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Engineers • Constructors • Scientists

SUPPLEMENTAL INFORMATION FOR PERMIT NO. 375

COAL REFUSE DISPOSAL FACILITY NOS. 1 AND 2
POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS

Prepared for

WILLIAMSON ENERGY, LLC
BECKLEY, WEST VIRGINIA

ALLIANCE PROJECT NO. B05-330-1413
JUNE 2007

Beckley, WV
Raleigh County Airport Industrial Park
124 Philpott Lane
Beaver, WV 25813-9502
Telephone: (304) 255-0491
Fax: (304) 255-4232

Alliance Consulting, Inc.
Engineers • Constructors • Scientists

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JUNE 2007

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

June 8, 2007

Project No. B05-330-1413

Mr. Scott Fowler
Ms. Victoria Broomhead
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
Land Reclamation Division
One Natural Way
Springfield, IL 62702-1271

Supplemental Information For Permit No. 375
Williamson Energy, LLC
Coal Refuse Disposal Facility Nos. 1 And 2
Pond Creek Mine No. 1
Williamson County, Illinois

Dear Mr. Fowler and Ms. Broomhead:

This submittal has been prepared pursuant to your requests for certain additional subsurface information in respect to geologic and hydrogeologic characterization of the above-referenced site. Primarily, the submittal addresses your concerns pertaining to the delineation of sandstone stratigraphy beneath the coal refuse disposal areas, quantifying the sandstone lithology's ability to transport groundwater, and discussing the methodology and confirmatory data for ensuring that a minimum thickness of 4 feet of clay soil exists beneath the floor of Coal Refuse Disposal Facility No. 1.

Sandstone Stratigraphic Unit Characterization

Seven (7) additional borings, namely B-1 through B-7, have recently been drilled over the site to further define the vertical thickness and horizontal distribution of a sandstone stratigraphic unit, as earlier discussed with you. The sandstone unit under study overlies a relatively thin coal seam, and the seam was utilized as a key marker bed for correlation of the stratigraphy across the site. The coal seam has excellent lateral continuity, and also was utilized for construction of a structure map for the study area. The drilling was conducted during April 2007 by Holcomb Foundation Engineering Co., Inc. (Holcomb), and Holcomb's report containing a discussion of drilling methodology and submittal of borehole logs, laboratory analytical data for sandstone permeability testing, and color photographs of rock cores are submitted herein as Appendix A. Borehole locations, structural contours generated upon the thin seam's bottom of coal elevations, and the depiction of other germane site features are presented on the drawing entitled Coal Refuse Disposal Area Borehole Location Map And Underlying Thin Coal Seam's Structure Map (hereinafter simply referenced as "Structure Map") in the "Figures" section of our submittal.

Also submitted is a drawing entitled Sandstone Unit Isopach Map (hereinafter referenced as "Sandstone Map"), which portrays the study stratigraphic unit's thickness on a 1-foot contour interval, based upon 26 boreholes penetrating that horizon. None of these boreholes encountered the sandstone unit at a thickness of 10 feet or greater. Borehole P-4, situated west of the proposed disposal area, had the thickest value at 9.75 feet. The Sandstone Map clearly demonstrates that the sandstone is discontinuous across the study area, with seven (7) boreholes reporting the unit as completely absent and an additional eight (8) reporting a thickness of 3 feet or less. The map further illustrates three (3) spatially distinct locations of sandstone having thicknesses of 6 feet or greater, as denoted by the dark purple areas on that drawing. The data do not reveal an interconnection of the thicker areas, and no trends of thickening laterally over any appreciable distance upon or away from the study area is discernible.

The vast majority of the area beneath the footprint of the proposed coal refuse disposal areas has either none of the sandstone unit present or else has a thickness of less than 3 feet. Only two (2) small areas of sandstone exhibiting a thickness exceeding 6 feet are present in the footprint – one located at the southeastern corner of the facility and the other at the southwestern corner. The Sandstone Map illustrates three (3) boreholes (B-6, B-7 and GW7A) with no sandstone at all present between these corners of the facility, and again demonstrates the discontinuous nature of the deposit. Furthermore, Holcomb's laboratory analytical report states the sandstone unit's permeability as a mere 4×10^{-7} cm/sec. Based upon these findings, it is our opinion that groundwater at the study area does not meet the criteria set forth in § 620.210 for classification as Class I: Potable Resource Groundwater.

The above-referenced information was also included in the Coal Refuse Disposal Facility No. 2 significant revision submitted to your office on May 18, 2007.

Methodology and Confirmatory Data for Determination of Clay Thickness Beneath Coal Refuse Disposal Facility No. 1

Within Alliance Consulting, Inc.'s (Alliance) July 7, 2006 Response to Comments addressed to Mr. Fowler, multiple methodologies were stated as options that may be used for ensuring that 4 feet of soil would be provided and documented between bedrock and the base of the incised cut (excavation) for the slurry cells Since then, this cut has been made for Coal Refuse Disposal Facility No. 1. The methodology selected from the options was "excavating to bedrock and placing four feet of material back, compacted in 6 to 8 inch lifts to 95% standard proctor".

By the latter part of September 2006, the cut had been completed and clay soil backfilled and compacted to a minimum depth of 4 feet above the cut grade elevation at Coal Refuse Disposal Facility No. 1. Photographs, dated September 22, 2006, of the compacted backfill over the floor of the facility are presented within Appendix B. Appendix C contains field nuclear density test data summaries for 49 points tested, all of which equaled or exceeded 95% standard proctor.

Appendix D submits relevant daily work logs from June through September 2006 for the excavation, backfill, compaction and determination of soil thickness upon the subject work area. For an even more comprehensive viewing and characterization of the backfill, a drawing entitled Compacted Clay Backfill Isopach Map has been prepared and submitted within the "Figures" section. Two (2) sets of contours are depicted on that drawing – one illustrating the surveyed cut floor elevations and the other showing the surveyed grades on the top of the compacted clay backfill. As verified by the drawing, no locations have less than 4 feet of backfill emplaced above the cut floor. Moreover, to achieve uniform grading over the entire floor of the facility, some areas had more than 5 feet of compacted backfill installed, as evidenced by the dark purple shaded areas on the drawing.

Geologic Cross Sections

In conformance with your request, the earlier geologic cross sections (A-A' through E-E') submitted to you have been updated and/or re-aligned, where necessary, to reflect the additional subsurface information generated by the expanded drilling program. New geologic cross sections, namely F-F', G-G' and H-H', have been constructed to reflect the new data, as well as to more fully present boreholes 8298 and 8299 in respect to your July 6, 2006 e-mailed comments. A full suite of these geologic cross sections are provided in the "Figures" section of our submittal. For your reference, the location and orientation of each of these geologic cross sections are highlighted on both the Structure Map and the Sandstone Map.

Response to Inquiry Regarding Correlation of Corehole 8312CG and Monitoring Well GW7A

During Ms. Broomhead's e-mail correspondence with Alliance during April 2007, we were requested to address the correlation of data from GW7A located on the subject study area to that of distant Corehole 8312CG. It appears that the same tool used for correlation between boreholes upon the current study property would serve as the appropriate methodology for correlating 8312CG – namely the thin coal marker bed. Upon reviewing the log for 8312CG, a thin coal (1.3 feet in thickness) is identified between the depths of 33.4 and 34.7 feet. Considering a surface elevation of 448 feet, this equates to a bottom of coal elevation of approximately 413 feet and is conformable with the contour elevation ranges depicted on the enclosed Structure Map of that seam.

Given that scenario, the 1.5-foot thickness of sandstone between depths 31.8 and 33.3 feet in 8312CG correlates as the sandstone stratigraphic unit evaluated by the expanded drilling program on the study property, and subsequently would also correlate as the thin sandstone unit into which GW7A terminates.

Deeper in 8312CG, below the thin coal seam, a thicker sandstone in excess of 10 feet is recorded below a depth of 40 feet. The data for our study area characterizes that particular unit as being

absent to only 2 feet thick, in respect to the location of Coal Refuse Disposal Facility Nos. 1 and 2.

CLOSING

We trust that these data and responses satisfy your informational requests and also complete the documentation of the clay soil thickness provided between bedrock and the top of compacted clay backfill in Coal Refuse Disposal Facility No. 1. Should you have any questions pertaining to our submittal, please let us know.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Larry K. Lucas
Senior Scientist

Stephen M. Sutphin
Project Manager

Claudio E. Yon, P.E.
Senior Project Manager

Enclosures

File: 05330-34

APPENDIX A

HOLCOMB FOUNDATION ENGINEERING CO.'S REPORT OF SOIL BORINGS AND ROCK CORING FOR BOREHOLES B-1 THROUGH B-7, AND SANDSTONE PERMEABILITY TEST DATA FOR B-1

HOLCOMB FOUNDATION ENGINEERING CO.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

WOOD ROAD

P.O. BOX 88
CARBONDALE, ILLINOIS 62903

618-529-5262
FAX 618-457-8991

SOIL BORINGS AN ROCK CORING
POND CREEK MINE NO. 1
PROPOSE REFUSE DISPOSAL FACILITY NO. 2
WILLIAMSON COUNTY, ILLINOIS
PURCHASE ORDER NO. 3149

Prepared for:

Williamson Energy, LLC
430 Harper Park Dr.
Beckey, West Virginia

Prepared by:

HOLCOMB FOUNDATION ENGINEERING CO.
Carbondale, Illinois
618-529-5262

April 25, 2007

HFE File Number: H-05278

TABLE OF CONTENTS

	PAGE
LETTER	1
BORING LOGS (7)	2-8
PERMEABILITY TESTS RESULTS	9
ROCK CORE PICTURES	10-15
GENERAL NOTES	16
UNIFIED SOIL CLASSIFICATIONS	17

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

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Box 393 Wood Road
Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

April 25, 2007

Williamson Energy, LLC
430 Harper Drive
Beckley, West Virginia 25801

Attention: Mr. James Plumley

Re: Soil Borings and Rock Coring
Pond Creek Mine No. 1
Propose Refuse Disposal Facility No. 2
Williamson County, Illinois
HFE File H-05278
Purchase Order No. 3149

Dear Sir:

From April 10 to 18, 2007, we drilled seven soil borings at this site. Boring coordinates and ground line elevations are indicated on top of each Boring Log. During drilling operations, we advanced the bore hole with hollow stem augers to rock, and cored the rock continuously to depths ranging from 35 to 60 feet below the existing ground line. Upon completion of drilling operations, five of the soil borings were grouted with bentonite. A 2" diameter PVC pipe was inserted to the bottom of Borings #5 and #7 to keep the bore holes open for further tests.

A permeability test was performed on the sandstone encountered in Boring #1 from 39 to 40 feet in depth. Results of this permeability test are attached.

Enclosed herewith are the Boring Logs and Core Pictures. If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 1

N 426451.59675
E 360239.04060

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6
Water Content (%)
Standard N Penetration, Blows/Ft.
10 20 30 40 50 60

Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 481.8
				4" Topsoil
				Brown Silty CLAY (CL) with sand
10				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
				Gray Weathered SHALE
20	1	rc		6" Limestone
				Gray Sandy SHALE
	2	rc		
30	3	rc		
	4	rc		Gray Sandstone
40	5	rc		
	6	rc		Gray SHALE
50	7	rc		
	8	rc		COAL
				Gray SHALE
				End of Boring @ -55.0'
60				
70				

Ground Water Data
Ground Water Encountered @ 18.0' During Drilling.

Project: Proposed Coal Refuse Disposal Facility
Pond Creek Mine No. 1 Williamson County, Illinois

Date of Boring
April 12, 2007

Client: Williamson Energy, LLC
Beckly, West Virginia

Project No.
H-05278

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 2

N 428637.14010
E 360254.28017

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6
Water Content (%)
Standard N Penetration, Blows/Ft.
10 20 30 40 50 60

Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 446.3
				4" Topsoil
				Brown Mottled Gray Silty CLAY (CL)
10				Brown Silty CLAY (CL) with sand and pebbles
20	1	rc		Brown Sandy SHALE
	2	rc		Gray SHALE 4.5" Sandstone Seam @ -27.5'
30	3	rc		
	4	rc		15" COAL Gray SHALE
40				End of Boring @ -40.0'
50				
60				
70				

Ground Water Data
Ground Water Encountered @ -16.0' During Drilling.

Project: Proposed Coal Refuse Disposal Facility
Pond Creek Mine No. 1 Williamson County, Illinois

Date of Boring
April 12, 2007

Client: Williamson Energy, LLC
Beckly, West Virginia

Project No.
H-05278

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

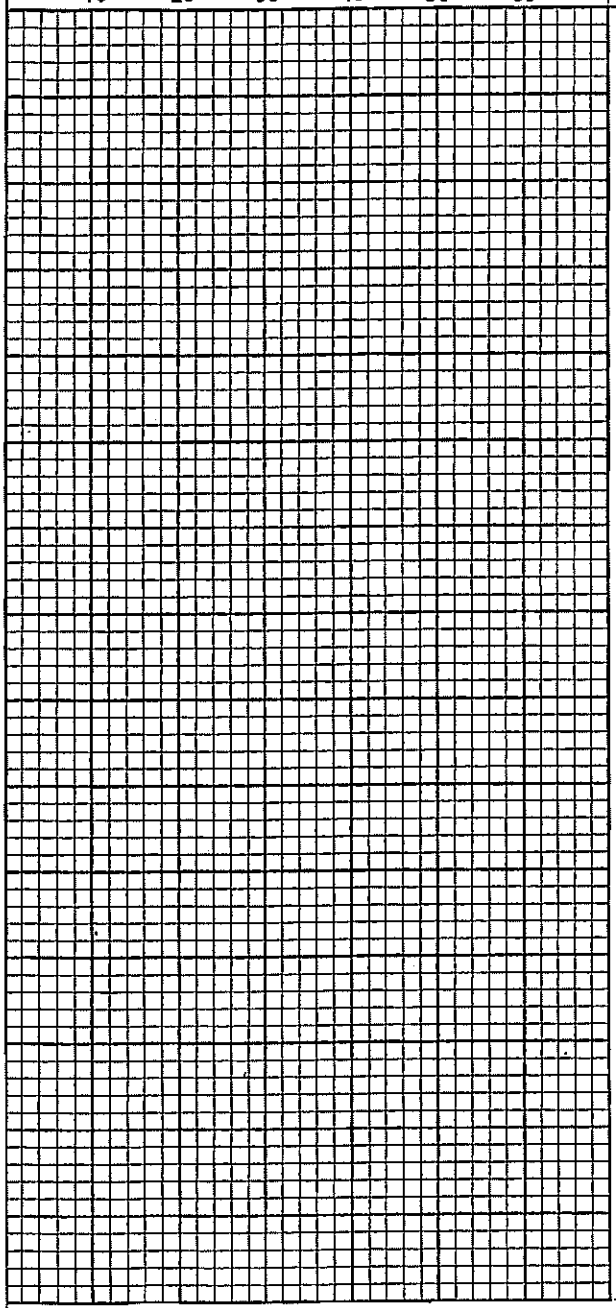
LOG of BORING 3

N 430497.44353
E 360292.39822

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 435.4
				3" Topsoil
				Gray Mottled Brown Silty CLAY (CL)
10				
20				
				Gray SHALE
	1	rc		
30	2	rc		
	3	rc		
				14" COAL
				Gray SHALE
40				End of Boring @ −39.0'
50				
60				
70				

Ground Water Data
Ground Water Encountered @ −5.0' During Drilling.

Project: Proposed Coal Refuse Disposal Facility
Pond Creek Mine No. 1 Williamson County, Illinois

Date of Boring
April 11, 2007

Client: Williamson Energy, LLC
Beckly, West Virginia

Project No.
H-05278

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 4

N 430626.06201
E 359192.23576

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60

Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 442.2
				5" Topsoil
				Gray Mottled Brown Silty CLAY (CL) with fine sand
10				Brown Silty CLAY (CL) with fine sand
20				
	1	rc		Gray SHALE
30	2	rc		
	3	ss		
40	4	ss		
	5	ss		
50	6	ss		
	7	ss		
60				12" COAL
				Gray SHALE
				End of Boring @ -60.0'
70				

Ground Water Data
Ground Water Encountered @ -18.0' During Drilling.

Project: Proposed Coal Refuse Disposal Facility
Pond Creek Mine No. 1 Williamson County, Illinois

Date of Boring: April 10, 2007

Client: Williamson Energy, LLC
Beckly, West Virginia

Project No.: H-05278

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 5

N 428636.96558
E 359062.81936

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60

Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 447.9
				4" Topsoil
				Gray Silty CLAY (CL)
10				Brown Mottled Gray Silty CLAY (CL) with fine sand
20				
	1	rc		Brown Mottled Gray SANDSTONE
30				Gray SHALE
	2	rc		COAL
				Gray SHALE
				End of Boring @ −35.0'
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ −18.0' During Drilling.

Project: Proposed Coal Refuse Disposal Facility
Pond Creek Mine No. 1 Williamson County, Illinois

Date of Boring: April 17, 2007

Client: Williamson Energy, LLC
Beckly, West Virginia

Project No.: H-05278

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 6

N 426044.95691
E 359006.99577

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60

Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 472.1
				Gray Mottled Brown SPOILS
10				Brown Silty CLAY (CL) with sand and pebbles
				Brown Weathered SHALE
	1	rc		Brown Mottled Gray Sandy SHALE
20				Brown to Gray SHALE
	2	rc		
	3	rc		Gray Sandy SHALE
30				
	4	rc		
	5	rc		
				11" COAL
40				Gray SHALE
				End of Boring @ −40.0'
50				
60				
70				

Ground Water Data

Project: Proposed Coal Refuse Disposal Facility
Pond Creek Mine No. 1 Williamson County, Illinois

Date of Boring: April 16, 2007

Client: Williamson Energy, LLC
Beckly, West Virginia

Project No.: H-05278

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 7

N 426964.4000
E 358695.4800

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60

Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 459.4
				Brown Mottled Gray Clayey SILT(ML)
10				Brown Mottled Gray Silty CLAY (CL) with fine sand
20	1	rc		Brown SHALE
				Gray SHALE
	2	rc		Gray Sandy SHALE
30	3	rc		
				14" COAL
	4	rc		Gray SHALE
40				End of Boring @ −39.0'
50				
60				
70				

Ground Water Data

Project: Proposed Coal Refuse Disposal Facility
Pond Creek Mine No. 1 Williamson County, Illinois

Date of Boring: April 18, 2007

Client: Williamson Energy, LLC
Beckly, West Virginia

Project No.: H-05278

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Permeability Tests Results

Williamson Energy - Pond Creek Mine #1
Johnston City, Illinois

Date: 4/24/2007

Client: Williamson Energy
Johnston City, IL

Project No.: H-05278

Boring No.	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Boring #1	39-40'	1.3	4.3	153.6	4 x 10-7

Permeability Tests performed in accordance with ASTM D-5084



H-05278 Pond Creek Mine No. 1 Williamson Energy, LLC

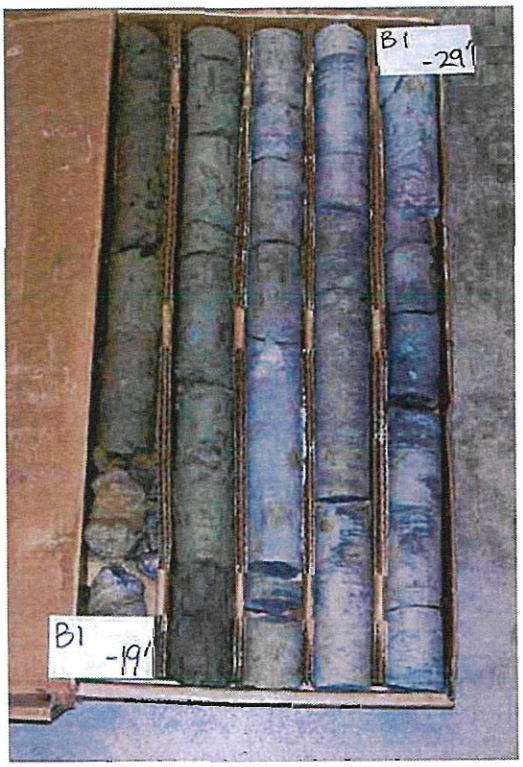

Figure 1.
Boring 1 Core Sample From –19' to –29'



Figure 2.
Boring 1 Core Sample From –29' to –39'

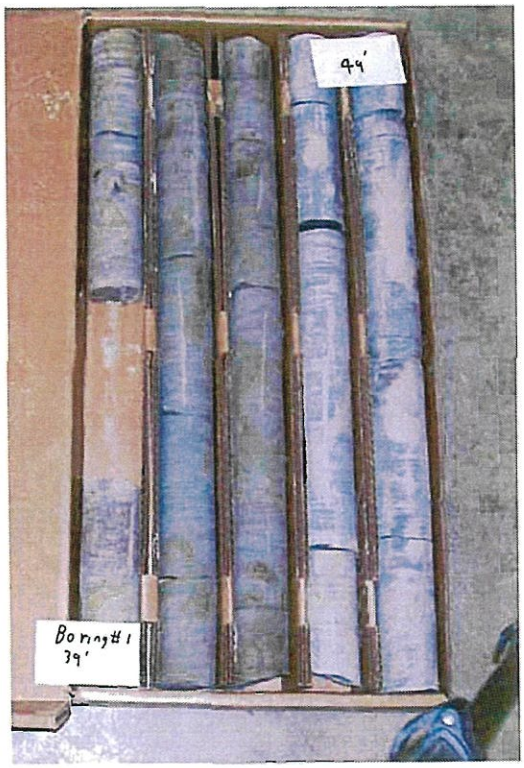

Figure 3.
Boring 1 Core Sample From –39' to –49'

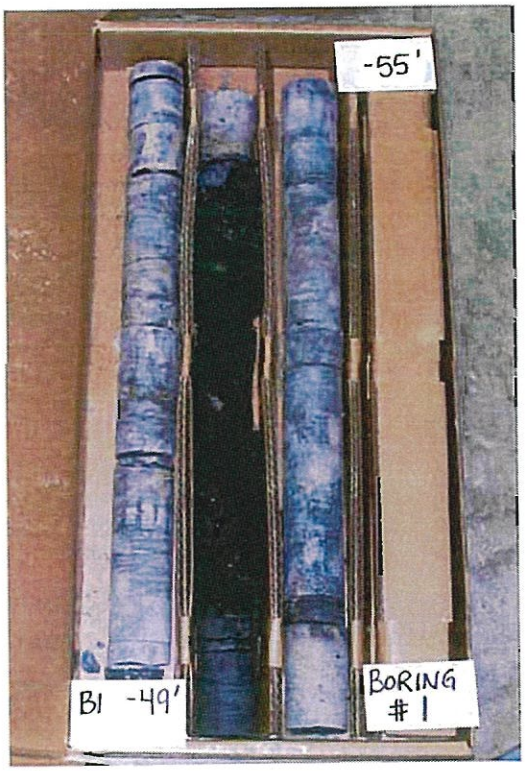

Figure 4.
Boring 1 Core Sample From –49' to –55'

H-05278 Pond Creek Mine No. 1 Williamson Energy, LLC



Figure 5.
Boring 2 Core Sample From –20' to –30'



Figure 6.
Boring 2 Core Sample From –30' to –40'

H-05278 Pond Creek Mine No. 1 Williamson Energy, LLC

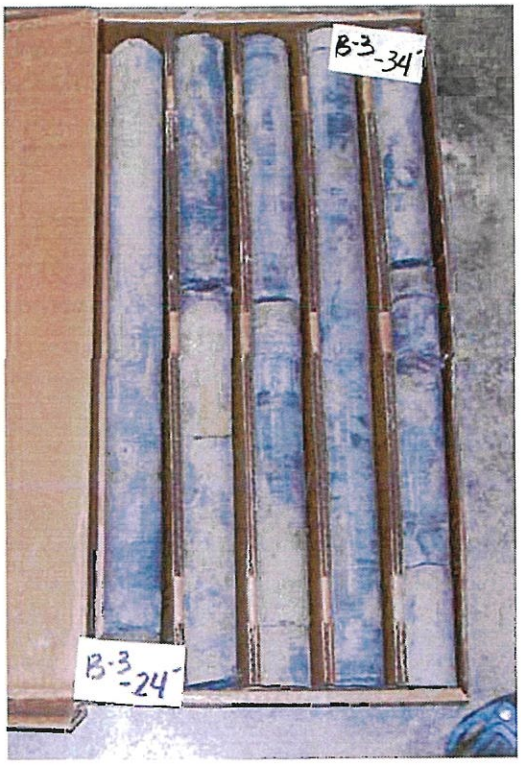

Figure 7.
Boring 3 Core Sample From –24' to –34'



Figure 8.
Boring 3 Core Sample From –34' to –39'

H-05278 Pond Creek Mine No. 1 Williamson Energy, LLC



Figure 9.
Boring 4 Core Sample From –25' to –35'



Figure 10.
Boring 4 Core Sample From –35' to –45'



Figure 11.
Boring 4 Core Sample From –45' to –55'



Figure 12.
Boring 4 Core Sample From –55' to –60'

H-05278 Pond Creek Mine No. 1 Williamson Energy, LLC

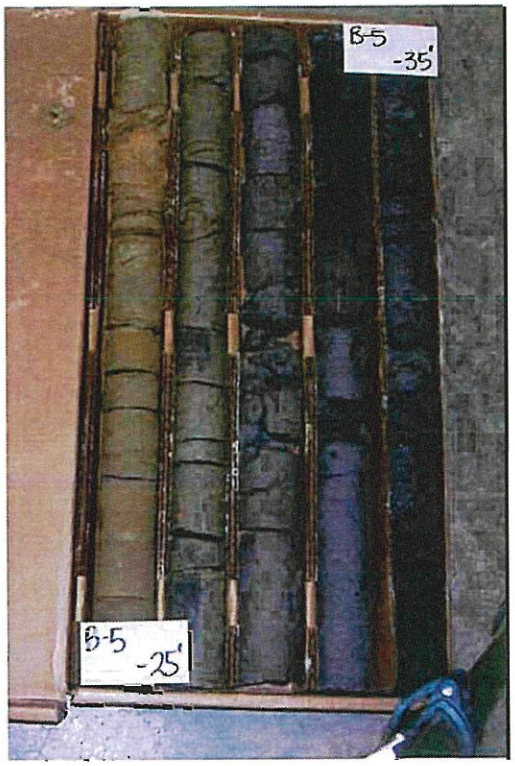

Figure 13.
Boring 5 Core Sample From –25' to –35'



Figure 14.
Boring 6 Core Sample From –15' to –25'

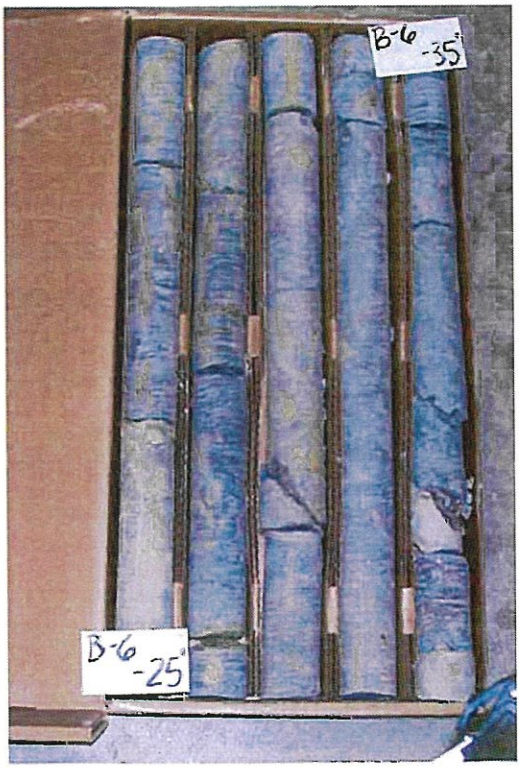

Figure 15.
Boring 6 Core Sample From –25' to –35'



Figure 16.
Boring 6 Core Sample From –35' to –40'

H-05278 Pond Creek Mine No. 1 Williamson Energy, LLC



Figure 17.
Boring 7 Core Sample From –19' to –29'



Figure 18.
Boring 7 Core Sample From –29' to –39'

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Classification System is used to identify the soil unless otherwise noted.

RELATIVE DENSITY & CONSISTENCY CLASSIFICATION

TERM (NON-COHESIVE SOILS)	BLOWS PER FOOT
Very Loose	0 - 4
Loose	5 - 10
Firm	11 - 30
Dense	31 - 50
Very Dense	Over 50

TERM (COHESIVE SOILS)	QU (tsf)
Very Soft	0 - 0.25
Soft	0.25 - 0.50
Firm	0.50 - 1.00
Stiff	1.00 - 2.00
Very Stiff	2.00 - 4.00
Hard	4.00+

DRILLING & SAMPLING SYMBOLS

ss:	Split Spoon - 1 3/8" I.D., 2" O.D.
st:	Shelby Tube - 2.80"I.D., 3" O.D.
au:	Auger Samples
cs:	Continuous Sampling - 2.0" I.D.

SOIL PROPERTY SYMBOLS

⊗	Unconfined Compressive Strength, Qu, (tsf)
+	Penetrometer Value, (tsf)
	Plastic Limit (%)
○	Water Content (%)
	Liquid Limit (%)
X	Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2" O.D. Split Spoon

PARTICLE SIZE

Boulders	8 in. +	Medium Sand	0.6 mm to 0.2 mm
Cobbles	8 in. to 3 in.	Fine Sand	0.2 mm to 0.74 mm
Gravel	3 in. to 5 mm	Silt	0.074 mm to 0.0005 mm
Coarse Sand	5 mm to 0.6 mm	Clay	less than 0.005 mm

UNIFIED SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS	GW	Well graded gravels, gravel-sand mixtures
			GP	Poorly graded gravels, gravel-sand mixtures
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand silt mixtures
			GC	Clayey gravels, gravel-sand clay mixtures
	SANDS AND SANDY SOILS	CLEAN SANDS	SW	Well-graded sands, gravelly sands
			SP	Poorly graded sands, gravelly sands
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, clay-sand mixtures
FINE GRAINED SOILS	SILTS AND CLAYS LOW PLASTICITY		ML	Inorganic silts of clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS HIGH PLASTICITY		MH	Inorganic silts of high plasticity
			CH	Inorganic clays of high plasticity
			OH	Organic clays of medium to high plasticity
HIGHLY ORGANIC SOILS			PT	Peat, humus, swamp soils with high organic contents

APPENDIX B

SEPTEMBER 22, 2006 PHOTOGRAPHS OF INITIAL CONSTRUCTION OF COAL REFUSE DISPOSAL FACILITY NO. 1 WITH COMPACTED CLAY BACKFILL ON POND FLOOR













APPENDIX C

FIELD NUCLEAR DENSITY TEST DATA FOR COMPACTED CLAY BACKFILL

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

FIELD NUCLEAR DENSITY TEST DATA SUMMARY

PROJECT NAME: MACH MINING LLC
PROJECT NO: B06-328-1444

TESTED BY: C. PARKULO
DATE: September 22, 2006

CHECKED BY:
SHEET 1 OF 5

REVISED 1-2005

TEST NO.	N-1	N-2	N-3	N-4	N-5	N-6	N-7	N-8	N-9	N-10	N-11	N-12
MATERIAL DESCRIPTION	BROWN CLAY											
LOCATION	SOUTHERN SOIL REFUSE CELL											
ELEVATION (FEET)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LIFT THICKNESS (INCHES)	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"
STAGE / LIFT NO.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MODE & DEPTH	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT
COMPACTION METHOD	VIBRATORY ROLLER											
NUMBER OF PASSES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WET DENSITY (PCF)	125.6	127.0	129.4	125.7	125.5	129.7	125.6	126.7	127.9	124.8	125.4	125.3
FIELD MOISTURE (%)	17.1	18.1	19.0	16.8	17.2	17.3	15.3	16.2	16.7	17.4	17.2	16.6
TARE NO.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WT. TARE + WET SOIL (GRAMS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WT. TARE + DRY SOIL (GRAMS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OVEN-DRIED MOISTURE (%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DRY DENSITY (PCF)	107.3	107.5	108.7	107.6	107.1	110.6	108.9	109.0	109.6	106.3	107.0	107.5
MAX. DRY DENSITY (PCF)	110.0	110.0	110.0	110.0	110.0	114.7	114.7	114.7	114.7	110.0	110.0	110.0
OPTIMUM MOISTURE (%)	14.7	14.7	14.7	14.7	14.7	14.1	14.1	14.1	14.1	14.7	14.7	14.7
REQUIRED COMPACTION (%)	95	95	95	95	95	95	95	95	95	95	95	95
RELATIVE COMPACTION (%)	98	98	99	98	97	96	95	95	96	97	97	98

■ STD. PROCTOR
☐ MOD. PROCTOR
☐ ROLLER PASS

REMARKS: TESTS WERE PERFORMED IN THE SOUTHERN CELL. PERCENT COMPACTION WAS BASED ON THE PROCTOR VALUES DEVELOPED BY GEOTECHNICS ON 7-19-06 AND 7-20-06.

124 PHILPOTT LANE BEAVER, WV 25813 (304) 255-0491

R11506

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

FIELD NUCLEAR DENSITY TEST DATA SUMMARY

PROJECT NAME: MACH MINING LLC
PROJECT NO: B06-328-1444

TESTED BY: C. PARKULO
DATE: September 22, 2006

CHECKED BY:
SHEET 2 OF 5

REVISED 1-20-05

TEST NO.	N-13	N-14	N-15	N-16	N-17	N-18	N-19	N-20	N-21	N-22	N-23	N-24
MATERIAL DESCRIPTION	BROWN CLAY											
LOCATION	SOUTHERN SOIL REFUSE CELL											
ELEVATION (FEET)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LIFT THICKNESS (INCHES)	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"
STAGE / LIFT NO.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MODE & DEPTH	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT
COMPACTION METHOD	VIBRATORY ROLLER											
NUMBER OF PASSES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WET DENSITY (PCF)	127.2	127.8	128.5	125.1	126.1	126.5	126.7	126.8	122.6	127.4	129.5	126.9
FIELD MOISTURE (%)	15.3	16.3	17.3	13.9	15.6	16.0	13.6	14.4	11.1	17.0	17.2	14.5
TARE NO.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WT. TARE + WET SOIL (GRAMS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WT. TARE + DRY SOIL (GRAMS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OVEN-DRIED MOISTURE (%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DRY DENSITY (PCF)	**110.3**	**109.9**	**109.5**	**109.8**	**109.1**	**109.1**	**111.5**	**110.8**	**110.4**	**108.9**	**110.5**	**110.8**
MAX. DRY DENSITY (PCF)	114.7	114.7	114.7	114.7	114.7	114.7	114.7	114.7	114.7	114.7	114.7	114.7
OPTIMUM MOISTURE (%)	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1
REQUIRED COMPACTION (%)	95	95	95	95	95	95	95	95	95	95	95	95
RELATIVE COMPACTION (%)	**96**	**96**	**96**	**96**	**95**	**95**	**97**	**97**	**96**	**95**	**96**	**97**

☒ STD. PROCTOR
☐ MOD. PROCTOR
☐ ROLLER PASS

REMARKS: SEE SHEET 1 OF 5.

124 PHILPOTT LANE BEAVER, WV 25813 (304) 255-0491

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FIELD NUCLEAR DENSITY TEST DATA SUMMARY

PROJECT NAME: MACH MINING LLC
PROJECT NO: B06-328-1444

TESTED BY: C. PARKULO
DATE: September 22, 2006

CHECKED BY:
SHEET 3 OF 5

REVISED 1-20-05

TEST NO.	N-25	N-26	N-27	N-28	N-29	N-30	N-31	N-32	N-33	N-34	N-35	N-36
MATERIAL DESCRIPTION	BROWN CLAY →											
LOCATION	SOUTHERN SOIL REFUSE CELL →											
ELEVATION (FEET)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LIFT THICKNESS (INCHES)	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"
STAGE / LIFT NO.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MODE & DEPTH	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT
COMPACTION METHOD	VIBRATORY ROLLER →											
NUMBER OF PASSES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WET DENSITY (PCF)	126.5	127.0	128.8	125.8	126.3	128.4	128.0	129.0	129.4	123.5	125.8	126.5
FIELD MOISTURE (%)	16.1	16.7	17.0	15.2	15.4	14.8	14.2	15.4	17.8	13.5	14	13.7
TARE NO.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WT. TARE + WET SOIL (GRAMS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WT. TARE + DRY SOIL (GRAMS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OVEN-DRIED MOISTURE (%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DRY DENSITY (PCF)	109.0	108.8	110.1	109.2	109.4	111.8	112.1	111.8	109.8	108.8	110.4	111.3
MAX. DRY DENSITY (PCF)	114.7	114.7	114.7	114.7	114.7	114.7	114.7	114.7	114.7	114.7	114.7	114.7
OPTIMUM MOISTURE (%)	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1
REQUIRED COMPACTION (%)	95	95	95	95	95	95	95	95	95	95	95	95
RELATIVE COMPACTION (%)	95	95	96	95	95	98	98	97	96	95	96	97

■ STD. PROCTOR
☐ MOD. PROCTOR
☐ ROLLER PASS

REMARKS: SEE SHEET 1 OF 5.

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FIELD NUCLEAR DENSITY TEST DATA SUMMARY

PROJECT NAME: MACH MINING LLC
PROJECT NO: B06-328-1444

TESTED BY: C. PARKULO
DATE: September 22, 2006

CHECKED BY:
SHEET 4 OF 5

REVISED 1-20-05

TEST NO.	N-37	N-38	N-39	N-40	N-41	N-42	N-43	N-44	N-45	N-46	N-47	N-48
MATERIAL DESCRIPTION	BROWN CLAY											
LOCATION	SOUTHERN SOIL REFUSE CELL											
ELEVATION (FEET)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LIFT THICKNESS (INCHES)	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"
STAGE / LIFT NO.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MODE & DEPTH	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT	12"DT
COMPACTION METHOD	VIBRATORY ROLLER											
NUMBER OF PASSES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WET DENSITY (PCF)	128.1	121.8	124.3	124.4	125.6	123.7	126.9	127.9	125.8	128.3	126.9	127.1
FIELD MOISTURE (%)	14.7	13.9	15.7	14.6	16.2	12.6	15.2	13.9	13.7	14.5	15	16.3
TARE NO.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WT. TARE + WET SOIL (GRAMS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WT. TARE + DRY SOIL (GRAMS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OVEN-DRIED MOISTURE (%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DRY DENSITY (PCF)	**111.7**	**106.9**	**107.4**	**108.6**	**108.1**	**109.9**	**110.2**	**112.3**	**110.6**	**112.1**	**110.3**	**109.3**
MAX. DRY DENSITY (PCF)	114.7	110.0	110.0	110.0	110.0	114.7	114.7	114.7	114.7	114.7	114.7	114.7
OPTIMUM MOISTURE (%)	14.1	14.7	14.7	14.7	14.7	14.1	14.1	14.1	14.1	14.1	14.1	14.1
REQUIRED COMPACTION (%)	95	95	95	95	95	95	95	95	95	95	95	95
RELATIVE COMPACTION (%)	**97**	**97**	**98**	**99**	**98**	**96**	**96**	**98**	**96**	**98**	**96**	**95**

■ STD. PROCTOR
☐ MOD. PROCTOR
☐ ROLLER PASS

REMARKS: SEE SHEET 1 OF 5.

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FIELD NUCLEAR DENSITY TEST DATA SUMMARY

PROJECT NAME: MACH MINING LLC
PROJECT NO: B06-328-1444

TESTED BY: C. PARKULO
DATE: September 22, 2006

CHECKED BY:
SHEET 5 OF 5

REVISED 1-2005

TEST NO.	N-49
MATERIAL DESCRIPTION	BROWN CLAY
LOCATION	SOUTHERN SOIL REFUSE CELL
ELEVATION (FEET)	N/A
LIFT THICKNESS (INCHES)	6"
STAGE / LIFT NO.	N/A
MODE & DEPTH	12"DT
COMPACTION METHOD	VIBRATORY ROLLER
NUMBER OF PASSES	N/A
WET DENSITY (PCF)	129.7
FIELD MOISTURE (%)	17.3
TARE NO.	N/A
WT. TARE + WET SOIL (GRAMS)	N/A
WT. TARE + DRY SOIL (GRAMS)	N/A
OVEN-DRIED MOISTURE (%)	N/A
DRY DENSITY (PCF)	110.6
MAX. DRY DENSITY (PCF)	114.7
OPTIMUM MOISTURE (%)	14.1
REQUIRED COMPACTION (%)	95
RELATIVE COMPACTION (%)	96

■ STD. PROCTOR
☐ MOD. PROCTOR
☐ ROLLER PASS

REMARKS: SEE SHEET 1 OF 5.

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APPENDIX D

DAILY WORK LOGS FOR POND (COAL REFUSE DISPOSAL FACILITY NO. 1) CUT AND COMPACTED CLAY BACKFILL ACTIVITIES

MONDAY 26 JUNE

Cloudy, Warm

2006 177th day – 188 days follow

Dan – 11 hrs.

	Wsm. En.	
D9L	9	Hillis – 9½
D8K #1	9	Sam – 9½
2	6	Rick – 9½
D5C	9	John – 9
D4H	9	Mark – 9
12G #1	9	Randy – 9
619 w.w.	4	Rick, Dan
325 hoe	9	David – 9½
631 #1	5½	Kelly – 9
2	2	James – 9
3	9	Brent – 9
5	7	James –
6	3½	Kelly –
Operator 330 hoe	9	Sid – 9
" ch #1	9	Harry – 9
" ch #2	9	Myron – 9
Laborer	9½	Jeremiah – 9½
"	5	Dan

hauled from pond to stockpile
Ditch 8 A, stripped topsoil
hauled Shale to Access Rd
pushed Slope material
installed 10" pipe from plant to FW pond

JUNE **27** TUESDAY

P. Sunny & Warm
Dan - 11 hrs.

178th day – 187 days follow

	Wsm. En.	
D9L	9	Hillis - 9½
D8K #1	9	Sam - 9½
2	9	Rick - 9½
D5C	9	John - 9
D4H	7	Mark - 7½
12G #1	9	Randy - 9
2	2	Sid - 9
325 hre	8½	David - 9½
619 w.w.	6½	Wade (Dan) - 8
631 #1	9	Kelly - 9
3	9	Brent - 9
5	9	James - 9
Operator 330 hre	7	Sid -
" ch #1	9	Harry - 9
2	9	Myron - 9
laborer	9½	Jeremiah - 9½
"	5	Dan -

hauled from S. Pond to stockpile, liner (4')
Finished pond 008, ditch 8A Areas
graded Slope Area, Rock on RR
cut ditch for pipe to pond 006
built guard shack pad

W

Sunny & Warm

2006 179th day – 186 days f

D8L
D8K #1
2
D5C
D4H
D3 #4
325 hre
12G #1
619 w.w.
631 #1
3
6
Operator 330
" ch #1
" ch #2
laborer
"

hauled from Slur
graded Slope
installed 1000'
pond 006 & FW
Put clay for liner

WEDNESDAY 28 JUNE

[illegible] & Warm

2006 179th day – 186 days follow

Dan – 11 hrs

	Wsm En.	
D8L	9	Hillis – 9½
D8K #1	9	Sam – 9½
2	7½	Rick – 9
D5C	5	John – 9
D4H	9	Mark – 9
D3 #4	4	John –
325 hre	9	David – 9½
12G #1	7	Randy – 9
619 w.w.	3½	" Rick –
631 #1	9	Kelly – 9
3	9	Brent – 9
6	9	James – 9
Operator 330	9	Sid – 9
" ch #1	9	Harry – 9
" ch #2	9	Myron – 9
[illegible]	9½	Jeremiah – 9½
"	4	Dan

hauled from slurry pond to stockpile
graded Slope Area
installed 1000' of 8", 1536 of 12" from
pond 006 & FW pond
Put clay for liner (4') Compacted – ok.

JUNE **29** THURSDAY

Sunny & hot
Dan 11 hrs.

2006 180th day – 185 days follow

	Wsm. En.	
D8L	9	Hillis – 9½
D8K #1	9	Sam – 9½
2	6½	Rick – 9½
D4H	7½	Mark – 9
D3 #4	9	John – 9
12G #1	6½	Randy – 9
619 w.w.	5½	Rick – Dan –
325 hve	8	David – 8
631 #1	9	Kelly – 9
3	9	Brent – 9
6	9	James – 9
Operator 330	9	Sid – 9
" Roller, ch #1	9	Harry – 9
" ch #2	9	Myron – 9
" Roller	1½	Mark –
laborer	8	Jeremiah – 9½
"	5	Dan –

hauled from slurry pond to stockpile
– clay to " " for liner (Rolled)
Spread slope material, pumped water
installed pipe 1000' of 12", 1000' of 8"
Cut test holes in bottom – ok – 4'

Cloudy, hot

2006 181st day – 184 days

D9H	
D8L	
D8K #1	
2	1
D4H	
D3 #4	9
619 w.w.	2
12G #1	6
325 hve	9
815	6
631 #1	9
3	9
6	9
Operator	9
"	9
laborer	8

hauled dirt to lin
Spread slope mat
installed pipe 1

Old Ben 26 & 2

FRIDAY **30** JUNE

Cloudy, hot

2006 181st day -- 184 days follow

	WSMEN		Dan - 11 hrs
D9H	2½		Hillis - 9½
D8L	7½		" (Rick) -
D8K #1	9		Sam - 9½
2	1½		Rick - 9
D4H	9		Mark - 9
D3 #4	9		John - 9
619 w.w.	2½		Randy - 9
12G #1	6½		Randy -
325 hoe	9		Sid - 9
815	6½		Rick -
631 #1	9		Kelly - 9
3	9		Brent - 9
4	9		James - 9
Operator	9	ch #1	Harry - 9
"	9	#2	Myron - 9
laborer	8		Dan -

hauled dirt to liner, shale to stockpile
spread slope material Rolled liner
installed pipe 1500' (8"), 1000 (12")

Old Ben 26 & 24

David - 12
Jeremiah - 12
Wade - 13

TUESDAY 18 JULY

Sunny & hot

2006 199th day – 166 days follow

Dan – 10 hrs.

	WSM En.	
D5C	5½	Mark – 9
D3#4	9	David – 9
619 w.w.	1	Dan –
325 hre	1½	Mark –
Operator (330 hre)	9	Sid – 9
" (420 hre)	2	Mark –
laborer	9	Jim – 9
"	3	Dan –

Cut ditch South of clean Coal stacker
dressed up Slope Area, misc.
helped drillers
Met with Jim + Darin – go to work

LCC Classic
D8K#1 – 9 John – 9
D8K#2 – 9 Rick – 9
pushed dirt to hole

Office
Put down time, looked over mail, misc.

JULY 19 WEDNESDAY

Sunny & hot

Dan - 11 hrs

2006 200th day – 165 days follow

	Wsm Ens.	Wsm Tr.	
D9L	2½		Hillis - 9
D9H	2½	4	" —
D8L	5	4	Sam - 9
D5C	6	2	Mark - 9
12G #1	3½		Randy - 9
619 w.w.	5½		" —
325 hoe		9	David - 9½
631 #1		4	Kelly - 9
3	3	4	Brent - 9
4	5		Kelly -
5	2		Brent -
6	5	4	Harry - 9
Operator (330 hoe)	4	5	Sid - 9
" Roller		1	Mark -
" ch #2	~~8~~	9	Myron - 9
laborer		9½	Jim - 9½
"	4		Dan -

Cut out RR cut ditches

hauled dirt from slurry pond - east side

Worked on ditch - s of stacker, RR Rock

Cut out for RR - spout, helped drillers

LCC Classic

D8K #1 - 8½	John - 9
D8K #2 - 8½	Rick - 9
D4H - 8½	Wade - 9½

pushed to hole, Covered sludge - N. end

Sunny & hot

2006 201st day – 164 day

	Ws
D9L	
D8L	9
D5C	
12G #1	5
619 w.w.	4
325 hoe	
631 #3	9
4	9
6	9
2670 & disk	1
Operator (330)	
" ch #2	
laborer	
"	4

hauled dirt from

disked & seeded A

hauled dirt from

Went to hospital

LCC - Classic

D8K #1	6
D8K #2	8
D4H	8½

Pushed to hole

Wade left to

THURSDAY 3 AUGUST

Cloudy, hot 0.1" rain

2006 215th day – 150 days follow

Dan – 11 hrs

	WSM En	
D8L	9	Hillis – 9
D8K #1	9	John – 9
D5C	4½	Wade – 11
D3 #4	9	Rick – 9
12G #1	9	Randy – 9
12G #2	4	Sid – 9
619 w.w.	6	Wardell – 9
815	3	" –
325 hre	9	David – 9
631 #1	9	Kelly – 9
3	9	Brent – 9
6	9	Harry – 9
7	9	Sam – 9
Operator 330 hre	5	Sid –
" ch #1	4	Wade –
ch #2	9	Myron – 9
Laborer	9½	Jim – 9½
"	4	Dan –

hauled from pond to bottom & Stockpile
Stockpiled Shale – test holes – ok
backfilled Airshaft, Started ditch to pond 2
Note: Mark – off

SATURDAY 5 AUGUST

Sunny & Warm

2006 217th day – 148 days follow

Dam – 10 hrs,

	Wsm En.	
D8L	8	Hillis – 8
D8K #1	8	Joba – 8
D3 #4	5½	Rick – 8
12G #1	7½	Randy – 8
2	2	Sid – 8
619 w.w.	8	Wardell – 8
325 bxe	8	David – 8
613 #2	2½	Rick —
631 #1	8	Kelly – 8
3	8	Blunt – 8
5	1½	Wade – 9
6	6½	" —
7	8	Sam – 8
Operator 330	6	Sid —
" ch #1	8	Harry – 8
" ch #2	8	Mykon – 8
Laborer	8½	Jim – 8½
"	4	Don —

hauled from pond to stockpile
" to W. pond bottom
graded around, put back – Ainshaft
Worked on Ainshaft ditch
top loaded mud from pond – backfilled
& Compacted

MONDAY 7 AUGUST

P. Sunny & hot

2006 219th day – 146 days follow

Civic Holiday (C)

Dan – 11 hrs.

	Wsm Fn		
D8L	9		Hillis – 9
D8K #1	9		John – 9
D5C	9		Mark – 9
D3 #4	9		Rick – 9½
12G #1	9		Randy – 9
619 w.w.	9		Wardell – 9
315	3		Sid – 9
325 hoe	9		David – 9
631 #1	9		Kelly – 9
3	9		Brent – 9
5	9		Wade – 10
7	9		Sam – 9
Operator	9	Ch #1	Harry – 9
"	9	Ch #2	Myron – 9
"	6	420, 330	Sid —
laborer	9½		Jim – 9½
"	4		Dan —

hauled from pond to stockpile & bottom (4')
Compacted bottom, put in pipe RipRap
Worked @ airshaft – ditch & Spread slope material

Met Chuck @ Brushy Creek about ditches will give estimate

AUGUST 8 TUESDAY

P. Sunny + hot

Dan - 10½

2006 220th day - 145 days follow

	Wsm. En.		
D8L	9		Hillis - 9
D8K#1	9		John - 9
D5C	9		Mark - 9
D3#4	8		Rick (David) - 9
12G#1	9		Randy - 9
2	5½		Sid - 9
619 ww	7		Wardell - 9
325 hoe	3½		David - 8
613 #2	4½		Rick -
631 #1	7		Kelly - 9
3	9		Brent - 9
5	9		Wade - 10½
7	9		Sam - 9
9	3		Kelly, Wardell
Operator	9	ch#1	Harry - 9
"	9	ch#2	Myron - 9
"	3½	330 hoe	Sid, David -
"	1	420	Sid -
laborer	9½		Jim - 9½
"	4		Dan -

test holes in bottom - filled thin Areas
hauled dirt from pond to stockpile
cleaned up airshaft site
grouted RipRap, helped drillers

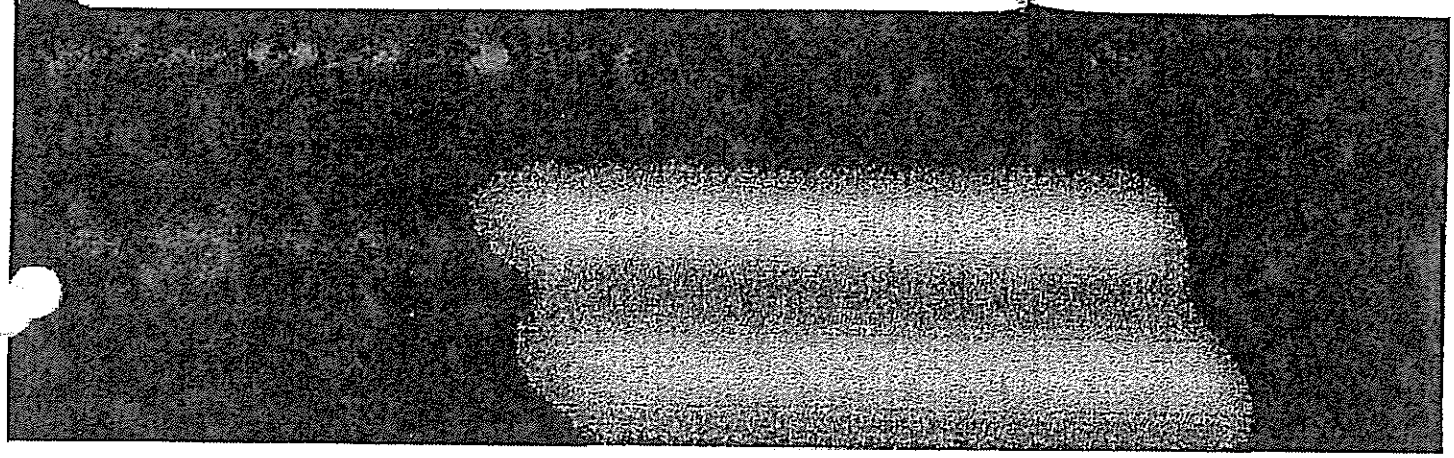
WE

Cloudy, hot, rain

2006 221st day - 144 days follo

D8L		
D8K#1		
D5C		
D3#4		
12G#1		
619 ww		
D8K#2		3
631 #1		7
3		7
5		7
7		7
Operator	ch#1	4
"	ch#2	8
"	420 hoe	8
"	330 hoe	4
laborer		8

hauled from pond
helped drillers, d
cleaned up ar
spread spoils at
cleaned up arou



AUGUST **16** WEDNESDAY

Sunny & Warm

Dan - 11 hrs.

2006 228th day – 137 days follow

	Wsm En	
D9H	9	Hillis - 9
D8K #2	9	John - 9
D5C	6½	Mark - 9
12G #1	9	Randy - 9
2	1½	Mark —
619 w.w.	9	Wardell - 9
631 #1	9	Kelly - 9
3	9	Rick - 9
4	9	Sam - 9
6	9	(dr. Appt.) David (sid) - 7
Operator ch #1	9	Harry - 9
" ch #2	7	Sid - 9½
" 330, 420	1½	" (Mark) —
laborer	9½	Jim - 9½
"	3	Dan

hauled from pond to Stockpile
cleaned tunnel put in rock
graded Roads, checked liner depth, ok
maintained pumps, located gas line

TH

Cloudy & Warm

2006 229th day – 136 days follo

D9H	239 loads W
D8K #1	
D5C	
12G #1	
619 w.w.	
631 #1	
3	
4	
6	
Operator ch #1	
" ch #2	
" 330 hr	
laborer	
"	

hauled dirt from pa
" Shale " "
" " " "
Stripped topsoil f
helped drillers, pu

AUGUST **18** FRIDAY

Sunny & hot

Dan 11 hrs.

2006 230th day – 135 days follow

	WSM. EN.		
D9H 239 loads	9		Hillis – 9
D8K #1	9		John – 9
D5C	6½		Mark – 8½
12G #1	9		Randy – 9
2	2		Wade – 10½
619 w.w.	9		Wardell – 9
815	2		David – 9
631 #1	9		Kelly – 9
3	9		Rick – 9
4	9		Sam – 9
6	7		David –
Operator	9	ch #1	Harry – 9
"	7	ch #2	Wade –
"	7½	330 hoe	Sid – 9
"	1½	420 hoe	—
"	2	Roller	Mark –
laborer	9½		Jim – 9½
"	5		Dan –

hauled shale from pond to Rds, misc. Areas
" dirt " " " stockpile
Stripped topsoil from Rd
Covered shale in pond bottom (4')
toploaded mud from pond
pushed brush & logs from field

SAT

Cloudy, hot

2006 231st day – 134 days follow

	WSM E
D9H	8
D8K #1	8
D5C	4½
12G #1	8
2	2
2670 + disk	5
619 w.w.	5
815	3
631 #1	8
3	5
5	8
7	8
Operator (ch #1)	8
" 420, Roller	6
" 330	1½
laborers	8½
"	4

hauled shale to pip
" dirt to pon
disked dove field

Total 38 reg
21½

AUGUST **26** SATURDAY

2006 238th day – 127 days follow

Cloudy, Warm
Day – 10½ hrs.

	Wsm Fn.	
D9H	8	Hillis – 8
D8K #1	8	John – 8
D5C	8	Mark – 8
12G #1	8	Randy – 8
619 w.w.	4	Wardell – 8
815	4	" —
631 #1	8	Kelly – 8
5	8	Sam – 8
7	8	Rick – 8
Operator 330	8	Sid – 8
" ch #1	8	Harry – 8
" ch #2	8	Wade – 9½
laborer	8½	Jim – 8½
"	4	Dan —

hauled from pond (plug) to stockpile
Cleaned topsoil from ditches
" out mud in bottom, Compacted clay
dismantled pipe

Note: gas stolen from blower

Total 37 Reg.
22½ Hrs

SU

2006 239th day – 126 days follow

Cloudy, Warm R

Went to SS
+ evening
Went to office,
misc. around

SEPTEMBER **9** SATURDAY

Sunny & Warm

Dan — 9½ hrs.

2006 252nd day – 113 days follow

	Wsm En.	
D9H	8	Hillis – 8
D8K #1	8	John – 8
2	3	David – 8
D5C	8	Sid – 8
D4H	4½	David –
12G #1	8½	Randy – 8½
2	2	Wade – 9½
619 w.w.	3½	Wardell – 8
2390 & w.w.	4½	" –
325 hoe	1½	Wade –
815	3	Sam – 8
631 #1	8	Kelly – 8
2	5	Sam –
8	8	Harry – 8
Operator (Roller)	4½	Wade –
Laborer	8½	Jim – 8½
"	4	Dan –

hauled Shale from pond to N. of plant
" dirt to bottom of pond Compacted
took out RR Crossing, misc. clean-up
finished pond 003 ✓

Total 32 reg.
21½ over

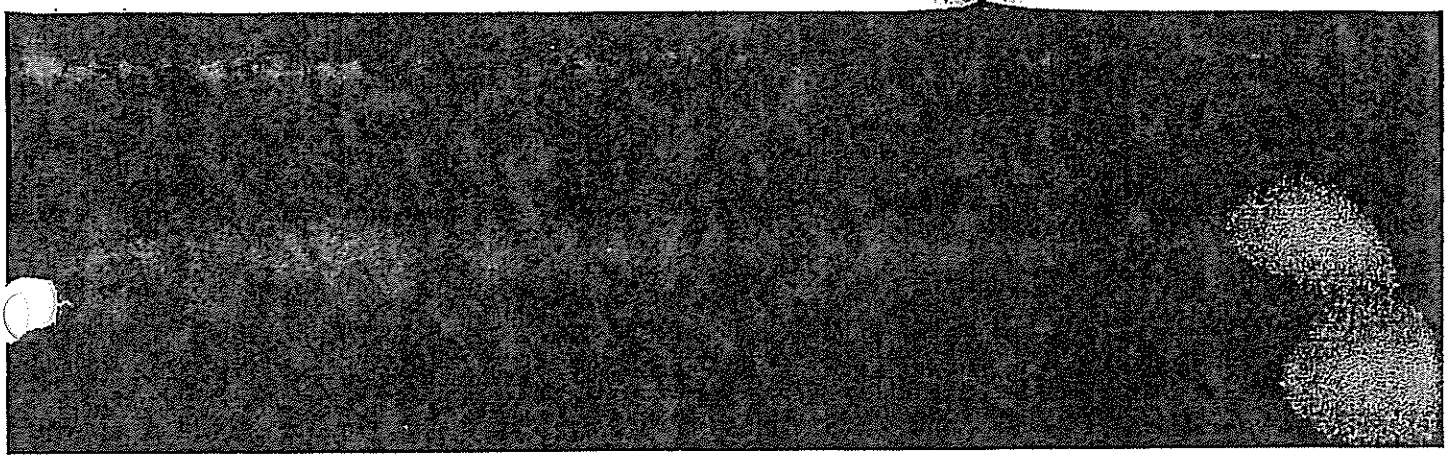
SI

Sunny & Warm

2006 253rd day – 112 days follow

Went to SS &
Skipped evenin
✓

Rested around h



DOCUMENT

67

6431-/12
R11528
Due date: 10-24-12
ORIGINAL

Alliance Consulting, Inc.
Engineers • Constructors • Scientists

INSIGNIFICANT PERMIT REVISION
PERMIT NO. 375

POND CREEK NO. 1 MINE
COAL REFUSE DISPOSAL FACILITY NO. 2
PHASES 5A, 7 AND 8

Prepared for

WILLIAMSON ENERGY, LLC
JOHNSTON CITY, ILLINOIS

ALLIANCE PROJECT NO. B11-530-1413
SEPTEMBER 2012

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Summersville, WV 26651
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6431-/12
R11529

Illinois Department of
Natural Resources
One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

Pat Quinn, Governor
Marc Miller, Director

October 25, 2012

Michael Beyer
Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951

Re: Permit No. 375
Insignificant Revision No. 44

Dear Mr. Beyer:

The appropriate Department technical staff has reviewed the proposed change dated November 2, 2011, and supplemental information dated September 14, 2012, submitted by Alliance Consulting, Inc. for the Pond Creek Mine. Alliance has requested approval to increase the life of the current facility by developing disposal facility No.2 Phases 5A, 7 and 8. Since this operation is not currently approved, it will constitute a change to the approved plan. Insignificant permit revisions are allowed under 62 Ill. Adm. Code 1774.13(b)(2).

The Department has determined the proposed alteration will have no significant potential adverse impact on the achievement of final reclamation plans or upon the surrounding area, is in compliance with 62 Ill. Adm. Code 1700 - 1850 and is insignificant, and hereby exempts the permittee from submitting a significant permit revision application in accordance with Section 1774.13(b)(2). The Department grants permission to develop disposal facility No.2 phases 5A, 7 and 8 as submitted. However, Department approval is conditioned as follows, with these requirements:

1. Groundwater monitoring well GW-8 shall be properly plugged and abandoned within thirty days of the date of this letter.

2. A replacement groundwater monitoring well, to be known as GW-8R shall be installed at the location depicted on Drawing No. B11-530-E2.

    a. This well shall be installed to the uppermost water-bearing unit at a depth sufficient to monitor potential groundwater impacts related to the refuse disposal area(s).

b. The Replacement well will be considered an upgradient well to the RDA's

3. Background groundwater quality data shall be collected by a minimum of six samples for, the replacement well, over the course of the first year after well installation (bi-monthly/every two months). Once background has been established for this well, groundwater monitoring shall occur quarterly. Bi-monthly data shall be submitted quarterly in accordance with the current groundwater monitoring plan.

   Groundwater monitoring well GW-8R shall be sampled for the following parameters:

Aluminum (Al)	Chromium (Cr)	Mercury (Hg)	Vanadium (V)
Antimony (Sb)	Cobalt (Ca)	Molybdenum (Mo)	Zinc (Zc)
Arsenic (As)	Copper (Cu)	Nickel (Ni)	pH
Barium (Ba)	Cyanide (Cn)	Selenium (Se)	Alkalintiy
Beryllium (Be)	Fluoride (F)	Silver (Ag)	Acidity
Boron (B)	Iron (Fe)	Sulfate (SO_4)	Hardness
Cadmium (Cd)	Lead (Pb)	Thallium (Tl)	H_2O Elevation**
Chloride (Cl)	Manganese (Mn)	Total Dissolved Solids (TDS)	

   *Total and Dissolved
   **Water Elevation is measured as true elevation, not depth to water.

4. Within thirty days of completion of well installation activities a boring log and well construction/well completion diagram shall be submitted to the Department. Top of casing and ground elevation must be surveyed and the surveyd elevations shall be included on the boring logs/well construction diagrams. Additionally, a revised/updated map shall be submitted showing the location of the newly installed well as well as all other groundwater montiroing wells at this facility.

5. Proof of plugging and abandonment of groundwater monitoring well GW-8 shall be submitted to the department within thirty days of completion of well lugging activities.

No additional bond is required because of this change.

All conditions and provisions contained in the approved permit also apply to this revision. Approval from this agency does not relieve the permittee from obtaining approval from other agencies requiring such.

Please submit two additional copies of your request letter and maps to Ronald Morse, Illinois Environmental Protection Agency, 2309 West Main Street, Marion, Illinois 62959.

Should you have any questions, please contact Brad Murphy at our Benton Office.

Sincerely,

Scott K. Fowler, Supervisor
Land Reclamation Division

SKF:CBM:gr

cc: B. Murphy
R. Morse
J. Slapak
V. Broomhead

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Office: 618-983-3020 Fax: 618-983-3017

November 7, 2011

Mr. Scott K. Fowler, Supervisor
ILLINOIS DEPARTMENT OF
NATURAL RESOURCES
One Natural Resources Way
Springfield, IL 62702-1271

Re: Williamson Energy, LLC - Permit No. 375; Insignificant Permit Revision

Dear Mr. Fowler:

This letter authorizes Mr. Jim Slapak and Alliance Consulting, Inc. (Alliance) and its representatives, permission to perform work on, receive comments and submit corrections on the above referenced application. Please send copies of any comments to Alliance Consulting, Inc. at 124 Philpott Lane, Beaver, WV 25813, as well as Williamson Energy, LLC at the above address.

Thank you for your cooperation.

Sincerely,

WILLIAMSON ENERGY, LLC

Anthony Webb
Authorized Agent

RECEIVED
SEP 25 2012
IL Environmental Protection Agency
MARION REGIONAL OFFICE

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

November 2, 2011

Project No. B11-530-1413

Mr. Scott Fowler
ILLINOIS DEPARTMENT
OF NATURAL RESOURCES
Land Reclamation Division
One Natural Resources Way
Springfield, IL 62702-1271

Transmittal
Insignificant Permit Revision
Pond Creek 1 - Permit No. 375
Coal Refuse Disposal Facility No. 2
Phases 5A, 7 and 8
Williamson Energy LLC

Dear Mr. Fowler:

On behalf of our client, Williamson Energy LLC, please find one original and one copy of an Insignificant Permit Revision for the permit referenced above. The purpose of the application is to increase the life of the facility.

One copy has been sent to Mr. Brad Murphy in the Benton Office.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Claudio E. Yon, P.E.
Senior Project Manager

CEY:wmb
Enclosures

FILE: 11530-01

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

November 2, 2011

Project No. B11-530-1413

Mr. Brad Murphy
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
Office of Mines and Minerals
Land Reclamation Division
503 E. Main; FL001
Benton, IL 62812

Transmittal
Insignificant Permit Revision
Pond Creek 1 - Permit No. 375
Coal Refuse Disposal Facility No. 2
Phases 5A, 7 and 8
Williamson Energy LLC

Dear Mr. Murphy:

On behalf of our client, Williamson Energy LLC, please find one copy of an Insignificant Permit Revision for the permit referenced above. The purpose of the application is to increase the life of the facility.

An original and one copy have been sent to Mr. Scott Fowler in the Springfield Office.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Claudio E. Yon, P. E.
Senior Project Manager

CEY:wmb
Enclosures

FILE: 11530-02

124 Philpott Lane • Raleigh County Airport Industrial Park • Beaver, WV 25813-9502 • TELE: (304) 255-0491 • FAX: (304) 255-4232

REPORT
COAL REFUSE DISPOSAL FACILITY
PHASE 5A, 7, AND 8
POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS

TABLE OF CONTENTS

		PAGE
1.0 INTRODUCTION		1
2.0 EXISTING SITE CONDITIONS		1
2.1	Site Characteristics	1
2.2	Geology	2
3.0 MINING OPERATIONS AND COAL REFUSE PRODUCTION		2
3.1	Mining Operations	2
3.2	Coal Refuse Production	3
4.0 SUBSURFACE EXPLORATION		3
4.1	Subsurface exploration	3
5.0 FIELD AND LABORATORY TESTING		4
5.1	Soil	4
5.2	Coarse Coal Refuse	4
5.3	Fine Coal Refuse	5
5.4	Piezo-Seismic Cone Penetration Testing	5
6.0 COAL REFUSE DISPOSAL PLAN		5
6.1	Phase 7 Embankment	6
6.2	Phase 5A Embankment	7
6.3	Phase 5A/7 Embankment	8
6.4	Buttress Construction	9
6.5	Phase 8 Embankment	10
6.6	Abandonment Plan	11
7.0 ENGINEERING ANALYSES		11
7.1	Hydrologic and Hydraulic Analyses	11
7.2	Slope Stability Analyses	12



TABLE OF CONTENTS (continued)

8.0 SUMMARY 13

APPENDIX A – GUIDELINE TECHNICAL SPECIFICATIONS

APPENDIX B – CALCULATION BRIEF

FIGURES

LIST OF FIGURES

FIGURE NO.	DRAWING NO.	TITLE
T1	B11-530-T1	Title Sheet
1	B11-530-E2	Existing Conditions Map
2	B11-530-E13	Drainage Map
3	B11-530-E3	Phase 7 Plan
4	B11-530-E4	Phase 5A Plan
5	B11-530-E5	Phase 5A/7 Plan
6	B11-530-E6	Phase 8 and Buttress Plan
7	B11-530-E9	Section A-A
8	B11-530-E10	Section B-B and C-C
9	B11-530-E8	Details (Sheet 1 of 2)
10	B11-530-E12	Details (Sheet 2 of 2)
11	B11-530-M5	Decant Installation and Uniform Section Mat Details
12	B11-530-E11	Slope Stability Sections
13	B11-530-E7	Abandonment Plan

ENGINEERING DESIGN PLAN
COAL REFUSE DISPOSAL FACILITY NO. 2
PHASE 5A, 7, AND 8
POND CREEK NO. 1 MINE
WILLIAMSON ENERGY, LLC
WILLIAMSON COUNTY, ILLINOIS
JOHNSON CITY, ILLINOIS

1.0 INTRODUCTION

Plans have been developed for the construction of a coarse and fine coal refuse disposal facility to be located near Johnston City in Williamson County, Illinois. The proposed coal refuse disposal facility will provide disposal capacity for both coarse and fine coal refuse produced by the Pond Creek No. 1 mine coal preparation plant located approximately 0.25 mile west of the proposed facility. The location of the site is just southwest of the intersection of Dwina Road and Dean Road and is shown on Figure No. 1.

The plan, as presented herein, provides for the disposal of approximately 3.1 years of coarse coal refuse and 4.3 years of fine coal refuse based on production rates provided by Williamson Energy, LLC. The facility shall be constructed in five phases of coarse coal refuse embankment construction. During construction of the proposed phase, fine coal refuse shall be disposed in the existing phases of the impoundment[1] MSHA ID No. IL08-03141-02 (Phases 4/6 and 5).

The proposed facility has been designed as a high hazard impoundment using the Probable Maximum Flood (PMF) storm event. The facility has been designed to be capable of storing the runoff associated with the design storm event. The stored runoff volume, as well as operational water, shall be evacuated using a pump for Phases 5A, and 7, and a decant pipe for Phase 8.

Proposed and existing combination, sedimentation, and perimeter ditches, access road gutters and bench gutters will be used to convey storm runoff away from the embankment in a controlled manner. The ditches have been designed for routing the runoff associated with the 100-year, 6-hour recurrence interval storm event.

This report presents the design drawings, guideline technical specifications (Appendix A), and calculations (Appendix B) necessary for the design and construction of the embankment.

2.0 EXISTING SITE CONDITIONS

2.1 Site Characteristics

The general area of the proposed impoundment has previously been used for agricultural purposes and has relatively flat to mild slopes to the ridgeline at approximate Elevation 572. The surrounding landscape is characterized by extensive agricultural and rural residential land use.

---

[1] Alliance Consulting, Inc. report entitled "Plan Modification Pond Creek No. 1 Mine, Coal Refuse Disposal Facility No. 2, Phase 4 Through 7, Impoundment ID No. IL08-3141-02"" prepared for Williamson Energy, LLC, Johnston City, Illinois, dated March 2011.

Regionally, the proposed permit area is located on the southern shelf of the Illinois Basin in the Mt. Vernon Hill Country physiographic division. Surrounding landforms are the results of both Wisconsinian glaciations and normal degradation processes such as weathering, mass wasting, and stream erosion. Surrounding topography is characterized by generally flat ridge tops, moderately steep hill slopes and broad flat valley floors associated with major streams. The local drainage pattern is dendritic reflecting the regional generally horizontal bedrock stratigraphy. The total relief of the Facility No. 2 footprint is approximately 32 feet ranging from approximately 436' to 468' above mean seal level (based on aerial photography).

Glacial deposits of the Carmi Member of the Equality Formation, consisting of quiet water lake silt and clay, constituted the original surface materials within the proposed permit area.

2.2 Geology

The proposed permit area is underlain by lower Pennsylvanian age rocks consisting of shale, sandstone, and siltstone with minor underclay, coal and limestone. These sequences reflect fluctuating shorelines, deltas, and shallow seas indicating deltaic, fluvial, and coal swamp depositional environments. These bedrock units can be highly variable in thickness and continuity. Mississippian rocks unconformably underlie the Pennsylvanian, however, they do not outcrop in the subject area and were not penetrated during exploration drilling.

The major stratigraphic marker is the Herrin No. 6 coal which is generally uniform and continuous in the subject area and occurs at approximate Elevation 10 beneath the proposed refuse disposal facility. Shale and sandstone units in the subject area exhibit a high degree of lateral facies changes and interbedding. The Herrin No. 6 seam is described as a normal bright-banded coal with a lower portion that contains a prominent claystone parting. The base of the Herrin No. 6 exhibits an undulating surface with a general structural trend toward the north-northeast dipping approximately 60 feet per mile. No major faults or other structural anomalies are known to be present within the proposed permit.

3.0 MINING OPERATIONS

3.1 Mining Operations

The Herrin No. 6 coal seam (average Elevation 10 feet above mean sea level) has been mined by both longwall and conventional mining techniques beneath the footprint area of the proposed facility. The disposal plan was staged to minimize the impacts of the mining on the integrity of the embankments. Due to the timing of the proposed mining, it was necessary to initiate Phases 3 and 4 embankment construction above unmined areas. Based on a report prepared by Syd S. Peng, et. al.[(2)], it was anticipated that substantially all of the significant surface subsidence resulting from the longwall mining activities should occur within approximately 14 to 21 days following longwall mining. Phase 3 has been filled to capacity with fine coal refuse and the impounding capability eliminated before being mined under. Following the subsidence period, a

[(2)]Report entitled "Prediction of Ground Movement Parameters due to Longwall Mining During different Phases of Impoundments", prepared by Syd S. Peng and Thomas Du, Department of Mining Engineering, West Virginia University, May 2009.

downstream stage (Phase 6) is currently being constructed around the Phase 4 impoundment area. This phase essentially "rings" the initial embankment and should serve to mitigate any cracks that may have developed in the initial embankment as a result of the subsidence. Internal drains were specified[1] for the Phase 3, 5, and 6 embankments to collect and convey potential seepage. Based on the predicted subsidence, the drains were designed so that positive drainage will occur post subsidence.

Subsidence monitoring baselines are being used to calibrate the subsidence prediction model and compare predicted to actual subsidence due to mining.

Concerning breakthrough potential, the Bureau of Mines Information Circular 8741 recommends an overburden thickness equal to 60 times the extraction height for total extraction mining. The lowest level of the subsided pool area is approximately Elevation 420, and the bottom of coal seam is at average Elevation 10 feet with an extraction height of 6.5 feet. Therefore, the existing overburden thickness is greater than the recommended thickness and there is no significant potential for a catastrophic breakthrough of fine coal refuse slurry into the mine to occur.

No proposed mining will occur during construction of the proposed phases, therefore, the majority of subsidence has already occurred and is not expected to impact construction of the new phases.

Based on these conditions and recommended guidelines, it is expected that no adverse effects shall impact the stability or breakthrough potential of the impoundments.

No significant depth of impoundment water will be allowed prior to any of the required remediation of subsidence disturbance prior to the raising of the post-subsidence stages to a suitable elevation.

3.2 Coal Refuse Production

Based on current plant operation information provided by Williamson Energy, the following annual production quantities were used in the design (see Calculations in Appendix B).

- Coarse Coal Refuse 2,568,200 cubic yards/year
- Fine Coal Refuse 2,064,400 cubic yards/year

4.0 SUBSURFACE EXPLORATION

4.1 Subsurface Exploration

During the month of February 2006, a subsurface exploration program consisting of drilling one soil boring (No. 8874) was conducted within the footprint of the proposed embankment. The intent of the program was to obtain soil samples to define the conditions and engineering characteristics relative to the construction and operation of the fine coal refuse slurry disposal impoundment. In addition to this soil boring, the results of a previous subsurface exploration program performed by Holcomb Foundation Engineering Co. (Holcomb) indicate the following:



- Sample number, type, standard penetration test blow counts, and depth;
- An overall description of the consistency, color and character of the soil; and,
- Indication of the observed groundwater level in the boreholes at the time of drilling.

Generally, the soils encountered beneath the dam footprint consist of brown and gray silty clay with sand and pebbles. The thickness of the soil varied from 12.5' to 22.5' while the surface elevation for the borings varied from Elevation 438.5± to Elevation 473.0±. Each of the borings was terminated at the top of the bedrock.

Groundwater was encountered in two (2) of the seven (7) borings (i.e. Nos. 8293 and 8295). Following drilling, the depth from the ground surface to groundwater level varied from 10 to 13.5 feet or from Elevation 432.4± to Elevation 438.5± in the borings.

5.0 FIELD AND LABORATORY TESTING

5.1 Soil

Samples of the soils obtained during the subsurface exploration program from Boring No. 8874 were used for laboratory testing. The scope of the testing is discussed below.

Visual classification tests were performed by Holcomb on the split spoon samples obtained during drilling. Samples from the borings represent the foundation conditions for the proposed embankment. Additional testing performed on the borings included the following:

- Grain Size Analysis – Grain size analysis were performed on a sample from Boring No. 8874;
- Atterberg Limits Test – Atterberg Limits tests were performed on a sample from Boring No. 8874;
- Unit Weight Determination – Performed on a Shelby tube sample from Boring No. 8874; and,
- Shear Strength Test – A consolidated, undrained triaxial shear strength test with pore pressure measurements was performed on a Shelby tube sample from Boring No. 8874.

5.2 Coarse Coal Refuse

The proposed embankment shall be constructed with coarse coal refuse. The coarse coal refuse used to construct the embankment has been sampled from the Pond Creek No. 1 mine coal processing plant and has undergone laboratory testing. The scope of the testing is discussed below.

- Grain Size Analysis – A grain size analysis was performed on the coarse coal refuse sample.
- Shear Strength Test – A consolidated, undrained triaxial shear strength test with pore pressure measurements was performed on re-molded samples of the coarse



coal refuse. Material from the sample was re-molded to a density equivalent to approximately 95 percent of Standard Proctor maximum dry density.

- Permeability – A constant head permeability test was performed on a re-molded sample to determine the permeability characteristics of the coarse coal refuse for the embankment construction. The sample was compacted to approximately 95 percent of the Standard Proctor maximum dry density.
- Compaction Test – A Standard Proctor compaction test was performed on the coarse coal refuse sample.

5.3 Fine Coal Refuse

Two fine coal refuse bulk samples were obtained from the South Pond (Phase 2) for laboratory testing. The scope of the testing is discussed below and the results are presented in Appendix I[3] (under separate cover).

- Moisture Content – Moisture contents were performed on the two fine coal refuse samples.
- Grain-size Analysis – Grain size distribution analysis was performed on the two fine coal refuse samples (sieve and hydrometer).
- Atterburg Limits – Atterberg Limit tests were performed on the two fine coal refuse samples.
- Specific Gravity – Specific gravity tests were performed on the two fine coal refuse samples.
- Shear Strength – Six consolidated – undrained triaxial tests were run on remolded fine coal refuse samples. These six tests included moisture content and total and dry density determinations.

5.4 Piezo-Seismic Cone Penetration Testing

- Fifteen piezo-seismic cone penetration soundings were performed at the Pond Creek site to measure tip stress, sleeve stress, pore water pressure, and shear wave velocities. The testing was used to correlate index and strength parameters for the coarse coal refuse and foundation soil and for use in a deformation analysis.

- The testing data and results are presented in Appendix I[3] (under separate cover).

6.0 COAL REFUSE DISPOSAL PLAN

The proposed plan provides disposal capacity for approximately 3.1 years of coarse and 4.3 years of fine coal refuse production beyond the current Phase 4/6 and 5 plan. The plan has been developed in accordance with prudent engineering principles and practices and current Mine Safety and Health Administration (MSHA) design criteria for coal refuse disposal facilities. It is

[3] GIA Consulting, Inc. report entitled "Response to MSHA Comment Nos. 1, 3, 7 and 8, Pond Creek Mine No. 1, Coal Refuse Disposal Facility No. 2, Phases 3 and 7, Impoundment ID No. 1211-IL08-03141-02, Williamson Energy, LLC,, Williamson County, Illinois," prepared for Alliance Consulting, Inc.Project C090403.01, May 2009.

intended that the construction of the facility be monitored by experienced persons knowledgeable of the design, specifications and regulatory requirements.
A brief description of the disposal plan is as follows:

1. Sedimentation control for the construction of the embankment shall be provided by sedimentation ditches. Bench gutters and conveyance ditches shall be constructed to route the runoff from the embankment area to the sedimentation ditches.

2. Phase 7 will be constructed to raise the Phase 4/6 crest. Phase 5A will then be constructed to match the Phase 7 crest Elevation. Phase 5A/7 will then be constructed as a joint cell, rising the entire footprint. Buttresses must then be constructed on the north and south sides. Phase 8 will then be constructed to raise the entire crest of the facility.

3. Fine coal refuse slurry may be pumped into the Phase 4/6 and 5 impoundments upon commencement of construction. The discharge line(s) shall be moved to result in a relatively uniform surface of fines throughout the impoundment and to minimize the depth of any water impounded directly against the embankment slope. Generally, a delta of fine coal refuse shall be maintained along the embankment slope.

4. Operational pump(s) and discharge line(s) shall be maintained to remove clarified water and normal rainfall from the impoundment. The facility has been designed to store the runoff associated with a PMF design storm event. A decant pipe has been specified to evacuate the design storm runoff for Phase 8 after its dam crest elevation reaches 588. Additional pumps with independent power supplies (diesel motors or generators) will be kept on site and used to evacuate storm water for all phases until final dam crest elevation is reached, and the decant is operational.

5. An internal drainage system located within the Phases 5A, 7, and 8 embankments shall be installed to aid in controlling the phreatic level within the embankments. Animal guards shall be installed on all internal drain outlets to prevent vector infiltration.

6.1 Phase 7 Embankment

Phase 7 will be constructed post-subsidence. The Phase 7 embankment shall be constructed using coarse coal refuse from the Pond Creek No. 1 mine coal preparation plant, as centerline construction above the Phase 4/6 embankment. The location of the Phase 7 embankment is shown in plan on Figure No. 3 and cross section on Figure Nos. 7 and 8, and requires approximately 0.45 years of coarse coal refuse production to construct. Pertinent construction items include:

1. Coarse Coal Refuse Disposal – Phase 7 involves constructing an embankment 18 feet high to Elevation 510 using coarse coal refuse to raise the Phase 4/6 crest as shown on Figure No. 2. The slope of the embankment shall be constructed on a grade of 3H:1V.



2. Fine Coal Refuse Disposal – Fine coal refuse slurry will be pumped into the Phase 4/6 and 5 impoundments during Phase 7 construction. Periodic relocation of the slurry discharge line shall be performed to promote a more uniform distribution of the fine coal refuse and to minimize the depth of clarified water impounded directly against the embankment slope.

3. Pump Installation – An operational pump, of sufficient capacity to remove clarified water and normal precipitation, and associated discharge lines shall be installed during construction of Phase 7. The pump shall discharge into Sediment Pond No. 6 and/or the Freshwater Pond. Additional pumps will be kept available on site to evacuate 90 percent of the design storm in 10 days or less.

4. Internal Drain - An internal drainage system consisting of a perforated pipe and gravel wrapped with filter fabric, shall be installed during the construction of Phase 7 to aid in controlling the phreatic level within the embankment. The location and invert elevations for the internal drain are presented on Figure No. 3. Animal guards shall be installed on drain outlets to prevent vector intrusion of the internal drain. Details pertaining to the drain construction are provided in the guideline technical specifications and on Figure No. 9.

5. Surface Drainage – Existing sedimentation/perimeter ditches shall be used as shown on Figure No. 2, to collect surface water and clarify the runoff before it is discharged into an existing channel. Bench gutters will be constructed to drain as shown on Figure No. 3, and according to Detail 1, on Figure No. 9. Proposed Ditches "O" and "P" will be constructed during this phase.

6.2 Phase 5A Embankment

Phase 5A, which is shown in plan on Figure No. 4 and cross section on Figure Nos. 7 and 8, requires approximately 0.42 years of coarse coal refuse production to construct and will raise the Phase 5 crest to Elevation 510, and match the Phase 7 crest. Pertinent construction items include:

1. Embankment Construction – The Phase 5A embankment shall be situated as shown on Figure No. 2 with an upstream toe at Elevation 488± and a crest at Elevation 510. The embankment will require the placement of approximately 1.08 million cubic yards of coarse coal refuse and will match the crest elevation of Phase 7. The material used for the embankment construction shall be compacted to 95 percent of Standard Proctor maximum dry density. The moisture content of the material shall be within -2 to +3 percent of the optimum moisture content. As indicated on Figure No. 3 the upstream and downstream slopes of the Phase 5A embankment shall be constructed on a grade of 3H:1V. Initial coarse refuse construction of this phase will temporarily make the impoundment incapable of storing the full design storm. It is requested to have consideration for Mach to have variance according to the MSHA Engineering and Design Manual for Coal Refuse Embankments, Section 9.5.2 to store only the short-term design storm of one half PMF. The facility will be regain control of the full PMF design storm in approximately 3.5 months after construction of this

phase begins as shown in the embankment construction and fines level schedule calculations (Appendix B).

2. Fine Coal Refuse Disposal – During construction of the Phase 5A embankment, the fine coal refuse slurry continue to be pumped into the Phase 7 and 5 impoundments. After the slurry level in Phase 7 reaches the maximum fines level, the Phase 5A crest will already be constructed to store one 72-hour PMF flood storage volume.

3. Pump Installation – an operational pump, of sufficient capacity to remove clarified water and normal precipitation, and associated discharge lines shall be used during construction of Phase 5A. The pumps shall discharge into Sediment Pond No. 6 and/or the Freshwater Pond. Additional pumps will be kept available on site to evacuate 90 percent of the design storm in 10 days or less.

4. Internal drain – An internal drainage system consisting of a non-calcareous gravel wrapped with a geotextile and perforated pipe, shall be installed during the construction of Phase 5A to aid in controlling the phreatic level within the embankment. The location and invert elevations for the internal drain are presented on Figure No. 4. Animal guards shall be installed on drain outlets to prevent vector intrusion of the internal drains. Details pertaining to the drain construction are provided in the guideline technical specifications and on Figure No. 9.

5. Surface Drainage – Existing sedimentation/perimeter ditches shall be used as shown on Figure No. 2, to collect surface water and clarify the runoff before it is discharged into an existing channel. Bench gutters will be constructed to drain as shown on Figure No. 3, and according to Detail 1, on Figure No. 9. Proposed Ditches "I" and "L" will be constructed during this phase.

6.3 Phase 5A/7 Embankment

Phase 5A/7 embankment will be built to raise Phase 5A and 7 from Elevation 510 to Elevation 538 as a combined storage cell. The Phase 5A/7 embankment shall be constructed using coarse coal refuse from the Pond Creek No. 1 mine preparation plant. The location of the embankment is shown in plan on Figure No. 5 and cross section of Figure Nos. 7 and 8, and requires approximately 0.65 years of coarse coal refuse production to construct. Pertinent construction items include:

1. Coarse Coal Refuse Disposal – Phase 5A/7 involves constructing an embankment 28 feet high to Elevation 538 using coarse coal refuse. The upstream and downstream slopes of the embankment shall be constructed on a grade of 3H:1V.

2. Fine Coal Refuse Disposal – Fine coal refuse slurry will continue to be pumped into the Phase 5A impoundment throughout construction. The average settled fine coal refuse level is expected to rise to Elevation 498± by the completion of the phase. Periodic relocation of the slurry discharge line shall be performed to promote a more uniform distribution of the fine coal refuse and to minimize the depth of clarified water impounded directly against the embankment slope.



3. Surface Drainage –Bench gutters shall be constructed as shown on Figure No. 5, to collect and convey surface water runoff to the sediment ditches. Ditches "I", "L", "O", and "P" shall be extended as necessary through construction. Ditch details are presented on Figure No. 9.

4. Instrumentation – Piezometer Nos. P-14, P-17, P-18, P-19, P-20, P-21, P-22, and P-23 shall be installed during Phase 5A/7 construction at the locations shown on Figure No. 4. The proposed piezometer tip elevations are presented on Figure No. 12 and the piezometer installation detail is presented on Figure No. 10. A conduit of the same type shall be used to extend the casing horizontally for the wires of pneumatic piezometers PN-3 and PN-4 to maintain access to readings.

6.4 Buttress Construction

Buttress construction will begin on the north side of impoundment around the Phase 5 cell as shown on Figure No. 6. The north buttress will take approximately 0.05 years of coarse coal refuse to construct. The south buttress may be built by two different options. The first option is a coarse coal toe buttress that would require about 0.02 years of coarse coal refuse to construct. The second option will be a connector impoundment constructed of approximately 0.04 years of coarse coal refuse in two small embankments as shown on Figure No. 6. The Phase 2-3 connector impoundment will also provide 0.24 years of survey storage. This option would require the abandonment of the underlying 8 inches methane pipeline prior to construction. Abandonment would be done by removing the existing pipeline and relocating it to a place not covered by the fill. The excavated pipeline trench shall be backfilled and compacted prior to placement of fines.

1. Coarse Coal Refuse Disposal – The slopes of the buttress shall be constructed on a grade of 3H:1V. The north buttress and one option of the south buttress must be constructed prior to construction of Phase 8 to ensure stability is adequate.

2. Fine Coal Refuse Disposal – Fine coal refuse slurry shall continue to be pumped into the Phase 7 impoundment during buttress construction. Fine coal reuse pumping into Phase 7 is expected to reach a level of approximately 508.4. Should Phase 2 – 3 connector impoundment option be constructed fines disposal may begin in this cell at any time after construction of the embankments is complete.

3. Internal drain – An internal drainage system consisting of a non-calcareous gravel wrapped with a geotextile and perforated pipe shall be installed during the construction of the Phase 2-3 connector, if constructed, to aid in controlling the phreatic level within the embankment. The location and invert elevations for the internal drain are presented on Figure No. 6. Animal guards shall be installed on drain outlets to prevent vector intrusion of the internal drains. Details pertaining to the drain construction are provided in the guideline technical specifications and on Figure No. 9.



4. Instrumentation – Piezometer Nos. P-32, P-33, P-34 and P-35 shall be installed in the Phase 2-3 connector embankment, if that option is constructed, in the location shown on Figure No. 6.

6.5 Phase 8 Embankment

Phase 8 is an upstream stage, which is shown in plan on Figure No. 6 and cross section on Figure Nos. 6 and 7, requires approximately 1.56 years of coarse coal refuse production to construct. Phase 8 will raise the Phase 5A/7 crest 50 feet from Elevation 538 to Elevation 588. Phase 8 construction will begin after the north and south buttresses have been completed, and the Phase 5A/7 fines level have reached the maximum limit. During the time required to fill the Phase 5A/7 cell it is desired to use coarse refuse to construct a separate refuse disposal facility (currently under review for approval, under separate cover.) Pertinent construction items include:

1. Coarse Coal Refuse Disposal –Phase 8 will be constructed in four stages to maintain the required storm runoff storage capacity. The upstream and downstream embankment slopes shall be constructed to 3H:1V. The final embankment slopes shall be soil covered and vegetated in accordance with the Illinois reclamation permit.

2. Fine Coal Refuse Disposal – During the first stage of construction fine coal refuse slurry shall be pumped into a separate facility as the Phase 8 embankment is being built. The Phase 8 embankment crest will be kept to at least one 72-hour flood storage volume, plus 3 feet of freeboard, above the fine coal refuse level in the Phase 5A/7 pool until the principal spillway/decant pipe is installed and the crest elevation reaches 588.0, its final elevation. Periodic relocation of the slurry discharge line shall be performed to promote a more uniform distribution of the fine coal refuse and to minimize the depth of clarified water impounded directly against the embankment slope.

3. Internal drain – An internal drainage system consisting of a non-calcareous gravel wrapped with a geotextile and perforated pipe, shall be installed during the construction of Phase 8 to aid in controlling the phreatic level within the embankment. The location and invert elevations for the internal drain are presented on Figure No. 6. Animal guards shall be installed on drain outlets to prevent vector intrusion of the internal drains. Details pertaining to the drain construction are provided in the guideline technical specifications and on Figure No. 9.

4. Surface Drainage –Bench and access road gutters shall be constructed as shown on Figure No. 5, to control and convey surface water runoff. Ditches "I", "L", "O", and "P" will be extended as necessary through construction.

5. Instrumentation – Piezometer Nos. P-24, P-25, P-26, P-27, P-28, P-29, P-30 and P-31 shall be installed, during Phase 8 construction at the locations shown on Figure No. 7. Piezometer extension and installation details are presented on Figure No. 10. The piezometer tip elevations are specified on Figure No. 12.



6. Decant Pipe – Construction of the decant pipe shall be performed concurrent with the construction of the Phase 8 embankment. The installation includes excavating a trench into the embankment and placing approximately 125 feet of HOPE pipe and appurtenant structures (drop inlet, ditch, filter and drainage diaphragm and outlet drain). The drop inlet shall be extended vertically to Elevation 582 by adding the appropriate length of 36-inch diameter DR 26 HDPE pipe to the HDPE elbow attached to the transport section of the decant pipe. The decant pipe shall be installed in accordance with the details presented on Figure No. 11. The principle spillway/decant pipe is capable of routing the runoff from a 72-hour duration PMF rainfall with 3 feet of freeboard and evacuating it in less than 10 days.

6.6 Abandonment Plan

An abandonment grading plan has been provided on Figure No. 13. Briefly, the impounding capability shall be eliminated by filling the impoundment with approximately 982,000 cubic yards of coarse coal refuse, and will take approximately 0.38 years to complete. The final embankment configuration and perimeter ditch drains shall be constructed to drain as per the lines and grades shown on Figure No. 13 and the entire site shall be soil covered and seeded in accordance with the Illinois reclamation permit. The plan shall be reevaluated prior to abandonment based on actual coal refuse production rates, existing site conditions and embankment configuration, and revised if necessary.

7.0 ENGINEERING ANALYSES

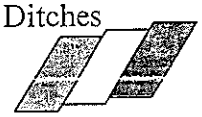
In support of the plan, engineering analyses included slope stability analyses and the hydrologic and hydraulic studies for the impoundment and surface drainage facilities. The calculations describing the design assumptions, methodology and results are included in Appendix B.

7.1 Hydrologic and Hydraulic Analyses

The proposed facility has been evaluated using storm criteria for high hazard dams. The impoundment shall be capable of storing the runoff associated with a PMF design storm event plus three feet of freeboard.

Evacuation of the stored water shall be accomplished by pumping for Phases 5A, 7 and 5A/7, and the Phase 2-3 connector should that option be constructed. The required pumping capacity is based on storing the runoff and evacuating 90 percent of the runoff associated with one design storm event within 10 days. Pumps with an independent power source (diesel motor or generator) and associated discharge lines and connections will be kept on site to evacuate the storage storm runoff. Required pumping capacities and existing on site capability has been defined in Appendix B.

Evacuation of the stored runoff shall be accomplished by means of a decant pipe for the Phase 8 impoundment after the final embankment crest elevation is reached. The required pipe size, 36-inch DR 26, is based on evacuating 90% of the runoff associated with one design storm event within 10 days. The surface drainage facilities, including road and bench gutters, and Ditches



"I", "L", "O", and "P", and abandonment Perimeter Ditches PD-1 through PD-10 and Combination Ditches CD-1 and CD-2 have been sized to convey runoff associated with the 100-year, 6-hour recurrence interval storm event. All permanent facilities have been designed with appropriate protection to minimize the potential for channel erosion. Details for the surface drainage facilities are presented on Figure Nos. 9 and 11.

7.2 Slope Stability Analyses

Slope stability analyses have been performed for the upstream and downstream slopes of the Phases 5A, 7 and 8 embankments using PCSTABL5, a computerized version of the modified Bishop Method of Slices, developed by Purdue University and the Indiana State Highway Commission. The critical potential failure surfaces, minimum factors of safety, and material properties used in the slope stability analyses are presented on Figure No. 12 in the calculation brief.

Slope stability was analyzed for static loading conditions for the downstream and upstream embankment slopes. Effective properties for the coal refuse and existing soil were used. The use of effective stress properties for the coal refuse and total stress properties for the existing cohesive soils is appropriate, giving the effects of the sudden loading in an earthquake event and the relatively slow drainage characteristics of the soils. The Phase 5A/7 analysis was performed without the north and south buttresses to show that it will not be required prior to construction of this phase. The Phase 8 analyses were calculated with the buttresses in place, as they will be required to achieve stability for Phase 8. The phreatic level used in the stability analyses was conservatively based on top flow line calculations performed on a transformed section and piezometer data. The transformed section was based on the horizontal permeability of the embankment material being nine times greater than the vertical permeability. The engineering properties of the embankment material were based on laboratory test results and our experience with similar materials.

The most critical potential long-term failure surfaces, as shown on Figure No. 12 are summarized below:

Stage	Case	Minimum Static F.S.
Phase 5A/7	Downstream	1.51
	Upstream	2.00
Phase 8	Downstream	1.58
	Upstream	2.12
Phase 5A/7 Dike	Downstream	1.92
Phase 2-3 Connector	Downstream	1.50
	Upstream	1.85

As indicated in the above table, the computed factors of safety meet the minimum requirements (1.5 for the static case).



8.0 SUMMARY

The design plans for the proposed Pond Creek No. 1 mine Coal Refuse Disposal Facility No. 2 (Phases 5A, 7 and 8) are based on the subsurface exploration program, field and laboratory testing, and the engineering analyses described herein.

The plan should provide disposal for approximately 3.1 years of coarse coal refuse and 4.3 years of fine coal refuse. The coarse coal refuse disposal life under this plan remaining that will be covered the Phases 5A, 7 and 8 pool areas, is about 0.38 years.



APPENDIX A

ENGINEERING DESIGN PLAN

APPENDIX A

GUIDELINE TECHNICAL SPECIFICATIONS

APPENDIX A

GUIDELINE TECHNICAL SPECIFICATIONS
ENGINEERING DESIGN PLAN
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 4
MACH #1 MINE
MACH MINING, LLC
JOHNSTON CITY, WILLIAMSON COUNTY, ILLINOIS

TABLE OF CONTENTS

	PAGE
INTRODUCTION	A-1
LIST OF DRAWINGS	A-2
1.0 SITE PREPARATION	A-3
1.01 General	A-3
1.02 Stripping and Topsoil Removal	A-3
1.03 Surface Sealing/Proofrolling	A-3
2.0 EMBANKMENT CONSTRUCTION	A-3
2.01 General	A-3
2.02 Coarse Coal Refuse Placement and Compaction	A-4
2.03 Decant Installation	A-5
2.04 Drop Inlet	A-6
2.05 Trash Rack	A-6
2.06 Filter and Drainage Diaphragm	A-6
2.07 Survey Control	A-7
2.08 Subsurface Drains	A-7
2.09 Piezometers	A-8
3.0 FINE COAL REFUSE DISPOSAL	A-8
3.01 General	A-8
3.02 Clarified Water Removal	A-9
4.0 SURFACE WATER DRAINAGE FACILITIES	A-9
5.0 REVEGETATION OF COMPLETED AREAS	A-9
6.0 MONITORING AND MAINTENANCE	A-9
6.01 Piezometers and Impoundment Level	A-9
6.02 General Observations	A-9
6.03 Maintenance	A-10
6.04 Data Review	A-10

APPENDIX A

GUIDELINE TECHNICAL SPECIFICATIONS
ENGINEERING DESIGN PLAN
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 4
MACH #1 MINE
MACH MINING, LLC
JOHNSTON CITY, WILLIAMSON COUNTY, ILLINOIS

INTRODUCTION

These guideline technical specifications have been prepared by Alliance Consulting, Inc. (Alliance) for the construction of the Mach Mining, LLC (Mach Mining), proposed Coal Refuse Disposal Facility No. 4, located near Johnston City, Williamson County, Illinois. The facility will serve the Mach #1 Mine coal preparation plant. The information contained herein is sufficiently detailed to provide Mach Mining with technical guidance to perform coal refuse disposal operations in a manner consistent with the design assumptions and prudent engineering practice. These specifications are intended to be supplemented with regular site visits by persons knowledgeable of these design documents and operational requirements for disposal of coal refuse. These specifications are not of sufficient detail for use in subcontracting the work. Should Mach Mining subcontract any portion of the work, more detailed specifications and construction drawings may be required.

The disposal plan for the Coal Refuse Disposal Facility No. 4 provides disposal capacity for approximately 8.65 months of coarse coal refuse production, 1.15 years of fine coal refuse production if a decant is used, and 11.63 months of fine coal refuse production if a pump is used, based on refuse production rates provided by Mach Mining. These guideline technical specifications pertain to the construction of the proposed embankment.

Briefly, the work items required in the coal refuse disposal plan include:

1. Site Preparation – Before construction of the coarse coal refuse embankment begins, excavation of the proposed incised area will be performed. In areas of embankment construction, the site preparation items include topsoil stripping and stockpiling, proofrolling/sealing, and construction of the perimeter sediment ditch. During the disposal operations, scarifying/tracking previously compacted surfaces shall be required to minimize seepage planes.

2. Embankment Construction - A coarse coal refuse embankment shall be constructed in one phase. The proposed facility has been designed to provide disposal capacity for approximately 8.65 months of coarse coal refuse production, 1.15 years of fine coal refuse production if a decant is used, and 11.63 months of fine coal refuse production if a pump is used.

3. Subsurface Drainage – An internal drainage system (gravel, perforated pipe, and geotextile) shall be installed during construction of the embankment to aid in controlling the phreatic level.

4. Fine Coal Refuse Disposal – Following completion of the embankment, fine coal refuse slurry may be pumped to the impoundment. A water pumping system shall be used to remove excess clarified slurry water and precipitation from the impoundment.

5. Surface Drainage Facilities - To control and direct surface water runoff away from the embankment, a perimeter sediment ditch shall be constructed.

6. Abandonment – An abandonment grading plan has been provided. The plan shall be re-evaluated prior to abandonment based on actual coal refuse production rates, existing site conditions and embankment configuration, and revised if necessary.

7. Revegetation - To control erosion and provide an acceptable post mining land use, all completed embankment surfaces shall be soil covered and revegetated in accordance with Mach Mining's State Permit.

8. Monitoring and Maintenance - A program of regular monitoring and maintenance of the disposal operations is described herein.

The following drawings form a part of these specifications:

FIGURE NO.	DRAWING NO.	TITLE
1	B11-087-T1	Title Sheet
2	B11-087-E3	Plan - Coarse Coal Refuse Embankment/Impoundment
3	B11-087-E4	Sections A-A, B-B, and C-C
4	B11-087-E10	Decant Pipe Profile
5	B11-087-E13	Slope Stability Analyses
6	B11-087-E11	Internal Drain Plan
7	B11-087-E12	Internal Drain Profile
8	B11-087-E5	Details (Sheet 1 of 3)
9	B11-087-E6	Details (Sheet 2 of 3)
10	B11-087-E14	Details (Sheet 3 of 3)
11	B11-087-E8	Abandonment Plan
12	B11-087-E9	Abandonment Section D-D
13	B11-087-E7	Mine Map-Ziegler No. 4 Mine

1.0 SITE PREPARATION

1.01 General

An incised fine coal refuse disposal area shall be excavated prior to construction of the embankment. Additionally, a soil fill shall be constructed in the northeast corner of the refuse disposal area to facilitate construction of the perimeter sediment ditch. Beneath all areas of the refuse disposal facility, site preparation shall be required.

1.02 Stripping and Topsoil Removal

Stripping and stockpiling of topsoil and root matter are required to provide an adequate foundation for facility construction. All topsoil shall be removed prior to embankment, impoundment, or road construction. The stripped topsoil shall be stockpiled.

As areas are prepared for final reclamation, topsoil may be removed from future disposal areas and hauled directly to areas being reclaimed.

1.03 Surface Sealing/Proofrolling

The footprint of the embankment shall be proofrolled following stripping and topsoil removal to seal and compact the soils. A minimum of three passes shall be made over each area using a large sheepsfoot roller or rubber-tired equipment (i.e. loaded truck) to produce a minimum density equal to 95 percent of the maximum dry density attainable by the Standard Proctor method of compaction (ASTM D 698).

Before being backfilled with compacted coarse coal refuse, the surface shall be inspected to determine whether any excessively wet or soft soils are present at the bottom of the topsoil excavation. Any soft/wet soils shall be removed to a minimum depth of 2 feet below the previously excavated surface and replaced with compacted soil. The over-excavated area shall be backfilled with silty, clay soil, placed in 12-inch lifts, and compacted to 95 percent of the Standard Proctor maximum dry density (ASTM D 698).

Random in-place density testing shall be performed throughout the embankment area to verify that the existing stripped surface is compacted to 95 percent of the Standard Proctor maximum dry density prior to fine coal refuse slurry disposal.

2.0 EMBANKMENT CONSTRUCTION

2.01 General

To provide storage capacity for approximately 8.65 months of coarse coal refuse production, 1.15 years of fine coal refuse production if a decant is used, and 11.63

months of fine coal refuse production if a pump is used, an embankment shall be constructed. Drawing Nos. B11-087-E3 and B11-087-E4 present the plan and profile of the proposed embankment.

Two sediment ditches shall be constructed to provide sediment control and to convey surface runoff away from the facility. The design details for the ditches are included in the Illinois state permit application.

2.02 Coarse Coal Refuse Placement and Compaction

a. Lines and Grades – Coarse coal refuse shall be placed to the lines and grades shown on the drawings. Control for placement can be established from the coordinate system provided on the drawings.

b. Material - Run-of-plant coarse coal refuse from the coal preparation plant shall be used for the embankment construction. Placement and compaction of the refuse shall be in accordance with Sections 2.02.c and d.

c. Placement - Coarse coal refuse shall be spread in lifts not more than 1 foot thick. Material that is too wet to be properly compacted shall be spread and graded to facilitate drainage. Discing of the wet material may also be performed to facilitate drying. Upon drying to within the acceptable moisture content range, compaction shall proceed.

d. Compaction - The coarse coal refuse shall be compacted by routing heavy equipment over it or utilizing specialized compaction equipment to attain the specified degree of compaction. No special compaction procedures are anticipated to be required to provide densities which are consistent with those used in the design. However, complete coverage of the entire working surface is required, with sufficient overlap between passes to consistently obtain the required density. A field density-testing program shall be conducted during the placement operations to determine the actual dry density being achieved. A compacted dry density of at least 95 percent of the Standard Proctor test (ASTM D 698) maximum dry density shall be required for all coarse coal refuse placed within the impounding embankment.

At 40,000 cubic yard placement intervals, the Standard Proctor test of the material shall be verified. Additionally, should mining or preparation plant operations change or other conditions indicate that a change in refuse material properties has occurred, a Standard Proctor test shall be performed.

e. Construction Procedures - To minimize penetration of precipitation, the work surface shall be sloped and backbladed as the material is spread. No fill shall be placed on frozen material. If the surface where fill is to be placed is frozen, the frozen material shall be removed over an area where one day's refuse will be placed prior to placement of a new lift. The frozen material shall be stored until it is thawed and then replaced. Frozen material shall not be placed within the

embankment. Surface material in the impounding embankment too wet to support construction equipment shall be removed to expose drier material prior to placement of the next refuse layer. After drying, these wet materials can be reused in the embankment. As the level of the embankment is raised, it shall be graded smoothly to the contours shown on the plans. The work surface shall be scarified with the dozer cleats or sheepsfoot roller prior to placement of each lift. Care shall be taken to avoid placement of new fill on a smooth, compacted surface. The work surface shall be graded to drain toward the impoundment or toward in-place drainage facilities to minimize pooling of surface water. For additional placement requirements, refer to Appendix E.

2.03 Decant Installation

a. General - To provide a mechanism to evacuate stored storm runoff, a decant pipe shall be installed with an inlet at Elevation 488 at the upstream face and gently slope toward the downstream face to approximate Elevation 482. The decant shall be extended along the downstream embankment slope to discharge into Ditch No. 1 as shown on Drawing No. B11-087-E10. The decant pipe shall be installed on an adequate foundation in a manner to minimize differential settlement. All pipe installation shall be supervised by qualified personnel familiar with the intent of the design and knowledgeable of proper installation procedures.

b. Decant Pipe - The pipe used for decant construction shall be 24-inch outside diameter, SDR 26 HDPE pipe (average inside diameter of 22.043 inches). The pipe joints shall be welded (fused) all around and checked for leaks prior to backfilling.

c. Alignment - The pipe shall be placed during the embankment construction at the location shown on Drawing No. B11-087-E3. Compaction shall be achieved in accordance with the detail presented on Drawing No. B11-087-E6 and Section 2.04e of these specifications. The decant drop inlet shall extend vertically from the upstream end of the pipe to Elevation 488.

d. Pipe Connections - The joints shall be welded (fused) sufficiently to provide a water-tight seal.

e. Backfilling - The backfill envelope, as shown on Drawing No. B11-087-E6, shall be raised uniformly on both sides of the pipe in 6-inch thick layers (8-inch thick loose lifts) and compacted to a density greater than or equal to 98 percent Standard Proctor maximum dry density (ASTM D 698) within -2 to +3 percent of the optimum water content. The bedding material shall be shaped to embed the 24-inch HDPE a minimum of 4 inches. One field density test (minimum) shall be performed for every 200 cubic yards of backfill placed and compacted with at least one test per lift.

f. Materials for Backfill - Materials used for backfilling shall consist of coarse coal refuse, free of any particles larger than 3 inches in any dimension.

2.04 Drop Inlet

a. General - To facilitate the installation of the trash rack and to prevent fines from entering the decant pipe, a 24-inch diameter SDR 26 HDPE elbow (drop inlet) shall be used. The elbow shall be fusion welded to the upstream end of the decant transport section and flange fitted at the other end to facilitate connection to the trash rack.

2.05 Trash Rack

a. General - To prevent large particles from entering and possibly clogging the decant pipe, a trash rack design has been provided. The trash rack shall be bolted to the riser pipe. The trash rack may be fabricated with readily available parts.

b. Material - Materials required for the trash rack include 1 inch by 1 inch by 1/8-inch angle irons, No. 4 rebar, and 1/8-inch thick steel plate. Details are shown on Drawing No. B11-087-E6. The trash rack shall be flange fitted and bolted to the riser flange.

c. Paint - The trash rack shall be protected with rust-resistant paint after fabrication. The trash rack shall be inspected periodically and any damage repaired accordingly.

2.06 Filter and Drainage Diaphragm

a. General - A filter diaphragm shall be installed, as shown in plan on Drawing No. B11-087-E3, in profile on Drawing No. B11-087-E10, and in detail on Drawing No. B11-087-E6, to minimize internal erosion (piping) along the decant.

b. Material - The diaphragm shall be constructed of hard, durable sandstone aggregate within the following gradation range and wrapped entirely in "Geotex 501" filter fabric or an equivalent approved by the Engineer.

Sieve Size	Percent Finer
3-inch	100
1-1/2-inch	95 to 100
3/4-inch	90 to 100
3/8-inch	77 to 100
No. 4	65 to 100
No. 10	45 to 100
No. 20	21 to 60
No. 40	0 to 44
No. 60	0 to 29
No. 140	0 to 9
No. 200	0 to 5

C-33 sand meets the required gradation

c. Filter and Drainage Diaphragm Outlet Drain - To convey seepage collected by the filter and drainage diaphragm to a surface drainage ditch, an outlet drain shall be constructed, as shown on Drawing No. B11-087-E3. The drain shall be constructed in accordance with the detail presented on Drawing No. B11-087-E6.

Gradation testing shall be performed on compacted samples of the coarse coal refuse and gravel prior to installation of the filter drainage diaphragm to verify the parameters used in the design of the diaphragm.

2.07 Survey Control

Survey control shall include establishment of permanent monuments outside of, but adjacent to the refuse disposal facility limits. This control shall be used for the management of day-to-day operations.

2.08 Subsurface Drains

a. General – To minimize the possible rise in the phreatic level as the impoundment level rises, an internal drain shall be installed at the base of the coarse coal refuse embankment. The drain shall consist of a perforated pipe within a gravel envelope wrapped entirely with filter fabric. The approximate alignment and elevations of the drain are indicated on Drawing Nos. B11-087-E11 and B11-087-E12.

b. Gravel – The gravel shall consist of non-acid, and non-toxic forming, non-calcareous particles that will not slake in water or degrade during the life of the

facility, and which are free of coal, clay or other non-durable material. The gravel shall be washed and in the size range of 3/8 inch to 1 ½ inches.

c. Pipe – The pipes used in the internal drains shall be SDR-21, perforated high-density polyethylene pipe. The required pipe diameters are presented on Drawing No. B11-087-E11. The perforations shall be in accordance with the detail on Drawing No. B11-087-E5. The drain outlet pips shall be non-perforated.

d. Filter Fabric – The filter fabric shall be "Geotex 501" or an approved equivalent geotextile that is ultraviolet stabilized to resist deterioration. The filter fabric shall be protected from ultraviolet exposure during storage.

e. Installation – Details pertaining to the internal drains are presented on Drawing No. B11-087-E5. As shown on the drawing, the gravel envelop shall be wrapped entirely with filter fabric with a minimum 2-foot overlap. The drain shall be constructed to the dimensions shown on the drawings.

To convey seepage collected by the internal drain, to the perimeter ditch, non-perforated SDR-21 HDPE outlet pipes shall be installed at the locations shown on Drawing No. B11-087-E11. The backfill envelope for the outlet pipes, as shown on Drawing No. B11-087-E5, shall be raised uniformly on both sides of the pipe in 8-inch thick loose lifts and compacted to a density greater than or equal to 98 percent of the Standard Proctor maximum dry density within -2 to +3 percent of the optimum water content. One field density test (minimum) shall be performed for every 200 cubic yards of backfill placed and compacted with at least one test per lift.

The installation of the underdrains shall be monitored by the engineer responsible for certifying the construction of the embankment or by a qualified person designated by the engineer.

2.09 Piezometers

Piezometers shall be installed at the locations shown on the drawings and in accordance with the detail on Drawing No. B11-087-E5. Clean concrete sand may be substituted for the pea gravel if the latter is difficult to obtain. The perforated section of the piezometer pipe shall be wrapped with filter fabric. Bentonite seals shall be placed immediately above the perforated section and just below the ground surface to isolate the piezometer tip from potential perched water tables and minimize any influence associated with surface water.

3.0 FINE COAL REFUSE DISPOSAL

3.01 General

Following the embankment construction, fine coal refuse may be disposed in the impoundment. The slurry line(s) shall be periodically moved along the embankment perimeter to maintain a relatively uniform fines level within the impoundment and to promote sealing of the coarse coal refuse in the impounding embankment, reducing seepage. Discharge shall initiate on the impoundment cell bottom and continue on fine coal refuse beaches as the slurry settles. In no case shall direct discharge onto embankment slopes be allowed.

3.02 Clarified Water Removal

Clarified water from the slurry impoundment shall be removed by a pumping system and directed into the proposed perimeter ditch system. The water level in the impoundment shall be maintained as low as practicable.

4.0 SURFACE WATER DRAINAGE FACILITIES

A sediment ditch shall be constructed around the perimeter of the embankment to control surface runoff and minimize erosion. For additional ditch requirements, refer to the Illinois state permit documents.

5.0 REVEGETATION OF COMPLETED AREAS

Revegetation of coarse coal refuse slopes can be accomplished by placing a cover of natural soil or other materials capable of supporting vegetation and subsequent planting to establish a continuous stand of vegetation. Soil cover and vegetation shall be in accordance with the Illinois reclamation permit.

6.0 MONITORING AND MAINTENANCE

6.01 Piezometers and Impoundment Level

Water level readings from the piezometers and the impoundment level shall be recorded at intervals not to exceed 7 days. The piezometers shall be flushed on an annual basis to ensure they are functioning properly. Should the piezometers become damaged during operations, they shall be repaired or replaced.

6.02 General Observations

Observations of the embankment and its appurtenant structures shall be made at maximum 7 day intervals and immediately following any unusual events such as floods, heavy rainfalls, abnormal structural behavior, etc. Any unusual features shall be reported immediately to the engineer responsible for certifying the construction.

a. Embankment Slopes - Any irregularities such as scarps, wet areas, or vegetation disturbance shall be recorded.

b. Working Disposal Surface - Irregularities shall be recorded.

c. Bench and Haul Road Gutters and Discharge Channels - General condition of channels, soil erosion adjacent to or beneath riprap and seeded slopes, blockage by debris, etc. shall be noted.

d. Vicinity of the Embankment - General conditions throughout the area of the embankment shall be observed to note any changes which could be associated with the behavior of the embankment and its foundation.

6.03 Maintenance

The following maintenance shall be performed regularly:

a. Routine Maintenance - Maintenance, including regrading temporary bench and haul road gutters, backfilling of erosion rills and gullies, removal of debris from the ditches at the site, etc. shall be performed.

b. Maintenance After Unusual Meteorological Events (Heavy Precipitation Events and Floods) - The most important maintenance tasks at these times are the timely backfilling of all erosion scarps and slumps and the repair and improvement of drainage systems and riprap.

c. Maintenance After Abnormal Changes in the Behavior of the Structure - If abnormal behavior of any portion of the embankment is observed, qualified persons knowledgeable of the facility design characteristics shall be advised immediately and any recommended maintenance measures undertaken.

6.04 Data Review

All facility performance data and data obtained during periodic inspections and maintenance shall be reviewed by qualified persons knowledgeable of the facility construction and disposal requirements, including the design recommendations presented in these documents.

APPENDIX B

CALCULATION BRIEF

APPENDIX B

CALCULATION BRIEF

APPENDIX B

CALCULATION BRIEF
COAL REFUSE DISPOSAL FACILITY
PHASE 5A, 7, AND 8
POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS

TABLE OF CONTENTS

TOPIC	PAGE(S)
Production Rates	1
Embankment Volumes	2-6
Impoundment Volumes	7-15
Embankment Construction and Fines Level Schedule	16-31
Required Freeboard Calculation	32-35
Surface Drainage Structures	36-108
Internal Drainage System	109-136
Animal Guards	137-139
Pump Capacity Calculations	140-146
Phase 8 Principal Spillway Pipe Discharge Table	147
Phase 8 HEC-1 Flood Routing and Drawdown	148-152
Phase 8 Decant Spillway Ditch	153-155
Trash Rack	156
Slope Stability Analyses	157-360



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CALC. BY:	RPC	**DATE:**	8/19/2011	**CHKD. BY:**	CAW	**DATE:**	12/3/11
PROJECT NAME:	MACH NO. 1 MINE, FACILITY NO. 2 WEST OF DIWANA						
PROJECT NUMBER:	B11-423-1413	**SHEET**	1	**OF**	1		
DESCRIPTION:	CCR AND FCR PRODUCTION RATES						

Production rates based on information provided by Mach Mining on 8/19/2011.
Clean coal production rate increased to 7 million tons/year from 6 million tons/year.
Ratios and unit weights are unchanged.

7,000,000 tons clean coal per year
Recovery ratio (clean coal / raw coal) = 55%
CCR weighs 117 PCF, FCR weighs 58 PCF
CCR to FCR ratio by weight = 3.11 : 1
CCR to FCR ratio by volume = 1.54 : 1, conservatively using 1.24 : 1
Conservatively assume CCR weighs 125 PCF, and FCR weighs 50 PCF

Total Refuse Production = 7,000,000 TPY (0.45/0.55) =	5,727,272.73 TPY
FCR Production = 5,727,272.73 TPY (1/(3.11+1)) =	1,393,497.01 TPY
CCR Production = (5,727,272.73 - 1,393,497.01) TPY =	4,333,775.71 TPY

FCR Production = 1,393,497.01 TPY (2000 lb/ton) / (50 PCF) =	55,739,880.56 CF/Yr
CCR Production = 4,333,775.71 TPY (2000 lb/ton) / (125 PCF) =	69,340,411.41 CF/Yr

Check CCR to FCR Ratio - (69,340,411.41 / 55,739,880.56) = 1.24

For timing and staging calculations (rounded to nearest 1,000 CF and 100 CY) use:

FCR Production Rate =	55,740,000 CF/Yr	=	2,064,400 CY/Yr
CCR Production Rate =	69,340,000 CF/Yr	=	2,568,200 CY/Yr

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BY: RPC DATE: 8/30/2011 CHKD BY: _____ DATE: _____

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET _____ OF _____

DESCRIPTION: EMBANKMENT VOLUMES - PHASE 5A

ELEVATION	VOLUME C.F.	VOLUME C.Y.	CUMMALTIVE VOLUME C.F.	CUMMALTIVE VOLUME C.Y.
480				
	5,356,484.1	198,388.30	5,356,484.1	198,388.30
485				
	5,478,502.4	202,907.50	10,834,986.5	401,295.80
490				
	5,289,640.9	195,912.63	16,124,627.4	597,208.42
495				
	4,868,138.7	180,301.43	20,992,766.1	777,509.86
500				
	4,378,911.8	162,181.92	25,371,677.9	939,691.77
505				
	3,884,602.2	143,874.16	29,256,280.1	1,083,565.93
510				

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PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET _____ OF _____

DESCRIPTION: EMBANKMENT VOLUMES - PHASE 7

ELEVATION	VOLUME C.F.	VOLUME C.Y.	CUMMALTIVE VOLUME C.F.	CUMMALTIVE VOLUME C.Y.
492				
	4,412,296.6	163,418.39	4,412,296.6	163,418.39
495				
	6,866,841.2	254,327.45	11,279,137.8	417,745.84
500				
	10,396,676.1	385,062.08	21,675,813.9	802,807.92
505				
	9,291,730.5	344,138.17	30,967,544.4	1,146,946.09
510				

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BY: RPC DATE: 8/30/2011 CHKD BY: _____ DATE: _____

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET _____ OF _____

DESCRIPTION: EMBANKMENT VOLUMES - PHASE 5A/7

ELEVATION	VOLUME C.F.	VOLUME C.Y.	CUMMALTIVE VOLUME C.F.	CUMMALTIVE VOLUME C.Y.
510				
	11,443,769.5	423,843.31	11,443,769.5	423,843.31
515				
	9,986,913.7	369,885.69	21,430,683.2	793,729.01
520				
	8,520,151.6	315,561.17	29,950,834.8	1,109,290.18
525				
	7,053,170.9	261,228.55	37,004,005.7	1,370,518.73
530				
	5,586,239.9	206,897.77	42,590,245.6	1,577,416.50
535				
	2,647,583.5	98,058.65	45,237,829.1	1,675,475.15
538				

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BY: RPC DATE: 8/30/2011 CHKD BY: _____ DATE: _____

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET _____ OF _____

DESCRIPTION: EMBANKMENT VOLUMES - PHASE 8

ELEVATION	VOLUME C.F.	VOLUME C.Y.	CUMMALTIVE VOLUME C.F.	CUMMALTIVE VOLUME C.Y.
524.0				
	11,161,019.7	413,371.10	11,161,019.7	413,371.10
529.0				
	11,334,802.6	419,807.50	22,495,822.3	833,178.60
534.0				
	11,971,265.0	443,380.19	34,467,087.3	1,276,558.79
539.0				
	13,128,066.7	486,224.69	47,595,154.0	1,762,783.48
544.0				
	11,852,972.7	438,998.99	59,448,126.7	2,201,782.47
549.0				
	10,577,941.7	391,775.62	70,026,068.4	2,593,558.09
554.0				
	9,302,812.6	344,548.61	79,328,881.0	2,938,106.70
559.0				
	8,027,806.4	297,326.16	87,356,687.4	3,235,432.87
564.0				
	6,752,664.9	250,098.70	94,109,352.3	3,485,531.57
569.0				
	5,477,668.1	202,876.60	99,587,020.4	3,688,408.16
574.0				
	4,202,535.4	155,649.46	103,789,555.8	3,844,057.62
579.0				
	2,927,529.3	108,427.01	106,717,085.1	3,952,484.63
584.0				
	1,423,957.5	52,739.17	108,141,042.6	4,005,223.80
588.0				

North Buttress Volume Report Tue Sep 06 11:19:59 2011

Comparing Grid: //Aci-acad/caddrawings/11146/existing-phases.grd
and Grid: //Aci-acad/caddrawings/11146/north-buttress.grd
Grid corner locations: 357461.66,425668.69 to 360813.66,430986.69
Grid resolution X: 1676, Y: 2659 Grid cell size X: 2.00, Y: 2.00
Area in Cut : 0.0 S.F., 0.00 Acres
Area in Fill: 637,983.0 S.F., 14.65 Acres
Total inclusion area: 639,635.5 S.F., 14.68 Acres
Cut to Fill ratio: 0.00
Average Cut Depth: 0.00 Average Fill Depth: 5.32
Max Cut Depth: 0.00 Max Fill Depth: 9.38
Cut (C.Y.) / Area (acres): 0.00
Fill (C.Y.) / Area (acres): 8567.69
Cut volume: 0.0 C.F., 0.00 C.Y.
Fill volume: 3,396,817.5 C.F., 125,808.05 C.Y.

South Buttress (Option) Volume Report Tue Sep 06 11:22:03 2011

Comparing Grid: //Aci-acad/caddrawings/11146/existing-phases.grd
and Grid: //Aci-acad/caddrawings/11146/south-buttress.grd
Grid corner locations: 357461.66,425668.69 to 360813.66,430986.69
Grid resolution X: 1676, Y: 2659 Grid cell size X: 2.00, Y: 2.00
Area in Cut : 0.0 S.F., 0.00 Acres
Area in Fill: 223,036.0 S.F., 5.12 Acres
Total inclusion area: 261,883.7 S.F., 6.01 Acres
Cut to Fill ratio: 0.00
Average Cut Depth: 0.00 Average Fill Depth: 4.63
Max Cut Depth: 0.00 Max Fill Depth: 6.67
Cut (C.Y.) / Area (acres): 0.00
Fill (C.Y.) / Area (acres): 6364.32
Cut volume: 0.0 C.F., 0.00 C.Y.
Fill volume: 1,033,086.1 C.F., 38,262.45 C.Y.

Phase 2-3 Connector (Option) Volume Report Fri Sep 16 11:22:50 2011

Comparing Grid: //Aci-acad/caddrawings/11146/existing-phases.grd
and Grid: //Aci-acad/caddrawings/11146/phase2-3-connector.grd
Grid corner locations: 357461.66,425668.69 to 360813.66,430986.69
Grid resolution X: 1676, Y: 2659 Grid cell size X: 2.00, Y: 2.00
Area in Cut : 0.0 S.F., 0.00 Acres
Area in Fill: 178,756.0 S.F., 4.10 Acres
Total inclusion area: 180,512.7 S.F., 4.14 Acres
Cut to Fill ratio: 0.00
Average Cut Depth: 0.00 Average Fill Depth: 18.21
Max Cut Depth: 0.00 Max Fill Depth: 44.00
Cut (C.Y.) / Area (acres): 0.00
Fill (C.Y.) / Area (acres): 29086.62
Cut volume: 0.0 C.F., 0.00 C.Y.
Fill volume: 3,254,445.5 C.F., 120,535.02 C.Y.

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BY: RPC DATE: 8/30/2011 CHKD BY: _____ DATE: _____

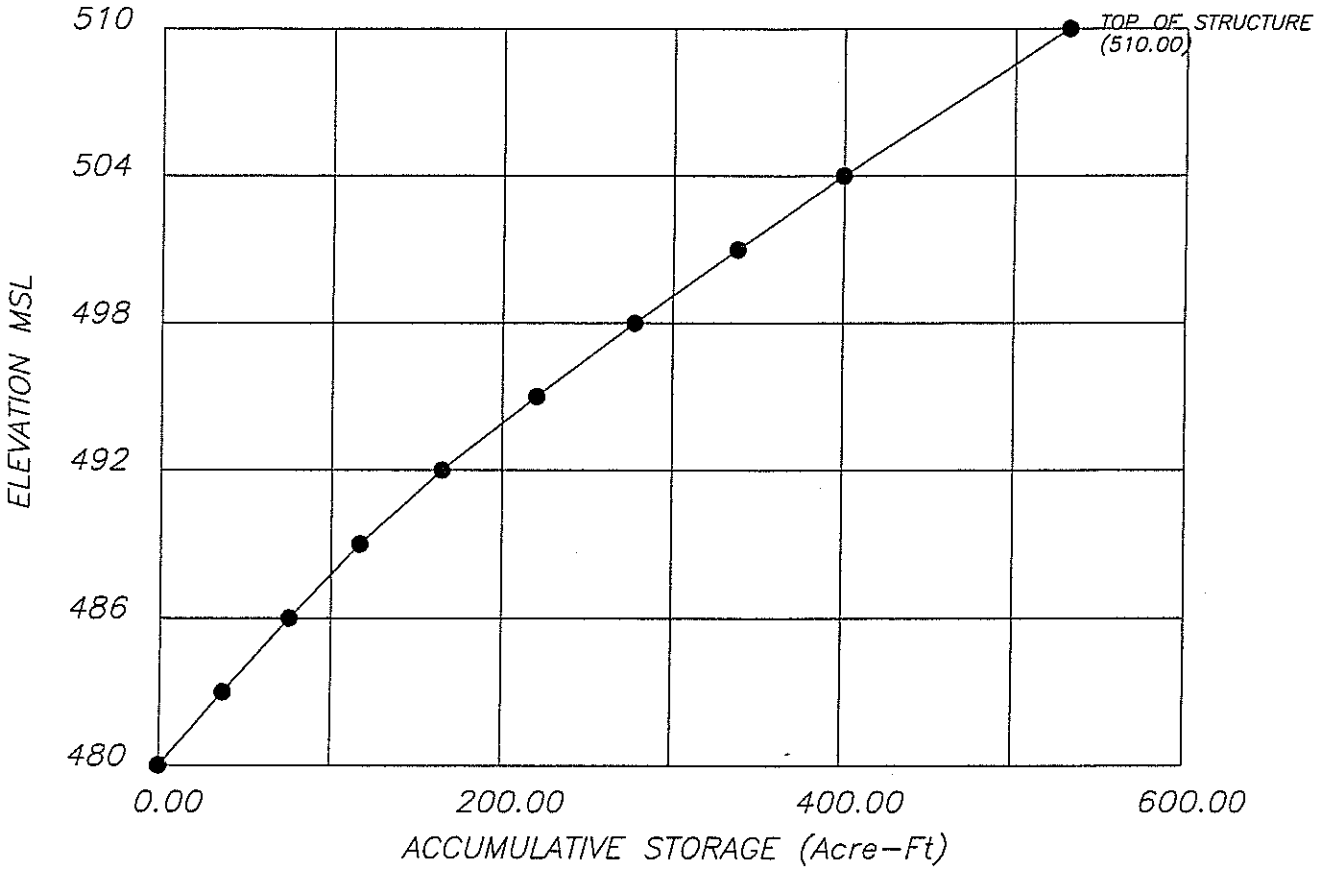
PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET _____ OF _____

DESCRIPTION: IMPOUNDMENT VOLUMES - PHASE 5A

ELEVATION	AREA (Ac.)	AVG. AREA	STAGE INTERVAL	STORAGE (AC-FT)	CUMMULATIVE VOLUME AC-FT	CUMMALTIVE VOLUME C.F.	CUMMALTIVE VOLUME C.Y.
480	11.909						
		12.265	3.00	36.80	36.80	1,602,842.47	59,364.54
483	12.622						
		12.984	3.00	38.95	75.75	3,299,558.92	122,205.89
486	13.346						
		13.715	3.00	41.15	116.89	5,091,854.72	188,587.21
489	14.085						
		16.039	3.00	48.12	165.01	7,187,785.51	266,214.28
492	17.993						
		18.382	3.00	55.15	220.16	9,589,971.40	355,184.13
495	18.772						
		19.167	3.00	57.50	277.66	12,094,656.16	447,950.23
498	19.561						
		19.963	3.00	59.89	337.54	14,703,381.79	544,569.70
501	20.364						
		20.774	3.00	62.32	399.86	17,418,115.04	645,115.37
504	21.184						
		21.999	6.00	131.99	531.86	23,167,760.62	858,065.21
510	22.814						

STAGE STORAGE CURVE
Phase 5A



STORAGE VOLUME COMPUTATIONS

Phase 5A

ELEV. (ft)	WIDTH (ft)	LENGTH (ft)	AREA (ac)	AVG. AREA (ac)	INTERVAL (ft)	STORAGE (ac-ft)	ACC. STORAGE (ac-ft)	STAGE INTERVAL (ft)
480.00	N/A	N/A	11.9089					
483.00	N/A	N/A	12.6219	12.2654	3.00	36.7962	36.7962	3.00
486.00	N/A	N/A	13.3456	12.9838	3.00	38.9513	75.7475	6.00
489.00	N/A	N/A	14.0847	13.7152	3.00	41.1455	116.8929	9.00
492.00	N/A	N/A	17.9926	16.0387	3.00	48.1160	165.0089	12.00
495.00	N/A	N/A	18.7718	18.3822	3.00	55.1466	220.1555	15.00
498.00	N/A	N/A	19.5613	19.1666	3.00	57.4997	277.6551	18.00
501.00	N/A	N/A	20.3641	19.9627	3.00	59.8881	337.5432	21.00
504.00	N/A	N/A	21.1837	20.7739	3.00	62.3217	399.8649	24.00
510.00	N/A	N/A	22.8142	21.9990	6.00	131.9937	531.8586	30.00

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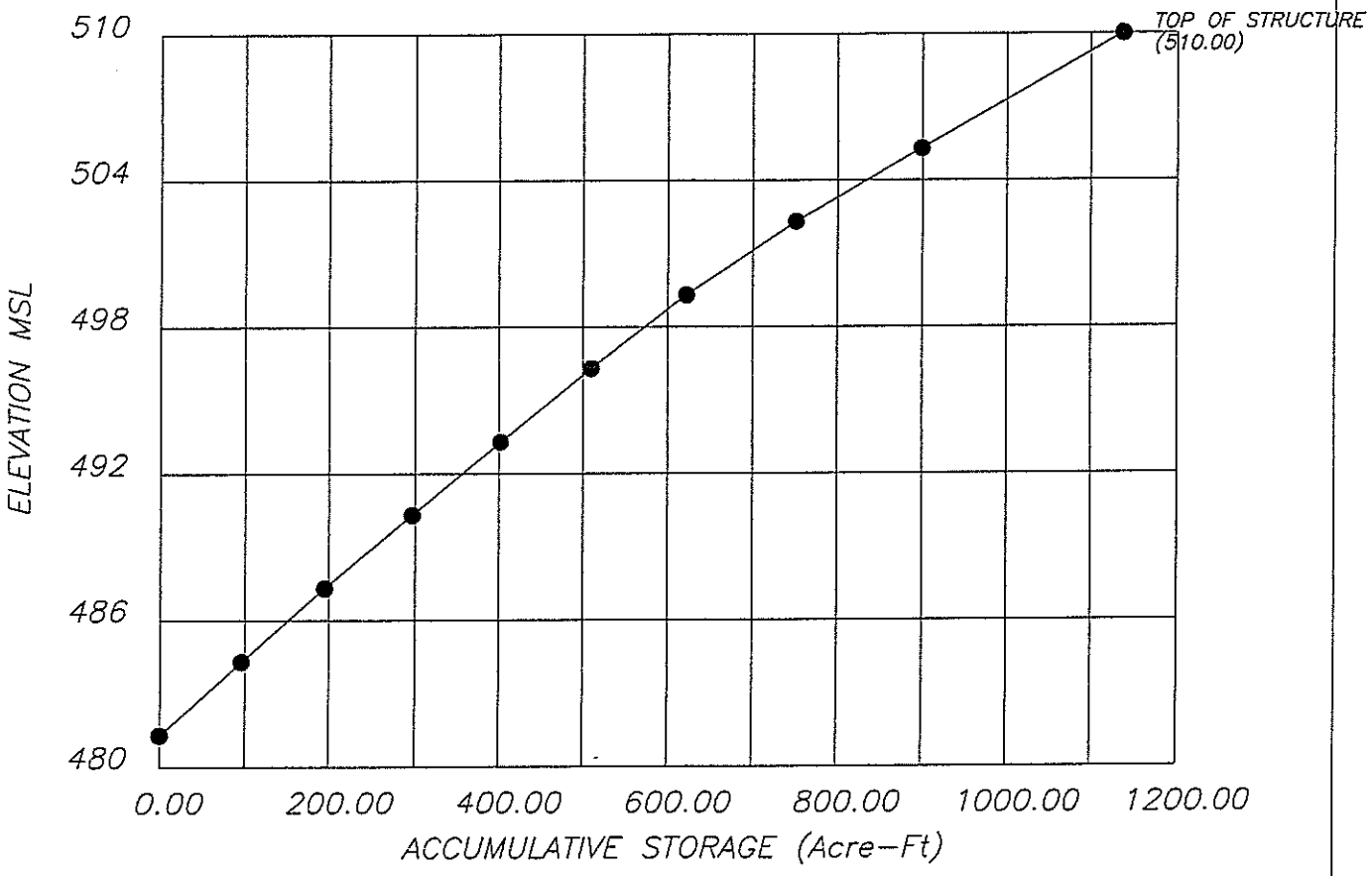
PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET _____ OF _____

DESCRIPTION: IMPOUNDMENT VOLUMES - PHASE 7

ELEVATION	AREA (Ac.)	AVG. AREA	STAGE INTERVAL	STORAGE (AC-FT)	CUMMULATIVE VOLUME AC-FT	CUMMALTIVE VOLUME C.F.	CUMMALTIVE VOLUME C.Y.
481.3	31.518						
		32.016	3.00	96.05	96.05	4,183,896.62	154,959.13
484.3	32.515						
		33.012	3.00	99.03	195.08	8,497,859.04	314,735.52
487.3	33.508						
		34.013	3.00	102.04	297.12	12,942,612.54	479,356.02
490.3	34.517						
		35.028	3.00	105.09	402.21	17,520,117.32	648,893.23
493.3	35.540						
		36.059	3.00	108.18	510.38	22,232,307.44	823,418.79
496.3	36.578						
		37.104	3.00	111.31	621.70	27,081,077.76	1,003,002.88
499.3	37.630						
		43.168	3.00	129.50	751.20	32,722,278.53	1,211,936.24
502.3	48.706						
		49.349	3.00	148.05	899.25	39,171,238.52	1,450,786.61
505.3	49.993						
		50.855	4.70	239.02	1,138.27	49,582,874.15	1,836,402.75
510	51.717						

STAGE STORAGE CURVE
Phase 7



STORAGE VOLUME COMPUTATIONS

Phase 7

ELEV. (ft)	WIDTH (ft)	LENGTH (ft)	AREA (ac)	AVG. AREA (ac)	INTERVAL (ft)	STORAGE (ac-ft)	ACC. STORAGE (ac-ft)	STAGE INTERVAL (ft)
481.30	N/A	N/A	31.5177					
484.30	N/A	N/A	32.5150	32.0164	3.00	96.0491	96.0491	3.00
487.30	N/A	N/A	33.5083	33.0117	3.00	99.0350	195.0840	6.00
490.30	N/A	N/A	34.5167	34.0125	3.00	102.0375	297.1215	9.00
493.30	N/A	N/A	35.5400	35.0284	3.00	105.0851	402.2066	12.00
496.30	N/A	N/A	36.5780	36.0590	3.00	108.1770	510.3836	15.00
499.30	N/A	N/A	37.6303	37.1042	3.00	111.3125	621.6960	18.00
502.30	N/A	N/A	48.7058	43.1681	3.00	129.5042	751.2002	21.00
505.30	N/A	N/A	49.9927	49.3493	3.00	148.0478	899.2479	24.00
510.00	N/A	N/A	51.7172	50.8550	4.70	239.0183	1138.2662	28.70

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BY: RPC DATE: 8/30/2011 CHKD BY: _____ DATE: _____

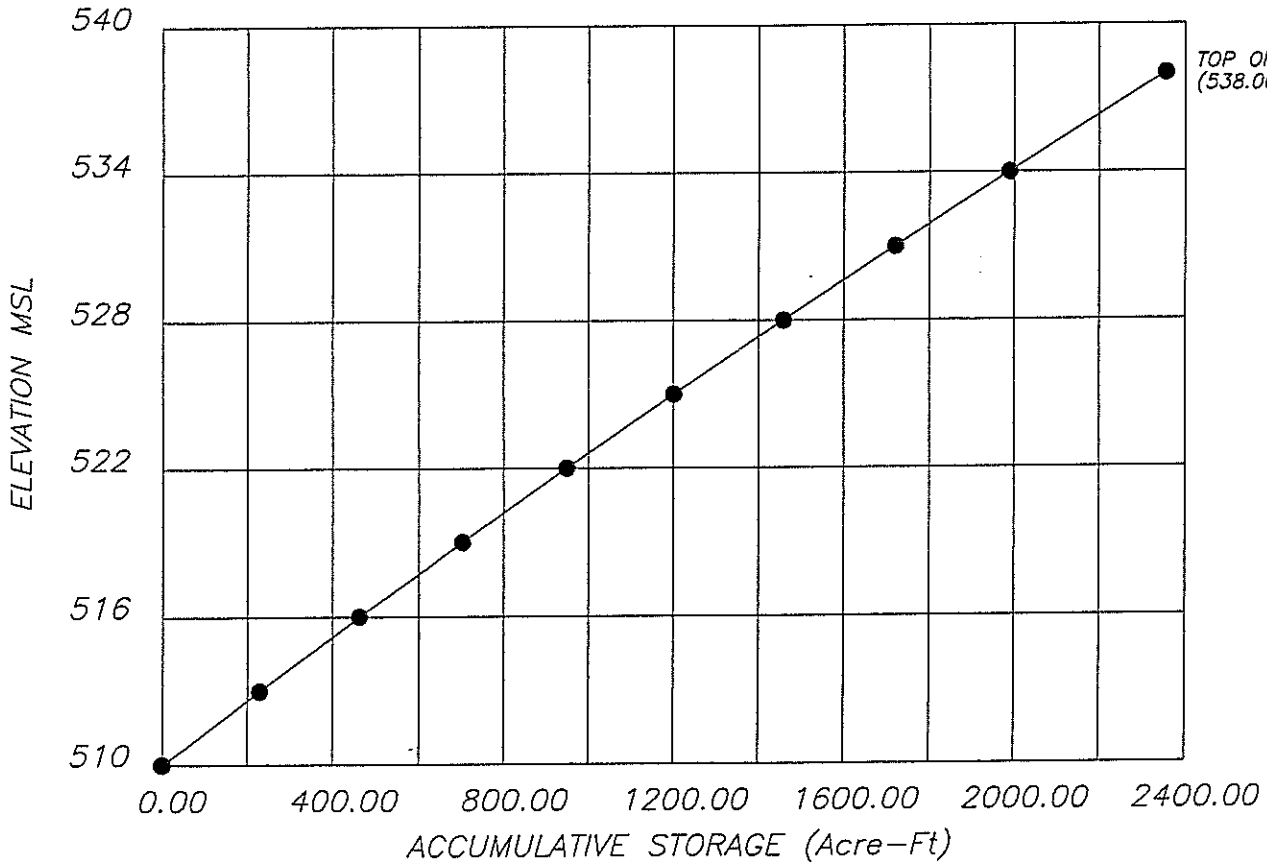
PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET _____ OF _____

DESCRIPTION: IMPOUNDMENT VOLUMES - PHASE 5A/7

ELEVATION	AREA (Ac.)	AVG. AREA	STAGE INTERVAL	STORAGE (AC-FT)	CUMMULATIVE VOLUME AC-FT	CUMMALTIVE VOLUME C.F.	CUMMALTIVE VOLUME C.Y.
510	75.464						
		76.393	3.00	229.18	229.18	9,983,076.44	369,743.57
513	77.323						
		78.238	3.00	234.71	463.89	20,207,211.75	748,415.25
516	79.153						
		80.075	3.00	240.22	704.12	30,671,386.61	1,135,977.28
519	80.997						
		81.926	3.00	245.78	949.90	41,377,535.10	1,532,501.30
522	82.856						
		83.793	3.00	251.38	1,201.28	52,327,617.41	1,938,059.90
525	84.730						
		85.674	3.00	257.02	1,458.30	63,523,554.53	2,352,724.24
528	86.619						
		87.571	3.00	262.71	1,721.01	74,967,352.42	2,776,568.61
531	88.523						
		89.482	3.00	268.45	1,989.46	86,660,912.45	3,209,663.42
534	90.442						
		91.674	4.00	366.69	2,356.16	102,634,120.51	3,801,263.72
538	92.906						

STAGE STORAGE CURVE
Phase 5A/7



STORAGE VOLUME COMPUTATIONS

Phase 5A/7

ELEV. (ft)	WIDTH (ft)	LENGTH (ft)	AREA (ac)	AVG. AREA (ac)	INTERVAL (ft)	STORAGE (ac-ft)	ACC. STORAGE (ac-ft)	STAGE INTERVAL (ft)
510.00	N/A	N/A	75.4638					
				76.3933	3.00	229.1799	229.1799	3.00
513.00	N/A	N/A	77.3228					
				78.2380	3.00	234.7139	463.8938	6.00
516.00	N/A	N/A	79.1531					
				80.0748	3.00	240.2244	704.1182	9.00
519.00	N/A	N/A	80.9965					
				81.9265	3.00	245.7794	949.8975	12.00
522.00	N/A	N/A	82.8564					
				83.7931	3.00	251.3793	1201.2768	15.00
525.00	N/A	N/A	84.7298					
				85.6745	3.00	257.0234	1458.3002	18.00
528.00	N/A	N/A	86.6191					
				87.5712	3.00	262.7135	1721.0136	21.00
531.00	N/A	N/A	88.5232					
				89.4824	3.00	268.4472	1989.4608	24.00
534.00	N/A	N/A	90.4416					
				91.6736	4.00	366.6944	2356.1552	28.00
538.00	N/A	N/A	92.9056					

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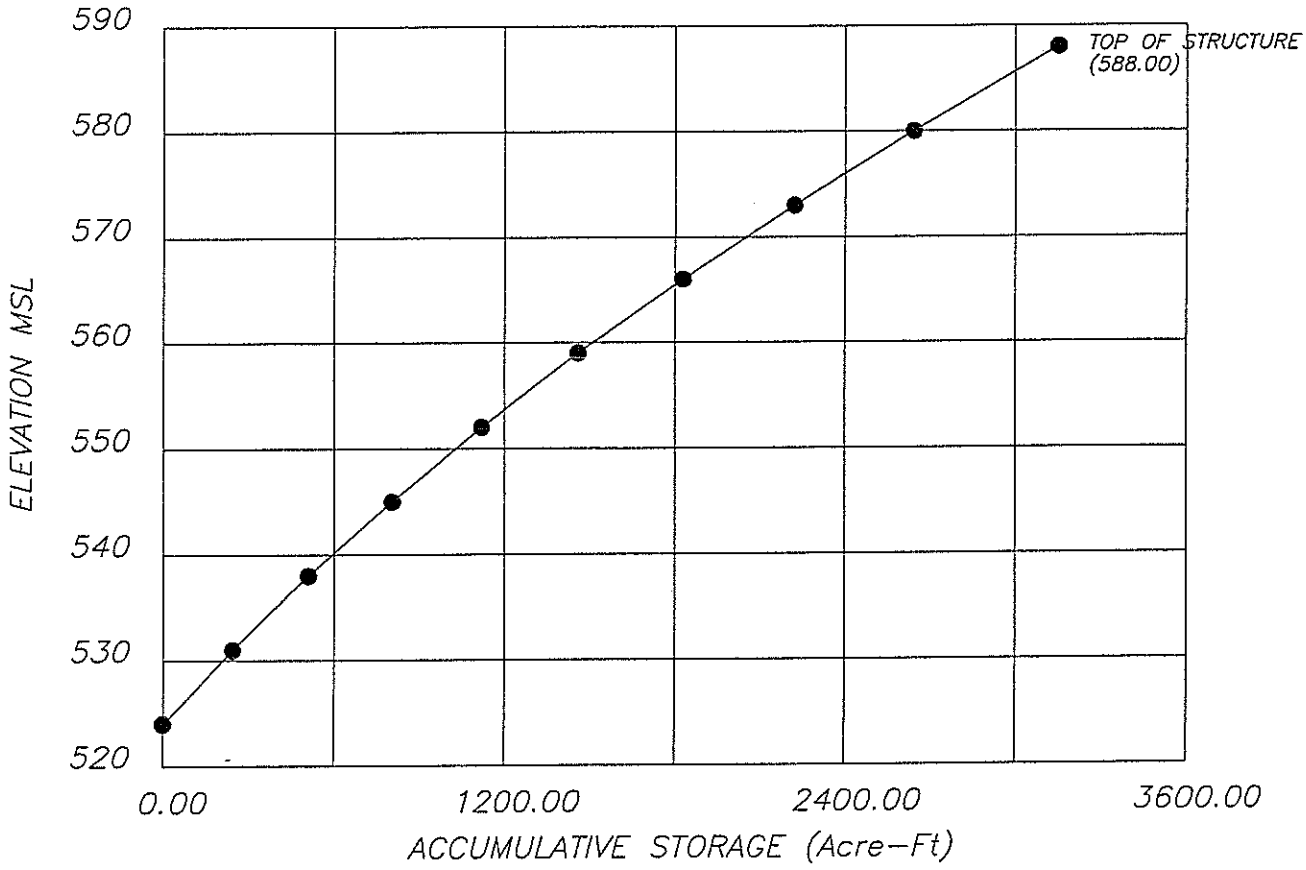
PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET _____ OF _____

DESCRIPTION: IMPOUNDMENT VOLUMES - PHASE 8

ELEVATION	AREA (Ac.)	AVG. AREA	STAGE INTERVAL	STORAGE (AC-FT)	CUMMULATIVE VOLUME AC-FT	CUMMALTIVE VOLUME C.F.	CUMMALTIVE VOLUME C.Y.
524	33.194						
		34.863	7.00	244.04	244.04	10,630,380.22	393,717.79
531	36.532						
		38.223	7.00	267.56	511.60	22,285,322.14	825,382.30
538	39.914						
		41.647	7.00	291.53	803.13	34,984,416.85	1,295,719.14
545	43.380						
		45.152	7.00	316.07	1,119.20	48,752,301.91	1,805,640.81
552	46.925						
		48.739	7.00	341.17	1,460.37	63,613,858.77	2,356,068.84
559	50.554						
		52.407	7.00	366.85	1,827.22	79,593,816.46	2,947,919.13
566	54.260						
		56.156	7.00	393.09	2,220.32	96,716,934.47	3,582,108.68
573	58.052						
		59.987	7.00	419.91	2,640.22	115,008,124.77	4,259,560.18
580	61.922						
		64.132	8.00	513.05	3,153.28	137,356,687.31	5,087,284.72
588	66.341						

STAGE STORAGE CURVE
Phase 8



STORAGE VOLUME COMPUTATIONS

Phase 8

ELEV. (ft)	WIDTH (ft)	LENGTH (ft)	AREA (ac)	AVG. AREA (ac)	INTERVAL (ft)	STORAGE (ac-ft)	ACC. STORAGE (ac-ft)	STAGE INTERVAL (ft)
524.00	N/A	N/A	33.1942					
				34.8629	7.00	244.0400	244.0400	7.00
531.00	N/A	N/A	36.5315					
				38.2230	7.00	267.5607	511.6006	14.00
538.00	N/A	N/A	39.9144					
				41.6473	7.00	291.5311	803.1317	21.00
545.00	N/A	N/A	43.3802					
				45.1525	7.00	316.0672	1119.1989	28.00
552.00	N/A	N/A	46.9247					
				48.7392	7.00	341.1744	1460.3733	35.00
559.00	N/A	N/A	50.5537					
				52.4071	7.00	366.8494	1827.2226	42.00
566.00	N/A	N/A	54.2604					
				56.1561	7.00	393.0927	2220.3153	49.00
573.00	N/A	N/A	58.0518					
				59.9869	7.00	419.9080	2640.2233	56.00
580.00	N/A	N/A	61.9219					
				64.1316	8.00	513.0524	3153.2757	64.00
588.00	N/A	N/A	66.3412					

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BY: RPC DATE: 6/21/2011 CHKD BY: _____ DATE: _____

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET _____ OF _____

DESCRIPTION: IMPOUNDMENT VOLUMES - PHASE 2-3 CONNECTOR

ELEVATION	AREA (Ac.)	AVG. AREA	STAGE INTERVAL	STORAGE (AC-FT)	CUMMULATIVE VOLUME AC-FT	CUMMALTIVE VOLUME C.F.	CUMMALTIVE VOLUME C.Y.
458	0.742						
		1.516	5.00	7.58	7.58	330,141.24	12,227.45
463	2.290						
		5.355	5.00	26.77	34.35	1,496,362.23	55,420.82
468	8.419						
		9.089	5.00	45.44	79.80	3,475,870.20	128,735.93
473	9.758						
		10.445	5.00	52.23	132.02	5,750,845.65	212,994.28
478	11.132						
		11.839	5.00	59.20	191.22	8,329,379.85	308,495.55
483	12.546						
		13.272	5.00	66.36	257.58	11,220,075.90	415,558.37
488	13.999						
		14.744	5.00	73.72	331.30	14,431,417.11	534,496.93
493	15.490						
		16.256	5.00	81.28	412.58	17,971,995.69	665,629.47
498	17.022						
		18.087	4.00	72.35	484.93	21,123,535.55	782,353.17
502	19.153						

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BY: RPC DATE: 8/30/2011 CHKD BY: CPD DATE: 10/24/11

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET 1 OF 16

DESCRIPTION: Embankment Construction and Fines Level Schedule

Current Phase 5 Fines Level = 477.0 As of 8/30/2011 Coarse Production Rate = 2,568,200 CY/Yr
Current Phase 5 Total Fines Volume = 1,705,000.00 CY Fines Production Rate = 2,064,400 CY/Yr
Fines Storage Volume Remaining in Phase 5 Cell = 135,000.00 CY
Current Phase 4/6 Fines Level = 459.00 As of 8/30/2011
Current Phase 4/6 Fines Volume = 630,880.25 CY
Estimated End of Phase 6 Construction = 11/23/2011 (Crest El. = 492.0)
Remaining Time to Complete Phase 6 Construction = 0.2329 Yr
Fines Produced Completing Phase 6 Construction = 480,750.68 CY
Volume to Fill Phase 5 Cell to Max Level (El. 480) = 135,000.00 CY Phase 5 Cell Max Fines Level Reached - 9/22/2011
Volume to Pump into Phase 4/6 Cell = (480,750.68 - 135,000) = 345,750.68 CY
Total Phase 4/6 Fines Volume = (630,880.25 + 345,750.68) = 976,630.93 CY

Fines Level at End of Construction = (Phase 4/6 Cell)

Elev.	Volume
466.0	921,496.70
X	976,630.93
468.0	1,009,004.60

X = 467.26 < 481.3 **OK**

Begin Phase 7 Construction to El. 500 - 11/24/2011
Volume to Construct = 417,745.84 CY
Time to construct = (417,745.84 / 2,568,200) = 0.1627 Yr Completion Date = 1/22/2012
Fines Produced During Construction = (0.1627 x 2,064,400) = 335,797.26 CY
Total Phase 4/6 Fines Volume = (976,630.93 + 335,797.26) = 1,312,428.19 CY
at End of Construction

Fines Level at End of Construction = (Phase 4/6 Cell)

Elev.	Volume
474.0	1,283,700.90
X	1,312,428.19
476.0	1,379,416.70

X = 474.60 < 481.3 **OK**

Phase 7 Available Storage will be:
1 PMF Volume for Crest at El. 500 = (41")(1 ft / 12")(97.9 Ac)(43,560 ft^2 / Ac)(1 CY / 27 CF) = 539,646.56 CY
Max Storm Level = 500 - 3 ft Freeboard = 497.0

Storage Volume at El. 497 =

Elev.	Volume
496.3	823,418.79
497.0	X
499.3	1,003,002.88

X = 865,321.74 CY

Fines Volume Available = (865,321.74 - 539,646.56) = 325,675.19 CY
Max Fines Level for Crest at El. 500 =

Elev.	Volume
487.3	314,735.52
X	325,675.19
490.3	479,356.02

X = 487.5

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BY: RPC DATE: 8/30/2011 CHKD BY: CPUD DATE: 9/23/11

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET 2 OF 16

DESCRIPTION: **Embankment Construction and Fines Level Schedule**

Continue Phase 7 Construction to El. 510
Begin Phase 7 Construction to El. 510 - 1/23/2012
Volume to Construct = (1,146,946.09 - 417,745.84) = 729,200.25 CY
Time to construct = (729,200.25 / 2,568,200) = 0.2839 Yr

Coarse Production Rate = 2,568,200 CY/Yr
Fines Production Rate = 2,064,400 CY/Yr

Completion Date = 5/6/2012

Fines Produced During Construction = (0.2839 x 2,064,400) = 586,154.11 CY

Total Fines Volume to Max. in Phase 4 Cell (El. 481.3) = 1,643,648.16 CY
Fines Volume Remaining in Phase 4 Cell = (1,643,648.16 -1,312,428.19) = 331,219.97 CY (Pumped to fill Phase 4 Cell Max. (El. 481.3))
Fines Volume Pumped into Phase 7 Cell = (586,154.11 - 331,219.97) = 254,934.14 CY

Fines Level at End of Construction = (Phase 7 Cell)

Elev.	Volume
484.3	154,959.13
X	254,934.14
487.3	314,735.52

X = 486.18 < 487.5 OK

Phase 7 Available Storage will be:
1 PMF Volume for Crest at El. 510 = (41")(1 ft / 12")(91.5 Ac)(43,560 ft^2 / Ac)(1 CY / 27 CF) = 504,368.33 CY

Max Storm Level = 510 - 3 ft Freeboard = 507.0
Storage Volume at El. 507 =

Elev.	Volume
505.3	1,450,786.61
507.0	X
510.0	1,836,402.75

X = 1,590,264.79 CY

Fines Volume Available = (1,590,264.79 - 504,368.33) = 1,085,896.45 CY

Max Fines Level for Crest at El. 510 =

Elev.	Volume
499.3	1,003,002.88
X	1,085,896.45
502.3	1,211,936.24

X = 500.5

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BY: RPC DATE: 8/30/2011 CHKD BY: DATE: 9/2/11

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET 3 OF 16

DESCRIPTION: **Embankment Construction and Fines Level Schedule**

Begin Phase 5A Construction to El. 490 - 5/7/2012
Volume to Construct = 401,295.80 CY
Time to construct = (401,295.80 / 2,568,200) = 0.1563 Yr

Coarse Production Rate = 2,568,200 CY/Yr
Fines Production Rate = 2,064,400 CY/Yr

Completion Date = 7/3/2012

Fines Produced During Construction = (0.1563 x 2,064,400) = 322,574.20 CY

Phase 7 Fines Volume at End of Construction= (322,574.20+254,934.14)= 577,508.34 CY

Fines Level at End of Construction = (Phase 7 Cell)

Elev.	Volume
490.3	479,356.02
X	577,508.34
493.3	648,893.23

X = 492.04 < 500.5 **OK**

Phase 5A Available Storage will be:
1 PMF Volume for Crest at El. 490 = (41")(1 ft / 12")(44.8 Ac)(43,560 ft^2 / Ac)(1 CY / 27 CF) = 246,947.56 CY
1/2 PFM Volume = 123,473.78 CY

Max Storm Level = 490 - 3 ft Freeboard = 487.0
Storage Volume at El. 487 =

Elev.	Volume
486.0	122,205.89
487.0	X
489.0	188,587.21

X = 144,333.00 CY

Fines Volume Available = (144,333.00 - 123,473.78) = 20,859.22 CY

Not Capable of Full PMF Storage on 5/7/2012
Request Short Term Storage Criteria

Max Fines Level for Crest at El. 490 = (For 1/2 PMF Storage)

Elev.	Volume
480.0	0.00
X	20,859.22
483.0	59,364.54

X = 481.1

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BY: RPC DATE: 8/30/2011 CHKD BY: CPW DATE: 9/2/11

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET 4 OF 16

DESCRIPTION: **Embankment Construction and Fines Level Schedule**

Begin Phase 5A Construction to El. 500 - 7/4/2012
Volume to Construct = (777,509.86 - 401,295.80) = 376,214.06 CY
Time to construct = (376,214.06 / 2,568,200) = 0.1465 Yr

Coarse Production Rate = 2,568,200 CY/Yr
Fines Production Rate = 2,064,400 CY/Yr

Completion Date = 8/26/2012

Fines Produced During Construction = (0.1465 x 2,064,400) = 302,412.70 CY

Phase 7 Fines Volume at End of Construction= (302,412.70+577,508.34)= 879,921.04

Fines Level at End of Construction = (Phase 7 Cell)

Elev.	Volume
496.3	823,418.79
X	879,921.04
499.3	1,003,002.88

X = 497.24 < 500.5 **OK**

Phase 5A Available Storage will be:
1 PMF Volume for Crest at El. 500 = (41")(1 ft / 12")(42.1 Ac)(43,560 ft^2 / Ac)(1 CY / 27 CF) = 232,064.56 CY

Max Storm Level = 500 - 3 ft Freeboard = 497.0
Storage Volume at El. 497 =

Elev.	Volume
495.0	355,184.13
497.0	X
498.0	447,950.23

X = 417,028.20 CY

Fines Volume Available = (417,028.20 - 232,064.56) = 184,963.64 CY **Regained Full PMF Control on 8/26/2012**

Max Fines Level for Crest at El. 500 = (For Full PMF Storage)

Elev.	Volume
486.0	122,205.89
X	184,963.64
489.0	188,587.21

X = 488.8

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BY: RPC DATE: 8/30/2011 CHKD BY: CPLS DATE: 9/23/11

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET 5 OF 16

DESCRIPTION: Embankment Construction and Fines Level Schedule

Begin Phase 5A Construction to El. 510 - 8/27/2012
Volume to Construct = (1,083,565.93 - 777,509.86) = 306,056.07 CY
Time to construct = (306,056.07 / 2,568,200) = 0.1192 Yr

Coarse Production Rate = 2,568,200 CY/Yr
Fines Production Rate = 2,064,400 CY/Yr

Completion Date = 10/10/2012

Fines Produced During Construction = (0.1192 x 2,064,400) = 246,017.50 CY

Phase 7 Fines Volume at End of Construction= (246,017.50+879,921.04) = 1,125,938.55 CY

Volume Remaining in Phase 7 Cell to Max (El. 500.5) = (1,085,896.45 - 879,921.04) = 205,975.41 CY
Phase 7 Cell Max Fines Level Reached on - 10/2/2012
Begin Pumping Fines into Phase 5A Cell
Volume Pumped into Phase 5A Cell = (246,017.50 - 205,975.41) = 40,042.09 CY

Fines Level at End of Construction = (Phase 5A Cell)

Elev.	Volume
480.0	0.00
X	40,042.09
483.0	59,364.54

X = 482.02 < 488.8 **OK**

Phase 5A Available Storage will be:
1 PMF Volume for Crest at El. 510 = (41")(1 ft / 12")(39.5 Ac)(43,560 ft^2 / Ac)(1 CY / 27 CF) = 217,732.78 CY

Max Storm Level = 510 - 3 ft Freeboard = 507.0
Storage Volume at El. 507 =

Elev.	Volume
504.0	645,115.37
507.0	X
510.0	858,065.21

X = 751,590.29 CY

Fines Volume Available = (751,590.29 - 217,732.78) = 533,857.51 CY

Max Fines Level for Crest at El. 510 = (For Full PMF Storage)

Elev.	Volume
498.0	447,950.23
X	533,857.51
501.0	544,569.70

X = 500.7

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BY: RPC DATE: 8/30/2011 CHKD BY: CRW DATE: 9/22/11

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET 6 OF 16

DESCRIPTION: **Embankment Construction and Fines Level Schedule**

Begin Phase 5A/7 Construction to El. 515 - 10/11/2012
Volume to Construct = 423,843.31 CY
Time to construct = (423,843.31 / 2,568,200) = 0.1650 Yr

Coarse Production Rate = 2,568,200 CY/Yr
Fines Production Rate = 2,064,400 CY/Yr

Completion Date = 12/10/2012

Fines Produced During Construction = (0.1650 x 2,064,400) = 340,698.59 CY

Phase 5A Fines Volume at End of Construction= (340,698.59+40,042.09)= 380,740.69 CY

Fines Level at End of Construction = (Phase 5A Cell)

Elev.	Volume
495.0	355,184.13
X	380,740.69
498.0	447,950.23

X = 495.83 < 500.7 **OK**

Phase 5A/7 Available Storage will be:
1 PMF Volume for Crest at El. 515 = (41")(1 ft / 12")(127.7 Ac)(43,560 ft^2 / Ac)(1 CY / 27 CF) = 703,910.78 CY

Max Storm Level = 515 - 3 ft Freeboard = 512.0
Storage Volume at El. 512 =

Elev.	Volume
510.0	0.00
512.0	X
513.0	369,743.57

X = 246,495.71 CY

Remaining Storage in Phase 5A Cell = 477,324.52 CY
(858,065.21 - 380,740.69)
(Volume at El. 510 - Volume at El. 495.83)

Remaining Volume in Phase 7 Cell = 750,506.30 CY
(1,836,402.75 - 1,085,896.45)
(Volume at El. 510 - Volume at El. 500.5)

Total Storage at El. 512 = (246,495.71 + 477,324.52 + 750,506.30) = 1,474,326.53 CY

Fines Volume Available = (1,474,326.53 - 703,910.78) = 770,415.76 CY
Fill Phase 5A Cell to El. 510 - (770,415.76 - 477,324.52) = 293,091.24 CY Available Storage Remaining
Phase 7 Cell Fines Volume will be = (1,836,402.75 - 293,091.24) = 1,555,438.40 CY

Max Fines Level for Crest at El. 515 =

Elev.	Volume
505.3	1,450,786.61
X	1,555,438.40
510.0	1,836,402.75

X = 506.6 With Phase 5A Cell at El. 510

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BY: RPC DATE: 8/30/2011 CHKD BY: CDS DATE: 9/2/11

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET 7 OF 16

DESCRIPTION: **Embankment Construction and Fines Level Schedule**

Begin Phase 5A/7 Construction to El. 525 - 12/11/2012
Volume to Construct = (1,109,290.18 - 423,843.31) = 685,446.87 CY
Time to construct = (685,446.87 / 2,568,200) = 0.2669 Yr

Coarse Production Rate = 2,568,200 CY/Yr
Fines Production Rate = 2,064,400 CY/Yr

Completion Date = 3/18/2013

Fines Produced During Construction = (0.2669 x 2,064,400) = 550,983.77 CY

Remaining Storage in Phase 5A Cell = 477,324.52 CY (To El. 510)
Resume Pumping in Phase 7 Cell - (550,983.77 - 477,324.52) = 73,659.25 CY
Phase 7 Fines Volume at End of Construction= (73,659.25+1,085,896.45)= 1,159,555.71 CY

Fines Level at End of Construction = (Phase 7 Cell)

Elev.	Volume
499.3	1,003,002.88
X	1,159,555.71
502.3	1,211,936.24

X = 501.55 < 506.6 **OK**

Phase 5A/7 Available Storage will be:
1 PMF Volume for Crest at El. 525 = (41")(1 ft / 12")(120.4 Ac)(43,560 ft^2 / Ac)(1 CY / 27 CF) = 663,671.56 CY

Max Storm Level = 525 - 3 ft Freeboard = 522.0
Storage Volume at El. 522 = 1,532,501.30 CY

Remaining Volume in Phase 7 Cell = 676,847.04 CY
(1,836,402.75 - 1,159,555.71)
(Volume at El. 510 - Volume at El. 501.55)

Total Storage at El. 522 = (1,532,501.30 + 676,847.04) = 2,209,348.34 CY

Fines Volume Available = (2,209,348.34 - 663,671.56) = 1,545,676.78 CY
To Fill Phase 7 to El. 510 - (1,545,676.78 - 676,847.04) = 868,829.74 CY Fill into Phase 5A/7 Cell

Max Fines Level for Crest at El. 525 =

Elev.	Volume
516.0	748,415.25
X	868,829.74
519.0	1,135,977.28

X = 516.9

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BY: RPC DATE: 8/30/2011 CHKD BY: CPCS DATE: 9/22/11

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET 8 OF 16

DESCRIPTION: **Embankment Construction and Fines Level Schedule**

Begin Phase 5A/7 Construction to El. 538 - 3/19/2013
Volume to Construct = (1,675,475.15 - 1,109,290.18) = 566,184.97 CY
Time to construct = (566,184.97 / 2,568,200) = 0.2205 Yr

Coarse Production Rate = 2,568,200 CY/Yr
Fines Production Rate = 2,064,400 CY/Yr

Completion Date = 6/8/2013

Fines Produced During Construction = (0.2205 x 2,064,400) = 455,117.30 CY

Phase 7 Fines Volume at End of Construction=(455,117.30+1,159,555.71)= 1,614,673.01 CY

Fines Level at End of Construction = (Phase 7 Cell)

Elev.	Volume
505.3	1,450,786.61
X	1,614,673.01
510.0	1,836,402.75

X = 507.30 < 516.9 **OK**

Phase 5A/7 Available Storage will be:
1 PMF Volume for Crest at El. 538 = (41")(1 ft / 12")(111.1 Ac)(43,560 ft^2 / Ac)(1 CY / 27 CF) = 612,407.89 CY

Max Storm Level = 538 - 3 ft Freeboard = 535.0

To Maintain Full PMF Control During Phase 8 Construction, Use Phase 8 Impoundment Volumes

Storm Level During Phase 8 Construction =

Elev.	Volume
531.0	393,717.79
X	612,407.89
538.0	825,382.30

X = 534.5 < El. 535.0 **OK**

Max Fines Level for Crest at El. 538 = 524.0 (Required to Maintain PMF Control During Phase 8 Construction)

Fines Volume at El 524.0 = (Phase 5A/7)

Elev.	Volume
522.0	1,532,501.30
524.0	X
525.0	1,938,059.90

X = 1,802,873.70 CY

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PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET 9 OF 16

DESCRIPTION: Embankment Construction and Fines Level Schedule

Begin North Buttress Construction - 6/9/2013
Volume to Construct = 125,808.05 CY
Time to construct = (125,808.05 / 2,568,200) = 0.0490 Yr

Coarse Production Rate = 2,568,200 CY/Yr
Fines Production Rate = 2,064,400 CY/Yr

Completion Date = 6/27/2013

Fines Produced During Construction = (0.0490 x 2,064,400) = 101,128.47 CY

Phase 7 Fines Volume at End of Construction=(101,128.47+1,614,673.01)= 1,715,801.48 CY

Fines Level at End of Construction = (Phase 7 Cell)

Elev.	Volume
505.3	1,450,786.61
X	1,715,801.48
510.0	1,836,402.75

X = 508.53 < 524.0 **OK**

Begin South Buttress Construction (Option) - 6/28/2013
Volume to Construct = 38,262.45 CY
Time to construct = (38,262.45 / 2,568,200) = 0.0149 Yr

Completion Date = 7/3/2013

Fines Produced During Construction = (0.0149 x 2,064,400) = 30,756.56 CY

Phase 7 Fines Volume at End of Construction=(29,148.90+1,715,801.48)= 1,746,558.04 CY

Fines Level at End of Construction = (Phase 7 Cell)

Elev.	Volume
505.3	1,450,786.61
X	1,746,558.04
510.0	1,836,402.75

X = 508.90 < 524.0 **OK**

Phase 7 Fines Storage Volume Remaining = (1,836,402.75-1,746,558.04)= 89,844.71 CY
Phase 5A/7 Fines Storage Volume Remaining = 1,802,873.70 CY
Total Fines Storage Remaining = (89,844.71 + 1,802,873.70) = 1,892,718.41 CY
Fines Life Remaining = (1,892,718.41 / 2,064,400) = 0.9168 Yr

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BY: RPC DATE: 8/30/2011 CHKD BY: CPW DATE: 9/2/11

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET 10 OF 16

DESCRIPTION: Embankment Construction and Fines Level Schedule

Begin Phase 2-3 Connector Construction (Option) - 6/28/2013
Volume to Construct = 120,535.02 CY
Time to construct = (120,535.02 / 2,568,200) = 0.0469 Yr

Coarse Production Rate = 2,568,200 CY/Yr
Fines Production Rate = 2,064,400 CY/Yr

Completion Date = 7/15/2013

Fines Produced During Construction = (0.0469 x 2,064,400) = 96,889.84 CY

Phase 7 Fines Volume at End of Construction=(96,889.84+1,715,801.48)= 1,812,691.32 CY

Fines Level at End of Construction = (Phase 7 Cell)

Elev.	Volume
505.3	1,450,786.61
X	1,812,691.32
510.0	1,836,402.75

X = 509.71 < 524.0 **OK**

Phase 2-3 Connector Available Storage will be:
1 PMF Volume for Crest at El. 502 = (41")(1 ft / 12")(37.3 Ac)(43,560 ft^2 / Ac)(1 CY / 27 CF) = 205,605.89 CY

Max Storm Level = 502 - 3 ft Freeboard = 499.0
Storage Volume at El. 499 =

Elev.	Volume
498.0	665,629.47
499.0	X
502.0	782,353.17

X = 694,810.40 CY

Fines Volume Available = (694,810.40 - 205,605.89) = 489,204.51 CY

Max Fines Level for Crest at El. 502 = (Phase 2-3 Connector)

Elev.	Volume
488.0	415,558.37
X	489,204.51
493.0	534,496.93

X = 491.1

Phase 2-3 Connector Option Will Provide:
(489,204.51 / 2,064,400) = 0.2370 Years of Fines Disposal Life
Should the Phase 2-3 Connector Option be chosen, fines disposal may begin at any time after construction is complete

Phase 7 Fines Storage Volume Remaining = (1,836,402.75-1,812,691.32)= 23,711.43 CY
Phase 5A/7 Fines Storage Volume Remaining = 1,802,873.70 CY
Total Fines Storage Remaining = (23,711.43 + 1,802,873.70) = 1,826,585.13 CY
Fines Life Remaining = (2,414,281.84 / 2,064,400) = 0.8848 Yr

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BY: RPC DATE: 8/30/2011 CHKD BY: CPW DATE: 9/23/11

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET 11 OF 16

DESCRIPTION: Embankment Construction and Fines Level Schedule

Coarse disposal will begin at a separate facility to maximize fines storage, and minimize coarse loss at this facility. For the purpose of the calculations, timing for Phase 8 will resume at a date when the maximum fines level of Phase 5A/7 has been reached. At this time, fines storage may begin at a separate facility until Phase 8 construction at this facility has been complete. Calculations were preformed on the assumption that the South Buttress Option has been chosen.

Coarse Production Rate = 2,568,200 CY/Yr
Fines Production Rate = 2,064,400 CY/Yr

Fines Volume Remaining in Phase 7 and 5A/7 = 1,892,718.41 CY
Fines Life Remaining = (2,482,022.78 / 2,064,400) = 0.9168 Yr

Begin Phase 8 Construction to El. 548 - 6/3/2014 (Begin With Fines Level at El. 524.0)

Volume to Construct =

Elev.	Volume
544.0	1,762,783.48
548.0	X
549.0	2,201,782.47

X = 2,113,982.67 CY

Time to Construct = (2,113,982.67 / 2,568,200) = 0.8231 Yr
Completion Date = 3/30/2015

Fines Produced During Construction = (0.8231 x 2,064,400) = 1,699,285.81 CY (To be Stored at Separate Facility)

Phase 8 Available Storage will be:
1 PMF Volume for Crest at El. 548 = (41")(1 ft / 12")(97.5 Ac)(43,560 ft^2 / Ac)(1 CY / 27 CF) = 537,441.67 CY

Max Storm Level = 548 - 3 ft Freeboard = 545.0

Storage Volume at El. 545 = 1,295,719.14 CY

Fines Volume Available = (1,295,719.14 - 537,441.67) = 758,277.47 CY

Max Fines Level for Crest at El. 548 = (Phase 8)

Elev.	Volume
531.0	393,717.79
X	758,277.47
538.0	825,382.30

X = 536.9

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BY: RPC DATE: 8/30/2011 CHKD BY: CPW DATE: 9/2/11

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET 12 OF 16

DESCRIPTION: Embankment Construction and Fines Level Schedule

Begin Phase 8 Construction to El. 558 - 3/31/2015

Coarse Production Rate = 2,568,200 CY/Yr
Fines Production Rate = 2,064,400 CY/Yr

Volume to Construct =

Elev.	Volume
554.0	2,593,558.09
558.0	X
559.0	2,938,106.70

X = 2,869,196.98 CY

(2,869,196.98 - 2,113,982.67) = 755,214.31 CY

Time to construct = (755,214.31 / 2,568,200) = 0.2941 Yr
Completion Date = 7/16/2015

Fines Produced During Construction = (0.2941 x 2,064,400) = 607,065.03 CY

Phase 8 Fines Volume at End of Construction= 607,065.03 CY (Assuming Fines Disposal Resumed in This Facility)

Fines Level at End of Construction = (Phase 8 Cell)

Elev.	Volume
531.0	393,717.79
X	607,065.03
538.0	825,382.30

X = 534.46 < 536.9 **OK**

Phase 8 Available Storage will be:
1 PMF Volume for Crest at El. 558 = (41")(1 ft / 12")(90.9 Ac)(43,560 ft^2 / Ac)(1 CY / 27 CF) = 501,061.00 CY

Max Storm Level = 558 - 3 ft Freeboard = 555.0
Storage Volume at El. 555 =

Elev.	Volume
552.0	1,805,640.81
555.0	X
559.0	2,356,068.84

X = 2,041,538.54 CY

Fines Volume Available = (2,041,538.54 - 501,061.00) = 1,540,477.54 CY

Max Fines Level for Crest at El. 558 =

Elev.	Volume
545.0	1,295,719.14
X	1,540,477.54
552.0	1,805,640.81

X = 548.4

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BY: RPC DATE: 8/30/2011 CHKD BY: CDW DATE: 9/2/11

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET 13 OF 16

DESCRIPTION: **Embankment Construction and Fines Level Schedule**

Begin Phase 8 Construction to El. 568 - 7/17/2015

Coarse Production Rate = 2,568,200 CY/Yr
Fines Production Rate = 2,064,400 CY/Yr

Volume to Construct =

Elev.	Volume
564.0	3,235,432.87
568.0	X
569.0	3,485,531.57

X = 3,435,511.83 CY

(3,435,511.83 - 2,869,196.98) = 566,314.85 CY

Time to construct = (566,314.85 / 2,568,200) = 0.2205 Yr
Completion Date = 10/6/2015

Fines Produced During Construction = (0.2205 x 2,064,400) = 455,221.70 CY

Fines Volume at End of Construction = (455,221.70 + 607,065.03) = 1,062,286.74

Fines Level at End of Construction = (Phase 8 Cell)

Elev.	Volume
538.0	825,382.30
X	1,062,286.74
545.0	1,295,719.14

X = 541.53 < 548.4 **OK**

Phase 8 Available Storage will be:
1 PMF Volume for Crest at El. 568 = (41")(1 ft / 12")(84.5 Ac)(43,560 ft^2 / Ac)(1 CY / 27 CF) = 465,782.78 CY

Max Storm Level = 568 - 3 ft Freeboard = 565.0
Storage Volume at El. 565 =

Elev.	Volume
559.0	2,356,068.84
565.0	X
566.0	2,947,919.13

X = 2,863,369.09 CY

Fines Volume Available = (2,863,369.09 - 465,782.78) = 2,397,586.31 CY

Max Fines Level for Crest at El. 568 =

Elev.	Volume
559.0	2,356,068.84
X	2,397,586.31
566.0	2,947,919.13

X = 559.5

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BY: RPC DATE: 8/30/2011 CHKD BY: CPD DATE: 10/3/11

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET 14 OF 16

DESCRIPTION: Embankment Construction and Fines Level Schedule

Begin Phase 8 Construction to El. 588 - 10/7/2015

Coarse Production Rate = 2,568,200 CY/Yr
Fines Production Rate = 2,064,400 CY/Yr

Volume to Construct = (4,005,223.80 - 3,435,511.83) = 569,711.97 CY
Time to construct = (569,711.97 / 2,568,200) = 0.2218 Yr

Completion Date = 12/27/2015

Fines Produced During Construction = (0.2218 x 2,064,400) = 457,952.41 CY

Fines Volume at End of Construction = (457,952.41 + 1,062,286.74) = 1,520,239.15 CY (Assuming Available Phase 8 Fines Disposal was used)

Fines Level at End of Construction = (Phase 8 Cell)

Elev.	Volume
545.0	1,295,719.14
X	1,520,239.15
552.0	1,805,640.81

X = 548.08 < 559.5 **OK**

Phase 8 Available Storage will be:
1 PMF Volume for Crest at El. 588 = (41")(1 ft / 12")(72.2 Ac)(43,560 ft^2 / Ac)(1 CY / 27 CF) = 397,982.44 CY

Max Storm Level = 588 - 3 ft Freeboard = 585.0

A 36" DR17 HDPE Pipe will be installed in Phase 8 to evacuate the storm volume. Through use of the decant the max. fines elevation for Phase 8 will be El. 582.0 (See HEC-1 Analysis).

Fines Storage Volume at El. 582.0 =

Elev.	Volume
580.0	4,259,560.18
582.0	X
588.0	5,087,284.72

X = 4,466,491.32

Fines Volume Remaining = (4,466,491.32 - 1,520,239.15) = 2,946,252.17 CY

Phase 8 Will Provide:
(2,946,252.17 / 2,064,400) = 1.4272 Years of Storage After Construction is Complete

Estimated Date to Max = 5/31/2017

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BY: RPC DATE: 8/30/2011 CHKD BY: CDW DATE: 10/3/11

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET 15 OF 16

DESCRIPTION: Embankment Construction and Fines Level Schedule Summary

Date	Description	Time to Construct (Yr)	Completed Crest El.	Fines Level	Max. Fines Level
8/30/2011	Current Phase 5 Construction		488.0 (Phase 5)	477.0	480.0
8/30/2011	Current Phase 4/6 Construction		492.0 (Phase 4/6)	459.0	481.3
11/23/2011	End Phase 4/6 Embankment Construction	0.233	492.0 (Phase 4/6)	467.3 (Phase 4/6)	481.3 (Phase 4/6)
			488.0 (Phase 5)	480.0 (Phase 5) *	480.0 (Phase 5)
1/22/2012	Complete Phase 7 Construction to El. 500	0.163	500.0 (Phase 7)	474.6 (Phase 4/6)	487.5 (Phase 7)
5/6/2012	Complete Phase 7 Construction to El. 510	0.284	510 (Phase 7)	486.18 (Phase 7)	500.5 (Phase 7)
7/3/2012	Complete Phase 5A Construction to El. 490	0.156	510.0 (Phase 7)	492.0 (Phase 7)	500.5 (Phase 7)
			490 (Phase 5A)	480.0 (Phase 5)	481.1 (Phase 5A)
8/26/2012	Complete Phase 5A Construction to El. 500	0.146	510.0 (Phase 7)	497.2 (Phase 7)	500.5 (Phase 7)
			500 (Phase 5A)	480.0 (Phase 5)	488.8 (Phase 5A)
10/2/2012	Phase 7 Max Fines Level Reached		510.0 (Phase 7)	500.5 (Phase 7) *	500.5 (Phase 7)
10/3/2012	Resume Pumping Fines in Phase 5/5A		500.0 (Phase 5A)	480.0 (Phase 5)	488.8 (Phase 5A)
10/10/2012	Complete Phase 5A Construction to El. 510	0.119	510.0 (Phase 5A)	482.0 (Phase 5A)	500.7 (Phase 5A)
12/10/2012	Complete Phase 5A/7 Construction to El. 515	0.165	515.0 (Phase 5A/7)	495.8 (Phase 5A)	510.0 (Phase 5A)
				500.5 (Phase 7)	506.6 (Phase 7)
3/18/2013	Complete Phase 5A/7 Construction to El. 525	0.267	525.0 (Phase 5A/7)	510.0 (Phase 5A)	516.9 (Phase 5A/7)
				501.6 (Phase 7)	
6/8/2013	Complete Phase 5A/7 Construction to El. 538	0.220	538.0 (Phase 5A/7)	510.0 (Phase 5)	524.0 (Phase 5A/7)
				507.3 (Phase 7)	
6/27/2013	Complete North Buttress Construction	0.049	538.0 (Phase 5A/7)	510.0 (Phase 5)	524.0 (Phase 5A/7)
				508.5 (Phase 7)	
7/3/2013	Complete Souh Buttress (Option) Construction	0.015	538.0 (Phase 5A/7)	510.0 (Phase 5)	524.0 (Phase 5A/7)
				508.9 (Phase 7)	

* Max Fines Level Reached

Note: Summary Includes Timing for South Buttress Option, and Does Not Include Timing for Phase 2-3 Connector Option

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BY: RPC DATE: 8/30/2011 CHKD BY: CPW DATE: 10/3/11

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2

PROJECT NO.: B11-146-1413 SHEET 16 OF 16

DESCRIPTION: Embankment Construction and Fines Level Schedule Summary

Date	Description	Time to Construct (Yr)	Completed Crest El.	Fines Level	Max. Fines Level
6/3/2014	Begin Phase 8 Construction to El. 548		538.0 (Phase 5A/7)	524.0 (Phase 5A/7)	524.0 (Phase 5A/7)
3/30/2015	Complete Phase 8 Construction to El. 548	0.823	548.0 (Phase 8)	524 (Phase 5A/7)	536.9 (Phase 8)
7/16/2015	Complete Phase 8 Construction to El. 558	0.294	558.0 (Phase 8)	534.5 (Phase 8)	548.4 (Phase 8)
10/6/2015	Complete Phase 8 Construction to El. 568	0.221	568.0 (Phase 8)	541.5 (Phase 8)	559.5 (Phase 8)
12/27/2015	Complete Phase 8 Construction to El. 588	0.222	588.0 (Phase 8)	548.1 (Phase 8)	582.0 (Phase 8)
5/31/2017	Complete Pumping Fines in Phase 8		588.0 (Phase 8)	582.0 (Phase 8)	582.0 (Phase 8)

Phase	Coarse Disposal Life (Years)	Fines Disposal Life (Years)
5A	0.422	0.416
7	0.447	0.890
5A/7	0.652	0.873
8	1.560	2.164
North Buttress	0.049	-
South Buttress (Option)	0.015	-
2-3 Connector (Option)	0.047	0.237
Total	**3.1**	**4.3**

Note: Total Disposal Life Includes South Buttress Option, and Does Not Include 2-3 Connector.
During Construction, 0.917 Yrs of Coarse Refuse and 0.823 Yrs of Fine Refuse
Will be Stored at a Separate Facility (Currently Under Review).

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CALC. BY: RPC DATE: 10/17/2011 CHKD. BY: _____ DATE: _____
PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2 WEST OF DIWANA
PROJECT NUMBER: B11-146-1413 SHEET 1 OF 1
DESCRIPTION: FREEBOARD CALCULATION

Calculation to check minimum required freeboard due to wind effects.

Use design values of:

Fetch = 3000 ft = 0.57 miles

Wind speed = 50 mph

Embankment slope = 3 : 1

Ref: Soil Conservation Service, Technical Release No. 69, February 1983

From Fig. No. 2:

For Fe = 0.57 and U_d = 50

H_s = 1.7

H_s / L = 0.0607

From Fig. No. 11:

For Fe = 0.57 and U_d = 50

L = 28

From Fig. No. 12:

For HS / L = 0.0607 and slope = 3 : 1

R / H_s = 1.35

For smooth embankment slope use R / H_s x 1.2

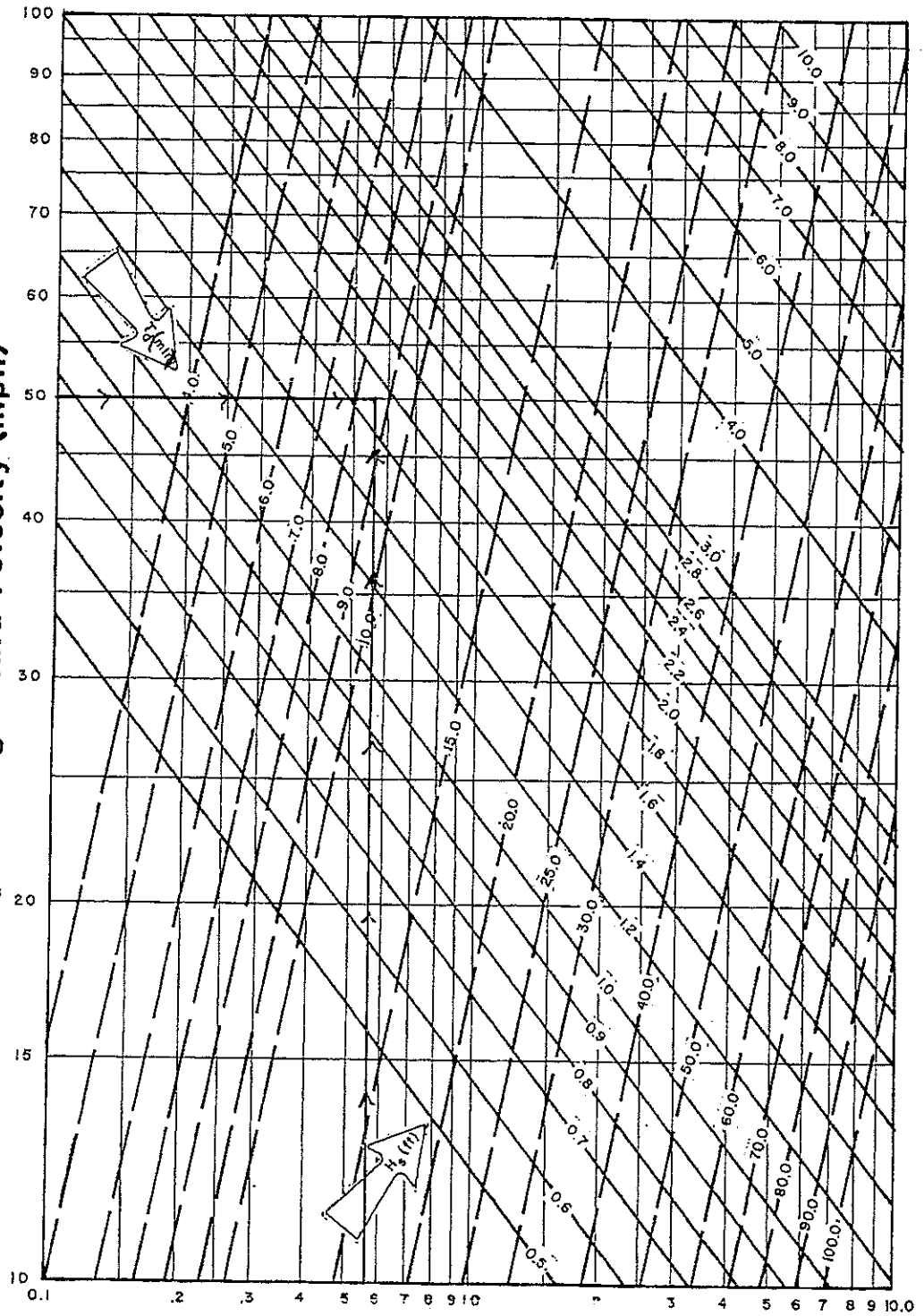
1.35 x 1.2 = 1.62

Runnup, R = 1.62 x H_s = 2.75

Wind setup, S = 0.1 x H_s = 0.17

Minimum Freeboard = R + S = 2.92 ft

Use Minimum Freeboard of 3 Feet



REF. (2)

Equation; (A17) & (A18) From Appendix A

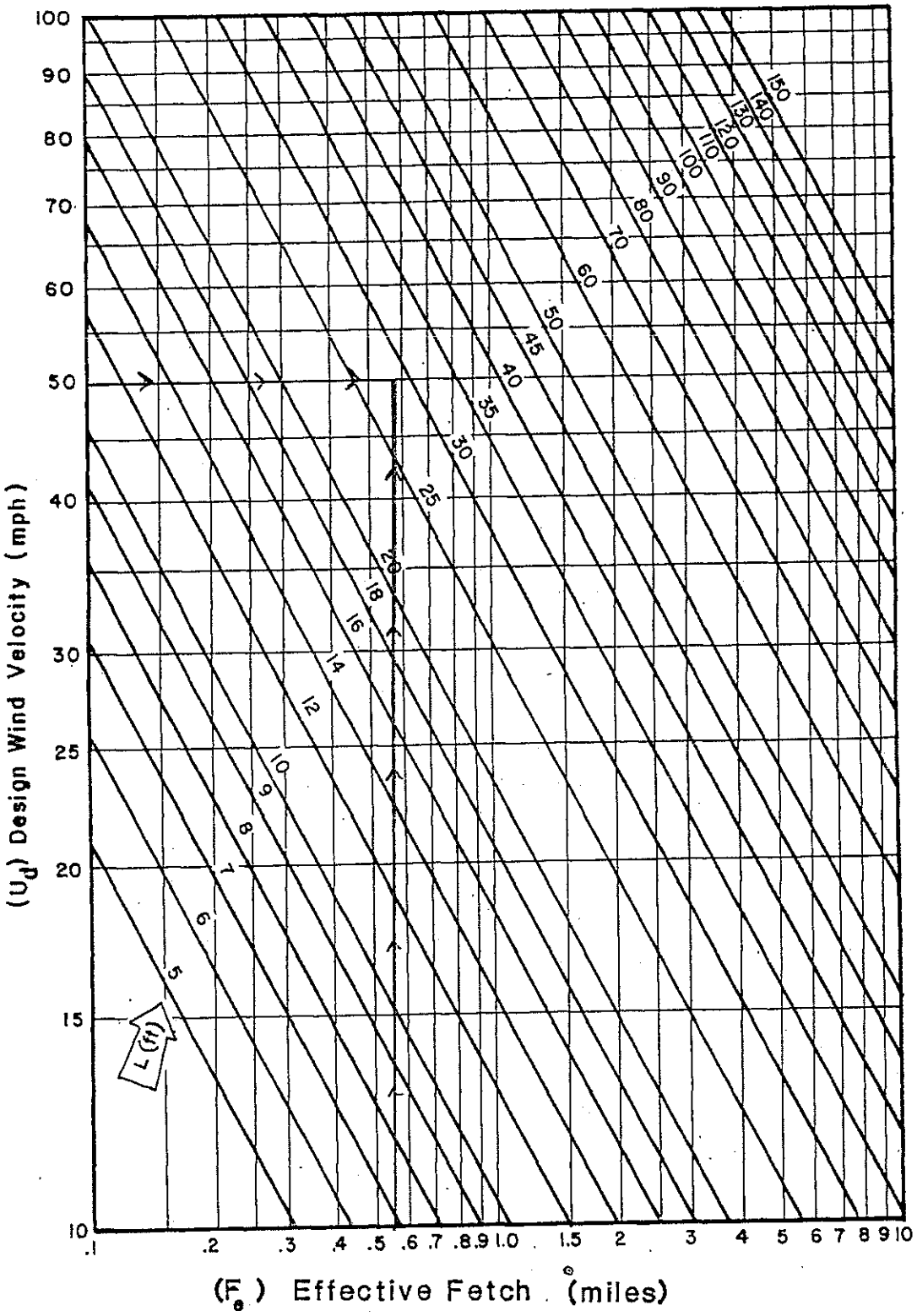
$$g\frac{H_s}{U^2} = 0.0026\left(\frac{gF_e}{U^2}\right)^{0.47}$$

$$g\frac{T}{U} = 0.46\left(\frac{gF_e}{U^2}\right)^{0.28}$$

FIGURE 2

GENERALIZED CORRELATIONS OF SIGNIFICANT WAVE HEIGHTS WITH RELATED FACTORS

WNTC ENG. STAFF
PORTLAND, OREGON

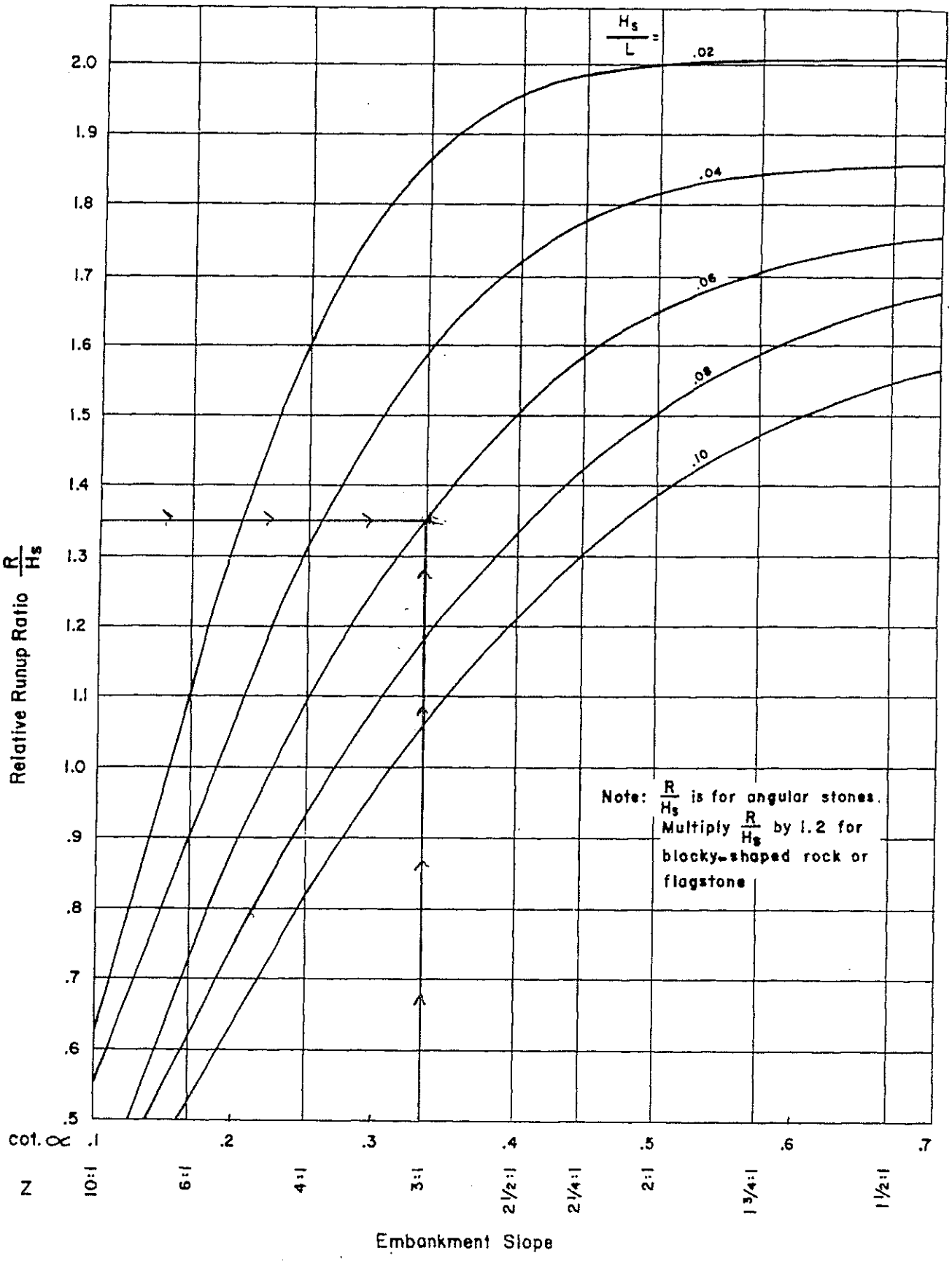


Equation (A21) From Appendix A

$$\frac{g\sqrt{L}}{U} = 1.041 \left(\frac{g F_e}{U^2}\right)^{0.28}$$

REF (2) (9)

FIGURE 11
WAVE LENGTH
RELATIONSHIP
WNTC ENG. STAFF
PORTLAND, OREGON



Note: See Ref. (2) and (20) and footnote 1 on page 9.

The surface smoothness represented by these curves is simulated by a single layer of rocks of uniform size.

FIGURE 12
WAVE RUNUP RATIO
WNTC ENG. STAFF
PORTLAND, OREGON

Mach No. 1 Mine, Facility No. 2 Phases 5A, 7 and 8

Perimeter Ditch PD-1

Flume Ditch 'L'

100 Yr - 6 Hr Event

RPC

Alliance Consulting, Inc.
124 Philpott Ln.
Beaver, WV 25813

Phone: 304-255-0491

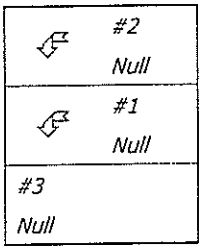
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#3	0.015	0.443	PD-1
Null	#2	==>	#3	0.002	0.454	Bench Flow
Null	#3	==>	End	0.000	0.000	Ditch 'L'



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	19.35	138.00	713.00	13.19	0.015
#1	**Muskingum K:**					**0.015**
#2	8. Large gullies, diversions, and low flowing streams	31.06	50.00	161.00	16.71	0.002
#2	**Muskingum K:**					**0.002**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#2	25.800	25.800	104.73	8.12
#1	19.200	19.200	86.28	6.13
#3	0.000	45.000	190.77	14.25

Structure Detail:

Structure #2 (Null)

Bench Flow

Structure #1 (Null)

PD-1

Structure #3 (Null)

Ditch 'L'

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Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	25.800	0.270	0.000	0.000	87.000	M	104.73	8.125
	Σ	**25.800**						**104.73**	**8.125**
#1	1	19.200	0.174	0.000	0.000	87.000	M	86.28	6.126
	Σ	**19.200**						**86.28**	**6.126**
#3	Σ	**45.000**						**190.77**	**14.250**

Subwatershed Time of Concentration Details:

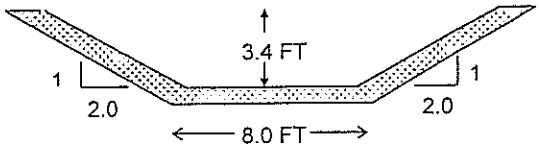
Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	2.65	265.00	3.000	0.024
		8. Large gullies, diversions, and low flowing streams	1.00	16.27	1,627.00	3.000	0.150
#1	**1**	**Time of Concentration:**					**0.174**
#2	1	8. Large gullies, diversions, and low flowing streams	33.33	50.00	150.00	17.320	0.002
		8. Large gullies, diversions, and low flowing streams	0.50	10.26	2,052.00	2.120	0.268
#2	**1**	**Time of Concentration:**					**0.270**

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

ABANDOMENT DITCH - PD-1

PEAK FLOW =	86.28	CFS
BOTTOM WIDTH =	8	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.01	FT/FT
MANNING'S N =	0.069	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	18.38	FT	DEPTH OF FLOW =	2.32	FT
AREA OF FLOW =	29.33	SQ.FT.	MEAN DEPTH =	1.70	FT
HYDRAULIC RADIUS, Rh =	1.60	FT	FROUDE NO. =	0.40	SUBCRITICAL
CALC. VELOCITY =	2.94	FPS			

FREEBOARD REQUIRED =	1.10	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	3.4	FT	**CHANNEL MATERIAL: SOIL AND GRASS LINING**

Mach No. 1 Mine, Facility No. 2
Phases 5A, 7, and 8

Perimeter Ditch PD-2

Flume Ditch 'I'

100 Yr - 6 Hr Event

RPC

Alliance Consulting, Inc.
124 Philpott Ln.
Beaver, WV 25813

Phone: 304-255-0491

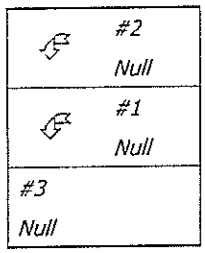
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#3	0.009	0.451	PD-2
Null	#2	==>	#3	0.002	0.455	Bench Flow
Null	#3	==>	End	0.000	0.000	Ditch 'I'



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	26.89	139.00	517.00	15.55	0.009
#1	**Muskingum K:**					**0.009**
#2	8. Large gullies, diversions, and low flowing streams	33.33	50.00	150.00	17.32	0.002
#2	**Muskingum K:**					**0.002**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#2	22.100	22.100	93.13	6.99
#1	16.200	16.200	73.30	5.18
#3	0.000	38.300	165.26	12.17

Structure Detail:

Structure #2 (Null)

Bench Flow

Structure #1 (Null)

PD-2

Structure #3 (Null)

Ditch 'I'

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	22.100	0.236	0.000	0.000	87.000	M	93.13	6.991
	Σ	**22.100**						**93.13**	**6.991**
#1	1	16.200	0.134	0.000	0.000	87.000	M	73.30	5.176
	Σ	**16.200**						**73.30**	**5.176**
#3	Σ	**38.300**						**165.26**	**12.168**

Subwatershed Time of Concentration Details:

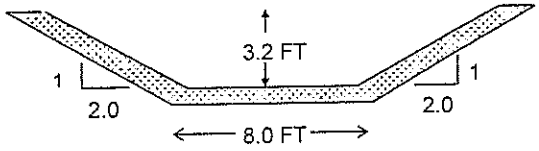
Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	2.65	265.00	3.000	0.024
		8. Large gullies, diversions, and low flowing streams	1.00	11.88	1,188.00	3.000	0.110
#1	**1**	**Time of Concentration:**					**0.134**
#2	1	8. Large gullies, diversions, and low flowing streams	33.33	50.00	150.00	17.320	0.002
		8. Large gullies, diversions, and low flowing streams	0.50	8.95	1,791.00	2.120	0.234
#2	**1**	**Time of Concentration:**					**0.236**

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

ABANDOMENT DITCH - PD-2

PEAK FLOW =	73.30	CFS
BOTTOM WIDTH =	8	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.01	FT/FT
MANNING'S N =	0.069	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	17.52	FT	DEPTH OF FLOW =	2.13	FT
AREA OF FLOW =	26.08	SQ.FT.	MEAN DEPTH =	1.58	FT
HYDRAULIC RADIUS, Rh =	1.49	FT	FROUDE NO. =	0.39	SUBCRITICAL
CALC. VELOCITY =	2.81	FPS			

FREEBOARD REQUIRED =	1.09	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	3.2	FT	CHANNEL MATERIAL: SOIL AND GRASS LINING

Mach No. 1 Mine, Facility No. 2
Phases 5A, 7, and 8

Perimeter Ditch PD-3

Flume Ditch 'P'

100 Yr - 6 Hr Event

RPC

Alliance Consulting, Inc.
124 Philpott Ln.
Beaver, WV 25813

Phone: 304-255-0491

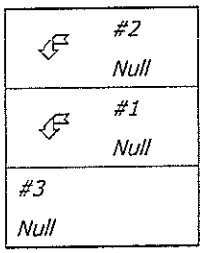
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#3	0.007	0.454	PD-3
Null	#2	==>	#3	0.002	0.454	Bench Flow
Null	#3	==>	End	0.000	0.000	Ditch 'P'



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	30.89	139.00	450.00	16.67	0.007
#1	**Muskingum K:**					**0.007**
#2	8. Large gullies, diversions, and low flowing streams	31.75	40.00	126.00	16.90	0.002
#2	**Muskingum K:**					**0.002**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#2	18.100	18.100	71.13	5.69
#1	21.100	21.100	95.47	6.74
#3	0.000	39.200	165.08	12.43

Structure Detail:

Structure #2 (Null)

Bench Flow

Structure #1 (Null)

PD-3

Structure #3 (Null)

Ditch 'P'

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	18.100	0.313	0.000	0.000	87.000	M	71.13	5.689
	Σ	**18.100**						**71.13**	**5.689**
#1	1	21.100	0.133	0.000	0.000	87.000	M	95.47	6.742
	Σ	**21.100**						**95.47**	**6.742**
#3	Σ	**39.200**						**165.08**	**12.431**

Subwatershed Time of Concentration Details:

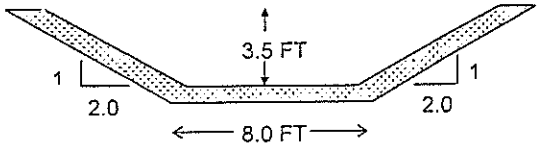
Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	14.45	1,445.00	3.000	0.133
#1	**1**	**Time of Concentration:**					**0.133**
#2	1	8. Large gullies, diversions, and low flowing streams	0.50	11.94	2,389.00	2.120	0.313
#2	**1**	**Time of Concentration:**					**0.313**

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

ABANDOMENT DITCH - PD-3

PEAK FLOW =	95.47	CFS
BOTTOM WIDTH =	8	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.01	FT/FT
MANNING'S N =	0.069	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	18.94	FT	DEPTH OF FLOW =	2.45	FT
AREA OF FLOW =	31.55	SQ.FT.	MEAN DEPTH =	1.77	FT
HYDRAULIC RADIUS, Rh =	1.67	FT	FROUDE NO. =	0.40	SUBCRITICAL
CALC. VELOCITY =	3.03	FPS			

FREEBOARD REQUIRED =	1.10	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	3.5	FT	CHANNEL MATERIAL: SOIL AND GRASS LINING

Mach No. 1 Mine, Facility No. 2
Phases 5A, 7 and 8

Perimeter Ditch PD-4

Flume Ditch 'O'

100 Yr - 6 Hr Event

RPC

Alliance Consulting, Inc.
124 Philpott Ln.
Beaver, WV 25813

Phone: 304-255-0491

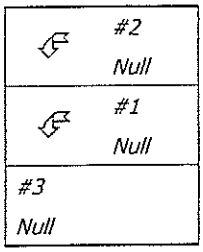
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#3	0.006	0.450	PD-4
Null	#2	==>	#3	0.003	0.450	Bench Flow
Null	#3	==>	End	0.000	0.000	Ditch 'O'



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	26.20	98.00	374.00	15.35	0.006
#1	**Muskingum K:**					**0.006**
#2	8. Large gullies, diversions, and low flowing streams	25.64	50.00	195.00	15.19	0.003
#2	**Muskingum K:**					**0.003**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#2	7.200	7.200	32.58	2.30
#1	15.600	15.600	70.44	4.98
#3	0.000	22.800	103.02	7.28

Structure Detail:

Structure #2 (Null)

Bench Flow

Structure #1 (Null)

PD-4

Structure #3 (Null)

Ditch 'O'

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	7.200	0.130	0.000	0.000	87.000	M	32.58	2.301
	Σ	**7.200**						**32.58**	**2.301**
#1	1	15.600	0.169	0.000	0.000	87.000	M	70.44	4.981
	Σ	**15.600**						**70.44**	**4.981**
#3	Σ	**22.800**						**103.02**	**7.282**

Subwatershed Time of Concentration Details:

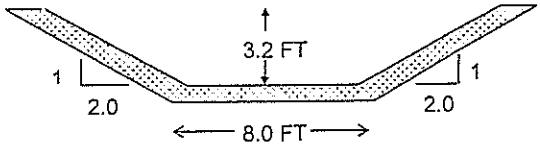
Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	6.75	675.00	3.000	0.062
		8. Large gullies, diversions, and low flowing streams	1.00	11.59	1,159.00	3.000	0.107
#1	**1**	**Time of Concentration:**					**0.169**
#2	1	8. Large gullies, diversions, and low flowing streams	33.33	50.00	150.00	17.320	0.002
		8. Large gullies, diversions, and low flowing streams	0.50	4.90	980.00	2.120	0.128
#2	**1**	**Time of Concentration:**					**0.130**

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

ABANDOMENT DITCH - PD-4

PEAK FLOW =	70.44	CFS
BOTTOM WIDTH =	8	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.01	FT/FT
MANNING'S N =	0.069	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	17.32	FT	DEPTH OF FLOW =	2.08	FT
AREA OF FLOW =	25.36	SQ.FT.	MEAN DEPTH =	1.55	FT
HYDRAULIC RADIUS, Rh =	1.46	FT	FROUDE NO. =	0.39	SUBCRITICAL
CALC. VELOCITY =	2.78	FPS			

FREEBOARD REQUIRED =	1.09	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	**3.2**	FT	**CHANNEL MATERIAL: SOIL AND GRASS LINING**

Mach No. 1 Mine, Facility No. 2
Phases 5A, 7, and 8

Perimeter Ditches PD-5, PD-6, and PD-7

Combination Ditch CD-1

100 Yr - 6 Hr Event

RPC

Alliance Consulting, Inc.
124 Philpott Ln.
Beaver, WV 25813

Phone: 304-255-0491

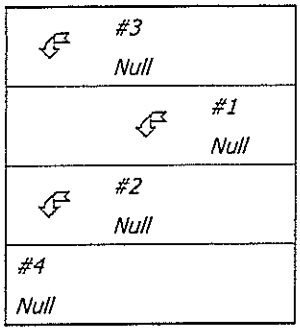
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.055	0.277	PD-5
Null	#2	==>	#4	0.002	0.449	PD-6
Null	#3	==>	#4	0.002	0.449	PD-7
Null	#4	==>	End	0.000	0.000	CD-1



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.50	2.10	422.00	2.12	0.055
#1	**Muskingum K:**					**0.055**
#2	8. Large gullies, diversions, and low flowing streams	25.19	34.00	135.00	15.05	0.002
#2	**Muskingum K:**					**0.002**
#3	8. Large gullies, diversions, and low flowing streams	25.19	34.00	135.00	15.05	0.002
#3	**Muskingum K:**					**0.002**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#3	13.900	13.900	54.54	4.37
#1	4.300	4.300	26.85	1.69
#2	8.400	12.700	63.17	4.37
#4	0.200	26.800	114.50	8.82

Structure Detail:

Structure #3 (Null)

PD-7

Structure #1 (Null)

PD-5

Structure #2 (Null)

PD-6

Structure #4 (Null)

CD-1

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#3	1	13.900	0.315	0.000	0.000	87.000	M	54.54	4.368
	Σ	**13.900**						**54.54**	**4.368**
#1	1	4.300	0.100	0.000	0.000	87.000	M	26.85	1.686
	Σ	**4.300**						**26.85**	**1.686**
#2	1	8.400	0.154	0.000	0.000	87.000	M	38.01	2.684
	Σ	**12.700**						**63.17**	**4.370**
#4	1	0.200	0.002	0.000	0.000	87.000	M	1.25	0.078
	Σ	**26.800**						**114.50**	**8.816**

Subwatershed Time of Concentration Details:

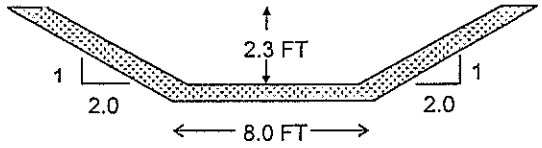
Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	33.33	27.00	81.00	17.320	0.001
		8. Large gullies, diversions, and low flowing streams	1.00	10.76	1,076.00	3.000	0.099
#1	**1**	**Time of Concentration:**					**0.100**
#2	1	8. Large gullies, diversions, and low flowing streams	1.00	10.76	1,076.00	3.000	0.099
		8. Large gullies, diversions, and low flowing streams	0.50	2.10	422.00	2.120	0.055
#2	**1**	**Time of Concentration:**					**0.154**
#3	1	8. Large gullies, diversions, and low flowing streams	1.00	8.50	850.00	3.000	0.078
		8. Large gullies, diversions, and low flowing streams	0.50	9.05	1,811.00	2.120	0.237
#3	**1**	**Time of Concentration:**					**0.315**
#4	1	8. Large gullies, diversions, and low flowing streams	25.19	34.00	135.00	15.050	0.002
#4	**1**	**Time of Concentration:**					**0.002**

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

ABANDOMENT DITCH - PD-5

PEAK FLOW =	26.85	CFS
BOTTOM WIDTH =	8	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.01	FT/FT
MANNING'S N =	0.069	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	13.49	FT	DEPTH OF FLOW =	1.23	FT
AREA OF FLOW =	12.84	SQ.FT.	MEAN DEPTH =	0.99	FT
HYDRAULIC RADIUS, Rh =	0.95	FT	FROUDE NO. =	0.37	SUBCRITICAL
CALC. VELOCITY =	2.08	FPS			

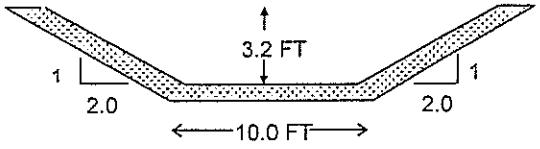
FREEBOARD REQUIRED =	1.06	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	2.3	FT	**CHANNEL MATERIAL: SOIL AND GRASS LINING**

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

ABANDOMENT DITCH - PD-6

PEAK FLOW =	63.17	CFS
BOTTOM WIDTH =	10	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.005	FT/FT
MANNING'S N =	0.069	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	19.61	FT	DEPTH OF FLOW =	2.15	FT
AREA OF FLOW =	30.72	SQ.FT.	MEAN DEPTH =	1.65	FT
HYDRAULIC RADIUS, Rh =	1.57	FT	FROUDE NO. =	0.28	SUBCRITICAL
CALC. VELOCITY =	2.05	FPS			

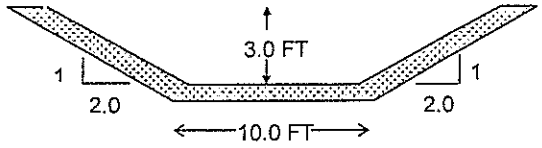
FREEBOARD REQUIRED =	1.07	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	**3.2**	**FT**	**CHANNEL MATERIAL: SOIL AND GRASS LINING**

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

ABANDOMENT DITCH - PD-7

PEAK FLOW =	54.54	CFS
BOTTOM WIDTH =	10	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.005	FT/FT
MANNING'S N =	0.069	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	18.87	FT	DEPTH OF FLOW =	1.98	FT
AREA OF FLOW =	27.72	SQ.FT.	MEAN DEPTH =	1.55	FT
HYDRAULIC RADIUS, Rh =	1.47	FT	FROUDE NO. =	0.28	SUBCRITICAL
CALC. VELOCITY =	1.97	FPS			

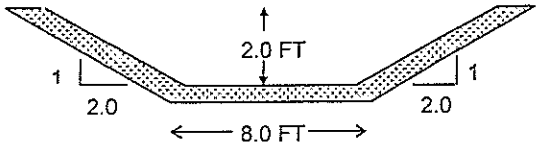
FREEBOARD REQUIRED =	1.06	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	3.0	FT	CHANNEL MATERIAL: SOIL AND GRASS LINING

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

COMBINATION DITCH - CD-1

PEAK FLOW =	114.50	CFS
BOTTOM WIDTH =	8	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.25	FT/FT
MANNING'S N =	0.015	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	10.09	FT	DEPTH OF FLOW =	0.47	FT
AREA OF FLOW =	4.17	SQ.FT.	MEAN DEPTH =	0.42	FT
HYDRAULIC RADIUS, Rh =	0.41	FT	FROUDE NO. =	7.45	SUPERCRITICAL
CALC. VELOCITY =	27.47	FPS			

FREEBOARD REQUIRED =	1.53	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	**2.0**	**FT**	

6431-12
Part 2

Mach No. 1 Mine, Facility No. 2
Phases 5A, 7, and 8

Perimeter Ditches PD-8, PD-9, and PD-10

Combination Ditch CD-2

100 Yr - 6 Hr Event

RPC

Alliance Consulting, Inc.
124 Philpott Ln.
Beaver, WV 25813

Phone: 304-255-0491

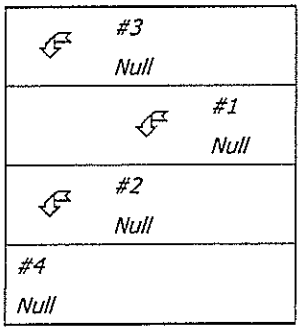
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.098	0.277	PD-8
Null	#2	==>	#4	0.022	0.410	PD-9
Null	#3	==>	#4	0.022	0.410	PD-10
Null	#4	==>	End	0.000	0.000	CD-2



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.50	3.77	755.00	2.12	0.098
#1	**Muskingum K:**					**0.098**
#2	8. Large gullies, diversions, and low flowing streams	6.75	42.00	622.00	7.79	0.022
#2	**Muskingum K:**					**0.022**
#3	8. Large gullies, diversions, and low flowing streams	6.75	42.00	622.00	7.79	0.022
#3	**Muskingum K:**					**0.022**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#3	14.900	14.900	63.88	4.69
#1	2.300	2.300	14.36	0.90
#2	9.200	11.500	56.07	3.84
#4	1.200	27.600	121.00	9.01

Structure Detail:

Structure #3 (Null)

PD-10

Structure #1 (Null)

PD-8

Structure #2 (Null)

PD-9

Structure #4 (Null)

CD-2

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#3	1	14.900	0.218	0.000	0.000	87.000	M	63.88	4.694
	Σ	**14.900**						**63.88**	**4.694**
#1	1	2.300	0.098	0.000	0.000	87.000	M	14.36	0.902
	Σ	**2.300**						**14.36**	**0.902**
#2	1	9.200	0.159	0.000	0.000	87.000	M	41.63	2.940
	Σ	**11.500**						**56.07**	**3.841**
#4	1	1.200	0.022	0.000	0.000	87.000	M	7.49	0.470
	Σ	**27.600**						**121.00**	**9.006**

Subwatershed Time of Concentration Details:

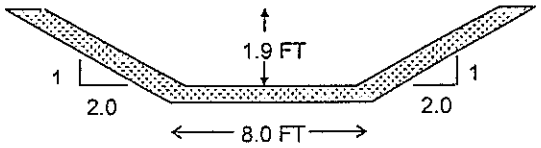
Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	33.33	27.00	81.00	17.320	0.001
		8. Large gullies, diversions, and low flowing streams	1.00	10.52	1,052.00	3.000	0.097
#1	**1**	**Time of Concentration:**					**0.098**
#2	1	8. Large gullies, diversions, and low flowing streams	1.00	8.84	885.00	3.000	0.081
		8. Large gullies, diversions, and low flowing streams	0.50	2.98	597.00	2.120	0.078
#2	**1**	**Time of Concentration:**					**0.159**
#3	1	8. Large gullies, diversions, and low flowing streams	1.00	8.50	850.00	3.000	0.078
		8. Large gullies, diversions, and low flowing streams	0.50	5.37	1,075.00	2.120	0.140
#3	**1**	**Time of Concentration:**					**0.218**
#4	1	8. Large gullies, diversions, and low flowing streams	6.75	42.00	622.00	7.790	0.022
#4	**1**	**Time of Concentration:**					**0.022**

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

ABANDOMENT DITCH - PD-8

PEAK FLOW =	14.36	CFS
BOTTOM WIDTH =	8	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.01	FT/FT
MANNING'S N =	0.069	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	11.86	FT	DEPTH OF FLOW =	0.86	FT
AREA OF FLOW =	8.39	SQ.FT.	MEAN DEPTH =	0.73	FT
HYDRAULIC RADIUS, Rh =	0.71	FT	FROUDE NO. =	0.35	SUBCRITICAL
CALC. VELOCITY =	1.71	FPS			

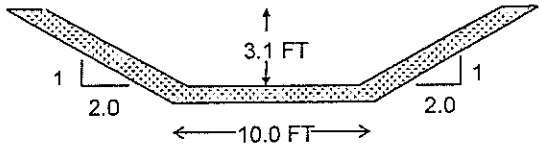
FREEBOARD REQUIRED =	1.04	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	**1.9**	FT	**CHANNEL MATERIAL: SOIL AND GRASS LINING**

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

ABANDOMENT DITCH - PD-9

PEAK FLOW =	56.07	CFS
BOTTOM WIDTH =	10	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.005	FT/FT
MANNING'S N =	0.069	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	19.01	FT	DEPTH OF FLOW =	2.01	FT
AREA OF FLOW =	28.25	SQ.FT.	MEAN DEPTH =	1.56	FT
HYDRAULIC RADIUS, Rh =	1.49	FT	FROUDE NO. =	0.28	SUBCRITICAL
CALC. VELOCITY =	1.98	FPS			

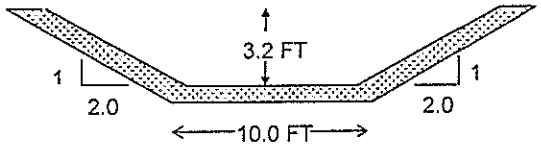
FREEBOARD REQUIRED =	1.06	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	**3.1**	**FT**	**CHANNEL MATERIAL: SOIL AND GRASS LINING**

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

ABANDOMENT DITCH - PD-10

PEAK FLOW =	63.88	CFS
BOTTOM WIDTH =	10	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.005	FT/FT
MANNING'S N =	0.069	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	19.67	FT	DEPTH OF FLOW =	2.16	FT
AREA OF FLOW =	30.98	SQ.FT.	MEAN DEPTH =	1.66	FT
HYDRAULIC RADIUS, Rh =	1.57	FT	FROUDE NO. =	0.28	SUBCRITICAL
CALC. VELOCITY =	2.06	FPS			

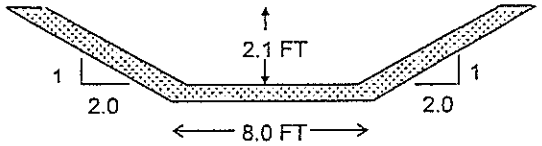
FREEBOARD REQUIRED =	1.07	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	**3.2**	FT	**CHANNEL MATERIAL: SOIL AND GRASS LINING**

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

COMBINATION DITCH - CD-2

PEAK FLOW =	121.00	CFS
BOTTOM WIDTH =	8	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.0675	FT/FT
MANNING'S N =	0.015	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	11.15	FT	DEPTH OF FLOW =	0.71	FT
AREA OF FLOW =	6.64	SQ.FT.	MEAN DEPTH =	0.61	FT
HYDRAULIC RADIUS, Rh =	0.60	FT	FROUDE NO. =	4.10	SUPERCRITICAL
CALC. VELOCITY =	18.21	FPS			

FREEBOARD REQUIRED =	1.41	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	**2.1**	FT	

Mach No. 1 Mine, Facility No. 2 Phases 5A, 7, and 8

Typical Bech Gutter

100 Yr - 6 Hr Event

RPC

Alliance Consulting, Inc.
124 Philpott Ln.
Beaver, WV 25813

Phone: 304-255-0491

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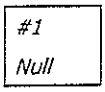
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Bench Gutter



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	7.800	7.800	31.66	2.46

Structure Detail:

Structure #1 (Null)

Bench Gutter

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	7.800	0.270		0.000	87.000	M	31.66	2.456
	Σ	**7.800**						**31.66**	**2.456**

Subwatershed Time of Concentration Details:

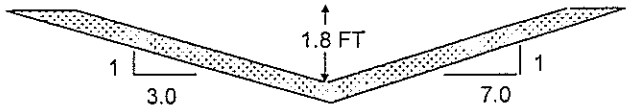
Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	33.33	50.00	150.00	17.320	0.002
		8. Large gullies, diversions, and low flowing streams	0.50	10.26	2,052.00	2.120	0.268
#1	**1**	**Time of Concentration:**					**0.270**

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

TYPICAL BENCH GUTTER

PEAK FLOW =	31.7	CFS
BOTTOM WIDTH =	0	FT
SIDE SLOPE 1 =	3.00:1	
SIDE SLOPE 2 =	7.00:1	
CHANNEL SLOPE =	0.005	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRIANGULAR DITCH

WETTED PERIMETER =	15.83	FT	DEPTH OF FLOW =	1.55	FT
AREA OF FLOW =	11.96	SQ.FT.	MEAN DEPTH =	0.77	FT
HYDRAULIC RADIUS, Rh =	0.76	FT	FROUDE NO. =	0.53	SUBCRITICAL
CALC. VELOCITY =	2.64	FPS			

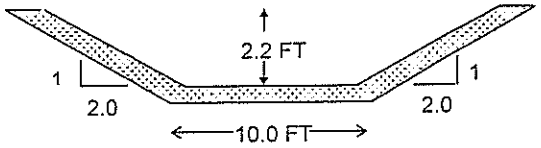
FREEBOARD REQUIRED =	0.30	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	1.8	FT	ADDITIONAL FREEBOARD AVAILABLE BY SLOPE OF BENCH

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

USM DESIGN - DITCH 'L'

PEAK FLOW =	190.77	CFS
BOTTOM WIDTH =	10	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.3333	FT/FT
MANNING'S N =	0.015	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	12.28	FT	DEPTH OF FLOW =	0.51	FT
AREA OF FLOW =	5.62	SQ.FT.	MEAN DEPTH =	0.47	FT
HYDRAULIC RADIUS, Rh =	0.46	FT	FROUDE NO. =	8.76	SUPERCRITICAL
CALC. VELOCITY =	33.96	FPS			

FREEBOARD REQUIRED =	1.68	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	2.2	FT	

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

BY: RPC DATE: 10/7/2011 CHKD BY: _____ DATE: _____
PROJECT NAME: Mach No. 1 Mine, Facility No. 2 Phases 5A, 7, and 8
PROJECT NUMBER: B11-146-1413 SHEET: _____ OF: _____
DESCRIPTION: ARMORFORM DITCH LINING DITCH 'L'

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	190.77
BOTTOM WIDTH (ft), b=	10.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	30.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.51
AREA OF FLOW (sq ft), A=	5.62
WETTED PERIMETER (ft), P=	12.28
HYDRAULIC RADIUS (ft), R=	0.46
VELOCITY OF FLOW (fps), V=	33.96
LINING PERIMETER (ft)=	19.79
TOP WIDTH (ft)=	18.75
FREEBOARD (ft)=	1.68
TOTAL DITCH DEPTH (ft), d=	2.19

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 9.52

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 7.52

TOTAL STRESS

t (psf) = 9.52
T (lb/ft) = 116.89

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 14.28
(lb/ft) = 175.33

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\tan(d)-So\right)$$ (psf)= 5.99

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 4.49

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 5.25 Tr,t (lb/ft) = 103.86

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

BY: RPC DATE: 10/7/2011 CHKD BY: _____ DATE: _____
PROJECT NAME: Mach No. 1 Mine, Facility No. 2 Phases 5A, 7, and 8
PROJECT NUMBER: B11-146-1413 SHEET: _____ OF: _____
DESCRIPTION: ARMORFORM DITCH LINING DITCH 'L'

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 9.03 (lb/ft) = 71.47

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

REBAR SIZE (#)= 5

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= 24.16

USE REBAR SPACING OF 20.00 20 ft MAXIMUM

RESISTANCE PROVIDED (psf)= 13.18

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), $W = \frac{Cw*H*Gw}{12*Z^{.33}}$

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Cw= 3.7

W (lbs)= 7.81

MAT WEIGHT (lbs), $Wm = \frac{t(Gc-Gw)}{12}$

Wm= 25.87

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: USE 4 INCH USM WITH ROOF BOLT (#5) ANCHORS ON 7 FOOT SPACING
(SEE ANCHOR BOLT SPACING CALC SHEET)

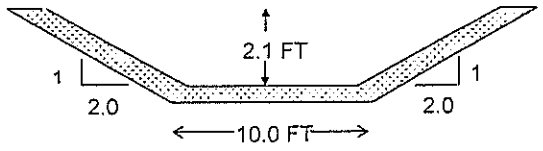
Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

USM DESIGN - DITCH 'I'

PEAK FLOW =	165.26	CFS
BOTTOM WIDTH =	10	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.3333	FT/FT
MANNING'S N =	0.015	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	12.09	FT	DEPTH OF FLOW =	0.47	FT
AREA OF FLOW =	5.12	SQ.FT.	MEAN DEPTH =	0.43	FT
HYDRAULIC RADIUS, Rh =	0.42	FT	FROUDE NO. =	8.65	SUPERCRITICAL
CALC. VELOCITY =	32.25	FPS			

FREEBOARD REQUIRED =	1.63	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	2.1	FT	

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

BY: RPC DATE: 10/7/2011 CHKD BY: _____ DATE: _____
PROJECT NAME: Mach No. 1 Mine, Facility No. 2 Phases 5A, 7, and 8
PROJECT NUMBER: B11-146-1413 SHEET: _____ OF: _____
DESCRIPTION: ARMORFORM DITCH LINING DITCH 'I'

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	165.26
BOTTOM WIDTH (ft), b=	10.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	30.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.47
AREA OF FLOW (sq ft), A=	5.14
WETTED PERIMETER (ft), P=	12.10
HYDRAULIC RADIUS (ft), R=	0.42
VELOCITY OF FLOW (fps), V=	32.32
LINING PERIMETER (ft)=	19.38
TOP WIDTH (ft)=	18.39
FREEBOARD (ft)=	1.63
TOTAL DITCH DEPTH (ft), d=	2.10

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 8.84

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 6.98

TOTAL STRESS

t (psf) = 8.84
T (lb/ft) = 106.94

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 13.25
(lb/ft) = 160.41

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\tan(d)-So\right)$$ (psf)= 5.99

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 4.49

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 5.26 Tr,t (lb/ft) = 102.05

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BY: RPC DATE: 10/7/2011 CHKD BY: _____ DATE: _____
PROJECT NAME: Mach No. 1 Mine, Facility No. 2 Phases 5A, 7, and 8
PROJECT NUMBER: B11-146-1413 SHEET: _____ OF: _____
DESCRIPTION: ARMORFORM DITCH LINING DITCH 'I'

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 7.99 (lb/ft) = 58.36

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

REBAR SIZE (#)= 5

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= 25.68

USE REBAR SPACING OF 20.00 20 ft MAXIMUM

RESISTANCE PROVIDED (psf)= 13.18

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), W= $\frac{Cw*H*Gw}{12*Z^{.33}}$

Cw= 3.7

W (lbs)= 7.19

MAT WEIGHT (lbs), Wm= $\frac{t(Gc-Gw)}{12}$

Wm= 25.87

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: USE 4 INCH USM WITH ROOF BOLT (#5) ANCHORS ON 8.5 FOOT SPACING.
(SEE ANCHOR BOLT SPACING CALC SHEET)

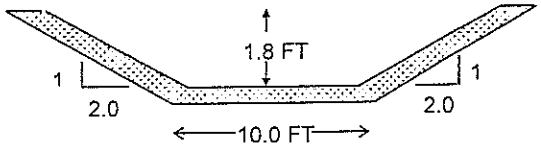
Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

USM DESIGN - DITCH 'O'

PEAK FLOW =	103.02	CFS
BOTTOM WIDTH =	10	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.3333	FT/FT
MANNING'S N =	0.015	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	11.58	FT	DEPTH OF FLOW =	0.35	FT
AREA OF FLOW =	3.79	SQ.FT.	MEAN DEPTH =	0.33	FT
HYDRAULIC RADIUS, Rh =	0.33	FT	FROUDE NO. =	8.31	SUPERCRITICAL
CALC. VELOCITY =	27.17	FPS			

FREEBOARD REQUIRED =	1.48	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	**1.8**	**FT**	

Alliance Consulting, Inc.
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BY: RPC DATE: 10/7/2011 CHKD BY: _____ DATE: _____
PROJECT NAME: Mach No. 1 Mine, Facility No. 2 Phases 5A, 7, and 8
PROJECT NUMBER: B11-146-1413 SHEET: _____ OF: _____
DESCRIPTION: ARMORFORM DITCH LINING DITCH 'O'

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	103.02
BOTTOM WIDTH (ft), b=	10.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	30.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.35
AREA OF FLOW (sq ft), A=	3.75
WETTED PERIMETER (ft), P=	11.57
HYDRAULIC RADIUS (ft), R=	0.32
VELOCITY OF FLOW (fps), V=	26.97
LINING PERIMETER (ft)=	18.16
TOP WIDTH (ft)=	17.30
FREEBOARD (ft)=	1.48
TOTAL DITCH DEPTH (ft), d=	1.83

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 6.73

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 5.32

TOTAL STRESS

t (psf) = 6.73
T (lb/ft) = 77.89

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 10.10
(lb/ft) = 116.83

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\tan(d)-So\right)$$ (psf)= 5.99

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 4.49

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 5.32 Tr,t (lb/ft) = 96.56

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BY: RPC DATE: 10/7/2011 CHKD BY: _____ DATE: _____
PROJECT NAME: Mach No. 1 Mine, Facility No. 2 Phases 5A, 7, and 8
PROJECT NUMBER: B11-146-1413 SHEET: _____ OF: _____
DESCRIPTION: ARMORFORM DITCH LINING DITCH 'O'

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 4.79 (lb/ft) = 20.27

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

REBAR SIZE (#)= 5

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= 33.19

USE REBAR SPACING OF 20.00 20 ft MAXIMUM

RESISTANCE PROVIDED (psf)= 13.18

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), $W = \frac{Cw*H*Gw}{12*Z^{.33}}$

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Cw= 3.7

W (lbs)= 5.36

MAT WEIGHT (lbs), $Wm = \frac{t(Gc-Gw)}{12}$

Wm= 25.87

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: USE 4 INCH USM WITH ROOF BOLT (#5) ANCHORS ON 20 FOOT SPACING.

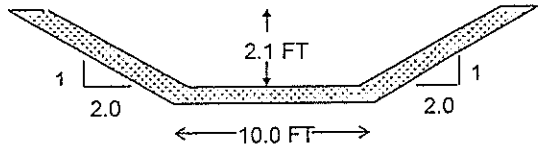
Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

USM DESIGN - DITCH 'P'

PEAK FLOW =	165.08	CFS
BOTTOM WIDTH =	10	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.3333	FT/FT
MANNING'S N =	0.015	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	12.09	FT	DEPTH OF FLOW =	0.47	FT
AREA OF FLOW =	5.12	SQ.FT.	MEAN DEPTH =	0.43	FT
HYDRAULIC RADIUS, Rh =	0.42	FT	FROUDE NO. =	8.65	SUPERCRITICAL
CALC. VELOCITY =	32.24	FPS			

FREEBOARD REQUIRED =	1.63	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	**2.1**	**FT**	

Alliance Consulting, Inc.
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BY: RPC DATE: 10/7/2011 CHKD BY: _____ DATE: _____
PROJECT NAME: Mach No. 1 Mine, Facility No. 2 Phases 5A, 7, and 8
PROJECT NUMBER: B11-146-1413 SHEET: _____ OF: _____
DESCRIPTION: ARMORFORM DITCH LINING DITCH 'P'

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	165.08
BOTTOM WIDTH (ft), b=	10.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	30.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.47
AREA OF FLOW (sq ft), A=	5.14
WETTED PERIMETER (ft), P=	12.10
HYDRAULIC RADIUS (ft), R=	0.42
VELOCITY OF FLOW (fps), V=	32.32
LINING PERIMETER (ft)=	19.38
TOP WIDTH (ft)=	18.39
FREEBOARD (ft)=	1.63
TOTAL DITCH DEPTH (ft), d=	2.10

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 8.84

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 6.98

TOTAL STRESS

t (psf) = 8.84
T (lb/ft) = 106.94

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 13.25
(lb/ft) = 160.41

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\tan(d)-So\right)$$ (psf)= 5.99

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 4.49

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 5.26 Tr,t (lb/ft) = 102.05

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

BY: RPC DATE: 10/7/2011 CHKD BY: _____ DATE: _____
PROJECT NAME: Mach No. 1 Mine, Facility No. 2 Phases 5A, 7, and 8
PROJECT NUMBER: B11-146-1413 SHEET: _____ OF: _____
DESCRIPTION: ARMORFORM DITCH LINING DITCH 'P'

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 7.99 (lb/ft) = 58.36

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

REBAR SIZE (#)= 5

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= 25.68

USE REBAR SPACING OF 20.00 20 ft MAXIMUM

RESISTANCE PROVIDED (psf)= 13.18

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), W= $\frac{Cw*H*Gw}{12*Z^{.33}}$

Cw= 3.7

W (lbs)= 7.19

MAT WEIGHT (lbs), Wm= $\frac{t(Gc-Gw)}{12}$

Wm= 25.87

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: USE 4 INCH USM WITH ROOF BOLT (#5) ANCHORS ON 8.5 FOOT SPACING.
(SEE ANCHOR BOLT SPACING CALC SHEET)

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

Alliance Consulting, Inc.
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BY: RPC DATE: 10/7/2011 CHKD BY: _____ DATE: _____
PROJECT NAME: Mach No. 1 Mine, Facility No. 2 Phases 5A, 7, and 8
PROJECT NUMBER: B11-146-1413 SHEET: _____ OF: _____
DESCRIPTION: ARMORFORM DITCH LINING COMBINATION DITCH CD-1

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	114.50
BOTTOM WIDTH (ft), b=	8.00
CHANNEL SLOPE (%), So=	25.00
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	30.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.47
AREA OF FLOW (sq ft), A=	4.20
WETTED PERIMETER (ft), P=	10.10
HYDRAULIC RADIUS (ft), R=	0.42
VELOCITY OF FLOW (fps), V=	27.60
LINING PERIMETER (ft)=	16.97
TOP WIDTH (ft)=	16.03
FREEBOARD (ft)=	1.54
TOTAL DITCH DEPTH (ft), d=	2.01

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 6.49

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 5.13

TOTAL STRESS

t (psf) = 6.49
T (lb/ft) = 65.55

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 9.73
(lb/ft) = 98.32

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\tan(d)-So\right)$$ (psf)= 8.21

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 6.69

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 7.41 Tr,t (lb/ft) = 125.70

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

BY: RPC DATE: 10/7/2011 CHKD BY: _____ DATE: _____
PROJECT NAME: Mach No. 1 Mine, Facility No. 2 Phases 5A, 7, and 8
PROJECT NUMBER: B11-146-1413 SHEET: _____ OF: _____
DESCRIPTION: ARMORFORM DITCH LINING COMBINATION DITCH CD-1

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 2.33 (lb/ft) = -27.38

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

REBAR SIZE (#)= 5

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= 47.59

USE REBAR SPACING OF 20.00 20 ft MAXIMUM

RESISTANCE PROVIDED (psf)= 13.18

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), W= $\frac{Cw*H*Gw}{12*Z^{.33}}$

Cw= 3.7

W (lbs)= 7.19

MAT WEIGHT (lbs), Wm= $\frac{t(Gc-Gw)}{12}$

Wm= 25.87

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: USE 4 INCH USM WITH ROOF BOLT (#5) ANCHORS ON 20 FOOT SPACING.

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

Alliance Consulting, Inc.
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BY: RPC DATE: 10/7/2011 CHKD BY: _____ DATE: _____
PROJECT NAME: Mach No. 1 Mine, Facility No. 2 Phases 5A, 7, and 8
PROJECT NUMBER: B11-146-1413 SHEET: _____ OF: _____
DESCRIPTION: ARMORFORM DITCH LINING COMBINATION DITCH CD-2

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	121.00
BOTTOM WIDTH (ft), b=	8.00
CHANNEL SLOPE (%), So=	6.75
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	30.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.71
AREA OF FLOW (sq ft), A=	6.69
WETTED PERIMETER (ft), P=	11.18
HYDRAULIC RADIUS (ft), R=	0.60
VELOCITY OF FLOW (fps), V=	18.28
LINING PERIMETER (ft)=	17.47
TOP WIDTH (ft)=	16.47
FREEBOARD (ft)=	1.41
TOTAL DITCH DEPTH (ft), d=	2.12

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 2.52

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 1.99

TOTAL STRESS

t (psf) = 2.52
T (lb/ft) = 28.17

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 3.78
(lb/ft) = 42.26

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}(\tan(d)-So)$$ (psf)= 13.16

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 11.59

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 12.31 Tr,t (lb/ft) = 214.98

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BY: RPC DATE: 10/7/2011 CHKD BY: _____ DATE: _____
PROJECT NAME: Mach No. 1 Mine, Facility No. 2 Phases 5A, 7, and 8
PROJECT NUMBER: B11-146-1413 SHEET: _____ OF: _____
DESCRIPTION: ARMORFORM DITCH LINING COMBINATION DITCH CD-2

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= -8.52 (lb/ft) = -172.73

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

REBAR SIZE (#)= 5

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= #NUM!

USE REBAR SPACING OF #NUM! #NUM!

RESISTANCE PROVIDED (psf)= #NUM!

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), W= $\frac{Cw*H*Gw}{12*Z^{.33}}$

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Cw= 3.7

W (lbs)= 10.87

MAT WEIGHT (lbs), Wm= $\frac{t(Gc-Gw)}{12}$

Wm= 25.87

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: NO ADDITIONAL RESISTANCE REQUIRED, USE 4 INCH USM WITH ROOF BOLT (#5) ANCHORS ON 20 FOOT SPACING.

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

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PROJECT NAME: Mach No. 1 Mine, Facility No. 2 Phases 5A, 7 and 8

PROJECT NO.: B11-146-1413 SHEET _____ OF _____

DESCRIPTION: ANCHOR BOLT DESIGN

Lined Channel Anchor Bolt Capacity

Case: Cohesionless Soil

Factor	Value
γ = soil weight, PCF	130
Φ = effective angle of soil friction, degrees	33.7
D = Bolt anchorage depth, FT	4
z = trial distance to balance forces	
FTx = Horizontal component of channel tractive force, LB	
α = channel slope, degrees	26.57
Ka = $\tan^2(45° - \Phi/2)$	0.28630
Kp = $\tan^2(45° + \Phi/2)$	3.49281
d = bolt diameter, feet	0.05208

Channel Slope (H:V)	α (degrees)
2 : 1	26.565
2.5 : 1	21.801
3 : 1	18.435
3.5 : 1	15.945
4 : 1	14.036

Bolt Φ (inches)	Bolt Φ (FT)
1/2	0.04167
5/8	0.05208
3/4	0.06250
1	0.08333

Σ Forces x = 0 Trial values, change these only!!

$F_{Tx} + (\gamma D^2/2)(Ka-3Kp) + z\gamma D(3Kp-Ka) = 0$

For given D, Compute FTx for trial z distance

$F_T = F_{Tx}/\cos\alpha$

D (FT)	Bolt Φ (FT)	Trial z (FT)	FTx (LB)	FT (LB)	$(\gamma D^2/2)(Ka-3Kp)$	$z\gamma D(3Kp-Ka)$
4	0.05208	1.5	138	154	-552	414
4	0.05208	1.51	135	151	-552	417
4	0.05208	1.52	132	148	-552	420
4	0.05208	1.528	130	146	-552	422
4	**0.05208**	**1.53**	**130**	**145**	**-552**	**422**

Σ Moments = 0 (about bottom of bolt)

$F_{Tx} + (\gamma z^2/3)(3Kp-Ka) = (\gamma D^2/6)(3Kp-Ka)$

For given D, use trial z and trial FTx to make ΣM = 0

D (FT)	Bolt Φ (FT)	Trial z (FT)	Trial FTx (LB)	FT (LB)	$(\gamma z^2/3)(3Kp-Ka)$	$\gamma D^2/6)(3kp-Ka$	Σ M = ?
4	0.05208	1.5	138	154.3	51.8	184.0	5.8
4	0.05208	1.51	135	151.2	52.4	184.0	3.7
4	0.05208	1.52	132	148.1	53.1	184.0	1.6
4	**0.05208**	**1.528**	**130**	**145.7**	**53.7**	**184.0**	**0.0**
4	0.05208	1.53	130	145.0	53.8	184.0	-0.4

ΣFx balanced with ΣM=0 at z = 1.528, FTx = 130 LBS

Notes:

1. FT and FTx multiplied by bolt Φ to get pounds on bolt
2. If it is impossible to make Σ M = 0, D is is too short
3. The above analysis is for anchor bolts driven vertically - if bolts are driven perpendicular to the channel slope, then $F_T = F_{TX}$.

File: Channel Anchor Bolts - 1.xls, hlo, rev. 02/11/2011

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PROJECT NAME: Mach No. 1 Mine, Facility No. 2 Phases 5A, 7 and 8

PROJECT NO.: B11-146-1413 SHEET _____ OF _____

DESCRIPTION: ANCHOR BOLT SPACING

From Anchor Bolt Design Sheet:

Bolt Capacity = 130 lb / bolt

Bolts per Row = 4

Bolt Capacity = 130 x 4 = 520 lb / row

From Armorform Ditch Lining Sheets:

Ditch 'L'
Resistance Required = 71.47 lb / ft

Spacing = (520 / 71.47) = 7.28 ft

Use Bolt Row Spacing = 7 ft

Ditch 'I'
Resistance Required = 58.36 lb / ft

Spacing = (520 / 58.36) = 8.91 ft

Use Bolt Row Spacing = 8.5 ft

Ditch 'O'
Resistance Required = 20.27 lb / ft

Spacing = (520 / 20.27) = 25.65 ft

Use Bolt Row Spacing = 20 ft (Maximum)

Ditch 'P'
Resistance Required = 58.36 lb / ft

Spacing = (520 / 58.36) = 8.91 ft

Use Bolt Row Spacing = 8.5 ft

Combination Ditch CD-1
Resistance Required = 0 lb / ft

Spacing = (520 / 15.63) = #DIV/0! ft

Use Bolt Row Spacing = 20 ft (Maximum)

Combination Ditch CD-2
Resistance Required = 0 lb / ft

Spacing = (520 / 15.63) = #DIV/0! ft

Use Bolt Row Spacing = 20 ft (Maximum)

Decant Ditch
Resistance Required = 15.63 lb / ft

Spacing = (520 / 15.63) = 33.27 ft

Use Bolt Row Spacing = 20 ft (Maximum)

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PROJECT NAME: **Mach No. 1 Mine, Facility No. 2**

PROJECT NO.: **B11-146-1413** SHEET 1 OF 1

DESCRIPTION: **Phreatic Line - Pool to Underdrain**
Phase 5A/7 - Section D-D

Ref: SM Note No. 7, Case V

Transformation Factor = $f_T = (k_y/k_x)^{1/2}$ = 0.3333

k_x = 0.0018 cm/sec
k_y = 0.0002 cm/sec
z_u = 3.00
z_d = 3.00

k_y/k_x = 0.1111

$y_o = (h^2 + d^2)^{1/2} - d$
$a = a_o = y_o/2$

$x_T = (y^2 - y_o^2)/(2y_o)$

$x_T = (f_T)(x_A)$
x_A = x distance on actual section
x_T = x distance on transformed section
y = y distance on both sections

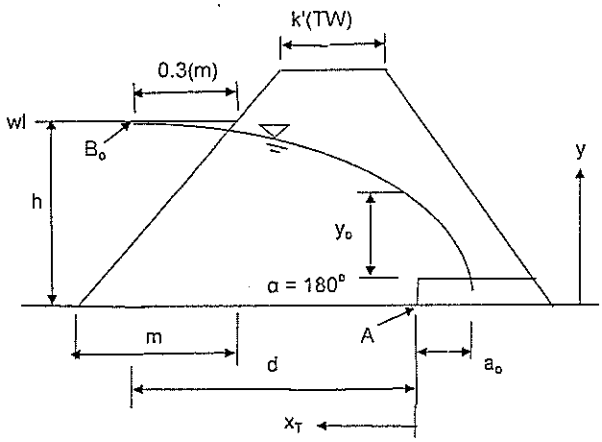
h (ft.)	d (ft.)	m (ft.)	0.3m (ft.)	y_o (ft.)	a_o (ft.)
50.0	44.67	50.00	15	22.38	11.19

Phreatic Line Coordinates

y (ft.)	x_T (ft.)	x_A (ft.)	Elev. (ft)
0.00	-11.19	-33.57	485.00
3.00	-10.99	-32.97	488.00
6.00	-10.39	-31.16	491.00
9.00	-9.38	-28.14	494.00
12.00	-7.97	-23.92	497.00
15.00	-6.16	-18.49	500.00
18.00	-3.95	-11.85	503.00
25.00	2.77	8.32	510.00
30.00	8.92	26.76	515.00
35.00	16.18	48.54	520.00
40.00	24.56	73.68	525.00
50.0	44.67	134.00	535.00

$k' = (k_v k_h)^{1/2}$ = 0.00060 cm/sec = 1.7008 ft/day
$q = k'(h^2)/(2d)$ 47.5967 ft^3/day/ft = **0.2472** *gpm/ft*

Note: $q = k'(h^2)/(2d)$ when $d < h$; $q = k'y_o$ when $d > h$ and $\alpha > 60^o$, SM Note No. 7



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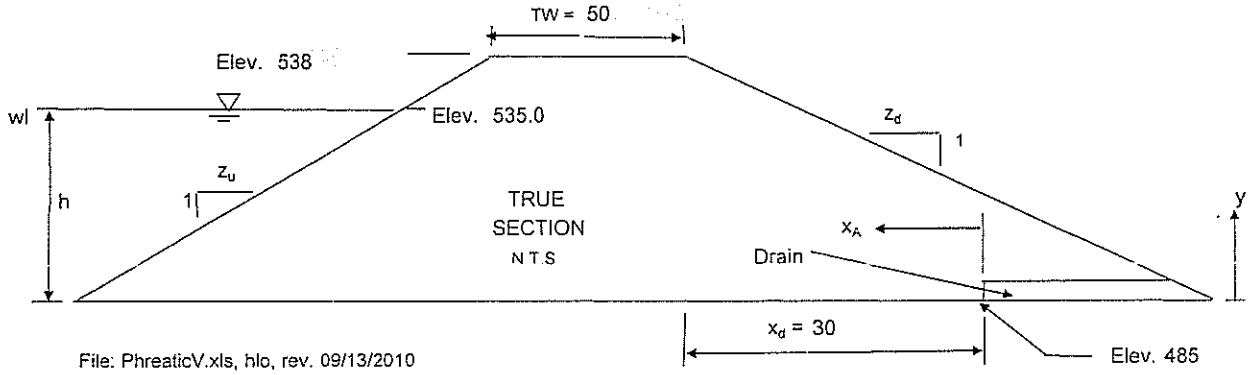

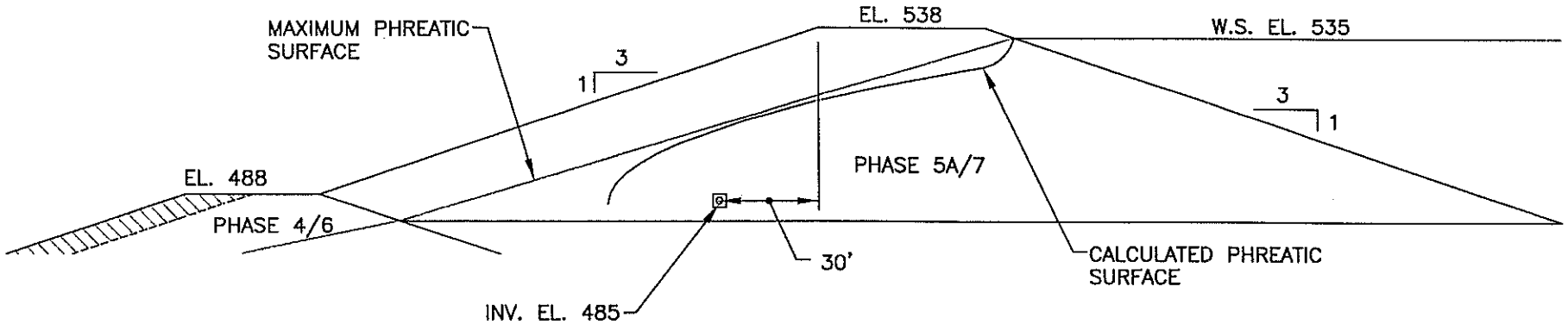

PHASE 5A/7 SECTION D–D
1"=50'

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INTERNAL DRAIN DESIGN
MACH NO. 1 MINE,
FACILITY NO. 2 PLAN MODIFICATION
PHASE 5A, 7, AND 8
PREPARED FOR
MACH MINING, LLC
P.O. BOX 300, JOHNSTON CITY, ILLINOIS 62951

DRAWN BY	JWD	10/11/11
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APPROVED BY		
DRAWING NUMBER		
B11-146-A1		

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BY: RPC DATE: 10/10/2011 CHKD BY: _____ DATE: _____

PROJECT NAME: **Mach No. 1 Mine, Facility No. 2**

PROJECT NO.: **B11-146-1413** SHEET 1 OF 1

DESCRIPTION: **Phreatic Line - Pool to Underdrain**
Phase 5A/7 - Section E-E

Ref: SM Note No. 7, Case V

Transformation Factor = $f_T = (k_y/k_x)^{1/2}$ = 0.3333

k_x = 0.0018 cm/sec
k_y = 0.0002 cm/sec
z_u = 3.00
z_d = 3.00

k_y/k_x = 0.1111

$y_o = (h^2 + d^2)^{1/2} - d$
$a = a_o = y_o/2$

$x_T = (y^2 - y_o^2)/(2y_o)$

$x_T = (f_T)(x_A)$
x_A = x distance on actual section
x_T = x distance on transformed section
y = y distance on both sections

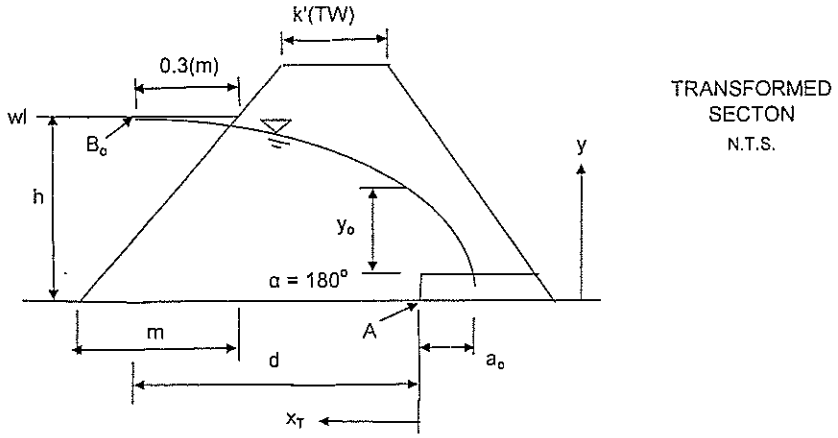
h (ft.)	d (ft.)	m (ft.)	0.3m (ft.)	y_o (ft.)	a_o (ft.)
43.0	50.90	43.00	12.9	15.73	7.87

Phreatic Line Coordinates

y (ft.)	x_T (ft.)	x_A (ft.)	Elev. (ft)
0.00	-7.87	-23.60	492.00
3.00	-7.58	-22.74	495.00
6.00	-6.72	-20.17	498.00
9.00	-5.29	-15.87	501.00
12.00	-3.29	-9.87	504.00
15.00	-0.71	-2.14	507.00
18.00	2.43	7.29	510.00
21.00	6.15	18.45	513.00
25.00	12.00	35.99	517.00
30.00	20.74	62.22	522.00
35.00	31.07	93.20	527.00
43.0	50.90	152.70	535.00

$k' = (k_v k_h)^{1/2}$ = 0.00060 cm/sec = 1.7008 ft/day
$q = k'y_o$ = 26.7566 ft^3/day/ft = **0.1390** *gpm/ft*

Note: $q = k'(h^2)/(2d)$ when $d < h$; $q = k'y_o$ when $d > h$ and $\alpha > 60°$, SM Note No. 7



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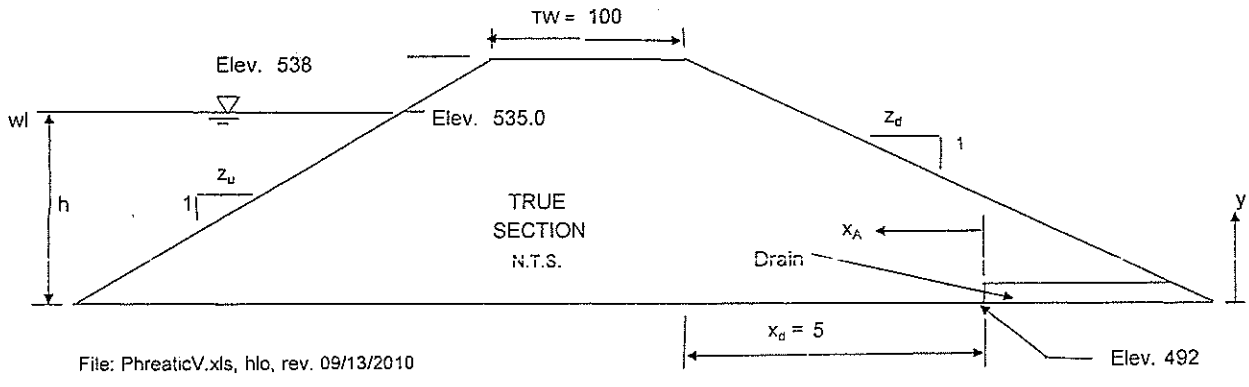

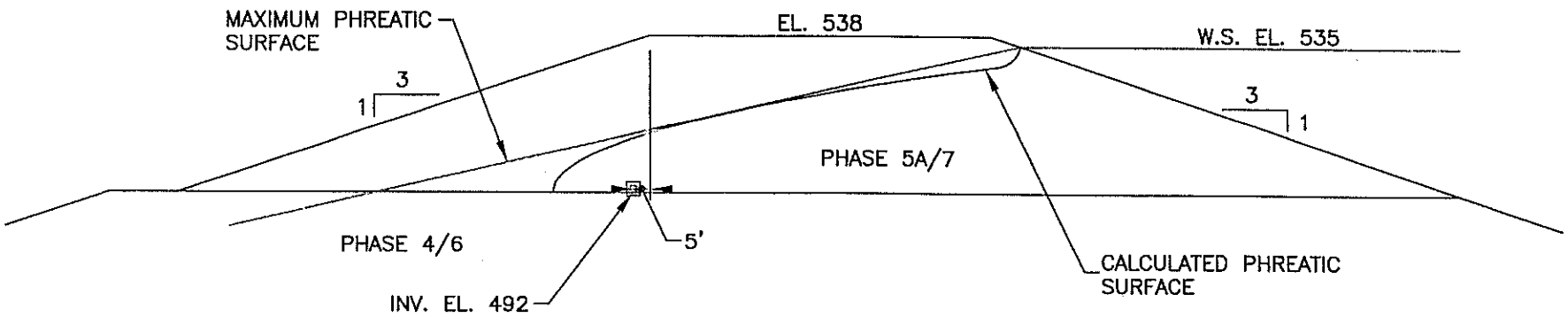

PHASE 5A/7 SECTION E–E

1"=50'

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FACILITY NO. 2 PLAN MODIFICATION
PHASE 5A, 7, AND 8
PREPARED FOR
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PROJECT NAME: **Mach No. 1 Mine, Facility No. 2**

PROJECT NO.: **B11-146-1413** SHEET 1 OF 1

DESCRIPTION: **Phreatic Line - Pool to Underdrain**
Phase 5A/7 - Section F-F

Ref: SM Note No. 7, Case V

k_x = 0.0018 cm/sec
k_y = 0.0002 cm/sec
z_u = 3.00
z_d = 3.00

k_y/k_x = 0.1111

$y_o = (h^2 + d^2)^{1/2} - d$
$a = a_o = y_o/2$

$x_T = (y^2 - y_o^2)/(2y_o)$

$x_T = (f_T)(x_A)$
x_A = x distance on actual section
x_T = x distance on transformed section
y = y distance on both sections

Transformation Factor = $f_T = (k_y/k_x)^{1/2}$ = 0.3333

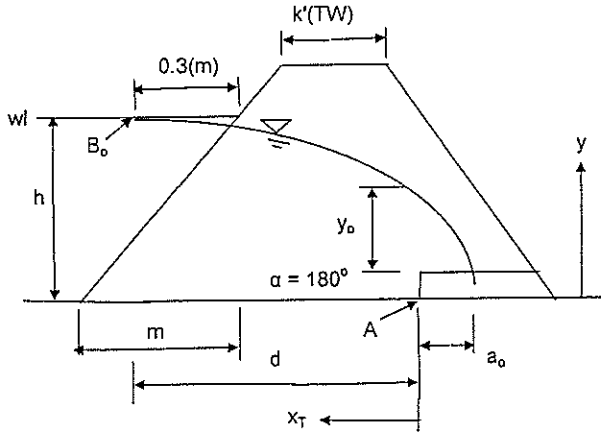
h (ft.)	d (ft.)	m (ft.)	0.3m (ft.)	y_o (ft.)	a_o (ft.)
35.0	40.17	35.00	10.5	13.11	6.55

Phreatic Line Coordinates

y (ft.)	x_T (ft.)	x_A (ft.)	Elev. (ft)
0.00	-6.55	-19.66	500.00
3.00	-6.21	-18.63	503.00
6.00	-5.18	-15.55	506.00
9.00	-3.47	-10.40	509.00
12.00	-1.06	-3.19	512.00
15.00	2.03	6.08	515.00
18.00	5.80	17.41	518.00
21.00	10.26	30.79	521.00
25.00	17.28	51.85	525.00
30.00	27.77	83.31	530.00
35.00	40.17	120.50	535.00
35.0	40.17	120.50	535.00

$k' = (k_v k_h)^{1/2}$ = 0.00060 cm/sec = 1.7008 ft/day
$q = k'y_o$ = 22.2967 ft^3/day/ft = **0.1158** *gpm/ft*

Note: $q = k'(h^2)/(2d)$ when $d < h$; $q = k'y_o$ when $d > h$ and $\alpha > 60^\circ$, SM Note No. 7



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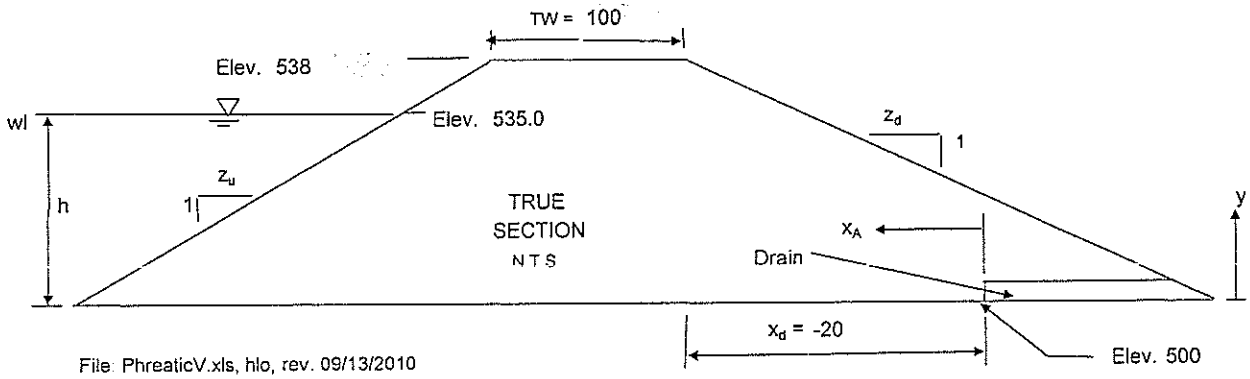

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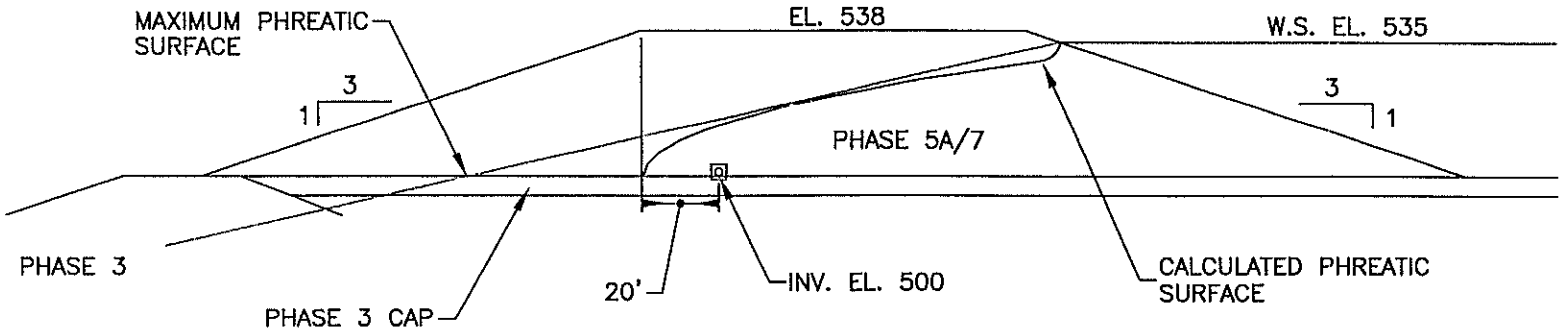

PHASE 5A/7 SECTION F–F

1"=50'

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PROJECT NAME: **Mach No. 1 Mine, Facility No. 2**

PROJECT NO.: **B11-146-1413** SHEET 1 OF 1

DESCRIPTION: **Phreatic Line - Pool to Underdrain**
Phase 8 - Section D-D

Ref: SM Note No. 7, Case V

Transformation Factor = $f_T = (k_y/k_x)^{1/2}$ = 0.3333

k_x = 0.0018 cm/sec
k_y = 0.0002 cm/sec
z_u = 3.00
z_d = 3.00

k_y/k_x = 0.1111

$y_o = (h^2 + d^2)^{1/2} - d$
$a = a_o = y_o/2$

$x_T = (y^2 - y_o^2)/(2y_o)$

$x_T = (f_T)(x_A)$
x_A = x distance on actual section
x_T = x distance on transformed section
y = y distance on both sections

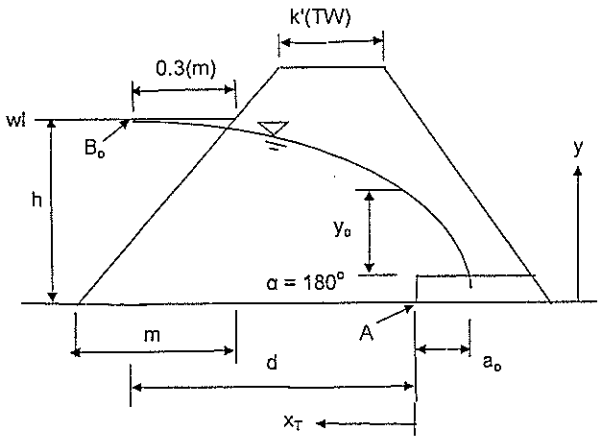
h (ft.)	d (ft.)	m (ft.)	0.3m (ft.)	y_o (ft.)	a_o (ft.)
52.0	31.93	52.00	15.6	29.09	14.54

Phreatic Line Coordinates

y (ft.)	x_T (ft.)	x_A (ft.)	Elev. (ft)
0.00	-14.54	-43.63	533.00
3.00	-14.39	-43.17	536.00
6.00	-13.93	-41.78	539.00
9.00	-13.15	-39.46	542.00
12.00	-12.07	-36.21	545.00
15.00	-10.68	-32.03	548.00
18.00	-8.98	-26.93	551.00
25.00	-3.80	-11.41	558.00
30.00	0.93	2.78	563.00
35.00	6.51	19.53	568.00
45.00	20.26	60.79	578.00
52.0	31.93	95.80	585.00

$k' = (k_v k_h)^{1/2}$ = 0.00060 cm/sec = 1.7008 ft/day
$q = k'(h^2)/(2d)$ 72.0083 ft^3/day/ft = **0.3740** *gpm/ft*

Note: $q = k'(h^2)/(2d)$ when $d < h$; $q = k'y_o$ when $d > h$ and $\alpha > 60^o$, SM Note No. 7



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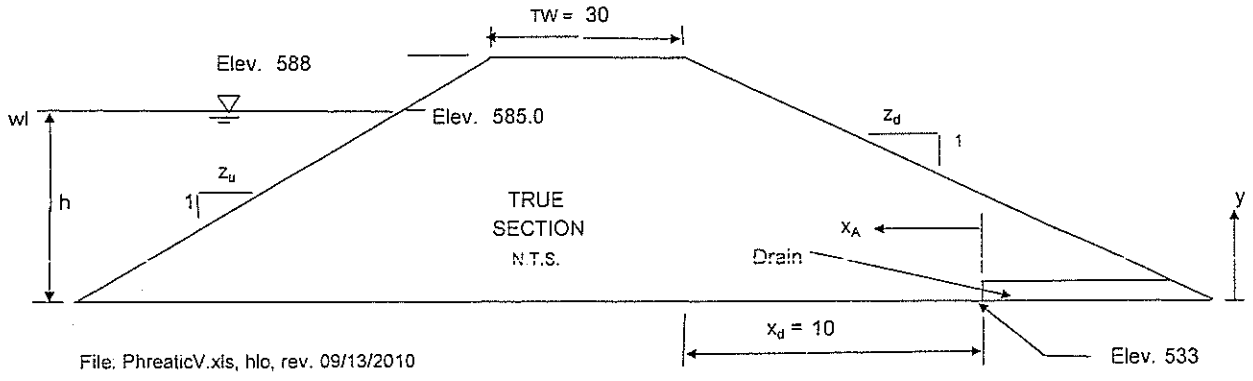

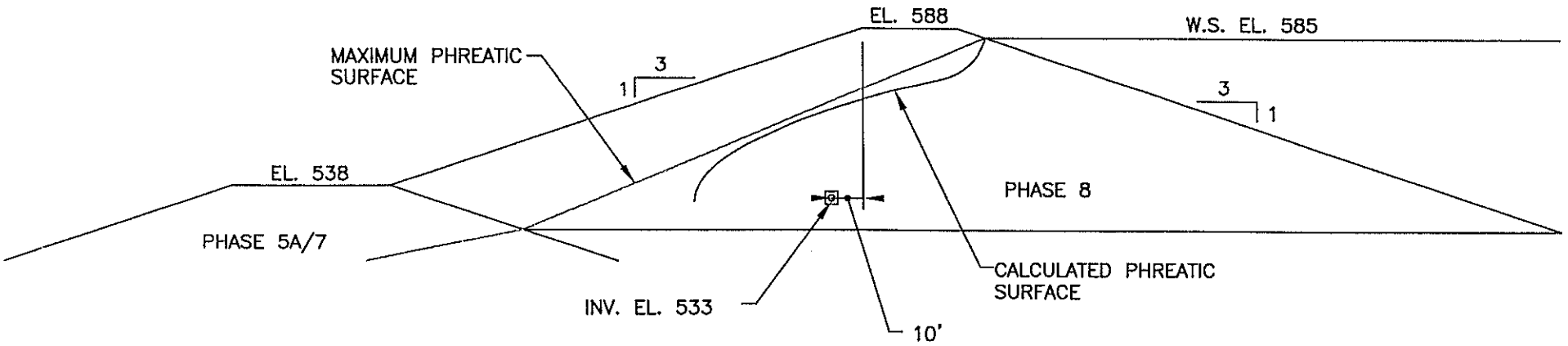

PHASE 8 SECTION D–D

1"=50'

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INTERNAL DRAIN DESIGN
MACH NO. 1 MINE,
FACILITY NO. 2 PLAN MODIFICATION
PHASE 5A, 7, AND 8
PREPARED FOR
MACH MINING, LLC
P.O. BOX 300, JOHNSTON CITY, ILLINOIS 62951

DRAWN BY	JWD	10/11/11
CHECKED BY		
APPROVED BY		
DRAWING NUMBER		
B11-146-A2		

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BY: RPC DATE: 10/10/2011 CHKD BY: _____ DATE: _____

PROJECT NAME: **Mach No. 1 Mine, Facility No. 2**

PROJECT NO.: B11-146-1413 SHEET 1 OF 1

DESCRIPTION: **Phreatic Line - Pool to Underdrain**
Phase 8 - Section E-E

Ref: SM Note No. 7, Case V

Transformation Factor = $f_T = (k_y/k_x)^{1/2}$ = 0.3333

k_x = 0.0018 cm/sec
k_y = 0.0002 cm/sec
z_u = 3.59
z_d = 3.00

k_y/k_x = 0.1111

$y_o = (h^2 + d^2)^{1/2} - d$
$a = a_o = y_o/2$

$x_T = (y^2 - y_o^2)/(2y_o)$

$x_T = (f_T)(x_A)$
x_A = x distance on actual section
x_T = x distance on transformed section
y = y distance on both sections

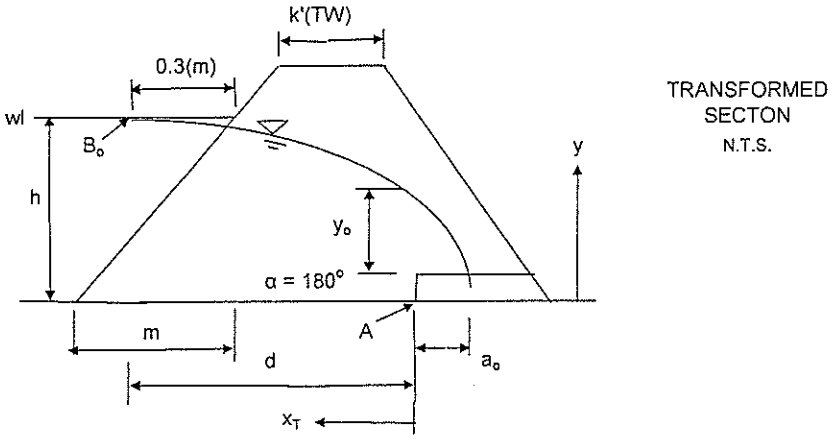
h (ft.)	d (ft.)	m (ft.)	0.3m (ft.)	y_o (ft.)	a_o (ft.)
52.0	52.26	62.23	18.668	21.46	10.73

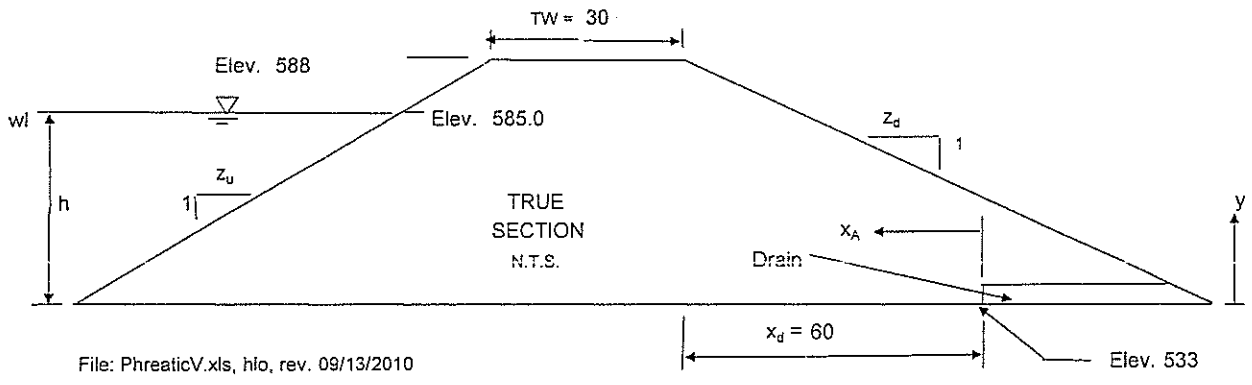
Phreatic Line Coordinates

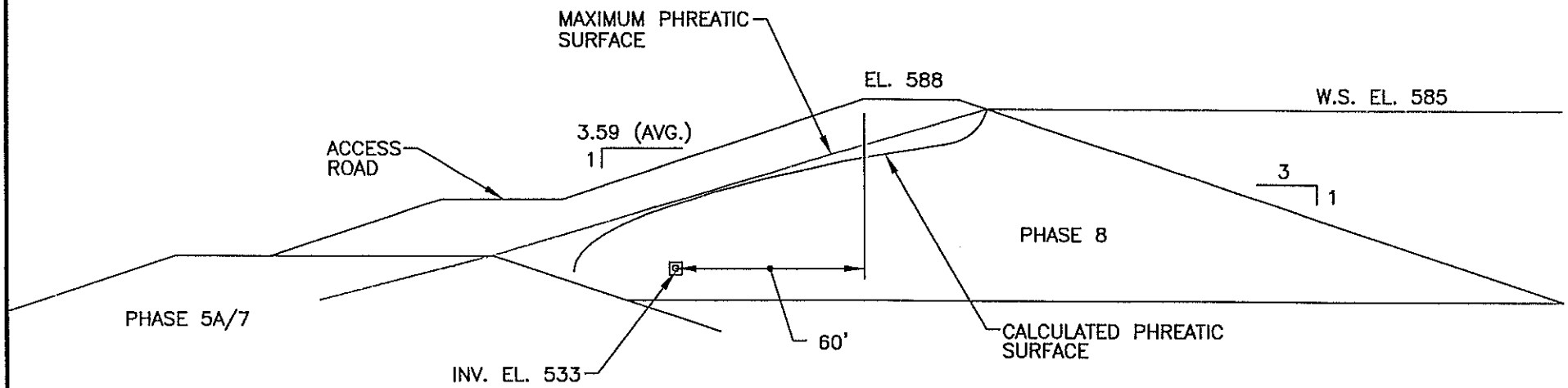
y (ft.)	x_T (ft.)	x_A (ft.)	Elev. (ft)
0.00	-10.73	-32.20	533.00
3.00	-10.52	-31.57	536.00
6.00	-9.89	-29.68	539.00
9.00	-8.84	-26.53	542.00
12.00	-7.38	-22.13	545.00
15.00	-5.49	-16.47	548.00
18.00	-3.18	-9.55	551.00
25.00	3.83	11.48	558.00
30.00	10.23	30.70	563.00
35.00	17.80	53.41	568.00
45.00	36.44	109.32	578.00
52.0	52.26	156.77	585.00

$k' = (k_v k_h)^{1/2}$ = 0.00060 cm/sec = 1.7008 ft/day
$q = k'y_o$ = 36.5053 ft^3/day/ft = **0.1896** *gpm/ft*

Note: $q = k'(h^2)/(2d)$ when $d < h$; $q = k'y_o$ when $d > h$ and $\alpha > 60°$, SM Note No. 7







PHASE 8 SECTION E–E

1"=50'

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INTERNAL DRAIN DESIGN

MACH NO. 1 MINE,
FACILITY NO. 2 PLAN MODIFICATION
PHASE 5A, 7, AND 8

PREPARED FOR

MACH MINING, LLC
P.O. BOX 300, JOHNSTON CITY, ILLINOIS 62951

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APPROVED BY		
DRAWING NUMBER		
B11-146-A4		

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BY: RPC DATE: 10/10/2011 CHKD BY: _____ DATE: _____

PROJECT NAME: **Mach No. 1 Mine, Facility No. 2**

PROJECT NO.: **B11-146-1413** SHEET 1 OF 1

DESCRIPTION: **Phreatic Line - Pool to Underdrain**
Phase 8 - Section F-F

Ref: SM Note No. 7, Case V

Transformation Factor = $f_T = (k_y/k_x)^{1/2}$ = 0.3333

k_x = 0.0018 cm/sec
k_y = 0.0002 cm/sec
z_u = 3.00
z_d = 3.00

k_y/k_x = 0.1111

$y_o = (h^2 + d^2)^{1/2} - d$
$a = a_o = y_o/2$

$x_T = (y^2 - y_o^2)/(2y_o)$

$x_T = (f_T)(x_A)$
x_A = x distance on actual section
x_T = x distance on transformed section
y = y distance on both sections

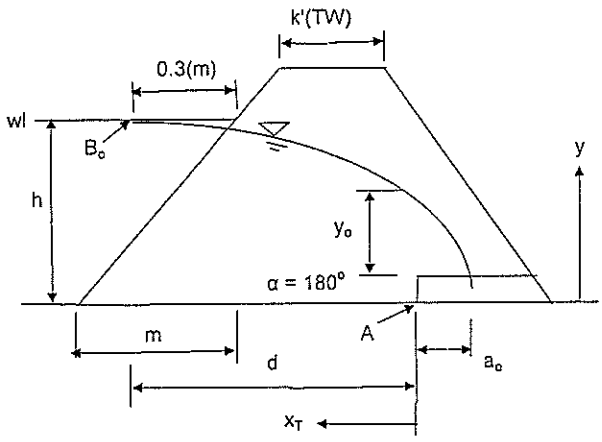
h (ft.)	d (ft.)	m (ft.)	0.3m (ft.)	y_o (ft.)	a_o (ft.)
52.0	35.27	52.00	15.6	27.56	13.78

Phreatic Line Coordinates

y (ft.)	x_T (ft.)	x_A (ft.)	Elev. (ft)
0.00	-13.78	-41.35	533.00
3.00	-13.62	-40.86	536.00
6.00	-13.13	-39.39	539.00
9.00	-12.31	-36.94	542.00
12.00	-11.17	-33.51	545.00
15.00	-9.70	-29.10	548.00
18.00	-7.91	-23.72	551.00
25.00	-2.45	-7.34	558.00
30.00	2.54	7.63	563.00
35.00	8.44	25.32	568.00
45.00	22.95	68.85	578.00
52.0	35.27	105.80	585.00

$k' = (k_v k_h)^{1/2}$ = 0.00060 cm/sec = 1.7008 ft/day
$q = k'(h^2)/(2d)$ 65.2022 ft^3/day/ft = **0.3387** *gpm/ft*

Note: $q = k'(h^2)/(2d)$ when $d < h$; $q = k'y_o$ when $d > h$ and $\alpha > 60^o$, SM Note No. 7



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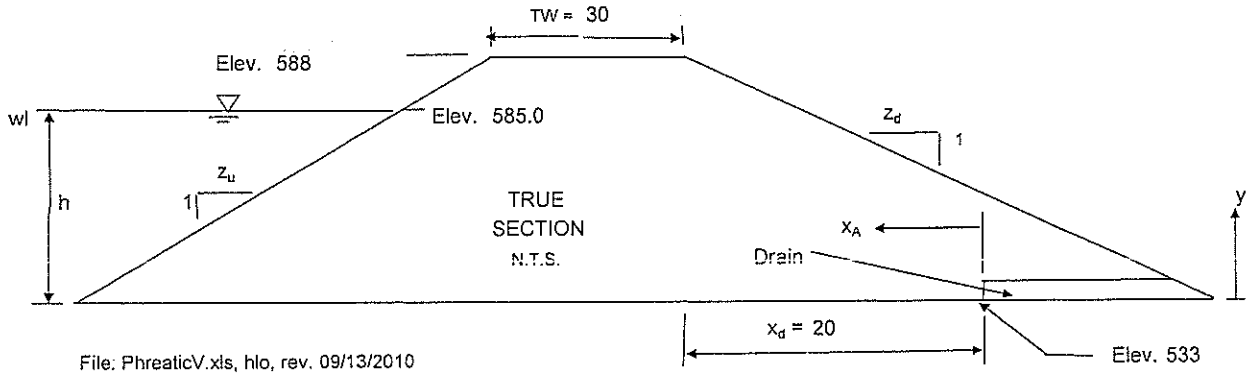

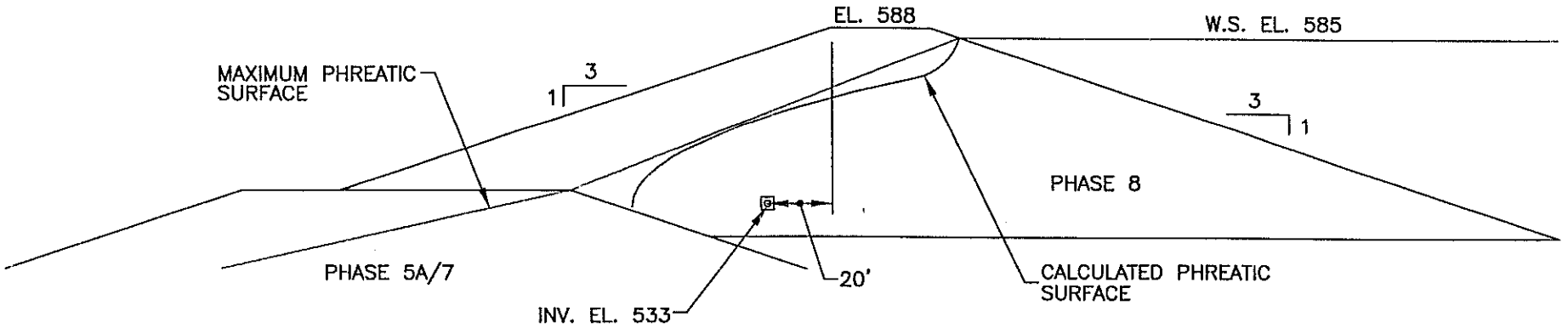

PHASE 8 SECTION F–F
1"=50'

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INTERNAL DRAIN DESIGN
MACH NO. 1 MINE,
FACILITY NO. 2 PLAN MODIFICATION
PHASE 5A, 7, AND 8
PREPARED FOR
MACH MINING, LLC
P.O. BOX 300, JOHNSTON CITY, ILLINOIS 62951

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APPROVED BY		
DRAWING NUMBER		
B11-146-A6		

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BY: RPC DATE: 10/10/2011 CHKD BY: _____ DATE: _____

PROJECT NAME: **Mach No. 1 Mine, Facility No. 2**

PROJECT NO.: **B11-146-1413** SHEET 1 OF 1

DESCRIPTION: **Phreatic Line - Pool to Underdrain**
Phase 2-3 Connector Option

Ref: SM Note No. 7, Case V

Transformation Factor = $f_T = (k_y/k_x)^{1/2}$ = 0.3333

k_x = 0.0018 cm/sec
k_y = 0.0002 cm/sec
z_u = 3.00
z_d = 3.00

k_y/k_x = 0.1111

$y_o = (h^2 + d^2)^{1/2} - d$
$a = a_o = y_o/2$

$x_T = (y^2 - y_o^2)/(2y_o)$

$x_T = (f_T)(x_A)$
x_A = x distance on actual section
x_T = x distance on transformed section
y = y distance on both sections

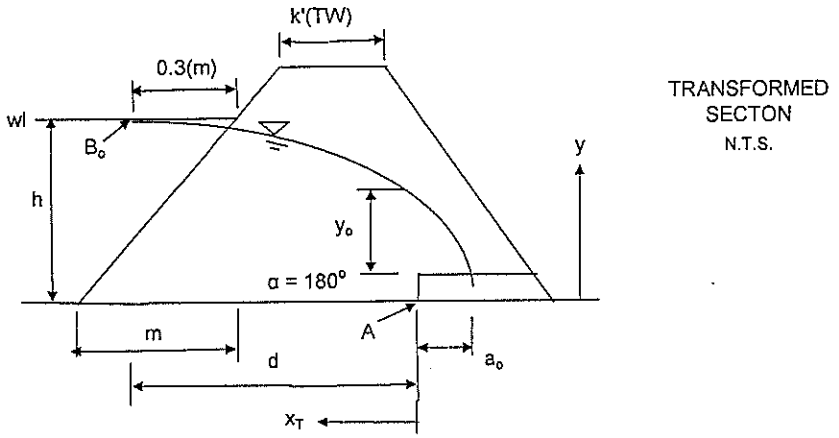
h (ft.)	d (ft.)	m (ft.)	0.3m (ft.)	y_o (ft.)	a_o (ft.)
37.5	51.49	37.50	11.25	12.21	6.10

Phreatic Line Coordinates

y (ft.)	x_T (ft.)	x_A (ft.)	Elev. (ft)
0.00	-6.10	-18.31	461.50
2.00	-5.94	-17.82	463.50
4.00	-5.45	-16.35	465.50
6.00	-4.63	-13.89	467.50
8.00	-3.48	-10.45	469.50
10.00	-2.01	-6.03	471.50
15.00	3.11	9.33	476.50
20.00	10.28	30.83	481.50
25.00	19.49	58.48	486.50
30.00	30.76	92.27	491.50
35.00	44.07	132.20	496.50
37.5	51.49	154.47	499.00

$k' = (k_v k_h)^{1/2}$ = 0.00060 cm/sec = 1.7008 ft/day
$q = k'y_o$ = 20.7637 ft^3/day/ft = **0.1079** *gpm/ft*

Note: $q = k'(h^2)/(2d)$ when $d < h$; $q = k'y_o$ when $d > h$ and $\alpha > 60°$, SM Note No. 7



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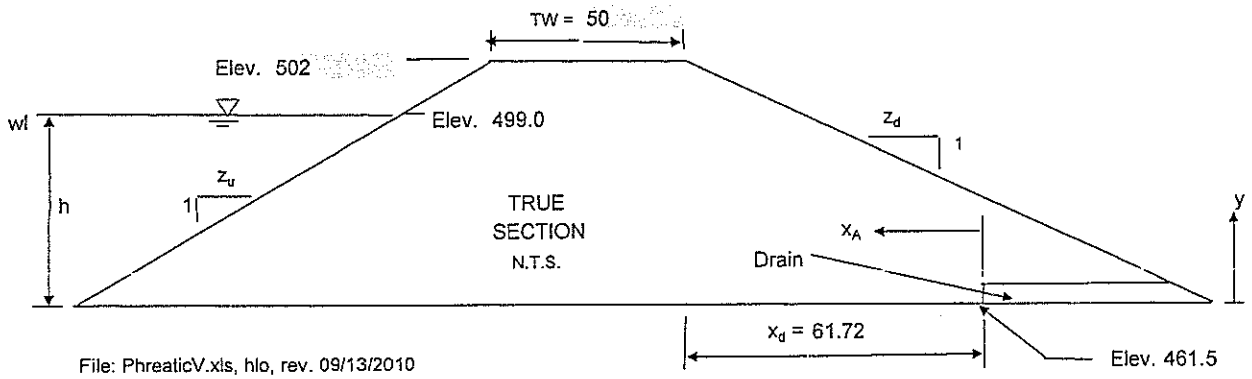

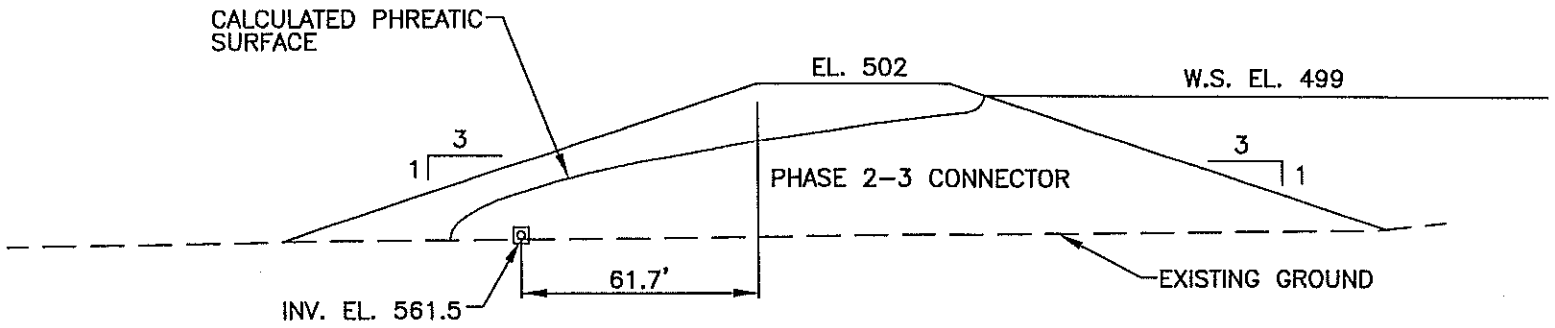

PHASE 2-3 CONNECTOR SECTION G-G

1"=50'

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INTERNAL DRAIN DESIGN
MACH NO. 1 MINE,
FACILITY NO. 2 PLAN MODIFICATION
PHASE 5A, 7, AND 8
PREPARED FOR
MACH MINING, LLC
P.O. BOX 300, JOHNSTON CITY, ILLINOIS 62951

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CALC. BY: RPC DATE: 10/11/2011 CHKD. BY: _____ DATE: _____
PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2 WEST OF DIWANA
PROJECT NUMBER: 811-146-1413 SHEET 1 OF 1
DESCRIPTION: INTERNAL GRAVEL DRAIN CAPACITY

Calculation to check capacity of internal gravel drain.

Use same aggregate as previous underdrain stages.
Aggregate supplied by Freedom Materials, washed river gravel.

3/8" to 1-1/2"
66.7% is 3/8" to 1" 0% < 3/8"
33.3% is 1" to 1-1/2" 0% > 1-1/2"

Underdrain is on a 0.005 ft/ft slope
Aggregate underdrain area = 15.4 ft^2
Aggregate should have a permeability > Gradation No. 15 (See Figure No. 1 and Figure No. C-15)

For hydraulic gradient (i) =0.005

$q/A = 0.38 \times 10^3$ ft/d
$Q =$ 5852 ft^3/d

Check ability of aggregate to admit flow to perforated pipe
Smallest head in Phase 5A/7

Calculated phreatic level above drain = 16.68 ft
To center of underdrain h = 14.68 ft
$i = 14.68 / 2 =$ 7.34
For i = 7.34, $(q/A)x10^3 > 4.0$
A = 4 ft x 4(1 ft width) = 16 ft^2 / ft
$Q > (16)(4x10^3) = 64x10^3$ ft^3/d-ft

Max calculated groundflow = 72 ft^3/d-ft
$Q = 64x10^3$ ft^3/d-ft > 72 ft^3/d-ft

F.S. = $64x10^3 / 72 = 888.9 > 10$ OK

Form SCS 130
5-65

4

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	DRAIN MATERIALS

PROJECT and STATE: Project Study No. 101

DESIGNED AT | BY: SML | DATE

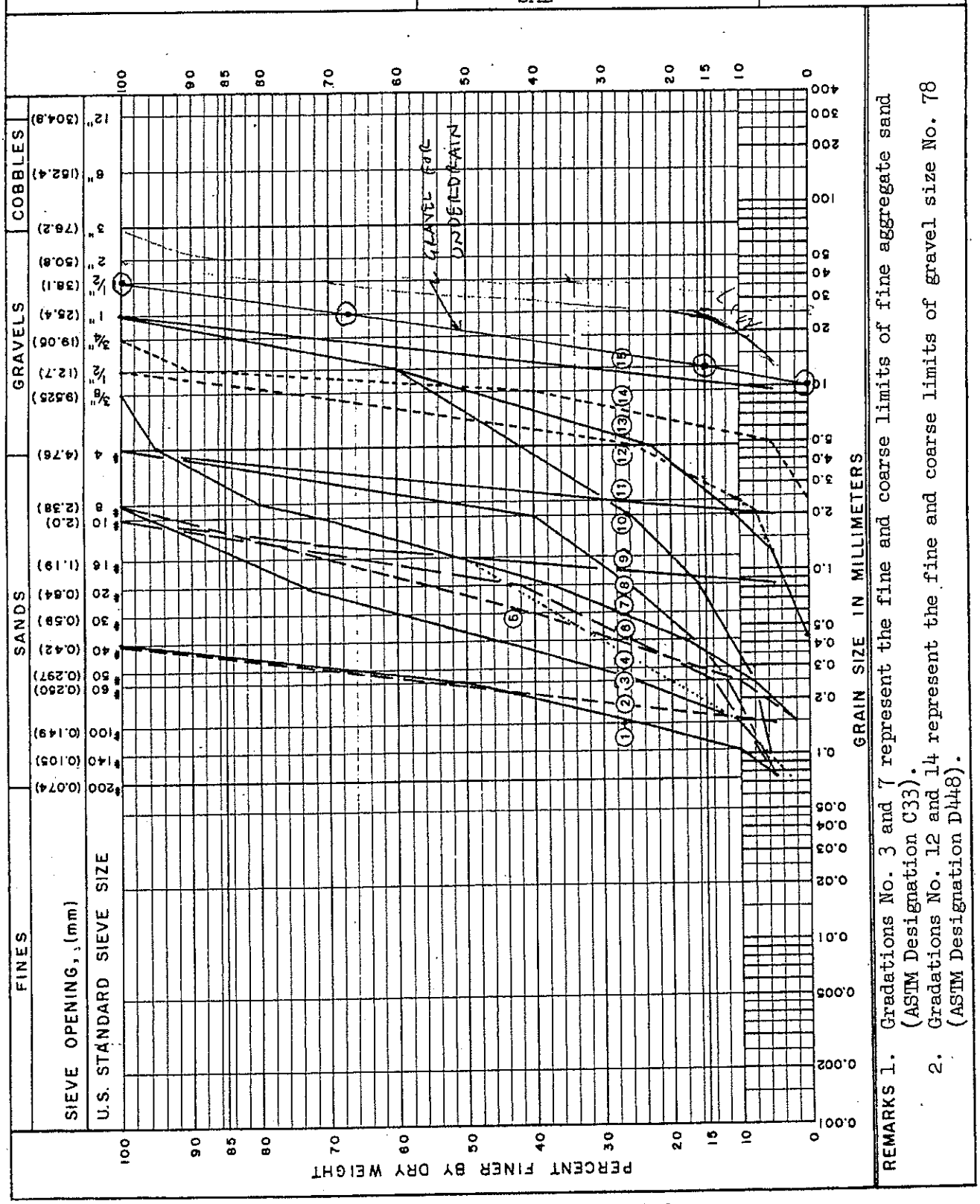
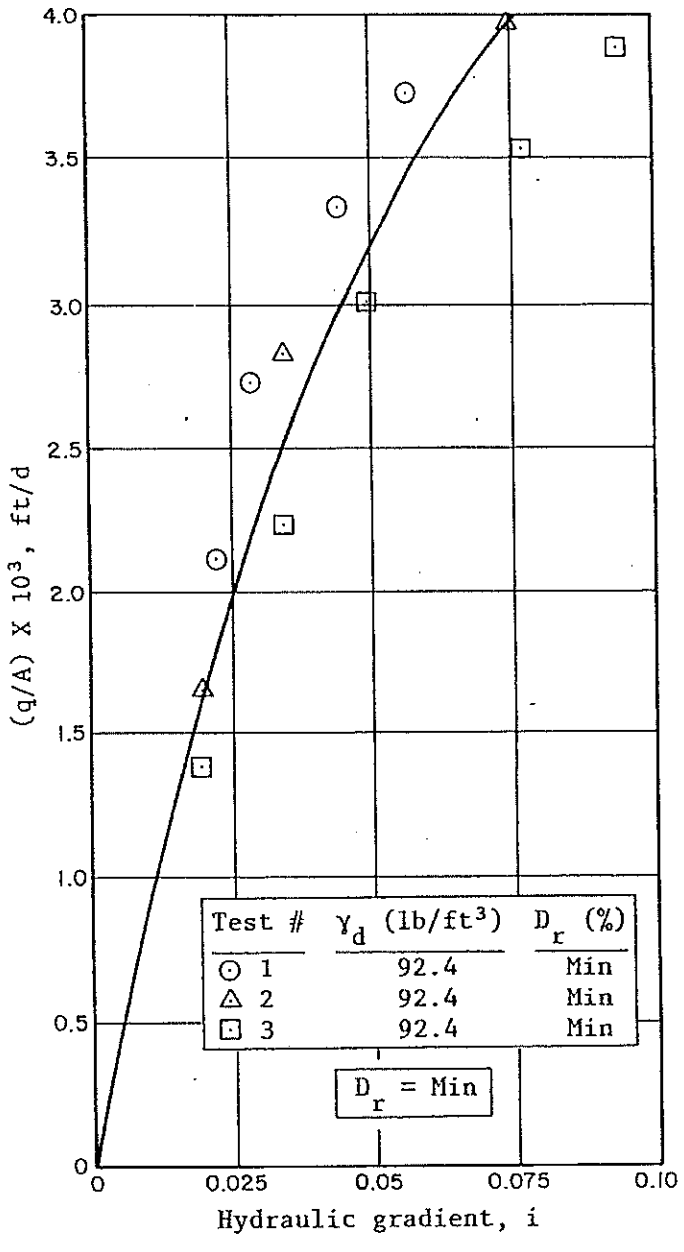
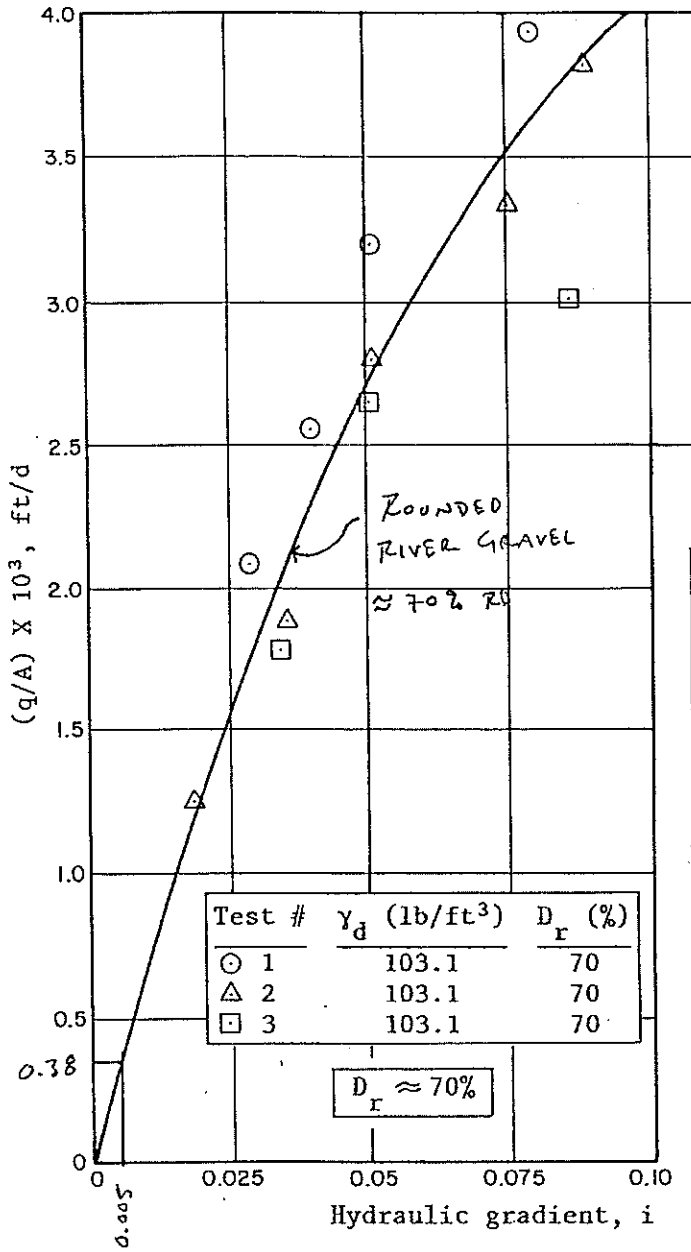


Figure 1. Gradations of sands and gravels tested





GRADATION #15	
GP (rounded particles)	
C_u = 1.7; C_z = 1.0	
Sieve #	% Passing
1"	100
1/2"	34
3/8"	5

Relative Density, D_r
Min γ_d = 92.5 lb/ft³
Max γ_d = 108.7 lb/ft³

Figure C-15. Relationship between q/A and i for Gradation No. 15 (GP, rounded)

*U.S. GOVERNMENT PRINTING OFFICE : 1984 0-420-937/SCS-628

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CALC. BY: RPC DATE: 10/11/2011 CHKD. BY: _____ DATE: _____
PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2 WEST OF DIWANA
PROJECT NUMBER: B11-146-1413 SHEET 1 OF 1
DESCRIPTION: FILTER FABRIC PERMITTIVITY AND CLOGGING POTENTIAL

Check ability of fabric to admit flow into the underdrain.

Use GEOTEX 501 (See Manufacturers Data Sheet for Specs)

Required permittivity:

$q = KiA = K(\Delta h/t)A$
$t =$ Thickness of fabric
$\Delta h =$ 16.68 ft
$q =$ 26.7566 $ft^3/d\text{-}ft =$ 0.0003097 $ft^3/s\text{-}ft$
$K/t = \psi =$ Permittivity of fabric
$K/t = \psi = q/(\Delta hA)$

For F.S. = 10 use 10xq = 0.003097 $ft^3/s\text{-}ft$

Required $\psi = \frac{0.003097}{(16.68)(16)} =$ 0.00001160 sec^{-1}

ψ Fabric = 1.4 sec^{-1} > 1.16x10^{-5} sec^{-1} **OK**

Check geotextile clogging potential.

From previous gradation tests on placed CCR:
Smallest d_{85} = 7 mm

Criteria - AOS ≤ d_{85} soil
EOS ≈ AOS = # 70 sieve = 0.210 mm < 7 mm **OK**

NRCS Criteria - For a nonwoven geotextile:
AOS ≤ # 40 sieve (# 70 Provided)
ψ > 0.7 sec^{-1} (1.4 sec^{-1} Provided)

Geotextile meets both criteria

PRODUCT DATA SHEET

GEOTEX® 501

GEOTEX 501 is a polypropylene, staple fiber, needlepunched nonwoven geotextile produced by Propex, and will meet the following Minimum Average Roll Values (MARV) when tested in accordance with the methods listed below. The fibers are needled to form a stable network that retains dimensional stability relative to each other. The geotextile is resistant to ultraviolet degradation and to biological and chemical environments normally found in soils.

GEOTEX 501 conforms to the property values listed below.[1] Propex performs internal Manufacturing Quality Control (MQC) tests that have been accredited by the Geosynthetic Accreditation Institute - Laboratory Accreditation Program (GAI-LAP).

		MARV[2]	
PROPERTY	TEST METHOD	ENGLISH	METRIC
Mechanical			
Tensile Strength (Grab)	ASTM D-4632	140 lbs	623 N
Elongation	ASTM D-4632	50%	50%
Puncture	ASTM D-4833	85 lbs	378 N
CBR Puncture	ASTM D-6241	360 lbs	1601 N
Mullen Burst	ASTM D-3786	280 psi	1930 kPa
Trapezoidal Tear	ASTM D-4533	60 lbs	267 N
Endurance			
UV Resistance	ASTM D-4355	70%	70%
Hydraulic			
Apparent Opening Size (AOS)[3]	ASTM D-4751	70 US Std. Sieve	0.212 mm
Permittivity	ASTM D-4491	1.40 sec^{-1}	1.40 sec^{-1}
Water Flow Rate	ASTM D-4491	115 gpm/ft^2	4686 $l/min/m^2$
Roll Sizes		15 ft x 360 ft	4.57 m x 109.8 m

NOTES:

1. The property values listed above are effective 08/2006 and are subject to change without notice.
2. Values shown are in weaker principal direction. Minimum average roll values (MARV) are calculated as the typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any samples taken from quality assurance testing will exceed the value reported.
3. Maximum average roll value.

PROPEX | THE ADVANTAGE CREATORS
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www.geotextile.com

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CALC. BY: RPC DATE: 10/11/2011 CHKD. BY: _____ DATE: _____
PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2 WEST OF DIWANA
PROJECT NUMBER: B11-146-1413 SHEET 1 OF 1
DESCRIPTION: PHASE 5A/7 INTERNAL DRAIN PIPE SIZE AND CAPACITY

For Factor of Safety = 10, Q_{DRAIN} has been multiplied by 10 and the pipe sized according to this flow.

$Q_{PIPE} = \frac{1.486}{n}(AR^{2/3}S_o^{1/2})$ n = 0.015 (aged HDPE)

Ref. : Hydrology and Hydraulic Systems, Table 10.1 Geometric Elements for Circular Section

* Min. Diameter based on Q_{REQ} flowing full.
Pipe I.D. based on DR-26 HDPE pipe

PHASE 5A/7 COLLECTION LINES

Outlet	q (ft^3/d/ft)	Length of pipe/dam, L (ft)	Q_{DRAIN} (ft^3/d) (qxL)	Q_{REQ} (10xQ_{DRAIN})	Q_{REQ} (cfs)	Design Slope (ft/ft)	Pipe Dia.* (inches)	Pipe O.D. (actual)	Pipe I.D. (actual)	Q_{FULL} (cfs)
1	47.5967	339.14	16,141.94	161,419.45	1.87	0.005	11.319	12	11.710	2.05
2	47.5967	339.14	16,141.94	161,419.45	1.87	0.005	11.319	12	11.710	2.05
3	47.5967	276.06	13,139.55	131,395.45	1.52	0.005	10.478	12	11.710	2.05
4	47.5967	276.06	13,139.55	131,395.45	1.52	0.005	10.478	12	11.710	2.05
5	47.5967	306.91	14,607.90	146,079.03	1.69	0.005	10.903	12	11.710	2.05
6	47.5967	306.91	14,607.90	146,079.03	1.69	0.005	10.903	12	11.710	2.05
7	26.7566	443.68	11,871.37	118,713.68	1.37	0.005	10.087	12	11.710	2.05
8	26.7566	433.12	11,588.82	115,888.19	1.34	0.005	9.996	12	11.710	2.05
9	22.2967	459.70	10,249.79	102,497.93	1.19	0.005	9.546	10	9.873	1.30
10	22.2967	459.70	10,249.79	102,497.93	1.19	0.005	9.546	10	9.873	1.30
11	22.2967	355.31	7,922.24	79,222.40	0.92	0.005	8.667	10	9.873	1.30
12	26.7566	351.83	9,413.77	94,137.75	1.09	0.005	9.246	10	9.873	1.30
13	26.7566	351.83	9,413.77	94,137.75	1.09	0.005	9.246	10	9.873	1.30
14	26.7566	302.19	8,085.58	80,855.77	0.94	0.005	8.734	10	9.873	1.30

PHASE 5A/7 OUTLET DRAIN LINES

Outlet	q (ft^3/d/ft)	Length of pipe/dam, L (ft)	Q_{DRAIN} (ft^3/d) (qxL)	Q_{REQ} (10xQ_{DRAIN})	Q_{REQ} (cfs)	Design Slope (ft/ft)	Pipe Dia.* (inches)	Pipe O.D. (actual)	Pipe I.D. (actual)	Q_{FULL} (cfs)
1	47.5967	678.28	32,283.89	322,838.90	3.74	0.010	12.889	16	14.695	5.30
2	47.5967	678.28	32,283.89	322,838.90	3.74	0.010	12.889	16	14.695	5.30
3	47.5967	552.12	26,279.09	262,790.90	3.04	0.010	11.932	14	12.858	3.71
4	47.5967	552.12	26,279.09	262,790.90	3.04	0.010	11.932	14	12.858	3.71
5	47.5967	613.82	29,215.81	292,158.06	3.38	0.010	12.416	14	12.858	3.71
6	47.5967	613.82	29,215.81	292,158.06	3.38	0.010	12.416	14	12.858	3.71
7	26.7566	887.36	23,742.74	237,427.37	2.75	0.010	11.487	12	11.710	2.89
8	26.7566	866.24	23,177.64	231,776.37	2.68	0.010	11.383	12	11.710	2.89
9	22.2967	919.40	20,499.59	204,995.86	2.37	0.010	10.871	14	12.858	3.71
10	22.2967	919.40	20,499.59	204,995.86	2.37	0.010	10.871	14	12.858	3.71
11	22.2967	710.62	15,844.48	158,444.81	1.83	0.010	9.870	12	11.710	2.89
12	26.7566	703.66	18,827.55	188,275.49	2.18	0.010	10.530	12	11.710	2.89
13	26.7566	703.66	18,827.55	188,275.49	2.18	0.010	10.530	12	11.710	2.89
14	26.7566	604.38	16,171.15	161,711.54	1.87	0.010	9.946	12	11.710	2.89

Note: Outlet drain lines convey flow from two collection lines (Q is doubled).

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CALC. BY: RPC DATE: 10/11/2011 CHKD. BY: _____ DATE: _____
PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2 WEST OF DIWANA
PROJECT NUMBER: B11-146-1413 SHEET 1 OF 1
DESCRIPTION: PHASE 8 INTERNAL DRAIN PIPE SIZE AND CAPACITY

For Factor of Safety = 10, Q_{DRAIN} has been multiplied by 10 and the pipe sized according to this flow.

$Q_{PIPE} = \frac{1.486}{n} (AR^{2/3}S_o^{1/2})$ n = 0.015 (aged HDPE)

Ref. : Hydrology and Hydraulic Systems, Table 10.1 Geometric Elements for Circular Section

* Min. Diameter based on Q_{REQ} flowing full.
Pipe I.D. based on DR-26 HDPE pipe

PHASE 8 COLLECTION LINES

Outlet	q (ft^3/d/ft)	Length of pipe/dam, L (ft)	Q_{DRAIN} (ft^3/d) (qxL)	Q_{REQ} (10xQ_{DRAIN})	Q_{REQ} (cfs)	Design Slope (ft/ft)	Pipe Dia.* (inches)	Pipe O.D. (actual)	Pipe I.D. (actual)	Q_{FULL} (cfs)
15	72.0083	331.53	23,872.91	238,729.12	2.76	0.005	13.108	16	14.695	3.75
16	72.0083	331.53	23,872.91	238,729.12	2.76	0.005	13.108	16	14.695	3.75
17	72.0083	352.40	25,375.72	253,757.25	2.94	0.005	13.411	16	14.695	3.75
18	72.0083	264.40	19,038.99	190,389.95	2.20	0.005	12.041	14	12.858	2.62
19	72.0083	264.40	19,038.99	190,389.95	2.20	0.005	12.041	14	12.858	2.62
20	65.2022	409.61	26,707.47	267,074.73	3.09	0.005	13.671	16	14.695	3.75
21	65.2022	409.61	26,707.47	267,074.73	3.09	0.005	13.671	16	14.695	3.75
22	65.2022	388.10	25,304.97	253,049.74	2.93	0.005	13.397	16	14.695	3.75
23	65.2022	388.10	25,304.97	253,049.74	2.93	0.005	13.397	16	14.695	3.75
24	65.2022	267.54	17,444.20	174,441.97	2.02	0.005	11.653	12	11.710	2.05
25	65.2022	294.44	19,198.14	191,981.36	2.22	0.005	12.079	14	12.858	2.62
26	36.5053	337.89	12,334.78	123,347.76	1.43	0.005	10.232	12	11.71	2.05
27	65.2022	316.67	20,647.58	206,475.81	2.39	0.005	12.413	14	12.858	2.62

PHASE 8 OUTLET DRAIN LINES

Outlet	q (ft^3/d/ft)	Length of pipe/dam, L (ft)	Q_{DRAIN} (ft^3/d) (qxL)	Q_{REQ} (10xQ_{DRAIN})	Q_{REQ} (cfs)	Design Slope (ft/ft)	Pipe Dia.* (inches)	Pipe O.D. (actual)	Pipe I.D. (actual)	Q_{FULL} (cfs)
15	72.0083	663.06	47,745.82	477,458.23	5.53	0.010	14.927	18	16.532	7.26
16	72.0083	663.06	47,745.82	477,458.23	5.53	0.010	14.927	18	16.532	7.26
17	72.0083	704.80	50,751.45	507,514.50	5.87	0.010	15.272	18	16.532	7.26
18	72.0083	528.80	38,077.99	380,779.89	4.41	0.010	13.713	16	14.695	5.30
19	72.0083	528.80	38,077.99	380,779.89	4.41	0.010	13.713	16	14.695	5.30
20	65.2022	819.22	53,414.95	534,149.46	6.18	0.010	15.568	18	16.532	7.26
21	65.2022	819.22	53,414.95	534,149.46	6.18	0.010	15.568	18	16.532	7.26
22	65.2022	776.20	50,609.95	506,099.48	5.86	0.010	15.256	18	16.532	7.26
23	65.2022	776.20	50,609.95	506,099.48	5.86	0.010	15.256	18	16.532	7.26
24	65.2022	535.08	34,888.39	348,883.93	4.04	0.010	13.270	16	14.695	5.30
25	65.2022	588.88	38,396.27	383,962.72	4.44	0.010	13.755	16	14.695	5.30
26	36.5053	675.78	24,669.55	246,695.52	2.86	0.010	11.653	12	11.710	2.89
27	65.2022	633.34	41,295.16	412,951.61	4.78	0.010	14.136	16	14.695	5.30

Note: Outlet drain lines convey flow from two collection lines (Q is doubled).

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CALC. BY: RPC DATE: 10/11/2011 CHKD. BY: _____ DATE: _____
PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2 WEST OF DIWANA
PROJECT NUMBER: B11-146-1413 SHEET 1 OF 1
DESCRIPTION: PHASE 2-3 CONNECTOR (OPTION) INTERNAL DRAIN
PIPE SIZE AND CAPACITY

For Factor of Safety = 10, Q_{DRAIN} has been multiplied by 10 and the pipe sized according to this flow.

$Q_{PIPE} = \frac{1.486}{n} (AR^{2/3}S_o^{1/2})$ n = 0.015 (aged HDPE)

Ref. : Hydrology and Hydraulic Systems, Table 10.1 Geometric Elements for Circular Section

* Min. Diameter based on Q_{REQ} flowing full.
Pipe I.D. based on DR-26 HDPE pipe

PHASE 2-3 CONNECTOR COLLECTION LINES										
Outlet	q (ft^3/d/ft)	Length of pipe/dam, L (ft)	Q_{DRAIN} (ft^3/d) (qxL)	Q_{REQ} (10xQ_{DRAIN})	Q_{REQ} (cfs)	Design Slope (ft/ft)	Pipe Dia.* (inches)	Pipe O.D. (actual)	Pipe I.D. (actual)	Q_{FULL} (cfs)
28	20.7637	135.28	2,808.91	28,089.13	0.33	0.005	5.875	6	6.085	0.36
29	20.7637	95.41	1,981.06	19,810.65	0.23	0.005	5.154	6	6.085	0.36

PHASE 2-3 CONNECTOR OUTLET DRAIN LINES										
Outlet	q (ft^3/d/ft)	Length of pipe/dam, L (ft)	Q_{DRAIN} (ft^3/d) (qxL)	Q_{REQ} (10xQ_{DRAIN})	Q_{REQ} (cfs)	Design Slope (ft/ft)	Pipe Dia.* (inches)	Pipe O.D. (actual)	Pipe I.D. (actual)	Q_{FULL} (cfs)
28	20.7637	270.56	5,617.83	56,178.27	0.65	0.010	6.690	8	7.922	1.02
29	20.7637	190.82	3,962.13	39,621.29	0.46	0.010	5.869	6	6.085	0.50

Note: Outlet drain lines convey flow from two collection lines (Q is doubled).

PE 3608/3408 IPS HDPE PIPE SIZES

Pressure Rating		DR 17 (100psi)			DR 19 (89psi)			DR 21 (80psi)			DR 26 (65psi)			DR 32.5 (50psi)		
Nominal Size	Actual O.D.	Min. wall	Average I.D.	Weight lb/lf	Min. wall	Average I.D.	Weight lb/lf	Min. wall	Average I.D.	Weight lb/lf	Min. wall	Average I.D.	Weight lb/lf	Min. wall	Average I.D.	Weight lb/lf
3/4"	1.050"	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1"	1.315"	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1 1/4"	1.660"	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1 1/2"	1.900"	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2"	2.375"	0.140"	2.079"	0.429	---	---	---	---	---	---	---	---	---	---	---	---
3"	3.500"	0.206"	3.064"	0.932	---	---	---	---	---	---	---	---	---	---	---	---
4"	4.500"	0.265"	3.939"	1.540	0.237"	3.998"	1.387	0.214"	4.046"	1.262	0.173"	4.133"	1.030	0.138"	4.206"	0.831
5"	5.375"	0.316"	4.705"	2.197	0.283"	4.775"	1.980	0.256"	4.832"	1.801	0.207"	4.937"	1.470	0.165"	5.024"	1.186
5"	5.563"	0.327"	4.869"	2.353	0.293"	4.942"	2.120	0.265"	5.001"	1.929	0.214"	5.109"	1.574	0.171"	5.200"	1.270
6"	6.625"	0.390"	5.799"	3.338	0.349"	5.886"	3.007	0.315"	5.956"	2.736	0.255"	6.085"	2.233	0.204"	6.193"	1.801
7"	7.125"	0.419"	6.236"	3.860	0.375"	6.330"	3.478	0.339"	6.406"	3.165	0.274"	6.544"	2.582	0.219"	6.660"	2.083
8"	8.625"	0.507"	7.549"	5.657	0.454"	7.663"	5.097	0.411"	7.754"	4.637	0.332"	7.922"	3.784	0.265"	8.062"	3.053
10"	10.750"	0.632"	9.409"	8.788	0.566"	9.551"	7.918	0.512"	9.665"	7.204	0.413"	9.873"	5.878	0.331"	10.049"	4.742
12"	12.750"	0.750"	11.160"	12.362	0.671"	11.327"	11.138	0.607"	11.463"	10.134	0.490"	11.710"	8.269	0.392"	11.918"	6.671
14"	14.000"	0.824"	12.254"	14.905	0.737"	12.438"	13.429	0.667"	12.587"	12.218	0.538"	12.858"	9.970	0.431"	13.087"	8.044
16"	16.00"	0.941"	14.005"	19.467	0.842"	14.215"	17.540	0.762"	14.385"	15.959	0.615"	14.695"	13.022	0.492"	14.956"	10.506
18"	18.00"	1.059"	15.755"	24.638	0.947"	15.992"	22.199	0.857"	16.183"	20.198	0.692"	16.532"	16.480	0.554"	16.826"	13.296
20"	20.00"	1.176"	17.506"	30.418	1.053"	17.768"	27.406	0.952"	17.981"	24.936	0.769"	18.369"	20.346	0.615"	18.695"	16.415
22"	22.00"	1.294"	19.256"	36.805	1.158"	19.545"	33.162	1.048"	19.779"	30.172	0.846"	20.206"	24.619	0.677"	20.565"	19.863
24"	24.00"	1.412"	21.007"	43.801	1.263"	21.322"	39.465	1.143"	21.577"	35.907	0.923"	22.043"	29.299	0.738"	22.434"	23.638
26"	26.00"	1.529"	22.758"	51.406	1.368"	23.099"	46.316	1.238"	23.375"	42.141	1.000"	23.880"	34.385	0.800"	24.304"	27.742
28"	28.00"	1.647"	24.508"	59.618	1.474"	24.876"	53.716	1.333"	25.173"	48.874	1.077"	25.717"	39.879	0.862"	26.174"	32.174
30"	30.00"	1.765"	26.259"	68.439	1.579"	26.653"	61.664	1.429"	26.971"	56.105	1.154"	27.554"	45.779	0.923"	28.043"	36.934
32"	32.00"	1.882"	28.009"	77.869	1.684"	28.429"	70.160	1.524"	28.770"	63.835	1.231"	29.391"	52.086	0.985"	29.913"	42.023
34"	34.00"	2.000"	29.760"	87.907	1.789"	30.206"	79.204	1.619"	30.568"	72.064	1.308"	31.228"	58.814	1.046"	31.782"	47.440
36"	36.00"	2.118"	31.511"	98.553	1.895"	31.983"	88.796	1.714"	32.366"	80.791	1.385"	33.065"	65.922	1.108"	33.652"	53.186
42"	42.00"	2.471"	36.762"	134.141	2.211"	37.314"	120.861	2.000"	37.760"	109.966	1.615"	38.575"	89.727	1.292"	39.260"	72.392
48"	48.00"	2.824"	42.014"	175.205	2.526"	42.644"	157.857	2.286"	43.154"	143.629	1.846"	44.086"	117.194	1.477"	44.869"	94.552
54"	54.00"	3.176"	47.266"	222.547	2.842"	47.975"	199.791	2.571"	48.549"	182.298	2.077"	49.597"	148.324	1.662"	50.478"	119.668
63"	62.99"	---	---	---	---	---	---	3.000"	56.631"	247.800	2.423"	57.854"	202.010	1.938"	58.881"	162.980

NOTE:

- Items highlighted in Blue indicates standard stocking items that are more readily available.
- Pressures are based on using water at 23°C (73°F).
- Average inside diameter calculated using nominal OD and minimum wall plus 6% for use in estimating fluid flows. Actual ID will vary.
- Service factors should be utilized to compensate for the effect of liquids other than water, and for other temperatures.
- Other piping sizes or DR's may be available upon request.
- Standard Lengths: 40' for 2"-24" / 50' for 26" and larger / Coils available for 3/4"-6"(8" by special order)

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CALC. BY: RPC DATE: 10/11/2011 CHKD. BY: _____ DATE: _____
PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2 WEST OF DIWANA
PROJECT NUMBER: B11-146-1413 SHEET 1 OF 2
DESCRIPTION: INTERNAL DRAIN AND DECANT PIPE STRUCTURAL DESIGN

Calculation to show the DR-26 HDPE Internal Drain Pipe and decant pipe is capable of sustaining the proposed cover loading.

Reference: Performance Pipe Design Manual, Ch. 7 - Buried Piped Design

Max proposed cover = 50 ft (Phase 8 Section D-D)

Unit Wt. of Material = 130 pcf

Pipe wall compressive stress:

$$S = \frac{P_T D_O}{288t}$$

Where:
S = Pipe wall compressive stress, lb/in^2
P_T = Vertical load applied to pipe, lb/ft^2
D_O = Pipe outside diameter, inches
t = Pipe wall thickness, inches

$P_T = 50 \times 130 =$ 6,500 psf = 45.14 psi

D_O	t	S
6	0.255	531.05
8	0.332	543.84
10	0.413	546.48
12	0.490	552.72
14	0.538	587.31
16	0.615	587.17
18	0.692	587.07
36	1.385	586.64

Highest compressive stress (S) = 587.07 psi, which is less than 800 psi (allowable according to manufacturer), therefore the DR-26 HDPE pipe will be resist the compressive stress of the backfill.

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CALC. BY: RPC DATE: 10/11/2011 CHKD. BY: _____ DATE: _____
PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2 WEST OF DIWANA
PROJECT NUMBER: B11-146-1413 SHEET 2 OF 2
DESCRIPTION: INTERNAL DRAIN AND DECANT PIPE STRUCTURAL DESIGN

Calculation to check constrained pipe wall buckling.

$P_{WC} = 5.65[RB'E'(E/(12(DR-1)^3)]^{1/2}$

Where:

P_{WC} = Allowable constrained buckling pressure, psi
R = Bouyancy reduction factor
H' = groundwater height above pipe, ft
H = Cover above pipe, ft
B' = Elastic support factor
E' = Soil reaction modulus, psi (Table 7-7)
E = Elastic modulus, psi (Table 1, 50 yr @ 73°F)
ΔX = Horizontal Deflection, inches
D_1 = Inside Diameter, inches
P_T = Vertical load applied to pipe, lb/ft²
K = Bedding factor
L = Deflection lag factor

$R = 1 - 0.33(H'/H)$

H' =	27.35	ft		
H =	50	ft		
R =	0.819			

$B' = 1 / (1 + 4e^{(-0.065xH)})$

B' =	0.866			
E' =	3,000	psi		
E =	28,200	psi		
P_T =	6500	psf =	45.14	psi
DR =	26			

P_{WC} = 101.09 psi

$$\text{Factor of Safety} = \frac{P_{WC}}{P_T} = \frac{101.09}{45.14}$$

$$= 2.24$$

Calculation to check ring deflection.

$$\frac{\Delta X}{D_1} = \frac{P_T}{144} \cdot \frac{KL}{2E/3(1/DR-1)^3+0.061E'}$$

Where:

K = 0.1
L = 1.5

$$\frac{\Delta X}{D_1} = 3.7\% < 6\% \text{ (Allowable)}$$

Table 7-7 Bureau of Reclamation Average E' Values for Iowa Formula (Initial Deflection)

Soil type – pipe bedding material (Unified Classification)†	*E' for Degree of Bedding Compaction, lb/in²*			
	Dumped	*Slight (<85% Proctor <40% relative density)*	*Moderate (48%-95% Proctor 40%-70% relative density)*	*High (>95% Proctor >70% relative density)*
Fine-grained soils (LL>50)‡ Soils with medium to high plasticity CH, MH, CH-MH	No data available; consult a competent soils engineer; otherwise, use E' = 0.			
Fine-grained soils (LL<50) Soils with medium to no plasticity CL, ML, CL-ML, with <25% coarse grained particles	50	200	400	1000
Fine-grained soils (LL<50) Soils with medium to no plasticity CL, ML, CL-ML, with >25% coarse grained particles Coarse-grained soils with fines GM, GC, SM, SC◊ contains >12% fines	100	400	1000	2000
Coarse-grained soils with little or no fines GW, GP, SW, SP◊ contains <12% fines	200	1000	2000	✳ 3000
Crushed rock	1000	3000	3000	3000
Accuracy in terms of percentage deflection▼	±2%	±2%	±1%	±0.5%

† ASTM D 2487; USBR Designation E-3. ‡ LL = Liquid limit. ◊ Or any borderline soil beginning with one of these symbols, i.e., GM-GC, GC-SC. ▼ For ±1% accuracy and predicted deflection of 3%, actual deflection would be between 2% and 4%.

Note – Values applicable only for fills less than 50 ft (15 m). No safety factor included in table values. For use in predicting initial deflections only; appropriate Deflection Lag Factor must be applied for long-term deflections. If bedding falls on the borderline between two compaction categories, select the lower E' value or average the two values. Percentage Proctor based on laboratory maximum dry density from test standards using 12,500 ft-lb/ft³ (598,000 J/m²) (ASTM D 698, AASHTO T-99, USBR Designation E-11). 1 lb/in² = 6.895 kPa.

Table 7-8 Duncan-Hartley Soil Reaction Modulus

Type of Soil	Depth of Cover, ft	E' for Standard AASHTO Relative Compaction, lb.in²			
		85%	90%	95%	100%
Fine-grained soils with <25% sand content (CL, ML, CL-ML)	0-5	500	700	1000	1500
	5-10	600	1000	1400	2000
	10-15	700	1200	1600	2300
	15-20	800	1300	1800	2600
Coarse-grained soils with fines (SM, SC)	0-5	600	1000	1200	1900
	5-10	900	1400	1800	2700
	10-15	1000	1500	2100	3200
	15-20	1100	1600	1400	3700
Coarse-grained soils with little or no fines (SP, SW, GP, GW)	0-5	700	1000	1600	2500
	5-10	1000	1500	2200	3300
	10-15	1050	1600	2400	3600
	15-20	1100	1700	2500	3800

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The modulus is selected using the same criteria used for determining the stress in the pipe wall due to the thermal change. The applicability of Euler's equation for any specific pipeline calculation must be evaluated. For pipe installed on top of a surface (i.e. the ground, a pipe rack) pipe and fluid weight in the pipe and frictional forces increase the critical thrust force whereas in aerial applications weight and initial curvature due to deflection reduce the critical thrust force.

While the amount of length change experienced by polyethylene pipe during thermal changes is greater than many other materials, the amount of force required to restrain the movement is less because of its lower modulus of elasticity.

Table 1 Typical Elastic Modulus for DriscoPlex® PE 3608

Load Duration	Elastic Modulus†, 1000 psi (MPa), at Temperature, °F (°C)							
	-20 (-29)	0 (-18)	40 (4)	60 (16)	73 (23)	100 (38)	120 (49)	140 (60)
Short-Term	300.0 (2069)	260.0 (1793)	170.0 (1172)	130.0 (896)	110.0 (758)	100.0 (690)	65.0 (448)	50.0 (345)
10 h	140.8 (971)	122.0 (841)	79.8 (550)	61.0 (421)	57.5 (396)	46.9 (323)	30.5 (210)	23.5 (162)
100 h	125.4 (865)	108.7 (749)	71.0 (490)	54.3 (374)	51.2 (353)	41.8 (288)	27.2 (188)	20.9 (144)
1000 h	107.0 (738)	92.8 (640)	60.7 (419)	46.4 (320)	43.7 (301)	35.7 (246)	23.2 (160)	17.8 (123)
1 y	93.0 (641)	80.6 (556)	52.7 (363)	40.3 (278)	38.0 (262)	31.0 (214)	20.2 (139)	15.5 (107)
10 y	77.4 (534)	67.1 (463)	43.9 (303)	33.5 (231)	31.6 (218)	25.8 (178)	16.8 (116)	12.9 (89)
50 y	69.1 (476)	59.9 (413)	39.1 (270)	29.9 (206)	28.2 (194)	23.0 (159)	15.0 (103)	11.5 (79)

† Typical values based on ASTM D 638 testing of molded plaque material specimens.
Modulus values for PE4710 are under development.

Controlling Expansion and Contraction

Black polyethylene pipe on the surface or above grade and exposed to the sun can absorb solar energy. The resulting pipe temperatures can be greater than the air temperature. To help reduce temperature changes resulting solar heating of a piping system, the pipe may be shaded or placed in a location that receives less direct sunlight.

The effects of thermal expansion and contraction on a piping system can be controlled in several ways, including

- Lateral deflection expansion loops (snaking the pipe)
- Anchor and guide the pipe
- Conventional Expansion loops
- Expansion joints (non-pressures systems only)
- Burying pipes

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CALC. BY: RPC DATE: 10/11/2011 CHKD. BY: _____ DATE: _____
PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2 WEST OF DIWANA
PROJECT NUMBER: B11-146-1413 SHEET 1 OF 1
DESCRIPTION: INTERNAL DRAIN PIPE PERFORATION SPACING

Calculation to determine number of perforations required for internal drains.

Ref: Soil Mechanics Note No. 3, Soil Mechanics Considerations for Embankment Drains, SCS, USDA, 1971

Aggregate $C_U = D_{60} / D_{10}$ = 23 mm / 13 mm = 1.8 <3.0 OK
Use 70% perforation flow area reduction

Design flowrate = Largest flowrate = q = 72.0083 $ft^3/d/ft$
For F.S. = 10, q = 720.083 $ft^3/d/ft$ = 0.0083343 $ft^3/s/ft$

Previous design selected 3/8" dia. holes to prevent aggregate from entering pipe.

For 3/8-inch perforations:

$$A = \frac{\pi(0.03125\ ft)^2}{4} = 0.000767\ ft^2 / hole$$

$q = CAe(2gh)^{1/2}$
$q = 0.6(0.3A)(2x32.2x2)^{1/2}$
$q = 2.0428A$

$A = 0.0040798\ ft^2$

Number of holes required:

$$\frac{0.0040798}{0.000767} = 5.32 \text{ Holes / ft -} \quad \text{Use 6 holes / ft}$$

Design: **Use 2 rows of 3/8" dia. holes at 4" C-C spacing.**
(See Drawing Detail No. 5, Figure No. 9)

Page No. 137

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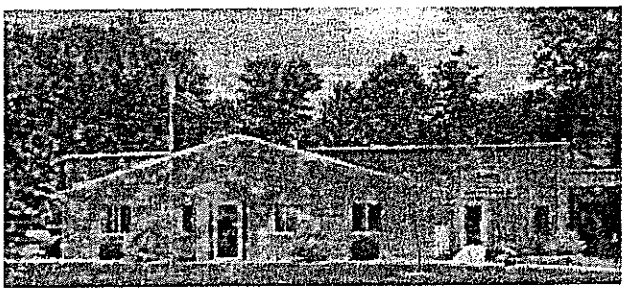

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- 12" Catch Basins & Grates
- 18" Catch Basins & Grates
- 24" Catch Basins & Grates

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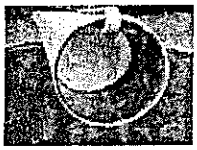

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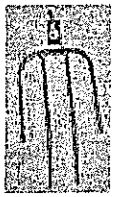

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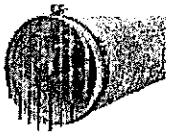

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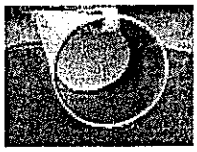

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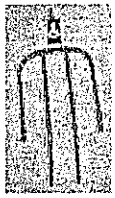

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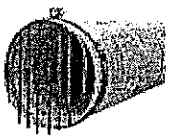

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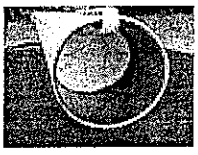

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4" DWV
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10" DWV
12" DWV
Fittings-PVC Repair
1/2" S/40 Repair
3/4" S/40 Repair
1" S/40 Repair
1 1/4" S/40 Repair
1 1/2" S/40 Repair
2" S/40 Repair
2 1/2" S/40 Repair
3" S/40 Repair
4" S/40 Repair
6" S/40 Repair
8" S/40 Repair
Fittings-PVC Schedule 40
1/8"
1/4"
3/8"
1/2"
3/4"
1"
1 1/4"
1 1/2"
2"
2 1/2"
3"
4"
5"
6"
8"
Fittings-PVC Schedule 80
1/4" Pressure
3/8" Pressure
1/2" Pressure
1" Pressure
1 1/4" Pressure
3/4" Pressure
1 1/2" Pressure
2" Pressure
2 1/2" Pressure
3" Pressure
4" Pressure
5" Pressure
6" Pressure
8" Pressure
Fittings-PVC SDR35
3" Solvent Weld
4" Solvent Weld
6" Solvent Weld
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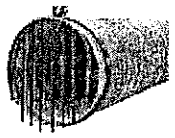

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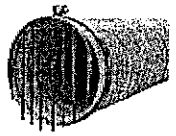

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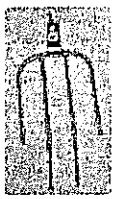

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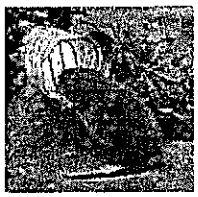

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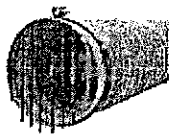

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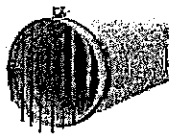

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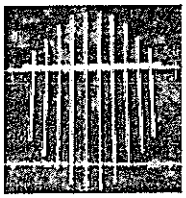

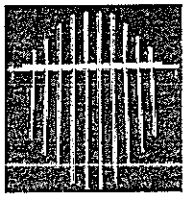

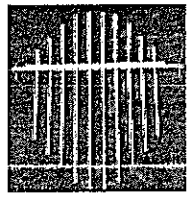

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Round 10"
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Rectangular 13" x 24"
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Valves-Backwater
Valves-Ball - Compact
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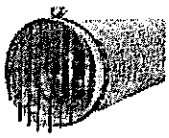

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CALC. BY: RPC DATE: 9/9/2011 CHKD. BY: _____ DATE: _____
PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2 WEST OF DIWANA
PROJECT NUMBER: B11-146-1413 SHEET 1 OF 1
DESCRIPTION: Hydrologic Design Parameters and Required Pump Capacity

Design Rainfall

The design rainfall is one PMF based on a 72-hour PMP of 41", to be stored and 90% evacuated in 10 days or less by pumps for all phases of construction until the decant pipe is installed and active for Phase 8. The decant pipe has been routed for draw down calculations using HEC-1.

Drainage Areas

Phase	Crest El.	DA (Ac.)	1 PMF Volume (Ac-ft)	1 PMF Volume (CY)	90% Volume (CY)	Pump Capacity Required (gpm)
7	500.0	97.9	334.492	539,646.56	485,681.90	6,811.69
	510.0	91.5	312.625	504,368.33	453,931.50	6,366.39
5A	490.0	44.80	153.067	246,947.56	222,252.80	3,117.10
	500.0	42.10	143.842	232,064.56	208,858.10	2,929.23
	510.0	39.50	134.958	217,732.78	195,959.50	2,748.33
5A/7	515.0	127.7	436.308	703,910.78	633,519.70	8,885.11
	525.0	120.4	411.367	663,671.56	597,304.40	8,377.19
	538.0	111.1	379.592	612,407.89	551,167.10	7,730.12
8	548.0	97.5	333.125	537,441.67	483,697.50	6,783.86
	558.0	90.9	310.575	501,061.00	450,954.90	6,324.64
	568.0	84.5	288.708	465,782.78	419,204.50	5,879.34
	588.0	72.2	246.683	397,982.44	358,184.20	5,023.53
2-3 Connector	502.0	37.3	127.442	205,605.89	185,045.30	2,595.26

Existing Pumping Capability

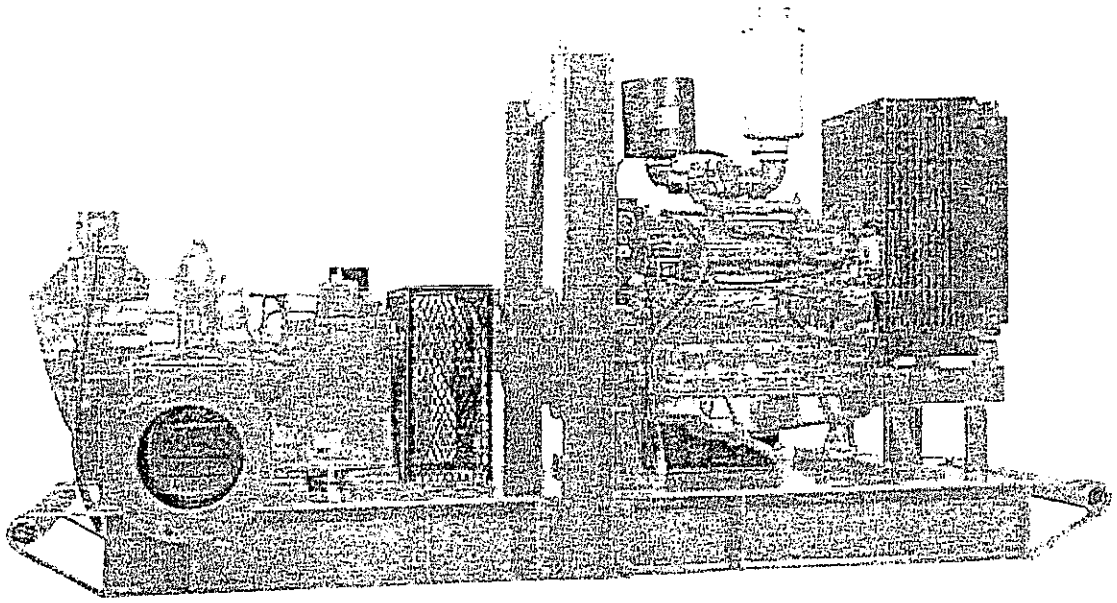
Diesel powered pumps are currently being used on site for existing storm evacuation requirements. Adequate pump capacity will be maintained onsite at all times. The current pumps maintained onsite are as follows:

Model	Size (in)	Capacity (gpm)	Qty.	Total Cap. (gpm)
Godwin DPC300	12	4,490	1	4,490
Godwin CD150M	6	1,700	2	3,400
Godwin CD100M	4	695	2	1,390
Total			5	9,280

The existing pump capacity onsite is more than adequate to meet the drawdown criteria with the greatest required capacity. This occurs when the crest of Phase 5A/7 is constructed to El. 515, and the required capacity will be 8,886 gpm. However, if the Phase 2-3 Connector is constructed one additional Godwin Model CD100M will be required to meet the required capacity. The required capacity in this case would be 10,326 gpm when the Phase5A/7 crest is constructed to El. 538.0, and the Phase 2-3 connector has been constructed.

R11706

DPC300 Dri-Prime® Pumps



The Godwin DPC300 automatic Dri-Prime 12" (300mm) centrifugal pump has gained recognition as the industry leader in high volume bypass pumping over the last fifteen years. With flows to 5,000 gallons per minute (315.5 l/sec.) and solids handling to 3-1/2" (89mm) in diameter, the DPC300 moves large volumes of water while providing the ease of automatic priming to 28 feet (8.5M). The convenience of a low profile discharge flange makes pipe connections easy and efficient. When the job calls for high volume, the Godwin DPC300 is the benchmark by which all others are judged.

Features

- Direct drive automatic priming 12" (300mm) high volume centrifugal pump with vacuum priming compressor mounted to a diesel engine. Available in electric drive or as bare shaft pumpend.
- All cast iron construction with 4 vane cast iron impeller.
- Extensive application flexibility — will handle raw sewage, sludges and liquids with solids up to 3-1/2" (89mm) in diameter.

  Continuously operated "Godwin" air ejector priming device requiring no form of periodic adjustment or control.

  Dry running, oil lubricated, mechanical seal with abrasion resistant solid silicon carbide interfaces.
- Solids handling swing check Non Return valve at pump discharge.
- Skid base incorporating integral overnight running fuel tank.

  Simple maintenance — normally limited to checking engine oil, compressor oil, and seal lubrication.
- Standard engine — John Deere 6068T. Available with a variety of engines including Cummins, Caterpillar and Deutz.

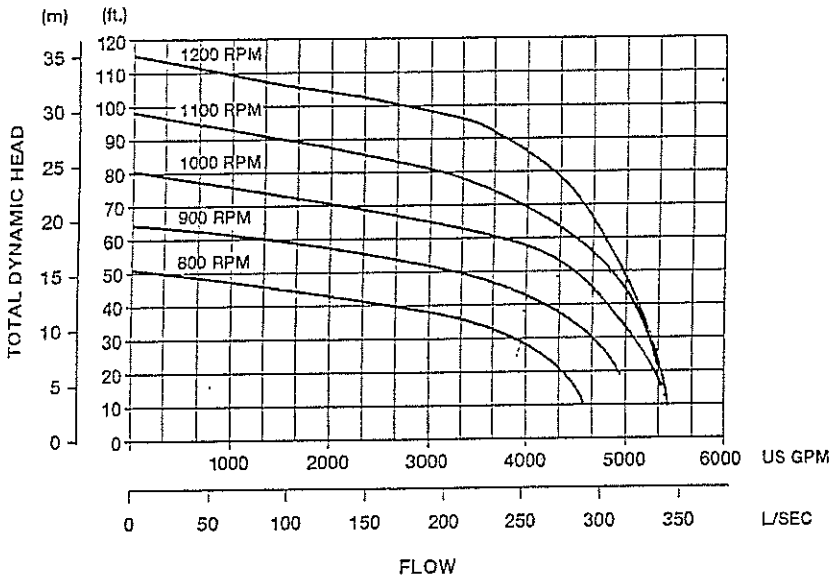
  Low profile side discharge for easy pipe connection.

  Balanced unit with centralized lifting bracket for easy handling.

  A variety of silenced units are available.

godwin pumps

DPC300 Performance Curve



Performance Table

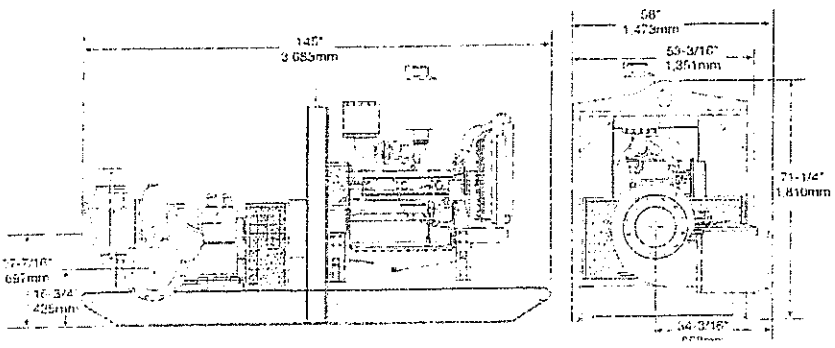
Diesel Set: John Deere 6068T, 151 hp (113kw) @ 2400 rpm, Skid Base
Impeller Diameter: 17 inches (430 mm)

	Total Delivery Head — Feet				
Total Suction Head — Feet	10	20	30	40	50
	Output — GPM				
10	5810	5620	5000	4490	3115
15	5500	5140	4710	4250	2900
20	4600	4500	4230	3130	1415
25	3875	3730	3250	2105	960

Performance data listed in table and curves are based on water tests at sea level and 68° F (20° C). Larger diameter pipes may be required for maximum flows.

Dimensions

DPC300 — John Deere 6068T, Skid Base
Weight: 7,265 lbs. (3,295 kg.)



Specifications

Maximum Operating Speed:
Engine: 2450 rpm/Pump: 1200 rpm
Maximum Operating Temperature:
+212° F (100° C)
Maximum Working Pressure:
52.0 psi (3.6 BAR)
Maximum Suction Pressure:
30 psi (2.1 BAR)
Maximum Casing Pressure:
75 psi (5.2 BAR)
Fuel Tank Capacity:
105 and 150 gal. sizes available
(397 and 548 liters)
Fuel Consumption:
7.8 gph (29.52 lph) @ 2400 rpm
(full load & max. speed)
Pipe Connections:
12 inch (300mm) ASA 150#
Solids Handling:
3-1/2" (89mm) diameter

Materials

Pump Casing, Suction Cover, Separation Tank and Wearplates:
Close Grained Cast Iron
Pump Shaft:
1-1/2% Nickel/Chromium Steel
Non Return Valve Body Ejector Housing:
Close Grained Cast Iron
Non Return Valve Flapper:
High Nitrile Rubber
Mechanical Seal Faces:
Solid Silicon Carbide

godwin pumps

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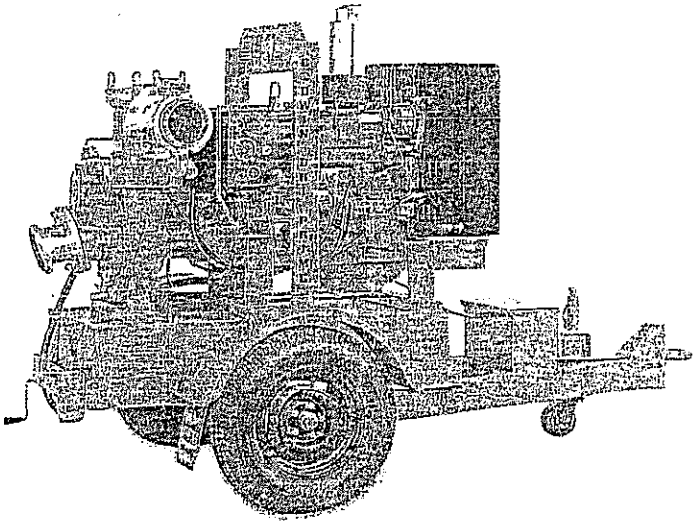
CD150M Dri-Prime® Pumps

The Godwin Dri-Prime six-inch(150mm) CD150M automatic priming centrifugal pump is clearly the backbone of the temporary portable pumping industry. With solids-handling to 3" (75 mm) in diameter, maximum flows of 1700 GPM (385.9 m³/h) and 160' (48.8 m) of total dynamic head, and indefinite dry-running capabilities, the CD150M can be found in a wide variety of applications from dewatering to sewage bypassing. Mounted on a highway trailer, the CD150M is the most maneuverable and versatile portable pumping system available, making it a favorite of contractors, municipalities, industry and environmental companies across the country.



Features

- Fully automatic priming from dry to 28' (8.5 m) of suction lift.
- Close coupled centrifugal pump with vacuum priming compressor mounted to a diesel engine. Also available in electric drive.
- Extensive application flexibility — will handle raw sewage, slurries and liquids with solids up to 3" (75 mm) in diameter.
- Dry running, oil bath mechanical seal with abrasion-resistant solid silicon carbide faces.
- Continuously operated Godwin venturi air ejector priming device featuring belt-driven air compressor requiring no form of periodic adjustment or control.
- All cast iron construction with cast chromium steel impelier.
- Standard John Deere 4045D-T2, John Deere 4045T-T3, or Caterpillar 3054C-NA engine. Also available with a variety of other engines including Hatz, Perkins and Deutz.

Specifications

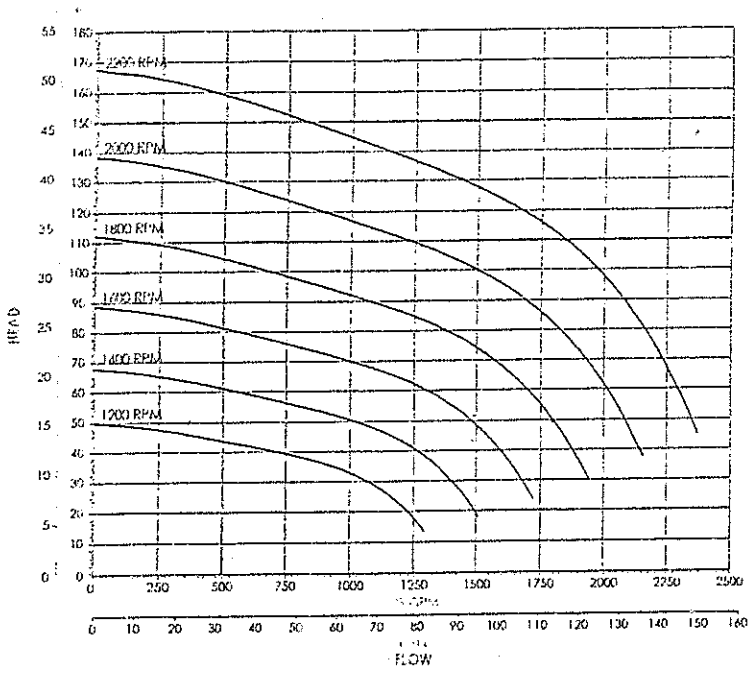
Pipe Connections	6" (150 mm) ASA150#
Max. Capacity	1700 GPM (385.9 m³/h)
Max. Head	160' (48.8 m)
Solids Handling	3" (75 mm)
Impeller Diameter	11" (279 mm)
Max. Op. Temp.	+212°F (100°C)
Max. Working Press.	58.5 psi (4 BAR)
Max. Suction Press.	40 psi (2.8 BAR)
Max. Test Press.	88 psi (6.1 BAR)
Max. Op. Speed	2200 RPM
Fuel Tank Capacity	30* - 100 gal (113.5 - 378.5 l)
Fuel Consumption @ 2200 RPM (Full Load)	JD4045D-T2 - 3.74 GPH (0.014 m³/h) JD4045T-T3 - 4.07 GPH (0.015 m³/h) CAT3054C-NA - 4.3 GPH (0.016 m³/h)

* 60 gal. (227 l) standard equipment

godwin pumps.

R11709

Pump Curves



Materials

Pump Casing, Suction Cover, Separation Tank, Weaplates, Non-Return Valve Body, Ejector Housing	Close-grained cast iron
Impeller	Cast chromium steel, hardened to minimum Brinell 341 HB
Non-Return Valve - Ball & Seat	High nitrile rubber
Mechanical Seal Faces	Solid silicon carbide
Pump Shaft	1½ Nickel/chromium steel

Performance Table

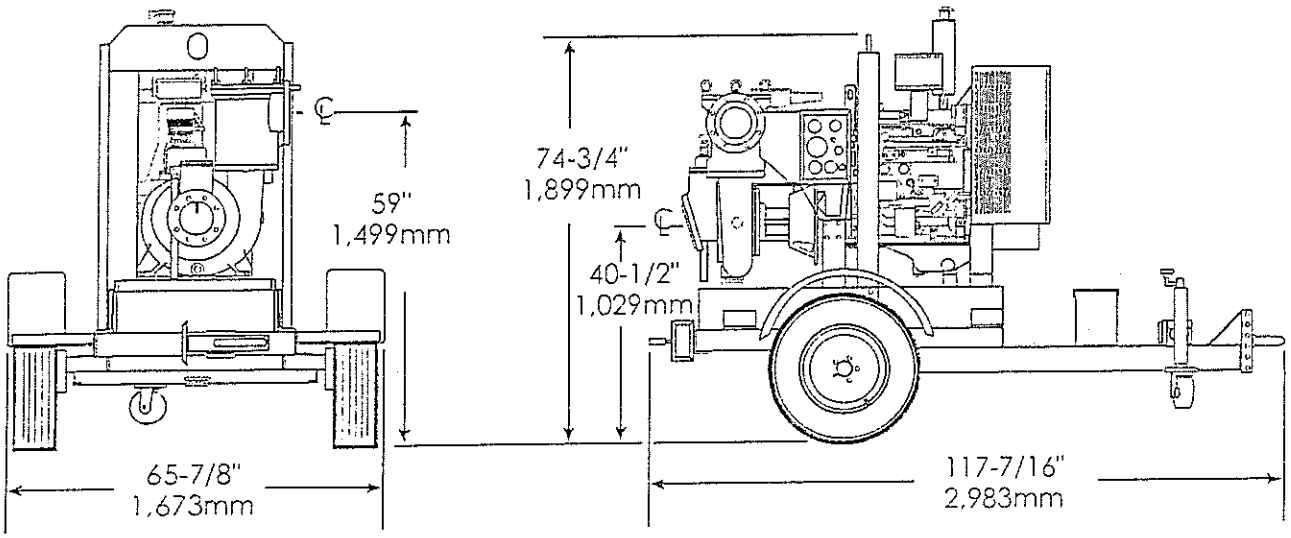
Diesel Set: JD4045D-T2, 68 HP (51 kW) @ 2200 RPM
JD4045T-T3, 71 HP (53 kW) @ 2200 RPM
CAT3054C-NA, 74 HP (55 kW) @ 2200 RPM
Impeller Diameter: 11" (279 mm)

Total Suction Head - Feet	Total Delivery Head - Feet 10	20	30	40	50
	Output - GPM				
10	1800	1780	1750	1700	1680
15	1700	1650	1600	1520	1400
20	1670	1590	1500	1380	1240
25	1500	1400	1340	1240	1100

Performance data listed in table and curves based on water tests at sea level and 68°F (20°C). Maximum flows may require larger diameter pipes.

Drawings

CD150M - John Deere 4045D, GP60 Highway Trailer
Dry weight - 3250 lbs. (1474 kg)



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godwin pumps®

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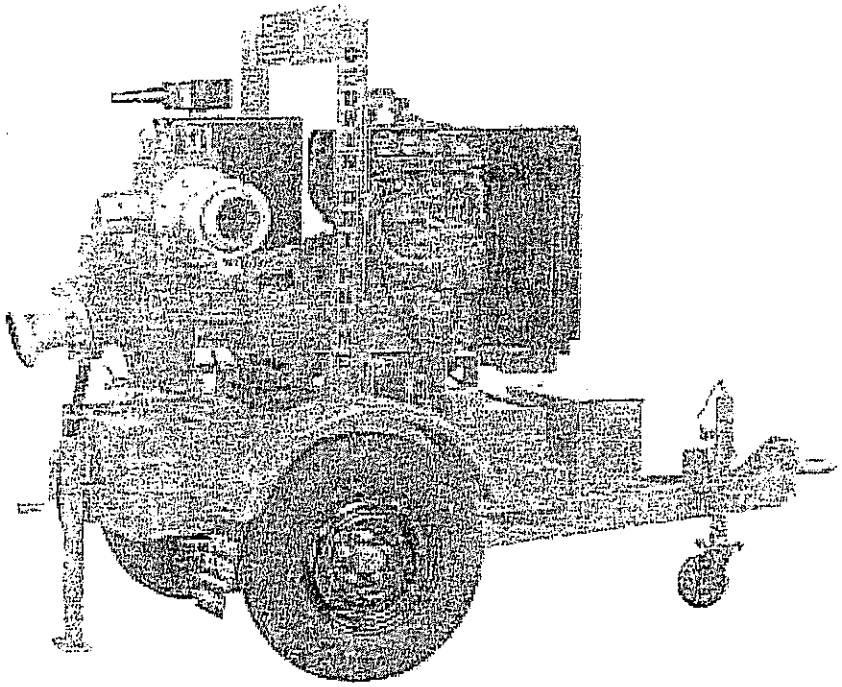
CD100M Dri-Prime® Pumps



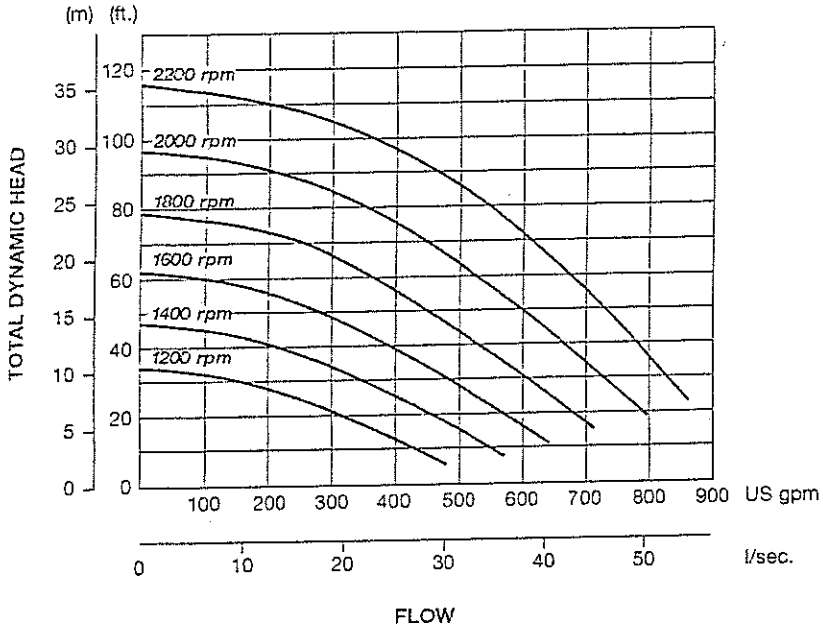
The Godwin Dri-Prime 4 inch (100mm) CD100M automatic priming centrifugal pump is a highly maneuverable portable trash pump with flow capabilities to 750 gallons per minute (47 liters per second), total dynamic heads to 115 feet (35 meters) and solids handling to 2 inch (50mm) in diameter. The unique Godwin venturi air evacuation system allows the CD100M to prime from dry conditions with suction lifts up to 28 feet (8.5 meters). Perfect in intermittent flow situations, the CD100M can run dry indefinitely without damage due to the oil bath mechanical seal design. For sewer bypass, general dewatering, and many other applications, the Godwin CD100M with 4 inch (100mm) hoses is a powerful, yet versatile and portable pumping system.

Features

- Close coupled centrifugal pump with vacuum priming compressor mounted to a diesel engine. Also available in electric drive or as bare shaft pumpend.
- All cast iron construction with cast chromium steel impeller.
- Extensive application flexibility — will handle raw sewage, slurries and liquids with solids up to 2 inch (50mm) in diameter.
- Recessed impeller version available handling solids in excess of 2-3/16 inch (56mm) in diameter.
- Continuously operated "Godwin" air ejector priming device requiring no form of periodic adjustment or control.
- Dry running, high pressure oil bath mechanical seal with abrasion resistant solid Silicon Carbide interfaces.
- Solids handling ball type Non Return Valve with renewable flexible rubber seat and quick release access feature.
- Compact unit mounted on skid base or two wheeled highway trailer both incorporating integral overnight running fuel tank.
- Simple maintenance — normally limited to checking engine and seal cavity oil levels.
- Standard engine — Yanmar 3TNV88 or Caterpillar 3013C. Available with a variety of engines including Hatz, Perkins and Deutz.
- A variety of silenced sets are available.

godwin pumps

CD100M Performance Curve



CD100M Performance Table

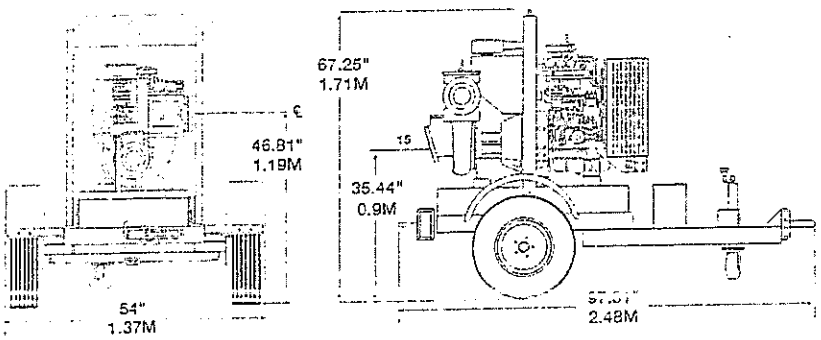
Diesel Set — Yanmar 3TNV88, 24 hp @ 2200 rpm
Caterpillar 3013C, 28 hp @ 2200 rpm
Impeller Diameter — 8-5/8 in. (220 mm)

	Total Delivery Head — Feet				
Total Suction Head - Feet	10	20	30	40	50
	Output — GPM				
10	720	710	700	695	690
15	615	580	530	500	450
20	510	490	475	430	375
25	450	440	400	390	350

Performance data listed in table and curves are based on water tests at sea level and 68° F (20° C). Larger diameter pipes may be required for maximum flows.

Dimensions

CD100M — Yanmar 3TNV88, GP30 Highway Trailer
Weight: 1734 lbs. (788 kg.)



Specifications

Maximum Operating Speed:
2200 rpm
Maximum Operating Temperature:
+212° F (100° C)
Maximum Working Pressure:
50.0 psi (3.4 BAR)
Maximum Suction Pressure:
40 psi (2.8 BAR)
Maximum Casing Pressure:
75.0 psi (5.2 BAR)
Fuel Tank Capacity:
30 to 100 gallons (30 gallon standard)
(113.5 to 378.5 liters)
Fuel Consumption (full load, max. speed):
Yanmar: 1.21 gph (4.58 lph) @ 2200 rpm
CAT: 1.67 gph (6.32 lph) @ 2200 rpm
Pipe Connections:
4" (100mm) ASA 150#
Solids Handling:
2" (50mm) dia. standard impeller
2-3/16" (56mm) dia. recessed impeller

Materials

Pump Casing, Suction Cover, Separation Tank and Wearplates:
Close grained cast iron
Impeller:
Cast chromium steel hardened to minimum Brinell 341 HB
Shaft Sleeve and Shaft:
1-1/2% nickel/chromium steel
Non Return Valve Body:
Close grained cast iron
Non Return Valve Ball and Seat:
High nitrile rubber
Mechanical Seal Faces:
Solid Silicon Carbide

godwin pumps

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BRANCH LOCATIONS:
Connecticut • Pennsylvania • New York • Ohio
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Georgia • South Carolina • North Carolina
Florida • Texas • Montana • California • Washington

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Alliance Consulting, Inc.
Engineers · Constructors · Scientists

PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2 **CALC. BY:** RPC 9-20-11

PROJECT NO.: B11-146-1413 **CHECKED BY:** CPW 9/4/11

DESCRIPTION: PHASE 8 DECANT 36" DR-17 HDPE PIPE

WEIR FLOW $Q=C_n D H^{1.5}$

$C=3.22+0.44(H/P)$

REF. MSHA MANUAL, PAGE 6.136

INLET DIAMETER(D)=	2.6259	FEET
WEIR HEIGHT(P)=	0.1	FEET
INLET EL.=	582	

ORIFICE FLOW $Q=CA(2gH)^{1/2}$

REF. HANDBOOK OF CONCRETE CULVERT PIPE HYDRAULICS, PORTLAND CEMENT ASSOCIATION, PAGE 70

DISCHARGE COEFFICIENT(C)=	0.8	
ORIFICE DIAMETER	2.6259	FEET
AREA(A)=	5.42	SQ. FT.
ORIFICE CONTROL ELEV.	582.0	

PRESSURE FLOW $Q=AV$

$V=(2GH/F(L/D)+K+1)^{1/2}$

$F=185(N^2/D^{0.33})$

REF. MSHA MANUAL, PAGE 6.154

MANNING'S N=	0.014	
PIPE LENGTH(L)=	125.33	FEET
ENERGY LOSSES(K)=	2.7	
OUTLET EL.=	570.24	
PIPE DIA. =	2.6259	FEET

ELEVATION	HEAD, FT.	Q.CFS		
		WEIR	ORIFICE	PRESSURE
582	0	0.00	0.00	66.96
582.5	0.5	15.81	24.58	68.37
582.7	0.7	30.44	29.09	68.92
583	1	62.86	34.77	69.75
583.3	1.3	109.32	39.64	70.56
583.5	1.5	148.83	42.58	71.10
584	2	280.46	49.17	72.43
584.5	2.5	463.70	54.97	73.73
585	3	703.85	60.22	75.01
585.5	3.5	1005.80	65.04	76.27
586	4	1374.04	69.54	77.51
586.5	4.5	1812.81	73.75	78.73
587	5	2326.10	77.74	79.93
587.42	5.42	2817.62	80.94	80.93
587.5	5.5	2917.69	81.54	81.12
588	6	3591.20	85.16	82.28

WEIR FLOW CONTROLS

ORIFICE FLOW CONTROLS

PRESSURE FLOW CONTROLS

```
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*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              MAY  1991                *
*            VERSION 4.0.1E             *
*                                       *
*  RUN DATE  10/03/2011  TIME  14:45:16 *
*                                       *
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```


```
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X      X  X        X                X
XXXXXXX   XXXX     X        XXXXX   X
X      X  X        X                X
X      X  X        X     X          X
X      X  XXXXXXX   XXXXX           XXX
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::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                  by                  :::
:::        Haestad Methods, Inc.         :::
:::                                      :::
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
```

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

Case 10/4/11

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

   1      ID  Facility No. 2 Phase 8 Decant
   2      IT       5 01JAN11    1000      865 04JAN11    1000       21
   3      IO       5        0

   4      KK  PMF
   5      KM  72-hour PMF
   6      KO                                      22
   7      BA   0.113
   8      PB      41
   9      IN      15 01JAN11    1000
  10      PI   0.015    0.015    0.015    0.015    0.015    0.015    0.015    0.015    0.015    0.015
  11      PI   0.015    0.015    0.015    0.015    0.015    0.015    0.015    0.015    0.015    0.015
  12      PI   0.015    0.015    0.015    0.015    0.018    0.018    0.018    0.018    0.018    0.018
  13      PI   0.018    0.018    0.018    0.018    0.018    0.018    0.018    0.018    0.018    0.018
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  16      PI   0.023    0.023    0.023    0.023    0.023    0.023    0.023    0.023    0.023    0.023
  17      PI   0.023    0.023    0.033    0.033    0.033    0.033    0.033    0.033    0.033    0.033
  18      PI   0.033    0.033    0.033    0.033    0.033    0.033    0.033    0.033    0.033    0.033
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  20      PI   0.049    0.050    0.050    0.051    0.051    0.052    0.053    0.054    0.054    0.055
  21      PI   0.056    0.057    0.058    0.059    0.060    0.061    0.062    0.063    0.064    0.066
  22      PI   0.117    0.122    0.126    0.131    0.136    0.141    0.147    0.152    0.158    0.165
  23      PI   0.170    0.176    0.182    0.188    0.195    0.202    0.208    0.215    0.222    0.230
  24      PI   0.237    0.244    0.252    0.260    0.289    0.380    0.455    0.515    0.558    0.587
  25      PI   0.669    0.856    0.845    1.002    2.354    4.611    4.973    3.381    1.290    0.854
  26      PI   0.886    0.783    0.595    0.575    0.538    0.487    0.419    0.336    0.113    0.109
  27      PI   0.106    0.102    0.099    0.096    0.093    0.091    0.088    0.086    0.083    0.081
  28      PI   0.079    0.077    0.076    0.074    0.074    0.071    0.070    0.069    0.068    0.067
  29      PI   0.067    0.066    0.041    0.041    0.041    0.041    0.041    0.041    0.041    0.041
  30      PI   0.041    0.041    0.041    0.041    0.041    0.041    0.041    0.041    0.041    0.041
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  38      PI   0.016    0.016    0.016    0.016    0.016    0.016    0.016    0.016
  39      LS       0      100
  40      UD       0

  41      KK  Phase8
  42      KM  Facility No. 2
  43      KO                                      22
  44      RS              ELEV      582
  45      SV  2640.2 3153.28
  46      SE     580      588
  47      SQ       0    15.81    29.09    34.77    39.64    42.58    49.17    54.97    60.22    65.04
  48      SQ   69.54    73.75    77.74    80.93    81.12    82.28
  49      SE     582    582.5    582.7      583    583.3    583.5      584    584.5      585    585.5
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  51      ZZ
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*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*               MAY   1991              *
*            VERSION 4.0.1E             *
*                                       *
*  RUN DATE  10/03/2011  TIME  14:45:16 *
*                                       *
*****************************************
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```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```


Facility No. 2 Phase 8 Decant

```
  3 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN           5  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1JAN11  STARTING DATE
                      ITIME        1000  STARTING TIME
                         NQ         865  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      4JAN11  ENDING DATE
                     NDTIME        1000  ENDING TIME
                      ICENT           0  CENTURY MARK

                  COMPUTATION INTERVAL     0.08 HOURS
                       TOTAL TIME BASE    72.00 HOURS

        ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
             TEMPERATURE            DEGREES FAHRENHEIT
```

*** ***

```
           **************
           *            *
  4 KK     *    PMF     *
           *            *
           **************

  6 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
```

```
                QSCAL          0.  HYDROGRAPH PLOT SCALE
                IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                 IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                ISAV2         865  LAST ORDINATE PUNCHED OR SAVED
               TIMINT       0.083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
 41 KK    *    Phase8  *
          *            *
          **************

 43 KO          OUTPUT CONTROL VARIABLES
                IPRNT           5  PRINT CONTROL
                IPLOT           0  PLOT CONTROL
                QSCAL          0.  HYDROGRAPH PLOT SCALE
                IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                 IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                ISAV2         865  LAST ORDINATE PUNCHED OR SAVED
               TIMINT       0.083  TIME INTERVAL IN HOURS
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER S ND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	PMF	1465.	39.25	347.	110.	42.	0.11		
ROUTED TO	Phase8	59.	42.08	58.	54.	27.	0.11	584.89	42.08

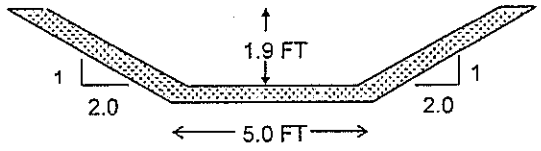
*** NORMAL END OF HEC-1 ***

CALCULATED BY: RPC 10/7/2011
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

USM DESIGN - DECANT DITCH

PEAK FLOW =	59.00	CFS
BOTTOM WIDTH =	5	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.3333	FT/FT
MANNING'S N =	0.015	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	6.69	FT	DEPTH OF FLOW =	0.38	FT
AREA OF FLOW =	2.18	SQ.FT.	MEAN DEPTH =	0.33	FT
HYDRAULIC RADIUS, Rh =	0.33	FT	FROUDE NO. =	8.25	SUPERCRITICAL
CALC. VELOCITY =	27.07	FPS			

FREEBOARD REQUIRED =	1.49	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	**1.9**	FT	

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

BY: RPC DATE: 10/7/2011 CHKD BY: _____ DATE: _____
PROJECT NAME: Mach No. 1 Mine, Facility No. 2 Phases 5A, 7, and 8
PROJECT NUMBER: B11-146-1413 SHEET: _____ OF: _____
DESCRIPTION: ARMORFORM DITCH LINING DECANT DITCH

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	59.00
BOTTOM WIDTH (ft), b=	5.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	30.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.47
AREA OF FLOW (sq ft), A=	2.79
WETTED PERIMETER (ft), P=	7.10
HYDRAULIC RADIUS (ft), R=	0.39
VELOCITY OF FLOW (fps), V=	30.69
LINING PERIMETER (ft)=	14.24
TOP WIDTH (ft)=	13.27
FREEBOARD (ft)=	1.60
TOTAL DITCH DEPTH (ft), d=	2.07

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 8.18

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 6.46

TOTAL STRESS

t (psf) = 8.18
T (lb/ft) = 58.06

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 12.26
(lb/ft) = 87.10

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\tan(d)-So\right)$$ (psf)= 5.99

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 4.49

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 5.02 Tr,t (lb/ft) = 71.47

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BY: RPC DATE: 10/7/2011 CHKD BY: _____ DATE: _____
PROJECT NAME: Mach No. 1 Mine, Facility No. 2 Phases 5A, 7, and 8
PROJECT NUMBER: B11-146-1413 SHEET: _____ OF: _____
DESCRIPTION: ARMORFORM DITCH LINING DECANT DITCH

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 7.25 (lb/ft) = 15.63

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

REBAR SIZE (#)= 5

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= 26.97

USE REBAR SPACING OF 20.00 20 ft MAXIMUM

RESISTANCE PROVIDED (psf)= 13.18

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), W= $\frac{Cw*H*Gw}{12*Z^{.33}}$

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Cw= 3.7

W (lbs)= 7.19

MAT WEIGHT (lbs), Wm= $\frac{t(Gc-Gw)}{12}$

Wm= 25.87

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: USE 4 INCH USM WITH ROOF BOLT (#5) ANCHORS ON 20 FOOT SPACING.

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

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CALC. BY: RPC DATE: 8/19/2011 CHKD. BY: DATE:
PROJECT NAME: MACH NO. 1 MINE, FACILITY NO. 2 WEST OF DIWANA
PROJECT NUMBER: B11-146-1413 SHEET 1 OF 1
DESCRIPTION: TRASH RACK SIZE AND FLOW SPACING

Calculation to size trash rack for Phase 8 decant.

From HEC-1 analysis - Q = 59 cfs.

For Velocity (V) through trash rack < 2 ft/s :
Q = VA, set V = 2 ft/s
A_n = 59 / 2
A_n = 29.5 ft^2

Try 5' x 5' x 18" rack.
Area top = (5 x 5) = 25 ft^2
Area sides = (4)(1.5x5) = 30 ft^2
Area (gross) = A_g = 55 ft^2

With #4 bars at 4" spacing
Bars on top = (2)(5 / (4/12) - 1) = 28
Bars on sides (horizontal)= (4)[(1.5 / (4/12) - 1)] = 16
Bars on sides (vertical)= (4)[(5 / (4/12) - 1)] = 56

Area of bar (top and long side) = A_b = [(0.5/12) x 5] = 0.2083 ft^2/bar
Area of bar (short side) = [(.5/12) x 1.5] = 0.0625 ft^2/bar

Total area of bars A_b = (28 + 16)(0.2083) + 56(0.0625) = 12.667 ft^2

$A_n = A_g - A_b$ = 42.333 ft^2 > 29.5 ft^2 OK

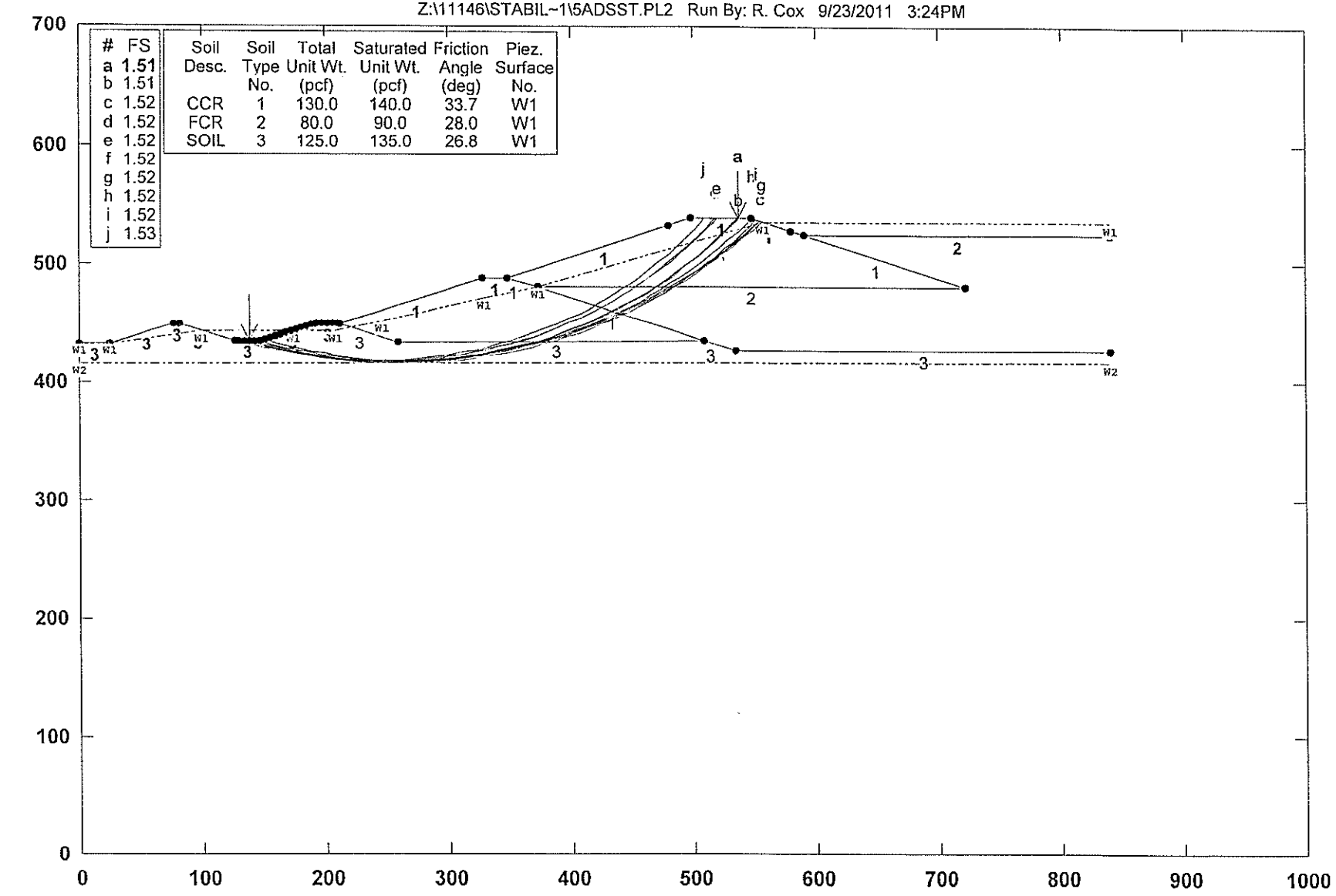
Check Flow
V = Q /A
V = 59 / 42.333 = 1.393701 ft/s < 2 ft/s OK

Use 5' x 5' x 18" trash rack with #4 bars at 4" spacing.

Page No. 156 R11721

Phase 5A/7 - Section D-D Downstream Static Whole Slope Circle

Z:\11146\STABIL~1\5ADSST.PL2 Run By: R. Cox 9/23/2011 3:24PM



PCSTABL5M/si FSmin=1.51

Safety Factors Are Calculated By The Modified Bishop Method

STED



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                    ** PCSTABL5M **
                          by
                    Purdue University
                --Slope Stability Analysis--
            Simplified Janbu, Simplified Bishop
               or Spencer`s Method of Slices
 Run Date:                    9/23/2011
 Time of Run:                 3:24PM
 Run By:                      R. Cox
 Input Data Filename:         Z:5adsst.
 Output Filename:             Z:5adsst.OUT
 Unit:                        ENGLISH
 Plotted Output Filename:     Z:5adsst.PLT
 PROBLEM DESCRIPTION    Phase 5A/7 - Section D-D
                        Downstream Static Whole Slope Circle
 BOUNDARY COORDINATES
    13 Top   Boundaries
    21 Total Boundaries
 Boundary     X-Left      Y-Left     X-Right     Y-Right     Soil Type
    No.         (ft)        (ft)        (ft)        (ft)     Below Bnd
     1           .00      431.59       25.25      431.74         3
     2         25.25      431.74       77.02      449.00         3
     3         77.02      449.00       82.02      449.00         3
     4         82.02      449.00      126.72      434.10         3
     5        126.72      434.10      146.72      434.10         3
     6        146.72      434.10      191.42      449.00         3
     7        191.42      449.00      211.42      449.00         3
     8        211.42      449.00      328.42      488.00         1
     9        328.42      488.00      348.42      488.00         1
    10        348.42      488.00      498.42      538.00         1
    11        498.42      538.00      548.42      538.00         1
    12        548.42      538.00      590.42      524.00         1
    13        590.42      524.00      840.00      524.00         2
    14        590.42      524.00      722.42      480.00         1
    15        348.42      488.00      372.42      480.00         1
    16        372.42      480.00      722.42      480.00         2
    17        372.42      480.00      508.62      434.60         1
    18        211.42      449.00      258.90      433.17         3
    19        258.90      433.17      508.62      434.60         3
    20        508.62      434.60      534.42      426.00         3
    21        534.42      426.00      840.00      426.00         3
 ISOTROPIC SOIL PARAMETERS
   3 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.   (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)    No.
   1    130.0    140.0       .0      33.7     .00        .0      1
   2     80.0     90.0       .0      28.0     .00        .0      1
   3    125.0    135.0       .0      26.8     .00        .0      1
 2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
 Unit Weight of Water =  62.40
 Piezometric Surface No.  1 Specified by 11 Coordinate Points
   Point      X-Water     Y-Water
    No.         (ft)        (ft)
     1           .00      431.59
     2         25.25      431.74
     3         99.36      443.22
     4        174.08      443.22
     5        208.42      443.22
     6        246.05      450.50
     7        328.91      471.00
     8        372.42      480.00
     9        372.43      480.00
    10        557.42      535.00
    11        840.00      535.00
 Piezometric Surface No.  2 Specified by  2 Coordinate Points
   Point      X-Water     Y-Water
```

No.	(ft)	(ft)
1	.00	415.86
2	840.00	416.63

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 130.00 ft.
and X = 210.00 ft.
Each Surface Terminates Between X = 480.00 ft.
and X = 580.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =416.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 45 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	138.42	434.10
2	148.00	431.21
3	157.64	428.57
4	167.35	426.18
5	177.12	424.04
6	186.94	422.15
7	196.80	420.52
8	206.71	419.14
9	216.64	418.01
10	226.61	417.14
11	236.59	416.53
12	246.58	416.18
13	256.58	416.09
14	266.58	416.25
15	276.57	416.67
16	286.55	417.35
17	296.50	418.28
18	306.43	419.47
19	316.33	420.92
20	326.18	422.62
21	335.99	424.57
22	345.74	426.78
23	355.44	429.23
24	365.06	431.94
25	374.62	434.89
26	384.09	438.09
27	393.48	441.53
28	402.78	445.22
29	411.98	449.14
30	421.07	453.29
31	430.06	457.68
32	438.93	462.30
33	447.68	467.15
34	456.29	472.22
35	464.78	477.51
36	473.13	483.02
37	481.33	488.74
38	489.38	494.67
39	497.28	500.80
40	505.01	507.14
41	512.58	513.68
42	519.98	520.40
43	527.20	527.32
44	534.24	534.42
45	537.62	538.00

Circle Center At X = 255.3 ; Y = 804.1 and Radius, 388.0

*** 1.513 ***
Individual data on the 64 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	8.3	1402.6	4722.5	5610.0	.0	.0	.0	.0	.0
2	1.3	500.8	747.1	982.1	.0	.0	.0	.0	.0
3	9.6	8127.3	4496.3	8317.5	.0	.0	.0	.0	.0
4	9.7	15708.8	2466.3	9887.6	.0	.0	.0	.0	.0
5	6.7	15133.9	496.5	7643.4	.0	.0	.0	.0	.0
6	3.0	7923.3	.0	3658.2	.0	.0	.0	.0	.0
7	9.8	29933.6	.0	12558.6	.0	.0	.0	.0	.0
8	4.5	15792.2	.0	6078.0	.0	.0	.0	.0	.0
9	5.4	20067.6	.0	7579.7	.0	.0	.0	.0	.0
10	9.9	38436.1	.0	14598.0	.0	.0	.0	.0	.0
11	1.7	6824.8	.0	2599.4	.0	.0	.0	.0	.0
12	3.0	12064.0	.0	4576.3	.0	.0	.0	.0	.0
13	5.2	21993.5	.0	8376.4	.0	.0	.0	.0	.0
14	4.6	20935.1	.0	7840.9	.0	.0	.0	.0	.0
15	5.3	25527.8	.0	9436.3	.0	.0	.0	.0	.0
16	10.0	52214.1	.0	18912.1	.0	.0	.0	.0	.0
17	9.5	54411.0	.0	19269.9	.0	.0	.0	.0	.0
18	.5	3196.5	.0	1109.5	.0	.0	.0	.0	.0
19	9.1	56887.7	.0	19677.2	.0	.0	.0	.0	.0
20	.9	5735.9	.0	1978.4	.0	.0	.0	.0	.0
21	.6	3933.8	.0	1356.3	.0	.0	.0	.0	.0
22	1.7	11270.0	.0	3882.6	.0	.0	.0	.0	.0
23	7.7	52058.6	.0	17895.5	.0	.0	.0	.0	.0
24	10.0	71388.8	.0	24456.4	.0	.0	.0	.0	.0
25	10.0	75103.0	.0	25620.7	.0	.0	.0	.0	.0
26	10.0	78401.5	.0	26626.7	.0	.0	.0	.0	.0
27	9.9	81276.6	.0	27473.4	.0	.0	.0	.0	.0
28	9.9	83724.1	.0	28160.6	.0	.0	.0	.0	.0
29	9.9	85740.0	.0	28687.6	.0	.0	.0	.0	.0
30	2.2	19757.5	.0	6601.7	.0	.0	.0	.0	.0
31	.5	4335.5	.0	1448.2	.0	.0	.0	.0	.0
32	7.1	62006.2	.0	21120.9	.0	.0	.0	.0	.0
33	9.8	83204.3	.0	29214.3	.0	.0	.0	.0	.0
34	2.7	22341.7	.0	8038.8	.0	.0	.0	.0	.0
35	7.0	58558.9	.0	20979.9	.0	.0	.0	.0	.0
36	9.6	81057.2	.0	28662.3	.0	.0	.0	.0	.0
37	6.1	51281.8	.0	17912.3	.0	.0	.0	.0	.0
38	1.3	11012.8	.0	3809.8	.0	.0	.0	.0	.0
39	.0	84.7	.0	29.8	.0	.0	.0	.0	.0
40	2.2	18506.1	.0	6276.3	.0	.0	.0	.0	.0
41	9.5	79190.7	.0	27278.8	.0	.0	.0	.0	.0
42	9.4	76738.5	.0	26970.2	.0	.0	.0	.0	.0
43	9.3	73929.8	.0	26500.9	.0	.0	.0	.0	.0
44	9.2	70780.4	.0	25871.3	.0	.0	.0	.0	.0
45	9.1	67307.9	.0	25081.7	.0	.0	.0	.0	.0
46	9.0	63531.3	.0	24132.8	.0	.0	.0	.0	.0
47	3.6	24785.3	.0	9580.5	.0	.0	.0	.0	.0
48	5.2	35270.3	.0	13444.5	.0	.0	.0	.0	.0
49	8.7	58800.3	.0	21759.3	.0	.0	.0	.0	.0
50	8.6	57568.7	.0	20336.4	.0	.0	.0	.0	.0
51	8.5	56090.2	.0	18757.3	.0	.0	.0	.0	.0
52	3.8	24704.4	.0	7923.2	.0	.0	.0	.0	.0
53	4.6	29327.7	.0	9099.6	.0	.0	.0	.0	.0
54	8.2	50032.5	.0	15134.5	.0	.0	.0	.0	.0
55	8.1	45590.6	.0	13093.3	.0	.0	.0	.0	.0
56	7.9	40967.8	.0	10900.7	.0	.0	.0	.0	.0
57	1.1	5605.6	.0	1417.0	.0	.0	.0	.0	.0
58	6.6	29644.5	.0	7141.1	.0	.0	.0	.0	.0
59	7.6	27886.2	.0	6067.1	.0	.0	.0	.0	.0
60	7.4	20565.8	.0	3429.3	.0	.0	.0	.0	.0
61	5.2	10375.9	.0	753.3	.0	.0	.0	.0	.0

62	2.0	2985.8	.0	.0	.0	.0	.0	.0	.0
63	7.0	6526.9	.0	.0	.0	.0	.0	.0	.0
64	3.4	784.6	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 45 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	142.63	434.10
2	152.20	431.19
3	161.84	428.53
4	171.54	426.12
5	181.31	423.97
6	191.13	422.07
7	200.99	420.43
8	210.90	419.05
9	220.83	417.94
10	230.80	417.08
11	240.78	416.48
12	250.77	416.15
13	260.77	416.08
14	270.77	416.27
15	280.76	416.72
16	290.74	417.44
17	300.69	418.42
18	310.61	419.65
19	320.50	421.15
20	330.34	422.91
21	340.14	424.92
22	349.88	427.19
23	359.55	429.71
24	369.16	432.49
25	378.69	435.52
26	388.14	438.80
27	397.50	442.32
28	406.76	446.09
29	415.92	450.10
30	424.97	454.35
31	433.91	458.83
32	442.73	463.55
33	451.42	468.50
34	459.98	473.67
35	468.40	479.07
36	476.67	484.68
37	484.80	490.51
38	492.77	496.55
39	500.57	502.80
40	508.22	509.25
41	515.68	515.90
42	522.98	522.74
43	530.09	529.77
44	537.01	536.99
45	537.93	538.00

Circle Center At X = 258.5 ; Y = 797.3 and Radius, 381.3

*** 1.514 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.00	434.10
2	139.62	431.37
3	149.30	428.85
4	159.03	426.56
5	168.82	424.49
6	178.64	422.65
7	188.51	421.03
8	198.41	419.63
9	208.35	418.46
10	218.30	417.52
11	228.28	416.81

12	238.26	416.32
13	248.26	416.06
14	258.26	416.03
15	268.26	416.23
16	278.25	416.65
17	288.23	417.31
18	298.19	418.19
19	308.13	419.30
20	318.04	420.63
21	327.92	422.19
22	337.75	423.98
23	347.55	425.99
24	357.30	428.22
25	366.99	430.68
26	376.63	433.35
27	386.20	436.24
28	395.70	439.36
29	405.13	442.68
30	414.48	446.23
31	423.75	449.98
32	432.93	453.95
33	442.02	458.12
34	451.01	462.50
35	459.90	467.09
36	468.68	471.87
37	477.35	476.86
38	485.90	482.04
39	494.33	487.41
40	502.64	492.98
41	510.82	498.73
42	518.86	504.67
43	526.77	510.79
44	534.54	517.09
45	542.16	523.57
46	549.63	530.22
47	555.46	535.65

Circle Center At X = 254.6 ; Y = 854.2 and Radius, 438.2

*** 1.517 ***

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	134.21	434.10
2	143.77	431.16
3	153.41	428.49
4	163.11	426.08
5	172.88	423.94
6	182.70	422.06
7	192.57	420.46
8	202.48	419.12
9	212.43	418.06
10	222.40	417.28
11	232.38	416.76
12	242.38	416.52
13	252.38	416.56
14	262.37	416.87
15	272.36	417.45
16	282.32	418.30
17	292.26	419.43
18	302.16	420.83
19	312.02	422.50
20	321.83	424.44
21	331.58	426.65
22	341.27	429.13
23	350.89	431.87
24	360.42	434.87
25	369.88	438.14
26	379.24	441.66

27	388.50	445.44
28	397.65	449.47
29	406.69	453.74
30	415.60	458.27
31	424.39	463.04
32	433.05	468.04
33	441.57	473.29
34	449.94	478.76
35	458.15	484.46
36	466.21	490.38
37	474.10	496.53
38	481.82	502.88
39	489.36	509.45
40	496.72	516.22
41	503.89	523.19
42	510.87	530.35
43	517.65	537.71
44	517.90	538.00

Circle Center At X = 246.1 ; Y = 781.2 and Radius, 364.7

*** 1.518 ***

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	134.21	434.10
2	143.79	431.21
3	153.43	428.59
4	163.15	426.22
5	172.93	424.12
6	182.76	422.28
7	192.63	420.71
8	202.55	419.41
9	212.49	418.37
10	222.46	417.60
11	232.45	417.10
12	242.45	416.88
13	252.45	416.92
14	262.44	417.23
15	272.43	417.81
16	282.39	418.66
17	292.33	419.78
18	302.23	421.17
19	312.09	422.82
20	321.91	424.74
21	331.67	426.92
22	341.36	429.37
23	350.99	432.07
24	360.54	435.04
25	370.01	438.26
26	379.38	441.74
27	388.66	445.46
28	397.84	449.44
29	406.90	453.66
30	415.85	458.13
31	424.67	462.84
32	433.37	467.78
33	441.92	472.95
34	450.34	478.36
35	458.60	483.99
36	466.71	489.84
37	474.66	495.91
38	482.44	502.19
39	490.05	508.67
40	497.48	515.36
41	504.73	522.25
42	511.79	529.33
43	518.66	536.60
44	519.91	538.00

Circle Center At X = 245.9 ; Y = 787.3 and Radius, 370.4
*** 1.518 ***
Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.00	434.10
2	139.63	431.41
3	149.32	428.95
4	159.07	426.70
5	168.86	424.68
6	178.70	422.88
7	188.57	421.30
8	198.48	419.95
9	208.42	418.82
10	218.38	417.92
11	228.35	417.24
12	238.34	416.80
13	248.34	416.57
14	258.34	416.58
15	268.34	416.81
16	278.33	417.27
17	288.30	417.96
18	298.26	418.87
19	308.20	420.01
20	318.10	421.38
21	327.98	422.97
22	337.81	424.78
23	347.60	426.81
24	357.34	429.07
25	367.03	431.55
26	376.66	434.25
27	386.23	437.16
28	395.72	440.29
29	405.15	443.64
30	414.49	447.20
31	423.75	450.97
32	432.93	454.95
33	442.01	459.14
34	450.99	463.53
35	459.87	468.13
36	468.65	472.92
37	477.31	477.92
38	485.86	483.11
39	494.29	488.49
40	502.59	494.06
41	510.77	499.82
42	518.81	505.77
43	526.71	511.89
44	534.48	518.19
45	542.10	524.67
46	549.56	531.32
47	554.54	535.96

Circle Center At X = 253.1 ; Y = 856.9 and Radius, 440.3
*** 1.519 ***
Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	138.42	434.10
2	148.04	431.37
3	157.72	428.86
4	167.46	426.59
5	177.25	424.54
6	187.08	422.71
7	196.95	421.12
8	206.86	419.76
9	216.80	418.64
10	226.76	417.74

11	236.73	417.08
12	246.72	416.65
13	256.72	416.45
14	266.72	416.49
15	276.72	416.76
16	286.71	417.27
17	296.68	418.01
18	306.63	418.98
19	316.56	420.18
20	326.46	421.62
21	336.32	423.29
22	346.13	425.18
23	355.91	427.31
24	365.62	429.66
25	375.29	432.24
26	384.88	435.04
27	394.42	438.07
28	403.87	441.32
29	413.25	444.79
30	422.55	448.48
31	431.75	452.39
32	440.87	456.50
33	449.88	460.83
34	458.79	465.37
35	467.59	470.12
36	476.28	475.07
37	484.85	480.22
38	493.30	485.58
39	501.62	491.12
40	509.81	496.86
41	517.86	502.79
42	525.77	508.91
43	533.53	515.21
44	541.15	521.69
45	548.61	528.35
46	555.92	535.18
47	556.17	535.42

Circle Center At X = 260.1 ; Y = 844.4 and Radius, 427.9

*** 1.520 ***

Failure Surface Specified By 45 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	146.84	434.14
2	156.46	431.39
3	166.13	428.87
4	175.87	426.60
5	185.67	424.57
6	195.51	422.79
7	205.39	421.26
8	215.30	419.98
9	225.25	418.94
10	235.22	418.15
11	245.21	417.62
12	255.20	417.33
13	265.20	417.29
14	275.20	417.51
15	285.19	417.97
16	295.16	418.69
17	305.12	419.65
18	315.04	420.86
19	324.93	422.33
20	334.79	424.03
21	344.59	425.99
22	354.35	428.19
23	364.05	430.63
24	373.68	433.32
25	383.24	436.24

26	392.73	439.41
27	402.13	442.81
28	411.45	446.45
29	420.67	450.31
30	429.79	454.41
31	438.81	458.74
32	447.71	463.29
33	456.50	468.06
34	465.17	473.05
35	473.71	478.25
36	482.11	483.67
37	490.38	489.30
38	498.50	495.13
39	506.48	501.16
40	514.30	507.39
41	521.96	513.82
42	529.46	520.43
43	536.79	527.23
44	543.95	534.21
45	547.64	538.00

Circle Center At X = 261.6 ; Y = 816.5 and Radius, 399.2

*** 1.521 ***

Failure Surface Specified By 45 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.05	435.54
2	160.60	432.57
3	170.22	429.85
4	179.91	427.37
5	189.66	425.15
6	199.46	423.17
7	209.32	421.46
8	219.21	419.99
9	229.13	418.78
10	239.09	417.83
11	249.06	417.13
12	259.05	416.69
13	269.05	416.51
14	279.05	416.59
15	289.05	416.92
16	299.03	417.51
17	308.99	418.36
18	318.93	419.47
19	328.84	420.83
20	338.71	422.44
21	348.53	424.31
22	358.30	426.44
23	368.02	428.81
24	377.67	431.43
25	387.25	434.31
26	396.75	437.42
27	406.17	440.78
28	415.50	444.39
29	424.73	448.23
30	433.86	452.31
31	442.88	456.62
32	451.79	461.16
33	460.58	465.94
34	469.24	470.93
35	477.77	476.15
36	486.16	481.59
37	494.41	487.24
38	502.51	493.10
39	510.46	499.17
40	518.25	505.44
41	525.87	511.91
42	533.33	518.58

43	540.61	525.43
44	547.71	532.47
45	551.90	536.84

Circle Center At X = 271.1 ; Y = 804.4 and Radius, 387.9

*** 1.524 ***

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	134.21	434.10
2	143.79	431.22
3	153.44	428.61
4	163.16	426.27
5	172.95	424.20
6	182.78	422.41
7	192.67	420.89
8	202.59	419.65
9	212.55	418.69
10	222.52	418.01
11	232.51	417.60
12	242.51	417.48
13	252.51	417.63
14	262.50	418.07
15	272.48	418.78
16	282.43	419.78
17	292.35	421.05
18	302.23	422.60
19	312.06	424.42
20	321.83	426.52
21	331.55	428.89
22	341.19	431.54
23	350.76	434.45
24	360.24	437.62
25	369.63	441.07
26	378.92	444.77
27	388.10	448.73
28	397.17	452.95
29	406.12	457.42
30	414.93	462.13
31	423.62	467.10
32	432.15	472.30
33	440.55	477.74
34	448.78	483.41
35	456.85	489.31
36	464.76	495.44
37	472.49	501.78
38	480.04	508.34
39	487.40	515.10
40	494.58	522.07
41	501.55	529.24
42	508.32	536.60
43	509.54	538.00

Circle Center At X = 241.9 ; Y = 774.9 and Radius, 357.4

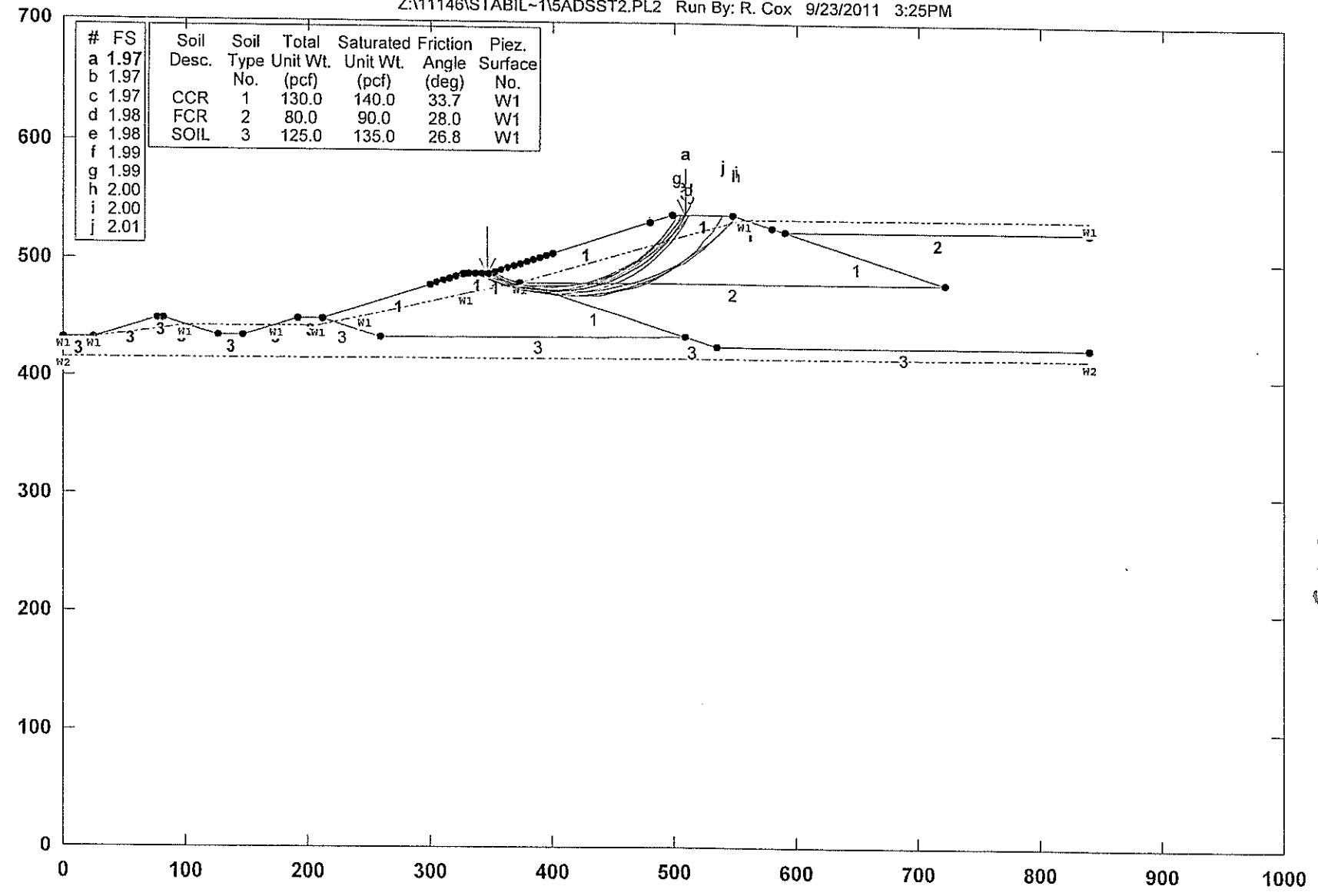
*** 1.527 ***

Phase 5A/7 - Section D-D Downstream Static Shallow Slope Circle

Z:\11146\STABIL~1\5ADSST2.PL2 Run By: R. Cox 9/23/2011 3:25PM

#	FS
a	1.97
b	1.97
c	1.97
d	1.98
e	1.98
f	1.99
g	1.99
h	2.00
i	2.00
j	2.01

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
SOIL	3	125.0	135.0	26.8	W1



PCSTABL5M/si FSmin=1.97

Safety Factors Are Calculated By The Modified Bishop Method

STED



6431.12 Part 3

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                    ** PCSTABL5M **
                          by
                    Purdue University
                --Slope Stability Analysis--
            Simplified Janbu, Simplified Bishop
               or Spencer`s Method of Slices
 Run Date:                    9/23/2011
 Time of Run:                 3:25PM
 Run By:                      R. Cox
 Input Data Filename:         Z:5ADSST2.
 Output Filename:             Z:5ADSST2.OUT
 Unit:                        ENGLISH
 Plotted Output Filename:     Z:5ADSST2.PLT
 PROBLEM DESCRIPTION   Phase 5A/7 - Section D-D
                       Downstream Static Shallow Slope Circle
 BOUNDARY COORDINATES
    13 Top   Boundaries
    21 Total Boundaries
 Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
    No.         (ft)       (ft)       (ft)       (ft)    Below Bnd
     1           .00     431.59      25.25     431.74        3
     2         25.25     431.74      77.02     449.00        3
     3         77.02     449.00      82.02     449.00        3
     4         82.02     449.00     126.72     434.10        3
     5        126.72     434.10     146.72     434.10        3
     6        146.72     434.10     191.42     449.00        3
     7        191.42     449.00     211.42     449.00        3
     8        211.42     449.00     328.42     488.00        1
     9        328.42     488.00     348.42     488.00        1
    10        348.42     488.00     498.42     538.00        1
    11        498.42     538.00     548.42     538.00        1
    12        548.42     538.00     590.42     524.00        1
    13        590.42     524.00     840.00     524.00        2
    14        590.42     524.00     722.42     480.00        1
    15        348.42     488.00     372.42     480.00        1
    16        372.42     480.00     722.42     480.00        2
    17        372.42     480.00     508.62     434.60        1
    18        211.42     449.00     258.90     433.17        3
    19        258.90     433.17     508.62     434.60        3
    20        508.62     434.60     534.42     426.00        3
    21        534.42     426.00     840.00     426.00        3
ISOTROPIC SOIL PARAMETERS
  3 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.   (pcf)     (pcf)     (psf)     (deg)   Param.     (psf)    No.
   1    130.0     140.0        .0      33.7     .00        .0      1
   2     80.0      90.0        .0      28.0     .00        .0      1
   3    125.0     135.0        .0      26.8     .00        .0      1
 2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
 Unit Weight of Water =  62.40
 Piezometric Surface No.  1 Specified by 11 Coordinate Points
   Point      X-Water    Y-Water
    No.         (ft)       (ft)
     1           .00     431.59
     2         25.25     431.74
     3         99.36     443.22
     4        174.08     443.22
     5        208.42     443.22
     6        246.05     450.50
     7        328.91     471.00
     8        372.42     480.00
     9        372.43     480.00
    10        557.42     535.00
    11        840.00     535.00
 Piezometric Surface No.  2 Specified by  2 Coordinate Points
   Point      X-Water    Y-Water
```

No.	(ft)	(ft)
1	.00	415.86
2	840.00	416.63

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 300.00 ft.
and X = 400.00 ft.
Each Surface Terminates Between X = 480.00 ft.
and X = 580.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =416.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	347.37	488.00
2	356.37	483.65
3	365.71	480.07
4	375.32	477.29
5	385.12	475.33
6	395.06	474.20
7	405.05	473.91
8	415.04	474.46
9	424.94	475.85
10	434.69	478.07
11	444.22	481.10
12	453.46	484.92
13	462.35	489.51
14	470.81	494.83
15	478.80	500.84
16	486.26	507.51
17	493.13	514.77
18	499.36	522.59
19	504.91	530.91
20	508.83	538.00

Circle Center At X = 403.5 ; Y = 592.5 and Radius, 118.6
*** 1.966 ***
Individual data on the 27 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.1	34.7	.0	.0	.0	.0	.0	.0	.0
2	8.0	3882.4	.0	.0	.0	.0	.0	.0	.0
3	9.3	12562.4	.0	.0	.0	.0	.0	.0	.0
4	2.9	5572.7	.0	.0	.0	.0	.0	.0	.0
5	3.8	8231.9	.0	225.2	.0	.0	.0	.0	.0
6	.0	23.4	.0	1.2	.0	.0	.0	.0	.0
7	2.9	7048.9	.0	489.7	.0	.0	.0	.0	.0
8	9.8	27708.1	.0	3597.3	.0	.0	.0	.0	.0
9	2.0	6332.8	.0	1072.3	.0	.0	.0	.0	.0
10	7.9	27128.4	.0	5207.6	.0	.0	.0	.0	.0
11	10.0	38877.2	.0	8478.8	.0	.0	.0	.0	.0
12	10.0	43323.9	.0	10178.4	.0	.0	.0	.0	.0
13	9.9	46654.5	.0	11366.6	.0	.0	.0	.0	.0
14	9.8	48786.0	.0	12035.1	.0	.0	.0	.0	.0
15	6.1	31475.6	.0	7775.6	.0	.0	.0	.0	.0
16	3.5	18108.8	.0	4403.5	.0	.0	.0	.0	.0
17	9.2	47949.0	.0	11797.5	.0	.0	.0	.0	.0
18	8.9	44612.3	.0	10893.0	.0	.0	.0	.0	.0
19	8.5	40054.1	.0	9472.2	.0	.0	.0	.0	.0

20	8.0	34511.8	.0	7545.0	.0	.0	.0	.0	.0
21	7.5	28266.1	.0	5125.1	.0	.0	.0	.0	.0
22	6.9	21632.7	.0	2229.7	.0	.0	.0	.0	.0
23	1.2	3165.2	.0	62.0	.0	.0	.0	.0	.0
24	4.1	9926.7	.0	.0	.0	.0	.0	.0	.0
25	.9	1958.6	.0	.0	.0	.0	.0	.0	.0
26	5.6	8118.8	.0	.0	.0	.0	.0	.0	.0
27	3.9	1803.2	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	342.11	488.00
2	351.51	484.60
3	361.13	481.86
4	370.91	479.80
5	380.82	478.43
6	390.80	477.75
7	400.80	477.77
8	410.77	478.49
9	420.67	479.90
10	430.45	482.00
11	440.06	484.77
12	449.45	488.21
13	458.57	492.29
14	467.39	497.00
15	475.87	502.32
16	483.95	508.21
17	491.59	514.65
18	498.78	521.61
19	505.45	529.05
20	511.60	536.94
21	512.31	538.00

Circle Center At X = 395.5 ; Y = 621.0 and Radius, 143.3

*** 1.972 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	342.11	488.00
2	351.46	484.46
3	361.05	481.62
4	370.82	479.50
5	380.72	478.09
6	390.70	477.42
7	400.70	477.48
8	410.67	478.28
9	420.55	479.80
10	430.29	482.05
11	439.84	485.01
12	449.15	488.67
13	458.17	492.99
14	466.84	497.97
15	475.13	503.57
16	482.98	509.77
17	490.35	516.52
18	497.21	523.80
19	503.51	531.56
20	508.00	538.00

Circle Center At X = 394.8 ; Y = 613.2 and Radius, 135.9

*** 1.972 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	342.11	488.00
2	350.88	483.21
3	360.03	479.16
4	369.48	475.89
5	379.17	473.42

6	389.03	471.76
7	398.99	470.93
8	408.99	470.93
9	418.96	471.76
10	428.82	473.42
11	438.51	475.90
12	447.96	479.17
13	457.10	483.22
14	465.88	488.01
15	474.23	493.52
16	482.08	499.70
17	489.40	506.52
18	496.13	513.92
19	502.21	521.86
20	507.62	530.27
21	511.71	538.00

Circle Center At X = 404.0 ; Y = 590.9 and Radius, 120.1

*** 1.984 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	336.84	488.00
2	345.79	483.53
3	355.07	479.81
4	364.62	476.84
5	374.38	474.65
6	384.28	473.26
7	394.26	472.68
8	404.26	472.90
9	414.21	473.93
10	424.04	475.76
11	433.69	478.38
12	443.10	481.76
13	452.20	485.90
14	460.94	490.76
15	469.26	496.31
16	477.10	502.51
17	484.42	509.33
18	491.16	516.72
19	497.29	524.62
20	502.75	533.00
21	505.47	538.00

Circle Center At X = 396.5 ; Y = 596.4 and Radius, 123.7

*** 1.984 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	336.84	488.00
2	345.94	483.86
3	355.35	480.45
4	364.99	477.80
5	374.81	475.92
6	384.75	474.83
7	394.75	474.53
8	404.73	475.03
9	414.65	476.31
10	424.43	478.38
11	434.02	481.22
12	443.35	484.82
13	452.37	489.14
14	461.02	494.16
15	469.24	499.86
16	476.98	506.19
17	484.19	513.11
18	490.84	520.59
19	496.86	528.57
20	502.24	537.00

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   21        502.77      538.00
Circle Center At X =  393.5 ; Y =  600.4  and Radius,  125.9
     ***     1.985    ***
Failure Surface Specified By 20 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        342.11      488.00
    2        351.14      483.71
    3        360.50      480.20
    4        370.13      477.49
    5        379.95      475.61
    6        389.89      474.57
    7        399.89      474.37
    8        409.87      475.02
    9        419.76      476.51
   10        429.48      478.84
   11        438.98      481.98
   12        448.17      485.92
   13        457.00      490.62
   14        465.40      496.05
   15        473.30      502.17
   16        480.66      508.94
   17        487.42      516.31
   18        493.54      524.22
   19        498.96      532.62
   20        501.81      538.00
Circle Center At X =  397.2 ; Y =  592.1  and Radius,  117.8
     ***     1.985    ***
Failure Surface Specified By 25 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        336.84      488.00
    2        345.91      483.79
    3        355.21      480.11
    4        364.71      476.98
    5        374.37      474.41
    6        384.17      472.40
    7        394.07      470.97
    8        404.03      470.12
    9        414.03      469.86
   10        424.02      470.17
   11        433.98      471.07
   12        443.87      472.55
   13        453.66      474.60
   14        463.31      477.22
   15        472.79      480.39
   16        482.07      484.12
   17        491.12      488.37
   18        499.91      493.15
   19        508.40      498.43
   20        516.57      504.20
   21        524.38      510.44
   22        531.83      517.12
   23        538.86      524.22
   24        545.48      531.72
   25        549.99      537.48
Circle Center At X =  413.6 ; Y =  641.3  and Radius,  171.5
     ***     1.998    ***
Failure Surface Specified By 24 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        342.11      488.00
    2        351.38      484.25
    3        360.84      481.03
    4        370.48      478.34
    5        380.24      476.20
    6        390.12      474.60
```

7	400.06	473.56
8	410.05	473.08
9	420.05	473.15
10	430.03	473.79
11	439.96	474.98
12	449.80	476.73
13	459.54	479.02
14	469.13	481.85
15	478.54	485.22
16	487.76	489.11
17	496.74	493.50
18	505.46	498.39
19	513.90	503.77
20	522.02	509.60
21	529.80	515.88
22	537.22	522.59
23	544.25	529.70
24	550.87	537.18

Circle Center At X = 413.7 ; Y = 651.8 and Radius, 178.8

*** 2.001 ***

Failure Surface Specified By 23 Coordinate Points

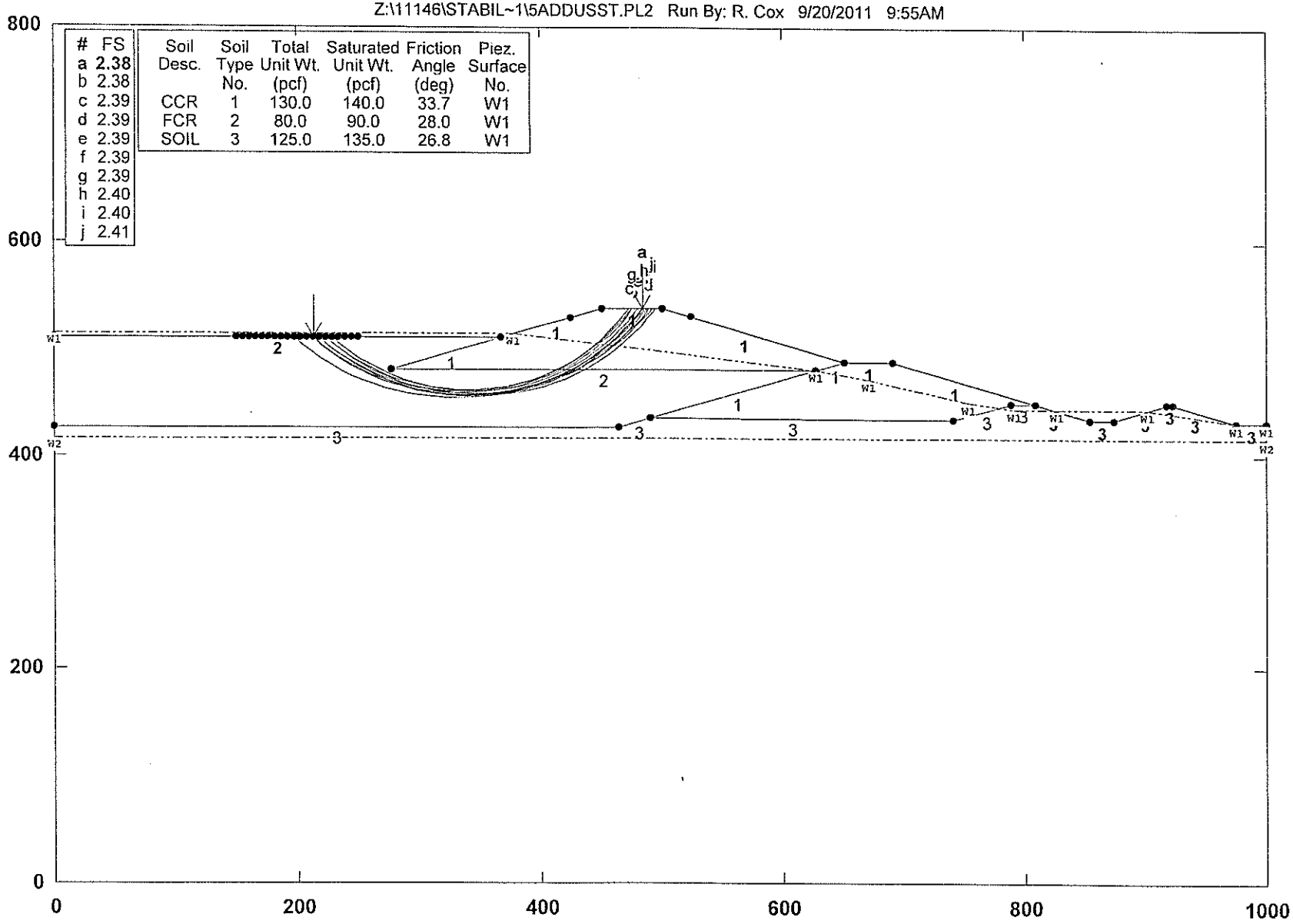
Point No.	X-Surf (ft)	Y-Surf (ft)
1	352.63	489.40
2	361.32	484.46
3	370.36	480.18
4	379.69	476.58
5	389.27	473.70
6	399.03	471.54
7	408.93	470.12
8	418.91	469.45
9	428.91	469.52
10	438.87	470.34
11	448.75	471.91
12	458.48	474.21
13	468.01	477.23
14	477.29	480.96
15	486.27	485.38
16	494.88	490.45
17	503.10	496.15
18	510.86	502.46
19	518.13	509.32
20	524.86	516.72
21	531.03	524.59
22	536.58	532.91
23	539.46	538.00

Circle Center At X = 422.9 ; Y = 602.8 and Radius, 133.4

*** 2.013 ***

Phase 5A/7 -Section D-D Upstream Static Whole Slope Circle

Z:\11146\STABIL~1\5ADDUSST.PL2 Run By: R. Cox 9/20/2011 9:55AM



#	FS
a	2.38
b	2.38
c	2.39
d	2.39
e	2.39
f	2.39
g	2.39
h	2.40
i	2.40
j	2.41

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
SOIL	3	125.0	135.0	26.8	W1

PCSTABL5M/si FSmin=2.38

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/20/2011
Time of Run: 9:55AM
Run By: R. Cox
Input Data Filename: Z:5ADDUSST.
Output Filename: Z:5ADDUSST.OUT
Unit: ENGLISH
Plotted Output Filename: Z:5ADDUSST.PLT
PROBLEM DESCRIPTION Phase 5A/7 -Section D-D
Upstream Static Whole Slope Circle

BOUNDARY COORDINATES
12 Top Boundaries
21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	510.00	367.58	510.00	2
2	367.58	510.00	451.58	538.00	1
3	451.58	538.00	501.58	538.00	1
4	501.58	538.00	651.58	488.00	1
5	651.58	488.00	691.58	488.00	1
6	691.58	488.00	808.58	449.00	1
7	808.58	449.00	853.28	434.10	3
8	853.28	434.10	873.28	434.10	3
9	873.28	434.10	917.98	449.00	3
10	917.98	449.00	922.98	449.00	3
11	922.98	449.00	974.75	431.74	3
12	974.75	431.74	1000.00	431.59	3
13	277.58	480.00	367.58	510.00	1
14	627.58	480.00	651.58	488.00	1
15	277.58	480.00	627.58	480.00	2
16	491.38	434.60	627.58	480.00	1
17	788.58	449.00	808.58	449.00	3
18	741.10	433.17	788.58	449.00	3
19	491.38	434.60	741.10	433.17	3
20	465.58	426.00	491.38	434.60	3
21	.00	426.00	465.58	426.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 11 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	513.17
2	377.09	513.17
3	627.57	480.00
4	627.58	480.00
5	671.09	471.00
6	753.95	450.50
7	791.58	443.22
8	825.92	443.22
9	900.64	443.22
10	974.75	431.76
11	1000.00	431.59

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point	X-Water	Y-Water

No.	(ft)	(ft)
1	.00	416.63
2	1000.00	415.86

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 150.00 ft.
and X = 250.00 ft.
Each Surface Terminates Between X = 425.00 ft.
and X = 525.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =416.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	213.16	510.00
2	220.23	502.93
3	227.70	496.28
4	235.55	490.08
5	243.74	484.35
6	252.25	479.09
7	261.05	474.35
8	270.11	470.12
9	279.40	466.42
10	288.89	463.27
11	298.55	460.68
12	308.34	458.65
13	318.24	457.19
14	328.20	456.31
15	338.19	456.01
16	348.19	456.30
17	358.15	457.16
18	368.05	458.59
19	377.85	460.60
20	387.51	463.18
21	397.00	466.31
22	406.30	469.99
23	415.37	474.20
24	424.18	478.93
25	432.70	484.17
26	440.91	489.89
27	448.76	496.08
28	456.25	502.71
29	463.33	509.76
30	470.00	517.22
31	476.22	525.05
32	481.97	533.23
33	484.93	538.00

Circle Center At X = 338.4 ; Y = 628.2 and Radius, 172.2
*** 2.382 ***
Individual data on the 38 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	7.1	2250.0	1399.0	4183.8	.0	.0	.0	.0	.0
2	7.5	6988.3	1477.8	8463.3	.0	.0	.0	.0	.0
3	7.8	11873.1	1551.7	12472.1	.0	.0	.0	.0	.0
4	8.2	16798.6	1620.3	16196.8	.0	.0	.0	.0	.0
5	8.5	21660.9	1683.4	19624.7	.0	.0	.0	.0	.0
6	8.8	26360.3	1740.9	22744.4	.0	.0	.0	.0	.0

7	9.1	30802.0	1792.5	25545.1	.0	.0	.0	.0	.0
8	7.5	27806.6	1477.4	22338.0	.0	.0	.0	.0	.0
9	1.8	7119.2	360.7	5679.5	.0	.0	.0	.0	.0
10	9.5	39607.7	1877.4	30153.3	.0	.0	.0	.0	.0
11	9.7	44341.4	1910.4	31945.3	.0	.0	.0	.0	.0
12	9.8	48581.8	1936.9	33387.4	.0	.0	.0	.0	.0
13	9.9	52258.7	1957.0	34474.7	.0	.0	.0	.0	.0
14	10.0	55312.5	1970.4	35203.6	.0	.0	.0	.0	.0
15	10.0	57695.7	1977.2	35571.6	.0	.0	.0	.0	.0
16	10.0	59372.6	1977.3	35577.5	.0	.0	.0	.0	.0
17	10.0	60320.8	1970.7	35221.3	.0	.0	.0	.0	.0
18	9.4	57651.7	1864.7	32887.9	.0	.0	.0	.0	.0
19	.5	2881.9	95.4	1616.1	.0	.0	.0	.0	.0
20	9.0	56738.5	896.0	30895.7	.0	.0	.0	.0	.0
21	.8	4839.4	.0	2508.4	.0	.0	.0	.0	.0
22	9.7	62844.9	.0	31264.2	.0	.0	.0	.0	.0
23	9.5	63152.8	.0	28714.2	.0	.0	.0	.0	.0
24	9.3	62662.2	.0	25837.8	.0	.0	.0	.0	.0
25	9.1	61400.8	.0	22645.0	.0	.0	.0	.0	.0
26	8.8	59409.4	.0	19146.5	.0	.0	.0	.0	.0
27	1.7	11649.3	.0	3450.7	.0	.0	.0	.0	.0
28	6.8	44385.7	.0	11903.3	.0	.0	.0	.0	.0
29	8.2	50582.0	.0	11280.4	.0	.0	.0	.0	.0
30	7.9	44554.6	.0	6939.4	.0	.0	.0	.0	.0
31	2.8	14900.2	.0	1436.8	.0	.0	.0	.0	.0
32	4.6	22679.8	.0	908.9	.0	.0	.0	.0	.0
33	.0	90.8	.0	.0	.0	.0	.0	.0	.0
34	7.1	29260.2	.0	.0	.0	.0	.0	.0	.0
35	6.7	21233.0	.0	.0	.0	.0	.0	.0	.0
36	6.2	13637.8	.0	.0	.0	.0	.0	.0	.0
37	5.8	6629.8	.0	.0	.0	.0	.0	.0	.0
38	3.0	918.2	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	218.42	510.00
2	225.50	502.93
3	232.99	496.31
4	240.87	490.16
5	249.12	484.51
6	257.70	479.37
7	266.58	474.76
8	275.72	470.71
9	285.09	467.23
10	294.66	464.32
11	304.39	462.01
12	314.25	460.30
13	324.18	459.20
14	334.17	458.71
15	344.17	458.83
16	354.14	459.56
17	364.05	460.90
18	373.86	462.85
19	383.53	465.39
20	393.03	468.53
21	402.32	472.23
22	411.36	476.50
23	420.12	481.32
24	428.58	486.66
25	436.69	492.52
26	444.42	498.85
27	451.75	505.65
28	458.65	512.89
29	465.10	520.53
30	471.07	528.56
31	476.53	536.94
32	477.13	538.00

Circle Center At X = 337.2 ; Y = 621.8 and Radius, 163.1
*** 2.384 ***
Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	218.42	510.00
2	225.50	502.93
3	233.00	496.32
4	240.90	490.19
5	249.16	484.56
6	257.76	479.45
7	266.66	474.90
8	275.83	470.90
9	285.23	467.49
10	294.82	464.66
11	304.57	462.44
12	314.44	460.83
13	324.39	459.84
14	334.39	459.47
15	344.38	459.72
16	354.34	460.60
17	364.23	462.09
18	374.01	464.20
19	383.63	466.91
20	393.07	470.22
21	402.28	474.10
22	411.24	478.56
23	419.90	483.56
24	428.23	489.09
25	436.20	495.13
26	443.77	501.66
27	450.93	508.64
28	457.64	516.06
29	463.87	523.88
30	469.61	532.07
31	473.23	538.00

Circle Center At X = 335.3 ; Y = 620.0 and Radius, 160.5
*** 2.390 ***
Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	213.16	510.00
2	220.28	502.98
3	227.78	496.37
4	235.64	490.19
5	243.84	484.47
6	252.36	479.22
7	261.15	474.46
8	270.20	470.20
9	279.47	466.46
10	288.95	463.25
11	298.58	460.59
12	308.36	458.47
13	318.23	456.90
14	328.18	455.90
15	338.17	455.46
16	348.17	455.59
17	358.15	456.28
18	368.07	457.53
19	377.90	459.34
20	387.62	461.71
21	397.19	464.62
22	406.58	468.06
23	415.75	472.03
24	424.69	476.51
25	433.37	481.49
26	441.74	486.96

27	449.80	492.88
28	457.50	499.25
29	464.84	506.05
30	471.78	513.25
31	478.30	520.83
32	484.38	528.77
33	490.00	537.04
34	490.58	538.00

Circle Center At X = 340.9 ; Y = 632.3 and Radius, 176.9

*** 2.391 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	228.95	510.00
2	236.03	502.94
3	243.55	496.35
4	251.46	490.24
5	259.75	484.64
6	268.37	479.57
7	277.29	475.05
8	286.48	471.11
9	295.90	467.75
10	305.51	464.99
11	315.28	462.84
12	325.16	461.31
13	335.12	460.40
14	345.12	460.12
15	355.11	460.48
16	365.06	461.46
17	374.93	463.06
18	384.68	465.28
19	394.27	468.11
20	403.67	471.54
21	412.83	475.56
22	421.71	480.14
23	430.30	485.27
24	438.54	490.93
25	446.41	497.10
26	453.88	503.75
27	460.91	510.86
28	467.48	518.40
29	473.56	526.34
30	479.14	534.64
31	481.10	538.00

Circle Center At X = 344.5 ; Y = 619.0 and Radius, 158.8

*** 2.392 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	223.68	510.00
2	230.76	502.93
3	238.25	496.30
4	246.11	490.13
5	254.34	484.44
6	262.88	479.25
7	271.73	474.58
8	280.83	470.44
9	290.17	466.86
10	299.70	463.84
11	309.40	461.40
12	319.22	459.54
13	329.14	458.26
14	339.12	457.59
15	349.12	457.51
16	359.10	458.03
17	369.04	459.14
18	378.90	460.85

19	388.63	463.14
20	398.21	466.00
21	407.60	469.44
22	416.77	473.43
23	425.69	477.96
24	434.32	483.01
25	442.63	488.57
26	450.59	494.62
27	458.18	501.13
28	465.37	508.08
29	472.13	515.45
30	478.43	523.21
31	484.27	531.34
32	488.47	538.00

Circle Center At X = 345.4 ; Y = 624.8 and Radius, 167.3

*** 2.394 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	223.68	510.00
2	230.86	503.03
3	238.45	496.53
4	246.43	490.50
5	254.78	484.99
6	263.45	480.01
7	272.41	475.58
8	281.64	471.71
9	291.08	468.43
10	300.72	465.75
11	310.50	463.66
12	320.39	462.20
13	330.35	461.35
14	340.35	461.12
15	350.34	461.52
16	360.29	462.54
17	370.15	464.17
18	379.90	466.42
19	389.48	469.27
20	398.87	472.72
21	408.03	476.74
22	416.92	481.32
23	425.50	486.45
24	433.75	492.10
25	441.63	498.26
26	449.11	504.90
27	456.16	511.98
28	462.76	519.50
29	468.88	527.41
30	474.49	535.69
31	475.85	538.00

Circle Center At X = 339.0 ; Y = 621.5 and Radius, 160.4

*** 2.394 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	197.37	510.00
2	204.52	503.01
3	212.04	496.41
4	219.90	490.23
5	228.08	484.48
6	236.56	479.18
7	245.31	474.34
8	254.31	469.99
9	263.53	466.12
10	272.95	462.75
11	282.53	459.89
12	292.25	457.56

13	302.09	455.75
14	312.01	454.47
15	321.98	453.73
16	331.98	453.53
17	341.97	453.86
18	351.93	454.73
19	361.83	456.14
20	371.65	458.08
21	381.34	460.54
22	390.88	463.52
23	400.25	467.01
24	409.42	471.00
25	418.37	475.48
26	427.05	480.43
27	435.46	485.84
28	443.57	491.69
29	451.35	497.98
30	458.78	504.67
31	465.84	511.76
32	472.50	519.21
33	478.76	527.01
34	484.59	535.14
35	486.42	538.00

Circle Center At X = 330.8 ; Y = 639.3 and Radius, 185.8

*** 2.396 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	218.42	510.00
2	225.49	502.93
3	232.95	496.27
4	240.78	490.05
5	248.95	484.28
6	257.44	478.99
7	266.21	474.19
8	275.24	469.89
9	284.50	466.12
10	293.96	462.87
11	303.59	460.17
12	313.35	458.03
13	323.23	456.44
14	333.17	455.41
15	343.16	454.96
16	353.16	455.07
17	363.14	455.75
18	373.06	456.99
19	382.90	458.80
20	392.61	461.17
21	402.18	464.08
22	411.57	467.53
23	420.74	471.51
24	429.67	476.01
25	438.33	481.00
26	446.70	486.48
27	454.74	492.43
28	462.43	498.83
29	469.74	505.65
30	476.65	512.87
31	483.14	520.48
32	489.19	528.45
33	494.77	536.74
34	495.52	538.00

Circle Center At X = 346.2 ; Y = 630.7 and Radius, 175.8

*** 2.403 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

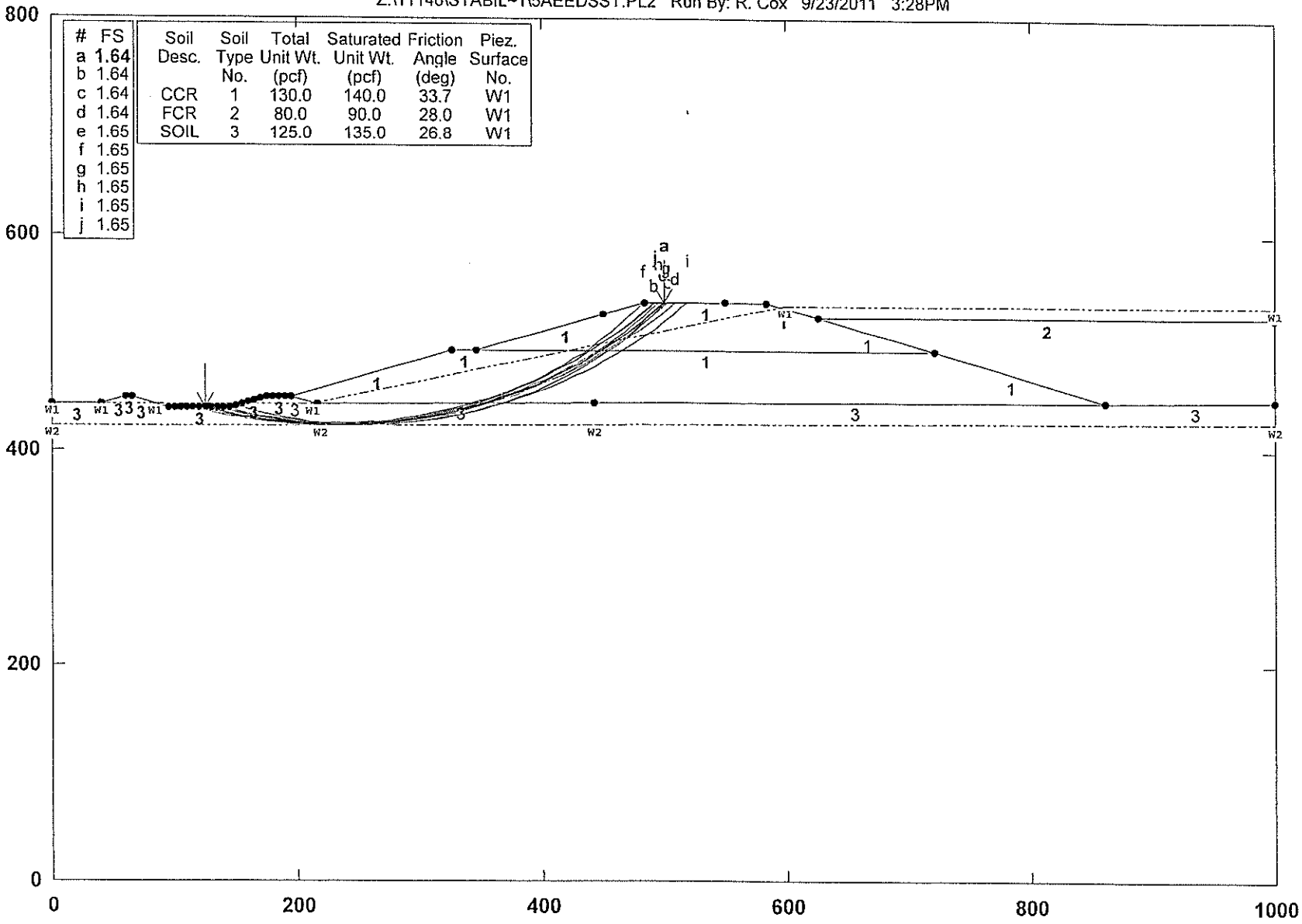
1	213.16	510.00
2	220.42	503.12
3	228.05	496.66
4	236.02	490.62
5	244.31	485.03
6	252.90	479.90
7	261.75	475.26
8	270.85	471.11
9	280.16	467.47
10	289.66	464.34
11	299.32	461.75
12	309.10	459.68
13	318.99	458.16
14	328.94	457.19
15	338.93	456.76
16	348.93	456.89
17	358.91	457.57
18	368.83	458.79
19	378.68	460.56
20	388.41	462.87
21	397.99	465.71
22	407.41	469.07
23	416.63	472.94
24	425.62	477.32
25	434.36	482.19
26	442.81	487.53
27	450.96	493.32
28	458.78	499.56
29	466.24	506.22
30	473.33	513.27
31	480.01	520.71
32	486.28	528.50
33	492.11	536.63
34	492.98	538.00

Circle Center At X = 341.6 ; Y = 638.3 and Radius, 181.6

*** 2.406 ***

Phase 5A/7 - Section E-E Downstream Static Whole Slope Circle

Z:\11146\STABIL~1\5AEEDSST.PL2 Run By: R. Cox 9/23/2011 3:28PM



PCSTABL5M/si FSmin=1.64

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/23/2011
Time of Run: 3:28PM
Run By: R. Cox
Input Data Filename: Z:5aeedsst.
Output Filename: Z:5aeedsst.OUT
Unit: ENGLISH
Plotted Output Filename: Z:5aeedsst.PLT
PROBLEM DESCRIPTION Phase 5A/7 - Section E-E
Downstream Static Whole Slope Circle

BOUNDARY COORDINATES
13 Top Boundaries
20 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	442.21	39.38	442.00	3
2	39.38	442.00	60.38	449.00	3
3	60.38	449.00	65.38	449.00	3
4	65.38	449.00	95.38	439.00	3
5	95.38	439.00	144.78	439.00	3
6	144.78	439.00	174.78	449.00	3
7	174.78	449.00	194.78	449.00	3
8	194.78	449.00	325.78	492.00	1
9	325.78	492.00	345.78	492.00	1
10	345.78	492.00	483.78	538.00	1
11	483.78	538.00	583.78	538.00	1
12	583.78	538.00	625.78	524.00	1
13	625.78	524.00	1000.00	524.00	2
14	625.78	524.00	721.78	492.00	1
15	345.78	492.00	721.78	492.00	1
16	721.78	492.00	861.81	445.32	1
17	194.78	449.00	215.78	442.00	3
18	215.78	442.00	442.73	444.00	3
19	442.73	444.00	861.81	445.32	3
20	861.81	445.32	1000.00	445.75	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 6 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	442.00
2	39.38	442.00
3	83.38	443.00
4	212.78	443.00
5	598.78	535.00
6	1000.00	535.00

Piezometric Surface No. 2 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	422.21
2	218.39	422.00
3	442.73	424.00
4	1000.00	425.76

A Critical Failure Surface Searching Method, Using A Random

Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 100.00 ft.
and X = 195.00 ft.
Each Surface Terminates Between X = 450.00 ft.
and X = 550.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =422.50 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	125.00	439.00
2	134.60	436.20
3	144.27	433.67
4	154.01	431.39
5	163.81	429.39
6	173.66	427.65
7	183.55	426.18
8	193.48	424.97
9	203.43	424.04
10	213.41	423.38
11	223.40	422.99
12	233.40	422.87
13	243.40	423.03
14	253.39	423.45
15	263.37	424.15
16	273.32	425.12
17	283.24	426.35
18	293.13	427.86
19	302.97	429.63
20	312.76	431.67
21	322.49	433.98
22	332.15	436.55
23	341.75	439.38
24	351.26	442.47
25	360.68	445.82
26	370.01	449.43
27	379.23	453.28
28	388.35	457.39
29	397.36	461.74
30	406.24	466.33
31	414.99	471.16
32	423.61	476.23
33	432.09	481.54
34	440.42	487.07
35	448.60	492.82
36	456.62	498.79
37	464.47	504.99
38	472.16	511.39
39	479.66	517.99
40	486.99	524.80
41	494.12	531.81
42	500.09	538.00

Circle Center At X = 232.8 ; Y = 790.8 and Radius, 368.0
*** 1.638 ***
Individual data on the 53 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.6	1813.1	2396.3	3368.9	.0	.0	.0	.0	.0

2	9.7	5309.2	2414.4	5033.0	.0	.0	.0	.0	.0
3	.5	368.2	126.2	304.4	.0	.0	.0	.0	.0
4	9.2	10055.4	1494.7	6228.7	.0	.0	.0	.0	.0
5	9.8	17545.8	.0	7868.0	.0	.0	.0	.0	.0
6	9.8	24157.4	.0	9036.9	.0	.0	.0	.0	.0
7	1.1	3156.5	.0	1093.7	.0	.0	.0	.0	.0
8	8.8	25717.7	.0	8945.1	.0	.0	.0	.0	.0
9	9.9	30798.3	.0	10873.0	.0	.0	.0	.0	.0
10	1.3	4163.8	.0	1478.8	.0	.0	.0	.0	.0
11	8.7	29818.4	.0	10060.2	.0	.0	.0	.0	.0
12	9.3	36850.4	.0	11264.0	.0	.0	.0	.0	.0
13	.6	2647.8	.0	754.2	.0	.0	.0	.0	.0
14	2.4	10148.9	.0	2894.5	.0	.0	.0	.0	.0
15	7.6	34569.0	.0	9951.4	.0	.0	.0	.0	.0
16	10.0	49588.4	.0	14446.9	.0	.0	.0	.0	.0
17	10.0	54056.0	.0	15883.3	.0	.0	.0	.0	.0
18	10.0	58112.3	.0	17154.1	.0	.0	.0	.0	.0
19	10.0	61746.3	.0	18258.5	.0	.0	.0	.0	.0
20	10.0	64948.7	.0	19195.5	.0	.0	.0	.0	.0
21	9.9	67712.1	.0	19964.5	.0	.0	.0	.0	.0
22	9.9	70031.3	.0	20564.9	.0	.0	.0	.0	.0
23	9.8	71903.6	.0	20996.4	.0	.0	.0	.0	.0
24	9.8	73327.2	.0	21258.4	.0	.0	.0	.0	.0
25	9.7	74303.3	.0	21350.9	.0	.0	.0	.0	.0
26	3.3	25376.8	.0	7259.4	.0	.0	.0	.0	.0
27	6.4	48591.1	.0	14014.4	.0	.0	.0	.0	.0
28	9.6	70355.5	.0	21027.2	.0	.0	.0	.0	.0
29	4.0	28533.7	.0	8805.2	.0	.0	.0	.0	.0
30	5.5	38293.2	.0	11805.9	.0	.0	.0	.0	.0
31	2.1	14536.9	.0	4473.6	.0	.0	.0	.0	.0
32	7.3	51259.7	.0	15552.5	.0	.0	.0	.0	.0
33	9.3	64602.6	.0	19272.3	.0	.0	.0	.0	.0
34	9.2	63000.9	.0	18350.6	.0	.0	.0	.0	.0
35	9.1	61009.7	.0	17261.4	.0	.0	.0	.0	.0
36	9.0	58646.8	.0	16005.7	.0	.0	.0	.0	.0
37	8.9	55930.7	.0	14584.2	.0	.0	.0	.0	.0
38	8.8	52882.6	.0	12998.2	.0	.0	.0	.0	.0
39	3.4	19709.1	.0	4621.3	.0	.0	.0	.0	.0
40	5.2	29815.0	.0	6627.4	.0	.0	.0	.0	.0
41	8.5	45880.0	.0	9337.1	.0	.0	.0	.0	.0
42	8.3	41975.2	.0	7264.7	.0	.0	.0	.0	.0
43	7.0	32660.0	.0	4457.1	.0	.0	.0	.0	.0
44	1.2	5176.6	.0	576.1	.0	.0	.0	.0	.0
45	8.0	33492.8	.0	2644.0	.0	.0	.0	.0	.0
46	4.2	16075.8	.0	379.2	.0	.0	.0	.0	.0
47	3.6	12932.2	.0	.0	.0	.0	.0	.0	.0
48	7.7	24627.5	.0	.0	.0	.0	.0	.0	.0
49	7.5	20183.9	.0	.0	.0	.0	.0	.0	.0
50	4.1	9317.5	.0	.0	.0	.0	.0	.0	.0
51	3.2	6119.6	.0	.0	.0	.0	.0	.0	.0
52	7.1	8991.7	.0	.0	.0	.0	.0	.0	.0
53	6.0	2402.6	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	439.00
2	129.59	436.17
3	139.26	433.62
4	148.99	431.33
5	158.79	429.31
6	168.63	427.56
7	178.53	426.09
8	188.45	424.89
9	198.41	423.96
10	208.39	423.31
11	218.38	422.94
12	228.38	422.85

13	238.38	423.03
14	248.37	423.49
15	258.34	424.23
16	268.29	425.24
17	278.21	426.53
18	288.09	428.09
19	297.92	429.93
20	307.69	432.03
21	317.40	434.41
22	327.05	437.05
23	336.62	439.96
24	346.10	443.14
25	355.49	446.57
26	364.78	450.27
27	373.97	454.22
28	383.04	458.42
29	392.00	462.88
30	400.82	467.58
31	409.52	472.52
32	418.07	477.70
33	426.47	483.12
34	434.73	488.77
35	442.82	494.64
36	450.75	500.73
37	458.50	507.05
38	466.08	513.57
39	473.48	520.31
40	480.68	527.24
41	487.69	534.37
42	491.06	538.00

Circle Center At X = 226.8 ; Y = 783.7 and Radius, 360.9

*** 1.640 ***

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.00	439.00
2	144.60	436.21
3	154.28	433.69
4	164.02	431.44
5	173.83	429.46
6	183.68	427.76
7	193.58	426.33
8	203.51	425.18
9	213.47	424.30
10	223.46	423.71
11	233.45	423.39
12	243.45	423.35
13	253.45	423.59
14	263.43	424.10
15	273.40	424.90
16	283.34	425.97
17	293.25	427.32
18	303.12	428.95
19	312.94	430.84
20	322.70	433.02
21	332.40	435.46
22	342.02	438.17
23	351.57	441.15
24	361.03	444.40
25	370.39	447.90
26	379.65	451.67
27	388.81	455.69
28	397.85	459.97
29	406.77	464.50
30	415.55	469.27
31	424.20	474.29
32	432.71	479.54

33	441.07	485.03
34	449.27	490.76
35	457.31	496.70
36	465.18	502.87
37	472.87	509.26
38	480.39	515.86
39	487.71	522.66
40	494.85	529.67
41	501.79	536.87
42	502.81	538.00

Circle Center At X = 239.9 ; Y = 782.1 and Radius, 358.8

*** 1.641 ***

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	115.00	439.00
2	124.62	436.27
3	134.31	433.79
4	144.05	431.54
5	153.85	429.55
6	163.70	427.80
7	173.58	426.29
8	183.50	425.04
9	193.45	424.04
10	203.43	423.28
11	213.41	422.78
12	223.41	422.52
13	233.41	422.52
14	243.41	422.77
15	253.39	423.27
16	263.37	424.01
17	273.32	425.01
18	283.24	426.26
19	293.12	427.76
20	302.97	429.50
21	312.77	431.49
22	322.52	433.73
23	332.21	436.21
24	341.83	438.93
25	351.38	441.90
26	360.85	445.10
27	370.24	448.54
28	379.54	452.21
29	388.75	456.11
30	397.86	460.25
31	406.85	464.61
32	415.74	469.20
33	424.51	474.00
34	433.15	479.03
35	441.67	484.27
36	450.05	489.73
37	458.29	495.39
38	466.39	501.25
39	474.34	507.32
40	482.13	513.59
41	489.77	520.05
42	497.24	526.70
43	504.54	533.53
44	509.08	538.00

Circle Center At X = 228.5 ; Y = 820.9 and Radius, 398.4

*** 1.645 ***

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.00	439.00
2	149.61	436.25
3	159.30	433.78

4	169.06	431.58
5	178.87	429.66
6	188.74	428.03
7	198.65	426.68
8	208.59	425.61
9	218.56	424.83
10	228.55	424.33
11	238.55	424.12
12	248.55	424.19
13	258.54	424.55
14	268.52	425.20
15	278.47	426.13
16	288.40	427.34
17	298.29	428.84
18	308.13	430.62
19	317.91	432.68
20	327.63	435.02
21	337.29	437.64
22	346.86	440.54
23	356.34	443.70
24	365.74	447.14
25	375.02	450.84
26	384.20	454.81
27	393.27	459.03
28	402.20	463.52
29	411.01	468.26
30	419.68	473.25
31	428.20	478.48
32	436.56	483.96
33	444.77	489.67
34	452.81	495.62
35	460.68	501.79
36	468.37	508.19
37	475.87	514.80
38	483.18	521.62
39	490.29	528.66
40	497.19	535.89
41	499.10	538.00

Circle Center At X = 241.0 ; Y = 773.7 and Radius, 349.6

*** 1.646 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.00	439.00
2	149.56	436.08
3	159.21	433.46
4	168.94	431.14
5	178.74	429.13
6	188.59	427.43
7	198.50	426.04
8	208.44	424.95
9	218.41	424.18
10	228.40	423.73
11	238.40	423.58
12	248.39	423.75
13	258.38	424.24
14	268.35	425.03
15	278.29	426.14
16	288.19	427.56
17	298.04	429.29
18	307.83	431.32
19	317.55	433.67
20	327.19	436.31
21	336.75	439.26
22	346.21	442.50
23	355.56	446.04
24	364.80	449.87

25	373.91	453.99
26	382.89	458.39
27	391.73	463.08
28	400.41	468.03
29	408.94	473.26
30	417.30	478.75
31	425.48	484.50
32	433.47	490.50
33	441.28	496.75
34	448.89	503.24
35	456.28	509.97
36	463.47	516.93
37	470.43	524.11
38	477.16	531.50
39	482.30	537.51

Circle Center At X = 238.0 ; Y = 742.6 and Radius, 319.0

*** 1.648 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.00	440.74
2	159.50	437.62
3	169.09	434.80
4	178.77	432.27
5	188.52	430.05
6	198.33	428.13
7	208.20	426.52
8	218.12	425.21
9	228.07	424.22
10	238.04	423.53
11	248.04	423.15
12	258.04	423.09
13	268.03	423.33
14	278.02	423.89
15	287.98	424.76
16	297.91	425.93
17	307.80	427.41
18	317.64	429.20
19	327.42	431.30
20	337.13	433.70
21	346.76	436.40
22	356.30	439.39
23	365.74	442.68
24	375.07	446.27
25	384.30	450.14
26	393.39	454.29
27	402.35	458.73
28	411.17	463.44
29	419.84	468.43
30	428.35	473.68
31	436.69	479.19
32	444.86	484.97
33	452.84	490.99
34	460.64	497.25
35	468.23	503.76
36	475.62	510.50
37	482.79	517.46
38	489.75	524.65
39	496.48	532.05
40	501.57	538.00

Circle Center At X = 255.1 ; Y = 744.7 and Radius, 321.7

*** 1.648 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.00	439.00
2	149.63	436.29

3	159.33	433.86
4	169.09	431.70
5	178.91	429.83
6	188.79	428.25
7	198.70	426.95
8	208.65	425.93
9	218.62	425.20
10	228.61	424.76
11	238.61	424.61
12	248.61	424.74
13	258.60	425.17
14	268.58	425.88
15	278.53	426.87
16	288.45	428.16
17	298.32	429.73
18	308.15	431.58
19	317.92	433.72
20	327.62	436.13
21	337.25	438.83
22	346.80	441.80
23	356.26	445.04
24	365.62	448.56
25	374.88	452.34
26	384.02	456.39
27	393.05	460.70
28	401.94	465.27
29	410.70	470.09
30	419.32	475.16
31	427.79	480.48
32	436.10	486.04
33	444.25	491.84
34	452.22	497.87
35	460.02	504.13
36	467.64	510.61
37	475.07	517.30
38	482.30	524.21
39	489.33	531.33
40	495.55	538.00

Circle Center At X = 238.9 ; Y = 771.7 and Radius, 347.1

*** 1.649 ***

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.00	439.00
2	144.61	436.24
3	154.29	433.73
4	164.04	431.48
5	173.83	429.49
6	183.68	427.75
7	193.57	426.27
8	203.50	425.04
9	213.45	424.08
10	223.43	423.38
11	233.42	422.94
12	243.41	422.76
13	253.41	422.84
14	263.41	423.19
15	273.39	423.80
16	283.35	424.66
17	293.29	425.79
18	303.19	427.18
19	313.06	428.82
20	322.87	430.73
21	332.64	432.88
22	342.34	435.30
23	351.98	437.97
24	361.54	440.88

25	371.03	444.05
26	380.43	447.47
27	389.73	451.13
28	398.94	455.03
29	408.04	459.17
30	417.04	463.55
31	425.91	468.16
32	434.66	473.00
33	443.28	478.07
34	451.76	483.36
35	460.10	488.88
36	468.30	494.61
37	476.34	500.55
38	484.23	506.70
39	491.95	513.05
40	499.50	519.61
41	506.88	526.36
42	514.08	533.30
43	518.71	538.00

Circle Center At X = 245.2 ; Y = 804.9 and Radius, 382.2

*** 1.649 ***

Failure Surface Specified By 42 Coordinate Points

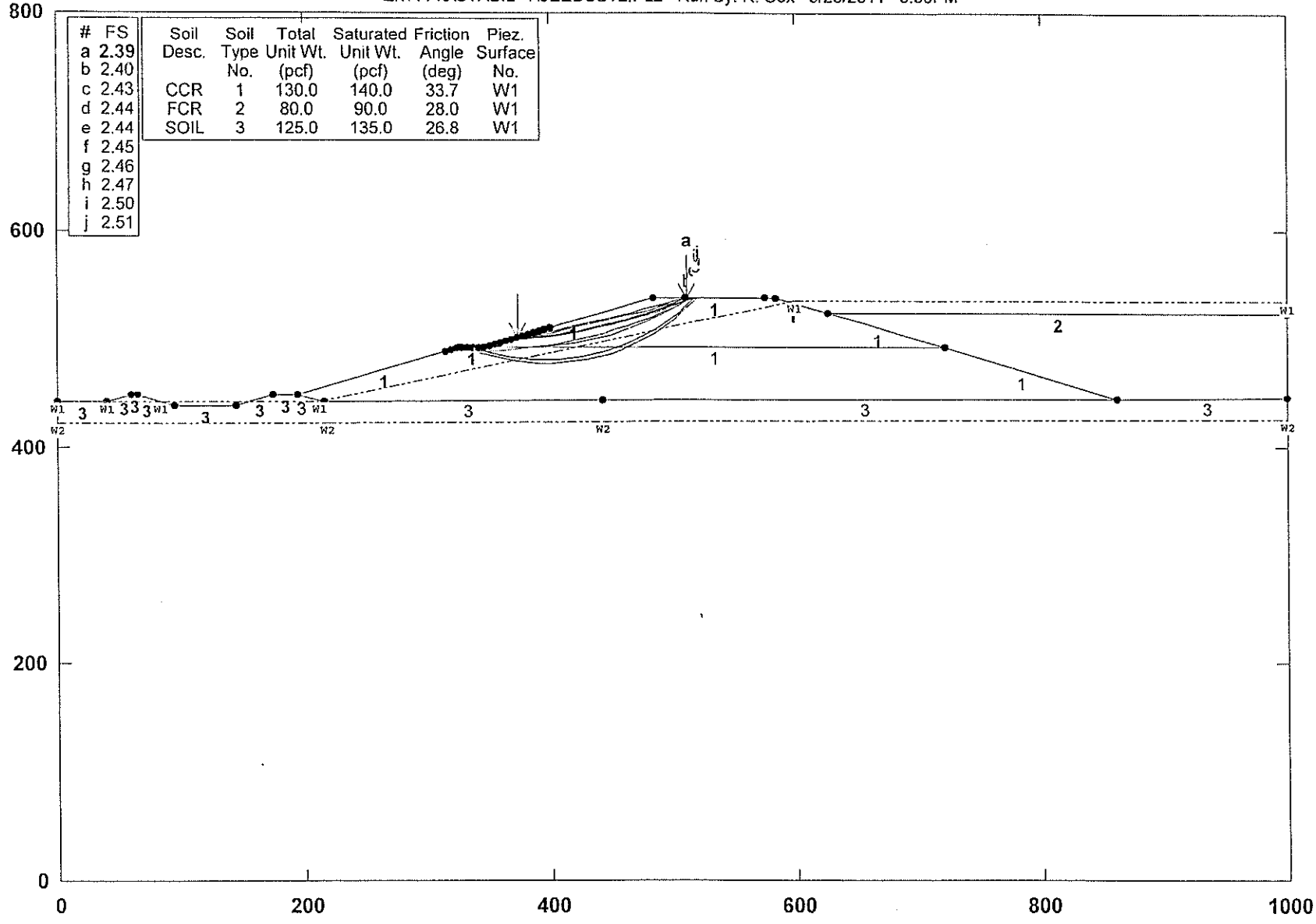
Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	439.00
2	129.64	436.33
3	139.34	433.92
4	149.11	431.76
5	158.93	429.88
6	168.79	428.25
7	178.70	426.89
8	188.64	425.80
9	198.61	424.97
10	208.59	424.41
11	218.59	424.12
12	228.59	424.10
13	238.58	424.35
14	248.57	424.86
15	258.54	425.64
16	268.49	426.69
17	278.40	428.00
18	288.27	429.58
19	298.10	431.43
20	307.88	433.53
21	317.59	435.90
22	327.24	438.53
23	336.82	441.42
24	346.31	444.56
25	355.72	447.95
26	365.03	451.60
27	374.24	455.49
28	383.34	459.63
29	392.33	464.02
30	401.20	468.64
31	409.94	473.50
32	418.54	478.59
33	427.01	483.91
34	435.33	489.45
35	443.50	495.22
36	451.52	501.20
37	459.37	507.40
38	467.05	513.80
39	474.55	520.41
40	481.88	527.22
41	489.02	534.22
42	492.67	538.00

Circle Center At X = 224.4 ; Y = 796.8 and Radius, 372.8

*** 1.651 ***

Phase 5A/7 - Section E-E Downstream Static Shallow Slope Circle

Z:\11146\STABIL~1\5EEDSST2.PL2 Run By: R. Cox 9/23/2011 3:30PM



#	FS
a	2.39
b	2.40
c	2.43
d	2.44
e	2.44
f	2.45
g	2.46
h	2.47
i	2.50
j	2.51

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
SOIL	3	125.0	135.0	26.8	W1

PCSTABL5M/si FSmin=2.39

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/23/2011
Time of Run: 3:30PM
Run By: R. Cox
Input Data Filename: Z:5EEDSST2.
Output Filename: Z:5EEDSST2.OUT
Unit: ENGLISH
Plotted Output Filename: Z:5EEDSST2.PLT
PROBLEM DESCRIPTION Phase 5A/7 - Section E-E
Downstream Static Shallow Slope Circle

BOUNDARY COORDINATES
13 Top Boundaries
20 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	442.21	39.38	442.00	3
2	39.38	442.00	60.38	449.00	3
3	60.38	449.00	65.38	449.00	3
4	65.38	449.00	95.38	439.00	3
5	95.38	439.00	144.78	439.00	3
6	144.78	439.00	174.78	449.00	3
7	174.78	449.00	194.78	449.00	3
8	194.78	449.00	325.78	492.00	1
9	325.78	492.00	345.78	492.00	1
10	345.78	492.00	483.78	538.00	1
11	483.78	538.00	583.78	538.00	1
12	583.78	538.00	625.78	524.00	1
13	625.78	524.00	1000.00	524.00	2
14	625.78	524.00	721.78	492.00	1
15	345.78	492.00	721.78	492.00	1
16	721.78	492.00	861.81	445.32	1
17	194.78	449.00	215.78	442.00	3
18	215.78	442.00	442.73	444.00	3
19	442.73	444.00	861.81	445.32	3
20	861.81	445.32	1000.00	445.75	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 6 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	442.00
2	39.38	442.00
3	83.38	443.00
4	212.78	443.00
5	598.78	535.00
6	1000.00	535.00

Piezometric Surface No. 2 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	422.21
2	218.39	422.00
3	442.73	424.00
4	1000.00	425.76

A Critical Failure Surface Searching Method, Using A Random

Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 315.00 ft.
and X = 400.00 ft.
Each Surface Terminates Between X = 510.00 ft.
and X = 575.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =422.50 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	373.16	501.13
2	383.15	501.58
3	393.12	502.36
4	403.06	503.46
5	412.96	504.88
6	422.81	506.61
7	432.59	508.66
8	442.31	511.02
9	451.95	513.69
10	461.49	516.67
11	470.94	519.95
12	480.27	523.54
13	489.49	527.42
14	498.57	531.60
15	507.52	536.06
16	511.11	538.00

Circle Center At X = 364.0 ; Y = 811.9 and Radius, 310.9
*** 2.390 ***
Individual data on the 16 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	10.0	1864.8	.0	.0	.0	.0	.0	.0	.0
2	10.0	5371.5	.0	.0	.0	.0	.0	.0	.0
3	9.9	8431.1	.0	.0	.0	.0	.0	.0	.0
4	9.9	11034.6	.0	.0	.0	.0	.0	.0	.0
5	9.8	13176.4	.0	.0	.0	.0	.0	.0	.0
6	9.8	14854.2	.0	.0	.0	.0	.0	.0	.0
7	9.7	16068.7	.0	.0	.0	.0	.0	.0	.0
8	9.6	16823.7	.0	.0	.0	.0	.0	.0	.0
9	9.5	17126.5	.0	.0	.0	.0	.0	.0	.0
10	9.4	16987.2	.0	.0	.0	.0	.0	.0	.0
11	9.3	16419.0	.0	.0	.0	.0	.0	.0	.0
12	3.5	5989.3	.0	.0	.0	.0	.0	.0	.0
13	5.7	8742.9	.0	.0	.0	.0	.0	.0	.0
14	9.1	10027.9	.0	.0	.0	.0	.0	.0	.0
15	8.9	4848.3	.0	.0	.0	.0	.0	.0	.0
16	3.6	450.8	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	359.74	496.65
2	369.47	498.96
3	379.19	501.30
4	388.90	503.69
5	398.60	506.12
6	408.29	508.60
7	417.96	511.12
8	427.63	513.69

9	437.28	516.29
10	446.93	518.94
11	456.56	521.64
12	466.18	524.37
13	475.78	527.15
14	485.38	529.97
15	494.96	532.84
16	504.52	535.75
17	511.82	538.00

Circle Center At X = -149.6 ; Y = 2670.6 and Radius, 2232.8

*** 2.399 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	350.79	493.67
2	360.76	492.83
3	370.75	492.42
4	380.75	492.43
5	390.74	492.86
6	400.70	493.72
7	410.62	494.99
8	420.47	496.68
9	430.25	498.79
10	439.93	501.31
11	449.49	504.23
12	458.92	507.56
13	468.20	511.28
14	477.32	515.39
15	486.25	519.89
16	494.99	524.75
17	503.51	529.98
18	511.81	535.57
19	515.10	538.00

Circle Center At X = 375.5 ; Y = 728.9 and Radius, 236.6

*** 2.435 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	364.21	498.14
2	374.03	500.05
3	383.83	502.05
4	393.61	504.13
5	403.37	506.30
6	413.11	508.56
7	422.83	510.91
8	432.53	513.34
9	442.21	515.86
10	451.86	518.47
11	461.49	521.17
12	471.10	523.95
13	480.68	526.81
14	490.23	529.77
15	499.76	532.81
16	509.26	535.93
17	515.37	538.00

Circle Center At X = 156.6 ; Y = 1592.2 and Radius, 1113.6

*** 2.444 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	368.68	499.63
2	378.66	500.27
3	388.62	501.18
4	398.55	502.35
5	408.45	503.78
6	418.31	505.48
7	428.11	507.44

8	437.86	509.67
9	447.55	512.15
10	457.17	514.89
11	466.71	517.89
12	476.16	521.14
13	485.53	524.64
14	494.80	528.39
15	503.97	532.38
16	513.02	536.62
17	515.77	538.00

Circle Center At X = 349.8 ; Y = 873.5 and Radius, 374.4

*** 2.444 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	315.00	488.46
2	325.00	488.16
3	335.00	488.13
4	344.99	488.37
5	354.98	488.87
6	364.95	489.64
7	374.90	490.67
8	384.81	491.97
9	394.69	493.53
10	404.52	495.35
11	414.30	497.44
12	424.02	499.78
13	433.68	502.38
14	443.26	505.24
15	452.77	508.35
16	462.18	511.72
17	471.51	515.33
18	480.73	519.19
19	489.85	523.30
20	498.86	527.64
21	507.74	532.23
22	516.51	537.05
23	518.13	538.00

Circle Center At X = 331.1 ; Y = 863.7 and Radius, 375.6

*** 2.447 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	364.21	498.14
2	374.17	499.03
3	384.11	500.13
4	394.02	501.45
5	403.90	502.99
6	413.75	504.74
7	423.55	506.71
8	433.31	508.90
9	443.02	511.29
10	452.67	513.90
11	462.27	516.72
12	471.80	519.75
13	481.26	522.99
14	490.65	526.44
15	499.96	530.09
16	509.19	533.94
17	518.33	537.99
18	518.34	538.00

Circle Center At X = 328.8 ; Y = 952.9 and Radius, 456.1

*** 2.462 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	364.21	498.14

2	374.14	499.34
3	384.04	500.72
4	393.92	502.27
5	403.77	503.99
6	413.59	505.89
7	423.37	507.97
8	433.12	510.21
9	442.82	512.63
10	452.48	515.22
11	462.09	517.98
12	471.65	520.91
13	481.16	524.01
14	490.61	527.27
15	500.00	530.71
16	509.33	534.31
17	518.43	538.00

Circle Center At X = 301.5 ; Y = 1059.2 and Radius, 564.6

*** 2.466 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	337.37	492.00
2	346.77	488.60
3	356.38	485.81
4	366.13	483.62
5	376.01	482.06
6	385.97	481.12
7	395.96	480.82
8	405.96	481.14
9	415.91	482.10
10	425.79	483.68
11	435.54	485.88
12	445.14	488.69
13	454.54	492.10
14	463.70	496.10
15	472.60	500.67
16	481.19	505.80
17	489.43	511.45
18	497.31	517.61
19	504.78	524.26
20	511.82	531.37
21	517.60	538.00

Circle Center At X = 395.8 ; Y = 639.2 and Radius, 158.4

*** 2.497 ***

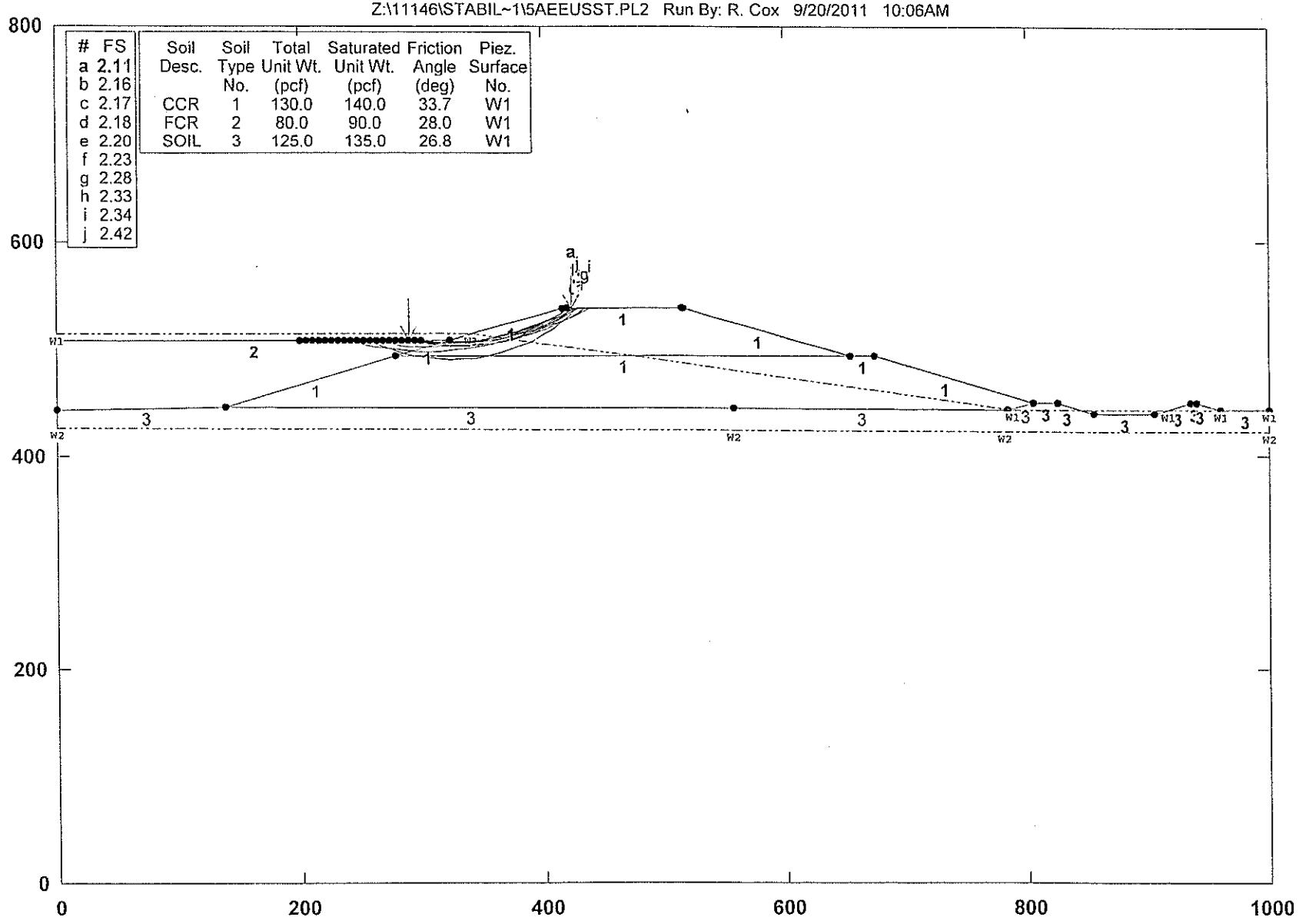
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	332.90	492.00
2	342.09	488.07
3	351.53	484.76
4	361.16	482.06
5	370.94	480.00
6	380.84	478.58
7	390.81	477.81
8	400.81	477.68
9	410.79	478.22
10	420.72	479.40
11	430.56	481.22
12	440.25	483.69
13	449.76	486.78
14	459.05	490.48
15	468.08	494.78
16	476.81	499.66
17	485.20	505.10
18	493.22	511.07
19	500.83	517.55
20	508.00	524.52

```
    21          514.71       531.94
    22          519.51       538.00
Circle Center At X =  397.6 ; Y =  630.9  and Radius,  153.2
      ***       2.514    ***
```

Phase 5A/7 - Section E-E Upstream Static Whole Slope Circle

Z:\11146\STABIL~1\5AEEUSST.PL2 Run By: R. Cox 9/20/2011 10:06AM



#	FS
a	2.11
b	2.16
c	2.17
d	2.18
e	2.20
f	2.23
g	2.28
h	2.33
i	2.34
j	2.42

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
SOIL	3	125.0	135.0	26.8	W1

PCSTABL5M/si FSmin=2.11

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/20/2011
Time of Run: 10:06AM
Run By: R. Cox
Input Data Filename: Z:5AEEUSST.
Output Filename: Z:5AEEUSST.OUT
Unit: ENGLISH
Plotted Output Filename: Z:5AEEUSST.PLT
PROBLEM DESCRIPTION Phase 5A/7 - Section E-E
Upstream Static Whole Slope Circle

BOUNDARY COORDINATES
13 Top Boundaries
20 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	507.30	324.12	507.30	2
2	324.12	507.30	416.22	538.00	1
3	416.22	538.00	516.22	538.00	1
4	516.22	538.00	654.22	492.00	1
5	654.22	492.00	674.22	492.00	1
6	674.22	492.00	805.22	449.00	1
7	805.22	449.00	825.22	449.00	3
8	825.22	449.00	855.22	439.00	3
9	855.22	439.00	904.62	439.00	3
10	904.62	439.00	934.62	449.00	3
11	934.62	449.00	939.62	449.00	3
12	939.62	449.00	960.62	442.00	3
13	960.62	442.00	1000.00	442.21	3
14	278.22	492.00	324.12	507.30	1
15	278.22	492.00	654.22	492.00	1
16	138.19	445.32	278.22	492.00	1
17	784.22	442.00	805.22	449.00	3
18	.00	442.75	138.19	445.32	3
19	138.19	445.32	557.27	444.00	3
20	557.27	444.00	784.22	442.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 6 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	513.17
2	341.73	513.17
3	787.22	443.00
4	916.62	443.00
5	960.62	442.00
6	1000.00	442.00

Piezometric Surface No. 2 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	425.76
2	557.27	424.00
3	781.61	422.00
4	1000.00	422.21

A Critical Failure Surface Searching Method, Using A Random

Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 200.00 ft.
and X = 300.00 ft.
Each Surface Terminates Between X = 420.00 ft.
and X = 515.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =422.50 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	289.47	507.30
2	299.40	506.10
3	309.38	505.41
4	319.38	505.26
5	329.37	505.63
6	339.33	506.52
7	349.23	507.93
8	359.04	509.86
9	368.74	512.31
10	378.29	515.26
11	387.68	518.70
12	396.87	522.64
13	405.85	527.05
14	414.58	531.93
15	423.04	537.26
16	424.09	538.00

Circle Center At X = 317.4 ; Y = 695.5 and Radius, 190.2
*** 2.109 ***
Individual data on the 20 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.9	537.9	3636.2	4038.5	.0	.0	.0	.0	.0
2	10.0	1386.9	3654.4	4626.7	.0	.0	.0	.0	.0
3	8.7	1525.5	3178.7	4237.0	.0	.0	.0	.0	.0
4	1.3	256.7	483.7	651.2	.0	.0	.0	.0	.0
5	4.7	1110.3	1737.3	2317.4	.0	.0	.0	.0	.0
6	5.3	1944.3	1724.9	2504.7	.0	.0	.0	.0	.0
7	10.0	6466.4	1611.6	4428.7	.0	.0	.0	.0	.0
8	2.4	2042.6	63.1	980.1	.0	.0	.0	.0	.0
9	7.5	7230.9	.0	2420.1	.0	.0	.0	.0	.0
10	9.8	10947.2	.0	1428.5	.0	.0	.0	.0	.0
11	1.4	1681.9	.0	26.0	.0	.0	.0	.0	.0
12	8.3	10260.0	.0	.0	.0	.0	.0	.0	.0
13	9.6	12399.4	.0	.0	.0	.0	.0	.0	.0
14	9.4	12131.1	.0	.0	.0	.0	.0	.0	.0
15	9.2	11170.4	.0	.0	.0	.0	.0	.0	.0
16	9.0	9567.4	.0	.0	.0	.0	.0	.0	.0
17	8.7	7385.0	.0	.0	.0	.0	.0	.0	.0
18	1.6	1127.2	.0	.0	.0	.0	.0	.0	.0
19	6.8	2562.0	.0	.0	.0	.0	.0	.0	.0
20	1.1	50.8	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	278.95	507.30
2	288.84	505.83
3	298.79	504.84
4	308.78	504.34

5	318.78	504.32
6	328.77	504.79
7	338.72	505.74
8	348.62	507.18
9	358.43	509.09
10	368.14	511.48
11	377.72	514.34
12	387.16	517.66
13	396.42	521.44
14	405.48	525.66
15	414.33	530.32
16	422.94	535.40
17	426.89	538.00

Circle Center At X = 314.1 ; Y = 709.9 and Radius, 205.6

*** 2.161 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	294.74	507.30
2	304.42	504.79
3	314.26	503.01
4	324.20	501.96
5	334.20	501.65
6	344.19	502.09
7	354.12	503.26
8	363.93	505.17
9	373.58	507.80
10	383.01	511.14
11	392.16	515.18
12	400.98	519.88
13	409.44	525.22
14	417.47	531.17
15	425.04	537.71
16	425.33	538.00

Circle Center At X = 333.3 ; Y = 636.2 and Radius, 134.6

*** 2.168 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.00	507.30
2	309.92	506.00
3	319.89	505.28
4	329.89	505.12
5	339.88	505.54
6	349.83	506.54
7	359.71	508.10
8	369.48	510.22
9	379.11	512.90
10	388.58	516.12
11	397.84	519.89
12	406.88	524.18
13	415.65	528.98
14	424.14	534.27
15	429.41	538.00

Circle Center At X = 327.6 ; Y = 679.6 and Radius, 174.5

*** 2.181 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	294.74	507.30
2	304.41	504.75
3	314.24	502.91
4	324.17	501.78
5	334.16	501.38
6	344.16	501.71
7	354.10	502.75
8	363.95	504.52

9	373.64	506.99
10	383.12	510.16
11	392.35	514.01
12	401.28	518.52
13	409.85	523.66
14	418.03	529.41
15	425.78	535.74
16	428.16	538.00

Circle Center At X = 334.7 ; Y = 639.0 and Radius, 137.6

*** 2.203 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	257.90	507.30
2	267.62	504.99
3	277.46	503.16
4	287.37	501.83
5	297.33	500.98
6	307.32	500.63
7	317.32	500.78
8	327.30	501.42
9	337.24	502.56
10	347.11	504.19
11	356.88	506.30
12	366.54	508.90
13	376.05	511.97
14	385.40	515.51
15	394.57	519.51
16	403.53	523.96
17	412.25	528.85
18	420.72	534.16
19	426.22	538.00

Circle Center At X = 309.4 ; Y = 702.3 and Radius, 201.7

*** 2.229 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	294.74	507.30
2	304.53	505.27
3	314.43	503.84
4	324.39	503.01
5	334.39	502.78
6	344.38	503.16
7	354.33	504.14
8	364.21	505.73
9	373.97	507.90
10	383.58	510.67
11	393.00	514.01
12	402.21	517.92
13	411.16	522.37
14	419.83	527.36
15	428.17	532.87
16	435.01	538.00

Circle Center At X = 333.1 ; Y = 667.7 and Radius, 165.0

*** 2.279 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.11	507.30
2	251.64	504.30
3	261.32	501.78
4	271.12	499.76
5	281.00	498.23
6	290.95	497.21
7	300.93	496.69
8	310.93	496.68
9	320.92	497.17

10	330.87	498.17
11	340.76	499.67
12	350.56	501.67
13	360.24	504.17
14	369.79	507.15
15	379.17	510.61
16	388.36	514.53
17	397.35	518.92
18	406.10	523.76
19	414.59	529.04
20	422.81	534.74
21	427.04	538.00

Circle Center At X = 306.2 ; Y = 694.1 and Radius, 197.5

*** 2.326 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	294.74	507.30
2	304.66	506.09
3	314.64	505.35
4	324.63	505.08
5	334.63	505.27
6	344.61	505.94
7	354.54	507.08
8	364.41	508.69
9	374.20	510.75
10	383.87	513.28
11	393.42	516.26
12	402.81	519.68
13	412.04	523.55
14	421.07	527.84
15	429.89	532.55
16	438.48	537.67
17	438.97	538.00

Circle Center At X = 325.4 ; Y = 717.5 and Radius, 212.4

*** 2.339 ***

Failure Surface Specified By 20 Coordinate Points

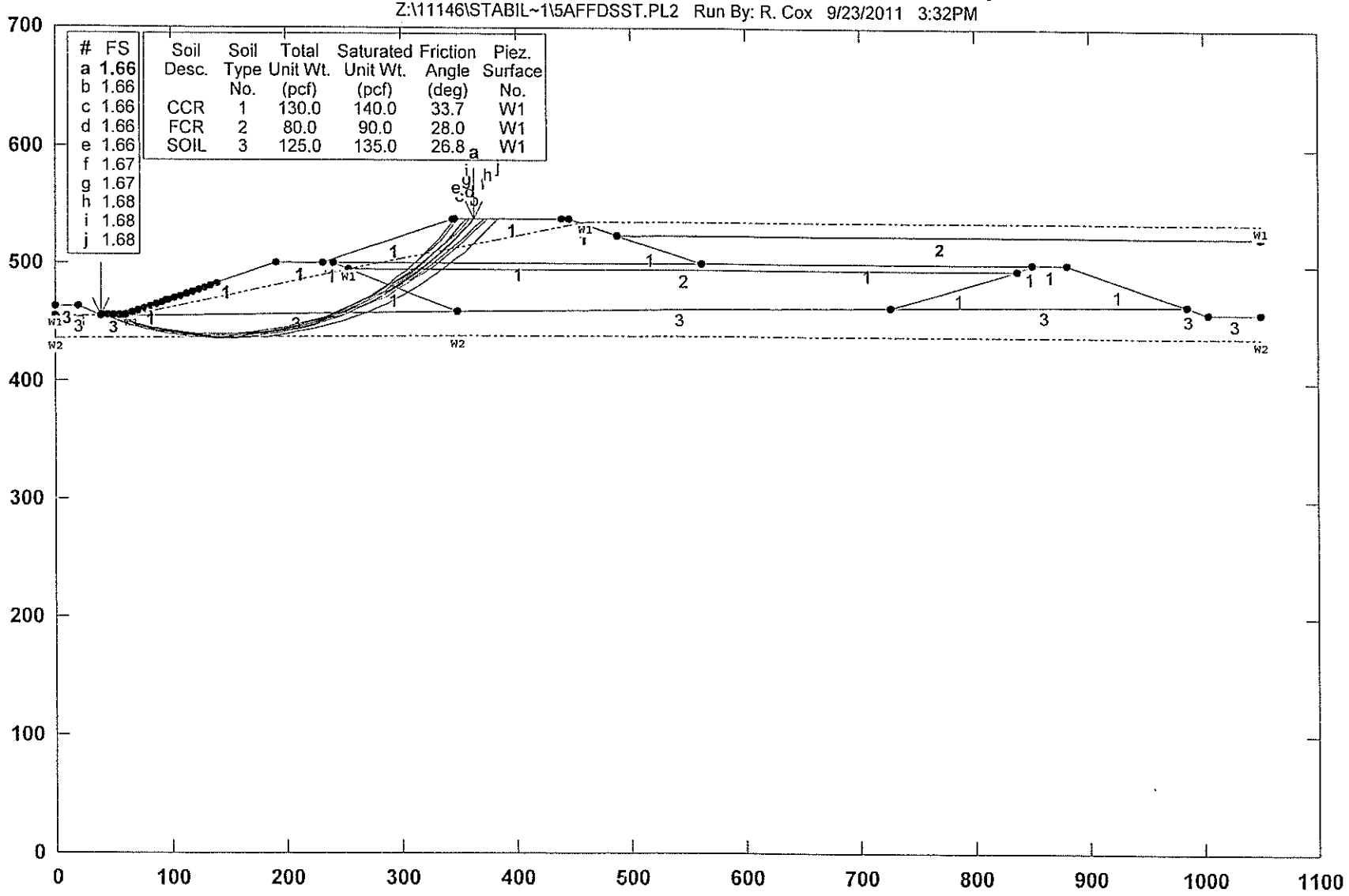
Point No.	X-Surf (ft)	Y-Surf (ft)
1	257.90	507.30
2	266.72	502.59
3	275.87	498.55
4	285.29	495.21
5	294.94	492.59
6	304.76	490.69
7	314.69	489.53
8	324.68	489.11
9	334.68	489.45
10	344.62	490.53
11	354.45	492.35
12	364.12	494.91
13	373.57	498.17
14	382.75	502.14
15	391.61	506.78
16	400.10	512.07
17	408.16	517.98
18	415.76	524.47
19	422.86	531.52
20	428.48	538.00

Circle Center At X = 325.2 ; Y = 622.7 and Radius, 133.6

*** 2.422 ***

Phase 5A/7 - Section F-F Downstream Static Whole Slope Circle

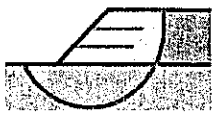
Z:\11146\STABIL~1\5AFFDSST.PL2 Run By: R. Cox 9/23/2011 3:32PM



PCSTABL5M/si FSmin=1.66

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/23/2011
Time of Run: 3:32PM
Run By: R. Cox
Input Data Filename: Z:5affdsst.
Output Filename: Z:5affdsst.OUT
Unit: ENGLISH
Plotted Output Filename: Z:5affdsst.PLT
PROBLEM DESCRIPTION Phase 5A/7 - Section F-F
Downstream Static Whole Slope Circle

BOUNDARY COORDINATES
10 Top Boundaries
27 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	462.92	19.25	462.92	3
2	19.25	462.92	40.00	456.00	3
3	40.00	456.00	60.00	456.00	3
4	60.00	456.00	96.00	468.00	1
5	96.00	468.00	192.00	500.00	1
6	192.00	500.00	232.00	500.00	1
7	232.00	500.00	346.00	538.00	1
8	346.00	538.00	446.00	538.00	1
9	446.00	538.00	488.00	524.00	1
10	488.00	524.00	1050.00	524.00	2
11	488.00	524.00	562.08	500.00	1
12	232.00	500.00	242.00	500.00	1
13	242.00	500.00	562.08	500.00	1
14	562.08	500.00	850.79	500.00	1
15	850.79	500.00	881.34	500.00	1
16	242.00	500.00	255.05	495.00	1
17	837.55	495.00	850.79	500.00	1
18	881.34	500.00	986.02	465.73	1
19	255.05	495.00	837.55	495.00	2
20	255.05	495.00	349.00	459.00	1
21	726.56	463.27	837.55	495.00	1
22	60.00	456.00	349.00	459.00	3
23	349.00	459.00	726.56	463.27	3
24	726.56	463.27	986.02	465.73	3
25	986.02	465.73	1003.52	460.00	3
26	1003.52	460.00	1050.00	460.00	3
27	.00	456.00	40.00	456.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	456.00
2	65.00	456.00
3	255.05	495.00
4	461.00	535.00
5	1050.00	535.00

Piezometric Surface No. 2 Specified by 3 Coordinate Points

Point	X-Water	Y-Water

No.	(ft)	(ft)
1	.00	435.38
2	349.00	439.00
3	1050.00	439.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced Along The Ground Surface Between X = 40.00 ft.
and X = 140.00 ft.
Each Surface Terminates Between X = 345.00 ft.
and X = 440.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =436.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	40.00	456.00
2	49.37	452.50
3	58.85	449.32
4	68.44	446.48
5	78.12	443.98
6	87.88	441.82
7	97.72	440.00
8	107.61	438.53
9	117.54	437.40
10	127.51	436.63
11	137.50	436.20
12	147.50	436.13
13	157.50	436.40
14	167.48	437.02
15	177.43	438.00
16	187.35	439.32
17	197.21	440.99
18	207.00	443.00
19	216.72	445.36
20	226.35	448.05
21	235.88	451.08
22	245.30	454.44
23	254.59	458.13
24	263.75	462.14
25	272.77	466.47
26	281.62	471.12
27	290.31	476.07
28	298.82	481.32
29	307.14	486.87
30	315.26	492.71
31	323.17	498.83
32	330.86	505.22
33	338.32	511.87
34	345.55	518.79
35	352.53	525.95
36	359.25	533.35
37	363.18	538.00

Circle Center At X = 144.7 ; Y = 721.5 and Radius, 285.4
*** 1.658 ***
Individual data on the 53 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.4	2215.4	.0	1093.3	.0	.0	.0	.0	.0

2	9.5	6517.8	.0	3177.0	.0	.0	.0	.0	.0
3	1.2	1063.9	.0	512.9	.0	.0	.0	.0	.0
4	5.0	5778.7	.0	2524.9	.0	.0	.0	.0	.0
5	.3	365.9	.0	145.5	.0	.0	.0	.0	.0
6	3.2	4820.2	.0	1906.5	.0	.0	.0	.0	.0
7	9.7	19780.3	.0	7622.8	.0	.0	.0	.0	.0
8	9.8	27315.6	.0	10268.3	.0	.0	.0	.0	.0
9	8.1	27998.3	.0	10325.7	.0	.0	.0	.0	.0
10	1.7	6513.7	.0	2388.4	.0	.0	.0	.0	.0
11	9.9	41325.9	.0	14957.2	.0	.0	.0	.0	.0
12	9.9	47717.0	.0	16995.0	.0	.0	.0	.0	.0
13	9.1	48843.6	.0	17147.4	.0	.0	.0	.0	.0
14	.9	4805.0	.0	1677.4	.0	.0	.0	.0	.0
15	10.0	59087.8	.0	20444.5	.0	.0	.0	.0	.0
16	10.0	64005.3	.0	21852.1	.0	.0	.0	.0	.0
17	10.0	68375.8	.0	23045.7	.0	.0	.0	.0	.0
18	10.0	72178.5	.0	24024.1	.0	.0	.0	.0	.0
19	1.1	7898.4	.0	2615.2	.0	.0	.0	.0	.0
20	8.9	67497.9	.0	22170.7	.0	.0	.0	.0	.0
21	9.9	78017.0	.0	25330.3	.0	.0	.0	.0	.0
22	4.7	37504.1	.0	12083.2	.0	.0	.0	.0	.0
23	5.2	41940.9	.0	13573.3	.0	.0	.0	.0	.0
24	9.8	77149.7	.0	25764.1	.0	.0	.0	.0	.0
25	9.7	73871.6	.0	25653.1	.0	.0	.0	.0	.0
26	9.6	70104.8	.0	25323.6	.0	.0	.0	.0	.0
27	5.6	39502.4	.0	14767.2	.0	.0	.0	.0	.0
28	3.9	26701.1	.0	10008.7	.0	.0	.0	.0	.0
29	6.1	42086.5	.0	15701.2	.0	.0	.0	.0	.0
30	3.3	22639.9	.0	8309.6	.0	.0	.0	.0	.0
31	9.0	61458.3	.0	22336.7	.0	.0	.0	.0	.0
32	.3	1940.4	.0	692.4	.0	.0	.0	.0	.0
33	.5	3098.9	.0	1120.6	.0	.0	.0	.0	.0
34	8.7	57633.8	.0	20726.7	.0	.0	.0	.0	.0
35	9.0	56643.7	.0	20374.7	.0	.0	.0	.0	.0
36	8.0	47442.5	.0	17017.2	.0	.0	.0	.0	.0
37	.8	4719.4	.0	1671.2	.0	.0	.0	.0	.0
38	8.7	47330.6	.0	16792.5	.0	.0	.0	.0	.0
39	5.4	27355.4	.0	9603.1	.0	.0	.0	.0	.0
40	3.1	15077.9	.0	5086.3	.0	.0	.0	.0	.0
41	8.3	39903.6	.0	12381.9	.0	.0	.0	.0	.0
42	8.1	37814.9	.0	9872.6	.0	.0	.0	.0	.0
43	3.0	13458.8	.0	3012.1	.0	.0	.0	.0	.0
44	4.9	21529.4	.0	4152.6	.0	.0	.0	.0	.0
45	1.4	5857.1	.0	1007.7	.0	.0	.0	.0	.0
46	6.3	24315.7	.0	3253.8	.0	.0	.0	.0	.0
47	6.5	21923.6	.0	1195.4	.0	.0	.0	.0	.0
48	1.0	3107.2	.0	.0	.0	.0	.0	.0	.0
49	7.2	20021.4	.0	.0	.0	.0	.0	.0	.0
50	.5	1108.7	.0	.0	.0	.0	.0	.0	.0
51	6.5	13068.8	.0	.0	.0	.0	.0	.0	.0
52	6.7	7298.1	.0	.0	.0	.0	.0	.0	.0
53	3.9	1188.7	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	40.00	456.00
2	49.45	452.71
3	59.00	449.75
4	68.64	447.11
5	78.37	444.80
6	88.17	442.81
7	98.03	441.16
8	107.95	439.85
9	117.90	438.87
10	127.88	438.22
11	137.87	437.92
12	147.87	437.95

13	157.87	438.32
14	167.84	439.03
15	177.79	440.07
16	187.69	441.45
17	197.54	443.17
18	207.33	445.21
19	217.05	447.59
20	226.67	450.29
21	236.20	453.32
22	245.63	456.66
23	254.93	460.33
24	264.11	464.30
25	273.15	468.58
26	282.03	473.17
27	290.76	478.05
28	299.31	483.23
29	307.69	488.69
30	315.88	494.43
31	323.87	500.45
32	331.65	506.73
33	339.21	513.27
34	346.55	520.07
35	353.65	527.10
36	360.52	534.38
37	363.71	538.00

Circle Center At X = 141.9 ; Y = 733.8 and Radius, 295.9

*** 1.661 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	40.00	456.00
2	49.37	452.51
3	58.87	449.37
4	68.47	446.58
5	78.17	444.14
6	87.95	442.07
7	97.80	440.35
8	107.71	439.00
9	117.66	438.02
10	127.64	437.40
11	137.64	437.15
12	147.64	437.27
13	157.63	437.76
14	167.59	438.61
15	177.52	439.83
16	187.39	441.42
17	197.20	443.37
18	206.93	445.67
19	216.57	448.34
20	226.10	451.36
21	235.52	454.72
22	244.80	458.43
23	253.95	462.48
24	262.93	466.87
25	271.75	471.58
26	280.39	476.61
27	288.84	481.96
28	297.09	487.62
29	305.12	493.57
30	312.93	499.82
31	320.50	506.35
32	327.83	513.16
33	334.90	520.23
34	341.71	527.55
35	348.24	535.13
36	350.54	538.00

Circle Center At X = 139.4 ; Y = 708.6 and Radius, 271.4

*** 1.661 ***
Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	40.00	456.00
2	49.49	452.85
3	59.08	450.02
4	68.76	447.52
5	78.52	445.34
6	88.35	443.49
7	98.24	441.98
8	108.17	440.79
9	118.13	439.95
10	128.12	439.43
11	138.12	439.26
12	148.11	439.42
13	158.10	439.91
14	168.07	440.75
15	178.00	441.91
16	187.89	443.41
17	197.72	445.25
18	207.48	447.41
19	217.17	449.90
20	226.76	452.71
21	236.26	455.84
22	245.64	459.30
23	254.91	463.06
24	264.04	467.14
25	273.03	471.52
26	281.86	476.20
27	290.54	481.17
28	299.04	486.44
29	307.36	491.98
30	315.49	497.81
31	323.42	503.90
32	331.14	510.26
33	338.64	516.87
34	345.91	523.73
35	352.95	530.84
36	359.59	538.00

Circle Center At X = 138.4 ; Y = 736.5 and Radius, 297.2

*** 1.663 ***
Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	40.00	456.00
2	49.32	452.36
3	58.76	449.08
4	68.33	446.16
5	78.00	443.61
6	87.76	441.43
7	97.59	439.62
8	107.49	438.19
9	117.43	437.14
10	127.41	436.46
11	137.40	436.17
12	147.40	436.26
13	157.39	436.72
14	167.36	437.57
15	177.28	438.80
16	187.15	440.40
17	196.95	442.38
18	206.67	444.73
19	216.30	447.45
20	225.81	450.54
21	235.20	453.98
22	244.45	457.78

23	253.55	461.93
24	262.48	466.42
25	271.24	471.25
26	279.80	476.41
27	288.17	481.89
28	296.32	487.69
29	304.24	493.79
30	311.92	500.19
31	319.36	506.88
32	326.53	513.84
33	333.43	521.08
34	340.06	528.57
35	346.39	536.31
36	347.67	538.00

Circle Center At X = 140.1 ; Y = 698.6 and Radius, 262.4

*** 1.663 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	40.00	456.00
2	49.51	452.92
3	59.12	450.14
4	68.81	447.67
5	78.57	445.50
6	88.40	443.65
7	98.28	442.10
8	108.20	440.87
9	118.16	439.96
10	128.14	439.36
11	138.14	439.07
12	148.14	439.11
13	158.13	439.46
14	168.11	440.12
15	178.06	441.10
16	187.98	442.39
17	197.85	444.00
18	207.66	445.92
19	217.41	448.15
20	227.08	450.68
21	236.67	453.52
22	246.17	456.67
23	255.56	460.11
24	264.83	463.84
25	273.98	467.87
26	283.01	472.19
27	291.89	476.79
28	300.62	481.66
29	309.19	486.81
30	317.59	492.23
31	325.82	497.92
32	333.86	503.86
33	341.72	510.05
34	349.37	516.48
35	356.81	523.16
36	364.05	530.07
37	371.05	537.20
38	371.79	538.00

Circle Center At X = 142.1 ; Y = 755.1 and Radius, 316.0

*** 1.669 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	45.26	456.00
2	54.67	452.60
3	64.19	449.55
4	73.82	446.84
5	83.54	444.48

6	93.33	442.48
7	103.20	440.83
8	113.11	439.54
9	123.07	438.60
10	133.05	438.03
11	143.05	437.82
12	153.05	437.97
13	163.04	438.48
14	173.00	439.35
15	182.92	440.58
16	192.79	442.17
17	202.60	444.12
18	212.34	446.41
19	221.98	449.06
20	231.52	452.06
21	240.95	455.40
22	250.25	459.07
23	259.41	463.08
24	268.42	467.42
25	277.26	472.08
26	285.94	477.06
27	294.42	482.35
28	302.72	487.94
29	310.80	493.83
30	318.66	500.00
31	326.30	506.46
32	333.70	513.18
33	340.85	520.17
34	347.74	527.42
35	354.37	534.91
36	356.91	538.00

Circle Center At X = 143.9 ; Y = 714.4 and Radius, 276.6

*** 1.669 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	45.26	456.00
2	54.78	452.93
3	64.39	450.17
4	74.09	447.71
5	83.85	445.57
6	93.68	443.73
7	103.57	442.21
8	113.49	441.01
9	123.45	440.12
10	133.44	439.55
11	143.44	439.29
12	153.44	439.36
13	163.43	439.74
14	173.40	440.44
15	183.35	441.46
16	193.26	442.80
17	203.12	444.44
18	212.93	446.41
19	222.67	448.68
20	232.33	451.26
21	241.90	454.15
22	251.38	457.34
23	260.75	460.83
24	270.01	464.62
25	279.14	468.70
26	288.13	473.06
27	296.98	477.72
28	305.68	482.65
29	314.22	487.85
30	322.59	493.33
31	330.78	499.07

32	338.78	505.06
33	346.59	511.31
34	354.20	517.80
35	361.59	524.54
36	368.77	531.50
37	375.05	538.00

Circle Center At X = 146.4 ; Y = 753.5 and Radius, 314.2

*** 1.679 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.53	456.00
2	59.90	452.51
3	69.40	449.38
4	79.00	446.61
5	88.71	444.20
6	98.50	442.15
7	108.36	440.48
8	118.27	439.17
9	128.23	438.24
10	138.21	437.68
11	148.21	437.50
12	158.21	437.69
13	168.19	438.26
14	178.15	439.21
15	188.06	440.52
16	197.92	442.21
17	207.70	444.27
18	217.41	446.69
19	227.01	449.47
20	236.50	452.62
21	245.87	456.11
22	255.10	459.96
23	264.18	464.15
24	273.10	468.68
25	281.84	473.54
26	290.39	478.72
27	298.74	484.23
28	306.88	490.04
29	314.79	496.15
30	322.47	502.56
31	329.90	509.25
32	337.08	516.21
33	343.99	523.44
34	350.62	530.92
35	356.43	538.00

Circle Center At X = 148.1 ; Y = 703.8 and Radius, 266.3

*** 1.681 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	45.26	456.00
2	54.68	452.64
3	64.21	449.59
4	73.82	446.84
5	83.52	444.41
6	93.29	442.29
7	103.13	440.48
8	113.02	438.99
9	122.95	437.82
10	132.91	436.97
11	142.90	436.44
12	152.90	436.23
13	162.89	436.34
14	172.89	436.77
15	182.86	437.53
16	192.80	438.60

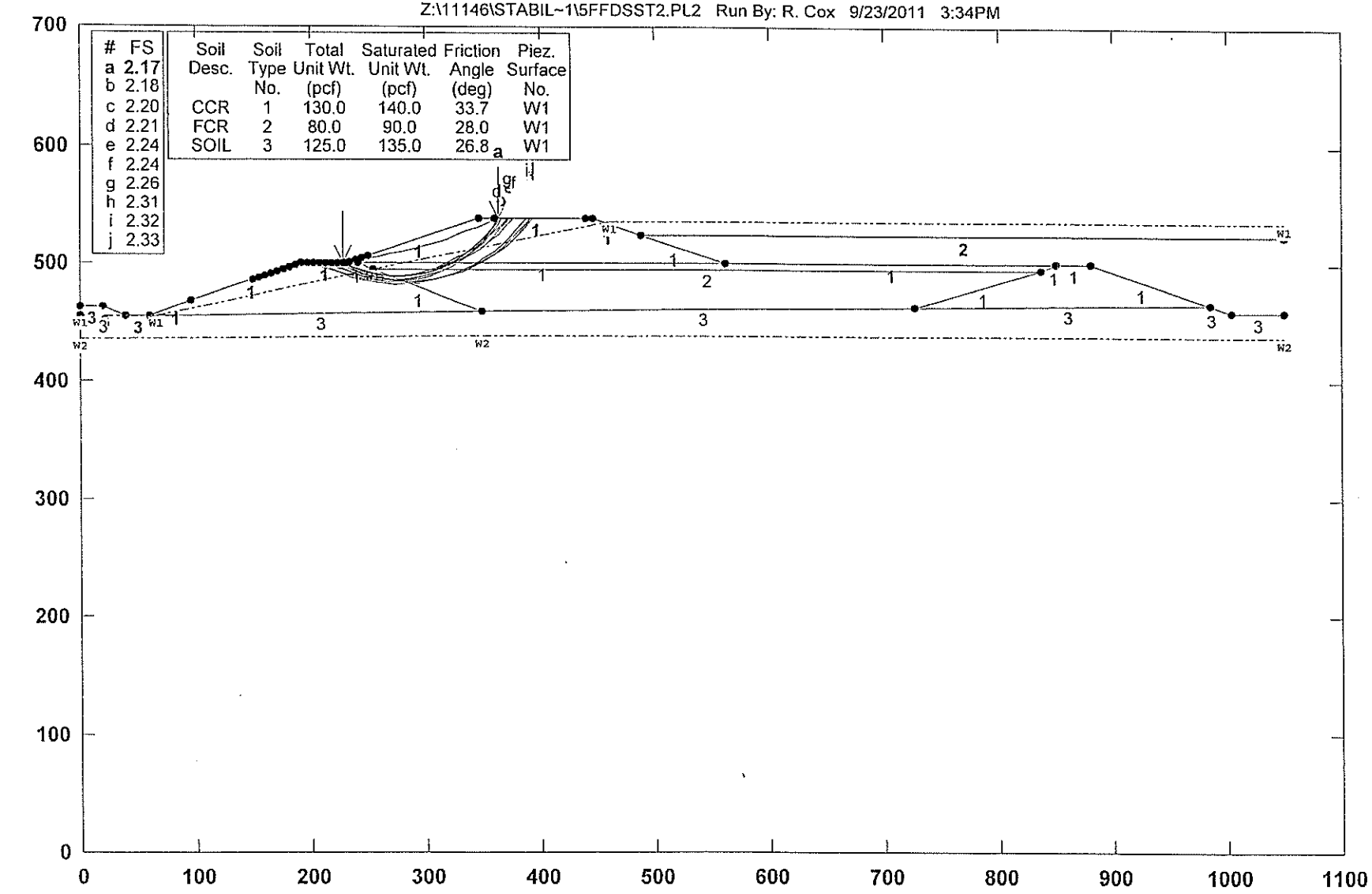
17	202.70	440.00
18	212.55	441.71
19	222.35	443.74
20	232.07	446.08
21	241.71	448.73
22	251.26	451.69
23	260.71	454.95
24	270.06	458.52
25	279.28	462.39
26	288.37	466.55
27	297.33	471.00
28	306.13	475.74
29	314.78	480.76
30	323.27	486.05
31	331.58	491.61
32	339.70	497.44
33	347.64	503.52
34	355.37	509.86
35	362.90	516.44
36	370.21	523.27
37	377.30	530.32
38	384.16	537.59
39	384.52	538.00

Circle Center At X = 154.4 ; Y = 747.3 and Radius, 311.1

*** 1.684 ***

Phase 5A/7 - Section F-F Downstream Static Shallow Slope Circle

Z:\11146\STABIL~1\5FFDSST2.PL2 Run By: R. Cox 9/23/2011 3:34PM



PCSTABL5M/si FSmin=2.17

Safety Factors Are Calculated By The Modified Bishop Method

STED



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                    ** PCSTABL5M **
                          by
                    Purdue University
                --Slope Stability Analysis--
              Simplified Janbu, Simplified Bishop
                 or Spencer`s Method of Slices
 Run Date:                    9/23/2011
 Time of Run:                 3:34PM
 Run By:                      R. Cox
 Input Data Filename:         Z:5FFDSST2.
 Output Filename:             Z:5FFDSST2.OUT
 Unit:                        ENGLISH
 Plotted Output Filename:     Z:5FFDSST2.PLT
 PROBLEM DESCRIPTION   Phase 5A/7 - Section F-F
                       Downstream Static Shallow Slope Circle
 BOUNDARY COORDINATES
    10 Top   Boundaries
    27 Total Boundaries
 Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
    No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
     1          .00     462.92      19.25     462.92        3
     2        19.25     462.92      40.00     456.00        3
     3        40.00     456.00      60.00     456.00        3
     4        60.00     456.00      96.00     468.00        1
     5        96.00     468.00     192.00     500.00        1
     6       192.00     500.00     232.00     500.00        1
     7       232.00     500.00     346.00     538.00        1
     8       346.00     538.00     446.00     538.00        1
     9       446.00     538.00     488.00     524.00        1
    10       488.00     524.00    1050.00     524.00        2
    11       488.00     524.00     562.08     500.00        1
    12       232.00     500.00     242.00     500.00        1
    13       242.00     500.00     562.08     500.00        1
    14       562.08     500.00     850.79     500.00        1
    15       850.79     500.00     881.34     500.00        1
    16       242.00     500.00     255.05     495.00        1
    17       837.55     495.00     850.79     500.00        1
    18       881.34     500.00     986.02     465.73        1
    19       255.05     495.00     837.55     495.00        2
    20       255.05     495.00     349.00     459.00        1
    21       726.56     463.27     837.55     495.00        1
    22        60.00     456.00     349.00     459.00        3
    23       349.00     459.00     726.56     463.27        3
    24       726.56     463.27     986.02     465.73        3
    25       986.02     465.73    1003.52     460.00        3
    26      1003.52     460.00    1050.00     460.00        3
    27          .00     456.00      40.00     456.00        3
ISOTROPIC SOIL PARAMETERS
  3 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.  (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)    No.
   1   130.0    140.0       .0      33.7     .00        .0      1
   2    80.0     90.0       .0      28.0     .00        .0      1
   3   125.0    135.0       .0      26.8     .00        .0      1
 2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
 Unit Weight of Water =  62.40
 Piezometric Surface No.  1 Specified by  5 Coordinate Points
   Point      X-Water     Y-Water
    No.         (ft)        (ft)
     1          .00      456.00
     2        65.00      456.00
     3       255.05      495.00
     4       461.00      535.00
     5      1050.00      535.00
 Piezometric Surface No.  2 Specified by  3 Coordinate Points
   Point      X-Water     Y-Water
```

No.	(ft)	(ft)
1	.00	435.38
2	349.00	439.00
3	1050.00	439.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced Along The Ground Surface Between X = 150.00 ft.
and X = 250.00 ft.
Each Surface Terminates Between X = 360.00 ft.
and X = 440.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =436.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	228.95	500.00
2	238.11	495.98
3	247.60	492.86
4	257.36	490.65
5	267.28	489.39
6	277.27	489.07
7	287.25	489.71
8	297.12	491.30
9	306.80	493.83
10	316.19	497.27
11	325.21	501.58
12	333.78	506.74
13	341.82	512.69
14	349.25	519.38
15	356.01	526.75
16	362.04	534.73
17	364.05	538.00

Circle Center At X = 275.6 ; Y = 593.8 and Radius, 104.7
*** 2.172 ***
Individual data on the 26 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.1	265.7	.0	.0	.0	.0	.0	.0	.0
2	6.1	2933.4	.0	.0	.0	.0	.0	.0	.0
3	3.9	3717.8	.0	.0	.0	.0	.0	.0	.0
4	4.5	5849.5	.0	.0	.0	.0	.0	.0	.0
5	1.2	1795.4	.0	22.8	.0	.0	.0	.0	.0
6	7.4	14127.6	.0	1036.8	.0	.0	.0	.0	.0
7	2.3	5193.9	.0	625.1	.0	.0	.0	.0	.0
8	9.9	25145.4	.0	3916.9	.0	.0	.0	.0	.0
9	2.6	7373.4	.0	1341.0	.0	.0	.0	.0	.0
10	7.4	22137.6	.0	4244.2	.0	.0	.0	.0	.0
11	3.5	11465.0	.0	2263.8	.0	.0	.0	.0	.0
12	6.5	22300.3	.0	4409.2	.0	.0	.0	.0	.0
13	9.9	36847.9	.0	7170.3	.0	.0	.0	.0	.0
14	9.7	38603.9	.0	7072.6	.0	.0	.0	.0	.0
15	3.2	13159.2	.0	2283.8	.0	.0	.0	.0	.0
16	6.2	25493.1	.0	4097.1	.0	.0	.0	.0	.0
17	5.7	23057.5	.0	3413.2	.0	.0	.0	.0	.0
18	3.3	13026.8	.0	1688.1	.0	.0	.0	.0	.0
19	8.6	32007.0	.0	3245.6	.0	.0	.0	.0	.0
20	6.5	21968.9	.0	879.8	.0	.0	.0	.0	.0
21	1.5	4838.2	.0	.0	.0	.0	.0	.0	.0

22	4.2	12362.3	.0	.0	.0	.0	.0	.0	.0
23	3.2	8479.7	.0	.0	.0	.0	.0	.0	.0
24	6.8	13124.5	.0	.0	.0	.0	.0	.0	.0
25	6.0	5687.5	.0	.0	.0	.0	.0	.0	.0
26	2.0	427.3	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	228.95	500.00
2	238.09	495.95
3	247.57	492.77
4	257.31	490.49
5	267.22	489.13
6	277.21	488.70
7	287.19	489.20
8	297.09	490.63
9	306.81	492.98
10	316.27	496.23
11	325.38	500.35
12	334.07	505.29
13	342.26	511.03
14	349.88	517.51
15	356.87	524.67
16	363.15	532.45
17	366.84	538.00

Circle Center At X = 276.8 ; Y = 595.7 and Radius, 107.1

*** 2.182 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	239.47	502.49
2	249.38	503.89
3	259.24	505.52
4	269.06	507.39
5	278.84	509.50
6	288.56	511.85
7	298.22	514.43
8	307.82	517.24
9	317.35	520.28
10	326.79	523.55
11	336.16	527.05
12	345.44	530.78
13	354.63	534.73
14	361.77	538.00

Circle Center At X = 186.8 ; Y = 912.2 and Radius, 413.1

*** 2.199 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	228.95	500.00
2	237.68	495.14
3	246.89	491.23
4	256.46	488.34
5	266.29	486.48
6	276.26	485.69
7	286.25	485.97
8	296.16	487.31
9	305.87	489.71
10	315.27	493.13
11	324.25	497.53
12	332.70	502.88
13	340.53	509.09
14	347.66	516.11
15	353.99	523.85
16	359.46	532.22
17	362.41	538.00

Circle Center At X = 278.7 ; Y = 579.0 and Radius, 93.4

*** 2.215 ***
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	207.90	500.00
2	216.94	495.74
3	226.29	492.18
4	235.88	489.35
5	245.66	487.25
6	255.57	485.92
7	265.55	485.34
8	275.55	485.53
9	285.50	486.48
10	295.35	488.19
11	305.05	490.64
12	314.53	493.83
13	323.73	497.74
14	332.61	502.34
15	341.11	507.60
16	349.19	513.50
17	356.79	520.00
18	363.87	527.06
19	370.39	534.64
20	372.86	538.00

Circle Center At X = 268.1 ; Y = 615.8 and Radius, 130.5

*** 2.237 ***
Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	213.16	500.00
2	222.53	496.50
3	232.11	493.65
4	241.87	491.47
5	251.76	489.97
6	261.72	489.16
7	271.72	489.03
8	281.71	489.60
9	291.63	490.85
10	301.44	492.78
11	311.09	495.39
12	320.55	498.65
13	329.75	502.56
14	338.66	507.10
15	347.24	512.24
16	355.44	517.96
17	363.23	524.23
18	370.57	531.02
19	377.13	538.00

Circle Center At X = 268.5 ; Y = 633.9 and Radius, 144.9

*** 2.243 ***
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	202.63	500.00
2	211.96	496.40
3	221.51	493.44
4	231.24	491.13
5	241.11	489.48
6	251.06	488.50
7	261.05	488.20
8	271.05	488.57
9	280.99	489.62
10	290.84	491.34
11	300.55	493.72
12	310.08	496.75
13	319.39	500.42
14	328.42	504.70

15	337.15	509.59
16	345.52	515.06
17	353.51	521.08
18	361.07	527.62
19	368.17	534.66
20	371.10	538.00

Circle Center At X = 260.5 ; Y = 635.9 and Radius, 147.7

*** 2.262 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	218.42	500.00
2	227.38	495.56
3	236.65	491.80
4	246.16	488.73
5	255.88	486.38
6	265.75	484.75
7	275.71	483.86
8	285.71	483.72
9	295.69	484.31
10	305.60	485.64
11	315.39	487.71
12	324.99	490.49
13	334.36	493.98
14	343.45	498.16
15	352.20	502.99
16	360.57	508.47
17	368.51	514.55
18	375.98	521.20
19	382.93	528.38
20	389.33	536.07
21	390.72	538.00

Circle Center At X = 282.7 ; Y = 618.4 and Radius, 134.7

*** 2.308 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	207.90	500.00
2	216.80	495.45
3	226.00	491.54
4	235.47	488.30
5	245.13	485.75
6	254.96	483.89
7	264.89	482.73
8	274.88	482.29
9	284.88	482.56
10	294.83	483.54
11	304.69	485.23
12	314.40	487.62
13	323.91	490.69
14	333.19	494.43
15	342.17	498.83
16	350.81	503.85
17	359.08	509.48
18	366.92	515.69
19	374.30	522.43
20	381.18	529.69
21	387.53	537.42
22	387.94	538.00

Circle Center At X = 276.1 ; Y = 622.4 and Radius, 140.1

*** 2.316 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	223.68	500.00
2	232.70	495.67
3	242.01	492.03

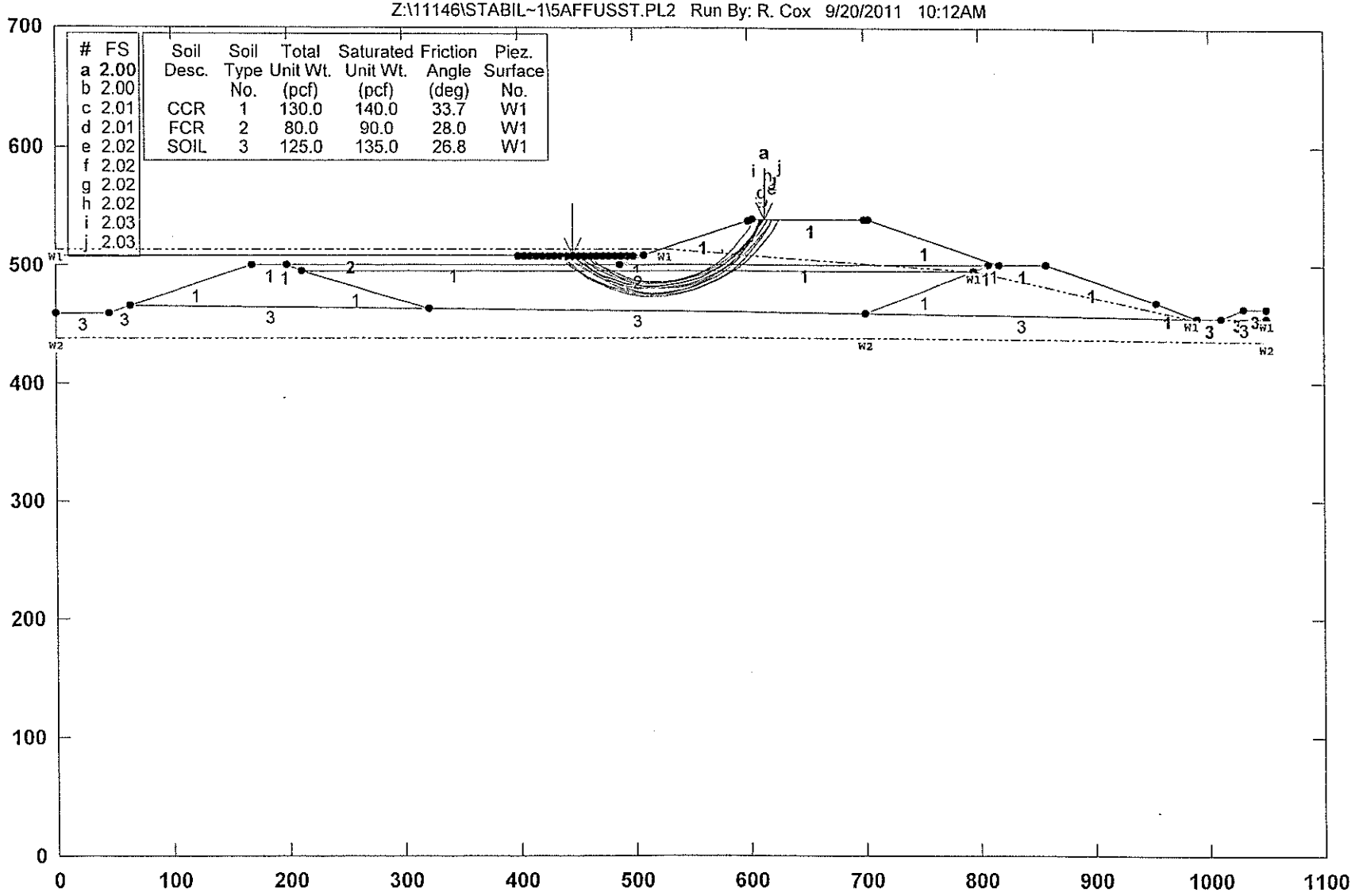
4	251.57	489.08
5	261.32	486.86
6	271.21	485.36
7	281.18	484.60
8	291.18	484.59
9	301.15	485.31
10	311.04	486.78
11	320.80	488.97
12	330.36	491.88
13	339.69	495.50
14	348.72	499.80
15	357.40	504.75
16	365.70	510.34
17	373.55	516.53
18	380.93	523.28
19	387.78	530.56
20	393.80	538.00

Circle Center At X = 286.4 ; Y = 619.1 and Radius, 134.6

*** 2.327 ***

Phase 5A/7 - Section F-F Upstream Static Whole Slope Circle

Z:\11146\STABIL~1\5AFFUSST.PL2 Run By: R. Cox 9/20/2011 10:12AM



#	FS
a	2.00
b	2.00
c	2.01
d	2.01
e	2.02
f	2.02
g	2.02
h	2.02
i	2.03
j	2.03

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
SOIL	3	125.0	135.0	26.8	W1

PCSTABL5M/si FSmin=2.00

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/20/2011
Time of Run: 10:12AM
Run By: R. Cox
Input Data Filename: Z:5AFFUSST.
Output Filename: Z:5AFFUSST.OUT
Unit: ENGLISH
Plotted Output Filename: Z:5AFFUSST.PLT
PROBLEM DESCRIPTION Phase 5A/7 - Section F-F
Upstream Static Whole Slope Circle

BOUNDARY COORDINATES
10 Top Boundaries
27 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	507.30	509.82	507.30	2
2	509.82	507.30	604.00	538.00	1
3	604.00	538.00	704.00	538.00	1
4	704.00	538.00	818.00	500.00	1
5	818.00	500.00	858.00	500.00	1
6	858.00	500.00	954.00	468.00	1
7	954.00	468.00	990.00	456.00	1
8	990.00	456.00	1010.00	456.00	3
9	1010.00	456.00	1030.75	462.92	3
10	1030.75	462.92	1050.00	462.92	3
11	487.92	500.00	509.82	507.30	1
12	168.66	500.00	199.21	500.00	1
13	199.21	500.00	487.92	500.00	1
14	487.92	500.00	808.00	500.00	1
15	808.00	500.00	818.00	500.00	1
16	199.21	500.00	212.45	495.00	1
17	794.95	495.00	808.00	500.00	1
18	63.98	465.73	168.66	500.00	1
19	212.45	495.00	794.95	495.00	2
20	212.45	495.00	323.44	463.27	1
21	701.00	459.00	794.95	495.00	1
22	63.98	465.73	323.44	463.27	3
23	323.44	463.27	701.00	459.00	3
24	701.00	459.00	990.00	456.00	3
25	1010.00	456.00	1050.00	456.00	3
26	46.48	460.00	63.98	465.73	3
27	.00	460.00	46.48	460.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	513.17
2	527.43	513.17
3	794.95	495.00
4	985.00	456.00
5	1050.00	456.00

Piezometric Surface No. 2 Specified by 3 Coordinate Points

Point	X-Water	Y-Water

No.	(ft)	(ft)
1	.00	439.00
2	701.00	439.00
3	1050.00	435.38

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced Along The Ground Surface Between X = 400.00 ft.
and X = 500.00 ft.
Each Surface Terminates Between X = 600.00 ft.
and X = 700.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =436.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	447.37	507.30
2	455.31	501.22
3	463.76	495.88
4	472.67	491.34
5	481.96	487.63
6	491.55	484.79
7	501.35	482.82
8	511.30	481.77
9	521.30	481.62
10	531.27	482.38
11	541.13	484.05
12	550.79	486.61
13	560.18	490.04
14	569.23	494.32
15	577.84	499.40
16	585.95	505.24
17	593.50	511.80
18	600.42	519.02
19	606.65	526.85
20	612.14	535.20
21	613.64	538.00

Circle Center At X = 517.9 ; Y = 591.1 and Radius, 109.6
*** 2.003 ***
Individual data on the 29 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	7.9	2172.6	2907.3	5560.7	.0	.0	.0	.0	.0
2	1.9	1162.5	707.1	1788.8	.0	.0	.0	.0	.0
3	6.5	6170.4	2391.3	7333.9	.0	.0	.0	.0	.0
4	1.7	2245.1	634.9	2152.2	.0	.0	.0	.0	.0
5	7.2	10919.3	2628.6	10051.2	.0	.0	.0	.0	.0
6	9.3	17208.5	3401.6	14777.4	.0	.0	.0	.0	.0
7	6.0	12511.2	2182.6	10248.4	.0	.0	.0	.0	.0
8	3.6	8190.4	1328.6	6574.7	.0	.0	.0	.0	.0
9	9.8	24579.7	3591.7	18323.3	.0	.0	.0	.0	.0
10	8.5	23604.0	3101.3	16362.8	.0	.0	.0	.0	.0
11	1.5	4341.4	545.6	2903.1	.0	.0	.0	.0	.0
12	10.0	32149.6	2466.8	19642.6	.0	.0	.0	.0	.0
13	6.1	21893.6	454.7	12023.2	.0	.0	.0	.0	.0
14	3.8	14406.2	.0	7379.2	.0	.0	.0	.0	.0
15	9.9	38969.0	.0	18277.8	.0	.0	.0	.0	.0
16	9.7	40300.5	.0	16548.0	.0	.0	.0	.0	.0
17	9.4	40358.6	.0	14279.3	.0	.0	.0	.0	.0

18	9.0	39186.4	.0	11490.8	.0	.0	.0	.0	.0
19	1.2	4999.0	.0	1306.3	.0	.0	.0	.0	.0
20	7.5	31060.7	.0	6899.4	.0	.0	.0	.0	.0
21	.8	3330.2	.0	641.9	.0	.0	.0	.0	.0
22	7.3	27284.5	.0	3809.4	.0	.0	.0	.0	.0
23	4.2	14189.7	.0	687.4	.0	.0	.0	.0	.0
24	3.3	10251.0	.0	.0	.0	.0	.0	.0	.0
25	6.9	18249.8	.0	.0	.0	.0	.0	.0	.0
26	3.6	7516.1	.0	.0	.0	.0	.0	.0	.0
27	2.7	4416.0	.0	.0	.0	.0	.0	.0	.0
28	5.5	4981.1	.0	.0	.0	.0	.0	.0	.0
29	1.5	271.5	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	452.63	507.30
2	459.80	500.32
3	467.65	494.13
4	476.10	488.79
5	485.07	484.36
6	494.44	480.88
7	504.13	478.41
8	514.03	476.95
9	524.02	476.53
10	534.00	477.15
11	543.86	478.81
12	553.49	481.49
13	562.80	485.15
14	571.67	489.76
15	580.01	495.28
16	587.74	501.63
17	594.76	508.75
18	601.00	516.56
19	606.40	524.98
20	610.89	533.92
21	612.43	538.00

Circle Center At X = 523.0 ; Y = 572.4 and Radius, 95.9

*** 2.004 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	463.16	507.30
2	470.47	500.48
3	478.51	494.53
4	487.17	489.52
5	496.33	485.52
6	505.88	482.57
7	515.71	480.71
8	525.68	479.98
9	535.68	480.36
10	545.56	481.87
11	555.21	484.49
12	564.51	488.17
13	573.34	492.87
14	581.58	498.54
15	589.13	505.09
16	595.89	512.46
17	601.79	520.54
18	606.73	529.23
19	610.49	538.00

Circle Center At X = 527.2 ; Y = 568.7 and Radius, 88.8

*** 2.008 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	447.37	507.30
2	454.60	500.39

3	462.49	494.25
4	470.95	488.92
5	479.91	484.47
6	489.27	480.94
7	498.93	478.37
8	508.80	476.78
9	518.78	476.19
10	528.78	476.60
11	538.68	478.01
12	548.38	480.40
13	557.80	483.76
14	566.84	488.04
15	575.40	493.21
16	583.40	499.21
17	590.76	505.99
18	597.40	513.46
19	603.26	521.57
20	608.27	530.22
21	611.79	538.00

Circle Center At X = 519.7 ; Y = 575.8 and Radius, 99.6

*** 2.009 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	442.11	507.30
2	450.08	501.26
3	458.53	495.91
4	467.39	491.28
5	476.61	487.40
6	486.12	484.31
7	495.85	482.01
8	505.74	480.53
9	515.72	479.87
10	525.71	480.05
11	535.66	481.06
12	545.49	482.89
13	555.14	485.53
14	564.53	488.97
15	573.60	493.17
16	582.30	498.12
17	590.55	503.77
18	598.30	510.08
19	605.50	517.02
20	612.10	524.53
21	618.06	532.57
22	621.42	538.00

Circle Center At X = 518.5 ; Y = 599.9 and Radius, 120.1

*** 2.016 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	452.63	507.30
2	460.93	501.72
3	469.70	496.91
4	478.86	492.90
5	488.34	489.73
6	498.07	487.42
7	507.97	485.99
8	517.96	485.45
9	527.95	485.80
10	537.87	487.05
11	547.64	489.17
12	557.18	492.17
13	566.42	496.00
14	575.28	500.65
15	583.68	506.06
16	591.57	512.21

17	598.87	519.04
18	605.54	526.50
19	611.51	534.52
20	613.65	538.00

Circle Center At X = 519.0 ; Y = 597.0 and Radius, 111.5

*** 2.019 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	436.84	507.30
2	444.16	500.48
3	452.04	494.33
4	460.44	488.90
5	469.28	484.23
6	478.50	480.35
7	488.02	477.29
8	497.77	475.08
9	507.68	473.74
10	517.67	473.28
11	527.66	473.69
12	537.58	474.98
13	547.34	477.13
14	556.88	480.13
15	566.12	483.96
16	574.99	488.59
17	583.41	493.98
18	591.33	500.08
19	598.68	506.86
20	605.41	514.26
21	611.46	522.22
22	616.79	530.68
23	620.55	538.00

Circle Center At X = 518.0 ; Y = 587.0 and Radius, 113.7

*** 2.020 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	457.90	507.30
2	466.18	501.70
3	474.94	496.88
4	484.11	492.88
5	493.60	489.73
6	503.34	487.45
7	513.24	486.07
8	523.23	485.60
9	533.22	486.04
10	543.13	487.38
11	552.87	489.62
12	562.38	492.74
13	571.56	496.71
14	580.33	501.49
15	588.64	507.06
16	596.41	513.36
17	603.57	520.34
18	610.07	527.94
19	615.85	536.10
20	616.95	538.00

Circle Center At X = 523.4 ; Y = 595.3 and Radius, 109.7

*** 2.021 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	452.63	507.30
2	460.57	501.22
3	469.08	495.97
4	478.08	491.61
5	487.47	488.18

6	497.17	485.72
7	507.06	484.25
8	517.05	483.78
9	527.03	484.33
10	536.91	485.89
11	546.58	488.43
12	555.95	491.94
13	564.91	496.38
14	573.37	501.70
15	581.26	507.85
16	588.49	514.76
17	594.97	522.37
18	600.66	530.59
19	604.74	538.00

Circle Center At X = 516.6 ; Y = 582.6 and Radius, 98.8

*** 2.026 ***

Failure Surface Specified By 24 Coordinate Points

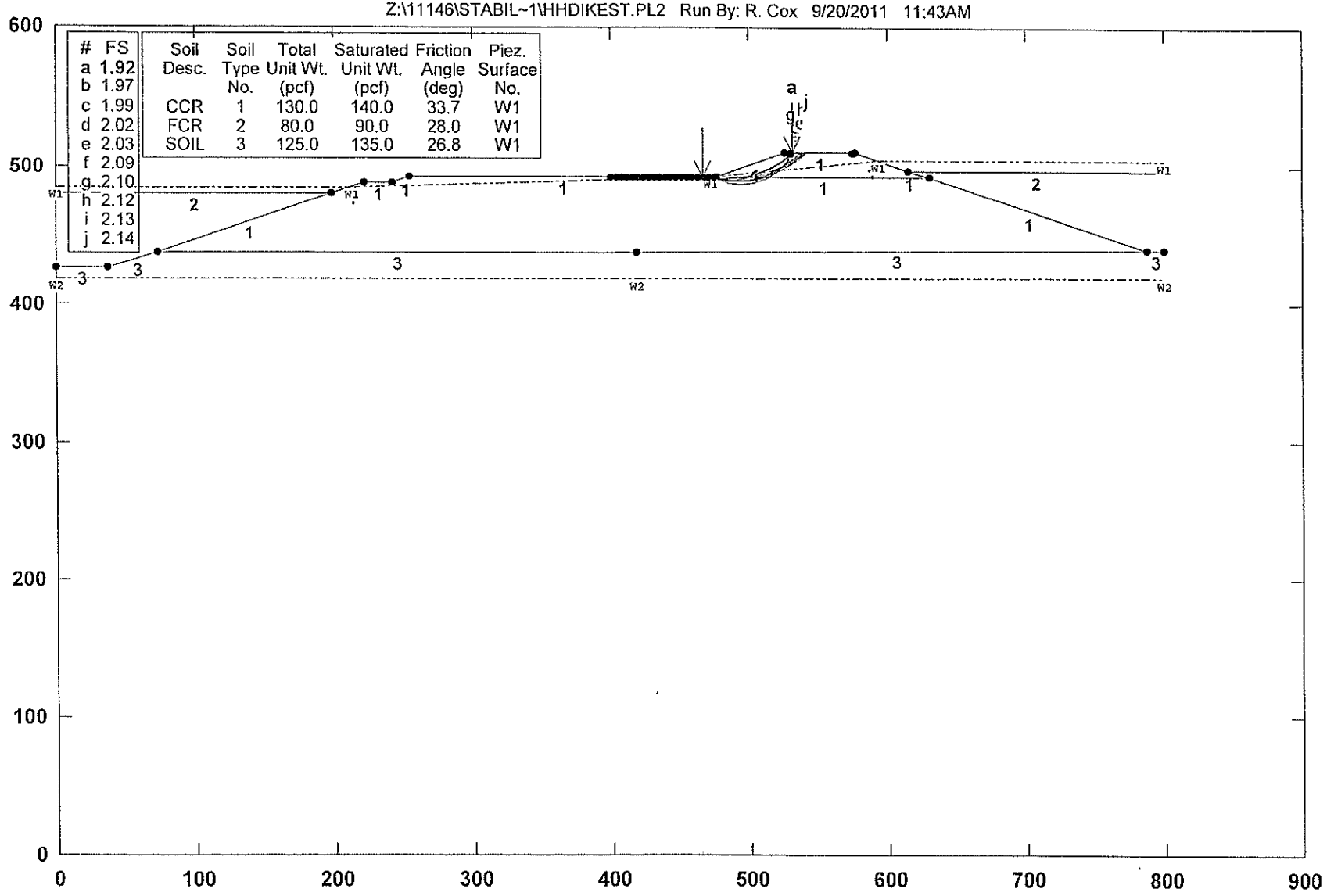
Point No.	X-Surf (ft)	Y-Surf (ft)
1	436.84	507.30
2	444.45	500.81
3	452.57	494.97
4	461.13	489.81
5	470.09	485.36
6	479.38	481.67
7	488.94	478.74
8	498.71	476.61
9	508.63	475.28
10	518.61	474.76
11	528.61	475.07
12	538.54	476.19
13	548.36	478.11
14	557.98	480.84
15	567.35	484.34
16	576.40	488.59
17	585.07	493.57
18	593.31	499.24
19	601.05	505.57
20	608.25	512.50
21	614.86	520.01
22	620.84	528.02
23	626.14	536.50
24	626.91	538.00

Circle Center At X = 519.9 ; Y = 596.9 and Radius, 122.2

*** 2.026 ***

Phase 5A - 7 Dike Static Slope Failure Toward Phase 5A

Z:\11146\STABIL~1\HHDIKEST.PL2 Run By: R. Cox 9/20/2011 11:43AM



PCSTABL5M/si FSmin=1.92

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/20/2011
Time of Run: 11:43AM
Run By: R. Cox
Input Data Filename: Z:HHDIKEST.
Output Filename: Z:HHDIKEST.OUT
Unit: ENGLISH
Plotted Output Filename: Z:HHDIKEST.PLT
PROBLEM DESCRIPTION Phase 5A - 7 Dike
Static Slope Failure Toward Phase 5A

BOUNDARY COORDINATES
9 Top Boundaries
18 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	480.00	198.62	480.00	2
2	198.62	480.00	222.62	488.00	1
3	222.62	488.00	242.62	488.00	1
4	242.62	488.00	254.62	492.00	1
5	254.62	492.00	476.63	492.00	1
6	476.63	492.00	526.62	510.00	1
7	526.62	510.00	576.62	510.00	1
8	576.62	510.00	614.90	497.24	1
9	614.90	497.24	800.00	497.24	2
10	614.90	497.24	630.62	492.00	1
11	476.63	492.00	630.62	492.00	1
12	630.62	492.00	787.36	439.76	1
13	72.62	438.00	198.62	480.00	1
14	72.62	438.00	418.61	438.00	3
15	418.61	438.00	787.36	439.76	3
16	787.36	439.76	800.00	439.76	3
17	36.62	426.00	72.62	438.00	3
18	.00	426.00	36.62	426.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	485.00
2	213.62	485.00
3	472.62	492.00
4	593.24	504.46
5	800.00	504.46

Piezometric Surface No. 2 Specified by 3 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	418.00
2	418.61	418.00
3	800.00	419.82

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 400.00 ft.

and X = 475.00 ft.
Each Surface Terminates Between X = 530.00 ft.
and X = 575.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =418.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	467.11	492.00
2	477.03	490.80
3	487.03	490.90
4	496.93	492.31
5	506.56	495.01
6	515.76	498.94
7	524.36	504.04
8	531.93	510.00

Circle Center At X = 481.2 ; Y = 566.8 and Radius, 76.2
*** 1.923 ***
Individual data on the 13 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.0	8.0	.0	.0	.0	.0	.0	.0	.0
2	4.5	246.8	.0	94.8	.0	.0	.0	.0	.0
3	4.0	512.0	50.3	280.6	.0	.0	.0	.0	.0
4	.4	70.6	9.5	40.7	.0	.0	.0	.0	.0
5	10.0	4236.7	.0	1318.2	.0	.0	.0	.0	.0
6	7.7	5874.2	.0	1176.1	.0	.0	.0	.0	.0
7	2.2	1980.8	.0	309.0	.0	.0	.0	.0	.0
8	9.6	9370.8	.0	836.2	.0	.0	.0	.0	.0
9	1.5	1539.9	.0	25.7	.0	.0	.0	.0	.0
10	7.7	7377.4	.0	.0	.0	.0	.0	.0	.0
11	8.6	6869.8	.0	.0	.0	.0	.0	.0	.0
12	2.3	1370.7	.0	.0	.0	.0	.0	.0	.0
13	5.3	1441.2	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	471.05	492.00
2	480.72	489.45
3	490.69	488.67
4	500.64	489.68
5	510.25	492.46
6	519.20	496.90
7	527.22	502.88
8	533.87	510.00

Circle Center At X = 490.0 ; Y = 544.3 and Radius, 55.7
*** 1.973 ***
Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	459.21	492.00
2	469.10	490.53
3	479.10	490.17
4	489.07	490.94
5	498.89	492.81
6	508.44	495.78
7	517.60	499.79
8	526.25	504.80
9	533.27	510.00

Circle Center At X = 477.3 ; Y = 579.4 and Radius, 89.2

*** 1.986 ***
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	475.00	492.00
2	484.74	489.73
3	494.73	489.29
4	504.63	490.70
5	514.10	493.92
6	522.81	498.83
7	530.47	505.26
8	534.35	510.00

Circle Center At X = 492.1 ; Y = 542.6 and Radius, 53.4

*** 2.024 ***
Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	471.05	492.00
2	480.84	489.97
3	490.83	489.45
4	500.78	490.44
5	510.47	492.93
6	519.66	496.86
7	528.16	502.14
8	535.75	508.64
9	536.92	510.00

Circle Center At X = 489.3 ; Y = 555.3 and Radius, 65.8

*** 2.026 ***
Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	471.05	492.00
2	480.98	490.79
3	490.98	490.79
4	500.90	492.01
5	510.61	494.43
6	519.95	498.01
7	528.78	502.70
8	536.98	508.42
9	538.74	510.00

Circle Center At X = 485.9 ; Y = 572.8 and Radius, 82.1

*** 2.085 ***
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	475.00	492.00
2	484.24	488.17
3	494.14	486.77
4	504.08	487.89
5	513.42	491.46
6	521.58	497.24
7	528.03	504.88
8	530.50	510.00

Circle Center At X = 494.6 ; Y = 526.0 and Radius, 39.3

*** 2.096 ***
Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	475.00	492.00
2	484.76	489.80
3	494.74	489.24
4	504.68	490.31
5	514.31	493.00
6	523.38	497.22
7	531.62	502.88
8	538.84	509.81
9	538.98	510.00

Circle Center At X = 493.2 ; Y = 550.1 and Radius, 60.9
*** 2.118 ***
Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	471.05	492.00
2	480.92	490.39
3	490.92	490.05
4	500.87	490.97
5	510.63	493.15
6	520.04	496.55
7	528.93	501.12
8	537.18	506.77
9	540.80	510.00

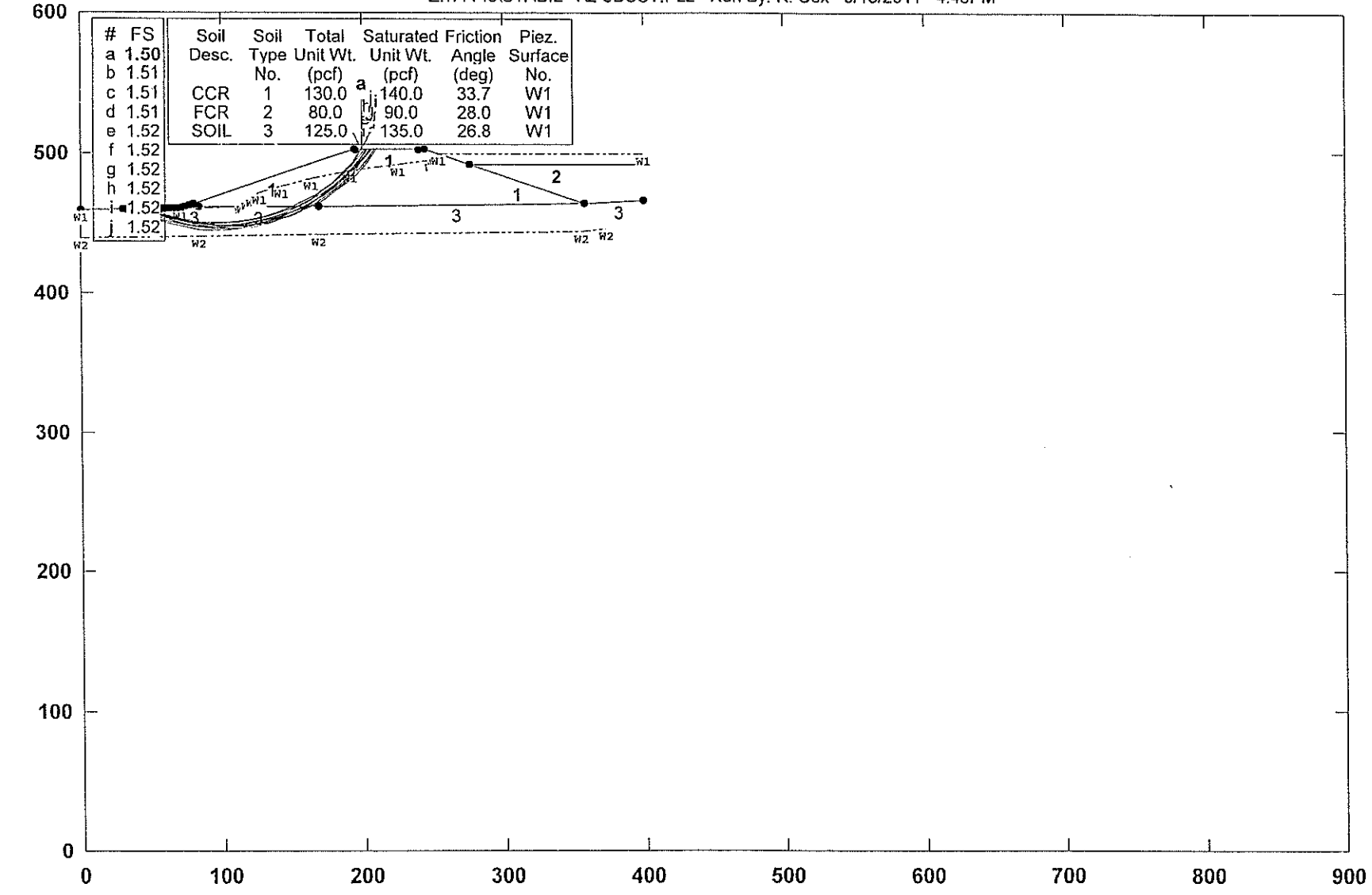
Circle Center At X = 488.6 ; Y = 568.7 and Radius, 78.7
*** 2.130 ***
Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	471.05	492.00
2	480.86	490.05
3	490.84	489.44
4	500.82	490.17
5	510.60	492.24
6	520.02	495.60
7	528.90	500.20
8	537.08	505.95
9	541.45	510.00

Circle Center At X = 490.4 ; Y = 563.7 and Radius, 74.2
*** 2.142 ***

Phase 2-3 Connector - Section G-G Downstream Static Whole Slope Circle

Z:\11146\STABIL~1\2-3DSST.PL2 Run By: R. Cox 9/15/2011 4:48PM



PCSTABL5M/si FSmin=1.50

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/15/2011
Time of Run: 4:48PM
Run By: R. Cox
Input Data Filename: Z:2-3DSST.
Output Filename: Z:2-3DSST.OUT
Unit: ENGLISH
Plotted Output Filename: Z:2-3DSST.PLT
PROBLEM DESCRIPTION Phase 2-3 Connector - Section G-G
Downstream Static Whole Slope Circle

BOUNDARY COORDINATES
5 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	459.46	70.94	460.86	3
2	70.94	460.86	194.37	502.00	1
3	194.37	502.00	244.37	502.00	1
4	244.37	502.00	276.47	491.30	1
5	276.47	491.30	400.00	491.30	2
6	276.47	491.30	357.57	464.27	1
7	70.94	460.86	83.64	461.11	3
8	83.64	461.11	168.48	461.80	3
9	168.48	461.80	357.57	464.27	3
10	357.57	464.27	400.00	466.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 17 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	459.46
2	70.94	460.86
3	114.31	461.36
4	114.84	463.50
5	116.31	465.50
6	118.77	467.50
7	122.21	469.50
8	126.63	471.50
9	141.99	476.50
10	163.43	481.50
11	191.14	486.50
12	224.93	491.50
13	249.11	494.53
14	251.66	495.63
15	253.23	497.91
16	253.57	499.00
17	400.00	499.00

Piezometric Surface No. 2 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	439.46
2	83.69	441.11
3	168.48	441.80
4	355.17	444.00

5 373.03 446.00
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 30.00 ft.
and X = 80.00 ft.
Each Surface Terminates Between X = 195.00 ft.
and X = 240.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =440.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	48.42	460.42
2	57.61	456.46
3	67.09	453.29
4	76.81	450.92
5	86.68	449.37
6	96.66	448.65
7	106.66	448.77
8	116.61	449.72
9	126.45	451.50
10	136.11	454.10
11	145.52	457.50
12	154.61	461.66
13	163.31	466.58
14	171.58	472.20
15	179.35	478.50
16	186.57	485.42
17	193.18	492.92
18	199.14	500.95
19	199.79	502.00

Circle Center At X = 100.3 ; Y = 568.2 and Radius, 119.6
*** 1.504 ***
Individual data on the 33 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.2	2563.8	.0	1290.0	.0	.0	.0	.0	.0
2	9.5	7444.9	.0	3628.0	.0	.0	.0	.0	.0
3	3.9	4159.3	.0	1978.5	.0	.0	.0	.0	.0
4	.0	2.1	.0	1.0	.0	.0	.0	.0	.0
5	5.9	8048.1	.0	3486.8	.0	.0	.0	.0	.0
6	6.8	12416.4	.0	4568.5	.0	.0	.0	.0	.0
7	3.0	6501.4	.0	2194.9	.0	.0	.0	.0	.0
8	10.0	24922.2	.0	7542.2	.0	.0	.0	.0	.0
9	10.0	29724.9	.0	7801.5	.0	.0	.0	.0	.0
10	7.5	24695.4	.0	5723.4	.0	.0	.0	.0	.0
11	.2	543.8	.0	118.5	.0	.0	.0	.0	.0
12	.5	1787.7	.0	226.7	.0	.0	.0	.0	.0
13	1.5	5051.7	.0	925.8	.0	.0	.0	.0	.0
14	.3	1056.2	.0	241.8	.0	.0	.0	.0	.0
15	2.2	7604.4	.0	1830.8	.0	.0	.0	.0	.0
16	3.4	12406.8	.0	3445.0	.0	.0	.0	.0	.0
17	4.2	15719.1	.0	4761.2	.0	.0	.0	.0	.0
18	.2	666.1	.0	209.0	.0	.0	.0	.0	.0
19	9.5	36135.3	.0	11790.3	.0	.0	.0	.0	.0
20	5.9	22663.3	.0	7570.0	.0	.0	.0	.0	.0
21	3.5	13561.7	.0	4568.9	.0	.0	.0	.0	.0
22	9.1	34244.3	.0	11429.7	.0	.0	.0	.0	.0

23	.0	148.5	.0	49.9	.0	.0	.0	.0	.0
24	8.7	30761.0	.0	9880.7	.0	.0	.0	.0	.0
25	.1	393.0	.0	126.3	.0	.0	.0	.0	.0
26	8.2	26057.2	.0	7754.6	.0	.0	.0	.0	.0
27	7.8	21189.0	.0	5110.4	.0	.0	.0	.0	.0
28	7.2	15449.5	.0	1881.6	.0	.0	.0	.0	.0
29	.3	479.2	.0	3.1	.0	.0	.0	.0	.0
30	6.3	9260.0	.0	.0	.0	.0	.0	.0	.0
31	1.2	1248.6	.0	.0	.0	.0	.0	.0	.0
32	4.8	2645.0	.0	.0	.0	.0	.0	.0	.0
33	.7	44.3	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	43.16	460.31
2	52.25	456.14
3	61.64	452.70
4	71.27	450.03
5	81.09	448.14
6	91.03	447.04
7	101.03	446.74
8	111.02	447.23
9	120.93	448.53
10	130.71	450.61
11	140.29	453.47
12	149.62	457.08
13	158.62	461.43
14	167.25	466.49
15	175.45	472.22
16	183.16	478.59
17	190.34	485.55
18	196.93	493.06
19	202.91	501.08
20	203.49	502.00

Circle Center At X = 99.8 ; Y = 571.6 and Radius, 124.9

*** 1.511 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.05	460.47
2	60.26	456.57
3	69.76	453.44
4	79.48	451.08
5	89.35	449.51
6	99.32	448.74
7	109.32	448.78
8	119.29	449.62
9	129.15	451.27
10	138.85	453.70
11	148.32	456.91
12	157.50	460.88
13	166.33	465.57
14	174.76	470.96
15	182.72	477.01
16	190.17	483.68
17	197.05	490.93
18	203.33	498.71
19	205.57	502.00

Circle Center At X = 103.8 ; Y = 572.5 and Radius, 123.9

*** 1.513 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	45.79	460.36
2	54.82	456.07
3	64.17	452.52
4	73.78	449.74

5	83.58	447.75
6	93.51	446.56
7	103.50	446.19
8	113.49	446.62
9	123.41	447.86
10	133.20	449.91
11	142.79	452.74
12	152.12	456.34
13	161.13	460.68
14	169.75	465.75
15	177.94	471.49
16	185.63	477.88
17	192.78	484.87
18	199.33	492.42
19	205.26	500.48
20	206.19	502.00

Circle Center At X = 103.1 ; Y = 569.2 and Radius, 123.0

*** 1.515 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	43.16	460.31
2	52.53	456.82
3	62.13	454.03
4	71.91	451.95
5	81.82	450.59
6	91.80	449.97
7	101.80	450.08
8	111.76	450.92
9	121.64	452.50
10	131.37	454.79
11	140.91	457.79
12	150.20	461.49
13	159.20	465.86
14	167.85	470.88
15	176.11	476.51
16	183.93	482.75
17	191.27	489.53
18	198.10	496.84
19	202.25	502.00

Circle Center At X = 95.3 ; Y = 586.0 and Radius, 136.1

*** 1.517 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.05	460.47
2	60.21	456.45
3	69.66	453.17
4	79.34	450.67
5	89.19	448.95
6	99.15	448.02
7	109.15	447.90
8	119.12	448.58
9	129.01	450.06
10	138.75	452.33
11	148.28	455.37
12	157.53	459.16
13	166.45	463.69
14	174.97	468.91
15	183.05	474.81
16	190.63	481.33
17	197.66	488.44
18	204.10	496.09
19	208.31	502.00

Circle Center At X = 105.7 ; Y = 572.4 and Radius, 124.5

*** 1.520 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	37.90	460.21
2	47.04	456.16
3	56.46	452.80
4	66.10	450.14
5	75.91	448.22
6	85.84	447.02
7	95.83	446.57
8	105.82	446.87
9	115.77	447.90
10	125.61	449.67
11	135.30	452.17
12	144.77	455.38
13	153.97	459.28
14	162.86	463.86
15	171.39	469.09
16	179.50	474.93
17	187.16	481.37
18	194.32	488.35
19	200.93	495.85
20	205.60	502.00

Circle Center At X = 96.9 ; Y = 580.9 and Radius, 134.3

*** 1.520 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	37.90	460.21
2	46.84	455.74
3	56.12	452.00
4	65.66	449.01
5	75.41	446.80
6	85.31	445.37
7	95.29	444.74
8	105.29	444.91
9	115.24	445.88
10	125.08	447.64
11	134.76	450.19
12	144.19	453.50
13	153.34	457.55
14	162.12	462.32
15	170.50	467.78
16	178.42	473.89
17	185.82	480.61
18	192.66	487.90
19	198.90	495.72
20	203.13	502.00

Circle Center At X = 98.1 ; Y = 569.5 and Radius, 124.8

*** 1.522 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	48.42	460.42
2	57.56	456.36
3	66.99	453.03
4	76.65	450.44
5	86.48	448.61
6	96.43	447.56
7	106.42	447.27
8	116.41	447.77
9	126.33	449.04
10	136.12	451.07
11	145.72	453.87
12	155.08	457.40
13	164.13	461.64
14	172.83	466.58
15	181.11	472.18

16	188.94	478.40
17	196.26	485.22
18	203.02	492.58
19	209.20	500.45
20	210.23	502.00

Circle Center At X = 105.0 ; Y = 575.7 and Radius, 128.4

*** 1.522 ***

Failure Surface Specified By 19 Coordinate Points

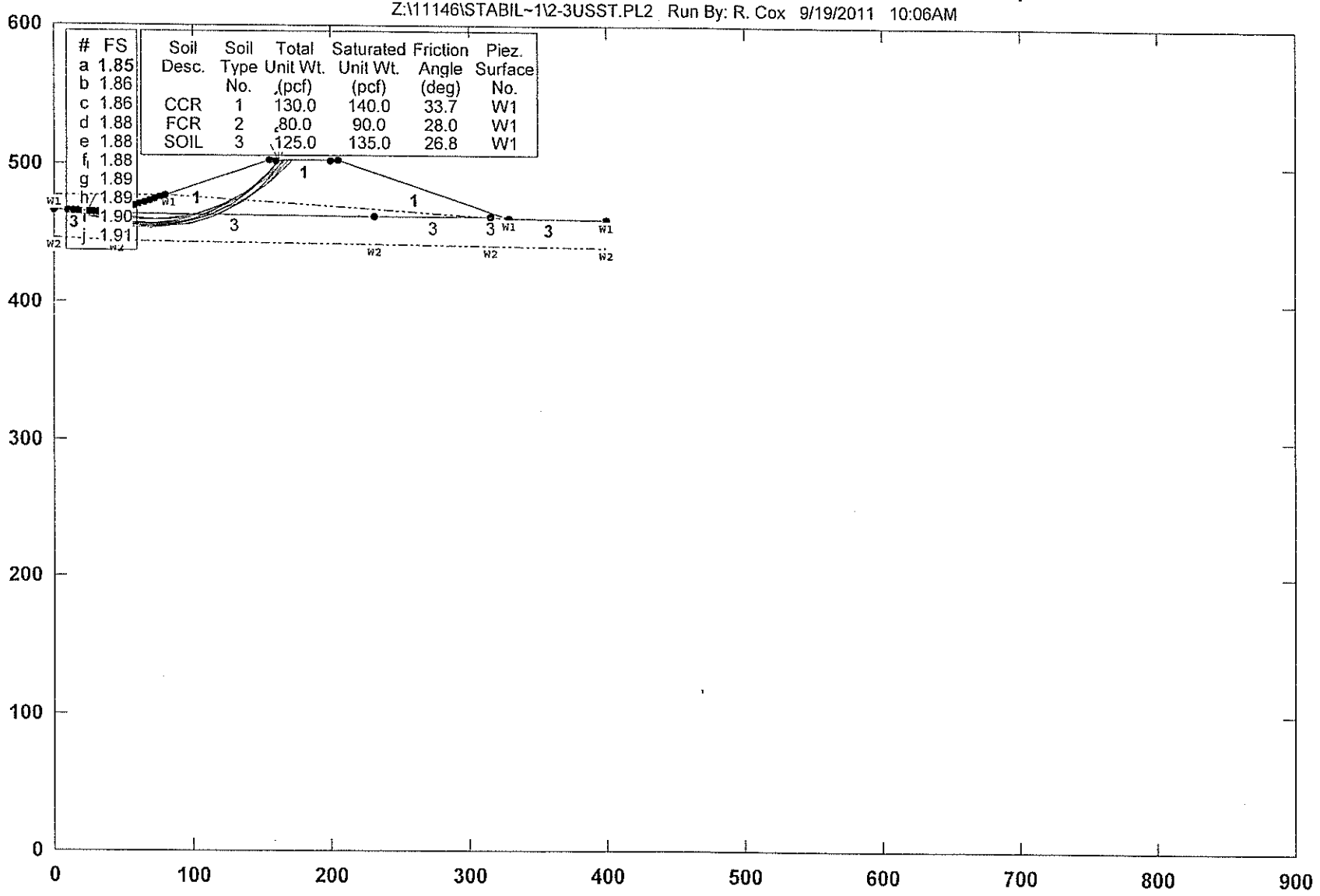
Point No.	X-Surf (ft)	Y-Surf (ft)
1	45.79	460.36
2	55.20	456.98
3	64.83	454.27
4	74.62	452.26
5	84.54	450.95
6	94.52	450.36
7	104.52	450.48
8	114.48	451.32
9	124.36	452.87
10	134.10	455.12
11	143.66	458.06
12	152.98	461.68
13	162.02	465.96
14	170.73	470.87
15	179.07	476.39
16	186.99	482.50
17	194.45	489.16
18	201.42	496.33
19	206.19	502.00

Circle Center At X = 97.8 ; Y = 590.0 and Radius, 139.7

*** 1.523 ***

Phase 2-3 Connector - Section G-G Upstream Static Whole Slope Circle

Z:\11146\STABIL~1\2-3USST.PL2 Run By: R. Cox 9/19/2011 10:06AM



PCSTABL5M/si FSmin=1.85

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/19/2011
Time of Run: 10:06AM
Run By: R. Cox
Input Data Filename: Z:2-3usst.
Output Filename: Z:2-3usst.OUT
Unit: ENGLISH
Plotted Output Filename: Z:2-3usst.PLT
PROBLEM DESCRIPTION Phase 2-3 Connector - Section G-G
Upstream Static Whole Slope Circle

BOUNDARY COORDINATES
5 Top Boundaries
8 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	42.42	464.27	3
2	42.42	464.27	155.63	502.00	1
3	155.63	502.00	205.63	502.00	1
4	205.63	502.00	329.06	460.86	1
5	329.06	460.86	400.00	459.46	3
6	42.43	464.27	231.52	461.80	3
7	231.52	461.80	316.36	461.11	3
8	316.36	461.11	329.06	460.86	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	477.56
2	82.31	477.56
3	329.06	460.86
4	400.00	459.46

Piezometric Surface No. 2 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	446.00
2	44.83	444.00
3	231.52	441.80
4	316.31	441.11
5	400.00	439.46

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 10.00 ft.
and X = 80.00 ft.
Each Surface Terminates Between X = 160.00 ft.
and X = 200.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =440.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	24.74	464.99
2	34.04	461.32
3	43.63	458.49
4	53.44	456.52
5	63.38	455.43
6	73.37	455.21
7	83.35	455.89
8	93.23	457.44
9	102.93	459.85
10	112.38	463.12
11	121.51	467.21
12	130.24	472.09
13	138.50	477.72
14	146.23	484.06
15	153.38	491.06
16	159.87	498.67
17	162.24	502.00

Circle Center At X = 70.8 ; Y = 568.2 and Radius, 113.0
*** 1.850 ***
Individual data on the 22 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.3	2064.3	7413.0	8986.9	.0	.0	.0	.0	.0
2	8.4	4923.2	6865.1	9524.3	.0	.0	.0	.0	.0
3	.0	7.6	8.7	12.2	.0	.0	.0	.0	.0
4	1.2	942.8	1034.8	1477.3	.0	.0	.0	.0	.0
5	9.8	11748.4	7256.0	12511.5	.0	.0	.0	.0	.0
6	9.9	18553.7	5205.5	13468.4	.0	.0	.0	.0	.0
7	10.0	24202.5	3051.2	13877.0	.0	.0	.0	.0	.0
8	8.9	25352.3	872.8	12320.8	.0	.0	.0	.0	.0
9	1.0	3145.9	.0	1407.8	.0	.0	.0	.0	.0
10	9.9	31079.0	.0	12759.2	.0	.0	.0	.0	.0
11	9.7	31985.3	.0	11111.2	.0	.0	.0	.0	.0
12	9.5	31396.3	.0	8938.2	.0	.0	.0	.0	.0
13	.5	1684.5	.0	427.5	.0	.0	.0	.0	.0
14	8.6	27635.0	.0	5829.7	.0	.0	.0	.0	.0
15	8.7	25887.9	.0	3089.1	.0	.0	.0	.0	.0
16	3.0	8118.4	.0	249.3	.0	.0	.0	.0	.0
17	5.3	13408.1	.0	.0	.0	.0	.0	.0	.0
18	7.7	16775.8	.0	.0	.0	.0	.0	.0	.0
19	7.1	11602.5	.0	.0	.0	.0	.0	.0	.0
20	2.3	2707.6	.0	.0	.0	.0	.0	.0	.0
21	4.2	3208.0	.0	.0	.0	.0	.0	.0	.0
22	2.4	514.2	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	32.11	464.69
2	41.76	462.07
3	51.59	460.23
4	61.53	459.19
5	71.53	458.96
6	81.51	459.53
7	91.42	460.91
8	101.18	463.08
9	110.73	466.03
10	120.02	469.74
11	128.98	474.19
12	137.54	479.34
13	145.67	485.17
14	153.30	491.64

15	160.38	498.69
16	163.20	502.00

Circle Center At X = 69.4 ; Y = 582.6 and Radius, 123.6

*** 1.860 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	21.05	465.14
2	30.29	461.32
3	39.83	458.31
4	49.60	456.16
5	59.51	454.86
6	69.50	454.43
7	79.49	454.88
8	89.40	456.20
9	99.16	458.38
10	108.70	461.40
11	117.93	465.25
12	126.79	469.88
13	135.21	475.27
14	143.13	481.38
15	150.48	488.16
16	157.22	495.55
17	162.14	502.00

Circle Center At X = 69.4 ; Y = 568.8 and Radius, 114.4

*** 1.861 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	21.05	465.14
2	30.20	461.10
3	39.67	457.87
4	49.38	455.49
5	59.26	453.96
6	69.24	453.30
7	79.23	453.51
8	89.18	454.59
9	98.98	456.54
10	108.58	459.34
11	117.90	462.97
12	126.87	467.39
13	135.42	472.58
14	143.48	478.50
15	150.99	485.10
16	157.90	492.33
17	164.15	500.14
18	165.39	502.00

Circle Center At X = 71.8 ; Y = 567.5 and Radius, 114.3

*** 1.877 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	43.16	464.52
2	52.87	462.12
3	62.75	460.60
4	72.73	459.96
5	82.73	460.21
6	92.66	461.35
7	102.45	463.37
8	112.03	466.26
9	121.31	469.98
10	130.22	474.52
11	138.69	479.83
12	146.66	485.87
13	154.06	492.60
14	160.83	499.97
15	162.39	502.00

Circle Center At X = 74.9 ; Y = 572.2 and Radius, 112.3
*** 1.879 ***
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.37	465.29
2	26.84	462.09
3	36.53	459.61
4	46.38	457.87
5	56.33	456.87
6	66.32	456.62
7	76.31	457.13
8	86.23	458.38
9	96.03	460.38
10	105.65	463.11
11	115.04	466.55
12	124.14	470.69
13	132.91	475.50
14	141.29	480.96
15	149.23	487.04
16	156.70	493.69
17	163.64	500.88
18	164.57	502.00

Circle Center At X = 64.6 ; Y = 589.4 and Radius, 132.8
*** 1.879 ***
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	21.05	465.14
2	30.30	461.34
3	39.83	458.32
4	49.58	456.08
5	59.48	454.64
6	69.46	454.02
7	79.46	454.21
8	89.40	455.22
9	99.24	457.05
10	108.89	459.66
11	118.29	463.06
12	127.39	467.22
13	136.11	472.10
14	144.41	477.68
15	152.23	483.92
16	159.50	490.78
17	166.20	498.21
18	169.09	502.00

Circle Center At X = 72.0 ; Y = 576.0 and Radius, 122.1
*** 1.892 ***
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.37	465.29
2	26.57	461.37
3	36.06	458.22
4	45.77	455.85
5	55.65	454.28
6	65.62	453.53
7	75.62	453.59
8	85.58	454.47
9	95.44	456.16
10	105.12	458.65
11	114.57	461.92
12	123.72	465.96
13	132.51	470.73
14	140.88	476.20
15	148.78	482.34
16	156.14	489.10

17	162.93	496.44
18	167.29	502.00

Circle Center At X = 69.8 ; Y = 575.5 and Radius, 122.1

*** 1.893 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	13.68	465.44
2	23.09	462.04
3	32.72	459.33
4	42.52	457.35
5	52.44	456.10
6	62.43	455.59
7	72.42	455.82
8	82.38	456.79
9	92.23	458.49
10	101.93	460.92
11	111.43	464.06
12	120.66	467.89
13	129.59	472.40
14	138.16	477.55
15	146.32	483.33
16	154.04	489.69
17	161.26	496.61
18	166.11	502.00

Circle Center At X = 64.3 ; Y = 590.4 and Radius, 134.8

*** 1.898 ***

Failure Surface Specified By 18 Coordinate Points

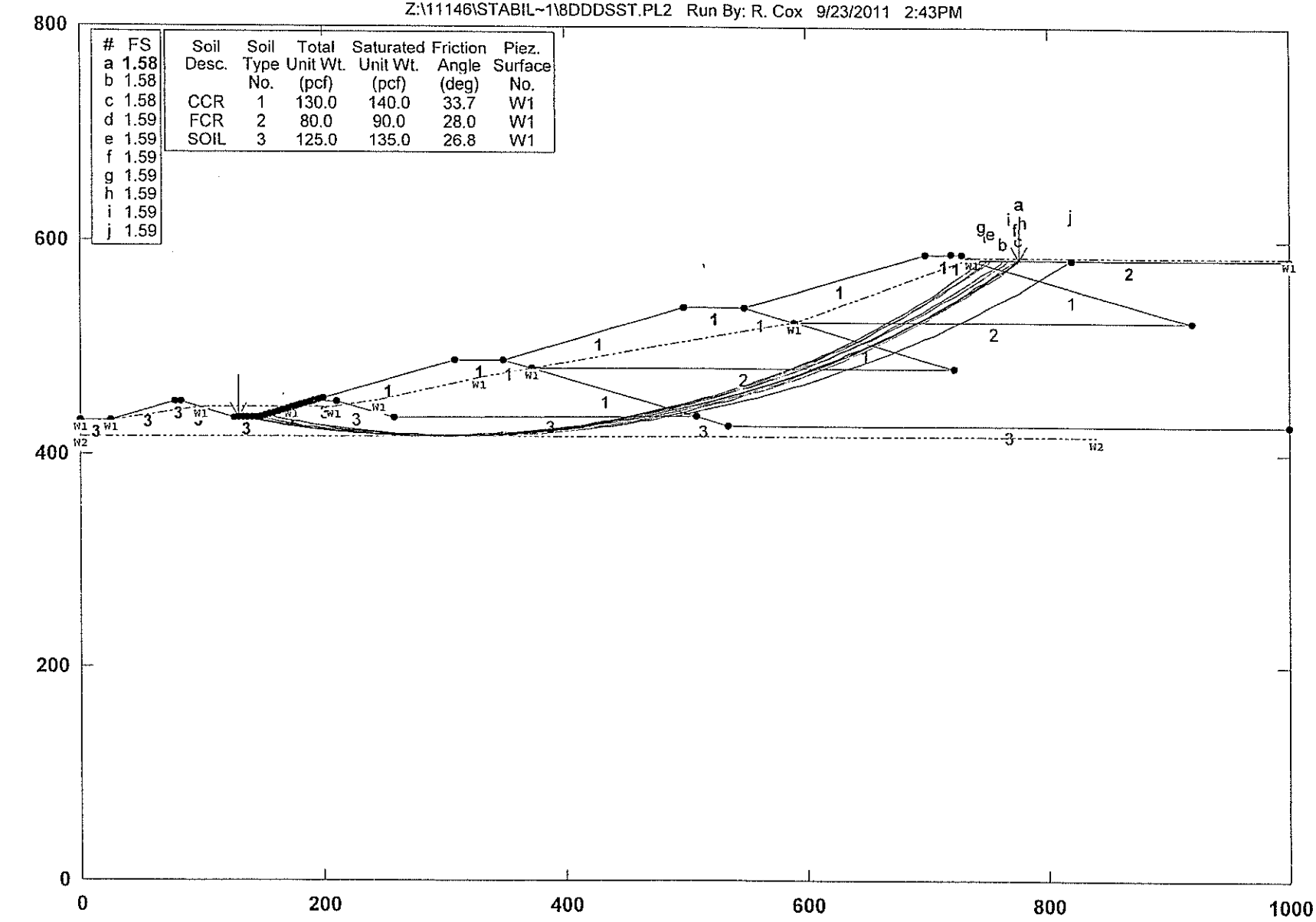
Point No.	X-Surf (ft)	Y-Surf (ft)
1	24.74	464.99
2	34.22	461.82
3	43.92	459.37
4	53.77	457.67
5	63.72	456.70
6	73.72	456.50
7	83.71	457.04
8	93.62	458.34
9	103.41	460.38
10	113.02	463.16
11	122.39	466.65
12	131.47	470.83
13	140.21	475.69
14	148.56	481.20
15	156.47	487.31
16	163.90	494.01
17	170.80	501.25
18	171.41	502.00

Circle Center At X = 71.5 ; Y = 588.9 and Radius, 132.5

*** 1.906 ***

Phase 8 - Section D-D Downstream Static Whole Slope Circle

Z:\11146\STABIL~1\8DDDSST.PL2 Run By: R. Cox 9/23/2011 2:43PM



PCSTABL5M/si FSmin=1.58

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/23/2011
Time of Run: 2:43PM
Run By: R. Cox
Input Data Filename: Z:8dddsst.
Output Filename: Z:8dddsst.OUT
Unit: ENGLISH
Plotted Output Filename: Z:8dddsst.PLT
PROBLEM DESCRIPTION Phase 8 - Section D-D
Downstream Static Whole Slope Circle

BOUNDARY COORDINATES
14 Top Boundaries
26 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	431.59	25.25	431.74	3
2	25.25	431.74	77.02	449.00	3
3	77.02	449.00	82.02	449.00	3
4	82.02	449.00	126.72	434.10	3
5	126.72	434.10	146.72	434.10	3
6	146.72	434.10	191.42	449.00	3
7	191.42	449.00	308.42	488.00	1
8	308.42	488.00	348.42	488.00	1
9	348.42	488.00	498.42	538.00	1
10	498.42	538.00	548.42	538.00	1
11	548.42	538.00	698.42	588.00	1
12	698.42	588.00	728.42	588.00	1
13	728.42	588.00	734.42	582.00	1
14	734.42	582.00	1000.00	582.00	2
15	734.42	582.00	920.42	524.00	1
16	548.42	538.00	590.42	524.00	1
17	590.42	524.00	920.42	524.00	2
18	590.42	524.00	722.42	480.00	1
19	348.42	488.00	372.42	480.00	1
20	372.42	480.00	722.42	480.00	2
21	372.42	480.00	508.62	434.60	1
22	191.42	449.00	211.42	449.00	3
23	211.42	449.00	258.90	433.17	3
24	258.90	433.17	508.62	434.60	3
25	508.62	434.60	534.42	426.00	3
26	534.42	426.00	1000.00	426.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 12 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	431.59
2	25.25	431.74
3	99.36	443.22
4	174.08	443.22
5	208.42	443.22
6	246.05	450.50
7	328.91	471.00
8	372.42	480.00

9	372.43	480.00
10	590.42	524.00
11	737.93	585.00
12	1000.00	585.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	415.86
2	840.00	416.63

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced Along The Ground Surface Between X = 130.00 ft.
and X = 200.00 ft.
Each Surface Terminates Between X = 720.00 ft.
and X = 820.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =416.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 70 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.00	434.10
2	139.78	432.02
3	149.59	430.06
4	159.42	428.24
5	169.27	426.53
6	179.15	424.96
7	189.04	423.51
8	198.96	422.19
9	208.89	421.00
10	218.83	419.94
11	228.78	419.00
12	238.75	418.19
13	248.73	417.52
14	258.71	416.96
15	268.71	416.54
16	278.70	416.25
17	288.70	416.09
18	298.70	416.05
19	308.70	416.14
20	318.70	416.37
21	328.69	416.72
22	338.68	417.20
23	348.66	417.80
24	358.63	418.54
25	368.60	419.41
26	378.55	420.40
27	388.48	421.52
28	398.40	422.77
29	408.31	424.15
30	418.20	425.65
31	428.06	427.28
32	437.91	429.04
33	447.73	430.93
34	457.52	432.94
35	467.29	435.08
36	477.03	437.34
37	486.74	439.73
38	496.42	442.24
39	506.07	444.88
40	515.68	447.64

41	525.25	450.53
42	534.79	453.54
43	544.29	456.67
44	553.74	459.92
45	563.16	463.30
46	572.52	466.79
47	581.85	470.41
48	591.12	474.15
49	600.35	478.00
50	609.53	481.97
51	618.65	486.07
52	627.72	490.27
53	636.74	494.60
54	645.70	499.04
55	654.60	503.60
56	663.44	508.27
57	672.22	513.05
58	680.94	517.95
59	689.60	522.96
60	698.19	528.08
61	706.71	533.30
62	715.17	538.64
63	723.55	544.09
64	731.87	549.65
65	740.11	555.31
66	748.28	561.08
67	756.38	566.95
68	764.39	572.92
69	772.33	579.00
70	776.15	582.00

Circle Center At X = 296.4 ; Y = 1192.3 and Radius, 776.3

*** 1.578 ***

Individual data on the 97 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.8	1373.9	5566.3	6340.1	.0	.0	.0	.0	.0
2	6.9	2597.0	3948.6	5250.3	.0	.0	.0	.0	.0
3	2.9	1637.4	1630.6	2349.1	.0	.0	.0	.0	.0
4	9.8	10013.9	4219.6	8779.7	.0	.0	.0	.0	.0
5	9.9	16749.7	2102.8	9881.1	.0	.0	.0	.0	.0
6	4.8	10554.3	253.2	5183.3	.0	.0	.0	.0	.0
7	5.1	12755.9	.0	5719.9	.0	.0	.0	.0	.0
8	9.9	29488.3	.0	11846.0	.0	.0	.0	.0	.0
9	2.4	7970.4	.0	2971.0	.0	.0	.0	.0	.0
10	7.5	27560.1	.0	9738.2	.0	.0	.0	.0	.0
11	9.5	39456.6	.0	12843.6	.0	.0	.0	.0	.0
12	.5	2076.9	.0	638.8	.0	.0	.0	.0	.0
13	2.5	11535.4	.0	3543.8	.0	.0	.0	.0	.0
14	7.4	35963.3	.0	11041.2	.0	.0	.0	.0	.0
15	2.5	12681.0	.0	3883.6	.0	.0	.0	.0	.0
16	7.5	40861.8	.0	12493.5	.0	.0	.0	.0	.0
17	10.0	59431.2	.0	18092.1	.0	.0	.0	.0	.0
18	7.3	47109.5	.0	14274.4	.0	.0	.0	.0	.0
19	2.7	18036.8	.0	5406.9	.0	.0	.0	.0	.0
20	10.0	70709.6	.0	21305.9	.0	.0	.0	.0	.0
21	.2	1368.8	.0	413.9	.0	.0	.0	.0	.0
22	9.8	74688.3	.0	22684.0	.0	.0	.0	.0	.0
23	10.0	81139.0	.0	24812.8	.0	.0	.0	.0	.0
24	7.8	66405.5	.0	20403.4	.0	.0	.0	.0	.0
25	2.2	19634.2	.0	6046.8	.0	.0	.0	.0	.0
26	10.0	90755.6	.0	28009.8	.0	.0	.0	.0	.0
27	9.7	92564.6	.0	28649.0	.0	.0	.0	.0	.0
28	.2	1621.2	.0	502.5	.0	.0	.0	.0	.0
29	.1	1096.1	.0	340.0	.0	.0	.0	.0	.0
30	10.0	97334.1	.0	30894.9	.0	.0	.0	.0	.0

31	10.0	97149.5	.0	32219.9	.0	.0	.0	.0	.0
32	.2	2132.4	.0	722.9	.0	.0	.0	.0	.0
33	9.8	94669.3	.0	32905.6	.0	.0	.0	.0	.0
34	9.7	93892.5	.0	33721.8	.0	.0	.0	.0	.0
35	.2	2310.5	.0	842.8	.0	.0	.0	.0	.0
36	10.0	97671.8	.0	35414.9	.0	.0	.0	.0	.0
37	10.0	100996.6	.0	36185.5	.0	.0	.0	.0	.0
38	3.8	39644.2	.0	14096.1	.0	.0	.0	.0	.0
39	.0	104.2	.0	37.7	.0	.0	.0	.0	.0
40	6.1	64061.3	.0	22758.6	.0	.0	.0	.0	.0
41	9.9	105202.9	.0	37488.0	.0	.0	.0	.0	.0
42	9.9	106274.7	.0	37988.8	.0	.0	.0	.0	.0
43	9.9	107149.9	.0	38409.5	.0	.0	.0	.0	.0
44	9.9	107828.5	.0	38750.0	.0	.0	.0	.0	.0
45	9.9	108310.9	.0	39010.2	.0	.0	.0	.0	.0
46	9.8	108597.7	.0	39189.9	.0	.0	.0	.0	.0
47	9.8	108689.9	.0	39289.4	.0	.0	.0	.0	.0
48	9.8	108588.6	.0	39308.5	.0	.0	.0	.0	.0
49	6.4	71112.1	.0	25779.8	.0	.0	.0	.0	.0
50	3.4	37176.6	.0	13467.4	.0	.0	.0	.0	.0
51	9.7	107721.4	.0	39105.4	.0	.0	.0	.0	.0
52	9.7	106938.0	.0	38883.5	.0	.0	.0	.0	.0
53	3.6	40004.9	.0	14575.5	.0	.0	.0	.0	.0
54	6.0	66496.0	.0	24005.5	.0	.0	.0	.0	.0
55	2.0	22212.2	.0	7952.1	.0	.0	.0	.0	.0
56	7.6	84452.4	.0	30246.3	.0	.0	.0	.0	.0
57	9.6	104218.9	.0	37735.5	.0	.0	.0	.0	.0
58	9.6	101578.5	.0	37192.6	.0	.0	.0	.0	.0
59	9.5	98832.0	.0	36569.6	.0	.0	.0	.0	.0
60	9.5	95982.8	.0	35866.6	.0	.0	.0	.0	.0
61	4.1	40991.7	.0	15439.6	.0	.0	.0	.0	.0
62	5.3	52655.5	.0	19644.2	.0	.0	.0	.0	.0
63	9.4	94078.7	.0	34221.5	.0	.0	.0	.0	.0
64	9.4	94732.9	.0	33279.4	.0	.0	.0	.0	.0
65	9.3	95240.5	.0	32257.9	.0	.0	.0	.0	.0
66	8.6	88326.2	.0	28834.7	.0	.0	.0	.0	.0
67	.7	7254.5	.0	2199.3	.0	.0	.0	.0	.0
68	9.2	94859.2	.0	28994.6	.0	.0	.0	.0	.0
69	4.6	47240.8	.0	14571.3	.0	.0	.0	.0	.0
70	4.6	46243.9	.0	14360.1	.0	.0	.0	.0	.0
71	9.1	90607.1	.0	28787.7	.0	.0	.0	.0	.0
72	9.1	87350.3	.0	28563.3	.0	.0	.0	.0	.0
73	9.0	83950.3	.0	28258.4	.0	.0	.0	.0	.0
74	9.0	80411.4	.0	27873.1	.0	.0	.0	.0	.0
75	7.7	66823.8	.0	23829.0	.0	.0	.0	.0	.0
76	1.2	9944.5	.0	3578.3	.0	.0	.0	.0	.0
77	8.8	75060.3	.0	26861.0	.0	.0	.0	.0	.0
78	8.8	74487.4	.0	26234.5	.0	.0	.0	.0	.0
79	8.7	73790.0	.0	25527.9	.0	.0	.0	.0	.0
80	8.7	72970.2	.0	24741.2	.0	.0	.0	.0	.0
81	1.8	14728.8	.0	4943.5	.0	.0	.0	.0	.0
82	6.8	56605.1	.0	18931.1	.0	.0	.0	.0	.0
83	.2	1880.6	.0	633.6	.0	.0	.0	.0	.0
84	8.3	64752.7	.0	22294.7	.0	.0	.0	.0	.0
85	8.5	60154.6	.0	21902.3	.0	.0	.0	.0	.0
86	8.4	53631.8	.0	20796.7	.0	.0	.0	.0	.0
87	4.9	28295.6	.0	11625.2	.0	.0	.0	.0	.0
88	3.4	18005.1	.0	7986.8	.0	.0	.0	.0	.0
89	2.6	11629.2	.0	5817.2	.0	.0	.0	.0	.0
90	3.5	14347.7	.0	7800.7	.0	.0	.0	.0	.0
91	2.2	8226.4	408.5	5028.4	.0	.0	.0	.0	.0
92	8.2	25983.5	1529.3	16728.0	.0	.0	.0	.0	.0
93	8.1	18123.9	1515.3	13096.5	.0	.0	.0	.0	.0
94	7.8	10086.3	1453.0	9157.2	.0	.0	.0	.0	.0
95	.3	211.4	47.9	242.6	.0	.0	.0	.0	.0
96	7.9	4313.8	1486.4	5638.8	.0	.0	.0	.0	.0
97	3.8	514.2	713.7	1361.3	.0	.0	.0	.0	.0

Failure Surface Specified By 69 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.00	434.10
2	139.78	432.00
3	149.58	430.03
4	159.41	428.19
5	169.26	426.48
6	179.14	424.90
7	189.03	423.45
8	198.95	422.14
9	208.88	420.95
10	218.82	419.90
11	228.78	418.99
12	238.75	418.20
13	248.73	417.55
14	258.71	417.03
15	268.70	416.65
16	278.70	416.39
17	288.70	416.27
18	298.70	416.29
19	308.70	416.44
20	318.70	416.72
21	328.69	417.13
22	338.67	417.68
23	348.65	418.36
24	358.62	419.17
25	368.57	420.11
26	378.51	421.19
27	388.44	422.40
28	398.35	423.75
29	408.24	425.22
30	418.11	426.83
31	427.96	428.56
32	437.78	430.43
33	447.58	432.43
34	457.35	434.56
35	467.09	436.82
36	476.80	439.21
37	486.48	441.73
38	496.12	444.38
39	505.73	447.15
40	515.30	450.05
41	524.83	453.09
42	534.32	456.24
43	543.76	459.53
44	553.16	462.94
45	562.52	466.47
46	571.83	470.13
47	581.08	473.91
48	590.29	477.81
49	599.44	481.84
50	608.54	485.99
51	617.58	490.26
52	626.57	494.65
53	635.49	499.16
54	644.36	503.79
55	653.16	508.53
56	661.90	513.40
57	670.57	518.37
58	679.18	523.47
59	687.71	528.67
60	696.18	534.00
61	704.58	539.43
62	712.90	544.97
63	721.15	550.63
64	729.32	556.39

65	737.41	562.27
66	745.43	568.25
67	753.36	574.33
68	761.21	580.52
69	763.03	582.00

Circle Center At X = 292.6 ; Y = 1166.7 and Radius, 750.4

*** 1.582 ***

Failure Surface Specified By 68 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	152.11	435.90
2	161.84	433.62
3	171.61	431.49
4	181.41	429.49
5	191.24	427.63
6	201.09	425.91
7	210.96	424.33
8	220.86	422.88
9	230.77	421.58
10	240.70	420.41
11	250.65	419.39
12	260.61	418.50
13	270.58	417.76
14	280.57	417.16
15	290.56	416.69
16	300.55	416.37
17	310.55	416.18
18	320.55	416.14
19	330.55	416.24
20	340.55	416.48
21	350.54	416.86
22	360.52	417.38
23	370.50	418.04
24	380.47	418.84
25	390.43	419.78
26	400.37	420.86
27	410.29	422.08
28	420.20	423.44
29	430.09	424.94
30	439.95	426.57
31	449.79	428.35
32	459.61	430.26
33	469.40	432.32
34	479.15	434.50
35	488.88	436.83
36	498.57	439.29
37	508.23	441.89
38	517.85	444.63
39	527.43	447.50
40	536.96	450.50
41	546.46	453.64
42	555.91	456.91
43	565.31	460.31
44	574.67	463.85
45	583.97	467.51
46	593.22	471.31
47	602.42	475.24
48	611.56	479.29
49	620.64	483.48
50	629.66	487.79
51	638.63	492.22
52	647.52	496.79
53	656.36	501.47
54	665.12	506.29
55	673.82	511.22
56	682.45	516.27
57	691.01	521.45

58	699.49	526.75
59	707.89	532.16
60	716.22	537.70
61	724.48	543.35
62	732.65	549.11
63	740.74	554.99
64	748.74	560.98
65	756.66	567.09
66	764.50	573.30
67	772.24	579.63
68	775.07	582.00

Circle Center At X = 318.6 ; Y = 1127.3 and Radius, 711.1

*** 1.583 ***

Failure Surface Specified By 66 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.74	434.10
2	154.49	431.90
3	164.28	429.83
4	174.09	427.91
5	183.93	426.14
6	193.80	424.50
7	203.69	423.01
8	213.59	421.67
9	223.52	420.46
10	233.47	419.41
11	243.42	418.49
12	253.39	417.72
13	263.37	417.10
14	273.36	416.62
15	283.36	416.29
16	293.36	416.10
17	303.36	416.06
18	313.36	416.16
19	323.35	416.41
20	333.34	416.80
21	343.33	417.34
22	353.31	418.02
23	363.27	418.85
24	373.22	419.82
25	383.16	420.94
26	393.08	422.20
27	402.98	423.61
28	412.86	425.16
29	422.72	426.85
30	432.55	428.69
31	442.35	430.67
32	452.12	432.79
33	461.86	435.05
34	471.57	437.45
35	481.24	440.00
36	490.87	442.68
37	500.47	445.51
38	510.02	448.47
39	519.52	451.57
40	528.98	454.81
41	538.40	458.19
42	547.76	461.71
43	557.07	465.35
44	566.33	469.14
45	575.53	473.06
46	584.67	477.11
47	593.75	481.29
48	602.77	485.61
49	611.73	490.06
50	620.62	494.63
51	629.44	499.34

52	638.20	504.17
53	646.88	509.13
54	655.49	514.21
55	664.03	519.42
56	672.49	524.75
57	680.87	530.21
58	689.17	535.79
59	697.39	541.48
60	705.52	547.30
61	713.57	553.23
62	721.54	559.28
63	729.41	565.44
64	737.20	571.72
65	744.89	578.11
66	749.43	582.00

Circle Center At X = 301.3 ; Y = 1104.1 and Radius, 688.0

*** 1.586 ***

Failure Surface Specified By 68 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.00	434.10
2	139.77	431.98
3	149.57	429.99
4	159.40	428.14
5	169.25	426.42
6	179.13	424.84
7	189.02	423.40
8	198.93	422.08
9	208.87	420.91
10	218.81	419.87
11	228.77	418.97
12	238.74	418.20
13	248.72	417.57
14	258.71	417.08
15	268.70	416.72
16	278.70	416.50
17	288.70	416.42
18	298.70	416.47
19	308.70	416.67
20	318.69	416.99
21	328.68	417.46
22	338.66	418.06
23	348.64	418.80
24	358.60	419.67
25	368.55	420.69
26	378.48	421.83
27	388.40	423.12
28	398.30	424.54
29	408.18	426.09
30	418.03	427.78
31	427.86	429.60
32	437.67	431.56
33	447.45	433.66
34	457.20	435.88
35	466.92	438.24
36	476.60	440.74
37	486.25	443.36
38	495.86	446.12
39	505.43	449.01
40	514.97	452.03
41	524.46	455.18
42	533.91	458.45
43	543.31	461.86
44	552.66	465.40
45	561.97	469.06
46	571.22	472.86
47	580.42	476.77

48	589.57	480.82
49	598.66	484.99
50	607.69	489.28
51	616.66	493.69
52	625.57	498.23
53	634.42	502.89
54	643.20	507.67
55	651.92	512.57
56	660.57	517.59
57	669.15	522.73
58	677.66	527.98
59	686.09	533.35
60	694.45	538.84
61	702.74	544.44
62	710.95	550.15
63	719.08	555.97
64	727.12	561.91
65	735.09	567.95
66	742.97	574.11
67	750.77	580.37
68	752.75	582.00

Circle Center At X = 289.7 ; Y = 1146.6 and Radius, 730.2

*** 1.586 ***

Failure Surface Specified By 68 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	152.11	435.90
2	161.86	433.68
3	171.64	431.60
4	181.45	429.65
5	191.28	427.84
6	201.14	426.17
7	211.02	424.64
8	220.93	423.25
9	230.85	422.00
10	240.79	420.88
11	250.74	419.91
12	260.70	419.07
13	270.68	418.37
14	280.66	417.82
15	290.65	417.40
16	300.65	417.12
17	310.65	416.98
18	320.65	416.99
19	330.65	417.13
20	340.64	417.41
21	350.63	417.83
22	360.62	418.39
23	370.59	419.10
24	380.56	419.94
25	390.51	420.92
26	400.45	422.04
27	410.37	423.30
28	420.27	424.69
29	430.15	426.23
30	440.01	427.90
31	449.85	429.71
32	459.65	431.66
33	469.43	433.75
34	479.18	435.97
35	488.90	438.33
36	498.58	440.83
37	508.23	443.46
38	517.84	446.22
39	527.41	449.12
40	536.94	452.16
41	546.43	455.32

42	555.87	458.62
43	565.26	462.05
44	574.61	465.61
45	583.90	469.30
46	593.14	473.13
47	602.33	477.08
48	611.46	481.15
49	620.53	485.36
50	629.54	489.69
51	638.49	494.15
52	647.38	498.73
53	656.20	503.44
54	664.96	508.27
55	673.65	513.22
56	682.27	518.30
57	690.81	523.49
58	699.28	528.80
59	707.68	534.23
60	716.00	539.78
61	724.24	545.44
62	732.40	551.22
63	740.48	557.11
64	748.48	563.12
65	756.39	569.24
66	764.22	575.46
67	771.96	581.80
68	772.20	582.00

Circle Center At X = 315.5 ; Y = 1131.5 and Radius, 714.5

*** 1.587 ***

Failure Surface Specified By 66 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	137.37	434.10
2	147.12	431.90
3	156.91	429.85
4	166.73	427.94
5	176.57	426.16
6	186.43	424.53
7	196.32	423.05
8	206.23	421.70
9	216.16	420.50
10	226.10	419.44
11	236.06	418.52
12	246.03	417.75
13	256.01	417.12
14	266.00	416.63
15	275.99	416.29
16	285.99	416.09
17	295.99	416.03
18	305.99	416.12
19	315.99	416.35
20	325.98	416.73
21	335.97	417.25
22	345.95	417.92
23	355.91	418.72
24	365.87	419.67
25	375.81	420.77
26	385.73	422.00
27	395.64	423.38
28	405.52	424.91
29	415.38	426.57
30	425.21	428.38
31	435.02	430.32
32	444.80	432.41
33	454.55	434.64
34	464.27	437.01
35	473.95	439.52

36	483.59	442.16
37	493.19	444.95
38	502.76	447.87
39	512.28	450.93
40	521.75	454.13
41	531.18	457.46
42	540.56	460.93
43	549.89	464.54
44	559.16	468.27
45	568.38	472.14
46	577.55	476.15
47	586.65	480.28
48	595.70	484.55
49	604.68	488.94
50	613.60	493.46
51	622.45	498.11
52	631.24	502.89
53	639.95	507.80
54	648.60	512.82
55	657.17	517.98
56	665.66	523.25
57	674.08	528.65
58	682.42	534.17
59	690.68	539.80
60	698.86	545.56
61	706.95	551.43
62	714.96	557.42
63	722.88	563.52
64	730.72	569.74
65	738.46	576.07
66	745.51	582.00

Circle Center At X = 294.8 ; Y = 1111.0 and Radius, 694.9

*** 1.588 ***

Failure Surface Specified By 69 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.74	434.10
2	154.54	432.10
3	164.36	430.23
4	174.21	428.49
5	184.07	426.87
6	193.96	425.39
7	203.87	424.03
8	213.80	422.80
9	223.73	421.70
10	233.69	420.73
11	243.65	419.89
12	253.63	419.18
13	263.61	418.60
14	273.60	418.15
15	283.59	417.83
16	293.59	417.64
17	303.59	417.58
18	313.59	417.65
19	323.59	417.85
20	333.59	418.18
21	343.57	418.64
22	353.56	419.23
23	363.53	419.95
24	373.49	420.80
25	383.45	421.78
26	393.38	422.89
27	403.31	424.13
28	413.21	425.50
29	423.10	426.99
30	432.97	428.62
31	442.81	430.37

32	452.64	432.25
33	462.43	434.26
34	472.20	436.40
35	481.94	438.66
36	491.65	441.05
37	501.33	443.57
38	510.97	446.21
39	520.58	448.98
40	530.16	451.87
41	539.69	454.88
42	549.18	458.02
43	558.64	461.29
44	568.05	464.67
45	577.41	468.18
46	586.73	471.81
47	596.00	475.56
48	605.22	479.43
49	614.39	483.43
50	623.50	487.54
51	632.57	491.76
52	641.57	496.11
53	650.52	500.57
54	659.41	505.15
55	668.24	509.85
56	677.01	514.65
57	685.71	519.58
58	694.35	524.61
59	702.93	529.76
60	711.43	535.02
61	719.87	540.39
62	728.24	545.86
63	736.53	551.45
64	744.75	557.15
65	752.90	562.95
66	760.97	568.85
67	768.96	574.86
68	776.87	580.98
69	778.16	582.00

Circle Center At X = 303.2 ; Y = 1185.8 and Radius, 768.3

*** 1.588 ***

Failure Surface Specified By 69 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.00	434.10
2	139.80	432.10
3	149.62	430.23
4	159.47	428.49
5	169.34	426.88
6	179.23	425.39
7	189.13	424.03
8	199.06	422.79
9	209.00	421.69
10	218.95	420.71
11	228.91	419.86
12	238.89	419.14
13	248.87	418.54
14	258.86	418.08
15	268.85	417.74
16	278.85	417.53
17	288.85	417.46
18	298.85	417.51
19	308.85	417.68
20	318.84	417.99
21	328.83	418.43
22	338.82	418.99
23	348.79	419.69
24	358.76	420.51

25	368.71	421.46
26	378.66	422.53
27	388.58	423.74
28	398.49	425.07
29	408.39	426.53
30	418.26	428.12
31	428.11	429.84
32	437.94	431.68
33	447.75	433.65
34	457.52	435.74
35	467.27	437.96
36	477.00	440.30
37	486.69	442.77
38	496.34	445.37
39	505.97	448.09
40	515.55	450.93
41	525.10	453.89
42	534.62	456.98
43	544.09	460.19
44	553.52	463.52
45	562.90	466.98
46	572.24	470.55
47	581.53	474.24
48	590.78	478.06
49	599.97	481.99
50	609.12	486.04
51	618.21	490.20
52	627.24	494.49
53	636.22	498.88
54	645.15	503.40
55	654.01	508.03
56	662.81	512.77
57	671.56	517.63
58	680.24	522.59
59	688.85	527.67
60	697.40	532.86
61	705.88	538.16
62	714.29	543.57
63	722.63	549.08
64	730.90	554.71
65	739.10	560.43
66	747.22	566.27
67	755.27	572.21
68	763.24	578.25
69	768.06	582.00

Circle Center At X = 290.0 ; Y = 1194.4 and Radius, 776.9

*** 1.589 ***

Failure Surface Specified By 74 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.68	434.10
2	143.49	432.12
3	153.31	430.26
4	163.16	428.51
5	173.02	426.87
6	182.91	425.35
7	192.81	423.94
8	202.72	422.65
9	212.65	421.47
10	222.60	420.41
11	232.55	419.46
12	242.52	418.63
13	252.49	417.91
14	262.47	417.31
15	272.46	416.82
16	282.45	416.45
17	292.45	416.20

18	302.45	416.06
19	312.45	416.04
20	322.45	416.13
21	332.45	416.34
22	342.44	416.66
23	352.43	417.10
24	362.42	417.66
25	372.39	418.33
26	382.36	419.11
27	392.32	420.01
28	402.27	421.03
29	412.21	422.16
30	422.13	423.41
31	432.04	424.77
32	441.93	426.24
33	451.80	427.83
34	461.65	429.54
35	471.49	431.35
36	481.30	433.29
37	491.09	435.33
38	500.85	437.49
39	510.59	439.76
40	520.30	442.14
41	529.99	444.64
42	539.64	447.25
43	549.26	449.97
44	558.85	452.80
45	568.41	455.74
46	577.93	458.79
47	587.42	461.95
48	596.87	465.22
49	606.28	468.60
50	615.65	472.09
51	624.99	475.69
52	634.27	479.39
53	643.52	483.20
54	652.72	487.12
55	661.87	491.15
56	670.98	495.28
57	680.04	499.51
58	689.05	503.85
59	698.01	508.30
60	706.91	512.85
61	715.77	517.50
62	724.56	522.25
63	733.31	527.10
64	741.99	532.06
65	750.62	537.11
66	759.19	542.27
67	767.70	547.52
68	776.15	552.87
69	784.53	558.32
70	792.85	563.86
71	801.11	569.51
72	809.30	575.24
73	817.43	581.07
74	818.69	582.00

Circle Center At X = 309.5 ; Y = 1280.2 and Radius, 864.1

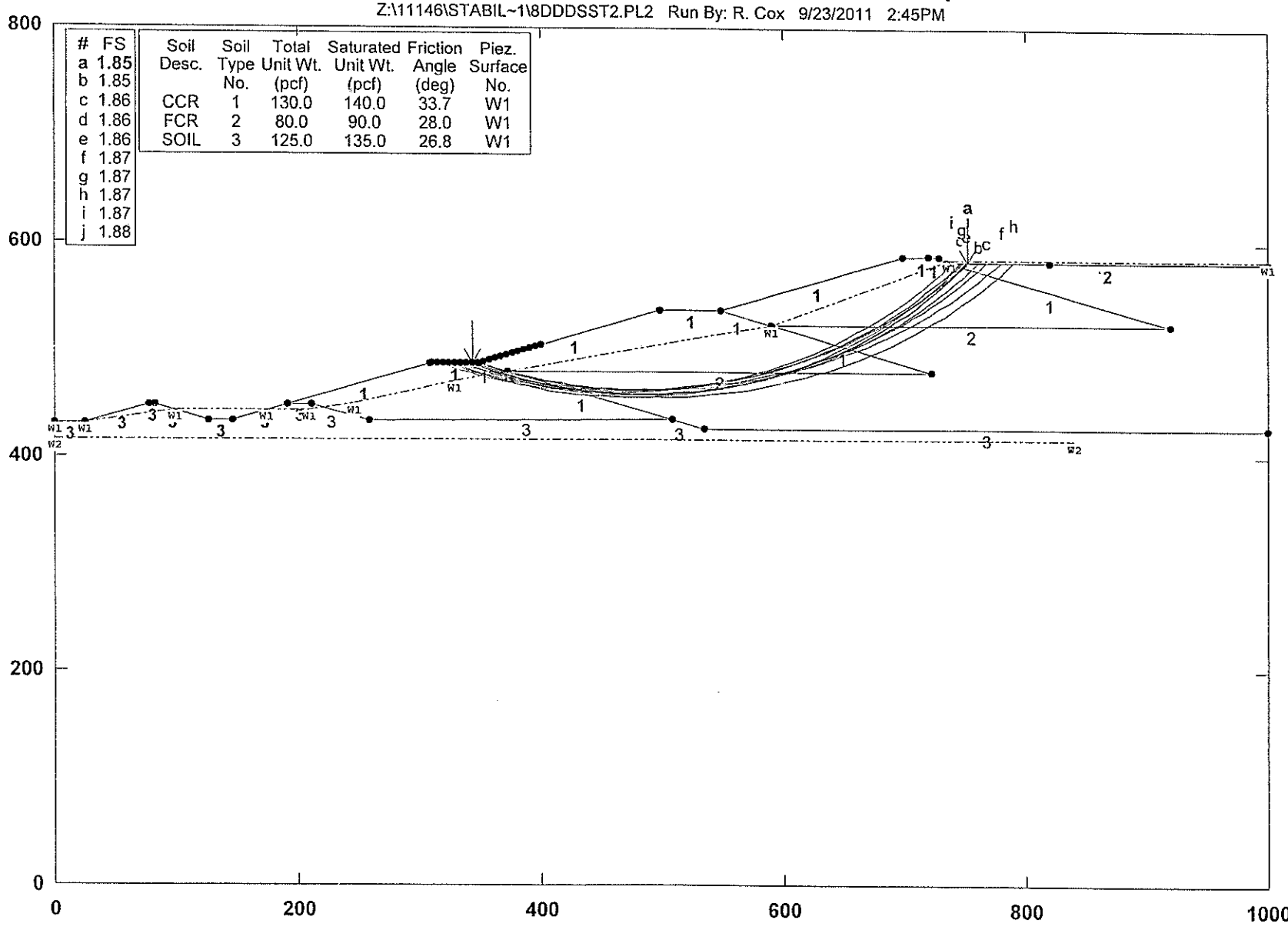
*** 1.589 ***

Phase 8 - Section D-D Downstream Static Shallow Slope Circle

Z:\11146\STABIL~1\8DDDSST2.PL2 Run By: R. Cox 9/23/2011 2:45PM

#	FS
a	1.85
b	1.85
c	1.86
d	1.86
e	1.86
f	1.87
g	1.87
h	1.87
i	1.87
j	1.88

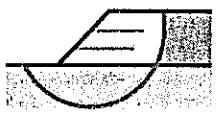
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
SOIL	3	125.0	135.0	26.8	W1



PCSTABL5M/si FSmin=1.85

Safety Factors Are Calculated By The Modified Bishop Method

STED



6431-12 Part 4

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/23/2011
Time of Run: 2:45PM
Run By: R. Cox
Input Data Filename: Z:8DDDSST2.
Output Filename: Z:8DDDSST2.OUT
Unit: ENGLISH
Plotted Output Filename: Z:8DDDSST2.PLT
PROBLEM DESCRIPTION Phase 8 - Section D-D
Downstream Static Shallow Slope Circle

BOUNDARY COORDINATES
14 Top Boundaries
26 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	431.59	25.25	431.74	3
2	25.25	431.74	77.02	449.00	3
3	77.02	449.00	82.02	449.00	3
4	82.02	449.00	126.72	434.10	3
5	126.72	434.10	146.72	434.10	3
6	146.72	434.10	191.42	449.00	3
7	191.42	449.00	308.42	488.00	1
8	308.42	488.00	348.42	488.00	1
9	348.42	488.00	498.42	538.00	1
10	498.42	538.00	548.42	538.00	1
11	548.42	538.00	698.42	588.00	1
12	698.42	588.00	728.42	588.00	1
13	728.42	588.00	734.42	582.00	1
14	734.42	582.00	1000.00	582.00	2
15	734.42	582.00	920.42	524.00	1
16	548.42	538.00	590.42	524.00	1
17	590.42	524.00	920.42	524.00	2
18	590.42	524.00	722.42	480.00	1
19	348.42	488.00	372.42	480.00	1
20	372.42	480.00	722.42	480.00	2
21	372.42	480.00	508.62	434.60	1
22	191.42	449.00	211.42	449.00	3
23	211.42	449.00	258.90	433.17	3
24	258.90	433.17	508.62	434.60	3
25	508.62	434.60	534.42	426.00	3
26	534.42	426.00	1000.00	426.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 12 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	431.59
2	25.25	431.74
3	99.36	443.22
4	174.08	443.22
5	208.42	443.22
6	246.05	450.50
7	328.91	471.00
8	372.42	480.00

9	372.43	480.00
10	590.42	524.00
11	737.93	585.00
12	1000.00	585.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	415.86
2	840.00	416.63

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced Along The Ground Surface Between X = 310.00 ft.
and X = 400.00 ft.
Each Surface Terminates Between X = 720.00 ft.
and X = 820.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =416.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 46 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	343.16	488.00
2	352.39	484.17
3	361.73	480.59
4	371.17	477.29
5	380.70	474.24
6	390.31	471.47
7	399.99	468.98
8	409.74	466.75
9	419.55	464.80
10	429.41	463.13
11	439.31	461.74
12	449.25	460.63
13	459.21	459.79
14	469.20	459.24
15	479.19	458.97
16	489.19	458.98
17	499.19	459.28
18	509.17	459.86
19	519.14	460.71
20	529.07	461.85
21	538.97	463.27
22	548.82	464.97
23	558.63	466.94
24	568.37	469.19
25	578.05	471.71
26	587.65	474.51
27	597.17	477.57
28	606.60	480.90
29	615.93	484.50
30	625.15	488.36
31	634.27	492.47
32	643.26	496.85
33	652.13	501.47
34	660.86	506.34
35	669.45	511.46
36	677.90	516.81
37	686.19	522.41
38	694.32	528.23
39	702.28	534.28
40	710.07	540.55

41	717.67	547.04
42	725.10	553.74
43	732.33	560.65
44	739.36	567.76
45	746.19	575.07
46	752.31	582.00

Circle Center At X = 483.7 ; Y = 813.5 and Radius, 354.6

*** 1.851 ***

Individual data on the 61 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	5.3	747.1	.0	.0	.0	.0	.0	.0	.0
2	4.0	1897.0	.0	.0	.0	.0	.0	.0	.0
3	9.3	10323.4	.0	.0	.0	.0	.0	.0	.0
4	5.0	8869.4	.0	.0	.0	.0	.0	.0	.0
5	4.4	9674.1	.0	350.6	.0	.0	.0	.0	.0
6	1.2	3071.1	.0	223.1	.0	.0	.0	.0	.0
7	.0	25.1	.0	2.0	.0	.0	.0	.0	.0
8	8.3	23305.5	.0	2798.3	.0	.0	.0	.0	.0
9	9.6	33178.3	.0	5982.7	.0	.0	.0	.0	.0
10	9.7	39676.7	.0	8785.6	.0	.0	.0	.0	.0
11	9.7	45881.9	.0	11430.2	.0	.0	.0	.0	.0
12	6.0	31085.2	.0	8243.2	.0	.0	.0	.0	.0
13	3.8	20731.0	.0	5671.2	.0	.0	.0	.0	.0
14	9.9	57959.5	.0	16236.0	.0	.0	.0	.0	.0
15	9.9	64009.6	.0	18393.5	.0	.0	.0	.0	.0
16	9.9	69823.4	.0	20385.0	.0	.0	.0	.0	.0
17	10.0	75380.3	.0	22209.0	.0	.0	.0	.0	.0
18	10.0	80661.1	.0	23863.9	.0	.0	.0	.0	.0
19	10.0	85648.1	.0	25348.6	.0	.0	.0	.0	.0
20	10.0	90324.8	.0	26661.7	.0	.0	.0	.0	.0
21	9.2	87244.0	.0	25626.9	.0	.0	.0	.0	.0
22	.8	7419.2	.0	2175.4	.0	.0	.0	.0	.0
23	10.0	96196.0	.0	28769.4	.0	.0	.0	.0	.0
24	10.0	95556.5	.0	29562.4	.0	.0	.0	.0	.0
25	9.9	94591.7	.0	30180.4	.0	.0	.0	.0	.0
26	9.9	93306.9	.0	30623.2	.0	.0	.0	.0	.0
27	9.5	87971.9	.0	29619.7	.0	.0	.0	.0	.0
28	.4	3738.9	.0	1270.4	.0	.0	.0	.0	.0
29	9.8	92054.8	.0	30981.2	.0	.0	.0	.0	.0
30	9.7	93963.6	.0	30896.5	.0	.0	.0	.0	.0
31	9.7	95498.3	.0	30635.7	.0	.0	.0	.0	.0
32	9.6	96659.5	.0	30199.3	.0	.0	.0	.0	.0
33	2.8	28212.7	.0	8684.9	.0	.0	.0	.0	.0
34	6.7	68725.3	.0	20056.0	.0	.0	.0	.0	.0
35	6.9	70018.2	.0	20841.6	.0	.0	.0	.0	.0
36	2.6	25960.3	.0	7792.7	.0	.0	.0	.0	.0
37	9.3	93565.5	.0	28874.4	.0	.0	.0	.0	.0
38	9.2	90333.6	.0	28937.9	.0	.0	.0	.0	.0
39	9.1	86720.4	.0	28824.9	.0	.0	.0	.0	.0
40	9.0	82748.8	.0	28535.5	.0	.0	.0	.0	.0
41	8.9	78442.8	.0	28070.1	.0	.0	.0	.0	.0
42	2.2	18949.3	.0	6982.8	.0	.0	.0	.0	.0
43	6.5	55828.9	.0	20445.9	.0	.0	.0	.0	.0
44	8.6	73146.4	.0	26612.2	.0	.0	.0	.0	.0
45	8.4	71335.1	.0	25621.0	.0	.0	.0	.0	.0
46	8.3	69251.0	.0	24455.9	.0	.0	.0	.0	.0
47	2.2	18428.4	.0	6470.4	.0	.0	.0	.0	.0
48	5.9	47859.5	.0	16647.5	.0	.0	.0	.0	.0
49	4.1	32134.8	.0	11336.2	.0	.0	.0	.0	.0
50	3.9	28989.6	.0	10271.8	.0	.0	.0	.0	.0
51	7.8	53699.1	.0	19927.4	.0	.0	.0	.0	.0
52	7.6	45921.4	.0	18077.6	.0	.0	.0	.0	.0
53	7.4	38194.5	.0	16059.8	.0	.0	.0	.0	.0
54	3.3	14888.0	.0	6661.0	.0	.0	.0	.0	.0

55	3.9	14678.0	.0	7214.9	.0	.0	.0	.0	.0
56	2.1	6223.3	.0	3686.6	.0	.0	.0	.0	.0
57	3.5	8481.6	182.6	5696.2	.0	.0	.0	.0	.0
58	1.4	2897.3	267.4	2276.2	.0	.0	.0	.0	.0
59	6.8	9230.3	1278.4	8476.8	.0	.0	.0	.0	.0
60	2.3	1334.0	423.0	1843.0	.0	.0	.0	.0	.0
61	3.9	760.5	723.3	1889.0	.0	.0	.0	.0	.0

Failure Surface Specified By 48 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	333.68	488.00
2	342.96	484.26
3	352.33	480.77
4	361.79	477.52
5	371.33	474.52
6	380.94	471.78
7	390.63	469.28
8	400.37	467.05
9	410.18	465.07
10	420.03	463.35
11	429.92	461.89
12	439.85	460.68
13	449.80	459.74
14	459.78	459.07
15	469.77	458.65
16	479.77	458.50
17	489.77	458.61
18	499.76	458.98
19	509.74	459.61
20	519.70	460.51
21	529.63	461.67
22	539.53	463.09
23	549.39	464.77
24	559.20	466.70
25	568.96	468.90
26	578.65	471.35
27	588.28	474.05
28	597.83	477.01
29	607.31	480.21
30	616.69	483.67
31	625.98	487.37
32	635.17	491.31
33	644.26	495.49
34	653.23	499.91
35	662.08	504.56
36	670.80	509.45
37	679.40	514.56
38	687.85	519.90
39	696.17	525.45
40	704.33	531.23
41	712.34	537.21
42	720.20	543.41
43	727.88	549.81
44	735.39	556.40
45	742.73	563.20
46	749.89	570.18
47	756.86	577.35
48	761.15	582.00

Circle Center At X = 480.6 ; Y = 838.9 and Radius, 380.4

*** 1.854 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	343.16	488.00
2	352.57	484.63
3	362.07	481.50
4	371.64	478.60

5	381.28	475.94
6	390.99	473.53
7	400.75	471.36
8	410.56	469.43
9	420.42	467.75
10	430.31	466.31
11	440.24	465.12
12	450.20	464.18
13	460.17	463.49
14	470.16	463.05
15	480.16	462.86
16	490.16	462.91
17	500.16	463.22
18	510.14	463.78
19	520.11	464.58
20	530.05	465.63
21	539.97	466.94
22	549.85	468.49
23	559.69	470.28
24	569.48	472.32
25	579.21	474.60
26	588.89	477.13
27	598.50	479.90
28	608.03	482.90
29	617.49	486.14
30	626.87	489.62
31	636.16	493.33
32	645.35	497.27
33	654.44	501.44
34	663.42	505.84
35	672.29	510.46
36	681.04	515.30
37	689.67	520.35
38	698.17	525.62
39	706.53	531.10
40	714.76	536.78
41	722.84	542.67
42	730.77	548.76
43	738.55	555.05
44	746.17	561.53
45	753.62	568.19
46	760.91	575.04
47	767.94	582.00

Circle Center At X = 482.9 ; Y = 863.4 and Radius, 400.6

*** 1.860 ***

Failure Surface Specified By 46 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	333.68	488.00
2	343.04	484.46
3	352.48	481.18
4	362.01	478.14
5	371.62	475.37
6	381.30	472.84
7	391.04	470.58
8	400.83	468.58
9	410.68	466.84
10	420.57	465.36
11	430.50	464.15
12	440.45	463.20
13	450.43	462.51
14	460.42	462.10
15	470.42	461.95
16	480.42	462.06
17	490.41	462.44
18	500.39	463.09
19	510.35	464.01

20	520.28	465.19
21	530.17	466.63
22	540.03	468.34
23	549.83	470.30
24	559.58	472.53
25	569.27	475.02
26	578.88	477.76
27	588.42	480.76
28	597.88	484.02
29	607.24	487.52
30	616.51	491.27
31	625.68	495.27
32	634.73	499.51
33	643.67	503.99
34	652.49	508.71
35	661.18	513.66
36	669.73	518.84
37	678.15	524.25
38	686.41	529.87
39	694.53	535.72
40	702.48	541.78
41	710.27	548.05
42	717.89	554.53
43	725.33	561.20
44	732.60	568.08
45	739.68	575.14
46	746.20	582.00

Circle Center At X = 471.1 ; Y = 837.2 and Radius, 375.3

*** 1.862 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	333.68	488.00
2	343.09	484.60
3	352.58	481.44
4	362.14	478.53
5	371.78	475.86
6	381.48	473.44
7	391.25	471.27
8	401.06	469.36
9	410.92	467.69
10	420.82	466.28
11	430.75	465.13
12	440.71	464.23
13	450.69	463.58
14	460.69	463.20
15	470.68	463.06
16	480.68	463.19
17	490.68	463.57
18	500.66	464.21
19	510.62	465.11
20	520.55	466.26
21	530.45	467.67
22	540.31	469.33
23	550.13	471.24
24	559.89	473.40
25	569.59	475.82
26	579.23	478.48
27	588.80	481.39
28	598.29	484.54
29	607.69	487.94
30	617.01	491.58
31	626.23	495.45
32	635.34	499.57
33	644.35	503.91
34	653.24	508.48
35	662.02	513.28

36	670.66	518.31
37	679.18	523.55
38	687.55	529.01
39	695.79	534.69
40	703.87	540.57
41	711.80	546.67
42	719.58	552.96
43	727.18	559.45
44	734.62	566.13
45	741.89	573.00
46	748.97	580.06
47	750.83	582.00

Circle Center At X = 470.8 ; Y = 852.3 and Radius, 389.3

*** 1.864 ***

Failure Surface Specified By 48 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	347.90	488.00
2	357.33	484.70
3	366.85	481.62
4	376.44	478.78
5	386.09	476.17
6	395.80	473.79
7	405.57	471.64
8	415.39	469.74
9	425.25	468.07
10	435.14	466.64
11	445.07	465.45
12	455.03	464.50
13	465.00	463.79
14	474.99	463.32
15	484.99	463.09
16	494.99	463.10
17	504.99	463.36
18	514.97	463.86
19	524.95	464.59
20	534.90	465.57
21	544.82	466.79
22	554.72	468.25
23	564.57	469.94
24	574.38	471.88
25	584.14	474.05
26	593.85	476.45
27	603.50	479.09
28	613.08	481.96
29	622.58	485.06
30	632.01	488.39
31	641.36	491.95
32	650.62	495.73
33	659.78	499.73
34	668.84	503.96
35	677.80	508.40
36	686.65	513.05
37	695.39	517.92
38	704.00	523.00
39	712.49	528.29
40	720.85	533.77
41	729.08	539.46
42	737.16	545.35
43	745.10	551.43
44	752.89	557.69
45	760.53	564.15
46	768.01	570.79
47	775.33	577.60
48	779.82	582.00

Circle Center At X = 489.4 ; Y = 877.1 and Radius, 414.0

*** 1.867 ***

Failure Surface Specified By 48 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	324.21	488.00
2	333.39	484.04
3	342.68	480.33
4	352.07	476.88
5	361.54	473.69
6	371.11	470.77
7	380.75	468.10
8	390.45	465.70
9	400.22	463.57
10	410.05	461.71
11	419.92	460.12
12	429.83	458.81
13	439.78	457.76
14	449.75	456.99
15	459.74	456.49
16	469.74	456.27
17	479.74	456.33
18	489.73	456.66
19	499.71	457.26
20	509.67	458.14
21	519.61	459.29
22	529.50	460.71
23	539.36	462.41
24	549.16	464.38
25	558.91	466.61
26	568.59	469.11
27	578.20	471.88
28	587.73	474.91
29	597.17	478.20
30	606.52	481.76
31	615.77	485.56
32	624.91	489.62
33	633.93	493.93
34	642.84	498.48
35	651.61	503.28
36	660.25	508.32
37	668.74	513.60
38	677.09	519.10
39	685.29	524.83
40	693.32	530.79
41	701.18	536.96
42	708.88	543.35
43	716.39	549.95
44	723.72	556.75
45	730.86	563.75
46	737.81	570.95
47	744.55	578.33
48	747.72	582.00

Circle Center At X = 472.8 ; Y = 819.7 and Radius, 363.5

*** 1.867 ***

Failure Surface Specified By 51 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	333.68	488.00
2	342.96	484.25
3	352.32	480.73
4	361.76	477.44
5	371.28	474.37
6	380.87	471.54
7	390.52	468.94
8	400.24	466.58
9	410.01	464.45
10	419.83	462.55
11	429.69	460.90

12	439.59	459.48
13	449.52	458.31
14	459.48	457.38
15	469.45	456.68
16	479.44	456.23
17	489.44	456.02
18	499.44	456.05
19	509.44	456.33
20	519.42	456.84
21	529.40	457.60
22	539.35	458.60
23	549.27	459.84
24	559.16	461.32
25	569.01	463.03
26	578.82	464.99
27	588.57	467.18
28	598.27	469.61
29	607.91	472.27
30	617.49	475.17
31	626.98	478.29
32	636.41	481.65
33	645.74	485.23
34	654.99	489.03
35	664.14	493.06
36	673.19	497.31
37	682.14	501.78
38	690.98	506.46
39	699.70	511.35
40	708.30	516.46
41	716.77	521.77
42	725.11	527.28
43	733.32	533.00
44	741.38	538.91
45	749.30	545.01
46	757.08	551.31
47	764.69	557.79
48	772.15	564.45
49	779.44	571.30
50	786.57	578.31
51	790.13	582.00

Circle Center At X = 493.1 ; Y = 869.2 and Radius, 413.2

*** 1.873 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	324.21	488.00
2	333.55	484.43
3	342.99	481.11
4	352.50	478.04
5	362.10	475.23
6	371.77	472.67
7	381.50	470.37
8	391.29	468.33
9	401.13	466.55
10	411.01	465.03
11	420.93	463.78
12	430.88	462.78
13	440.86	462.06
14	450.85	461.60
15	460.84	461.40
16	470.84	461.47
17	480.84	461.80
18	490.82	462.41
19	500.78	463.27
20	510.72	464.40
21	520.62	465.79
22	530.48	467.45

23	540.30	469.37
24	550.06	471.54
25	559.76	473.98
26	569.39	476.67
27	578.94	479.62
28	588.42	482.82
29	597.80	486.27
30	607.10	489.97
31	616.28	493.91
32	625.37	498.10
33	634.33	502.52
34	643.18	507.19
35	651.90	512.08
36	660.49	517.21
37	668.93	522.56
38	677.23	528.13
39	685.39	533.93
40	693.38	539.94
41	701.21	546.15
42	708.88	552.58
43	716.37	559.20
44	723.68	566.02
45	730.81	573.04
46	737.75	580.24
47	739.36	582.00

Circle Center At X = 463.2 ; Y = 837.9 and Radius, 376.5

*** 1.874 ***

Failure Surface Specified By 49 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	314.74	488.00
2	324.10	484.50
3	333.55	481.22
4	343.08	478.18
5	352.68	475.37
6	362.34	472.80
7	372.06	470.47
8	381.84	468.38
9	391.67	466.52
10	401.54	464.91
11	411.44	463.54
12	421.38	462.41
13	431.34	461.53
14	441.32	460.89
15	451.31	460.50
16	461.31	460.35
17	471.31	460.45
18	481.31	460.79
19	491.29	461.37
20	501.25	462.20
21	511.20	463.28
22	521.11	464.60
23	530.99	466.16
24	540.82	467.96
25	550.61	470.00
26	560.35	472.28
27	570.03	474.80
28	579.64	477.56
29	589.18	480.55
30	598.65	483.78
31	608.03	487.23
32	617.33	490.92
33	626.53	494.83
34	635.64	498.96
35	644.64	503.32
36	653.53	507.90
37	662.30	512.69

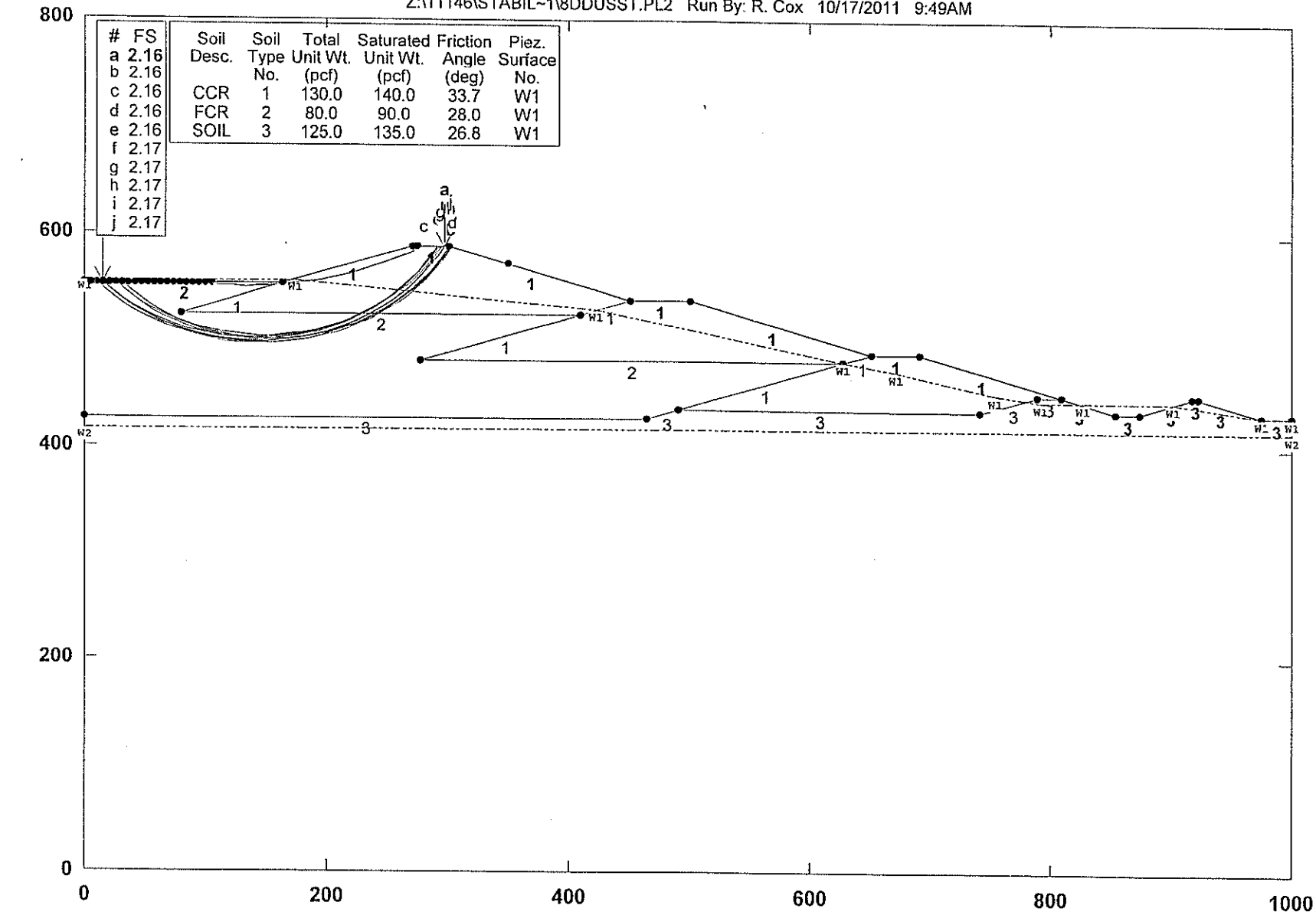
38	670.96	517.69
39	679.49	522.91
40	687.89	528.34
41	696.16	533.97
42	704.28	539.80
43	712.26	545.82
44	720.09	552.04
45	727.77	558.46
46	735.28	565.05
47	742.63	571.83
48	749.81	578.79
49	752.97	582.00

Circle Center At X = 462.4 ; Y = 868.3 and Radius, 408.0

*** 1.875 ***

Phase 8 -Section D-D Upstream Static Whole Slope Circle

Z:\11146\STABIL~1\8DDUSST.PL2 Run By: R. Cox 10/17/2011 9:49AM



#	FS
a	2.16
b	2.16
c	2.16
d	2.16
e	2.16
f	2.17
g	2.17
h	2.17
i	2.17
j	2.17

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
SOIL	3	125.0	135.0	26.8	W1

PCSTABL5M/si FSmin=2.16

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/23/2011
Time of Run: 2:54PM
Run By: R. Cox
Input Data Filename: Z:8ddusst.
Output Filename: Z:8ddusst.OUT
Unit: ENGLISH
Plotted Output Filename: Z:8ddusst.PLT
PROBLEM DESCRIPTION Phase 8 -Section D-D
Upstream Static Whole Slope Circle

BOUNDARY COORDINATES
14 Top Boundaries
26 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	552.10	163.88	552.10	2
2	163.88	552.10	271.58	588.00	1
3	271.58	588.00	301.58	588.00	1
4	301.58	588.00	451.58	538.00	1
5	451.58	538.00	501.58	538.00	1
6	501.58	538.00	651.58	488.00	1
7	651.58	488.00	691.58	488.00	1
8	691.58	488.00	808.58	449.00	1
9	808.58	449.00	853.28	434.10	3
10	853.28	434.10	873.28	434.10	3
11	873.28	434.10	917.98	449.00	3
12	917.98	449.00	922.98	449.00	3
13	922.98	449.00	974.75	431.74	3
14	974.75	431.74	1000.00	431.59	3
15	79.58	524.00	163.88	552.10	1
16	409.58	524.00	451.58	538.00	1
17	79.58	524.00	409.58	524.00	2
18	277.58	480.00	409.58	524.00	1
19	627.58	480.00	651.58	488.00	1
20	277.58	480.00	627.58	480.00	2
21	491.38	434.60	627.58	480.00	1
22	788.58	449.00	808.58	449.00	3
23	741.10	433.17	788.58	449.00	3
24	491.38	434.60	741.10	433.17	3
25	465.58	426.00	491.38	434.60	3
26	.00	426.00	465.58	426.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 12 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	555.38
2	173.72	555.38
3	422.48	528.30
4	627.57	480.00
5	627.58	480.00
6	671.09	471.00
7	753.95	450.50
8	791.58	443.22

9	825.92	443.22
10	900.64	443.22
11	974.75	431.76
12	1000.00	431.59

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	416.63
2	1000.00	415.86

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced Along The Ground Surface Between X = 5.00 ft.
and X = 105.00 ft.
Each Surface Terminates Between X = 275.00 ft.
and X = 350.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =416.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.53	552.10
2	22.63	545.06
3	30.12	538.43
4	37.97	532.24
5	46.16	526.50
6	54.66	521.23
7	63.44	516.46
8	72.49	512.19
9	81.76	508.43
10	91.22	505.21
11	100.86	502.53
12	110.63	500.40
13	120.50	498.82
14	130.45	497.81
15	140.44	497.36
16	150.44	497.48
17	160.42	498.16
18	170.34	499.41
19	180.17	501.22
20	189.89	503.58
21	199.46	506.48
22	208.85	509.93
23	218.03	513.90
24	226.96	518.38
25	235.64	523.36
26	244.01	528.82
27	252.06	534.75
28	259.77	541.13
29	267.10	547.93
30	274.03	555.14
31	280.55	562.72
32	286.62	570.67
33	292.24	578.94
34	297.38	587.52
35	297.63	588.00

Circle Center At X = 143.4 ; Y = 673.9 and Radius, 176.6
*** 2.157 ***
Individual data on the 40 slices

	Water Force	Water Force	Tie Force	Tie Force	Earthquake Force	Surcharge

Slice No.	Width (ft)	Weight (lbs)	Top (lbs)	Bot (lbs)	Norm (lbs)	Tan (lbs)	Hor (lbs)	Ver (lbs)	Load (lbs)
1	7.1	2249.9	1453.4	4243.4	.0	.0	.0	.0	.0
2	7.5	6978.5	1532.7	8507.9	.0	.0	.0	.0	.0
3	7.9	11846.6	1607.0	12507.9	.0	.0	.0	.0	.0
4	8.2	16753.6	1676.2	16230.6	.0	.0	.0	.0	.0
5	8.5	21601.2	1740.0	19664.1	.0	.0	.0	.0	.0
6	8.8	26294.1	1798.2	22797.2	.0	.0	.0	.0	.0
7	9.0	30742.3	1850.6	25620.0	.0	.0	.0	.0	.0
8	7.1	26398.9	1451.9	21312.8	.0	.0	.0	.0	.0
9	2.2	8502.5	445.3	6810.7	.0	.0	.0	.0	.0
10	9.5	39666.3	1937.6	30299.6	.0	.0	.0	.0	.0
11	9.6	44459.4	1971.8	32141.3	.0	.0	.0	.0	.0
12	9.8	48784.1	1999.7	33642.8	.0	.0	.0	.0	.0
13	9.9	52572.0	2021.2	34799.1	.0	.0	.0	.0	.0
14	9.9	55764.5	2036.2	35606.7	.0	.0	.0	.0	.0
15	10.0	58313.9	2044.7	36063.0	.0	.0	.0	.0	.0
16	10.0	60183.4	2046.6	36166.3	.0	.0	.0	.0	.0
17	10.0	61348.1	2042.0	35916.5	.0	.0	.0	.0	.0
18	3.5	21515.4	709.0	12418.0	.0	.0	.0	.0	.0
19	6.5	40905.7	936.1	22896.3	.0	.0	.0	.0	.0
20	3.4	21982.3	125.4	11943.3	.0	.0	.0	.0	.0
21	6.5	42786.4	.0	22144.1	.0	.0	.0	.0	.0
22	9.7	66198.5	.0	32104.1	.0	.0	.0	.0	.0
23	9.6	66814.4	.0	29819.3	.0	.0	.0	.0	.0
24	9.4	66637.2	.0	27209.6	.0	.0	.0	.0	.0
25	9.2	65687.3	.0	24283.4	.0	.0	.0	.0	.0
26	8.9	63997.8	.0	21050.1	.0	.0	.0	.0	.0
27	8.7	61614.1	.0	17520.0	.0	.0	.0	.0	.0
28	1.0	6921.3	.0	1809.4	.0	.0	.0	.0	.0
29	7.4	50780.6	.0	11895.2	.0	.0	.0	.0	.0
30	8.1	51868.5	.0	9615.9	.0	.0	.0	.0	.0
31	7.7	45554.7	.0	5267.1	.0	.0	.0	.0	.0
32	4.7	25548.3	.0	973.4	.0	.0	.0	.0	.0
33	2.6	13404.0	.0	.0	.0	.0	.0	.0	.0
34	4.5	21554.0	.0	.0	.0	.0	.0	.0	.0
35	2.5	10881.8	.0	.0	.0	.0	.0	.0	.0
36	6.5	24620.7	.0	.0	.0	.0	.0	.0	.0
37	6.1	16826.0	.0	.0	.0	.0	.0	.0	.0
38	5.6	9634.1	.0	.0	.0	.0	.0	.0	.0
39	5.1	3186.3	.0	.0	.0	.0	.0	.0	.0
40	.3	7.9	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.26	552.10
2	17.39	545.09
3	24.89	538.47
4	32.74	532.27
5	40.91	526.51
6	49.39	521.20
7	58.14	516.36
8	67.14	512.01
9	76.36	508.15
10	85.78	504.79
11	95.37	501.96
12	105.10	499.65
13	114.94	497.87
14	124.87	496.63
15	134.84	495.93
16	144.84	495.77
17	154.83	496.16
18	164.79	497.09
19	174.68	498.57
20	184.48	500.57
21	194.15	503.11
22	203.67	506.17

23	213.01	509.74
24	222.14	513.82
25	231.04	518.38
26	239.68	523.42
27	248.02	528.93
28	256.06	534.88
29	263.76	541.26
30	271.10	548.05
31	278.07	555.23
32	284.63	562.77
33	290.77	570.66
34	296.48	578.88
35	301.73	587.39
36	301.98	587.87

Circle Center At X = 142.7 ; Y = 679.6 and Radius, 183.8

*** 2.159 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	94.47	552.10
2	104.40	550.90
3	114.36	550.03
4	124.35	549.50
5	134.35	549.32
6	144.35	549.47
7	154.33	549.97
8	164.30	550.80
9	174.23	551.97
10	184.12	553.48
11	193.94	555.33
12	203.70	557.51
13	213.38	560.01
14	222.97	562.85
15	232.46	566.01
16	241.84	569.50
17	251.09	573.30
18	260.20	577.41
19	269.17	581.83
20	277.99	586.55
21	280.49	588.00

Circle Center At X = 134.8 ; Y = 843.2 and Radius, 293.9

*** 2.161 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.53	552.10
2	22.62	545.05
3	30.10	538.41
4	37.93	532.19
5	46.08	526.41
6	54.55	521.08
7	63.30	516.24
8	72.30	511.88
9	81.52	508.02
10	90.95	504.68
11	100.54	501.86
12	110.28	499.58
13	120.13	497.83
14	130.05	496.63
15	140.03	495.98
16	150.03	495.88
17	160.02	496.34
18	169.97	497.34
19	179.85	498.89
20	189.63	500.98
21	199.28	503.60
22	208.77	506.76

23	218.07	510.43
24	227.15	514.61
25	236.00	519.28
26	244.56	524.43
27	252.84	530.05
28	260.79	536.12
29	268.39	542.61
30	275.63	549.51
31	282.47	556.81
32	288.90	564.46
33	294.90	572.46
34	300.45	580.78
35	304.20	587.13

Circle Center At X = 146.8 ; Y = 677.3 and Radius, 181.4

*** 2.161 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.05	552.10
2	33.15	545.06
3	40.66	538.46
4	48.56	532.32
5	56.81	526.67
6	65.39	521.54
7	74.27	516.93
8	83.40	512.86
9	92.77	509.36
10	102.33	506.43
11	112.05	504.08
12	121.90	502.32
13	131.83	501.16
14	141.81	500.60
15	151.81	500.65
16	161.79	501.30
17	171.71	502.56
18	181.54	504.41
19	191.24	506.85
20	200.77	509.88
21	210.10	513.47
22	219.20	517.62
23	228.03	522.32
24	236.56	527.54
25	244.75	533.26
26	252.59	539.48
27	260.04	546.15
28	267.07	553.26
29	273.66	560.78
30	279.78	568.69
31	285.41	576.95
32	290.53	585.54
33	291.81	588.00

Circle Center At X = 146.0 ; Y = 665.9 and Radius, 165.4

*** 2.162 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.26	552.10
2	17.45	545.14
3	25.01	538.60
4	32.93	532.49
5	41.18	526.84
6	49.73	521.66
7	58.56	516.97
8	67.64	512.78
9	76.95	509.11
10	86.44	505.97
11	96.09	503.36

12	105.88	501.31
13	115.77	499.80
14	125.72	498.85
15	135.71	498.47
16	145.71	498.64
17	155.68	499.38
18	165.60	500.68
19	175.43	502.53
20	185.14	504.93
21	194.69	507.87
22	204.07	511.34
23	213.24	515.34
24	222.17	519.84
25	230.83	524.84
26	239.19	530.32
27	247.24	536.26
28	254.94	542.64
29	262.27	549.44
30	269.20	556.65
31	275.72	564.23
32	281.80	572.17
33	287.43	580.43
34	291.98	588.00

Circle Center At X = 137.6 ; Y = 676.4 and Radius, 177.9

*** 2.166 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.53	552.10
2	22.83	545.27
3	30.50	538.86
4	38.53	532.89
5	46.87	527.38
6	55.52	522.35
7	64.43	517.81
8	73.58	513.79
9	82.95	510.28
10	92.49	507.31
11	102.19	504.88
12	112.02	503.00
13	121.93	501.67
14	131.90	500.91
15	141.90	500.70
16	151.89	501.06
17	161.85	501.98
18	171.74	503.46
19	181.53	505.50
20	191.19	508.08
21	200.69	511.20
22	210.00	514.85
23	219.09	519.02
24	227.93	523.70
25	236.49	528.86
26	244.75	534.50
27	252.68	540.59
28	260.25	547.12
29	267.45	554.07
30	274.24	561.41
31	280.61	569.12
32	286.53	577.17
33	291.99	585.55
34	293.40	588.00

Circle Center At X = 140.5 ; Y = 678.3 and Radius, 177.6

*** 2.167 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	31.32	552.10
2	38.42	545.06
3	45.93	538.46
4	53.81	532.30
5	62.04	526.63
6	70.60	521.45
7	79.44	516.78
8	88.55	512.65
9	97.88	509.05
10	107.41	506.02
11	117.10	503.55
12	126.92	501.66
13	136.83	500.36
14	146.81	499.64
15	156.81	499.51
16	166.80	499.97
17	176.74	501.02
18	186.61	502.66
19	196.36	504.87
20	205.96	507.66
21	215.38	511.01
22	224.59	514.91
23	233.56	519.34
24	242.24	524.30
25	250.62	529.76
26	258.66	535.71
27	266.33	542.12
28	273.62	548.97
29	280.48	556.24
30	286.91	563.90
31	292.87	571.93
32	298.35	580.30
33	302.57	587.67

Circle Center At X = 154.0 ; Y = 668.8 and Radius, 169.3

*** 2.171 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.05	552.10
2	33.41	545.32
3	41.14	538.98
4	49.22	533.10
5	57.64	527.69
6	66.35	522.78
7	75.33	518.38
8	84.55	514.51
9	93.98	511.18
10	103.58	508.40
11	113.33	506.18
12	123.20	504.53
13	133.14	503.45
14	143.13	502.95
15	153.13	503.03
16	163.10	503.68
17	173.03	504.92
18	182.86	506.72
19	192.58	509.09
20	202.14	512.02
21	211.52	515.49
22	220.68	519.51
23	229.59	524.04
24	238.22	529.09
25	246.55	534.62
26	254.55	540.63
27	262.18	547.09
28	269.42	553.98
29	276.26	561.28

30	282.66	568.96
31	288.61	577.00
32	294.08	585.37
33	295.59	588.00

Circle Center At X = 146.8 ; Y = 675.7 and Radius, 172.8

*** 2.172 ***

Failure Surface Specified By 33 Coordinate Points

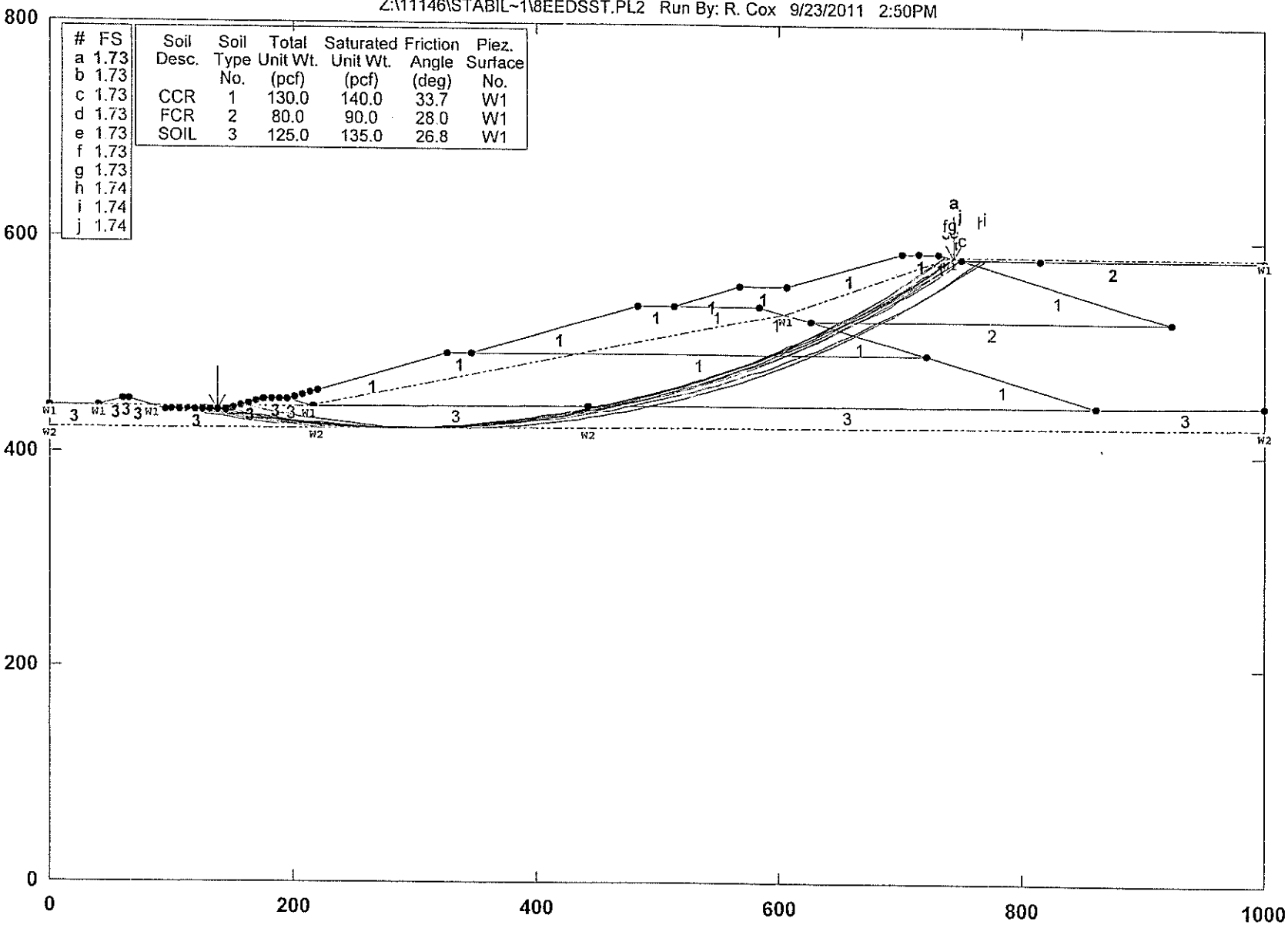
Point No.	X-Surf (ft)	Y-Surf (ft)
1	31.32	552.10
2	38.43	545.08
3	45.95	538.48
4	53.85	532.35
5	62.09	526.68
6	70.65	521.51
7	79.50	516.86
8	88.61	512.73
9	97.95	509.15
10	107.48	506.12
11	117.17	503.66
12	126.99	501.77
13	136.90	500.47
14	146.88	499.75
15	156.88	499.62
16	166.87	500.07
17	176.81	501.12
18	186.68	502.74
19	196.43	504.95
20	206.04	507.72
21	215.47	511.06
22	224.68	514.95
23	233.65	519.37
24	242.34	524.31
25	250.73	529.75
26	258.79	535.68
27	266.48	542.07
28	273.78	548.91
29	280.66	556.16
30	287.11	563.80
31	293.10	571.81
32	298.60	580.16
33	302.88	587.57

Circle Center At X = 154.1 ; Y = 669.4 and Radius, 169.8

*** 2.172 ***

Phase 8 - Section E-E Downstream Static Whole Slope Circle

Z:\11146\STABIL~1\8EEDSST.PL2 Run By: R. Cox 9/23/2011 2:50PM



PCSTABL5M/si FSmin=1.73

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/23/2011
Time of Run: 2:50PM
Run By: R. Cox
Input Data Filename: Z:8eedsst.
Output Filename: Z:8eedsst.OUT
Unit: ENGLISH
Plotted Output Filename: Z:8eedsst.PLT
PROBLEM DESCRIPTION Phase 8 - Section E-E
Downstream Static Whole Slope Circle

BOUNDARY COORDINATES
17 Top Boundaries
28 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	442.21	39.38	442.00	3
2	39.38	442.00	60.38	449.00	3
3	60.38	449.00	65.38	449.00	3
4	65.38	449.00	95.38	439.00	3
5	95.38	439.00	144.78	439.00	3
6	144.78	439.00	174.78	449.00	3
7	174.78	449.00	194.78	449.00	3
8	194.78	449.00	325.78	492.00	1
9	325.78	492.00	345.78	492.00	1
10	345.78	492.00	483.78	538.00	1
11	483.78	538.00	513.78	538.00	1
12	513.78	538.00	567.79	556.00	1
13	567.79	556.00	605.95	556.00	1
14	605.95	556.00	701.59	588.00	1
15	701.59	588.00	731.59	588.00	1
16	731.59	588.00	749.59	582.00	1
17	749.59	582.00	1000.00	582.00	2
18	749.59	582.00	923.59	524.00	1
19	513.78	538.00	583.78	538.00	1
20	583.78	538.00	625.78	524.00	1
21	625.78	524.00	923.59	524.00	2
22	625.78	524.00	721.78	492.00	1
23	345.78	492.00	721.78	492.00	1
24	721.78	492.00	861.81	445.32	1
25	194.78	449.00	215.78	442.00	3
26	215.78	442.00	442.73	444.00	3
27	442.73	444.00	861.81	445.32	3
28	861.81	445.32	1000.00	445.75	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 7 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	442.00
2	39.38	442.00
3	83.38	443.00
4	212.78	443.00
5	605.38	530.80
6	740.59	585.00

7	1000.00	585.00

Piezometric Surface No. 2 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	422.21
2	218.39	422.00
3	442.73	424.00
4	1000.00	425.76

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced Along The Ground Surface Between X = 100.00 ft.
and X = 220.00 ft.
Each Surface Terminates Between X = 715.00 ft.
and X = 815.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =422.50 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 66 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	137.90	439.00
2	147.68	436.94
3	157.49	435.01
4	167.33	433.22
5	177.19	431.57
6	187.08	430.06
7	196.98	428.68
8	206.91	427.44
9	216.85	426.34
10	226.80	425.38
11	236.77	424.56
12	246.74	423.87
13	256.73	423.33
14	266.72	422.92
15	276.72	422.66
16	286.72	422.53
17	296.72	422.55
18	306.71	422.70
19	316.71	422.99
20	326.70	423.42
21	336.68	423.99
22	346.66	424.70
23	356.62	425.55
24	366.57	426.53
25	376.51	427.66
26	386.43	428.92
27	396.33	430.33
28	406.21	431.87
29	416.07	433.54
30	425.90	435.36
31	435.71	437.31
32	445.49	439.40
33	455.24	441.62
34	464.96	443.98
35	474.64	446.48
36	484.29	449.11
37	493.90	451.87
38	503.47	454.77
39	513.00	457.80
40	522.49	460.96
41	531.93	464.26

42	541.32	467.69
43	550.67	471.24
44	559.97	474.93
45	569.21	478.75
46	578.40	482.69
47	587.53	486.76
48	596.61	490.96
49	605.62	495.29
50	614.58	499.74
51	623.47	504.31
52	632.30	509.01
53	641.06	513.83
54	649.75	518.78
55	658.37	523.84
56	666.93	529.02
57	675.40	534.33
58	683.81	539.75
59	692.14	545.28
60	700.39	550.93
61	708.56	556.70
62	716.65	562.58
63	724.65	568.57
64	732.57	574.67
65	740.41	580.89
66	744.04	583.85

Circle Center At X = 290.8 ; Y = 1139.9 and Radius, 717.4

*** 1.725 ***

Individual data on the 90 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	6.9	674.5	1718.4	2074.8	.0	.0	.0	.0	.0
2	2.9	877.2	670.8	1064.8	.0	.0	.0	.0	.0
3	9.8	7455.7	902.2	4384.2	.0	.0	.0	.0	.0
4	9.8	14108.4	.0	5543.4	.0	.0	.0	.0	.0
5	7.4	14890.4	.0	4902.1	.0	.0	.0	.0	.0
6	2.4	5469.9	.0	1715.0	.0	.0	.0	.0	.0
7	9.9	23677.0	.0	7605.1	.0	.0	.0	.0	.0
8	7.7	19790.4	.0	6540.1	.0	.0	.0	.0	.0
9	2.2	5975.2	.0	1966.9	.0	.0	.0	.0	.0
10	9.9	30609.0	.0	9322.8	.0	.0	.0	.0	.0
11	5.9	20922.9	.0	5857.2	.0	.0	.0	.0	.0
12	3.0	11473.6	.0	3072.3	.0	.0	.0	.0	.0
13	1.1	4209.2	.0	1136.1	.0	.0	.0	.0	.0
14	10.0	42484.9	.0	11672.5	.0	.0	.0	.0	.0
15	10.0	48183.7	.0	13572.5	.0	.0	.0	.0	.0
16	10.0	53704.5	.0	15389.5	.0	.0	.0	.0	.0
17	10.0	59042.5	.0	17123.1	.0	.0	.0	.0	.0
18	10.0	64192.9	.0	18772.9	.0	.0	.0	.0	.0
19	10.0	69151.7	.0	20338.7	.0	.0	.0	.0	.0
20	6.4	46974.5	.0	13859.6	.0	.0	.0	.0	.0
21	3.6	26940.1	.0	7960.5	.0	.0	.0	.0	.0
22	10.0	78477.8	.0	23216.9	.0	.0	.0	.0	.0
23	10.0	82837.6	.0	24528.7	.0	.0	.0	.0	.0
24	4.4	38144.7	.0	11296.6	.0	.0	.0	.0	.0
25	5.6	48846.3	.0	14458.8	.0	.0	.0	.0	.0
26	9.1	82394.7	.0	24372.9	.0	.0	.0	.0	.0
27	.9	8521.9	.0	2523.7	.0	.0	.0	.0	.0
28	10.0	92146.9	.0	27952.2	.0	.0	.0	.0	.0
29	9.1	83392.1	.0	26336.3	.0	.0	.0	.0	.0
30	.9	8042.3	.0	2585.7	.0	.0	.0	.0	.0
31	10.0	93015.5	.0	29805.7	.0	.0	.0	.0	.0
32	10.0	96171.3	.0	30603.2	.0	.0	.0	.0	.0
33	9.9	99107.7	.0	31314.4	.0	.0	.0	.0	.0
34	9.9	101822.5	.0	31939.1	.0	.0	.0	.0	.0
35	9.9	104315.1	.0	32477.1	.0	.0	.0	.0	.0

36	9.9	106584.3	.0	32928.4	.0	.0	.0	.0	.0
37	9.9	108629.3	.0	33292.9	.0	.0	.0	.0	.0
38	9.8	110450.1	.0	33570.6	.0	.0	.0	.0	.0
39	6.0	68108.1	.0	20568.9	.0	.0	.0	.0	.0
40	3.8	43938.1	.0	13192.4	.0	.0	.0	.0	.0
41	7.0	81226.9	.0	24295.5	.0	.0	.0	.0	.0
42	2.8	32190.7	.0	9569.5	.0	.0	.0	.0	.0
43	9.7	114566.8	.0	33881.7	.0	.0	.0	.0	.0
44	9.7	115493.4	.0	33811.4	.0	.0	.0	.0	.0
45	.3	4084.8	.0	1191.5	.0	.0	.0	.0	.0
46	9.3	112057.5	.0	32462.8	.0	.0	.0	.0	.0
47	9.1	110322.0	.0	31649.6	.0	.0	.0	.0	.0
48	.5	6175.4	.0	1760.4	.0	.0	.0	.0	.0
49	9.6	114425.0	.0	33078.8	.0	.0	.0	.0	.0
50	9.6	110368.8	.0	32660.9	.0	.0	.0	.0	.0
51	9.5	106142.8	.0	32156.2	.0	.0	.0	.0	.0
52	.8	8502.9	.0	2614.9	.0	.0	.0	.0	.0
53	8.7	94892.4	.0	28950.0	.0	.0	.0	.0	.0
54	9.4	102696.9	.0	30887.1	.0	.0	.0	.0	.0
55	9.4	101800.6	.0	30122.6	.0	.0	.0	.0	.0
56	9.3	100697.6	.0	29272.2	.0	.0	.0	.0	.0
57	9.3	99390.3	.0	28335.3	.0	.0	.0	.0	.0
58	7.8	82931.7	.0	23191.0	.0	.0	.0	.0	.0
59	1.4	14908.8	.0	4121.9	.0	.0	.0	.0	.0
60	9.2	93787.2	.0	26204.4	.0	.0	.0	.0	.0
61	5.4	52636.5	.0	14889.6	.0	.0	.0	.0	.0
62	3.8	35646.5	.0	10121.0	.0	.0	.0	.0	.0
63	9.1	82660.3	.0	23731.6	.0	.0	.0	.0	.0
64	2.2	18912.5	.0	5487.6	.0	.0	.0	.0	.0
65	6.6	56015.4	.0	16297.3	.0	.0	.0	.0	.0
66	.2	1994.1	.0	555.8	.0	.0	.0	.0	.0
67	.3	2691.9	.0	756.6	.0	.0	.0	.0	.0
68	8.6	69944.6	.0	19674.7	.0	.0	.0	.0	.0
69	8.9	70281.0	.0	19887.8	.0	.0	.0	.0	.0
70	2.3	17941.0	.0	5106.2	.0	.0	.0	.0	.0
71	6.5	49467.2	.0	14151.3	.0	.0	.0	.0	.0
72	8.8	63491.0	.0	18540.4	.0	.0	.0	.0	.0
73	5.6	38854.6	.0	11572.5	.0	.0	.0	.0	.0
74	3.1	20761.9	.0	6164.3	.0	.0	.0	.0	.0
75	8.6	58103.5	.0	16846.7	.0	.0	.0	.0	.0
76	.3	1763.5	.0	502.6	.0	.0	.0	.0	.0
77	8.3	54373.2	.0	15367.8	.0	.0	.0	.0	.0
78	8.5	52875.7	.0	14808.1	.0	.0	.0	.0	.0
79	8.4	49484.2	.0	13659.9	.0	.0	.0	.0	.0
80	8.3	45970.0	.0	12426.1	.0	.0	.0	.0	.0
81	8.2	42340.0	.0	11106.9	.0	.0	.0	.0	.0
82	1.2	5900.6	.0	1520.1	.0	.0	.0	.0	.0
83	7.0	31645.9	.0	8182.5	.0	.0	.0	.0	.0
84	8.1	30888.7	.0	8213.5	.0	.0	.0	.0	.0
85	8.0	24193.1	.0	6639.8	.0	.0	.0	.0	.0
86	6.9	15679.8	.0	4455.5	.0	.0	.0	.0	.0
87	1.0	1799.4	.0	526.4	.0	.0	.0	.0	.0
88	7.8	9154.4	.0	3240.0	.0	.0	.0	.0	.0
89	.2	101.8	.0	53.9	.0	.0	.0	.0	.0
90	3.5	959.3	130.7	711.8	.0	.0	.0	.0	.0

Failure Surface Specified By 66 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.21	439.00
2	154.00	436.96
3	163.82	435.05
4	173.66	433.28
5	183.53	431.65
6	193.41	430.16
7	203.32	428.80
8	213.25	427.59
9	223.19	426.51

10	233.14	425.56
11	243.11	424.76
12	253.09	424.10
13	263.08	423.57
14	273.07	423.19
15	283.07	422.94
16	293.06	422.83
17	303.06	422.86
18	313.06	423.03
19	323.06	423.34
20	333.05	423.79
21	343.03	424.38
22	353.00	425.10
23	362.97	425.97
24	372.92	426.97
25	382.85	428.11
26	392.77	429.39
27	402.67	430.81
28	412.55	432.37
29	422.40	434.06
30	432.23	435.89
31	442.04	437.86
32	451.81	439.96
33	461.56	442.20
34	471.27	444.57
35	480.95	447.08
36	490.60	449.72
37	500.21	452.50
38	509.77	455.41
39	519.30	458.46
40	528.78	461.63
41	538.22	464.94
42	547.61	468.38
43	556.95	471.94
44	566.24	475.64
45	575.48	479.47
46	584.66	483.43
47	593.79	487.51
48	602.86	491.72
49	611.88	496.05
50	620.83	500.51
51	629.71	505.10
52	638.54	509.80
53	647.29	514.63
54	655.98	519.59
55	664.60	524.66
56	673.15	529.85
57	681.62	535.16
58	690.02	540.58
59	698.34	546.13
60	706.59	551.79
61	714.75	557.56
62	722.84	563.44
63	730.84	569.44
64	738.76	575.55
65	746.59	581.77
66	747.66	582.64

Circle Center At X = 295.8 ; Y = 1141.4 and Radius, 718.6

*** 1.727 ***

Failure Surface Specified By 66 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.21	439.00
2	154.01	436.99
3	163.83	435.12
4	173.68	433.39
5	183.55	431.79

6	193.44	430.32
7	203.35	428.99
8	213.28	427.80
9	223.23	426.74
10	233.18	425.81
11	243.15	425.03
12	253.13	424.38
13	263.12	423.86
14	273.11	423.49
15	283.11	423.25
16	293.11	423.14
17	303.11	423.18
18	313.11	423.35
19	323.10	423.65
20	333.09	424.10
21	343.07	424.68
22	353.05	425.40
23	363.01	426.25
24	372.96	427.24
25	382.90	428.36
26	392.82	429.63
27	402.72	431.02
28	412.60	432.56
29	422.46	434.22
30	432.30	436.03
31	442.11	437.96
32	451.89	440.03
33	461.65	442.24
34	471.37	444.58
35	481.06	447.05
36	490.72	449.65
37	500.33	452.38
38	509.91	455.25
39	519.46	458.25
40	528.95	461.37
41	538.41	464.63
42	547.82	468.02
43	557.18	471.53
44	566.49	475.17
45	575.76	478.94
46	584.97	482.84
47	594.12	486.86
48	603.22	491.00
49	612.26	495.27
50	621.25	499.67
51	630.17	504.18
52	639.03	508.82
53	647.82	513.58
54	656.55	518.46
55	665.22	523.45
56	673.81	528.57
57	682.33	533.80
58	690.78	539.15
59	699.16	544.61
60	707.46	550.19
61	715.68	555.88
62	723.82	561.68
63	731.89	567.60
64	739.87	573.62
65	747.77	579.75
66	750.58	582.00

Circle Center At X = 295.7 ; Y = 1154.0 and Radius, 730.8

*** 1.730 ***

Failure Surface Specified By 66 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	121.58	439.00

2	141.37	436.95
3	151.18	435.03
4	161.02	433.25
5	170.89	431.61
6	180.77	430.11
7	190.68	428.74
8	200.60	427.52
9	210.54	426.43
10	220.50	425.48
11	230.47	424.67
12	240.44	424.01
13	250.43	423.48
14	260.42	423.09
15	270.42	422.84
16	280.42	422.73
17	290.42	422.76
18	300.42	422.93
19	310.41	423.24
20	320.40	423.69
21	330.38	424.28
22	340.36	425.01
23	350.32	425.88
24	360.27	426.89
25	370.20	428.04
26	380.12	429.32
27	390.02	430.75
28	399.89	432.31
29	409.75	434.01
30	419.58	435.85
31	429.38	437.83
32	439.16	439.94
33	448.90	442.19
34	458.61	444.58
35	468.29	447.10
36	477.93	449.76
37	487.53	452.55
38	497.09	455.48
39	506.61	458.54
40	516.09	461.73
41	525.52	465.06
42	534.90	468.51
43	544.24	472.10
44	553.52	475.82
45	562.75	479.66
46	571.93	483.64
47	581.05	487.75
48	590.11	491.98
49	599.11	496.33
50	608.05	500.82
51	616.92	505.43
52	625.73	510.16
53	634.47	515.01
54	643.15	519.99
55	651.75	525.08
56	660.28	530.30
57	668.74	535.64
58	677.12	541.09
59	685.43	546.66
60	693.65	552.35
61	701.80	558.15
62	709.86	564.06
63	717.84	570.09
64	725.74	576.23
65	733.54	582.47
66	737.76	585.94

Circle Center At X = 283.2 ; Y = 1137.2 and Radius, 714.5

*** 1.730 ***

Failure Surface Specified By 67 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	125.26	439.00
2	135.06	437.00
3	144.88	435.13
4	154.73	433.39
5	164.60	431.78
6	174.49	430.30
7	184.40	428.96
8	194.33	427.75
9	204.27	426.67
10	214.23	425.73
11	224.19	424.92
12	234.17	424.24
13	244.15	423.69
14	254.15	423.28
15	264.14	423.00
16	274.14	422.86
17	284.14	422.85
18	294.14	422.97
19	304.14	423.23
20	314.13	423.62
21	324.12	424.14
22	334.09	424.80
23	344.06	425.59
24	354.02	426.51
25	363.96	427.57
26	373.89	428.76
27	383.81	430.08
28	393.70	431.54
29	403.57	433.12
30	413.42	434.84
31	423.25	436.69
32	433.05	438.67
33	442.83	440.78
34	452.57	443.03
35	462.29	445.40
36	471.97	447.90
37	481.62	450.53
38	491.23	453.29
39	500.80	456.18
40	510.34	459.20
41	519.83	462.34
42	529.28	465.61
43	538.69	469.00
44	548.05	472.52
45	557.36	476.17
46	566.62	479.94
47	575.83	483.83
48	584.99	487.85
49	594.09	491.99
50	603.14	496.25
51	612.13	500.63
52	621.06	505.13
53	629.93	509.75
54	638.74	514.48
55	647.48	519.34
56	656.16	524.31
57	664.77	529.39
58	673.31	534.59
59	681.78	539.91
60	690.18	545.34
61	698.50	550.88
62	706.75	556.53
63	714.93	562.28
64	723.03	568.15

65	731.04	574.13
66	738.98	580.21
67	743.73	583.95

Circle Center At X = 279.9 ; Y = 1171.0 and Radius, 748.2

*** 1.731 ***

Failure Surface Specified By 65 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.21	439.00
2	153.99	436.92
3	163.80	434.99
4	173.64	433.19
5	183.50	431.54
6	193.39	430.04
7	203.30	428.68
8	213.22	427.46
9	223.17	426.39
10	233.12	425.46
11	243.09	424.68
12	253.07	424.04
13	263.06	423.55
14	273.05	423.20
15	283.05	423.00
16	293.05	422.94
17	303.05	423.03
18	313.05	423.26
19	323.04	423.64
20	333.03	424.17
21	343.00	424.84
22	352.97	425.65
23	362.92	426.61
24	372.86	427.72
25	382.79	428.97
26	392.69	430.36
27	402.57	431.90
28	412.43	433.58
29	422.26	435.41
30	432.06	437.37
31	441.84	439.48
32	451.58	441.73
33	461.29	444.13
34	470.96	446.66
35	480.60	449.34
36	490.20	452.15
37	499.75	455.10
38	509.26	458.20
39	518.72	461.43
40	528.14	464.80
41	537.50	468.30
42	546.82	471.94
43	556.08	475.72
44	565.28	479.63
45	574.43	483.67
46	583.52	487.84
47	592.54	492.15
48	601.50	496.59
49	610.40	501.16
50	619.22	505.86
51	627.98	510.68
52	636.67	515.63
53	645.29	520.71
54	653.83	525.91
55	662.29	531.24
56	670.67	536.69
57	678.98	542.26
58	687.20	547.95
59	695.34	553.76

60	703.40	559.69
61	711.36	565.73
62	719.24	571.89
63	727.03	578.16
64	734.72	584.55
65	736.75	586.28

Circle Center At X = 291.9 ; Y = 1110.3 and Radius, 687.4

*** 1.731 ***

Failure Surface Specified By 68 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	118.95	439.00
2	128.75	437.02
3	138.58	435.17
4	148.43	433.45
5	158.30	431.85
6	168.19	430.39
7	178.10	429.06
8	188.03	427.86
9	197.97	426.79
10	207.93	425.85
11	217.90	425.04
12	227.87	424.36
13	237.86	423.82
14	247.85	423.40
15	257.85	423.12
16	267.84	422.97
17	277.84	422.95
18	287.84	423.06
19	297.84	423.30
20	307.83	423.67
21	317.82	424.18
22	327.80	424.82
23	337.77	425.58
24	347.73	426.48
25	357.68	427.51
26	367.61	428.68
27	377.53	429.97
28	387.42	431.39
29	397.30	432.94
30	407.16	434.62
31	417.00	436.44
32	426.81	438.38
33	436.59	440.45
34	446.34	442.64
35	456.07	444.97
36	465.76	447.43
37	475.43	450.01
38	485.05	452.71
39	494.64	455.55
40	504.19	458.51
41	513.70	461.60
42	523.18	464.81
43	532.60	468.14
44	541.99	471.60
45	551.32	475.18
46	560.61	478.89
47	569.85	482.72
48	579.04	486.66
49	588.17	490.73
50	597.25	494.92
51	606.28	499.23
52	615.24	503.65
53	624.15	508.20
54	633.00	512.86
55	641.79	517.63
56	650.51	522.52

57	659.17	527.53
58	667.76	532.65
59	676.28	537.88
60	684.73	543.22
61	693.11	548.68
62	701.42	554.24
63	709.66	559.91
64	717.82	565.69
65	725.90	571.58
66	733.91	577.57
67	741.83	583.67
68	742.65	584.31

Circle Center At X = 274.4 ; Y = 1183.0 and Radius, 760.1

*** 1.734 ***

Failure Surface Specified By 66 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	156.84	443.02
2	166.56	440.68
3	176.32	438.47
4	186.10	436.41
5	195.92	434.49
6	205.76	432.71
7	215.62	431.07
8	225.51	429.57
9	235.42	428.22
10	245.34	427.01
11	255.29	425.95
12	265.24	425.03
13	275.21	424.25
14	285.19	423.62
15	295.18	423.13
16	305.18	422.79
17	315.17	422.59
18	325.17	422.54
19	335.17	422.63
20	345.17	422.86
21	355.16	423.24
22	365.15	423.76
23	375.13	424.43
24	385.10	425.24
25	395.05	426.20
26	404.99	427.30
27	414.91	428.54
28	424.81	429.93
29	434.70	431.46
30	444.56	433.13
31	454.39	434.95
32	464.20	436.91
33	473.97	439.01
34	483.72	441.25
35	493.43	443.63
36	503.11	446.15
37	512.75	448.81
38	522.35	451.61
39	531.91	454.54
40	541.42	457.62
41	550.89	460.83
42	560.32	464.18
43	569.69	467.67
44	579.01	471.29
45	588.28	475.04
46	597.49	478.93
47	606.65	482.95
48	615.74	487.11
49	624.78	491.39
50	633.75	495.81

51	642.66	500.35
52	651.50	505.02
53	660.27	509.82
54	668.98	514.75
55	677.61	519.80
56	686.16	524.97
57	694.64	530.27
58	703.05	535.69
59	711.37	541.23
60	719.62	546.90
61	727.78	552.68
62	735.85	558.57
63	743.84	564.59
64	751.74	570.71
65	759.56	576.96
66	765.68	582.00

Circle Center At X = 323.9 ; Y = 1114.1 and Radius, 691.6

*** 1.735 ***

Failure Surface Specified By 68 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.21	439.00
2	154.02	437.04
3	163.85	435.22
4	173.70	433.51
5	183.58	431.94
6	193.47	430.50
7	203.39	429.18
8	213.32	427.99
9	223.26	426.93
10	233.22	426.00
11	243.18	425.20
12	253.16	424.53
13	263.15	423.98
14	273.14	423.57
15	283.13	423.28
16	293.13	423.13
17	303.13	423.10
18	313.13	423.21
19	323.13	423.44
20	333.12	423.81
21	343.11	424.30
22	353.09	424.92
23	363.06	425.67
24	373.02	426.55
25	382.97	427.56
26	392.91	428.70
27	402.83	429.97
28	412.73	431.37
29	422.61	432.89
30	432.48	434.54
31	442.32	436.32
32	452.13	438.23
33	461.92	440.26
34	471.69	442.42
35	481.42	444.71
36	491.13	447.12
37	500.80	449.66
38	510.44	452.32
39	520.04	455.11
40	529.61	458.02
41	539.14	461.06
42	548.62	464.22
43	558.07	467.50
44	567.47	470.91
45	576.83	474.43
46	586.14	478.08

47	595.41	481.84
48	604.62	485.73
49	613.78	489.74
50	622.89	493.86
51	631.95	498.10
52	640.95	502.46
53	649.89	506.94
54	658.77	511.53
55	667.60	516.23
56	676.36	521.05
57	685.06	525.98
58	693.69	531.03
59	702.26	536.18
60	710.76	541.45
61	719.19	546.83
62	727.56	552.31
63	735.85	557.91
64	744.06	563.61
65	752.20	569.41
66	760.27	575.32
67	768.26	581.34
68	769.12	582.00

Circle Center At X = 300.1 ; Y = 1194.8 and Radius, 771.7

*** 1.736 ***

Failure Surface Specified By 69 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	106.32	439.00
2	116.12	437.05
3	125.96	435.22
4	135.81	433.52
5	145.68	431.94
6	155.58	430.48
7	165.49	429.14
8	175.41	427.93
9	185.35	426.84
10	195.31	425.88
11	205.27	425.04
12	215.25	424.32
13	225.23	423.73
14	235.22	423.27
15	245.21	422.93
16	255.21	422.71
17	265.21	422.62
18	275.21	422.65
19	285.21	422.81
20	295.20	423.09
21	305.20	423.49
22	315.18	424.02
23	325.16	424.68
24	335.13	425.46
25	345.09	426.36
26	355.04	427.39
27	364.97	428.54
28	374.89	429.82
29	384.79	431.21
30	394.67	432.74
31	404.54	434.38
32	414.38	436.15
33	424.20	438.04
34	433.99	440.05
35	443.76	442.19
36	453.51	444.44
37	463.22	446.82
38	472.90	449.32
39	482.55	451.94
40	492.17	454.68

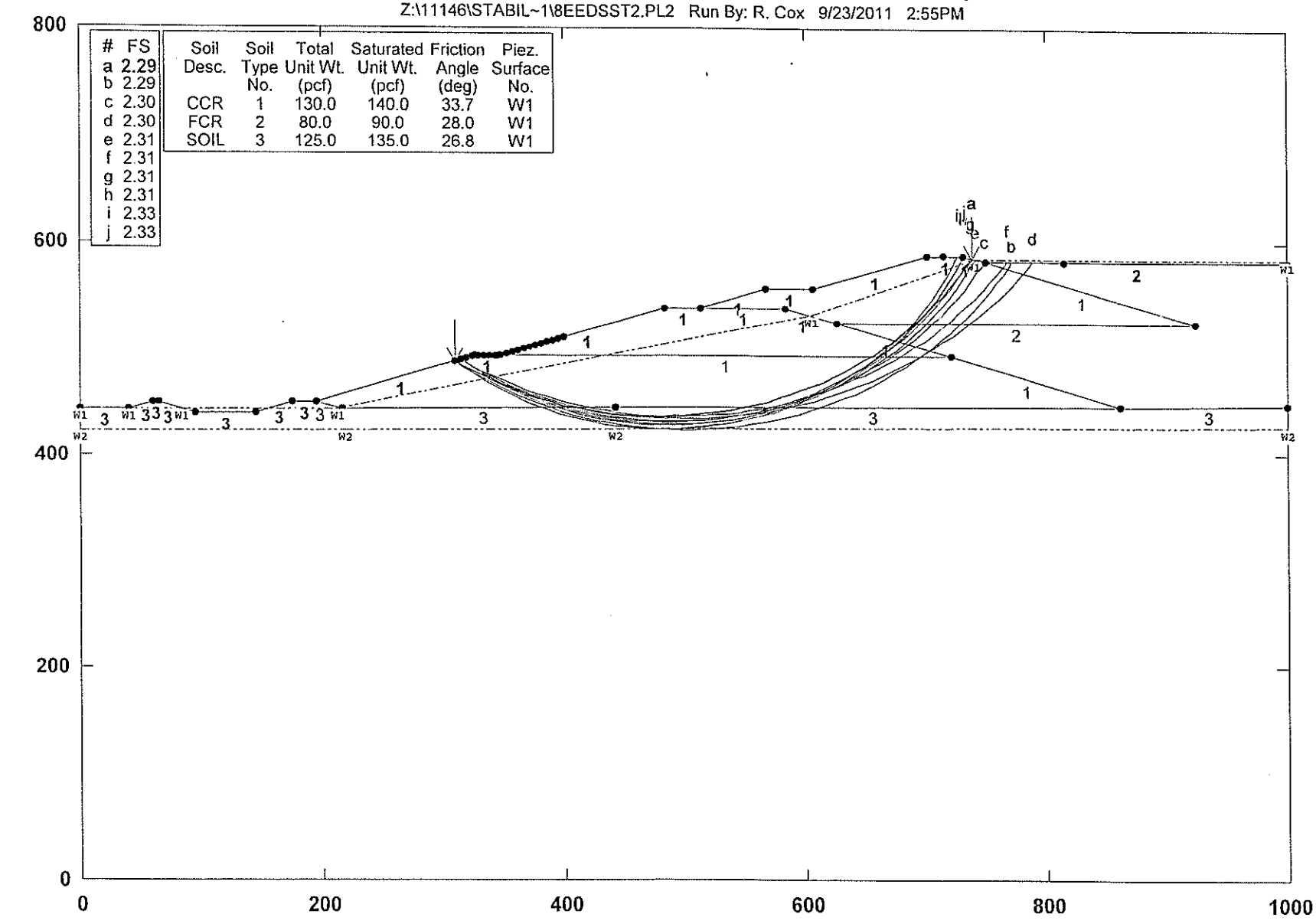
41	501.75	457.54
42	511.30	460.52
43	520.81	463.61
44	530.28	466.83
45	539.71	470.16
46	549.09	473.61
47	558.43	477.18
48	567.73	480.86
49	576.98	484.66
50	586.18	488.57
51	595.34	492.60
52	604.44	496.74
53	613.49	501.00
54	622.48	505.37
55	631.42	509.85
56	640.31	514.44
57	649.13	519.14
58	657.90	523.95
59	666.61	528.87
60	675.25	533.89
61	683.83	539.03
62	692.35	544.27
63	700.80	549.62
64	709.18	555.07
65	717.50	560.63
66	725.74	566.29
67	733.91	572.05
68	742.01	577.91
69	748.16	582.48

Circle Center At X = 267.6 ; Y = 1224.8 and Radius, 802.2

*** 1.736 ***

Phase 8 - Section E-E Downstream Static Shallow Slope Circle

Z:\11146\STABIL~1\8EEDSST2.PL2 Run By: R. Cox 9/23/2011 2:55PM



PCSTABL5M/si FSmin=2.29

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/23/2011
Time of Run: 2:55PM
Run By: R. Cox
Input Data Filename: Z:8eedsst2.
Output Filename: Z:8eedsst2.OUT
Unit: ENGLISH
Plotted Output Filename: Z:8eedsst2.PLT
PROBLEM DESCRIPTION Phase 8 - Section E-E
Downstream Static Shallow Slope Circle

BOUNDARY COORDINATES
17 Top Boundaries
28 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	442.21	39.38	442.00	3
2	39.38	442.00	60.38	449.00	3
3	60.38	449.00	65.38	449.00	3
4	65.38	449.00	95.38	439.00	3
5	95.38	439.00	144.78	439.00	3
6	144.78	439.00	174.78	449.00	3
7	174.78	449.00	194.78	449.00	3
8	194.78	449.00	325.78	492.00	1
9	325.78	492.00	345.78	492.00	1
10	345.78	492.00	483.78	538.00	1
11	483.78	538.00	513.78	538.00	1
12	513.78	538.00	567.79	556.00	1
13	567.79	556.00	605.95	556.00	1
14	605.95	556.00	701.59	588.00	1
15	701.59	588.00	731.59	588.00	1
16	731.59	588.00	749.59	582.00	1
17	749.59	582.00	1000.00	582.00	2
18	749.59	582.00	923.59	524.00	1
19	513.78	538.00	583.78	538.00	1
20	583.78	538.00	625.78	524.00	1
21	625.78	524.00	923.59	524.00	2
22	625.78	524.00	721.78	492.00	1
23	345.78	492.00	721.78	492.00	1
24	721.78	492.00	861.81	445.32	1
25	194.78	449.00	215.78	442.00	3
26	215.78	442.00	442.73	444.00	3
27	442.73	444.00	861.81	445.32	3
28	861.81	445.32	1000.00	445.75	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 7 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	442.00
2	39.38	442.00
3	83.38	443.00
4	212.78	443.00
5	605.38	530.80
6	740.59	585.00

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    7       1000.00       585.00
Piezometric Surface No.  2 Specified by  4 Coordinate Points
  Point       X-Water       Y-Water
   No.          (ft)          (ft)
    1            .00        422.21
    2         218.39        422.00
    3         442.73        424.00
    4        1000.00        425.76
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
 20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between  X = 310.00 ft.
                              and  X = 400.00 ft.
Each Surface Terminates Between   X = 715.00 ft.
                              and  X = 815.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is  Y =422.50 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
      Failure Surfaces Examined.  They Are Ordered - Most Critical
      First.
      * * Safety Factors Are Calculated By The Modified Bishop Method * *
      Failure Surface Specified By 51 Coordinate Points
        Point       X-Surf       Y-Surf
         No.          (ft)         (ft)
          1         310.00       486.82
          2         318.39       481.37
          3         326.95       476.20
          4         335.67       471.32
          5         344.56       466.73
          6         353.59       462.44
          7         362.76       458.46
          8         372.06       454.77
          9         381.48       451.40
         10         391.00       448.35
         11         400.61       445.61
         12         410.32       443.19
         13         420.10       441.10
         14         429.94       439.33
         15         439.83       437.89
         16         449.77       436.78
         17         459.74       436.00
         18         469.73       435.55
         19         479.73       435.43
         20         489.73       435.65
         21         499.71       436.20
         22         509.68       437.08
         23         519.60       438.29
         24         529.48       439.82
         25         539.31       441.69
         26         549.06       443.88
         27         558.74       446.39
         28         568.33       449.23
         29         577.82       452.38
         30         587.21       455.84
         31         596.47       459.62
         32         605.60       463.70
         33         614.59       468.08
         34         623.42       472.75
         35         632.10       477.72
         36         640.61       482.97
         37         648.94       488.51
         38         657.08       494.31
         39         665.03       500.39
         40         672.77       506.72
         41         680.29       513.31
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42	687.59	520.14
43	694.66	527.21
44	701.49	534.51
45	708.08	542.04
46	714.41	549.78
47	720.48	557.73
48	726.28	565.87
49	731.81	574.20
50	737.06	582.71
51	738.73	585.62

Circle Center At X = 478.2 ; Y = 736.5 and Radius, 301.1

*** 2.288 ***

Individual data on the 70 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	8.4	4470.0	.0	.0	.0	.0	.0	.0	.0
2	7.4	11196.6	.0	.0	.0	.0	.0	.0	.0
3	1.2	2341.8	.0	.0	.0	.0	.0	.0	.0
4	8.7	20692.7	.0	.0	.0	.0	.0	.0	.0
5	1.1	3089.4	.0	.0	.0	.0	.0	.0	.0
6	7.8	23662.0	.0	1524.4	.0	.0	.0	.0	.0
7	1.2	4127.8	.0	507.2	.0	.0	.0	.0	.0
8	7.8	30166.5	.0	4909.3	.0	.0	.0	.0	.0
9	9.2	43887.9	.0	9177.8	.0	.0	.0	.0	.0
10	9.3	53388.6	.0	12771.7	.0	.0	.0	.0	.0
11	9.4	62710.2	.0	16194.1	.0	.0	.0	.0	.0
12	9.5	71801.0	.0	19441.4	.0	.0	.0	.0	.0
13	9.6	80610.5	.0	22509.8	.0	.0	.0	.0	.0
14	7.7	69850.3	.0	19858.6	.0	.0	.0	.0	.0
15	2.0	19238.0	.0	5537.4	.0	.0	.0	.0	.0
16	9.8	97117.8	.0	28097.0	.0	.0	.0	.0	.0
17	9.8	104706.7	.0	30609.5	.0	.0	.0	.0	.0
18	1.9	21493.3	.0	6300.3	.0	.0	.0	.0	.0
19	7.9	90360.1	.0	26630.7	.0	.0	.0	.0	.0
20	2.9	33913.8	.0	10004.7	.0	.0	.0	.0	.0
21	7.0	84608.7	.0	25054.1	.0	.0	.0	.0	.0
22	10.0	124682.1	.0	36990.5	.0	.0	.0	.0	.0
23	10.0	130300.2	.0	38724.1	.0	.0	.0	.0	.0
24	10.0	135350.5	.0	40257.6	.0	.0	.0	.0	.0
25	4.0	56102.0	.0	16693.1	.0	.0	.0	.0	.0
26	5.9	82940.8	.0	24896.3	.0	.0	.0	.0	.0
27	10.0	138923.5	.0	42717.9	.0	.0	.0	.0	.0
28	10.0	137851.6	.0	43642.1	.0	.0	.0	.0	.0
29	4.1	56482.9	.0	18268.0	.0	.0	.0	.0	.0
30	5.8	80440.4	.0	26092.7	.0	.0	.0	.0	.0
31	9.9	138552.8	.0	44873.0	.0	.0	.0	.0	.0
32	9.8	139909.7	.0	45178.3	.0	.0	.0	.0	.0
33	9.8	140629.9	.0	45276.8	.0	.0	.0	.0	.0
34	1.8	25633.8	.0	8267.6	.0	.0	.0	.0	.0
35	7.9	115039.9	.0	36899.9	.0	.0	.0	.0	.0
36	9.0	132060.8	.0	42320.7	.0	.0	.0	.0	.0
37	.5	7938.8	.0	2530.7	.0	.0	.0	.0	.0
38	9.5	136531.3	.0	44328.3	.0	.0	.0	.0	.0
39	6.0	83553.2	.0	27777.2	.0	.0	.0	.0	.0
40	3.4	47254.6	.0	15821.8	.0	.0	.0	.0	.0
41	9.3	124636.5	.0	42664.5	.0	.0	.0	.0	.0
42	8.9	115321.3	.0	40558.1	.0	.0	.0	.0	.0
43	.2	2726.1	.0	922.5	.0	.0	.0	.0	.0
44	.4	4467.5	.0	1537.2	.0	.0	.0	.0	.0
45	8.6	108054.8	.0	37261.5	.0	.0	.0	.0	.0
46	8.8	108782.6	.0	38244.2	.0	.0	.0	.0	.0
47	2.4	28621.0	.0	10257.7	.0	.0	.0	.0	.0
48	6.3	75617.0	.0	27225.2	.0	.0	.0	.0	.0
49	8.5	98422.2	.0	36515.9	.0	.0	.0	.0	.0
50	8.3	92235.7	.0	35344.1	.0	.0	.0	.0	.0

51	4.9	52165.4	.0	20620.5	.0	.0	.0	.0	.0
52	3.2	33604.5	.0	13348.4	.0	.0	.0	.0	.0
53	7.9	79070.3	.0	32391.7	.0	.0	.0	.0	.0
54	7.7	72185.8	.0	30614.2	.0	.0	.0	.0	.0
55	1.3	11975.0	.0	5248.0	.0	.0	.0	.0	.0
56	6.2	54348.2	.0	23390.6	.0	.0	.0	.0	.0
57	7.3	62486.2	.0	26466.9	.0	.0	.0	.0	.0
58	3.9	32203.3	.0	13461.0	.0	.0	.0	.0	.0
59	3.2	26057.6	.0	10640.6	.0	.0	.0	.0	.0
60	6.8	52055.5	.0	21545.3	.0	.0	.0	.0	.0
61	.1	700.0	.0	295.4	.0	.0	.0	.0	.0
62	6.5	43847.3	.0	18505.1	.0	.0	.0	.0	.0
63	6.3	36252.3	.0	15870.8	.0	.0	.0	.0	.0
64	6.1	28267.6	.0	12758.9	.0	.0	.0	.0	.0
65	5.8	20647.5	.0	9468.6	.0	.0	.0	.0	.0
66	5.3	13023.0	.0	5829.3	.0	.0	.0	.0	.0
67	.2	420.7	.0	174.0	.0	.0	.0	.0	.0
68	5.3	6062.9	.0	2367.0	.0	.0	.0	.0	.0
69	.6	237.1	.0	33.0	.0	.0	.0	.0	.0
70	1.0	139.5	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 55 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	310.00	486.82
2	318.05	480.89
3	326.29	475.22
4	334.71	469.82
5	343.29	464.70
6	352.04	459.84
7	360.93	455.27
8	369.97	450.99
9	379.14	447.00
10	388.43	443.31
11	397.84	439.91
12	407.35	436.82
13	416.95	434.03
14	426.64	431.55
15	436.40	429.39
16	446.23	427.53
17	456.11	426.00
18	466.03	424.77
19	475.99	423.87
20	485.98	423.29
21	495.97	423.03
22	505.97	423.08
23	515.97	423.46
24	525.94	424.16
25	535.89	425.17
26	545.80	426.50
27	555.66	428.15
28	565.47	430.12
29	575.21	432.39
30	584.87	434.98
31	594.44	437.88
32	603.91	441.08
33	613.28	444.58
34	622.53	448.38
35	631.65	452.48
36	640.64	456.86
37	649.48	461.53
38	658.17	466.48
39	666.70	471.70
40	675.05	477.20
41	683.22	482.96
42	691.21	488.98
43	699.00	495.25
44	706.58	501.77

45	713.96	508.53
46	721.11	515.52
47	728.03	522.73
48	734.72	530.16
49	741.17	537.81
50	747.37	545.65
51	753.32	553.69
52	759.00	561.92
53	764.42	570.32
54	769.57	578.90
55	771.30	582.00

Circle Center At X = 499.2 ; Y = 735.4 and Radius, 312.4

*** 2.291 ***

Failure Surface Specified By 52 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	314.74	488.38
2	322.91	482.61
3	331.27	477.12
4	339.81	471.92
5	348.52	467.01
6	357.39	462.39
7	366.41	458.07
8	375.57	454.06
9	384.86	450.36
10	394.27	446.98
11	403.79	443.91
12	413.40	441.16
13	423.10	438.74
14	432.88	436.65
15	442.73	434.89
16	452.62	433.45
17	462.56	432.36
18	472.53	431.59
19	482.52	431.16
20	492.52	431.07
21	502.52	431.32
22	512.50	431.90
23	522.46	432.82
24	532.38	434.07
25	542.26	435.65
26	552.07	437.56
27	561.82	439.81
28	571.48	442.38
29	581.05	445.27
30	590.52	448.48
31	599.88	452.01
32	609.11	455.85
33	618.21	460.01
34	627.16	464.46
35	635.96	469.21
36	644.60	474.26
37	653.05	479.59
38	661.33	485.21
39	669.41	491.10
40	677.29	497.25
41	684.96	503.67
42	692.41	510.35
43	699.62	517.27
44	706.61	524.43
45	713.34	531.82
46	719.83	539.43
47	726.05	547.25
48	732.01	555.29
49	737.70	563.51
50	743.10	571.92
51	748.22	580.51

52	749.13	582.15

Circle Center At X = 490.2 ; Y = 728.4 and Radius, 297.3

*** 2.296 ***

Failure Surface Specified By 55 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	310.00	486.82
2	318.58	481.69
3	327.30	476.79
4	336.16	472.14
5	345.14	467.74
6	354.24	463.60
7	363.45	459.70
8	372.76	456.07
9	382.18	452.70
10	391.68	449.59
11	401.27	446.75
12	410.93	444.17
13	420.66	441.87
14	430.45	439.84
15	440.30	438.08
16	450.19	436.60
17	460.12	435.39
18	470.07	434.46
19	480.05	433.81
20	490.04	433.44
21	500.04	433.35
22	510.04	433.53
23	520.03	434.00
24	530.00	434.74
25	539.95	435.76
26	549.87	437.06
27	559.74	438.64
28	569.57	440.48
29	579.34	442.61
30	589.05	445.00
31	598.69	447.66
32	608.25	450.60
33	617.73	453.79
34	627.11	457.25
35	636.39	460.97
36	645.57	464.95
37	654.63	469.18
38	663.56	473.67
39	672.37	478.40
40	681.05	483.37
41	689.58	488.59
42	697.97	494.04
43	706.19	499.72
44	714.26	505.63
45	722.16	511.76
46	729.89	518.11
47	737.43	524.68
48	744.79	531.45
49	751.96	538.42
50	758.93	545.59
51	765.69	552.95
52	772.25	560.50
53	778.60	568.23
54	784.73	576.13
55	789.02	582.00

Circle Center At X = 498.4 ; Y = 791.9 and Radius, 358.5

*** 2.304 ***

Failure Surface Specified By 52 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	314.74	488.38

2	322.71	482.35
3	330.90	476.60
4	339.28	471.15
5	347.86	466.00
6	356.60	461.16
7	365.52	456.62
8	374.59	452.41
9	383.80	448.52
10	393.14	444.96
11	402.61	441.73
12	412.18	438.84
13	421.85	436.29
14	431.61	434.08
15	441.43	432.22
16	451.32	430.71
17	461.25	429.55
18	471.22	428.74
19	481.21	428.29
20	491.20	428.19
21	501.20	428.44
22	511.18	429.05
23	521.14	430.01
24	531.05	431.32
25	540.91	432.98
26	550.71	434.99
27	560.43	437.34
28	570.06	440.04
29	579.58	443.08
30	589.00	446.45
31	598.29	450.15
32	607.44	454.18
33	616.44	458.53
34	625.29	463.20
35	633.96	468.17
36	642.46	473.45
37	650.76	479.03
38	658.85	484.90
39	666.74	491.05
40	674.40	497.47
41	681.83	504.17
42	689.02	511.12
43	695.96	518.32
44	702.63	525.76
45	709.05	533.44
46	715.18	541.34
47	721.03	549.44
48	726.59	557.75
49	731.86	566.26
50	736.82	574.94
51	741.47	583.79
52	741.85	584.58

Circle Center At X = 489.1 ; Y = 710.7 and Radius, 282.5

*** 2.308 ***

Failure Surface Specified By 53 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	314.74	488.38
2	323.21	483.07
3	331.84	478.02
4	340.62	473.23
5	349.54	468.71
6	358.60	464.47
7	367.78	460.50
8	377.08	456.82
9	386.48	453.42
10	395.98	450.30
11	405.57	447.48

12	415.25	444.95
13	425.00	442.71
14	434.81	440.77
15	444.67	439.13
16	454.58	437.79
17	464.53	436.75
18	474.50	436.01
19	484.49	435.58
20	494.49	435.45
21	504.49	435.63
22	514.48	436.11
23	524.44	436.89
24	534.39	437.97
25	544.29	439.36
26	554.15	441.04
27	563.95	443.03
28	573.68	445.31
29	583.35	447.89
30	592.93	450.75
31	602.41	453.91
32	611.80	457.36
33	621.08	461.08
34	630.24	465.09
35	639.28	469.38
36	648.18	473.94
37	656.94	478.76
38	665.55	483.85
39	673.99	489.20
40	682.28	494.80
41	690.39	500.66
42	698.31	506.75
43	706.05	513.08
44	713.59	519.65
45	720.93	526.44
46	728.06	533.45
47	734.98	540.68
48	741.67	548.11
49	748.13	555.74
50	754.36	563.57
51	760.34	571.58
52	766.09	579.77
53	767.55	582.00

Circle Center At X = 493.7 ; Y = 764.6 and Radius, 329.2

*** 2.309 ***

Failure Surface Specified By 51 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	314.74	488.38
2	322.78	482.44
3	331.03	476.79
4	339.48	471.43
5	348.11	466.39
6	356.92	461.65
7	365.89	457.22
8	375.01	453.12
9	384.27	449.34
10	393.65	445.90
11	403.16	442.79
12	412.77	440.02
13	422.47	437.59
14	432.25	435.51
15	442.10	433.78
16	452.00	432.40
17	461.95	431.37
18	471.93	430.70
19	481.92	430.38
20	491.92	430.42

21	501.91	430.81
22	511.89	431.55
23	521.83	432.65
24	531.72	434.11
25	541.56	435.91
26	551.32	438.06
27	561.01	440.56
28	570.59	443.39
29	580.08	446.57
30	589.44	450.08
31	598.67	453.93
32	607.76	458.09
33	616.70	462.58
34	625.47	467.39
35	634.06	472.50
36	642.47	477.91
37	650.68	483.62
38	658.68	489.62
39	666.47	495.89
40	674.02	502.44
41	681.34	509.26
42	688.42	516.33
43	695.23	523.64
44	701.79	531.20
45	708.07	538.98
46	714.07	546.98
47	719.78	555.19
48	725.19	563.59
49	730.31	572.19
50	735.12	580.96
51	737.64	585.98

Circle Center At X = 485.9 ; Y = 711.8 and Radius, 281.5

*** 2.311 ***

Failure Surface Specified By 52 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	310.00	486.82
2	317.79	480.54
3	325.80	474.56
4	334.02	468.88
5	342.46	463.50
6	351.08	458.44
7	359.89	453.71
8	368.87	449.30
9	378.00	445.23
10	387.28	441.49
11	396.69	438.11
12	406.22	435.07
13	415.85	432.39
14	425.58	430.07
15	435.38	428.11
16	445.26	426.52
17	455.18	425.29
18	465.14	424.43
19	475.13	423.94
20	485.13	423.82
21	495.13	424.07
22	505.11	424.68
23	515.06	425.67
24	524.97	427.03
25	534.82	428.75
26	544.60	430.83
27	554.29	433.28
28	563.89	436.08
29	573.38	439.24
30	582.75	442.74
31	591.98	446.59

32	601.06	450.78
33	609.98	455.30
34	618.72	460.15
35	627.28	465.32
36	635.65	470.80
37	643.80	476.59
38	651.74	482.67
39	659.44	489.05
40	666.90	495.71
41	674.11	502.63
42	681.06	509.82
43	687.74	517.27
44	694.14	524.95
45	700.25	532.87
46	706.07	541.00
47	711.57	549.35
48	716.77	557.90
49	721.64	566.63
50	726.19	575.53
51	730.41	584.60
52	731.81	587.93

Circle Center At X = 483.4 ; Y = 693.9 and Radius, 270.1

*** 2.313 ***

Failure Surface Specified By 51 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	310.00	486.82
2	317.73	480.48
3	325.70	474.43
4	333.88	468.69
5	342.28	463.26
6	350.88	458.16
7	359.67	453.38
8	368.62	448.93
9	377.74	444.83
10	387.01	441.08
11	396.42	437.67
12	405.94	434.63
13	415.57	431.95
14	425.30	429.63
15	435.11	427.68
16	444.99	426.11
17	454.91	424.90
18	464.88	424.08
19	474.87	423.63
20	484.87	423.55
21	494.86	423.86
22	504.84	424.54
23	514.78	425.60
24	524.68	427.03
25	534.52	428.84
26	544.28	431.02
27	553.95	433.56
28	563.52	436.47
29	572.97	439.73
30	582.29	443.35
31	591.47	447.32
32	600.49	451.64
33	609.34	456.29
34	618.01	461.27
35	626.49	466.57
36	634.76	472.20
37	642.81	478.13
38	650.63	484.36
39	658.21	490.88
40	665.54	497.68
41	672.61	504.76

42	679.41	512.09
43	685.92	519.68
44	692.14	527.51
45	698.06	535.57
46	703.68	543.84
47	708.98	552.32
48	713.95	561.00
49	718.59	569.86
50	722.90	578.88
51	726.83	588.00

Circle Center At X = 481.8 ; Y = 688.3 and Radius, 264.8

*** 2.327 ***

Failure Surface Specified By 51 Coordinate Points

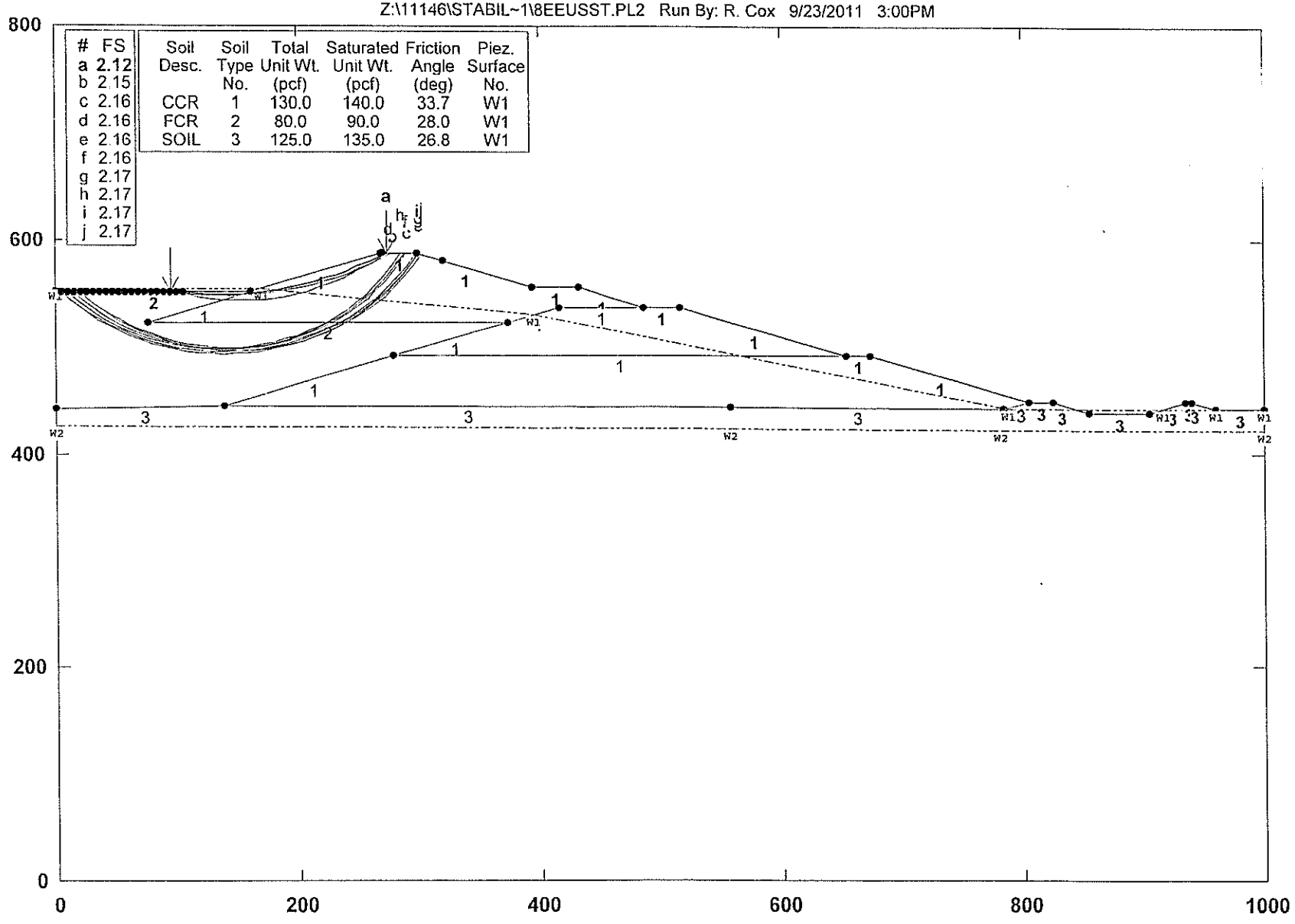
Point No.	X-Surf (ft)	Y-Surf (ft)
1	314.74	488.38
2	322.59	482.19
3	330.67	476.29
4	338.96	470.70
5	347.46	465.42
6	356.14	460.46
7	365.00	455.83
8	374.03	451.52
9	383.21	447.56
10	392.53	443.93
11	401.97	440.66
12	411.54	437.74
13	421.20	435.17
14	430.96	432.96
15	440.78	431.12
16	450.67	429.64
17	460.61	428.53
18	470.58	427.79
19	480.58	427.42
20	490.58	427.42
21	500.57	427.78
22	510.54	428.52
23	520.48	429.63
24	530.37	431.11
25	540.20	432.95
26	549.96	435.16
27	559.62	437.72
28	569.18	440.64
29	578.63	443.92
30	587.95	447.54
31	597.13	451.50
32	606.16	455.81
33	615.02	460.44
34	623.71	465.40
35	632.20	470.68
36	640.49	476.27
37	648.57	482.16
38	656.43	488.35
39	664.05	494.82
40	671.43	501.57
41	678.55	508.59
42	685.40	515.87
43	691.98	523.40
44	698.28	531.17
45	704.29	539.17
46	709.99	547.38
47	715.39	555.80
48	720.47	564.41
49	725.23	573.21
50	729.65	582.17
51	732.18	587.80

Circle Center At X = 485.6 ; Y = 697.1 and Radius, 269.8

*** 2.330 ***

Phase 8 - Section E-E Upstream Static Whole Slope Circle

Z:\11146\STABIL~1\8EEUSST.PL2 Run By: R. Cox 9/23/2011 3:00PM



#	FS
a	2.12
b	2.15
c	2.16
d	2.16
e	2.16
f	2.16
g	2.17
h	2.17
i	2.17
j	2.17

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
SOIL	3	125.0	135.0	26.8	W1

PCSTABL5M/si FSmin=2.12

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/23/2011
Time of Run: 3:00PM
Run By: R. Cox
Input Data Filename: Z:8eeusst.
Output Filename: Z:8eeusst.OUT
Unit: ENGLISH
Plotted Output Filename: Z:8eeusst.PLT
PROBLEM DESCRIPTION Phase 8 - Section E-E
Upstream Static Whole Slope Circle

BOUNDARY COORDINATES
17 Top Boundaries
28 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	552.10	161.01	552.10	2
2	161.01	552.10	268.41	588.00	1
3	268.41	588.00	298.41	588.00	1
4	298.41	588.00	394.05	556.00	1
5	394.05	556.00	432.22	556.00	1
6	432.22	556.00	486.22	538.00	1
7	486.22	538.00	516.22	538.00	1
8	516.22	538.00	654.22	492.00	1
9	654.22	492.00	674.22	492.00	1
10	674.22	492.00	805.22	449.00	1
11	805.22	449.00	825.22	449.00	3
12	825.22	449.00	855.22	439.00	3
13	855.22	439.00	904.62	439.00	3
14	904.62	439.00	934.62	449.00	3
15	934.62	449.00	939.62	449.00	3
16	939.62	449.00	960.62	442.00	3
17	960.62	442.00	1000.00	442.21	3
18	76.41	524.00	161.01	552.10	1
19	416.22	538.00	486.22	538.00	1
20	374.22	524.00	416.22	538.00	1
21	76.41	524.00	374.22	524.00	2
22	278.22	492.00	374.22	524.00	1
23	278.22	492.00	654.22	492.00	1
24	138.19	445.32	278.22	492.00	1
25	784.22	442.00	805.22	449.00	3
26	.00	442.75	138.19	445.32	3
27	138.19	445.32	557.27	444.00	3
28	557.27	444.00	784.22	442.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 7 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	555.38
2	170.55	555.38
3	394.62	530.80
4	787.22	443.00
5	916.62	443.00
6	960.62	442.00

7 1000.00 442.00
Piezometric Surface No. 2 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	425.76
2	557.27	424.00
3	781.61	422.00
4	1000.00	422.21

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced Along The Ground Surface Between X = 5.00 ft.
and X = 105.00 ft.
Each Surface Terminates Between X = 270.00 ft.
and X = 320.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =422.50 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	94.47	552.10
2	104.40	550.90
3	114.37	550.05
4	124.35	549.57
5	134.35	549.44
6	144.35	549.68
7	154.33	550.27
8	164.29	551.23
9	174.20	552.55
10	184.06	554.22
11	193.85	556.24
12	203.56	558.62
13	213.19	561.35
14	222.70	564.42
15	232.10	567.84
16	241.37	571.59
17	250.50	575.67
18	259.48	580.08
19	268.29	584.81
20	273.75	588.00

Circle Center At X = 132.8 ; Y = 826.2 and Radius, 276.8
*** 2.124 ***
Individual data on the 24 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.9	537.8	2031.9	2422.4	.0	.0	.0	.0	.0
2	10.0	1458.6	2039.4	3061.7	.0	.0	.0	.0	.0
3	10.0	2060.0	2044.3	3476.7	.0	.0	.0	.0	.0
4	10.0	2336.6	2046.6	3666.9	.0	.0	.0	.0	.0
5	10.0	2285.8	2046.2	3632.0	.0	.0	.0	.0	.0
6	10.0	1908.1	2043.1	3372.1	.0	.0	.0	.0	.0
7	1.7	261.2	340.2	523.7	.0	.0	.0	.0	.0
8	5.0	791.6	1026.5	1479.2	.0	.0	.0	.0	.0
9	3.3	722.1	589.1	884.6	.0	.0	.0	.0	.0
10	6.3	2276.1	468.9	1472.0	.0	.0	.0	.0	.0
11	3.6	1810.1	.0	656.8	.0	.0	.0	.0	.0
12	8.7	5408.6	.0	667.2	.0	.0	.0	.0	.0
13	1.1	816.9	.0	.0	.0	.0	.0	.0	.0
14	9.8	7906.0	.0	.0	.0	.0	.0	.0	.0

15	9.7	9177.6	.0	.0	.0	.0	.0	.0	.0
16	9.6	9939.3	.0	.0	.0	.0	.0	.0	.0
17	9.5	10200.9	.0	.0	.0	.0	.0	.0	.0
18	9.4	9975.7	.0	.0	.0	.0	.0	.0	.0
19	9.3	9282.1	.0	.0	.0	.0	.0	.0	.0
20	9.1	8142.1	.0	.0	.0	.0	.0	.0	.0
21	9.0	6582.0	.0	.0	.0	.0	.0	.0	.0
22	8.8	4632.1	.0	.0	.0	.0	.0	.0	.0
23	.1	50.4	.0	.0	.0	.0	.0	.0	.0
24	5.3	1083.5	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.00	552.10
2	114.92	550.80
3	124.87	549.90
4	134.86	549.38
5	144.86	549.25
6	154.86	549.51
7	164.84	550.16
8	174.78	551.20
9	184.68	552.62
10	194.51	554.43
11	204.27	556.62
12	213.93	559.20
13	223.49	562.14
14	232.92	565.46
15	242.22	569.14
16	251.37	573.18
17	260.35	577.58
18	269.16	582.32
19	277.77	587.40
20	278.69	588.00

Circle Center At X = 143.2 ; Y = 805.5 and Radius, 256.2

*** 2.149 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.53	552.10
2	22.62	545.05
3	30.12	538.43
4	37.99	532.26
5	46.20	526.56
6	54.74	521.35
7	63.56	516.64
8	72.64	512.46
9	81.96	508.82
10	91.47	505.72
11	101.14	503.19
12	110.94	501.22
13	120.85	499.83
14	130.81	499.02
15	140.81	498.79
16	150.80	499.15
17	160.76	500.09
18	170.64	501.60
19	180.42	503.70
20	190.06	506.36
21	199.53	509.57
22	208.80	513.34
23	217.82	517.64
24	226.59	522.45
25	235.05	527.78
26	243.19	533.58
27	250.98	539.85
28	258.39	546.57
29	265.40	553.71

30	271.98	561.24
31	278.10	569.14
32	283.76	577.39
33	288.92	585.95
34	289.99	588.00

Circle Center At X = 139.7 ; Y = 670.0 and Radius, 171.2

*** 2.159 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	99.74	552.10
2	109.42	549.59
3	119.21	547.59
4	129.10	546.09
5	139.05	545.12
6	149.04	544.66
7	159.04	544.72
8	169.03	545.30
9	178.97	546.40
10	188.84	548.01
11	198.61	550.13
12	208.26	552.75
13	217.76	555.88
14	227.08	559.49
15	236.21	563.58
16	245.11	568.14
17	253.76	573.16
18	262.14	578.61
19	270.22	584.50
20	274.54	588.00

Circle Center At X = 152.9 ; Y = 736.9 and Radius, 192.3

*** 2.159 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	5.00	552.10
2	12.07	545.03
3	19.51	538.35
4	27.31	532.08
5	35.43	526.25
6	43.85	520.86
7	52.55	515.93
8	61.51	511.48
9	70.69	507.52
10	80.07	504.06
11	89.63	501.11
12	99.33	498.68
13	109.15	496.78
14	119.05	495.42
15	129.02	494.59
16	139.01	494.30
17	149.01	494.55
18	158.98	495.34
19	168.89	496.66
20	178.72	498.52
21	188.43	500.91
22	197.99	503.82
23	207.39	507.24
24	216.59	511.16
25	225.56	515.58
26	234.28	520.47
27	242.73	525.82
28	250.87	531.63
29	258.69	537.86
30	266.16	544.51
31	273.26	551.55
32	279.97	558.97

33	286.27	566.74
34	292.14	574.83
35	297.56	583.23
36	299.99	587.47

Circle Center At X = 139.4 ; Y = 679.3 and Radius, 185.0

*** 2.160 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.26	552.10
2	17.39	545.09
3	24.91	538.49
4	32.80	532.34
5	41.02	526.65
6	49.56	521.45
7	58.38	516.74
8	67.46	512.54
9	76.76	508.88
10	86.26	505.75
11	95.92	503.17
12	105.71	501.15
13	115.61	499.69
14	125.57	498.81
15	135.56	498.50
16	145.56	498.76
17	155.52	499.59
18	165.43	501.00
19	175.23	502.97
20	184.90	505.50
21	194.42	508.57
22	203.74	512.20
23	212.84	516.34
24	221.68	521.01
25	230.25	526.17
26	238.50	531.82
27	246.42	537.93
28	253.97	544.48
29	261.13	551.46
30	267.89	558.83
31	274.21	566.59
32	280.07	574.69
33	285.46	583.11
34	288.20	588.00

Circle Center At X = 136.0 ; Y = 672.7 and Radius, 174.2

*** 2.164 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	5.00	552.10
2	12.25	545.21
3	19.85	538.71
4	27.79	532.63
5	36.03	526.97
6	44.57	521.76
7	53.36	517.00
8	62.40	512.72
9	71.65	508.92
10	81.09	505.61
11	90.69	502.81
12	100.42	500.52
13	110.26	498.75
14	120.18	497.50
15	130.16	496.78
16	140.16	496.58
17	150.15	496.92
18	160.11	497.78
19	170.02	499.17

20	179.83	501.08
21	189.53	503.50
22	199.09	506.44
23	208.48	509.88
24	217.68	513.81
25	226.66	518.21
26	235.38	523.09
27	243.84	528.42
28	252.01	534.20
29	259.86	540.39
30	267.37	546.99
31	274.52	553.99
32	281.29	561.34
33	287.67	569.05
34	293.62	577.08
35	299.15	585.42
36	300.29	587.37

Circle Center At X = 138.8 ; Y = 685.6 and Radius, 189.0

*** 2.166 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.53	552.10
2	22.63	545.06
3	30.14	538.45
4	38.02	532.30
5	46.26	526.64
6	54.82	521.47
7	63.67	516.82
8	72.79	512.70
9	82.13	509.13
10	91.67	506.12
11	101.36	503.69
12	111.19	501.84
13	121.11	500.57
14	131.09	499.90
15	141.09	499.82
16	151.07	500.33
17	161.01	501.44
18	170.87	503.13
19	180.61	505.41
20	190.19	508.27
21	199.59	511.68
22	208.77	515.65
23	217.69	520.16
24	226.33	525.19
25	234.66	530.73
26	242.64	536.75
27	250.26	543.24
28	257.47	550.16
29	264.26	557.51
30	270.60	565.24
31	276.47	573.34
32	281.85	581.77
33	285.32	588.00

Circle Center At X = 137.4 ; Y = 668.0 and Radius, 168.2

*** 2.166 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	20.79	552.10
2	28.01	545.19
3	35.62	538.69
4	43.58	532.65
5	51.88	527.06
6	60.48	521.95
7	69.35	517.35

8	78.48	513.25
9	87.82	509.68
10	97.35	506.65
11	107.03	504.16
12	116.84	502.23
13	126.75	500.86
14	136.72	500.06
15	146.71	499.83
16	156.71	500.16
17	166.67	501.06
18	176.56	502.53
19	186.35	504.55
20	196.01	507.14
21	205.51	510.26
22	214.82	513.92
23	223.90	518.11
24	232.73	522.80
25	241.28	527.99
26	249.52	533.66
27	257.42	539.79
28	264.96	546.35
29	272.12	553.34
30	278.87	560.72
31	285.18	568.47
32	291.05	576.57
33	296.44	584.99
34	298.14	588.00

Circle Center At X = 145.8 ; Y = 675.5 and Radius, 175.6

*** 2.166 ***

Failure Surface Specified By 34 Coordinate Points

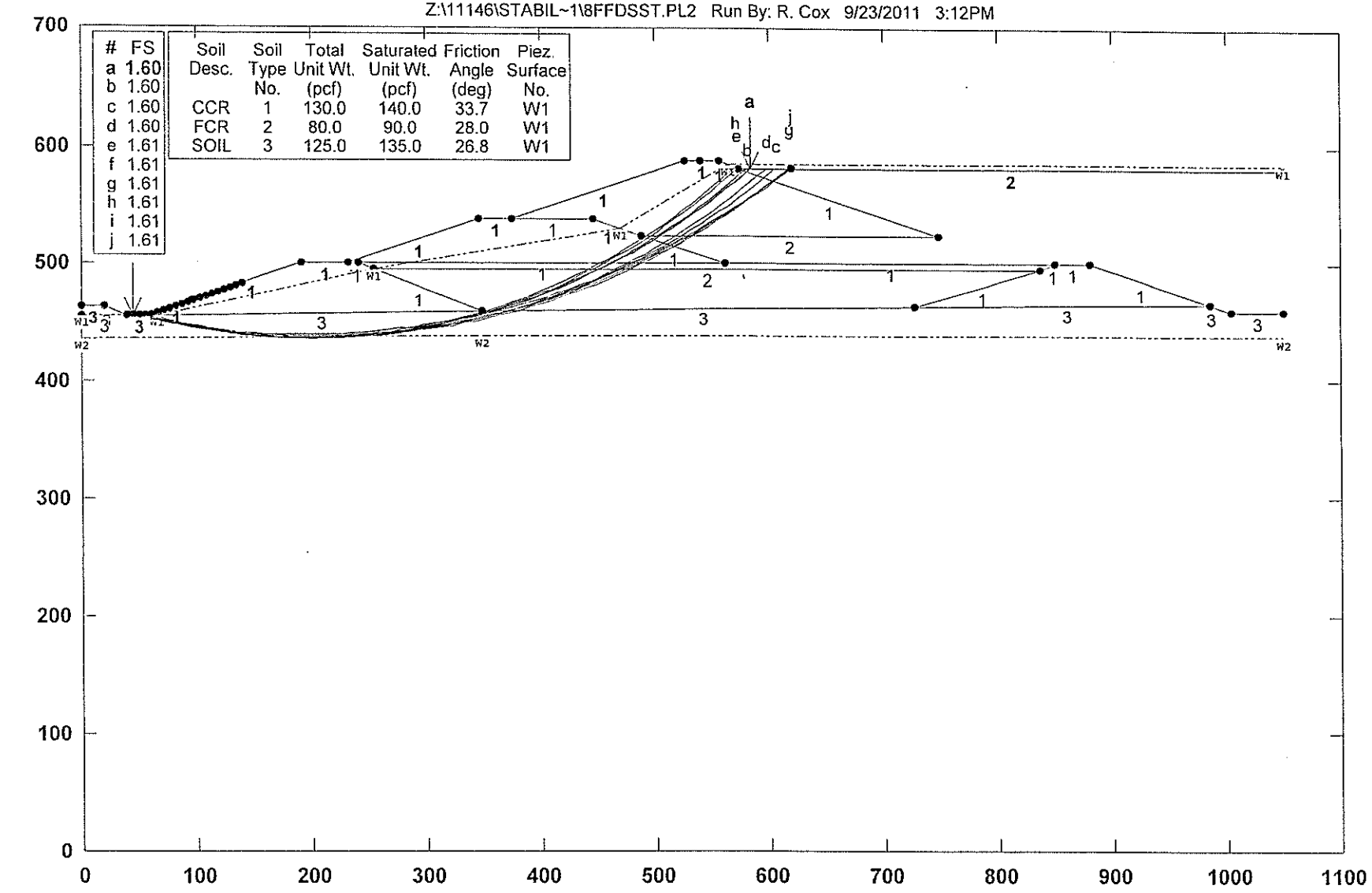
Point No.	X-Surf (ft)	Y-Surf (ft)
1	20.79	552.10
2	27.87	545.03
3	35.33	538.38
4	43.17	532.17
5	51.34	526.41
6	59.83	521.12
7	68.60	516.32
8	77.64	512.03
9	86.90	508.26
10	96.36	505.02
11	105.99	502.33
12	115.76	500.18
13	125.63	498.60
14	135.58	497.58
15	145.57	497.12
16	155.57	497.24
17	165.54	497.92
18	175.47	499.17
19	185.30	500.98
20	195.02	503.35
21	204.58	506.26
22	213.97	509.71
23	223.14	513.69
24	232.07	518.19
25	240.74	523.19
26	249.10	528.67
27	257.14	534.61
28	264.83	541.01
29	272.14	547.83
30	279.05	555.05
31	285.55	562.66
32	291.60	570.62
33	297.18	578.92
34	301.89	586.84

Circle Center At X = 148.5 ; Y = 673.0 and Radius, 175.9

*** 2.168 ***

Phase 8 - Section F-F Downstream Static Whole Slope Circle

Z:\11146\STABIL~1\8FFDSST.PL2 Run By: R. Cox 9/23/2011 3:12PM



PCSTABL5M/si FSmin=1.60

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/23/2011
Time of Run: 3:12PM
Run By: R. Cox
Input Data Filename: Z:8ffdsst.
Output Filename: Z:8ffdsst.OUT
Unit: ENGLISH
Plotted Output Filename: Z:8ffdsst.PLT
PROBLEM DESCRIPTION Phase 8 - Section F-F
Downstream Static Whole Slope Circle

BOUNDARY COORDINATES
12 Top Boundaries
33 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	462.92	19.25	462.92	3
2	19.25	462.92	40.00	456.00	3
3	40.00	456.00	60.00	456.00	3
4	60.00	456.00	96.00	468.00	1
5	96.00	468.00	192.00	500.00	1
6	192.00	500.00	232.00	500.00	1
7	232.00	500.00	346.00	538.00	1
8	346.00	538.00	376.00	538.00	1
9	376.00	538.00	526.00	588.00	1
10	526.00	588.00	556.00	588.00	1
11	556.00	588.00	574.00	582.00	1
12	574.00	582.00	1050.00	582.00	2
13	574.00	582.00	748.00	524.00	1
14	376.00	538.00	446.00	538.00	1
15	446.00	538.00	488.00	524.00	1
16	488.00	524.00	748.00	524.00	2
17	488.00	524.00	562.08	500.00	1
18	232.00	500.00	242.00	500.00	1
19	242.00	500.00	562.08	500.00	1
20	562.08	500.00	850.79	500.00	1
21	850.79	500.00	881.34	500.00	1
22	242.00	500.00	255.05	495.00	1
23	837.55	495.00	850.79	500.00	1
24	881.34	500.00	986.02	465.73	1
25	255.05	495.00	837.55	495.00	2
26	255.05	495.00	349.00	459.00	1
27	726.56	463.27	837.55	495.00	1
28	60.00	456.00	349.00	459.00	3
29	349.00	459.00	726.56	463.27	3
30	726.56	463.27	986.02	465.73	3
31	986.02	465.73	1003.52	460.00	3
32	1003.52	460.00	1050.00	460.00	3
33	.00	456.00	40.00	456.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 6 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	456.00

2	65.00	456.00
3	255.05	495.00
4	470.00	530.00
5	565.00	585.00
6	1050.00	585.00

Piezometric Surface No. 2 Specified by 3 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	435.38
2	349.00	439.00
3	1050.00	439.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced Along The Ground Surface Between X = 40.00 ft.
and X = 140.00 ft.
Each Surface Terminates Between X = 540.00 ft.
and X = 620.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =436.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 59 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	45.26	456.00
2	54.95	453.52
3	64.68	451.20
4	74.44	449.04
5	84.24	447.06
6	94.08	445.24
7	103.94	443.58
8	113.83	442.10
9	123.74	440.78
10	133.67	439.63
11	143.63	438.65
12	153.59	437.84
13	163.57	437.20
14	173.56	436.73
15	183.56	436.42
16	193.56	436.29
17	203.56	436.33
18	213.55	436.53
19	223.55	436.91
20	233.53	437.46
21	243.51	438.17
22	253.47	439.06
23	263.41	440.11
24	273.34	441.33
25	283.24	442.72
26	293.12	444.28
27	302.97	446.01
28	312.79	447.90
29	322.57	449.96
30	332.32	452.18
31	342.03	454.57
32	351.70	457.13
33	361.32	459.85
34	370.90	462.73
35	380.43	465.77
36	389.90	468.97
37	399.31	472.34
38	408.67	475.86

39	417.97	479.55
40	427.20	483.39
41	436.37	487.38
42	445.47	491.53
43	454.49	495.84
44	463.45	500.30
45	472.32	504.91
46	481.11	509.67
47	489.83	514.57
48	498.46	519.63
49	507.00	524.83
50	515.45	530.17
51	523.81	535.66
52	532.07	541.29
53	540.24	547.06
54	548.31	552.96
55	556.28	559.01
56	564.15	565.18
57	571.90	571.49
58	579.55	577.93
59	584.23	582.00

Circle Center At X = 196.4 ; Y = 1025.4 and Radius, 589.1

*** 1.598 ***

Individual data on the 85 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.7	1623.8	.0	774.8	.0	.0	.0	.0	.0
2	5.0	2103.2	.0	999.4	.0	.0	.0	.0	.0
3	4.7	3154.0	.0	1273.7	.0	.0	.0	.0	.0
4	.3	277.8	.0	99.6	.0	.0	.0	.0	.0
5	.3	235.3	.0	82.2	.0	.0	.0	.0	.0
6	9.2	11356.1	.0	3987.2	.0	.0	.0	.0	.0
7	9.8	18988.9	.0	6659.4	.0	.0	.0	.0	.0
8	9.8	25946.7	.0	9054.9	.0	.0	.0	.0	.0
9	1.9	5864.5	.0	2037.3	.0	.0	.0	.0	.0
10	7.9	26867.8	.0	9315.1	.0	.0	.0	.0	.0
11	9.9	39336.1	.0	13550.9	.0	.0	.0	.0	.0
12	9.9	45748.8	.0	15650.0	.0	.0	.0	.0	.0
13	9.9	51961.4	.0	17648.9	.0	.0	.0	.0	.0
14	10.0	57965.8	.0	19547.3	.0	.0	.0	.0	.0
15	10.0	63753.7	.0	21344.5	.0	.0	.0	.0	.0
16	10.0	69317.7	.0	23039.9	.0	.0	.0	.0	.0
17	2.1	15413.5	.0	5099.4	.0	.0	.0	.0	.0
18	7.9	59237.0	.0	19533.7	.0	.0	.0	.0	.0
19	10.0	79745.3	.0	26123.7	.0	.0	.0	.0	.0
20	8.4	71117.9	.0	23140.9	.0	.0	.0	.0	.0
21	1.6	13425.6	.0	4370.3	.0	.0	.0	.0	.0
22	10.0	86355.6	.0	28795.2	.0	.0	.0	.0	.0
23	10.0	86369.5	.0	29975.3	.0	.0	.0	.0	.0
24	10.0	86130.0	.0	31051.3	.0	.0	.0	.0	.0
25	8.5	72530.4	.0	27048.7	.0	.0	.0	.0	.0
26	1.5	13157.9	.0	4974.0	.0	.0	.0	.0	.0
27	5.6	49190.0	.0	18508.2	.0	.0	.0	.0	.0
28	2.8	25044.0	.0	9360.6	.0	.0	.0	.0	.0
29	1.5	13476.8	.0	5020.4	.0	.0	.0	.0	.0
30	10.0	91014.3	.0	33650.8	.0	.0	.0	.0	.0
31	1.6	14760.8	.0	5418.9	.0	.0	.0	.0	.0
32	8.4	78636.7	.0	29011.3	.0	.0	.0	.0	.0
33	9.9	94261.2	.0	34769.5	.0	.0	.0	.0	.0
34	9.9	94831.9	.0	34959.2	.0	.0	.0	.0	.0
35	2.5	24205.0	.0	8927.6	.0	.0	.0	.0	.0
36	7.4	70936.8	.0	26115.5	.0	.0	.0	.0	.0
37	9.8	95192.0	.0	35021.0	.0	.0	.0	.0	.0
38	9.8	94983.7	.0	34893.0	.0	.0	.0	.0	.0
39	9.8	94519.5	.0	34659.1	.0	.0	.0	.0	.0

40	9.7	93802.1	.0	34319.4	.0	.0	.0	.0	.0
41	9.7	92834.1	.0	33873.9	.0	.0	.0	.0	.0
42	4.0	37713.2	.0	13749.0	.0	.0	.0	.0	.0
43	3.0	28215.2	.0	10327.7	.0	.0	.0	.0	.0
44	2.7	25058.8	.0	9246.3	.0	.0	.0	.0	.0
45	7.0	63943.9	.0	23900.2	.0	.0	.0	.0	.0
46	2.6	23300.9	.0	8766.2	.0	.0	.0	.0	.0
47	9.6	84253.1	.0	31904.7	.0	.0	.0	.0	.0
48	5.1	43901.0	.0	16733.0	.0	.0	.0	.0	.0
49	4.4	37944.1	.0	14305.0	.0	.0	.0	.0	.0
50	9.5	82213.2	.0	30066.4	.0	.0	.0	.0	.0
51	9.4	82945.9	.0	28990.2	.0	.0	.0	.0	.0
52	9.4	83481.9	.0	27810.0	.0	.0	.0	.0	.0
53	9.3	83822.4	.0	26525.9	.0	.0	.0	.0	.0
54	9.2	83970.1	.0	25138.4	.0	.0	.0	.0	.0
55	9.2	83927.3	.0	23647.7	.0	.0	.0	.0	.0
56	9.1	83697.2	.0	22054.4	.0	.0	.0	.0	.0
57	.5	4904.8	.0	1248.6	.0	.0	.0	.0	.0
58	6.7	62123.4	.0	15277.1	.0	.0	.0	.0	.0
59	1.8	16217.6	.0	3833.2	.0	.0	.0	.0	.0
60	8.4	75953.4	.0	17381.4	.0	.0	.0	.0	.0
61	.6	5361.1	.0	1180.3	.0	.0	.0	.0	.0
62	6.6	58223.0	.0	12495.8	.0	.0	.0	.0	.0
63	2.3	20262.1	.0	3761.0	.0	.0	.0	.0	.0
64	8.8	75548.0	.0	14516.7	.0	.0	.0	.0	.0
65	6.9	57630.6	.0	11566.6	.0	.0	.0	.0	.0
66	1.8	15034.2	.0	3078.2	.0	.0	.0	.0	.0
67	8.6	68785.1	.0	14665.9	.0	.0	.0	.0	.0
68	1.1	8163.3	.0	1809.6	.0	.0	.0	.0	.0
69	6.1	47089.9	.0	10457.7	.0	.0	.0	.0	.0
70	1.4	10401.0	.0	2312.7	.0	.0	.0	.0	.0
71	8.5	63009.3	.0	14387.0	.0	.0	.0	.0	.0
72	8.4	59442.8	.0	14087.1	.0	.0	.0	.0	.0
73	2.2	15077.5	.0	3671.1	.0	.0	.0	.0	.0
74	6.1	39846.2	.0	10009.2	.0	.0	.0	.0	.0
75	8.2	48265.0	.0	13166.8	.0	.0	.0	.0	.0
76	8.1	41475.9	.0	12546.6	.0	.0	.0	.0	.0
77	7.7	33558.3	.0	11416.3	.0	.0	.0	.0	.0
78	.3	1113.6	.0	403.8	.0	.0	.0	.0	.0
79	7.9	26435.4	.0	10987.4	.0	.0	.0	.0	.0
80	.9	2321.7	.0	1155.0	.0	.0	.0	.0	.0
81	6.9	14659.0	522.6	9060.3	.0	.0	.0	.0	.0
82	2.1	2927.0	365.4	2158.4	.0	.0	.0	.0	.0
83	5.6	4725.3	1039.8	4262.0	.0	.0	.0	.0	.0
84	1.8	643.4	344.6	954.9	.0	.0	.0	.0	.0
85	2.8	313.9	529.7	991.2	.0	.0	.0	.0	.0

Failure Surface Specified By 59 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	45.26	456.00
2	54.95	453.50
3	64.67	451.16
4	74.43	448.99
5	84.23	446.99
6	94.06	445.16
7	103.92	443.49
8	113.81	442.00
9	123.72	440.67
10	133.65	439.52
11	143.60	438.54
12	153.57	437.73
13	163.55	437.09
14	173.54	436.62
15	183.53	436.32
16	193.53	436.20
17	203.53	436.24
18	213.53	436.46

19	223.52	436.85
20	233.51	437.41
21	243.48	438.15
22	253.44	439.05
23	263.38	440.13
24	273.30	441.37
25	283.20	442.79
26	293.08	444.37
27	302.92	446.13
28	312.73	448.05
29	322.51	450.15
30	332.25	452.41
31	341.96	454.83
32	351.61	457.43
33	361.22	460.19
34	370.79	463.11
35	380.30	466.20
36	389.76	469.45
37	399.16	472.86
38	408.50	476.44
39	417.77	480.17
40	426.98	484.06
41	436.13	488.11
42	445.20	492.32
43	454.20	496.68
44	463.12	501.20
45	471.96	505.87
46	480.72	510.69
47	489.40	515.66
48	497.99	520.77
49	506.50	526.04
50	514.91	531.45
51	523.22	537.00
52	531.44	542.70
53	539.56	548.53
54	547.58	554.51
55	555.49	560.62
56	563.30	566.87
57	571.00	573.25
58	578.59	579.76
59	581.12	582.00

Circle Center At X = 195.8 ; Y = 1018.2 and Radius, 582.0

*** 1.598 ***

Failure Surface Specified By 61 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.53	456.00
2	60.23	453.59
3	69.97	451.33
4	79.75	449.23
5	89.56	447.28
6	99.40	445.50
7	109.26	443.87
8	119.16	442.40
9	129.07	441.09
10	139.00	439.94
11	148.95	438.95
12	158.92	438.12
13	168.90	437.45
14	178.88	436.94
15	188.88	436.58
16	198.88	436.39
17	208.88	436.36
18	218.88	436.50
19	228.87	436.79
20	238.86	437.24
21	248.84	437.85

22	258.81	438.62
23	268.77	439.56
24	278.71	440.65
25	288.63	441.90
26	298.53	443.31
27	308.41	444.88
28	318.26	446.61
29	328.08	448.49
30	337.87	450.54
31	347.62	452.74
32	357.34	455.09
33	367.02	457.61
34	376.66	460.27
35	386.25	463.09
36	395.80	466.07
37	405.29	469.20
38	414.74	472.48
39	424.13	475.91
40	433.47	479.49
41	442.75	483.22
42	451.97	487.10
43	461.12	491.13
44	470.21	495.30
45	479.23	499.62
46	488.17	504.08
47	497.05	508.69
48	505.85	513.44
49	514.57	518.33
50	523.22	523.36
51	531.78	528.52
52	540.26	533.83
53	548.65	539.27
54	556.95	544.84
55	565.17	550.54
56	573.29	556.38
57	581.31	562.35
58	589.24	568.44
59	597.07	574.66
60	604.80	581.01
61	605.97	582.00

Circle Center At X = 205.7 ; Y = 1059.2 and Radius, 622.9

*** 1.600 ***

Failure Surface Specified By 59 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.79	456.00
2	65.47	453.51
3	75.20	451.17
4	84.96	449.01
5	94.76	447.01
6	104.59	445.17
7	114.45	443.50
8	124.33	442.00
9	134.24	440.66
10	144.18	439.49
11	154.13	438.49
12	164.09	437.66
13	174.07	436.99
14	184.06	436.50
15	194.05	436.17
16	204.05	436.01
17	214.05	436.02
18	224.05	436.20
19	234.04	436.55
20	244.03	437.06
21	254.01	437.75
22	263.97	438.60

23	273.92	439.62
24	283.85	440.81
25	293.75	442.16
26	303.64	443.69
27	313.49	445.37
28	323.32	447.23
29	333.11	449.25
30	342.87	451.44
31	352.59	453.79
32	362.27	456.30
33	371.91	458.98
34	381.49	461.82
35	391.03	464.82
36	400.52	467.98
37	409.95	471.30
38	419.33	474.78
39	428.64	478.42
40	437.90	482.21
41	447.08	486.16
42	456.20	490.26
43	465.25	494.52
44	474.23	498.93
45	483.13	503.49
46	491.95	508.20
47	500.69	513.06
48	509.35	518.06
49	517.92	523.21
50	526.40	528.51
51	534.79	533.94
52	543.09	539.52
53	551.30	545.24
54	559.41	551.09
55	567.41	557.08
56	575.32	563.21
57	583.12	569.46
58	590.81	575.85
59	597.97	582.00

Circle Center At X = 208.5 ; Y = 1028.6 and Radius, 592.6

*** 1.601 ***

Failure Surface Specified By 58 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.53	456.00
2	60.19	453.43
3	69.90	451.03
4	79.65	448.81
5	89.44	446.76
6	99.26	444.90
7	109.12	443.21
8	119.00	441.70
9	128.91	440.36
10	138.85	439.21
11	148.80	438.24
12	158.77	437.44
13	168.75	436.83
14	178.74	436.40
15	188.74	436.15
16	198.74	436.08
17	208.74	436.19
18	218.73	436.48
19	228.72	436.95
20	238.70	437.60
21	248.66	438.43
22	258.61	439.45
23	268.54	440.64
24	278.45	442.01
25	288.33	443.56

26	298.18	445.29
27	307.99	447.20
28	317.77	449.28
29	327.51	451.54
30	337.21	453.97
31	346.87	456.58
32	356.47	459.37
33	366.02	462.33
34	375.52	465.46
35	384.96	468.76
36	394.34	472.23
37	403.65	475.87
38	412.90	479.68
39	422.08	483.65
40	431.18	487.79
41	440.20	492.10
42	449.15	496.56
43	458.02	501.19
44	466.80	505.98
45	475.49	510.92
46	484.09	516.02
47	492.60	521.28
48	501.01	526.69
49	509.32	532.25
50	517.53	537.96
51	525.64	543.81
52	533.63	549.81
53	541.52	555.96
54	549.30	562.25
55	556.96	568.67
56	564.50	575.24
57	571.93	581.94
58	572.52	582.49

Circle Center At X = 197.6 ; Y = 989.2 and Radius, 553.1

*** 1.606 ***

Failure Surface Specified By 62 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	45.26	456.00
2	55.00	453.73
3	64.78	451.61
4	74.58	449.63
5	84.41	447.80
6	94.27	446.12
7	104.15	444.58
8	114.05	443.19
9	123.97	441.95
10	133.91	440.85
11	143.87	439.90
12	153.84	439.10
13	163.81	438.45
14	173.80	437.94
15	183.79	437.59
16	193.79	437.38
17	203.79	437.32
18	213.79	437.41
19	223.79	437.65
20	233.78	438.04
21	243.77	438.57
22	253.74	439.25
23	263.71	440.08
24	273.66	441.06
25	283.60	442.19
26	293.52	443.46
27	303.41	444.89
28	313.29	446.45
29	323.14	448.17

30	332.97	450.03
31	342.76	452.04
32	352.53	454.19
33	362.26	456.48
34	371.96	458.92
35	381.62	461.51
36	391.24	464.24
37	400.82	467.11
38	410.36	470.12
39	419.85	473.27
40	429.29	476.57
41	438.68	480.00
42	448.02	483.57
43	457.31	487.28
44	466.54	491.13
45	475.71	495.12
46	484.82	499.24
47	493.87	503.50
48	502.85	507.89
49	511.77	512.41
50	520.62	517.06
51	529.40	521.85
52	538.11	526.77
53	546.74	531.81
54	555.30	536.98
55	563.78	542.28
56	572.19	547.71
57	580.51	553.25
58	588.74	558.92
59	596.89	564.72
60	604.96	570.63
61	612.93	576.66
62	619.78	582.00

Circle Center At X = 202.8 ; Y = 1110.6 and Radius, 673.3

*** 1.606 ***

Failure Surface Specified By 61 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.79	456.00
2	65.51	453.66
3	75.27	451.46
4	85.06	449.42
5	94.88	447.54
6	104.73	445.80
7	114.60	444.22
8	124.50	442.79
9	134.42	441.52
10	144.35	440.40
11	154.31	439.44
12	164.28	438.63
13	174.25	437.98
14	184.24	437.48
15	194.24	437.13
16	204.23	436.95
17	214.23	436.91
18	224.23	437.04
19	234.23	437.32
20	244.22	437.75
21	254.20	438.34
22	264.17	439.08
23	274.13	439.98
24	284.08	441.04
25	294.00	442.25
26	303.91	443.61
27	313.80	445.13
28	323.65	446.80
29	333.49	448.63

30	343.29	450.60
31	353.06	452.73
32	362.80	455.01
33	372.50	457.44
34	382.16	460.03
35	391.78	462.76
36	401.35	465.64
37	410.88	468.67
38	420.36	471.85
39	429.79	475.18
40	439.17	478.65
41	448.49	482.27
42	457.76	486.03
43	466.97	489.93
44	476.11	493.98
45	485.19	498.17
46	494.20	502.50
47	503.15	506.97
48	512.02	511.58
49	520.82	516.33
50	529.55	521.21
51	538.20	526.23
52	546.77	531.38
53	555.26	536.67
54	563.67	542.08
55	571.99	547.63
56	580.22	553.30
57	588.37	559.11
58	596.42	565.03
59	604.38	571.09
60	612.25	577.26
61	618.09	582.00

Circle Center At X = 211.3 ; Y = 1079.8 and Radius, 642.9

*** 1.609 ***

Failure Surface Specified By 57 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.53	456.00
2	60.20	453.47
3	69.92	451.12
4	79.68	448.95
5	89.48	446.95
6	99.31	445.13
7	109.18	443.48
8	119.07	442.02
9	128.99	440.73
10	138.92	439.62
11	148.88	438.69
12	158.85	437.94
13	168.84	437.38
14	178.83	436.99
15	188.83	436.78
16	198.83	436.75
17	208.83	436.91
18	218.82	437.24
19	228.81	437.76
20	238.78	438.45
21	248.74	439.33
22	258.69	440.38
23	268.61	441.61
24	278.51	443.03
25	288.38	444.62
26	298.23	446.39
27	308.04	448.33
28	317.81	450.46
29	327.54	452.76
30	337.23	455.23

31	346.87	457.88
32	356.47	460.70
33	366.01	463.70
34	375.49	466.87
35	384.92	470.20
36	394.28	473.71
37	403.58	477.39
38	412.81	481.23
39	421.97	485.24
40	431.06	489.41
41	440.07	493.75
42	449.00	498.25
43	457.85	502.91
44	466.61	507.73
45	475.29	512.71
46	483.87	517.84
47	492.36	523.12
48	500.75	528.56
49	509.04	534.15
50	517.23	539.89
51	525.32	545.77
52	533.30	551.80
53	541.16	557.98
54	548.92	564.29
55	556.56	570.74
56	564.08	577.33
57	570.50	583.17

Circle Center At X = 195.3 ; Y = 990.7 and Radius, 553.9

*** 1.610 ***

Failure Surface Specified By 62 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.53	456.00
2	60.28	453.78
3	70.06	451.70
4	79.87	449.77
5	89.71	447.99
6	99.58	446.36
7	109.47	444.87
8	119.38	443.53
9	129.30	442.34
10	139.25	441.30
11	149.21	440.41
12	159.18	439.67
13	169.17	439.07
14	179.16	438.63
15	189.15	438.34
16	199.15	438.19
17	209.15	438.20
18	219.15	438.35
19	229.14	438.66
20	239.13	439.11
21	249.12	439.72
22	259.09	440.47
23	269.05	441.38
24	278.99	442.43
25	288.92	443.63
26	298.83	444.98
27	308.71	446.48
28	318.58	448.12
29	328.42	449.92
30	338.23	451.86
31	348.01	453.94
32	357.75	456.18
33	367.47	458.56
34	377.14	461.08
35	386.78	463.75

36	396.37	466.56
37	405.93	469.52
38	415.44	472.62
39	424.90	475.86
40	434.31	479.24
41	443.66	482.77
42	452.97	486.43
43	462.22	490.23
44	471.41	494.17
45	480.54	498.25
46	489.61	502.46
47	498.61	506.81
48	507.55	511.29
49	516.42	515.91
50	525.22	520.66
51	533.95	525.54
52	542.61	530.55
53	551.19	535.69
54	559.69	540.96
55	568.11	546.35
56	576.44	551.87
57	584.70	557.51
58	592.87	563.28
59	600.95	569.17
60	608.94	575.18
61	616.85	581.31
62	617.71	582.00

Circle Center At X = 203.8 ; Y = 1105.8 and Radius, 667.6

*** 1.611 ***

Failure Surface Specified By 63 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	40.00	456.00
2	49.78	453.90
3	59.58	451.93
4	69.41	450.11
5	79.27	448.42
6	89.15	446.88
7	99.05	445.47
8	108.97	444.21
9	118.91	443.08
10	128.86	442.10
11	138.82	441.26
12	148.80	440.56
13	158.78	440.00
14	168.78	439.58
15	178.77	439.30
16	188.77	439.17
17	198.77	439.17
18	208.77	439.32
19	218.77	439.61
20	228.76	440.04
21	238.74	440.61
22	248.71	441.32
23	258.68	442.18
24	268.63	443.17
25	278.56	444.31
26	288.48	445.59
27	298.38	447.01
28	308.26	448.56
29	318.11	450.26
30	327.94	452.10
31	337.75	454.07
32	347.52	456.19
33	357.26	458.44
34	366.97	460.83
35	376.65	463.35

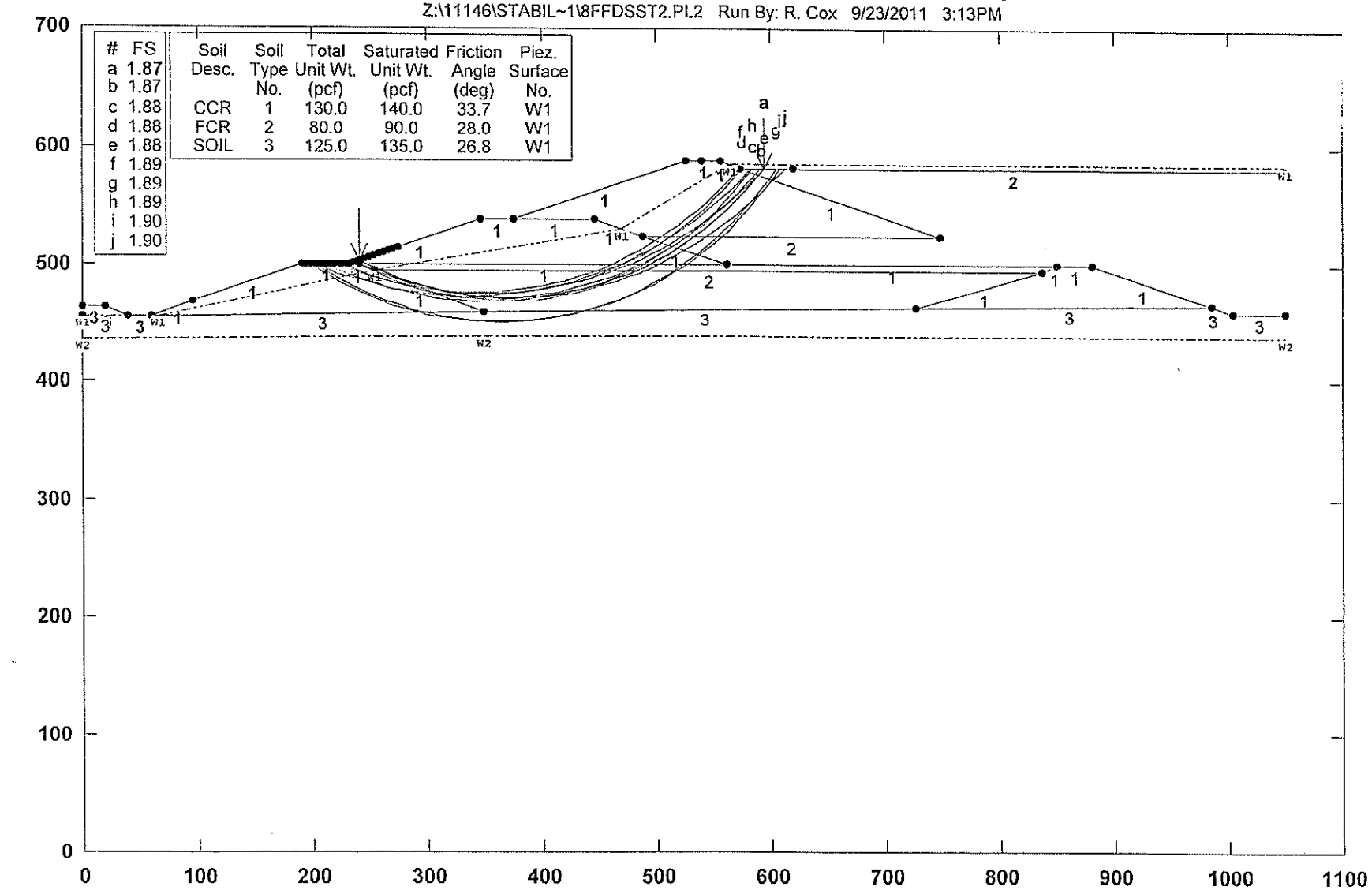
36	386.29	466.02
37	395.89	468.82
38	405.45	471.75
39	414.96	474.82
40	424.44	478.03
41	433.86	481.37
42	443.24	484.84
43	452.57	488.45
44	461.84	492.18
45	471.07	496.05
46	480.23	500.05
47	489.34	504.17
48	498.39	508.43
49	507.38	512.81
50	516.30	517.32
51	525.16	521.96
52	533.96	526.72
53	542.68	531.60
54	551.34	536.61
55	559.92	541.74
56	568.43	546.99
57	576.87	552.36
58	585.23	557.85
59	593.51	563.46
60	601.71	569.19
61	609.82	575.03
62	617.86	580.98
63	619.19	582.00

Circle Center At X = 193.3 ; Y = 1145.4 and Radius, 706.2

*** 1.613 ***

Phase 8 - Section F-F Downstream Static Shallow Slope Circle

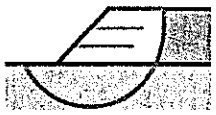
Z:\11146\STABIL~1\8FFDSST2.PL2 Run By: R. Cox 9/23/2011 3:13PM



PCSTABL5M/si FSmin=1.87

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/23/2011
Time of Run: 3:13PM
Run By: R. Cox
Input Data Filename: Z:8FFDSST2.
Output Filename: Z:8FFDSST2.OUT
Unit: ENGLISH
Plotted Output Filename: Z:8FFDSST2.PLT
PROBLEM DESCRIPTION Phase 8 - Section F-F
Downstream Static Shallow Slope Circle

BOUNDARY COORDINATES
12 Top Boundaries
33 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	462.92	19.25	462.92	3
2	19.25	462.92	40.00	456.00	3
3	40.00	456.00	60.00	456.00	3
4	60.00	456.00	96.00	468.00	1
5	96.00	468.00	192.00	500.00	1
6	192.00	500.00	232.00	500.00	1
7	232.00	500.00	346.00	538.00	1
8	346.00	538.00	376.00	538.00	1
9	376.00	538.00	526.00	588.00	1
10	526.00	588.00	556.00	588.00	1
11	556.00	588.00	574.00	582.00	1
12	574.00	582.00	1050.00	582.00	2
13	574.00	582.00	748.00	524.00	1
14	376.00	538.00	446.00	538.00	1
15	446.00	538.00	488.00	524.00	1
16	488.00	524.00	748.00	524.00	2
17	488.00	524.00	562.08	500.00	1
18	232.00	500.00	242.00	500.00	1
19	242.00	500.00	562.08	500.00	1
20	562.08	500.00	850.79	500.00	1
21	850.79	500.00	881.34	500.00	1
22	242.00	500.00	255.05	495.00	1
23	837.55	495.00	850.79	500.00	1
24	881.34	500.00	986.02	465.73	1
25	255.05	495.00	837.55	495.00	2
26	255.05	495.00	349.00	459.00	1
27	726.56	463.27	837.55	495.00	1
28	60.00	456.00	349.00	459.00	3
29	349.00	459.00	726.56	463.27	3
30	726.56	463.27	986.02	465.73	3
31	986.02	465.73	1003.52	460.00	3
32	1003.52	460.00	1050.00	460.00	3
33	.00	456.00	40.00	456.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 6 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	456.00

2	65.00	456.00
3	255.05	495.00
4	470.00	530.00
5	565.00	585.00
6	1050.00	585.00

Piezometric Surface No. 2 Specified by 3 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	435.38
2	349.00	439.00
3	1050.00	439.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced Along The Ground Surface Between X = 195.00 ft.
and X = 275.00 ft.
Each Surface Terminates Between X = 540.00 ft.
and X = 620.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =436.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	241.32	503.11
2	250.28	498.67
3	259.40	494.56
4	268.65	490.78
5	278.04	487.32
6	287.54	484.20
7	297.14	481.42
8	306.84	478.99
9	316.62	476.89
10	326.47	475.15
11	336.37	473.76
12	346.32	472.71
13	356.29	472.03
14	366.29	471.69
15	376.29	471.71
16	386.28	472.09
17	396.25	472.82
18	406.19	473.90
19	416.09	475.33
20	425.93	477.12
21	435.70	479.25
22	445.39	481.73
23	454.98	484.55
24	464.47	487.71
25	473.84	491.20
26	483.08	495.02
27	492.18	499.17
28	501.13	503.64
29	509.91	508.42
30	518.51	513.51
31	526.94	518.91
32	535.16	524.60
33	543.18	530.57
34	550.98	536.83
35	558.55	543.36
36	565.89	550.15
37	572.98	557.21
38	579.82	564.50

39 586.39 572.04
40 592.69 579.80
41 594.35 582.00

Circle Center At X = 370.7 ; Y = 753.6 and Radius, 281.9

*** 1.865 ***

Individual data on the 58 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	6.3	2123.0	.0	.0	.0	.0	.0	.0	.0
2	2.7	2200.4	.0	.0	.0	.0	.0	.0	.0
3	7.3	9674.0	.0	.0	.0	.0	.0	.0	.0
4	.9	1570.0	.0	16.6	.0	.0	.0	.0	.0
5	1.0	1785.3	.0	55.5	.0	.0	.0	.0	.0
6	9.3	20932.7	.0	2334.9	.0	.0	.0	.0	.0
7	9.4	28206.6	.0	5499.2	.0	.0	.0	.0	.0
8	7.7	28248.1	.0	6663.8	.0	.0	.0	.0	.0
9	1.8	7147.4	.0	1806.9	.0	.0	.0	.0	.0
10	9.6	42455.9	.0	11245.7	.0	.0	.0	.0	.0
11	9.7	49345.8	.0	13820.7	.0	.0	.0	.0	.0
12	9.8	56025.1	.0	16192.6	.0	.0	.0	.0	.0
13	9.8	62454.9	.0	18358.4	.0	.0	.0	.0	.0
14	9.9	68598.6	.0	20315.2	.0	.0	.0	.0	.0
15	9.6	71978.1	.0	21335.4	.0	.0	.0	.0	.0
16	.3	2441.9	.0	725.2	.0	.0	.0	.0	.0
17	10.0	77600.5	.0	23592.5	.0	.0	.0	.0	.0
18	10.0	78361.2	.0	24908.8	.0	.0	.0	.0	.0
19	9.7	76451.3	.0	25249.7	.0	.0	.0	.0	.0
20	.3	2256.8	.0	758.3	.0	.0	.0	.0	.0
21	10.0	80921.5	.0	26888.7	.0	.0	.0	.0	.0
22	10.0	84742.3	.0	27549.8	.0	.0	.0	.0	.0
23	9.9	88108.4	.0	27990.4	.0	.0	.0	.0	.0
24	9.9	91004.7	.0	28209.9	.0	.0	.0	.0	.0
25	9.8	93419.5	.0	28208.1	.0	.0	.0	.0	.0
26	9.8	95345.0	.0	27985.1	.0	.0	.0	.0	.0
27	9.7	96775.7	.0	27541.0	.0	.0	.0	.0	.0
28	.6	6182.5	.0	1737.7	.0	.0	.0	.0	.0
29	9.0	91527.8	.0	25138.8	.0	.0	.0	.0	.0
30	9.5	98149.8	.0	25992.3	.0	.0	.0	.0	.0
31	5.5	57771.1	.0	14834.9	.0	.0	.0	.0	.0
32	3.8	40183.1	.0	9086.4	.0	.0	.0	.0	.0
33	9.2	96869.6	.0	22663.8	.0	.0	.0	.0	.0
34	.1	583.9	.0	138.4	.0	.0	.0	.0	.0
35	4.9	51959.6	.0	12641.9	.0	.0	.0	.0	.0
36	4.2	43726.9	.0	10882.3	.0	.0	.0	.0	.0
37	1.7	17201.9	.0	4427.1	.0	.0	.0	.0	.0
38	7.3	74320.9	.0	19596.5	.0	.0	.0	.0	.0
39	8.8	86714.0	.0	24299.8	.0	.0	.0	.0	.0
40	8.6	81498.3	.0	24352.5	.0	.0	.0	.0	.0
41	.6	5747.6	.0	1796.6	.0	.0	.0	.0	.0
42	6.9	63070.4	.0	19711.8	.0	.0	.0	.0	.0
43	.9	8549.7	.0	2673.1	.0	.0	.0	.0	.0
44	7.4	65567.6	.0	21319.0	.0	.0	.0	.0	.0
45	.9	7460.2	.0	2468.2	.0	.0	.0	.0	.0
46	8.0	65945.3	.0	23169.8	.0	.0	.0	.0	.0
47	7.8	57852.2	.0	22330.3	.0	.0	.0	.0	.0
48	5.0	33723.1	.0	14235.9	.0	.0	.0	.0	.0
49	2.6	15882.2	.0	7034.1	.0	.0	.0	.0	.0
50	6.4	35380.9	.0	17643.6	.0	.0	.0	.0	.0
51	.9	4365.9	8.7	2663.4	.0	.0	.0	.0	.0
52	7.1	29627.2	689.4	19543.6	.0	.0	.0	.0	.0
53	1.0	3488.1	189.9	2537.5	.0	.0	.0	.0	.0
54	5.8	16494.4	1088.9	12529.5	.0	.0	.0	.0	.0
55	6.6	11638.0	1230.6	10439.0	.0	.0	.0	.0	.0
56	3.7	3113.5	697.4	3934.3	.0	.0	.0	.0	.0
57	2.6	877.8	482.4	1731.1	.0	.0	.0	.0	.0

58 1.7 163.9 310.4 704.0 .0 .0 .0 .0 .0

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	228.68	500.00
2	237.81	495.91
3	247.06	492.12
4	256.44	488.64
5	265.92	485.47
6	275.51	482.61
7	285.18	480.07
8	294.93	477.86
9	304.75	475.96
10	314.62	474.39
11	324.55	473.15
12	334.50	472.23
13	344.49	471.65
14	354.48	471.39
15	364.48	471.47
16	374.48	471.87
17	384.45	472.60
18	394.39	473.66
19	404.30	475.05
20	414.15	476.77
21	423.94	478.81
22	433.65	481.17
23	443.29	483.85
24	452.83	486.85
25	462.26	490.16
26	471.59	493.78
27	480.78	497.70
28	489.85	501.93
29	498.76	506.45
30	507.53	511.27
31	516.13	516.37
32	524.56	521.75
33	532.80	527.41
34	540.86	533.34
35	548.71	539.53
36	556.36	545.97
37	563.79	552.67
38	570.99	559.60
39	577.96	566.77
40	584.69	574.17
41	591.18	581.78
42	591.35	582.00

Circle Center At X = 357.2 ; Y = 774.4 and Radius, 303.0

*** 1.873 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	237.11	501.70
2	246.00	497.14
3	255.06	492.91
4	264.28	489.02
5	273.63	485.47
6	283.10	482.27
7	292.69	479.42
8	302.37	476.93
9	312.14	474.80
10	321.98	473.04
11	331.89	471.64
12	341.83	470.60
13	351.81	469.94
14	361.81	469.65
15	371.81	469.72
16	381.80	470.17

17	391.76	470.99
18	401.69	472.17
19	411.57	473.72
20	421.39	475.64
21	431.12	477.92
22	440.77	480.56
23	450.31	483.55
24	459.73	486.90
25	469.03	490.59
26	478.18	494.62
27	487.17	498.99
28	496.00	503.69
29	504.65	508.72
30	513.10	514.06
31	521.35	519.70
32	529.39	525.66
33	537.20	531.90
34	544.77	538.43
35	552.10	545.24
36	559.17	552.31
37	565.97	559.64
38	572.50	567.21
39	578.74	575.03
40	583.90	582.00

Circle Center At X = 364.7 ; Y = 739.6 and Radius, 269.9

*** 1.876 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	237.11	501.70
2	246.22	497.60
3	255.49	493.82
4	264.88	490.39
5	274.38	487.29
6	284.00	484.53
7	293.70	482.13
8	303.49	480.07
9	313.34	478.37
10	323.25	477.03
11	333.20	476.04
12	343.18	475.41
13	353.18	475.14
14	363.18	475.23
15	373.17	475.68
16	383.14	476.49
17	393.07	477.66
18	402.95	479.18
19	412.77	481.06
20	422.52	483.29
21	432.18	485.88
22	441.75	488.80
23	451.20	492.07
24	460.52	495.68
25	469.71	499.62
26	478.76	503.89
27	487.64	508.48
28	496.35	513.39
29	504.88	518.61
30	513.22	524.13
31	521.35	529.95
32	529.27	536.06
33	536.96	542.45
34	544.42	549.11
35	551.63	556.03
36	558.59	563.21
37	565.29	570.64
38	571.71	578.30

39	574.59	582.00

Circle Center At X = 355.7 ; Y = 752.9 and Radius, 277.8

*** 1.877 ***

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	224.47	500.00
2	233.79	496.35
3	243.20	492.99
4	252.72	489.90
5	262.32	487.11
6	272.00	484.61
7	281.75	482.39
8	291.56	480.47
9	301.43	478.85
10	311.34	477.53
11	321.29	476.50
12	331.26	475.77
13	341.26	475.34
14	351.25	475.22
15	361.25	475.39
16	371.24	475.86
17	381.21	476.64
18	391.15	477.71
19	401.06	479.08
20	410.92	480.75
21	420.72	482.71
22	430.47	484.97
23	440.14	487.51
24	449.73	490.35
25	459.22	493.48
26	468.63	496.89
27	477.92	500.58
28	487.10	504.54
29	496.16	508.78
30	505.08	513.30
31	513.86	518.07
32	522.50	523.11
33	530.98	528.41
34	539.30	533.96
35	547.45	539.76
36	555.42	545.79
37	563.21	552.07
38	570.80	558.58
39	578.20	565.31
40	585.39	572.26
41	592.36	579.42
42	594.73	582.00

Circle Center At X = 350.5 ; Y = 807.9 and Radius, 332.7

*** 1.885 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	224.47	500.00
2	233.75	496.26
3	243.14	492.83
4	252.64	489.71
5	262.24	486.90
6	271.93	484.42
7	281.69	482.25
8	291.52	480.41
9	301.40	478.89
10	311.33	477.70
11	321.29	476.84
12	331.28	476.30
13	341.28	476.10
14	351.28	476.22

15	361.27	476.68
16	371.24	477.46
17	381.17	478.58
18	391.07	480.02
19	400.91	481.78
20	410.69	483.87
21	420.40	486.28
22	430.02	489.01
23	439.54	492.05
24	448.96	495.41
25	458.27	499.08
26	467.44	503.05
27	476.49	507.32
28	485.38	511.89
29	494.12	516.74
30	502.70	521.89
31	511.10	527.31
32	519.32	533.01
33	527.34	538.97
34	535.17	545.20
35	542.78	551.68
36	550.18	558.41
37	557.35	565.38
38	564.29	572.58
39	570.98	580.01
40	572.96	582.35

Circle Center At X = 342.5 ; Y = 779.2 and Radius, 303.1

*** 1.887 ***

Failure Surface Specified By 48 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	199.21	500.00
2	207.62	494.58
3	216.20	489.45
4	224.96	484.62
5	233.87	480.10
6	242.94	475.88
7	252.15	471.97
8	261.48	468.38
9	270.93	465.12
10	280.49	462.18
11	290.14	459.57
12	299.88	457.29
13	309.69	455.35
14	319.56	453.74
15	329.48	452.48
16	339.44	451.56
17	349.42	450.97
18	359.42	450.73
19	369.42	450.84
20	379.41	451.28
21	389.38	452.07
22	399.31	453.20
23	409.20	454.67
24	419.04	456.48
25	428.81	458.62
26	438.49	461.10
27	448.09	463.91
28	457.59	467.05
29	466.97	470.51
30	476.23	474.29
31	485.35	478.38
32	494.33	482.79
33	503.15	487.50
34	511.80	492.51
35	520.28	497.81
36	528.57	503.40

37	536.66	509.28
38	544.55	515.42
39	552.22	521.84
40	559.67	528.51
41	566.89	535.43
42	573.86	542.60
43	580.58	550.00
44	587.05	557.63
45	593.25	565.48
46	599.18	573.53
47	604.82	581.79
48	604.96	582.00

Circle Center At X = 361.4 ; Y = 742.3 and Radius, 291.6

*** 1.892 ***

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	203.42	500.00
2	212.68	496.22
3	222.05	492.73
4	231.52	489.50
5	241.07	486.56
6	250.71	483.91
7	260.43	481.54
8	270.21	479.46
9	280.05	477.66
10	289.94	476.16
11	299.86	474.96
12	309.82	474.04
13	319.80	473.43
14	329.80	473.10
15	339.80	473.08
16	349.79	473.35
17	359.78	473.91
18	369.74	474.77
19	379.67	475.92
20	389.57	477.37
21	399.42	479.11
22	409.21	481.14
23	418.94	483.45
24	428.59	486.06
25	438.16	488.94
26	447.65	492.12
27	457.04	495.56
28	466.32	499.29
29	475.48	503.29
30	484.53	507.55
31	493.44	512.09
32	502.22	516.88
33	510.85	521.93
34	519.32	527.24
35	527.64	532.79
36	535.79	538.59
37	543.76	544.62
38	551.55	550.89
39	559.16	557.38
40	566.57	564.10
41	573.77	571.03
42	580.77	578.18
43	584.30	582.00

Circle Center At X = 335.7 ; Y = 811.2 and Radius, 338.2

*** 1.894 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	203.42	500.00
2	211.84	494.60

3	220.44	489.49
4	229.20	484.69
5	238.13	480.18
6	247.21	475.99
7	256.43	472.10
8	265.77	468.54
9	275.23	465.30
10	284.80	462.38
11	294.46	459.80
12	304.20	457.55
13	314.01	455.63
14	323.89	454.05
15	333.81	452.82
16	343.77	451.92
17	353.76	451.36
18	363.75	451.15
19	373.75	451.28
20	383.74	451.76
21	393.71	452.57
22	403.64	453.73
23	413.53	455.23
24	423.36	457.06
25	433.12	459.24
26	442.80	461.74
27	452.39	464.58
28	461.87	467.74
29	471.25	471.23
30	480.49	475.04
31	489.60	479.16
32	498.57	483.59
33	507.38	488.33
34	516.01	493.37
35	524.48	498.70
36	532.75	504.31
37	540.82	510.21
38	548.69	516.38
39	556.35	522.82
40	563.77	529.52
41	570.96	536.46
42	577.92	543.65
43	584.61	551.08
44	591.06	558.73
45	597.23	566.59
46	603.13	574.67
47	608.11	582.00

Circle Center At X = 364.9 ; Y = 742.6 and Radius, 291.4

*** 1.897 ***

Failure Surface Specified By 45 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	211.84	500.00
2	220.98	495.93
3	230.23	492.13
4	239.58	488.59
5	249.03	485.34
6	258.58	482.35
7	268.21	479.65
8	277.91	477.22
9	287.68	475.08
10	297.50	473.22
11	307.38	471.65
12	317.29	470.37
13	327.25	469.37
14	337.22	468.67
15	347.21	468.25
16	357.21	468.12
17	367.21	468.29

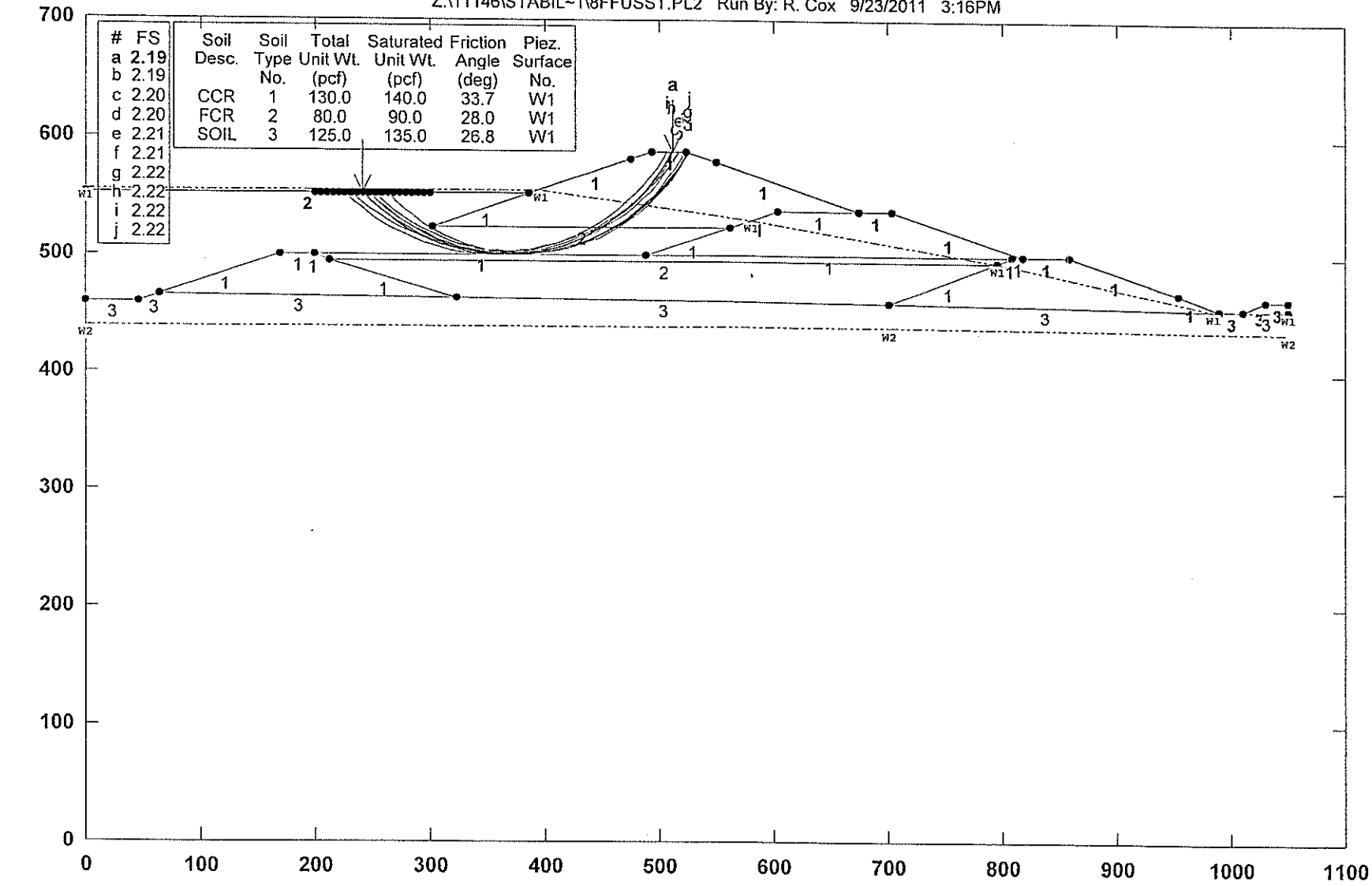
18	377.20	468.74
19	387.17	469.49
20	397.12	470.52
21	407.03	471.84
22	416.90	473.45
23	426.72	475.35
24	436.48	477.53
25	446.17	479.99
26	455.79	482.73
27	465.32	485.75
28	474.76	489.05
29	484.10	492.62
30	493.34	496.46
31	502.45	500.56
32	511.45	504.93
33	520.31	509.56
34	529.04	514.44
35	537.62	519.58
36	546.05	524.96
37	554.32	530.58
38	562.42	536.44
39	570.35	542.54
40	578.10	548.86
41	585.66	555.40
42	593.03	562.16
43	600.20	569.14
44	607.16	576.31
45	612.36	582.00

Circle Center At X = 356.5 ; Y = 812.5 and Radius, 344.4

*** 1.897 ***

Phase 8 - Section F-F Upstream Static Whole Slope Circle

Z:\11146\STABIL~1\8FFUSST.PL2 Run By: R. Cox 9/23/2011 3:16PM



#	FS
a	2.19
b	2.19
c	2.20
d	2.20
e	2.21
f	2.21
g	2.22
h	2.22
i	2.22
j	2.22

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
SOIL	3	125.0	135.0	26.8	W1

PCSTABL5M/si FSmin=2.19

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 9/23/2011
Time of Run: 3:16PM
Run By: R. Cox
Input Data Filename: Z:8ffusst.
Output Filename: Z:8ffusst.OUT
Unit: ENGLISH
Plotted Output Filename: Z:8ffusst.PLT
PROBLEM DESCRIPTION Phase 8 - Section F-F
Upstream Static Whole Slope Circle

BOUNDARY COORDINATES
12 Top Boundaries
33 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	552.10	386.30	552.10	2
2	386.30	552.10	494.00	588.00	1
3	494.00	588.00	524.00	588.00	1
4	524.00	588.00	674.00	538.00	1
5	674.00	538.00	704.00	538.00	1
6	704.00	538.00	818.00	500.00	1
7	818.00	500.00	858.00	500.00	1
8	858.00	500.00	954.00	468.00	1
9	954.00	468.00	990.00	456.00	1
10	990.00	456.00	1010.00	456.00	3
11	1010.00	456.00	1030.75	462.92	3
12	1030.75	462.92	1050.00	462.92	3
13	302.00	524.00	386.30	552.10	1
14	604.00	538.00	674.00	538.00	1
15	562.00	524.00	604.00	538.00	1
16	302.00	524.00	562.00	524.00	2
17	487.92	500.00	562.00	524.00	1
18	168.66	500.00	199.21	500.00	1
19	199.21	500.00	487.92	500.00	1
20	487.92	500.00	808.00	500.00	1
21	808.00	500.00	818.00	500.00	1
22	199.21	500.00	212.45	495.00	1
23	794.95	495.00	808.00	500.00	1
24	63.98	465.73	168.66	500.00	1
25	212.45	495.00	794.95	495.00	2
26	212.45	495.00	323.44	463.27	1
27	701.00	459.00	794.95	495.00	1
28	63.98	465.73	323.44	463.27	3
29	323.44	463.27	701.00	459.00	3
30	701.00	459.00	990.00	456.00	3
31	1010.00	456.00	1050.00	456.00	3
32	46.48	460.00	63.98	465.73	3
33	.00	460.00	46.48	460.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 6 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	555.39

2	396.14	555.38
3	580.00	530.00
4	794.95	495.00
5	985.00	456.00
6	1050.00	456.00

Piezometric Surface No. 2 Specified by 3 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	439.00
2	701.00	439.00
3	1050.00	435.38

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 200.00 ft.
and X = 300.00 ft.
Each Surface Terminates Between X = 475.00 ft.
and X = 550.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =436.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.11	552.10
2	249.22	545.08
3	256.75	538.49
4	264.65	532.36
5	272.90	526.71
6	281.47	521.55
7	290.33	516.92
8	299.45	512.82
9	308.80	509.27
10	318.34	506.28
11	328.04	503.86
12	337.87	502.02
13	347.80	500.77
14	357.77	500.11
15	367.77	500.04
16	377.76	500.57
17	387.70	501.69
18	397.55	503.39
19	407.28	505.68
20	416.87	508.54
21	426.26	511.97
22	435.44	515.94
23	444.36	520.46
24	453.00	525.49
25	461.33	531.03
26	469.31	537.05
27	476.92	543.54
28	484.13	550.47
29	490.92	557.81
30	497.26	565.54
31	503.13	573.64
32	508.51	582.07
33	511.82	588.00

Circle Center At X = 363.9 ; Y = 668.4 and Radius, 168.4
*** 2.190 ***
Individual data on the 38 slices

	Water Force	Water Force	Tie Force	Tie Force	Earthquake Force	Surcharge

Slice No.	Width (ft)	Weight (lbs)	Top (lbs)	Bot (lbs)	Norm (lbs)	Tan (lbs)	Hor (lbs)	Ver (lbs)	Load (lbs)
1	7.1	2249.8	1456.9	4238.1	.0	.0	.0	.0	.0
2	7.5	6985.6	1539.6	8485.2	.0	.0	.0	.0	.0
3	7.9	11858.3	1617.0	12453.7	.0	.0	.0	.0	.0
4	8.3	16757.7	1688.6	16129.8	.0	.0	.0	.0	.0
5	8.6	21575.9	1754.3	19500.1	.0	.0	.0	.0	.0
6	8.9	26209.5	1813.7	22553.1	.0	.0	.0	.0	.0
7	9.1	30561.3	1866.8	25277.9	.0	.0	.0	.0	.0
8	2.5	9124.6	521.9	7325.7	.0	.0	.0	.0	.0
9	6.8	25801.8	1391.5	20339.3	.0	.0	.0	.0	.0
10	9.5	39908.0	1953.1	29705.9	.0	.0	.0	.0	.0
11	9.7	44497.6	1986.0	31393.4	.0	.0	.0	.0	.0
12	9.8	48560.2	2011.9	32721.5	.0	.0	.0	.0	.0
13	9.9	52026.3	2030.6	33685.6	.0	.0	.0	.0	.0
14	10.0	54837.5	2042.3	34282.3	.0	.0	.0	.0	.0
15	10.0	56948.9	2046.7	34509.5	.0	.0	.0	.0	.0
16	10.0	58328.2	2043.9	34366.3	.0	.0	.0	.0	.0
17	8.5	50633.0	1748.1	29137.9	.0	.0	.0	.0	.0
18	1.4	8353.9	279.9	4715.5	.0	.0	.0	.0	.0
19	8.4	51831.2	781.5	28319.5	.0	.0	.0	.0	.0
20	1.4	8859.7	.0	4600.8	.0	.0	.0	.0	.0
21	9.7	62338.4	.0	30894.2	.0	.0	.0	.0	.0
22	9.6	63025.2	.0	28478.7	.0	.0	.0	.0	.0
23	9.4	62883.4	.0	25726.1	.0	.0	.0	.0	.0
24	9.2	61934.7	.0	22646.1	.0	.0	.0	.0	.0
25	8.9	60215.6	.0	19249.8	.0	.0	.0	.0	.0
26	6.1	40741.2	.0	11343.7	.0	.0	.0	.0	.0
27	2.6	16940.2	.0	4205.1	.0	.0	.0	.0	.0
28	8.3	52908.4	.0	11556.5	.0	.0	.0	.0	.0
29	8.0	47000.9	.0	7286.8	.0	.0	.0	.0	.0
30	7.6	40642.5	.0	2754.7	.0	.0	.0	.0	.0
31	.6	3140.4	.0	18.4	.0	.0	.0	.0	.0
32	6.6	31086.4	.0	.0	.0	.0	.0	.0	.0
33	6.8	27976.1	.0	.0	.0	.0	.0	.0	.0
34	3.1	11132.6	.0	.0	.0	.0	.0	.0	.0
35	3.3	10358.3	.0	.0	.0	.0	.0	.0	.0
36	5.9	14048.1	.0	.0	.0	.0	.0	.0	.0
37	5.4	7095.1	.0	.0	.0	.0	.0	.0	.0
38	3.3	1274.6	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.11	552.10
2	249.36	545.22
3	257.00	538.76
4	264.99	532.75
5	273.32	527.21
6	281.95	522.16
7	290.85	517.61
8	300.00	513.57
9	309.37	510.07
10	318.92	507.11
11	328.62	504.70
12	338.45	502.85
13	348.37	501.57
14	358.34	500.86
15	368.34	500.72
16	378.33	501.15
17	388.28	502.16
18	398.16	503.73
19	407.93	505.87
20	417.56	508.56
21	427.02	511.80
22	436.28	515.57
23	445.31	519.88
24	454.07	524.69

25	462.55	529.99
26	470.71	535.77
27	478.52	542.01
28	485.97	548.69
29	493.02	555.78
30	499.65	563.27
31	505.84	571.12
32	511.57	579.31
33	516.82	587.82
34	516.92	588.00

Circle Center At X = 365.8 ; Y = 675.2 and Radius, 174.5

*** 2.190 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	252.63	552.10
2	259.86	545.19
3	267.50	538.74
4	275.52	532.76
5	283.88	527.28
6	292.57	522.32
7	301.54	517.90
8	310.76	514.04
9	320.20	510.74
10	329.83	508.03
11	339.60	505.90
12	349.48	504.38
13	359.44	503.46
14	369.43	503.15
15	379.43	503.45
16	389.39	504.35
17	399.27	505.86
18	409.05	507.97
19	418.68	510.68
20	428.12	513.96
21	437.35	517.81
22	446.33	522.22
23	455.02	527.17
24	463.39	532.63
25	471.42	538.60
26	479.06	545.04
27	486.30	551.94
28	493.11	559.27
29	499.46	566.99
30	505.32	575.09
31	510.68	583.53
32	513.15	588.00

Circle Center At X = 369.5 ; Y = 667.1 and Radius, 164.0

*** 2.199 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	247.37	552.10
2	254.67	545.27
3	262.34	538.85
4	270.36	532.88
5	278.70	527.36
6	287.34	522.33
7	296.25	517.78
8	305.40	513.74
9	314.76	510.23
10	324.30	507.24
11	334.00	504.80
12	343.82	502.90
13	353.73	501.55
14	363.70	500.77
15	373.69	500.54

16	383.69	500.88
17	393.65	501.78
18	403.54	503.24
19	413.34	505.24
20	423.01	507.80
21	432.51	510.89
22	441.84	514.51
23	450.94	518.65
24	459.79	523.30
25	468.38	528.43
26	476.65	534.04
27	484.61	540.11
28	492.21	546.61
29	499.43	553.52
30	506.25	560.83
31	512.65	568.52
32	518.61	576.55
33	524.11	584.90
34	525.60	587.47

Circle Center At X = 372.7 ; Y = 678.5 and Radius, 178.0

*** 2.202 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	231.58	552.10
2	239.17	545.59
3	247.09	539.48
4	255.32	533.80
5	263.84	528.57
6	272.62	523.79
7	281.65	519.48
8	290.88	515.64
9	300.31	512.31
10	309.90	509.47
11	319.62	507.14
12	329.46	505.33
13	339.37	504.03
14	349.34	503.26
15	359.34	503.02
16	369.34	503.30
17	379.30	504.11
18	389.21	505.45
19	399.04	507.30
20	408.76	509.67
21	418.33	512.55
22	427.75	515.92
23	436.97	519.79
24	445.97	524.14
25	454.73	528.96
26	463.23	534.23
27	471.44	539.94
28	479.34	546.08
29	486.90	552.62
30	494.10	559.56
31	500.94	566.86
32	507.37	574.51
33	513.40	582.49
34	517.12	588.00

Circle Center At X = 358.9 ; Y = 692.7 and Radius, 189.7

*** 2.213 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	263.16	552.10
2	270.23	545.03
3	277.73	538.42
4	285.63	532.28

5	293.90	526.66
6	302.50	521.56
7	311.40	517.01
8	320.57	513.02
9	329.98	509.61
10	339.57	506.80
11	349.33	504.60
12	359.20	503.00
13	369.15	502.03
14	379.15	501.68
15	389.14	501.96
16	399.10	502.86
17	408.99	504.38
18	418.75	506.52
19	428.37	509.26
20	437.80	512.59
21	447.00	516.51
22	455.94	521.00
23	464.57	526.04
24	472.88	531.60
25	480.83	537.68
26	488.37	544.24
27	495.50	551.25
28	502.17	558.70
29	508.36	566.55
30	514.05	574.78
31	519.22	583.34
32	521.65	588.00

Circle Center At X = 379.7 ; Y = 661.6 and Radius, 159.9

*** 2.214 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	247.37	552.10
2	254.60	545.20
3	262.22	538.72
4	270.19	532.68
5	278.49	527.10
6	287.09	522.00
7	295.97	517.40
8	305.10	513.31
9	314.44	509.74
10	323.97	506.71
11	333.65	504.22
12	343.47	502.29
13	353.37	500.91
14	363.34	500.10
15	373.33	499.86
16	383.33	500.18
17	393.29	501.07
18	403.18	502.52
19	412.98	504.53
20	422.65	507.10
21	432.15	510.20
22	441.46	513.84
23	450.56	518.00
24	459.40	522.68
25	467.96	527.84
26	476.22	533.48
27	484.14	539.58
28	491.71	546.12
29	498.89	553.08
30	505.66	560.44
31	512.01	568.17
32	517.91	576.24
33	523.34	584.64
34	525.06	587.65

Circle Center At X = 372.6 ; Y = 676.1 and Radius, 176.2
*** 2.216 ***
Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.11	552.10
2	249.19	545.04
3	256.68	538.42
4	264.55	532.25
5	272.78	526.57
6	281.34	521.39
7	290.19	516.73
8	299.30	512.61
9	308.64	509.05
10	318.18	506.04
11	327.88	503.62
12	337.71	501.77
13	347.63	500.52
14	357.61	499.87
15	367.61	499.81
16	377.59	500.35
17	387.53	501.48
18	397.38	503.21
19	407.11	505.53
20	416.68	508.42
21	426.06	511.88
22	435.22	515.90
23	444.12	520.45
24	452.74	525.53
25	461.03	531.12
26	468.98	537.19
27	476.54	543.72
28	483.71	550.70
29	490.44	558.09
30	496.72	565.88
31	502.52	574.02
32	507.83	582.50
33	510.83	588.00

Circle Center At X = 363.6 ; Y = 666.9 and Radius, 167.1
*** 2.221 ***
Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	226.32	552.10
2	233.65	545.30
3	241.34	538.91
4	249.38	532.96
5	257.73	527.47
6	266.38	522.44
7	275.29	517.90
8	284.44	513.87
9	293.80	510.35
10	303.34	507.35
11	313.03	504.88
12	322.84	502.96
13	332.75	501.58
14	342.71	500.76
15	352.71	500.48
16	362.71	500.77
17	372.67	501.60
18	382.58	502.99
19	392.39	504.92
20	402.08	507.40
21	411.61	510.41
22	420.97	513.94
23	430.11	517.98
24	439.02	522.53

25	447.66	527.56
26	456.01	533.07
27	464.04	539.02
28	471.73	545.42
29	479.05	552.23
30	485.99	559.43
31	492.51	567.01
32	498.60	574.94
33	504.25	583.20
34	507.16	588.00

Circle Center At X = 352.6 ; Y = 680.7 and Radius, 180.3

*** 2.222 ***

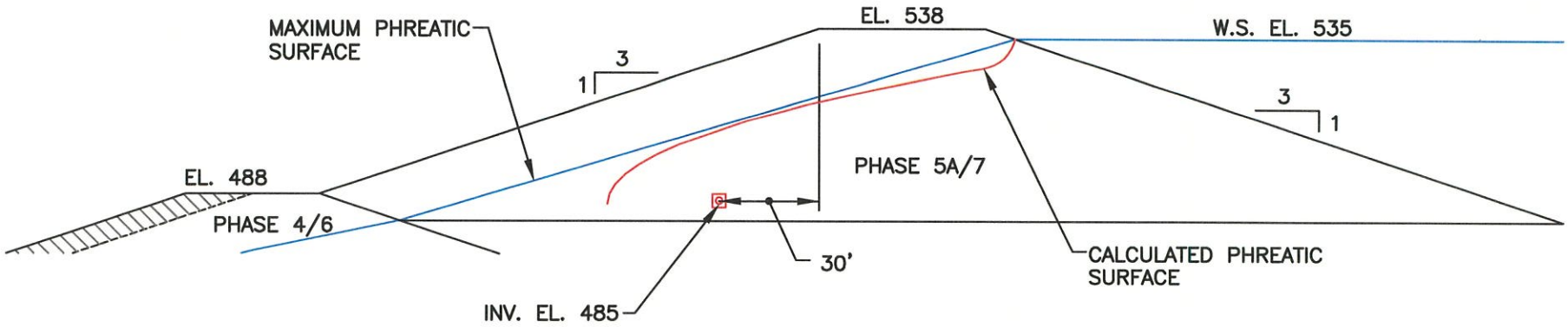
Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	263.16	552.10
2	270.28	545.08
3	277.81	538.50
4	285.73	532.40
5	294.01	526.79
6	302.62	521.69
7	311.52	517.14
8	320.68	513.13
9	330.07	509.69
10	339.65	506.84
11	349.39	504.57
12	359.25	502.90
13	369.20	501.84
14	379.19	501.39
15	389.18	501.54
16	399.16	502.31
17	409.06	503.69
18	418.86	505.67
19	428.53	508.24
20	438.01	511.40
21	447.29	515.13
22	456.32	519.42
23	465.08	524.26
24	473.52	529.62
25	481.62	535.49
26	489.34	541.84
27	496.66	548.65
28	503.56	555.89
29	509.99	563.54
30	515.95	571.58
31	521.41	579.96
32	525.66	587.45

Circle Center At X = 381.6 ; Y = 665.0 and Radius, 163.6

*** 2.222 ***

FIGURES



PHASE 5A/7 SECTION D–D

1"=50'

Alliance Consulting, Inc.

Engineers · Constructors · Scientists

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SUMMERSVILLE, WV (304) 883–2360
CANONSBURG, PA (724) 745–3630

INTERNAL DRAIN DESIGN

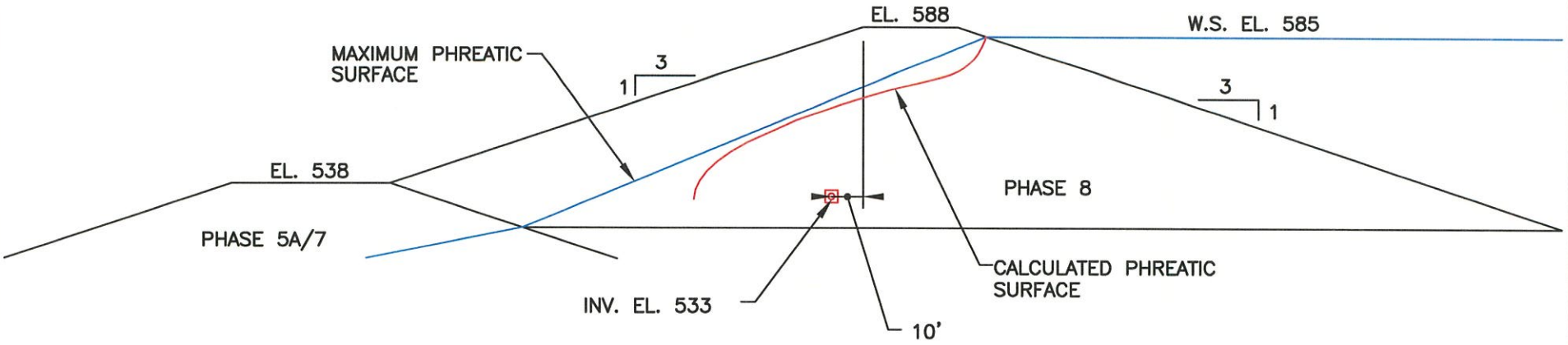
MACH NO. 1 MINE,
FACILITY NO. 2 PLAN MODIFICATION
PHASE 5A, 7, AND 8

PREPARED FOR

WILLIAMSON ENERGY, LLC
P.O. BOX 300, JOHNSTON CITY, ILLINOIS 62951

DRAWN BY	JWD	10/11/11
CHECKED BY		
APPROVED BY		
DRAWING NUMBER		
B11–530–A1		

B11923



PHASE 8 SECTION D–D

1"=50'

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INTERNAL DRAIN DESIGN

MACH NO. 1 MINE,
FACILITY NO. 2 PLAN MODIFICATION
PHASE 5A, 7, AND 8

PREPARED FOR

WILLIAMSON ENERGY, LLC
P.O. BOX 300, JOHNSTON CITY, ILLINOIS 62951

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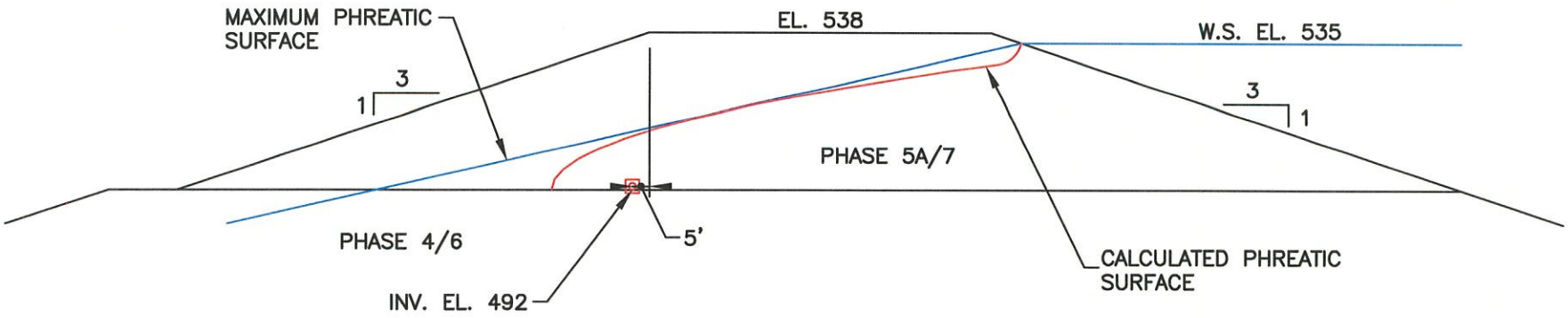
R11924



PHASE 5A/7 SECTION E–E

1"=50'

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INTERNAL DRAIN DESIGN

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FACILITY NO. 2 PLAN MODIFICATION
PHASE 5A, 7, AND 8

PREPARED FOR

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P.O. BOX 300, JOHNSTON CITY, ILLINOIS 62951

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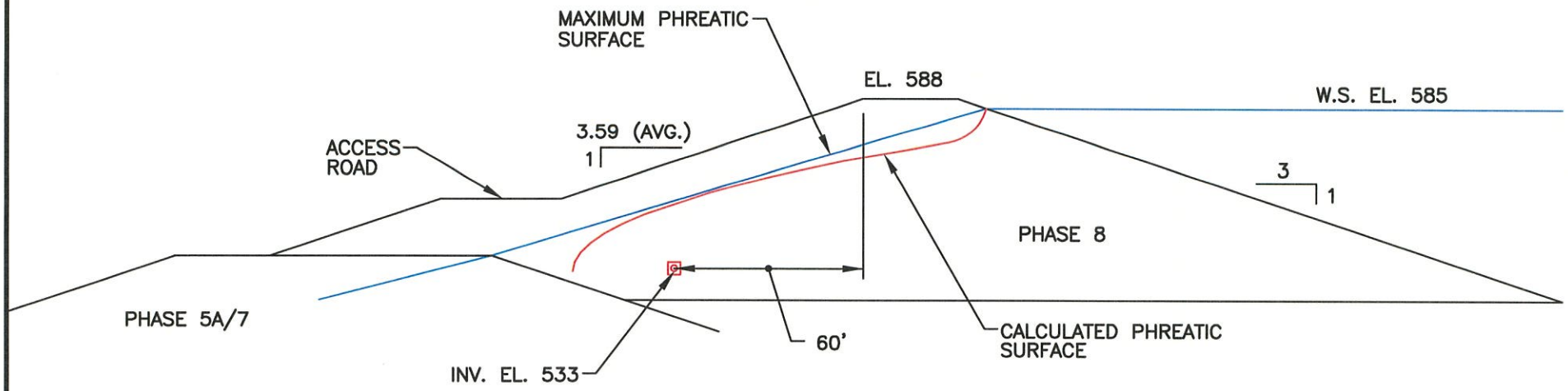
R444925



PHASE 8 SECTION E–E

1"=50'

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INTERNAL DRAIN DESIGN

MACH NO. 1 MINE,
FACILITY NO. 2 PLAN MODIFICATION
PHASE 5A, 7, AND 8

PREPARED FOR

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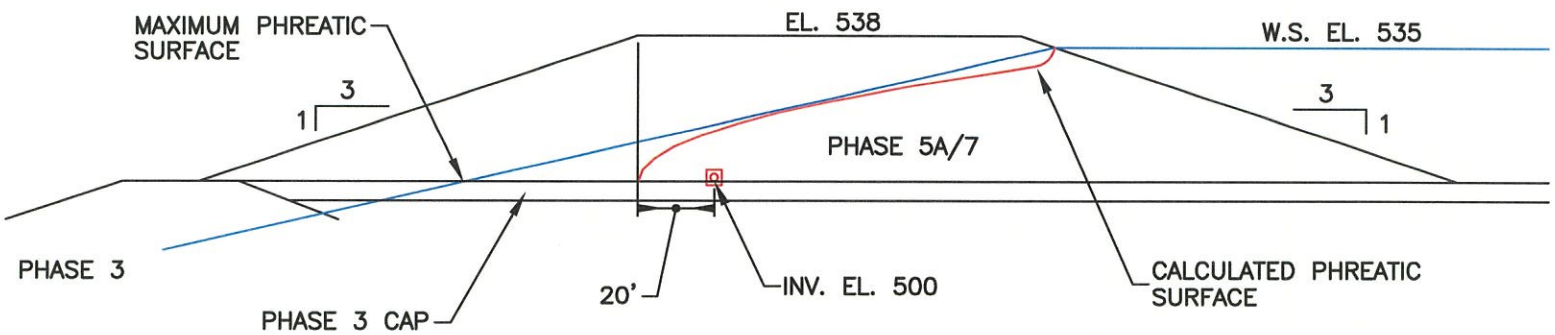
R11926



PHASE 5A/7 SECTION F–F

1"=50'

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INTERNAL DRAIN DESIGN

MACH NO. 1 MINE,
FACILITY NO. 2 PLAN MODIFICATION
PHASE 5A, 7, AND 8

PREPARED FOR

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P.O. BOX 300, JOHNSTON CITY, ILLINOIS 62951

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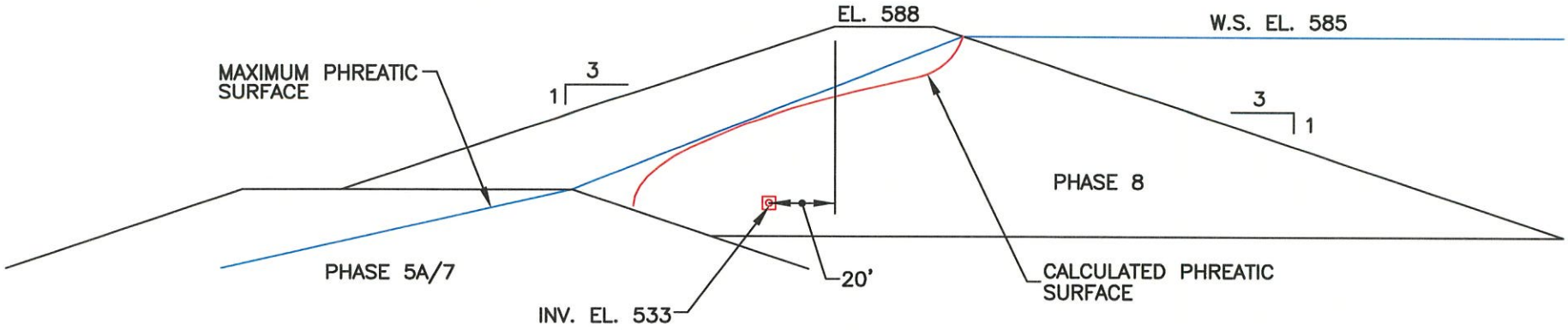
B11–530–A5		

R41627



PHASE 8 SECTION F–F
1"=50'

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INTERNAL DRAIN DESIGN
MACH NO. 1 MINE,
FACILITY NO. 2 PLAN MODIFICATION
PHASE 5A, 7, AND 8
PREPARED FOR
WILLIAMSON ENERGY, LLC
P.O. BOX 300, JOHNSTON CITY, ILLINOIS 62951

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DRAWING NUMBER		
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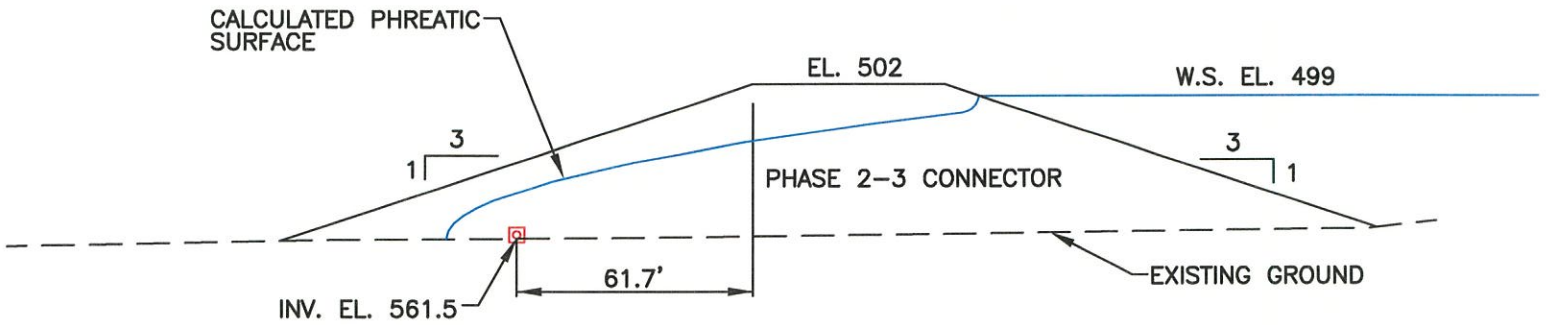
R11928



PHASE 2-3 CONNECTOR SECTION G-G

1"=50'

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INTERNAL DRAIN DESIGN
MACH NO. 1 MINE,
FACILITY NO. 2 PLAN MODIFICATION
PHASE 5A, 7, AND 8
PREPARED FOR
WILLIAMSON ENERGY, LLC
P.O. BOX 300, JOHNSTON CITY, ILLINOIS 62951

DRAWN BY	JWD	10/11/11
CHECKED BY		
APPROVED BY		
DRAWING NUMBER		
B11-530-A7		

R11929

DOCUMENT

68

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
MINE RELATED WATER POLLUTION CONTROL PERMIT

PERMIT NO.: 2012-MA-6141-1

DATE ISSUED: May 21, 2012

FINAL PLANS, SPECIFICATIONS, APPLICATION AND SUPPORTING DOCUMENTS

EXPIRATION DATE: February 28, 2017

PREPARED BY: James M. Miller
Alliance Consulting, Inc.

LOG NUMBERS: 6141-12

SUBJECT: Williamson Energy, LLC – Pond Creek Mine

Williamson Energy, LLC – Pond Creek Mine
P.O. Box 99
Johnston City, IL 62951

Supplemental Permit is hereby granted to the above designated permittee to construct and operate the surface facilities to support the underground mine facility which was previously approved under Permit No. 2012-MA-6141.

A permit area consisting of 0.64 acres, also identified as an Incidental Boundary Revision (IBR) to OMM Permit No. 375, located in Section 13, T8S, R3E, Williamson County, Illinois, as described and depicted in IEPA Log No. 6141-12 is to be utilized for the construction of the borehole for the batch material supply of crushed stone and concrete to the underground mine.

Runoff from the area approved herein will be controlled by silt fence, mulching, seeding, vegetation, rock check dams, erosion control blankets, etc.

The abandonment plan shall be executed and completed in accordance with 35 Ill. Adm. Code 405.109.

This Supplemental Permit supersedes and replaces Permit Number 2012-MA-6141 which was previously issued for the herein permitted facilities.

This Permit is issued subject to the following Special Condition. If such Special Condition requires additional or revised facilities, satisfactory engineering plan documents must be submitted to this Agency for review and approval for issuance of a Supplemental Permit.

Special Condition No. 1: This permit is issued with the expressed understanding that there shall be no surface discharge from these facilities. If such discharge occurs, additional or alternate facilities shall be provided. The construction of such additional or alternate facilities may not be started until a Permit for the construction is issued by the Agency.

This permit is issued in accordance with the Illinois Environmental Protection Act of 1970, the Title 35, Subtitle C: Water Pollution and Subtitle D: Mine Related Pollution Regulations adopted pursuant thereto by the Illinois Environmental Protection Act. THE STANDARD CONDITIONS OF ISSUANCE INDICATED ON THE ATTACHMENT TO THIS PERMIT (PAGE 1a) MUST BE COMPLIED WITH IN FULL. READ ALL CONDITIONS CAREFULLY.

Larry D. Crislip, P.E.
Manager, Permit Section
Mine Pollution Control Program
Bureau of Water

cc: IDNR, Office of Mines and Minerals
IDNR, Division of Water Resources
BOW/MPCP/FOS/Marion

LDC:IW:cs/6026c/5-18-12

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
MINE RELATED WATER POLLUTION CONTROL PERMIT

PERMIT NO.: 2012-MA-6141

DATE ISSUED: March 14, 2012

FINAL PLANS, SPECIFICATIONS, APPLICATION AND SUPPORTING DOCUMENTS

EXPIRATION DATE: February 28, 2017

PREPARED BY: James M. Miller
Alliance Consulting, Inc.

LOG NUMBERS: 6141-12

SUBJECT: Williamson Energy, LLC – Pond Creek Mine

Williamson Energy, LLC – Pond Creek Mine
P.O. Box 99
Johnston City, IL 62951

Permit is hereby granted to the above designated permittee to construct and operate the surface facilities to support the underground mine facility described as follows:

A permit area consisting of 0.64 acres, also identified as an Incidental Boundary Revision (IBR) to OMM Permit No. 375, located in Section 13, T8S, R3E, Williamson County, Illinois, as described and depicted in IEPA Log No. 6141-12 is to be utilized for the construction of the borehole for the batch material supply of crushed stone and concrete to the underground mine.

Runoff from the area approved herein will be controlled by silt fence, mulching, seeding, vegetation, rock check dams, erosion control blankets, etc.

The abandonment plan shall be executed and completed in accordance with 35 Ill. Adm. Code 405.109.

This Permit is issued subject to the following Special Condition. If such Special Condition requires additional or revised facilities, satisfactory engineering plan documents must be submitted to this Agency for review and approval for issuance of a Supplemental Permit.

Special Condition No. 1: This permit is issued with the expressed understanding that there shall be no surface discharge from these facilities. If such discharge occurs, additional or alternate facilities shall be provided. The construction of such additional or alternate facilities may be started until a Permit for the construction is issued by the Agency.

This permit is issued in accordance with the Illinois Environmental Protection Act of 1970, the Title 35, Subtitle C: Water Pollution and Subtitle D: Mine Related Pollution Regulations adopted pursuant thereto by the Illinois Environmental Protection Act. THE STANDARD CONDITIONS OF ISSUANCE INDICATED ON THE ATTACHMENT TO THIS PERMIT (PAGE 1a) MUST BE COMPLIED WITH IN FULL. READ ALL CONDITIONS CAREFULLY.

Larry D. Crislip

Larry D. Crislip, P.E.
Manager, Permit Section
Mine Pollution Control Program
Bureau of Water

cc: IDNR, Office of Mines and Minerals
IDNR, Division of Water Resources
BOW/MPCP/FOS/Marion

LDC:IW:cs/6026c/3-14-12

6141-/12
Due date: 4-13-12
R11933

Illinois Department of
Natural Resources
One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

Pat Quinn, Governor
Marc Miller, Director

March 21, 2012

James Miller
Williamson Energy
P.O. Box 99
Johnston City, IL 62951

Re: Permit No. 375
Incidental Boundary Revision No. 41

Dear Mr. Miller:

The appropriate Department technical staff have reviewed the proposed incidental boundary revision dated February 29, 2012 and the supplemental information dated March 6, 2012, submitted by Williamson Energy for Pond Creek Mine, Permit No. 375. The request would add 0.64 acres to conduct surface coal mining activities. The additional acres would be used for a service borehole.

The Department finds Williamson Energy has demonstrated in its request, and field inspections by the Department's field representative have confirmed that these areas (0.64 acres) meet the requirements for an incidental boundary change as outlined in 62 Ill. Adm. Code 1774.13(d). Section 1774.13(d)(6) publication requirements have been met.

A sediment pond exemption is requested for an area delineated in the application. The regulations at 62 Ill. Adm. Code 1817.46(e) allow the Department to grant exemptions from the requirement to pass all disturbed drainage through a siltation structure when:

a. The disturbed drainage area within the total disturbed area is small; and

b. The permittee demonstrates that siltation structures and alternate sediment control measures are not necessary for drainage from the disturbed drainage areas to meet the effluent limitations and water quality standards for the receiving waters set forth in Section 1817.42.

The Department has determined that the area for which a sediment pond exemption is requested meets the criteria established in Section 1817.46(e) and hereby grants an exemption from the use of a sedimentation pond for this area.

Sediment control measures necessary to minimize sediment loss outside the permit area shall be in place and functional, prior to any disturbance. All disturbed area, including any stockpiled soil material, shall be vegetated and/or mulched as soon as those activities are completed.

RECEIVED
MAR 23 2012
IL Environmental Protection Agency
MARION REGIONAL OFFICE

The fee for the area will be $16.00. The fee is comprised of $16.00 for non-surface mining area ($5/acres x .064 acres x 5 years the bond is in force).

The bond for the area will be $6,128. Copies of bond form SCML-2 have been enclosed for your use. For additional bonding and other forms, please contact this office or download a copy from the web at: www.dnr.state.il.us/mines/lrd/forms.htm. Please note many forms have been modified. **Only** the most current versions will be accepted.

Upon receipt by the Department of the fee and bond, plus forward two complete copies of your request letter and map(s) to Ronald Morse, Illinois Environmental Protection Agency, 2309 West Main Street, Marion, Illinois 62959, mining activities on these 0.64 acres may commence, following Department approval.

All conditions and provisions contained in the approved permit also apply to this revision. Approval from this agency does not relieve Williamson Energy from obtaining approval from other agencies requiring such.

Should you have any questions, please contact Brad Murphy at our Benton office.

Sincerely,

Scott K. Fowler, Supervisor
Land Reclamation Division

SKF:CBM:gr

Enclosure
cc: B. Murphy
R. Morse
M. Parrish
J. Slapak

STATE OF ILLINOIS

ENVIRONMENTAL PROTECTION AGENCY

Subject: Williamson Energy, LLC – Pond Creek Mine

Data: Log No. 6141-12

Reviewed by: I. Ward **Date:** 03-09-12

Log No. 6141-12 ⇒ IBR to OMM Permit No. 375

Log No. 6141-12

- A permit area consisting of 0.64 acres
- Facility is located in Section 13, T8S, R4E, Williamson County, Illinois.
- Permit to be utilized for the construction of the borehole for the batch material supply of crushed stone and concrete to the underground mine.
- Runoff from the area approved herein will be controlled by silt fence, mulching, seeding, vegetation, rock check dams, erosion control blankets, etc.

* Action: Prepare Subtitle D Permit No.2012-MA-6141.

6141 · 112
R11936
Due date 4-13-12

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Office: 618-983-3020 Fax: 618-983-3017

0.64 ACRES NON-CONTIGUOUS INCIDENTAL BOUNDARY REVISION FOR PERMIT NO. 375

WILLIAMSON COUNTY, IL
POND CREEK MINE NO. 1

FEBRUARY 29, 2012

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Office: 618-983-3020 Fax: 618-983-3017

February 29, 2012

Mr. Larry Crislip
Illinois Environmental Protection Agency
Mine Pollution Control Program
2309 West Main
Marion, IL 62959

Re: Incident Boundary Revision
Service Borehole
Pond Creek No. 1 Mine, Permit #375

Mr. Crislip:

Please find enclosed (2) copies of a 0.64 acre non-contiguous IBR application to the Pond Creek No. 1 Mine, Permit #375. The IBR will be used for drilling a service borehole. Please refer to the enclosed material for details of the IBR.

Should additional information or questions exist with regard to this proposed IBR, please contact me directly at (618) 983-3020 Ext 154 or (618) 889-8905.

Respectfully submitted,

James Miller

James Miller, PE
Authorized Representative
Williamson Energy, LLC

RECEIVED
MAR 0 2 2012
IL Environmental Protection Agency
MARION REGIONAL OFFICE

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Office: 618-983-3020 Fax: 618-983-3017

February 29, 2012

Mr. Scott Fowler, Supervisor
Office of Mines and Minerals
Land Reclamation Division
Illinois Dept. of Natural Resources
One Natural Resources Way
Springfield, IL 62702-1271

Re: Incident Boundary Revision
Service Borehole
Pond Creek No. 1 Mine, Permit #375

Dear Mr. Fowler:

Please find enclosed an original and one copy of a 0.64 acre non-contiguous IBR application to the Pond Creek No. 1 Mine, Permit #375.

Please be advised that one copy of this IBR application has also been sent to Mr. Brad Murphy in the Benton office.

Should additional information or questions exist with regard to this proposed IBR, please contact me directly at (618) 983-3020 Ext 154 or (618) 889-8905.

Sincerely,

James Miller

James Miller, P.E.
Authorized Representative
Williamson Energy, LLC

Cc: ILDNR/OMM Benton attn. B. Murphy (1) +.pdf
ILEPA Marion, attn. L. Crislip (2) +.pdf

Permit ID 375 IBR
Rev Date 2/29/12

State of Illinois
Department of Natural Resources
Office of Mines and Minerals
One Natural Resources Way
Springfield, Illinois 62702-1271

APPLICATION FOR SURFACE COAL MINING AND RECLAMATION OPERATIONS PERMIT INCIDENTAL BOUNDARY REVISION IBR-1

PART I

(Application to be submitted 120 days (180 day for NPDES) prior to the desired effective date of the permit)

DATE: February 29, 2012

NOTICE

This state agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Ill Rev Stat 1989, Ch. 961/2, par. 7901.01 et seq. Disclosure of this information is voluntary, however failure to comply may result in this form not being processed. This form has been approved by the Forms Management Center.

1) A) General Information

(I) (We) (The) Williamson Energy, LLC
(Name of Company, Corporation, Partnership or Individual)

P. O. Box 99 Johnston City, ILL 62951 (Address) [618] 983-3020 (Telephone Number)

hereby submits application for an Incidental Boundary Revision to Permit No. #375

Name of Mine: Pond Creek No. 1 Mine

MSHA ID No. 11-03141

I, Anthony Webb
(vice president or his duly authorized representative)

under penalty of perjury declare that all information provided in this application is true and correct to the best of my knowledge.

Signature Anthony Webb
Title: Authorized Agent

EXISTING PERMIT ACREAGE 633.96 ADDITIONAL ACRES REQUESTED 0.64

Permit ID	375 IBR
Rev Date	2/29/12

B) **Indicate the type of disturbance and associated acreage.**

Type of Disturbance	Acreage		
	Existing Permit	IBR	Total
Area Stripping	20.13		20.13
Mine Waste Areas	277.39		277.39
Processing Areas & Support Facilities	136.67	0.64	137.31
Access, Haul Roads & Transport Facilities	23.57		23.57
Soil Storage Areas	75.70		75.70
Diversions	32.85		32.85
Coal Recovery (Gob & Slurry)	0.00		0.00
Other	30.46		30.46
Not to be Disturbed	37.19		37.19
Total	633.96	0.64	634.60

2) A) **Provide the name and address of every legal or equitable owner of record of the proposed IBR area.**

RESPONSE: See Attachment I.2.A

B) **Provide the name and address of the owner of record of all surface and subsurface areas contiguous to any part of the proposed IBR area.**

RESPONSE: See Attachment I.2.A.

C) **Show the location of owners of record of those lands, both surface and subsurface, included in or contiguous to the proposed IBR area on the pre-mining land use map or another map, if necessary.**

RESPONSE: See Map 1, Identification of Interests

3) **Provide name and address of any holder of record of leasehold interest for the proposed IBR area.**

RESPONSE: Williamson Energy, LLC
P. O. Box 99
Johnston City, IL 62951

4) **Affidavits, Certifications**

A) **Complete affidavit regarding applicant's legal right to enter and begin surface coal mining and reclamation operations in the IBR area and whether that right is the subject of pending litigation. Identify the documents upon which affidavit is based by type and date of execution and identify specific lands to which each document pertains and explain the legal rights claimed by the applicant (1778.15(a)). If the private mineral estate to be mined has been severed from the private surface estate, provide copies of the documents required under Section 1778.15(B)(1)-(3). On the permit map or other designated map show the boundaries of land within the permit area upon which the applicant has the legal right to enter and begin surface mining activities.**

RESPONSE: See Attachment I.2.A and I.4.A.

B) **Complete certification for engineering aspects of the application. In addition to the general certification, three specific certifications are included which are applicable only if the box in front of each is marked. The first two cover special permit requirements and should be marked only when they occur for the**

Permit ID 375 IBR
Rev Date 2/29/12

proposed permit. The third certification covers the Illinois Environmental Protection Agency permit requirements. In most cases, an Illinois registered engineer will be required to certify I.E.P.A. permit requirements. Except as otherwise provided all maps, plans and cross-sections included in the permit application shall be prepared by, or under the direction of, and sealed by a qualified registered professional engineer licensed under the Illinois Professional Engineering Act, a qualified registered structural engineer licensed under the Illinois Structural Engineering Act or if authorized by state law, a qualified registered professional land surveyor licensed under the Illinois Land Surveyors Act with assistance from experts in related fields.

RESPONSE: See Attachment I.4.B.

5) **Areas Designated Unsuitable for Mining**

A) **Does proposed IBR area include:**

1) **Lands within boundaries of the National Park System, National Wildlife Refuge System, National Recreation Areas, etc. [Section 1761.11(a)]?**

Yes [ ] No [X]

2) **National forest land?**

Yes [ ] No [X]

3) **Any land which will adversely affect any publicly owned park or places included in or eligible for listing in the National Register of Historic places, etc. [per 62 Ill. Adm. Code 1761.11(a)(3) or Section 10, (B)(c) of the SCM-1?**

Yes [ ] No [X]

If yes, complete Part II, Section 10, (B) & (C) of the SCM-1 or the UCM-1 Application.

4) **Any public roads, which are to be removed, relocated or temporarily closed?**

Yes [ ] No [X]

Indicate on the pre-mining land use map or other designated map the location of the public roads and attach a copy of the written agreement from the appropriate authority authorizing the relocation, removal or temporary closure. Describe the measures to be used to insure that the interest of the public and landowners affected will be protected.

RESPONSE: Not Applicable.

B) **Will the proposed IBR area be located:**

1) **Within 100 feet of the right-of-way line of any public road?**

Yes [X] No [ ]

If yes, explain proposed procedure for complying with regulation Section 1761.12 (c), including request for variance, if relevant. Provide location of public roads on pre-mining land use map or other

Permit ID 375 IBR
Rev Date 2/29/12

designated map. Describe the measures to be used to insure that the interest of the public and landowners affected will be protected.

RESPONSE: The access road will encroach upon the right-of-way of Dwina Road. No additional disturbance will be located within 100 feet of the right of way.

2) **Within 300 feet measured horizontally from any occupied dwelling?**

Yes [ ] No [X]

If yes, is waiver provided meeting requirements of Section 1761.12(d)?

3) **Within 300 feet measured horizontally of any public building, school, church, community or institutional building or public park?**

Yes [ ] No [X]

4) **Within 100 feet measured horizontally of a cemetery?**

Yes [ ] No [X]

C) **Are valid existing rights (per 1761.11) claimed for any part of the IBR area?**

Yes [ ] No [X]

If yes, provide documentation to substantiate claim.

RESPONSE: Not Applicable.

D) **Provide a draft copy of the proposed newspaper notice and name of local newspaper of general circulation in which advertisement of the application will be published, per 62 Ill. Adm. Code 1774.13(d)(6). Certification of publication is to be furnished to the Department and must be received prior to Department approval of the IBR.**

RESPONSE: Please see Attachment I.5.D.

Permit ID 375 IBR
Rev Date 2/29/12

PART II

PREMINING INFORMATION

Pre-mining information is to be displayed on pre-mining land use map unless otherwise indicated.

1) **Describe how the IBR area perimeter will be marked and discuss the method or system employed to locate permit area perimeter and set markers along it. Designate a reference point outside the IBR area if different than the original permit. Provide a description of the reference point and a sketch relating the reference point to the IBR area perimeter.**

RESPONSE: The IBR boundary will be delineated by using PVC and/or metal posts and will be located within eye sight of one another.

2) **Explain and locate areas where the IBR is contiguous to an existing permit.**

RESPONSE: The proposed IBR is not contiguous to the current permitted boundary, but does overly the Shadow Area of UG Mining Permit #375. See Map 1, Identification of Interests for a delineation of the IBR boundary and the relationship of IBR boundary to the existing permit boundary.

3) **Give the acreage of each land use within the proposed IBR and existing permit area, employing land use categories of Section 1701.5 listed below, and delineate on pre-mining land use map existing land uses in the proposed permit area and adjacent to it. Include on the pre-mining land use map the location of all buildings and identify the current use of these buildings.**

Pre-Mine Land Use	Acreage		
	Existing Permit	IBR	Total
Cropland	512.44	0.00	512.44
Pasture Land	0.00	0.00	0.00
Grazing land	0.00	0.00	0.00
Forestry	101.86	0.00	101.86
Residential	3.33	0.00	3.33
Industrial/Commercial	0.00	0.00	0.00
Recreation	0.00	0.00	0.00
Fish & Wildlife Habitat	14.89	0.64	15.53
Developed Water Resources	1.44	0.00	1.44
Undeveloped Land	0.00	0.00	0.00
Total	633.96	0.64	634.60

RESPONSE: See Pre-Mining Land Use Map.

4) **Soils Information**

A) Does the submitted soils map represent a map developed by the National Resources Conservation Service (NRCS)?

Yes [X] No [ ]

If no, explain:

B) Delineate on the soils map(s) the area, which will incur actual mining (removal of overburden and/or deposition of overburden for the extraction of coal).

Permit ID 375 IBR
Rev Date 2/29/12

RESPONSE: No removal of overburden or deposition of overburden for the extraction of coal will occur on the IBR area. Proposed site disturbance is minimal and will include a single cased drill hole and short access driveway. Topsoil material will be temporarily stored on site.

C) Are any of the identified map units correlated as prime farmland by NRCS criteria?

Yes [X] No [ ]

If yes, explain and provide documentation to meet the requirements of Section 1785.17, if a determination for grandfathering and/or negative determination is sought. If prime farmlands exist which will not meet the exemption criteria described above, the approved prime farmlands restoration plan must be followed.

RESPONSE: An existing gravel road provides access for adjacent landowners from Dwina Road. The road includes a total of 0.28 acres Class 2 Subclass E capability soils.

D) Submit, by completing soils information chart, acreage totals of each map unit (soil type and slope classification) and land use capability classes in the IBR area and the percent slope range of each lettered slope classification used on the soil map.

RESPONSE: See Attachment II.4.

E) Provide, by completing soil information chart, acreage for each of the map units of high capability land (including grandfathered and negatively determined prime farmland) and non-cropland capability land with respect to areas which will be mined and areas which will incur other forms of disturbance (i.e., roads, ditches, etc.). Identify and provide map unit acreage values, if any, for areas which will not be disturbed.

RESPONSE: See Attachment II.4.

F) Are selected overburden materials proposed to be used in lieu of or as a supplement to the A-horizon?

Yes [ ] No [X]

If yes, provide the appropriate information required under 1780.18(b)(4)/1784.13(b)(4).

RESPONSE: Not Applicable.

Permit ID 375 IBR
Rev Date 2/29/12

PART III

OPERATIONS PLAN

1) **Explain the proposed operation and why the IBR is needed. Locate on a mining operations map.**

RESPONSE: The proposed IBR will include a steel cased borehole for batch delivery of crushed stone and concrete supplies to the underground mine. Delivered products will be offloaded directly from the truck to the underground mine via the borehole. The borehole will be drilled to an approximate twelve inch diameter and lined to an approximate ten inch finished diameter extending approximately 470ft +/- 5ft to the active underground works. Materials are commonly used for underground construction and maintenance. An existing gravel lane will be upgraded to allow delivery truck access from Dwina Road. Please see the attached Mining Operations Map for site layout. Soil stockpiles will be seeded with a cover crop to minimize exposure to excessive water and wind erosion. Mulch, chemical binders or other stabilization techniques may be used, as required for stockpile protection. Signs will be posted to identify topsoil piles.

2) **Surface Drainage Control**

A) 1) **Locate on the mining operations map or on a separate drainage map all proposed drainage control systems and show drainage patterns of all affected mining areas.**

RESPONSE: Disturbed area drainage will be controlled with proven alternate methods of drainage control which may include installation of silt fencing, straw bale containment check dams, earthen berms and/or mulched filter strips. Following completion of the access driveway and borehole installation, long term surface drainage will be controlled by well-established vegetative cover.

2) **Will all surface drainage from the affected mining area be collected and treated prior to leaving the IBR area?**

Yes [ ] No [X]

If yes, delineate how and where surface drainage will be collected and treated, and list the permit numbers and type of permit that the drainage control systems are operated under. If the above answer is no, explain how regulatory compliance will be achieved without treatment, i.e., address the requirements of 1816.46(e)/1817.46(e).

RESPONSE: See Part III.2.A.1.

B) **Will all surface drainage from unaffected areas be intercepted and diverted around the affected mining area?**

Yes [ ] No [X]

If no, please discuss.

RESPONSE: See Part III.2.A.1.

C) **Overland Flow Diversions and Sediment Ponds. Are either overland flow diversions or sediment ponds to be constructed?**

Yes [ ] No [X]

Permit ID 375 IBR
Rev Date 2/29/12

If yes, complete applicable parts of the SCM-1 or UCM-1 Part IV (Surface Drainage Control).

D) Does a perennial or intermittent stream occur within the proposed IBR area?

Yes [ ] No [X]

If yes, is an exception to the 100' buffer zone being requested or is a stream diversion being proposed. For an exception to the 100' buffer zone, indicate how compliance with 1816.57/1817.57 will be assured. For a stream diversion, complete applicable parts of the SCM-1 or UCM-1.

RESPONSE: Not Applicable.

3) Roads and other activities

A) Are roads to be constructed in the IBR area?

Yes [X] No [ ]

If yes, complete the applicable part of the SCM-1or UCM-1 (transportation facilities).

RESPONSE: An existing right-of-way lane used by adjacent landowners for property access from Dwina Road will be used to access the service borehole location and will be incorporated as part of the IBR. The lane profile will not be modified and since it is at the point of a drainage divide, culvert design is not applicable. However, the road surface will be upgraded and maintained to handle the appropriate payload capacity. A profile of the access road is shown on Mining Operations Map.

B) If the operations involve other activities not specifically addressed above, complete applicable parts of the SCM-1 or UCM-1.

RESPONSE: No other activities are proposed.

4) Are any existing structures proposed for utilization in the IBR?

Yes [ ] No [X]

If yes, complete Part IV.4 of the SCM-1.

RESPONSE: Not Applicable.

Permit ID	375 IBR
Rev Date	2/29/12

PART IV

RECLAMATION PLAN

1) Provide a reclamation plan map outlining proposed reclamation of the lands within the proposed IBR area and state how the IBR area will be reclaimed in conformity with the original plan.

RESPONSE: When delivery of materials to the underground mine is no longer required at this location, the casing will be removed a minimum distance of four feet below the surface and the borehole will be sealed with concrete. All gravel less any pre-existing road base will be removed and topsoil will be replaced. The original #375 permit provides more detail regarding soil conservation and reclamation practices. The original permit will be followed with regard to soil handling and replacement. Pre-mine topography and land use will remain as is currently present at the site.

2) Post Mining Land Use

A) Provide a detailed description of proposed post-mining land uses and capabilities employing land use and capability categories listed below. Provide acreage figures for each post-mining land use proposed for the existing permit, the IBR area and total permit after inclusion of the IBR acreage and designate the post-mining land uses on the Post Mining Land Use Map. Acreage figures for post-mining land use must differentiate between mined and surface disturbance areas based on the mining line used in the pre-mining section of the application.

Land Use	Capability								
	Existing Permit (ac)			IBR (ac)			Total (ac)		
	Prime	HCap	NonCrop	Prime	HCap	NonCrop	Prime	HCap	NonCrop
Cropland			0.00						0.00
Pasture Land			0.00						0.00
Grazing Land			0.00						0.00
Forestry			13.36						13.36
Residential			0.00						0.00
Industrial/Commercial			0.00						0.00
Recreation			0.00						0.00
Fish & Wildlife Habitat (Herbacious)			34.83			0.64			35.47
Fish & Wildlife Habitat (Woody)			566.51						566.51
Fish & Wildlife Habitat (Wetland)			0.00						0.00
Developed Water Resources			19.26						19.26
Undeveloped Land			0.00						0.00
Total			633.96						634.60

Prime: Prime farmland
HCap: High Capability - meeting productivity requirements of 62 Ill. Adm. Code 1825.
NonCrop: Non-Cropland - All soils which do not qualify as prime farmland or high capability.

Permit ID 375 IBR
Rev Date 2/29/12

3) **Pursuant to Section 1784.21 the applicant shall provide a protection and enhancement plan for the Indiana bat meeting the specifications of the July 2009 Range-wide Indiana bat protection and enhancement plan guidelines developed by the U.S. Fish and Wildlife Service and the Office of Surface Mining, or justify why no protection and enhancement plan is required under those guidelines.**

RESPONSE: The IBR permit area is an open field. No trees are present on the site and the permit boundary has been situated so that no trees will be affected by this permitted area. Therefore, the Protection and Enhancement Plan will not be necessary. Refer to the Pre-Mining Land Use Map 3 for an orthophotographic map of the site with the IBR boundary delineated.

Permit ID	375 IBR
Rev Date	2/29/12

Attachment List

Attachment I.2.A	Property Ownership Information
Attachment I.4.A	Real Estate Affidavit
Attachment I.4.B	Engineering Certification
Attachment I.5.D	Newspaper Public Notice
Attachment II.4	Soils Information Chart

Permit ID	375 IBR
Rev Date	2/29/12

PROPERTY INDEX NO.	PROPERTY OWNERSHIP Owner of Record	PROPERTY LOCATION Within	PROPERTY LOCATION Adjacent	APPLICANT CONTROL Ownership Percentage	APPLICANT CONTROL ROE Type	APPLICANT CONTROL Comments
03-13-400-017	*Williamson Development Company, LLC	X		100%	Warranty Deed Dated: 4/14/2008	Recorded within the Office of the Williamson County Clerk and Recorder in Deed Record 479, Page 727.
03-13-400-003	*Williamson Development Company, LLC		X	100%	Warranty Deed Dated: 9/24/2008	Recorded within the Office of the Williamson County Clerk and Recorder in Deed Record 481, Page 85.
04-18-300-017	Allan D. & Terri L. Thompson 15862 Dwina Road Marion, IL 62959		X	100%	Warranty Deed Dated: 6/28/2005	Recorded within the Office of the Williamson County Clerk and Recorder in Deed Record 470, Page 484.
	*New River Royalty, LLC 3801 PGA Boulevard, Suite 903 Palm Beach Gardens, FL 33410				Notice and Affidavit of Merger Dated: 8/12/2010	Recorded within the Office of the Williamson County Clerk and Recorder in Miscellaneous Record 330, Page 922

PARCEL NOS.	PROPERTY OWNERSHIP Owner of Record	PROPERTY LOCATION Within	PROPERTY LOCATION Adjacent	APPLICANT CONTROL Ownership Percentage	APPLICANT CONTROL ROE Type	APPLICANT CONTROL Comments
04-18-700-003	WPP, LLC Suite 300, 1035 Third Ave. Huntington, WV 25727	X		100%	Special Warranty Deeds Dated: 1/20/2006	Recorded within the Office of the Williamson County Clerk and Recorder in Deed Record 472, Page 571.
03-13-700-007	Williamson Energy, LLC P. O. Box 99 Johnston City, IL 62951	X		0%	Short Form of Amended & Restated Coal Mining Lease Agreement Dated: 8/14/2006	Recorded within the Office of the Williamson County Clerk and Recorder in Miscellaneous Record 301, Page 480.
	Coal Properties Corporation Involuntarily dissolved on 6/04/02. No determination of successor.	X			Special Warranty Deed Dated 8/22/1990	Recorded within the Office of the Williamson County Clerk and Recorder in Deed Record 420, Page 321.

R11950

Permit ID	375 IBR
Rev Date	2/29/12

REAL ESTATE AFFIDAVIT
LEGAL RIGHT TO ENTER & CONDUCT MINING SUPPORT OPERATIONS

I, Anthony Webb
(Individual or Individuals)
under penalty of perjury declare on behalf of the applicant, Williamson Energy, LLC, that said applicant has valid documents which bestow upon the applicant a legal right to enter and commence surface coal mining and reclamation operations upon lands contained in the proposed IBR area, and that such legal right is not in any way the subject of pending court litigation.

Dated this 29th day of February 2012.

Signed: Anthony Webb Authorized Agent
Signature/Title

State of Illinois

County of Williamson

Signed and subscribed to before me on 2-29-12 by Anthony Webb
(date) (name of person)

OFFICIAL SEAL
CATHY L. SKELTON
Notary Public - State of Illinois
My Commission Expires Feb 15, 2016

Cathy L Skelton
(Signature of Notary Public)

Permit ID	375 IBR
Rev Date	2/29/12

ENGINEERING CERTIFICATION

I hereby certify the engineering design used in preparation of this application, attachments, and supplements were done by me or under my direct supervision.

I further certify to the best of my knowledge all such design is in accordance with all applicable local, state and federal laws, rules and regulations. I have placed an "X" in the box below if that item is relevant.

	Whereas the Reclamation Plan calls for an alternative land use, I also certify the plans to conform to applicable accepted standards for adequate land stability, drainage, vegetative cover, and aesthetic design appropriate for the post-mine use of the site.
	Whereas the operation proposes disposal of spoil or waste materials in areas other than mining workings or excavations, I also certify such fills are designed in accordance with recognized professional standards and all applicable laws.
X	Certification of Illinois Environmental Protection Agency - 35 Ill. Adm. Code 405.104(a) Permit. In my professional judgment, the plans and specifications submitted as part of this application describe an operation which will meet all applicable effluent and water quality standards. I certify that I am familiar with all of the plans, specifications, reports, and maps submitted as part of this application and that said plans, etc. are accurate insofar as they represent existing conditions.

James M. Miller, Chief Engineer
Name

062-059719
Illinois Registration Number (seal)

Mach Mining, LLC
Firm

(618) 983-3020
Phone Number

P. O. Box 99
Address

Johnston City, Illinois 62951

James Miller
Signature

2/29/12
Date

SEAL



Permit ID	375 IBR
Rev Date	2/29/12

Public Notice

Pursuant to the Surface Coal Mining Land Conservation and Reclamation Act (PA-81-1015, as amended) and the Rules and Regulations of the Act, Williamson Energy, LLC, P. O. Box 99, Johnston City, IL 62951 hereby gives notice that on _____ 2012, an incidental boundary revision has been submitted to the Illinois Department of Natural Resources, Office of Mines and Minerals, Land Reclamation Division, One Natural Resources Way, Springfield, IL 62707-1271. The IBR application is for 0.64 acres located West of and adjacent to Dwina Road in the S1/2 of the NE¼ of the NE¼ of the SE¼ of Section 13, T8S, R3E, Williamson County.

The IBR proposes constructing a mine support facility including a service borehole for batch material supply of crushed stone and concrete to the underground mine. The access road to the facility will encroach upon the right-of-way of Dwina Road.

Copies of the application are on file for public viewing at Illinois Department of Natural Resources, Office of Mines and Minerals, 503 East Main Street, Benton, Illinois 62812, and at the Springfield office. Public hearing requests regarding activity within the public road right-of-way may be submitted no later than fourteen [14] days from the publication of this notice. Written comments concerning the operations should be submitted to the Illinois Department of Natural Resources Springfield office no later than seven [7] days from the date of this notice.

Permit ID 375 IBR

Rev Date 2/29/12

Soil Identification				Mining Area							Support Area						
				Prime Soils		NonPrime Soils					Prime Soils		NonPrime Soils				
Soil Map Symbol	Soil Name	Slope Class [%]	Capability Class	Prime Farmland [acres]	Neg Det PFL [acres]	High Capable [acres]	Low Capable [acres]	Alternate Topsoil [acres]	Previous Mined [acres]	Totals [acres]	Prime Farmland [acres]	Neg Det PFL [acres]	High Capable [acres]	Low Capable [acres]	Alternate Topsoil [acres]	Previous Mined [acres]	Totals [acres]
10D	Plumfield silty clay loam	10-18	VIe										0.36				0.36
301B	Grantsburg silt loam	2-5	IIe									0.28					0.28
			Total									0.28	0.36				0.64

Note : Soil information was determined from the Soil Survey of Williamson County, Illinois, 1978, prepared by the United States Department of Agriculture, Soil Conservation Service in cooperation with the Illinois Agricultural Experiment Station.

R11954

Williamson County, Illinois (IL199)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10D	Plumfield silty clay loam, 10 to 18 percent slopes	0.36	55.8%
301B	Grantsburg silt loam, 2 to 5 percent slopes	0.28	44.2%
Totals for Area of Interest		0.64	100.0%

Detailed Soil Map Units

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil

series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Land capability classification

Determinations of land capability involve consideration of the risks of land damage from erosion and other causes and the difficulties in land use resulting from physical land characteristics and from climate. Land capability, as used in the USA, is an expression of the effect of physical land characteristics and climate on the suitability of soils for crops that require regular tillage, for grazing, for woodland, and for wildlife habitat.

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, forestland, or engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit.

Capability classes, the broadest groups, are designated by the numbers 1 through 8. Capability classes are determined for both irrigated and nonirrigated land. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have slight limitations that restrict their use.

Class 2 soils have moderate limitations that restrict the choice of plants or require moderate conservation practices.

Class 3 soils have severe limitations that restrict the choice of plants or require special conservation practices, or both.

Class 4 soils have very severe limitations that restrict the choice of plants or require very careful management, or both.

Class 5 soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 7 soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 8 soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, 2e. In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class 5 are subject to little or no erosion. These soils have other limitations that restrict their use to pasture, rangeland, forestland, wildlife habitat, or recreation. The significance of each subclass letter is described as follows:

Subclass letter e shows that the main problem is the hazard of erosion unless close-growing plant cover is maintained. The susceptibility to erosion and past erosion damage are the major soil-related factors affecting the soils that are assigned this subclass letter.

Subclass letter w shows that water in or on the soil interferes with plant growth or cultivation. In some soils the wetness can be partly corrected by artificial drainage. Ponding, a high water table, and/or flooding affect the soils that are assigned this subclass letter.

Subclass letter s shows that the soil has limitations within the root zone, such as shallowness of the root zone, a high content of stones, a low available water capacity, low fertility, and excessive salinity or sodicity. Overcoming these limitations is difficult.

Subclass letter c shows that the chief hazard or limitation is climate that is very cold or very dry. This subclass letter is used only in some parts of the United States.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, 2e-4 and 3e-6. The use of this category of the land capability classification is a state option. This category of the system is not stored in the soil survey database. For information about capability units, please contact the local NRCS State Soil Scientist. For locations of the offices of the State Soil Scientists, click on the State Contacts link in the upper portion of this window.

Reference:
"National Soil Survey Handbook," Part 622 (00-Exhibit 1), USDA, NRCS

Williamson County, Illinois

10D—Plumfield silty clay loam, 10 to 18 percent slopes

Map Unit Setting

Elevation: 360 to 840 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition

Plumfield and similar soils: 90 percent

Description of Plumfield

Setting

Landform: Till plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess over glacial drift

Properties and qualities

Slope: 10 to 18 percent
Depth to restrictive feature: 5 to 20 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Very low (about 1.0 inches)

Interpretive groups

Land capability (nonirrigated): 6e

Typical profile

0 to 5 inches: Silty clay loam
5 to 12 inches: Silt loam
12 to 36 inches: Silt loam
36 to 60 inches: Silt loam

Data Source Information

Soil Survey Area: Williamson County, Illinois
Survey Area Data: Version 7, Jan 20, 2012

Williamson County, Illinois

301B—Grantsburg silt loam, 2 to 5 percent slopes

Map Unit Setting

Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition

Grantsburg and similar soils: 90 percent

Description of Grantsburg

Setting

Landform: Loess hills
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Peoria and roxana loess over residuum

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: 24 to 40 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum: 4.0
Available water capacity: Moderate (about 6.5 inches)

Interpretive groups

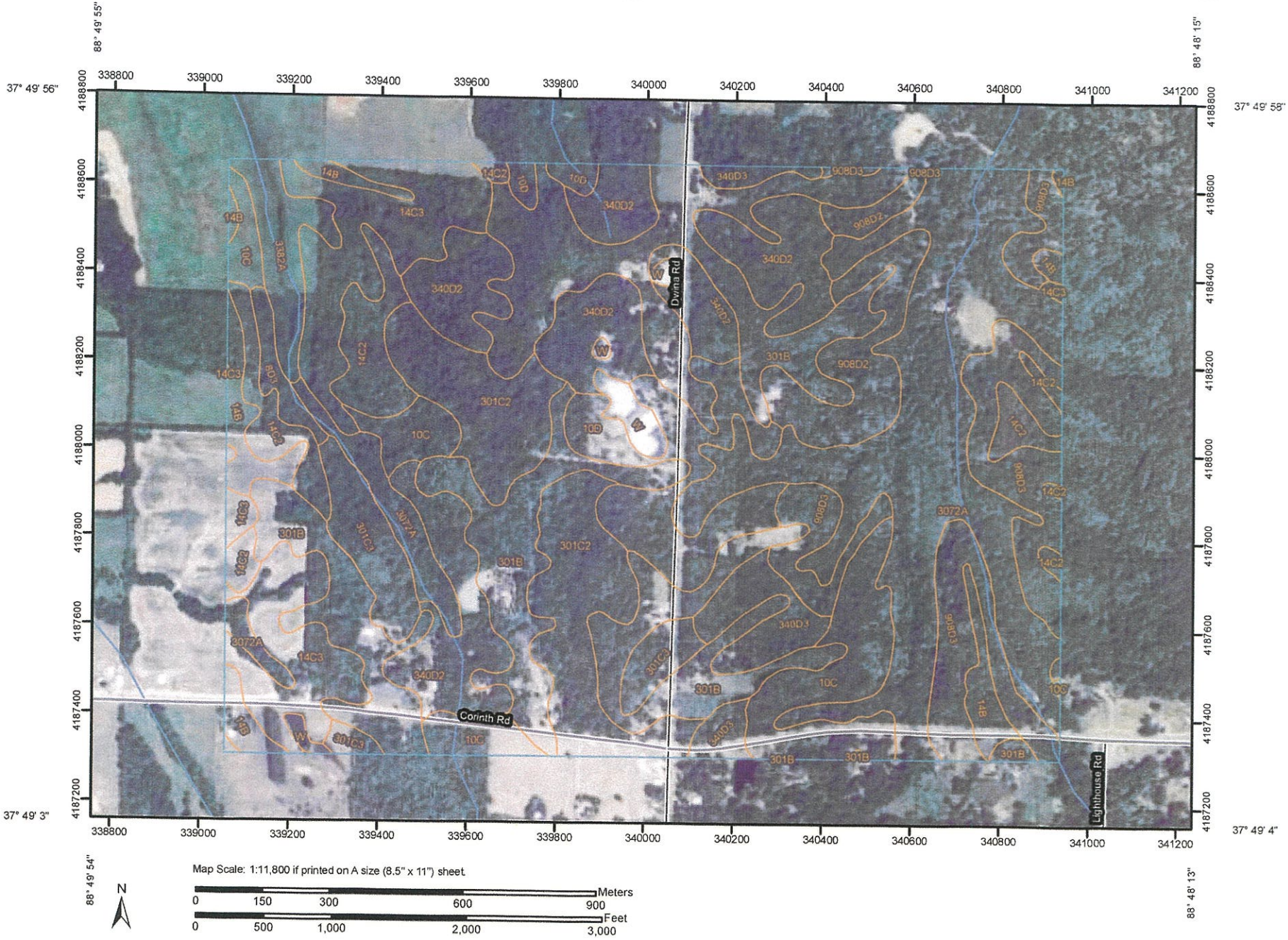
Land capability (nonirrigated): 2e

Typical profile

0 to 11 inches: Silt loam
11 to 24 inches: Silt loam
24 to 38 inches: Silty clay loam
38 to 61 inches: Silt loam
61 to 80 inches: Silt loam

Data Source Information

Soil Survey Area: Williamson County, Illinois
Survey Area Data: Version 7, Jan 20, 2012



USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

R11960

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:11,800 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 16N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Williamson County, Illinois
Survey Area Data: Version 7, Jan 20, 2012

Date(s) aerial images were photographed: 6/13/2007

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

R11961

Map Unit Legend

Williamson County, Illinois (IL199)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
8D3	Hickory clay loam, 10 to 18 percent slopes, severely eroded	4.1	0.7%
10C	Plumfield silty clay loam, 5 to 10 percent slopes	36.3	5.8%
10D	Plumfield silty clay loam, 10 to 18 percent slopes	30.7	4.9%
14B	Ava silt loam, 2 to 5 percent slopes	17.7	2.8%
14C2	Ava silt loam, 5 to 10 percent slopes, eroded	25.7	4.1%
14C3	Ava silty clay loam, 5 to 10 percent slopes, severely eroded	49.3	7.9%
301B	Grantsburg silt loam, 2 to 5 percent slopes	119.0	19.0%
301C2	Grantsburg silt loam, 5 to 10 percent slopes, eroded	47.9	7.7%
301C3	Grantsburg silt loam, 5 to 10 percent slopes, severely eroded	18.3	2.9%
340D2	Zanesville silt loam, 10 to 18 percent slopes, eroded	68.9	11.0%
340D3	Zanesville silty clay loam, 10 to 18 percent slopes, severely eroded	16.2	2.6%
908D2	Hickory-Kell silt loams, 10 to 18 percent slopes, eroded	22.0	3.5%
908D3	Hickory-Kell clay loams, 10 to 18 percent slopes, severely eroded	49.9	8.0%
3072A	Sharon silt loam, 0 to 2 percent slopes, frequently flooded	102.3	16.4%
3382A	Belknap silt loam, 0 to 2 percent slopes, frequently flooded	11.7	1.9%
W	Water	5.5	0.9%
Totals for Area of Interest		**625.4**	**100.0%**

EcoCAT
Ecological Compliance Assessment Tool

Applicant:	James Miller	*IDNR Project #:*	1209752
Contact:	James Miller	Alternate #:	1209751
Address:	16824 Liberty School Road Mairon, IL 62959	Date:	02/28/2012

Project: Service Borehole - batch material supply
Address: Dwina Road, Marion

Description: Site proposed for installation of a service borehole to supply batch materials for underground mining construction

Natural Resource Review Results

This project was submitted for information only. It is not a consultation under Part 1075.

The Illinois Natural Heritage Database contains no record of State-listed threatened or endangered species, Illinois Natural Area Inventory sites, dedicated Illinois Nature Preserves, or registered Land and Water Reserves in the vicinity of the project location.

Location

The applicant is responsible for the accuracy of the location submitted for the project.

County: Williamson
Township, Range, Section:
8S, 3E, 13



IL Department of Natural Resources Contact
Impact Assessment Section
217-785-5500
Division of Ecosystems & Environment

Disclaimer

The Illinois Natural Heritage Database cannot provide a conclusive statement on the presence, absence, or condition of natural resources in Illinois. This review reflects the information existing in the Database at the time of this inquiry, and should not be regarded as a final statement on the site being considered, nor should it be a substitute for detailed site surveys or field surveys required for environmental assessments. If additional protected resources are encountered during the project's implementation, compliance with applicable statutes and regulations is required.

Terms of Use

By using this website, you acknowledge that you have read and agree to these terms. These terms may be revised by IDNR as necessary. If you continue to use the EcoCAT application after we post changes to these terms, it will mean that you accept such changes. If at any time you do not accept the Terms of Use, you may not continue to use the website.

1. The IDNR EcoCAT website was developed so that units of local government, state agencies and the public could request information or begin natural resource consultations on-line for the Illinois Endangered Species Protection Act, Illinois Natural Areas Preservation Act, and Illinois Interagency Wetland Policy Act. EcoCAT uses databases, Geographic Information System mapping, and a set of programmed decision rules to determine if proposed actions are in the vicinity of protected natural resources. By indicating your agreement to the Terms of Use for this application, you warrant that you will not use this web site for any other purpose.

2. Unauthorized attempts to upload, download, or change information on this website are strictly prohibited and may be punishable under the Computer Fraud and Abuse Act of 1986 and/or the National Information Infrastructure Protection Act.

3. IDNR reserves the right to enhance, modify, alter, or suspend the website at any time without notice, or to terminate or restrict access.

Security

EcoCAT operates on a state of Illinois computer system. We may use software to monitor traffic and to identify unauthorized attempts to upload, download, or change information, to cause harm or otherwise to damage this site. Unauthorized attempts to upload, download, or change information on this server is strictly prohibited by law. Unauthorized use, tampering with or modification of this system, including supporting hardware or software, may subject the violator to criminal and civil penalties. In the event of unauthorized intrusion, all relevant information regarding possible violation of law may be provided to law enforcement officials.

Privacy

EcoCAT generates a public record subject to disclosure under the Freedom of Information Act. Otherwise, IDNR uses the information submitted to EcoCAT solely for internal tracking purposes.

U.S. Fish and Wildlife Service

National Wetlands Inventory

Wetlands Map

Feb 28, 2012



Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

Riparian

- Herbaceous
- Forested/Shrub

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

User Remarks:

Permit #375 Incidental Boundary Revision

R11965

DOCUMENT

69

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
MINE RELATED WATER POLLUTION CONTROL PERMIT

PERMIT NO.: 2015-MA-6039

DATE ISSUED: February 23, 2015

FINAL PLANS, SPECIFICATIONS, APPLICATION AND SUPPORTING DOCUMENTS
PREPARED BY: Anthony Webb
Williamson Energy, LLC

EXPIRATION DATE: January 31, 2020

LOG NUMBERS: 6039-12

SUBJECT: Williamson Energy, LLC
Pond Creek No. 1 Mine

Williamson Energy, LLC
P.O. Box 99
Johnston City, Illinois 62951

Permit is hereby granted to the above designated permittee to construct and operate the surface facilities to support the underground mine facility described as follows:

A permit area consisting of 4.65 acres, also identified as Incidental Boundary Revision (IBR) No. 38 to OMM Permit No. 375, located in Section 14, Township 8 South, Range 4 East, Williamson County, Illinois, as described and depicted in IEPA Log No. 6039-12 is to be utilized for the installation of a ventilation shaft site. This area will consist of access road, ventilation shaft, fan, power borehole and associated structures.

Runoff from the area approved herein will be controlled by silt fence, mulching, seeding, vegetation, rock check dams, erosion control blankets, etc.

The abandonment plan shall be executed and completed in accordance with 35 Ill. Adm. Code 405.109.

(Continued on Page 2)

This permit is issued in accordance with the Illinois Environmental Protection Act of 1970, the Title 35, Subtitle C: Water Pollution and Subtitle D: Mine Related Pollution Regulations adopted pursuant thereto by the Illinois Environmental Protection Act. THE STANDARD CONDITIONS OF ISSUANCE INDICATED ON THE ATTACHMENT TO THIS PERMIT (PAGE 1a) MUST BE COMPLIED WITH IN FULL. READ ALL CONDITIONS CAREFULLY.

Joseph D. Stitely, P.E.
Acting Manager, Permit Section
Mine Pollution Control Program
Bureau of Water

cc: IDNR, Office of Mines and Minerals
IDNR, Division of Water Resources
BOW/MPCP/FOS/Marion

JDS:DM:cs/6999c/2-20-15

This Permit is issued subject to the following Special Condition. If such Special Condition requires additional or revised facilities, satisfactory engineering plan documents must be submitted to this Agency for review and approval for issuance of a Supplemental Permit.

Special Condition No. 1: This permit is issued with the expressed understanding that there shall be no surface discharge from these facilities. If such discharge occurs, additional or alternate facilities shall be provided. The construction of such additional or alternate facilities may not be started until a Permit for the construction is issued by the Agency.

6039 / 12
Due date: 2-29-12
R11969

Illinois Department of
Natural Resources
One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

Pat Quinn, Governor
Marc Miller, Director

January 10, 2012

Steve Sutphin
Alliance Consulting, Inc.
c/o Williamson Energy
124 Philpott Lane
Raleigh County Airport Industrial Park
Beaver, WV 25813-9502

Re: Permit No. 375
Incidental Boundary Revision No. 38

Dear Mr. Sutphin:

The appropriate Department technical staff has reviewed the proposed incidental boundary revision dated October 4, 2011 and the supplemental information dated November 14, 2011 and December 5, 2011, submitted by Williamson Energy for Pond Creek Mine, Permit No. 375. The request would add 4.65 acres to conduct surface coal mining activities. The additional acres would be used for a bleeder shaft and associated facilities.

The Department finds Williamson Energy has demonstrated in its request, and field inspections by the Department's field representative have confirmed that these areas (4.65 acres) meet the requirements for an incidental boundary change as outlined in 62 Ill. Adm. Code 1774.13(d). Section 1774.13(d)(6) publication requirements have been met.

1817.46(e) A sediment pond exemption is requested for an area delineated in the application. The regulations at 62 Ill. Adm. Code 1817.46(e) allow the Department to grant exemptions from the requirement to pass all disturbed drainage through a siltation structure when:

a. The disturbed drainage area within the total disturbed area is small; and

b. The permittee demonstrates that siltation structures and alternate sediment control measures are not necessary for drainage from the disturbed drainage areas to meet the effluent limitations and water quality standards for the receiving waters set forth in Section 1817.42.

The Department has determined that the area for which a sediment pond exemption is requested meets the criteria established in Section 1816/1817.46(e) and hereby grants an exemption from the use of a sedimentation pond for this area.

RECEIVED
JAN 19 2012
IL Environmental Protection Agency
MARION REGIONAL OFFICE

1761.11(d) The proposed permit area is within one hundred (100) feet of the outside right-of-way line of a public road in Williamson County, described as follows:

The proposed permit area is adjacent to the right-of-way of Corinth. The proposed activities in the permit area include an access road within 100 feet of the road.

No approvals from the authority with jurisdiction over the road were required.

The applicant provided proper public notice and opportunity for a public hearing. No hearing was requested and no written comments were submitted to the Department concerning these roads.

The Department finds the interests of the public and affected landowners will be protected from the proposed mining operations as a result of the measures to be taken by the applicant as described in the mining operations plan concerning this road.

The fee for the area will be $116.25. The fee is comprised of $116.25 for non-surface mining area ($5/acres x 4.65 acres x 5 years the bond is in force).

The bond for the area will be $27,595.00. Copies of bond form SCML-2 have been enclosed for your use. For additional bonding and other forms, please contact this office or download a copy from the web at: www.dnr.state.il.us/mines/lrd/forms.htm. Please note many forms have been modified. **Only** the most current versions will be accepted.

Upon receipt by the Department of the fee and bond, plus forwarding two complete copies of your request and maps to Ronald Morse, Illinois Environmental Protection Agency, 2309 West Main Street, Marion, Illinois 62959, mining activities on these 4.65 acres may commence, following Department approval.

All conditions and provisions contained in the approved permit also apply to this revision. Approval from this agency does not relieve Williamson Energy from obtaining approval from other agencies requiring such.

Should you have any questions, please contact Brad Murphy at our Benton office.

Sincerely,

Scott K. Fowler, Supervisor
Land Reclamation Division

SKF:CBM:gr

Enclosure

cc: B. Murphy
R. Morse
M. Parrish
J. Slapak

12071104.doc

STATE OF ILLINOIS
ENVIRONMENTAL PROTECTION AGENCY

Subject: Williamson Energy, LLC – Pond Creek Mine

Data: Log No. 6039-12

Reviewed by: D. Maschhoff **Date:** 2/20/15

Log No. 6039-12 ⇒ IBR No. 38 to OMM Permit No. 375

Log No. 6039-12

- IBR consisting of 4.65 acres located in Section 14, Township 8 South, Range 4 East, Williamson County.
- Activities in this IBR area will include drilling a ventilation shaft, constructing an access road, installing a ventilation fan and installation of an electrical line.
- This site is located due south of Corinth Road and west of the Illinois Central Railroad.
- Topsoil from this area will either be bermed along the site or place in the soil storage area.
- A small cuttings pit will be constructed to collect the cuttings from the shaft drilling, however, the shaft construction will be a raise bore operation and therefore the majority of the cuttings will be transported by the mines haulage system.
- Disturbance will be kept to a minimum. A sediment pond exemption is requested for this permit area. Silt fence and/or straw bales will be placed for drainage control.

* Action: Prepare Subtitle D Permit 2015-MA-6039.

R11972

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

Transmittal Letter

Project No. B11-500-1413

To: Illinois Environmental Protection Agency
Mine Pollution Control Program
2309 West Main Street
Marion, IL 62959

Date: January 19, 2012

If enclosures are not as noted, please inform us immediately

Attention: Ronald Morse

We Transmit:

☒ Herewith ☐ Under Separate Cover

For Your:

☐ Approval ☐ Record

☒ Review & Comment

☐ Use

The Following:

☐ Drawings ☐ Laboratory Data

☐ Specifications ☐ Field Data

☒ Other

Copies	Date	No.	Description
2			Copies of the 4.65 Acres Non0Contiguous IBR #38 for Permit 375

Remarks:

Per Mr. Scott Fowler's approval letter dated January 10, 2012(attached), two copies of the IBR are being submitted to IEPA.

If you have any questions, please contact me at (304) 255-0491; extension 113.

By: Steve Sutphin

Copies To: J Slapak, File

RECEIVED
JAN 20 2012
IL Environmental Protection Agency
MARION REGIONAL OFFICE

124 Philpott Lane, Beaver, WV 25813 Telephone: 304 / 255-0491 Fax: 304 / 255-4232

Alliance Consulting, Inc.
Engineers • Constructors • Scientists

4.65 ACRES NON-CONTIGUOUS INCIDENTAL BOUNDARY REVISION #38 FOR PERMIT NO. 375

WILLIAMSON COUNTY, IL
POND CREEK MINE NO. 1

Prepared for

WILLIAMSON ENERGY LLC
JOHNSTON CITY, IL

ALLIANCE PROJECT NO. B11-287-1413
SEPTEMBER, 2011

Summersville, WV

848 Northside Drive
Summersville, WV 26651
Telephone: (304) 883-2360
Fax: (304) 883-2361

Beckley, WV

Raleigh County Airport Industrial Park
124 Philpott Lane
Beaver, WV 25813-9502
Telephone: (304) 255-0491
Fax: (304) 255-4232

Canonsburg, PA

151 East Pike Street
Canonsburg, PA 15317
Telephone: (724) 745-3630
Fax: (724) 745-3631

Illinois Department of
Natural Resources

One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

Pat Quinn, Governor
Marc Miller, Director

January 10, 2012

Steve Sutphin
Alliance Consulting, Inc.
c/o Williamson Energy
124 Philpott Lane
Raleigh County Airport Industrial Park
Beaver, WV 25813-9502

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Incidental Boundary Revision No. 38

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The appropriate Department technical staff has reviewed the proposed incidental boundary revision dated October 4, 2011 and the supplemental information dated November 14, 2011 and December 5, 2011, submitted by Williamson Energy for Pond Creek Mine, Permit No. 375. The request would add 4.65 acres to conduct surface coal mining activities. The additional acres would be used for a bleeder shaft and associated facilities.

The Department finds Williamson Energy has demonstrated in its request, and field inspections by the Department's field representative have confirmed that these areas (4.65 acres) meet the requirements for an incidental boundary change as outlined in 62 Ill. Adm. Code 1774.13(d). Section 1774.13(d)(6) publication requirements have been met.

1817.46(e) A sediment pond exemption is requested for an area delineated in the application. The regulations at 62 Ill. Adm. Code 1817.46(e) allow the Department to grant exemptions from the requirement to pass all disturbed drainage through a siltation structure when:

a. The disturbed drainage area within the total disturbed area is small; and

b. The permittee demonstrates that siltation structures and alternate sediment control measures are not necessary for drainage from the disturbed drainage areas to meet the effluent limitations and water quality standards for the receiving waters set forth in Section 1817.42.

The Department has determined that the area for which a sediment pond exemption is requested meets the criteria established in Section 1816/1817.46(e) and hereby grants an exemption from the use of a sedimentation pond for this area.

RECEIVED
JAN 20 2012
IL Environmental Protection Agency
MARION REGIONAL OFFICE

1761.11(d) The proposed permit area is within one hundred (100) feet of the outside right-of-way line of a public road in Williamson County, described as follows:

The proposed permit area is adjacent to the right-of-way of Corinth. The proposed activities in the permit area include an access road within 100 feet of the road.

No approvals from the authority with jurisdiction over the road were required.

The applicant provided proper public notice and opportunity for a public hearing. No hearing was requested and no written comments were submitted to the Department concerning these roads.

The Department finds the interests of the public and affected landowners will be protected from the proposed mining operations as a result of the measures to be taken by the applicant as described in the mining operations plan concerning this road.

The fee for the area will be $116.25. The fee is comprised of $116.25 for non-surface mining area ($5/acres x 4.65 acres x 5 years the bond is in force).

The bond for the area will be $27,595.00. Copies of bond form SCML-2 have been enclosed for your use. For additional bonding and other forms, please contact this office or download a copy from the web at: www.dnr.state.il.us/mines/lrd/forms.htm. Please note many forms have been modified. **Only** the most current versions will be accepted.

Upon receipt by the Department of the fee and bond, plus forwarding two complete copies of your request and maps to Ronald Morse, Illinois Environmental Protection Agency, 2309 West Main Street, Marion, Illinois 62959, mining activities on these 4.65 acres may commence, following Department approval.

All conditions and provisions contained in the approved permit also apply to this revision. Approval from this agency does not relieve Williamson Energy from obtaining approval from other agencies requiring such.

Should you have any questions, please contact Brad Murphy at our Benton office.

Sincerely,

Scott K. Fowler, Supervisor
Land Reclamation Division

SKF:CBM:gr

Enclosure
cc: B. Murphy
R. Morse
M. Parrish
J. Slapak

SCML-2

State of Illinois
Department of Natural Resources
Office of Mines and Minerals - Land Reclamation Division
One Natural Resources Way, Springfield, IL 62702-1271

SURETY BOND

SURFACE-COAL MINING LAND CONSERVATION AND RECLAMATION ACT

Surety Company Bond No. _____

KNOW ALL MEN BY THESE PRESENTS, That the undersigned _____

_____ of _____

_____ as principal, and _____

_____, duly licensed to do business in the State of Illinois of _____

_____ as surety are held and firmly bound unto the People of the State of Illinois, in the penal sum of _____ Dollars ($_____

_____) for the payment of which sum, we hereby jointly and severally bind ourselves, our heirs, administrators, executors, successors, and assigns.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, that whereas, the above-named principal filed with the Department of Natural Resources, Office of Mines and Minerals Surface Coal Mining and Reclamation Operations Application No._____, a Permit to engage in surface coal mining and reclamation operations in the State of Illinois, under the terms and provisions of the Surface-Coal Mining Land Conservation and Reclamation Act, effective June 1, 1980.

NOTICE - This state agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under 225 ILCS 715/1 (Ill. Rev. Stat., Ch. 96 1/2 par. 4501 et seq.). Disclosure of this information is voluntary; however, failure to comply may result in this form not being processed. This form has been approved by the Forms Management Center.

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

Transmittal Letter

Project No. B11-500-1413

Office of Mines and Minerals
Land Reclamation Division
503 E. Main; FL001
Benton, IL 62812

Date: December 5, 2011

If enclosures are not as noted, please inform us immediately

Attention: Brad Murphy

We Transmit:

☒ Herewith ☐ Under Separate Cover

For Your:

☐ Approval ☐ Record

☒ Review & Comment

☐ Use

The Following:

☐ Drawings ☐ Laboratory Data

☐ Specifications ☐ Field Data

☒ Other

Copies	Date	No.	Description
3			1-Original & 2 Copies of Supplemental Information for Permit 375; 4.65 Ac. IBR

Remarks:

This information is being submitted in response to your November 17th email concerning borehole depths and diameters. These boreholes have been removed from the application.

If you have any questions, please contact me.

By: Steve Sutphin SMS

Copies To: J. Slapak, File

124 Philpott Lane, Beaver, WV 25813 Telephone: 304 / 255-0491 Fax: 304 / 255-4232

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

December 5, 2011

Project No. B11-500-1413

Mr. Charles Murphy
IDNR – Office of Mines & Minerals
Land Reclamation Division
503 E. Main Street
Benton, Illinois, 62812

Supplemental Information for
Incidental Boundary Revision for 4.65 Acres
Williamson Energy LLC - Permit No. 375
Pond Creek Mine No. 1
Williamson County, Illinois

Dear Mr. Murphy:

On behalf of our client, Williamson Energy, LLC, Alliance Consulting, Inc. is submitting three copies of supplemental information to address the agency's review. Please forward two copies to the appropriate reviewer in the Springfield office. The following summarizes our responses.

1. Part III.1 has been revised. According to our client, Williamson Energy, the boreholes for the water and power will not be drilled. References to the boreholes have been removed from Part III.1 and Map 6 S.F. (supplemental) has been revised.

If you have any questions or need additional information, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Stephen M. Sutphin
Project Manager

SMS:wmb
Enclosures

FILE: 11500-04

updated 02/25/2011

PART III

OPERATIONS PLAN

1) Explain the proposed operation and why the IBR is needed. Locate on a mining operations map.

RESPONSE: The purpose of this IBR is to permit 4.65 acres for the installation of a ventilation shaft site. MSHA has mandated that the mining operation must install an additional ventilation fan located in the bleeder entries of Tailgate No. 6. This IBR will consist of an infrequently used access road, a ventilation shaft, fan, and associated structures. Refer to Map 6 S.F. and Map 6 S.F. (Supplemental) for the location of the IBR area.

The 18 feet diameter hole will be drilled and cased to a 16 feet diameter to a depth of 365 feet. The casing will be grouted with concrete and a small fan will be installed. A 30 foot by 30 foot by 1 foot thick concrete pad will be constructed for the fan and the electronics associated with the fan. Power will be supplied to the site by coming off an existing power line. A 12 foot by 12 foot by 1 foot thick pad will be constructed for the transformer.

The site is located due south of Corinth Road and west of the Illinois Central Railroad. Topsoil from the IBR area will either be bermed along the site or placed in the soil storage area. A small cuttings pit will be constructed to collect the cuttings from the shaft drilling, however, the shaft construction will be a raise bore operation and therefore the majority of the cuttings will transported by the mine's haulage system.

Access to the site will be by an existing access road beside of an abandoned barn. Topsoil from the access road will be removed and stored and a minimum of one foot of gravel will be placed on the road.

The fan site will be in service during the mining of future longwall panels. Upon abandonment, the shaft will be backfilled and the site will be regarded, topsoil will be redistributed and the site will be revegetated with the approved seed mixture.

Upon abandonment, the entire disturbed area will be covered using the stored topsoil, seeded and mulched using the approved revegetation plan.

Refer to enclosed maps for the location of the IBR area outlined in red.

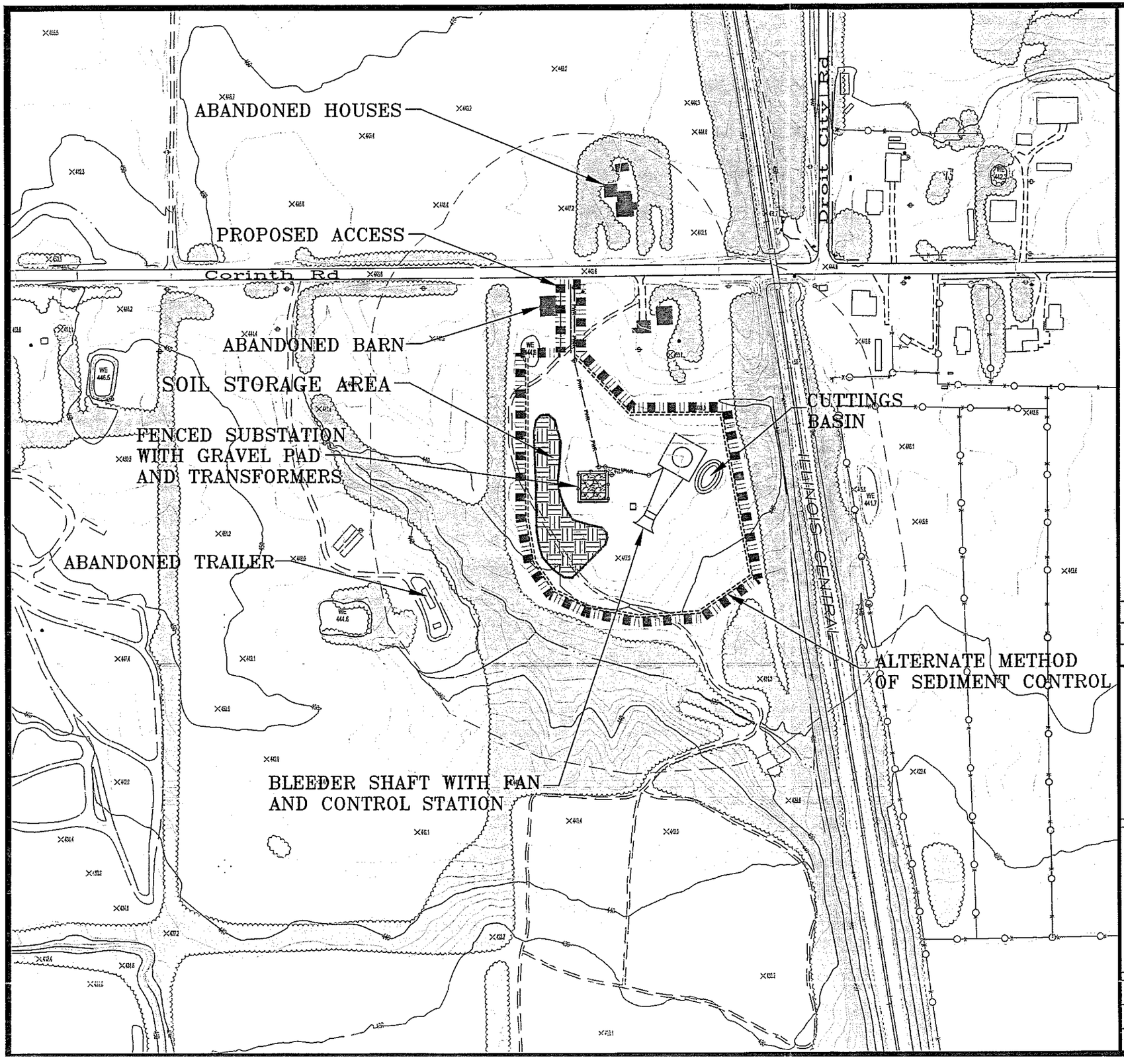
2) Surface Drainage Control

A) 1) Locate on the mining operations map or on a separate drainage map all proposed drainage control systems. Show drainage patterns of all affected mining areas.

RESPONSE: Refer to Map 6 S.F. Supplemental.

2) Will all surface drainage from the affected mining area be collected and treated prior to leaving the IBR area?

R11980



GENERAL INFORMATION

- PROPOSED IBR AREA (4.65 AC.)
- EPHEMERAL STREAMS
- ELECTRICAL POWER LINE
- POWER POLE
- TREES / SHRUBS
- STRUCTURES
- STRUCTURES OWNED BY NEW RIVER ROYALITY
- 300 FEET RADIUS
- UNIMPROVED ROADS / TRAILS
- DRIVEWAYS

200' 0 200' 400'

SCALE: 1"=200'

N

REV.	DATE	DESCRIPTION	
1	11/17/11	REMOVAL OF POWER & PUMP BOREHOLES	SMS

Alliance Consulting, Inc.

Engineers · Constructors · Scientists

BECKLEY, WV (304) 255-0491 | SUMMERSVILLE, WV (304) 883-2360 | CANONSBURG, PA (724) 745-3630

MAP 6

MAP 6 S.F. (SUPPLEMENTAL)

POND CREEK 1 MINE

Prepared For

WILLIAMSON ENERGY LLC.

JOHNSTON CITY, IL

CAD BY	SMS	10/02/11	PROJECT NO. B11-500-1413
CHECKED BY	SMS	10/06/11	
APPROVED BY	CEY	10/06/11	DRAWING NO. B11-500-B1

R11981

Alliance Consulting, Inc.
Engineers · Construction · Scientists

Steve Sutphin <ssutphin@aci-wv.com>

IBR dated 10-4-11 4.65 ac.

1 message

Murphy, Brad <Brad.Murphy@illinois.gov> **Thu, Nov 17, 2011 at 12:35 PM**
To: Steve Sutphin <ssutphin@aci-wv.com>
Cc: Jim Slapak <jslapak@machmining.com>

Again, we have to have borehole depth and dia. to calculate bond. Please email these dimensions to alan.meyers@illinois.gov and to me. I didn't see the dia. and depth for the two boreholes in the submittal but maybe it is somewhere. Please follow your emails in writing with the dia. and depth so I can include it with the submittal. The email will get this moving again so you can get the approval.

Charles B. Murphy

Land Reclamation Specialist

Office of Mines and Minerals

618 439-911 ext. 234

brad.murphy@illinois.gov

R11982

Alliance Consulting, Inc.
Engineers · Constructors · Specialists

Steve Sutphin <ssutphin@aci-wv.com>

eeder Shaft Permit

1 message

Jim Slapak <jslapak@machmining.com> **Thu, Nov 17, 2011 at 1:12 PM**
To: Steve Sutphin <ssutphin@aci-wv.com>

Steve,

I'm assuming Brad is talking about the power borehole and the pump hole. Neither will be done. SEIEC will be able to provide power for the raisebore shaft. If we needed a turbine we would bring it up the bleeder shaft as we did with the other one. I don't know how much it might change Al's bond dollars but the shaft will only be about 365 feet deep. Might want to include that as well. Thanks.

Jim

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

November 14, 2011

Project No. B11-500-1413

Mr. Charles Murphy
IDNR – Office of Mines & Minerals
Land Reclamation Division
503 E. Main Street
Benton, Illinois, 62812

Supplemental Information for
Incidental Boundary Revision for 4.65 Acres
Williamson Energy LLC - Permit No. 375
Pond Creek Mine No. 1
Williamson County, Illinois

Dear Mr. Murphy:

On behalf of our client, Williamson Energy, LLC, Alliance Consulting, Inc. is submitting three copies of supplemental information to address the agency's review. Please forward two copies to the appropriate reviewer in the Springfield office. The following summarizes our responses.

Comment No. 1: *The response to Part I[5][B][1] is not correct. Revise answer to "Yes" and provide narrative explaining what type of disturbance, if any, is being proposed and whether the provisions of 1716.11[d] are applicable.*

Response: Part I(5)(B)(1) has been revised. Please refer to the attached revised page.

Comment No. 2: *The response at Part I[5][D] does not specify the name of the local newspaper in which the public notice will be published*

Response: Part I(5)(D) has been revised and now list the name of the newspaper the advertisement will published in.

124 Philpott Lane • Raleigh County Airport Industrial Park • Beaver, WV 25813-9502 • TELE: (304) 255-0491 • FAX (304) 255-4232

If you have any questions or need additional information, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Stephen M. Sutphin
Project Manager

SMS:wmb
Enclosures

FILE: 11500-03

boundaries of land within the permit area upon which the applicant has the legal right to enter and begin surface mining activities.

RESPONSE: Refer to Attachment Part I.4.A.

B) Complete certification for engineering aspects of the application. In addition to the general certification, three specific certifications are included which are applicable only if the box in front of each is marked. The first two cover special permit requirements and should be marked only when they occur for the proposed permit. The third certification covers the Illinois Environmental Protection Agency permit requirements. In most cases, an Illinois registered engineer will be required to certify IEPA permit requirements. Except as otherwise provided all maps, plans and cross-sections included in the permit application shall be prepared by, or under the direction of, and sealed by a qualified registered professional engineer licensed under the Illinois Professional Engineering Act, a qualified registered structural engineer licensed under the Illinois Structural Engineering Act or if authorized by state law, a qualified registered professional land survey or licensed under the Illinois Land Surveyors Act with assistance from experts in related fields.

RESPONSE: Refer to Attachment Part I.4.B.

5) Areas Designated Unsuitable for Mining

A) Does proposed IBR area include --

(1) Lands within boundaries of the National Park System, National Wildlife Refuge System, National Recreation Areas, etc. [Section 1761.11(a)]?

Yes _____ No __X__

(2) National forest land?

Yes _____ No __X__

(3) Any land which will adversely affect any publicly-owned park or places included in or eligible for listing in the National Register of Historic places, etc. [per 62 Ill. Adm. Code 1761.11(a)(3) or Section 10, (B)(C) of the SCM-1?

Yes _____ No __X__

If yes, complete Part II, Section 10, (B) & (C) of the SCM-1 or the UCM-1 Application.

(4) Any public roads which are to be removed, relocated or temporarily closed?

Yes _____ No __X__

Indicate on the pre-mining land use map or other designated map the location of the public roads and attach a copy of the written agreement from the appropriate authority authorizing the relocation, removal or temporary closure. Describe the measures to be used to insure that the interest of the public and land owners affected will be protected.

B) Will proposed IBR area be located --

(1) Within 100 feet of the right-of-way line of any public road?

Yes __X__ No _____

If yes, explain proposed procedure for complying with regulation section 1761.11(d), including request for variance, if relevant. Provide location of public roads on pre-mining

land use map or other designated map. Describe the measures to be used to insure that the interest of the public and land owners affected will be protected.

RESPONSE: The area within 100 feet of the public road right-of-way will be for access only, which is exempt under Section 1761.11(d)(1).

(2) Within 300 feet measured horizontally from any occupied dwelling?

Yes _____ No __X__

If so, is waiver provided meeting requirements of Section 1761.15?

(3) Within 300 feet measured horizontally of any public building, school, church, community or institutional building or public park?

Yes _____ No __X__

(4) Within 100 feet measured horizontally of a cemetery?

Yes _____ No __X__

C) Are valid existing rights (per 1761.11) claimed for any part of the IBR area?

Yes _____ No __X__

If yes, provide documentation to substantiate claim.

D) Provide a draft copy of the proposed newspaper notice and name of local newspaper of general circulation in which advertisement of the application will be published, per 62 Ill. Adm. Code 1774.13(d)(6). Certification of publication is to be furnished to the Department and must be received prior to Department approval of the IBR.

RESPONSE: Refer to Attachment Part I.5.D. for the draft copy of the newspaper notice. The notice will be published in The Daily American newspaper.

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

Transmittal Letter

Project No. B11-500-1413

To: Illinois Department of Natural Resources
Office of Mines and Minerals
Land Reclamation Division
One Natural Resources Way
Springfield, IL 62702-1271

Date: October 12, 2011

If enclosures are not as noted, please inform us immediately

Attention: Scott Fowler

We Transmit:

☒ Herewith ☐ Under Separate Cover

For Your:

☐ Approval ☐ Record

☒ Review & Comment

☐ Use

The Following:

☐ Drawings ☐ Laboratory Data

☐ Specifications ☐ Field Data

☒ Other

Copies	Date	No.	Description
1			Original of 4.65 Acre Non-Contiguous IBR for Williamson Energy - Permit 375.
1			Copy of 4.65 Acre Non-Contiguous IBR for Williamson Energy - Permit 375.

Remarks:

One copy of the application has been sent to Mr. Brad Murphy.

If you have any questions, please contact me.

By: Steve Sutphin

Copies To: J. Slapák, File

124 Philpott Lane, Beaver, WV 25813 Telephone: 304 / 255-0491 Fax: 304 / 255-4232

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

Transmittal Letter

Project No. B11-500-1413

Office of Mines and Minerals
Land Reclamation Division
503 E. Main; FL001
Benton, IL 62812

Date: October 12, 2011

If enclosures are not as noted, please inform us immediately

Attention: Brad Murphy

We Transmit:

- ■ Herewith
- ☐ Under Separate Cover

For Your:

- ☐ Approval
- ☐ Record
- ■ Review & Comment
- ☐ Use

The Following:

- ☐ Drawings
- ☐ Laboratory Data
- ☐ Specifications
- ☐ Field Data
- ■ Other

Copies	Date	No.	Description
1			Copy of 4.65 Acre Non-Contiguous IBR for Williamson Energy - Permit 375.

Remarks:

An original and one copy of the application have been sent to Mr. Scott Fowler.

If you have any questions, please contact me.

By: Steve Sutphin

Copies To: J. Slapak, File

124 Philpott Lane, Beaver, WV 25813 Telephone: 304 / 255-0491 Fax: 304 / 255-4232

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

October 4, 2011

Project No. B11-500-1413

Mr. Scott Fowler
ILLINOIS DEPARTMENT
OF NATURAL RESOURCES
Office of Mines and Minerals
Land Reclamation Division
One Natural Resources Way
Springfield, IL 62702-1271

Request for Non-Contiguous
Incidental Boundary Revision for 4.65 Acres
Williamson Energy LLC - Permit No. 375
Pond Creek Mine No. 1
Williamson County, Illinois

Dear Mr. Fowler:

On behalf of our client, Williamson Energy LLC, Alliance Consulting, Inc. is submitting an original and one copy of a 4.65 acre non-contiguous IBR application. The IBR is for a bleeder shaft and associated facilities. Please refer to the enclosed incidental boundary revision material.

Please be advised that one copy of this IBR application has been sent to Mr. Brad Murphy in the Benton office.

If you have any questions, or require additional information, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Stephen M. Sutphin
Project Manager

SMS:sms
Enclosures

FILE: 11500-01

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

October 4, 2011

Project No. B11-500-1413

Mr. Brad Murphy
ILLINOIS DEPARTMENT
OF NATURAL RESOURCES
Land Reclamation Division
503 E. Main, FL 001
Benton, IL 62812

Request for Non-Contiguous
Incidental Boundary Revision for 4.65 Acres
Williamson Energy LLC - Permit No. 375
Pond Creek Mine No. 1
Williamson County, Illinois

Dear Mr. Murphy:

On behalf of our client, Williamson Energy LLC, Alliance Consulting, Inc. is submitting one copy of a 4.65 acre non-contiguous IBR application. The IBR is for a bleeder shaft and associated facilities. Please refer to the enclosed incidental boundary revision material.

Please be advised that Mr. Scott Fowler in the Springfield office has received an original and one copy of this IBR application.

If you have any questions, or require additional information, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Stephen M. Sutphin
Project Manager

SMS:sms
Enclosures

FILE: 11500-02

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Office: 618-983-3020 Fax: 618-983-3017

Mr. Scott K. Fowler, Supervisor
ILLINOIS DEPARTMENT OF
NATURAL RESOURCES
One Natural Resources Way
Springfield, IL 62702-1271

Re: Williamson Energy, LLC - Permit No. 375; 4.65acre Non-Contiguous IBR

Dear Mr. Fowler:

This letter authorizes Mr. Jim Slapak and Alliance Consulting, Inc. (Alliance) and its representatives, permission to perform work on, receive comments and submit corrections on the above referenced application. Please send copies of any comments to Alliance Consulting, Inc. at 124 Philpott Lane, Beaver, WV 25813, as well as Williamson Energy, LLC at the above address.

Thank you for your cooperation.

Sincerely,

WILLIAMSON ENERGY, LLC

Anthony Webb
Authorized Agent

4.65 ACRES NON-CONTIGUOUS INCIDENTAL BOUNDARY REVISION FOR PERMIT NO. 375

WILLIAMSON COUNTY, IL
POND CREEK MINE NO. 1

Prepared for

WILLIAMSON ENERGY LLC
JOHNSTON CITY, IL

ALLIANCE PROJECT NO. B11-500-1413
OCTOBER 2011

PART I

State of Illinois
Department of Natural Resources
Office of Mines and Minerals
Land Reclamation Division
One Natural Resources Way
Springfield, IL 62702-1271

APPLICATION FOR SURFACE COAL MINING AND RECLAMATION OPERATIONS INCIDENTAL BOUNDARY REVISION IBR-1

PART I

DATE: October 6, 2011

NOTICE : This state agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Ill. Rev. Stat. 1987 Ch. 96 1/2, par. 7901.01 et seq. Disclosure of this information is voluntary, however failure to comply may result in this form not being processed. This form has been approved by the Forms Management Center.

1) A) General Information

(~~I~~)(~~We~~)(The) Williamson Energy LLC
(Name of Company, Corporation, Partnership or Individual)

P. O. Box 99, Johnston City, IL 62951 (618) 983-3020
(Address) (Telephone Number)

hereby submit application for an Incidental Boundary Revision to Permit 375

Name of Mine Pond Creek No. 1.

MSHA No. 11-03141

I, Anthony Webb under penalty of
(vice president or his duly authorized representative under the existing permit)

perjury declare that all information provided in this application is true and correct to the best of my knowledge.

Anthony Webb Authorized Agent
Title

Surface Area:

ADDITIONAL ACRES REQUESTED 4.65 EXISTING PERMIT ACREAGE 624.80

B) Indicate the type of disturbance and associated acreage.

Type of Disturbance	Existing Permit	IBR	Total
Area Stripping	20.13	0	20.13
Mine Waste Areas	277.39	0	277.39
Processing Areas & Support Facilities	127.51	4.65	132.16
Access, Haul Roads & Transport Facilities	23.57	0	23.57
Soil Storage Areas	75.70	0	75.70
Diversions	32.85	0	32.85
Coal Recovery (Gob & Slurry)	0	0	0
Other	30.46	0	30.46
Not to be Disturbed	37.19	0	37.19
Total	624.8	4.65	629.45

2) A) Provide name and address of every legal or equitable owner of record of the IBR area.

RESPONSE: Map ID: A080414-402. Owner: New River Royalty LLC, 208 Public Square; 4th Floor, Benton, IL 62812

B) Provide name and address of the owner of record for all surface and subsurface areas contiguous to any part of the proposed IBR area.

RESPONSE: Map ID: A080414-206. Surface Owner: Southern Illinois Land Co., Inc., South La Salle St. Suite 3700, Chicago, IL 60602. Map ID: A080414-207. Owner: New River Royalty LLC, 208 Public Square; 4th Floor, Benton, IL 62812. Map ID: A080414-401. Surface Owner: Deon Patton, 450 College Road, Eldorado, IL 62930

C) Show location of owners of record of those lands, both surface and subsurface, included in or contiguous to the IBR area on premining land use map or another map, if necessary.

RESPONSE: Refer to Map 6 S.F. (Drawing No. B11-500-M1)

3) Provide name and address of any holder of record of leasehold interest for the IBR area.

RESPONSE: Williamson Energy LLC. P. O. Box 99, Johnston City, IL 62951

4) Affidavits, Certifications

A) Complete affidavit regarding applicant's legal right to enter and begin surface coal mining and reclamation operations in the IBR area and whether that right is the subject of pending litigation. Identify the documents upon which affidavit is based by type and date of execution and identify specific lands to which each document pertains and explain the legal rights claimed by the applicant (1778.15(a)). If the private mineral estate to be mined has been severed from the private surface estate, provide copies of the documents required under Section 1778.15(B)(1)-(3). On the permit map or other designated map show the

boundaries of land within the permit area upon which the applicant has the legal right to enter and begin surface mining activities.

RESPONSE: Refer to Attachment Part I.4.A.

B) Complete certification for engineering aspects of the application. In addition to the general certification, three specific certifications are included which are applicable only if the box in front of each is marked. The first two cover special permit requirements and should be marked only when they occur for the proposed permit. The third certification covers the Illinois Environmental Protection Agency permit requirements. In most cases, an Illinois registered engineer will be required to certify IEPA permit requirements. Except as otherwise provided all maps, plans and cross-sections included in the permit application shall be prepared by, or under the direction of, and sealed by a qualified registered professional engineer licensed under the Illinois Professional Engineering Act, a qualified registered structural engineer licensed under the Illinois Structural Engineering Act or if authorized by state law, a qualified registered professional land survey or licensed under the Illinois Land Surveyors Act with assistance from experts in related fields.

RESPONSE: Refer to Attachment Part I.4.B.

5) Areas Designated Unsuitable for Mining

A) Does proposed IBR area include --

(1) Lands within boundaries of the National Park System, National Wildlife Refuge System, National Recreation Areas, etc. [Section 1761.11(a)]?

Yes _____ No __X__

(2) National forest land?

Yes _____ No __X__

(3) Any land which will adversely affect any publicly-owned park or places included in or eligible for listing in the National Register of Historic places, etc. [per 62 Ill. Adm. Code 1761.11(a)(3) or Section 10, (B)(C) of the SCM-1?

Yes _____ No __X__

If yes, complete Part II, Section 10, (B) & (C) of the SCM-1 or the UCM-1 Application.

(4) Any public roads which are to be removed, relocated or temporarily closed?

Yes _____ No __X__

Indicate on the pre-mining land use map or other designated map the location of the public roads and attach a copy of the written agreement from the appropriate authority authorizing the relocation, removal or temporary closure. Describe the measures to be used to insure that the interest of the public and land owners affected will be protected.

B) Will proposed IBR area be located --

(1) Within 100 feet of the right-of-way line of any public road?

Yes _____ No __X__

If yes, explain proposed procedure for complying with regulation section 1761.11(d), including request for variance, if relevant. Provide location of public roads on pre-mining

land use map or other designated map. Describe the measures to be used to insure that the interest of the public and land owners affected will be protected.

(2) Within 300 feet measured horizontally from any occupied dwelling?

Yes _____ No ___X___

If so, is waiver provided meeting requirements of Section 1761.15?

(3) Within 300 feet measured horizontally of any public building, school, church, community or institutional building or public park?

Yes _____ No ___X___

(4) Within 100 feet measured horizontally of a cemetery?

Yes _____ No ___X___

C) Are valid existing rights (per 1761.11) claimed for any part of the IBR area?

Yes _____ No ___X___

If yes, provide documentation to substantiate claim.

D) Provide a draft copy of the proposed newspaper notice and name of local newspaper of general circulation in which advertisement of the application will be published, per 62 Ill. Adm. Code 1774.13(d)(6). Certification of publication is to be furnished to the Department and must be received prior to Department approval of the IBR.

RESPONSE: Refer to Attachment Part I.5.D.

PART I ATTACHMENTS

ATTACHMENT PART I.4.A

Attachment I.4.A

(I) (~~We~~) Anthony Webb
(Individual or Individuals)

under penalty of perjury declare on behalf of the applicant, Williamson Energy LLC, that said applicant has valid documents which bestow upon the applicant a legal right to enter and commence surface coal mining and reclamation operations upon lands contained in the proposed IBR area, and such legal right is not in any way the subject of pending court litigation.

Dated this 6th day of October, 2011.

Anthony Webb Authorized Agent
Signature /Title

State of Illinois

County of Williamson

Signed by and subscribed to before me on 10/6/11 by Anthony Webb.
(date) (name of person)

(Seal)
Official Seal
Cathy L Skelton
Notary Public State of Illinois
My Commission Expires 02/15/2012

Cathy L Skelton
(Signature of Notary Public)

ATTACHMENT PART I.4.B

Attachment I.4.B.

ENGINEERING CERTIFICATION

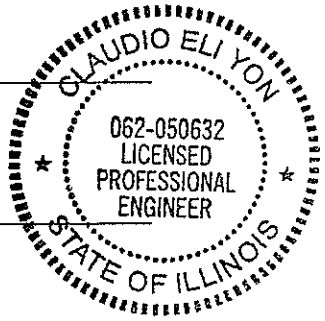
I hereby certify the engineering design used in preparation of this application, attachments, and supplements was done by me or under my direct supervision.

I further certify to the best of my knowledge all such design is in accordance with all applicable local, state and federal laws, rules and regulations. I have placed an "X" in the box below if that item is relevant.

☐ Whereas the Reclamation Plan calls for an alternative land use, I also certify the plans to conform to applicable accepted standards for adequate land stability, drainage, vegetative cover, and aesthetic design appropriate for the post-mining use of the site.

☐ Whereas the operation proposes disposal of spoil or waste materials in areas other than mining workings or excavations, I also certify such fills are designed in accordance with recognized professional standards and all applicable laws.

☒ Certification of Illinois Environmental Protection Agency-35 Ill. Adm. Code 405.104(a) Permit. In my professional judgement, the plans and specifications submitted as part of this application describe an operation which will meet all applicable effluent and water quality standards. I certify that I am familiar with all of the plans, specifications, reports, and maps submitted as part of this application and that said plans, etc. are accurate insofar as they represent existing conditions.



Claudio E. Yon
Name

062-050632
Illinois Registration Number (Seal)

Alliance Consulting, Inc.
Firm

(304) 255-0491
Phone Number

124 Philpott Lane, Beaver, West Virginia 25801
Address

Signature

10/10/11
Date

ATTACHMENT PART I.5.D

Attachment I.5.D.

PUBLIC NOTICE

Pursuant to the Surface Coal Mining Land Conservation and Reclamation Act (PA-81-1015, as amended) and the Rules and Regulations of the Act, Williamson Energy LLC, P. O. Box 99, Johnston City, IL 62951 hereby gives notice that on _____ 2011, an incidental boundary revision (IBR) has been submitted to the Illinois Department of Natural Resources, Office of Mines and Minerals, Land Reclamation Division, One Natural Resources Way, Springfield, IL 62702-1271. The IBR application is for 4.65 acres located in Williamson County, Township 8 South, Range 4 East, Section 14, at the intersection of Corinth Road and Driot City Road.

Activities will include drilling a ventilation shaft, constructing an access road, installing a ventilation fan and installation of an electrical line. No mining operations are proposed within 100' of the outside right-of-way of the above referenced roads.

Copies of the application are on file with the Illinois Department of Natural Resources, Office of Mines and Mineral, 503 East Main St., Benton, Illinois 62812, and the Springfield, Illinois Office.

Written comments concerning the operations should be addressed to the Office of Mines and Minerals, Land Reclamation Division at the Springfield office, no later than 7 days from the date of this notice.

PART II

PART II

PREMINING INFORMATION

Premining information is to be displayed on premining land use map unless otherwise indicated.

1) Describe how the IBR area perimeter will be marked and discuss the method or system employed to locate permit area perimeter and set markers along it. Designate a reference point outside the IBR area if different then the original permit. Provide a description of the reference point and a sketch relating the reference point to the IBR area perimeter.

RESPONSE: The perimeter of the IBR area will be delineated by using PVC and/or metal post and be located within eye sight of one another.

2) Explain and locate areas where the IBR is contiguous to an existing permit.

RESPONSE: The proposed IBR area is not adjacent to the current permitted boundary. Refer to Map 6 S.F. for the location of the IBR area and the currently approved permit boundary.

3) Give the acreages of each land use within the proposed IBR and existing permit area, employing land use categories of Section 1701.5 listed below, and delineate on premining land use map existing land uses in the proposed permit area and adjacent to it. Include on the premining land use map the location of all buildings and identify the current use of these buildings.

Pre-Mine Land Use	Existing Permit	IBR	Total
Cropland	507.79	4.65	512.44
Pasture land	0	0	0
Grazing land	0	0	0
Forestry	101.86	0	105.85
Residential	2.55	0	2.55
Industrial/Commercial			
Recreation	0	0	0
Fish and Wildlife Habitat	11.16	0	11.16
Developed Water Resources	1.44	0	1.44
Undeveloped land	0	0	0
Total	624.8	4.65	629.45

RESPONSE: Refer to Map 3 S.F. – Environmental Resources Map.

4) Soils Information Map

A) Does the submitted soils map represent a map developed by the National Resources Conservation Service (NRCS)?

Yes X No_____.

If no, explain.

B) Delineate on the soils map(s) the area which will incur actual mining (removal of overburden and/or deposition of overburden for the extraction of coal).

RESPONSE: No removal of overburden or deposition of overburden for the extraction of coal will occur on the IBR area. Topsoil material will be temporarily stored on site.

C) Are any of the identified map units correlated as prime farmland by NRCS criteria?

Yes ___X___ No_____.

If yes, explain and provide documentation to meet the requirements of Section 1785.17, if a determination for grandfathering and/or negative determination is sought. If prime farmlands exist, which will not meet the exemption criteria described above, the approved prime farmlands restoration plan must be followed.

RESPONSE: Refer to Map 5 – Soils Resources Map. Additional information can be found in the NRCS Custom Soil Resource Report.

D) Submit, by completing soils information chart, acreage totals of each map unit (soil type and slope classification) and land use capability classes in the IBR area and the percent slope range of each lettered slope classification used on the soil map.

RESPONSE: Refer to Map 5 – Soils Resources Map. Additional information can be found in the NRCS Custom Soil Resource Report.

E) Provide, by completing soil information chart, acreage for each of the map units of high capability land (including grandfathered and negatively determined prime farmland) and non-cropland capability land with respect to areas which will be mined and areas which will incur other forms of disturbance (i.e., roads, ditches, etc.). Identify and provide map unit acreage values, if any, for areas which will not be disturbed.

RESPONSE: Refer to Map 5 – Soils Resources Map.

F) Are selected overburden materials proposed to be used in lieu of or as a supplement to the A-horizon?

Yes _____ No___X_____.

If yes, provide the appropriate information required under 1780.18(b)(4)/1784.13(b)(4).

PART II ATTACHMENTS

ATTACHMENT PART II.3.

ATTACHMENT PART II.4.

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Williamson County, Illinois

Bleeder Shaft IBR Site



October 3, 2011

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means

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Contents

Preface
How Soil Surveys Are Made
Soil Map
Soil Map (Bleeder Shaft Site)
Legend
Map Unit Legend (Bleeder Shaft Site)
Map Unit Descriptions (Bleeder Shaft Site)
Williamson County, Illinois3
10C—Plumfield silty clay loam, 5 to 10 percent slopes
14B—Ava silt loam, 2 to 5 percent slopes
14C3—Ava silty clay loam, 5 to 10 percent slopes, severely eroded
3382A—Belknap silt loam, 0 to 2 percent slopes, frequently flooded
W—Water
References

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

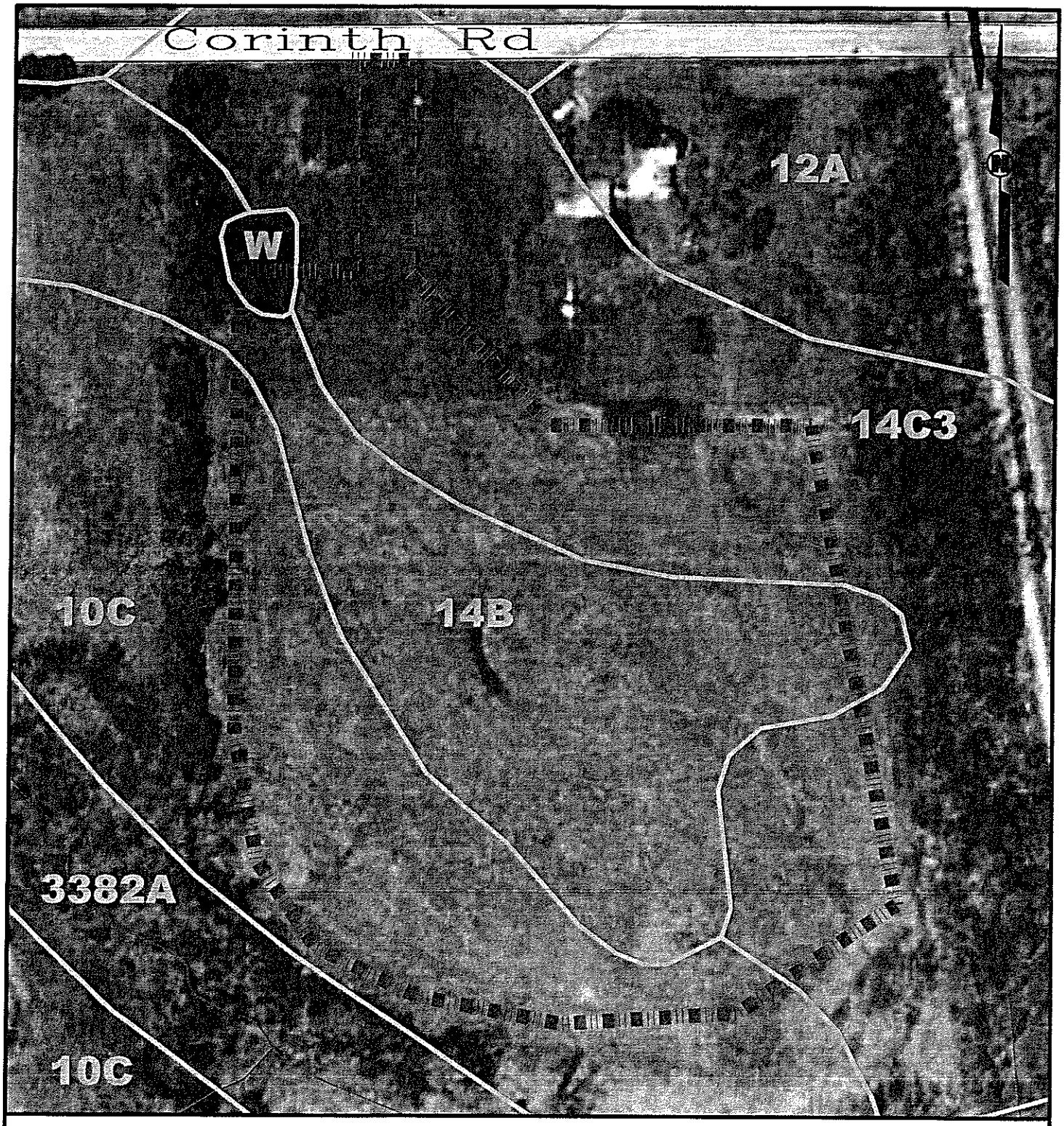
While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.



SCALE

100' 0 100' 200 FEET

Alliance Consulting, Inc.
Engineers
Constructors
Scientists
BECKLEY, WV (304) 255-0491
CANONSBURG, PA (724) 745-3630
SUMMERSVILLE, WV (304) 883-2360

SOILS MAP

BLEEDER SHAFT SITE
PERMIT NO. 375, NON-CONTIGUOUS IBR
PREPARED FOR
WILLIAMSON ENERGY LLC
JOHNSTON CITY, ILLINOIS

DRAWN BY	SMS	10/03/11
CHECKED BY		
APPROVED BY		
DRAWING NUMBER		FIGURE NUMBER
B11-500-A1		

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:12,500 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 16N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Williamson County, Illinois
Survey Area Data: Version 6, Feb 7, 2011

Date(s) aerial images were photographed: 6/13/2007

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend (Bleeder Shaft Site)

Williamson County, Illinois (IL199)	
Map Unit Symbol	Map Unit Name
10C	Plumfield silty clay loam, 5 to 10 percent slopes
14B	Ava silt loam, 5 to 10 percent slopes
14C3	Ava silty clay loam, 5 to 10 percent slopes, severely eroded
3382A	Belknap silt loam, 0 to 2 percent slopes, frequently flooded

Map Unit Descriptions (Bleeder Shaft Site)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was

impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Williamson County, Illinois

10C—Plumfield silty clay loam, 5 to 10 percent slopes

Map Unit Setting

Elevation: 360 to 840 feet *Mean annual precipitation:* 35 to 46 inches *Mean annual air temperature:* 54 to 57 degrees F *Frost-free period:* 175 to 195 days

Map Unit Composition

Plumfield and similar soils: 90 percent

Description of Plumfield

Setting

Landform: Till plains *Landform position (two-dimensional):* Shoulder, backslope *Landform position (three-dimensional):* Head slope, side slope *Down-slope shape:* Convex *Across-slope shape:* Linear *Parent material:* Loess over glacial drift

Properties and qualities

Slope: 5 to 10 percent *Depth to restrictive feature:* 5 to 20 inches to fragipan *Drainage class:* Moderately well drained *Capacity of the most limiting layer to transmit water (Ksat):* Low to moderately low
(0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Very low (about 1.0 inches)

Interpretive groups

Land capability (nonirrigated): 4e

Typical profile

0 to 5 inches: Silty clay loam
5 to 12 inches: Silt loam
12 to 36 inches: Silt loam
36 to 60 inches: Silt loam

14B—Ava silt loam, 2 to 5 percent slopes

Map Unit Setting

Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition
Ava and similar soils: 90 percent

Description of Ava

Setting

Landform: Till plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Peoria and roxana loess over glacial drift

Properties and qualities
Slope: 2 to 5 percent *Depth to restrictive feature:* 25 to 40 inches to fragipan *Drainage class:* Moderately well drained *Capacity of the most limiting layer to transmit water (Ksat):* Low to moderately low
(0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Moderate (about 6.3 inches)

Interpretive groups
Land capability (nonirrigated): 2e

Typical profile
0 to 8 inches: Silt loam
8 to 18 inches: Silt loam
18 to 36 inches: Silty clay loam
36 to 53 inches: Silt loam
53 to 80 inches: Silt loam

14C3—Ava silty clay loam, 5 to 10 percent slopes, severely eroded

Map Unit Setting
Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches

Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition
Ava, severely eroded, and similar soils: 90 percent

Description of Ava, Severely Eroded Setting

Landform: Till plains
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Peoria and roxana loess over glacial drift

Properties and qualities

Slope: 5 to 10 percent *Depth to restrictive feature:* 25 to 40 inches to fragipan *Drainage class:* Moderately well drained *Capacity of the most limiting layer to transmit water (Ksat):* Low to moderately low
(0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Low (about 4.9 inches)

Interpretive groups

Land capability (nonirrigated): 3e

Typical profile

0 to 9 inches: Silty clay loam
9 to 28 inches: Silty clay loam
28 to 64 inches: Silt loam
64 to 78 inches: Silt loam

3382A—Belknap silt loam, 0 to 2 percent slopes, frequently flooded

Map Unit Setting

Elevation: 340 to 490 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition

Belknap, frequently flooded, and similar soils: 90 percent

Description of Belknap, Frequently Flooded

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty alluvium

Properties and qualities

Slope: 0 to 2 percent *Depth to restrictive feature:* More than 80 inches *Drainage class:* Somewhat poorly drained *Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 6 to 24 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: Very high (about 12.7 inches)

Interpretive groups

Land capability (nonirrigated): 3w

Typical profile

0 to 7 inches: Silt loam
7 to 59 inches: Silt loam
59 to 80 inches: Silt loam

W—Water

Map Unit Composition

Water: 100 percent

Description of Water

Setting

Landform: Channels, drainageways, lakes, oxbows, perenial streams, rivers
Parent material: Water

References

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Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

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Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://soils.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.glti.nrcs.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://soils.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://soils.usda.gov/

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210.

PART III

PART III

OPERATIONS PLAN

1) Explain the proposed operation and why the IBR is needed. Locate on a mining operations map.

RESPONSE: The purpose of this IBR is to permit 4.65 acres for the installation of a ventilation shaft site. MSHA has mandated that the mining operation must install an additional ventilation fan located in the bleeder entries of Tailgate No. 6. This IBR will consist of an infrequently used access road, a ventilation shaft, fan, a power borehole and associated structures. Refer to Map 6 S.F. and Map 6 S.F. (Supplemental) for the location of the IBR area.

The 18 feet diameter hole will be drilled and cased to a 16 feet diameter to a depth of 460 feet. The casing will be grouted with concrete and a small fan will be installed. A 30 foot by 30 foot by 1 foot thick concrete pad will be constructed for the fan and the electronics associated with the fan. Power will be supplied to the site by coming off an existing power line. A 12 foot by 12 foot by 1 foot thick pad will be constructed for the transformer and a power pole will be installed next to the transformer pad.

The site is located due south of Corinth Road and west of the Illinois Central Railroad. Topsoil from the IBR area will either be bermed along the site or placed in the soil storage area. A small cuttings pit will be constructed to collect the cuttings from the shaft drilling, however, the shaft construction will be a raise bore operation and therefore the majority of the cuttings will transported by the mine's haulage system.

Access to the site will be by an existing access road beside of an abandoned barn. Topsoil from the access road will be removed and stored and a minimum of one foot of gravel will be placed on the road.

The fan site will be in service during the mining of future longwall panels. Upon abandonment, the shaft will be backfilled and the site will be regarded, topsoil will be redistributed and the site will be revegetated with the approved seed mixture.

Upon abandonment, the entire disturbed area will be covered using the stored topsoil, seeded and mulched using the approved revegetation plan.

Refer to enclosed maps for the location of the IBR area outlined in red.

2) Surface Drainage Control

A) 1) Locate on the mining operations map or on a separate drainage map all proposed drainage control systems. Show drainage patterns of all affected mining areas.

RESPONSE: Refer to Map 6 S.F. Supplemental.

2) Will all surface drainage from the affected mining area be collected and treated prior to leaving the IBR area?

Yes _____ No __X__

If yes, delineate how and where surface drainage will be collected and treated, and list permit numbers and type of permit that the drainage control systems are operated under. If above answer is no, explain how regulatory compliance will be achieved without treatment, i.e., address the requirements of 1816.46(e)/1817.46(e).

RESPONSE: The applicant is requesting to utilize alternate sediment control measures as described in 1817.46(e). Disturbance will be kept to a minimum. Silt fence, hay/straw bales, earthen berms and/or other alternative methods of sediment control will be utilized. Access and traffic areas will be graveled. All disturbed areas will be graveled or vegetated as soon possible.

B) Will all surface drainage from unaffected areas be intercepted and diverted around the affected mining area?

Yes _____ No __X__

If no, please discuss.

RESPONSE: The site is situated on higher ground. Existing drainage channels will divert surface drainage around the site.

C) Overland Flow Diversions and Sediment Ponds:

Are either overland flow diversions or sediment ponds to be constructed?

Yes _____ No __X__

If yes, complete applicable parts of the SCM-1 or UCM-1 Part IV (surface drainage control).

D) Does a perennial or intermittent stream occur within the proposed IBR area?

Yes _____ No __X__

If yes, is an exception to the 100 foot buffer zone being requested or is a stream diversion being proposed. For an exception to the 100 foot buffer zone, indicate how compliance with 1816.57/1817.57 will be assured. For a stream diversion, complete applicable parts of the SCM-1 or UCM-1.

3) Roads and other activities:

A) Are roads to be constructed in the IBR area?

Yes __X__ No _____

If yes, complete the applicable part of the SCM-1or UCM-1 (transportation facilities).

B) If the operations involve blasting, or any other activities not specifically addressed above, complete applicable parts of the SCM-1 or UCM-1.

RESPONSE: Refer to Attachment III.3.A.

4) Are any existing structures proposed for utilization in the IBR?

Yes _____ No __X__

If yes, complete Part IV.4 of the SCM-1 or UCM-1.

PART III ATTACHMENTS

ATTACHMENT PART III.3.A

Attachment III.3.A.

Transportation Facilities

1) Provide a detailed description on mining operations map or other map and show location of the following:

   a) Proposed road(s), conveyor system(s), or rail system.

   b) Related sediment control facilities.

   c) Earth borrow locations and/or locations for deposition of excess excavation.

RESPONSE: Williamson Energy and its contractor, Mach Mining is proposing to construct an access road to a ventilation shaft site. Topsoil will be removed and either placed in the soils storage area or windrowed along the IBR permit boundary. The road will be bedded with gravel in order to create a stabilized road surface. The graveled surface will be the sediment control for the road. After the ventilation shaft is in place and functioning, the access road will be used infrequently.

2) Provide specifications and plan-profiles of existing gradeline, proposed road centerline, ditch flow lines, road cut, fill embankment, culvert, bridge and drainage structures. Provide typical cross sections where appropriate.

RESPONSE: Refer to Map 6 - Access Road Plan View and Profile drawing for details concerning the proposed access road.

3) For all transportation facilities to be constructed, provide construction details for all sediment control facilities to be constructed to prevent additional contributions of suspended solids to streamflow or to runoff outside the permit area.

RESPONSE: The access road will be constructed and graveled. Topsoil material will be stockpile (windrowed) on-site or placed in the soil storage area. Vegetation will be windrowed along the IBR permit boundary. Gravel and temporary/permanent vegetation will be utilized to prevent additional contributions of suspended solids or runoff. As needed, silt fence, straw and/or hay bales or other methods of sediment control will be installed.

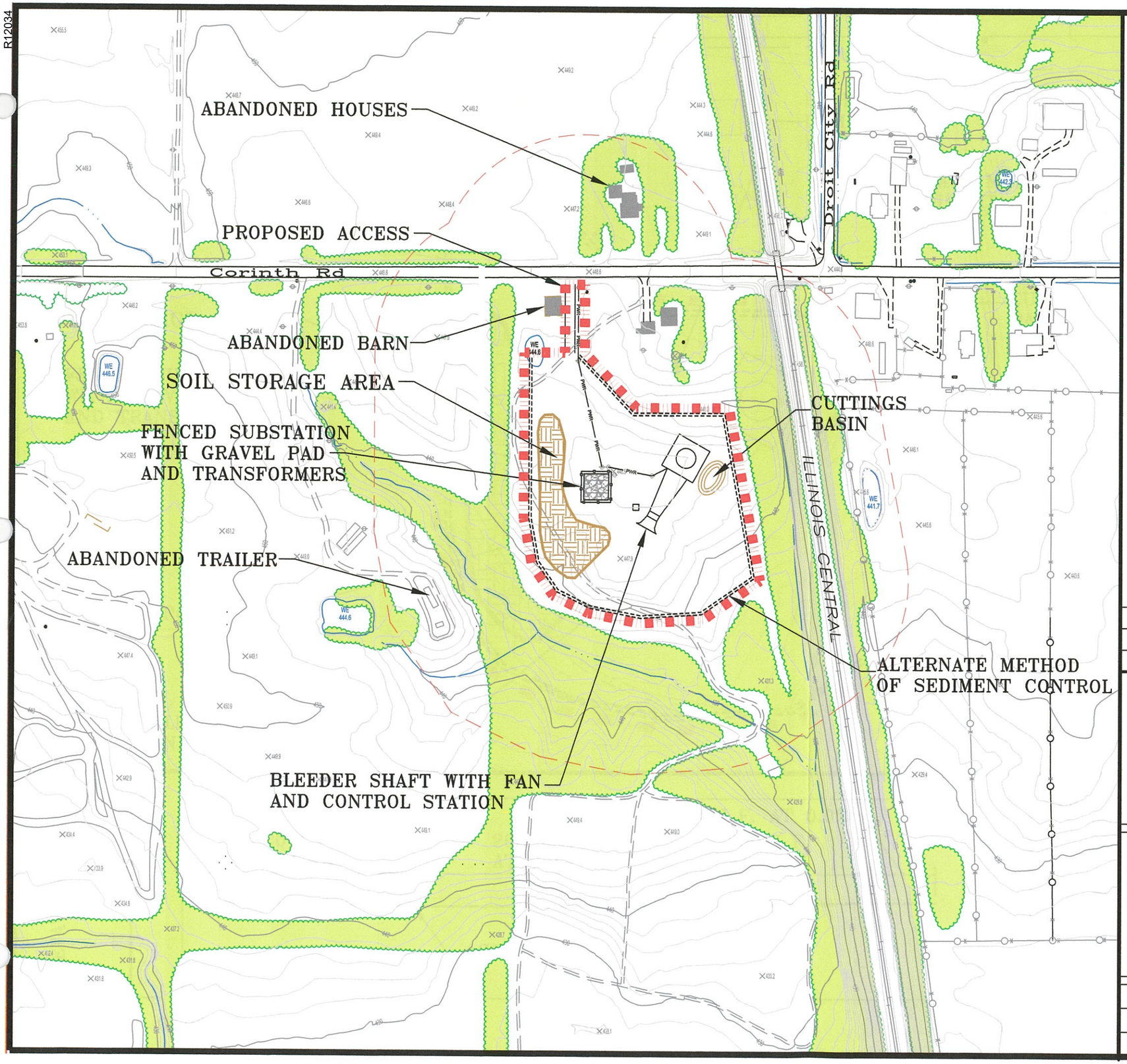
4) Discuss the revegetation of ditch and borrow areas involved in construction.

RESPONSE: No ditches or borrow areas are proposed by this IBR application.

5) Discuss the estimated life of each facility and how materials will be removed when the facility becomes inactive.

RESPONSE: The estimated life of the proposed IBR area is approximately five years. When the ventilation shaft is no longer needed, abandoned as per MSHA regulation and the site will be reclaimed. The graveled road bed will be removed and hauled off or buried. The stockpiled topsoil will be used to cover all disturbed areas and the entire site will be vegetated with the approved seed mixture.

R12034



GENERAL INFORMATION

- PROPOSED IBR AREA (4.65 AC.)
- EPHEMERAL STREAMS
- ELECTRICAL POWER LINE
- POWER POLE
- TREES / SHRUBS
- STRUCTURES
- STRUCTURES OWNED BY NEW RIVER ROYALITY
- 300 FEET RADIUS
- UNIMPROVED ROADS / TRAILS
- DRIVEWAYS

200' 0 200' 400'

SCALE: 1"=200'

N

REV.	DATE	DESCRIPTION	P.M.
1	11/17/11	REMOVAL OF POWER & PUMP BOREHOLES	SMS

Alliance Consulting, Inc.

Engineers · Constructors · Scientists

BECKLEY, WV (304) 255-0491 SUMMERSVILLE, WV (304) 883-2360 CANONSBURG, PA (724) 745-3630

MAP 6

MAP 6 S.F. (SUPPLEMENTAL)

POND CREEK 1 MINE

Prepared For

WILLIAMSON ENERGY LLC.

JOHNSTON CITY, IL

CAD BY	SMS	10/02/11	PROJECT NO. B11-500-1413
CHECKED BY	SMS	10/06/11	
APPROVED BY	CEY	10/06/11	DRAWING NO. B11-500-B1

PART IV

PART IV

RECLAMATION PLAN

1) Provide a reclamation plan map outlining proposed reclamation of the lands within the proposed IBR area and state how the IBR area will be reclaimed in conformity with the original plan.

RESPONSE: Refer to Map 7 S.F.; Reclamation Plan Map. The reclamation of the IBR area will comply with the approved reclamation.

2) Post Mining Land Use

A) Provide a detailed description of proposed post-mining land uses and capabilities employing land use and capability categories listed below. Provide acreage figures for each post-mining land use proposed for the existing permit, the IBR area and total permit after inclusion of the IBR acreage and designate the postmining land uses on the Post Mining Land Use Map. Acreage figures for postmining land use must differentiate between mined and surface disturbance areas based on the mining line used in the premining section of the application.

RESPONSE: Refer to Map 7 S.F.; Reclamation Plan Map

Land Use	Capability								
	Existing Permit (ac)			IBR (ac)			Total (ac)		
	Prime	HCap	NonCr	Prime	HCap	NonCr	Prime	HCap	NonCr
Cropland			0.00			0.00			0.00
Pasture Land			0.00			0.00			0.00
Grazing Land			0.00			0.00			0.00
Forestry			13.36			0.00			13.36
Residential			0.00			0.00			0.00
Industrial / Commercial			0.00			0.00			0.00
Recreation			0.00			0.00			0.00
Fish & Wildlife Habitat (Herbaceous)			29.36			4.65			34.01
Fish & Wildlife Habitat (Woody)			562.82			0.00			562.82
Fish & Wildlife Habitat (Wetland)			0.00			0.00			0.00
Developed Water Resources			19.26			0.00			19.26
Undeveloped Land			0.00			0.00			0.00
Totals			620.23			2.86			628.79

Prime: Prime farmland
HCap: High Capability - meeting productivity requirements of 62 Ill. Adm. Code 1825.
NonCrop: Non-Cropland - All soils which do not qualify as prime farmland or high capability.

3) Pursuant to Section 1784.21 the applicant shall provide a protection and enhancement plan for the Indiana bat meeting the specifications of the July 2009 Range-wide Indiana bat protection and enhancement plan guidelines developed by the U.S. Fish and Wildlife Service and the Office of Surface Mining, or justify why no protection and enhancement plan is required under those guidelines.

RESPONSE: The IBR permit area is an open field. No trees are present on the site and the permit boundary has been situated so that no trees will be affected by this permitted area. Therefore, a Protection and Enhancement Plan will not be necessary. Refer to Map 3 S.F. – Environmental Resources Map for an orthophotographic map of the site with the IBR boundary delineated.

DOCUMENT 70

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
MINE RELATED WATER POLLUTION CONTROL PERMIT

PERMIT NO.: 2012-MA-7395-1 DATE ISSUED: May 21, 2012

FINAL PLANS, SPECIFICATIONS, APPLICATION AND SUPPORTING DOCUMENTS PREPARED BY: Claudio Eli Yon, Alliance Consulting, Inc.

EXPIRATION DATE: January 31, 2017

LOG NUMBERS: 7395-11

SUBJECT: Williamson Energy, LLC – Pond Creek Mine

Williamson Energy, LLC – Pond Creek Mine
P.O. Box 99
Johnston City, Illinois 62951

Supplemental Permit is hereby granted to the above designated permittee to construct and operate the surface facilities to support the underground mine facility which was previously approved under Permit No. 2012-MA-7395.

A permit area consisting of 9.82 acres, also identified as OMM Permit No. 375, IBR No. 33, located in Section 10, T8S, R4E, Williamson County, Illinois, as described and depicted in IEPA Log No. 7395-11 is to be utilized for the construction of the compressor bore hole, installation and maintenance of a buried power line and an access road.

Runoff from the area approved herein will be controlled by berms, silt fence, straw bale dikes and vegetation.

The abandonment plan shall be executed and completed in accordance with 35 Ill. Adm. Code 405.109.

This Supplemental Permit supersedes and replaces Permit Number 2012-MA-7395 which was previously issued for the herein permitted facilities.

This Permit is issued subject to the following Special Condition. If such Special Condition requires additional or revised facilities, satisfactory engineering plan documents must be submitted to this Agency for review and approval for issuance of a Supplemental Permit.

Special Condition No. 1: This permit is issued with the expressed understanding that there shall be no surface discharge from these facilities. If such discharge occurs, additional or alternate facilities shall be provided. The construction of such additional or alternate facilities may not be started until a Permit for the construction is issued by the Agency.

This permit is issued in accordance with the Illinois Environmental Protection Act of 1970, the Title 35, Subtitle C: Water Pollution and Subtitle D: Mine Related Pollution Regulations adopted pursuant thereto by the Illinois Environmental Protection Act. THE STANDARD CONDITIONS OF ISSUANCE INDICATED ON THE ATTACHMENT TO THIS PERMIT (PAGE 1a) MUST BE COMPLIED WITH IN FULL. READ ALL CONDITIONS CAREFULLY.

Larry D. Crislip, P.E.
Manager, Permit Section
Mine Pollution Control Program
Bureau of Water

cc: IDNR, Office of Mines and Minerals
IDNR, Division of Water Resources
BOW/MPCP/FOS/Marion

LDC:IW:cs/6001c/5-18-12

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
MINE RELATED WATER POLLUTION CONTROL PERMIT

PERMIT NO.: 2012-MA-7395

DATE ISSUED: February 3, 2012

FINAL PLANS, SPECIFICATIONS, APPLICATION AND SUPPORTING DOCUMENTS PREPARED BY: Claudio Eli Yon
Alliance Consulting, Inc.

EXPIRATION DATE: January 31, 2017

LOG NUMBERS: 7395-11

SUBJECT: Williamson Energy, LLC – Pond Creek Mine

Williamson Energy, LLC – Pond Creek Mine
P.O. Box 99
Johnston City, Illinois 62951

Permit is hereby granted to the above designated permittee to construct and operate the surface facilities to support the underground mine facility as follows:

A permit area consisting of 9.82 acres, also identified as OMM Permit No. 375, IBR No. 33, located in Section 10, T8S, R4E, Williamson County, Illinois, as described and depicted in IEPA Log No. 7395-11 is to be utilized for the construction of the compressor bore hole, installation and maintenance of a buried power line and an access road.

Runoff from the area approved herein will be controlled by berms, silt fence, straw bale dikes and vegetation.

The abandonment plan shall be executed and completed in accordance with 35 Ill. Adm. Code 405.109.

This Permit is issued subject to the following Special Condition. If such Special Condition requires additional or revised facilities, satisfactory engineering plan documents must be submitted to this Agency for review and approval for issuance of a Supplemental Permit.

Special Condition No. 1: This permit is issued with the expressed understanding that there shall be no surface discharge from these facilities. If such discharge occurs, additional or alternate facilities shall be provided. The construction of such additional or alternate facilities may be started until a Permit for the construction is issued by the Agency.

This permit is issued in accordance with the Illinois Environmental Protection Act of 1970, the Title 35, Subtitle C: Water Pollution and Subtitle D: Mine Related Pollution Regulations adopted pursuant thereto by the Illinois Environmental Protection Act. THE STANDARD CONDITIONS OF ISSUANCE INDICATED ON THE ATTACHMENT TO THIS PERMIT (PAGE 1a) MUST BE COMPLIED WITH IN FULL. READ ALL CONDITIONS CAREFULLY.

Larry D. Crislip

Larry D. Crislip, P.E.
Manager, Permit Section
Mine Pollution Control Program
Bureau of Water

cc: IDNR, Office of Mines and Minerals
IDNR, Division of Water Resources
BOW/MPCP/FOS/Marion

LDC:IW:cs/6001c/2-7-12

STATE OF ILLINOIS

ENVIRONMENTAL PROTECTION AGENCY

Subject: Williamson Energy, LLC – Pond Creek Mine

Data: Log No. 7395-11

Reviewed by: I. Ward **Date:** 02-13-12

Log No. 7395-11 ⇒ IBR No. 33 to OMM Permit No. 375

Log No. 7395-11

- A permit area consisting of 0.82 acres
- Facility is located in Section 10, T8S, R4E, Williamson County, Illinois.
- Permit to be utilized for the construction of the compressor bore hole, installation and maintenance of a buried power line and an access road.
- Runoff from the area approved herein will be controlled by berms, silt fence, straw bale dikes and vegetation.

* Action: Prepare Subtitle D Permit No.2012-MA-7395 for IBR No. 33, OMM Permit No. 395.

7395 / 11
R12042
Due date: 11-16-11

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Office: 618-983-3020 Fax: 618-983-3017

October 3, 2011

Mr. Ronald Morse
Illinois Environmental Protection Agency
2309 West Main Street
Marion, IL 62959

RE: Pond Creek Mine – Permit 375
Incidental Boundary Revision 33

Dear Mr. Morse:

Enclosed please find two copies of the above referenced IBR. Please contact me if you need anything further.

Sincerely,

James W Slapak

James W. Slapak
Chief Surveyor - Williamson Energy, LLC

RECEIVED
OCT 04 2011
IL Environmental Protection Agency
MARION REGIONAL OFFICE

Alliance Consulting, Inc.
Engineers • Constructors • Scientists

INCIDENTAL BOUNDARY REVISION FOR PERMIT NO. 375

(0.82 ACRES FOR EMERGENCY CONPRESSOR BOREHOLE SITE)

WILLIAMSON COUNTY, IL
POND CREEK MINE NO. 1

Prepared for

WILLIAMSON ENERGY LLC
JOHNSTON CITY, IL

ALLIANCE PROJECT NO. B11-371-1413
JULY 2011

Summersville, WV
848 Northside Drive
Summersville, WV 26651
Telephone: (304) 883-2360
Fax: (304) 883-2361

Beckley, WV
Raleigh County Airport Industrial Park
124 Philpott Lane
Beaver, WV 25813-9502
Telephone: (304) 255-0491
Fax: (304) 255-4232

Canonsburg, PA
151 East Pike Street
Canonsburg, PA 15317
Telephone: (724) 745-3630
Fax: (724) 745-3631

Illinois Department of
Natural Resources
One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

Pat Quinn, Governor
Marc Miller, Director

September 23, 2011

James Slapak
Williamson Energy, LLC
P.O. Box 99
Johnston City, IL 62951

Re: Permit No. 375
Incidental Boundary Revision No. 33

Dear Mr. Slapak:

The appropriate Department technical staff have reviewed the proposed incidental boundary revision dated July 19, 2011, submitted by Williamson Energy for Pond Creek Mine, Permit No. 375. The request would add 0.82 acres to conduct surface coal mining activities. The additional acres would be used for a compressor borehole, which will include the compressor site pad and access road.

The Department finds Williamson Energy has demonstrated in its request, and field inspections by the Department's field representative have confirmed that these areas (0.82 acres) meet the requirements for an incidental boundary change as outlined in 62 Ill. Adm. Code 1774.13(d). Section 1774.13(d)(6) publication requirements have been met.

The Department has determined that the area delineated in the request meets the criteria established in Section 1817.46(e) and hereby grants an exemption from the use of a sedimentation pond for this area, with the following conditions:

> Sediment control measures necessary to minimize erosion shall be in place and functional, prior to any disturbance. All stockpiled material, along with any disturbed area that will not be rocked, shall be vegetated and/or mulched as soon as those activities are completed.

The bond for the area will be $6,108.00. Copies of bond form SCML-2 have been enclosed for your use. For additional bonding and other forms, please contact this office or download a copy from the web at: www.dnr.state.il.us/mines/lrd/forms.htm. Please note many forms have been modified. **Only** the most current versions will be accepted.

Upon receipt by the Department of the fee and bond, plus 3 copies of your request letter and map(s) and, at the same time, forwarding two copies to Ronald Morse, Illinois Environmental Protection Agency, 2309 West Main Street, Marion, Illinois 62959, mining activities on these 0.82 acres may commence, following Department approval.

All conditions and provisions contained in the approved permit also apply to this revision. Approval from this agency does not relieve Williamson Energy, LLC from obtaining approval from other agencies requiring such.

Should you have any questions, please contact Brad Murphy at our Benton office.

Sincerely,

Scott K. Fowler, Supervisor
Land Reclamation Division

SKF:CBM:gr

Enclosure
cc: C.B. Murphy
R. Morse
M. Parrish

SCML-2

State of Illinois
Department of Natural Resources
Office of Mines and Minerals - Land Reclamation Division
One Natural Resources Way, Springfield, IL 62702-1271

SURETY BOND

SURFACE-COAL MINING LAND CONSERVATION AND RECLAMATION ACT

Surety Company Bond No. _____

KNOW ALL MEN BY THESE PRESENTS, That the undersigned _____

_____ of _____

_____ as principal, and _____

_____, duly licensed to do business in the State of Illinois of _____

_____ as surety are held and firmly bound unto the People of the State of Illinois, in the penal sum of _____ Dollars ($_____

_____) for the payment of which sum, we hereby jointly and severally bind ourselves, our heirs, administrators, executors, successors, and assigns.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, that whereas, the above-named principal filed with the Department of Natural Resources, Office of Mines and Minerals Surface Coal Mining and Reclamation Operations Application No._____, a Permit to engage in surface coal mining and reclamation operations in the State of Illinois, under the terms and provisions of the Surface-Coal Mining Land Conservation and Reclamation Act, effective June 1, 1980.

NOTICE - This state agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under 225 ILCS 715/1 (Ill. Rev. Stat., Ch. 96 1/2 par. 4501 et seq.). Disclosure of this information is voluntary; however, failure to comply may result in this form not being processed. This form has been approved by the Forms Management Center.

IL472-0008b

Now if the said principal shall faithfully perform all requirements of the Surface Coal Mining Land Conservation and Reclamation Act and comply with all rules of the Department made in accordance with the provisions of this Act, and satisfactorily reclaim all lands disturbed by surface coal mining and reclamation operations by said principal for which this bond was executed, within the State of Illinois, as per approval of the principal's reclamation plan by the Department to the aforesaid application then this obligation shall be null and void; otherwise it shall remain in full force and effect.

_____
(Principal)

Date: _____ By: _____

_____
(Official Position)

Date: _____ By: _____
(Surety)

_____

Where one signs by virtue of Power of Attorney for a surety company, such Power of Attorney must be filed with the bond.

This bond may be released by the Department upon not less than 90 days advance written notice served by Certified Mail by the surety to the Department, and at the same time furnishing the Department, by the party desiring to cancel this bond, proof satisfactory to the Department that the principal or surety has fully complied with the terms and conditions of this bond for area obligated under the bond prior to the date of release request.

A release of this bond for an area not disturbed by surface coal mining and reclamation operations shall not relieve the principal or surety of any obligation which arose prior to release for which obligation the bond was given to secure.

This bond may be released in part or in its entirety. The surety company shall be notified at the following address: _____

_____

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Admin Office: 618-983-3020 Fax: 618-983-3017
Mine Office: 618-983-3020 Mine Fax: 618-983-5474

July 19, 2011

Mr. Scott K. Fowler
Illinois Department of Natural Resources
Land Reclamation Division
One Natural Resources Way
Springfield, IL 62702-1271

Request for
Incidental Boundary Revision for 0.82 Acres
Williamson Energy LLC – Permit 375
Pond Creek Mine No 1
Williamson County

Dear Mr. Fowler:

Williamson Energy is submitting an original and one copy of a 0.82 acre IBR application. The IBR is for a compressor borehole, which will include the compressor site pad and access road. Please refer to the incidental boundary revision material.

Please be advised that one copy of this IBR application has been sent to Mr. Brad Murphy in the Benton office.

If you have any questions or require additional information, please contact us.

Respectively submitted,

James W. Slapak
Chief Surveyor Mach Mining, LLC

Enclosures

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Admin Office: 618-983-3020 Fax: 618-983-3017
Mine Office: 618-983-3020 Mine Fax: 618-983-5474

July 19, 2011

Mr. Brad Murphy
Illinois Department of Natural Resources
Land Reclamation Division
503 East Main St.
Benton, IL 62812

Request for
Incidental Boundary Revision for 0.82 Acres
Williamson Energy LLC – Permit 375
Pond Creek Mine No 1
Williamson County

Dear Mr. Murphy:

Williamson Energy is submitting one copy of a 0.82 acre IBR application. The IBR is for a compressor borehole, which will include the compressor site pad and access road. Please refer to the incidental boundary revision material.

Please be advised that one original and one copy of this IBR application has been sent to Mr. Scott Fowler in the Springfield office.

If you have any questions or require additional information, please contact us.

Respectively submitted,

James W. Slapak
Chief Surveyor Mach Mining, LLC

Enclosures

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Office: 618-983-3020 Fax: 618-983-3017

Mr. Scott K. Fowler, Supervisor
ILLINOIS DEPARTMENT OF
NATURAL RESOURCES
One Natural Resources Way
Springfield, IL 62702-1271

Re: Williamson Energy, LLC - Permit No. 375; 0.82 acres IBR

Dear Mr. Fowler:

This letter authorizes Mr. Jim Slapak and Alliance Consulting, Inc. (Alliance) and its representatives, permission to perform work on, receive comments and submit corrections on the above referenced application. Please send copies of any comments to Alliance Consulting, Inc. at 124 Philpott Lane, Beaver, WV 25813, as well as Williamson Energy, LLC at the above address.

Thank you for your cooperation.

Sincerely,

WILLIAMSON ENERGY, LLC

Anthony Webb
Authorized Agent

INCIDENTAL BOUNDARY REVISION FOR PERMIT NO. 375

(0.82 ACRES FOR EMERGENCY CONPRESSOR BOREHOLE SITE)

WILLIAMSON COUNTY, IL
POND CREEK MINE NO. 1

Prepared for

WILLIAMSON ENERGY LLC
JOHNSTON CITY, IL

ALLIANCE PROJECT NO. B11-371-1413
JULY 2011

PART I

State of Illinois
Department of Natural Resources
Office of Mines and Minerals
Land Reclamation Division
One Natural Resources Way
Springfield, IL 62702-1271

APPLICATION FOR SURFACE COAL MINING AND RECLAMATION OPERATIONS INCIDENTAL BOUNDARY REVISION IBR-1

PART I

DATE: July 15, 2011

NOTICE : This state agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Ill. Rev. Stat. 1987 Ch. 96 1/2, par. 7901.01 et seq. Disclosure of this information is voluntary, however failure to comply may result in this form not being processed. This form has been approved by the Forms Management Center.

1) A) General Information

(I)(We)(The) Williamson Energy LLC
(Name of Company, Corporation, Partnership or Individual)

P. O. Box 99, Johnston City, IL 62951 (618) 983-3020
(Address) (Telephone Number)

hereby submit application for an Incidental Boundary Revision to Permit 375

Name of Mine Pond Creek No. 1

MSHA No. 11-03141

I, Anthony Webb under penalty of
(vice president or his duly authorized representative under the existing permit)

perjury declare that all information provided in this application is true and correct to the best of my knowledge.

Anthony Webb Authorized Agent
Title

Surface Area:

ADDITIONAL ACRES REQUESTED 0.82 EXISTING PERMIT ACREAGE 624.80

B) Indicate the type of disturbance and associated acreage.

Type of Disturbance	Existing Permit	IBR	Total
Area Stripping	20.13	0	20.13
Mine Waste Areas	277.39	0	277.39
Processing Areas & Support Facilities	127.5	0.82	128.32
Access, Haul Roads & Transport Facilities	23.57	0	23.57
Soil Storage Areas	75.70	0	75.70
Diversions	32.85	0	32.85
Coal Recovery (Gob & Slurry)	0	0	0
Other	30.46	0	30.46
Not to be Disturbed	37.19	0	37.19

2) A) Provide name and address of every legal or equitable owner of record of the IBR area.

RESPONSE: Randy L. and Rebecca A Wright, 917 13th Street, St. Cloud, FL 34772

B) Provide name and address of the owner of record for all surface and subsurface areas contiguous to any part of the proposed IBR area.

RESPONSE: Randy L. and Rebecca A Wright, 917 13th Street, St. Cloud, FL 34772

C) Show location of owners of record of those lands, both surface and subsurface, included in or contiguous to the IBR area on premining land use map or another map, if necessary.

RESPONSE: Refer to Map 6 S.F.

3) Provide name and address of any holder of record of leasehold interest for the IBR area.

RESPONSE: Refer to Attachment Part I.3.

4) Affidavits, Certifications

A) Complete affidavit regarding applicant's legal right to enter and begin surface coal mining and reclamation operations in the IBR area and whether that right is the subject of pending litigation. Identify the documents upon which affidavit is based by type and date of execution and identify specific lands to which each document pertains and explain the legal rights claimed by the applicant (1778.15(a)). If the private mineral estate to be mined has been severed from the private surface estate, provide copies of the documents required under Section 1778.15(B)(1)-(3). On the permit map

or other designated map show the boundaries of land within the permit area upon which the applicant has the legal right to enter and begin surface mining activities.

RESPONSE: Refer to Attachment Part I.4.A.

B) Complete certification for engineering aspects of the application. In addition to the general certification, three specific certifications are included which are applicable only if the box in front of each is marked. The first two cover special permit requirements and should be marked only when they occur for the proposed permit. The third certification covers the Illinois Environmental Protection Agency permit requirements. In most cases, an Illinois registered engineer will be required to certify IEPA permit requirements. Except as otherwise provided all maps, plans and cross-sections included in the permit application shall be prepared by, or under the direction of, and sealed by a qualified registered professional engineer licensed under the Illinois Professional Engineering Act, a qualified registered structural engineer licensed under the Illinois Structural Engineering Act or if authorized by state law, a qualified registered professional land survey or licensed under the Illinois Land Surveyors Act with assistance from experts in related fields.

RESPONSE: Refer to Attachment Part I.4.B.

5) Areas Designated Unsuitable for Mining

A) Does proposed IBR area include --

(1) Lands within boundaries of the National Park System, National Wildlife Refuge System, National Recreation Areas, etc. [Section 1761.11(a)]?

Yes _____ No __X__

(2) National forest land?

Yes _____ No __X__

(3) Any land which will adversely affect any publicly-owned park or places included in or eligible for listing in the National Register of Historic places, etc. [per 62 Ill. Adm. Code 1761.11(a)(3) or Section 10, (B)(C) of the SCM-1?

Yes _____ No __X__

If yes, complete Part II, Section 10, (B) & (C) of the SCM-1 or the UCM-1 Application.

(4) Any public roads which are to be removed, relocated or temporarily closed?

Yes _____ No __X__

Indicate on the pre-mining land use map or other designated map the location of the public roads and attach a copy of the written agreement from the appropriate authority authorizing the relocation, removal or temporary closure. Describe the measures to be used to insure that the interest of the public and land owners affected will be protected.

B) Will proposed IBR area be located --

(1) Within 100 feet of the right-of-way line of any public road?

Yes _____ No __X__

If yes, explain proposed procedure for complying with regulation section 1761.11(d), including request for variance, if relevant. Provide location of public roads on pre-mining land use map or other designated map. Describe the measures to be used to insure that the interest of the public and land owners affected will be protected.

(2) Within 300 feet measured horizontally from any occupied dwelling?

Yes _____ No __X__

If so, is waiver provided meeting requirements of Section 1761.15?

(3) Within 300 feet measured horizontally of any public building, school, church, community or institutional building or public park?

Yes _____ No __X__

(4) Within 100 feet measured horizontally of a cemetery?

Yes _____ No __X__

C) Are valid existing rights (per 1761.11) claimed for any part of the IBR area?

Yes _____ No __X__

If yes, provide documentation to substantiate claim.

D) Provide a draft copy of the proposed newspaper notice and name of local newspaper of general circulation in which advertisement of the application will be published, per 62 Ill. Adm. Code 1774.13(d)(6). Certification of publication is to be furnished to the Department and must be received prior to Department approval of the IBR.

RESPONSE: Refer to Attachment Part I.5.D.

PART I ATTACHMENTS

ATTACHMENT PART I.2.A

Prepared by:
Williamson Energy, LLC
P.O. Box 99
Johnston City, IL 62951

FIRST AMENDMENT TO SURFACE LEASE AGREEMENT

This First Amendment to Surface Lease Agreement (herein this "First Amendment") is made this 11th day of July, 2011, by and between the RANDY L. WRIGHT and REBECCA A. WRIGHT, husband and wife, with a mailing address at 917 13th, St. Cloud, Florida 34774, (herein "Wright"), and WILLIAMSON ENERGY, LLC, of P.O. Box 99, Johnston City, Illinois, 62951, (herein "Williamson").

WHEREAS, Wright, as Lessor and Williamson, as Compamy entered into a Surface Lease Agreement having an effective date of the 11th day of December, 2009, (herein "Lease") pertaining to operating a dewatering well, injection well or wells and related appurtenances to be situated on Property described in said Lease.; and,

WHEREAS, Wright and Williamson desire to amend the Lease so as to include matters corresponding to the location of a new well site and related appurtenances and incorporate other surface owned by Wright.

NOW, THEREFORE, for and in consideration of the foregoing recitals, the mutual benefits to be derived herefrom and Ten Dollars and other valuable consideration, Wright and Williamson amend the Lease as follows:

1. The following described surface, owned by Wright, shall be added to and be a part of the Property under the Lease:

The NW/4 NW/4 of Section 15, Township 8 South, Range 4 East of the 3rd P.M., Williamson County, Illinois.

2. The general location of the area contemplated to be affected on the Property under the Lease is shown or depicted on the Plat entitled Exhibit "A" to First Amendment attached hereto and made a part hereof..

3. This First Amendment shall be binding upon and inure to the benefit of the Wright and Williamson together with their heirs, successors, personal representatives and assigns.

4. Any assignment, transfer or successor in initerest of the Lease, as amended herein, shall be encumbered by the terms of said Lease and any assignee, transferee or successor in interest shall be bound thereby. Notice of any assignment by Wright or

Williamson shall be given in writing at the time of the assignment to the other party to the Lease.

5. Wright and Williamson ratify and confirm the Lease in all respects as originally drafted and as amended herein.

DATED the day and year above written.

WRIGHT

BY: _____

Printed Name: RANDY L. WRIGHT

BY: _____

Printed Name: REBECCA A. WRIGHT

WILLIAMSON

BY: Gary L. Schmitz

Printed Name: GARY L. SCHMITZ

TITLE: AUTHORIZED PERSON

RW
RAW

STATE OF FLORIDA)
) SS.
COUNTY OF OSCEOLA)

I, the undersigned Notary Public, in and for said County in the State aforesaid, do hereby certify that RANDY L. WRIGHT and REBECCA A.WRIGHT, husband and wife, personally known to me to be the same persons whose names are subscribed to the foregoing instrument, appeared before me this day in person, and acknowledged that they signed and delivered the said instrument of writing as their free and voluntary act and deed for the uses and purposes therein set forth including the release and waiver of the right of homestead.

Given under my hand and seal this 12th day of July, 2011.

Melinda Klein
Notary Public

My Commission Expires:

Seal:

MELINDA KLEIN
Comm# DD0827752
Expires 10/1/2012
Florida Notary Assn., Inc

STATE OF ILLINOIS)
) SS.
COUNTY OF WILLIAMSON)

I, the undersigned Notary Public, in and for said County in the State aforesaid, do hereby certify that Shay Shrite personally known to me to be a duly authorized person of WILLIAMSON ENERGY, LLC, a Delaware limited liability company, and personally known to me to be the same person whose name is subscribed to the foregoing instrument, appeared before me this day in person, and acknowledged that he signed, sealed and delivered the said instrument as such authorized person pursuant to authority given by the Members of said limited liability company, as his free and voluntary act, and as the free and voluntary act and deed of said Company, for the uses and purposes therein set forth.

Given under my hand and seal this 11th day of July, 2011.

Cathy L Skelton
Notary Public

My Commission Expires: 2/15/12

Seal:

Official Seal
Cathy L Skelton
Notary Public State of Illinois
My Commission Expires 02/15/2012

ATTACHMENT PART I.4.A

Attachment 1.4.A

(I) (We) Anthony Webb
(Individual or Individuals)

under penalty of perjury declare on behalf of the applicant, Williamson Energy LLC, that said applicant has valid documents which bestow upon the applicant a legal right to enter and commence surface coal mining and reclamation operations upon lands contained in the proposed IBR area, and such legal right is not in any way the subject of pending court litigation.

Dated this 15th day of July, 2011.

Anthony Webb Authorized Agent
Signature / Title

State of Illinois

County of Williamson

Signed by and subscribed to before me on 15th (date) by Anthony Webb (name of person)

Official Seal
Cathy L Skelton
Notary Public State of Illinois
My Commission Expires 02/15/2012

Cathy L Skelton
(Signature of Notary Public)

ATTACHMENT PART I.4.B

Attachment I.4.B.

ENGINEERING CERTIFICATION

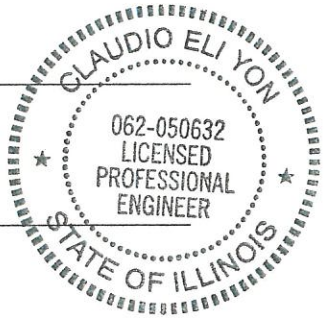
I hereby certify the engineering design used in preparation of this application, attachments, and supplements was done by me or under my direct supervision.

I further certify to the best of my knowledge all such design is in accordance with all applicable local, state and federal laws, rules and regulations. I have placed an "X" in the box below if that item is relevant.

☐ Whereas the Reclamation Plan calls for an alternative land use, I also certify the plans to conform to applicable accepted standards for adequate land stability, drainage, vegetative cover, and aesthetic design appropriate for the post-mining use of the site.

☐ Whereas the operation proposes disposal of spoil or waste materials in areas other than mining workings or excavations, I also certify such fills are designed in accordance with recognized professional standards and all applicable laws.

☒ Certification of Illinois Environmental Protection Agency-35 Ill. Adm. Code 405.104(a) Permit. In my professional judgement, the plans and specifications submitted as part of this application describe an operation which will meet all applicable effluent and water quality standards. I certify that I am familiar with all of the plans, specifications, reports, and maps submitted as part of this application and that said plans, etc. are accurate insofar as they represent existing conditions.



Claudio E. Yon
Name

062-050632
Illinois Registration Number (Seal)

Alliance Consulting, Inc.
Firm

(304) 255-0491
Phone Number

124 Philpott Lane, Beaver, West Virginia 25801
Address

Claudio E. Yon
Signature

07/15/11
Date

ATTACHMENT PART I.5.D

Attachment I.5.D.

PUBLIC NOTICE

Pursuant to the Surface Coal Mining Land Conservation and Reclamation Act (PA-81-1015, as amended) and the Rules and Regulations of the Act, Williamson Energy LLC, P. O. Box 99, Johnston City, IL 62951 hereby gives notice that on _____ 2011, an incidental boundary revision (IBR) has been submitted to the Illinois Department of Natural Resources, Office of Mines and Minerals, Land Reclamation Division, One Natural Resources Way, Springfield, IL 62702-1271. The IBR application is for 0.82 acres located in Williamson County, Township 8 South, Range 4 East, the southwest quadrant of Section 10, south of Locust Grove Road.

Activities will include compressor bore hole, installation and maintenance of a buried power line, and an access road.

Copies of the application are on file with the Illinois Department of Natural Resources, Office of Mines and Mineral, 503 East Main St., Benton, Illinois 62812, and the Springfield, Illinois Office.

Written comments concerning the operations should be addressed to the Office of Mines and Minerals, Land Reclamation Division at the Springfield office, no later than 7 days from the date of this notice.

PART II

PART II

PREMINING INFORMATION

Premining information is to be displayed on premining land use map unless otherwise indicated.

1) Describe how the IBR area perimeter will be marked and discuss the method or system employed to locate permit area perimeter and set markers along it. Designate a reference point outside the IBR area if different then the original permit. Provide a description of the reference point and a sketch relating the reference point to the IBR area perimeter.

RESPONSE: The perimeter of the IBR area will be delineated by using PVC and/or metal post and be located within eye sight of one another, if the property owner will allow it. A reference point will be adjacent permitted site.

2) Explain and locate areas where the IBR is contiguous to an existing permit.

RESPONSE: The IBR area is adjacent to the previously permitted IBR Nos. 16 and 25 and the purpose of this application is to permit an emergency compressor bore hole. The bore hole will be located in Headgate #4 bleeder entries. This area has been filling with water reducing ventilation and making it a safety hazard for the mine examiners. Currently the operation has air pumps in this area but the compressors are located 4.5 miles away and no longer provide enough air to move the large volume of water. Another compressor hole is needed to ensure this area will stay open to provide adequate ventilation and safe travel for the mine examiners.

This IBR area is to construct an access road, drill a 9 7/8-inch diameter bore hole that will be cased to a 5- inch diameter hole and will have a depth of approximately 500 to 530 feet. When the bore hole is no longer needed, it will be grouted the entire length. In addition to the compressor bore hole, a concrete pad measuring 12 feet by 12 feet by 1 foot will be constructed.

3) Give the acreages of each land use within the proposed IBR and existing permit area, employing land use categories of Section 1701.5 listed below, and delineate on premining land use map existing land uses in the proposed permit area and adjacent to it. Include on the premining land use map the location of all buildings and identify the current use of these buildings.

Pre-Mine Land Use	Existing Permit	IBR	Total
Cropland	503.22	0	503.22
Pasture land	0	0	0
Grazing land	0	0	0
Forestry	101.86	0	101.86
Residential	2.55	0	2.55
Industrial/Commercial			
Recreation	0	0	0
Fish and Wildlife Habitat	8.30	0.82	9.12
Developed Water Resources	1.44	0	1.44
Undeveloped land	0	0	0

4) Soils Information Map

A) Does the submitted soils map represent a map developed by the National Resources Conservation Service (NRCS)?

Yes ___X___ No_____.

If no, explain.

B) Delineate on the soils map(s) the area which will incur actual mining (removal of overburden and/or deposition of overburden for the extraction of coal).

RESPONSE: No removal of overburden or deposition of overburden for the extraction of coal will occur on the IBR area. Topsoil material will be temporarily stored on site.

C) Are any of the identified map units correlated as prime farmland by NRCS criteria?

Yes ___X___ No_____.

If yes, explain and provide documentation to meet the requirements of Section 1785.17, if a determination for grandfathering and/or negative determination is sought. If prime farmlands exist, which will not meet the exemption criteria described above, the approved prime farmlands restoration plan must be followed.

RESPONSE: Map 5 - Soils Resources Map indicates that the IBR area is considered prime farmland. However, the IBR area has been utilized for hunting and not for farmland.

D) Submit, by completing soils information chart, acreage totals of each map unit (soil type and slope classification) and land use capability classes in the IBR area and the percent slope range of each lettered slope classification used on the soil map.

RESPONSE: Refer to Map 5 – Soils Resources Map. Additional information can be found in the NRCS Custom Soil Resource Report.

E) Provide, by completing soil information chart, acreage for each of the map units of high capability land (including grandfathered and negatively determined prime farmland) and non-cropland capability land with respect to areas which will be mined and areas which will incur other forms of disturbance (i.e., roads, ditches, etc.). Identify and provide map unit acreage values, if any, for areas which will not be disturbed.

RESPONSE: Refer to Map 5 – Soils Resources Map. Although the Soil Resource Report indicates that the soil type is prime farmland, the area has been designated as hunting club property for a number of years and has not been cultivated for farming.

F) Are selected overburden materials proposed to be used in lieu of or as a supplement to the A-horizon?

Yes _____ No___X___.

If yes, provide the appropriate information required under 1780.18(b)(4)/1784.13(b)(4).

PART II ATTACHMENTS

ATTACHMENT PART II.4.

United States Department of Agriculture

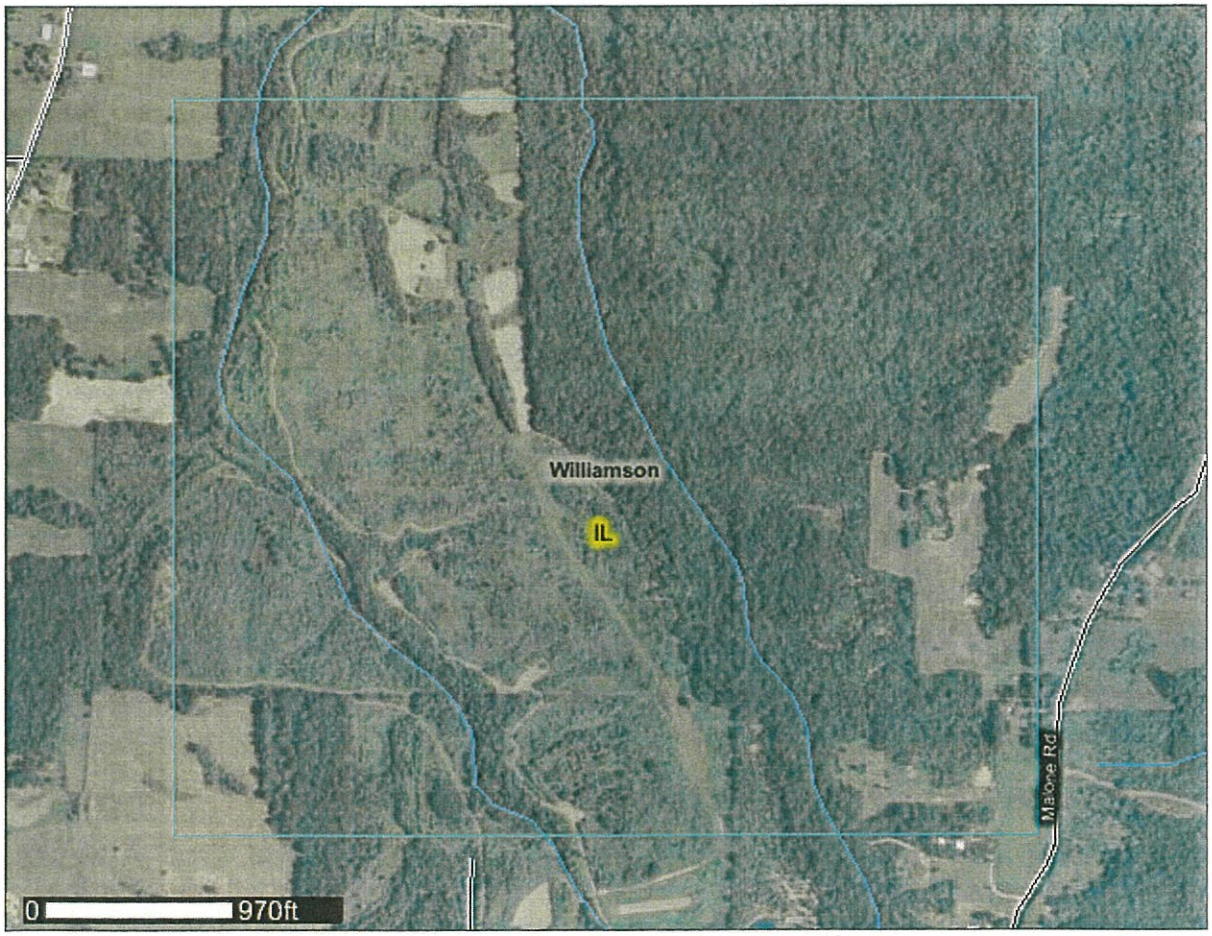
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Williamson County, Illinois

Permit 375 0.82 Acre IBR



July 15, 2011

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means

for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Preface.....2
How Soil Surveys Are Made.....5
Soil Map.....7
Soil Map.....8
Legend.....9
Map Unit Legend.....10
Map Unit Descriptions.....10
Williamson County, Illinois.....13
10C—Plumfield silty clay loam, 5 to 10 percent slopes.....13
10D—Plumfield silty clay loam, 10 to 18 percent slopes.....13
14B—Ava silt loam, 2 to 5 percent slopes.....14
14B2—Ava silt loam, 2 to 5 percent slopes, eroded.....15
14C2—Ava silt loam, 5 to 10 percent slopes, eroded.....16
301B—Grantsburg silt loam, 2 to 5 percent slopes.....17
301C2—Grantsburg silt loam, 5 to 10 percent slopes, eroded.....18
339D2—Wellston silt loam, 10 to 18 percent slopes, eroded.....18
340D2—Zanesville silt loam, 10 to 18 percent slopes, eroded.....19
340D3—Zanesville silty clay loam, 10 to 18 percent slopes, severely eroded.....20
908D3—Hickory-Kell clay loams, 10 to 18 percent slopes, severely eroded.....21
3072A—Sharon silt loam, 0 to 2 percent slopes, frequently flooded.....22
3382A—Belknap silt loam, 0 to 2 percent slopes, frequently flooded.....23
W—Water.....24
Soil Information for All Uses.....25
Suitabilities and Limitations for Use.....25
Land Classifications.....25
Farmland Classification.....25
Nonirrigated Capability Class.....28
Soil Reports.....33
Vegetative Productivity.....33
Nonirrigated Yields by Map Unit.....33
References.....37

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

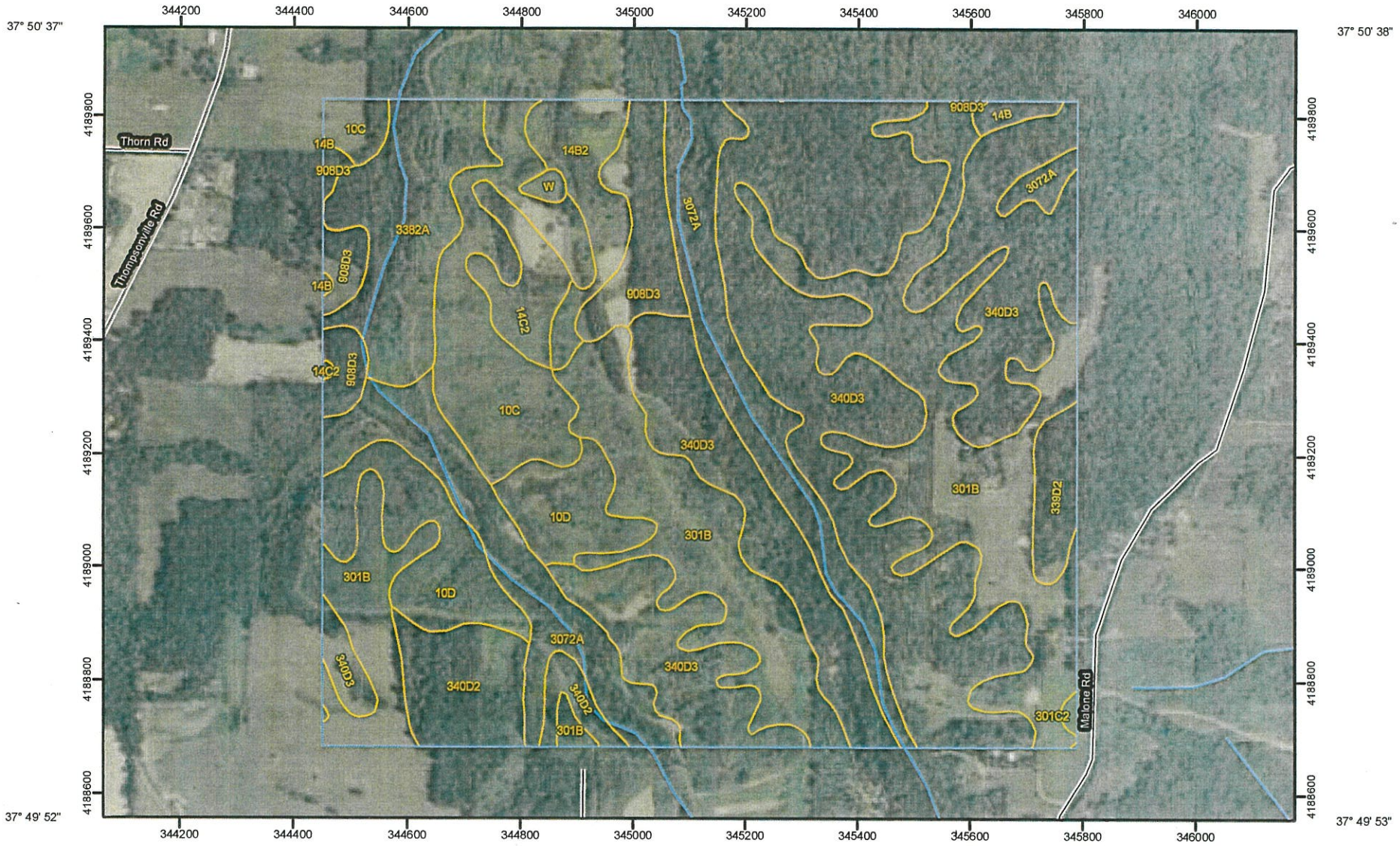
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



R12081

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:10,000 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 16N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Williamson County, Illinois
Survey Area Data: Version 6, Feb 7, 2011

Date(s) aerial images were photographed: 6/13/2007

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Williamson County, Illinois (IL199)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10C	Plumfield silty clay loam, 5 to 10 percent slopes	26.6	7.0%
10D	Plumfield silty clay loam, 10 to 18 percent slopes	22.9	6.1%
14B	Ava silt loam, 2 to 5 percent slopes	1.6	0.4%
14B2	Ava silt loam, 2 to 5 percent slopes, eroded	9.8	2.6%
14C2	Ava silt loam, 5 to 10 percent slopes, eroded	7.1	1.9%
301B	Grantsburg silt loam, 2 to 5 percent slopes	85.5	22.6%
301C2	Grantsburg silt loam, 5 to 10 percent slopes, eroded	0.4	0.1%
339D2	Wellston silt loam, 10 to 18 percent slopes, eroded	5.2	1.4%
340D2	Zanesville silt loam, 10 to 18 percent slopes, eroded	13.9	3.7%
340D3	Zanesville silty clay loam, 10 to 18 percent slopes, severely eroded	125.0	33.0%
908D3	Hickory-Kell clay loams, 10 to 18 percent slopes, severely eroded	16.1	4.3%
3072A	Sharon silt loam, 0 to 2 percent slopes, frequently flooded	43.2	11.4%
3382A	Belknap silt loam, 0 to 2 percent slopes, frequently flooded	20.9	5.5%
W	Water	0.8	0.2%
Totals for Area of Interest		**379.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be

made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas.* Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Williamson County, Illinois

10C—Plumfield silty clay loam, 5 to 10 percent slopes

Map Unit Setting

Elevation: 360 to 840 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition

Plumfield and similar soils: 90 percent

Description of Plumfield

Setting

Landform: Till plains
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loess over glacial drift

Properties and qualities

Slope: 5 to 10 percent
Depth to restrictive feature: 5 to 20 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Very low (about 1.0 inches)

Interpretive groups

Land capability (nonirrigated): 4e

Typical profile

0 to 5 inches: Silty clay loam
5 to 12 inches: Silt loam
12 to 36 inches: Silt loam
36 to 60 inches: Silt loam

10D—Plumfield silty clay loam, 10 to 18 percent slopes

Map Unit Setting

Elevation: 360 to 840 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition
Plumfield and similar soils: 90 percent

Description of Plumfield

Setting
Landform: Till plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess over glacial drift

Properties and qualities
Slope: 10 to 18 percent
Depth to restrictive feature: 5 to 20 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Very low (about 1.0 inches)

Interpretive groups
Land capability (nonirrigated): 6e

Typical profile
0 to 5 inches: Silty clay loam
5 to 12 inches: Silt loam
12 to 36 inches: Silt loam
36 to 60 inches: Silt loam

14B—Ava silt loam, 2 to 5 percent slopes

Map Unit Setting
Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition
Ava and similar soils: 90 percent

Description of Ava

Setting
Landform: Till plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex

Across-slope shape: Convex
Parent material: Peoria and roxana loess over glacial drift

Properties and qualities
Slope: 2 to 5 percent
Depth to restrictive feature: 25 to 40 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Moderate (about 6.3 inches)

Interpretive groups
Land capability (nonirrigated): 2e

Typical profile
0 to 8 inches: Silt loam
8 to 18 inches: Silt loam
18 to 36 inches: Silty clay loam
36 to 53 inches: Silt loam
53 to 80 inches: Silt loam

14B2—Ava silt loam, 2 to 5 percent slopes, eroded

Map Unit Setting
Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition
Ava, eroded, and similar soils: 90 percent

Description of Ava, Eroded

Setting
Landform: Till plains
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Peoria and roxana loess over glacial drift

Properties and qualities
Slope: 2 to 5 percent
Depth to restrictive feature: 25 to 40 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)

Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Low (about 5.2 inches)

Interpretive groups
Land capability (nonirrigated): 2e

Typical profile
0 to 9 inches: Silt loam
9 to 28 inches: Silty clay loam
28 to 64 inches: Silt loam
64 to 78 inches: Silt loam

14C2—Ava silt loam, 5 to 10 percent slopes, eroded

Map Unit Setting
Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition
Ava, eroded, and similar soils: 90 percent

Description of Ava, Eroded

Setting
Landform: Till plains
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Peoria and roxana loess over glacial drift

Properties and qualities
Slope: 5 to 10 percent
Depth to restrictive feature: 25 to 40 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Low (about 5.2 inches)

Interpretive groups
Land capability (nonirrigated): 3e

Typical profile
0 to 9 inches: Silt loam

9 to 28 inches: Silty clay loam
28 to 64 inches: Silt loam
64 to 78 inches: Silt loam

301B—Grantsburg silt loam, 2 to 5 percent slopes

Map Unit Setting

Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition

Grantsburg and similar soils: 90 percent

Description of Grantsburg

Setting

Landform: Loess hills
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Peoria and roxana loess over residuum

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: 24 to 40 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum: 4.0
Available water capacity: Moderate (about 6.5 inches)

Interpretive groups

Land capability (nonirrigated): 2e

Typical profile

0 to 11 inches: Silt loam
11 to 24 inches: Silt loam
24 to 38 inches: Silty clay loam
38 to 61 inches: Silt loam
61 to 80 inches: Silt loam

301C2—Grantsburg silt loam, 5 to 10 percent slopes, eroded

Map Unit Setting

Elevation: 340 to 1,020 feet
Mean annual precipitation: 38 to 48 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 180 to 210 days

Map Unit Composition

Grantsburg, eroded, and similar soils: 90 percent

Description of Grantsburg, Eroded

Setting

Landform: Loess hills
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope, head slope, interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Peoria and roxana loess over residuum

Properties and qualities

Slope: 5 to 10 percent
Depth to restrictive feature: 24 to 40 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum: 4.0
Available water capacity: Low (about 5.8 inches)

Interpretive groups

Land capability (nonirrigated): 3e

Typical profile

0 to 7 inches: Silt loam
7 to 21 inches: Silt loam
21 to 35 inches: Silty clay loam
35 to 58 inches: Silt loam
58 to 80 inches: Silt loam

339D2—Wellston silt loam, 10 to 18 percent slopes, eroded

Map Unit Setting

Elevation: 890 to 1,230 feet

Mean annual precipitation: 35 to 45 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition
Wellston, eroded, and similar soils: 90 percent

Description of Wellston, Eroded

Setting
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope, nose slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess over residuum

Properties and qualities
Slope: 10 to 18 percent
Depth to restrictive feature: 40 to 72 inches to lithic bedrock; 40 to 72 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 8.1 inches)

Interpretive groups
Land capability (nonirrigated): 4e

Typical profile
0 to 5 inches: Silt loam
5 to 28 inches: Silt loam
28 to 40 inches: Channery silt loam
40 to 57 inches: Very channery loam
57 to 67 inches: Bedrock

340D2—Zanesville silt loam, 10 to 18 percent slopes, eroded

Map Unit Setting
Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 45 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition
Zanesville, eroded, and similar soils: 90 percent

Description of Zanesville, Eroded

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope, nose slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess over residuum

Properties and qualities

Slope: 10 to 18 percent
Depth to restrictive feature: 19 to 32 inches to fragipan; 40 to 80 inches to paralithic bedrock; 40 to 80 inches to lithic bedrock
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum: 4.0
Available water capacity: Low (about 3.8 inches)

Interpretive groups

Land capability (nonirrigated): 4e

Typical profile

0 to 4 inches: Silt loam
4 to 19 inches: Silty clay loam
19 to 39 inches: Silt loam
39 to 57 inches: Channery silt loam
57 to 67 inches: Bedrock

340D3—Zanesville silty clay loam, 10 to 18 percent slopes, severely eroded

Map Unit Setting

Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition

Zanesville, severely eroded, and similar soils: 90 percent

Description of Zanesville, Severely Eroded

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope, head slope

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess over residuum

Properties and qualities

Slope: 10 to 18 percent
Depth to restrictive feature: 19 to 32 inches to fragipan; 40 to 80 inches to paralithic bedrock; 40 to 80 inches to lithic bedrock
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.20 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum: 4.0
Available water capacity: Low (about 3.8 inches)

Interpretive groups

Land capability (nonirrigated): 6e

Typical profile

0 to 2 inches: Silty clay loam
2 to 19 inches: Silty clay loam
19 to 37 inches: Silt loam
37 to 55 inches: Channery silt loam
55 to 65 inches: Bedrock

908D3—Hickory-Kell clay loams, 10 to 18 percent slopes, severely eroded

Map Unit Setting

Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition

Hickory, severely eroded, and similar soils: 50 percent
Kell, severely eroded, and similar soils: 40 percent

Description of Hickory, Severely Eroded

Setting

Landform: Till plains
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear

Properties and qualities

Slope: 10 to 18 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Sodium adsorption ratio, maximum: 2.0
Available water capacity: High (about 9.9 inches)

Interpretive groups

Land capability (nonirrigated): 4e

Typical profile

0 to 8 inches: Clay loam
8 to 46 inches: Clay loam
46 to 58 inches: Clay loam
58 to 80 inches: Loam

Description of Kell, Severely Eroded

Setting

Landform: Till plains
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear

Properties and qualities

Slope: 10 to 18 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to high (0.01 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.2 inches)

Interpretive groups

Land capability (nonirrigated): 4e

Typical profile

0 to 7 inches: Clay loam
7 to 13 inches: Clay loam
13 to 35 inches: Very channery silt loam
35 to 60 inches: Bedrock

3072A—Sharon silt loam, 0 to 2 percent slopes, frequently flooded

Map Unit Setting

Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches

Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition
Sharon, frequently flooded, and similar soils: 90 percent

Description of Sharon, Frequently Flooded

Setting
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty alluvium

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 36 to 72 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: Very high (about 12.4 inches)

Interpretive groups
Land capability (nonirrigated): 2w

Typical profile
0 to 13 inches: Silt loam
13 to 40 inches: Silt loam
40 to 80 inches: Silt loam

3382A—Belknap silt loam, 0 to 2 percent slopes, frequently flooded

Map Unit Setting
Elevation: 340 to 490 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition
Belknap, frequently flooded, and similar soils: 90 percent

Description of Belknap, Frequently Flooded

Setting
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty alluvium

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 6 to 24 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: Very high (about 12.7 inches)

Interpretive groups

Land capability (nonirrigated): 3w

Typical profile

0 to 7 inches: Silt loam
7 to 59 inches: Silt loam
59 to 80 inches: Silt loam

W—Water

Map Unit Composition

Water: 100 percent

Description of Water

Setting

Landform: Channels, drainageways, lakes, oxbows, perenial streams, rivers
Parent material: Water

Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

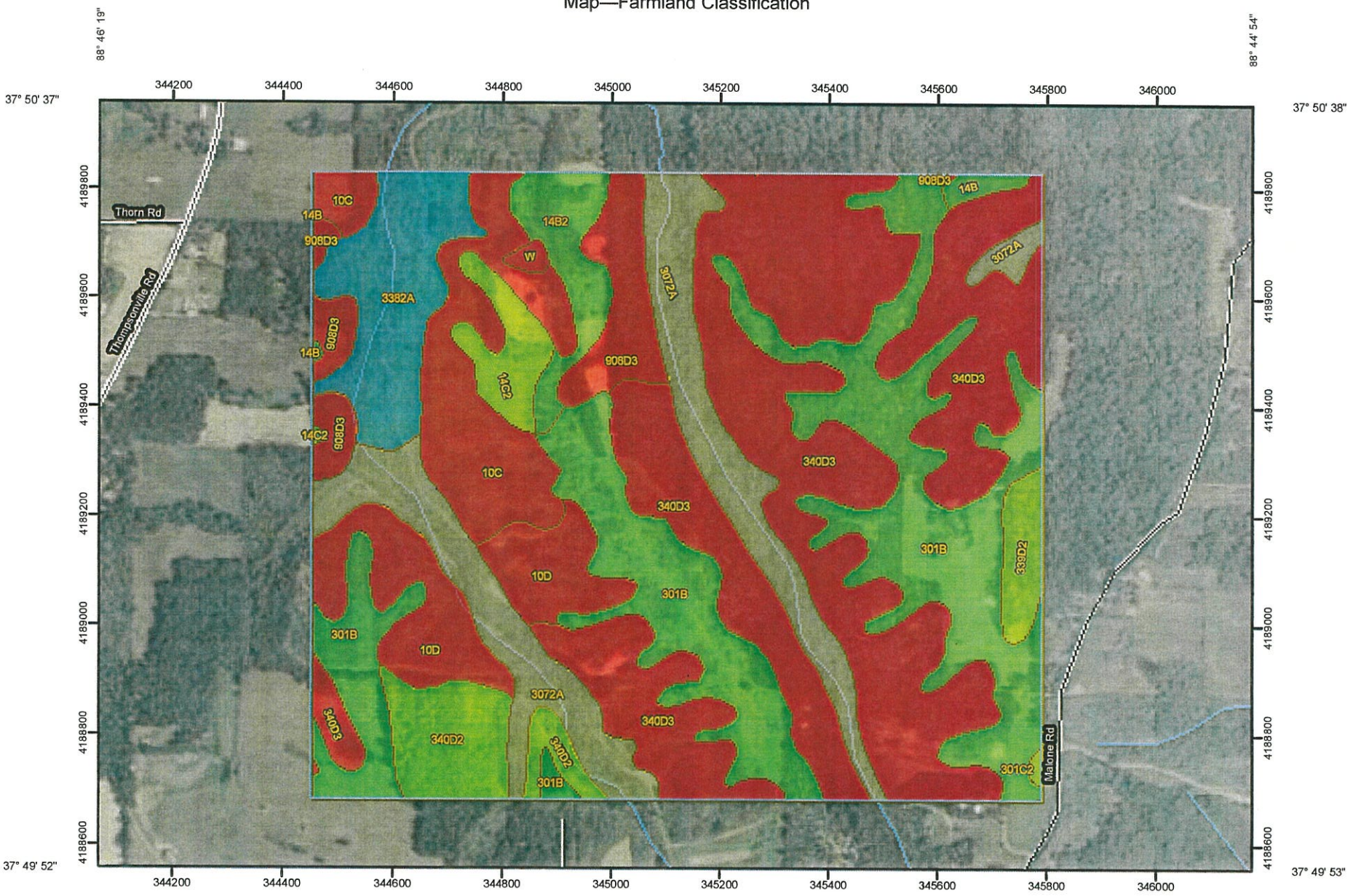
Land Classifications

Land Classifications are specified land use and management groupings that are assigned to soil areas because combinations of soil have similar behavior for specified practices. Most are based on soil properties and other factors that directly influence the specific use of the soil. Example classifications include ecological site classification, farmland classification, irrigated and nonirrigated land capability classification, and hydric rating.

Farmland Classification

Farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. It identifies the location and extent of the soils that are best suited to food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the "Federal Register," Vol. 43, No. 21, January 31, 1978.

Custom Soil Resource Report
Map—Farmland Classification



R12099

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if subsoiled, completely removing the root inhibiting soil layer
- Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance
- Farmland of local importance
- Farmland of unique importance
- Not rated or not available

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

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The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 16N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Williamson County, Illinois
Survey Area Data: Version 6, Feb 7, 2011

Date(s) aerial images were photographed: 6/13/2007

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Farmland Classification

Farmland Classification— Summary by Map Unit — Williamson County, Illinois				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10C	Plumfield silty clay loam, 5 to 10 percent slopes	Not prime farmland	26.6	7.0%
10D	Plumfield silty clay loam, 10 to 18 percent slopes	Not prime farmland	22.9	6.1%
14B	Ava silt loam, 2 to 5 percent slopes	All areas are prime farmland	1.6	0.4%
14B2	Ava silt loam, 2 to 5 percent slopes, eroded	All areas are prime farmland	9.8	2.6%
14C2	Ava silt loam, 5 to 10 percent slopes, eroded	Farmland of statewide importance	7.1	1.9%
301B	Grantsburg silt loam, 2 to 5 percent slopes	All areas are prime farmland	85.5	22.6%
301C2	Grantsburg silt loam, 5 to 10 percent slopes, eroded	Farmland of statewide importance	0.4	0.1%
339D2	Wellston silt loam, 10 to 18 percent slopes, eroded	Farmland of statewide importance	5.2	1.4%
340D2	Zanesville silt loam, 10 to 18 percent slopes, eroded	Farmland of statewide importance	13.9	3.7%
340D3	Zanesville silty clay loam, 10 to 18 percent slopes, severely eroded	Not prime farmland	125.0	33.0%
908D3	Hickory-Kell clay loams, 10 to 18 percent slopes, severely eroded	Not prime farmland	16.1	4.3%
3072A	Sharon silt loam, 0 to 2 percent slopes, frequently flooded	Prime farmland if protected from flooding or not frequently flooded during the growing season	43.2	11.4%
3382A	Belknap silt loam, 0 to 2 percent slopes, frequently flooded	Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season	20.9	5.5%
W	Water	Not prime farmland	0.8	0.2%
Totals for Area of Interest			**379.0**	**100.0%**

Rating Options—Farmland Classification

Aggregation Method: No Aggregation Necessary

Tie-break Rule: Lower

Nonirrigated Capability Class

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in

grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations that show suitability and limitations of groups of soils for rangeland, for woodland, or for engineering purposes.

In the capability system, soils are generally grouped at three levels-capability class, subclass, and unit. Only class and subclass are included in this data set.

Capability classes, the broadest groups, are designated by the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

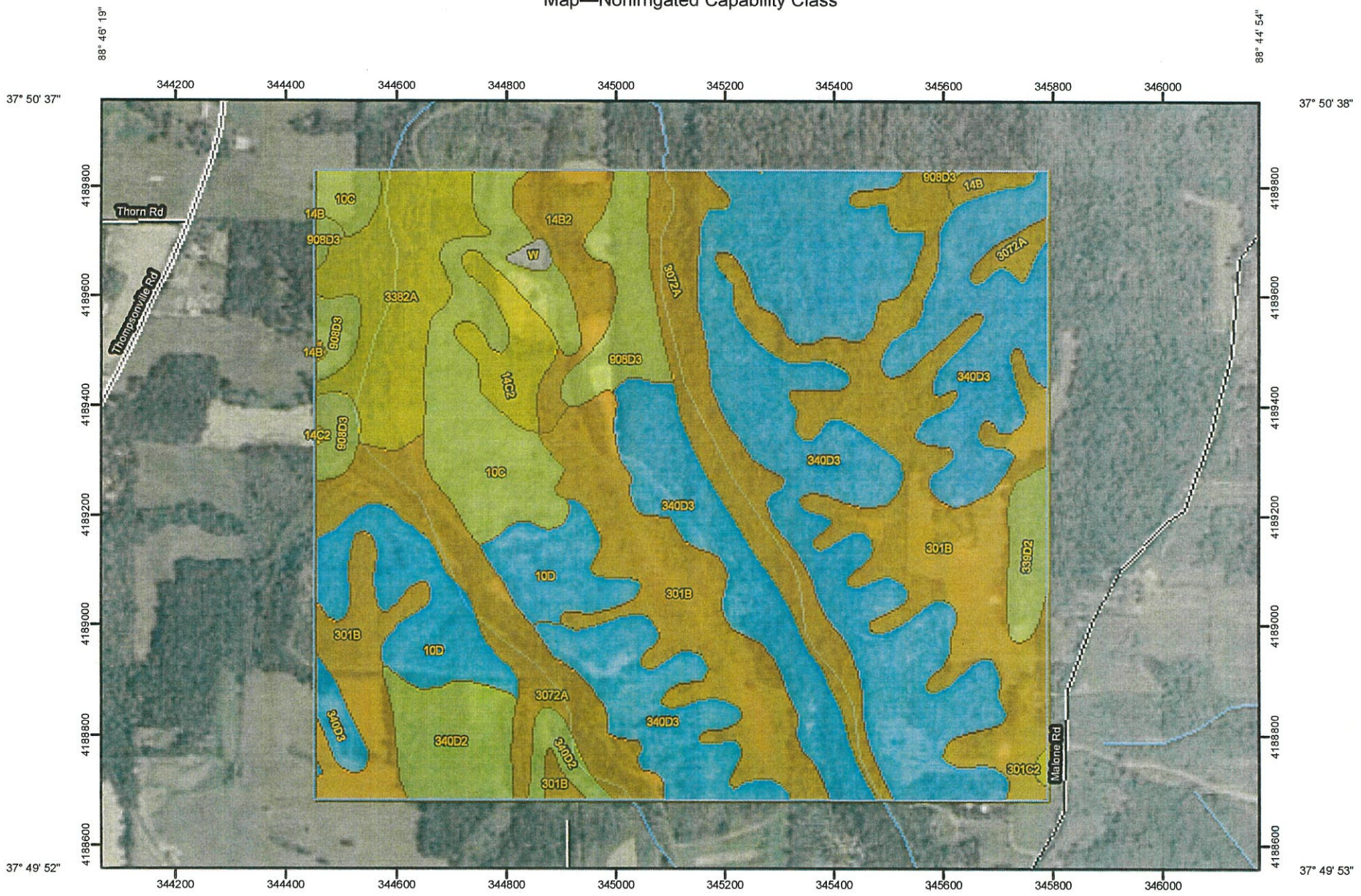
Class 5 soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 7 soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to grazing, forestland, or wildlife habitat.

Class 8 soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

Custom Soil Resource Report
Map—Nonirrigated Capability Class



R12103

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- Capability Class - I
- Capability Class - II
- Capability Class - III
- Capability Class - IV
- Capability Class - V
- Capability Class - VI
- Capability Class - VII
- Capability Class - VIII
- Not rated or not available

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:10,000 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 16N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Williamson County, Illinois
Survey Area Data: Version 6, Feb 7, 2011

Date(s) aerial images were photographed: 6/13/2007

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Nonirrigated Capability Class

Nonirrigated Capability Class— Summary by Map Unit — Williamson County, Illinois				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10C	Plumfield silty clay loam, 5 to 10 percent slopes	4	26.6	7.0%
10D	Plumfield silty clay loam, 10 to 18 percent slopes	6	22.9	6.1%
14B	Ava silt loam, 2 to 5 percent slopes	2	1.6	0.4%
14B2	Ava silt loam, 2 to 5 percent slopes, eroded	2	9.8	2.6%
14C2	Ava silt loam, 5 to 10 percent slopes, eroded	3	7.1	1.9%
301B	Grantsburg silt loam, 2 to 5 percent slopes	2	85.5	22.6%
301C2	Grantsburg silt loam, 5 to 10 percent slopes, eroded	3	0.4	0.1%
339D2	Wellston silt loam, 10 to 18 percent slopes, eroded	4	5.2	1.4%
340D2	Zanesville silt loam, 10 to 18 percent slopes, eroded	4	13.9	3.7%
340D3	Zanesville silty clay loam, 10 to 18 percent slopes, severely eroded	6	125.0	33.0%
908D3	Hickory-Kell clay loams, 10 to 18 percent slopes, severely eroded	4	16.1	4.3%
3072A	Sharon silt loam, 0 to 2 percent slopes, frequently flooded	2	43.2	11.4%
3382A	Belknap silt loam, 0 to 2 percent slopes, frequently flooded	3	20.9	5.5%
W	Water		0.8	0.2%
Totals for Area of Interest			**379.0**	**100.0%**

Rating Options—Nonirrigated Capability Class

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Vegetative Productivity

This folder contains a collection of tabular reports that present vegetative productivity data. The reports (tables) include all selected map units and components for each map unit. Vegetative productivity includes estimates of potential vegetative production for a variety of land uses, including cropland, forestland, hayland, pastureland, horticulture and rangeland. In the underlying database, some states maintain crop yield data by individual map unit component. Other states maintain the data at the map unit level. Attributes are included for both, although only one or the other is likely to contain data for any given geographic area. For other land uses, productivity data is shown only at the map unit component level. Examples include potential crop yields under irrigated and nonirrigated conditions, forest productivity, forest site index, and total rangeland production under of normal, favorable and unfavorable conditions.

Nonirrigated Yields by Map Unit

The average yields per acre that can be expected of the principal crops under a high level of management are shown in this table. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations also are considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

If yields of irrigated crops are given, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good-quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

Pasture yields are expressed in terms of animal unit months. An animal unit month (AUM) is the amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in the table are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

The land capability classification of map units in the survey area is shown in this table. This classification shows, in a general way, the suitability of soils for most kinds of field crops (United States Department of Agriculture, Soil Conservation Service, 1961). Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forestland, or for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit.

Capability classes, the broadest groups, are designated by the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

- Class 1 soils have slight limitations that restrict their use.
- Class 2 soils have moderate limitations that restrict the choice of plants or that require moderate conservation practices.
- Class 3 soils have severe limitations that restrict the choice of plants or that require special conservation practices, or both.
- Class 4 soils have very severe limitations that restrict the choice of plants or that require very careful management, or both.
- Class 5 soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.
- Class 6 soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.
- Class 7 soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to grazing, forestland, or wildlife habitat.
- Class 8 soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, 2e. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class 5 are subject to little or no erosion.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, 2e-4 and 3e-6. These units are not given in all soil surveys.

Reference:
United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210.

Report—Nonirrigated Yields by Map Unit

Nonirrigated Yields by Map Unit– Williamson County, Illinois			
Map symbol and soil name	**Land capability**	**Corn**	**Grass-legume hay**
		Bu	*Tons*
10C—Plumfield silty clay loam, 5 to 10 percent slopes		71	2.00
Plumfield	4e		
10D—Plumfield silty clay loam, 10 to 18 percent slopes		—	1.90
Plumfield	**6e**		
14B—Ava silt loam, 2 to 5 percent slopes		120	2.91
Ava	2e		
14B2—Ava silt loam, 2 to 5 percent slopes, eroded		113	2.73
Ava, eroded	**2e**		
14C2—Ava silt loam, 5 to 10 percent slopes, eroded		109	2.65
Ava, eroded	3e		
301B—Grantsburg silt loam, 2 to 5 percent slopes		119	2.91
Grantsburg	**2e**		
301C2—Grantsburg silt loam, 5 to 10 percent slopes, eroded		108	2.70
Grantsburg, eroded	3e		
339D2—Wellston silt loam, 10 to 18 percent slopes, eroded		86	2.60
Wellston, eroded	**4e**		
340D2—Zanesville silt loam, 10 to 18 percent slopes, eroded		92	2.87
Zanesville, eroded	4e		
340D3—Zanesville silty clay loam, 10 to 18 percent slopes, severely eroded		—	2.35
Zanesville, severely eroded	**6e**		
908D3—Hickory-Kell clay loams, 10 to 18 percent slopes, severely eroded		79	2.60
Hickory, severely eroded Kell, severely eroded	4e 4e		
3072A—Sharon silt loam, 0 to 2 percent slopes, frequently flooded		133	3.86
Sharon, frequently flooded	**2w**		
3382A—Belknap silt loam, 0 to 2 percent slopes, frequently flooded		127	3.96
Belknap, frequently flooded	3w		
W—Water		—	—
Water	—		

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

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Federal Register. July 13, 1994. Changes in hydric soils of the United States.

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United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://soils.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.glti.nrcs.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://soils.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://soils.usda.gov/

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210.

R12112



SOILS RESOURCES MAP

GENERAL INFORMATION

- MINING PERMIT #375 SURFACE FACILITIES
- PROPOSED IBR AREA (8.10 AC.)
- DRAINAGE DITCHES (CONSTRUCTED)
- ROAD
- SOIL SERIES BOUNDARY (14B)

SOIL INFORMATION

Acres	Soil ID	Soil Series	Slope (%)	Capability
0.00	10C	Plumfield	5 - 10	LC
0.00	10D	Plumfield	10 - 18	LC
0.00	14B2	Ava	2 - 5	PF
0.82	301B	Grantsburg	2 - 5	PF
0.00	340D3	Zanesville	10 - 18	LC
0.00	908D3	Hickroy-Kell	10 - 18	LC
0.00	3072A	Sharon	0 - 2	PF
0.00	3382A	Belknap	0 - 2	PF

PF = Prime Farmland | HC = High Capability | LC = Limited Capability

*** REFER TO THE NRCS SOIL RESOURCE REPORT FOR ADDITIONAL INFORMATION ON SOIL CAPABILITIES.**

400' 0 400' 800'

SCALE: 1"=400'

N

Mine Name: POND CREEK MINE #1	Permit No: 375
Quadrangle: PITTSBURG, ILLINOIS	Description: WILLIAMSON COUNTY, ILLINOIS T8S R3E - SECTIONS 1, 2, 11, 12, 13, 14, 23, & 24 T8S R4E - SECTIONS 4, 5, 6, 7, 8, 9, 16, 17, 18, 19, 20, & 21
Date: 07/15/11	

REV.	DATE	DESCRIPTION	P.M.

BECKLEY, WV
(304) 255-0491

Alliance Consulting, Inc.
Engineers Constructors Scientists

MAP 5

SOILS RESOURCES MAP

POND CREEK 1 MINE

Prepared For

WILLIAMSON ENERGY LLC.

JOHNSTON CITY, IL

CAD BY	SMS	07/15/11	PROJECT NO. B11-371-1413	
CHECKED BY	SMS	07/15/11		
APPROVED BY	CEY	07/15/11	**DRAWING NO. B11-371-B1**	

PART III

PART III

OPERATIONS PLAN

1) Explain the proposed operation and why the IBR is needed. Locate on a mining operations map.

RESPONSE: The purpose of this IBR is to permit an emergency compressor bore hole. The bore hole will be located in Headgate #4 bleeder entries. This area has been filling with water reducing ventilation and making it a safety hazard for the mine examiners. Currently the operation has air pumps in this area but the compressors are located 4.5 miles away and no longer provide enough air to move the large volume of water. Another compressor hole is needed to ensure this area will stay open to provide adequate ventilation and safe travel for the mine examiners.

This IBR area is to construct an access road, drill a 9 7/8-inch diameter bore hole that will be cased to a 5- inch diameter hole and will have a depth of approximately 500 to 530 feet. When the bore hole is no longer needed, it will be grouted the entire length. In addition to the compressor bore hole, a concrete pad measuring 12 feet by 12 feet by 1 foot will be constructed.

Access to the site will be by using the previously permitted areas and a new access road to the compressor site. Topsoil will be stripped and stockpiled and/or windrowed. Trees will be windrowed along the road in accordance to the land owners' request. Existing roads/trails will be utilized where possible.

A power line will be buried in a trench and will connect with power lines located on the previous IBR area.

Upon the completing the compressor installation, the entire disturbed area will be seeded and mulched using the approved revegetation plan.

Refer to Supplemental Map 6 S.F. for the location of the IBR area outlined in red.

2) Surface Drainage Control

A) 1) Locate on the mining operations map or on a separate drainage map all proposed drainage control systems. Show drainage patterns of all affected mining areas.

RESPONSE: Refer to Supplemental Map 6 S.F.

2) Will all surface drainage from the affected mining area be collected and treated prior to leaving the IBR area?

Yes _____ No ___X___

If yes, delineate how and where surface drainage will be collected and treated, and list permit numbers and type of permit that the drainage control systems are operated under. If above answer is no, explain how regulatory compliance will be achieved without treatment, i.e., address the requirements of 1816.46(e)/1817.46(e).

RESPONSE: The applicant is requesting to utilize alternate sediment control measures as described in 1817.46(e). Disturbance will be kept to a minimum to compile with the land owners' request. Topsoil and vegetation will be windrowed along the access road and to the specifications of the land owner. An existing road/trail will be utilized where possible. Access to the emergency compressor bore hole will be reclaimed and vegetated as soon as the compressor is no longer needed.

Surface drainage in the compressor site will be directed to the cuttings pond for retention and de-watering. Berms, silt fence and/or straw/hay bales will be used where needed to prevent sedimentation from entering the receiving stream. All disturbances will be vegetated with the approved seed mixture as soon as possible.

B) Will all surface drainage from unaffected areas be intercepted and diverted around the affected mining area?

Yes _____ No __X__

If no, please discuss.

RESPONSE: There will be no unaffected areas within the IBR area.

C) Overland Flow Diversions and Sediment Ponds:

Are either overland flow diversions or sediment ponds to be constructed?

Yes _____ No __X__

If yes, complete applicable parts of the SCM-1 or UCM-1 Part IV (surface drainage control).

D) Does a perennial or intermittent stream occur within the proposed IBR area?

Yes _____ No __X__

If yes, is an exception to the 100 foot buffer zone being requested or is a stream diversion being proposed. For an exception to the 100 foot buffer zone, indicate how compliance with 1816.57/1817.57 will be assured. For a stream diversion, complete applicable parts of the SCM-1 or UCM-1.

3) Roads and other activities:

A) Are roads to be constructed in the IBR area?

Yes __X__ No _____

If yes, complete the applicable part of the SCM-1or UCM-1 (transportation facilities).

B) If the operations involve blasting, or any other activities not specifically addressed above, complete applicable parts of the SCM-1 or UCM-1

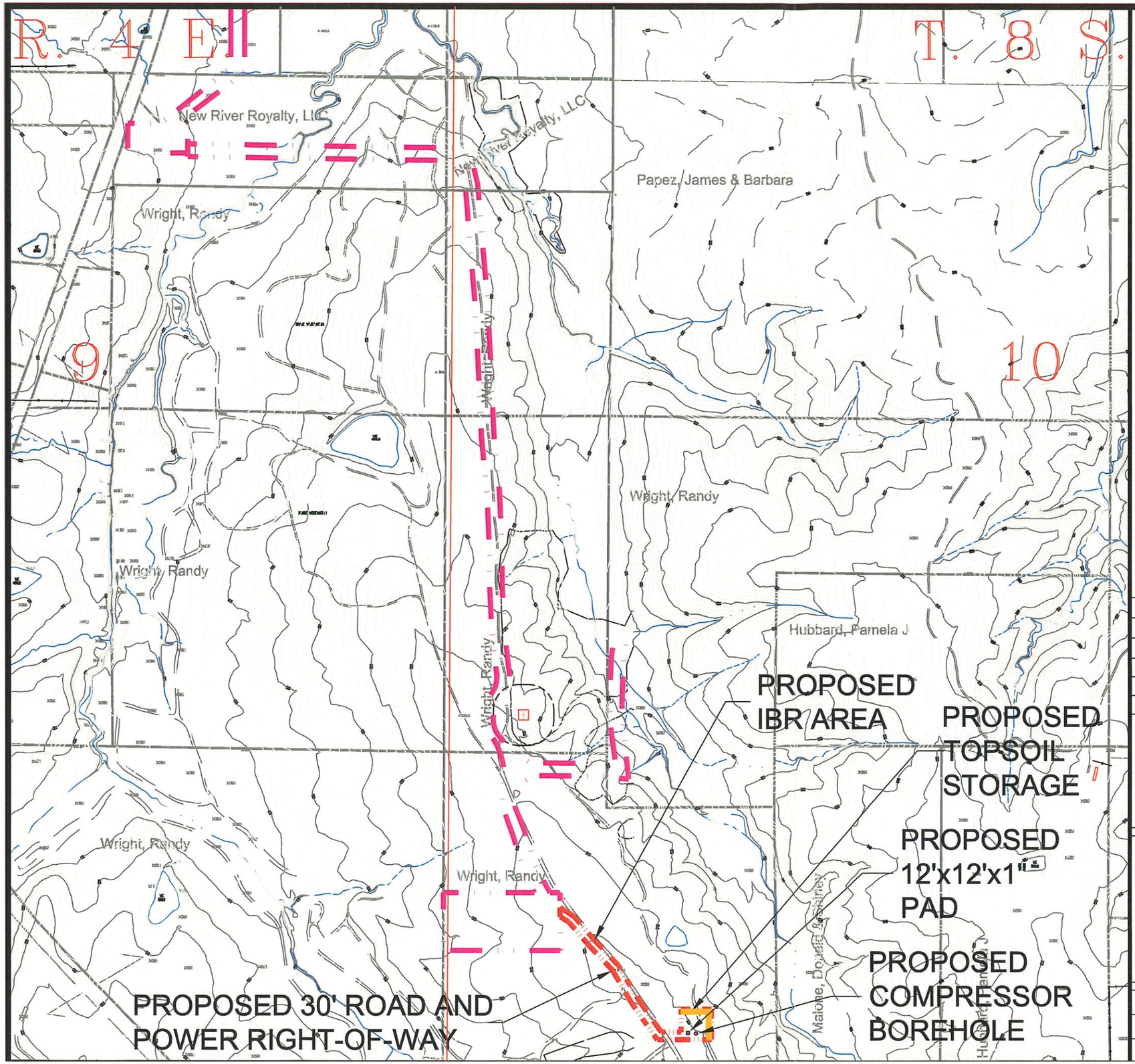
RESPONSE: Refer to Attachment III.3.A.

4) Are any existing structures proposed for utilization in the IBR?

Yes _____ No __X_____

If yes, complete Part IV.4 of the SCM-1 or UCM-1.

R12117



GENERAL INFORMATION

- MINING PERMIT #375
- MINING PERMIT #375 IBR AREA (0.82 AC.)
- ROAD
- PROPERTY BOUNDARY
- FENCE LINE
- PERENNIAL STREAMS
- NON-PERENNIAL STREAMS
- PROPERTY BOUNDARY & OWNER

400' 0' 400' 800'

SCALE: 1"=400'

N

Mine Name: POND CREEK MINE #1	Permit No: 375
Quadrangle: PITTSBURG, ILLINOIS	Description: WILLIAMSON COUNTY, ILLINOIS T8S R3E - SECTIONS 1, 2, 11, 12, 13, 14, 23, & 24 T8S R4E - SECTIONS 4, 5, 6, 7, 8, 9, 16, 17, 18, 19, 20, & 21
Date: 07/15/11	

REV.	DATE	DESCRIPTION	P.M.

BECKLEY, WV
(304) 255-0491

Alliance Consulting, Inc.
Engineers Constructors Scientists

MAP 6 S.F.

OPERATION PLAN MAP

POND CREEK 1 MINE

Prepared For

WILLIAMSON ENERGY LLC.

JOHNSTON CITY, IL

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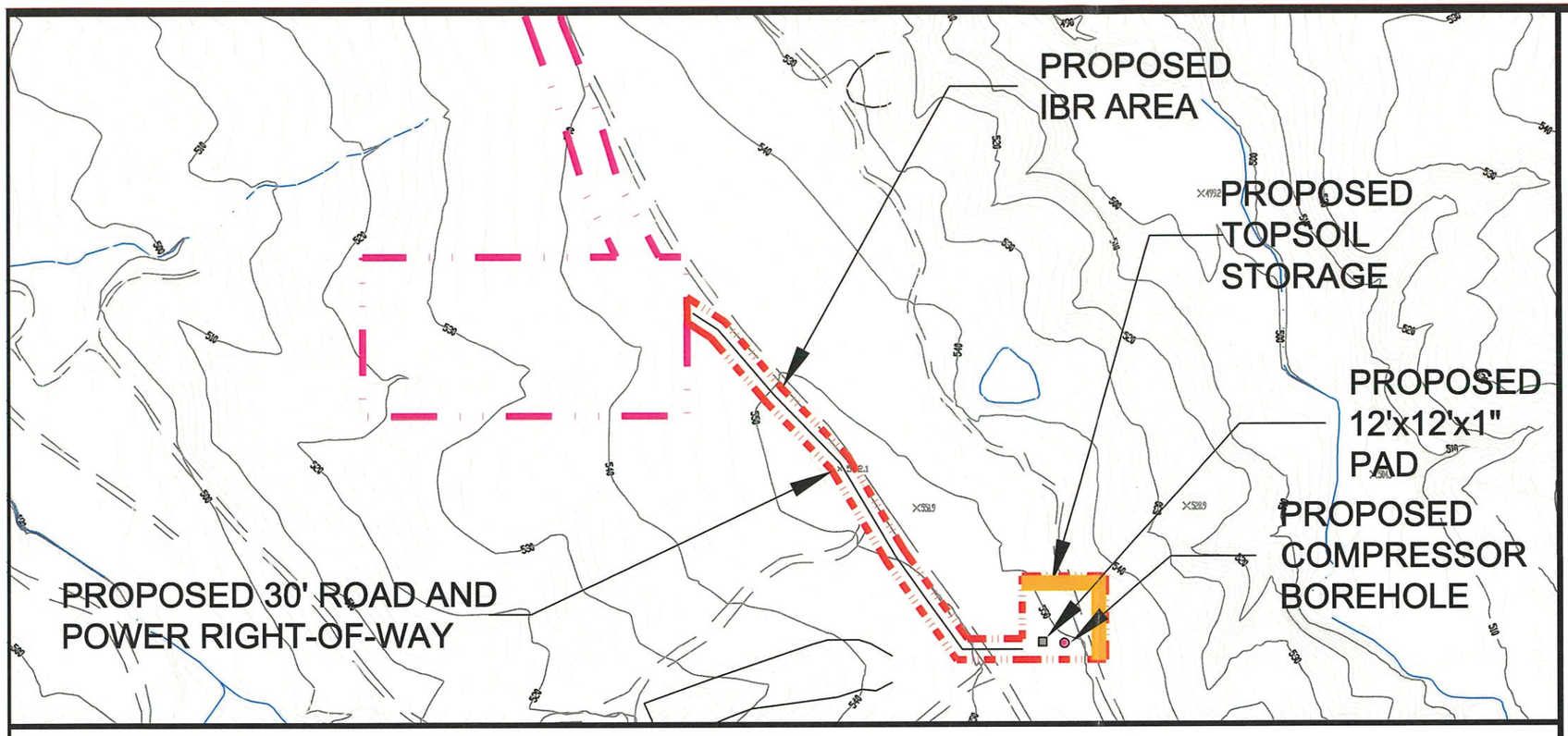
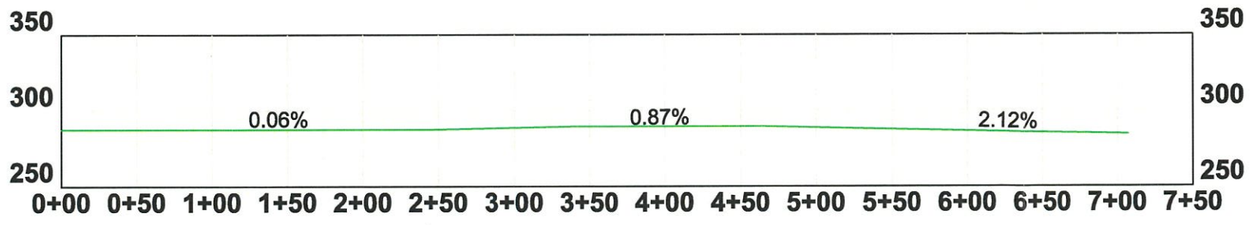
R12118





ACCESS ROAD PROFILE
SCALE: 1" = 100"

GENERAL INFORMATION

- MINING PERMIT #375
- MINING PERMIT #375 IBR AREA (0.82 AC.)
- ROAD
- PROPERTY BOUNDARY
- FENCE LINE
- PERENNIAL STREAMS
- NON-PERENNIAL STREAMS

200' 0' 200' 400'
SCALE: 1"=200'
N

Mine Name: POND CREEK MINE #1	Permit No: 375
Quadrangle: PITTSBURG, ILLINOIS	Description: WILLIAMSON COUNTY, ILLINOIS T8S R3E - SECTIONS 1, 2, 11, 12, 13, 14, 23, & 24 T8S R4E - SECTIONS 4, 5, 6, 7, 8, 9, 16, 17, 18, 19, 20, & 21
Date: 07/15/11	

REV.	DATE	DESCRIPTION	P.M.

BECKLEY, WV
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ACCESS ROAD PLAN AND PROFILE

OPERATION PLAN MAP

POND CREEK 1 MINE

Prepared For
WILLIAMSON ENERGY LLC.
JOHNSTON CITY, IL

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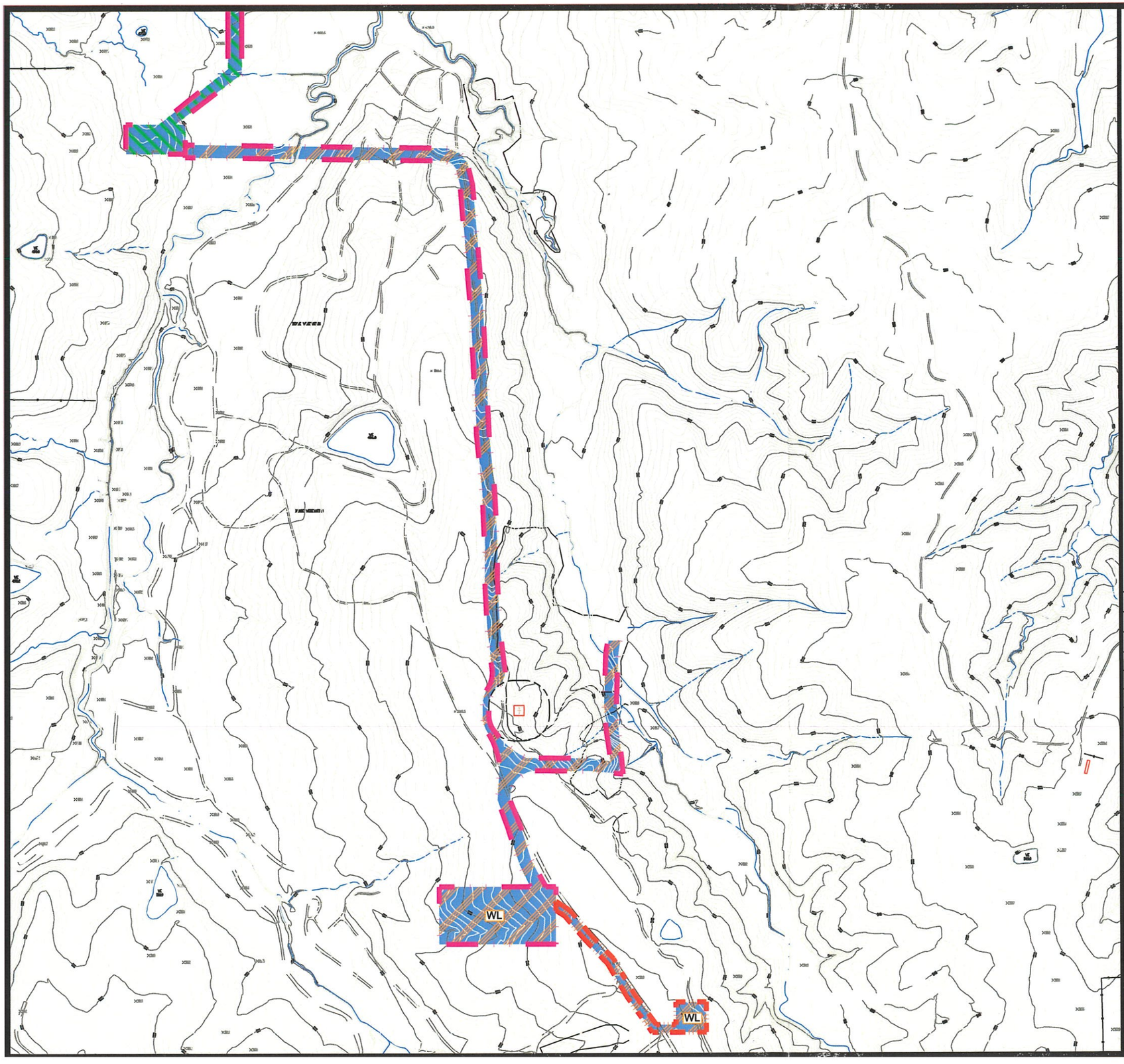
R12119



Map 7 S.F. - RECLAMATION PLAN MAP

GENERAL INFORMATION

- MINING PERMIT #375 SURFACE FACILITIES
- PROPOSED IBR AREA (8.10 AC.)
- ROAD

SOIL INFORMATION

- LOW CAPABILITY SOILS
- ALTERNATIVE SOILS
- 0.82 AC. WOODY WILDLIFE AREA
- HERBACEOUS WILDLIFE AREA
- PONDS, STREAMS & WETLANDS

LAND USE INFORMATION

C CROPLAND
F FORESTRY
WL WILDLIFE
W WATER

400' 0' 400' 800'
SCALE: 1"=400'
N

Mine Name: POND CREEK MINE #1	Permit No: 375
Quadrangle: PITTSBURG, ILLINOIS	Description: WILLIAMSON COUNTY, ILLINOIS T8S R3E - SECTIONS 1, 2, 11, 12, 13, 14, 23, & 24 T8S R4E - SECTIONS 4, 5, 6, 7, 8, 9, 16, 17, 18, 19, 20, & 21
Date: 07/15/11	

REV.	DATE	DESCRIPTION	P.M.

BECKLEY, WV
(304) 255-0491

Alliance Consulting, Inc.
Engineers Constructors Scientists

MAP 7 S.F.

RECLAMATION PLAN MAP

POND CREEK 1 MINE

Prepared For

WILLIAMSON ENERGY LLC.
JOHNSTON CITY, IL

CAD BY	SMS	07/15/11	PROJECT NO. B11-371-1413
CHECKED BY	SMS	07/15/11	
APPROVED BY	CEY	07/15/11	**DRAWING NO. B09-514-B4**

DOCUMENT

71

Sue date - 6-R13121

Illinois Department of
Natural Resources
One Natural Resources Way Springfield, Illinois 62702-1271
www.dnr.illinois.gov

Pat Quinn, Governor
Marc Miller, Director

February 1, 2011

Anthony Webb
Williamson Energy, LLC
P.O. Box 99
Johnston City, IL 62951

RECEIVED
APR 27 2011
IL Environmental Protection Agency
MARION REGIONAL OFFICE

Re: Permit No. 375
Insignificant Revision No. 38

Dear Mr. Webb:

The appropriate Department technical staff has reviewed the proposed change dated November 23, 2010 submitted by Williamson Energy for the Pond Creek Mine. This request was then resubmitted in its entirety with additional information but maintained the November 23, 2010 date. The final complete request was received January 31, 2011. The permittee has requested to:

1. Remove the prohibitions of Condition "K" to Revision No. 2 to Permit No. 375 and extend longwall Panels 3 and 4 under the impounding structures identified as Phase 2 and Phase 3.

2. This request also addresses Condition "J" to Revision No. 2 to Permit No. 375 in that the required construction authorization approvals from the Mine Safety and Health Administration (MSHA) and The Illinois Department of Natural Resources, Office of Water Resources (OWR) were included. This request documents MSHA and OWR approvals of the construction of Phases 3 through 7 and the subsidence of Phases 2 and 3.

Since this operation is not currently approved, it will constitute a change to the approved plan. Insignificant permit revisions are allowed under 62 Ill. Adm. Code 1774.13(b)(2).

The Department has determined the proposed alteration will have no significant potential adverse impact on the achievement of final reclamation plans or upon the surrounding area, and will have no significant potential adverse impact on the achievement of subsidence control plans or upon the surrounding area. The Department has determined that the proposed operation is in compliance with 62 Ill. Adm. Code 1700 – 1850 and is insignificant, and hereby exempts the permittee from submitting a significant permit revision application in accordance with Section 1774.13(b)(2). The Department

grants permission to execute longwall extraction under the refuse impoundment of Phases 2 and 3 as conditioned below.

1. This approval is specifically limited to subsidence associated with the extension of Panel No. 3. The stop point for Panel No. 4 shall remain east of the toe of the impounding structure off set by the approved angle of draw pursuant to Condition "K" to Revision No. 2 to Permit No. 375. Based on the success of the pass of Panel No. 3 under Phases 2 and 3, the Department will determine if Panel No. 4 can proceed past the current stop point. Separate Departmental approval for alteration of the stop point for Panel No. 4 is necessary.

2. Impoundment inspection during and after the pass of Panel No. 3 is critical to the initiation of the contingency buttressing plan if deemed necessary. Therefore, inspection frequency shall be a minimum of once every eight hours from the time the longwall reaches the angle of draw on the east side until a minimum of four weeks after the completion of the longwall panel. Frequency of inspections shall increase as dictated by observed deformations. A person or persons qualified in impoundment inspection Pursuant to 62 Ill. Adm. Code 1817.49(a)(10)(A) shall be on sight at all times through the duration of the accelerated inspection period as defined above.

3. In the event monitoring and conditions warrant, the permittee shall notify the Department of the initiation of the buttressing operation immediately.

The Department also finds that the requirements of Condition "J" to Revision No. 2 to Permit No. 375 have been satisfactorily met.

All conditions and provisions contained in the approved permit also apply to this revision. Approval from this agency does not relieve the permittee from obtaining approval from other agencies requiring such.

Please submit two additional copies of your request letter and maps to Ronald Morse, Illinois Environmental Protection Agency, 2309 West Main Street, Marion, Illinois 62959.

Should you have any questions, please contact Brad Murphy at our Benton Office or Dan Barkley in our Springfield Office.

Sincerely,

Scott K. Fowler, Supervisor
Land Reclamation Division

SKF:dwb
cc: J. Slapak
B. Murphy
R. Morse

7225 · / 11
Due date: 6-10-11

Alliance Consulting, Inc.
Engineers • Constructors • Scientists

IDNR PERMIT NO. 375
RESPONSE TO OCTOBER 6, 2010 COMMENTS
VOLUME 1 OF 7

COAL REFUSE DISPOSAL FACILITY NO. 2
PHASE 3 THROUGH 7
IMPOUNDMENT I.D. NO. 1211-IL08-0341-02
MSHA I.D. NO. 11-03141
WILLIAMSON COUNTY, ILLINOIS

Prepared for

WILLIAMSON ENERGY, LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B10-148-1413
NOVEMBER 2010

Summersville, WV
848 Northside Drive
Summersville, WV 26651
Telephone: (304) 883-2360
Fax: (304) 883-2361

Beckley, WV
Raleigh County Airport Industrial Park
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Telephone: (304) 255-0491
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Canonsburg, PA
151 East Pike Street
Canonsburg, PA 15317
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Fax: (724) 745-3631

IDNR PERMIT NO. 375
RESPONSE TO OCTOBER 6, 2010 COMMENTS
VOLUME 1 OF 7

COAL REFUSE DISPOSAL FACILITY NO. 2
PHASE 3 THROUGH 7
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ALLIANCE PROJECT NO. B10-148-1413
NOVEMBER 2010

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

November 23, 2010

Project No. B10-148-1413

Mr. Ron Morse
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
2309 West Main Street, Suite 116
Marion, IL 62959

Transmittal
Additional Information
Williamson Energy, LLC
Pond Creek No. 1 Mine
Permit No. IL0077666
Williamson County, Illinois

Dear Mr. Crislip:

On behalf of our client, Williamson Energy, LLC, please find enclosed two (2) sets (Volumes 1 through 7) of the coal refuse facility design for Stage 3 through Stage 7 for the Pond Creek No. 1 Mine. This information was requested by the Illinois Department of Natural Resources, Land Reclamation Division. Volumes 2 through 7 contain the plan approved for Stages 3 through 7 and includes longwall mining beneath the refuse facility approved by MSHA. Volume 1 is additional information requested by Dan Barkley after the plan was approved by MSHA. This submittal (Volumes 2 through 7) are identical to the information originally submitted to your office as Revision No. 2 to Permit No. 375 with the exception of the additional information requested by MSHA.

One (1) copy of the information was sent to Mr. Larry Crislip at the Illinois Environmental Protection Agency office in Marion.

If you have any questions, or require additional information, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Claudio E. Yon, P.E.
Senior Project Manager

RECEIVED
APR 27 2011
IL Environmental Protection Agency
MARION REGIONAL OFFICE

CEY:wmb
Enclosures

cc: Mr. Larry Crislip, IEPA w/enclosures
FILE: 10148-03

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

November 23, 2010

Project No. B10-148-1413

Mr. Larry Crislip
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
2309 West Main Street, Suite 116
Marion, IL 62959

Transmittal
Additional Information
Williamson Energy, LLC
Pond Creek No. 1 Mine
Permit No. IL0077666
Williamson County, Illinois

Dear Mr. Crislip:

On behalf of our client, Williamson Energy, LLC, please find enclosed one (1) set (Volumes 1 through 7) of the coal refuse facility design for Stage 3 through Stage 7 for the Pond Creek No. 1 Mine. This information was requested by the Illinois Department of Natural Resources, Land Reclamation Division. Volumes 2 through 7 contain the plan approved for Stages 3 through 7 and includes longwall mining beneath the refuse facility approved by MSHA. Volume 1 is additional information requested by Dan Barkley after the plan was approved by MSHA. This submittal (Volumes 2 through 7) are identical to the information originally submitted to your office as Revision No. 2 to Permit No. 375 with the exception of the additional information requested by MSHA.

Two (2) copies of the information was sent to Mr. Ron Morse at the Illinois Environmental Protection Agency office in Marion.

If you have any questions, or require additional information, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Claudio E. Yon, P.E.
Senior Project Manager

CEY:wmb
Enclosures

cc: Mr. Ron Morse, IEPA w/enclosures
FILE: 10148-02

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

November 23, 2010

Project No. B05-330-1413

Mr. Dan Barkley
Division Supervisor Land Reclamation
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
Office of Mines and Minerals
One Natural Resources Way
Springfield, IL 62702

Response to Comments
Permit No. 375-Revision No. 2
Williamson Energy, LLC, Pond Creek Mine
Williamson County, Illinois

Dear Mr. Barkley:

On behalf of our client, Williamson Energy, LLC, this letter and attachments are being submitted in response to your October 6, 2010 email (copy attached).

1. *A cover letter that clearly states the intent to remove the condition that prohibits subsidence of the impoundments. The condition is Condition K to Permit No. 375, Revision No. 2.*

RESPONSE:

Included with this submittal is a letter from Williamson Energy, LLC to Land Reclamation Division, Office of Mines and Minerals, Illinois Department of Natural Resources, requesting that Condition K to Permit No. 375, Revision No. 2, be removed. Condition K required that the stop point of the longwall mining panel be set off the eastern most toe of Refuse Facility No. 2 by the angle of draw. The letter is contained in Appendix A.

2. *The complete set of information provided to MSHA to achieve approval of subsidence of Phases 3 through 6.*

RESPONSE:

The accompanying Volumes 2 of 7 through 7 of 7 contained the most recent information submitted to and approved by MSHA for Phases 3 through 6 and, although not directly related to achieving approval of mine subsidence, is the most recent revision to Phase 7 that was approved by MSHA. The revision was made to address MSHA's concerns concerning short-term construction stability of the portion of Phase 7 that will be built out over a portion of the Phase 3 impoundment.

3. *Any additional information that MSHA may require to specifically grant approval to subside Phase 1 and 2.*

RESPONSE:

No additional information has been requested by or submitted to MSHA for approval of subsidence of Phase 1 and 2 other than what is included in accompanying Volumes 2 of 7 through 7 through 7. Longwall mining under Phases 2 and 3 has been approved by MSHA, provided that the impoundment pools are capped before the subsidence occurs.

4. *Alliance Consulting has on several occasions referred to other operations where longwall subsidence has been conducted under slurry impoundments. It may be beneficial to present a summary of this information concerning where it occurred and some specifics on the size and age of the impoundment structure (i.e. how long it was capped before subsidence), the condition of the slurry material at the time of subsidence, etc. Case histories would be helpful only if they are similar in nature to the proposed Pond Creek action.*

RESPONSE:

Almes & Associates, predecessor of Alliance Consulting, Inc. monitored the subsidence at the Sprucelick Slurry Impoundment, Robinhood Preparation Plant, Federal ID No. 46-03137, Pineridge Coal Company, located near Twilight, Boone County, WV. The large, cross-valley slurry impoundment was longwall undermined under the dam and pool in the fall of 1998. The water was pumped from the impoundment and the fine coal refuse was covered with four feet of coarse coal refuse before the undermining occurred. Some cracking of the bedrock exposed in the hillside diversion ditches occurred. Maximum vertical subsidence was about three feet. No cracking of the coarse coal refuse dam or release of slurry or black water occurred.



Appendix B in this volume contains the paper "Case Study of Undermining Impoundment Embankments by the Longwall Mining Method", Choi, D.S. et al. The mining under the slurry impoundment occurred during April 1991. The Harvey Run Slurry impoundment and fresh water impoundments described in the paper are located at the Loveridge No. 22 mine, Federal ID No. 46-01433, Consolidation Coal Company, located in Marion County, WV.

Several other large slurry impoundments have been undermined in the Appalachian bituminous coal fields. Although we do not have access to detailed information concerning the specific sites, we have not heard of any slurry releases related to subsidence from the mining.

5. *Incorporate the fine refuse and push out pad drilling and testing and provide a discussion of how the testing results substantiate the material will not be released through subsidence induced fracturing.*

RESPONSE:

Appendix C of this volume contains a letter report entitled "Response to October 6, 2010 IDNR Comments Nos. 5 and 7" by Blaise E. Genes, GAI Consultants, Inc., dated November 18, 2010, that addresses the effects of capping the impoundments on a subsidence-induced slurry release. Also included in this appendix are the drill logs and soil test results for the borings through the caps over the eastern ends of the Phase 2 and Phase 3 impoundments.

The in place moisture contents of the fine coal refuse were obtained during test drilling in late July though late August, 2010. The fine coal refuse in the upper portion of the impoundments was in the plastic state. The fine coal refuse in the lower portions of the impoundments ranged from slightly fluid to fairly fluid as defined by the liquid limit and liquidity index. We are conservatively using the fine coal refuse liquid limit (liquidity index = 100) as the border between a liquid state and a plastic state. Persons present during the drilling observed that the fine coal refuse samples were difficult to extract from the split spoon and Shelby tube samplers. Progressive capping of the impoundments is having the effect of greatly reducing the introduction of additional water to the impounded fine coal refuse slurry and is adding additional weight to assist in dewatering and consolidation. It a has been our experience at other sites that fine coal refuse samples of dominantly clay and silt and in place moisture contents equal to or slightly more than the liquid limit are free standing, either when sampled by tubes or excavated. Since no more water will be introduced into the Phase 2 and Phase 3 impoundments by slurry pumping, consolidation weight is progressively being added due to impoundment capping, and direct rainfall water is being eliminated by capping, the fine coal refuse is progressively being

reduced in moisture content. The two impoundments will be totally capped before being undermined in February 2011 and the moisture contents of the fine coal refuse should be result in the material being in the plastic or solid state.

6. *Provide any proposed testing in other capped areas as may be necessary to show the area beyond the eastern third is consistent and non-flowable. You may wish to refer to Mr. Donahue's field report after his site visit where he documented subsidence impacts to the non-impounding embankment over Panel 2. He made several additional recommendations in this report.*

RESPONSE:

We feel that adequate testing has been conducted to date of the character of the fine coal refuse after capping. Fine coal refuse slurry is no longer being pumped into Phases 2 and 3. The slurry is progressively drying out and is consolidating as the impoundment capping progresses.

Experience gained in longwall mining under the Phase 4 embankment indicates that embankment cracking to the extent that would allow release of flowable slurry is limited to the upper 10' to 12' of the embankment. To begin the impoundment capping operation, a coarse coal refuse "ring" was placed into and completely around the edges of the Phase 2 and Phase 3 pools to establish a base from which to start. The "ring is about 20 feet wide and the drilling indicated that it extends down against the into the pool against the upstream slope of the Phase 2 and Phase 3 embankments to a depth of at least 18 feet. Before the longwall Panel passes mines under Phases 2 and 3, both impoundments will have been completely capped.

The drilling conducted through the Phase 2 and Phase 3 partial caps indicated that the fine coal refuse is consolidating and the in place moisture contents and void ratios are being significantly reduced. In addition, the thickened fine coal refuse slurry will serve to seal any crack with which it may contact. Observations of Phase 4 indicate that the extent of any cracks wide enough to admit slurry are limited to short lengths of the embankment and generally quickly close up as the longwall panel advances.

In summary, a barrier "ring" has been constructed along the interior of the Phase 2 and Phase 3 impoundments. The ring extends in depth below open cracks observed in Phase 4. Impoundment capping is densifying the slurry to a non-flowable moisture content, and if it did start to flow out of an embankment crack, experiences at other sites indicates that it would seal the crack (it has been a successful practice at other sites to direct slurry discharge over foundation and

embankment cracks to fill and seal them). If any slurry were forced through any embankment cracks, it is anticipated that it would be of a thick paste-like consistency and could be easily contained in the sediment ditches which surround both impoundments.

7. *Based on all data and modeling conducted to date, provide a clear discussion, analysis and conclusion that the laboratory data, field data and modeling demonstrate that flow will not propagate through and/or outside the coarse refuse impounding structure in a worst case scenario.*

RESPONSE:

This is addressed in the letter report entitled "Response to October 6, 2010 IDNR Comments Nos. 5 and 7" by Blaise E. Genes, dated November 18, 2010, in Appendix C of this volume.

8. *Any additional monitoring proposed of the Phase 2 structure similar to what MSHA required in their review and approval of Phase 3.*

RESPONSE:

Additional subsidence survey monument baselines I, J, and K have been added to the crest of Phase 2. These lines will be used to measure the vertical and horizontal subsidence movement and to determine when subsidence has reached predicted values and is complete. As with Phase 3, the existing standpipe piezometers will be use to monitor any phreatic line increases due to pore water pressure or increases due to water mitigating into embankment subsidence cracks. Drawing No. B05-330-M36 has been revised to show the 3 subsidence baselines.

Guideline Technical Specification 6.03, now titled Phase 2 and Phase 3 Enhanced Monitoring, Appendix A, Volume 2 of 7, has been revised to include Phase 2 in the enhanced monitoring program as the longwall passes under the site.

The Subsidence Monitoring Plan, Appendix F, Volume 2 of 7, has been revised to include Phase 2 subsidence monitoring baselines I, J, and K. Drawing No. B05-330-M36, Volume 4 of 7, has been revised to show the additional baselines.

9. *A description of the contingency plan for buttressing any problem areas. Provide delineation of the available material in the event the contingency plan to buttress the exterior of the refuse area is needed. Describe the availability of equipment to quickly*



execute the buttressing plan and the approximate time frame to complete the necessary buttressing plan. The plan should also discuss the impacts to existing structures that may be covered over by the buttressing plan if any (Sediment ditch, groundwater monitoring wells, etc.)

RESPONSE:

A 20-foot wide contingency buttress has been designed in the event excessive embankment deformation, excessive embankment cracking, or leakage of slurry occurs. The buttress construction detail is shown on Drawing No. B05-330-E47 in Volume 3 of 7.

The buttress can be constructed of either coarse coal refuse or soil. It is anticipated that soil will be used for any buttress construction needed. The soil will be incorporated into the required soil covering of the embankment outside slopes. A stockpile of approximately 750,000 CY of clay soil is located immediately to the south of Phase 2. If it becomes necessary to use coarse coal refuse, it can come from normal plant refuse production or borrowed from the Phase 4 embankment. Construction of full embankment height contingency buttresses around Phases 2 and 3 requires 300,450 CY of material.

A description of the construction equipment readily available and calculation for the times needed to construct various contingency buttress scenarios is included in Appendix D of this volume. While we do not anticipate that a contingency buttress will be needed, the most likely location for partial contingency buttress construction is at the west end of Phase 3. This opinion is based on embankment cracks observed during the undermining of Phase 4 and because the impoundment capping process for Phase 3 has been progressing from east to west, which will result in the fine coal refuse at the west end being not as consolidated as in the remainder of the impoundment. One hundred lineal feet of full height contingency buttress can be built in about 7.5 hours for Phase 2 and about 10.2 hours for Phase 3. Times for 100 feet of a partial height contingency buttress are 3.1 hours for Phase 2 and 5.5 hours for Phase 3. Additional bulldozers and tractor scrapers in addition to those assigned are currently located on the refuse areas and will be maintained at the site until the longwall mining is completed beneath Phase III for contingency buttress construction should an emergency condition develop. Additional equipment can also be remobilized when longwall mining occurs in Panel No. 3.

Detailed descriptions of structures that would be affected by construction of a contingency buttress at various locations around the outside perimeter of the sites are as follows:

Phase 2:

North Side – Construction of a 20-foot wide buttress would infringe on the gas line right-of-way about 10 feet. The toe area of the embankment could be regraded to accommodate the buttress and keep off the gas line right-of-way Ground water monitoring well GW-8 is located at 37° 50' 16.4", 88° 49' 10.7" at ground Elevation 435.5. If a buttress is needed at this location, the well casing will be extended vertically as needed.

Southwest Side - Room is available for the buttress. Fill will be placed on the access road along the perimeter of the toe at this location to the extent necessary. South Side – Same as above for the southwest side.

East Side - The access road along the embankment toe will be covered by the buttress and the road will be moved eastward.

Phase 3:

North Side - Some of this side is either already adequately buttressed by the Phase 4 embankment or any slurry emitted through cracks would run into the incised Phase 4 area and not be of concern. Adequate room in the Phase 4 impoundment area exists for a buttress should construction of one become necessary.

Northwest Corner – Adequate room for a buttress is available. Since the Phase 6 embankment will tie into this area this area, coarse coal refuse rather than soil will be used.

West Side – Adequate room for a buttress is available.

South Side – With some minor regarding between the embankment toe and the sediment ditch adequate room is available.

East Side – Covering of the access road would be required. The access road would be raised or otherwise relocated to meet operational needs.

Northeast Corner- Adequate room for a buttress is available. Since the Phase 6 embankment will later tie into this area, coarse coal refuse rather than soil will be used.

Notes:

A 10-foot wide buttress would be adequate if only a partial height buttress is needed, or to get quick emergency coverage, the buttress could be built in two ten-foot wide increments.

Piezometers casings will be extended vertically as needed.

10. *Copies of existing and yet to be obtained approvals from both MSHA and OWR as outlined above.*

RESPONSE:

Copies of the MSHA approval letter to mine under Phase 2 and 3 are located in Appendix E of this volume.

By submission of this report, we are requesting any remaining required approvals from the Office of Mines and Minerals. Specifically needed at this time is the approval to subside the Phase 3 impoundment provided that:

1. The placement of the cap over the pool area is completed prior to subsidence occurring.

2. Monitoring of the Phase 3 impoundment is conducted according to the procedures outlined in Alliance Consulting, Inc.'s October 22, 2009 submittal (see ILDNR's April 12, 2010 letter for Phase 2).

11. *In reviewing the original Permit No. 375 and Revision No. 1 to Permit No. 375 applications, the LRD required modifications to address adequate protection of groundwater quality and potential impacts to the integrity of the impoundment's base material from longwall subsidence. In both instances, the operator withdrew the request to longwall mine under the refuse areas and therefore did not address the questions. Therefore, the applicant must now answer modification question 13 of the Department's letter dated May 16, 2005, and modification question 9 of the Department's letter dated April 3, 2007. Appropriate information to address the concerns raised should be provided in this submittal.*



RESPONSE:

For reference – Comment No. 13 – Letter Dated May 16, 2005

Questions 9 through 12, above, address the engineering and construction of the refuse pile and slurry impoundments for stability, and protection of surface and ground water resources. The Map 6UG Underground Operations provides the longwall panel locations. Several longwall panels will impact the surface facilities of this operation. Pursuant to 62 Ill. Adm. Code1784.14(g), the applicant shall provide additional information on expected changes in porosity and permeability due to the proposed longwall subsidence of the disposal areas and coal storage areas. Any potential adverse impact to surface or ground water as the result of subsidence impacts to the base and sides of the refuse disposal areas shall be discussed. The applicant shall demonstrate that longwall mining under these sites will not compromise the integrity of the lining

For reference – Comment No. 9 – Letter Dated April 3, 2007

The revised longwall layout stops longwall panes 3 and 4 short of the only approved refuse area. Further refuse disposal areas will be sought for permitted ground to the northeast and above longwall panes 1 and 2. At this time, the applicant has not provided sufficient documentation and justification to allow longwall impacts to occur under existing or further refuse areas. Currently, a liner of 4 feet is required for the existing refuse disposal area. Pursuant to 62 Ill. Adm. Code 1784.20(b)(10), the applicant shall provide approximate timing of any refuse disposal yet to be approved over panels 1 and 2. If the applicant proposes refuse disposal above a subsided panel at a later date, the amount of time to allow completion of ground movements prior to construction of an impervious clay liner will need to be taken into consideration.

RESPONSE: See document entitled "Subsidence Impact/Groundwater contained in Appendix F of this volume.

12. *The position of the applicant is that the slurry material, once capped, will not possess flow characteristics under expected subsidence induced strains and therefore will not result in a release of slurry through subsidence cracks in the coarse refuse ring. A specific engineering certification summarizing this conclusion and sealed by those who arrived at this decision should accompany the submittal in order to assist the Department to find that the action will comply with 1817.121(d).*

The specific regulation we need to assure compliance with is 62 Ill. Adm. Code 1817.121(d). This regulation which is unique to the SMCRA state and federal regulatory programs specifically requires that the subsidence control plan demonstrate that material damage will not occur to impoundments larger than 20 acre foot. It allows for the regulatory program to limit the percentage of coal extracted under such features in order to minimize the potential for material damage. This is the threshold we need to arrive at to allow longwall subsidence of the impoundments.

RESPONSE:

Current and prudent engineering practices have been used to minimize the potential for release of slurry from the capped Phase 2 and Phase 3 impoundments during mining. This work includes the following:

1. The beneficial effect of capping both impoundments to preclude the introduction of additional water to the fine coal refuse to the extent practical and adding overburden weight to assist in consolidation of the fine coal refuse,

2. The beneficial effect of effectively widening the top portions of both embankments during the impoundment capping process which increases the length that cracks must promulgate and the distance that slurry must travel to exit the embankments,

3. The results obtained from drilling through capped portions of both impoundments which shows that the slurry is consolidating and reducing in moisture content (flowability),

4. An analysis which shows that the fine coal refuse will not liquefy during subsidence induced strains, and

5. Experience gained from other refuse impoundments which have been capped and undermined without loss of slurry.

Our Professional Liability Insurance carrier prohibits language such as warranty or guarantee that will void our coverage. The definition of certify, as it pertains to Alliance engineering documents, is as follows:

"An Engineer's certification of conditions is a declaration of professional judgment. It does not constitute a warranty or guarantee, either expressed or implied, nor does it

relieve any other party of their responsibility to abide by contract documents, applicable codes, standards, regulations, or ordinances."

This definition has been used for all states in which Alliance engineers certify engineering documents.

If you have any questions or need additional information, please do not hesitate to contact us.

Sincerely,

ALLIANCE CONSULTING, INC.

Harold L. Owens, P.E.
Senior Project Manager

Claudio E. Yon, P. E.
Principal Engineer

HLO/CEY:knb
Enclosures

FILE: 05330-93

Claudio E. Yon

062-050632
Illinois Registration No.

CLAUDIO ELI YON
062-050632
LICENSED
PROFESSIONAL
ENGINEER
STATE OF ILLINOIS

ENGINEERING CERTIFICATION

I hereby certify the engineering design used in preparation of this application, attachments, and supplements was done by me or under my direct supervision.

I further certify to the best of my knowledge all such design is in accordance with all applicable local, state and federal laws, rules and regulations. I have placed an "X" in the box below if that item is relevant.

☐ Whereas the Reclamation Plan calls for an alternative land use, I also certify the plans to conform to applicable accepted standards for adequate land stability, drainage, vegetative cover, and aesthetic design appropriate for the post-mining use of the site.

☒ Whereas the operation proposes disposal of spoil or waste materials in areas other than mining workings or excavations, I also certify such fills are designed in accordance with recognized professional standards and all applicable laws.

☒ Certification of Illinois Environmental Protection Agency-35 Ill. Adm. Code 405.104(a) Permit. In my professional judgment, the plans and specifications submitted as part of this application describe an operation which will meet all applicable effluent and water quality standards. I certify that I am familiar with all of the plans, specifications, reports, and maps submitted as part of this application and that said plans, etc. are accurate insofar as they represent existing conditions.

Claudio E. Yon
Name

062-050632
Illinois Registration Number (Seal)

Alliance Consulting, Inc.
Firm

(304) 255-0491
Phone Number

124 Philpott Lane, Beaver, West Virginia 25801
Address

CLAUDIO ELI YON
062-050632
LICENSED
PROFESSIONAL
ENGINEER
STATE OF ILLINOIS

Signature

1/28/11
Date

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

Harold Owens <howens@aci-wv.com>

followup to our Thursday September 30th meeting

3 messages

Barkley, Dan <Dan.Barkley@illinois.gov> **Wed, Oct 6, 2010 at 6:02 PM**
To: Claudio Yon <cyon@aci-wv.com>, Jim Slapak <jslapak@machmining.com>, Harold Owens <howens@aci-wv.com>, "Blaise E. Genes" <b.genes@gaiconsultants.com>, "dshort@clineres.com" <dshort@clineres.com>, "mgauldin@machmining.com" <mgauldin@machmining.com>
Cc: "Fowler, Scott" <Scott.Fowler@illinois.gov>, "Devardo, Tim" <Tim.Devardo@illinois.gov>, "Holloway, Cliff" <Cliff.Holloway@illinois.gov>, "Murphy, Brad" <Brad.Murphy@illinois.gov>, "Broomhead, Vickie" <Vickie.Broomhead@illinois.gov>

Gentlemen:

After our meeting on Thursday September 30, 2010, I contacted Paul Donahue of MSHA Pittsburgh Tech support. Mr. Donahue informed me that your meeting with his MSHA Pittsburgh office had been canceled by your staff. Mr. Donahue's impression of the purpose of the canceled meeting was to simply learn about new technologies of Hayward and Baker for the co-mingling of material in the upper crust to achieve covering.

The purpose of this email is to reiterate that the Land Reclamation Division will need written approval from both MSHA and The Illinois Department of Natural Resources' Office of Water Resources (OWR) for longwall subsidence of all existing phases over panels 3 and 4 in order for either panel to proceed beyond the current approved stop point. Verification of these approvals would be in addition to the technical information and analysis we discussed in the meeting and are awaiting.

MSHA APPROVAL: It is our position that the current written approval dated December 4, 2009 from the Vincennes MSHA office clearly grants approval for construction and subsidence of Phases 3 through 6 and denies construction of Phase 7. The approval clearly omits approval for Phases 1 and 2. This Vincennes approval letter attached Mr. Donahue's recommendation report dated November 12, 2009. To date, we have not seen any written MSHA approval of longwall subsidence of Phase 1 and 2. We are still concerned if any consideration was provided by MSHA's Pittsburgh tech support concerning Phase 1 and 2. The lack of any required monitoring (piezometers, inclinometers, surveying etc.) for Phases 1 and 2 as required for Phase 3 reinforces our concerns.

OWR APPROVAL: It is also our position that the OWR's letter dated April 2, 2010, clearly approves the abandonment plan with a soil cover but indicates that the dam will still fall under OWR jurisdictional purview pursuant to their Dam Safety Rules. This means that you are approved to execute the final cover plan of the slurry cell, but that the dam is not released from their jurisdiction. It will still be considered an impounding structure in the eyes of OWR. This letter does clearly grant approval to subside the Phase 2 structure once covered.

A separate OWR letter dated June 2, 2010 approves construction of Phase 7. It is likely that they intended to approve construction of all phases, including 3 through 6 in addition to Phase 7 but OWR's letter did not clearly

state this. It is clear in this correspondence that they specifically denied subsidence of the impounding structures through Phase 7 (See Special Condition C). The LRD is taking the position that no subsidence is approved by OWR beyond Phase 2.

REQUEST TO LRD: Another issue discussed at the meeting concerned submittals that were made to MSHA and OWR and copied to the LRD. The following email from March 29 and subsequent emails through April 12, 2010 (copied below) clarifies the LRD's consistent position that these submittals were not considered as formal requests from the operator, but only for our information. My email offered to return the 2 sets of 3 binders if it would help you prepare a formal submittal to LRD. Although Tim Devardo indicated in the meeting on Thursday that we would accept a reference to the submittal, we want to clarify that we still need one cohesive package requesting LRD action. If there is material in these binders that is no longer valid based on changes required by either MSHA or OWR, then we would request that we return the binders so you can assemble a new stand alone request package with only relevant and correct information.

The following is a summary to the best of our recollection of what we discussed in the meeting regarding the aforementioned submittal requesting approval to subside the slurry impoundments. The LRD has also incorporated additional requirements envisioned to be needed to aid you in preparing a request. Any submittal should include the following information:

1. A cover letter that clearly states the intent to remove the condition that prohibits subsidence of the impoundments. The condition is Condition K to Permit No. 375, Revision No. 2.

2. The complete set of information provided to MSHA to achieve approval of subsidence of Phases 3 through 6.

3. Any additional information that MSHA may require to specifically grant approval to subside Phase 1 and 2.

4. Alliance Consulting has on several occasions referred to other operations where longwall subsidence has been conducted under slurry impoundments. It may be beneficial to present a summary of this information concerning where it occurred and some specifics on the size and age of the impounding structure (i.e. how long it was capped before subsidence), the condition of the slurry material at the time of subsidence etc. Case histories would be helpful only if they are similar in nature to the proposed Pond Creek action.

5. Incorporate the fine refuse and push out pad drilling and testing and provide a discussion of how the testing results substantiate the material will not be released through subsidence induced fracturing .

6. Provide any proposed testing in other capped areas as may be necessary to show the area beyond the eastern third is consistent and non-flowable. You may wish to refer to Mr. Donahue's field report after his site visit where he documented subsidence impacts to the non-impounding embankment over Panel 2. He made several additional recommendations in this report.

7. Based on all data and modeling conducted to date, provide a clear discussion, analysis and conclusion that the laboratory data, field data and modeling demonstrate that flow will not propagate through and/or outside the coarse refuse impounding structure in a worst case scenario.

8. Any additional monitoring proposed of the Phase 2 structure similar to what MSHA required in their review and approval of Phase 3.

9. A description of the contingency plan for buttressing any problem areas. Provide delineation of the available material in the event the contingency plan to buttress the exterior of the refuse area is needed. Describe the availability of equipment to quickly execute the buttressing plan and the approximate time frame to complete the necessary buttressing plan. The plan should also discuss the impacts to existing structures that may be covered over by the buttressing plan if any (Sediment ditch, groundwater monitoring wells, etc.)

10. Copies of existing and yet to be obtained approvals from both MSHA and OWR as outlined above.

11. In reviewing the original Permit No. 375 and Revision No. 1 to Permit No. 375 applications, the LRD required modifications to address adequate protection of groundwater quality and potential impacts to the integrity of the impoundment's base material from longwall subsidence. In both instances, the operator withdrew the request to longwall mine under the refuse areas and therefore did not address the questions. Therefore, the applicant must now answer modification question 13 of the Department's Letter dated May 16, 2005, and modification question 9 of the Department's letter dated April 3, 2007. Appropriate information to address the concerns raised should be provided in this submittal.

12. The position of the applicant is that the slurry material, once capped, will not possess flow characteristics under expected subsidence induced strains and therefore will not result in a release of slurry through subsidence cracks in the coarse refuse ring. A specific engineering certification summarizing this conclusion and sealed by those who arrived at this decision should accompany the submittal in order to assist the Department to find that the action will comply with 1817.121(d).

The specific regulation we need to assure compliance with is 62 Ill. Adm. Code 1817.121(d). This regulation which is unique to the SMCRA state and federal regulatory programs specifically requires that the subsidence control plan demonstrate that material damage will not occur to impoundments larger than 20 acre foot. It allows for the regulatory program to limit the percentage of coal extracted under such features in order to minimize the potential for material damage. This is the threshold we need to arrive at to allow longwall subsidence of the impoundments.

PREVIOUS EMAILS:

(As a corrective note, I had a typo in the email below in the first paragraph under the heading Condition J. My response mis-stated it as condition K.)

April 12, 2010 Email from LRD, Dan Barkley:

Claudio: I discussed your email with both Tim and Scott. I have summarized our position after each of your points. If you have any issues with our position or the process to gain approval from this agency, please let us know so we can all stay on the same page to avoid problems.

Also, Operator Memorandum 2007-1 requires copies of requests involving refuse disposal to also be sent to IEPA. When you send in the request for longwall mining under the refuse impoundment as outlined below, please make sure IEPA receives their copies as well.

From: Claudio Yon [mailto:cyon@aci-wv.com]
Sent: Wednesday, April 07, 2010 1:19 PM
To: Barkley, Dan
Cc: Devardo, Tim; Diedrichsen, Mike; Fowler, Scott; Jim Slapak; Harold Owens
Subject: Re: MSHA submittal

I appologize that it has taken so long to respond to this email.

Condition J

Harold Owens has attempted to correspond with MSHA at the Vincennes District Office since the receipt of this email and was only recently successful. Apparently this office currently has staffing issues which has created a backlog. We believe this facility will be approved as submitted to Tech Support with no further changes to the documents submitted to your office and the OWR. We will continue to pursue the approval document.

-

Condition K is specific and limited to impoundment construction, not subsidence. Harold has just sent a District 8 approval via email attachment for Phases 3 though 6 dated December 8, 2009. For the purpose of condition K, this demonstrates MSHA approval of construction of phases 3 through 6. This leaves Phase 7 as the only outstanding approval from MSHA for the purposes of impoundment construction and condition K.

We jointly submitted the application for Phases 3 through 7 to your Office and the OWR. To the best of my knowledge no correspondence has been received from the OWR since that time.

I am not sure of the status of their review of Phases 3 through 7 for either construction or subsidence.

Condition K

Since the LRD is in possession of all engineering documents submitted to MSHA, I assume that the only additional information you will need is a response to comments generated by the OWR. I assume we could submit this to the LRD as an IPR?

-

To clarify our position, all copies provided to date were to keep the LRD abreast of your pursuit of MSHA approval and informational only. We have not treated these multiple submittals as an official request to remove condition K and subside the refuse areas. When OWR and LRD determine what if any additional testing or analysis is needed to satisfy our collective agency above and beyond what MSHA required and approved, we will communicate these additional needs to you. At that time, we believe the cleanest way to handle this is for a re-submittal of all information including any additional information as determined by OWR and LRD with a cover letter asking LRD to consider lifting the prohibition of Condition K. We will then officially review and make a decision based on this stand alone complete package and OWR's ultimate comfort level as well. If it helps you to retrieve what we now have in our possession (LRD), we can return the binders for your use in preparing the submittal to our LRD office.

-

Water resources may already be reviewing the information provided to them in an official capacity for both construction and subsidence of Phases 3 through 7. We should both (you and I) get on the same

page with OWR's process. If it is clear to OWR that the submittal also attempts to address the subsidence of Phase 2, then good. Phase 2 has the complicating factor of being affected by not only Panel 3, but also panel 4. I don't recall if the phase 3 through 7 analysis prepared for MSHA looked at phase 2 and the impact of both panel 3 and 4 combined. This is something I am sure OWR and LRD will need to take a close look at and may be where additional information will be necessary beyond what has already been provided to MSHA.

Keep in mind that at the meeting, it was discussed that while drilling piezometers, additional field testing of refuse flowability would be a good idea. This type of field testing at depth should be discussed with Paul Mauer of OWR before drilling so that appropriate testing he may need is completed.

We have submitted a response to comments to MSHA for Phase 7. A copy of the response was also submitted to OWR and LRD. If we recieve further comments, responses and the final approval will be forwarded to the OWR and LRD.

That will again help us stay informed. Ultimately, we need the MSHA District 8 written approval for phase 7 as just provided for phases 3 through 6. We also need a specific stand alone request to remove Condition K as stated above.

-

Although not specifically stated in the MSHA memo from Tech Support, we believe that Phase 2 is also included. The plan submitted shows the longwall mining beneath Phase 2. We have, in our response to comments for Phase 7, requested that MSHA specifically reference that approval is granted for Phase 2.

We will need to receive MSHA's District 8 written approval for subsidence of Phase 2 once this is resolved.

I appreciate all of your assitance in this matter. If you have any other questions, please call or email me.

Thanks.

On Mon, Mar 29, 2010 at 4:53 PM, Barkley, Dan <Dan.Barkley@illinois.gov> wrote:

Claudio:

As you know, this process has been a complicated one with several agencies involved. Therefore, I am summarizing what I believe to be the current status of the permitting of construction and subsidence of refuse impoundments at Pond Creek as we sit today.

Condition J. (375 Revision No. 2)

This is specific to construction only. Condition J to Revision 2 requires submittal of documentation of both MSHA and Office of Water Resources approvals. Thus far, no documentation of approval from either agency authorizing construction of phased 3 through 7 has been provided to OMM, LRD.

The MSHA document you provided from Stan Michalek and the accompanying report by Paul Donahue is a technical review of Phases 3 through 7 construction and subsidence. This report is simply a recommendation made by Pittsburgh MSHA to the District 8 MSHA office. It is our understanding that the MSHA Tech Support group in Pittsburgh does not issue approvals, but only makes recommendations back to the District Offices and only when asked for assistance by the District Manager. To our knowledge, District 8 has not acted on approving or denying any part of construction of Phases 3 through 7.

To comply with condition J, we still need specific written authorization for construction of phases 3 through 7 by the MSHA District 8 office, and specific written approval for construction by the DNR Office of Water Resources.

Condition K.

This prohibits subsidence of Refuse facility No. 1 (Phases 2) or any part of Refuse Facility 2 (Phases 3 through 7) that is acting as an impounding structure at the time of subsidence. We still regard Phase 2 (the first cell) as an impounding structure even after capping until proven otherwise.

We regard the approval for subsidence of the refuse impounding structures as a separate action from construction. Construction is already approved by LRD in issuance of Revision No. 2 with the only outstanding construction issue being compliance with condition J as outlined above.

The ability to subside the structure has not been granted by the Land Reclamation Division based on Condition K. To receive approval to subside the impoundments from the LRD, a separate request with technical justification will be necessary.

We realize you are working with MSHA to get this approval at the same time as seeking approval for construction of phases 3 through 7. We acknowledge that MSHA approval of subsidence is one component of getting us comfortable with the subsidence. We realize that there has been some back and forth technical exchange with MSHA to date seeking written approval from MSHA. You have copied us on most if not all of this information to keep us informed. However, we believe the LRD has no official pending submittal requesting subsidence of the slurry impoundments.

Ultimately, we will need a separate stand alone submittal requesting subsidence of Phases 2 through 7. This submittal should incorporate whatever analysis and justification is deemed necessary by us and the Office of Water Resources assuring subsidence will not jeopardize public safety or the environment. Obviously, much of the effort you have made to satisfy MSHA will help meet this goal but additional information, testing and analysis may be necessary. We will work closely with the OWR so that it is clear to the company what needs to be done to achieve both our approvals.

Finally, we point out that to the best of our knowledge, the subsidence of Phase 2 was not addressed by the MSHA Pittsburgh Support groups recommendation. Mr. Donahue did not consider this in his analysis as it was not part of the request made by District 8. Therefore, you should determine if you need specific approval from MSHA District 8 regarding subsidence of Phase 2. It would appear that getting Phase 3 through 7 approved by MSHA would be a wasted exercised if MSHA prohibits subsiding Phase 2.

If you see anything inaccurate above, please let us know.

And to answer your initial question, I don't see any need to copy anyone else. If it is a large submittal, we will make sure Tim Devardo see this submittal to keep him informed as well. If not , feel free to give Tim a copy in Benton as well.

Dan Barkley; P.E.

Mining Engineer, Land Reclamation Division

217 - 785 - 5197

From: Claudio Yon [mailto:cyon@aci-wv.com]
Sent: Friday, March 26, 2010 7:06 AM

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

November 23, 2010

Project No. B10-148-1413

Mr. Ron Morse
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
2309 West Main Street, Suite 116
Marion, IL 62959

Transmittal
Additional Information
Williamson Energy, LLC
Pond Creek No. 1 Mine
Permit No. IL0077666
Williamson County, Illinois

Dear Mr. Crislip:

On behalf of our client, Williamson Energy, LLC, please find enclosed two (2) sets (Volumes 1 through 7) of the coal refuse facility design for Stage 3 through Stage 7 for the Pond Creek No. 1 Mine. This information was requested by the Illinois Department of Natural Resources, Land Reclamation Division. Volumes 2 through 7 contain the plan approved for Stages 3 through 7 and includes longwall mining beneath the refuse facility approved by MSHA. Volume 1 is additional information requested by Dan Barkley after the plan was approved by MSHA. This submittal (Volumes 2 through 7) are identical to the information originally submitted to your office as Revision No. 2 to Permit No. 375 with the exception of the additional information requested by MSHA.

One (1) copy of the information was sent to Mr. Larry Crislip at the Illinois Environmental Protection Agency office in Marion.

If you have any questions, or require additional information, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Claudio E. Yon, P. E.
Senior Project Manager

CEY:wmb
Enclosures

cc: Mr. Larry Crislip. IEPA w/enclosures
FILE: 10148-03

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

November 23, 2010

Project No. B10-148-1413

Mr. Larry Crislip
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
2309 West Main Street, Suite 116
Marion, IL 62959

Transmittal
Additional Information
Williamson Energy, LLC
Pond Creek No. 1 Mine
Permit No. IL0077666
Williamson County, Illinois

Dear Mr. Crislip:

On behalf of our client, Williamson Energy, LLC, please find enclosed one (1) set (Volumes 1 through 7) of the coal refuse facility design for Stage 3 through Stage 7 for the Pond Creek No. 1 Mine. This information was requested by the Illinois Department of Natural Resources, Land Reclamation Division. Volumes 2 through 7 contain the plan approved for Stages 3 through 7 and includes longwall mining beneath the refuse facility approved by MSHA. Volume 1 is additional information requested by Dan Barkley after the plan was approved by MSHA. This submittal (Volumes 2 through 7) are identical to the information originally submitted to your office as Revision No. 2 to Permit No. 375 with the exception of the additional information requested by MSHA.

Two (2) copies of the information was sent to Mr. Ron Morse at the Illinois Environmental Protection Agency office in Marion.

If you have any questions, or require additional information, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Claudio E. Yon, P.E.
Senior Project Manager

CEY:wmb
Enclosures

cc: Mr. Ron Morse, IEPA w/enclosures
FILE: 10148-02

Response to Comments
Permit No. 375-Revision No. 2
Williamson Energy, LLC, Pond Creek Mine
Williamson County, Illinois

TABLE OF CONTENTS

Appendix A - Williamson Energy, LLC's Request for Removal of Condition "K"

Appendix B - "A Case Study of Undermining Impoundment Embankments by the Longwall Mining Method", D.S. Choi, G.J. Hasengus and P.S. Carter

Appendix C - "Response to October 6, 2020 IDNR Comments Nos. 5 and 7", Prepared by GAI Consultants, November 2010

Appendix D - Contingency Buttress Time Calculations and Volumes

Appendix E - MSHA and Illinois Department of Natural Resources Office of Water Resources Approvals

Appendix F - Subsidence Impact/Groundwater

Appendix G - Piezometer Readings

Appendix H - Pin Line Data

Appendix I - Enhanced Monitoring Piezometer Reading Table

APPENDIX A

WILLIAMSON ENERGY, LLC'S REQUEST FOR REMOVAL CONDITION "K"

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Office: 618-983-3020 Fax: 618-983-3017

November 23, 2010

Project No. B05-330-1413

Mr. Scott Fowler
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
Land Reclamation Division
One Natural Resources Way
Springfield, IL 62702

Request for Removal
Condition "K"
Permit No. 375-Revision No. 2
Williamson Energy, LLC, Pond Creek Mine
Williamson County, Illinois

Dear Mr. Fowler:

Based on information contained within a submittal dated 11/23/2010 prepared on our behalf by Alliance Consulting, Inc., we are requesting the removal of Condition "K" from Revision No. 2 to Permit No. 375. Condition K required that the stop point of the longwall mining pond be set off the eastern most toe of Refuse Facility No. 2 by the angle of draw.

If you have any questions, or require additional information, please do not hesitate to contact us.

Sincerely

WILLIAMSON ENERGY, LLC

Anthony Webb
Authorized Agent

AW:knb

FILE: 05330-92

APPENDIX B

"A CASE STUDY OF UNDERMINING IMPOUNDMENT EMBANKMENTS BY THE LONGWALL MINING METHOD" BY D. S. CHOI, G. J. HASENFUS AND P. S. CARTER

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A CASE STUDY OF UNDERMINING IMPOUNDMENT EMBANKMENTS BY THE LONGWALL MINING METHOD

D. S. Choi[1]; G. J. Hasenfus[1]; P. S. Carter[2]

[1] CONSOL Inc. Research and Development, 4000 Brownsville Road, Library, PA 15129, USA

[2] Consolidation Coal Company, Northern West Virginia Operations State Route 7, U.S. 19, P.O. Box 100, Osage, WV 26543, USA

ABSTRACT

Undermining of impoundment embankments over coal mines has been strictly regulated by state and federal agencies since the failure of the Buffalo Creek dams in West Virginia in 1972. This paper will discuss the safe and successful undermining of one coal fines refuse impoundment and three freshwater supply impoundments and their associated embankments. In cooperation with regulatory authorities, the embankments were undermined with both room-and-pillar development and subsequent longwall mining methodologies at a single mine in the Northern Appalachian coalfield. The mine overburden thickness ranges from 225 to 260 meters and consists of typical upper Pennsylvanian and lower Permian sedimentary deposits. Before the embankments were undermined, the impoundments were drained. After undermining was complete and the embankment integrity was verified, the impoundments were refilled. All embankment crests were monitored for horizontal displacement and tilt using an automated recording system. These measurements were augmented with frequent manual recordings of both vertical surface subsidence and borehole inclination as well as water levels within the embankments.

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KEYWORDS

Fine Coal Refuse • Longwall Mining • Subsidence • Earth Embankment • Waste Disposal • Freshwater Impoundment • Instruments

INTRODUCTION

Both public and miner safety as well as environmental considerations are of paramount concern when undermining water filled impoundments and/or embankments over coal mines. The construction, maintenance, and undermining of impounding structures over coal mines is strictly regulated by both federal and state agencies, such as the Mine Safety and Health Administration (MSHA), the Office of Surface Mining (OSM), and individual state natural resource agencies. Subsequent to the 1972 failure of the Buffalo Creek dams in West Virginia (Davies 1973), the Federal Code of Regulations 1978 was revised to require mine operators to obtain permit approval from MSHA prior to undermining impounded bodies of water or water impounding structures. In addition, the U.S. Bureau of Mines commissioned several studies in the mid-to-late 1970's to address undermining of water bodies by U.S. mines, particularly as it related to miner safety. Two of the original studies, summarized by Babcock , Hooker 1977, define guidelines for mining in close proximity to surface waters. These guidelines, based

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primarily on foreign experience, made it difficult to undermine impoundments unless undermining was in deep cover or "local observations and/or experience so dictate(d)." Undermining of large water impounding embankments was not permitted by the guidelines. A subsequent study by Kendorski *et al.* 1979, refined the criteria for determining when a surface water body constitutes a mining hazard. More recently, the August 1995 failure of the Omai tailings dam in Guyana again focused wide international attention on the issue of dam safety (Vick 1996).

Since the early 1970's CONSOL Inc. has been collecting subsidence data resulting from longwall mining (Dahl , Choi 1974). Such studies, as well as observations from 25 years of longwall mining, have improved our understanding of the longwall subsidence process and have allowed for prediction of subsidence effects on surface structures.

In the 1980's two of CONSOL's mining operations, working with MSHA and state regulatory authorities, were permitted to longwall mine under an acidic mine drainage (AMD) impoundment and a coal fines impoundment (Born 1986; Perin , Puglio 1988). However, in neither case did the existing impounding embankment lie over the longwall (high extraction) panel, although the AMD facility did lie over room-and-pillar longwall development. In the case of the AMD treatment impoundment, approval to directly undermine the impoundment and undermine adjacent to the overlying embankment had been granted by MSHA under the following conditions: 1) water from the impoundment had to be drained prior to undermining, and 2) a monitoring program had to be established to measure and observe the embankment structure and pool area for a period of 40 days following undermining as well as during and after subsequent refilling. The monitoring program established that there were no measurable deleterious effects of mining on the embankment or pool area, and refilling was allowed. Upon refilling, no leakage was observed.

In the early 1990's, to maximize reserve recovery at one of CONSOL's northern West Virginia mines, mine plans were projected to undermine a fine coal refuse impoundment and three freshwater impoundments with a series of five longwall panels and associated room-and-pillar development (Figure 1). The projected panel widths ranged from 168 to 229 meters and were located at depths ranging from 225 to 260 meters below the impoundment valley bottoms. The fine coal refuse impoundment and its coarse refuse embankment were undermined first by two consecutive longwall panels. Portions of the three freshwater impoundments (Nos. 1 through 3) were then undermined by three additional panels. One of the embankments (No. 3) was directly undermined by longwalling. Undermining of the refuse impoundment began in April 1991. The last of the three freshwater impoundments (No. 1) was undermined in August 1996.

Undermining of all impoundments and associated embankments was achieved in full cooperation with MSHA and the West Virginia Division of Environmental Protection. As per past practice, approvals were contingent on instituting a detailed monitoring program for each impoundment structure and, in instances of embankment undermining by longwalls (coal refuse and No. 3 freshwater impoundments), draining of the impoundments prior to preundermining. Extensive monitoring programs were thus established to measure embankment structure movement and internal water levels, and to detect possible leakage. In each case, monitoring was initiated well prior to possible mining influence on the embankment and was continued for several months after mining had progressed beyond the embankment and after the impoundment had been refilled.

This paper discusses the successful undermining of all four of the impoundments and associated embankments. Due to the abundance of data and monitoring details for each embankment, the discussion

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of instrumentation and undermining results will focus mostly on the coal refuse impoundment embankment. Nevertheless, all impoundments and impoundment embankments were undermined without any deleterious effect and are completely functional.

GEOLOGIC SETTING

The study mine is located in the Northern Appalachian coal field of West Virginia. The fine coal refuse embankment is situated in a small ephemeral tributary of a perennial stream valley. The freshwater impoundment embankments lie within an adjacent perennial valley and its tributaries. These impoundment structures were built in 1978 primarily to support preparation plant operation, although some of the water is used for mining operations.

The impoundment embankments were all constructed transverse to valleys, from hillslope to opposing hillslope. The stratigraphy in which they were constructed is of the Dunkard series of the Pennsylvania system. Typical strata of the Dunkard series in this area consists mostly of various shales and sandstones, the thicknesses of which vary within short horizontal distances. In addition, several bony coal seams are present in the hillsides.

Four major coal seams are present below the surface. In descending order, they are: the Waynesburg seam, 1.1 meters thick; the Sewickley seam, 1.8 meters thick; the Redstone seam, 0.9 meter thick; and the Pittsburgh seam, 2.4 meters thick. At present, the Pittsburgh seam is the only seam being mined in this area. None of the other overlying seams below the impoundments had been mined. The interburdens between the coal seams are 83, 20, and 8 meters, respectively, and consist of shales, sandstones, and limestones. The Pittsburgh seam lies at an average depth of 226 meters below the fine coal refuse embankment and approximately 244 meters below the freshwater impoundment embankments.

No major geologic anomalies are present near the embankment sites. The Pittsburgh seam dips very gently with less than a 2% grade to the northwest. The surface soil is classified as a clay loam. The soil is residual in nature, derived from weathering of shales and sandstones. The 1.58-to 3.15-centimeter thick surface soil is immediately underlain by a subsoil of silty loam or silty-clay loam which changes to clay with a variable amount of rock fragments. The underlying bedrock consists of interbedded sandstones, shales, and claystones.

MINE DEVELOPMENT AND LONGWALL EXTRACTION

The longwall panels in the two mine blocks underlying the impoundments were all developed using four-entry gateroad systems (Figure 1). Most entries were driven on 33.5-meter centers, with the crosscut centers of the two pillars closest to the tailgate being 54.9 meters and those of the headgate-side pillars being 27.4 meters. Entries were mined 4.88 meters wide by 2.14 meters high. The resulting pillar dimensions were 28.7 by 50.0 meters and 28.7 by 22.6 meters. To separate the panels from preexisting parallel mains development, two barrier pillars, one on each side with widths ranging from 15.2 to 70.1 meters, were left adjacent to the mains, which resulted in a reduction in pillar sizes for the adjacent tailgate developments for the two panels to the north and south of the mains. Both panel blocks were mined progressively toward the mains (northern block to the south, southern block to the north) and panels in both blocks were extracted from west to east (Figure 1).

Panel lengths for the northern block of panels were all 1990 meters. The southern block panels varied in length; the panel undermining the No. 1 freshwater impoundment was 1740 meters long. All impoundments were located at least 365 meters from the panel ends, thus eliminating end-panel support

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influence for all impoundments and associated embankments. The two panels underlying the refuse impoundment were 195 and 218 meters wide, respectively. The two southernmost panels of the northern block, which underlay the No. 3 and No. 2 embankments, were 226 and 159 meters wide, respectively. The southern block panel, underlying the No. 1 freshwater impoundment, was 226 meters wide.

EMBANKMENT DESIGN

The fine coal refuse impoundment was designed to last for the life of the mine. Its embankment was built in multiple stages to permit the controlled placement of coal refuse, and reached a height of 61 meters by the time of undermining and monitoring (Figure 2).

The first stage dam was constructed of clay borrowed from adjacent pits, and included a cutoff trench. The downstream portion of the second stage was constructed of compacted, coarse coal mine refuse, while the upstream portion consisted of an impervious zone of cohesive soil extending upward from the impervious zone of the first stage structure. Successive stages used the same method as the second stage, except that the thickness of the impervious zone was reduced. Proper internal filter drains were constructed immediately downstream of the impervious zone to collect and control the flow of any impoundment seepage. The drains were also designed to minimize the flow of water through the coal refuse portion of the embankment to reduce the potential for acidic drainage.

Although the three freshwater impoundment embankments had slightly varying sizes, they were all nearly identical in design, using a homogeneous earthen fill and equivalent 2:1 upstream and downstream slopes (Figure 3). A cutoff trench, about 4.9 meters high and 6.1 meters wide (at the top) was included. A rock drainage blanket (filter drain) and toe drain were constructed to drain water from the downstream side of the embankment. The rock blanket was 0.9 meter thick, including 0.3 meter of graded filter and 0.6 meter of rock fill. To reduce any wave erosion, 0.2 meter of stone riprap was placed on the upstream slope. The freshwater embankments were all constructed to a maximum height of about 16 meters.

The outlet works for the freshwater embankments consisted of a freshwater intake tower with an arched pipe culvert beneath the embankment. Each embankment also included an earth spillway, with a 7.6-meter wide, 2:1 side slope, concrete weir at the crest. The freshwater impoundments had storage capacities ranging from 0.17 to 0.24 million cubic meters.

The original clay and coarse coal refuse used for embankment construction were tested in the laboratory for geomechanical properties prior to construction. The original ground clay shear strength characteristics included a 31° friction angle and a 20.1 kPa cohesion, while the compacted embankment clay had a 26° friction angle and a 21.6 kPa cohesion. The compacted coarse coal refuse had a 37° friction angle and a 23.9 kPa cohesion. Using these shear strength parameters, all of the embankments were designed with minimum downslope safety factors of 1.6 for static loading and 1.4 for earthquake loading.

REFUSE EMBANKMENT INSTRUMENTATION

Descriptions of the instrumentation used by others to monitor the integrity of impoundment embankments can be found in the literature (Green , Roberts 1982; Lytle 1984). The instruments employed for this project, and particularly for the fine coal impoundment embankment, were selected and/or designed primarily for their practical use in accurately measure mining subsidence. Continuous monitoring of subsidence-related displacements was also desirable. The final layout for the refuse embankment instrumentation is shown in Figure 4. Along an upstream slope bench, several meters below

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the crest and within the clay liner, a 427-meter long subsidence survey line was established with stations on 15.2-meter intervals to measure vertical displacement, relative horizontal movement (strain), and tilt. The horizontal strain was measured across the impoundment (parallel to the crest), to detect any tensile zones, which may be indicative of cracks (failure planes) extending through the impoundment from the upstream to downstream slopes. The survey line extended 61 meters beyond the embankment onto both abutting hillsides. In addition to the survey line, four inclinometer holes were installed to monitor internal relative displacements of the embankment and locate possible shear zones that might indicate imminent slope failure. Three inclinometers were located along the upper crest of the embankment and one on the first downstream slope bench. Finally, four piezometers, each extending to the embankment base were installed along the four downstream slope benches to monitor the water level within the embankment.

Along the survey line, vertical displacements were monitored manually with level surveys at various time increments that decreased as undermining drew closer, and ranged between once per week and once per month. The extensometer and tilt monitoring instruments were mounted on the same station pedestals. Extensometer and tilt readings were measured both automatically and manually. Manual recording dates were coordinated to coincide with the vertical subsidence surveys previously mentioned. The automated system recorded data on 4-hour intervals.

The automated subsidence monitoring system was developed at CONSOL. The extensometer measurement portion of the system consisted of a cable, chain, and sprocket arrangement with a counterweight as shown in Figure 5. The sprocket rotation was sensed by a current angular transducer. Given the operational conditions at the site (temperature, humidity, and hardware), the resolution of the extensometer data was approximately 0.25 millimeters (16.7 microstrain). A precision tape extensometer was used periodically as a manual calibration check for the automated extensometer system.

Tilt measurements were automatically recorded parallel to the survey line with single component angular transducers at each station. The data were checked against periodic manual measurements of slope changes parallel and transverse to the subsidence survey line. One use of the tiltmeter data was to estimate vertical subsidence between manual level survey dates. In addition, it indicated if the individual measuring stations were physically disturbed. Since the slope change data are of limited value in the evaluation of the stability of these embankments, the data are not included in this paper.

The holes for the inclinometer and piezometer instrumentation were drilled with a track-mounted auger drill. The inclinometer holes were completed to bedrock or until the auger could not penetrate any further, and the piezometer holes were drilled to within several meters of the drainage blankets. The inclinometer holes were cased with internally grooved plastic pipe. The piezometer holes were cased with perforated pipe to full depth. The annulus between the respective holes and both types of casing was filled with sand so that lateral movement and phreatic surface fluctuation could be detected.

MEASUREMENT RESULTS AND DISCUSSION

The large refuse impoundment and embankment straddled two longwall panels: a 195-meter wide panel, which first undermined the northern end of both the impoundment and embankment; and a 218-meter wide panel, which subsequently undermined the southern extent of the impoundment and embankment (Figure 1). A four-entry, 100.5-meter wide gateroad system, consisting of 28.7-by 50.0-meter and 28.7-by 22.6-meter pillars was positioned directly under the center of the embankment. Undermining of the upstream end of the impoundment by the 195-meter wide panel commenced in April 1991. The

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northern end of the embankment was subsequently undermined during June and July 1991. The second panel progressed under the southern end of the embankment during December 1991. Prior to undermining of the embankment, the coal slurry (water) from the refuse impoundment was drained into a surplus slurry impoundment. A small amount of precipitation runoff water was still present after impoundment draining, but the beachhead remained about 300 meters from the upstream embankment slope. The impoundment remained drained during monitoring, which concluded in January 1992.

Figure 6 shows the vertical component of ground subsidence relative to the survey line stations depicted in Figure 4. The maximum measured vertical subsidence values were 1.13 meters measured at Station 23 for the narrower panel and 1.16 meters measured at Station 2 for the wider panel. The largest vertical subsidence above the gateroad abutment pillars was about 0.15 meter. With extraction heights of about 2.38 meters for both panels, the maximum subsidence factors were 47.5% and 48.7%, respectively. Even given the subcritical nature of both extraction widths (the panel width to overburden depth ratios at the embankment base elevations were approximately 0.88 and 0.98, respectively), these vertical displacements were still slightly less than those typically expected for a flat horizon with similar panel geometry, depth, and extraction height.

Ground strain was determined from both automated and manual measurements of relative movement (extension or contraction) along a line approximately parallel to the ground surface between the survey line stations. For the stations located on the embankment, the ground slope was approximately zero, and thus, the corresponding strain measurements were horizontal. To illustrate the sensitivity and capability of the automated monitoring system, the time dependent development of relative displacement between Stations 4 and 5 is depicted in Figure 7. Note that decelerating rates coincident with pauses in face advance are readily discernable. Manual extensometer measurements are included to show the relative accuracy of the automated system.

The maximum relative ground movement measured during the refuse embankment monitoring program was recorded between Stations 4 and 5 on the southern edge of the embankment directly adjacent to the abutting hillside and approximately 60 meters inside the 218-meter wide panel. However, as shown in Figure 7, the maximum 29.0-centimeter relative displacement was contraction, not the expansion typically predicted under such conditions. In addition, the corresponding 19 mm/m compressive strain was considerably higher than that typically anticipated for a horizontal surface under similar conditions. Conversely, the maximum horizontal tensile strain across the embankment was only 3 mm/m (5.1-centimeter expansion), which was significantly lower than tensile strains typically anticipated for a horizontal surface under similar conditions. A detailed analysis of the data suggests that the higher vertical component of ground displacement in the uphill slope direction, coupled with a slight downward slope movement, was probably responsible for the higher than anticipated embankment compressive strains, and both the lower than anticipated tensile strains and vertical subsidence values. In essence, the side slopes served to compress and confine the embankment.

Figure 8 shows the developing and final ground strain profiles across the entire embankment and the adjacent abutting hillsides that resulted from the 218-meter wide longwall face advancing under the embankment. This profile demonstrates that tensile ground strains occurred primarily over the panel gateroads and progressed to no more than 50 meters inside the panel-edge projection. With the exception of that measured between Stations 7 and 8, the tensile strain across the entire embankment was less than 2 mm/m. After mining was complete, no visible cracks were apparent anywhere on the embankment, including the soil liner. Given the relatively low cohesions and high deformabilities of the coarse refuse and compacted clay soil used for embankment construction, postmining embankment integrity was

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expected.

In addition to the embankment surface, internal stability of the refuse embankment was demonstrated through inclinometer and piezometer monitoring. Throughout the refuse impoundment monitoring program, none of the four inclinometers detected any sign of shear plane development within the embankment. As exemplified by the No. 2 inclinometer data shown in Figure 9, all computed inclinometer displacement profiles (referenced from the bottom of hole) were smooth and void of offsets, with the exception of artificially induced movement in the near-surface casing due to excessive hole tolerance. Among the four inclinometers, No. 2, located slightly inside the 218-meter wide panel edge, was the only one to show significant movement during mining of either panel. It first moved toward the direction of the first panel as it was mined. Then as the second panel was mined it reversed direction, moving toward the second panel centerline. However, despite this direction reversal, no abrupt inclinometer movements were observed.

Water levels in the six piezometers installed within the coarse refuse embankment substantiated postmining embankment stability. During the entire undermining period, the water levels within all six wells remained stable, which indicated that no mining-induced, water-filled fractures developed within the embankment. In fact, seepage measurements near the downstream embankment toe indicated that the overall seepage outflow declined slightly during undermining. This observation is consistent with the slope-induced compressive confinement mentioned previously.

After the undermining of the refuse embankment was completed, monitoring was continued in order to validate post-undermining stability. After more than 12 months of monitoring, no additional ground movements had occurred beyond those attributed to measurement error, and thus, permission was granted to reactivate the embankment.

Although not presented here in detail, monitoring of the freshwater impoundment embankments using instrumentation equivalent to that installed on the refuse embankment provided very similar results despite differences in geometries and orientations. This confirmed the postmining stabilities of all three freshwater embankments. As an example, the crest of the No. 3 freshwater embankment was subjected to only 0.30 to 0.37 meter vertical subsidence, due to its relatively close proximity (less than 60 meters) to the panel edge. Unlike the refuse embankment, the freshwater embankment crest was oriented nearly parallel to the direction of mining. Examples of relative horizontal displacement data, collected by the continuous recording system and plotted as a function of time, are shown in Figure 10. The relative locations of the measuring stations are shown in Figure 11. The data show that several different temporal responses occurred as the face advanced under the embankment. As the traveling subsidence wave passed under the embankment, the zone between Stations 4 and 5 first expanded (tension), after which it rapidly contracted and remained in a state of slight compression (1.0 mm/m) after mining influence concluded. This response was similar to most movements measured on the No. 3 freshwater embankment crest. Conversely, the zone between Stations 13 and 14 (located on the abutting hillside) first contracted (compression), then slowly expanded, concluding in a state of slight tension (less than 0.5 mm/m). On the other hand, the zone between Stations 10 and 11 (located across the embankment/hillside abutment) contracted immediately and remained in compression, although a slight decrease from peak compression was observed at the conclusion of undermining. This zone recorded the highest peak and permanent compressional strains of approximately 1.8 and 1.3 mm/m, respectively. In summary, at the conclusion of undermining, the entire crest of the No. 3 freshwater embankment was in a state of compression in the direction of the crest, probably as a result of the slope effect previously mentioned. With a mining rate of about 60 feet per day, the traveling horizontal strain profiles passed in less than 2 weeks.

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CONCLUSIONS

This case study shows that under certain site-specific conditions, coal mine impoundment embankments can be safely and effectively undermined by the longwall method without any deleterious effects. The four large impoundments and embankments described in this study were successfully undermined in 226- to 244-meter cover depths, requiring no remedial work. Under the given site conditions, impoundment undermining created no problems and required no additional monitoring action beyond that required for MSHA permit approval. For this case study, embankments in close proximity to mining were monitored to verify embankment stability and water retention. Embankments that were directly undermined were first drained.

The monitoring instrumentation and associated observations showed that, regardless of orientation, the two longwall-undermined embankments, as well as the two embankments adjacent to undermining, were subject to higher horizontal compressive strains than tensile strains. The maximum recorded tensile strain was approximately 3 mm/m, and the maximum recorded compressive strain was 19 mm/m. This post-undermining compressive state likely resulted from abutting slope movements, which served to confine the transversely constructed valley-bottom embankments, and compress them upon undermining. Instrument data and visual observations suggest that this effect helped to reduce the potential formation of cracks along the embankment. The ability to undermine these structures without consequence was also a result of proper embankment construction design and the deformable characteristics of the compacted earthen fill and coarse refuse construction material.

The automated, continuous monitoring system was a valuable tool for efficiently and accurately verifying embankment stability. It provided a continuous picture of mining-induced ground and embankment movements that made initiation and completion of such movements readily discernable. The steady development of smooth strain profiles until ground stabilization was completed provided assurance that the embankments were stable throughout the undermining process.

FIGURES

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Paper 053, Figure 1.

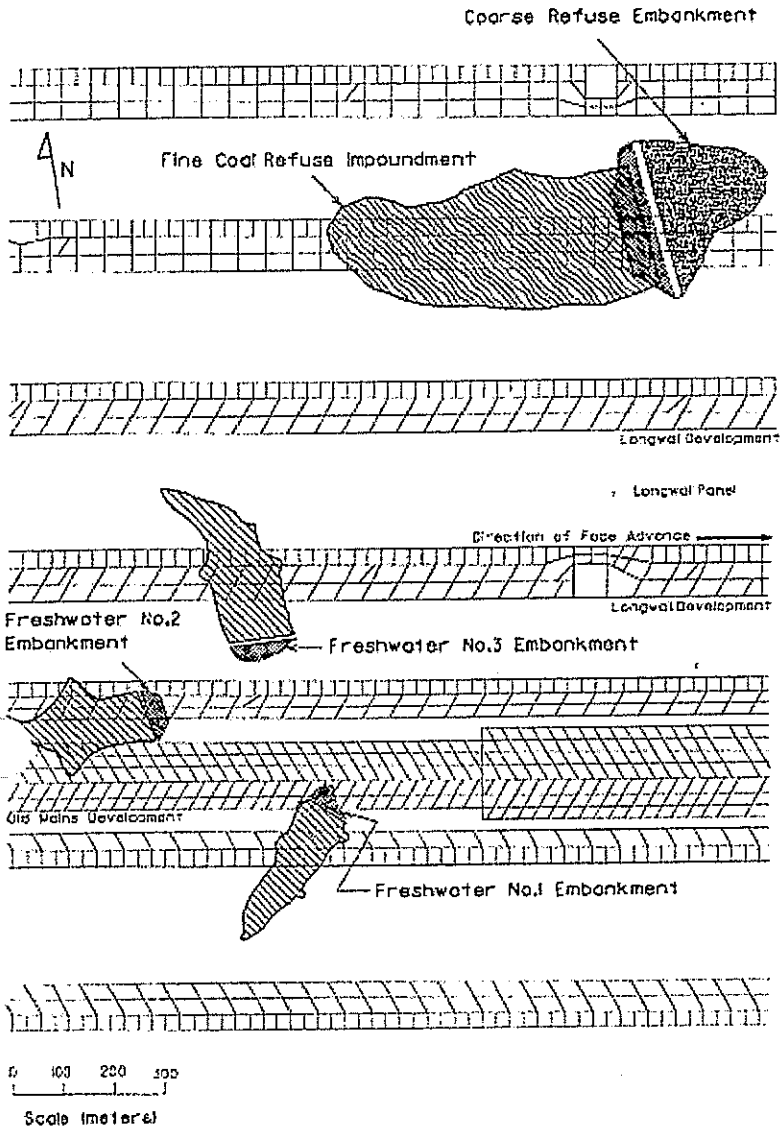

Figure 1. Plan view of case study impoundments, embankments, and mine development

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'aper 053, Figure 2.

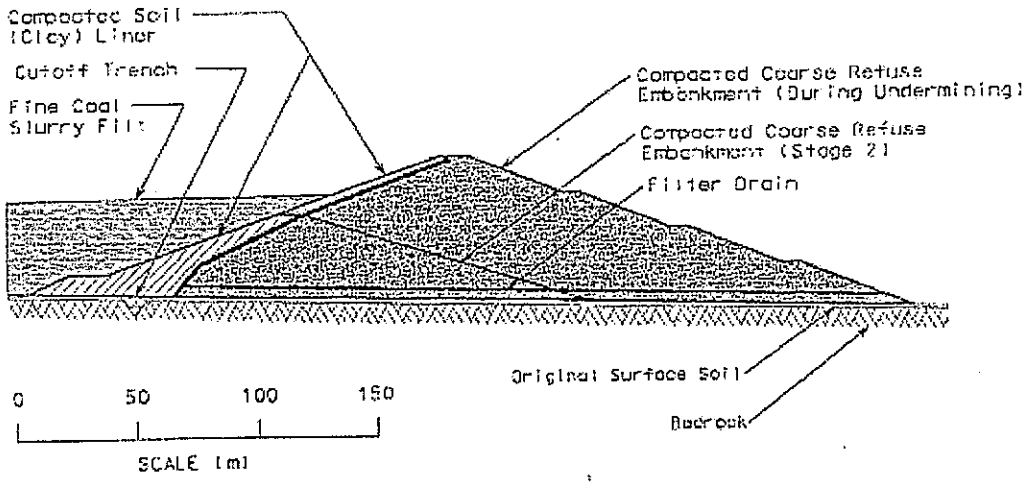

Figure 2. Cross section of coarse refuse embankment for coal fines impoundment

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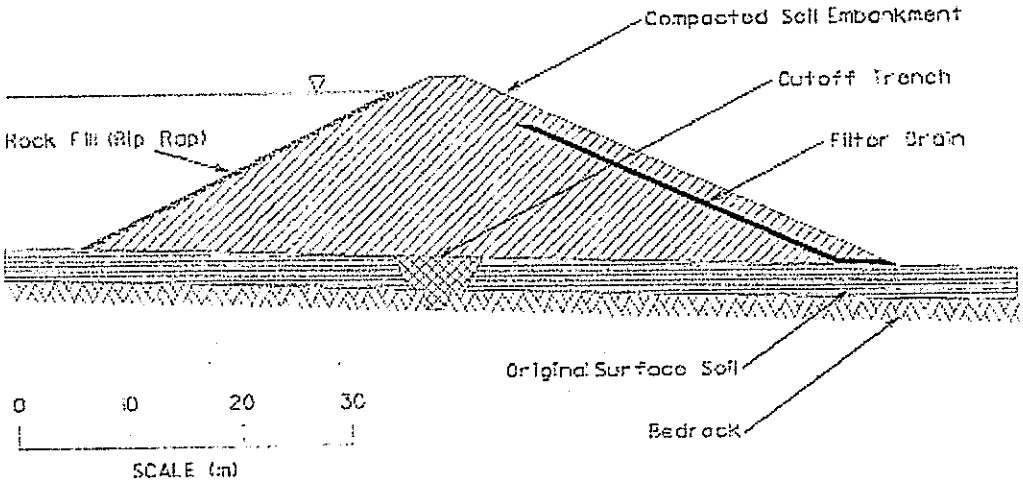

Figure 3. Typical cross section of freshwater impoundment embankments

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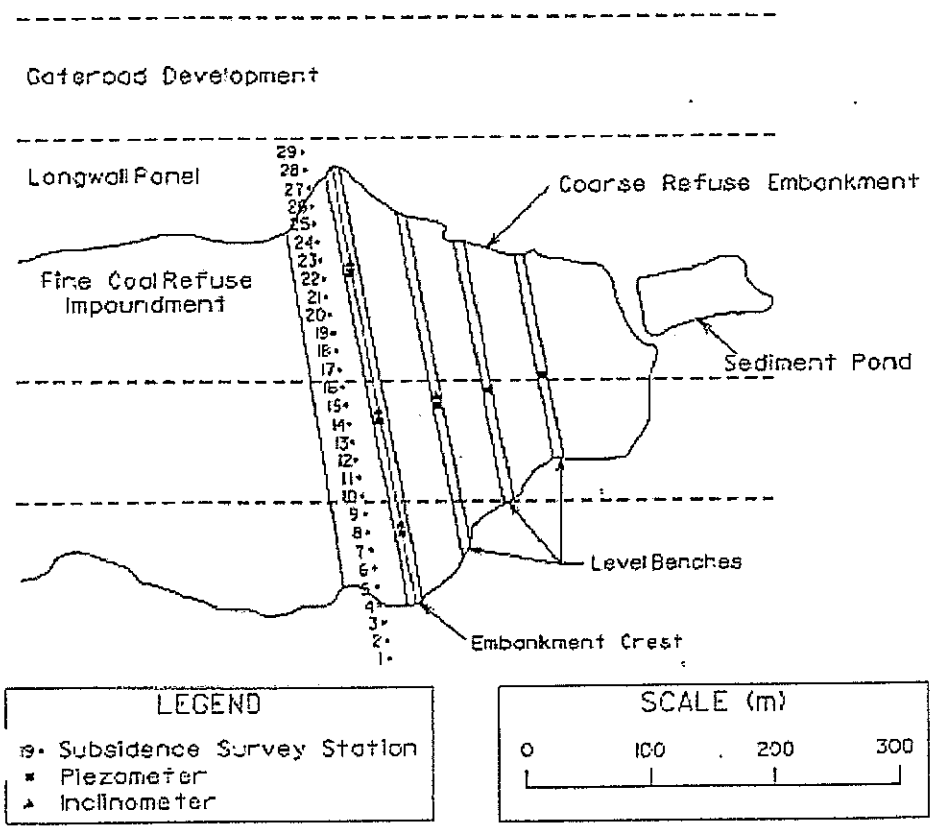

Figure 4. Refuse embankment monitoring instrumentation layout

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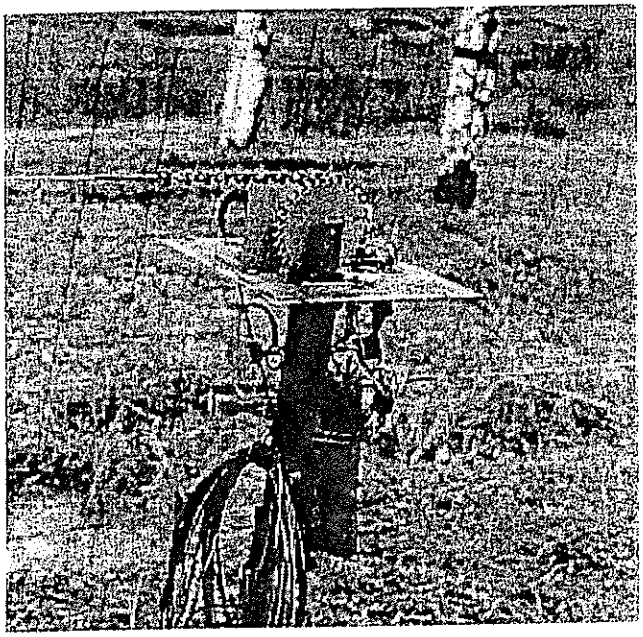

Figure 5. Extensometer sprocket assembly for automated monitoring

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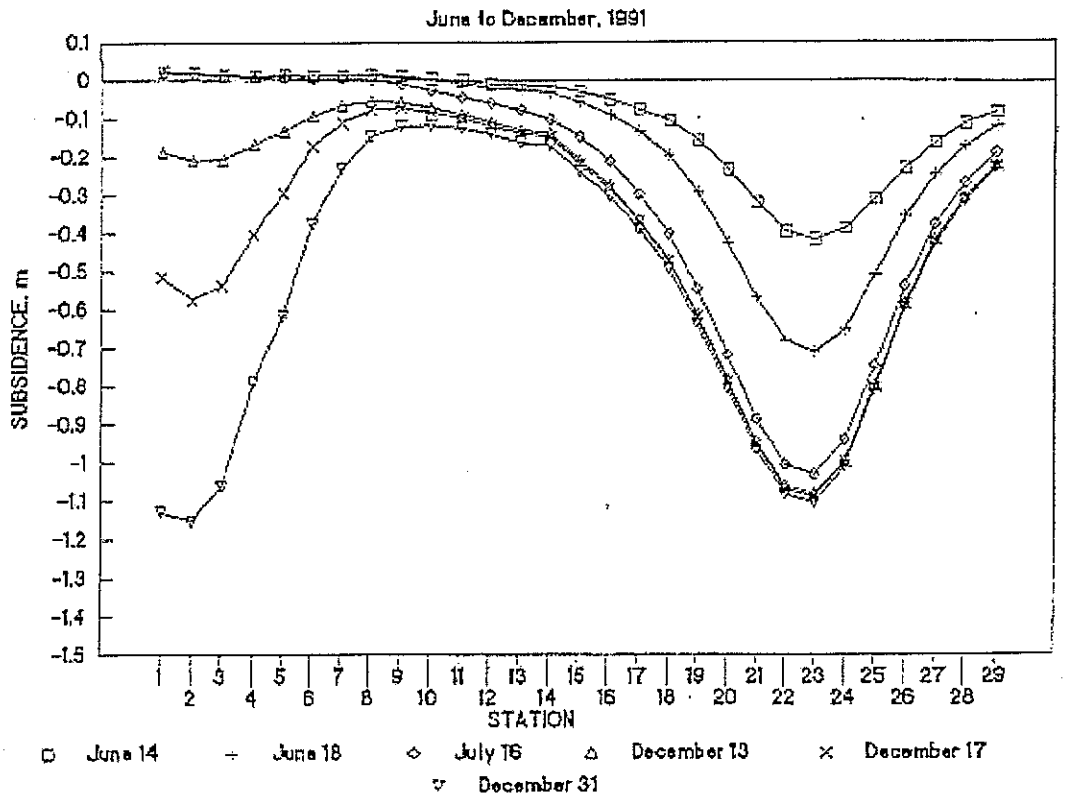

Figure 6. Incremental time, vertical subsidence profiles for coarse refuse embankment

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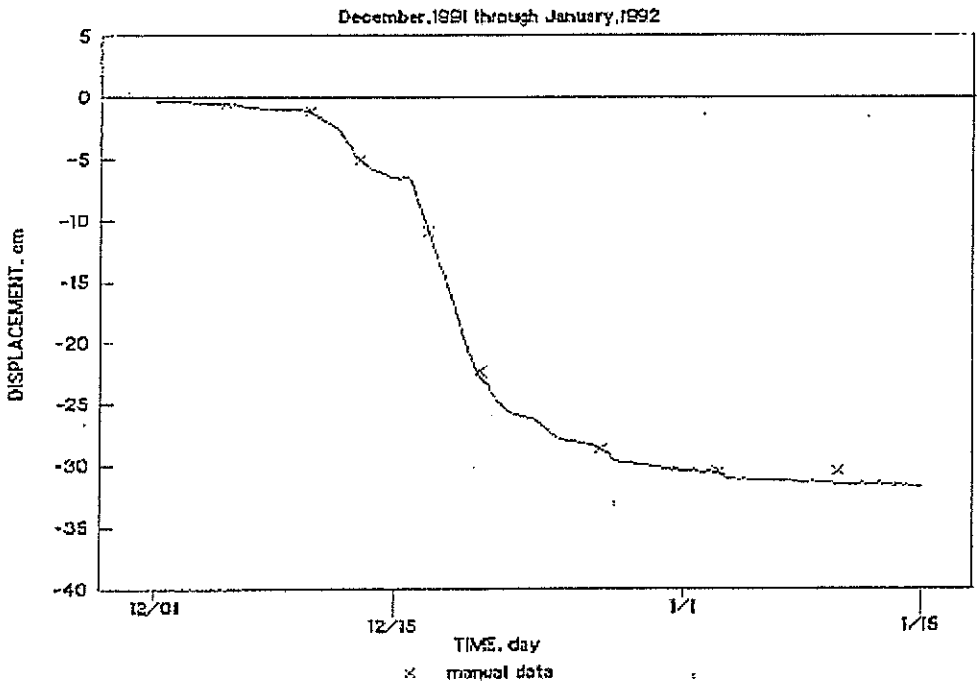

Figure 7. Time-dependent relative horizontal displacement response between Stations 4 and 5

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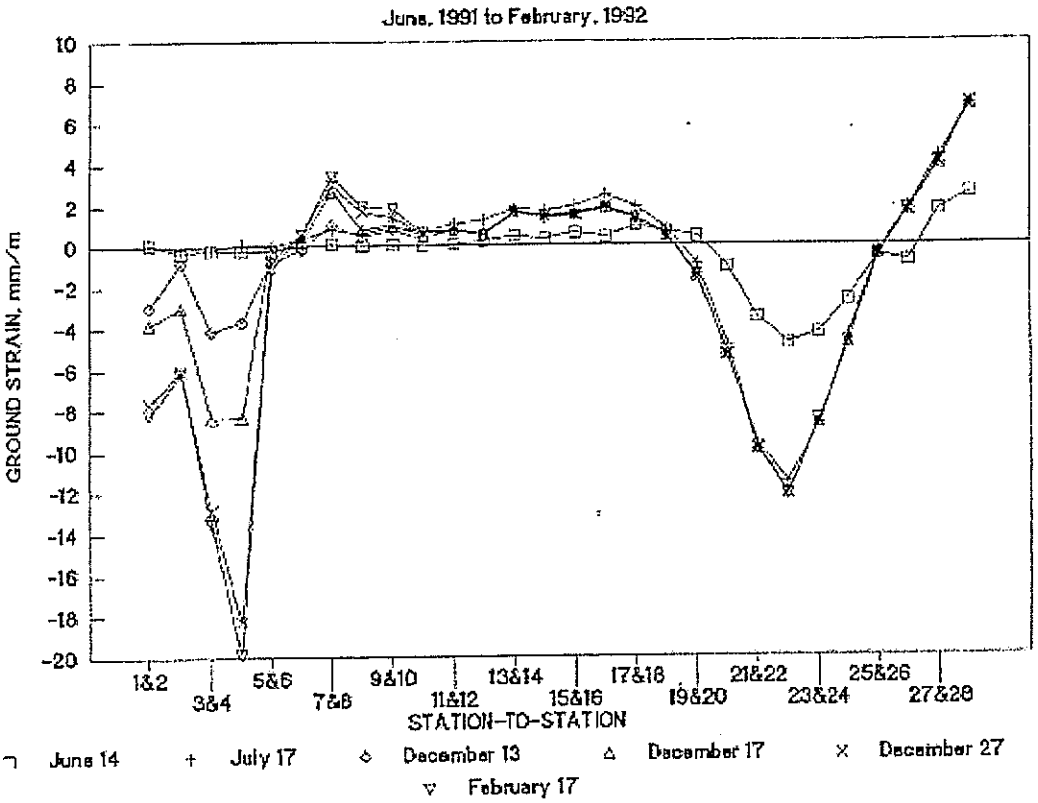

Figure 8. Incremental time, horizontal strain profiles for coarse refuse embankment

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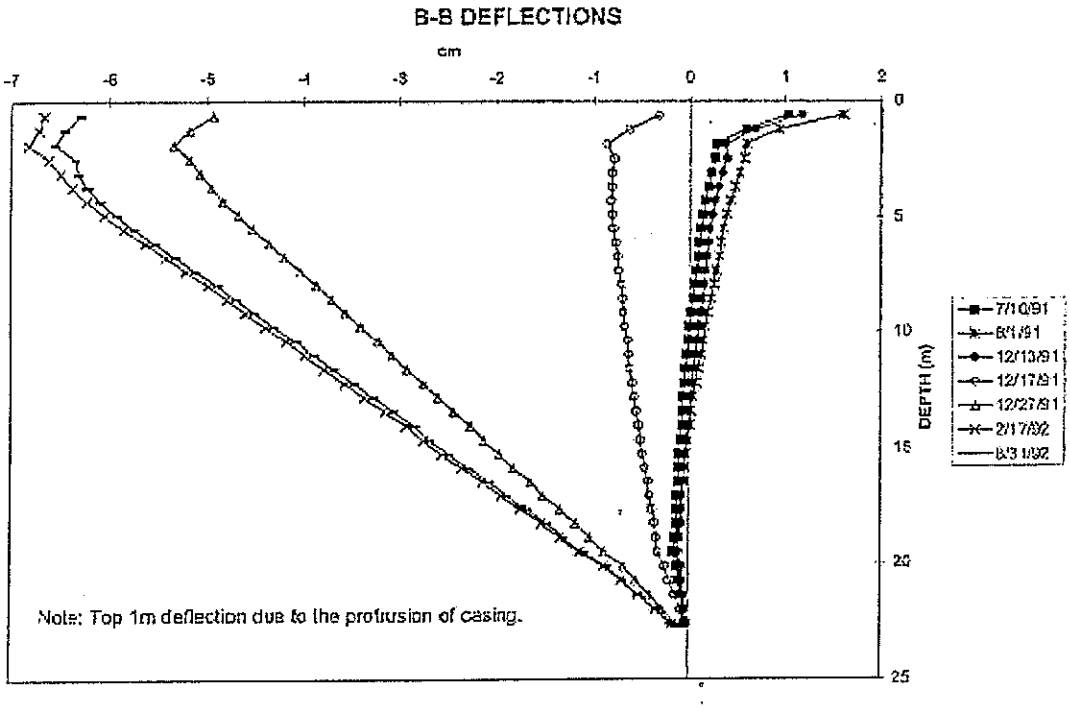

Figure 9. Incremental time, inclinometer response parallel to the coarse refuse embankment crest

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Paper 053, Figure 10.

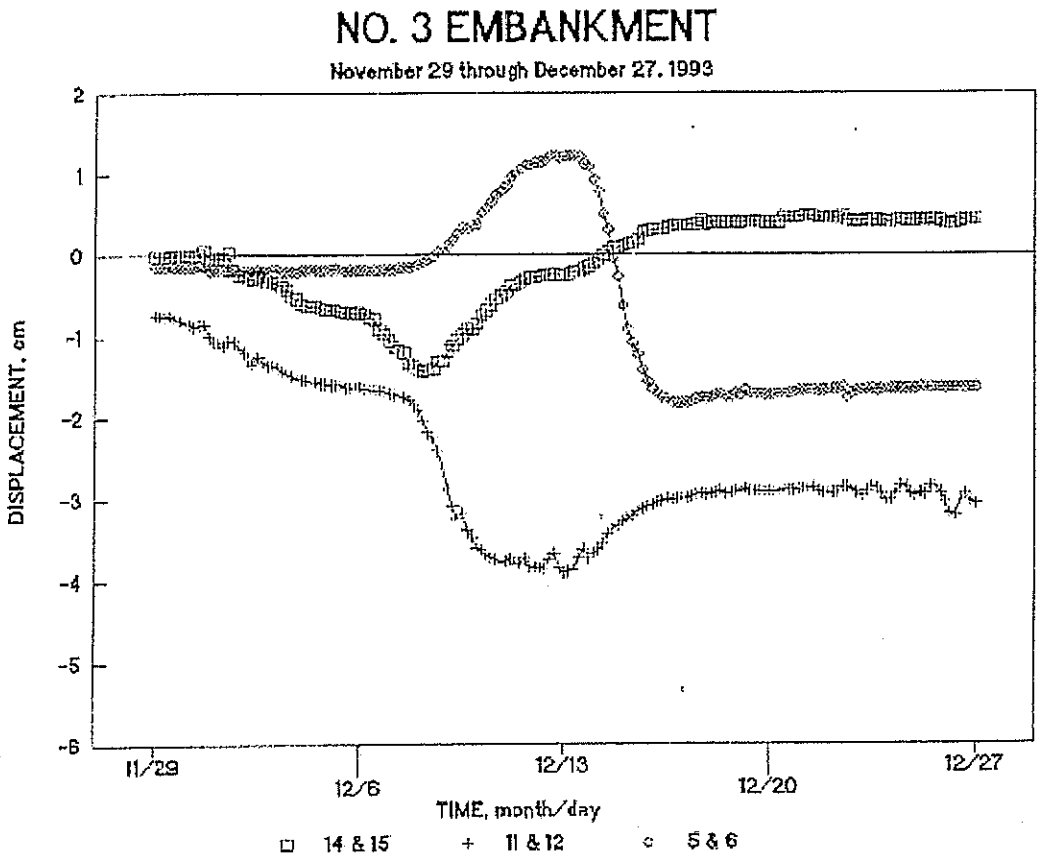

Figure 10. Time-dependent, relative horizontal movement examples for freshwater No. 3 embankment

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Paper 053, Figure 11.

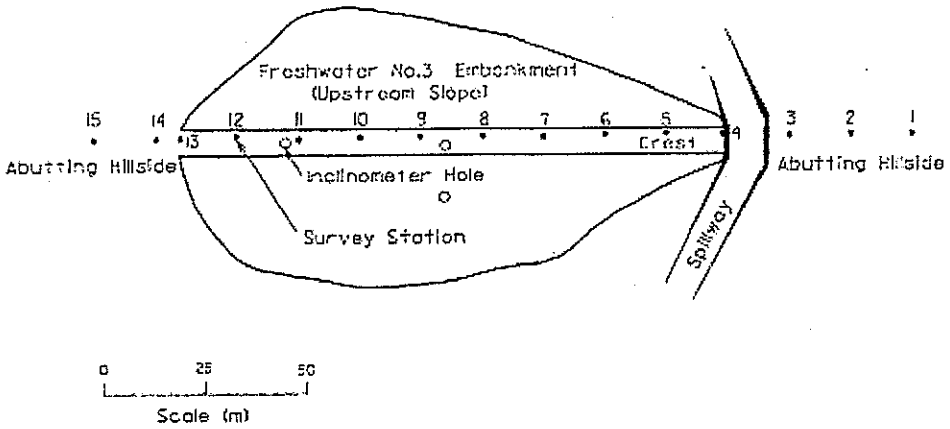

Figure 11. Freshwater No. 3 embankment, subsidence monitoring instrumentation layout

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Phone: 304-255-0491, Ext. 320
Fax: 304-255-4232

APPENDIX C

"RESPONSE TO OCTOBER 6, 2010 IDNR COMMENT NOS. 5 AND 7"
PREPARED BY GAI CONSULTANTS
NOVEMBER 2010

gai consultants

RESPONSE TO OCTOBER 6, 2010 IDNR COMMENT NOS. 5 AND 7

Pond Creek Mine No. 1
Coal Refuse Disposal Facility No. 2 – Phase 2 and 3

GAI Project Number: C090403.01

November 2010

Prepared for: Alliance Consulting, Inc.
124 Philpott Lane
Raleigh County Airport Industrial Park
Beaver, West Virginia 25813-9502

Prepared by: GAI Consultants, Inc.
Murrysville Office
4101 Triangle Lane
Export, PA 15632-1358

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November 18, 2010

Project C090403.01

Mr. Claudio Yon, P.E.
Alliance Consulting, Inc.
124 Philpott Lane
Raleigh County Airport Industrial Park
Beaver, West Virginia 25813-9502

Letter Report
Response to October 6, 2010 IDNR Comment Nos. 5 and 7
Pond Creek Mine No. 1 Coal Refuse Disposal Facility No.2 – Phases 2 and 3
Williamson Energy, LLC
Williamson County, Illinois

Dear Mr. Yon:

As requested, GAI Consultants, Inc. (GAI) has prepared comment responses for the Illinois Department of Natural Resources (IDNR) email correspondence, particularly Comment Nos. 5 and 7 dated October 6, 2010, which was a follow-up to the September 30, 2010 meeting. In general, this comment response assesses the results of site-specific mixed fine coal refuse testing, evaluates the potential for subsidence-induced flow of the Phases 2 and 3 fine coal refuse impoundment, and compares the results to a study performed by GAI and approved by the Mine Safety and Health Administration (MSHA) addressing similar issues of post-subsidence impacts at the Williamson Energy, LLC (Williamson), Pond Creek Coal Refuse Disposal Facility No. 2 (Pond Creek). The following comments were provided by IDNR, which are addressed herein:

5. *Incorporate the fine refuse and push out pad drilling and testing and provide a discussion of how the testing results substantiate the material will not be released through subsidence induced fracturing; and*

7. *Based on all data and modeling conducted to date, provide a clear discussion, analysis and conclusion that the laboratory data, field data and modeling demonstrate that flow will not propagate through and/or outside the coarse refuse impounding structure in a worst case scenario.*

GAI performed engineering analyses and prepared this comment response, which supplements the April 7, 2009 MSHA comment response, which was approved by MSHA on November 12, 2009. The MSHA comments and responses are presented in Appendix A in their entirety for information and the analyses/results are summarized below. Although an evaluation of Phase 2 was not required for the MSHA submittal, GAI notes that the geometry of the Phase 2 and Phase 3 embankments and impoundments are essentially the same, the Phase 2 and 3 testing results were similar, and thus the Phase 3 results/conclusions are considered applicable to Phase 2.

SUMMARY OF THE 2009 – 2010 SUBSIDENCE-INDUCED ENGINEERING ANALYSES

Subsidence-related engineering analyses were performed by GAI for the Pond Creek Phase 3 embankment and impoundment, which included characterizing materials and engineering properties, evaluating whether the materials are susceptible to a loss of strength due to subsidence strains, performing post-subsidence slope stability analyses to estimate factors of safety against subsidence and cracking, and providing recommendations for monitoring and a contingency plan for mitigation of potential adverse subsidence strains. The analyses summarized below were submitted and approved by MSHA as noted in the attached November 12, 2009 approval letter.

Additional field and laboratory testing was performed in July and August 2010 following initial FCR mitigation efforts, which included mixing CCR (and in the future cement) with the FCR in the Phase 2 and 3 impoundments. Field and laboratory testing results are evaluated relative to the previously approved subsidence analyses to assess the benefit and/or potential impact of the ongoing/proposed FCR mitigation.

In general, subsidence is considered a rapid loading, or undrained loading event generating excess pore pressure in the saturated FCR materials and inducing horizontal surface strain in the CCR embankment. Therefore, a subsidence event is not unlike that of an earthquake, and thus the procedure used to evaluate subsidence induced impacts on the Phases 2 and 3 impoundments is similar to that used to evaluate the susceptibility of an impoundment to a liquefaction 'flow' type failure.

The following analysis objectives were identified and performed:

1. Assess the liquefaction susceptibility and stability of the impoundment due to deformations from subsidence induced shear strains.
2. Assess the potential for development of large transverse cracks in the CCR embankment or foundation materials capable of releasing flowable FCR.
3. Determine if liquefaction of the FCR would occur due to subsidence induced strain in conjunction with transverse cracking, possibly resulting in flow into and/or erosion of cracks in CCR.

Our analyses included:

- Characterizing the CCR, FCR and residual soil and assessing the consistency of the materials relative to potential strength loss, i.e., loose sands or soft clays, which can only occur in materials that are loose and saturated;
- Evaluating if the subsidence event, i.e., strain due to subsidence will trigger a loss of strength from the peak to the steady state undrained shear strength;
- Evaluating the overall stability of the impoundment and embankment using post-subsidence strengths to estimate factors of safety against liquefaction and cracking; and
- Providing an action plan for monitoring and/or remediation in the wake of the actual subsidence.

The following inputs and data are summarized:

- Horizontal strains were estimated (by others) at about 3 percent from subsidence models and field observations;
- Site specific field and laboratory testing of CCR, FCR and residual soil was performed including PSCPT in CCR and residual soil, and index and CU triaxial testing in CCR, FCR and residual soil; and
- Engineering properties including appropriate drained and undrained shear strength for use in liquefaction and cracking stability analyses.

The results of liquefaction flow and embankment cracking engineering analyses indicated the following:

- In general, the compacted CCR embankment is well graded, cohesionless and characterized as dense sand-like material. Laboratory testing indicated an approximate 33.7 degree drained friction angle, and a 14 percent strain to peak due mainly to the clay shale derived materials within the refuse. CCR behaves dilatant during undrained loading and its drained strength controls in the evaluation of liquefaction stability.
- Cracking potential was evaluated based on a derived tensile strength of 425 pounds per square foot (psf) from consolidated-undrained (CU) testing of CCR and a corresponding factor of safety (FS) against cracking was estimated at 1.1. Alternatively and noted by MSHA in their review, a minimum friction angle of 19 degrees, which is less than the angle of repose of loose CCR, yielded a FS of 1.3. Therefore, slope failure of the CCR embankment from subsidence induced shear is unlikely.
- CCR and foundation cracking susceptibility following subsidence-induced strain was also performed based on material properties and literature correlations, and it was determined that although cracking is unlikely, it cannot be precluded.
- A key factor for the purpose of subsidence-induced stability analyses is the strain at peak undrained strength (Sup) and the abruptness of the drop-off in shearing resistance as strains increase beyond the strain at peak. Loose sands and highly sensitive clays can reach Sup at small strains, and experience abrupt drop-off in resistance at higher strains. Most silt and clay tend to reach Sup at higher strains, and experience more gradual and limited drop-off in shearing resistance at higher strains, as is the case for the Phase 2 and 3 FCR and mixed CCR/FCR.
- FCR was characterized as clay-like based on the percent fines and plasticity index (PI). CCR, FCR and residual soil CU triaxial testing also indicated axial strain to peak between 12 and 15 percent. These peak strains are compared to induced strains of three percent due to the subsidence event. Thus, peak undrained shear strength controls the behavior for these materials during the subsidence event, and used in the post-subsidence slope stability analyses.
- The resulting post-subsidence stability analyses of the impoundment yielded FS against liquefaction of 2.2 and 1.3 in the downstream and upstream direction using a zero strength for FCR. The actual strength of the FCR and CCR/FCR mix is significantly greater than the zero strength assumed in the analyses. GAI notes that the analyses assumed that a five-foot thick CCR cap is installed to eliminate any impounding

capability, which has/is being performed as part of the ongoing mitigation plan. This analysis also assumed that all of the fines were saturated, and the phreatic levels in the impoundment has and will continue to decline.

SUMMARY OF 2010 FIELD AND LABORATORY TESTING OF MIXED FINE AND COARSE COAL REFUSE, AND ENGINEERING ANALYSES

Additional field testing was performed by Holcomb Foundation Engineering Co., Inc. (Holcomb) between July and August, 2010 at the Pond Creek site. Field testing was performed within remediation zones of Phases 2 and 3 that have undergone mixing of the FCR with CCR. A total of four borings were drilled within each pond from which Standard penetration testing was performed and undisturbed samples of the mixed CCR/FCR and FCR materials obtained for laboratory testing. The results of the Phase 2 and Phase 3 field and laboratory testing are summarized in reports prepared by Holcolm, which are presented in Appendix B.

At the time of performing the 2010 field testing, the Phase 2 and 3 FCR was not completely mixed with the CCR and/or cement materials; however, GAI notes that the data from this recent CCR and FCR testing is an indicator of the engineering properties of each of the materials.

In general, the benefits from the mitigation of the fines by mixing FCR with CCR and/or the proposed cement mixing has and will greatly improve the conditions of the FCR from their original condition. In conjunction with the data/analyses discussed above that suggest the ponds are not susceptible to flow, the additional data from these tests indicates that the mixing has:

- Significantly decreased the void ratio of the FCR from an average of about 1.6 to 0.40, which correspondingly has decreased the volume of FCR;
- Significantly decreased the moisture content and liquidity index of the FCR, which eliminates any potential for increased pore pressure, lateral spreading and liquefaction susceptibility;
- Increased the grain size both on the top and bottom ends (added gravel and decreased fines content), which has strengthened a significant volume of FCR.
- Significantly increased the strength of the mixed material thereby increasing stability and further decreasing the sensitivity of the material to strength loss.

The significant aspects of the 2010 field/laboratory testing results and comparative analyses indicate:

- A significant volume of low strength, high moisture FCR has been replaced by a CCR/FCR mix material with an a drained strength of about 36 degrees, as opposed to the zero strength assumed in the original analyses, which has eliminated this material from consideration as flowable;
- The existing FCR has a very low sensitivity to strength loss as its peak strength and residual strength are essentially the same, i.e., sensitivity (St) = 1, which is characterized as insensitive;
- In conjunction with insensitivity, the strain to peak of the FCR and CCR/FCR mix is equal to or greater than 15 percent, as compared to measured/predicted subsidence strains of up to three percent;

- The CCR mix already placed around the perimeter acts as a filter and eliminates potential piping, and any additional mixing will increase the thickness/depth of the filter adjacent the embankment;

PHASE 2 AND 3 SUBSIDENCE-INDUCED ANALYSIS CONCLUSIONS:

Based on our 2009 and 2010 subsidence-induced liquefaction analyses, the following conclusions were noted relative to the potential subsidence impacts on the Phase 2 and 3 impoundments:

- Conservatively-derived shear strength parameters were estimated based on the 2010 field and laboratory testing, and adequate factors of safety exist relative to the Phase 2 and 3 overall liquefaction (flow) stability;
- Although marginal factor of safety exists relative to embankment cracking, the analyses were based on very conservative CCR strength parameters. Therefore, significant transverse cracking of the embankment due to subsidence strain is unlikely but cannot be precluded. Some near-surface cracking was observed due to previous subsidence strains; however, the cracking was not deep seated or transverse;
- The impoundment FCR is not susceptible to a liquefaction flow failure based on the clayey characteristics of the material, particularly the strain to peak strength of 12 to 15 percent relative to the subsidence induced strain of three percent. Therefore, the FCR will not flow;
- MSHA provided a November 12, 2009 letter approving previous subsidence-induced analyses, results and conclusions;
- A pre-mining survey will be performed and instrumentation installed at key locations on the embankment and within the pond(s) to monitor key engineering parameters including displacement, pore pressure and inclination; and
- A contingency plan is in place for buttress construction in the event of potential adverse conditions during/following subsidence.

GAI appreciates this opportunity to provide to Alliance specialized subsidence and seismic engineering services. Please do not hesitate to contact us if you have any questions concerning any of the information presented.

Respectfully submitted,
GAI Consultants, Inc.

Blaise E. Genes
Manager of Geotechnical and Structural

BEG/jab
0940301-idnr-ltr-beg/jab d-1

Attachments

7225-11
part 2

APPENDIX A

LETTER REPORT
RESPONSE TO MSHA COMMENT NOS. 1, 3, 7 AND 8

THIS INFORMATION IS CONTAINED IN

VOLUME 3 OF 7

gai consultants
transforming ideas into reality

Project C090403.01
November 18, 2010

APPENDIX B

SUMMARY OF POND CREEK PHASES 2 AND 3 FIELD AND LABORATORY TESTING PREPARED BY HOLCOMB FOUNDATION ENGINEERING CO., INC.

Holcomb Foundation Engineering Co., Inc.

R12181

SOILS • BITUMINOUS • CONCRETE • ENGINEERING AND TESTING

SHIPPING ADDRESS
393 Wood Road
Carbondale, IL 62901

MAILING ADDRESS
PO Box 88
Carbondale, IL 62903

PHONE 618-529-5262
TOLL FREE 800-333-1740
FAX 618-457-8991

August 16, 2010

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. Jim Slapak

Re: Soil Borings and Laboratory Testing
Pond Creek Mine Slurry Cell
Johnston City, Illinois
HFE File H-07227
Purchase Order No. 17678

Dear Sir:

From July 29 to August 1, 2010, we drilled four soil borings at the above referenced project. Two of the borings were advanced with continuous split barrel sampling, and two borings were sampled at ten foot centers with Shelby tubes. The tubes were sealed and transported to our laboratory for additional testing.

In our laboratory, two of the Shelby tube samples were subjected to consolidated-undrained triaxial tests, and one slurry sample was subjected to a consolidation test. Results of the laboratory tests and the Boring Logs are enclosed. If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

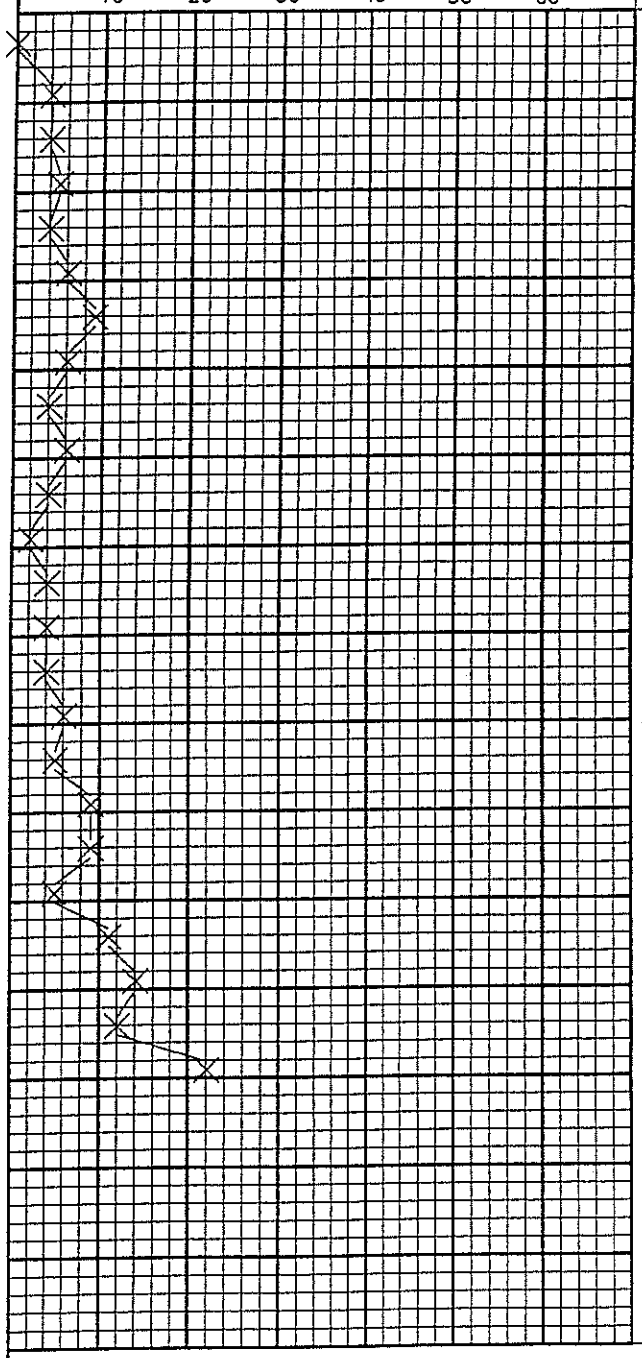
Timothy J. Holcomb, P.E.



R12182

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING D1



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
	1	ss		Gray Coarse Mine Refuse
	2	ss		
	3	ss		
10	4	ss		
	5	ss		
	6	ss		
	7	ss		
20	8	ss		
	9	ss		
	10	ss		
	11	ss		
30	12	ss		
	13	ss		
	14	ss		
	15	ss		
40	16	ss		
	17	ss		
	18	ss		
	19	ss		
50	20	ss		
	21	ss		
	22	ss		
	23	ss		
60	24	ss		Gray Mottled Brown Silty CLAY(CL)
				Brown SHALE
				End of Boring @ -61.0'
70				

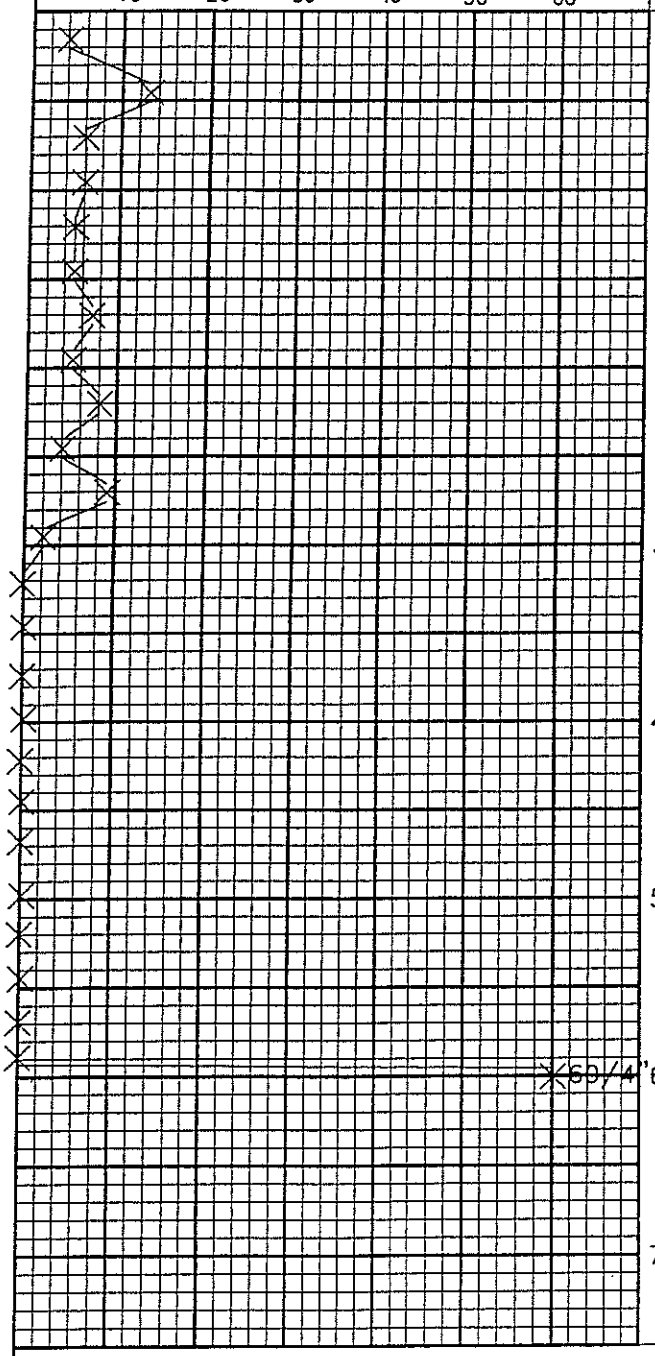
Ground Water Data
Ground Water Encountered @ -13.0' During Drilling and @ -26.0' Upon Completion.

Project: Pond Creek Mine Slurry Cell Johnston City, Illinois	Date of Boring July 29, 2010
Client: Mach Mining Johnston City, Illinois	Project No. H-07227

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING D2

R12183



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
	1	ss		Gray Coarse Mine Refuse
	2	ss		
	3	ss		
10	4	ss		
	5	ss		
	6	ss		
	7	ss		
20	8	ss		
	9	ss		
	10	ss		
	11	ss		
30	12	ss		Fine Coal Slurry
	13	ss		
	14	ss		
	15	ss		
40	16	ss		
	17	ss		
	18	ss		
	19	ss		
50	20	ss		
	21	ss		
	22	ss		
	23	ss		
	24	ss		
60	25	ss		Brown SHALE
				End of Boring @ -60.5'
70				

Ground Water Data
Ground Water Encountered @ -17.0' During Drilling and Plugged Upon Completion.

Project: Pond Creek Mine Slurry Cell Johnston City, Illinois	Date of Boring July 30, 2010
Client: Mach Mining Johnston City, Illinois	Project No. H-07227

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

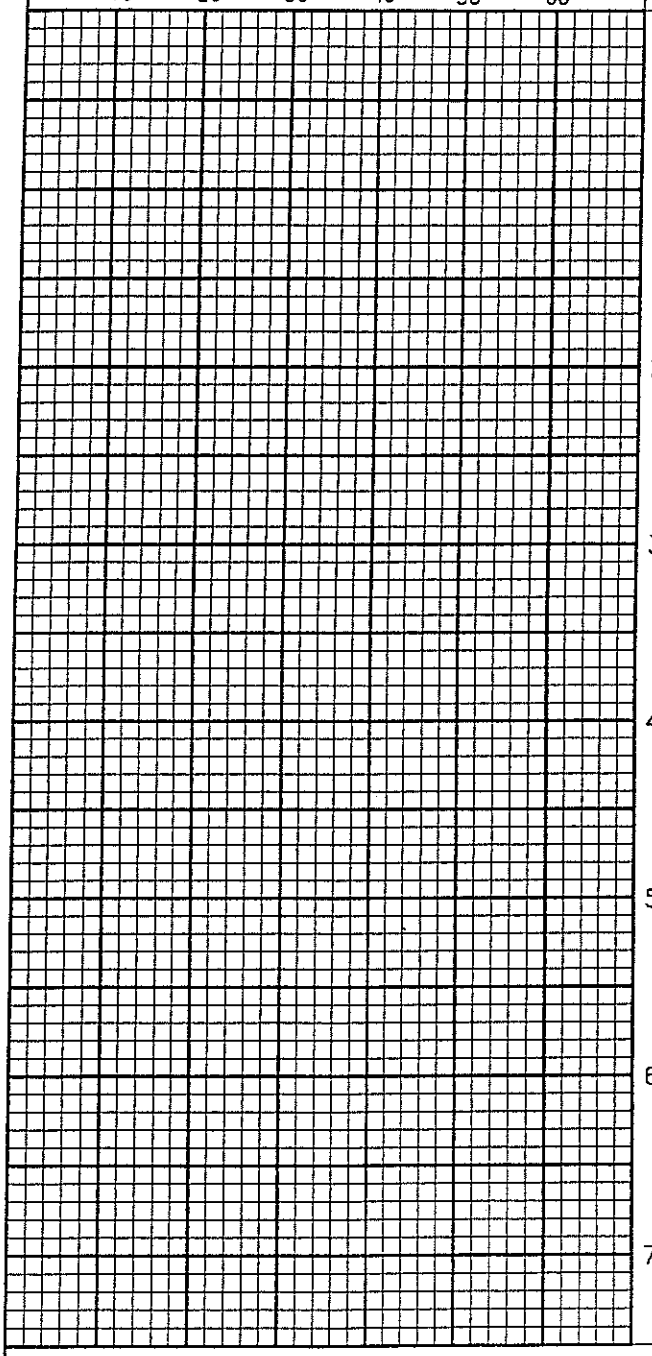
LOG of BORING D3

R12184

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Coal Refuse
10	1	st		24" Recovery
20	2	st		21" Recovery
30	3	st		23" Recovery
40	4	st		24" Recovery
50	5	st		No Recovery
60	6	st		11" Recovery
				End of Boring @ −60.0'
70				

Ground Water Data
Ground Water Encountered @ −18.0' During Drilling and @ −11.0' Upon Completion.

Project: Pond Creek Mine Slurry Cell
Johnston City, Illinois

Date of Boring
July 29, 2010

Client: Mach Mining
Johnston City, Illinois

Project No.
H-07227

R12185

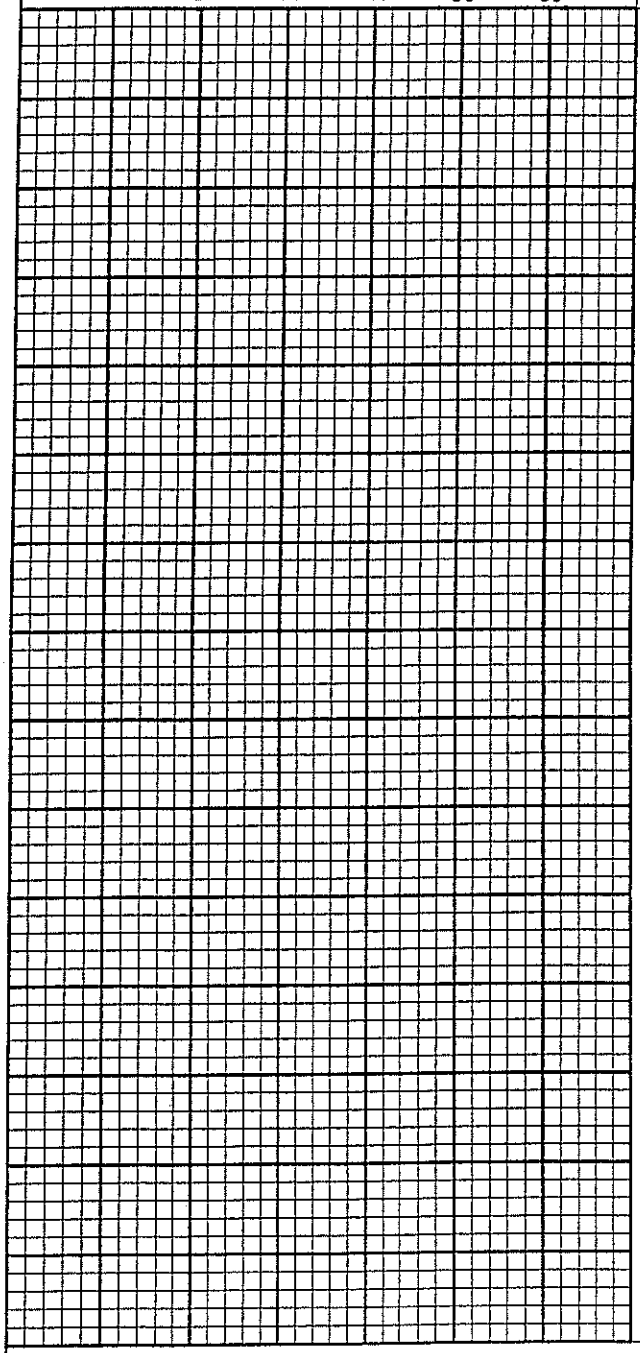
Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING D4

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Coal Refuse
10	1	st		19" Recovery
20	2	st		21" Recovery
30	3	st		9" Recovery
40	4	st		25" Recovery
50	5	st		26" Recovery
60	6	st		26" Recovery
				End of Boring @ -60.0'
70				

Ground Water Data
Ground Water Encountered @ -18.0' During Drilling and @ -2.0' Upon Completion.

Project: Pond Creek Mine Slurry Cell
Johnston City, Illinois

Date of Boring
August 1, 2010

Client: Mach Mining
Johnston City, Illinois

Project No.
H-07227

Holcomb Foundation Engineering Company

Moisture Content Worksheet

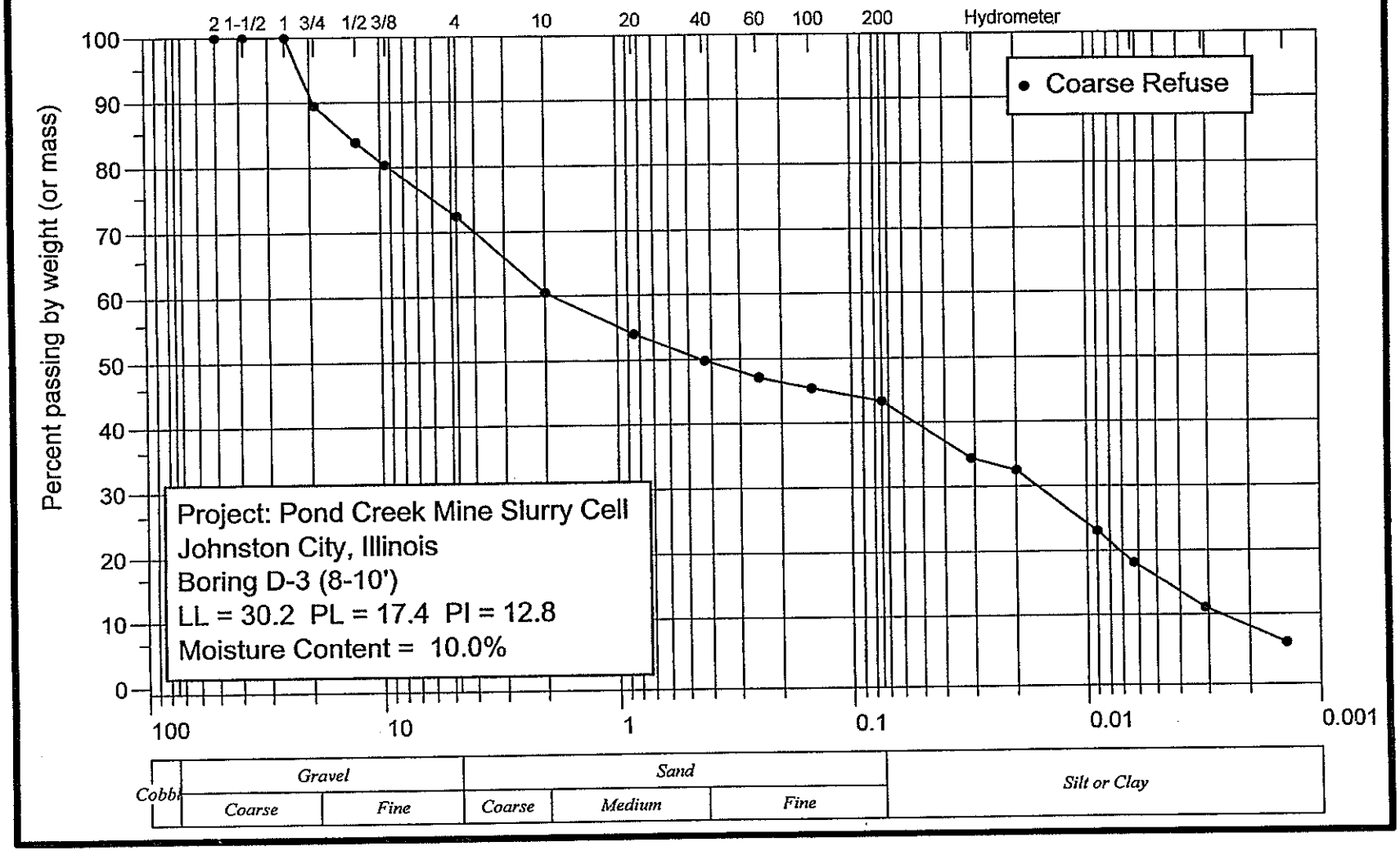
Project: Williamson Energy

Project No.: H-07227

Boring	Sample	Wet Wt.	Pan	Dry Wt.	Mc. (%)
D-1	1	308.8	48.4	283.4	10.8
D-1	2	905.1	103.6	846.3	7.9
D-1	3	576.8	94.9	543.4	7.4
D-1	4	943.4	102.4	884.4	7.5
D-1	5	664.3	103.1	623.8	7.8
D-1	6	1104.7	108.1	1016.4	9.7
D-1	7	1065.1	104.7	941.8	14.7
D-1	8	1147.2	130.1	1032.4	12.7
D-1	9	1203.2	129.7	1053.6	16.2
D-1	10	1352.6	137.5	1210.3	13.3
D-1	11	819.1	106.7	726.9	14.9
D-1	12	1102.0	145.7	959.6	17.5
D-1	13	832.6	126.0	740.3	15.0
D-1	14	1108.3	111.6	984.8	14.1
D-1	15	555.5	132.6	496.9	16.1
D-1	16	1306.2	101.4	1150.7	14.8
D-1	17	1097.4	120.0	973.7	14.5
D-1	18	1400.0	137.2	1251.8	13.3
D-1	19	1046.7	109.8	927.8	14.5
D-1	20	1786.6	121.0	1568.5	15.1
D-1	21	1224.2	101.9	1092.5	13.3
D-1	22	1797.1	109.8	1574.2	15.2
D-1	23	759.2	89.2	678.5	13.7
D-1	24	1269.8	121.4	1138.4	12.9
D-2	1	885.0	98.4	812.8	10.1
D-2	2	838.3	102.4	794.9	6.3
D-2	3	525.5	104.8	500.7	6.3
D-2	4	843.1	103.5	793.9	7.1
D-2	5	695.5	120.1	657.0	7.2
D-2	6	1092.2	109.7	1026.0	7.2
D-2	7	880.9	108.1	811.9	9.8
D-2	8	909.2	94.8	820.0	12.3
D-2	9	943.2	102.8	841.8	13.7
D-2	10	1504.4	125.8	1338.6	13.7
D-2	11	1043.7	145.1	932.3	14.2
D-2	12	1071.7	189.5	813.8	41.3
D-2	13	843.5	105.8	637.4	38.8
D-2	14	448.6	136.8	347.0	48.3
D-2	15	722.2	132.2	542.3	43.9
D-2	16	410.5	111.0	330.9	36.2
D-2	17	983.7	88.3	719.0	42.0
D-2	18	358.8	136.9	288.4	46.5
D-2	19	843.3	120.8	637.8	39.7
D-2	20	897.4	128.4	686.4	37.8
D-2	21	1114.3	127.5	863.3	34.1
D-2	22	1312.5	120.5	957.3	42.4
D-2	23	868.6	101.7	643.3	41.6
D-2	24	1821.7	101.4	1438.3	28.7

Holcomb Foundation Engineering

Grain Size Analysis



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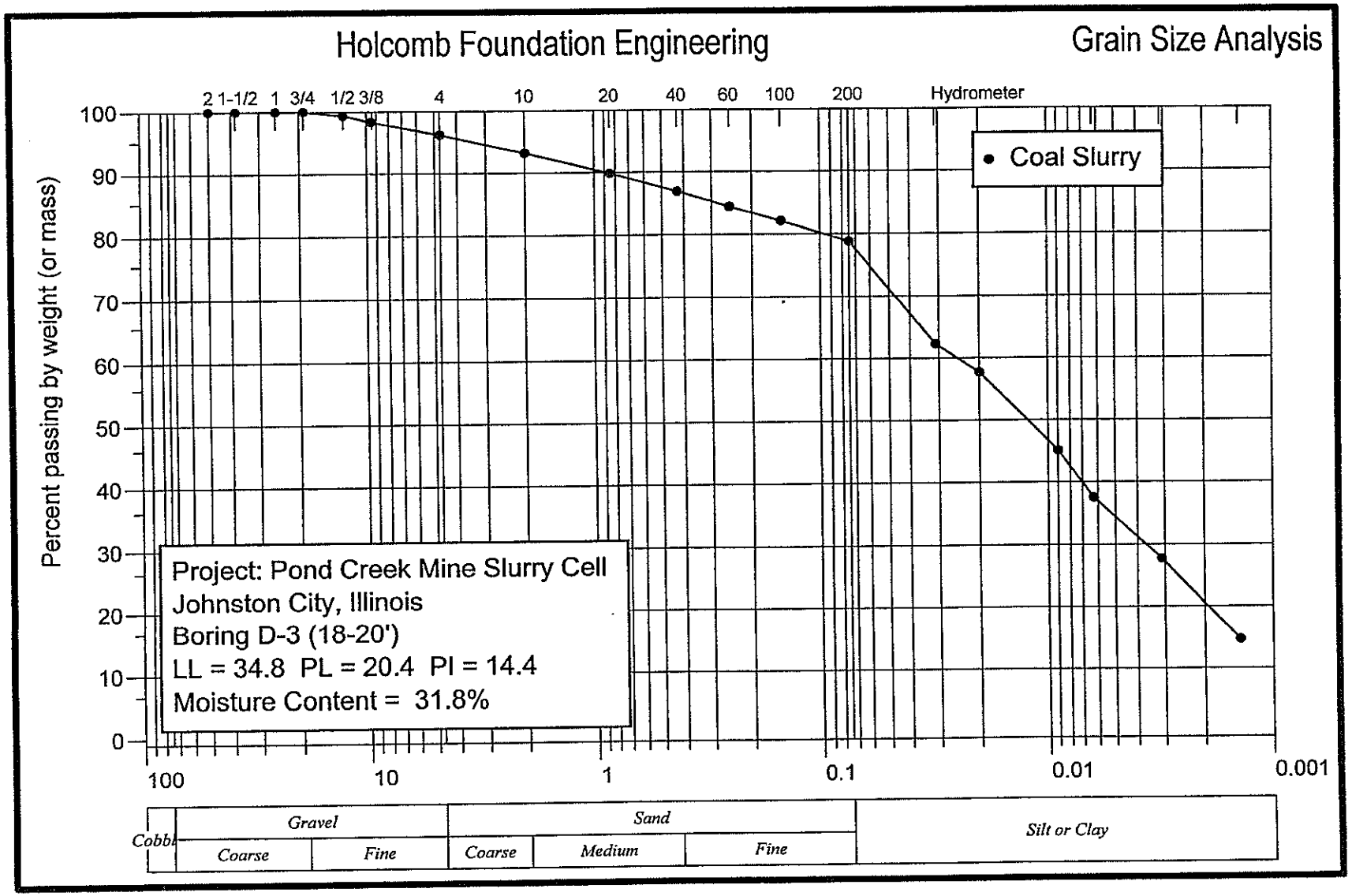
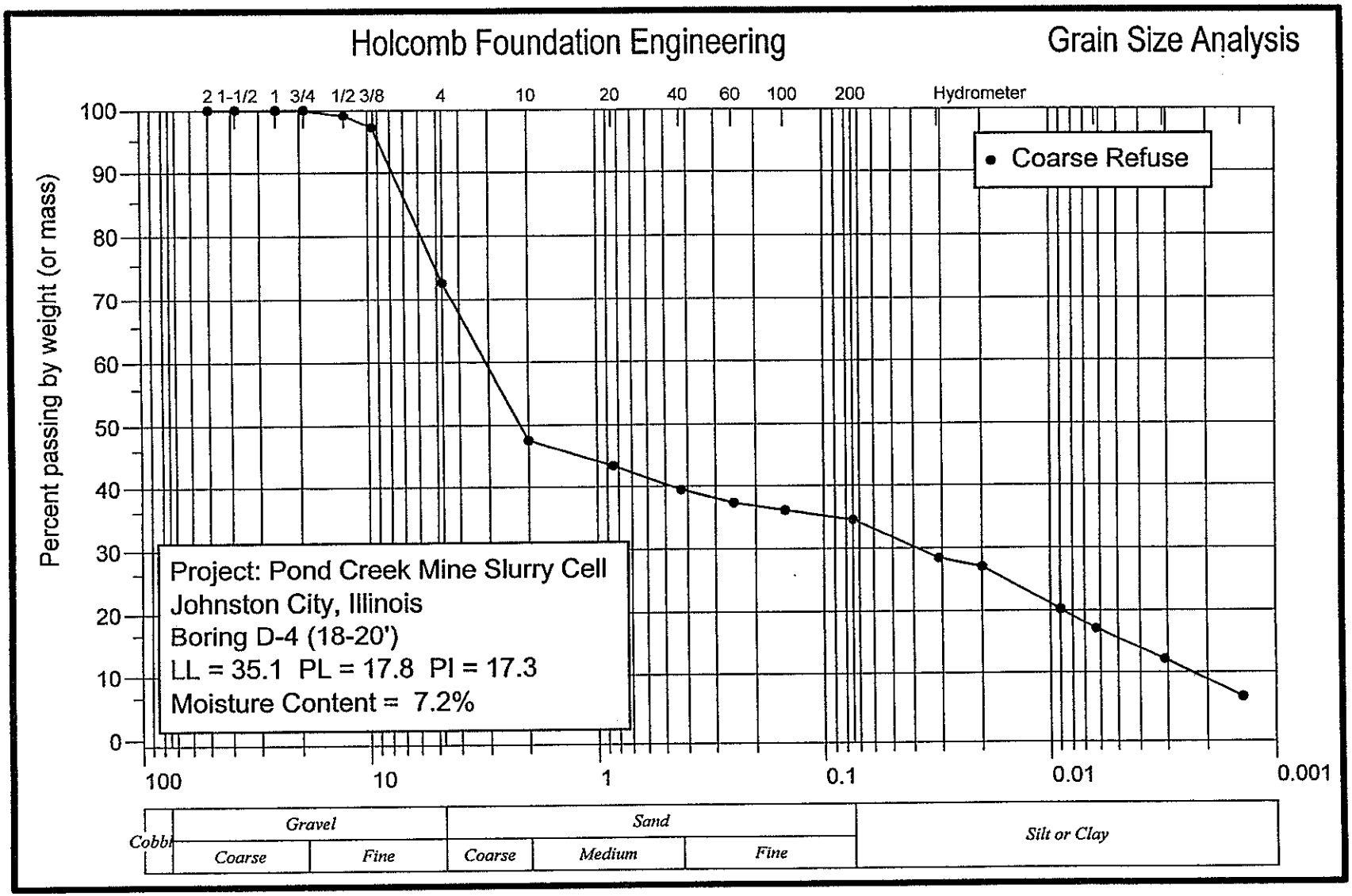
R12187


Holcomb Foundation Engineering
Grain Size Analysis
Percent passing by weight (or mass)
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
100 90 80 70 60 50 40 30 20 10 0
Coal Slurry
Project: Pond Creek Mine Slurry Cell
Johnston City, Illinois
Boring D-3 (18-20')
LL = 34.8 PL = 20.4 PI = 14.4
Moisture Content = 31.8%
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

CL

R12188

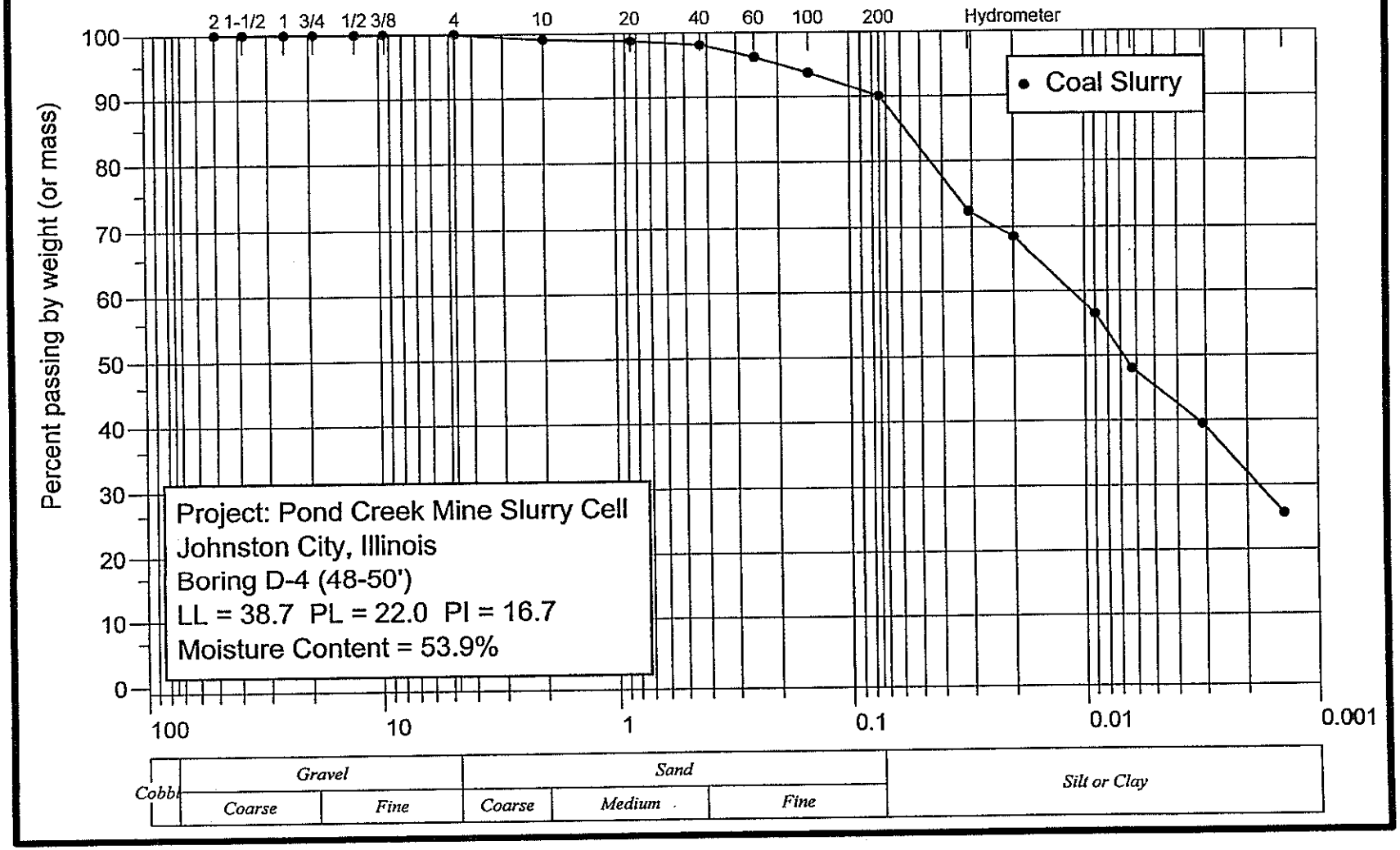

Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
Coarse Refuse
Project: Pond Creek Mine Slurry Cell
Johnston City, Illinois
Boring D-4 (18-20')
LL = 35.1 PL = 17.8 PI = 17.3
Moisture Content = 7.2%
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

SC

R12189

Holcomb Foundation Engineering

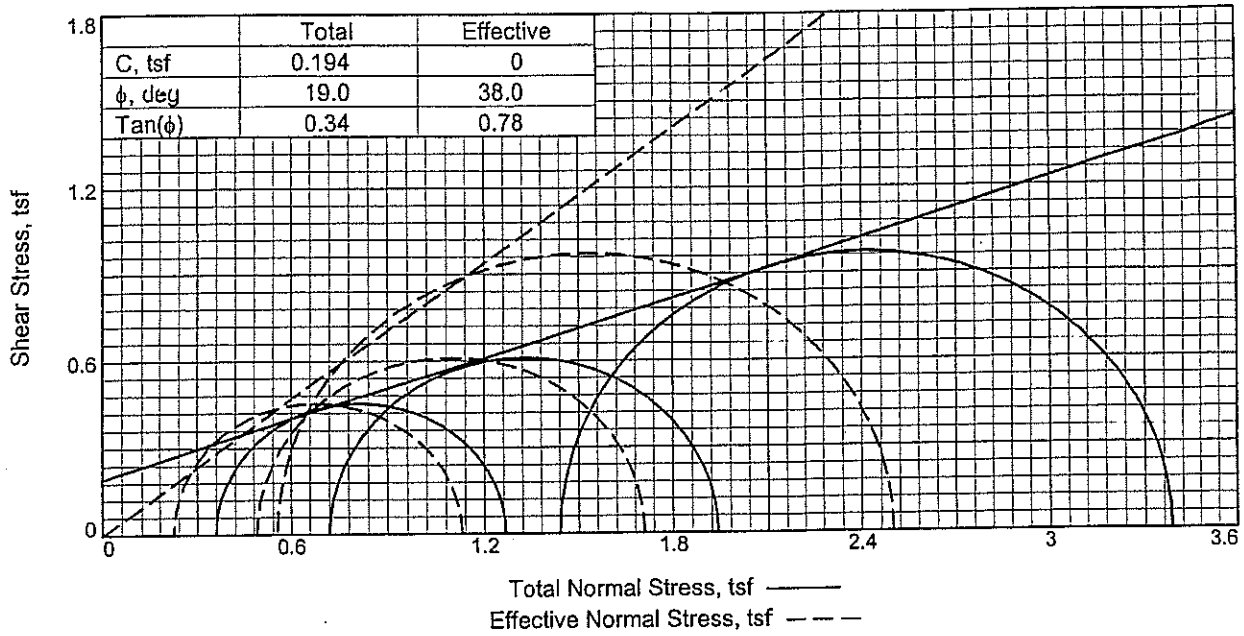
Grain Size Analysis

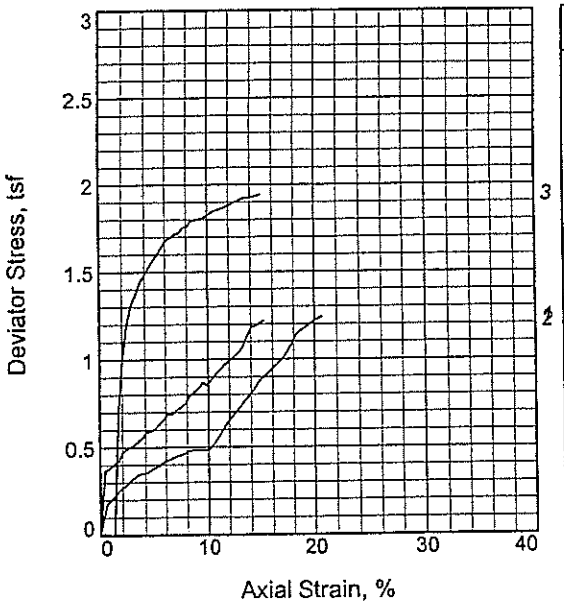


CL

R12190

	Total	Effective
C, tsf	0.194	0
ϕ, deg	19.0	38.0
Tan(ϕ)	0.34	0.78





Sample No.		1	2	3
Initial	Water Content,	8.3	7.2	7.6
	Dry Density, pcf	105.5	102.2	113.8
	Saturation,	39.9	32.0	46.5
	Void Ratio	0.5389	0.5885	0.4259
	Diameter, in.	2.80	2.80	2.80
	Height, in.	3.46	4.96	5.04
At Test	Water Content,	20.7	22.6	16.4
	Dry Density, pcf	105.5	102.2	113.8
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.5389	0.5885	0.4259
	Diameter, in.	2.80	2.80	2.80
	Height, in.	3.46	4.96	5.04
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.60	3.60	3.60
Cell Pressure, tsf		3.96	4.32	5.04
Fail. Stress, tsf		0.91	1.22	1.94
Total Pore Pr., tsf		3.74	3.83	4.49
Ult. Stress, tsf		0.91	1.22	1.94
Total Pore Pr., tsf		3.74	3.83	4.49
$\bar{\sigma}_1$ Failure, tsf		1.13	1.71	2.50
$\bar{\sigma}_3$ Failure, tsf		0.22	0.49	0.55

Type of Test:
CU with Pore Pressures
Sample Type: Undisturbed
Description: Coarse Refuse

Assumed Specific Gravity= 2.6
Remarks:

Client: Pond Creek Mine

Project: Proposed Slurry Cell
Pond Creek Mine
Location: Boring D-4 (8.0-10.0')

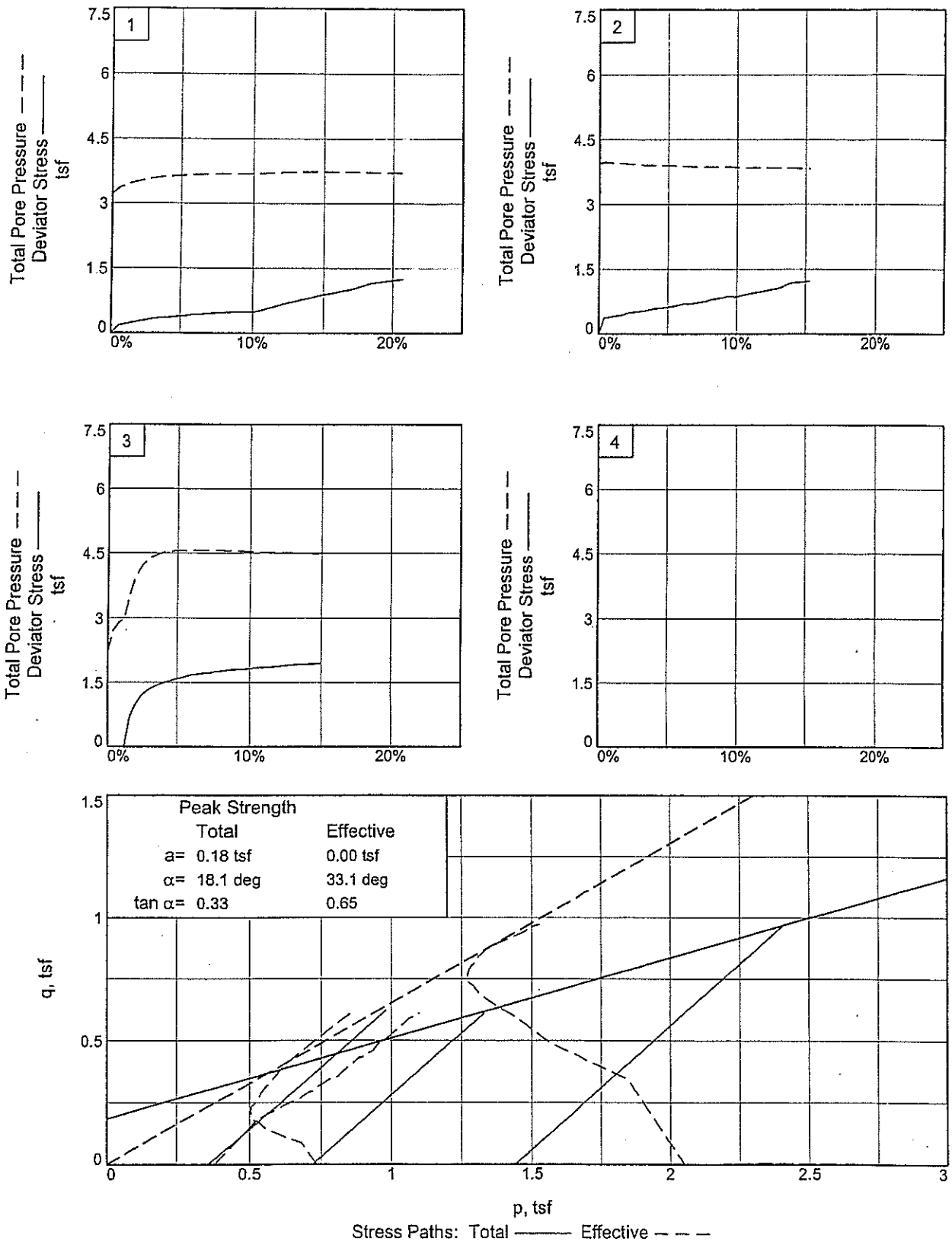
Proj. No.: H-07227 **Date:** 8-13-10

TRIAXIAL SHEAR TEST REPORT

HOLCOMB FOUNDATION ENGINEERING CO.

Plate _____

Tested By: LC **Checked By:** TH



Client: Pond Creek Mine
Project: Proposed Slurry Cell
Location: Boring D-4 (8.0-10.0')
Project No.: H-07227

Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC _____ **Checked By:** TH _____

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

8/13/2010
3:23 PM

Date: 8-13-10
Client: Pond Creek Mine
Project: Proposed Slurry Cell
Pond Creek Mine
Johnston City, Illinois
Location: Boring D-4 (8.0-10.0')
Description: Coarse Refuse
Remarks:
Type of Sample: Undisturbed
Assumed Specific Gravity=2.6 **LL=** **PL=** **PI=**
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	484.900			769.700
Moisture content: Dry soil+tare, gms.	456.000			691.000
Moisture content: Tare, gms.	106.500			106.500
Moisture, %	8.3	20.7	20.7	13.5
Moist specimen weight, gms.	638.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	3.46	3.46	3.46	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	114.2	127.3	127.3	
Dry density, pcf	105.5	105.5	105.5	
Void ratio	0.5389	0.5389	0.5389	
Saturation, %	39.9	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 55.00 psi (3.960 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 0.360 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.906 tsf **at reading no.** 26
Ult. Stress = 0.906 tsf **at reading no.** 26

Test Results for Sample No. [illegible]

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	11.70	0.0	0.0	0.000	0.734	0.734	1.00	44.80	0.734	0.000
1	0.0200	28.30	16.6	0.6	0.177	0.590	0.767	1.30	46.80	0.679	0.088
2	0.0410	33.30	21.6	1.2	0.216	0.518	0.734	1.42	47.80	0.626	0.108
3	0.0610	38.30	26.6	1.8	0.256	0.461	0.717	1.55	48.60	0.589	0.128
4	0.0820	41.60	29.9	2.4	0.285	0.418	0.702	1.68	49.20	0.560	0.142
5	0.1020	44.90	33.2	2.9	0.320	0.382	0.702	1.84	49.70	0.542	0.160
6	0.1230	47.70	36.0	3.6	0.349	0.353	0.702	1.99	50.10	0.528	0.175
7	0.1430	48.30	36.6	4.1	0.354	0.338	0.692	2.05	50.30	0.515	0.177
8	0.1640	50.80	39.1	4.7	0.379	0.317	0.696	2.20	50.60	0.506	0.189
9	0.1840	52.40	40.7	5.3	0.394	0.310	0.704	2.27	50.70	0.507	0.197
10	0.2040	54.90	43.2	5.9	0.419	0.295	0.714	2.42	50.90	0.505	0.209
11	0.2250	56.60	44.9	6.5	0.434	0.288	0.722	2.51	51.00	0.505	0.217
12	0.2450	58.30	46.6	7.1	0.450	0.281	0.731	2.60	51.10	0.506	0.225
13	0.2660	59.90	48.2	7.7	0.464	0.274	0.737	2.69	51.20	0.505	0.232
14	0.2860	61.60	49.9	8.3	0.479	0.274	0.752	2.75	51.20	0.513	0.239
15	0.3070	62.40	50.7	8.9	0.484	0.274	0.757	2.77	51.20	0.515	0.242
16	0.3270	62.40	50.7	9.4	0.480	0.274	0.754	2.76	51.20	0.514	0.240
17	0.3480	63.20	51.5	10.1	0.485	0.274	0.759	2.77	51.20	0.516	0.243
18	0.3680	67.40	55.7	10.6	0.525	0.266	0.792	2.97	51.30	0.529	0.263
19	0.3880	73.20	61.5	11.2	0.582	0.252	0.834	3.31	51.50	0.543	0.291
20	0.4090	79.10	67.4	11.8	0.638	0.245	0.883	3.61	51.60	0.564	0.319
21	0.4290	84.10	72.4	12.4	0.685	0.238	0.923	3.88	51.70	0.580	0.343
22	0.4500	89.00	77.3	13.0	0.730	0.230	0.960	4.17	51.80	0.595	0.365
23	0.4700	94.00	82.3	13.6	0.775	0.223	0.998	4.47	51.90	0.611	0.388
24	0.4910	99.00	87.3	14.2	0.819	0.223	1.043	4.67	51.90	0.633	0.410
25	0.5110	104.90	93.2	14.8	0.872	0.223	1.096	4.91	51.90	0.659	0.436
26	0.5320	109.00	97.3	15.4	0.906	0.223	1.129	5.06	51.90	0.676	0.453
27	0.5930	122.30	110.6	17.1	1.015	0.230	1.246	5.41	51.80	0.738	0.508
28	0.6340	131.50	119.8	18.3	1.144	0.238	1.382	5.82	51.70	0.810	0.572
29	0.6750	139.00	127.3	19.5	1.198	0.245	1.443	5.89	51.60	0.844	0.599
30	0.7160	145.60	133.9	20.7	1.242	0.245	1.487	6.07	51.60	0.866	0.621

Test Results for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	329.900			1013.600
Moisture content: Dry soil+tare, gms.	313.900			905.300
Moisture content: Tare, gms.	92.700			101.400
Moisture, %	7.2	22.6	22.6	13.5
Moist specimen weight, gms.	878.6			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	4.96	4.96	4.96	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	109.6	125.3	125.3	
Dry density, pcf	102.2	102.2	102.2	
Void ratio	0.5885	0.5885	0.5885	
Saturation, %	32.0	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 60.00 psi (4.320 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 0.720 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.220 tsf **at reading no.** 32
Ult. Stress = 1.220 tsf **at reading no.** 32

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0030	71.60	0.0	0.0	0.000	0.382	0.382	1.00	54.70	0.382	0.000
1	0.0240	103.20	31.6	0.4	0.368	0.346	0.714	2.06	55.20	0.530	0.184
2	0.0440	106.50	34.9	0.8	0.381	0.353	0.734	2.08	55.10	0.543	0.191
3	0.0650	109.90	38.3	1.2	0.407	0.360	0.767	2.13	55.00	0.563	0.203
4	0.0850	112.40	40.8	1.7	0.422	0.367	0.790	2.15	54.90	0.578	0.211
5	0.1060	118.20	46.6	2.1	0.477	0.382	0.859	2.25	54.70	0.620	0.239
6	0.1260	119.80	48.2	2.5	0.493	0.389	0.882	2.27	54.60	0.635	0.247
7	0.1470	121.50	49.9	2.9	0.510	0.396	0.906	2.29	54.50	0.651	0.255
8	0.1670	123.20	51.6	3.3	0.527	0.410	0.937	2.28	54.30	0.674	0.263
9	0.1870	125.70	54.1	3.7	0.553	0.410	0.963	2.35	54.30	0.687	0.276
10	0.2060	129.00	57.4	4.1	0.587	0.418	1.005	2.41	54.20	0.711	0.294
11	0.2280	129.80	58.2	4.5	0.593	0.425	1.018	2.40	54.10	0.721	0.297
12	0.2490	131.50	59.9	5.0	0.609	0.425	1.034	2.43	54.10	0.729	0.305
13	0.2690	134.00	62.4	5.4	0.634	0.425	1.059	2.49	54.10	0.742	0.317
14	0.2900	136.50	64.9	5.8	0.658	0.432	1.090	2.52	54.00	0.761	0.329
15	0.3100	139.80	68.2	6.2	0.692	0.439	1.131	2.57	53.90	0.785	0.346
16	0.3300	139.80	68.2	6.6	0.688	0.446	1.135	2.54	53.80	0.791	0.344
17	0.3510	142.30	70.7	7.0	0.712	0.454	1.166	2.57	53.70	0.810	0.356
18	0.3710	144.00	72.4	7.4	0.727	0.454	1.181	2.60	53.70	0.817	0.364
19	0.3920	146.50	74.9	7.8	0.751	0.454	1.204	2.65	53.70	0.829	0.375
20	0.4120	150.60	79.0	8.2	0.791	0.454	1.245	2.74	53.70	0.849	0.396
21	0.4330	153.10	81.5	8.7	0.814	0.454	1.267	2.79	53.70	0.861	0.407

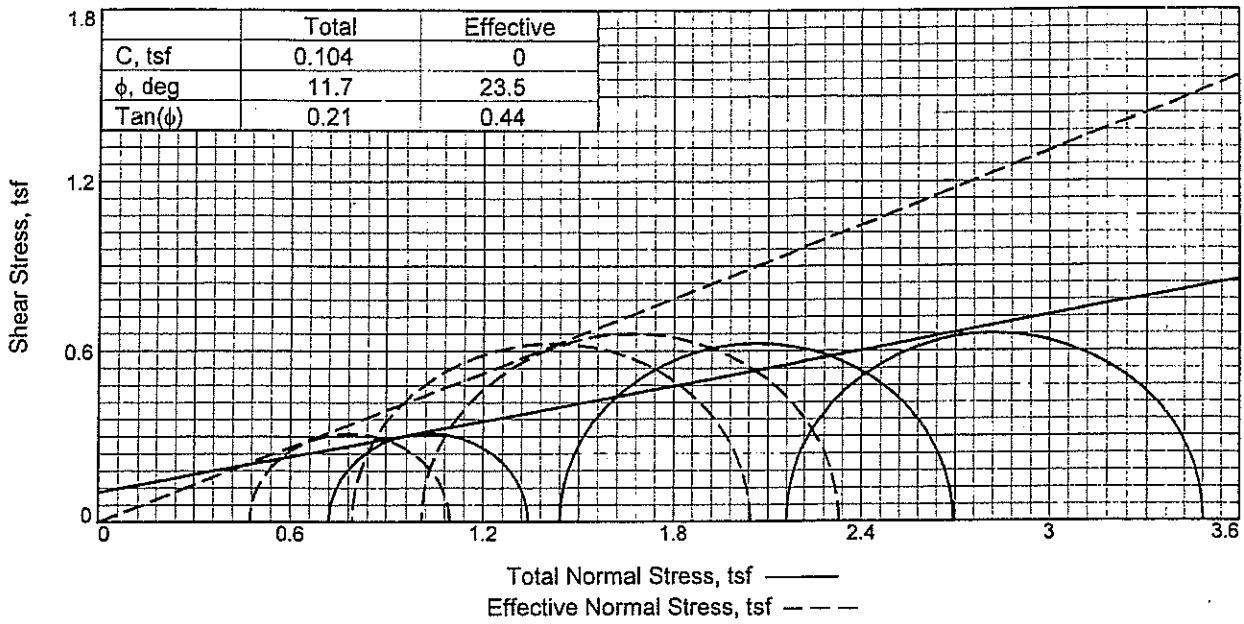
No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4530	155.60	84.0	9.1	0.837	0.454	1.290	2.84	53.70	0.872	0.418
23	0.4740	159.00	87.4	9.5	0.868	0.454	1.322	2.91	53.70	0.888	0.434
24	0.4940	158.10	86.5	9.9	0.855	0.461	1.316	2.85	53.60	0.888	0.427
25	0.5350	164.80	93.2	10.7	0.916	0.475	1.392	2.93	53.40	0.933	0.458
26	0.5760	170.60	99.0	11.6	0.967	0.468	1.435	3.07	53.50	0.952	0.484
27	0.6170	175.60	104.0	12.4	1.009	0.475	1.484	3.12	53.40	0.980	0.505
28	0.6580	182.30	110.7	13.2	1.067	0.475	1.542	3.25	53.40	1.009	0.533
29	0.6980	188.90	117.3	14.0	1.179	0.475	1.655	3.48	53.40	1.065	0.590
30	0.7190	190.60	119.0	14.4	1.191	0.482	1.673	3.47	53.30	1.078	0.595
31	0.7390	192.20	120.6	14.8	1.201	0.482	1.683	3.49	53.30	1.083	0.600
32	0.7600	194.70	123.1	15.3	1.220	0.490	1.709	3.49	53.20	1.099	0.610

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	212.200			434.600
Moisture content: Dry soil+tare, gms.	203.700			402.200
Moisture content: Tare, gms.	92.200			182.000
Moisture, %	7.6	16.4	16.4	14.7
Moist specimen weight, gms.	998.6			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.04	5.04	5.04	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	122.5	132.5	132.5	
Dry density, pcf	113.8	113.8	113.8	
Void ratio	0.4259	0.4259	0.4259	
Saturation, %	46.5	100.0	100.0	

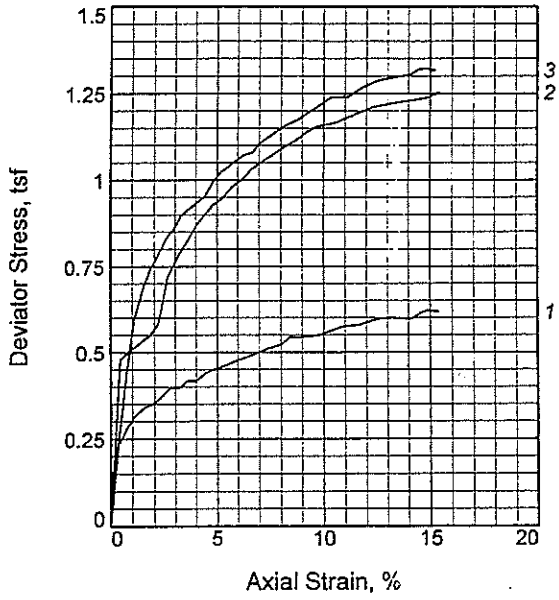
Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.944 tsf **at reading no.** 33
Ult. Stress = 1.944 tsf **at reading no.** 33

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	17.50	0.0	0.0	0.000	2.822	2.822	1.00	30.80	2.822	0.000
1	0.0190	19.10	1.6	0.4	0.008	2.326	2.334	1.00	37.70	2.330	0.004
2	0.0400	19.10	1.6	0.8	0.000	2.138	2.138	1.00	40.30	2.138	0.000
3	0.0600	19.10	1.6	1.2	0.000	2.052	2.052	1.00	41.50	2.052	0.000
4	0.0810	81.60	64.1	1.6	0.692	1.498	2.190	1.46	49.20	1.844	0.346
5	0.1010	108.20	90.7	2.0	0.983	1.073	2.056	1.92	55.10	1.564	0.491
6	0.1220	122.30	104.8	2.4	1.196	0.842	2.038	2.42	58.30	1.440	0.598

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
7	0.1420	132.30	114.8	2.8	1.305	0.706	2.010	2.85	60.20	1.358	0.652
8	0.1620	139.00	121.5	3.2	1.375	0.626	2.001	3.20	61.30	1.314	0.688
9	0.1830	145.60	128.1	3.6	1.444	0.569	2.012	3.54	62.10	1.291	0.722
10	0.2030	149.80	132.3	4.0	1.485	0.526	2.010	3.82	62.70	1.268	0.742
11	0.2240	154.80	137.3	4.4	1.534	0.504	2.038	4.04	63.00	1.271	0.767
12	0.2440	159.00	141.5	4.8	1.575	0.490	2.064	4.22	63.20	1.277	0.787
13	0.2650	162.30	144.8	5.3	1.604	0.482	2.087	4.33	63.30	1.284	0.802
14	0.2850	166.40	148.9	5.7	1.643	0.482	2.125	4.41	63.30	1.304	0.821
15	0.3060	170.60	153.1	6.1	1.682	0.468	2.150	4.59	63.50	1.309	0.841
16	0.3260	172.30	154.8	6.5	1.693	0.468	2.161	4.62	63.50	1.315	0.847
17	0.3460	174.80	157.3	6.9	1.713	0.468	2.181	4.66	63.50	1.325	0.857
18	0.3670	176.40	158.9	7.3	1.723	0.468	2.191	4.68	63.50	1.329	0.861
19	0.3870	179.80	162.3	7.7	1.752	0.468	2.220	4.74	63.50	1.344	0.876
20	0.4080	181.40	163.9	8.1	1.761	0.475	2.237	4.71	63.40	1.356	0.881
21	0.4280	184.80	167.3	8.5	1.790	0.482	2.273	4.71	63.30	1.378	0.895
22	0.4490	186.40	168.9	8.9	1.799	0.482	2.282	4.73	63.30	1.382	0.900
23	0.4690	187.30	169.8	9.3	1.801	0.490	2.290	4.68	63.20	1.390	0.900
24	0.4890	188.90	171.4	9.7	1.810	0.497	2.307	4.64	63.10	1.402	0.905
25	0.5100	191.40	173.9	10.1	1.828	0.504	2.332	4.63	63.00	1.418	0.914
26	0.5300	193.90	176.4	10.5	1.846	0.511	2.357	4.61	62.90	1.434	0.923
27	0.5510	195.60	178.1	10.9	1.855	0.518	2.373	4.58	62.80	1.446	0.927
28	0.5920	198.90	181.4	11.7	1.872	0.526	2.398	4.56	62.70	1.462	0.936
29	0.6330	203.10	185.6	12.6	1.898	0.533	2.431	4.56	62.60	1.482	0.949
30	0.6730	207.20	189.7	13.3	1.922	0.540	2.462	4.56	62.50	1.501	0.961
31	0.7140	209.70	192.2	14.2	1.929	0.540	2.469	4.57	62.50	1.505	0.965
32	0.7350	211.40	193.9	14.6	1.937	0.547	2.484	4.54	62.40	1.516	0.968
33	0.7550	213.00	195.5	15.0	1.944	0.554	2.498	4.51	62.30	1.526	0.972



	Total	Effective
C, tsf	0.104	0
ϕ, deg	11.7	23.5
Tan(ϕ)	0.21	0.44



Sample No.		1	2	3
Initial	Water Content,	55.1	61.0	59.8
	Dry Density, pcf	63.2	60.7	70.2
	Saturation,	91.4	94.8	118.6
	Void Ratio	1.5674	1.6728	1.3105
	Diameter, in.	2.48	2.46	2.60
	Height, in.	5.06	4.66	5.51
At Test	Water Content,	60.3	64.3	50.4
	Dry Density, pcf	63.2	60.7	70.2
	Saturation,	100.0	100.0	100.0
	Void Ratio	1.5674	1.6728	1.3105
	Diameter, in.	2.48	2.46	2.60
	Height, in.	5.06	4.66	5.51
Strain rate, in./min.		0.01	0.01	0.01
Back Pressure, tsf		3.60	3.60	3.60
Cell Pressure, tsf		4.32	5.04	5.76
Fail. Stress, tsf		0.62	1.25	1.32
Total Pore Pr., tsf		3.84	4.25	4.75
Ult. Stress, tsf		0.62	1.25	1.32
Total Pore Pr., tsf		3.84	4.25	4.75
$\bar{\sigma}_1$ Failure, tsf		1.10	2.05	2.33
$\bar{\sigma}_3$ Failure, tsf		0.48	0.79	1.01

Type of Test:
CU with Pore Pressures
Sample Type: Undisturbed
Description: Fine Coal Slurry

Assumed Specific Gravity= 2.6
Remarks:

Plate _____

Client: Pond Creek Mine

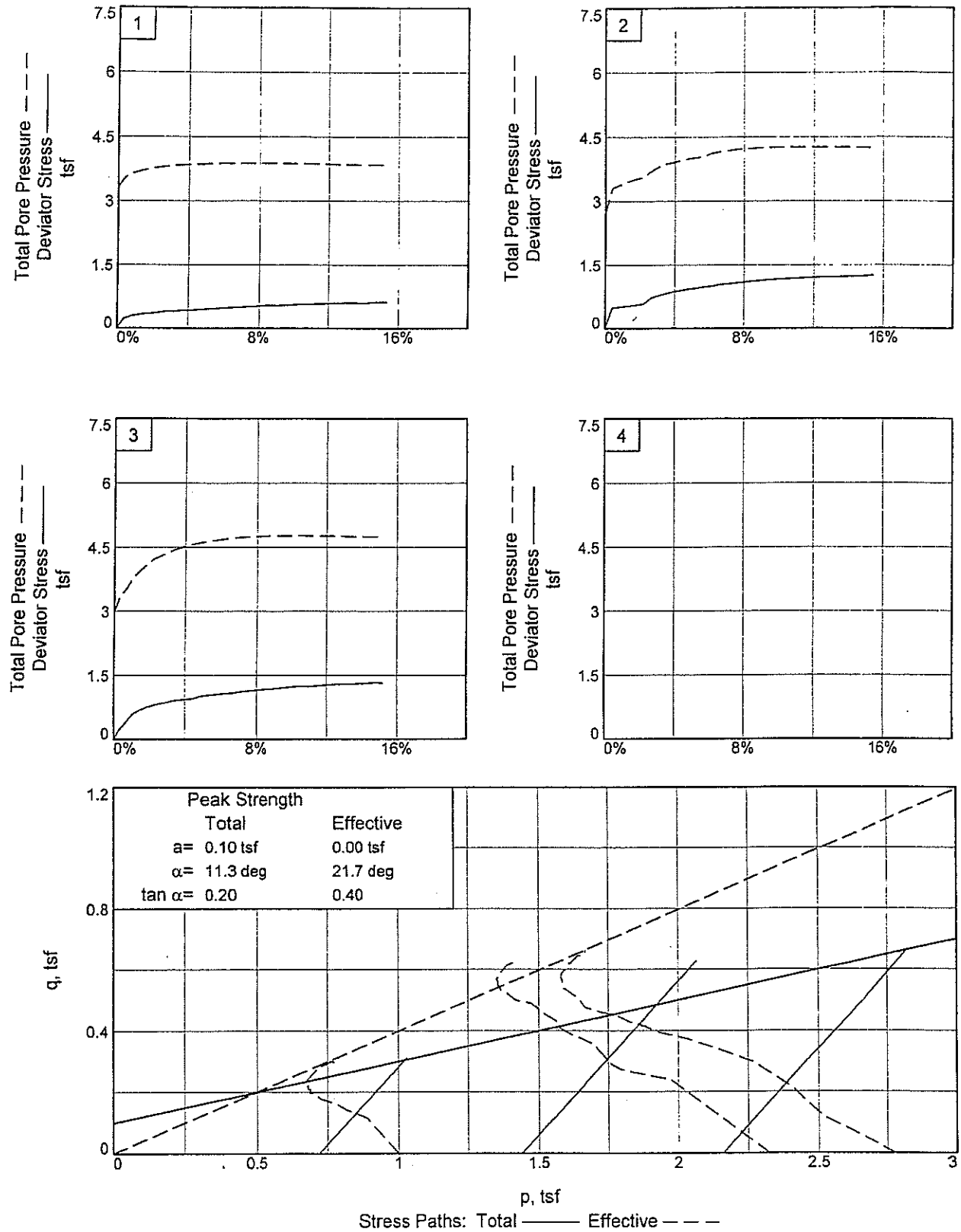
Project: Proposed Slurry Cell
Pond Creek Mine
Location: D-4 (38-40')

Proj. No.: H-07227 **Date:** 8-9-10

TRIAXIAL SHEAR TEST REPORT

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC **Checked By:** TH



Client: Pond Creek Mine
Project: Proposed Slurry Cell
Location: D-4 (38-40')
Project No.: H-07227

Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC **Checked By:** TH

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

8/11/2010
6:29 PM

Date:	8-9-10
Client:	Pond Creek Mine
Project:	Proposed Slurry Cell Pond Creek Mine Johnston City, Illinois
Location:	D-4 (38-40')
Description:	Fine Coal Slurry
Remarks:	
Type of Sample:	Undisturbed
Assumed Specific Gravity=2.6	**LL=** **PL=** **PI=**
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	266.900			607.700
Moisture content: Dry soil+tare, gms.	205.000			482.500
Moisture content: Tare, gms.	92.700			92.100
Moisture, %	55.1	60.3	60.3	32.1
Moist specimen weight, gms.	631.6			
Diameter, in.	2.48	2.48	2.48	
Area, in.²	4.85	4.85	4.85	
Height, in.	5.06	5.06	5.06	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	98.1	101.3	101.3	
Dry density, pcf	63.2	63.2	63.2	
Void ratio	1.5674	1.5674	1.5674	
Saturation, %	91.4	100.0	100.0	

Consolidation cell pressure = 60.00 psi (4.320 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 0.720 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 0.621 tsf **at reading no.** 31
Ult. Stress = 0.618 tsf **at reading no.** 32

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	24.10	0.0	0.0	0.000	1.001	1.001	1.00	46.10	1.001	0.000
1	0.0190	39.90	15.8	0.4	0.234	0.770	1.004	1.30	49.30	0.887	0.117
2	0.0400	43.30	19.2	0.8	0.283	0.677	0.960	1.42	50.60	0.818	0.142
3	0.0600	45.80	21.7	1.2	0.319	0.626	0.945	1.51	51.30	0.786	0.159
4	0.0810	47.40	23.3	1.6	0.341	0.583	0.924	1.58	51.90	0.754	0.170
5	0.1010	48.30	24.2	2.0	0.352	0.554	0.907	1.64	52.30	0.731	0.176
6	0.1220	49.90	25.8	2.4	0.374	0.526	0.900	1.71	52.70	0.713	0.187
7	0.1420	51.60	27.5	2.8	0.397	0.511	0.908	1.78	52.90	0.710	0.199
8	0.1620	51.60	27.5	3.2	0.396	0.490	0.885	1.81	53.20	0.687	0.198
9	0.1830	53.30	29.2	3.6	0.418	0.482	0.901	1.87	53.30	0.691	0.209
10	0.2030	53.30	29.2	4.0	0.416	0.475	0.892	1.88	53.40	0.683	0.208
11	0.2240	54.90	30.8	4.4	0.437	0.461	0.898	1.95	53.60	0.679	0.219
12	0.2440	55.80	31.7	4.8	0.448	0.461	0.909	1.97	53.60	0.685	0.224
13	0.2650	56.60	32.5	5.2	0.458	0.446	0.904	2.03	53.80	0.675	0.229
14	0.2850	57.40	33.3	5.6	0.467	0.446	0.913	2.05	53.80	0.680	0.233
15	0.3060	58.30	34.2	6.0	0.477	0.439	0.917	2.09	53.90	0.678	0.239
16	0.3260	59.10	35.0	6.4	0.487	0.439	0.926	2.11	53.90	0.682	0.243
17	0.3460	59.90	35.8	6.8	0.496	0.439	0.935	2.13	53.90	0.687	0.248
18	0.3670	60.80	36.7	7.2	0.506	0.439	0.945	2.15	53.90	0.692	0.253
19	0.3870	61.60	37.5	7.6	0.515	0.439	0.954	2.17	53.90	0.696	0.257
20	0.4080	62.40	38.3	8.1	0.523	0.439	0.962	2.19	53.90	0.701	0.262
21	0.4280	64.10	40.0	8.5	0.544	0.439	0.983	2.24	53.90	0.711	0.272
22	0.4490	64.10	40.0	8.9	0.542	0.439	0.981	2.23	53.90	0.710	0.271
23	0.4890	64.90	40.8	9.7	0.548	0.439	0.987	2.25	53.90	0.713	0.274
24	0.5100	65.70	41.6	10.1	0.556	0.446	1.002	2.25	53.80	0.724	0.278
25	0.5510	67.40	43.3	10.9	0.573	0.446	1.020	2.28	53.80	0.733	0.287
26	0.5920	68.20	44.1	11.7	0.579	0.454	1.032	2.28	53.70	0.743	0.289
27	0.6330	69.90	45.8	12.5	0.595	0.461	1.056	2.29	53.60	0.758	0.298
28	0.6730	70.70	46.6	13.3	0.600	0.468	1.068	2.28	53.50	0.768	0.300
29	0.7140	70.70	46.6	14.1	0.595	0.475	1.070	2.25	53.40	0.773	0.297
30	0.7350	72.40	48.3	14.5	0.613	0.475	1.089	2.29	53.40	0.782	0.307
31	0.7550	73.20	49.1	14.9	0.621	0.475	1.096	2.31	53.40	0.786	0.310
32	0.7760	73.20	49.1	15.3	0.618	0.475	1.093	2.30	53.40	0.784	0.309

R12202

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	280.800			568.900
Moisture content: Dry soil+tare, gms.	211.300			455.400
Moisture content: Tare, gms.	97.300			92.400
Moisture, %	61.0	64.3	64.3	31.3
Moist specimen weight, gms.	565.4			
Diameter, in.	2.46	2.46	2.46	
Area, in.^{2}	4.73	4.73	4.73	
Height, in.	4.66	4.66	4.66	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	97.8	99.8	99.8	
Dry density, pcf	60.7	60.7	60.7	
Void ratio	1.6728	1.6728	1.6728	
Saturation, %	94.8	100.0	100.0	

Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 1.254 tsf **at reading no.** 29
Ult. Stress = 1.254 tsf **at reading no.** 29

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	12.50	0.0	0.0	0.000	2.326	2.326	1.00	37.70	2.326	0.000
1	0.0200	44.10	31.6	0.4	0.479	1.735	2.214	1.28	45.90	1.974	0.239
2	0.0410	45.80	33.3	0.9	0.502	1.656	2.158	1.30	47.00	1.907	0.251
3	0.0610	47.40	34.9	1.3	0.524	1.584	2.108	1.33	48.00	1.846	0.262
4	0.0820	49.10	36.6	1.8	0.547	1.519	2.066	1.36	48.90	1.793	0.273
5	0.1020	51.60	39.1	2.2	0.582	1.469	2.050	1.40	49.60	1.760	0.291
6	0.1230	60.80	48.3	2.6	0.715	1.339	2.054	1.53	51.40	1.697	0.358
7	0.1430	64.90	52.4	3.1	0.773	1.231	2.004	1.63	52.90	1.617	0.386
8	0.1640	68.20	55.7	3.5	0.817	1.166	1.984	1.70	53.80	1.575	0.409
9	0.1840	71.60	59.1	4.0	0.863	1.130	1.994	1.76	54.30	1.562	0.432
10	0.2040	74.10	61.6	4.4	0.896	1.087	1.983	1.82	54.90	1.535	0.448
11	0.2250	76.60	64.1	4.8	0.928	1.044	1.972	1.89	55.50	1.508	0.464
12	0.2450	78.20	65.7	5.3	0.947	1.022	1.969	1.93	55.80	1.496	0.473
13	0.2660	80.70	68.2	5.7	0.978	0.986	1.964	1.99	56.30	1.475	0.489
14	0.2860	82.40	69.9	6.1	0.998	0.922	1.919	2.08	57.20	1.421	0.499
15	0.3070	84.90	72.4	6.6	1.029	0.886	1.914	2.16	57.70	1.400	0.514
16	0.3270	86.60	74.1	7.0	1.048	0.864	1.912	2.21	58.00	1.388	0.524
17	0.3480	88.20	75.7	7.5	1.065	0.835	1.901	2.28	58.40	1.368	0.533
18	0.3680	89.90	77.4	7.9	1.084	0.821	1.905	2.32	58.60	1.363	0.542
19	0.3880	91.50	79.0	8.3	1.101	0.806	1.908	2.37	58.80	1.357	0.551
20	0.4090	93.20	80.7	8.8	1.120	0.799	1.919	2.40	58.90	1.359	0.560
21	0.4290	94.90	82.4	9.2	1.138	0.785	1.923	2.45	59.10	1.354	0.569
22	0.4500	96.50	84.0	9.7	1.154	0.785	1.939	2.47	59.10	1.362	0.577
23	0.4910	98.20	85.7	10.5	1.166	0.778	1.944	2.50	59.20	1.361	0.583
24	0.5320	100.70	88.2	11.4	1.188	0.778	1.966	2.53	59.20	1.372	0.594
25	0.5720	103.20	90.7	12.3	1.210	0.778	1.988	2.56	59.20	1.383	0.605

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
26	0.6130	104.90	92.4	13.2	1.220	0.778	1.998	2.57	59.20	1.388	0.610
27	0.6540	106.50	94.0	14.0	1.229	0.778	2.006	2.58	59.20	1.392	0.614
28	0.6950	108.20	95.7	14.9	1.238	0.785	2.023	2.58	59.10	1.404	0.619
29	0.7160	109.90	97.4	15.4	1.254	0.792	2.046	2.58	59.00	1.419	0.627

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	262.700			722.900
Moisture content: Dry soil+tare, gms.	199.000			585.200
Moisture content: Tare, gms.	92.400			127.400
Moisture, %	59.8	50.4	50.4	30.1
Moist specimen weight, gms.	858.5			
Diameter, in.	2.60	2.60	2.60	
Area, in.²	5.29	5.29	5.29	
Height, in.	5.51	5.51	5.51	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	112.2	105.7	105.7	
Dry density, pcf	70.2	70.2	70.2	
Void ratio	1.3105	1.3105	1.3105	
Saturation, %	118.6	100.0	100.0	

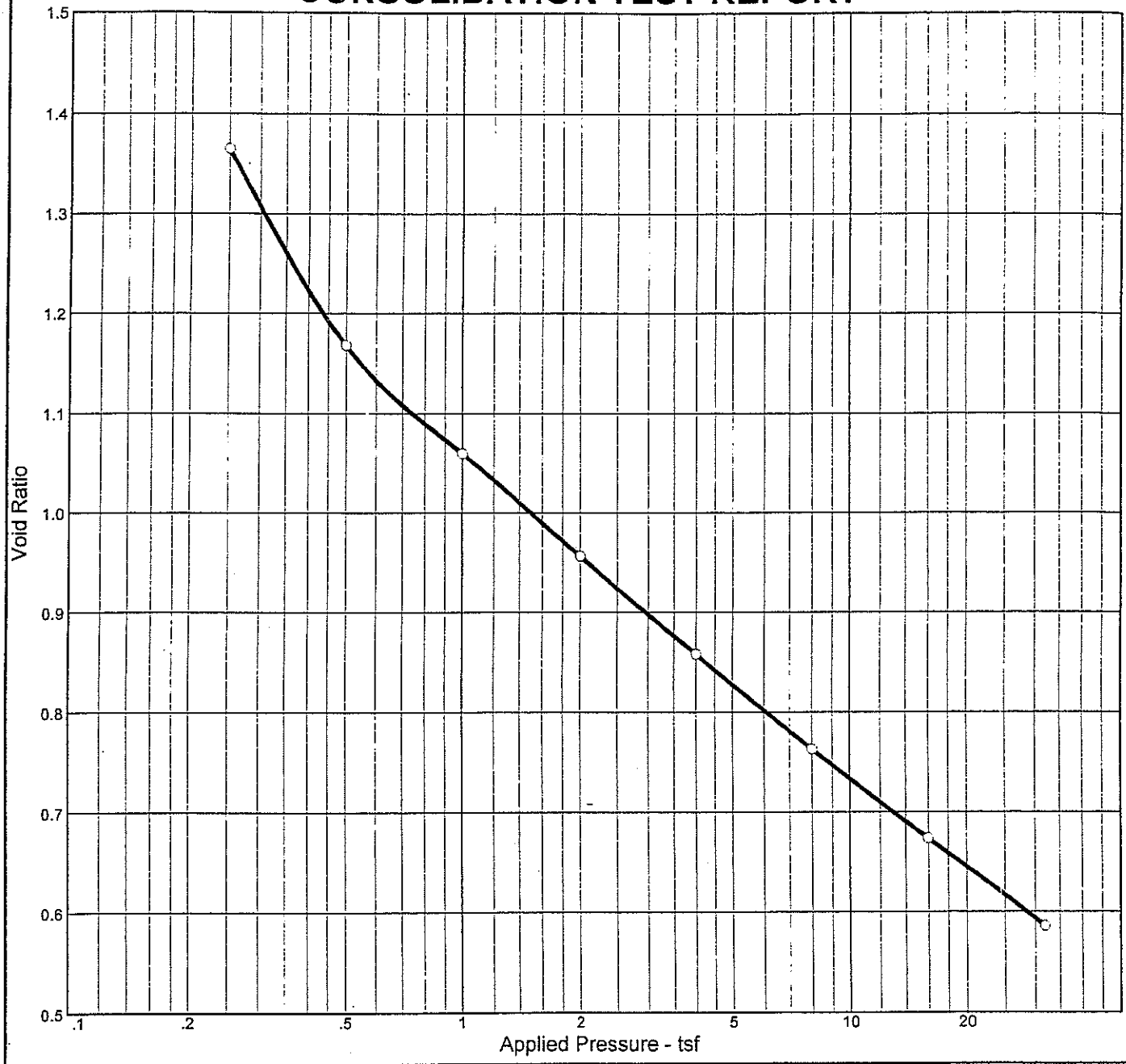
Consolidation cell pressure = 80.00 psi (5.760 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.160 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 1.322 tsf **at reading no.** 31
Ult. Stress = 1.316 tsf **at reading no.** 32

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	33.30	0.0	0.0	0.000	2.779	2.779	1.00	41.40	2.779	0.000
1	0.0190	50.80	17.5	0.3	0.237	2.398	2.635	1.10	46.70	2.516	0.119
2	0.0400	64.90	31.6	0.7	0.427	2.196	2.623	1.19	49.50	2.410	0.214
3	0.0600	77.40	44.1	1.1	0.594	1.973	2.567	1.30	52.60	2.270	0.297
4	0.0810	84.10	50.8	1.5	0.681	1.800	2.481	1.38	55.00	2.141	0.341
5	0.1010	89.00	55.7	1.8	0.744	1.663	2.408	1.45	56.90	2.035	0.372
6	0.1220	92.40	59.1	2.2	0.787	1.541	2.328	1.51	58.60	1.934	0.393
7	0.1420	95.70	62.4	2.6	0.828	1.469	2.296	1.56	59.60	1.883	0.414
8	0.1620	98.20	64.9	2.9	0.858	1.397	2.254	1.61	60.60	1.826	0.429
9	0.1830	101.50	68.2	3.3	0.898	1.332	2.230	1.67	61.50	1.781	0.449
10	0.2030	103.20	69.9	3.7	0.917	1.274	2.191	1.72	62.30	1.733	0.458
11	0.2240	104.90	71.6	4.1	0.935	1.231	2.166	1.76	62.90	1.699	0.468
12	0.2440	106.50	73.2	4.4	0.952	1.188	2.140	1.80	63.50	1.664	0.476
13	0.2650	109.90	76.6	4.8	0.993	1.152	2.145	1.86	64.00	1.648	0.496
14	0.2850	112.40	79.1	5.2	1.021	1.123	2.144	1.91	64.40	1.634	0.511
15	0.3060	114.00	80.7	5.6	1.038	1.102	2.139	1.94	64.70	1.620	0.519
16	0.3260	115.70	82.4	5.9	1.055	1.080	2.135	1.98	65.00	1.608	0.528
17	0.3460	117.30	84.0	6.3	1.072	1.058	2.130	2.01	65.30	1.594	0.536

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
18	0.3670	118.20	84.9	6.7	1.079	1.044	2.123	2.03	65.50	1.583	0.539
19	0.3870	120.70	87.4	7.0	1.106	1.030	2.136	2.07	65.70	1.583	0.553
20	0.4080	122.30	89.0	7.4	1.122	1.022	2.144	2.10	65.80	1.583	0.561
21	0.4490	125.70	92.4	8.1	1.155	1.001	2.156	2.15	66.10	1.578	0.578
22	0.4890	128.20	94.9	8.9	1.177	0.994	2.171	2.18	66.20	1.582	0.589
23	0.5300	131.50	98.2	9.6	1.208	0.994	2.202	2.22	66.20	1.598	0.604
24	0.5710	134.80	101.5	10.4	1.239	0.986	2.225	2.26	66.30	1.606	0.619
25	0.6120	135.70	102.4	11.1	1.239	0.994	2.233	2.25	66.20	1.613	0.620
26	0.6530	139.00	105.7	11.9	1.268	0.994	2.262	2.28	66.20	1.628	0.634
27	0.6940	141.50	108.2	12.6	1.287	0.994	2.281	2.30	66.20	1.637	0.644
28	0.7350	143.10	109.8	13.3	1.295	1.008	2.303	2.29	66.00	1.656	0.648
29	0.7760	144.80	111.5	14.1	1.304	1.008	2.312	2.29	66.00	1.660	0.652
30	0.7960	146.50	113.2	14.4	1.318	1.008	2.326	2.31	66.00	1.667	0.659
31	0.8170	147.30	114.0	14.8	1.322	1.008	2.330	2.31	66.00	1.669	0.661
32	0.8370	147.30	114.0	15.2	1.316	1.008	2.324	2.31	66.00	1.666	0.658

R12205

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture							
87.8 %	48.4 %	66.7			2.6	0.20	0.31	1.434

MATERIAL DESCRIPTION	USCS	AASHTO
Black Coal Slurry		

Project No. H-07227 **Client:** Pond Creek Mine

Project: Proposed Slurry Cell
Pond Creek Mine

Location: Boring D-4 (39.5-40.0')

Remarks:

CONSOLIDATION TEST REPORT

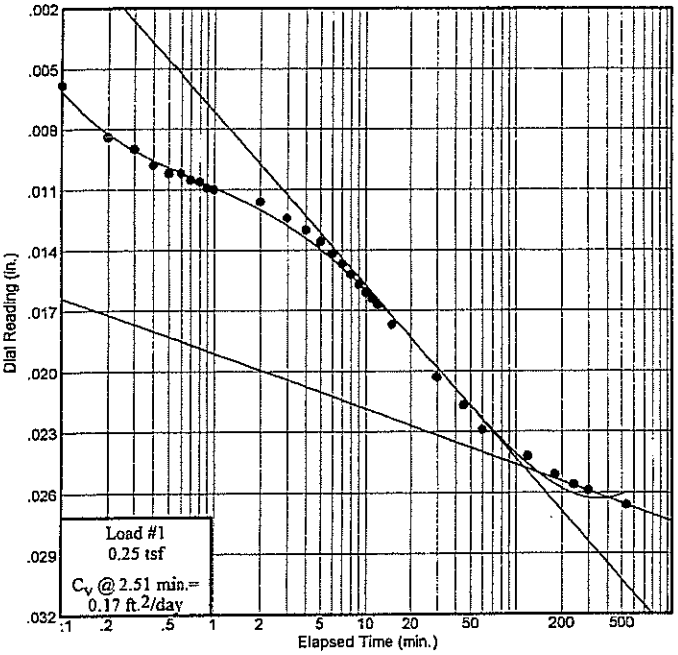
HOLCOMB FOUNDATION ENGINEERING CO.

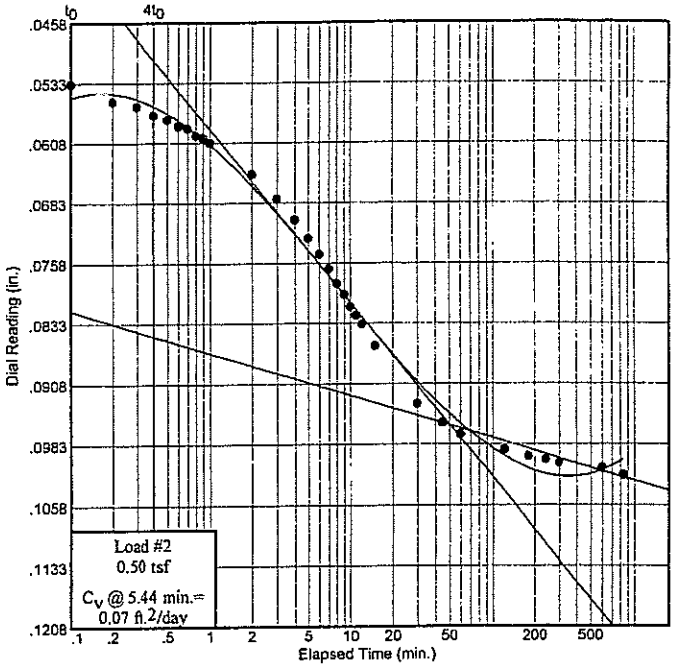
Plate

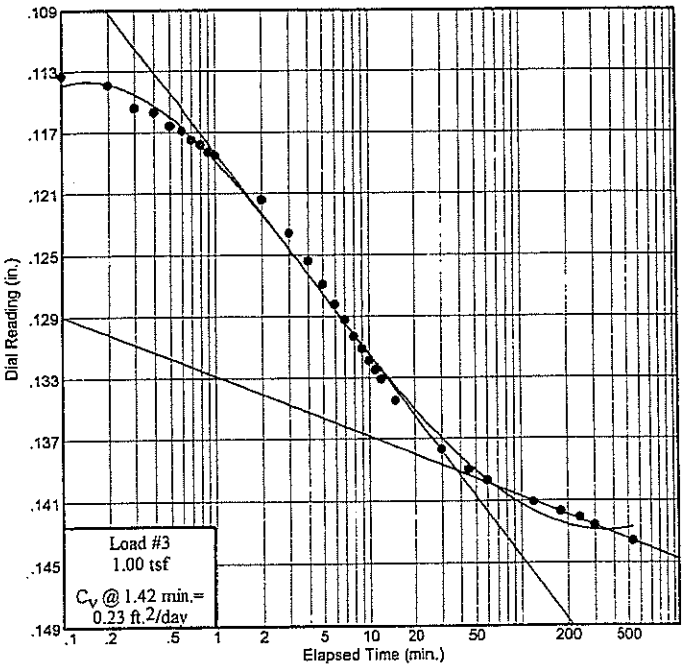
R12206

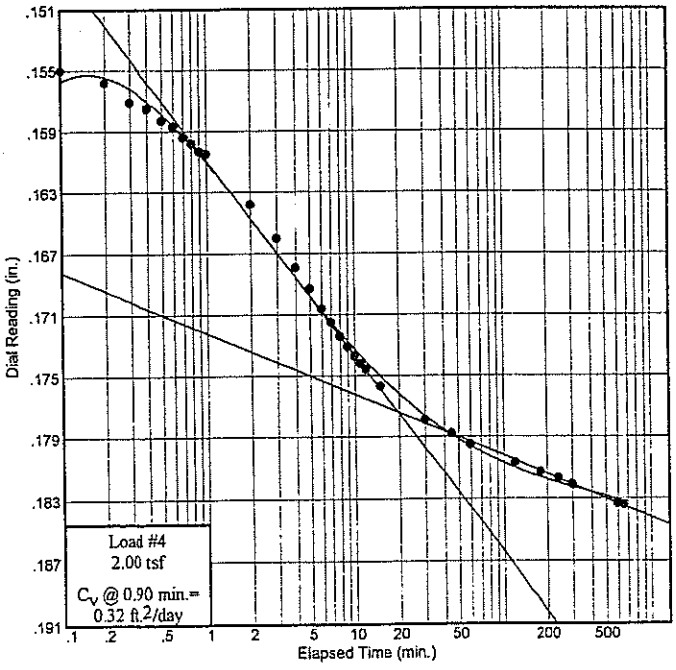
Dial Reading vs. Time

Project No.: H-07227
Project: Proposed Slurry Cell
Pond Creek Mine
Location: Boring D-4 (39.5-40.0')









Dial Reading vs. Time

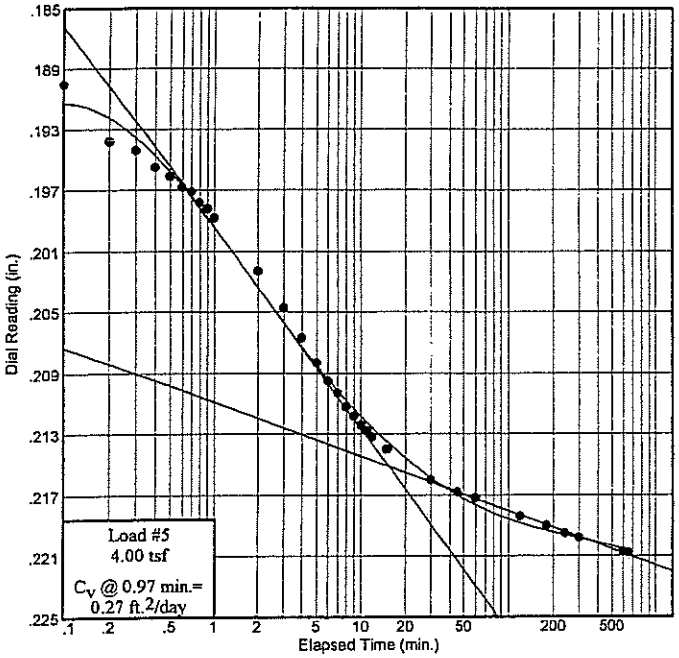
HOLCOMB FOUNDATION ENGINEERING CO.

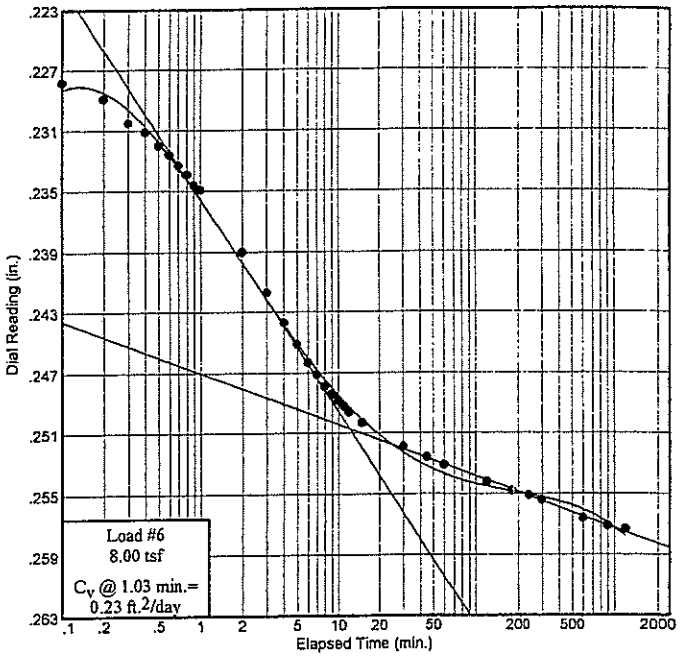
Plate

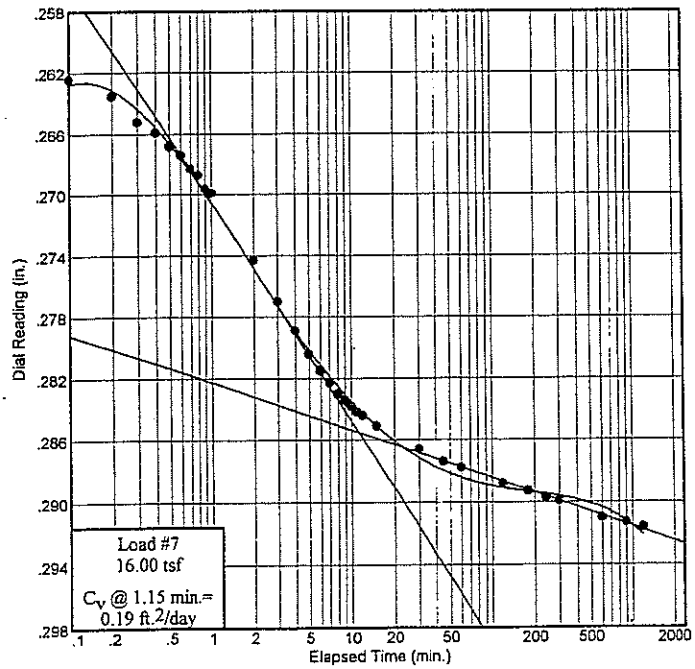
R12207

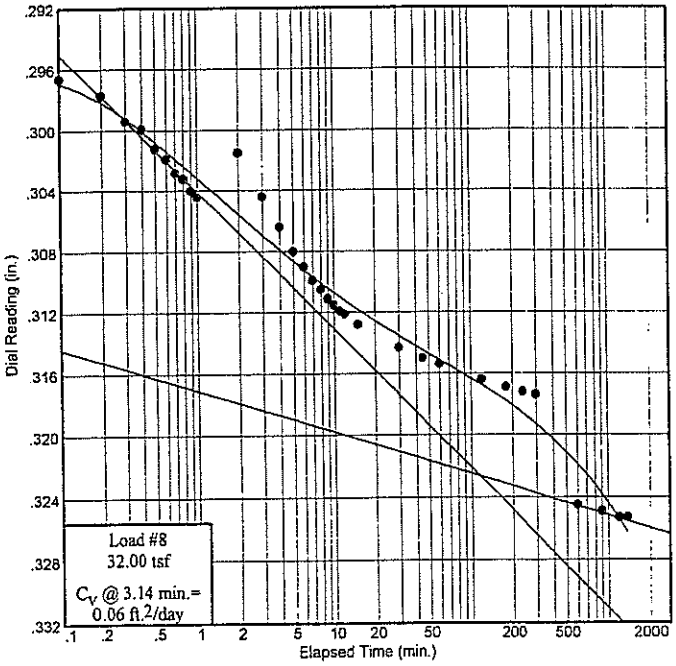
Dial Reading vs. Time

Project No.: H-07227
Project: Proposed Slurry Cell
Pond Creek Mine
Location: Boring D-4 (39.5-40.0')









Dial Reading vs. Time

HOLCOMB FOUNDATION ENGINEERING CO.

Plate

Holcomb Foundation Engineering Co., Inc.

SOILS • BITUMINOUS • CONCRETE • ENGINEERING AND TESTING

SHIPPING ADDRESS
393 Wood Road
Carbondale, IL 62901

MAILING ADDRESS
PO Box 88
Carbondale, IL 62903

PHONE 618-529-5262
TOLL FREE 800-333-1740
FAX 618-457-8991

September 14, 2010

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. Jim Slapak

Re: Soil Borings and Laboratory Testing
Pond Creek Mine Slurry Cell E
Johnston City, Illinois
HFE File H-07227
Purchase Order No. 17678

Dear Sir:

From August 24 to 25, 2010, we drilled four soil borings at the above referenced project. Two of the borings were advanced with continuous split barrel sampling, and two borings were sampled at ten foot centers with Shelby tubes. The tubes were sealed and transported to our laboratory for additional testing.

In our laboratory, two of the Shelby tube samples were subjected to consolidated-undrained triaxial tests, and one slurry sample was subjected to a consolidation test. The split barrel samples were subjected to moisture content determinations. Results of the laboratory tests and the Boring Logs are enclosed. If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

REGISTERED PROFESSIONAL ENGINEER
TIMOTHY J.
HOLCOMB
062-042149
Exp 11-30 10
ILLINOIS

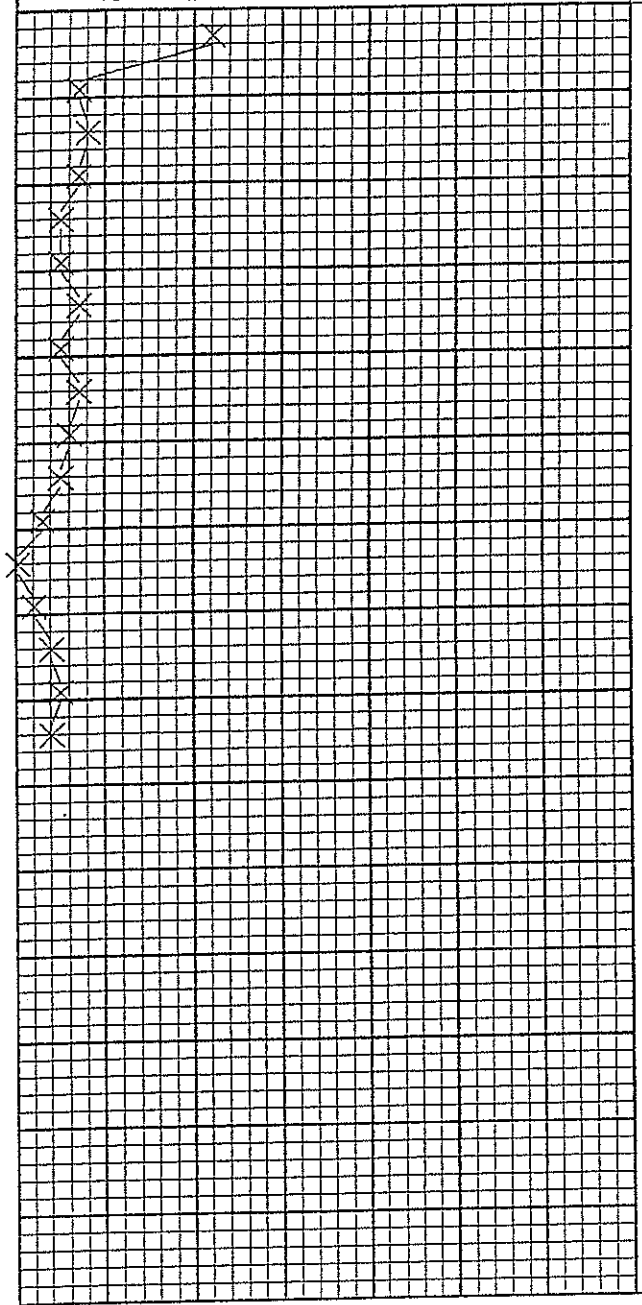
Holcomb Foundation
Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING F1

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 503.8
	1	ss		Gray Coarse Mine Refuse
	2	ss		
	3	ss		
10	4	ss		
	5	ss		
	6	ss		
	7	ss		
20	8	ss		
	9	ss		
	10	ss		
	11	ss		
	12	ss		Fine Coal Slurry
30	13	ss		
	14	ss		
	15	ss		
	16	ss		
40	17	ss		
				Brown Mottled Gray Silty CLAY (CL)
				End of Boring @ -43.0'
50				
60				
70				

Ground Water Data
Ground Water Encountered @ -30.0' During Drilling and @ -19.0' Upon Completion.

Project: Pond Creek Mine Slurry Cell
Johnston City, Illinois

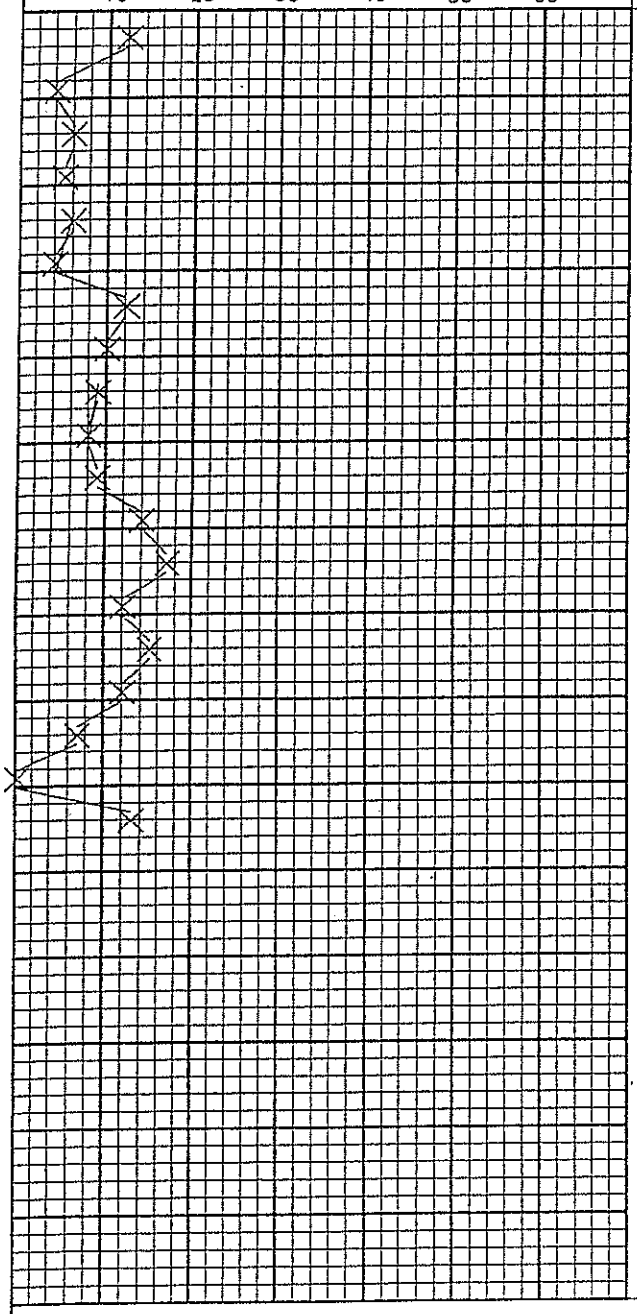
Date of Boring
August 24, 2010

Client: Mach Mining
Johnston City, Illinois

Project No.
H-07227

Holcomb Foundation
Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING E2



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 503.8
	1	ss		Gray Coarse Mine Refuse
	2	ss		
	3	ss		
10	4	ss		
	5	ss		
	6	ss		
	7	ss		
20	8	ss		
	9	ss		
	10	ss		
	11	ss		
30	12	ss		
	13	ss		
	14	ss		
	15	ss		
40	16	ss		
	17	ss		
	18	ss		
	19	ss		Brown Mottled Gray Silty CLAY (CL)
50				End of Boring @ -48.0'
60				
70				

Ground Water Data
No Ground Water Encountered During Drilling and Plugged Upon Completion.

Project: Pond Creek Mine Slurry Cell Johnston City, Illinois	Date of Boring August 24, 2010
Client: Mach Mining Johnston City, Illinois	Project No. H-07227

Holcomb Foundation
Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING E3

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60

Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 503.2
				Gray Coarse Refuse
10	1	st		10" Recovery
20	2	st		19" Recovery
30	3	st		24" Recovery
40	4	st		19.5" Recovery
50	5	st		Brown SANDSTONE
				End of Boring @ -50.5'
60				
70				

Ground Water Data
Ground Water Encountered @ -45.0' During Drilling and Plugged Upon Completion.

Project: Pond Creek Mine Slurry Cell
Johnston City, Illinois

Date of Boring
August 25, 2010

Client: Mach Mining
Johnston City, Illinois

Project No.
H-07227

R12212

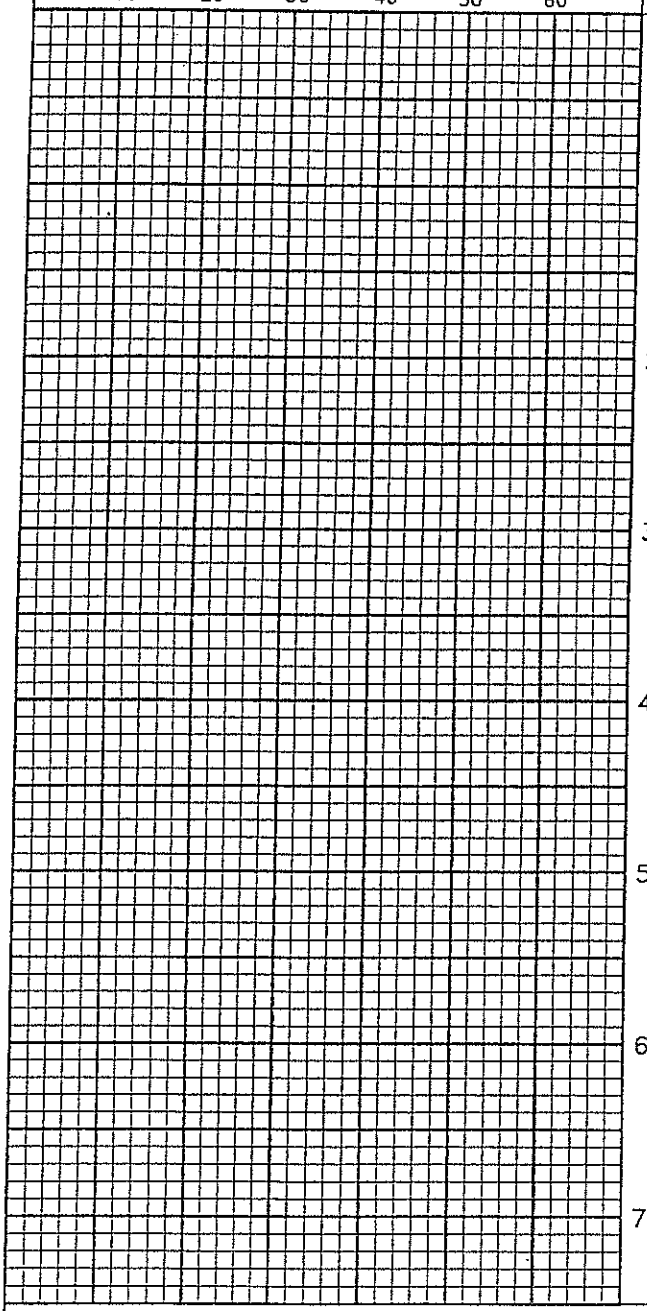
Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING E4

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 503.0
				Gray Coarse Refuse
10	1	st		19.5" Recovery
20	2	st		11.5" Recovery
30	3	st		21" Recovery
40	4	st		17" Recovery
50	5	st		24" Recovery
				Brown Mottled Gray Silty CLAY (CL)
				End of Boring @ -50.5'
60				
70				

Ground Water Data
Ground Water Encountered @ -40.0' During Drilling and Plugged Upon Completion.

Project: Pond Creek Mine Slurry Cell
Johnston City, Illinois

Date of Boring
August 25, 2010

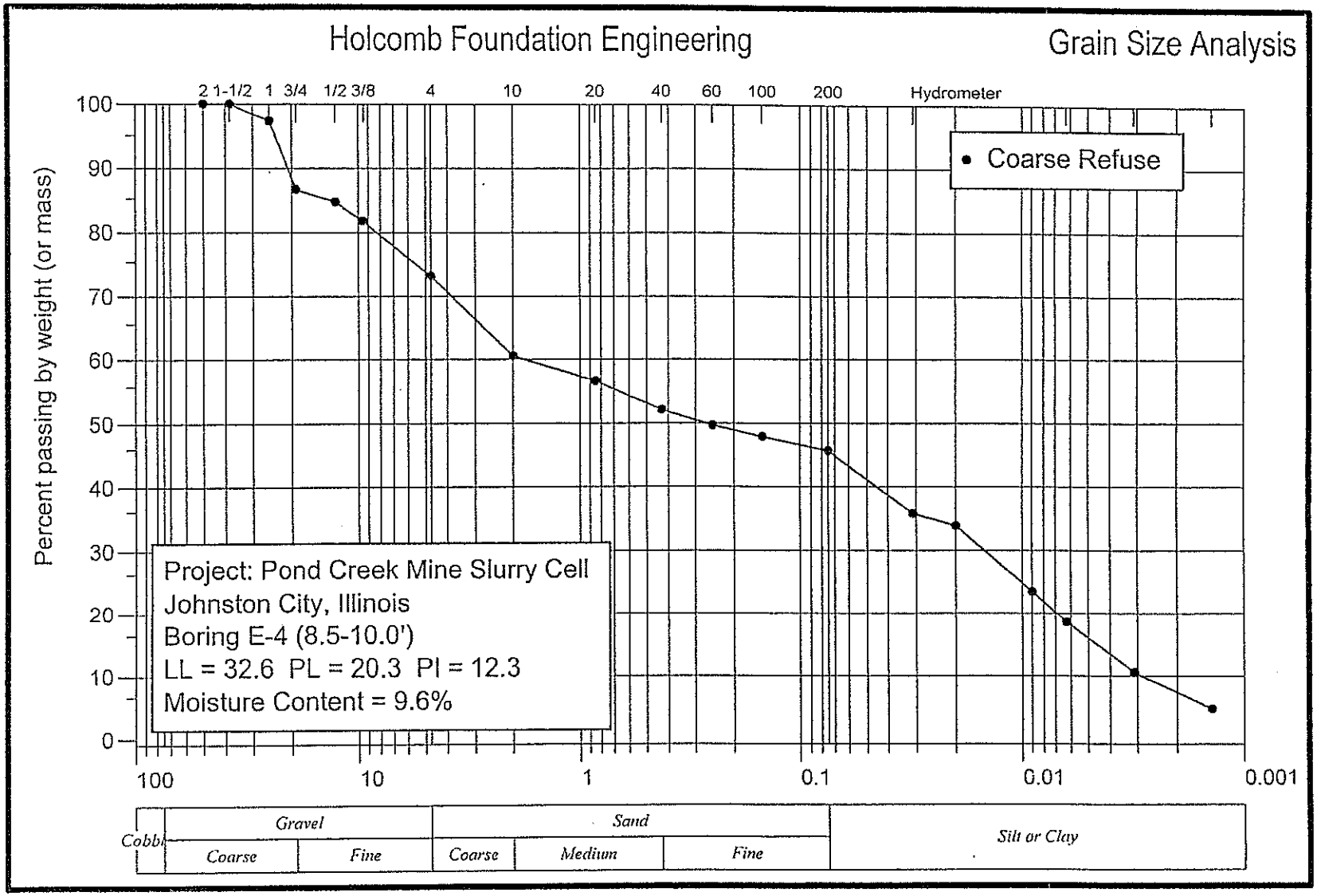
Client: Mach Mining
Johnston City, Illinois

Project No.
H-07227

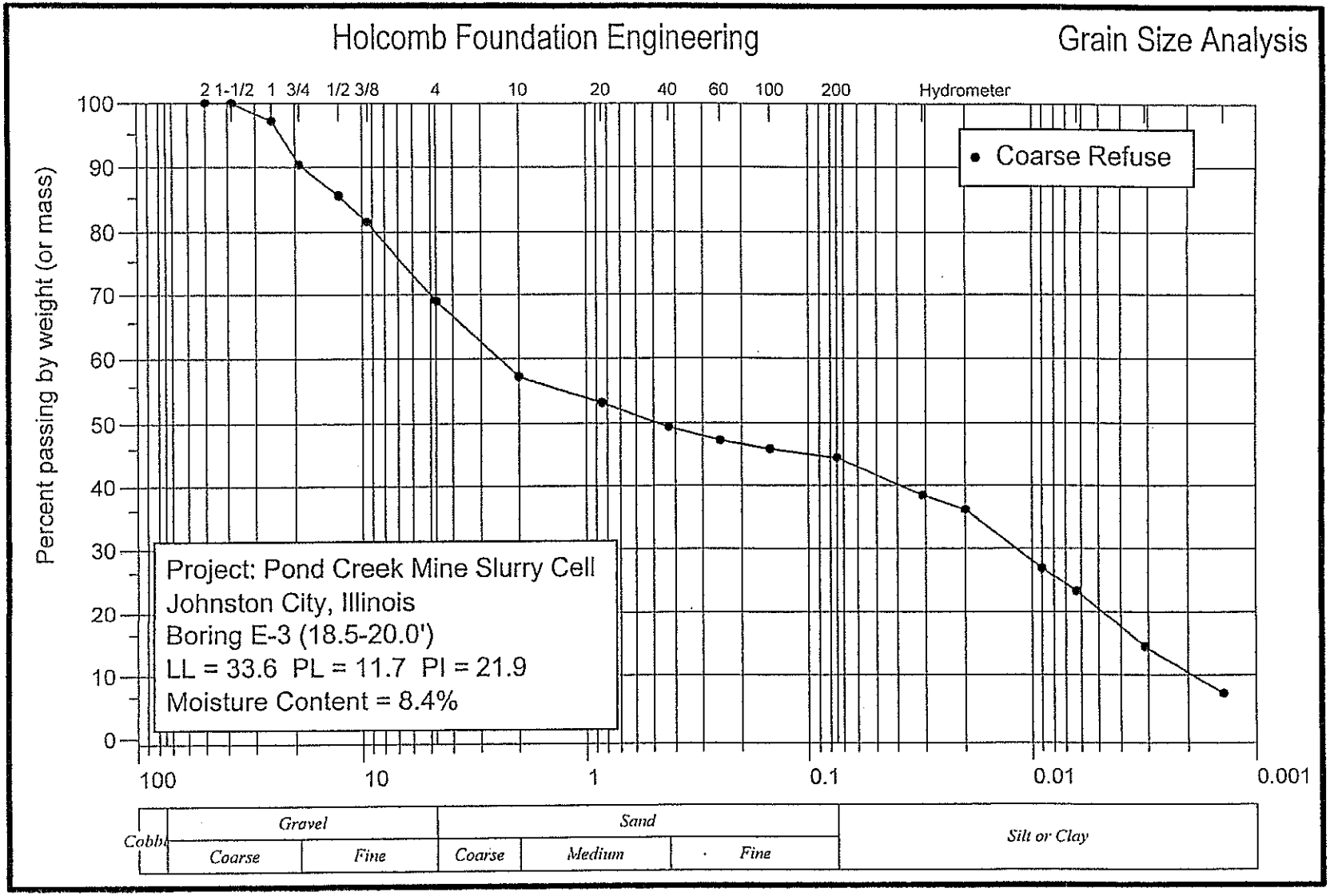
Holcomb Foundation Engineering Company

Moisture Content Worksheet

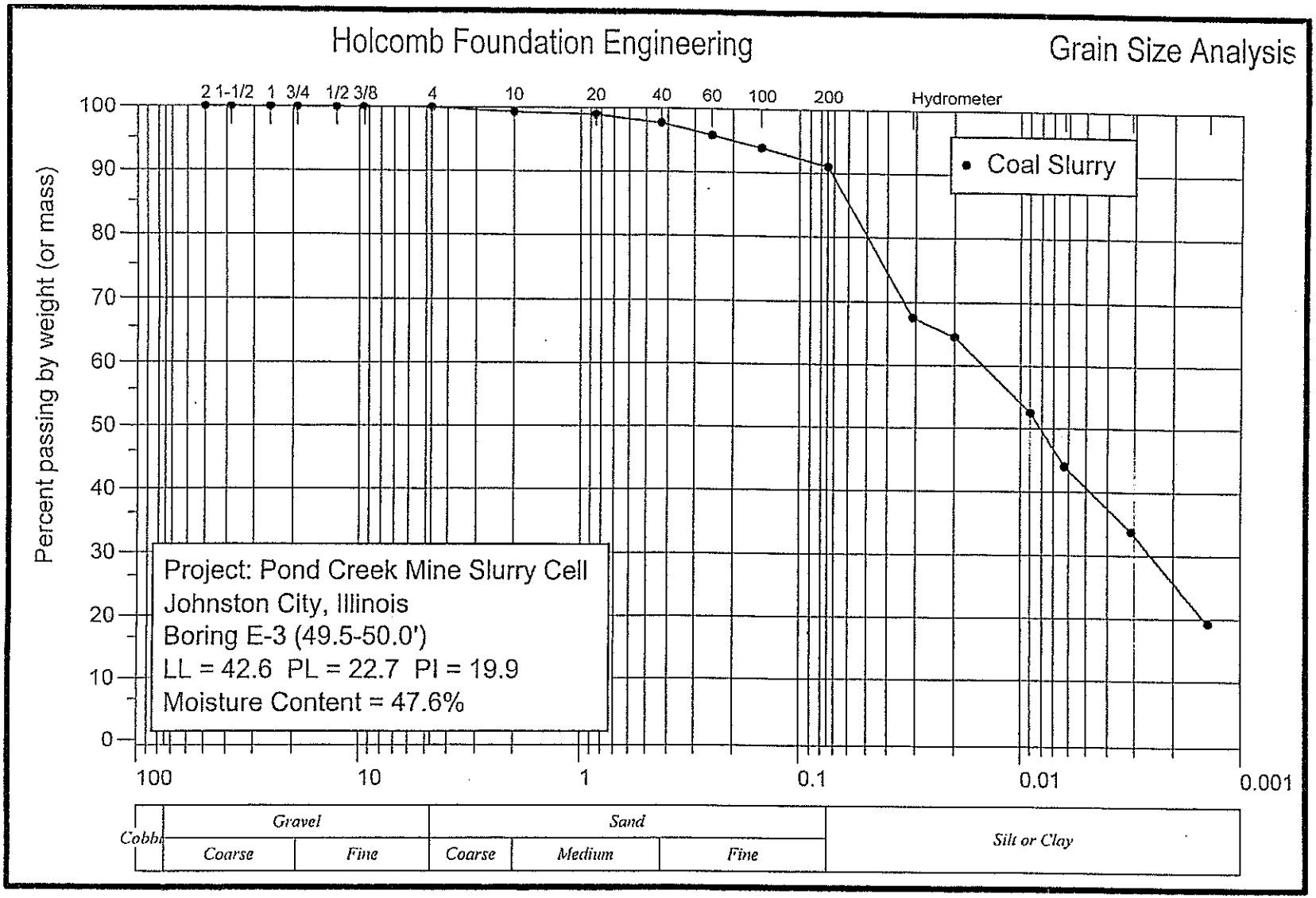
Project:	Williamson Energy				
Project No.:	H-07227				
	Sample				
Boring	Depth	Wet Wt.	Pan	Dry Wt.	Mc. (%)
E-1	0-3'	902.3	102.3	852.8	6.6
E-1	3-6'	847.8	137.1	803.6	6.6
E-1	6-8'	727.3	102.9	607.2	23.8
E-1	8-11'	400.4	101.1	383.6	5.9
E-1	11-13'	454.6	98.4	427.3	8.3
E-1	13-16'	1075.4	103.4	1006.5	7.6
E-1	16-18'	710.8	113.5	669.4	7.4
E-1	21-23'	611.7	101.8	575.7	7.6
E-1	23-26'	881.5	88.3	811.2	9.7
E-1	26-28'	766.8	145.4	709.4	10.2
E-1	28-31'	878.7	108.1	758.7	18.4
E-1	31-33'	518.9	119.7	412.7	36.2
E-1	33-36'	589.6	123.8	480.3	30.7
E-1	36-38'	700.8	137.2	570.3	30.1
E-1	38-41'	757.5	125.8	642.6	22.2
E-1	41-43'	585.5	106.3	482.7	27.3
E-2	0-3	1074.1	112.2	1008.8	7.3
E-2	3-6'	857.3	94.9	794.3	9.0
E-2	6-8'	567.4	113.5	538.2	6.9
E-2	8-11'	1019.4	104.7	949.5	8.3
E-2	11-13'	645.5	109.7	605.3	8.1
E-2	13-16'	1015.4	129.4	946.4	8.4
E-2	16-18'	568.9	120.8	539.9	6.9
E-2	18-21'	266.5	132.7	257.3	7.4
E-2	21-23'	899.2	109.9	834.6	8.9
E-2	23-26'	1603.4	135.4	1464.4	10.5
E-2	26-28'	1107.8	207.7	1022.9	10.4
E-2	28-31'	1243.9	143.8	1151.3	9.2
E-2	31-33'	907.0	139.6	832.4	10.8
E-2	33-36'	1095.8	192.6	1018.0	9.4
E-2	36-38'	719.4	208.3	675.4	9.4
E-2	38-41'	1105.7	209.8	1025.5	9.8
E-2	41-43'	912.8	211.1	814.6	16.3
E-2	43-46'	644.2	153.7	516.2	35.3
E-2	46-48'	1330.2	166.7	1056.2	30.8


Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
Coarse Refuse
Project: Pond Creek Mine Slurry Cell
Johnston City, Illinois
Boring E-4 (8.5-10.0')
LL = 32.6 PL = 20.3 PI = 12.3
Moisture Content = 9.6%
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

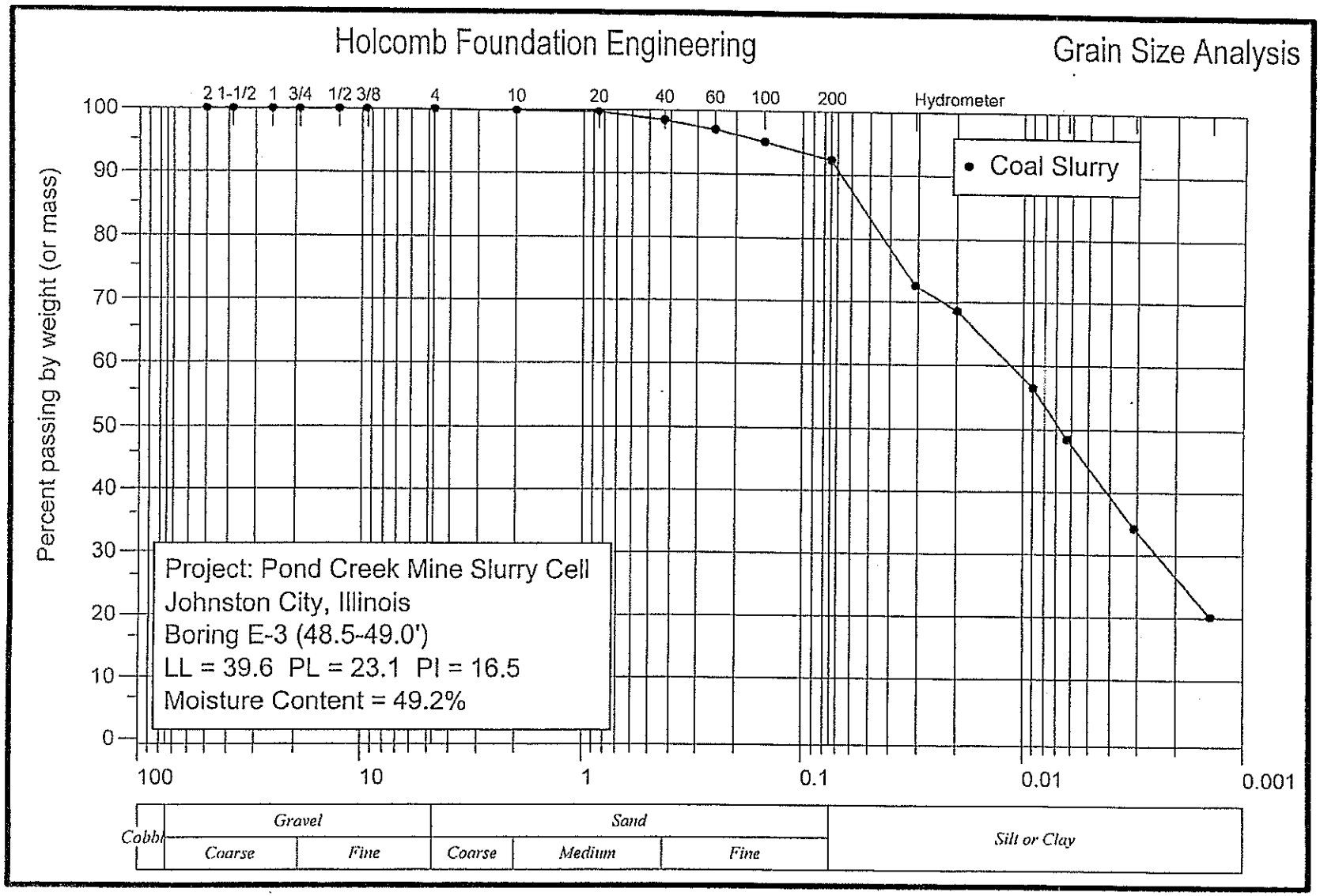
R12214


Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
Coarse Refuse
Project: Pond Creek Mine Slurry Cell
Johnston City, Illinois
Boring E-3 (18.5-20.0')
LL = 33.6 PL = 11.7 PI = 21.9
Moisture Content = 8.4%
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

R12215

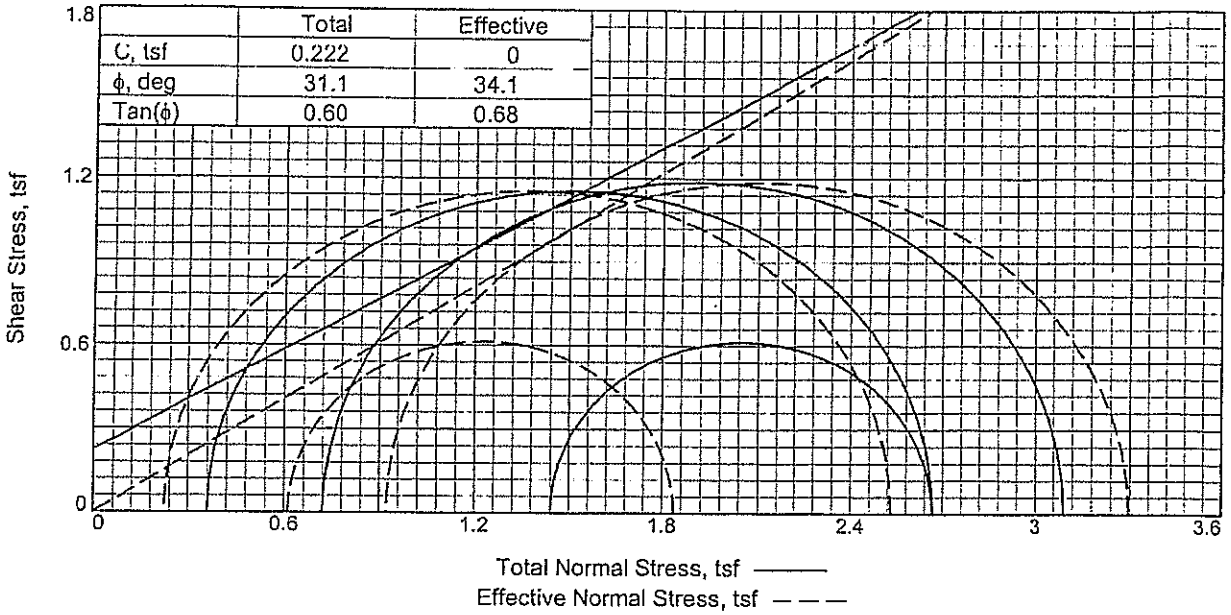

Holcomb Foundation Engineering
Grain Size Analysis
Percent passing by weight (or mass)
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
100 90 80 70 60 50 40 30 20 10 0
Coal Slurry
Project: Pond Creek Mine Slurry Cell
Johnston City, Illinois
Boring E-3 (49.5-50.0')
LL = 42.6 PL = 22.7 PI = 19.9
Moisture Content = 47.6%
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

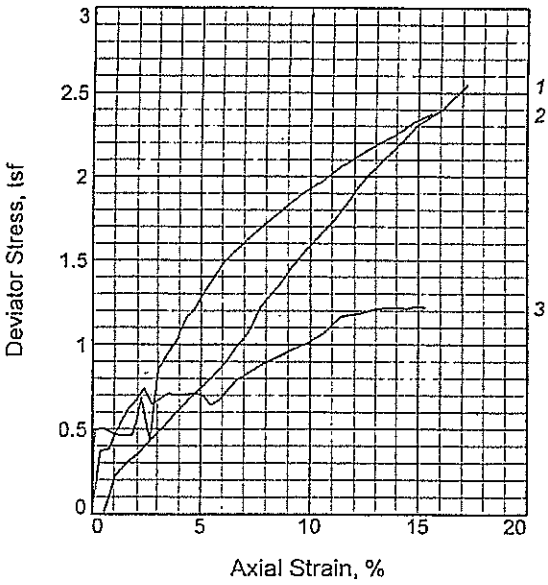
R12216


Holcomb Foundation Engineering
Grain Size Analysis
Percent passing by weight (or mass)
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
100
90
80
70
60
50
40
30
20
10
0
Coal Slurry
Project: Pond Creek Mine Slurry Cell
Johnston City, Illinois
Boring E-3 (48.5-49.0')
LL = 39.6 PL = 23.1 PI = 16.5
Moisture Content = 49.2%
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

R12217

	Total	Effective
C, tsf	0.222	0
ϕ, deg	31.1	34.1
Tan(ϕ)	0.60	0.68





Sample No.		1	2	3
Initial	Water Content,	8.4	7.9	8.5
	Dry Density, pcf	120.3	124.2	134.5
	Saturation,	62.8	66.6	107.3
	Void Ratio	0.3494	0.3066	0.2066
	Diameter, in.	2.80	2.80	2.80
	Height, in.	3.68	4.89	5.19
At Test	Water Content,	13.4	11.8	7.9
	Dry Density, pcf	120.3	124.2	134.5
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.3494	0.3066	0.2066
	Diameter, in.	2.80	2.80	2.80
	Height, in.	3.68	4.89	5.19
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.60	3.60	3.60
Cell Pressure, tsf		3.96	4.32	5.04
Fail. Stress, tsf		2.31	2.37	1.23
Total Pore Pr., tsf		3.74	3.40	4.43
Ult. Stress, tsf		2.31	2.37	1.23
Total Pore Pr., tsf		3.74	3.40	4.43
$\bar{\sigma}_1$ Failure, tsf		2.53	3.30	1.84
$\bar{\sigma}_3$ Failure, tsf		0.22	0.92	0.61

Type of Test: CU with Pore Pressures
Sample Type: Undisturbed
Description: Coarse Refuse

Assumed Specific Gravity= 2.6
Remarks:

Client: Pond Creek Mine

Project: Proposed Slurry Cell
Pond Creek Mine
Location: Boring E-3 (18.5-20.5')

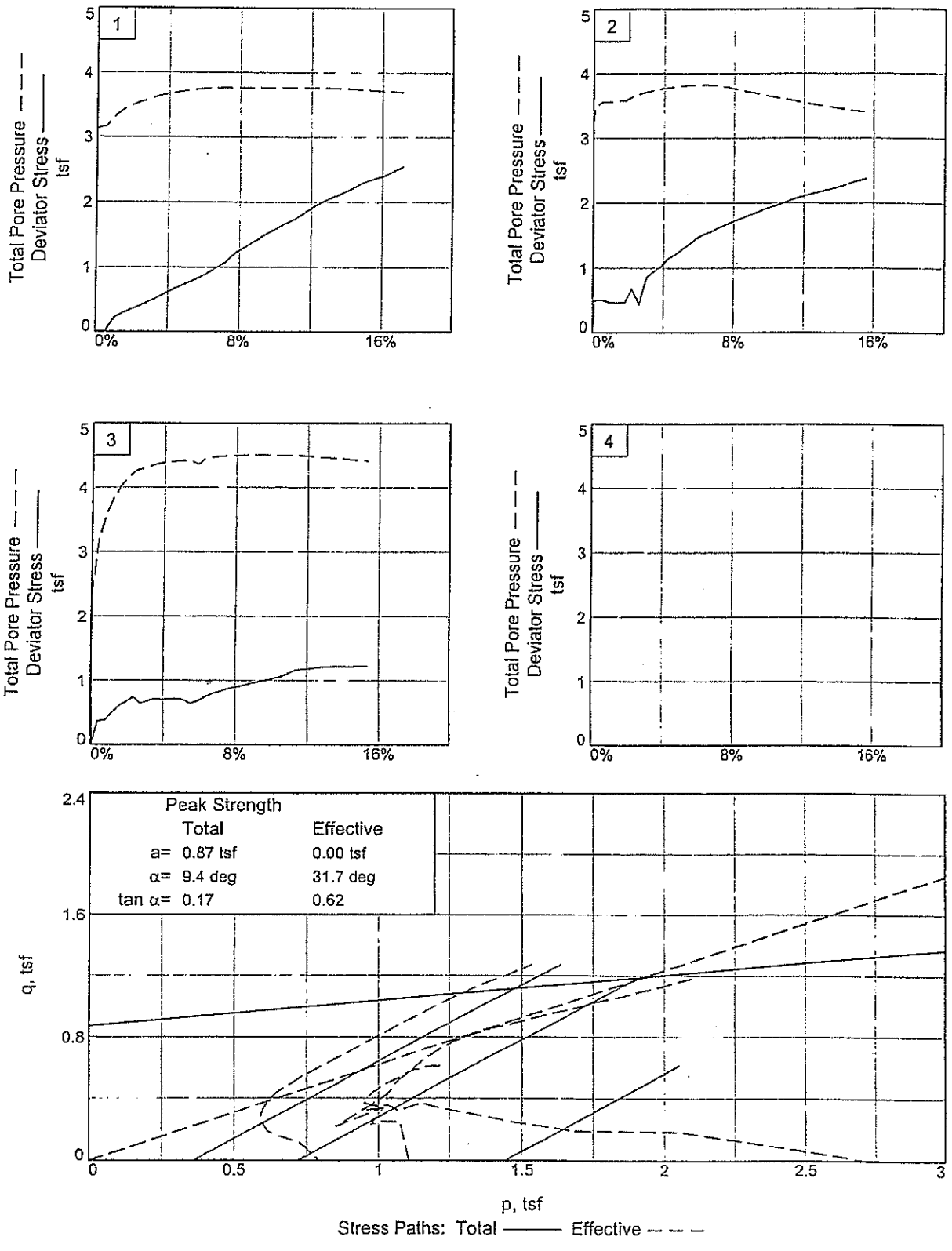
Proj. No.: H-07227 **Date:** 9-9-10

TRIAXIAL SHEAR TEST REPORT

HOLCOMB FOUNDATION ENGINEERING CO.

Plate _____

Tested By: LC Checked By: TH

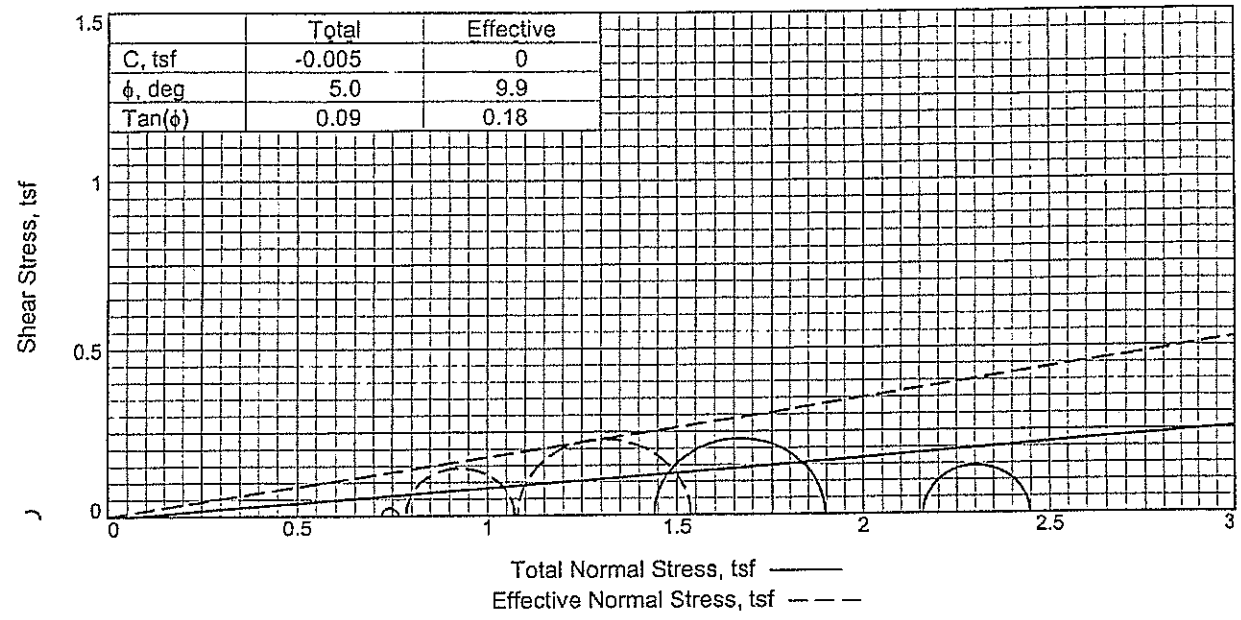


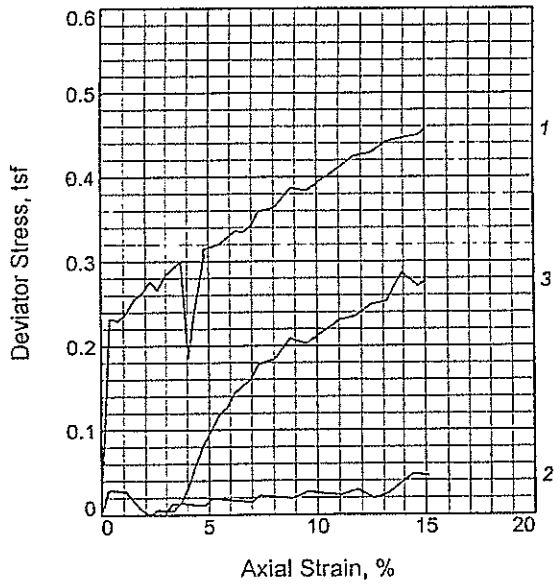
Client: Pond Creek Mine
Project: Proposed Slurry Cell
Location: Boring E-3 (18.5-20.5')
Project No.: H-07227

Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH





Sample No.		1	2	3
Initial	Water Content,	49.2	48.5	47.6
	Dry Density, pcf	53.8	64.3	61.5
	Saturation,	63.4	82.9	75.5
	Void Ratio	2.0153	1.5229	1.6381
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.58	5.53	5.57
At Test	Water Content,	77.5	58.6	63.0
	Dry Density, pcf	53.8	64.3	61.5
	Saturation,	100.0	100.0	100.0
	Void Ratio	2.0153	1.5229	1.6381
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.58	5.53	5.57
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.60	3.60	3.60
Cell Pressure, tsf		5.04	4.32	5.76
Fail. Stress, tsf		0.46	0.05	0.29
Total Pore Pr., tsf		3.96	4.54	4.98
Ult. Stress, tsf		0.46	0.05	0.28
Total Pore Pr., tsf		3.96	4.56	5.00
$\bar{\sigma}_1$ Failure, tsf		1.54	-0.18	1.07
$\bar{\sigma}_3$ Failure, tsf		1.08	-0.22	0.78

Type of Test: CU with Pore Pressures
Sample Type: Undisturbed
Description: Black Coal Slurry

Assumed Specific Gravity= 2.6
Remarks:

Plate _____

Client: Pond Creek Mine

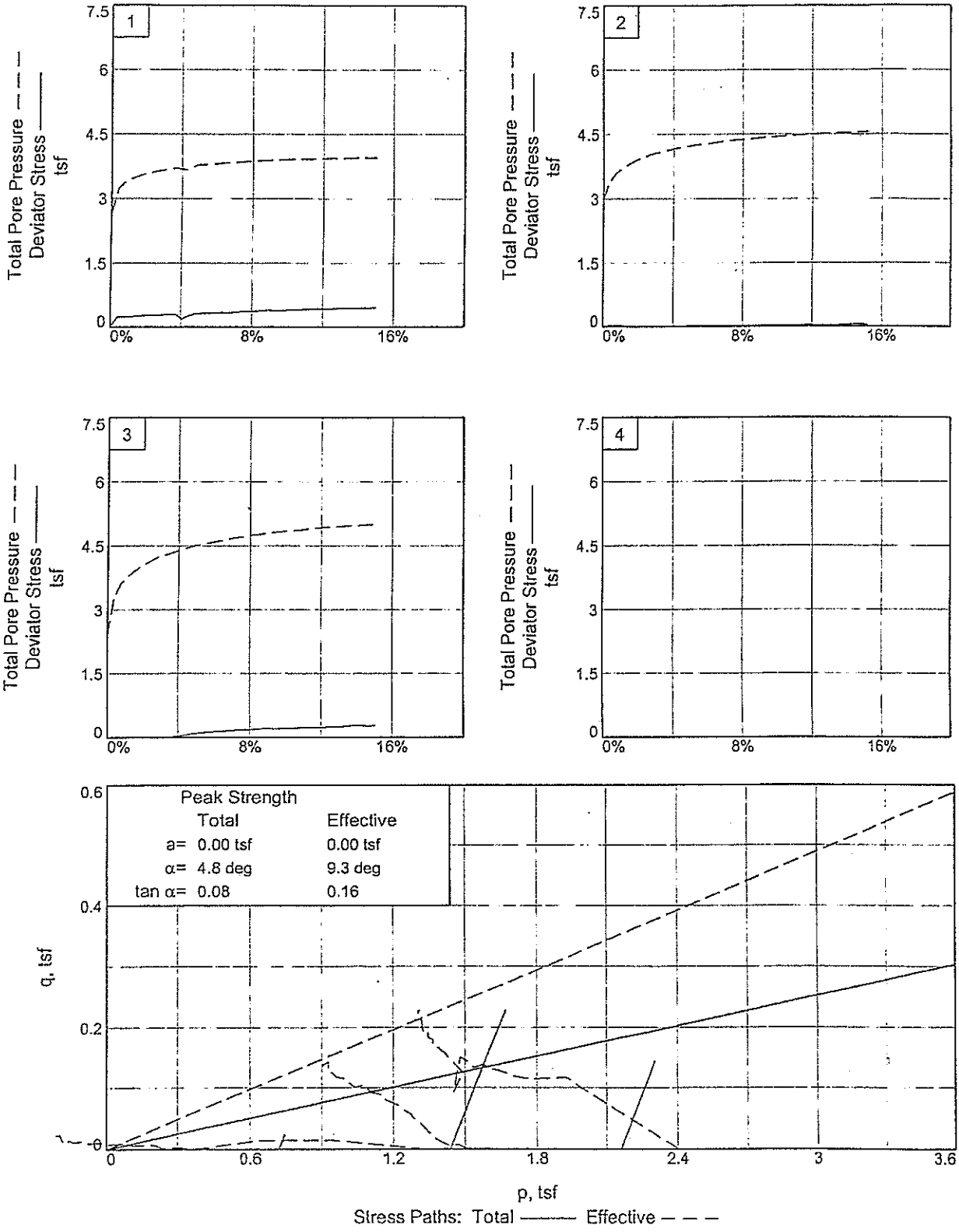
Project: Proposed Slurry Cell
Pond Creek Mine
Location: Boring E-3 (48.5-50.0')

Proj. No.: H-07227 **Date:** 9-9-10

TRIAXIAL SHEAR TEST REPORT

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH



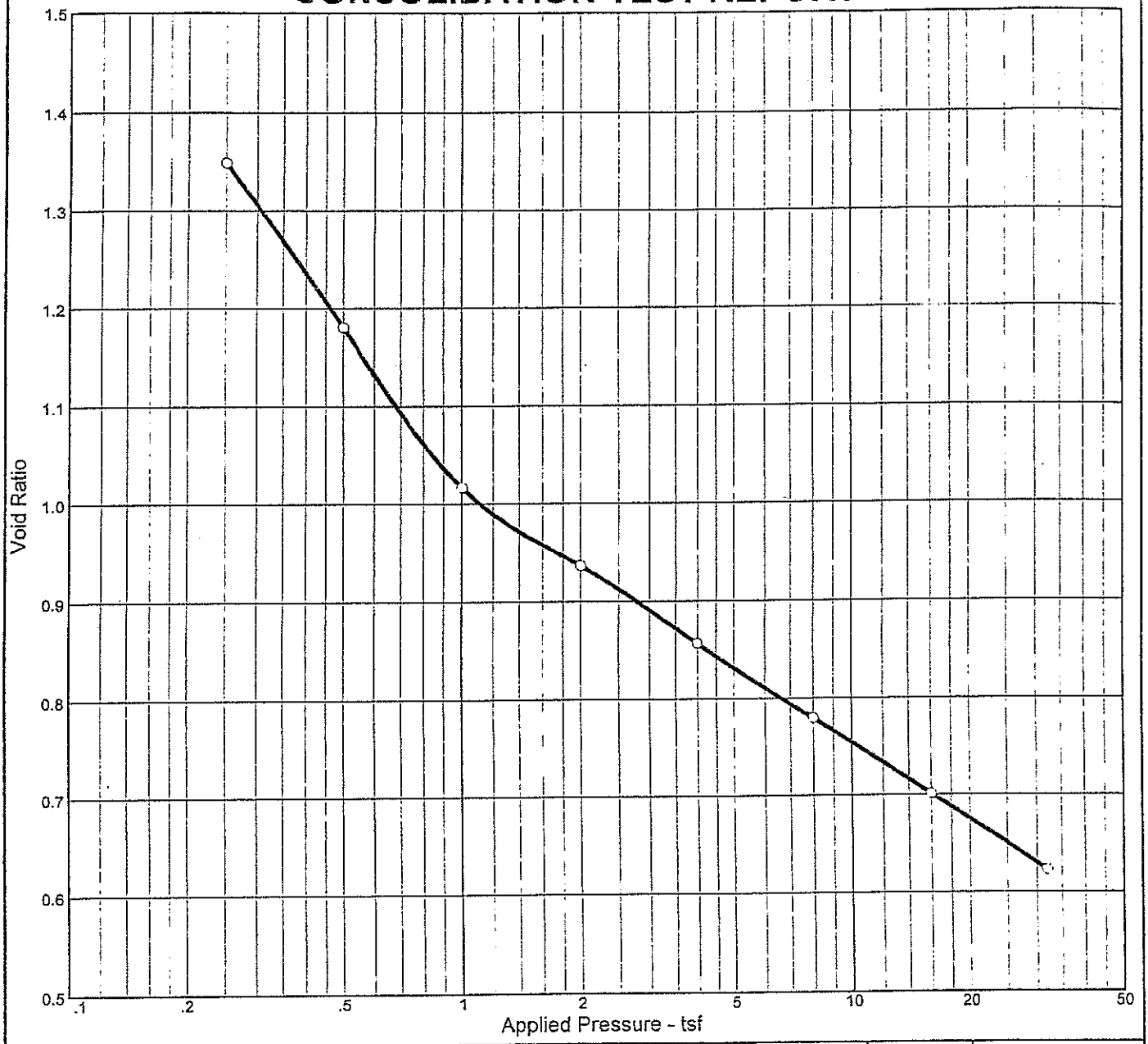
Client: Pond Creek Mine
Project: Proposed Slurry Cell
Location: Boring E-3 (48.5-50.0')
Project No.: H-07227

Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC _____ Checked By: TH _____

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture							
87.0 %	46.0 %	68.3			2.6	0.94	0.26	1.375

MATERIAL DESCRIPTION	USCS	AASHTO
Black Coal Slurry		

Project No. H-07227 **Client:** Pond Creek Mine

Project: Proposed Slurry Cell
Pond Creek Mine

Location: Boring E-3 (49.0-49.5')

CONSOLIDATION TEST REPORT

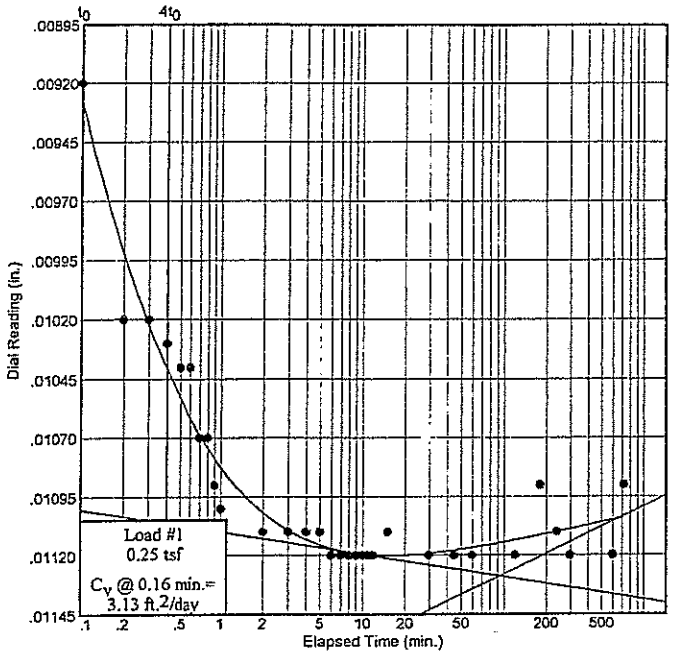
HOLCOMB FOUNDATION ENGINEERING CO.

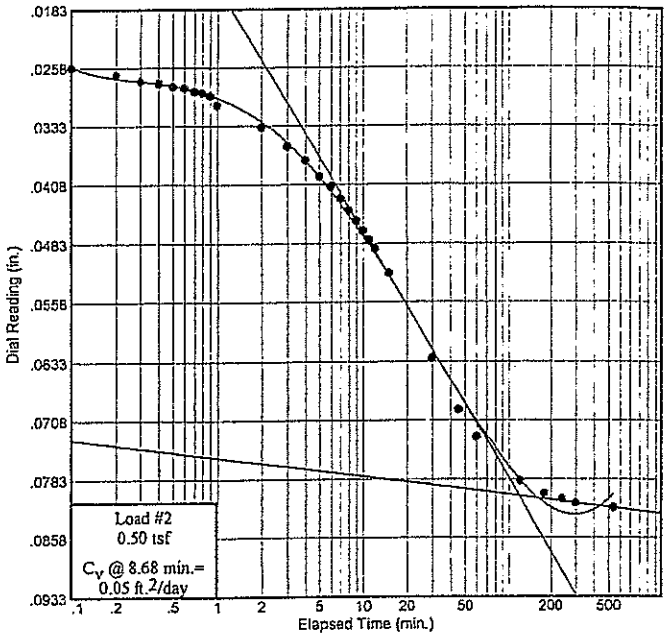
Remarks:

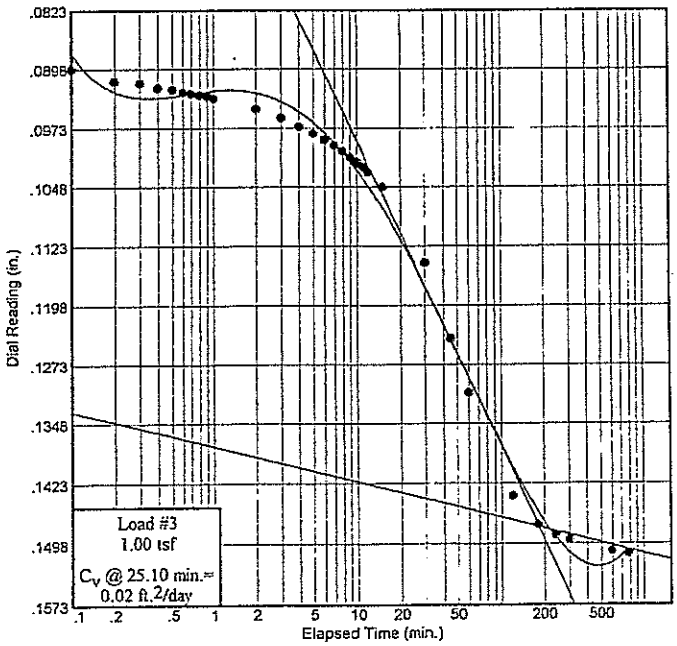
Plate

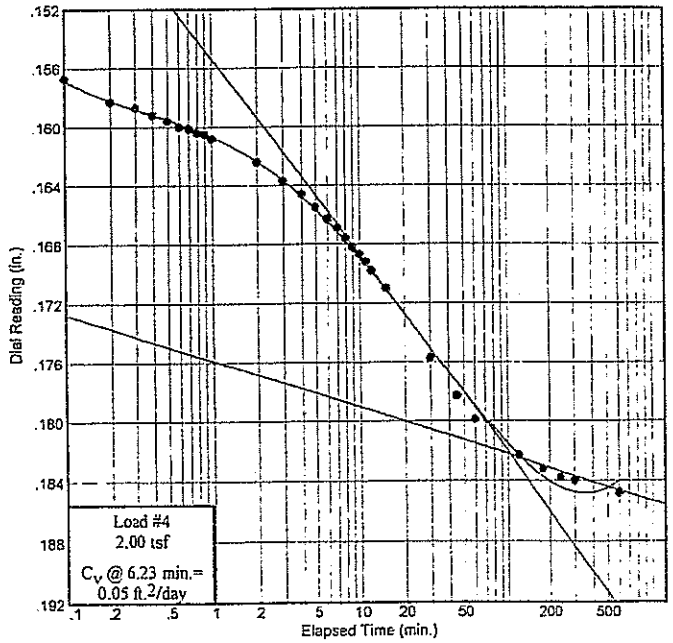
Dial Reading vs. Time

Project No.: H-07227
Project: Proposed Slurry Cell
Pond Creek Mine
Location: Boring E-3 (49.0-49.5')









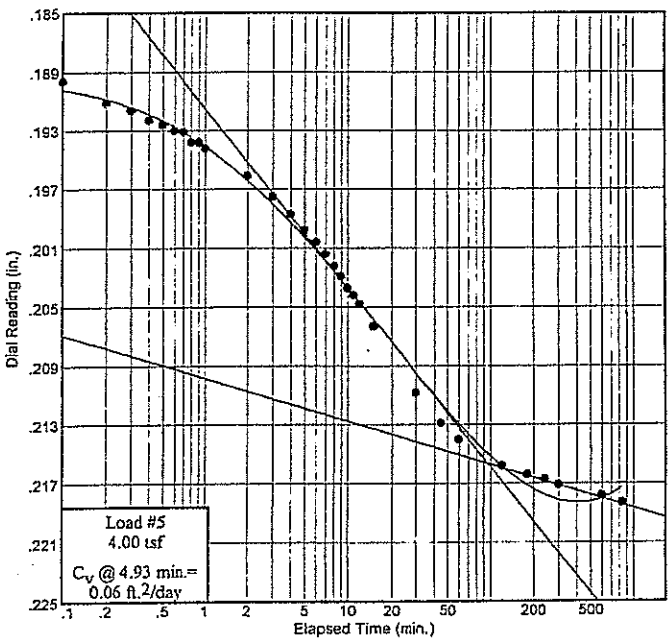
Dial Reading vs. Time

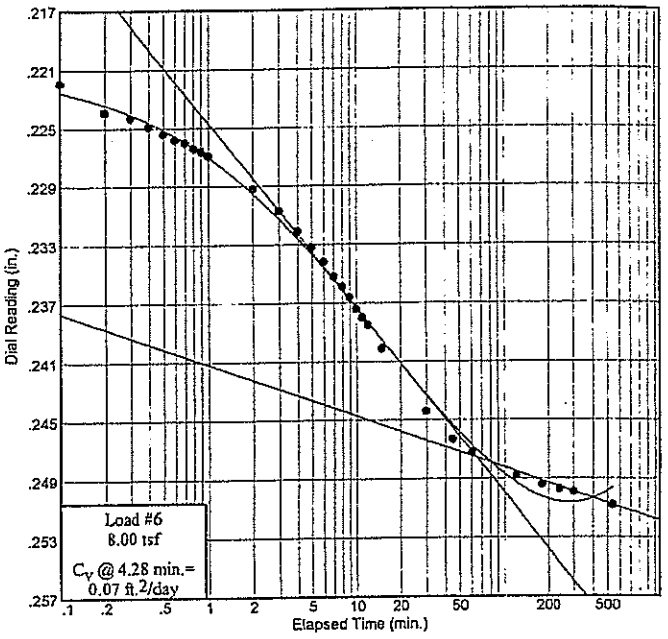
HOLCOMB FOUNDATION ENGINEERING CO.

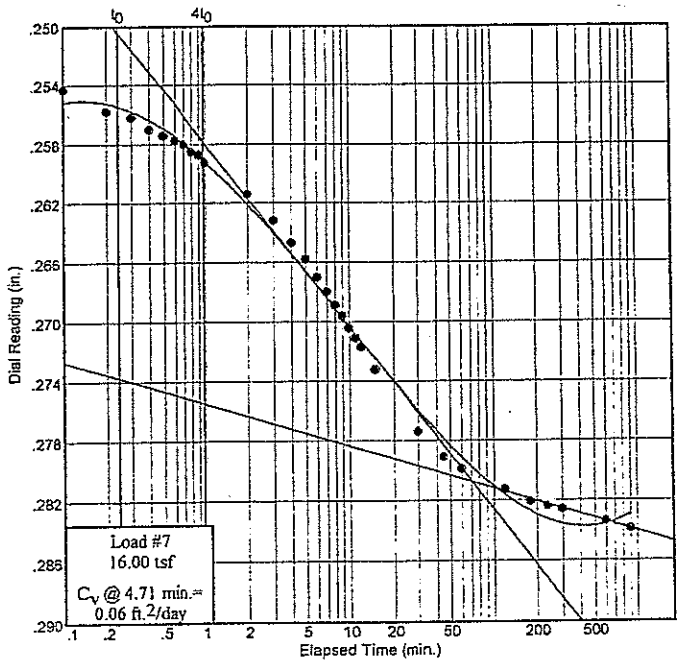
Plate

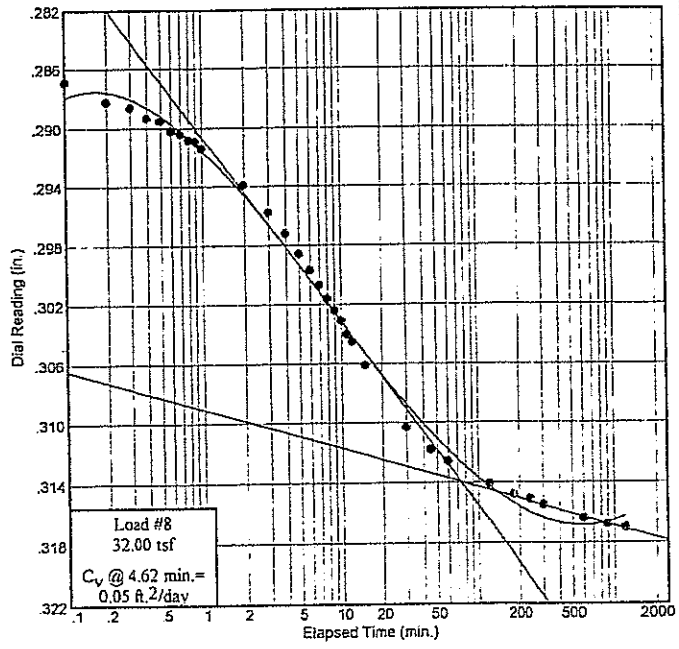
Dial Reading vs. Time

Project No.: H-07227
Project: Proposed Slurry Cell
Pond Creek Mine
Location: Boring E-3 (49.0-49.5')









Dial Reading vs. Time

HOLCOMB FOUNDATION ENGINEERING CO.

Plate

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Classification System is used to identify the soil unless otherwise noted.

RELATIVE DENSITY & CONSISTENCY CLASSIFICATION

TERM (NON-COHESIVE SOILS)	BLOWS PER FOOT
Very Loose	0 - 4
Loose	5 - 10
Firm	11 - 30
Dense	31 - 50
Very Dense	Over 50

TERM (COHESIVE SOILS)	QU (tsf)
Very Soft	0 - 0.25
Soft	0.25 - 0.50
Firm	0.50 - 1.00
Stiff	1.00 - 2.00
Very Stiff	2.00 - 4.00
Hard	4.00+

DRILLING & SAMPLING SYMBOLS

ss:	Split Spoon - 1 3/8" I.D., 2" O.D.
st:	Shelby Tube - 2.80"I.D., 3" O.D.
au:	Auger Samples
cs:	Continuous Sampling - 2.0" I.D.

SOIL PROPERTY SYMBOLS

⊗	Unconfined Compressive Strength, Qu, (tsf)
+	Penetrometer Value, (tsf)
	Plastic Limit (%)
O	Water Content (%)
	Liquid Limit (%)
X	Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2" O.D. Split Spoon

PARTICLE SIZE

Boulders	8 in. +	Medium Sand	0.6 mm to 0.2 mm
Cobbles	8 in. to 3 in.	Fine Sand	0.2 mm to 0.74 mm
Gravel	3 in. to 5 mm	Silt	0.074 mm to 0.0005 mm
Coarse Sand	5 mm to 0.6 mm	Clay	less than 0.005 mm

HIGH PLASTICITY

plasticity

Alliance Consulting, Inc.
Engineers · Constructors · Scientists
Beckley, WV

BY: HLO DATE: 9/28/2010 CHKD BY: _____ DATE: _____

PROJECT NAME: Williamson Energy LLC

PROJECT NO.: B09-341-1413 SHEET 1 OF 2

DESCRIPTION: Borehole Soil Testing - E and D Holes, Phases 2 and 3

File: D and E Holes1.xls, hlo, rev. 11/23/2010

Atterburg Limits

Borehole No.	Depth (Ft,)	%<#200	LL	PL	PI	W_N (%)	USCS	Soil Type
D-1	0 - 58					7.4 - 17.5		*CCR*
D-2	0 - 29					7.0 - 14.2		*CCR*
	29 - 59					34.1 - 48.3		*FCR*
D-3	8 - 10	43	30.2	17.4	12.8	10.0	SC	*CCR*
	18 - 20	79	34.8	20.4	14.4	31.8	CL	*FCR*
D-4	18 - 20	35	35.1	17.8	17.3	7.2	SC	*CCR*
	48 - 50	90	38.7	22	16.7	53.9	CL	*FCR*
E-1	0 - 28							*CCR*
	28 - 43							*FCR*
E-2	0 - 47							*CCR*
E-3 **	0 - 18.5							*CCR*
	18.5 - 20	45	33.6	11.7	21.9	8.4	SC	*CCR*
	48.5 - 49	93	39.6	23.1	16.5	49.2	CL	*FCR*
	49.5 - 50	91	42.6	22.7	19.9	47.6	CL	*FCR*
E-4	0 - 50							*CCR*
	8.5 - 10	46	32.6	9.6	12.3	9.6	SC	*CCR*
Bucket 1	-	93	36.0	19	17.0		CL	*FCR*
Bucket 2	-	93	36.0	19	17.0		CL	*FCR*

R12226

Alliance Consulting, Inc.
Engineers · Constructors · Scientists
Beckley, WV

BY: HLO DATE: 9/28/2010 CHKD BY: DATE:

PROJECT NAME: **Williamson Energy LLC**

PROJECT NO.: **B09-341-1413** SHEET **2** OF **2**

DESCRIPTION: **Borehole Soil Testing - E and D Holes, Phases 2 and 3**

File: D and E Holes4.xls, hlo, rev. 11/23/2010

Triaxial & Consolidation Tests

Borehole	Depth (ft.)	Φ'	C' (tsf/psf)	Φ	C	Cc	Soil Type
D-4	8 - 10	19.0	0.194/388	38.0	0		CCR
D-4	38 - 40	11.7	0.104/208	23.5	0	0.31	FCR
E-3	18.5 - 20.5	31.1	0.222/444	34.1	0		CCR
	48.5 - 50	5.0	0	9.9	0	0.26	FCR

Φ', C' = Total stress values
Φ, C = normal stress values
Cc = Conpression Index

W_N = In-place moisture content at time sample was obtained
PL = Plastic Limit
PI = Plasticity Index
LL= Liquid Limit

Soil Type - CCR is coarse coal refuse, FCR is fine coal refuse

R12227

Project C090403.01
November 18, 2010

APPENDIX C

MSHA APPROVAL LETTER – PHASES 3 THROUGH 6
NOVEMBER 12, 2009

U.S. Department of Labor

Mine Safety and Health Administration
Pittsburgh Safety & Health Technology Center
P.O. Box 18233
Pittsburgh, PA 15236

November 12, 2009

MEMORANDUM FOR JOSEPH O'DONNELL
Acting District Manager, District 8
Coal Mine Safety and Health

THROUGH: JOHN W. FREDLAND
Acting Chief, Pittsburgh Safety and Health Technology Center

FROM: STANLEY J. MICHALEK
Chief, Mine Waste and Geotechnical Engineering Division

SUBJECT: Recommendation for Approval of Design Plans for Phases 3 through 6, and Request for Additional Information for Phase 7, Refuse Disposal Facility No. 2, Impoundment I.D. No. 1211-IL08-03141-02, Mach Mining, LLC, Mach Mine No. 1, Mine I.D. No. 11-03141, Williamson County, Illinois

As requested by your office, a technical review of the subject proposed impoundment plans has been completed. Our review included an initial submittal and two revisions submitted in response to our requests for additional information. Report No. MW09-077, which is attached, indicates that the subject plans appear to be technically acceptable only through Phase 6 and approval through Phase 6 is recommended. Additional information will be required before we can recommend approval of Phase 7.

The proposed mining under Phase 3 will be the most significant event at this facility. Phase 3 must be closed and covered with a stable cap of coarse refuse, be incapable of impounding water or slurry, and all the proposed instrumentation must be in place and operational before the proposed longwall mining is advanced within 100 feet of any part of the Phase 3 embankment.

The Impoundment and IRPI data sheets have been completed for Phases 3 through 6 and are included with the report. Please contact this office if there are any questions regarding this review.

Attachment

cc: L. Zeiler – Acting Director, TS
M. Smith – Acting Chief, Safety Div., CMS&H

UNITED STATES DEPARTMENT OF LABOR

MINE SAFETY AND HEALTH ADMINISTRATION

PITTSBURGH SAFETY AND HEALTH TECHNOLOGY CENTER
MINE WASTE AND GEOTECHNICAL ENGINEERING DIVISION
COCHRANS MILL ROAD
P.O. BOX 18233
PITTSBURGH, PENNSYLVANIA 15236

REPORT NO. MW09-077

REVIEW OF DESIGN PLANS FOR PHASES 3 THROUGH 7 REFUSE DISPOSAL AREA NO. 2 MSHA I.D. NO. 1211-IL08-03141-02 MACH MINING LLC MINE I.D. NO. 11-03141 WILLIAMSON COUNTY, ILLINOIS

NOVEMBER 12, 2009

BY

PAUL J. DONAHUE, P.E.
CIVIL ENGINEER

REPORT NUMBER MW09-077

OWNERSHIP AND LOCATION

The Refuse Disposal Area No. 2 is owned and operated by Mach Mining, LLC and receives coarse and fine coal refuse from the preparation plant for the Mach No. 1 Mine. The site can be found on the USGS 7.5 Minute Pittsburg (IL) quadrangle map at geographic coordinates N 37°50'30" latitude and W 88°49'17" longitude. This facility is located on a tract comprising the east half of Section 12, Township 8S, and Range 3E, Third Principal Meridian.

MATERIAL REVIEWED

Original Design Submittal

The original submitted design documents were prepared for Mach Mining, LLC by Alliance Consulting, Incorporated (Alliance) and included the following.

1. A report entitled "Engineering Design Plan – Proposed Coal Refuse Disposal, Facility No. 2, Williamson County, Illinois, dated January 2007." The report included a narrative description of the proposed design, and the testing and analyses performed. Appendices to the report included construction specifications, calculations, geotechnical test boring and laboratory test data.

2. Thirteen drawings depicting plans, profiles and details of the proposed facility dated January 16, 2007.

During our review of this plan, Mr. Duffy Stradner, former District 8 Impoundment Specialist, notified this reviewer in a phone conversation on October 23, 2007, that the impoundment layout and geometry would be substantially revised and a new plan submitted. Due to proposed mining under the impoundments and other issues that would similarly affect the new design, we completed the review and requested additional information in a memorandum to Robert Phillips, District Manager, Coal Mine Safety and Health (CMS&H) District 8, dated December 13, 2007. The memorandum identified 14 design issues to be addressed in the revised design submittal.

First Revised Design Submittal

The revised design package for the coal refuse impoundments was hand delivered to our office on August 19, 2008, in conjunction with a meeting with Mach Mining and Alliance Consulting personnel to discuss the new design.

The design documents received at this meeting included the following items.

1. A report entitled "Response to February 11, 2008, Comments, I.D. No. IL08-03141-02, Mach Mining, LLC – Mach No. 1 Mine ID No. 11-03141, Williamson County, Illinois – Coal Refuse Disposal Facility No. 2 Phases 3 through 7," dated August 2008. Appendices to

the report contained construction specifications, various design calculations, geotechnical test boring logs, laboratory test data and a CISPM Mine Subsidence Analysis Report prepared by Dr. Syd Peng of West Virginia University.

2. Nineteen drawings, with revision dates from February 14, 2008, to July 7, 2008, depicting plans, profiles and details of the proposed facility.

In addition, the following additional materials were submitted concurrent with the review of this submittal.

1. A set of three drawings depicting longwall panel surface subsidence measurements at Baselines "A" through "D" located over the eastern end of longwall Panel No. 1 of the subject mine. These drawings are dated August 29, 2008, and were received by the Mine Waste and Geotechnical Engineering Division (MWGED) on September 3, 2008,

2. Two Drawings entitled "Map 6 UG - Operations Plan Map" and "Map 10 – Geologic columns," prepared by Alliance and dated December 3, 2004, and November 29, 2004, respectively, and received by MWGED on September 3, 2008.

In addition to the submitted document, we also gathered additional information, concurrent with the review, through phone and e-mail communication with Mr. Claudio Yon of Alliance and Dan Barkley of the Illinois DNR.

We completed our review of the new design and found eleven items requiring additional substantiating data or calculations and/or design changes. These were outlined in our memorandum to Robert Phillips, District Manager, CMS&H District 8, dated November 10, 2008.

Second Revised Design Submittal

The second revised design submittal was received by MWGED on July 20, 2009, and included the following.

1. A report volume entitled "Additional information- Volume 1 of 3, Comments 2, 4, 5, 6, 9, 10 and 11, Coal Refuse Disposal Facility No. 2 Phases 3 through 7," Impoundment ID No. IL08-03141-02 (MSHA ID No. 11-03141), Williamson County, Illinois," dated July 2009. This volume included new, revised and copies of previously submitted materials from the earlier August 2008 submittal and was prepared by Alliance.

2. A second report volume entitled "Additional information- Volume 2 of 3, Comments 1, 3, 7 and 8, Coal Refuse Disposal Facility No. 2 Phases 3 through 7," Impoundment ID No. IL08-03141-02 (MSHA ID No. 11-03141), Williamson County, Illinois," dated July 2009. This volume contained new calculations and analysis performed by GAI consultants for Alliance.
3. A third volume containing 22 drawings, with revision dates from July 8, 2009, to July 13, 2009, depicting plans, profiles, and details of the proposed facility.

4. An addendum to the submittal, received on August 21, 2009. This addendum included corrected transmittal letters and tables of contents, a revised drawing B05-330-M32 – Phase 5 Plan View, revised August 18, 2009, and revised Phase 5 dam underdrain calculations.

Additionally, prior to the receipt of this submittal, we received electronically transmitted drawings depicting a longitudinal dynamic subsidence survey over the advancing face of Longwall Panel No. 1 at a location immediately to the east of the future Phase 5. These drawings were received in our office on February 10, 2009. This survey was performed in response to comment No. 4 in the November 10, 2008, memorandum.

The results of our review of this revised design are discussed in this report.

BACKGROUND

The revised Refuse Disposal Facility No. 2 will provide for the disposal of about 3 ½ years of coarse coal refuse (CCR) and 6 years of fine coal refuse (FCR) that will be produced from the Pond Creek No. 1 Mine following closure of previously approved Facility No. 1 which included Phases 1 and 2. This facility is to be constructed in five phases – Phase 3 through Phase 7.

As planned, the facility will consist of three, approximately rectangular, diked impoundments aligned in a north-south direction and sharing common embankments between them. The southernmost impoundment will be constructed during Phase 3, with fine refuse placement starting upon completion of the embankment to the design crest height. The central impoundment will be constructed in three Phases (Phases 4, 6 and 7) with fine refuse placement starting during Phase 7, when the embankment will be about 50 percent of the total completed height. The northernmost impoundment will be constructed during Phase 5 and will be partly incised by excavating the footprint of the impoundment. Fine refuse placement in this impoundment will begin once Phase 3 is filled to capacity, and the Phase 5 embankment is about 80 percent complete.

The impoundments will cover about 200 acres, and all the impounding embankments will be raised longitudinally in segments using belt-delivered coarse coal refuse. The upstream and downstream slopes will be 3 horizontal to 1 vertical (3H:1V) except for Phase 3 which will have 2.6H:1V upstream slopes. Maximum embankment heights will range from 49 feet for Phase 3 to 100 feet for Phase 7. All embankments, with the exception of a portion of the Phase 7 central impoundment, will be founded on 15 to 22 feet of medium to stiff clay deposits overlying shale bedrock. The south-facing slope of the Phase 7 embankment will be founded on the impounded fine refuse of the adjoining Phase 3.

The designer considered the impoundments to be of high hazard potential classification for the purposes of hydrologic/hydraulic design. Following one year from the start of construction, all phases will be able to accommodate a rainfall volume of two PMF's with pumping capacity capable of drawing down one 72-hour PMF in 30 days. When the final crest elevation is reached, an 18-inch-diameter HDPE SDR 26 decant spillway will be installed and be capable of

drawing down 90 percent of one PMF in less than 10 days. The only exception is the Phase 3 impoundment. Because of an expected life of less than 1 year, this phase was designed to handle at least one half of a 72-hour PMF, but less than a full 72-hour PMF.

The most significant consideration for these impoundments will be the concurrent mining of three longwall panels in the 6.5-foot-thick Herrin No. 6 coal seam beneath the impoundment footprints. There are 430 to 450 feet of overburden, with at least 420 feet of this being rock, between the embankment foundations or impoundment bottoms and the Herrin No. 6 seam. Boring data indicates that about 75 to 90 percent of the overburden rock is shale. A sandstone unit, 200 to 240 feet above the No. 6 seam and ranging from 21 to 54 feet thick, is the only persistent competent unit encountered in the borings.

The development entries for the longwall mining have a calculated minimum pillar safety factor of 2.3 as calculated by the program ALPS. A minimum rock overburden thickness of about 65 times the mine height is present above the seam. Therefore, this facility complies with the guidance contained in Bureau of Mines publication IC 8741 for limiting breakthrough risk. However, subsidence from the longwall mining will considerably impact surface structures over the mine.

The subsidence effects on the proposed coal refuse impoundments will be largely mitigated by the proposed phasing of the impoundments. Except for Phases 3 and 4, all refuse placement will take place after mining has been completed beneath the impoundment and subsidence is substantially complete. For Phase 3, FCR placement will be completed to an elevation of 5 feet below the crest, about 9 months prior to longwall mining beneath the impoundment. A 5-foot-thick cover of coarse refuse, level with the crest, will be placed over the fine refuse in order to eliminate any impounded water before the mining advances beneath the impoundment. Phase 4 will consist of a 45-foot-high non-impounding embankment placed prior to mining. After the mining, the 300-foot-wide Phase 6 embankment will buttress the downstream slope of the Phase 4 embankment. The width of this embankment is expected to mitigate any possible effects of subsidence-related damage to the Phase 4 embankment.

The planned mining beneath the Phase 3 impoundment, a short time after filling and capping of this impoundment, is the most significant issue in evaluating the subsidence impacts. There is currently little engineering experience in accommodating longwall mining under a coal refuse impoundment and a conservative consideration of all possible potential failure modes and mitigatory measures was the primary item of concern in the review of this plan.

REVIEW DISCUSSION

The submittal received on July 20, 2009, provided responses to the eleven items of additional information that were requested in the November 10, 2008, memorandum. Additionally the submitted addendum included a revised plan for the Phase 5, which will be enlarged by locating its north dike approximately 250 feet further north.

Phase 7 Stability

The submittal did not satisfactorily address comment Nos. 7 and 8 in the November 10, 2008, memorandum. These comments noted that a stability analysis of the Phase 7 south dike, which will be founded on the settled Phase 3 FCR, had not been performed and requested this analysis be performed along with a seismic liquefaction and deformation analysis. The submitted analysis in response to these comments included only an analysis of the less-critical completed Phase 7C configuration, and not the critical Phase 7A, which will entail advancing the 38-foot-high south dike embankment over the thin cover overlying the consolidating fine refuse. An independent check calculation using the "SlopeW" stability analysis program and normalized undrained strength parameters for the FCR developed in the submittal indicated a short-term post construction safety factor for the south dike of Phase 7A of considerably less than one. Therefore, Phase 7A, as currently planned, will require design revisions before MWGED can recommend approval.

Subsidence Impacts - Phase 3 Impoundment

The largest part of the most recent submittal consisted of various analyses and new test data submitted as justification for the proposed longwall mining beneath the capped Phase 3 impoundment, as requested in items 1 through 3 of the November 10, 2008, memorandum. MWGED performed this review in conjunction with a literature review of soil behavior when subjected to tensile strains and a published case-study of longwall mining under an impoundment in West Virginia.(1)

The Phase 3 impoundment is located so the dike bounding the FCR pool to the north is centered over the Panel's 2 and 3 gateroad development entries, the east and west dikes extend southward to approximately the center of the longwall panel, and the south dike runs along the center portion of the panel. The panel width (1,400 feet) with respect to depth is such that subsidence is supercritical, so the south dike will be subjected only to transient tensile, then compressive, strains in a longitudinal direction as the mine face advances east to west. The east and west dikes will be subjected to permanent tensile strains near the northwest and northeast corners of the impoundment and the north dike will be subjected to significant strains only near the inside toe.

Assuming the impoundment is capped and no longer impounding water at the time the longwall panel is advanced, the specific potential failure mechanisms that were examined for the Phase 3 impoundment included:

(1) Choi, D. S., et al, 1997, "A Case Study of Undermining Impoundment Embankment by the Longwall Mining Method," Proc. 36th US Rock Mechanics Symposium

1. Stability failure of the CCR embankment due to deformations and weakening from subsidence-induced shear strains and cracking.

2. The potential for the development of large, persistent transverse cracks in the CCR embankment or foundation materials capable of releasing flowable FCR. The calculated horizontal strains induced by the subsidence, using revised CISPM model calculations calibrated to actual subsidence measurements at this mine, is about 30 microstrain (3 percent).

3. Weakening and/or liquefaction of the FCR due to subsidence strain-induced pore pressures in conjunction with transverse cracking, possibly resulting in flow into, and/or erosion of, cracks in the CCR.

CCR Embankment Stability Under Subsidence Condition

In order to evaluate the possibility of the first of these mechanisms, a separate analysis performed by GAI Consultants for Alliance applied data from existing triaxial test data of the coarse refuse (CU with pore pressures) to the formula developed for the double-punch shear test developed by Fang and Chen[2] to determine a tensile strength for the CCR. The consolidation stresses for each test point were then corrected for equivalent effective vertical stress (σ'_v) and used to develop a "normalized tensile strength" ratio ($\sigma_t/\ \sigma'_v$) of 0.15 for the CCR. Using this ratio, an average tensile strength of C=475 psf and φ=0 degrees was used in a slope stability analysis to obtain a worst-case stability safety factor for the subsidence disturbed embankment of 1.10. We do not believe the derivation of this strength is technically correct. However, the strength parameter derived appears to be very conservative for coarse coal refuse in even the loosest condition. An independent analysis showed a factor of safety of 1.3 was achieved with φ=19 degrees, which is lower than CCR in its loosest condition based on the typical angle of repose of this material. Therefore, slope failure of the CCR embankment from subsidence-induced shear is very unlikely.

CCR and Foundation Cracking Susceptibility Under Subsidence

The second failure mechanism that was evaluated was the potential for large persistent cracks through the CCR embankment which, in conjunction with the third mechanism, could result in a breach and release of flowable FCR. The submitted data showed the CCR produced at the plant is a well graded gravel material (USCS classification GW) with very little fines (2.0 to 2.5 percent passing the No. 200 sieve). The gradation of oven-dried, compacted Proctor test specimens prepared by Alliance was somewhat higher, with an average of 30 percent passing the No. 200 sieve and was classified under the USCS system as "SC," a clayey sand. However, the lab sample preparation and oven drying likely produced a material with more fines than in the constructed embankment.

(2) Fang, H.Y. and Chen, Wai-Fai, "Determination of Tensile Strength of Soil by Unconfined Penetration Test," ASTM STP-740, R.N Young Ed., 1981

The gradation of the CCR and the foundation soil was compared to published correlations of deformation cracking and piping potential. The CCR as delivered to the impoundment prior to compaction is a cohesionless material and is not subject to cracking. The laboratory compacted and oven-dried CCR material was evaluated as having a medium deformation and cracking potential. However, this material is not likely to be representative of the material in the embankment which will have less fines; therefore, the overall deformation cracking susceptibility of the CCR was evaluated to be low.

The foundation soils are moderately plastic clays (USCS classification CL with a plasticity index of 24). These materials were evaluated as having low cracking potential because such materials in a saturated condition are subject to deformation rather than cracking under the expected strains. Mr. Harold Owens reported, in a phone conversation on June 4, 2009, that aside from a 1-inch-wide crack in desiccated materials, no obvious cracking was observed in the clayey native soils over the previously advanced Longwall Panel No. 1 in the future Phase 5 area. Considerable cracking was observed in a more brittle asphalt and chip pavement that crossed the edge of the panel. Due to the possibility of localized higher than predicted tensile deformations at any surface point over longwall panel edges, the development of significant cracks in the foundation and embankments is low but cannot be excluded.

A similar evaluation was performed for the piping resistance of the foundation and CCR materials. Piping resistance was evaluated as "high" for the foundation clay and plant-run CCR materials, and medium for the laboratory compacted materials. While not addressed in the submittal, we believe that if the impoundment is capped and not impounding water, there will be insufficient seepage water to erosively propagate any piping even if persistent cracks develop in the embankment. Therefore, for a capped impoundment, cracking and subsequent internal erosion via seepage piping is an unlikely possible failure mode.

Subsidence Induced FCR Flow Through Cracks

The third potential subsidence induced failure mechanism examined was the possibility of flowage of fluid FCR through large transverse cracks in the embankment or foundation. As described above, such cracks are unlikely, but cannot be precluded. However, if the FCR is not in a sufficiently flowable state, the cracking will be inconsequential, and this mode of failure can be precluded.

The most recent submittal provided the results of laboratory testing and an analysis of the potential for triggering strength loss (liquefaction) for the FCR under cyclic stresses from either earthquakes or the advancing subsidence across the impoundment. The FCR produced at the Mach Mine preparation plant was bulk-sampled and characterized as a fine grained plastic material with 93 percent passing the No. 200 sieve and more than 99 percent passing the No. 40 sieve. The liquid limit was 36 and the plasticity index was 17 and the material was classified under the USCS classification system as "CL."

The submittal included calculations from two triaxial tests performed on remolded FCR specimens prepared from bucket samples of the slurry produced by the preparation plant. These calculations showed a post-seismic strength ratio (S_{us}/ σ'_v) of 0.24, which is only slightly less than the peak (S_u/ σ'_v) value of 0.27. If fully consolidated, these materials are not flowable under any anticipated seismic or mine subsidence conditions. However, the fine grained FCR at this facility is likely to dissipate excess pore pressure and consolidate under self-weight very slowly, so the undrained strength of the FCR at the time of mining is likely to be the most critical condition, with a very weak upper FCR layer being potentially flowable through cracks extending through the embankment. The submittal did not include specific calculations addressing this scenario; however, a CCR cap with a minimum thickness of 5 feet is specified to be placed over the impoundment prior to mining. It is expected, based on MWGED's previous observations and independent calculations, that when CCR is pushed-out over the FCR, the upper materials with undrained strength (S_u) less than at least 150 pounds per square foot will be displaced during the pushout process and therefore are unlikely to be present beneath the pushout. The FCR and/or mixed FCR and CCR material that has reached an S_u of at least 150 psf is not flowable through a cracked embankment except in conjunction with erosive water flow, which will be precluded by the CCR cover. Therefore, provided that the Phase 3 impoundment is capped as shown in the submitted design, a failure by FCR flowage through cracks in the CCR embankment is also unlikely.

CONCLUSIONS AND RECOMMENDATIONS

MWGED noted some deficiencies in the submitted responses to our request for information; however, check calculations show the results of the analyses are conservative and the construction of this facility through Phase 6 is technically satisfactory. However, the submittal did not substantiate the stability of the Phase 7A south embankment which will be constructed over Phase 3A fine refuse, and an independent analysis performed in this office found that the design as currently planned will not be stable under static or seismic conditions. Therefore, approval is recommended through Phase 6 only. Additional information and design revisions as needed to substantiate the static and seismic stability of Phase7A will be needed before approval of this stage can be recommended.

Our recommendation for approval assumes the facility is constructed strictly in accordance with the submitted plan. In particular, the Phase 3 impoundment must be capped with a stable CCR cover and incapable of impounding water before longwall mining approaches the impoundment. Also, per the submitted Specification 6.03 for enhanced monitoring, the operability of all the specified instrumentation and preparations for the contingency buttress shall be verified by the operator's engineer before the longwall mining face is within 100 feet of any part of the Phase 3 capped impoundment.

The CCR embankments at this facility will be constructed in 500- to 600-foot-long longitudinal segments in order to take advantage of belt delivery of the CCR to the placement location. In order to assure the segments are adequately compacted and keyed into the adjoining segments, a specific placement plan was developed and is included in Appendix E of Volume 1 of the

submitted plan. This placement plan, particularly the use of the specified equipment, maximum push distances, and excavation of keys into the adjoining segment should be strictly followed.

The design report narratives and test data should also be considered part of the approved plan. If dam or foundation materials or conditions are discovered that are different than those described in the submitted reports, the plan should be modified as needed to address the changed conditions and submitted to MSHA for approval. In particular, the safety of this facility is contingent on the adherence to the specific mining schedule shown in Drawing B05-330-M36 -Mining/Impoundment Construction Timing Map, revised July 10, 2009.

Approved Plan Documents

Care should be taken to assure the most recent revisions to the drawings and specifications are incorporated into the revised plan documents. The approved plan consists of all the documents listed in the section of this report titled "Second Revised Design Submittal" with the exception of drawing B05-330-M33 – Phase 7 – Plan View and any other Phase 7 details shown on other drawings.

Report Prepared by:

Paul J. Donahue, P.E.
Civil Engineer

Report Approved by:

Darren J Blank, P.E.
Supervisory Civil Engineer

IRPI DATA FROM IMPOUNDMENT PLANS

Date 10/19/2009 Completed by: PJD

(2) State IL (2) County Williamson

(3) Impoundment Name Mach Mine South Impoundment (Phase 3)

(4) Impoundment ID No. 1211-IL08-03141-02

(8) All Information Pertains to Construction Stage 3

(9) Nearest Downstream City/Town West Frankfort, IL (10) Distance to Nearest City/Town (mi.) 6.5

(11) Latitude N 37.8389 (Degrees + (Minutes/60) + (Seconds/3600)) (12) Longitude W 88.8222 (Degrees + (Minutes/60) + (Seconds/3600))

(15) Stream impoundment is located on or tributary to: Pond Creek

(16) Section/Range/Township East Half of S12, R3E, T8S, 3rd PM

(20) Company or consultant who prepared plan Alliance Consulting Inc.

(35) Foundation Type (rock; rock and soil; soil; unknown) Clay/Silt Soil ~ 12 to 20 ft thick over Shale

(37) Core Type (earth, plastic, etc.) None

(38) Core Position (Upstream, Homogeneous, Core) [ ] U [X] H [ ] C

(40) Type of Construction (Upstream, Downstream, Centerline) [ ] U [ ] D [X] C

(41) Dam Crest Length 5,450 ft. - Rectangular diked structure feet

(42) Structure Height (from downstream toe) 52 feet

(43) Open Channel Spillway Type [ ] Controlled [X] Uncontrolled [ ] None

(44) Spillway Width at Maximum Discharge N/A feet

(45) Maximum Storage 812 (@ min freeboard) acre-feet

(46) Normal Storage 750 (@ riser elev 494.8) acre-feet

(47) Maximum Discharge 14.8 cfs

(49) Drainage Area 35.0 Acres square miles

(50) Surface Area 30.9 Acres acres

(51) Decant Pipe Type SDR 26 HDPE

(52) Decant Pipe Diameter (ID) 16.6 inch (Pipe and Riser) inches

(54) Mining Underneath or Adjacent: [X] Yes [ ] No

(55) Hazard Potential Classification [X] High [ ] Significant [ ] Low

IRPI DATA FROM IMPOUNDMENT PLANS

Date 10/26/2009 Completed by: PJD

(2) State IL (2) County Williamson

(3) Impoundment Name Mach Mine Center Impoundment First Crest Elev. (Phase 4/6)

(4) Impoundment ID No. 1211-IL08-03141-02

(8) All Information Pertains to Construction Stage 4/6

(9) Nearest Downstream City/Town West Frankfort, IL (10) Distance to Nearest City/Town (mi.) 6.5

(11) Latitude N 37.8427 (Degrees + (Minutes/60) + (Seconds/3600)) (12) Longitude W 88.8212 (Degrees + (Minutes/60) + (Seconds/3600))

(15) Stream impoundment is located on or tributary to: Pond Creek

(16) Section/Range/Township East Half of S12, R3E, T8S, 3rd PM

(20) Company or consultant who prepared plan Alliance Consulting Inc.

(35) Foundation Type (rock; rock and soil; soil; unknown) Clay/Silt Soil - 15 to 20 ft thick over Shale

(37) Core Type (earth, plastic, etc.) None

(38) Core Position (Upstream, Homogeneous, Core) U [ ] H [X] C [ ]

(40) Type of Construction (Upstream, Downstream, Centerline) U [ ] D [X] C [ ] Ph 6 placed as outer Buttress of Ph. 4

(41) Dam Crest Length 3750 ft. Rectangular diked structure feet

(42) Structure Height (from downstream toe) 47 feet

(43) Open Channel Spillway Type [ ] Controlled [ ] Uncontrolled [X] None

(44) Spillway Width at Maximum Discharge N/A feet

(45) Maximum Storage 1066 (@ 3 ft. freeboard) acre-feet

(46) Normal Storage 805 @ storm evacuation pump elev 481 acre-feet

(47) Maximum Discharge N/A cfs

(49) Drainage Area 46.6 Acres square miles

(50) Surface Area 31.3 acres

(51) Decant Pipe Type None

(52) Decant Pipe Diameter (ID) None inches

(54) Mining Underneath or Adjacent: [X] Yes [ ] No

(55) Hazard Potential Classification [X] High [ ] Significant [ ] Low

IRPI DATA FROM IMPOUNDMENT PLANS

Date 10/19/2009 Completed by: PJD

(2) State IL (2) County Williamson

(3) Impoundment Name Mach Mine North Impoundment (Phase 5)

(4) Impoundment ID No. 1211-IL08-03141-02

(8) All Information Pertains to Construction Stage 5

(9) Nearest Downstream City/Town West Frankfort, IL (10) Distance to Nearest City/Town (mi.) 6.5

(11) Latitude N 37.8465 (Degrees + (Minutes/60) + (Seconds/3600)) (12) Longitude W 88.8202 (Degrees + (Minutes/60) + (Seconds/3600))

(15) Stream impoundment is located on or tributary to: Pond Creek

(16) Section/Range/Township East Half of S12, R3E, T8S, 3rd PM

(20) Company or consultant who prepared plan Alliance Consulting Inc.

(35) Foundation Type (rock; rock and soil; soil; unknown) Clay/Silt Soil – 20 to 25 ft thick over Shale

(37) Core Type (earth, plastic, etc.) None

(38) Core Position (Upstream, Homogeneous, Core) [ ] U [X] H [ ] C

(40) Type of Construction (Upstream, Downstream, Centerline) [ ] U [ ] D [X] C

(41) Dam Crest Length 5,260 ft. - Rectangular diked structure feet

(42) Structure Height (from downstream toe) 51 feet

(43) Open Channel Spillway Type [ ] Controlled [X] Uncontrolled [ ] None

(44) Spillway Width at Maximum Discharge N/A feet

(45) Maximum Storage 1382 (@ 3 ft. freeboard, excl. incised portion) acre-feet

(46) Normal Storage 750 (@ riser elev 488 excl incised portion) acre-feet

(47) Maximum Discharge 16.1 cfs

(49) Drainage Area 38.4 Acres square miles

(50) Surface Area 36.0 acres

(51) Decant Pipe Type SDR 26 HDPE

(52) Decant Pipe Diameter (ID) 16.6 inch (Pipe and Riser) inches

(54) Mining Underneath or Adjacent: [X] Yes [ ] No

(55) Hazard Potential Classification [X] High [ ] Significant [ ] Low

IMPOUNDMENT DATA SHEET

Completed by: PJD Date 27 October 2009
All Information Pertains to Construction **South Impoundment (Stage 3)**
Impoundment Name **Mach Mine Coal Refuse Impoundment**
Site ID No. **1211-IL08-03141-02**

Hazard Potential Classification ☒ High ☐ Significant ☐ Low

CONFIGURATION

Maximum Crest Elevation **500.00** feet
Minimum Crest Width **30** feet
Minimum Required Freeboard from Max. Normal Pool to Crest is **5.20** feet

Decant Pipe
Material Type **SDR 26 HDPE**
Inside Diameter **16.6** inches
Inlet Elevation **494.8** feet

Open Channel (Emergency) Spillway
Invert Elevation **N/A** feet
Bottom Width feet
Lining Type

Embankment Slopes
Upstream **2.6H:1V**
Downstream **3.0H:1V**

Embankment Benches
Width **20.0** feet
Vertical Interval **40.0** feet

Groin Ditches
Lining Type N/A

COMPACTION

Compaction Test Frequency 1 Test per 2000 CY or min. 1 per lift
Moisture Content Range minus 2.00 % to plus 3.00 %
Compaction Density Standard 95.00 % Lift Thickness(es) 12.00 inches

INSTRUMENTATION

Standpipe Piezometers Piezometer No.	Maximum Allowable Water Elevation (feet)
P-6	463
P-7	475
P-8	487

Pneumatic Piezometers Piezometer No.	Maximum Allowable Pressure (PSI)*
PN-1	10.0
PN-2	10.0
PN-3	6.5
PN-4	6.5

See sheets E39 and E48 for Tip elevations.

Inclinometers:

Inclinometer No.	Action Criteria
I-1	1. Development of Breaks or other discontinuities in profile; or
I-2	2, Continued steady movement more than1 week after mine face passes borehole location
	3. Accelerating movement later than 3 days after mine face passes borehole location

Subsidence Profile Baselines "G" and "H" are to be used to verify previous subsidence predictions and interpret other instrument data. No action criteria are applicable.

* Pneumatic Piezo readings are to be used to measure pore pressure changes associated with consolidation of the FCR and from mine subsidence related shear strains.

CRITICAL CONSTRUCTION ITEMS

The most critical event affecting this phase will be the Longwall Panel No. 3 mining beneath this impoundment expected to occur mid-July through August, 2010. The following measures must be strictly implemented. **No mining within 100 feet of the projected footprint of the Phase 3 embankment should be permitted until the following measures are in place:**

1. The CCR cap over the settled FCR must be in place, sloped for drainage, and any capability to impound any water removed. **This is a critical measure.**

2. All instrumentation shown on drawing M30 and E47 (Piezometers and inclinometers) and M36 (Subsidence Baselines) are in place and operable. Also see Specification 2.05 through 2.07 and Appendix F – Subsidence Monitoring Plan

3. The procedures in Specification Section 6.03 – Enhanced Monitoring must be strictly followed.

IMPOUNDMENT DATA SHEET

Completed by: PJD Date 27 October 2009
All Information Pertains to Construction Central Impoundment (Stage 4/6)
Impoundment Name **Mach Mine Coal Refuse Impoundment**
Site ID No. **1211-IL08-03141-02**

Hazard Potential Classification ☒ High ☐ Significant ☐ Low

CONFIGURATION

Maximum Crest Elevation **492.00** feet
Minimum Crest Width **100** feet
Minimum Required Freeboard from **Pump Activation Elevation** to Crest is **8.0** feet

Decant Pipe — Material Type **None – pump with min capacity of 1902 gpm will be used**
Start Pumping at **481.0** feet

Open Channel (Emergency) Spillway — Invert Elevation **N/A** feet
Bottom Width feet
Lining Type

Embankment Slopes — Upstream **3.0H:1V**
Downstream **3.0H:1V**

Embankment Benches — Width **None** feet
Vertical Interval feet (One bench near toe)

Groin Ditches — Lining Type N/A

COMPACTION

Compaction Test Frequency 1 Test per 2000 CY or min. 1 per lift
Moisture Content Range minus 2.00 % to plus 3.00 %
Compaction Density Standard 95.00 % Lift Thickness(es) 12.00 inches

INSTRUMENTATION

Standpipe Piezometers Piezometer No.	Maximum Allowable Water Elevation (feet)
P-12	445
P-13	450
P-15	451
P-16	465

See Sheets E12, Section D-D and E39 Section G-G for tip elevations. No FCR placement will be placed and impoundment will normally be dry.

CRITICAL CONSTRUCTION ITEMS

Stages 4/6 will be normally maintained in a dry condition. FCR placement will not start until Stage 7 raise is 50% complete. A pump will be provided for evacuation in event of a severe storm. See Appendix G.

Stage 4 will be constructed then undermined by the advance of Longwall panel No. 2. A thorough post-subsidence inspection is required before constructing the Stage 6 on the outer slope of Stage 4.

IMPOUNDMENT DATA SHEET

Completed by: PJD Date 27 October 2009
All Information Pertains to Construction North Impoundment (Stage 5)
Impoundment Name Mach Mine Coal Refuse Impoundment
Site ID No. 1211-IL08-03141-02

Hazard Potential Classification ☒ High ☐ Significant ☐ Low

CONFIGURATION

Maximum Crest Elevation 500.00 feet
Minimum Crest Width 30 feet
Minimum Required Freeboard from Max. Normal Pool to Crest is 8.0 feet

Decant Pipe
Material Type SDR 26 HDPE
Inside Diameter 16.6 inches
Inlet Elevation 480.0 feet

Open Channel (Emergency) Spillway
Invert Elevation N/A feet
Bottom Width feet
Lining Type

Embankment Slopes
Upstream 3.0H:1V
Downstream 3.0H:1V

Embankment Benches
Width 20.0 feet
Vertical Interval 45.0 feet (One bench near toe)

Groin Ditches
Lining Type N/A

COMPACTION

Compaction Test Frequency 1 Test per 2000 CY or min. 1 per lift
Moisture Content Range minus 2.00 % to plus 3.00 %
Compaction Density Standard 95.00 % Lift Thickness(es) 12.00 inches

INSTRUMENTATION

Standpipe Piezometers Piezometer No.	Maximum Allowable Water Elevation (feet)
P-9	437
P-10	455
P-11	473

See Sheets E12, Section C-C for tip elevations. Piezometers relocated to North Dike, but all values are still applicable.

CRITICAL CONSTRUCTION ITEMS

CCR embankment fill will be placed in segments by belt delivery and dozer. The fill placement procedure described in Appendix E of the approved plan including drawing A-4 should be strictly followed.

APPENDIX D

CONTINGENCY BUTTRESS CONSTRUCTION TIME CALCULATION AND VOLUMES

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BY: HLO DATE: 11/12/2010 CHKD BY: _____ DATE: _____

PROJECT NAME: **Refuse Disposal Areas No's. 1 & 2, Williamson Energy LLC**

PROJECT NO. **B09-341-1413** SHEET 1 OF //

DESCRIPTION **Contingency Buttress Construction Times**
Phases 2 and 3

Equipment Available at Mine Site

Mach Mining Equipment - 2 Caterpillar D9 dozers, 1 Caterpillar 330 tracked excavator.

K. D. Crain & Sons Inc. - 2 Komatsu D65PX dozers, 1 Caterpillar D5L dozer, 1 Caterpillar 240 tracked excavator, 1 Caterpillar 330 tracked excavator, 1 Caterpillar D9L dozer, 3 Caterpillar MT 865 Challenger tracked tractors with 13 CY bowl scraper, & 1 MT875 Challenger tracked tractor with 13 CY bowl scraper. The contractor also has a number of Caterpillar 631 wheel tractor scrapers (25 CY) available if needed.

Cycle Times Reference: Caterpillar Performance Handbook, Edition 33, October 2002

The soil will be hauled from the soil stock pile (750,000 CY) to the crest of the Phase 2 and Phase 3 contingency buttress areas by Cat MT675C or Cat MT875C track tractor drawn bowl scrapers (about 13 CY capacity) or Cat 631G wheel tractor scrapers (about 24 CY capacity). The soil will then be pushed down slope and compacted by dozers. The buttress spreading and compacting will be concurrent with hauling soil from the stockpile.

Fixed Times: Loading - 0.9 minutes Maneuver & Dump - 0.7 minutes
Assume wait and other delays make hauling operation 75% effective.

The MT865C and MT875Ctractors have similar horsepower and speed to the Cat 631G tractors. Therefore can use the travel time curves for the 631G tractors for all of the tractors readily available.

Rolling Resistance (roadway is dirt flexing under load)
Tracked MT675C or MT685 tractors - 0 13 CY bowl scraper - 5% grade equilvalent
Cat 631 wheel tractor with 25 CY scraper - 5% grade equilvalent

Cycle Time =(Loading Time + Travel Time (Loaded) + Dump Time + Travel Time (Empty)) x 1.33

Travel Distances:

Phase No.	Stockpile to Toe (ft)	Grade (%)	Toe to Crest (ft)	Grade (%)	Ave. Haul Distance Along Crest (ft)	Grade (%)
2	1,800	0	360	8	1,225	0
3	2,600	0	250	12	1,400	0

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PROJECT NAME: Refuse Disposal Areas No's. 1 & 2, Williamson Energy LLC

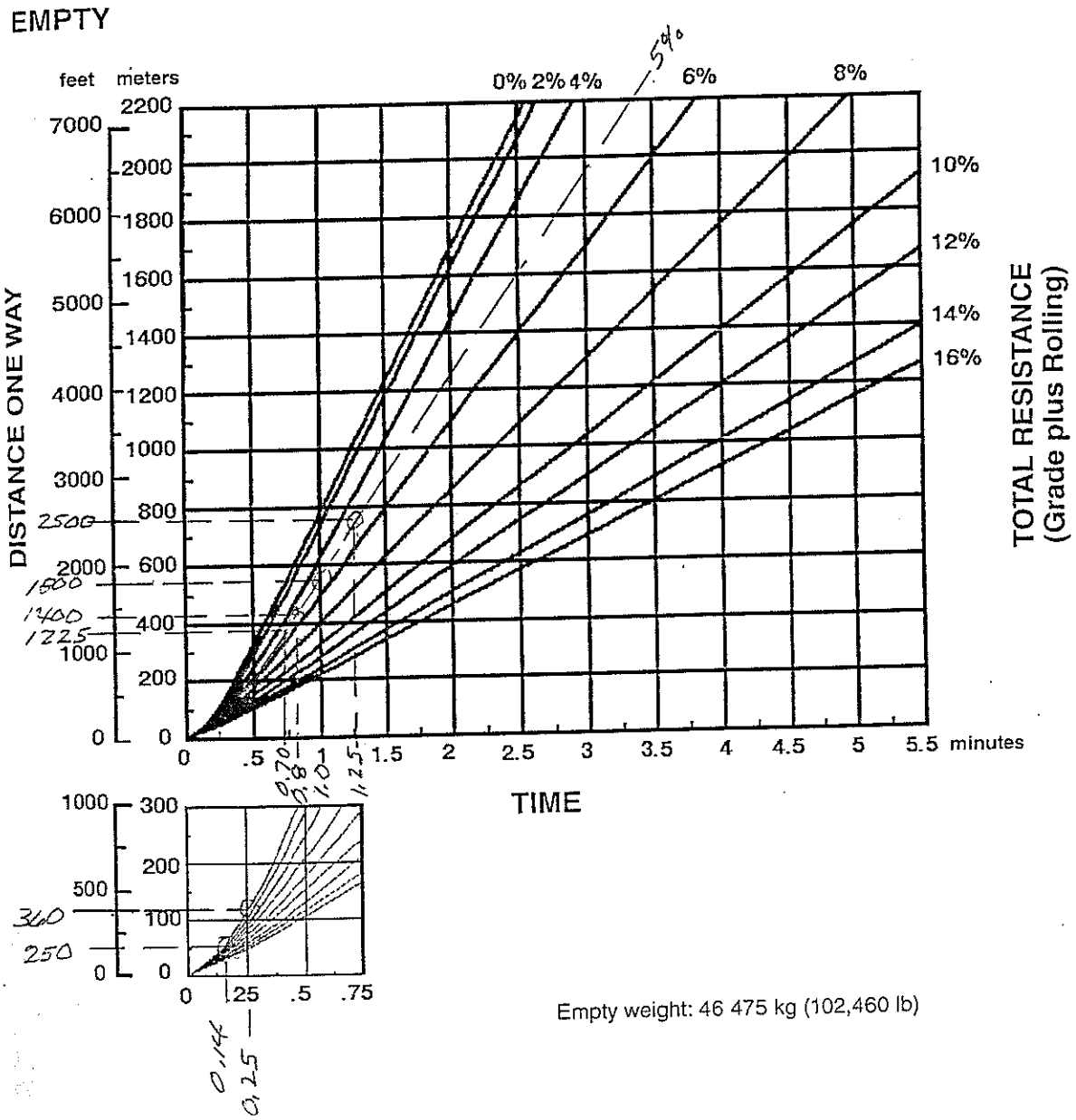
PROJECT NO. B09-341-1413 SHEET 2 OF //

DESCRIPTION Contingency Buttress construction Times

Phases 2 & 3

631G Travel Time — Empty
• 37.25R35 Tires

Wheel Tractor-Scrapers



Empty weight: 46 475 kg (102,460 lb)

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PROJECT NAME: Refuse Disposal Areas No's. 1 & 2, Williamson Energy LLC

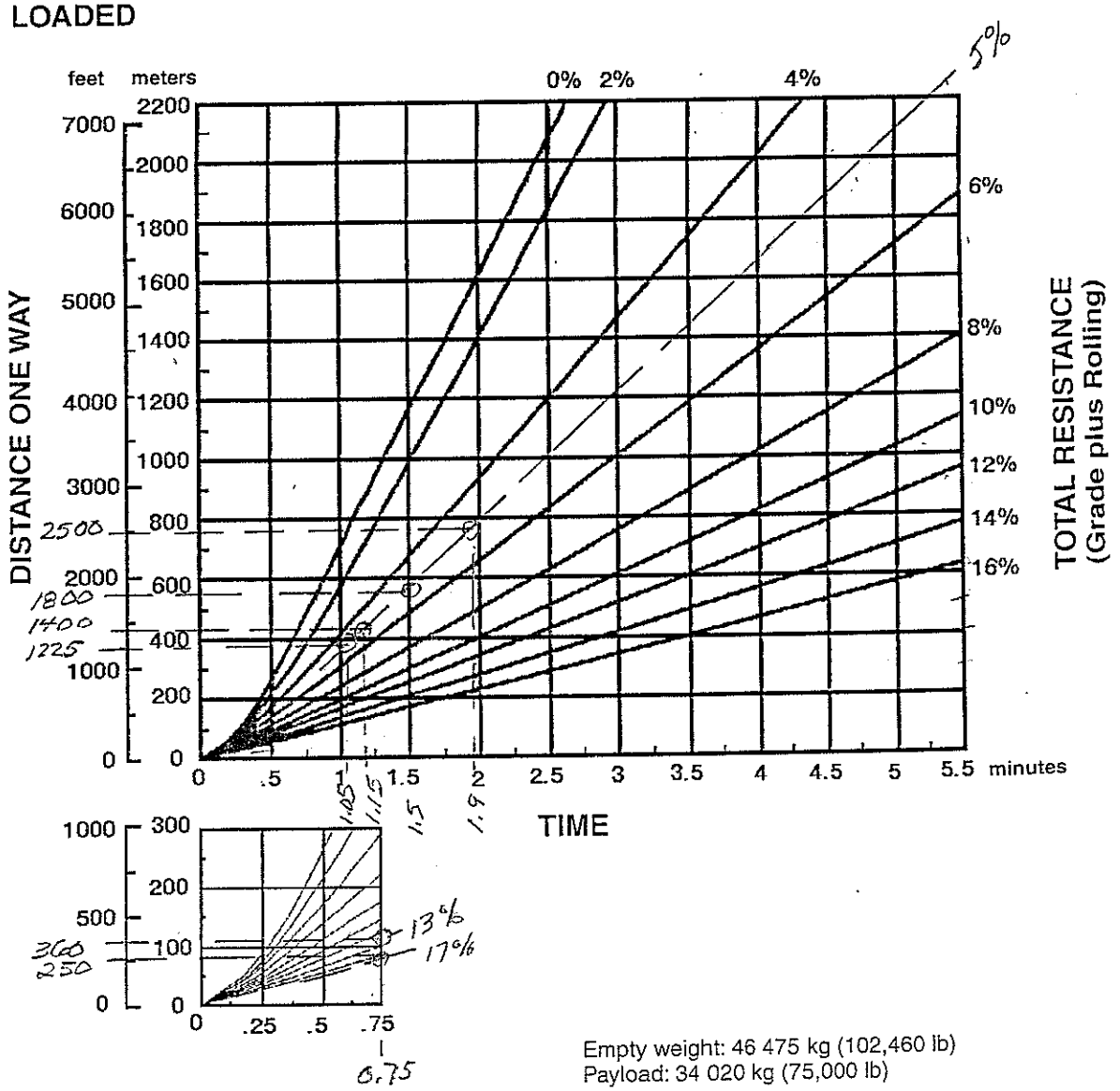
PROJECT N: B09-341-1413 SHEET 3 OF //

DESCRIPTION: Contingency Buttress construction Times

Phases 2 & 3

Wheel Tractor-Scrapers | 631G Travel Time — Loaded
• 37.25R35 Tires

LOADED



Empty weight: 46 475 kg (102,460 lb)
Payload: 34 020 kg (75,000 lb)

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BY: HLO DATE: 11/12/2010 CHKD BY: _____ DATE: _____

PROJECT NAME: Refuse Disposal Areas No's. 1 & 2, Williamson Energy LLC

PROJECT NO. B09-341-1413 SHEET 4 OF //

DESCRIPTION Contingency Buttress Construction Times
Phases 2 & 3

• • •

TYPICAL FIXED TIMES FOR SCRAPERS
(Times may vary depending on job conditions)

Model	Loaded By	Load Time (Min.)	Maneuver and Spread or Maneuver and Dump (Min.)
613C Series II	Self	0.9	0.7
615C Series II	Self	0.9	0.7
623G	Self	0.9	0.7
611	One D6R	0.5	0.7
621G	One D8R	0.5	0.7
627G	One D8R	0.5	0.6
621G	One D9R	0.4	0.7
627G	One D9R	0.4	0.6
627G/PP	Self	0.9*	0.6
631G	One D9R	0.6	0.7
637G	One D9R	0.6	0.6
631G	One D10R	0.5	0.7
637G	One D10R	0.5	0.6
637G/PP	Self	1.0*	0.6
651E	One D11R	0.6	0.7
657E	One D11R	0.6	0.6
657E	Push Pull Self	1.1*	0.6
621G	Auger	0.9	0.7
627G	Auger	0.7	0.7
631G	Auger	0.9	0.7
637G	Auger	0.8	0.7
651E	Auger	1.3	0.7
657E	Auger	1.0	0.7

*Load time per pair, including transfer time.

8-11

Phase 2 Cycle Time

Component	Time (minutes)
Loaded	
Stockpile load time	0.90
Stockpile to ramp	1.50
Ramp to crest	0.75
Crest to dump point	1.05
Dump time	0.70
Unloaded	
Dump point to ramp	0.70
Down ramp	0.25
Ramp to stockpile	1.00
Basic cycle time	6.85
Delay time	2.26
Total cycle time	**9.11**

Phase 3 Cycle Time

Component	Time (minutes)
Loaded	
Stockpile load time	0.90
Stockpile to ramp	1.90
Ramp to crest	0.75
Crest to dump point	1.15
Dump time	0.70
Unloaded	
Dump point to ramp	0.80
Down ramp	0.14
Ramp to stockpile	1.00
Basic cycle time	7.34
Delay time	2.42
Total cycle time	**9.76**

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PROJECT NAME: Refuse Disposal Areas No's. 1 & 2, Williamson Energy LLC

PROJECT NO. B09-341-1413 SHEET 5 OF //

DESCRIPTION Contingency Buttress Construction Times
Phases 2 & 3

Swell and Load Factors

Assume clay soil stockpile density = 110 pcf
Load Factor = 0.73, % swell = 37%
Assume clay soil loose density = 80 pcf (in scraper)
Ave. max. dry density of buttress = 112.4 pcf, Ave optimum moisture content = 14.4%
(see attached Proctor Curves for Samples S-1 and S-2)
Ave. density compacted buttress soil = $\gamma_{dry}(1 + w)$ = 112.4(1 + 0.141) = 130.9 pcf (say 131 pcf)

Net Load compaction factor = 80/131 = 0.61 (must haul 1.0/0.61 = 1.64 CY to get 1 CY compacted fill)

Full Height Contingency Buttress Volumes
Phase 2 = 125,320 CY (see accompanying computation sheet for volumes)
Phase 3 = 175,130 CY

Construction Times (Full Height Contingency Buttress using two 13 CY Scrapers)

Phase 2 = (125,320 CY)(9.11 min./load)/((0.61)(13 CY/load)(2 scrapers))
= 71,984 min. = 1,200 hrs = 50.0 days (2,506) CY/day)

Phase 3 = (175,130 CY)(9.76 min./load)/((0.61)(13 CY/load)(2 scrapers))
= 107,772 min. = 1,796 hrs = 74.8 days (2,382 CY/day)

Construction Times (Full Height Contingency Buttress using two 25 CY Scrapers)

Phase 2 = 50.0(13)/(25) = 26.0 days (4,820 CY/day)
Phase 3 = 74.8(13)/(25) = 38.9 days (4,502 CY/day)

Construction Times (Full Height Contingency Buttress using two 25 CY & two 13 CY Scrapers)

Phase 2 = (125,320 CY)/((2,506 + 4,820)CY/day) = 17.1 days (7,326 CY/day)
Phase 3 = (175,130 CY)/((2,382 + 4,502)CY/day) = 25.4 days (6,884 CY/day)
Total = 42.5 days

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PROJECT NAME: Refuse Disposal Areas No's. 1 & 2, Williamson Energy LLC

PROJECT NO. B09-341-1413 SHEET 6 OF //

DESCRIPTION Contingency Buttress Construction Times
Phases 2 & 3

Average Time to build 100' Length of Full Height Buttress

Phase 2 Ave. Volume/100 feet = (125,320 CY)(100 ft.)/(5,500 ft. ave. perimeter) = 2,278 CY/100 ft.
Time for two 13 CY scrapers = (2,278 CY)/(2,506 CY/day) = 0.91 days = 21.8 hours
Time for two 25 CY scrapers = (2,278 CY)/(4,820 CY/day) = 0.473 days = 11.3 hours
Time for two 13 CY and two 25 CY scrapers = (2,278 CY)/((2,506 + 4,820) CY/day) = 0.311 days = 7.5 hours

Phase 3 Ave. Volume/100 feet = (175,130 CY)(100 ft.)/(6,000 ft. ave. perimeter) = 2,919 CY/100 ft.
Time for two 13 CY scrapers = (2,919 CY)/(2,382 CY/day) = 1.225 days = 29.4 hours
Time for two 25 CY scrapers = (2,919 CY)/(4,502 CY/day) = 0.648 days = 15.6 hours
Time of two 13 CY and two 25 CY scrapers = (2,919 CY)/((2,382 + 4,502)CY/day) = 0.424 days = 10.2 hours

Ave. Time to Build 100' of Partial Height Contingency Buttress

Drilling done on the partially capped Phase 2 and Phase 3 revealed that as a miminum, the coarse coal refuse (CCR) penetrated down into the slurry 18' (at Borings D-3. The range of penetration was 18' to 50'. Since both phases have a "ring" of CCR around the perimeter of the cap, assume this will serve as an adequate barrier to block leakage of slurrry through subsidence cracks in the top 18' of each embankment. Determine the time needed to build 100' of contingency buttress less the top 18'.

Volume reduction = (18' high x 20' wide x 100' long)/27 ft^3/CY = 1,333 CY per 100'

Phase 2 Volume = (2,278 - 1,333)CY = 945 CY/100 feet
Time reducton factor to build 100' of buttress = 945/2,278 = 0.41

Phase 3 Volume = (2,919 - 1,333)CY = 1,586 CY/100 feet
Time reduction factor = 1,586/2,919 = 0.54

Scraper Combinations	Phase 2	Phase 3
2 ea. 13 CY	8.9 hours	15.9 hours
2 ea. 25 CY	4.6 hours	8.4 hours
2 ea. 13 CY + 2 ea. 25 CY	3.1 hours	5.5 hours

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PROJECT NAME: Refuse Disposal Areas No's. 1 & 2, Williamson Energy LLC

PROJECT NO. B09-341-1413 SHEET 7 OF //

DESCRIPTION Contingency Buttress Construction Times
Phases 2 and 3

Discussion: Experience gained in longwall mining under the Phase 4 embankment indicates that embankment cracking to the extent that would allow release of slurry is limited to the upper 10' to 12' of the embankment. In addition, a coarse coal refuse "ring" has been placed adjacent to the upstream slope of The "ring" is about 20' wide and extends against the interior slopes of the embankments to a depth of at least 18' in the pools of Phases 2 and 3. This "ring" was placed to establish a stable base from which to start impoundment capping operations. By the time the longwall passes under Phases 2 and 3, both impoundments will be completely capped. Drilling conducted though the cap indicates that the fine coal refuse slurry is consolidating and the moisture content is less that the fluid condition. In addition, the thickened slurry will serve to seal any crack with which it may contact. Observations of Phase 4 indicate that the extent of any cracks wide enough to emit slurry are limited to short lengths of the embankment and close up quickly as the longwall advances.

In summary, a barrier "ring" has been constructed along the interior of the impoundments. The ring extends in depth below observed depth of open cracks observed in Phase 4. Impoundment capping operations have densified the slurry to a non-flowable moisture content, and if it did start to flow out of an embankment crack, experience at other sites indicates that it would seal the crack (it has been a successful practice at other sites to direct slurry discharges over foundation and embankment cracks to seal them). If any slurry were to be forced through any embankment subsidence cracks, it is anticipated that it would be the consistency of tooth paste and could easily be contained in the sediment ditches which surround both phases.

A variety of earth moving equipment is available on the mine property to deal with any cracks that could develop in the embankments. Although we do not anticipate any slurry leakage, a contingency buttress of a length to cover 100' of embankment could be constructed in as little as 3.1 to 5.5 hours for a partial height buttress to 7.5 to 10.2 hours for a full height buttress.

It is anticipated that stockpile clay soil would be used to construct any contingency/crack repair buttresses needed. Approximately 750,000 CY of clay soil is stockpiled immediately south of Phase 2. Full contingency buttresses for both phases would require 300,450 CY, therefore plenty of buttress material is readily available.

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PROJECT NAME: Refuse Disposal Areas No's. 1 & 2, Williamson Energy LLC

PROJECT NO. B09-341-1413 SHEET 8 OF 11

DESCRIPTION Contingency Buttress Times
Phases 2 and 3

PHASE 2

BUTTRESS

Volumes by Triangulation (Prisms)

Fri Nov 12 10:53:49 2010

Existing Surface: Z:\05330\20 BUTTRESS BASE.tin
Final Surface: Z:\05330\20 BUTTRESS.tin

Cut volume: 2,393.1 C.F., 88.63 C.Y.
Fill volume: 3,383,756.5 C.F., 125,324.31 C.Y.

Area in Cut : 36,606.4 S.F., 0.84 Acres
Area in Fill: 666,533.2 S.F., 15.30 Acres
Total inclusion area: 705,843.2 S.F., 16.20 Acres

Average Cut Depth: 0.07 feet
Average Fill Depth: 5.08 feet
Cut to Fill ratio: 0.00
Import Volume: 125,235.7 C.Y.
Elevation Change To Reach Balance: -4.791
Volume Change Per .1 ft: 2,614.2 C.Y.

Cut (C.Y.) / Area (acres): 5.47
Fill (C.Y.) / Area (acres): 7734.19

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BY: HLO/HT DATE: 11/12/2010 CHKD BY: _____ DATE: _____

PROJECT NAME: Refuse Disposal Areas No's. 1 & 2, Williamson Energy LLC

PROJECT NO. B09-341-1413 SHEET 9 OF 11

DESCRIPTION Contingency Buttress Times
Phases 2 and 3

PHASE 3

BUTTRESS

Volumes by Triangulation (Prisms)

Fri Nov 12 10:55:43 2010

Existing Surface: Z:\05330\20 BUTTRESS BASE.tin
Final Surface: Z:\05330\20 BUTTRESS.tin

Cut volume: 7,242.4 C.F., 268.24 C.Y.
Fill volume: 4,728,428.1 C.F., 175,126.97 C.Y.

Area in Cut : 9,465.2 S.F., 0.22 Acres
Area in Fill: 913,291.8 S.F., 20.97 Acres
Total inclusion area: 930,151.6 S.F., 21.35 Acres

Average Cut Depth: 0.77 feet
Average Fill Depth: 5.18 feet
Cut to Fill ratio: 0.00
Import Volume: 174,858.7 C.Y.
Elevation Change To Reach Balance: -5.076
Volume Change Per .1 ft: 3,445.0 C.Y.

Cut (C.Y.) / Area (acres): 12.56
Fill (C.Y.) / Area (acres): 8201.38

R12256

geotechnics
INTEGRITY IN TESTING

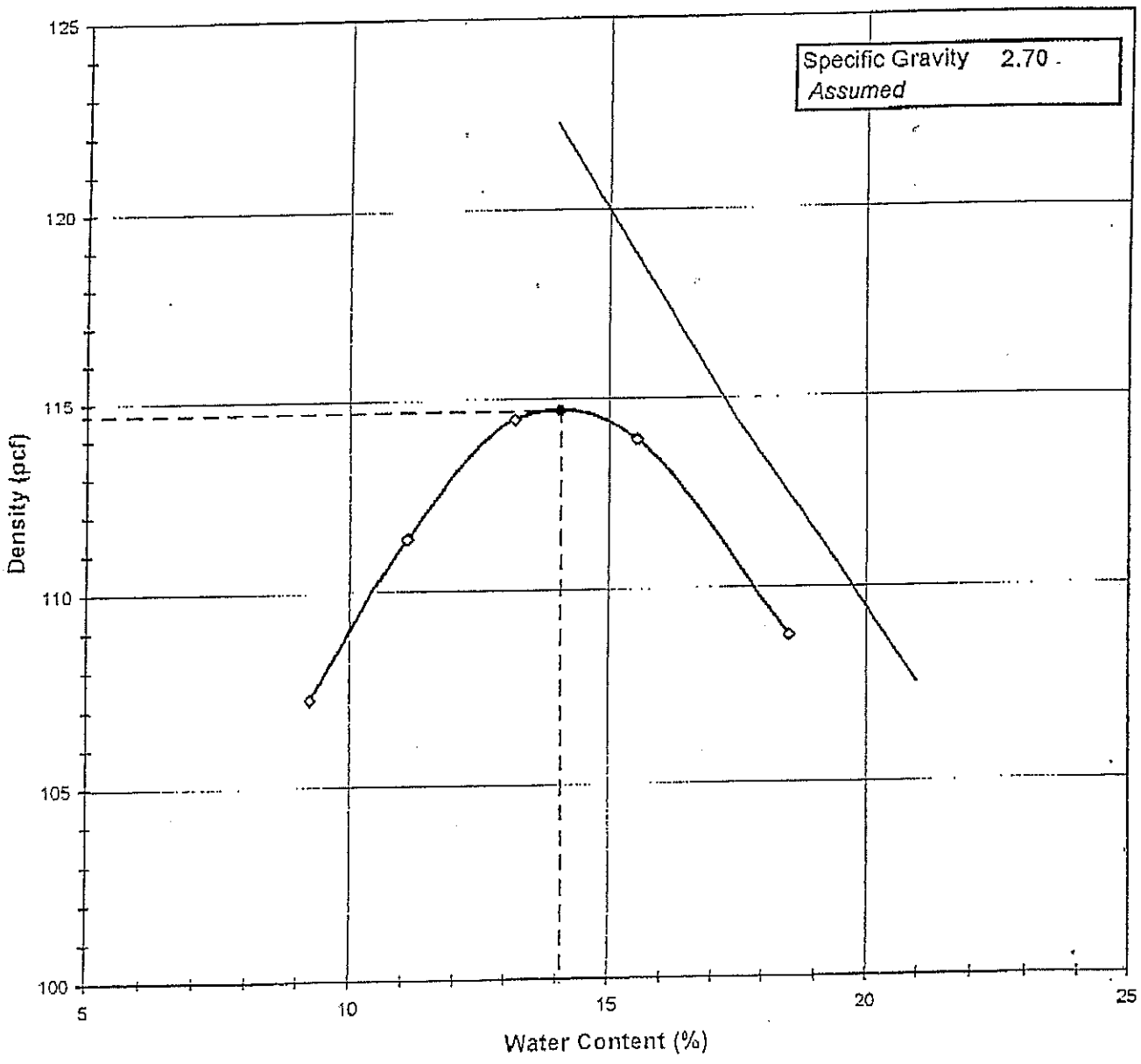
MOISTURE DENSITY RELATIONSHIP

ASTM D698-00 SOP-S12

SHEET 10 OF 11

Client	ALLIANCE CONSULTING	Boring No.	SOIL REF CELL
Client Reference	MACH MINING B05-330-1413	Depth (ft)	NA
Project No.	2006-263-01	Sample No.	S-1
Lab ID	2006-263-01-01	Test Method	STANDARD
Visual Description	BROWN CLAY		

Optimum Water Content	14.1
Maximum Dry Density	114.7



Tested By PC Date 7/20/06 Checked By KB Date 7-21-06

C:\MSOFFICE\Excel\Print\QUIX95.xls]Sheet1

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R12257

geotechnics
INTEGRITY IN TESTING

MOISTURE DENSITY RELATIONSHIP

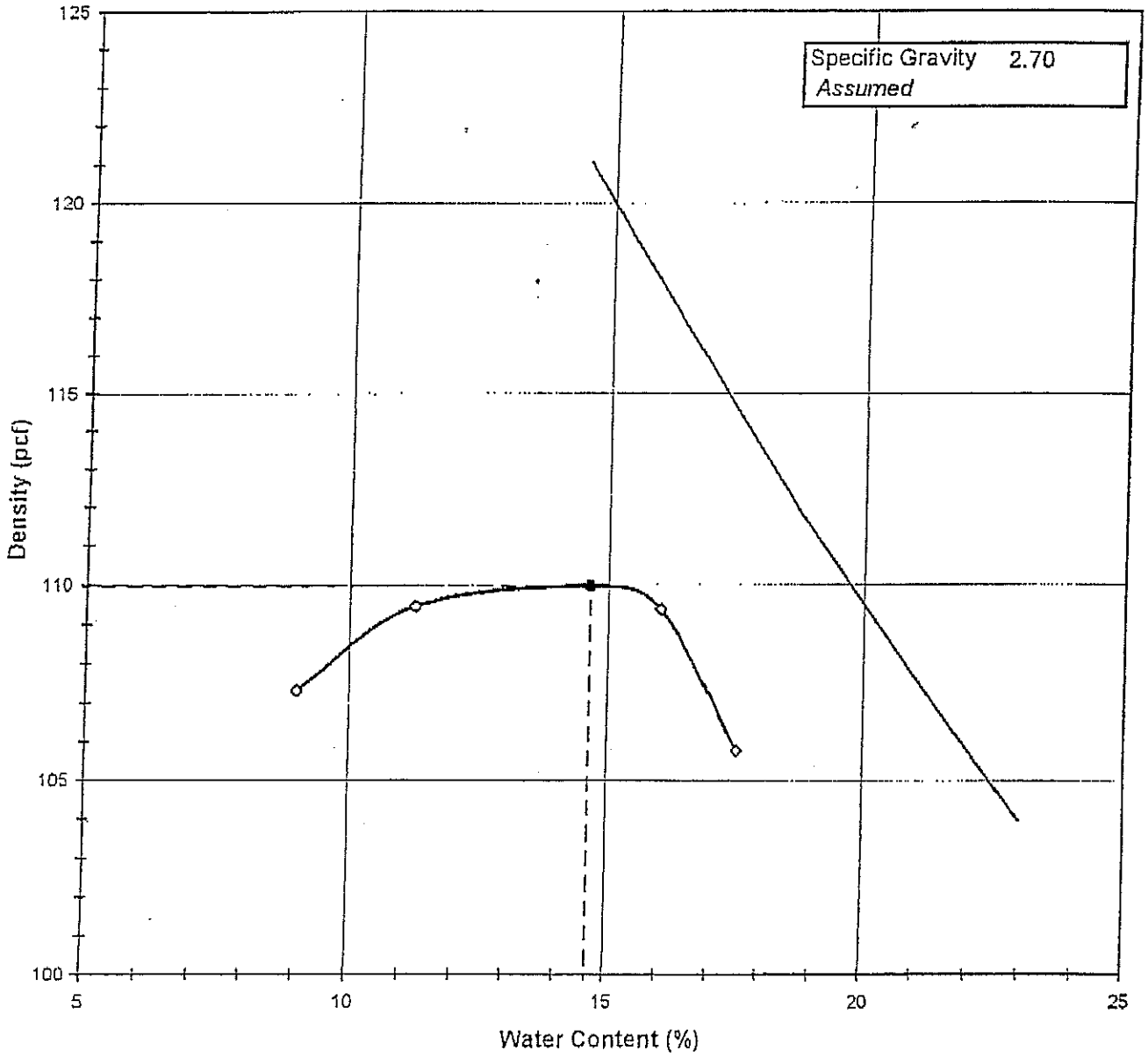
ASTM D698-00 SOP-S12

SHEET 11 OF 11

Client	ALLIANCE CONSULTING	Boring No.	SOIL REF CELL
Client Reference	MACH MINING B05-330-1413	Depth (ft)	NA
Project No.	2006-263-01	Sample No.	S-2
Lab ID	2006-263-01-02	Test Method	STANDARD

Visual Description BROWN CLAY

Optimum Water Content	14.7
Maximum Dry Density	110.0



Tested By BB *Date* 7/19/06 *Checked By* KVB *Date* 7-20-06

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7225-11
part 3

R12258

APPENDIX E

MSHA AND ILLINOIS DEPARTMENT OF NATURAL RESOURCES OFFICE OF WATER RESOURCES APPROVALS

U. S. Department of Labor
Mine Safety and Health Administration
2300 Willow Street
Suite 200
Vincennes, Indiana 47591-5416

DEC 0 8 2010

Mr. Anthony Webb, Mine Manager
Mach Mining, LLC
P.O. Box 300
Johnston City, Illinois 62951

RE: Mach #1 Mine, Mine ID No. 11- 03141, Refuse Disposal Facility No. 2, Impoundment No. 1211-IL08-03141-02, Revised Plans for Phase 7

Dear Mr. Webb:

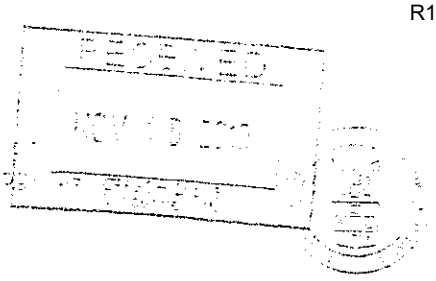
The attached report is documentation of the review and recommendations of the Mine Waste and Geotechnical Engineering Division (MWGED), Report No. MW-10-072, dated November 1, 2010. This report addresses the revised plan for Phase 7 of Refuse Disposal Facility No. 2. **Based on the information submitted, the revised plan for Phase 7 is approved.**

If Mach Mining, LLC has any questions concerning the approval of this plan, please contact Stan Reeder at (812) 882-7617.

Sincerely,

Hubert Payne
District Manager
Coal Mine Safety & Health
District 8

Enclosure



November 1, 2010

MEMORANDUM FOR HUBERT PAYNE
District Manager, District 8
Coal Mine Safety and Health

THROUGH: KENNETH G. FIELDS
Chief, Pittsburgh Safety and Health Technology Center

FROM: STANLEY J. MICHALEK
Chief, Mine Waste and Geotechnical Engineering Division

SUBJECT: Recommendation for Approval of Revised Design Plan for Phase 7, Refuse Disposal Facility No. 2, Impoundment I.D. No. 1211-IL08-03141-02, Mach Mining, LLC, Mach Mine No. 1, Mine I.D. No. 11-03141, Williamson County, Illinois

As requested by your office, a technical review of the plan for proposed Phase 7 of the impoundment has been completed. Our review included the submitted revised design documentation for Phase 7 in response to our request for additional information in Report No. MW09-077. This report recommended approval of the Phases 3 through 6, but not Phase 7. Report No. MW10-072, which is attached, indicates that the revised plan for the Refuse Disposal Facility No. 2 now appears to be technically acceptable through Phase 7, which is the final phase planned for this facility.

The Impoundment and IRPI data sheets have been completed for Phase 7 and are included with the report. Please contact this office if there are any questions regarding this review.

Attachment

cc: J. Kravitz – Acting Director, TS
S. Gigliotti – Chief, Safety Div., CMS&H

UNITED STATES DEPARTMENT OF LABOR

MINE SAFETY AND HEALTH ADMINISTRATION

PITTSBURGH SAFETY AND HEALTH TECHNOLOGY CENTER
MINE WASTE AND GEOTECHNICAL ENGINEERING DIVISION
COCHRANS MILL ROAD
P.O. BOX 18233
PITTSBURGH, PENNSYLVANIA 15236

REPORT NO. MW10-072

REVIEW OF REVISED DESIGN PLANS FOR PHASE 7 REFUSE DISPOSAL FACILITY NO. 2 MSHA I.D. NO. 1211-IL08-03141-02 MACH MINING, LLC MINE I.D. NO. 11-03141 WILLIAMSON COUNTY, ILLINOIS

NOVEMBER 1, 2010

BY

PAUL J. DONAHUE, P.E.
CIVIL ENGINEER

REPORT NUMBER MW10-072

OWNERSHIP AND LOCATION

The Refuse Disposal Facility No. 2 is owned and operated by Mach Mining LLC, and receives coarse and fine coal refuse from the preparation plant for the Mach No. 1 Mine. The site can be found on the USGS 7.5 Minute Pittsburg (Illinois) quadrangle map at geographic coordinates N 37°50'30" latitude and W 88°49'17" longitude. This facility is located on a tract comprising the east half of Section 12, Township 8S, and Range 3E, Third Principal Meridian.

MATERIAL REVIEWED

Revised Design Submittal

The revised design documents were prepared for Mach Mining LLC by Alliance Consulting, Incorporated (Alliance) and included the following items.

1. A letter report titled "Response to MSHA Comments – Phase 7 - Coal Refuse Disposal, Facility No. 2 – Mach Mining LLC – Impoundment ID No. 1211-IL08-03141-02," dated March 22, 2010. The report included a narrative description of the proposed design revisions; revised pages 1, 12, 14, A-4, and stability analysis summary sheet of the original design report, and supporting calculations for the revised design.

2. The following are seven revised impoundment plan drawings.

   B05-330-M32 – Figure No. 5-Revised 3/10/10
   B05-330-M34 – Figure No. 6-Revised 3/10/10
   B05-330-M33 – Figure No. 7-Revised 3/10/10
   B05-330-E22 – Figure No. 9-Revised 3/10/10
   B05-330-E12 – Figure No. 14-Revised 3/18/10
   B05-330-E48 – Figure No. 16-Revised 3/17/10
   B05-330-M36 – Figure No. 17-Revised 3/16/10

The above materials were received by this office on March 29, 2010.

In addition to the above submittals, we also reviewed geotechnical test boring logs and laboratory test data for the fine coal refuse (FCR) and the coarse coal refuse (CCR) capping materials currently being placed at the Phase 1, 2, and 3 cells. The borings and lab testing were performed by Holcomb Foundation Engineering Company, Carbondale, Illinois, and furnished to Mach Mining LLC, under a transmittal letter dated August 16, 2010. This information was transmitted to Technical Support via e-mail from Dan Barkley of the Illinois Department of Natural Resources and Harold Owens of Alliance on October 1, 2010. This geotechnical data was obtained as required under the currently approved plan in order to characterize the properties of the capped FCR prior to the advance of longwall panel No. 3 under the Phase 1, 2, and 3 cells in early 2011. However, this data was also used in verifying the stability analyses for the revised configuration of Phase 7 in the subject submittal.

BACKGROUND

The revised Refuse Disposal Facility No. 2 will provide for the disposal of about 3 1/2 years of CCR and 6 years of FCR that will be produced from the Mach No. 1 Mine following closure of the previously approved Facility No. 1 which included Phases 1 and 2. This facility is being constructed in five phases (Phase 3 through Phase 7).

Refuse Disposal Facility No. 2 consists of three approximately rectangular diked impoundments (cells) aligned in a north-south direction and sharing common embankments between them. The southernmost cell, Phase 3 has been completed and is currently being capped with CCR and soil. Phase 5, the northernmost cell, has also been completed and is currently receiving FCR. The central cell will be constructed in three phases. The initial Phase 4 embankments enclose the future FCR storage cell, and have been completed. The Phase 6 will consist of embankments buttressing the outside of the Phase 4 embankments, forming a 380- to 400-foot-wide crest at an elevation of 492 feet. Phase 7 will involve raising the Phase 4/6 crest to elevation 538 feet. The embankment for this raise will be centerline construction, founded on the existing 400-foot-wide Phase 4/6 crest on the north, east, and west sides, but will be founded on the CCR cap and FCR of Phase 3 to the south. FCR placement in the central cell will start during Phase 7 when the embankment will be about 50 percent of the completed height.

Under the original plan, Phase 7 was broken into three sub-phases. The south embankment was to be raised to its full height (elevation 538 feet) in conjunction with raising the north, east and west embankments during Phases 7A and 7B. CCR would then be placed over the rest of the former Phase 3 cell to the final crest elevation during Phase 7C. Our review revealed that the original plan would have likely resulted in an unstable condition due to the rapid raise of the south (outside) slope of the Phase 7 south embankment over a foundation consisting of the clay-like and slow-consolidating FCR within the capped Phase 3 cell. An analysis of the stability of the south embankment at the end of Phase 7B was overlooked in the original submittal. An analysis performed by the Mine Waste and Geotechnical Engineering Division (MWGED), using the same normalized undrained strengths for the FCR developed in the submittal, resulted in safety factors of less than one.

MWGED's Report No. MW09-077, dated November 12, 2009, recommended approval through Phase 6, but stated that a new submittal that addresses the stability issue would be required before MWGED could recommend approval of Phase 7.

REVIEW DISCUSSION

The March 22, 2010, submittal included a redesign of the Phase 7B embankments. The new design specifies that the south embankment for Phase 7 will be raised in six intervals, to elevations 500, 504, 509, 517, 531, and 538 feet, over the entire area of the capped Phase 3 cell. This will prevent the development of an unbalanced loading sufficient to cause a failure of the FCR embankment foundation. Stability analyses included in the submittal included both end-of-construction (EOC) and long-term steady-state conditions. In both of these cases a minimum factor of safety of 1.5 was reported. MWGED performed additional stability analyses to verify the results of the submitted analyses. For the EOC condition, a conservative assumption that the

normalized und ained strength of the FCR will only be that which develops under self weight prior to any fill lacement over it. Both circular and non-circular failure surfaces were analyzed. While safety fac ors for some failure surfaces involving the outside (south) slope were slightly less than the allo vable minimum of 1.3 for the EOC condition, all types of failures for which a release of impou ded water or FCR was possible had a factor of safety in excess of 1.5.

The highly plastic FCR at this site exhibits plasticity indices of 17 to 20, and will not be subject to significant seis ic strength loss. However, MWGED performed conservative post-seismic stability analyses u ing the recommended lower-bound post-seismic strengths for clay-like materials in the cur ent MSHA Impoundment Engineering and Design Manual. This analysis yielded a satisfacto y factor of safety of at least 1.2. Previous submittals had satisfactorily analyzed and precl ded significant seismic deformations for the Phase 7 embankments.

The submittal inclu ed analyses of the impounding cell capacities for the six proposed crest elevations. The imp undment will be capable of storing two Probable Maximum Precipitation (PMP) events throug the construction period. A pump with a capacity of at least 2,180 gallons per minute is specifie l which will allow draw-down of the volume of one PMP in 30 days. Upon reaching the final cres elevation, an 18-inch-diameter HDPE decant pipe and riser spillway will be installed. This fin configuration of the Stage 7 cell will be capable of storing one PMP event and discharging t within 10 days.

CONCLUSIONS AN RECOMMENDATIONS

We find the revised des gn of Phase 7 of Disposal Facility No. 2 to be satisfactory and recommend that the rev ed plan be approved. Our recommendation for approval assumes the facility is constructed str ctly in accordance with the submitted plan. In particular, stability considerations require th t the south embankment of Phase 7 be raised uniformly to elevations 504, 509, 517, 531, and 5 8 feet over the entire area of the former Stage 3 cell.

Approved Plan Document

The revised design report n rratives, specifications and calculations should also be considered part of the approved plan. or ease of reference, the revised pages listed in the "Material Reviewed" section above sh uld be marked as revised and inserted into the original deign report. The revised drawings listed bove should be inserted into, and the drawings they replace removed from, the approved plan.

Report Prepared by:

Paul J. Donahue, P.E.
Civil Engineer

Report Approved by:

FOR

Darren J. Blank, P.E.
Supervisory Civil Engineer

IMPOUNDMENT DATA SHEET

Completed by: PJD Date 02 November 2010
All Information Pertains to Construction Central Cell Impoundment (Stage 7)
Impoundment Name Mach Mine Coal Refuse Disposal Facility No. 2
Site ID No. 1211-IL08-03141-02

Hazard Potential Classification ☒ High ☐ Significant ☐ Low

CONFIGURATION

Maximum Crest Elevation 538.00 feet
Minimum Crest Width 100 feet
Minimum Required Freeboard from Pump Activation Elevation to Crest - See Graph on Drawing No. M33
Final decant riser elevation to crest – 8 feet.

Decant Pipe	Pump with min capacity of 2180 gpm until final crest is reached When final crest is reached install 18 inch, SDR 26 pipe and riser to Elev. 530.0
Open Channel (Emergency) Spillway	Invert Elevation N/A feet Bottom Width N/A feet Lining Type N/A
Embankment Slopes	Upstream 3.0H:1V Downstream 3.0H:1V
Embankment Benches	Width 20 feet Vertical Interval 50 feet (One bench at mid-height)
Groin Ditches	Lining Type N/A

COMPACTION

Compaction Test Frequency 1 Test per 2000 CY or min. 1 per lift
Moisture Content Range minus 2.00 % to plus 3.00 %
Compaction Density Standard 95.00 % Lift Thickness(es) 12.00 inches

INSTRUMENTATION

Standpipe Piezometers Piezometer No.	Maximum Allowable Water Elevation (feet)
P-6	463.4
P-7	475.2
P-8	487.2
P-12	441.0
P-13	467.1
P-14	502.4
P-15	452.0
P-16	472.2
P-17	504.8

See Sheets E12, Section D-D and E39 Section G-G for tip elevations.

CRITICAL CONSTRUCTION ITEMS

1. Use the current revised drawings for Phase 7:
   B05-330-M32 – Figure No. 5 -Revised 3/10/10
   B05-330-M34 – Figure No. 6- Revised 3/10/10
   B05-330-M33 – Figure No. 7- Revised 3/10/10
   B05-330-E22 – Figure No. 9- Revised 3/10/10
   B05-330-E12 – Figure No. 14- Revised 3/18/10
   B05-330-E48 – Figure No. 16- Revised 3/17/10
   B05-330-M36 – Figure No. 17- Revised 3/16/10

2. Stability considerations require that the south dike of Phase 7 be raised at uniformly over the entire area of the capped Phase 3 Cell in six raise intervals. These intervals are Elevation 500 (initial), 504. 509, 517, 531, and 538. See Sheet 12 of the revised March 22 submittal calculations for the schedule of these raises.

IRPI DATA FROM IMPOUNDMENT PLANS

Date 11/02/2010 Completed by: PID

(2) State IL (2) County Williamson

(3) Impoundment Name Mach Mine Central Cell (Impoundment) - Phase 7

(4) Impoundment ID No. 1211-IL08-03141-02

(8) All Information Pertains to Construction Stage 7

(9) Nearest Downstream City/Town West Frankfort, IL (10) Distance to Nearest City/Town (mi.) 6.5

(11) Latitude N 37.8427 (Degrees + (Minutes/60) + (Seconds/3600)) (12) Longitude W 88.8212 (Degrees + (Minutes/60) + (Seconds/3600))

(15) Stream impoundment is located on or tributary to: Pond Creek

(16) Section/Range/Township East Half of S12, R3E, T8S, 3rd PM

(20) Company or consultant who prepared plan Alliance Consulting Inc.

(35) Foundation Type (rock; rock and soil; soil; unknown) Clay/Silt Soil - 15 to 20 ft thick over Shale

(37) Core Type (earth, plastic, etc.) None

(38) Core Position (Upstream, Homogeneous, Core) [ ] U [X] H [ ] C

(40) Type of Construction (Upstream, Downstream, Centerline) [ ] U [ ] D [X] C S. dike const. over Phase 3

(41) Dam Crest Length 6450 ft. Rectangular diked structure feet

(42) Structure Height (from downstream toe) 96 feet

(43) Open Channel Spillway Type [ ] Controlled [ ] Uncontrolled [X] None

(44) Spillway Width at Maximum Discharge N/A feet

(45) Maximum Storage 2999 (@ 3 ft. freeboard) acre-feet

(46) Normal Storage 2755 @ decant elev. 530 acre-feet

(47) Maximum Discharge 16.2 cfs

(49) Drainage Area 68 Acres square miles

(50) Surface Area 45 Acres acres

(51) Decant Pipe Type SDR 26 HDPE

(52) Decant Pipe Diameter (ID) 16.6 inches

(54) Mining Underneath or Adjacent: [X] Yes [ ] No

(55) Hazard Potential Classification [X] High [ ] Significant [ ] Low

Illinois Department of
Natural Resources

One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

Pat Quinn, Governor
Marc Miller, Director

April 12, 2010

SUBJECT: Permit No. DS2008111
Pond Creek Mine, Phase 2 Dam – IL50592
Proposed Subsidence & Abandonment
Williamson County

Williamson Energy, LLC
430 Harper Park Drive, Suite A
Beckley, West Virginia 25801

ATTENTION: Mr. James R. Morris, President

Dear Mr. Morris:

In accordance with the January 22, 2010 submittal from Alliance Consulting, Inc., the plans and specifications for the modifications to the referenced impoundment are hereby approved.

The approved plans are entitled:

ABANDONMENT PLAN
(Figure No. 22, Dated 11/5/09)

The approved plans show that a soil cover will be placed on the impoundment. As stated in previous correspondence, the abandonment procedures outlined by MSHA differ significantly from abandonment as defined by IDNR/OWR's "Procedural Guidelines...". Due to these differences, review of the plans for the MSHA abandonment by this office was limited to evaluating their acceptability as a modification to the originally permitted plans. Although the IDNR/OWR approves the plans for the proposed modifications necessary to accomplish MSHA abandonment procedures, the impoundment will still fall within our jurisdictional purview pursuant to our Dam Safety Rules.

Based on the submitted geotechnical, structural, and impounded material flowability analyses, this office has determined that the proposed subsidence beneath the impoundment can be allowed. Although the testing and calculations indicate that the subsidence will not alter the structural stability or impounding capability, due to the possibility of unforeseen conditions and circumstances, measures must be taken to ensure that safety to on-site personnel and downstream residences is held in the highest regard. The following are conditions which will be required to be met before, during, and after the proposed subsidence:

1. The placement of the soil cover shall be completed prior to subsidence of the Phase 2 Impoundment.

2. Monitoring of the Phase 2 Impoundment and vicinity will be conducted according to the procedures outlined in the Subsidence Monitoring Plan document, contained in your October 22, 2009 submittal. Inspection and monitoring reports shall be submitted regularly to IDNR/OWR for our review throughout the subsidence process. Record drawings shall be submitted along with the final inspection report.

Approximately 6 months following completion of the proposed subsidence beneath the impoundment, this office will continue to review the possible removal of the Phase 2 Impoundment from our jurisdiction. Provided that at least 90% of the predicted subsidence has occurred, and upon our receipt and acceptance of the post-subsidence inspection report, we can anticipate removing the subject structure from IDNR/OWR jurisdiction. **The Pond Creek Mine, Phase 2 Dam shall be considered a jurisdictional dam until written notification is received from IDNR/OWR allowing its removal from our jurisdiction, according to our guidelines. All of the other conditions of Permit No. DS2008111 remain in full force and effect.**

Please feel free to contact Jerry Bishoff of my staff at 217/558-6617 if you have any questions or comments concerning this permit.

EXAMINED AND RECOMMENDED:

Michael L. Diedrichsen, Acting Manager
Downstate Regulatory Programs

APPROVAL RECOMMENDED:

Gary Clark, Director
Office of Water Resources

APPROVED:

Marc Miller, Acting Director
Department of Natural Resources

MLD:JMB:crw
cc: Alliance Consulting, Inc. (Claudio Yon, P.E.)
IDNR, Office of Mines and Minerals (Scott Fowler)
Inspection File

Illinois Department of
Natural Resources
One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

Pat Quinn, Governor
Marc Miller, Director

October 15, 2010

SUBJECT: Permit No. DS2008111
Pond Creek Mine, Phase 2 Dam – IL50592
Proposed Subsidence & Abandonment
Williamson County

Approval letter

Williamson Energy, LLC
430 Harper Park Drive, Suite A
Beckley, West Virginia 25801

ATTENTION: Mr. James R. Morris, President

Dear Mr. Morris:

This office is in receipt of an inquiry by Alliance Consulting, Inc. concerning the required documentation and procedures necessary to subside beneath the referenced impoundment.

From review of our records, a revision to Permit No. DS2008111 was issued on April 12, 2010 authorizing the placement of a soil cover on the Phase 2 Dam. At the time this revision was issued, it was the understanding of the Illinois Department of Natural Resources, Office of Water Resources (IDNR/OWR) that placement of this cover would be completed prior to the proposed subsidence. Based on this understanding, and the fact that having a soil cover in place would provide an additional factor of safety, Condition 1 of the April 12 revision required that the placement of a soil cover be complete prior to subsidence.

This office has learned that, due to unforeseen conditions, the placement of soil cover prior to subsidence may not be possible. In consideration of these circumstances, the IDNR/OWR has re-evaluated the conditions of the permit. Our geotechnical engineering staff has determined that subsidence of the Phase 2 Dam, without soil cover, will also meet the requirements of our Part 3702 Rules. Therefore, Condition 1 of our April 12, 2010 revision to Permit No. DS2008111 is hereby rescinded, and subsidence activities beneath Phase 2 Dam may be commenced without further IDNR/OWR authorization.

Please note that Condition 2, which requires that the impoundment be monitored and remedial actions taken during and after subsidence, and all other conditions of the permit, remain in full force and effect.

Please feel free to contact Jerry Bishoff at 217/558-6617 if you have any questions or comments concerning this authorization.

EXAMINED AND RECOMMENDED:

Michael L. Diedrichsen, Acting Manager
Downstate Regulatory Programs

APPROVAL RECOMMENDED:

Gary R. Clark, Director
Office of Water Resources

APPROVED:

Marc Miller, Acting Director
Department of Natural Resources

MM:GRC:MLD:JMB:crw
cc: Alliance Consulting, Inc. (Claudio Yon, P.E.)
IDNR, Office of Mines and Minerals (Scott Fowler)
Inspection File

Illinois Department of
Natural Resources
One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

Pat Quinn, Governor
Marc Miller, Director

June 2, 2010

SUBJECT: Permit No. DS2010047
Williamson Energy, Pond Creek Mine
Phase 7 Dam – IL50624
Williamson County

Williamson Energy, LLC
P.O. Box 99
Johnston City, Illinois 62951

ATTENTION: Mr. Michael J. Beyer

Dear Mr. Beyer:

Enclosed is Illinois Department of Natural Resources, Office of Water Resources Permit No. DS2010047 authorizing the construction, operation and maintenance of the Williamson Energy, LLC, Pond Creek Mine, Phase 7 Dam, an intermediate-size Class I (high hazard potential) dam. This permit does not supersede any other federal, state or local authorizations that may be required for the project.

As stated in Special Condition (c) of this permit, the eventual subsidence beneath this structure is not authorized by this permit. Upon completion of the impoundment, separate approval should be obtained from the IDNR/OWR for this portion of the work.

Please note that this permit is subject to a number of general and special conditions. Upon receipt and review of this permit and all of its conditions, please properly execute and return the attached acceptance blank within sixty (60) days from the date of the permit.

Please feel free to contact Jerry Bishoff of my staff at 217/558-6617 if you have any questions concerning this authorization.

Sincerely,

Michael L. Diedrichsen, P.E.
Acting Manager, Downstate Regulatory Programs

MLD:JMB:crw
Enclosure
cc: Alliance Consulting, Inc. (Claudio Yon)
Illinois Environmental Protection Agency
IDNR, Office of Mines and Minerals (Scott Fowler)
U.S. Army Corps of Engineers, St. Louis District (Regulatory Branch)
Inspection File

PERMIT NO. DS2010047
DATE: June 2, 2010

State of Illinois
Department of Natural Resources, Office of Water Resources

Permission is hereby granted to:

WILLIAMSON ENERGY, LLC
P.O. BOX 99
JOHNSTON CITY, ILLINOIS 62951

to construct, operate and maintain the Williamson Energy, Pond Creek Mine, Phase 7 Dam, an intermediate-size Class I (high hazard potential) dam within the watershed of a tributary to Pond Creek in the Southwest ¼ of Section 12, Township 8 South, Range 3 East of the 3rd Principal Meridian in Williamson County, in accordance with an application dated June 11, 2009, and the plans and cifications entitled:

POND CREEK MINE NO. 1, PROPOSED COAL REFUSE DISPOSAL FACILITY, WILLIAMSON COUNTY, ILLINOIS (Figure Nos. 1 – 15 of 15, Dated 4/23/2010); OPERATION AND MAINTENANCE MANUAL, ILLINOIS DEPARTMENT OF NATURAL RESOURCES, OFFICE OF WATER RESOURCES, APPLICATION NO. 20093068, POND CREEK MINE NO. 1 COAL REFUSE DISPOSAL FACILITY NO. 2, WILLIAMSON ENERGY LLC, WILLIAMSON COUNTY, ILLINOIS (Dated May 2010); and EMERGENCY ACTION PLAN, OFFICE OF WATER RESOURCES, APPLICATION NO. 20093068 (Dated May 2010).

Examined and Recommended:

Michael L. Diedrichsen, Acting Manager
Downstate Regulatory Programs

Approval Recommended:

Gary R. Clark, Director
Office of Water Resources

Approved:

Marc Miller, Director
Department of Natural Resources

This PERMIT is subject to the terms and special conditions contained herein.

THIS PERMIT IS SUBJECT TO THE FOLLOWING CONDITIONS:

This permit is granted in accordance with the Rivers, Lakes and Streams Act "615 ILCS 5."

2) This permit does not convey title to the permittee or recognize title of the permittee to any submerged or other lands, and furthermore, does not convey, lease or provide any right or rights of occupancy or use of the public or private property on which the activity or any part thereof will be located, or otherwise grant to the permittee any right or interest in or to the property, whether the property is owned or possessed by the State of Illinois or by any private or public party or parties.

3) This permit does not release the permittee from liability for damage to persons or property resulting from the work covered by this permit, and does not authorize any injury to private property or invasion of private rights.

4) This permit does not relieve the permittee of the responsibility to obtain other federal, state or local authorizations required for the construction of the permitted activity; and if the permittee is required by law to obtain approvals from any federal or other state agency to do the work, this permit is not effective until the federal and state approvals are obtained.

5) The permittee shall, at the permittee's own expense, remove all temporary piling, cofferdams, false work, and material incidental to the construction of the project. If the permittee fails to remove such structures or materials, the Department may have removal made at the expense of the permittee.

6) In public waters, if future need for public navigation or other public interest by the state or federal government necessitates changes in any part of the structure or structures, such changes shall be made by and at the expense of the permittee or the permittee's successors as required by the Department or other properly constituted agency, within sixty (60) days from receipt of written notice of the necessity from the Department or other agency, unless a longer period of time is specifically authorized.

7) The execution and details of the work authorized shall be subject to the review and approval of the Department. Department personnel shall have the right of access to accomplish this purpose.

Starting work on the activity authorized will be considered full acceptance by the permittee of the terms and conditions of the permit.

9) The Department in issuing this permit has relied upon the statements and representations made by the permittee; if any substantive statement or representation made by the permittee is found to be false, this permit will be revoked; and when revoked, all rights of the permittee under the permit are voided.

10) In public waters, the permittee and the permittee's successors shall make no claim whatsoever to any interest in any accretions caused by the activity.

11) In issuing this permit, the Department does not ensure the adequacy of the design or structural strength of the structure or improvement.

12) Noncompliance with the conditions of this permit will be considered grounds for revocation.

13) If the construction activity permitted is not completed on or before December 31, 2013, this permit shall cease and be null and void.

THIS PERMIT IS SUBJECT TO THE ATTACHED SPECIAL CONDITIONS

SPECIAL CONDITIONS
PERMIT NO. DS2010047
WILLIAMSON ENERGY, POND CREEK MINE
PHASE 7 DAM

a) The dam and appurtenances shall be inspected during construction, immediately after completion, and at frequent intervals during the filling of the reservoir. Work will be performed, as necessary, to prevent excessive erosion of the impounding embankment.

b) Prior to discharging fine coal refuse material into the facility, the Permittee shall provide "as-built" plans and specifications of the embankment and request, in writing, the Department of Natural Resources, Office of Water Resources' inspection of the dam and authorization to commence filling operations. If the Office of Water Resources has not acted to grant or deny the authorization to fill within 30 days after receipt of the written request, the owner may proceed with filling operations.

c) This permit does not authorize the eventual subsidence beneath this impoundment. When, at a future date, intentional subsidence is anticipated, prior written approval should be obtained from the Illinois Department of Natural Resources, Office of Water Resources.

d) The Permittee shall operate, inspect, and maintain the dam and appurtenances in accordance with the approved plans and in accordance with the latest edition of the "Rules for Construction and Maintenance of Dams" adopted by the Department of Natural Resources. If the approved operation, inspection and maintenance plans are not complied with by the Permittee, this permit shall cease and be null and void. If changes in the operation and maintenance plans are found necessary, revised plans should be submitted promptly to the Department of natural Resources, Office of Water Resources for review and approval.

e) The Permittee grants the Department of Natural Resources, Office of Water Resources, the right of access to inspect the dam site and immediate vicinity beginning from the date of this permit, for the life of the dam and appurtenances.

f) The Permittee authorizes the Department of Natural Resources, Office of Water Resources, in the event that the dam is found to be in immediate danger of failure, to enter upon the dam property, if necessary, to prevent or alleviate any dam breach damage. The Permittee agrees to compensate the Office of Water Resources for costs reasonably incurred by such emergency action.

g) The Permittee shall have the dam and appurtenances inspected annually by an engineer or other qualified personnel as defined in Section 3702.20 of the "Rules for Construction and Maintenance of Dams" and shall have the engineer or qualified personnel prepare and submit an inspection report on forms provided by the Department of Natural Resources to the Department of Natural Resources, Office of Water Resources.

Illinois Department of
Natural Resources
One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

Pat Quinn, Governor
Marc Miller, Director

October 14, 2010

SUBJECT: Permit No. DS2010047
Williamson Energy, Pond Creek Mine
Phases 3 - 7 Dam – IL50624
Williamson County

Williamson Energy, LLC
P.O. Box 99
Johnston City, Illinois 62951

ATTENTION: Mr. Michael J. Beyer

Dear Mr. Beyer:

Reference is made to our June 2, 2010 issuance of Illinois Department of Natural Resources, Office of Water Resources (IDNR/OWR) Permit No. DS2010047 authorizing the construction, operation and maintenance of the Williamson Energy, LLC, Pond Creek Mine, Phases 3 - 7 Dam. Special Condition (c) of that permit stated that written approval would be required from IDNR/OWR prior to the anticipated subsidence beneath that structure.

After further review, we have determined that our inclusion of that special condition was in error. No further IDNR/OWR authorization will be required for subsidence beneath this structure provided the site is monitored and the appropriate remedial actions are taken as specified in the Subsidence Monitoring Plan, Coal Refuse Disposal Facility No. 2, Mach #1 Mine received with Alliance Consulting's October 22, 2009 letter.

Special Condition (c) of Permit No. DS2010047 is hereby voided.

Please feel free to contact Jerry Bishoff or me at 217/782-3863 if you have any questions concerning this matter.

Sincerely,

Michael L. Diedrichsen, P.E.
Acting Manager, Downstate Regulatory Programs

MLD:crw

cc: Alliance Consulting, Inc. (Claudio Yon)
IDNR, Office of Mines and Minerals (Scott Fowler)
Inspection File

HOWERS@ACINOV.COM

U.S. Department of Labor

Mine Safety and Health Administration
Pittsburgh Safety & Health Technology Center
P.O. Box 18233
Pittsburgh, PA 15236

Mine Waste and Geotechnical Engineering Division

JK Copy

June 22, 2007

MEMORANDUM FOR DAVID L. WHITCOMB
Acting District Manager, District 8
Coal Mine Safety and Health

THROUGH: Stanley J. Michalek for
M. TERRY HOCH
Chief, Pittsburgh Safety and Health Technology Center

FROM: Stanley J. Michalek
STANLEY J. MICHALEK
Chief, Mine Waste and Geotechnical Engineering Division

SUBJECT: Recommendation for Approval of Engineering Design Plan for Refuse Disposal Impoundment, MSHA I.D. No. 1211-IL08-03141-01, Mach Mining, LLC, Mach #1 Mine, Mine I.D. No. 11-03141, Johnston City, Williamson County, Illinois

As requested by your office, a technical review on the above subject plan has been completed by a member of my staff. The attached Report No. MW07-035 indicates that the subject plan appears to be technically acceptable and approval is recommended. Please contact this office if there are any questions regarding this review.

Attachment

cc: M. Kalich – Acting Chief, Safety Div., CMS&H
M. Skiles – Director, TS

UNITED STATES DEPARTMENT OF LABOR

MINE SAFETY AND HEALTH ADMINISTRATION

PITTSBURGH SAFETY AND HEALTH TECHNOLOGY CENTER
MINE WASTE AND GEOTECHNICAL ENGINEERING DIVISION
COCHRANS MILL ROAD
P.O. BOX 18233
PITTSBURGH, PENNSYLVANIA 15236

REPORT NO. MW07-035

REVIEW OF ENGINEERING DESIGN PLAN FOR REFUSE DISPOSAL IMPOUNDMENT MSHA I.D. NO. 1211-IL08-03141-01 MACH #1 MINE MINE I.D. NO. 11-03141 MACH MINING, LLC JOHNSTON CITY, WILLIAMSON COUNTY, ILLINOIS

JUNE 22, 2007

BY

JAMES M. KELLY
CIVIL ENGINEER

REPORT NO. MW07-035

LOCATION AND OWNERSHIP

The refuse disposal impoundment at the Mach #1 Mine is owned and operated by Mach Mining, LLC. The site is located approximately 7 miles northeast of Johnston City in Williamson County, Illinois. The site can be found on the Pittsburg, IL, USGS 7-1/2-minute series topographic map at Longitude 88.82° West, Latitude 37.84° North.

MATERIAL REVIEWED

The following information was evaluated during the review process:

1. "Engineering Design Plan for Proposed Coal Refuse Disposal Facility, Pond Creek Mine No. 1," prepared by Alliance Consulting, Inc. and dated April 2006. (Although the design plan identifies the facility with "Pond Creek Mine No. 1" and Williamson Energy, LLC, the district's receipt acknowledgment letter to Alliance Consulting, Inc. identifies the operator as Mach Mining, LLC and the mine name as Mach #1 Mine.) This submittal is a plan for a new impoundment, and it was received at the Mine Waste and Geotechnical Engineering Division (MWGED) on May 8, 2006. Following its review, MWGED issued a request for additional information, dated September 19, 2006.
2. "Pillar Stability Calculations," prepared by Alliance Consulting, Inc. and dated August 16, 2006. This submittal was received at MWGED on August 18, 2006. The calculations were reviewed concurrently with item 1.
3. "Response to September 19, 2006 MSHA Comments," prepared by Alliance Consulting, Inc. and dated December 19, 2006. This submittal was received at MWGED on January 16, 2007. Following its review, MWGED issued a request for additional information, dated April 16, 2007.
4. "In-Place Density Test Results - Dozer Compaction," prepared by Alliance Consulting, Inc. and dated January 25, 2007, was received at MWGED on February 1, 2007. This submittal was reviewed concurrently with item 3.
5. "Distribution of Drawing No. 05-330-E11, Figure No. 7, Details 1 of 1," prepared by Alliance Consulting, Inc. and dated March 6, 2007. This submittal was received at MWGED on March 8, 2007. The drawing had been inadvertently omitted from inclusion as part of item 3 and was reviewed as part of that submittal.
6. "Response to April 23, 2007 MSHA Comments" dated May 10, 2007, and prepared by Alliance Consulting, Inc. This submittal was received at MWGED on June 7, 2007, and this report reflects the completion of its review.

BACKGROUND

The Mach #1 Mine coal refuse disposal site is a diked slurry impoundment classified as low hazard potential. The embankment will be built using coarse coal refuse, and its foundation will be natural ground. Phase 1 of construction will be excavation of an incised impoundment into existing clay. Phase 2 consists of the construction of an embankment around the initial impoundment, with a final crest elevation of 502 feet. (All elevations in this report are referenced to mean sea level.) The existing ground surface on which the embankment will be built ranges from elevation 460 to 486 feet, making the embankment's maximum height above natural ground 42 feet. The impoundment will have a total storage capacity of 800 acre-feet. The embankment will utilize approximately 584,000 cubic yards of coarse coal refuse in its construction. The plan states that the facility will provide for the disposal of approximately 1.6 years of coarse coal refuse (CCR) and 3.2 years of fine coal refuse (FCR), based on estimated production rates.

During Phase 2 of construction, there will be a series of gate entries mined below the impoundment, providing access to a future longwall below the impoundment. There is over 400 feet of solid cover and a minimum of 4 feet of soil (after excavation) between the coal seam and the bottom of the impoundment. This plan has been evaluated with the understanding (as stated in the plan) that no longwall mining will be conducted below the impoundment until abandonment operations of the impoundment are complete.

The original design for this impoundment included a pumping system to evacuate storm water. It was revised in the items 3 and 5 submittals to include a decant to evacuate storm water, but will use an operational pumping system to remove clarified water from the impoundment and keep the water level as low as practical.

COMMENTS AND RECOMMENDATIONS

Item 1 of "Material Reviewed" is the initial submittal of the engineering design plan for the facility, including the narrative description, specifications, and drawings. The plans and the hydraulic and hydrologic analyses and stability analyses were checked. Review of this submittal raised several concerns, including aspects of the stability and hydrologic analyses, the effectiveness of the internal drain, the inadvisability of longwall mining below the facility before abandonment, and the frequency of density testing. These concerns were expressed in a request for additional information.

Item 2 was submitted prior to the issuance of the first request for additional information, to establish that the gate entries that are proposed to be mined below the impoundment during Phase 2 do not present a hazard. This submittal was adequate.

Item 3 (and item 5) responded to MSHA's first request for additional information. Most of the issues were adequately addressed. The size of the internal drain was increased, but its location, below the centerline of the crest, still made its effectiveness questionable, so analytical substantiation or redesign was requested, and the installation of additional piezometers to confirm its performance was suggested. This submittal also included the construction of a decant pipe that would only see flow during storm events, with the operational level of the impoundment depth as low as possible with a pumping system. This submittal included assurance that longwall mining would not take place below the impoundment until after its abandonment. Also at this time, MSHA was made aware that the CCR would be transported to the site via conveyor belt, and this fact raised concern that placement and compaction of the material could be problematic. Within MSHA's April 23, 2007, request for additional information, a material handling analysis and placement guidelines were requested to document and substantiate the adequacy of the proposed placement method.

Item 4 was submitted as substantiation of the adequacy of tracked dozer compaction, and in preparation for a possible request to use a modified "Roller-Pass Method" to establish a standard maximum density for the CCR, against which field dry densities would be compared. This method was being considered due to the high percentage of plus ¾-inch size particles in the CCR. After discussions between MSHA and the owner's engineer, it was determined that the standard Proctor Method would be appropriate for the material. This submittal did establish that, within the appropriate moisture range, adequate compaction of the CCR could be achieved, given a sufficient number of passes.

Item 6 provided the responses to all issues raised in MSHA's April 16, 2007, request for additional information. The internal drain was moved downstream and additional piezometers were proposed to confirm its effectiveness. The material placement guidelines contain two procedures that are not commonly used for the construction of impounding embankments, namely, the use of slopes averaging up to 10 percent and all compaction being performed by the tracked dozer that is spreading the material. The owner's engineer believes that the 10 percent slope will not prevent the achievement of 95 percent of Standard Proctor maximum density. In the absence of evidence to the contrary, and considering the facts that compaction tests will be performed regularly and that this is a low hazard potential facility, it is MSHA's position that this method should be allowed until and unless it is shown (by compaction test results) that it is not achieving adequate compaction. At such time, the operator would need to revise compaction procedures and/or decrease the maximum allowable slope.

CONCLUSIONS

The submittal appears to be technically acceptable and approval is recommended. Please contact this office if you have any questions or concerns with this review.

Report Prepared By:

James M. Kelly
Civil Engineer

Report Approved by:

Donald T. Kirkwood
Supervisory Civil Engineer

U.S. Department of Labor

Mine Safety and Health Administration
2300 Willow Street
Suite 200
Vincennes, Indiana 47591-5416

June 26, 2007

Mr. R.M. "Pete" Hendrick, President
Mach Mining, LLC
P.O. Box 300
Johnston City, IL 62951

RE: Approval of Revised Plan for Proposed Coal Disposal Facility Impoundment, MSHA ID No. 1211 IL08 03141-01, Mach Mining LLC, Mach #1 Mine, Johnston City, Williamson County, Illinois

Dear Mr. Hendrick:

The Mine Safety and Health Administration has completed a review of the engineering plan, referred to as Williamson Energy, LLC, "Pond Creek Mine No. 1", dated April 2006, for the design, construction, and maintenance for the subject project. The review includes the following information:

- Pillar Stability Calculations, dated August 16, 2006
- Response to September 19, 2006 MSHA Comments, dated December 19, 2006
- In-place Density Test Results-Dozer Compaction, dated January 25, 2007
- Distribution of Drawing No. 05-330-E11, Figure No.7, Details 1 of 1, dated March 6, 2007
- Response to April 23, 2007 MSHA Comments, dated May 10, 2007

Based on the information submitted, the plan is approved.

Section 77.216-2(b) requires that any changes or modifications to this plan be approved by the District Manager prior to the initiation of such changes or modifications.

Sincerely,

Carl E. Boone II
District Manager
Coal Mine Safety and Health
District 8

U.S. Department of Labor

Mine Safety and Health Administration
Pittsburgh Safety & Health Technology Center
P.O. Box 18233
Pittsburgh, PA 15236

November 12, 2009

MEMORANDUM FOR JOSEPH O'DONNELL
Acting District Manager, District 8
Coal Mine Safety and Health

THROUGH: JOHN W. FREDLAND
Acting Chief, Pittsburgh Safety and Health Technology Center

FROM: STANLEY J. MICHALEK
Chief, Mine Waste and Geotechnical Engineering Division

SUBJECT: Recommendation for Approval of Design Plans for Phases 3 through 6, and Request for Additional Information for Phase 7, Refuse Disposal Facility No. 2, Impoundment I.D. No. 1211-IL08-03141-02, Mach Mining, LLC, Mach Mine No. 1, Mine I.D. No. 11-03141, Williamson County, Illinois

As requested by your office, a technical review of the subject proposed impoundment plans has been completed. Our review included an initial submittal and two revisions submitted in response to our requests for additional information. Report No. MW09-077, which is attached, indicates that the subject plans appear to be technically acceptable only through Phase 6 and approval through Phase 6 is recommended. Additional information will be required before we can recommend approval of Phase 7.

The proposed mining under Phase 3 will be the most significant event at this facility. Phase 3 must be closed and covered with a stable cap of coarse refuse, be incapable of impounding water or slurry, and all the proposed instrumentation must be in place and operational before the proposed longwall mining is advanced within 100 feet of any part of the Phase 3 embankment.

The Impoundment and IRPI data sheets have been completed for Phases 3 through 6 and are included with the report. Please contact this office if there are any questions regarding this review.

Attachment

cc: L. Zeiler – Acting Director, TS
M. Smith – Acting Chief, Safety Div., CMS&H

UNITED STATES DEPARTMENT OF LABOR

MINE SAFETY AND HEALTH ADMINISTRATION

PITTSBURGH SAFETY AND HEALTH TECHNOLOGY CENTER
MINE WASTE AND GEOTECHNICAL ENGINEERING DIVISION
COCHRANS MILL ROAD
P.O. BOX 18233
PITTSBURGH, PENNSYLVANIA 15236

REPORT NO. MW09-077

REVIEW OF DESIGN PLANS FOR PHASES 3 THROUGH 7 REFUSE DISPOSAL AREA NO. 2 MSHA I.D. NO. 1211-IL08-03141-02 MACH MINING LLC MINE I.D. NO. 11-03141 WILLIAMSON COUNTY, ILLINOIS

NOVEMBER 12, 2009

BY

PAUL J. DONAHUE, P.E.
CIVIL ENGINEER

REPORT NUMBER MW09-077

OWNERSHIP AND LOCATION

The Refuse Disposal Area No. 2 is owned and operated by Mach Mining, LLC and receives coarse and fine coal refuse from the preparation plant for the Mach No. 1 Mine. The site can be found on the USGS 7.5 Minute Pittsburg (IL) quadrangle map at geographic coordinates N 37°50'30" latitude and W 88°49'17" longitude. This facility is located on a tract comprising the east half of Section 12, Township 8S, and Range 3E, Third Principal Meridian.

MATERIAL REVIEWED

Original Design Submittal

The original submitted design documents were prepared for Mach Mining, LLC by Alliance Consulting, Incorporated (Alliance) and included the following.

1. A report entitled "Engineering Design Plan – Proposed Coal Refuse Disposal, Facility No. 2, Williamson County, Illinois, dated January 2007." The report included a narrative description of the proposed design, and the testing and analyses performed. Appendices to the report included construction specifications, calculations, geotechnical test boring and laboratory test data.

2. Thirteen drawings depicting plans, profiles and details of the proposed facility dated January 16, 2007.

During our review of this plan, Mr. Duffy Stradner, former District 8 Impoundment Specialist, notified this reviewer in a phone conversation on October 23, 2007, that the impoundment layout and geometry would be substantially revised and a new plan submitted. Due to proposed mining under the impoundments and other issues that would similarly affect the new design, we completed the review and requested additional information in a memorandum to Robert Phillips, District Manager, Coal Mine Safety and Health (CMS&H) District 8, dated December 13, 2007. The memorandum identified 14 design issues to be addressed in the revised design submittal.

First Revised Design Submittal

The revised design package for the coal refuse impoundments was hand delivered to our office on August 19, 2008, in conjunction with a meeting with Mach Mining and Alliance Consulting personnel to discuss the new design.

The design documents received at this meeting included the following items.

1. A report entitled "Response to February 11, 2008, Comments, I.D. No. IL08-03141-02, Mach Mining, LLC – Mach No. 1 Mine ID No. 11-03141, Williamson County, Illinois – Coal Refuse Disposal Facility No. 2 Phases 3 through 7," dated August 2008. Appendices to

the report contained construction specifications, various design calculations, geotechnical test boring logs, laboratory test data and a CISPM Mine Subsidence Analysis Report prepared by Dr. Syd Peng of West Virginia University.

2. Nineteen drawings, with revision dates from February 14, 2008, to July 7, 2008, depicting plans, profiles and details of the proposed facility.

In addition, the following additional materials were submitted concurrent with the review of this submittal.

1. A set of three drawings depicting longwall panel surface subsidence measurements at Baselines "A" through "D" located over the eastern end of longwall Panel No. 1 of the subject mine. These drawings are dated August 29, 2008, and were received by the Mine Waste and Geotechnical Engineering Division (MWGED) on September 3, 2008,

2. Two Drawings entitled "Map 6 UG - Operations Plan Map" and "Map 10 – Geologic columns," prepared by Alliance and dated December 3, 2004, and November 29, 2004, respectively, and received by MWGED on September 3, 2008.

In addition to the submitted document, we also gathered additional information, concurrent with the review, through phone and e-mail communication with Mr. Claudio Yon of Alliance and Dan Barkley of the Illinois DNR.

We completed our review of the new design and found eleven items requiring additional substantiating data or calculations and/or design changes. These were outlined in our memorandum to Robert Phillips, District Manager, CMS&H District 8, dated November 10, 2008.

Second Revised Design Submittal

The second revised design submittal was received by MWGED on July 20, 2009, and included the following.

1. A report volume entitled "Additional information- Volume 1 of 3, Comments 2, 4, 5, 6, 9, 10 and 11, Coal Refuse Disposal Facility No. 2 Phases 3 through 7," Impoundment ID No. IL08-03141-02 (MSHA ID No. 11-03141), Williamson County, Illinois," dated July 2009. This volume included new, revised and copies of previously submitted materials from the earlier August 2008 submittal and was prepared by Alliance.

2. A second report volume entitled "Additional information- Volume 2 of 3, Comments 1, 3, 7 and 8, Coal Refuse Disposal Facility No. 2 Phases 3 through 7," Impoundment ID No. IL08-03141-02 (MSHA ID No. 11-03141), Williamson County, Illinois," dated July 2009. This volume contained new calculations and analysis performed by GAI consultants for Alliance.
3. A third volume containing 22 drawings, with revision dates from July 8, 2009, to July 13, 2009, depicting plans, profiles, and details of the proposed facility.

4. An addendum to the submittal, received on August 21, 2009. This addendum included corrected transmittal letters and tables of contents, a revised drawing B05-330-M32 – Phase 5 Plan View, revised August 18, 2009, and revised Phase 5 dam underdrain calculations.

Additionally, prior to the receipt of this submittal, we received electronically transmitted drawings depicting a longitudinal dynamic subsidence survey over the advancing face of Longwall Panel No. 1 at a location immediately to the east of the future Phase 5. These drawings were received in our office on February 10, 2009. This survey was performed in response to comment No. 4 in the November 10, 2008, memorandum.

The results of our review of this revised design are discussed in this report.

BACKGROUND

The revised Refuse Disposal Facility No. 2 will provide for the disposal of about 3 ½ years of coarse coal refuse (CCR) and 6 years of fine coal refuse (FCR) that will be produced from the Pond Creek No. 1 Mine following closure of previously approved Facility No. 1 which included Phases 1 and 2. This facility is to be constructed in five phases – Phase 3 through Phase 7.

As planned, the facility will consist of three, approximately rectangular, diked impoundments aligned in a north-south direction and sharing common embankments between them. The southernmost impoundment will be constructed during Phase 3, with fine refuse placement starting upon completion of the embankment to the design crest height. The central impoundment will be constructed in three Phases (Phases 4, 6 and 7) with fine refuse placement starting during Phase 7, when the embankment will be about 50 percent of the total completed height. The northernmost impoundment will be constructed during Phase 5 and will be partly incised by excavating the footprint of the impoundment. Fine refuse placement in this impoundment will begin once Phase 3 is filled to capacity, and the Phase 5 embankment is about 80 percent complete.

The impoundments will cover about 200 acres, and all the impounding embankments will be raised longitudinally in segments using belt-delivered coarse coal refuse. The upstream and downstream slopes will be 3 horizontal to 1 vertical (3H:1V) except for Phase 3 which will have 2.6H:1V upstream slopes. Maximum embankment heights will range from 49 feet for Phase 3 to 100 feet for Phase 7. All embankments, with the exception of a portion of the Phase 7 central impoundment, will be founded on 15 to 22 feet of medium to stiff clay deposits overlying shale bedrock. The south-facing slope of the Phase 7 embankment will be founded on the impounded fine refuse of the adjoining Phase 3.

The designer considered the impoundments to be of high hazard potential classification for the purposes of hydrologic/hydraulic design. Following one year from the start of construction, all phases will be able to accommodate a rainfall volume of two PMF's with pumping capacity capable of drawing down one 72-hour PMF in 30 days. When the final crest elevation is reached, an 18-inch-diameter HDPE SDR 26 decant spillway will be installed and be capable of

drawing down 90 percent of one PMF in less than 10 days. The only exception is the Phase 3 impoundment. Because of an expected life of less than 1 year, this phase was designed to handle at least one half of a 72-hour PMF, but less than a full 72-hour PMF.

The most significant consideration for these impoundments will be the concurrent mining of three longwall panels in the 6.5-foot-thick Herrin No. 6 coal seam beneath the impoundment footprints. There are 430 to 450 feet of overburden, with at least 420 feet of this being rock, between the embankment foundations or impoundment bottoms and the Herrin No. 6 seam. Boring data indicates that about 75 to 90 percent of the overburden rock is shale. A sandstone unit, 200 to 240 feet above the No. 6 seam and ranging from 21 to 54 feet thick, is the only persistent competent unit encountered in the borings.

The development entries for the longwall mining have a calculated minimum pillar safety factor of 2.3 as calculated by the program ALPS. A minimum rock overburden thickness of about 65 times the mine height is present above the seam. Therefore, this facility complies with the guidance contained in Bureau of Mines publication IC 8741 for limiting breakthrough risk. However, subsidence from the longwall mining will considerably impact surface structures over the mine.

The subsidence effects on the proposed coal refuse impoundments will be largely mitigated by the proposed phasing of the impoundments. Except for Phases 3 and 4, all refuse placement will take place after mining has been completed beneath the impoundment and subsidence is substantially complete. For Phase 3, FCR placement will be completed to an elevation of 5 feet below the crest, about 9 months prior to longwall mining beneath the impoundment. A 5-foot-thick cover of coarse refuse, level with the crest, will be placed over the fine refuse in order to eliminate any impounded water before the mining advances beneath the impoundment. Phase 4 will consist of a 45-foot-high non-impounding embankment placed prior to mining. After the mining, the 300-foot-wide Phase 6 embankment will buttress the downstream slope of the Phase 4 embankment. The width of this embankment is expected to mitigate any possible effects of subsidence-related damage to the Phase 4 embankment.

The planned mining beneath the Phase 3 impoundment, a short time after filling and capping of this impoundment, is the most significant issue in evaluating the subsidence impacts. There is currently little engineering experience in accommodating longwall mining under a coal refuse impoundment and a conservative consideration of all possible potential failure modes and mitigatory measures was the primary item of concern in the review of this plan.

REVIEW DISCUSSION

The submittal received on July 20, 2009, provided responses to the eleven items of additional information that were requested in the November 10, 2008, memorandum. Additionally the submitted addendum included a revised plan for the Phase 5, which will be enlarged by locating its north dike approximately 250 feet further north.

Phase 7 Stability

The submittal did not satisfactorily address comment Nos. 7 and 8 in the November 10, 2008, memorandum. These comments noted that a stability analysis of the Phase 7 south dike, which will be founded on the settled Phase 3 FCR, had not been performed and requested this analysis be performed along with a seismic liquefaction and deformation analysis. The submitted analysis in response to these comments included only an analysis of the less-critical completed Phase 7C configuration, and not the critical Phase 7A, which will entail advancing the 38-foot-high south dike embankment over the thin cover overlying the consolidating fine refuse. An independent check calculation using the "SlopeW" stability analysis program and normalized undrained strength parameters for the FCR developed in the submittal indicated a short-term post construction safety factor for the south dike of Phase 7A of considerably less than one. Therefore, Phase 7A, as currently planned, will require design revisions before MWGED can recommend approval.

Subsidence Impacts - Phase 3 Impoundment

The largest part of the most recent submittal consisted of various analyses and new test data submitted as justification for the proposed longwall mining beneath the capped Phase 3 impoundment, as requested in items 1 through 3 of the November 10, 2008, memorandum. MWGED performed this review in conjunction with a literature review of soil behavior when subjected to tensile strains and a published case-study of longwall mining under an impoundment in West Virginia.(1)

The Phase 3 impoundment is located so the dike bounding the FCR pool to the north is centered over the Panel's 2 and 3 gateroad development entries, the east and west dikes extend southward to approximately the center of the longwall panel, and the south dike runs along the center portion of the panel. The panel width (1,400 feet) with respect to depth is such that subsidence is supercritical, so the south dike will be subjected only to transient tensile, then compressive, strains in a longitudinal direction as the mine face advances east to west. The east and west dikes will be subjected to permanent tensile strains near the northwest and northeast corners of the impoundment and the north dike will be subjected to significant strains only near the inside toe.

Assuming the impoundment is capped and no longer impounding water at the time the longwall panel is advanced, the specific potential failure mechanisms that were examined for the Phase 3 impoundment included:

(1) Choi, D. S., et al, 1997, "A Case Study of Undermining Impoundment Embankment by the Longwall Mining Method," Proc. 36th US Rock Mechanics Symposium

1. Stability failure of the CCR embankment due to deformations and weakening from subsidence-induced shear strains and cracking.

2. The potential for the development of large, persistent transverse cracks in the CCR embankment or foundation materials capable of releasing flowable FCR. The calculated horizontal strains induced by the subsidence, using revised CISPM model calculations calibrated to actual subsidence measurements at this mine, is about 30 microstrain (3 percent).

3. Weakening and/or liquefaction of the FCR due to subsidence strain-induced pore pressures in conjunction with transverse cracking, possibly resulting in flow into, and/or erosion of, cracks in the CCR.

CCR Embankment Stability Under Subsidence Condition

In order to evaluate the possibility of the first of these mechanisms, a separate analysis performed by GAI Consultants for Alliance applied data from existing triaxial test data of the coarse refuse (CU with pore pressures) to the formula developed for the double-punch shear test developed by Fang and Chen[2] to determine a tensile strength for the CCR. The consolidation stresses for each test point were then corrected for equivalent effective vertical stress (σ'_v) and used to develop a "normalized tensile strength" ratio (σ_t/σ'_v) of 0.15 for the CCR. Using this ratio, an average tensile strength of C=475 psf and φ=0 degrees was used in a slope stability analysis to obtain a worst-case stability safety factor for the subsidence disturbed embankment of 1.10. We do not believe the derivation of this strength is technically correct. However, the strength parameter derived appears to be very conservative for coarse coal refuse in even the loosest condition. An independent analysis showed a factor of safety of 1.3 was achieved with φ=19 degrees, which is lower than CCR in its loosest condition based on the typical angle of repose of this material. Therefore, slope failure of the CCR embankment from subsidence-induced shear is very unlikely.

CCR and Foundation Cracking Susceptibility Under Subsidence

The second failure mechanism that was evaluated was the potential for large persistent cracks through the CCR embankment which, in conjunction with the third mechanism, could result in a breach and release of flowable FCR. The submitted data showed the CCR produced at the plant is a well graded gravel material (USCS classification GW) with very little fines (2.0 to 2.5 percent passing the No. 200 sieve). The gradation of oven-dried, compacted Proctor test specimens prepared by Alliance was somewhat higher, with an average of 30 percent passing the No. 200 sieve and was classified under the USCS system as "SC," a clayey sand. However, the lab sample preparation and oven drying likely produced a material with more fines than in the constructed embankment.

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(2) Fang, H.Y. and Chen, Wai-Fai, "Determination of Tensile Strength of Soil by Unconfined Penetration Test," ASTM STP-740, R.N Young Ed., 1981

The gradation of the CCR and the foundation soil was compared to published correlations of deformation cracking and piping potential. The CCR as delivered to the impoundment prior to compaction is a cohesionless material and is not subject to cracking. The laboratory compacted and oven-dried CCR material was evaluated as having a medium deformation and cracking potential. However, this material is not likely to be representative of the material in the embankment which will have less fines; therefore, the overall deformation cracking susceptibility of the CCR was evaluated to be low.

The foundation soils are moderately plastic clays (USCS classification CL with a plasticity index of 24). These materials were evaluated as having low cracking potential because such materials in a saturated condition are subject to deformation rather than cracking under the expected strains. Mr. Harold Owens reported, in a phone conversation on June 4, 2009, that aside from a 1-inch-wide crack in desiccated materials, no obvious cracking was observed in the clayey native soils over the previously advanced Longwall Panel No. 1 in the future Phase 5 area. Considerable cracking was observed in a more brittle asphalt and chip pavement that crossed the edge of the panel. Due to the possibility of localized higher than predicted tensile deformations at any surface point over longwall panel edges, the development of significant cracks in the foundation and embankments is low but cannot be excluded.

A similar evaluation was performed for the piping resistance of the foundation and CCR materials. Piping resistance was evaluated as "high" for the foundation clay and plant-run CCR materials, and medium for the laboratory compacted materials. While not addressed in the submittal, we believe that if the impoundment is capped and not impounding water, there will be insufficient seepage water to erosively propagate any piping even if persistent cracks develop in the embankment. Therefore, for a capped impoundment, cracking and subsequent internal erosion via seepage piping is an unlikely possible failure mode.

Subsidence Induced FCR Flow Through Cracks

The third potential subsidence induced failure mechanism examined was the possibility of flowage of fluid FCR through large transverse cracks in the embankment or foundation. As described above, such cracks are unlikely, but cannot be precluded. However, if the FCR is not in a sufficiently flowable state, the cracking will be inconsequential, and this mode of failure can be precluded.

The most recent submittal provided the results of laboratory testing and an analysis of the potential for triggering strength loss (liquefaction) for the FCR under cyclic stresses from either earthquakes or the advancing subsidence across the impoundment. The FCR produced at the Mach Mine preparation plant was bulk-sampled and characterized as a fine grained plastic material with 93 percent passing the No. 200 sieve and more than 99 percent passing the No. 40 sieve. The liquid limit was 36 and the plasticity index was 17 and the material was classified under the USCS classification system as "CL."

The submittal included calculations from two triaxial tests performed on remolded FCR specimens prepared from bucket samples of the slurry produced by the preparation plant. These calculations showed a post-seismic strength ratio (S_{us}/ σ'_v) of 0.24, which is only slightly less than the peak (S_u/ σ'_v) value of 0.27. If fully consolidated, these materials are not flowable under any anticipated seismic or mine subsidence conditions. However, the fine grained FCR at this facility is likely to dissipate excess pore pressure and consolidate under self-weight very slowly, so the undrained strength of the FCR at the time of mining is likely to be the most critical condition, with a very weak upper FCR layer being potentially flowable through cracks extending through the embankment. The submittal did not include specific calculations addressing this scenario; however, a CCR cap with a minimum thickness of 5 feet is specified to be placed over the impoundment prior to mining. It is expected, based on MWGED's previous observations and independent calculations, that when CCR is pushed-out over the FCR, the upper materials with undrained strength (S_u) less than at least 150 pounds per square foot will be displaced during the pushout process and therefore are unlikely to be present beneath the pushout. The FCR and/or mixed FCR and CCR material that has reached an S_u of at least 150 psf is not flowable through a cracked embankment except in conjunction with erosive water flow, which will be precluded by the CCR cover. Therefore, provided that the Phase 3 impoundment is capped as shown in the submitted design, a failure by FCR flowage through cracks in the CCR embankment is also unlikely.

CONCLUSIONS AND RECOMMENDATIONS

MWGED noted some deficiencies in the submitted responses to our request for information; however, check calculations show the results of the analyses are conservative and the construction of this facility through Phase 6 is technically satisfactory. However, the submittal did not substantiate the stability of the Phase 7A south embankment which will be constructed over Phase 3A fine refuse, and an independent analysis performed in this office found that the design as currently planned will not be stable under static or seismic conditions. Therefore, approval is recommended through Phase 6 only. Additional information and design revisions as needed to substantiate the static and seismic stability of Phase7A will be needed before approval of this stage can be recommended.

Our recommendation for approval assumes the facility is constructed strictly in accordance with the submitted plan. In particular, the Phase 3 impoundment must be capped with a stable CCR cover and incapable of impounding water before longwall mining approaches the impoundment. Also, per the submitted Specification 6.03 for enhanced monitoring, the operability of all the specified instrumentation and preparations for the contingency buttress shall be verified by the operator's engineer before the longwall mining face is within 100 feet of any part of the Phase 3 capped impoundment.

The CCR embankments at this facility will be constructed in 500- to 600-foot-long longitudinal segments in order to take advantage of belt delivery of the CCR to the placement location. In order to assure the segments are adequately compacted and keyed into the adjoining segments, a specific placement plan was developed and is included in Appendix E of Volume 1 of the

submitted plan. This placement plan, particularly the use of the specified equipment, maximum push distances, and excavation of keys into the adjoining segment should be strictly followed.

The design report narratives and test data should also be considered part of the approved plan. If dam or foundation materials or conditions are discovered that are different than those described in the submitted reports, the plan should be modified as needed to address the changed conditions and submitted to MSHA for approval. In particular, the safety of this facility is contingent on the adherence to the specific mining schedule shown in Drawing B05-330-M36 -Mining/Impoundment Construction Timing Map, revised July 10, 2009.

Approved Plan Documents

Care should be taken to assure the most recent revisions to the drawings and specifications are incorporated into the revised plan documents. The approved plan consists of all the documents listed in the section of this report titled "Second Revised Design Submittal" with the exception of drawing B05-330-M33 – Phase 7 – Plan View and any other Phase 7 details shown on other drawings.

Report Prepared by:

Paul J. Donahue, P.E.
Civil Engineer

Report Approved by:

Darren J Blank, P.E.
Supervisory Civil Engineer

U.S. Department of Labor

Mine Safety and Health Administration
2300 Willow Street
Suite 200
Vincennes, Indiana 47591-5416

62-A2

December 4, 2009

Mr. Anthony Webb
Mach Mining, LLC
P.O. Box 300
Johnston City, IL 62951

RE: Approval of Revised Design Plans for Phases 3 through 6 of the Proposed Coal Refuse Disposal Facility No. 2, Impoundment ID No. 1211 IL08 03141-02, Mach Mining, LLC, Mach #1 Mine, MSHA ID No. 11-03141, Johnston City, Williamson County, Illinois

Dear Mr. Webb:

The Mine Safety and Health Administration has completed a review of the engineering plan, referred to as Mach Mining, LLC, Coal Refuse Disposal Facility No. 2, dated January 2007, for the design, construction, and maintenance for the subject project. The review includes the following information:

- The original submitted design entitled "Engineering Design Plan – Proposed Coal Refuse Disposal, Facility No. 2", Williamson County, Illinois, dated January 2007.
- The first revised submitted design entitled "Response to February 11, 2008 Comments, dated August 2008.
- The second revised submitted design entitled "Additional Information – Volume 1-Volume 3, Coal Refuse Disposal Facility No. 2 Phase 3 through 7" dated July 20, 2009.

Based on the information submitted, the plan is approved through Phase 6. Additional information as specified in the attached report MW09-077, dated November 12, 2009, will be required before Phase 7 can be approved.

Section 77.216-2(b) requires that any changes or modifications to this plan be approved by the District Manager prior to initiation of such changes or modifications. If Mach Mining, LLC has any questions concerning this matter, please contact Stan Reeder at (812) 882-7617.

Sincerely,

Timothy R. Watkins
Acting District Manager
Coal Mine Safety and Health
District 8

cc: SReeder
Benton Filed Office – Files
Law Files

TRWatkins:llh:12/04/09

982

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

Harold Owens <howens@aci-wv.com>

Clarification of Recommendations - Mach Mine Facility No. 1 (Phase 1 and 2) - ID No. 1211-IL08-03141-01

1 message

Donahue, Paul - MSHA <Donahue.Paul@dol.gov> Thu, Oct 7, 2010 at 6:48 PM
To: "Reeder, Stanley E. - MSHA" <Reeder.Stanley@dol.gov>
Cc: "Blank, Darren J - MSHA" <Blank.Darren@dol.gov>, Harold Owens <howens@aci-wv.com>, "Kelly, James - MSHA" <Kelly.James@dol.gov>

Stan,

Technical Support received a submittal, prepared by Alliance Consulting, which contains revisions and additional information we requested regarding Phase 7 of the Mach Mine Disposal Facility No. 2 (ID No. 1211-IL08-02141-02). This submittal is dated March 22, 2010 and was received by Technical Support on March 29, 2010. This submittal is currently under review.

The submittal also includes the following statement, which for expediency, I am addressing, in this e-mail, separately from the Phase 7 review:

"...we assume that longwall mining beneath the Phase 2 cell is approved as shown in the currently approved plan although this was not specifically mentioned in your November 12, 2009 memorandum. For clarification purposes with other reviewing agencies, we would appreciate this language being added to your next memorandum."

The reason the Phase 2 cell wasn't mentioned in the report recommending approval of Phases 3 through 6, (dated November 12, 2009) is because this cell is a separate facility (different ID number) from Disposal Facility No. 2. Technical Support had already reviewed and recommended approval for Phase 2 in a separate report (Report No. MW07-035), prepared by James Kelly, and dated June 22, 2007. A copy of this report attached to this e-mail for your reference.

With regard to the future longwall mining under Phase 2, the June 22, 2007 report states the following:

"This plan has been evaluated with the understanding (as stated in the plan) that no longwall mining will be conducted below the impoundment until abandonment operations of the impoundment are complete"

Therefore, the plan that Technical Support recommended approval already requires that the Phase 2 cell be abandoned prior to longwall mining under the footprint of the cell. We consider this requirement to be technically adequate, and no other recommendation is needed. For the specific situation of mining under this cell, "abandonment" means the placement of a stable cap of coarse refuse or other fill over the settled fine refuse and graded in a manner that precludes any ponding of water on the fill surface within the diked area. This same requirement is also part of the approved plan for the Phase 3 cell which we recommended approval in the November 12, 2009 report.

I recommend that the above clarification of what constitutes "abandonment" be provided in any correspondence that CMS&H District 8 furnishes to Mach Mining regarding Phase 2 of the disposal facility.

Paul Donahue
Pittsburgh Technical Support
Mine Waste and Geotechnical Engineering Division
412-306-5338

APPENDIX F

SUBSIDENCE IMPACT/GROUNDWATER

GROUNDWATER IMPACT

Longwall mining beneath capped coal refuse impoundments Phase 2 and Phase 3 should have no impact to groundwater. This opinion is based on the following:

- A clay barrier exists beneath these structures. This clay is self-healing.
- Fine coal refuse deposited on top of the clay barrier consists of over 90 percent clay-size and silt-size particles which further reduces the flow of water vertically into the groundwater regime.
- The source of water (pumped fine coal refuse) has been discontinued for quite some time. The draining of the coal fines is evidenced by the settlement of the coal fines since pumping was discontinued.
- The addition of the cap further reduced the quantity of water contained in the impoundments by assisting in consolidating the fine coal refuse.
- The cap will eliminate pooled water (rainfall) from accumulating by elimination of impounding capability.
- The cap will be crowned to minimize water infiltration.
- The footprints of the Phase 4 and Phase 5 impoundments contained pooled water when longwall mining in Panel Nos. 1 and 2 occurred beneath them. The pooled water remained during and after longwall mining.
- A portions of the sediment control structures which encircles the refuse area were undermined by longwall mining. The pool elevations did not diminish during or after longwall mining. These structures were constructed on-site clay.

APPENDIX G

PIEZOMETER READINGS

Piezometer No.	Date														Warning Level
	3/26/2008	4/17/2008	4/30/2008	5/14/2008	5/21/2008	5/28/2008	6/4/2008	6/11/2008	6/18/2008	6/25/2008	7/2/2008	7/9/2008	7/16/2008	7/23/2008	7/30/2008	
P1	DRY	DRY	DRY	466.5	466.8	466.5	466.5	466.8	466.7	466.6	467.0	466.8	467.0	467.2	467.6	467.0
P2	DRY	DRY	DRY	469.0	469.0	469.0	469.0	469.0	469.0	469.5	469.9	470.2	470.8	471.4	472.4	475.0
P3	DRY	DRY	DRY	467.0	467.4	467.1	467.9	467.8	468.0	468.0	468.3	468.3	468.3	468.4	468.5	467.0
P4	DRY	DRY	DRY	470.1	470.3	470.5	470.6	470.6	471.0	471.8	472.3	471.9	471.6	470.4	470.1	472.0
P5	DRY	DRY	DRY	473.8	473.8	473.8	473.8	473.8	474.0	474.1	474.9	474.6	474.5	474.3	474.2	485.5

Piezometer No.	Date														Warning Level
	7/30/2008	8/6/2008	8/13/2008	8/20/2008	8/27/2008	9/3/2008	9/10/2008	9/17/2008	9/24/2008	10/1/2008	10/8/2008	10/15/2008	10/22/2008	10/29/2008	11/5/2008	
P1	467.6	467.5	467.9	467.5	467.6	467.5	467.4	467.5	467.5	467.8	467.5	467.5	467.4	467.3	468.4	467.0
P2	472.4	474.3	476.1	477.6	478.2	477.0	479.1	479.5	479.7	480.0	480.0	479.8	479.7	479.7	479.7	475.0
P3	468.5	468.3	468.3	468.0	468.2	468.2	468.1	468.0	468.1	468.3	468.1	468.1	468.0	467.8	467.9	467.0
P4	470.1	470.0	470.0	470.7	471.0	471.2	471.1	470.6	470.1	470.1	470.0	470.0	469.9	469.9	469.9	472.0
P5	474.2	474.1	474.0	474.1	474.5	474.6	474.6	474.7	474.8	475.1	475.4	475.6	475.7	475.9	475.8	485.5

Piezometer No.	DATE														Warning Level
	11/5/2008	11/12/2008	11/19/2008	11/26/2008	12/3/2008	12/10/2008	12/17/2008	12/24/2008	12/31/2008	1/7/2009	1/14/2009	1/21/2009	1/28/2009	2/4/2009	2/11/2009	
P1	468.4	468.8	468.4	468.4	468.4	468.2	467.8	467.9	467.7	468.1	467.4	467.5	467.4	467.1	467.6	467.0
P2	479.7	479.7	479.3	479.2	479.2	478.9	478.5	478.5	478.2	478.2	477.7	477.7	477.7	477.2	477.6	475.0
P3	467.9	468.2	469.0	468.2	467.9	467.6	467.5	467.6	467.3	468.1	466.9	467.5	467.6	467.3	468.2	467.0
P4	469.9	469.9	470.6	470.5	470.4	470.4	470.3	469.9	470.2	470.3	470.1	470.2	470.2	470.1	470.2	472.0
P5	475.8	476.0	476.1	476.4	476.6	476.5	476.5	476.5	476.4	476.5	476.3	476.4	476.5	476.3	476.4	485.5

Piezometer No.	DATE														Warning Level
	2/18/2009	2/25/2009	3/4/2009	3/11/2009	3/18/2009	3/25/2009	4/1/2009	4/8/2009	4/15/2009	4/22/2009	4/29/2009	5/6/2009	5/13/2009	5/20/2009	5/27/2009	
P1	467.7	467.4	467.3	467.4	467.4	467.5	467.7	467.7	467.5	467.8	467.4	467.8	467.5	467.6	468.0	467.0
P2	477.1	476.9	476.8	476.8	476.9	476.9	477.2	477.4	477.4	477.5	477.4	477.7	477.7	477.7	478.0	475.0
P3	468.0	467.6	467.5	467.1	467.7	467.7	467.7	467.8	467.5	467.8	467.5	468.1	468.1	467.8	468.2	467.0
P4	470.1	470.1	470.1	470.0	470.1	470.1	470.0	470.0	470.0	470.0	469.8	470.0	469.9	469.9	469.9	472.0
P5	476.4	476.2	476.2	476.2	476.2	476.2	476.2	476.3	476.2	476.1	476.3	476.3	476.0	476.0	476.1	485.5

Piezometer No.	DATE														Warning Level
	6/3/2009	6/10/2009	6/17/2009	6/24/2009	7/1/2009	7/8/2009	7/15/2009	7/22/2009	7/29/2009	8/5/2009	8/12/2009	8/19.2009	8/26/2009	9/2/2009	9/9/2009	
P1	467.7	467.7	467.6	467.7	467.7	467.0	467.1	467.3	467.4	467.1	467.0	467.0	466.4	466.6	466.6	467.0
P2	478.2	478.2	478.3	478.5	478.8	478.7	478.5	478.5	478.7	478.6	478.5	478.5	478.4	478.4	478.4	475.0
P3	467.9	467.9	467.9	467.8	467.7	467.7	467.8	467.7	467.8	467.5	467.5	467.5	467.3	467.0	467.2	467.0
P4	469.9	469.9	469.9	469.9	469.8	469.9	470.0	469.9	469.9	469.9	469.9	469.9	469.9	469.9	469.9	472.0
P5	476.1	476.1	476.1	476.2	476.2	476.3	476.8	476.1	476.2	476.2	476.1	476.2	476.2	476.1	476.2	485.5

Piezometer No.	DATE														Warning Level
	9/16/2009	9/23/2009	9/30/2009	10/07009	10/14/2009	10/21/2009	10/28/2009	11/4/2009	11/11/2009	11/18/2009	11/25/2009	12/2/2009	12/9/2009	12/16/2009	12/23/2009	
P1	466.6	466.5	466.6	466.9	466.8	467.0	466.9	467.1	467.2	467.2	467.2	467.1	467.1	467.0	467.0	467.0
P2	478.4	478.3	478.3	478.2	478.0	477.8	477.8	477.6	477.4	477.4	477.3	477.2	477.2	476.9	476.9	475.0
P3	467.4	467.3	467.4	467.4	467.7	467.7	467.8	467.7	467.6	467.6	467.7	467.6	467.6	467.3	467.2	467.0
P4	469.9	469.9	469.9	469.9	469.9	469.9	469.8	469.8	469.8	469.8	469.8	469.8	469.9	469.7	469.7	472.0
P5	476.2	476.2	476.2	476.2	476.2	476.1	476.1	476.1	476.0	476.0	476.3	476.3	476.3	476.2	476.2	485.5

Piezometer No.	DATE														Warning Level
	12/30/2009	1/6/2010	1/13/2010	1/20/2010	1/27/2010	2/3/2010	2/10/2010	2/17/2010	2/24/2010	3/3/2010	3/10/2010	3/17/2010	3/24/2010	3/31/2010	4/7/2010	
P1	467.2	467.0	466.7	466.6	466.7	466.6	466.4	466.3	467.3	467.2	467.2	466.9	466.8	467.3	467.5	467.0
P2	476.8	476.5	476.3	476.5	476.4	476.4	476.4	476.2	476.0	476.0	476.0	476.0	476.0	476.1	476.3	475.0
P3	467.6	467.2	467.2	467.2	467.2	467.3	467.5	467.5	467.5	467.4	467.3	467.3	467.6	467.6	467.7	467.0
P4	469.7	469.6	469.6	469.6	469.6	469.6	469.6	469.6	469.5	469.5	469.5	469.4	469.4	469.4	469.5	472.0
P5	476.2	476.1	476.1	476.1	476.2	476.2	476.2	476.2	476.3	476.3	476.3	476.3	476.4	476.3	476.3	485.5

Piezometer No.	DATE														Warning Level
	4/14/2010	4/21/2010	4/28/2010	5/5/2010	5/12/2010	5/19/2010	5/26/2010	6/2/2010	6/9/2010	6/16/2010	6/23/2010	6/30/2010	7/7/2010	7/14/2010	7/21/2010	
P1	466.9	467.1	467.3	467.3	467.1	467.0	466.9	467.0	466.6	466.7	467.2	467.5	467.7	467.8	467.7	467.0
P2	476.1	476.3	476.6	476.6	477.1	477.1	477.2	477.4	477.6	477.6	477.7	477.9	478.1	478.4	478.8	475.0
P3	467.1	467.4	467.6	467.6	467.3	467.2	467.2	467.3	467.0	467.1	467.4	467.3	467.8	468.2	468.9	467.0
P4	469.4	469.3	469.3	469.3	470.1	470.1	470.1	470.1	470.0	470.0	469.9	469.9	469.9	469.9	469.9	472.0
P5	476.2	476.4	476.4	476.4	476.6	476.5	476.4	476.4	476.3	476.2	476.2	476.1	476.1	476.2	476.3	485.5

Phase 2

R12299

Piezometer No.	DATE														Warning Level
	7/28/2010	8/4/2010	8/11/2010	8/18/2010	8/25/2010	9/1/2010	9/8/2010	9/15/2010	9/22/2010	9/29/2010	10/6/2010	10/13/2010	10/20/2010	10/27/2010	11/3/2010	
P1	467.8	467.8	467.6	467.4	467.2	467.3	467.1	467.0	467.0	467.0	466.4	466.4	466.2	466.2	465.7	467.0
P2	479.1	479.6	480.1	480.3	480.4	480.5	480.6	480.6	480.7	480.6	480.3	480.5	480.3	480.4	479.8	475.0
P3	469.4	469.6	469.2	469.2	469.3	469.3	468.9	468.9	468.8	468.9	468.5	468.4	468.5	468.4	468.2	467.0
P4	470.7	471.6	471.9	472.7	473.0	472.5	471.9	471.6	471.4	471.2	471.0	470.8	470.5	470.4	470.3	472.0
P5	476.3	476.4	476.5	476.7	477.0	477.4	477.8	478.1	478.5	479.1	479.5	480.0	480.3	480.6	480.4	485.5

Piezometer No.	DATE															Warning Level
	11/10/2010	11/17/2010	11/24/2010	12/1/2010	12/8/2010	12/15/2010	12/22/2010	12/29/2010	1/5/2011	1/12/2011	1/19/2011	1/26/2011	2/2/2011	2/9/2011	2/16/2011	
P1	465.7	465.6	465.6	465.7	465.7	465.7	465.9	466.0	466.5	465.9	466.1					467.0
P2	479.7	479.6	479.6	479.7	478.9	478.6	478.6	478.6	478.4	478.1	478.2					475.0
P3	468.2	468.2	468.2	468.3	468.0	467.9	467.9	468.1	468.1	467.4	467.8					467.0
P4	470.2	470.2	470.3	470.2	470.1	470.1	470.0	470.1	470.0	470.0	469.9					472.0
P5	480.6	480.6	480.6	480.6	480.5	480.5	480.5	480.4	480.5	480.1	480.2					485.5

Piezometer No.	DATE								Warning Level Elev.
	10/8/2008	10/15/2008	10/22/2008	10/29/2008	11/5/2008	11/12/2008	11/19/2008	11/26/2008	
P6	465.5	465.8	466.1	466.4	466.9	467.3	467.5	467.7	463.4
P7	465.7	466.2	466.8	467.6	468.2	469.0	469.4	469.9	475.2
P8	464.3	464.3	464.3	464.3	464.4	464.7	464.8	465.0	487.2

Piezometer No.	DATE								Warning Level Elev.
	12/03/2008`	12/10/2008	12/17/2008	12/24/2008	12/31/2008	1/7/2009	1/14/2009	1/21/2009	
P6	467.8	467.7	467.8	468.1	468.1	468.8	467.9	468.5	463.4
P7	470.5	470.6	470.8	470.8	471.3	471.8	471.6	472.0	475.2
P8	465.2	466.1	467.4	467.5	469.2	470.1	471.0	471.8	487.2

Piezometer No.	DATE								Warning Level Elev.
	1/28/2009	2/4/2009	2/11/2009	2/18/2009	2/25/2009	3/4/2009	3/11/2009	3/18/2009	
P6	468.4	468.8	469.5	469.4	468.9	468.9	468.5	468.9	463.4
P7	472.1	473.1	473.6	473.1	472.5	472.3	472.2	472.2	475.2
P8	472.3	473.6	477.6	478.9	478.8	479.1	479.0	479.0	487.2

Piezometer No.	DATE								Warning Level Elev.
	3/25/2009	4/1/2009	4/8/2009	4/15/2009	4/22/2009	4/29/2009	5/6/2009	5/13/2009	
P6	469.1	469.3	469.7	469.6	469.9	469.9	470.0	470.0	463.4
P7	472.2	472.5	473.2	473.5	473.8	473.6	474.2	473.7	475.2
P8	479.0	479.7	480.3	480.4	480.9	481.2	481.6	481.7	487.2

Piezometer No.	DATE								Warning Level Elev.
	5/20/2009	5/27/2008	6/3/2009	6/10/2009	6/17/2009	6/24/2009	7/1/2009	7/8/2009	
P6	470.0	470.0	470.0	470.0	470.0	470.0	469.9	469.9	463.4
P7	474.0	474.1	473.8	473.9	473.9	473.7	473.5	473.3	475.2
P8	480.7	480.4	480.1	480.2	480.2	479.7	479.4	479.1	487.2

Phase 3

R12301

Piezometer No.	DATE								Warning Level Elev.
	7/15/2009	7/22/2009	7/29/2009	8/5/2009	8/12/2009	8/19/2009	8/26/2009	9/2/2009	
P6	469.7	469.7	469.7	469.6	469.4	469.4	469.1	469.1	463.4
P7	473.1	472.9	472.9	472.6	472.5	472.5	472.3	472.1	475.2
P8	479.0	478.7	478.7	478.5	478.4	478.3	478.2	478.0	487.2

Piezometer No.	DATE								Warning Level Elev.
	9/9/2009	9/16/2009	9/23/2009	9/30/2009	10/7/2009	10/14/2009	10/21/2009	10/28/2009	
P6	469.3	469.3	469.2	469.2	469.1	469.1	469.0	469.1	463.4
P7	472.3	472.1	472.1	472.1	472.0	471.4	471.7	471.7	475.2
P8	477.9	478.0	477.8	477.7	477.7	477.6	477.5	477.6	487.2

Piezometer No.	DATE								Warning Level Elev.
	11/4/2009	11/11/2009	11/18/2008	11/25/2009	12/2/2009	12/9/2009	12/16/2009	12/23/2008	
P6	468.9	468.8	468.8	468.8	468.6	468.6	468.0	468.0	463.4
P7	471.7	471.5	471.6	471.5	471.4	471.4	471.0	470.9	475.2
P8	477.3	477.3	477.3	477.3	477.1	477.0	476.8	476.8	487.2

Piezometer No.	DATE								Warning Level Elev.
	12/30/2009	1/6/2010	1/13/2010	1/20/2010	1/27/2010	2/3/2010	2/10/2010	2/17/2010	
P6	468.3	468.2	467.9	467.9	467.8	467.9	468.0	467.9	463.4
P7	471.2	470.8	470.7	470.6	470.7	470.7	470.7	470.7	475.2
P8	477.0	477.0	476.9	476.9	477.0	477.0	476.8	476.9	487.2

Piezometer No.	DATE								Warning Level Elev.
	2/24/2010	3/3/2010	3/10/2010	3/17/2010	3/24/2010	3/31/2010	4/7/2010	4/14/2010	
P6	467.8	467.8	467.7	467.7	468.0	468.0	467.3	467.7	463.4
P7	470.5	470.3	470.3	470.3	470.4	470.4	470.6	470.0	475.2
P8	476.8	476.6	476.6	476.4	476.4	476.4	476.1	475.9	487.2

R12302

Piezometer No.	DATE								Warning Level Elev.
	4/21/2010	4/28/2010	5/5/2010	5/12/2010	5/19/2010	5/26/2010	6/2/2010	6/9/2010	
P6	468.1	468.4	468.4	468.1	468.1	468.1	468.2	468.0	463.4
P7	470.5	470.5	470.5	470.2	470.2	470.2	470.2	470.0	475.2
P8	476.2	476.0	476.0	476.6	476.5	476.3	476.3	476.0	487.2

Piezometer No.	DATE								Warning Level Elev.
	6/16/2010	6/23/2010	6/30/2010	7/7/2010	7/14/2010	7/21/2010	7/28/2010	8/4/2010	
P6	467.9	468.0	467.8	467.9	467.9	467.9	468.0	468.1	463.4
P7	469.9	470.0	469.9	469.9	469.9	469.9	469.9	469.9	475.2
P8	475.8	475.7	475.5	475.4	475.4	475.3	475.2	475.1	487.2

Piezometer No.	DATE								Warning Level Elev.
	8/11/2010	8/18/2010	8/25/2010	9/1/2010	9/8/2010	9/15/2010	9/22/2010	9/29/2010	
P6	468.1	468.1	468.1	468.4	468.4	468.8	469.4	469.9	463.4
P7	470.0	470.0	470.1	470.3	470.6	470.8	471.4	472.6	475.2
P8	475.2	475.1	475.1	475.1	475.3	475.8	476.4	477.0	487.2

Piezometer No.	DATE								Warning Level Elev.
	10/6/2010	10/13/2010	10/20/2010	10/27/2010	11/3/2010	11/10/2010	11/17/2010	11/24/2010	
P6	470.0	469.9	470.0	469.9	469.9	469.9	469.9	469.9	463.4
P7	473.3	475.4	476.2	476.5	476.1	476.2	476.1	476.1	475.2
P8	477.2	477.1	477.3	477.4	477.4	477.4	477.4	477.5	487.2

Piezometer No.	DATE								Warning Level Elev.
	12/1/2010	12/8/2010	12/15/2010	12/22/2010	12/29/2010	1/5/2011	1/12/2011	1/19/2011	
P6	469.9	469.8	469.8	469.8	469.8	469.8	469.8	469.4	463.4
P7	476.0	474.7	474.5	474.1	473.8	473.6	473.4	473.2	475.2
P8	477.6	477.5	477.5	477.4	477.4	477.5	477.1	477.2	487.2

Piezometer No.	DATE								Warning Level Elev.
	1/26/2011	2/2/2011	2/9/2011	2/16/2011	2/23/2011	3/2/2011	3/9/2011	3/16/2011	
P6									463.4
P7									475.2
P8									487.2

R12304

APPENDIX H

PIN LINE DATA

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

December 31, 2009 Data			
Point #	Northing	Easting	Elevation
1231101	428411.2488	358718.9261	449.83
1231102	428411.0934	358743.8222	449.94
1231103	428411.1765	358768.9119	450.01
1231104	428411.1296	358793.9224	450.04
1231105	428411.3205	358818.8424	450.14
1231106	428411.1766	358843.8259	450.13
1231107	428411.1233	358868.9040	450.15
1231108	428411.3094	358893.8823	450.15
1231109	428411.1941	358918.9280	450.15
1231110	428411.1462	358943.8776	449.92
1231111	428411.1829	358968.9241	449.77
1231112	428411.2042	358993.9440	449.69
1231113	428411.1991	359018.9536	449.61
1231114	428386.1826	359018.8372	450.05
1231115	428361.1102	359018.8627	450.11
1231116	428336.1516	359018.8980	450.82
1231117	428311.2125	359018.9063	450.75
1231118	428286.1455	359018.9677	450.55
1231119	428261.1909	359019.0124	450.87
1231120	428236.2756	359018.9120	451.35
1231121	428211.2112	359018.9185	452.08
1231122	428186.2592	359018.8568	452.68
1231123	428161.2272	359018.9443	452.85
1231124	428136.2277	359018.9424	452.39
1231125	428111.2281	359018.9446	452.58
1231126	428086.2406	359018.8845	451.95
1231127	428061.2668	359018.9024	451.92
1231128	428036.2506	359018.8248	452.32
1231129	428011.2841	359018.8635	452.44
1231130	427986.2543	359018.8713	452.63
1231131	427961.2483	359018.8380	453.13
1231132	427936.1889	359018.8281	453.14
1231133	427911.2045	359018.8766	453.42
1231134	427886.1970	359018.8614	453.80
1231135	427861.2422	359018.8280	454.09
1231136	427836.2187	359018.8538	454.41
1231137	427811.1960	359018.9186	454.73

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031.	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

December 31, 2009 Data			
Point #	Northing	Easting	Elevation
1231101	428411.2488	358718.9261	449.58
1231102	428411.0934	358743.8222	449.69
1231103	428411.1765	358768.9119	449.82
1231104	428411.1296	358793.9224	449.82
1231105	428411.3205	358818.8424	449.95
1231106	428411.1766	358843.8259	449.98
1231107	428411.1233	358868.9040	450.01
1231108	428411.3094	358893.8823	450.00
1231109	428411.1941	358918.9280	449.95
1231110	428411.1462	358943.8776	449.75
1231111	428411.1829	358968.9241	449.56
1231112	428411.2042	358993.9440	449.53
1231113	428411.1991	359018.9536	449.39
1231114	428386.1826	359018.8372	449.80
1231115	428361.1102	359018.8627	449.89
1231116	428336.1516	359018.8980	450.62
1231117	428311.2125	359018.9063	450.60
1231118	428286.1455	359018.9677	450.32
1231119	428261.1909	359019.0124	450.69
1231120	428236.2756	359018.9120	451.17
1231121	428211.2112	359018.9185	451.86
1231122	428186.2592	359018.8568	452.52
1231123	428161.2272	359018.9443	452.65
1231124	428136.2277	359018.9424	452.16
1231125	428111.2281	359018.9446	452.39
1231126	428086.2406	359018.8845	451.79
1231127	428061.2668	359018.9024	451.76
1231128	428036.2506	359018.8248	452.17
1231129	428011.2841	359018.8635	452.24
1231130	427986.2543	359018.8713	452.43
1231131	427961.2483	359018.8380	452.94
1231132	427936.1889	359018.8281	452.95
1231133	427911.2045	359018.8766	453.23
1231134	427886.1970	359018.8614	453.63
1231135	427861.2422	359018.8280	453.91
1231136	427836.2187	359018.8538	454.22
1231137	427811.1960	359018.9186	454.56

Data Compared			
Point #	Northing	Easting	Elevation
101	-0.01	-0.09	-0.02
102	-0.05	-0.05	-0.03
103	-0.03	-0.06	-0.03
104	-0.05	-0.07	-0.03
105	-0.04	-0.05	-0.02
106	-0.07	-0.06	-0.03
107	-0.08	-0.05	-0.02
108	-0.05	-0.08	-0.02
109	-0.05	-0.10	-0.02
110	-0.06	-0.05	-0.02
111	-0.06	-0.06	-0.02
112	-0.05	-0.09	-0.02
113	-0.05	-0.07	-0.01
114	-0.01	-0.12	-0.01
115	-0.02	-0.09	-0.01
116	-0.02	-0.12	-0.01
117	-0.03	-0.11	-0.01
118	-0.04	-0.12	-0.01
119	-0.09	-0.14	-0.01
120	-0.05	-0.10	-0.01
121	-0.03	-0.15	-0.01
122	-0.08	-0.12	-0.01
123	-0.06	-0.13	-0.01
124	-0.05	-0.14	-0.01
125	-0.09	-0.12	-0.02
126	-0.06	-0.12	-0.02
127	-0.14	-0.09	-0.03
128	-0.08	-0.09	-0.03
129	-0.07	-0.10	-0.02
130	-0.05	-0.11	-0.03
131	-0.04	-0.11	-0.03
132	-0.07	-0.11	-0.03
133	-0.05	-0.09	-0.03
134	-0.08	-0.11	-0.02
135	-0.07	-0.08	-0.02
136	-0.07	-0.09	-0.03
137	-0.08	-0.09	-0.03
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

R12307

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 4, 2010 Data			
Point #	Northing	Easting	Elevation
14101	428411.2173	358719.0011	449.56
14102	428411.1018	358743.8186	449.67
14103	428411.2118	358768.8875	449.80
14104	428411.1424	358793.9200	449.80
14105	428411.3170	358818.8499	449.93
14106	428411.1952	358843.8387	449.96
14107	428411.1501	358868.9141	449.99
14108	428411.2916	358893.8671	449.98
14109	428411.1945	358918.8918	449.94
14110	428411.1585	358943.8710	449.73
14111	428411.1835	358968.9374	449.54
14112	428411.2042	358993.9396	449.51
14113	428411.2215	359018.9589	449.37
14114	428386.2728	359018.8580	449.78
14115	428361.1900	359018.9210	449.87
14116	428336.2125	359018.9364	450.60
14117	428311.2737	359018.9561	450.58
14118	428286.2382	359018.9909	450.30
14119	428261.2300	359019.0007	450.67
14120	428236.3537	359018.9324	451.15
14121	428211.3301	359018.9059	451.84
14122	428186.3094	359018.8630	452.50
14123	428161.2661	359018.9395	452.63
14124	428136.2693	359018.9400	452.14
14125	428111.2734	359018.9629	452.36
14126	428086.2943	359018.8831	451.76
14127	428061.2888	359018.9183	451.73
14128	428036.2868	359018.8337	452.13
14129	428011.3035	359018.8683	452.20
14130	427986.3151	359018.8650	452.40
14131	427961.2950	359018.8341	452.91
14132	427936.2301	359018.8284	452.92
14133	427911.2616	359018.8760	453.19
14134	427886.2589	359018.8375	453.59
14135	427861.2947	359018.8260	453.87
14136	427836.2469	359018.8641	454.19
14137	427811.2392	359018.9329	454.53

R12308

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009				January 4, 2010 Data				Data Compared			
Point #	Northing	Easting	Elevation	Point #	Northing	Easting	Elevation	Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55	14101	428411.2173	358719.0011	449.56	101	0.03	-0.16	0.00
102	428411.0404	358743.7741	449.66	14102	428411.1018	358743.8186	449.67	102	-0.06	-0.04	-0.01
103	428411.1509	358768.8500	449.79	14103	428411.2118	358768.8875	449.80	103	-0.06	-0.04	-0.01
104	428411.0827	358793.8495	449.79	14104	428411.1424	358793.9200	449.80	104	-0.06	-0.07	-0.01
105	428411.2768	358818.7893	449.92	14105	428411.3170	358818.8499	449.93	105	-0.04	-0.06	-0.01
106	428411.1052	358843.7660	449.95	14106	428411.1952	358843.8387	449.96	106	-0.09	-0.07	-0.01
107	428411.0468	358868.8559	449.99	14107	428411.1501	358868.9141	449.99	107	-0.10	-0.06	0.00
108	428411.2624	358893.8016	449.98	14108	428411.2916	358893.8671	449.98	108	-0.03	-0.07	0.00
109	428411.1398	358918.8297	449.93	14109	428411.1945	358918.8918	449.94	109	-0.05	-0.06	0.00
110	428411.0829	358943.8231	449.73	14110	428411.1585	358943.8710	449.73	110	-0.08	-0.05	0.00
111	428411.1221	358968.8653	449.54	14111	428411.1835	358968.9374	449.54	111	-0.06	-0.07	0.00
112	428411.1495	358993.8497	449.51	14112	428411.2042	358993.9396	449.51	112	-0.05	-0.09	0.00
113	428411.1486	359018.8786	449.38	14113	428411.2215	359018.9589	449.37	113	-0.07	-0.08	0.01
114	428386.1691	359018.7194	449.79	14114	428386.2728	359018.8580	449.78	114	-0.10	-0.14	0.01
115	428361.0914	359018.7749	449.88	14115	428361.1900	359018.9210	449.87	115	-0.10	-0.15	0.01
116	428336.1338	359018.7739	450.61	14116	428336.2125	359018.9364	450.60	116	-0.08	-0.16	0.01
117	428311.1872	359018.8005	450.59	14117	428311.2737	359018.9561	450.58	117	-0.09	-0.16	0.01
118	428286.1082	359018.8465	450.31	14118	428286.2382	359018.9909	450.30	118	-0.13	-0.14	0.01
119	428261.1057	359018.8769	450.68	14119	428261.2300	359019.0007	450.67	119	-0.12	-0.12	0.01
120	428236.2287	359018.8089	451.16	14120	428236.3537	359018.9324	451.15	120	-0.12	-0.12	0.01
121	428211.1790	359018.7712	451.85	14121	428211.3301	359018.9059	451.84	121	-0.15	-0.13	0.01
122	428186.1793	359018.7400	452.51	14122	428186.3094	359018.8630	452.50	122	-0.13	-0.12	0.01
123	428161.1638	359018.8099	452.64	14123	428161.2661	359018.9395	452.63	123	-0.10	-0.13	0.01
124	428136.1816	359018.8031	452.15	14124	428136.2693	359018.9400	452.14	124	-0.09	-0.14	0.01
125	428111.1367	359018.8270	452.37	14125	428111.2734	359018.9629	452.36	125	-0.14	-0.14	0.01
126	428086.1810	359018.7625	451.77	14126	428086.2943	359018.8831	451.76	126	-0.11	-0.12	0.01
127	428061.1300	359018.8122	451.73	14127	428061.2888	359018.9183	451.73	127	-0.16	-0.11	0.00
128	428036.1720	359018.7347	452.14	14128	428036.2868	359018.8337	452.13	128	-0.11	-0.10	0.01
129	428011.2166	359018.7676	452.22	14129	428011.3035	359018.8683	452.20	129	-0.09	-0.10	0.02
130	427986.2052	359018.7642	452.40	14130	427986.3151	359018.8650	452.40	130	-0.11	-0.10	0.00
131	427961.2040	359018.7292	452.91	14131	427961.2950	359018.8341	452.91	131	-0.09	-0.10	0.00
132	427936.1225	359018.7231	452.92	14132	427936.2301	359018.8284	452.92	132	-0.11	-0.11	0.00
133	427911.1533	359018.7862	453.20	14133	427911.2616	359018.8760	453.19	133	-0.11	-0.09	0.01
134	427886.1123	359018.7523	453.60	14134	427886.2589	359018.8375	453.59	134	-0.15	-0.09	0.01
135	427861.1730	359018.7483	453.88	14135	427861.2947	359018.8260	453.87	135	-0.12	-0.08	0.01
136	427836.1478	359018.7636	454.19	14136	427836.2469	359018.8641	454.19	136	-0.10	-0.10	0.00
137	427811.1182	359018.8285	454.53	14137	427811.2392	359018.9329	454.53	137	-0.12	-0.10	0.00
4383	427345.2341	360349.8149	463.22					4383	427345.23	360349.81	463.22
4384	429209.1676	360379.8928	442.31					4384	429209.17	360379.89	442.31
4388	430665.6266	360378.9926	435.57					4388	430665.63	360378.99	435.57
p248	425434.6524	360202.4261	531.87					p248	425434.65	360202.43	531.87

R12309

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 5, 2010 Data			
Point #	Northing	Easting	Elevation
15101	428411.2966	358718.9434	449.56
15102	428411.1232	358743.8260	449.68
15103	428411.2402	358768.9223	449.81
15104	428411.1765	358793.9482	449.81
15105	428411.3412	358818.8425	449.93
15106	428411.2046	358843.8569	449.97
15107	428411.1752	358868.9222	450.00
15108	428411.3497	358893.8896	449.99
15109	428411.2446	358918.9139	449.94
15110	428411.1707	358943.8946	449.74
15111	428411.2159	358968.9539	449.54
15112	428411.2119	358993.9516	449.50
15113	428411.2190	359018.9837	449.36
15114	428386.3034	359018.8690	449.78
15115	428361.1947	359018.9389	449.86
15116	428336.2569	359018.9600	450.59
15117	428311.2965	359018.9517	450.57
15118	428286.2552	359019.0079	450.29
15119	428261.2451	359018.9995	450.66
15120	428236.3740	359018.9494	451.14
15121	428211.3102	359018.9395	451.83
15122	428186.3101	359018.8939	452.49
15123	428161.2892	359018.9880	452.62
15124	428136.3212	359018.9540	452.13
15125	428111.2925	359018.9631	452.36
15126	428086.3170	359018.9210	451.76
15127	428061.3152	359018.9122	451.72
15128	428036.3063	359018.8204	452.13
15129	428011.3518	359018.8807	452.21
15130	427986.3442	359018.8921	452.40
15131	427961.3170	359018.8665	452.91
15132	427936.2528	359018.8468	452.92
15133	427911.2879	359018.8824	453.19
15134	427886.2650	359018.8574	453.60
15135	427861.2936	359018.8507	453.88
15136	427836.2401	359018.8912	454.19
15137	427811.2600	359018.9292	454.53

R12310

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 5, 2010 Data			
Point #	Northing	Easting	Elevation
15101	428411.2966	358718.9434	449.56
15102	428411.1232	358743.8260	449.68
15103	428411.2402	358768.9223	449.81
15104	428411.1765	358793.9482	449.81
15105	428411.3412	358818.8425	449.93
15106	428411.2046	358843.8569	449.97
15107	428411.1752	358868.9222	450.00
15108	428411.3497	358893.8896	449.99
15109	428411.2446	358918.9139	449.94
15110	428411.1707	358943.8946	449.74
15111	428411.2159	358968.9539	449.54
15112	428411.2119	358993.9516	449.50
15113	428411.2190	359018.9837	449.36
15114	428386.3034	359018.8690	449.78
15115	428361.1947	359018.9389	449.86
15116	428336.2569	359018.9600	450.59
15117	428311.2965	359018.9517	450.57
15118	428286.2552	359019.0079	450.29
15119	428261.2451	359018.9995	450.66
15120	428236.3740	359018.9494	451.14
15121	428211.3102	359018.9395	451.83
15122	428186.3101	359018.8939	452.49
15123	428161.2892	359018.9880	452.62
15124	428136.3212	359018.9540	452.13
15125	428111.2925	359018.9631	452.36
15126	428086.3170	359018.9210	451.76
15127	428061.3152	359018.9122	451.72
15128	428036.3063	359018.8204	452.13
15129	428011.3518	359018.8807	452.21
15130	427986.3442	359018.8921	452.40
15131	427961.3170	359018.8665	452.91
15132	427936.2528	359018.8468	452.92
15133	427911.2879	359018.8824	453.19
15134	427886.2650	359018.8574	453.60
15135	427861.2936	359018.8507	453.88
15136	427836.2401	359018.8912	454.19
15137	427811.2600	359018.9292	454.53

Data Compared			
Point #	Northing	Easting	Elevation
101	-0.05	-0.10	-0.01
102	-0.08	-0.05	-0.02
103	-0.09	-0.07	-0.02
104	-0.09	-0.10	-0.02
105	-0.06	-0.05	-0.01
106	-0.10	-0.09	-0.02
107	-0.13	-0.07	-0.01
108	-0.09	-0.09	-0.01
109	-0.10	-0.08	-0.01
110	-0.09	-0.07	0.00
111	-0.09	-0.09	0.00
112	-0.06	-0.10	0.01
113	-0.07	-0.11	0.02
114	-0.13	-0.15	0.02
115	-0.10	-0.16	0.02
116	-0.12	-0.19	0.02
117	-0.11	-0.15	0.02
118	-0.15	-0.16	0.02
119	-0.14	-0.12	0.02
120	-0.15	-0.14	0.02
121	-0.13	-0.17	0.02
122	-0.13	-0.15	0.02
123	-0.13	-0.18	0.02
124	-0.14	-0.15	0.02
125	-0.16	-0.14	0.01
126	-0.14	-0.16	0.01
127	-0.19	-0.10	0.01
128	-0.13	-0.09	0.01
129	-0.14	-0.11	0.01
130	-0.14	-0.13	0.00
131	-0.11	-0.14	0.01
132	-0.13	-0.12	0.00
133	-0.13	-0.10	0.01
134	-0.15	-0.11	0.00
135	-0.12	-0.10	0.00
136	-0.09	-0.13	0.00
137	-0.14	-0.10	0.00
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 6, 2010 Data			
Point #	Northing	Easting	Elevation
16101	428411.2823	358718.8738	449.514
16102	428411.1146	358743.8004	449.628
16103	428411.2247	358768.9070	449.759
16104	428411.1307	358793.8787	449.754
16105	428411.2927	358818.8382	449.885
16106	428411.1501	358843.8218	449.914
16107	428411.1177	358868.9095	449.949
16108	428411.2571	358893.8807	449.935
16109	428411.1560	358918.9014	449.881
16110	428411.1112	358943.8753	449.666
16111	428411.1631	358968.9489	449.468
16112	428411.1827	358993.9700	449.417
16113	428411.2550	359019.0058	449.258
16114	428386.2918	359018.8726	449.671
16115	428361.1831	359018.9227	449.755
16116	428336.2569	359018.9519	450.484
16117	428311.2952	359019.0030	450.458
16118	428286.2475	359018.9972	450.177
16119	428261.2472	359019.0344	450.545
16120	428236.3485	359018.9289	451.025
16121	428211.3037	359018.9155	451.719
16122	428186.3013	359018.8743	452.382
16123	428161.2909	359018.9655	452.513
16124	428136.3018	359018.9667	452.032
16125	428111.2775	359018.9455	452.261
16126	428086.3114	359018.8706	451.672
16127	428061.3051	359018.9063	451.641
16128	428036.2982	359018.8179	452.056
16129	428011.3376	359018.8270	452.138
16130	427986.3131	359018.8075	452.333
16131	427961.3171	359018.8001	452.846
16132	427936.2493	359018.7991	452.864
16133	427911.2973	359018.8557	453.142
16134	427886.2710	359018.8480	453.545
16135	427861.3152	359018.7980	453.83
16136	427836.2893	359018.8206	454.144
16137	427811.2552	359018.9216	454.497

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 6, 2010 Data			
Point #	Northing	Easting	Elevation
16101	428411.2823	358718.8738	449.514
16102	428411.1146	358743.8004	449.628
16103	428411.2247	358768.9070	449.759
16104	428411.1307	358793.8787	449.754
16105	428411.2927	358818.8382	449.885
16106	428411.1501	358843.8218	449.914
16107	428411.1177	358868.9095	449.949
16108	428411.2571	358893.8807	449.935
16109	428411.1560	358918.9014	449.881
16110	428411.1112	358943.8753	449.666
16111	428411.1631	358968.9489	449.468
16112	428411.1827	358993.9700	449.417
16113	428411.2550	359019.0058	449.258
16114	428386.2918	359018.8726	449.671
16115	428361.1831	359018.9227	449.755
16116	428336.2569	359018.9519	450.484
16117	428311.2952	359019.0030	450.458
16118	428286.2475	359018.9972	450.177
16119	428261.2472	359019.0344	450.545
16120	428236.3485	359018.9289	451.025
16121	428211.3037	359018.9155	451.719
16122	428186.3013	359018.8743	452.382
16123	428161.2909	359018.9655	452.513
16124	428136.3018	359018.9667	452.032
16125	428111.2775	359018.9455	452.261
16126	428086.3114	359018.8706	451.672
16127	428061.3051	359018.9063	451.641
16128	428036.2982	359018.8179	452.056
16129	428011.3376	359018.8270	452.138
16130	427986.3131	359018.8075	452.333
16131	427961.3171	359018.8001	452.846
16132	427936.2493	359018.7991	452.864
16133	427911.2973	359018.8557	453.142
16134	427886.2710	359018.8480	453.545
16135	427861.3152	359018.7980	453.83
16136	427836.2893	359018.8206	454.144
16137	427811.2552	359018.9216	454.497

Data Compared			
Point #	Northing	Easting	Elevation
101	-0.04	-0.04	0.04
102	-0.07	-0.03	0.03
103	-0.07	-0.06	0.03
104	-0.05	-0.03	0.04
105	-0.02	-0.05	0.04
106	-0.04	-0.06	0.04
107	-0.07	-0.05	0.04
108	0.01	-0.08	0.05
109	-0.02	-0.07	0.05
110	-0.03	-0.05	0.06
111	-0.04	-0.08	0.07
112	-0.03	-0.12	0.09
113	-0.11	-0.13	0.12
114	-0.12	-0.15	0.12
115	-0.09	-0.15	0.13
116	-0.12	-0.18	0.13
117	-0.11	-0.20	0.13
118	-0.14	-0.15	0.13
119	-0.14	-0.16	0.13
120	-0.12	-0.12	0.14
121	-0.12	-0.14	0.13
122	-0.12	-0.13	0.13
123	-0.13	-0.16	0.13
124	-0.12	-0.16	0.12
125	-0.14	-0.12	0.11
126	-0.13	-0.11	0.10
127	-0.18	-0.09	0.09
128	-0.13	-0.08	0.08
129	-0.12	-0.06	0.08
130	-0.11	-0.04	0.07
131	-0.11	-0.07	0.06
132	-0.13	-0.08	0.06
133	-0.14	-0.07	0.06
134	-0.16	-0.10	0.06
135	-0.14	-0.05	0.05
136	-0.14	-0.06	0.05
137	-0.14	-0.09	0.03
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

R12313

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 7, 2010 Data			
Point #	Northing	Easting	Elevation
107101	428411.2306	358718.9533	449.53
107102	428411.0550	358743.8586	449.64
107103	428411.1753	358768.9530	449.77
107104	428411.1634	358793.9047	449.77
107105	428411.2923	358818.8912	449.89
107106	428411.1486	358843.9019	449.93
107107	428411.1061	358868.9704	449.96
107108	428411.2925	358893.9407	449.94
107109	428411.1650	358918.9695	449.88
107110	428411.1174	358943.9499	449.66
107111	428411.1659	358969.0280	449.45
107112	428411.1602	358994.0498	449.38
107113	428411.1901	359019.1422	449.18
107114	428386.2207	359019.0079	449.60
107115	428361.1413	359019.0347	449.68
107116	428336.2009	359019.0525	450.41
107117	428311.2987	359019.0497	450.38
107118	428286.2642	359019.0983	450.10
107119	428261.2043	359019.1589	450.47
107120	428236.3687	359019.0593	450.95
107121	428211.3395	359019.0328	451.65
107122	428186.2701	359019.0066	452.31
107123	428161.2647	359019.0685	452.44
107124	428136.3320	359019.0458	451.96
107125	428111.2346	359019.0864	452.20
107126	428086.2536	359019.0006	451.61
107127	428061.2681	359019.0214	451.59
107128	428036.2610	359018.9428	452.01
107129	428011.3086	359018.9683	452.09
107130	427986.3177	359018.9485	452.29
107131	427961.2886	359018.9226	452.81
107132	427936.2320	359018.9019	452.83
107133	427911.2484	359018.9379	453.12
107134	427886.2271	359018.9058	453.53
107135	427861.3552	359018.8448	453.82
107136	427836.3269	359018.8367	454.14
107137	427811.2950	359018.8788	454.49

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 7, 2010 Data			
Point #	Northing	Easting	Elevation
107101	428411.2306	358718.9533	449.53
107102	428411.0550	358743.8586	449.64
107103	428411.1753	358768.9530	449.77
107104	428411.1634	358793.9047	449.77
107105	428411.2923	358818.8912	449.89
107106	428411.1486	358843.9019	449.93
107107	428411.1061	358868.9704	449.96
107108	428411.2925	358893.9407	449.94
107109	428411.1650	358918.9695	449.88
107110	428411.1174	358943.9499	449.66
107111	428411.1659	358969.0280	449.45
107112	428411.1602	358994.0498	449.38
107113	428411.1901	359019.1422	449.18
107114	428386.2207	359019.0079	449.60
107115	428361.1413	359019.0347	449.68
107116	428336.2009	359019.0525	450.41
107117	428311.2987	359019.0497	450.38
107118	428286.2642	359019.0983	450.10
107119	428261.2043	359019.1589	450.47
107120	428236.3687	359019.0593	450.95
107121	428211.3395	359019.0328	451.65
107122	428186.2701	359019.0066	452.31
107123	428161.2647	359019.0685	452.44
107124	428136.3320	359019.0458	451.96
107125	428111.2346	359019.0864	452.20
107126	428086.2536	359019.0006	451.61
107127	428061.2681	359019.0214	451.59
107128	428036.2610	359018.9428	452.01
107129	428011.3086	359018.9683	452.09
107130	427986.3177	359018.9485	452.29
107131	427961.2886	359018.9226	452.81
107132	427936.2320	359018.9019	452.83
107133	427911.2484	359018.9379	453.12
107134	427886.2271	359018.9058	453.53
107135	427861.3552	359018.8448	453.82
107136	427836.3269	359018.8367	454.14
107137	427811.2950	359018.8788	454.49

Data Compared			
Point #	Northing	Easting	Elevation
101	0.01	-0.11	0.02
102	-0.01	-0.08	0.02
103	-0.02	-0.10	0.02
104	-0.08	-0.06	0.02
105	-0.02	-0.10	0.03
106	-0.04	-0.14	0.02
107	-0.06	-0.11	0.04
108	-0.03	-0.14	0.04
109	-0.03	-0.14	0.05
110	-0.03	-0.13	0.07
111	-0.04	-0.16	0.09
112	-0.01	-0.20	0.13
113	-0.04	-0.26	0.20
114	-0.05	-0.29	0.19
115	-0.05	-0.26	0.20
116	-0.07	-0.28	0 20
117	-0.11	-0.25	0 21
118	-0.16	-0.25	0 21
119	-0.10	-0.28	0 21
120	-0.14	-0.25	0 21
121	-0.16	-0.26	0 20
122	-0 09	-0.27	0 20
123	-0.10	-0.26	0.20
124	-0.15	-0.24	0 19
125	-0.10	-0.26	0.17
126	-0.07	-0.24	0.16
127	-0.14	-0.21	0.15
128	-0.09	-0.21	0.13
129	-0.09	-0.20	0.13
130	-0.11	-0.18	0.11
131	-0.08	-0.19	0.10
132	-0.11	-0.18	0.09
133	-0.10	-0.15	0.08
134	-0.11	-0.15	0.07
135	-0.18	-0.10	0.06
136	-0.18	-0.07	0.05
137	-0.18	-0.05	0.04
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

R12315

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 8, 2010 Data			
Point #	Northing	Easting	Elevation
18101	428411.2200	358718.9029	449.52
18102	428411.0757	358743.8117	449.64
18103	428411.1961	358768.9013	449.76
18104	428411.1268	358793.9222	449.76
18105	428411.3093	358818.8509	449.88
18106	428411.1589	358843.8731	449.90
18107	428411.1484	358868.9104	449.92
18108	428411.2765	358893.9217	449.90
18109	428411.1753	358918.9574	449.82
18110	428411.1662	358943.9844	449.56
18111	428411.1821	358969.1643	449.26
18112	428411.2021	358994.4031	448.93
18113	428411.2230	359019.7460	448.16
18114	428386.2509	359019.6234	448.58
18115	428361.1956	359019.6872	448.65
18116	428336.2440	359019.7172	449.37
18117	428311.3139	359019.7310	449.35
18118	428286.2711	359019.7151	449.08
18119	428261.2908	359019.7628	449.48
18120	428236.4266	359019.6611	449.99
18121	428211.3831	359019.6526	450.73
18122	428186.3891	359019.5697	451.44
18123	428161.3758	359019.6535	451.65
18124	428136.3998	359019.6284	451.25
18125	428111.3916	359019.6417	451.58
18126	428086.3846	359019.4836	451.10
18127	428061.3692	359019.4310	451.14
18128	428036.3734	359019.2569	451.60
18129	428011.4165	359019.2478	451.70
18130	427986.4076	359019.1726	451.92
18131	427961.4029	359019.0942	452.47
18132	427936.3525	359019.0694	452.53
18133	427911.4056	359019.0406	452.88
18134	427886.3918	359018.9368	453.36
18135	427861.4073	359018.8514	453.71
18136	427836.3481	359018.8535	454.07
18137	427811.2885	359018.8878	454.44

R12316

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 8, 2010 Data			
Point #	Northing	Easting	Elevation
18101	428411.2200	358718.9029	449.52
18102	428411.0757	358743.8117	449.64
18103	428411.1961	358768.9013	449.76
18104	428411.1268	358793.9222	449.76
18105	428411.3093	358818.8509	449.88
18106	428411.1589	358843.8731	449.90
18107	428411.1484	358868.9104	449.92
18108	428411.2765	358893.9217	449.90
18109	428411.1753	358918.9574	449.82
18110	428411.1662	358943.9844	449.56
18111	428411.1821	358969.1643	449.26
18112	428411.2021	358994.4031	448.93
18113	428411.2230	359019.7460	448.16
18114	428386.2509	359019.6234	448.58
18115	428361.1956	359019.6872	448.65
18116	428336.2440	359019.7172	449.37
18117	428311.3139	359019.7310	449.35
18118	428286.2711	359019.7151	449.08
18119	428261.2908	359019.7628	449.48
18120	428236.4266	359019.6611	449.99
18121	428211.3831	359019.6526	450.73
18122	428186.3891	359019.5697	451.44
18123	428161.3758	359019.6535	451.65
18124	428136.3998	359019.6284	451.25
18125	428111.3916	359019.6417	451.58
18126	428086.3846	359019.4836	451.10
18127	428061.3692	359019.4310	451.14
18128	428036.3734	359019.2569	451.60
18129	428011.4165	359019.2478	451.70
18130	427986.4076	359019.1726	451.92
18131	427961.4029	359019.0942	452.47
18132	427936.3525	359019.0694	452.53
18133	427911.4056	359019.0406	452.88
18134	427886.3918	359018.9368	453.36
18135	427861.4073	359018.8514	453.71
18136	427836.3481	359018.8535	454.07
18137	427811.2885	359018.8878	454.44

Data Compared			
Point #	Northing	Easting	Elevation
101	0.02	-0.06	0.03
102	-0.04	-0.04	0.03
103	-0.05	-0.05	0.03
104	-0.04	-0.07	0.03
105	-0.03	-0.06	0.04
106	-0.05	-0.11	0.05
107	-0.10	-0.05	0.07
108	-0.01	-0.12	0.09
109	-0.04	-0.13	0.11
110	-0.08	-0.16	0.17
111	-0.06	-0.30	0.28
112	-0.05	-0.55	0.58
113	-0.07	-0.87	1.22
114	-0.08	-0.90	1.21
115	-0.10	-0.91	1.24
116	-0.11	-0.94	1.24
117	-0.13	-0.93	1.24
118	-0.16	-0.87	1.23
119	-0.19	-0.89	1.20
120	-0.20	-0.85	1.17
121	-0.20	-0.88	1.12
122	-0.21	-0.83	1.07
123	-0.21	-0.84	0.99
124	-0.22	-0.83	0.90
125	-0.25	-0.81	0.79
126	-0.20	-0.72	0.67
127	-0.24	-0.62	0.59
128	-0.20	-0.52	0.54
129	-0.20	-0.48	0.52
130	-0.20	-0.41	0.48
131	-0.20	-0.36	0.44
132	-0.23	-0.35	0.39
133	-0.25	-0.25	0.32
134	-0.28	-0.18	0.24
135	-0.23	-0.10	0.17
136	-0.20	-0.09	0.12
137	-0.17	-0.06	0.09
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

R12317

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 9, 2010 Data			
Point #	Northing	Easting	Elevation
19101	428411.2523	358718.9348	449.51
19102	428411.0825	358743.8501	449.62
19103	428411.2055	358768.9254	449.75
19104	428411.1464	358793.9340	449.73
19105	428411.3506	358818.8726	449.85
19106	428411.2127	358843.8751	449.86
19107	428411.1559	358868.9751	449.87
19108	428411.3134	358893.9639	449.80
19109	428411.2087	358919.0663	449.65
19110	428411.1730	358944.2197	449.24
19111	428411.2270	358969.5584	448.67
19112	428411.2579	358994.8361	447.86
19113	428411.2105	359019.9409	446.64
19114	428386.2607	359019.8685	447.09
19115	428361.2035	359019.9295	447.21
19116	428336.2496	359019.9429	448.00
19117	428311.3142	359019.9518	448.03
19118	428286.2784	359019.9614	447.81
19119	428261.2720	359020.0336	448.24
19120	428236.4325	359019.9447	448.80
19121	428211.3768	359019.9042	449.58
19122	428186.3754	359019.8586	450.33
19123	428161.3422	359019.8885	450.58
19124	428136.3558	359019.8486	450.18
19125	428111.3559	359019.8799	450.59
19126	428086.2956	359019.6262	450.11
19127	428061.2781	359019.5506	450.06
19128	428036.2758	359019.4601	450.42
19129	428011.3517	359019.4364	450.43
19130	427986.3793	359019.4295	450.58
19131	427961.4379	359019.3768	451.13
19132	427936.4669	359019.3272	451.28
19133	427911.5930	359019.2543	451.85
19134	427886.6340	359019.1223	452.66
19135	427861.6189	359018.9742	453.34
19136	427836.4607	359018.9059	453.89
19137	427811.3641	359018.9143	454.34

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 9, 2010 Data			
Point #	Northing	Easting	Elevation
19101	428411.2523	358718.9348	449.51
19102	428411.0825	358743.8501	449.62
19103	428411.2055	358768.9254	449.75
19104	428411.1464	358793.9340	449.73
19105	428411.3506	358818.8726	449.85
19106	428411.2127	358843.8751	449.86
19107	428411.1559	358868.9751	449.87
19108	428411.3134	358893.9639	449.80
19109	428411.2087	358919.0663	449.65
19110	428411.1730	358944.2197	449.24
19111	428411.2270	358969.5584	448.67
19112	428411.2579	358994.8361	447.86
19113	428411.2105	359019.9409	446.64
19114	428386.2607	359019.8685	447.09
19115	428361.2035	359019.9295	447.21
19116	428336.2496	359019.9429	448.00
19117	428311.3142	359019.9518	448.03
19118	428286.2784	359019.9614	447.81
19119	428261.2720	359020.0336	448.24
19120	428236.4325	359019.9447	448.80
19121	428211.3768	359019.9042	449.58
19122	428186.3754	359019.8586	450.33
19123	428161.3422	359019.8885	450.58
19124	428136.3558	359019.8486	450.18
19125	428111.3559	359019.8799	450.59
19126	428086.2956	359019.6262	450.11
19127	428061.2781	359019.5506	450.06
19128	428036.2758	359019.4601	450.42
19129	428011.3517	359019.4364	450.43
19130	427986.3793	359019.4295	450.58
19131	427961.4379	359019.3768	451.13
19132	427936.4669	359019.3272	451.28
19133	427911.5930	359019.2543	451.85
19134	427886.6340	359019.1223	452.66
19135	427861.6189	359018.9742	453.34
19136	427836.4607	359018.9059	453.89
19137	427811.3641	359018.9143	454.34

Data Compared			
Point #	Northing	Easting	Elevation
101	-0.01	-0.10	0.04
102	-0.04	-0.08	0.04
103	-0.05	-0.08	0.04
104	-0.06	-0.08	0.06
105	-0.07	-0.08	0.07
106	-0.11	-0.11	0.09
107	-0.11	-0.12	0.12
108	-0.05	-0.16	0.18
109	-0.07	-0.24	0.28
110	-0.09	-0.40	0.49
111	-0.10	-0.69	0.87
112	-0.11	-0.99	1.65
113	-0.06	-1.06	2.74
114	-0.09	-1.15	2.70
115	-0.11	-1.15	2.67
116	-0.12	-1.17	2.61
117	-0.13	-1.15	2.56
118	-0.17	-1.11	2.50
119	-0.17	-1.16	2.44
120	-0.20	-1.14	2.36
121	-0.20	-1.13	2.27
122	-0.20	-1.12	2.18
123	-0.18	-1.08	2.06
124	-0.17	-1.05	1.97
125	-0.22	-1.05	1.78
126	-0.11	-0.86	1.66
127	-0.15	-0.74	1.67
128	-0.10	-0.73	1.72
129	-0.14	-0.67	1.79
130	-0.17	-0.67	1.82
131	-0.23	-0.65	1.78
132	-0.34	-0.60	1.64
133	-0.44	-0.47	1.35
134	-0.52	-0.37	0.94
135	-0.45	-0.23	0.54
136	-0.31	-0.14	0.30
137	-0.25	-0.09	0.19
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 10, 2010 Data			
Point #	Northing	Easting	Elevation
110101	428411.2759	358718.9170	449.50
110102	428411.1213	358743.8323	449.61
110103	428411.2271	358768.9310	449.73
110104	428411.1710	358793.9320	449.72
110105	428411.3470	358818.8875	449.83
110106	428411.2118	358843.8950	449.85
110107	428411.1855	358868.9813	449.86
110108	428411.3465	358893.9981	449.78
110109	428411.2403	358919.1255	449.62
110110	428411.1902	358944.2670	449.19
110111	428411.2545	358969.5817	448.58
110112	428411.2615	358994.8466	447.75
110113	428411.2193	359019.9360	446.54
110114	428386.2864	359019.8629	446.98
110115	428361.2128	359019.9050	447.10
110116	428336.2569	359019.9256	447.89
110117	428311.3249	359019.9443	447.91
110118	428286.2845	359019.9522	447.70
110119	428261.3143	359020.0551	448.13
110120	428236.4522	359019.9803	448.69
110121	428211.3943	359019.9472	449.48
110122	428186.3983	359019.8879	450.23
110123	428161.3580	359019.9218	450.48
110124	428136.3346	359019.8917	450.08
110125	428111.3345	359019.8906	450.48
110126	428086.2925	359019.6558	450.00
110127	428061.2832	359019.5790	449.94
110128	428036.2739	359019.4698	450.29
110129	428011.3325	359019.4940	450.30
110130	427986.3662	359019.4662	450.44
110131	427961.4428	359019.4115	450.99
110132	427936.4846	359019.3804	451.14
110133	427911.6358	359019.2846	451.71
110134	427886.6660	359019.1491	452.56
110135	427861.6692	359019.0218	453.27
110136	427836.4860	359018.9026	453.87
110137	427811.3698	359018.9528	454.32

R12320

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 10, 2010 Data			
Point #	Northing	Easting	Elevation
110101	428411.2759	358718.9170	449.50
110102	428411.1213	358743.8323	449.61
110103	428411.2271	358768.9310	449.73
110104	428411.1710	358793.9320	449.72
110105	428411.3470	358818.8875	449.83
110106	428411.2118	358843.8950	449.85
110107	428411.1855	358868.9813	449.86
110108	428411.3465	358893.9981	449.78
110109	428411.2403	358919.1255	449.62
110110	428411.1902	358944.2670	449.19
110111	428411.2545	358969.5817	448.58
110112	428411.2615	358994.8466	447.75
110113	428411.2193	359019.9360	446.54
110114	428386.2864	359019.8629	446.98
110115	428361.2128	359019.9050	447.10
110116	428336.2569	359019.9256	447.89
110117	428311.3249	359019.9443	447.91
110118	428286.2845	359019.9522	447.70
110119	428261.3143	359020.0551	448.13
110120	428236.4522	359019.9803	448.69
110121	428211.3943	359019.9472	449.48
110122	428186.3983	359019.8879	450.23
110123	428161.3580	359019.9218	450.48
110124	428136.3346	359019.8917	450.08
110125	428111.3345	359019.8906	450.48
110126	428086.2925	359019.6558	450.00
110127	428061.2832	359019.5790	449.94
110128	428036.2739	359019.4698	450.29
110129	428011.3325	359019.4940	450.30
110130	427986.3662	359019.4662	450.44
110131	427961.4428	359019.4115	450.99
110132	427936.4846	359019.3804	451.14
110133	427911.6358	359019.2846	451.71
110134	427886.6660	359019.1491	452.56
110135	427861.6692	359019.0218	453.27
110136	427836.4860	359018.9026	453.87
110137	427811.3698	359018.9528	454.32

Data Compared			
Point #	Northing	Easting	Elevation
101	-0.03	-0.08	0.05
102	-0.08	-0.06	0.05
103	-0.08	-0.08	0.06
104	-0.09	-0.08	0.07
105	-0.07	-0.10	0.09
106	-0.11	-0.13	0.10
107	-0.14	-0.13	0.13
108	-0.08	-0.20	0.20
109	-0.10	-0.30	0.31
110	-0.11	-0.44	0.54
111	-0.13	-0.72	0.96
112	-0.11	-1.00	1.76
113	-0.07	-1.06	2.84
114	-0.12	-1.14	2.81
115	-0.12	-1.13	2.78
116	-0.12	-1.15	2.72
117	-0.14	-1.14	2.68
118	-0.18	-1.11	2.62
119	-0.21	-1.18	2.55
120	-0.22	-1.17	2.47
121	-0.22	-1.18	2.37
122	-0.22	-1.15	2.28
123	-0.19	-1.11	2.16
124	-0.15	-1.09	2.07
125	-0.20	-1.06	1.89
126	-0.11	-0.89	1.77
127	-0.15	-0.77	1.79
128	-0.10	-0.74	1.85
129	-0.12	-0.73	1.92
130	-0.16	-0.70	1.96
131	-0.24	-0.68	1.92
132	-0.36	-0.66	1.79
133	-0.48	-0.50	1.49
134	-0.55	-0.40	1.04
135	-0.50	-0.27	0.61
136	-0.34	-0.14	0.32
137	-0.25	-0.12	0.21
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

R12321

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009				January 11, 2010 Data			
Point #	Northing	Easting	Elevation	Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55	111101	428411.1885	358718.9845	449.49
102	428411.0404	358743.7741	449.66	111102	428411.1024	358743.8204	449.59
103	428411.1509	358768.8500	449.79	111103	428411.2112	358768.9369	449.71
104	428411.0827	358793.8495	449.79	111104	428411.1585	358793.9457	449.68
105	428411.2768	358818.7893	449.92	111105	428411.3567	358818.8948	449.77
106	428411.1052	358843.7660	449.95	111106	428411.2132	358843.9210	449.75
107	428411.0468	358868.8559	449.99	111107	428411.1728	358869.0904	449.67
108	428411.2624	358893.8016	449.98	111108	428411.3743	358894.1936	449.40
109	428411.1398	358918.8297	449.93	111109	428411.2469	358919.4760	448.83
110	428411.0829	358943.8231	449.73	111110	428411.1955	358944.6017	447.88
111	428411.1221	358968.8653	449.54	111111	428411.2169	358969.6915	446.89
112	428411.1495	358993.8497	449.51	111112	428411.2124	358994.6297	446.11
113	428411.1486	359018.8786	449.38	111113	428411.2020	359019.5854	445.30
114	428386.1691	359018.7194	449.79	111114	428386.2532	359019.5059	445.72
115	428361.0914	359018.7749	449.88	111115	428361.1891	359019.5708	445.85
116	428336.1338	359018.7739	450.61	111116	428336.2501	359019.5668	446.66
117	428311.1872	359018.8005	450.59	111117	428311.3255	359019.6022	446.71
118	428286.1082	359018.8465	450.31	111118	428286.2965	359019.6480	446.54
119	428261.1057	359018.8769	450.68	111119	428261.3225	359019.7190	446.98
120	428236.2287	359018.8089	451.16	111120	428236.4599	359019.6229	447.58
121	428211.1790	359018.7712	451.85	111121	428211.3936	359019.5959	448.37
122	428186.1793	359018.7400	452.51	111122	428186.3869	359019.5457	449.12
123	428161.1638	359018.8099	452.64	111123	428161.3292	359019.5731	449.35
124	428136.1816	359018.8031	452.15	111124	428136.3104	359019.5440	448.90
125	428111.1367	359018.8270	452.37	111125	428111.2847	359019.5317	449.17
126	428086.1810	359018.7625	451.77	111126	428086.2618	359019.4029	448.58
127	428061.1300	359018.8122	451.73	111127	428061.2789	359019.3758	448.50
128	428036.1720	359018.7347	452.14	111128	428036.2555	359019.2552	448.86
129	428011.2166	359018.7676	452.22	111129	428011.3431	359019.2547	448.86
130	427986.2052	359018.7642	452.40	111130	427986.4004	359019.2274	449.01
131	427961.2040	359018.7292	452.91	111131	427961.4648	359019.2161	449.58
132	427936.1225	359018.7231	452.92	111132	427936.5639	359019.2025	449.79
133	427911.1533	359018.7862	453.20	111133	427911.7896	359019.1725	450.54
134	427886.1123	359018.7523	453.60	111134	427886.9009	359019.0591	451.72
135	427861.1730	359018.7483	453.88	111135	427861.9225	359018.9820	452.81
136	427836.1478	359018.7636	454.19	111136	427836.6280	359018.8994	453.71
137	427811.1182	359018.8285	454.53	111137	427811.4422	359018.8998	454.26
4383	427345.2341	360349.8149	463.22				
4384	429209.1676	360379.8928	442.31				
4388	430665.6266	360378.9926	435.57				
p248	425434.6524	360202.4261	531.87				

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 11, 2010 Data			
Point #	Northing	Easting	Elevation
111101	428411.1885	358718.9845	449.49
111102	428411.1024	358743.8204	449.59
111103	428411.2112	358768.9369	449.71
111104	428411.1585	358793.9457	449.68
111105	428411.3567	358818.8948	449.77
111106	428411.2132	358843.9210	449.75
111107	428411.1728	358869.0904	449.67
111108	428411.3743	358894.1936	449.40
111109	428411.2469	358919.4760	448.83
111110	428411.1955	358944.6017	447.88
111111	428411.2169	358969.6915	446.89
111112	428411.2124	358994.6297	446.11
111113	428411.2020	359019.5854	445.30
111114	428386.2532	359019.5059	445.72
111115	428361.1891	359019.5708	445.85
111116	428336.2501	359019.5668	446.66
111117	428311.3255	359019.6022	446.71
111118	428286.2965	359019.6480	446.54
111119	428261.3225	359019.7190	446.98
111120	428236.4599	359019.6229	447.58
111121	428211.3936	359019.5959	448.37
111122	428186.3869	359019.5457	449.12
111123	428161.3292	359019.5731	449.35
111124	428136.3104	359019.5440	448.90
111125	428111.2847	359019.5317	449.17
111126	428086.2618	359019.4029	448.58
111127	428061.2789	359019.3758	448.50
111128	428036.2555	359019.2552	448.86
111129	428011.3431	359019.2547	448.86
111130	427986.4004	359019.2274	449.01
111131	427961.4648	359019.2161	449.58
111132	427936.5639	359019.2025	449.79
111133	427911.7896	359019.1725	450.54
111134	427886.9009	359019.0591	451.72
111135	427861.9225	359018.9820	452.81
111136	427836.6280	359018.8994	453.71
111137	427811.4422	359018.8998	454.26

Data Compared			
Point #	Northing	Easting	Elevation
101	0.05	-0.15	0.06
102	-0.06	-0.05	0.07
103	-0.06	-0.09	0.08
104	-0.08	-0.10	0.11
105	-0.08	-0.11	0.15
106	-0.11	-0.15	0.20
107	-0.13	-0.23	0.32
108	-0.11	-0.39	0.58
109	-0.11	-0.65	1.10
110	-0.11	-0.78	1.85
111	-0.09	-0.83	2.65
112	-0.06	-0.78	3.40
113	-0.05	-0.71	4.08
114	-0.08	-0.79	4.07
115	-0.10	-0.80	4.03
116	-0.12	-0.79	3.95
117	-0.14	-0.80	3.88
118	-0.19	-0.80	3.77
119	-0.22	-0.84	3.70
120	-0.23	-0.81	3.58
121	-0.21	-0.82	3.49
122	-0.21	-0.81	3.39
123	-0.17	-0.76	3.29
124	-0.13	-0.74	3.25
125	-0.15	-0.70	3.20
126	-0.08	-0.64	3.19
127	-0.15	-0.56	3.23
128	-0.08	-0.52	3.28
129	-0.13	-0.49	3.36
130	-0.20	-0.46	3.39
131	-0.26	-0.49	3.33
132	-0.44	-0.48	3.13
133	-0.64	-0.39	2.66
134	-0.79	-0.31	1.88
135	-0.75	-0.23	1.07
136	-0.48	-0.14	0.48
137	-0.32	-0.07	0.27
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

R12323

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 12, 2010 Data			
Point #	Northing	Easting	Elevation
112101	428411.2862	358718.9611	449.42
112102	428411.0978	358743.9025	449.50
112103	428411.2184	358769.0539	449.56
112104	428411.1561	358794.2533	449.40
112105	428411.3761	358819.4997	449.17
112106	428411.2189	358844.6295	448.59
112107	428411.1869	358869.6526	447.90
112108	428411.3502	358894.5369	447.07
112109	428411.1874	358919.3274	446.33
112110	428411.1316	358944.1447	445.66
112111	428411.1627	358969.0684	445.17
112112	428411.1667	358993.9298	444.93
112113	428411.1762	359018.9509	444.53
112114	428386.2437	359018.8245	444.97
112115	428361.1932	359018.9230	445.10
112116	428336.2523	359018.9300	445.91
112117	428311.3425	359018.9612	445.97
112118	428286.3092	359019.0242	445.79
112119	428261.3047	359019.0822	446.27
112120	428236.4197	359018.9846	446.83
112121	428211.3622	359018.9663	447.59
112122	428186.3420	359018.9101	448.32
112123	428161.2942	359018.9393	448.53
112124	428136.2878	359018.9100	448.06
112125	428111.2542	359018.8806	448.30
112126	428086.2476	359018.7955	447.70
112127	428061.2815	359018.7588	447.63
112128	428036.2815	359018.6676	447.99
112129	428011.3457	359018.6977	448.01
112130	427986.4005	359018.6840	448.16
112131	427961.4576	359018.6667	448.71
112132	427936.5778	359018.6813	448.91
112133	427911.8930	359018.7460	449.68
112134	427887.1040	359018.7377	451.00
112135	427862.1768	359018.7247	452.33
112136	427836.8523	359018.7884	453.48
112137	427811.5186	359018.8342	454.16

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 12, 2010 Data			
Point #	Northing	Easting	Elevation
112101	428411.2862	358718.9611	449.42
112102	428411.0978	358743.9025	449.50
112103	428411.2184	358769.0539	449.56
112104	428411.1561	358794.2533	449.40
112105	428411.3761	358819.4997	449.17
112106	428411.2189	358844.6295	448.59
112107	428411.1869	358869.6526	447.90
112108	428411.3502	358894.5369	447.07
112109	428411.1874	358919.3274	446.33
112110	428411.1316	358944.1447	445.66
112111	428411.1627	358969.0684	445.17
112112	428411.1667	358993.9298	444.93
112113	428411.1762	359018.9509	444.53
112114	428386.2437	359018.8245	444.97
112115	428361.1932	359018.9230	445.10
112116	428336.2523	359018.9300	445.91
112117	428311.3425	359018.9612	445.97
112118	428286.3092	359019.0242	445.79
112119	428261.3047	359019.0822	446.27
112120	428236.4197	359018.9846	446.83
112121	428211.3622	359018.9663	447.59
112122	428186.3420	359018.9101	448.32
112123	428161.2942	359018.9393	448.53
112124	428136.2878	359018.9100	448.06
112125	428111.2542	359018.8806	448.30
112126	428086.2476	359018.7955	447.70
112127	428061.2815	359018.7588	447.63
112128	428036.2815	359018.6676	447.99
112129	428011.3457	359018.6977	448.01
112130	427986.4005	359018.6840	448.16
112131	427961.4576	359018.6667	448.71
112132	427936.5778	359018.6813	448.91
112133	427911.8930	359018.7460	449.68
112134	427887.1040	359018.7377	451.00
112135	427862.1768	359018.7247	452.33
112136	427836.8523	359018.7884	453.48
112137	427811.5186	359018.8342	454.16

Data Compared			
Point #	Northing	Easting	Elevation
101	-0.04	-0.12	0.13
102	-0.06	-0.13	0.16
103	-0.07	-0.20	0.23
104	-0.07	-0.40	0.39
105	-0.10	-0.71	0.75
106	-0.11	-0.86	1.37
107	-0.14	-0.80	2.09
108	-0.09	-0.74	2.91
109	-0.05	-0.50	3.60
110	-0.05	-0.32	4.07
111	-0.04	-0.20	4.37
112	-0.02	-0.08	4.58
113	-0.03	-0.07	4.85
114	-0.07	-0.11	4.82
115	-0.10	-0.15	4.78
116	-0.12	-0.16	4.70
117	-0.16	-0.16	4.62
118	-0.20	-0.18	4.52
119	-0.20	-0.21	4.42
120	-0.19	-0.18	4.33
121	-0.18	-0.20	4.26
122	-0.16	-0.17	4.19
123	-0.13	-0.13	4.11
124	-0.11	-0.11	4.09
125	-0.12	-0.05	4.07
126	-0.07	-0.03	4.07
127	-0.15	0.05	4.10
128	-0.11	0.07	4.15
129	-0.13	0.07	4.21
130	-0.20	0.08	4.24
131	-0.25	0.06	4.20
132	-0.46	0.04	4.01
133	-0.74	0.04	3.52
134	-0.99	0.01	2.60
135	-1.00	0.02	1.55
136	-0.70	-0.02	0.71
137	-0.40	-0.01	0.37
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

R12325

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 13, 2010 Data			
Point #	Northing	Easting	Elevation
113101	428411.2767	358718.9847	449.39
113102	428411.0705	358743.9881	449.42
113103	428411.2011	358769.1954	449.37
113104	428411.1787	358794.6039	448.90
113105	428411.3802	358819.6929	448.26
113106	428411.2226	358844.6790	447.39
113107	428411.1980	358869.5692	446.63
113108	428411.3057	358894.3291	446.09
113109	428411.1625	358919.0722	445.62
113110	428411.1118	358943.9297	445.21
113111	428411.1528	358968.9272	444.88
113112	428411.1804	358993.8089	444.74
113113	428411.1939	359018.8645	444.41
113114	428386.2495	359018.7275	444.84
113115	428361.2048	359018.8354	444.97
113116	428336.2492	359018.8719	445.78
113117	428311.3223	359018.8941	445.85
113118	428286.2979	359018.9529	445.67
113119	428261.3165	359019.0012	446.14
113120	428236.4150	359018.9087	446.71
113121	428211.3705	359018.8899	447.46
113122	428186.3589	359018.8419	448.18
113123	428161.3025	359018.8893	448.40
113124	428136.2988	359018.8034	447.93
113125	428111.2555	359018.8065	448.16
113126	428086.2533	359018.6782	447.56
113127	428061.2708	359018.6842	447.49
113128	428036.2773	359018.5907	447.86
113129	428011.3434	359018.6153	447.87
113130	427986.3948	359018.6089	448.02
113131	427961.4606	359018.6010	448.56
113132	427936.5805	359018.6003	448.76
113133	427911.9117	359018.6683	449.53
113134	427887.1433	359018.6366	450.86
113135	427862.2082	359018.6341	452.22
113136	427836.9143	359018.6999	453.42
113137	427811.5773	359018.8197	454.13

R12326

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 14, 2010 Data			
Point #	Northing	Easting	Elevation
114101	428411.2924	358719.1443	449.29
114102	428411.0997	358744.2413	449.20
114103	428411.1915	358769.7374	448.72
114104	428411.1648	358794.8886	447.73
114105	428411.3343	358819.7513	446.85
114106	428411.2210	358844.5095	446.06
114107	428411.1762	358869.2138	445.67
114108	428411.3066	358893.9716	445.49
114109	428411.1902	358918.8137	445.26
114110	428411.1284	358943.7461	444.99
114111	428411.1922	358968.7875	444.75
114112	428411.1736	358993.7414	444.66
114113	428411.1752	359018.8099	444.36
114114	428386.2382	359018.7255	444.80
114115	428361.1887	359018.7748	444.92
114116	428336.2236	359018.7982	445.74
114117	428311.3061	359018.8202	445.80
114118	428286.2740	359018.8834	445.62
114119	428261.2727	359018.9399	446.10
114120	428236.3990	359018.8570	446.66
114121	428211.3209	359018.8312	447.41
114122	428186.3176	359018.7847	448.13
114123	428161.2539	359018.8281	448.36
114124	428136.2377	359018.7691	447.88
114125	428111.2254	359018.7629	448.11
114126	428086.2240	359018.6901	447.51
114127	428061.2592	359018.6655	447.44
114128	428036.2590	359018.5409	447.81
114129	428011.3148	359018.5707	447.83
114130	427986.3482	359018.5838	447.97
114131	427961.4466	359018.5649	448.52
114132	427936.5621	359018.5771	448.71
114133	427911.8941	359018.6286	449.48
114134	427887.1223	359018.6120	450.81
114135	427862.2208	359018.6485	452.18
114136	427836.8992	359018.7091	453.40
114137	427811.5490	359018.7963	454.12

R12327

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 15, 2010 Data			
Point #	Northing	Easting	Elevation
115101	428411.2180	358719.5241	448.75
115102	428411.0379	358744.6949	448.07
115103	428411.1172	358769.8631	447.02
115104	428411.1335	358794.6495	445.90
115105	428411.3094	358819.2554	445.42
115106	428411.1765	358843.9830	445.12
115107	428411.1694	358868.8227	445.10
115108	428411.3080	358893.6852	445.12
115109	428411.1662	358918.6214	445.02
115110	428411.1178	358943.6113	444.82
115111	428411.1476	358968.7174	444.63
115112	428411.1600	358993.6770	444.56
115113	428411.1988	359018.7828	444.29
115114	428386.2767	359018.6342	444.72
115115	428361.2143	359018.6851	444.85
115116	428336.2865	359018.7149	445.66
115117	428311.3587	359018.7179	445.73
115118	428286.3091	359018.7908	445.55
115119	428261.3418	359018.8445	446.03
115120	428236.4365	359018.7869	446.59
115121	428211.3693	359018.7744	447.34
115122	428186.3608	359018.6842	448.06
115123	428161.3201	359018.7493	448.28
115124	428136.2941	359018.6944	447.81
115125	428111.2588	359018.6887	448.04
115126	428086.2795	359018.5899	447.45
115127	428061.3064	359018.5914	447.38
115128	428036.2713	359018.4668	447.75
115129	428011.3565	359018.5215	447.77
115130	427986.3850	359018.4924	447.91
115131	427961.4622	359018.4878	448.45
115132	427936.6032	359018.5371	448.65
115133	427911.9407	359018.5894	449.41
115134	427887.1582	359018.5583	450.75
115135	427862.2682	359018.6027	452.13
115136	427836.9538	359018.6756	453.35
115137	427811.6057	359018.7994	454.08

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 16, 2010 Data			
Point #	Northing	Easting	Elevation
116101	428411.1915	358719.7641	447.14
116102	428411.0837	358744.5060	446.37
116103	428411.1764	358769.3985	445.66
116104	428411.1756	358794.1862	445.03
116105	428411.3715	358818.8893	444.89
116106	428411.2308	358843.7275	444.80
116107	428411.1926	358868.6341	444.90
116108	428411.3583	358893.5591	444.99
116109	428411.2207	358918.5340	444.93
116110	428411.1400	358943.5280	444.76
116111	428411.1877	358968.6500	444.58
116112	428411.1953	358993.6282	444.53
116113	428411.2210	359018.7329	444.26
116114	428386.2934	359018.6111	444.70
116115	428361.2123	359018.7053	444.83
116116	428336.2858	359018.7588	445.64
116117	428311.3911	359018.7275	445.70
116118	428286.3107	359018.7384	445.53
116119	428261.3562	359018.8535	446.01
116120	428236.4249	359018.8039	446.57
116121	428211.3934	359018.7502	447.31
116122	428186.3629	359018.6990	448.03
116123	428161.2974	359018.7763	448.25
116124	428136.2856	359018.7001	447.77
116125	428111.2574	359018.6925	448.01
116126	428086.2582	359018.6141	447.42
116127	428061.2970	359018.6037	447.35
116128	428036.3282	359018.4885	447.72
116129	428011.3779	359018.4994	447.74
116130	427986.4084	359018.4977	447.88
116131	427961.4829	359018.5114	448.43
116132	427936.6197	359018.5199	448.62
116133	427911.9452	359018.5834	449.39
116134	427887.1706	359018.5744	450.72
116135	427862.2896	359018.6102	452.10
116136	427836.9862	359018.6903	453.33
116137	427811.6296	359018.8222	454.07

R12329

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 17, 2010 Data			
Point #	Northing	Easting	Elevation
117101	428411.1948	358719.7075	447.08
117102	428411.0575	358744.5811	446.31
117103	428411.0734	358769.3857	445.61
117104	428411.0692	358794.1646	444.99
117105	428411.2533	358818.8880	444.86
117106	428411.1175	358843.7083	444.77
117107	428411.1243	358868.6333	444.88
117108	428411.2516	358893.6183	444.97
117109	428411.1620	358918.5544	444.92
117110	428411.0905	358943.5532	444.75
117111	428411.1351	358968.6739	444.58
117112	428411.1501	358993.6432	444.53
117113	428411.1879	359018.7312	444.26
117114	428386.1724	359018.6039	444.70
117115	428361.1414	359018.6568	444.83
117116	428336.2266	359018.6357	445.64
117117	428311.3605	359018.7109	445.70
117118	428286.2586	359018.7304	445.52
117119	428261.2531	359018.7915	446.00
117120	428236.4275	359018.7523	446.56
117121	428211.3482	359018.7391	447.31
117122	428186.3657	359018.7031	448.03
117123	428161.2807	359018.6964	448.25
117124	428136.3067	359018.6841	447.77
117125	428111.2848	359018.6795	448.00
117126	428086.2840	359018.5580	447.41
117127	428061.3052	359018.5760	447.35
117128	428036.2763	359018.4612	447.72
117129	428011.3206	359018.4662	447.74
117130	427986.3987	359018.4691	447.88
117131	427961.5058	359018.5106	448.43
117132	427936.5905	359018.5068	448.62
117133	427911.9498	359018.5518	449.39
117134	427887.1479	359018.5420	450.72
117135	427862.2716	359018.5791	452.10
117136	427836.9583	359018.7068	453.33
117137	427811.5776	359018.7883	454.07

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 18, 2010 Data			
Point #	Northing	Easting	Elevation
118101	428411.2141	358719.2360	445.77
118102	428411.0599	358744.0457	445.46
118103	428411.1329	358769.0418	445.13
118104	428411.1319	358793.9494	444.74
118105	428411.3380	358818.7633	444.72
118106	428411.1866	358843.6777	444.69
118107	428411.1326	358868.6448	444.83
118108	428411.2987	358893.5566	444.94
118109	428411.1655	358918.5612	444.89
118110	428411.1329	358943.5616	444.74
118111	428411.1588	358968.6818	444.57
118112	428411.1628	358993.6616	444.52
118113	428411.1619	359018.7569	444.26
118114	428386.2095	359018.5936	444.69
118115	428361.1689	359018.6741	444.82
118116	428336.2337	359018.6730	445.63
118117	428311.3139	359018.6959	445.69
118118	428286.2825	359018.7559	445.51
118119	428261.2702	359018.8259	446.00
118120	428236.4139	359018.7316	446.56
118121	428211.3466	359018.7128	447.30
118122	428186.3174	359018.6577	448.02
118123	428161.2759	359018.7051	448.24
118124	428136.2461	359018.6621	447.76
118125	428111.2288	359018.6431	447.99
118126	428086.2400	359018.5667	447.40
118127	428061.2478	359018.5419	447.34
118128	428036.2518	359018.4267	447.71
118129	428011.3338	359018.4692	447.73
118130	427986.3497	359018.4914	447.87
118131	427961.4418	359018.4845	448.41
118132	427936.5884	359018.4875	448.60
118133	427911.8951	359018.5625	449.37
118134	427887.1422	359018.5476	450.71
118135	427862.2256	359018.5806	452.09
118136	427836.9229	359018.6824	453.32
118137	427811.5831	359018.7930	454.06

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 18, 2010 Data			
Point #	Northing	Easting	Elevation
118101	428411.2141	358719.2360	445.77
118102	428411.0599	358744.0457	445.46
118103	428411.1329	358769.0418	445.13
118104	428411.1319	358793.9494	444.74
118105	428411.3380	358818.7633	444.72
118106	428411.1866	358843.6777	444.69
118107	428411.1326	358868.6448	444.83
118108	428411.2987	358893.5566	444.94
118109	428411.1655	358918.5612	444.89
118110	428411.1329	358943.5616	444.74
118111	428411.1588	358968.6818	444.57
118112	428411.1628	358993.6616	444.52
118113	428411.1619	359018.7569	444.26
118114	428386.2095	359018.5936	444.69
118115	428361.1689	359018.6741	444.82
118116	428336.2337	359018.6730	445.63
118117	428311.3139	359018.6959	445.69
118118	428286.2825	359018.7559	445.51
118119	428261.2702	359018.8259	446.00
118120	428236.4139	359018.7316	446.56
118121	428211.3466	359018.7128	447.30
118122	428186.3174	359018.6577	448.02
118123	428161.2759	359018.7051	448.24
118124	428136.2461	359018.6621	447.76
118125	428111.2288	359018.6431	447.99
118126	428086.2400	359018.5667	447.40
118127	428061.2478	359018.5419	447.34
118128	428036.2518	359018.4267	447.71
118129	428011.3338	359018.4692	447.73
118130	427986.3497	359018.4914	447.87
118131	427961.4418	359018.4845	448.41
118132	427936.5884	359018.4875	448.60
118133	427911.8951	359018.5625	449.37
118134	427887.1422	359018.5476	450.71
118135	427862.2256	359018.5806	452.09
118136	427836.9229	359018.6824	453.32
118137	427811.5831	359018.7930	454.06

Data Compared			
Point #	Northing	Easting	Elevation
101	0.03	-0.40	3.78
102	-0.02	-0.27	4.21
103	0.02	-0.19	4.66
104	-0.05	-0.10	5.06
105	-0.06	0.03	5.20
106	-0.08	0.09	5.26
107	-0.09	0.21	5.16
108	-0.04	0.25	5.04
109	-0.03	0.27	5.04
110	-0.05	0.26	4.89
111	-0.04	0.18	4.97
112	-0.01	0.19	4.99
113	-0.01	0.12	5.12
114	-0.04	0.13	5.10
115	-0.08	0.10	5.06
116	-0.10	0.10	4.98
117	-0.13	0.10	4.90
118	-0.17	0.09	4.80
119	-0.16	0.05	4.69
120	-0.19	0.08	4.60
121	-0.17	0.06	4.55
122	-0.14	0.08	4.49
123	-0.11	0.10	4.40
124	-0.06	0.14	4.39
125	-0.09	0.18	4.38
126	-0.06	0.20	4.37
127	-0.12	0.27	4.39
128	-0.08	0.31	4.43
129	-0.12	0.30	4.49
130	-0.14	0.27	4.53
131	-0.24	0.24	4.50
132	-0.47	0.24	4.32
133	-0.74	0.22	3.83
134	-1.03	0.20	2.89
135	-1.05	0.17	1.79
136	-0.78	0.08	0.87
137	-0.46	0.04	0.47
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 19, 2010 Data			
Point #	Northing	Easting	Elevation
119101	428411.2238	358718.7177	444.70
119102	428411.0404	358743.6440	444.79
119103	428411.1555	358768.7670	444.73
119104	428411.1365	358793.7890	444.50
119105	428411.3546	358818.6409	444.57
119106	428411.2108	358843.5940	444.60
119107	428411.1718	358868.5806	444.77
119108	428411.3255	358893.5537	444.90
119109	428411.1975	358918.5286	444.87
119110	428411.1435	358943.5415	444.72
119111	428411.1703	358968.6638	444.56
119112	428411.1754	358993.6479	444.51
119113	428411.1899	359018.7588	444.25
119114	428386.2315	359018.5846	444.68
119115	428361.1834	359018.6526	444.81
119116	428336.2401	359018.6852	445.62
119117	428311.3197	359018.6998	445.69
119118	428286.2680	359018.7499	445.51
119119	428261.2842	359018.8174	445.99
119120	428236.3795	359018.7114	446.55
119121	428211.3500	359018.6939	447.29
119122	428186.3477	359018.6390	448.01
119123	428161.3179	359018.6873	448.23
119124	428136.2753	359018.6598	447.75
119125	428111.2537	359018.6383	447.99
119126	428086.2680	359018.5685	447.40
119127	428061.2939	359018.5399	447.34
119128	428036.2985	359018.4348	447.71
119129	428011.3526	359018.4734	447.72
119130	427986.3606	359018.4720	447.87
119131	427961.4543	359018.4778	448.41
119132	427936.5800	359018.4807	448.60
119133	427911.9212	359018.5422	449.37
119134	427887.1748	359018.5362	450.71
119135	427862.2587	359018.5672	452.09
119136	427836.9565	359018.6598	453.32
119137	427811.5793	359018.7772	454.06

Data Compared			
Point #	Northing	Easting	Elevation
101	0.02	0.12	4.85
102	0.00	0.13	4.87
103	0.00	0.08	5.06
104	-0.05	0.06	5.29
105	-0.08	0.15	5.35
106	-0.11	0.17	5.35
107	-0.12	0.28	5.23
108	-0.06	0.25	5.08
109	-0.06	0.30	5.06
110	-0.06	0.28	5.01
111	-0.05	0.20	4.98
112	-0.03	0.20	5.00
113	-0.04	0.12	5.13
114	-0.06	0.13	5.11
115	-0.09	0.12	5.07
116	-0.11	0.09	4.99
117	-0.13	0.10	4.90
118	-0.16	0.10	4.80
119	-0.18	0.06	4.69
120	-0.15	0.10	4.61
121	-0.17	0.08	4.56
122	-0.17	0.10	4.50
123	-0.15	0.12	4.41
124	-0.09	0.14	4.40
125	-0.12	0.19	4.38
126	-0.09	0.19	4.37
127	-0.16	0.27	4.39
128	-0.13	0.30	4.43
129	-0.14	0.29	4.50
130	-0.16	0.29	4.53
131	-0.25	0.25	4.50
132	-0.46	0.24	4.32
133	-0.77	0.24	3.83
134	-1.06	0.22	2.89
135	-1.09	0.18	1.79
136	-0.81	0.10	0.87
137	-0.46	0.05	0.47
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	53[illegible].87

R12333

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 20, 2010 Data			
Point #	Northing	Easting	Elevation
120101	428411.2186	358718.4996	444.46
120102	428411.0700	358743.4669	444.621
120103	428411.1577	358768.6650	444.609
120104	428411.1618	358793.6426	444.421
120105	428411.3547	358818.5651	444.515
120106	428411.1848	358843.5095	444.551
120107	428411.1474	358868.4573	444.728
120108	428411.2900	358893.4797	444.873
120109	428411.1777	358918.4649	444.848
120110	428411.1231	358943.4737	444.702
120111	428411.1496	358968.6249	444.538
120112	428411.1853	358993.6048	444.493
120113	428411.1843	359018.6953	444.233
120114	428386.2345	359018.5692	444.667
120115	428361.1825	359018.6399	444.795
120116	428336.2427	359018.6286	445.606
120117	428311.3352	359018.6528	445.67
120118	428286.2961	359018.7226	445.49
120119	428261.3003	359018.7644	445.971
120120	428236.4191	359018.7045	446.532
120121	428211.3321	359018.6469	447.27
120122	428186.3457	359018.6103	447.989
120123	428161.3027	359018.6448	448.208
120124	428136.2915	359018.6025	447.731
120125	428111.2379	359018.5804	447.966
120126	428086.2748	359018.4940	447.378
120127	428061.2944	359018.4853	447.317
120128	428036.2911	359018.3832	447.684
120129	428011.3670	359018.4182	447.703
120130	427986.4044	359018.4152	447.845
120131	427961.4629	359018.4430	448.39
120132	427936.5988	359018.4542	448.581
120133	427911.9444	359018.5112	449.35
120134	427887.1685	359018.5059	450.689
120135	427862.2776	359018.5329	452.067
120136	427836.9943	359018.6299	453.301
120137	427811.5754	359018.7415	454.036

Data Compared			
Point #	Northing	Easting	Elevation
101	0.02	0.34	5.09
102	-0.03	0.31	5.04
103	-0.01	0.18	5.18
104	-0.08	0.21	5.37
105	-0.08	0.22	5.41
106	-0.08	0.26	5.40
107	-0.10	0.40	5.26
108	-0.03	0.32	5.11
109	-0.04	0.36	5.08
110	-0.04	0.35	5.03
111	-0.03	0.24	5.00
112	-0.04	0.24	5.02
113	-0.04	0.18	5.15
114	-0.07	0.15	5.12
115	-0.09	0.14	5.08
116	-0.11	0.15	5.00
117	-0.15	0.15	4.92
118	-0.19	0.12	4.82
119	-0.19	0.11	4.71
120	-0.19	0.10	4.63
121	-0.15	0.12	4.58
122	-0.17	0.13	4.52
123	-0.14	0.17	4.43
124	-0.11	0.20	4.42
125	-0.10	0.25	4.40
126	-0.09	0.27	4.39
127	-0.16	0.33	4.41
128	-0.12	0.35	4.46
129	-0.15	0.35	4.52
130	-0.20	0.35	4.55
131	-0.26	0.29	4.52
132	-0.48	0.27	4.34
133	-0.79	0.27	3.85
134	-1.06	0.25	2.91
135	-1.10	0.22	1.81
136	-0.85	0.13	0.89
137	-0.46	0.09	0.49
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

R12334

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 21, 2010 Data			
Point #	Northing	Easting	Elevation
121101	428411.2035	358718.4758	444.39
121102	428411.0156	358743.4448	444.57
121103	428411.1615	358768.6226	444.58
121104	428411.1388	358793.6475	444.40
121105	428411.3774	358818.5818	444.50
121106	428411.2149	358843.5262	444.54
121107	428411.1411	358868.4801	444.72
121108	428411.2936	358893.4811	444.87
121109	428411.1893	358918.4812	444.85
121110	428411.1289	358943.5110	444.70
121111	428411.1654	358968.6287	444.54
121112	428411.1808	358993.6241	444.50
121113	428411.1853	359018.7081	444.24
121114	428386.2157	359018.5424	444.67
121115	428361.1700	359018.6138	444.80
121116	428336.2267	359018.6299	445.61
121117	428311.3205	359018.6729	445.67
121118	428286.2672	359018.7288	445.49
121119	428261.2851	359018.7633	445.97
121120	428236.3901	359018.6850	446.54
121121	428211.3270	359018.6707	447.27
121122	428186.3433	359018.6157	447.99
121123	428161.2813	359018.6577	448.21
121124	428136.2764	359018.6253	447.73
121125	428111.2560	359018.6136	447.97
121126	428086.2592	359018.5336	447.38
121127	428061.2819	359018.5178	447.32
121128	428036.2758	359018.3961	447.69
121129	428011.3495	359018.4371	447.71
121130	427986.3690	359018.4442	447.85
121131	427961.4311	359018.4401	448.39
121132	427936.5684	359018.4600	448.58
121133	427911.9151	359018.5311	449.35
121134	427887.1562	359018.5117	450.69
121135	427862.2475	359018.5348	452.07
121136	427836.9284	359018.6491	453.30
121137	427811.5989	359018.7698	454.04

Data Compared			
Point #	Northing	Easting	Elevation
101	0.04	0.36	5.16
102	0.02	0.33	5.09
103	-0.01	0.23	5.21
104	-0.06	0.20	5.39
105	-0.10	0.21	5.42
106	-0.11	0.24	5.41
107	-0.09	0.38	5.27
108	-0.03	0.32	5.11
109	-0.05	0.35	5.08
110	-0.05	0.31	5.03
111	-0.04	0.24	5.00
112	-0.03	0.23	5.01
113	-0.04	0.17	5.14
114	-0.05	0.18	5.12
115	-0.08	0.16	5.08
116	-0.09	0.14	5.00
117	-0.13	0.13	4.92
118	-0.16	0.12	4.82
119	-0.18	0.11	4.71
120	-0.16	0.12	4.63
121	-0.15	0.10	4.58
122	-0.16	0.12	4.52
123	-0.12	0.15	4.43
124	-0.09	0.18	4.42
125	-0.12	0.21	4.40
126	-0.08	0.23	4.39
127	-0.15	0.29	4.41
128	-0.10	0.34	4.45
129	-0.13	0.33	4.51
130	-0.16	0.32	4.55
131	-0.23	0.29	4.52
132	-0.45	0.26	4.34
133	-0.76	0.26	3.85
134	-1.04	0.24	2.91
135	-1.07	0.21	1.81
136	-0.78	0.11	0.89
137	-0.48	0.06	0.49
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

R12335

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 22, 2010 Data			
Point #	Northing	Easting	Elevation
122101	428411.2117	358718.3736	444.37
122102	428411.0761	358743.3450	444.55
122103	428411.1606	358768.5122	444.57
122104	428411.1437	358793.5665	444.39
122105	428411.3775	358818.4793	444.50
122106	428411.2401	358843.4386	444.54
122107	428411.1792	358868.4169	444.72
122108	428411.3240	358893.3960	444.87
122109	428411.1879	358918.4114	444.85
122110	428411.1433	358943.4229	444.71
122111	428411.1689	358968.5516	444.54
122112	428411.2129	358993.5504	444.50
122113	428411.1791	359018.6443	444.24
122114	428386.2622	359018.5369	444.67
122115	428361.1912	359018.6187	444.80
122116	428336.2603	359018.6458	445.61
122117	428311.3630	359018.6548	445.68
122118	428286.3223	359018.7358	445.50
122119	428261.3236	359018.7622	445.98
122120	428236.4399	359018.6956	446.54
122121	428211.3694	359018.6694	447.28
122122	428186.3604	359018.6151	447.99
122123	428161.3392	359018.6551	448.21
122124	428136.3086	359018.6133	447.73
122125	428111.3140	359018.6041	447.97
122126	428086.2837	359018.5295	447.38
122127	428061.3157	359018.5128	447.32
122128	428036.3414	359018.3877	447.69
122129	428011.3801	359018.4323	447.71
122130	427986.4571	359018.4308	447.85
122131	427961.5161	359018.4241	448.39
122132	427936.6242	359018.4414	448.58
122133	427911.9706	359018.5231	449.35
122134	427887.2013	359018.5030	450.69
122135	427862.3145	359018.4995	452.07
122136	427837.0190	359018.6379	453.30
122137	427811.6288	359018.6902	454.04

Data Compared			
Point #	Northing	Easting	Elevation
101	0.03	0.47	5.19
102	-0.04	0.43	5.11
103	-0.01	0.34	5.22
104	-0.06	0.28	5.40
105	-0.10	0.31	5.42
106	-0.13	0.33	5.41
107	-0.13	0.44	5.27
108	-0.06	0.41	5.11
109	-0.05	0.42	5.08
110	-0.06	0.40	5.03
111	-0.05	0.31	5.00
112	-0.06	0.30	5.01
113	-0.03	0.23	5.14
114	-0.09	0.18	5.12
115	-0.10	0.16	5.08
116	-0.13	0.13	5.00
117	-0.18	0.15	4.91
118	-0.21	0.11	4.81
119	-0.22	0.11	4.70
120	-0.21	0.11	4.62
121	-0.19	0.10	4.57
122	-0.18	0.12	4.52
123	-0.18	0.15	4.43
124	-0.13	0.19	4.42
125	-0.18	0.22	4.40
126	-0.10	0.23	4.39
127	-0.19	0.30	4.41
128	-0.17	0.35	4.45
129	-0.16	0.34	4.51
130	-0.25	0.33	4.55
131	-0.31	0.31	4.52
132	-0.50	0.28	4.34
133	-0.82	0.26	3.85
134	-1.09	0.25	2.91
135	-1.14	0.25	1.81
136	-0.87	0.13	0.89
137	-0.51	0.14	0.49
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

R12336

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 23, 2010 Data			
Point #	Northing	Easting	Elevation
123101	428411.2168	358718.3507	444.36
123102	428411.0648	358743.3711	444.55
123103	428411.1589	358768.5385	444.56
123104	428411.1463	358793.5719	444.39
123105	428411.3843	358818.4919	444.50
123106	428411.2365	358843.4554	444.54
123107	428411.1923	358868.4317	444.72
123108	428411.3304	358893.4105	444.87
123109	428411.2160	358918.4160	444.85
123110	428411.1722	358943.4177	444.70
123111	428411.1996	358968.5589	444.54
123112	428411.2109	358993.5658	444.50
123113	428411.2063	359018.6491	444.24
123114	428386.2616	359018.4890	444.67
123115	428361.2026	359018.5626	444.80
123116	428336.2880	359018.6508	445.61
123117	428311.3493	359018.6593	445.67
123118	428286.3260	359018.7387	445.49
123119	428261.3233	359018.7986	445.97
123120	428236.4484	359018.7191	446.54
123121	428211.3815	359018.6856	447.28
123122	428186.4139	359018.6380	447.99
123123	428161.3286	359018.6637	448.21
123124	428136.3467	359018.6107	447.74
123125	428111.3114	359018.6062	447.97
123126	428086.3277	359018.5161	447.38
123127	428061.3291	359018.4993	447.32
123128	428036.3591	359018.3816	447.69
123129	428011.3986	359018.4146	447.71
123130	427986.4109	359018.4049	447.86
123131	427961.4770	359018.4056	448.40
123132	427936.6487	359018.4514	448.59
123133	427911.9658	359018.4985	449.36
123134	427887.2098	359018.4808	450.70
123135	427862.3186	359018.4984	452.07
123136	427836.9941	359018.6086	453.31
123137	427811.6377	359018.7231	454.04

Data Compared			
Point #	Northing	Easting	Elevation
101	0.03	0.49	5.19
102	-0.02	0.40	5.11
103	-0.01	0.31	5.23
104	-0.06	0.28	5.40
105	-0.11	0.30	5.42
106	-0.13	0.31	5.41
107	-0.15	0.42	5.27
108	-0.07	0.39	5.11
109	-0.08	0.41	5.08
110	-0.09	0.41	5.03
111	-0.08	0.31	5.00
112	-0.06	0.28	5.01
113	-0.06	0.23	5.14
114	-0.09	0.23	5.12
115	-0.11	0.21	5.08
116	-0.15	0.12	5.00
117	-0.16	0.14	4.92
118	-0.22	0.11	4.82
119	-0.22	0.08	4.71
120	-0.22	0.09	4.62
121	-0.20	0.09	4.57
122	-0.23	0.10	4.52
123	-0.16	0.15	4.43
124	-0.17	0.19	4.41
125	-0.17	0.22	4.40
126	-0.15	0.25	4.39
127	-0.20	0.31	4.41
128	-0.19	0.35	4.45
129	-0.18	0.35	4.51
130	-0.21	0.36	4.54
131	-0.27	0.32	4.51
132	-0.53	0.27	4.33
133	-0.81	0.29	3.84
134	-1.10	0.27	2.91
135	-1.15	0.25	1.81
136	-0.85	0.15	0.88
137	-0.52	0.11	0.49
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 24, 2010 Data			
Point #	Northing	Easting	Elevation
124101	428411.2902	358718.4137	444.35
124102	428411.1108	358743.3580	444.55
124103	428411.2095	358768.5113	444.56
124104	428411.2023	358793.5718	444.39
124105	428411.3899	358818.4639	444.50
124106	428411.2304	358843.4126	444.54
124107	428411.2301	358868.4120	444.72
124108	428411.3432	358893.3978	444.87
124109	428411.2414	358918.4044	444.85
124110	428411.1812	358943.4190	444.71
124111	428411.2471	358968.5546	444.54
124112	428411.2261	358993.5727	444.50
124113	428411.2540	359018.7144	444.24
124114	428386.3116	359018.5417	444.67
124115	428361.2473	359018.6107	444.80
124116	428336.3209	359018.6213	445.61
124117	428311.3865	359018.6438	445.68
124118	428286.3389	359018.7131	445.50
124119	428261.3744	359018.7720	445.98
124120	428236.4731	359018.6898	446.54
124121	428211.3975	359018.6860	447.28
124122	428186.4072	359018.6269	447.99
124123	428161.3596	359018.6493	448.21
124124	428136.3477	359018.5391	447.73
124125	428111.3467	359018.5800	447.97
124126	428086.3405	359018.5108	447.38
124127	428061.3601	359018.4916	447.32
124128	428036.3707	359018.3801	447.69
124129	428011.4218	359018.4158	447.71
124130	427986.4598	359018.4309	447.85
124131	427961.5334	359018.4008	448.39
124132	427936.6759	359018.4576	448.59
124133	427911.9890	359018.5260	449.35
124134	427887.2156	359018.5106	450.69
124135	427862.3334	359018.5270	452.07
124136	427837.0373	359018.6078	453.30
124137	427811.6752	359018.7371	454.04

Data Compared			
Point #	Northing	Easting	Elevation
101	-0.05	0.43	5.20
102	-0.07	0.42	5.12
103	-0.06	0.34	5.23
104	-0.12	0.28	5.40
105	-0.11	0.33	5.42
106	-0.13	0.35	5.41
107	-0.18	0.44	5.27
108	-0.08	0.40	5.11
109	-0.10	0.43	5.08
110	-0.10	0.40	5.03
111	-0.13	0.31	5.00
112	-0.08	0.28	5.01
113	-0.11	0.16	5.14
114	-0.14	0.18	5.12
115	-0.16	0.16	5.08
116	-0.19	0.15	5.00
117	-0.20	0.16	4.91
118	-0.23	0.13	4.81
119	-0.27	0.10	4.70
120	-0.24	0.12	4.62
121	-0.22	0.09	4.57
122	-0.23	0.11	4.52
123	-0.20	0.16	4.43
124	-0.17	0.26	4.42
125	-0.21	0.25	4.40
126	-0.16	0.25	4.39
127	-0.23	0.32	4.41
128	-0.20	0.35	4.45
129	-0.21	0.35	4.51
130	-0.25	0.33	4.55
131	-0.33	0.33	4.52
132	-0.55	0.27	4.34
133	-0.84	0.26	3.85
134	-1.10	0.24	2.91
135	-1.16	0.22	1.81
136	-0.89	0.16	0.89
137	-0.56	0.09	0.49
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

R12338

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 25, 2010 Data			
Point #	Northing	Easting	Elevation
125101	428411.2545	358718.3646	444.35
125102	428411.1084	358743.3264	444.55
125103	428411.2168	358768.4988	444.56
125104	428411.1622	358793.5279	444.39
125105	428411.3463	358818.4528	444.50
125106	428411.2418	358843.4088	444.54
125107	428411.2124	358868.4174	444.73
125108	428411.3603	358893.3924	444.88
125109	428411.2306	358918.3986	444.85
125110	428411.1722	358943.4226	444.71
125111	428411.2311	358968.5451	444.55
125112	428411.2338	358993.5528	444.50
125113	428411.2419	359018.6595	444.25
125114	428386.2856	359018.5550	444.68
125115	428361.2317	359018.6449	444.81
125116	428336.3243	359018.6509	445.62
125117	428311.3664	359018.6520	445.68
125118	428286.3233	359018.7213	445.50
125119	428261.3314	359018.7718	445.98
125120	428236.4468	359018.7063	446.54
125121	428211.4061	359018.6591	447.28
125122	428186.4184	359018.6240	448.00
125123	428161.3578	359018.6302	448.22
125124	428136.3299	359018.5798	447.74
125125	428111.3298	359018.5777	447.98
125126	428086.3249	359018.4978	447.39
125127	428061.3613	359018.4633	447.33
125128	428036.3449	359018.3721	447.70
125129	428011.4268	359018.4117	447.71
125130	427986.4567	359018.4106	447.86
125131	427961.5063	359018.3952	448.40
125132	427936.6559	359018.4580	448.59
125133	427911.9978	359018.4872	449.36
125134	427887.2137	359018.4329	450.70
125135	427862.3196	359018.4791	452.08
125136	427837.0114	359018.5663	453.31
125137	427811.6204	359018.6843	454.05

Data Compared			
Point #	Northing	Easting	Elevation
101	-0.01	0.47	5.20
102	-0.07	0.45	5.11
103	-0.07	0.35	5.23
104	-0.08	0.32	5.40
105	-0.07	0.34	5.42
106	-0.14	0.36	5.41
107	-0.17	0.44	5.26
108	-0.10	0.41	5.11
109	-0.09	0.43	5.08
110	-0.09	0.40	5.02
111	-0.11	0.32	4.99
112	-0.08	0.30	5.01
113	-0.09	0.22	5 13
114	-0.12	0.16	5 11
115	-0.14	0.13	5 07
116	-0.19	0.12	4 99
117	-0.18	0.15	4 91
118	-0.22	0.13	4 81
119	-0.23	0.11	4 70
120	-0.22	0.10	4 62
121	-0.23	0.11	4 57
122	-0.24	0.12	4 51
123	-0.19	0.18	4 42
124	-0.15	0.22	4 41
125	-0.19	0.25	4 39
126	-0.14	0.26	4 38
127	-0.23	0.35	4 41
128	-0.17	0.36	4 44
129	-0.21	0.36	4 51
130	-0.25	0.35	4 54
131	-0.30	0.33	4 51
132	-0.53	0.27	4 33
133	-0.84	0.30	3 84
134	-1.10	0.32	2 90
135	-1.15	0.27	1 80
136	-0.86	0.20	0 88
137	-0.50	0.14	0.48
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

R12339

Data for 68 Pin Monitoring at Pond Creek Mine

Baseline Data Average: Shot On November 10 & 12, 2009				January 26, 2010 Data				Data Compared			
Point #	Northing	Easting	Elevation	Point #	Northing	Easting	Elevation	Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55	126101	428411.2680	358718.3680	444.34	101	-0.02	0.47	5.21
102	428411.0404	358743.7741	449.66	126102	428411.0935	358743.3504	444.54	102	-0.05	0.42	5.12
103	428411.1509	358768.8500	449.79	126103	428411.2233	358768.5304	444.55	103	-0.07	0.32	5.24
104	428411.0827	358793.8495	449.79	126104	428411.2019	358793.5899	444.39	104	-0.12	0.26	5.41
105	428411.2768	358818.7893	449.92	126105	428411.4411	358818.4899	444.49	105	-0.16	0.30	5.43
106	428411.1052	358843.7660	449.95	126106	428411.2610	358843.4716	444.53	106	-0.16	0.29	5.42
107	428411.0468	358868.8559	449.99	126107	428411.2208	358868.4575	444.71	107	-0.17	0.40	5.28
108	428411.2624	358893.8016	449.98	126108	428411.3505	358893.4306	444.87	108	-0.09	0.37	5.12
109	428411.1398	358918.8297	449.93	126109	428411.2323	358918.4422	444.84	109	-0.09	0.39	5.09
110	428411.0829	358943.8231	449.73	126110	428411.1827	358943.4439	444.70	110	-0.10	0.38	5.03
111	428411.1221	358968.8653	449.54	126111	428411.2291	358968.5796	444.54	111	-0.11	0.29	5.00
112	428411.1495	358993.8497	449.51	126112	428411.2105	358993.5948	444.49	112	-0.06	0.25	5.02
113	428411.1486	359018.8786	449.38	126113	428411.2164	359018.6994	444.23	113	-0.07	0.18	5.15
114	428386.1691	359018.7194	449.79	126114	428386.2245	359018.5712	444.67	114	-0.06	0.15	5.12
115	428361.0914	359018.7749	449.88	126115	428361.1627	359018.6666	444.80	115	-0.07	0.11	5.08
116	428336.1338	359018.7739	450.61	126116	428336.2459	359018.6679	445.61	116	-0.11	0.11	5.00
117	428311.1872	359018.8005	450.59	126117	428311.3165	359018.6647	445.67	117	-0.13	0.14	4.92
118	428286.1082	359018.8465	450.31	126118	428286.2842	359018.7530	445.49	118	-0.18	0.09	4.82
119	428261.1057	359018.8769	450.68	126119	428261.2991	359018.8008	445.97	119	-0.19	0.08	4.71
120	428236.2287	359018.8089	451.16	126120	428236.4142	359018.7083	446.53	120	-0.19	0.10	4.63
121	428211.1790	359018.7712	451.85	126121	428211.3301	359018.6957	447.27	121	-0.15	0.08	4.58
122	428186.1793	359018.7400	452.51	126122	428186.3508	359018.6279	447.99	122	-0.17	0.11	4.52
123	428161.1638	359018.8099	452.64	126123	428161.2866	359018.6678	448.21	123	-0.12	0.14	4.43
124	428136.1816	359018.8031	452.15	126124	428136.2947	359018.6213	447.73	124	-0.11	0.18	4.42
125	428111.1367	359018.8270	452.37	126125	428111.2455	359018.6159	447.97	125	-0.11	0.21	4.41
126	428086.1810	359018.7625	451.77	126126	428086.2828	359018.5449	447.38	126	-0.10	0.22	4.39
127	428061.1300	359018.8122	451.73	126127	428061.2731	359018.5209	447.31	127	-0.14	0.29	4.42
128	428036.1720	359018.7347	452.14	126128	428036.2975	359018.4181	447.69	128	-0.13	0.32	4.45
129	428011.2166	359018.7676	452.22	126129	428011.3625	359018.4533	447.71	129	-0.15	0.31	4.51
130	427986.2052	359018.7642	452.40	126130	427986.3779	359018.4633	447.85	130	-0.17	0.30	4.55
131	427961.2040	359018.7292	452.91	126131	427961.4688	359018.4717	448.39	131	-0.26	0.26	4.52
132	427936.1225	359018.7231	452.92	126132	427936.5915	359018.5028	448.59	132	-0.47	0.22	4.34
133	427911.1533	359018.7862	453.20	126133	427911.9305	359018.5558	449.36	133	-0.78	0.23	3.84
134	427886.1123	359018.7523	453.60	126134	427887.1646	359018.5538	450.69	134	-1.05	0.20	2.91
135	427861.1730	359018.7483	453.88	126135	427862.2622	359018.5814	452.07	135	-1.09	0.17	1.81
136	427836.1478	359018.7636	454.19	126136	427836.9683	359018.6794	453.30	136	-0.82	0.08	0.89
137	427811.1182	359018.8285	454.53	126137	427811.6129	359018.7873	454.04	137	-0.49	0.04	0.49
4383	427345.2341	360349.8149	463.22					4383	427345.23	360349.81	463.22
4384	429209.1676	360379.8928	442.31					4384	429209.17	360379.89	442.31
4388	430665.6266	360378.9926	435.57					4388	430665.63	360378.99	435.57
p248	425434.6524	360202.4261	531.87					p248	425434.65	360202.43	531.87

R12340

Data for 68 Pin Monitoring at Pond Creek Mine

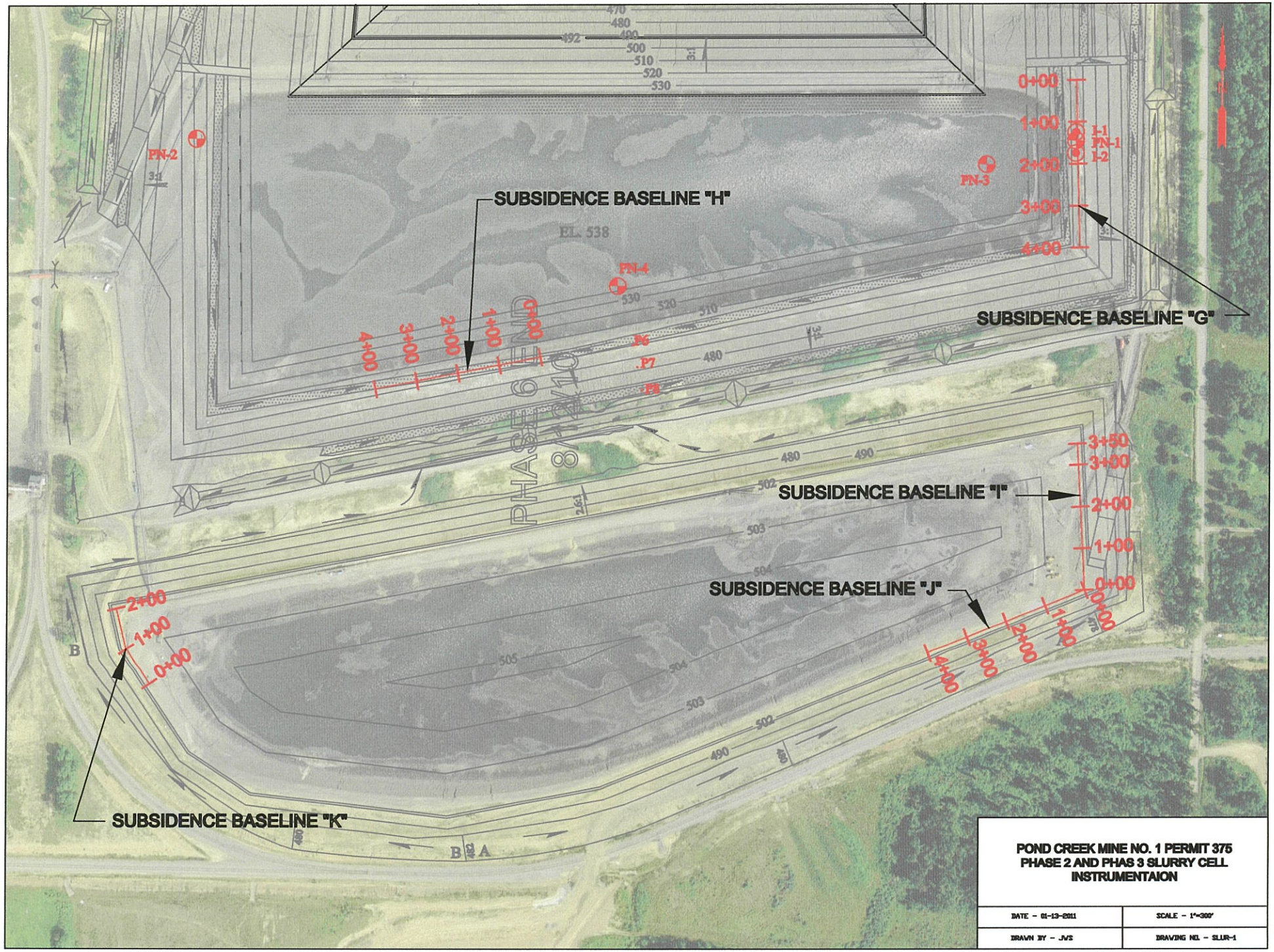
Baseline Data Average: Shot On November 10 & 12, 2009			
Point #	Northing	Easting	Elevation
101	428411.2433	358718.8388	449.55
102	428411.0404	358743.7741	449.66
103	428411.1509	358768.8500	449.79
104	428411.0827	358793.8495	449.79
105	428411.2768	358818.7893	449.92
106	428411.1052	358843.7660	449.95
107	428411.0468	358868.8559	449.99
108	428411.2624	358893.8016	449.98
109	428411.1398	358918.8297	449.93
110	428411.0829	358943.8231	449.73
111	428411.1221	358968.8653	449.54
112	428411.1495	358993.8497	449.51
113	428411.1486	359018.8786	449.38
114	428386.1691	359018.7194	449.79
115	428361.0914	359018.7749	449.88
116	428336.1338	359018.7739	450.61
117	428311.1872	359018.8005	450.59
118	428286.1082	359018.8465	450.31
119	428261.1057	359018.8769	450.68
120	428236.2287	359018.8089	451.16
121	428211.1790	359018.7712	451.85
122	428186.1793	359018.7400	452.51
123	428161.1638	359018.8099	452.64
124	428136.1816	359018.8031	452.15
125	428111.1367	359018.8270	452.37
126	428086.1810	359018.7625	451.77
127	428061.1300	359018.8122	451.73
128	428036.1720	359018.7347	452.14
129	428011.2166	359018.7676	452.22
130	427986.2052	359018.7642	452.40
131	427961.2040	359018.7292	452.91
132	427936.1225	359018.7231	452.92
133	427911.1533	359018.7862	453.20
134	427886.1123	359018.7523	453.60
135	427861.1730	359018.7483	453.88
136	427836.1478	359018.7636	454.19
137	427811.1182	359018.8285	454.53
4383	427345.2341	360349.8149	463.22
4384	429209.1676	360379.8928	442.31
4388	430665.6266	360378.9926	435.57
p248	425434.6524	360202.4261	531.87

January 27, 2010 Data			
Point #	Northing	Easting	Elevation
127101	428411.2331	358718.3565	444.34
127102	428411.0746	358743.3093	444.54
127103	428411.2137	358768.4965	444.55
127104	428411.1495	358793.5315	444.38
127105	428411.3646	358818.4458	444.49
127106	428411.2321	358843.4060	444.53
127107	428411.1709	358868.4065	444.71
127108	428411.3763	358893.4047	444.87
127109	428411.1930	358918.4117	444.84
127110	428411.1387	358943.4082	444.70
127111	428411.1625	358968.5705	444.54
127112	428411.1634	358993.5630	444.49
127113	428411.1459	359018.6606	444.23
127114	428386.2733	359018.5241	444.67
127115	428361.2448	359018.5796	444.80
127116	428336.2992	359018.6038	445.61
127117	428311.3620	359018.6174	445.67
127118	428286.3254	359018.6823	445.49
127119	428261.3433	359018.7164	445.97
127120	428236.4541	359018.6384	446.53
127121	428211.3920	359018.6306	447.27
127122	428186.3761	359018.5782	447.99
127123	428161.3480	359018.6103	448.21
127124	428136.3409	359018.5467	447.73
127125	428111.2916	359018.5287	447.97
127126	428086.3099	359018.4518	447.38
127127	428061.3093	359018.4410	447.32
127128	428036.3479	359018.3357	447.69
127129	428011.4117	359018.3772	447.70
127130	427986.4389	359018.3909	447.85
127131	427961.4960	359018.3937	448.39
127132	427936.6210	359018.4528	448.58
127133	427911.9594	359018.4810	449.35
127134	427887.2018	359018.5196	450.69
127135	427862.2985	359018.5180	452.07
127136	427837.0094	359018.6140	453.30
127137	427811.6508	359018.7212	454.04

Data Compared			
Point #	Northing	Easting	Elevation
101	0.01	0.48	5.21
102	-0.03	0.46	5.12
103	-0.06	0.35	5.24
104	-0.07	0.32	5.41
105	-0.09	0.34	5.43
106	-0.13	0.36	5.42
107	-0.12	0.45	5.28
108	-0.11	0.40	5.11
109	-0.05	0.42	5.09
110	-0.06	0.41	5.03
111	-0.04	0.29	5.00
112	-0.01	0.29	5.02
113	0.00	0.22	5.15
114	-0.10	0.20	5.12
115	-0.15	0.20	5.08
116	-0.17	0.17	5.00
117	-0.17	0.18	4.92
118	-0.22	0.16	4.82
119	-0.24	0.16	4.71
120	-0.23	0.17	4.63
121	-0.21	0.14	4.58
122	-0.20	0.16	4.52
123	-0.18	0.20	4.43
124	-0.16	0.26	4.42
125	-0.15	0.30	4.40
126	-0.13	0.31	4.39
127	-0.18	0.37	4.41
128	-0.18	0.40	4.45
129	-0.20	0.39	4.52
130	-0.23	0.37	4.55
131	-0.29	0.34	4.52
132	-0.50	0.27	4.34
133	-0.81	0.31	3.85
134	-1.09	0.23	2.91
135	-1.13	0.23	1.81
136	-0.86	0.15	0.89
137	-0.53	0.11	0.49
4383	427345.23	360349.81	463.22
4384	429209.17	360379.89	442.31
4388	430665.63	360378.99	435.57
p248	425434.65	360202.43	531.87

R12341

R12342



POND CREEK MINE NO. 1 PERMIT 375
PHASE 2 AND PHAS 3 SLURRY CELL
INSTRUMENTAION

DATE - 01-13-2011	SCALE - 1"=300'
DRAWN BY - JVS	DRAWING NO. - SLUR-1

APPENDIX I

ENHANCED MONITORING PIEZOMETER READING TABLE

Enhanced Monitoring Piezometer Reading Table
Refuse Disposal Area No. 2, Phase 2 and Phase 3
Williamson Energy LLC
Project No. B10-148-1413

Exceeding the following water depths and pressures over the sensing zones of the below listed piezometers will define "elevated pore pressures" and cause evaluation of the embankments for the need to initiate remedial measures as described in Guideline Technical Specification 6.03.b of the approved plan:

PIEZOMETER NO.	EMBANKMENT PHASE	ALERT PIEZOMETER LEVELWATER DEPTH OR PRESSURE
P-1	2	8.4 Feet
P-3	2	10.4 Feet
P-4	2	6.2 Feet
P-5	2	11.4 Feet
P-6	3	15.3 Feet
P-7	3	16.7 Feet
P-8	3	15.7 Feet
PN-1	3	7.41 PSI
PN-2	3	8.41 PSI

Notes:

The above alert piezometer water levels are based on a combination of values for each phase which will result in a downstream static slope stability safety factor of 1.5. Exceeding of the stipulated level in any one of the piezometers on a given date will cause reevaluation of the embankment stability using the piezometric levels in all of the applicable piezometers on that date.

Standpipe Piezometer P-1 in the Phase 2 embankment is not included in the above table because its location is not related to the critical stability sections in the embankment.

The vibrating wire piezometers PN-3 and PN-4 in the Phase 3 capped pool area are not included in the above table because they are not critical to the embankment stability until Phase 7, Stage 2 is built.

All of the piezometers in Phase 2 and Phase 3 will be read on the prescribed intervals.

Alliance Consulting, Inc.
Engineers • Constructors • Scientists

ILLINOIS DEPARTMENT OF NATURAL RESOURCES
PERMIT NO. 375
ADDITIONAL MSHA INFORMATION
COMMENTS 2, 4, 5, 6, 9, 10 AND 11
VOLUME 2 OF 7

COAL REFUSE DISPOSAL FACILITY NO. 2
PHASE 3 THROUGH 7
IMPOUNDMENT I.D. NO. 1211-IL08-0341-02
MSHA I.D. NO. 11-03141
WILLIAMSON COUNTY, ILLINOIS

Prepared for

WILLIAMSON ENERGY, LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B10-148-1413
NOVEMBER 2010

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Alliance Consulting, Inc.
Engineers · Constructors · Scientists

March 26, 2010

Project No. B05-330-1413

Mr. Robert L. Phillips
District Manager
MINE SAFETY AND HEALTH ADMINISTRATION
2300 Willow Street, Suite 00
Vincennes, IN 47591-5416

Transmittal
Response to MSHA Comments
Phase 7
Coal Refuse Disposal Facility No. 2
Mach Mining LLC
Impoundment ID No. 1211-IL08-03141-02

Dear Mr. Phillips:

On behalf of our client, Mach Mining LLC, please find attached two copies of the subject response for your approval. One copy of the response has also been forwarded by Alliance Consulting, Inc. to Mr. Paul Donahue at the Pittsburgh Safety and Health Technology Center. If there are any questions, or if additional information is required, please contact us.

Respectively submitted,

ALLIANCE CONSULTING, INC.

Frederick R. Vass, P.E.
Principal Engineer

FRV:frv
Attachments

cc: P. Donahue (MSHA) w/attachments
S. Fowler (IDNR) w/attachments
M. Diedrichsen (IOWR) w/attachments
B. Genes (GAI) w/attachments
J. Slapak (Mach) w/attachments

file: 05330-79

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SUMMERSVILLE, WV (304) 883-2360
CANONSBURG, PA (724) 745-3630

BY: FAV DATE: 3/17/10 CHKD BY: — DATE: — (I.A.)
PROJECT NAME: MACH Mining, LLC
PROJECT NO: B05-330-1413 SHEET 1A OF 32
DESCRIPTION Timing - Phases 4-7 as of Dec 4, 2009

The purpose of the following calculations is to revise the staging based on current production data and the planned installation/operation of the fine coal refuse plate press. Initially, the attached calculations starting on Page 1.e were based on previously provided production data and the embankment configurations and impoundment levels as of December 4, 2009 as provided by Williamson Energy. In mid March 2010, after these calculations were performed, revised production data was provided along with a revised mine timing map. Generally, the clean coal production remained about the same, but the percent recovery increased, resulting in a lesser amount of total refuse produced. The coarse to fine refuse ratio previously determined based on aerial mapping and plant weights was assumed to remain unchanged. Therefore, the relative staging as previously calculated is appropriate, but the time to construct each individual stage and the estimated completion dates have been revised as shown on attached Page 1.d.

Mach Mining/Processing 2010

Month	Raw Tons	Clean Tons	Recovery	Shipped	Mined Tonnage	Refuse
January	704,569	492,736	69.93%	558,851	754,282	211,833
February	348,582	241,571	69.30%	197,089	360,734	107,011
March	*0*	*0*	*0.00%*	*110,919*	*40,500*	*0*
April	*936,200*	*569,500*	*60.83%*	*553,500*	*1,002,000*	*366,700*
May	*1,002,800*	*598,000*	*59.63%*	*594,000*	*980,000*	*404,800*
June	*1,075,900*	*654,500*	*60.83%*	*621,000*	*1,078,000*	*421,400*
July	*825,200*	*476,000*	*57.68%*	*499,500*	*882,000*	*349,200*
August	*1,113,800*	*652,200*	*58.56%*	*634,500*	*1,078,000*	*461,600*
September	*987,100*	*556,250*	*56.35%*	*567,000*	*1,029,000*	*430,850*
October	*1,091,600*	*651,000*	*59.64%*	*661,500*	*1,050,000*	*440,600*
November	*818,700*	*525,300*	*64.16%*	*540,000*	*850,000*	*293,400*
December	*847,400*	*534,800*	*63.11%*	*540,000*	*864,000*	*312,600*
2010 Projected	9,751,851	5,951,857	61.03%	6,077,860	9,968,516	3,799,994

Year	Raw Tons	Clean Tons	Recovery	Shipped	Mined Tonnage	Refuse
2006 Total	191,671	94,728	49.42%	65,776		96,943
2007 Total	2,307,020	1,050,258	45.52%	1,021,930		1,256,762
2008 Total	9,426,634	5,435,173	57.66%	5,451,646		3,991,461
2009 Total	9,285,096	5,917,580	63.73%	5,810,652	9,691,541	3,367,516
2010 Projected	9,751,851	5,951,857	61.03%	6,077,860	9,968,516	3,799,994
Total	30,962,272	18,449,596	59.59%	18,427,863	19,660,057	12,512,676

1.b R12348

2010 Data from Micky

Annual Clean Coal	5,951,857	tons
Percent Recovery	61%	
Total Refuse	3,805,286	tons
Coarse:Fines(by weight)	3.11	:1
Coarse:Fines(by volume)	1.24	:1
Coarse Refuse	2,879,425	tons
Fine Refuse	925,860	tons
Fine Refuse After Plate Press (1/3rd to press)	617,240	tons

Dry Unit Weight	
Coarse, pcf	Fine, pcf
125	50

1,706,326 cy
1,371,645 cy
914,430 cy

Beginning Date	12/4/2009				
Stage	coarse volume cy	Annual Production cy/yr	Time to Build years	Cumulative time years	completion date
5	451,750	1,706,326	0.26	0.26	3/10/2010
4	421,211	1,706,326	0.25	0.51	6/8/2010
Cap Phase 2	241,032	1,706,326	0.14	0.65	7/30/2010
Cap Phase 3	272,008	1,706,326	0.16	0.81	9/26/2010
7B to El 492 and 6 to El. 461.6	626,800	1,706,326	0.37	1.18	2/7/2011
Complete 6	1,190,000	1,706,326	0.70	1.88	10/20/2011
Phase 7, Stage 1	315,000	1,706,326	0.18	2.06	12/26/2011
Phase 7, Stage 2	398,000	1,706,326	0.23	2.29	3/20/2012
Phase 7, Stage 3	498,000	1,706,326	0.29	2.59	7/5/2012
Phase 7, Stage 4	681,000	1,706,326	0.40	2.99	11/27/2012
Phase 7, Stage 5	981,000	1,706,326	0.57	3.56	6/25/2013
Phase 7, Stage 6	379,000	1,706,326	0.22	3.78	9/14/2013
	Fines Volume cy				
Fines life remaining after Phase 7, Stage 6	1,846,000	914,430	2.02	5.80	9/21/2015

GOES WITH COLUMNS 1, 2, 6, 47
SHEET 12

I.d R12350

Phase 3

Embankment built to mirror Ph 2 to the north. Ph 3 will be abandoned before Ph 6 or Ph 7 begin so it is being designed with a ½ PMF design storm.

Time to build Embankment.

Emb Vol = 1.18×10^6 yd^3

$1.18 \times 10^6 \div 2.53 \times 10^6 =$ 0.47 yrs or ~~10-16-08~~

ACTUAL COMPLETED DATE 9-17-08

Fines life of Ph 3 imp. may Fines level

Design Storm Vol: $(20.5 (1/2) 31.9 \times 43560) \div 27 = 87919$ yd^3

$500 - 3 = 497 = 13.21 \times 10^5$ yd^3 $= 87919 = 1.23 \times 10^6$ yd^3

490	10.2
494.88	12.3
500	14.5

May Fines level = 494.88

life = $12.3 \times 10^5 \div 1.32 \times 10^6 =$ 0.93 yrs or 10-21-09

Phase 4

Time to build Emb

Vol of Emb = 1.33×10^6 yd^3

$1.33 \times 10^6 \div 2.53 \times 10^6 =$ 0.53 yrs or 3-28-09

No fines are to be pumped into Ph 4

The water level will be maintained to a minimum by pumps.

R12352

Alliance Consulting, Inc.
Engineers — BECKLEY, WV (304) 255-0491
Constructors — SUMMERSVILLE, WV (304) 883-2360
Scientists — CANONSBURG, PA (724) 745-3630

BY: TLG DATE: 2/5/10 CHKD BY: FW DATE: 2/22/10
PROJECT NAME: MACH MINING, LLC
PROJECT NO. B05-330-1413 SHEET 1.e OF
DESCRIPTION TIMING PHASE 4-7 AS OF DEC 4 2009 AND WITH 1/3 FINES PRODUCTION REDUCED MAY 1 2010

PURPOSE: TO CALCULATE TIMING BASED ON INFORMATION PROVIDED BY WILLIAMSON ENERGY FOR MINING TO BE COMPLETED AS OF DECEMBER 4, 2009.

PRODUCTION RATES: 6 MILLION TONS/YEAR
CLEAN COAL 55% RECOVERY
TOTAL REFUSE = 6 ÷ 0.55 × 0.45 = 4.9 MILLION TONS/YR
THE UNIT WEIGHT WAS CALCULATED TO BE FOR THE COARSE 117 PCF AND THE FINES 58 PCF. THE RATIO BY WEIGHT IS 3.11:1 AND BY VOLUME IS 1.54:1, FOR THE CALCULATIONS TO BE CONSERVATION THE RATIO USED 1.24:1 SO THE UNIT WEIGHT WILL BE USED FOR THE COARSE IS 125 PCF AND 50 PCF FOR THE FINES, WILL USED FOR THE COARSE IS 125 PCF AND 50 PCF FOR THE FINES. IF THERE ARE 4.9 MILLION TONS/YR AND 3.11:1, SO FOR
COARSE = 3.71 MILLION TONS/YR
FINES = 1.19 MILLION TONS/YR
COARSE = 3.71 MILLION TONS/YR (2000 LBS/TON) ÷ 125 PCF ÷ 27 CY/CF
= 2.19 MCY (59.36 MCF)
FINES = 1.19 MILLION TONS/YR (2000 LBS/TON) ÷ 50 PCF ÷ 27 CY/CF
= 1.76 MCY (47.60 MCF)
2.19 MCY / 1.76 MCY = 1.84:1 RATIO

FINES LEVEL AS DECEMBER 4, 2009 IN PHASE 5 = 455 FT ±
THE FINES LEVEL WAS PREVIOUSLY CALCULATED TO BE AT 452.80 FT ± AT DEC 4
TO CALCULATE HOW MANY MORE FINES WERE PRODUCED
VOLUME AT 455 FT BY INTERPOLATION:

ELEV	VOLUME
454	1.18
455	x
461	1.51

$$\frac{455-454}{461-454} = \frac{x-1.18}{1.51-1.18}$$
$$\frac{1}{7} = \frac{x-1.18}{0.33}$$
$$0.33 = 7x - 8.26$$
$$x = 1.22 \times 10^6 \text{ CY}$$

VOLUME AT 452.80 FT BY INTERPOLATION:

ELEV	VOLUME
447	0.88
452.8	x
454	1.18

$$\frac{452.8-447}{454-447} = \frac{x-0.88}{1.18-0.88}$$
$$\frac{5.8}{7} = \frac{x-0.88}{0.30}$$
$$1.74 = 7x - 6.16$$
$$x = 1.13 \times 10^6 \text{ CY}$$

$1.22 \times 10^6 - 1.13 \times 10^6$ CY = 0.09×10^6 CY MORE PRODUCED
0.09×10^6 CY / 1.76×10^6 = 0.05 YRS (0.7 MONTHS OR 21 DAYS)

Alliance Consulting, Inc.
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Constructors SUMMERSVILLE, WV (304) 883-2360
Scientists CANONSBURG, PA (724) 745-3630

BY: TLA DATE: 2/5/10 CHKD BY: [illegible] DATE: 2/22/10

PROJECT NAME: MACH MINING LLC

PROJECT NO. 805-358-1413 SHEET 2 OF

DESCRIPTION TIMING PHASE 4-5 AS OF DEC 4 2009 AND WITH 1/2 FINES PRODUCTION REDUCED MAY 1, 2010

TO CALCULATE HOW LONG TO COMPLETE CONSTRUCTION OF PHASE 5:
FROM WILLIAMSON ENERGY, AS OF DECEMBER 4, 2009, 80% OF THE EAST SIDE AND 50% OF THE NORTH SIDE MUST BE COMPLETED.
TOTAL EMBANKMENT VOLUME TO ELEV 488 = 1.39 X 10⁶ C.Y.
32.5% OF THE EMBANKMENT IS LEFT TO BE COMPLETED.
0.325 (1.39 X 10⁶ CY) = 451,750 CY COARSE LEFT TO BE PLACED IN PHASE 5
TIME TO COMPLETE:
451,750 ÷ 2.19 X 10⁶ = 0.21 YRS (252 MON OR 75.4 DAYS)
PHASE 5 EMBANKMENT WILL BE COMPLETED APPROXIMATELY FEBRUARY 17, 2010

AT WHAT ELEVATION WILL THE FINES BE UPON COMPLETION OF PHASE 5 EMBANKMENT:
0.21 YRS (1.76 X 10⁶) = 369,600 CY
FINES VOLUME AT 455 FT = 1.23 MCY
1.23 X 10⁶ + 369,600 = 1,599,600 CY

BY INTERPOLATION:

ELEV	VOL
461	1.51 MCY
X	1.60 MCY
468	1.96 MCY

$\frac{X-461}{468-461} = \frac{1.60-1.51}{1.96-1.51}$

$\frac{X-461}{7} = \frac{0.08}{0.45}$

0.45X − 161.35 = 0.56
X = 462.8 FT

TO CALCULATE HOW LONG TO COMPLETE PHASE FOUR:
FROM WILLIAMSON ENERGY, AS OF DECEMBER 4, 2009, 50% OF THE EAST SIDE AND 45% OF THE NORTH SIDE MUST BE COMPLETED
TOTAL EMBANKMENT VOLUME IS 1.33 X 10⁶ C.Y.
31.67% OF THE EMBANKMENT IS LEFT TO BE COMPLETED
0.3167 (1.33 X 10⁶ CY) = 421,211 C.Y. COARSE LEFT TO BE PLACED IN PHASE 4
TIME TO COMPLETE:
421,211 ÷ 2.19 X 10⁶ = 0.19 YRS (2.3 MONTHS OR 69.4 DAYS)
PHASE 4 EMBANKMENT WILL BE COMPLETED APPROXIMATELY APRIL 29, 2010

STARTING MAY 1, 2010, MACH MINING WILL BE REDUCING FINES PRODUCTION BY 1/2 THE PRODUCTION RATE, MINE 4 PREP SYSTEM
SINCE IT IS UNKNOWN HOW MUCH THIS WILL AFFECT COARSE COAL PRODUCTION AND TO BE CONSERVATIVE, THESE CALCULATIONS WILL NOT SHOW ANY CHANGE IN THE COARSE COAL PRODUCTION RATE.
THE NEW FINES PRODUCTION RATES AS OF MAY 1, 2010:
1.19 MILLION TONS/YR (0.35 FEET) = 394,697 TONS/YR
1.19 X 10⁶ − 394,697 = 793,373 TONS/YR
793,373 TONS/YR (2000 LBS/TON) ÷ 50 LBS/CF = 27 CY/CF = 1.18 X 10⁶ CY

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BY: TLC DATE: 3/2/2010 CHKD BY: JV DATE: 2/22/10

PROJECT NAME: MACH MINING LLC

PROJECT NO. B05-330-1413 SHEET 3 OF

DESCRIPTION TIMING PHASE 4-7 AS OF DEC 4 2009 AND WITH 1'S FINES PRODUCTION REDUCED MAY 1 2010

WHERE ARE FINES AT COMPLETION OF PHASE 4

0.19 YRS + 0.21 YRS (TIME TO COMPLETE PHASE 3) = 0.40 YRS

0.40 yrs (1.76 mcy) = 0.704 MCY

0.70 MCY + 1.23 MCY (FINES VOLUME PREVIOUSLY REACHED) = 1.92 MCY

ELEVATION	VOLUME
468	1.86
X	1.93
475	2.25

$\frac{X-468}{475-468} = \frac{1.93-1.86}{2.25-1.86}$

$\frac{X-468}{7} = \frac{0.07}{0.39}$

$0.39X - 182.52 = 0.49$

$X = 469.3$ FT

HOW LONG TO COMPLETE PHASE 5 TO MAX FINES ELEV. 480 FT

FINES VOLUME AT 480 FT

ELEV	VOLUME
475	2,247,700
480	X
482	2,655,754

$\frac{480-475}{482-475} = \frac{X-2,247,400}{2,655,754-2,247,700}$

$\frac{5}{1} = \frac{X-2,247,400}{408,354}$

$2,041,770 = 7X - 15,731,800$

$X = 2,539,081.43$ CY

2.54 MCY - 1.93 MCY = 0.61 MCY

0.61 MCY / 1.18 x 10⁶ = 0.52 YRS TO COMPLETE PHASE 5 (NOVEMBER 4, 2010)

PHASE 2 AND 3 ARE TO BE CAPPED BEFORE MINING BEGINS (MID-DECEMBER 2010) HOW LONG TO COMPLETE PHASE 2 AND 3 CAPPING WITH 6FT COARSE COAL REFUSE VOLUME NEEDED:

PHASE 2 = 24.9 ACRES (45,560 SF/ACRE) (6FT) ÷ 27 CY/SF = 241,032 CY

241,032 CY ÷ 2.19 MCY = 0.11 YRS (1.32 MONTHS)

PHASE 3 = 25.1 ACRES (43,560 SF/ACRE) (6FT) ÷ 27 CY/SF = 272,008 CY

272,008 CY ÷ 2.19 MCY = 0.12 YRS (1.44 MONTHS)

WHERE WILL PHASE 6 BE WHEN PHASE 5 IS AT MAXIMUM FINES ELEV. 480 FT AND PHASES 2 AND 3 ARE CAPPED: 0.52 YRS - 0.12 YRS - 0.11 YRS = 0.29 YRS

0.29 YRS (2.19 MCY/YR) = 635,100 CY

ELEV	VOLUME
460	0.47
X	0.64
470	0.84

$\frac{X-460}{470-460} = \frac{0.64-0.47}{0.84-0.47}$

$\frac{X-460}{10} = \frac{0.17}{0.37}$

$0.37X - 170.2 = 1.70$

$X = 464.6$ FT

BY NOVEMBER 4 2010, THE PHASE 5 IMPOUNDMENT IS FULL AND BY JUNE 8, 2010 PHASE 2 IS CAPPED AND BY JULY 21, 2010 PHASE 3 IS CAPPED, PHASE 6 HAS BEEN CONSTRUCTED TO ELEVATION 464.6 FT, THEREFORE MINING WOULD HAVE TO START IN PHASE 6 BEFORE PHASE 7B IS CONSTRUCTED, NEED TO CONSTRUCT STAGE 7B TO ELEVATION 482 BEFORE MINE INTO PHASE 6.

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PROJECT NAME: MACH MINING LLC

PROJECT NO. 605-320-1413 SHEET 4 OF

DESCRIPTION TIMING PHASES 4-7 AS OF DEC. 4 2009 AND FINES PRODUCTION REDUCED MAY 1 2010

PHASE 7B TO ELEVATION 492 IS BY INTERPOLATION.

ELEVATION	VOLUME
490	0.096
492	X
500	0.122

$\frac{492-490}{500-490} = \frac{X-0.096}{0.122-0.096}$

$\frac{2}{10} = \frac{X-0.096}{0.026}$

$0.052 = 10X - 0.96$

$X = 0.1012$ MCY

TIME TO CONSTRUCT PHASE 7B = 0.1012 MCY / 2.13 MCY = 0.046 yrs

TIME LEFT TO CONSTRUCT PHASE 7 BEFORE PHASE 5 IMPOUNDMENT FILLS 0.52 yrs (TIME TO COMPLETE PHASE 5) - 0.11 (TIME TO CAP PHASE 2) - 0.12 yrs (TIME TO CAP PHASE 3) - 0.05 yrs (TIME TO CONSTRUCT PHASE 7.5 TO ELEV. 492) = 0.24 yrs

0.24 yrs (2.19 x 10^6) = 525,600 CY

BY INTERPOLATION.

ELEVATION	VOLUME
460	0.47
X	0.53
470	0.24

$\frac{X-460}{470-460} = \frac{0.53-0.47}{0.24-0.47}$

$\frac{X-460}{10} = \frac{0.06}{-0.23}$

$-0.23X - 170.2 = -0.60$

$X = 461.5$ FT.

STAGE 5 IS FULL WHEN PHASE 6 AT ELEVATION 461.5 FT

TIME TO COMPLETE PHASE 6

1.72 MCY - 0.53 MCY = 1.19 MCY / 2.19 MCY = 0.54 yrs

FINES LEVEL WHEN PHASE 5 IS COMPLETED USE PHASE 7 IMPOUNDMENT VOLUMES ADJUST FOR THE CONSTRUCTION OF PHASE 7B

HOW MANY FINES WHERE PRODUCED SINCE PHASE 5 IS FILLED.

0.54 yrs (1.18 MCY/YR) = 0.637 MCY

WHERE ARE FINES LEVEL IN PHASE 7B IMPOUNDMENT

ELEVATION	VOLUME
460	0.306
X	0.637
470	0.796

$\frac{X-460}{470-460} = \frac{0.637-0.306}{0.796-0.306}$

$\frac{X-460}{10} = \frac{0.331}{0.49}$

$0.49X - 184 = 3.31$

$X = 468.3$ FT

MAXIMUM ALLOWABLE FILL IN PHASE 6 PRIOR TO RAISING CREST ABOVE ELEVATION 492 FT IS ELEVATION 473 FT, 468.3 FT < 473 GO OK!

TO DETERMINE TIME TO CONSTRUCT AND CONSTRUCT PHASE 7A AND REMAINING 5 TO AND 7B PHASE

SUBTRACT CAPPING TIME FROM TO EMBANKMENT VOLUMES (SEE REVISED VOLUME SHEET)

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PROJECT NAME: MACH MINING LLC

PROJECT NO. B05-330-1413 SHEET 5 OF

DESCRIPTION TIMING PHASE 4-7 AS OF DEC 4 2009 AND WITH 1/2 FINES PRODUCTION REDUCED MAY 1 2010

HOW MUCH TIME TO RAISE FINES FROM 468.3FT TO 473FT
0.84MCY - 0.637MCY = 0.203MCY
TIME FOR IMPOUNDMENT TO RAISE 0.203MCY ÷ 1.18MCY/YR = 0.172YRS
COARSE PRODUCED IN 0.172 YRS = 2.19MCY/YR (0.172YR) = 0.377MCY

ELEVATION	VOLUME
500	0.315
X	0.377
510	1.31

$\frac{X-500}{510-500} = \frac{0.377-0.315}{1.31-0.315}$

$\frac{X-500}{10} = \frac{0.0377}{0.995}$

$0.995X - 497.5 = 0.377$

$X = 500.6$ FT

CONSTRUCT STAGE ONE PHASE 7 TO ELEV. 500FT
HOW LONG TO CONSTRUCT EMBANKMENT TO 500 FT:
0.315MCY / 2.19 MCY/YR = 0.144 YRS
WHERE WILL FINES BE PUT IN PHASE 6
FINES WERE AT ELEV. 468.3FT W/VOLUME 0.637MCY, PREVIOUSLY
0.144YRS (1.18 MCY/YR) = 0.17MCY + 0.637 MCY = 0.807MCY

ELEVATION	VOLUME
470	0.706
X	0.807
480	1.152

$\frac{X-470}{480-470} = \frac{0.807-0.706}{1.152-0.706}$

$\frac{X-470}{10} = \frac{0.101}{0.446}$

$0.446X - 209.62 = 1.10$

$X = 472.3$ FT

TO CALCULATE MAXIMUM ALLOWABLE FINES ELEVATION FOR CREST 500 FT
500FT - 3FT (FREEBOARD) = 497FT

ELEVATION	VOLUME
490	1.654
497	X
500	2.208

$\frac{497-490}{500-490} = \frac{X-1.654}{2.208-1.654}$

$\frac{7}{10} = \frac{X-1.654}{0.554}$

$3.878 = 10X - 16.54$

$X = 2.042$ MCY

ASSUME PHASE 7 DRAINS AWAY FROM IMPOUNDMENT
DRAINAGE AREA AT CREST ELEVATION 500FT = ± 96.8 ACRES
PMF RAINFALL = 41 INCHES STORM CRITERIA IS DAM FAILURE
ASSUME CURVE NUMBER IS 100 (CONSERVATIVE)
STORM RUNOFF = 24.41 IN)(1FT/12IN)(96.8 ACRES)(43,560 SF/ACRE) ÷ 27 CF/CY = 6.957 MCY
MAXIMUM ALLOWABLE VOLUME FOR FINES = 2.042 - 6.957 = 1.085 MCY

ELEVATION	VOLUME
470	0.706
Y	1.085
480	1.152

$\frac{Y-470}{480-470} = \frac{1.085-0.706}{1.152-0.706}$

$\frac{Y-470}{10} = \frac{0.379}{0.446}$

$3.71 = 0.446Y - 209.62$

$Y = 478.517$

MAXIMUM FINES ELEVATION FOR CREST AT 500FT IS 478.5FT

R12357

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PROJECT NAME: MACH MINING LLC
PROJECT NO. R05-330-1413 SHEET 6 OF
DESCRIPTION TIMING PHASES 4-7 AS OF DEC 4 2009 AND WITH 1/3 FINES REDUCED MAY 1, 2010

FINES LIFE FROM 472.3 FT TO 478.5 FT: 1.085 MCY - 0.807 MCY = 0.278 MCY
0.278 MCY ÷ 1.18 MCY/YR = 0.24 YRS
COARSE PRODUCED IN 0.24 YRS = 0.24 YRS (2.19 MCY/YR) = 0.53 MCY
0.315 MCY (COARSE AT 500 FT) + 0.53 MCY = 0.845 MCY

ELEVATION	VOLUME
500	0.315
x	0.845
510	1.310

$\frac{x-500}{500-500} = \frac{0.797-0.315}{1.310-0.315}$

$\frac{x-500}{10} = \frac{0.482}{0.995}$

$0.995x - 497.5 = 4.82$ $x = 505.3$

CONSTRUCT STAGE 2 OF PHASE 7 TO ELEV. 504 FT

ELEVATION	VOLUME
500	0.315
504	x
510	1.310

$\frac{504-500}{510-500} = \frac{x-0.315}{1.31-0.315}$

$\frac{4}{10} = \frac{x-0.315}{0.995}$

$3.98 = 10x - 3.15$ $x = 0.713$ MCY

0.713 MCY - 0.315 MCY = 0.398 MCY, 0.398 MCY ÷ 2.19 MCY/YR = 0.18 YRS

CALCULATE MAXIMUM ALLOWABLE FINES AT CREST 504 FT
DRAINAGE AREA AT 504 FT IS 84.7 ACRES ±
ASSUME PHASE 7C DRAINS AWAY FROM IMPOUNDMENT
THE DESIGN STORM:
(2)(41 IN)(1 FT/12 IN)(84.7 ACRES)(43,560 SF/ACRE) ÷ 27 CF/CF = 0.934 MCY
CREST ELEV. 504 FT - 3 FT = 501 FT

ELEVATION	VOLUME
500	2.208
501	x
510	2.821

$\frac{501-500}{510-500} = \frac{x-2.208}{2.821-2.208}$

$\frac{1}{10} = \frac{x-2.208}{0.631}$

$0.613 = 10x - 22.08$

$x = 2.27$ MCY

2.27 MCY - 0.934 MCY = 1.336 MCY

ELEVATION	VOLUME
480	1.152
x	1.336
490	1.654

$\frac{x-480}{490-480} = \frac{1.336-1.152}{1.654-1.152}$

$\frac{x-480}{10} = \frac{0.184}{0.502}$

$0.502x - 240.96 = 1.84$

$x = 483.7$ FT

MAXIMUM FINES ELEV AT CREST 504 FT IS 483.7 FT
CALCULATE WHERE FINES ARE WHEN CREST REACHES 504 FT
PREVIOUS FINES ELEVATION WAS 472.3 W/ VOLUME 0.807 MCY
IT TAKES 0.19 YRS TO GO FROM 500 FT TO 504 FT
0.19 YRS (1.18 MCY/YR) = 0.212 MCY + 0.807 MCY = 1.019 MCY

R12358

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PROJECT NAME: MACH MINING LLC
PROJECT NO. 805-330-1413 SHEET 7 OF
DESCRIPTION TIMING PHASES 4-7 AS OF DEC 4 2009 AND WITH 1/3 FINES PRODUCTION REDUCED MAY 1 2010

ELEVATION	VOLUME		
470	0.706	X-480 / 480-470 =	1.043 = 0.706 / 1.152 - 0.706
X	1.019	X-470 / 10 =	0.337 / 0.446
480	1.152	0.446 X - 209.62 = 337	
		X = 477.0 FT	

CALCULATE LIFE BETWEEN 477.0 FT AND 483.7 FT
1.330 INCY = 1.019 MCY = 0.317 MCY
0.317 MCY = 1.15 MCY/YR = 0.2097 YR
PORTION VOLUME 0.669 YR (2.19 TIME PE) = 0.589 MCY
PREVIOUS CREST 504 FT IS 0.713 MCY + 0.589 MCY = 1.302 MCY

ELEVATION	VOLUME		
500	0.315	X-500 / 510-500 =	1.310-0.315 / 1.302-0.315
X	1.302	X-500 / 10 =	0.904 / 0.987
510	1.31	9.04 = 0.995X - 497.5	
		X = 509.90 FT	

CONSTRUCT STAGE 3 OF FINES TO ELEV 509 FT

ELEVATION	VOLUME		
500	0.315	509-500 / 510-500 =	X-0.315 / 1.310-0.315
509	X	9 / 10 =	X = 0.315 / 0.995
510	1.310	8.955 = 10X - 3.15	
		X = 1.211 MCY	

TIME TO REACH 509 FT = (1.211 - 0.713) / 2.19 = 0.23 YR
MAXIMUM ALLOWABLE FINES ELEVATION AT CREST OF 509 FT
DRAINAGE AREA = 3 61.9 ACRES
THE DESIGN STORM RUNOFF
[2.04 IN/HR/FT] [1.81 ACRES] [43,560 SQ FT/ACRE] = 0.903 MCY
509 + 3 FT (FREEBOARD) = 512 FT

ELEVATION	VOLUME		
500	2.208	506-500 / 510-500 =	X-2.208 / 2.621-2.208
506	X	6 / 10 =	X-2.208 / 0.613
510	2.621	3.678 = 10X - 22.08	
		X = 2.575 MCY	

0.57% MCY - 0.903 MCY = 1.673 MCY

ELEVATION	VOLUME		
490	1.069	X-490 / 500-490 =	1.673-1.069 / 2.208-1.069
X	1.673	X-490 / 10 =	3.019 / 5.309
500	2.208	5.309X - 2601.41 = 3.019	
		X = 493.7 FT	

R12359

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PROJECT NAME: MACH MINING, LLC

PROJECT NO. BDS-330-1413 SHEET 8 OF

DESCRIPTION TIMING PHASES 3-7 AS OF DEC 4 2009 AND WITH 1/3 FINES PRODUCTION REDUCED MAY 1 2010

MAXIMUM FINES ELEVATION FOR CREST ELEV. 509 FT IS 490.3 FT.
CALCULATE FINES ELEVATION WHEN CREST REACHES 509 FT
0.32 YRS (1.2 MCY/YR) = 0.260 MCY
PREVIOUS FINES ELEVATION 477.0 W/ VOLUME 1.079 MCY
0.260 MCY + 1.079 MCY = 1.339 MCY

ELEVATION	VOLUME	
480	1.152	X-480 / 490-480 = 1.279-1.152 / 1.655-1.152
X	1.279	X-480 / 10 = 0.127 / 0.503
490	1.655	1.27 = 0.503X - 241.44
		X = 482.5 FT

CALCULATE FINES LIFE BETWEEN 482.5 FT AND 490.3 FT
1.673 MCY - 1.279 MCY = 0.394 MCY
0.394 MCY ÷ 1.18 MCY/YR = 0.33 YRS
COARSE PRODUCED IN 0.33 YRS = 0.33 YR (2.19 MCY/YR) = 0.723 MCY
PREVIOUS CREST 509 FT W/ VOLUME 1.211 MCY
1.211 MCY + 0.723 MCY = 1.934 MCY

ELEVATION	VOLUME	
510	1.310	Y-510 / 520-510 = 1.934-1.310 / 2.141-1.310
X	1.934	X-510 / 10 = 0.624 / 0.831
520	2.141	0.831X = 483.1 + 0.624
		X = 517 FT

CONSTRUCT STAGE 4 OF PHASE 7 TO ELEV 517 FT

ELEVATION	VOLUME	
510	1.310	517-510 / 520-510 = Y-1.310 / 2.141-1.310
517	X	Y / 10 = X-1.310 / 0.831
520	2.141	5.817 = 10X - 13.10
		X = 1.892 MCY

TIME TO REACH 517 FT = 1.892 MCY ÷ 2.19 MCY/YR = 0.864 YR = 0.55 YRS + 0.31 YR
MAXIMUM ALLOWABLE FINES ELEVATION @ CREST OF 517 FT
DRAINAGE AREA = ± 77.9 ACRES
[(2)(4)(IN)(1 FT/12 IN)(77.8 ACRES)(43,560 SF/ACRE)] / 27 CY/CF = 0.853 MCY
517 FT - 3 FT (OF FREEBOARD) = 514 FT

ELEVATION	VOLUME	
510	2.220	Y-510 / 520-510 = X-2.220 / 2.472-2.220
514	X	Y / 10 = X-2.220 / 0.252
520	2.472	10X - 22.20 = 2.668
		X = 3.089 MCY

3.089 - 0.853 = 2.231 MCY

R12360

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PROJECT NAME: MACH MINING, LLC

PROJECT NO. P05-330-1413 SHEET 9 OF

DESCRIPTION TIMING PHASES 4-7 AS OF DEC 4 2009 AND 1/3 FINES PRODUCTION REDUCED MAY 1, 2010

ELEVATION	VOLUME
500	2.208
X	2.031
510	1.820

$\frac{X-500}{510-500} = \frac{2.031-2.208}{1.820-2.208}$

$\frac{Y-500}{10} = \frac{0.025}{0.612}$

$0.612Y - 306 = 0.25$

$Y = 500.4$ FT

MAXIMUM FINES ELEVATION WHEN CREST ELEVATION 517 FT IS 500.4 FT

CALCULATE FINES ELEVATION WHEN CREST REACHES 517 FT

0.03 LYR (1.16 MCY/YR) = 0.306 MCF

PREVIOUS FINES ELEVATION 482.5 FT W/ VOLUME 1.279 MCY

0.306 + 1.279 MCY = 1.585 MCY

ELEVATION	VOLUME
480	1.152
X	1.645
490	1.654

$\frac{X-480}{490-480} = \frac{1.645-1.152}{1.654-1.152}$

$\frac{Y-480}{10} = \frac{0.493}{0.502}$

$4.93 = 0.502X - 240.76$

$X = 489.8$ FT

CALCULATE FINES LIFE BETWEEN 489.5 FT AND 500.4 FT

2.231 MCY - 1.645 MCY = 0.586 MCY

0.586 ÷ 1.18 ACY/YR = 0.497 YR

COARSE PRODUCED IN 0.497 YR

0.460 YR (2.19 MCY/YR) = 1.088 MCF

PREVIOUS CREST ELEVATION 517 FT W/ VOLUME 1.892 MCY

1.892 MCY + 1.088 MCF = 2.980 MCY

ELEVATION	VOLUME
530	2.717
X	2.980
538	3.252

$\frac{X-530}{538-530} = \frac{2.980-2.717}{3.252-2.717}$

$\frac{Y-530}{8} = \frac{0.161}{0.433}$

$1.288 = 0.433X - 229.49$

$X = 533.0$ FT

CONSTRUCT STAGE 5 OF PHASE 7 TO 531 FT

ELEVATION	VOLUME
530	2.819
531	X
538	3.252

$\frac{531-530}{538-530} = \frac{Y-2.819}{3.252-2.819}$

$\frac{Y-2.819}{0.433} = \frac{1}{8}$

$8Y - 22.552 = 0.433$

$Y = 2.872$ MCY

TIME TO REACH CREST ELEVATION 531 FT = 2.872 - 1.892 / 2.19 = 0.448 YR

MAXIMUM ALLOWABLE FINES ELEV. AT CREST ELEVATION 531 FT

DRAINAGE AREA = 30.1 ACRES

DESIGN STORM = 10 YEAR

CAPACITY (IN) = 0.7 ACF ÷ 1.18 ACY/MCY = 0.719 MCY

R12361

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PROJECT NAME: MACH MINING, LLC

PROJECT NO. PINE-530-4113 SHEET 10 OF

DESCRIPTION TIMING PHASES 4-7 AS OF DEC 4 2009 AND 1/3 FINES PRODUCTION REDUCED MAY 1 2010

531FT - 3FT (FREEBOARD) = 528 FT

ELEVATION	VOLUME
520	3.493
528	X
530	4.224

$\frac{528-520}{530-520} = \frac{X-3.493}{4.224-3.493}$

$\frac{8}{10} = \frac{X-3.493}{0.731}$

$5.848 = 10X - 34.93$

$X = 4.078$ MCY

4.078 MCY − 0.779 MCY = 3.299 MCY

ELEVATION	VOLUME
510	2.821
X	3.299
520	3.493

$\frac{X-510}{520-510} = \frac{3.299-2.821}{3.493-2.821}$

$\frac{X-510}{10} = \frac{0.478}{0.672}$

$0.672X - 342.72 = 4.78$

$X = 517.1$ FT

CALCULATE FINES ELEVATION WHEN CREST REACHES 531 FT

0.448 HR (1.18 MCY/HR) = 0.529 MCY

PREVIOUS FINES ELEVATION 489.5 FT W/ 1.645 MCY

0.529 + 1.645 = 2.174 MCY

ELEVATION	VOLUME
490	1.654
X	2.174
500	2.205

$\frac{X-490}{500-490} = \frac{2.174-1.654}{2.205-1.654}$

$\frac{X-490}{10} = \frac{0.520}{0.551}$

$5.20 = 0.551X - 270.49$

$X = 499.4$ FT

CALCULATE FINES VOLUME BETWEEN 499.4 FT AND 517.1 FT

3.299 MCY − 2.174 MCY = 1.125 MCY

1.125 MCY / 1.18 MCY/HR = 0.953 HRS

COAL PRODUCED IN 0.953 HRS = 2.19 MCY/HR (0.953 HRS) = 2.087 MCY

PREVIOUS CREST ELEVATION 531 FT W/ VOLUME 2.173 MCY

2.087 MCY + 2.821 MCY = 4.96 MCY > 3.252 MCY, SO CONSTRUCT STAGES (FINAL STAGE) TO ELEV 538 FT

3.252 − 2.873 MCY = 0.379 MCY

0.379 MCY / 2.19 MCY/HR = 0.173 HRS TO COMPLETE EMBANKMENT

FINES ELEVATION UPON COMPLETION OF EMBANKMENT

0.173 HRS (1.18 MCY/HR) = 0.204 MCY

PREVIOUS FINES ELEVATION 489.5 FT W/ VOLUME 2.174 MCY

2.174 MCY + 0.204 MCY = 2.378 MCY

ELEVATION	VOLUME
500	2.205
X	2.378
510	2.821

$\frac{X-500}{510-500} = \frac{2.378-2.205}{2.821-2.205}$

$\frac{X-500}{10} = \frac{0.17}{0.616}$

$0.616X - 308 = 1.70$

$X = 504.8$ FT

R12362

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Engineers
Constructors
Scientists

BECKLEY, WV (304) 255-0491
SUMMERSVILLE, WV (304) 883-2360
CANONSBURG, PA (724) 745-3630

BY: JLB DATE: 3/3/10 CHKD BY: JW DATE: 3/8/10

PROJECT NAME: MACH MINING LLC

PROJECT NO. 205-330.14-2 SHEET 11 OF

DESCRIPTION TIMINA PHASES 4-7 AS OF DEC 4 2009
AND 1/3 FINES PRODUCTION REDUCED MAY 1 2010

FINES LIFE REMAINING:
MAXIMUM FINES ELEVATION ACCORDING TO PLAN IS ELEV 530 FT.
VOLUME AT 530 FT = 4,224 BCY
4,224 BCY = 2,378 BCY E VOLUME OF FINES AT 502 BENCH = 1,846 MCY
1,846 MCY / 11.18 MCY/YR = 165 YRS LEFT

R12363

Alliance Consulting, Inc.
Engineers
Constructors
Scientists

BECKLEY, WV (304) 255-0491
SUMMERSVILLE, WV (304) 883-2360
CANONSBURG, PA (724) 745-3630

BY: TLG DATE: 3/5/10 CHKD BY: _____ DATE: _____

PROJECT NAME: MACH MINING, LLC

PROJECT NO. B05-330-1413 SHEET 12 OF _____

DESCRIPTION TIMING PHASE 4-7, AS OF DECEMBER 4, 2009 AND FINES WITH 1/3 FINES PRODUCTION REDUCED MAY 1, 2010

PHASES/ 1 STAGES	CREST 2 ELEVATION	TIME TO 3 CONSTRUCT	DATE OF 4 COMPLETION	CUMMULATIVE 5 TIME	FINES 6 ELEVATION	ALLOWABLE FINES 7
5	488 FT	0.21 YRS	2/18/2010	0.21 YRS	462.8 FT	480 FT
					USE	PHASE 5
USE						USE
4	492 FT	0.19 YRS	4/29/2010	0.40 YRS	469.3 FT	480 FT
					PHASE 5	PHASE 5
CAP PHASE 2	6 FT CAP	0.11 YRS	6/8/2010	0.51 YRS	471.6 FT	480 FT
					PHASE 5	PHASE 5
CAP PHASE 3	6 FT CAP	0.12 YRS	7/21/2010	0.63 YRS	474.1 FT	480 FT
					PHASE 5	PHASE 5
7B TO ELEV.	461.6 FT	0.29 YRS	11/4/2010	0.92 YRS	480 FT	480 FT
492 FT & PHASE 6					PHASE 5	PHASE 5
TO ELEV. 461.6 FT						
PHASE 6	492 FT	0.54 YRS	5/20/2011	1.46 YRS	468.3 FT	473 FT
					PHASE 7	
PHASE 7						
STAGE 1	500 FT	0.14 YRS	7/11/2011	1.60 YRS	472.3 FT	478.5 FT
STAGE 2	504 FT	0.18 YRS	9/14/2011	1.78 YRS	477.8 FT	483.7 FT
STAGE 3	509 FT	0.23 YRS	12/7/2011	2.01 YRS	482.5 FT	490.3 FT
STAGE 4	517 FT	0.31 YRS	3/29/2012	2.32 YRS	489.8 FT	500.4 FT
STAGE 5	531 FT	0.45 YRS	9/10/2012	2.77 YRS	499.4 FT	517.1 FT
STAGE 6	538 FT	0.17 YRS	11/11/2012	2.94 YRS	502.8 FT	530 FT
FINES LIFE						
REMAINING AFTER						
PHASE 7, STAGE 6		1.56 YRS	6/3/2014	4.5 YRS	530 FT	530 FT

Superceded — See Page 1.d.
of These Calculations

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VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY PHASE 3 IMP VOL

SCALE: 1

CALCS. BY: JLH 10-22-07

CHECKED BY: MDB

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
452	1727.00	1.73E+03				0.00E+00	0.00E+00
			7.15E+03	2	1.43E+04		
454	12582.00	1.26E+04				1.43E+04	5.30E+02
			2.95E+04	2	5.90E+04		
456	46388.00	4.64E+04				7.33E+04	2.71E+03
			1.15E+05	2	2.29E+05		
458	182827.00	1.83E+05				3.02E+05	1.12E+04
			3.48E+05	2	6.97E+05		
460	514141.00	5.14E+05				9.99E+05	3.70E+04
			6.12E+05	2	1.22E+06		
462	710341.00	7.10E+05				2.22E+06	8.24E+04
			7.35E+05	2	1.47E+06		
464	758662.00	7.59E+05				3.69E+06	1.37E+05
			7.71E+05	2	1.54E+06		
466	783329.00	7.83E+05				5.23E+06	1.94E+05
			7.96E+05	2	1.59E+06		
468	807685.00	8.08E+05				6.83E+06	2.53E+05
			8.20E+05	2	1.64E+06		
470	832117.00	8.32E+05				8.47E+06	3.14E+05
			8.95E+05	10	8.95E+06		
480	957207.00	9.57E+05				1.74E+07	6.45E+05
			1.02E+06	10	1.02E+07		
490	1087747.00	1.09E+06				2.76E+07	1.02E+06
			1.16E+06	10	1.16E+07		
500	1223738.00	1.22E+06				3.92E+07	1.45E+06

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VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY PHASE 4 EMB VOL

SCALE: 1

CALCS. BY: JLH 10-22-07

CHECKED BY: MDB

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
444	26965.00	2.70E+04				0.00E+00	0.00E+00
			1.25E+05	2	2.50E+05		
446	222931.00	2.23E+05				2.50E+05	9.26E+03
			4.36E+05	2	8.73E+05		
448	649798.00	6.50E+05				1.12E+06	4.16E+04
			7.37E+05	2	1.47E+06		
450	823513.00	8.24E+05				2.60E+06	9.61E+04
			8.93E+05	2	1.79E+06		
452	962794.00	9.63E+05				4.38E+06	1.62E+05
			1.03E+06	2	2.05E+06		
454	1087982.00	1.09E+06				6.43E+06	2.38E+05
			1.09E+06	2	2.17E+06		
456	1085414.00	1.09E+06				8.61E+06	3.19E+05
			1.07E+06	2	2.14E+06		
458	1055127.00	1.06E+06				1.07E+07	3.98E+05
			1.04E+06	2	2.08E+06		
460	1024374.00	1.02E+06				1.28E+07	4.75E+05
			1.01E+06	2	2.02E+06		
462	995317.00	9.95E+05				1.48E+07	5.50E+05
			9.81E+05	2	1.96E+06		
464	966870.00	9.67E+05				1.68E+07	6.23E+05
			9.51E+05	2	1.90E+06		
466	934862.00	9.35E+05				1.87E+07	6.93E+05
			9.14E+05	2	1.83E+06		
468	893583.00	8.94E+05				2.05E+07	7.61E+05
			8.73E+05	2	1.75E+06		
470	852054.00	8.52E+05				2.23E+07	8.25E+05
			7.46E+05	10	7.46E+06		
480	640656.00	6.41E+05				2.97E+07	1.10E+06
			5.32E+05	10	5.32E+06		
490	423007.00	4.23E+05				3.51E+07	1.30E+06
			4.01E+05	2	8.02E+05		
492	378726.00	3.79E+05				3.59E+07	1.33E+06

(14)

R12365

✓ Coarse Coal Refuse - Stage 5 expansion - bulk 15
not included

B09-018-1413

PHASE V COAL DISPOSAL AREA 2A

Volumes by elevation zone Apr 15 14:04:01 2009

FROM ORIGINAL GROUND MAPPING

Zone 426.00 to 431.00
Cut volume : 4,461,022.5 C.F., 165,223.05 C.Y.
Fill volume: 0.0 C.F., 0.00 C.Y.
Running total:
Cut volume : 4,461,022.5 C.F., 165,223.05 C.Y.
Fill volume: 0.0 C.F., 0.00 C.Y.

Zone 431.00 to 436.00
Cut volume : 4,751,126.5 C.F., 175,967.65 C.Y.
Fill volume: 0.0 C.F., 0.00 C.Y.
Running total:
Cut volume : 9,212,148.9 C.F., 341,190.70 C.Y.
Fill volume: 0.0 C.F., 0.00 C.Y.

Zone 436.00 to 441.00
Cut volume : 5,212,544.3 C.F., 193,057.20 C.Y.
Fill volume: 917,696.2 C.F., 33,988.75 C.Y.
Running total:
Cut volume : 14,424,693.2 C.F., 534,247.90 C.Y.
Fill volume: 917,696.2 C.F., 33,988.75 C.Y.

Zone 441.00 to 446.00
Cut volume : 3,992,077.7 C.F., 147,854.73 C.Y.
Fill volume: 4,833,661.6 C.F., 179,024.51 C.Y.
Running total:
Cut volume : 18,416,770.9 C.F., 682,102.63 C.Y.
Fill volume: 5,751,357.9 C.F., 213,013.25 C.Y.

Zone 446.00 to 451.00
Cut volume : 0.0 C.F., 0.00 C.Y.
Fill volume: 6,758,492.3 C.F., 250,314.53 C.Y.
Running total:
Cut volume : 18,416,770.9 C.F., 682,102.63 C.Y.
Fill volume: 12,509,850.2 C.F., 463,327.79 C.Y.

Zone 451.00 to 456.00
Cut volume : 0.0 C.F., 0.00 C.Y.
Fill volume: 5,970,510.2 C.F., 221,130.01 C.Y.
Running total:

Cut volume : 18,416,770.9 C.F., 682,102.63 C.Y.
Fill volume: 18,480,360.4 C.F., 684,457.79 C.Y.

Zone 456.00 to 461.00
Cut volume : 0.0 C.F., 0.00 C.Y.
Fill volume: 5,152,215.8 C.F., 190,822.81 C.Y.
Running total:
Cut volume : 18,416,770.9 C.F., 682,102.63 C.Y.
Fill volume: 23,632,576.2 C.F., 875,280.60 C.Y.

Zone 461.00 to 466.00
Cut volume : 0.0 C.F., 0.00 C.Y.
Fill volume: 4,298,999.3 C.F., 159,222.20 C.Y.
Running total:
Cut volume : 18,416,770.9 C.F., 682,102.63 C.Y.
Fill volume: 27,931,575.5 C.F., 1,034,502.80 C.Y.

Zone 466.00 to 471.00
Cut volume : 0.0 C.F., 0.00 C.Y.
Fill volume: 3,456,065.3 C.F., 128,002.42 C.Y.
Running total:
Cut volume : 18,416,770.9 C.F., 682,102.63 C.Y.
Fill volume: 31,387,640.8 C.F., 1,162,505.22 C.Y.

Zone 471.00 to 476.00
Cut volume : 0.0 C.F., 0.00 C.Y.
Fill volume: 2,672,881.5 C.F., 98,995.61 C.Y.
Running total:
Cut volume : 18,416,770.9 C.F., 682,102.63 C.Y.
Fill volume: 34,060,522.4 C.F., 1,261,500.83 C.Y.

Zone 476.00 to 481.00
Cut volume : 0.0 C.F., 0.00 C.Y.
Fill volume: 1,930,138.0 C.F., 71,486.59 C.Y.
Running total:
Cut volume : 18,416,770.9 C.F., 682,102.63 C.Y.
Fill volume: 35,990,660.4 C.F., 1,332,987.42 C.Y.

Zone 481.00 to 486.00
Cut volume : 0.0 C.F., 0.00 C.Y.
Fill volume: 1,190,821.8 C.F., 44,104.51 C.Y.
Running total:
Cut volume : 18,416,770.9 C.F., 682,102.63 C.Y.
Fill volume: 37,181,482.2 C.F., 1,377,091.93 C.Y.

Zone 486.00 to 491.00
Cut volume : 0.0 C.F., 0.00 C.Y.

Fill volume: 269,351.5 C.F., 9,975.98 C.Y.
Running total:
Cut volume : 18,416,770.9 C.F., 682,102.63 C.Y.
Fill volume: 37,450,833.7 C.F., 1,387,067.92 C.Y.

Fine Coal Reuse - Stage 5 expansion
hole not included

B09-018-1413

PHASE V COAL DISPOSAL AREA 2A

Volume Report FOR FINES

Wed Apr 15 14:12:38 2009

Lower left grid corner : 358646.98,429211.68
Upper right grid corner: 360016.98,430581.68
X grid resolution: 137, Y grid resolution: 137
X grid cell size : 10.00, Y grid cell size: 10.00

Pond/Pit volume : 78,644,800.1 C.F., 2,912,770.37 C.Y., 1,805.44 Acre-Ft
Area: 1,695,534.0 S.F., 38.924 Acres
Elevation Range: 426.00 to 488.00

Storage Volumes

Elevation	Storage(AcreFt)	(C.Y.)	(C.F.)	Area(Acre)
433.00	145.02230	345869.96 233969.3	6317171.2	21.674
440.00	303.42103	601419.96 489519.3	13217020.2	23.596
447.00	475.56481	979145.26 767244.6	20715603.0	25.601
454.00	662.02363	1199965.46 1068064.8	28837749.4	27.686
461.00	863.74581	1605409.66 1393509.9	37624767.3	30.088
468.00	1084.18813	1861057.56 1749156.9	47227235.1	33.025
475.00	1323.65671	2247400.16 2135499.5	57658486.2	35.151
482.00	1576.76859	2655753.96 2543853.3	68684039.9	37.207
488.00	1805.43618	3024671.06 2912770.4	78644800.1	38.924

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VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY
PHASE 6 EMB VOL

SCALE: 1

CALCS. BY: JLH 10-22-07

CHECKED BY: MOB

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
440	20548.00	2.05E+04				0.00E+00	0.00E+00
			3.93E+05	10	3.93E+06		
450	765316.00	7.65E+05				3.93E+06	1.46E+05
			8.77E+05	10	8.77E+06		
460	988066.00	9.88E+05				1.27E+07	4.70E+05
			9.98E+05	10	9.98E+06		
470	1008580.00	1.01E+06				2.27E+07	8.40E+05
			1.02E+06	10	1.02E+07		
480	1027914.00	1.03E+06				3.29E+07	1.22E+06
			1.04E+06	8	8.28E+06		
488	1043059.00	1.04E+06				4.11E+07	1.52E+06
			1.20E+06	0	0.00E+00		
488	1350082.00	1.35E+06				4.11E+07	1.52E+06
			1.34E+06	2	2.68E+06		
490	1330975.00	1.33E+06				4.38E+07	1.62E+06
			1.32E+06	2	2.64E+06		
492	1311871.00	1.31E+06				4.65E+07	1.72E+06

19

R12370

'olume Report 2/21/2008 12:18

:r ring Grid: //Aci-acad/caddrawings/05330/7B-7C MERGED.grd
and Grid: //Aci-acad/caddrawings/05330/7B-7C PROPOSED EMB.grd
irid corner locations: 357504.45,426355.33 to 360456.45,427963.33
irid resolution X: 492, Y: 268 Grid cell size X: 6.00, Y: 6.00
.rea in Cut : 382.3 S.F., 0.01 Acres
.rea in Fill: 428,616.4 S.F., 9.84 Acres
otal inclusion area: 428,998.6 S.F., 9.85 Acres
ut to Fill ratio: 0.00
verage Cut Depth: 0.11 Average Fill Depth: 14.51
ax Cut Depth: 0.52 Max Fill Depth: 22.85
ut (C.Y.) / Area (acres): 0.16
ill (C.Y.) / Area (acres): 23389.91
ut volume: 41.8 C.F., 1.55 C.Y.
ill volume: 6,219,569.8 C.F., 230,354.44 C.Y.

R12372

one 453.19 to 460.00
olume : 38.8 C.F., 1.44 C.Y.
volume: 348,025.6 C.F., 12,889.84 C.Y.
unning total:
ut volume : 38.8 C.F., 1.44 C.Y.
ill volume: 348,025.6 C.F., 12,889.84 C.Y.

one 460.00 to 470.00
ut volume : 1.3 C.F., 0.05 C.Y.
ill volume: 740,644.0 C.F., 27,431.26 C.Y.
unning total:
ut volume : 40.1 C.F., 1.49 C.Y.
ill volume: 1,088,669.6 C.F., 40,321.10 C.Y.

one 470.00 to 480.00
ut volume : 1.6 C.F., 0.06 C.Y.
ill volume: 755,968.6 C.F., 27,998.84 C.Y.
unning total:
ut volume : 41.8 C.F., 1.55 C.Y.
ill volume: 1,844,638.2 C.F., 68,319.93 C.Y.

one 480.00 to 490.00
volume : 1.2 C.F., 0.04 C.Y.
volume: 739,011.0 C.F., 27,370.78 C.Y.
g total:
lume : 43.0 C.F., 1.59 C.Y.
olume: 2,583,649.3 C.F., 95,690.71 C.Y.

ne 490.00 to 500.00
t volume : 1.2 C.F., 0.05 C.Y.
ll volume: 718,441.7 C.F., 26,608.95 C.Y.
nning total:
t volume : 44.2 C.F., 1.64 C.Y.
ll volume: 3,302,091.0 C.F., 122,299.67 C.Y.

ne 500.00 to 510.00
t volume : 0.7 C.F., 0.02 C.Y.
ll volume: 723,597.6 C.F., 26,799.91 C.Y.
nning total:
t volume : 44.9 C.F., 1.66 C.Y.
ll volume: 4,025,688.6 C.F., 149,099.58 C.Y.

e 510.00 to 520.00
volume : 0.9 C.F., 0.03 C.Y.
l volume: 755,277.5 C.F., 27,973.24 C.Y.
ning total:
volume : 45.8 C.F., 1.70 C.Y.
volume: 4,780,966.1 C.F., 177,072.82 C.Y.

.00 to 530.00

Fill volume: 786,986.3 C.F., 29,147.64 C.Y.
Running total:
Cut volume : 47.1 C.F., 1.74 C.Y.
Fill volume: 5,567,952.4 C.F., 206,220.46 C.Y.

530.00 to 540.00
olume : 1.4 C.F., 0.05 C.Y.
Fill volume: 651,624.1 C.F., 24,134.23 C.Y.
Running total:
Cut volume : 48.5 C.F., 1.80 C.Y.
Fill volume: 6,219,576.5 C.F., 230,354.69 C.Y.

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VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY
PHASE 7 EMB VOL

SCALE: 1

CALCS. BY: JLH 10-22-07

CHECKED BY: MDB

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
492	1689957.00	1.69E+06				0.00E+00	0.00E+00
			1.91E+06	8	1.53E+07		
500	2130161.00	2.13E+06				1.53E+07	5.66E+05
			1.93E+06	10	1.93E+07		
510	1739771.00	1.74E+06				3.46E+07	1.28E+06
			1.54E+06	10	1.54E+07		
520	1349290.00	1.35E+06				5.01E+07	1.85E+06
			1.15E+06	10	1.15E+07		
530	958717.00	9.59E+05				6.16E+07	2.28E+06
			8.02E+05	8	6.42E+06		
538	646196.00	6.46E+05				6.80E+07	2.52E+06

R12374

TAGE 7C EMBANKMENT VOLUME

me Report 2/21/2008 11:38

ing Grid: //Aci-acad/caddrawings/05330/7B-7C MERGED.grd
and Grid: //Aci-acad/caddrawings/05330/7B-7C PROPOSED EMB.grd
rid corner locations: 357504.45,426355.33 to 360456.45,427963.33
rid resolution X: 492, Y: 268 Grid cell size X: 6.00, Y: 6.00
rea in Cut : 27.4 S.F., 0.00 Acres
rea in Fill: 942,917.1 S.F., 21.65 Acres
otal inclusion area: 942,944.5 S.F., 21.65 Acres
ut to Fill ratio: 0.00
verage Cut Depth: 0.07 Average Fill Depth: 25.05
ax Cut Depth: 0.44 Max Fill Depth: 38.00
ut (C.Y.) / Area (acres): 0.00
ill (C.Y.) / Area (acres): 40417.06
ut volume: 1.9 C.F., 0.07 C.Y.
ill volume: 23,622,547.1 C.F., 874,909.15 C.Y.

olumes by elevation zone 2/21/2008 11:39

500.00 to 510.00
ut olume : 1.3 C.F., 0.05 C.Y.
ill volume: 6,851,079.0 C.F., 253,743.67 C.Y.
unning total:
ut volume : 1.3 C.F., 0.05 C.Y.
ill volume: 6,851,079.0 C.F., 253,743.67 C.Y.

one 510.00 to 520.00
ut volume : 0.0 C.F., 0.00 C.Y.
ill volume: 6,292,799.0 C.F., 233,066.63 C.Y.
unning total:
ut volume : 1.3 C.F., 0.05 C.Y.
ill volume: 13,143,878.0 C.F., 486,810.30 C.Y.

ne 520.00 to 530.00
t volume : 0.0 C.F., 0.00 C.Y.
ll volume: 5,899,045.6 C.F., 218,483.17 C.Y.
nning total:
t volume : 1.3 C.F., 0.05 C.Y.
ll volume: 19,042,923.7 C.F., 705,293.47 C.Y.

530.00 to 538.00
olume : 0.0 C.F., 0.00 C.Y.
l volume: 4,578,137.9 C.F., 169,560.66 C.Y.
total:
lume : 1.3 C.F., 0.05 C.Y.
ll volume: 23,621,061.6 C.F., 874,854.13 C.Y.

PH
EMBANKMENT VOLUMES
CUBIC YARDS

ELVATION		PHASE 7	PHASE 7B	PHASE 7C	CAPPING FOR PHASE 3	CUMMULATIVE COARSE
492		0		0	0	0
500		566,000	21,300	0	272,000	315,300
510		1,280,000	48,100	253,744	272,000	1,309,844
520		1,850,000	76,073	486,810	272,000	2,140,883
530		2,280,000	105,220	705,293	272,000	2,818,513
538		2,520,000	129,355	874,853	272,000	3,252,208

R12377

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

VOLUME COMPUTATIONS

PROJECT NO : B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY
PHASE 7 IMP VOL

SCALE: 1

CALCS. BY: JLH 10-22-07

CHECKED BY: MDB

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
448	59575.00	5.96E+04				0.00E+00	0.00E+00
			1.78E+05	2	3.56E+05		
450	295995.00	2.96E+05				3.56E+05	1.32E+04
			4.18E+05	2	8.36E+05		
452	540498.00	5.40E+05				1.19E+06	4.42E+04
			6.73E+05	2	1.35E+06		
454	805935.00	8.06E+05				2.54E+06	9.40E+04
			9.18E+05	2	1.84E+06		
456	1030203.00	1.03E+06				4.37E+06	1.62E+05
			1.05E+06	2	2.09E+06		
458	1062845.00	1.06E+06				6.47E+06	2.40E+05
			1.08E+06	2	2.15E+06		
460	1087807.00	1.09E+06				8.62E+06	3.19E+05
			1.15E+06	10	1.15E+07		
470	1216944.00	1.22E+06				2.01E+07	7.46E+05
			1.29E+06	10	1.29E+07		
480	1353294.00	1.35E+06				3.30E+07	1.22E+06
			1.43E+06	10	1.43E+07		
490	1496858.00	1.50E+06				4.72E+07	1.75E+06
			1.57E+06	10	1.57E+07		
500	1647636.00	1.65E+06				6.30E+07	2.33E+06
			1.73E+06	10	1.73E+07		
510	1805627.00	1.81E+06				8.02E+07	2.97E+06
			1.89E+06	10	1.89E+07		
520	1970832.00	1.97E+06				9.91E+07	3.67E+06
			2.06E+06	10	2.06E+07		
530	2143251.00	2.14E+06				1.20E+08	4.43E+06
			2.21E+06	8	1.77E+07		
538	2286379.00	2.29E+06				1.37E+08	5.09E+06

PH 7 IMPOUNDMENT VOLMES CUBIC YARD
Corrected for Phase 7B embankment construction

ELEVATION		ORIGINAL PHASE 7		PHASE 7B		PHASE 7 WITH 7B TAKEN OUT
448		0		0		0
450		13,200		0		13,200
452		44,200		0		44,200
454		94,000		0		94,000
456		162,000		0		162,000
458		240,000		0		240,000
460		319,000		12,890		306,110
470		746,000		40,321		705,679
480		1,220,000		68,320		1,151,680
490		1,750,000		95,691		1,654,309
500		2,330,000		122,300		2,207,700
510		2,970,000		149,100		2,820,900
520		3,670,000		177,073		3,492,927
530		4,430,000		206,220		4,223,780
538		5,090,000		230,355		4,859,645

R12379

Alliance Consulting, Inc.
Engineers Constructors Scientists
BECKLEY, WV (304) 255-0491
SUMMERSVILLE, WV (304) 883-2360
CANONSBURG, PA (724) 745-3630

BY: TLC DATE: 3/10/10 CHKD BY: JW DATE: 3/11/10

PROJECT NAME: MACH MINING LLC

PROJECT NO. B15-330-1413 SHEET 29 OF

DESCRIPTION PUMPING CALCULATIONS - PHASE 7, STAGES 1-6

PURPOSE: TO DETERMINE PUMPING CAPACITY AND PUMPING ACTIVATION LEVEL FOR PHASE 7 STAGES I - III

EMBANKMENT CREST IS 500 FT FOR PHASE 7, STAGE I
TO PUMP 100% OF ONE FULL DESIGN STORM WITHIN 30 DAYS
DRAINAGE AREA AT CREST ELEVATION 500 FT = = 86.8 ACRES
PMF RAINFALL = 41 INCHES
(1)(41 IN)(1 FT/12 IN)(86.8 ACRES)(43,560 SF/ACRE) = 12,918,444 CF
12,918,444 CF (7.48 GAL/CF) = 96,629,961 GAL
(30 DAYS)(24 HR)(60 MIN) = 43,200 MIN
96,629,961 GAL / 43,200 MIN = 2,237 GPM
A PUMP SYSTEM WITH THE CAPACITY TO TRANSFER A MINIMUM OF 2,237 GPM SHALL BE USED

FOR PUMP ACTIVATION LEVEL:
500 FT - 3 FT = 497 FT
VOLUME AT 497 FT IS 2,042 MCY
FOR (1) FULL STORM 12,918,444 CF ÷ 27 CY/CF = 478,461 CY
2,042 MCY - 478 MCY = 1,564 MCY
BY INTERPOLATION:

ELEVATION	VOLUME	
480	1,152	$\frac{Y-480}{490-480} = \frac{1,564-1,152}{1,654-1,152}$
X	1,564	$\frac{X-480}{10} = \frac{0.412}{0.502}$
490	1,654	$4.12 = 0.502X = 240.96$
		$Y = 488.2$ FT

PUMP ACTIVATION LEVEL FOR PHASE 7, STAGE 1 IS 488.2 FT.

PHASE 7, STAGE 2
EMBANKMENT CREST IS 504 FT
TO PUMP 100% OF ONE FULL DESIGN STORM WITHIN 30 DAYS
DRAINAGE AREA AT CREST ELEVATION 504 FT = = 89.7 ACRES
PMF RAINFALL = 41 INCHES
(1)(41 IN)(1 FT/12 IN)(89.7 ACRES)(43,560 SF/ACRE) = 12,605,901 CF
12,605,901 CF (7.48 GAL/CF) = 94,292,139 GAL
(30 DAYS)(24 HR)(60 MIN) = 43,200 MIN
94,292,139 GAL / 43,200 MIN = 2,183 GPM
A PUMP SYSTEM WITH THE CAPACITY TO TRANSFER A MINIMUM OF 2,183 GPM SHALL BE USED

FOR PUMP ACTIVATION LEVEL:
504 FT - 3 FT = 501 FT
VOLUME AT 501 FT IS 2,227 MCY

Alliance Consulting, Inc.
Engineers, Constructors, Scientists
BECKLEY, WV (304) 255-0491
SUMMERSVILLE, WV (304) 883-2360
CANONSBURG, PA (724) 745-3630

BY: T.E DATE: 3/10/10 CHKD BY: FW DATE: 3/11/10

PROJECT NAME: MACH MINING LLC

PROJECT NO. B05-330-1413 SHEET 30 OF

DESCRIPTION PUMPING CALCULATIONS - PHASE 7 - STAGES 1-6

FOR (1) FULL STORM 12,605,901CF ÷ 27CF/CF = 466,885 CY
2.27MCY - 0.467MCY = 1.803MCY
BY INTERPOLATION:

ELEVATION	VOLUME	
490	1.654	$\frac{X-490}{500-490} = \frac{1.803-1.654}{2.207-1.654}$
X	1.803	$\frac{X-490}{10} = \frac{0.148}{0.553}$
500	2.207	$0.553X - 270.97 = 1.48$

PUMP ACTIVATION LEVEL = 492.7FT $X = 492.68FT$
PHASE 7, STAGE 3
EMBANKMENT CREST IS 509FT
TO PUMP 100% OF ONE FULL DESIGN STORM WITHIN 30 DAYS
DRAINAGE AREA AT CREST ELEVATION 509FT = ± 81.9 ACRES
PMF RAINFALL = 41 INCHES
(1)(41 IN)(1FT/12IN)(81.9ACRES)(43,560SF/ACRE) = 12,189,177CF
12,189,177CF (7.48GAL/CF) = 91,175,044 GAL
(30 DAYS)(24HR)(60MIN) = 43,200 MIN
91,175,044 GAL / 43,200 MIN = 2,110 GPM
A PUMP SYSTEM WITH THE CAPACITY TO TRANSFER A MINIMUM OF 2,110 GPM SHOULD BE USED

FOR PUMP ACTIVATION LEVEL:
509FT - 3FT = 506FT
VOLUME AT 506FT IS 2.576MCY
FOR (1) FULL STORM 12,189,177CF ÷ 27CF/CY = 451,451 CY
2.576MCY - 0.451MCY = 2.125MCY
BY INTERPOLATION:

ELEVATION	VOLUME	
490	1.654	$\frac{X-490}{500-490} = \frac{2.125-1.654}{2.207-1.654}$
X	2.125	$\frac{X-490}{10} = \frac{0.471}{0.553}$
500	2.207	$4.71 = 0.553X - 270.97$

$X = 498.52$
PUMP ACTIVATION LEVEL IS 498.5FT

PHASE 7, STAGE 4
EMBANKMENT CREST IS 517FT
TO PUMP 100% OF ONE FULL DESIGN STORM WITHIN 30 DAYS
DRAINAGE AREA AT CREST ELEVATION 517FT = 277.3 ACRES
PMF RAINFALL = 41 INCHES
(1)(41 IN)(1FT/12IN)(277.3ACRES)(43,560SF/ACRE) = 11,578,974CF
11,578,974CF (7.48GAL/CF) = 86,610,726 GAL
(30DAYS)(24HRS)(60MIN) = 43,200 MIN
86,610,726 GAL / 43,200 MIN = 2005 GAL/MIN

Alliance Consulting, Inc.
Engineers
Constructors
Scientists
BECKLEY, WV (304) 255-0491
SUMMERSVILLE, WV (304) 883-2360
CANONSBURG, PA (724) 745-3630

BY: TLG DATE: 3/10/10 CHKD BY: JW DATE: 3/11/10

PROJECT NAME: MACH MINING LLC

PROJECT NO. 605-330-1413 SHEET 51 OF

DESCRIPTION PUMPING CALCULATIONS - PHASE 7 - STAGES 1-6

A PUMP SYSTEM WITH A CAPACITY TO TRANSFER A MINIMUM OF 2,005 GAL/MIN

FOR PUMP ACTIVATION LEVEL:

517 FT - 3 FT = 514 FT

VOLUME AT 514 FT IS 3.089 MCY

FOR (1) FULL STORM 11,578,774 CF = 27 CY/CF = 428,851 CY

3.089 MCY - 0.429 MCY = 2.660 MCY

BY INTERPOLATION:

ELEVATION	VOLUME
500	2.207
X	2.660
510	2.820

$\frac{V-500}{370-500} = \frac{2660-2207}{2820-2207}$

$\frac{X-500}{10} = \frac{0.453}{0.613}$

$4.53 = 0.613X - 306.5$

$X = 507.39$

POMP ACTIVATION LEVEL FOR PHASE 7, STAGE 4 IS 507.4 FT

PHASE 7, STAGE 5

EMBANKMENT CREST IS 531 FT

TO PUMP 100% OF ONE FULL DESIGN STORM WITHIN 30 DAYS

DRAINAGE AREA AT CREST ELEVATION 531 FT = ± 70.7 ACRES

PMF RAINFALL = 41 INCHES

(1)(41 IN)(1 FT/12 IN)(70.7 ACRES)(43,560 SF/ACRE) = 10,522,881 CF

10,522,281 CF (7.48 GAL/CF) = 78,706,662 GAL

(30 DAYS)(24 HR)(60 MIN) = 43,200 MIN

78,706,662 GAL/43,200 MIN = 1822 GAL/MIN

A PUMP SYSTEM WITH THE CAPACITY TO TRANSFER A MINIMUM OF 1822 GAL/MIN SHALL BE USED.

FOR PUMP ACTIVATION LEVEL

531 FT - 3 FT = 528 FT

VOLUME AT 528 FT IS 4.078 MCY

FOR (1) FULL STORM 10,522,281 CF = 27 CY/CF = 389,714 CY

4.078 MCY - 0.390 MCY = 3.688 MCY

BY INTERPOLATION:

ELEVATION	VOLUME
520	3.493
X	3.688
530	4.224

$\frac{X-520}{530-520} = \frac{3688-3493}{4224-3493}$

$\frac{X-520}{10} = \frac{0.195}{0.731}$

$1.95 = 0.731X - 380.12$

$X = 522.67$ FT

POMP ACTIVATION LEVEL FOR PHASE 7 STAGES IS 522.7 FT

R12383

Alliance Consulting, Inc.
Engineers Constructors Scientists
BECKLEY, WV (304) 255-0491
SUMMERSVILLE, WV (304) 883-2360
CANONSBURG, PA (724) 745-3630

BY: TLB DATE: 3/10/12 CHKD BY: JMW DATE: 3/14/12

PROJECT NAME: Black Mining LLC

PROJECT NO. BOS-330-1413 SHEET 32 OF

DESCRIPTION Pumping Calculations - Phase 7 - Stages 1-6

PHASE 7, STAGE 6
EMBANKMENT CREST IS 538 FT
TO PUMP 100% OF ONE FULL DESIGN STORM WITHIN 30 DAYS
DRAINAGE AREA AT CREST ELEVATION 538 FT = 67.3 ACRES
PMF RAINFALL = 41 INCHES

(1)(41 IN)(1 FT/12 IN)(67.3 ACRES)(43,560 SF/ACRE) = 10,016,259 CF
10,016,259 CF (7.48 GAL/CF) = 74,921,617 GAL
(30 DAYS)(24 HR/DAY)(60 MIN/HR) = 43,200 MIN
74,921,617 GAL / 43,200 MIN = 1,734 GPM
A PUMP SYSTEM WITH THE CAPACITY TO TRANSFER A MINIMUM
OF 1,743 GPM

FOR PUMP ACTUATION LEVEL
538 FT - 3 FT = 535 FT
VOLUME AT 535 FT

ELEVATION	VOLUME
530	4,224
535	X
538	4,860

$\frac{535-530}{538-530} = \frac{X-4,224}{4,860-4,224}$

$\frac{5}{8} = \frac{X-4,224}{0.636}$

$318 = 8X - 33,792$

$X = 4,622 \text{ MCY}$

FOR (1) FULL STORM = 10,016,259 CF = 27 CYICF = 370,972 CY
4,622 - 0,371 MCY = 4,251 MCY

ELEVATION	VOLUME
530	4,224
X	4,251
538	4,860

$\frac{X-530}{8} = \frac{4,251-4,224}{4,860-4,224}$

$\frac{X-530}{8} = \frac{0.027}{0.636}$

$0.216 = 0.636X - 337.08$

$X = 530.34 \text{ FT}$

PUMP ACTUATION LEVEL FOR PHASE 7, STAGE 6 IS 530.5 FT

AT COMPLETION OF PHASE 7 STAGE 6, A DECANT SIZED TO EVACUATE 90% OF THE DESIGN STORM RUNOFF IN 10 DAYS SHALL BE INSTALLED AT INLET EL 530. THEREBY ELIMINATING EMERGENCY PUMPING REQUIREMENTS.

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

March 22, 2010

Project No. B05-330-1413

Mr. Robert L. Phillips
District Manager
MINE SAFETY AND HEALTH ADMINISTRATION
2300 Willow Street, Suite 00
Vincennes, IN 47591-5416

Response to MSHA Comments
Phase 7
Coal Refuse Disposal Facility No. 2
Mach Mining LLC
Impoundment ID No. 1211-IL08-03141-02

Dear Mr. Phillips:

On behalf of our client, Mach Mining LLC, this letter and attached documents have been prepared in response to the Mine Safety and Health Administration (MSHA) Pittsburgh Safety and Health Technology Center's November 12, 2009 memorandum (copy attached) pertaining to the review of our previous submittal[1]. The memorandum generally recommended approval for Phases 3 through 6 of the subject facility, but requested additional information concerning Phase 7. Specifically, the memorandum questioned the static and seismic slope stability of Phase 7A and stated that design revisions would be required before approval could be recommended. The memorandum stated that the safety of the facility was contingent on the adherence to the specific mining schedule shown on Drawing No. B05-330-M36 (Figure No. 17).

In response to the comment, the embankment staging was re-evaluated and revised using coarse to fine refuse ratios developed previously from plant production data and aerial mapping, revised mine timing and percent clean coal recovery data, and considering that beginning in approximately May 2010, one-third of the fine coal refuse production will be diverted to a plate press and then combined with the coarse refuse for final disposal. It is anticipated that adding one-third of the fine coal refuse production to the coarse refuse will result in a combined refuse material that can be placed and compacted in accordance with the approved specifications. Once the plate press is operational, samples of the combined refuse shall be obtained for laboratory testing including Standard Proctor, grain size analysis, and shear strength to verify the material parameters are consistent with the design. Figure No. 17, the mining/impoundment timing map, has been revised accordingly and is attached.

---

[1] Alliance Consulting, Inc. 3 volume submittal entitled "Additional Information, Coal Refuse Disposal Facility No. 2, Phases 3 through 7, Impoundment I.D. No. 1211-IL08-0341-02, MSHA I.D. 11-03141, Williamson County, Illinois", prepared for Mach Mining, LLC, dated July 2009.

As indicated in the attached revised staging calculations and revised Figure Nos. 6, 7, 9 and 17, the embankment staging (construction sequence) has been modified, but the final configuration remains unchanged. Briefly, during Phase 6 construction, but prior to initiating fines disposal in the Phase 6 impoundment, the construction of former Phase 7B below Elevation 492 shall be started, and the work surface shall be maintained above the settled fine coal refuse level. Attached Figure No. 6 has been modified accordingly. As shown on revised Figure Nos. 7 and 9, the remainder of former Phase 7B and all of former Phases 7A and 7C shall be constructed as a single phase in six steps (stages). By constructing the embankment in this fashion, the "cap" over the Phase 3 impoundment is raised simultaneously with the embankment crest; therefore, unbalanced loading does not occur. The end of construction (short-term) stability analyses for the Phase 7 embankment has been revised to better model the assumption that the fine coal refuse will have total strength parameters and to estimate the maximum allowable phreatic level. The PCSTABL5M output for these analyses is attached (Appendix B, Pages 231.a through 231.p) and replace their equivalents in our July 2009 submittal. Also enclosed is Drawing No. B05-330-E48, "Slope Stability Analysis, Section F-F (Phase 7)", which has been changed to show the revised allowable short-term piezometer readings and the critical failure circle. Applicable sections of the report narrative have also been revised and attached for inclusion in the previously submitted documents[1].

In addition to the above, Figure Nos. 5 and 14 have been revised to show the as-built locations of Piezometer Nos. P-9, P-10, and P-11. The as-drilled locations were only slightly different than the design locations but the measured water level at Piezometer No. P-9 has been slightly higher than anticipated; therefore, the previously submitted stability analysis was revised. The revised Phase 5 slope stability analysis is attached (revised pages 206 through 211 of Appendix B) and the warning levels on Figure No. 14 have been revised. Also, Page 14 of the report narrative has been revised with the new Phase 5 downstream slope stability factors of safety.

In summary, the following revised/new documents are attached as part of this response to comments. The revised documents should be used to replace same documents in our July 2009 submittal.

- Copy of November 12, 2009 MSHA review memorandum;
- Revised Report Pages 1, 12, and 14;
- Revised Guideline Technical Specifications Page A-4;
- Revised Calculation Brief Pages 120, 206 through 211, and 231.a through 231.p;
- New Phases 4 through 7 staging/timing calculations (Pages 1.a of 32 through 32 of 32, intended to supersede but not directly replace calculations from the original submittal)
- Revised Drawing Nos.:
  - B05-330-M32, Revision 4 - (Figure No. 5);
  - B05-330-M34, Revision 4 - (Figure No. 6);
  - B05-330-M33, Revision 4 - (Figure No. 7);

B05-330-E22, Revision 4 - (Figure No. 9);
B05-330-E12, Revision 3 - (Figure No. 14);
B05-330-E48, Revision 1 - (Figure No. 16); and
B05-330-M36, Revision 4 - (Figure No. 17).

Additionally, we assume that longwall mining beneath the Phase 2 cell is approved as shown in the currently approved plan[1] although this was not specifically mentioned in your November 12, 2009 memorandum. For clarification purposes with other reviewing agencies, we would appreciate this language being added in your next memorandum.

We trust this letter and attached documents are sufficient for your review and approval. If you have any questions, or require additional information, please contact us.

Respectively submitted,

ALLIANCE CONSULTING, INC.

Frederick R. Vass, P.E.
Senior Project Manager

Claudio E. Yon, P.E.
Principal Engineer

FRV:CEY/frv
Enclosures

file: 05330-78

[1]Alliance Consulting, Inc. 3 volume submittal entitled "Additional Information, Coal Refuse Disposal Facility No. 2, Phases 3 through 7, Impoundment I.D. No. 1211-IL08-0341-02, MSHA I.D. 11-03141, Williamson County, Illinois", prepared for Mach Mining, LLC, dated July 2009.

U.S. Department of Labor

Mine Safety and Health Administration
Pittsburgh Safety & Health Technology Center
P.O. Box 18233
Pittsburgh, PA 15236

November 12, 2009

MEMORANDUM FOR JOSEPH O'DONNELL
Acting District Manager, District 8
Coal Mine Safety and Health

THROUGH: JOHN W. FREDLAND
Acting Chief, Pittsburgh Safety and Health Technology Center

FROM: STANLEY J. MICHALEK
Chief, Mine Waste and Geotechnical Engineering Division

SUBJECT: Recommendation for Approval of Design Plans for Phases 3 through 6, and Request for Additional Information for Phase 7, Refuse Disposal Facility No. 2, Impoundment I.D. No. 1211-IL08-03141-02, Mach Mining, LLC, Mach Mine No. 1, Mine I.D. No. 11-03141, Williamson County, Illinois

As requested by your office, a technical review of the subject proposed impoundment plans has been completed. Our review included an initial submittal and two revisions submitted in response to our requests for additional information. Report No. MW09-077, which is attached, indicates that the subject plans appear to be technically acceptable only through Phase 6 and approval through Phase 6 is recommended. Additional information will be required before we can recommend approval of Phase 7.

The proposed mining under Phase 3 will be the most significant event at this facility. Phase 3 must be closed and covered with a stable cap of coarse refuse, be incapable of impounding water or slurry, and all the proposed instrumentation must be in place and operational before the proposed longwall mining is advanced within 100 feet of any part of the Phase 3 embankment.

The Impoundment and IRPI data sheets have been completed for Phases 3 through 6 and are included with the report. Please contact this office if there are any questions regarding this review.

Attachment

cc: L. Zeiler – Acting Director, TS
M. Smith – Acting Chief, Safety Div., CMS&H

UNITED STATES DEPARTMENT OF LABOR

MINE SAFETY AND HEALTH ADMINISTRATION

PITTSBURGH SAFETY AND HEALTH TECHNOLOGY CENTER
MINE WASTE AND GEOTECHNICAL ENGINEERING DIVISION
COCHRANS MILL ROAD
P.O. BOX 18233
PITTSBURGH, PENNSYLVANIA 15236

REPORT NO. MW09-077

REVIEW OF DESIGN PLANS FOR PHASES 3 THROUGH 7 REFUSE DISPOSAL AREA NO. 2 MSHA I.D. NO. 1211-IL08-03141-02 MACH MINING LLC MINE I.D. NO. 11-03141 WILLIAMSON COUNTY, ILLINOIS

NOVEMBER 12, 2009

BY

PAUL J. DONAHUE, P.E.
CIVIL ENGINEER

REPORT NUMBER MW09-077

OWNERSHIP AND LOCATION

The Refuse Disposal Area No. 2 is owned and operated by Mach Mining, LLC and receives coarse and fine coal refuse from the preparation plant for the Mach No. 1 Mine. The site can be found on the USGS 7.5 Minute Pittsburg (IL) quadrangle map at geographic coordinates N 37°50'30" latitude and W 88°49'17" longitude. This facility is located on a tract comprising the east half of Section 12, Township 8S, and Range 3E, Third Principal Meridian.

MATERIAL REVIEWED

Original Design Submittal

The original submitted design documents were prepared for Mach Mining, LLC by Alliance Consulting, Incorporated (Alliance) and included the following.

1. A report entitled "Engineering Design Plan – Proposed Coal Refuse Disposal, Facility No. 2, Williamson County, Illinois, dated January 2007." The report included a narrative description of the proposed design, and the testing and analyses performed. Appendices to the report included construction specifications, calculations, geotechnical test boring and laboratory test data.

2. Thirteen drawings depicting plans, profiles and details of the proposed facility dated January 16, 2007.

During our review of this plan, Mr. Duffy Stradner, former District 8 Impoundment Specialist, notified this reviewer in a phone conversation on October 23, 2007, that the impoundment layout and geometry would be substantially revised and a new plan submitted. Due to proposed mining under the impoundments and other issues that would similarly affect the new design, we completed the review and requested additional information in a memorandum to Robert Phillips, District Manager, Coal Mine Safety and Health (CMS&H) District 8, dated December 13, 2007. The memorandum identified 14 design issues to be addressed in the revised design submittal.

First Revised Design Submittal

The revised design package for the coal refuse impoundments was hand delivered to our office on August 19, 2008, in conjunction with a meeting with Mach Mining and Alliance Consulting personnel to discuss the new design.

The design documents received at this meeting included the following items.

1. A report entitled "Response to February 11, 2008, Comments, I.D. No. IL08-03141-02, Mach Mining, LLC – Mach No. 1 Mine ID No. 11-03141, Williamson County, Illinois – Coal Refuse Disposal Facility No. 2 Phases 3 through 7," dated August 2008. Appendices to

the report contained construction specifications, various design calculations, geotechnical test boring logs, laboratory test data and a CISPM Mine Subsidence Analysis Report prepared by Dr. Syd Peng of West Virginia University.

2. Nineteen drawings, with revision dates from February 14, 2008, to July 7, 2008, depicting plans, profiles and details of the proposed facility.

In addition, the following additional materials were submitted concurrent with the review of this submittal.

1. A set of three drawings depicting longwall panel surface subsidence measurements at Baselines "A" through "D" located over the eastern end of longwall Panel No. 1 of the subject mine. These drawings are dated August 29, 2008, and were received by the Mine Waste and Geotechnical Engineering Division (MWGED) on September 3, 2008,

2. Two Drawings entitled "Map 6 UG - Operations Plan Map" and "Map 10 – Geologic columns," prepared by Alliance and dated December 3, 2004, and November 29, 2004, respectively, and received by MWGED on September 3, 2008.

In addition to the submitted document, we also gathered additional information, concurrent with the review, through phone and e-mail communication with Mr. Claudio Yon of Alliance and Dan Barkley of the Illinois DNR.

We completed our review of the new design and found eleven items requiring additional substantiating data or calculations and/or design changes. These were outlined in our memorandum to Robert Phillips, District Manager, CMS&H District 8, dated November 10, 2008.

Second Revised Design Submittal

The second revised design submittal was received by MWGED on July 20, 2009, and included the following.

1. A report volume entitled "Additional information- Volume 1 of 3, Comments 2, 4, 5, 6, 9, 10 and 11, Coal Refuse Disposal Facility No. 2 Phases 3 through 7," Impoundment ID No. IL08-03141-02 (MSHA ID No. 11-03141), Williamson County, Illinois," dated July 2009. This volume included new, revised and copies of previously submitted materials from the earlier August 2008 submittal and was prepared by Alliance.

2. A second report volume entitled "Additional information- Volume 2 of 3, Comments 1, 3, 7 and 8, Coal Refuse Disposal Facility No. 2 Phases 3 through 7," Impoundment ID No. IL08-03141-02 (MSHA ID No. 11-03141), Williamson County, Illinois," dated July 2009. This volume contained new calculations and analysis performed by GAI consultants for Alliance.
3. A third volume containing 22 drawings, with revision dates from July 8, 2009, to July 13, 2009, depicting plans, profiles, and details of the proposed facility.

4. An addendum to the submittal, received on August 21, 2009. This addendum included corrected transmittal letters and tables of contents, a revised drawing B05-330-M32 – Phase 5 Plan View, revised August 18, 2009, and revised Phase 5 dam underdrain calculations.

Additionally, prior to the receipt of this submittal, we received electronically transmitted drawings depicting a longitudinal dynamic subsidence survey over the advancing face of Longwall Panel No. 1 at a location immediately to the east of the future Phase 5. These drawings were received in our office on February 10, 2009. This survey was performed in response to comment No. 4 in the November 10, 2008, memorandum.

The results of our review of this revised design are discussed in this report.

BACKGROUND

The revised Refuse Disposal Facility No. 2 will provide for the disposal of about 3 ½ years of coarse coal refuse (CCR) and 6 years of fine coal refuse (FCR) that will be produced from the Pond Creek No. 1 Mine following closure of previously approved Facility No. 1 which included Phases 1 and 2. This facility is to be constructed in five phases – Phase 3 through Phase 7.

As planned, the facility will consist of three, approximately rectangular, diked impoundments aligned in a north-south direction and sharing common embankments between them. The southernmost impoundment will be constructed during Phase 3, with fine refuse placement starting upon completion of the embankment to the design crest height. The central impoundment will be constructed in three Phases (Phases 4, 6 and 7) with fine refuse placement starting during Phase 7, when the embankment will be about 50 percent of the total completed height. The northernmost impoundment will be constructed during Phase 5 and will be partly incised by excavating the footprint of the impoundment. Fine refuse placement in this impoundment will begin once Phase 3 is filled to capacity, and the Phase 5 embankment is about 80 percent complete.

The impoundments will cover about 200 acres, and all the impounding embankments will be raised longitudinally in segments using belt-delivered coarse coal refuse. The upstream and downstream slopes will be 3 horizontal to 1 vertical (3H:1V) except for Phase 3 which will have 2.6H:1V upstream slopes. Maximum embankment heights will range from 49 feet for Phase 3 to 100 feet for Phase 7. All embankments, with the exception of a portion of the Phase 7 central impoundment, will be founded on 15 to 22 feet of medium to stiff clay deposits overlying shale bedrock. The south-facing slope of the Phase 7 embankment will be founded on the impounded fine refuse of the adjoining Phase 3.

The designer considered the impoundments to be of high hazard potential classification for the purposes of hydrologic/hydraulic design. Following one year from the start of construction, all phases will be able to accommodate a rainfall volume of two PMF's with pumping capacity capable of drawing down one 72-hour PMF in 30 days. When the final crest elevation is reached, an 18-inch-diameter HDPE SDR 26 decant spillway will be installed and be capable of

drawing down 90 percent of one PMF in less than 10 days. The only exception is the Phase 3 impoundment. Because of an expected life of less than 1 year, this phase was designed to handle at least one half of a 72-hour PMF, but less than a full 72-hour PMF.

The most significant consideration for these impoundments will be the concurrent mining of three longwall panels in the 6.5-foot-thick Herrin No. 6 coal seam beneath the impoundment footprints. There are 430 to 450 feet of overburden, with at least 420 feet of this being rock, between the embankment foundations or impoundment bottoms and the Herrin No. 6 seam. Boring data indicates that about 75 to 90 percent of the overburden rock is shale. A sandstone unit, 200 to 240 feet above the No. 6 seam and ranging from 21 to 54 feet thick, is the only persistent competent unit encountered in the borings.

The development entries for the longwall mining have a calculated minimum pillar safety factor of 2.3 as calculated by the program ALPS. A minimum rock overburden thickness of about 65 times the mine height is present above the seam. Therefore, this facility complies with the guidance contained in Bureau of Mines publication IC 8741 for limiting breakthrough risk. However, subsidence from the longwall mining will considerably impact surface structures over the mine.

The subsidence effects on the proposed coal refuse impoundments will be largely mitigated by the proposed phasing of the impoundments. Except for Phases 3 and 4, all refuse placement will take place after mining has been completed beneath the impoundment and subsidence is substantially complete. For Phase 3, FCR placement will be completed to an elevation of 5 feet below the crest, about 9 months prior to longwall mining beneath the impoundment. A 5-foot-thick cover of coarse refuse, level with the crest, will be placed over the fine refuse in order to eliminate any impounded water before the mining advances beneath the impoundment. Phase 4 will consist of a 45-foot-high non-impounding embankment placed prior to mining. After the mining, the 300-foot-wide Phase 6 embankment will buttress the downstream slope of the Phase 4 embankment. The width of this embankment is expected to mitigate any possible effects of subsidence-related damage to the Phase 4 embankment.

The planned mining beneath the Phase 3 impoundment, a short time after filling and capping of this impoundment, is the most significant issue in evaluating the subsidence impacts. There is currently little engineering experience in accommodating longwall mining under a coal refuse impoundment and a conservative consideration of all possible potential failure modes and mitigatory measures was the primary item of concern in the review of this plan.

REVIEW DISCUSSION

The submittal received on July 20, 2009, provided responses to the eleven items of additional information that were requested in the November 10, 2008, memorandum. Additionally the submitted addendum included a revised plan for the Phase 5, which will be enlarged by locating its north dike approximately 250 feet further north.

Phase 7 Stability

The submittal did not satisfactorily address comment Nos. 7 and 8 in the November 10, 2008, memorandum. These comments noted that a stability analysis of the Phase 7 south dike, which will be founded on the settled Phase 3 FCR, had not been performed and requested this analysis be performed along with a seismic liquefaction and deformation analysis. The submitted analysis in response to these comments included only an analysis of the less-critical completed Phase 7C configuration, and not the critical Phase 7A, which will entail advancing the 38-foot-high south dike embankment over the thin cover overlying the consolidating fine refuse. An independent check calculation using the "SlopeW" stability analysis program and normalized undrained strength parameters for the FCR developed in the submittal indicated a short-term post construction safety factor for the south dike of Phase 7A of considerably less than one. Therefore, Phase 7A, as currently planned, will require design revisions before MWGED can recommend approval.

Subsidence Impacts - Phase 3 Impoundment

The largest part of the most recent submittal consisted of various analyses and new test data submitted as justification for the proposed longwall mining beneath the capped Phase 3 impoundment, as requested in items 1 through 3 of the November 10, 2008, memorandum. MWGED performed this review in conjunction with a literature review of soil behavior when subjected to tensile strains and a published case-study of longwall mining under an impoundment in West Virginia.[1]

The Phase 3 impoundment is located so the dike bounding the FCR pool to the north is centered over the Panel's 2 and 3 gateroad development entries, the east and west dikes extend southward to approximately the center of the longwall panel, and the south dike runs along the center portion of the panel. The panel width (1,400 feet) with respect to depth is such that subsidence is supercritical, so the south dike will be subjected only to transient tensile, then compressive, strains in a longitudinal direction as the mine face advances east to west. The east and west dikes will be subjected to permanent tensile strains near the northwest and northeast corners of the impoundment and the north dike will be subjected to significant strains only near the inside toe.

Assuming the impoundment is capped and no longer impounding water at the time the longwall panel is advanced, the specific potential failure mechanisms that were examined for the Phase 3 impoundment included:

(1) Choi, D. S., et al, 1997, "A Case Study of Undermining Impoundment Embankment by the Longwall Mining Method," Proc. 36th US Rock Mechanics Symposium

1. Stability failure of the CCR embankment due to deformations and weakening from subsidence-induced shear strains and cracking.

2. The potential for the development of large, persistent transverse cracks in the CCR embankment or foundation materials capable of releasing flowable FCR. The calculated horizontal strains induced by the subsidence, using revised CISPM model calculations calibrated to actual subsidence measurements at this mine, is about 30 microstrain (3 percent).

3. Weakening and/or liquefaction of the FCR due to subsidence strain-induced pore pressures in conjunction with transverse cracking, possibly resulting in flow into, and/or erosion of, cracks in the CCR.

CCR Embankment Stability Under Subsidence Condition

In order to evaluate the possibility of the first of these mechanisms, a separate analysis performed by GAI Consultants for Alliance applied data from existing triaxial test data of the coarse refuse (CU with pore pressures) to the formula developed for the double-punch shear test developed by Fang and Chen[(2)] to determine a tensile strength for the CCR. The consolidation stresses for each test point were then corrected for equivalent effective vertical stress (σ'_v) and used to develop a "normalized tensile strength" ratio (σ_t / σ'_v) of 0.15 for the CCR. Using this ratio, an average tensile strength of C=475 psf and φ=0 degrees was used in a slope stability analysis to obtain a worst-case stability safety factor for the subsidence disturbed embankment of 1.10. We do not believe the derivation of this strength is technically correct. However, the strength parameter derived appears to be very conservative for coarse coal refuse in even the loosest condition. An independent analysis showed a factor of safety of 1.3 was achieved with φ=19 degrees, which is lower than CCR in its loosest condition based on the typical angle of repose of this material. Therefore, slope failure of the CCR embankment from subsidence-induced shear is very unlikely.

CCR and Foundation Cracking Susceptibility Under Subsidence

The second failure mechanism that was evaluated was the potential for large persistent cracks through the CCR embankment which, in conjunction with the third mechanism, could result in a breach and release of flowable FCR. The submitted data showed the CCR produced at the plant is a well graded gravel material (USCS classification GW) with very little fines (2.0 to 2.5 percent passing the No. 200 sieve). The gradation of oven-dried, compacted Proctor test specimens prepared by Alliance was somewhat higher, with an average of 30 percent passing the No. 200 sieve and was classified under the USCS system as "SC," a clayey sand. However, the lab sample preparation and oven drying likely produced a material with more fines than in the constructed embankment.

(2) Fang, H.Y. and Chen, Wai-Fai, "Determination of Tensile Strength of Soil by Unconfined Penetration Test," ASTM STP-740, R.N Young Ed., 1981

The gradation of the CCR and the foundation soil was compared to published correlations of deformation cracking and piping potential. The CCR as delivered to the impoundment prior to compaction is a cohesionless material and is not subject to cracking. The laboratory compacted and oven-dried CCR material was evaluated as having a medium deformation and cracking potential. However, this material is not likely to be representative of the material in the embankment which will have less fines; therefore, the overall deformation cracking susceptibility of the CCR was evaluated to be low.

The foundation soils are moderately plastic clays (USCS classification CL with a plasticity index of 24). These materials were evaluated as having low cracking potential because such materials in a saturated condition are subject to deformation rather than cracking under the expected strains. Mr. Harold Owens reported, in a phone conversation on June 4, 2009, that aside from a 1-inch-wide crack in desiccated materials, no obvious cracking was observed in the clayey native soils over the previously advanced Longwall Panel No. 1 in the future Phase 5 area. Considerable cracking was observed in a more brittle asphalt and chip pavement that crossed the edge of the panel. Due to the possibility of localized higher than predicted tensile deformations at any surface point over longwall panel edges, the development of significant cracks in the foundation and embankments is low but cannot be excluded.

A similar evaluation was performed for the piping resistance of the foundation and CCR materials. Piping resistance was evaluated as "high" for the foundation clay and plant-run CCR materials, and medium for the laboratory compacted materials. While not addressed in the submittal, we believe that if the impoundment is capped and not impounding water, there will be insufficient seepage water to erosively propagate any piping even if persistent cracks develop in the embankment. Therefore, for a capped impoundment, cracking and subsequent internal erosion via seepage piping is an unlikely possible failure mode.

Subsidence Induced FCR Flow Through Cracks

The third potential subsidence induced failure mechanism examined was the possibility of flowage of fluid FCR through large transverse cracks in the embankment or foundation. As described above, such cracks are unlikely, but cannot be precluded. However, if the FCR is not in a sufficiently flowable state, the cracking will be inconsequential, and this mode of failure can be precluded.

The most recent submittal provided the results of laboratory testing and an analysis of the potential for triggering strength loss (liquefaction) for the FCR under cyclic stresses from either earthquakes or the advancing subsidence across the impoundment. The FCR produced at the Mach Mine preparation plant was bulk-sampled and characterized as a fine grained plastic material with 93 percent passing the No. 200 sieve and more than 99 percent passing the No. 40 sieve. The liquid limit was 36 and the plasticity index was 17 and the material was classified under the USCS classification system as "CL."

The submittal included calculations from two triaxial tests performed on remolded FCR specimens prepared from bucket samples of the slurry produced by the preparation plant. These calculations showed a post-seismic strength ratio (S_{us}/ σ'_v) of 0.24, which is only slightly less than the peak (S_u/ σ'_v) value of 0.27. If fully consolidated, these materials are not flowable under any anticipated seismic or mine subsidence conditions. However, the fine grained FCR at this facility is likely to dissipate excess pore pressure and consolidate under self-weight very slowly, so the undrained strength of the FCR at the time of mining is likely to be the most critical condition, with a very weak upper FCR layer being potentially flowable through cracks extending through the embankment. The submittal did not include specific calculations addressing this scenario; however, a CCR cap with a minimum thickness of 5 feet is specified to be placed over the impoundment prior to mining. It is expected, based on MWGED's previous observations and independent calculations, that when CCR is pushed-out over the FCR, the upper materials with undrained strength (S_u) less than at least 150 pounds per square foot will be displaced during the pushout process and therefore are unlikely to be present beneath the pushout. The FCR and/or mixed FCR and CCR material that has reached an S_u of at least 150 psf is not flowable through a cracked embankment except in conjunction with erosive water flow, which will be precluded by the CCR cover. Therefore, provided that the Phase 3 impoundment is capped as shown in the submitted design, a failure by FCR flowage through cracks in the CCR embankment is also unlikely.

CONCLUSIONS AND RECOMMENDATIONS

MWGED noted some deficiencies in the submitted responses to our request for information; however, check calculations show the results of the analyses are conservative and the construction of this facility through Phase 6 is technically satisfactory. However, the submittal did not substantiate the stability of the Phase 7A south embankment which will be constructed over Phase 3A fine refuse, and an independent analysis performed in this office found that the design as currently planned will not be stable under static or seismic conditions. Therefore, approval is recommended through Phase 6 only. Additional information and design revisions as needed to substantiate the static and seismic stability of Phase7A will be needed before approval of this stage can be recommended.

Our recommendation for approval assumes the facility is constructed strictly in accordance with the submitted plan. In particular, the Phase 3 impoundment must be capped with a stable CCR cover and incapable of impounding water before longwall mining approaches the impoundment. Also, per the submitted Specification 6.03 for enhanced monitoring, the operability of all the specified instrumentation and preparations for the contingency buttress shall be verified by the operator's engineer before the longwall mining face is within 100 feet of any part of the Phase 3 capped impoundment.

The CCR embankments at this facility will be constructed in 500- to 600-foot-long longitudinal segments in order to take advantage of belt delivery of the CCR to the placement location. In order to assure the segments are adequately compacted and keyed into the adjoining segments, a specific placement plan was developed and is included in Appendix E of Volume 1 of the

submitted plan. This placement plan, particularly the use of the specified equipment, maximum push distances, and excavation of keys into the adjoining segment should be strictly followed.

The design report narratives and test data should also be considered part of the approved plan. If dam or foundation materials or conditions are discovered that are different than those described in the submitted reports, the plan should be modified as needed to address the changed conditions and submitted to MSHA for approval. In particular, the safety of this facility is contingent on the adherence to the specific mining schedule shown in Drawing B05-330-M36 -Mining/Impoundment Construction Timing Map, revised July 10, 2009.

Approved Plan Documents

Care should be taken to assure the most recent revisions to the drawings and specifications are incorporated into the revised plan documents. The approved plan consists of all the documents listed in the section of this report titled "Second Revised Design Submittal" with the exception of drawing B05-330-M33 – Phase 7 – Plan View and any other Phase 7 details shown on other drawings.

Report Prepared by:

Paul J. Donahue, P.E.
Civil Engineer

Report Approved by:

Darren J Blank, P.E.
Supervisory Civil Engineer

U.S. Department of Labor

Mine Safety and Health Administration
2300 Willow Street
Suite 200
Vincennes, Indiana 47591-5416

August 21, 2009

Mr. Claudio E. Yon, P.E.
Principal Engineer
Alliance Consulting, Inc.
124 Philpott Lane
Raleigh County Airport Industrial Park
Beaver, WV 25813-9502

Dear Mr. Yon:

Subject: 77.216(a) - Impoundment Construction Plan
(Revised Information) (08/18/09)
Coal Refuse Disposal Facility No. 2
Impoundment I.D. No. 1211-IL08-03141-02
Mach #1 Mine (11-03141)
Mach Mining, LLC
Marion, Williamson County, Illinois

This will acknowledge receipt of the subject report, as required by the Federal Mine Safety and Health Act of 1977, Public Law 91-173, as amended by Public Law 95-164 or implementing regulations. Review by the District Manager is required, and action is being started to determine that this report provides the required information.

Sincerely,

Robert L. Phillips
District Manager
Coal Mine Safety and Health
District 8

U.S. Department of Labor

Mine Safety and Health Administration
2300 Willow Street
Suite 200
Vincennes, Indiana 47591-5416

July 27, 2009

Mr. Harold Owens
Project Manager, P.E.
Alliance Consulting, Inc.
124 Philpott Lane
Raleigh County Airport Industrial Park
Beaver, WV 25813-9502

Dear Mr. Owens:

Subject: 77.216(a) - Impoundment Construction Plan
(Additional Information) (07/15/09)
Coal Refuse Facility No. 2
Impoundment I.D. No. 1211-IL08-03141-02
Mach #1 Mine (11-03141)
Mach Mining, LLC
Marion, Williamson County, Illinois

This will acknowledge receipt of the subject report, as required by the Federal Mine Safety and Health Act of 1977, Public Law 91-173, as amended by Public Law 95-164 or implementing regulations. Review by the District Manager is required, and action is being started to determine that this report provides the required information.

Sincerely,

Robert L. Phillips
District Manager
Coal Mine Safety and Health
District 8

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

July 20, 2009

Project No. B05-330-1413

Mr. Robert L. Phillips
District Manager
Mine Safety and Health Administration
2300 Willow Street, Suite00
Vincennes, IN 47591-5416

Correction
Additional Information
Coal Refuse Disposal Facility No. 2
Phases 3 Through 7
Impoundment ID No. 1211-IL08-03141-02
Mach Mining LLC
Mach # 1 Mine
Mine ID No.11-03141

Dear Mr. Phillips:

On behalf of our client, Mach Mining LLC, please substitute the enclosed transmittal letters dated July 15, 2009 and July 16, 2009 and the revised Engineering Design Plan Report Table of Contents for the same dated letters and table of contents we sent to you on July 17, 2009. The enclosures correct the previously submitted information by showing the correct number of report volumes to be three rather than two.

Please accept our apologies in advance for any inconvenience caused by our oversight.

If you have any questions, or require additional information, please contact us.

Respectively submitted,

ALLIANCE CONSULTING, INC.

Harold L. Owens, P.E.
Senior Project Manager

Claudio E. Yon, P.E.
Principal Engineer
3 Enclosures

File: MSHA Response 01.doc, hlo, rev.7/20/09
xc: w/enclosure P. Donahue and J. Slapak

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

July 15, 2009

Project No. B05-330-1413

Mr. Robert L. Phillips
District Manager, District 8
MINE SAFETY AND HEALTH ADMINISTRATION
2300 Willow Street, Suite 200
Vincennes, IN 47591

Transmittal
Additional Information
Coal Refuse Disposal Facility No. 2
Phase 3 through 7
Impoundment ID No. 1211-IL08-03141-02
Mach Mining LLC
Mine ID No. 11-03141
Williamson County, Illinois

Dear Mr. Phillips:

On behalf of our client, Mach Mining, LLC, please find enclosed two copies of the information referencing above. This information is transmitted in response to a memo dated Nov. 10, 2008 from Paul J. Donahue P.E. MSHA, Pittsburgh Safety and Health Administration Technology Center, Mine Waste and Geotechnical Engineering Division.

The additional information is contained in three volumes. Volumes 1 of 3 was prepared by Alliance Consulting, Inc. and Dr. Syd Peng, and is a response to comments 2, 4, 5, 6, 9, 10 and 11. Volume 2 of 3 was prepared by GAI Consultants, Inc. and is a response to comments 1, 3, 7 and 8. One copy of the additional information was sent directly to Stanley J. Michalek at the MSHA Pittsburgh Technical Support, Mine Waste and Geotechnical Engineering Division.

If you have any questions, or require additional information, please contact us.

Sincerely,

ALLIANCE CONSULTING, INC.

Harold Owens
Project Manager, P.E.

Claudio E. Yon, P.E.
Senior Project Manager

HO/CEY:knm
Enclosures

File: 05330-61

xc: w/enclosure Paul J, Donahue and Jim Slapak

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

July 16, 2009

Project No. B05-330-1413

Mr. Robert L. Phillips
District Manager
Mine Safety and Health Administration
2300 Willow Street, Suite00
Vincennes, IN 47591-5416

Transmittal
Volume 1 of 3,
Additional Information Comments 2, 4, 5, 6, 9 10 and 11;
Volume 2 of 3,
Additional Information Comments 1, 3, 7 and 8
And
Volume 3 of 3,
Additional Information -Drawings
Coal Refuse Disposal Facility No. 2
Phases 3 Through 7
Impoundment ID No. 1211-IL08-03141-02
Mach Mining LLC
Mach # 1 Mine
Mine ID No.11-03141

Dear Mr. Phillips:

On behalf of our client, Mach Mining LLC, this letter and the subject report have been prepared in response to MSHA's Pittsburgh Safety and Health Technology Center's November 10, 2008 memorandum. The memorandum requested additional information concerning the plan for Phases 3 through 7 of Coal Refuse Disposal Facility No. 2. The impoundment plan has been modified to include the following information requested in the memorandum:

Comments – Design Analysis

1. Characterization of Fine Refuse

   Fine coal refuse samples were collected from the Phase 2 impoundment and tested. The testing results are described in the report "Response to MSHA Comments 1, 3, 7 and 8, Pond Creek Mine No. 1, Coal Refuse Facility No. 2, Phases 3 and 7, Impoundment

I.D. No. 1211-IL08-03141-02, Williamson Energy LLC, Mach Mining Company, Williamson County, Illinois," Project C090403.01, GAI Consultants, Inc., May 12, 2009. This report is Volume 2 of 3 of this report.

2. Impacts of Greater Than Predicted Subsidence Strains

The subsidence prediction model previously submitted was recalibrated and revised based on the subsidence measurements made to date. Revised predicted subsidence, horizontal strain, and displacement profiles have been include in the report "Prediction of Ground Movement due to Longwall Mining During Different Phases of Impoundment Construction, A Modified Report", Dr. Syd S. Peng and Thomas Du, May 2009. This report is included as Appendix H of Volume 1 of 3 of this report.

The impacts of the subsidence-induced deformations and strains are addressed in Volume 2 of 3 of this report. The predicted factor of safety against Phase 3 embankment cracking due to subsidence is 1.1 and significant embankment cracking is not anticipated due to the high peak strain characteristic of the coarse coal refuse. Additional monitoring and contingency measures to be implemented during longwall mining beneath Phase 3 are described in Item 3, below.

3. Fine Refuse Behavior when Subjected to Subsidence

It is intended that the fine coal refuse in Phase 3 will be dewatered and covered with coarse coal refuse before the longwall face passes under the phase. Fine coal refuse laboratory testing, properties, and flow slide susceptibility are presented in Volume 2 of 3 of this report. Flow slide factors of safety of 2.2 and 1.3 in the downstream and upstream directions, respectively, were obtained. The additional instrumentation, additional embankment monitoring, and a contingency buttress/seal plan for the Phase 3 embankment as recommended in GAI's report will be implemented. These provisions are included in Appendix A, "Guideline Technical Specifications", in Volume 1 of 3 of this report.

4. Longwall Mining Subsidence Monitoring – Baseline "A"

As recommended, an additional subsidence baseline, "Subsidence Survey Panel No. 1" was established and data was obtained on the progression of the dynamic subsidence profile. This data was used to calibrate the revised dynamic subsidence prediction model referred to in Item 2, above. The data was previously submitted to MSHA and is shown on Drawing No. B05-330-M44.

5. Longwall Mining Subsidence Monitoring – Baselines "E" through "I"

Appendix F in Volume 1 of 3 of this report has been revised to reflect the recommended daily monitoring frequency for remaining baselines orientated in the direction of mining. Based on the results of the previously surveyed baselines, the baseline lengths and distances between the monitoring stations have been adjusted to target critical



information. Baseline measurement points will be 25 feet apart to meet the criteria of the overburden depth divided by 20.

6. Longwall Mining Subsidence Monitoring – Phase 3 Monitoring

   As recommended, a baseline "H" will be located on the southern crest of the Phase 3 impoundment. The locations of the subsidence monitoring baselines are shown on Drawing No. B05-330-M36 and the subsidence monitoring plan is in Appendix F in Volume 1 of 3 of this report.

7. Stability of Phase 7 South Slope

   Stability analysis were performed for the Phase 7 south slope (Phase 7C) using zero strength for the fine coal refuse for the end-of –construction condition and total undrained strength for the long-term condition. Safety factors of 1.6 and 1.8, respectively, were obtained. These stability analyses are contained in Volume 2 of 3 of this report.

8. Seismic Stability of Phase 7 South Slope

   A liquefaction susceptibility evaluation and a post-earthquake stability analysis were performed for the Phase 7 south slope (Phase 7C). The post-earthquake factor of safety was found to be 1.6. The analyses are contained in Volume 2 of 3 of this report.

Comments – Plans and Specifications

9. Specification Paragraph 2.08a – Decant Pipe Alignment

   The profile for the Phase 3 decant pipe has been put on Drawing No. B05-33-E13 and Specification 2.09.a has been revised to cite the correct drawing.

10. Drawing No. B05-330-E24

    The tractive forces and the uniform section mat ditch lining anchorage requirements have been reevaluated for Ditches "D", "F", "I", "L", "M", and the Decant Ditches. The anchorage capacity for a 5/8-inch diameter bolt with embedment length of 4-foot into the embankment has been determined and the required anchor bolt spacing for the various ditches has been shown on Drawing B05-330-E24 The revised and additional computations are in Appendix B of Volume 1 of 3 of this report. A tractive force analysis of the grouted riprap channel lining was also performed.

11. Coarse Coal Refuse Placement Guidelines

    Appendix E, "Coarse Coal Refuse Placement Guidelines," in Volume 1 of 3 of this report has been revised to include provisions concerning lift thickness, end slopes, trimming slopes, and keying new and old fills together. A typical drawing, B05-330-A4, showing refuse placement procedures, has been added to Appendix E.



The report narrative, technical specifications, computations, appendices, and drawings have all been revised as needed. The accompanying report, Volume 1 of 3 and Volume 3 of 3, supercedes the previously submitted design reports.

If you have any questions, or require additional information, please contact us.

Respectively submitted,

ALLIANCE CONSULTING, INC.

Harold L. Owens, P.E.
Senior Project Manager

Claudio E. Yon, P.E.
Principal Engineer

File: 05330-MSHA Response

U.S. Department of Labor

Mine Safety and Health Administration
Pittsburgh Safety & Health Technology Center
P.O. Box 18233
Pittsburgh, PA 15236

.Mine Waste and Geotechnical Engineering Division

November 10, 2008

MEMORANDUM FOR ROBERT L. PHILLIPS
District Manager, District 8
Coal Mine Safety and Health

THROUGH: M. TERRY HOCH
Chief, Pittsburgh Safety and Health Technology Center

STANLEY J. MICHALEK
Chief, Mine Waste and Geotechnical Engineering Division

DARREN J. BLANK
Supervisory Civil Engineer, Mine Waste and Geotechnical Engineering Division

FROM: PAUL J. DONAHUE
Civil Engineer, Mine Waste and Geotechnical Engineering Division

SUBJECT: Request for Additional Information for Coal Refuse Disposal Facility No. 2, Phases 3 through 7, Impoundment I.D. No. 1211-IL08-03141-02, Williamson Energy LLC, Mach Mining Company, Pond Creek Mine No. 1, Mine I.D. No. 11-03141, Williamson County, Illinois

As requested by your office, we have reviewed the revised design documents submitted by Williamson Energy LLC/Mach Mining, and prepared by Alliance Consulting, Incorporated. The submitted materials included the following:

1. A report entitled "Response to Comments - February 11, 2008, I.D. No. 1211-IL08-03141-02 - Mach Mining, LLC - Mach No. 1 Mine I.D. No. 11-03141 - Williamson County, Illinois - Coal Refuse Disposal Facility No. 2 Phases 3 through 7." Appendices to the report contained proposed construction guidance specifications, various design calculations; geotechnical test boring and laboratory test data; and

thirteen drawings depicting plans, profiles, and details of the proposed facility. This report is dated August 2008 and was hand delivered to our office on August 19, 2008, in conjunction with a meeting with Mach Mining and Alliance Consulting personnel to discuss the plan.

2. A set of three drawings depicting longwall panel subsidence measurements at Baselines "A" through "D" at the subject mine. These drawings are dated August 29, 2008, and were received in our office on September 3, 2008.

Description of Proposed Facility

The revised Disposal Facility No. 2 will provide for the disposal of about 3 ½ years of coarse coal refuse (CCR) and 6 years of fine coal refuse (FCR) produced from the Pond Creek No. 1 Mine. This facility is to be constructed in five phases – Phase 3 through Phase 7. Phases 1 and 2 are part of Disposal Facility No. 1 which lies immediately to the south of Disposal Facility No. 2.

The currently planned facility will consist of three, four-sided diked impoundments aligned in a north-south direction and sharing common embankments between them. The southernmost impoundment will be constructed during Phase 3 with fine refuse placement starting upon completion of the embankment to the design crest height. The central impoundment will be constructed during Phases 4, 6 and 7 with fine refuse placement starting during Phase 7 when the embankment will be about 50 percent of the total completed height. The northernmost impoundment will be constructed during Phase 5 and will be partly incised by excavating the bottom of the impoundment. Fine refuse placement in this impoundment will begin when the embankment is about 80 percent complete.

The impoundments will cover about 200 acres, and all the impounding coarse refuse embankments will be raised by downstream or centerline construction methods. The upstream and downstream slopes will be of 3 horizontal to 1 vertical (3H:1V) except for Phase 3 which will have 2.6H:1V upstream slopes. Maximum slope heights will range from 49 feet for Phase 3 to 100 feet for Phase 7. All embankments with the exception of a portion of Phase 7 will be founded on 15 to 22 feet of medium to stiff clay deposits overlying shale bedrock. The south-facing slope of the Phase 7 embankment will be founded on the impounded fine refuse of the adjoining Phase 3.

The designer considered the impoundments to be of high-hazard potential classification for the purposes of hydrologic/hydraulic design. Following 1 year from the start of construction, all phases will be able to accommodate a rainfall volume of two PMF's with pumping capacity capable of drawing down one 72-hour PMF in 30 days. When the final crest elevation is reached, an 18-inch-diameter HDPE SDR 26 decant spillway will be installed and be capable of drawing down 90 percent of one PMF in less than 10

days. The only exception is the Phase 3 impoundment. Because of an impoundment life of less than 1 year, this impoundment was designed to handle at least one half of a 72 hour PMF but less than a full 72-hour PMF.

The most significant consideration for these impoundments will be the concurrent mining of three longwall panels in the 6.5-foot-thick Herrin No. 6 coal seam beneath the impoundment footprints. There is 430 to 450 feet of overburden with at least 420 feet of this being rock between the embankment foundations or impoundment bottoms and the Herrin No. 6 seam. Also, the development entries for the longwall mining have a calculated minimum pillar safety factor of 2.3 as calculated by the program ALPS. Therefore, breakthrough or sinkhole potential is low, but surface subsidence will considerably impact the facility.

The construction is to be phased so that, with the exception of Phases 3 and 4, all refuse placements will take place after mining has been completed beneath the impoundment and subsidence is substantially complete. For Phase 3, FCR placement will be completed to an elevation 5 feet below the crest, about 9 months prior to longwall mining beneath the impoundment. A 5-foot-thick cover of coarse refuse, level with the crest, will be placed over the fine refuse in order to eliminate any impounded water before the mining advances beneath the impoundment. Phase 4 will consist of a 45-foot-high non-impounding embankment placed prior to mining. After the mining and treatment of any subsidence related surface cracks, the 300-foot-wide Phase 6 embankment will buttress the downstream slope of the Phase 4 embankment. The width of this embankment is expected to mitigate the effects of any subsidence-related cracking of the Phase 4 embankment.

Based on our review of this submittal, the items of additional information for the original design, outlined in our memorandum dated December 13, 2007, have been satisfactorily addressed. However, the new impoundment design includes extensive changes from the old design, and mine subsidence data became available after the design was finalized. This subsidence data indicates the potential for more severe subsidence impacts which will require some additional analysis to justify the safety of the impoundment design.

The planned mining beneath the Phase 3 impoundment, a short time after filling and capping of this impoundment, is a critical issue. There is currently very little engineering experience in safely accommodating longwall mining under a coal refuse dam, and a conservative consideration of all possible potential failure modes and the implementation of mitigatory measures may be required.

The following items of additional information will be required to complete our review:

COMMENTS - DESIGN ANALYSIS

1. Characterization of Fine Refuse

   The submittal does not include any site-specific fine refuse strength test data. Laboratory and/or in-situ testing of fine refuse should be performed and submitted as appropriate to address the additional analyses requested in items 3, 7 and 8 below.

2. Impacts of Greater than Predicted Subsidence Strains

   The submitted subsidence data from Baselines "B" and "C" indicated up to 250 percent greater subsidence-related angular deformations, and consequently, much higher surface strains than the predictions furnished by Syd Peng, Anil Ray, and Thomas Doe that were relied on for the design. An independent subsidence analysis done in this office, using the computer program SDPS, with parameters calibrated from the actual measured subsidence profiles, indicates maximum horizontal tensile strains of about 3.3 percent compared with about 1.0 percent in Peng's analysis.

   The expected subsidence-related deformations and surface strains should be recalculated based on the actual survey measurements. The impacts of the higher deformations and strains on the embankments and related structures should be re-evaluated. If necessary, the proposed measures for subsidence monitoring and mitigation of the subsidence should be revised or new measures proposed.

3. Fine Refuse Behavior when Subjected to Subsidence

   The mining of the westernmost 2,300 feet of Longwall Panel No 3 is scheduled to occur beneath the Phase 3 impoundment about 9 months after completion of fine refuse placement, and an unspecified time after a 5-foot coarse refuse cover is placed. The submitted subsidence measurements indicate that somewhat higher-than-predicted tensile strains will occur in conjunction with a transient lowering of the eastern embankment crest to the approximate fine refuse elevation as the mine face advances beneath the embankment. The degree that the fine refuse will consolidate, gain strength, or resist possible strength loss under subsidence-related disturbance is not known. The possibilities of fine refuse flowage through large cracks in the embankment, or failures resulting from hydrostatic pressures from flowable slurry or water in subsidence-induced embankment cracks have not been analyzed or excluded.

Appropriate field and/or lab test analyses and calculations should be furnished that exclude the failure mode described above. Mitigatory measures to preclude a cracking and fine refuse flowage failure mode should also be provided if needed. Such measures may include provisions to dewater or accelerate the consolidation of the fine refuse prior to subsidence, or measures to prevent continuous cracks through the embankment.

Alternatively, any mining under Phase 3 may be limited to room-and-pillar mining using conservative pillar safety factors.

4. Longwall Mining Subsidence Monitoring - Baselines "A"

The submitted subsidence survey readings at Baseline "A" were not performed as specified in the submitted subsidence monitoring plan. No readings were taken until the mining face had advanced well beyond the end of the line. Since the purpose of this survey baseline was to obtain data on the progression of the dynamic subsidence profile in the direction of the longwall mining, no useful data was obtained at this line.

A new mid-panel survey baseline should be established as soon as possible and readings taken at sufficient frequency to obtain measurements of the subsidence profile in the direction of mining and its progression over time. The subsidence data should be submitted to this office for review.

5. Longwall Mining Subsidence Monitoring - Baselines "E" through "I"

The subsidence monitoring plan (Appendix F) does not specify a frequency of readings for these baselines shown on Drawing B05-330-M36. A frequency of readings should be specified for each line. Because of the dynamic nature of settlement in the direction of mining more frequent readings, daily at a minimum, will be required along Baseline "F."

6. Longwall Mining Subsidence Monitoring -Phase 3 Monitoring

The most critical phase of surface subsidence monitoring will be when mining of Panel No. 3 advances beneath the recently completed and capped Phase 3 impoundment. In addition to Baseline "I," an additional baseline should be considered for the southern crest of this impoundment, or other suitable location that is aligned in the direction of mining.

7. Stability of Phase 7 South Slope

The Phase 7 embankment will be founded on the impounded FCR from Phase 3 and therefore is the most critical stability analysis case. However, no stability analysis was furnished for this slope.

A stability analysis should be provided for a section through the Phase 7 and underlying Stage 3, using site-specific FCR strength parameters as requested in item No. 1 above. Because of the anticipated speed at which the Stage 7 embankment will be raised, analyses should be run for both the short-term end-of-construction and long-term steady-state conditions. Note that for loading of the consolidating, saturated FCR, appropriate undrained (phi=0) strength parameters should be used.

8. Seismic Stability of Phase 7 South Slope

The fine refuse on which Phase 7 will be founded may be subject to triggering strength loss (liquefaction) under earthquake shaking.

An evaluation of the susceptibility of the fine refuse to strength loss under appropriate earthquake shaking should be performed, and if required, the post seismic stability evaluated using estimated reduced post-seismic strengths. Alternatively, stability analyses can be performed using conservatively estimated post-earthquake strengths for the fine and coarse refuse. If a factor of safety of 1.20 or greater can be obtained with this conservative analysis, then additional liquefaction analyses will not be needed.

COMMENTS - PLANS AND SPECIFICATIONS

9. Specification Paragraph 2.08a - Decant Pipe Alignment

This paragraph references Drawing B05-330-E-14 and B05-330-E-32 for decant pipe profiles. However, drawing E-13, not E-14, contains the profiles for the Phase 5 and Phase 7 decants. Drawing E-32 does not exist in the submittal, and no profile or other elevation information was provided for the Phase 3 decant in any of the drawings.

A detail showing the intended Phase 3 decant profile with riser, inlet and outlet elevations should be added to the design drawings.

10. Drawing No. B05-330-E24 - Detail No. 5

This detail shows 5/8-inch-diameter roof bolts extending 4 feet into the embankment soil for anchorage of the Armorform uniform section grouted mats which will be used to line the decant outlet ditches running down the embankment

slopes. However, the design calculations show that a satisfactory factor of safety against sliding relies on the full allowable shear strength of the roof bolts. This is not possible if the bars are embedded into only 4 feet of soil.

Appropriate concrete deadman blocks or other provisions should be added to the design to provide satisfactory anchorage for the proposed roof bolts.

11. Coarse Coal Refuse Placement Guidelines

These guidelines specify the proposed CCR placement procedures using conveyors and dozers. The guidelines specify the use of two D-9 dozers and a D-10 dozer equipped with reclamation universal blades and maximum average push distances of 500 to 600 feet. Consequently, the operator's proposed construction method will be to construct the CCR dike embankments to their design crest elevation in 500 to 600 feet long segments by pushing refuse from a conveyor stacker at the end of the previously completed segment. Supporting calculations are included with the guidelines.

While the calculations appear to show this placement approach may be satisfactory with regard to the material handling capacity of the dozers, other potential problems must be addressed if such a placement method is used. The proposed dozer placement procedure must address a number of potential issues that include the following:

a. Inadequate compaction or excessive lift thickness at the conveyor end of a new embankment segment, or at the far end of the dozer pushes;

b. Preventing loose, over steepened and effectively end-dumped slopes at the end and sides of each dozed-out embankment segment;

c. Assuring that adequately compacted CCR extends to the limits of the design embankment template;

d. Assuring each embankment segment is suitably tied-in, by benching or other means, to assure loose or permeable zones are not present between segments.

Suitable drawings, cross sections and written specifications should be provided that address these issues and show the specific conveyor/dozer placement procedure that is proposed.

Satisfactory submission of the requested information will be required before we can recommend technical approval of this impoundment design from Phase 3 through Phase 7. However, item Nos. 7 and 8 are only applicable to Phase 7. Therefore, to

facilitate approval of the earlier phases, Mach Mining may first address all issues except for item Nos. 7 and 8 in an initial submittal with item Nos. 7 and 8 addressed in a later submittal.

If there are any questions concerning this review, please contact this office.

cc: S. Gigliotti - Chief, Safety Div., CMS&H
M. Skiles - Director, TS

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

November 9, 2009

Project No. B05-330-1413

Mr. Robert L. Phillips
District Manager
MINE SAFETY AND HEALTH ADMINISTRATION
Coal Mine Safety and Health, District 8
2300 Willow Street, Suite 200
Vincennes, IN 47591-5416

Transmittal
Response to Verbal Comments
Phase V Enlargement
Impoundment ID No. 1211-IL08-03141-02
Mach Mining LLC
Mach # 1 Mine, Mine ID No.11-03141

Dear Mr. Phillips:

On behalf of our client, Mach Mining LLC, please find enclosed two copies of response to verbal comments from Mr. Paul Donahue to Mr. Harold Owen concerning enlargement of Phase 5. The northern embankment of Phase 5 was moved approximately 300 feet north. This move was made as a result of the purchase of a piece of property. Enclosed is a set of revised drawings and calculations showing the enlarged Phase 5 cell.

One copy of the information has been sent directly to Mr. Donahue at Pittsburgh, Tech Support.

If you have any questions, or require additional information, please contact us.

Sincerely,

ALLIANCE CONSULTING, INC.

Brian W. Matherly
Assistant Project Engineer

Claudio E. Yon, P.E.
Principal Engineer

BWM/CEY:wmb
Enclosures

File: 05330-67

cc: Paul Donahue (w/enclosures)
J. Slapak (w/enclosures)

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

November 10, 2009

Project No. B05-330-1413

Mr. Paul J. Donahue
PITTSBURGH SAFETY AND HEALTH TECHNOLOGY CENTER
Cochrans Mill Road, Building 38
Pittsburgh, PA 15236

Transmittal
Response to Verbal Comments
Phase V Enlargement
Impoundment ID No. 1211-IL08-03141-02
Mach Mining LLC
Mach # 1 Mine, Mine ID No.11-03141

Dear Mr. Donahue:

On behalf of our client, Mach Mining LLC, please find enclosed one copy of response to verbal comments to Mr. Harold Owen concerning enlargement of Phase 5. The northern embankment of Phase 5 was moved approximately 300 feet north. This move was made as a result of the purchase of a piece of property. Enclosed is a set of revised drawings and calculations showing the enlarged Phase 5 cell.

Two copies of the information has been sent directly to Mr. Robert L. Phillips at the Mine Safety and Health Administration in Vincennes, IN.

If you have any questions, or require additional information, please contact us.

Sincerely,

ALLIANCE CONSULTING, INC.

Brian W. Matherly
Assistant Project Engineer

Claudio E. Yon, P.E.
Principal Engineer

BWM/CEY:knm
Enclosures

File: 05330-68

cc: Robert L. Phillips (w/enclosures)
J. Slapak (w/enclosures)

7225-11
part 5

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Office: 618-983-3020 Fax: 618-983-3017

August 8, 2008

Mr. Robert L. Phillips
District Manager
MINE SAFETY AND HEALTH ADMINISTRATION
2300 Willow Street, Suite 200
Vincennes, IN 47591

Re: Pond Creek Mine No. 1, MSHA ID No. 1211IL0803141-01

Dear Mr. Phillips:

This letter authorizes Alliance Consulting, Inc. (Alliance) to perform work on MSHA Id No. 1211IL0803141-01 and make corrections as necessary. Please send copies of any comments to Alliance as well as Williams Energy, LLC.

Thank you for your cooperation.

Sincerely,

WILLIAMSON ENERGY, LLC

James Plumley

James Plumley – Authorized Person

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

August 6, 2008

Project No. B05-330-1413

Mr. Robert L. Phillips
District Manager
MINE SAFETY AND HEALTH ADMINISTRATION
2300 Willow Street, Suite 200
Vincennes, IN 47591

Transmittal
Williamson Energy
Pond Creek Mine No. 1
MSHA ID No. 1211IL0803141-01
Williamson County, Illinois

Dear Mr. Phillips:

On behalf of our client, Williamson Energy, LLC, please find enclosed two copies of the above-referenced application for your review. A preliminary review of this plan was conducted with Messers Mark Eslinger and Douglas Stradner of your office.

e copy of this application will be provided to MSHA, Pittsburgh Safety And Technology Center, P. O. Box 18233, Pittsburgh, PA 15236 at a meeting to be held to review the final plan

If you have any questions, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Harold R. Owens, P. E.
Senior Project Engineer

Claudio E. Yon, P. E.
Senior Project Manager

HRO/CEY:wmb
Enclosures

James Plumley, Mach Mining

FILE: 05330-49

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

August 5, 2008

Project No. B07-038-1413

Mr. Robert L. Phillips, District Manager
MINE SAFETY AND HEALTH ADMINISTRATION
2300 Willow Street, Suite 200
Vincennes, IN 47591-5416

Transmittal
Additional Information
Coal Refuse Disposal Facility No. 2
Phases 3 Through 7
Impoundment I. D. No. 1211-IL08-03141-02
Williamson Energy, LLC
Pond Creek Mine No. 1
Mine I. D. No. 11-03141
Williamson County, Illinois

Dear Mr. Phillips:

On behalf of our client, Williamson Energy, LLC, this letter has been prepared in response to your request for additional information dated February 11, 2008.

As described in the memorandum attached to your letter on Page 3, the plan has been modified slightly since the original submittal. The sequence of construction will be from South to Center Cells to North Cell rather than South Cell to North Cell to Center Cells. The North and Center Cell configuration have changed but the overall concept remains the same. It should be noted that the two most southerly cells, Phase 2 and 3 will have been constructed, filled with fine coal refuse and abandoned prior to mining beneath the abandoned structures. The northern most cell will not be constructed until the longwall mining is completed and subsidence has occurred. Drawing No. B05-330-M36 entitled "Mining/Impoundment Construction" has been included which depicts the individual phases of construction sequentially and the timing of the mining. The following information has been included in response to your letter.

1. Longwall Mining Subsidence Analysis and Mitigation

   a) Predicted subsidence, horizontal strain and displacement profiles have been included in a report entitled "Prediction of Ground Movement Parameters due to Longwall Mining During different Phases of Impoundments" by Dr. Syd Peng and are included in Appendix H of this response.

b) Measures for mitigation of the effects of mining subsidence on the dam embankment and foundation are included in Section 3.1.

Mining subsidence impact and mitigation measures for the various phases is described as follows:

Phase 3 – This impounding embankment of Phase 3 will be completed and slurry pumping into the impoundment will be completed before mining beneath the phase occurs. The Phase 3 impoundment will be capped before undermining occurs. Based on subsidence predictions, the internal drainage system for the embankment has been redesigned to continue to function post-subsidence. Any disruption of surface drainage features due to subsidence will be repaired.

Phase 4 – Phase 4 is an intermediate phase in preparation for the construction of Phases 5, 6, and 7. No slurry will be pumped into Phase 4 and no internal drainage features are included in this phase. Undermining of Phase 4 will occur shortly after its construction. The embankment and pool area of this phase will be examined for subsidence cracks and repairs will be made as needed. It is anticipated that when slurry pumping begins in Phase 7 any undetected subsidence cracks in the Phase 4 embankment and foundation will be sealed by the slurry. This Phase will be buttressed to the south by Phase 3, which will be already completed and full of slurry; by Phase 6 to the east and west, which will be built post-subsidence; and by Phase 5 to the north, which will be also built post-subsidence.

Phase 5 – Phase 5 will be built post-undermining and the pool and embankment foundation area will be examined for subsidence cracks and repairs will be made as needed prior to construction. As previously stated, it is anticipated that theslurry will seal any undetected cracks. Phase 5 will be buttressed to the south by Phase 4. Phase 5 will contain an internal drain. This phase is predicted to be pumped full 22 months after construction starts (provides 17 months of slurry pumping).

Phase 6 – Phase 6 will be built post-mining and the embankment foundation area will be examined for subsidence cracks and repairs made as needed prior to construction. Phase 6 buttresses Phase 4 and an underdrain will be installed in this phase. No slurry will be pumped into Phase 6.

Phase 7 – Phase 7 will be built post-mining. Phase 7A will partially cap and consolidate the slurry in Phase 3. Phase 7B will provide a lining/buttress between the Phase 7 pool and the potentially cracked Phase 3 embankment (Phase 3 will be undermined after it has been pumped full of slurry). The remainder of Phase 7 will sit on top of the previously constructed Phases 4, 5, and 6. Phase 7C will finish covering and consolidating the slurry contained in the Phase 3 embankment. As previously stated, it is anticipated that the slurry will seal any undetected cracks not detected and repaired during Phases 4 and 6.

2. Treatment of Subsidence Cracking

The horizontal strain map, Drawing No. B05-330-M42, included in this report shows the areas that are most susceptible to cracking and which will be given special attention for the detection and repair of subsidence cracks. Areas considered susceptible to subsidence cracking are those predicted to have surface horizontal tensile strain of 0.1 percent or greater.

Examination of the subsidence prediction study data shows that horizontal strain and vertical subsidence values do not change significantly when mining occurs in a longwall panel adjacent to a previously mined panel directly beneath a phase undergoing construction. Overlapping subsidence and strain profiles should have negligible impact on ongoing construction.

The coarse coal refuse fill to be used in all phases of construction is broadly graded and should be less susceptible to cracking than earthern materials traditionally usually used in dam construction. Comparison of the gradation curves of the foundation soil and coarse coal refuse indicates that they do not fall into the most critical range for cracking (see Fig. 2.3:6 adopted from "Design of Earth and Earth Rock Dams", Sherard, etal, 1963, and the gradation curves for the foundation soil and coarse coal refuse contained in .... of this report). Based on Table 2.2.1 contained in Sherard, on a scale of 1 (highest) to 8 (lowest), the foundation soil has a piping resistance of (2, high) and the coarse coal refuse has a piping resistance of (3, intermediate).

2.a Crack Repair - Slurry discharge lines will be moved around the interior perimeter of each impoundment phase to maintain a delta against the slope and aid in sealing any embankment and foundation cracks not discovered by visual observation and sealed.

Subsidence crack repair of the foundation and the Phase 4 embankment will consist of excavation of the areas containing cracks to a depth of at least four feet, proof rolling the areas, and backfilling and sealing the areas with a compacted coarse coal refuse seal placed to the compaction standard in the Guideline Technical Specifications. In the unlikely event that extensive, deep cracking is discovered, a slurry trench or cutoff trench will be extended to bedrock through the affected areas. The trench will be located beneath the underdrain alignment for Stages 5 and 6. If it is discovered that a slurry or cutoff trench is needed, a specific design will be submitted for approval prior to its construction.

The Phase 4 embankment is the only embankment subject to subsidence cracking prior to slurry pumping. Before the construction of Phase 6, the Phase 4 embankment will be examined for cracking and any areas containing cracks will be excavated to a depth of at least 4 feet and sealed with compacted coarse coal refuse. Any additional cracks

discovered after slurry pumping begins during Phase 7 will be sealed by directing the slurry into the pool adjacent to the cracks.

2.b Defensive Measures - Phase 6, a wide zone of embankment, will be constructed post-mining by the downstream construction method on the east and west sides of Phase 4. It would serve as a "crack stopper" for any undetected cracks which may develop in the east and west sides of the Phase 4 embankment. The Phase 4 embankment will be buttressed on the north side by the Phase 5 embankment and impoundment. Phase 7 will be constructed partially on top of Phase 4, the resulting additional consolidation should aid in closing any cracks in the Phase 4 embankment. Likewise, the construction of Phases 6 and 7 should cause consolidation which should aid in closing any cracks in the underlying foundation soil.

The Stage 5 and 6 embankment underdrains have been redesigned to lower them as closely as possible to the predicted subsided original ground surface and still maintain gravity outlets. Neglecting the flow capacity of the gravel, the perforated collection pipes are designed to have a flow capacity safety factor of five or greater. The use of a safety factor of five for the collection pipe is felt to be justified as the entry of seepage water into the gravel drain envelope has a safety factor in excess of ten and the collection pipe is an engineered material which will be installed in a controlled fashion.

3. Subsidence Monitoring Plan

A subsidence monitoring plan which includes subsidence monument locations, reading schedules has been included in Appendix F, the rate and magnitude of vertical and horizontal movement will be recorded. The location of subsidence monuments are shown on Drawing No. B05-330-M36.

4. Coordination of Mining and Surface Disposal Operations

The construction timing and staging are contained in the calculation brief and are based on production ratios and rates provided by Mach Mining, LLC (Mach Mining). Mach Mining is the operator of the deep mine, preparation plant and coal refuse disposal facility. Therefore, coordination of the mining operation and surface operation should not be an issue. The timing of the panel advancement and developmental mining was modeled by Mach Mining. The modeling was performed using SurvCADD software. The mining completed during each stage is color coded on the map of each stage. Charts with the dates of mining, beginning and ending, fine and coarse coal refuse placement has been included for each phase on the "Mining/Impoundment Timing Map", Drawing No. B05-330-M36.

5. Drawing

The decant outlet ditch has been shown on Drawing Nos. B05-330-M30 and B05-330-M33.



6. The horizontal scale for the impoundment curve has been corrected on Drawing No. B05-330-E13.

7. Additional piezometer locations have been indicated on Drawing Nos. B05-330-M30, B05-330-M32, B05-330-M33 and B05-330-M34.

8. Design Comments – Specifications

The reference to maintaining a four-foot thick (minimum) soil layer between the coal refuse and bedrock has been deleted from Page A-3. This was an issue related to groundwater protection and was applicable to construction of the Phase 1 (incised area only) for the Illinois Department of Natural Resources. This language was contained in the approved MSHA plan (IL08-03131-01) for Phase 1 and was the method by which it was constructed.

A soil layer inside the incised portion would not affect the stability of the embankment.

9. Additional information has been provided on Page A-3 for the replacement of soft or wet soils with compacted coarse coal refuse. We propose that the soft soils be removed and replaced with coarse coal refuse.

10.

a) If subsidence cracks are discovered in the pool or embankment foundation area of Phases 5 or 6, areas containing cracks will be excavated to a depth of at least four feet, proof rolled, and sealed with a compacted coarse coal refuse placed to the compaction standard in the Guideline Technical Specifications.
b) The topsoil has already been removed from the entire site. No drain tiles or drain pipes were encountered. Additionally, the sediment cell has already been excavated around the entire perimeter of the facility to depths greater than the topsoil removal. The minimum excavation depth was approximately 4 feet up to approximately 15 feet. No drain tiles or pipes were encountered. We assume these excavations would have encountered any such structure and therefore no addition to the specifications should be required.

11. A placement plan for utilizing belts and dozers has been included in Appendix E. This plan is similar to the currently approved plan for Phase 2 (ID No. IL08-03141-01) for this type of placement at this facility except that an additional D-9 dozer has been purchased and two stackers (dump points) are proposed in-lieu of one. Compaction has been achieved by dozer traffic.

12. The pump activation levels have been added to Drawing No. B05-330-M5 for Phase 4, Drawing No. B05-330-M7 for Phase 6 and Drawing No. B05-330-M8 for Phase 7.

A statement has been added to the specifications in Section 3.1 of the engineering report stating that no significant depth of impounded water will be allowed prior to any of the required

remediation of subsidence disturbance or prior to the raising of the post subsidence stages to a suitable elevation.

13. Grout mix and placement procedures have been provided in Section 4.04, Page A-12. Uniform section mat has also been provided as an option for grouted rip-rap on Drawing No. B05-330-E24.

14. Additional Required Specifications

a) Specific pump specifications have been provided in Appendix G. The maximum required pumping rate for Phases 4 and 6 are 1,902 gpm with 32.5 feet of static head. For Phase 7, a pump will be required until the decant line is installed. The pump will be a Goodwin CD 3000 M Dri-Prime Pump manufactured by Goodwin Pumps of America, Inc. with a Caterpillar -9 diesel engine or equivalent. This pump will deliver 4,870 gpm at a total suction head of 120 feet.
b) Measures to address mine subsidence have been added in Section 3.1.

If you have any questions, or require additional information, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Harold L. Owens, P. E.
Senior Project Engineer

Claudio E. Yon, P. E.
Principal Engineer

HLO/CEY:wmb
Enclosures

FILE: 07038-17

U.S. Department of Labor

Mine Safety and Health Administration
2300 Willow Street
Suite 200
Vincennes, Indiana 47591-5416

February 11, 2008

Mr. Justin L. Harry, Staff Engineer
Alliance Consulting, Inc.
124 Philpott Lane
Raleigh County Airport Industrial Park
Beaver, WV 25813-9502

Dear Mr. Harry:

Re: Request of Additional Information dated December 13, 2007, for Coal Refuse Disposal Facility No. 2, Impoundment I.D. Number IL08 03141-02, Mach Mining, LLC, Mach #1 Mine, Mine I.D. No. 11-03141, Johnston City, Williamson County, Illinois

The Mine Safety Health Administration completed a review of the engineering plan for the design, construction, and maintenance of Mach #1 Mine, Mach Mining, LLC. Before the plan can be approved, some additional information is needed.

Please find attached a memorandum from the Mine Waste and Geotechnical Engineering Division of the Pittsburgh Safety and Health Technology Division. The information requested in the memorandum must be satisfactorily answered before approval can be granted.

If you have any questions concerning this matter, please contact Mark Eslinger, Supervisory Mining Engineer (Ventilation) at 812-882-7617.

Sincerely,

Robert L. Phillips

Robert L. Phillips
District Manager
Coal Mine Safety and Health
District 8

Attachment

cc: Mr. Pete Hendrick, President
Mach Mining, LLC
P.O. Box 300
Johnston City, IL 62951

U.S. Department of Labor

Mine Safety and Health Administration
Pittsburgh Safety & Health Technology Center
P.O. Box 18233
Pittsburgh, PA 15236

Mine Waste and Geotechnical Engineering Division

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December 13, 2007

MEMORANDUM FOR ROBERT PHILLIPS
District Manager, District 8
Coal Mine Safety and Health

THROUGH: M. TERRY HOCH
Chief, Pittsburgh Safety and Health Technology Center

STANLEY J. MICHALEK
Chief, Mine Waste and Geotechnical Engineering Division

FOR
DONALD T. KIRKWOOD
Supervisory Civil Engineer, Mine Waste and Geotechnical Engineering Division

FROM: PAUL J. DONAHUE
Civil Engineer, Mine Waste and Geotechnical Engineering Division

SUBJECT: Request for Additional Information, Coal Refuse Disposal Facility No. 2, Phases 3 through 7, Impoundment I.D. No. 1211-IL08-03141-02, Williamson Energy LLC, Pond Creek Mine No. 1, Mine I.D. No. 11-03141, Williamson County, Illinois

As requested by your office, we have reviewed the design documents submitted by Williamson Energy LLC, and prepared by Alliance Consulting, Incorporated The submitted material was received in our office on February 8, 2007.

The submitted design document consists of a report entitled: "Engineering Design Plan, Proposed Coal Refuse Disposal, Facility No. 2, Williamson County, Illinois, dated January 2007." The report includes a narrative description of the proposed design, and

the testing and analyses performed. Appendices to the report contain various design calculations; geotechnical test boring and laboratory test data; and thirteen drawings depicting plans, profiles, and details of the proposed facility.

Disposal Facility No. 2, as currently planned, will provide for the disposal of about 11 years of coarse coal refuse and 17 years of fine coal refuse produced from the Pond Creek No. 1 Mine, which has been previously referred to in District 8 correspondence as the "Mach No. 1 Mine." This facility is to be constructed in five phases - Phases 3 through 7. Phases 1 and 2 are part of currently active Disposal Facility No. 1, which lies immediately to the south of the proposed Disposal Facility No 2.

Description of Proposed Facility

The currently planned facility will consist of two four-sided diked impoundments that, upon completion, will share a common embankment separating them on their southern and northern margins, respectively. The smaller, partly incised north impoundment will be constructed as part of the placement Phases 3 and 5, and the larger south impoundment that will be constructed as part of Phases 4, 6 and 7. The north impoundment will be 1250 by 1850 feet, and the south impoundment 2400 feet by 2400 feet, in footprint dimensions. Both impoundments will be raised by downstream construction methods with upstream and downstream slopes of 3 horizontal to 1 vertical. The north impoundment will be a maximum of 52 feet in height above the downstream toe, and the south impoundment will be a maximum of 98 feet above the downstream toe.

The designer considered the impoundments to be of high hazard potential classification for the purposes of hydrologic/hydraulic design. Following 1 year from the start of construction, Phases 3, 4, and 6 will accommodate a rainfall volume of two PMF's with pumping capacity capable of drawing down one PMF in 30 days. Phases 5 and 7 will utilize an 18-inch SDR 26 decant spillway capable of drawing down 90% of one PMF in less than 10 days.

The most significant consideration for these impoundments will be the longwall mining of the 6.5-foot-thick Herrin No. 6 Coal Seam beneath the impoundment footprints concurrent with the disposal facility development. There is 420 to 450 feet of overburden, with at least 420 feet of this being rock, between the embankment foundations or impoundment bottoms and the Herrin No. 6 seam. Also, the headgate and tailgate pillars have a calculated minimum pillar safety factor of 2.3 as calculated by the program ALPS. Therefore, breakthrough or sinkhole potential is low, but surface subsidence is a significant consideration in the design of this facility.

The north impoundment will span the surface projection of the northernmost of the three 1200-foot-wide longwall panels that will impact the impoundments. The south

impoundment will span the southern two panels. The longwall mining for each panel will proceed east to west and panels will be mined north to south. The designer intends to accommodate the surface subsidence from the expected longwall mining by staging construction so that the downstream coarse refuse stage of each impoundment is placed after longwall mining is completed, subsidence is substantially ended, and surficial cracks on critical parts of the pre-mining stage are treated. No fine refuse slurry will be placed in either impoundment until this post-subsidence downstream stage has been raised to at least the expected slurry level. Fine refuse will be placed in the currently active Disposal Facility No. 1 impoundment prior to the start of the first post-subsidence stage. Longwall mining will be performed under Facility No. 1 after its closure. Thus, the safe operation of the proposed impoundments will rely on critical coordination of the surface disposal activities with the underground mining activities.

Design Comments - Longwall Mining Impacts

Based on our review of the submittal, we have concluded that additional engineering analyses will be required to assure the safe operation of the proposed mine waste facility. The potential impacts of mine subsidence on this facility are significant. However, the submittal does not contain sufficient information to demonstrate that the designer has thoroughly considered the adverse effects of longwall subsidence on the embankments or their foundations in the design of this facility.

In a phone conversation with Mr. Douglas (Duffy) Stradner, District 1 Impoundment Specialist, on October 23, 2007, we were notified that major revisions to the impoundment layout and geometry may be forthcoming. However, we expect that the comments and requested information in this memorandum will be applicable to any revised designs.

The following items of additional information will be required to complete our review:

1. Longwall Mining Subsidence Analysis and Mitigation

   The designer used the Bureau of Mines IC 8741 guidance to demonstrate that an adequate overburden thickness exists to preclude breakthrough. However, IC 8741 also specifies a dam protection zone where no mining is allowed within specified "safety zone " limits beneath the footprint of a dam. MSHA generally has allowed only essential ventilation or haulage way development mining within the IC 8741 limits at coal waste dams unless it can be demonstrated that the mining will not impact the integrity of the dam or that specific proposed measures will protect the integrity of the dam. Therefore, a detailed analysis of the mining related subsidence and possible impacts on the planned impoundments should be provided. This analysis should include the following:

a. Develop predicted subsidence, horizontal strain, and displacement profiles, at all significant stages of the mining and impoundment construction;

b. Furnish any designs and supporting calculations for any measures needed to mitigate the effects of the mining subsidence on the dam embankment and foundation. Additional, post-subsidence remedial features, such as a cutoff trench, compacted clay liner, or other defensive anti-seepage measures to address foundation or embankment disturbance should be considered.

2. Treatment of Subsidence Cracking

The submitted report narrative proposes to "over excavate and fill cracks to a minimum depth of 5 to 10 feet" at the south side of the Phase 5 embankment after expected longwall mining subsidence and cracking has occurred. However, no construction details of the proposed repair were provided. Also, the effectiveness of this repair is questionable because it will only address the near surface part of a crack and cracks that are visible at the surface.

a. The designer should provide additional details of the proposed crack repair procedure with specific dimensions for the excavation and backfilling for the various sizes of cracks expected, and provide a justification that the repairs will be effective.

b. Alternatively, the designer should consider suitable defensive design measures such as a graded rock filter zone between the pre- and post-mining stages, which may preclude the need for crack repair.

3. Subsidence Monitoring

The proposed design relies on mine surface subsidence being substantially complete before placing the downstream stages of the impoundments. However, no subsidence monitoring has been proposed. A subsidence monitoring plan should be proposed. This plan should include monument locations, reading schedules, and action thresholds for the rates and magnitudes of vertical and horizontal movement.

4. Coordination of Mining and Surface Disposal Operations

The proposed facility design relies on close coordination between the longwall mining operations and the staging of the surface refuse disposal operations. The mine operator should provide a plan for coordinating the underground mining and the surface disposal activities and any supporting documentation. This should

include timelines for the longwall mining development and impoundment construction that supports the assumptions used in the impoundment staging design.

Mining and impoundment timeline and expected production data should be provided in bar chart or other form for easy reference by mine and MSHA inspection personnel.

Design Comments - Drawings

5. Drawings B05-33-M6 and M8 - Decant Outlet Ditch

A decant ditch is specified on the ditch schedule on Drawing No. 05-330-E14, but is not shown on the plan drawings. The locations and intended plan extents of this ditch should be shown on the plan drawings.

6. Drawing B05-330-E13 - Stage/Storage Curves

The horizontal axis (storage volume) scale for the Phase 3/5 impoundment curve is incorrect (too high by a factor of 10). This error should be corrected.

7. Drawings B05-33-M6 and M8 - Piezometer Locations

The above drawings show pairs of proposed piezometers to be installed only in the lower half of the downstream slopes. In order to verify assumptions used in the slope stability analysis and confirm adequate performance of the underdrain, at least one additional piezometer will be needed further up the slope. Therefore, additional piezometers should be specified for the downstream edge of the Phase 5 and Phase 8 crests, or other suitable higher location, or justification provided for the currently proposed piezometer layout.

Design Comments - Specifications

8. Paragraph 1.02 - Stripping and Topsoil Removal

This paragraph specifies that a 4-foot-thick (minimum) soil layer shall be maintained between the coal refuse and bedrock.

a. It should be clarified if this minimum soil layer thickness is intended for beneath the impounded fine refuse as well as the coarse refuse embankment.

b. A list of specific acceptable soil types for the protective layer, using the Unified Soil classification System (USCS) should be included in this specification.

c. A means to confirm this soil thickness should be provided.

d. The excavation of the incised bottom of the north pond will likely encounter bedrock in some portions of the pond bottom. If the minimum soil layer requirement is applicable to the pond bottom, a specific treatment, such as over excavation and replacement with compacted clay soil, should be included in this specification.

9. Paragraph 1.03. - Surface Sealing/Proof rolling

Specific acceptable USCS soil types should be specified for replacement of soft or wet soils.

10. Section 1.0 - Site Preparation - General

a. As required to address Comment No. 1, additional preparation measures in both the embankment foundation and impoundment bottom areas will likely be needed to address mine subsidence impacts. The specific measures developed to address this issue should be included in this section of the specifications.

b. Underdrains or "drain tiles" are often used in level, low-lying former cropland such as this site. The site preparation specifications should include measures to explore for, and if necessary, remove a suitable portion of any drain pipes that could provide a seepage path under the coarse refuse embankment.

11. Paragraph 2.02.e. - Coarse Coal Refuse Placement and Compaction - Construction Procedures

This paragraph specifies that fill shall be placed in "nearly horizontal layers." However, similar wording has been used on sites where MSHA has observed excessively sloping coarse refuse fill with thick or poorly defined lifts. This typically occurs when dozers are used to push the coarse refuse excessive distances from the tail end of a conveyor used to convey the coarse refuse to the dam crest.

The specification should be revised with additional details to clearly define the maximum tolerable slope of the fill surface, and describe specific, acceptable lift spreading methods.

12. Paragraph 3.02 - Clarified Water Removal

a. This paragraph states that the water level in the impoundments should be maintained as "low as practicable." However, the submittal contains

calculations for specific maximum design storm storage water levels and pump activation levels prior to installation of the decant spillways. These elevations need to be provided in table or other form in the specifications for easy reference.

b. Additionally, the longwall mining will significantly disturb Phases 3, 4 and 6 embankments. Therefore, the specification should contain measures to prevent any impounding of water prior to any required remediation of subsidence disturbance or prior to the raising of the post-subsidence stages to a suitable elevation.

13. Paragraph 4.04 – Rock Riprap

a. "Grouted rock riprap" is specified for the decant ditches and other steep surface drainage ditches that will run down the embankment slopes. However, specifications for the grout mix and grout placement procedures were not provided. These details should be added to this specification.

b. Subparagraph "d" of this specification also provides the option of using grouted 8-inch filter point mat or 4-inch uniform section mat in place of riprap. Clarification is needed whether this lining is intended as a replacement for both grouted and ungrouted riprap lining. Additionally, calculations supporting the suitability of this alternate channel lining for the steep channels on the embankment slopes should be provided.

14. Additional Required Specifications

Additional significant construction requirements were not included in the submitted specifications. Additional sections to the specification should be provided for the following:

a. Pumping Requirements

Pumping will be required to meet storm water handling requirements during certain stages of construction. Required pumping capacity calculations were furnished, but no pump specifications were provided. Specifications should be furnished with specific requirements for pump capacity, power source or supply, and any testing required to assure reliable operation.

b. Specifications for Measures to Address Mine Subsidence

Additional detailed specification sections should be provided, as needed, for any new features of work developed from the additional subsidence analysis requested in items 1 through 4 of this memorandum.

If there are any questions concerning this review, please contact this office.

cc: S. Gigliotti - Acting Chief, Safety Div., CMS&H
M. Skiles - Director, TS
J. Fredland - DSO, TS

REPORT
ENGINEERING DESIGN PLAN
MACH #1 MINE
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
WILLIAMSON COUNTY, ILLINOIS
MACH MINING LLC
JOHNSON CITY, ILLINOIS

TABLE OF CONTENTS

VOLUME 1 of 3		PAGE
1.0 INTRODUCTION		1
2.0 EXISTING SITE CONDITIONS		2
2.1	Site Characteristics	2
2.2	Geology	
3.0 MINING OPERATIONS AND COAL REFUSE PRODUCTION		2
3.1	Mining Operations	2
3.2	Coal Refuse Production	4
4.0 SUBSURFACE EXPLORATION		4
4.1	Subsurface Exploration	4
5.0 FIELD AND LABORATORY TESTING		4
5.1	Soil	4
5.2	Coarse Coal Refuse	5
5.3	Fine Coal Refuse	6
5.4	Piezo-Seismic Cone Penetration Testing	6
6.0 COAL REFUSE DISPOSAL PLAN		6
6.1	Phase 3	7
6.2	Phase 4	8
6.3	Phase 5	9
6.4	Phase 6	10
6.5	Phase 7	11
6.6	Abandonment Plan	13

7.0 ENGINEERING ANALYSES 13

7.1 Hydrologic and Hydraulic Analyses 13
7.2 Slope Stability Analyses 13

TABLE OF CONTENTS (continued)

PAGE

8.0 SUMMARY 15

CERTIFICATION OF PLAN 15

APPENDIX A – GUIDELINE TECHNICAL SPECIFICATIONS

APPENDIX B – CALCULATION BRIEF

APPENDIX C – LABORATORY TESTING

APPENDIX D – BORING LOGS

APPENDIX E – COARSE COAL REFUSE PLACEMENT PLAN

APPENDIX F – SUBSIDENCE MONITORING PLAN

APPENDIX G – PUMP SPECIFICATIONS

APPENDIX H – "PREDICTION OF GROUND MOVEMENT PARAMETERS DUE TO LONGWALL MINING DURING DIFFERENT PHASES OF IMPOUNDMENT", A MODIFIED REPORT SUBMITTED TO ALLIANCE CONSULTING, INC, SYD S. PENG AND THOMAS DU, DEPARTMENT OF MINING ENGINEERING, WEST VIRGINIA UNIVERSITY, MAY, 2009.

VOLUME 2 OF 3

"RESPONSE TO MSHA COMMENT NOS. 1, 3, 7 AND 8 POND CREEK MINE NO. 1, COAL REFUSE DISPOSAL FACILITY NO. 2, PHASES 3 AND 7,"GAI CONSULTANTS, INC., MAY, 2009.

VOLUME 3 OF 3

FIGURES

FIGURE NO.	DRAWING NO.	TITLE
1	B05-330-T2	Title Sheet
2	B05-330-M19	Existing Conditions
3	B05-330-M30	Plan – Phase 3
4	B05-330-M31	Plan – Phase 4
5	B05-330-M32	Plan – Phase 5
6	B05-330-M34	Plan – Phase 6
7	B05-330-M33	Plan – Phase 7
8	B05-330-E13	Sections C-C, D-D, and F-F

TABLE OF CONTENTS (continued)

9	B05-330-E22	Section E-E
10	B05-330-E14	Details
11	B05-330-E24	Decant Installation and Uniform Section Mat Details
12	B05-330-E49	Ditch "F" Profile and Details
13	B05-330-E47	Instrumentation and Contingency Buttress Details
14	B05-330-E12	Slope Stability Analysis – Sections C-C and D-D
15	B05-330-E39	Slope Stability Analysis – Sections F-F and G-G
16	B05-330-E48	Slope Stability Analysis – Section F-F (Phase 7C)
17	B05-330-M36	Mining/Impoundment Construction Timing Map
18	B05-330-E46	Subsidence Effects Predictions Map
19	B05-330-M50	Mine Vertical Subsidence Predictions
20	B05-330-M51	Mine Subsidence Horizontal Strain Predictions
21	B05-330-M44	Subsidence Survey Panel No. 1 Section
22	B05-330-M20	Abandonment Plan

REPORT
ENGINEERING DESIGN PLAN
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
MACH #1 MINE
MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS
JOHNSON CITY, ILLINOIS

1.0 INTRODUCTION

Plans have been developed for the construction of a coarse and fine coal refuse disposal facility to be located near Johnston City in Williamson County, Illinois. The proposed coal refuse disposal facility will provide disposal capacity for both coarse and fine coal refuse produced by the Mach #1 mine coal preparation plant located approximately 0.25 mile west of the proposed facility. The location of the site is just southwest of the intersection of Dwina Road and Dean Road and is shown on Figure No. 1.

The plan, as presented herein, provides for the disposal of approximately 4 years of coarse coal refuse and 7 years of fine coal refuse based on production rates provided by Mach Mining operations for Mach Mining LLC (Mach Mining). The facility shall be constructed in five phases of coarse coal refuse embankment construction (Phases 3 through 7). During the initial construction of the Disposal Facility No. 2, fine coal refuse shall be disposed in the Disposal Facility No. 1 impoundment[1] MSHA ID No. 1211-IL08-03141-02 (Phases 1 and 2).

The proposed facility has been designed as a high hazard impoundment using the Probable Maximum Flood (PMF) storm event. Based on the design production rates, at the 1-year anniversary of initial impounding capability and thereafter, the facility will be capable of storing the runoff associated with the design storm event. The stored runoff volume, as well as operational water, shall be evacuated using a pump for Phases 4 and 6 and decant pipes for Phases 3, 5 and 7.

Combination sedimentation and perimeter ditches, access road gutters and bench gutters have been specified to convey storm runoff away from the embankment in a controlled manner. The ditches have been designed for routing the runoff associated with the 100-year, 6-hour recurrence interval storm event.

This report presents the design drawings, guideline technical specifications (Appendix A), and calculations (Appendix B) necessary for the design and construction of the embankment. The laboratory data and boring logs are contained in Appendices C and D, respectively.

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[1] Alliance Consulting, Inc. report entitled "Report, Engineering Design Plan, Proposed Coal Refuse Disposal Facility, Pond Creek Mine No. 1, Williamson County, Illinois" prepared for Williamson Energy, LLC, Beckley, West Virginia, dated April 2006.

2.0 EXISTING SITE CONDITIONS

2.1 Site Characteristics

The general area of the proposed impoundment has previously been used for agricultural purposes and has relatively flat to mild slopes to the ridgeline at approximate Elevation 572. The surrounding landscape is characterized by extensive agricultural and rural residential land use. Regionally, the proposed permit area is located on the southern shelf of the Illinois Basin in the Mt. Vernon Hill Country physiographic division. Surrounding landforms are the results of both Wisconsinian glaciations and normal degradation processes such as weathering, mass wasting, and stream erosion. Surrounding topography is characterized by generally flat ridge tops, moderately steep hill slopes and broad flat valley floors associated with major streams. The local drainage pattern is dendritic reflecting the regional generally horizontal bedrock stratigraphy. The total relief of the Facility No. 2 footprint is approximately 32 feet ranging from approximately 436' to 468' above mean seal level (based on aerial photography).

Glacial deposits of the Carmi Member of the Equality Formation, consisting of quiet water lake silt and clay, constituted the original surface materials within the proposed permit area.

2.2 Geology

The proposed permit area is underlain by lower Pennsylvanian age rocks consisting of shale, sandstone, and siltstone with minor underclay, coal and limestone. These sequences reflect fluctuating shorelines, deltas, and shallow seas indicating deltaic, fluvial, and coal swamp depositional environments. These bedrock units can be highly variable in thickness and continuity. Mississippian rocks unconformably underlie the Pennsylvanian, however, they do not outcrop in the subject area and were not penetrated during exploration drilling.

The major stratigraphic marker is the Herrin No. 6 coal which is generally uniform and continuous in the subject area and occurs at approximate Elevation 10 beneath the proposed refuse disposal facility. Shale and sandstone units in the subject area exhibit a high degree of lateral facies changes and interbedding. The Herrin No. 6 seam is described as a normal bright-banded coal with a lower portion that contains a prominent claystone parting. The base of the Herrin No. 6 exhibits an undulating surface with a general structural trend toward the north-northeast dipping approximately 60 feet per mile. No major faults or other structural anomalies are known to be present within the proposed permit.

3.0 MINING OPERATIONS AND COAL REFUSE PRODUCTION

3.1 Mining Operations

The Herrin No. 6 coal seam (average Elevation 10 feet above mean sea level) is proposed to be mined by both longwall and conventional mining techniques beneath the footprint area of the proposed facility. The disposal plan has been staged to minimize the impacts of the mining on the integrity of the embankments. Due to the timing of the proposed mining, it will be necessary to initiate Phases 3 and 4 embankment construction above unmined areas.

Based on a report prepared by Syd S. Peng, etal[2], it is anticipated that substantially all of the significant surface subsidence resulting from the longwall mining activities should occur within approximately 14 to 21 days following longwall mining. Phase 3 shall be filled to capacity with fine coal refuse and the impounding capability eliminated before being mined under. Prior to the deposition of the fines, but following the subsidence period, a downstream stage (Phase 6) will be constructed around the Phase 4 impoundment area. This phase essentially "rings" the initial embankment and should serve to mitigate any cracks that may have developed in the initial embankment as a result of the subsidence. Internal drains have been specified for the Phase 3, 5, and 6 embankments to collect and convey potential seepage. Based on the predicted subsidence, the drains have been designed so that positive drainage will occur post subsidence. Also, as discussed in Section 6 of this report, observed cracks in the pool area of Phase 4, on the upstream and downstream slopes of Phase 4, the pool area and foundation area of Phase 5, and the foundation area of Phase 6 shall be over excavated to a depth of at least 4 feet and backfilled with compacted coarse coal refuse.

Subsidence monitoring baselines will be used to calibrate the subsidence prediction model and compare predicted to actual subsidence due to mining. The location of the baselines are shown on Figure No. 17 and the monitoring plan is discussed in Appendix F.

Concerning breakthrough potential, the Bureau of Mines Information Circular 8741 recommends an overburden thickness equal to 60 times the extraction height for total extraction mining. The lowest level of the proposed pool area is Elevation 426, and the bottom of coal seam is at average Elevation 10 feet with an extraction height of 6.5 feet. Therefore, the existing overburden thickness is greater than the recommended thickness and there is no significant potential for a catastrophic breakthrough of fine coal refuse slurry into the mine to occur.

Chapter 8, Section 25 of the MSHA Coal Mine Inspection and Plan Review Handbook, October, 2007, recommends a pillar factor of safety should be greater than 2.0 for the long-term support of critical areas. The maximum crest elevation of the proposed embankment is 538 which create an overburden height of 528 feet. Based on these dimensions, the ALPS factor of safety is 2.30, which is greater than the recommended minimum of 2.0.

Based on these conditions and recommended guidelines, it is expected that no adverse effects shall impact the stability or breakthrough potential of the impoundments.

No significant depth of impoundment water will be allowed prior to any of the required remediation of subsidence disturbance prior to the raising of the post-subsidence stages to a suitable elevation.

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[2]Report entitled "Prediction of Ground Movement Parameters due to Longwall Mining During different Phases of Impoundments", prepared by Syd S. Peng and Thomas Du, Department of Mining Engineering, West Virginia University, May 2009.

3.2 Coal Refuse Production

Based on information provided by Mach Mining, the following annual production quantities, beginning with the first year of plant operation, were used in the design (see Calculations in Appendix B).

• Coarse Coal Refuse	Prior to longwall startup	34,330 cubic yards/year
	After longwall startup	2.53 million cubic yards/year
• Fine Coal Refuse	Prior to longwall startup	17,945 cubic yards/year
	After longwall startup	1.32 million cubic yards/year

4.0 SUBSURFACE EXPLORATION

4.1 Subsurface Exploration

During the month of February 2006, a subsurface exploration program consisting of drilling one soil boring (No. 8874) was conducted within the footprint of the proposed embankment. The intent of the program was to obtain soil samples to define the conditions and engineering characteristics relative to the construction and operation of the fine coal refuse slurry disposal impoundment. In addition to this soil boring, the results of a previous subsurface exploration program performed by Holcomb Foundation Engineering Co. (Holcomb) are presented in Appendix C and indicate the following:

- Sample number, type, standard penetration test blow counts, and depth;
- An overall description of the consistency, color and character of the soil; and,
- Indication of the observed groundwater level in the boreholes at the time of drilling.

The locations of the borings are depicted on Figure No. 2.

Generally, the soils encountered beneath the dam footprint consist of brown and gray silty clay with sand and pebbles. The thickness of the soil varied from 12.5' to 22.5' while the surface elevation for the borings varied from Elevation 438.5± to Elevation 473.0±. Each of the borings was terminated at the top of the bedrock.

Groundwater was encountered in two (2) of the seven (7) borings (i.e. Nos. 8293 and 8295). Following drilling, the depth from the ground surface to groundwater level varied from 10 to 13.5 feet or from Elevation 432.4± to Elevation 438.5± in the borings.

5.0 FIELD AND LABORATORY TESTING

5.1 Soil

Samples of the soils obtained during the subsurface exploration program from Boring No. 8874 were used for laboratory testing. The scope of the testing is discussed below and the results are presented in Appendix D.

Visual classification tests were performed by Holcomb on the split spoon samples obtained during drilling. Samples from the borings represent the foundation conditions for the proposed embankment. Additional testing performed on the borings included the following:

- Grain Size Analysis – Grain size analysis were performed on a sample from Boring No. 8874;
- Atterberg Limits Test – Atterberg Limits tests were performed on a sample from Boring No. 8874;
- Unit Weight Determination – Performed on a Shelby tube sample from Boring No. 8874; and,
- Shear Strength Test – A consolidated, undrained triaxial shear strength test with pore pressure measurements was performed on a Shelby tube sample from Boring No. 8874.

5.2 Coarse Coal Refuse

The proposed embankment shall be constructed with coarse coal refuse. The coarse coal refuse used to construct the embankment has been sampled from the Mach #1 Mine coal processing plant and has undergone laboratory testing. The scope of the testing is discussed below and results are presented in Appendix C.

- Grain Size Analysis – A grain size analysis was performed on the coarse coal refuse sample.
- Shear Strength Test – A consolidated, undrained triaxial shear strength test with pore pressure measurements was performed on re-molded samples of the coarse coal refuse. Material from the sample was re-molded to a density equivalent to approximately 95 percent of Standard Proctor maximum dry density.
- Permeability – A constant head permeability test was performed on a re-molded sample to determine the permeability characteristics of the coarse coal refuse for the embankment construction. The sample was compacted to approximately 95 percent of the Standard Proctor maximum dry density.
- Compaction Test – A Standard Proctor compaction test was performed on the coarse coal refuse sample.

5.3 Fine Coal Refuse

Two fine coal refuse bulk samples were obtained from the South Pond (Phase 2) for laboratory testing. The scope of the testing is discussed below and the results are presented in Appendix I [3] (under separate cover).

- Moisture Content – Moisture contents were performed on the two fine coal refuse samples.
- Grain-size Analysis – Grain size distribution analysis was performed on the two fine coal refuse samples (sieve and hydrometer).
- Atterburg Limits – Atterberg Limit tests were performed on the two fine coal refuse samples.

- Specific Gravity – Specific gravity tests were performed on the two fine coal refuse samples.
- Shear Strength – Six consolidated – undrained triaxial tests were run on remolded fine coal refuse samples. These six tests included moisture content and total and dry density determinations.

1

5.3 Piezo-Seismic Cone Penetration Testing

- Fifteen piezo-seismic cone penetration soundings were performed at the Pond Creek site to measure tip stress, sleeve stress, pore water pressure, and shear wave velocities. The testing g was used to correlate index and strength parameters for the coarse coal refuse and foundation soil and for use in a deformation analysis.

- The testing data and results are presented in Appendix I (under separate cover).

6.0 COAL REFUSE DISPOSAL PLAN

The proposed plan provides disposal capacity for approximately 4 years of coarse and 7 years of fine coal refuse production. The plan has been developed in accordance with prudent engineering principles and practices and current Mine Safety and Health Administration (MSHA) design criteria for coal refuse disposal facilities. It is intended that the construction of the facility be monitored by experienced persons knowledgeable of the design, specifications and regulatory requirements.

A brief description of the disposal plan is as follows:

1. Sedimentation control for the construction of the embankment shall be provided by sedimentation ditches. Bench gutters and conveyance ditches shall be constructed to route the runoff from the embankment area to the sedimentation ditches.

2. Following topsoil removal, the Phase 3 embankment footprint shall be proofrolled and the Phase 3 embankment shall be constructed. Subsequently, the Phase 4 embankment footprint shall be proofrolled and Phase 4 embankment constructed followed by Phases 5, 6 and 7. Phase 6 shall be constructed using downstream construction techniques and Phase 7 shall raise the Phase 6 crest.

3. Fine coal refuse slurry may be pumped into the Phase 3 impoundment upon commencement of the construction of the Phase 4 embankment. The discharge line(s) shall be moved to result in a relatively uniform surface of fines throughout the impoundment and to minimize the depth of any water impounded directly against the

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(3) GAI Consulting, Inc. report entitled " Response to MSHA Comment Nos. 1, 3, 7 and 8, Pond Creek Mine No. 1, Coal Refuse Disposal Facility No. 2, Phases 3 and 7, Impoundment ID No. 1211-IL08-03141-02, Williamson Energy LLC, Mach Mining Company, Williamson County, Illinois," prepared for Alliance Consulting, Inc., Project C090403.01, May 2009.

embankment slope. Generally, a delta of fine coal refuse shall be maintained along the embankment slope.

4. Operational pump(s) and discharge line(s) shall be maintained to remove clarified water and normal rainfall from the impoundment. The facility has been designed to store the runoff associated with a PMF design storm event. Decant pipes have been specified to evacuate the design storm runoff.

5. An internal drainage system located within the Phases 3, 5 and 6 embankments shall be installed to aid in controlling the phreatic level within the embankments.

6. Bench and road gutters shall be installed to control surface runoff and minimize erosion. All final surfaces shall be revegetated upon completion.

6.1 Phase 3

Prior to Phase 2 embankment construction, it will be necessary to initiate general site preparation activities to include topsoil removal and proof rolling. Soft areas encountered during the proof rolling shall be compacted or the material shall be removed and replaced with the same material as used in the Phase 3 embankment. Following proof rolling, the Phase 3 embankment shall be constructed using coarse coal refuse from the Mach #1 Mine coal preparation plant. The approximate location of the Phase 3 embankment is shown in plan and cross section on Figure Nos. 3 and 8, respectively, requires approximately 0.5 years of coarse coal refuse production to construct. Pertinent construction items include:

1. Coarse Coal Refuse Disposal – Phase 3 involves constructing an embankment 50 feet high to Elevation 500 using coarse coal refuse. As shown on Figure No. 8, the upstream slope of the embankment shall be constructed on a grade of 2.6H:1V and the downstream slope shall be on a grade of 3H:1V.

2. Fine Coal Refuse Disposal – Fine coal refuse slurry may be pumped into the impoundment upon the end of Phase 3 construction. Periodic relocation of the slurry discharge line shall be performed to promote a more uniform distribution of the fine coal refuse and to minimize the depth of clarified water impounded directly against the embankment slope.

3. Decant Pipe – Construction of the decant pipe shall be performed concurrent with the construction of the Phase 3 embankment. The installation includes excavating a trench into the embankment and placing an HDPE pipe and appurtenant structures (drop inlet, ditch, filter and drainage diaphragm and outlet drain). The drop inlet shall be extended vertically to Elevation 494.8 by adding the appropriate length of 18-inch diameter SDR 26 HPDE pipe to the HDPE elbow attached to the transport section of the decant pipe. The decant pipe shall be installed in accordance with the details presented on Figure No. 11.

4. Internal Drain - An internal drainage system consisting of a perforated pipe and gravel, both wrapped with filter fabric, shall be installed during the construction of Phase 3 to

aid in controlling the phreatic level within the embankment. The location and invert elevations for the internal drain are presented on Figure No. 3. Details pertaining to the drain construction are provided in the guideline technical specifications and on Figure No. 10.

5. Surface Drainage – Sedimentation/perimeter ditches shall be constructed as shown on Figure No. 3, to collect surface water and clarify the runoff before it is discharged into an existing channel. Ditch details are included on Figure Nos. 10, 11 and 12.

6. Instrumentation – Piezometer Nos. P-6, P-7, and P-8 shall be installed during Phase 3 construction at the locations shown on Figure No. 3. The proposed piezometer tip elevations are presented on Figure No. 15 and the piezometer installation detail is presented on Figure No. 13. Pressure transducers PN-1 and PN-2 (pneumatic piezometers or vibrating wire piezometers) and inclinometers I-1 and I-2 shall be installed in the Phase 3 embankment prior to undermining the phase. Their locations are shown on Figure No. 3. The proposed pressure transducer elevations are shown on Figure No. 16 and the installations details for the transducers and inclinometers are shown on Figure No. 13.

7. This impounding embankment of Phase 3 will be completed and slurry pumping into the impoundment will be completed before mining beneath the phase occurs. The Phase 3 impoundment will be capped before undermining occurs. Based on subsidence predictions, the internal drainage system for the embankment has been redesigned to continue to function post-subsidence. Any disruption of surface drainage features due to subsidence will be repaired. In the unlikely event embankment cracking and potential loss of slurry occurs during undermining of Phase 3, a contingency buttress and blanket drain have been designed as shown on Figure No. 13.

6.2 Phase 4

Phase 4, which is shown in plan and cross section on Figure Nos. 4 and 8, respectively, requires approximately 0.5 years of coarse coal refuse production to construct. Pertinent construction items include:

1. Embankment Construction – The Phase 4 embankment shall be situated approximately as shown on Figure No. 4 with an upstream toe at Elevation 446± and a final crest at Elevation 492. The embankment will require the placement of approximately 1.33 million cubic yards of coarse coal refuse. The material used for the embankment construction shall be compacted to 95 percent of Standard Proctor maximum dry density. The moisture content of the material shall be within -2 to +3 percent of the optimum moisture content. As indicted on Figure No. 8 the upstream and downstream slopes of the Phase 4 embankment shall be constructed on a grade of 3 (horizontal) to 1 (vertical).

2. Fine Coal Refuse Disposal – During construction of the Phase 4 embankment, the fine coal refuse slurry shall continue to be pumped into the Phase 2 and 3 impoundments.

3. Pump Installation – An operational pump, of sufficient capacity to remove clarified water and normal precipitation, and associated discharge lines shall be installed during construction of Phase 4. The pump shall discharge into Sediment Pond No. 6 and/or the Freshwater Pond.

Phase 4 is an intermediate phase in preparation for the construction of Phases 5, 6, and 7. No slurry will be pumped into Phase 4 and no internal drainage features are included in this phase. Undermining of Phase 4 will occur shortly after its construction. The embankment and pool area of this phase will be examined for subsidence cracks and repairs will be made as needed. It is anticipated that when slurry pumping begins in Phase 7 any undetected subsidence cracks in the Phase 4 embankment and foundation will be sealed by the slurry. This Phase will be buttressed to the south by Phase 3, which will be already completed and full of slurry; by Phase 6 to the east and west, which will be built post-subsidence; and by Phase 5 to the north, which will be also built post-subsidence.

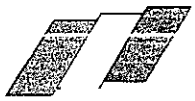
7.3 Phase 5

Phase 5 will be built post-undermining. Prior to Phase 5 embankment construction, the Phase 5 cell shall be excavated and general site preparation activities including topsoil removal, subsidence crack sealing, and proof rolling. Soft areas encountered during the proof rolling shall be compacted or the material shall be removed and replaced with the same material as used in the Phase 5 embankment. Following subsidence crack sealing and proof rolling, the Phase 5 embankment shall be constructed using coarse coal refuse from the Mach #1 Mine preparation plant. The approximate location of the Phase 5 embankment is shown in plan and cross section on Figure Nos. 5 and 8, respectively, requires approximately 0.6 years of coarse coal refuse production to construct. Pertinent construction items include:

1. Coarse Coal Refuse Disposal – Phase 5 involves constructing an embankment 50 feet high to Elevation 488 using coarse coal refuse. The upstream slope of the embankment shall be constructed on a grade of 3H:1V and the downstream slope shall be on a grade of 3H:1V.

2. Fine Coal Refuse Disposal – Fine coal refuse slurry may be pumped into the impoundment throughout Phase 5 construction. The average settled fine coal refuse level is expected to rise to Elevation 432± by the completion of the phase. Periodic relocation of the slurry discharge line shall be performed to promote a more uniform distribution of the fine coal refuse and to minimize the depth of clarified water impounded directly against the embankment slope.

3. Internal drain – An internal drainage system consisting of either a geocomposite and perforated pipe or non-calcareous gravel wrapped with a geotextile and perforated pipe, shall be installed during the construction of Phase 5 to aid in controlling the phreatic level within the embankment. The location and invert elevations for the internal drain are presented on Figure No. 5. Details pertaining to the drain construction are provided in the guideline technical specifications and on Figure No. 10.



4. Surface Drainage – Bench gutters shall be constructed as shown on Figure No. 5, to collect and convey surface water runoff to the sediment ditches. Ditch details are presented on Figure No. 10, 11 and 12.

5. Instrumentation – Piezometer Nos. P-9, P-10 and P-11 shall be installed during Phase 5 construction at the locations shown on Figure No. 5. The proposed piezometer tip elevations are presented on Figure No. 14 and the piezometer installation detail is presented on Figure No. 13.

6. Decant Pipe – Construction of the decant pipe shall be performed concurrent with the construction of the Phase 5 embankment. The installation includes excavating a trench into the embankment and placing approximately 94 feet of HDPE pipe and appurtenant structures (drop inlet, ditch, filter and drainage diaphragm and outlet drain). The drop inlet shall be extended vertically to Elevation 480 by adding the appropriate length of 18-inch diameter SDR 26 HPDE pipe to the HDPE elbow attached to the transport section of the decant pipe. The decant pipe shall be installed in accordance with the details presented on Figure No. 11.

7. Subsidence Crack Repair – The Phase 5 pool area will be examined for cracking and any areas containing cracks will be excavated to a depth of at least four feet, proof rolled, and backfilled and sealed with compacted coarse coal refuse placed to the compaction standard in the Guideline Technical Specifications. In the event that extensive, deep cracking is discovered, a slurry trench or cutoff trench will be extended to bedrock through the affected areas. The trench will be located beneath the underdrain alignment for Stage 5. If it is discovered that a slurry or cutoff trench is needed, a specific design will be submitted for approval prior to its construction. Any additional cracks discovered after slurry pumping begins during Phase 5 will be sealed by directing the slurry into the pool over to the cracks.

Phase 5 will be buttressed to the south by Phase 4.

6.4 Phase 6

Phase 6 will be built post-mining and no slurry will be pumped into this phase. Phase 6, which is shown in plan and cross section on Figure Nos. 6 and 8, respectively, requires approximately 0.7 years of coarse coal refuse production to construct. Pertinent construction items include:

1. Coarse Coal Refuse Disposal – Phase 6 involves widening the Phase 4 embankment crest and downstream construction techniques. The upstream and downstream slopes of the embankment shall be constructed on a grade of 3H:1V.

2. Fine Coal Refuse Disposal – Fine coal refuse slurry shall continue to be pumped into the Phase 3/5 impoundment throughout Phase 6 construction. The average settled fine coal refuse level is expected to rise to Elevation 462± in Phase 5 by the completion of Phase 6. Periodic relocation of the slurry discharge line shall be performed to promote a more uniform distribution of the fine coal refuse and to

minimize the depth of clarified water impounded directly against the Phase 5 embankment slope.

3. Pump Installation – An operational pump, of sufficient capacity to remove clarified water and normal precipitation, and associated discharge lines shall be installed during construction of Phase 6. The pump shall discharge into Sediment Pond No. 6 and/or the Fresh Water Pond.

4. Internal drain – An internal drainage system consisting of either a geocomposite and perforated pipe or non-calcareous gravel wrapped with a geotextile and perforated pipe, shall be installed during the construction of Phase 6 to aid in controlling the phreatic level within the embankment. The location and invert elevations for the internal drain are presented on Figure No. 6. Details pertaining to the drain construction are provided in the guideline technical specifications and on Figure No. 10.

5. Surface Drainage – Sedimentation/perimeter ditches shall be constructed as shown on Figure No. 6, to collect surface water and clarify the runoff before it is discharged into an existing channel. Ditch details are included on Figure Nos. 10, 11 and 12.

6. Instrumentation – Piezometer Nos. P-12, P-13, P-15 and P-16 shall be installed during Phase 6 construction at the locations shown on Figure No. 6. The proposed piezometer tip elevations are presented on Figure Nos. 14 and 15 and the piezometer installation detail is presented on Figure No. 13.

7. Subsidence Crack Repair – Prior to construction of the Phase 6 embankment, the Phase 4 pool area, Phase 4 embankment, and Phase 6 foundation area will be examined for cracking and any areas containing cracks will be excavated to a depth of at least four feet, proof rolled, and backfilled and sealed with a compacted coarse coal refuse placed to the compaction standard in the Guideline Technical Specifications. In the event that extensive, deep cracking is discovered, a slurry trench or cutoff trench will be extended to bedrock through the affected areas. The trench will be located beneath the underdrain alignment for Stage 6. If it is discovered that a slurry or cutoff trench is needed, a specific design will be submitted for approval prior to its construction. Any additional cracks discovered after slurry pumping begins during Phase 6 will be sealed by directing the slurry into the pool over to the cracks. The Phase 4 embankment is the only embankment subject to subsidence cracking prior to slurry pumping. Any additional cracks discovered after slurry pumping begins during Phase 6 will be sealed by directing the slurry into the pool over to the cracks.

6.5 Phase 7

Phase 7, which is shown in plan and cross section on Figures No. 7 and on Figure 8, respectively, requires approximately 1.0 years of coarse coal refuse production to construct. Pertinent construction items include:

1. Coarse Coal Refuse Disposal – Phase 7 involves raising the Phase 6 embankment crest 46 feet to Elevation 538 using coarse coal refuse. Phase 7 will be constructed in six stages to maintain the required storm runoff storage capacity. The upstream and downstream embankment slopes shall be constructed to 3H:1V. The final embankment slopes shall be soil covered and vegetated in accordance with the Illinois reclamation permit.

2. Fine Coal Refuse Disposal – Fine coal refuse slurry shall be pumped into the Phase 5 impoundment to maximum Elevation 480, at which time slurry shall begin to be pumped into the Phase 7 impoundment. The average settled fine coal refuse level is expected to rise to Elevation 464± by the completion of the Phase 7 embankment. Periodic relocation of the slurry discharge line shall be performed to promote a more uniform distribution of the fine coal refuse and to minimize the depth of clarified water impounded directly against the embankment slope.

3. Surface Drainage – Bench and access road gutters shall be constructed as shown on Figure No. 7, to control and convey surface water runoff. Ditch details are presented on Figure Nos. 10, 11 and 12.

4. Instrumentation – Piezometer Nos. P-14 and P-17 shall be installed, during Phase 7 construction at the locations shown on Figure No. 7. Piezometer extension and installation details are presented on Figure No. 13. The piezometer tip elevations are specified on Figure Nos. 14 and 15. Pressure transducers PN-3 and PN-4 will be installed after Phase 3 is capped but before Phase 7C is started at the locations shown on Figure No. 3. The proposed pressure transducer elevations are shown on Figure 16 and the installation details are shown on Figure No. 13.

5. Decant Pipe – Construction of the decant pipe shall be performed concurrent with the construction of the Phase 7 embankment. The installation includes excavating a trench into the embankment and placing approximately 190 feet of HDPE pipe and appurtenant structures (drop inlet, ditch, filter and drainage diaphragm and outlet drain). The drop inlet shall be extended vertically to Elevation 530 by adding the appropriate length of 18-inch diameter SDR 26 HPDE pipe to the HDPE elbow attached to the transport section of the decant pipe. The decant pipe shall be installed in accordance with the details presented on Figure No. 11.

Phase 7 will be built post-mining. As shown on Figure No. 6, the part of original Phase 7B below Elevation 492 shall be constructed during Phase 6 construction. The remainder of Phase 7B, along with Phase 7A and Phase 7C shall be constructed in six stages as indicated on Figure Nos. 7 and 9. As previously stated, it is anticipated that the slurry will seal any undetected cracks not detected and repaired during Phases 4 and 6.



6.6 Abandonment Plan

An abandonment grading plan has been provided on Figure No. 22. Briefly, the impounding capability shall be eliminated by filling the impoundment with coarse coal refuse. The final embankment configuration shall be constructed to drain as per the lines and grades shown on Figure No. 22 and the entire site shall be soil covered and seeded in accordance with the Illinois reclamation permit. The plan shall be reevaluated prior to abandonment based on actual coal refuse production rates, existing site conditions and embankment configuration, and revised if necessary.

7.0 ENGINEERING ANALYSES

In support of the plan, engineering analyses included slope stability analyses and the hydrologic and hydraulic studies for the impoundment and surface drainage facilities. The calculations describing the design assumptions, methodology and results are included in Appendix B.

7.1 Hydrologic and Hydraulic Analyses

The proposed facility has been evaluated using storm criteria for high hazard dams. Upon the one-year anniversary and thereafter, the impoundment shall be capable of storing the runoff associated with a PMF design storm event plus three feet of freeboard.

Evacuation of the stored water shall be accomplished by pumping for Phases 4 and 6. The required pumping capacity (1901.8 gallons per minute for Phases 4 and 6) is based on storing the runoff associated with two design storm events and evacuating the runoff associated with one design storm event within a reasonable time period (approximately 30 days). Should the available storage capacity be reduced to one design storm event, the emergency pumps shall be mobilized to the site to evacuate the stored runoff and provisions shall be made so the pumps and associated discharge line are readily available, when needed.

Evacuation of the stored runoff shall be accomplished by means of a decant pipe for the Phases 3, 5 and 7 impoundments. The required pipe size, 18-inch SDR 26, is based on evacuating 90% of the runoff associated with one design storm event within 10 days. The surface drainage facilities, including road and bench gutters, and Ditches C through M have been sized to convey runoff associated with the 100-year, 6-hour recurrence interval storm event. The computed peak discharges were estimated using the computer program SedCad developed by the University of Kentucky. All permanent facilities have been designed with appropriate protection to minimize the potential for channel erosion. Details for the surface drainage facilities are presented on Figure Nos. 10, 11 and 12.

7.2 Slope Stability Analyses

Slope stability analyses have been performed for the upstream and downstream slopes of the Phases 3, 5 and 7 embankments using PCSTABL5, a computerized version of the modified Bishop Method of Slices, developed by Purdue University and the Indiana State Highway Commission. The critical potential failure surfaces, minimum factors of safety,

and material properties used in the slope stability analyses are presented on Figure Nos. 14, 15 and 16 and in the calculation brief.

Slope stability was analyzed for both static and seismic (pseudo static) loading conditions for the downstream and upstream embankment slopes. For the static analysis, effective properties for the coal refuse and existing soil were used. For the pseudo-static analysis, total stress properties were used for the existing soils. The use of effective stress properties for the coal refuse and total stress properties for the existing cohesive soils is appropriate, giving the effects of the sudden loading in an earthquake event and the relatively slow drainage characteristics of the soils. Also, for the pseudo-static analysis, a horizontal acceleration of 0.15g[4] was used. The phreatic level used in the stability analyses was conservatively based on top flow line calculations performed on a transformed section. The transformed section was based on the horizontal permeability of the embankment material being nine times greater than the vertical permeability. The engineering properties of the embankment material were based on laboratory test results and our experience with similar materials.

The most critical potential long-term failure surfaces, as shown on Figure Nos. 14, 15 and 16, are summarized below:

Stage	Case	Minimum Static F.S.	Minimum Seismic F.S.
Phase 3	Downstream	1.51	1.23
	Upstream	1.89	1.20
Phase 5	Downstream	1.58	1.21
	Upstream	1.76	1.32
Phase 7	Downstream	1.52	1.20
	Upstream	1.82	1.26
Phase 7C South Slope	Downstream	1.50	*

As indicated in the above table, the computed factors of safety meet the minimum requirements (1.5 and 1.2 for the static and seismic cases, respectively).

* A liquefaction susceptibility analysis for Phase 7C was performed using zero-strength to very low strength for the fine coal refuse to evaluate the post-earthquake factors of safety. Factors of safety range from 1.2 to 1.6 for shallow and deep failure circles, respectively. The possibility of liquefaction of the fine coal refuse in Phase 3 during mining subsidence related disturbance was evaluated using a driving shear stress slope stability analysis with zero strength for the fine coal refuse. Factors of safety for the Phase 3 embankment, in the upstream and downstream directions, were 2.2 and 1.3 respectively. The factor of safety against embankment cracking during mine subsidence was evaluated and estimated to be 1.1. These analyses are contained in Appendix I (under separate cover).

[4] National Earthquake Hazards Reduction Program, Part I, Provisions for the Development of Seismic Regulations for New Buildings, Map 1, 1991 Edition.

8.0 SUMMARY

The design plans for the proposed Mach #1 Mine Coal Refuse Disposal Facility No. 2 (Phases 3 through 7) are based on the subsurface exploration program, field and laboratory testing, and the engineering analyses described herein. The plan should provide disposal for approximately 3.3 years of coarse coal refuse and 5.8 years of fine coal refuse.

We trust that the plans, design calculations and guideline technical specifications described herein are acceptable to Mach Mining and the appropriate regulatory authorities. In preparing this document, our professional services have been performed with care and skill ordinarily exercised by reputable members of the profession practicing under similar conditions at the same time and the same or similar locality. No warranty, expressed or implied, is made by rendition of these consulting services or by furnishing oral or written reports of the findings made.

If there are any questions, or if further clarification is required, please contact us.

Respectfully submitted,

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HLO/CEY:knm

APPENDIX A

GUIDELINE TECHNICAL SPECIFICATIONS
ENGINEERING DESIGN PLAN
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
MACH #1 MINE
MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS
JOHNSON CITY, ILLINOIS

TABLE OF CONTENTS

	PAGE
INTRODUCTION	A-1
LIST OF DRAWINGS	A-2
1.0 SITE PREPARATION	A-3
1.01 General	A-3
1.02 Stripping and Topsoil Removal	A-3
1.03 Surface Sealing/Proofrolling	A-3
2.0 EMBANKMENT CONSTRUCTION	A-4
2.01 General	A-4
2.02 Coarse Coal Refuse Placement and Compaction	A-4
2.03 Survey Con trol	A-6
? 04 Subsurface Drains	A-6
2.05 Standpipe Piezometers	A-7
2.06 Pore Pressure Transducers	A-7
2.07 Inclinometers	A-9
2.08 Refu se Haul and Access Road Construction	A-9
2.09 Decant Installation	A-9
2.10 Pipe Installation	A-10
2.11 Drop Inlet	A-11
2.12 Trash Rack	A-11
2.13 Filter and Drainage Diaphragm	A-12
3.0 FINE COAL REFUSE DISPOSAL	A-12
3.01 General	A-12
3.02 Clarified Water Removal	A-13
4.0 SURFACE WATER DRAINAGE FACILITIES	A-13
4.01 General	A-13
4.02 Ditches C through M	A-13
4.03 Access Road Gutters	A-13
4.04 Rock Riprap	A-14
4.05 Uniform Section Mat	A-15
5.0 REVEGETATION OF COMPLETED AREAS	A-16

TABLE OF CONTENTS
(Continued)

6.0	MONITORING AND MAINTENANCE	A-16
	6.01 Piezo meters and Impoundment Level	A-16
	6.02 General Observations	A-17
	6.03 Phase 2 and Phase 3 Enhanced Monitoring	A-17
	6.04 Subsidence Baselines	A-18
	6.05 Maint enance	A-18
	6.06 Data Review	A-19

APPENDIX A

GUIDELINE TECHNICAL SPECIFICATIONS
ENGINEERING DESIGN PLAN
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
MACH #1 MINE
MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS
JOHNSON CITY, ILLINOIS

INTRODUCTION

These specifications are intended to serve as guidelines for the construction of the Pond Creek No. 1 Mine Coal Refuse Disposal Facility No. 2 to serve Mach Mining LLC's (Mach Mining) coal preparation plant in Williamson County, Illinois. The information contained herein, including the accompanying drawings which illustrate the disposal plan, is sufficiently detailed to provide Mach Mining with the technical guidance required to perform coal refuse disposal operations in a manner consistent with the design assumptions and sound engineering practice. These specifications are intended to be supplemented with periodic site visits by persons knowledgeable of the design in order to conduct inspections of the construction procedures, conduct field tests and, if necessary, obtain samples and perform laboratory testing.

The specifications have been prepared to aid Mach Mining in the design, planning, and construction of the specific project. Its scope is limited to the project and location described herein and represents our understanding of the significant aspects relevant to the planned operations. If there are any differences in location and/or design features, the modification should be reviewed to determine if revision of conclusions or recommendations is required.

This refuse disposal plan provides for the construction of a two embankments sharing a common side, utilizing coarse coal refuse to form an impoundment for the disposal of fine coal refuse slurry. The disposal plan for the facility will provide approximately 4 years of coarse and 7 years of fine coal refuse disposal capacity based on refuse production rates supplied by Mach Mining.

Briefly, the work items required in the coal refuse disposal plan include:

1. Site Preparation - In areas of embankment construction, the site preparation items include topsoil stripping and stockpiling and proofrolling/sealing. During the disposal operations, benching of each lift of material into existing slopes shall be required as well as scarifying previously compacted surfaces.

2. Embankment Construction - Coarse coal refuse embankments shall be constructed to provide disposal capacity for approximately 7 years of fine coal refuse.

3. Subsurface Drainage – An internal drainage system shall be installed in the Phases 5 and 6 embankment to aid in controlling the phreatic level.

4. Fine Coal Refuse Disposal – Upon commencement of Phase 4 construction, fine coal refuse slurry may be pumped into the Phase 3 impoundment. A water pumping system shall be used to remove excess clarified slurry water and precipitation from the impoundment.

5. Surface Drainage Facilities - To control and direct surface water runoff from the embankment and road ditches, Ditches C through M shall be constructed concurrent with construction operations.

6. Abandonment – An abandonment grading plan has been provided. The plan shall be re-evaluated prior to abandonment based on actual coal refuse production rates, existing site conditions and embankment configuration, and revised if necessary.

7. Revegetation - To control erosion and provide an acceptable post mining land use, all completed embankment surfaces shall be revegetated in accordance with Mach Mining Mine Permit.

8. Monitoring and Maintenance - A program of regular monitoring and maintenance of the disposal operations is described herein.

LIST OF DRAWINGS

The following drawings form a part of these specifications:

FIGURE NO.	DRAWING NO.	TITLE
1	B05-330-T2	Title Sheet
2	B05-330-M19	Plan – Existing Conditions
3	B05-330-M30	Plan – Phase 3
4	B05-330-M31	Plan – Phase 4
5	B05-330-M32	Plan – Phase 5
6	B05-330-M34	Plan – Phase 6
7	B05-330-M33	Plan – Phase 7

FIGURE NO.	DRAWING NO.	TITLE
8	B05-330-E13	Sections C-C, D-D and F-F
9	B05-330-E22	Section E-E
10	B05-330-E14	Details
11	B05-330-E24	Decant Installation and Uniform Section Mat Details
12	B05-330-E49	Ditch "F" Profile and Details
13	B05-330-E47	Instrumentation and Contingency Buttress Details
14	B05-330-E12	Slope Stability Analysis – Sections C-C and D-D
15	B05-330-E39	Slope Stability Analysis – Sections F-F and G-G
16	B05-330-E48	Slope Stability Analysis – Section F-F (Phase 7C)
17	B05-330-M36	Mining/Impoundment Construction Timing Map
18	B05-330-E46	Subsidence Effects Predictions Map
19	B05-330-M50	Mine Vertical Subsidence Predictions
20	B05-330-M51	Mine Subsidence Horizontal Strain Predictions
21	B05-330-M44	Subsidence Survey Panel No. 1 Section
22	B05-330-M20	Abandonment Plan

1.0 SITE PREPARATION

1.01 General

Beneath all areas of the coarse coal refuse embankment, site preparation shall be required.

1.02 Stripping and Topsoil Removal

Stripping and stockpiling of topsoil and root matter are required to provide an adequate foundation for facility construction. All topsoil shall be removed prior to embankment construction. The stripped topsoil shall be stockpiled.

1.03 Surface Sealing/Proofrolling

The footprint of the embankment shall be proofrolled following stripping and topsoil removal to seal and compact the foundation soils. A minimum of three passes shall be made over each area using a large sheepsfoot roller or rubber-tired equipment (i.e. loaded truck) to produce a minimum dry density equivalent to 95 percent of the maximum dry density attainable by the Standard Proctor method of compaction (ASTM D 698). Any soft or wet soils shall be removed to a minimum depth of 2 feet below the previously excavated surface and replaced with coarse coal refuse. The

over-excavated area shall be backfilled in 12-inch lifts, and compacted to 95 percent of the Standard Proctor maximum dry density (ASTM D 698).

Random in-place density testing shall be performed throughout the impoundment area to verify that the existing stripped surface is compacted to 95 percent of the Standard Proctor maximum dry density prior to fine coarse coal refuse slurry disposal.

If subsidence cracks are discovered in the pool or embankment foundation area of Phases 5 or 6, areas containing cracks will be excavated to a depth of at least four feet, proof rolled, and sealed with compacted coarse coal refuse placed to the compaction standards in Section 2.02 of these specifications. Areas of subsidence cracking in the Phase 4 embankment shall be excavated to the extent of the visible limits of cracking. The excavated areas shall be backfilled with coarse coal refuse placed to the compaction standards of Section 2.02 and keyed into the sides of the excavation in the manner shown on Drawing Number B05-330-A4 in Section E of this report.

2.0 EMBANKMENT CONSTRUCTION

2.01 General

To provide storage capacity for approximately 4 years of coarse and 7 years of fine coal refuse, 3 embankments shall be constructed of coarse coal refuse sharing a common side. Drawing Nos. B05-330-M30, -M31, -M32, -M33, -M34 and -E13 present the plans and section of the proposed embankment phases.

Sediment control shall be provided by the combination sediment/perimeter ditches. Conveyance ditches shall be constructed to convey surface runoff to the sediment/perimeter ditches.

2.02 Coarse Coal Refuse Placement and Compaction

a. Lines and Grades – Coarse coal refuse shall be placed to the lines and grades shown on the drawings for the various stages. Control for placement can be established from the coordinate system provided on the drawings.

b. Material: Run-of-plant coarse coal refuse from the coal preparation plant shall be used for the embankment construction. Placement and compaction of the refuse shall be in accordance with Sections 2.02.c and d.

c. Placement: Coarse coal refuse shall be spread in lifts not more than 1 foot thick when compacted. Material that is too wet to be properly compacted shall be spread

and graded to facilitate drainage. Upon drying to within the acceptable moisture content range, compaction shall proceed.

d. Compaction: The coarse coal refuse in the impounding embankment shall be spread in layers having a compacted thickness of 1 foot or less. The material shall be compacted by routing heavy equipment (dozers, trucks, etc.) over it or utilizing specialized compaction equipment to attain the specified degree of compaction. No special compaction procedures are anticipated to be required to provide resulting densities which are consistent with those used in the design. A field density testing program shall be conducted during the placement operations to determine the actual dry density being achieved.

Field density testing of the foundation soil and coarse coal refuse placed in the embankment areas shall be performed to confirm that the compactive effort employed is yielding an in-place dry density of at least 95 percent of the maximum density obtainable by the Standard Proctor Compaction Method (ASTM D 698). Density testing shall be performed at equivalent frequencies of one test per 2,000 cubic yards of material placed and compacted and at least one test for each lift. Locations, elevations and dates of the tests shall be recorded and maintained for documentation purposes. The moisture at time of compaction shall be within the range of optimum moisture by -2 percent to +3 percent. If in-place dry densities are observed to be less than that required, additional compaction shall be performed on the effective test area and the area retested. Such work shall continue until satisfactory results are obtained.

At least one Standard Proctor test of the material shall be verified for every 20 field density tests performed. Additionally, should mining or preparation plant operations change such that a change in refuse material properties is anticipated, the Proctor shall be verified.

e. Construction Procedures: The work surface shall be advanced upward in nearly horizontal layers. To minimize penetration of precipitation, the work surface shall be sloped to drain and backbladed as the material is spread. No fill shall be placed that is or on frozen material. If the surface where fill is to be placed is frozen, the frozen material shall be removed over an area where one day's refuse will be placed prior to placement of a new lift. The frozen material shall be stored until it is thawed and then replaced. Surface material in the impounding embankment too wet to support construction equipment shall be removed to expose drier material

prior to placement of the next refuse layer. After drying, these wet materials can be reused in the embankment. As the level of the embankment is raised, it shall be graded smoothly to the contours shown on the plans. Coarse coal refuse placement guidelines are contained in Appendix E.

2.03 Survey Control

Survey control shall include establishment of permanent monuments outside of, but adjacent to the refuse disposal facility and underground mining limits. This control shall be used for the management of day-to-day operations.

2.04 Subsurface Drains

a. General – To minimize the possible rise in the phreatic level as the impoundment level rises, internal underdrains shall be installed within the embankment. The drains shall consist of either a geocomposite drainage material or non-calcareous gravel both with an HDPE perforated pipe wrapped entirely with geotextile. The approximate alignment and elevations of the drains are indicated on Drawing Nos. B05-330-M30, -M32, -M34 and –E22. The underdrain details are presented on Drawing No. B05-330-E14.

b. Filter Fabric – The filter fabric shall be "Propex 4550" manufactured by Propex Fabrics, Inc., or an approved equivalent geotextile that is ultraviolet stabilized to resist deterioration. The filter fabric shall be protected from ultraviolet exposure during storage.

c. Pipe – The pipe used in the internal drain shall be a perforated high-density polyethylene pipe as specified on the individual phase drawings. The perforations shall be in accordance with the detail on Drawing No. B05-330-E14. The outlet pipes shall not be perforated.

d. Rock Gravel – Competent, durable, clean gravel in the size range of 3/8" to 1½" shall be used in the drains. The gravel shall consist of non-acid, non-toxic, non-calcareous rock that will not slake in water or degrade to soil material during the life of the facility, and which is free of coal, clay or other non-durable material.

e. Geocomposite – If a geocomposite drainage material is selected for the drain in lieu of the river gravel, the geocomposite shall be PermaNet HL, manufactured by GSE Lining Technologies, or equivalent. The geocomposite shall be entirely wrapped with filter fabric and shall be wrapped around the HDPE perforated collection/conveyance pipe. The geocomposite underdain detail is presented on Drawing No. B05-330-E14.

3. Installation – Details pertaining to the internal drains are presented on Drawing No. B05-330-E14. As shown on the drawing, the pipe shall be perforated with ½ - inch diameter holes and wrapped entirely with filter fabric with a minimum 2-foot overlap for Phase 3. For Phases 5 and 6, 3/8 – inch perforations may be used in lieu if wrapping the pipe with filter fabric. The drain shall be constructed to the dimensions shown on the drawing.

   The installation of the underdrains shall be monitored by the engineer responsible for certifying the construction of the embankment or by a qualified person designated by the engineer.

2.05 Standpipe Piezometers

Standpipe Piezometers shall be installed at the locations shown on the drawings and in accordance with the detail on Drawing No. B05-330-E47. Clean concrete sand may be substituted for the pea gravel if the latter is difficult to obtain. The perforated section of the piezometer pipe shall be wrapped with filter fabric. Bentonite seals shall be placed immediately above the perforated section and just below the ground surface to isolate the piezometer tip from potential perched water tables and minimize any influence associated with surface water.

2.06 Pore Pressure Transducers (Piezometers)

a. Installed in Embankment – Pore pressure transducers shall be installed at the locations shown on the Drawing No. B05-330-M30 and in accordance with the details on Drawing No. B05-330-M47 Either pneumatic or vibrating wire piezometers may be used. Bentonite seals shall be placed immediately above the filter zone and just below the ground surface to isolate the piezometer from potential perched water tables and to minimize any influence associated with

surface water. Alternately, the borehole may be completely backfilled above the sand filter with bentonite or bentonite-cement grout.

b. Installed in Slurry - Pneumatic piezometers enclosed in a push-in well point or vibrating wire push-in piezometers shall be installed at the locations shown on the Drawing No. B05-330-M30 and in accordance with the detail on Drawing No. B05-330-M47 Bentonite seals shall be placed in the borehole through the coarse coal refuse immediately above the slurry zone and just below the ground surface to isolate the piezometer from potential perched water tables and to minimize any influence associated with surface water. The remainder of the borehole shall backfilled above the slurry zone with bentonite or bentonite-cement grout.

c. Pneumatic piezometers shall meet the following requirements:

Sensor Type	Twin-tube pneumatic transducer
Range	180 psi, pressure rated for 400 psi
Resolution	0.01 psi
Accuracy	± 0.015% FS (digital gauge)
Repeatability	± 0.05 psi
Filter	Sintered stainless steel, 50 micron pores
Materials	ABS and PVC plastic body, synthetic rubber diaphragm
Diameter	~ 1 inch

d. Vibrating wire piezometers shall meet the following requirements:

Sensor Type	Pluck-wire vibrating wire sensor with built-in thermistor or RTD
Range	100 psi
Resolution	0.025%
Accuracy	0.1% FS
Maximum Pressure	150% of range
Filter	Sintered stainless steel, 50 micron pores
Temperature Coefficient	<0.04%FS per °C
Materials	Stainless steel
Dimensions	~ 0.75" x 7.75"

2.07 Inclinometers

Inclinometers shall be installed at the locations shown on Drawing No. B05-330-M30. The inclinometer casing shall be 85 mm (3.34 – inch) diameter QC or Standard Casing as manufactured by Durham Geo Slope Indicator, or equivalent. The inclinometer casing shall grouted into a borehole extending to bedrock as shown in the detail on Drawing No. B05-330-M47.

Casing grooves are to be aligned with the direction of expected ground movement (north-south and east-west). Casing shall be supported evenly during transportation and storage and kept out of direct until installation to prevent deformation.

The top of the inclinometer casings shall be accurately located in plan view and elevation by surveying after installation. The locations shall be resurveyed prior to each reading during periods of ground movement (i.e. before the longwall approaches within 100-foot of the east side of the Phase 3 embankment, during mining under the embankment, and for two weeks after longwall wall mining under the east side of the Embankment)

2.08 Refuse Haul and Access Road Construction

An access road shall be extended to refuse facility operations as shown on the drawings. Throughout construction, access roads on the refuse pile shall be constructed to provide routes for access to the impoundment. Variations of road width or grade shall be determined by Mach Mining based upon site-specific considerations. The locations of the roads may vary from the roads shown on the drawings provided the specified crest widths and embankment slope grades are maintained.

2.09 Decant Installation

a. General

To aid in maintaining a normal pool elevation in the impoundment and to provide a mechanism to evacuate stored storm runoff, a 18-inch outside diameter, SDR 26 high density polyethylene (HDPE) decant pipe shall be installed at the elevations shown on Drawing No. B05-330-E13 where it shall discharge into a surface drainage ditch.

b. Decant Pipe

The pipe used for decant construction shall be 18-inch outside diameter, SDR 26 HDPE pipe (average inside diameter of 1.38 feet). The pipe joints shall be welded (fused) all around and pressure tested. Pressures used for the testing shall be for the maximum anticipated static water head of approximately 13 feet or approximately 6 pounds per square inch (psi) measured at the outlet end of the pipe. The pipe shall be tested prior to backfilling to facilitate repair or rewelding. End caps used for the pressure testing shall be welded sufficiently to withstand the test pressures. A pressure relief valve and pressure gauge shall be mounted on the downstream end of the pipe. The pipe shall maintain the constant test pressure for a minimum time period of 2 hours. No leakage is recommended, so extreme care shall be taken to account for any water added to or discharged from the pipe to maintain the specified test pressures. Records of the testing shall be maintained. Safety precautions for conducting the pressure testing shall be in accordance with current MSHA and Occupational Safety and Health Administration (OSHA) guidelines.

2.10 Pipe Installation

a. General - The decant pipe shall be installed on an adequate foundation in a manner to minimize differential settlement and excessive seepage along the outside of the pipe. All pipe installation shall be supervised by qualified personnel familiar with the intent of the design and knowledge of proper installation procedures.

b. Alignment - The pipe shall be placed in a trench excavated into the embankment at locations shown on Drawings No. B05-330-M30, -M32 and –M33 as determined by the engineer. Compacted fill used to level the pipe subgrade and form the bedding shall be a minimum of 6 inches thick, but shall not exceed approximately 2 feet beneath the pipe invert. Compaction shall be achieved in accordance with the detail presented on Drawing No. B05-330-E24 and Section 2.08e of these specifications. The decant drop inlet shall extended vertically from the upstream end of the pipe to the elevations shown on Drawing No. B05-330-E13.

c. Foundation Preparation - A 4-foot wide (minimum) trench shall be excavated at a location, determined by the Engineer, as per the detail presented on Drawing No. B05-330-E24. The trench shall be excavated 2 feet (minimum) below the final pipe invert. The backfill envelope shall be placed, as per the details shown on Drawing No. B05-330-E24 and in accordance with these specifications.

d. Pipe Connections - To provide a water-tight seal, the joints shall be welded (fused) sufficiently to withstand the design internal water pressure (6 psi, minimum) without leakage.

e. Backfilling - The backfill envelope, as shown on Drawing No. B05-330-E24, shall be raised uniformly on both sides of the pipe in 6-inch thick layers (8-inch thick loose lifts) and compacted to a density greater than or equal to 100 percent Standard Proctor maximum dry density (ASTM D 698) within -2 to +3 percent of the optimum water content. The bedding material shall be shaped to embed the 18-inch HDPE a minimum of 4 inches. One field density test (minimum) shall be performed for every 200 cubic yards of backfill placed and compacted with at least one test per lift.

f. Materials for Backfill - Materials used for backfilling shall consist of coarse coal refuse, free of any particles larger than 3 inches in any dimension.

2.11 Drop Inlet

a. General - To facilitate the installation of the trash rack and to prevent fines from entering the decant pipe, a drop inlet fabricated out of a 18-inch diameter SDR 26 HDPE 90 degree elbow shall be used. The elbow shall be fuse welded to the decant transport section and to the drop inlet riser.

b. Riser- The riser used to extend the drop inlet shall be 18-inch outside diameter, SDR 26 HDPE pipe, flange fitted at one end to facilitate connection to the trash rack. The riser connections shall be in accordance with the manufacturer's recommendations.

2.12 Trash Rack

a. General - To prevent large particles from entering and possibly clogging the decant pipe, a trash rack design has been provided. The trash rack shall be bolted to the riser pipe and can be removed for extension of the decant pipe. The trash rack may be fabricated with readily available parts.

b. Material - Materials required for the trash rack include 1 inch by 1 inch by 1/8-inch angle irons, No. 4 rebar, and 1/8-inch thick steel plate. Details are shown on Drawing No. B05-330-E24. The trash rack shall be flange fitted and bolted to the riser flange.

c. Paint - The trash rack shall be protected with rust-resistant paint after fabrication. The trash rack shall be inspected periodically and any damage repaired accordingly.

2.13 Filter and Drainage Diaphragm

a. General - A filter diaphragm shall be installed, as shown in plan and in detail on Drawing No. B05-330-E24, to minimize internal erosion (piping) along the outside of the decant pipe.

b. Material - The diaphragm shall be constructed of hard, durable, non-calcareous aggregate within the following gradation range and wrapped entirely in "Propex 4550" filter fabric or an equivalent approved by the Engineer.

Sieve Size	Percent Finer
3-inch	100
1-1/2-inch	84 to 100
3/4-inch	36 to 100
3/8-inch	6 to 100
No. 4	0 to 52
No. 10	0 to 10
No. 20	0 to 9
No. 40	0 to 8
No. 60	0 to 7
No. 140	0 to 6
No. 200	0 to 5

c. Filter and Drainage Diaphragm Outlet Drain - To convey seepage collected by the filter and drainage diaphragm to a surface drainage ditch, an outlet drain shall be constructed in accordance with the detail presented on Drawing No. B05-330-E24.

3.0 FINE COAL REFUSE DISPOSAL

3.01 General

Following disposal of the fine coal refuse in the Phase 2 impoundment to maximum Elevation 496, fine coal refuse shall be disposed in the Phase 3 impoundment. The slurry line(s) shall be periodically moved along the slope of the impoundment to maintain a relatively uniform fines level within the impoundment. Discharge shall initiate on the impoundment bottom and continue on fine coal refuse beaches as the slurry settles. In no case shall direct discharge onto embankment slopes be allowed.

3.02 Clarified Water Removal

Clarified water from the slurry impoundment shall be removed by a pumping system and directed into the proposed perimeter ditch system or to the coal preparation plant. The water level in the impoundment shall be maintained as low as practicable.

4.0 SURFACE WATER DRAINAGE FACILITIES

4.01 General

A system of sediment/perimeter ditches, access road gutters, bench gutters, and conveyance ditches shall be constructed to control surface runoff and minimize erosion. All runoff collected from the embankment area will be directed toward proposed sediment/perimeter ditches located at the toe of the Phases 5 and 7 embankment slopes. The conveyance ditches convey the flow from the embankment benches to the sediment/perimeter ditches.

4.02 Ditches C through M

To convey runoff from the embankment and slopes to the sediment/perimeter ditches, Ditches C through M, shall be constructed. The ditch locations are shown on the plan view Drawing Nos. B05-330-M20, -M30, -M32, -M33, and –M34 and the construction details are presented on Drawing Nos. B05-330-E14, -E24, and -E49. The final ditches shall be lined with the erosion protection specified on Drawing No. B05-330-E14. Temporary ditches shall be maintained around the base of the slopes. Any erosion damage sustained shall be immediately repaired.

4.03 Access Road Gutters

Surface runoff intercepted by access roads shall be kept off the road surface and in gutters on the uphill side. The roadway shall slope toward the gutter with the gutter approximately the same gradient as the access road. Permanent gutters shall be provided at abandonment with erosion protection (riprap) as shown in detail on Drawing No. B05-330-E14.

4.04 Rock Riprap

Where rock riprap protection is required in ditches and gutters because of high flow velocity, the riprap must have the following characteristics:

a. Material - Riprap shall be hard, durable cobbles and boulders of sandstone or limestone in the sizes specified on the details.

b. Size Gradation - Riprap size shall be predominantly in the range specified on the drawings. Smaller stones and cobbles shall be used to fill the voids between larger pieces.

c. Subgrade Preparation - The riprap subgrade shall be well compacted before riprap is placed. A layer of "Propex 4550" filter fabric, or approved equivalent, shall be placed on the subgrade prior to the riprap placement.

d. Riprap Placement - Riprap shall be spread to the thickness required in a single lift.

e. Grouted Riprap – The grout shall be a sand-concrete mixture, proportioned to result in a minimum 28-day compressive strength of 2000 pounds per square inch (psi). The stones shall be thoroughly moistened and any excess fines shall be sluiced to the underside of the stone blanket before grouting. The grout may be delivered to the site by any means that will assure uniformity and prevent segregation of the particles. The grout shall be vibrated by mechanical means to achieve grout penetration. If pressure grouting is used, care shall be taken to avoid unseating the stones. Penetration of the grout into the rock riprap shall be at least 12 inches. For a smooth surface, grout shall fill the void spaces to within ½-inch of the surface. Weep holes shall be provided through the blanket. A weep hole detail is presented on Drawing No. B05-330-E24.

Curing and Protection - The completed finished surface shall be prevented from drying for a minimum curing period of 7 days following placement. Exposed surfaces shall be maintained in a moist condition continuously for the 7-day curing period or until curing compound has been applied as specified in this

section. Moisture shall be maintained by sprinkling, fog spraying or by covering with continuously moistened canvas, cloth mats, straw, sand, or other approved material. Water or moist covering shall be used to protect the grout during the curing process without causing damage to the grout surface by erosion or other mechanisms that may cause physical damage.

The grouted rock may be coated with an approved curing compound as an alternative method to maintaining a continuous moisture condition during the curing period. The compound shall be sprayed on the moist grout surface as soon as free water has disappeared and all surface finishing has been completed. The compound shall be applied at a minimum uniform rate of 1 gallon per 175 square feet of surface and shall form a continuous adherent membrane over the entire surface. Curing compound shall not be applied to surfaces requiring bond to subsequently placed grout and/or concrete. If the membrane is damaged during the curing period, the damaged area shall be re-sprayed at the rate of application specified for the original treatment.

Grout mix shall be placed when the temperature is above 35 degrees Fahrenheit and rising and shall be protected from freezing. Grout mix shall not be placed on a frozen surface. After grouting is completed, no weight shall be placed on the grouted riprap until the grout has cured properly.

4.05 Uniform Section Mat

a. Material - In lieu of riprap, 4-inch thick Armorform®, or equivalent, uniform section mat may be used. The mat shall be keyed 18 inches (minimum) along both edges of the ditch and at the upstream end of each section. The mat shall be underlain with Propex 4550 filter fabric and installed in accordance with the manufacturer's recommendations. Weep holes shall be provided at 15-foot elevation intervals and anchor bolts shall be installed on the spacing shown on Drawing No. B05-330- E24.
b. Grout - The grout shall be a pumpable fine aggregate concrete (structural grout) proportioned to result in a minimum 28-day compressive strength of 3000

pounds per square inch (psi). A pozzolan grade fly ash may be substituted for up to 35 percent of the cement. Fine aggregate concrete consistency should be in the 9 – 11 second range when passed through the ¾ - inch orifice of the standard flow cone described in ASTM C-939-93. Tests utilizing a concrete slump cone are not appropriate. The grouted mat shall be protected from freezing and damage as described in Section 4.04.f above.

5.0 REVEGETATION OF COMPLETED AREAS

Revegetation of coarse coal refuse slopes can be accomplished by placing a cover of natural soil or other materials capable of supporting vegetation and subsequent planting to establish a continuous stand of vegetation. Soil cover and vegetation shall be in accordance with the Illinois reclamation permit.

6.0 MONITORING AND MAINTENANCE

6.01 Piezometers and Impoundment Level

Except as required by Section 6.03 below, water level readings from the piezometers and the impoundment level shall be recorded at 7-day intervals and compared to the levels used in the design. The standpipe piezometers shall be flushed on an annual basis to ensure they are functioning properly. Should the piezometers become damaged during operations, they shall be repaired or replaced. Maximum piezometer water levels used in the design of the embankments are shown in tables on Drawing Nos. B05-330-E12, -E39, and –E48. The piezometer levels in the tables are based on estimated maximum allowable phreatic surface to maintain a slope stability factor of safety of 1.5 for the static condition and 1.2 for seismic loading. Exceedance of the tabulated values does not necessarily mean that the slope stability has been reduced to unacceptable levels. It does mean that maximum anticipated phreatic level has been exceeded and that action in the form of reevaluation of the slope stability, reduction of the amount of water in the impoundment, reduction in the rate of embankment construction, installation of additional piezometers, or other remedial measures may be needed.

6.02 General Observations

Observations of the embankment and its appurtenant structures shall be made at 7-day intervals and immediately following any unusual events such as floods, heavy rainfalls, abnormal structural behavior, etc. Any unusual features shall be reported immediately to the engineer responsible for certifying the construction.

a. Embankment Slopes - Any irregularities such as scarps, wet areas, or vegetation disturbance shall be recorded.

b. Working Disposal Surface - Irregularities shall be recorded.

c. Access Road Gutters and Discharge Channels - General condition of channels, soil erosion adjacent to or beneath riprap and seeded slopes, blockage by debris, etc. shall be noted.

d. Pumps, Spillway Pipes and Underdrain Outlets – General condition of the discharge facilities and that they are not blocked and are functioning properly. Underdrain discharges shall be measured or estimated.

e. Vicinity of the Embankment - General conditions throughout the area of the embankment shall be observed to note any changes which could be associated with the behavior of the embankment and its foundation. During and post-longwall mining Particular attention should be paid to the predicted areas of high surface strain for the Phase 2, Phase 3 and Phase 4 embankments when the longwall mining passes beneath them. Horizontal strain and vertical subsidence predictions are shown on Drawing Nos. B05-330-M50 and –M51. Embankment deformation, cracking, and pore pressure buildup are of particular concern.

6.03 Phase 2 and Phase 3 Enhanced Monitoring

a. Pore Pressure Transducers (pneumatic or vibrating wire) and Inclinometers will be installed in the Phase 3 embankment after the phase is capped with coarse coal refuse but prior to Phase 7C construction or longwall undermining under Phase 3.

b. Monitoring Frequency – Phase 2 and Phase 3 instruments and general observations will be made twice daily beginning when the longwall face is within 100 feet of the eastern perimeter of the embankments and ending two weeks after the longwall face passes under their western ends.

If post-subsidence instrumentation monitoring and inspection results indicate that Phase 2 and Phase 3 embankment/impoundment distress is not a concern, i.e., no adverse cracking, seepage, excess pore pressure or deformation, then general observations and instrumentation readings for Phase 2 and Phase 3 shall be conducted twice weekly for two additional months. If, after the two months of additional monitoring, no adverse pore pressures or embankment performance factors exist, monitoring may then revert to a 7-day basis until the sites are reclassified as a non-impounding embankments or are abandoned.

If embankment distress such as excessive seepage, elevated pore pressures, excessive deformation or cracking is evident, remedial measures will be initiated and the inspection and instrumentation reading frequency will be decreased to eight hours until stable conditions are achieved. The construction of the Contingency Buttress shown on Drawing No. B05-330-E47 will be implemented.

c. Abandonment of Instrumentation – The Phase 3 pneumatic piezometers and inclinometers may be left in place but considered abandoned and auxiliary to the approved plan starting two months after Phase 7C is completed - provided that no adverse conditions exists at the Phase 3 and Phase 7C embankments.

6.04 Subsidence Baselines - Subsidence baselines "A" through "K" shall be monitored as described in Appendix F.

6.05 Maintenance

The following maintenance shall be performed regularly:

a. Routine Maintenance - Maintenance, including replacement or patching of grouted riprap, regrading temporary bench and haul road gutters, backfilling of erosion rills and gullies, removal of debris from the ditches at the site, etc. shall be performed.

b. Maintenance After Unusual Meteorological Events (Heavy Precipitation Events and Floods). - The most important maintenance tasks at these times are the timely backfilling of all erosion scarps and slumps and the repair and improvement of drainage systems and riprap.

c. Maintenance After Abnormal Changes in the Behavior of the Structure - If abnormal behavior of any portion of the embankment is observed, qualified persons knowledgeable of the facility design characteristics shall be advised immediately and any recommended maintenance measures undertaken.

6.04 Data Review

All facility performance data and data obtained during periodic inspections and maintenance shall be reviewed by qualified persons knowledgeable of the facility construction and disposal requirements, including the design recommendations presented in these documents.

7225-11
part 6

APPENDIX B

Calculation Brief

APPENDIX B

CALCULATION BRIEF
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
MACH #1 MINE
MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS

TABLE OF CONTENTS

TOPIC	PAGE
Production Rates	1
Staging Calculations	1-6
Storm Excavation Pump Activation Level and Pump Capacity Calculations	7-14
Volumes	15-29
Decant Pipe	30-35
Trash Rack	36
Freeboard Calculations	37-41
Filter Drainage Diaphragm Design	42-44
Filter Drainage Diaphragm Outlet Drain Design	45-46
Armorform Ditch Lining Tractive Force Calculations	47-58a
Armorform Ditch Lining Anchorage Calculations	58b-58i
Underdrain Design and Subsidence Effects Calculations	59-91
Structural Design and Underdrain Pipes	92-97
Horizontal Strain Due to Subsidence Calculations	98
Piping and Cracking Potential of Foundation Soil and Coarse Coal Refuse Due to Subsidence Calculations	99-119
Slope Stability Analysis	120-231z
Pillar Stability	232-234
Subsidence Baseline Survey Station Spacing	234a
Surface Drainage Ditch Calculations	235-368
Surface Drainage Design	369-383

Consulting, Inc.
Engineers
Instructors
Scientists
BECKLEY, WV
(304) 255-0491

PROJECT NAME: Williamson Energy
PROJECT NO. 805-330-1413 SHEET ____ OF ____
DESCRIPTION Staging Calcs.

R12475

Production Rates:

Prior to 3-18-08 (long wall start up)

(From Mach Mining)

599598 Tons / 9 months Total refuse

= 66622 Tons / month

$CCR = \frac{66622}{5} \times 4 = 53297 \times 2000 \div 115 \div 27 = 34330\ yd^3/month$

$FCR = \frac{66622}{5} \times 1 = 13324 \times 2000 \div 55 \div 27 = 17945\ yd^3/month$

After 3-1-08

$CCR = 2.53 \times 10^6\ yd^3$

$FCR = 1.32 \times 10^6\ yd^3$

Phase 2

Time to Complete embankment

Vol of Emb = $584047\ yd^3$

$584047 - 234277\ yd^3$ (2007 prod.) = $349770\ yd^3$

$(349770 - 68660) \div 2.53 \times 10^6 =$ 0.11 yrs or 4-27-08

Finish of Phase 2 imp.

Imp Vol = $1035338\ yd^3$ (more Fines from approved Plan.)

$1035338 - 122463$ (2007 prod) = $(912875 - 35890) \div 1.32 \times 10^6$

= 0.66 yrs or 11-15-08

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CANONSBURG, PA (724) 745-3630

BY: BWM DATE: 11-3-09 CHKD BY: RLF DATE: 11/4/09 (3) R12476

PROJECT NAME: WILLIAMSON ENERGY

PROJECT NO. 805-330-1413 SHEET ____ OF ____

DESCRIPTION STAGING CALCS (REVISED PHASE 5)

11/3/09 REVISED

PHASE 5

TIME TO BUILD EMBANKMENT

EMBANKMENT VOLUME = 1.166×10^6 yd^3

1.166×10^6 yd^3 ÷ 2.53×10^6 = 0.466 YRS OR 11-26-09

FINES LIFE OF PHASE 5

MAX. FINES LEVEL:

DRAINAGE AREA = 48.4 Ac DESIGN STORM = 1 PMF (41 INCHES)

$$41 \text{ in} \times 48.4 \text{ Ac} \times \frac{1 \text{ ft}}{12 \text{ in}} \times \frac{43,560 \text{ ft}^2}{\text{Ac}} \times \frac{1 \text{ c.y.}}{27 \text{ ft}^3} = 266,792 \text{ yd}^3$$

CREST EL 488 - 3' (FB) = 485

VOL @ 485 - 1 PMF VOL => $2.70 \times 10^6 - 266,792 = 2.43 \times 10^6$ yd^3

EL	VOL $\times 10^6$
480	2.40
X	2.43
485	2.70

X = 480.50 = MAX. FINES LEVEL

FINES LIFE = $2.43 \times 10^6 \div 1.32 \times 10^6$ = 1.84 YRS OR 8-23-11

PHASE 6

TIME TO BUILD EMBANKMENT

EMBANKMENT VOLUME = 1.72×10^6 yd^3

$1.72 \times 10^6 \div 2.53 \times 10^6$ = 0.7 YRS OR 8-08-10

NO FINES WILL BE PUMPED INTO THE PHASE 6 IMPOUNDMENT.

Alliance Consulting, Inc.
Engineers
Constructors
Scientists
BECKLEY, WV
(304) 255-0491

BY: GLH DATE: 1-31/08 CHKD BY: BWM RLF DATE: 4/8/08 11/4/09 (4)

PROJECT NAME: Williamson Energy

PROJECT NO. B05-330-1413 SHEET ____ OF ____

DESCRIPTION Staging Calcs.

R2477 11/3/09 REVISED

Phase 7

Time to build

Vol of Emb = 2.52×10^6 yd^3

$2.52 \times 10^6 \div 2.53 \times 10^6$ = 1.0 yrs or 8-8-11

Ph 7 max Fines

Drainage Area to Phase 7 imp = 67 AC

Design Storm = 1 pmf

$(41(1/12) + 67 \times 43560) \div 27 = 369319$ yd^3

$538 - 3 = 535 = 4.84 \times 10^6$ yd^3

530	4.43
535	4.84
538	5.09

$4.84 \times 10^6 - 369319 = 4.47 \times 10^6 = 530.48$

life = $4.47 \times 10^6 \div 1.32 \times 10^6$ = 3.4 yrs or 1-17-15

Fines Elevations at specific Times during Construction:

Fines elev at end of Phase 2 construction:

Ph 2 emb = 0.11 yrs

$(0.11 \times 1.32 \times 10^6) + 122463 + 35890 = 303553$ yd^3

257313	472
303553	473.7 = El of Fines in Ph 2 imp @ completion of Ph 2 emb.
311912	474

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(304) 255-0491

BY: [illegible] DATE: 7/31/08 CHKD BY: [illegible] DATE: 4/8/08

PROJECT NAME: Williamson Energy

PROJECT NO. B05-330-1413 SHEET ____ OF ____

DESCRIPTION Staging Calcs

R12478

Fines elev at end of Ph3 construction (Ph 2 imp)

Elev @ beginning of Ph3 = 473.7

Time to build Ph3 = 0.47 yrs

$1.32 \times 10^6 \times 0.47 = 620400$

473.7 = 303553 + 620400 = 923953

886585 492

923953 493.02 = El of Fines in Ph2 imp at end of Ph3 construction.

959994 494

Phase 4

Fines pumped into Ph2 and 3 imp.

Ph2 max Fines = 496 = 1035338 yd^3

At Ph3 end 1035338 - 923953 = 111385 yd^3 remain in 2

Time to build Ph4 = 0.53 yrs

$.53 \times 1.32 \times 10^6 = 699600\ yd^3$

$699600 - 111385 = 588215\ yd^3$

3.14 470

5.88 478.3 = el of Fines in Ph3 imp at end of Ph4 construction

6.45 480

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BY: JLH DATE: 1-31-08 CHKD BY: BWM RE DATE: 4/8/08 11/4/09 (6)
PROJECT NAME: Williamson Energy
PROJECT NO. 305-330-1413 SHEET ____ OF ____
DESCRIPTION Staging Calcs

REVISED 11/3/09

Phase 5

Fines Pumped into Phase 3 imp and Ph 5 cell.

@ beginning of Phase Fines = 478.3 in Ph 3 imp = 5.88×10^5

Time to build Ph 5:

$0.66 \text{ yrs} \times 1.32 \times 10^6 = 871{,}200 \text{ yd}^3$

Ph 3 max Fines = 494.88 = 12.3×10^5

$12.3 \times 10^5 - 5.88 \times 10^5 - 871{,}200 = 229{,}200 \text{ yd}^3$ pumped into Ph 5 cell

1.31×10^5	430	
2.29×10^5	X = 432.8	= El of Fines in Ph 5 cell @ end of Ph 5 construction.
3.05×10^5	435	

Phase 6

Fines pumped into Ph 5 throughout construction.

At Beg. Fines = 432.8 = 2.29×10^5 in Ph 5 imp

Time to build Ph 6 = $0.7 \text{ yrs} \times 1.32 \times 10^6 = 924{,}000 \text{ yd}^3$

$2.29 \times 10^5 + 924{,}000 = 1.15 \times 10^6 \text{ yd}^3$

1.11	455	
1.15	455.8	= El of Fines in Ph 5 cell @ end of Ph 6
1.35	460	Construction

Phase 7

Fines Pumped into the Ph 5 and 7 imp.

Beg. @ 455.8 in Ph 5 imp = $1.15 \times 10^6 \text{ yd}^3$

Time to build Ph 7 emb = $1.0 \text{ yrs} \times 1.32 \times 10^6 = 1.32 \times 10^6$

$1.15 \times 10^6 + 1.32 \times 10^6 = 2.47 \times 10^6$, Max Fines of Ph 5 = 480.65 or 2.43×10^6

$2.47 \times 10^6 - 2.43 \times 10^6 = 40{,}000 \text{ yd}^3$ into Ph 7 imp

1.32	450	
4.00	451.7	El of Fines in Ph 7 imp @ end of Ph 7 const.
4.42	452	

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BY: MOB DATE: 3-20-08 CHKD BY: BWM DATE: 4/8/08

PROJECT NAME: Williamson Energy

PROJECT NO. 605-330-1413 SHEET ____ OF ____

DESCRIPTION Storm Evacuation Pump activation Level

R12480

Phase 4 & 6

→ Crest Elev. = 492

* Most critical time is when phase 6 reaches the phase 4 crest.

→ Drainage Area = 73.8 AC

Maximum slurry level prior to this point is:

→ 2 PMF vols = $\left[\frac{(41\ (\text{pmf rainfall})(1/12)(73.8)(43560))}{27}\right] \times 2 = 813604$ CY

492 - 3' (freeboard) = 489 vol @ 489 = 1.70×10^6

$1.70 \times 10^6 - 813604 = 8.86 \times 10^5$

EL	VOL
470	7.46×10^5
X	8.86×10^5
480	1.22×10^6

$\Rightarrow X = 472.95$ = Max Fins level until phase 6 reaches 492

Pump Activation Level

→ 489 - 1 Storm Volume

$1.70 \times 10^6 - 406802 = 1.29 \times 10^6$

EL	VOL
480	1.22×10^6
X	1.29×10^6
490	1.75×10^6

$\Rightarrow X = 481.32$ = Pump activation level for phase 4 crest

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BY: MOB DATE: 3-20-08 CHKD BY: TMW DATE: 4-08-08

PROJECT NAME: Williamson Energy

PROJECT NO. BAS-330-1413 SHEET ____ OF ____

DESCRIPTION Storm Evacuation Pump Capacity

Purpose: To determine the evacuation pump capacity for the phase 4 Impoundment.

Phase 4 & 6

∴ Worst case is when phase 6 reaches the phase 4 crest. (Elev. 492)

→ PMF Storm:

$41\left(\frac{1}{12}\right)(73.8) \times 43560 = 1.09837 \times 10^7 \text{ ft}^3$

$1.09837 \times 10^7 \times 7.48 \text{ gal/ft}^3 = 8.21577 \times 10^7 \text{ gal.}$

$30 \text{ days} \times 24 \text{ hrs} \times 60 \text{ min} = 43200 \text{ mins}$

$\frac{8.21577 \times 10^7 \text{ gal}}{43200 \text{ mins}} = 1901.8 \text{ gpm}$

* A pumping system with the capacity to transfer a minimum of 1901.8 gallons per minute shall be used.

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BY: MDB DATE: 4/1/03 CHKD BY: [illegible] DATE: 4-8-08 R12482
PROJECT NAME: Williamson Energy
PROJECT NO. B05-330-1413 SHEET 1 OF 2
DESCRIPTION Storm Evacuation Pump activation level

Phase 7:

→ Crest Elev. = 510

→ Drainage Area = 81.4 Ac.

∴ Maximum slurry level prior to this point is:

→ 2 PMF Vols. = $\left[\frac{(41\ (\text{Pmf rainfall})\ (1/12)(81.4)(43560)}{27}\right] \times 2 = 897390$ cy

510 - 3' (Freeboard) = 507 Vol @ 507 = 2.78×10^6 cy

$2.78 \times 10^6 - 897390 = 1.88 \times 10^6$

EL	VOL
490	1.75×10
X	1.88×10^6
500	2.33×10^6

⇒ X = 492.24 = Max Fins level until phase 7 reaches 510

∴ Pump Activation level:

→ 507 - 1 Storm Volume

$2.78 \times 10^6 - 448695 = 2.33 \times 10^6$

EL	VOL
500	2.33×10^6
X	2.33×10^6
510	2.97×10^6

⇒ X = 500

Pump Activation level for phase 7 construction [illegible] max before [illegible] 510.

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BY: MDB DATE: 4/1/08 CHKD BY: LWM DATE: 4-08-08

PROJECT NAME: Williamson Energy

PROJECT NO. 805-330-1413 SHEET ____ OF ____

DESCRIPTION Storm Evacuation Pump Capacity

R12483

Purpose: To determine the evacuation pump capacity for Phase 7 construction at elevation 510.

Phase 7

∴ Worst case is when construction reaches elevation 510

→ PMF Storm:

$$41\left(\tfrac{1}{12}\right)(81.4) \times 43560 = 1.21148 \times 10^7 \text{ ft}^3$$

$$1.21148 \times 10^7 \times 7.48 \text{ gal/ft}^3 = 9.06184 \times 10^7 \text{ gal.}$$

$$30 \text{ days} \times 24 \text{ hrs} \times 60 \text{ min} = 43200 \text{ mins}$$

$$\frac{9.06184 \times 10^7 \text{ gal}}{43200 \text{ mins}} = 2097.65 \text{ gpm}$$

* A pumping system with the capacity to transfer a minimum of 2097.65 gallons per minute shall be used.

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BY: MDB DATE: 4/9/08 CHKD BY: BMSM DATE: 4-9-08

PROJECT NAME: Williamson Energy

PROJECT NO. 805-330-1413 SHEET ____ OF ____

DESCRIPTION Storm Evacuation Pump Activation Level.

Phase 7:

→ Crest Elev. = 500

→ Drainage Area = 86.7 Ac.

∴ Maximum Slurry level prior to this point is:

→ 2 PMF Vols. = $\left[\frac{(4)(\text{PMF Rainfall})(\frac{1}{12})(86.7)(43560)}{27}\right] \times 2 = 955819$ cy

500 − 3' (freeboard) = 497 vol @ 497 = 2.156×10^6 cy

$2.156 \times 10^6 - 955819 = 1.2 \times 10^6$

EL	VOL
470	7.46×10^5
X	1.2×10^6
480	1.22×10^6

$\Rightarrow X = 479.58$ = Max Fines level until Phase 7 reaches 500

∴ Pump Activation level:

→ 497 − 1 storm Volume

$2.156 \times 10^6 - 477919 = 1.678 \times 10^6$

EL	VOL
480	1.72×10^6
X	1.678×10^6
490	1.75×10^6

$\Rightarrow X = 488.64$ = Pump Activation level for phase 7 construction must take before elevation 500.

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BY: MDB DATE: 4/9/08 CHKD BY: RTM DATE: 4/11/08

PROJECT NAME: Williamson Energy

PROJECT NO. 805-330-1413 SHEET ____ OF ____

DESCRIPTION Storm Evacuation Pump Capacity.

R12485

Purpose: To determine the elevation pump capacity for Phase 7 construction at elevation 500.

Phase 7

∴ Worst case is when construction reaches elevation 500

→ PMF Storm:

$$41\left(\tfrac{1}{12}\right)(86.7) \times 43560 = 1.29036 \times 10^7 \text{ ft}^3$$

$$1.29036 \times 10^7 \times 7.48 \text{ gal/ft}^3 = 9.65186 \times 10^7 \text{ gal.}$$

$$30 \text{ days} \times 24 \text{ hrs} \times 60 \text{ min} = 43200 \text{ mins}$$

$$\frac{9.65186 \times 10^7 \text{ gal}}{43200 \text{ min}} = 2234.23 \text{ gpm}$$

* A pumping system with the capacity to transfer a minimum of 2234.23 gallons per minute shall be used.

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BY: MDB DATE: 3/24/08 CHKD BY: [illegible] DATE: [illegible] R12486
PROJECT NAME: Williamson Energy
PROJECT NO. B05-330-1413 SHEET ____ OF ____
DESCRIPTION Storm Evacuation Pump Activation Level

Phase 7:

→ Crest EL. = 528

* Most critical time is when elevation of phase 7 construction is at maximum before installation of Decant Pipe.

→ Drainage Area = 71.3 Ac

Maximum slurry level prior to this point is:

→ 2 PMF Vols. = $\left[\frac{(41\ (\text{pmf rainfall})\ (1/12)(71.3)(43560)}{27}\right] \times 2 = 786043$ cy

528 − 3' (freeboard) = 525 vol @ 525 = 4.05×10^6

$4.05 \times 10^6 - 786043 = 3.26 \times 10^6$

EL	VOL
510	2.97×10^6
x	3.26×10^6
520	3.67×10^6

⇒ 514.14 = Max fines level until Phase 7 reaches 528

Pump Activation Level

→ 525 − 1 Storm Volume

$4.05 \times 10^6 - 393022 = 3.65 \times 10^6$

EL	VOL
510	[illegible]
x	[illegible]
520	[illegible]

⇒ x = 519.71 = Pump Activation level for phase 7 [illegible] before [illegible] pipe installation

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BY: MDB DATE: 4/1/08 CHKD BY: [illegible] DATE: 4-09-08

PROJECT NAME: Williamson Shores

PROJECT NO. B05-330-1413 SHEET ____ OF ____

DESCRIPTION Storm Evacuation Pump Capacity

R12487

Purpose: To determine the evacuation pump capacity for the Phase 7 Impoundment.

Phase 7:

∴ Worst case is when elevation of phase 7 construction is at maximum before installation of decant pipe (Elev 528)

→ PMF Storm:

$$41\left(\tfrac{1}{12}\right)(71.3) \times 43500 = 1.06116 \times 10^7 \text{ ft}^3$$

$$1.06116 \times 10^7 \times 7.48 \text{ gal/ft}^3 = 7.93746 \times 10^7 \text{ gal.}$$

$$30 \text{ days} \times 24 \text{ hrs} \times 60 \text{ min} = 43200 \text{ mins.}$$

$$\frac{7.93746 \times 10^7 \text{ gal}}{43200 \text{ min}} = 1837.4 \text{ gpm}$$

∴ A pumping system with the capacity to transfer a minimum of 1837.4 gallons per minute shall be used.

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VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY PHASE 3 IMP VOL

SCALE: 1

CALCS. BY: JLH 10-22-07

CHECKED BY: MOB

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
452	1727.00	1.73E+03				0.00E+00	0.00E+00
			7.15E+03	2	1.43E+04		
454	12582.00	1.26E+04				1.43E+04	5.30E+02
			2.95E+04	2	5.90E+04		
456	46388.00	4.64E+04				7.33E+04	2.71E+03
			1.15E+05	2	2.29E+05		
458	182827.00	1.83E+05				3.02E+05	1.12E+04
			3.48E+05	2	6.97E+05		
460	514141.00	5.14E+05				9.99E+05	3.70E+04
			6.12E+05	2	1.22E+06		
462	710341.00	7.10E+05				2.22E+06	8.24E+04
			7.35E+05	2	1.47E+06		
464	758662.00	7.59E+05				3.69E+06	1.37E+05
			7.71E+05	2	1.54E+06		
466	783329.00	7.83E+05				5.23E+06	1.94E+05
			7.96E+05	2	1.59E+06		
468	807685.00	8.08E+05				6.83E+06	2.53E+05
			8.20E+05	2	1.64E+06		
470	832117.00	8.32E+05				8.47E+06	3.14E+05
			8.95E+05	10	8.95E+06		
480	957207.00	9.57E+05				1.74E+07	6.45E+05
			1.02E+06	10	1.02E+07		
490	1087747.00	1.09E+06				2.76E+07	1.02E+06
			1.16E+06	10	1.16E+07		
500	1223738.00	1.22E+06				3.92E+07	1.45E+06

R12488

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VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY PHASE 4 EMB VOL

SCALE: 1

CALCS. BY: JLH 10-22-07

CHECKED BY: MDB

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
444	26965.00	2.70E+04				0.00E+00	0.00E+00
			1.25E+05	2	2.50E+05		
446	222931.00	2.23E+05				2.50E+05	9.26E+03
			4.36E+05	2	8.73E+05		
448	649798.00	6.50E+05				1.12E+06	4.16E+04
			7.37E+05	2	1.47E+06		
450	823513.00	8.24E+05				2.60E+06	9.61E+04
			8.93E+05	2	1.79E+06		
452	962794.00	9.63E+05				4.38E+06	1.62E+05
			1.03E+06	2	2.05E+06		
454	1087982.00	1.09E+06				6.43E+06	2.38E+05
			1.09E+06	2	2.17E+06		
456	1085414.00	1.09E+06				8.61E+06	3.19E+05
			1.07E+06	2	2.14E+06		
458	1055127.00	1.06E+06				1.07E+07	3.98E+05
			1.04E+06	2	2.08E+06		
460	1024374.00	1.02E+06				1.28E+07	4.75E+05
			1.01E+06	2	2.02E+06		
462	995317.00	9.95E+05				1.48E+07	5.50E+05
			9.81E+05	2	1.96E+06		
464	966870.00	9.67E+05				1.68E+07	6.23E+05
			9.51E+05	2	1.90E+06		
466	934862.00	9.35E+05				1.87E+07	6.93E+05
			9.14E+05	2	1.83E+06		
468	893583.00	8.94E+05				2.05E+07	7.61E+05
			8.73E+05	2	1.75E+06		
470	852054.00	8.52E+05				2.23E+07	8.25E+05
			7.46E+05	10	7.46E+06		
480	640656.00	6.41E+05				2.97E+07	1.10E+06
			5.32E+05	10	5.32E+06		
490	423007.00	4.23E+05				3.51E+07	1.30E+06
			4.01E+05	2	8.02E+05		
492	378726.00	3.79E+05				3.59E+07	1.33E+06

(17)

R12489

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VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY (PHASE 5)
EMB. VOLS

SCALE: 1

CALCS. BY: BWM 11-04-09

CHECKED BY: CAD

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
436	8,117	8.12E+03				0.00E+00	0.00E+00
			3.70E+04	2	7.40E+04		
438	65,894	6.59E+04				7.40E+04	2.74E+03
			1.52E+05	2	3.03E+05		
440	237,202	2.37E+05				3.77E+05	1.40E+04
			4.05E+05	2	8.09E+05		
442	572,057	5.72E+05				1.19E+06	4.39E+04
			8.45E+05	2	1.69E+06		
444	1,118,526	1.12E+06				2.88E+06	1.07E+05
			1.23E+06	1	1.23E+06		
445	1,351,072	1.35E+06				4.11E+06	1.52E+05
			1.30E+06	0	0.00E+00		
445	1,250,920	1.25E+06				4.11E+06	1.52E+05
			1.28E+06	1	1.28E+06		
446	1,310,776	1.31E+06				5.39E+06	2.00E+05
			1.34E+06	4	5.36E+06		
450	1,368,975	1.37E+06				1.08E+07	3.98E+05
			1.31E+06	5	6.55E+06		
455	1,249,069	1.25E+06				1.73E+07	6.41E+05
			1.19E+06	5	5.94E+06		
460	1,127,319	1.13E+06				2.32E+07	8.61E+05
			1.07E+06	5	5.33E+06		
465	1,003,768	1.00E+06				2.86E+07	1.06E+06
			9.41E+05	5	4.71E+06		
470	878,628	8.79E+05				3.33E+07	1.23E+06
			8.15E+05	5	4.08E+06		
475	751,474	7.51E+05				3.73E+07	1.38E+06

REVISED 11/4/09

18 R12490

480	622,199	6.22E+05	6.87E+05	5	3.43E+06	4.08E+07	1.51E+06	
485	491,443	4.91E+05	5.57E+05	5	2.78E+06	4.36E+07	1.61E+06	
488	412,125	4.12E+05	4.52E+05	3	1.36E+06	4.49E+07	1.66E+06	

REVISED 11/4/09

19 RTP2491

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VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY (PHASE 5)
IMP. VOLS

SCALE: 1

CALCS. BY: BWM 11-04-09

CHECKED BY: CAD

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
426	863,976	8.64E+05				0.00E+00	0.00E+00
			8.87E+05	4	3.55E+06		
430	909,372	9.09E+05				3.55E+06	1.31E+05
			9.39E+05	5	4.69E+06		
435	967,748	9.68E+05				8.24E+06	3.05E+05
			9.98E+05	5	4.99E+06		
440	1,027,935	1.03E+06				1.32E+07	4.90E+05
			1.06E+06	5	5.29E+06		
445	1,089,935	1.09E+06				1.85E+07	6.86E+05
			1.12E+06	5	5.61E+06		
450	1,153,746	1.15E+06				2.41E+07	8.94E+05
			1.19E+06	5	5.93E+06		
455	1,219,370	1.22E+06				3.01E+07	1.11E+06
			1.25E+06	5	6.27E+06		
460	1,286,743	1.29E+06				3.63E+07	1.35E+06
			1.32E+06	5	6.61E+06		
465	1,355,821	1.36E+06				4.29E+07	1.59E+06
464			1.39E+06	5	6.96E+06	44.3	
470	1,426,605	1.43E+06				4.99E+07	1.85E+06
			1.46E+06	5	7.31E+06		
475	1,499,093	1.50E+06				5.72E+07	2.12E+06
			1.54E+06	5	7.68E+06		
480	1,573,288	1.57E+06				6.49E+07	2.40E+06
			1.61E+06	5	8.06E+06		

REVISED 11/4/09

2 OF 2

12492

485	1,649,305	1.65E+06	1.67E+06	3	5.02E+06	7.29E+07	2.70E+06	
488	1,695,545	1.70E+06				7.80E+07	2.89E+06	

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2 IR12493

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VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY PHASE 6 EMB VOL

SCALE: 1

CALCS. BY: JLH 10-22-07

CHECKED BY: MOB

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
440	20548.00	2.05E+04				0.00E+00	0.00E+00
			3.93E+05	10	3.93E+06		
450	765316.00	7.65E+05				3.93E+06	1.46E+05
			8.77E+05	10	8.77E+06		
460	988066.00	9.88E+05				1.27E+07	4.70E+05
			9.98E+05	10	9.98E+06		
470	1008580.00	1.01E+06				2.27E+07	8.40E+05
			1.02E+06	10	1.02E+07		
480	1027914.00	1.03E+06				3.29E+07	1.22E+06
			1.04E+06	8	8.28E+06		
488	1043059.00	1.04E+06				4.11E+07	1.52E+06
			1.20E+06	0	0.00E+00		
488	1350082.00	1.35E+06				4.11E+07	1.52E+06
			1.34E+06	2	2.68E+06		
490	1330975.00	1.33E+06				4.38E+07	1.62E+06
			1.32E+06	2	2.64E+06		
492	1311871.00	1.31E+06				4.65E+07	1.72E+06

R12494

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VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY PHASE 7 EMB VOL

SCALE: 1

CALCS. BY: JLH 10-22-07

CHECKED BY: MDB

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
492	1689957.00	1.69E+06				0.00E+00	0.00E+00
500	2130161.00	2.13E+06	1.91E+06	8	1.53E+07	1.53E+07	5.66E+05
510	1739771.00	1.74E+06	1.93E+06	10	1.93E+07	3.46E+07	1.28E+06
520	1349290.00	1.35E+06	1.54E+06	10	1.54E+07	5.01E+07	1.85E+06
530	958717.00	9.59E+05	1.15E+06	10	1.15E+07	6.16E+07	2.28E+06
538	646196.00	6.46E+05	8.02E+05	8	6.42E+06	6.80E+07	2.52E+06

(23)

R12495

Alliance Consulting, Inc.
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VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY PHASE 7 IMP VOL

SCALE: 1

CALCS. BY: JLH 10-22-07

CHECKED BY: MDB

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
448	59575.00	5.96E+04				0.00E+00	0.00E+00
			1.78E+05	2	3.56E+05		
450	295995.00	2.96E+05				3.56E+05	1.32E+04
			4.18E+05	2	8.36E+05		
452	540498.00	5.40E+05				1.19E+06	4.42E+04
			6.73E+05	2	1.35E+06		
454	805935.00	8.06E+05				2.54E+06	9.40E+04
			9.18E+05	2	1.84E+06		
456	1030203.00	1.03E+06				4.37E+06	1.62E+05
			1.05E+06	2	2.09E+06		
458	1062845.00	1.06E+06				6.47E+06	2.40E+05
			1.08E+06	2	2.15E+06		
460	1087807.00	1.09E+06				8.62E+06	3.19E+05
			1.15E+06	10	1.15E+07		
470	1216944.00	1.22E+06				2.01E+07	7.46E+05
			1.29E+06	10	1.29E+07		
480	1353294.00	1.35E+06				3.30E+07	1.22E+06
			1.43E+06	10	1.43E+07		
490	1496858.00	1.50E+06				4.72E+07	1.75E+06
			1.57E+06	10	1.57E+07		
500	1647636.00	1.65E+06				6.30E+07	2.33E+06
			1.73E+06	10	1.73E+07		
510	1805627.00	1.81E+06				8.02E+07	2.97E+06
			1.89E+06	10	1.89E+07		
520	1970832.00	1.97E+06				9.91E+07	3.67E+06
			2.06E+06	10	2.06E+07		
530	2143251.00	2.14E+06				1.20E+08	4.43E+06
			2.21E+06	8	1.77E+07		
538	2286379.00	2.29E+06				1.37E+08	5.09E+06

R12496

TAGE 7B EMBANKMENT VOLUME

R12497

olume Report 2/21/2008 12:18

ing Grid: //Aci-acad/caddrawings/05330/7B-7C MERGED.grd
and Grid: //Aci-acad/caddrawings/05330/7B-7C PROPOSED EMB.grd
rid corner locations: 357504.45,426355.33 to 360456.45,427963.33
rid resolution X: 492, Y: 268 Grid cell size X: 6.00, Y: 6.00
rea in Cut : 382.3 S.F., 0.01 Acres
rea in Fill: 428,616.4 S.F., 9.84 Acres
otal inclusion area: 428,998.6 S.F., 9.85 Acres
ut to Fill ratio: 0.00
verage Cut Depth: 0.11 Average Fill Depth: 14.51
ax Cut Depth: 0.52 Max Fill Depth: 22.85
ut (C.Y.) / Area (acres): 0.16
ill (C.Y.) / Area (acres): 23389.91
ut volume: 41.8 C.F., 1.55 C.Y.
ill volume: 6,219,569.8 C.F., 230,354.44 C.Y.

olumes by elevation zone 2/21/2008 12:19

R12498

one 453.19 to 460.00
lume : 38.8 C.F., 1.44 C.Y.
ill volume: 348,025.6 C.F., 12,889.84 C.Y.
unning total:
ut volume : 38.8 C.F., 1.44 C.Y.
ill volume: 348,025.6 C.F., 12,889.84 C.Y.

one 460.00 to 470.00
ut volume : 1.3 C.F., 0.05 C.Y.
ill volume: 740,644.0 C.F., 27,431.26 C.Y.
unning total:
ut volume : 40.1 C.F., 1.49 C.Y.
ill volume: 1,088,669.6 C.F., 40,321.10 C.Y.

one 470.00 to 480.00
ut volume : 1.6 C.F., 0.06 C.Y.
ill volume: 755,968.6 C.F., 27,998.84 C.Y.
unning total:
ut volume : 41.8 C.F., 1.55 C.Y.
ill volume: 1,844,638.2 C.F., 68,319.93 C.Y.

ne 480.00 to 490.00
volume : 1.2 C.F., 0.04 C.Y.
volume: 739,011.0 C.F., 27,370.78 C.Y.
nning total:
lume : 43.0 C.F., 1.59 C.Y.
ll volume: 2,583,649.3 C.F., 95,690.71 C.Y.

ne 490.00 to 500.00
t volume : 1.2 C.F., 0.05 C.Y.
ll volume: 718,441.7 C.F., 26,608.95 C.Y.
nning total:
t volume : 44.2 C.F., 1.64 C.Y.
ll volume: 3,302,091.0 C.F., 122,299.67 C.Y.

ne 500.00 to 510.00
t volume : 0.7 C.F., 0.02 C.Y.
ll volume: 723,597.6 C.F., 26,799.91 C.Y.
nning total:
t volume : 44.9 C.F., 1.66 C.Y.
ll volume: 4,025,688.6 C.F., 149,099.58 C.Y.

ne 510.00 to 520.00
volume : 0.9 C.F., 0.03 C.Y.
l volume: 755,277.5 C.F., 27,973.24 C.Y.
nning total:
volume : 45.8 C.F., 1.70 C.Y.
volume: 4,780,966.1 C.F., 177,072.82 C.Y.

0.00 to 530.00

ill volume: 786,986.3 C.F., 29,147.64 C.Y.
unning total:
ut volume : 47.1 C.F., 1.74 C.Y.
ill volume: 5,567,952.4 C.F., 206,220.46 C.Y.

530.00 to 540.00
olume : 1.4 C.F., 0.05 C.Y.
ill volume: 651,624.1 C.F., 24,134.23 C.Y.
unning total:
ut volume : 48.5 C.F., 1.80 C.Y.
ill volume: 6,219,576.5 C.F., 230,354.69 C.Y.

TAGE 7C EMBANKMENT VOLUME

R12500

me Report 2/21/2008 11:38

ing Grid: //Aci-acad/caddrawings/05330/7B-7C MERGED.grd
and Grid: //Aci-acad/caddrawings/05330/7B-7C PROPOSED EMB.grd
rid corner locations: 357504.45,426355.33 to 360456.45,427963.33
rid resolution X: 492, Y: 268 Grid cell size X: 6.00, Y: 6.00
rea in Cut : 27.4 S.F., 0.00 Acres
rea in Fill: 942,917.1 S.F., 21.65 Acres
otal inclusion area: 942,944.5 S.F., 21.65 Acres
ut to Fill ratio: 0.00
verage Cut Depth: 0.07 Average Fill Depth: 25.05
ax Cut Depth: 0.44 Max Fill Depth: 38.00
ut (C.Y.) / Area (acres): 0.00
ill (C.Y.) / Area (acres): 40417.06
ut volume: 1.9 C.F., 0.07 C.Y.
ill volume: 23,622,547.1 C.F., 874,909.15 C.Y.

olumes by elevation zone 2/21/2008 11:39

00.00 to 510.00
ut volume : 1.3 C.F., 0.05 C.Y.
ill volume: 6,851,079.0 C.F., 253,743.67 C.Y.
unning total:
ut volume : 1.3 C.F., 0.05 C.Y.
ill volume: 6,851,079.0 C.F., 253,743.67 C.Y.

one 510.00 to 520.00
ut volume : 0.0 C.F., 0.00 C.Y.
ill volume: 6,292,799.0 C.F., 233,066.63 C.Y.
unning total:
ut volume : 1.3 C.F., 0.05 C.Y.
.ll volume: 13,143,878.0 C.F., 486,810.30 C.Y.

one 520.00 to 530.00
ut volume : 0.0 C.F., 0.00 C.Y.
.ll volume: 5,899,045.6 C.F., 218,483.17 C.Y.
unning total:
t volume : 1.3 C.F., 0.05 C.Y.
ll volume: 19,042,923.7 C.F., 705,293.47 C.Y.

530.00 to 538.00
volume : 0.0 C.F., 0.00 C.Y.
volume: 4,578,137.9 C.F., 169,560.66 C.Y.
total:
t volume : 1.3 C.F., 0.05 C.Y.
ll volume: 23,621,061.6 C.F., 874,854.13 C.Y.

PIPE FLOW CALCULATIONS

PROJECT NAME: WILLIAMSON ENERGY

CALC. BY: MDB 4/2/08

PROJECT NO.: B05-330-1413

CHECKED BY: [signature] 4-08-08

DESCRIPTION: PHASE 3

WEIR FLOW Q=C(3.14)DH^1.5
C=3.22+0.44(H/P)

REF. MSHA MANUAL, PAGE 6.136

INLET DIAMETER(D)=	1.38	FEET
WEIR HEIGHT(P)=	1	FEET
INLET EL.=	494.8	

ORIFICE FLOW Q=CA(2GH)^0.5

REF. HANDBOOK OF CONCRETE CULVERT PIPE HYDRAULICS, PORTLAND CEMENT ASSOCIATION, PAGE 70

DISCHARGE COEFFICIENT(C)=	0.6	
ORIFICE DIAMETER	1.38	FEET
AREA(A)=	1.50	SQ. FT.
ORIFICE CONTROL ELEV.	493	

PRESSURE FLOW Q=AV
V=(2GH/F(L/D)+K+1)^0.5
F=185(N^2/D^.33)

REF. MSHA MANUAL, PAGE 6.154

MANNING'S N=	0.012	
PIPE LENGTH(L)=	98	FEET
ENERGY LOSSES(K)=	2.5	
OUTLET EL.=	482	
PIPE DIA. =	1.38	FEET

ELEVATION	HEAD, FT.	Q.CFS		
		WEIR	ORIFICE	PRESSURE
494.8	0	0.00	10.18	18.63
495	0.2	1.28	10.68	18.98
495.6	0.8	11.08	12.05	19.41
496	1.2	21.36	12.88	19.70
497	2.2	59.25	14.76	20.39

PROJECT NAME: WILLIAMSON ENERGY

PROJECT NUMBER: B05-330-1413

DESCRIPTION: PHASE 3

CALC. BY: MDB

CHECKED BY: BJM

TOTAL STORED VOLUME: 2.37 (FT^3 X 10^6)

ELEV.	CUM. VOLUME (FT.^3 X 10^6)	DISCHARGE (CFS)	TIME (HRS)	CUM. TIME (HRS)	CUM. TIME (DAYS)
494.8	33.16	0		165.58	6.90
			104.17		
495	33.4	1.28		61.41	2.56
			31.01		
495.6	34.09	11.08		30.39	1.27
			10.90		
496	34.56	12.88		19.50	0.81
			19.50		
497	35.53	14.76		0.00	0.00

VOLUME BELOW DECANT = 33.16 (FT^3 X 10^6)

10% VOLUME = 0.237 (FT^3 X 10^6)

10% LEVEL

ELEV.	VOLUME (FT.^3 X 10^6)
494.8	33.16
495.00	33.397
495.6	34.09

90% EVACUATION

ELEV	TIME,DAYS
494.8	6.9
495.00	5.47
495.6	1.27

PIPE FLOW CALCULATIONS

PROJECT NAME: WILLIAMSON

PROJECT NO.: B05-330-1413

DESCRIPTION: PHASE 5

CALC. BY: JLH 12/20/06

CHECKED BY: RJF 12/20/06

WEIR FLOW Q=C(3.14)DH^1.5
C=3.22+0.44(H/P)

REF. MSHA MANUAL, PAGE 6.136

INLET DIAMETER(D)=	1.38	FEET
WEIR HEIGHT(P)=	1	FEET
INLET EL.=	480	

ORIFICE FLOW Q=CA(2GH)^0.5

REF. HANDBOOK OF CONCRETE CULVERT PIPE HYDRAULICS, PORTLAND CEMENT ASSOCIATION, PAGE 70

DISCHARGE COEFFICIENT(C)=	0.6	
ORIFICE DIAMETER	1.38	FEET
AREA(A)=	1.50	SQ. FT.
ORIFICE CONTROL ELEV.	478.00	

PRESSURE FLOW Q=AV
V=(2GH/F(L/D)+K+1)^0.5
F=185(N^2/D^.33)

REF. MSHA MANUAL, PAGE 6.154

MANNING'S N=	0.012	
PIPE LENGTH(L)=	100	FEET
ENERGY LOSSES(K)=	2.5	
OUTLET EL.=	472.7	
PIPE DIA. =	1.38	FEET

ELEVATION	HEAD, FT.	Q.CFS		
		WEIR	ORIFICE	PRESSURE
480	0	0.00	10.18	14.18
480.85	0.85	12.21	12.16	14.98
482	2	50.28	14.40	16.00
483	3	102.27	16.10	16.84
484.1	4.1	180.82	17.79	17.71
485	5	262.71	19.05	18.40
486	6	373.38	20.37	19.13
488	8	661.19	22.77	20.52

PROJECT NAME: Williamson Energy

PROJECT NUMBER: B05-330-1413

DESCRIPTION: Phase 5

CALC. BY: BWM 11/04/09

CHECKED BY: RLF 11/4/09

TOTAL STORED VOLUME: 7.21 (FT^3 X 10^6)

ELEV.	CUM. VOLUME (FT.^3 X 10^6)	DISCHARGE (CFS)	TIME (HRS)	CUM. TIME (HRS)	CUM. TIME (DAYS)
480	64.9	0		169.67	7.07
			63.96		
480.85	66.3	12.16		105.71	4.40
			37.65		
482	68.1	14.4		68.06	2.84
			29.14		
483	69.7	16.1		38.91	1.62
			29.58		
484.1	71.5	17.71		9.33	0.39
			9.33		
484.5	72.1	18.0		0.00	0.00

VOLUME BELOW DECANT = 64.9 (FT^3 X 10^6)

10% VOLUME = 0.721 (FT^3 X 10^6)

10% LEVEL

ELEV.	VOLUME (FT.^3 X 10^6)
480	64.9
480.44	65.621
480.85	66.3

90% EVACUATION

ELEV	TIME,DAYS
480	7.07
480.44	5.69
480.85	4.4

STORM EVACUATION

R12506

PROJECT NAME: WILLIAMSON ENERGY

CALC. BY: MDB

PROJECT NUMBER: B05-330-1413

CHECKED BY:

DESCRIPTION: PHASE 7

TOTAL STORED VOLUME: 9.97 (FT^3 X 10^6)

ELEV.	CUM. VOLUME (FT.^3 X 10^6)	DISCHARGE (CFS)	TIME (HRS)	CUM. TIME (HRS)	CUM. TIME (DAYS)
530	120	0		213.52	8.90
			82.69		
530.85	121.81	12.16		130.83	5.45
			51.54		
532	124.25	14.14		79.29	3.30
			40.73		
533	126.38	14.91		38.55	1.61
			38.55		
534	128.5	15.64		0.00	0.00
534.72	130.02	16.13			

VOLUME BELOW DECANT = 120 (FT^3 X 10^6)

10% VOLUME = 0.997 (FT^3 X 10^6)

10% LEVEL

ELEV.	VOLUME (FT.^3 X 10^6)
530	120
530.20	121.002
530.85	124.25

90% EVACUATION

ELEV	TIME,DAYS
530	8.9
530.20	8.09
530.85	5.45

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RALEIGH, NC (919) 851-2257

BY: ALH DATE: 12/20/06 CHKD BY: RLF DATE: 12/20/06

PROJECT NAME: Williamson Energy

PROJECT NO. B05-330-1413 SHEET 3 OF

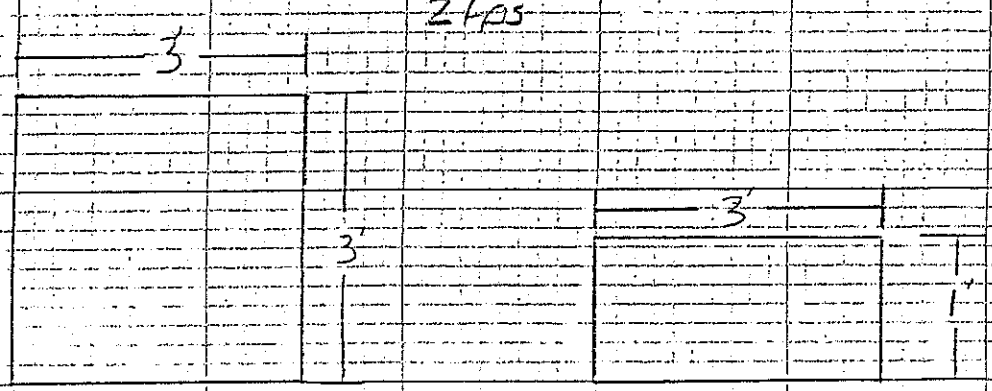
DESCRIPTION Phase 5 and 7 Trash Rack Design

R12507

The maximum anticipated peak flow for the 18" ϕ decant is 15.91cfs (el 534 Phase 7)

The area of the trash rack is governed by limiting the velocity through the rack to 2 ft/sec (Ref: Design of Small Dams, p 452)

Req Area of Trash Rack = $\frac{15.91 \text{ cfs}}{2 \text{ fps}} = 7.96 \text{ ft}^2$



Area of Trash Rack = $(3 \times 3) + ((3 \times 1) \times 4) = 21 \text{ ft}^2$

Since the bars in the trash rack are 1/2" dia. and are spaced on 4" centers every square foot is reduced by 25%

Actual Area = $21 - (21 \times .25) = 15.75 \text{ ft}^2$

Actual Velocity = $\frac{15.91 \text{ cfs}}{15.75 \text{ ft}^2} = 1.01 \text{ fps} < 2$ ok

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BY: MDB DATE: 3/19/08 CHKD BY: [illegible] DATE: 4-17-08

PROJECT NAME: WILLIAMSON ENERGY

PROJECT NO. B05-330-1413 SHEET _____ OF _____

DESCRIPTION FREEBOARD CALCULATION

R12508

PURPOSE: TO DETERMINE THE MINIMUM FREEBOARD REQUIRED FOR THE PROPOSED EMBANKMENT.

ASSUMPTIONS:

FETCH (Fe) = 2200 ft. (0.42 MILES)

WIND SPEED (Ud) = 50 MPH

EMBANKMENT SLOPE = 3:1

REFERENCE: SOIL CONSERVATION SERVICE, TECHNICAL RELEASE NO. 69, FEBRUARY 1983

FROM FIGURE NO. 2:

FOR Fe = 0.42 AND Ud = 50 $\Rightarrow$ H_s = 1.5

FROM FIGURE NO. 11:

FOR Fe = 0.42 AND Ud = 50 $\Rightarrow$ L = 24

$$H_s/L = \frac{1.5}{24} = 0.0625$$

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BY: MDB DATE: 3/19/08 CHKD BY: [illegible] DATE: 4/17/08

PROJECT NAME: WILLIAMSON ENERGY

PROJECT NO. 805-230-1413 SHEET ____ OF ____

DESCRIPTION FREEBOARD CALCULATION

(3X)

R12509

From Figure No. 12:

For $H_s/L = 0.0625$ and 3:1 slope $\Rightarrow R/H_s = 1.32$

For smooth embankment slope, multiply $R/H_s \times 1.2$

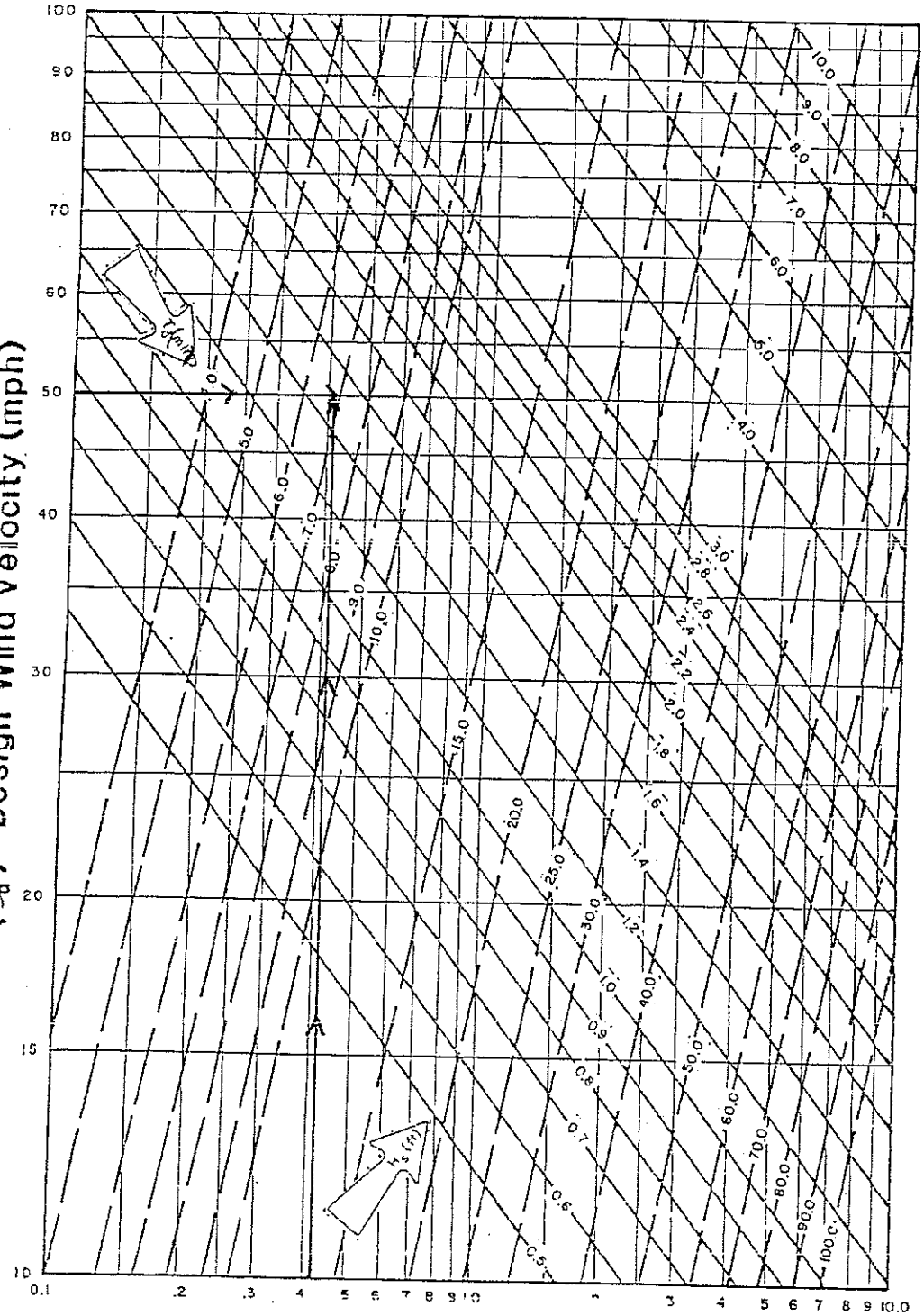
$\rightarrow 1.32 \times 1.2 = 1.58$

* Runup (R) = $1.58 \times H_s = 1.58 \times 1.5 = 2.37$

* Wind Setup (S) = $0.1 \times H_s = 0.1 \times 1.5 = 0.15$

* Minimum Freeboard = $R + S = 2.37 + 0.15 = 2.52'$

Use: Minimum Freeboard = 3 Feet



REF. (2)

Equation; (A17) & (A18) From Appendix A

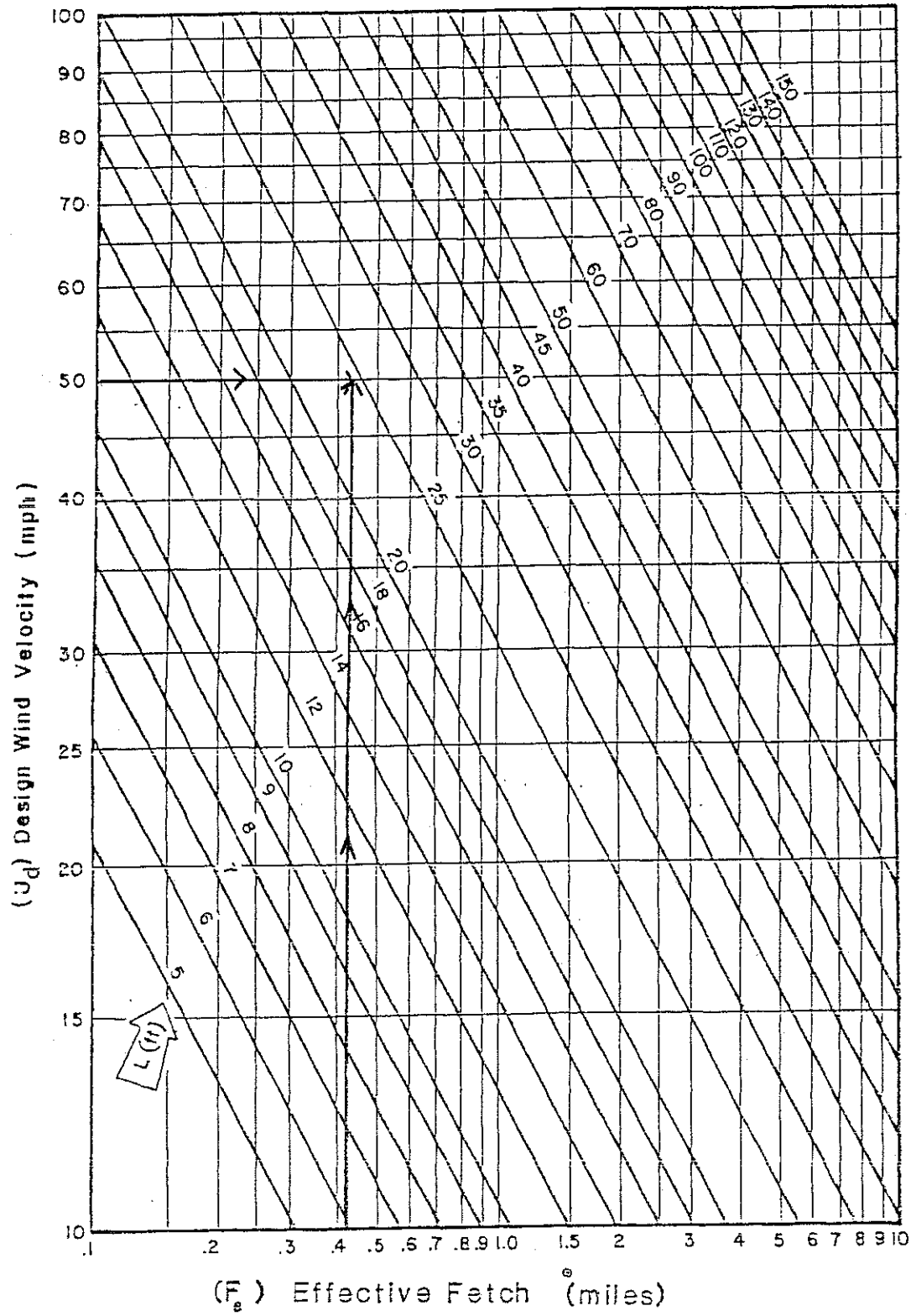
$$\frac{H_s}{U^2} = 0.0025 \left(\frac{gF_e}{U^2}\right)^{0.47}$$

$$\frac{T}{U} = 0.46 \left(\frac{gF_e}{U^2}\right)^{0.28}$$

FIGURE 2

GENERALIZED CORRELATIONS OF SIGNIFICANT WAVE HEIGHTS WITH RELATED FACTORS

WNTC ENG. STAFF
PORTLAND, OREGON



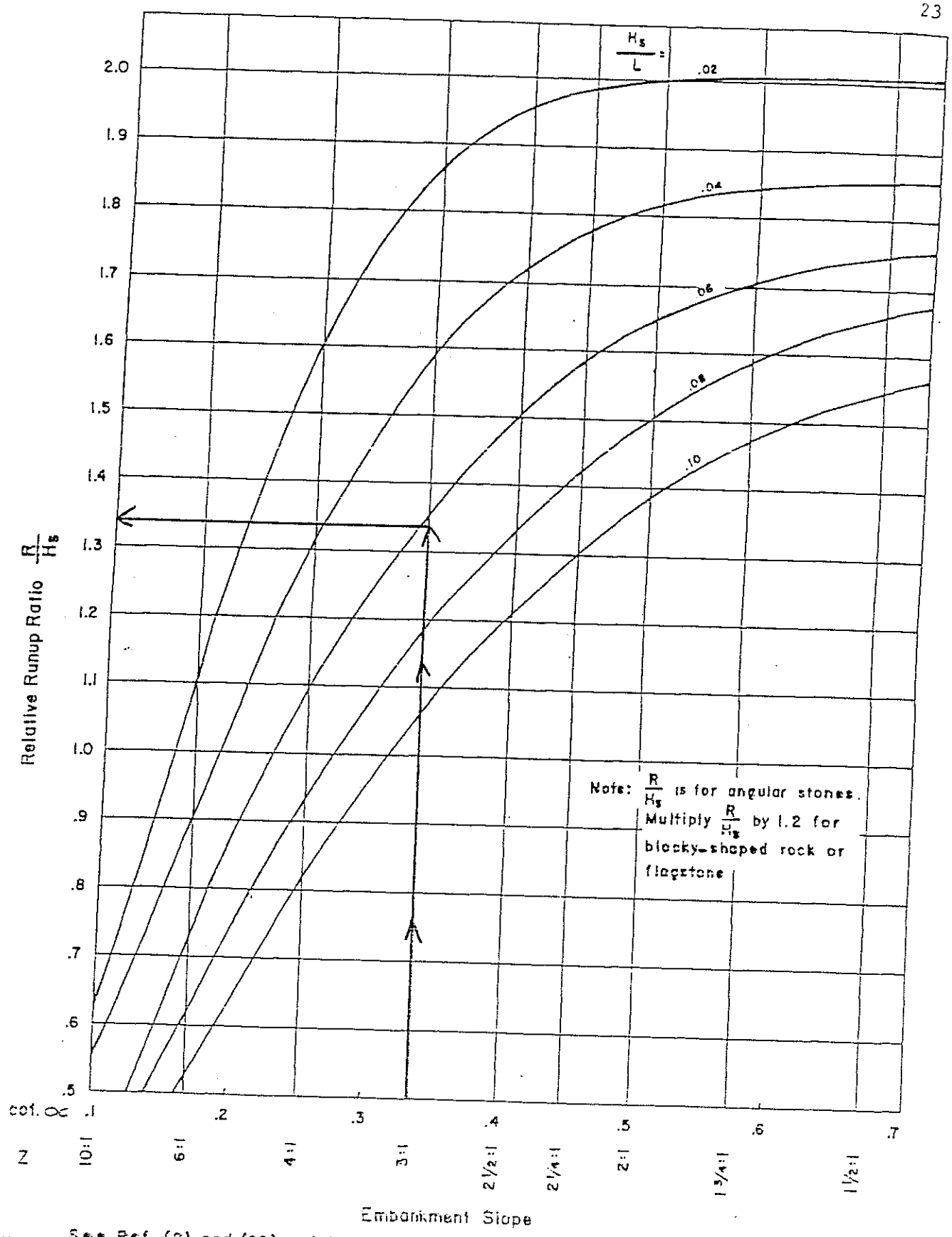
Equation (A21) From Appendix A

$$\frac{g\sqrt{L}}{U} = 1.041 \left(\frac{g F_e}{U^2}\right)^{0.28}$$

REF (2) (8)

FIGURE 11
WAVE LENGTH
RELATIONSHIP
WNTC ENG. STAFF
PORTLAND, OREGON

R12512



Note: See Ref. (2) and (20) and footnote 1 on page 9.

The surface smoothness represented by these curves is simulated by a single layer of rocks of uniform size.

FIGURE 12
WAVE RUNUP RATIO
WNTC ENG. STAFF
PORTLAND, OREGON

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PROJECT NAME: WILLIAMSON ENERGY

PROJECT NO. B05-330-1413 SHEET ____ OF ____

DESCRIPTION FILTER DRAINAGE DIAPHRAGM DESIGN

R12513

The purpose of the following calculations is to design a filter drainage diaphragm for the proposed decant pipe.

Reference: Soil Conservation Service, National Engineering Handbook, Chapter 26, Gradation Design of sand and gravel filters.

The attached sheet presents a grain size distribution curve for the Coarse Coal Refuse that will be placed at the subject facility which shall be used to backfill around the proposed pipe. Since the refuse has particles larger than the No. 4 sieve the grain size distribution curve will be adjusted by dividing 100 by the percent passing the No. 4 sieve.

Correction Factor = 100/34.1 = 2.93

Following are the adjusted percentages:

#4	100
#10	48.1
#20	24.0
#40	16.4
#60	12.3
#200	7.6

For 7.6% passing the No. 200 sieve, use category 4 for the soil (ref, table 26-1, p.26-3)

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PROJECT NAME: Williamson Energy
PROJECT NO. BOS-330-143 SHEET ____ OF ____
DESCRIPTION Filter Drainage Diaphragm Design

R12514

For category 4 base material

D_{15} max $\leq 4 \times d_{85}$ after regrading
$= 4 \times 3.6 = 14.4$mm

D_{15} min $\equiv 14.4 / 5 = 2.88$mm

Set $\frac{D_{90}}{D_{10}} \leq 6$ and $\frac{\text{max}}{\text{min}} \leq 5$

Set $D_{100} \leq 3"$

$D_5 \geq .075$mm

Set D_{10} (max) $= \frac{D_{15}\,\text{max}}{1.2} = \frac{14.4}{1.2} = 12$mm

Set D_{10} (min) $= \frac{D_{15}\,\text{min}}{1.2} = \frac{2.88}{1.2} = 2.4$mm

D_{10} min $\equiv 2.4$mm D_{90} max $= 40$mm

The filter drainage diaphragm shall have the following Gradation:

Sieve Size	% Passing
3	100
1½	84-100
¾	36-100
⅜	6-100
4	0-52
10	0-10
20	0-9
40	0-8
60	0-7
140	0-6
200	0-5

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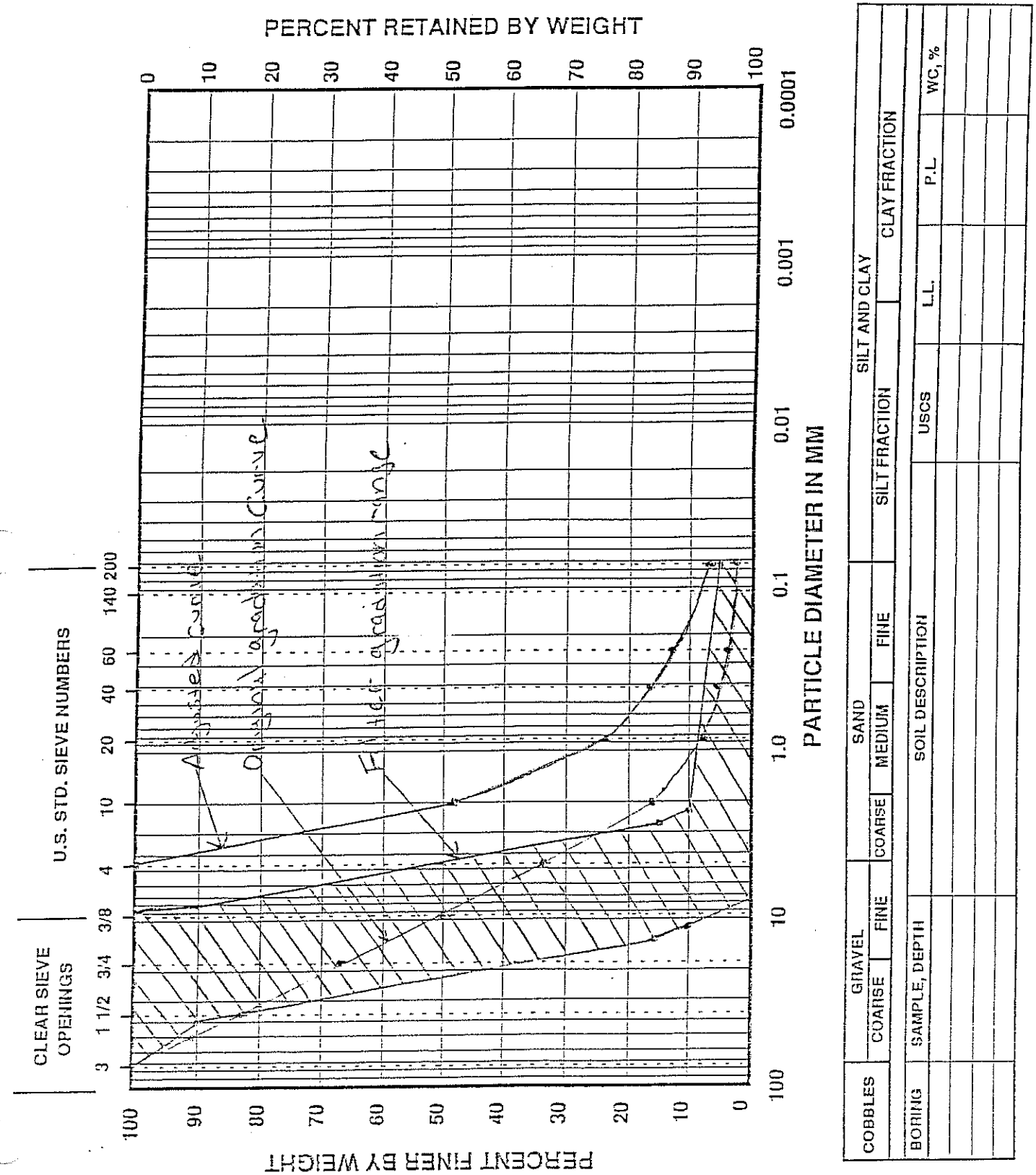
PROJECT NAME: Williamson Energy
PROJECT NO.: R05-330-1413
BORING NUMBER: 44
PLOTTED BY:
CHECKED BY:

R12515

GRAIN SIZE ANALYSIS



COBBLES	GRAVEL		SAND			SILT AND CLAY						
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT FRACTION	CLAY FRACTION					
BORING	SAMPLE, DEPTH		SOIL DESCRIPTION					USCS	L.L.	P.L	WC, %	

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BY: [illegible] DATE: 12/20/06 CHKD BY: RLF DATE: 12/22/06 (45)

PROJECT NAME: Williamson Energy

PROJECT NO. B05-330-1413 SHEET ____ OF ____

DESCRIPTION Filter Drainage diaphragm Outlet drain Phase 5

R12516

The purpose of the following Calculation is to design an Outlet drain for the proposed filter drainage diaphragm.

Reference: Soil Conservation Service Technical Note Supplement Series No 209, Filter drainage diaphragm Outlet.

Area of diaphragm = $40.5 ft^2$

Maximum Head (H) = 8ft

Seepage length (L) = 62ft

Hydraulic Gradient = $H/L = 8/62 = 0.13$

Permeability of embankment material = 0.57 ft/day

$K = 100$ times $= 100 \times .57 = 57$ ft/day

$Q = kiA = 57 \times .13 \times 40.5 = 300 ft^3/day$

For $D_{50} = 1/2"$ stone $\Rightarrow$ $Wm^{.5} = 57600$ ft/day

$$Q_{drain} = A_{drain} \times Wm^{.5} \times (.159) \times \frac{C}{1+e}$$

$$300 = A \times 57600 \times (0.06)^{.54} \times \frac{.125}{1+.25}$$

$A = 300 / 2521.5$

$= .12 ft^2$

A $4 ft^2$ drain is proposed therefore Ok

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BY: [illegible] DATE: 12/20/05 CHKD BY: [illegible] DATE: 12/20/05

PROJECT NAME: Williamson Energy

R12517

PROJECT NO. 805-330-1413 SHEET ____ OF ____

DESCRIPTION Filter drainage diaphragm Outlet drain Phase 7

The purpose of the following Calculation is to design an Outlet drain for the proposed filter drainage diaphragm.

Reference: Soil Conservation Service, Technical Note Supplement Series No. 709, Filter Drainage Diaphragm Outlet

Area of diaphragm = $40.5\ ft^2$

Maximum Head (H) = 9 ft

Seepage length (L) = 97 ft

Hydraulic Gradient = $H/L = 9/97 = 0.09$

Permeability of embankment material = 0.57 ft/day

$K = 100\ k_{emb} = 100 \times .57 = 57$ ft/day

$Q = KiA = 57 \times .09 \times 40.5 = 207.8\ ft^3/day$

For D_{50} = ½" stone $\Rightarrow$ $V_m^{.5} = 57{,}600$ ft/day

$Q_{drain} = A_{drain} \times V_m^{.5} \times .59 \times \frac{e}{1+e}$

$207.8 = A_{drain} \times 57600 \times (0.06)^{.59} \times \frac{.25}{1+.25}$

$A_{drain} = 207.8 / 2521.5$

$= 0.08\ ft^2$

A $4\ ft^2$ drain is proposed therefore OK

47

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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF _____
DESCRIPTION: Ditch "D" Tractive Force Computations, 4" USM

File: Ditch D 4-in USM.xls

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	99.10
BOTTOM WIDTH (ft), b=	12.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	25.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.31
AREA OF FLOW (sq ft), A=	3.91
WETTED PERIMETER (ft), P=	13.39
HYDRAULIC RADIUS (ft), R=	0.29
VELOCITY OF FLOW (fps), V=	25.19
LINING PERIMETER (ft)=	19.76
TOP WIDTH (ft)=	18.94
FREEBOARD (ft)=	1.43
TOTAL DITCH DEPTH (ft), d=	1.74

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 6.08

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 4.80

TOTAL STRESS

t (psf) = 6.08
T (lb/ft) = 81.37

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 9.12
(lb/ft) = 122.06

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\tan(d)-So\right)$$ (psf)= 3.26

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 2.06

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 2.79 Tr,t (lb/ft) = 55.12

(48)

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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF ___
DESCRIPTION: Ditch "D" Tractive Force Computations, 4" USM

File: Ditch D 4-in USM.xls

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 6.33 (lb/ft) = 66.94

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

REBAR SIZE (#)= 5

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= 28.85

USE REBAR SPACING OF 20.00 20 ft MAXIMUM

RESISTANCE PROVIDED (psf)= 13.18

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), $W = \frac{Cw*H*Gw}{12*Z^{.33}}$

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Cw= 3.7

W (lbs)= 4.74

MAT WEIGHT (lbs), $Wm = \frac{t(Gc-Gw)}{12}$

= 25.87

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: USE 4 INCH USM WITH ROOF BOLT (#5) ANCHORS ON 20 FOOT SPACING.

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

(49)

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BY: HLO DATE: 5/14/09 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ____ OF _____
DESCRIPTION: Ditch "F" Tractive Force Computations, 4" USM

File: Ditch F 4-in USM.xls

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	119.30
BOTTOM WIDTH (ft), b=	12.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	25.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.35
AREA OF FLOW (sq ft), A=	4.45
WETTED PERIMETER (ft), P=	13.57
HYDRAULIC RADIUS (ft), R=	0.33
VELOCITY OF FLOW (fps), V=	27.18
LINING PERIMETER (ft)=	20.18
TOP WIDTH (ft)=	19.32
FREEBOARD (ft)=	1.48
TOTAL DITCH DEPTH (ft), d=	1.83

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 6.81

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 5.38

TOTAL STRESS

t (psf) = 6.81
T (lb/ft) = 92.45

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 10.22
(lb/ft) = 138.67

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}(\tan(d)-So)$$ (psf)= 3.26

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 2.06

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 2.77 Tr,t (lb/ft) = 55.98

(52)

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BY: HLO DATE: 5/14/09 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF _____
DESCRIPTION: Ditch "F" Tractive Force Computations, 4" USM

File: Ditch F 4-in USM.xls

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 7.45 (lb/ft) = 82.69

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

REBAR SIZE (#)= 4

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= 21.37

USE REBAR SPACING OF 20.00 20 ft MAXIMUM

RESISTANCE PROVIDED (psf)= 8.50

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), W= $\frac{Cw*H*Gw}{12*Z^{.33}}$

Cw= 3.7

W (lbs)= 5.36

MAT WEIGHT (lbs), Wm= $\frac{t(Gc-Gw)}{12}$

= 25.87

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: USE 4 INCH USM WITH ROOF BOLT (#4) ANCHORS ON 20 FOOT SPACING.

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

(51)

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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF _____
DESCRIPTION: Ditch "I" Tractive Force Computations, 4" USM

File: Ditch I 4-in USM.xls

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	82.90
BOTTOM WIDTH (ft), b=	12.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	25.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.28
AREA OF FLOW (sq ft), A=	3.52
WETTED PERIMETER (ft), P=	13.25
HYDRAULIC RADIUS (ft), R=	0.27
VELOCITY OF FLOW (fps), V=	23.62
LINING PERIMETER (ft)=	19.45
TOP WIDTH (ft)=	18.67
FREEBOARD (ft)=	1.39
TOTAL DITCH DEPTH (ft), d=	1.67

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 5.52

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 4.36

TOTAL STRESS

t (psf) = 5.52
T (lb/ft) = 73.15

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 8.28
(lb/ft) = 109.72

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}(\tan(d)-So)$$ (psf)= 3.26

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 2.06

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 2.80 Tr,t (lb/ft) = 54.47

52

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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ____ OF _____
DESCRIPTION: Ditch "I" Tractive Force Computations, 4" USM

File: Ditch I 4-in USM.xls

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 5.48 (lb/ft) = 55.25

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

REBAR SIZE (#)= 5

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= 31.01

USE REBAR SPACING OF 20.00 20 ft MAXIMUM

RESISTANCE PROVIDED (psf)= 13.18

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), W= $\frac{Cw*H*Gw}{12*Z^{.33}}$

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Cw= 3.7

W (lbs)= 4.29

MAT WEIGHT (lbs), Wm= $\frac{t(Gc-Gw)}{12}$

= 25.87

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: USE 4 INCH USM WITH ROOF BOLT (#5) ANCHORS ON 20 FOOT SPACING.

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

53

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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF _____
DESCRIPTION: Ditch "L" Tractive Force Computations, 4" USM

File: Ditch L 4-in USM.xls

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	118.00
BOTTOM WIDTH (ft), b=	12.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	25.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.35
AREA OF FLOW (sq ft), A=	4.45
WETTED PERIMETER (ft), P=	13.57
HYDRAULIC RADIUS (ft), R=	0.33
VELOCITY OF FLOW (fps), V=	27.18
LINING PERIMETER (ft)=	20.18
TOP WIDTH (ft)=	19.32
FREEBOARD (ft)=	1.48
TOTAL DITCH DEPTH (ft), d=	1.83

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 6.82

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 5.38

TOTAL STRESS

t (psf) = 6.82
T (lb/ft) = 92.46

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 10.22
(lb/ft) = 138.68

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\tan(d)-So\right)$$ (psf)= 3.26

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 2.06

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 2.77 Tr,t (lb/ft) = 55.97

54

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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF ___
DESCRIPTION: Ditch "L" Tractive Force Computations, 4" USM

File: Ditch L 4-in USM.xls

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 7.45 (lb/ft) = 82.71

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

REBAR SIZE (#)= 5

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= 26.60

USE REBAR SPACING OF 20.00 20 ft MAXIMUM

RESISTANCE PROVIDED (psf)= 13.18

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), $W = \frac{Cw*H*Gw}{12*Z^{.33}}$

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Cw= 3.7

W (lbs)= 5.36

MAT WEIGHT (lbs), $Wm = \frac{t(Gc-Gw)}{12}$

= 25.87

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: USE 4 INCH USM WITH ROOF BOLT (#5) ANCHORS ON 20 FOOT SPACING.

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

55

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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ____ OF _____
DESCRIPTION: Ditch "M" Tractive Force Computations, 4" USM

File: Ditch M 4-in USM.xls

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	75.40
BOTTOM WIDTH (ft), b=	12.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	25.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.27
AREA OF FLOW (sq ft), A=	3.39
WETTED PERIMETER (ft), P=	13.21
HYDRAULIC RADIUS (ft), R=	0.26
VELOCITY OF FLOW (fps), V=	23.08
LINING PERIMETER (ft)=	19.35
TOP WIDTH (ft)=	18.57
FREEBOARD (ft)=	1.37
TOTAL DITCH DEPTH (ft), d=	1.64

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 5.33

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 4.21

TOTAL STRESS

t (psf) = 5.33
T (lb/ft) = 70.42

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 8.00
(lb/ft) = 105.64

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\tan(d) - So\right)$$ (psf)= 3.26

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}} - So\right)$$ (psf)= 2.06

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 2.80 Tr,t (lb/ft) = 54.26

56

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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF _____
DESCRIPTION: Ditch "M" Tractive Force Computations, 4" USM

File: Ditch M 4-in USM.xls

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 5.19 (lb/ft) = 51.38

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

REBAR SIZE (#)= 5

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= 31.85

USE REBAR SPACING OF 20.00 20 ft MAXIMUM

RESISTANCE PROVIDED (psf)= 13.18

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), W= $\frac{Cw*H*Gw}{12*Z^{.33}}$

Cw= 3.7

W (lbs)= 4.13

MAT WEIGHT (lbs), Wm= $\frac{t(Gc-Gw)}{12}$

= 25.87

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: USE 4 INCH USM WITH ROOF BOLT (#5) ANCHORS ON 20 FOOT SPACING.

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

57

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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF ___
DESCRIPTION: Decant Ditch Tractive Force Computations, 4" USM

File: Decant Ditch 4-in USM.xls

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	19.10
BOTTOM WIDTH (ft), b=	0.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	25.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.63
AREA OF FLOW (sq ft), A=	0.79
WETTED PERIMETER (ft), P=	2.82
HYDRAULIC RADIUS (ft), R=	0.28
VELOCITY OF FLOW (fps), V=	24.58
LINING PERIMETER (ft)=	9.65
TOP WIDTH (ft)=	8.63
FREEBOARD (ft)=	1.53
TOTAL DITCH DEPTH (ft), d=	2.16

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 5.86

THE DITCH IS V-SHAPED THEREFORE BOTTOM TRACTIVE STRESS IS ZERO. BOTTOM TRACTIVE STRESS IS ONLY CALCULATED TO ALLOW CALCULATION OF SIDE SLOPE TRACTIVE STRESS.

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 4.63

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

TOTAL STRESS

t (psf) = 4.63
T (lb/ft) = 13.04

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 6.94
(lb/ft) = 19.57

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}(\tan(d)-So)$$ (psf)= 0.00 DITCH IS V-SHAPED THEREFORE BOTTOM STRESS IS ZERO

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 2.06

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 2.06 Tr,t (lb/ft) = 19.82

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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____

PROJECT NAME: Williamson Energy LLC

PROJECT NO.: B05-330-1413 SHEET ___ OF _____

DESCRIPTION: Decant Ditch Tractive Force Computations, 4" USM

File: Decant Ditch 4-in USM.xls

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 4.89 (lb/ft) = -0.26

NOTE: NO ANCHORS REQUIRED FOR THIS DITCH, REQUIRED RESISTING STRESS < AVE. RESISTING STRESS FROM MAT IN LB/FT !

CHECK UPLIFT

REQUIRED WEIGHT (lbs), W= $\frac{Cw*H*Gw}{12*Z^{.33}}$

Cw= 3.7

W (lbs)= 9.64

MAT WEIGHT (lbs), Wm= $\frac{t(Gc-Gw)}{12}$

= 25.87

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

58

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BY: HLO DATE: 7/2/09 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF _____
DESCRIPTION: Ditch "F" Tractive Force Computations, 15" Grouted RRP

File: Ditch F 15-in GRRP

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	119.30
BOTTOM WIDTH (ft), b=	12.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	Grouted Riprap
UNIT WEIGHT OF CONCRETE (pcf), Gc=	150.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	25.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.035
DEPTH OF FLOW (ft), y=	0.58
AREA OF FLOW (sq ft), A=	7.63
WETTED PERIMETER (ft), P=	14.59
HYDRAULIC RADIUS (ft), R=	0.52
VELOCITY OF FLOW (fps), V=	15.91
LINING PERIMETER (ft)=	20.55
TOP WIDTH (ft)=	19.65
FREEBOARD (ft)=	1.33
TOTAL DITCH DEPTH (ft), d=	1.91

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 10.88

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 8.59

TOTAL STRESS

t (psf) = 10.88
T (lb/ft) = 158.75

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 16.32
(lb/ft) = 238.12

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 15

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\tan(d)-So\right)$$ (psf)= 13.82

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 8.70

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 11.69 Tr,t (lb/ft) = 240.21

$FS = \frac{240.2\ LB}{158.8\ LB}$

$= 1.51 > 1.50$, OK

NOTE: 15" LAYER SPECIFIED WITH 12" GROUT PENETRATION

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BY: HLO DATE: 7/2/09 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF _____
DESCRIPTION: Ditch "F" Tractive Force Computations, 15" Grouted RRP

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 4.63 (lb/ft) = -2.09

CHECK UPLIFT

REQUIRED WEIGHT (lbs), W= $\frac{Cw*H*Gw}{12*Z^{.33}}$

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Cw= 3.7

W (lbs)= 8.88

MAT WEIGHT (lbs), Wm= $\frac{t(Gc-Gw)}{12}$

= 109.50

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

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BY: HJO DATE: 03/02/09 CHKD BY: MKT DATE: 3/4/09 (586)

PROJECT NAME: WILLIAMSON ENERGY, LLC

PROJECT NO. 805-330-H13 SHEET 1 OF

DESCRIPTION DETERMINE METHOD TO ESTIMATE THE ANCHORAGE CAPACITY OF A BOLT

REFERENCES

(1) "FOUNDATION DESIGN", WAYNE C. TENG, PRENTICE HALL, INC., 1962

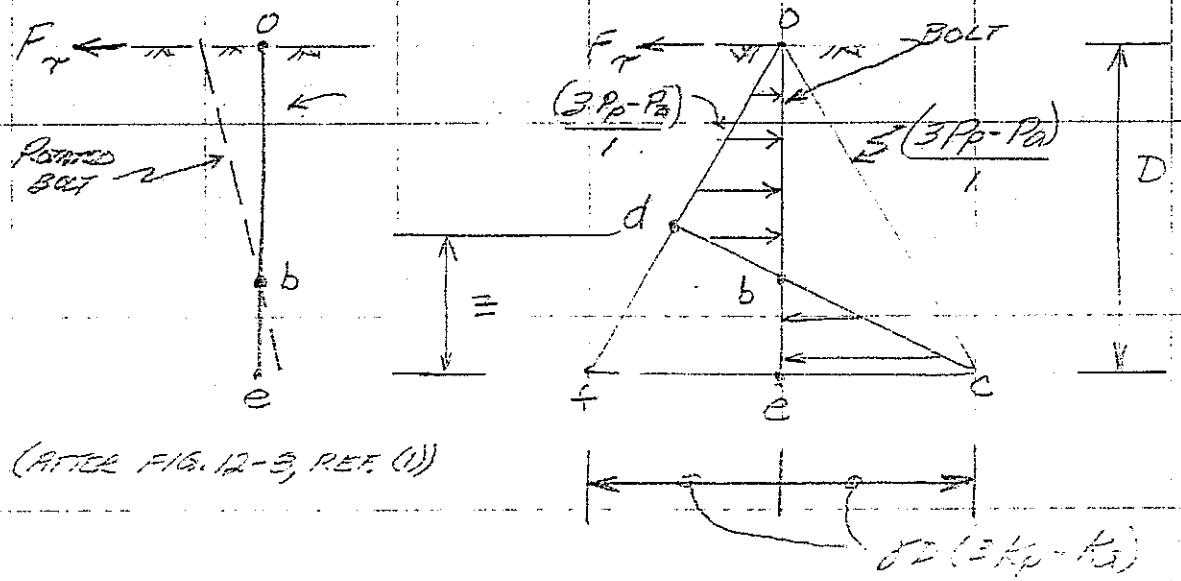
(2) REPORT NO. FHWA-RD-75-128, "LATERAL SUPPORT AND UNDERPINNING, VOL. I, DESIGN AND CONSTRUCTION", APRIL 1976.

(3) "GEOTECHNICAL ENGINEERING CIRCULAR NO. 4, GROUND ANCHORS AND ANCHORED SYSTEMS", REPORT NO. FHWA-IF-99-015, JUNE 1999.

FIND: THE ANCHORAGE CAPACITY OF ROOF BOLTS OR SIMILAR RODS TO ANCHOR RIGID CHANNEL LINING AGAINST TRACTIVE FORCE AND UPLIFT CAUSED BY FLOWING WATER.

ASSUMPTIONS

1. THE ROOF BOLTS WILL BEHAVE IN UNDERLOAD IN A MANNER SIMILAR TO SOLDIER PILES
2. THE ROOF BOLTS ARE RELATIVELY RIGID AND WILL ROTATE UNDER LATERAL LOADS AROUND SOME POINT ABOVE THE BOTTOM OF THE BOLT (FREE EARTH SUPPORT CONDITION).
3. IN COHESIONLESS SOILS AND FOR DRAINED CONDITIONS IN COHESIVE SOILS PASSIVE RESISTANCE AT DEPTH IS DEVELOPED OVER 3 TIMES THE ROOT BOLT (SOLDIER PILE) WIDTH.
4. RANKINE EARTH PRESSURE COEFFICIENTS APPLY.



(AFTER FIG. 12-5, REF. (1))

D = DEPTH BOLT IS DRIVEN INTO GROUND

P_p = PASSIVE EARTH PRESSURE = $\frac{1}{2} K_p \gamma D$

P_a = ACTIVE EARTH PRESSURE = $K_a D \gamma$

$K_p = \tan^2(45° + \phi/2)$

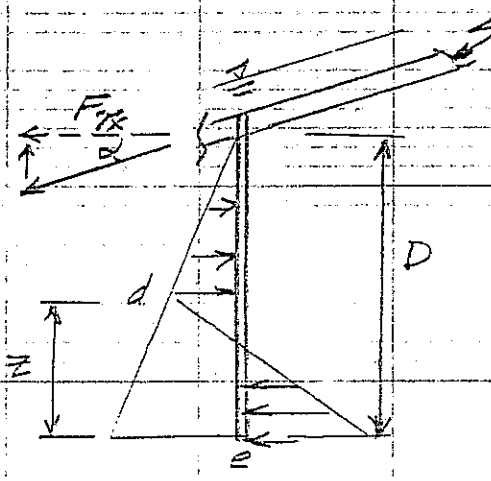
$K_a = \tan^2(45° - \phi/2)$

ϕ = DRAINED SOIL ϕ (EFFECTIVE STRESS)

γ = SOIL DENSITY

F_T = LOAD ON BOLT DUE TO TRACTIVE FORCE OF WATER

TO SOLVE FOR F_T, CHECK STATIC EQUILIBRIUM OF THE FORCES IN THE PRECEDING DIAGRAM ($\Sigma F_x = 0$) AND TRY ΣM ABOUT ANY POINT ON THE BOLT = 0. WHEN DISTANCE z IS CORRECT, FORCES WILL BALANCE. THIS IS A TRIAL AND ERROR SOLUTION.



$F_{Tx} = F_T \cos\alpha$

α = CHANNEL SLOPE

SURCHARGE LOAD OF CHANNEL LINING MAT AND DEPTH OF WATER IGNORED AS IT IS ON ALL SIDES OF THE BOLT

$\Sigma F_x = 0$

$\Sigma M_e = 0$

NOTE: THIS IS FOR COHESIONLESS, GRADUAL SOILS ONLY

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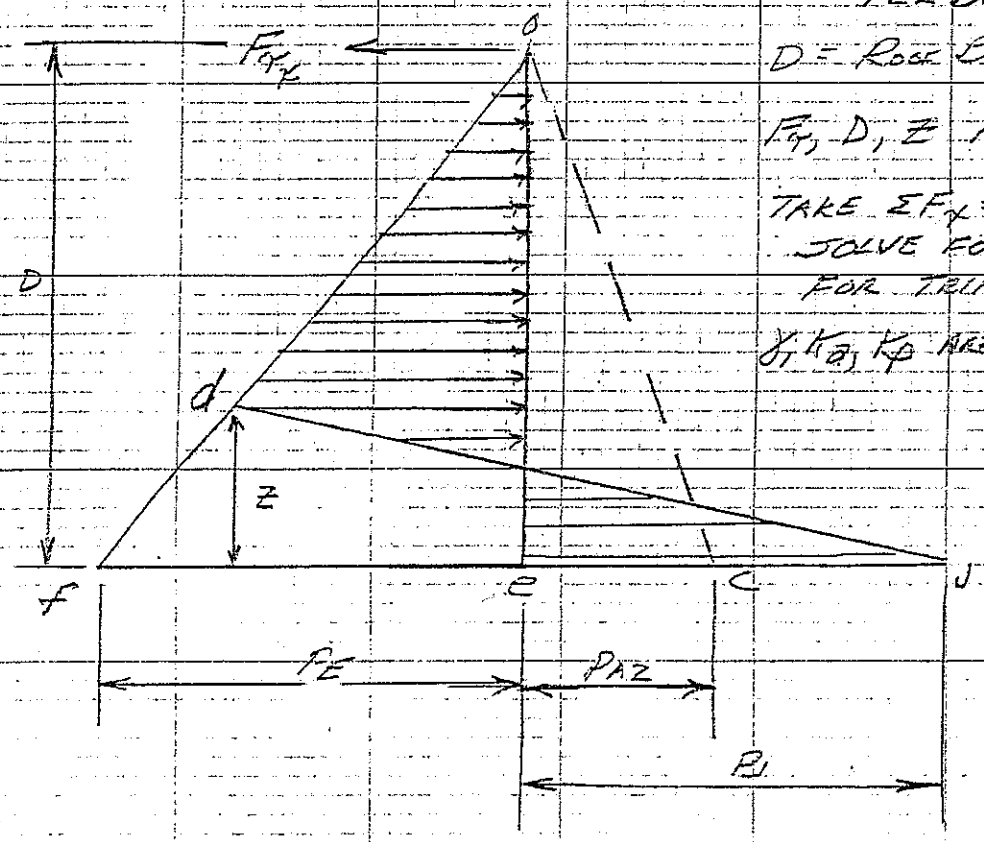
BY: HLD DATE: 3/19/09 CHKD BY: MKT DATE: 7/6/09 (58d) R12534

PROJECT NAME: WILLIAMSON ENERGY LLC

PROJECT NO. B05-330-1413 SHEET 3 OF

DESCRIPTION DETERMINE METHOD TO ESTIMATE THE ANCHORAGE CAPACITY OF A BOLT



F_{T_x} = TRACTIVE FORCE PER BOLT

D = ROCK BOLT DEPTH

F_T, D, Z ARE UNKNOWNS

TAKE $\Sigma F_x = 0$, $\Sigma M_F = 0$, SOLVE FOR F_T AND Z FOR TRIAL D.

γ, K_a, K_p ARE KNOWN

$P_{A2} = \gamma D K_a$

$P_E = \gamma D (3K_p - K_a)$

$P_J = \gamma D (3K_p - K_a)$

$P_E = P_J$ FOR THIS CASE

SUM FORCES BY PRESSURE AREAS

$\Sigma F_x = 0$ ←

- $F_{T_x} + P_{A2}(D/2) + (P_E + P_J)\, z/2 - (P_E + P_{A2})\, D/2 = 0$
- $F_{T_x} + \gamma D K_a (D/2) + 2(\gamma D)(3K_p - K_a)\, z/2 - [\gamma D(3K_p - K_a) + \gamma D K_a]\, D/2 = 0$
- $F_{T_x} + \frac{\gamma D^2 K_a}{2} + z\gamma D(3K_p - K_a) - \left[\frac{\gamma D^2}{2}(3K_p - K_a) + \frac{\gamma D^2}{2}(K_a)\right] = 0$
- $F_{T_x} + \frac{\gamma D^2}{2}[K_a - (3K_p - K_a + K_a)] + z\gamma D(3K_p - K_a) = 0$
- $F_{T_x} + \frac{\gamma D^2}{2}(K_a - 3K_p) + z\gamma D(3K_p - K_a) = 0$

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(304) 255-0491

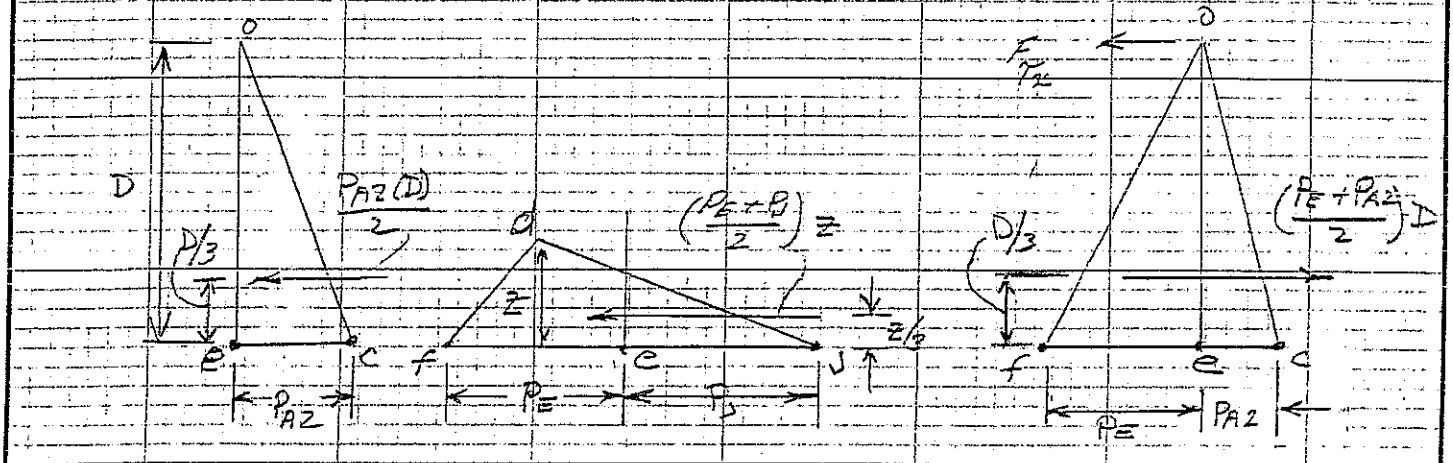
BY: HRD DATE: 3/20/09 CHKD BY: TLT DATE: 7/1/09 (SBE)

PROJECT NAME: WILLIAMSON ENERGY LLC

PROJECT NO. 805-330-1413 SHEET 4 OF

DESCRIPTION DETERMINE METHOD TO ESTIMATE THE ANCHORAGE CAPACITY OF A BOLT

FORCE PRESSURE AREAS



$$\Sigma M_e = 0 \quad +$$

$$-D(F_{Tx}) + \frac{P_{A2}(D)}{2}\left(\frac{D}{3}\right) + \left(\frac{P_E+P_J}{2}\right)Z\left(\frac{Z}{3}\right) - \left(\frac{P_E+P_{A2}}{2}\right)D\left(\frac{D}{3}\right) = 0$$

$$D(F_{Tx}) + P_{A2}\left(\frac{D^2}{6}\right) + (P_E+P_J)\frac{Z^2}{6} - (P_E+P_{A2})\frac{D^2}{6} = 0$$

$$D(F_{Tx}) - \frac{D^2}{6}(P_E) + \frac{Z^2}{6}(P_E+P_J) = 0$$

$$D(F_{Tx}) - \frac{D^2}{6}\left[\gamma D(3K_p - K_a)\right] + \frac{Z^2}{6}\left[\gamma D(3K_p-K_a)Z\right]$$

$$D(F_{Tx}) - \frac{\gamma D^3}{6}(3K_p-K_a) + \frac{\gamma D Z^2}{3}(3K_p-K_a) = 0$$

$$F_{Tx} - \frac{\gamma D^2}{6}(3K_p-K_a) + \frac{\gamma Z^2}{3}(3K_p-K_a) = 0$$

NOW HAVE 2 EQUATIONS AND 3 UNKNOWNS - F_{Tx}, D, AND Z FOR TRIAL VALUE OF D, TRIAL AND ERROR SOLVE FOR Z AND F_{Tx} UNTIL $\Sigma F_x = 0$ AND $\Sigma M_f = 0$

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BY: HLO DATE: 3/31/2009 CHKD BY: [illegible] DATE: 7/14/09 (587)

PROJECT NAME: Williamson Energy LLC

PROJECT NO.: B05-330-1413 SHEET 5 OF

DESCRIPTION: Drainage Channel USM Lining Anchorage Bolt Design

Lined Channel Anchor Bolt Capacity - 4' long, 5/8" diameter
Case: Cohesionless Soil

Factor	Value
γ = soil weight, PCF	120
Φ = effective angle of soil friction, degrees	34
D = Bolt anchorage depth, FT	4
z = trial distance to balance forces	
FTx = Horizontal component of channel tractive force, LB	
α = channel slope, degrees	18.44
Ka = $\tan^2(45^\circ - \Phi/2)$	0.28271
Kp = $\tan^2(45^\circ + \Phi/2)$	3.53713
d = bolt diameter, feet	0.05208

Channel Slope (H:V)	α (degrees)
2 : 1	26.565
2.5 : 1	21.801
3 : 1	18.435
3.5 : 1	15.945
4 : 1	14.036

Bolt Φ (inches)	Bolt Φ (FT)
1/2	0.04167
5/8	0.05208
3/4	0.06250
1	0.08333

Σ Forces x = 0

$F_{Tx} + (\gamma D^2/2)(Ka-3Kp) + z\gamma D(3Kp-Ka) = 0$
For given D, Compute FTx for trial z distance
$F_T = F_{Tx}/(\cos\alpha)$

D (FT)	Bolt Φ (FT)	Trial z (FT)	FTx (LB)	FT (LB)	(γD2/2)(Ka-3Kp)	zγD(3Kp-Ka)
4	0.05208	1.2	207	218	-516	310
4	0.05208	1.3	181	191	-516	336
4	0.05208	1.4	155	163	-516	361
4	0.05208	1.526	122	129	-516	394

Σ Moments = 0 (about bottom of bolt)

$F_{Tx} + (\gamma z^2/3)(3Kp-Ka) = (\gamma D^2/6)(3Kp-Ka)$
For given D, use trial z and trial FTx to make ΣM = 0

D (FT)	Bolt Φ (FT)	Trial z (FT)	Trial FTx (LB)	FT (LB)	(γz2/3)(3Kp-Ka)	(γD2/6)(3kp-Ka)	Σ M = ?
4	0.05208	1.4	130	137.0	42.2	172.1	0.0
4	0.05208	1.014	150	158.1	22.1	172.1	0.0
4	0.05208	1.526	122	128.6	50.1	172.1	0.0

ΣFx balanced with ΣM=0 at z = 1.53', FT = 129 LBS ←

Note: FT and FTx multiplied by bolt Φ to get pounds on bolt
If it is impossible to make Σ M = 0, D is is too short

File: Channel Anchor Bolts - No 5 - 4 ft long.xls, Sheet 1, hlo, rev. 05/18/09

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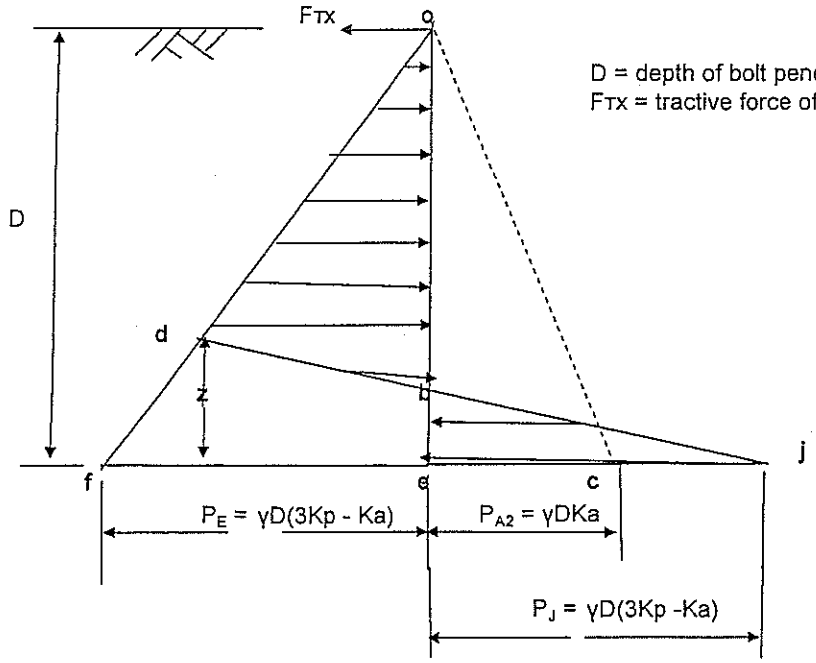
BY: HLO DATE: 3/31/2009 CHKD BY: TJK DATE: 7/16/09 (589)

PROJECT NAME: Williamson Energy LLC

PROJECT NO.: B05-330-1413 SHEET 6 OF

DESCRIPTION: Drainage Channel USM Lining Anchorage Bolt Design

Case: Cohesionless Soils



D = depth of bolt penetration
FTX = tractive force of water in x directon

$\Sigma Fx = 0$ by force areas

$F_{TX} + (oec) + (fdj) - (cfo) = 0$, reduces to :

$F_{TX} + (\gamma D^2/2)(Ka - 3Kp) + z\gamma D(3Kp - Ka) = 0$

$\Sigma Me = 0$ by force areas

$(D)F_{TX} + (oec)D/3 + (fdj)z/3 - (cfo)D/3 = 0$, reduces to:

$F_{TX} - (\gamma D^2/6)(3Kp - Ka) + (\gamma z^2/3)(3kp-Ka) = 0$

Reference: "Foundation Design", Wayne C. Teng, Prentice Hall, Inc., 1962, Figure 12-8.

File: Channel Anchor Bolts Force Diagram.xls, hlo, rev. 05/19/09

CHECK ANCHORAGE STRESSES ON BOLTS AND CONCRETE

BOLTS

LOAD/BOLT = 87.7 LB/FT (6 FT ROWS C-C)/(4 BOLTS - ROW)

= 124 LB/BOLT

ALLOW $f_y = 0.85 f_s = 0.85(20{,}000 \text{ PSI}) = 17000 \text{ PSI}$

A_s FOR 5/8" BOLT = 0.31 IN^2

ACTUAL $f_y = 124 \text{ LB}/0.31 \text{ IN}^2 = 400 \text{ PSI}$, $< 17000 \text{ PSI}$, OK

CONCRETE (USM)

$f_c' = 4000$ PSI FOR ARMORFORM MAT

$f_c = \phi(0.85 f_c' A_1)$ (ACI-318-95, SECT. 10.17)

A_1 = BEARING AREA BOLT TO USM

= 5/8" X 4" = 2.5 IN^2

$\phi = 0.70$ (ACI-318-95, SECT. 9.3.2.4)

$f_c = 0.70(0.85)4000(2.5) = 5950$ LB

f_c (ACTUAL) = 124 LB << 5,950 LB, ∴ OK

Alliance Consulting, Inc.
Engineers
Constructors
Scientists
BECKLEY, WV
(304) 255-0491

BY: HJO DATE: 6/9/09 CHKD BY: MKT DATE: 7/16/09

PROJECT NAME: WILLIAMSON ENERGY LLC

PROJECT NO. 805-330-1413 SHEET 9 OF

DESCRIPTION DRAINAGE CHANNEL USM LINING ANCHORAGE DESIGN

DETERMINE ANCHOR BOLT SPACING

ANCHORAGE CAPACITY FOR A 4'-LONG 3/8" BOLT = 129 LBS

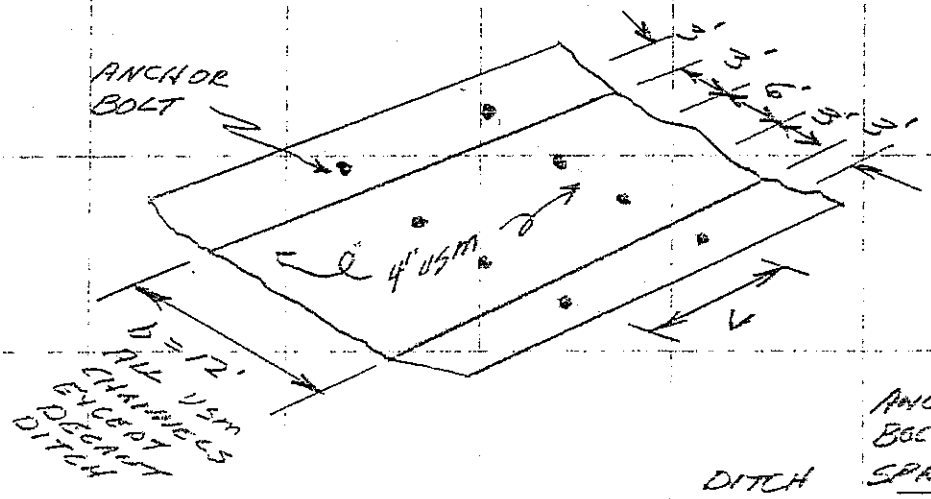
TRY 4 BOLTS/ROW

ANCHORAGE CAPACITY = 4 (129 LB/BOLT) = 516 LB/ROW

BOLT ROW SPACING = (516 LB/ROW) ÷ (REMAINING RESISTANCE REQUIRED - LB/FT)

DITCH	REMAINING RESISTANCE REQ'D (LB/FT)	MIN. ROW SPACING (FT)	ROW SPACING TO USE (FT)
D	66.9	7.71	7.5'
F	82.7	6.24	6'
I	55.2	9.35	9'
L	82.7	6.24	6'
M	51.4	10.04	10'
DECANT	0	NONE	NONE REQ'D

TYPICAL DITCH USM ANCHORING ISOMETRIC VIEW



DITCH	ANCHOR BOLT ROW SPACING (FT)
D	7.5'
F	6'
I	9'
L	6'
M	10'

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BY:	HLO	DATE:	6/18/2008	CHKD BY:	CEY	DATE:	8/8/08
PROJECT NAME:	Williamson Energy LLC						
PROJECT NO.	B05-033-1413	SHEET	1	OF	12		
DESCRIPTION	Phase 5 & 6 Underdrain Design Revisions						
	Outlet Pipes	File: PondCkUDOutlets.xls					

Phases 5 & 6: Revised Design - Underdrain Collector Pipe Outlets Capacity
12" SDR 13.5 HDPE Pipe, ID = 10.749", n = 0.015 (aged)
16" SDR 13.5 HDPE Pipe, ID = 13.488", n = 0.015 (aged)
10" SDR 26 HDPE Pipe, ID = 9.874", n = 0.015 (aged)

Phase	Sta.	Σ ΔL to Sta. (ft)	Σ Q to Sta. (gpm)	Inlet Elev. (msl)	Outlet Elev (msl)	Outlet Pipe Length	Pipe Slope (ft/ft)	Pipe) Q (full) (gpm)	Outlet Pipe Flow S.F.	Outlet Pipe Type
5	3+40	1080	317	438.5	437.0	150	0.01000	1893	6.0	16" SDR 13.5 HDPE
	10+00	820	142	435.0	433.5	110	0.01364	962	6.8	10" SDR 26 HDPE
	16+00	440	76	441.5	440.5	110	0.00909	786	10.3	10" SDR 26 HDPE
	29+50	1300	225	435.0	433.0	110	0.01818	1111	4.9	10" SDR 26 HDPE
	34+00	600	104	436.0	435.0	110	0.00909	786	7.6	16 " SDR 13.5 HDPE
	39+00	710	427	438.5	437.0	110	0.01364	2210	5.2	16 " SDR13.5 HDPE
6 (EAST)	0+00		197		442.5					Connect to Phase 5
	7+60	710	332	445.0	442.0	330	0.00909	1805	5.4	16" SDR 13.5 HDPE
	12+30	400	187	449.0	448.0	310	0.00323	1076	5.7	16" SDR 13.5 HDPE
6 (WEST)	0+00		206		444.0					Connect to Phase 5
	7+60	460	215	445.5	442.0	330	0.01061	1064	4.9	12" SDR 13.5 HDPE
	13+40	700	328	446.0	443.0	360	0.00833	1727	5.3	16" SDR 13.5 HDPE
					Σ =	2030				

Note: A 16" SDR 26 HDPE Pipe can be used instead of a 16" SDR 13.5 HDPE Pipe for Phase 5 (except at Sta. 3+40).

Outlet Pipe Footage: 10" SDR 26 = 330' 12" SDR 13.5 = 330' 16" SDR 13.5 = 1370'

R12540

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BY: RBO DATE: 8/10/2006 CHKD BY: CLY DATE: 8/28/06

PROJECT: Williamson Energy LLC

NO: B05-33--1413 SHEET 2 OF 12

TITLE: Phase 5 Underdrain Design Revisions

for Predicted Subsidence File: PondCkUD5(rev2).xls)

R12541

Phase 5 Underdrain: Revised Design: Post Subsidence Underdrain Collector Pipe Capacity
12" SDR 13.5 HDPE Collector Pipe, ID = 10.749", n = 0.015 (aged), 0+00 TO 3+40
10" SDR 26 HDPE Collection Pipe, ID = 9.874" n =0.015 (aged), 3+40 to 40+90

Sta.	Δ L (ft)	Pipe Invert Elev	Pipe Slope (ft/ft)	Pipe Q (full) (gpm)	Σ ΔL Sta. to Sta (ft)	Σ Inflow Q (gpm)	Post Sub. Flow S.F.	
						(206 gpm)		from Phase 6
0		444.00						ties to phase 6
	110		0.01618	1314	110	225	5.8	
110		442.22						
	230		0.01618	1314	***340***	265	5.0	
340		438.50						outlet
	300		0.00500	582	***300***	52	11.2	
640		440.00						
	360		0.01389	939	***360***	62	15.1	
1000		435.00						outlet
	160		0.00938	798	***460***	80	10.0	
1160		436.50						
	300		0.02167	1213	300	52	23.4	
1460		443.00						
	140		0.01071	853	***140***	24	35.2	
1600		441.50						outlet
	300		0.00667	693	***300***	52	13.4	
1900		443.50						
	600		0.00500	582	600	104	5.6	
2500		440.50						
	450		0.01222	911	***1050***	182	5.0	
2950		435.00						outlet
	250		0.01200	903	***250***	43	20.9	
3200		438.00						
	200		0.01000	824	***200***	35	23.8	
3400		436.00						outlet
	400		0.01125	874	***400***	69	12.6	
3800		440.50						
	100		0.02000	1165	***100***	17	68.5	
3900		438.50						outlet
	190		0.02105	1195	***190***	230	5.2	
4090		442.50						ties to phase 6
Σ =	4090			Σ (bold) =	4090	(197 gpm)		from Phase 6

Bold - grade change *Bold & Italic* - sum of foot of pipe draining to outlet

Σ Inflow Q = 0.173 gpm/ft of pipe for Phase 5 embankment

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BY:	HLO	DATE:	4/29/2008	CHKD BY:	CFY	DATE:	8/6/08
PROJECT NAME:	Williamson Energy LLC						
PROJECT NO.	B05-33-1413			SHEET	3	OF	12
DESCRIPTION	Phase 5 Underdrain Design Revisions for Predicted Subsidence (File: PondCkUD5.xls)						

R12542

Phase 5 Underdrain: Existing Design: Underdrain Collector Pipe Capacity
12" SDR 13.5 HDPE Collector Pipe, ID = 10.749", n = 0.015 (aged)

Sta.	Δ L (ft)	Pipe Invert Elev	Pipe Slope (ft/ft)	Pipe Q (full) (gpm)	Σ ΔL Sta. to Sta (ft)	Σ Inflow Q (gpm)	Post Sub. Flow S.F. (1)		
0		444.00							ties to phase 6
	110		0.00588	792	110	21	37.3		
110		443.35							
	230		0.00588	792	*340*	66	12.1		
340		442.00							outlet
	190		0.00526	749	*190*	37	20.4		
530		443.00							
	360		0.00833	943	**360**	69	13.6		
890		440.00							outlet
	270		0.00504	734	*1190*	230	3.2		
1160		441.36							
	220		0.00504	734	920	178	4.1		
30		442.47							
	80		0.00504	734	700	135	5.4		
1460		442.87							
	480		0.00504	734	620	120	6.1		
1940		445.29							
	140		0.00504	734	140	27	27.2		
2080		446.00							
	870		0.00632	821	870	168	4.9		
2950		440.50							
	80		0.00632	821	*950*	183	4.5		
3030		440.00							outlet
	655		0.00611	808	*655*	126	6.4		
3685		444.00							
	230		0.00494	726	230	44	16.4		
3915		442.86							
	175		0.00494	726	*405*	78	9.3		
4090		442.00							ties to phase 6
Σ =	4090		Σ (bold) =	4090					

)ld - grade change
...ic & Bold - sum of foot of pipe draining to outlet

Σ Inflow Q = 0.193 gpm/ft of pipe

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BY:	HLO	DATE:	5/14/2008	CHKD BY:	CEY	DATE:	5/15/08
PROJECT NAME:	Williamson Energy LLC						R12543
PROJECT NO.	B05-33--1413			SHEET	4	OF	12
DESCRIPTION	Phase 6 Underdrain Design Revisions - West Side						
	for Predicted Subsidence (File: PondCkUD6W(rev2).xls)						

Phase 6 Underdrain: Revised Design - Post Subsidence Underdrain Collector Pipe Capacity
West Side 12" SDR 13.5 HDPE Collector Pipe, ID = 10.749", n = 0.015 (aged)

Sta.	Δ L (ft)	Pipe Invert Elev	Pipe Slope	Pipe Q (full) (gpm)	Σ ΔL Sta. to Sta. (ft)	Σ Inflow Q (gpm) (1)	Post Sub. Flow S.F. (1)	
0		444.00						
	290		0.01023	1045	***440***	206	5.1	connect to phase 5
290		446.97						
	150		0.01023	1045	*150*	70	14.9	
440		448.50						
	60		0.00938	1001	60	28	35.6	
500		447.94						
	160		0.00938	1001	220	103	9.7	
660		446.44						
	100		0.00938	1001	***320***	150	6.7	
760		445.50						Outlet
	110		0.03929	2048	***140***	66	31.3	
0		449.82						
	30		0.03929	2048	30	14	145.9	
		451.00						
	335		0.01136	1101	335	157	7.0	Outlet
1235		447.19						
	105		0.01136	1101	***440***	206	5.3	
1340		446.00						Outlet
	30		0.00577	785	***260***	122	6.5	
1370		446.17						
	60		0.00577	785	230	108	7.3	
1430		446.52						
	100		0.00577	785	170	80	9.9	
1530		447.10						
	20		0.00577	785	70	33	24.0	
1550		447.21						
	50		0.00577	785	50	23	33.5	
1600		447.50						
Σ =	1600			Σ (bold) =	1600			

id - grade change .Σ Inflow Q = 0.468 gpm/ft of pipe
llic & Bold - sum of foot of pipe draining to outlet

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BY:	HLO	DATE:	5/3/2008	CHKD BY:	CEV	DATE:	5/8/08
PROJECT NAME:	Williamson Energy LLC						
PROJECT NO.	B05-33--1413			SHEET	5	OF	12
DESCRIPTION	Phase 6 Underdrain Design Revisions - West Side						
	for Predicted Subsidence (File: PondCkUD6W.xls)						

R12544

Phase 6 Underdrain: Existing Design - Underdrain Collector Pipe Capacity
West Side 12" SDR 13.5 HDPE Collector Pipe, ID = 10.749", n = 0.015 (aged)

Sta.	Δ L (ft)	Pipe Invert Elev	Pipe Slope (ft/ft)	Pipe Q (full) (gpm)	Σ ΔL Sta. to Sta (ft)	Σ Inflow Q (gpm) (1)	Post Sub. Flow S.F. (1)	
0		444.00		0				ties to phase 5
	290		0.01222	1142	***900***	421	2.7	
290		447.54						
	210		0.01222	1142	610	285	4.0	
500		450.11						
	156		0.01222	1142	400	187	6.1	
656		452.02						
	104		0.01222	1142	244	114	10.0	
760		453.29						
	110		0.01222	1142	140	66	17.4	
870		454.63						
	30		0.01222	1142	30	14	81.3	
00		455.00						Outlet
	335		0.00571	781	335	157	5.0	
1		453.09						
	105		0.00571	781	440	206	3.8	
1340		452.49						
	30		0.00571	781	470	220	3.6	
1370		452.31						
	60		0.00571	781	530	248	3.1	
1430		451.97						
	100		0.00571	781	630	295	2.6	
1530		451.40						
	20		0.00571	781	650	304	2.6	
1550		451.29						
	50		0.00571	781	***700***	328	2.4	
1600		451.00						ties to phase3
Σ =	1600			Σ (bold) =	1600			

- Not including flows into or from Phases 3 or 5 underdrains
)ld - grade change Σ Inflow = 0.468 gpm/ft of pipe
ilic & Bold - sum of foot of pipe draining to outlet

Alliance Consulting, Inc.
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BY:	HLO	DATE:	5/14/2008	CHKD BY:	LEN	DATE:	5/8/09
PROJECT NAME:	Williamson Energy LLC						
PROJECT NO.	B05-33--1413			SHEET	6	OF	12
DESCRIPTION	Phase 6 Underdrain Design Revisions -East Side						
	for Predicted Subsidence - File: PondCkUD6E(rev).xls						

Phase 6 Underdrain: Revised Design - Underdrain Collector Pipe Capacity
East Side 12" SDR HDPE Collector Pipe, ID = 10.749", n = 0.015 (aged)

Note: Phase 6 will be built post subsidence.

Sta.	Δ L (ft)	Pipe Invert Elev.	Pipe Slope (ft/ft)	Pipe Q (full) (gpm)	Σ ΔL Sta. to Sta (ft)	Σ Inflow Q (gpm)	Post Sub. Flow S.F.	
0		442.50					Connect to Phase 5	
	225		0.01071	1069	***420***	197	5.4	
225		444.91						
	165		0.01071	1069	*195*	91	11.7	
390		446.68						
	30		0.01071	1069	30	14	76.1	
420		447.00						
	60		0.00645	830	60	28	29.6	
480		446.61						
	250		0.00645	830	***310***	145	5.7	
730		445.00						OUTLET
	400		0.01125	1096	***400***	187	5.9	
1130		449.50						
	100		0.00500	731	***100***	47	15.6	
1230		449.00						OUTLET
	300		0.01167	1116	***300***	140	7.9	
1530		452.50						
Σ ΔL =	1530			Σ (bold) =	1530			

Bold - grade change
Σ Inflow = 0.468 gpm/ft of pipe
Italic & Bold - *sum of pipe footage draining to outlet*

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BY:	HLO	DATE:	5/6/2008	CHKD BY:	CJH	DATE:	8/8/08
PROJECT NAME:	Williamson Energy LLC						
PROJECT NO.	B05-33--1413			SHEET	7	OF	
DESCRIPTION	Phase 6 Underdrain Design Revisions - East Side for Predicted Subsidence (File: PondCkUD6E.xls)						

R12546

Phase 6 Underdrain: Existing Design - Underdrain Collector Pipe Capacity

East Side 12" SDR 13.5 HDPE Collector Pipe, N = 0.015 (aged)

Sta.	Δ L (ft)	Pipe Invert Elev	Pipe Slope (ft/ft)	Pipe Q (full) (gpm)	Σ ΔL Sta. to Sta (ft)	Σ inflow Q (gpm)	Post Sub. Flow S.F.	
0		442.00						outlet & ties to Phase 5
	225		0.01111	1089	***1440***	674	1.6	
225		444.50						
	165		0.00864	960	1215	569	1.7	
390		445.93						
	170		0.00864	960	1050	491	2.0	
560		447.40						
	172		0.00864	960	880	412	2.3	
732		448.88						
	168		0.00864	960	708	331	2.9	
900		450.33						
	330		0.00864	960	540	253	3.8	
		453.19						
	210		0.00864	960	210	98	9.8	
1440		455.00						
	90		0.01111	1089	***90***	42	25.9	
1530		454.00						outlet & ties to Phase 3
Σ =	1530			Σ (bold) =	1530			

old - grade change

Σ Inflow Q = 0.468 gpm/ft of pipe

Italic & Bold - sum of foot of pipe draining to outlet

10" SDR 13.5 HDPE Pipe Rating Curve
Plotted Curves for Circular Channel

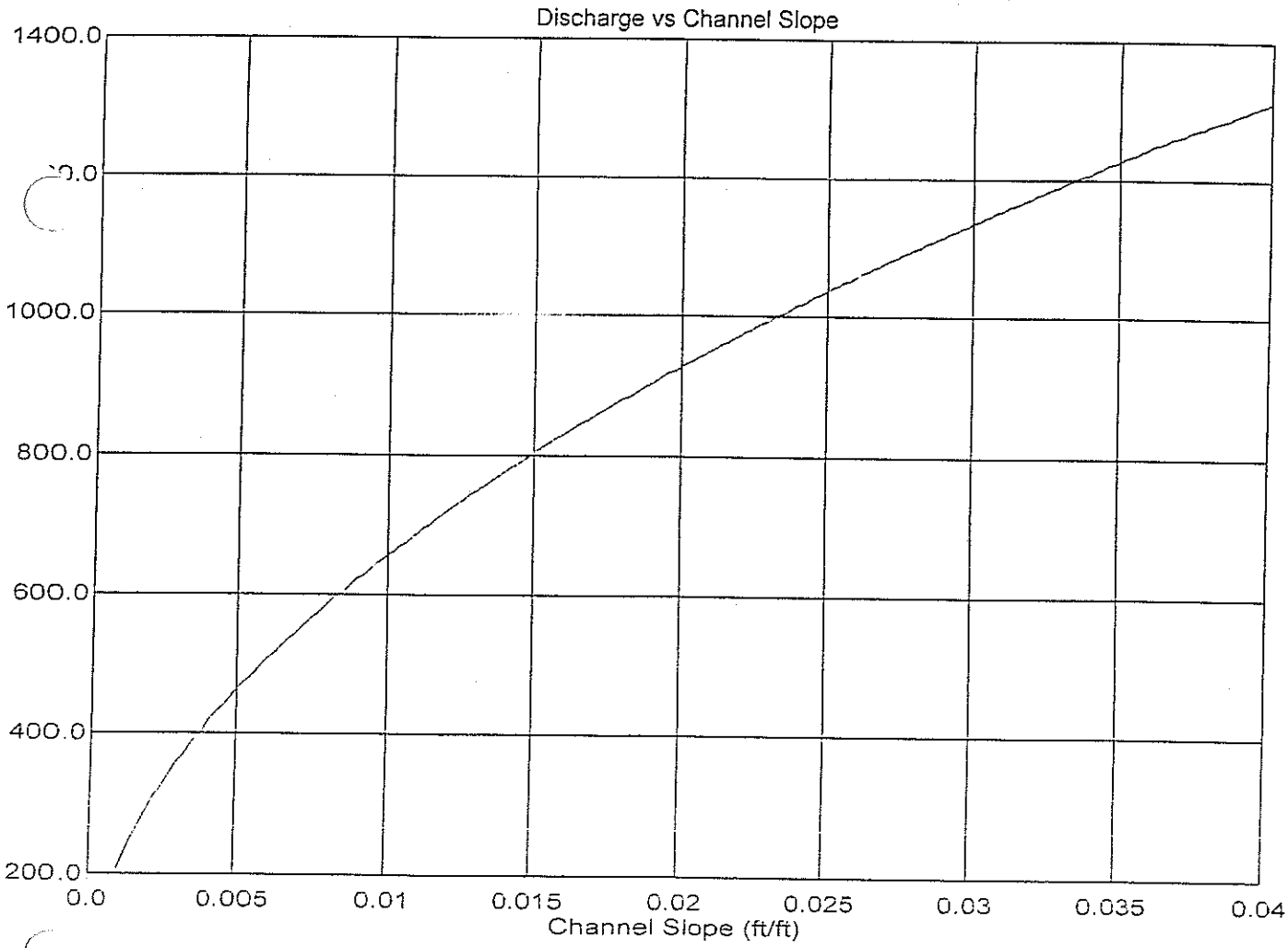
R12547

WILLIAMSTON ENERGY LLC
252-330-1413
UNDERDRAIN REVISIONS
PHASES 3, 5 AND 6
WTB 4/29/05
SHEET 9 OF 12

Project Description	
Project File	c:\haestad\fmw\pondck.fm2
Worksheet	10" SDR 13.5 HDPE Pipe Rating Curve
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data	
Mannings Coefficient	0.015
Depth	9.062 in
Diameter	9.062 in

Input Data			
	Minimum	Maximum	Increment
Channel Slope	0.001000	0.040000	0.000200 ft/ft



10" SDR 26 HDPE Pipe Rating Curve
Plotted Curves for Circular Channel

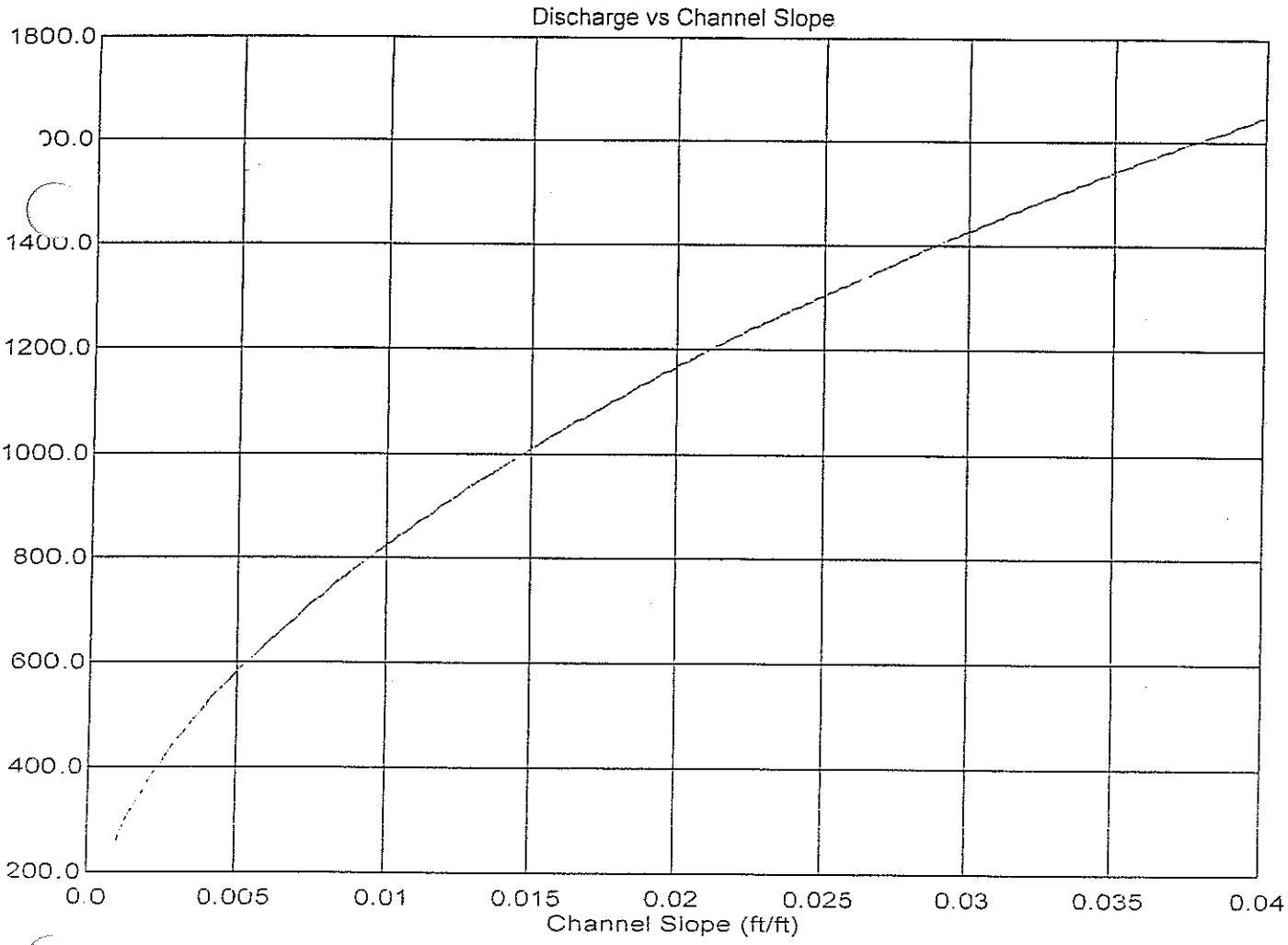
R12548

WILLIAMSON ENERGY LLC
805-330-1413
UNDERDRAIN REVISIONS
PHASES 3, 5 AND 6
HZO 4/29/08
SHEET 9 OF 12

Project Description	
Project File	c:\haestad\fmw\pondck.fm2
Worksheet	10" SDR 26 HDPE Pipe Rating curve
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data	
Mannings Coefficient	0.015
Depth	9.874 in
Diameter	9.874 in

Input Data			
	Minimum	Maximum	Increment
Channel Slope	0.001000	0.040000	0.000200 ft/ft



12" SDR 13.5 HDPE Pipe Rating Curve
Plotted Curves for Circular Channel

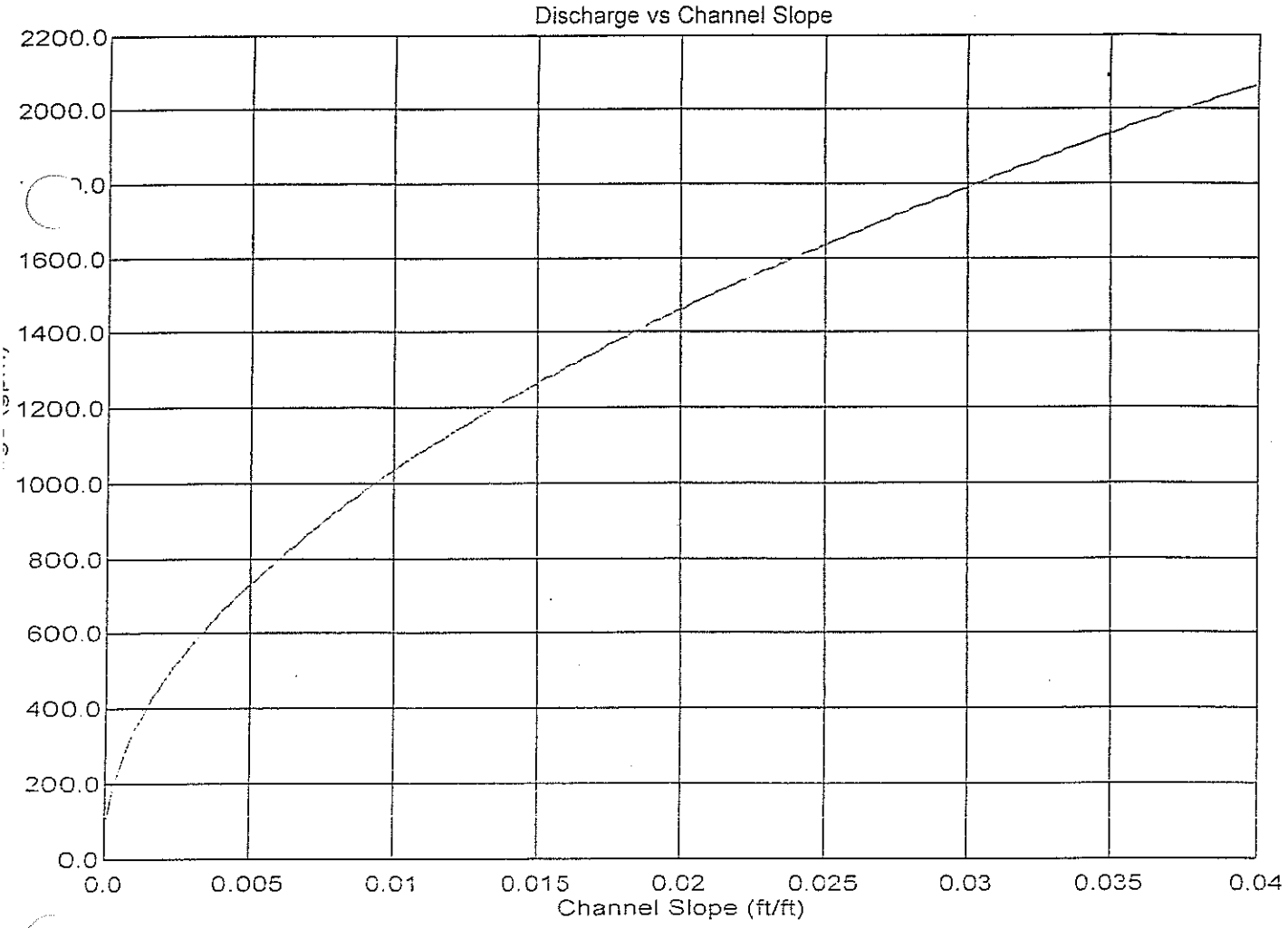
R12549

WILLIAMSON ENERGY LLC
805-330-1443
UNDERDRAIN REVISIONS
PAGES 3, 5, AND 6
H20 4/29/13
SHEET 10 OF 12

Project Description	
Project File	c:\haestad\fmw\pondck.fm2
Worksheet	12" SDR 13.5 HDPE Pipe Rating Curve
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data	
Mannings Coefficient	0.015
Depth	10.749 in
Diameter	10.749 in

Input Data			
	Minimum	Maximum	Increment
Channel Slope	0.000100	0.040000	0.000200 ft/ft



16" SDR 13.5 HDPE Pipe Rating Curve
Plotted Curves for Circular Channel

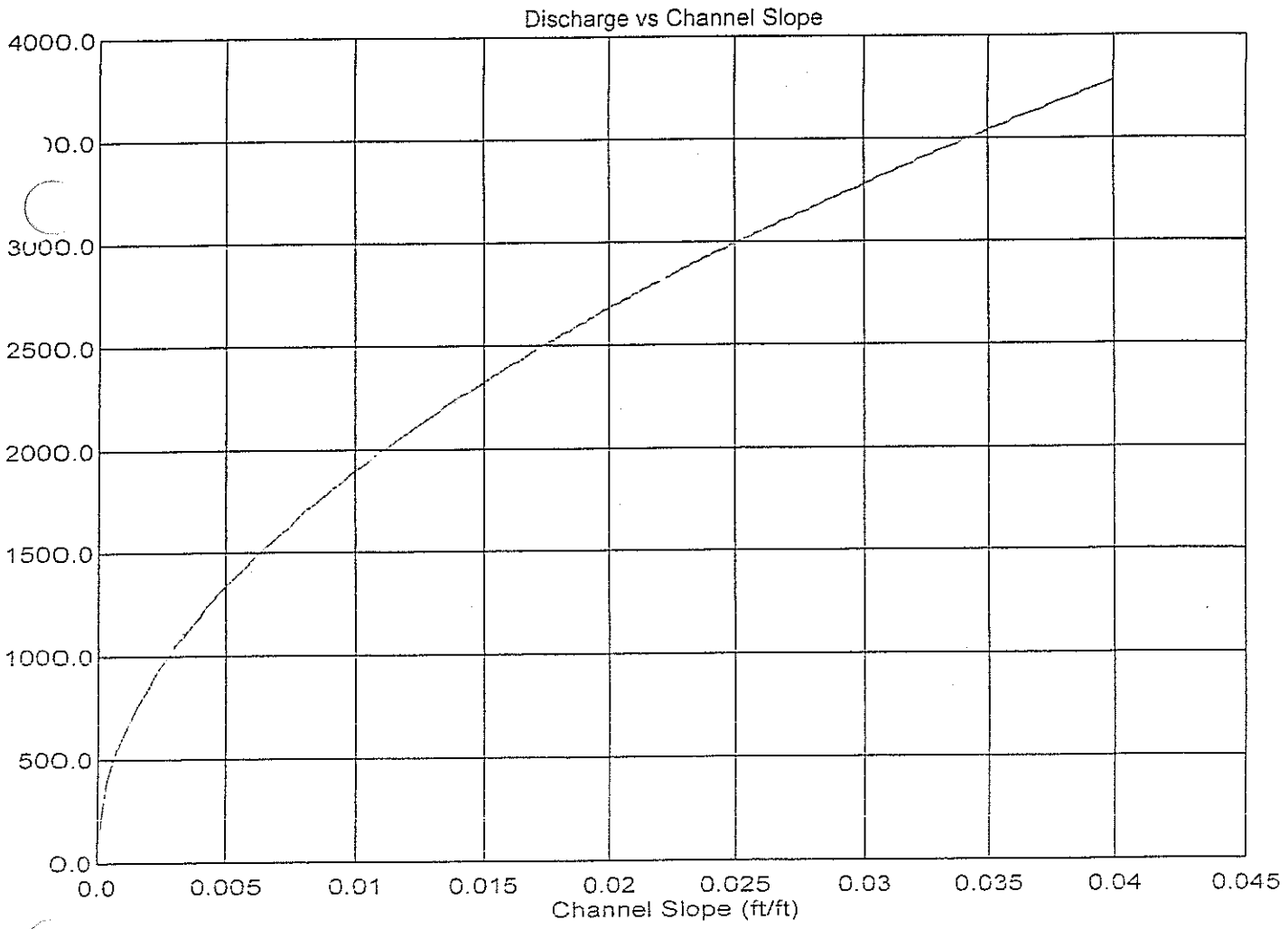
R12550

WILLIAMSON ENERGY LLC
805-330-1413
UNDERDRAIN REVISIONS
PARTS 3, 5, AND 6
NJD 4/29/08
SHEET 11 OF 12

Project Description	
Project File	c:\haestad\fmw\pondck.fm2
Worksheet	16" SDR 13.5 HDPE Pipe Rating curve
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data	
Mannings Coefficient	0.015
Depth	13.488 in
Diameter	13.488 in

Input Data			
	Minimum	Maximum	Increment
Channel Slope	0.000010	0.040000	0.000200 ft/ft



16" SDR 26 HDPE Pipe Rating Curve
Plotted Curves for Circular Channel

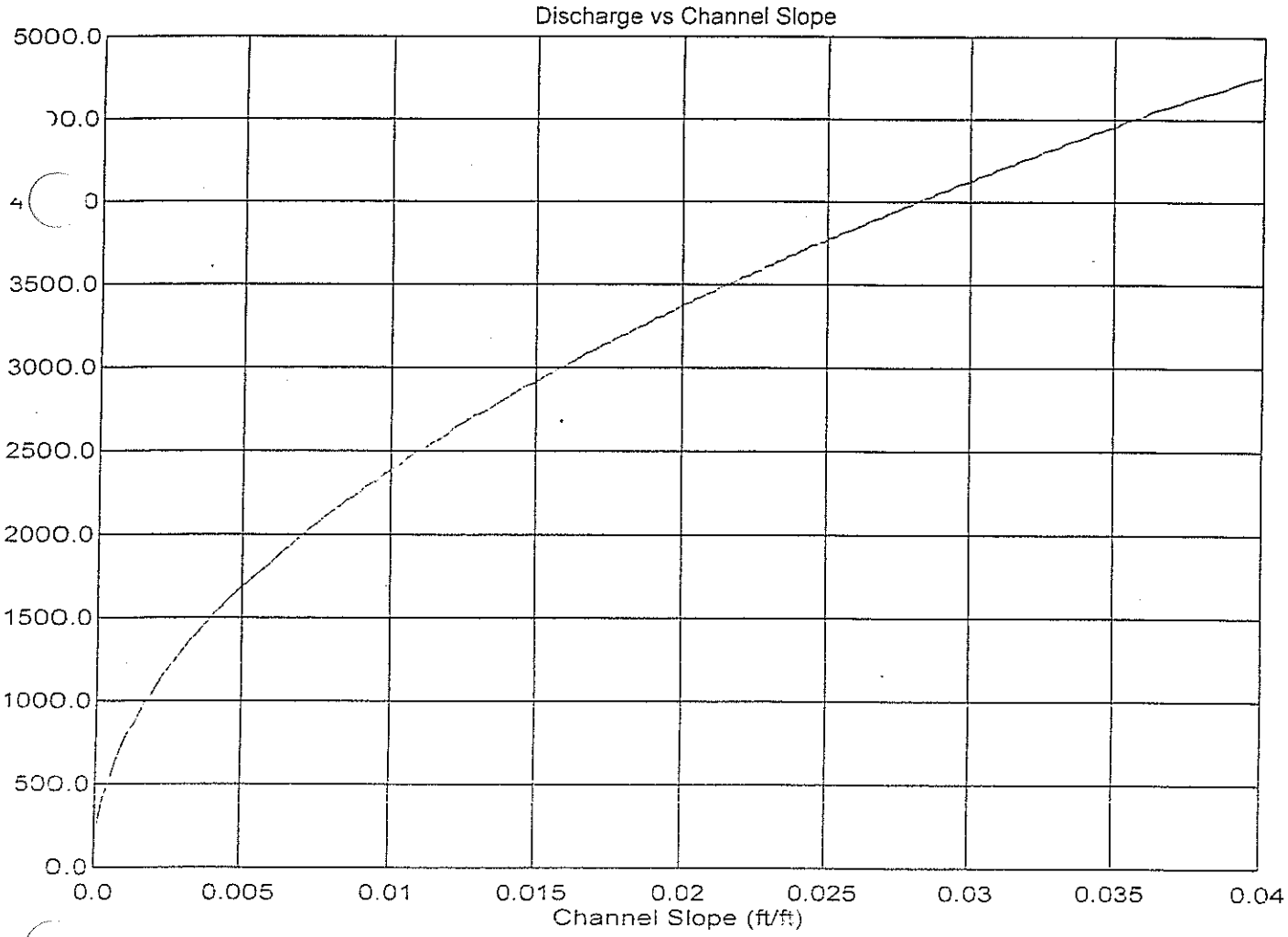
R12551

WILLIAMSON ENERGY LLC
905-330-1413
UNDERDRAIN REVISIONS
PHASES 3, 5, AND 6
NJO 4/29/09
SHEET 12 OF 12

Project Description	
Project File	c:\haestad\fmw\pondck.fm2
Worksheet	12" SDR HDPE Pipe Rating Curve
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data	
Mannings Coefficient	0.015
Depth	14.696 in
Diameter	14.696 in

Input Data			
	Minimum	Maximum	Increment
Channel Slope	0.000100	0.040000	0.000200 ft/ft



Alliance Consulting, Inc.
124 Philpott Lane, Beaver, West Virginia 25813
Phone: (304) 255-0491 Fax: (304) 255-4232

Title: WILLIAMSON ENERGY, LLC
UNDERDRAIN DESIGN
R12552
Project No.: 865-330-1413
By: HO Date: 4/16/08 Chkd: CH Date: 8/8/08
SHEET 1 OF 10

REFERENCES: "PREDICTION OF GROUND MOVEMENT PARAMETERS DUE TO LONGWALL MINING DURING DIFFERENT PHASES OF IMPOUNDMENT," PENG, RAY, DU, WVU, MARCH 2003
DRAWING - "PLAN - PHASE 2", ALLIANCE CONSULTING, INC., REV. 2, 08/16/06, DWG NO. BCE-330-M3, FIGURE NO. 4.

USING PENG'S REPORT, DETERMINE IF PREDICTED SUBSIDENCE ADVERSELY EFFECTS THE FUNCTION OF THE PHASE 2 EMBANKMENT UNDER DRAINS.

RESULTS - THE GROUND UNDER THE UNDERDRAINS WILL SUBSIDE 3.84' TO 1.72'. NO ADVERSE SLOPES WILL BE CREATED. THE OUTLET DRAIN ON THE SOUTH SIDE WILL BE SUBSIDED TO -0% SLOPE FOR IT'S 50' LENGTH. (THIS DRAIN IS ALREADY CONSTRUCTED) ←

PHASE 2 COMPLETION DATE: 11/13/08 (END OF DUMPING FOR)
LW MINING BENEATH:
PANEL 3: START -> 4/18/10 FINISH - 7/14/10
PANEL 4: START -> 1/18/11 FINISH - 7/11/11

∴ PHASE 2 WILL BE FINISHED & CAPPED BEFORE LW MINES UNDER

SEE ATTACHED DRAWING FOR SUBSIDENCE AMOUNTS ALONG UNDERDRAIN.

SUBSIDENCE EFFECTS ON PHASE 3 UNDERDRAIN

SEE ATTACHED DRAWING FOR SUBSIDENCE AMOUNTS ALONG DRAIN AND RECOMMENDED DRAIN INVERT ELEVATION CHANGES.

START ELEVATION ADJUSTMENT FROM EXISTING DRAIN OUTLET INVERTS.

THE UNDERDRAIN IS A PERFORATED 12" DR-13.5 HDPE PIPE IN A 4' x 4' GRAVEL ENVELOPE. THE DRAIN SLOPE IS 0.43% TO 1.0%

PHASE 3 COMPLETION DATE: 9/8/09 (END OF DUMPING FOR)
LW MINING BENEATH:
PANEL 3: START -> 7/13/10 FINISH - 8/30/10
PANEL 2: START -> 10/17/09 FINISH - 10/28/09

∴ PHASE 3 WILL BE FINISHED (BY ABOUT A MONTH) BEFORE IT STARTS TO SUBSIDENCE.

SEE ATTACHED DRAWING FOR RECOMMENDED UNDERDRAIN INVERT ELEVATION ADJUSTMENTS. DRAIN OUTLETS SHOULD BE MOVED TO EAST AND WEST SIDE TO AVOID THEIR TERMINATION INTO THE POOL OF PHASE 4 AND PHASE 6 EMBANKMENT.

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Title: WILLIAMSON SHELF LLC
UNDERDRAIN DESIGN R12553

Project No.: 305-330-1413

By: MD Date: 4/14/08 Chk'd: CEW Date: 5/8/08

SHEET 2 OF 10

CASE 2 UNDERDRAIN

REFERENCE: "SOIL MECHANICS NOTE NO. 7, THE MECHANICS OF SEEPAGE ANALYSIS", SCS, USDA, OCTOBER 1979.

USE CASE II + NOMOGRAPH SHT. FIGURE 2, PAGE 11, TO SET DESIGN DISTANCE FOR DRAINS.

SEE SHEET 3 OF 4 FOR TRANSFORMED SECTION.

FROM TESTING CAVE SAND REFUSE $K_V = 2 \times 10^{-4}$ cm/sec.

ASSUME $K_H = 9\ K_V$

TRANSFORMING FACTOR $= \sqrt{K_H/K_V} = \sqrt{9/1} = 3$ (HORIZONTAL)

q = DISCHARGE PER UNIT LENGTH

$K' = \sqrt{K_V K_H} = 10^{-4}\sqrt{1 \times 9} = 6.0(10^{-4})$ cm/sec $= 1.7$ FT/DAY

$$q = K' \frac{h^2}{2D'} = \left(1.7 \frac{FT}{DAY}\right)\frac{(39 FT)^2}{2(33 FT)} = 30.2 \frac{FT^3}{DAY\text{-}FT}$$

$$= \frac{37.2 FT^2}{DAY\text{-}FT}\left(\frac{7.48 GAL}{FT^3}\right)\frac{DAY}{24(60) MIN} = 0.193 \frac{GPM}{FT}$$

THE SOUTH AND PARTS OF THE EAST AND WEST SIDES OF PHASE 3 ARE AS SHOWN ON THE SHEET 2 OF CROSS-SECTION. PHASE 1 WILL NOT AND COVER ON THE NORTH SIDE.

USE A 10" SDR-26 HDPE PIPE FOR THE UNDERDRAIN FOR COLLECTED PIPE ON THE SOUTH SIDE AND LINES COVER CAVE AREA CALCULATED ABOUT 1" ON THE EAST AND WEST SIDES (SEE "LAYS 4/12/08 MEMORANDUM FOR PHASE 3)

USE A 10" SDR-13.5 PLUS HDPE FOR THE NORTH SIDE AND EAST AND WEST SIDES WHERE COVER OVER THE PIPE EXCEED 37' (SEE "LAYS 5/8/08 COMPUTATIONS FOR LINES 3 THROUGH 7). NOTE WHERE LOAD FOR 12" PIPE, SAME SHEET, INDICATES USE OF 10" PIPE WITH SDR-13.5

NOTE: RECENTLY, THE UNDERDRAIN SHOULD BE AT LEAST 20 - 30' MADE TO CONFORM WITH THE FINAL PHASE 3 IS SHORT TERM

ABOUT 10 MONTH OF SLOPE MONITORING DOES NOT GIVE AN INDICATION OF SLOPE OF LINES IN WHERE THE UNDERDRAIN SHALL STOP OR BEGIN AND NEED WHERE THE FACTOR OF SAFETY WILL BE ENOUGH TO KEEP DRAINED. KEEP IN MIND = WE'D CAN SEEPAGE THROUGH THE EMBANKMENT CONTINUOUSLY

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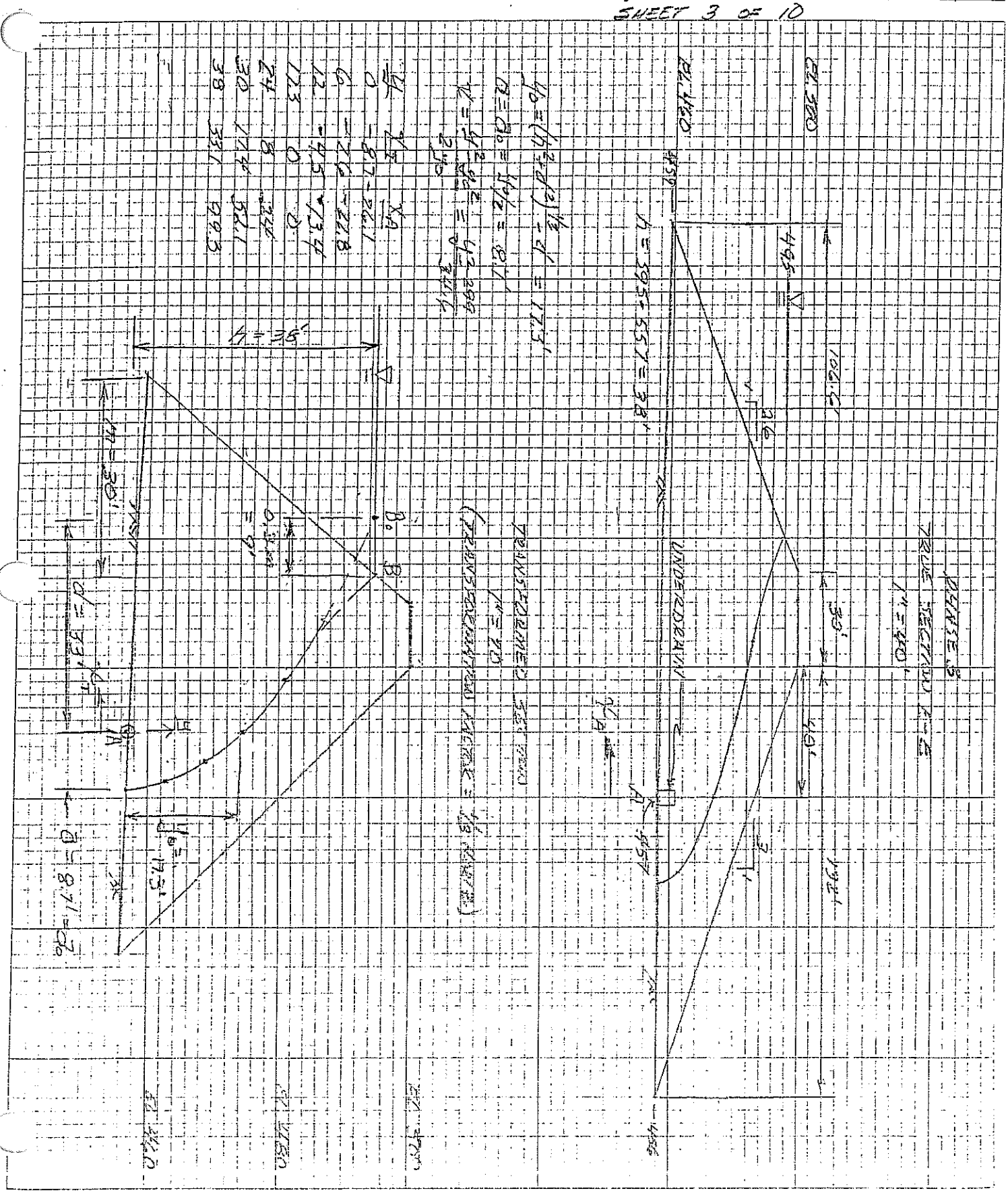
Title: WILLIAMSON ENERGY LLC
UNDERDRAIN DESIGN

R12554

Project No.: BOS-330-1413

By: MD Date: 4/14/08 Chkd: CH Date: 8/8/08

SHEET 3 OF 10



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Title: WILLIAMSON ENERGY LLC UNDERDRAIN DESIGN R12555

Project No.: 805-330-1413

By: MJC Date: 4/14/08 Chkd: CEH Date: 8/8/08

SHEET 4 OF 10

UNDERDRAIN COLLECTOR PIPE CAPACITY - PHASE 3

PIPE: 10" SDR-26 HDPE PIPE (CSP SIZE)
n = 0.015, ID = 9.874", OD = 10.75", t = 0.438"
A = 0.532 FT²

DETERMINE PIPE CAPACITY FOR VARIOUS SLOPES

SLOPE (FT/FT)	FLOW DEPTH (IN)	Q(FULL) (GPM)	Q(MAX) (GPM)	MAX. RUN LENGTH (FT)	
0.005	9.874	583	427	3021'	MAX. RUN LENGTH
0.006		638	486	3306'	TO COLLECT
0.007		689	742	3570'	0.193 GPM/FT
0.0075		714	768	3699'	FLOWING FULL
0.008		737	793	3819'	(NO S.F.)
0.009		782	841	4052'	
0.010		824	886	4269'	
0.011		864	930	4477'	
0.0128		934	469	2259'	

PIPE: 10" SDR-13.5 HDPE PIPE (IPS SIZE)
n = 0.015, ID = 9.062", OD = 10.75", t = 0.796"
A = 0.448 SF

DETERMINE PIPE CAPACITY FOR VARIOUS SLOPES

SLOPE (FT/FT)	FLOW DEPTH (IN)	Q(FULL) (GPM)	Q(MAX) (GPM)	MAX RUN LENGTH (FT)
0.005	9.062	463	446	2580'
0.006		508	544	2622'
0.007		548	590	2839'
0.0075		568	610	2943'
0.008		587	631	3534'
0.009		622	669	3223'
0.010		655	705	3394'

NOTE: Q(FULL) ≥ 93% Q(MAX.)

PRELIMINARY DESIGN
NOT TO BE USED FOR CONSTRUCTION
FOR DISCUSSION

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Title: Williamson Energy LLC
Under Drain Design

R12556

Project No.: R05-330-1413

By: MS Date: 4/7/08 Chkd: [illegible] Date: 8/8/08

SHEET 5 OF 10

CHECK PHASE 3 UNDERDRAIN COLLECTOR PIPE CAPACITY - PRE-SETTLEMENT

REFERENCE: DOS. MD, PHASE 330-E37, CAD BY DSH 04/07/08
SEEPAGE BY MANNING'S EQ, n = 0.015 (ADS, HDPE)
10" SDR-26 HDPE PIPE

MIN. ID = 9.814", A = 0.532 FT²

18" SDR-135 HDPE PIPE
MIN. ID = 16.822", A = 1.543 FT²

STA.	PIPE SIZE	ΔL (FT)	ΣL (FT)	INFLOW @ (GPM)	PIPE SLOPE	PIPE FULL CAPACITY (GPM)	INFLOW Q.F.
0+00	SDR 26	430	430	83	0.00512	590	7.11
4+30	"	430	430	93	0.00512	590	7.14
8+60	"	700	700	135	0.00286	441	3.27
15+60	SDR 13.5	165	165	32	0.05907	624	19.51
17+25	"	375	540	104	0.00907	624	6.0
21+00	"	310	315	60	0.00437	450	7.49
24+10	"	1890	1890	365	0.00503	465	1.27
43+00	"	370	960	185	0.00830	597	3.23
47+70	SDR 26	100	590	114	0.00830	751	6.59
48+70	"	470	470	93	0.02347	1062	11.28
53+40	"	450	620	131	0.00662	670	5.11
57+90							

INFLOW Q = 0.193 GPM/FT OF PIPE DRAINING TO THAT STA.

CHECK OUTLET PIPES CAPACITY

OUTLET NO.	PIPE SIZE	ΣL (FT)	ΣINFLOW @ (GPM)	PIPE SLOPE	PIPE FULL CAPACITY (GPM)	ΣINFLOW @ S.F.
1	SDR 13.5	850	164	0.021	950	5.79
2	SDR 26	1130	218	0.010	824	4.78
3	SDR 26	1410	274	0.010	824	3.85
4	SDR 26	2850	550	0.0059	534	0.97
		3940 SF	764 CF			

ABOVE PIPE CAPACITY (INFLOW @) DIVIDED BY PIPE FULL CAPACITY GIVES THE REQUIRED PIPE UNIFORM FLOW DEPTH (DIA.) WHICH CORRELATES TO THE CHART VALUES.

NOTE: 1450 CFS = 100 YEAR (EMERGENCY) OUTLET CAPACITY

CONCLUSION: OUTLET PIPE SIZE RANGE FROM 18" TO 8" SDR 26 PIPE
(SHEET 5 OF 10 SHEETS)

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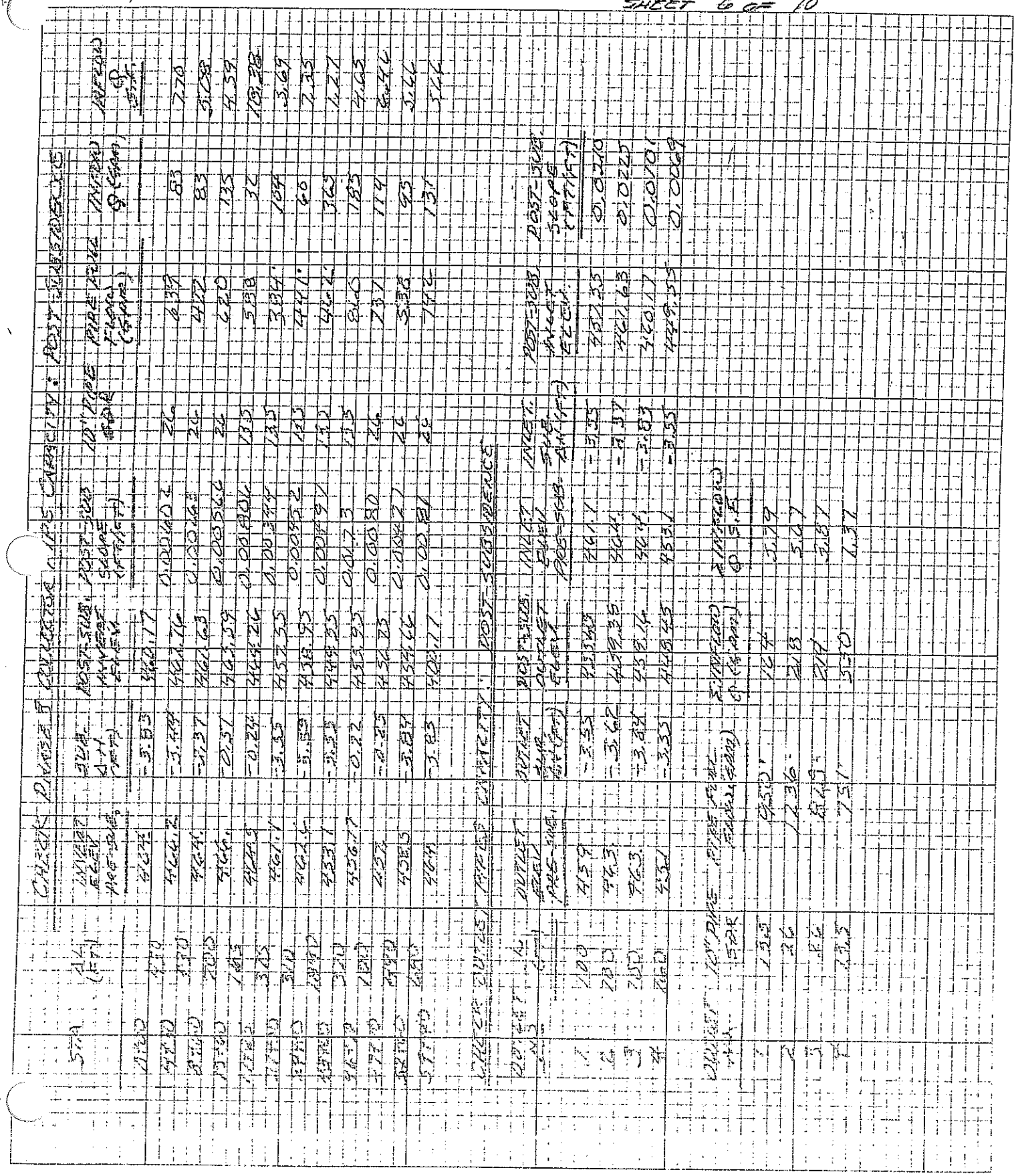
Title: WILLIAMSON ENERGY LLC
UNDERDRAIN DESIGN

R12557

Project No.: 205-330-1413

By: NB Date: 4/21/08 Chkd: DW Date: 8/8/08

SHEET 6 OF 10



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Title: WILLIAMSON GREASY LLC
UNDERDRAIN DESIGN

R12558

Project No.: 205-330-1413

By: MD Date: 4/25/08 Chkd: EJH Date: 8/8/08

SHEET 7 OF 10

PHASE 4 UNDERDRAIN

NO UNDERDRAINS WILL BE INSTALLED IN THIS PHASE

PHASE 5 UNDERDRAIN

PIPE: 12" SDR 13.5 (HDPE) (SEWER'S HYDRO CALCULATIONS)
OD = 12.75" ID = 10.749"
n = 0.015

EXISTING DESIGN: (PHASE 5 WILL BE BUILT POST-DEVELOPMENT)

STA.	ΔL (FT)	INVERT ELEV.	ΔH (FT)	SLOPE (FT/FT)	Q (CFS) (RAM)	INFLOW (GPM)	FLOW VEL.
0+00		424					
3+40	340	422	2	0.005 88	792	26	12.0
5+30	190	421	1	0.005 26	749	37	20.2
8+70	340	418	3	0.008 83	943	69	12.7
10+90	1720	406	6	0.003 49	734	280	3.2
20+80	1950	400	6	0.003 02	521	183	4.5
30+30	650	396	4	0.006 15	808	127	6.4
34+85	405	394	2	0.004 94	726	77	9.4
40+90	6090 ✓						

INFLOW Q = 45 (0.1 SCFM) = MAX HEAD (ft) = 420 - 440 = 40" 3.3'
CHECK OF DESIGN WAS THE PHASE 4 UNDERDRAIN CONNECTED TO THE PHASE 6 UNDERDRAIN.

REVISE PHASE 5 AND PHASE 6 UNDERDRAIN DESIGN FROM GRAVITY TO PRESSURE FLOW CONDITIONS TO ELIMINATE THE NEED FOR THE PERFORATED COLLECTION PIPE (SINCE THE PIPE IS A CONFINED, PRESSURIZED PIPE, IT IS UNDERSTOOD) USE A SAFETY FACTOR OF 10 FOR THE QUANTITIES ABOVE THE UNDERDRAIN REQUIRE AND THE FLOW THROUGH THE PIPE PERFORATIONS.

PHASE 6

NOTE: IT WILL USE THE PHASE 6 UNDERDRAIN DESIGN, THE PHASE 6 UNDERDRAIN WILL HAVE ESTIMATED SEEPAGE FROM PHASE 5.

PHASE 7

NO USE THE UNDERDRAINS ARE PLANNED OR TO BE BUILT

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Title: WILLIAMSON ENERGY LLC
UNDERDRAIN DESIGN

R12559

Project No.: BOS-330-1413

By: HB Date: 4/29/08 Chkd: EH Date: 8/8/08

SHEET 8 OF 10

PHASE 5 UNDERDRAIN - EXISTING DESIGN

SUBSIDENCE ALONG UNDERDRAIN (FROM PENG'S MARCH 2008 REPORT)

	UNDERDRAIN STATION	DISTANCE ON A-A	SUBSIDENCE (FT)	ORIGINAL GROUND ELEV.	REMARKS
x	0+00	1440	0.35	442	TIE TO PHASE 6 UNDERDRAIN
	1+10	1440	0.35	444	CORNER
	3+40	1210	3.36	441	OUTLET
	5+30	1020	3.87	442.5	GRADE CHANGE
	8+90	660	3.87	440	" " & OUTLET
	11+60	390	3.86	439.5	SUBSIDENCE PROFILE CHANGE
	13+80	170	1.90	442	" " "
	14+60	80	0.39	443.5	CORNER
	19+40	160	1.69	444	SUBSIDENCE PROFILE CHANGE
	20+80	185	2.22	444	GRADE CHANGE
	29+50	320	3.78	439	CORNER
	30+30	400	3.87	440	GRADE CHANGE & OUTLET
	36+85	1055	3.87	442	GRADE CHANGE
	39+15	1295	2.10	441	SUBSIDENCE PROFILE CHANGE
x	40+90	1460	0.24	442	TIE TO PHASE 6 UNDERDRAIN (OUTLET)

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Title: WILLIAMSON ENERGY LLC
UNDERDRAIN DESIGN - PHASE 6

R12560

Project No.: 805-330-1413

By: MD Date: 5/6/08 Chkd: EW Date: 8/8/08

SHEET 9 OF 10

PHASE 6 UNDERDRAIN DESIGN - EXISTING DESIGN - EAST SIDE

PIPE STA.	EXIST. GROUND ELEV.	PIPE INVERT ELEV.	SUB. (FT)	POST-SUB. GROUND ELEV	PENG'S SECT AT STATION
0+00	442.4	442	0.24	442.2	1405
2+25	443.4	444.5	0.24	444.3	1460
5+60	446.8	—	1.46	445.3	1795
9+00	450	—	3.85	446.2	2135
12+30	452	—	3.85	448.2	2465
14+40	—	455	3.85	—	2675
15+30	454.5	454	3.80	450.7	2765

CRITICAL SUBSIDENCE STATIONS (CHANGE IN CURVATURE)

PIPE STA	PENG'S SECT AT STA	SUB. (FT.)
0+00	1445	0.24 (AND 2435)
3+91	1626	0.22
5+71	1806	1.66
7+32	1967	3.79

(PIPE STA. + 1235) = PENG'S STA

PHASE 6 EXISTING DESIGN FLOW CAPACITY SAFETY FACTOR

PIPE STA	PIPE INVERT ELEV	ΔL (FT)	SLOPE (FT/FT)	PIPE FULL FLOW (GPM)	INFLOW Q (GPM)	INFLOW S.F.
0+00	442	325	0.01111	1099	674	1.6
2+25	444.5	125	0.03364	960	569	1.7
14+40	455	90	0.01111	1099	42	25.9
15+30	454					

NOTE - PHASE 3 UNDERDRAINS WILL NOT BE CONNECTED TO PHASE 6 UNDERDRAINS

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Title: WILLIAMSON ENERGY
UNDERDRAIN DESIGN - PHASE 6

R12561

Project No.: 205-330-1413

By: HE Date: 5/2/08 Chkd: CEY Date: 8/8/08

SHEET 10 OF 10

PHASE 6 UNDERDRAIN PROFILES - EXISTING DESIGN - WESTSIDE

PIPE STATION	EXIST. GROUND ELEV.	PIPE INVERT ELEV.	SUB. (FT)	POST-SUB. GROUND ELEV.	PENES SEGT. A-P STATION	
0+00	447	444	0.70	446.7	1+00	
2+50	444	—	0.52	443.7	1+50	
5+83	441	—	0.25	445.6	1+50	
7+93	445	—	3.37	449.4	1+90	
8+70	450	—	3.82	447.2	2+20	Edge Spoil
9+00	455	445	3.84	451.2	2+50	
12+33	452	—	3.85	448.2	2+85	Edge Spoil
13+40	448	—	3.55	447.2	2+90	
13+70	449	—	3.85	447.2	2+20	Creek
14+50	450	—	3.85	447.2	2+50	
15+30	448	—	3.85	447.2	2+50	
15+50	445	—	3.85	449.4	2+00	Creek
16+00	454	451	3.52	450.2	2+50	

LATERAL SUBSTRATA STATIONS (GAUGE AT CUL-DE-SACS)

PIPE STATION	PIPE SEGMENT LENGTH	SLOPE (%)
2+95	1+45	0.26
4+76	1+81	0.22
6+82	2+06	1.66
7+71	0+89	8.79

CREEK STR. 1+50' = 2+65 [illegible]

PHASE 6 UNDERDRAIN PIPE

[illegible] SUB 13.5 ACRE, TO = 10.7 MIN, Tf = 21.5 MIN

PHASE 6 UNDERDRAIN - STORM DESIGN - PIPE - SUBSIDENCE FLOW [illegible]

STATION	LAYER	LENGTH (FT)	RATIO (Q/Qfull)	SLOPE (FT/FT)	PIPE FULL FLOW (CFS)	VELOCITY (FPS)
0+00						
0+50	500	500	424	0.02222	14.2	9.77
2+50	200	200	258	0.00574	7.91	2.59
4+00						
21+50	225	1750	694	0.0117	10.57	11.2
22+75	125	125	567	0.00864	8.60	6.69
23+00	50	50	42	0.0111	10.57	2.27

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01

Title: WILLIAMSON ENERGY LLC R12562
PHASE 5 SEEPAGE THROUGH DAM
Project No.: 805-330-1443
By: MO Date: 5/14/09 Chkd: DEH Date: 8/9/09
SHEET 1 OF 2

PHASE 5 EMBANKMENT

REFERENCE: SM NOTE NO. 7, SCS, USDA, OCT. 1979. CASE II, FIG. 4, PG 11. ANISOTROPIC SOIL, $K_H = K_V$ (ASSUMED)

CROSS-SECTION DATA - MOST CONSERVATIVE SECTION
- UPSTREAM SLOPE = 3:1
- DOWNSTREAM SLOPE = 3:1
- DAM CREST TO = WIDTH = 20', ELEV. 498
- UNDERDRAIN IS 50' D.S. OF D.S. EDGE OF DAM CREST
- (SEE ATTACHED CROSS-SECTIONS)

GROUND ELEVATIONS (AT UNDERDRAIN STA. 26+10)

X-SECT STA	PRE-SUBSIDENCE	SUBSIDENCE ΔH-FT	POST-SUBSIDENCE	PERP X-A STA
0+00	444.2	3.67	440.3	505
0+75	444.0	3.57	440.1	440
2+00	442.5	3.81	438.7	330
2+50	442.0	3.64	438.4	285
3+50	440.0	2.12	437.9	180
4+00	440.0	1.09	438.9	130

DAM CROSS-SECTION (TRUE SECTION)

X-SECT STA	ΔL (FT)	ΣL (FT)	ELEV.	REMARKS
0+00		0	440 ±	IN CUT (INCISED PART, POST SUBSIDENCE)
	30			
0+30		30	440 ±	U.S. TOE (POST SUBSIDENCE)
	120			
1+50		150	480.0	MAX. SLURRY LEVEL
	24			
1+74		174	498.0	U.S. EDGE DAM CREST
	20			
1+94		194	498.0	D.S. EDGE DAM CREST
	50			
2+44		244	438 ±	℄ UNDERDRAIN (POST SUBSIDENCE)
	81			
3+25		325	444 ±	U.S. EDGE BENCH
	20			
3+45		345	444 ±	D.S. " "
	18			
3+63		363	438 ±	D.S. TOE OF DAM (POST SUBSIDENCE)

FLOW THROUGH DAM

$K_V = 2 \times 10^{-4}$ cm/sec, $K_H = 9K_V = 18 \times 10^{-4}$ cm/sec

$K' = (K_V K_H)^{1/2} = 6 \times 10^{-4}$ cm/sec = 1.7 ft/day

$q = K'\left(\frac{h^2}{2L}\right) = (1.7 \text{ ft/day})\frac{(44 \text{ ft})^2}{2(44 \text{ ft})} = 32.3 \text{ ft}^2/\text{day}$

$= \frac{32.3 \text{ ft}^2}{\text{day}} \left(\frac{7.48 \text{ gal}}{\text{ft}^3}\right) \frac{\text{day}}{24 \text{ hr}} \frac{\text{hr}}{60 \text{ min}} = 0.173$ GPM/FT OF DAM

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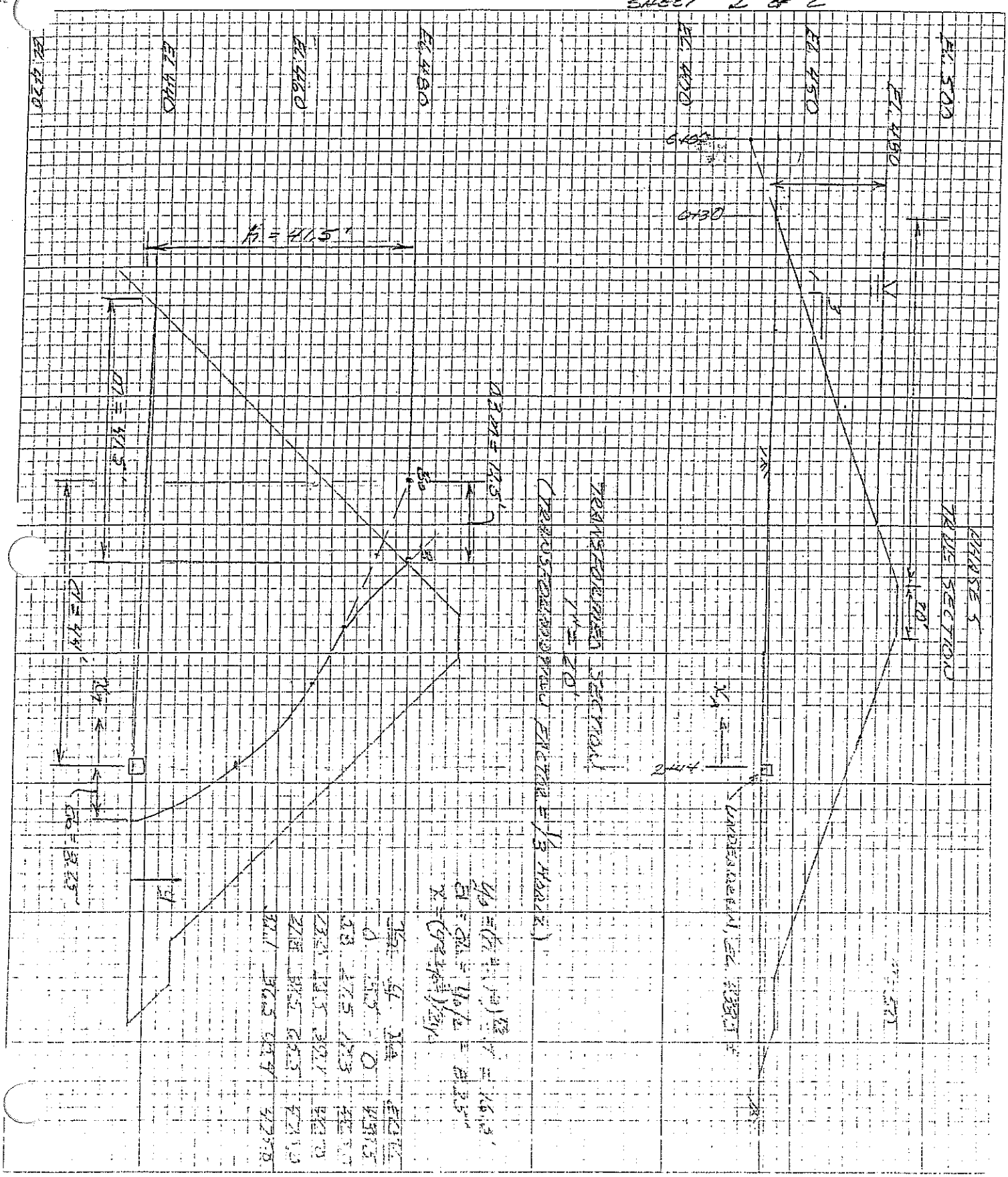
Title: Williamson Energy LLC
Phase 5 Seepage Through Dam

R12563

Project No.: 205-330-1413

By: MS Date: 5/14/08 Chkd: EY Date: 8/8/08

Sheet 2 of 2


EL. 4220
EL. 4400
EL. 4490
EL. 4580
EL. 4670
EL. 4760
EL. 4850
EL. 4940
EL. 5030
6'
6'
6'

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Title: WILLIAMSON ENERGY LLC
UNDERDRAIN DESIGN - PHASE 7

R12564

Project No.: 805-330-1413

By: HO Date: 5/1/08 Chkd: CEY Date: 8/8/08

PHASE 7 UNDERDRAIN (INSTALLED IN PHASE 6)

REFERENCE: "SOIL MECHANICS NOTE NO. 7, THE MECHANICS OF SEEPAGE ANALYSIS", SCS, USDA, OCTOBER 1979

USE CASE V - ANISTROPIC SOIL, FIGURE 6, PAGE 11, TO GET DESIGN DISCHARGE FOR UNDERDRAIN.

SEE NEXT SHEET FOR TRUE AND TRANSFORMED SECTION

TRANSFORMATION FACTORS

$K_V = 2 \times 10^{-4}$ CM/SEC (FROM CCR PERMABILITY TEST)

ASSUME $K_H = 4 K_V$

TRANSFORMATION FACTOR $= (K_V/K_H)^{1/2} = 1/3$ (HORIZONTAL)

$K' = (K_V K_H)^{1/2} = 10^{-4}(2 \times 8)^{1/2} = 6(10^{-4})$ CM/SEC $= 1.7$ FT/DAY

EQUATIONS:

$y_0 = (h^2 + d^2)^{1/2} - d = (84^2 + 66.5^2)^{1/2} - 66.5 = 40.6'$

$a = a_0 = y_0/2 = 40.6/2 = 20.3'$

$x = (y^2 - y_0^2)/2y_0 = (y^2 - 1651)/81.3$

X & Y COORDINATES OF TRANSFORMED & TRUE SECTION PHREATIC LINE

y	x_T	x_A		ELEV (y)	STA (x_A)	
0	-20.3'	60.91	a_0	446	4+37	
10	-19.1'	57.2		456	4+33	
20	-15.4	46.2		466	4+22	
30	-9.2	27.7		476	4+04	
40.6	0	0	UNDERDRAIN	486.6	3+76	
50	10.4	31.3		496	3+45	
60	24.0	71.9		516	3+16	INGRESS TRANS.
70	40.1	119.9		516	2+86	" "
84	66.4	199.4	B_0	530	2+52	POOL EDGE

FLOW THROUGH DAM

$$q = K' \frac{A^2}{2d} = (1.7 \text{ FT/DAY}) \frac{(84 \text{ FT})^2}{2(66.5 \text{ FT})} = 90.2 \text{ FT}^3/\text{DAY-FT}$$

$$= \frac{90.2 \text{ FT}^3}{\text{DAY-FT}} \left(\frac{7.48 \text{ GAL}}{\text{FT}^3}\right) \frac{\text{DAY}}{24(60) \text{ MIN}} = 0.463 \text{ GPM/FT}$$

CHECK PHREATIC LEVEL USED IN STABILITY ANALYSIS SECTION D-D, DWG. NO. 805-330-EY2 (PORTION ATTACHED)

THE THEORETICAL LEVEL IS WELL BELOW THE DESIGN ASSUMPTION.

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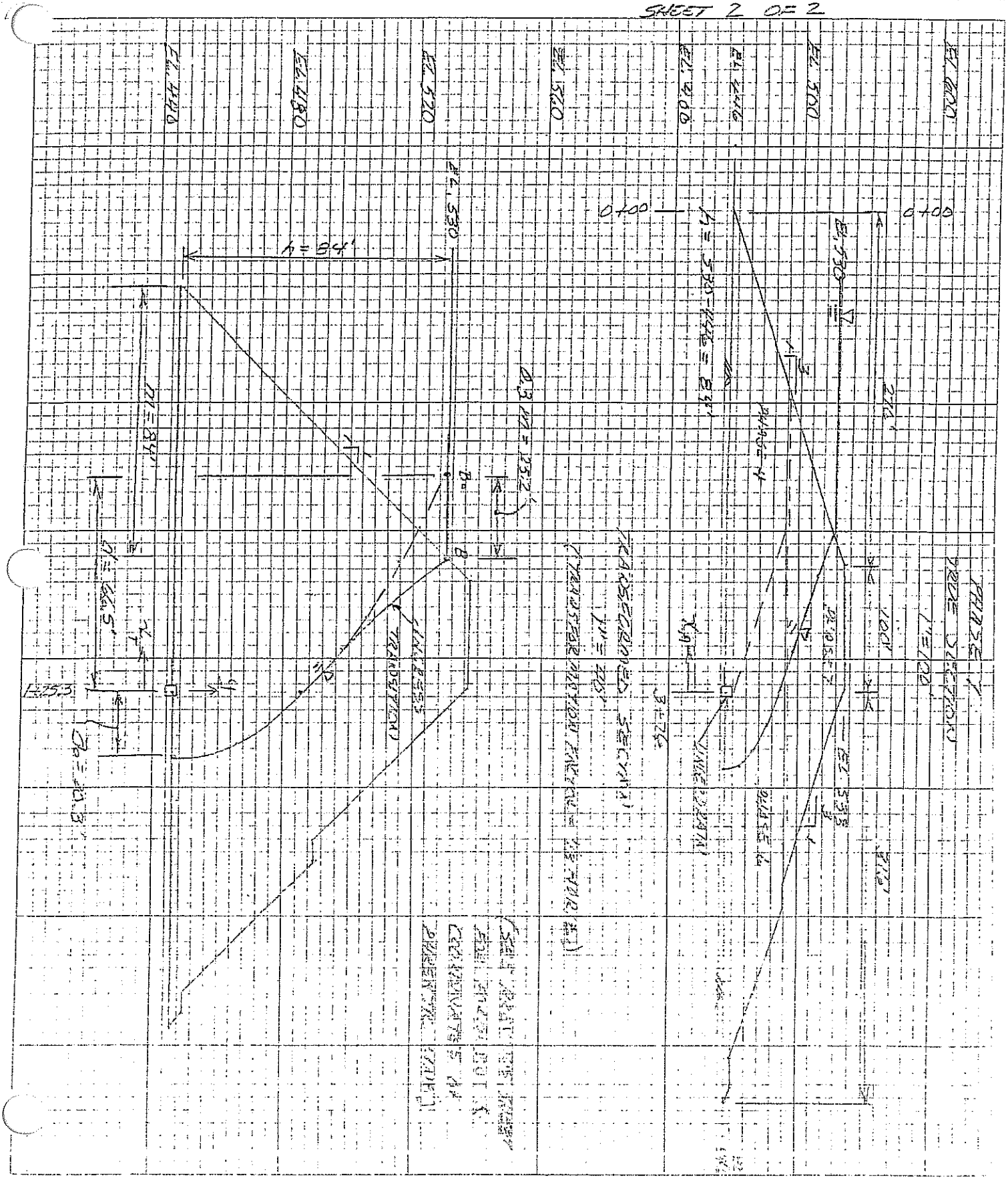
Title: Williamstown Energy LLC
UNDERDRAIN DESIGN - Plan

Project No.: 805-330-1413

By: MD Date: 5/1/09 Chkd: EY Date: 8/8/08

SHEET 2 OF 2



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Title: WILLIAMSON ENERGY LLC
UNDERDRAIN DESIGN

R12566

Project No.: 805-330-1413

By: HO Date: 5/16/08 Chkd: KEY Date: 8/8/08

SHEET 1 OF 6

PHASES 5 AND 6 REVISED DESIGN

UNDERDRAIN AGGREGATE SUPPLIED

REF: 05/16/08 PHONE CONVERSATION WITH BOB ORR, FREEDOM MATERIALS
(618) 937-6415
AGGREGATE IS WASHED RIVER GRAVEL (WALBASH RIVER)
3/8" TO 1 1/2"
2/3's IS 3/8" TO 1" (67% < 1")
1/3 IS 1" TO 1 1/2" 0% < 3/8"
0% > 1 1/2"

GEOTEXTILE SPECIFIED

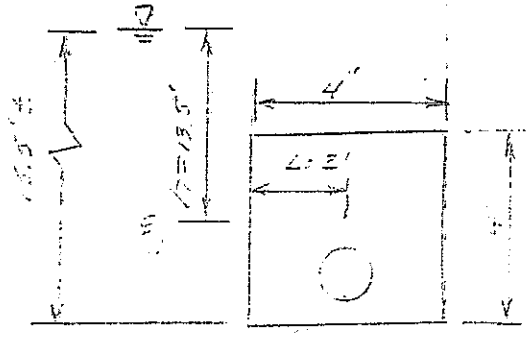
PROPEX 4550 (NOW KNOWN AS GEOTEX 501)
NONWOVEN, NEEDLE PUNCHED
AOS = # 70 SIEVE (
PERMITTIVITY = 1.40 SEC^{-1}
WATER FLOW RATE = 115 GPM/FT^2
THIS FABRIC IS CLASS 3 (LOW SURVIVABILITY)
GRAB TENSILE STR. = 140 LB @ 50% (< 180)
TRAP. TEAR = 60 LBS (< 68)
CBR PUNCTURE = 360 LBS (< 380)

UNDERDRAIN CAPACITY (AGGREGATE PORTION)

THE UNDERDRAIN IS GENERALLY ON A 0.005 TO 0.01 FT/FT SLOPE
AGGREGATE UNDER DRAIN AREA = 15.4 SF = A
THE AGGERGATE SHOULD HAVE A PERMABILITY ≥ GRADATION NO. 15
(SEE ATTACHED FIG. 1 AND FIG. C-15

HYDRAULIC GRADIENT, L	$q/A \times 10^3$ FPD	q (FT^3/DAY)	q (GPM)
0.005	0.38	5852	30
0.100	0.66	10164	53

CHECK ABILITY OF AGGREGATE TO ADMIT FLOW TO PERFORATED PIPE



FOR PHASE 5:
DESIGN PHREATIC LEVEL
= 15.5' OVER UNDERDRAIN

TO ℄ UNDERDRAIN
[illegible] $h = 13.5'$, $L \cong \frac{13.5'}{2'} = 6.75$ FT/FT
[illegible] (FIG. C-15)
$A = (4 \times 4)$ (1 FT WIDTH) = [illegible]
[illegible] $\frac{FT^3}{DAY}$ [illegible] $\frac{FT^3}{DAY}$ [illegible]
> 337 GPM/FT

PHASE 5 q = 0.73 GPM/FT
S.F. ≥ 337/0.73 = 1948 > 10 [illegible] OK

[illegible]

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Title: Williamson Energy LLC
Underdrain Design
R12567

Project No.: 805-330-PM3

By: HC Date: 7/16/08 Chkd: EN Date: 8/8/08

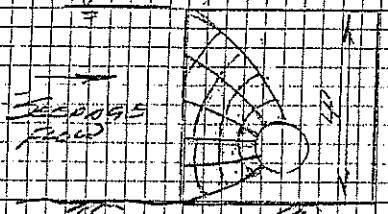
SHEET 2 OF 6

PHASES 5 AND 6 REVISED DESIGN

CHECK DEPTH OF GRAVEL TO INTERCEPT SEEPAGE AT PHREATIC SURFACE FOR UNDERDRAIN

(ASSUMING ALL FLOW COMES FROM ONE SIDE)

$\frac{d}{T} = \frac{5}{17} = \frac{5}{35} = 1.4$



$Q/k > 4(10^{-3})$ FROM

$A_T = 7 FT^2 = 5 SQFT$

$Q > (4 SQFT) 4(10)^{-3} FT/FT + 14 (10^{-3}) FT$ DUE TO

$Q > 83 GPM/FT$

THIS IS THE INFLOWS OF THE 0.173 CFS/FT PROJECTED ACHIEVED WITH TRENCH

PHASE 5 FOR 0.965 CFS/FT PHASE 5)

CHECK DEPTH OF GEOTEXTILE TO ENSURE WATER NOT TOO UNDERDRAIN

USE J-FLOW: GEOTEXTILE (EXPECTED PROPERTIES)

CHECK NEED FOR PERMITTIVITY OF GEOTEXTILE

STRESS IS FOR PHREATIC HEAD

$Q = KiA = K(\Delta H/L)A$

K = PERMITTIVITY OF FABRIC

ΔH = HEAD = 16.5

$K/L = \psi$ = PERMITTIVITY OF FABRIC

$(K/L) = \psi = (Q/(\Delta H A))$

$Q = 33.3 FT^3/DAY = 0.000385 FT^3/SEC$ / FT

ASSUMING $\Delta H = 10$, $Q = 0.0025 FT^3/SEC-FT$

$A = 10 SQFT$

$\psi_{REQ'D} = \frac{0.00385 FT^3}{10 SQFT (16 FT^3/SQFT)(SEC)} = 1.3 \times 10^{-5} SEC^{-1}$

$\psi_{SOIL} = 1.4 SEC^{-1} >> 1.3(10)^{-5} SEC^{-1}$ OK

CHECK T = TIME REQ'D TO REACH (USES STAGE 6 WATERSHED)

$\Delta H = 40.6'$

$T = 0.165 GPM/FT = 22 FT^3/DAY-FT = 0.00154 FT^3/SEC-FT$

POROSITY $n = 15\% = 0.15$ $V = 3 FT^3/SQ-FT$

$A = 1 SQ FT$

$\psi_{REQ'D} = \frac{0.15 \times 3}{(40.6)(1)} = 0.000221 = 1.4(10)^{-5} SEC^{-1}$

$\psi_{SOIL} = 1.4 SEC^{-1} >> 1.4(10)^{-5} SEC^{-1}$ OK

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Title: WILLIAMSON TRACK LLC
UNDERDRAIN DESIGN

R12568

Project No.: 805-330-M13

By: MO Date: 5/14/08 Chkd: CEY Date: 8/8/08

PHASES 5 AND 6 REVISED DESIGN

SHEET 3 OF 4

END STATE - RETAINING FROM ENTIRES ONLY ONE SIDE DESIGN

(REFER TO SKETCH SHEET 2)

L_H = 2' (ASSUMED) ; A_f = 4 FT²/FT (ONE SIDE)

USE 6 MIL SHEET ; γ = 0.062 LB/FT² (GE = 10)

$q_{ALLOW} = q_{USA} = \frac{0.062}{2(4)} = 1.3(10)^{-3}$ SEC^{-1}

q_{SH} = 1.4 SEC^{-1} >> $1.3(10^{-3})$ SEC^{-1} ∴ OK

CHECK GEOTEXTILE CLOGGING POTENTIAL

USE ALLIANCE'S MOST RECENT GRADATION TESTS ON PLACED CCR

SAMPLE DATE	D_{85}	O_{90}
4/15/08	32.8	8.5mm
10/26/07	24.6	16 mm
8/22/07	23.6	7mm = SMALLEST O_{90}
7/30/07	22.7	8mm

$AOS \leq O_{90}$ SOIL (CRITERIA)

$EOS \leq AOS = \#70$ SIEVE = 0.210mm < 7mm ∴ OK

USING MEC CRITERIA: (DOW MOST AGGRESSIVE)

FOR A NON WOVEN GEOTEXTILE:

$AOS \leq \#40$ SIEVE (#70 ACCEPTED)

$\psi \geq$ 0.1 SEC^{-1} (1.40 SEC^{-1} PROVIDED)

GEOTEX 351 MEETS BOTH OF THESE CRITERIA

CHECK SITE PERMEATIONS VS UNDERDRAIN REQUIREMENTS

CURRENT DESIGN: 2 RODS (1/2" DIA) 12" C-C

ANTICIPATED FLOWS: 1/2" > Qes > 1" ∴ OK

CENTER FOR EARTH AND ENVIRONMENTAL SCIENCE OF THE STATE UNIVERSITY OF NEW YORK AT BUFFALO

[illegible]

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Title: WILLIAMSON ENERGY LLC
UNDERDRAIN DESIGN
R12569

Project No.: 205-330-1413

By: MC Date: 4/20/08 Chkd: CEY Date: 8/8/08

PHASES 5 AND 6 REVISED DESIGN

SHEET 4 OF 6

CHECK SIZE PERFORATIONS IN UNDERDRAIN COLLECTION LINE (CONTINUED)

REF: SDR MECHANICS NOTE NO. 3, SDR MECHANICS CONSIDERATIONS FOR EMBANKMENT DESIGN, SCS, USDA, MAY, 1971

AGGREGATE $C_u = D_{60}/D_{10} = 25\text{mm}/3\text{mm} = 1.8 < 30$, OK (REF, PG 4-4)

FOR PERFORATION FLOW AREA REDUCTION (" ")

DESIGN INFLOW RATE (STAGE 7) = 0.465 SQ FT OF DRE
= 0.00104 CFS/FT

ASSUME .1 S.F. = 10 %, $Q = 0.0104$ CFS/FT

ASSUME $h = 2'$ (2' HEAD WATER WITHIN BACK ENVELOPE)

$$Q = CA_e(2gh)^{1/2} = 0.6(0.3A)(2gh)^{1/2}$$
$$= 1.4445\,A\,h^{1/2}$$
$$= 2.043\,A, \quad A = \frac{0.0104\ \text{CFS}}{2.043} = 0.0051\ \frac{\text{SF}}{\text{FT}}$$

$h/D = 2$

FOR 3/8" HOLES

$$A = \frac{\pi D^2}{4} = \frac{\pi}{4}(0.375)^2 = 0.1104\ \text{SF} = 0.0011\ \frac{\text{SF}}{\text{FT}}$$

NO. HOLES = $0.0051/0.0011 = 4.6$ HOLES/FT

FOR 1/2" HOLES

$$A = \frac{\pi D^2}{4} = \frac{\pi}{4}(0.5)^2 = 0.1963\ \text{SF} = 0.0020\ \frac{\text{SF}}{\text{FT}}$$

NO. HOLES = $0.0051/0.0020 = 2.7$ HOLES/FT

CHOOSE 3/8" HOLES, 4 PER FT, 2 ROWS, HOLES 4" C-C FOR PHASES 5 AND 6.

USE THE 4 HOLES OF ABOVE.

NOTE: A HEAD REDUCTION FACTOR OF 10% WAS USED TO ACCOUNT FOR 70% REDUCTION FACTOR FOR PARTIAL BLOCKAGE OF PERFORATIONS AS RECOMMENDED BY SCS.

Form SCS 130
5-65

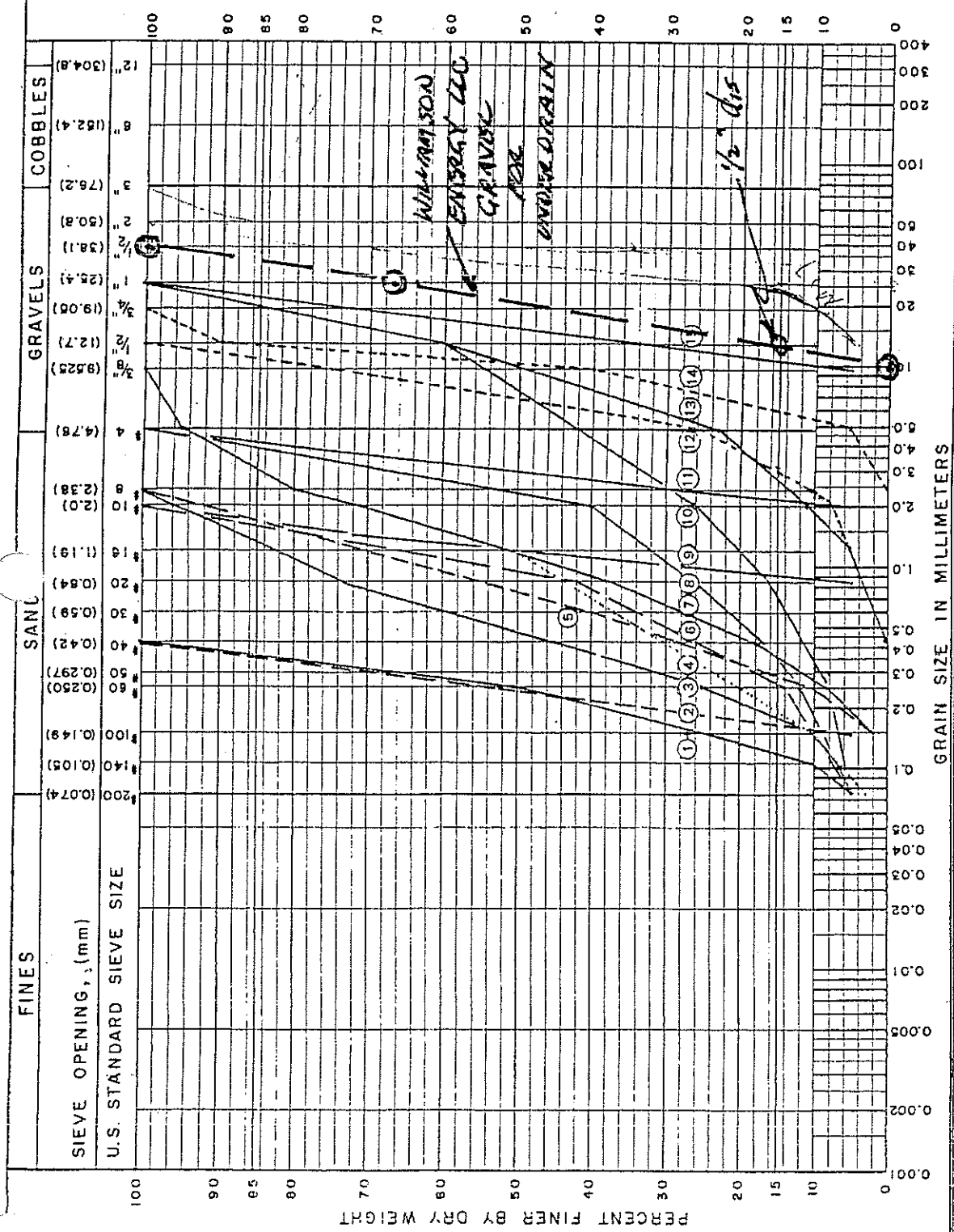
B05-330-1-13 (89)

R12570

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	DRAIN MATERIALS

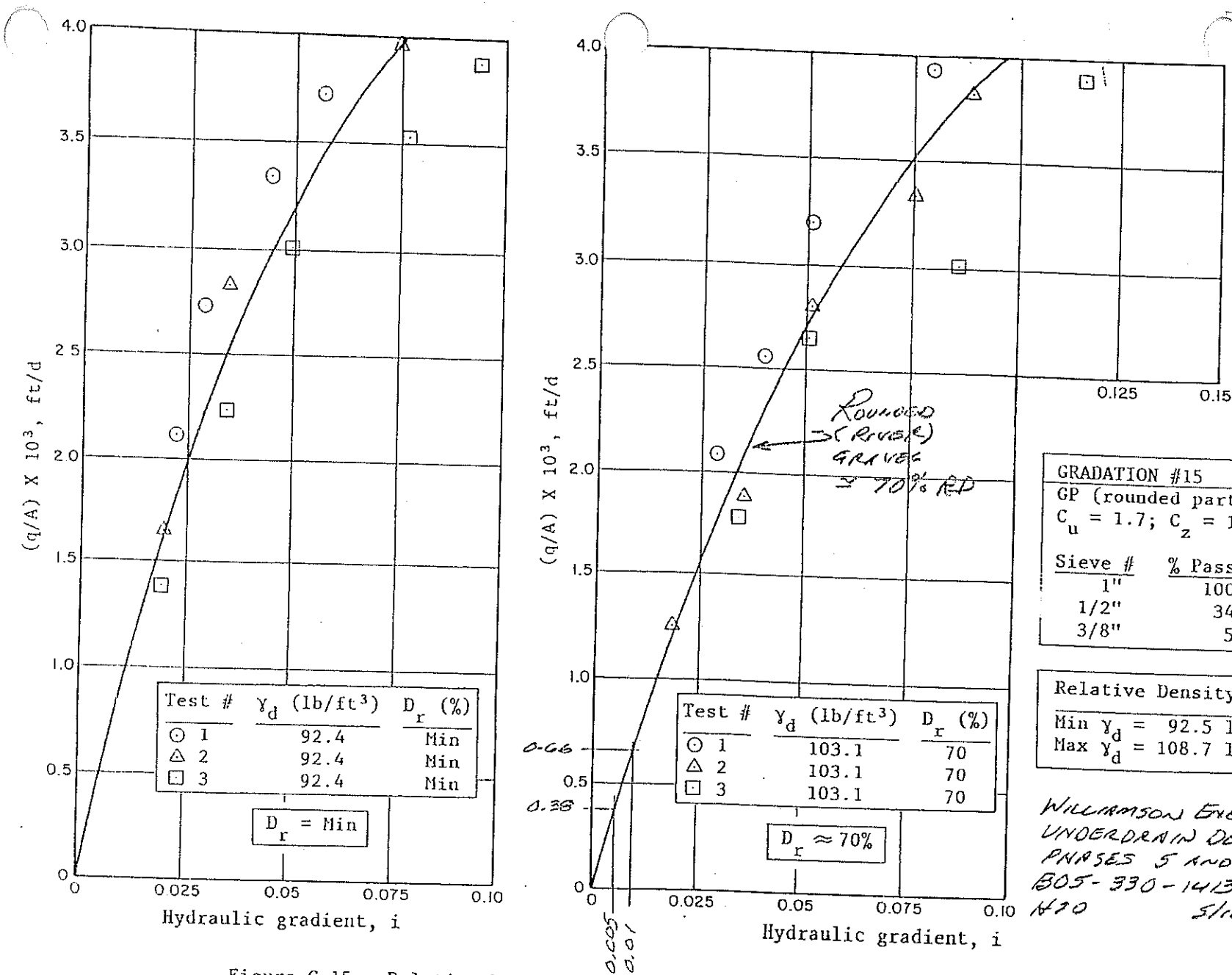
PROJECT and STATE: Project Study No. 101 — SHEET 5 OF 6

DESIGNED AT: | BY: SML | DATE: HJD 5/16/08



REMARKS 1. Gradations No. 3 and 7 represent the fine and coarse limits of fine aggregate sand (ASTM Designation C33).
2. Gradations No. 12 and 14 represent the fine and coarse limits of gravel size No. 78 (ASTM Designation D448).

Figure 1. Gradations of sands and gravels tested – SM NOTE No. 9, SCS, [illegible]



GRADATION #15
GP (rounded particles)
C_u = 1.7; C_z = 1.0

Sieve #	% Passing
1"	100
1/2"	34
3/8"	5

Relative Density, D_r
Min γ_d = 92.5 lb/ft³
Max γ_d = 108.7 lb/ft³

WILLIAMSON ENERGY LLC
UNDERDRAIN DESIGN
PHASES 5 AND 6
B05-330-1413
HJO 5/16/08

Figure C-15. Relationship between q/A and i for Gradation No. 15 (GP, rounded)

SM NOTE NO. 9, SCS, USDA, MARCH 1984

WILLIAMSON ENERGY LLC
B05-330-1413
UNDERDRAIN DESIGN (PHASES 5 & 6)
HJO 5/16/08
SHEET 6 OF 6

C - 20

90

R12571

*U.S. GOVERNMENT PRINTING OFFICE : 1984 0-420-[illegible]

7225-11
part 7

(41)

R12572

PRODUCT DATA SHEET

GEOTEX® 501

GEOTEX 501 is a polypropylene, staple fiber, needlepunched nonwoven geotextile produced by Propex, and will meet the following Minimum Average Roll Values (MARV) when tested in accordance with the methods listed below. The fibers are needled to form a stable network that retains dimensional stability relative to each other. The geotextile is resistant to ultraviolet degradation and to biological and chemical environments normally found in soils.

GEOTEX 501 conforms to the property values listed below.[1] Propex performs internal Manufacturing Quality Control (MQC) tests that have been accredited by the Geosynthetic Accreditation Institute - Laboratory Accreditation Program (GAI-LAP).

PROPERTY	TEST METHOD	MARV ENGLISH	MARV METRIC
Mechanical			
Tensile Strength (Grab)	ASTM D-4632	140 lbs	623 N
Elongation	ASTM D-4632	50%	50%
Puncture	ASTM D-4833	85 lbs	378 N
CBR Puncture	ASTM D-6241	360 lbs	1601 N
Mullen Burst	ASTM D-3786	280 psi	1930 kPa
Trapezoidal Tear	ASTM D-4533	60 lbs	267 N
Endurance			
UV Resistance	ASTM D-4355	70%	70%
Hydraulic			
Apparent Opening Size (AOS)[3]	ASTM D-4751	70 US Std. Sieve	0.212 mm
Permittivity	ASTM D-4491	1.40 sec^{-1}	1.40 sec^{-1}
Water Flow Rate	ASTM D-4491	115 gpm/ft^2	4686 $l/min/m^2$
Roll Sizes		15 ft x 360 ft	4.57 m x 109.8 m

NOTES:

1. The property values listed above are effective 08/2006 and are subject to change without notice.
2. Values shown are in weaker principal direction. Minimum average roll values (MARV) are calculated as the typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any samples taken from quality assurance testing will exceed the value reported.
3. Maximum average roll value.

WILLIAMSON ENERGY LLC
805-330-1413
UNCONFIRMED DESIGN
470 SHEET 6A OF 6

PROPEX | THE ADVANTAGE CREATORS

GEOSYNTHETICS

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(42)

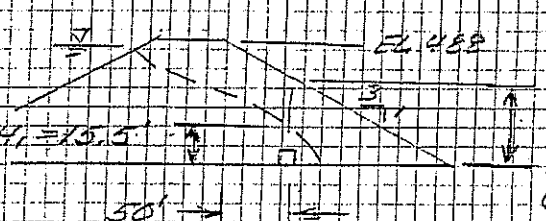
Title: WILLIAMSON ENERGY LLC R12573
UNDERDRAIN DESIGN

Project No.: 825-330-1413

By: MC Date: 5/22/08 Chkd: CH Date: 8/8/08

SHEET 1 OF 2

CHECK EMBANKMENT LOADING ON PIPE 5 CONCRETE PIPE



- SAND ≤ 130 PCF
- PIPE BEDDING IS GRAVEL AT 95% PROCTOR EQUIV.
- PIPE IS NO MORE THAN 36' BELOW EMBANKMENT

REFERENCE: "THE PERFORMANCE PIPE ENGINEERING MANUAL" FIRST EDITION, 2003 CHEVRON PHILLIPS CHEMICAL CO. LP

PE 3408 PIPE PROPERTIES & DESIGN PARAMETERS

E' = SOIL MODULUS = 2000 PSI (TABLE 7-7)
K = BEDDING FACTOR = 0.1 (PAGE 105)
L = DEFLECTION LAG FACTOR = 1.5 (PAGE 111)
S = 29,000 PSI (120°F AT 50 YRS) (TABLE 1, PP 814-7)
SP = 1600 PSI @ 73°F (USE 800 PSI) (TABLE 7-1)
M = 0.45 (OHIO TURN) (PAGE 104)
Cp = STANDARD WALL THICK = 5% (PAGE 112)
(OR 4.2% FOR X CONCENTRIC WALLS)

PIPE IS 10" SDR 26, ID = 9.614", t = 0.413", OD = 10.173"

DESIGN PARAMETERS

$D_m = D_o - t = 10.173 - 1.06(0.413) = 10.812"$ (EQ 7-27)
= MEAN DIAMETER

$E = 1+4(e^{-0.065H}) - 0.065H = 1+4(e^{-0.065(36)}) - 0.065(36)$ (EQ 7-23)
= 0.722 = EARTH LOAD FACTOR

$K = K - 0.33\left(\frac{H_1}{H}\right) = 1 - 0.33\left(\frac{13.5}{36}\right) = 0.876$ (EQ 7-24)
= BEDDING REDUCTION FACTOR

$D_{def} = \frac{S_{cc}}{M}\left[\frac{E}{\frac{1}{3}(DR-1)^3}\right]^{1/2}$ (EQ 7-25)

$= \frac{1.5}{2}\left[\frac{(0.876)(0.722)(3500)}{\frac{1}{3}(26-1)^3}\right]^{1/2}$

$= 4.6\%$ = PERCENT DEFLECTION

$D_y = \frac{S_{cc}}{M}$ = 4500 PSF = 32.5 PSI (EQ 7-26)
= FACTORY SPECIFICATION = PE

SF = Pipe / = 800 / = 4.5 (EQ 7-27)

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Title: WILLIAMSON ENERGY LLC
UNDERDRAIN DESIGN

R12574

Project No.: 505-330-1413

By: MC Date: 5/27/08 Chkd: CEY Date: 8/8/08

SHEET 2 of 2

PHASE 3 COLLECTOR AND LATERALS (CONTINUED)

$S = \frac{P_T D}{288 t} =$ PIPE WALL COMPRESSIVE STRESS (EQ. 7-23)

$= \frac{1640 \text{ PSF}(10.75 \text{ in})}{288(0.438 \text{ in})} = 439 \text{ PSI} < 500 \text{ PSI}, \therefore \text{OK}$

$\frac{\Delta X}{D_L} = \frac{P_T}{144}\left(\frac{2E'}{3}\left(\frac{K_L}{D_R - 1}\right)^3 + 0.061E'\right) =$ RING DEFLECTION (EQ. 7-22)

$= \frac{1640}{144}\left(\frac{0.1(1.5)}{\frac{2}{3}(2,900)\left(\frac{1}{24-1}\right)^3 + 0.061(2250)}\right) = 0.0365$

WHERE $K =$ BEDDING CONSTANT = 0.1 (TABLE 7-15)

$L =$ DEFLECTION LAG FACTOR = 1.5 (PAR. 7.11)

$E' = 0.75(E) = 0.75(3000) = 2250$ PSI

(CONSERVATIVELY, TAKE 25% REDUCTION IN E')

% DEFLECTION $= \frac{\Delta X}{D_L}(100) = 0.0365(100) = 3.65\%$ (EQ. 7-25)

ALLOWABLE DEFLECTION FOR DR-26 = 7.0% > 3.65%, OK (TABLE 7-8)

$\varepsilon = \frac{f}{E}\left(\frac{\Delta m}{D m}\right)\left(\frac{2 z}{D m}\right) =$ RING BENDING STRAIN (EQ. 7-24)

$f =$ [illegible] SHAPE FACTOR = 1 (TABLE 7-16)

$D_m = D_o - t = 10.75 - 0.438 = 10.312$ in (EQ. 7-27)

$C = 0.5(1.0 + 2) = 0.5(1.04)(0.44) = 0.219$ (EQ. 7-29)

$\Delta z = (\text{AS}(2)) D_L = 0.365(0.219) = 0.080$ in

$\Delta z / D m = 0.080 / 10.312 = 0.0078$

$\varepsilon = 1(0.0078)\left(\frac{2(0.438)}{10.312}\right) = 0.00067 = 0.07\%$

ALLOWABLE ε = 4.2% TO 5.0% > 0.07%, OK (PAR. 7.6)

∴ 24" DIA. HDPE PIPE IS THE PIPE SIZE, MIN. USED = 24" ←

Alliance Consulting, Inc.

Engineers
Constructors
Scientists

BECKLEY, WV (304) 255-0491
BRISTOL, VA (540) 466-2710

BY: JCH DATE: 5/9/05 CHKD BY: [illegible] DATE: 6-29-05

PROJECT NAME: Mach Mining

PROJECT NO. B05-330-1413 SHEET 1 OF 4

DESCRIPTION Structural Design of Drain Pipe
PHASE 7

(94)

R12575

The purpose of the following calculations is to determine if the proposed 12-inch, SDR 13.5 high density polyethylene pipe is structurally adequate for the pressures associated with the anticipated depth of cover.

Design Assumptions

1) maximum Coal Refuse Cover height = 100'
2) Average Density of refuse 120 pcf
3) Soil modulus (E') of compacted soil = 2500 psi

References:

1) A guide for design and installation 2nd Ed American Water Works Association AWWA Manual/ M11 1981
2) Plexco Manual
3) Driscopipe Manual

Check F.S. Against Internal Pressure.

SDR 13.5 is Rated at 128 psi

Max head loss

EL 535 (max water level) − 442.5 (outlet) = 92.5'

92.5 × 62.4 = 5772 lb/ft² = 40.08 psi

F.S. 128 / 40.08 = 3.19 ok

Check F.S. Against External Pressure

Total External Pressure (P_t) = 100' × 120 lb/ft³ = 12000 lb/ft² = 83.3 psi

Wall crushing

$$S_A = \frac{(SDR-1)P_t}{2} = \frac{12.5 \times 83.3}{2}$$

= 520.6 psi

$$F.S. = \frac{CYS}{S_A}$$

CYS = Compressive Yield Strength of Pipe = 1500 psi (Driscopipe Manual)

$$\frac{1500}{520.6} = 2.88 \text{ ok}$$

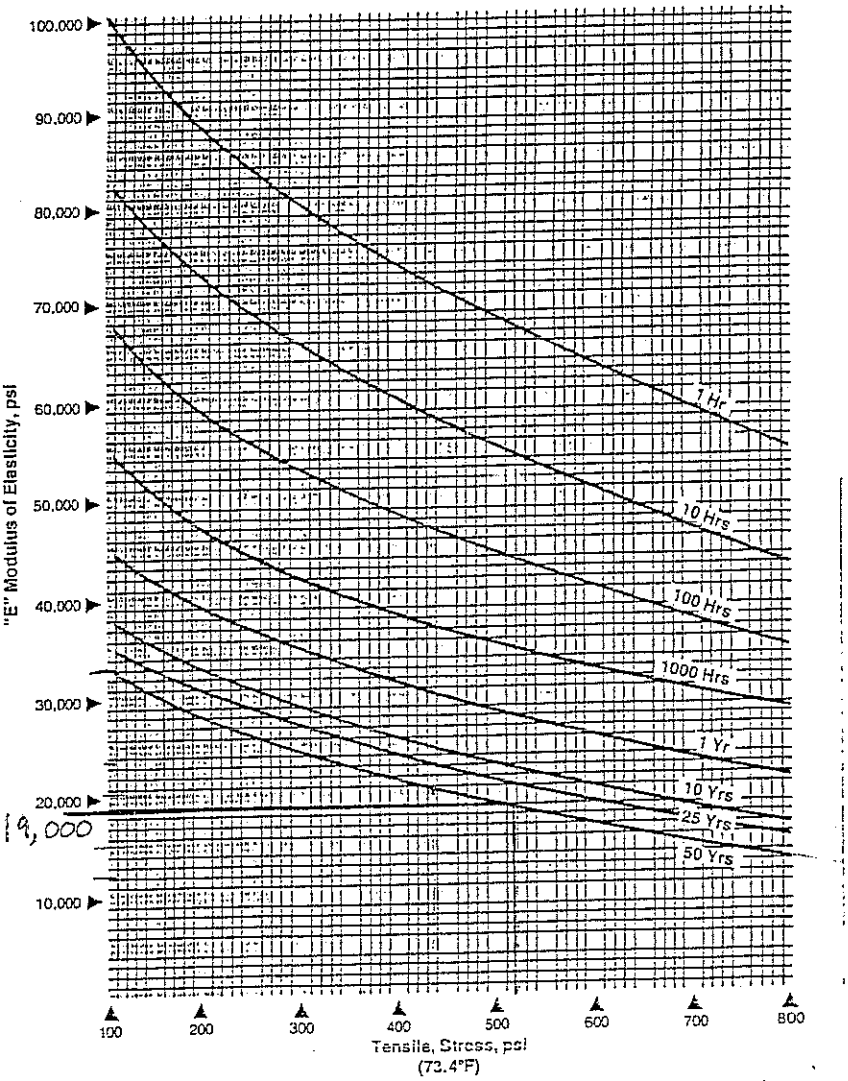
Wall Buckling

SA = 520.6

Reference Driscopipe Manual 037

Chart 25

Time Dependent Modulus of Elasticity for Polyethylene Pipe vs. Stress Intensity (73.4°F)



NOTE: The short term modulus of elasticity of Driscopipe per ASTM D 638 is approximately 100,000 psi. Due to the cold flow (creep) characteristic of the pipe material, this modulus is dependent upon the stress intensity and the time duration of the applied stress.

From chart modulus of Elasticity (E) = 19,000 psi (50 yr. life)

Critical Collapse Differential Pressure (P_c)

$$= \frac{2.32\,(E)}{(SDR)^3}$$

$$= \frac{2.32\,(19{,}000)}{(13.5)^3} = 17.9 \text{ psi}$$

Critical Buckling Pressure (P_{cb})

$= 0.6\sqrt{E' P_c}$ where E' = soil Modulus of Backfill

$= 0.6\sqrt{2500 \times 17.9}$

$= 169.2$ psi

$F.S. = P_{cb} \div P_T = 169.2 \div 83.3 = 2.0$ ok

Check F.S. Against Deflection

Allowable deflection for SDR 13.5 = 3.4%

With flexible pipe the total deflection will = 5%

The deflection of the backfill material

Total deflection = $P_T / E' = 83.3/2500 \times 100 = 3.33\%$ ok

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BY: HTO DATE: 7/3/03 CHKD BY: CEY DATE: 8/8/08 (98)

R12579

PROJECT NAME: WILLIAMSON ENERGY LLC

PROJECT NO. BOS-330-14B SHEET 1 OF 1

DESCRIPTION HORIZONTAL STRAIN DUE TO SUBSIDENCE
CRITICAL AREAS

REFERENCE: "PREDICTION OF GROUNDMOVEMENT... IMPOUNDMENTS," SYD E. PENG, ET AL, MARCH 2008, APPENDIX I

DETERMINE: ZONES MOST SUSCEPTIBLE TO FOUNDATION SOIL OR EMBANKMENT CRACKING

CRITERIA:
FOR TENSILE STRAIN IN THE RANGE OF 0.1 TO 0.3% MAY INDUCE CRACKING, SHERARD (1972) - THIS IS FOR EARTH DAMS BUT SINCE THE FOUNDATION IS A CLAY SOIL USE THIS TO IDENTIFY AREAS FOR EXTRA OBSERVATION AND POSSIBLE REMEDIAL TREATMENT

INTERPRETATION OF THE STRAIN DATA IN PENG'S REPORT:
PLUS STRAIN - TENSION (+)
MINUS " - COMPRESSION (-)

LOCATIONS ON PENG'S SECTION A-A WHERE HORIZ. STRAIN > +1.0E-3
(0.1% = 0.001 = 1×10^{-3} = 1.0E-3) FT/FT

DISTANCE ALONG CROSS SECTION A-A (FT)

START	FINISH
-19	161
1300	1465
1646	1806
2950	3110
3291	3452
4595	4776

Alliance Consulting, Inc.
Engineers
Constructors
Scientists
BECKLEY, WV
(304) 255-0491

BY: HJP DATE: 7/3/08 CHKD BY: CEY DATE: 8/8/08 (09)

PROJECT NAME: Williamson Energy LLC

PROJECT NO. P06-330-1413 SHEET 1 OF 21

DESCRIPTION: Check Piping and Cracking Potential of Foundation Soil and Coarse Coal Refuse

SAMPLE	SOIL TYPE	PIPING RESISTANCE		CRACKING RESISTANCE	
		SM-TO, SCS	SHERARD	SM-TO, SCS	SHERARD
HOLCOMB (2/18/04)	CL-SOIL PI-24	HIGH	1-HIGH	LOW	—
HOLCOMB (11/1/06)	GW-COR CU=1.8	HIGH	3-INTERMEDIATE	NONE	—
ALLIANCE (4/8/08)	SC-COR PI=24	MEDIUM	3-INTERMEDIATE	MEDIUM	—

* IT APPEARS THAT THE COARSE COAL REFUSE (COR) HAS HIGH TO MEDIUM RESISTANCE TO PIPING AND MEDIUM RESISTANCE TO CRACKING. THE HOLCOMB SAMPLE IS REFUSE AS DELIVERED TO THE SITE. THE ALLIANCE SAMPLE IS REFUSE AFTER COMPACTION.

THE HOLCOMB FOUNDATION SOIL SAMPLE HAS HIGH PIPING RESISTANCE AND LOW CRACKING RESISTANCE (BUT NOT IN THE OPTIONAL PAGES), SEE SHEET 4.

* THE FOUNDATION SOIL FOR THE IMPOUNDING EMBANKMENT SHOULD BE EXAMINED PRIOR TO PIPING FOR CRACKS AND SEAMS. IT SHOULD BE RECOGNIZED THAT THE SILVERY WIRE TEND TO SEAL THE CRACKS AND THAT THE FOUNDATION COR HAS A HIGH RESISTANCE TO PIPING.

SEE SHEET 3 FOR REFERENCES AND SHEET 2 FOR THE TABLES.

SEE SHEETS 5 THROUGH 21 FOR THE SOIL TESTS DATA

R12580

Group Symbol	TYPICAL NAMES	RELATIVE PROPERTIES OF MATERIALS COMPACTED TO 95% OF (1) MAXIMUM STANDARD DENSITY OR (2) 70% RELATIVE DENSITY: Shear strength when saturated	Compressibility when saturated	Permeability*	Resistance to piping	Susceptibility to cracking by deformation
GW	Well graded gravels, gravel-sand mixtures, little or no fines.	High	Low	High	High	None
GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.	High	Low	High	High	None
GM	Silty gravels, gravel-sand-silt mixtures.	High	Low	Medium	Medium to low	Medium
GC	Clayey gravels, gravel-sand-clay mixtures.	High	Low	Low	High	Medium
SW	Well graded sands, gravelly sands, little or no fines.	High	Low	High	Medium	None
SP	Poorly graded sands, gravelly sands, little or no fines.	Medium	Low	High	Medium to low	None
SM	Silty sands, sand-silt mixtures	Medium	Medium	Medium	Med. PI>6 - Low PI<6	Medium to high
SC	Clayey sands, sand-clay mixtures.	Medium	Medium	Low	Medium	Medium
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.	Medium to Low	Medium	Medium	High PI>15 Med. PI<15	High PI<15 Low PI>15
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Medium	Medium	Low	High PI>15 Med. PI<15	High PI<15 Low PI>15
OL	Organic silts and organic silty clays of low plasticity.	Low	High	Medium	Medium to low	Medium
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.	Low	High	Low	Medium to low	Medium
CH	Inorganic clays of high plasticity, fat clays.	Low	High	Low	High	Low
OH	Organic clays of medium to high plasticity, organic silts.	Low	High	Low	Medium to high	Medium
Pt	Peat and other highly organic soils	NOT SUITABLE FOR CONSTRUCTION				

* High > 1.0 ft./day; Medium 0.001 - 1.0 ft./day; Low < 0.001 ft./day

8-9 Tentative

FIGURE 8-2(d). RELATIVE PROPERTIES OF COMPACTED MATERIALS (UNIFIED SOIL CLASSIFICATION SYSTEM)

Table 2.2:1 Rough Empirical Relationship Observed between Piping Resistance in Earth Dam Embankments and Soil Types and Construction Methods (In Order of Decreasing Piping Resistance)

Greatest piping resistance	1. Clay of high plasticity (P.I. greater than 15%). Well compacted.
	2. Clay of high plasticity (P.I. greater than 15). Poorly compacted.
Intermediate piping resistance	3. Well-graded coarse sand or sand-gravel mixtures with binder of clay of medium plasticity (P.I. greater than 6). Well compacted.
	4. Well-graded coarse sand or sand-gravel mixtures with binder of clay of medium plasticity (P.I. greater than 6). Poorly compacted.
	5. Well-graded cohesionless gravel-sand-silt mixtures (P.I. less than 6). Well compacted.
Least piping resistance	6. Well-graded cohesionless gravel-sand-silt mixtures (P.I. less than 6). Poorly compacted.
	7. Very uniform fine cohesionless sand. (P.I. less than 6). Well compacted.
	8. Very uniform fine cohesionless sand. (P.I. less than 6). Poorly compacted.

Alliance Consulting, Inc.

124 Philpott Lane, Beaver, West Virginia 25813
Phone: (304) 255-0491 Fax: (304) 255-4232

(101) R12582

Title: WILLIAMSON ENERGY LLC
MSHA COMMENTS

Project No.: BOS-330-1413

By: WC Date: 4/6/09 Chkd: FEY Date: 8/8/08

SHEET 3 OF 21

REFERENCES:

1. "DESIGN OF EARTH AND EARTH-ROCK DAMS", SHERARD, WOODWARD, GIZIENSKI AND CLEVENGER, JOHN WILEY AND SONS, INC., 1963.
2. "BASIC SOIL MECHANICS (COURSE SM-101), VOL. 1 OF 3", SCS, USDA, REV. 6/84, EM 5-2(a)

CHARACTERISTICS OF FOUNDATION SOIL & COARSE COAL REFUSE

FOUNDATION SOIL

DEPTH = 18.5' - 25.5'
USCS = SILTY CLAY (CL)
w = 21.5%

C = 0
Φ = 28.2°
70% < #200 SIEVE

LL = 44.3%
PI = 17.2%
γd = 102.1 pcf

COARSE COAL REFUSE

BEFORE COMPACTION

USCS = GW
K = 2x10⁻⁴ cm/sec
@ γd = 119.3 pcf

C = 0
Φ = 33.7°
22% < #200
23.7% > #4

PROCTOR TEST
γmax = 124.6 pcf
wopt = 9.3%

POST COMPACTION (AFTER OVER DRIVE)

TEST DATE	% > #4	% < #200	USCS
10/26/07	64.2	24.6	SM
3/22/07	25.6	44.9	SM
4/23/07	27.7	19.1	SM
4/15/09	35.7	32.8	SC

ALL PC TESTS WERE DONE

∴ THE C&R BERMS WOULD RANGE FROM A SW TO A SM OR SC USCS CLASSIFICATION DEPENDING ON COMPACTION

∴ THE PC CALCULATIONS WILL USE PROPERTIES FROM THE TEST VALUE AT #200 CUTOFF. #200 CUTOFF FALLS WITHIN THE SELECTED RANGE OF A SILTY SAND

SEE ATTACHED PHOTOS FOR C&R AND FOUNDATION SOIL SAMPLING
- USE CRITICAL DESIGN CASE(S)

THE C&R BERMS TO BE ON THE SAFE SIDE OF THE CRITICAL CRACKING POTENTIAL SOILS (HAS LOWER C AND Φ VALUES)

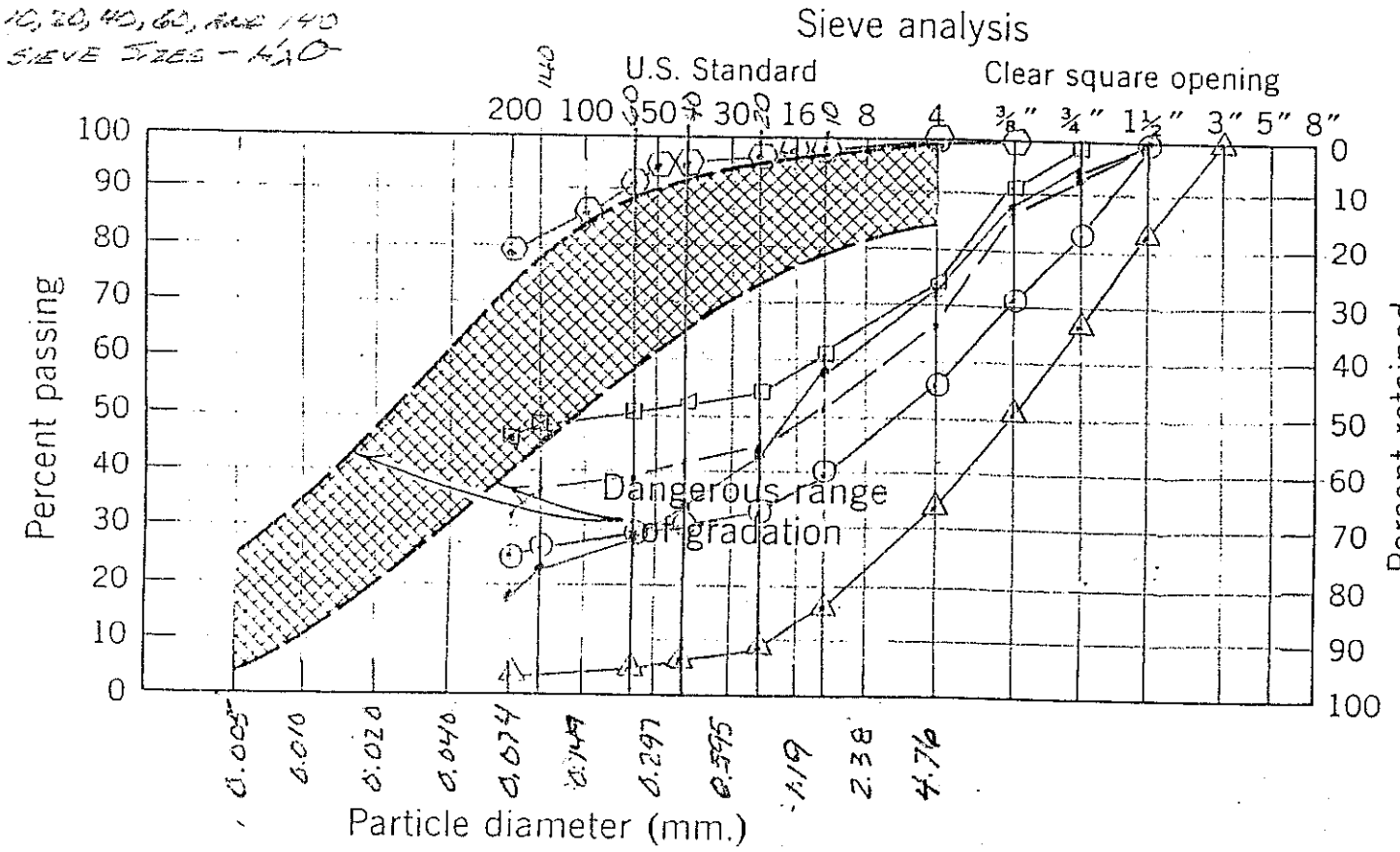
TO KEEP CRACKING

THE FOUNDATION SOILS MUST BE SIDE OF THE CRITICAL CRACKING POTENTIAL SOILS

SEE "EARTH AND EARTH-ROCK DAMS" PAGE 38 FOR IMPACTING OF THE MOISTURE CONTENT OF THE FILL

THE C&R BERMS SHOULD BE COMPATIBLE TO CRACKING OF THE FOUNDATION SOILS

FIG. 2.3.6 MODIFIED TO CORRECT PARTICLE DIAMETER AND TO ADD 10, 20, 40, 60, AND 140 SIEVE SIZES – H2O



COARSE COAL REFUSE SAMPLES

ALLIANCE SAMPLES
4-30-07
8-22-07
10-26-07
4-15-08

HOLCOMB SAMPLE
11-30-06

ALLIANCE SAMPLES ARE AFTER PLACEMENT IN FILL

HOLCOMB SAMPLE IS AS DELIVERED TO SITE

FOUNDATION SOIL HOLCOMB SAMPLE
2-6-06

Fig. 2.3:6 Range of gradation of soils suspected to be most critical embankment materials from standpoint of cracking (Ref. 95).

REFERENCE: "EARTH AND EARTH-ROCK DAMS", SHERARD, J. L., et al, JOHN WILEY AND SONS, INC., 1963

WILLIAMSON ENERGY LLC
BOS-330-1413
H2O 4/23/08
SHEET 4 OF 21

R12583

WILLIAMSON ENERGY LLC
BOS-330-1413
FOUNDATION SOIL
SHEET 5 OF 21

Holcomb Foundation Engineering Company

Laboratory Testing Results

2/8/2006

Project: Mach #1 Mine
Project No: H-05278

Sieve Analysis - ASTM C136-96a

Sample: Silty CLAY (CL)

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
1.5000	38.1000	1 -1/2"	0.0	0.0	100.0
1.0000	25.4000	1"	0.0	0.0	100.0
0.7500	19.1000	3/4"	0.0	0.0	100.0
0.5000	12.7000	1/2"	0.0	0.0	100.0
3.7500	9.5200	3/8"	0.0	0.0	100.0
0.1870	4.7600	No. 4	2.1	0.9	99.1
0.0790	2.0000	No. 10	4.6	2.0	98.0
0.0469	1.1800	No. 16	4.6	2.0	98.0
0.0331	0.8500	No. 20	8.6	3.8	96.2
0.0165	0.4200	No. 40	12.6	5.5	94.5
0.0117	0.2980	No. 50	12.6	5.5	94.5
0.0083	0.2500	No. 60	22.2	9.8	90.2
0.0059	0.1490	No. 100	34.6	15.2	84.8
0.0029	0.0740	No. 200	47.7	21.0	79.0

Total Weight in Grams 227.20

R12585

Holcomb Foundation Engineering Company

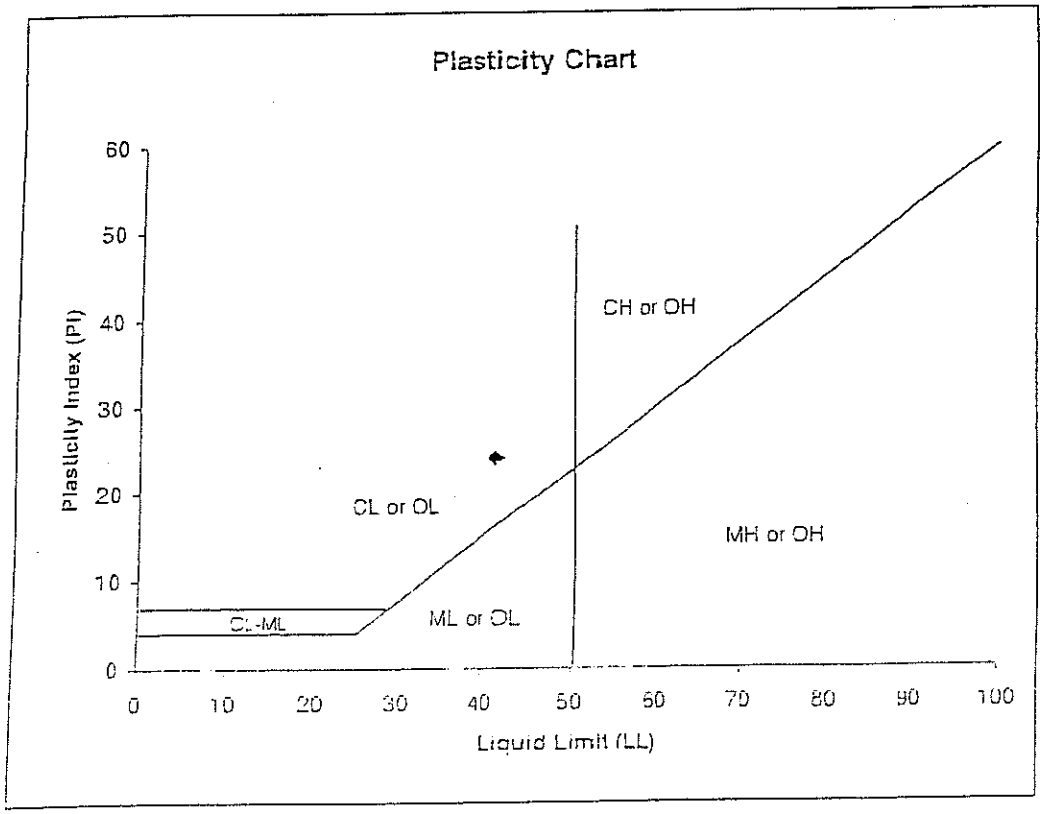
Laboratory Testing Results

Project: Mach #1 Mine
Project No: H-05278

Sample	1	2	3
Dish Number	LL_1	LL_2	LL_3
Mass of can, W_1 (g)	34.70		
Mass of can + moist soil, W_2 (g)	62.84		
Mass of can + dry soil, W_3 (g)	54.52		
Moisture content, w (%)	41.98		
Number of blows, N	24		
Liquid Limit, LL	41.8		

Dish Number	PL_1
Mass of can, W_1 (g)	39.76
Mass of can + moist soil, W_2 (g)	54.79
Mass of can + dry soil, W_3 (g)	52.53
Plastic Limit, PL	17.7

PI = 24.1



Holcomb Foundation Engineering Company

Laboratory Testing Results

11/30/2006

Project: Coarse Refuse Disposal Area
Pond Creek Mine Johnston City, Illinois

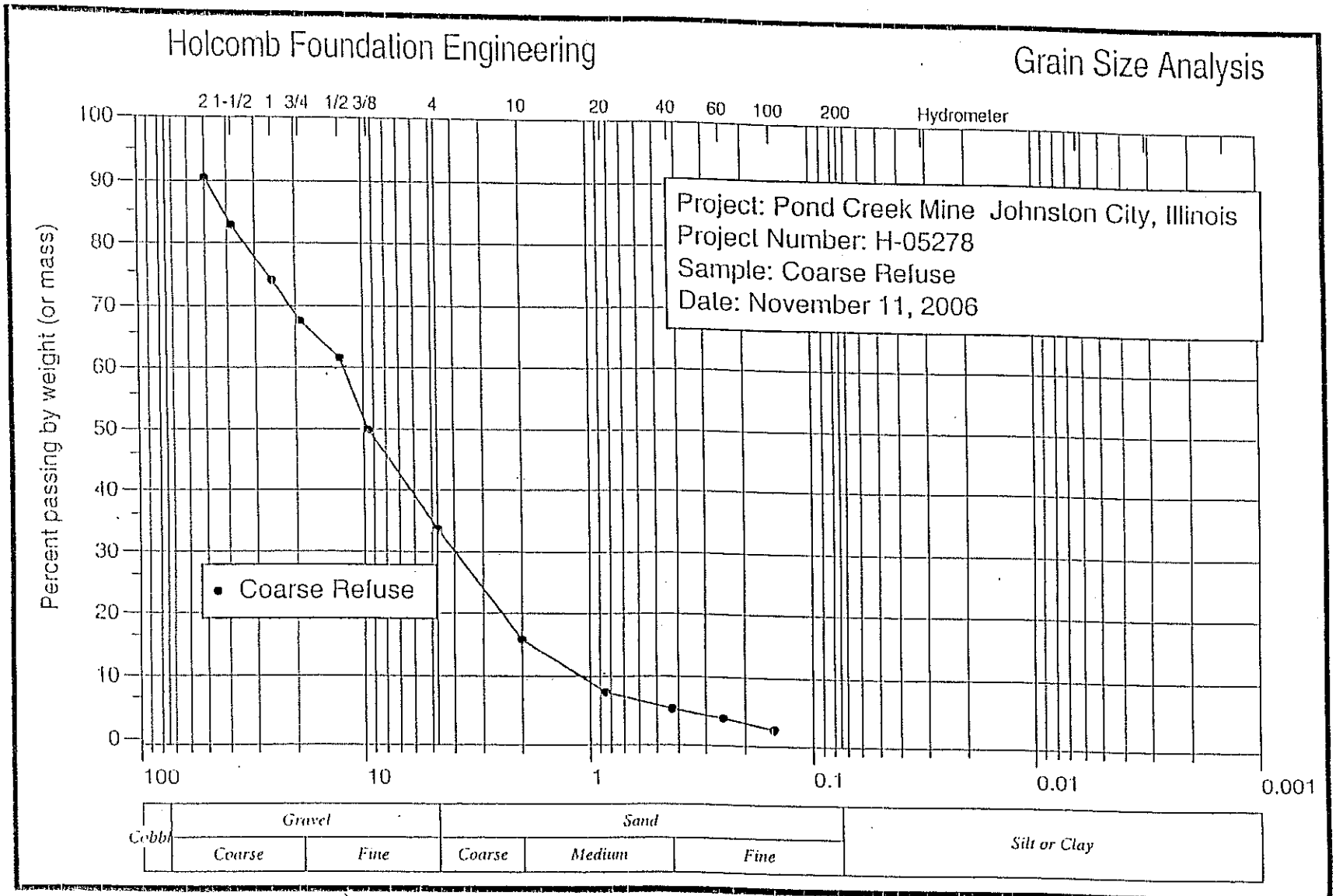
Project No: H-05317

Sieve Analysis - ASTM C136-96a

Sample: Coarse Refuse

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
3	76.2	3"	0.0	0.0	100.0
2.0000	50.8100	2"	619.6	9.5	90.5
1.5000	38.1000	1 -1/2"	1124.0	17.2	82.8
1.0000	25.4000	1"	1696.2	25.9	74.1
0.7500	19.1000	3/4"	2110.9	32.3	67.7
0.5000	12.7000	1/2"	2513.0	38.4	61.6
3.7500	9.5200	3/8"	3263.7	49.9	50.1
0.1870	4.7600	No. 4	4310.7	65.9	34.1
0.0790	2.0000	No. 10	5470.5	83.6	16.4
0.0469	1.1800	No. 16			
0.0331	0.8500	No. 20	6004.4	91.8	8.2
0.0165	0.4200	No. 40	6178.9	94.4	5.6
0.0117	0.2980	No. 50			
0.0083	0.2500	No. 60	6267.8	95.8	4.2
0.0059	0.1490	No. 100			
0.0029	0.0740	No. 200	6372.4	97.4	2.6

Total Weight in Grams 6542.80



USCS - GW

$C_U = 13/1.1 = 11.8$ (>4)

% < #200 = 2.6

% > #4 = 65.9

$C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = \frac{4^2}{(1.1)13} = 1.1$ (BETWEEN 1 AND 3)

SHEET 9 OF 21

10a

R12587

GRAIN SIZE DISTRIBUTION TEST DATA

ient: MACH MINING
oject: POND CREEK MINE REFUSE DISPOSAL FACILITY
oject Number: B06-328-1444

Sample Data

ource:
mple No.:
ev. or Depth:
cation:
scription: 4-30-07 STANDARD PROCTOR
te: 4-30-07 PL:
CS Classification:
sting Remarks:

Sample Length(in./cm.):
LL: PI:
AASHTO Classification:

Mechanical Analysis Data

	Initial	After wash
y sample and tare=	4012.00	3326.00
re =	215.40	215.40
y sample weight =	3796.60	3110.60

nus #200 from wash= 18.1 %
re for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
3 inch	0.00	100.0
2 inch	0.00	100.0
1.5 inch	0.00	100.0
nch	104.50	97.2
inch	201.30	94.7
inch	446.90	88.2
# 4	1059.70	72.1
# 10	1598.10	57.9
# 20	2156.50	43.2
# 40	2522.10	33.6
# 60	2718.80	28.4
# 140	2944.50	22.4
# 200	3110.90	18.1

GRAVEL
SAND

Fractional Components

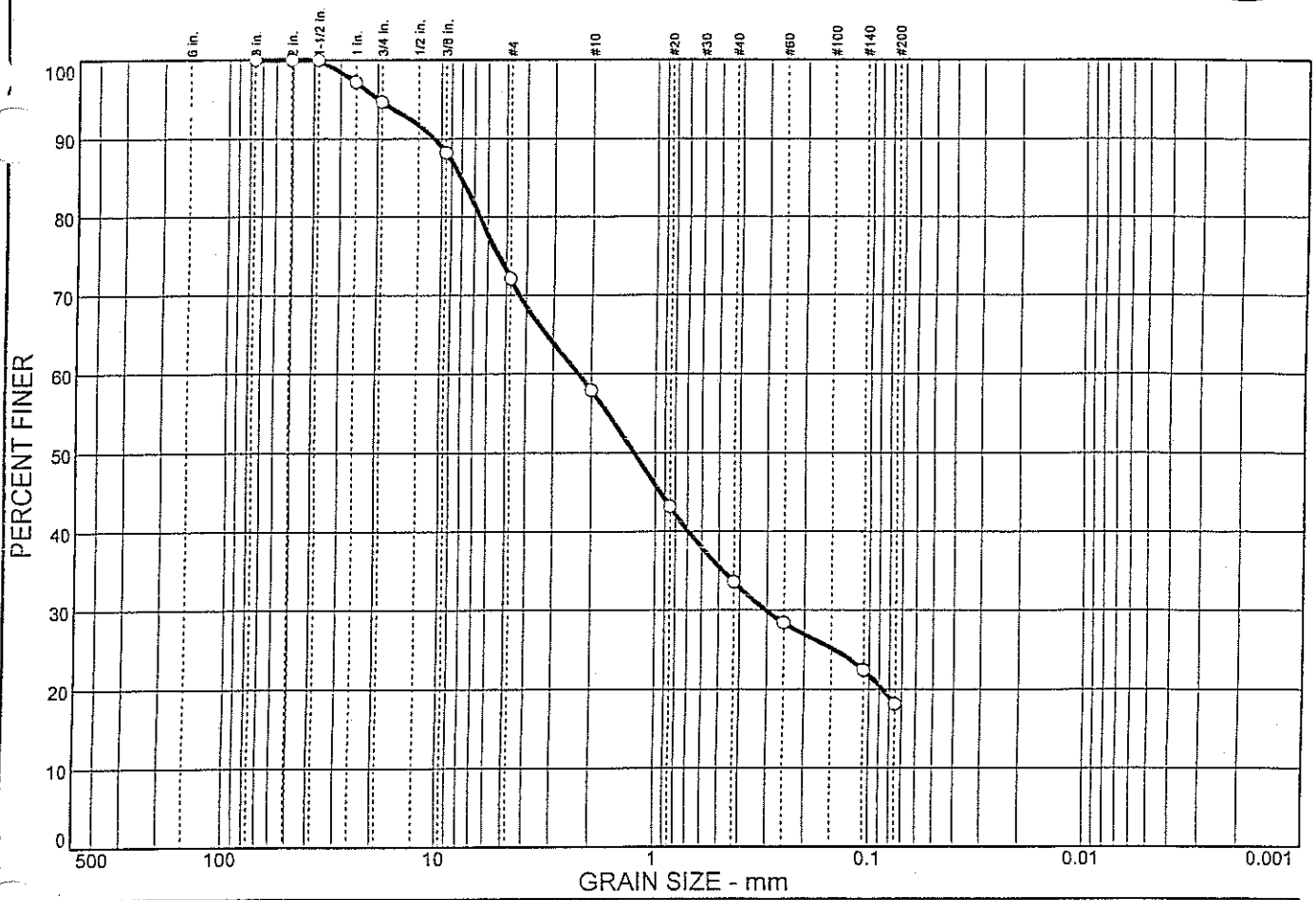
avel/Sand based on #4
nd/Fines based on #200
COBBLES = 0.0 % GRAVEL = 27.9 % SAND = 54.0
FINES = 18.1

5= 8.09 D_{60}= 2.30 D_{50}= 1.26
0= 0.30

Particle Size Distribution Report

108

R12589



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	27.9	54.0	18.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
2 in.	100.0		
1.5 in.	100.0		
1 in.	97.2		
.75 in.	94.7		
.375 in.	88.2		
#4	72.1		
#10	57.9		
#20	43.2		
#40	33.6		
#60	28.4		
#140	22.4		
#200	18.1		

* (no specification provided)

Material Description

4-30-07 STANDARD PROCTOR

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 8.09 D_{60}= 2.30 D_{50}= 1.26
D_{30}= 0.302 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample No.: Source of Sample: Date: 4-30-07
Location: Elev./Depth:

ALLIANCE CONSULTING, INC.
Beaver, West Virginia

Client: MACH MINING
Project: POND CREEK MINE REFUSE DISPOSAL FACILITY

Project No: B06-328-1444 Figure

GRAIN SIZE DISTRIBUTION TEST DATA

SHEET 11 of 21 (109) R12590

.ient: MACH MINING
:oject: POND CREEK MINE REFUSE DISPOSAL FACILITY
- ect Number: B06-328-1444

Sample Data

)urce:
ımple No.:
.ev. or Depth:
)cation:
escription: 8-22-07 STANDARD PROCTOR
ıte: 8-22-07 PL:
CS Classification:
esting Remarks:

Sample Length(in./cm.):
LL: PI:
AASHTO Classification:

Mechanical Analysis Data

	Initial	After wash
y sample and tare=	3992.00	2396.90
re =	436.00	436.00
y sample weight =	3556.00	1960.90

nus #200 from wash= 44.9 %
re for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
3 inch	0.00	100.0
2 inch	0.00	100.0
5 inch	0.00	100.0
nch	0.00	100.0
inch	58.50	98.4
inch	293.80	91.7
# 4	911.80	74.4
# 10	1402.30	60.6
# 20	1630.40	54.2
# 40	1722.60	51.6
# 60	1768.00	50.3
# 140	1837.70	48.3
# 200	1959.90	44.9

Fractional Components

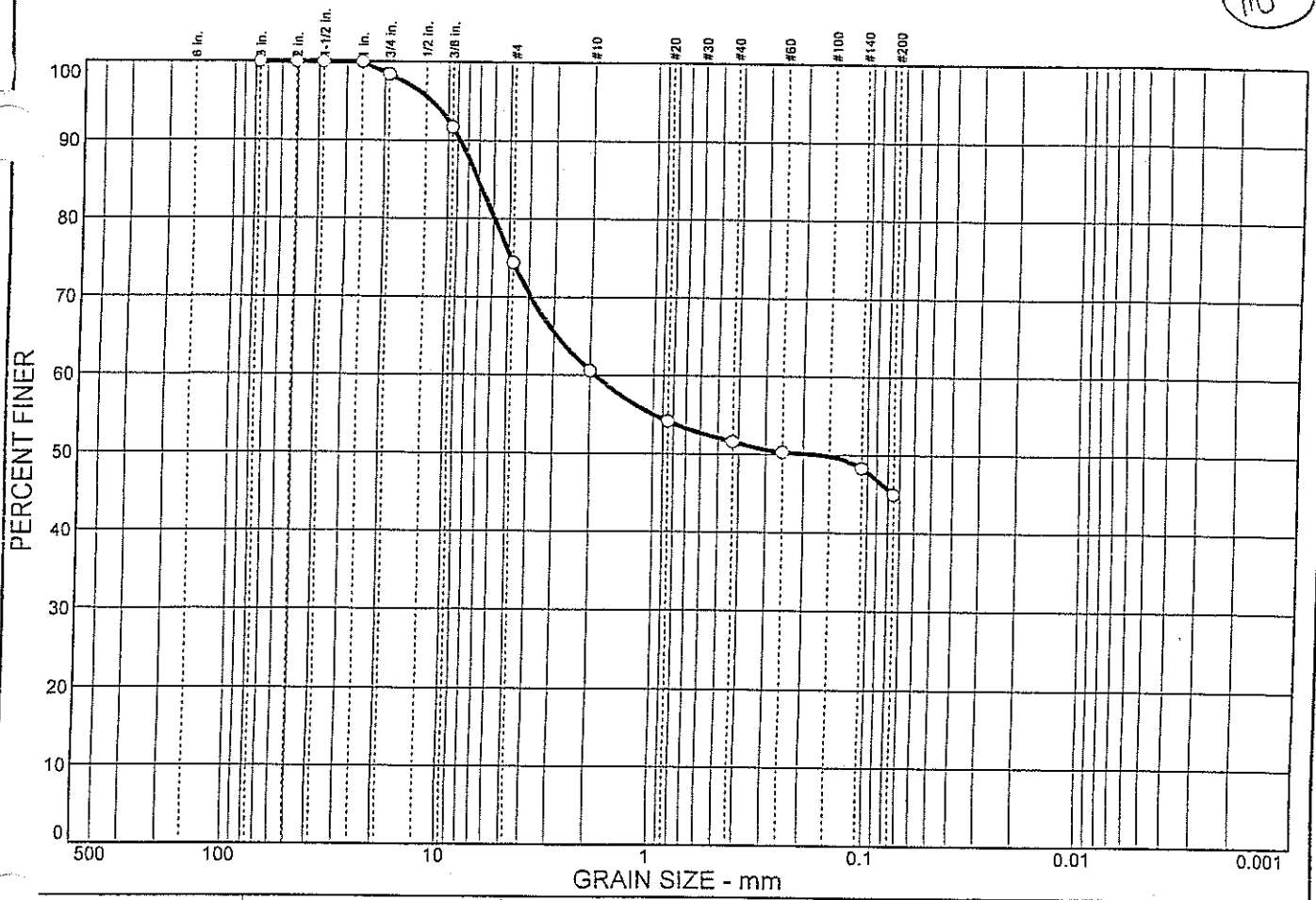
avel/Sand based on #4
nd/Fines based on #200
COBBLES = 0.0 % GRAVEL = 25.6 % SAND = 29.5
FINES = 44.9

$_5$= 7.12 D_{60}= 1.89 D_{50}= 0.17

Particle Size Distribution Report

R12591

(10)



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	25.6	29.5	44.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
2 in.	100.0		
1.5 in.	100.0		
1 in.	100.0		
.75 in.	98.4		
.375 in.	91.7		
#4	74.4		
#10	60.6		
#20	54.2		
#40	51.6		
#60	50.3		
#140	48.3		
#200	44.9		

* (no specification provided)

Material Description

8-22-07 STANDARD PROCTOR

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 7.12 D_{60}= 1.89 D_{50}= 0.168
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample No.: Source of Sample: Date: 8-22-07
Location: Elev./Depth:

ALLIANCE CONSULTING, INC.
Beaver, West Virginia

Client: MACH MINING
Project: POND CREEK MINE REFUSE DISPOSAL FACILITY
Project No: B06-328-1444 Figure

GRAIN SIZE DISTRIBUTION TEST DATA

lient: MACH MINING
roject: POND CREEK MINE REFUSE DISPOSAL FACILITY
r-ject Number: B06-328-1444

Sample Data

ource:
ample No.:
lev. or Depth: Sample Length(in./cm.):
ocation:
escription: 10-26-07 STANDARD PROCTOR
ate: 10-26-07 PL: LL: PI:
CS Classification: AASHTO Classification:
esting Remarks:

Mechanical Analysis Data

	Initial	After wash
y sample and tare=	3949.30	3089.10
re =	412.50	412.50
y sample weight =	3536.80	2676.60

nus #200 from wash= 24.3 %
re for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
3 inch	0.00	100.0
2 inch	0.00	100.0
5 inch	0.00	100.0
nch	120.20	96.6
inch	270.30	92.4
inch	1023.50	71.1
# 4	1562.90	55.8
# 10	2144.50	39.4
# 20	2386.40	32.5
# 40	2482.30	29.8
# 60	2526.70	28.6
# 140	2587.30	26.8
# 200	2667.70	24.6

Fractional Components

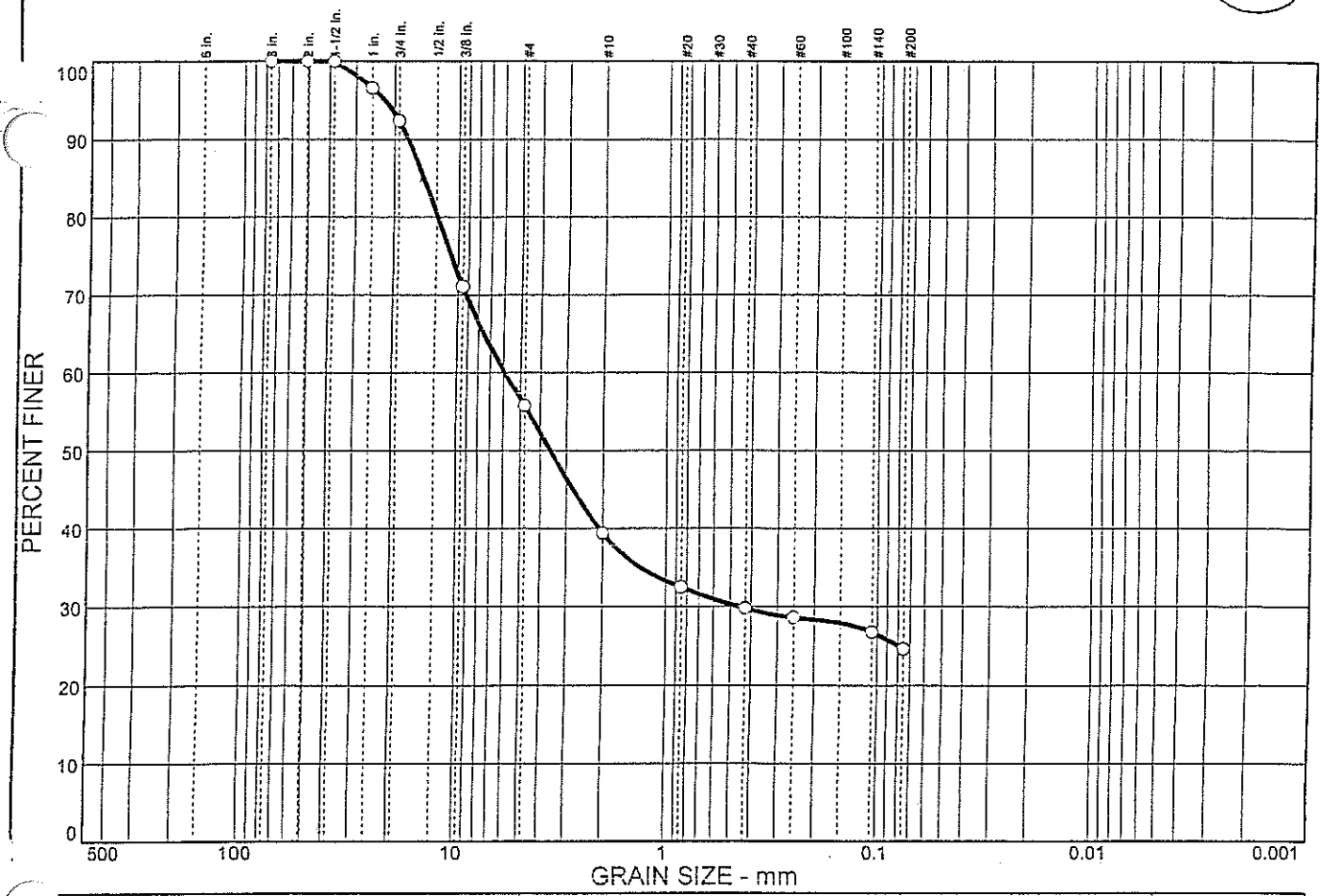
avel/Sand based on #4
d/Fines based on #200
OBBLES = 0.0 % GRAVEL = 44.2 % SAND = 31.2
INES = 24.6

= 14.55 D_{60}= 5.90 D_{50}= 3.57
= 0.45

Particle Size Distribution Report

112

R12593



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	44.2	31.2	24.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
2 in.	100.0		
1.5 in.	100.0		
1 in.	96.6		
.75 in.	92.4		
.375 in.	71.1		
#4	55.8		
#10	39.4		
#20	32.5		
#40	29.8		
#60	28.6		
#140	26.8		
#200	24.6		

* (no specification provided)

Material Description

10-26-07 STANDARD PROCTOR

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 14.5 D_{60}= 5.90 D_{50}= 3.57
D_{30}= 0.453 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample No.: Source of Sample: Date: 10-26-07
Location: Elev./Depth:

ALLIANCE CONSULTING, INC.
Beaver, West Virginia

Client: MACH MINING
Project: POND CREEK MINE REFUSE DISPOSAL FACILITY

Project No: B06-328-1444 Figure

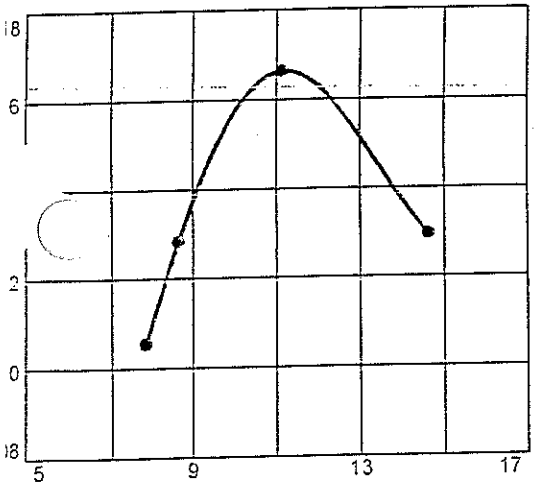
ient: MACH MINING
oject: POND CREEK MINE REFUSE DISPOSAL FACILITY
oject Number: B06-328-1444

Specimen Data

mple No.:
ev. or Depth:
Sample Length(in./cm.):
cation:
scription: 4-15-08 STANDARD PROCTOR
ter Content:
Liquid Limit: 32
Plasticity Index: 10
CS:
AASHTO:
sting Remarks: 116.6 PCF @ 11.2% (METHOD "C")
rcent retained on 3/4 in. sieve: 6.9
rcent passing No. 200 sieve: 32.8
Specific gravity: 2.23

Test Data And Results

pe of test: ASTM D 698-91 Procedure C Standard
ld Dia.: 6.00 in. Hammer Wt.: 5.5 lb. Drop: 12 in.
Layers: three Blows per Layer: 56



POINT NO.	1	2	3	4
WM + WS	9720.0	9606.0	9960.0	9955.0
WM	5550.0	5550.0	5550.0	5550.0
WW+T #1	256.56	235.69	223.31	267.45
WD+T #1	244.70	224.58	204.41	224.60
TARE #1	102.78	94.55	38.96	36.57
MOIST #1	8.4	8.5	11.4	22.8
WW+T #2	261.85	270.29	232.15	251.18
WD+T #2	248.96	259.08	212.88	238.33
TARE #2	104.64	102.78	35.38	39.84
MOIST #2	8.9	7.2	10.9	6.5
MOISTURE	8.6	7.9	11.1	14.6
DRY DEN	112.8	110.5	116.6	113.0

Max dry den= 118.0 pcf Opt moisture= 10.8 %
Uncorrected Results: Max dry den= 116.6 pcf Opt moisture= 11.2 %

TM D 4718 Correction Data:
Bulk Specific Gravity of Oversize Material = 2.23
Moisture of Oversize Material = 5.5 %
rrections Applied to Calculated Maximum Density and Optimum Moisture Values

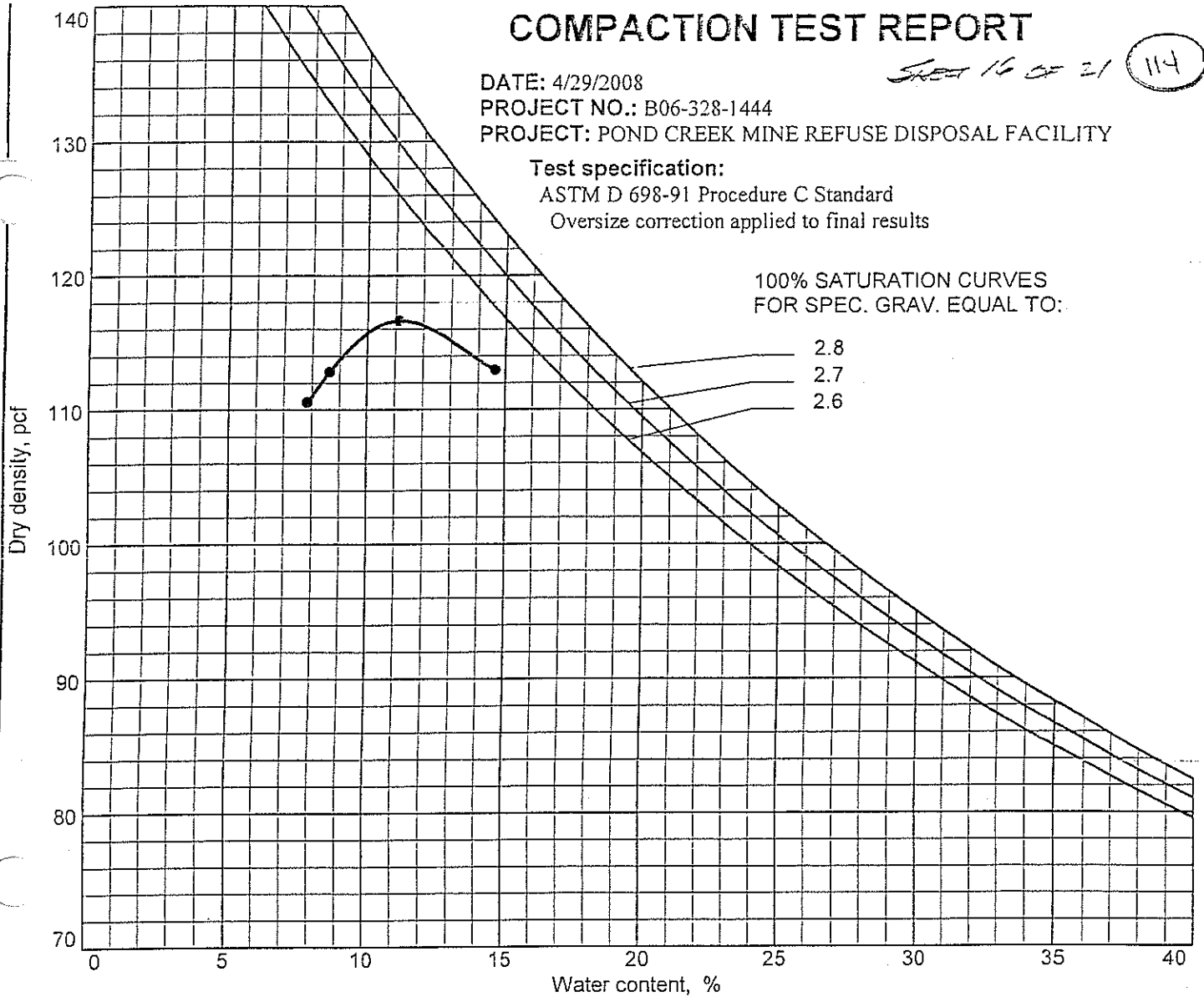
4/29/08

COMPACTION TEST REPORT

SHEET 16 OF 21 (114) R12595

DATE: 4/29/2008
PROJECT NO.: B06-328-1444
PROJECT: POND CREEK MINE REFUSE DISPOSAL FACILITY

Test specification:
ASTM D 698-91 Procedure C Standard
Oversize correction applied to final results



	No.	LOCATION AND DESCRIPTION	REMARKS
•		Source: 4-15-08 STANDARD PROCTOR	116.6 PCF @ 11.2% (METHOD "C")

	No.	USCS	LL	PI	NAT. MOIST.	OVERSIZE	%< No.200	MAX. DRY DEN.	OPT. MOIST.
•			32	10		%>3/4 in.=6.9	32.8 %	118.0 pcf	10.8 %

Figure

ALLIANCE CONSULTING, INC.

115

lient: MACH MINING
roject: POND CREEK MINE REFUSE DISPOSAL FACILITY
roject Number: B06-328-1444

Sample Data

ource:
ample No.:
lev. or Depth: Sample Length(in./cm.):
ocation:
escription: 4-15-08 STANDARD PROCTOR
ate: 4-15-08 PL: 22 LL: 32 PI: 10
SCS Classification: AASHTO Classification:
esting Remarks:

Mechanical Analysis Data

	Initial	After wash
ry sample and tare=	3750.30	2627.80
are =	332.00	332.00
ry sample weight =	3418.30	2295.80

inus #200 from wash= 32.8 %
are for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
3 inch	0.00	100.0
2 inch	0.00	100.0
1 5 inch	0.00	100.0
nch	117.90	96.6
inch	234.90	93.1
inch	436.40	87.2
# 4	1157.70	66.1
# 10	1666.30	51.3
# 20	1907.60	44.2
# 40	2009.80	41.2
# 60	2078.70	39.2
# 140	2187.00	36.0
# 200	2297.90	32.8

Fractional Components

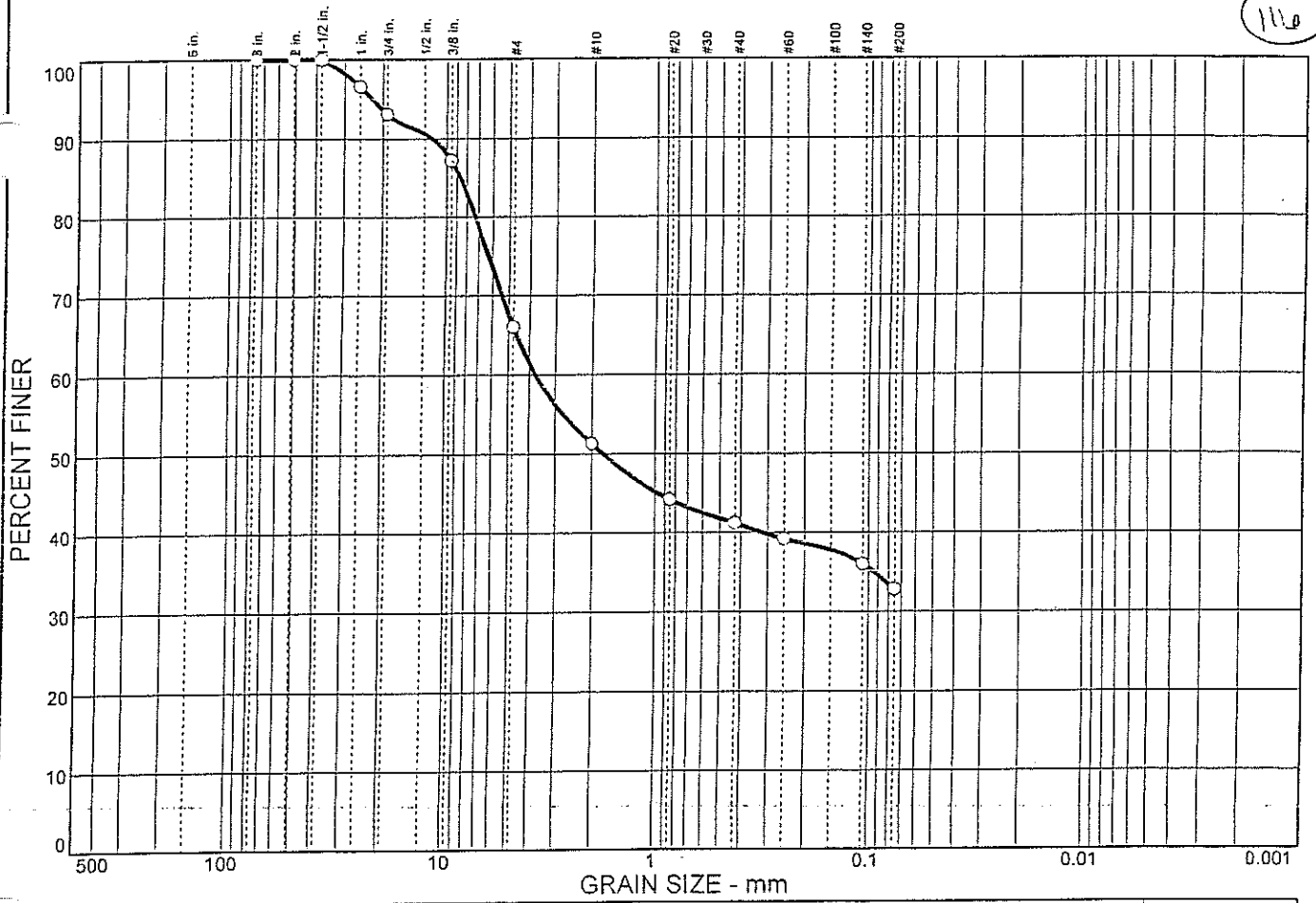
avel/Sand based on #4
d/Fines based on #200
OBBLES = 0.0 % GRAVEL = 33.9 % SAND = 33.3
INES = 32.8

= 8.64 D_{60}= 3.70 D_{50}= 1.76

4 of 4 tests

Particle Size Distribution Report

R12597



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	33.9	33.3	32.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
2 in.	100.0		
1.5 in.	100.0		
1 in.	96.6		
.75 in.	93.1		
.375 in.	87.2		
#4	66.1		
#10	51.3		
#20	44.2		
#40	41.2		
#60	39.2		
#140	36.0		
#200	32.8		

* (no specification provided)

Material Description

4-15-08 STANDARD PROCTOR

Atterberg Limits

PL= 22 LL= 32 PI= 10

Coefficients

D_{85}= 8.64 D_{60}= 3.70 D_{50}= 1.76
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample No.: Source of Sample: Date: 4-15-08
Location: Elev./Depth:

ALLIANCE CONSULTING, INC.
Beaver, West Virginia

Client: MACH MINING
Project: POND CREEK MINE REFUSE DISPOSAL FACILITY

Project No: B06-328-1444 Figure

+3/4 INCH SPECIFIC GRAVITY

(117)

R12598

Weight of dry sample & pan	3405.0	gms
Weight of pan	424.3	gms
Weight of oven-dried sample (A)	2980.7	gms
Weight of saturated surface-dry sample & pan	3570.0	gms
Weight of pan	424.3	gms
Weight of saturated surface-dry sample (B)	3145.7	gms
Weight of saturated sample in water & basket	3600.0	gms
Weight of basket in water	1790.0	gms
Weight of saturated sample in water (C)	1810.0	gms

TEST RESULTS		Material Description
Specific gravity of sample A/(B-C)	2.23	COARSE COAL REFUSE
Percent absorption B-A/A X 100	5.5%	

Project No.: B06-328-1444 Client: WILLIAMSON ENERGY, LLC Tested By: CRKII

Project: POND CREEK MINE Sample Date: 4-15-08 Checked By: AP 4/28/08

Source: REFUSE FACILITY Sample No.: Elev./Depth:

Remarks:

+3/4 INCH SPECIFIC GRAVITY

ALLIANCE CONSULTING, INC.

R12599

(118)

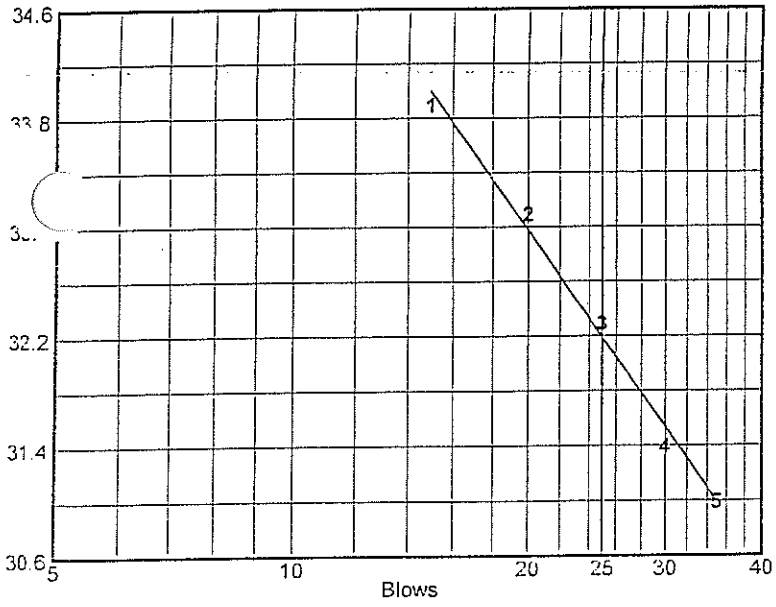
lient: MACH MINING
roject: POND CREEK MINE REFUSE DISPOSAL FACILITY
roject Number: B06-328-1444

Sample Data

ɔu e:
ample No.:
lev. or Depth: Sample Length(in./cm.):
ɔcation:
escription: Clayey gravel with sand4-15-08 STANDARD PROCTOR
ater Content: USCS: GC AASHTO:
esting Remarks:

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	36.46	39.14	35.32	35.46	38.23	
Dry+Tare	31.08	33.19	30.41	30.63	32.78	
Tare	15.20	15.23	15.21	15.26	15.21	
# Blows	15	20	25	30	35	
Moisture	33.9	33.1	32.3	31.4	31.0	



Liquid Limit= 32
Plastic Limit= 22
Plasticity Index= 10

Plastic Limit Data

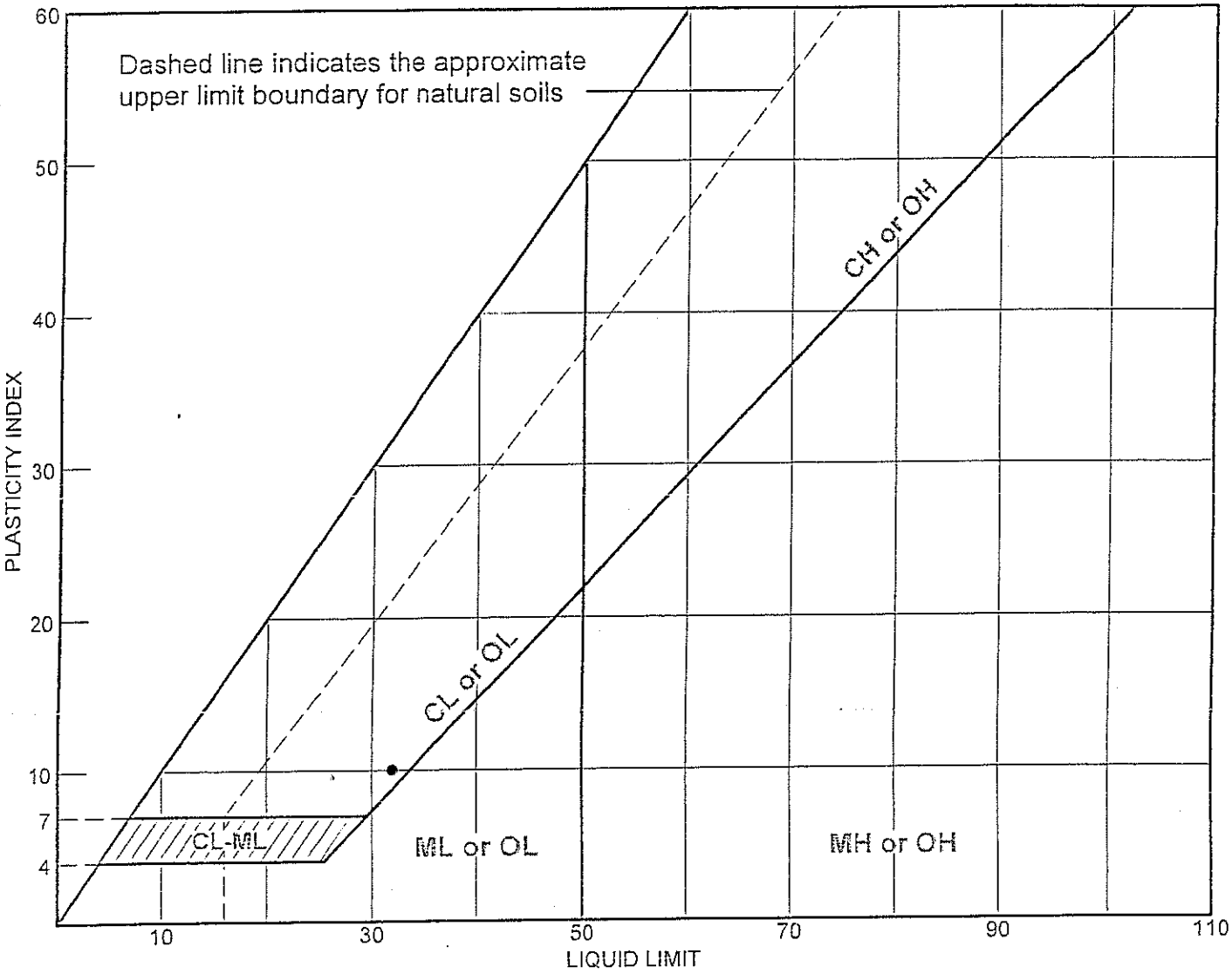
Run No.	1	2	3	4	
et+Tare	19.82	20.62	18.83		
ry+Tare	18.99	19.62	18.17		
Tare	15.27	15.21	15.21		
oisture	22.3	22.7	22.3		

HCP 4/24/08

LIQUID AND PLASTIC LIMITS TEST REPORT

119

R12600



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●					22	32	10	GC

LIQUID AND PLASTIC LIMITS TEST REPORT

ALLIANCE CONSULTING, INC.
Beaver, West Virginia

Client: MACH MINING

Project: POND CREEK MINE REFUSE DISPOSAL FACILITY

Project No.: B06-328-1444

Figure

(120) REV.

STABILTY ANALYSIS FILES – Phase 3 & Phase 7
Williamson Energy, LLC
Refuse Disposal Area No. 2
Project No.: B05-330-1413

File Name	Subject	F.S.
PH3DSST2	Downstream static, Phase 3, Section F-F	1.51
PH3DSSE1	Downstream seismic, Phase 3, two phreatic surfaces, to get Allowable phreatic level for Piezometers P-6, -7 and -8	1.23
PH3USSE2	Upstream seismic, Phase 3 two phreatic surfaces, pond about 1/2 full, (these are shallow circles that do not go through the crest)	1.16
PH3USSE3	Upstream seismic, Phase 3, two phreatic surfaces, pond full, done to check if slurry can be released during earthquake	1.20
PH3USSE4	Upstream seismic, Phase 3, two phreatic surfaces, pond about 1/4 full	1.20
PH3USST	Upstream static, Phase 3, pond about ½ full	1.89
PH7DSST	Downstream static, Phase 7, toe circle.	1.53
PH7DSST2	Downstream static, Phase 7, Section G-G, whole slope circle.	1.52
PH7DDSE	Downstream seismic, Phase 7, Section G-G, two phreatic surfaces, pond level the same as for Section D-D, to get allow Phreatic level for Piezometers P-15 -16, and -17.	1.20
PH7USSE	Upstream seismic, Phase 7, Section G-G, two phreatic surfaces, pond level the same as for Section D-D.	1.26
PH7USST	Upstream static, Phase 7, Section G-G, pond level same as for Section D-D.	1.82
PH7CEOC3	Downstream static, total strength foundation soil, total strength FCR, effective strength CCR, - for allowable phreatic level end of construction Phase 3/7C, Section F-F (P-6, -7, & -8), deep toe circles.	1.50
PH7CEOC4	Downstream static, total strength foundation soil, total strength FCR, effective strength CCR, - for allowable phreatic level end of construction Phase 3/7C, Section F-F (P-6, -7, & -8),. "hinge" circles Phase 3 to Phase 7 interface.	2.05
PH7CDSLT	Downstream static, effective strength foundation soil, FCR, & CCR - for allowable phreatic level long term Phase 3/&C, Section F-F (P-6, -7, & -8), deep toe circles.	1.50

(File: Stability RunsRev.doc, hlo, rev. 03/16/10)

Alliance Consulting, Inc.
Engineers
Constructors
Scientists
BECKLEY, WV
(304) 255-0491

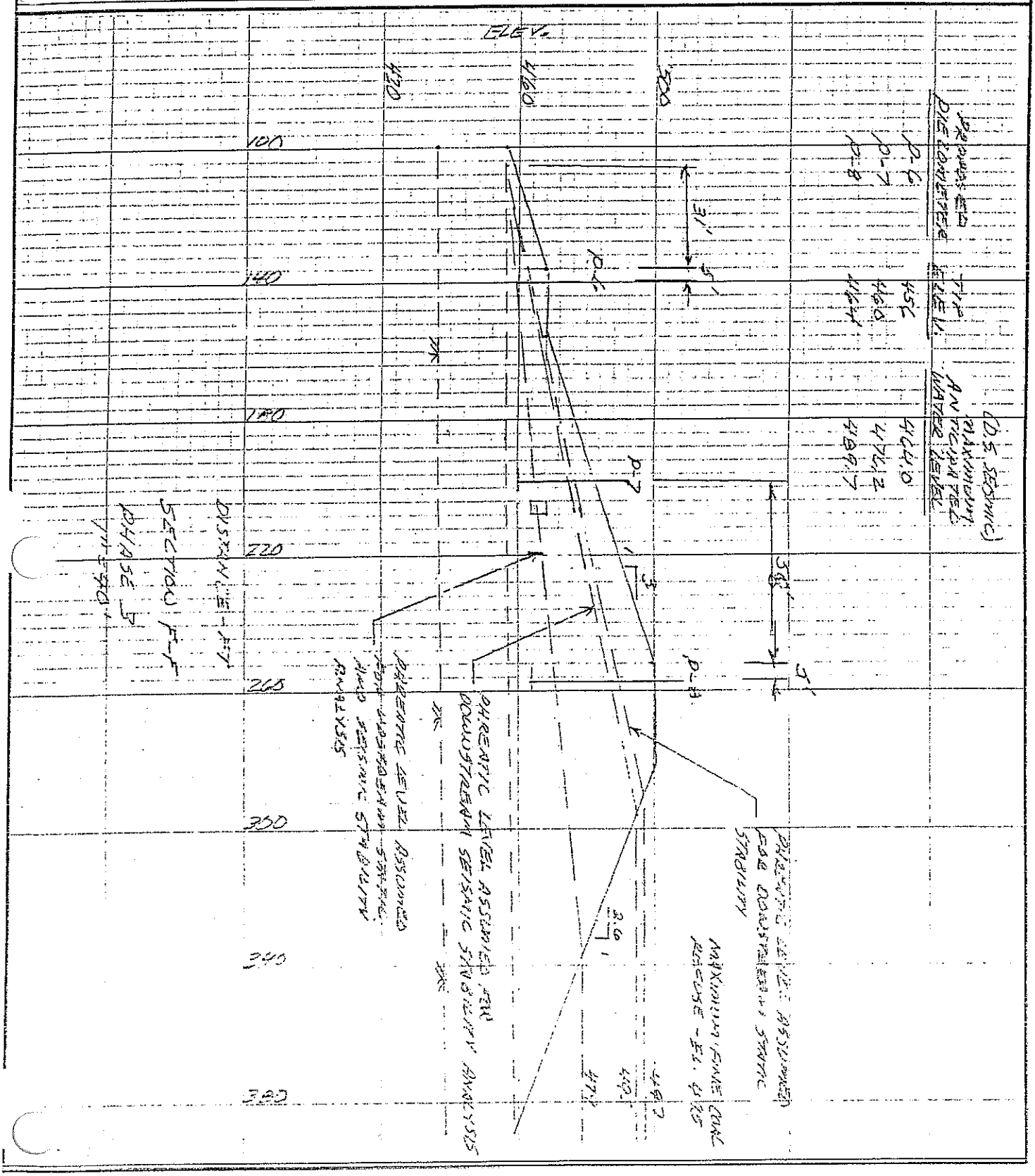
BY: H2O DATE: 6/30/08 CHKD BY: CEY DATE: 8/8/09 (121)

PROJECT NAME: WILLIAMSON ENERGY LLC

PROJECT NO. 805-330-1413 SHEET 1 OF 1

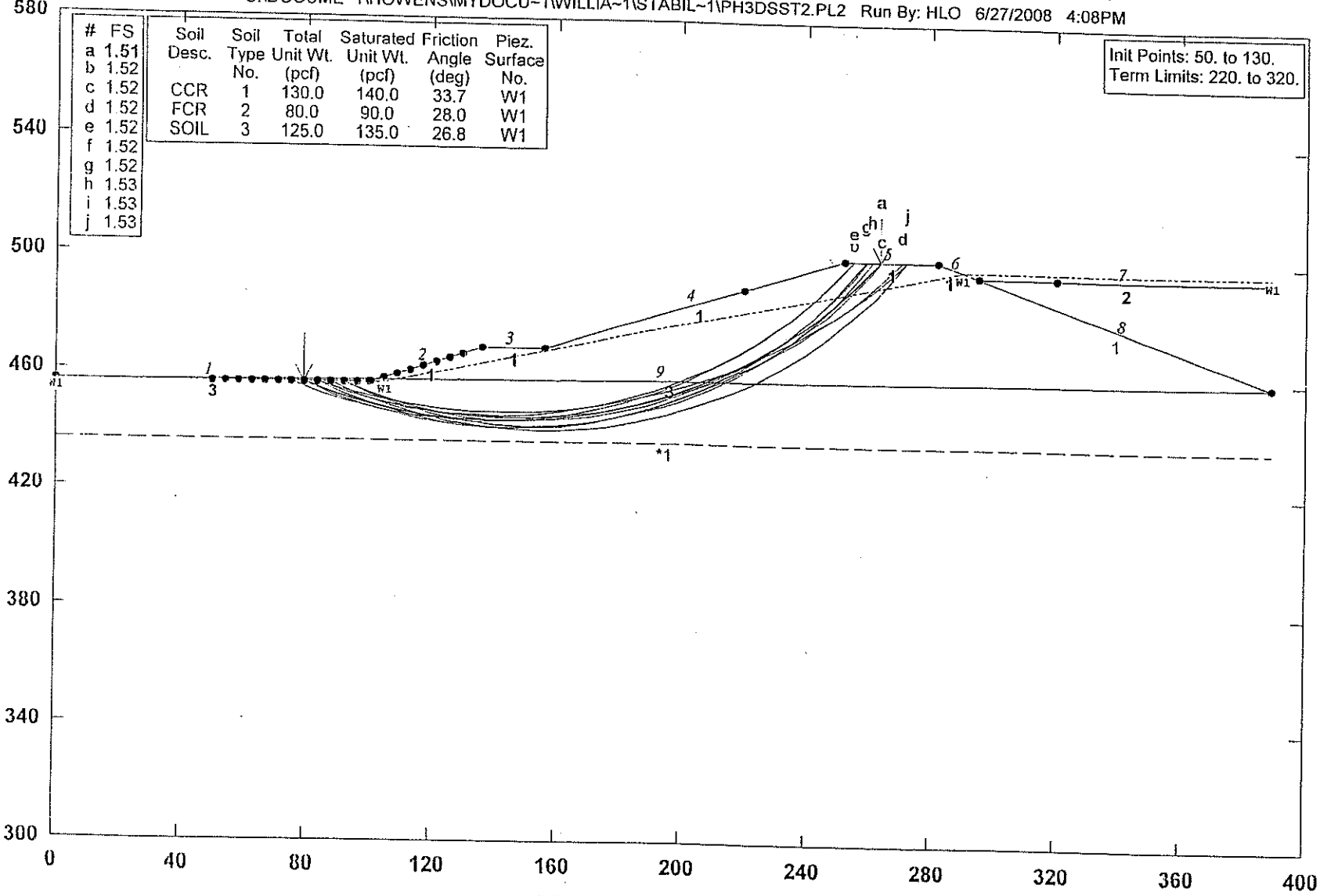
DESCRIPTION PHASE 3 STABILITY CROSS-SECTION SHOWING PIEZOMETER LOCATIONS

R12602



PHASE 3 DOWNSTREAM STATIC REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH3DSST2.PL2 Run By: HLO 6/27/2008 4:08PM



PCSTABL5M/si FSmin=1.51

Safety Factors Are Calculated By The Modified Bishop Method

STED

122

R12603

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 6/27/2008
Time of Run: 4:08PM
Run By: HLO
Input Data Filename: C:ph3dsst2.
Output Filename: C:ph3dsst2.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3dsst2.PLT
PROBLEM DESCRIPTION PHASE 3 DOWNSTREAM STATIC
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

7 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	156.00	100.00	156.00	3
2	100.00	156.00	136.00	168.00	1
3	136.00	168.00	156.00	168.00	1
4	156.00	168.00	252.00	200.00	1
5	252.00	200.00	282.00	200.00	1
6	282.00	200.00	295.00	195.00	1
7	295.00	195.00	389.00	195.00	2
8	295.00	195.00	389.00	159.00	1
9	.00	156.00	389.00	159.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	156.00
2	105.00	156.00
3	289.80	197.00
4	389.00	197.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	136.00	389.00	136.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 130.00 ft.
Each Surface Terminates Between X = 220.00 ft.
and X = 320.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical

First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	79.47	156.00
2	88.79	152.36
3	98.31	149.31
4	108.01	146.86
5	117.84	145.04
6	127.77	143.83
7	137.75	143.25
8	147.75	143.30
9	157.73	143.98
10	167.64	145.29
11	177.45	147.21
12	187.12	149.76
13	196.62	152.90
14	205.89	156.64
15	214.92	160.95
16	223.65	165.82
17	232.06	171.23
18	240.11	177.16
19	247.77	183.59
20	255.02	190.48
21	261.81	197.82
22	263.59	200.00

Circle Center At X = 141.9 ; Y = 301.9 and Radius, 158.7
*** 1.513 ***
Individual data on the 29 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.3	2229.3	.0	1136.4	.0	.0	.0	.0	.0
2	9.5	6574.4	.0	3224.1	.0	.0	.0	.0	.0
3	1.7	1561.3	.0	750.4	.0	.0	.0	.0	.0
4	5.0	5751.1	.0	2492.6	.0	.0	.0	.0	.0
5	3.0	4394.6	.0	1718.1	.0	.0	.0	.0	.0
6	.8	1243.4	.0	477.5	.0	.0	.0	.0	.0
7	9.1	17703.0	.0	6717.4	.0	.0	.0	.0	.0
8	9.9	25619.0	.0	9455.1	.0	.0	.0	.0	.0
9	8.2	25582.2	.0	9233.8	.0	.0	.0	.0	.0
10	1.7	5834.7	.0	2111.2	.0	.0	.0	.0	.0
11	10.0	33509.6	.0	12856.9	.0	.0	.0	.0	.0
12	8.3	27467.6	.0	11498.2	.0	.0	.0	.0	.0
13	1.7	5750.9	.0	2486.6	.0	.0	.0	.0	.0
14	9.9	34700.8	.0	14724.5	.0	.0	.0	.0	.0
15	9.8	36606.4	.0	15072.8	.0	.0	.0	.0	.0
16	9.7	37452.6	.0	15028.4	.0	.0	.0	.0	.0
17	9.5	37257.4	.0	14591.5	.0	.0	.0	.0	.0
18	9.3	36063.5	.0	13763.8	.0	.0	.0	.0	.0
19	2.0	7746.6	.0	2937.2	.0	.0	.0	.0	.0
20	7.0	26133.5	.0	9611.4	.0	.0	.0	.0	.0
21	8.7	30721.4	.0	10950.6	.0	.0	.0	.0	.0
22	8.4	26818.7	.0	8976.4	.0	.0	.0	.0	.0
23	8.1	22313.1	.0	6633.6	.0	.0	.0	.0	.0
24	7.7	17358.2	.0	3931.6	.0	.0	.0	.0	.0
25	4.2	7631.6	.0	905.6	.0	.0	.0	.0	.0
26	1.4	2105.8	.0	58.1	.0	.0	.0	.0	.0
27	1.6	2197.2	.0	.0	.0	.0	.0	.0	.0
28	6.8	5168.6	.0	.0	.0	.0	.0	.0	.0
29	1.8	252.5	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	83.68	156.00

2	93.07	152.54
3	102.66	149.72
4	112.42	147.55
5	122.31	146.04
6	132.27	145.21
7	142.27	145.04
8	152.26	145.55
9	162.19	146.74
10	172.02	148.58
11	181.70	151.09
12	191.19	154.24
13	200.44	158.03
14	209.42	162.43
15	218.09	167.42
16	226.39	172.99
17	234.31	179.10
18	241.79	185.74
19	248.81	192.86
20	254.95	200.00

Circle Center At X = 139.7 ; Y = 293.3 and Radius, 148.3

*** 1.516 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	79.47	156.00
2	88.61	151.93
3	98.00	148.49
4	107.60	145.68
5	117.36	143.52
6	127.25	142.02
7	137.21	141.18
8	147.21	141.02
9	157.20	141.52
10	167.13	142.69
11	176.96	144.53
12	186.64	147.02
13	196.14	150.15
14	205.41	153.91
15	214.40	158.28
16	223.08	163.25
17	231.41	168.78
18	239.35	174.86
19	246.86	181.46
20	253.92	188.55
21	260.48	196.09
22	263.45	200.00

Circle Center At X = 144.7 ; Y = 290.0 and Radius, 149.1

*** 1.517 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	83.68	156.00
2	93.10	152.63
3	102.70	149.83
4	112.45	147.60
5	122.31	145.95
6	132.25	144.89
7	142.24	144.42
8	152.24	144.54
9	162.22	145.26
10	172.13	146.57
11	181.95	148.46
12	191.64	150.93
13	201.17	153.98
14	210.49	157.58
15	219.59	161.72
16	228.43	166.41

17	236.97	171.60
18	245.20	177.30
19	253.06	183.47
20	260.55	190.09
21	267.64	197.15
22	270.17	200.00

Circle Center At X = 145.1 ; Y = 312.8 and Radius, 168.4

*** 1.520 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	75.26	156.00
2	84.54	152.28
3	94.05	149.17
4	103.74	146.70
5	113.57	144.87
6	123.50	143.70
7	133.49	143.18
8	143.49	143.31
9	153.46	144.11
10	163.35	145.56
11	173.13	147.66
12	182.75	150.40
13	192.16	153.77
14	201.34	157.74
15	210.23	162.32
16	218.80	167.47
17	227.02	173.17
18	234.84	179.40
19	242.23	186.13
20	249.17	193.34
21	254.78	200.00

Circle Center At X = 136.4 ; Y = 294.9 and Radius, 151.8

*** 1.523 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	92.11	156.00
2	101.31	152.10
3	110.79	148.89
4	120.47	146.39
5	130.31	144.62
6	140.26	143.58
7	150.25	143.28
8	160.24	143.72
9	170.17	144.90
10	179.99	146.81
11	189.63	149.45
12	199.06	152.79
13	208.21	156.82
14	217.04	161.51
15	225.50	166.85
16	233.54	172.80
17	241.11	179.33
18	248.18	186.40
19	254.71	193.97
20	259.17	200.00

Circle Center At X = 149.3 ; Y = 278.1 and Radius, 134.8

*** 1.524 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	83.68	156.00
2	92.73	151.74
3	102.07	148.15
4	111.64	145.26
5	121.40	143.08

6	131.29	141.62
7	141.27	140.90
8	151.27	140.90
9	161.24	141.64
10	171.13	143.11
11	180.89	145.30
12	190.46	148.20
13	199.79	151.79
14	208.83	156.06
15	217.54	160.98
16	225.86	166.53
17	233.75	172.67
18	241.17	179.38
19	248.08	186.61
20	254.43	194.33
21	258.45	200.00

Circle Center At X = 146.2 ; Y = 277.0 and Radius, 136.2

*** 1.524 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	92.11	156.00
2	101.18	151.80
3	110.55	148.30
4	120.16	145.53
5	129.95	143.50
6	139.87	142.22
7	149.85	141.70
8	159.85	141.95
9	169.80	142.95
10	179.64	144.71
11	189.33	147.22
12	198.79	150.46
13	207.98	154.40
14	216.84	159.04
15	225.32	164.34
16	233.37	170.27
17	240.94	176.80
18	248.00	183.88
19	254.50	191.48
20	260.40	199.56
21	260.67	200.00

Circle Center At X = 151.7 ; Y = 272.8 and Radius, 131.1

*** 1.532 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	83.68	156.00
2	93.23	153.03
3	102.93	150.59
4	112.75	148.69
5	122.66	147.32
6	132.62	146.51
7	142.62	146.23
8	152.61	146.51
9	162.58	147.33
10	172.49	148.70
11	182.30	150.61
12	192.00	153.06
13	201.55	156.03
14	210.92	159.52
15	220.08	163.52
16	229.02	168.01
17	237.69	172.99
18	246.08	178.43
19	254.15	184.33
20	261.90	190.66

21	269.28	197.41
22	271.82	200.00

Circle Center At X = 142.6 ; Y = 328.5 and Radius, 182.2

*** 1.534 ***

Failure Surface Specified By 22 Coordinate Points

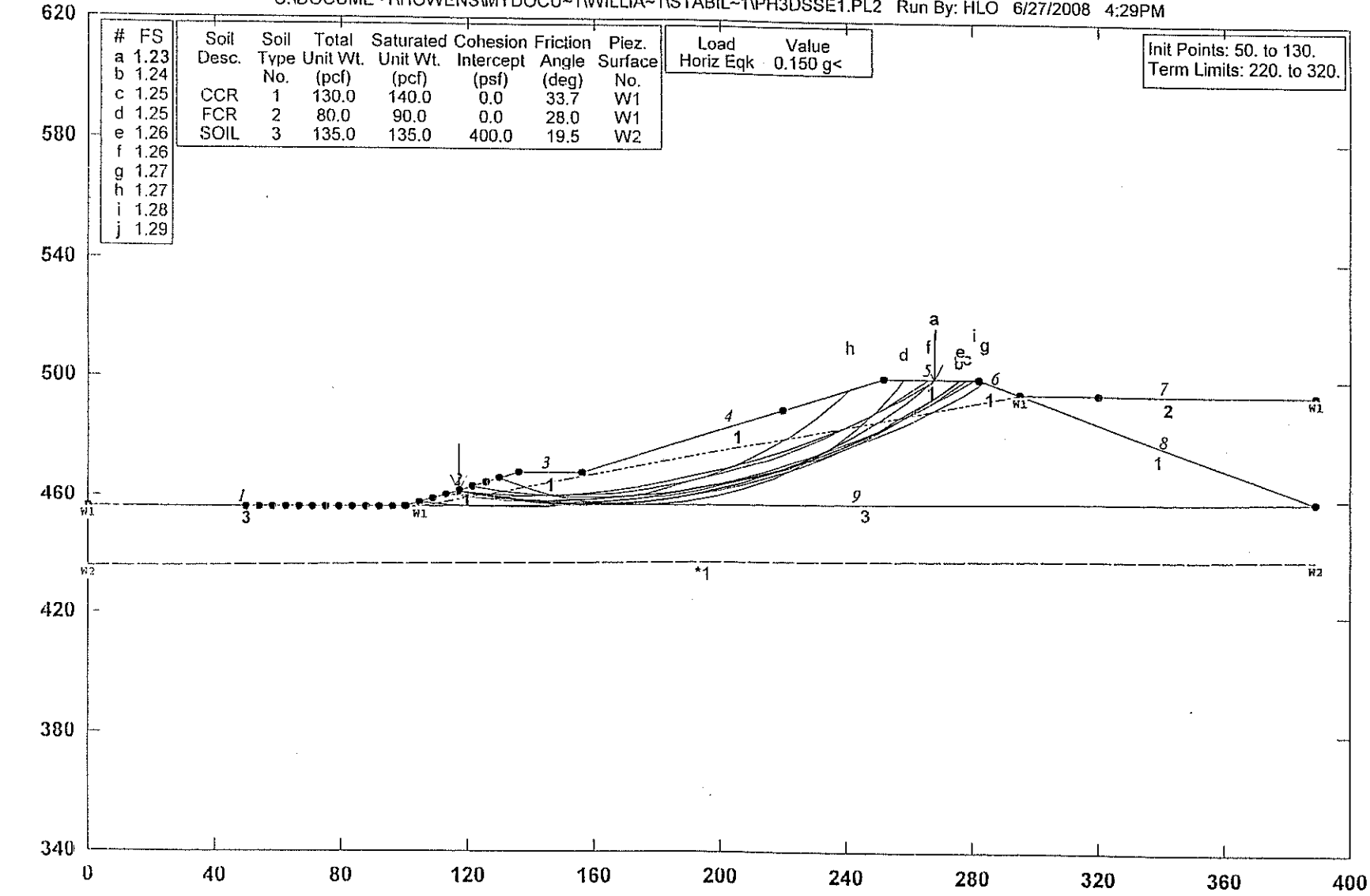
Point No.	X-Surf (ft)	Y-Surf (ft)
1	87.90	156.00
2	96.96	151.77
3	106.29	148.17
4	115.84	145.22
5	125.58	142.94
6	135.45	141.32
7	145.40	140.39
8	155.40	140.14
9	165.39	140.58
10	175.33	141.70
11	185.16	143.50
12	194.85	145.97
13	204.35	149.09
14	213.61	152.86
15	222.60	157.26
16	231.25	162.27
17	239.55	167.85
18	247.44	173.99
19	254.89	180.66
20	261.87	187.82
21	268.34	195.45
22	271.70	200.00

Circle Center At X = 154.0 ; Y = 285.7 and Radius, 145.6

*** 1.535 ***

PHASE 3 DOWNSTREAM SEISMIC REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH3DSSE1.PL2 Run By: HLO 6/27/2008 4:29PM



PCSTABL5M/si FSmin=1.23

Safety Factors Are Calculated By The Modified Bishop Method

STED



129

R12610

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 6/27/2008
Time of Run: 4:29PM
Run By: HLO
Input Data Filename: C:ph3dsse1.
Output Filename: C:ph3dsse1.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3dsse1.PLT
PROBLEM DESCRIPTION PHASE 3 DOWNSTREAM SEISMIC
REFUSE DISPOSAL AREA NO. 2
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 340.00 to Y-values listed.

7 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	116.00	100.00	116.00	3
2	100.00	116.00	136.00	128.00	1
3	136.00	128.00	156.00	128.00	1
4	156.00	128.00	252.00	160.00	1
5	252.00	160.00	282.00	160.00	1
6	282.00	160.00	295.00	155.00	1
7	295.00	155.00	389.00	155.00	2
8	295.00	155.00	389.00	119.00	1
9	100.00	116.00	389.00	119.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	135.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	116.00
2	105.00	116.00
3	295.00	155.00
4	389.00	155.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	96.00
2	389.00	99.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	96.00	389.00	99.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.

20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 130.00 ft.
Each Surface Terminates Between X = 220.00 ft.
and X = 320.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 96.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	117.37	121.79
2	127.15	119.72
3	137.04	118.24
4	147.00	117.36
5	157.00	117.08
6	166.99	117.41
7	176.95	118.33
8	186.84	119.85
9	196.61	121.96
10	206.24	124.66
11	215.69	127.93
12	224.93	131.76
13	233.92	136.14
14	242.62	141.06
15	251.02	146.49
16	259.08	152.41
17	266.76	158.81
18	268.03	160.00

Circle Center At X = 156.6 ; Y = 283.1 and Radius, 166.0
*** 1.231 ***
Individual data on the 22 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	7.8	2154.5	.0	.0	.0	.0	323.2	.0	.0
2	2.0	1243.4	.0	51.2	.0	.0	186.5	.0	.0
3	8.8	8794.8	.0	1310.2	.0	.0	1319.2	.0	.0
4	1.0	1354.5	.0	267.5	.0	.0	203.2	.0	.0
5	10.0	13770.1	.0	3543.8	.0	.0	2065.5	.0	.0
6	9.0	13318.4	.0	4570.8	.0	.0	1997.8	.0	.0
7	1.0	1531.8	.0	579.4	.0	.0	229.8	.0	.0
8	10.0	17594.6	.0	6391.3	.0	.0	2639.2	.0	.0
9	10.0	21165.7	.0	7262.4	.0	.0	3174.9	.0	.0
10	9.9	23767.3	.0	7760.4	.0	.0	3565.1	.0	.0
11	9.8	25379.1	.0	7883.5	.0	.0	3806.9	.0	.0
12	9.6	26003.4	.0	7631.2	.0	.0	3900.5	.0	.0
13	9.5	25665.2	.0	7004.5	.0	.0	3849.8	.0	.0
14	9.2	24411.8	.0	6005.7	.0	.0	3661.8	.0	.0
15	9.0	22311.6	.0	4638.3	.0	.0	3346.7	.0	.0
16	8.7	19453.1	.0	2907.3	.0	.0	2918.0	.0	.0
17	7.2	13925.0	.0	840.6	.0	.0	2088.8	.0	.0
18	1.2	2021.5	.0	.0	.0	.0	303.2	.0	.0
19	1.0	1650.2	.0	.0	.0	.0	247.5	.0	.0
20	7.1	9380.0	.0	.0	.0	.0	1407.0	.0	.0
21	7.7	4386.6	.0	.0	.0	.0	658.0	.0	.0
22	1.3	98.2	.0	.0	.0	.0	14.7	.0	.0

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	117.37	121.79
2	127.18	119.87

3	137.09	118.48
4	147.05	117.63
5	157.04	117.32
6	167.04	117.55
7	177.01	118.33
8	186.93	119.64
9	196.75	121.49
10	206.47	123.86
11	216.04	126.76
12	225.44	130.17
13	234.64	134.09
14	243.62	138.50
15	252.34	143.38
16	260.79	148.74
17	268.93	154.54
18	275.78	160.00

Circle Center At X = 157.8 ; Y = 301.9 and Radius, 184.5

*** 1.243 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.16	120.39
2	123.06	119.00
3	133.02	118.07
4	143.01	117.59
5	153.01	117.57
6	163.00	118.00
7	172.96	118.89
8	182.87	120.23
9	192.71	122.02
10	202.45	124.26
11	212.09	126.94
12	221.59	130.05
13	230.94	133.59
14	240.12	137.56
15	249.11	141.94
16	257.89	146.72
17	266.45	151.90
18	274.76	157.47
19	278.19	160.00

Circle Center At X = 148.5 ; Y = 337.1 and Radius, 219.5

*** 1.247 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.00	126.00
2	139.33	122.40
3	148.95	119.69
4	158.79	117.89
5	168.75	117.02
6	178.75	117.10
7	188.70	118.11
8	198.51	120.04
9	208.10	122.89
10	217.37	126.63
11	226.26	131.22
12	234.67	136.62
13	242.54	142.79
14	249.80	149.67
15	256.38	157.20
16	258.40	160.00

Circle Center At X = 173.0 ; Y = 223.2 and Radius, 106.3

*** 1.255 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	121.58	123.19

2	131.44	121.53
3	141.37	120.38
4	151.35	119.75
5	161.35	119.64
6	171.34	120.06
7	181.30	121.00
8	191.19	122.45
9	201.00	124.42
10	210.69	126.90
11	220.23	129.87
12	229.61	133.35
13	238.79	137.31
14	247.76	141.74
15	256.48	146.63
16	264.93	151.97
17	273.10	157.75
18	275.95	160.00

Circle Center At X = 158.4 ; Y = 310.9 and Radius, 191.3

*** 1.261 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	117.37	121.79
2	127.31	120.72
3	137.29	120.13
4	147.29	120.04
5	157.29	120.43
6	167.25	121.31
7	177.15	122.67
8	186.98	124.51
9	196.71	126.84
10	206.31	129.63
11	215.76	132.89
12	225.05	136.61
13	234.14	140.78
14	243.01	145.38
15	251.66	150.42
16	260.04	155.86
17	265.77	160.00

Circle Center At X = 144.3 ; Y = 324.8 and Radius, 204.8

*** 1.261 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.16	120.39
2	123.10	119.32
3	133.08	118.64
4	143.07	118.36
5	153.07	118.47
6	163.06	118.97
7	173.02	119.86
8	182.94	121.15
9	192.80	122.82
10	202.58	124.88
11	212.28	127.32
12	221.87	130.14
13	231.35	133.33
14	240.69	136.90
15	249.89	140.83
16	258.92	145.12
17	267.78	149.75
18	276.45	154.74
19	283.75	159.33

Circle Center At X = 145.3 ; Y = 372.9 and Radius, 254.5

*** 1.273 ***

Failure Surface Specified By 15 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	117.37	121.79
2	127.18	119.83
3	137.10	118.62
4	147.09	118.16
5	157.09	118.45
6	167.03	119.50
7	176.87	121.30
8	186.54	123.83
9	196.00	127.08
10	205.18	131.04
11	214.04	135.69
12	222.52	140.98
13	230.58	146.90
14	238.17	153.42
15	241.13	156.38

Circle Center At X = 148.2 ; Y = 250.6 and Radius, 132.4

*** 1.273 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	104.74	117.58
2	114.70	116.72
3	124.69	116.24
4	134.69	116.12
5	144.68	116.37
6	154.67	116.99
7	164.62	117.99
8	174.52	119.34
9	184.37	121.07
10	194.15	123.15
11	203.85	125.60
12	213.45	128.40
13	222.94	131.56
14	232.30	135.06
15	241.53	138.91
16	250.61	143.10
17	259.53	147.62
18	268.28	152.47
19	276.84	157.63
20	280.45	160.00

Circle Center At X = 132.9 ; Y = 386.2 and Radius, 270.0

*** 1.280 ***

Failure Surface Specified By 18 Coordinate Points

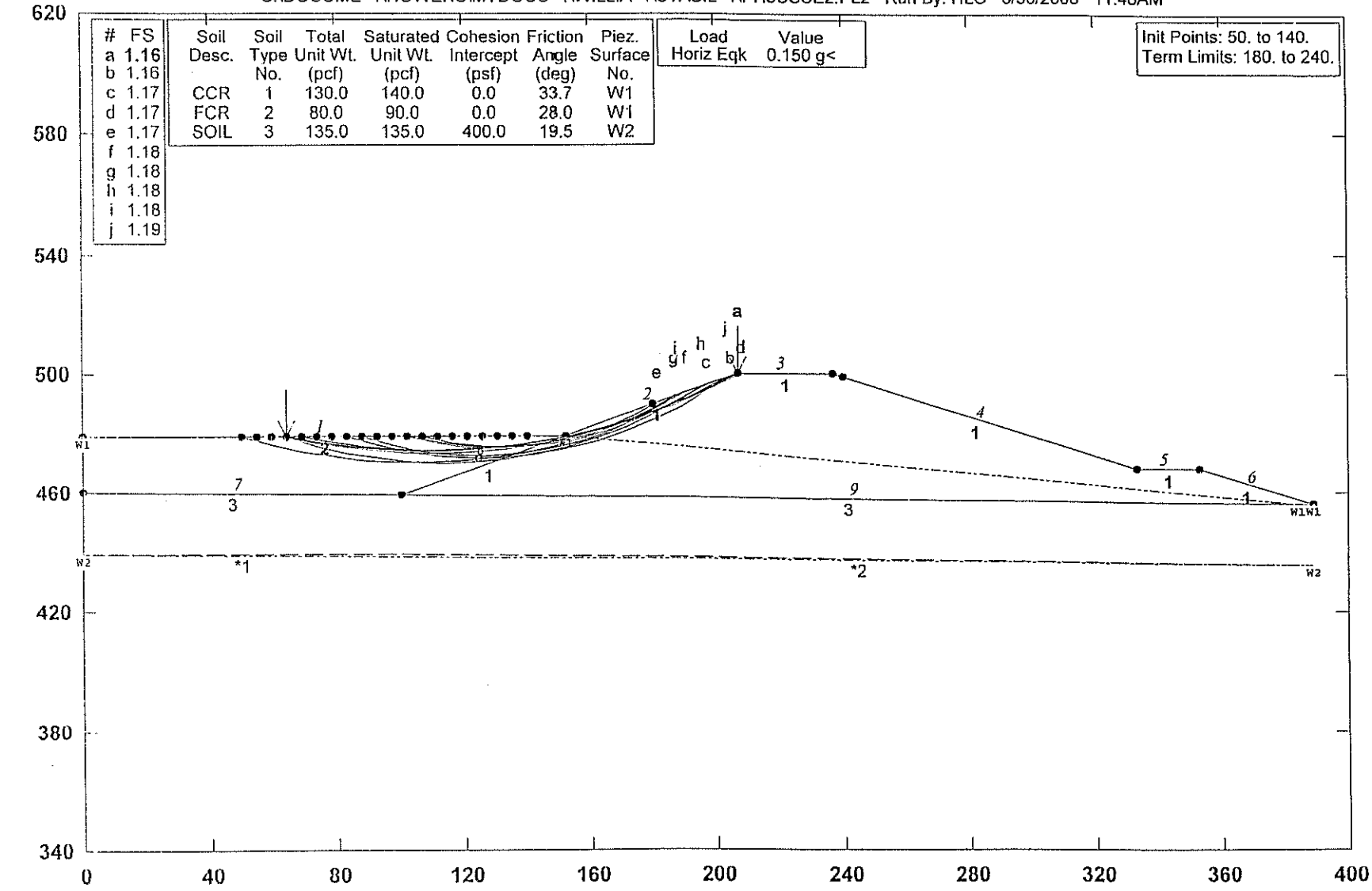
Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.16	120.39
2	123.15	119.88
3	133.14	119.76
4	143.14	120.04
5	153.12	120.70
6	163.06	121.76
7	172.96	123.21
8	182.79	125.04
9	192.54	127.26
10	202.20	129.86
11	211.74	132.83
12	221.17	136.18
13	230.45	139.90
14	239.58	143.97
15	248.55	148.40
16	257.33	153.18
17	265.92	158.30
18	268.54	160.00

Circle Center At X = 131.2 ; Y = 374.3 and Radius, 254.6

*** 1.286 ***

PHASE 3 UPSTREAM SEISMIC REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH3USSE2.PL2 Run By: HLO 6/30/2008 11:46AM



PCSTABL5M/si FSmin=1.16

Safety Factors Are Calculated By The Modified Bishop Method

STED

135

R12616

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 6/30/2008
Time of Run: 11:46AM
Run By: HLO
Input Data Filename: C:ph3usse2.
Output Filename: C:ph3usse2.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3usse2.PLT
PROBLEM DESCRIPTION PHASE 3 UPSTREAM SEISMIC
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 340.00 to Y-values listed.

6 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	139.00	152.00	139.00	2
2	152.00	139.00	207.00	160.00	1
3	207.00	160.00	237.00	160.00	1
4	237.00	160.00	333.00	128.00	1
5	333.00	128.00	353.00	128.00	1
6	353.00	128.00	389.00	116.00	1
7	.00	120.00	100.00	119.00	3
8	100.00	119.00	152.00	139.00	1
9	100.00	119.00	389.00	116.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	135.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	139.00
2	152.00	139.00
3	384.00	116.00
4	389.00	116.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	99.00
2	389.00	96.00

Searching Routine Will Be Limited To An Area Defined By 2 Boundaries
Of Which The First 2 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	99.00	100.00	99.00
2	100.00	99.00	389.00	96.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 140.00 ft.
Each Surface Terminates Between X = 180.00 ft.
and X = 240.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 99.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.21	139.00
2	74.01	137.01
3	83.90	135.52
4	93.85	134.52
5	103.84	134.02
6	113.84	134.03
7	123.82	134.53
8	133.77	135.53
9	143.66	137.03
10	153.46	139.02
11	163.15	141.50
12	172.70	144.46
13	182.09	147.89
14	191.30	151.79
15	200.30	156.15
16	207.34	160.00

Circle Center At X = 108.8 ; Y = 333.5 and Radius, 199.5
*** 1.161 ***
Individual data on the 19 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.8	876.2	.0	619.8	.0	.0	131.4	.0	.0
2	9.9	2432.6	.0	1705.8	.0	.0	364.9	.0	.0
3	10.0	3563.3	.0	2483.0	.0	.0	534.5	.0	.0
4	10.0	4248.9	.0	2949.5	.0	.0	637.3	.0	.0
5	10.0	4477.3	.0	3104.3	.0	.0	671.6	.0	.0
6	10.0	4244.9	.0	2946.9	.0	.0	636.7	.0	.0
7	9.9	3555.5	.0	2477.6	.0	.0	533.3	.0	.0
8	9.9	2421.0	.0	1697.7	.0	.0	363.2	.0	.0
9	6.8	784.4	.0	554.9	.0	.0	117.7	.0	.0
10	1.5	70.3	.0	42.2	.0	.0	10.5	.0	.0
11	.9	44.2	.0	8.1	.0	.0	6.6	.0	.0
12	.5	34.6	.0	.0	.0	.0	5.2	.0	.0
13	9.7	1447.0	.0	.0	.0	.0	217.1	.0	.0
14	9.6	2610.7	.0	.0	.0	.0	391.6	.0	.0
15	9.4	3078.7	.0	.0	.0	.0	461.8	.0	.0
16	9.2	2879.2	.0	.0	.0	.0	431.9	.0	.0
17	9.0	2052.0	.0	.0	.0	.0	307.8	.0	.0
18	6.7	644.3	.0	.0	.0	.0	96.7	.0	.0
19	.3	4.1	.0	.0	.0	.0	.6	.0	.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.21	139.00
2	73.97	136.81
3	83.83	135.14
4	93.76	134.00
5	103.74	133.40
6	113.74	133.33

7	123.73	133.80
8	133.68	134.80
9	143.57	136.34
10	153.35	138.40
11	163.01	140.98
12	172.52	144.07
13	181.85	147.67
14	190.97	151.76
15	199.87	156.34
16	204.48	159.04

Circle Center At X = 110.0 ; Y = 319.6 and Radius, 186.3

*** 1.161 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	139.00
2	59.58	136.14
3	69.31	133.84
4	79.16	132.09
5	89.09	130.90
6	99.07	130.27
7	109.07	130.22
8	119.06	130.73
9	129.00	131.81
10	138.86	133.45
11	148.62	135.64
12	158.23	138.39
13	167.68	141.68
14	176.92	145.50
15	185.93	149.84
16	194.68	154.68
17	197.15	156.24

Circle Center At X = 105.1 ; Y = 306.3 and Radius, 176.1

*** 1.166 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	68.95	139.00
2	78.76	137.10
3	88.67	135.69
4	98.63	134.80
5	108.62	134.41
6	118.62	134.53
7	128.60	135.16
8	138.53	136.30
9	148.40	137.94
10	158.17	140.08
11	167.81	142.72
12	177.31	145.84
13	186.64	149.44
14	195.77	153.52
15	204.69	158.05
16	208.08	160.00

Circle Center At X = 111.2 ; Y = 330.4 and Radius, 196.0

*** 1.168 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	106.84	139.00
2	116.61	136.85
3	126.55	135.77
4	136.55	135.76
5	146.49	136.83
6	156.26	138.96
7	165.75	142.13
8	174.84	146.30
9	181.46	150.25

Circle Center At X = 131.6 ; Y = 228.5 and Radius, 92.8
*** 1.174 ***
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.11	139.00
2	111.90	136.97
3	121.83	135.84
4	131.83	135.59
5	141.81	136.25
6	151.69	137.80
7	161.39	140.24
8	170.83	143.53
9	179.94	147.66
10	188.64	152.59
11	189.91	153.47

Circle Center At X = 129.5 ; Y = 246.8 and Radius, 111.2
*** 1.178 ***
Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.11	139.00
2	111.84	136.69
3	121.74	135.35
4	131.74	134.99
5	141.72	135.63
6	151.59	137.24
7	161.25	139.82
8	170.61	143.34
9	179.57	147.77
10	186.85	152.31

Circle Center At X = 130.3 ; Y = 235.9 and Radius, 100.9
*** 1.179 ***
Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.21	139.00
2	73.70	135.85
3	83.39	133.37
4	93.23	131.58
5	103.17	130.47
6	113.16	130.07
7	123.15	130.36
8	133.10	131.35
9	142.96	133.04
10	152.68	135.41
11	162.20	138.45
12	171.49	142.15
13	180.50	146.49
14	189.18	151.45
15	195.29	155.53

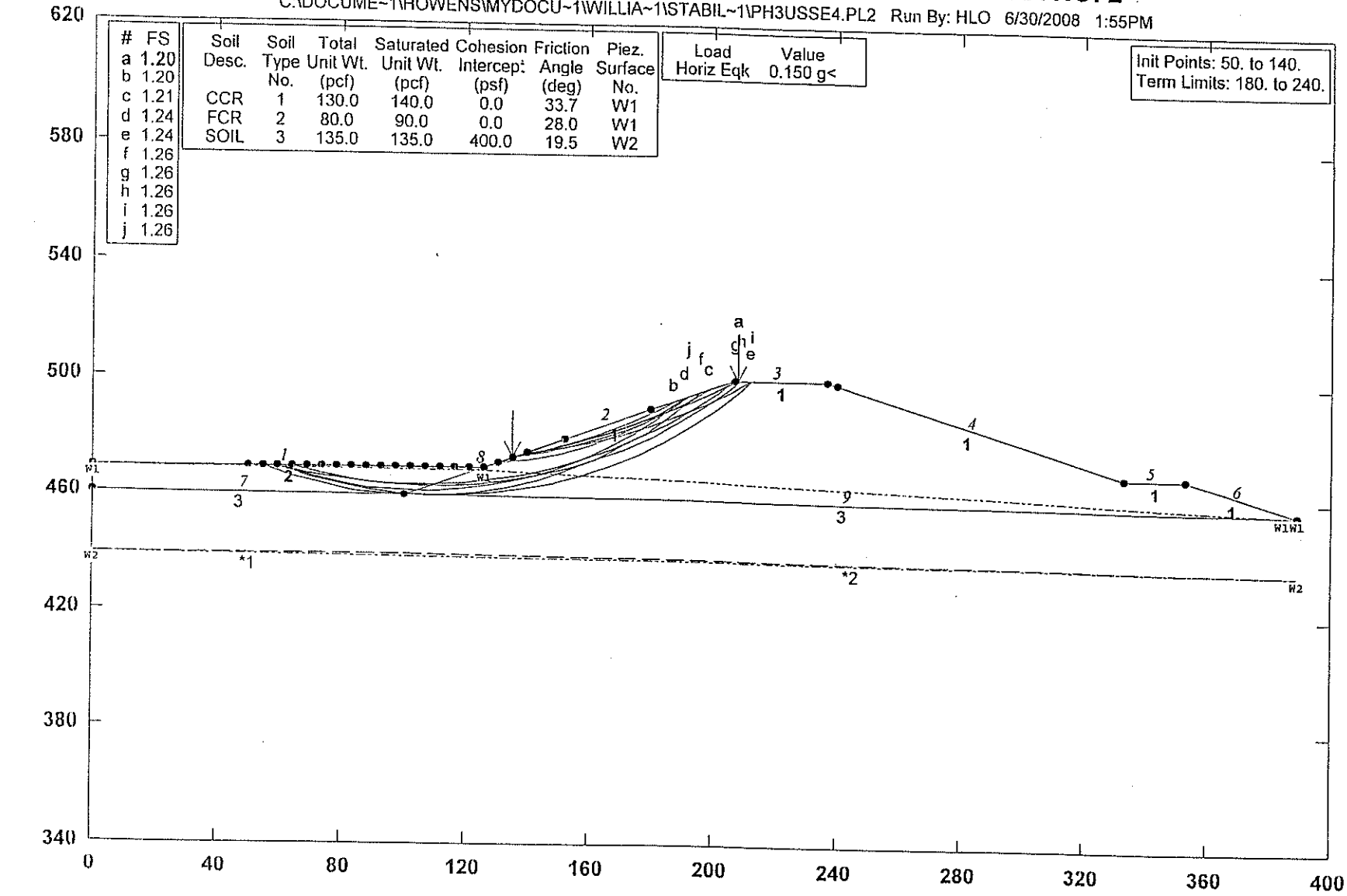
Circle Center At X = 114.0 ; Y = 273.0 and Radius, 143.0
*** 1.181 ***
Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	87.90	139.00
2	97.43	136.00
3	107.21	133.89
4	117.14	132.70
5	127.14	132.44
6	137.11	133.11
7	146.99	134.70
8	156.67	137.19
9	166.08	140.58
10	175.13	144.82
11	183.76	149.89

```
   12        187.41      152.52
 Circle Center At X =  124.9 ; Y =  239.6  and Radius,  107.2
      ***     1.182   ***
 Failure Surface Specified By 14 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1         83.16      139.00
     2         92.71      136.03
     3        102.46      133.82
     4        112.36      132.40
     5        122.34      131.76
     6        132.34      131.91
     7        142.29      132.85
     8        152.14      134.57
     9        161.82      137.07
    10        171.28      140.33
    11        180.45      144.32
    12        189.27      149.03
    13        197.69      154.42
    14        203.08      158.50
 Circle Center At X =  125.4 ; Y =  257.7  and Radius,  126.0
      ***     1.188   ***
```

PHASE 3 UPSTREAM SEISMIC REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH3USSE4.PL2 Run By: HLO 6/30/2008 1:55PM



PCSTABL5M/si FSmin=1.20

Safety Factors Are Calculated By The Modified Bishop Method

STED



R12622

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 6/30/2008
Time of Run: 1:55PM
Run By: HLO
Input Data Filename: C:PH3USSE4.
Output Filename: C:PH3USSE4.OUT
Unit: ENGLISH
Plotted Output Filename: C:PH3USSE4.PLT
PROBLEM DESCRIPTION PHASE 3 UPSTREAM SEISMIC
REFUSE DISPOSAL AREA NO. 2
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 340.00 to Y-values listed.

6 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	129.00	126.00	129.00	2
2	126.00	129.00	207.00	160.00	1
3	207.00	160.00	237.00	160.00	1
4	237.00	160.00	333.00	128.00	1
5	333.00	128.00	353.00	128.00	1
6	353.00	128.00	389.00	116.00	1
7	.00	120.00	100.00	119.00	3
8	100.00	119.00	152.00	139.00	1
9	100.00	119.00	389.00	116.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	135.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	129.00
2	126.00	128.00
3	384.00	116.00
4	389.00	116.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	99.00
2	389.00	96.00

Searching Routine Will Be Limited To An Area Defined By 2 Boundaries
Of Which The First 2 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	99.00	100.00	99.00
2	100.00	99.00	389.00	96.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 140.00 ft.
Each Surface Terminates Between X = 180.00 ft.
and X = 240.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 99.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.26	132.55
2	144.98	134.92
3	154.60	137.63
4	164.13	140.68
5	173.54	144.06
6	182.83	147.76
7	191.98	151.80
8	200.98	156.15
9	208.30	160.00

Circle Center At X = 72.5 ; Y = 410.6 and Radius, 285.1
*** 1.195 ***
Individual data on the 10 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.7	849.6	.0	.0	.0	.0	127.4	.0	.0
2	7.0	1551.9	.0	.0	.0	.0	232.8	.0	.0
3	2.6	739.9	.0	.0	.0	.0	111.0	.0	.0
4	9.5	3239.4	.0	.0	.0	.0	485.9	.0	.0
5	9.4	3702.5	.0	.0	.0	.0	555.4	.0	.0
6	9.3	3695.1	.0	.0	.0	.0	554.3	.0	.0
7	9.2	3235.3	.0	.0	.0	.0	485.3	.0	.0
8	9.0	2345.1	.0	.0	.0	.0	351.8	.0	.0
9	6.0	874.0	.0	.0	.0	.0	131.1	.0	.0
10	1.3	57.5	.0	.0	.0	.0	8.6	.0	.0

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.26	132.55
2	145.04	134.66
3	154.65	137.42
4	164.06	140.80
5	173.23	144.79
6	182.12	149.37
7	187.14	152.40

Circle Center At X = 108.0 ; Y = 282.1 and Radius, 152.0
*** 1.201 ***
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.26	132.55
2	145.13	134.19
3	154.86	136.50
4	164.40	139.49
5	173.72	143.12
6	182.76	147.38
7	191.49	152.26
8	198.20	156.63

Circle Center At X = 116.6 ; Y = 275.7 and Radius, 144.3
*** 1.214 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.53	130.73
2	140.48	131.73
3	150.29	133.67
4	159.87	136.54
5	169.13	140.32
6	177.99	144.96
7	186.36	150.42
8	190.40	153.65

Circle Center At X = 125.3 ; Y = 234.0 and Radius, 103.4

*** 1.242 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.00	134.36
2	149.91	135.73
3	159.71	137.70
4	169.38	140.26
5	178.87	143.41
6	188.15	147.13
7	197.18	151.42
8	205.94	156.24
9	211.87	160.00

Circle Center At X = 122.6 ; Y = 297.2 and Radius, 163.7

*** 1.243 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	54.74	129.00
2	64.12	125.53
3	73.73	122.79
4	83.53	120.78
5	93.45	119.53
6	103.44	119.03
7	113.44	119.29
8	123.38	120 31
9	133.22	122.09
10	142.90	124.60
11	152.36	127.85
12	161.55	131.80
13	170.41	136.44
14	178.89	141.74
15	186.94	147.67
16	194.52	154.19
17	196.19	155.86

Circle Center At X = 105.0 ; Y = 250.6 and Radius, 131.5

*** 1.257 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	59.47	129.00
2	69.17	126.56
3	79.00	124.73
4	88.93	123.50
5	98.91	122.88
6	108.91	122.88
7	118.89	123.50
8	128.81	124.72
9	138.64	126.56
10	148.34	128.99
11	157.87	132.02
12	167.20	135.63
13	176.29	139.80
14	185.10	144.53
15	193.61	149.79

16	201.77	155.56
17	207.30	160.00

Circle Center At X = 103.9 ; Y = 285.4 and Radius, 162.5

*** 1.261 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.21	129.00
2	73.87	126.40
3	83.67	124.44
4	93.59	123.13
5	103.57	122.46
6	113.57	122.45
7	123.54	123.08
8	133.46	124.37
9	143.27	126.30
10	152.94	128.87
11	162.42	132.06
12	171.67	135.86
13	180.65	140.26
14	189.32	145.23
15	197.65	150.76
16	205.61	156.82
17	209.27	160.00

Circle Center At X = 108.8 ; Y = 275.6 and Radius, 153.3

*** 1.261 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	59.47	129.00
2	68.90	125.67
3	78.54	122.99
4	88.34	121.00
5	98.25	119.69
6	108.23	119.07
7	118.23	119.14
8	128.20	119.91
9	138.09	121.37
10	147.86	123.52
11	157.46	126.33
12	166.83	129.81
13	175.95	133.93
14	184.75	138.67
15	193.20	144.01
16	201.27	149.93
17	208.90	156.39
18	212.61	160.00

Circle Center At X = 112.1 ; Y = 262.7 and Radius, 143.7

*** 1.262 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	59.47	129.00
2	68.97	125.85
3	78.67	123.44
4	88.53	121.79
5	98.49	120.90
6	108.49	120.78
7	118.47	121.44
8	128.37	122.86
9	138.13	125.04
10	147.69	127.96
11	157.00	131.62
12	166.00	135.98
13	174.64	141.02
14	182.86	146.71
15	190.61	153.02

146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   16        191.86       154.20
Circle Center At X =  105.0 ; Y =  250.2  and Radius,  129.4
      ***     1.263    ***
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PHASE 3 UPSTREAM SEISMIC REFUSE DISPOSAL AREA NO. 2

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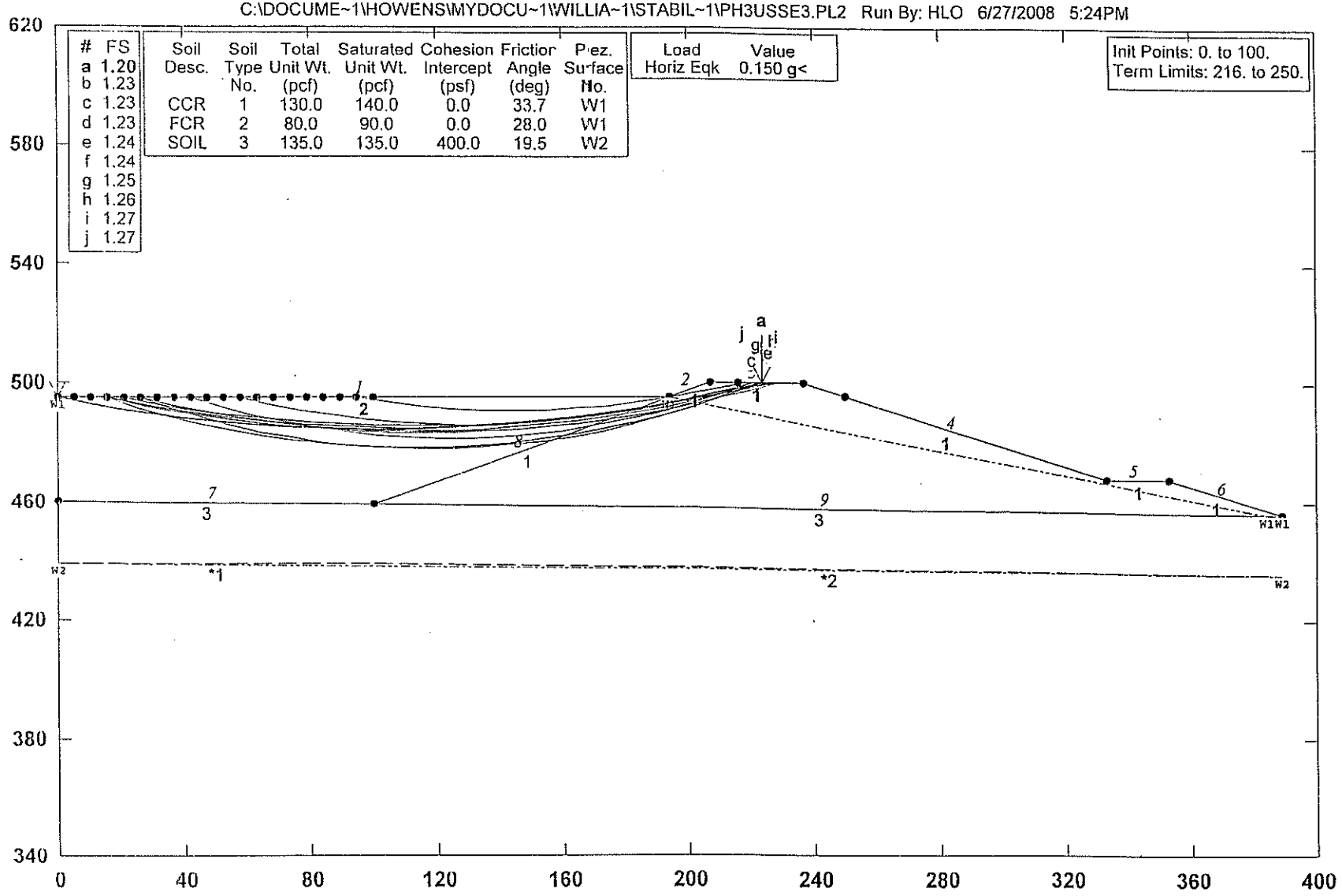

PCSTABL5M/si FSmin=1.20

Safety Factors Are Calculated By The Modified Bishop Method

STED



147

R12628

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 6/27/2008
Time of Run: 5:24PM
Run By: HLO
Input Data Filename: C:ph3usse3.
Output Filename: C:ph3usse3.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3usse3.PLT
PROBLEM DESCRIPTION PHASE 3 UPSTREAM SEISMIC
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 340.00 to Y-values listed.

6 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	155.00	194.00	155.00	2
2	194.00	155.00	207.00	160.00	1
3	207.00	160.00	237.00	160.00	1
4	237.00	160.00	333.00	128.00	1
5	333.00	128.00	353.00	128.00	1
6	353.00	128.00	389.00	116.00	1
7	.00	120.00	100.00	119.00	3
8	100.00	119.00	194.00	155.00	1
9	100.00	119.00	389.00	116.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Pie? Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	135.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	155.00
2	194.00	155.00
3	384.00	116.00
4	389.00	116.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	99.00
2	389.00	96.00

Searching Routine Will Be Limited To An Area Defined By 2 Boundaries
Of Which The First 2 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	99.00	100.00	99.00
2	100.00	99.00	389.00	96.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = .00 ft.
and X = 100.00 ft.
Each Surface Terminates Between X = 216.00 ft.
and X = 250.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 99.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	.00	155.00
2	9.81	153.06
3	19.66	151.31
4	29.54	149.77
5	39.45	148.42
6	49.38	147.28
7	59.33	146.33
8	69.31	145.59
9	79.29	145.05
10	89.29	144.71
11	99.29	144.57
12	109.29	144.64
13	119.28	144.91
14	129.27	145.38
15	139.25	146.05
16	149.21	146.93
17	159.15	148.00
18	169.07	149.28
19	178.96	150.75
20	188.82	152.43
21	198.64	154.30
22	208.43	156.38
23	218.16	158.65
24	223.48	160.00

Circle Center At X = 101.0 ; Y = 638.6 and Radius, 494.0
*** 1.202 ***
Individual data on the 27 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.8	858.0	.0	606.5	.0	.0	128.7	.0	.0
2	9.8	2495.7	.0	1757.3	.0	.0	374.4	.0	.0
3	9.9	3967.1	.0	2784.0	.0	.0	595.1	.0	.0
4	9.9	5267.9	.0	3685.9	.0	.0	790.2	.0	.0
5	9.9	6394.5	.0	4462.9	.0	.0	959.2	.0	.0
6	10.0	7343.7	.0	5114.5	.0	.0	1101.6	.0	.0
7	10.0	8112.8	.0	5640.5	.0	.0	1216.9	.0	.0
8	10.0	8699.7	.0	6040.6	.0	.0	1305.0	.0	.0
9	10.0	9102.6	.0	6314.8	.0	.0	1365.4	.0	.0
10	10.0	9320.5	.0	6462.8	.0	.0	1398.1	.0	.0
11	10.0	9352.7	.0	6484.7	.0	.0	1402.9	.0	.0
12	10.0	9199.2	.0	6380.4	.0	.0	1379.9	.0	.0
13	10.0	8860.4	.0	6150.0	.0	.0	1329.1	.0	.0
14	10.0	8337.2	.0	5793.5	.0	.0	1250.6	.0	.0
15	10.0	7631.1	.0	5311.2	.0	.0	1144.7	.0	.0
16	9.9	6744.1	.0	4703.1	.0	.0	1011.6	.0	.0
17	9.9	5678.7	.0	3969.7	.0	.0	851.8	.0	.0
18	9.9	4437.9	.0	3111.0	.0	.0	665.7	.0	.0
19	7.1	2328.4	.0	1637.5	.0	.0	349.3	.0	.0
20	2.8	737.4	.0	490.1	.0	.0	110.6	.0	.0

21	5.2	1249.6	.0	683.6	.0	.0	187.4	.0	.0
22	4.0	1054.2	.0	196.8	.0	.0	158.1	.0	.0
23	.6	203.4	.0	.0	.0	.0	30.5	.0	.0
24	8.4	3481.1	.0	.0	.0	.0	522.2	.0	.0
25	1.4	699.3	.0	.0	.0	.0	104.9	.0	.0
26	9.7	3150.4	.0	.0	.0	.0	472.6	.0	.0
27	5.3	467.5	.0	.0	.0	.0	70.1	.0	.0

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.90	155.00
2	67.62	152.69
3	77.43	150.71
4	87.29	149.07
5	97.21	147.77
6	107.16	146.80
7	117.14	146.18
8	127.14	145.90
9	137.14	145.96
10	147.13	146.36
11	157.10	147.10
12	167.04	148.19
13	176.94	149.61
14	186.78	151.37
15	196.56	153.46
16	206.26	155.89
17	215.88	158.65
18	220.05	160.00

Circle Center At X = 130.3 ; Y = 438.0 and Radius, 292.1

*** 1.226 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	42.11	155.00
2	51.64	152.00
3	61.29	149.37
4	71.03	147.11
5	80.86	145.23
6	90.74	143.74
7	100.68	142.62
8	110.66	141.90
9	120.65	141.56
10	130.65	141.60
11	140.64	142.04
12	150.61	142.86
13	160.53	144.06
14	170.41	145.65
15	180.21	147.62
16	189.93	149.97
17	199.55	152.69
18	209.06	155.78
19	218.45	159.24
20	220.28	160.00

Circle Center At X = 124.4 ; Y = 399.6 and Radius, 258.1

*** 1.228 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.79	155.00
2	25.55	152.81
3	35.35	150.85
4	45.21	149.14
5	55.10	147.66
6	65.02	146.42
7	74.97	145.43
8	84.94	144.67
9	94.93	144.16

10	104.92	143.90
11	114.92	143.87
12	124.92	144.09
13	134.91	144.55
14	144.89	145.25
15	154.84	146.19
16	164.77	147.38
17	174.67	148.80
18	184.53	150.47
19	194.35	152.37
20	204.11	154.51
21	213.83	156.89
22	223.48	159.50
23	225.15	160.00

Circle Center At X = 111.0 ; Y = 555.9 and Radius, 412.0

*** 1.231 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.79	155.00
2	25.59	153.01
3	35.43	151.24
4	45.31	149.69
5	55.22	148.36
6	65.16	147.25
7	75.12	146.36
8	85.10	145.69
9	95.09	145.25
10	105.09	145.02
11	115.09	145.01
12	125.08	145.23
13	135.07	145.67
14	145.05	146.33
15	155.01	147.21
16	164.95	148.31
17	174.87	149.64
18	184.75	151.18
19	194.59	152.94
20	204.39	154.92
21	214.15	157.11
22	223.85	159.52
23	225.61	160.00

Circle Center At X = 110.3 ; Y = 596.0 and Radius, 451.0

*** 1.237 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.79	155.00
2	25.28	151.85
3	34.87	149.03
4	44.56	146.53
5	54.32	144.36
6	64.15	142.53
7	74.04	141.04
8	83.97	139.88
9	93.94	139.06
10	103.93	138.58
11	113.92	138.44
12	123.92	138.64
13	133.91	139.18
14	143.87	140.07
15	153.79	141.29
16	163.67	142.84
17	173.49	144.74
18	183.24	146.96
19	192.91	149.52
20	202.48	152.41

21	211.95	155.61
22	221.31	159.14
23	223.36	160.00

Circle Center At X = 113.0 ; Y = 432.1 and Radius, 293.6

*** 1.238 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.32	155.00
2	35.72	151.60
3	45.25	148.58
4	54.89	145.92
5	64.63	143.65
6	74.45	141.76
7	84.34	140.25
8	94.27	139.13
9	104.25	138.39
10	114.24	138.05
11	124.24	138.09
12	134.23	138.53
13	144.20	139.35
14	154.12	140.57
15	164.00	142.16
16	173.80	144.15
17	183.51	146.51
18	193.13	149.25
19	202.63	152.36
20	212.01	155.84
21	221.24	159.69
22	221.91	160.00

Circle Center At X = 118.1 ; Y = 394.3 and Radius, 256.3

*** 1.245 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	21.05	155.00
2	30.87	153.10
3	40.73	151.41
4	50.62	149.93
5	60.54	148.68
6	70.48	147.64
7	80.45	146.81
8	90.43	146.21
9	100.42	145.82
10	110.42	145.65
11	120.42	145.70
12	130.42	145.97
13	140.41	146.45
14	150.38	147.16
15	160.34	148.08
16	170.27	149.21
17	180.18	150.57
18	190.06	152.14
19	199.90	153.92
20	209.70	155.92
21	219.45	158.14
22	226.90	160.00

Circle Center At X = 113.1 ; Y = 603.4 and Radius, 457.8

*** 1.259 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.32	155.00
2	36.03	152.64
3	45.81	150.55
4	55.65	148.73
5	65.52	147.17

6	75.44	145.87
7	85.39	144.85
8	95.36	144.09
9	105.35	143.60
10	115.34	143.39
11	125.34	143.44
12	135.34	143.77
13	145.32	144.36
14	155.28	145.22
15	165.22	146.35
16	175.12	147.75
17	184.98	149.42
18	194.79	151.35
19	204.55	153.55
20	214.24	156.01
21	223.86	158.73
22	227.93	160.00

Circle Center At X = 118.3 ; Y = 513.1 and Radius, 369.7

*** 1.272 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	94.74	155.00
2	104.62	153.49
3	114.55	152.31
4	124.52	151.47
5	134.50	150.96
6	144.50	150.79
7	154.50	150.96
8	164.49	151.47
9	174.45	152.31
10	184.38	153.49
11	194.27	155.01
12	204.10	156.85
13	213.86	159.03
14	217.60	160.00

Circle Center At X = 144.4 ; Y = 446.0 and Radius, 295.2

*** 1.275 ***

PHASE 3 UPSTREAM STATIC REFUSE DISPOSAL AREA NO. 2

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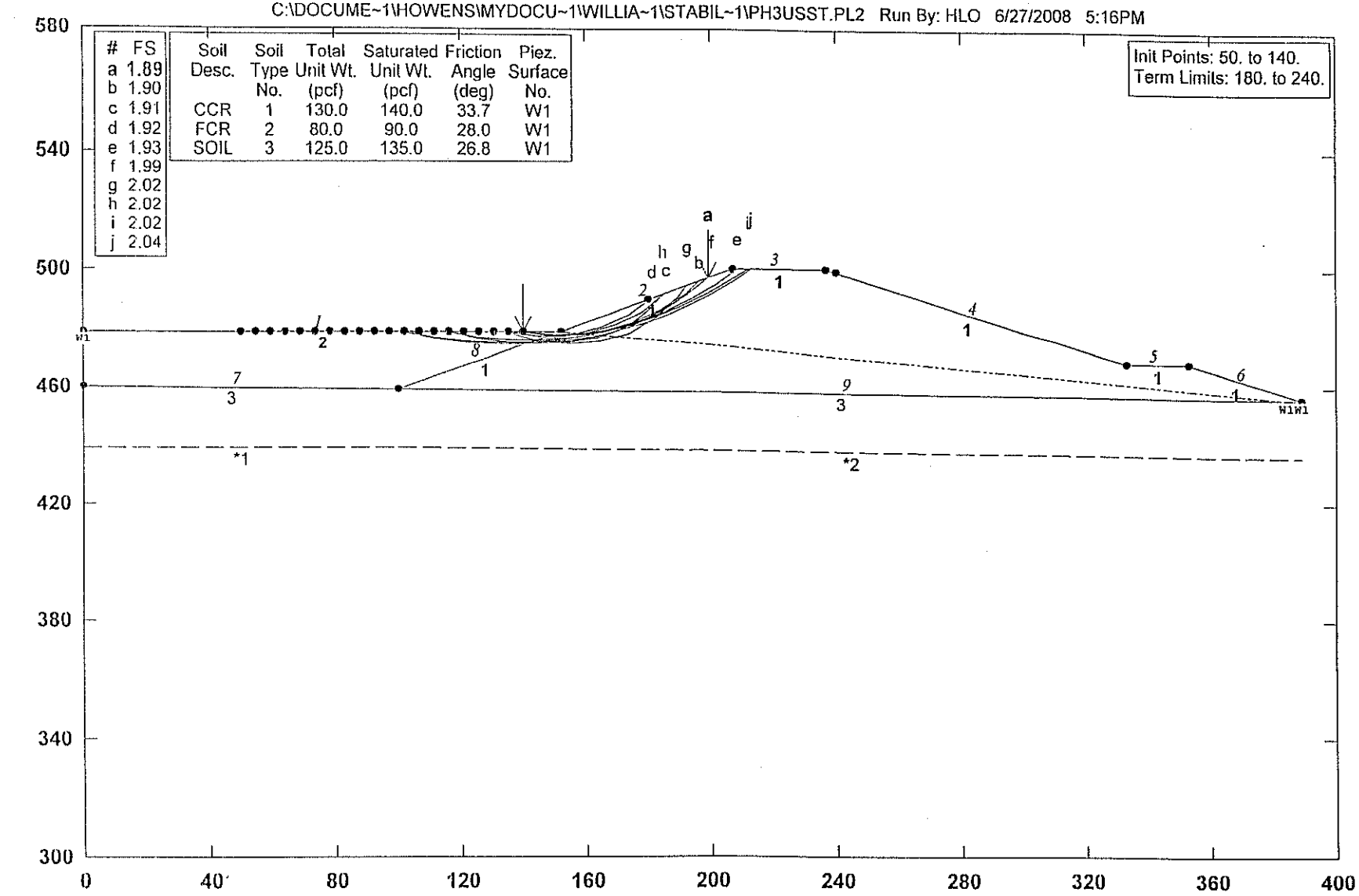

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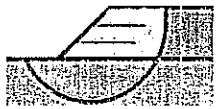
Safety Factors Are Calculated By The Modified Bishop Method

STED



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155

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 6/27/2008
Time of Run: 5:16PM
Run By: HLO
Input Data Filename: C:ph3usst.
Output Filename: C:ph3usst.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3usst.PLT
PROBLEM DESCRIPTION PHASE 3 UPSTREAM STATIC
REFUSE DISPOSAL AREA NO. 2
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

6 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	179.00	152.00	179.00	2
2	152.00	179.00	207.00	200.00	1
3	207.00	200.00	237.00	200.00	1
4	237.00	200.00	333.00	168.00	1
5	333.00	168.00	353.00	168.00	1
6	353.00	168.00	389.00	156.00	1
7	.00	160.00	100.00	159.00	3
8	100.00	159.00	152.00	179.00	1
9	100.00	159.00	389.00	156.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	179.00
2	152.00	179.00
3	384.00	156.00
4	389.00	156.00

Searching Routine Will Be Limited To An Area Defined By 2 Boundaries
Of Which The First 2 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	139.00	100.00	139.00
2	100.00	139.00	389.00	136.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 140.00 ft.
Each Surface Terminates Between X = 180.00 ft.
and X = 240.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =139.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial

Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.00	179.00
2	149.94	177.88
3	159.93	178.24
4	169.76	180.09
5	179.20	183.38
6	188.05	188.04
7	196.11	193.96
8	199.18	197.01

Circle Center At X = 152.5 ; Y = 244.1 and Radius, 66.3
*** 1.895 ***
Individual data on the 10 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.3	437.7	.0	305.4	.0	.0	.0	.0	.0
2	.7	70.5	.0	45.4	.0	.0	.0	.0	.0
3	2.1	272.9	.0	140.0	.0	.0	.0	.0	.0
4	7.7	2433.3	.0	251.8	.0	.0	.0	.0	.0
5	.2	99.5	.0	.0	.0	.0	.0	.0	.0
6	9.8	6054.0	.0	.0	.0	.0	.0	.0	.0
7	9.4	7180.4	.0	.0	.0	.0	.0	.0	.0
8	8.8	6175.1	.0	.0	.0	.0	.0	.0	.0
9	8.1	3463.3	.0	.0	.0	.0	.0	.0	.0
10	3.1	375.9	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.26	179.00
2	145.13	177.39
3	155.13	177.30
4	165.03	178.74
5	174.59	181.67
6	183.60	186.01
7	191.83	191.68
8	196.34	195.93

Circle Center At X = 150.7 ; Y = 242.0 and Radius, 64.8
*** 1.902 ***
Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.00	179.00
2	149.92	177.70
3	159.89	178.44
4	169.50	181.19
5	178.36	185.83
6	185.78	191.90

Circle Center At X = 151.3 ; Y = 226.6 and Radius, 49.0
*** 1.909 ***
Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.26	179.00
2	145.15	177.49
3	155.14	177.95
4	164.84	180.36
5	173.88	184.64
6	181.39	190.22

Circle Center At X = 147.8 ; Y = 227.8 and Radius, 50.4
*** 1.919 ***
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.32	179.00
2	126.13	177.09
3	136.08	176.11
4	146.08	176.07
5	156.04	176.97
6	165.87	178.80
7	175.49	181.55
8	184.80	185.19
9	193.74	189.69
10	202.21	195.00
11	208.71	200.00

Circle Center At X = 141.5 ; Y = 282.3 and Radius, 106.3

*** 1.929 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.32	179.00
2	125.96	176.37
3	135.86	174.91
4	145.85	174.66
5	155.81	175.60
6	165.58	177.73
7	175.02	181.02
8	184.00	185.42
9	192.39	190.87
10	200.06	197.28
11	200.17	197.39

Circle Center At X = 143.0 ; Y = 257.8 and Radius, 83.2

*** 1.989 ***

Failure Surface Specified By 8 Coordinate Points

Point No	X-Surf (ft)	Y-Surf (ft)
1	135.26	179.00
2	144.68	175.63
3	154.61	174.41
4	164.56	175.40
5	174.05	178.54
6	182.63	183.68
7	189.87	190.58
8	192.44	194.44

Circle Center At X = 155.1 ; Y = 219.2 and Radius, 44.8

*** 2.017 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.26	179.00
2	144.73	175.78
3	154.70	175.02
4	164.55	176.77
5	173.65	180.91
6	181.43	187.20
7	184.59	191.44

Circle Center At X = 152.7 ; Y = 214.8 and Radius, 39.8

*** 2.017 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.11	179.00
2	111.90	176.96
3	121.81	175.66
4	131.80	175.10
5	141.79	175.28
6	151.75	176.21
7	161.61	177.87
8	171.32	180.26

9	180.83	183.37
10	190.08	187.17
11	199.02	191.65
12	207.60	196.79
13	212.16	200.00

Circle Center At X = 134.3 ; Y = 309.5 and Radius, 134.4

*** 2.022 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.11	179.00
2	111.84	176.72
3	121.73	175.20
4	131.70	174.46
5	141.70	174.49
6	151.67	175.30
7	161.54	176.88
8	171.26	179.23
9	180.77	182.32
10	190.01	186.15
11	198.92	190.68
12	207.46	195.89
13	213.14	200.00

Circle Center At X = 136.3 ; Y = 302.9 and Radius, 128.5

*** 2.037 ***

PHASE 7 D.S. STATIC, PIEZ. 15, 16, 17 REFUSE DISPOSAL AREA NO. 2

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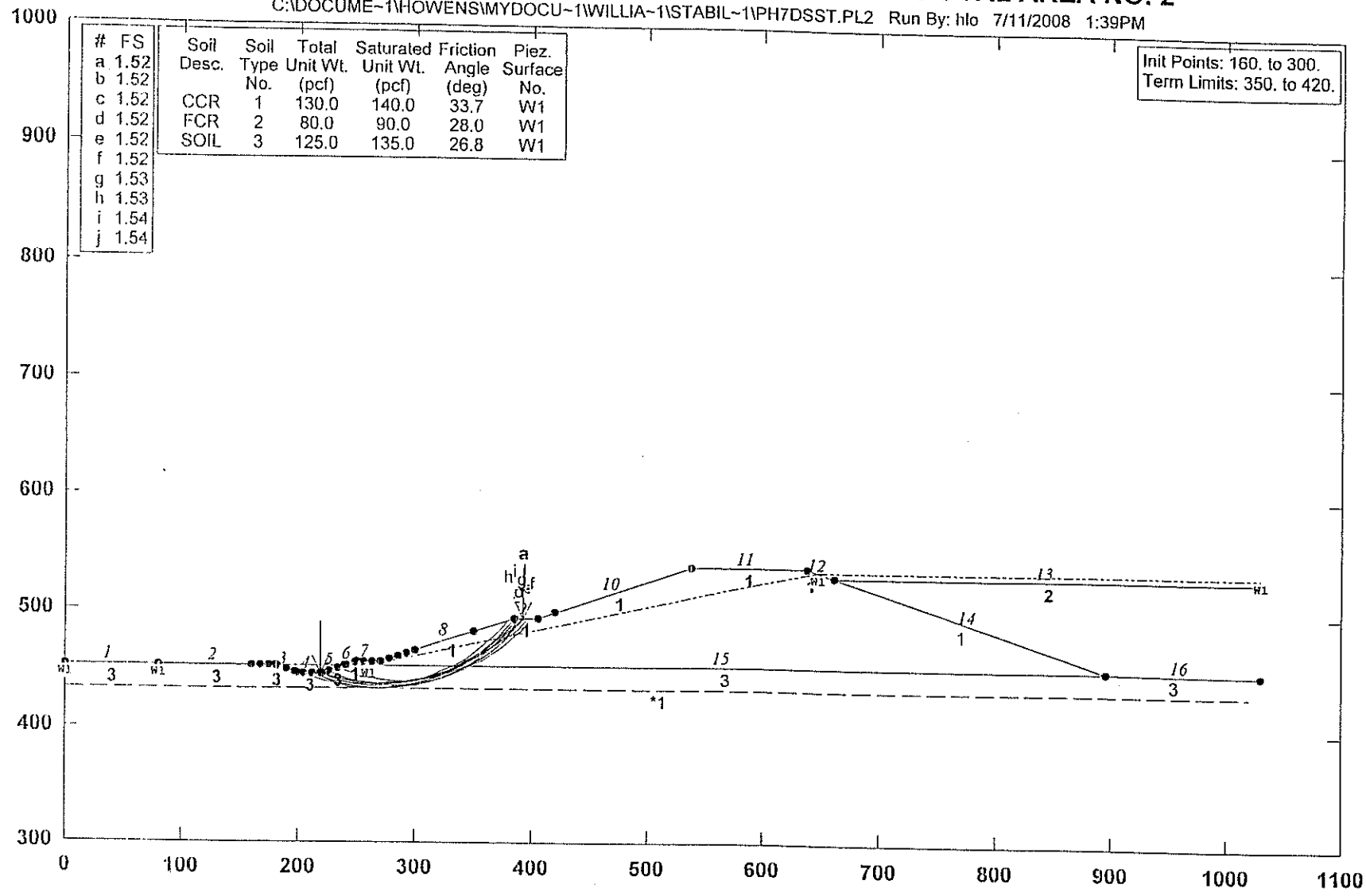
#	FS
a	1.52
b	1.52
c	1.52
d	1.52
e	1.52
f	1.52
g	1.53
h	1.53
i	1.54
j	1.54

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
SOIL	3	125.0	135.0	26.8	W1

Init Points: 160. to 300.
Term Limits: 350. to 420.



PCSTABL5M/si FSmin=1.52

Safety Factors Are Calculated By The Modified Bishop Method

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160

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 7/11/2008
Time of Run: 1:39PM
Run By: hlo
Input Data Filename: C:PH7DSST.
Output Filename: C:PH7DSST.OUT
Unit: ENGLISH
Plotted Output Filename: C:PH7DSST.PLT
PROBLEM DESCRIPTION PHASE 7 D.S. STATIC, PIEZ. 15, 16, 17
REFUSE DISPOSAL AREA NO. 2
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

13 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	151.50	80.00	152.50	3
2	80.00	152.50	180.00	152.00	3
3	180.00	152.00	200.00	145.30	3
4	200.00	145.30	220.00	145.30	3
5	220.00	145.30	240.00	152.00	3
6	240.00	152.00	250.00	155.30	1
7	250.00	155.30	270.00	155.30	1
8	270.00	155.30	385.00	193.60	1
9	385.00	193.60	405.00	193.60	1
10	405.00	193.60	538.20	238.00	1
11	538.20	238.00	638.20	238.00	1
12	638.20	238.00	662.20	230.00	1
13	662.20	230.00	1030.00	230.00	2
14	662.20	230.00	896.20	152.00	1
15	240.00	152.00	896.20	152.00	3
16	896.20	152.00	1030.00	150.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	151.50
2	80.00	152.00
3	260.00	152.00
4	647.20	235.00
5	1030.00	235.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	132.00	1020.00	132.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 160.00 ft.

and X = 300.00 ft.
Each Surface Terminates Between X = 350.00 ft.
and X = 420.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	218.95	145.30
2	228.53	142.43
3	238.27	140.16
4	248.13	138.50
5	258.07	137.45
6	268.06	137.01
7	278.06	137.20
8	288.03	138.00
9	297.93	139.41
10	307.72	141.44
11	317.37	144.06
12	326.84	147.28
13	336.09	151.08
14	345.09	155.44
15	353.80	160.34
16	362.20	165.78
17	370.24	171.73
18	377.90	178.16
19	385.14	185.05
20	391.95	192.37
21	392.95	193.60

Circle Center At X = 270.1 ; Y = 298.8 and Radius, 161.8
*** 1.516 ***
Individual data on the 28 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.1	22.4	439.9	469.9	.0	.0	.0	.0	.0
2	8.5	3476.2	2958.5	4605.4	.0	.0	.0	.0	.0
3	9.7	11162.3	1417.6	6677.9	.0	.0	.0	.0	.0
4	1.7	2735.2	33.1	1314.0	.0	.0	.0	.0	.0
5	8.1	15477.7	.0	6591.0	.0	.0	.0	.0	.0
6	1.9	4165.0	.0	1597.5	.0	.0	.0	.0	.0
7	8.1	18855.5	.0	7154.3	.0	.0	.0	.0	.0
8	1.9	4624.3	.0	1756.9	.0	.0	.0	.0	.0
9	8.1	19621.8	.0	7720.3	.0	.0	.0	.0	.0
10	1.9	4775.3	.0	1998.6	.0	.0	.0	.0	.0
11	8.1	21264.9	.0	8799.7	.0	.0	.0	.0	.0
12	10.0	29735.5	.0	11803.9	.0	.0	.0	.0	.0
13	9.9	32516.2	.0	12427.1	.0	.0	.0	.0	.0
14	9.8	34273.6	.0	12665.6	.0	.0	.0	.0	.0
15	9.6	35004.6	.0	12518.4	.0	.0	.0	.0	.0
16	9.5	34729.7	.0	11986.2	.0	.0	.0	.0	.0
17	9.3	33493.2	.0	11070.9	.0	.0	.0	.0	.0
18	1.9	6776.2	.0	2194.1	.0	.0	.0	.0	.0
19	7.1	24524.7	.0	7582.0	.0	.0	.0	.0	.0
20	8.7	28167.4	.0	8106.7	.0	.0	.0	.0	.0
21	8.4	24323.9	.0	6069.0	.0	.0	.0	.0	.0
22	8.0	19906.7	.0	3670.9	.0	.0	.0	.0	.0
23	6.2	12600.4	.0	971.4	.0	.0	.0	.0	.0
24	1.4	2470.1	.0	.0	.0	.0	.0	.0	.0
25	7.1	10050.8	.0	.0	.0	.0	.0	.0	.0
26	.1	159.1	.0	.0	.0	.0	.0	.0	.0

27 6.8 4326.6 .0 .0 .0 .0 .0 .0 .0
28 1.0 80.2 .0 .0 .0 .0 .0 .0 .0

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	218.95	145.30
2	228.34	141.86
3	237.94	139.08
4	247.72	136.99
5	257.62	135.58
6	267.60	134.88
7	277.60	134.87
8	287.57	135.57
9	297.48	136.96
10	307.26	139.05
11	316.87	141.81
12	326.26	145.24
13	335.39	149.33
14	344.21	154.04
15	352.67	159.36
16	360.75	165.26
17	368.39	171.71
18	375.56	178.68
19	382.22	186.14
20	388.00	193.60

Circle Center At X = 272.7 ; Y = 277.3 and Radius, 142.5

*** 1.518 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	211.58	145.30
2	221.07	142.16
3	230.75	139.62
4	240.56	137.70
5	250.48	136.41
6	260.45	135.75
7	270.45	135.72
8	280.44	136.32
9	290.36	137.56
10	300.18	139.42
11	309.87	141.90
12	319.38	144.99
13	328.68	148.67
14	337.73	152.94
15	346.48	157.77
16	354.91	163.14
17	362.99	169.04
18	370.68	175.44
19	377.94	182.31
20	384.76	189.62
21	388.02	193.60

Circle Center At X = 265.9 ; Y = 293.5 and Radius, 157.8

*** 1.518 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	211.58	145.30
2	220.83	141.49
3	230.32	138.34
4	240.00	135.84
5	249.83	134.02
6	259.77	132.89
7	269.76	132.44
8	279.75	132.69
9	289.71	133.63
10	299.58	135.25
11	309.31	137.55

12	318.86	140.52
13	328.18	144.14
14	337.23	148.40
15	345.96	153.27
16	354.34	158.73
17	362.31	164.76
18	369.86	171.33
19	376.92	178.40
20	383.49	185.95
21	389.27	193.60

Circle Center At X = 271.2 ; Y = 277.0 and Radius, 144.6

*** 1.522 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	204.21	145.30
2	213.59	141.83
3	223.15	138.91
4	232.88	136.57
5	242.72	134.81
6	252.65	133.63
7	262.63	133.05
8	272.63	133.06
9	282.62	133.66
10	292.54	134.85
11	302.39	136.62
12	312.10	138.98
13	321.67	141.91
14	331.04	145.40
15	340.19	149.44
16	349.08	154.01
17	357.69	159.10
18	365.98	164.69
19	373.92	170.77
20	381.49	177.30
21	388.66	184.27
22	395.40	191.66
23	396.98	193.60

Circle Center At X = 267.5 ; Y = 301.7 and Radius, 168.7

*** 1.523 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	204.21	145.30
2	213.59	141.82
3	223.15	138.89
4	232.86	136.52
5	242.70	134.72
6	252.62	133.49
7	262.60	132.84
8	272.60	132.77
9	282.59	133.27
10	292.53	134.36
11	302.39	136.02
12	312.14	138.24
13	321.74	141.03
14	331.17	144.37
15	340.39	148.25
16	349.36	152.66
17	358.07	157.58
18	366.48	162.99
19	374.55	168.89
20	382.28	175.24
21	389.62	182.03
22	396.55	189.23
23	400.30	193.60

Circle Center At X = 268.9 ; Y = 305.2 and Radius, 172.5

*** 1.525 ***
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	226.32	147.42
2	235.52	143.49
3	244.99	140.29
4	254.68	137.82
5	264.53	136.09
6	274.48	135.13
7	284.48	134.93
8	294.46	135.49
9	304.37	136.82
10	314.15	138.90
11	323.75	141.73
12	333.10	145.28
13	342.15	149.53
14	350.84	154.47
15	359.14	160.05
16	366.98	166.26
17	374.32	173.04
18	381.13	180.37
19	387.35	188.20
20	391.01	193.60

Circle Center At X = 282.1 ; Y = 265.3 and Radius, 130.4

*** 1.529 ***
Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	218.95	145.30
2	228.45	142.18
3	238.15	139.74
4	247.99	137.99
5	257.94	136.94
6	267.93	136.60
7	277.93	136.96
8	287.87	138.03
9	297.71	139.80
10	307.40	142.26
11	316.90	145.40
12	326.15	149.20
13	335.10	153.65
14	343.73	158.71
15	351.97	164.38
16	359.79	170.61
17	367.15	177.38
18	374.01	184.65
19	379.96	191.92

Circle Center At X = 267.8 ; Y = 278.0 and Radius, 141.4

*** 1.532 ***
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	204.21	145.30
2	213.51	141.61
3	223.02	138.55
4	232.73	136.12
5	242.57	134.34
6	252.50	133.23
7	262.49	132.77
8	272.49	132.98
9	282.45	133.85
10	292.34	135.38
11	302.09	137.56
12	311.69	140.39
13	321.07	143.85
14	330.20	147.92

15	339.05	152.59
16	347.56	157.83
17	355.71	163.64
18	363.45	169.96
19	370.75	176.79
20	377.59	184.09
21	383.93	191.83
22	385.19	193.60

Circle Center At X = 264.4 ; Y = 283.2 and Radius, 150.4

*** 1.536 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	233.68	149.88
2	243.02	146.29
3	252.59	143.41
4	262.36	141.26
5	272.26	139.84
6	282.24	139.17
7	292.24	139.25
8	302.20	140.08
9	312.08	141.65
10	321.81	143.96
11	331.34	146.99
12	340.61	150.72
13	349.58	155.14
14	358.20	160.22
15	366.40	165.93
16	374.16	172.25
17	381.42	179.12
18	388.15	186.52
19	393.68	193.60

Circle Center At X = 286.2 ; Y = 272.5 and Radius, 133.3

*** 1.536 ***

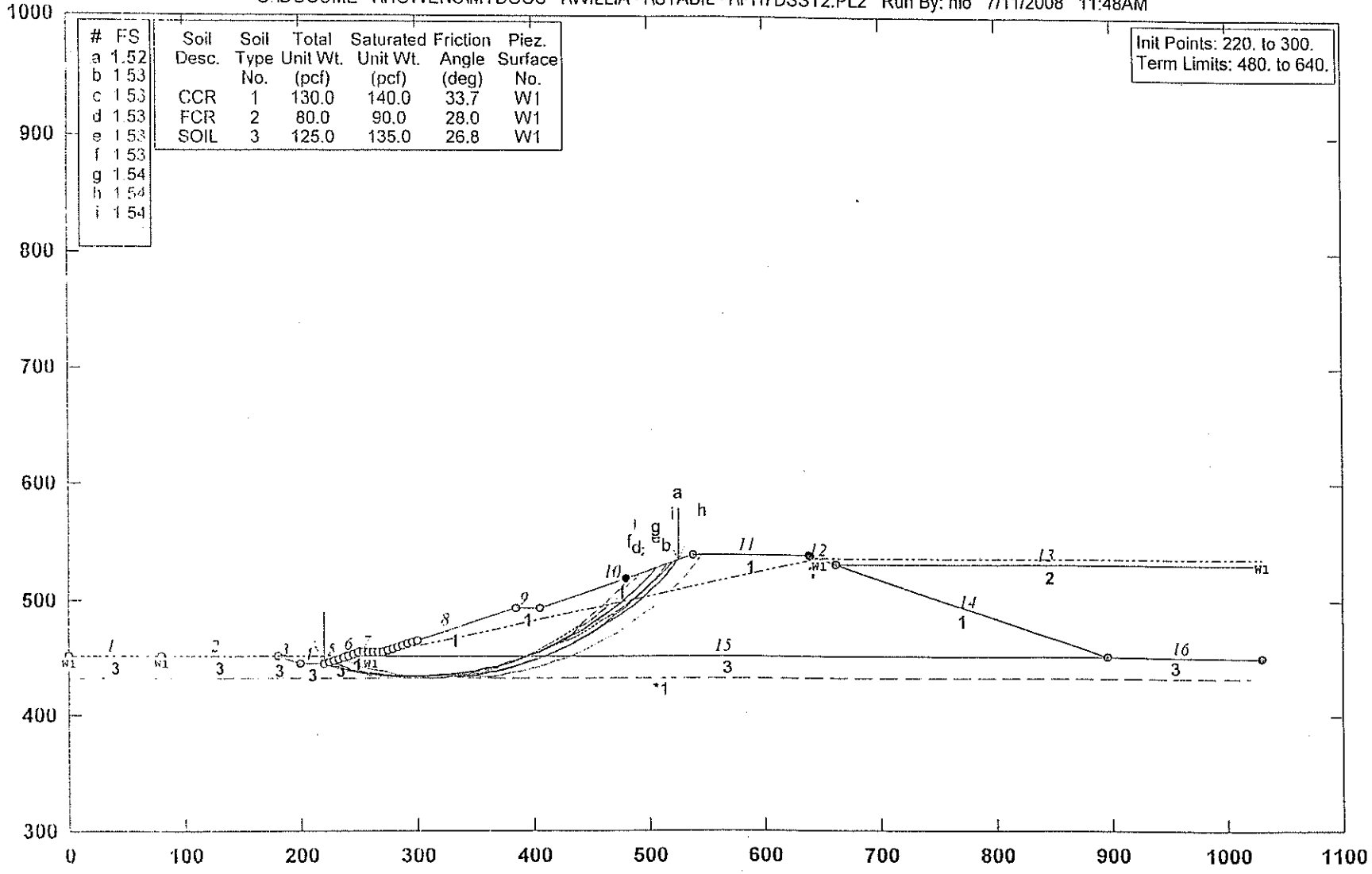
PHASE 7 D.S. STATIC, PIEZ. 15, 16, 17 REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH7DSST2.PL2 Run By: hlo 7/11/2008 11:48AM

#	FS
a	1.52
b	1.53
c	1.53
d	1.53
e	1.53
f	1.53
g	1.54
h	1.54
i	1.54

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
SOIL	3	125.0	135.0	26.8	W1

Init Points: 220. to 300.
Term Limits: 480. to 640.



PCSTABL5M/si FSmin=1.52

Safety Factors Are Calculated By The Modified Bishop Method

STED



R12647

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 7/11/2008
Time of Run: 11:48AM
Run By: hlo
Input Data Filename: C:ph7dsst2.
Output Filename: C:ph7dsst2.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph7dsst2.PLT
PROBLEM DESCRIPTION PHASE 7 D.S. STATIC, PIEZ. 15, 16, 17
REFUSE DISPOSAL AREA NO. 2
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

13 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	151.50	80.00	152.50	3
2	80.00	152.50	180.00	152.00	3
3	180.00	152.00	200.00	145.30	3
4	200.00	145.30	220.00	145.30	3
5	220.00	145.30	240.00	152.00	3
6	240.00	152.00	250.00	155.30	1
7	250.00	155.30	270.00	155.30	1
8	270.00	155.30	385.00	193.60	1
9	385.00	193.60	405.00	193.60	1
10	405.00	193.60	538.20	238.00	1
11	538.20	238.00	638.20	238.00	1
12	638.20	238.00	662.20	230.00	1
13	662.20	230.00	1030.00	230.00	2
14	662.20	230.00	896.20	152.00	1
15	240.00	152.00	896.20	152.00	3
16	896.20	152.00	1030.00	150.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	151.50
2	80.00	152.00
3	260.00	152.00
4	647.20	235.00
5	1030.00	235.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	132.00	1020.00	132.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 220.00 ft.

and X = 300.00 ft.
Each Surface Terminates Between X = 480.00 ft.
and X = 640.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	220.00	145.30
2	229.61	142.53
3	239.31	140.10
4	249.09	138.00
5	258.93	136.23
6	268.83	134.81
7	278.77	133.73
8	288.74	132.99
9	298.73	132.59
10	308.73	132.54
11	318.73	132.83
12	328.71	133.47
13	338.66	134.45
14	348.57	135.77
15	358.43	137.43
16	368.23	139.43
17	377.96	141.77
18	387.59	144.43
19	397.13	147.43
20	406.56	150.76
21	415.88	154.41
22	425.06	158.37
23	434.09	162.65
24	442.98	167.24
25	451.70	172.13
26	460.25	177.32
27	468.62	182.79
28	476.79	188.56
29	484.76	194.60
30	492.51	200.91
31	500.05	207.48
32	507.35	214.31
33	514.42	221.39
34	521.24	228.71
35	525.69	233.83

Circle Center At X = 305.2 ; Y = 423.1 and Radius, 290.6
*** 1.524 ***
Individual data on the 42 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.6	3883.3	3218.9	5044.3	.0	.0	.0	.0	.0
2	9.7	11560.6	1184.7	6667.7	.0	.0	.0	.0	.0
3	.7	1107.0	5.3	528.5	.0	.0	.0	.0	.0
4	9.1	17749.9	.0	7554.5	.0	.0	.0	.0	.0
5	.9	2113.1	.0	816.5	.0	.0	.0	.0	.0
6	8.9	21872.0	.0	8471.8	.0	.0	.0	.0	.0
7	1.1	2750.2	.0	1069.7	.0	.0	.0	.0	.0
8	8.8	23564.8	.0	9525.2	.0	.0	.0	.0	.0
9	1.2	3253.6	.0	1387.5	.0	.0	.0	.0	.0
10	8.8	26720.5	.0	11238.5	.0	.0	.0	.0	.0
11	10.0	35700.9	.0	14484.3	.0	.0	.0	.0	.0
12	10.0	41131.6	.0	16136.4	.0	.0	.0	.0	.0

13	10.0	46002.2	.0	17580.7	.0	.0	.0	.0	.0
14	10.0	50357.2	.0	18815.1	.0	.0	.0	.0	.0
15	10.0	54176.6	.0	19838.4	.0	.0	.0	.0	.0
16	10.0	57444.6	.0	20649.3	.0	.0	.0	.0	.0
17	9.9	60148.6	.0	21246.8	.0	.0	.0	.0	.0
18	9.9	62280.9	.0	21630.2	.0	.0	.0	.0	.0
19	9.8	63838.0	.0	21799.2	.0	.0	.0	.0	.0
20	9.7	64819.9	.0	21753.4	.0	.0	.0	.0	.0
21	7.0	47606.0	.0	15746.2	.0	.0	.0	.0	.0
22	2.6	17479.3	.0	5746.7	.0	.0	.0	.0	.0
23	9.5	62038.7	.0	21018.1	.0	.0	.0	.0	.0
24	7.9	48243.7	.0	17013.1	.0	.0	.0	.0	.0
25	1.6	9309.2	.0	3316.4	.0	.0	.0	.0	.0
26	3.2	18830.0	.0	6728.9	.0	.0	.0	.0	.0
27	6.1	36219.2	.0	12699.0	.0	.0	.0	.0	.0
28	9.2	53255.8	.0	18314.4	.0	.0	.0	.0	.0
29	9.0	50965.3	.0	16990.3	.0	.0	.0	.0	.0
30	8.9	48216.5	.0	15457.2	.0	.0	.0	.0	.0
31	8.7	45042.4	.0	13716.8	.0	.0	.0	.0	.0
32	8.5	41479.5	.0	11771.4	.0	.0	.0	.0	.0
33	8.4	37567.0	.0	9623.0	.0	.0	.0	.0	.0
34	8.2	33347.4	.0	7274.4	.0	.0	.0	.0	.0
35	8.0	28866.0	.0	4728.2	.0	.0	.0	.0	.0
36	7.8	24170.5	.0	1987.6	.0	.0	.0	.0	.0
37	1.4	3961.8	.0	53.5	.0	.0	.0	.0	.0
38	6.1	15469.4	.0	.0	.0	.0	.0	.0	.0
39	7.3	14814.4	.0	.0	.0	.0	.0	.0	.0
40	7.1	10142.1	.0	.0	.0	.0	.0	.0	.0
41	6.8	5459.1	.0	.0	.0	.0	.0	.0	.0
42	4.5	1053.3	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	224.21	146.71
2	233.72	143.62
3	243.34	140.90
4	253.06	138.55
5	262.86	136.56
6	272.73	134.95
7	282.66	133.71
8	292.62	132.86
9	302.61	132.38
10	312.61	132.28
11	322.60	132.56
12	332.58	133.23
13	342.53	134.26
14	352.43	135.68
15	362.27	137.47
16	372.03	139.64
17	381.70	142.17
18	391.27	145.07
19	400.73	148.33
20	410.05	151.95
21	419.23	155.92
22	428.25	160.24
23	437.10	164.89
24	445.77	169.88
25	454.24	175.19
26	462.50	180.82
27	470.55	186.76
28	478.36	193.01
29	485.93	199.54
30	493.24	206.36
31	500.29	213.45
32	507.07	220.80
33	513.57	228.41
34	515.05	230.28

Circle Center At X = 310.2 ; Y = 395.4 and Radius, 263.1

*** 1.531 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	220.00	145.30
2	229.53	142.28
3	239.18	139.65
4	248.93	137.40
5	258.75	135.55
6	268.65	134.10
7	278.59	133.05
8	288.57	132.40
9	298.57	132.15
10	308.57	132.30
11	318.55	132.85
12	328.51	133.81
13	338.41	135.16
14	348.26	136.92
15	358.02	139.06
16	367.70	141.60
17	377.26	144.53
18	386.70	147.84
19	395.99	151.52
20	405.13	155.58
21	414.10	160.00
22	422.89	164.78
23	431.47	169.90
24	439.85	175.37
25	447.99	181.17
26	455.90	187.30
27	463.55	193.73
28	470.94	200.47
29	478.05	207.51
30	484.87	214.82
31	491.39	222.40

Circle Center At X = 299.8 ; Y = 380.6 and Radius, 248.5

*** 1.532 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	220.00	145.30
2	229.53	142.27
3	239.17	139.62
4	248.92	137.37
5	258.74	135.52
6	268.64	134.06
7	278.58	133.02
8	288.56	132.37
9	298.56	132.13
10	308.56	132.30
11	318.54	132.87
12	328.49	133.85
13	338.40	135.23
14	348.24	137.01
15	358.00	139.19
16	367.66	141.77
17	377.21	144.73
18	386.63	148.08
19	395.91	151.82
20	405.03	155.92
21	413.97	160.39
22	422.73	165.22
23	431.28	170.40
24	439.62	175.93
25	447.72	181.79
26	455.58	187.97

27	463.18	194.47
28	470.51	201.27
29	477.56	208.37
30	484.31	215.74
31	489.36	221.72

Circle Center At X = 299.4 ; Y = 378.3 and Radius, 246.2

*** 1.532 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	220.00	145.30
2	229.64	142.63
3	239.36	140.31
4	249.17	138.34
5	259.04	136.73
6	268.96	135.47
7	278.92	134.58
8	288.90	134.04
9	298.90	133.87
10	308.90	134.06
11	318.89	134.61
12	328.84	135.52
13	338.76	136.79
14	348.63	138.42
15	358.43	140.40
16	368.15	142.74
17	377.78	145.43
18	387.31	148.46
19	396.73	151.84
20	406.01	155.56
21	415.15	159.61
22	424.14	163.98
23	432.97	168.68
24	441.62	173.70
25	450.09	179.02
26	458.35	184.65
27	466.41	190.57
28	474.25	196.78
29	481.86	203.27
30	489.22	210.04
31	496.34	217.06
32	503.20	224.33
33	505.68	227.16

Circle Center At X = 298.7 ; Y = 410.3 and Radius, 276.4

*** 1.534 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	220.00	145.30
2	229.53	142.25
3	239.17	139.61
4	248.91	137.37
5	258.74	135.53
6	268.64	134.11
7	278.59	133.10
8	288.57	132.51
9	298.57	132.33
10	308.57	132.58
11	318.55	133.23
12	328.49	134.31
13	338.38	135.79
14	348.20	137.69
15	357.93	140.00
16	367.55	142.71
17	377.06	145.81
18	386.43	149.32
19	395.64	153.21

20	404.68	157.48
21	413.54	162.12
22	422.19	167.13
23	430.63	172.49
24	438.84	178.20
25	446.80	184.25
26	454.51	190.63
27	461.94	197.32
28	469.08	204.32
29	475.93	211.60
30	482.47	219.17
31	482.74	219.51

Circle Center At X = 297.8 ; Y = 372.1 and Radius, 239.8

*** 1.535 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	220.00	145.30
2	229.66	142.71
3	239.41	140.47
4	249.23	138.58
5	259.11	137.04
6	269.03	135.85
7	279.00	135.02
8	288.99	134.54
9	298.99	134.41
10	308.99	134.65
11	318.97	135.23
12	328.92	136.18
13	338.84	137.48
14	348.70	139.13
15	358.50	141.13
16	368.22	143.47
17	377.85	146.17
18	387.38	149.20
19	396.79	152.57
20	406.08	156.27
21	415.23	160.30
22	424.24	164.66
23	433.08	169.33
24	441.75	174.32
25	450.23	179.61
26	458.52	185.20
27	466.61	191.08
28	474.49	197.24
29	482.13	203.68
30	489.55	210.39
31	496.72	217.36
32	503.64	224.58
33	506.05	227.28

Circle Center At X = 297.4 ; Y = 415.2 and Radius, 280.8

*** 1.537 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	232.63	149.53
2	242.08	146.26
3	251.64	143.32
4	261.30	140.73
5	271.05	138.49
6	280.87	136.60
7	290.75	135.07
8	300.68	133.89
9	310.64	133.07
10	320.63	132.61
11	330.63	132.51
12	340.63	132.77

13	350.61	133.39
14	360.56	134.36
15	370.47	135.70
16	380.33	137.38
17	390.12	139.43
18	399.83	141.82
19	409.45	144.56
20	418.96	147.64
21	428.35	151.06
22	437.62	154.82
23	446.75	158.91
24	455.72	163.33
25	464.53	168.06
26	473.16	173.11
27	481.60	178.47
28	489.85	184.12
29	497.89	190.07
30	505.71	196.31
31	513.30	202.82
32	520.65	209.60
33	527.75	216.64
34	534.60	223.93
35	541.18	231.46
36	546.49	238.00

Circle Center At X = 328.5 ; Y = 410.6 and Radius, 278.1

*** 1.537 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	220.00	145.30
2	229.71	142.89
3	239.49	140.80
4	249.33	139.04
5	259.23	137.60
6	269.16	136.49
7	279.13	135.71
8	289.12	135.26
9	299.12	135.14
10	309.12	135.34
11	319.11	135.88
12	329.07	136.75
13	339.00	137.94
14	348.88	139.46
15	358.71	141.31
16	368.47	143.48
17	378.15	145.97
18	387.75	148.78
19	397.25	151.90
20	406.64	155.34
21	415.92	159.08
22	425.06	163.13
23	434.06	167.48
24	442.92	172.12
25	451.62	177.05
26	460.15	182.27
27	468.51	187.76
28	476.68	193.53
29	484.65	199.57
30	492.42	205.86
31	499.98	212.41
32	507.32	219.20
33	514.43	226.23
34	519.76	231.85

Circle Center At X = 297.8 ; Y = 438.1 and Radius, 303.0

*** 1.538 ***

Failure Surface Specified By 31 Coordinate Points

Point	X-Surf	Y-Surf

(174)

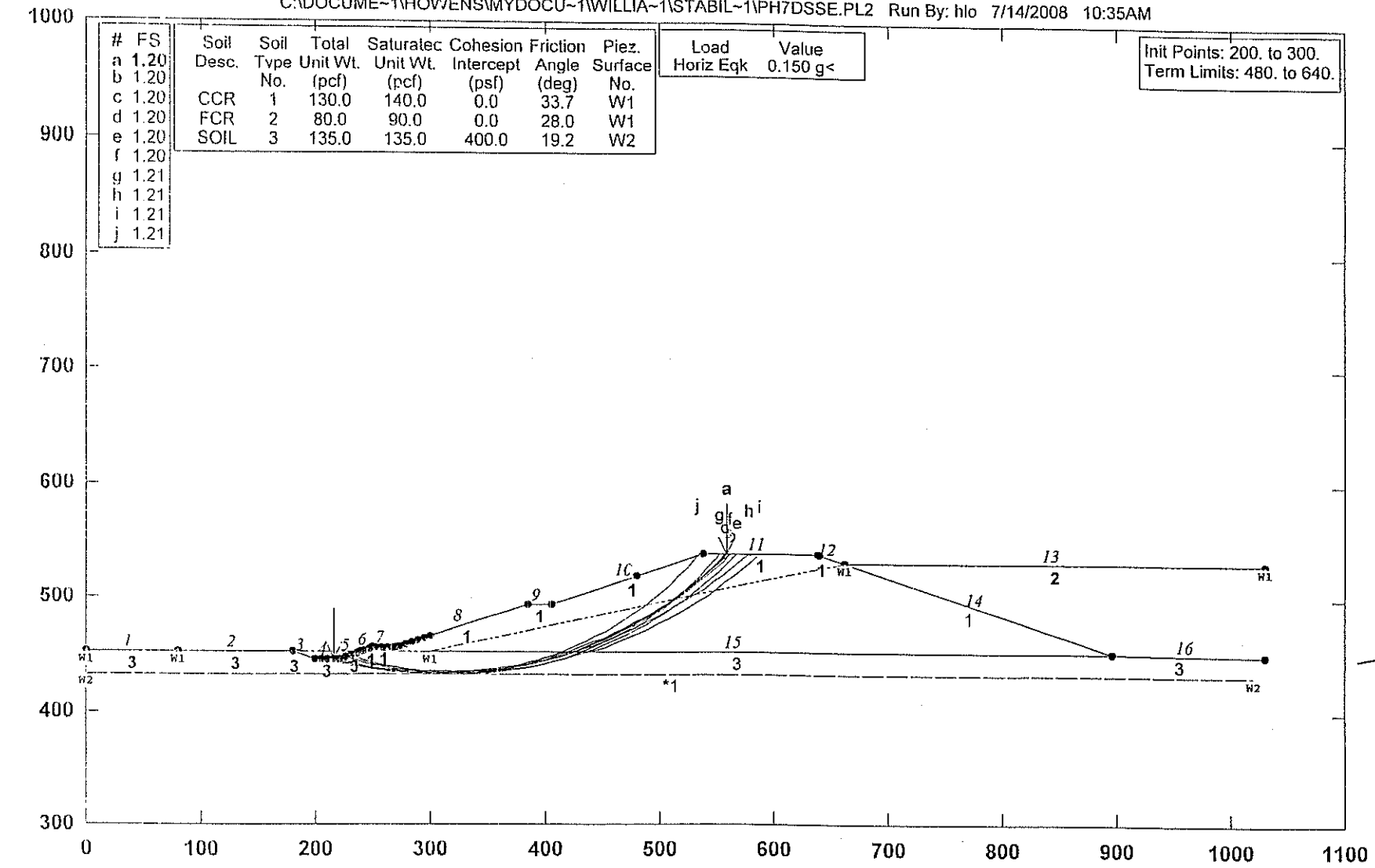
No.	(ft)	(ft)
1	224.21	146.71
2	233.70	143.55
3	243.31	140.78
4	253.03	138.43
5	262.84	136.49
6	272.72	134.97
7	282.66	133.86
8	292.64	133.18
9	302.63	132.92
10	312.63	133.08
11	322.61	133.66
12	332.56	134.67
13	342.46	136.09
14	352.29	137.93
15	362.03	140.19
16	371.67	142.85
17	381.19	145.92
18	390.57	149.39
19	399.79	153.25
20	408.84	157.50
21	417.71	162.13
22	426.37	167.13
23	434.81	172.49
24	443.02	178.20
25	450.98	184.25
26	458.68	190.63
27	466.10	197.34
28	473.23	204.35
29	480.06	211.65
30	486.57	219.24
31	488.23	221.34

Circle Center At X = 303.8 ; Y = 369.5 and Radius, 236.6

*** 1.541 ***

PHASE 7 D.S. SEISMIC, PIEZ. 15, 16, 17 REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH7DSSE.PL2 Run By: hlo 7/14/2008 10:35AM



PCSTABL5M/si FSmin=1.20

Safety Factors Are Calculated By The Modified Bishop Method

STED

7225-11
part 8

173

R12656

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 7/14/2008
Time of Run: 10:35AM
Run By: hlo
Input Data Filename: C:PH7DSSE.
Output Filename: C:PH7DSSE.OUT
Unit: ENGLISH
Plotted Output Filename: C:PH7DSSE.PLT
PROBLEM DESCRIPTION PHASE 7 D.S. SEISMIC, PIEZ. 15, 16, 17
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

13 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	151.50	80.00	152.50	3
2	80.00	152.50	180.00	152.00	3
3	180.00	152.00	200.00	145.30	3
4	200.00	145.30	220.00	145.30	3
5	220.00	145.30	240.00	152.00	3
6	240.00	152.00	250.00	155.30	1
7	250.00	155.30	270.00	155.30	1
8	270.00	155.30	385.00	193.60	1
9	385.00	193.60	405.00	193.60	1
10	405.00	193.60	538.20	238.00	1
11	538.20	238.00	638.20	238.00	1
12	638.20	238.00	662.20	230.00	1
13	662.20	230.00	1030.00	230.00	2
14	662.20	230.00	896.20	152.00	1
15	240.00	152.00	896.20	152.00	3
16	896.20	152.00	1030.00	150.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	135.0	135.0	400.0	19.2	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	151.50
2	80.00	152.00
3	300.00	152.00
4	662.20	230.00
5	1030.00	230.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	132.00
2	1020.00	132.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	132.00	1020.00	132.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 200.00 ft.
and X = 300.00 ft.
Each Surface Terminates Between X = 480.00 ft.
and X = 640.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	215.79	145.30
2	225.45	142.73
3	235.19	140.45
4	244.99	138.44
5	254.84	136.72
6	264.73	135.28
7	274.67	134.13
8	284.63	133.26
9	294.61	132.68
10	304.61	132.39
11	314.61	132.39
12	324.60	132.68
13	334.59	133.25
14	344.55	134.12
15	354.48	135.26
16	364.38	136.70
17	374.23	138.42
18	384.03	140.42
19	393.76	142.71
20	403.43	145.27
21	413.02	148.11
22	422.52	151.23
23	431.93	154.62
24	441.23	158.28
25	450.43	162.20
26	459.51	166.39
27	468.47	170.84
28	477.29	175.55
29	485.98	180.50
30	494.51	185.71
31	502.90	191.16
32	511.12	196.85
33	519.18	202.77
34	527.06	208.93
35	534.76	215.31
36	542.28	221.91
37	549.60	228.72
38	556.72	235.74
39	558.89	238.00

Circle Center At X = 309.7 ; Y = 479.3 and Radius, 346.9
*** 1.197 ***
Individual data on the 48 slices

	Water Force	Water Force	Tie Force	Tie Force	Earthquake Force	Surcharge

Slice No.	Width (ft)	Weight (lbs)	Top (lbs)	Bot (lbs)	Norm (lbs)	Tan (lbs)	Hor (lbs)	Ver (lbs)	Load (lbs)
1	4.2	317.8	.0	.0	.0	.0	47.7	.0	.0
2	5.5	2029.8	.0	.0	.0	.0	304.5	.0	.0
3	9.7	9421.2	.0	.0	.0	.0	1413.2	.0	.0
4	4.8	7299.9	.0	.0	.0	.0	1095.0	.0	.0
5	5.0	9318.2	.0	.0	.0	.0	1397.7	.0	.0
6	5.0	11086.2	.0	.0	.0	.0	1662.9	.0	.0
7	4.8	11778.6	.0	.0	.0	.0	1766.8	.0	.0
8	9.9	25623.5	.0	.0	.0	.0	3843.5	.0	.0
9	5.3	14365.8	.0	.0	.0	.0	2154.9	.0	.0
10	4.7	13562.5	.0	.0	.0	.0	2034.4	.0	.0
11	10.0	33055.4	.0	.0	.0	.0	4958.3	.0	.0
12	10.0	38407.6	.0	.0	.0	.0	5761.1	.0	.0
13	5.4	22787.1	.0	.0	.0	.0	3418.1	.0	.0
14	4.6	20579.5	.0	.0	.0	.0	3086.9	.0	.0
15	10.0	48066.7	.0	.0	.0	.0	7210.0	.0	.0
16	10.0	52392.2	.0	.0	.0	.0	7858.8	.0	.0
17	10.0	56275.6	.0	.0	.0	.0	8441.3	.0	.0
18	10.0	59705.3	.0	.0	.0	.0	8955.8	.0	.0
19	9.9	62672.0	.0	.0	.0	.0	9400.8	.0	.0
20	9.9	65168.7	.0	.0	.0	.0	9775.3	.0	.0
21	9.9	67191.3	.0	.0	.0	.0	10078.7	.0	.0
22	9.8	68737.8	.0	.0	.0	.0	10310.7	.0	.0
23	1.0	6904.4	.0	.0	.0	.0	1035.7	.0	.0
24	8.8	61241.2	.0	.0	.0	.0	9186.2	.0	.0
25	9.7	64716.1	.0	.0	.0	.0	9707.4	.0	.0
26	1.6	10208.4	.0	.0	.0	.0	1531.3	.0	.0
27	8.0	52080.8	.0	.0	.0	.0	7812.1	.0	.0
28	9.5	61983.9	.0	.0	.0	.0	9297.6	.0	.0
29	2.1	13973.9	.0	.0	.0	.0	2096.1	.0	.0
30	7.3	47267.8	.0	12404.2	.0	.0	7090.2	.0	.0
31	9.3	59957.1	.0	15233.2	.0	.0	8993.6	.0	.0
32	9.2	58243.6	.0	14134.9	.0	.0	8736.5	.0	.0
33	9.1	56123.6	.0	12859.9	.0	.0	8418.5	.0	.0
34	9.0	53616.6	.0	11409.4	.0	.0	8042.5	.0	.0
35	8.8	50745.2	.0	9784.5	.0	.0	7611.8	.0	.0
36	8.7	47533.5	.0	7986.6	.0	.0	7130.0	.0	.0
37	8.5	44007.1	.0	6017.2	.0	.0	6601.1	.0	.0
38	8.4	40194.6	.0	3877.9	.0	.0	6029.2	.0	.0
39	8.2	36125.3	.0	1570.5	.0	.0	5418.8	.0	.0
40	1.2	4902.2	.0	27.5	.0	.0	735.3	.0	.0
41	6.9	27048.6	.0	.0	.0	.0	4057.3	.0	.0
42	7.9	27790.7	.0	.0	.0	.0	4168.6	.0	.0
43	7.7	23480.3	.0	.0	.0	.0	3522.0	.0	.0
44	3.4	9212.5	.0	.0	.0	.0	1381.9	.0	.0
45	4.1	9476.5	.0	.0	.0	.0	1421.5	.0	.0
46	7.3	12076.5	.0	.0	.0	.0	1811.5	.0	.0
47	7.1	5344.7	.0	.0	.0	.0	801.7	.0	.0
48	2.2	318.7	.0	.0	.0	.0	47.8	.0	.0

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	210.53	145.30
2	220.21	142.79
3	229.95	140.56
4	239.76	138.59
5	249.61	136.89
6	259.51	135.47
7	269.44	134.31
8	279.41	133.44
9	289.39	132.83
10	299.38	132.51
11	309.38	132.46
12	319.38	132.68
13	329.37	133.18
14	339.34	133.95

15	349.28	135.00
16	359.19	136.33
17	369.07	137.92
18	378.89	139.79
19	388.66	141.93
20	398.37	144.33
21	408.00	147.01
22	417.56	149.94
23	427.04	153.14
24	436.42	156.60
25	445.70	160.32
26	454.88	164.29
27	463.94	168.51
28	472.89	172.98
29	481.71	177.70
30	490.39	182.65
31	498.94	187.85
32	507.34	193.28
33	515.58	198.93
34	523.67	204.82
35	531.59	210.92
36	539.34	217.24
37	546.91	223.77
38	554.30	230.51
39	561.51	237.44
40	562.05	238.00

Circle Center At X = 306.3 ; Y = 495.2 and Radius, 362.7

*** 1.199 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	210.53	145.30
2	220.21	142.78
3	229.95	140.54
4	239.75	138.57
5	249.61	136.87
6	259.51	135.45
7	269.44	134.31
8	279.41	133.45
9	289.39	132.86
10	299.38	132.55
11	309.38	132.52
12	319.38	132.78
13	329.37	133.31
14	339.33	134.12
15	349.27	135.20
16	359.18	136.57
17	369.04	138.21
18	378.86	140.12
19	388.62	142.31
20	398.31	144.77
21	407.93	147.50
22	417.47	150.50
23	426.92	153.77
24	436.28	157.29
25	445.53	161.08
26	454.68	165.12
27	463.71	169.42
28	472.62	173.97
29	481.39	178.76
30	490.03	183.80
31	498.52	189.08
32	506.87	194.59
33	515.05	200.33
34	523.08	206.30
35	530.93	212.50
36	538.61	218.90

37	546.10	225.52
38	553.41	232.35
39	559.12	238.00

Circle Center At X = 305.4 ; Y = 490.5 and Radius, 358.0

*** 1.199 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	226.32	147.42
2	235.87	144.46
3	245.51	141.82
4	255.24	139.49
5	265.03	137.47
6	274.89	135.76
7	284.79	134.38
8	294.73	133.31
9	304.70	132.56
10	314.70	132.13
11	324.69	132.03
12	334.69	132.24
13	344.68	132.78
14	354.64	133.64
15	364.57	134.81
16	374.46	136.31
17	384.29	138.12
18	394.07	140.25
19	403.76	142.68
20	413.38	145.43
21	422.90	148.49
22	432.32	151.85
23	441.62	155.52
24	450.81	159.47
25	459.86	163.73
26	468.77	168.27
27	477.53	173.09
28	486.12	178.19
29	494.56	183.57
30	502.81	189.22
31	510.88	195.12
32	518.75	201.29
33	526.43	207.70
34	533.89	214.36
35	541.13	221.25
36	548.15	228.37
37	554.94	235.72
38	556.92	238.00

Circle Center At X = 323.0 ; Y = 443.2 and Radius, 311.2

*** 1.199 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	226.32	147.42
2	235.92	144.63
3	245.61	142.14
4	255.36	139.94
5	265.18	138.03
6	275.05	136.42
7	284.96	135.10
8	294.91	134.07
9	304.88	133.35
10	314.87	132.92
11	324.87	132.80
12	334.87	132.97
13	344.86	133.44
14	354.83	134.21
15	364.77	135.27
16	374.68	136.64

17	384.54	138.29
18	394.35	140.25
19	404.09	142.49
20	413.76	145.03
21	423.36	147.85
22	432.86	150.96
23	442.27	154.35
24	451.57	158.02
25	460.76	161.97
26	469.82	166.19
27	478.76	170.68
28	487.56	175.44
29	496.21	180.45
30	504.70	185.73
31	513.04	191.25
32	521.21	197.02
33	529.20	203.03
34	537.00	209.28
35	544.62	215.76
36	552.04	222.47
37	559.26	229.39
38	566.26	236.52
39	567.63	238.00

Circle Center At X = 324.1 ; Y = 467.3 and Radius, 334.5

*** 1.200 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	215.79	145.30
2	225.52	142.98
3	235.31	140.93
4	245.15	139.15
5	255.03	137.64
6	264.95	136.40
7	274.91	135.42
8	284.88	134.72
9	294.87	134.30
10	304.87	134.14
11	314.87	134.26
12	324.86	134.65
13	334.84	135.31
14	344.80	136.25
15	354.72	137.45
16	364.61	138.93
17	374.46	140.68
18	384.26	142.69
19	393.99	144.97
20	403.66	147.51
21	413.26	150.32
22	422.78	153.39
23	432.21	156.72
24	441.54	160.30
25	450.78	164.14
26	459.91	168.22
27	468.92	172.56
28	477.81	177.14
29	486.57	181.95
30	495.20	187.01
31	503.68	192.30
32	512.02	197.82
33	520.21	203.57
34	528.23	209.53
35	536.09	215.71
36	543.78	222.11
37	551.29	228.71
38	558.62	235.52
39	561.15	238.00

Circle Center At X = 305.6 ; Y = 500.7 and Radius, 366.6
*** 1.203 ***
Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	231.58	149.18
2	241.09	146.07
3	250.69	143.30
4	260.39	140.84
5	270.16	138.72
6	280.00	136.94
7	289.89	135.49
8	299.83	134.37
9	309.80	133.60
10	319.79	133.16
11	329.79	133.06
12	339.79	133.31
13	349.77	133.89
14	359.73	134.81
15	369.65	136.07
16	379.52	137.67
17	389.33	139.60
18	399.07	141.87
19	408.73	144.46
20	418.29	147.38
21	427.75	150.63
22	437.09	154.19
23	446.31	158.07
24	455.39	162.26
25	464.32	166.76
26	473.10	171.56
27	481.70	176.65
28	490.13	182.04
29	498.37	187.70
30	506.41	193.65
31	514.25	199.86
32	521.86	206.34
33	529.26	213.07
34	536.42	220.05
35	543.34	227.27
36	550.01	234.72
37	552.76	238.00

Circle Center At X = 327.6 ; Y = 427.1 and Radius, 294.1
*** 1.207 ***
Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	205.26	145.30
2	215.01	143.05
3	224.80	141.04
4	234.65	139.27
5	244.53	137.73
6	254.44	136.44
7	264.39	135.38
8	274.35	134.57
9	284.34	134.00
10	294.33	133.67
11	304.33	133.58
12	314.33	133.73
13	324.32	134.13
14	334.30	134.76
15	344.26	135.64
16	354.20	136.76
17	364.11	138.12
18	373.98	139.72
19	383.81	141.55
20	393.59	143.63

21	403.32	145.94
22	412.99	148.48
23	422.60	151.26
24	432.14	154.27
25	441.60	157.51
26	450.98	160.97
27	460.27	164.67
28	469.47	168.58
29	478.57	172.72
30	487.58	177.08
31	496.47	181.65
32	505.25	186.44
33	513.91	191.44
34	522.45	196.64
35	530.86	202.05
36	539.13	207.67
37	547.27	213.48
38	555.26	219.49
39	563.11	225.69
40	570.81	232.07
41	577.61	238.00

Circle Center At X = 303.0 ; Y = 546.9 and Radius, 413.3

*** 1.209 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	226.32	147.42
2	236.01	144.97
3	245.77	142.78
4	255.58	140.84
5	265.44	139.16
6	275.34	137.73
7	285.27	136.57
8	295.23	135.66
9	305.20	135.01
10	315.20	134.63
11	325.20	134.50
12	335.20	134.63
13	345.19	135.03
14	355.17	135.68
15	365.12	136.59
16	375.06	137.77
17	384.95	139.20
18	394.81	140.89
19	404.62	142.83
20	414.37	145.03
21	424.07	147.48
22	433.70	150.19
23	443.25	153.14
24	452.72	156.34
25	462.11	159.79
26	471.40	163.48
27	480.60	167.41
28	489.69	171.58
29	498.66	175.99
30	507.52	180.63
31	516.26	185.49
32	524.87	190.59
33	533.34	195.90
34	541.67	201.43
35	549.85	207.18
36	557.88	213.14
37	565.75	219.31
38	573.46	225.68
39	581.00	232.25
40	587.26	238.00

Circle Center At X = 325.1 ; Y = 518.4 and Radius, 383.9

*** 1.210 ***
Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	221.05	145.65
2	230.65	142.85
3	240.34	140.37
4	250.11	138.22
5	259.94	136.41
6	269.83	134.93
7	279.76	133.78
8	289.73	132.98
9	299.72	132.51
10	309.72	132.39
11	319.72	132.60
12	329.70	133.15
13	339.66	134.05
14	349.59	135.28
15	359.46	136.84
16	369.28	138.74
17	379.03	140.98
18	388.69	143.54
19	398.27	146.43
20	407.74	149.64
21	417.09	153.18
22	426.32	157.02
23	435.42	161.19
24	444.36	165.65
25	453.15	170.42
26	461.78	175.48
27	470.22	180.84
28	478.48	186.48
29	486.54	192.39
30	494.40	198.58
31	502.04	205.02
32	509.46	211.73
33	516.65	218.68
34	523.60	225.88
35	530.30	233.30
36	532.72	236.17

Circle Center At X = 308.4 ; Y = 426.6 and Radius, 294.2

*** 1.212 ***

PHASE 7 UPSTREAM SEISMIC, SECTION G-G REFUSE DISPOSAL AREA NO. 2

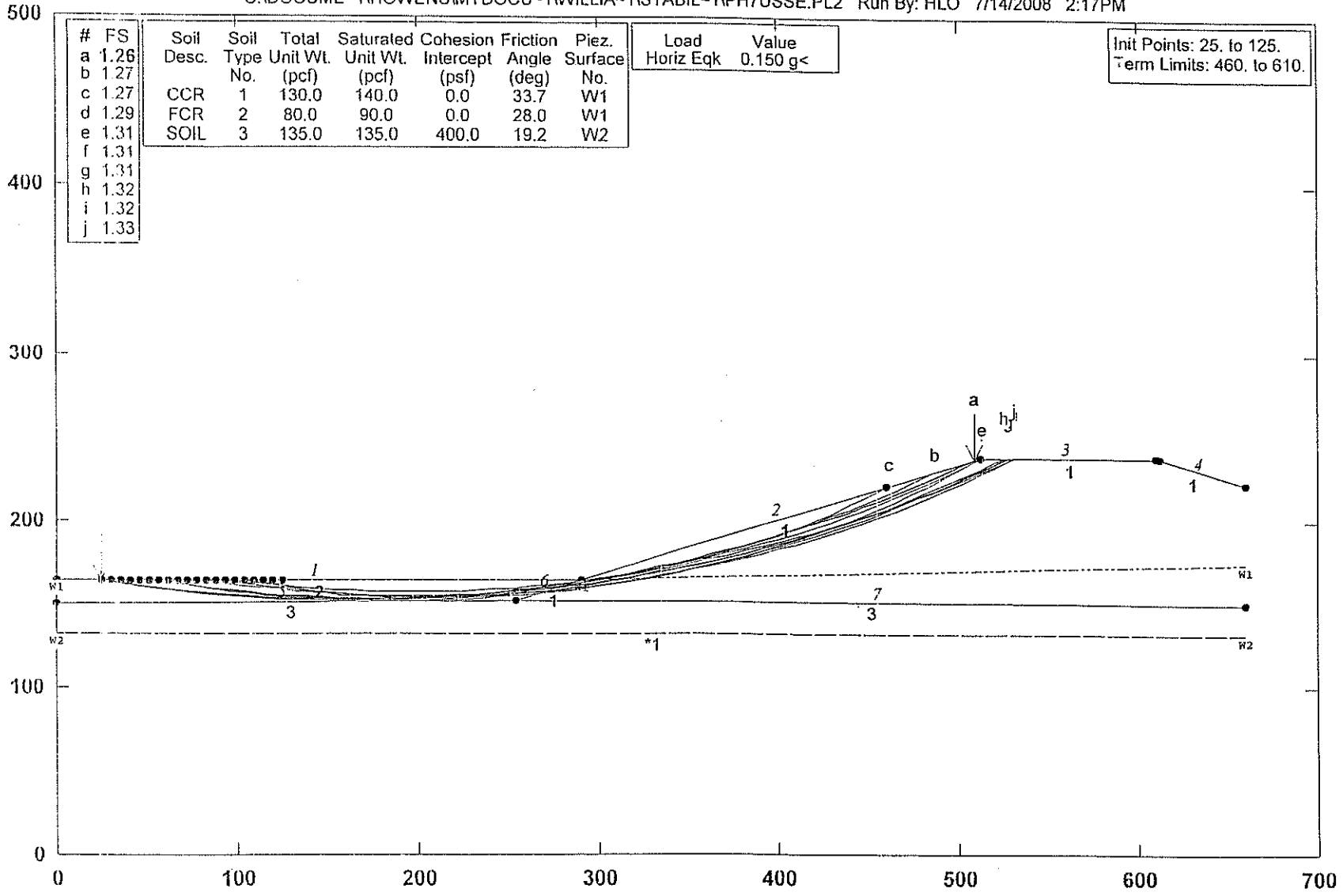
C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH7USSE.PL2 Run By: HLO 7/14/2008 2:17PM

#	FS
a	1.26
b	1.27
c	1.27
d	1.29
e	1.31
f	1.31
g	1.31
h	1.32
i	1.32
j	1.33

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	28.0	W1
SOIL	3	135.0	135.0	400.0	19.2	W2

Load	Value
Horiz Eqk	0.150 g<

Init Points: 25. to 125.
Term Limits: 460. to 610.



PCSTABL5M/si FSmin=1.26

Safety Factors Are Ca culated By The Modified Bishop Method

STED



125

R12666

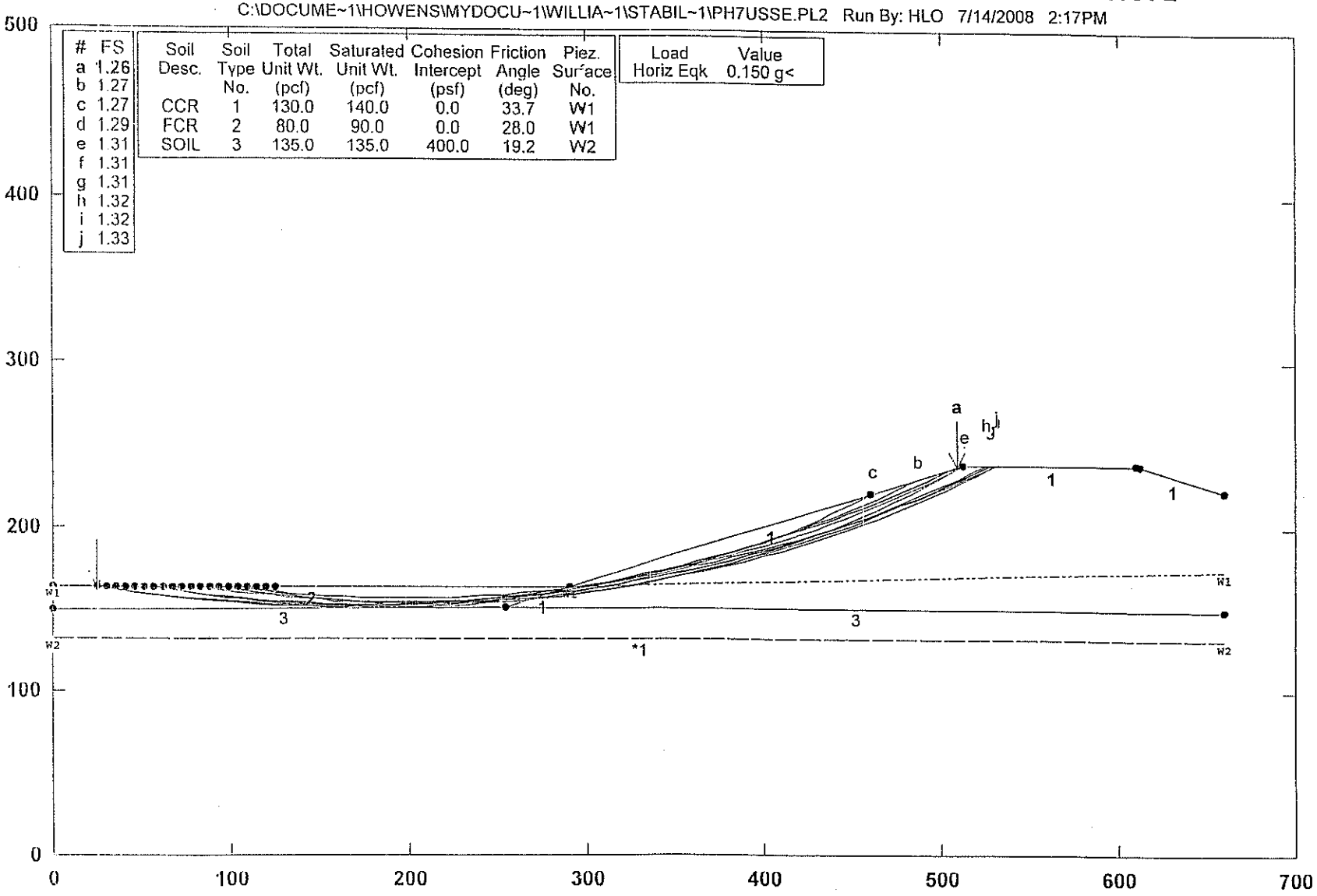
PHASE 7 UPSTREAM SEISMIC, SECTION G-G REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH7USSE.PL2 Run By: HLO 7/14/2008 2:17PM

#	FS
a	1.26
b	1.27
c	1.27
d	1.29
e	1.31
f	1.31
g	1.31
h	1.32
i	1.32
j	1.33

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	28.0	W1
SOIL	3	135.0	135.0	400.0	19.2	W2

Load	Value
Horiz Eqk	0.150 g<



PCSTABL5M/si FSmin=1.26

Safety Factors Are Calculated By The Modified Bishop Method

STED



R12667

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 7/14/2008
Time of Run: 2:17PM
Run By: HLO
Input Data Filename: C:PH7USSE.
Output Filename: C:PH7USSE.OUT
Unit: ENGLISH
Plotted Output Filename: C:PH7USSE.PLT
PROBLEM DESCRIPTION PHASE 7 UPSTREAM SEISMIC, SECTION G-G
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
4 Top Boundaries
7 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	164.00	290.00	164.00	2
2	290.00	164.00	512.00	238.00	1
3	512.00	238.00	612.00	238.00	1
4	612.00	238.00	660.00	222.00	1
5	.00	150.00	254.00	152.00	3
6	254.00	152.00	290.00	164.00	1
7	254.00	152.00	660.00	150.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	0	28.0	.00	0	1
3	135.0	135.0	400.0	19.2	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 3 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	164.00
2	290.00	164.00
3	660.00	175.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	132.00
2	660.00	132.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	132.00	660.00	132.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 25.00 ft.
and X = 125.00 ft.
Each Surface Terminates Between X = 460.00 ft.
and X = 610.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 51 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.00	164.00
2	34.86	162.30
3	44.73	160.74
4	54.63	159.30
5	64.54	157.99
6	74.47	156.82
7	84.42	155.77
8	94.38	154.85
9	104.35	154.07
10	114.32	153.41
11	124.31	152.89
12	134.30	152.49
13	144.30	152.23
14	154.30	152.10
15	164.30	152.10
16	174.30	152.23
17	184.29	152.49
18	194.29	152.89
19	204.27	153.41
20	214.25	154.07
21	224.22	154.85
22	234.18	155.77
23	244.12	156.82
24	254.05	157.99
25	263.97	159.30
26	273.86	160.74
27	283.74	162.30
28	293.59	164.00
29	303.43	165.83
30	313.23	167.78
31	323.01	169.86
32	332.77	172.07
33	342.49	174.41
34	352.18	176.88
35	361.84	179.47
36	371.46	182.19
37	381.05	185.03
38	390.60	188.00
39	400.11	191.10
40	409.58	194.32
41	419.00	197.66
42	428.38	201.13
43	437.71	204.72
44	447.00	208.43
45	456.24	212.26
46	465.42	216.21
47	474.55	220.29
48	483.63	224.48
49	492.66	228.79
50	501.62	233.22
51	509.07	237.02

Circle Center At X = 159.3 ; Y = 914.8 and Radius, 762.7
*** 1.262 ***
Individual data on the 53 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)

1	9.9	752.2	.0	529.2	.0	.0	112.8	.0	.0
2	9.9	2204.0	.0	1547.2	.0	.0	330.6	.0	.0
3	9.9	3546.1	.0	2484.4	.0	.0	531.9	.0	.0
4	9.9	4776.9	.0	3340.7	.0	.0	716.5	.0	.0
5	9.9	5895.0	.0	4115.8	.0	.0	884.3	.0	.0
6	9.9	6899.0	.0	4809.7	.0	.0	1034.9	.0	.0
7	10.0	7787.7	.0	5422.3	.0	.0	1168.2	.0	.0
8	10.0	8560.1	.0	5953.4	.0	.0	1284.0	.0	.0
9	10.0	9215.1	.0	6402.9	.0	.0	1382.3	.0	.0
10	10.0	9752.2	.0	6770.8	.0	.0	1462.8	.0	.0
11	10.0	10170.5	.0	7057.0	.0	.0	1525.6	.0	.0
12	10.0	10469.7	.0	7261.5	.0	.0	1570.5	.0	.0
13	10.0	10649.3	.0	7384.2	.0	.0	1597.4	.0	.0
14	10.0	10709.2	.0	7425.0	.0	.0	1606.4	.0	.0
15	10.0	10649.2	.0	7384.1	.0	.0	1597.4	.0	.0
16	10.0	10469.5	.0	7261.4	.0	.0	1570.4	.0	.0
17	10.0	10170.3	.0	7056.8	.0	.0	1525.5	.0	.0
18	10.0	9751.9	.0	6770.6	.0	.0	1462.8	.0	.0
19	10.0	9214.7	.0	6402.6	.0	.0	1382.2	.0	.0
20	10.0	8559.6	.0	5953.1	.0	.0	1283.9	.0	.0
21	10.0	7787.2	.0	5421.9	.0	.0	1168.1	.0	.0
22	9.9	6898.4	.0	4809.3	.0	.0	1034.8	.0	.0
23	9.9	5894.3	.0	4115.3	.0	.0	884.1	.0	.0
24	9.9	4776.1	.0	3340.1	.0	.0	716.4	.0	.0
25	9.9	3545.2	.0	2483.8	.0	.0	531.8	.0	.0
26	9.9	2203.1	.0	1546.6	.0	.0	330.5	.0	.0
27	2.4	324.9	.0	228.6	.0	.0	48.7	.0	.0
28	3.8	385.7	.0	229.7	.0	.0	57.9	.0	.0
29	3.6	437.0	.0	82.3	.0	.0	65.6	.0	.0
30	.7	110.3	.0	2.3	.0	.0	16.5	.0	.0
31	9.2	2348.2	.0	.0	.0	.0	352.2	.0	.0
32	9.8	4216.0	.0	.0	.0	.0	632.4	.0	.0
33	9.8	5789.4	.0	.0	.0	.0	868.4	.0	.0
34	9.8	7179.0	.0	.0	.0	.0	1076.8	.0	.0
35	9.7	8385.1	.0	.0	.0	.0	1257.8	.0	.0
36	9.7	9408.6	.0	.0	.0	.0	1411.3	.0	.0
37	9.7	10250.4	.0	.0	.0	.0	1537.6	.0	.0
38	9.6	10911.7	.0	.0	.0	.0	1636.8	.0	.0
39	9.6	11393.9	.0	.0	.0	.0	1709.1	.0	.0
40	9.5	11698.6	.0	.0	.0	.0	1754.8	.0	.0
41	9.5	11827.7	.0	.0	.0	.0	1774.2	.0	.0
42	9.5	11783.1	.0	.0	.0	.0	1767.5	.0	.0
43	9.4	11567.2	.0	.0	.0	.0	1735.1	.0	.0
44	9.4	11182.2	.0	.0	.0	.0	1677.3	.0	.0
45	9.3	10631.0	.0	.0	.0	.0	1594.6	.0	.0
46	9.3	9916.3	.0	.0	.0	.0	1487.4	.0	.0
47	9.2	9041.1	.0	.0	.0	.0	1356.2	.0	.0
48	9.2	8008.7	.0	.0	.0	.0	1201.3	.0	.0
49	9.1	6822.6	.0	.0	.0	.0	1023.4	.0	.0
50	9.1	5486.3	.0	.0	.0	.0	822.9	.0	.0
51	9.0	4003.7	.0	.0	.0	.0	600.5	.0	.0
52	9.0	2378.6	.0	.0	.0	.0	356.8	.0	.0
53	7.5	639.7	.0	.0	.0	.0	96.0	.0	.0

Failure Surface Specified By 46 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	56.58	164.00
2	66.42	162.24
3	76.29	160.63
4	86.19	159.17
5	96.10	157.86
6	106.03	156.70
7	115.98	155.69
8	125.94	154.83
9	135.92	154.12
10	145.90	153.56
11	155.90	153.16

12	165.89	152.90
13	175.89	152.80
14	185.89	152.85
15	195.89	153.05
16	205.88	153.40
17	215.87	153.90
18	225.85	154.55
19	235.82	155.35
20	245.77	156.31
21	255.71	157.41
22	265.63	158.67
23	275.53	160.07
24	285.41	161.62
25	295.26	163.33
26	305.09	165.18
27	314.89	167.18
28	324.66	169.33
29	334.39	171.63
30	344.08	174.07
31	353.74	176.66
32	363.36	179.40
33	372.94	182.28
34	382.47	185.30
35	391.95	188.47
36	401.39	191.79
37	410.77	195.24
38	420.10	198.84
39	429.38	202.57
40	438.60	206.45
41	447.76	210.47
42	456.85	214.62
43	465.88	218.91
44	474.85	223.34
45	483.75	227.90
46	487.16	229.72

Circle Center At X = 177.7 ; Y = 813.5 and Radius, 660.7

*** 1.266 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	98.68	164.00
2	108.50	162.11
3	118.36	160.40
4	128.24	158.88
5	138.15	157.55
6	148.09	156.41
7	158.04	155.46
8	168.01	154.70
9	178.00	154.12
10	187.99	153.74
11	197.99	153.54
12	207.99	153.54
13	217.99	153.72
14	227.98	154.09
15	237.96	154.66
16	247.93	155.41
17	257.89	156.35
18	267.83	157.48
19	277.74	158.80
20	287.62	160.31
21	297.48	162.00
22	307.30	163.88
23	317.08	165.95
24	326.83	168.20
25	336.53	170.64
26	346.18	173.26
27	355.78	176.06

28	365.32	179.05
29	374.81	182.21
30	384.23	185.56
31	393.59	189.08
32	402.88	192.78
33	412.10	196.66
34	421.24	200.71
35	430.31	204.93
36	439.29	209.33
37	448.19	213.89
38	457.00	218.62
39	461.57	221.19

Circle Center At X = 203.3 ; Y = 680.4 and Radius, 526.9

*** 1.270 ***

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	103.95	164.00
2	113.78	162.19
3	123.65	160.54
4	133.54	159.07
5	143.45	157.77
6	153.39	156.65
7	163.34	155.69
8	173.31	154.91
9	183.29	154.31
10	193.28	153.87
11	203.28	153.61
12	213.28	153.53
13	223.28	153.61
14	233.28	153.88
15	243.27	154.31
16	253.25	154.92
17	263.22	155.70
18	273.17	156.66
19	283.11	157.79
20	293.02	159.09
21	302.91	160.56
22	312.78	162.21
23	322.61	164.03
24	332.41	166.01
25	342.18	168.17
26	351.90	170.50
27	361.59	172.99
28	371.23	175.66
29	380.82	178.49
30	390.36	181.48
31	399.84	184.65
32	409.27	187.97
33	418.64	191.46
34	427.95	195.12
35	437.20	198.93
36	446.37	202.90
37	455.48	207.04
38	464.51	211.33
39	473.47	215.77
40	482.35	220.38
41	491.14	225.13
42	499.86	230.04
43	508.48	235.10
44	513.24	238.00

Circle Center At X = 213.2 ; Y = 728.6 and Radius, 575.0

*** 1.294 ***

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	103.95	164.00

2	113.86	162.64
3	123.78	161.44
4	133.73	160.38
5	143.69	159.48
6	153.66	158.73
7	163.64	158.13
8	173.63	157.69
9	183.63	157.39
10	193.62	157.25
11	203.62	157.26
12	213.62	157.42
13	223.62	157.74
14	233.61	158.21
15	243.59	158.83
16	253.56	159.60
17	263.52	160.52
18	273.46	161.60
19	283.38	162.83
20	293.29	164.21
21	303.17	165.73
22	313.03	167.41
23	322.86	169.24
24	332.66	171.22
25	342.43	173.35
26	352.17	175.63
27	361.87	178.05
28	371.53	180.62
29	381.16	183.34
30	390.74	186.21
31	400.27	189.22
32	409.76	192.38
33	419.20	195.68
34	428.59	199.12
35	437.92	202.71
36	447.20	206.44
37	456.42	210.31
38	465.58	214.32
39	474.68	218.47
40	483.72	222.75
41	492.69	227.18
42	501.58	231.74
43	510.41	236.44
44	513.25	238.00

Circle Center At X = 197.9 ; Y = 813.2 and Radius, 656.0

*** 1.306 ***

Failure Surface Specified By 50 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	56.58	164.00
2	66.42	162.24
3	76.29	160.61
4	86.18	159.13
5	96.09	157.78
6	106.01	156.57
7	115.96	155.50
8	125.91	154.57
9	135.88	153.77
10	145.86	153.12
11	155.85	152.61
12	165.84	152.24
13	175.84	152.00
14	185.84	151.91
15	195.84	151.96
16	205.84	152.14
17	215.83	152.47
18	225.82	152.94
19	235.80	153.54

20	245.77	154.29
21	255.73	155.17
22	265.68	156.20
23	275.61	157.36
24	285.53	158.66
25	295.42	160.10
26	305.30	161.68
27	315.15	163.40
28	324.98	165.25
29	334.78	167.25
30	344.55	169.38
31	354.29	171.64
32	363.99	174.04
33	373.67	176.58
34	383.30	179.25
35	392.90	182.06
36	402.46	185.00
37	411.98	188.07
38	421.45	191.28
39	430.87	194.62
40	440.25	198.09
41	449.58	201.69
42	458.86	205.42
43	468.08	209.28
44	477.25	213.27
45	486.37	217.39
46	495.42	221.63
47	504.41	226.01
48	513.35	230.50
49	522.21	235.12
50	527.55	238.00

Circle Center At X = 187.5 ; Y = 866.6 and Radius, 714.6

*** 1.306 ***

Failure Surface Specified By 50 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	56.58	164.00
2	66.45	162.39
3	76.34	160.91
4	86.25	159.56
5	96.17	158.35
6	106.12	157.27
7	116.07	156.32
8	126.04	155.51
9	136.01	154.82
10	146.00	154.27
11	155.99	153.86
12	165.99	153.57
13	175.98	153.42
14	185.98	153.41
15	195.98	153.53
16	205.98	153.78
17	215.97	154.16
18	225.96	154.68
19	235.94	155.33
20	245.91	156.11
21	255.87	157.03
22	265.81	158.08
23	275.74	159.26
24	285.65	160.58
25	295.55	162.03
26	305.42	163.61
27	315.28	165.32
28	325.10	167.16
29	334.91	169.13
30	344.68	171.23
31	354.43	173.47

32	364.15	175.83
33	373.83	178.33
34	383.48	180.95
35	393.10	183.70
36	402.67	186.58
37	412.21	189.58
38	421.71	192.72
39	431.16	195.98
40	440.57	199.36
41	449.93	202.87
42	459.25	206.51
43	468.52	210.27
44	477.73	214.15
45	486.89	218.16
46	496.00	222.29
47	505.05	226.54
48	514.05	230.90
49	522.98	235.39
50	528.00	238.00

Circle Center At X = 182.2 ; Y = 902.5 and Radius, 749.1

*** 1.314 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	82.90	164.00
2	92.78	162.49
3	102.69	161.13
4	112.61	159.90
5	122.55	158.81
6	132.51	157.87
7	142.48	157.07
8	152.45	156.41
9	162.44	155.89
10	172.43	155.51
11	182.43	155.28
12	192.43	155.18
13	202.43	155.23
14	212.43	155.42
15	222.42	155.76
16	232.41	156.23
17	242.39	156.85
18	252.36	157.61
19	262.32	158.51
20	272.27	159.55
21	282.20	160.73
22	292.11	162.06
23	302.00	163.52
24	311.87	165.13
25	321.72	166.87
26	331.54	168.76
27	341.33	170.78
28	351.10	172.94
29	360.83	175.24
30	370.53	177.68
31	380.19	180.26
32	389.81	182.98
33	399.40	185.83
34	408.94	188.81
35	418.44	191.93
36	427.90	195.19
37	437.30	198.58
38	446.66	202.10
39	455.97	205.76
40	465.23	209.55
41	474.43	213.47
42	483.57	217.52
43	492.65	221.69

44	501.68	226.00
45	510.64	230.44
46	519.54	235.00
47	525.20	238.00

Circle Center At X = 194.0 ; Y = 859.1 and Radius, 703.9

*** 1.319 ***

Failure Surface Specified By 54 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.00	164.00
2	34.88	162.45
3	44.78	161.02
4	54.69	159.70
5	64.62	158.50
6	74.56	157.42
7	84.51	156.46
8	94.48	155.61
9	104.45	154.88
10	114.43	154.26
11	124.42	153.77
12	134.41	153.39
13	144.41	153.12
14	154.41	152.98
15	164.41	152.95
16	174.41	153.05
17	184.40	153.25
18	194.40	153.58
19	204.39	154.02
20	214.37	154.59
21	224.35	155.26
22	234.32	156.06
23	244.28	156.97
24	254.22	158.00
25	264.16	159.15
26	274.08	160.41
27	283.98	161.80
28	293.87	163.29
29	303.74	164.90
30	313.59	166.63
31	323.42	168.48
32	333.22	170.44
33	343.00	172.51
34	352.76	174.70
35	362.49	177.01
36	372.19	179.43
37	381.87	181.96
38	391.51	184.61
39	401.12	187.37
40	410.70	190.24
41	420.25	193.22
42	429.76	196.32
43	439.23	199.53
44	448.66	202.85
45	458.05	206.28
46	467.40	209.82
47	476.71	213.47
48	485.98	217.23
49	495.20	221.10
50	504.38	225.07
51	513.51	229.16
52	522.59	233.35
53	531.62	237.65
54	532.34	238.00

Circle Center At X = 161.6 ; Y = 1003.3 and Radius, 850.4

*** 1.319 ***

Failure Surface Specified By 47 Coordinate Points

Point	X-Surf	Y-Surf

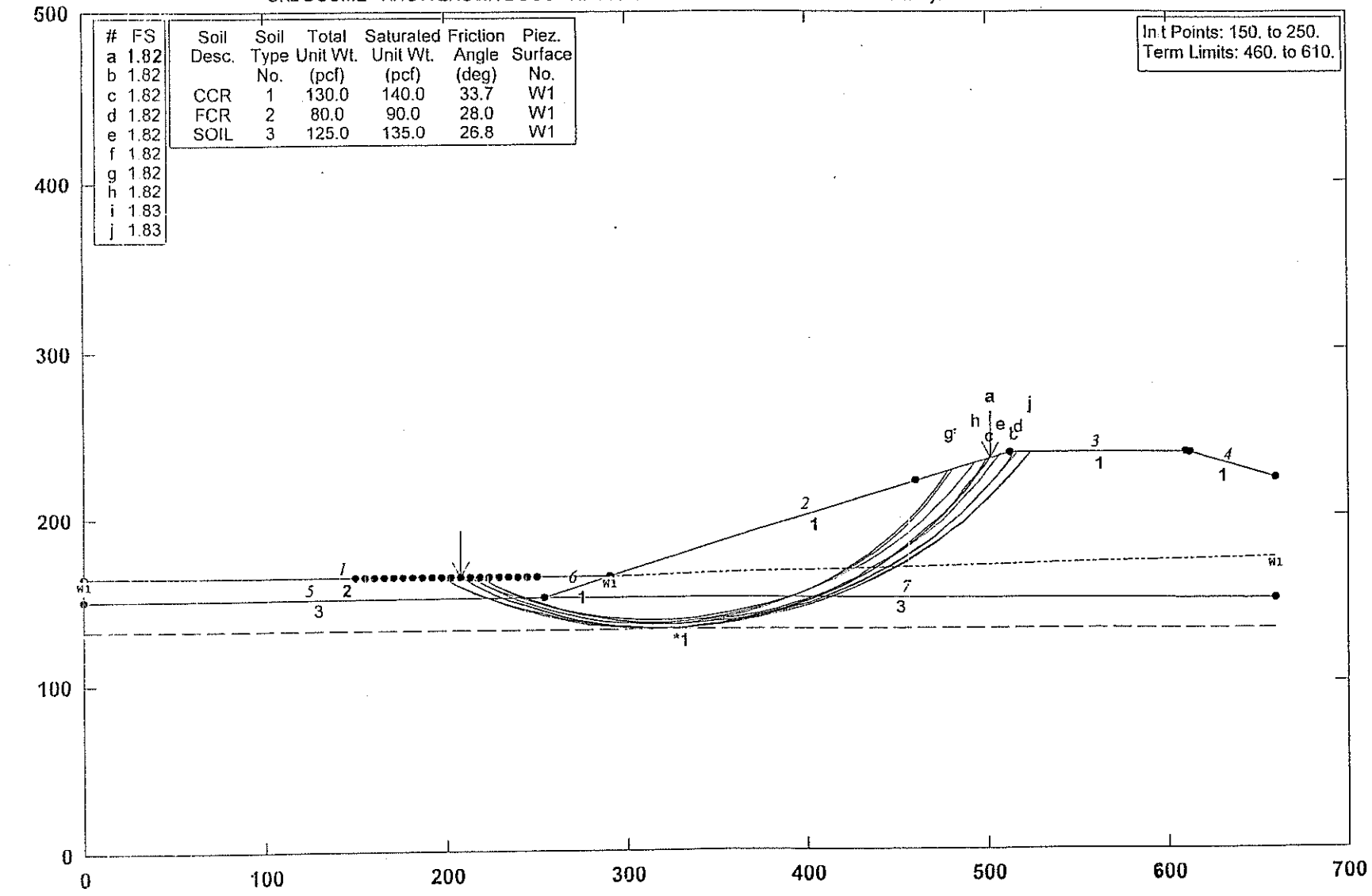
No.	(ft)	(ft)
1	93.42	164.00
2	103.29	162.40
3	113.19	160.95
4	123.10	159.64
5	133.03	158.48
6	142.98	157.47
7	152.95	156.61
8	162.92	155.89
9	172.90	155.32
10	182.89	154.90
11	192.89	154.63
12	202.89	154.51
13	212.89	154.53
14	222.89	154.70
15	232.88	155.02
16	242.87	155.49
17	252.85	156.11
18	262.82	156.87
19	272.78	157.79
20	282.73	158.85
21	292.65	160.05
22	302.56	161.41
23	312.45	162.91
24	322.31	164.55
25	332.15	166.35
26	341.96	168.28
27	351.74	170.37
28	361.49	172.60
29	371.20	174.97
30	380.88	177.48
31	390.52	180.14
32	400.12	182.95
33	409.68	185.89
34	419.19	188.97
35	428.66	192.20
36	438.07	195.57
37	447.44	199.07
38	456.75	202.71
39	466.01	206.49
40	475.21	210.41
41	484.35	214.46
42	493.43	218.65
43	502.45	222.98
44	511.40	227.43
45	520.29	232.02
46	529.10	236.74
47	531.38	238.00

Circle Center At X = 206.3 ; Y = 829.3 and Radius, 674.8

*** 1.331 ***

PHASE 7 UPSTREAM STATIC, SECTION G-G REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH7USST.PL2 Run By: HLO 7/15/2008 11:43AM



PCSTABL5M/si FSmin=1.82

Safety Factors Are Calculated By The Modified Bishop Method

STED

197

R12678

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 7/14/2008
Time of Run: 2:30PM
Run By: HLO
Input Data Filename: C:PH7USST.
Output Filename: C:PH7USST.OUT
Unit: ENGLISH
Plotted Output Filename: C:PH7USST.PLT
PROBLEM DESCRIPTION PHASE 7 UPSTREAM SEISMIC, SECTION G-G
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
4 Top Boundaries
7 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	164.00	290.00	164.00	2
2	290.00	164.00	512.00	238.00	1
3	512.00	238.00	612.00	238.00	1
4	612.00	238.00	660.00	222.00	1
5	.00	150.00	254.00	152.00	3
6	254.00	152.00	290.00	164.00	1
7	254.00	152.00	660.00	150.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 3 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	164.00
2	290.00	164.00
3	660.00	175.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	132.00	660.00	132.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 150.00 ft.
and X = 250.00 ft.
Each Surface Terminates Between X = 460.00 ft.
and X = 610.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	207.90	164.00

2	216.56	159.01
3	225.45	154.42
4	234.54	150.26
5	243.81	146.52
6	253.25	143.22
7	262.84	140.36
8	272.54	137.95
9	282.35	136.00
10	292.24	134.51
11	302.18	133.48
12	312.17	132.91
13	322.17	132.81
14	332.16	133.18
15	342.13	134.01
16	352.04	135.31
17	361.89	137.06
18	371.64	139.27
19	381.28	141.94
20	390.78	145.05
21	400.13	148.60
22	409.30	152.58
23	418.28	156.99
24	427.04	161.81
25	435.57	167.03
26	443.84	172.65
27	451.85	178.64
28	459.56	185.00
29	466.98	191.71
30	474.07	198.77
31	480.82	206.14
32	487.22	213.82
33	493.26	221.79
34	498.92	230.04
35	501.74	234.58

Circle Center At X = 319.3 ; Y = 347.3 and Radius, 214.5

*** 1.817 ***

Individual data on the 39 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	8.7	1946.9	.0	1558.0	.0	.0	.0	.0	.0
2	8.9	5827.6	.0	4546.4	.0	.0	.0	.0	.0
3	5.7	5560.8	.0	4240.9	.0	.0	.0	.0	.0
4	3.4	4102.1	.0	3035.4	.0	.0	.0	.0	.0
5	9.3	14491.5	.0	9741.7	.0	.0	.0	.0	.0
6	9.4	19263.3	.0	11937.5	.0	.0	.0	.0	.0
7	.7	1704.0	.0	1016.5	.0	.0	.0	.0	.0
8	8.8	22505.5	.0	12842.1	.0	.0	.0	.0	.0
9	9.7	29526.3	.0	15501.1	.0	.0	.0	.0	.0
10	9.8	34318.9	.0	16861.3	.0	.0	.0	.0	.0
11	7.7	29490.5	.0	13796.3	.0	.0	.0	.0	.0
12	2.2	9101.5	.0	4142.9	.0	.0	.0	.0	.0
13	9.9	44027.6	.0	18849.1	.0	.0	.0	.0	.0
14	10.0	49611.8	.0	19531.8	.0	.0	.0	.0	.0
15	10.0	54500.0	.0	19924.7	.0	.0	.0	.0	.0
16	10.0	58647.5	.0	20027.0	.0	.0	.0	.0	.0
17	10.0	62019.3	.0	19838.5	.0	.0	.0	.0	.0
18	9.9	64590.3	.0	19359.6	.0	.0	.0	.0	.0
19	9.8	66345.8	.0	18591.3	.0	.0	.0	.0	.0
20	9.8	67281.3	.0	17535.4	.0	.0	.0	.0	.0
21	9.6	67402.7	.0	16193.9	.0	.0	.0	.0	.0
22	9.5	66726.4	.0	14570.1	.0	.0	.0	.0	.0
23	9.3	65278.9	.0	12667.2	.0	.0	.0	.0	.0
24	6.1	42099.7	.0	7233.3	.0	.0	.0	.0	.0
25	3.1	20986.2	.0	3256.2	0	0	0	0	0
26	9.0	60064.0	.0	8041.7	.0	.0	.0	.0	.0

27	8.8	56357.3	.0	5329.2	.0	.0	.0	.0	.0
28	8.5	52073.5	.0	2357.7	.0	.0	.0	.0	.0
29	2.0	11733.2	.0	97.5	.0	.0	.0	.0	.0
30	6.3	35681.2	.0	.0	.0	.0	.0	.0	.0
31	8.0	42634.7	.0	.0	.0	.0	.0	.0	.0
32	7.7	37532.1	.0	.0	.0	.0	.0	.0	.0
33	7.4	32180.4	.0	.0	.0	.0	.0	.0	.0
34	7.1	26670.8	.0	.0	.0	.0	.0	.0	.0
35	6.8	21098.5	.0	.0	.0	.0	.0	.0	.0
36	6.4	15561.1	.0	.0	.0	.0	.0	.0	.0
37	6.0	10158.7	.0	.0	.0	.0	.0	.0	.0
38	5.7	4991.6	.0	.0	.0	.0	.0	.0	.0
39	2.8	660.3	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	218.42	164.00
2	227.24	159.28
3	236.26	154.97
4	245.46	151.06
5	254.84	147.57
6	264.35	144.51
7	274.00	141.87
8	283.76	139.68
9	293.60	137.92
10	303.52	136.61
11	313.48	135.75
12	323.47	135.33
13	333.47	135.37
14	343.46	135.85
15	353.41	136.79
16	363.32	138.17
17	373.15	139.99
18	382.89	142.25
19	392.52	144.95
20	402.02	148.08
21	411.36	151.64
22	420.54	155.61
23	429.53	159.99
24	438.32	164.77
25	446.88	169.94
26	455.19	175.49
27	463.26	181.41
28	471.04	187.68
29	478.54	194.30
30	485.73	201.25
31	492.60	208.51
32	499.14	216.08
33	505.33	223.93
34	511.16	232.06
35	515.04	238.00

Circle Center At X = 327.7 ; Y = 357.6 and Radius, 222.3

*** 1.819 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	218.42	164.00
2	227.16	159.13
3	236.11	154.69
4	245.28	150.68
5	254.62	147.12
6	264.13	144.02
7	273.77	141.37
8	283.53	139.20
9	293.39	137.50
10	303.31	136.27
11	313.28	135.53

201

12	323.28	135.26
13	333.28	135.48
14	343.25	136.18
15	353.18	137.36
16	363.04	139.02
17	372.81	141.15
18	382.47	143.75
19	391.99	146.82
20	401.35	150.33
21	410.53	154.30
22	419.51	158.70
23	428.27	163.53
24	436.78	168.78
25	445.03	174.43
26	453.00	180.47
27	460.66	186.89
28	468.01	193.68
29	475.02	200.81
30	481.69	208.26
31	487.98	216.03
32	493.89	224.10
33	499.41	232.44
34	500.42	234.14

Circle Center At X = 323.7 ; Y = 342.6 and Radius, 207.3

*** 1.819 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	197.37	164.00
2	206.17	159.25
3	215.16	154.87
4	224.32	150.86
5	233.64	147.23
6	243.10	143.99
7	252.68	141.14
8	262.38	138.69
9	272.17	136.65
10	282.03	135.01
11	291.96	133.77
12	301.92	132.95
13	311.91	132.54
14	321.91	132.54
15	331.90	132.95
16	341.87	133.77
17	351.79	135.01
18	361.66	136.65
19	371.45	138.70
20	381.14	141.15
21	390.73	144.00
22	400.19	147.24
23	409.51	150.87
24	418.67	154.88
25	427.65	159.26
26	436.45	164.01
27	445.05	169.12
28	453.43	174.58
29	461.57	180.38
30	469.47	186.52
31	477.11	192.97
32	484.48	199.73
33	491.56	206.79
34	498.35	214.14
35	504.82	221.76
36	510.98	229.64
37	516.81	237.76
38	516.96	238.00

Circle Center At X = 316.9 ; Y = 374.9 and Radius, 242.4

*** 1.819 ***
Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	197.37	164.00
2	206.12	159.15
3	215.06	154.69
4	224.19	150.61
5	233.49	146.93
6	242.94	143.66
7	252.52	140.80
8	262.22	138.35
9	272.01	136.32
10	281.88	134.72
11	291.81	133.55
12	301.79	132.80
13	311.78	132.49
14	321.78	132.61
15	331.77	133.15
16	341.72	134.13
17	351.62	135.54
18	361.45	137.38
19	371.19	139.63
20	380.83	142.31
21	390.34	145.39
22	399.71	148.89
23	408.92	152.79
24	417.95	157.08
25	426.79	161.75
26	435.42	166.80
27	443.82	172.22
28	451.98	178.00
29	459.89	184.13
30	467.52	190.59
31	474.87	197.37
32	481.92	204.46
33	488.65	211.86
34	495.06	219.53
35	501.14	227.48
36	506.86	235.68
37	507.35	236.45

Circle Center At X = 314.1 ; Y = 364.2 and Radius, 231.7

*** 1.822 ***
Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	213.16	164.00
2	221.80	158.97
3	230.70	154.40
4	239.81	150.28
5	249.12	146.64
6	258.61	143.49
7	268.25	140.82
8	278.01	138.65
9	287.87	136.99
10	297.81	135.83
11	307.78	135.18
12	317.78	135.05
13	327.78	135.43
14	337.74	136.33
15	347.64	137.73
16	357.45	139.64
17	367.16	142.05
18	376.73	144.95
19	386.13	148.35
20	395.36	152.22
21	404.36	156.55

22	413.14	161.35
23	421.66	166.59
24	429.90	172.26
25	437.83	178.34
26	445.44	184.83
27	452.71	191.69
28	459.62	198.92
29	466.15	206.50
30	472.28	214.40
31	478.00	222.60
32	481.20	227.73

Circle Center At X = 315.3 ; Y = 329.7 and Radius, 194.7

*** 1.823 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	218.42	164.00
2	227.07	158.98
3	235.97	154.42
4	245.10	150.34
5	254.44	146.76
6	263.95	143.67
7	273.61	141.09
8	283.40	139.04
9	293.28	137.50
10	303.23	136.49
11	313.21	136.01
12	323.21	136.06
13	333.20	136.64
14	343.14	137.75
15	353.00	139.39
16	362.76	141.55
17	372.40	144.23
18	381.88	147.41
19	391.18	151.09
20	400.27	155.26
21	409.12	159.91
22	417.72	165.02
23	426.03	170.58
24	434.03	176.57
25	441.71	182.98
26	449.03	189.79
27	455.98	196.98
28	462.54	204.53
29	468.69	212.42
30	474.41	220.62
31	478.22	226.74

Circle Center At X = 317.3 ; Y = 324.2 and Radius, 188.2

*** 1.823 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	213.16	164.00
2	222.03	159.39
3	231.11	155.20
4	240.38	151.44
5	249.81	148.12
6	259.39	145.24
7	269.09	142.81
8	278.89	140.84
9	288.78	139.33
10	298.72	138.28
11	308.70	137.70
12	318.70	137.59
13	328.70	137.94
14	338.66	138.76
15	348.58	140.05

16	358.43	141.80
17	368.18	144.00
18	377.82	146.66
19	387.32	149.77
20	396.67	153.32
21	405.85	157.31
22	414.82	161.71
23	423.58	166.53
24	432.11	171.76
25	440.38	177.38
26	448.38	183.38
27	456.09	189.75
28	463.50	196.47
29	470.58	203.53
30	477.32	210.91
31	483.71	218.60
32	489.74	226.58
33	493.28	231.76

Circle Center At X = 316.1 ; Y = 351.4 and Radius, 213.8

*** 1.824 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	197.37	164.00
2	206.21	159.33
3	215.23	155.01
4	224.41	151.05
5	233.74	147.46
6	243.21	144.24
7	252.80	141.40
8	262.50	138.95
9	272.28	136.88
10	282.14	135.21
11	292.06	133.92
12	302.02	133.04
13	312.01	132.55
14	322.00	132.45
15	332.00	132.76
16	341.98	133.46
17	351.92	134.55
18	361.80	136.05
19	371.62	137.93
20	381.36	140.20
21	391.00	142.86
22	400.53	145.90
23	409.93	149.31
24	419.19	153.10
25	428.28	157.25
26	437.21	161.75
27	445.95	166.61
28	454.49	171.82
29	462.81	177.36
30	470.91	183.22
31	478.77	189.40
32	486.38	195.89
33	493.73	202.68
34	500.79	209.76
35	507.58	217.11
36	514.06	224.72
37	520.24	232.58
38	524.15	238.00

Circle Center At X = 319.3 ; Y = 383.9 and Radius, 251.5

*** 1.825 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	197.37	164.00

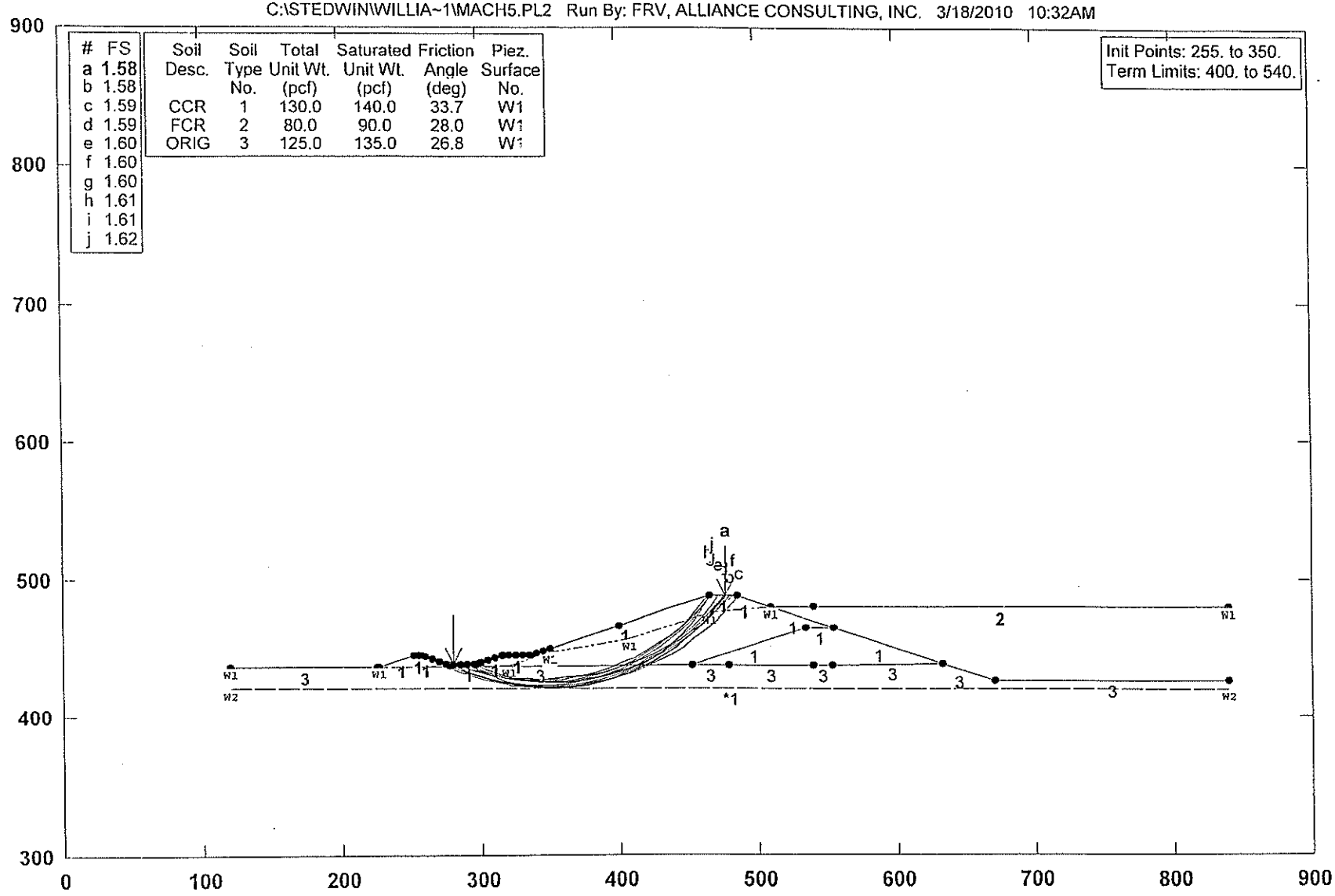
2	206.22	159.35
3	215.26	155.06
4	224.45	151.13
5	233.79	147.57
6	243.27	144.38
7	252.87	141.57
8	262.57	139.14
9	272.36	137.10
10	282.22	135.45
11	292.14	134.19
12	302.10	133.32
13	312.09	132.85
14	322.09	132.78
15	332.09	133.11
16	342.06	133.83
17	352.00	134.95
18	361.89	136.46
19	371.70	138.36
20	381.44	140.64
21	391.07	143.32
22	400.60	146.37
23	409.99	149.80
24	419.24	153.60
25	428.33	157.76
26	437.25	162.28
27	445.99	167.15
28	454.52	172.36
29	462.84	177.91
30	470.94	183.78
31	478.79	189.97
32	486.39	196.47
33	493.73	203.26
34	500.80	210.34
35	507.57	217.69
36	514.06	225.30
37	520.23	233.17
38	523.72	238.00

Circle Center At X = 318.9 ; Y = 384.7 and Radius, 251.9

*** 1.825 ***

Phase 5 Emb DS Static MACH5.in

C:\STEDWIN\WILLIA~1\MACH5.PL2 Run By: FRV, ALLIANCE CONSULTING, INC. 3/18/2010 10:32AM



#	FS
a	1.58
b	1.58
c	1.59
d	1.59
e	1.60
f	1.60
g	1.60
h	1.61
i	1.61
j	1.62

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
ORIG	3	125.0	135.0	26.8	W1

PCSTABL5M/si FSmin=1.58

Safety Factors Are Calculated By The Modified Bishop Method

STED

Rev 3/18/10

2/26/87

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 3/18/2010
Time of Run: 10:32AM
Run By: FRV, ALLIANCE CONSULTING, INC.
Input Data Filename: C:MACH5.
Output Filename: C:MACH5.OUT
Unit: ENGLISH
Plotted Output Filename: C:MACH5.PLT
PROBLEM DESCRIPTION Phase 5 Emb DS Static
MACH5.in

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

11 Top Boundaries
22 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	120.00	136.00	226.50	136.40	3
2	226.50	136.40	252.20	145.00	1
3	252.20	145.00	257.20	145.00	1
4	257.20	145.00	276.70	138.00	1
5	276.70	138.00	296.70	138.50	1
6	296.70	138.50	316.20	145.00	1
7	316.20	145.00	336.20	145.00	1
8	336.20	145.00	465.20	188.00	1
9	465.20	188.00	485.20	188.00	1
10	485.20	188.00	509.20	180.00	1
11	509.20	180.00	840.00	180.00	2
12	225.50	136.40	452.70	137.80	3
13	509.20	180.00	554.20	165.00	1
14	452.70	137.80	534.20	165.00	1
15	452.70	137.80	478.80	138.00	3
16	534.20	165.00	554.20	165.00	1
17	478.80	138.00	539.40	138.00	3
18	539.40	138.00	553.30	138.00	3
19	554.20	165.00	632.90	138.70	1
20	553.30	138.00	632.90	138.70	3
21	632.90	138.70	671.20	126.00	3
22	671.20	126.00	840.00	126.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)	
1	120.00	136.00	
2	226.50	136.40	
3	320.00	137.20	
4	350.00	147.00	P-9
5	407.00	156.00	P-10
6	465.00	175.00	P-11
7	509.20	180.00	
8	840.00	180.00	

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	120.00	121.00
2	840.00	120.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	120.00	121.00	840.00	120.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 255.00 ft.
and X = 350.00 ft.
Each Surface Terminates Between X = 400.00 ft.
and X = 540.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =100.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 24 Coordinate Points

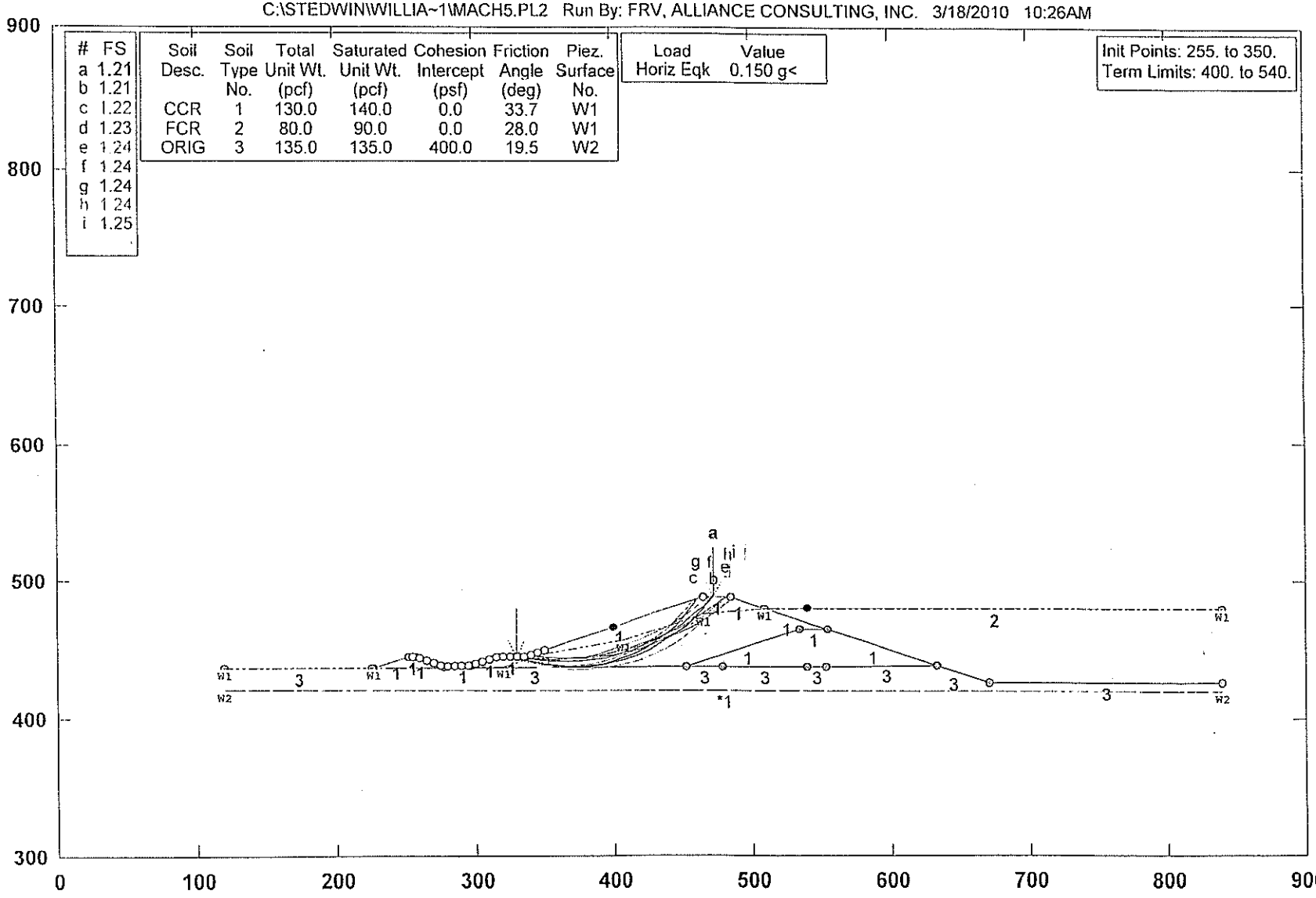
Point No.	X-Surf (ft)	Y-Surf (ft)
1	280.00	138.08
2	289.02	133.77
3	298.31	130.06
4	307.82	126.96
5	317.50	124.48
6	327.33	122.65
7	337.26	121.46
8	347.25	120.92
9	357.25	121.04
10	367.22	121.81
11	377.12	123.22
12	386.90	125.28
13	396.53	127.98
14	405.97	131.30
15	415.16	135.22
16	424.08	139.74
17	432.69	144.83
18	440.95	150.48
19	448.82	156.65
20	456.27	163.32
21	463.27	170.46
22	469.78	178.05
23	475.79	186.04
24	477.07	188.00

Circle Center At X = 350.5 ; Y = 273.8 and Radius, 153.0
*** 1.577 ***
Individual data on the 35 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.5	207.2	.0	.0	.0	.0	.0	.0	.0
2	.3	46.0	.0	1.2	.0	.0	.0	.0	.0
3	6.2	2463.9	.0	710.7	.0	.0	.0	.0	.0
4	7.7	6344.5	.0	2441.9	.0	.0	.0	.0	.0
5	1.6	1808.1	.0	716.3	.0	.0	.0	.0	.0
6	9.5	15387.3	.0	5334.2	.0	.0	.0	.0	.0
7	8.4	19790.4	.0	6071.7	.0	.0	.0	.0	.0
8	1.3	3534.5	.0	1052.1	.0	.0	.0	.0	.0
9	2.5	6894.7	.0	2049.2	.0	.0	.0	.0	.0

Phase 5 Emb DS Pseudo-Static MACH5.in

C:\STEDWIN\WILLIA~1\MACH5.PL2 Run By: FRV, ALLIANCE CONSULTING, INC. 3/18/2010 10:26AM



PCSTABL5M/si FSmin=1.21

Safety Factors Are Calculated By The Modified Bishop Method

STED

Rev 3/18/10

R12890

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 3/18/2010
Time of Run: 10:26AM
Run By: FRV, ALLIANCE CONSULTING, INC.
Input Data Filename: C:MACH5.
Output Filename: C:MACH5.OUT
Unit: ENGLISH
Plotted Output Filename: C:MACH5.PLT
PROBLEM DESCRIPTION Phase 5 Emb DS Pseudo-Static
MACH5.in

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

11 Top Boundaries
22 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	120.00	136.00	226.50	136.40	3
2	226.50	136.40	252.20	145.00	1
3	252.20	145.00	257.20	145.00	1
4	257.20	145.00	276.70	138.00	1
5	276.70	138.00	296.70	138.50	1
6	296.70	138.50	316.20	145.00	1
7	316.20	145.00	336.20	145.00	1
8	336.20	145.00	465.20	188.00	1
9	465.20	188.00	485.20	188.00	1
10	485.20	188.00	509.20	180.00	1
11	509.20	180.00	840.00	180.00	2
12	225.50	136.40	452.70	137.80	3
13	509.20	180.00	554.20	165.00	1
14	452.70	137.80	534.20	165.00	1
15	452.70	137.80	478.80	138.00	3
16	534.20	165.00	554.20	165.00	1
17	478.80	138.00	539.40	138.00	3
18	539.40	138.00	553.30	138.00	3
19	554.20	165.00	632.90	138.70	1
20	553.30	138.00	632.90	138.70	3
21	632.90	138.70	671.20	126.00	3
22	671.20	126.00	840.00	126.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	135.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	120.00	136.00
2	226.50	136.40
3	320.00	137.20
4	350.00	147.00
5	407.00	156.00
6	465.00	175.00
7	509.20	180.00
8	840.00	180.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	120.00	121.00
2	840.00	120.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	120.00	121.00	840.00	120.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 255.00 ft.
and X = 350.00 ft.
Each Surface Terminates Between X = 400.00 ft.
and X = 540.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =100.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	330.00	145.00
2	339.55	142.02
3	349.30	139.81
4	359.20	138.38
5	369.18	137.75
6	379.17	137.92
7	389.13	138.88
8	398.97	140.64
9	408.65	143.17
10	418.09	146.47
11	427.23	150.51
12	436.03	155.27
13	444.42	160.71
14	452.35	166.81
15	459.76	173.52
16	466.62	180.80
17	472.39	188.00

Circle Center At X = 372.1 ; Y = 263.0 and Radius, 125.3
*** 1.206 ***
Individual data on the 22 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	6.2	780.3	.0	.0	.0	.0	117.0	.0	.0
2	.9	258.8	.0	.0	.0	.0	38.8	.0	.0
3	2.5	1071.5	.0	119.4	.0	.0	160.7	.0	.0
4	9.8	9051.7	.0	2532.7	.0	.0	1357.8	.0	.0
5	.7	934.6	.0	300.1	.0	.0	140.2	.0	.0
6	9.2	15239.6	.0	4971.7	.0	.0	2285.9	.0	.0
7	10.0	22199.3	.0	6887.0	.0	.0	3329.9	.0	.0
8	10.0	27049.2	.0	8002.3	.0	.0	4057.4	.0	.0
9	10.0	30597.5	.0	8624.8	.0	.0	4589.6	.0	.0
10	9.8	32766.7	.0	8750.3	.0	.0	4915.0	.0	.0
11	8.0	27770.0	.0	6995.8	.0	.0	4165.5	.0	.0

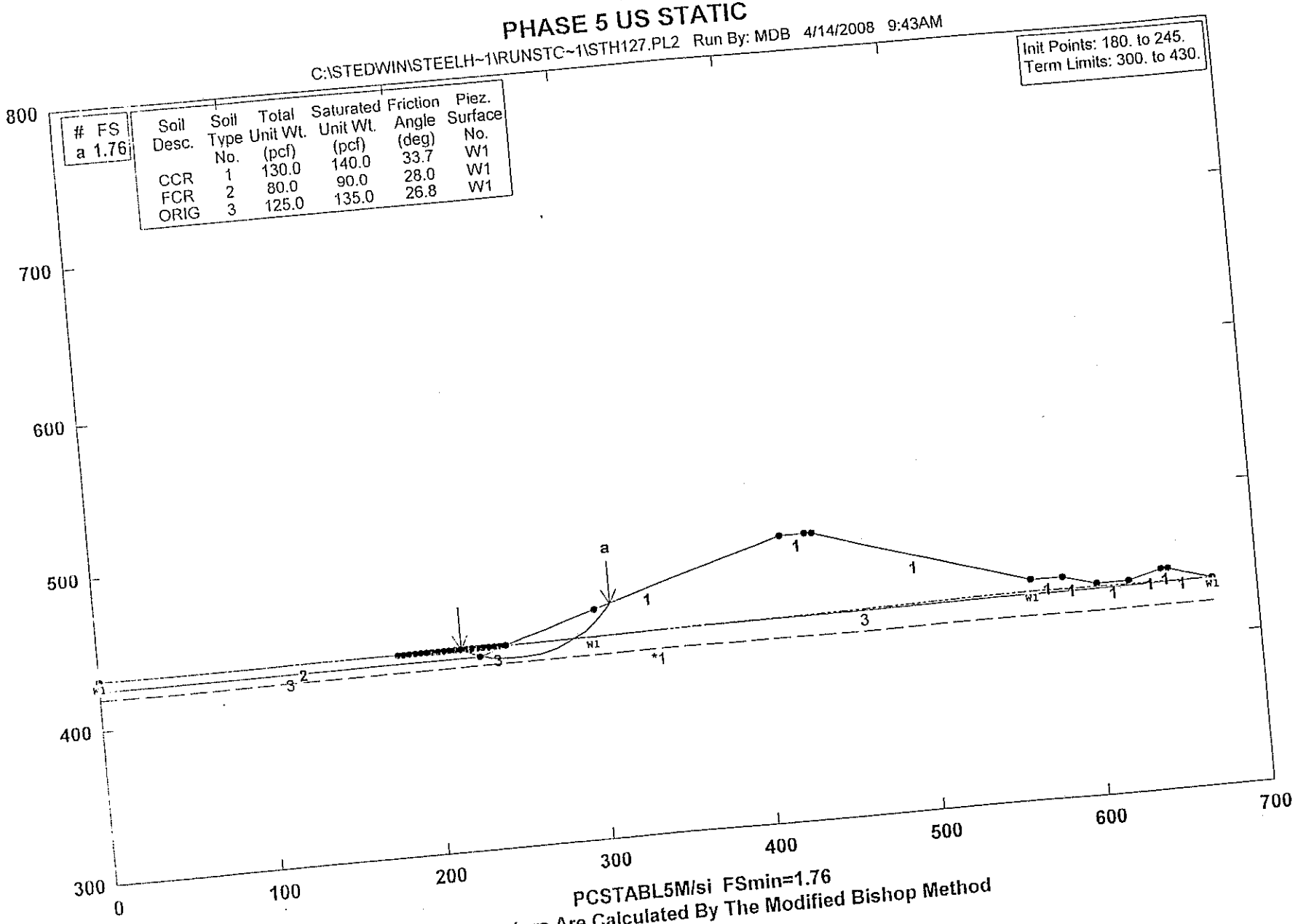
PHASE 5 US STATIC

C:\STEDWIN\STEELH~1\RUNSTC~1\STH127.PL2 Run By: MDB 4/14/2008 9:43AM

Init Points: 180. to 245.
Term Limits: 300. to 430.

FS
a 1.76

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
ORIG	3	125.0	135.0	26.8	W1



PCSTABL5M/si FSmin=1.76

Safety Factors Are Calculated By The Modified Bishop Method

STED



R12693

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4/15/2008
Time of Run: 2:55PM
Run By: MDB
Input Data Filename: C:sth127.
Output Filename: C:sth127.OUT
Unit: ENGLISH
Plotted Output Filename: C:sth127.PLT
PROBLEM DESCRIPTION PHASE 5 US STATIC
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

10 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	132.00	245.00	132.00	2
2	245.00	132.00	414.70	188.00	1
3	414.70	188.00	434.70	188.00	1
4	434.70	188.00	563.70	145.00	1
5	563.70	145.00	583.70	145.00	1
6	583.70	145.00	603.20	138.50	1
7	603.20	138.50	623.20	138.50	1
8	623.20	138.50	642.70	145.00	1
9	642.70	145.00	647.70	145.00	1
10	647.70	145.00	673.40	136.40	1
11	.00	126.00	228.70	126.00	3
12	228.70	126.00	245.00	132.00	3
13	245.00	132.00	673.40	136.40	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00		1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	132.00
2	297.70	132.00
3	563.70	137.00
4	673.40	136.40

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	120.00	673.40	121.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Horizontal Earthquake Loading Coefficient
Of .000 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 180.00 ft.
and X = 245.00 ft.

Each Surface Terminates Between X = 300.00 ft.
and X = 430.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =100.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	217.63	132.00
2	226.71	127.82
3	236.29	124.95
4	246.18	123.45
5	256.18	123.35
6	266.10	124.65
7	275.73	127.33
8	284.89	131.34
9	293.40	136.59
10	301.10	142.98
11	307.82	150.38
12	309.87	153.41

Circle Center At X = 251.8 ; Y = 194.1 and Radius, 70.9
*** 1.762 ***

PHASE 5 US SEISMIC

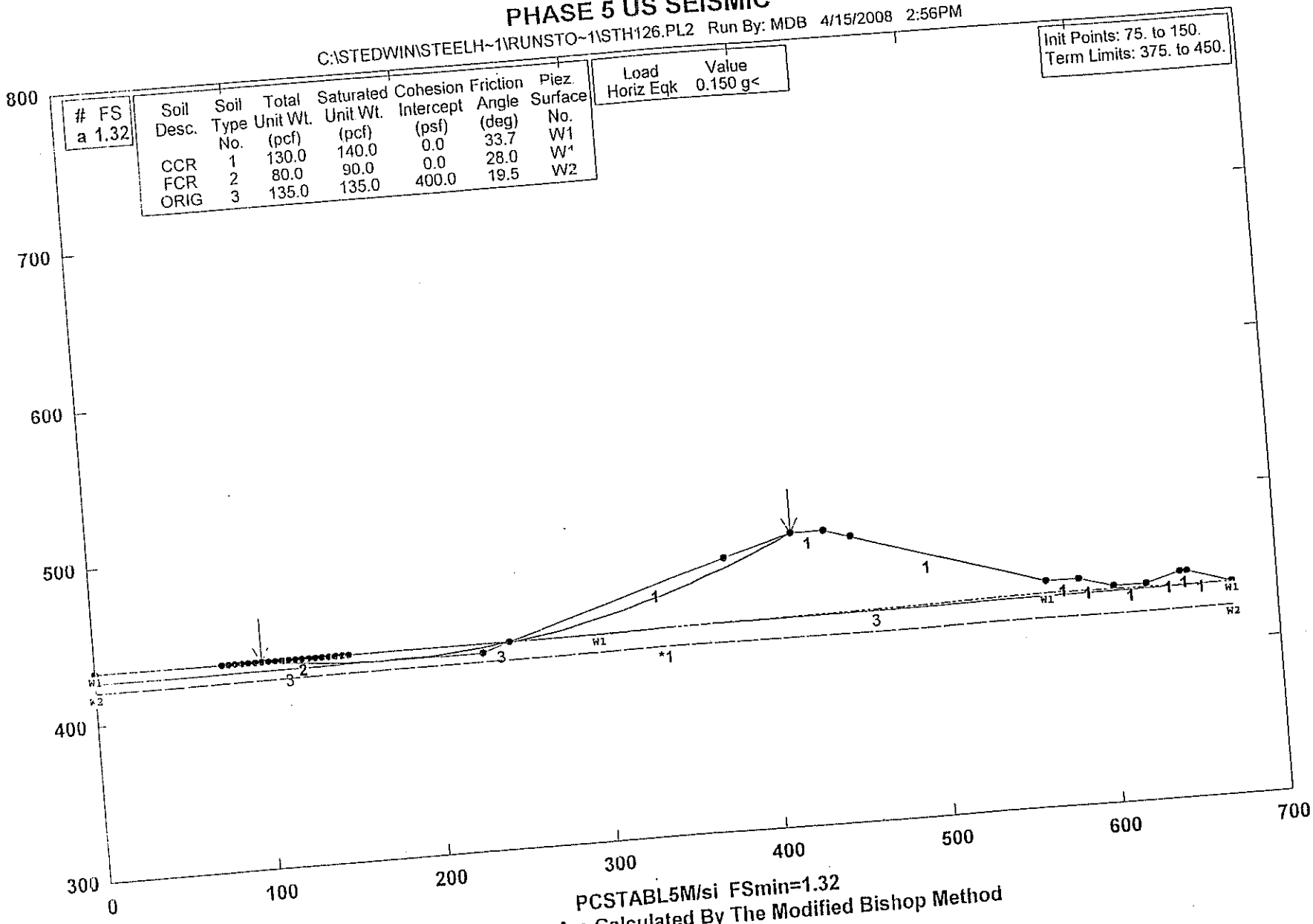
C:\STEDWIN\STEELH~1\RUNSTO~1\STH126.PL2 Run By: MDB 4/15/2008 2:56PM

#	FS
a	1.32

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	28.0	W1
ORIG	3	135.0	135.0	400.0	19.5	W2

Load	Value
Horiz Eqk	0.150 g<

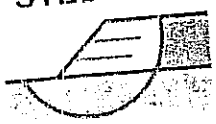
Init Points: 75. to 150.
Term Limits: 375. to 450.



PCSTABL5M/si FSmin=1.32

Safety Factors Are Calculated By The Modified Bishop Method

STED



215

R12696

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4/15/2008
Time of Run: 2:56PM
Run By: MDB
Input Data Filename: C:sth126.
Output Filename: C:sth126.OUT
Unit: ENGLISH
Plotted Output Filename: C:sth126.PLT
PROBLEM DESCRIPTION PHASE 5 US SEISMIC
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

10 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	132.00	245.00	132.00	2
2	245.00	132.00	414.70	188.00	1
3	414.70	188.00	434.70	188.00	1
4	434.70	188.00	563.70	145.00	1
5	563.70	145.00	583.70	145.00	1
6	583.70	145.00	603.20	138.50	1
7	603.20	138.50	623.20	138.50	1
8	623.20	138.50	642.70	145.00	1
9	642.70	145.00	647.70	145.00	1
10	647.70	145.00	673.40	136.40	1
11	.00	126.00	228.70	126.00	3
12	228.70	126.00	245.00	132.00	3
13	245.00	132.00	673.40	136.40	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	135.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	132.00
2	297.70	132.00
3	563.70	137.00
4	673.40	136.40

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	120.00
2	673.40	121.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	120.00	673.40	121.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 75.00 ft.
and X = 150.00 ft.
Each Surface Terminates Between X = 375.00 ft.
and X = 450.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =100.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 34 Coordinate Points

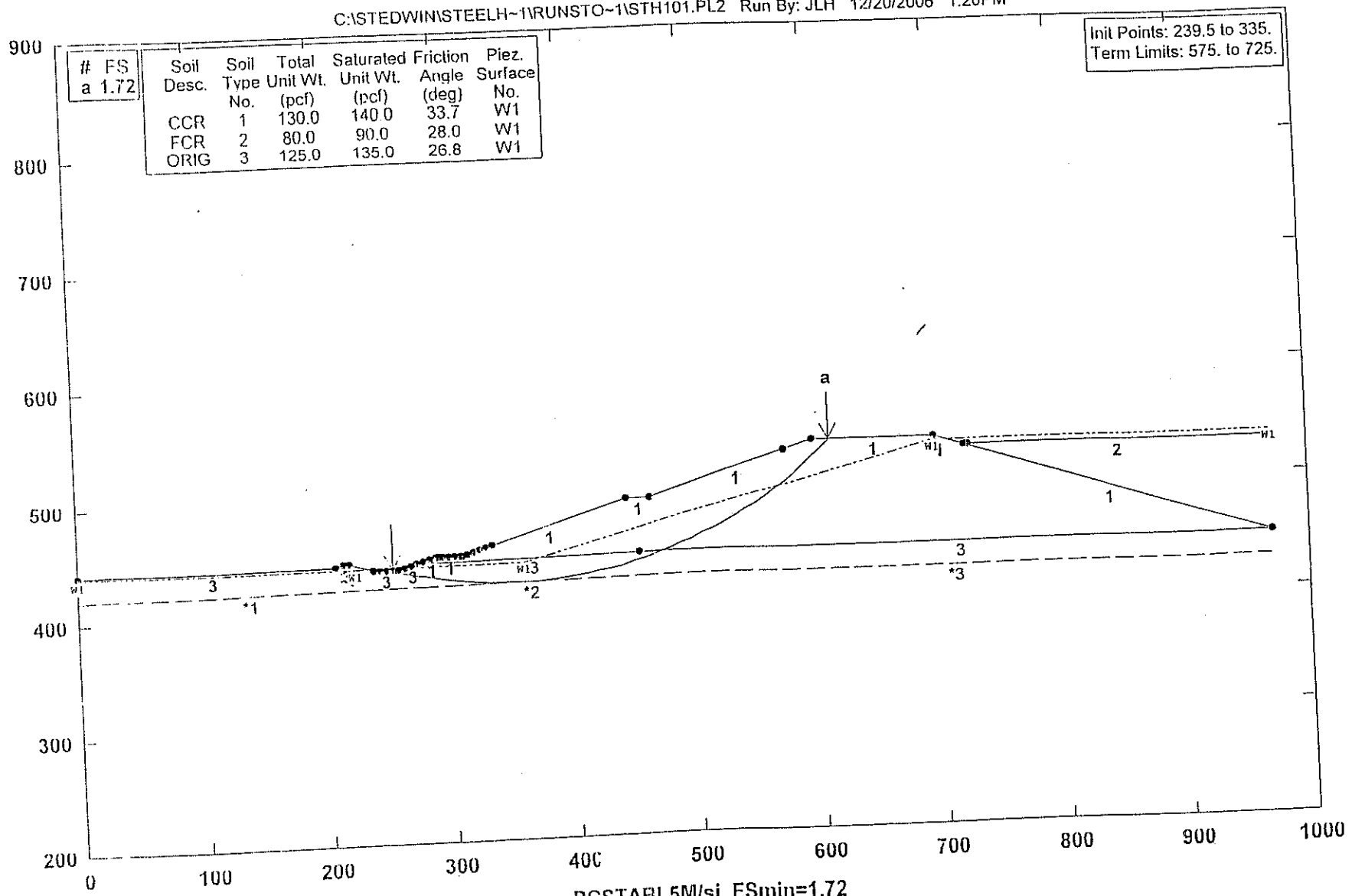
Point No.	X-Surf (ft)	Y-Surf (ft)
1	98.68	132.00
2	108.59	130.66
3	118.53	129.50
4	128.48	128.55
5	138.45	127.79
6	148.44	127.22
7	158.43	126.85
8	168.43	126.68
9	178.43	126.70
10	188.43	126.91
11	198.42	127.32
12	208.40	127.93
13	218.37	128.73
14	228.32	129.73
15	238.25	130.92
16	248.15	132.30
17	258.02	133.88
18	267.87	135.65
19	277.67	137.62
20	287.44	139.77
21	297.16	142.12
22	306.83	144.65
23	316.45	147.38
24	326.02	150.29
25	335.53	153.38
26	344.97	156.67
27	354.35	160.13
28	363.66	163.78
29	372.90	167.62
30	382.06	171.63
31	391.14	175.82
32	400.14	180.18
33	409.05	184.72
34	415.17	188.00

Circle Center At X = 172.4 ; Y = 637.8 and Radius, 511.1
*** 1.322 ***

SECT. -D

PHASE 7 EMB DS STATIC

C:\STEDWIN\STEELH~1\RUNSTO~1\STH101.PL2 Run By: JLH 12/20/2006 1:20PM



PCSTABL5M/si FSmin=1.72

Safety Factors Are Calculated By The Modified Bishop Method

STED



218

R12699

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 12/20/2006
Time of Run: 1:20PM
Run By: JLH
Input Data Filename: C:sth101.
Output Filename: C:sth101.OUT
Unit: ENGLISH
Plotted Output Filename: C:sth101.PLT
PROBLEM DESCRIPTION PHASE 7 EMB DS STATIC
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 200.00 to Y-values listed.

14 Top Boundaries
17 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	241.00	208.60	242.90	3
2	208.60	242.90	214.90	245.00	3
3	214.90	245.00	219.90	245.00	3
4	219.90	245.00	239.40	238.50	3
5	239.40	238.50	259.40	238.50	3
6	259.40	238.50	274.40	243.40	3
7	274.40	243.40	291.00	249.00	1
8	291.00	249.00	311.00	249.00	1
9	311.00	249.00	445.10	293.70	1
10	445.10	293.70	465.10	293.50	1
11	465.10	293.50	597.90	338.00	1
12	597.90	338.00	697.90	338.00	1
13	697.90	338.00	721.90	330.00	1
14	721.90	330.00	970.70	330.00	2
15	274.40	243.40	455.30	246.00	3
16	721.90	330.00	970.70	247.00	1
17	455.30	246.00	970.70	247.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	240.00
2	225.00	240.00
3	360.00	242.00
4	696.70	335.00
5	970.71	335.00

Searching Routine Will Be Limited To An Area Defined By 3 Boundaries
Of Which The First 3 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	220.00	277.00	223.00
2	277.00	223.00	455.00	226.00
3	455.00	226.00	970.00	227.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient

Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Horizontal Earthquake Loading Coefficient
Of .000 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 239.50 ft.
and X = 335.00 ft.
Each Surface Terminates Between X = 575.00 ft.
and X = 725.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =200.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	254.58	238.50
2	264.21	235.82
3	273.92	233.43
4	283.70	231.30
5	293.52	229.46
6	303.40	227.90
7	313.32	226.63
8	323.27	225.63
9	333.25	224.92
10	343.24	224.50
11	353.24	224.36
12	363.23	224.51
13	373.23	224.94
14	383.20	225.66
15	393.15	226.66
16	403.07	227.94
17	412.94	229.51
18	422.77	231.36
19	432.54	233.49
20	442.25	235.89
21	451.88	238.58
22	461.43	241.53
23	470.90	244.76
24	480.27	248.26
25	489.53	252.02
26	498.69	256.05
27	507.72	260.33
28	516.63	264.87
29	525.41	269.67
30	534.04	274.71
31	542.53	280.00
32	550.86	285.52
33	559.04	291.29
34	567.04	297.28
35	574.87	303.50
36	582.52	309.94
37	589.98	316.60
38	597.25	323.47
39	604.32	330.54
40	611.19	337.81
41	611.56	338.00

Circle Center At X = 353.1 ; Y = 574.7 and Radius, 350.3

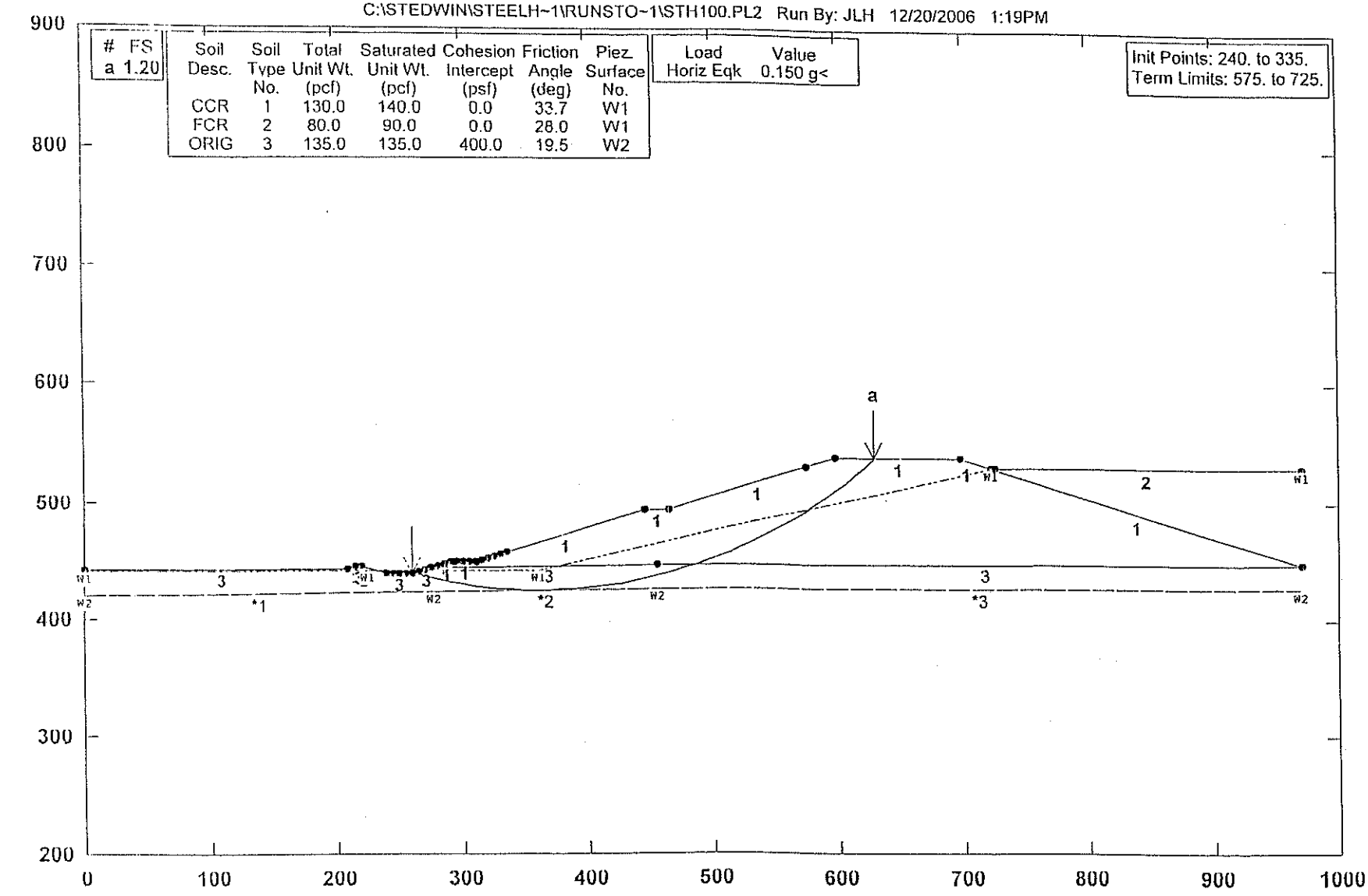
291

*** 1.717 ***

Sect. D-D

PHASE 7 EMB DS SEISMIC

C:\STEDWIN\STEELH~1\RUNSTO~1\STH100.PL2 Run By: JLH 12/20/2006 1:19PM



PCSTABL5M/si FSmin=1.20

Safety Factors Are Calculated By The Modified Bishop Method

STED



222

R12703

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                    ** PCSTABL5M **
                         by
                   Purdue University
              --Slope Stability Analysis--
          Simplified Janbu, Simplified Bishop
             or Spencer`s Method of Slices
 Run Date:                    12/20/2006
 Time of Run:                 1:19PM
 Run By:                      JLH
 Input Data Filename:         C:sth100.
 Output Filename:             C:sth100.OUT
 Unit:                        ENGLISH
 Plotted Output Filename:     C:sth100.PLT
 PROBLEM DESCRIPTION   PHASE 7  EMB DS SEISMIC
 BOUNDARY COORDINATES
      Note: User origin value specified.
      Add 0.00 to X-values and 200.00 to Y-values listed.

    14 Top   Boundaries
    17 Total Boundaries
 Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
    No.         (ft)       (ft)       (ft)       (ft)     Below Bnd
     1           .00     241.00     208.60     242.90        3
     2        208.60     242.90     214.90     245.00        3
     3        214.90     245.00     219.90     245.00        3
     4        219.90     245.00     239.40     238.50        3
     5        239.40     238.50     259.40     238.50        3
     6        259.40     238.50     274.40     243.40        3
     7        274.40     243.40     291.00     249.00        1
     8        291.00     249.00     311.00     249.00        1
     9        311.00     249.00     445.10     293.70        1
    10        445.10     293.70     465.10     293.50        1
    11        465.10     293.50     597.90     338.00        1
    12        597.90     338.00     697.90     338.00        1
    13        697.90     338.00     721.90     330.00        1
    14        721.90     330.00     970.70     330.00        2
    15        274.40     243.40     455.30     246.00        3
    16        721.90     330.00     970.70     247.00        1
    17        455.30     246.00     970.70     247.00        3
ISOTROPIC SOIL PARAMETERS
  3 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.   (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)    No.
   1   130.0    140.0       .0      33.7     .00        .0      1
   2    80.0     90.0       .0      28.0     .00        .0      1
   3   135.0    135.0     400.0     19.5     .00        .0      2
 2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
 Unit Weight of Water =  62.40
 Piezometric Surface No.  1 Specified by  5 Coordinate Points
   Point      X-Water     Y-Water
    No.         (ft)        (ft)
     1           .00      240.00
     2        225.00      242.00
     3        360.00      242.00
     4        721.90      330.00
     5        970.71      330.00
 Piezometric Surface No.  2 Specified by  4 Coordinate Points
   Point      X-Water     Y-Water
    No.         (ft)        (ft)
     1           .00      220.00
     2        277.00      223.00
     3        455.00      226.00
     4        970.00      227.00
Searching Routine Will Be Limited To An Area Defined By  3 Boundaries
 Of Which The First  3 Boundaries Will Deflect Surfaces Upward
 Boundary     X-Left     Y-Left     X-Right    Y-Right
```

No.	(ft)	(ft)	(ft)	(ft)
1	.00	220.00	277.00	223.00
2	277.00	223.00	455.00	226.00
3	455.00	226.00	970.00	227.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 240.00 ft.
and X = 335.00 ft.
Each Surface Terminates Between X = 575.00 ft.
and X = 725.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =200.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	260.00	238.70
2	269.67	236.13
3	279.40	233.82
4	289.18	231.78
5	299.02	229.99
6	308.91	228.48
7	318.83	227.22
8	328.78	226.23
9	338.75	225.51
10	348.74	225.06
11	358.74	224.87
12	368.74	224.96
13	378.74	225.30
14	388.72	225.92
15	398.68	226.81
16	408.61	227.96
17	418.51	229.37
18	428.37	231.05
19	438.18	232.99
20	447.93	235.20
21	457.62	237.66
22	467.24	240.39
23	476.79	243.37
24	486.25	246.60
25	495.63	250.09
26	504.90	253.83
27	514.07	257.81
28	523.14	262.04
29	532.08	266.51
30	540.90	271.21
31	549.60	276.16
32	558.16	281.33
33	566.57	286.73
34	574.84	292.35
35	582.96	298.19
36	590.92	304.25
37	598.71	310.52
38	606.33	316.99
39	613.77	323.67
40	621.04	330.54

```
    41          628.11        337.61
    42          628.49        338.00
Circle Center At X =   360.7 ; Y =   598.4   and Radius,   373.5
      ***       1.203    ***
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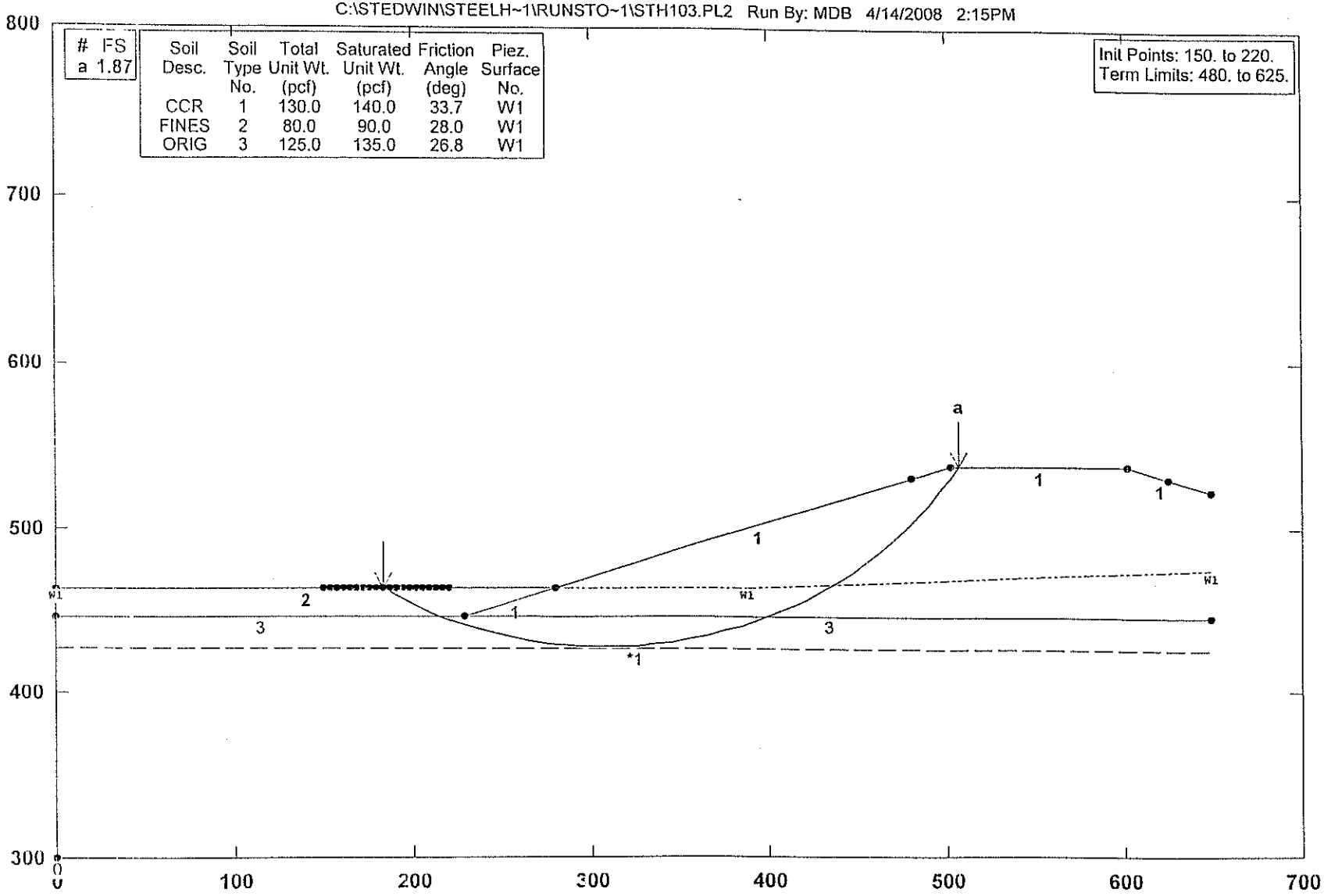
Sc[illegible]n D-D

PHASE 7 EMB US STATIC

C:\STEDWIN\STEELH~1\RUNSTO~1\STH103.PL2 Run By: MDB 4/14/2008 2:15PM



Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FINES	2	80.0	90.0	28.0	W1
ORIG	3	125.0	135.0	26.8	W1

PCSTABL5M/si FSmin=1.87

Safety Factors Are Calculated By The Modified Bishop Method

STED

226

R12707

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                    ** PCSTABL5M **
                          by
                    Purdue University
                --Slope Stability Analysis--
            Simplified Janbu, Simplified Bishop
               or Spencer`s Method of Slices
 Run Date:                  4/15/2008
 Time of Run:               2:50PM
 Run By:                    MDB
 Input Data Filename:       C:sth103.
 Output Filename:           C:sth103.OUT
 Unit:                      ENGLISH
 Plotted Output Filename:   C:sth103.PLT
 PROBLEM DESCRIPTION   PHASE 7 EMB US STATIC
 BOUNDARY COORDINATES
      Note: User origin value specified.
      Add 0.00 to X-values and 300.00 to Y-values listed.

     4 Top   Boundaries
     8 Total Boundaries
 Boundary     X-Left      Y-Left     X-Right     Y-Right     Soil Type
    No.         (ft)        (ft)       (ft)        (ft)     Below Bnd
     1           .00      164.00      280.00      164.00         2
     2        280.00      164.00      502.00      238.00         1
     3        502.00      238.00      602.00      238.00         1
     4        602.00      238.00      649.00      222.00         1
     5           .00      147.00      229.00      147.00         3
     6        229.00      147.00      280.00      164.00         1
     7        229.00      147.00      649.00      146.00         3
     8           .00         .00         .00         .00         0
ISOTROPIC SOIL PARAMETERS
  3 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.  (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)    No.
   1   130.0    140.0       .0      33.7     .00        .0      1
   2    80.0     90.0       .0      28.0     .00        .0      1
   3   125.0    135.0       .0      26.8     .00        .0      1
 1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
 Unit Weight of Water =  62.40
 Piezometric Surface No.  1 Specified by  3 Coordinate Points
   Point      X-Water     Y-Water
    No.         (ft)        (ft)
     1           .00      164.00
     2        388.00      164.00
     3        649.00      175.00
Searching Routine Will Be Limited To An Area Defined By  1 Boundaries
 Of Which The First  1 Boundaries Will Deflect Surfaces Upward
 Boundary     X-Left      Y-Left     X-Right     Y-Right
    No.         (ft)        (ft)       (ft)        (ft)
     1           .00      127.00      649.00      126.00
 A Horizontal Earthquake Loading Coefficient
 Of .150 Has Been Assigned
 A Vertical Earthquake Loading Coefficient
 Of .000 Has Been Assigned
 Cavitation Pressure =      .0 (psf)
 A Horizontal Earthquake Loading Coefficient
 Of .000 Has Been Assigned
 A Vertical Earthquake Loading Coefficient
 Of .000 Has Been Assigned
 Cavitation Pressure =      .0 (psf)
 A Critical Failure Surface Searching Method, Using A Random
 Technique For Generating Circular Surfaces, Has Been Specified.
 400 Trial Surfaces Have Been Generated.
  20 Surfaces Initiate From Each Of 20 Points Equally Spaced
 Along The Ground Surface Between  X = 150.00 ft.
                              and  X = 220.00 ft.
```

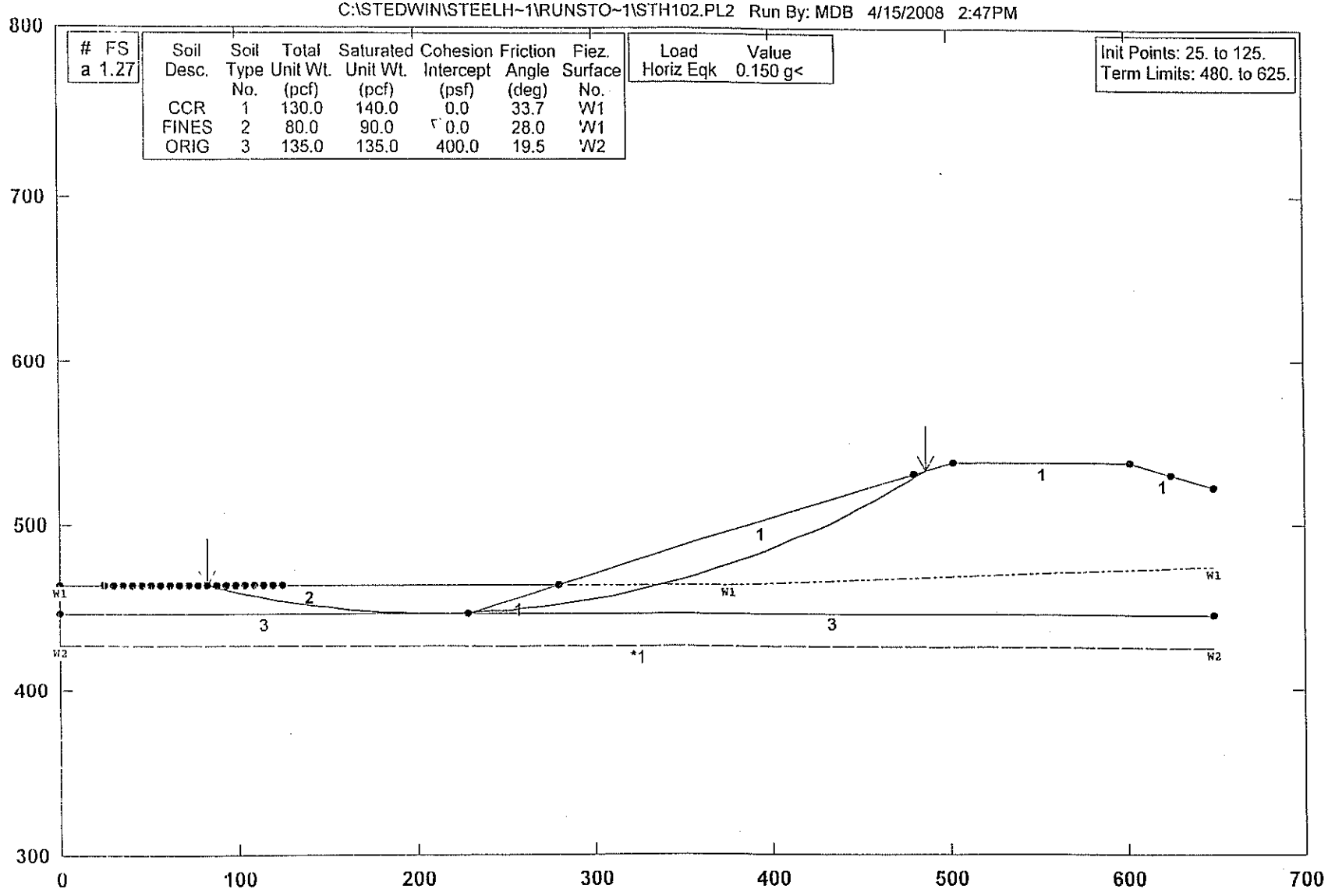
Each Surface Terminates Between X = 480.00 ft.
and X = 625.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =100.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	183.16	164.00
2	191.72	158.84
3	200.50	154.05
4	209.48	149.64
5	218.63	145.61
6	227.95	141.99
7	237.41	138.76
8	247.01	135.94
9	256.71	133.53
10	266.51	131.54
11	276.39	129.97
12	286.32	128.82
13	296.30	128.10
14	306.29	127.81
15	316.29	127.94
16	326.28	128.50
17	336.23	129.48
18	346.13	130.89
19	355.96	132.72
20	365.70	134.97
21	375.34	137.64
??	384.86	140.71
23	394.23	144.19
24	403.45	148.06
25	412.50	152.33
26	421.35	156.98
27	430.00	162.00
28	438.43	167.38
29	446.61	173.12
30	454.55	179.21
31	462.22	185.63
32	469.60	192.37
33	476.69	199.42
34	483.48	206.77
35	489.94	214.40
36	496.08	222.30
37	501.86	230.45
38	506.75	238.00

Circle Center At X = 308.2 ; Y = 361.8 and Radius, 234.0
*** 1.867 ***

PHASE 7 EMB US SEISMIC

C:\STEDWIN\STEELH~1\RUNSTO~1\STH102.PL2 Run By: MDB 4/15/2008 2:47PM



PCSTABL5M/si FSmin=1.27

Safety Factors Are Calculated By The Modified Bishop Method

STED



R12710

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                    ** PCSTABL5M **
                         by
                    Purdue University
               --Slope Stability Analysis--
           Simplified Janbu, Simplified Bishop
              or Spencer's Method of Slices
 Run Date:                    4/15/2008
 Time of Run:                 2:47PM
 Run By:                      MDB
 Input Data Filename:         C:sth102.
 Output Filename:             C:sth102.OUT
 Unit:                        ENGLISH
 Plotted Output Filename:     C:sth102.PLT
 PROBLEM DESCRIPTION   PHASE 7 EMB US SEISMIC
 BOUNDARY COORDINATES
      Note: User origin value specified.
      Add 0.00 to X-values and 300.00 to Y-values listed.

     4 Top   Boundaries
     7 Total Boundaries
 Boundary     X-Left      Y-Left     X-Right     Y-Right     Soil Type
    No.         (ft)        (ft)       (ft)        (ft)     Below Bnd
     1           .00      164.00      280.00      164.00         2
     2        280.00      164.00      502.00      238.00         1
     3        502.00      238.00      602.00      238.00         1
     4        602.00      238.00      649.00      222.00         1
     5           .00      147.00      229.00      147.00         3
     6        229.00      147.00      280.00      164.00         1
     7        229.00      147.00      649.00      146.00         3
ISOTROPIC SOIL PARAMETERS
  3 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.   (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)    No.
   1   130.0    140.0       .0      33.7     .00        .0      1
   2    80.0     90.0       .0      28.0     .00        .0      1
   3   135.0    135.0     400.0     19.5     .00        .0      2
 2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
 Unit Weight of Water =  62.40
 Piezometric Surface No.  1 Specified by  3 Coordinate Points
   Point      X-Water     Y-Water
    No.         (ft)        (ft)
     1           .00      164.00
     2        376.00      164.00
     3        649.00      175.00
 Piezometric Surface No.  2 Specified by  2 Coordinate Points
   Point      X-Water     Y-Water
    No.         (ft)        (ft)
     1           .00      127.00
     2        649.00      126.00
Searching Routine Will Be Limited To An Area Defined By  1 Boundaries
 Of Which The First  1 Boundaries Will Deflect Surfaces Upward
 Boundary     X-Left      Y-Left     X-Right     Y-Right
    No.         (ft)        (ft)       (ft)        (ft)
     1           .00      127.00      649.00      126.00
 A Horizontal Earthquake Loading Coefficient
 Of .150 Has Been Assigned
 A Vertical Earthquake Loading Coefficient
 Of .000 Has Been Assigned
 Cavitation Pressure =      .0 (psf)
 A Critical Failure Surface Searching Method, Using A Random
 Technique For Generating Circular Surfaces, Has Been Specified.
 400 Trial Surfaces Have Been Generated.
  20 Surfaces Initiate From Each Of 20 Points Equally Spaced
 Along The Ground Surface Between  X =  25.00 ft.
                                   and  X = 125.00 ft.
 Each Surface Terminates Between   X - 480.00 ft.
```

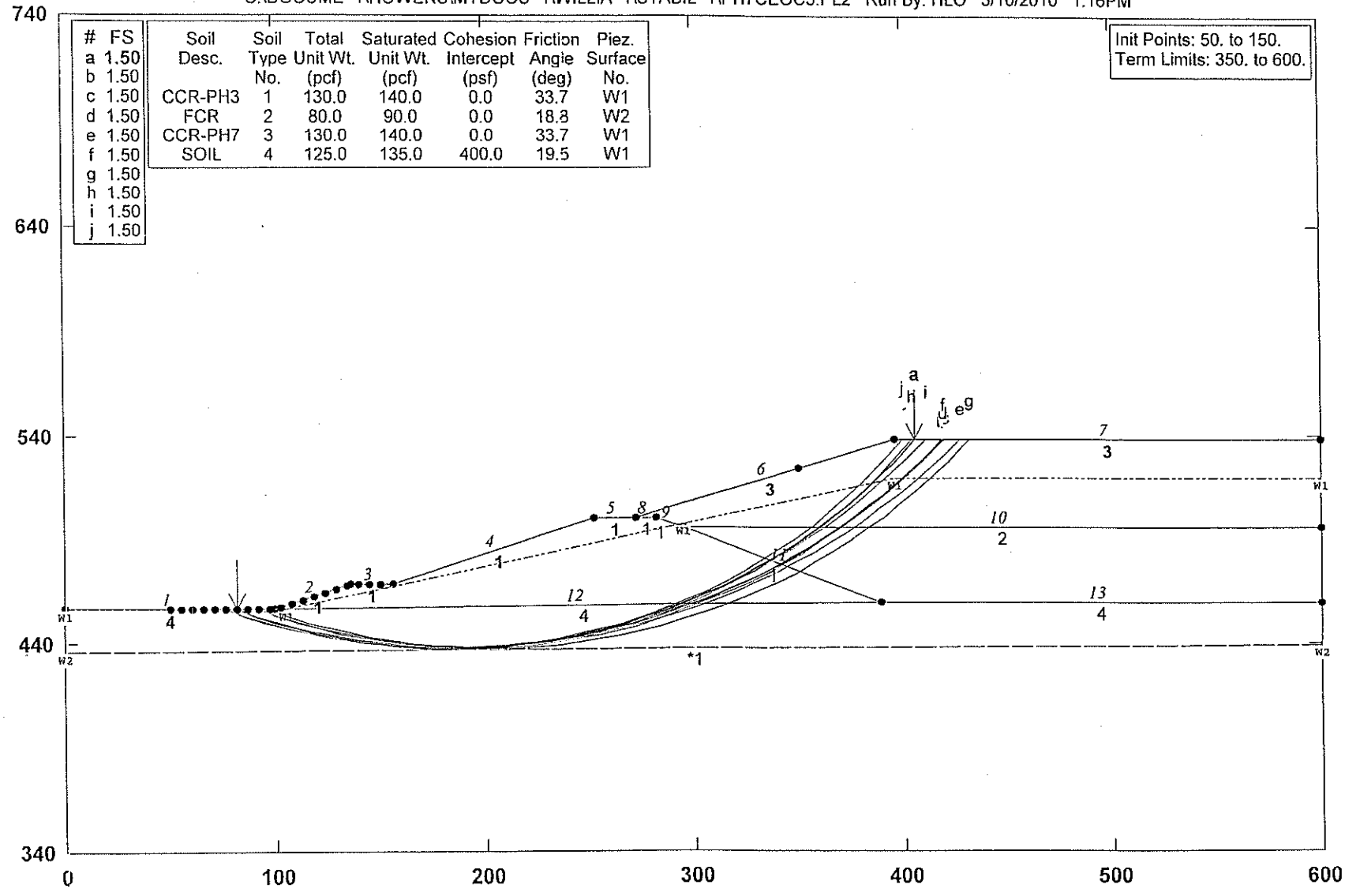
and X = 625.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =100.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	82.90	164.00
2	92.58	161.49
3	102.31	159.18
4	112.08	157.07
5	121.90	155.16
6	131.75	153.46
7	141.64	151.95
8	151.55	150.65
9	161.49	149.55
10	171.45	148.65
11	181.42	147.96
12	191.41	147.47
13	201.41	147.18
14	211.41	147.10
15	221.41	147.23
16	231.40	147.56
17	241.39	148.09
18	251.36	148.83
19	261.32	149.77
20	271.25	150.91
21	281.16	152.26
22	291.04	153.81
23	300.88	155.56
24	310.69	157.52
25	320.46	159.67
26	330.18	162.02
27	339.85	164.57
28	349.46	167.32
29	359.02	170.26
30	368.51	173.40
31	377.94	176.74
32	387.30	180.26
33	396.58	183.98
34	405.79	187.88
35	414.91	191.97
36	423.95	196.25
37	432.90	200.71
38	441.76	205.36
39	450.52	210.18
40	459.18	215.18
41	467.73	220.36
42	476.18	225.71
43	484.51	231.24
44	487.12	233.04

Circle Center At X = 210.3 ; Y = 635.8 and Radius, 488.7
*** 1.270 ***

PHASE 3/7C DOWNSTREAM EOC STATIC REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH7CEOC3.PL2 Run By: HLO 3/10/2010 1:16PM



#	FS
a	1.50
b	1.50
c	1.50
d	1.50
e	1.50
f	1.50
g	1.50
h	1.50
i	1.50
j	1.50

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR-PH3	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	18.8	W2
CCR-PH7	3	130.0	140.0	0.0	33.7	W1
SOIL	4	125.0	135.0	400.0	19.5	W1

PCSTABL5M/si FSmin=1.50

Safety Factors Are Calculated By The Modified Bishop Method

STED

23 R12713
Rev.

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 3/10/2010
Time of Run: 1:16PM
Run By: HLO
Input Data Filename: C:PH7CEOC3.
Output Filename: C:PH7CEOC3.OUT
Unit: ENGLISH
Plotted Output Filename: C:PH7CEOC3.PLT
PROBLEM DESCRIPTION PHASE 3/7C DOWNSTREAM EOC STATIC
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 340.00 to Y-values listed.

7 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	116.00	100.00	116.00	4
2	100.00	116.00	136.00	128.00	1
3	136.00	128.00	156.00	128.00	1
4	156.00	128.00	252.00	160.00	1
5	252.00	160.00	272.00	160.00	1
6	272.00	160.00	396.00	198.00	3
7	396.00	198.00	600.00	198.00	3
8	272.00	160.00	282.00	160.00	1
9	282.00	160.00	295.00	155.00	1
10	295.00	155.00	600.00	155.00	2
11	295.00	155.00	389.00	119.00	1
12	100.00	116.00	389.00	119.00	4
13	389.00	119.00	600.00	119.00	4

ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	18.8	.00	.0	2
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	400.0	19.5	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	116.00
2	105.00	116.00
3	295.00	157.10
4	396.00	179.00
5	600.00	179.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	96.00
2	600.00	99.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	96.00	600.00	99.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 150.00 ft.
Each Surface Terminates Between X = 350.00 ft.
and X = 600.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 96.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	116.00
2	91.00	112.66
3	100.54	109.64
4	110.17	106.95
5	119.88	104.58
6	129.68	102.55
7	139.53	100.85
8	149.44	99.49
9	159.38	98.46
10	169.36	97.77
11	179.35	97.43
12	189.35	97.42
13	199.35	97.75
14	209.33	98.42
15	219.28	99.43
16	229.18	100.78
17	239.04	102.46
18	248.84	104.48
19	258.56	106.83
20	268.19	109.51
21	277.73	112.52
22	287.16	115.84
23	296.47	119.49
24	305.65	123.45
25	314.70	127.72
26	323.59	132.29
27	332.32	137.17
28	340.88	142.34
29	349.26	147.79
30	357.45	153.53
31	365.44	159.54
32	373.22	165.83
33	380.78	172.37
34	388.12	179.16
35	395.22	186.20
36	402.08	193.48
37	406.06	198.00

Circle Center At X = 184.6 ; Y = 391.6 and Radius, 294.2
*** 1.496 ***
Individual data on the 51 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.4	2125.9	.0	1042.6	.0	.0	.0	.0	.0
2	9.0	5787.7	.0	2806.2	.0	.0	.0	.0	.0
3	.5	462.0	.0	220.9	.0	.0	.0	.0	.0
4	4.5	4742.2	.0	2019.4	.0	.0	.0	.0	.0
5	.3	315.6	.0	122.5	.0	.0	.0	.0	.0
6	4.9	7212.7	.0	2788.3	.0	.0	.0	.0	.0
7	9.7	19930.6	.0	7568.0	.0	.0	.0	.0	.0

8	9.8	27320.9	.0	10196.6	.0	.0	.0	.0	.0
9	6.3	21290.7	.0	7837.3	.0	.0	.0	.0	.0
10	3.5	12809.9	.0	4794.0	.0	.0	.0	.0	.0
11	9.9	37398.2	.0	14869.2	.0	.0	.0	.0	.0
12	6.6	25788.5	.0	10937.5	.0	.0	.0	.0	.0
13	3.4	13816.1	.0	5970.3	.0	.0	.0	.0	.0
14	10.0	44447.6	.0	18744.8	.0	.0	.0	.0	.0
15	10.0	49752.8	.0	20378.1	.0	.0	.0	.0	.0
16	10.0	54560.4	.0	21805.6	.0	.0	.0	.0	.0
17	10.0	58847.5	.0	23025.9	.0	.0	.0	.0	.0
18	10.0	62595.0	.0	24037.4	.0	.0	.0	.0	.0
19	9.9	65787.4	.0	24839.1	.0	.0	.0	.0	.0
20	9.9	68413.6	.0	25429.9	.0	.0	.0	.0	.0
21	9.9	70466.0	.0	25809.2	.0	.0	.0	.0	.0
22	9.8	71941.4	.0	25976.6	.0	.0	.0	.0	.0
23	3.2	23580.1	.0	8458.6	.0	.0	.0	.0	.0
24	6.6	48329.0	.0	17473.2	.0	.0	.0	.0	.0
25	9.6	68419.3	.0	25675.0	.0	.0	.0	.0	.0
26	3.8	26112.2	.0	10137.3	.0	.0	.0	.0	.0
27	5.7	38810.1	.0	15069.1	.0	.0	.0	.0	.0
28	4.3	28885.5	.0	11207.8	.0	.0	.0	.0	.0
29	5.2	34742.0	.0	13318.7	.0	.0	.0	.0	.0
30	4.3	29111.9	.0	11158.2	.0	.0	.0	.0	.0
31	1.2	7742.1	.0	2944.0	.0	.0	.0	.0	.0
32	2.3	15506.6	.0	5868.6	.0	.0	.0	.0	.0
33	1.5	9709.3	.0	3665.1	.0	.0	.0	.0	.0
34	9.2	58663.3	.0	22536.1	.0	.0	.0	.0	.0
35	9.0	54132.4	.0	21231.3	.0	.0	.0	.0	.0
36	8.9	49249.1	.0	19719.7	.0	.0	.0	.0	.0
37	8.7	44053.6	.0	18003.3	.0	.0	.0	.0	.0
38	3.6	16752.0	.0	6985.0	.0	.0	.0	.0	.0
39	5.0	22568.9	.0	.0	.0	.0	.0	.0	.0
40	8.4	37545.5	.0	.0	.0	.0	.0	.0	.0
41	8.2	35883.0	.0	.0	.0	.0	.0	.0	.0
42	2.0	8405.9	.0	.0	.0	.0	.0	.0	.0
43	6.0	24745.8	.0	6659.8	.0	.0	.0	.0	.0
44	7.8	28257.1	.0	6424.7	.0	.0	.0	.0	.0
45	7.6	23122.3	.0	3528.5	.0	.0	.0	.0	.0
46	4.7	11996.9	.0	651.2	.0	.0	.0	.0	.0
47	2.6	5911.3	.0	.0	.0	.0	.0	.0	.0
48	7.1	12915.8	.0	.0	.0	.0	.0	.0	.0
49	.8	1138.9	.0	.0	.0	.0	.0	.0	.0
50	6.1	6121.9	.0	.0	.0	.0	.0	.0	.0
51	4.0	1168.1	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	92.11	116.00
2	101.58	112.80
3	111.15	109.91
4	120.82	107.34
5	130.56	105.09
6	140.37	103.16
7	150.24	101.56
8	160.16	100.29
9	170.12	99.34
10	180.10	98.72
11	190.09	98.43
12	200.09	98.47
13	210.09	98.84
14	220.06	99.54
15	230.01	100.57
16	239.92	101.92
17	249.78	103.60
18	259.57	105.61
19	269.30	107.94
20	278.94	110.59

21	288.49	113.55
22	297.94	116.83
23	307.27	120.42
24	316.48	124.31
25	325.56	128.50
26	334.50	133.00
27	343.28	137.78
28	351.89	142.85
29	360.34	148.21
30	368.61	153.84
31	376.68	159.73
32	384.56	165.90
33	392.23	172.31
34	399.68	178.98
35	406.91	185.89
36	413.90	193.04
37	418.45	198.00

Circle Center At X = 193.9 ; Y = 401.5 and Radius, 303.1

*** 1.497 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	116.00
2	91.07	112.85
3	100.65	109.99
4	110.32	107.44
5	120.06	105.19
6	129.87	103.24
7	139.74	101.60
8	149.65	100.27
9	159.60	99.25
10	169.57	98.54
11	179.56	98.14
12	189.56	98.06
13	199.56	98.28
14	209.55	98.82
15	219.51	99.67
16	229.44	100.83
17	239.33	102.30
18	249.18	104.08
19	258.96	106.17
20	268.67	108.55
21	278.30	111.25
22	287.84	114.24
23	297.28	117.52
24	306.62	121.10
25	315.84	124.97
26	324.94	129.13
27	333.90	133.56
28	342.72	138.28
29	351.39	143.26
30	359.89	148.52
31	368.23	154.04
32	376.40	159.81
33	384.38	165.84
34	392.16	172.12
35	399.75	178.63
36	407.13	185.38
37	414.30	192.35
38	419.75	198.00

Circle Center At X = 187.3 ; Y = 418.3 and Radius, 320.3

*** 1.499 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	116.00
2	91.07	112.85

3	100.65	109.99
4	110.32	107.44
5	120.06	105.19
6	129.87	103.24
7	139.74	101.61
8	149.65	100.28
9	159.60	99.27
10	169.57	98.56
11	179.57	98.17
12	189.57	98.09
13	199.56	98.33
14	209.55	98.88
15	219.51	99.73
16	229.44	100.91
17	239.33	102.39
18	249.17	104.18
19	258.95	106.27
20	268.66	108.68
21	278.28	111.38
22	287.82	114.39
23	297.26	117.69
24	306.59	121.28
25	315.81	125.17
26	324.89	129.34
27	333.85	133.80
28	342.66	138.53
29	351.31	143.53
30	359.81	148.81
31	368.14	154.35
32	376.29	160.14
33	384.25	166.19
34	392.02	172.48
35	399.59	179.02
36	406.95	185.79
37	414.10	192.78
38	419.11	198.00

Circle Center At X = 187.1 ; Y = 417.5 and Radius, 319.4

*** 1.499 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.32	116.00
2	85.80	112.84
3	95.38	109.96
4	105.04	107.36
5	114.77	105.06
6	124.56	103.05
7	134.41	101.32
8	144.31	99.90
9	154.25	98.76
10	164.21	97.93
11	174.20	97.39
12	184.19	97.14
13	194.19	97.20
14	204.19	97.55
15	214.17	98.20
16	224.12	99.14
17	234.04	100.38
18	243.93	101.92
19	253.76	103.75
20	263.53	105.87
21	273.23	108.28
22	282.86	110.98
23	292.41	113.96
24	301.86	117.23
25	311.21	120.77
26	320.45	124.60

27	329.57	128.69
28	338.57	133.06
29	347.43	137.69
30	356.16	142.58
31	364.73	147.73
32	373.14	153.13
33	381.39	158.78
34	389.47	164.68
35	397.37	170.81
36	405.09	177.17
37	412.61	183.76
38	419.93	190.57
39	427.05	197.60
40	427.43	198.00

Circle Center At X = 187.4 ; Y = 433.2 and Radius, 336.1

*** 1.499 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.32	116.00
2	85.80	112.82
3	95.37	109.94
4	105.03	107.35
5	114.77	105.06
6	124.57	103.07
7	134.42	101.39
8	144.33	100.00
9	154.27	98.92
10	164.24	98.15
11	174.23	97.69
12	184.23	97.53
13	194.23	97.68
14	204.22	98.13
15	214.19	98.90
16	224.13	99.97
17	234.03	101.34
18	243.89	103.02
19	253.69	105.00
20	263.43	107.28
21	273.09	109.86
22	282.67	112.74
23	292.16	115.90
24	301.54	119.36
25	310.81	123.11
26	319.96	127.13
27	328.99	131.44
28	337.88	136.02
29	346.62	140.88
30	355.21	146.00
31	363.64	151.38
32	371.90	157.02
33	379.98	162.91
34	387.87	169.04
35	395.58	175.42
36	403.08	182.03
37	410.38	188.87
38	417.47	195.92
39	419.43	198.00

Circle Center At X = 184.4 ; Y = 422.8 and Radius, 325.3

*** 1.499 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.37	116.00
2	106.82	112.74
3	116.38	109.79
4	126.02	107.14

5	135.74	104.81
6	145.54	102.79
7	155.39	101.09
8	165.30	99.71
9	175.24	98.65
10	185.21	97.91
11	195.20	97.49
12	205.20	97.39
13	215.20	97.61
14	225.19	98.16
15	235.15	99.03
16	245.08	100.22
17	254.96	101.72
18	264.80	103.55
19	274.56	105.69
20	284.26	108.15
21	293.87	110.91
22	303.38	113.99
23	312.79	117.37
24	322.09	121.05
25	331.27	125.03
26	340.31	129.30
27	349.21	133.86
28	357.95	138.71
29	366.54	143.84
30	374.96	149.24
31	383.19	154.90
32	391.25	160.84
33	399.10	167.02
34	406.76	173.46
35	414.20	180.14
36	421.42	187.06
37	428.41	194.20
38	431.90	198.00

Circle Center At X = 203.2 ; Y = 407.5 and Radius, 310.2

*** 1.499 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.37	116.00
2	106.79	112.64
3	116.32	109.63
4	125.96	106.97
5	135.70	104.67
6	145.50	102.72
7	155.38	101.14
8	165.30	99.92
9	175.27	99.06
10	185.25	98.57
11	195.25	98.44
12	205.25	98.68
13	215.23	99.29
14	225.18	100.26
15	235.09	101.60
16	244.95	103.30
17	254.74	105.35
18	264.44	107.77
19	274.05	110.54
20	283.55	113.66
21	292.93	117.12
22	302.18	120.93
23	311.28	125.08
24	320.22	129.55
25	328.99	134.35
26	337.58	139.47
27	345.98	144.90
28	354.18	150.63

29	362.15	156.66
30	369.91	162.97
31	377.42	169.57
32	384.69	176.44
33	391.70	183.57
34	398.45	190.95
35	404.43	198.00

Circle Center At X = 193.7 ; Y = 371.3 and Radius, 272.9

*** 1.501 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.32	116.00
2	85.78	112.78
3	95.35	109.86
4	105.00	107.26
5	114.74	104.96
6	124.54	102.97
7	134.40	101.30
8	144.30	99.95
9	154.25	98.92
10	164.23	98.20
11	174.22	97.81
12	184.22	97.73
13	194.21	97.97
14	204.20	98.54
15	214.16	99.42
16	224.09	100.63
17	233.97	102.15
18	243.80	103.98
19	253.57	106.13
20	263.26	108.59
21	272.87	111.36
22	282.38	114.44
23	291.79	117.82
24	301.09	121.50
25	310.27	125.48
26	319.31	129.74
27	328.21	134.30
28	336.97	139.14
29	345.56	144.25
30	353.98	149.64
31	362.23	155.30
32	370.29	161.21
33	378.16	167.38
34	385.83	173.80
35	393.28	180.47
36	400.52	187.36
37	407.54	194.49
38	410.78	198.00

Circle Center At X = 181.6 ; Y = 409.8 and Radius, 312.1

*** 1.501 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	92.11	116.00
2	101.52	112.62
3	111.05	109.59
4	120.68	106.91
5	130.41	104.59
6	140.21	102.62
7	150.08	101.02
8	160.01	99.78
9	169.97	98.90
10	179.95	98.39
11	189.95	98.25
12	199.95	98.48

23 J
rev.
R12722

13	209.93	99.07
14	219.89	100.03
15	229.80	101.35
16	239.66	103.04
17	249.44	105.09
18	259.15	107.49
19	268.76	110.25
20	278.27	113.36
21	287.65	116.82
22	296.90	120.62
23	306.00	124.76
24	314.95	129.23
25	323.72	134.02
26	332.32	139.14
27	340.72	144.56
28	348.91	150.29
29	356.89	156.32
30	364.64	162.64
31	372.16	169.23
32	379.43	176.10
33	386.44	183.23
34	393.18	190.62
35	399.45	198.00

Circle Center At X = 188.8 ; Y = 370.5 and Radius, 272.3
*** 1.503 ***

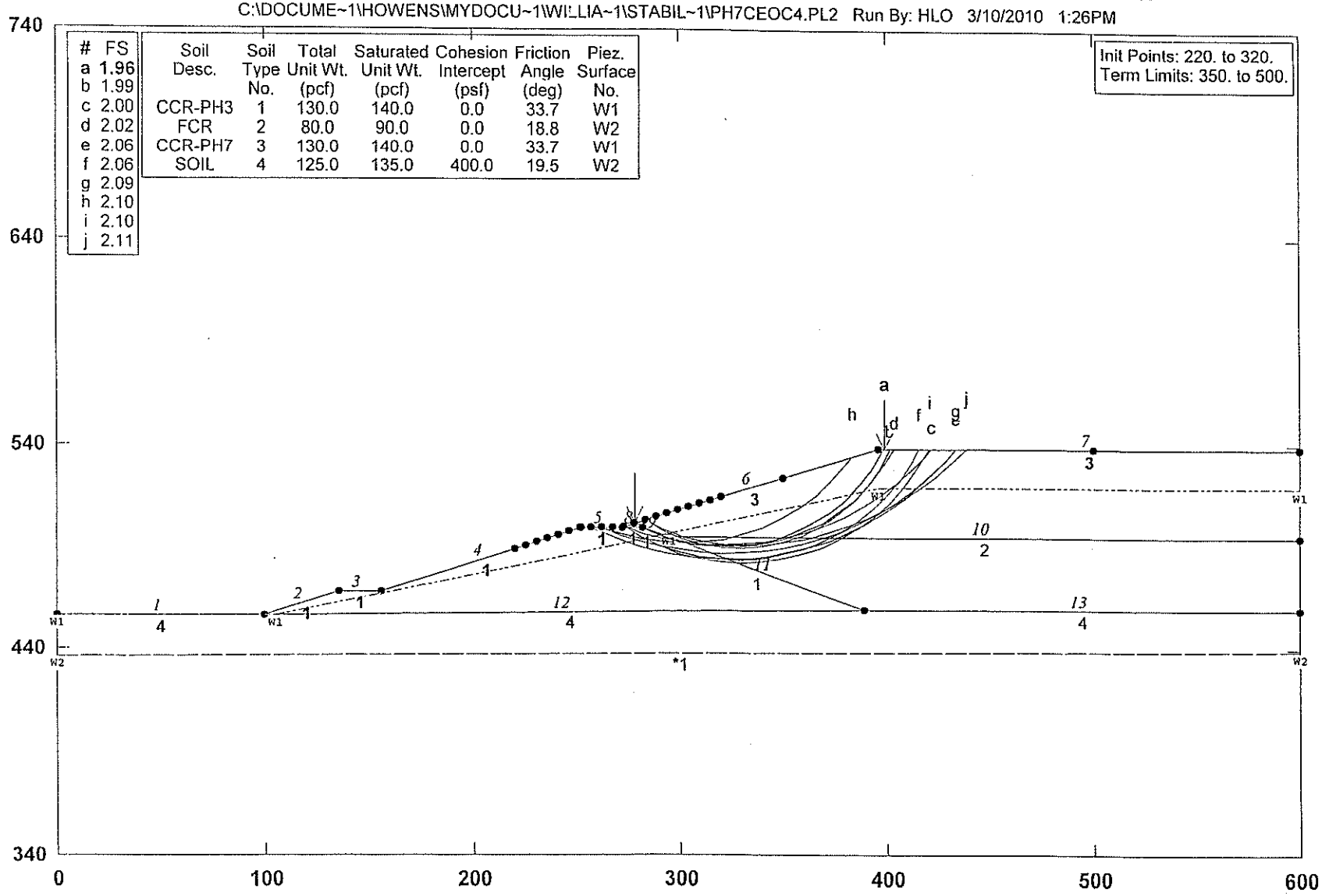
PHASE 3/7C DOWNSTREAM EOC STATIC REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH7CEOC4.PL2 Run By: HLO 3/10/2010 1:26PM

#	FS
a	1.96
b	1.99
c	2.00
d	2.02
e	2.06
f	2.06
g	2.09
h	2.10
i	2.10
j	2.11

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR-PH3	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	18.8	W2
CCR-PH7	3	130.0	140.0	0.0	33.7	W1
SOIL	4	125.0	135.0	400.0	19.5	W2

Init Points: 220. to 320.
Term Limits: 350. to 500.



PCSTABL5M/si FSmin=1.96

Safety Factors Are Calculated By The Modified Bishop Method

STED



231 K REV.

R12723

231 1 REV.

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 3/10/2010
Time of Run: 1:26PM
Run By: HLO
Input Data Filename: C:PH7CEOC4.
Output Filename: C:PH7CEOC4.OUT
Unit: ENGLISH
Plotted Output Filename: C:PH7CEOC4.PLT
PROBLEM DESCRIPTION PHASE 3/7C DOWNSTREAM EOC STATIC
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 340.00 to Y-values listed.

7 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	116.00	100.00	116.00	4
2	100.00	116.00	136.00	128.00	1
3	136.00	128.00	156.00	128.00	1
4	156.00	128.00	252.00	160.00	1
5	252.00	160.00	272.00	160.00	1
6	272.00	160.00	396.00	198.00	3
7	396.00	198.00	600.00	198.00	3
8	272.00	160.00	282.00	160.00	1
9	282.00	160.00	295.00	155.00	1
10	295.00	155.00	600.00	155.00	2
11	295.00	155.00	389.00	119.00	1
12	100.00	116.00	389.00	119.00	4
13	389.00	119.00	600.00	119.00	4

ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	18.8	.00	.0	2
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	116.00
2	105.00	116.00
3	295.00	157.10
4	396.00	179.00
5	600.00	179.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	96.00
2	600.00	99.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	96.00	600.00	99.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 220.00 ft.
and X = 320.00 ft.
Each Surface Terminates Between X = 350.00 ft.
and X = 500.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 96.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	277.90	161.81
2	286.87	157.39
3	296.28	154.02
4	306.02	151.75
5	315.96	150.60
6	325.96	150.59
7	335.89	151.72
8	345.63	153.98
9	355.06	157.33
10	364.04	161.73
11	372.46	167.13
12	380.21	173.44
13	387.19	180.61
14	393.30	188.51
15	398.48	197.07
16	398.91	198.00

Circle Center At X = 321.0 ; Y = 238.0 and Radius, 87.6
*** 1.955 ***
Individual data on the 24 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.7	699.1	.0	.0	.0	.0	.0	.0	.0
2	.4	175.8	.0	.0	.0	.0	.0	.0	.0
3	4.9	3304.3	.0	.0	.0	.0	.0	.0	.0
4	3.6	3876.6	.0	.0	.0	.0	.0	.0	.0
5	1.1	1376.8	.0	21.2	.0	.0	.0	.0	.0
6	3.5	5237.1	.0	365.8	.0	.0	.0	.0	.0
7	1.3	2185.8	.0	248.3	.0	.0	.0	.0	.0
8	3.2	5941.0	.0	830.1	.0	.0	.0	.0	.0
9	6.5	13715.0	.0	.0	.0	.0	.0	.0	.0
10	9.9	25457.0	.0	.0	.0	.0	.0	.0	.0
11	10.0	30269.8	.0	.0	.0	.0	.0	.0	.0
12	9.9	33787.0	.0	.0	.0	.0	.0	.0	.0
13	9.7	35836.1	.0	.0	.0	.0	.0	.0	.0
14	2.9	10947.1	.0	.0	.0	.0	.0	.0	.0
15	6.6	24935.5	.0	5618.1	.0	.0	.0	.0	.0
16	9.0	32882.3	.0	7055.3	.0	.0	.0	.0	.0
17	8.4	28141.2	.0	5218.0	.0	.0	.0	.0	.0
18	7.8	22188.0	.0	2714.5	.0	.0	.0	.0	.0
19	2.6	6452.8	.0	245.2	.0	.0	.0	.0	.0
20	4.3	9185.9	.0	.0	.0	.0	.0	.0	.0
21	6.1	9288.1	.0	.0	.0	.0	.0	.0	.0
22	2.7	2398.7	.0	.0	.0	.0	.0	.0	.0
23	2.5	962.2	.0	.0	.0	.0	.0	.0	.0
24	.4	25.8	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	283.16	163.42

2	291.77	158.33
3	300.95	154.36
4	310.55	151.56
5	320.42	149.99
6	330.42	149.66
7	340.37	150.58
8	350.14	152.73
9	359.56	156.09
10	368.48	160.60
11	376.78	166.19
12	384.31	172.76
13	390.96	180.23
14	396.63	188.47
15	401.23	197.35
16	401.46	198.00

Circle Center At X = 328.0 ; Y = 229.5 and Radius, 79.9

*** 1.985 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	272.63	160.19
2	282.10	156.98
3	291.79	154.49
4	301.63	152.73
5	311.58	151.70
6	321.57	151.43
7	331.56	151.90
8	341.49	153.12
9	351.29	155.08
10	360.93	157.76
11	370.33	161.16
12	379.46	165.25
13	388.25	170.01
14	396.66	175.42
15	404.65	181.44
16	412.16	188.04
17	419.16	195.18
18	421.53	198.00

Circle Center At X = 320.2 ; Y = 284.8 and Radius, 133.4

*** 2.004 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	283.16	163.42
2	292.02	158.79
3	301.37	155.23
4	311.06	152.79
5	320.98	151.49
6	330.98	151.37
7	340.92	152.42
8	350.68	154.62
9	360.11	157.95
10	369.08	162.36
11	377.48	167.78
12	385.19	174.16
13	392.10	181.39
14	398.11	189.38
15	403.14	198.00

Circle Center At X = 327.0 ; Y = 236.6 and Radius, 85.3

*** 2.016 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	262.11	160.00
2	271.38	156.25
3	280.88	153.14
4	290.57	150.68

5	300.41	148.88
6	310.35	147.75
7	320.34	147.29
8	330.33	147.51
9	340.29	148.41
10	350.17	149.98
11	359.92	152.21
12	369.49	155.10
13	378.85	158.62
14	387.95	162.77
15	396.74	167.53
16	405.20	172.87
17	413.27	178.77
18	420.93	185.21
19	428.13	192.14
20	433.44	198.00

Circle Center At X = 322.1 ; Y = 294.9 and Radius, 147.6

*** 2.060 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	272.63	160.19
2	281.29	155.19
3	290.41	151.08
4	299.88	147.89
5	309.63	145.67
6	319.56	144.42
7	329.55	144.18
8	339.53	144.92
9	349.37	146.66
10	359.00	149.37
11	368.31	153.03
12	377.20	157.60
13	385.60	163.03
14	393.42	169.27
15	400.57	176.25
16	406.99	183.92
17	412.62	192.18
18	415.78	198.00

Circle Center At X = 327.0 ; Y = 244.2 and Radius, 100.1

*** 2.063 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	256.84	160.00
2	265.91	155.79
3	275.25	152.21
4	284.82	149.30
5	294.57	147.07
6	304.44	145.51
7	314.41	144.65
8	324.41	144.49
9	334.39	145.03
10	344.32	146.26
11	354.13	148.18
12	363.79	150.78
13	373.24	154.04
14	382.44	157.96
15	391.34	162.51
16	399.91	167.67
17	408.09	173.42
18	415.86	179.72
19	423.16	186.55
20	429.98	193.87
21	433.32	198.00

Circle Center At X = 321.7 ; Y = 287.8 and Radius, 143.3

*** 2.088 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	262.11	160.00
2	271.51	156.60
3	281.20	154.14
4	291.09	152.65
5	301.08	152.15
6	311.07	152.63
7	320.96	154.10
8	330.66	156.53
9	340.07	159.91
10	349.10	164.20
11	357.67	169.36
12	365.68	175.35
13	373.07	182.09
14	379.75	189.53
15	383.05	194.03

Circle Center At X = 301.2 ; Y = 253.4 and Radius, 101.2

*** 2.095 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	272.63	160.19
2	281.19	155.02
3	290.21	150.71
4	299.61	147.29
5	309.30	144.81
6	319.18	143.29
7	329.17	142.74
8	339.16	143.17
9	349.06	144.56
10	358.78	146.92
11	368.22	150.22
12	377.29	154.42
13	385.91	159.49
14	394.00	165.37
15	401.47	172.02
16	408.26	179.36
17	414.30	187.33
18	419.53	195.85
19	420.58	198.00

Circle Center At X = 329.8 ; Y = 245.1 and Radius, 102.3

*** 2.104 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	272.63	160.19
2	282.13	157.06
3	291.81	154.55
4	301.63	152.65
5	311.55	151.39
6	321.53	150.76
7	331.53	150.77
8	341.51	151.42
9	351.42	152.71
10	361.24	154.62
11	370.91	157.16
12	380.40	160.31
13	389.67	164.06
14	398.68	168.40
15	407.40	173.30
16	415.79	178.75
17	423.81	184.72
18	431.43	191.19
19	438.49	198.00

Circle Center At X = 326.4 ; Y = 307.3 and Radius, 156.6

2.108 ***

ALPS, 1/23/2007, 11:41:04

(233)

ALPS module build: 5.1.21
Project File: UnTitled
Units: (ft) (psi)

[PROJECT TITLE]
POND CREEK NO. 1 PILLAR STABILITY

[PROJECT DESCRIPTION]
AREA UNDER PHASE 7 IMPOUNDMENT

[GEOMETRY PARAMETERS]
Entry Height.....8 (ft)
Depth of Cover.....528 (ft)
Panel Width.....1250 (ft)
Entry Width.....18 (ft)
Number of Entries.....3
Center to Center Distance #1.....100 (ft)
Center to Center Distance #2.....100 (ft)
Crosscut Spacing.....100 (ft)

[DEFAULT PARAMETERS]
In Situ Coal Strength.....900 (psi)
Abutment Angle.....21 (deg)
Unit Weight of Overburden.....154 (pcf)

[ALPS STABILITY FACTORS - STANDARD GEOMETRY]

	Classic ALPS	ALPS (R)
Development Loading	4.64	4.64
Headgate Loading	3.70	3.70
Bleeder Loading	3.08	3.08
*** Tailgate Loading	2.49	2.49
Isolated Loading	2.30	2.30

[PILLAR LOAD BEARING CAPACITY]

PILLAR #1
for Pillar Width (ft).....82.0
and Pillar Length (ft).....82.0
Width/Height Ratio.....10.25
Unit Pillar Strength (psi).....3897
Pillar Load Bearing Capacity (lbs) / (ft) of gate entry.....3.77E+07

Unit Pillar Strength (R) (psi).....3897
Pillar Load Bearing Capacity (R) (lbs) / (ft) of gate entry....3.77E+07

PILLAR #2
for Pillar Width (ft).....82.0
and Pillar Length (ft).....82.0
Width/Height Ratio.....10.25
Unit Pillar Strength (psi).....3897
Pillar Load Bearing Capacity (lbs) / (ft) of gate entry.....3.77E+07

Unit Pillar Strength (R) (psi).....3897
Pillar Load Bearing Capacity (R) (lbs) / (ft) of gate entry....3.77E+07

TOTAL PILLAR SYSTEM LOAD BEARING CAPACITY [ALPS Classic]
Total Load (lbs) / (ft) of gate entry.....7.55E+07

TOTAL PILLAR SYSTEM LOAD BEARING CAPACITY [ALPS (R)]
Total Load (lbs) / (ft) of gate entry.....7.55E+07

[DESIGN LOADINGS ON PILLAR SYSTEM (lbs) / (ft) of gate entry]

(232)


```
    Development Loading.....16,262,400
    Headgate Loading.....20,381,370
    Bleeder Loading.....24,500,340
*** Tailgate Loading.....30,270,590
    Isolated Loading.....32,742,620
```

[INDIVIDUAL PILLAR LOADING (psi)]

LOADING CONDITION	PILLAR #1	PILLAR #2
Development	840	840
Headgate	1201	904
Bleeder	1562	968
Unit Pill.Str.	3897	3897
Unit Pill.Str.(R)	3897	3897

NOTE: INDIVIDUAL PILLAR LOADINGS DO NOT CONSIDER LOAD TRANSFER DUE TO PILLAR YIELDING!

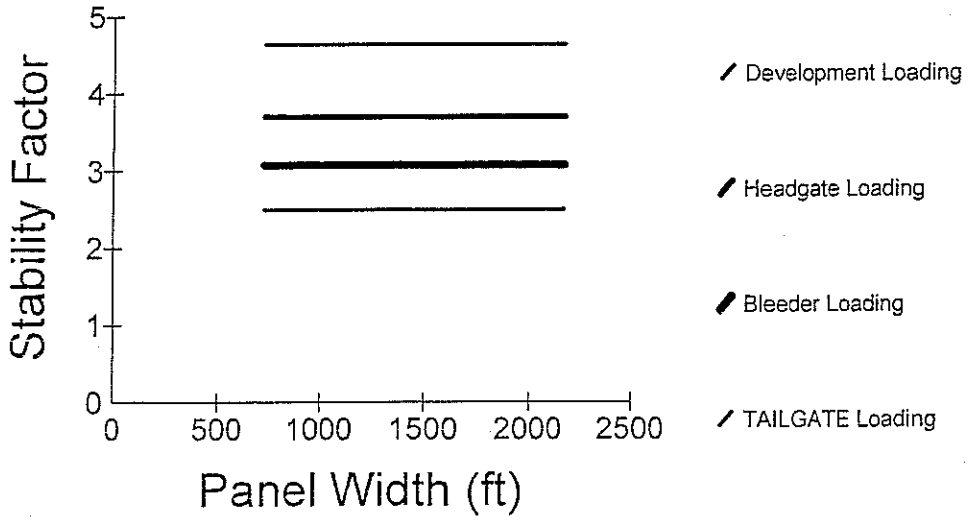
Unit weight of overburden =
100'X130lb (coal refuse) + 20'X 120lb (existing soil) + 408'X162lb (Rock) ÷ 528
= 154 pcf

Entry Height = 15 8' in general with as much as 10' in isolated areas

(All mine related input supplied by Williamson Energy LLC.)

234

Analysis of Longwall Pillar Stability



Alliance Consulting, Inc.
Engineers
Constructors
Scientists
BECKLEY, WV
(304) 255-0491

BY: HJO DATE: 4/5/09 CHKD BY: _____ DATE: _____ (234a)

PROJECT NAME: WILLIAMSON ENERGY LLC

PROJECT NO. 805-330-1413 SHEET _____ OF _____

DESCRIPTION SUBSIDENCE BASELINE CRITERIA

REFERENCE: "COAL MINE GROUND CONTROL", S. PENG, JOHN WILEY AND SONS, 1978.

FIND: REQUIRED DISTANCE BETWEEN BASELINE SURVEY STATIONS

CRITERIA: DISTANCE ≤ h/20 (PENG, PG 315)

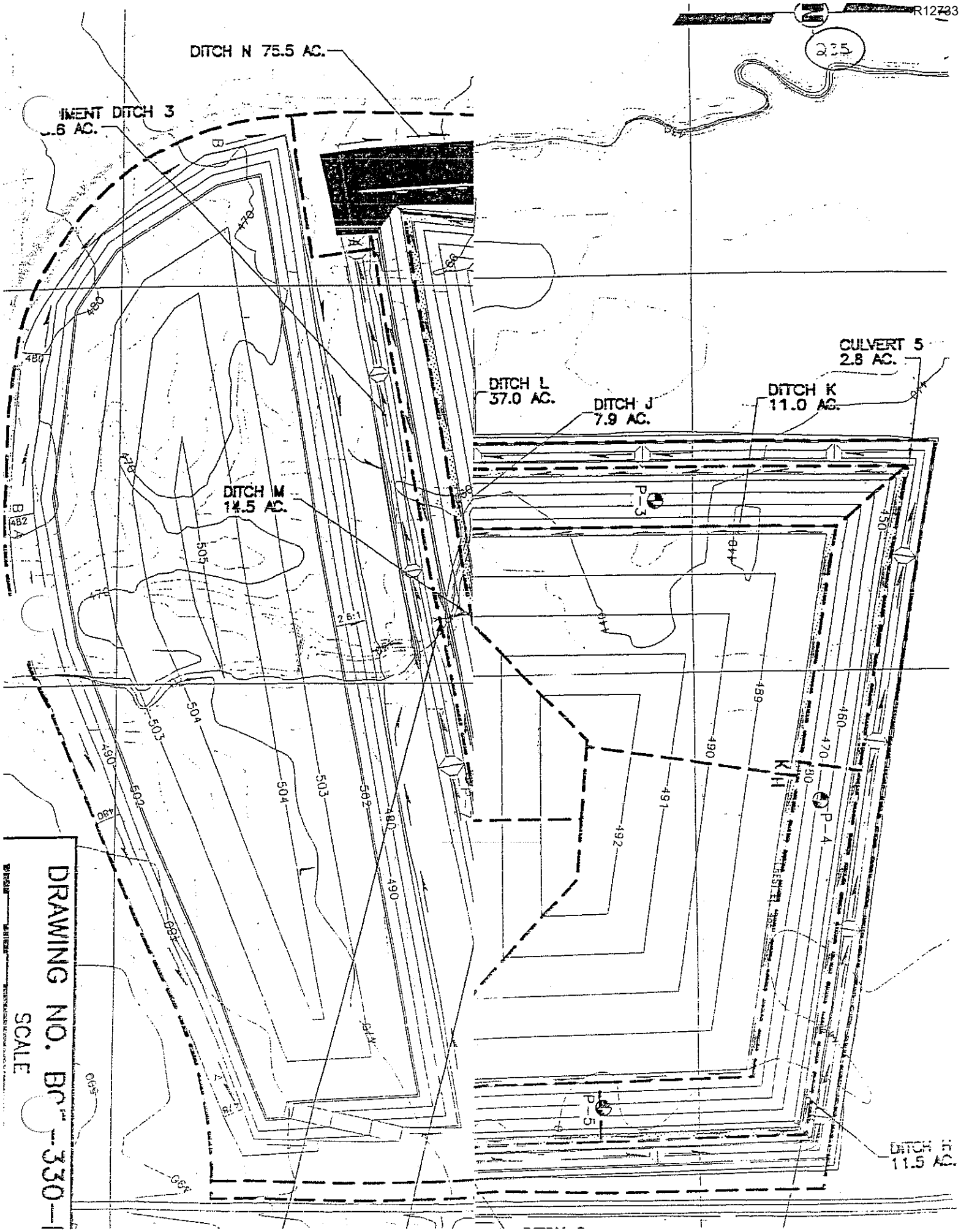
h = DEPTH OF COAL SEAM BELOW SURFACE

464' < h < 522'

464/20 < DISTANCE < 522/20

23.2' < DISTANCE < 26.1'

USE SURVEY STATIONS 25' APART FOR SUBSIDENCE BASELINES "E", "F", "G", AND "H"


R12733
235
DITCH N 75.5 AC.
IMENT DITCH 3
.6 AC.
CULVERT 5
2.8 AC.
DITCH L
37.0 AC.
DITCH J
7.9 AC.
DITCH K
11.0 AC.
DITCH M
14.5 AC.
P-3
P-4
P-5
DITCH H
11.5 AC.
DRAWING NO. BC -330-
SCALE

MACH MINING

DITCH "C"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH C



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	39.500	39.500	95.83	13.07

Structure Detail:

Structure #1 (Null)

DITCH C

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	39.500	0.667	0.000	0.000	80.000	M	95.83	13.072
	Σ	**39.500**						**95.83**	**13.072**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	9.00	900.00	3.000	0.083
		8. Large gullies, diversions, and low flowing streams	0.25	7.88	3,155.00	1.500	0.584
							0.667
#1	**1**	**Time of Concentration:**					

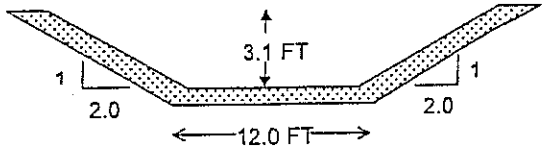
242

CALCULATED BY: JLH 5/24/2006
CHECKED BY: [illegible] 6/20/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH C

PEAK FLOW =	95.8	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.0025	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	20.95	FT	DEPTH OF FLOW =	2.00	FT
AREA OF FLOW =	32.05	SQ.FT.	MEAN DEPTH =	1.60	FT
HYDRAULIC RADIUS, Rh =	1.53	FT	FROUDE NO. =	0.42	SUBCRITICAL
CALC. VELOCITY =	2.99	FPS			

FREEBOARD REQUIRED =	1.09	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	3.1	FT	(CHANNEL LINING: SOIL AND GRASS)

MACH MINING

DITCH "D"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

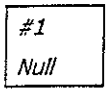
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH D



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	41.000	41.000	99.13	13.57

Structure Detail:

Structure #1 (Null)

DITCH D

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	41.000	0.671	0.000	0.000	80.000	M	99.13	13.568
	Σ	**41.000**						**99.13**	**13.568**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	9.00	900.00	3.000	0.083
		8. Large gullies, diversions, and low flowing streams	27.69	72.00	260.00	15.780	0.004
		8. Large gullies, diversions, and low flowing streams	0.25	7.88	3,155.00	1.500	0.584
#1	**1**	**Time of Concentration:**					**0.671**

CULVERT NO. 1

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 36 inches

Detailed Performance Curves

Design Discharge = 49.56 cfs X 2 pipes = 99.13 cfs

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (30 in)	**Discharge (cfs) (36 in)**	Discharge (cfs) (42 in)
0.50	1.86	**2.22**	2.59
1.00	5.24	**6.28**	7.33
1.50	9.62	**11.54**	13.47
2.00	14.81	**17.77**	20.73
2.50	20.69	**24.83**	28.97
3.00	26.85	**32.64**	38.08
3.50	31.83	**41.13**	47.99
4.00	36.21	**47.70**	58.63
4.50	40.12	**53.79**	67.36
5.00	43.68	**59.27**	75.38
5.50	46.97	**64.27**	82.63
6.00	50.04	**68.91**	89.30
6.50	52.94	**73.27**	95.50
7.00	55.69	**77.37**	101.32
7.50	58.30	**81.27**	106.82

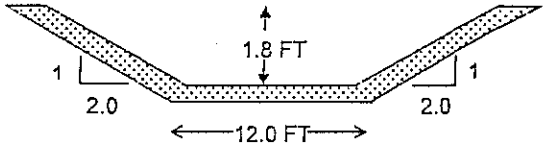
250

CALCULATED BY: JLH / 4/24/2006
CHECKED BY: [illegible] 4/20/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH D

PEAK FLOW =	99.1	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.33	FT/FT
MANNING'S N =	0.035	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	14.31	FT	DEPTH OF FLOW =	0.52	FT
AREA OF FLOW =	6.72	SQ.FT.	MEAN DEPTH =	0.48	FT
HYDRAULIC RADIUS, Rh =	0.47	FT	FROUDE NO. =	3.76	SUPERCRITICAL
CALC. VELOCITY =	14.74	FPS			

FREEBOARD REQUIRED =	1.30	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	1.8	FT	(CHANNEL LINING: GROUTED RIPRAP)

MACH MINING

DITCH "E"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

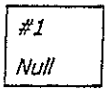
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH E



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	42.000	42.000	101.89	13.90

Structure Detail:

Structure #1 (Null)

DITCH E

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	42.000	0.667	0.000	0.000	80.000	M	101.89	13.899
	Σ	**42.000**						**101.89**	**13.899**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	9.00	900.00	3.000	0.083
		8. Large gullies, diversions, and low flowing streams	0.25	7.88	3,155.00	1.500	0.584
#1	**1**	**Time of Concentration:**					**0.667**

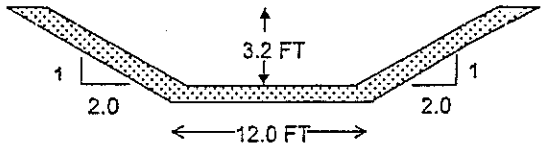
357

CALCULATED BY: JLH 5/24/2006
CHECKED BY: TJM 6/12/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH E

PEAK FLOW =	101.9	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.0025	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	21.27	FT	DEPTH OF FLOW =	2.07	FT
AREA OF FLOW =	33.45	SQ.FT.	MEAN DEPTH =	1.65	FT
HYDRAULIC RADIUS, Rh =	1.57	FT	FROUDE NO. =	0.42	SUBCRITICAL
CALC. VELOCITY =	3.05	FPS			

FREEBOARD REQUIRED =	1.10	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	3.2	FT	(CHANNEL LINING: SOIL AND GRASS)

MACH MINING

DITCH "F"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

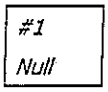
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH F



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	49.400	49.400	119.34	16.35

Structure Detail:

Structure #1 (Null)

DITCH F

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	49.400	0.672	0.000	0.000	80.000	M	119.34	16.348
	Σ	**49.400**						**119.34**	**16.348**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	9.00	900.00	3.000	0.083
		8. Large gullies, diversions, and low flowing streams	28.67	86.00	300.00	16.060	0.005
		8. Large gullies, diversions, and low flowing streams	0.25	7.88	3,155.00	1.500	0.584
#1	**1**	**Time of Concentration:**					**0.672**

SEDCAD 4.0

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264

CULVERT NO. 2

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max Headwater (ft)	Tailwater (ft)	Entrance Loss Coef (Ke)
30.00	3.00	0.0240	5.05	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 36 inches

Detailed Performance Curves

Design Discharge = 59.67 cfs x 2 pipes = 119.34 cfs

Maximum Headwater = 5.05 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (30 in)	**Discharge (cfs) (36 in)**	Discharge (cfs) (42 in)
0.50	1.88	**2.26**	2.63
1.01	5.32	**6.38**	7.44
1.51	9.76	**11.72**	13.67
2.02	15.03	**18.03**	21.04
2.53	21.00	**25.20**	29.41
3.03	27.09	**33.13**	38.65
3.54	32.15	**41.55**	48.71
4.04	36.54	**48.21**	59.51
4.55	40.45	**54.31**	68.11
5.05	44.02	**59.78**	76.13
5.56	47.32	**64.80**	83.39
6.06	50.40	**69.45**	90.06
6.57	53.31	**73.81**	96.27
7.07	56.06	**77.92**	102.10
7.58	58.69	**81.83**	107.62

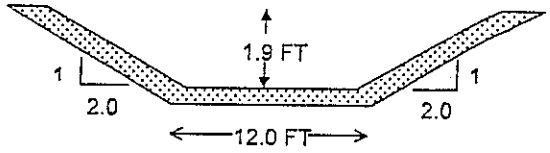
(245)

CALCULATED BY: JLH 5/24/2006
CHECKED BY: [signature] 6/20/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH F

PEAK FLOW =	119.3	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.33	FT/FT
MANNING'S N =	0.035	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	14.57	FT	DEPTH OF FLOW =	0.58	FT
AREA OF FLOW =	7.57	SQ.FT.	MEAN DEPTH =	0.53	FT
HYDRAULIC RADIUS, Rh =	0.52	FT	FROUDE NO. =	3.82	SUPERCRITICAL
CALC. VELOCITY =	15.76	FPS			

FREEBOARD REQUIRED =	1.33	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	1.9	FT	(CHANNEL LINING: GROUTED RIPRAP)

(265/2)

Williamson Energy, LLC, Ditch F, USM
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\williams.fm2
Worksheet	Williamson Energy, LLC - Ditch "F"
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.015	
Channel Slope	0.100000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	12.00	ft
Discharge	119.30	cfs

Results		
Depth	0.50	ft
Flow Area	6.45	ft²
Wetted Perimeter	14.22	ft
Top Width	13.99	ft
Critical Depth	1.34	ft
Critical Slope	0.003296	ft/ft
Velocity	18.49	ft/s
Velocity Head	5.32	ft
Specific Energy	5.81	ft
Froude Number	4.80	
Flow is supercritical.		

No Hydraulic Jump

10% SECTION THROUGH BENCH GUTTER

$y = 0.5'$
$V = 18.49$ FPS

$FB = 1.0 + 0.025 V y^{1/3}$
$= 1.0 + 0.4 = 1.4'$

$d = y + FB = 0.5 + 1.4 = 1.9'$

USE FOR DITCHES/FLUMES D, F, I, L, & M

SEE DWG. NO. BOS-330-E49

SD: PUT DITCH ON 10% GRADE THROUGH CURVES, KEEP DEPTH THE SAME.

MACH MINING

DITCH "G"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

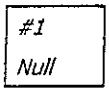
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH G



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	7.200	7.200	28.29	2.38

Structure Detail:

Structure #1 (Null)

DITCH G

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	7.200	0.170	0.000	0.000	80.000	M	28.29	2.383
	Σ	**7.200**						**28.29**	**2.383**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	5.00	500.00	3.000	0.046
		8. Large gullies, diversions, and low flowing streams	0.25	1.67	670.00	1.500	0.124
#1	**1**	**Time of Concentration:**					**0.170**

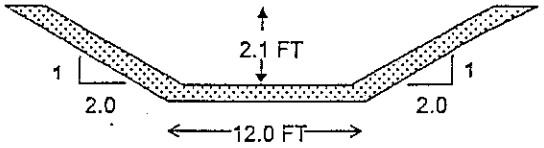
272

CALCULATED BY: JLH 5/24/2006
CHECKED BY: [illegible] 6/20/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH G

PEAK FLOW =	28.3	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.0025	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	16.47	FT	DEPTH OF FLOW =	1.00	FT
AREA OF FLOW =	14.00	SQ.FT.	MEAN DEPTH =	0.88	FT
HYDRAULIC RADIUS, Rh =	0.85	FT	FROUDE NO. =	0.38	SUBCRITICAL
CALC. VELOCITY =	2.02	FPS			

FREEBOARD REQUIRED =	1.05	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	2.1	FT	(CHANNEL LINING: SOIL AND GRASS)

MACH MINING

DITCH "H"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

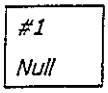
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH H



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	11.500	11.500	37.18	3.81

Structure Detail:

Structure #1 (Null)

DITCH H

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	11.500	0.356	0.000	0.000	80.000	M	37.18	3.806
	Σ	**11.500**						**37.18**	**3.806**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	5.20	520.00	3.000	0.048
		8. Large gullies, diversions, and low flowing streams	0.25	4.17	1,668.00	1.500	0.308
#1	**1**	**Time of Concentration:**					**0.256**

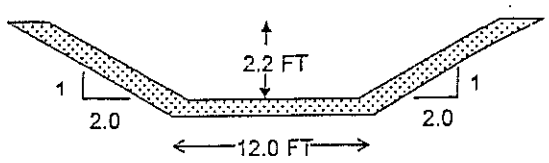
279

CALCULATED BY: JLH 5/24/2006
CHECKED BY: [signature] 5/24/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH H

PEAK FLOW =	37.2	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.0025	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	17.23	FT	DEPTH OF FLOW =	1.17	FT
AREA OF FLOW =	16.78	SQ.FT.	MEAN DEPTH =	1.01	FT
HYDRAULIC RADIUS, Rh =	0.97	FT	FROUDE NO. =	0.39	SUBCRITICAL
CALC. VELOCITY =	2.21	FPS			

FREEBOARD REQUIRED =	1.06	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	2.2	FT	(CHANNEL LINING: SOIL AND GRASS)

MACH MINING

DITCH "I"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

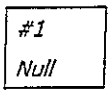
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH I



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	25.700	25.700	82.86	8.51

Structure Detail:

Structure #1 (Null)

DITCH I

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	25.700	0.359	0.000	0.000	80.000	M	82.86	8.505
	Σ	**25.700**						**82.86**	**8.505**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	5.20	520.00	3.000	0.048
		8. Large gullies, diversions, and low flowing streams	24.21	46.00	190.00	14.760	0.003
		8. Large gullies, diversions, and low flowing streams	0.25	4.17	1,668.00	1.500	0.308
#1	**1**	**Time of Concentration:**					**0.359**

CULVERT NO. 3

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.60	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 42 inches

Detailed Performance Curves

Design Discharge = 82.86 cfs

Maximum Headwater = 5.60 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (36 in)	**Discharge (cfs) (42 in)**	Discharge (cfs) (45 in)
0.56	2.63	**3.07**	3.29
1.12	7.45	**8.69**	9.31
1.68	13.68	**15.96**	17.10
2.24	21.06	**24.57**	26.33
2.80	29.44	**34.34**	36.79
3.36	38.69	**45.14**	48.36
3.92	46.65	**56.88**	60.94
4.48	53.56	**67.01**	73.53
5.04	59.68	**75.99**	84.06
5.60	65.22	**84.01**	93.58
6.16	70.34	**91.32**	102.22
6.72	75.09	**98.10**	110.18
7.28	79.57	**104.44**	117.60
7.84	83.82	**110.41**	124.58
8.40	87.85	**116.08**	131.19

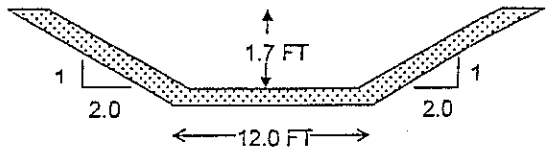
287

CALCULATED BY: JLH 6/29/2006
CHECKED BY: [illegible] 6/30/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH I

PEAK FLOW =	82.9	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.33	FT/FT
MANNING'S N =	0.035	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	14.07	FT	DEPTH OF FLOW =	0.46	FT
AREA OF FLOW =	6.00	SQ.FT.	MEAN DEPTH =	0.43	FT
HYDRAULIC RADIUS, Rh =	0.43	FT	FROUDE NO. =	3.70	SUPERCRITICAL
CALC. VELOCITY =	13.81	FPS			

FREEBOARD REQUIRED =	1.27	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	1.7	FT	(CHANNEL LINING: GROUTED RIPRAP)

MACH MINING

DITCH "J"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

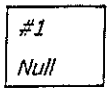
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH J



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	7.900	7.900	31.07	2.61

Structure Detail:

Structure #1 (Null)

DITCH J

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	7.900	0.169	0.000	0.000	80.000	M	31.07	2.614
	Σ	**7.900**						**31.07**	**2.614**

Subwatershed Time of Concentration Details:

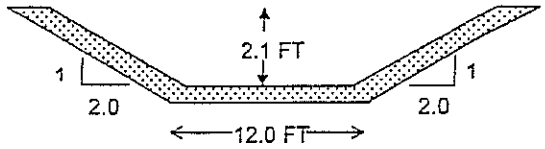
Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	5.00	500.00	3.000	0.046
		8. Large gullies, diversions, and low flowing streams	0.25	1.67	668.00	1.500	0.123
#1	**1**	**Time of Concentration:**					**0.169**

CALCULATED BY: JLH 5/24/2006
CHECKED BY: 6/14/06

ITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH J

PEAK FLOW =	31.0	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.0025	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	16.72	FT	DEPTH OF FLOW =	1.05	FT
AREA OF FLOW =	14.88	SQ.FT.	MEAN DEPTH =	0.92	FT
HYDRAULIC RADIUS, Rh =	0.89	FT	FROUDE NO. =	0.38	SUBCRITICAL
CALC. VELOCITY =	2.08	FPS			

FREEBOARD REQUIRED =	1.05	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	2.1	FT	(CHANNEL LINING: SOIL AND GRASS)

MACH MINING

DITCH "K"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LN
BEAVER, WV 25813

Phone: 304
Email: 255-0491

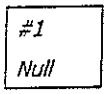
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH K



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	10.800	10.800	34.53	2.85

Structure Detail:

Structure #1 (Null)

DITCH K

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	10.800	0.368	0.000	0.000	80.000	M	34.53	2.852
	Σ	**10.800**						**34.53**	**2.852**

Subwatershed Time of Concentration Details:

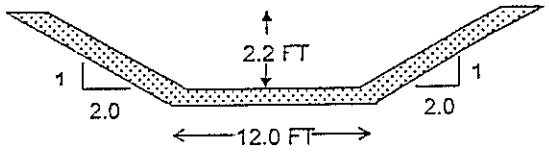
Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	5.20	520.00	3.000	0.048
		8. Large gullies, diversions, and low flowing streams	0.25	4.32	1,730.00	1.500	0.320
#1	**1**	**Time of Concentration:**					**0.368**

CALCULATED BY: JLH 1/8/2007
CHECKED BY: JLF 1/9/07

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH K

PEAK FLOW =	34.5	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.0025	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	17.02	FT	DEPTH OF FLOW =	1.12	FT
AREA OF FLOW =	15.98	SQ.FT.	MEAN DEPTH =	0.97	FT
HYDRAULIC RADIUS, Rh =	0.94	FT	FROUDE NO. =	0.39	SUBCRITICAL
CALC. VELOCITY =	2.16	FPS			

FREEBOARD REQUIRED =	1.06	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	2.2	FT	(CHANNEL LINING: SOIL AND GRASS)

MACH MINING

DITCH "L"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

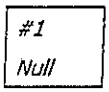
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH L



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	37.000	37.000	117.98	12.24

Structure Detail:

Structure #1 (Null)

DITCH L

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	37.000	0.371	0.000	0.000	80.000	M	117.98	12.245
	Σ	**37.000**						**117.98**	**12.245**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	5.20	520.00	3.000	0.048
		8. Large gullies, diversions, and low flowing streams	21.50	43.00	200.00	13.910	0.003
		8. Large gullies, diversions, and low flowing streams	0.25	4.31	1,728.00	1.500	0.320
#1	**1**	**Time of Concentration:**					**0.371**

CULVERT NO. 6

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 36 inches

Detailed Performance Curves

Design Discharge = 59.00 cfs x 2 pipes = 117.98 cfs

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

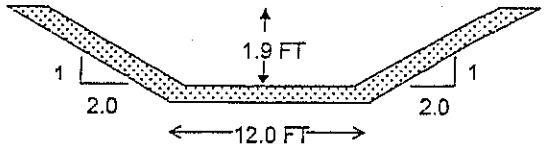
Headwater (ft)	Discharge (cfs) (30 in)	**Discharge (cfs) (36 in)**	Discharge (cfs) (42 in)
0.50	1.86	**2.22**	2.59
1.00	5.24	**6.28**	7.33
1.50	9.62	**11.54**	13.47
2.00	14.81	**17.77**	20.73
2.50	20.69	**24.83**	28.97
3.00	26.85	**32.64**	38.08
3.50	31.83	**41.13**	47.99
4.00	36.21	**47.70**	58.63
4.50	40.12	**53.79**	67.36
5.00	43.68	**59.27**	75.38
5.50	46.97	**64.27**	82.63
6.00	50.04	**68.91**	89.30
6.50	52.94	**73.27**	95.50
7.00	55.69	**77.37**	101.32
7.50	58.30	**81.27**	106.82

CALCULATED BY: JLH 6/28/2006
CHECKED BY: [illegible] 6/29/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH L

PEAK FLOW =	118.0	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.33	FT/FT
MANNING'S N =	0.035	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	14.56	FT	DEPTH OF FLOW =	0.57	FT
AREA OF FLOW =	7.51	SQ.FT.	MEAN DEPTH =	0.53	FT
HYDRAULIC RADIUS, Rh =	0.52	FT	FROUDE NO. =	3.81	SUPERCRITICAL
CALC. VELOCITY =	15.69	FPS			

FREEBOARD REQUIRED =	1.33	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	1.9	FT	(CHANNEL LINING: GROUTED RIPRAP)

MACH MINING

DITCH "M"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LN
BEAVER, WV 25813

Phone: 304
Email: 255-0491

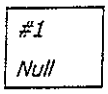
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH M



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	14.500	14.500	75.40	5.39

Structure Detail:

Structure #1 (Null)

DITCH M

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	14.500	0.277	0.000	0.000	87.000	F	75.40	5.390
	Σ	**14.500**						**75.40**	**5.390**

Subwatershed Time of Concentration Details:

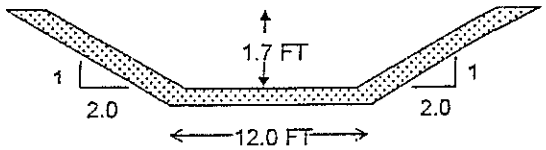
Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	10.00	40.00	400.00	9.480	0.011
		8. Large gullies, diversions, and low flowing streams	0.50	10.17	2,035.00	2.120	0.266
		8. Large gullies, diversions, and low flowing streams	33.33	20.00	60.00	17.320	0.000
#1	**1**	**Time of Concentration:**					**0.277**

CALCULATED BY: JLH 1/8/2007
CHECKED BY: KLF 1/8/07

TCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH M

PEAK FLOW =	75.4	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.33	FT/FT
MANNING'S N =	0.035	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	13.96	FT	DEPTH OF FLOW =	0.44	FT
AREA OF FLOW =	5.65	SQ.FT.	MEAN DEPTH =	0.41	FT
HYDRAULIC RADIUS, Rh =	0.40	FT	FROUDE NO. =	3.67	SUPERCRITICAL
CALC. VELOCITY =	13.34	FPS			

FREEBOARD REQUIRED =	1.25	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	1.7	FT	(CHANNEL LINING: GROUTED RIPRAP)

WILLIAMSON ENERGY, LLC

POND CREEK MINE NO. 1

WILLIAMSON COUNTY, ILLINOIS

DITCH "N"

AND

CULVERTS 12 AND 15

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LN
BEAVER, WV 25813

Phone: 304
Email: 255-0491

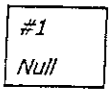
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	5.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH N



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac ft)
#1	75.500	75.500	84.55	14.49

Structure Detail:

Structure #1 (Null)

DITCH N

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	75.500	0.854	0.000	0.000	78.000	M	84.55	14.486
	Σ	**75.500**						**84.55**	**14.486**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	0.27	5.00	1,867.06	1.550	0.334
		8. Large gullies, diversions, and low flowing streams	2.32	12.00	518.00	4.560	0.031
		8. Large gullies, diversions, and low flowing streams	0.25	5.70	2,286.00	1.490	0.426
		8. Large gullies, diversions, and low flowing streams	1.00	2.42	243.00	2.990	0.022
		8. Large gullies, diversions, and low flowing streams	1.50	8.17	545.00	3.670	0.041
#1	**1**	**Time of Concentration:**					**0.854**

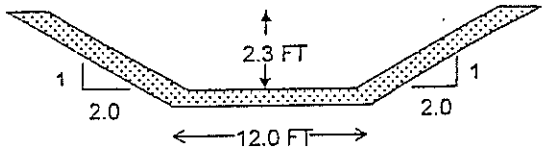
CALCULATED BY: JLH 1/4/2007
CHECKED BY: RLF 1/4/07

(333)

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH N

PEAK FLOW =	84.6	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.015	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	17.02	FT	DEPTH OF FLOW =	1.12	FT
AREA OF FLOW =	15.98	SQ.FT.	MEAN DEPTH =	0.97	FT
HYDRAULIC RADIUS, Rh =	0.94	FT	FROUDE NO. =	0.95	SUBCRITICAL
CALC. VELOCITY =	5.29	FPS			

FREEBOARD REQUIRED =	1.14	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	2.3	FT	(CHANNEL LINING: SOIL LINED)

CULVERTS 12 AND 15

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
60.00	3.00	0.0240	4.70	0.00	0.90

Culvert Results:

Minimum pipe diameter: 1 - 48 inch pipe(s) required

Detailed Performance Curves

Design Discharge = 84.55 cfs

Maximum Headwater = 4.70 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (45 in)	**Discharge (cfs) (48 in)**	Discharge (cfs) (54 in)
0.47	2.53	**2.70**	3.04
0.94	7.16	**7.63**	8.59
1.41	13.15	**14.03**	15.78
1.88	20.24	**21.59**	24.29
2.35	28.29	**30.17**	33.95
2.82	37.19	**39.67**	44.62
3.29	46.86	**49.98**	56.23
3.76	57.25	**61.06**	68.70
4.23	68.31	**72.86**	81.97
4.70	77.71	**85.07**	96.01
5.17	86.36	**94.61**	110.76
5.64	94.22	**103.87**	122.59
6.11	101.47	**112.37**	134.05
6.58	108.24	**120.26**	144.62
7.05	114.61	**127.67**	154.46

MACH MINING

CULVERT NO. 4

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

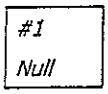
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT NO. 4



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	5.300	5.300	33.09	2.08

Structure Detail:

Structure #1 (Null)

CULVERT NO. 4

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	5.300	0.084	0.000	0.000	87.000	F	33.09	2.084
	Σ	**5.300**						**33.09**	**2.084**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	31.62	43.00	136.00	16.860	0.002
		8. Large gullies, diversions, and low flowing streams	1.00	8.89	890.00	3.000	0.082
#1	**1**	**Time of Concentration:**					**0.084**

CULVERT NO. 4

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 30 inches

Detailed Performance Curves

Design Discharge = 33.09 cfs

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (24 in)	**Discharge (cfs) (30 in)**	Discharge (cfs) (36 in)
0.50	1.49	**1.86**	2.22
1.00	4.19	**5.24**	6.28
1.50	7.69	**9.62**	11.54
2.00	11.85	**14.81**	17.77
2.50	16.11	**20.69**	24.83
3.00	19.52	**26.85**	32.64
3.50	22.43	**31.83**	41.13
4.00	25.01	**36.21**	47.70
4.50	27.23	**40.12**	53.79
5.00	29.01	**43.68**	59.27
5.50	30.67	**46.97**	64.27
6.00	32.26	**50.04**	68.91
6.50	33.78	**52.94**	73.27
7.00	35.24	**55.69**	77.37
7.50	36.63	**58.30**	81.27

MACH MINING

CULVERT NO. 5

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

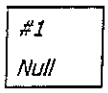
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT NO. 5



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	2.800	2.800	17.48	1.10

Structure Detail:

Structure #1 (Null)

CULVERT NO. 5

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	2.800	0.071	0.000	0.000	87.000	F	17.48	1.101
	Σ	**2.800**						**17.48**	**1.101**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	31.62	43.00	136.00	16.860	0.002
		8. Large gullies, diversions, and low flowing streams	1.00	7.50	750.00	3.000	0.069
#1	**1**	**Time of Concentration:**					**0.071**

CULVERT NO. 5

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 21 inches

Detailed Performance Curves

Design Discharge = 17.48 cfs

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (18 in)	**Discharge (cfs) (21 in)**	Discharge (cfs) (24 in)
0.50	1.12	**1.30**	1.49
1.00	3.14	**3.66**	4.19
1.50	5.77	**6.73**	7.69
2.00	8.43	**10.33**	11.85
2.50	10.45	**13.32**	16.11
3.00	11.83	**15.78**	19.52
3.50	12.91	**17.78**	22.43
4.00	13.91	**19.28**	25.01
4.50	14.83	**20.64**	27.23
5.00	15.71	**21.92**	29.01
5.50	16.54	**23.13**	30.67
6.00	17.33	**24.28**	32.26
6.50	18.08	**25.38**	33.78
7.00	18.80	**26.43**	35.24
7.50	19.50	**27.44**	36.63

MACH MINING

CULVERT NO. 7

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LN
BEAVER, WV 25813

Phone: 304
Email: 255-0491

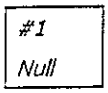
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT NO. 7



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	3.600	3.600	22.48	1.41

Structure Detail:

Structure #1 (Null)

CULVERT NO. 7

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	3.600	0.015	0.000	0.000	87.000	F	22.48	1.411
	Σ	**3.600**						**22.48**	**1.411**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	10.00	52.10	521.00	9.480	0.015
#1	**1**	**Time of Concentration:**					**0.015**

CULVERT NO. 7

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter: 1 - 24 inch pipe(s) required

Detailed Performance Curves

Design Discharge = 22.48 cfs

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (21 in)	**Discharge (cfs) (24 in)**	Discharge (cfs) (30 in)
0.50	1.30	**1.49**	1.86
1.00	3.66	**4.19**	5.24
1.50	6.73	**7.69**	9.62
2.00	10.33	**11.85**	14.81
2.50	13.32	**16.11**	20.69
3.00	15.78	**19.52**	26.85
3.50	17.78	**22.43**	31.83
4.00	19.28	**25.01**	36.21
4.50	20.64	**27.23**	40.12
5.00	21.92	**29.01**	43.68
5.50	23.13	**30.67**	46.97
6.00	24.28	**32.26**	50.04
6.50	25.38	**33.78**	52.94
7.00	26.43	**35.24**	55.69
7.50	27.44	**36.63**	58.30

346

MACH MINING

CULVERT NO. 8

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

General Information

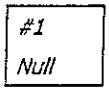
Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

3-R

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT NO. 8



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	1.200	1.200	7.49	0.47

Structure Detail:

Structure #1 (Null)

CULVERT NO. 8

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	1.200	0.053	0.000	0.000	87.000	F	7.49	0.472
	Σ	**1.200**						**7.49**	**0.472**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	0.50	2.05	410.00	2.120	0.053
#1	**1**	**Time of Concentration:**					**0.053**

CULVERT NO. 8

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 15 inches

Detailed Performance Curves

Design Discharge = 7.49 cfs

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (12 in)	**Discharge (cfs) (15 in)**	Discharge (cfs) (18 in)
0.50	0.74	**0.94**	1.12
1.00	2.10	**2.62**	3.14
1.50	3.37	**4.78**	5.77
2.00	3.99	**6.36**	8.43
2.50	4.45	**7.28**	10.45
3.00	4.87	**8.02**	11.83
3.50	5.25	**8.70**	12.91
4.00	5.61	**9.32**	13.91
4.50	5.95	**9.90**	14.83
5.00	6.27	**10.46**	15.71
5.50	6.57	**10.99**	16.54
6.00	6.86	**11.49**	17.33
6.50	7.14	**11.98**	18.08
7.00	7.40	**12.44**	18.80
7.50	7.67	**12.89**	19.50

352

MACH MINING

CULVERT NO. 9

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

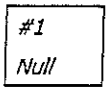
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT NO. 9



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	16.200	16.200	84.24	6.37

7225-11
part 10
(357)

Structure Detail:

Structure #1 (Null)

CULVERT NO. 9

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	16.200	0.277	0.000	0.000	87.000	F	84.24	6.370
	Σ	**16.200**						**84.24**	**6.370**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	10.00	40.00	400.00	9.480	0.011
		8. Large gullies, diversions, and low flowing streams	33.33	20.00	60.00	17.320	0.000
		8. Large gullies, diversions, and low flowing streams	0.50	10.17	2,035.00	2.120	0.266
#1	**1**	**Time of Concentration:**					**0.277**

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259

CULVERT NO. 9

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 30 inches

Detailed Performance Curves

Design Discharge = 42.12 cfs x 2 pipes = 84.24 cfs

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (24 in)	**Discharge (cfs) (30 in)**	Discharge (cfs) (36 in)
0.50	1.49	**1.86**	2.22
1.00	4.19	**5.24**	6.28
1.50	7.69	**9.62**	11.54
2.00	11.85	**14.81**	17.77
2.50	16.11	**20.69**	24.83
3.00	19.52	**26.85**	32.64
3.50	22.43	**31.83**	41.13
4.00	25.01	**36.21**	47.70
4.50	27.23	**40.12**	53.79
5.00	29.01	**43.68**	59.27
5.50	30.67	**46.97**	64.27
6.00	32.26	**50.04**	68.91
6.50	33.78	**52.94**	73.27
7.00	35.24	**55.69**	77.37
7.50	36.63	**58.30**	81.27

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360

MACH MINING

CULVERT NO. 10

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

361

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

362

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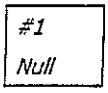
Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT NO. 10



3 of 3

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	1.500	1.500	9.37	0.59

364

Structure Detail:

Structure #1 (Null)

CULVERT NO. 10

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365

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	1.500	0.087	0.000	0.000	87.000	F	9.37	0.590
	Σ	**1.500**						**9.37**	**0.590**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	0.50	3.35	670.00	2.120	0.087
#1	**1**	**Time of Concentration:**					**0.087**

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366

CULVERT NO. 10

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 15 inches

Detailed Performance Curves

Design Discharge = 9.37 cfs

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (12 in)	**Discharge (cfs) (15 in)**	Discharge (cfs) (18 in)
0.50	0.74	**0.94**	1.12
1.00	2.10	**2.62**	3.14
1.50	3.37	**4.78**	5.77
2.00	3.99	**6.36**	8.43
2.50	4.45	**7.28**	10.45
3.00	4.87	**8.02**	11.83
3.50	5.25	**8.70**	12.91
4.00	5.61	**9.32**	13.91
4.50	5.95	**9.90**	14.83
5.00	6.27	**10.46**	15.71
5.50	6.57	**10.99**	16.54
6.00	6.86	**11.49**	17.33
6.50	7.14	**11.98**	18.08
7.00	7.40	**12.44**	18.80
7.50	7.67	**12.89**	19.50

CULVERT 11

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
170.00	1.00	0.0240	5.20	0.00	0.90

Culvert Results:

Minimum pipe diameter: 1 - 48 inch pipe(s) required

Detailed Performance Curves

Design Discharge = 86.22 cfs *

Maximum Headwater = 5.20 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (45 in)	**Discharge (cfs) (48 in)**	Discharge (cfs) (54 in)
0.52	18.97	**21.43**	26.54
1.04	22.68	**25.78**	32.32
1.56	26.02	**29.69**	37.54
2.08	29.06	**33.27**	42.33
2.60	31.90	**36.60**	46.76
3.12	37.00	**39.70**	50.91
3.64	48.36	**50.77**	55.47
4.16	60.05	**63.64**	69.72
4.68	70.71	**76.44**	85.18
5.20	76.26	**86.49**	100.75
5.72	81.42	**92.69**	116.12
6.24	86.28	**98.50**	124.23
6.76	90.88	**103.99**	131.85
7.28	95.25	**109.20**	139.05
7.80	99.44	**114.18**	145.87

* Q Based on Spillway Flow for Sediment Ditch 3

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368

CULVERTS 13 AND 14

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter: 1 - 21 inch pipe(s) required

Detailed Performance Curves

Design Discharge = 19.10 cfs *

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (18 in)	**Discharge (cfs) (21 in)**	Discharge (cfs) (24 in)
0.50	1.12	**1.30**	1.49
1.00	3.14	**3.66**	4.19
1.50	5.77	**6.73**	7.69
2.00	8.43	**10.33**	11.85
2.50	10.45	**13.32**	16.11
3.00	11.83	**15.78**	19.52
3.50	12.91	**17.78**	22.43
4.00	13.91	**19.28**	25.01
4.50	14.83	**20.64**	27.23
5.00	15.71	**21.92**	29.01
5.50	16.54	**23.13**	30.67
6.00	17.33	**24.28**	32.26
6.50	18.08	**25.38**	33.78
7.00	18.80	**26.43**	35.24
7.50	19.50	**27.44**	36.63

* Q Baseflow Flow From Decant Pipes.

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369

MACH MINING

ROAD GUTTER

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

370

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

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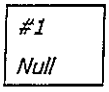
(301)

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	ROAD GUTTER



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	0.900	0.900	5.62	0.35

393

Structure Detail:

Structure #1 (Null)

ROAD GUTTER

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	0.900	0.011	0.000	0.000	87.000	F	5.62	0.354
	Σ	**0.900**						**5.62**	**0.354**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	10.00	40.00	400.00	9.480	0.011
#1	**1**	**Time of Concentration:**					**0.011**

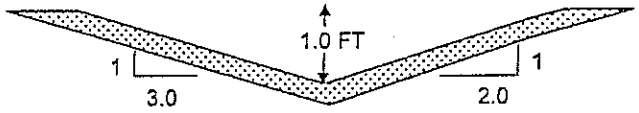
375

CALCULATED BY: JLH 5/25/2006
CHECKED BY: [illegible] 6/21/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: ROAD GUTTER

PEAK FLOW =	5.6	CFS
BOTTOM WIDTH =	0	FT
SIDE SLOPE 1 =	3.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.1	FT/FT
MANNING'S N =	0.035	FT^(1/6)



OUTPUT:

TRIANGULAR DITCH

WETTED PERIMETER =	3.34	FT	DEPTH OF FLOW =	0.62	FT
AREA OF FLOW =	0.96	SQ.FT.	MEAN DEPTH =	0.31	FT
HYDRAULIC RADIUS, Rh =	0.29	FT	FROUDE NO. =	1.85	SUPERCRITICAL
CALC. VELOCITY =	5.84	FPS			

	0.00	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	1.0	FT	(SLOPE OF ROAD WILL PROVIDE ADDITIONAL FREEBOARD)

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376

MACH MINING

BENCH GUTTER

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

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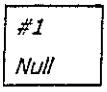
378

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	BENCH GUTTER



379

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	8.200	8.200	40.81	3.22

(350)

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Structure Detail:

Structure #1 (Null)

BENCH GUTTER

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	8.200	0.338	0.000	0.000	87.000	F	40.81	3.224
	Σ	**8.200**						**40.81**	**3.224**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	0.50	12.92	2,586.00	2.120	0.338
#1	**1**	**Time of Concentration:**					**0.338**

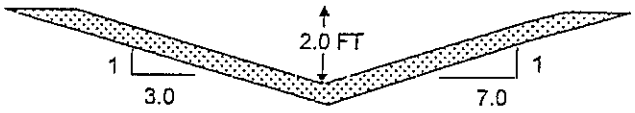
382

CALCULATED BY: JLH 6/28/2006
CHECKED BY: [illegible] 6/29/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: BENCH GUTTER

PEAK FLOW =	40.8	CFS
BOTTOM WIDTH =	0	FT
SIDE SLOPE 1 =	3.00:1	
SIDE SLOPE 2 =	7.00:1	
CHANNEL SLOPE =	0.005	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRIANGULAR DITCH

WETTED PERIMETER =	17.41	FT	DEPTH OF FLOW =	1.70	FT
AREA OF FLOW =	14.48	SQ.FT.	MEAN DEPTH =	0.85	FT
HYDRAULIC RADIUS, Rh =	0.83	FT	FROUDE NO. =	0.54	SUBCRITICAL
CALC. VELOCITY =	2.82	FPS			

	0.00	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	2.0	FT	(SLOPE OF BENCH WILL PROVIDE ADDITIONAL FREEBOARD)

(32)

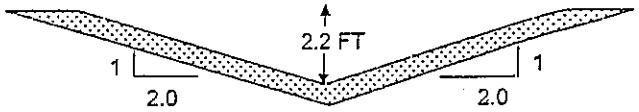
CALCULATED BY: JLH 12/28/2006
CHECKED BY: _____

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DECANT DITCH

PEAK FLOW =	19.1	CFS
BOTTOM WIDTH =	0	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.33	FT/FT
MANNING'S N =	0.035	FT^(1/6)

FLOW BASED ON MAXIMUM FLOW OF DECANT PIPE



OUTPUT:

TRIANGULAR DITCH

WETTED PERIMETER =	3.84	FT	DEPTH OF FLOW =	0.86	FT
AREA OF FLOW =	1.48	SQ.FT.	MEAN DEPTH =	0.43	FT
HYDRAULIC RADIUS, Rh =	0.38	FT	FROUDE NO. =	3.47	SUPERCRITICAL
CALC. VELOCITY =	12.89	FPS			

FREEBOARD REQUIRED =	1.31	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	2.2	FT	(CHANNEL LINING: GROUTED RIPRAP)

APPENDIX C

Laboratory Testing

(-2)

APPENDIX C

LABORATORY TESTING
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY, LLC
~~BECKLEY, WEST VIRGINIA~~

TABLE OF CONTENTS

	PAGE
SOIL TESTING	
Summary	1
Strength Test	3
Grain Size	10
Atterberg Limits Test Results	12
COARSE COAL REFUSE TESTING	
Summary	13
Grain Size	15
Proctor Test	17
Permeability Test	18
Strength Test	20

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

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Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

3

February 10, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Soil Boring and Laboratory Tests
Boring #8874
Mach Mine #1
Johnston City, Illinois
HFE File H-05278
Mach Mining Purchase Order No. _____

Dear Sir:

In accordance with your instructions, on February 1, 2006, we drilled one soil boring and sampled the subsoils with Shelby tubes. The soil sample taken from 10 to 12 feet in depth was subjected to laboratory tests. Results of the tests are as follows:

Boring No.:	8874
Depth:	8.0-10.0'
Visual Classification:	Silty CLAY (CL)
Atterberg Limits:	LL = 41.8% PL = 17.7% PI = 24.1
Unit Weight:	105.3 PCF
Moisture Content:	21.5%
Effective Cohesion:	0 PSF
Effective Phi Angle:	26.8 Degrees

4

The Boring Log and test results are enclosed. If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

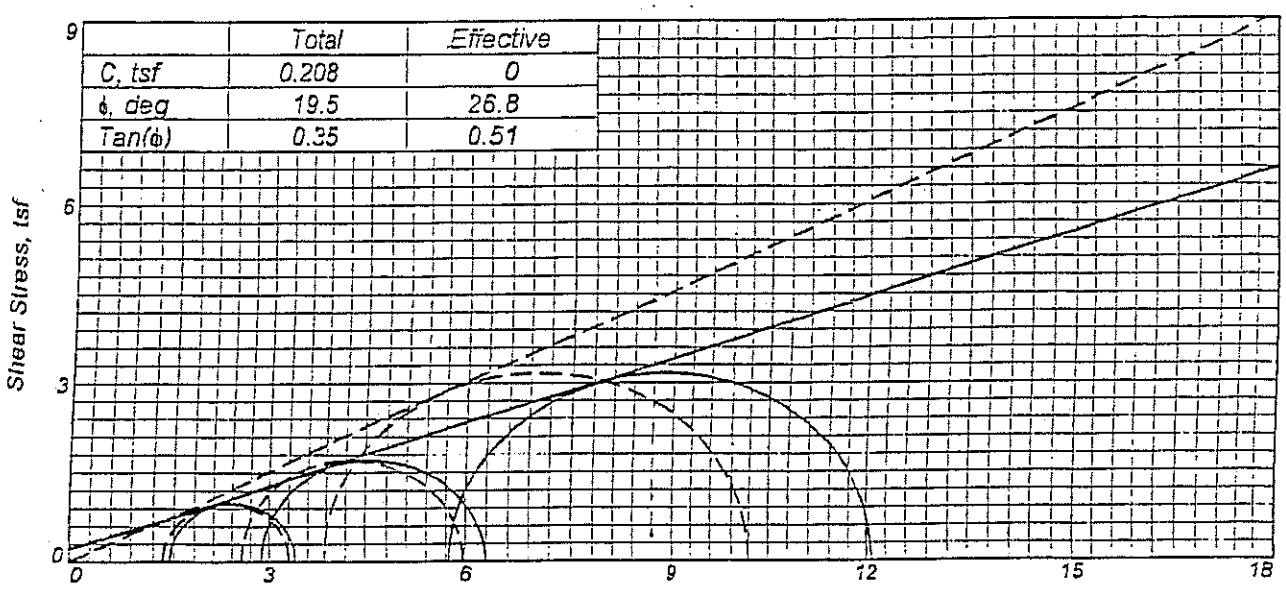
Timothy J. Holcomb, P.E.

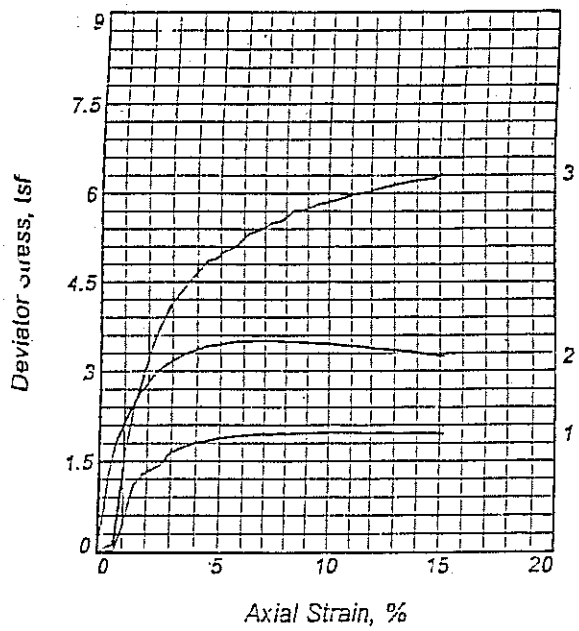
REGISTERED PROFESSIONAL ENGINEER
TIMOTHY J.
HOLCOMB
062-042149
2-10-06
ILLINOIS

1 copy: Fred Vass - Alliance Consulting

5

	Total	Effective
C, tsf	0.208	0
ϕ, deg	19.5	26.8
Tan(ϕ)	0.35	0.51





Sample No.		1	2	3
Initial	Water Content,	21.5	20.8	17.6
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	99.7	98.9
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
At Test	Water Content,	21.5	20.9	17.8
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.6	3.6	2.2
Cell Pressure, tsf		5.0	6.5	7.9
Fail. Stress, tsf		2.0	3.4	6.3
Total Pore Pr., tsf		3.7	3.9	4.1
Ult. Stress, tsf		2.0	3.2	6.3
Total Pore Pr., tsf		3.6	3.8	4.1
$\bar{\sigma}_1$ Failure, tsf		3.3	6.0	10.2
$\bar{\sigma}_3$ Failure, tsf		1.3	2.6	3.9

Type of Test:
CU with Pore Pressures
Sample Type: Shelby Tube - Undisturbed
Description: Gray Mottled Brown Silty CLAY

LL= 41.8 PL= 17.7 PI= 24.1
Assumed Specific Gravity= 2.65
Remarks:

Client: Alliance Consulting

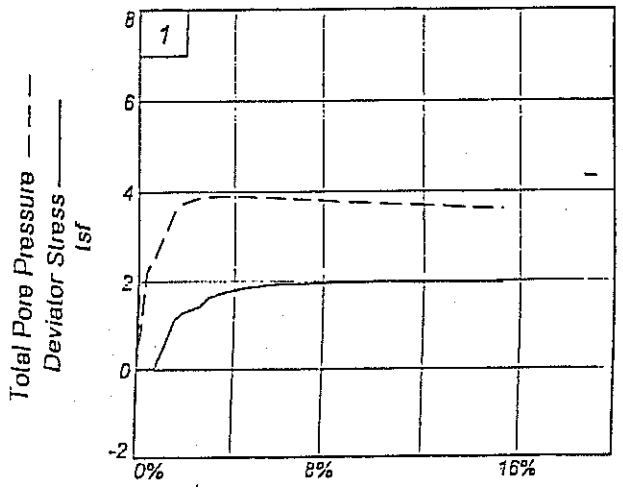
Project: Triaxial Test
Mach Mine #1
Location: Boring #8874
Sample Number: 3 **Depth:** 10.0-12.0'
Proj. No.: H-05278 **Date:** 2-1-05

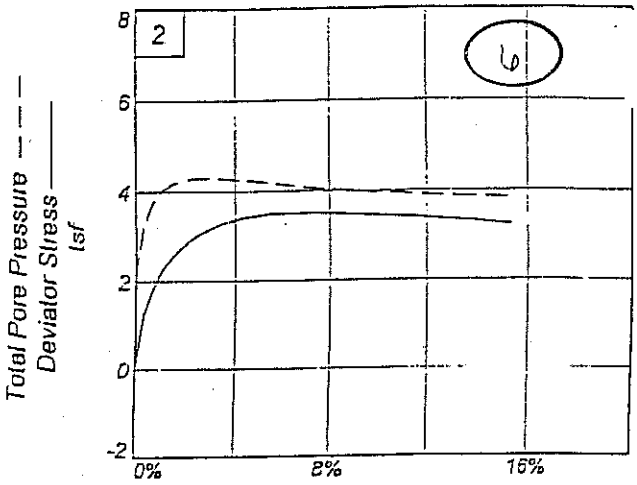
TRIAXIAL SHEAR TEST REPORT

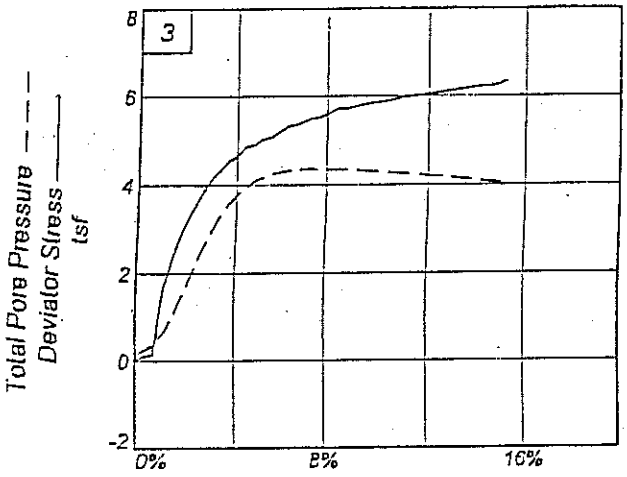
HOLCOMB FOUNDATION ENGINEERING CO.

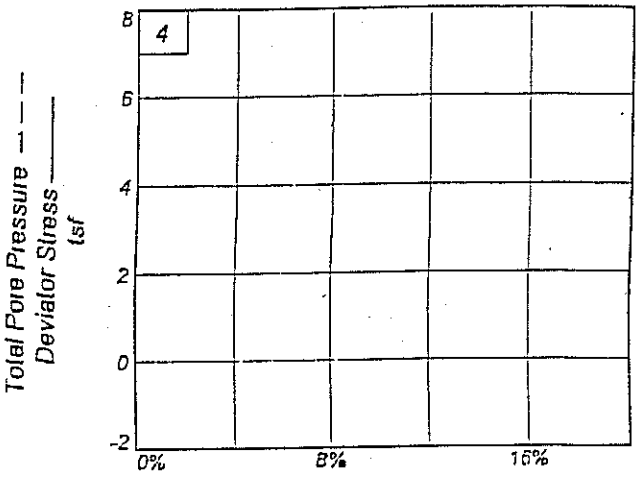
Plate _____

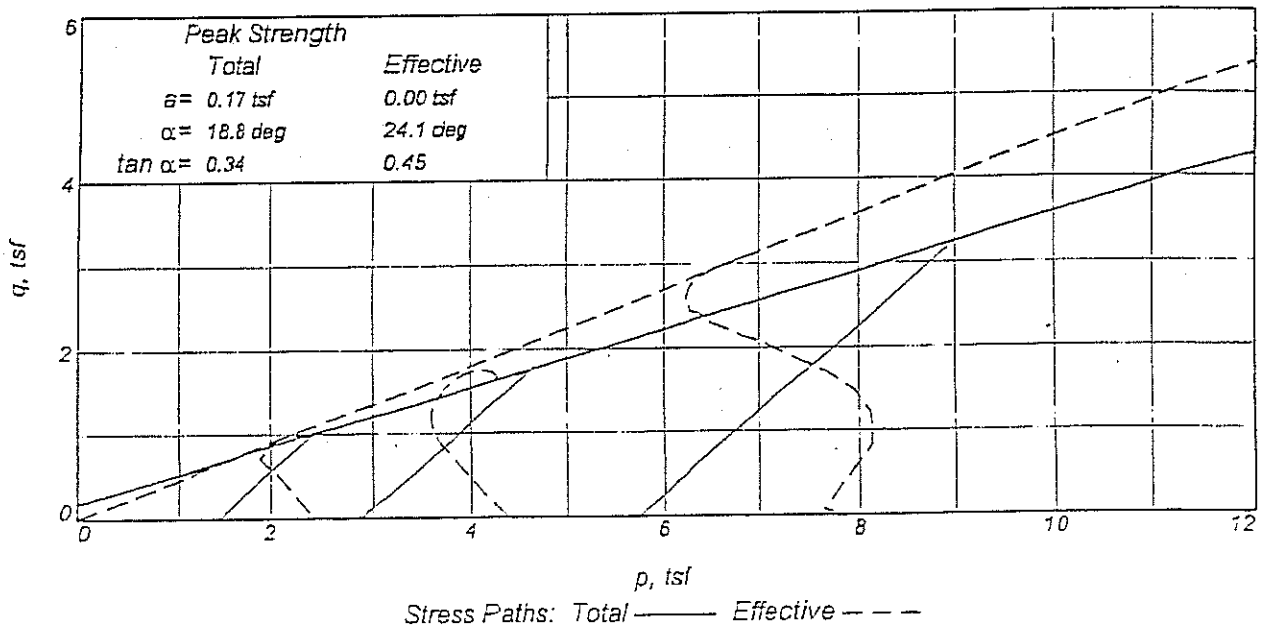
Tested By: LC Checked By: TH











Client: Alliance Consulting
Project: Triaxial Test
Location: Boring #8874
Project No.: H 05278

Depth: 10.0-12.0'
Plate

Sample Number: 3

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC

Checked By: TH

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

7

Date:	2-1-05
Client:	Alliance Consulting
Project:	Triaxial Test Mach Mine #1 Johnston City, Illinois
Location:	Boring #8874
Depth:	10.0-12.0' Sample Number: 3
Description:	Gray Mottled Brown Silty CLAY
Remarks:	
Type of Sample:	Shelby Tube - Undisturbed
Assumed Specific Gravity=2.65	LL=41.8 PL=17.7 PI=24.1
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	189.100			1279.000
Moisture content: Dry soil+tare, gms.	176.100			1072.200
Moisture content: Tare, gms.	115.700			103.200
Moisture, %	21.5	21.5	21.5	21.3
Moist specimen weight, gms.	1140.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.51	5.51	5.51	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.0	128.0	128.0	
Dry density, pcf	105.3	105.3	105.3	
Void ratio	0.5706	0.5706	0.5706	
Saturation, %	100.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.981 tsf at reading no. 24
Ult. Stress = 1.955 tsf at reading no. 30

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	18.30	0.0	0.0	0.000	5.112	5.112	1.00	-1.00	5.112	0.000
1	0.0190	20.00	1.7	0.3	0.014	2.830	2.844	1.00	30.70	2.837	0.007
2	0.0400	21.60	3.3	0.7	0.026	2.426	2.452	1.01	36.30	2.439	0.013
3	0.0810	113.20	94.9	1.5	1.093	1.505	2.598	1.73	49.10	2.051	0.547
4	0.1010	129.80	111.5	1.8	1.280	1.318	2.597	1.97	51.70	1.958	0.640
5	0.1420	143.10	124.8	2.6	1.422	1.181	2.602	2.20	53.60	1.892	0.711
6	0.1620	161.50	143.2	2.9	1.625	1.159	2.784	2.40	53.90	1.972	0.813
7	0.1830	168.90	150.6	3.3	1.702	1.145	2.847	2.49	54.10	1.996	0.851
8	0.2030	174.80	156.5	3.7	1.763	1.138	2.900	2.55	54.20	2.019	0.881
9	0.2240	178.90	160.6	4.1	1.802	1.145	2.946	2.57	54.10	2.046	0.901
10	0.2440	182.30	164.0	4.4	1.833	1.145	2.978	2.60	54.10	2.061	0.916
11	0.2650	186.40	168.1	4.8	1.871	1.152	3.023	2.62	54.00	2.088	0.936
12	0.2850	188.10	169.8	5.2	1.883	1.166	3.049	2.61	53.80	2.108	0.941
13	0.3060	191.40	173.1	5.6	1.912	1.166	3.078	2.64	53.80	2.122	0.956
14	0.3260	193.10	174.8	5.9	1.923	1.181	3.104	2.63	53.60	2.142	0.962
15	0.3460	194.70	176.4	6.3	1.933	1.188	3.121	2.63	53.50	2.155	0.967
16	0.3670	196.40	178.1	6.7	1.944	1.202	3.146	2.62	53.30	2.174	0.972
17	0.3870	198.10	179.8	7.0	1.955	1.210	3.164	2.62	53.20	2.187	0.977
18	0.4080	198.10	179.8	7.4	1.947	1.224	3.171	2.59	53.00	2.197	0.973
19	0.4280	200.60	182.3	7.8	1.966	1.231	3.197	2.60	52.90	2.214	0.983
20	0.4490	200.60	182.3	8.1	1.958	1.238	3.196	2.58	52.80	2.217	0.979
21	0.4890	203.10	184.8	8.9	1.969	1.267	3.236	2.55	52.40	2.252	0.985
22	0.5300	204.70	186.4	9.6	1.970	1.289	3.259	2.53	52.10	2.274	0.985
23	0.5710	207.20	188.9	10.4	1.980	1.310	3.290	2.51	51.80	2.300	0.990
24	0.6120	208.90	190.6	11.1	1.981	1.332	3.313	2.49	51.50	2.323	0.991
25	0.6530	209.10	190.8	11.8	1.967	1.346	3.313	2.46	51.30	2.330	0.983
26	0.6940	211.40	193.1	12.6	1.974	1.361	3.334	2.45	51.10	2.348	0.987
27	0.7350	212.20	193.9	13.3	1.965	1.390	3.354	2.41	50.70	2.372	0.982
28	0.7790	213.90	195.6	14.1	1.964	1.404	3.368	2.40	50.50	2.386	0.982
29	0.8170	215.50	197.2	14.8	1.964	1.426	3.390	2.38	50.20	2.408	0.982
30	0.8380	215.50	197.2	15.2	1.955	1.433	3.388	2.36	50.10	2.410	0.978

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	154.800			1347.900
Moisture content: Dry soil+tare, gms.	145.800			1154.100
Moisture content: Tare, gms.	102.600			135.100
Moisture, %	20.8	20.9	20.9	19.0
Moist specimen weight, gms.	1142.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.49	5.49	5.49	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.7	128.7	128.7	
Dry density, pcf	106.5	106.5	106.5	
Void ratio	0.5536	0.5536	0.5536	
Saturation, %	99.7	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 3.418 tsf at reading no. 24
Ult. Stress = 3.250 tsf at reading no. 29

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	27.50	0.0	0.0	0.000	4.385	4.385	1.00	29.10	4.385	0.000
1	0.0190	134.00	106.5	0.3	1.241	3.254	4.495	1.38	44.80	3.875	0.620
2	0.0400	183.10	155.6	0.7	1.806	2.750	4.557	1.66	51.80	3.653	0.903
3	0.0600	218.90	191.4	1.1	2.214	2.484	4.698	1.89	55.50	3.591	1.107
4	0.0810	243.80	216.3	1.5	2.492	2.340	4.832	2.06	57.50	3.586	1.246
5	0.1010	264.60	237.1	1.8	2.721	2.254	4.975	2.21	58.70	3.614	1.361
6	0.1220	282.10	254.6	2.2	2.911	2.210	5.121	2.32	59.30	3.666	1.455
7	0.1420	295.40	267.9	2.6	3.052	2.182	5.233	2.40	59.70	3.707	1.526
8	0.1620	305.40	277.9	2.9	3.154	2.182	5.335	2.45	59.70	3.758	1.577
9	0.1830	314.60	287.1	3.3	3.245	2.189	5.434	2.48	59.60	3.811	1.623
10	0.2030	322.10	294.6	3.7	3.317	2.196	5.513	2.51	59.50	3.855	1.659
11	0.2240	327.10	299.6	4.1	3.360	2.218	5.578	2.52	59.20	3.898	1.680
12	0.2440	332.90	305.4	4.4	3.412	2.232	5.644	2.53	59.00	3.938	1.706
13	0.2650	336.20	308.7	4.8	3.435	2.254	5.689	2.52	58.70	3.971	1.718
14	0.2850	339.50	312.0	5.2	3.459	2.275	5.734	2.52	58.40	4.005	1.729
15	0.3060	343.70	316.2	5.6	3.491	2.297	5.788	2.52	58.10	4.042	1.746
16	0.3260	345.40	317.9	5.9	3.497	2.318	5.815	2.51	57.80	4.067	1.748
17	0.3670	348.70	321.2	6.7	3.505	2.369	5.874	2.48	57.10	4.121	1.752
18	0.4080	352.00	324.5	7.4	3.512	2.412	5.924	2.46	56.50	4.168	1.756
19	0.4490	353.70	326.2	8.2	3.502	2.441	5.943	2.43	56.10	4.192	1.751
20	0.4890	354.50	327.0	8.9	3.483	2.470	5.953	2.41	55.70	4.211	1.742
21	0.5300	355.40	327.9	9.7	3.464	2.498	5.963	2.39	55.30	4.230	1.732

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.5510	357.00	329.5	10.0	3.466	2.513	5.979	2.38	55.10	4.246	1.733
23	0.5920	356.20	328.7	10.8	3.429	2.534	5.964	2.35	54.80	4.249	1.715
24	0.6330	357.90	330.4	11.5	3.418	2.556	5.974	2.34	54.50	4.265	1.709
25	0.6730	357.00	329.5	12.3	3.381	2.585	5.966	2.31	54.10	4.275	1.690
26	0.7140	357.90	330.4	13.0	3.361	2.599	5.960	2.29	53.90	4.280	1.681
27	0.7550	357.90	330.4	13.7	3.332	2.614	5.946	2.27	53.70	4.280	1.666
28	0.7960	356.20	328.7	14.5	3.286	2.628	5.914	2.25	53.50	4.271	1.643
29	0.8370	355.40	327.9	15.2	3.250	2.635	5.885	2.23	53.40	4.260	1.625

10

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	248.400			1374.500
Moisture content: Dry soil+tare, gms.	226.700			1195.400
Moisture content: Tare, gms.	103.200			127.700
Moisture, %	17.6	17.8	17.8	16.8
Moist specimen weight, gms.	1184.7			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.54	5.54	5.54	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	132.3	132.5	132.5	
Dry density, pcf	112.5	112.5	112.5	
Void ratio	0.4707	0.4707	0.4707	
Saturation, %	98.9	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 6.334 tsf at reading no. 33
Ult. Stress = 6.334 tsf at reading no. 33

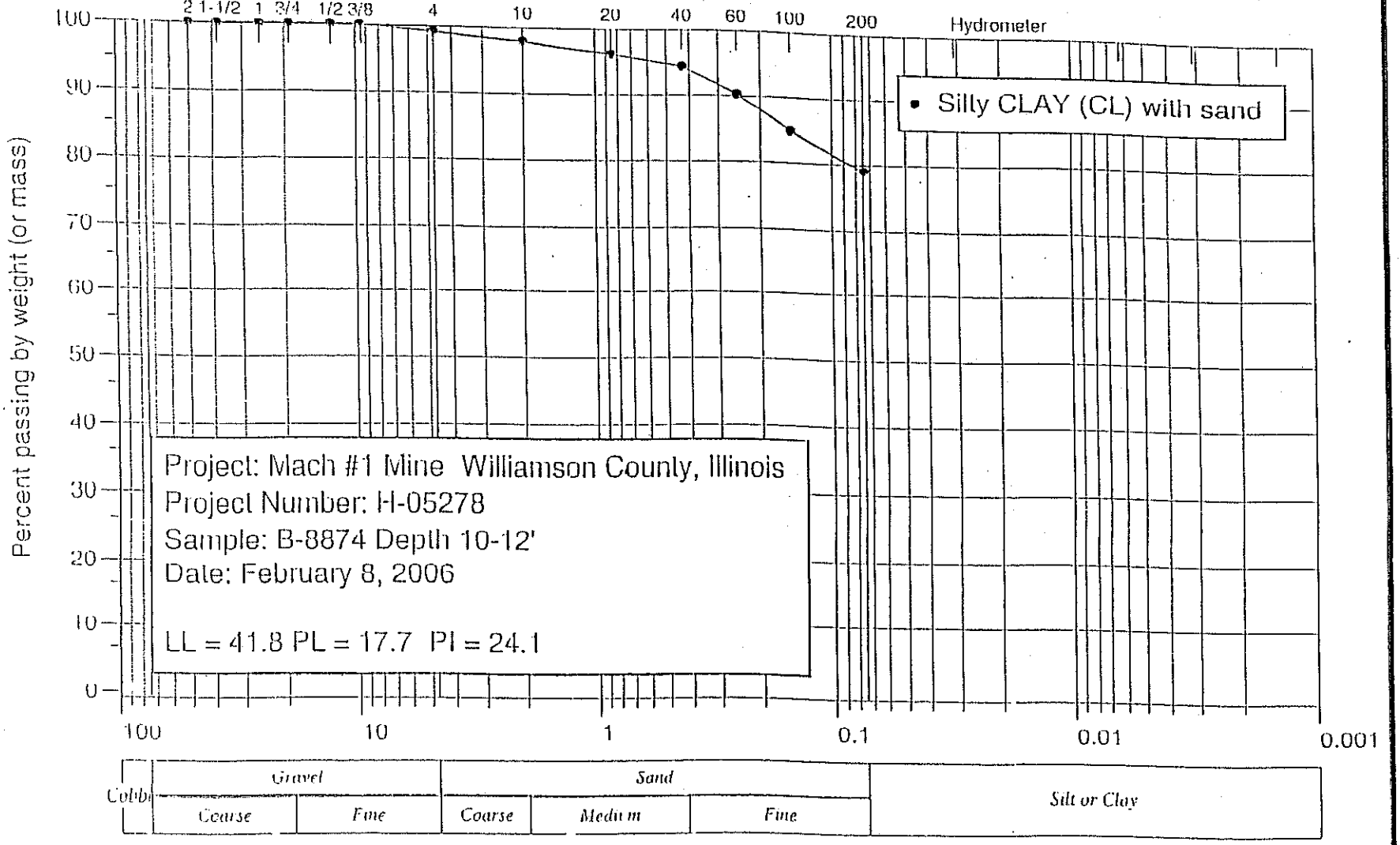
No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	31.60	0.0	0.0	0.000	7.812	7.812	1.00	1.50	7.812	0.000
1	0.0190	39.90	8.3	0.3	0.091	7.690	7.781	1.01	3.20	7.735	0.045
2	0.0400	44.10	12.5	0.7	0.133	7.574	7.707	1.02	4.80	7.641	0.066
3	0.0600	175.60	144.0	1.1	1.666	7.308	8.974	1.23	8.50	8.141	0.833
4	0.0810	240.50	208.9	1.5	2.407	6.926	9.333	1.35	13.80	8.130	1.203
5	0.1010	291.30	259.7	1.8	2.981	6.466	9.447	1.46	20.20	7.956	1.491
6	0.1220	329.60	298.0	2.2	3.408	5.983	9.391	1.57	26.90	7.687	1.704
7	0.1420	362.00	330.4	2.6	3.764	5.479	9.244	1.69	33.90	7.361	1.882
8	0.1620	392.00	360.4	2.9	4.091	5.040	9.131	1.81	40.00	7.085	2.045
9	0.1830	412.80	381.2	3.3	4.310	4.666	8.976	1.92	45.20	6.821	2.155

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
10	0.2030	432.80	401.2	3.7	4.519	4.363	8.883	2.04	49.40	6.623	2.260
11	0.2240	446.90	415.3	4.0	4.660	4.140	8.800	2.13	52.50	6.470	2.330
12	0.2440	465.20	433.6	4.4	4.847	3.982	8.828	2.22	54.70	6.405	2.423
13	0.2650	471.00	439.4	4.8	4.892	3.852	8.744	2.27	56.50	6.298	2.446
14	0.2850	483.50	451.9	5.1	5.012	3.766	8.778	2.33	57.70	6.272	2.506
15	0.3060	490.20	458.6	5.5	5.066	3.694	8.760	2.37	58.70	6.227	2.533
16	0.3260	503.50	471.9	5.9	5.193	3.643	8.837	2.43	59.40	6.240	2.597
17	0.3460	516.80	485.2	6.2	5.319	3.607	8.926	2.47	59.90	6.267	2.660
18	0.3670	521.80	490.2	6.6	5.352	3.586	8.938	2.49	60.20	6.262	2.676
19	0.3870	530.10	498.5	7.0	5.422	3.571	8.993	2.52	60.40	6.282	2.711
20	0.4080	538.40	506.8	7.4	5.490	3.564	9.054	2.54	60.50	6.309	2.745
21	0.4280	543.40	511.8	7.7	5.522	3.564	9.086	2.55	60.50	6.325	2.761
22	0.4490	554.30	522.7	8.1	5.617	3.571	9.188	2.57	60.40	6.380	2.808
23	0.4690	565.90	534.3	8.5	5.719	3.578	9.297	2.60	60.30	6.438	2.859
24	0.4890	567.60	536.0	8.8	5.714	3.578	9.293	2.60	60.30	6.436	2.857
25	0.5300	581.70	550.1	9.6	5.817	3.600	9.417	2.62	60.00	6.509	2.909
26	0.5710	591.70	560.1	10.3	5.874	3.636	9.510	2.62	59.50	6.573	2.937
27	0.6120	605.00	573.4	11.0	5.964	3.665	9.629	2.63	59.10	6.647	2.982
28	0.6530	615.00	583.4	11.8	6.018	3.701	9.719	2.63	58.60	6.710	3.009
29	0.6940	626.70	595.1	12.5	6.087	3.737	9.824	2.63	58.10	6.780	3.044
30	0.7350	638.30	606.7	13.3	6.153	3.773	9.926	2.63	57.60	6.849	3.077
31	0.7760	649.10	617.5	14.0	6.209	3.816	10.025	2.63	57.00	6.921	3.105
32	0.8170	657.50	625.9	14.7	6.240	3.852	10.092	2.62	56.50	6.972	3.120
33	0.8390	669.90	638.3	15.1	6.334	3.866	10.200	2.64	56.30	7.033	3.167

11

Holcomb Foundation Engineering

Grain Size Analysis



12

R12894

13

Holcomb Foundation Engineering Company

Laboratory Testing Results

2/8/2006

Project: Mach #1 Mine

Project No: H-05278

Sieve Analysis - ASTM C136-96a

Sample: Silty CLAY (CL)

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
1.5000	38.1000	1 -1/2"	0.0	0.0	100.0
1.0000	25.4000	1"	0.0	0.0	100.0
0.7500	19.1000	3/4"	0.0	0.0	100.0
0.5000	12.7000	1/2"	0.0	0.0	100.0
3.7500	9.5200	3/8"	0.0	0.0	100.0
0.1870	4.7600	No. 4	2.1	0.9	99.1
0.0790	2.0000	No. 10	4.6	2.0	98.0
0.0469	1.1800	No. 16	4.6	2.0	98.0
0.0331	0.8500	No. 20	8.6	3.8	96.2
0.0165	0.4200	No. 40	12.6	5.5	94.5
0.0117	0.2980	No. 50	12.6	5.5	94.5
0.0083	0.2500	No. 60	22.2	9.8	90.2
0.0059	0.1490	No. 100	34.6	15.2	84.8
0.0029	0.0740	No. 200	47.7	21.0	79.0

Total Weight in Grams 227.20

14

Holcomb Foundation Engineering Company

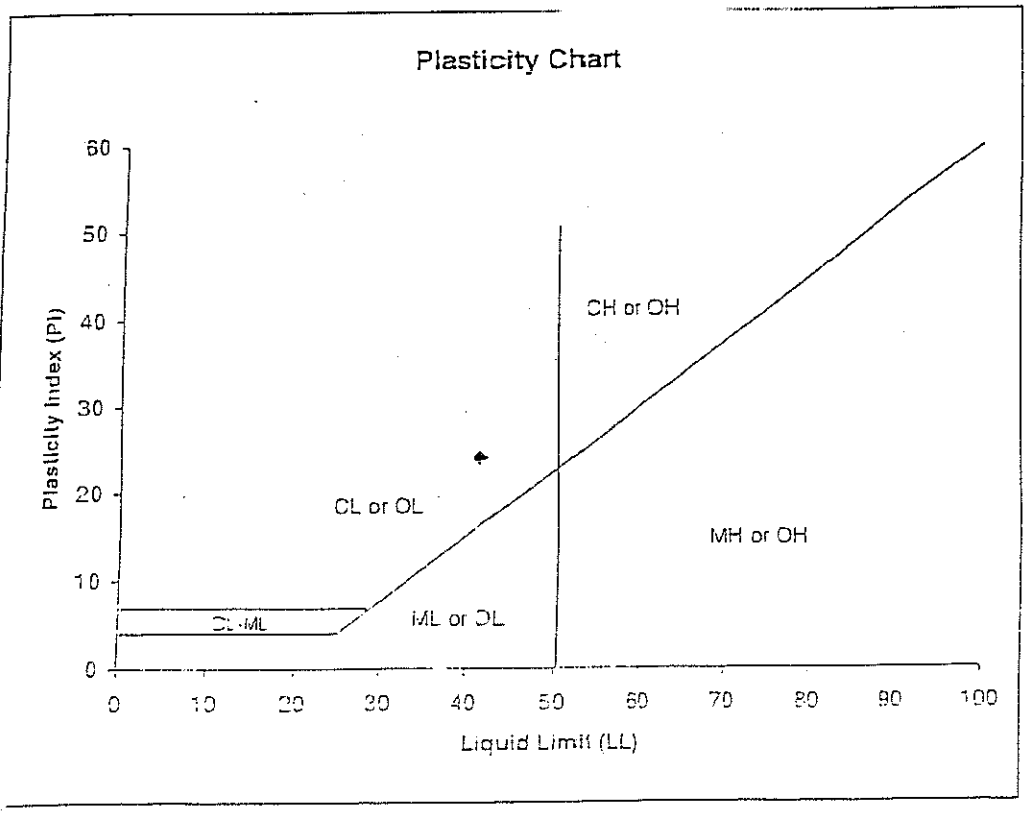
Laboratory Testing Results

Project: Mach #1 Mine
Project No: H-05278

Sample	1	2	3
Dish Number	LL_1	LL_2	LL_3
Mass of can, W_1 (g)	34.70		
Mass of can + moist soil, W_2 (g)	62.84		
Mass of can + dry soil, W_3 (g)	54.52		
Moisture content, w (%)	41.98		
Number of blows, N	24		
Liquid Limit, LL	41.8		

Dish Number	PL_1
Mass of can, W_1 (g)	39.76
Mass of can + moist soil, W_2 (g)	54.79
Mass of can + dry soil, W_3 (g)	52.53
Plastic Limit, PL	17.7

PI =	24.1



15

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

SHIPPING ADDRESS
Box 393 Wood Road
Carbondale, IL 62901

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P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

November 30, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Pond Creek Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on November 17, 2006, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification: Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)

Proctor Test Results:
Maximum Dry Unit Weight: 124.6 PCF
Optimum Moisture Content: 9.3 %

Specific Gravity: 2.37

Triaxial Test Results:
Effective Cohesion: 0 PSF
Effective Phi Angle: 33.7 Degrees

Permeability: 2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

16

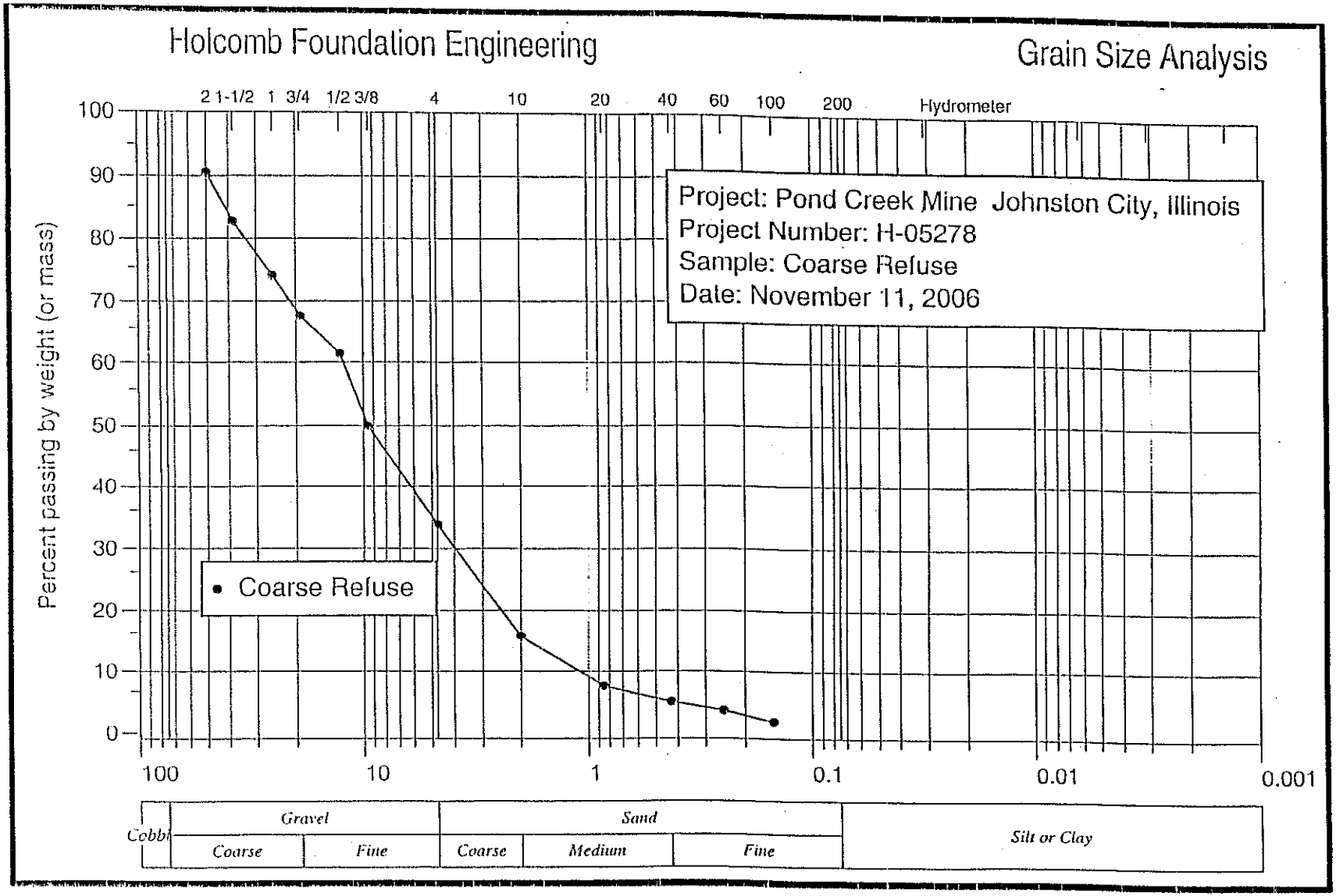
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting


Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
Project: Pond Creek Mine Johnston City, Illinois
Project Number: H-05278
Sample: Coarse Refuse
Date: November 11, 2006
• Coarse Refuse
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

R12899

R

Holcomb Foundation Engineering Company

Laboratory Testing Results

11/30/2006

Project: Coarse Refuse Disposal Area
Pond Creek Mine Johnston City, Illinois

Project No: H-05317

Sieve Analysis - ASTM C136-96a

Sample: Coarse Refuse

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
3	76.2	3"	0.0	0.0	100.0
2.0000	50.8100	2"	619.6	9.5	90.5
1.5000	38.1000	1 -1/2"	1124.0	17.2	82.8
1.0000	25.4000	1"	1696.2	25.9	74.1
0.7500	19.1000	3/4"	2110.9	32.3	67.7
0.5000	12.7000	1/2"	2513.0	38.4	61.6
3.7500	9.5200	3/8"	3263.7	49.9	50.1
0.1870	4.7600	No. 4	4310.7	65.9	34.1
0.0790	2.0000	No. 10	5470.5	83.6	16.4
0.0469	1.1800	No. 16			
0.0331	0.8500	No. 20	6004.4	91.8	8.2
0.0165	0.4200	No. 40	6178.9	94.4	5.6
0.0117	0.2980	No. 50			
0.0083	0.2500	No. 60	6267.8	95.8	4.2
0.0059	0.1490	No. 100			
0.0029	0.0740	No. 200	6372.4	97.4	2.6

Total Weight in Grams 6542.80

19

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

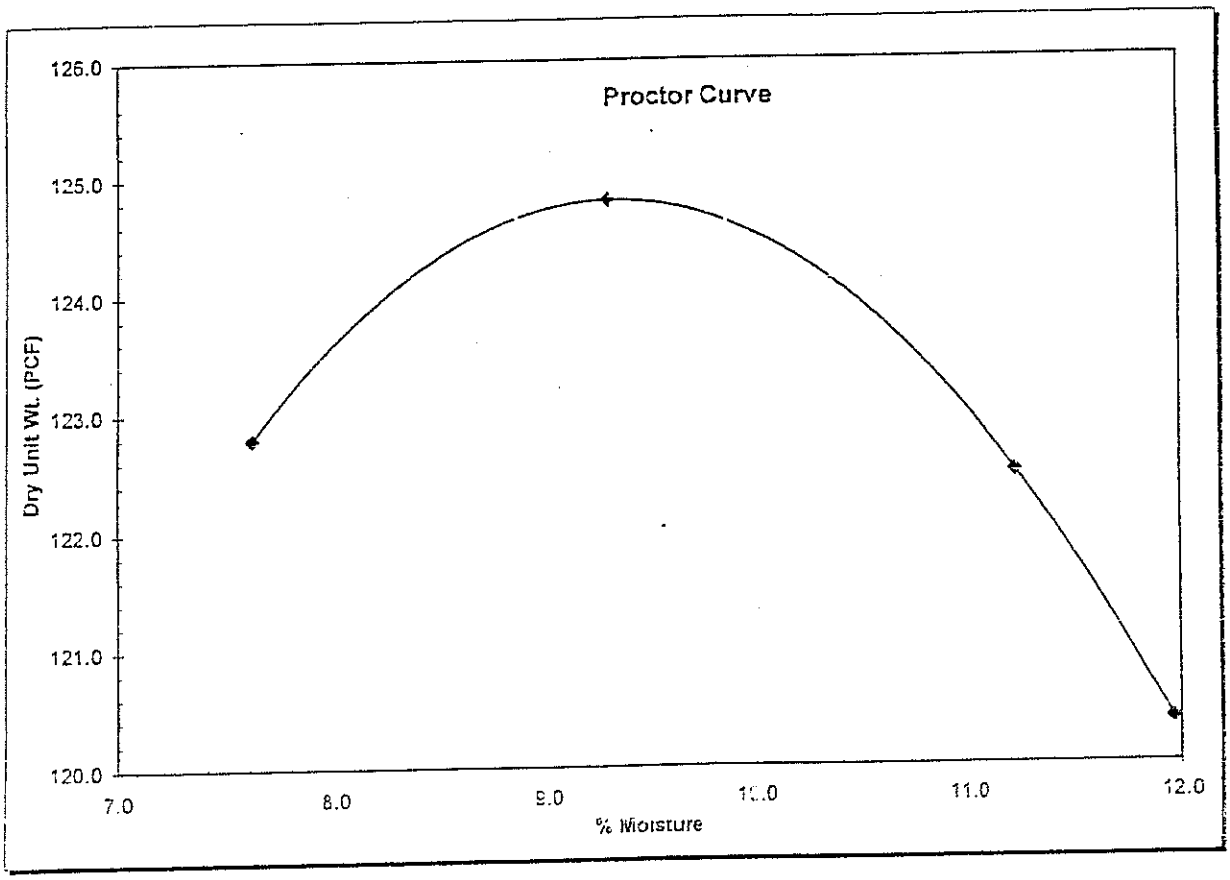
Date: 11/30/2006

Proctor Test Results

Soil Classification:	Gray Coarse Refuse
Maximum Dry Density (PCF)	124.8
Optimum Moisture Content (%)	9.3

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
7.6	122.8
11.2	122.5
12.0	120.4
9.3	124.8



30

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618-529-5262
800-333-1740
FAX 618-457-8991

Permeability Tests Results

Laboratory Tests
Coarse Refuse
Pond Creek Mine - Johnston City, Illinois

Date: 11/30/2006

Client: Pond Creek Mine
Johnston City, Illinois

Project No.: H-05278

Sample	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse		7.7	11.8	119.3	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

21

PERMEABILITY TEST RESULTS

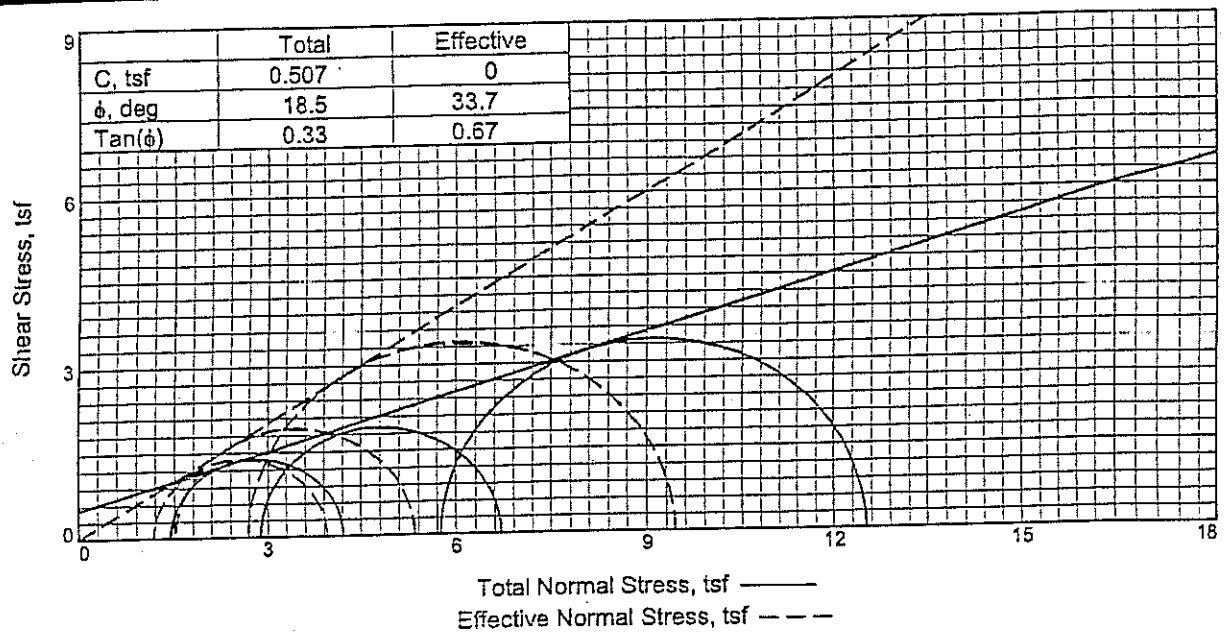
Project	Pond Creek Mine	Boring/Sample Depth	Coarse Refuse
Project #	H-05278	Classification	
Da	11/30/2006	Diameter	2.8 Inch
		Length	5.6 Inch

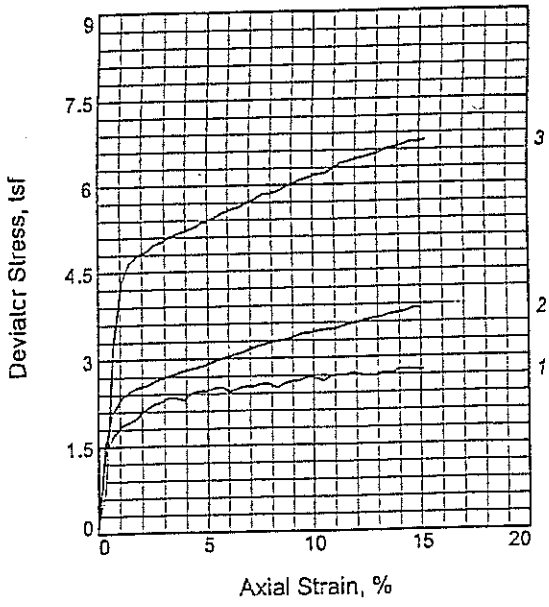
In Place Mc		After Test Mc		Unit Weight (PCF)	
Wet Wt.	195.3	Wet Wt.	1300.4	Sample Wt.	1161.8
Pan	94.2	Pan	103.1		
Dry Wt.	188.1	Dry Wt.	1173.6	Wet UW=	128.5
Mc (%)	7.7	Mc (%)	11.8	Dry UW=	119.3

Time(hrs)	Time(min)	Quantity (cc)	Head (psi)	Permeability (cm/sec)
7	26	24.7		
7	34	8.2	1	1.75E-04
7	33	24.5		
7	45	2.7	1	1.54E-04
7	47	0.8	1	1.44E-04
9	16	24.4		
9	23	9.6	1	1.79E-04
9	30	0.9	1	1.43E-04
		Average Permeability		1.63E-04

22

	Total	Effective
C, tsf	0.507	0
ϕ, deg	18.5	33.7
Tan(ϕ)	0.33	0.67





Sample No.		1	2	3
Initial	Water Content,	10.1	10.8	10.3
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	97.0	99.8	99.3
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
At Test	Water Content,	10.4	10.8	10.4
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
Strain rate, in./min.		0.01	0.01	0.01
Back Pressure, tsf		3.60	3.60	2.16
Cell Pressure, tsf		5.04	6.48	7.92
Fail. Stress, tsf		2.78	3.83	6.76
Total Pore Pr., tsf		3.86	4.96	5.23
Ult. Stress, tsf		2.77	3.83	6.76
Total Pore Pr., tsf		3.85	4.95	5.23
$\bar{\sigma}_1$ Failure, tsf		3.96	5.35	9.44
$\bar{\sigma}_3$ Failure, tsf		1.18	1.52	2.69

Type of Test:
CU with Pore Pressures
Sample Type: Remolded
Description: Coarse Coal Refuse

Assumed Specific Gravity= 2.37
Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

Location: Coarse Refuse Stockpile
Sample Number: Coarse Refuse
Proj. No.: H-05278 **Date:** 11/17/06

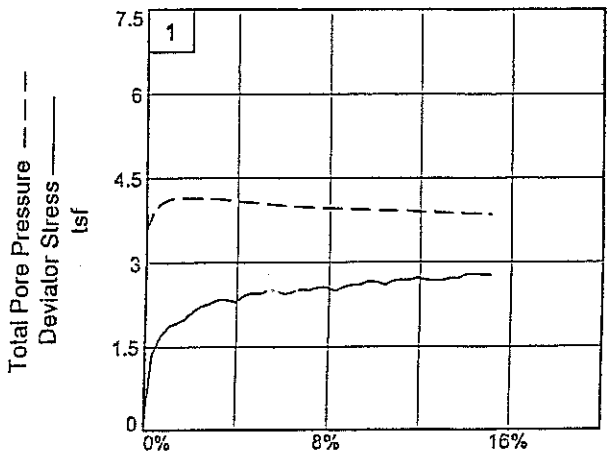
TRIAXIAL SHEAR TEST REPORT

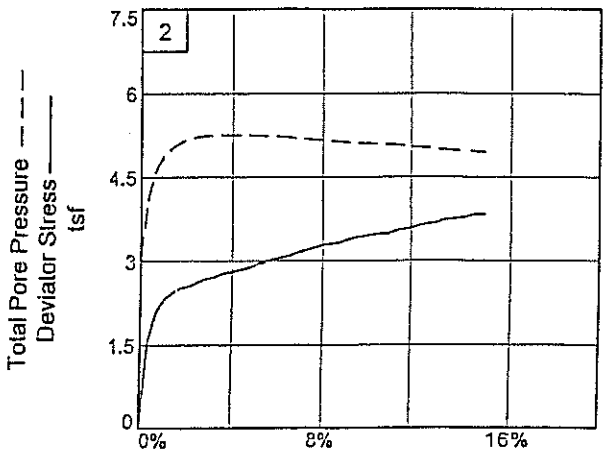
HOLCOMB FOUNDATION ENGINEERING CO.

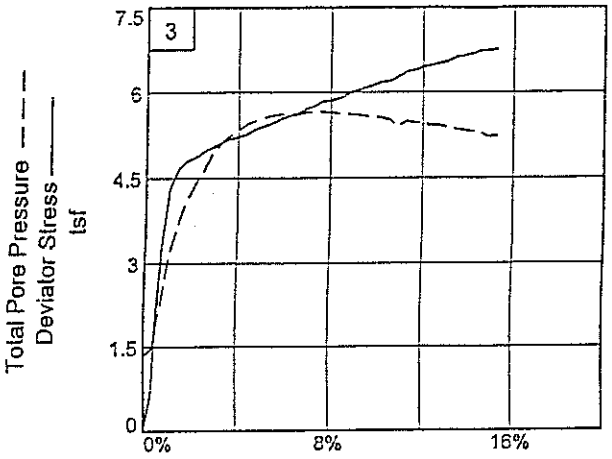
Plate _____

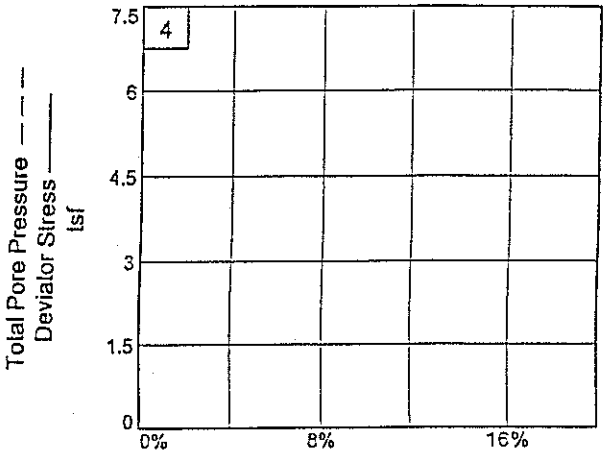
Tested By: LC Checked By: TH

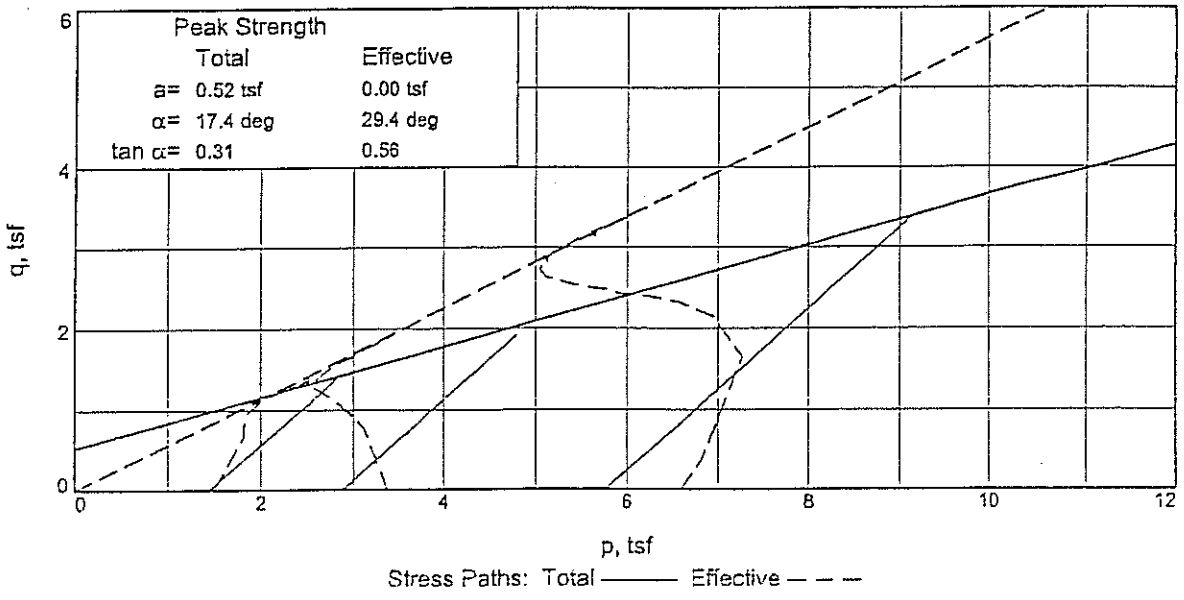
23











Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Coarse Refuse Stockpile
Project No.: H-05278

Sample Number: Coarse Refuse
Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH

(24)

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

11/30/2006
10:19 AM

Date:	11/17/06
Client:	Pond Creek Mine
Project:	Coarse Refuse Laboratory Tests
Location:	Coarse Refuse Stockpile
Sample Number:	Coarse Refuse
Description:	Coarse Coal Refuse
Remarks:	
Type of Sample:	Remolded
Assumed Specific Gravity=2.37	LL= PL= PI=
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	226.800			1320.700
Moisture content: Dry soil+tare, gms.	218.600			1195.800
Moisture content: Tare, gms.	137.500			107.600
Moisture, %	10.1	10.4	10.4	11.5
Moist specimen weight, gms.	1193.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.65	5.65	5.65	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.6	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2470	0.2470	0.2470	
Saturation, %	97.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 2.778 tsf at reading no. 41
Ult. Stress = 2.767 tsf at reading no. 42

25

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0010	46.60	0.0	0.0	0.000	1.498	1.498	1.00	49.20	1.498	0.000
1	0.0180	160.60	114.0	0.3	1.329	1.152	2.481	2.15	54.00	1.816	0.664
2	0.0390	189.70	143.1	0.7	1.662	1.001	2.663	2.66	56.10	1.832	0.831
3	0.0590	205.60	159.0	1.0	1.840	0.929	2.769	2.98	57.10	1.849	0.920
4	0.0800	212.20	165.6	1.4	1.909	0.907	2.816	3.10	57.40	1.862	0.955
5	0.1000	218.90	172.3	1.8	1.979	0.900	2.879	3.20	57.50	1.890	0.990
6	0.1200	232.20	185.6	2.1	2.125	0.900	3.025	3.36	57.50	1.962	1.062
7	0.1410	240.50	193.9	2.5	2.211	0.907	3.118	3.44	57.40	2.013	1.106
8	0.1610	245.50	198.9	2.8	2.260	0.914	3.174	3.47	57.30	2.044	1.130
9	0.1820	252.20	205.6	3.2	2.327	0.922	3.249	3.53	57.20	2.085	1.164
10	0.2020	253.80	207.2	3.6	2.337	0.936	3.273	3.50	57.00	2.104	1.168
11	0.2230	250.50	203.9	3.9	2.291	0.958	3.248	3.39	56.70	2.103	1.145
12	0.2430	261.30	214.7	4.3	2.403	0.972	3.375	3.47	56.50	2.173	1.201
13	0.2630	266.30	219.7	4.6	2.450	0.979	3.429	3.50	56.40	2.204	1.225
14	0.2840	266.30	219.7	5.0	2.440	0.994	3.434	3.46	56.20	2.214	1.220
15	0.3040	272.10	225.5	5.4	2.495	1.008	3.503	3.48	56.00	2.256	1.248
16	0.3250	274.60	228.0	5.7	2.513	1.022	3.536	3.46	55.80	2.279	1.257
17	0.3450	268.00	221.4	6.1	2.431	1.037	3.468	3.34	55.60	2.252	1.216
18	0.3660	273.00	226.4	6.5	2.476	1.051	3.527	3.36	55.40	2.289	1.238
19	0.3860	278.00	231.4	6.8	2.521	1.058	3.580	3.38	55.30	2.319	1.261
20	0.4070	278.00	231.4	7.2	2.511	1.066	3.577	3.36	55.20	2.321	1.256
21	0.4270	283.00	236.4	7.5	2.556	1.073	3.629	3.38	55.10	2.351	1.278
22	0.4470	284.60	238.0	7.9	2.563	1.080	3.643	3.37	55.00	2.362	1.282
23	0.4680	278.80	232.2	8.3	2.491	1.087	3.578	3.29	54.90	2.333	1.245
24	0.4880	286.30	239.7	8.6	2.561	1.087	3.648	3.36	54.90	2.368	1.281
25	0.5090	290.40	243.8	9.0	2.594	1.094	3.689	3.37	54.80	2.392	1.297
26	0.5290	292.10	245.5	9.3	2.602	1.102	3.704	3.36	54.70	2.403	1.301
27	0.5500	298.80	252.2	9.7	2.662	1.109	3.771	3.40	54.60	2.440	1.331
28	0.5700	299.60	253.0	10.1	2.660	1.116	3.776	3.38	54.50	2.446	1.330
29	0.5910	294.60	248.0	10.4	2.597	1.116	3.713	3.33	54.50	2.415	1.299
30	0.6110	302.10	255.5	10.8	2.665	1.123	3.788	3.37	54.40	2.456	1.333
31	0.6310	306.30	259.7	11.2	2.698	1.130	3.828	3.39	54.30	2.479	1.349
32	0.6520	306.30	259.7	11.5	2.687	1.130	3.817	3.38	54.30	2.474	1.343
33	0.6720	312.10	265.5	11.9	2.736	1.145	3.881	3.39	54.10	2.513	1.368
34	0.6930	309.60	263.0	12.2	2.699	1.145	3.843	3.36	54.10	2.494	1.349
35	0.7130	308.80	262.2	12.6	2.680	1.152	3.832	3.33	54.00	2.492	1.340
36	0.7340	309.60	263.0	13.0	2.676	1.159	3.835	3.31	53.90	2.497	1.338
37	0.7540	315.40	268.8	13.3	2.724	1.166	3.891	3.34	53.80	2.528	1.362
38	0.7750	316.20	269.6	13.7	2.721	1.166	3.887	3.33	53.80	2.527	1.360
39	0.7950	323.70	277.1	14.1	2.785	1.181	3.966	3.36	53.60	2.573	1.392
40	0.8150	325.40	278.8	14.4	2.790	1.181	3.971	3.36	53.60	2.576	1.395
41	0.8360	325.40	278.8	14.8	2.778	1.181	3.959	3.35	53.60	2.570	1.389
42	0.8560	325.40	278.8	15.1	2.767	1.188	3.955	3.33	53.50	2.571	1.383

26

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	211.600			1335.900
Moisture content: Dry soil+tare, gms.	203.200			1222.200
Moisture content: Tare, gms.	125.200			134.800
Moisture, %	10.8	10.8	10.8	10.5
Moist specimen weight, gms.	1175.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.57	5.57	5.57	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.5	130.5	130.5	
Dry density, pcf	117.8	117.8	117.8	
Void ratio	0.2558	0.2558	0.2558	
Saturation, %	99.8	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 3.829 tsf at reading no. 40
Ult. Stress = 3.828 tsf at reading no. 41

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	51.60	0.0	0.0	0.000	3.377	3.377	1.00	43.10	3.377	0.000
1	0.0190	185.60	134.0	0.3	1.562	2.340	3.902	1.67	57.50	3.121	0.781
2	0.0400	233.00	181.4	0.7	2.106	1.814	3.920	2.16	64.80	2.867	1.053
3	0.0600	253.00	201.4	1.1	2.330	1.562	3.892	2.49	68.30	2.727	1.165
4	0.0810	263.80	212.2	1.5	2.445	1.433	3.878	2.71	70.10	2.655	1.223
5	0.1010	270.50	218.9	1.8	2.513	1.346	3.860	2.87	71.30	2.603	1.257
6	0.1220	274.60	223.0	2.2	2.550	1.289	3.839	2.98	72.10	2.564	1.275
7	0.1420	281.30	229.7	2.5	2.617	1.260	3.877	3.08	72.50	2.569	1.309
8	0.1620	287.10	235.5	2.9	2.674	1.238	3.912	3.16	72.80	2.575	1.337
9	0.1830	291.30	239.7	3.3	2.711	1.231	3.942	3.20	72.90	2.587	1.355
10	0.2030	297.10	245.5	3.6	2.766	1.224	3.990	3.26	73.00	2.607	1.383
11	0.2240	301.30	249.7	4.0	2.802	1.224	4.026	3.29	73.00	2.625	1.401
12	0.2440	305.40	253.8	4.4	2.838	1.224	4.062	3.32	73.00	2.643	1.419
13	0.2650	309.60	258.0	4.8	2.873	1.224	4.097	3.35	73.00	2.661	1.437
14	0.2850	315.40	263.8	5.1	2.927	1.231	4.158	3.38	72.90	2.695	1.463
15	0.3060	320.40	268.8	5.5	2.970	1.238	4.209	3.40	72.80	2.724	1.485
16	0.3260	326.20	274.6	5.9	3.023	1.246	4.269	3.43	72.70	2.757	1.512
17	0.3460	330.40	278.8	6.2	3.058	1.253	4.310	3.44	72.60	2.782	1.529
18	0.3670	334.60	283.0	6.6	3.091	1.267	4.358	3.44	72.40	2.813	1.546
19	0.3870	341.20	289.6	6.9	3.151	1.282	4.433	3.46	72.20	2.857	1.576
20	0.4080	346.20	294.6	7.3	3.192	1.296	4.488	3.46	72.00	2.892	1.596
21	0.4280	351.20	299.6	7.7	3.234	1.310	4.544	3.47	71.80	2.927	1.617

27

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	357.00	305.4	8.1	3.283	1.318	4.601	3.49	71.70	2.959	1.642
23	0.4690	359.50	307.9	8.4	3.297	1.332	4.629	3.48	71.50	2.981	1.649
24	0.4890	362.80	311.2	8.8	3.319	1.339	4.659	3.48	71.40	2.999	1.660
25	0.5100	368.70	317.1	9.2	3.368	1.346	4.715	3.50	71.30	3.031	1.684
26	0.5300	374.50	322.9	9.5	3.416	1.361	4.777	3.51	71.10	3.069	1.708
27	0.5510	377.00	325.4	9.9	3.429	1.368	4.797	3.51	71.00	3.082	1.714
28	0.5710	381.20	329.6	10.2	3.459	1.368	4.827	3.53	71.00	3.098	1.730
29	0.5920	384.50	332.9	10.6	3.479	1.382	4.861	3.52	70.80	3.122	1.739
30	0.6120	386.20	334.6	11.0	3.483	1.390	4.872	3.51	70.70	3.131	1.741
31	0.6330	392.00	340.4	11.4	3.528	1.397	4.925	3.53	70.60	3.161	1.764
32	0.6530	397.00	345.4	11.7	3.565	1.411	4.977	3.53	70.40	3.194	1.783
33	0.6730	400.30	348.7	12.1	3.585	1.426	5.010	3.51	70.20	3.218	1.792
34	0.6940	406.10	354.5	12.5	3.629	1.440	5.069	3.52	70.00	3.254	1.814
35	0.7140	410.30	358.7	12.8	3.657	1.454	5.111	3.51	69.80	3.283	1.828
36	0.7350	413.60	362.0	13.2	3.674	1.469	5.143	3.50	69.60	3.306	1.837
37	0.7550	420.30	368.7	13.6	3.727	1.483	5.210	3.51	69.40	3.347	1.863
38	0.7760	423.60	372.0	13.9	3.744	1.498	5.242	3.50	69.20	3.370	1.872
39	0.7960	427.80	376.2	14.3	3.770	1.505	5.275	3.51	69.10	3.390	1.885
40	0.8170	435.30	383.7	14.7	3.829	1.519	5.348	3.52	68.90	3.434	1.914
41	0.8370	436.90	385.3	15.0	3.828	1.526	5.355	3.51	68.80	3.441	1.914

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	184.300			1333.800
Moisture content: Dry soil+tare, gms.	177.100			1230.400
Moisture content: Tare, gms.	107.500			135.300
Moisture, %	10.3	10.4	10.4	9.4
Moist specimen weight, gms.	1185.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.60	5.60	5.60	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.9	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2468	0.2468	0.2468	
Saturation, %	99.3	100.0	100.0	

28

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 6.758 tsf at reading no. 42
Ult. Stress = 6.758 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	25.00	0.0	0.0	0.000	6.588	6.588	1.00	18.50	6.588	0.000
1	0.0190	88.20	63.2	0.3	0.736	6.458	7.195	1.11	20.30	6.827	0.368
2	0.0400	309.60	284.6	0.7	3.304	5.623	8.927	1.59	31.90	7.275	1.652
3	0.0600	397.00	372.0	1.1	4.303	4.795	9.098	1.90	43.40	6.947	2.152
4	0.0810	428.60	403.6	1.4	4.651	4.234	8.885	2.10	51.20	6.559	2.326
5	0.1010	441.90	416.9	1.8	4.787	3.830	8.617	2.25	56.80	6.224	2.393
6	0.1220	449.40	424.4	2.2	4.854	3.521	8.375	2.38	61.10	5.948	2.427
7	0.1420	460.20	435.2	2.5	4.960	3.283	8.243	2.51	64.40	5.763	2.480
8	0.1620	467.70	442.7	2.9	5.027	3.017	8.044	2.67	68.10	5.530	2.513
9	0.1830	476.00	451.0	3.3	5.101	2.837	7.938	2.80	70.60	5.387	2.551
10	0.2030	483.50	458.5	3.6	5.167	2.693	7.860	2.92	72.60	5.276	2.583
11	0.2240	489.30	464.3	4.0	5.212	2.585	7.797	3.02	74.10	5.191	2.606
12	0.2440	495.20	470.2	4.4	5.258	2.491	7.750	3.11	75.40	5.120	2.629
13	0.2650	505.20	480.2	4.7	5.349	2.419	7.768	3.21	76.40	5.094	2.675
14	0.2850	511.00	486.0	5.1	5.394	2.369	7.762	3.28	77.10	5.066	2.697
15	0.3060	518.50	493.5	5.5	5.455	2.333	7.788	3.34	77.60	5.060	2.728
16	0.3260	526.80	501.8	5.8	5.526	2.304	7.830	3.40	78.00	5.067	2.763
17	0.3460	533.50	508.5	6.2	5.579	2.297	7.875	3.43	78.10	5.086	2.789
18	0.3670	539.30	514.3	6.6	5.620	2.326	7.945	3.42	77.70	5.135	2.810
19	0.3870	548.40	523.4	6.9	5.697	2.275	7.972	3.50	78.40	5.124	2.849
20	0.4080	555.90	530.9	7.3	5.756	2.261	8.016	3.55	78.60	5.139	2.878
21	0.4280	565.90	540.9	7.6	5.841	2.261	8.102	3.58	78.60	5.181	2.921

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	569.20	544.2	8.0	5.853	2.268	8.121	3.58	78.50	5.195	2.927
23	0.4690	575.10	550.1	8.4	5.894	2.282	8.176	3.58	78.30	5.229	2.947
24	0.4890	584.20	559.2	8.7	5.968	2.297	8.265	3.60	78.10	5.281	2.984
25	0.5100	592.50	567.5	9.1	6.031	2.311	8.343	3.61	77.90	5.327	3.016
26	0.5300	599.20	574.2	9.5	6.079	2.333	8.411	3.61	77.60	5.372	3.039
27	0.5510	605.90	580.9	9.8	6.124	2.354	8.479	3.60	77.30	5.416	3.062
28	0.5710	613.30	588.3	10.2	6.178	2.362	8.539	3.62	77.20	5.450	3.089
29	0.5920	617.50	592.5	10.6	6.196	2.405	8.601	3.58	76.60	5.503	3.098
30	0.6120	626.70	601.7	10.9	6.267	2.527	8.794	3.48	74.90	5.661	3.133
31	0.6330	638.30	613.3	11.3	6.361	2.426	8.787	3.62	76.30	5.607	3.180
32	0.6530	644.10	619.1	11.7	6.395	2.448	8.843	3.61	76.00	5.646	3.198
33	0.6730	650.80	625.8	12.0	6.438	2.477	8.915	3.60	75.60	5.696	3.219
34	0.6940	656.60	631.6	12.4	6.470	2.498	8.968	3.59	75.30	5.733	3.235
35	0.7140	662.50	637.5	12.8	6.504	2.506	9.009	3.60	75.20	5.758	3.252
36	0.7350	669.10	644.1	13.1	6.543	2.542	9.085	3.57	74.70	5.813	3.271
37	0.7550	678.30	653.3	13.5	6.609	2.563	9.172	3.58	74.40	5.868	3.305
38	0.7760	684.10	659.1	13.9	6.639	2.585	9.224	3.57	74.10	5.904	3.319
39	0.7960	690.70	665.7	14.2	6.678	2.614	9.291	3.55	73.70	5.952	3.339
40	0.8170	699.10	674.1	14.6	6.732	2.635	9.367	3.55	73.40	6.001	3.366
41	0.8370	701.60	676.6	14.9	6.729	2.700	9.429	3.49	72.50	6.065	3.365
42	0.8570	707.40	682.4	15.3	6.758	2.686	9.444	3.52	72.70	6.065	3.379

1

APPENDIX D

Boring Logs

(2)

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING B874

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6
Water Content (%)
Standard N Penetration, Blows/Ft.
10 20 30 40 50 60

Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Brown Silty CLAY (CL) with sand and pebbles
5	1	st		
	2	st		
10				Gray Mottled Brown Silty CLAY (CL)
	3	st		
15				
	4	st		
	5	st		
20				End of Boring @ -20.0'
25				
30				
35				

round Water Data
No Ground Water Encountered During Drilling and None Upon Completion.

Mach #1 Mine Soils Investigation
Mach #1 Mine Williamson County Illinois

Date of Boring
February 1, 2006

Alliance Consulting, Inc.
Beaver, West Virginia

Project No.
H-05278

3

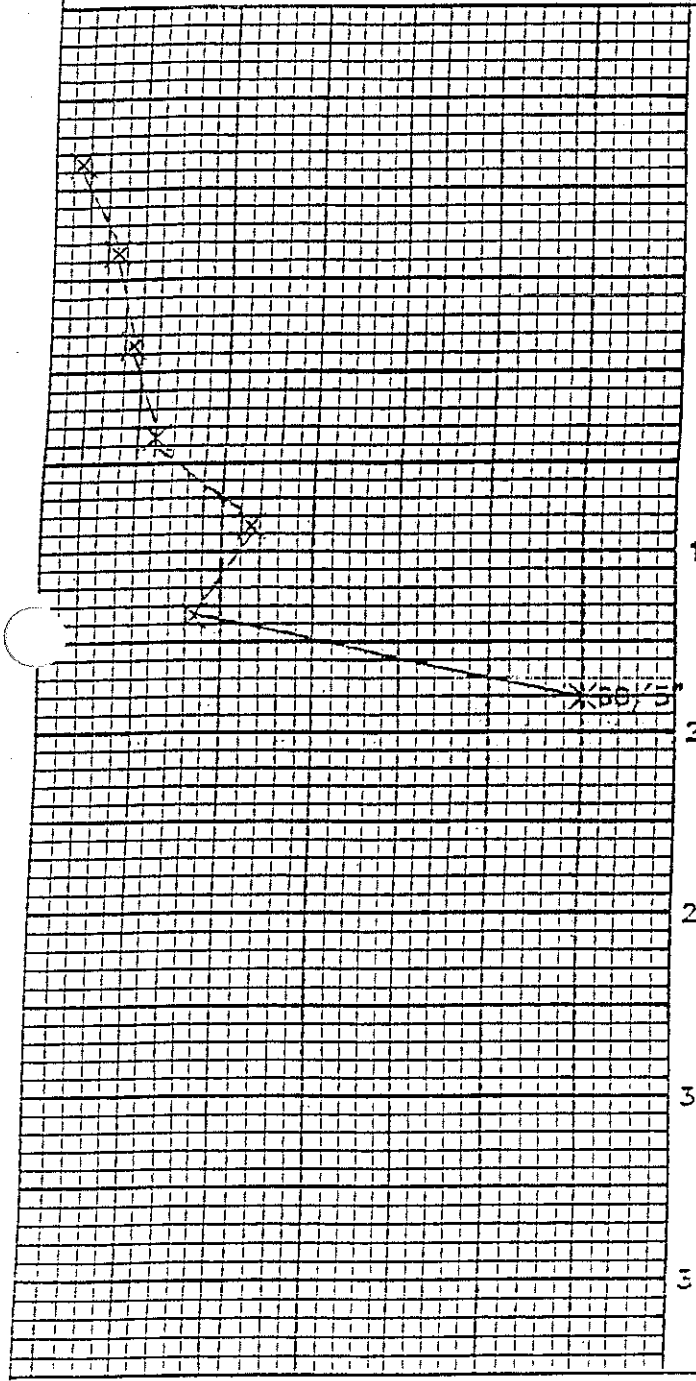
LOG of BORING B293

Holcomb Foundation Engineering Co.

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				7" Topsoil
				Gray Mottled Brown Silty CLAY (CL) with trace of sand
5	1	ss		
	2	ss		
	3	ss		
10				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
	4	ss		
	5	ss		
15				
	6	ss		
	7	ss		Gray SHALE
20				End of Boring @ −19.0'
25				
30				
35				

Ground Water Data
Ground Water Encountered @ −12.0' During Drilling.

Job: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

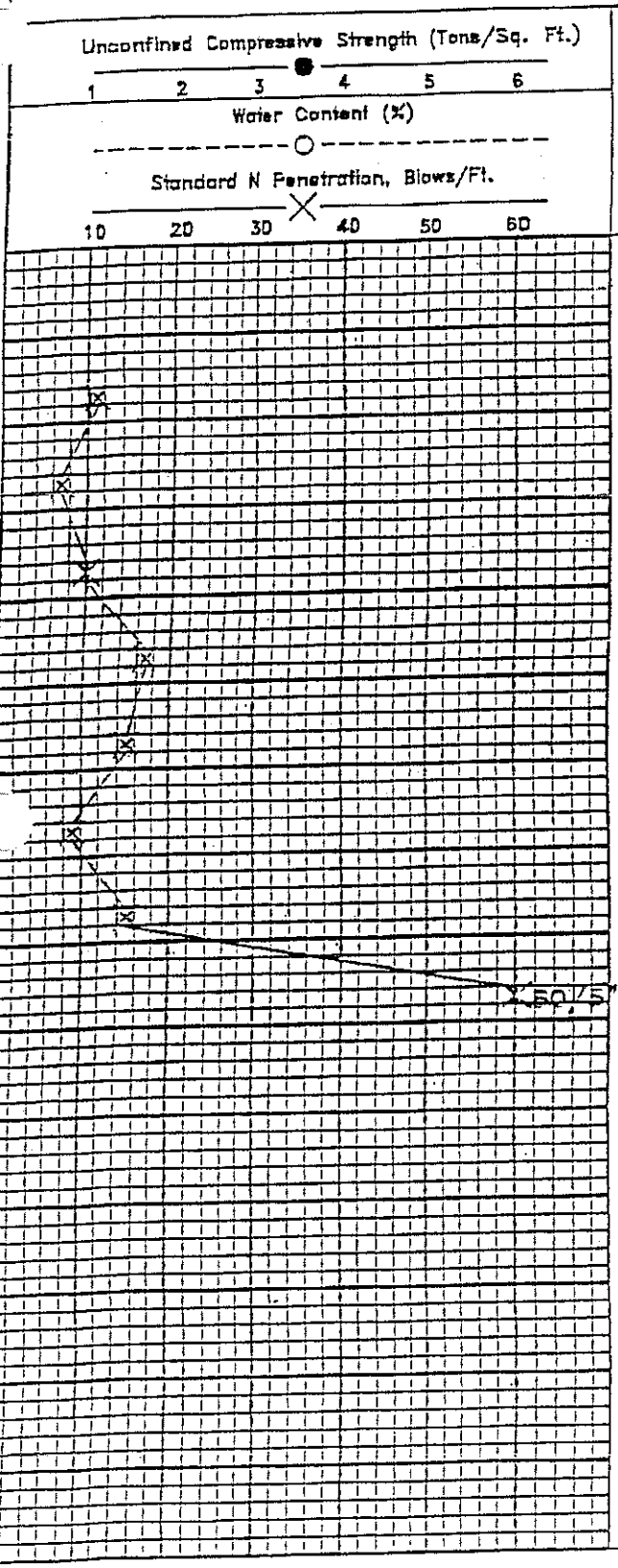
Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

4

LOG of BORING B294

Holcomb Foundation Engineering Co.



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				7" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	SS		
	2	SS		
	3	SS		
10	4	SS		
	5	SS		
15	6	SS		
	7	SS		
20	8	SS		Brown SHALE
				End of Boring @ -22.5'
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

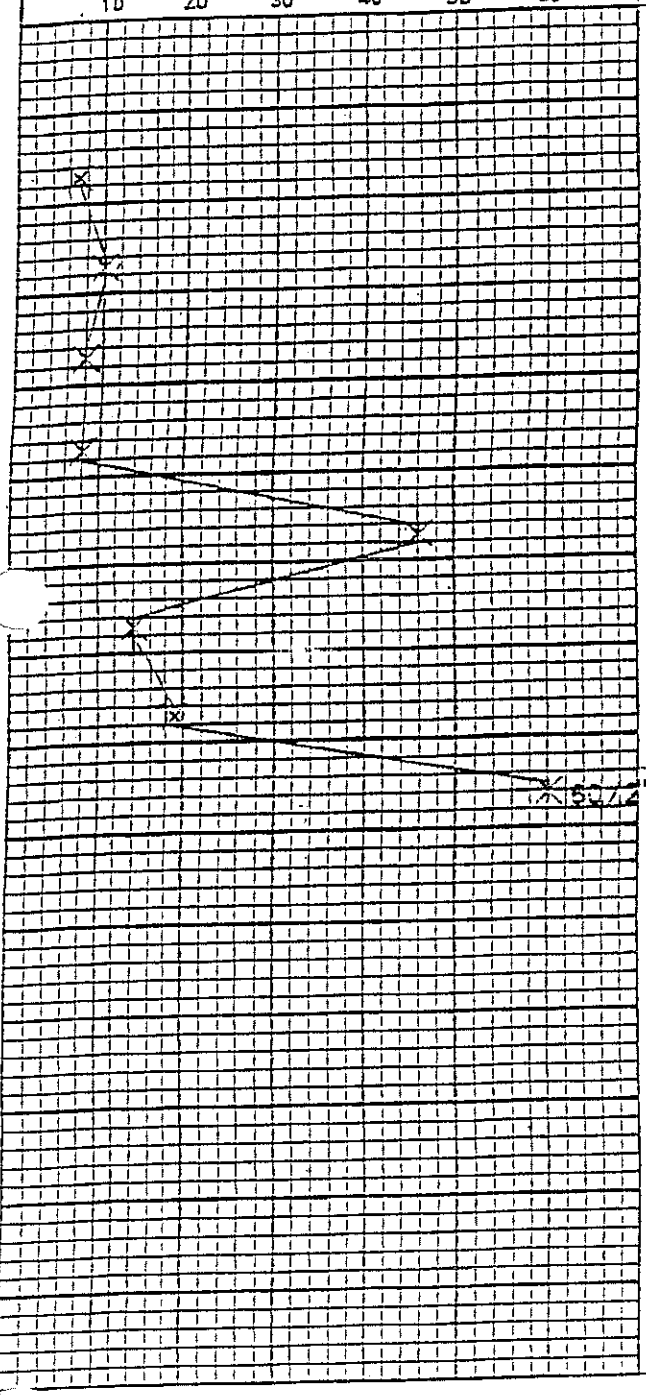
Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

5

LOG of BORING B295

Holcomb Foundation Engineering Co.



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				9" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	SS		
	2	SS		
10	3	SS		
	4	SS		
15	5	SS		Brown SILT (ML)
	6	SS		Brown Medium to Coarse SAND (SC-SP)
20	7	SS		
	8	SS		Gray Mottled Brown SHALE
				End of Boring @ -22.0'
25				
30				
35				

Ground Water Data
Ground Water Encountered @ -16.0' During Drilling/ @ -10.0' Upon Completion.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring: December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.: H-05278

(6)

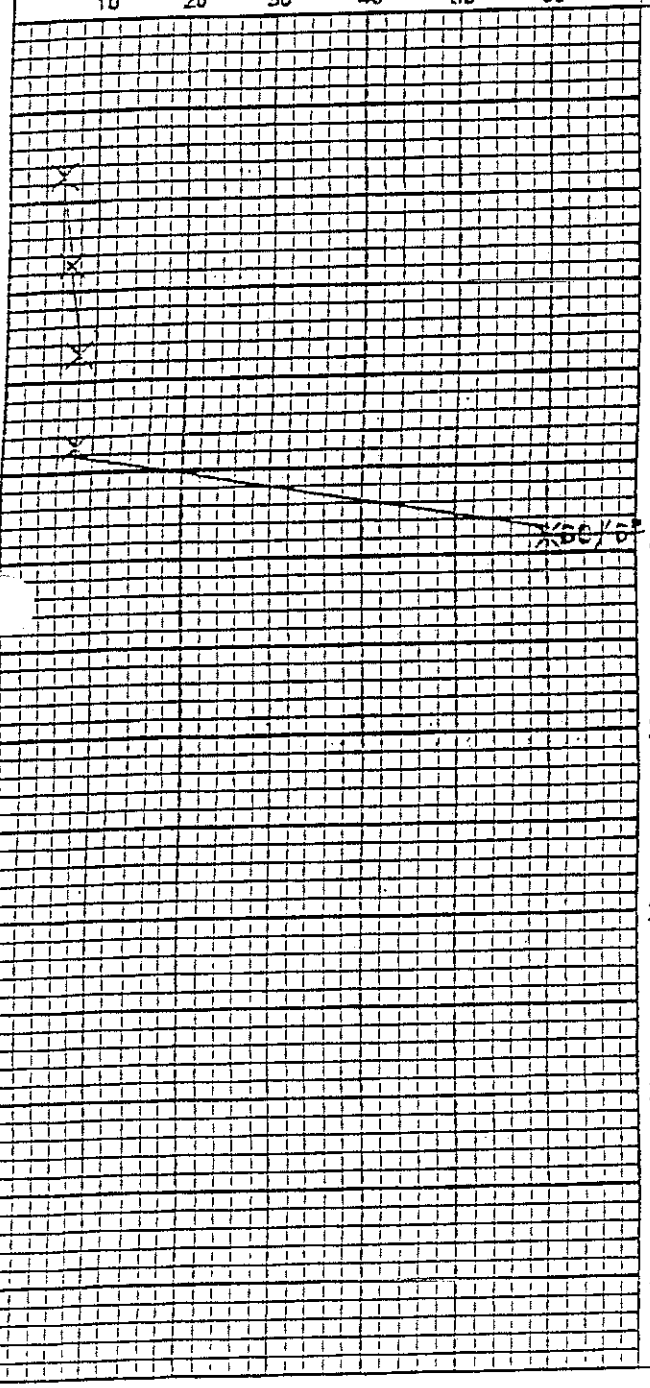
LOG of BORING B297

Holcomb Foundation Engineering Co.

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				9" Topsoil
				Gray Mottled Brown Silty CLAY (CL) with sand and pebbles
	1	ss		
5	2	ss		
	3	ss		Brown Mottled Gray Silty CLAY (CL) with trace of sand
10	4	ss		Gray Mottled Brown Silty CLAY (CL) with trace of sand
	5	ss		Brown SHALE
15				End of Boring @ -15.5'
20				
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

7

LOG of BORING B298

Holcomb Foundation Engineering Co.

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6
Water Content (%)
Standard N Penetration, Blows/Ft.
10 20 30 40 50 60

Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				6" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	SS		
	2	SS		
	3	SS		Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
10	4	SS		Brown Mottled Gray SHALE
	5	SS		Gray SHALE
15				End of Boring @ −14.5'
20				
25				
30				
35				

80/3"

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring: December 5, 2005

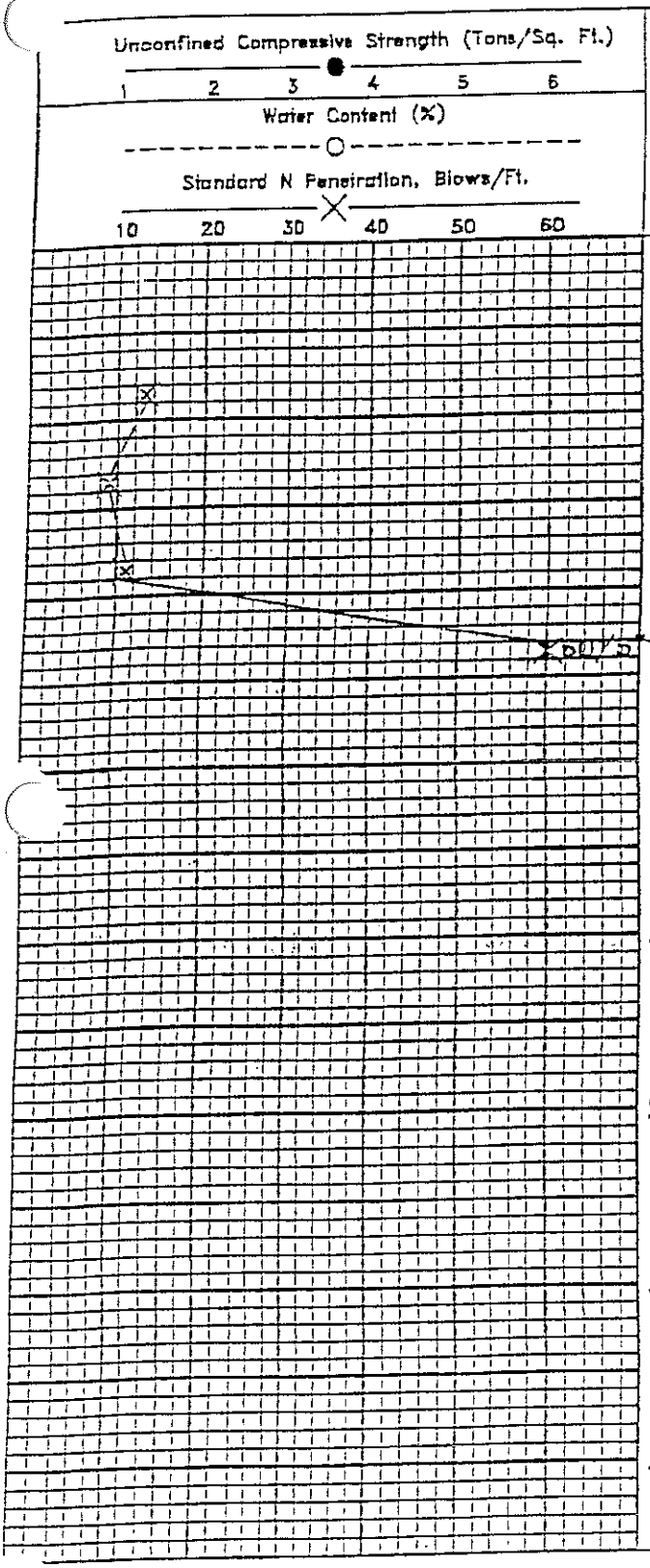
Client: Williamson County Energy
Marion, Illinois

Project No.: H-05278

(8)

LOG of BORING B299

Holcomb Foundation Engineering Co.



Sample No.	Type Sample	Sample Distance	Description of Material
			Surface Elevation
			Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
1	SS		
2	SS		
3	SS		
4	SS		Brown SHALE
			End of Boring @ -12.5'

nd Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

1

APPENDIX E

COARSE COAL REFUSE PLACEMENT GUIDELINES

APPENDIX E

COARSE COAL REFUSE PLACEMENT GUIDELINES
COAL REFUSE DISPOSAL FACILITY NO. 2
MACH #1 MINE
MACH MINING LLC
WILLIAMSON, ILLINOIS

INTRODUCTION

This coal refuse placement plan is intended to serve as a guidance document for the placement of coarse coal refuse at the Pond Creek Mine No.1 coal refuse disposal area which serves Mach Mining LLC's (Mach Mining) Mach #1 Mine coal preparation plant located in Williamson County, Illinois. The information contained herein is sufficiently detailed to provide Mach Mining with the technical guidance required to perform coal refuse disposal operations in a manner consistent with generally accepted construction techniques and sound engineering practice. This plan has been developed based on our understanding of the proposed production rates, proposed placement techniques, and the heavy equipment available for use at the facility, as provided by Mach Mining. The general placement technique for the coarse coal refuse proposed by Mach Mining is to discharge the refuse from a conveyor belt into a stockpile adjacent to the active work surface of the disposal area. Tracked dozers will then be used to push the refuse contained in the stockpile across the work surface in lifts.

HEAVY EQUIPMENT AND ESTIMATED PRODUCTION CAPABILITY

As provided by Mach Mining, two Caterpillar D-9 tracked type dozers and one D-10 tracked type dozer will be available for use at the disposal facility. The D-9 dozers will be dedicated to placing refuse at disposal facility. The D-10 dozer will be utilized at the disposal facility on an as needed basis and be a backup dozer for the D-9 dozers in the event of unexpected downtime. The D-10 will also be used to perform other task at the mine facility. Both the D-9 and D-10 dozers are equipped with a reclamation universal blade which has added capacity over a standard universal blade.

Utilizing information and procedures contained in the Caterpillar Performance Handbook, Edition 33, the estimated production capability for each of the dozers was determined. The procedures require obtaining the maximum estimated production capability of the machine for an average distance of push from a chart and applying

appropriate correction factors to the maximum production in order to estimate on the job performance.

The estimated production capability of the D-9 dozer was determined to be 136 cubic yards/hour at an average push distance of 600 feet and 170 cubic yards/hour at an average push distance of 500 feet. The estimated production capability of the D-10 dozer was determined to be 256 cubic yards/hour at an average push distance of 600 feet and 292 cubic yards/hour at an average push distance of 500 feet. One of the correction factors used to estimate the production capability provided that each dozer would place refuse for 45 minutes of each hour worked. This factor allows approximately 2 hours per each 10 hour work shift for work surface grading, backblading and compaction. The supporting calculations are attached.

The information taken from the handbook and used to determine these production rates is based on a wide variety of job conditions and should only be considered estimates. The only correct way to determine machine performance is by measuring on the job production.

PRODUCTION RATE AND OPERATING SCHEDULE

As provided by Mach Mining, coarse coal refuse production is estimated to be 2.53×10^6 cubic yards per year or 486 cubic yards per hour. Mach Mining is projecting to be operating on a double shift, 20 hour per day, 5 days per week work schedule.

REFUSE PLACEMENT

Coarse coal refuse will be transported to the work surface by a conveyor belt and discharged at two different locations from a stacker belt into stockpiles located adjacent to the active work surfaces. The refuse production will be divided by approximately 50 percent between the two different stockpile locations. The dozers will be used to push the refuse out of the stockpiles onto the two work surfaces in lifts. The dozers will also be used to provide compactive effort to the refuse.

Comparing the production rates and work schedule to the estimated production capability of the dozers indicates that both of the D-9 dozers and the D-10 dozer will be required to manage the refuse production. One D-9 dozer will be required to place refuse on a full time basis from each stockpile area. The D-10 will be required to provide additional

placement capacity for an estimated combined maximum time of 10 hours per day. The dozers will be able to place the refuse in lifts extending an average distance of 500 to 600 feet from the stockpile.

Refuse shall be placed in lifts not to exceed one-foot thickness as specified in the Technical Specifications. The work surface should be graded to drain surface water away from the refuse stockpile area. As a section of the lift is completed the area should be backbladed to eliminate windrows. With each backblade pass the dozer should be offset one half of the dozer width to provide compactive effort over the work surface. The field density testing program will indicate if additional passes are required.

Mach Mining proposes to construct the embankments in 500 to 600 feet long sections. Each section will be completed from the foundation to the proposed crest elevation in compacted lifts not exceeding one-foot. As each section is completed, the conveyor belt and stacker will be advanced on the completed section. The refuse belt discharge point shall be positioned so that the stockpile is over top of the previously placed and compacted refuse.

Refuse shall be pushed from the stockpile area on top of the completed section down onto the working surface on a slope of 2 horizontal to 1 vertical or flatter. All embankment side slopes, except the working end slope of the completed section, shall be kept trimmed to design grade in compacted material. When each new one-foot thick lift is started, it shall be keyed in to the end slope of the completed section trimmed to no steeper than 2 horizontal to 1 vertical in compacted material as shown on Drawing No. B05-33-A4. Compacted material means coarse coal refuse compacted to the density required in the Technical Specifications.

Each of the proposed stacker belts which will discharge the refuse is approximately 29 feet high. Assuming that the natural angle of repose of the refuse is 36°, each belt will stockpile approximately 1,800 cubic yards or a total of 3,600 cubic yards for both belts. This volume provides approximately 8 hours of refuse production storage. This storage volume should be adequate to provide time for the dozers to perform other tasks on the work surface.

These recommendations are based on information contained in the Caterpillar Performance Handbook. This information has been developed from studies performed at various job sites operating under various conditions and should only be considered

estimates of performance. These guidelines may have to be altered to best suit actual field conditions.

File: Appendix E Revised.doc, hlo, 6/11/09

(5)

Alliance Consulting, Inc.
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BY: DI DATE: 1/10/03 CHKD BY: _____ DATE: _____
PROJECT NAME: MACH MINING
PROJECT NO. 605-330-1413 SHEET ____ OF ____
DESCRIPTION REFUSE DOZER PRODUCTION ESTIMATE

PURPOSE: MACH MINING IS PROPOSING TO USE 2 D-9 TRACK TYPE CATERPILLAR DOZERS TO PUSH REFUSE FROM A STOCKPILE AND PLACE IT ON THE WORK SURFACE. ONE CATERPILLAR D-10 DOZER WILL BE AVALIABLE ON AN AS NEEDED BASIS TO ASSIST IN MANAGING THE REFUSE. THE MACHINES ARE EQUIPED WITH RECLAMATION U-BLADES. USING THE CATERPILLAR PERFORMANCE HANDBOOK DETERMINE THE ESTIMATED AVERAGE DISTANCE THE DOZERS CAN PUSH REFUSE.

(1)

PRODUCTION CORRECTION FACTORS

OPERATOR	
EXCELLENT TO AVG.	.88
MATERIAL	
LOOSE STOCKPILE	1.20
VISIBILITY	
.90 FOR DARK USE .90 FOR 50% DAY / 50% NIGHT	.95
EFFICIENCY	
45 MIN OF PLACEMENT/ HOUR - ALLOWS FOR LUNCH BREAK, BACKBLADING AND COMPACTING	.75

(6)

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

BY: _____ DATE: _____ CHKD BY: _____ DATE: _____

PROJECT NAME: _____

PROJECT NO. _____ SHEET _____ OF _____

DESCRIPTION _____

RECLAMATION BLADE

D-9 STANDARD U-BLADE 1.28
CAPACITY = 21.4 CY
RECLAMATION BLADE
CAPACITY = 27.3 CY
27.3 / 21.4

D-10 STANDARD U-BLADE = 1.39
28.7 CY RECLAMATION
U BLADE = 40 CY
40.0 / 28.7

WEIGHT CORRECTION .74
LOOSE REFUSE = 3105 LBS/CY
PRODUCTION CHART IS
BASED ON 2300 LBS/CY
MATERIAL
2300 LBS/CY / 3105 LBS/CY

D-9 CORRECTION FACTOR = (.88)(1.20)(.90)(.75)(1.28)(.74)
D-9 CF = .68

D-10 CORRECTION FACTOR = (.88)(1.20)(.90)(.75)(1.39)(.74)
D-10 CF = .73

600' PUSH
D-9 FROM CHART (1) = 200 CY/HR
CORRECTED = 200 x .68 = 136 CY/HR
D-10 FROM CHART (1) = 350 CY/HR
CORRECTED = 350 x .73 = 256 CY/HR

500' PUSH
D-9 FROM CHART (1) = 250 CY/HR
CORRECTED = 250 x .68 = 170 CY/HR
D-10 FROM CHART (1) = 400 CY/HR
CORRECTED = 400 x .73 = 292 CY/HR

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BY: _____ DATE: _____ CHKD BY: _____ DATE: _____

PROJECT NAME: _____

PROJECT NO. _____ SHEET _____ OF _____

DESCRIPTION _____

400' PUSH

D-9 FROM CHART[1] = 300 CY/HR

CORRECTED = 300 x .68 = 204 CY/HR

D-10 FROM CHART[1]

CORRECTED = 500 x .73 = 365 CY/HR

REFUSE PRODUCTION

MAXIMUM PRODUCTION = 2.53×10^6 CY/YEAR

PRODUCTION DAYS/YEAR = 260 DAYS

DAILY PRODUCTION = 20 HOURS

$$\frac{2.53 \times 10^6 \text{ CY}}{\text{YR}} \times \frac{\text{YR}}{260 \text{ DAYS}} \times \frac{\text{DAY}}{20 \text{ HOURS}} = 486 \text{ CY/HR}$$

TWO D-9 DOZERS WILL BE USED 20 HOURS/DAY TO PLACE REFUSE; THE PUSH DISTANCE WILL BE LIMITED TO 500'.

D-9 = 170 CY/HR x 2 = 340 CY/HR

REMAINING REFUSE TO BE PLACED BY D-10 = 486 - 340 = 146 CY/HR

$$\text{D-10} = \frac{146 \text{ CY/HR} \times 20 \text{ HRS}}{292 \text{ CY/HR}} = 10 \text{ HOURS}$$

THE D-10 WILL BE REQUIRED TO PUSH REFUSE 10 HOURS/DAY.

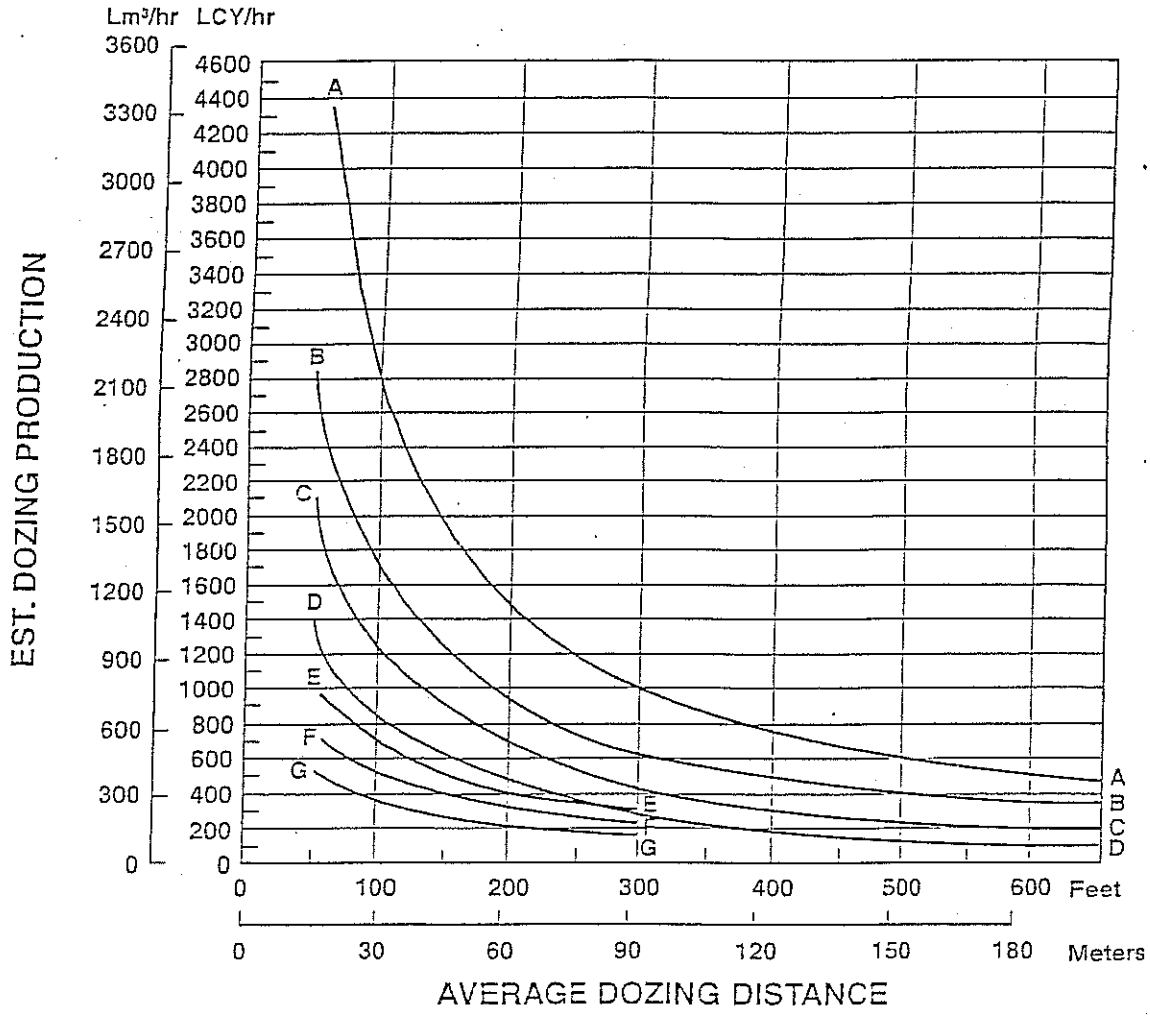
(1) CATERPILLAR PERFORMANCE HANDBOOK, EDITION 33
PAGES 1-38 THROUGH 1-44

Alliance Consulting, Inc.
124 Philpott Lane, Beaver, West Virginia 25813
Phone: (304) 255-0491 Fax: (304) 255-4232

Title: MAIN MINING ESTATE
PLACEMENT PLAN (8)
Project No.: B05-330-1413
By: DI Date: 1/10/05 Chkd: ____ Date: ____

Bulldozers | Estimating Production Off-The-Job
• SU-Blades

ESTIMATED DOZING PRODUCTION • Semi-Universal Blades • D6N through D11R



KEY
A — D11R-11SU
B — D10R-10SU
C — D9R-9SU
D — D8R/D8R Series II-8SU
E — D7R Series II-7SU
F — D6R Series II-6SU
G — D6N-6SU

NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

REF: CATERPILLAR PERFORMANCE HANDBOOK, EDITION 33

(3)

Alliance Consulting, Inc.
124 Philpott Lane, Beaver, West Virginia 25813
Phone: (304) 255-0491 Fax: (304) 255-4232

Title: MACH MINING REFUSE PLACEMENT PLAN (9)

Project No.: 805-330-1413

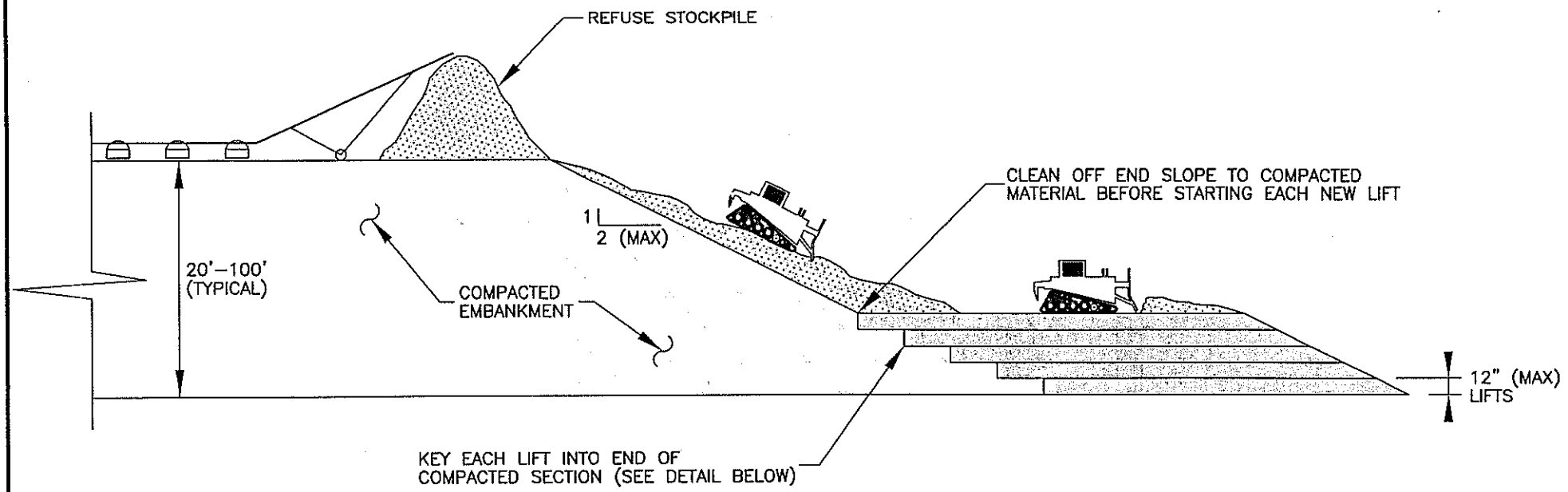
By: DL Date: 1/19/09 Chkd: ____ Date: ____

JOB CONDITION CORRECTION FACTORS

	TRACK-TYPE TRACTOR	WHEEL-TYPE TRACTOR
OPERATOR —		
Excellent	1.00	1.00
Average	0.75	0.60
Poor	0.60	0.50
MATERIAL —		
Loose stockpile	1.20	1.20
Hard to cut; frozen —		
with tilt cylinder	0.80	0.75
without tilt cylinder	0.70	—
Hard to drift; "dead" (dry, non-cohesive material) or very sticky material	0.80	0.80
Rock, ripped or blasted	0.60-0.80	—
SLOT DOZING	1.20	1.20
SIDE BY SIDE DOZING	1.15-1.25	1.15-1.25
VISIBILITY —		
Dust, rain, snow, fog or darkness	0.80	0.70
JOB EFFICIENCY —		
50 min/hr	0.83	0.83
40 min/hr	0.67	0.67
BULLDOZER*		
Adjust based on SAE capacity relative to the base blade used in the Estimated Dozing Production graphs.		
GRADES — See following graph.		

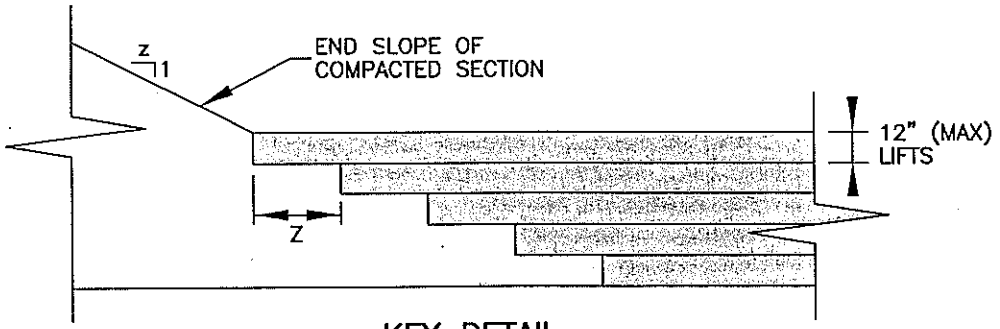
*NOTE: Angling blades and cushion blades are not considered production dozing tools. Depending on job conditions, the A-blade and C-blade will average 50-75% of straight blade production.

REF. CATERPILLAR PERFORMANCE HANDBOOK, EDITION 33



REFUSE PLACEMENT PROCEDURE

N.T.S.



KEY DETAIL

NEW EMBANKMENT TO COMPLETED EMBANKMENT SECTION

N.T.S.

Alliance Consulting, Inc.
Engineers
Constructors
Scientists
BECKLEY, WV (304) 255–0491
HOUSTON, PA (724) 503–7242

REFUSE PLACEMENT PROCEDURE DETAILS
MACH #1 MINE
PROPOSED COAL REFUSE DISPOSAL FACILITY
PREPARED FOR
WILLIAMSON ENERGY, LLC.
P.O. BOX 99, JOHNSTON CITY, ILLINOIS 62951

DRAWN BY	DSM	06/15/09
CHECKED BY		
APPROVED BY		
DRAWING NUMBER		FIGURE NUMBER
B05–330–A4		

R12930

APPENDIX F

SUBSIDENCE MONITORING PLAN

APPENDIX F

SUBSIDENCE MONITORING PLAN
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
MACH #1 MINE
MACH MINING, LLC
WILLIAMSON ENERGY LLC
JOHNSON CITY, ILLIOIS

Installation and Location

Subsidence survey control monuments will be installed away from areas of potential ground movement. The monuments will be constructed to minimize the impact of frost heave. A detail of the monument is included on Drawing No. B05-330-A3.

The locations for all of the subsidence monitoring baselines are shown on Drawing No. B05-330-M36.

Subsidence monitoring baseline stations have been installed on 25-foot spacing for Baselines A through D on the eastern end of Panel No. 1.

Baseline A has been installed near the center of the panel. The direction of the baseline is east to west and starts at a point 300 feet west of the initial longwall face. The baseline is 325-foot long.

Baseline B has been installed 700 feet west of the initial longwall face and runs from Baseline A north for a distance of 1200 feet.

Baseline C has been installed 1250 feet west of the initial longwall face and is 550-foot long running south to north over the developmental entries between Panel No. 1 and Panel No. 2. The purpose for this baseline is to determine the effect of the chain pillars on surface subsidence after mining on both sides of the chain pillars.

Baseline D has been installed in the northeast corner of Panel 1 and extends at an Azimuth of 45 degrees for a distance of 500 feet. This baseline provides information on surface subsidence in the panel corners.

Baselines E and F will be installed in the Phase 4 pool area over Panel No. 2 on 25-foot station spacing. These baselines will provide information as to when foundation subsidence is complete and provide dynamic subsidence data. Baseline E will be 650 feet long, extending one-half the panel width in a south to north direction. Baseline F will run west to east for 300 feet over the center of the panel.

Old Baseline I has been replaced by Baselines G and H.

Baselines G and H – Baseline G and H will be installed on the Stage 3 embankment crest on 25-foot station spacing. Baseline G will be located on the entire length of eastern crest running a

distance of 400 feet north to south. This baseline begins over the Panel No. 3 edge and should provide data on the maximum embankment strain and slope. Baseline H will be located on the southern crest for a distance of 400 feet over the center of Panel No. 3 and should provide data on the maximum vertical surface movement for Phase 3 and the dynamic subsidence profile in the direction of mining.

New Baseline I and Baseline J and K – These three baselines will be installed on the Phase 2 embankment crest. Baseline I is located on the eastern embankment crest running 350 feet south to north. It should provide data on the maximum embankment subsidence. New Baseline I is located on the southeastern embankment crest running a distance of 400 feet east to west to the edge of Longwall Panel No. 2. This baseline should provide data on the maximum embankment strain and slope and the dynamic subsidence profile near the edge of lonwall Panel No. 3 in the direction of mining. Baseline K is located on the western embankment crest running 200 feet approximately south to north from the edge of the Panel No. 2. This baseline will provide data on the maximum embankment strain.

A primary purpose of all of the baseline measurements is to determine when subsidence is compete.

Pneumatic piezometers and inclinometers will be installed in the Phase 3 embankment/impoundment prior to its being undermined as described in Technical Specification 6.03.

Panel No. 1 Subsidence Survey baseline was established over the center of Panel No. 1 in a west to east direction starting about 250 feet east of the impoundment Phase 5 footprint. This line contained 21 surface subsidence monuments spaced 30 feet apart. The main purpose of this baseline was to obtain dynamic subsidence survey measurements.

Monitoring

The monitoring will consist of collecting data including elevation, coordinates in east and north planes, date of monitoring, time of monitoring and the location of the longwall face by its underground survey station.

Baselines A, B, C, and D were surveyed on April 24, May 6, and May 19, 2008. The longwall started in Panel 1 on March 18, 2008. The longwall face passed under the southwest end of Baseline D on April 2, 2008, under Baseline B on April 10, 2008, and under the western end of Baseline A on April 14, 2008. The longwall face passed under Baseline C on April 24, 2008, the day the first post-mining subsidence monitoring survey was conducted.

Due to the time lag between the subsidence monitoring surveys and the position of the longwall face with respect to the baseline locations, the survey measurements for Baseline A, B, and D represent near total surface subsidence.

Panel No. 1 Subsidence Survey Baseline was surveyed from November 18, 2008 through January 9, 2009. The longwall face moved under the eastern end of this baseline on November 21, 2008 and left its western end on December 9, 2008. The subsidence monuments were

surveyed on a daily basis from November 18, 2008 through January 9, 2009 on those days when the longwall was advancing. Drawing No. B05-330-M36 (and Drawing No. B05-330-B4 in this Appendix) show the location of the baseline survey points and the timing of the longwall face movement and Drawing No. B05-330-M44 shows the tabular and plotted data.

The subsidence measurement data from the five baselines described above was used to recalibrate the subsidence prediction model used in our August 2008 report. The modified subsidence prediction report is contained in Appendix H and the drawings which show subsidence predictions have been revised to reflect the changes.

Baseline E will be surveyed daily starting when or before the longwall face approaches it within 100 feet and ending two weeks after the face passes under it.

Baseline F will be surveyed daily starting when or before the longwall face is within 100 feet of its eastern end and ending two weeks after the face passes under its western end.

Baselines G, I and K will be surveyed daily starting when or before the longwall face approaches them within 100 feet and ending two weeks after the face passes under them.

Baselines H and J will be surveyed daily starting when or before the longwall face is within 100 feet of their eastern end and ending two weeks after the face passes under its western end.

Before, during, and after undermining of the Phase 3 embankment and impoundment , Phase 3 inspections and instrumentation readings will be done on the frequency described in Technical Specification 6.03.b

The top of the inclinometer casings shall be accurately located in plan view and elevation by surveying after installation. The locations shall be resurveyed prior to each reading during periods of ground movement (i.e. before the longwall approaches within 100-foot of the east side of the Phase 3 embankment, during mining under the embankment, and for two weeks after longwall wall mining under the east side of the Embankment)

(1)

APPENDIX G

PUMP SPECIFICATIONS

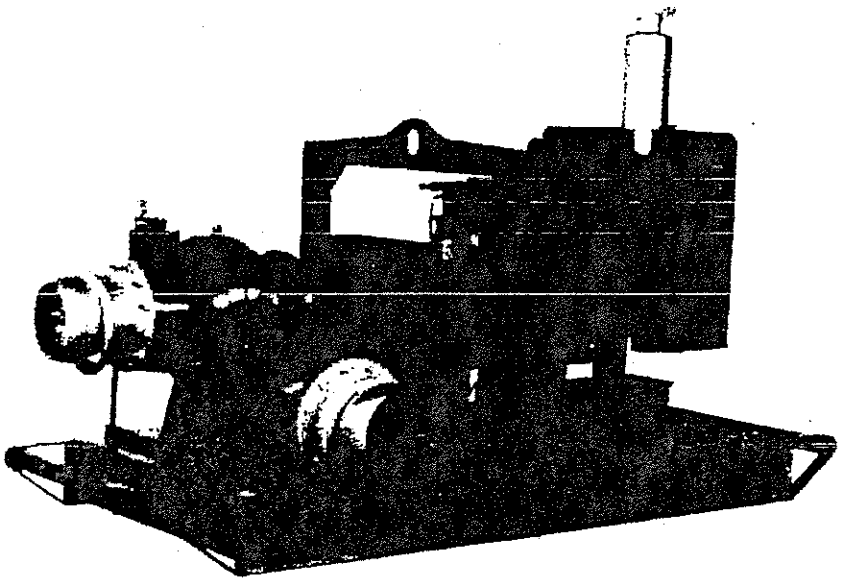
The following specifications are for a pump capable of evacuating 1902 gpm with 32.5 feet of static head during Phases 4 through 6 construction until the Phase 7 decant is installed. If this particular pump is not utilized, any equally sized pump will be maintained.

2

godwin pumps

ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data



Attn: Claudio Maris Niday

The Godwin CD300M Dri-Prime pump is a 12 inch (300mm) centrifugal trash pump perfect for your biggest jobs. Offering flows to 6,000 gallons per minute (380 liters per second), discharge heads to 200 feet (60 meters), and solids handling to 3-3/4" (95mm) in diameter, the CD300M moves large volumes of water and provides automatic self-priming to 28 feet. For intermittent flows, the double high pressure mechanical seal means the CD300M can run dry indefinitely without damage. And the underslung discharge flange makes pump connections easy and efficient. When your job calls for both high volume and high head, the Godwin CD300M is the pump that does it all.

Features

- Direct drive automatic priming 12" (300mm) high volume centrifugal pump with vacuum priming compressor mounted to a diesel engine. Also available in electric drive or as bare shaft pumpend.
- Extensive application flexibility – handles raw sewage, sludges and liquids with solids up to 3-3/4" (95mm) in diameter.
- Continuously operated "Godwin" air ejector priming device requiring no form of periodic adjustment or control.
- Compact design – Pump is direct coupled to engine flywheel for increased reliability.
- Underslung side discharge for easy pipe connection.
- Double, high pressure mechanical seal with high abrasion resistant silicon carbide interfaces. Oil bath immersion for dry running.
- Skid base incorporating integral overnight running fuel tank.
- Simple maintenance – normally limited to checking engine oil, compressor oil and seal lubrication.
- Standard Caterpillar C-9 engine. Also available with a variety of other engines including John Deere, Cummins and Deutz.
- Balanced unit with centralized lifting bracket for easy handling.

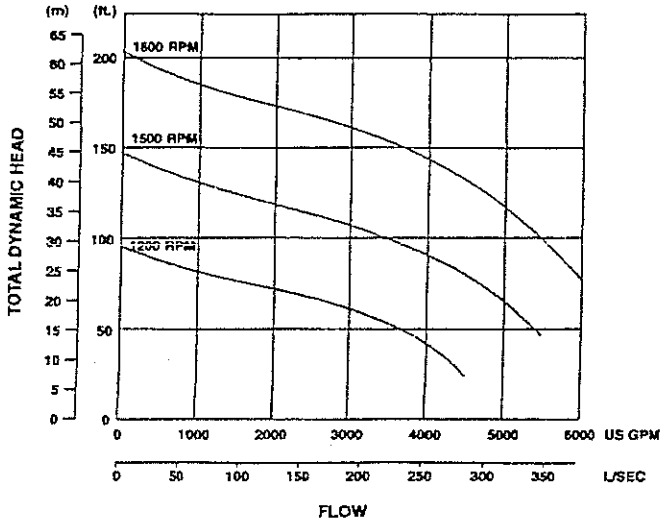
3

godwin pumps

ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data

Summary Performance Curve



Performance Table

Diesel Set: Caterpillar C-9, 275 hp (170 kw) @ 1800 rpm
Impeller Diameter: 14 1/4 in. (362 mm)

Total Suction Head – Feet	Total Delivery Head – Feet			
	40	80	120	160
	Output – GPM			
10	6000	5810	4870	3010
15	5480	5250	4700	3000
20	4850	4780	4500	2900
25	4300	4100	3800	2800

Performance data listed in table and curves are based on water tests at sea level and 68° F (20° C). Larger diameter pipes may be required for maximum flows.

4

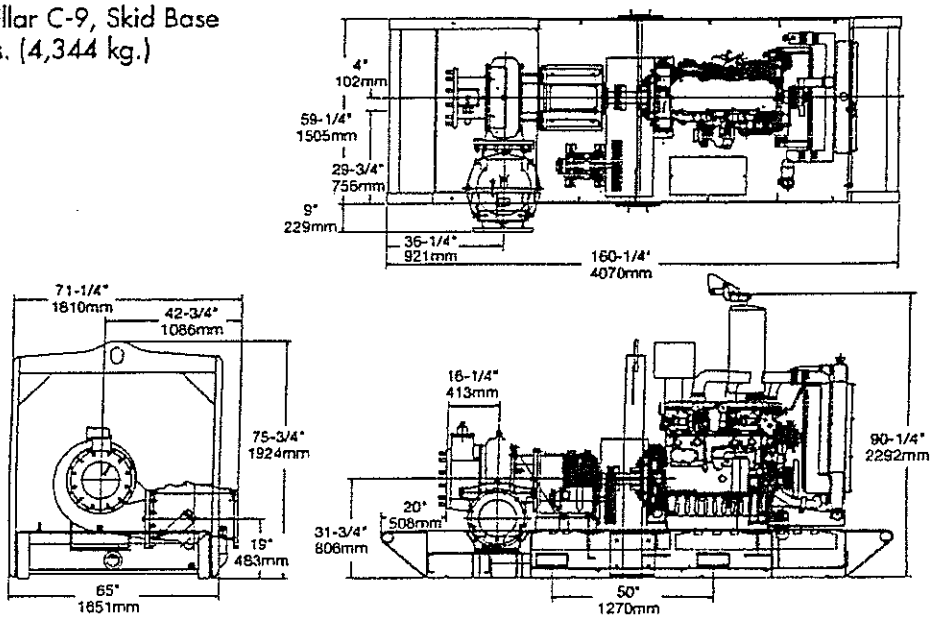
godwin pumps

ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data

Dimensions

CD300M, Caterpillar C-9, Skid Base
Weight: 9,600 lbs. (4,344 kg.)



Specifications

Maximum Operating Speed	1800 rpm
Maximum Operating Temperature	+212° F (100° C)
Maximum Working Pressure	87 psi (6.0 BAR)
Maximum Suction Pressure	88 psi (6.1 BAR)
Maximum Casing Pressure	130 psi (9.0 BAR)
Fuel tank Capacity	250 gallons (946 liters)
Fuel Consumption	11.1 gph (42.0 lph) @ 1800 rpm
Pipe Connections	12" (300mm) ASA 150#
Solids Handling	3-3/4" (95mm) diameter

Materials

Pump Casing, Suction Cover and Separation Tank	Close Grained Cast Iron
Impeller	Nitride Hardened Cast Chromium Steel
Front Wearplate	25% Chromium Iron
Rear Wearplate	Nitride Hardened Cast Iron
Pump shaft	1-1/2% Nickel/Chromium Steel
Non Return Valve Body Ejector Housing	Close Grained Cast Iron
Non Return Valve Flapper	High Nitrile Rubber
Mechanical Seal Faces	Solid Silicon Carbide

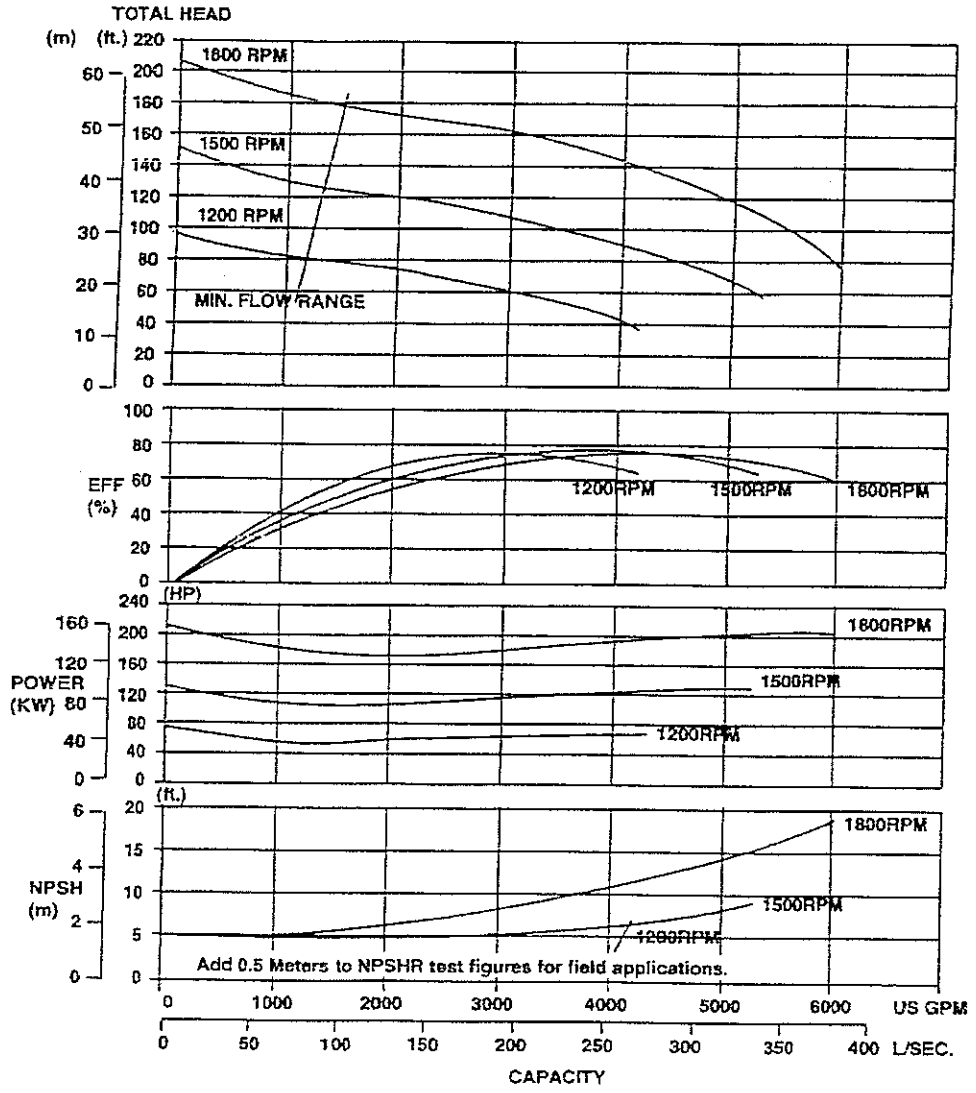
5

godwin pumps

ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data

Pump CD300M
Curve CD300M-2B-1
Branch Sizes 12" x 12" (300mm x 300mm)
Speed Variable



Notes:

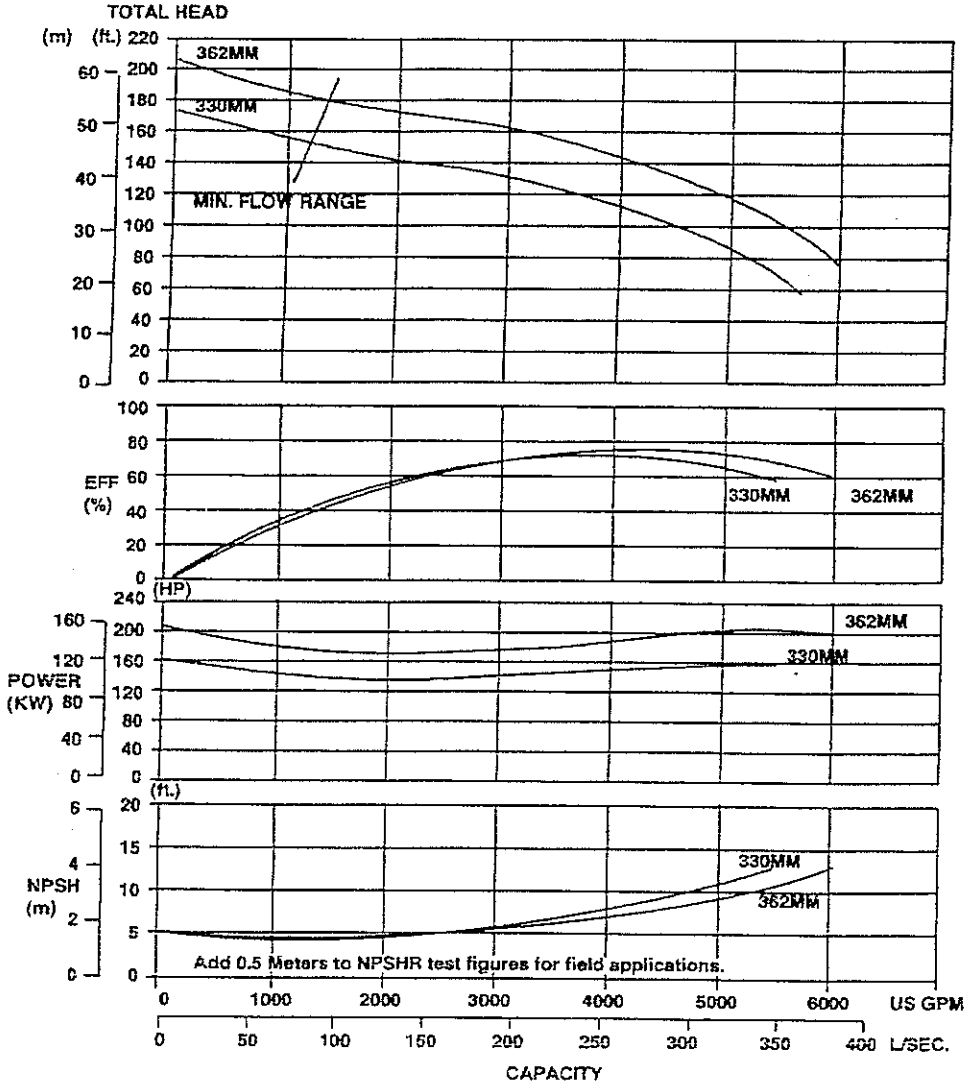
1. Max. impeller diameter 362mm (14.25").
2. Min. impeller diameter 330mm (13").
3. Max. solids handling 95.0mm (3.75").
4. Add 12% for V-belt drives.
5. Max. V-belt speed 1600 rpm.
6. Where a compressor is fitted, add 2.6Kw (3.5 HP) for small size and for large size 8.25 Kw (11.1 HP).
7. Published performance is achieved at total suction heads up to 2.05m (10ft.). When great, reduce performance.

godwin pumps

ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data

Pump	CD300M Electric
Curve	CD300M-2B-2A
Branch Sizes	12" x 12" (300mm x 300mm)
Speed	1800 rpm



Notes:

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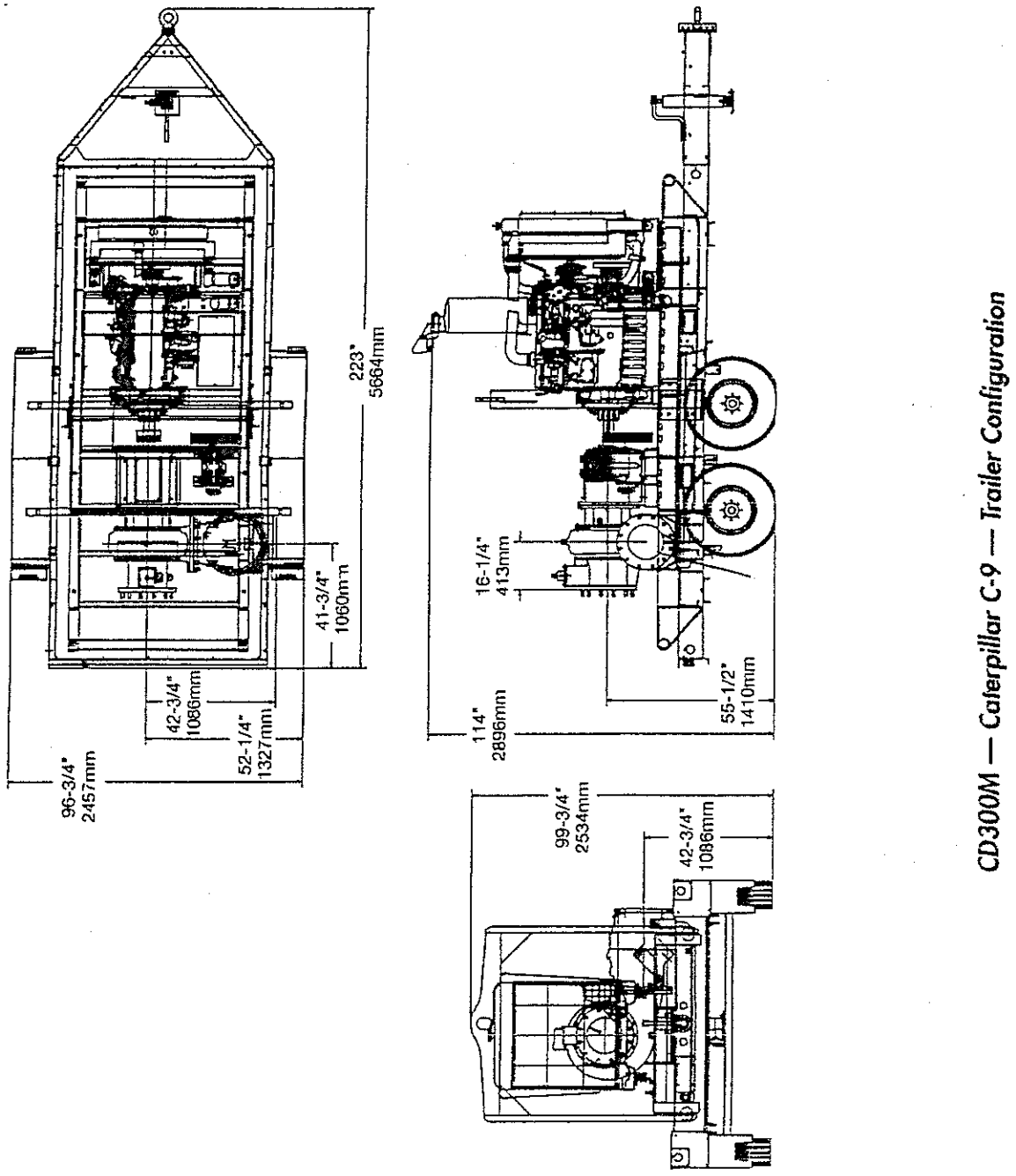
7

godwin pumps

ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data

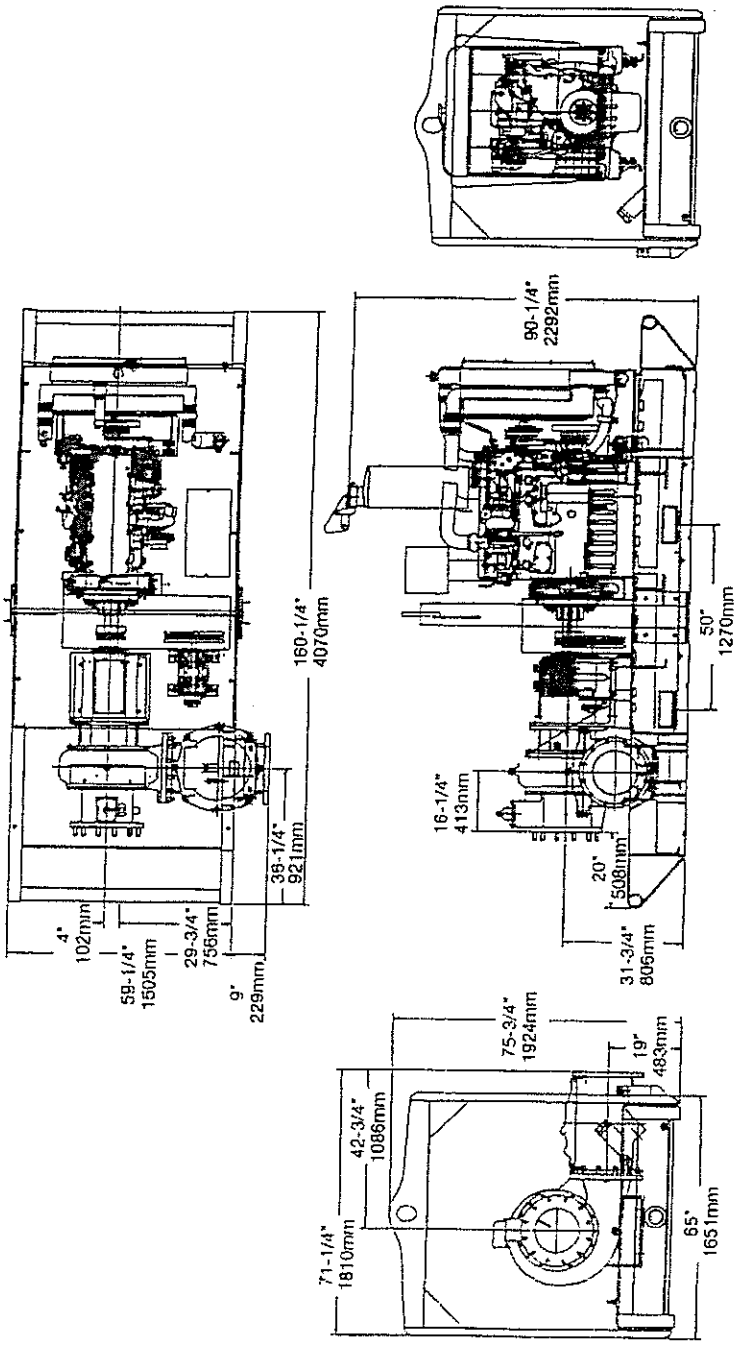


CD300M — Caterpillar C-9 — Trailer Configuration

godwin pumps

ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data



CD300M — Caterpillar C-9 — 250 Gallon Skid Base Configuration

9

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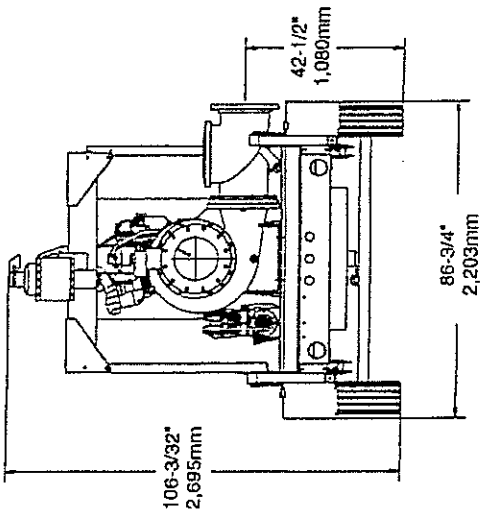
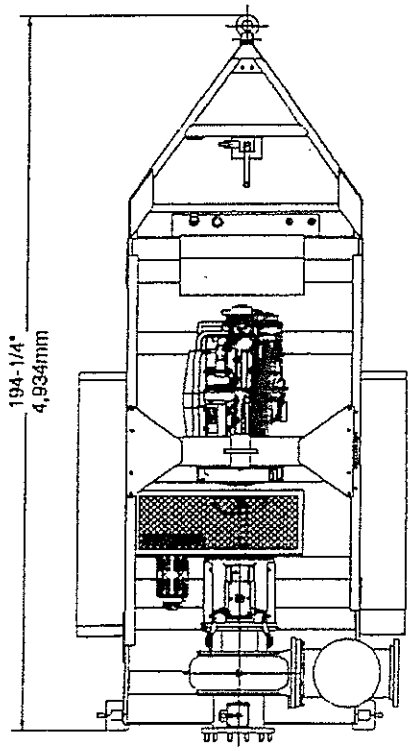
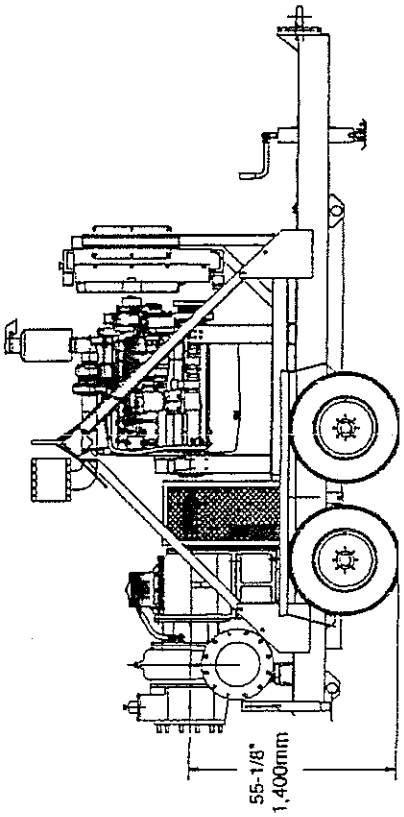
ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data







CD300M — John Deere 6081A — GP10000 Trailer Mounted Configuration

godwin pumps

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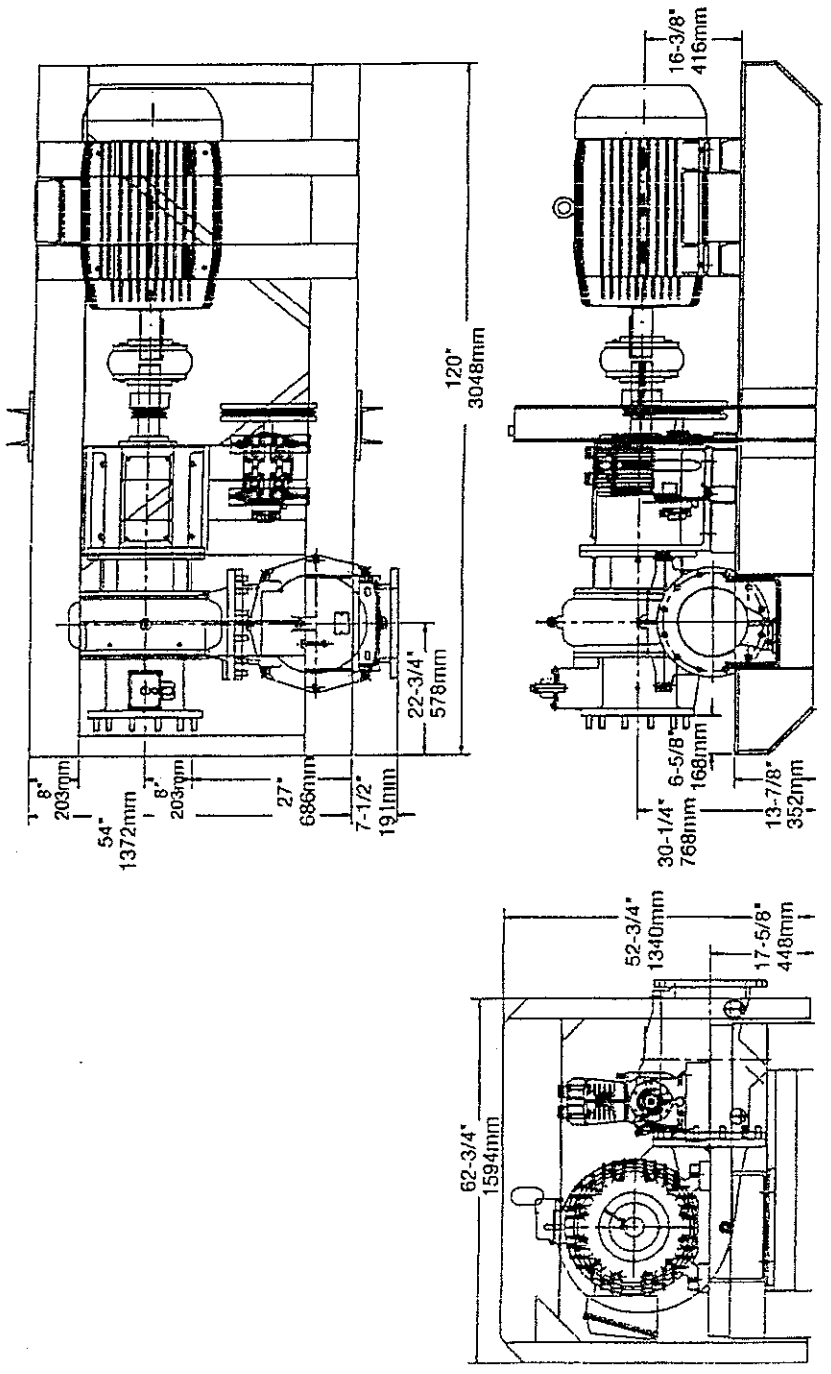
CD300M Dri-Prime® Pump Engineering Data



CD300M — 200 HP Electric Motor — Portable Skid Base Configuration

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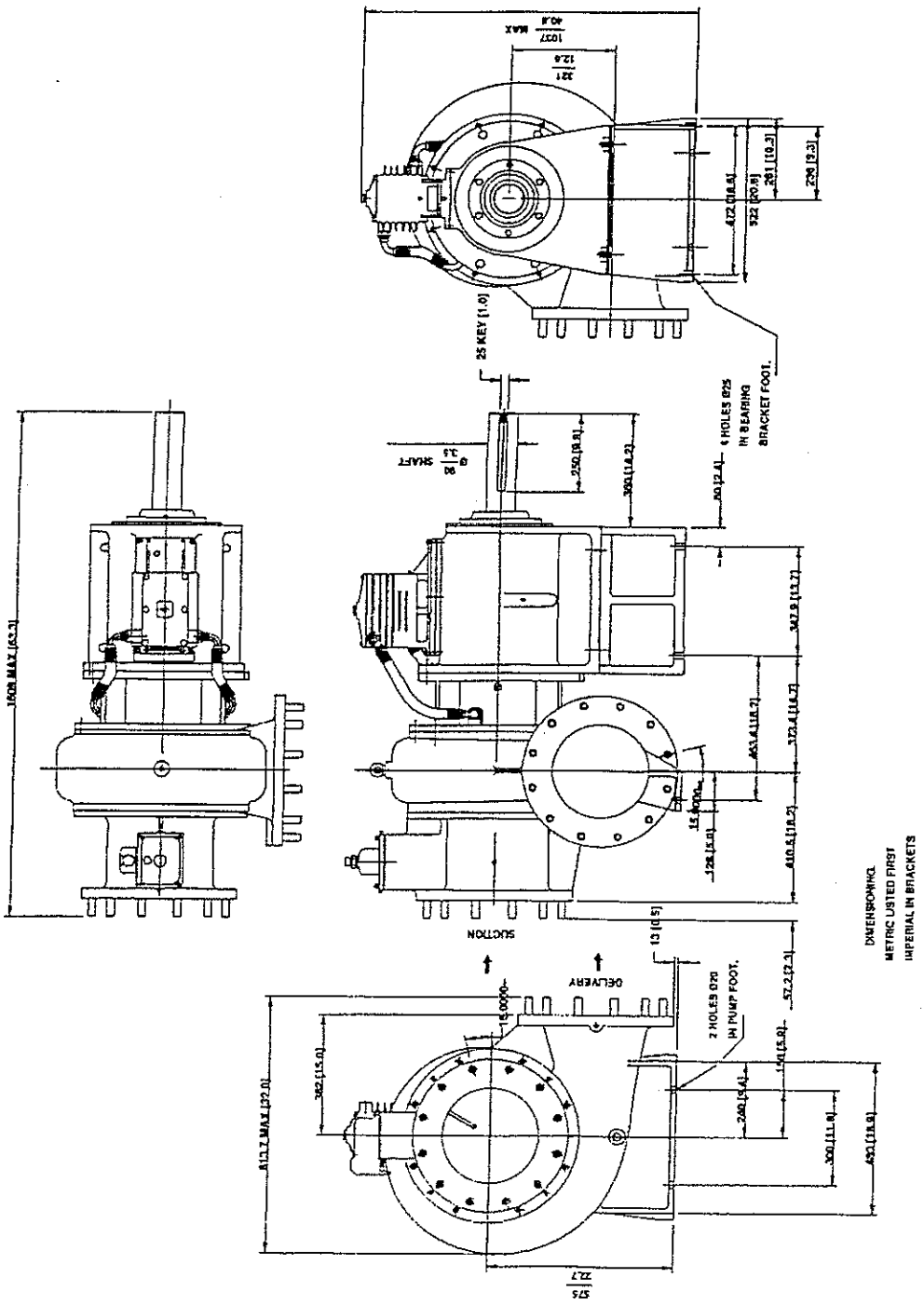
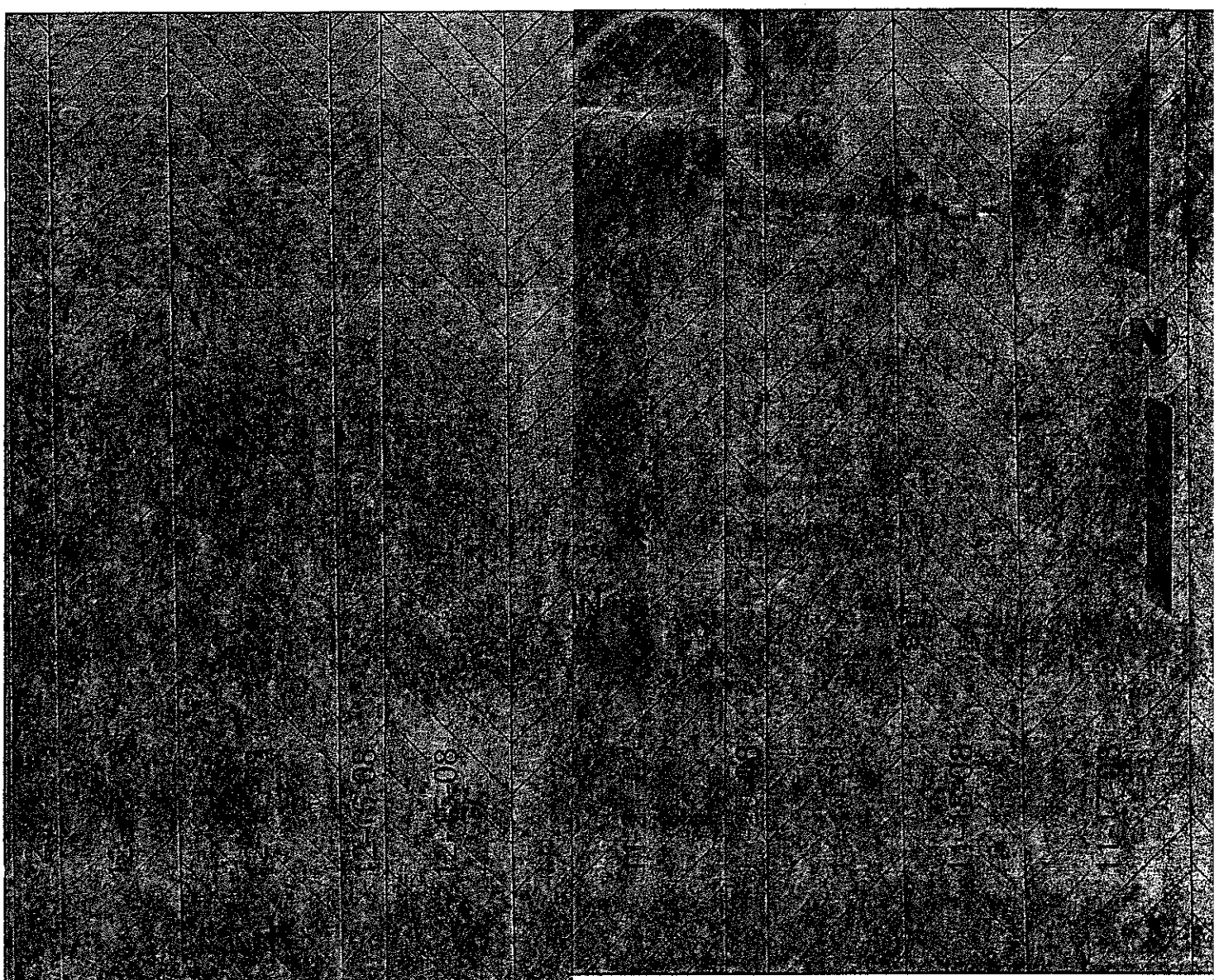
CD300M Dri-Prime® Pump Engineering Data



CD300M-BS-002 — CD300M Bareshaft Outline Drawing



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MSHA ID NO. IL08-03141-02

INOIS DEPARTMENT OF NATURAL RESOURCES PERMIT NO. 375

UBSIDENCE SURVEY PANEL NO. 1 PLAN VIEW

MACH #1 MINE
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
WILLIAMSON COUNTY, ILLINOIS

Prepared For

WILLIAMSON ENERGY, LLC.
P.O. BOX 99, JOHNSTON CITY, ILLINOIS 62951

D BY	JUS	07/09/09	PROJECT NO. B05-533-1413
ECKED BY			DRAWING NO. B05-330-B4
PROVED BY			

(1)

Prediction of Ground Movement due to Longwall Mining During different Phases of Impoundments Construction

A Modified report

Submitted to

Alliance Consulting, Inc.

by

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Thomas Du, Graduate Research Assistant

Department of Mining Engineering

West Virginia University

May 2009

1.0 INTRODUCTION – REGRESSION ANALYSIS OF THE MEASURED SUBSIDENCE DATA IN PANEL 1

Among the five survey lines in panel 1 (Fig. 1), line A with 13 monuments was located at the panel center along the mining direction; line D was diagonal and intersects the tailgate corner of the set-up room; lines B and C were transverse to panel 1 mining direction; and points 1-21 just east of the proposed impoundment location (Phase 5), was at the panel center along the mining direction. Therefore, only line B and C are amenable for regression calibration.

CISPM, a subsidence prediction software developed by the senior author, was used to calibrate the subsidence parameters using the subsidence data measured on lines B and C in Panel 1 (Fig. 1). The regression results of calibration are shown in Figs. 2 and 3 for lines B and C, respectively. From these two figures, the subsidence factors are:

For line B: Subsidence factor = 0.83

Major influence angle = 75.86°

Offset of inflection point (left) = 112 ft

Offset of inflection point (right) = 76.46 ft

For line C Subsidence factor = 0.81

Major influence angle = 78.53°

Offset of inflection point (left) = 157.16 ft

Offset of inflection point (right) = 119.78 ft

Combine the regression results for line B and C, the modified subsidence parameters are:

Subsidence factor = 0.83

Major influence angle = 80°

Offset of inflection point (left) = 140 ft

Offset of inflection point (right) = 110 ft

The above modified subsidence parameters were used to predict the final and dynamic subsidence indices along lines A, B, and C, and points 1-21, respectively. Figs. 4; 5 and 6 show the measured and predicted subsidence profiles and slope profiles using the regressed subsidence parameters for line A, line B, and the combined regression results, respectively. The subsidence profiles match perfectly except on both edges. For the slope profiles, using the line B combined parameters match better than using the regression parameters.

Figs. 7 and 8 show the measured and predicted subsidence profiles and slope profiles using the regressed subsidence parameters for lines C and the combined regression results, respectively. Similarly, the subsidence profiles match well except on both edges probably showing the effect of not a complete survey line where the monuments did not extend far enough toward the panel center. For the slope profiles, using the line C combined parameters match

better than using the regression parameters. Note the slope for C line is positive while for B is negative because they are in opposite direction.

For calibration of dynamic subsidence profile, only those subsidence data obtained for points 1-21 were used. Those obtained for line A could not be used for two reasons: (1) Line A is flat and only the final subsidence profile was available, and (2) Line A had only 13 monuments, too short for dynamic subsidence calibration.

Figures 9 and 10 show the dynamic subsidence and slope profiles for points 1-21, respectively. The solid lines with subsidence and slope data points are the measured dynamic profiles, while the dashed lines are the predicted dynamic profiles using the combined regressed subsidence parameters. Note the maximum possible subsidence is 5.1 ft and since the mining height in points 1-21 is 82 in. (6.83 ft.), the subsidence factor in this area is 0.75 (5.1/6.83) instead of 0.83 in lines A, B and C areas.

In summary, using the subsidence survey data for lines A, B, C, and points 1-21, the combined regressed subsidence parameters were obtained which proved to be valid for subsidence prediction for subsequent panels as demonstrated by Figs. 4 -10.

The calibrated input parameters were used to predict the subsidence profiles from Figs. 11 to 18 using the subsidence prediction program CISPM.

2.0 Predicted subsidence movements

Figure 1 shows the location of impoundments and longwall panels 1 to 4. The gateroads of the longwall panels are orientated towards east-west direction. Table 1 shows the mining conditions for the four longwall panels over which impoundment will be constructed. The panel widths are 1,250 for the first two longwall panels and 1,400 ft for the third and fourth longwall panel. The width of chain pillar /gateroad system is 220 ft for all the panels.

Cross section 'A-A' (Figure 1) parallel to the longwall panel width and in the center of the impoundment has been considered for prediction of the subsidence movements. Table 1 shows the longwall panel parameters.

Table 1 Longwall panels parameters

Panel No.	Panel Length, ft	Panel Width, ft	Overburden Depth, ft			Mining Height, ft		
			Max.	Min.	Average	Max.	Min.	Average
Panel 1	17,200	1,250	498	470	482	6.83	5.8	6.3
Panel 2	17,200	1,250	522	486	501	5.8	5.8	5.8
Panel 3	17,200	1,400	522	490	506	5.8	5.8	5.8
Panel 4	18,000	1,400	504	464	475	6.0	6.0	6.0

3.0 Prediction of Final Subsidence Parameters

In order to estimate the ground movement parameters associated with longwall mining over the surface where impoundments are located, a local coordinate system has been selected with origin (0, 0) at the right edge of 1st longwall panel gateroad system (Figure 1). The X-axis is parallel to the mining direction and the distance is measured from the setup room. The Y-axis is along the panel width direction or along section A-A.

The prediction of surface subsidence and subsidence parameters due to mining on the surface was performed with monument spacing at 20 ft interval across the panel width. The total width along the cross section A-A is 6,360 ft covering all four longwall panels and gateroad systems. The prediction points along the cross section A-A are shown in Figure 1.

The final surface movements and deformations along the cross-section A-A have been predicted using the subsidence prediction program CISPM version 2.01. Average mining parameters of longwall panels (Table 1) were used for this subsidence prediction.

3.1 Surface Subsidence during Phases 2 and 3

The predicted final subsidence profile across the impoundments after phase 2 and 3 and before phase 5 is shown in Fig. 11. Since there is no longwall workings below phase 2 and 3 before phase 2 and 3 gets eliminated, no ground movement effect will be observed during phase 2 and 3 periods.

3.2 Subsidence movements during Phase 4

Phase 4 will be built before completion of longwall retreat in panel 1. So during construction it will not be influenced by mining induced subsidence.

3.3 Surface movements during Phase 5

Before Phase 5 construction starts, the surface will experience mining induced ground movements. The subsidence, horizontal displacement, slopes and horizontal strain profiles are shown in Figures 11, 12, 13, and 14.

The maximum subsidence may be 5.67 ft at the center of the panel with a flat bottom. The predicted value of maximum horizontal displacement, slopes and horizontal strain are 1.87 ft, 6.6% and 3.50×10^{-2} ft/ft, respectively.

3.4 Subsidence Movements during Phase 6

During Phases 4 and 6 the longwall retreat will be below the impoundments in panel 2. Hence it may be affected by the mining induced subsidence and other ground movements. During Phases 4 and 6 the final surface movements are shown in Figs. 15, 16, 17 and 18.

4.0 Time Required to Attain Majority of Final Surface movements

From past field experience, the final subsidence at any point/cross section takes place after 2 to 3 weeks of passing of the longwall face. Furthermore, the final surface subsidence also depends upon the face retreat rate.

The dynamic subsidence prediction has been performed for three face retreat rate, i.e., 60, 80, and 100 ft/day [2] as shown in figure 19.

There is no subsidence when the longwall face is directly under the point of interest. Thereafter, the subsidence process accelerates and reaches about one half of its final subsidence at which subsidence process is most active. A deceleration process is followed. The ground surface re-establishes about 500 ft behind the face. Figure 19 also shows that a slower advance rate induces a steeper subsidence development curve. However, the differences between the subsidence development curves are not significant for the range of high face advance rates used in the dynamic subsidence predictions.

Based on the dynamic subsidence prediction for face retreat rate of 60 ft/day, it will take more than 10 working days for the dynamic subsidence to reach the values of final subsidence. Hence, on the safe side, 2 weeks is used as the time required to reach the final subsidence.

5.0 Reference

1. S.S. Peng and Y Luo, Instruction Manual for CISPM software for Subsidence prediction
2. S.S. peng, Khaled Morsey, Anil Ray and Thomas Du, "Assessment of subsidence influence on Buried Pipeline due to Longwall Mining: Williamson Energy, Johnson City, IL ,July 2007

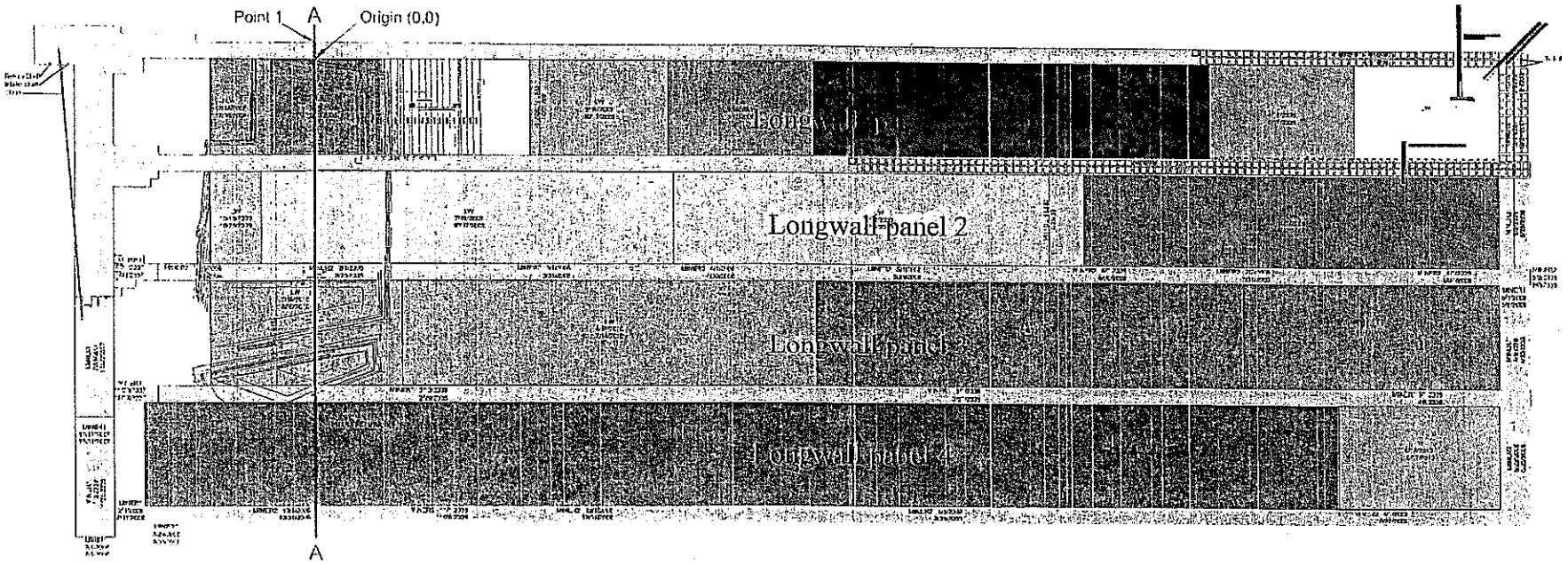

Figure 1 Mine map showing cross section A-A across the longwall panels and Lines A, B, C, D, E, and Points 1-21

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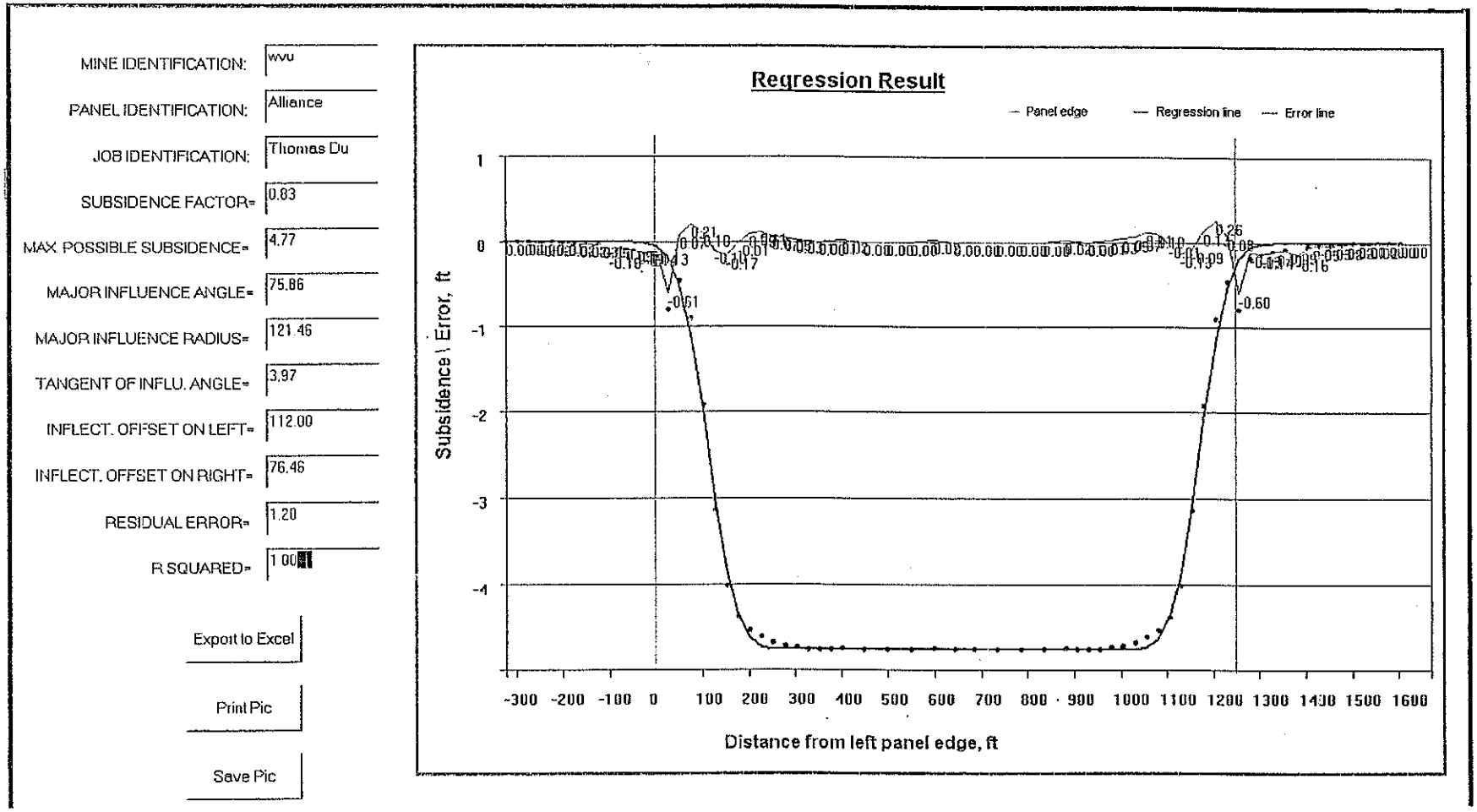

Fig. 2 Line B Regression Results

R12953

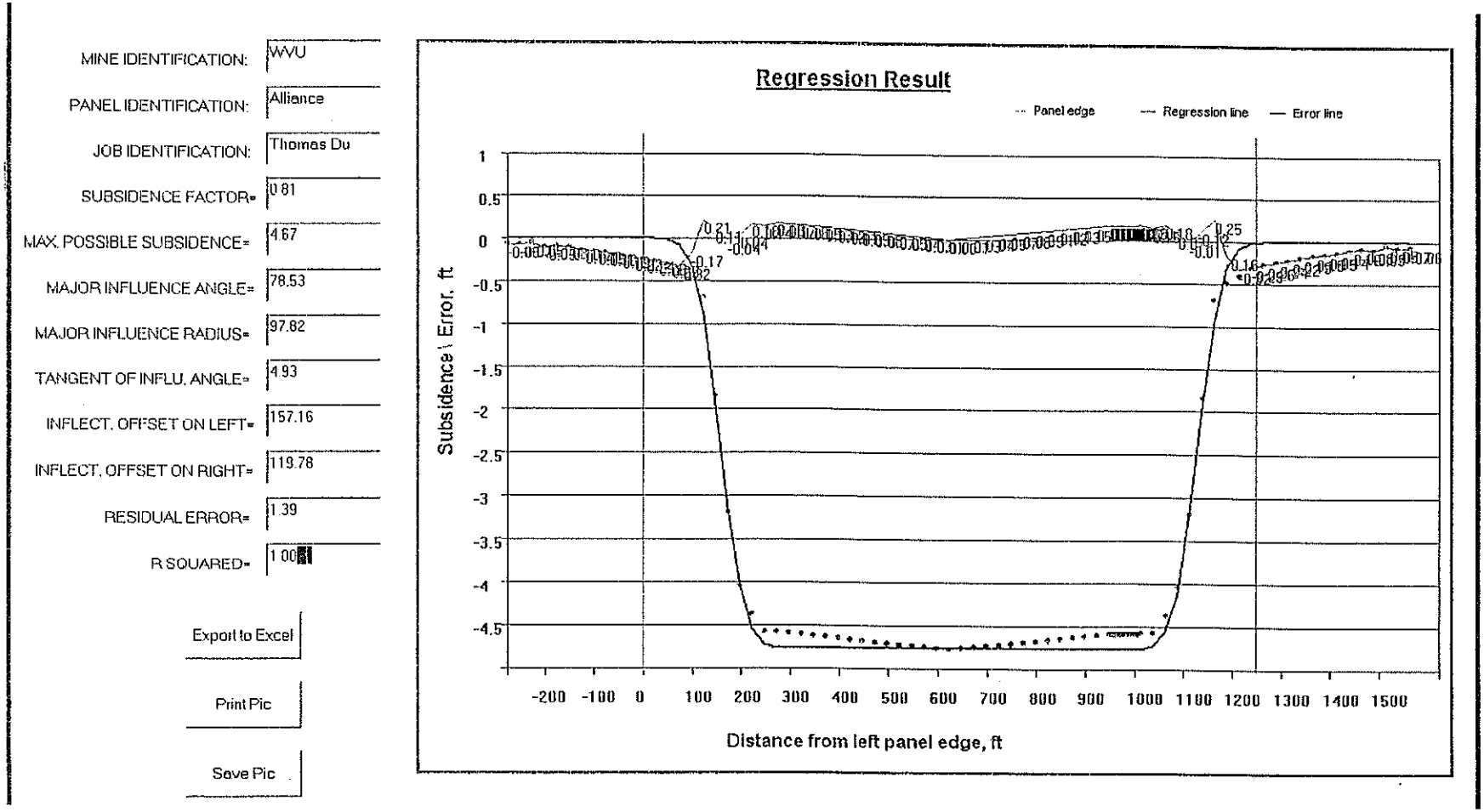

Fig. 3 Line C Regression Results

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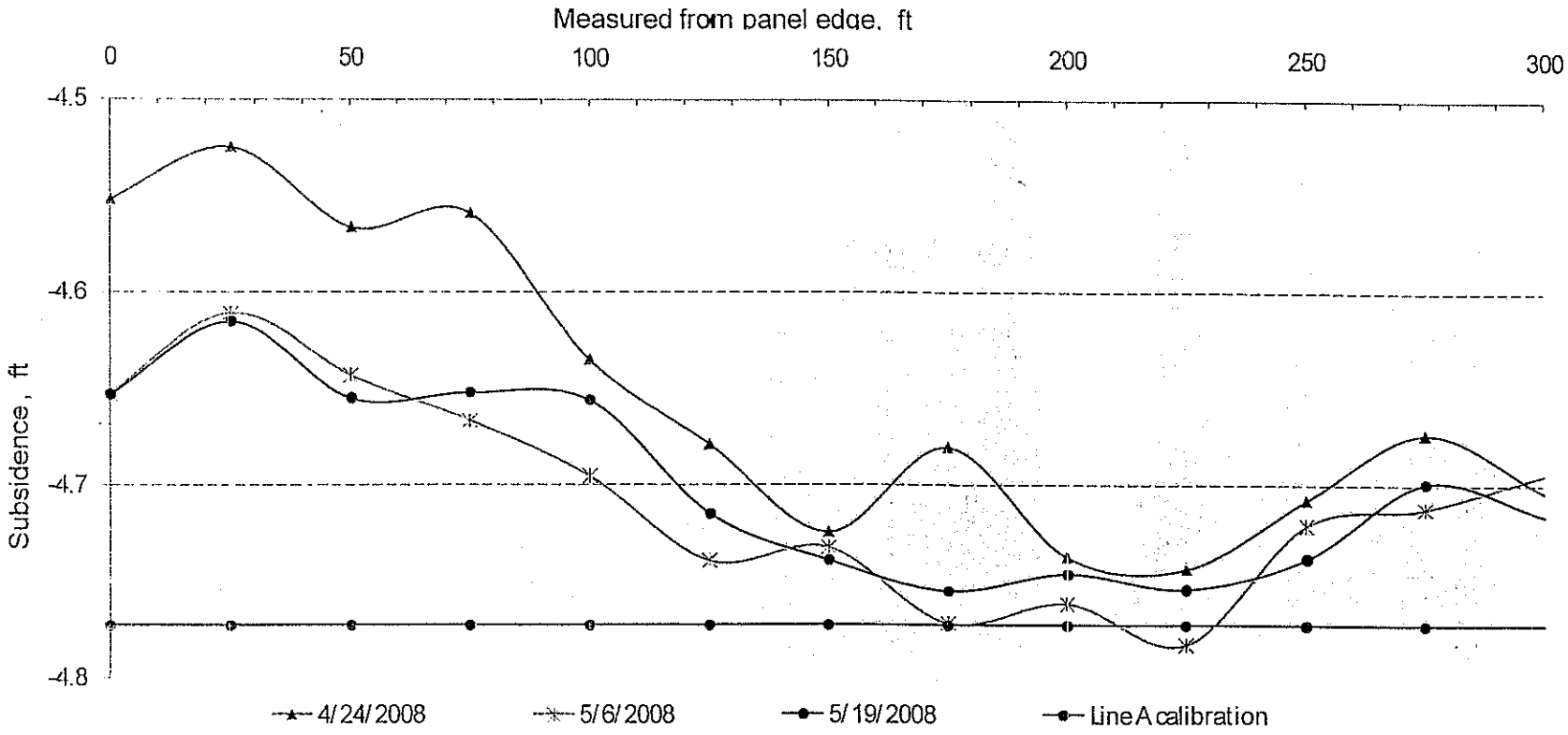

Fig. 4 Line A subsidence profile calibration

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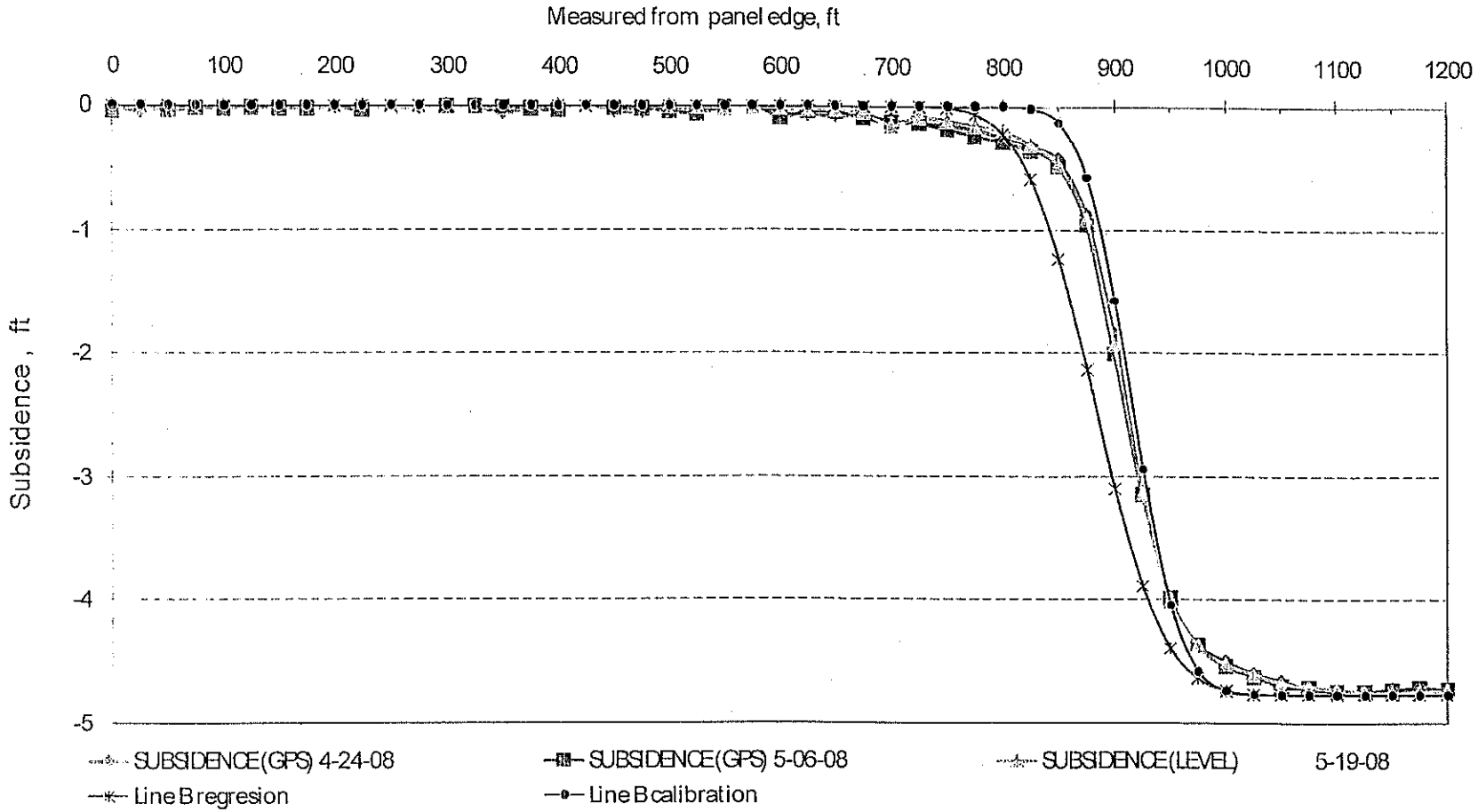

Fig. 5 Line B subsidence profile calibration

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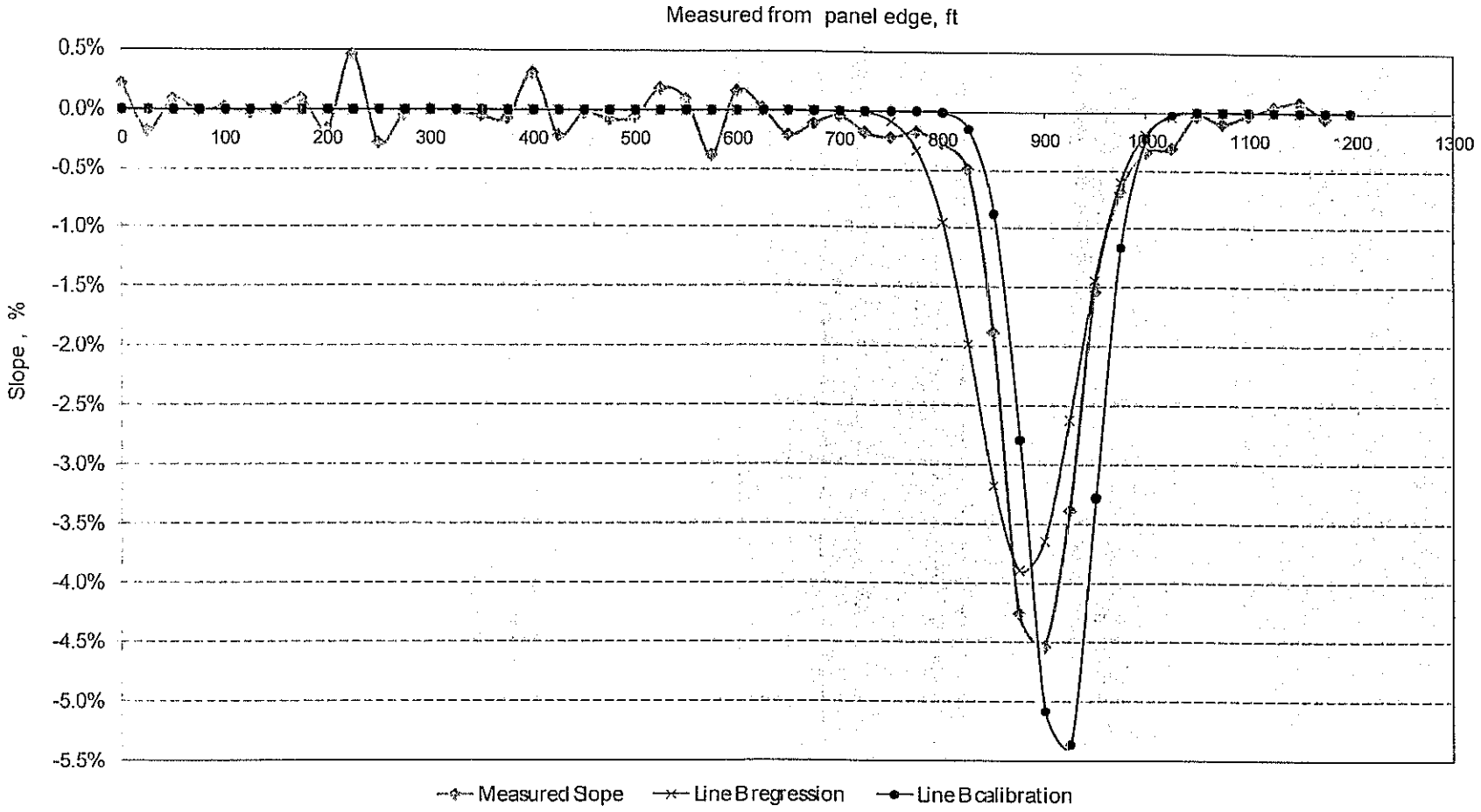

Fig. 6 Line B slope profile calibration

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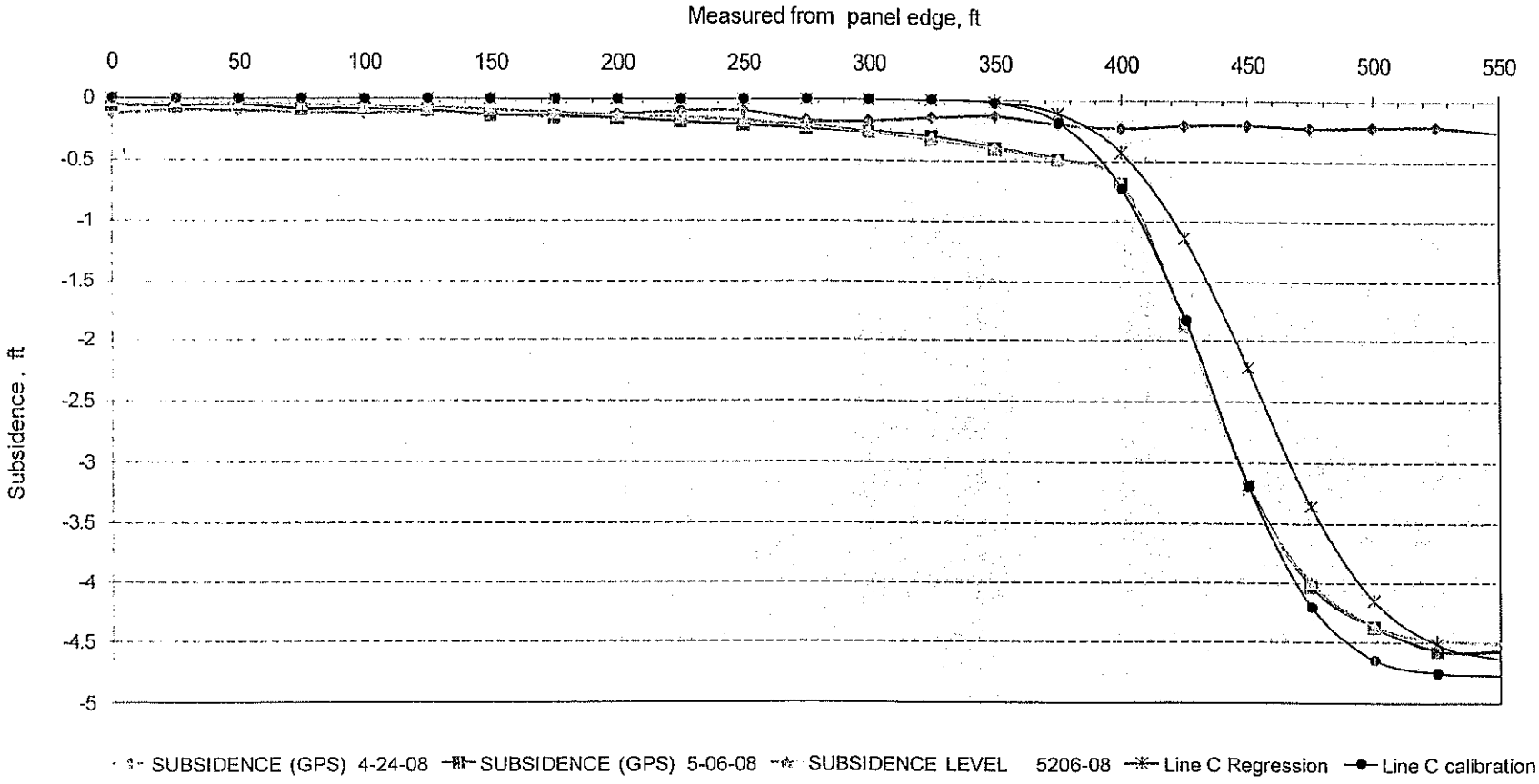

Fig. 7 Line C subsidence profile calibration

12 R12958

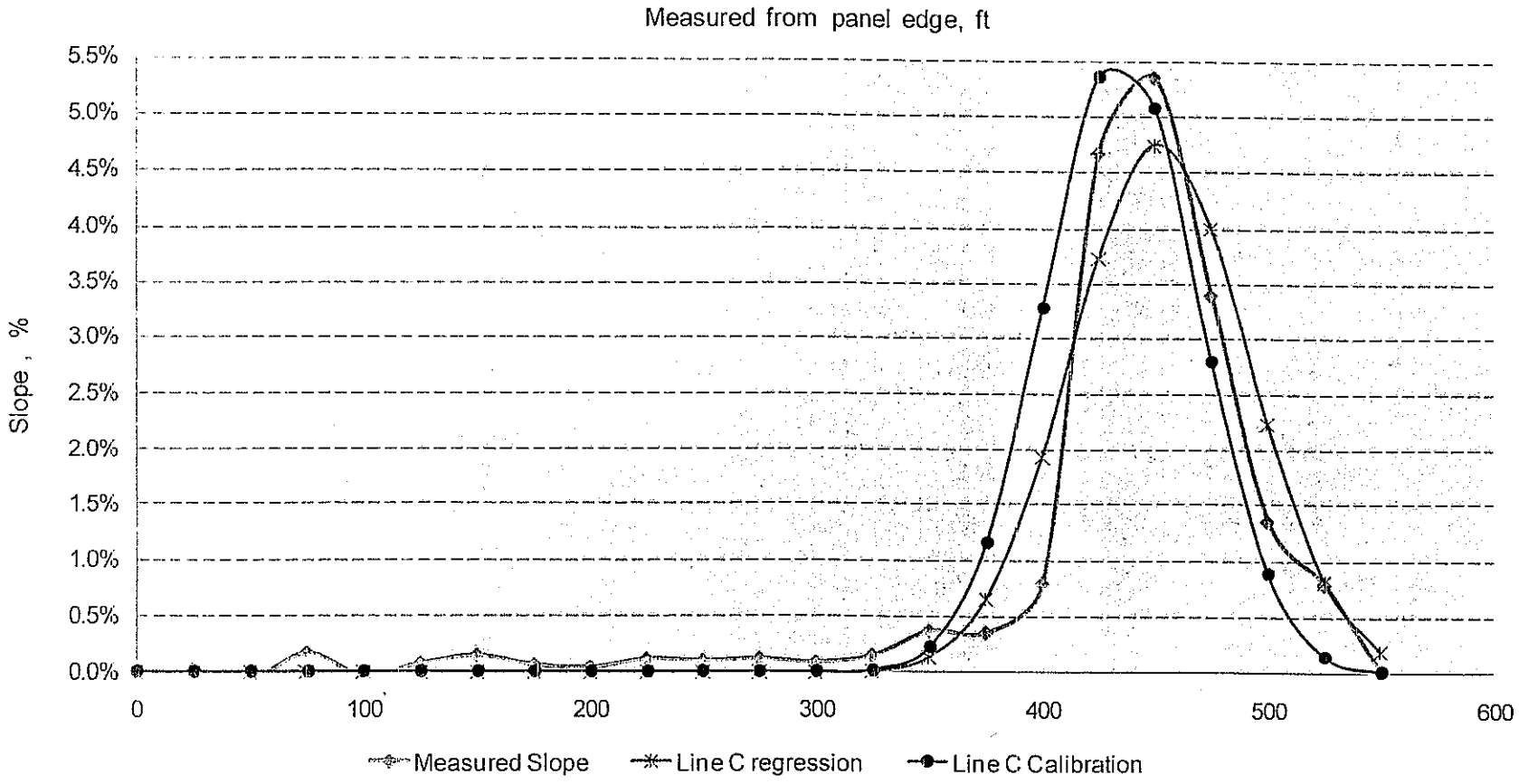

Fig. 8 Line C slope profile calibration

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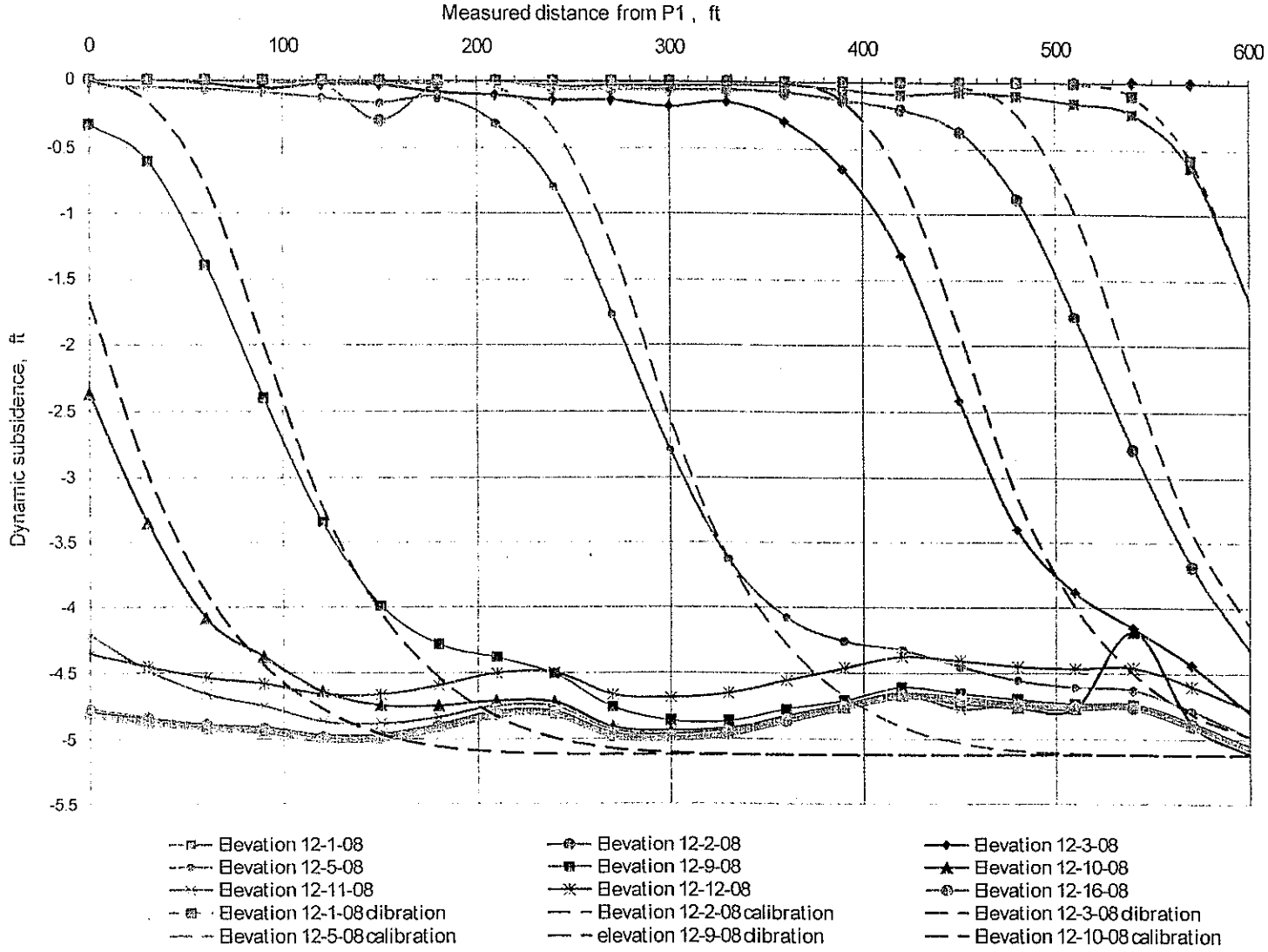

Fig. 9 Dynamic subsidence Calibration

R12960

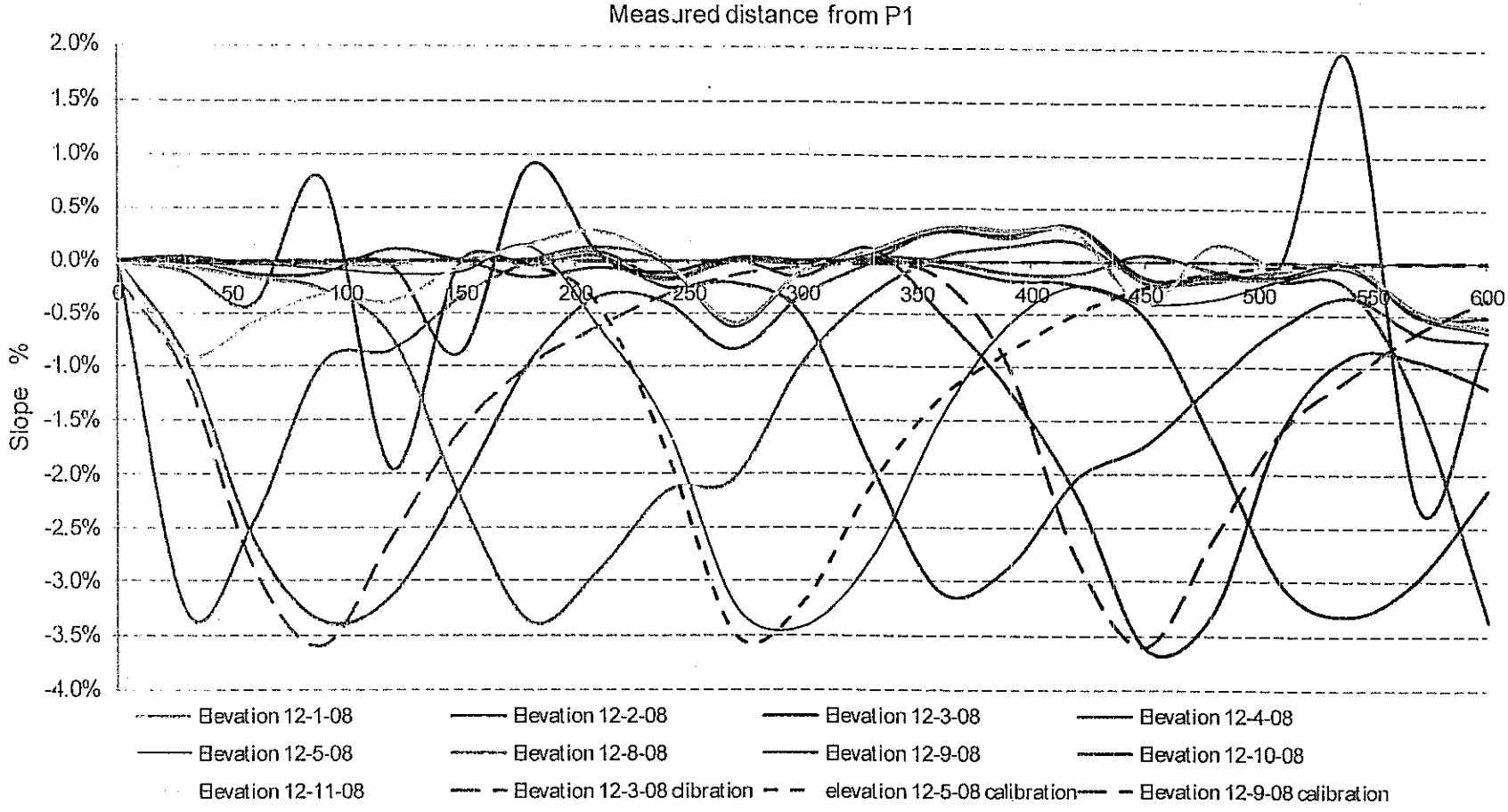

Fig. 10 Dynamic profile Calibration

R12961

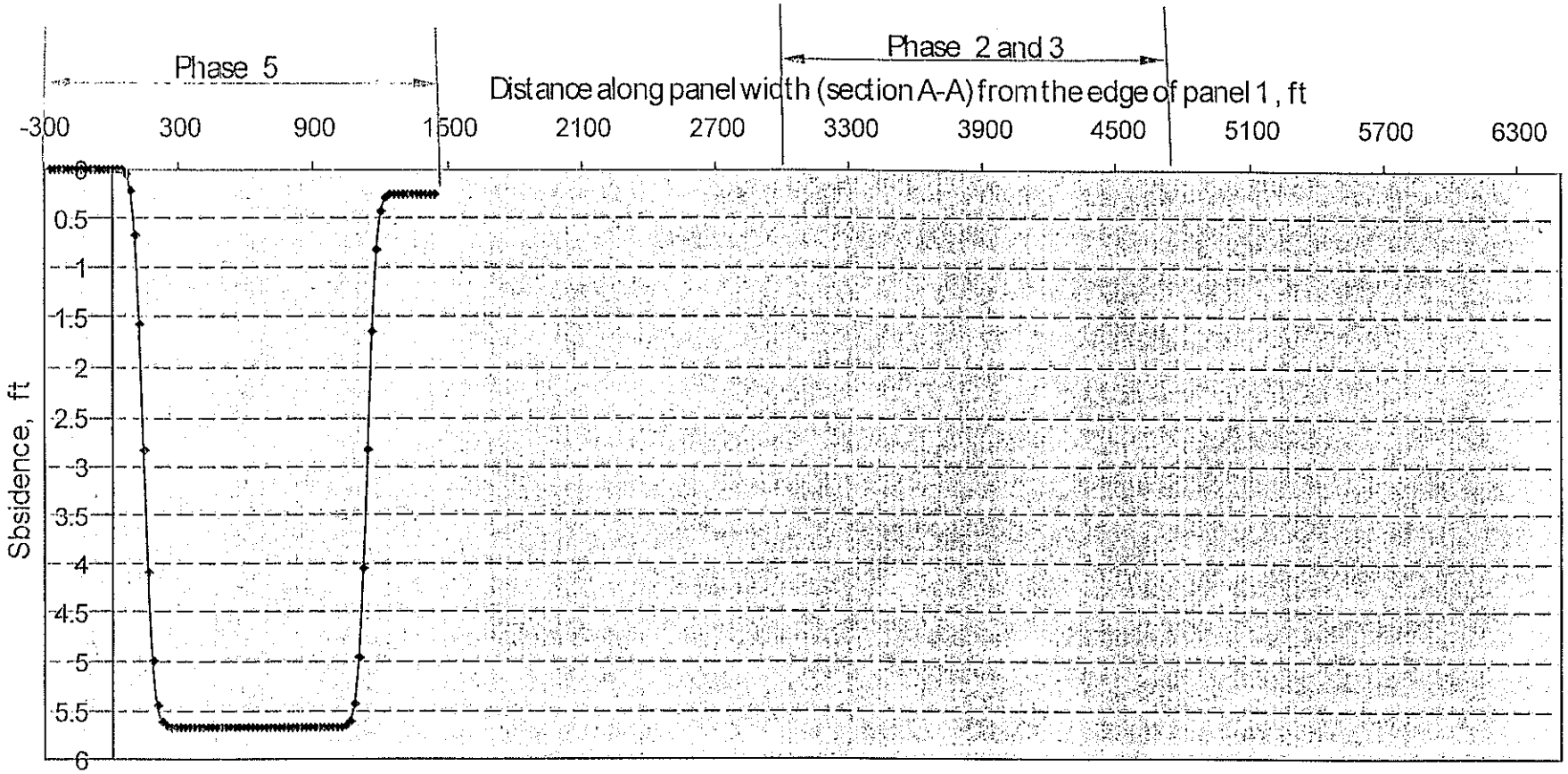

Fig. 11 Predicated Subsidence profile before phase 5 begins (No longwall mining below phase 2 workings)

R12962

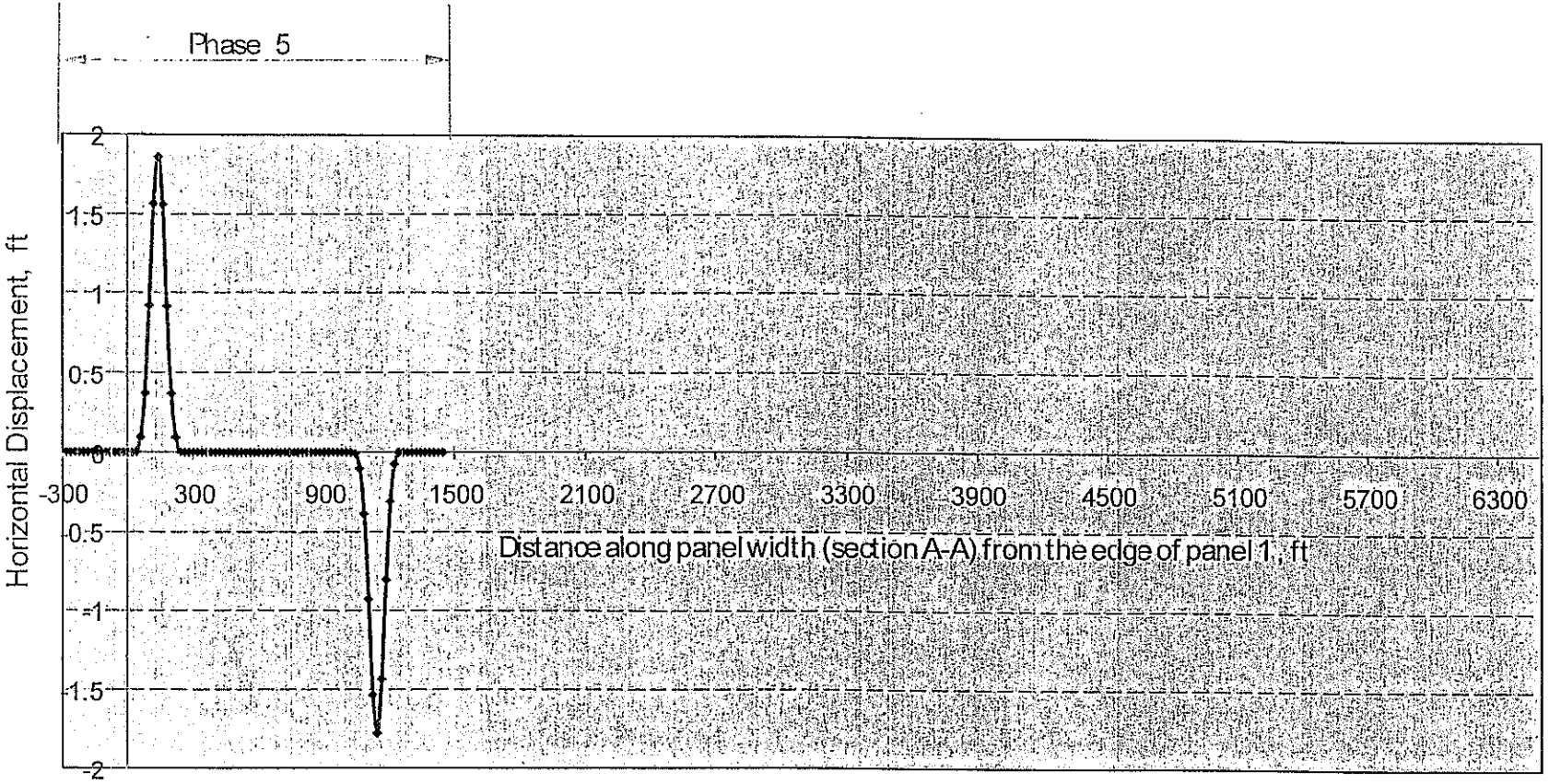

Fig. 12 Predicted horizontal displacement profile before phase 5 begins

R12963

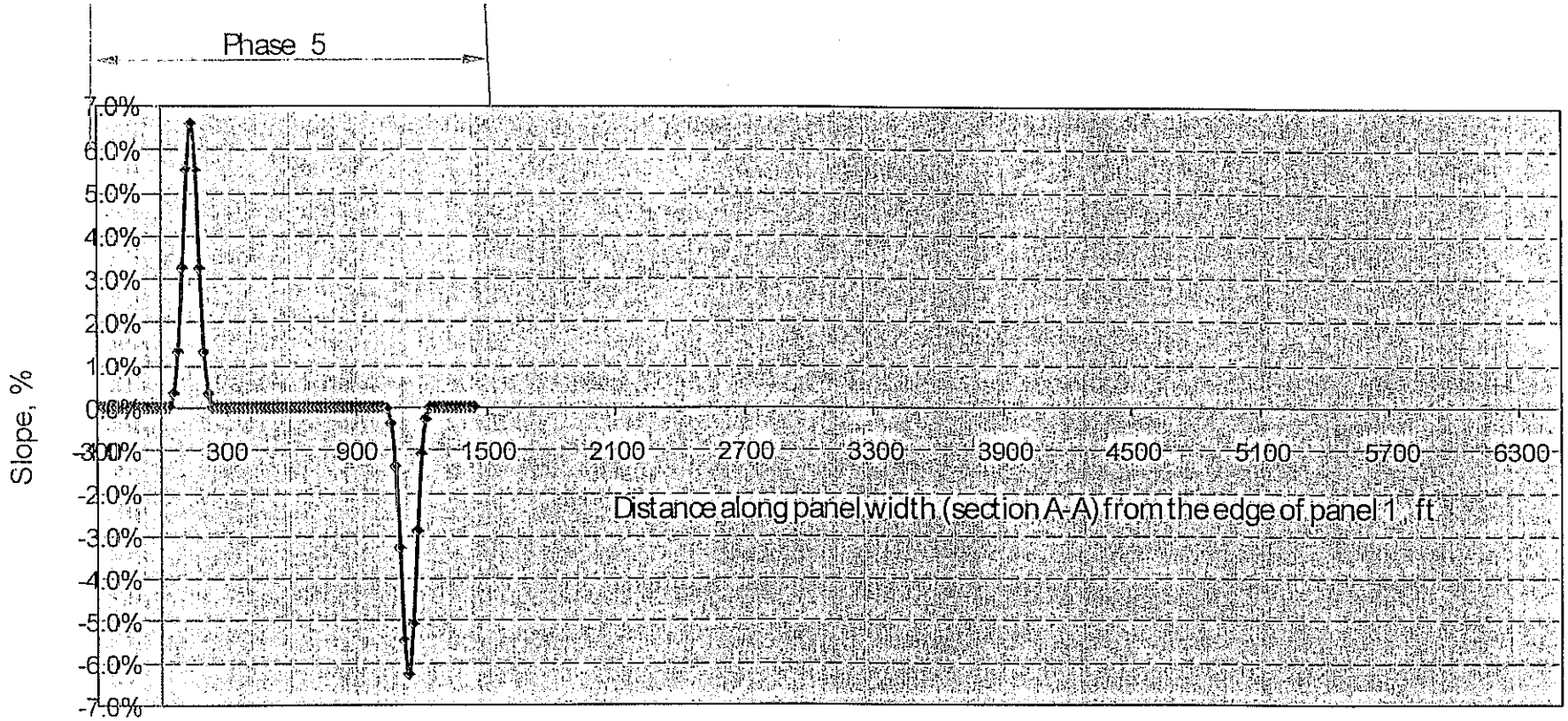

Fig. 13 Predicted slope profile before phase 5 begins

R12964

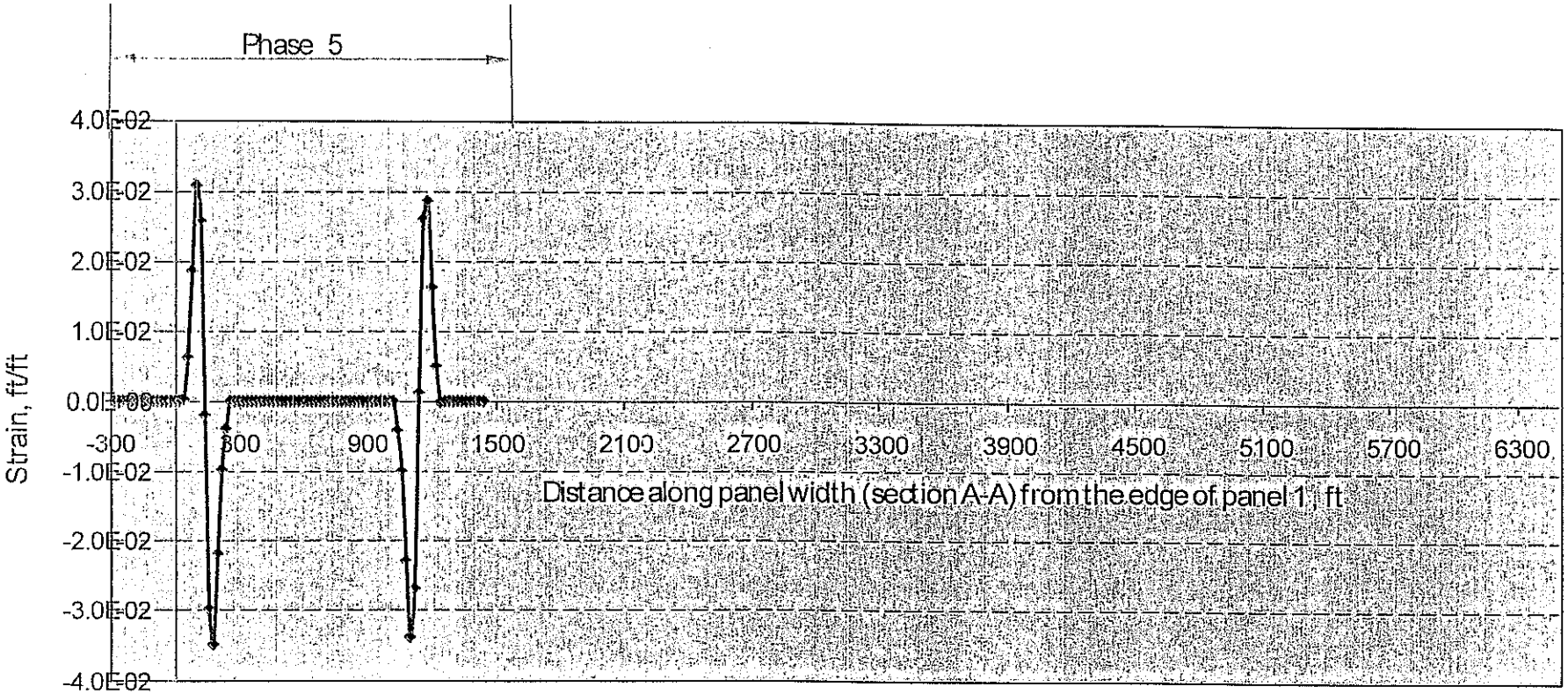

Fig. 14 Predicted horizontal strain profile before phase 5 begins

R12965

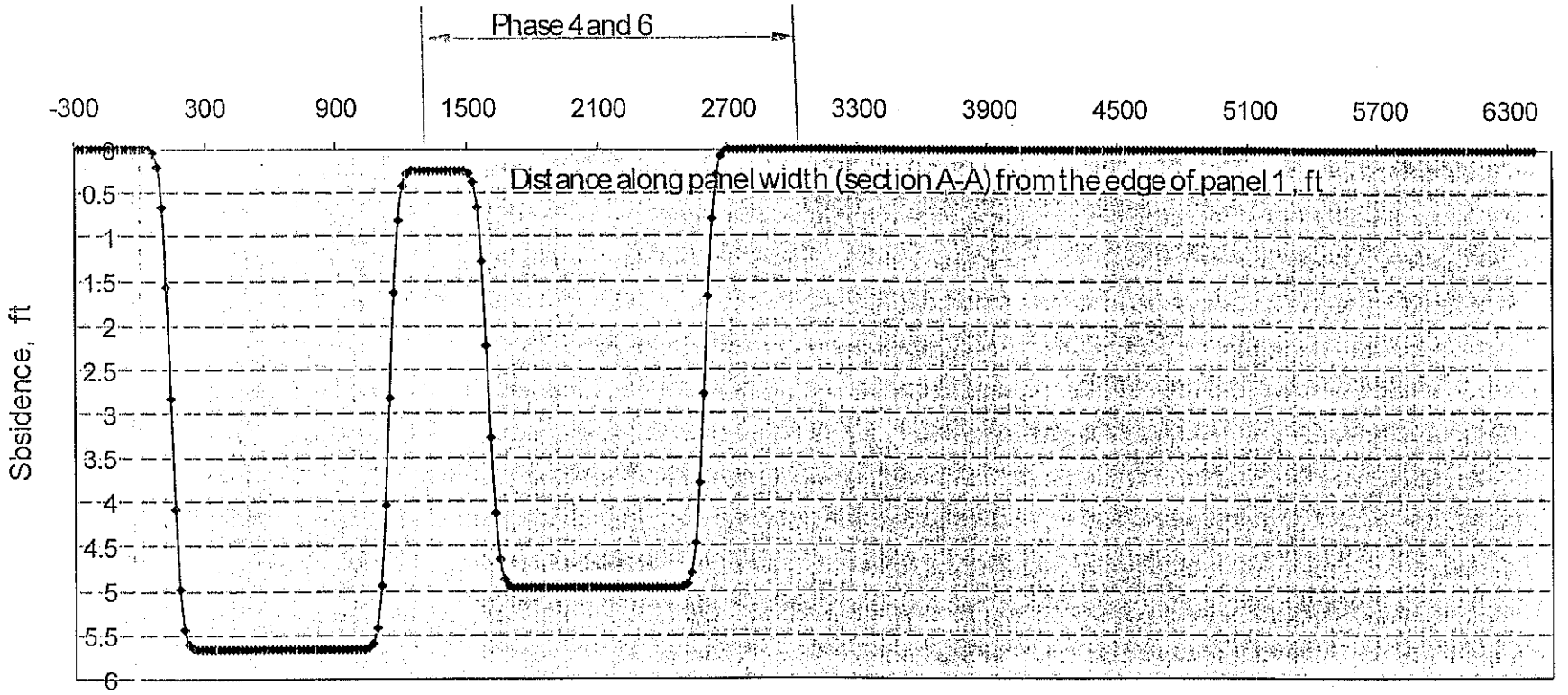

Fig. 15 Predicted subsidence profile during phases 4 and 6

R12966

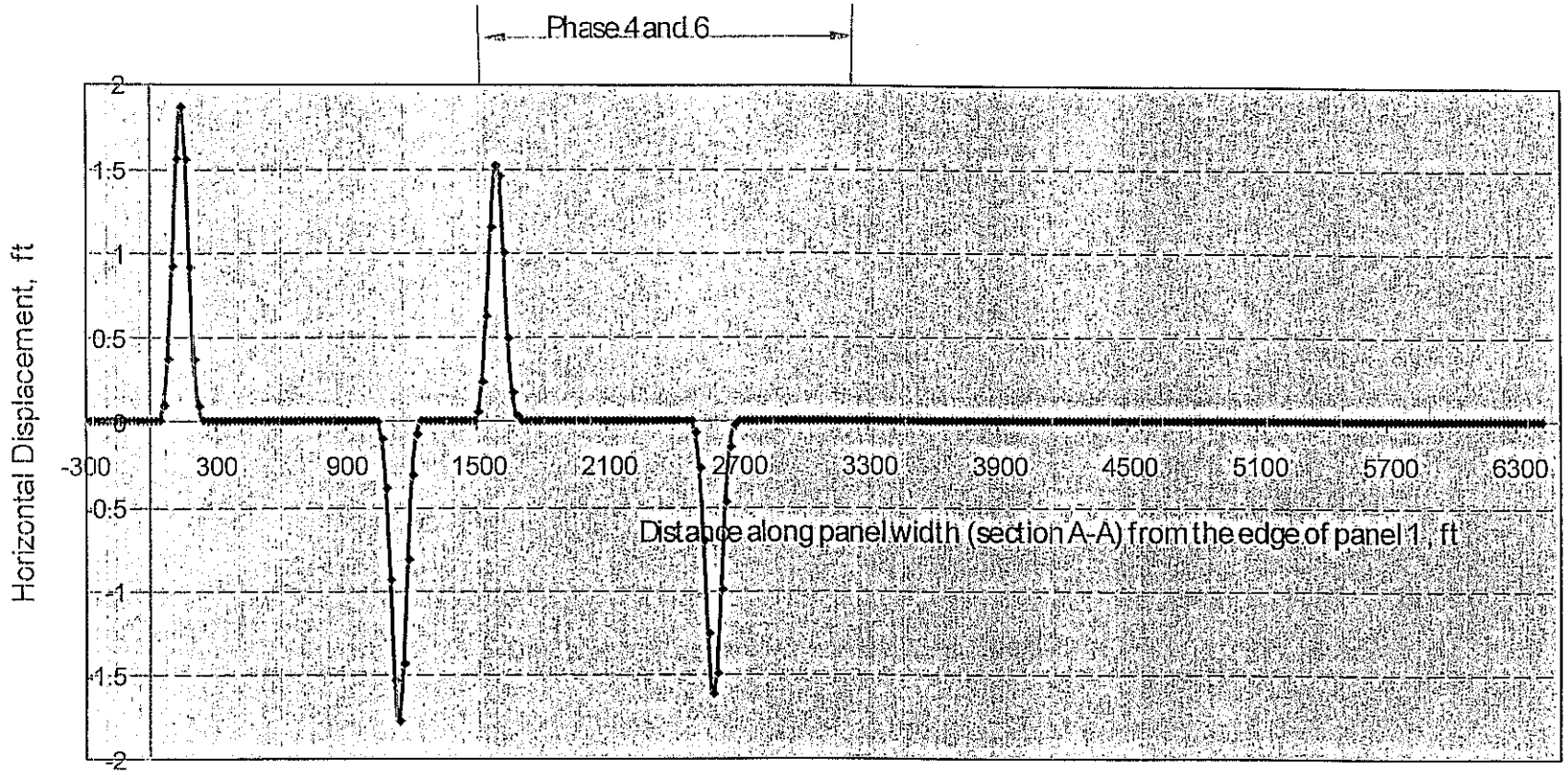

Fig. 16 Predicted horizontal displacement profile during phases 4 and 6

R12967

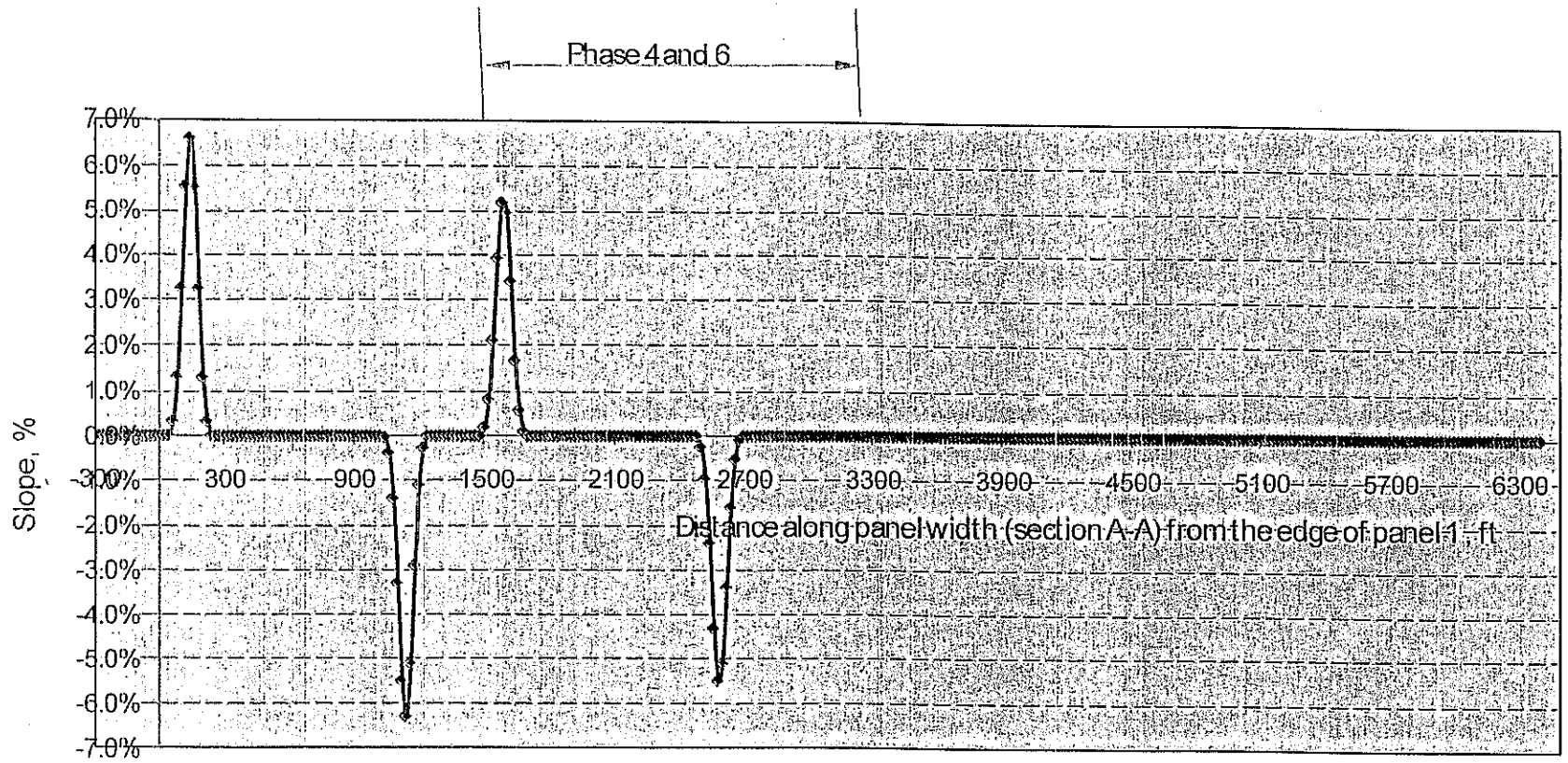

Fig. 17 Predicted slope profile during phases 4 and 6

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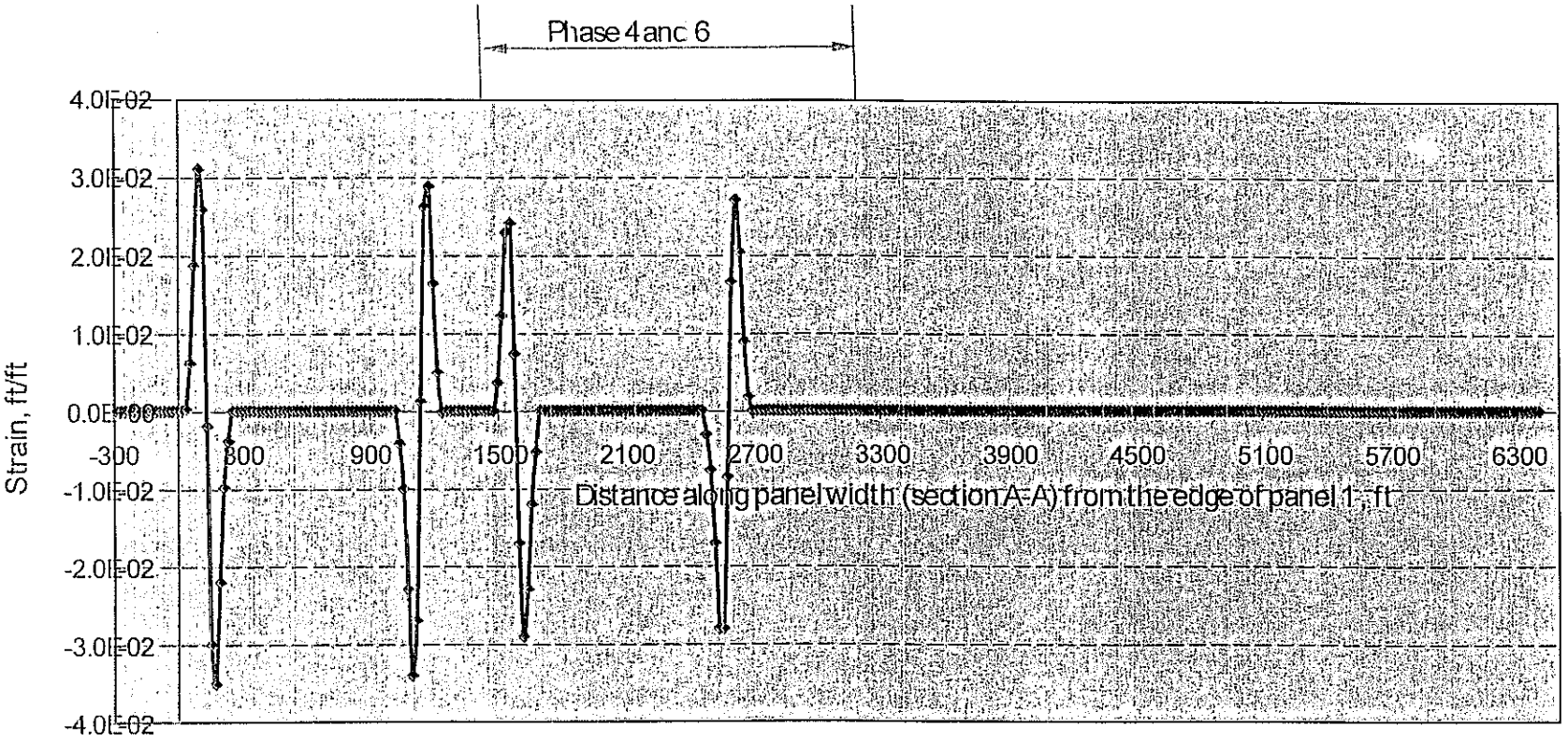

Fig. 18 Predicted strain profile during phases 4 and 6

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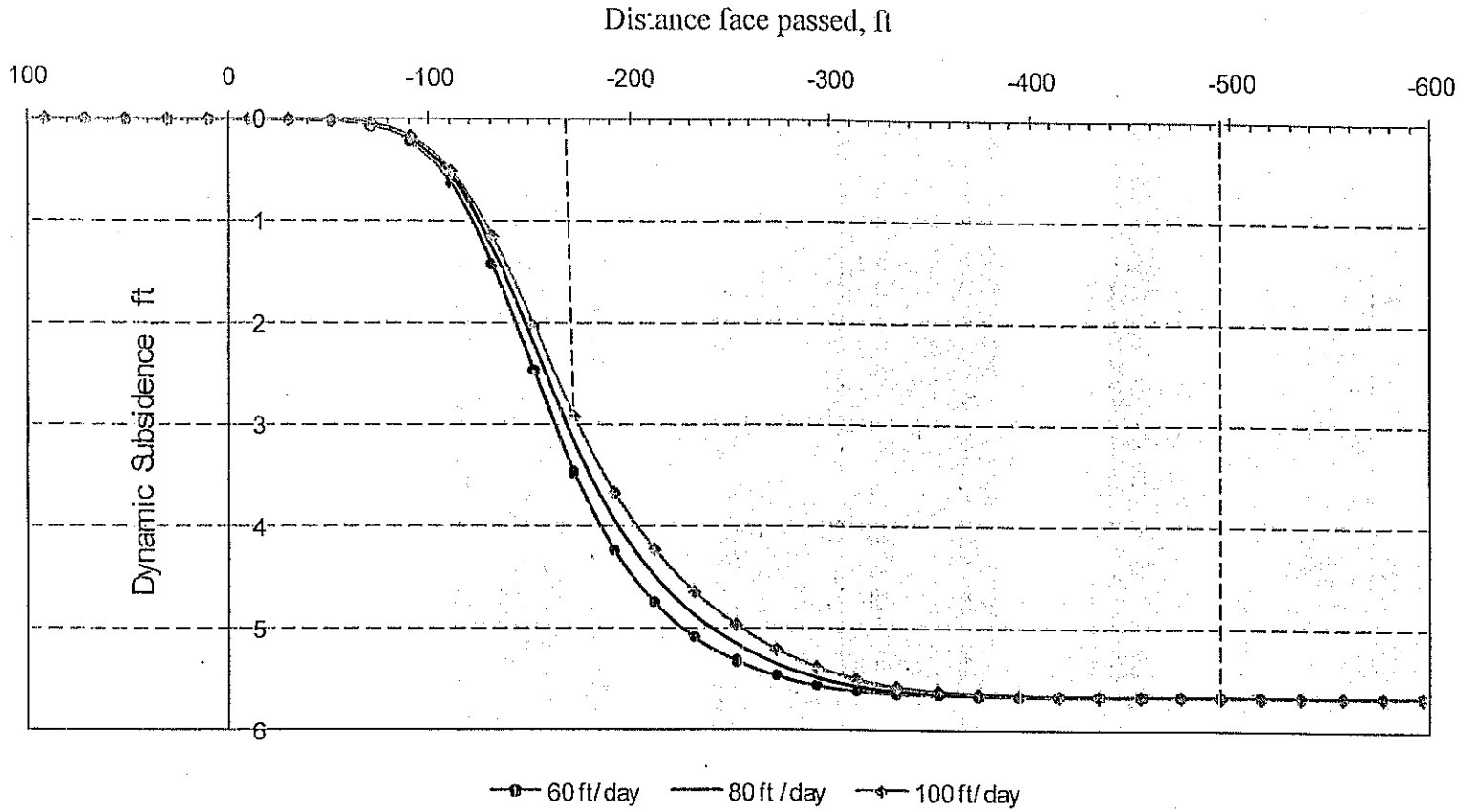

Fig. 19 Predicted dynamic subsidence development curves

R12970

Appendix 1

Final subsidence parameters along cross section A-A after mining all four longwall panels (note -the distance is measured from the right edge of panel1)

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
1	-220	0	0	0.00E+00	0.00E+00	0.00E+00
2	-200	0	0	0.00E+00	0.00E+00	0.00E+00
3	-180	0	0	0.00E+00	0.00E+00	0.00E+00
4	-160	0	0	0.00E+00	0.00E+00	0.00E+00
5	-140	0	0	0.00E+00	0.00E+00	0.00E+00
6	-120	0	0	0.00E+00	0.00E+00	0.00E+00
7	-100	0	0	0.00E+00	0.00E+00	0.00E+00
8	-80	0	0	0.00E+00	0.00E+00	0.00E+00
9	-59	0	0	0.00E+00	0.00E+00	0.00E+00
10	-39	0	0	0.00E+00	0.00E+00	0.00E+00
11	-19	0	0	0.00E+00	0.00E+00	0.00E+00
12	1	0	0	0.00E+00	0.00E+00	0.00E+00
13	21	0	0	0.00E+00	0.00E+00	0.00E+00
14	41	0.002	0.006	2.01E-04	4.42E-04	1.56E-05
15	61	0.048	0.104	3.66E-03	6.72E-03	2.37E-04
16	81	0.224	0.394	1.39E-02	1.95E-02	6.88E-04
17	101	0.702	0.954	3.37E-02	3.12E-02	1.10E-03
18	121	1.627	1.595	5.64E-02	2.48E-02	8.76E-04
19	141	2.903	1.866	6.59E-02	-3.70E-03	-1.30E-04
20	161	4.154	1.532	5.41E-02	-3.00E-02	-1.10E-03
21	181	5.028	0.88	3.11E-02	-3.40E-02	-1.20E-03
22	201	5.462	0.347	1.23E-02	-2.10E-02	-7.60E-04
23	221	5.615	0.085	3.02E-03	-9.30E-03	-3.30E-04
24	241	5.654	0.001	3.52E-05	-3.70E-03	-1.30E-04
25	262	5.669	0	0.00E+00	0.00E+00	0.00E+00
26	282	5.669	0	0.00E+00	0.00E+00	0.00E+00
27	302	5.669	0	0.00E+00	0.00E+00	0.00E+00
28	322	5.669	0	0.00E+00	0.00E+00	0.00E+00
29	342	5.669	0	0.00E+00	0.00E+00	0.00E+00
30	362	5.669	0	0.00E+00	0.00E+00	0.00E+00
31	382	5.669	0	0.00E+00	0.00E+00	0.00E+00
32	402	5.669	0	0.00E+00	0.00E+00	0.00E+00
33	422	5.669	0	0.00E+00	0.00E+00	0.00E+00
34	442	5.669	0	0.00E+00	0.00E+00	0.00E+00
35	462	5.669	0	0.00E+00	0.00E+00	0.00E+00
36	482	5.669	0	0.00E+00	0.00E+00	0.00E+00
37	502	5.669	0	0.00E+00	0.00E+00	0.00E+00
38	522	5.669	0	0.00E+00	0.00E+00	0.00E+00
39	542	5.669	0	0.00E+00	0.00E+00	0.00E+00
40	562	5.669	0	0.00E+00	0.00E+00	0.00E+00
41	583	5.669	0	0.00E+00	0.00E+00	0.00E+00
42	603	5.669	0	0.00E+00	0.00E+00	0.00E+00

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
43	623	5.669	0	0.00E+00	0.00E+00	0.00E+00
44	643	5.669	0	0.00E+00	0.00E+00	0.00E+00
45	663	5.669	0	0.00E+00	0.00E+00	0.00E+00
46	683	5.669	0	0.00E+00	0.00E+00	0.00E+00
47	703	5.669	0	0.00E+00	0.00E+00	0.00E+00
48	723	5.669	0	0.00E+00	0.00E+00	0.00E+00
49	743	5.669	0	0.00E+00	0.00E+00	0.00E+00
50	763	5.669	0	0.00E+00	0.00E+00	0.00E+00
51	783	5.669	0	0.00E+00	0.00E+00	0.00E+00
52	803	5.669	0	0.00E+00	0.00E+00	0.00E+00
53	823	5.669	0	0.00E+00	0.00E+00	0.00E+00
54	843	5.669	0	0.00E+00	0.00E+00	0.00E+00
55	863	5.669	0	0.00E+00	0.00E+00	0.00E+00
56	883	5.669	0	0.00E+00	0.00E+00	0.00E+00
57	904	5.669	0	0.00E+00	0.00E+00	0.00E+00
58	924	5.669	0	0.00E+00	0.00E+00	0.00E+00
59	944	5.669	0	0.00E+00	0.00E+00	0.00E+00
60	964	5.669	0	0.00E+00	0.00E+00	0.00E+00
61	984	5.669	0	0.00E+00	0.00E+00	0.00E+00
62	1004	5.669	0	0.00E+00	0.00E+00	0.00E+00
63	1024	5.669	0	0.00E+00	0.00E+00	0.00E+00
64	1044	5.649	-0.013	-4.60E-04	-4.60E-03	-1.60E-04
65	1064	5.593	-0.127	-4.50E-03	-1.20E-02	-4.10E-04
66	1084	5.392	-0.444	-1.60E-02	-2.40E-02	-8.70E-04
67	1104	4.873	-1.015	-3.60E-02	-3.40E-02	-1.20E-03
68	1124	3.918	-1.604	-5.70E-02	-2.40E-02	-8.60E-04
69	1144	2.67	-1.776	-6.30E-02	4.82E-03	1.71E-04
70	1164	1.51	-1.378	-4.90E-02	2.78E-02	9.82E-04
71	1184	0.742	-0.747	-2.60E-02	2.78E-02	9.82E-04
72	1204	0.381	-0.276	-9.80E-03	1.47E-02	5.21E-04
73	1225	0.261	-0.061	-2.10E-03	4.03E-03	1.43E-04
74	1245	0.234	0	0.00E+00	0.00E+00	0.00E+00
75	1265	0.234	0	0.00E+00	0.00E+00	0.00E+00
76	1285	0.234	0	0.00E+00	0.00E+00	0.00E+00
77	1305	0.234	0	0.00E+00	0.00E+00	0.00E+00
78	1325	0.234	0	0.00E+00	0.00E+00	0.00E+00
79	1345	0.234	0	0.00E+00	0.00E+00	0.00E+00
80	1365	0.234	0	0.00E+00	0.00E+00	0.00E+00
81	1385	0.234	0	0.00E+00	0.00E+00	0.00E+00
82	1405	0.234	0	0.00E+00	0.00E+00	0.00E+00
83	1425	0.234	0	0.00E+00	0.00E+00	0.00E+00
84	1445	0.234	0	0.00E+00	0.00E+00	0.00E+00
85	1465	0.234	0	0.00E+00	0.00E+00	0.00E+00
86	1485	0.234	0	0.00E+00	0.00E+00	0.00E+00
87	1505	0.235	0.002	7.64E-05	1.69E-04	5.75E-06
88	1525	0.266	0.07	2.38E-03	4.32E-03	1.47E-04

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
89	1546	0.383	0.271	9.20E-03	1.33E-02	4.53E-04
90	1566	0.705	0.675	2.29E-02	2.31E-02	7.84E-04
91	1586	1.351	1.186	4.03E-02	2.19E-02	7.45E-04
92	1606	2.297	1.497	5.09E-02	3.62E-03	1.23E-04
93	1626	3.309	1.363	4.63E-02	-1.90E-02	-6.50E-04
94	1646	4.099	0.893	3.03E-02	-2.80E-02	-9.40E-04
95	1666	4.549	0.417	1.42E-02	-2.10E-02	-7.20E-04
96	1686	4.736	0.133	4.53E-03	-1.10E-02	-3.60E-04
97	1706	4.793	0.021	7.09E-04	-4.40E-03	-1.50E-04
98	1726	4.814	0	0.00E+00	0.00E+00	0.00E+00
99	1746	4.814	0	0.00E+00	0.00E+00	0.00E+00
100	1766	4.814	0	0.00E+00	0.00E+00	0.00E+00
101	1786	4.814	0	0.00E+00	0.00E+00	0.00E+00
102	1806	4.814	0	0.00E+00	0.00E+00	0.00E+00
103	1826	4.814	0	0.00E+00	0.00E+00	0.00E+00
104	1846	4.814	0	0.00E+00	0.00E+00	0.00E+00
105	1867	4.814	0	0.00E+00	0.00E+00	0.00E+00
106	1887	4.814	0	0.00E+00	0.00E+00	0.00E+00
107	1907	4.814	0	0.00E+00	0.00E+00	0.00E+00
108	1927	4.814	0	0.00E+00	0.00E+00	0.00E+00
109	1947	4.814	0	0.00E+00	0.00E+00	0.00E+00
110	1967	4.814	0	0.00E+00	0.00E+00	0.00E+00
111	1987	4.814	0	0.00E+00	0.00E+00	0.00E+00
112	2007	4.814	0	0.00E+00	0.00E+00	0.00E+00
113	2027	4.814	0	0.00E+00	0.00E+00	0.00E+00
114	2047	4.814	0	0.00E+00	0.00E+00	0.00E+00
115	2067	4.814	0	0.00E+00	0.00E+00	0.00E+00
116	2087	4.814	0	0.00E+00	0.00E+00	0.00E+00
117	2107	4.814	0	0.00E+00	0.00E+00	0.00E+00
118	2127	4.814	0	0.00E+00	0.00E+00	0.00E+00
119	2147	4.814	0	0.00E+00	0.00E+00	0.00E+00
120	2168	4.814	0	0.00E+00	0.00E+00	0.00E+00
121	2188	4.814	0	0.00E+00	0.00E+00	0.00E+00
122	2208	4.814	0	0.00E+00	0.00E+00	0.00E+00
123	2228	4.814	0	0.00E+00	0.00E+00	0.00E+00
124	2248	4.814	0	0.00E+00	0.00E+00	0.00E+00
125	2268	4.814	0	0.00E+00	0.00E+00	0.00E+00
126	2288	4.814	0	0.00E+00	0.00E+00	0.00E+00
127	2308	4.814	0	0.00E+00	0.00E+00	0.00E+00
128	2328	4.814	0	0.00E+00	0.00E+00	0.00E+00
129	2348	4.814	0	0.00E+00	0.00E+00	0.00E+00
130	2368	4.814	0	0.00E+00	0.00E+00	0.00E+00
131	2388	4.814	0	0.00E+00	0.00E+00	0.00E+00
132	2408	4.814	0	0.00E+00	0.00E+00	0.00E+00
133	2428	4.814	0	0.00E+00	0.00E+00	0.00E+00
134	2448	4.814	0	0.00E+00	0.00E+00	0.00E+00

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
135	2468	4.814	0	0.00E+00	0.00E+00	0.00E+00
136	2489	4.814	0	0.00E+00	0.00E+00	0.00E+00
137	2509	4.798	-0.008	-2.60E-04	-3.50E-03	-1.20E-04
138	2529	4.759	-0.09	-3.10E-03	-8.50E-03	-2.90E-04
139	2549	4.619	-0.32	-1.10E-02	-1.80E-02	-6.20E-04
140	2569	4.252	-0.755	-2.60E-02	-2.70E-02	-9.20E-04
141	2589	3.549	-1.26	-4.30E-02	-2.30E-02	-7.90E-04
142	2609	2.569	-1.512	-5.10E-02	-2.90E-03	-9.90E-05
143	2629	1.571	-1.307	-4.40E-02	1.87E-02	6.34E-04
144	2649	0.831	-0.812	-2.80E-02	2.45E-02	8.32E-04
145	2669	0.43	-0.358	-1.20E-02	1.63E-02	5.54E-04
146	2689	0.272	-0.106	-3.60E-03	6.27E-03	2.13E-04
147	2709	0.226	-0.012	-4.20E-04	7.68E-04	2.61E-05
148	2729	0.222	0	0.00E+00	0.00E+00	0.00E+00
149	2749	0.222	0	0.00E+00	0.00E+00	0.00E+00
150	2769	0.222	0	0.00E+00	0.00E+00	0.00E+00
151	2789	0.222	0	0.00E+00	0.00E+00	0.00E+00
152	2810	0.222	0	0.00E+00	0.00E+00	0.00E+00
153	2830	0.222	0	0.00E+00	0.00E+00	0.00E+00
154	2850	0.222	0	0.00E+00	0.00E+00	0.00E+00
155	2870	0.222	0	0.00E+00	0.00E+00	0.00E+00
156	2890	0.222	0	0.00E+00	0.00E+00	0.00E+00
157	2910	0.222	0	0.00E+00	0.00E+00	0.00E+00
158	2930	0.222	0	0.00E+00	0.00E+00	0.00E+00
159	2950	0.222	0	0.00E+00	0.00E+00	0.00E+00
160	2970	0.222	0	0.00E+00	0.00E+00	0.00E+00
161	2990	0.242	0.046	1.56E-03	2.94E-03	9.88E-05
162	3010	0.329	0.207	6.95E-03	1.08E-02	3.62E-04
163	3030	0.587	0.559	1.88E-02	2.11E-02	7.09E-04
164	3050	1.143	1.063	3.58E-02	2.38E-02	8.00E-04
165	3070	2.021	1.457	4.90E-02	9.69E-03	3.26E-04
166	3090	3.039	1.449	4.87E-02	-1.40E-02	-4.60E-04
167	3110	3.907	1.044	3.51E-02	-2.70E-02	-9.10E-04
168	3131	4.45	0.542	1.82E-02	-2.40E-02	-8.00E-04
169	3151	4.699	0.198	6.65E-03	-1.30E-02	-4.50E-04
170	3171	4.782	0.043	1.45E-03	-5.80E-03	-2.00E-04
171	3191	4.814	0	0.00E+00	0.00E+00	0.00E+00
172	3211	4.814	0	0.00E+00	0.00E+00	0.00E+00
173	3231	4.814	0	0.00E+00	0.00E+00	0.00E+00
174	3251	4.814	0	0.00E+00	0.00E+00	0.00E+00
175	3271	4.814	0	0.00E+00	0.00E+00	0.00E+00
176	3291	4.814	0	0.00E+00	0.00E+00	0.00E+00
177	3311	4.814	0	0.00E+00	0.00E+00	0.00E+00
178	3331	4.814	0	0.00E+00	0.00E+00	0.00E+00
179	3351	4.814	0	0.00E+00	0.00E+00	0.00E+00
180	3371	4.814	0	0.00E+00	0.00E+00	0.00E+00

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
181	3391	4.814	0	0.00E+00	0.00E+00	0.00E+00
182	3411	4.814	0	0.00E+00	0.00E+00	0.00E+00
183	3431	4.814	0	0.00E+00	0.00E+00	0.00E+00
184	3452	4.814	0	0.00E+00	0.00E+00	0.00E+00
185	3472	4.814	0	0.00E+00	0.00E+00	0.00E+00
186	3492	4.814	0	0.00E+00	0.00E+00	0.00E+00
187	3512	4.814	0	0.00E+00	0.00E+00	0.00E+00
188	3532	4.814	0	0.00E+00	0.00E+00	0.00E+00
189	3552	4.814	0	0.00E+00	0.00E+00	0.00E+00
190	3572	4.814	0	0.00E+00	0.00E+00	0.00E+00
191	3592	4.814	0	0.00E+00	0.00E+00	0.00E+00
192	3612	4.814	0	0.00E+00	0.00E+00	0.00E+00
193	3632	4.814	0	0.00E+00	0.00E+00	0.00E+00
194	3652	4.814	0	0.00E+00	0.00E+00	0.00E+00
195	3672	4.814	0	0.00E+00	0.00E+00	0.00E+00
196	3692	4.814	0	0.00E+00	0.00E+00	0.00E+00
197	3712	4.814	0	0.00E+00	0.00E+00	0.00E+00
198	3732	4.814	0	0.00E+00	0.00E+00	0.00E+00
199	3752	4.814	0	0.00E+00	0.00E+00	0.00E+00
200	3773	4.814	0	0.00E+00	0.00E+00	0.00E+00
201	3793	4.814	0	0.00E+00	0.00E+00	0.00E+00
202	3813	4.814	0	0.00E+00	0.00E+00	0.00E+00
203	3833	4.814	0	0.00E+00	0.00E+00	0.00E+00
204	3853	4.814	0	0.00E+00	0.00E+00	0.00E+00
205	3873	4.814	0	0.00E+00	0.00E+00	0.00E+00
206	3893	4.814	0	0.00E+00	0.00E+00	0.00E+00
207	3913	4.814	0	0.00E+00	0.00E+00	0.00E+00
208	3933	4.814	0	0.00E+00	0.00E+00	0.00E+00
209	3953	4.814	0	0.00E+00	0.00E+00	0.00E+00
210	3973	4.814	0	0.00E+00	0.00E+00	0.00E+00
211	3993	4.814	0	0.00E+00	0.00E+00	0.00E+00
212	4013	4.814	0	0.00E+00	0.00E+00	0.00E+00
213	4033	4.814	0	0.00E+00	0.00E+00	0.00E+00
214	4053	4.814	0	0.00E+00	0.00E+00	0.00E+00
215	4074	4.814	0	0.00E+00	0.00E+00	0.00E+00
216	4094	4.814	0	0.00E+00	0.00E+00	0.00E+00
217	4114	4.814	0	0.00E+00	0.00E+00	0.00E+00
218	4134	4.792	-0.023	-7.80E-04	-4.60E-03	-1.50E-04
219	4154	4.733	-0.139	-4.70E-03	-1.10E-02	-3.70E-04
220	4174	4.543	-0.425	-1.40E-02	-2.10E-02	-7.10E-04
221	4194	4.093	-0.899	-3.00E-02	-2.80E-02	-9.30E-04
222	4214	3.308	-1.366	-4.60E-02	-1.90E-02	-6.40E-04
223	4234	2.304	-1.504	-5.10E-02	3.26E-03	1.09E-04
224	4254	1.36	-1.202	-4.00E-02	2.15E-02	7.24E-04
225	4274	0.707	-0.695	-2.30E-02	2.32E-02	7.78E-04
226	4294	0.376	-0.286	-9.60E-03	1.37E-02	4.62E-04

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
227	4314	0.253	-0.077	-2.60E-03	4.67E-03	1.57E-04
228	4334	0.22	-0.004	-1.50E-04	3.31E-04	1.11E-05
229	4354	0.218	0	0.00E+00	0.00E+00	0.00E+00
230	4374	0.218	0	0.00E+00	0.00E+00	0.00E+00
231	4395	0.218	0	0.00E+00	0.00E+00	0.00E+00
232	4415	0.218	0	0.00E+00	0.00E+00	0.00E+00
233	4435	0.218	0	0.00E+00	0.00E+00	0.00E+00
234	4455	0.218	0	0.00E+00	0.00E+00	0.00E+00
235	4475	0.218	0	0.00E+00	0.00E+00	0.00E+00
236	4495	0.218	0	0.00E+00	0.00E+00	0.00E+00
237	4515	0.218	0	0.00E+00	0.00E+00	0.00E+00
238	4535	0.218	0	0.00E+00	0.00E+00	0.00E+00
239	4555	0.218	0	0.00E+00	0.00E+00	0.00E+00
240	4575	0.218	0	0.00E+00	0.00E+00	0.00E+00
241	4595	0.218	0	0.00E+00	0.00E+00	0.00E+00
242	4615	0.238	0.046	1.63E-03	3.09E-03	1.11E-04
243	4635	0.336	0.224	8.05E-03	1.24E-02	4.44E-04
244	4655	0.641	0.63	2.26E-02	2.43E-02	8.72E-04
245	4675	1.309	1.191	4.28E-02	2.50E-02	8.98E-04
246	4695	2.334	1.554	5.58E-02	4.72E-03	1.70E-04
247	4716	3.445	1.406	5.05E-02	-2.20E-02	-7.70E-04
248	4736	4.292	0.881	3.16E-02	-3.00E-02	-1.10E-03
249	4756	4.746	0.377	1.36E-02	-2.10E-02	-7.70E-04
250	4776	4.918	0.104	3.72E-03	-9.90E-03	-3.60E-04
251	4796	4.963	0.009	3.07E-04	-3.90E-03	-1.40E-04
252	4816	4.98	0	0.00E+00	0.00E+00	0.00E+00
253	4836	4.98	0	0.00E+00	0.00E+00	0.00E+00
254	4856	4.98	0	0.00E+00	0.00E+00	0.00E+00
255	4876	4.98	0	0.00E+00	0.00E+00	0.00E+00
256	4896	4.98	0	0.00E+00	0.00E+00	0.00E+00
257	4916	4.98	0	0.00E+00	0.00E+00	0.00E+00
258	4936	4.98	0	0.00E+00	0.00E+00	0.00E+00
259	4956	4.98	0	0.00E+00	0.00E+00	0.00E+00
260	4976	4.98	0	0.00E+00	0.00E+00	0.00E+00
261	4996	4.98	0	0.00E+00	0.00E+00	0.00E+00
262	5016	4.98	0	0.00E+00	0.00E+00	0.00E+00
263	5037	4.98	0	0.00E+00	0.00E+00	0.00E+00
264	5057	4.98	0	0.00E+00	0.00E+00	0.00E+00
265	5077	4.98	0	0.00E+00	0.00E+00	0.00E+00
266	5097	4.98	0	0.00E+00	0.00E+00	0.00E+00
267	5117	4.98	0	0.00E+00	0.00E+00	0.00E+00
268	5137	4.98	0	0.00E+00	0.00E+00	0.00E+00
269	5157	4.98	0	0.00E+00	0.00E+00	0.00E+00
270	5177	4.98	0	0.00E+00	0.00E+00	0.00E+00
271	5197	4.98	0	0.00E+00	0.00E+00	0.00E+00
272	5217	4.98	0	0.00E+00	0.00E+00	0.00E+00

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
273	5237	4.98	0	0.00E+00	0.00E+00	0.00E+00
274	5257	4.98	0	0.00E+00	0.00E+00	0.00E+00
275	5277	4.98	0	0.00E+00	0.00E+00	0.00E+00
276	5297	4.98	0	0.00E+00	0.00E+00	0.00E+00
277	5317	4.98	0	0.00E+00	0.00E+00	0.00E+00
278	5337	4.98	0	0.00E+00	0.00E+00	0.00E+00
279	5358	4.98	0	0.00E+00	0.00E+00	0.00E+00
280	5378	4.98	0	0.00E+00	0.00E+00	0.00E+00
281	5398	4.98	0	0.00E+00	0.00E+00	0.00E+00
282	5418	4.98	0	0.00E+00	0.00E+00	0.00E+00
283	5438	4.98	0	0.00E+00	0.00E+00	0.00E+00
284	5458	4.98	0	0.00E+00	0.00E+00	0.00E+00
285	5478	4.98	0	0.00E+00	0.00E+00	0.00E+00
286	5498	4.98	0	0.00E+00	0.00E+00	0.00E+00
287	5518	4.98	0	0.00E+00	0.00E+00	0.00E+00
288	5538	4.98	0	0.00E+00	0.00E+00	0.00E+00
289	5558	4.98	0	0.00E+00	0.00E+00	0.00E+00
290	5578	4.98	0	0.00E+00	0.00E+00	0.00E+00
291	5598	4.98	0	0.00E+00	0.00E+00	0.00E+00
292	5618	4.98	0	0.00E+00	0.00E+00	0.00E+00
293	5638	4.98	0	0.00E+00	0.00E+00	0.00E+00
294	5658	4.98	0	0.00E+00	0.00E+00	0.00E+00
295	5679	4.98	0	0.00E+00	0.00E+00	0.00E+00
296	5699	4.98	0	0.00E+00	0.00E+00	0.00E+00
297	5719	4.98	0	0.00E+00	0.00E+00	0.00E+00
298	5739	4.98	0	0.00E+00	0.00E+00	0.00E+00
299	5759	4.958	-0.022	-7.90E-04	-4.90E-03	-1.80E-04
300	5779	4.891	-0.154	-5.50E-03	-1.30E-02	-4.50E-04
301	5799	4.659	-0.498	-1.80E-02	-2.50E-02	-9.00E-04
302	5819	4.094	-1.06	-3.80E-02	-3.20E-02	-1.10E-03
303	5839	3.123	-1.554	-5.60E-02	-1.70E-02	-6.10E-04
304	5859	1.948	-1.58	-5.70E-02	1.14E-02	4.10E-04
305	5879	0.946	-1.115	-4.00E-02	2.80E-02	1.00E-03
306	5899	0.343	-0.542	-1.90E-02	2.31E-02	8.27E-04
307	5919	0.088	-0.175	-6.30E-03	1.04E-02	3.71E-04
308	5939	0.012	-0.028	-1.00E-03	2.09E-03	7.50E-05
309	5959	0	0	0.00E+00	0.00E+00	0.00E+00
310	5979	0	0	0.00E+00	0.00E+00	0.00E+00
311	6000	0	0	0.00E+00	0.00E+00	0.00E+00
312	6020	0	0	0.00E+00	0.00E+00	0.00E+00
313	6040	0	0	0.00E+00	0.00E+00	0.00E+00
314	6060	0	0	0.00E+00	0.00E+00	0.00E+00
315	6080	0	0	0.00E+00	0.00E+00	0.00E+00
316	6100	0	0	0.00E+00	0.00E+00	0.00E+00
317	6120	0	0	0.00E+00	0.00E+00	0.00E+00
318	6140	0	0	0.00E+00	0.00E+00	0.00E+00

Alliance Consulting, Inc.
Engineers • Constructors • Scientists

7225 / 11
part II

ILLINOIS DEPARTMENT OF NATURAL RESOURCES
PERMIT NO. 375
ADDITIONAL MSHA INFORMATION
COMMENTS 1, 3, 7, AND 8
VOLUME 3 OF 7

COAL REFUSE DISPOSAL FACILITY NO. 2
PHASE 3 THROUGH 7
IMPOUNDMENT I.D. NO. 1211-IL08-0341-02
MSHA I.D. NO. 11-03141
WILLIAMSON COUNTY, ILLINOIS

Prepared for

WILLIAMSON ENERGY, LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B10-148-1413
NOVEMBER 2010

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U.S. Department of Labor

Mine Safety and Health Administration
Pittsburgh Safety & Health Technology Center
P.O. Box 18233
Pittsburgh, PA 15236

November 12, 2009

MEMORANDUM FOR JOSEPH O'DONNELL
Acting District Manager, District 8
Coal Mine Safety and Health

THROUGH: JOHN W. FREDLAND
Acting Chief, Pittsburgh Safety and Health Technology Center

FROM: STANLEY J. MICHALEK
Chief, Mine Waste and Geotechnical Engineering Division

SUBJECT: Recommendation for Approval of Design Plans for Phases 3 through 6, and Request for Additional Information for Phase 7, Refuse Disposal Facility No. 2, Impoundment I.D. No. 1211-IL08-03141-02, Mach Mining, LLC, Mach Mine No. 1, Mine I.D. No. 11-03141, Williamson County, Illinois

As requested by your office, a technical review of the subject proposed impoundment plans has been completed. Our review included an initial submittal and two revisions submitted in response to our requests for additional information. Report No. MW09-077, which is attached, indicates that the subject plans appear to be technically acceptable only through Phase 6 and approval through Phase 6 is recommended. Additional information will be required before we can recommend approval of Phase 7.

The proposed mining under Phase 3 will be the most significant event at this facility. Phase 3 must be closed and covered with a stable cap of coarse refuse, be incapable of impounding water or slurry, and all the proposed instrumentation must be in place and operational before the proposed longwall mining is advanced within 100 feet of any part of the Phase 3 embankment.

The Impoundment and IRPI data sheets have been completed for Phases 3 through 6 and are included with the report. Please contact this office if there are any questions regarding this review.

Attachment

cc: L. Zeiler – Acting Director, TS
M. Smith – Acting Chief, Safety Div., CMS&H

UNITED STATES DEPARTMENT OF LABOR

MINE SAFETY AND HEALTH ADMINISTRATION

PITTSBURGH SAFETY AND HEALTH TECHNOLOGY CENTER
MINE WASTE AND GEOTECHNICAL ENGINEERING DIVISION
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REPORT NO. MW09-077

REVIEW OF DESIGN PLANS FOR PHASES 3 THROUGH 7 REFUSE DISPOSAL AREA NO. 2 MSHA I.D. NO. 1211-IL08-03141-02 MACH MINING LLC MINE I.D. NO. 11-03141 WILLIAMSON COUNTY, ILLINOIS

NOVEMBER 12, 2009

BY

PAUL J. DONAHUE, P.E.
CIVIL ENGINEER

REPORT NUMBER MW09-077

OWNERSHIP AND LOCATION

The Refuse Disposal Area No. 2 is owned and operated by Mach Mining, LLC and receives coarse and fine coal refuse from the preparation plant for the Mach No. 1 Mine. The site can be found on the USGS 7.5 Minute Pittsburg (IL) quadrangle map at geographic coordinates N 37°50'30" latitude and W 88°49'17" longitude. This facility is located on a tract comprising the east half of Section 12, Township 8S, and Range 3E, Third Principal Meridian.

MATERIAL REVIEWED

Original Design Submittal

The original submitted design documents were prepared for Mach Mining, LLC by Alliance Consulting, Incorporated (Alliance) and included the following.

1. A report entitled "Engineering Design Plan – Proposed Coal Refuse Disposal, Facility No. 2, Williamson County, Illinois, dated January 2007." The report included a narrative description of the proposed design, and the testing and analyses performed. Appendices to the report included construction specifications, calculations, geotechnical test boring and laboratory test data.

2. Thirteen drawings depicting plans, profiles and details of the proposed facility dated January 16, 2007.

During our review of this plan, Mr. Duffy Stradner, former District 8 Impoundment Specialist, notified this reviewer in a phone conversation on October 23, 2007, that the impoundment layout and geometry would be substantially revised and a new plan submitted. Due to proposed mining under the impoundments and other issues that would similarly affect the new design, we completed the review and requested additional information in a memorandum to Robert Phillips, District Manager, Coal Mine Safety and Health (CMS&H) District 8, dated December 13, 2007. The memorandum identified 14 design issues to be addressed in the revised design submittal.

First Revised Design Submittal

The revised design package for the coal refuse impoundments was hand delivered to our office on August 19, 2008, in conjunction with a meeting with Mach Mining and Alliance Consulting personnel to discuss the new design.

The design documents received at this meeting included the following items.

1. A report entitled "Response to February 11, 2008, Comments, I.D. No. IL08-03141-02, Mach Mining, LLC – Mach No. 1 Mine ID No. 11-03141, Williamson County, Illinois – Coal Refuse Disposal Facility No. 2 Phases 3 through 7," dated August 2008. Appendices to

the report contained construction specifications, various design calculations, geotechnical test boring logs, laboratory test data and a CISPM Mine Subsidence Analysis Report prepared by Dr. Syd Peng of West Virginia University.

2. Nineteen drawings, with revision dates from February 14, 2008, to July 7, 2008, depicting plans, profiles and details of the proposed facility.

In addition, the following additional materials were submitted concurrent with the review of this submittal.

1. A set of three drawings depicting longwall panel surface subsidence measurements at Baselines "A" through "D" located over the eastern end of longwall Panel No. 1 of the subject mine. These drawings are dated August 29, 2008, and were received by the Mine Waste and Geotechnical Engineering Division (MWGED) on September 3, 2008,

2. Two Drawings entitled "Map 6 UG - Operations Plan Map" and "Map 10 – Geologic columns," prepared by Alliance and dated December 3, 2004, and November 29, 2004, respectively, and received by MWGED on September 3, 2008.

In addition to the submitted document, we also gathered additional information, concurrent with the review, through phone and e-mail communication with Mr. Claudio Yon of Alliance and Dan Barkley of the Illinois DNR.

We completed our review of the new design and found eleven items requiring additional substantiating data or calculations and/or design changes. These were outlined in our memorandum to Robert Phillips, District Manager, CMS&H District 8, dated November 10, 2008.

Second Revised Design Submittal

The second revised design submittal was received by MWGED on July 20, 2009, and included the following.

1. A report volume entitled "Additional information- Volume 1 of 3, Comments 2, 4, 5, 6, 9, 10 and 11, Coal Refuse Disposal Facility No. 2 Phases 3 through 7," Impoundment ID No. IL08-03141-02 (MSHA ID No. 11-03141), Williamson County, Illinois," dated July 2009. This volume included new, revised and copies of previously submitted materials from the earlier August 2008 submittal and was prepared by Alliance.

2. A second report volume entitled "Additional information- Volume 2 of 3, Comments 1, 3, 7 and 8, Coal Refuse Disposal Facility No. 2 Phases 3 through 7," Impoundment ID No. IL08-03141-02 (MSHA ID No. 11-03141), Williamson County, Illinois," dated July 2009. This volume contained new calculations and analysis performed by GAI consultants for Alliance.
3. A third volume containing 22 drawings, with revision dates from July 8, 2009, to July 13, 2009, depicting plans, profiles, and details of the proposed facility.

4. An addendum to the submittal, received on August 21, 2009. This addendum included corrected transmittal letters and tables of contents, a revised drawing B05-330-M32 – Phase 5 Plan View, revised August 18, 2009, and revised Phase 5 dam underdrain calculations.

Additionally, prior to the receipt of this submittal, we received electronically transmitted drawings depicting a longitudinal dynamic subsidence survey over the advancing face of Longwall Panel No. 1 at a location immediately to the east of the future Phase 5. These drawings were received in our office on February 10, 2009. This survey was performed in response to comment No. 4 in the November 10, 2008, memorandum.

The results of our review of this revised design are discussed in this report.

BACKGROUND

The revised Refuse Disposal Facility No. 2 will provide for the disposal of about 3 ½ years of coarse coal refuse (CCR) and 6 years of fine coal refuse (FCR) that will be produced from the Pond Creek No. 1 Mine following closure of previously approved Facility No. 1 which included Phases 1 and 2. This facility is to be constructed in five phases – Phase 3 through Phase 7.

As planned, the facility will consist of three, approximately rectangular, diked impoundments aligned in a north-south direction and sharing common embankments between them. The southernmost impoundment will be constructed during Phase 3, with fine refuse placement starting upon completion of the embankment to the design crest height. The central impoundment will be constructed in three Phases (Phases 4, 6 and 7) with fine refuse placement starting during Phase 7, when the embankment will be about 50 percent of the total completed height. The northernmost impoundment will be constructed during Phase 5 and will be partly incised by excavating the footprint of the impoundment. Fine refuse placement in this impoundment will begin once Phase 3 is filled to capacity, and the Phase 5 embankment is about 80 percent complete.

The impoundments will cover about 200 acres, and all the impounding embankments will be raised longitudinally in segments using belt-delivered coarse coal refuse. The upstream and downstream slopes will be 3 horizontal to 1 vertical (3H:1V) except for Phase 3 which will have 2.6H:1V upstream slopes. Maximum embankment heights will range from 49 feet for Phase 3 to 100 feet for Phase 7. All embankments, with the exception of a portion of the Phase 7 central impoundment, will be founded on 15 to 22 feet of medium to stiff clay deposits overlying shale bedrock. The south-facing slope of the Phase 7 embankment will be founded on the impounded fine refuse of the adjoining Phase 3.

The designer considered the impoundments to be of high hazard potential classification for the purposes of hydrologic/hydraulic design. Following one year from the start of construction, all phases will be able to accommodate a rainfall volume of two PMF's with pumping capacity capable of drawing down one 72-hour PMF in 30 days. When the final crest elevation is reached, an 18-inch-diameter HDPE SDR 26 decant spillway will be installed and be capable of

drawing down 90 percent of one PMF in less than 10 days. The only exception is the Phase 3 impoundment. Because of an expected life of less than 1 year, this phase was designed to handle at least one half of a 72-hour PMF, but less than a full 72-hour PMF.

The most significant consideration for these impoundments will be the concurrent mining of three longwall panels in the 6.5-foot-thick Herrin No. 6 coal seam beneath the impoundment footprints. There are 430 to 450 feet of overburden, with at least 420 feet of this being rock, between the embankment foundations or impoundment bottoms and the Herrin No. 6 seam. Boring data indicates that about 75 to 90 percent of the overburden rock is shale. A sandstone unit, 200 to 240 feet above the No. 6 seam and ranging from 21 to 54 feet thick, is the only persistent competent unit encountered in the borings.

The development entries for the longwall mining have a calculated minimum pillar safety factor of 2.3 as calculated by the program ALPS. A minimum rock overburden thickness of about 65 times the mine height is present above the seam. Therefore, this facility complies with the guidance contained in Bureau of Mines publication IC 8741 for limiting breakthrough risk. However, subsidence from the longwall mining will considerably impact surface structures over the mine.

The subsidence effects on the proposed coal refuse impoundments will be largely mitigated by the proposed phasing of the impoundments. Except for Phases 3 and 4, all refuse placement will take place after mining has been completed beneath the impoundment and subsidence is substantially complete. For Phase 3, FCR placement will be completed to an elevation of 5 feet below the crest, about 9 months prior to longwall mining beneath the impoundment. A 5-foot-thick cover of coarse refuse, level with the crest, will be placed over the fine refuse in order to eliminate any impounded water before the mining advances beneath the impoundment. Phase 4 will consist of a 45-foot-high non-impounding embankment placed prior to mining. After the mining, the 300-foot-wide Phase 6 embankment will buttress the downstream slope of the Phase 4 embankment. The width of this embankment is expected to mitigate any possible effects of subsidence-related damage to the Phase 4 embankment.

The planned mining beneath the Phase 3 impoundment, a short time after filling and capping of this impoundment, is the most significant issue in evaluating the subsidence impacts. There is currently little engineering experience in accommodating longwall mining under a coal refuse impoundment and a conservative consideration of all possible potential failure modes and mitigatory measures was the primary item of concern in the review of this plan.

REVIEW DISCUSSION

The submittal received on July 20, 2009, provided responses to the eleven items of additional information that were requested in the November 10, 2008, memorandum. Additionally the submitted addendum included a revised plan for the Phase 5, which will be enlarged by locating its north dike approximately 250 feet further north.

Phase 7 Stability

The submittal did not satisfactorily address comment Nos. 7 and 8 in the November 10, 2008, memorandum. These comments noted that a stability analysis of the Phase 7 south dike, which will be founded on the settled Phase 3 FCR, had not been performed and requested this analysis be performed along with a seismic liquefaction and deformation analysis. The submitted analysis in response to these comments included only an analysis of the less-critical completed Phase 7C configuration, and not the critical Phase 7A, which will entail advancing the 38-foot-high south dike embankment over the thin cover overlying the consolidating fine refuse. An independent check calculation using the "SlopeW" stability analysis program and normalized undrained strength parameters for the FCR developed in the submittal indicated a short-term post construction safety factor for the south dike of Phase 7A of considerably less than one. Therefore, Phase 7A, as currently planned, will require design revisions before MWGED can recommend approval.

Subsidence Impacts - Phase 3 Impoundment

The largest part of the most recent submittal consisted of various analyses and new test data submitted as justification for the proposed longwall mining beneath the capped Phase 3 impoundment, as requested in items 1 through 3 of the November 10, 2008, memorandum. MWGED performed this review in conjunction with a literature review of soil behavior when subjected to tensile strains and a published case-study of longwall mining under an impoundment in West Virginia.(1)

The Phase 3 impoundment is located so the dike bounding the FCR pool to the north is centered over the Panel's 2 and 3 gateroad development entries, the east and west dikes extend southward to approximately the center of the longwall panel, and the south dike runs along the center portion of the panel. The panel width (1,400 feet) with respect to depth is such that subsidence is supercritical, so the south dike will be subjected only to transient tensile, then compressive, strains in a longitudinal direction as the mine face advances east to west. The east and west dikes will be subjected to permanent tensile strains near the northwest and northeast corners of the impoundment and the north dike will be subjected to significant strains only near the inside toe.

Assuming the impoundment is capped and no longer impounding water at the time the longwall panel is advanced, the specific potential failure mechanisms that were examined for the Phase 3 impoundment included:

(1) Choi, D. S., et al, 1997, "A Case Study of Undermining Impoundment Embankment by the Longwall Mining Method," Proc. 36th US Rock Mechanics Symposium

1. Stability failure of the CCR embankment due to deformations and weakening from subsidence-induced shear strains and cracking.

2. The potential for the development of large, persistent transverse cracks in the CCR embankment or foundation materials capable of releasing flowable FCR. The calculated horizontal strains induced by the subsidence, using revised CISPM model calculations calibrated to actual subsidence measurements at this mine, is about 30 microstrain (3 percent).

3. Weakening and/or liquefaction of the FCR due to subsidence strain-induced pore pressures in conjunction with transverse cracking, possibly resulting in flow into, and/or erosion of, cracks in the CCR.

CCR Embankment Stability Under Subsidence Condition

In order to evaluate the possibility of the first of these mechanisms, a separate analysis performed by GAI Consultants for Alliance applied data from existing triaxial test data of the coarse refuse (CU with pore pressures) to the formula developed for the double-punch shear test developed by Fang and Chen[(2)] to determine a tensile strength for the CCR. The consolidation stresses for each test point were then corrected for equivalent effective vertical stress (σ'_v) and used to develop a "normalized tensile strength" ratio (σ_t / σ'_v) of 0.15 for the CCR. Using this ratio, an average tensile strength of C=475 psf and φ=0 degrees was used in a slope stability analysis to obtain a worst-case stability safety factor for the subsidence disturbed embankment of 1.10. We do not believe the derivation of this strength is technically correct. However, the strength parameter derived appears to be very conservative for coarse coal refuse in even the loosest condition. An independent analysis showed a factor of safety of 1.3 was achieved with φ=19 degrees, which is lower than CCR in its loosest condition based on the typical angle of repose of this material. Therefore, slope failure of the CCR embankment from subsidence-induced shear is very unlikely.

CCR and Foundation Cracking Susceptibility Under Subsidence

The second failure mechanism that was evaluated was the potential for large persistent cracks through the CCR embankment which, in conjunction with the third mechanism, could result in a breach and release of flowable FCR. The submitted data showed the CCR produced at the plant is a well graded gravel material (USCS classification GW) with very little fines (2.0 to 2.5 percent passing the No. 200 sieve). The gradation of oven-dried, compacted Proctor test specimens prepared by Alliance was somewhat higher, with an average of 30 percent passing the No. 200 sieve and was classified under the USCS system as "SC," a clayey sand. However, the lab sample preparation and oven drying likely produced a material with more fines than in the constructed embankment.

(2) Fang, H.Y. and Chen, Wai-Fai, "Determination of Tensile Strength of Soil by Unconfined Penetration Test," ASTM STP-740, R.N Young Ed., 1981

The gradation of the CCR and the foundation soil was compared to published correlations of deformation cracking and piping potential. The CCR as delivered to the impoundment prior to compaction is a cohesionless material and is not subject to cracking. The laboratory compacted and oven-dried CCR material was evaluated as having a medium deformation and cracking potential. However, this material is not likely to be representative of the material in the embankment which will have less fines; therefore, the overall deformation cracking susceptibility of the CCR was evaluated to be low.

The foundation soils are moderately plastic clays (USCS classification CL with a plasticity index of 24). These materials were evaluated as having low cracking potential because such materials in a saturated condition are subject to deformation rather than cracking under the expected strains. Mr. Harold Owens reported, in a phone conversation on June 4, 2009, that aside from a 1-inch-wide crack in desiccated materials, no obvious cracking was observed in the clayey native soils over the previously advanced Longwall Panel No. 1 in the future Phase 5 area. Considerable cracking was observed in a more brittle asphalt and chip pavement that crossed the edge of the panel. Due to the possibility of localized higher than predicted tensile deformations at any surface point over longwall panel edges, the development of significant cracks in the foundation and embankments is low but cannot be excluded.

A similar evaluation was performed for the piping resistance of the foundation and CCR materials. Piping resistance was evaluated as "high" for the foundation clay and plant-run CCR materials, and medium for the laboratory compacted materials. While not addressed in the submittal, we believe that if the impoundment is capped and not impounding water, there will be insufficient seepage water to erosively propagate any piping even if persistent cracks develop in the embankment. Therefore, for a capped impoundment, cracking and subsequent internal erosion via seepage piping is an unlikely possible failure mode.

Subsidence Induced FCR Flow Through Cracks

The third potential subsidence induced failure mechanism examined was the possibility of flowage of fluid FCR through large transverse cracks in the embankment or foundation. As described above, such cracks are unlikely, but cannot be precluded. However, if the FCR is not in a sufficiently flowable state, the cracking will be inconsequential, and this mode of failure can be precluded.

The most recent submittal provided the results of laboratory testing and an analysis of the potential for triggering strength loss (liquefaction) for the FCR under cyclic stresses from either earthquakes or the advancing subsidence across the impoundment. The FCR produced at the Mach Mine preparation plant was bulk-sampled and characterized as a fine grained plastic material with 93 percent passing the No. 200 sieve and more than 99 percent passing the No. 40 sieve. The liquid limit was 36 and the plasticity index was 17 and the material was classified under the USCS classification system as "CL."

The submittal included calculations from two triaxial tests performed on remolded FCR specimens prepared from bucket samples of the slurry produced by the preparation plant. These calculations showed a post-seismic strength ratio (S_{us}/ σ'_v) of 0.24, which is only slightly less than the peak (S_u/ σ'_v) value of 0.27. If fully consolidated, these materials are not flowable under any anticipated seismic or mine subsidence conditions. However, the fine grained FCR at this facility is likely to dissipate excess pore pressure and consolidate under self-weight very slowly, so the undrained strength of the FCR at the time of mining is likely to be the most critical condition, with a very weak upper FCR layer being potentially flowable through cracks extending through the embankment. The submittal did not include specific calculations addressing this scenario; however, a CCR cap with a minimum thickness of 5 feet is specified to be placed over the impoundment prior to mining. It is expected, based on MWGED's previous observations and independent calculations, that when CCR is pushed-out over the FCR, the upper materials with undrained strength (S_u) less than at least 150 pounds per square foot will be displaced during the pushout process and therefore are unlikely to be present beneath the pushout. The FCR and/or mixed FCR and CCR material that has reached an S_u of at least 150 psf is not flowable through a cracked embankment except in conjunction with erosive water flow, which will be precluded by the CCR cover. Therefore, provided that the Phase 3 impoundment is capped as shown in the submitted design, a failure by FCR flowage through cracks in the CCR embankment is also unlikely.

CONCLUSIONS AND RECOMMENDATIONS

MWGED noted some deficiencies in the submitted responses to our request for information; however, check calculations show the results of the analyses are conservative and the construction of this facility through Phase 6 is technically satisfactory. However, the submittal did not substantiate the stability of the Phase 7A south embankment which will be constructed over Phase 3A fine refuse, and an independent analysis performed in this office found that the design as currently planned will not be stable under static or seismic conditions. Therefore, approval is recommended through Phase 6 only. Additional information and design revisions as needed to substantiate the static and seismic stability of Phase7A will be needed before approval of this stage can be recommended.

Our recommendation for approval assumes the facility is constructed strictly in accordance with the submitted plan. In particular, the Phase 3 impoundment must be capped with a stable CCR cover and incapable of impounding water before longwall mining approaches the impoundment. Also, per the submitted Specification 6.03 for enhanced monitoring, the operability of all the specified instrumentation and preparations for the contingency buttress shall be verified by the operator's engineer before the longwall mining face is within 100 feet of any part of the Phase 3 capped impoundment.

The CCR embankments at this facility will be constructed in 500- to 600-foot-long longitudinal segments in order to take advantage of belt delivery of the CCR to the placement location. In order to assure the segments are adequately compacted and keyed into the adjoining segments, a specific placement plan was developed and is included in Appendix E of Volume 1 of the

submitted plan. This placement plan, particularly the use of the specified equipment, maximum push distances, and excavation of keys into the adjoining segment should be strictly followed.

The design report narratives and test data should also be considered part of the approved plan. If dam or foundation materials or conditions are discovered that are different than those described in the submitted reports, the plan should be modified as needed to address the changed conditions and submitted to MSHA for approval. In particular, the safety of this facility is contingent on the adherence to the specific mining schedule shown in Drawing B05-330-M36 -Mining/Impoundment Construction Timing Map, revised July 10, 2009.

Approved Plan Documents

Care should be taken to assure the most recent revisions to the drawings and specifications are incorporated into the revised plan documents. The approved plan consists of all the documents listed in the section of this report titled "Second Revised Design Submittal" with the exception of drawing B05-330-M33 – Phase 7 – Plan View and any other Phase 7 details shown on other drawings.

Report Prepared by:

Paul J. Donahue, P.E.
Civil Engineer

Report Approved by:

Darren J Blank, P.E.
Supervisory Civil Engineer

ADDITIONAL INFORMATION
VOLUME 2 OF 3
COMMENTS 1, 3, 7, AND 8

COAL REFUSE DISPOSAL FACILITY NO. 2
PHASE 3 THROUGH 7
IMPOUNDMENT I.D. NO. 1211-IL08-0341-02
MSHA I.D. NO. 11-03141
WILLIAMSON COUNTY, ILLINOIS

Prepared for

MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B05-330-1413
JULY 2009

gai consultants
transforming ideas into reality®

May 12, 2009

Project C090403.01

Mr. Claudio Yon, P.E.
Alliance Consulting, Inc.
124 Philpott Lane
Raleigh County Airport Industrial Park
Beaver, West Virginia 25813-9502

Letter Report
Response to MSHA Comments Nos. 1, 3, 7 and 8
Pond Creek Mine No. 1 Coal Refuse Disposal Facility No.2 – Phases 3 and 7
Williamson Energy, LLC
Williamson County, Illinois
GAI Project C090403.01

Dear Mr. Yon:

In accordance with our Work Order Memorandum No. 001, dated March 25, 2009, GAI Consultants, Inc. (GAI) has prepared comment responses for the Draft Mine Safety and Health Administration (MSHA) Memorandum and request for additional information, dated November 10, 2008. In general, this comment response addresses site-specific fine coal refuse testing, evaluates the potential for subsidence-induced triggering of the Phase 3 fine coal refuse impoundment, as well as the stability of proposed Phase 7 South embankment at the Williamson Energy, LLC (Williamson), Pond Creek Coal Refuse Disposal Facility No. 2 (Pond Creek).

GAI performed engineering analyses and prepared detailed comment responses for MSHA Comment Nos. 1, 3, 7 and 8 based on our discussions, our understanding of the site conditions, and our experience performing similar analyses. MSHA Comment Nos. 1 and 3 pertain to site-specific laboratory testing and characterization of fine coal refuse materials (FCR), and liquefaction (flow) potential of the Phase 3 fine refuse due to longwall mining beneath the Phase 3 impoundment. Comment Nos. 7 and 8 are associated with performing static and liquefaction (seismic) stability analyses of the Phase 7 South slope, respectively.

GAI notes only Comment Nos. 1, 3, 7 and 8 are addressed herein. Further, GAI understands responses to Comment Nos. 2, 4, 5 and 6 were prepared by others, and will be submitted under separate cover.

INTRODUCTION

Plans have been developed by Alliance Consulting, Inc. (Alliance), Beaver, West Virginia for the construction of a coal refuse disposal facility located near Johnston City in Williamson County, Illinois. The proposed Pond Creek facility will provide disposal capacity for both coarse and fine coal refuse, and will provide for approximately 3 ½ years of coarse coal refuse (CCR) and

six (6) years of fine coal refuse (FCR) produced from the Pond Creek No. 1 mine. The facility will be constructed in five (5) phases designated Phase 3 through 7.

The design plans for the Pond Creek facility, submitted under separate cover by Alliance includes constructing three (3) four-sided impoundments aligned in a north-south direction, which share common embankments in between. The southernmost impoundment, Phase 3 will include FCR placement, starting upon completion of the embankment to the design crest elevation (El.) 500 feet. The central impoundment will be constructed during Phases 4, 6 and 7 with FCR placement starting during Phase 7 when the embankment will be about 50 percent of the total proposed height. The northernmost impoundment will be constructed during Phase 5 and will be partly incised by excavating the bottom of the impoundment. FCR placement during Phase 5 will begin when the embankment is about 80 percent complete.

The proposed Phases 3 through 7 impoundments will occupy an area approximately 200 acres, and all of the impounding CCR embankments will be constructed by downstream or centerline methods. The upstream and downstream slopes will be about three horizontal to one vertical (3H:1V) except for Phase 3, which will have 2.6H:1V upstream slopes. Maximum slope heights will range from 49 feet for Phase 3 to 100 feet for Phase 7. All of the embankments, with the exception of a portion of Phase 7 will be founded on 15 to 22 feet of medium stiff to stiff, sandy clay overlying shale bedrock. The south facing slope of Phase 7 (designated 7A and 7C) will be founded on impounded FCR of Phase 3.

NOTED MSHA CONCERNS

MSHA noted in their November 2008 information request that the most significant consideration for the impoundments will be the concurrent mining of three (3) longwall panels in the 6.5-foot Herrin No. 6 Coal Seam beneath the impoundment footprints. GAI understands there is 430 to 450 feet of overburden between the base of the embankments/impoundments and the Herron No. 6 seam, with at least 420 feet of the overburden being rock. MSHA also noted that the breakthrough or sinkhole potential was low, but surface subsidence will considerably impact the facility.

Similarly, MSHA noted the construction is to be phased such that, with the exception of Phases 3 and 4, all refuse placement will take place after mining has been completed beneath the impoundment and subsidence is substantially complete. For Phase 3, FCR placement will be completed to an elevation five (5) feet below the crest, and about ten (10) months prior to longwall mining beneath the impoundment. A 5-foot thick cover of CCR, level with the crest, will be placed over the FCR to eliminate any impounded water before the mining advances beneath the impoundment. Phase 4 will consist of a 45-foot high, non-impounding embankment placed prior to mining. After the mining and treatment of any subsidence related surface cracks, the 300-foot wide Phase 6 embankment will buttress the downstream slope of the Phase 4 embankment. The width of this embankment is expected to mitigate the effects of any subsidence-induced cracking of the Phase 4 embankment. MSHA considers the proposed longwall mining beneath the Phase 3 impoundment to be a short time line after filling and capping, and a critical issue.

SUBSIDENCE PREDICTION EVALUATION AND SURFACE SURVEY MONITORING DATA

Alliance subcontracted Dr. Syd S. Peng of the Department of Mining Engineering at the West Virginia University to perform a subsidence study for the prediction of ground movement parameters due to longwall mining during the various phases of impoundment construction at

the Pond Creek facility. Final surface movements and deformations along a north-south trending cross-section through the proposed facility were predicted using the subsidence prediction program CSIPM version 2.01, and a complete copy of the Peng evaluation, and related figures prepared by Alliance are presented in Appendix A.

As previously noted, longwall mining will occur beneath only the Phase 3 impoundment approximately 10 months following its completion and the construction of a 5-foot thick CCR cap (part of Phase 6) to eliminate the Phase 3 impounding capability. In general, the results of the subsidence prediction evaluation suggest the magnitude of surface deformations was about 4 feet with surface strains estimated at just over one (1) percent.

GAI understands that survey monitoring was performed during the initial stages of mining Longwall Panel No. 1, which indicated surface deformations of about 5 feet, of which approximately 50 percent occurred within two (2) days, and total deformation occurred within about three (3) days.

MSHA noted that their independent subsidence verification analyses, which incorporated parameters in the SDPS computer program calibrated to the actual measured subsidence profiles, resulted in potential strains of 3.3 percent. MSHA further noted in their November 2008 request for information (Comment No. 2) that updated subsidence-related deformations and surface strains should be recalculated based on actual survey measurements.

The following sections of this letter report include generalized descriptions of the analytical approach and responses to the MSHA Comment Nos. 1, 3, 7 and 8. Included in the comment responses are summaries of previous deformation and abandonment analyses reports, where appropriate, prepared by Civil & Environmental Consultants, Inc. (CEC), pertinent laboratory testing results, summaries of our engineering analyses pertaining to the development and use of the various material engineering properties, liquefaction (flow) susceptibility and slope stability, our conclusions and recommendations, and a reference list.

Pertinent copies of figures from previous analyses are also included, as appropriate, including the results of the subsidence evaluation prepared by Dr. Peng. Appendices A through F present supporting information including detailed calculation briefs for development of pertinent engineering parameters, and the slope stability analyses results for the various liquefaction (flow slide), subsidence-induced embankment cracking, and static and post-earthquake seismic failure scenarios discussed herein.

ANALYTICAL APPROACH

In general, the procedure utilized by GAI for evaluating the susceptibility of the Phase 3 impoundment to a flow-type (liquefaction) failure is presented by Poulos, Castro and France (1985) and the Draft MSHA Engineering and Design Manual, particularly Chapter 7, "Seismic Design: Stability and Deformation." Our analyses included characterizing the impounded FCR material and assessing the susceptibility of the impoundment and embankment to a liquefaction (flow slide) failure. Liquefaction susceptibility was determined by evaluating whether or not the Phase 3 FCR would resist triggering a loss of strength, and subsequently estimating the factor of safety against post-subsidence instability. The analysis requires the in-situ static driving shear stress be determined in the critical layer FCR and a "zero-strength" stability analysis of the FCR employed to conservatively represent the undrained shear strength of the FCR, and asses the factors of safety against a liquefaction (flow slide) failure.

Poulos, et al (1985) states a soil mass susceptible to liquefaction will only experience a flow slide failure when a sufficiently large triggering event causes the strength of the soil to decrease to the undrained steady-state strength. Conversely, a soil mass which is not susceptible to liquefaction physically cannot fail by liquefaction since the minimum undrained strength exceeds the in-situ driving shear stress along the critical failure surface. If stable, a zero-strength analysis is considered the most conservative type of analysis since the FCR will possess some minimum strength (greater than zero) when subject to a rapid loading event such as an earthquake or subsidence-induced disturbance.

Additionally, the possibilities of failures resulting from FCR flowing and/or hydrostatic pressures from flowable FCR or water in subsidence-induced embankment cracks was evaluated in conjunction with the results of the liquefaction susceptibility analyses previously described. The procedure for evaluating the potential for and resistance to embankment cracking from subsidence-related disturbance includes evaluating the tensile strength (σ_t) of site-specific CCR material, based on Winterkorn and Fang, (1975), from six (6) consolidated-undrained (CU) triaxial test points of compacted CCR at various confining pressures. CCR tensile strength is normalized to equivalent vertical effective stress (σ'_v) and a 2/3-1/3 relationship of σ_t-to-σ'_v determined. Post-subsidence slope stability analyses are performed, which includes a conservatively derived tensile strength of the CCR embankment and the factor of safety against embankment cracking estimated.

Based on the results of these analyses, conclusions are drawn as to the likelihood of failure from a flow slide and/or embankment cracking. Recommendations are provided for remedial measures, if necessary, and monitoring pore pressure, verticality and deformation before, during and following longwall mining to quantify the impact of subsidence on the embankment.

RESPONSE TO MSHA COMMENT NOS. 1 and 3

In accordance with this letter report, GAI has performed various analyses, prepared comment responses and provide pertinent field and laboratory data, calculation briefs, etc. as appendices. To expedite further review, MSHA comments are presented below in **bold** type, followed by GAI's response.

COMMENT NO. 1: Characterization of Fine Refuse

The submittal does not include any site-specific fine refuse strength test data. Laboratory and/or in-situ testing of fine refuse should be performed and submitted as appropriate to address the additional analyses requested in items 3, 7 and 8 below.

RESPONSE TO COMMENT NO.1:

Laboratory Testing of FCR

In May 2008, Alliance obtained bulk fine coal refuse slurry samples from the Phase 2 impoundment for subsequent laboratory index and strength testing. Surface samples of fine coal refuse slurry were obtained from the existing tailings pond adjacent to the upstream slope of the coarse embankment. The samples were generally fine-grained, very soft and wet. The slurry material was shipped to CEC's Export, Pennsylvania office and subsequently hand-delivered to the laboratory.

CEC retained Geotechnics, Inc. (Geotechnics) of East Pittsburgh, Pennsylvania to perform laboratory tests and characterize the FCR. Laboratory testing performed included moisture

content, Atterberg limit, grain size and specific gravity testing on slurry samples to aid in soil classification and evaluation of the material properties. The FCR material was composited in the laboratory to form two (2) remolded slurry samples. The sample preparation was designed to simulate the in-situ hydraulic deposition process, and estimate the in-situ undrained shear strength after consolidation to various effective stresses. CU triaxial strength tests on the remolded slurry samples were performed to estimate peak and steady-state undrained shear strength data of the FCR and assess liquefaction susceptibility of the Phase 2 abandonment geometry. Effective and total strength parameters were also determined for the slurry samples. Laboratory testing procedures and results are summarized in Appendix B. Similarly, the results of the site-specific FCR laboratory testing are used to address liquefaction (flow slide) susceptibility of the Phase 3 impoundment as discussed below in the response to Comment No. 3.

In general, the as-received moisture contents of the sampled fine coal refuse ranged from about 86 to 94 percent. Liquid and plastic limits were 36 and 19, respectively, yielding a plasticity index of 17. CU triaxial shear strength testing was performed at confining pressures of about 5, 10 and 20 pounds per square inch (psi). The CU testing produced peak undrained shear strengths (S_{up}) ranging from about 2.6 to 9.3 psi [375 to 1,340 pounds per square foot (psf)]. Peak (axial) strains ranged from about 8.4 to 18.4 percent. Steady-state (or residual) undrained shear strengths (S_{us}) ranged from about 2.5 to 8.7 psi (360 to 1250 psf) at maximum strains of about 17.3 to 21.7 percent.

Response to Comment No. 1 Conclusions

The results of the laboratory testing indicated the fine coal refuse is clay-like based on an average 93 percent passing the No. 200 sieve and plasticity index of 17. Peak and steady-state undrained strengths, presented and discussed in Appendix B were reached at generally high strains (between 8 and 18 percent), and there was very little drop-off from peak to steady-state with increasing strain. The results generally indicated a higher resistance to strength loss (and flow) due to the large strains required to exceed the peak strength and correspondingly small decrease to the steady-state strength at higher strains. The results will be incorporated, as appropriate into the engineering analyses performed to address MSHA Comment Nos. 3, 7 and 8.

COMMENT NO. 3: Fine Refuse Behavior when Subject to Subsidence

The mining of the westernmost 2,300 feet of Longwall Panel No. 3 is scheduled to occur beneath the Phase 3 impoundment about nine months after completion of fine refuse placement, and an unspecified time after a 5-foot coarse refuse cover is placed. The submitted subsidence measurements indicate that somewhat higher-than-predicted tensile strains will occur in conjunction with a transient lowering of the eastern embankment crest to the approximate fine-refuse elevation as the mine face advances beneath the embankment. The degree that the fine refuse will consolidate, gain strength, or resist possible strength loss under subsidence-related disturbance is not known. The possibilities of fine refuse flowage through large cracks in the embankment, or failures resulting from hydrostatic pressures from flowable slurry or water in subsidence-induced embankment cracks have not been analyzed or excluded.

Appropriate field and/or lab test analyses and calculations should be furnished that exclude the failure mode described above. Mitigatory (sic.) measures to preclude a cracking and fine refuse flowage failure mode should also be provided if needed. Such measures may include provisions to dewater or accelerate the consolidation of the fine refuse prior to subsidence, or measures to prevent continuous cracks through the embankment.

RESPONSE TO COMMENT NO.3:

Liquefaction (flow slide) susceptibility is determined by evaluating whether or not the Phase 3 FCR would resist triggering a loss of strength due to a rapid loading event such as subsidence-related disturbance, and subsequently estimating the factor of safety against post-subsidence instability. The analysis requires the in-situ static driving shear stress be determined within the critical layer Phase 3 FCR impoundment, and the appropriate undrained peak (S_{up}) and/or steady-state (S_{us}) shear strength of the FCR to evaluate post-subsidence factors of safety.

Phase 3 In-Situ Driving Shear Stress and Subsidence-Induced Liquefaction Susceptibility

Estimating the in-situ static driving shear stress in the critical soil layer (i.e., fine coal refuse) is one of the steps for evaluating liquefaction susceptibility. The driving shear stress in the critical fine coal refuse layer is equal to the minimum shear resistance the layer must have to simply maintain stability of the slope (i.e., factor of safety of 1.0). The driving stress assumes fully mobilized shear strengths in the structurally-placed, dense CCR and underlying stiff residual soil layers comprising the model. The fully mobilized strengths are those that would act while deformation of the slope is occurring and thus, would be available to resist a massive flow slide. These shear strengths are quantified by performing a stability analysis for the Phase 3 slope in question.

The driving shear stress (τ_d) acting along the critical failure surface is determined by assuming the shearing resistance (i.e., shear strength) of the material through which the failure surface passes is provided solely by cohesion [i.e., angle of internal friction (ϕ) = 0]. The driving stress is determined by varying the cohesion value used in the analysis until a factor of safety of 1.0 is obtained. For this condition, the driving stress acting along the failure surface analyzed is equal to the cohesion value used for the material.

A series of PCSTABL analyses were performed to identify the most critical circular failure surface passing through the Phase 3 impoundment in both the downstream and upstream conditions. The range of starting and ending points for failure circle generation were iteratively analyzed to evaluate the critical failure surface and included the entire impoundment surface. Effective strength of the CCR and total strength parameters of the residual soil described above were used while the cohesion values for the FCR layers were modeled and varied until a factor of safety of 1.0 was obtained.

The following soil properties were estimated based on previous field and laboratory testing and used in the various driving stress and post-subsidence liquefaction slope stability analyses. Appendix B presents summaries of laboratory testing of coarse and fine coal refuse and residual soil. Appendix B also presents a summary of previous field testing at the Pond Creek

facility, particularly piezo-seismic cone penetration testing (PS-CPT) performed by CEC and ConeTec, Inc., West Berlin, New Jersey as part of an evaluation by CEC to address comments by Illinois Department of Natural Resources (IDNR) pertaining to Phase 2 permanent deformations. Appendix C presents summaries of the various analyses to develop pertinent engineering parameters.

Table 1
Summary of Coarse and Fine Coal Refuse and Residual Soil Engineering Properties

Description	Unit Weights ($\gamma_b\gamma_s$) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion (c) (psf)	Strength
Coarse Coal Refuse (CCR)	130, 140	33.7 18.0 0	0 736 σ_t/σ'_v=0.15 (See Below)	Effective Strength (Drained) Total Strength (Undrained) Tensile Strength
Fine Coal Refuse (FCR)	80, 90	36.9 18.8 0	0 0 S_u/σ'_v=0 (Assumed)	Effective Strength (Drained) Total Strength (Undrained) Zero-Strength (Undrained)
Residual Soil	125, 135	26.8 19.5	0 416	Effective Strength (Drained) Total Strength (Undrained)

The results of the driving shear stress slope stability analyses indicate the Phase 3 embankment and impoundment geometry is very favorable, and there is zero (0) in-situ driving shear stress along the critical failure surface passing through the Phase 3 FCR in both the upstream and downstream directions. Utilizing this zero-strength approach in FCR, effective strengths parameters for CCR and total strength parameters for residual soil, minimum factors of safety for the critical Phase 3 downstream and upstream impoundment conditions were 2.2 and 1.3, respectively.

The results indicate that a rapid loading event such as subsidence-related disturbance will not trigger a strength loss in FCR, and is therefore NOT susceptible to a flow slide failure.

Engineering properties derived from laboratory testing of site specific materials are presented in Appendix C. Hard copies of the input and output files for the driving stress analyses are presented in Appendix D.

Phase 3 Factors of Safety Against Embankment Cracking and Failure

As previously discussed, GAI evaluated the possibility of a flow slide failure of the Phase 3 FCR impoundment, and based on the results of the analyses, triggering a FCR strength loss and/or

flow slide failure is not a feasible failure mode. Additionally, the susceptibility of the Phase 3 CCR embankment to cracking from subsidence-induced disturbance, and/or failure of the embankment due to elevated hydrostatic (pore) pressures from water in embankment cracks were evaluated.

GAI's analysis of embankment cracking included evaluating the tensile strength (σ_t) of site-specific CCR material, based on Winterkorn and Fang (1975), from six (6) consolidated-undrained (CU) triaxial test points of compacted CCR at various confining pressures. CCR tensile strength was subsequently normalized to equivalent vertical effective stress (σ'_v) and a conservative 2/3-1/3 relationship of σ_t-to-σ'_v (σ_t/σ'_v) estimated at 0.15. Appendix C presents calculations deriving CCR σ_t as a function of σ'_v for the Phase 3 embankment, and the corresponding average CCR σ_t was estimated at 475 psf. This σ_t is considered to be a reasonable, low tensile strength value for the Phase 3 structurally-placed CCR embankment.

Phase 3 post-subsidence slope stability analyses were performed to evaluate the potential for embankment cracking, and included using a conservatively-derived CCR σ_t value as cohesion (ϕ=0 condition) for the embankment, a conservative zero (0) strength value for the FCR, and total undrained shear strength values for residual soil. The minimum factor of safety against embankment cracking was estimated at 1.1.

Additional Phase 3 post-subsidence, undrained slope stability analyses were performed to evaluate the possibility of failure due to the subsidence event. The analyses include using total undrained strength parameters for the CCR embankment and residual soil, which assumes an increase in pore pressure of the saturated portions of the embankment and underlying soil due to the rapid loading subsidence event and corresponding decrease in strength from drained to undrained, and a conservative zero (0) strength cohesion value for the FCR. The minimum factor of safety against post-subsidence embankment failure using these consecutive shear strengths was estimated at 2.4. Hard copies of the input and output files for the embankment cracking stability analyses are presented in Appendix E.

The results of the post-subsidence analyses suggest that marginal stability exists against embankment cracking and adequate factor of safety against embankment failure due to increase pore pressure in the embankment and residual soil. Conservatisms inherent in the engineering properties used in the post-subsidence stability analyses, which will increase the estimated factor of safety, include the following:

- CCR strength estimates discount negative pore pressures that will undoubtedly develop during the initial stages of the subsidence rapid loading event due to the compacted, dense initial state of stress of the CCR;
- CU testing results of all six (6) CCR points suggest that the peak strain for the CCR material ranges from about 12.5 to 15.3 percent, which is attributed to the claystone and shale rock materials in the CCR; and
- Peak strain for the CCR material is significantly higher than the range of predicted subsidence threshold strains of about 1 to 3 percent.

Response to Comment No. 3 Conclusions

GAI has completed an evaluation of the liquefaction susceptibility of the proposed Pond Creek Phase 3 impoundment geometry. Based on this evaluation, the impoundment is not susceptible to a liquefaction (flow) failure. Additional stability analyses were performed to evaluate the potential for embankment cracking and embankment failure due to subsidence-related disturbance. Based on conservatively-derived strength parameters, adequate factor of safety exists relative to a failure of the Phase 3 embankment. Marginal factor of safety exists relative to Phase 3 embankment cracking; however, conservatisms in the analyses exist. Additionally, the following conclusions are noted:

- FCR was characterized as clay-like, which typically is more resistant to strength loss (or flow) than sand-like materials;
- In-situ driving shear stresses through the FCR are 0 psf;
- Site-specific FCR and CCR laboratory testing results indicate high peak and steady-state undrained shear strains of about 12 to 15 percent relative to the strains induced from subsidence of approximately 1 to 3 percent;
- Phase 3 minimum factors of safety against flow slide susceptibility, with zero-strength FCR in the downstream and upstream directions of 2.2 and 1.3, respectively;
- Phase 3 factor of safety against embankment failure of 2.4; and
- Phase 3 factor of safety against embankment cracking of 1.1.

Response to Comment No. 3 Recommendations

Based on the results of the Phase 3 subsidence-related stability analyses, adequate factors of safety exist relative to catastrophic failure scenarios including a potential flow slide and embankment failure. Marginal stability exists relative to potential cracking of the Phase 3 embankment due to the proposed longwall mining beneath the impoundment; however, some conservatism exists in the analyses as previously noted, including derivation of tensile strength properties, negative pore pressure and increased strength during loading, and high strain capability of the CCR embankment materials relative to estimated induced subsidence strain. Consequently, GAI does not anticipate significant embankment cracking, if any. However, there are various unknowns relative to the actual performance of the impoundment that require attention.

Therefore, GAI recommends that instrumentation installations and monitoring of the Phase 3 embankment be performed prior to, during and following longwall mining beneath the Phase 3 impoundment including installing pore pressure transducers and inclinometers. Also, GAI recommends that detailed inspections of the embankment, cap, toe areas and outlet structures be performed two (2) times/days prior to, daily during, and daily following longwall mining beneath the Phase 3 impoundment for a period of two (2) weeks following completion of mining, and any deviations noted.

Further, GAI recommends that a CCR buttress or sealing layer remedial alternative, such as that proposed for the northern slope of the Phase 7 impoundment (Phase 7B) be designed, and construction implementation provisions made based on the results of the Phase 3 detailed inspections and instrumentation monitoring. If extensive cracking, seepage and/or other noticeable surface features are noted, and the magnitude of pore pressure and deformation are deemed potentially detrimental to the short- or long-term performance of the Phase 3 impoundment, then the implementation of the buttress/seal remedial alternative should be employed.

If the post-subsidence instrumentation monitoring and inspection results indicate that the Phase 3 embankment/impoundment distress is not a concern, i.e., no adverse cracking, seepage, excess pore pressure or deformation, then monitoring of the Phase 3 should continue twice a week for a period of two (2) months. If after an additional two (2) months of satisfactory monitoring results, and the embankment/impoundment continues to exhibit adequate performance characteristics, i.e., the magnitudes of pore pressure and deformation decrease, level off, or approach normal operating levels, and no increased seepage conditions or cracking exist, then monitoring of the Phase 3 embankment could be discontinued.

RESPONSE TO MSHA COMMENT NOS. 7 and 8

In accordance with this letter report, GAI has performed various analyses, prepared comment responses and provide pertinent figures, field and laboratory data, calculation briefs, etc. as appendices. To expedite further review, MSHA comments are presented below in **bold** type, followed by GAI's response.

COMMENT NO. 7: **Stability of Phase 7 South Slope**

The Phase 7 embankment will be founded on the impounded FCR from Phase 3 and therefore is the most critical stability analysis case. However, no stability analysis was furnished for this slope.

A stability analysis should be provided for a section through the Phase 7 and underlying Stage 3, using site-specific FCR strength parameters as requested in item No. 1 above. Because of the anticipated speed at which the Stage 7 embankment will be raised, analyses should be run for both the short-term end-of-construction and long-term steady-state conditions. Note that for loading of the consolidating, saturated FCR, appropriate undrained (phi=0) strength parameters should be used.

RESPONSE TO COMMENT NO.7:

Static slope stability analyses were performed for the Phase 7 South slope geometry (Phase 7C), which includes the underlying Phase 3 impoundment FCR. The short-term, end-of-construction analysis condition includes using effective strength parameters for the CCR, total undrained shear strengths for the residual soil, and zero (0) strength for the FCR. A "zero-strength" type analysis of the FCR, if stable, is considered the most conservative analysis because a true zero strength condition physically cannot occur. Some minimum strength, i.e.,

steady-state undrained exists even if the material is susceptible to a strength loss triggering event. Effective strength for CCR and total undrained strength for FCR and residual soil are utilized for the long-term, steady-state conditions stability analyses of the Phase 7C South slope geometry.

Soil properties, presented above in Response to Comment No. 3, were estimated based on previous field and laboratory testing and used in the appropriate static and liquefaction susceptibility slope stability analyses. Laboratory testing procedures and results are summarized in Appendix B and estimates of engineering properties are presented in Appendix C.

The results of the Phase 7C static slope stability analyses indicate the Phase 7C embankment and underlying Phase 3 impoundment geometry is stable under both short-term, end-of-construction and long-term, steady-state conditions. Utilizing conservative strength parameters for the various materials including "zero-strength" for FCR, the end-of-construction and steady-state static factors of safety are 1.6 and 1.8, respectively. Hard copies of the input and output files for the Phase 7C end-of-construction and long-term steady-state slope stability analyses are presented in Appendix F.

COMMENT NO. 8: **Seismic Stability of Phase 7 South Slope**

The fine refuse on which Phase 7 will be founded may be subject to triggering strength loss (liquefaction) under earthquake shaking.

An evaluation of the susceptibility of the fine refuse to strength loss under appropriate earthquake shaking should be performed, and if required, the post-seismic stability evaluated using estimate reduced post-seismic strengths. Alternatively, stability analyses can be performed using conservatively estimated post-earthquake strengths for the fine and coarse refuse. If a factor of safety of 1.20 or greater can be obtained with this conservative analysis, than (sic.) additional liquefaction analyses will not be needed.

RESPONSE TO COMMENT NO.8:

Liquefaction susceptibility of the proposed Phase 7C slope geometry and the FCR hydraulically placed beneath the Phase 7 CCR embankment depends on the strength of all the soils along the critical failure surface. Zones of loose (contractive) soils are critical to analyzing liquefaction potential since only loose soils can have an undrained strength that is significantly lower than their drained strength. For the purpose of this evaluation, a conservative, simplified approach was employed, and assumes the FCR will lose strength during an earthquake, which changes the condition from drained to undrained.

Liquefaction susceptibility was determined by evaluating the Phase 7C embankment and underlying Phase 3 FCR utilizing a zero-strength to very low strength approach for the FCR to evaluate the post-earthquake factors of safety. The post-earthquake analyses included using effective strength parameters for the CCR, total undrained shear strengths for the residual soil, and zero (0) strength for the FCR for a deep failure and 260 psf for a shallow failure. The 260 psf equates to Sus/σ'_v=0.05, far less than the site-specific laboratory testing Sus/σ'_v =0.24. Soil properties used in the post-earthquake slope stability analyses are summarized in Appendix C.

The results of the Phase 7C post-earthquake stability analyses indicate the Phase 7C embankment and underlying Phase 3 impoundment geometry is stable. Utilizing conservative strength parameters for the various materials including zero-strength to 260 psf for FCR, the post-earthquake factor of safety ranges from 1.2 to 1.6 for shallow and deep failure circles, respectively. Hard copies of the input and output files for the Phase 7C post-earthquake slope stability analyses are also presented in Appendix F.

Poulos, et al (1985) states a soil mass that is not susceptible to liquefaction physically cannot fail by liquefaction since the minimum undrained strength exceeds the in-situ driving shear stress along the critical failure surface. Permanent deformation analyses were not considered pertinent to the Phase 7C geometry since there is no impounded FCR or freeboard. Therefore, permanent deformation analyses were not performed.

GAI appreciates this opportunity to provide to Alliance specialized subsidence and seismic engineering services. Please do not hesitate to contact us if you have any questions concerning any of the information presented.

Respectfully submitted,
GAI CONSULTANTS, INC.

Blaise E. Genes
Manager of Geotechnical and Structural

BEG /tlg
0943001-ltr rpt-rtmc-beg/tlg D1

Attachments

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FIGURES

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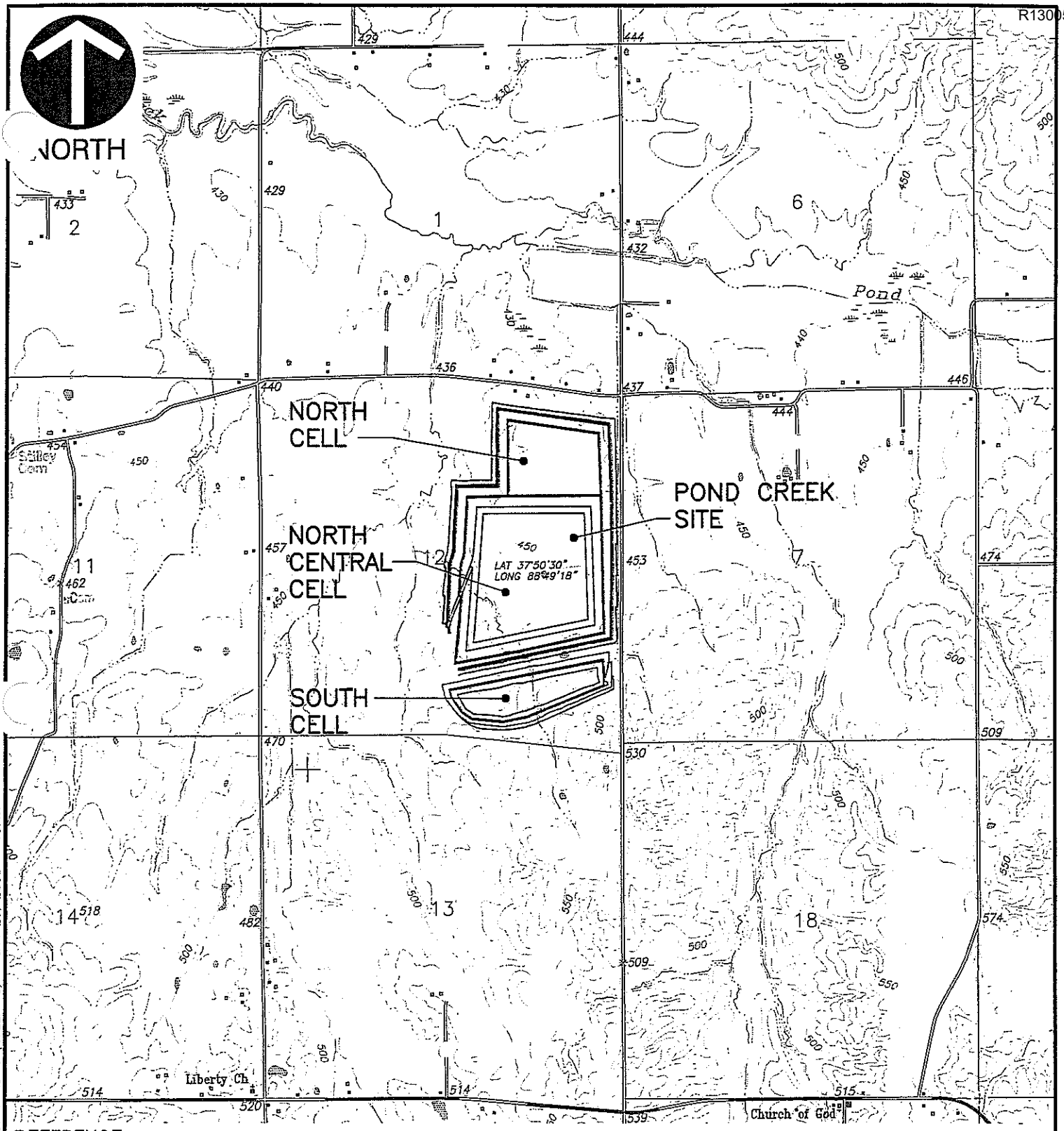

REFERENCE
U.S.G.S. 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAP OF PITTSBURG, IL
DATE: 1963

SCALE IN FEET
0 2000 4000

Civil & Environmental Consultants, Inc.
Four Triangle Lane, Suite 200, Export, PA 15632-9522
(724) 327-5200 · (800) 899-3610
...sburgh, PA
Cincinnati, OH
Columbus, OH
Indianapolis, IN
Nashville, TN
Chicago, IL
St. Louis, MO
Detroit, MI

SITE LOCATION MAP
POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY LLC.

QUALITY MANAGER APPROVAL:	BEG*	*HAND SIGNATURE ON FILE		PROJECT NO:	072-046	FIGURE NO:	1
DRAWN BY:	CAF	CHKD BY:	RJS	DWG SCALE:	1"=2000'	LAST EDIT DATE:	JAN. 21, 2008

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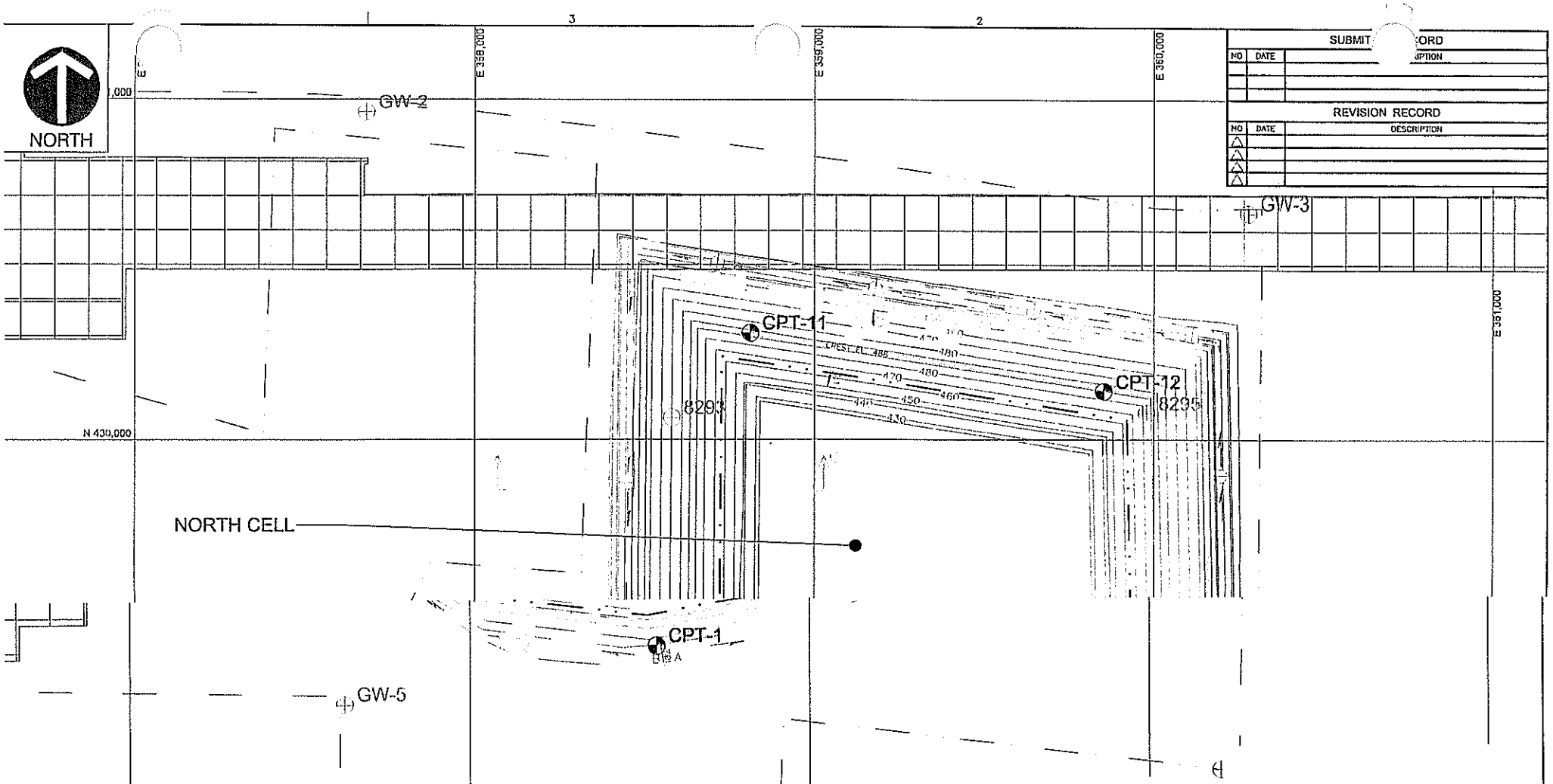

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

REVISION RECORD

NO	DATE	DESCRIPTION
1		
2		
3		
4		

CPT SOUNDING LOCATIONS

	NORTHING	EASTING	ELEVATION
CPT-1	425784.16	358546.87	482.19
CPT-2	426832.42	357857.50	494.21
CPT-2A	426828.92	358156.73	492.40
CPT-3	426792.78	359207.80	466.98
CPT-4	426331.10	360108.80	482.55
CPT-5	427485.26	357913.86	482.55
CPT-5A	427007.60	357920.84	463.00
CPT-6	427450.46	358992.62	457.78
CPT-7	427450.88	359850.00	457.83
CPT-8	429006.12	358034.04	444.95
CPT-9	429077.69	359026.20	445.88
CPT-10	428965.83	359998.45	442.09
CPT-11	430316.82	358810.96	440.59
CPT-12	430141.83	359852.30	442.08

PREVIOUS BORING / WELL LOCATIONS

	NORTHING	EASTING
GW-6	425414.53	360201.23
GW-5	425606.61	357626.97
8299	426148.35	358205.38
8298	425471.27	359601.55
GW-1A	427584.82	358263.84
8294	426248.64	358131.20
8074	426255.58	358150.19
8297	426029.69	359955.38
8293	430064.93	358579.92
8295	430077.80	359979.43

NOTES

1. SITE LAYOUT PROVIDED BY ALLIANCE CONSULTING INC.
2. CPT SOUNDING AND PREVIOUS BORING/WELL LOCATIONS AND ELEVATIONS PROVIDED BY WILLIAMSON ENERGY LLC.
3. REFER TO FIGURE 3 FOR REVISED PSEUDO-STATIC (PGA=0.54g) AND YIELD ACCELERATION SLOPE STABILITY ANALYSES RESULTS FOR CROSS SECTION A-A.

LEGEND

8874 — PREVIOUS BORINGS (BY OTHERS)

GW-6 — PREVIOUS WELLS (BY OTHERS)

CPT-3 — CPT SOUNDING LOCATIONS (OCT. 2007)

SCALE IN FEET
0 200 400

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☐ Design Dev. ☐ Bidding ☐ -

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POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY LLC.

QUALITY MANAGER APPROVAL:	* HAND SIGNATURE ON FILE		BEG*
LAST EDIT DATE:	JAN. 22, 2008	DWG SCALE:	1"=200'
DRAWN BY: CAF	CHECKED BY: RJS	PROJECT NO:	072-046
		SHEET NO OF NO	

CPT SOUNDING LOCATION PLAN

DWG NO.: FIG. 2 REV 0

APPENDIX A

PREDICTION OF GROUND MOVEMENT PARAMETERS DUE TO LONGWALL MINING DURING DIFFERENT PHASES OF IMPOUNDMENTS

BY SYD S. PENG, ANIL RAY AND THOMAS DU
DEPARTMENT OF MINING ENGINEERING, WEST VIRGINIA UNIVERSITY

MARCH 2008

SUBMITTED TO AND PROVIDED BY ALLIANCE CONSULTING, INC.

Prediction of Ground Movement Parameters due to Longwall Mining During different Phases of Impoundments

A report
submitted to

Alliance Consulting, Inc.

by

Syd S. Peng, Charles E. Lawall Chair of Mining Engineering
Anil Ray, Graduate Research Assistant
Thomas Du, Graduate Research Assistant

Department of Mining Engineering
West Virginia University
March 2008

1.0 INTRODUCTION

The Williamson Energy has proposed construction of four impoundments over the longwall panels located near the end of the panels. These four impoundments will be constructed and used during different phase with respect to longwall mining. The phase sequences for these impoundments are given in Figure 1. The phase 2 and 3 impoundment (impoundment 1 and 2) constructions are over panel 3 and 4. The impoundments 3 and 4 are over longwall panel 2 and 1, respectively.

From the information and details of different phase provided in Figure 1, it is obvious that phase 2 and 3 will be completed much before the longwall mining, i.e. over virgin area. In relation to longwall mining retreat, only in phase 5, the longwall retreat will be done towards the end of longwall panel 1, prior to any impoundment construction over it. During Phase 4 and 6, the longwall retreat will be at the end of panel 2.

The objective of this study is to predict the ground movement parameters associated with longwall mining in different phase of impoundments. To predict these parameters, the subsidence prediction program CISPM version 2.01 developed by the senior author [1] has been used.

The input parameter for this software has been used from our earlier report [2].

2.0 Longwall Panels Parameters

Figure 1 shows the location of impoundments and longwall panels 1 to 4. The gateroads of the longwall panels are orientated towards east-west direction. Table 1 shows the mining conditions for the four longwall panels over which impoundment will be constructed. The panel widths are 1,250 for the first two longwall panels and 1,400 ft for the third and fourth longwall panel. The width of chain pillar /gateroad system is 220 ft for all the panels.

A cross section 'A-A' (Figure 1) parallel to the longwall panel width and in center of the impoundment has been considered to predict the subsidence parameters. Table 1 shows the longwall panel parameters.

Table 1 Longwall panels parameters

Panel No.	Panel Length, ft	Panel Width, ft	Overburden Depth, ft			Mining Height, ft		
			Max.	Min.	Average	Max.	Min.	Average
Panel 1	17,200	1,250	498	470	482	5.8	5.8	5.8
Panel 2	17,200	1,250	522	486	501	5.8	5.8	5.8
Panel 3	17,200	1,400	522	490	506	5.8	5.8	5.8
Panel 4	18,000	1,400	504	464	475	6.0	6.0	6.0

3.0 Prediction of Final Subsidence Parameters

In order to estimate the ground movement parameters associated with longwall mining over the surface where impoundments are located, a local coordinate system has been selected with origin (0, 0) at the right edge of 1st longwall panel gateroad system (Figure 1). The X-axis is parallel to the mining direction and the distance is measured from the setup room. The Y-axis is along the panel width direction or along section A-A.

The prediction of surface subsidence and subsidence parameters due to mining on the surface has been done at a distance of 20 ft across the panel width. The total width along the cross section A-A is 6,360 ft covering all four longwall panels and gateroad systems. The prediction points along the cross section A-A are shown in Figure 1.

The final surface movements and deformations along the cross-section AA have been predicted using the subsidence prediction program CISPM version 2.01. Average mining parameters of longwall panels (Table 1) were used for this subsidence prediction.

3.1 Subsidence Parameters during Phase 2 and 3

The predicted final subsidence profile across the impoundments after phase 2 and 3 and before phase 5 is shown in Figures 2. Since there is no longwall workings below phase 2 and 3 before phase 2 and 3 gets eliminated, no ground movement effect will be observed during phase 2 and 3 period.

3.2 Subsidence Parameters during Phase 4

Phase 4 will be built before completion of longwall retreat in panel 1. So during construction it won't be influenced by mining induced subsidence.

3.3 Subsidence Parameters during Phase 5

Before Phase 5 construction starts, the surface will experience mining induced ground movements. The subsidence, horizontal displacement, slopes and horizontal strain profiles are shown in Figure 2, 3, 4, and 5.

1.15% STRAIN

The maximum subsidence may be 3.87 ft at the center of the panel with a flat bottom. The predicted value of maximum horizontal displacement, slopes and horizontal strain are 1.27 ft, 2.37% and 11.5×10^{-3} ft/ft, respectively.

3.4 Subsidence Parameters during 6 Phase

During Phase 4 and 6 the longwall retreat will be below the impoundments in panel 2. Hence it may be affected by the mining induced subsidence and other ground movement parameters. During Phase 4 and 6 the final subsidence parameters are shown in Figures 6, 7, 8 and 9.

The Final subsidence parameters after mining all four longwall panels are given in Appendix 1.

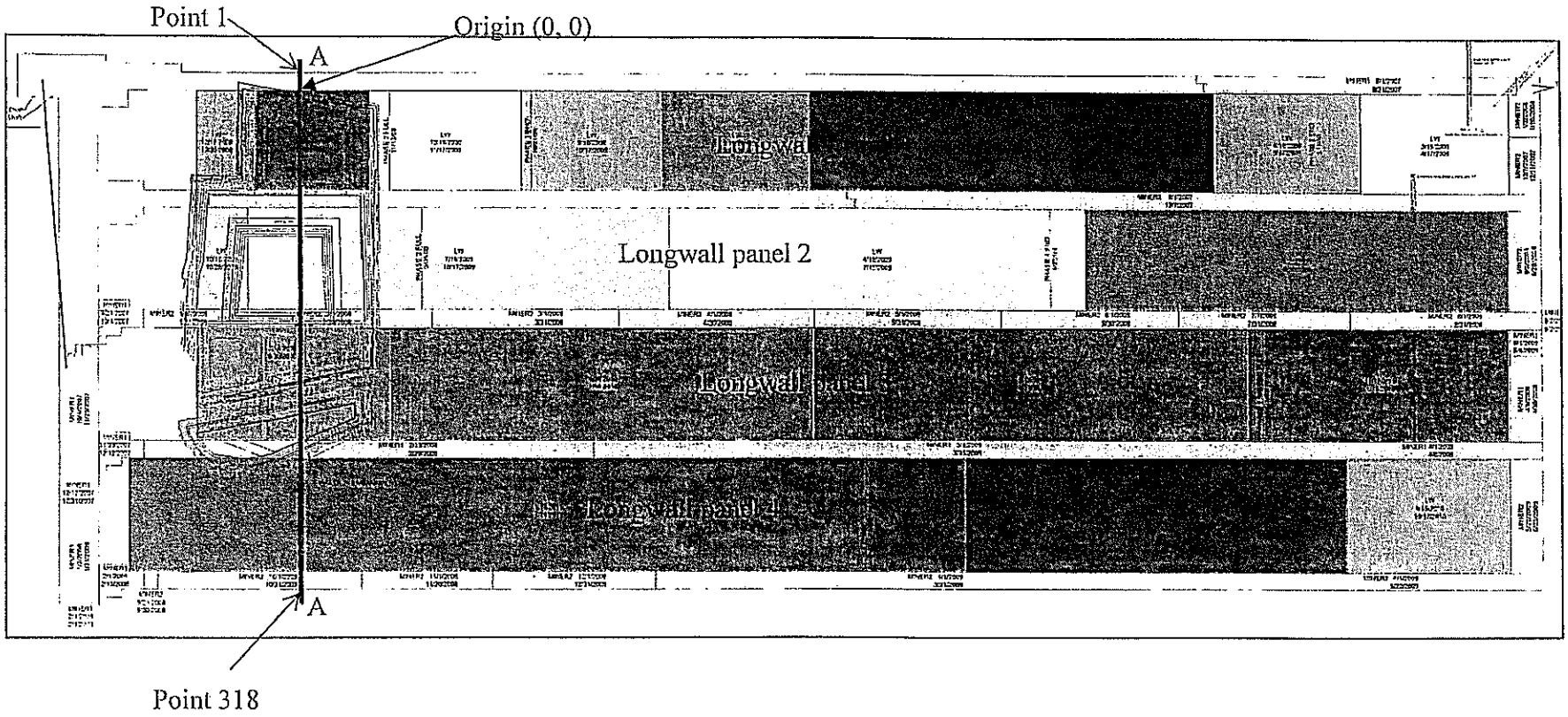


Figure 1 Plan showing cross section A-A across the longwall panels along with origin and first and last prediction points on the cross section

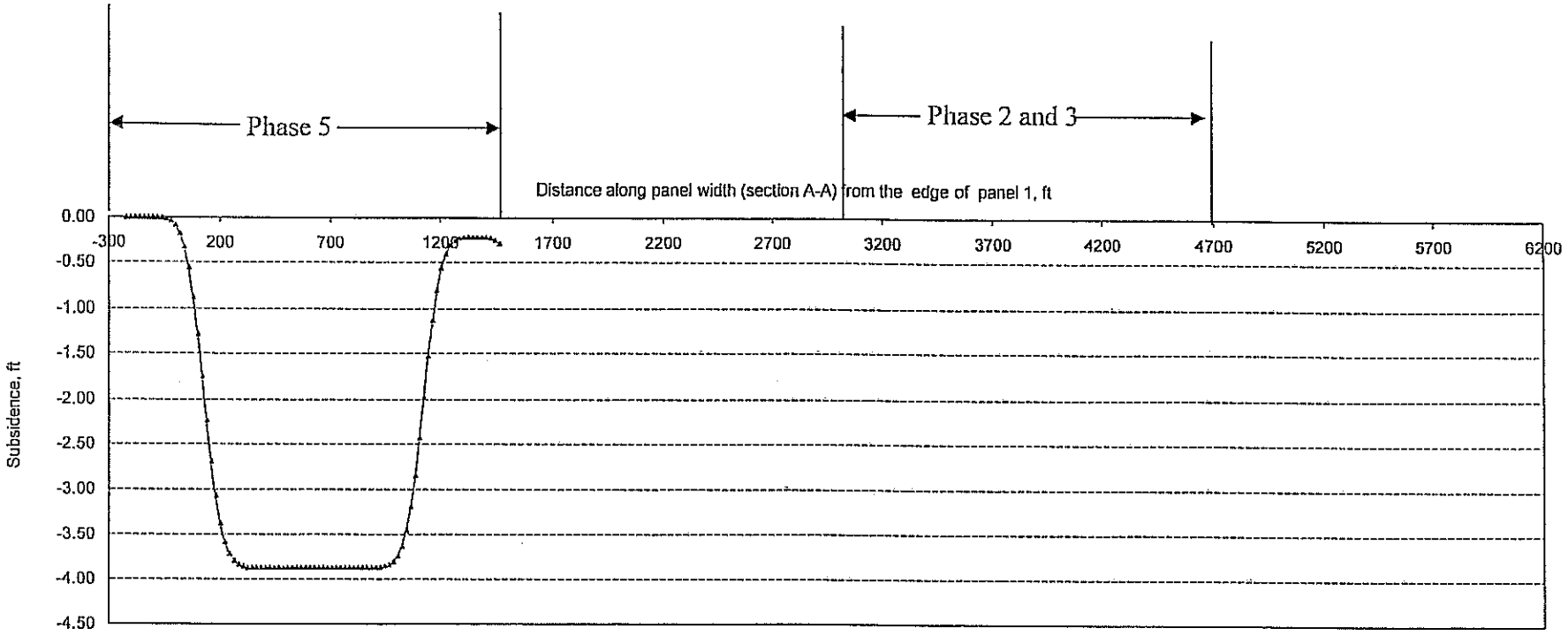


Figure 2 Subsidence profile after phase 2 and 3 and before phase 5(No longwall mining below phase 2 workings)

R13012

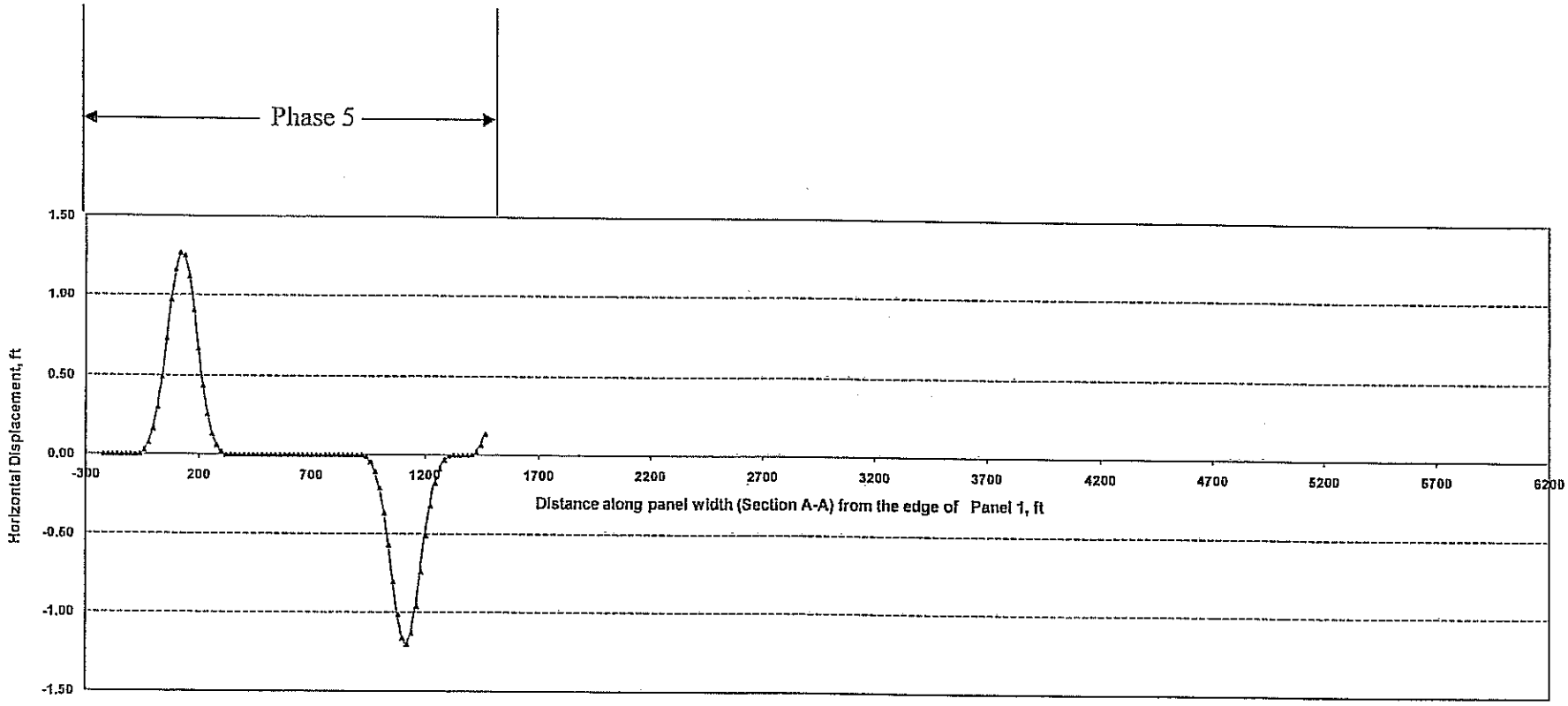


Figure 3 Horizontal distance profile before phase 5 begins

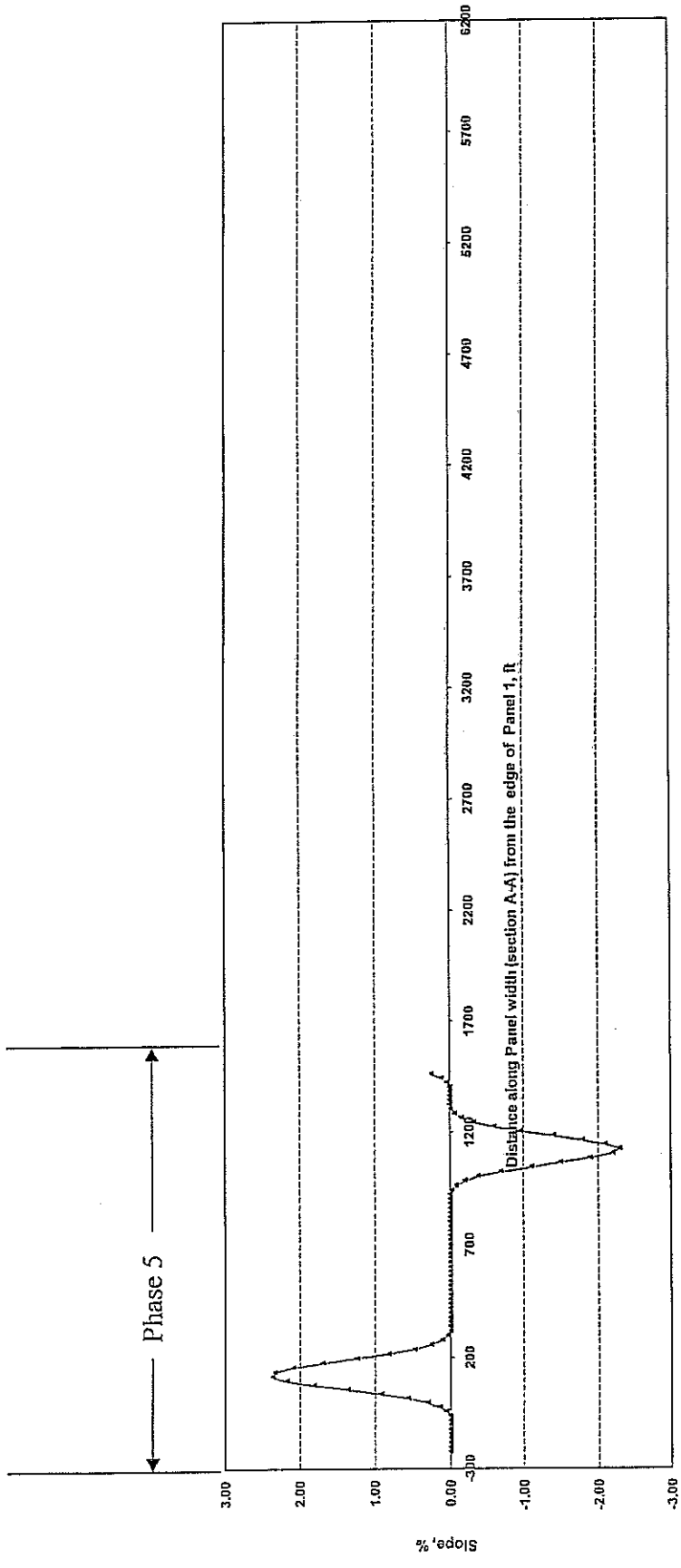


Figure 4 Slope profile before phase 5 begins

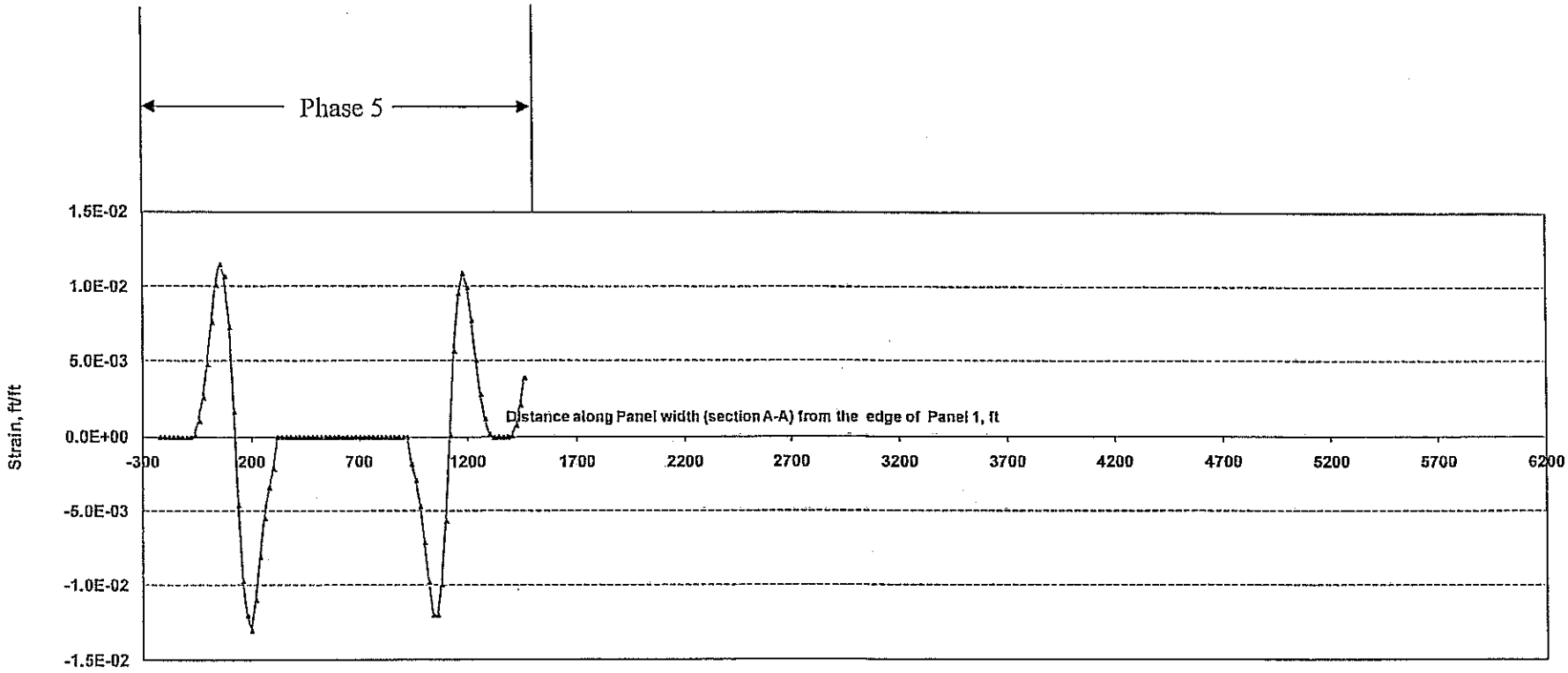


Figure 5 Horizontal strain profile before phase 5 begins

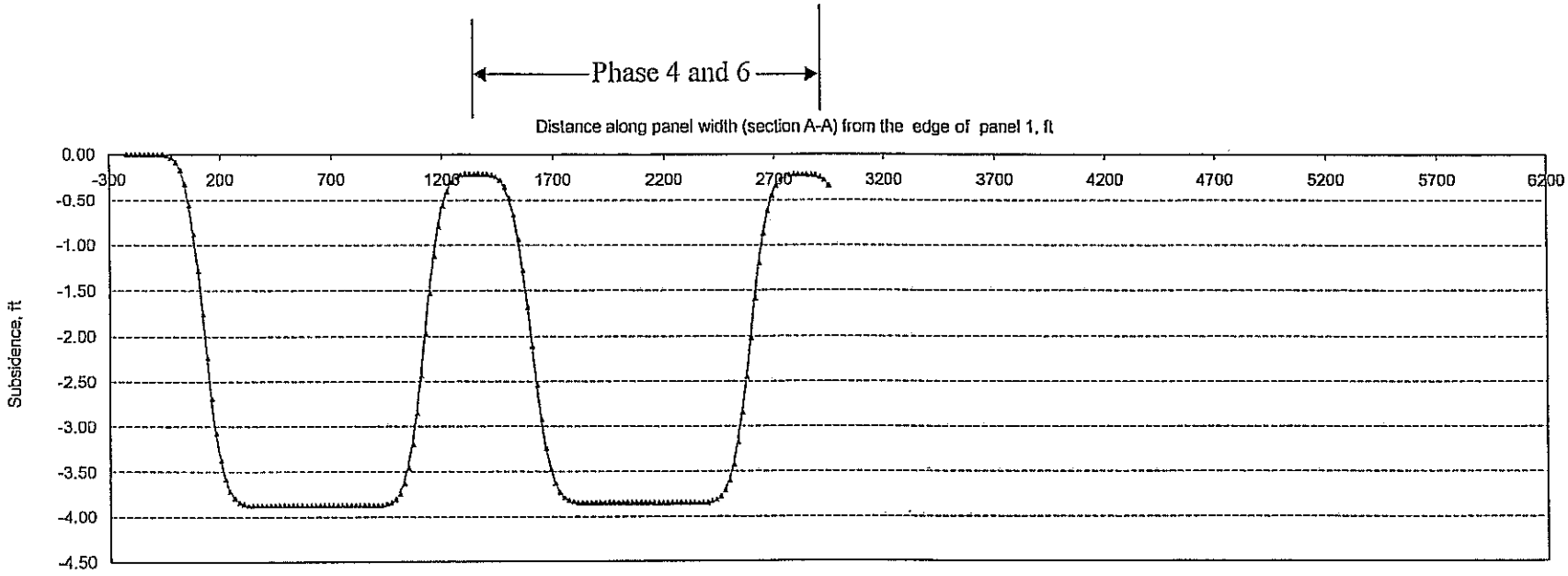


Figure 6 Subsidence profile during phase 4 and 6

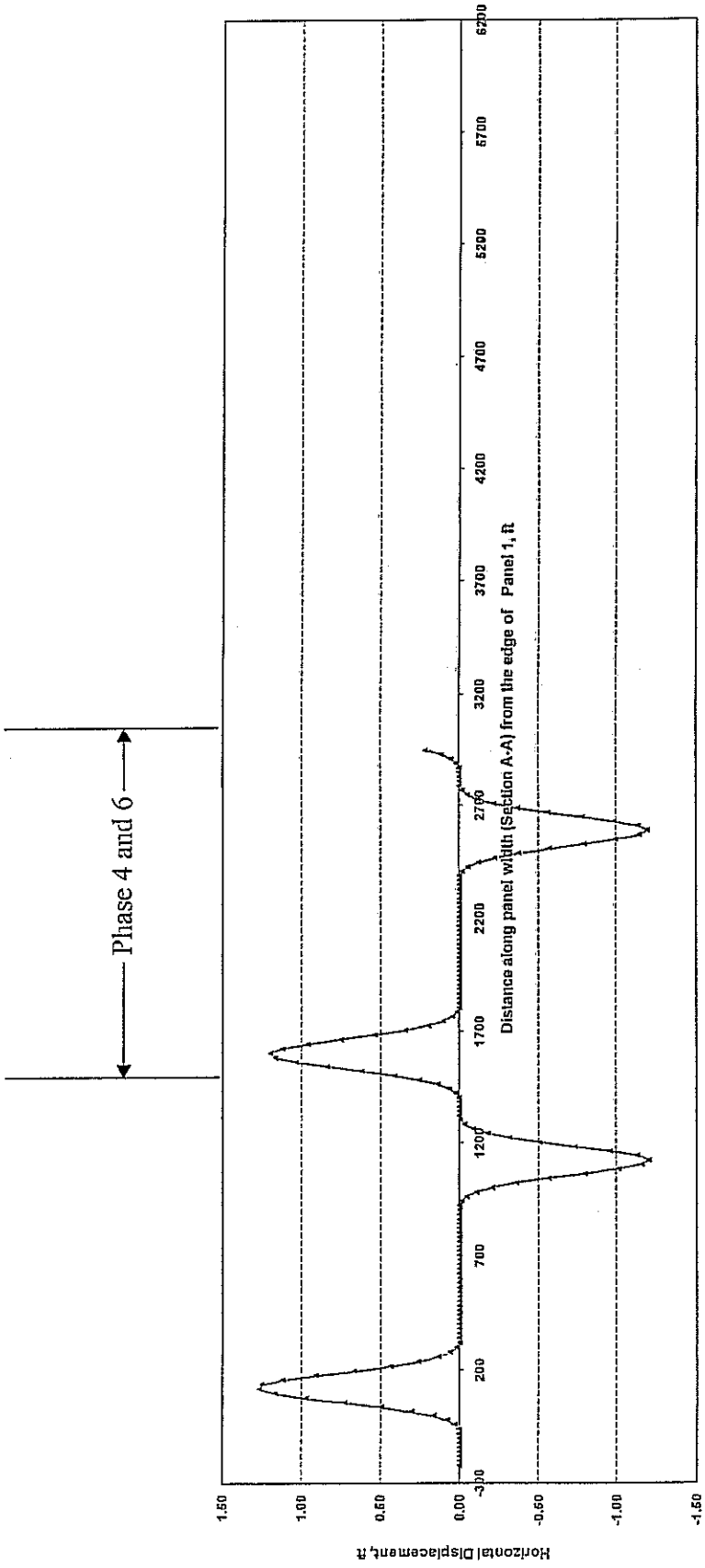


Figure 7 Horizontal displacement profile during phase 4 and 6

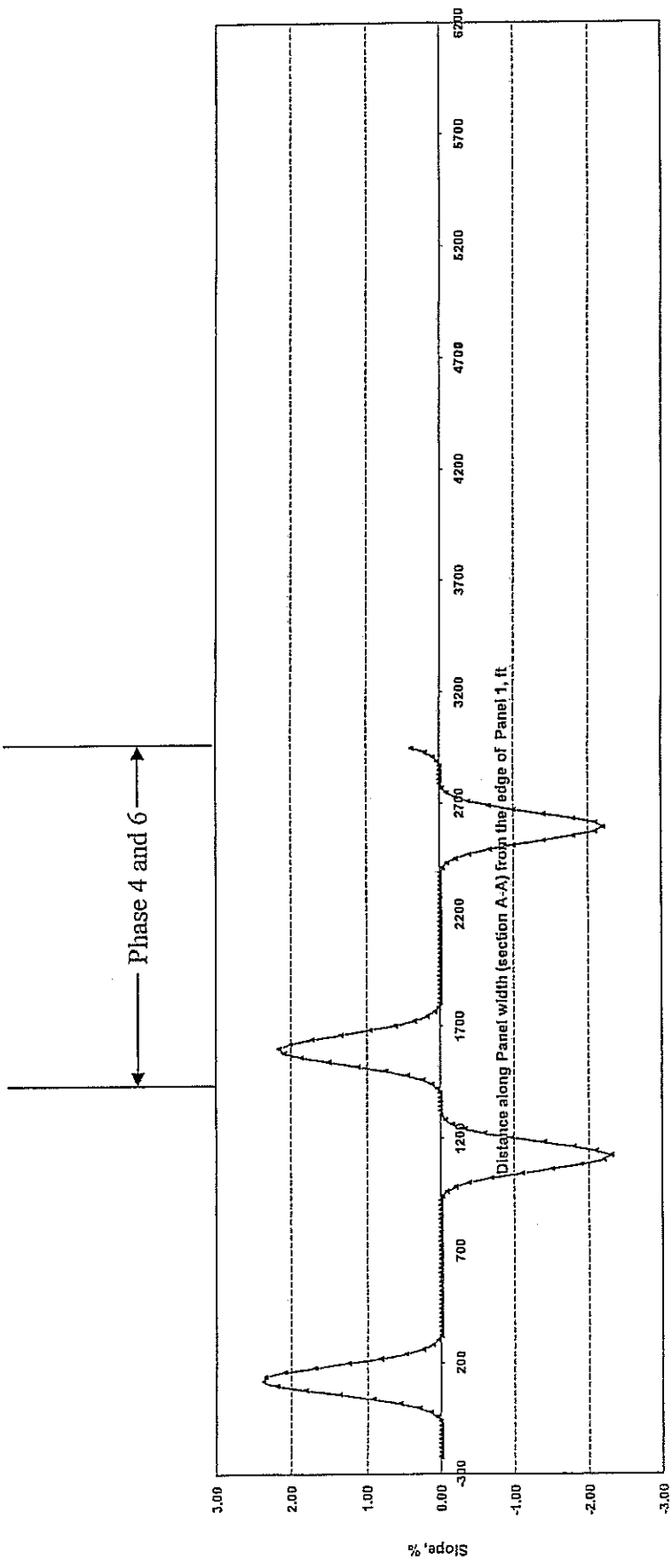


Figure 8 Slope profile during phase 4 and 6

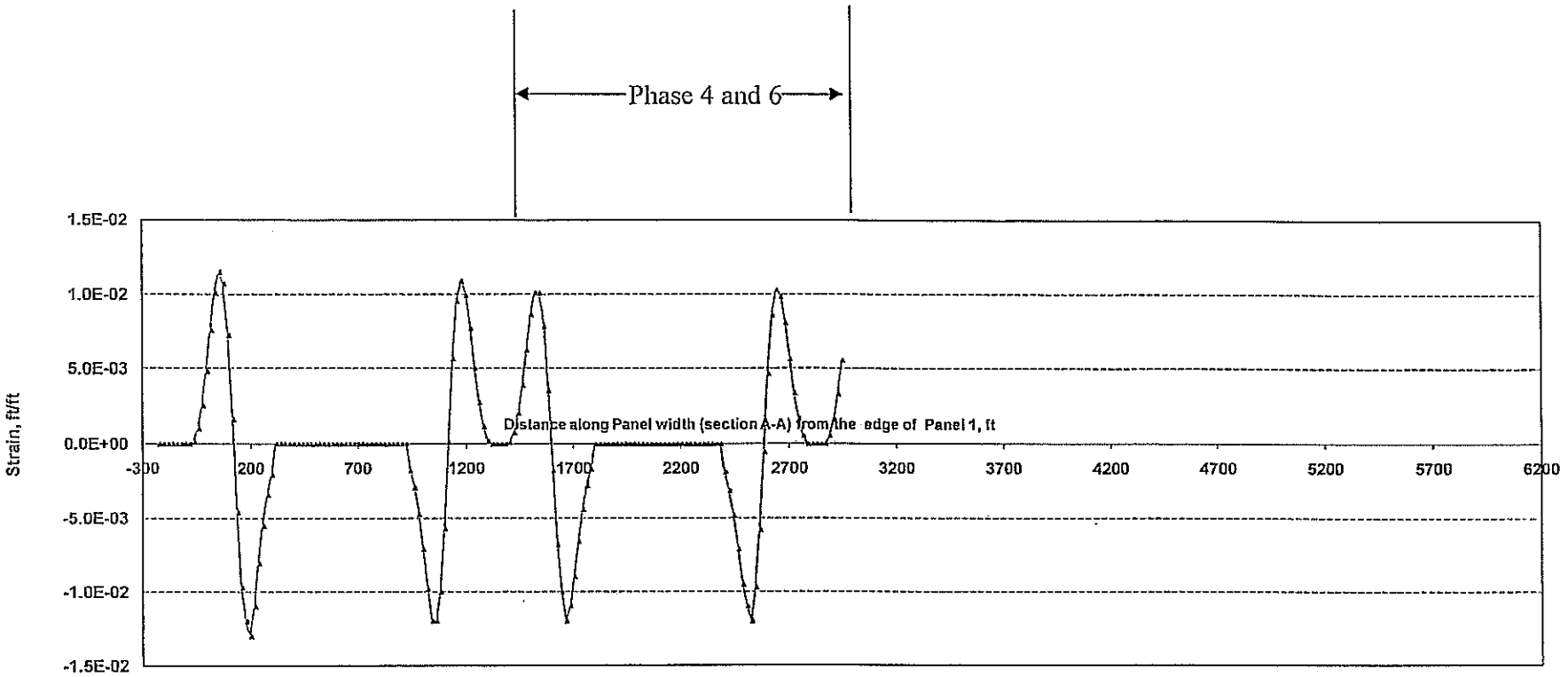


Figure 9 Horizontal strain profile during phase 4 and 6

4.0 Time Required to Attain Majority of Final Subsidence Parameters

From the past field experience, the final subsidence at any points/cross section takes place after 2 to 3 weeks of longwall face passing. Further the final subsidence also depends upon the face retreat rate.

The dynamic subsidence prediction has been performed for three face retreat rate 60, 80 and 100 ft/day [2] as shown in figure 10.

There is 0.06 inch of subsidence when the longwall face is directly under the point of interest. Thereafter, the subsidence process accelerates and reaches about one half of its final amount when the face is about 200 ft passed the point of interest. During this phase of time, the subsidence process is most active. A deceleration process is followed. The ground surface re-establishes the stable condition in vertical direction when the face has passed the point of interest a distance about 500 ft. Figure 10 also shows that a slower advance rate induces a steeper subsidence development curve. However, the differences between the subsidence development curves are not significant for the range of high face advance rates used in the dynamic subsidence predictions.

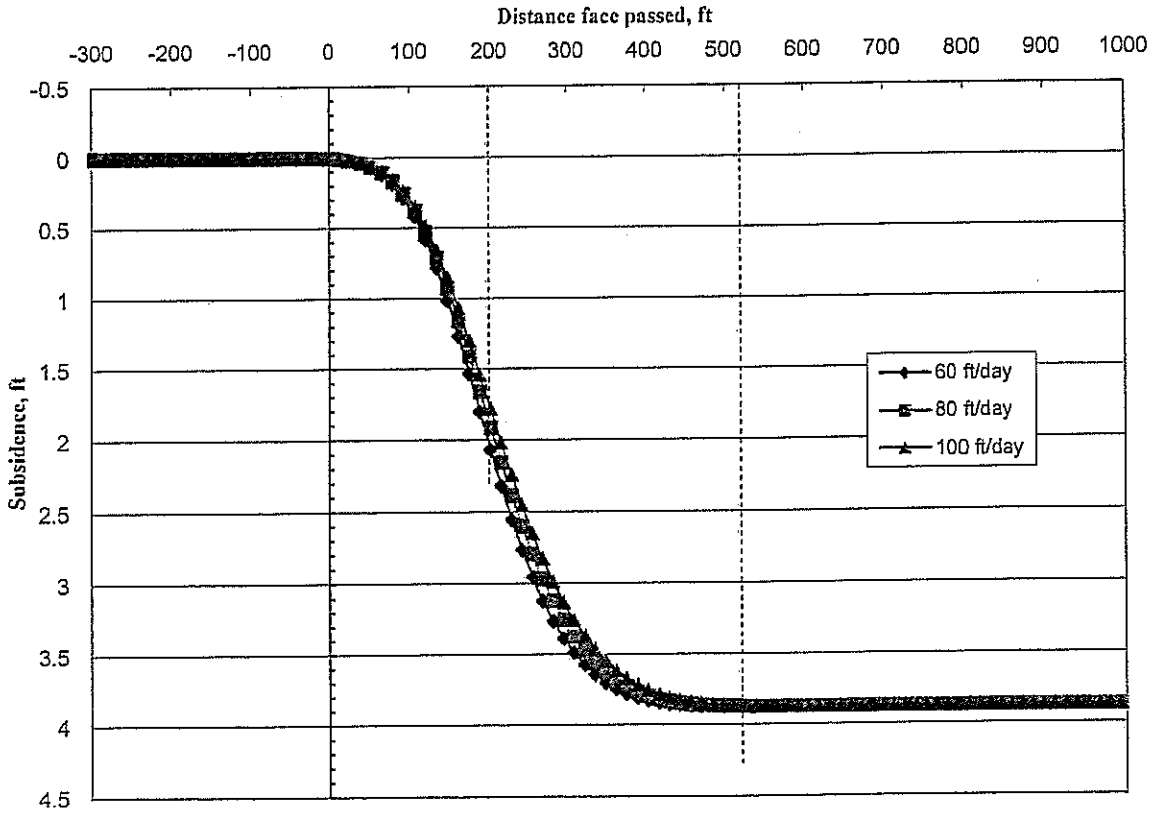


Figure 10 Predicted Dynamic Subsidence Development Curves

Based on dynamic subsidence prediction for a face retreat of 60 ft/day, more than 10 working days will be sufficient to attain the dynamic subsidence almost equal to the final subsidence value. Hence 2 weeks can be on the safer side.

5.0 Reference

1. S.S. Peng and Y Luo, Instruction Manual for CISPM software for Subsidence prediction

2. S.S. Peng, Khaled Morsey, Anil Ray and Thomas Du, "Assessment of Subsidence Influence on Buried Pipelines due to Longwall Mining" Williamson Energy, Johnson City, IL, July 2007

Appendix 1

Final subsidence parameters along cross section A-A after mining all four longwall panels (note -the distance is measured from the right edge of panel1)

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
1	-220	0	0	0	0.00E+00	0.00E+00
2	-200	0	0	0	0.00E+00	0.00E+00
3	-180	0	0	0	0.00E+00	0.00E+00
4	-160	0	0	0	0.00E+00	0.00E+00
5	-140	0	0	0	0.00E+00	0.00E+00
6	-120	0	0	0	0.00E+00	0.00E+00
7	-100	0	0	0	0.00E+00	0.00E+00
8	-80	0	0	0	0.00E+00	0.00E+00
9	-59	0	0	0	0.00E+00	0.00E+00
10	-39	0.00	0.00	0.01	1.22E-04	2.03E-06
11	-19	0.01	0.02	0.04	8.11E-04	1.35E-05
12	1	0.03	0.06	0.10	1.94E-03	3.23E-05
13	21	0.06	0.11	0.21	3.57E-03	5.96E-05
14	41	0.13	0.21	0.39	5.64E-03	9.41E-05
15	61	0.23	0.34	0.63	7.84E-03	1.31E-04
16	81	0.40	0.51	0.95	9.62E-03	1.60E-04
17	101	0.63	0.70	1.30	1.03E-02	1.72E-04
18	121	0.93	0.88	1.65	9.27E-03	1.55E-04
19	141	1.29	1.04	1.94	6.38E-03	1.06E-04
20	161	1.71	1.12	2.10	2.00E-03	3.34E-05
21	181	2.14	1.13	2.11	-3.00E-03	-4.90E-05
22	201	2.55	1.04	1.95	-7.40E-03	-1.20E-04
23	221	2.92	0.89	1.67	-1.00E-02	-1.70E-04
24	241	3.22	0.70	1.32	-1.10E-02	-1.90E-04
25	262	3.46	0.51	0.96	-1.10E-02	-1.80E-04
26	282	3.62	0.34	0.65	-9.10E-03	-1.50E-04
27	302	3.73	0.21	0.40	-6.90E-03	-1.20E-04
28	322	3.79	0.12	0.22	-4.80E-03	-8.10E-05
29	342	3.83	0.06	0.11	-3.20E-03	-5.30E-05
30	362	3.85	0.02	0.04	-2.00E-03	-3.40E-05
31	382	3.86	0.00	0.01	-1.30E-03	-2.20E-05
32	402	3.87	0.00	0.00	0.00E+00	0.00E+00
33	422	3.87	0.00	0.00	0.00E+00	0.00E+00
34	442	3.87	0.00	0.00	0.00E+00	0.00E+00
35	462	3.87	0.00	0.00	0.00E+00	0.00E+00
36	482	3.87	0.00	0.00	0.00E+00	0.00E+00
37	502	3.87	0.00	0.00	0.00E+00	0.00E+00
38	522	3.87	0.00	0.00	0.00E+00	0.00E+00
39	542	3.87	0.00	0.00	0.00E+00	0.00E+00
40	562	3.87	0.00	0.00	0.00E+00	0.00E+00
41	583	3.87	0.00	0.00	0.00E+00	0.00E+00
42	603	3.87	0.00	0.00	0.00E+00	0.00E+00

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
43	623	3.87	0.00	0.00	0.00E+00	0.00E+00
44	643	3.87	0.00	0.00	0.00E+00	0.00E+00
45	663	3.87	0.00	0.00	0.00E+00	0.00E+00
46	683	3.87	0.00	0.00	0.00E+00	0.00E+00
47	703	3.87	0.00	0.00	0.00E+00	0.00E+00
48	723	3.87	0.00	0.00	0.00E+00	0.00E+00
49	743	3.87	0.00	0.00	0.00E+00	0.00E+00
50	763	3.87	0.00	0.00	0.00E+00	0.00E+00
51	783	3.87	0.00	0.00	0.00E+00	0.00E+00
52	803	3.87	0.00	0.00	0.00E+00	0.00E+00
53	823	3.87	0.00	0.00	0.00E+00	0.00E+00
54	843	3.87	0.00	0.00	0.00E+00	0.00E+00
55	863	3.87	0.00	0.00	0.00E+00	0.00E+00
56	883	3.87	0.00	0.00	0.00E+00	0.00E+00
57	904	3.87	0.00	0.00	0.00E+00	0.00E+00
58	924	3.87	0.00	0.00	0.00E+00	0.00E+00
59	944	3.87	0.00	0.00	0.00E+00	0.00E+00
60	964	3.87	0.00	0.00	0.00E+00	0.00E+00
61	984	3.87	0.00	0.00	0.00E+00	0.00E+00
62	1004	3.87	0.00	0.00	0.00E+00	0.00E+00
63	1024	3.87	0.00	0.00	0.00E+00	0.00E+00
64	1044	3.87	0.00	0.00	0.00E+00	0.00E+00
65	1064	3.87	0.00	0.00	0.00E+00	0.00E+00
66	1084	3.86	-0.01	-0.01	-1.50E-03	-2.50E-05
67	1104	3.85	-0.03	-0.06	-2.30E-03	-3.80E-05
68	1124	3.82	-0.07	-0.13	-3.50E-03	-5.80E-05
69	1144	3.78	-0.14	-0.25	-5.20E-03	-8.70E-05
70	1164	3.71	-0.23	-0.44	-7.30E-03	-1.20E-04
71	1184	3.59	-0.37	-0.70	-9.30E-03	-1.50E-04
72	1204	3.42	-0.54	-1.00	-1.10E-02	-1.80E-04
73	1225	3.18	-0.72	-1.40	-1.10E-02	-1.80E-04
74	1245	2.87	-0.89	-1.70	-9.10E-03	-1.50E-04
75	1265	2.50	-1.02	-1.90	-5.80E-03	-9.70E-05
76	1285	2.10	-1.07	-2.00	-1.40E-03	-2.30E-05
77	1305	1.70	-1.04	-2.00	3.24E-03	5.42E-05
78	1325	1.32	-0.94	-1.80	7.01E-03	1.17E-04
79	1345	0.99	-0.78	-1.50	9.20E-03	1.54E-04
80	1365	0.73	-0.60	-1.10	9.61E-03	1.60E-04
81	1385	0.53	-0.42	-0.79	8.58E-03	1.43E-04
82	1405	0.40	-0.28	-0.52	6.70E-03	1.12E-04
83	1425	0.31	-0.16	-0.31	4.61E-03	7.69E-05
84	1445	0.26	-0.09	-0.16	2.76E-03	4.61E-05
85	1465	0.24	-0.04	-0.07	1.37E-03	2.29E-05
86	1485	0.22	-0.01	-0.02	4.50E-04	7.53E-06
87	1505	0.22	0.00	0.00	-6.80E-05	-1.10E-06
88	1525	0.22	0.00	0.00	0.00E+00	0.00E+00

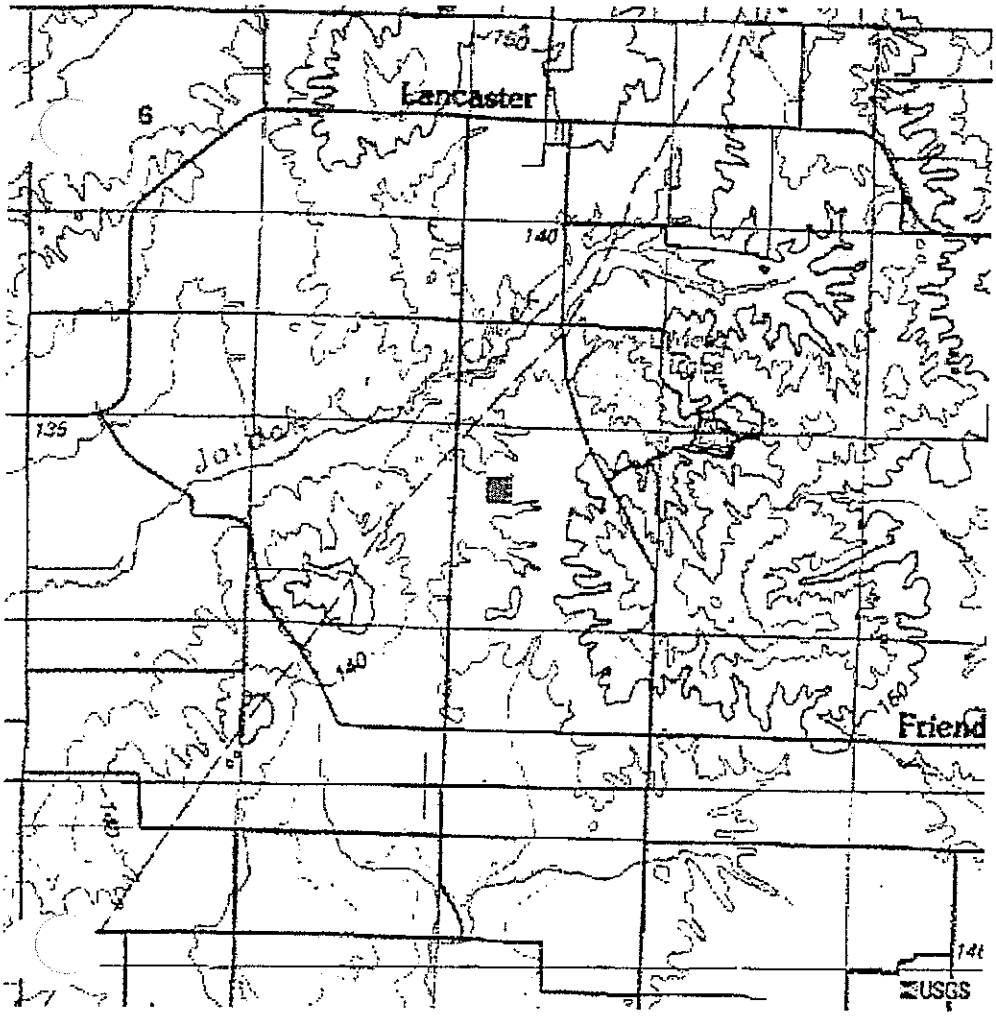
Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
89	1546	0.22	0.00	0.00	0.00E+00	0.00E+00
90	1566	0.22	0.00	0.00	0.00E+00	0.00E+00
91	1586	0.22	0.00	0.00	0.00E+00	0.00E+00
92	1606	0.22	0.00	0.01	4.63E-05	7.23E-07
93	1626	0.22	0.02	0.03	6.37E-04	1.02E-05
94	1646	0.24	0.05	0.09	1.59E-03	2.54E-05
95	1666	0.27	0.10	0.18	2.96E-03	4.75E-05
96	1686	0.32	0.18	0.32	4.72E-03	7.56E-05
97	1706	0.41	0.29	0.52	6.64E-03	1.06E-04
98	1726	0.55	0.44	0.78	8.30E-03	1.33E-04
99	1746	0.74	0.60	1.08	9.18E-03	1.47E-04
100	1766	0.99	0.78	1.40	8.76E-03	1.40E-04
101	1786	1.30	0.93	1.67	6.78E-03	1.09E-04
102	1806	1.66	1.03	1.85	3.39E-03	5.43E-05
103	1826	2.05	1.06	1.92	-8.20E-04	-1.30E-05
104	1846	2.43	1.02	1.84	-5.00E-03	-8.00E-05
105	1867	2.78	0.91	1.64	-8.20E-03	-1.30E-04
106	1887	3.09	0.76	1.36	-1.00E-02	-1.60E-04
107	1907	3.34	0.59	1.05	-1.00E-02	-1.70E-04
108	1927	3.52	0.42	0.75	-9.30E-03	-1.50E-04
109	1947	3.65	0.28	0.50	-7.60E-03	-1.20E-04
110	1967	3.73	0.17	0.30	-5.70E-03	-9.10E-05
111	1987	3.79	0.09	0.17	-4.00E-03	-6.40E-05
112	2007	3.81	0.05	0.08	-2.70E-03	-4.30E-05
113	2027	3.83	0.02	0.03	-1.70E-03	-2.80E-05
114	2047	3.84	0.00	0.00	-1.20E-03	-1.90E-05
115	2067	3.85	0.00	0.00	0.00E+00	0.00E+00
116	2087	3.85	0.00	0.00	0.00E+00	0.00E+00
117	2107	3.85	0.00	0.00	0.00E+00	0.00E+00
118	2127	3.85	0.00	0.00	0.00E+00	0.00E+00
119	2147	3.85	0.00	0.00	0.00E+00	0.00E+00
120	2168	3.85	0.00	0.00	0.00E+00	0.00E+00
121	2188	3.85	0.00	0.00	0.00E+00	0.00E+00
122	2208	3.85	0.00	0.00	0.00E+00	0.00E+00
123	2228	3.85	0.00	0.00	0.00E+00	0.00E+00
124	2248	3.85	0.00	0.00	0.00E+00	0.00E+00
125	2268	3.85	0.00	0.00	0.00E+00	0.00E+00
126	2288	3.85	0.00	0.00	0.00E+00	0.00E+00
127	2308	3.85	0.00	0.00	0.00E+00	0.00E+00
128	2328	3.85	0.00	0.00	0.00E+00	0.00E+00
129	2348	3.85	0.00	0.00	0.00E+00	0.00E+00
130	2368	3.85	0.00	0.00	0.00E+00	0.00E+00
131	2388	3.85	0.00	0.00	0.00E+00	0.00E+00
132	2408	3.85	0.00	0.00	0.00E+00	0.00E+00
133	2428	3.85	0.00	0.00	0.00E+00	0.00E+00
134	2448	3.85	0.00	0.00	0.00E+00	0.00E+00

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
135	2468	3.85	0.00	0.00	0.00E+00	0.00E+00
136	2489	3.85	0.00	0.00	0.00E+00	0.00E+00
137	2509	3.85	0.00	0.00	0.00E+00	0.00E+00
138	2529	3.85	0.00	0.00	0.00E+00	0.00E+00
139	2549	3.85	0.00	0.00	0.00E+00	0.00E+00
140	2569	3.85	0.00	0.00	0.00E+00	0.00E+00
141	2589	3.85	0.00	0.00	0.00E+00	0.00E+00
142	2609	3.85	0.00	0.00	0.00E+00	0.00E+00
143	2629	3.85	0.00	0.00	0.00E+00	0.00E+00
144	2649	3.85	0.00	0.00	0.00E+00	0.00E+00
145	2669	3.85	0.00	0.00	0.00E+00	0.00E+00
146	2689	3.85	0.00	0.00	0.00E+00	0.00E+00
147	2709	3.85	0.00	0.00	6.96E-07	1.11E-08
148	2729	3.83	-0.01	-0.02	-1.60E-03	-2.60E-05
149	2749	3.82	-0.04	-0.07	-2.40E-03	-3.90E-05
150	2769	3.79	-0.08	-0.15	-3.70E-03	-5.90E-05
151	2789	3.75	-0.15	-0.27	-5.40E-03	-8.60E-05
152	2810	3.67	-0.25	-0.46	-7.30E-03	-1.20E-04
153	2830	3.55	-0.39	-0.70	-9.10E-03	-1.50E-04
154	2850	3.38	-0.55	-0.99	-1.00E-02	-1.60E-04
155	2870	3.14	-0.73	-1.30	-1.00E-02	-1.60E-04
156	2890	2.85	-0.89	-1.60	-8.70E-03	-1.40E-04
157	2910	2.50	-1.01	-1.80	-5.60E-03	-9.10E-05
158	2930	2.12	-1.06	-1.90	-1.60E-03	-2.60E-05
159	2950	1.73	-1.04	-1.90	2.68E-03	4.29E-05
160	2970	1.37	-0.95	-1.70	6.27E-03	1.01E-04
161	2990	1.05	-0.80	-1.40	8.52E-03	1.37E-04
162	3010	0.78	-0.63	-1.10	9.21E-03	1.48E-04
163	3030	0.58	-0.46	-0.83	8.52E-03	1.37E-04
164	3050	0.44	-0.31	-0.56	6.95E-03	1.11E-04
165	3070	0.34	-0.19	-0.35	5.04E-03	8.08E-05
166	3090	0.28	-0.11	-0.20	3.23E-03	5.19E-05
167	3110	0.25	-0.06	-0.10	1.79E-03	2.87E-05
168	3131	0.23	-0.02	-0.04	7.66E-04	1.23E-05
169	3151	0.22	-0.01	-0.01	1.22E-04	1.97E-06
170	3171	0.22	0.00	0.00	0.00E+00	0.00E+00
171	3191	0.22	0.00	0.00	0.00E+00	0.00E+00
172	3211	0.22	0.00	0.00	0.00E+00	0.00E+00
173	3231	0.22	0.00	0.00	0.00E+00	0.00E+00
174	3251	0.22	0.00	0.00	-3.50E-05	-5.50E-07
175	3271	0.23	0.02	0.03	4.86E-04	7.71E-06
176	3291	0.24	0.04	0.07	1.34E-03	2.12E-05
177	3311	0.27	0.09	0.15	2.59E-03	4.12E-05
178	3331	0.32	0.16	0.28	4.24E-03	6.73E-05
179	3351	0.39	0.26	0.46	6.11E-03	9.69E-05
180	3371	0.51	0.40	0.70	7.84E-03	1.25E-04

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
181	3391	0.69	0.56	0.99	8.95E-03	1.42E-04
182	3411	0.92	0.73	1.30	8.90E-03	1.41E-04
183	3431	1.22	0.89	1.58	7.38E-03	1.17E-04
184	3452	1.56	1.00	1.79	4.40E-03	6.99E-05
185	3472	1.93	1.06	1.89	4.36E-04	6.91E-06
186	3492	2.32	1.04	1.85	-3.70E-03	-5.90E-05
187	3512	2.68	0.95	1.69	-7.30E-03	-1.20E-04
188	3532	3.00	0.81	1.44	-9.50E-03	-1.50E-04
189	3552	3.26	0.64	1.14	-1.00E-02	-1.60E-04
190	3572	3.46	0.47	0.84	-9.70E-03	-1.50E-04
191	3592	3.61	0.32	0.57	-8.20E-03	-1.30E-04
192	3612	3.70	0.20	0.36	-6.30E-03	-1.00E-04
193	3632	3.76	0.12	0.21	-4.50E-03	-7.20E-05
194	3652	3.80	0.06	0.11	-3.10E-03	-4.90E-05
195	3672	3.82	0.03	0.05	-2.00E-03	-3.20E-05
196	3692	3.83	0.01	0.01	-1.40E-03	-2.10E-05
197	3712	3.84	0.00	0.00	0.00E+00	0.00E+00
198	3732	3.84	0.00	0.00	0.00E+00	0.00E+00
199	3752	3.84	0.00	0.00	0.00E+00	0.00E+00
200	3773	3.84	0.00	0.00	0.00E+00	0.00E+00
201	3793	3.84	0.00	0.00	0.00E+00	0.00E+00
202	3813	3.84	0.00	0.00	0.00E+00	0.00E+00
203	3833	3.84	0.00	0.00	0.00E+00	0.00E+00
204	3853	3.84	0.00	0.00	0.00E+00	0.00E+00
205	3873	3.84	0.00	0.00	0.00E+00	0.00E+00
206	3893	3.84	0.00	0.00	0.00E+00	0.00E+00
207	3913	3.84	0.00	0.00	0.00E+00	0.00E+00
208	3933	3.84	0.00	0.00	0.00E+00	0.00E+00
209	3953	3.84	0.00	0.00	0.00E+00	0.00E+00
210	3973	3.84	0.00	0.00	0.00E+00	0.00E+00
211	3993	3.84	0.00	0.00	0.00E+00	0.00E+00
212	4013	3.84	0.00	0.00	0.00E+00	0.00E+00
213	4033	3.84	0.00	0.00	0.00E+00	0.00E+00
214	4053	3.84	0.00	0.00	0.00E+00	0.00E+00
215	4074	3.84	0.00	0.00	0.00E+00	0.00E+00
216	4094	3.84	0.00	0.00	0.00E+00	0.00E+00
217	4114	3.84	0.00	0.00	0.00E+00	0.00E+00
218	4134	3.84	0.00	0.00	0.00E+00	0.00E+00
219	4154	3.84	0.00	0.00	0.00E+00	0.00E+00
220	4174	3.84	0.00	0.00	0.00E+00	0.00E+00
221	4194	3.84	0.00	0.00	0.00E+00	0.00E+00
222	4214	3.84	0.00	0.00	0.00E+00	0.00E+00
223	4234	3.84	0.00	0.00	0.00E+00	0.00E+00
224	4254	3.84	0.00	0.00	0.00E+00	0.00E+00
225	4274	3.84	0.00	0.00	0.00E+00	0.00E+00
226	4294	3.84	0.00	0.00	0.00E+00	0.00E+00

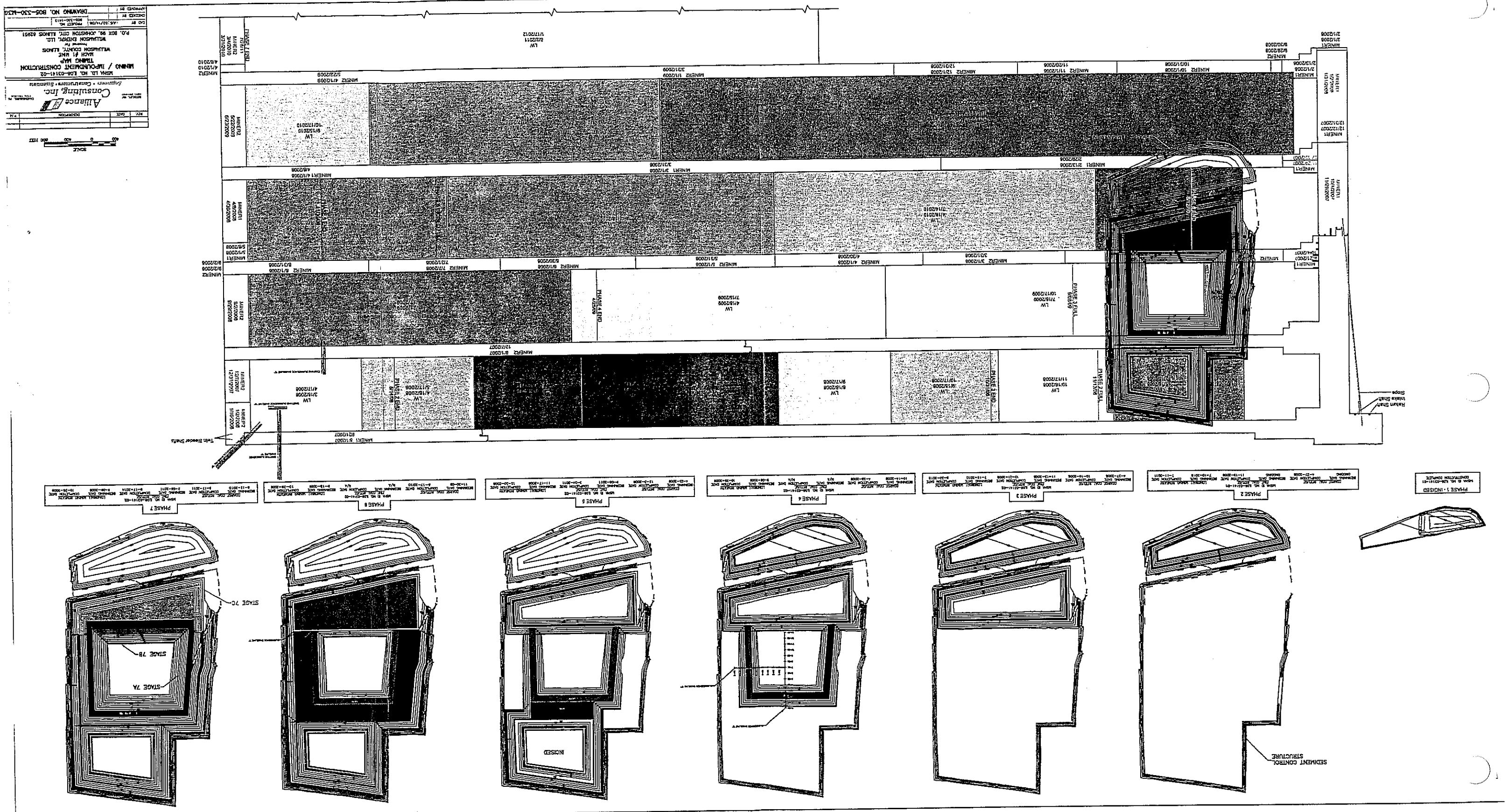
Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
227	4314	3.84	0.00	0.00	0.00E+00	0.00E+00
228	4334	3.84	0.00	0.00	0.00E+00	0.00E+00
229	4354	3.84	0.00	0.00	0.00E+00	0.00E+00
230	4374	3.82	-0.01	-0.02	-1.50E-03	-2.50E-05
231	4395	3.81	-0.04	-0.06	-2.30E-03	-3.70E-05
232	4415	3.79	-0.08	-0.14	-3.50E-03	-5.60E-05
233	4435	3.75	-0.14	-0.25	-5.10E-03	-8.10E-05
234	4455	3.68	-0.24	-0.42	-6.90E-03	-1.10E-04
235	4475	3.56	-0.37	-0.66	-8.70E-03	-1.40E-04
236	4495	3.40	-0.53	-0.94	-1.00E-02	-1.60E-04
237	4515	3.18	-0.70	-1.20	-1.00E-02	-1.60E-04
238	4535	2.90	-0.86	-1.50	-8.90E-03	-1.40E-04
239	4555	2.56	-0.99	-1.80	-6.20E-03	-9.90E-05
240	4575	2.19	-1.06	-1.90	-2.40E-03	-3.80E-05
241	4595	1.81	-1.05	-1.90	1.79E-03	2.83E-05
242	4615	1.44	-0.97	-1.70	5.50E-03	8.71E-05
243	4635	1.11	-0.84	-1.50	8.03E-03	1.27E-04
244	4655	0.84	-0.67	-1.20	9.06E-03	1.44E-04
245	4675	0.62	-0.50	-0.90	8.69E-03	1.38E-04
246	4695	0.47	-0.35	-0.62	7.33E-03	1.16E-04
247	4716	0.36	-0.22	-0.40	5.51E-03	8.73E-05
248	4736	0.30	-0.13	-0.23	3.68E-03	5.83E-05
249	4756	0.26	-0.07	-0.12	2.15E-03	3.41E-05
250	4776	0.23	-0.03	-0.06	1.03E-03	1.63E-05
251	4796	0.22	-0.01	-0.02	2.92E-04	4.61E-06
252	4816	0.22	0.00	0.00	0.00E+00	0.00E+00
253	4836	0.22	0.00	0.00	0.00E+00	0.00E+00
254	4856	0.22	0.00	0.00	0.00E+00	0.00E+00
255	4876	0.22	0.00	0.00	0.00E+00	0.00E+00
256	4896	0.22	0.00	0.00	0.00E+00	0.00E+00
257	4916	0.22	0.01	0.01	1.39E-04	2.40E-06
258	4936	0.23	0.03	0.05	9.02E-04	1.53E-05
259	4956	0.25	0.06	0.12	2.14E-03	3.62E-05
260	4976	0.29	0.13	0.24	3.89E-03	6.60E-05
261	4996	0.36	0.23	0.43	6.05E-03	1.03E-04
262	5016	0.48	0.37	0.70	8.24E-03	1.40E-04
263	5037	0.66	0.54	1.03	9.83E-03	1.67E-04
264	5057	0.91	0.73	1.40	1.01E-02	1.71E-04
265	5077	1.23	0.91	1.74	8.52E-03	1.44E-04
266	5097	1.61	1.05	2.00	5.08E-03	8.61E-05
267	5117	2.03	1.11	2.11	3.49E-04	5.96E-06
268	5137	2.45	1.08	2.06	-4.60E-03	-7.80E-05
269	5157	2.85	0.97	1.86	-8.70E-03	-1.50E-04
270	5177	3.20	0.81	1.54	-1.10E-02	-1.90E-04
271	5197	3.48	0.62	1.17	-1.10E-02	-1.90E-04
272	5217	3.68	0.43	0.82	-1.00E-02	-1.70E-04

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
273	5237	3.82	0.28	0.53	-8.20E-03	-1.40E-04
274	5257	3.91	0.16	0.31	-6.00E-03	-1.00E-04
275	5277	3.96	0.09	0.16	-4.10E-03	-6.90E-05
276	5297	3.98	0.04	0.07	-2.60E-03	-4.40E-05
277	5317	4.00	0.01	0.02	-1.70E-03	-2.90E-05
278	5337	4.01	0.00	0.00	4.20E-06	6.89E-08
279	5358	4.01	0.00	0.00	0.00E+00	0.00E+00
280	5378	4.01	0.00	0.00	0.00E+00	0.00E+00
281	5398	4.01	0.00	0.00	0.00E+00	0.00E+00
282	5418	4.01	0.00	0.00	0.00E+00	0.00E+00
283	5438	4.01	0.00	0.00	0.00E+00	0.00E+00
284	5458	4.01	0.00	0.00	0.00E+00	0.00E+00
285	5478	4.01	0.00	0.00	0.00E+00	0.00E+00
286	5498	4.01	0.00	0.00	0.00E+00	0.00E+00
287	5518	4.01	0.00	0.00	0.00E+00	0.00E+00
288	5538	4.01	0.00	0.00	0.00E+00	0.00E+00
289	5558	4.01	0.00	0.00	0.00E+00	0.00E+00
290	5578	4.01	0.00	0.00	0.00E+00	0.00E+00
291	5598	4.01	0.00	0.00	0.00E+00	0.00E+00
292	5618	4.01	0.00	0.00	0.00E+00	0.00E+00
293	5638	4.01	0.00	0.00	0.00E+00	0.00E+00
294	5658	4.01	0.00	0.00	0.00E+00	0.00E+00
295	5679	4.01	0.00	0.00	0.00E+00	0.00E+00
296	5699	4.01	0.00	0.00	0.00E+00	0.00E+00
297	5719	4.01	0.00	0.00	0.00E+00	0.00E+00
298	5739	4.01	0.00	0.00	0.00E+00	0.00E+00
299	5759	4.01	0.00	0.00	0.00E+00	0.00E+00
300	5779	4.01	0.00	0.00	0.00E+00	0.00E+00
301	5799	4.01	0.00	0.00	0.00E+00	0.00E+00
302	5819	4.01	0.00	0.00	0.00E+00	0.00E+00
303	5839	4.01	0.00	0.00	0.00E+00	0.00E+00
304	5859	4.01	0.00	0.00	0.00E+00	0.00E+00
305	5879	4.01	0.00	0.00	0.00E+00	0.00E+00
306	5899	4.01	0.00	0.00	0.00E+00	0.00E+00
307	5919	4.01	0.00	0.00	0.00E+00	0.00E+00
308	5939	4.01	0.00	0.00	0.00E+00	0.00E+00
309	5959	4.01	0.00	0.00	0.00E+00	0.00E+00
310	5979	4.01	0.00	0.00	0.00E+00	0.00E+00
311	6000	4.01	0.00	0.00	0.00E+00	0.00E+00
312	6020	4.01	0.00	0.00	0.00E+00	0.00E+00
313	6040	4.01	0.00	0.00	0.00E+00	0.00E+00
314	6060	4.01	0.00	0.00	0.00E+00	0.00E+00
315	6080	4.01	0.00	0.00	0.00E+00	0.00E+00
316	6100	4.01	0.00	0.00	0.00E+00	0.00E+00
317	6120	4.01	0.00	0.00	0.00E+00	0.00E+00
318	6140	4.01	0.00	0.00	0.00E+00	0.00E+00



SGS Topographic Map, Resolution: 16.0 meters/pixel

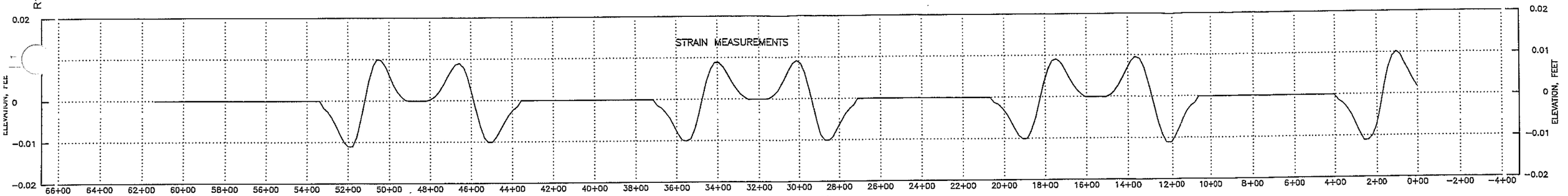
1 km



MINING / IMPOUNDMENT CONSTRUCTION
TIMING MAP
WILLIAMSON COUNTY, ILLINOIS
P.O. BOX 99, JOHNSTON CITY, ILLINOIS 62951
Alliance Consulting, Inc.
Engineers • Constructors • Scientists
DRAWING NO. 805-330-M30
PHASE 1 - INCISED
PHASE 2
PHASE 3
PHASE 4
PHASE 5
PHASE 6
PHASE 7
STAGE 7A
STAGE 7B
STAGE 7C
INCISED
SEDIMENT CONTROL STRUCTURE
Rehm Shaft Intake Shaft Slope
Twin Bleeder Shafts

R13030

R13031



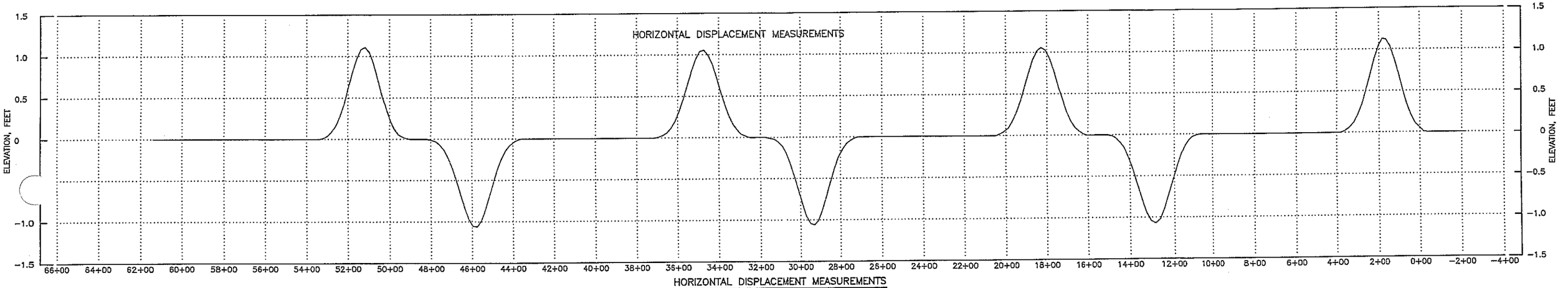
STRAIN MEASUREMENTS

VERTICAL SCALE

0.01 0 0.01 0.02 FEET

HORIZONTAL SCALE

200 0 200 400 FEET



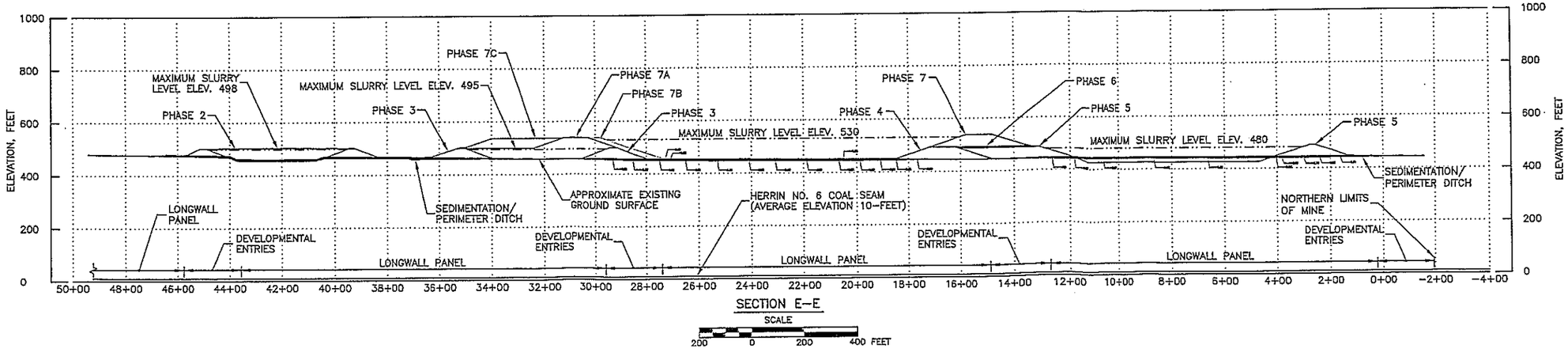
HORIZONTAL DISPLACEMENT MEASUREMENTS

VERTICAL SCALE

0.5 0 0.5 1 FEET

HORIZONTAL SCALE

200 0 200 400 FEET



SECTION E–E

SCALE

200 0 200 400 FEET

NO.	DATE	DESCRIPTION	P.M.

KLEY, WV 1 330-0491

Alliance Consulting, Inc.

Engineers • Constructors • Scientists

RALEIGH, NC (919) 861-2257

ILLINOIS DEPARTMENT OF NATURAL RESOURCES PERMIT NO. 375

PHASE II IMPOUNDMENT

STRAIN/HORIZONTAL/VERTICAL DISPLACEMENT

POND CREEK MINE NO. 1

PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2

WILLIAMSON COUNTY, ILLINOIS

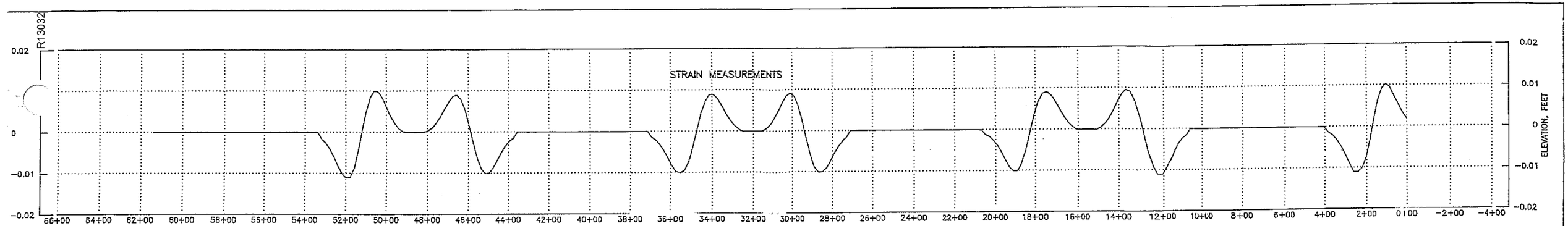
Prepared For

WILLIAMSON ENERGY, LLC.

P.O. BOX 99, JOHNSTON CITY, ILLINOIS 62951

BY	DSM 04/15/08	PROJECT NO. B05-330-1413
CKED BY		
ROVED BY		DRAWING NO. B05-330-E38

R13032



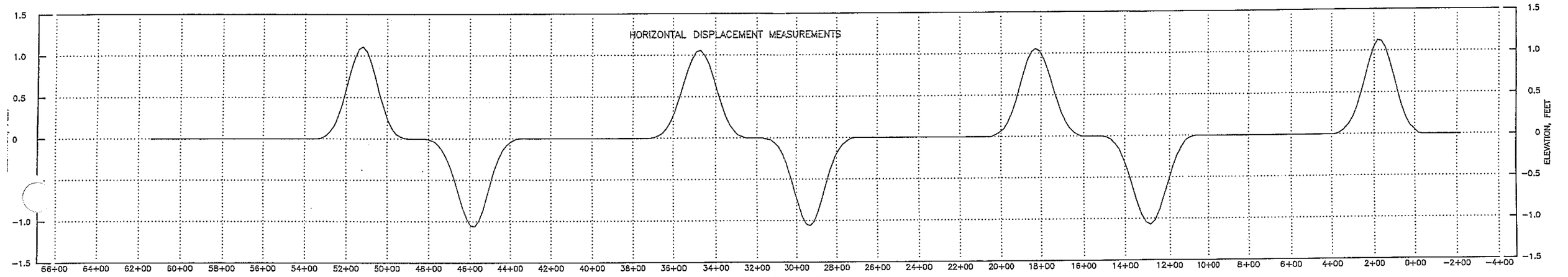
STRAIN MEASUREMENTS

VERTICAL SCALE

0.01 0 0.01 0.02 FEET

HORIZONTAL SCALE

200 0 200 400 FEET



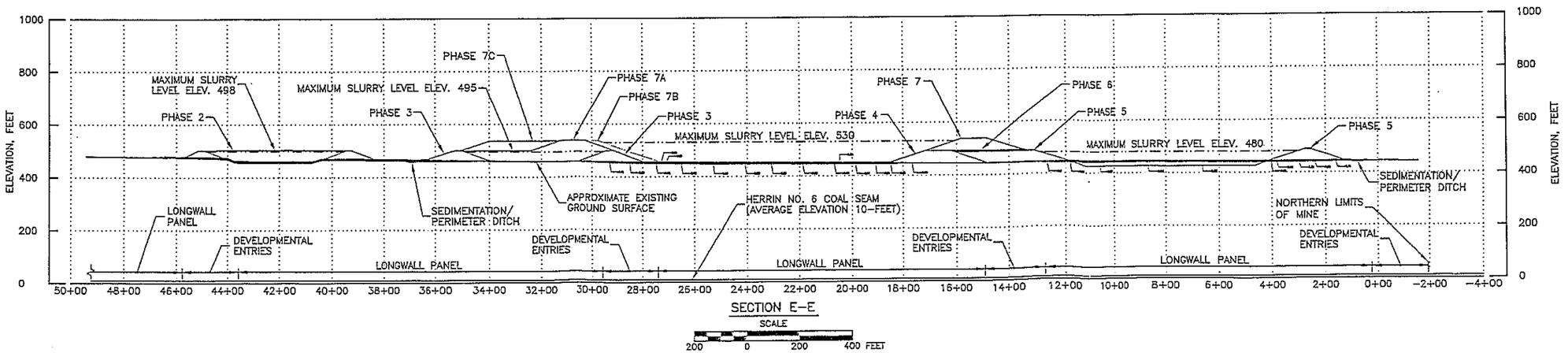
HORIZONTAL DISPLACEMENT MEASUREMENTS

VERTICAL SCALE

0.5 0 0.5 1 FEET

HORIZONTAL SCALE

200 0 200 400 FEET



SECTION E−E

SCALE

200 0 200 400 FEET

DATE	DESCRIPTION	P.M.

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RALEIGH, NC (919) 861-2261

OIS DEPARTMENT OF NATURAL RESOURCES PERMIT NO. 375
PHASE II IMPOUNDMENT
RAIN/HORIZONTAL/VERTICAL DISPLACEMENT
POND CREEK MINE NO. 1
ROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
WILLIAMSON COUNTY, ILLINOIS
Prepared For
WILLIAMSON ENERGY, LLC.
P.O. BOX 99, JOHNSTON CITY, ILLINOIS 62951

DSM: 04/15/08 | PROJECT NO. B05-330-1413

DRAWING NO. B05-330-E38

M225-11
Part 12

APPENDIX B

SUMMARY OF LABORATORY TESTING RESULTS AND SUPPLEMENTAL CHARACTERIZATION OF THE SUBSURFACE MATERIALS PREPARED BY GAI, CHARACTERIZATION OF THE SUBSURFACE MATERIALS PREPARED BY CEC SUMMARY OF PIEZO-SEISMIC CONE PENETRATION TESTING PREPARED BY CEC

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Summary of Laboratory Testing

BY BEG DATE 2009-MAR-30 PROJ. NO. C090403.01.001

CHKD. BY _____ DATE _____ SHEET NO. 2 OF 2

gai consultants

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b. Shear strength tests on remolded slurried fine refuse samples:
   - (6) Consolidated-Undrained Triaxial points including (6) additional moisture contents and (6) total and dry density..

FEBRUARY 2006 – APRIL 2007: Holcolm Foundation Engineering Company, Inc.

Holcolm Foundation Engineering Company, Inc. (Holcolm) was retained in 2006 and 2007 (Reference Nos. 2, 3 and 4) by Williamson Energy, LLC. (Williamson) to perform laboratory testing on an undisturbed (Shelby tube) sample of residual soil and two (2) remolded bulk samples of coarse coal refuse materials collected from the Pond Creek site. The laboratory testing was performed between February 2006 and April 2007 at Holcolm. The purpose of the testing program was to determine index, strength, density and permeability parameters, and summarize the results for the residual and coarse refuse materials.

The laboratory testing program performed by Holcolm included:

a. Index tests on undisturbed residual soil sample:
   - (1) Moisture content;
   - (1) Grain-size distributions;
   - (1) Atterberg limits;
   - (1) Total and dry density;

b. Shear strength test on undisturbed residual soil sample:
   - (3) Consolidated Undrained Triaxial points;

c. Index tests on remolded coarse refuse samples:
   - (2) Moisture content;
   - (2) Grain-size distributions;
   - (2) Standard proctor maximum dry density and optimum moisture content;

d. Shear strength test on remolded coarse refuse samples:
   - (6) Consolidated Undrained Triaxial points; and

e. Permeability tests on remolded coarse refuse samples:
   - (3) Falling head permeability tests.

SUMMARY OF LABORATORY TESTING RESULTS:

The attached table presents a results summary of the various laboratory tests, and copies of the laboratory testing data performed by Geotechnics and Holcolm are attached.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Summary of Laboratory Testing

BY BEG DATE 2009-MAR-30 PROJ. NO. C090403.01.001

CHKD. BY [signature] DATE 5/1/09 SHEET NO. 1 OF 2

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CALCULATION BRIEF
FOR
SUMMARY OF LABORATORY TESTING

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE: Summarize the laboratory testing program and results obtained for coarse coal refuse, fine coal refuse and residual soil materials sampled at the Pond Creek Coal Refuse Disposal Facility. A laboratory testing summary table is attached, as well as laboratory testing results.

REFERENCES:

1. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Laboratory Testing," Pond Creek Coal Refuse Disposal Site – South Pond, BEG, dated 7/8/08.

2. Holcolm Foundation Engineering Company, Inc., "Soil Boring and Laboratory Tests Boring #8874," Mach Mine No. 1, dated February 10, 2006.

3. Holcolm Foundation Engineering Company, Inc., "Coarse Refuse Laboratory Tests," Pond Creek Mine, dated November 30, 2006.

4. Holcolm Foundation Engineering Company, Inc., "Coarse Refuse Laboratory Tests," Mach Mine, dated April 9, 2007.

LABORATORY TESTING PROGRAMS:

MAY – JUNE 2008: Civil & Environmental Consultants, Inc.

Civil & Environmental Consultants, Inc. (CEC) retained Geotechnics, Inc. (Geotechnics) of East Pittsburgh, Pennsylvania in May 2008 to perform laboratory testing on bulk samples of fine coal refuse materials collected from the South Pond (Phase 2) impoundment at the Pond Creek Coal Refuse Disposal Facility in Williamson County, Illinois (Reference No. 1). The laboratory testing was performed between May 2008 and June 2008 at Geotechnics. The purpose of the testing program was to determine index and strength parameters, and summarize the results for the fine coal refuse materials.

The laboratory testing program performed by Geotechnics included:

a. Index tests on bulk/slurried fine refuse samples:
   - (2) Moisture content;
   - (2) Grain-size distributions;
   - (2) Hydrometers;
   - (2) Atterberg limits; and
   - (2) Specific gravity.

Summary of Laboratory Test Results
Pond Creek Coal Refuse Disposal Facility
Williamson County, Illinois

BOREHOLE STATISTICS				INDEX						LIMITS			CONSOLIDATION		SHEAR STRENGTH								
															Peak Strength			Steady State			Effective Strength		Total Strength	
Sample Type	Sample No.	Depth (ft)	Material	Wat. Con. (w) (%)	Total Den. (γ) (pcf)	Dry Den. (γd) (pcf)	Spec. Gr. (dim)	Passing No. 200 (%)	Passing No. 40 (%)	LL (%)	PI (%)	PI (%)	Initial Void Ratio (eo) (dim)	After Void Ratio (e) (dim)	f_p (deg)	ε_{fp} (%)	q_p (ksf)	ϕ_{ss} (Deg)	ε_{fss} (%)	q_{ss} (ksf)	φ (Deg)	c (ksf)	φ (Deg)	c (ksf)
Bucket	1	Remold	FCR	82.60	76.60	42.00	2.24						2.333	0.944	40.40	18.40	0.664	40.40	21.51	0.485				
Test No.	1		See Note 1																					
Bucket	1	Remold	FCR	82.70	84.20	46.10	2.24						2.035	0.955	39.60	13.40	1.086	39.00	21.67	0.817	36.14	0.000	17.30	0.216
Test No.	2		See Note 1																					
Bucket	1	Remold	FCR	79.50	80.50	44.80	2.24						2.119	0.956	37.80	13.50	1.558	36.70	21.74	1.149				
Test No.	3		See Note 1																					
Bucket	1	Bulk	FCR	85.80			2.24	92.83	99.41	36	19	17												
			See Note 1																					
Bucket	2	Remold	FCR	82.90	82.60	45.20	2.24						2.095	1.129	38.30	10.30	0.485	36.30	17.29	0.354				
Test No.	1		See Note 1																					
Bucket	2	Remold	FCR	85.70	85.70	44.30	2.24						2.159	0.931	39.20	14.20	0.825	38.60	21.32	0.616	37.71	0.000	20.30	0.013
Test No.	2		See Note 1																					
Bucket	2	Remold	FCR	83.00	83.00	46.20	2.24						2.029	0.910	37.50	8.40	1.681	35.70	21.49	1.245				
Test No.	3		See Note 1																					
Bucket	2	Bulk	FCR	94.40			2.24	92.62	99.29	36	19	17												
Boring 8874	2	8-10	Residual	21.50	127.90	105.30		79.00	94.50	42	18	24												
Undisturbed	3	10-12	See Note 2																		26.80	0.000	19.50	0.416
																				k (cm/sec)				
11/30/06		Remold	CCR	9.30		124.60	2.37	2.60	5.60											2x10-4	33.70	0.000	18.50	1.014
Bulk			See Note 3																					
04/09/07		Remold	CCR	10.70		120.30	2.50	2.00	5.40											2x10-4	29.30	0.152	17.40	0.458
Bulk			See Note 3																	3x10-4				

Notes:
1. Fine coal refuse (FCR) testing performed by Civil & Environmental Consultants, Inc. in May - June 2008.
2. Residual soil testing performed by Holcolm Foundation Engineering Company, Inc. in February 2006.
3. Coarse Coal Refuse (CCR) testing perfomed by Holcolm Foundation Engineering Company, Inc. in November 2006 and April 2007.

ATTACHMENT 1

LABORATORY TESTING RESULTS – FINE COAL REFUSE
GEOTECHNICS, INC.

Geotechnics
.....GEOTECHNICAL AND
GEOSYNTHETIC SERVICES

June 5, 2008

Project No. 2008-210-01

Mr. Blaise Genes
Civil & Environmental Consultants
4 Triangle Dr, Suite 200
Export, PA 15632-9255

Transmittal
Laboratory Test Results
Pond Creek

Please find attached the laboratory test results for the above referenced project. The tests were outlined on the Project Verification Form that was faxed to your firm prior to the testing. The testing was performed in general accordance with the methods listed on the enclosed data sheets. The test results are believed to be representative of the samples that were submitted for testing and are indicative only of the specimens which were evaluated. We have no direct knowledge of the origin of the samples and imply no position with regard to the nature of the test results, i.e. pass/fail and no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization by our Client. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please contact our office.

Respectively submitted,
Geotechnics, Inc.

David R. Backstrom
Laboratory Director

We understand that you have a choice in your laboratory services and we thank you for choosing Geotechnics.

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MOISTURE CONTENT

ASTM D 2216 (SOP-S1)

Client	CEC
Client Reference	POND CREEK 080851
Project No.	2008-210-01

Lab ID	01	02
Boring No.	SOUTH POND	SOUTH POND
Depth (ft)	NA	NA
Sample No.	BUCKET 1	BUCKET 2
Tare Number	877	729
Wt. of Tare & WS (gm)	621.7	578.3
Wt. of Tare & DS (gm)	385.56	339.54
Wt. of Tare (gm)	110.33	86.52
Wt. of Water (gm)	236.14	238.76
Wt. of DS (gm)	275.23	253.02
Water Content (%)	**85.8**	**94.4**

Notes : *NA*

Tested By PC *Date* 5/13/08 *Checked By* KB *Date* 5-14-08

DCN: CT-S1 DATE 6-30-98 REVISION: 2

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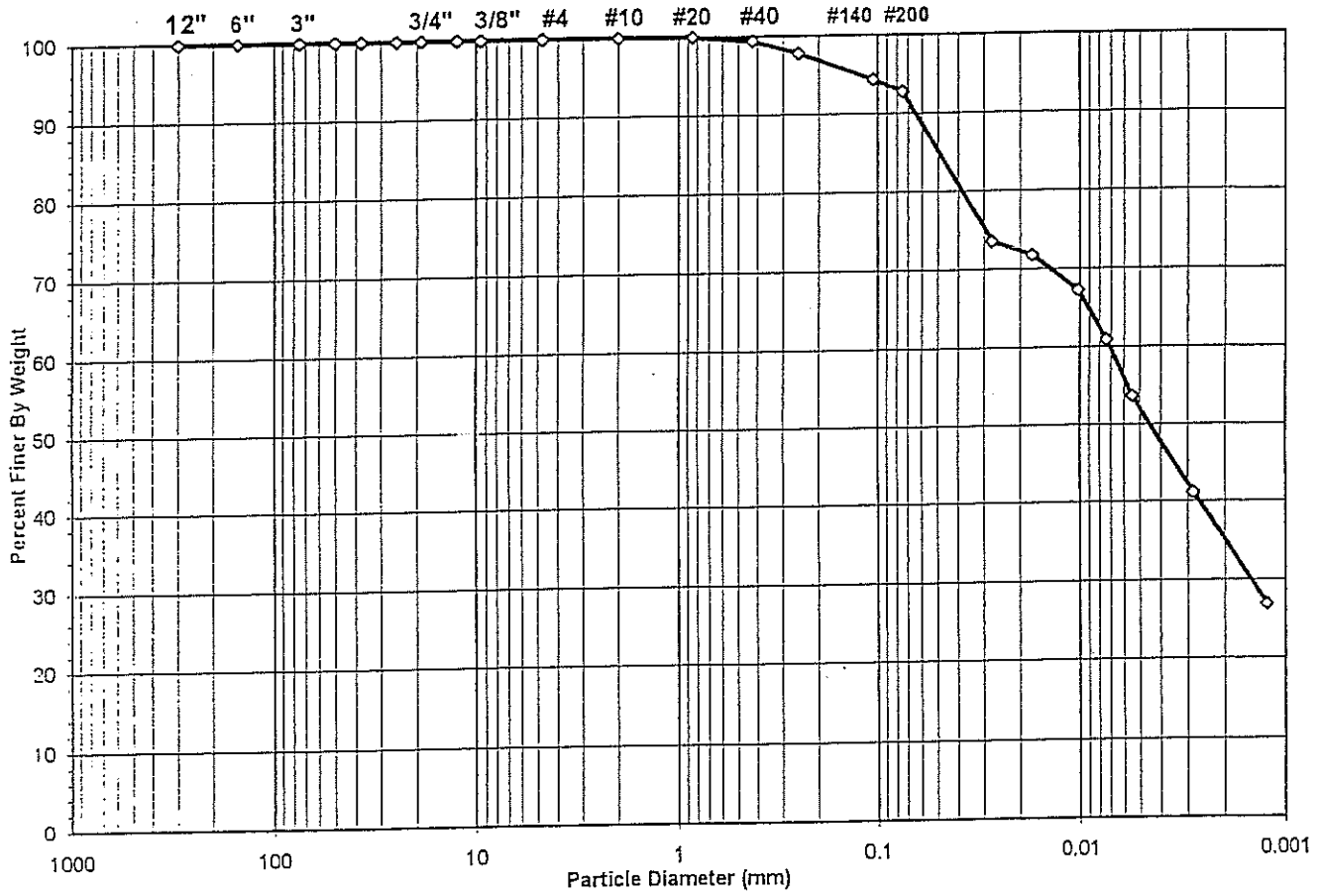
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Color	BLACK

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	7.17
Finer Than #200	*Silt & Clay*	92.83

USCS Symbol *CL, TESTED*

USCS Classification *LEAN CLAY*

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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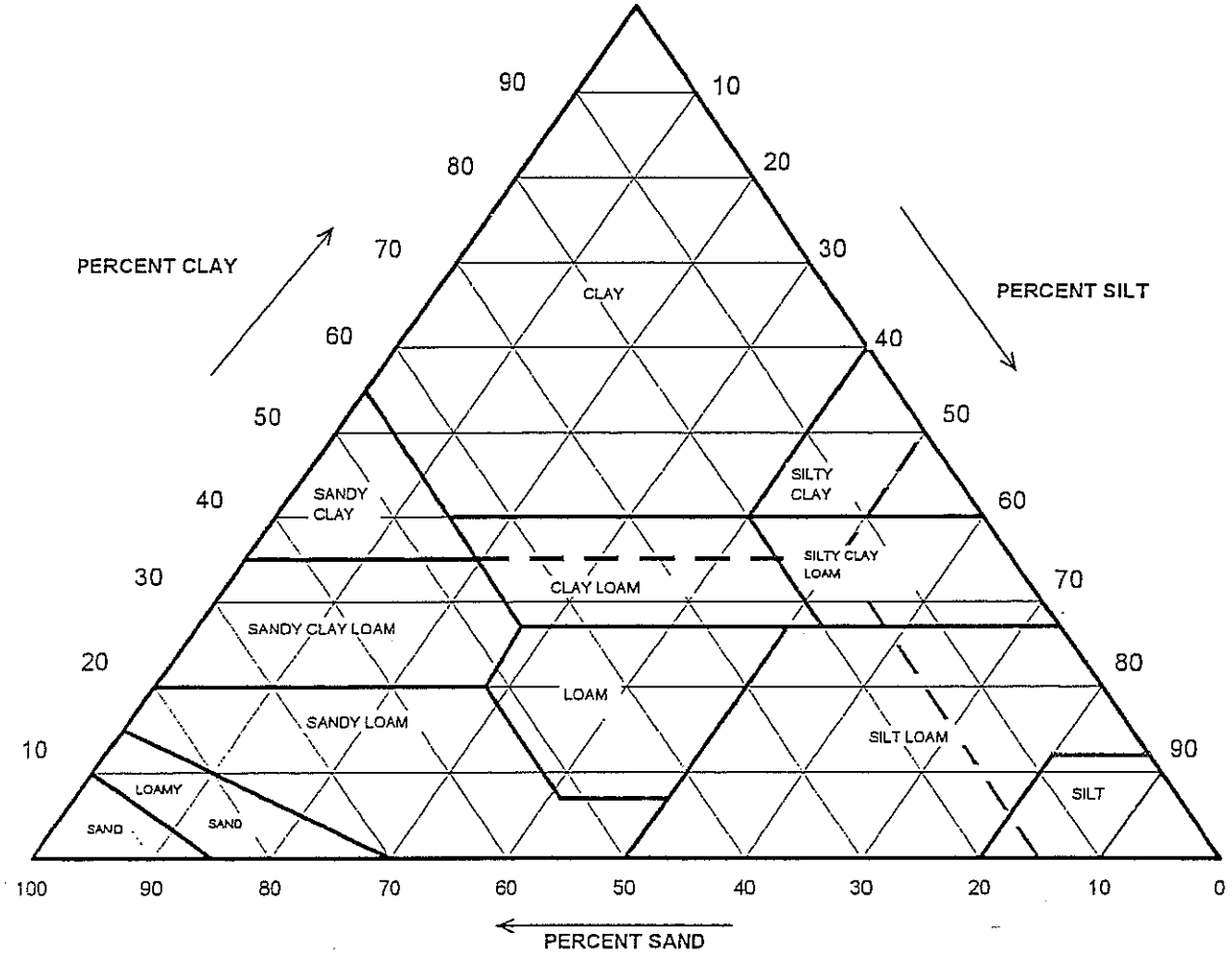
USDA CLASSIFICATION CHART

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Color	BLACK



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.00	**0.00**
2	100.00	*Sand*	14.88	**14.88**
0.05	85.12	*Silt*	50.02	**50.02**
0.002	35.10	*Clay*	35.10	**35.10**

USDA Classification: *SILTY CLAY LOAM*

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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WASH SIEVE ANALYSIS

ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Color	BLACK

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	703	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	1020.20	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	609.00	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	100.40	Weight of Tare (gm)	NA
Weight of Water (gm)	411.20	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	508.60	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**80.8**	**Moisture Content (%)**	NA

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	508.60
Dry Weight - 3/4" Sample (gm)	36.47	Weight of minus #200 material (gm)	472.13
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	36.47
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	100.00
6"	150	0.00	0.00	0.00	100.00	100.00
3"	75	0.00	0.00	0.00	100.00	100.00
2"	50	0.00	0.00	0.00	100.00	100.00
1 1/2"	37.5	0.00	0.00	0.00	100.00	100.00
1"	25.0	0.00	0.00	0.00	100.00	100.00
3/4"	19.0	0.00	0.00	0.00	100.00	100.00
1/2"	12.5	0.00	0.00	0.00	100.00	100.00
3/8"	9.50	0.00	0.00	0.00	100.00	100.00
#4	4.75	0.00	0.00	0.00	100.00	100.00
#10	2.00	0.00	0.00	0.00	100.00	100.00
#20	0.85	0.12	0.02	0.02	99.98	99.98
#40	0.425	2.90	0.57	0.59	99.41	99.41
#60	0.250	7.89	1.55	2.15	97.85	97.85
#140	0.106	17.74	3.49	5.63	94.37	94.37
#200	0.075	7.82	1.54	7.17	92.83	92.83
Pan	-	472.13	92.83	100.00	-	-

Tested By JP Date 5/21/08 Checked By KR Date 5-23-08

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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HYDROMETER ANALYSIS

ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Color	BLACK

Elapsed Time (min)	R Measured	Temp. (° C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	47.0	21.9	6.02	41.0	79.2	0.01314	0.0272	**73.6**
5	46.0	21.9	6.02	40.0	77.3	0.01314	0.0174	**71.8**
15	43.5	21.9	6.02	37.5	72.5	0.01314	0.0103	**67.3**
31	40.0	21.9	6.02	34.0	65.7	0.01314	0.0074	**61.0**
60	36.0	21.8	6.07	29.9	57.9	0.01316	0.0055	**53.7**
250	29.0	21.7	6.11	22.9	44.3	0.01317	0.0028	**41.1**
1440	21.0	21.9	6.02	15.0	29.0	0.01314	0.0012	**26.9**

Soil Specimen Data		Other Corrections	
Tare No.	2487		
Tare + Dry Material (gm)	151.2	a - Factor	0.99
Weight of Tare (gm)	95.01		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 200	92.83
Weight of Dry Material (gm)	51.19		
		Specific Gravity	2.7 Assumed

Note: Hydrometer test is performed on - # 200 sieve material.

Tested By TO Date 5/21/08 Checked By VP Date 5-23-08

DCN: CT-53A DATE:2/20/08 REVISION: 8

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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Description	BLACK LEAN CLAY

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

(Minus No. 40 sieve material, Airdried)

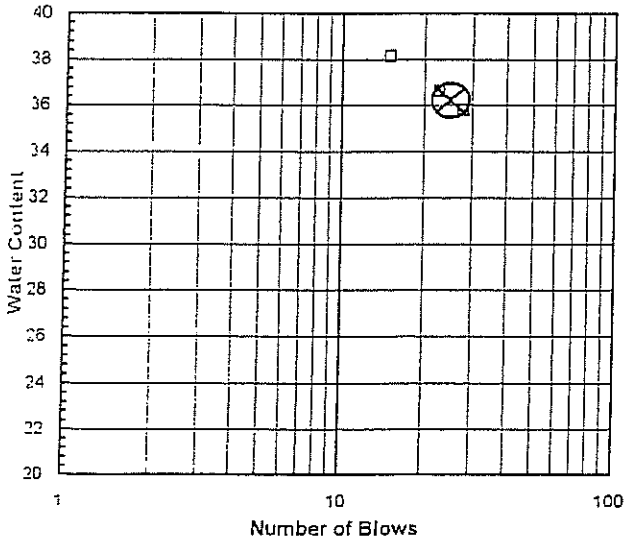
Liquid Limit Test	1	2	3	MULTIPOINT
Tare Number	110	37	40	
Wt. of Tare & WS (gm)	36.10	35.31	37.89	
Wt. of Tare & DS (gm)	30.53	29.82	31.72	
Wt. of Tare (gm)	14.96	14.83	15.54	
Wt. of Water (gm)	5.6	5.5	6.2	
Wt. of DS (gm)	15.6	15.0	16.2	
Moisture Content (%)	**35.8**	**36.6**	**38.1**	
Number of Blows	**28**	**23**	**15**	

Plastic Limit Test	1	2	Range
Tare Number	134	267	
Wt. of Tare & WS (gm)	21.41	20.16	
Wt. of Tare & DS (gm)	20.44	19.10	
Wt. of Tare (gm)	15.29	13.36	
Wt. of Water (gm)	1.0	1.1	
Wt. of DS (gm)	5.2	5.7	
Moisture Content (%)	**18.8**	**18.5**	**0.4**

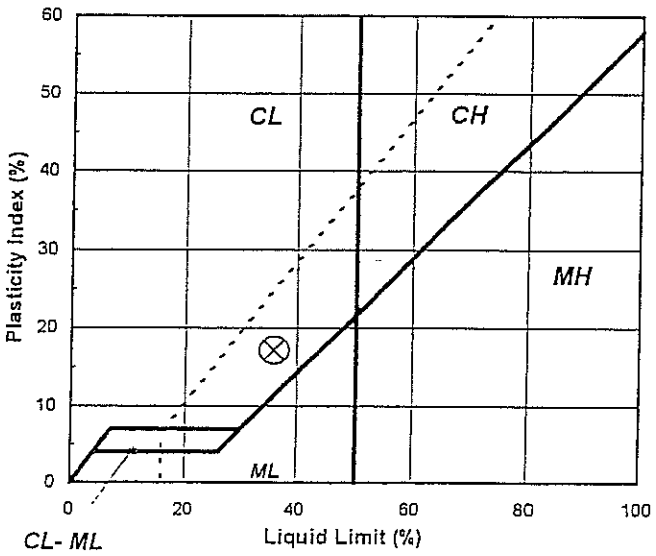
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	36
Plastic Limit (%)	19
Plasticity Index (%)	17
USCS Symbol	CL

Flow Curve



Plasticity Chart



Tested By TO *Date* 5/21/08 *Checked By* HB *Date* 5-23-08

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SPECIFIC GRAVITY

ASTM D 854-02, AASHTO T100-03 (SOP - S5)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Visual Description	BLACK SLUDGE
			(MInus No.4 sieve material, airdried)

Replicate Number	1	2
Pycnometer ID	G 1155	G 1156
Weight of Pycnometer + Soil + Water (gm)	737.55	736.34
Temperature, T (°Celsius)	26.4	25.5
Weight of Pycnometer + Water (gm)	682.36	681.04
Tare Number	674	2487
Weight of Tare + Dry Soil (gm)	199.03	195.46
Weight of Tare (gm)	99.26	95.76
Weight of Dry Soil (gm)	99.77	99.70
Specific Gravity of Soil @ T	2.238	2.246
Specific Gravity of Water @ T	0.9967	0.9969
Conversion Factor for Temperature T	0.9985	0.9987
Specific Gravity @ 20° Celsius	2.241	2.248

Average Specific Gravity @ 20° Celsius	2.24

Tested By TO *Date* 05/20/08 *Checked By* KB *Date* 5-23-08

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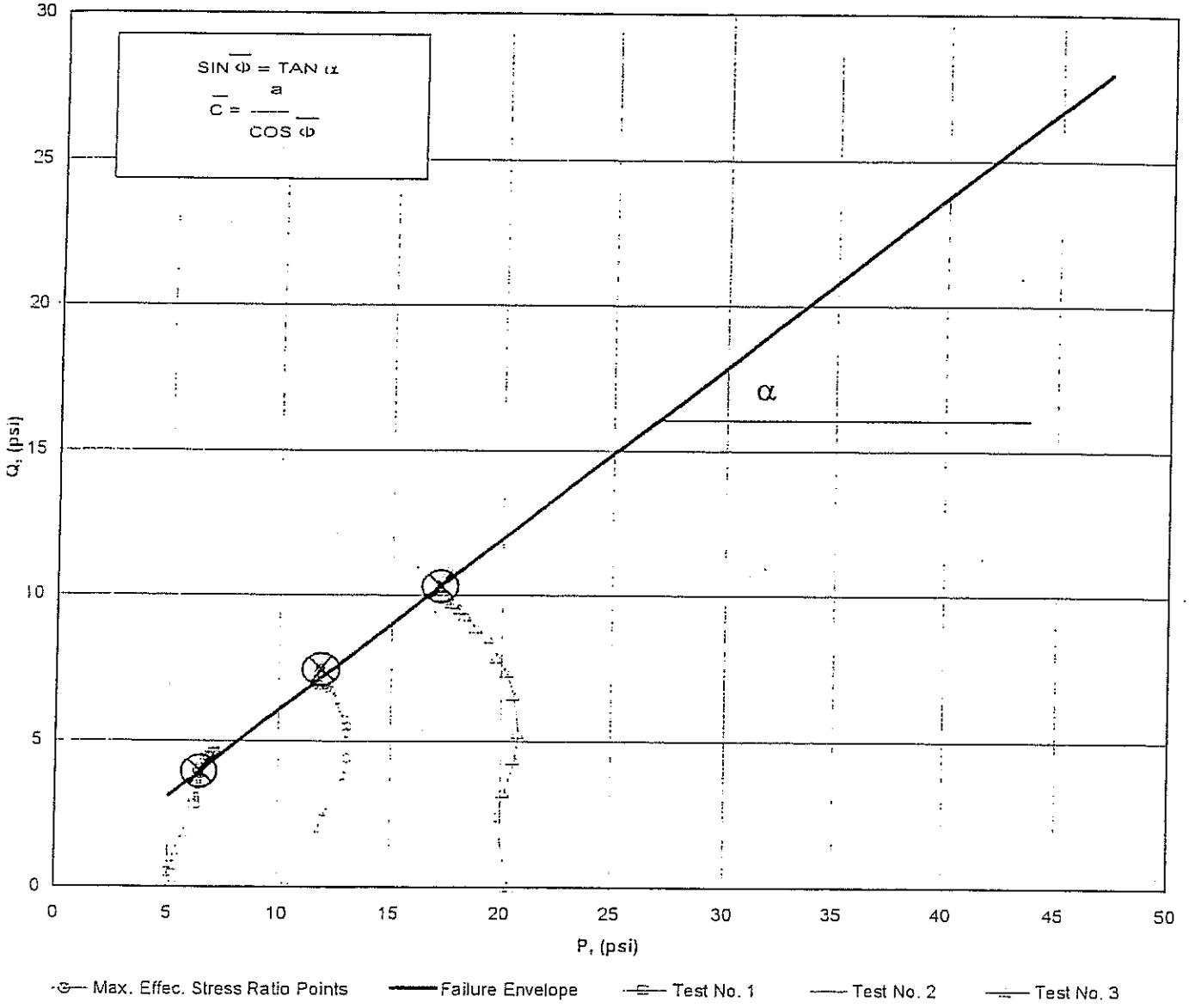
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	30.5	$\bar{\Phi}$	=	36.14

Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

DCN: CT-S28 DATE 6-25-96 REVISION 1

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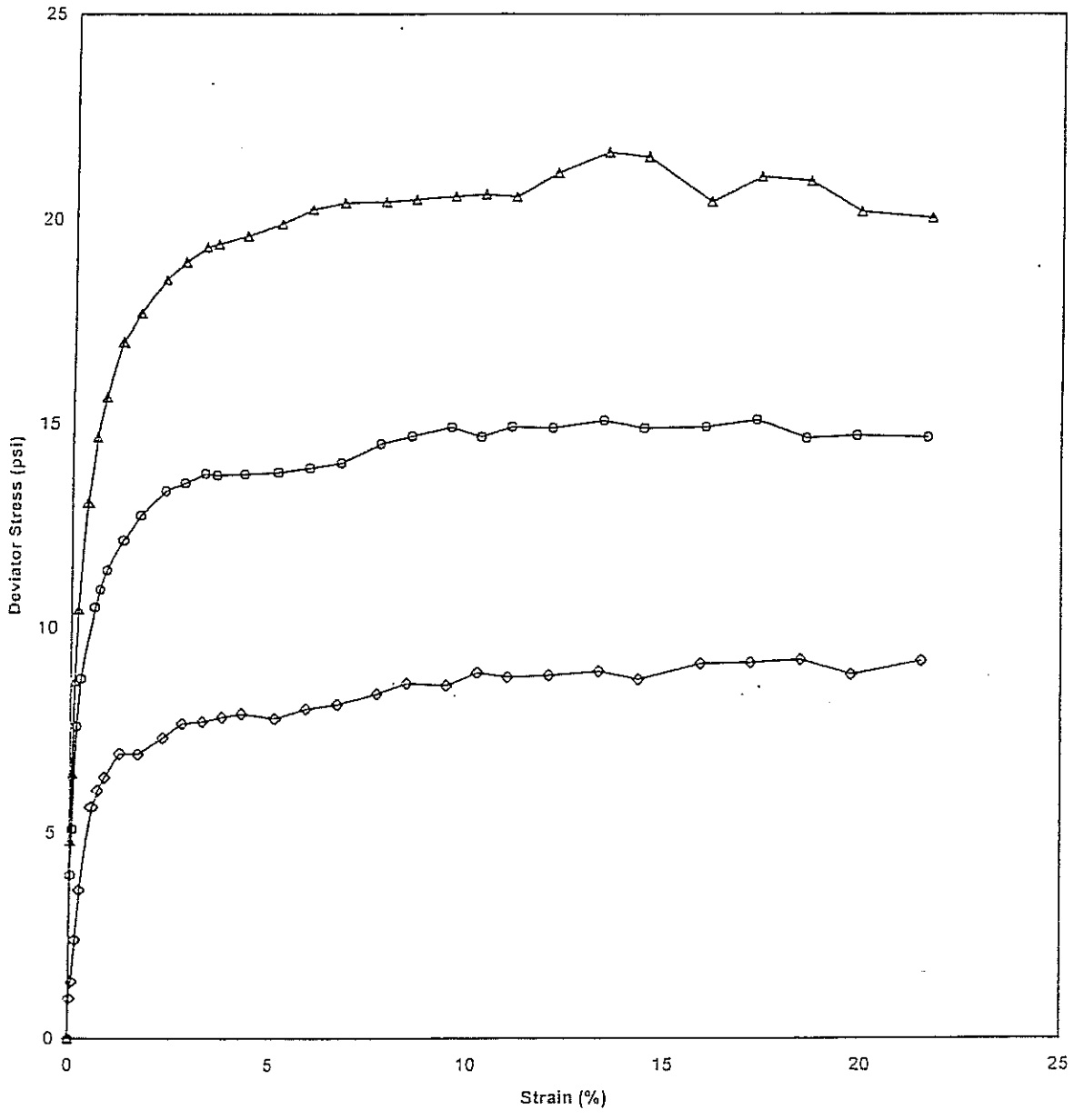
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	1

PRESSURES (psi)

Cell Pressure(psi)	36.6
Back Pressure(psi)	31.4
Eff. Cons. Pressure(psi)	5.2
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	6.41
Q	=	3.95

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.140	Diameter 1	1.375
Length 2	3.148	Diameter 2	1.389
Length 3	3.151	Diameter 3	1.399
Avg Leng.=	3.146	Avg. Diam.=	1.388

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.7
Final Change (ml)	2.3

Initial Dial Reading (D.R.), mils	235
D.R. After Saturation, mils	250
D.R. After Consolidation, mils	294

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.4
8.2	0.001	32.1
8.8	0.002	32.1
10.3	0.005	32.5
12.1	0.008	32.8
15.1	0.016	33.2
15.8	0.020	33.4
16.2	0.026	33.6
17.1	0.038	33.7
17.2	0.051	33.8
17.8	0.069	33.9
18.4	0.085	34.0
18.5	0.101	34.0
18.8	0.116	34.1
19.0	0.132	34.1
18.9	0.158	34.1
19.4	0.182	34.2
19.6	0.205	34.2
20.2	0.236	34.2
20.7	0.260	34.2
20.8	0.292	34.1
21.4	0.316	34.3
21.4	0.340	34.1
21.6	0.371	34.1
22.0	0.411	34.1
21.8	0.443	34.1
22.8	0.490	34.1
23.1	0.530	34.2
23.5	0.569	34.1
23.1	0.610	34.1
24.0	0.664	34.2

Tested By JCM Date 05/21/08 Input Checked By MB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.2	*Stage No.*	1
		Test No	1

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.51
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.55
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.474

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	0.98	0.73	5.45	4.5	1.219	0.76	4.96	0.49
0.07	1.39	0.75	5.84	4.5	1.311	0.55	5.14	0.69
0.15	2.40	1.15	6.46	4.1	1.593	0.49	5.25	1.20
0.25	3.62	1.36	7.46	3.8	1.941	0.38	5.65	1.81
0.52	5.63	1.79	9.04	3.4	2.649	0.32	6.23	2.81
0.66	6.03	2.01	9.22	3.2	2.893	0.34	6.20	3.02
0.84	6.35	2.21	9.34	3.0	3.125	0.36	6.16	3.18
1.22	6.92	2.33	9.79	2.9	3.417	0.34	6.33	3.46
1.64	6.91	2.40	9.71	2.8	3.469	0.35	6.26	3.46
2.25	7.31	2.55	9.96	2.7	3.753	0.36	6.31	3.65
2.75	7.66	2.61	10.25	2.6	3.961	0.35	6.42	3.83
3.27	7.71	2.64	10.26	2.6	4.017	0.35	6.41	3.85
3.77	7.81	2.68	10.34	2.5	4.098	0.35	6.43	3.91
4.28	7.90	2.74	10.37	2.5	4.208	0.35	6.41	3.95
5.11	7.78	2.71	10.27	2.5	4.124	0.36	6.38	3.89
5.89	8.02	2.84	10.38	2.4	4.400	0.36	6.37	4.01
6.65	8.13	2.78	10.56	2.4	4.359	0.35	6.49	4.07
7.66	8.39	2.83	10.76	2.4	4.538	0.34	6.56	4.19
8.42	8.64	2.76	11.09	2.4	4.536	0.33	6.77	4.32
9.45	8.59	2.72	11.07	2.5	4.464	0.32	6.77	4.29
10.23	8.90	2.86	11.25	2.3	4.797	0.33	6.79	4.45
11.00	8.80	2.67	11.33	2.5	4.474	0.31	6.93	4.40
12.03	8.83	2.74	11.29	2.5	4.594	0.32	6.87	4.42
13.30	8.93	2.72	11.41	2.5	4.601	0.31	6.94	4.46
14.34	8.73	2.69	11.25	2.5	4.477	0.31	6.88	4.37
15.88	9.12	2.66	11.66	2.5	4.587	0.30	7.10	4.56
17.15	9.15	2.77	11.59	2.4	4.762	0.31	7.01	4.58
18.44	9.22	2.70	11.72	2.5	4.691	0.30	7.11	4.61
19.74	8.86	2.70	11.36	2.5	4.536	0.31	6.93	4.43
21.51	9.19	2.82	11.56	2.4	4.864	0.31	6.97	4.59

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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ent	CEC	Boring No.	SOUTH POND
ient Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	2

PRESSURES (psi)

Cell Pressure(psi)	46.5
Back Pressure(psi)	36.1
Eff. Cons. Pressure(ps	10.4
Pore Pressure Response (%)	100

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	11.84
Q	=	7.45

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.120	Diameter 1	1.396
Length 2	3.137	Diameter 2	1.398
Length 3	3.135	Diameter 3	1.344
Avg Leng.=	3.131	Avg. Diam.=	1.379

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	18.4
Final Change (ml)	5.6

Initial Dial Reading (D.R.), mils	77
D.R. After Saturation, mils	112
D.R. After Consolidation, mils	166

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.9	0.000	36.1
13.4	0.001	36.8
14.9	0.002	37.0
18.3	0.005	37.4
20.0	0.008	37.8
22.4	0.017	38.7
23.0	0.020	38.9
23.7	0.026	39.3
24.8	0.038	39.9
25.7	0.051	40.3
26.7	0.069	40.9
27.1	0.085	41.1
27.5	0.100	41.3
27.5	0.110	41.5
27.7	0.131	41.6
27.9	0.157	41.8
28.2	0.181	41.9
28.6	0.204	41.9
29.5	0.235	42.0
30.0	0.259	42.1
30.5	0.290	42.1
30.4	0.313	42.0
31.0	0.337	42.1
31.2	0.368	42.0
31.8	0.408	42.2
31.8	0.439	42.1
32.3	0.486	42.1
33.0	0.526	42.2
32.6	0.565	42.1
33.1	0.604	42.2
33.6	0.659	42.2

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

ent	CEC	Boring No.	SOUTH POND
lient Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.4	*Stage No.*	1
		Test No	2

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.49
Initial Sample Volume (in^3)	4.68

VOLUME CHANGE

Volume After Consolidation (in^3)	4.18
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.03	3.98	0.65	13.73	9.7	1.408	0.16	11.74	1.99
0.06	5.09	0.89	14.59	9.5	1.535	0.18	12.05	2.54
0.15	7.59	1.34	16.65	9.1	1.838	0.18	12.85	3.79
0.25	8.76	1.72	17.44	8.7	2.010	0.20	13.06	4.38
0.54	10.51	2.62	18.29	7.8	2.351	0.25	13.04	5.26
0.67	10.94	2.79	18.56	7.6	2.438	0.25	13.08	5.47
0.86	11.42	3.19	18.64	7.2	2.584	0.28	12.92	5.71
1.25	12.16	3.85	18.71	6.6	2.856	0.32	12.63	6.08
1.67	12.77	4.19	18.98	6.2	3.055	0.33	12.60	6.38
2.28	13.37	4.77	19.00	5.6	3.373	0.36	12.32	6.68
2.79	13.56	5.04	18.92	5.4	3.530	0.37	12.14	6.78
3.30	13.79	5.25	18.94	5.2	3.675	0.38	12.05	6.89
3.60	13.76	5.40	18.76	5.0	3.751	0.39	11.88	6.88
4.32	13.77	5.50	18.67	4.9	3.812	0.40	11.79	6.89
5.16	13.82	5.69	18.52	4.7	3.934	0.41	11.62	6.91
5.95	13.93	5.80	18.52	4.6	4.029	0.42	11.56	6.96
6.72	14.04	5.83	18.61	4.6	4.072	0.42	11.59	7.02
7.73	14.51	5.87	19.04	4.5	4.205	0.40	11.78	7.26
8.52	14.69	6.01	19.08	4.4	4.349	0.41	11.73	7.35
9.54	14.91	6.01	19.30	4.4	4.397	0.40	11.84	7.45
10.30	14.68	5.94	19.15	4.5	4.289	0.40	11.80	7.34
11.07	14.93	6.00	19.33	4.4	4.390	0.40	11.87	7.46
12.10	14.89	5.95	19.34	4.5	4.346	0.40	11.90	7.45
13.40	15.08	6.10	19.38	4.3	4.506	0.40	11.84	7.54
14.44	14.89	6.03	19.25	4.4	4.410	0.41	11.81	7.44
15.98	14.92	5.99	19.34	4.4	4.381	0.40	11.88	7.46
17.28	15.10	6.12	19.38	4.3	4.528	0.41	11.83	7.55
18.58	14.65	5.96	19.09	4.4	4.303	0.41	11.76	7.33
19.86	14.71	6.07	19.04	4.3	4.398	0.41	11.68	7.35
21.67	14.66	6.08	18.99	4.3	4.393	0.41	11.65	7.33

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	3

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	20.4
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	17.19
Q	=	10.31

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.130	Diameter 1	1.404
Length 2	3.121	Diameter 2	1.373
Length 3	3.136	Diameter 3	1.371
Avg Leng.=	3.129	Avg. Diam.=	1.383

VOLUME CHANGE

Initial Burette Reading (ml)	48.0
Final Burette Reading (ml)	40.5
Final Change (ml)	7.5
Initial Dial Reading (D.R.), mils	60
D.R. After Saturation, mils	68
D.R. After Consolidation, mils	154

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.0
13.5	0.001	34.0
15.7	0.002	34.5
18.9	0.003	35.2
21.3	0.005	35.9
25.0	0.011	37.4
27.3	0.017	38.5
28.7	0.024	39.4
30.6	0.036	40.5
31.7	0.049	41.4
33.1	0.067	42.3
33.8	0.083	42.8
34.5	0.099	43.2
34.7	0.108	43.4
35.2	0.131	43.7
35.9	0.157	44.0
36.6	0.180	44.2
37.1	0.204	44.3
37.5	0.236	44.4
37.8	0.260	44.4
38.3	0.290	44.5
38.7	0.314	44.5
38.8	0.337	44.5
40.1	0.369	44.6
41.4	0.408	44.6
41.7	0.440	44.6
40.5	0.488	44.6
42.1	0.527	44.6
42.5	0.566	44.6
41.7	0.605	44.6
42.3	0.660	44.7

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN CT-S28 DATE 6-25-96 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.4	*Stage No.*	1
		Test No	3

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.20
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.385

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	4.82	3.04	22.17	17.4	1.278	0.64	19.76	2.41
0.05	6.44	3.45	23.39	16.9	1.380	0.54	20.17	3.22
0.10	8.70	4.15	24.95	16.2	1.536	0.48	20.60	4.35
0.17	10.46	4.86	26.01	15.5	1.673	0.47	20.77	5.23
0.37	13.09	6.38	27.10	14.0	1.934	0.49	20.56	6.54
0.58	14.68	7.49	27.59	12.9	2.137	0.52	20.25	7.34
0.80	15.66	8.40	27.66	12.0	2.305	0.54	19.83	7.83
1.18	17.01	9.52	27.89	10.9	2.563	0.57	19.38	8.50
1.61	17.71	10.40	27.71	10.0	2.772	0.59	18.85	8.86
2.22	18.54	11.31	27.63	9.1	3.039	0.62	18.36	9.27
2.74	18.96	11.76	27.60	8.6	3.196	0.63	18.12	9.48
3.26	19.34	12.21	27.53	8.2	3.361	0.64	17.86	9.67
3.57	19.40	12.35	27.45	8.0	3.411	0.64	17.75	9.70
4.31	19.60	12.73	27.27	7.7	3.556	0.66	17.47	9.80
5.17	19.89	12.96	27.33	7.4	3.676	0.66	17.38	9.95
5.94	20.25	13.15	27.50	7.2	3.795	0.66	17.37	10.13
6.73	20.42	13.27	27.54	7.1	3.864	0.66	17.34	10.21
7.78	20.44	13.38	27.46	7.0	3.912	0.66	17.24	10.22
8.55	20.50	13.40	27.50	7.0	3.928	0.66	17.25	10.25
9.57	20.57	13.48	27.49	6.9	3.973	0.66	17.20	10.28
10.34	20.62	13.52	27.50	6.9	3.995	0.66	17.19	10.31
11.11	20.56	13.51	27.45	6.9	3.982	0.66	17.17	10.28
12.15	21.14	13.55	27.99	6.8	4.088	0.65	17.42	10.57
13.45	21.64	13.57	28.47	6.8	4.170	0.63	17.65	10.82
14.49	21.53	13.56	28.36	6.8	4.149	0.64	17.60	10.76
16.07	20.44	13.58	27.26	6.8	3.997	0.67	17.04	10.22
17.35	21.06	13.58	27.88	6.8	4.086	0.65	17.35	10.53
18.64	20.95	13.63	27.72	6.8	4.094	0.66	17.25	10.48
19.92	20.20	13.64	26.96	6.8	3.988	0.68	16.86	10.10
21.74	20.03	13.67	26.77	6.7	3.975	0.69	16.75	10.02

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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MOHR TOTAL STRENGTH ENVELOPE

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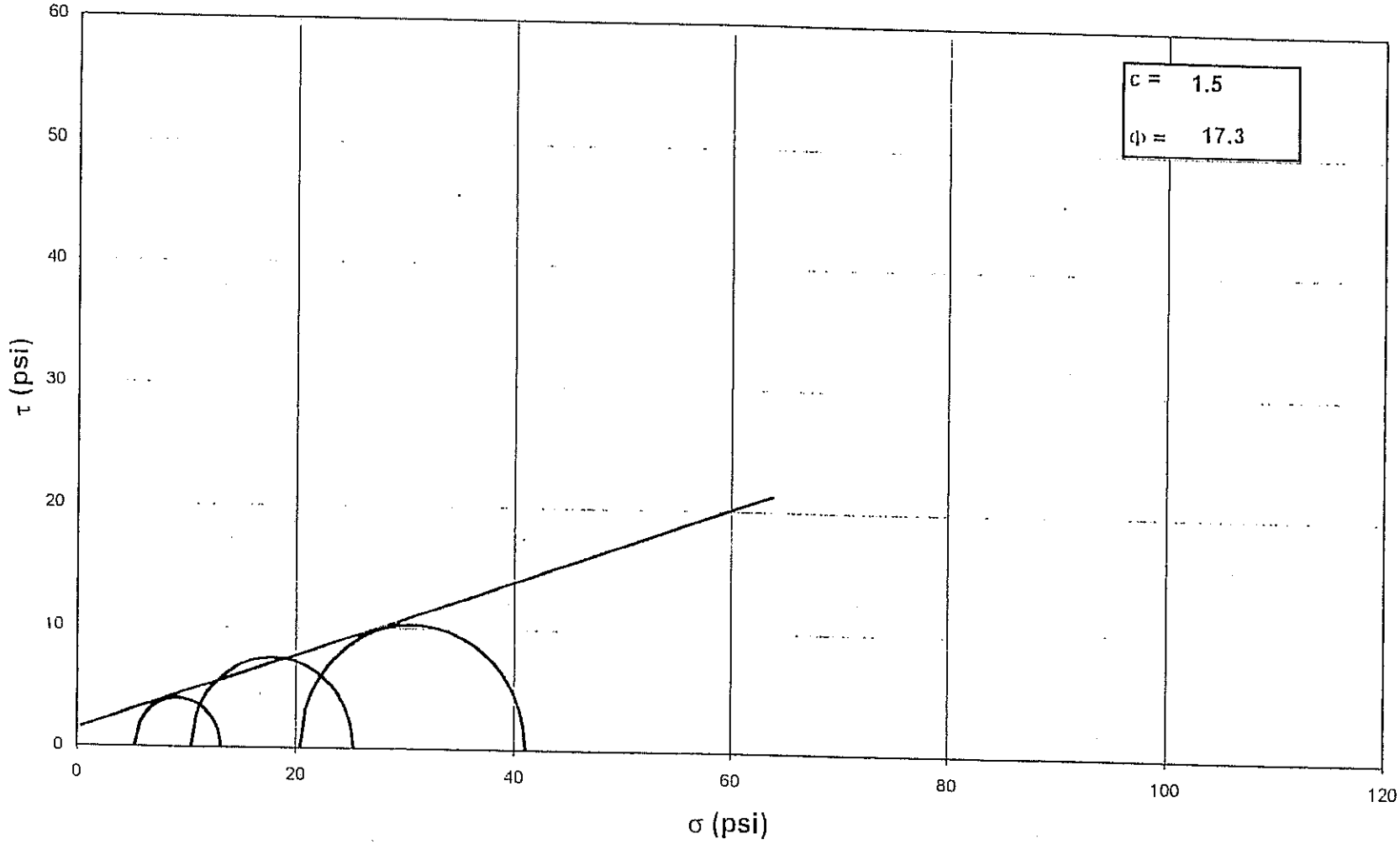
Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/19/08

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	82.6	82.7	79.5
Total Unit Weight (pcf)	76.6	84.2	80.5
Dry Unit Weight (pcf)	42.0	46.1	44.8
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	2.333	2.035	2.119

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	41.7	43.3	42.4
Total Unit Weight (pcf)	102.0	102.5	101.8
Dry Unit Weight (pcf)	71.9	71.5	71.5
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	0.944	0.955	0.956

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

DCN CT-S28 DATE 6-25-96 REVISION 1

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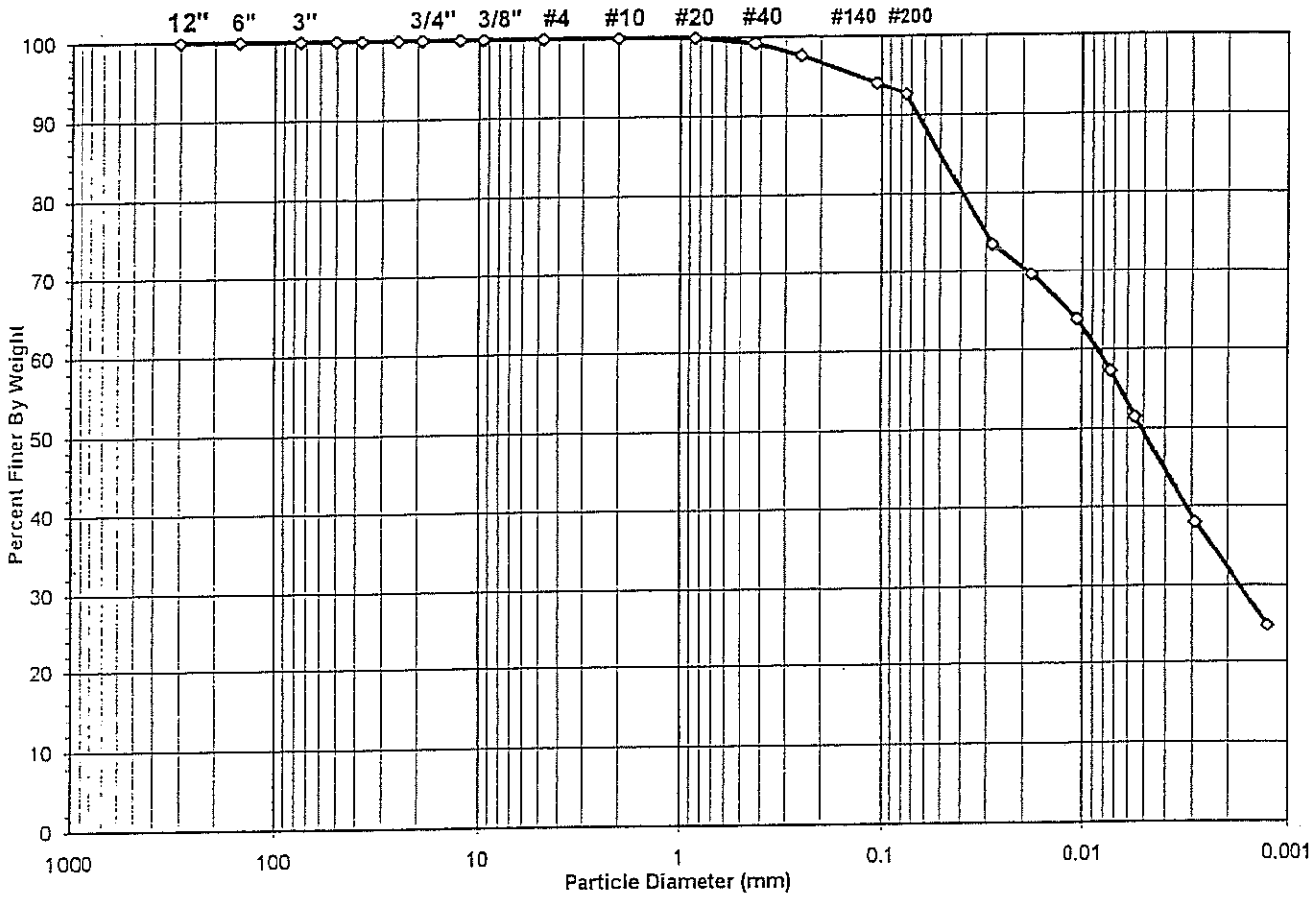
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Color	BLACK

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	7.38
Finer Than #200	*Silt & Clay*	92.62

USCS Symbol *CL, TESTED*

USCS Classification *LEAN CLAY*

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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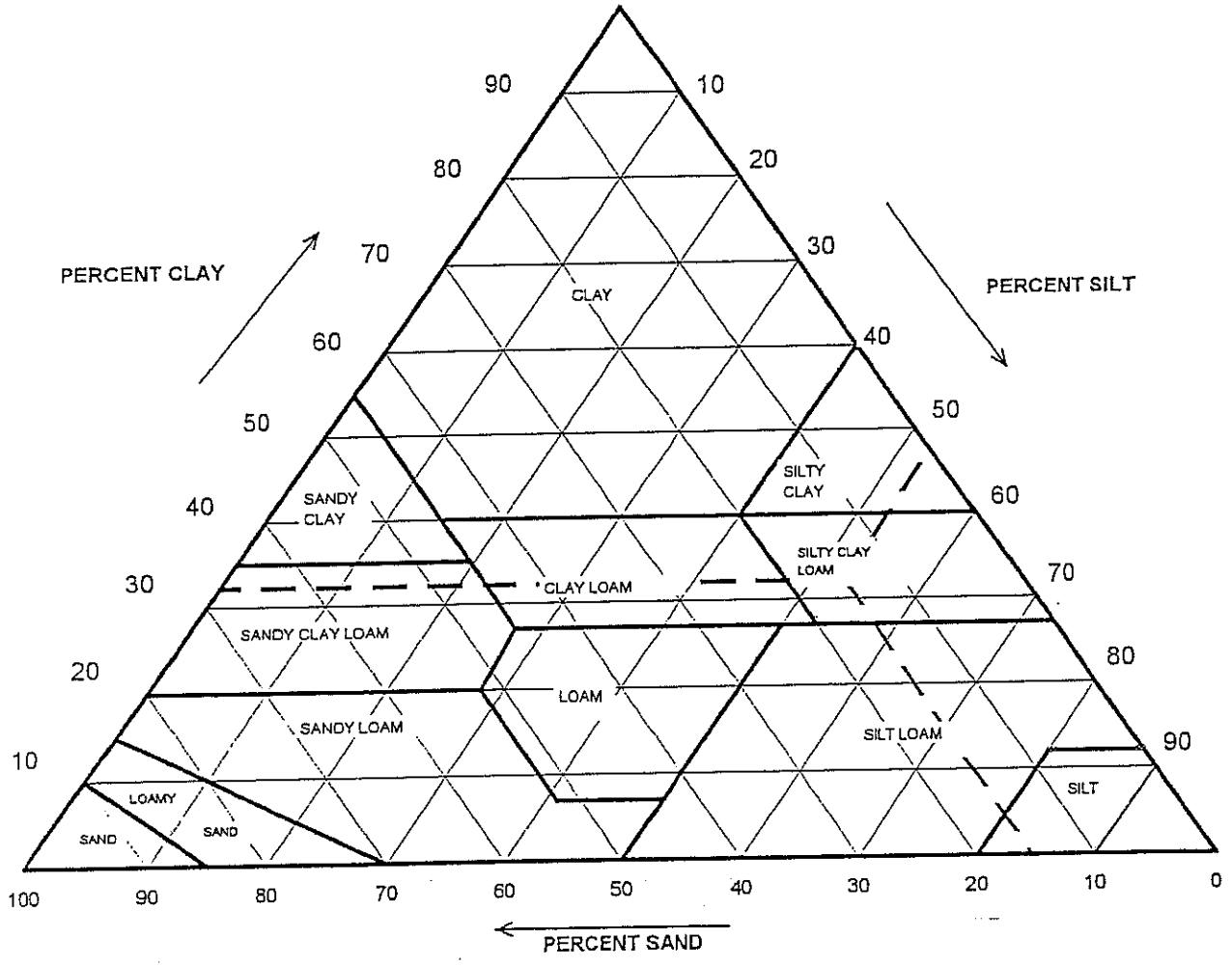
USDA CLASSIFICATION CHART

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Color	BLACK



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.00	0.00
2	100.00	*Sand*	15.22	15.22
0.05	84.78	*Silt*	52.64	52.64
0.002	32.14	*Clay*	32.14	32.14

USDA Classification: *SILTY CLAY LOAM*

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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WASH SIEVE ANALYSIS

ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Color	BLACK

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	517	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	1095.30	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	630.20	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	97.36	Weight of Tare (gm)	NA
Weight of Water (gm)	465.10	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	532.84	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**87.3**	**Moisture Content (%)**	NA

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	532.84
Dry Weight - 3/4" Sample (gm)	39.31	Weight of minus #200 material (gm)	493.53
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	39.31
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	100.00
6"	150	0.00	0.00	0.00	100.00	100.00
3"	75	0.00	0.00	0.00	100.00	100.00
2"	50	0.00	0.00	0.00	100.00	100.00
1 1/2"	37.5	0.00	0.00	0.00	100.00	100.00
1"	25.0	0.00	0.00	0.00	100.00	100.00
3/4"	19.0	0.00	0.00	0.00	100.00	100.00
1/2"	12.5	0.00	0.00	0.00	100.00	100.00
3/8"	9.50	0.00	0.00	0.00	100.00	100.00
#4	4.75	0.00	0.00	0.00	100.00	100.00
#10	2.00	0.00	0.00	0.00	100.00	100.00
#20	0.85	0.13	0.02	0.02	99.98	99.98
#40	0.425	3.63	0.68	0.71	99.29	99.29
#60	0.250	8.79	1.65	2.36	97.64	97.64
#140	0.106	19.00	3.57	5.92	94.08	94.08
#200	0.075	7.76	1.46	7.38	92.62	92.62
Pan	-	493.53	92.62	100.00	-	-

Tested By JP Date 5/21/08 Checked By [signature] Date 5-23-08

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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HYDROMETER ANALYSIS

ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Color	BLACK

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	44.5	21.9	6.02	38.5	79.3	0.01314	0.0279	**73.5**
5	42.5	21.9	6.02	36.5	75.2	0.01314	0.0180	**69.7**
15	39.5	21.9	6.02	33.5	69.0	0.01314	0.0106	**63.9**
34	36.0	21.9	6.02	30.0	61.8	0.01314	0.0073	**57.2**
62	33.0	21.8	6.07	26.9	55.5	0.01316	0.0055	**51.4**
250	26.0	21.7	6.11	19.9	41.0	0.01317	0.0029	**38.0**
1440	19.0	21.9	6.02	13.0	26.8	0.01314	0.0013	**24.8**

Soil Specimen Data		Other Corrections	
Tare No.	2343		
Tare + Dry Material (gm)	151.6	a - Factor	0.99
Weight of Tare (gm)	98.58		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 200	92.62
Weight of Dry Material (gm)	48.02		
		Specific Gravity	2.7 Assumed

Note: Hydrometer test is performed on - # 200 sieve material.

Tested By TO Date 5/21/08 Checked By MB Date 5-23-08

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Description	BLACK LEAN CLAY

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

(Minus No. 40 sieve material, Airdried)

Liquid Limit Test	1	2	3
Tare Number	250	20	284
Wt. of Tare & WS (gm)	37.67	39.66	39.57
Wt. of Tare & DS (gm)	32.45	34.22	33.70
Wt. of Tare (gm)	17.54	19.33	18.37
Wt. of Water (gm)	5.2	5.4	5.9
Wt. of DS (gm)	14.9	14.9	15.3
Moisture Content (%)	**35.0**	**36.5**	**38.3**
Number of Blows	**31**	**22**	**15**

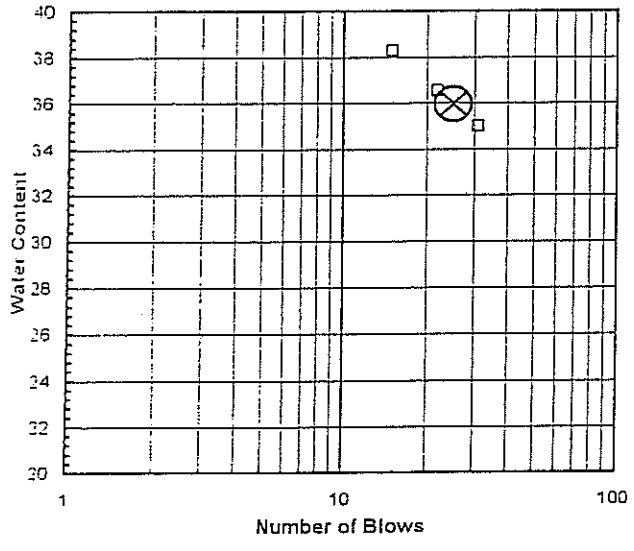
MULTIPOINT

Plastic Limit Test	1	2	Range
Tare Number	43	274	
Wt. of Tare & WS (gm)	25.49	26.20	
Wt. of Tare & DS (gm)	24.45	25.21	
Wt. of Tare (gm)	19.03	19.96	
Wt. of Water (gm)	1.0	1.0	
Wt. of DS (gm)	5.4	5.3	
Moisture Content (%)	**19.2**	**18.9**	**0.3**

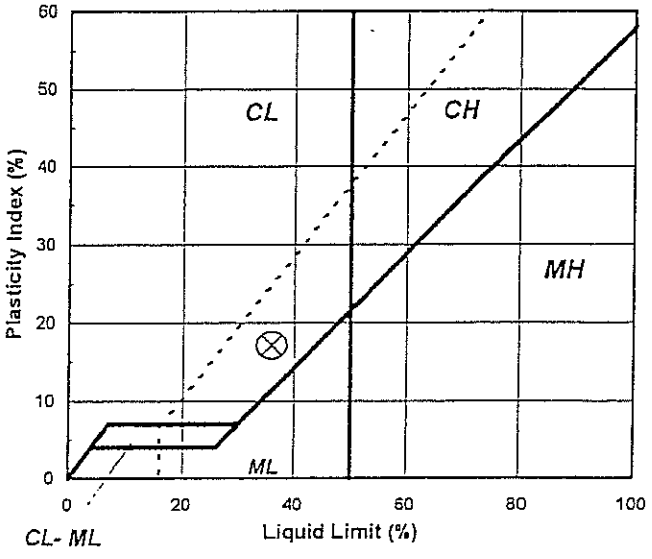
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	36
Plastic Limit (%)	19
Plasticity Index (%)	17
USCS Symbol	CL

Flow Curve



Plasticity Chart



Tested By TO *Date* 5/21/08 *Checked By* AR *Date* 5-23-08

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SPECIFIC GRAVITY

ASTM D 854-02, AASHTO T100-03 (SOP - S5)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Visual Description	BLACK SLUDGE
			(Minus No.4 sieve material, airdried)

Replicate Number	1	2
Pycnometer ID	G 1155	G 1156
Weight of Pycnometer + Soil + Water (gm)	738.67	736.62
Temperature, T (°Celsius)	23.6	22.8
Weight of Pycnometer + Water (gm)	682.72	681.37
Tare Number	932	966
Weight of Tare + Dry Soil (gm)	203.65	202.41
Weight of Tare (gm)	102.67	102.57
Weight of Dry Soil (gm)	100.98	99.84
Specific Gravity of Soil @ T	2.242	2.239
Specific Gravity of Water @ T	0.9974	0.9976
Conversion Factor for Temperature T	0.9992	0.9994
Specific Gravity @ 20° Celsius	2.244	2.240

Average Specific Gravity @ 20° Celsius	2.24

Tested By TO Date 05/20/08 Checked By KB Date 5-23-08

DCN: CT-S5 Date 09/25/06 Revision: 12

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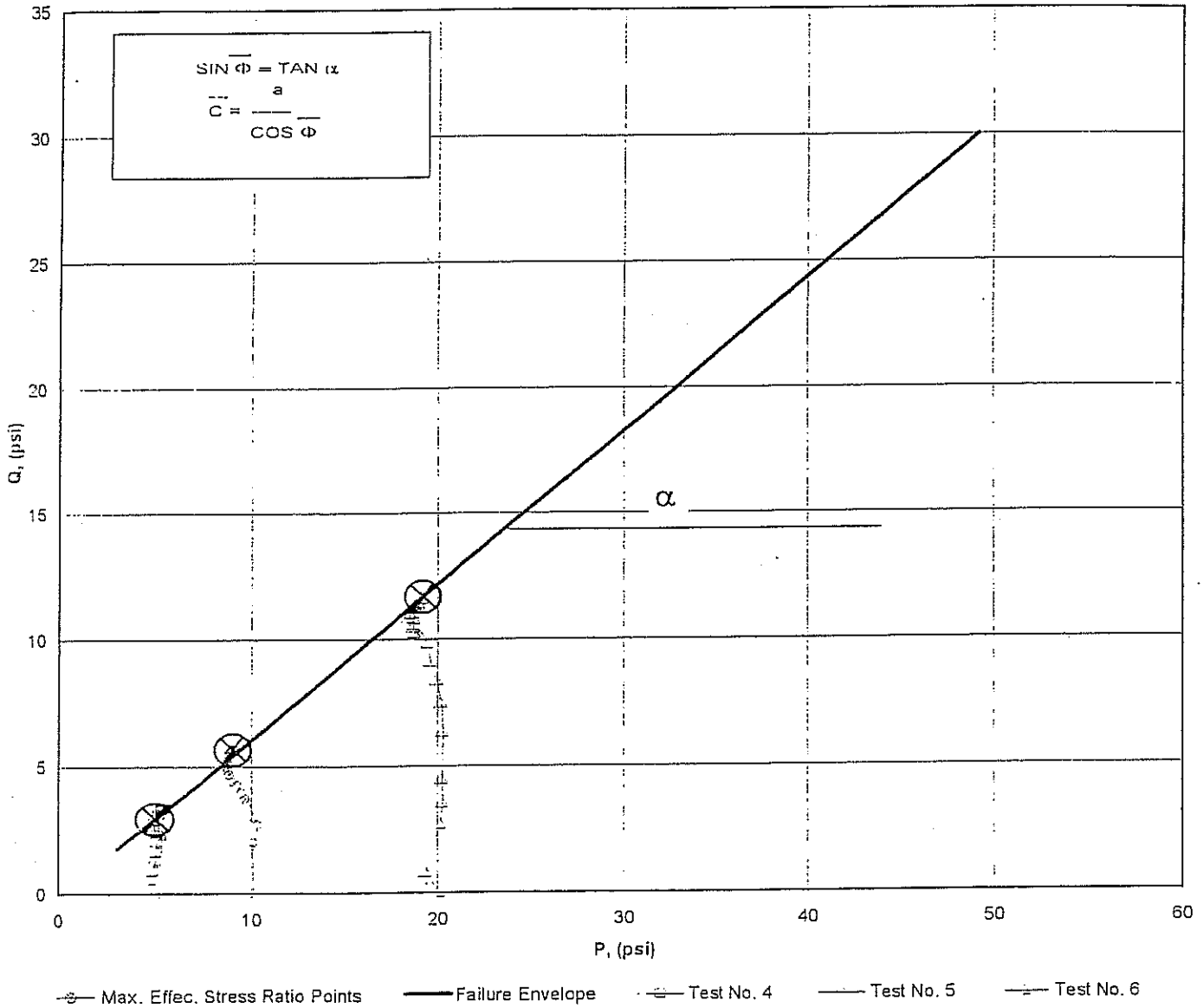
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	31.5	$\bar{\Phi}$	=	37.71

Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

DCN CT-S28 DATE 6-25-98 REVISION 1

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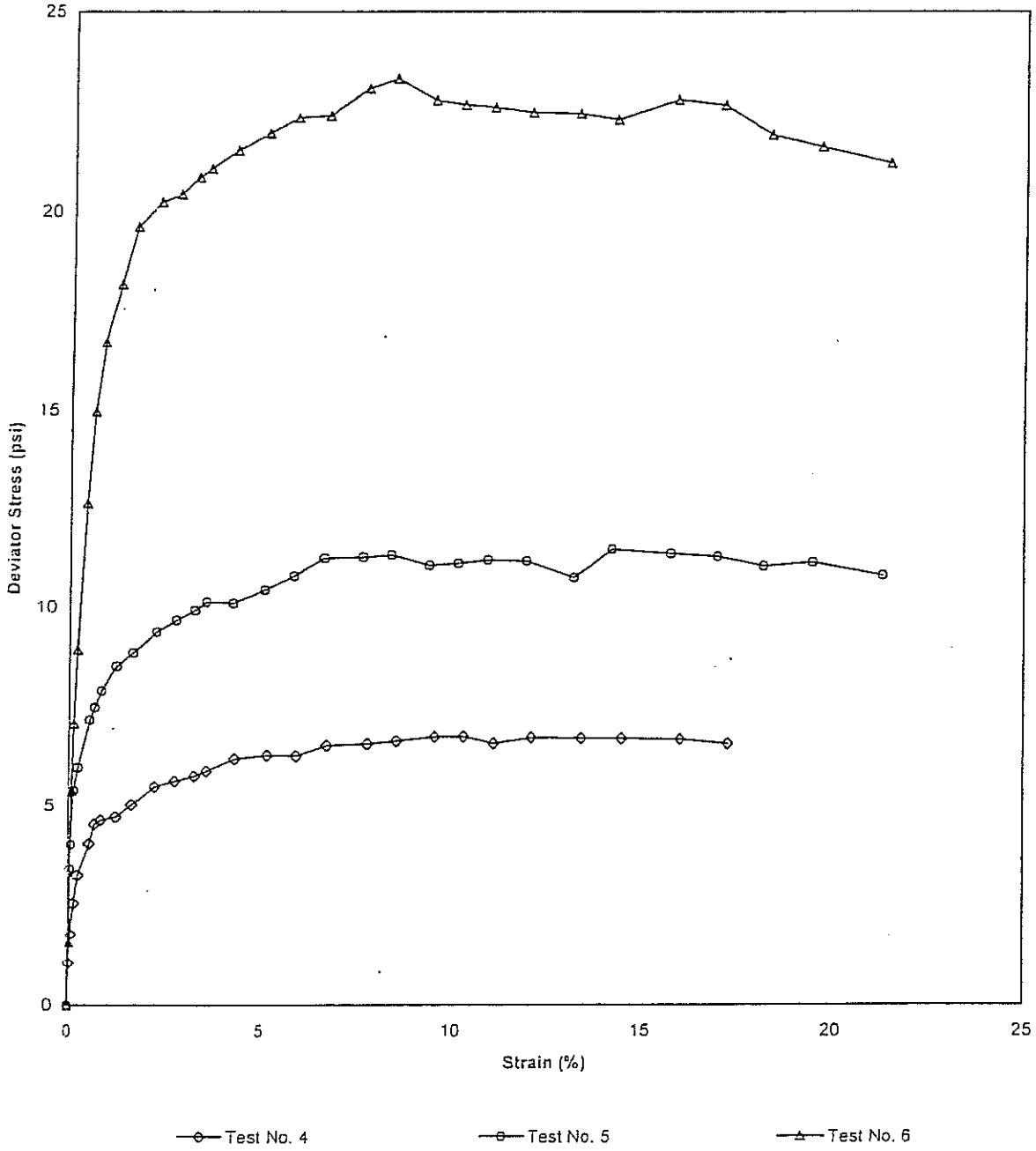
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	4

PRESSURES (psi)

Cell Pressure(psi)	36.3
Back Pressure(psi)	31.2
Eff. Cons. Pressure(psi)	5.1
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	4.92
Q	=	2.94

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.150	Diameter 1	1.453
Length 2	3.142	Diameter 2	1.463
Length 3	3.147	Diameter 3	1.461
Avg Leng.=	3.146	Avg. Diam.=	1.459

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.9
Final Change (ml)	2.1

Initial Dial Reading (D.R.), mils	54
D.R. After Saturation, mils	110
D.R. After Consolidation, mils	130

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.6	0.000	31.2
9.3	0.001	32.1
10.4	0.002	32.3
11.6	0.005	32.6
12.8	0.008	32.9
14.0	0.016	33.3
14.8	0.020	33.3
15.0	0.025	33.6
15.2	0.037	33.8
15.7	0.050	33.9
16.5	0.068	34.2
16.7	0.084	34.2
17.0	0.100	34.2
17.2	0.110	34.3
17.8	0.133	34.2
18.1	0.159	34.3
18.1	0.182	34.3
18.6	0.205	34.2
18.8	0.237	34.2
19.0	0.261	34.3
19.3	0.293	34.3
19.5	0.316	34.2
19.3	0.340	34.3
19.7	0.372	34.2
19.8	0.412	34.3
19.9	0.445	34.3
20.1	0.491	34.2
20.1	0.531	34.2

Tested By JCM Date 05/27/08 Input Checked By KRS Date 6-19-08

DCN CT-S28 DATE 6-26-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.1	*Stage No.*	1
		Test No	4

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.46
Initial Sample Area (in^2)	1.67
Initial Sample Volume (in^3)	5.26

VOLUME CHANGE

Volume After Consolidation (in^3)	4.85
Length After Consolidation (in)	3.07
Area After Consolidation (in^2)	1.580

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	1.06	0.90	5.26	4.2	1.253	0.86	4.73	0.53
0.07	1.77	1.15	5.72	4.0	1.449	0.66	4.84	0.89
0.15	2.55	1.44	6.21	3.7	1.698	0.58	4.94	1.28
0.25	3.26	1.71	6.65	3.4	1.959	0.53	5.02	1.63
0.53	4.05	2.11	7.04	3.0	2.358	0.53	5.01	2.03
0.65	4.54	2.14	7.50	3.0	2.531	0.48	5.23	2.27
0.82	4.65	2.39	7.36	2.7	2.712	0.52	5.04	2.32
1.21	4.72	2.58	7.25	2.5	2.873	0.56	4.89	2.36
1.62	5.03	2.72	7.42	2.4	3.112	0.55	4.90	2.52
2.22	5.48	2.95	7.63	2.1	3.550	0.55	4.89	2.74
2.74	5.62	3.02	7.70	2.1	3.705	0.55	4.89	2.81
3.27	5.75	3.04	7.81	2.1	3.790	0.54	4.93	2.87
3.59	5.88	3.12	7.86	2.0	3.968	0.54	4.92	2.94
4.33	6.18	3.02	8.27	2.1	3.967	0.50	5.17	3.09
5.17	6.27	3.08	8.30	2.0	4.101	0.50	5.16	3.14
5.93	6.25	3.13	8.22	2.0	4.176	0.51	5.10	3.13
6.69	6.51	3.03	8.58	2.1	4.152	0.48	5.32	3.26
7.73	6.56	3.04	8.62	2.1	4.176	0.47	5.34	3.28
8.50	6.63	3.14	8.59	2.0	4.380	0.48	5.27	3.31
9.53	6.72	3.14	8.68	2.0	4.436	0.48	5.32	3.36
10.30	6.74	3.03	8.81	2.1	4.256	0.46	5.44	3.37
11.09	6.56	3.07	8.59	2.0	4.235	0.48	5.31	3.28
12.10	6.71	3.03	8.78	2.1	4.233	0.46	5.43	3.35
13.42	6.69	3.06	8.74	2.0	4.281	0.47	5.39	3.35
14.49	6.68	3.10	8.68	2.0	4.342	0.47	5.34	3.34
16.00	6.66	3.02	8.74	2.1	4.204	0.46	5.41	3.33
17.29	6.55	3.03	8.62	2.1	4.171	0.47	5.34	3.28

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	5

PRESSURES (psi)

Cell Pressure(psi)	41.1
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	10.1
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	9.00
Q	=	5.66

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.138	Diameter 1	1.407
Length 2	3.138	Diameter 2	1.383
Length 3	3.137	Diameter 3	1.378
Avg Leng.=	3.138	Avg. Diam.=	1.389

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	20.2
Final Change (ml)	3.8
Initial Dial Reading (D.R.), mils	88
D.R. After Saturation, mils	94
D.R. After Consolidation, mils	124

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
8.5	0.000	31.0
13.5	0.001	32.8
14.3	0.002	33.0
16.3	0.004	33.4
17.2	0.007	33.9
18.9	0.016	34.9
19.4	0.020	35.2
20.0	0.025	35.6
21.0	0.038	36.1
21.5	0.051	36.6
22.4	0.070	37.0
22.9	0.085	37.2
23.4	0.101	37.4
23.7	0.110	37.4
23.8	0.132	37.5
24.5	0.158	37.6
25.1	0.181	37.7
26.0	0.205	37.7
26.2	0.236	37.7
26.4	0.259	37.8
26.2	0.290	37.7
26.4	0.314	37.8
26.7	0.338	37.8
26.9	0.370	37.8
26.5	0.410	37.8
27.9	0.441	37.8
28.0	0.488	37.8
28.2	0.527	37.8
28.1	0.566	37.8
28.5	0.605	37.8
28.4	0.661	37.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics
INTEGRITY IN TESTING

ent	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.1	*Stage No.*	1
		Test No	5

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.52
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.50
Length After Consolidation (in)	3.10
Area After Consolidation (in^2)	1.450

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	3.42	1.75	11.77	8.3	1.410	0.52	10.06	1.71
0.06	4.03	2.01	12.12	8.1	1.497	0.50	10.11	2.01
0.13	5.39	2.43	13.05	7.7	1.703	0.46	10.36	2.69
0.23	5.96	2.92	13.13	7.2	1.830	0.50	10.16	2.98
0.51	7.15	3.87	13.37	6.2	2.148	0.55	9.80	3.57
0.64	7.46	4.19	13.37	5.9	2.262	0.57	9.64	3.73
0.82	7.88	4.57	13.41	5.5	2.427	0.59	9.47	3.94
1.21	8.51	5.13	13.48	5.0	2.714	0.61	9.22	4.26
1.63	8.84	5.57	13.38	4.5	2.950	0.64	8.96	4.42
2.24	9.37	5.97	13.50	4.1	3.271	0.64	8.81	4.69
2.75	9.67	6.18	13.59	3.9	3.468	0.65	8.75	4.84
3.25	9.92	6.35	13.66	3.7	3.648	0.65	8.70	4.96
3.56	10.14	6.40	13.83	3.7	3.741	0.64	8.76	5.07
4.26	10.10	6.55	13.65	3.6	3.843	0.66	8.60	5.05
5.08	10.44	6.59	13.95	3.5	3.978	0.64	8.73	5.22
5.85	10.80	6.68	14.21	3.4	4.161	0.63	8.81	5.40
6.60	11.25	6.70	14.65	3.4	4.304	0.60	9.03	5.62
7.60	11.27	6.75	14.63	3.4	4.363	0.60	8.99	5.64
8.34	11.32	6.76	14.66	3.3	4.395	0.60	9.00	5.66
9.36	11.06	6.74	14.42	3.4	4.292	0.62	8.89	5.53
10.13	11.11	6.76	14.46	3.3	4.323	0.61	8.90	5.56
10.91	11.20	6.81	14.49	3.3	4.401	0.61	8.89	5.60
11.94	11.17	6.80	14.47	3.3	4.383	0.62	8.88	5.58
13.21	10.75	6.76	14.09	3.3	4.214	0.64	8.72	5.37
14.21	11.47	6.77	14.80	3.3	4.445	0.60	9.06	5.73
15.72	11.35	6.78	14.67	3.3	4.418	0.60	9.00	5.68
16.98	11.28	6.79	14.59	3.3	4.411	0.61	8.95	5.64
18.25	11.04	6.80	14.33	3.3	4.350	0.62	8.81	5.52
19.51	11.13	6.82	14.40	3.3	4.397	0.62	8.84	5.56
1.32	10.80	6.85	14.05	3.3	4.318	0.64	8.65	5.40

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	6

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.3
Eff. Cons. Pressure(ps	20.1
Pore Pressure Response (%)	97

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	19.19
Q	=	11.67

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.142	Diameter 1	1.379
Length 2	3.130	Diameter 2	1.377
Length 3	3.141	Diameter 3	1.386
Avg Leng.=	3.138	Avg. Diam.=	1.381

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	17.7
Final Change (ml)	6.3
Initial Dial Reading (D.R.), mils	40
D.R. After Saturation, mils	56
D.R. After Consolidation, mils	91

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
4.3	0.000	31.3
6.5	0.001	32.8
11.7	0.002	33.9
14.0	0.004	34.7
16.6	0.006	35.6
21.7	0.012	37.4
25.0	0.019	38.7
27.5	0.026	39.8
29.6	0.038	40.9
31.7	0.051	41.7
32.8	0.070	42.4
33.2	0.085	42.8
33.9	0.101	43.1
34.3	0.110	43.2
35.2	0.132	43.4
36.1	0.157	43.7
37.0	0.181	43.7
37.3	0.205	43.8
38.7	0.236	43.8
39.3	0.259	43.9
38.9	0.291	43.8
39.0	0.316	43.9
39.2	0.340	43.9
39.4	0.371	43.8
39.9	0.410	43.8
40.1	0.441	43.9
41.5	0.489	43.8
41.9	0.528	43.7
41.2	0.568	43.8
41.3	0.608	43.8
41.4	0.663	43.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.1	*Stage No.*	1
		Test No	6

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.24
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	1.58	1.52	20.16	18.6	1.085	0.99	19.37	0.79
0.07	5.38	2.62	22.86	17.5	1.308	0.50	20.17	2.69
0.12	7.06	3.36	23.80	16.7	1.422	0.49	20.27	3.53
0.19	8.92	4.30	24.73	15.8	1.565	0.50	20.26	4.46
0.40	12.65	6.12	26.62	14.0	1.905	0.50	20.30	6.32
0.61	14.97	7.35	27.72	12.7	2.174	0.51	20.23	7.48
0.85	16.72	8.47	28.36	11.6	2.438	0.52	19.99	8.36
1.24	18.18	9.56	28.72	10.5	2.724	0.54	19.63	9.09
1.64	19.63	10.41	29.32	9.7	3.025	0.55	19.51	9.81
2.26	20.24	11.15	29.19	9.0	3.262	0.57	19.07	10.12
2.77	20.44	11.54	29.00	8.6	3.388	0.58	18.78	10.22
3.26	20.87	11.82	29.15	8.3	3.521	0.58	18.71	10.43
3.58	21.09	11.94	29.25	8.2	3.584	0.58	18.70	10.54
4.27	21.54	12.14	29.50	8.0	3.705	0.58	18.73	10.77
5.09	21.97	12.38	29.69	7.7	3.846	0.58	18.71	10.99
5.86	22.37	12.43	30.04	7.7	3.918	0.57	18.85	11.19
6.64	22.41	12.54	29.98	7.6	3.962	0.58	18.77	11.21
7.63	23.10	12.49	30.71	7.6	4.034	0.56	19.16	11.55
8.39	23.33	12.58	30.85	7.5	4.102	0.56	19.19	11.67
9.43	22.79	12.55	30.34	7.6	4.018	0.57	18.95	11.39
10.22	22.67	12.59	30.18	7.5	4.021	0.57	18.84	11.34
11.00	22.61	12.56	30.14	7.5	4.001	0.57	18.84	11.30
12.01	22.49	12.53	30.05	7.6	3.973	0.57	18.81	11.24
13.28	22.46	12.52	30.04	7.6	3.961	0.57	18.81	11.23
14.28	22.30	12.63	29.77	7.5	3.986	0.58	18.62	11.15
15.84	22.80	12.50	30.40	7.6	4.001	0.57	19.00	11.40
17.12	22.66	12.41	30.35	7.7	3.948	0.56	19.02	11.33
18.40	21.92	12.46	29.57	7.6	3.868	0.59	18.61	10.96
19.69	21.62	12.51	29.21	7.6	3.846	0.60	18.40	10.81
21.49	21.21	12.54	28.77	7.6	3.805	0.61	18.17	10.61

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MOHR TOTAL STRENGTH ENVELOPE

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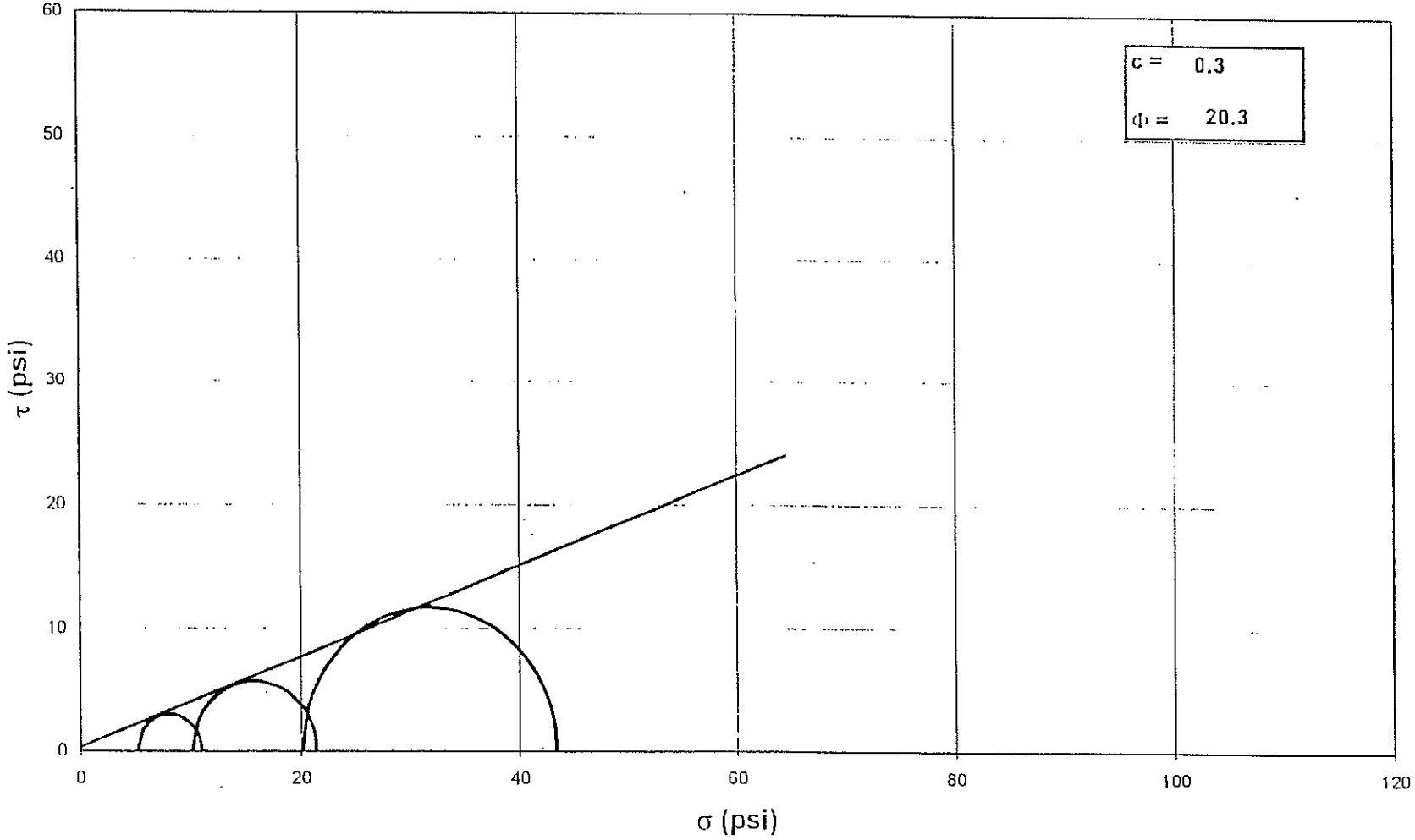
Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/14/08

#N/A

R13071

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	82.9	85.7	83.0
Total Unit Weight (pcf)	82.6	82.2	84.5
Dry Unit Weight (pcf)	45.2	44.3	46.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	2.095	2.159	2.029

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-5-08

DCN CT-528 DATE 6-25-98 REVISION 1

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	41.5	41.5	40.9
Total Unit Weight (pcf)	92.9	102.5	103.2
Dry Unit Weight (pcf)	65.7	72.4	73.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	1.129	0.931	0.910

Tested By JCM Date 05/27/08 Input Checked By Date

DCN CT-S28 DATE 5-25-98 REVISION 1 C:\MSOFFICE\Excel\Printq\[F187.xls]Sheet1

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ATTACHMENT 2

LABORATORY TESTING RESULTS – RESIDUAL SOIL AND COARSE COAL REFUSE
HOLCOLM FOUNDATION ENGINEERING COMPANY, INC.
(PROVIDED BY ALLIANCE CONSULTING, INC.)

7 of 57

(1)

HOLCOMB FOUNDATION ENGINEERING CO., INC.

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P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

February 10, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Soil Boring and Laboratory Tests
Boring #8874
Mach Mine #1
Johnston City, Illinois
HFE File H-05278
Mach Mining Purchase Order No. _____

Dear Sir:

In accordance with your instructions, on February 1, 2006, we drilled one soil boring and sampled the subsoils with Shelby tubes. The soil sample taken from 10 to 12 feet in depth was subjected to laboratory tests. Results of the tests are as follows:

Boring No.:	8874
Depth:	8.0-10.0'
Visual Classification:	Silty CLAY (CL)
Atterberg Limits:	LL = 41.8% PL = 17.7% PI = 24.1
Unit Weight:	105.3 PCF
Moisture Content:	21.5%
Effective Cohesion:	0 PSF
Effective Phi Angle:	26.8 Degrees

All Tubes From Boring 8874

8 of 51

(2)

The Boring Log and test results are enclosed. If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

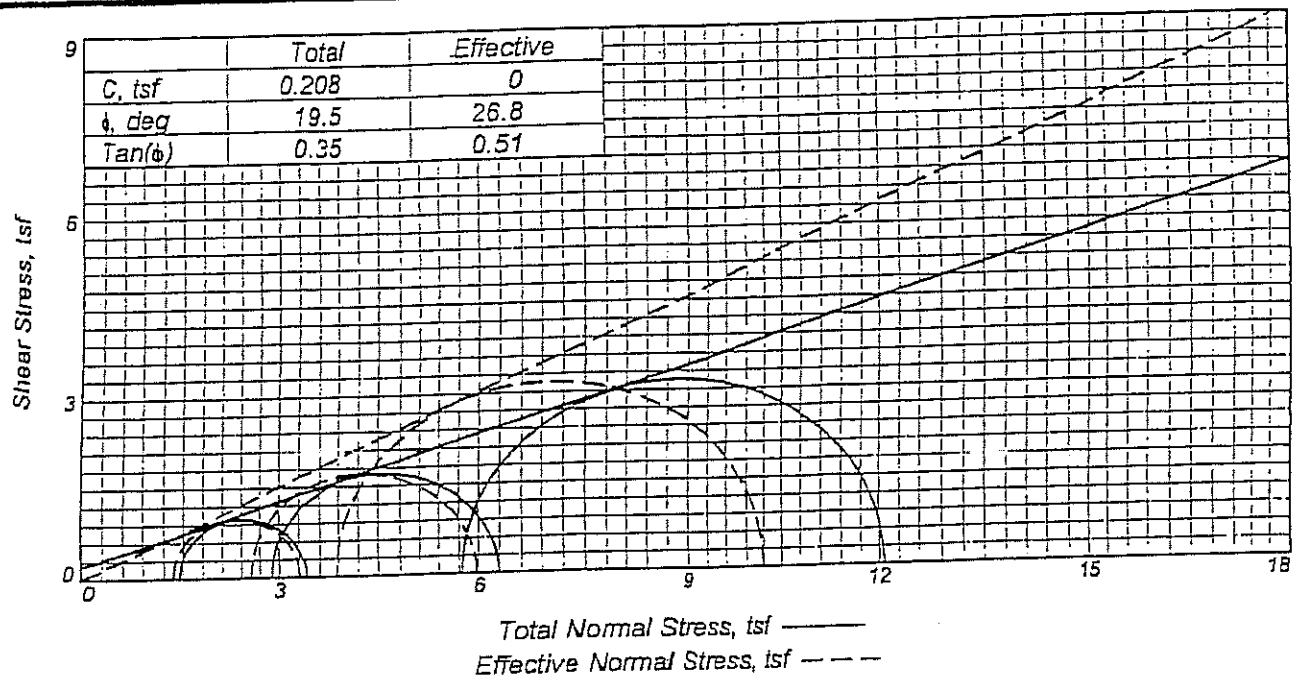
REGISTERED PROFESSIONAL ENGINEER
TIMOTHY J.
HOLCOMB
062-042149
2-10-06
ILLINOIS

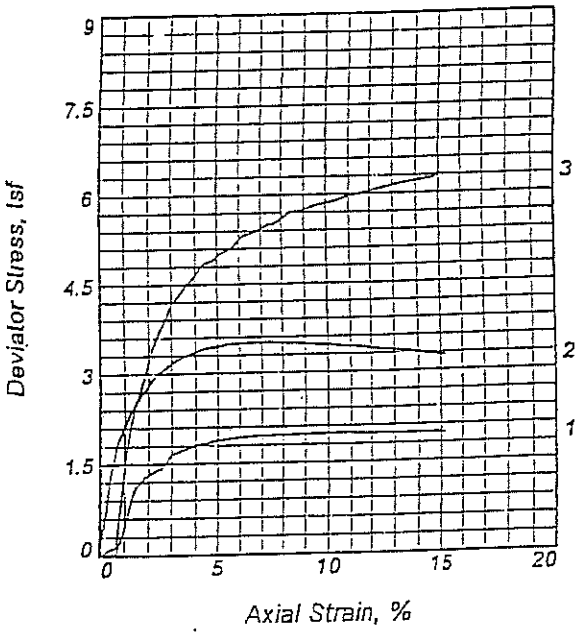
1 copy: Fred Vass - Alliance Consulting

17 21

(3)

	Total	Effective
C, tsf	0.208	0
ϕ, deg	19.5	26.8
Tan(ϕ)	0.35	0.51





Sample No.		1	2	3
Initial	Water Content,	21.5	20.8	17.6
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	99.7	98.9
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
At Test	Water Content,	21.5	20.9	17.8
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.6	3.6	2.2
Cell Pressure, tsf		5.0	6.5	7.9
Fail. Stress, tsf		2.0	3.4	6.3
Total Pore Pr., tsf		3.7	3.9	4.1
Ult. Stress, tsf		2.0	3.2	6.3
Total Pore Pr., tsf		3.6	3.8	4.1
$\bar{\sigma}_1$ Failure, tsf		3.3	6.0	10.2
$\bar{\sigma}_3$ Failure, tsf		1.3	2.6	3.9

Type of Test: CU with Pore Pressures
Sample Type: Shelby Tube - Undisturbed
Description: Gray Mottled Brown Silty CLAY

LL= 41.8 PL= 17.7 PI= 24.1
Assumed Specific Gravity= 2.65
Remarks:

Client: Alliance Consulting

Project: Triaxial Test
Mach Mine #1
Location: Boring #8874
Sample Number: 3 **Depth:** 10.0-12.0'
Proj. No.: H-05278 **Date:** 2-1-05

TRIAXIAL SHEAR TEST REPORT

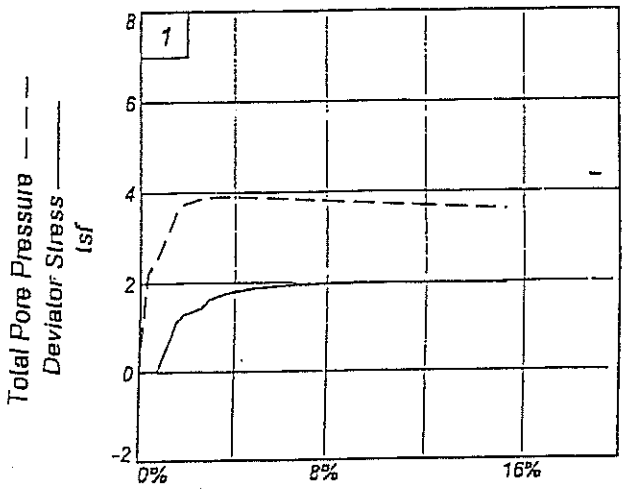
HOLCOMB FOUNDATION ENGINEERING CO.

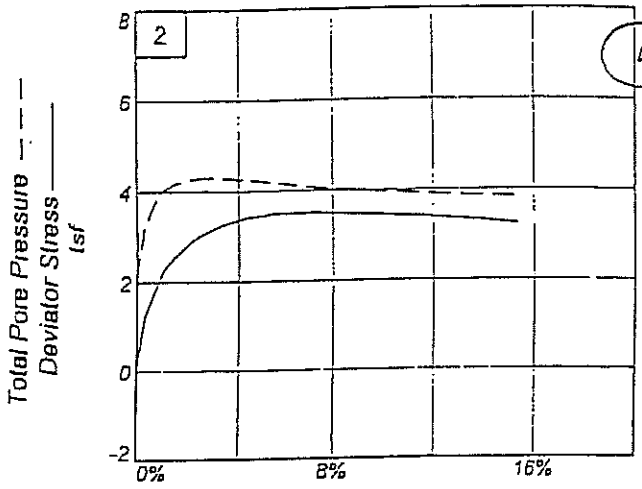
Plate _____

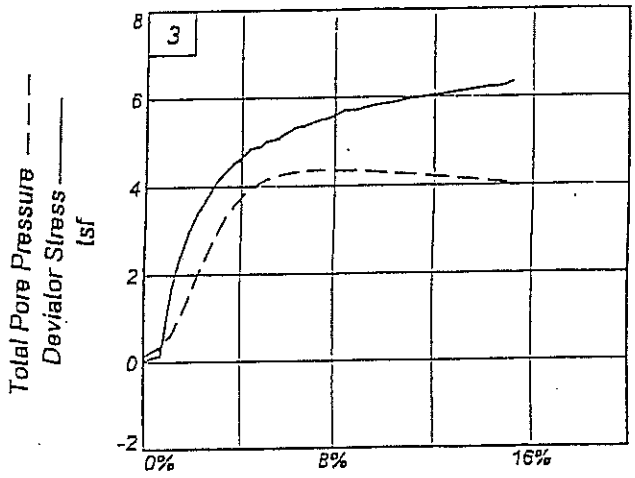
Tested By: LC Checked By: TH

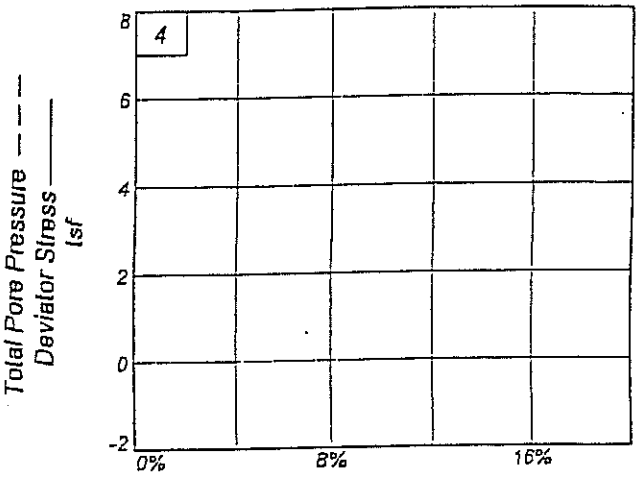
10 of 57

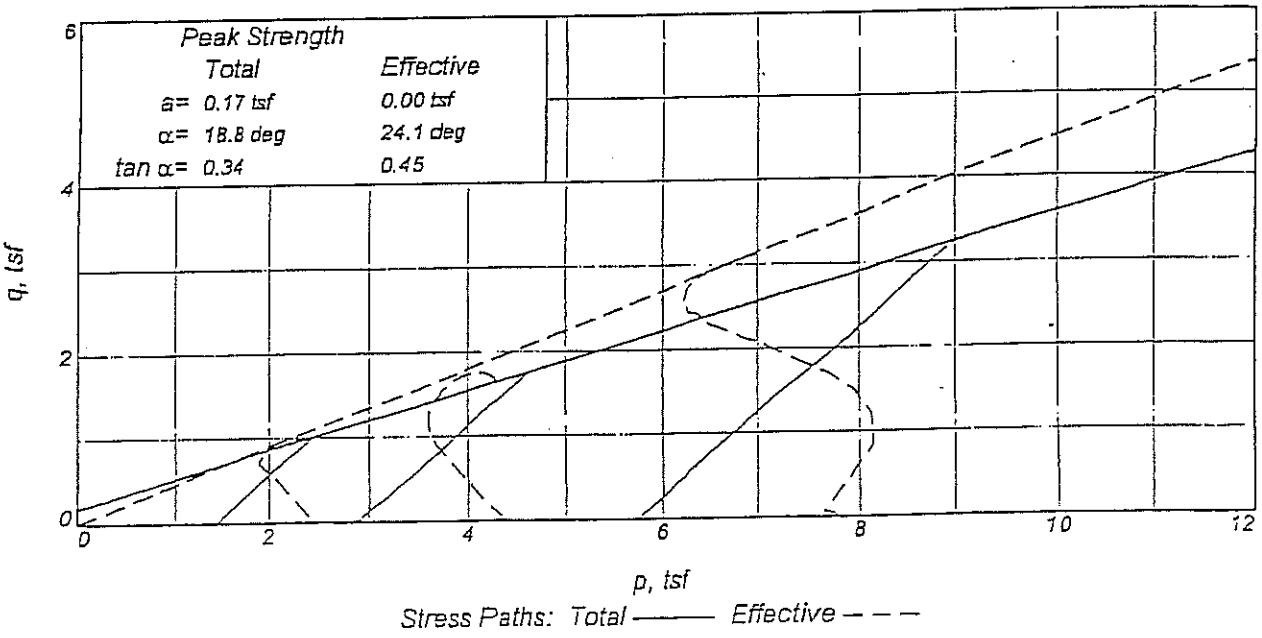
4











Client: Alliance Consulting
Project: Triaxial Test
Location: Boring #8874
Project No.: H-05278

Depth: 10.0-12.0'
Plate _____

Sample Number: 3

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC

Checked By: TH

11 of 57

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

2/9/2006 5
8:50 PM

Date:	2-1-05
Client:	Alliance Consulting
Project:	Triaxial Test
	Mach Mine #1
	Johnston City, Illinois
Location:	Boring #8874
Depth:	10.0-12.0'
Sample Number:	3
Description:	Gray Mottled Brown Silty CLAY
Remarks:	
Type of Sample:	Shelby Tube - Undisturbed
Assumed Specific Gravity=2.65	LL=41.8 PL=17.7 PI=24.1
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	189.100			1279.000
Moisture content: Dry soil+tare, gms.	176.100			1072.200
Moisture content: Tare, gms.	115.700			103.200
Moisture, %	21.5	21.5	21.5	21.3
Moist specimen weight, gms.	1140.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.51	5.51	5.51	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.0	128.0	128.0	
Dry density, pcf	105.3	105.3	105.3	
Void ratio	0.5706	0.5706	0.5706	
Saturation, %	100.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.981 tsf at reading no. 24
Ult. Stress = 1.955 tsf at reading no. 30

(6)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	18.30	0.0	0.0	0.000	5.112	5.112	1.00	-1.00	5.112	0.000
1	0.0190	20.00	1.7	0.3	0.014	2.830	2.844	1.00	30.70	2.837	0.007
2	0.0400	21.60	3.3	0.7	0.026	2.426	2.452	1.01	36.30	2.439	0.013
3	0.0810	113.20	94.9	1.5	1.093	1.505	2.598	1.73	49.10	2.051	0.547
4	0.1010	129.80	111.5	1.8	1.280	1.318	2.597	1.97	51.70	1.958	0.640
5	0.1420	143.10	124.8	2.6	1.422	1.181	2.602	2.20	53.60	1.892	0.711
6	0.1620	161.50	143.2	2.9	1.625	1.159	2.784	2.40	53.90	1.972	0.813
7	0.1830	168.90	150.6	3.3	1.702	1.145	2.847	2.49	54.10	1.996	0.851
8	0.2030	174.80	156.5	3.7	1.763	1.138	2.900	2.55	54.20	2.019	0.881
9	0.2240	178.90	160.6	4.1	1.802	1.145	2.946	2.57	54.10	2.046	0.901
10	0.2440	182.30	164.0	4.4	1.833	1.145	2.978	2.60	54.10	2.061	0.916
11	0.2650	186.40	168.1	4.8	1.871	1.152	3.023	2.62	54.00	2.088	0.936
12	0.2850	188.10	169.8	5.2	1.883	1.166	3.049	2.61	53.80	2.108	0.941
13	0.3060	191.40	173.1	5.6	1.912	1.166	3.078	2.64	53.80	2.122	0.956
14	0.3260	193.10	174.8	5.9	1.923	1.181	3.104	2.63	53.60	2.142	0.962
15	0.3460	194.70	176.4	6.3	1.933	1.188	3.121	2.63	53.50	2.155	0.967
16	0.3670	196.40	178.1	6.7	1.944	1.202	3.146	2.62	53.30	2.174	0.972
17	0.3870	198.10	179.8	7.0	1.955	1.210	3.164	2.62	53.20	2.187	0.977
18	0.4080	198.10	179.8	7.4	1.947	1.224	3.171	2.59	53.00	2.197	0.973
19	0.4280	200.60	182.3	7.8	1.966	1.231	3.197	2.60	52.90	2.214	0.983
20	0.4490	200.60	182.3	8.1	1.958	1.238	3.196	2.58	52.80	2.217	0.979
21	0.4890	203.10	184.8	8.9	1.969	1.267	3.236	2.55	52.40	2.252	0.985
22	0.5300	204.70	186.4	9.6	1.970	1.289	3.259	2.53	52.10	2.274	0.985
23	0.5710	207.20	188.9	10.4	1.980	1.310	3.290	2.51	51.80	2.300	0.990
24	0.6120	208.90	190.6	11.1	1.981	1.332	3.313	2.49	51.50	2.323	0.991
25	0.6530	209.10	190.8	11.8	1.967	1.346	3.313	2.46	51.30	2.330	0.983
26	0.6940	211.40	193.1	12.6	1.974	1.361	3.334	2.45	51.10	2.348	0.987
27	0.7350	212.20	193.9	13.3	1.965	1.390	3.354	2.41	50.70	2.372	0.982
28	0.7790	213.90	195.6	14.1	1.964	1.404	3.368	2.40	50.50	2.386	0.982
29	0.8170	215.50	197.2	14.8	1.964	1.426	3.390	2.38	50.20	2.408	0.982
30	0.8380	215.50	197.2	15.2	1.955	1.433	3.388	2.36	50.10	2.410	0.978

13 of 57

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	154.800			1347.900
Moisture content: Dry soil+tare, gms.	145.800			1154.100
Moisture content: Tare, gms.	102.600			135.100
Moisture, %	20.8	20.9	20.9	19.0
Moist specimen weight, gms.	1142.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.49	5.49	5.49	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.7	128.7	128.7	
Dry density, pcf	106.5	106.5	106.5	
Void ratio	0.5536	0.5536	0.5536	
Saturation, %	99.7	100.0	100.0	

(7)

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 3.418 tsf at reading no. 24
Ult. Stress = 3.250 tsf at reading no. 29

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	27.50	0.0	0.0	0.000	4.385	4.385	1.00	29.10	4.385	0.000
1	0.0190	134.00	106.5	0.3	1.241	3.254	4.495	1.38	44.80	3.875	0.620
2	0.0400	183.10	155.6	0.7	1.806	2.750	4.557	1.66	51.80	3.653	0.903
3	0.0600	218.90	191.4	1.1	2.214	2.484	4.698	1.89	55.50	3.591	1.107
4	0.0810	243.80	216.3	1.5	2.492	2.340	4.832	2.06	57.50	3.586	1.246
5	0.1010	264.60	237.1	1.8	2.721	2.254	4.975	2.21	58.70	3.614	1.361
6	0.1220	282.10	254.6	2.2	2.911	2.210	5.121	2.32	59.30	3.666	1.455
7	0.1420	295.40	267.9	2.6	3.052	2.182	5.233	2.40	59.70	3.707	1.526
8	0.1620	305.40	277.9	2.9	3.154	2.182	5.335	2.45	59.70	3.758	1.577
9	0.1830	314.60	287.1	3.3	3.245	2.189	5.434	2.48	59.60	3.811	1.623
10	0.2030	322.10	294.6	3.7	3.317	2.196	5.513	2.51	59.50	3.855	1.659
11	0.2240	327.10	299.6	4.1	3.360	2.218	5.578	2.52	59.20	3.898	1.680
12	0.2440	332.90	305.4	4.4	3.412	2.232	5.644	2.53	59.00	3.938	1.706
13	0.2650	336.20	308.7	4.8	3.435	2.254	5.689	2.52	58.70	3.971	1.718
14	0.2850	339.50	312.0	5.2	3.459	2.275	5.734	2.52	58.40	4.005	1.729
15	0.3060	343.70	316.2	5.6	3.491	2.297	5.788	2.52	58.10	4.042	1.746
16	0.3260	345.40	317.9	5.9	3.497	2.318	5.815	2.51	57.80	4.067	1.748
17	0.3670	348.70	321.2	6.7	3.505	2.369	5.874	2.48	57.10	4.121	1.752
18	0.4080	352.00	324.5	7.4	3.512	2.412	5.924	2.46	56.50	4.168	1.756
19	0.4490	353.70	326.2	8.2	3.502	2.441	5.943	2.43	56.10	4.192	1.751
20	0.4890	354.50	327.0	8.9	3.483	2.470	5.953	2.41	55.70	4.211	1.742
21	0.5300	355.40	327.9	9.7	3.464	2.498	5.963	2.39	55.30	4.230	1.732

(8)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.5510	357.00	329.5	10.0	3.466	2.513	5.979	2.38	55.10	4.246	1.733
23	0.5920	356.20	328.7	10.8	3.429	2.534	5.964	2.35	54.80	4.249	1.715
24	0.6330	357.90	330.4	11.5	3.418	2.556	5.974	2.34	54.50	4.265	1.709
25	0.6730	357.00	329.5	12.3	3.381	2.585	5.966	2.31	54.10	4.275	1.690
26	0.7140	357.90	330.4	13.0	3.361	2.599	5.960	2.29	53.90	4.280	1.681
27	0.7550	357.90	330.4	13.7	3.332	2.614	5.946	2.27	53.70	4.280	1.666
28	0.7960	356.20	328.7	14.5	3.286	2.628	5.914	2.25	53.50	4.271	1.643
29	0.8370	355.40	327.9	15.2	3.250	2.635	5.885	2.23	53.40	4.260	1.625

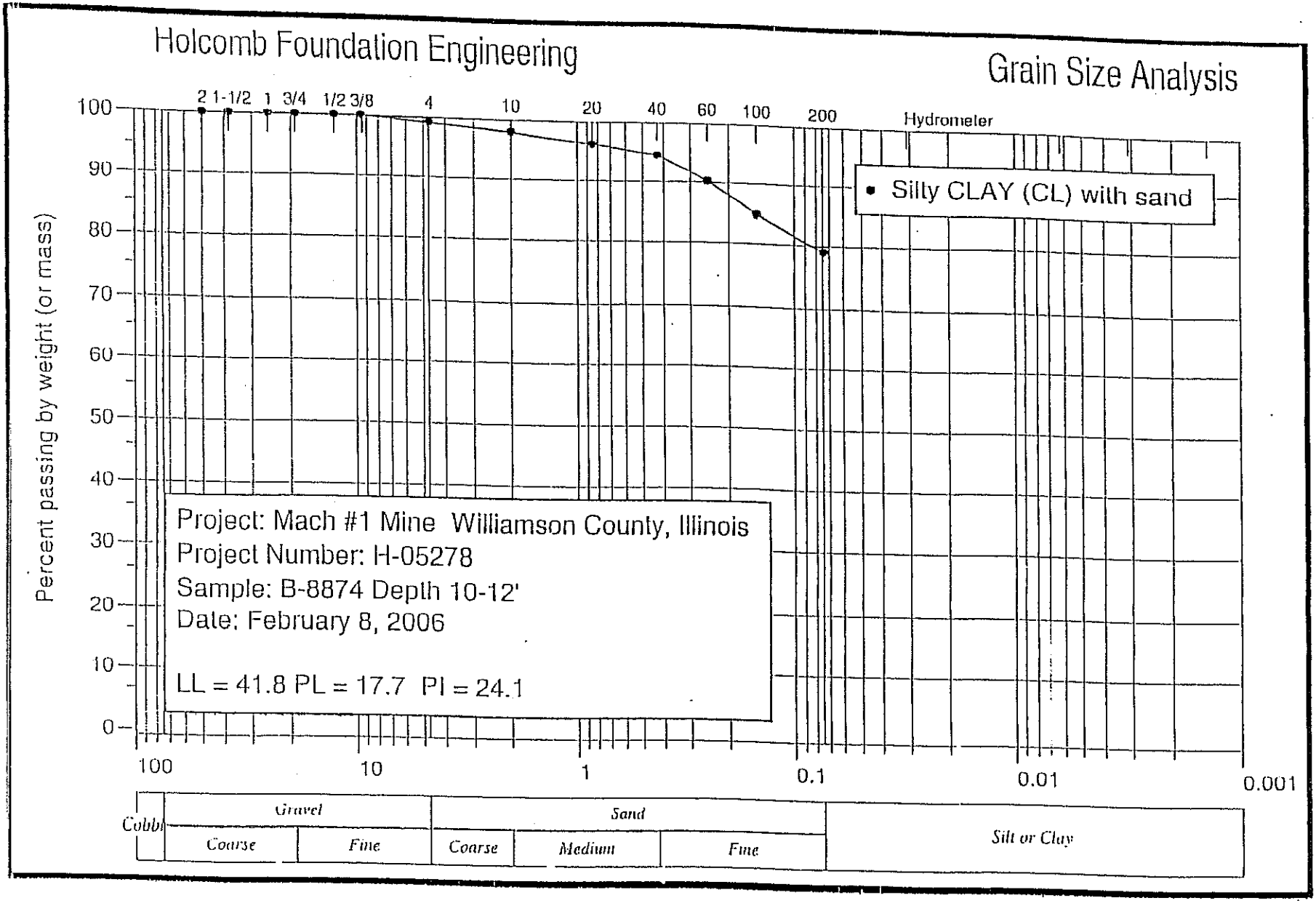
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	248.400			1374.500
Moisture content: Dry soil+tare, gms.	226.700			1195.400
Moisture content: Tare, gms.	103.200			127.700
Moisture, %	17.6	17.8	17.8	16.8
Moist specimen weight, gms.	1184.7			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.54	5.54	5.54	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	132.3	132.5	132.5	
Dry density, pcf	112.5	112.5	112.5	
Void ratio	0.4707	0.4707	0.4707	
Saturation, %	98.9	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 6.334 tsf at reading no. 33
Ult. Stress = 6.334 tsf at reading no. 33

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	31.60	0.0	0.0	0.000	7.812	7.812	1.00	1.50	7.812	0.000
1	0.0190	39.90	8.3	0.3	0.091	7.690	7.781	1.01	3.20	7.735	0.045
2	0.0400	44.10	12.5	0.7	0.133	7.574	7.707	1.02	4.80	7.641	0.066
3	0.0600	175.60	144.0	1.1	1.666	7.308	8.974	1.23	8.50	8.141	0.833
4	0.0810	240.50	208.9	1.5	2.407	6.926	9.333	1.35	13.80	8.130	1.203
5	0.1010	291.30	259.7	1.8	2.981	6.466	9.447	1.46	20.20	7.956	1.491
6	0.1220	329.60	298.0	2.2	3.408	5.983	9.391	1.57	26.90	7.687	1.704
7	0.1420	362.00	330.4	2.6	3.764	5.479	9.244	1.69	33.90	7.361	1.882
8	0.1620	392.00	360.4	2.9	4.091	5.040	9.131	1.81	40.00	7.085	2.045
9	0.1830	412.80	381.2	3.3	4.310	4.666	8.976	1.92	45.20	6.821	2.155

(9)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
10	0.2030	432.80	401.2	3.7	4.519	4.363	8.883	2.04	49.40	6.623	2.260
11	0.2240	446.90	415.3	4.0	4.660	4.140	8.800	2.13	52.50	6.470	2.330
12	0.2440	465.20	433.6	4.4	4.847	3.982	8.828	2.22	54.70	6.405	2.423
13	0.2650	471.00	439.4	4.8	4.892	3.852	8.744	2.27	56.50	6.298	2.446
14	0.2850	483.50	451.9	5.1	5.012	3.766	8.778	2.33	57.70	6.272	2.506
15	0.3060	490.20	458.6	5.5	5.066	3.694	8.760	2.37	58.70	6.227	2.533
16	0.3260	503.50	471.9	5.9	5.193	3.643	8.837	2.43	59.40	6.240	2.597
17	0.3460	516.80	485.2	6.2	5.319	3.607	8.926	2.47	59.90	6.267	2.660
18	0.3670	521.80	490.2	6.6	5.352	3.586	8.938	2.49	60.20	6.262	2.676
19	0.3870	530.10	498.5	7.0	5.422	3.571	8.993	2.52	60.40	6.282	2.711
20	0.4080	538.40	506.8	7.4	5.490	3.564	9.054	2.54	60.50	6.309	2.745
21	0.4280	543.40	511.8	7.7	5.522	3.564	9.086	2.55	60.50	6.325	2.761
22	0.4490	554.30	522.7	8.1	5.617	3.571	9.188	2.57	60.40	6.380	2.808
23	0.4690	565.90	534.3	8.5	5.719	3.578	9.297	2.60	60.30	6.438	2.859
24	0.4890	567.60	536.0	8.8	5.714	3.578	9.293	2.60	60.30	6.436	2.857
25	0.5300	581.70	550.1	9.6	5.817	3.600	9.417	2.62	60.00	6.509	2.909
26	0.5710	591.70	560.1	10.3	5.874	3.636	9.510	2.62	59.50	6.573	2.937
27	0.6120	605.00	573.4	11.0	5.964	3.665	9.629	2.63	59.10	6.647	2.982
28	0.6530	615.00	583.4	11.8	6.018	3.701	9.719	2.63	58.60	6.710	3.009
29	0.6940	626.70	595.1	12.5	6.087	3.737	9.824	2.63	58.10	6.780	3.044
30	0.7350	638.30	606.7	13.3	6.153	3.773	9.926	2.63	57.60	6.849	3.077
31	0.7760	649.10	617.5	14.0	6.209	3.816	10.025	2.63	57.00	6.921	3.105
32	0.8170	657.50	625.9	14.7	6.240	3.852	10.092	2.62	56.50	6.972	3.120
33	0.8390	669.90	638.3	15.1	6.334	3.866	10.200	2.64	56.30	7.033	3.167


Holcomb Foundation Engineering
Grain Size Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
2
1-1/2
1
3/4
1/2
3/8
4
10
20
40
60
100
200
Hydrometer
Silty CLAY (CL) with sand
Project: Mach #1 Mine Williamson County, Illinois
Project Number: H-05278
Sample: B-8874 Depth 10-12'
Date: February 8, 2006
LL = 41.8 PL = 17.7 PI = 24.1
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

R13084

17 of 57

(11)

Holcomb Foundation Engineering Company

Laboratory Testing Results

2/8/2006

Project: Mach #1 Mine

Project No: H-05278

Sieve Analysis - ASTM C136-96a

Sample: Silty CLAY (CL)

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
1.5000	38.1000	1 -1/2"	0.0	0.0	100.0
1.0000	25.4000	1"	0.0	0.0	100.0
0.7500	19.1000	3/4"	0.0	0.0	100.0
0.5000	12.7000	1/2"	0.0	0.0	100.0
3.7500	9.5200	3/8"	0.0	0.0	100.0
0.1870	4.7600	No. 4	2.1	0.9	99.1
0.0790	2.0000	No. 10	4.6	2.0	98.0
0.0469	1.1800	No. 16	4.6	2.0	98.0
0.0331	0.8500	No. 20	8.6	3.8	96.2
0.0165	0.4200	No. 40	12.6	5.5	94.5
0.0117	0.2980	No. 50	12.6	5.5	94.5
0.0083	0.2500	No. 60	22.2	9.8	90.2
0.0059	0.1490	No. 100	34.6	15.2	84.8
0.0029	0.0740	No. 200	47.7	21.0	79.0

Total Weight in Grams 227.20

18 / 57

Holcomb Foundation Engineering Company

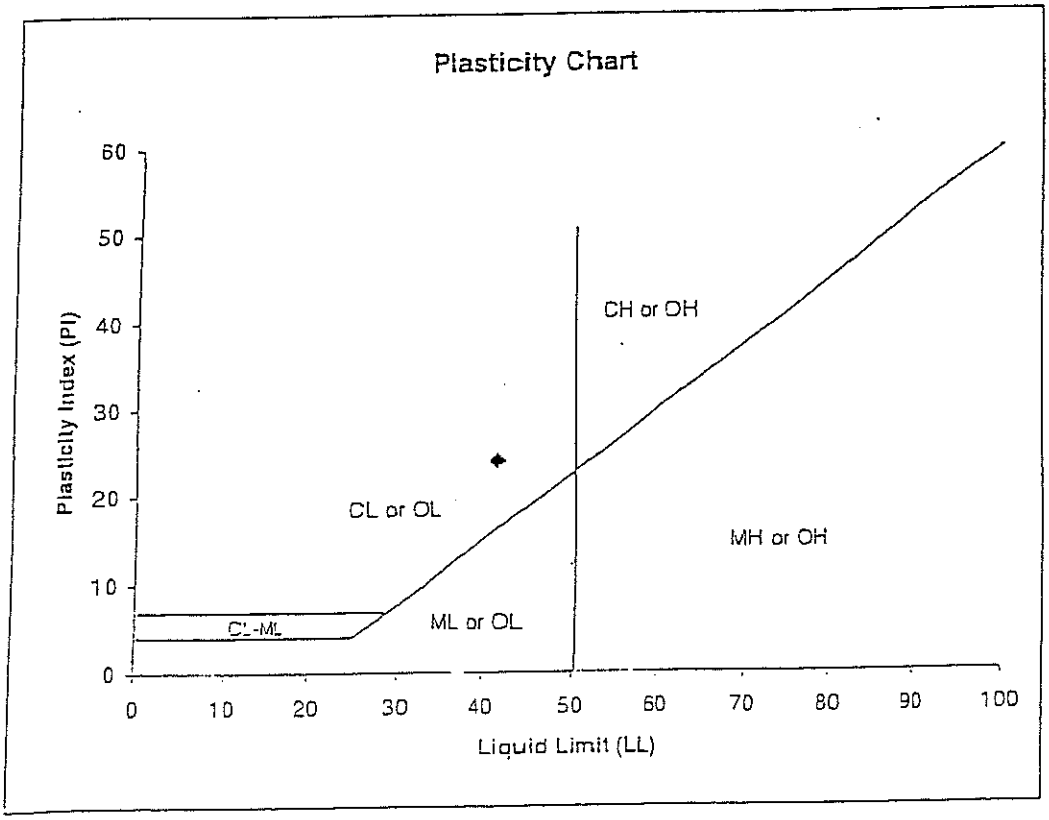
Laboratory Testing Results

Project: Mach #1 Mine
Project No: H-05278

Sample	1	2	3
Dish Number	LL_1	LL_2	LL_3
Mass of can, W_1 (g)	34.70		
Mass of can + moist soil, W_2 (g)	62.84		
Mass of can + dry soil, W_3 (g)	54.52		
Moisture content, w (%)	41.98		
Number of blows, N	24		
Liquid Limit, LL	41.8		

Dish Number	PL_1
Mass of can, W_1 (g)	39.76
Mass of can + moist soil, W_2 (g)	54.79
Mass of can + dry soil, W_3 (g)	52.53
Plastic Limit, PL	17.7

PI = 24.1



19 of 57

(13)

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

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Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

November 30, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Pond Creek Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on November 17, 2006, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification:	Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)
Proctor Test Results:	
Maximum Dry Unit Weight:	124.6 PCF
Optimum Moisture Content:	9.3 %
Specific Gravity:	2.37
Triaxial Test Results:	
Effective Cohesion:	0 PSF
Effective Phi Angle:	33.7 Degrees
Permeability:	2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

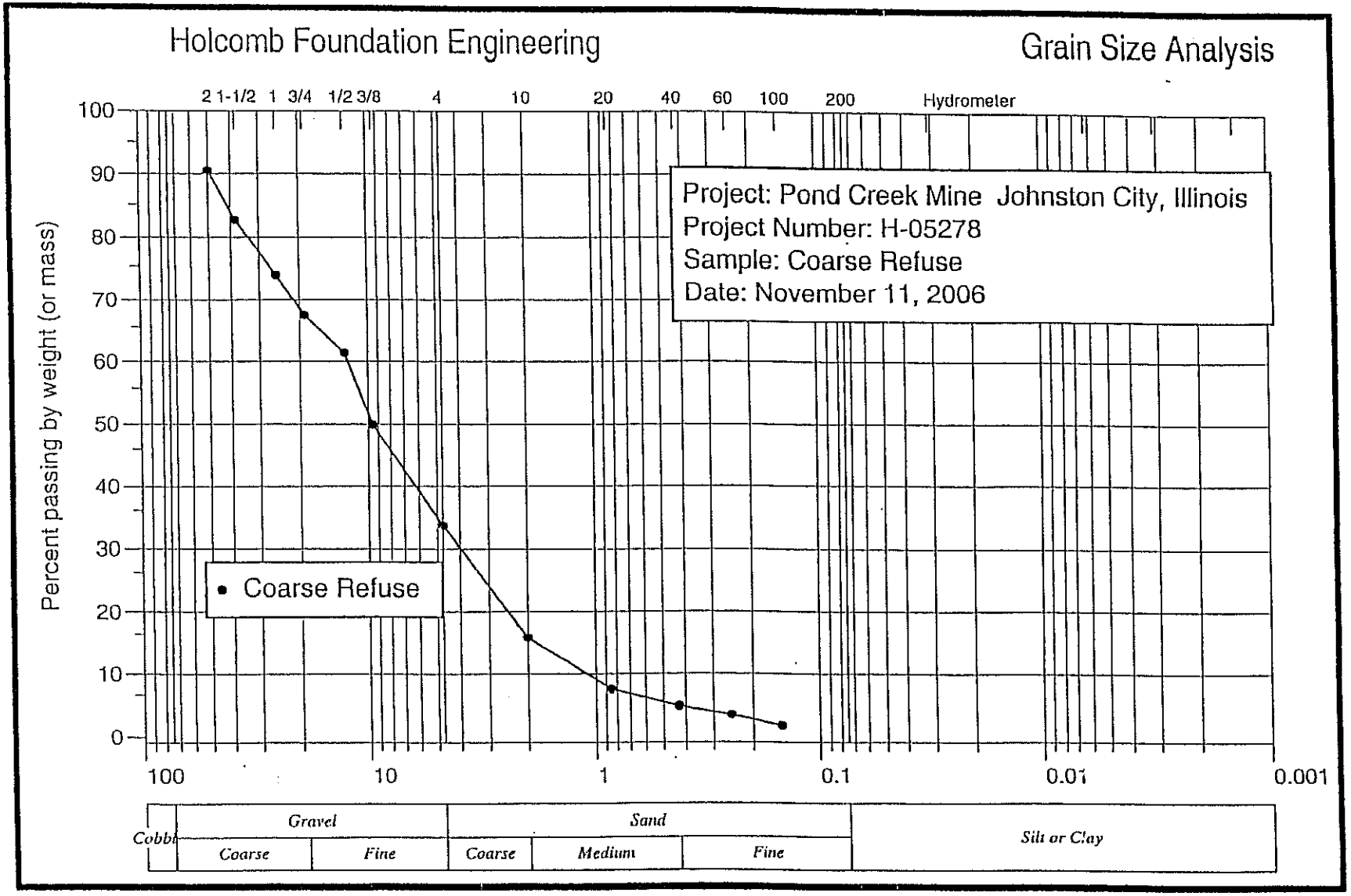
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting



21 of 57

15

R13089

22 of 51 (16)

Holcomb Foundation Engineering Company

Laboratory Testing Results

11/30/2006

Project: Coarse Refuse Disposal Area
Pond Creek Mine Johnston City, Illinois

Project No: H-05317

Sieve Analysis - ASTM C136-96a

Sample: Coarse Refuse

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
3	76.2	3"	0.0	0.0	100.0
2.0000	50.8100	2"	619.6	9.5	90.5
1.5000	38.1000	1 -1/2"	1124.0	17.2	82.8
1.0000	25.4000	1"	1696.2	25.9	74.1
0.7500	19.1000	3/4"	2110.9	32.3	67.7
0.5000	12.7000	1/2"	2513.0	38.4	61.6
3.7500	9.5200	3/8"	3263.7	49.9	50.1
0.1870	4.7600	No. 4	4310.7	65.9	34.1
0.0790	2.0000	No. 10	5470.5	83.6	16.4
0.0469	1.1800	No. 16			
0.0331	0.8500	No. 20	6004.4	91.8	8.2
0.0165	0.4200	No. 40	6178.9	94.4	5.6
0.0117	0.2980	No. 50			
0.0083	0.2500	No. 60	6267.8	95.8	4.2
0.0059	0.1490	No. 100			
0.0029	0.0740	No. 200	6372.4	97.4	2.6

Total Weight in Grams 6542.80

23 of 57 (17)

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

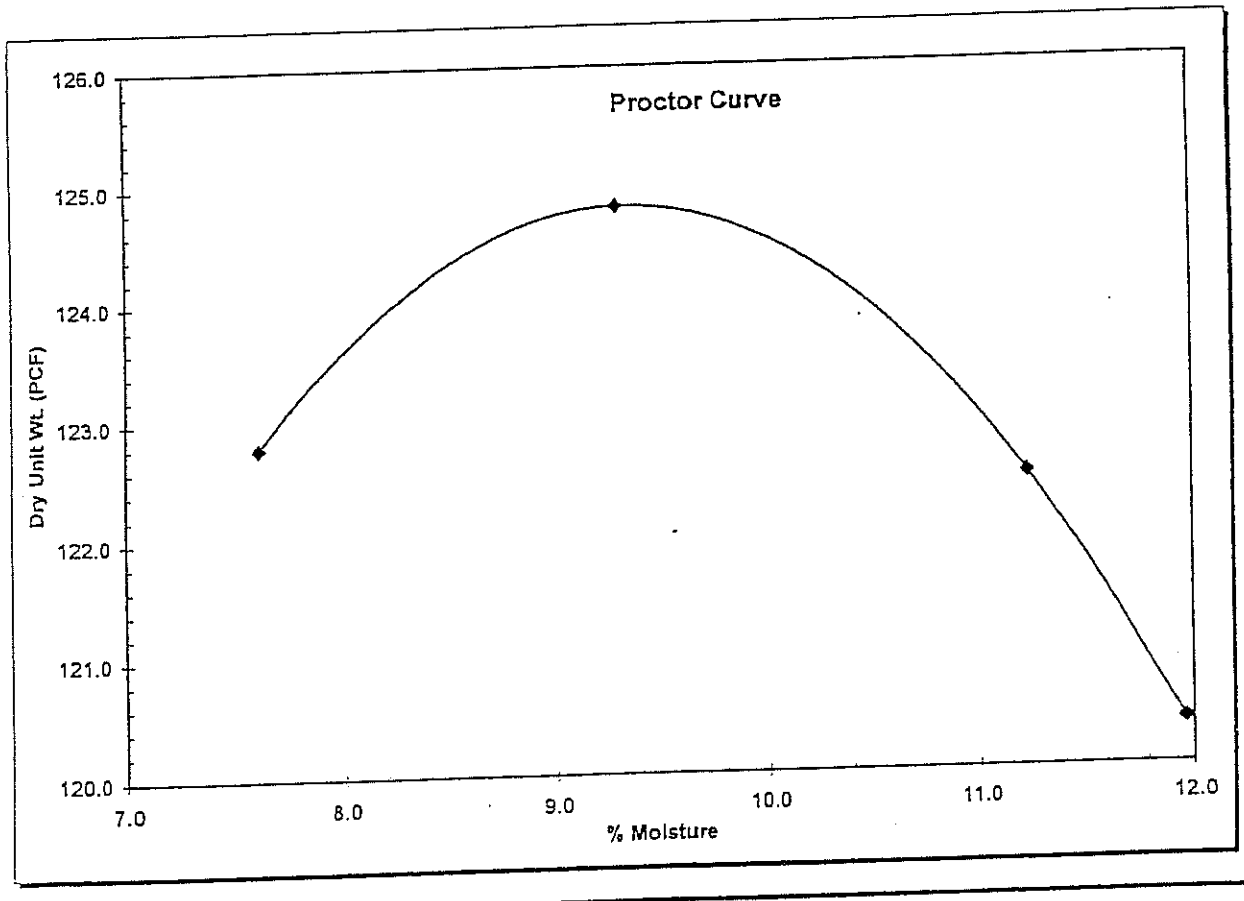
Date: 11/30/2006

Proctor Test Results

Soil Classification:	Gray Coarse Refuse
Maximum Dry Density (PCF)	124.8
Optimum Moisture Content (%)	9.3

Test Data: ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
7.6	122.8
11.2	122.5
12.0	120.4
9.3	124.8



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Permeability Tests Results

Laboratory Tests
Coarse Refuse
Pond Creek Mine - Johnston City, Illinois

Date: 11/30/2006

Client: Pond Creek Mine
Johnston City, Illinois

Project No.: H-05278

Sample	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse		7.7	11.8	119.3	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

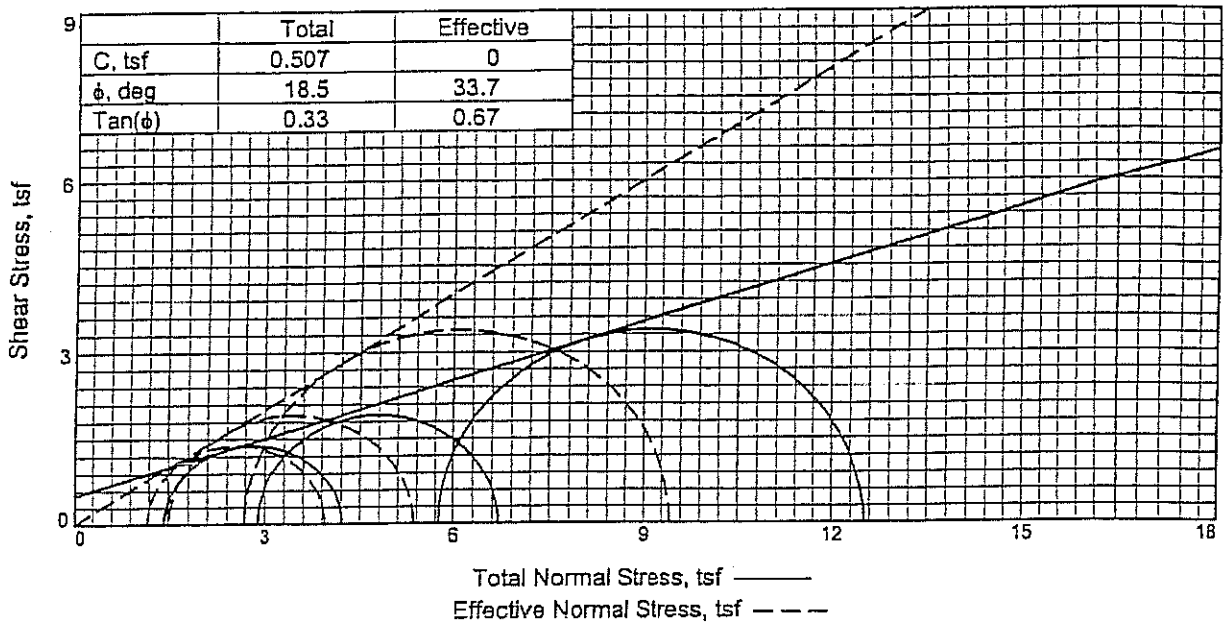
(19)

PERMEABILITY TEST RESULTS

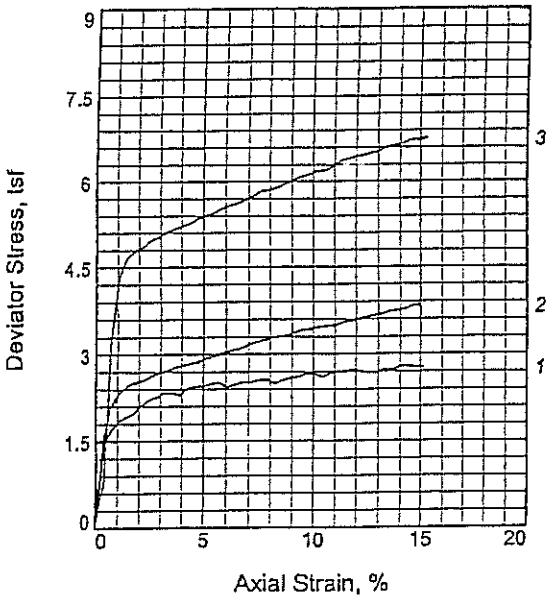
Project	Pond Creek Mine	Boring/Sample Depth	Coarse Refuse
#	H-05278	Classification	
Date	11/30/2006	Diameter	2.8 Inch
		Length	5.6 Inch

In Place Mc		After Test Mc		Unit Weight (PCF)	
Wet Wt.	195.3	Wet Wt.	1300.4	Sample Wt.	1161.8
Pan	94.2	Pan	103.1		
Dry Wt.	188.1	Dry Wt.	1173.6	Wet UW=	128.5
Mc (%)	7.7	Mc (%)	11.8	Dry UW=	119.3

Time(hrs)	Time(min)	Quantity (cc)	Head (psi)	Permeability (cm/sec)
7	26	24.7		
7	34	8.2	1	1.75E-04
7	33	24.5		
7	45	2.7	1	1.54E-04
7	47	0.8	1	1.44E-04
9	16	24.4		
9	23	9.6	1	1.79E-04
9	30	0.9	1	1.43E-04
			Average Permeability	1.63E-04



	Total	Effective
C, tsf	0.507	0
ϕ, deg	18.5	33.7
Tan(ϕ)	0.33	0.67



Sample No.		1	2	3
Initial	Water Content,	10.1	10.8	10.3
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	97.0	99.8	99.3
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
At Test	Water Content,	10.4	10.8	10.4
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
Strain rate, in./min.		0.01	0.01	0.01
Back Pressure, tsf		3.60	3.60	2.16
Cell Pressure, tsf		5.04	6.48	7.92
Fail. Stress, tsf		2.78	3.83	6.76
Total Pore Pr., tsf		3.86	4.96	5.23
Ult. Stress, tsf		2.77	3.83	6.76
Total Pore Pr., tsf		3.85	4.95	5.23
$\bar{\sigma}_1$ Failure, tsf		3.96	5.35	9.44
$\bar{\sigma}_3$ Failure, tsf		1.18	1.52	2.69

Type of Test:
CU with Pore Pressures
Sample Type: Remolded
Description: Coarse Coal Refuse

Assumed Specific Gravity= 2.37
Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

Location: Coarse Refuse Stockpile
Sample Number: Coarse Refuse
Proj. No.: H-05278 **Date:** 11/17/06

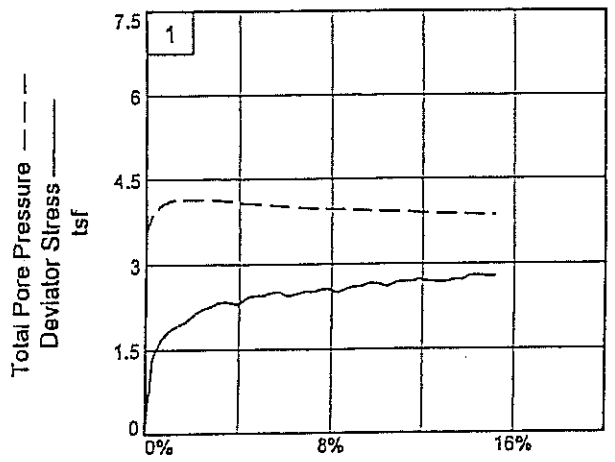
TRIAXIAL SHEAR TEST REPORT

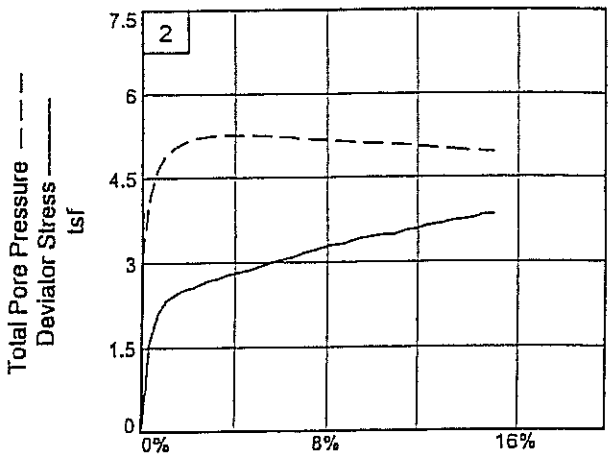
HOLCOMB FOUNDATION ENGINEERING CO.

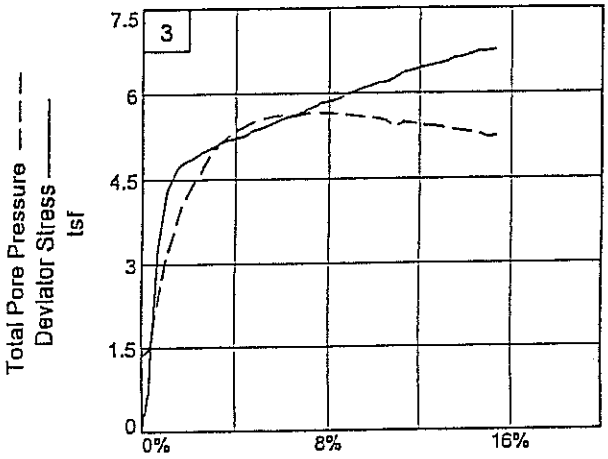
Plate _____

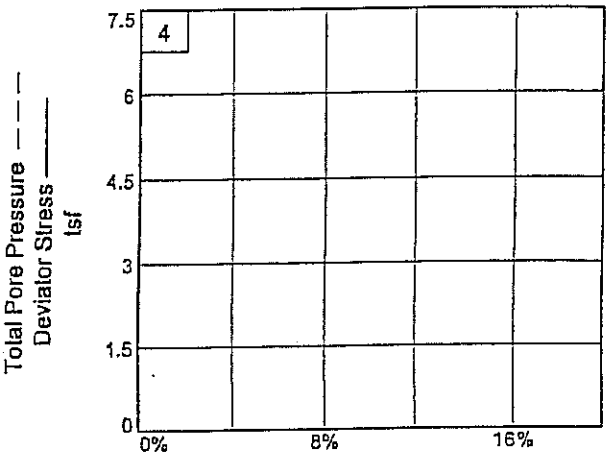
Tested By: LC Checked By: TH

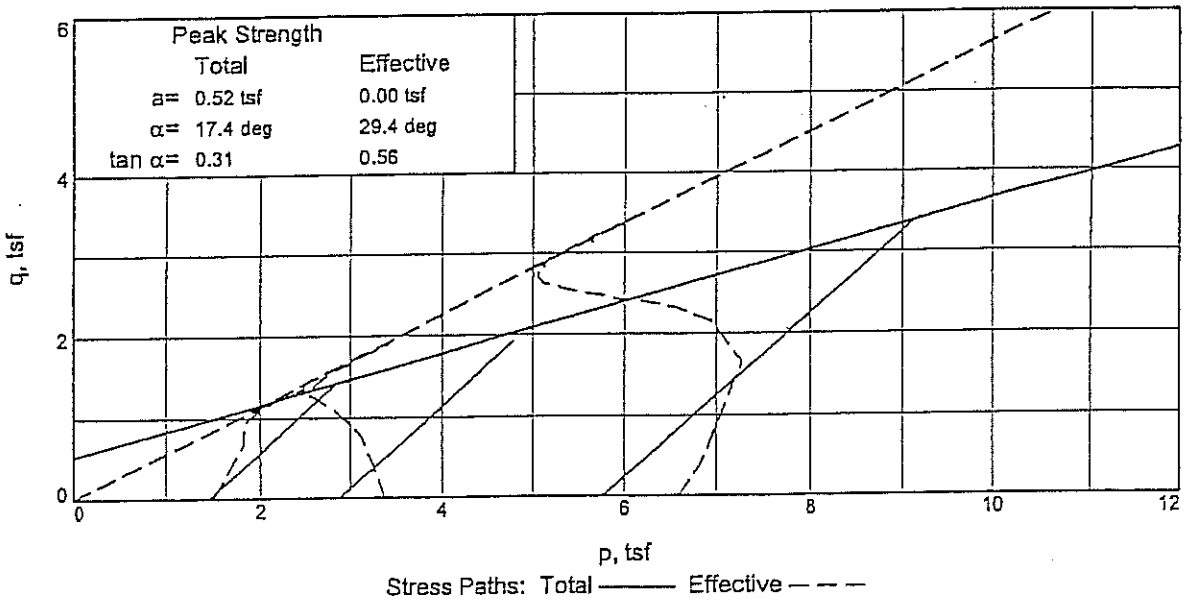
27 of 57 (21)











Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Coarse Refuse Stockpile
Project No.: H-05278

Sample Number: Coarse Refuse
Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC _____ Checked By: TH _____

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

11/30/2006
10:19 AM

Date:	11/17/06
Client:	Pond Creek Mine
Project:	Coarse Refuse Laboratory Tests
Location:	Coarse Refuse Stockpile
Sample Number:	Coarse Refuse
Description:	Coarse Coal Refuse
Remarks:	
Type of Sample:	Remolded
Assumed Specific Gravity=2.37	LL= PL= PI=
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	226.800			1320.700
Moisture content: Dry soil+tare, gms.	218.600			1195.800
Moisture content: Tare, gms.	137.500			107.600
Moisture, %	10.1	10.4	10.4	11.5
Moist specimen weight, gms.	1193.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.65	5.65	5.65	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.6	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2470	0.2470	0.2470	
Saturation, %	97.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 2.778 tsf at reading no. 41
Ult. Stress = 2.767 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0010	46.60	0.0	0.0	0.000	1.498	1.498	1.00	49.20	1.498	0.000
1	0.0180	160.60	114.0	0.3	1.329	1.152	2.481	2.15	54.00	1.816	0.664
2	0.0390	189.70	143.1	0.7	1.662	1.001	2.663	2.66	56.10	1.832	0.831
3	0.0590	205.60	159.0	1.0	1.840	0.929	2.769	2.98	57.10	1.849	0.920
4	0.0800	212.20	165.6	1.4	1.909	0.907	2.816	3.10	57.40	1.862	0.955
5	0.1000	218.90	172.3	1.8	1.979	0.900	2.879	3.20	57.50	1.890	0.990
6	0.1200	232.20	185.6	2.1	2.125	0.900	3.025	3.36	57.50	1.962	1.062
7	0.1410	240.50	193.9	2.5	2.211	0.907	3.118	3.44	57.40	2.013	1.106
8	0.1610	245.50	198.9	2.8	2.260	0.914	3.174	3.47	57.30	2.044	1.130
9	0.1820	252.20	205.6	3.2	2.327	0.922	3.249	3.53	57.20	2.085	1.164
10	0.2020	253.80	207.2	3.6	2.337	0.936	3.273	3.50	57.00	2.104	1.168
11	0.2230	250.50	203.9	3.9	2.291	0.958	3.248	3.39	56.70	2.103	1.145
12	0.2430	261.30	214.7	4.3	2.403	0.972	3.375	3.47	56.50	2.173	1.201
13	0.2630	266.30	219.7	4.6	2.450	0.979	3.429	3.50	56.40	2.204	1.225
14	0.2840	266.30	219.7	5.0	2.440	0.994	3.434	3.46	56.20	2.214	1.220
15	0.3040	272.10	225.5	5.4	2.495	1.008	3.503	3.48	56.00	2.256	1.248
16	0.3250	274.60	228.0	5.7	2.513	1.022	3.536	3.46	55.80	2.279	1.257
17	0.3450	268.00	221.4	6.1	2.431	1.037	3.468	3.34	55.60	2.252	1.216
18	0.3660	273.00	226.4	6.5	2.476	1.051	3.527	3.36	55.40	2.289	1.238
19	0.3860	278.00	231.4	6.8	2.521	1.058	3.580	3.38	55.30	2.319	1.261
20	0.4070	278.00	231.4	7.2	2.511	1.066	3.577	3.36	55.20	2.321	1.256
21	0.4270	283.00	236.4	7.5	2.556	1.073	3.629	3.38	55.10	2.351	1.278
22	0.4470	284.60	238.0	7.9	2.563	1.080	3.643	3.37	55.00	2.362	1.282
23	0.4680	278.80	232.2	8.3	2.491	1.087	3.578	3.29	54.90	2.333	1.245
24	0.4880	286.30	239.7	8.6	2.561	1.087	3.648	3.36	54.90	2.368	1.281
25	0.5090	290.40	243.8	9.0	2.594	1.094	3.689	3.37	54.80	2.392	1.297
26	0.5290	292.10	245.5	9.3	2.602	1.102	3.704	3.36	54.70	2.403	1.301
27	0.5500	298.80	252.2	9.7	2.662	1.109	3.771	3.40	54.60	2.440	1.331
28	0.5700	299.60	253.0	10.1	2.660	1.116	3.776	3.38	54.50	2.446	1.330
29	0.5910	294.60	248.0	10.4	2.597	1.116	3.713	3.33	54.50	2.415	1.299
30	0.6110	302.10	255.5	10.8	2.665	1.123	3.788	3.37	54.40	2.456	1.333
31	0.6310	306.30	259.7	11.2	2.698	1.130	3.828	3.39	54.30	2.479	1.349
32	0.6520	306.30	259.7	11.5	2.687	1.130	3.817	3.38	54.30	2.474	1.343
33	0.6720	312.10	265.5	11.9	2.736	1.145	3.881	3.39	54.10	2.513	1.368
34	0.6930	309.60	263.0	12.2	2.699	1.145	3.843	3.36	54.10	2.494	1.349
35	0.7130	308.80	262.2	12.6	2.680	1.152	3.832	3.33	54.00	2.492	1.340
36	0.7340	309.60	263.0	13.0	2.676	1.159	3.835	3.31	53.90	2.497	1.338
37	0.7540	315.40	268.8	13.3	2.724	1.166	3.891	3.34	53.80	2.528	1.362
38	0.7750	316.20	269.6	13.7	2.721	1.166	3.887	3.33	53.80	2.527	1.360
39	0.7950	323.70	277.1	14.1	2.785	1.181	3.966	3.36	53.60	2.573	1.392
40	0.8150	325.40	278.8	14.4	2.790	1.181	3.971	3.36	53.60	2.576	1.395
41	0.8360	325.40	278.8	14.8	2.778	1.181	3.959	3.35	53.60	2.570	1.389
42	0.8560	325.40	278.8	15.1	2.767	1.188	3.955	3.33	53.50	2.571	1.383

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	211.600			1335.900
Moisture content: Dry soil+tare, gms.	203.200			1222.200
Moisture content: Tare, gms.	125.200			134.800
Moisture, %	10.8	10.8	10.8	10.5
Moist specimen weight, gms.	1175.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.57	5.57	5.57	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.5	130.5	130.5	
Dry density, pcf	117.8	117.8	117.8	
Void ratio	0.2558	0.2558	0.2558	
Saturation, %	99.8	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²

Membrane thickness = 0.02 cm

Filter paper coefficient = 0.001926 kN/cm

Filter paper coverage = 50%

Consolidation cell pressure = 90.00 psi (6.480 tsf)

Consolidation back pressure = 50.00 psi (3.600 tsf)

Consolidation effective confining stress = 2.880 tsf

Strain rate, in./min. = 0.01

Fail. Stress = 3.829 tsf at reading no. 40

Ult. Stress = 3.828 tsf at reading no. 41

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	51.60	0.0	0.0	0.000	3.377	3.377	1.00	43.10	3.377	0.000
1	0.0190	185.60	134.0	0.3	1.562	2.340	3.902	1.67	57.50	3.121	0.781
2	0.0400	233.00	181.4	0.7	2.106	1.814	3.920	2.16	64.80	2.867	1.053
3	0.0600	253.00	201.4	1.1	2.330	1.562	3.892	2.49	68.30	2.727	1.165
4	0.0810	263.80	212.2	1.5	2.445	1.433	3.878	2.71	70.10	2.655	1.223
5	0.1010	270.50	218.9	1.8	2.513	1.346	3.860	2.87	71.30	2.603	1.257
6	0.1220	274.60	223.0	2.2	2.550	1.289	3.839	2.98	72.10	2.564	1.275
7	0.1420	281.30	229.7	2.5	2.617	1.260	3.877	3.08	72.50	2.569	1.309
8	0.1620	287.10	235.5	2.9	2.674	1.238	3.912	3.16	72.80	2.575	1.337
9	0.1830	291.30	239.7	3.3	2.711	1.231	3.942	3.20	72.90	2.587	1.355
10	0.2030	297.10	245.5	3.6	2.766	1.224	3.990	3.26	73.00	2.607	1.383
11	0.2240	301.30	249.7	4.0	2.802	1.224	4.026	3.29	73.00	2.625	1.401
12	0.2440	305.40	253.8	4.4	2.838	1.224	4.062	3.32	73.00	2.643	1.419
13	0.2650	309.60	258.0	4.8	2.873	1.224	4.097	3.35	73.00	2.661	1.437
14	0.2850	315.40	263.8	5.1	2.927	1.231	4.158	3.38	72.90	2.695	1.463
15	0.3060	320.40	268.8	5.5	2.970	1.238	4.209	3.40	72.80	2.724	1.485
16	0.3260	326.20	274.6	5.9	3.023	1.246	4.269	3.43	72.70	2.757	1.512
17	0.3460	330.40	278.8	6.2	3.058	1.253	4.310	3.44	72.60	2.782	1.529
18	0.3670	334.60	283.0	6.6	3.091	1.267	4.358	3.44	72.40	2.813	1.546
19	0.3870	341.20	289.6	6.9	3.151	1.282	4.433	3.46	72.20	2.857	1.576
20	0.4080	346.20	294.6	7.3	3.192	1.296	4.488	3.46	72.00	2.892	1.596
21	0.4280	351.20	299.6	7.7	3.234	1.310	4.544	3.47	71.80	2.927	1.617

No.	Def. Dial In.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	357.00	305.4	8.1	3.283	1.318	4.601	3.49	71.70	2.959	1.642
23	0.4690	359.50	307.9	8.4	3.297	1.332	4.629	3.48	71.50	2.981	1.649
24	0.4890	362.80	311.2	8.8	3.319	1.339	4.659	3.48	71.40	2.999	1.660
25	0.5100	368.70	317.1	9.2	3.368	1.346	4.715	3.50	71.30	3.031	1.684
26	0.5300	374.50	322.9	9.5	3.416	1.361	4.777	3.51	71.10	3.069	1.708
27	0.5510	377.00	325.4	9.9	3.429	1.368	4.797	3.51	71.00	3.082	1.714
28	0.5710	381.20	329.6	10.2	3.459	1.368	4.827	3.53	71.00	3.098	1.730
29	0.5920	384.50	332.9	10.6	3.479	1.382	4.861	3.52	70.80	3.122	1.739
30	0.6120	386.20	334.6	11.0	3.483	1.390	4.872	3.51	70.70	3.131	1.741
31	0.6330	392.00	340.4	11.4	3.528	1.397	4.925	3.53	70.60	3.161	1.764
32	0.6530	397.00	345.4	11.7	3.565	1.411	4.977	3.53	70.40	3.194	1.783
33	0.6730	400.30	348.7	12.1	3.585	1.426	5.010	3.51	70.20	3.218	1.792
34	0.6940	406.10	354.5	12.5	3.629	1.440	5.069	3.52	70.00	3.254	1.814
35	0.7140	410.30	358.7	12.8	3.657	1.454	5.111	3.51	69.80	3.283	1.828
36	0.7350	413.60	362.0	13.2	3.674	1.469	5.143	3.50	69.60	3.306	1.837
37	0.7550	420.30	368.7	13.6	3.727	1.483	5.210	3.51	69.40	3.347	1.863
38	0.7760	423.60	372.0	13.9	3.744	1.498	5.242	3.50	69.20	3.370	1.872
39	0.7960	427.80	376.2	14.3	3.770	1.505	5.275	3.51	69.10	3.390	1.885
40	0.8170	435.30	383.7	14.7	3.829	1.519	5.348	3.52	68.90	3.434	1.914
41	0.8370	436.90	385.3	15.0	3.828	1.526	5.355	3.51	68.80	3.441	1.914

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	184.300			1333.800
Moisture content: Dry soil+tare, gms.	177.100			1230.400
Moisture content: Tare, gms.	107.500			135.300
Moisture, %	10.3	10.4	10.4	9.4
Moist specimen weight, gms.	1185.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.60	5.60	5.60	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.9	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2468	0.2468	0.2468	
Saturation, %	99.3	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²

Membrane thickness = 0.02 cm

Filter paper coefficient = 0.001926 kN/cm

Filter paper coverage = 50%

Consolidation cell pressure = 110.00 psi (7.920 tsf)

Consolidation back pressure = 30.00 psi (2.160 tsf)

Consolidation effective confining stress = 5.760 tsf

Strain rate, in./min. = 0.01

Fail. Stress = 6.758 tsf at reading no. 42

Ult. Stress = 6.758 tsf at reading no. 42

No.	Def. Dial In.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	25.00	0.0	0.0	0.000	6.588	6.588	1.00	18.50	6.588	0.000
1	0.0190	88.20	63.2	0.3	0.736	6.458	7.195	1.11	20.30	6.827	0.368
2	0.0400	309.60	284.6	0.7	3.304	5.623	8.927	1.59	31.90	7.275	1.652
3	0.0600	397.00	372.0	1.1	4.303	4.795	9.098	1.90	43.40	6.947	2.152
4	0.0810	428.60	403.6	1.4	4.651	4.234	8.885	2.10	51.20	6.559	2.326
5	0.1010	441.90	416.9	1.8	4.787	3.830	8.617	2.25	56.80	6.224	2.393
6	0.1220	449.40	424.4	2.2	4.854	3.521	8.375	2.38	61.10	5.948	2.427
7	0.1420	460.20	435.2	2.5	4.960	3.283	8.243	2.51	64.40	5.763	2.480
8	0.1620	467.70	442.7	2.9	5.027	3.017	8.044	2.67	68.10	5.530	2.513
9	0.1830	476.00	451.0	3.3	5.101	2.837	7.938	2.80	70.60	5.387	2.551
10	0.2030	483.50	458.5	3.6	5.167	2.693	7.860	2.92	72.60	5.276	2.583
11	0.2240	489.30	464.3	4.0	5.212	2.585	7.797	3.02	74.10	5.191	2.606
12	0.2440	495.20	470.2	4.4	5.258	2.491	7.750	3.11	75.40	5.120	2.629
13	0.2650	505.20	480.2	4.7	5.349	2.419	7.768	3.21	76.40	5.094	2.675
14	0.2850	511.00	486.0	5.1	5.394	2.369	7.762	3.28	77.10	5.066	2.697
15	0.3060	518.50	493.5	5.5	5.455	2.333	7.788	3.34	77.60	5.060	2.728
16	0.3260	526.80	501.8	5.8	5.526	2.304	7.830	3.40	78.00	5.067	2.763
17	0.3460	533.50	508.5	6.2	5.579	2.297	7.875	3.43	78.10	5.086	2.789
18	0.3670	539.30	514.3	6.6	5.620	2.326	7.945	3.42	77.70	5.135	2.810
19	0.3870	548.40	523.4	6.9	5.697	2.275	7.972	3.50	78.40	5.124	2.849
20	0.4080	555.90	530.9	7.3	5.756	2.261	8.016	3.55	78.60	5.139	2.878
21	0.4280	565.90	540.9	7.6	5.841	2.261	8.102	3.58	78.60	5.181	2.921

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	569.20	544.2	8.0	5.853	2.268	8.121	3.58	78.50	5.195	2.927
23	0.4690	575.10	550.1	8.4	5.894	2.282	8.176	3.58	78.30	5.229	2.947
24	0.4890	584.20	559.2	8.7	5.968	2.297	8.265	3.60	78.10	5.281	2.984
25	0.5100	592.50	567.5	9.1	6.031	2.311	8.343	3.61	77.90	5.327	3.016
26	0.5300	599.20	574.2	9.5	6.079	2.333	8.411	3.61	77.60	5.372	3.039
27	0.5510	605.90	580.9	9.8	6.124	2.354	8.479	3.60	77.30	5.416	3.062
28	0.5710	613.30	588.3	10.2	6.178	2.362	8.539	3.62	77.20	5.450	3.089
29	0.5920	617.50	592.5	10.6	6.196	2.405	8.601	3.58	76.60	5.503	3.098
30	0.6120	626.70	601.7	10.9	6.267	2.527	8.794	3.48	74.90	5.661	3.133
31	0.6330	638.30	613.3	11.3	6.361	2.426	8.787	3.62	76.30	5.607	3.180
32	0.6530	644.10	619.1	11.7	6.395	2.448	8.843	3.61	76.00	5.646	3.198
33	0.6730	650.80	625.8	12.0	6.438	2.477	8.915	3.60	75.60	5.696	3.219
34	0.6940	656.60	631.6	12.4	6.470	2.498	8.968	3.59	75.30	5.733	3.235
35	0.7140	662.50	637.5	12.8	6.504	2.506	9.009	3.60	75.20	5.758	3.252
36	0.7350	669.10	644.1	13.1	6.543	2.542	9.085	3.57	74.70	5.813	3.271
37	0.7550	678.30	653.3	13.5	6.609	2.563	9.172	3.58	74.40	5.868	3.305
38	0.7760	684.10	659.1	13.9	6.639	2.585	9.224	3.57	74.10	5.904	3.319
39	0.7960	690.70	665.7	14.2	6.678	2.614	9.291	3.55	73.70	5.952	3.339
40	0.8170	699.10	674.1	14.6	6.732	2.635	9.367	3.55	73.40	6.001	3.366
41	0.8370	701.60	676.6	14.9	6.729	2.700	9.429	3.49	72.50	6.065	3.365
42	0.8570	707.40	682.4	15.3	6.758	2.686	9.444	3.52	72.70	6.065	3.379

HOLCOMB FOUNDATION ENGINEERING CO., INC.

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Carbondale, IL 62901

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P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

April 9, 2007

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Mach Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on March 29, 2007, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification:	Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)
Proctor Test Results:	
Maximum Dry Unit Weight:	120.3 PCF
Optimum Moisture Content:	10.7 %
Specific Gravity:	2.50
Triaxial Test Results:	
Effective Cohesion:	152 PSF
Effective Phi Angle:	29.3 Degrees
Permeability (2 tests):	3 x 10-4 cm./sec.
	2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

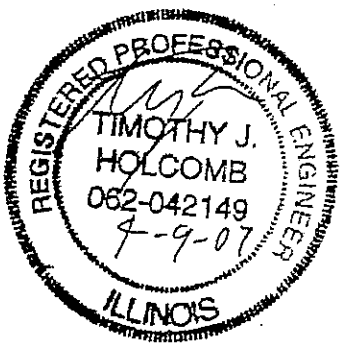
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting



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Permeability Tests Results

Mach Mine
Johnston City, Illinois

Date: 4/9/2007 Client: Williamson Energy

Project No.: H-05278

Boring No.	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse Sample #1		10.9	14.6	115.7	3 x 10-4
Coarse Refuse Sample #2		10.1	14.3	114.7	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

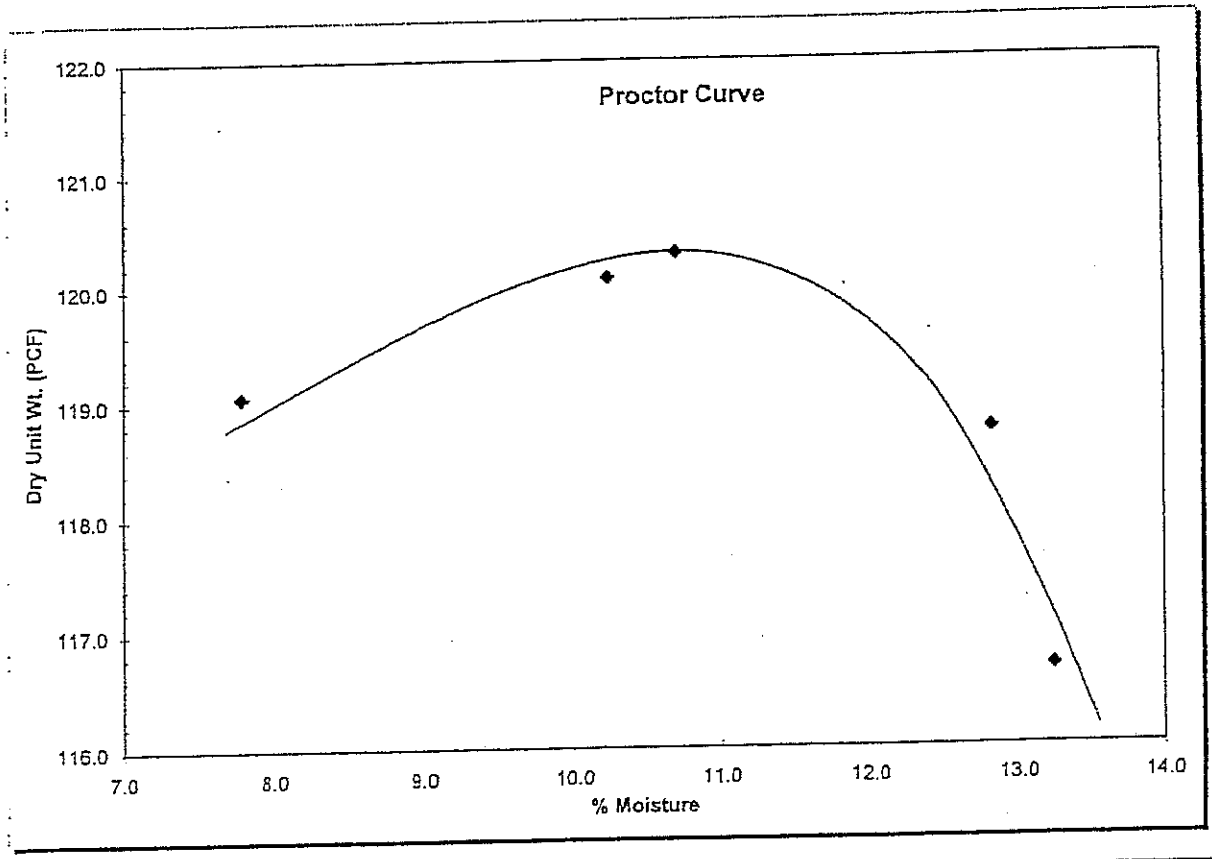
Date: 4/9/2007

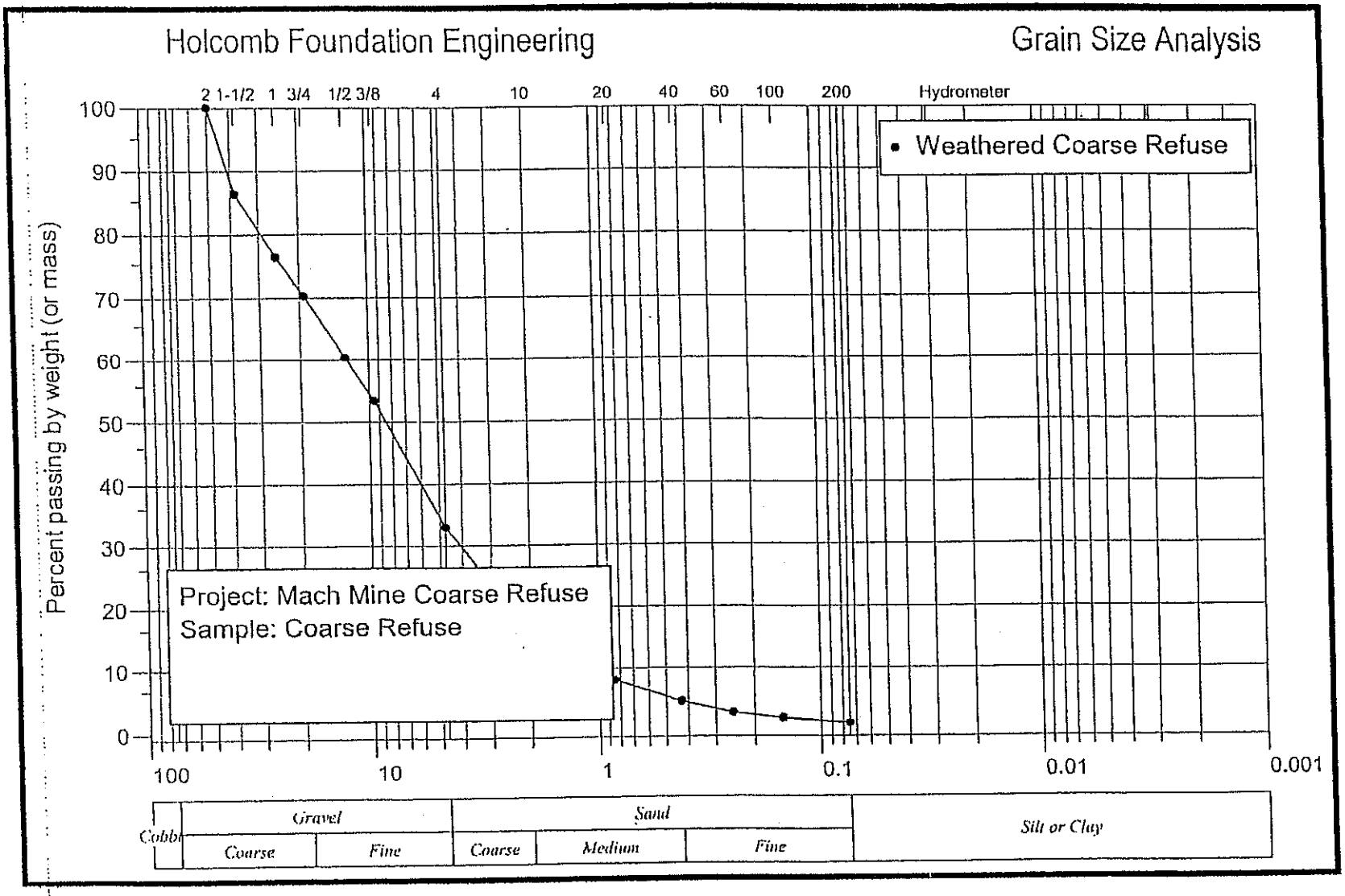
Proctor Test Results

Soil Classification:	Weathered Coarse Refuse
Maximum Dry Density (PCF)	120.3
Optimum Moisture Content (%)	10.7

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
12.8	118.7
13.2	116.7
10.2	120.1
7.8	119.1
10.7	120.3




Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
Weathered Coarse Refuse
Project: Mach Mine Coarse Refuse
Sample: Coarse Refuse
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

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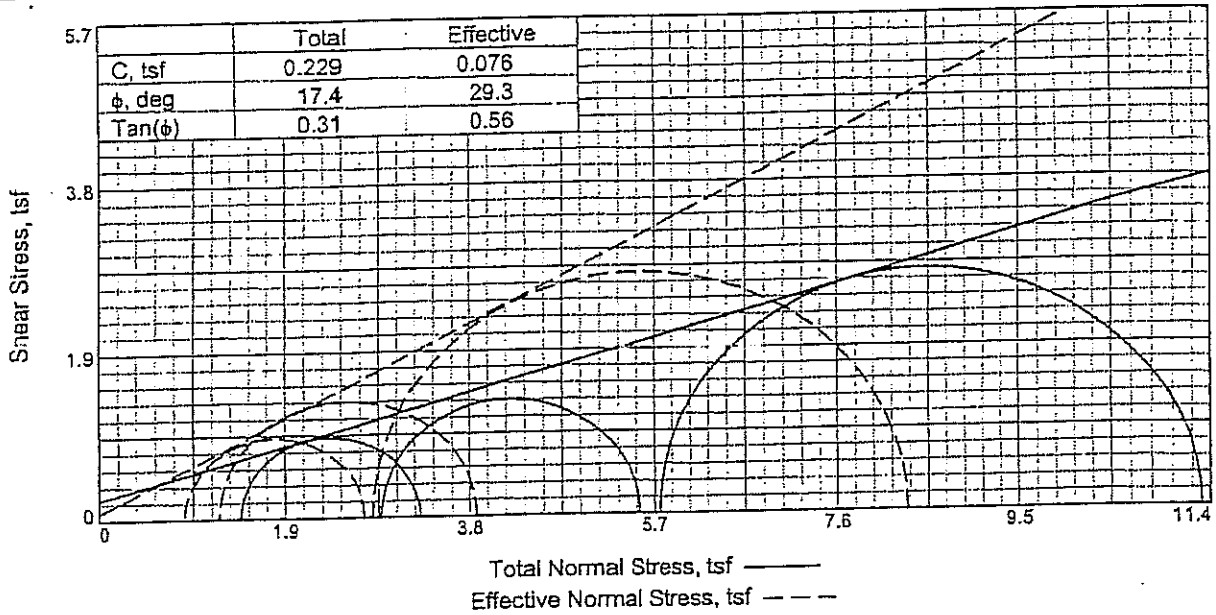
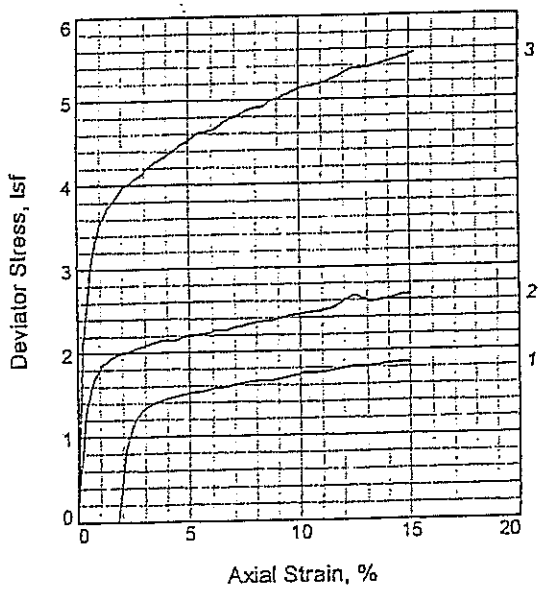
Grain Size Analysis

Project:	Mach Mine	Client:	Mach Mine
Project No.:	H-05278	Date:	4/9/2007
Sample No.	Coarse Refuse	Total Weight:	2290.30

Sieve	Wt. Retained	% Ret.	% Passing
2"	0.0	0.0	100.0
1.5"	314.4	13.7	86.3
1"	536.7	23.4	76.6
3/4"	674.8	29.5	70.5
1/2"	901.6	39.4	60.6
3/8"	1061.2	46.3	53.7
#4	1522.1	66.5	33.5
#10	1911.6	83.5	16.5
#20	2091.9	91.3	8.7
#40	2166.2	94.6	5.4
#60	2202.2	96.2	3.8
#100	2223.7	97.1	2.9
#200	2245.2	98.0	2.0





Sample No.		1	2	3
Initial	Water Content,	14.4	12.7	13.1
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	95.1	89.0	90.4
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
At Test	Water Content,	15.2	14.2	14.5
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.60	3.60	1.80
Cell Pressure, tsf		5.04	6.48	7.56
Fail. Stress, tsf		1.85	2.67	5.55
Total Pore Pr., tsf		4.18	5.27	4.77
Ult. Stress, tsf		1.85	2.66	5.55
Total Pore Pr., tsf		4.18	5.22	4.77
$\bar{\sigma}_1$ Failure, tsf		2.71	3.88	8.34
$\bar{\sigma}_3$ Failure, tsf		0.86	1.21	2.79

Type of Test:
CU with Pore Pressures
Sample Type: Coarse Refuse
Description:

Assumed Specific Gravity= 2.50
Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

Location: Weathered Coarse Refuse

Proj. No.: H-05278 **Date:** 4/2/07

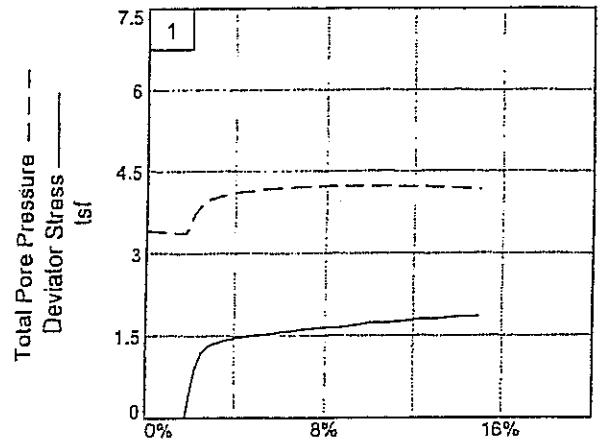
TRIAXIAL SHEAR TEST REPORT

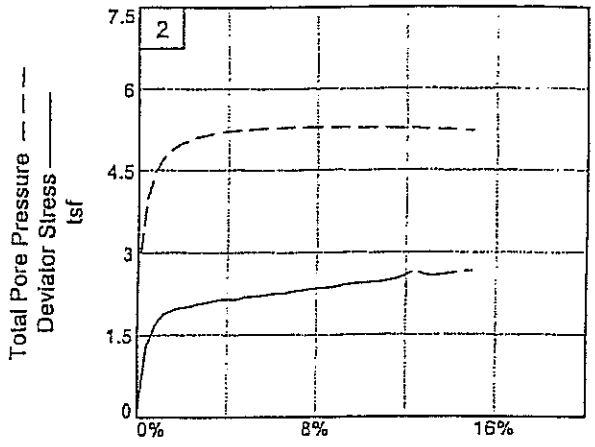
HOLCOMB FOUNDATION ENGINEERING CO.

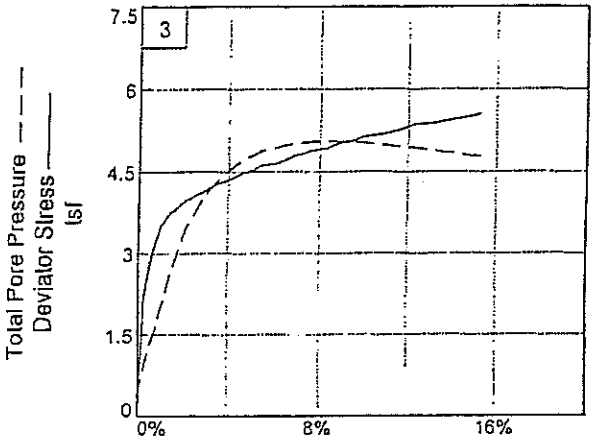
Plate _____

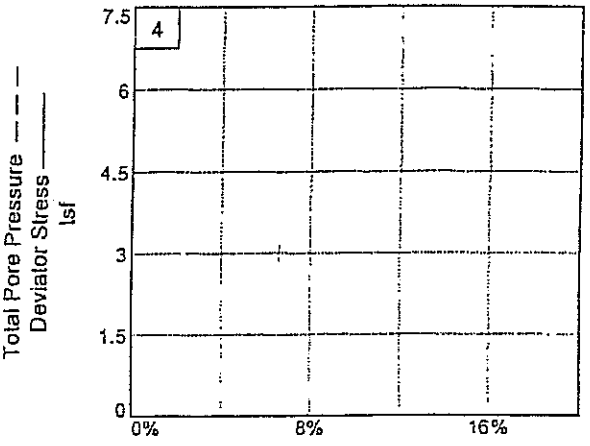
Tested By: LC Checked By: TH

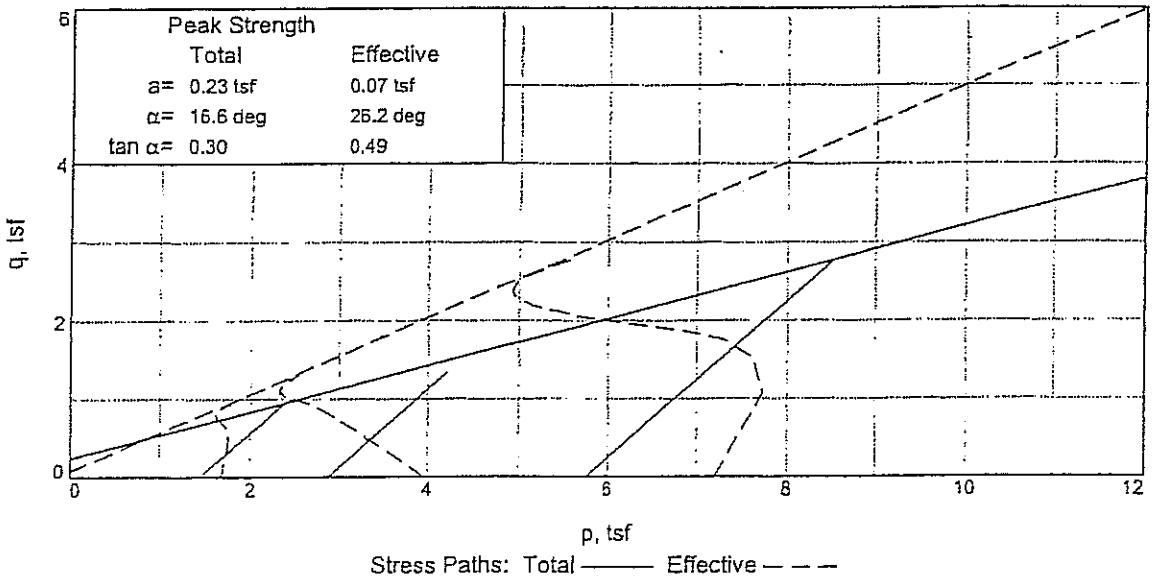
41 of 51











Stress Paths: Total ——— Effective — — —

Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Weathered Coarse Refuse
Project No.: H-05278

Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

4/9/2007
11:10 AM

Date: 4/2/07
Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Weathered Coarse Refuse
Description:
Remarks:
Type of Sample: Coarse Refuse
Assumed Specific Gravity=2.50 LL= PL= PI=
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	179.300			1255.500
Moisture content: Dry soil+tare, gms.	165.700			1117.500
Moisture content: Tare, gms.	71.400			79.600
Moisture, %	14.4	15.2	15.2	13.3
Moist specimen weight, gms.	1170.0			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.59	5.59	5.59	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.5	130.3	130.3	
Dry density, pcf	113.2	113.2	113.2	
Void ratio	0.3793	0.3793	0.3793	
Saturation, %	95.1	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.845 tsf at reading no. 31
Ult. Stress = 1.845 tsf at reading no. 31

75 7

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	19.10	0.0	0.0	0.000	1.627	1.627	1.00	47.40	1.627	0.000
1	0.0190	20.00	0.9	0.3	0.001	1.642	1.642	1.00	47.20	1.642	0.000
2	0.0400	20.00	0.9	0.7	0.000	1.656	1.656	1.00	47.00	1.656	0.000
3	0.0600	20.00	0.9	1.1	0.000	1.663	1.663	1.00	46.90	1.663	0.000
4	0.0810	20.00	0.9	1.4	0.000	1.678	1.678	1.00	46.70	1.678	0.000
5	0.1010	25.00	5.9	1.8	0.017	1.678	1.694	1.01	46.70	1.686	0.008
6	0.1220	99.00	79.9	2.2	0.857	1.318	2.175	1.65	51.70	1.746	0.429
7	0.1420	124.00	104.9	2.5	1.195	1.152	2.347	2.04	54.00	1.750	0.598
8	0.1620	134.80	115.7	2.9	1.314	1.058	2.372	2.24	55.30	1.715	0.657
9	0.1830	140.60	121.5	3.3	1.374	1.001	2.375	2.37	56.10	1.688	0.687
10	0.2030	144.80	125.7	3.6	1.416	0.965	2.381	2.47	56.60	1.673	0.708
11	0.2240	148.10	129.0	4.0	1.448	0.936	2.384	2.55	57.00	1.660	0.724
12	0.2440	150.60	131.5	4.4	1.471	0.914	2.385	2.61	57.30	1.650	0.735
13	0.2650	153.10	134.0	4.7	1.493	0.900	2.393	2.66	57.50	1.646	0.746
14	0.2850	155.60	136.5	5.1	1.515	0.878	2.393	2.72	57.80	1.636	0.757
15	0.3060	157.30	138.2	5.5	1.528	0.864	2.392	2.77	58.00	1.628	0.764
16	0.3260	159.80	140.7	5.8	1.549	0.857	2.406	2.81	58.10	1.631	0.775
17	0.3460	162.30	143.2	6.2	1.571	0.850	2.420	2.85	58.20	1.635	0.785
18	0.3670	163.10	144.0	6.6	1.573	0.835	2.408	2.88	58.40	1.622	0.787
19	0.3870	166.40	147.3	6.9	1.603	0.828	2.431	2.94	58.50	1.630	0.802
20	0.4080	168.90	149.8	7.3	1.624	0.821	2.445	2.98	58.60	1.633	0.812
21	0.4490	172.30	153.2	8.0	1.648	0.814	2.461	3.02	58.70	1.637	0.824
22	0.4890	173.90	154.8	8.7	1.652	0.806	2.458	3.05	58.80	1.632	0.826
23	0.5300	178.90	159.8	9.5	1.691	0.806	2.498	3.10	58.80	1.652	0.846
24	0.5710	184.80	165.7	10.2	1.740	0.814	2.553	3.14	58.70	1.683	0.870
25	0.6120	186.40	167.3	10.9	1.742	0.806	2.549	3.16	58.80	1.677	0.871
26	0.6530	190.60	171.5	11.7	1.771	0.821	2.592	3.16	58.60	1.706	0.886
27	0.6940	195.60	176.5	12.4	1.808	0.821	2.628	3.20	58.60	1.725	0.904
28	0.7350	197.20	178.1	13.1	1.809	0.835	2.644	3.17	58.40	1.740	0.904
29	0.7760	201.40	182.3	13.9	1.836	0.842	2.678	3.18	58.30	1.760	0.918
30	0.8170	204.70	185.6	14.6	1.853	0.857	2.710	3.16	58.10	1.783	0.927
31	0.8370	204.70	185.6	15.0	1.845	0.864	2.709	3.14	58.00	1.787	0.923

77 7

Parameters for Specimen No. 7

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	169.900			1238.700
Moisture content: Dry soil+tare, gms.	158.800			1117.200
Moisture content: Tare, gms.	71.200			73.100
Moisture, %	12.7	14.2	14.2	11.6
Moist specimen weight, gms.	1169.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.7	131.5	131.5	
Dry density, pcf	115.1	115.1	115.1	
Void ratio	0.3560	0.3560	0.3560	
Saturation, %	89.0	100.0	100.0	

Test Readings for Specimen No. 7

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 2.666 tsf at reading no. 27
Ult. Stress = 2.663 tsf at reading no. 31

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	62.40	0.0	0.0	0.000	3.967	3.967	1.00	34.90	3.967	0.000
1	0.0220	173.10	110.7	0.4	1.289	2.484	3.773	1.52	55.50	3.129	0.645
2	0.0420	206.40	144.0	0.8	1.671	2.016	3.687	1.83	62.00	2.852	0.836
3	0.0620	223.00	160.6	1.1	1.857	1.764	3.621	2.05	65.50	2.693	0.929
4	0.0830	230.50	168.1	1.5	1.936	1.613	3.549	2.20	67.60	2.581	0.968
5	0.1030	235.50	173.1	1.8	1.987	1.512	3.499	2.31	69.00	2.505	0.993
6	0.1240	238.00	175.6	2.2	2.008	1.447	3.455	2.39	69.90	2.451	1.004
7	0.1440	242.20	179.8	2.6	2.048	1.390	3.438	2.47	70.70	2.414	1.024
8	0.1650	245.50	183.1	3.0	2.078	1.346	3.424	2.54	71.30	2.385	1.039
9	0.1850	248.80	186.4	3.3	2.107	1.310	3.418	2.61	71.80	2.364	1.054
10	0.2060	252.20	189.8	3.7	2.137	1.289	3.426	2.66	72.10	2.358	1.069
11	0.2260	254.70	192.3	4.0	2.158	1.267	3.425	2.70	72.40	2.346	1.079
12	0.2460	253.80	191.4	4.4	2.139	1.253	3.392	2.71	72.60	2.322	1.070
13	0.2670	258.80	196.4	4.8	2.187	1.238	3.425	2.77	72.80	2.332	1.093
14	0.2870	260.50	198.1	5.1	2.197	1.231	3.428	2.78	72.90	2.330	1.099
15	0.3080	263.00	200.6	5.5	2.216	1.217	3.433	2.82	73.10	2.325	1.108
16	0.3280	265.50	203.1	5.9	2.235	1.210	3.445	2.85	73.20	2.327	1.118
17	0.3490	268.80	206.4	6.3	2.263	1.210	3.472	2.87	73.20	2.341	1.131
18	0.3690	268.80	206.4	6.6	2.254	1.202	3.456	2.87	73.30	2.329	1.127
19	0.3900	273.00	210.6	7.0	2.290	1.195	3.486	2.92	73.40	2.340	1.145
20	0.4100	275.50	213.1	7.3	2.309	1.195	3.504	2.93	73.40	2.350	1.154
21	0.4510	281.30	218.9	8.1	2.353	1.188	3.541	2.98	73.50	2.364	1.176

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4920	284.60	222.2	8.8	2.369	1.195	3.564	2.98	73.40	2.380	1.185
23	0.5330	292.10	229.7	9.6	2.429	1.195	3.625	3.03	73.40	2.410	1.215
24	0.5740	296.30	233.9	10.3	2.454	1.202	3.656	3.04	73.30	2.429	1.227
25	0.6140	300.40	238.0	11.0	2.477	1.202	3.679	3.06	73.30	2.441	1.238
26	0.6440	305.40	243.0	11.5	2.514	1.217	3.730	3.07	73.10	2.474	1.257
27	0.6960	322.90	260.5	12.5	2.666	1.210	3.876	3.20	73.20	2.543	1.333
28	0.7370	316.20	253.8	13.2	2.576	1.238	3.814	3.08	72.80	2.526	1.288
29	0.7780	322.10	259.7	13.9	2.613	1.238	3.852	3.11	72.80	2.545	1.307
30	0.8190	328.70	266.3	14.7	2.657	1.253	3.910	3.12	72.60	2.581	1.328
31	0.8390	330.40	268.0	15.0	2.663	1.260	3.923	3.11	72.50	2.591	1.331

Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	171.400			1284.500
Moisture content: Dry soil+tare, gms.	160.000			1180.500
Moisture content: Tare, gms.	72.800			134.900
Moisture, %	13.1	14.5	14.5	9.9
Moist specimen weight, gms.	1168.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.6	131.2	131.2	
Dry density, pcf	114.6	114.6	114.6	
Void ratio	0.3615	0.3615	0.3615	
Saturation, %	90.4	100.0	100.0	

Test Readings for Specimen No. 3

Membrane modulus = 0.124105 kN/cm²

Membrane thickness = 0.02 cm

Filter paper coefficient = 0.001926 kN/cm

Filter paper coverage = 50%

Consolidation cell pressure = 105.00 psi (7.560 tsf)

Consolidation back pressure = 25.00 psi (1.800 tsf)

Consolidation effective confining stress = 5.760 tsf

Strain rate, in./min. = 0.00

Fail. Stress = 5.549 tsf at reading no. 35

Ult. Stress = 5.549 tsf at reading no. 35

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0020	102.40	0.0	0.0	0.000	7.207	7.207	1.00	4.90	7.207	0.000
1	0.0170	286.30	183.9	0.3	2.145	6.674	8.819	1.32	12.30	7.747	1.072
2	0.0370	364.50	262.1	0.6	3.046	6.113	9.158	1.50	20.10	7.636	1.523
3	0.0580	407.00	304.6	1.0	3.526	5.537	9.063	1.64	28.10	7.300	1.763
4	0.0780	426.10	323.7	1.4	3.733	4.997	8.730	1.75	35.60	6.864	1.867
5	0.0990	437.70	335.3	1.7	3.853	4.536	8.389	1.85	42.00	6.462	1.926
6	0.1190	449.40	347.0	2.1	3.972	4.133	8.105	1.96	47.60	6.119	1.986
7	0.1400	457.70	355.3	2.5	4.052	3.838	7.889	2.06	51.70	5.863	2.026

Test Readings for Specimen No. 1

No.	Def. Dial In.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
8	0.1600	464.40	362.0	2.8	4.113	3.593	7.706	2.14	55.10	5.649	2.056
9	0.1810	474.40	372.0	3.2	4.210	3.384	7.594	2.24	58.00	5.489	2.105
10	0.2010	481.90	379.5	3.6	4.279	3.211	7.490	2.33	60.40	5.351	2.140
11	0.2210	487.70	385.3	3.9	4.328	3.074	7.403	2.41	62.30	5.239	2.164
12	0.2420	495.20	392.8	4.3	4.395	2.959	7.355	2.49	63.90	5.157	2.198
13	0.2620	503.50	401.1	4.7	4.471	2.851	7.323	2.57	65.40	5.087	2.236
14	0.2830	509.30	406.9	5.0	4.518	2.772	7.290	2.63	66.50	5.031	2.259
15	0.3030	519.30	416.9	5.4	4.612	2.693	7.305	2.71	67.60	4.999	2.306
16	0.3240	522.60	420.2	5.8	4.630	2.650	7.279	2.75	68.20	4.965	2.315
17	0.3440	526.00	423.6	6.1	4.650	2.621	7.270	2.77	68.60	4.946	2.325
18	0.3650	534.30	431.9	6.5	4.722	2.578	7.299	2.83	69.20	4.938	2.361
19	0.3850	541.80	439.4	6.9	4.785	2.549	7.334	2.88	69.60	4.941	2.393
20	0.4050	546.80	444.4	7.2	4.821	2.534	7.355	2.90	69.80	4.945	2.411
21	0.4260	553.40	451.0	7.6	4.873	2.520	7.393	2.93	70.00	4.956	2.436
22	0.4460	558.40	456.0	8.0	4.908	2.506	7.413	2.96	70.20	4.959	2.454
23	0.4670	560.90	458.5	8.3	4.914	2.506	7.420	2.96	70.20	4.963	2.457
24	0.4870	569.20	466.8	8.7	4.984	2.506	7.489	2.99	70.20	4.997	2.492
25	0.5080	574.20	471.8	9.1	5.016	2.513	7.529	3.00	70.10	5.021	2.508
26	0.5280	580.10	477.7	9.4	5.059	2.520	7.579	3.01	70.00	5.050	2.530
27	0.5690	592.50	490.1	10.2	5.148	2.534	7.683	3.03	69.80	5.109	2.574
28	0.6100	600.00	497.6	10.9	5.184	2.570	7.755	3.02	69.30	5.163	2.592
29	0.6510	610.90	508.5	11.6	5.254	2.599	7.853	3.02	68.90	5.226	2.627
30	0.6920	625.80	523.4	12.4	5.363	2.628	7.991	3.04	68.50	5.310	2.682
31	0.7330	631.70	529.3	13.1	5.378	2.671	8.049	3.01	67.90	5.360	2.689
32	0.7730	641.60	539.2	13.8	5.434	2.707	8.141	3.01	67.40	5.424	2.717
33	0.8140	651.60	549.2	14.6	5.487	2.750	8.238	3.00	66.80	5.494	2.744
34	0.8350	656.60	554.2	14.9	5.513	2.772	8.285	2.99	66.50	5.528	2.756
35	0.8540	662.50	560.1	15.3	5.549	2.786	8.335	2.99	66.30	5.561	2.775

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Characterization of Subsurface Materials

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY TJT DATE 5/1/09 SHEET NO. 1 OF 6

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Engineers • Geologists • Planners
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CALCULATION BRIEF
FOR
SUPPLEMENTAL CHARACTERIZATION OF SUBSURFACE MATERIALS – COARSE REFUSE AND RESIDUAL SOIL

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE: To supplement characterization of the subsurface materials Reference (Ref.) Number (No.) 1, particularly from coarse coal refuse and residual soil laboratory testing from site-specific samples/testing from the Pond Creek Coal Refuse Disposal Facility. Materials are characterized as either sand-like or clay-like in accordance with various pertinent references shown below and included within the "Draft" Mine Health and Safety Administration (MSHA) Engineering and Design Manual, specifically Chapter 7: Seismic Design: Stability and Deformation Analyses (Ref. No. 2).

REFERENCES:

1. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Characterization of Sand-Like and Clay-Like Subsurface Materials," Pond Creek Coal Refuse Disposal Site – South Cell, BEG, dated 7/11/08.

2. Mine Safety and Health Administration, "Draft - Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 – Seismic Design: Stability and Deformation Analyses," dated, December 2007 (Updated August 2008).

3. GAI Consultants, Inc. Calculation Brief Entitled "Summary of Laboratory Testing," Pond Creek Coal Refuse Disposal Site, BEG, dated 3/30/09.

4. Civil & Environmental Consultants, Inc. Report Entitled "Abandonment Evaluation, Pond Creek No. 1 Coal Refuse Disposal Facility, Phase 2 South Pond Slurry Impoundment, Johnston City, Williamson County, Illinois," dated July 23, 2008.

5. Civil & Environmental Consultants, Inc. Report Entitled "Permanent Deformation Evaluation, Pond Creek No. 1 Coal Refuse Disposal Facility, South Cell Slurry Impoundment, Johnston City, Williamson County, Illinois," dated January 23, 2008.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Characterization of Subsurface Materials

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY [illegible] DATE 5/1/05 SHEET NO. 2 OF 6

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GENERAL:

Reference (Ref.) Number (No.) 1 presents the analyses prepared by Civil & Environmental Consultants, Inc. (CEC) addressing the characterization of coarse and fine coal refuse, and residual soil materials previously required for evaluating Illinois Department of Natural Resources (IDNR) comments pertaining to an abandonment evaluation of the Phase 2 South Cell. A similar characterization approach will be utilized to assess the characterization of the coarse and fine coal refuse and residual soils relative to assessing the likelihood of flow failure (liquefaction) following a subsidence related loading event associated with the mining of Longwall Panel No. 3 beneath the Phase 3 impoundment at the Pond Creek site.

Therefore, the first step of this and previous analyses is to characterize the subsurface conditions to evaluate the fluid nature and whether any zones have the potential for strength loss (i.e., liquefaction potential) due to a rapid loading event such as surface strains from subsidence or an earthquake. Previously (Ref. No. 5), the materials making up the existing Pond Creek South Cell (Phases 2/3) coarse refuse dike and underlying site residual soils were evaluated using piezo-seismic cone penetration testing (PSCPT) as part of a permanent deformation analyses of the South Cell. Subsequently, and as part of the abandonment evaluation (Ref. No. 4), laboratory testing and characterization of site specific fine coal refuse (Ref. No. 1) was performed by CEC.

Coal refuse and residual soils are referred to as sand-like or clay-like depending on whether they exhibit monotonic and cyclic undrained shear loading behavior that is fundamentally more similar to that of either sand or clay. This differentiation is significant primarily if the material is loose enough (sands) or soft enough (clays) that it is potentially susceptible to strength loss.

SUMMARY OF SITE-SPECIFIC FIELD AND LABORATORY TESTING AND RESULTS:

In November 2007, CEC developed, implemented and oversaw a detailed field testing program consisting of performing PS-CPT at several sounding locations throughout the Pond Creek site, including the South Cell. PS-CPT was performed by ConeTec, Inc. (ConeTec) of West Berlin, New Jersey. Subsequently, Alliance Consulting, Inc. (Alliance) provided bulk (bucket) samples of fine coal refuse, which were obtained for abandonment-related laboratory testing. Geotechnics, Inc. (Geotechnics) of Pittsburgh, Pennsylvania performed consolidated undrained triaxial shear strength laboratory testing of the fine coal refuse materials. Ref. Nos. 1, 3, 4 and 5 present summaries of the field and laboratory testing programs, and appropriate calculation briefs are attached for information.

PIEZO-SEISMIC CONE PENETRATION TEST RESULTS SUMMARY:

Ref. Nos. 1 and 5 presents the details and results of the November 2007 PS-CPT program performed by CEC/ConeTec at the Pond Creek site, which are generalized/summarized below.

LABORATORY TESTING RESULTS SUMMARY:

Ref. Nos. 1 and 4 presents the details and results of the June 2008 laboratory testing program performed by CEC/Geotechnics on bulk samples of fine coal refuse. In general, the following summarizes laboratory testing results of each of 2 buckets of fine coal refuse sampled from the South Pond impoundment.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Characterization of Subsurface Materials

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY [illegible] DATE 5/1/09 SHEET NO. 3 OF 6

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Bucket 1	Bucket 2
Fine Coal Refuse	Fine Coal Refuse
Moisture = 85.8 %	Moisture = 94.4 %
Passing No. 200 = 92.8 %	Passing No. 200 = 92.6 %
Passing No. 40 = 99.4 %	Passing No. 40 = 99.3%
Plasticity Index = 17 %	Plasticity Index = 17 %
Avg. Strain to Peak = 15.1 %	Avg. Strain to Peak = 11.0 %

Ref. Nos. 3 and 4 present the details and results of the November 2006 and April 2007 laboratory testing program performed by Holcolm Foundation Engineering Company, Inc. (Holcolm) on bulk samples of coarse coal refuse from the Pond Creek site:

November 2006	April 2007
Coarse Coal Refuse	Coarse Coal Refuse
Maximum Dry Density = 124.6 pcf	Maximum Dry Density = 120.3 pcf
Optimum Moisture = 9.3%	Moisture = 10.7%
Passing No. 200 = 2.6%	Passing No. 200 = 2.0%
Passing No. 40 = 5.6%	Passing No. 40 = 5.4%
Effective Friction = 33.7 degrees	Effective Friction = 29.3 degrees
Effective Cohesion = 0 psf	Effective Cohesion = 152 psf
Total Friction = 18.5 degrees	Total Friction = 17.4 degrees
Cohesion = 1,014 psf	Cohesion = 458 psf
Avg. Strain to Peak = 14.8 %	Avg. Strain to Peak = 14.1 %

Ref. Nos. 3 and 4 also present the details and results of the February 2006 laboratory testing program performed by Holcolm on an undisturbed sample of residual soil from the Pond Creek site:

February 2006 – Boring 8874
Residual Soil
Dry Density = 105.3 pcf
Moisture = 21.5%
Passing No. 200 = 79%
Passing No. 40 = 94.5%
Plasticity Index = 24%
Avg. Strain to Peak = 12.6%

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Characterization of Subsurface Materials

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY DATE 5/1/09 SHEET NO. 4 OF 6

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CHARACTERIZATION CRITERIA AND METHODOLOGY:

From Ref. No. 2, the first step common to evaluating liquefaction potential (and correspondingly, subsidence-related flowability) is to review the subsurface conditions of the embankment, subgrade and impoundment contents to evaluate whether any zones have the potential for strength loss.

Generalized field-related CPT-derived criteria noted in various references within Ref. No. 2 include:

Sand-like: Fines content < 50% or PI < 12%
Loose: SPT $N_{1,60}$ < 15 or CPT q_{c1} > 75 tsf, & SBT Ic < 2.6 or F_r < 2%).

Clay-like: Fines content > 50% and PI >12%
Soft: OCR < 5, S_u/σ'_v < 1.0, CPT Q_t < 20 tsf & SBT Ic > 2.6, SPT $N_{1,60}$ < 8

CPT data may be used in conjunction with Atterberg limit data (criteria shown below) to differentiate sand-like from clay-like material. CPT Soil Behavior Type Index (I_c), as described in Robertson and Wride 1998 and reproduced in Youd et al. 2001, values below 2.6 should be considered sand-like. I_c values above 2.6 may be considered clay-like.

Generalized laboratory results criteria noted in various references within and in Ref. No. 1 and 3 include the following Atterberg Limit and sieve criteria:

Atterberg Limits.

Material should be considered sand-like if any of the following three (3) criteria apply:

1. The material has less than 35% particles by dry weight passing the No. 40 sieve and less than 20% by dry weight passing the No. 200 sieve; or

2. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 12%; or

3. The material has 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 20%.

The material may be considered clay-like if any of the following two (2) criteria apply:

1. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 12% or higher; or

2. The material has 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 20% or higher.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Characterization of Subsurface Materials

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY TDS DATE 5/1/09 SHEET NO. 5 OF 6

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Atterberg limit criteria include as sand-like some materials that are considered clay-like by some investigators (e.g. Boulanger and Idriss, 2004, who suggested a break between sand-like and clay-like behavior at a PI of 7%). The intent is to classify borderline materials as sand-like to be conservative.

Another key factor in differentiating loose sand-like material from soft or medium clay-like material, for the purposes of liquefaction analyses, are the strain at peak undrained strength and the abruptness of the drop-off in shearing resistance as strains increase beyond the strain at peak. Loose sands and highly sensitive clays can reach S_{up} at small strains, and experience abrupt drop-off in resistance at higher strains. Most clays tend to reach S_{up} at higher strains, and tend to experience more gradual and limited drop-off in shearing resistance at higher strains. Fine coal refuse deposits often include materials falling within both classifications, and near the boundary of these two types of behavior.

Loose materials with shear strain at peak strength of less than 2% in an undrained monotonic (non-cyclic) test, and a rapid drop-off in resistance after reaching peak strength, are considered sand-like. Loose or soft materials with shear strain at peak strength of more than about 5%, and a gradual drop-off in resistance after reaching peak strength are considered clay-like. Materials with strain behavior between these descriptions are considered borderline and, to be conservative, should generally be analyzed as sand-like. (Note that shear strain in an undrained triaxial test is 1.5 times axial strain.)

SUMMARY OF PREVIOUS AND SUPPLEMENTAL MATERIAL CHARACTERIZATIONS

WEIGHTED AVERAGE FIELD AND LAB RESULTS SUMMARY
Coarse Coal Refuse (138')
Avg. Tip Stress, Qc avg. = 46 tsf
Avg. Fines Content, FC avg. = 23%
Avg. SBT Index, Ic = 2.25
Avg. % Passing No. 200 = 2.3%
Avg. % Passing No. 40 = 5.5 %
Avg. Strain to Peak = 14.5 %

Fine Coal Refuse
Avg. % Passing No. 200 = 92.7%
Avg. % Passing No. 40 = 99.4 %
Avg. Plasticity Index = 17%
Avg. Strain to Peak = 13.1 %

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Characterization of Subsurface Materials

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY TDS DATE 5/1/09 SHEET NO. 6 OF 6

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Residual Soil (150.6')
Avg. Tip Stress, Qc avg. = 61 tsf
Avg. Fines Content, FC avg. = 46%
Avg. SBT Index, Ic = 2.73
Avg. % Passing No. 200 = 79%
Avg. % Passing No. 40 = 94.5%
Avg. Strain to Peak = 12.6%

Plots of individual and average normalized tip stress with depth are included with an attached copy of Ref. No. 1 with copies of the appropriate references also attached.

CONCLUSION

Based on the information presented in this supplemental and previous calculation briefs, the following material characteristic designations were determined for the coarse coal refuse, fine coal refuse and residual soil:

Coarse Coal Refuse: Medium Dense Sand-Like to Medium Stiff Clay-Like (based on peak strain);

Fine Coal Refuse: Medium Stiff Clay-Like;

Residual Soil: Medium Dense Sand-Like and Medium Stiff Clay-Like.

Further, the results of the laboratory testing indicate that the fine coal refuse is clay-like based on an average 93% passing the No. 200 sieve and plasticity index of 17%. Peak and steady-state undrained strengths presented in Ref. No. 3 were reached at generally high strains (between 8 and 18%), and there was very little drop off from peak to steady-state with increasing strain. Similar peak undrained shear strains were observed for coarse refuse and residual soil testing results. The results generally indicated a higher resistance to strength loss (and flow) due to the large strains required to exceed the peak strength and correspondingly small decrease to the steady-state strength at higher strains, particularly for the fine coal refuse.

The susceptibility of the embankment and impoundment to a liquefaction flow failure is a function of both the undrained strength (worst case steady-state strength) and the in-situ driving shear stress on a critical failure plane passing through the critical layer fine coal refuse material, which is further addressed in subsequent calculation briefs. Similarly, subsidence induced strains are subsequently compared to (peak) triggering strains of the coarse and fine coal refuse to further assess flowability of fines and potential embankment cracking.

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ATTACHMENT 1
Reference No. 1

Civil & Environmental Consultants, Inc., Calculation Brief Entitled "Characterization of Sand-Like and Clay-Like Subsurface Materials," Pond Creek Coal Refuse Disposal Site – South Cell, BEG, dated 7/11/08.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

PAGE 1 OF 12

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CALCULATION BRIEF
FOR
CHARACTERIZATION OF SAND-LIKE AND CLAY-LIKE SUBSURFACE MATERIALS

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH CELL

OBJECTIVE: To characterize subsurface materials including coarse coal refuse, fine coal refuse and residual soils encountered at the Pond Creek South Cell refuse disposal facility. Materials are characterized as either sand-like or clay-like in accordance with various pertinent references shown below and included within the "Draft" Mine Health and Safety Administration (MSHA) Engineering and Design Manual, specifically Chapter 7: Seismic Design: Stability and Deformation Analyses, March 2007.

REFERENCES:

1. Illinois Department of Natural Resources, Office of Water Resources, Construction and Maintenance of Dams, Part 3702, Chapter IX.

2. Mine Safety and Health Administration, "Draft - Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 – Seismic Design: Stability and Deformation Analyses," dated, March 13, 2007.

3. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Piezo-Cone Penetration Testing," Pond Creed Coal Refuse Disposal Site, BEG, dated 12/21/07.

4. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Normalized PS-CPT Data and Parameter Correlations," Pond Creek Coal Refuse Disposal Site, BEG, dated 12/28/07.

5. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Laboratory Testing," Pond Coal Refuse Disposal Site – South Pond, BEG, dated 7/8/08.

6. Boulanger, R.W. and Idriss, I.M. (2004). "Evaluating the Potential for Liquefaction or Cyclic Failure of Silts and Clays," Report No. UCD/CGM-04/01, Center for Geotechnical Modeling, Department of Civil and Environmental Engineering, University of California, Davis, California.

7. Robertson, P.K., (Fear) Wride, C.E., List, B.R., Atukorala, U., Biggar, K.W., Byrne, P.M., Campanella, R.G., Cathro, D.C., Chan, D.H., Czajewski, K., Finn, W.D.L., Gu, W.H., Hammamji, Y., Hofmann, B.A., Howie, J.A., Hughes, J., Imrie, A.S., Konrad, J.-M., Küpper, A., Law, T., Lord, E.R.F., Monahan, P.A., Morgenstern, N.R., Phillips, R., Piché, Plewes, H.D., Scott, D., Sego, D.C., Sobkowicz, J., Stewart, R.A., Tan, S., Vaid, Y.P., Watts, B.D., Woeller, D.J., Youd, T.L., and Zavodni, Z., The CANLEX Project: Summary and Conclusions. Canadian Geotechnical Journal, 2000, Vol. 37, No. 3, June, pp. 499-504

8. Youd, T. L. et al. (2001). "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 127, No. 10, pp. 817-833.

9. Blight, G. E. and Bentel, G. M., (1983) "The Behaviour of Mine Tailings During Hydraulic Deposition," Journal of the South African Institute of Mining and Metallurgy, April 1983.

GENERAL:

Reference (Ref.) Number (No.) 1 presents the following guidelines regarding the methods of testing, analyses and computations which must be completed and submitted with an application to support an owner's request for abandonment of a disposal impoundment dam:

1. The classification of the existing condition of the impounded material with respect to its fluid nature;
2. The liquefaction potential of the impounded material and the related stability of the containing dam;
3. The final surface configuration for the impounded materials, especially from any surface water impounding characteristics and the erosion potential of the surface material; and
4. The establishment of a follow-up inspection schedule to ensure the proposed plans have been effective and the submittal of record drawings.

This, and subsequent calculation briefs prepared by Civil & Environmental Consultants, Inc. (CEC), address the characterization of the impounded fine coal refuse and the liquefaction potential of the fine coal refuse and related stability (i.e., Requirements 1 and 2 above). Alliance Consulting, Inc. (Alliance) will provide the final surface configuration and the follow-up inspection schedule.

From Ref. No. 2, the basic elements for seismic design and analysis are:

1. Characterize the subsurface materials;
2. Evaluate if design earthquake will trigger strength loss;
3. Evaluate seismic stability using post-earthquake strength parameters; and
4. Evaluate deformations.

Therefore, the first step for both abandonment and seismic design and analysis is to characterize the subsurface conditions to evaluate the fluid nature and whether any zones have the potential for strength loss due to earthquake shaking (i.e., liquefaction potential). Previously, the materials making up the coarse refuse dike and underlying residual soils were evaluated using piezo-seismic cone penetration testing (PSCPT) (Ref. Nos. 3 and 4) as part of the deformation analyses of the South Pond. Subsequently, and as part of the abandonment evaluation, laboratory testing (Ref. No. 5) and characterization of the fine coal refuse retained behind the embankment was performed as described below.

For many aspects of seismic stability analyses described in Ref. No. 2, coal refuse and natural soils are referred to as sand-like or clay-like depending on whether they exhibit monotonic and cyclic undrained shear loading behavior that is fundamentally more similar to that of either sand or clay. This differentiation is significant primarily if the material is loose enough (sands) or soft enough (clays) that it is potentially susceptible to strength loss.

SUMMARY OF POND CREEK FIELD AND LABORATORY TESTING/RESULTS:

CEC developed, implemented and oversaw a detailed and thorough field testing program consisting of performing PS-CPT at several sounding locations throughout the Pond Creek site, including the ongoing South Pond impoundment. PS-CPT was executed at Pond Creek by ConeTec, Inc. (ConeTec) of West Berlin, New Jersey. Also, Alliance provided bulk (bucket) samples of fine coal refuse, which were obtained for subsequent laboratory testing. Geotechnics, Inc. (Geotechnics) of Pittsburgh, Pennsylvania performed consolidated undrained triaxial shear strength laboratory testing of the fine coal refuse materials. Ref. Nos. 3 -5 present summaries of the field and laboratory testing programs and Appendixes A - C of the Pond Creek abandonment report present the results of the field and laboratory testing.

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 4 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

PIEZO-SEISMIC CONE PENETRATION TEST RESULTS SUMMARY:

Generalized South Cell CPT Profiles from the October 2007 field testing presented in Ref. Nos. 3 and 4 indicated the following:

CPT-1	CPT-2
El. 482.19 – Surface Elevation	El. 494.21 – Surface Elevation
15.3 feet – Depth to Static Ground Water	38.8 feet – Depth to Static Ground Water
0 – 18.4 feet – Residual Soil	0 – 32 feet – Coarse Refuse
Refusal at 18.4 feet - Bedrock	32 – 45.3 feet – Residual Soil
	Refusal at 45.3 feet - Bedrock

CPT-2A	CPT-3
El. 492.40 – Surface Elevation	El. 466.98 – Surface Elevation
37.0 feet – Depth to Static Ground Water	11.1 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 22.2 feet – Residual Soil
29 – 41.7 feet – Residual Soil	Refusal at 22.2 feet – Bedrock
Refusal at 41.7 feet - Bedrock	

CPT-4	CPT-5
El. 482.55 – Surface Elevation	El. 482.55 – Surface Elevation
21.7 feet – Depth to Static Ground Water	34.4 feet – Depth to Static Ground Water
0 – 18.9 feet – Residual Soil	0 – 29 feet – Coarse Refuse
Refusal at 18.9 feet – Bedrock	29 – 49.2feet – Residual Soil
	Refusal at 49.2 feet - Bedrock

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PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-5A	CPT-5B
El. 483.00 – Surface Elevation	El. 479.90 – Surface Elevation
35.9 feet – Depth to Static Ground Water	28.0 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 19 feet – Coarse Refuse
29 – 53.2 feet – Residual Soil	19 – 39.7 feet – Residual Soil
Refusal at 53.2 feet - Bedrock	Refusal at 39.7 feet - Bedrock

Cone penetration testing results for CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A AND CPT-5B presented in Ref. Nos. 3 and 4 indicated the following:

CPT-1	CPT-3
Residual Soil (Layer Thickness = 18.4)	**Residual Soil (Layer Thickness = 22.2)**
Avg. Tip Stress, Qc avg. = 79 tsf	Avg. Tip Stress, Qc avg. = 43 tsf
Avg. Fines Content, FC avg. = 27%	Avg. Fines Content, FC avg. = 32%
Avg. SBT Index, Ic = 2.38	Avg. SBT Index, Ic = 2.49

CPT-4
Residual Soil (Layer Thickness = 18.9)
Avg. Tip Stress, Qc avg. = 64 tsf
Avg. Fines Content, FC avg. = 28%
Avg. SBT Index, Ic = 2.41

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PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

PAGE 6 OF 12

MADE BY BEG DATE 7/11/08 CHECKED BY MRS DATE 7/23/08

CPT-2	CPT-2A
Coarse Coal Refuse (Layer Thickness = 32')	**Coarse Coal Refuse (Layer Thickness = 29')**
Avg. Tip Stress, Qc avg. = 54 tsf	Avg. Tip Stress, Qc avg. = 45 tsf
Avg. Fines Content, FC avg. = 24%	Avg. Fines Content, FC avg. = 22%
Avg. SBT Index, Ic = 2.30	Avg. SBT Index, Ic = 2.23

Residual Soil (Layer Thickness = 13.3')	**Residual Soil (Layer Thickness = 12.7')**
Avg. Tip Stress, Qc avg. = 47 tsf	Avg. Tip Stress, Qc avg. = 86 tsf
Avg. Fines Content, FC avg. = 60%	Avg. Fines Content, FC avg. = 48%
Avg. SBT Index, Ic = 2.99	Avg. SBT Index, Ic = 2.80

CPT-5	CPT-5A
Coarse Coal Refuse (Layer Thickness = 29')	**Coarse Coal Refuse (Layer Thickness = 29')**
Avg. Tip Stress, Qc avg. = 50 tsf	Avg. Tip Stress, Qc avg. = 37 tsf
Avg. Fines Content, FC avg. = 23%	Avg. Fines Content, FC avg. = 24%
Avg. SBT Index, Ic = 2.24	Avg. SBT Index, Ic = 2.29

Residual Soil (Layer Thickness = 20.2')	**Residual Soil (Layer Thickness = 24.2')**
Avg. Tip Stress, Qc avg. = 66 tsf	Avg. Tip Stress, Qc avg. = 49 tsf
Avg. Fines Content, FC avg. = 64%	Avg. Fines Content, FC avg. = 56%
Avg. SBT Index, Ic = 3.04	Avg. SBT Index, Ic = 2.94

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PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 7 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-5B
Coarse Coal Refuse (Layer Thickness = 19')
Avg. Tip Stress, Qc avg. = 41 tsf
Avg. Fines Content, FC avg. = 19%
Avg. SBT Index, Ic = 2.15

Residual Soil (Layer Thickness = 20.7')
Avg. Tip Stress, Qc avg. = 63 tsf
Avg. Fines Content, FC avg. = 51%
Avg. SBT Index, Ic = 2.84

Cone Penetration Testing Results – Shear Wave Velocities

CPT No.	Shear Wave Velocity Coarse Coal Refuse (ft/sec)			Shear Wave Velocity Residual Soil (ft/sec)		
	Max.	Min.	Avg.	Max.	Min.	Avg.
CPT-1	NA			1402	645	905
CPT-2	1284	1029	1120	1173	795	957
CPT-2A	1169	895	1042	1256	780	918
CPT-3	NA			1058	569	765
CPT-4	NA			1242	476	817
CPT-5	1190	936	1063	1599	780	947
CPT-5A	1396	779	1064	1580	728	1005
CPT-5B	1517	818	1080	1649	686	978

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 8 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

LABORATORY TESTING RESULTS SUMMARY:

Ref. No. 4 and Appendix A present the details and results of the June 2008 laboratory testing program performed by Geotechnics. The following summarizes laboratory testing results of each of 2 buckets of fine coal refuse sampled from the South Pond impoundment.

Bucket 1	Bucket 2
Fine Coal Refuse	Fine Coal Refuse
Moisture = 85.8 %	Moisture = 94.4 %
Passing No. 200 = 92.8 %	Passing No. 200 = 92.6 %
Passing No. 40 = 99.4 %	Passing No. 40 = 99.3%
Plasticity Index = 17 %	Plasticity Index = 17 %
Avg. Strain to Peak = 15.1 %	Avg. Strain to Peak = 11.0 %

Normalized tip stress and fines content with depth for CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B including a summary of pertinent average field and laboratory test results for each material layer are attached.

CRITERIA AND METHODOLOGY:

From Ref. No. 2, the first step common to all approaches is to review the subsurface conditions at the embankment to evaluate whether any zones have the potential for strength loss. For this initial screening step, saturated to nearly saturated sand-like materials with $N_{1,60}$ values less than 15 blows per foot (bpf), or q_{c1} (or Qc) values less than 75 tons per square foot (tsf), should be considered potentially susceptible to strength loss. Ref. No. 2 noted these values are likely too conservative and apply only to clean sands. Their application to silty sands and sands with high fines content, which are more representative of fine coal refuse, will likely be overly conservative.

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 9 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

Generalized field-related CPT-derived criteria noted in various references within Reference 2 include:

Sand-like:	Fines content < 50% or PI < 12%
Loose:	SPT $N_{1,60} < 15$ or CPT $q_{c1} > 75$ tsf, & SBT Ic < 2.6 or $F_r < 2\%$).
Clay-like:	Fines content > 50% and PI >12%
Soft:	OCR < 5, $S_u/\sigma'_v < 1.0$, CPT $Q_t < 20$ tsf & SBT Ic > 2.6, SPT $N_{1,60} < 8$

CPT data may be used in conjunction with Atterberg limit data (criteria shown below) to differentiate sand-like from clay-like material. CPT Soil Behavior Type Index (I_c), as described in Robertson and Wride 1998 and reproduced in Youd et al. 2001, values below 2.6 should be considered sand-like. I_c values above 2.6 may be considered clay-like.

Generalized laboratory results criteria noted in various references within and in Ref. No. 1 include the following Atterberg Limit and sieve criteria:

Atterberg Limits.

- Material should be considered sand-like if any of the following three (3) criteria apply:

  1. The material has less than 35% particles by dry weight passing the No. 40 sieve and less than 20% by dry weight passing the No. 200 sieve; or

  2. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 12%; or

  3. The material has 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 20%.

The material may be considered clay-like if any of the following two (2) criteria apply:

1. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 12% or higher; or

2. The material has 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 20% or higher.

Atterberg limit criteria include as sand-like some materials that are considered clay-like by some investigators (e.g. Boulanger and Idriss, 2004, who suggested a break between sand-like and clay-like behavior at a PI of 7%). The intent is to classify borderline materials as sand-like to be conservative.

Another key factor in differentiating loose sand-like material from soft or medium clay-like material, for the purposes of seismic stability and deformation analyses, are the strain at peak undrained strength and the abruptness of the drop-off in shearing resistance as strains increase beyond the strain at peak. Loose sands and highly sensitive clays can reach S_{up} at small strains, and experience abrupt drop-off in resistance at higher strains. Most clays tend to reach S_{up} at higher strains, and tend to experience more gradual and limited drop-off in shearing resistance at higher strains. Fine coal refuse deposits often include materials falling within both classifications, and near the boundary of these two types of behavior.

Loose materials with shear strain at peak strength of less than 2% in an undrained monotonic (non-cyclic) test, and a rapid drop-off in resistance after reaching peak strength, are considered sand-like. Loose or soft materials with shear strain at peak strength of more than about 5%, and a gradual drop-off in resistance after reaching peak strength are considered clay-like. Materials with strain behavior between these descriptions are considered borderline and, to be conservative, should generally be analyzed as sand-like. (Note that shear strain in an undrained triaxial test is 1.5 times axial strain.)

Soil, rock, and mixtures of soil and rock that are not coal refuse such as the underlying starter embankment will be referred to as natural soils. Natural soils may be described as sand-like, or clay-like, using the same general criteria as refuse.

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 11 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A AND CPT-5B AVG. WEIGHTED AVERAGE FIELD AND LAB RESULTS SUMMARY
Coarse Coal Refuse (138')
Avg. Tip Stress, Qc avg. = 46 tsf
Avg. Fines Content, FC avg. = 23%
Avg. SBT Index, Ic = 2.25

Fine Coal Refuse
Avg. % Passing No. 200 = 92.7%
Avg. % Passing No. 40 = 99.4 %
Avg. Plasticity Index = 17%
Avg. Strain to Peak = 13.1 %

Residual Soil (150.6')
Avg. Tip Stress, Qc avg. = 61 tsf
Avg. Fines Content, FC avg. = 46%
Avg. SBT Index, Ic = 2.73

Plots of individual and average normalized tip stress with depth are included with an attached complete copy of Ref. No. 4.

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 12 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CONCLUSION

Based on the information presented in this calculation brief, the following material characteristic designations were determined for the coarse coal refuse, fine coal refuse and residual soil:

Coarse Coal Refuse: Medium Dense Sand-Like;

Fine Coal Refuse: Medium Stiff Clay-Like;

Residual Soil: Medium Dense Sand-Like and Medium Stiff Clay-Like.

Further, the results of the laboratory testing indicate that the fine coal refuse is clay-like based on an average 93% passing the No. 200 sieve and plasticity index of 17%. Peak and steady-state undrained strengths presented in Appendix A were reached at generally high strains (between 8 and 18%), and there was very little drop off from peak to steady-state with increasing strain. The results generally indicated a higher resistance to strength loss (and flow) due to the large strains required to exceed the peak strength and correspondingly small decrease to the steady-state strength at higher strains. Further, previous deformation analyses results indicated induced shear strains from the PGA at less than 0.1%, which is well below a threshold (peak) triggering strain of the material.

The susceptibility of the embankment and impoundment to a liquefaction flow failure is a function of both the undrained strength (worst case steady-state strength) and the in-situ driving shear stress on a critical failure plane passing through the critical layer fine coal refuse material, which is further addressed in subsequent calculation briefs.

ATTACHMENT 2

Reference Nos. 3 and 4 of Reference No. 1

APPENDIX A-1

SUMMARY OF PIEZO-SEISMIC CONE PENETRATION TESTING

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 1 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY ZJS DATE 1/25/08

CALCULATION BRIEF
FOR
SUMMARY OF PIEZO-SEISMIC CONE PENETRATION TESTING

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE:

Summarize the piezo-seismic cone penetration testing (PS-CPT) activities performed by ConeTec, Inc. (ConeTec), West Berlin, in October 2007 as part of the subsurface exploration at the Williamson Energy Pond Creek facility, Williamson County, Illinois.

REFERENCES:

1. ConeTec, Inc. (2007), Field Report Entitled "Presentation of CPTU Test Results for: Pond Creek Mine – Williamson County, Illinois, December 10, 2007.

2. Robertson, P.K., et.al. (1992) "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE 109 (11): 1449-1459.

3. Robertson, P.K and Campanella, R.G, (1989), "Guidelines for Geotechnical Design Using CPT and CPTU", UBC Soil Mechanics Series No. 120, Civil Eng. Dept., Vancouver, B.C., Canada

4. Robertson, P.K and Campanella, R.G, (1983), "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE Vol. 109 No. 11, pp. 1449-1459.

METHODOLOGY:

As part of the subsurface exploration, a total of 15 PS-CPT soundings were performed at the Pond Creek site on October 30 and 31, 2007, at approximate locations shown in Figure 2 of the Pond Creek Deformation Evaluation report. PS-CPT exploration was performed under the full-time observation and guidance of CEC personnel. PS-CPT locations designated as CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A, CPT-5B, CPT-6, CPT-7, CPT-8, CPT-9, CPT-10, CPT-11 and CPT-12 were located by CEC within areas that included existing coarse coal refuse and the proposed South Cell, North Central Cell and North Cell impoundments. CPT-2, CPT-

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 2 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

2A, CPT-5, CPT-5A and CPT-5B soundings were located on the existing coarse coal refuse embankment crest, and were pushed through coarse refuse and the underlying subgrade residual soil. CPT-1, CPT-3, CPT-4, CPT-6, CPT-7, CPT-8, CPT-9, CPT-10, CPT-11 and CPT-12 were located throughout the facility at approximate existing ground surface and pushed exclusively through residual soil. The following presents the CPT sounding, site coordinates, existing ground surface elevation, total depth, interpolated ground water depth and applicable slurry cell.

CPT No.	Northing (ft)	Easting (ft)	Ground Surface Elev.(ft)	Total Depth (ft)	GWT Interpolated (ft)	Applicable Slurry Cell
CPT-1	425784.316	358548.865	482.19	18.4	15.3	South
CPT-2	426832.420	357857.498	494.21	45.3	38.8	South, Central, North
CPT-2A	426828.920	358156.731	492.40	41.7	37.0	South, Central, North
CPT-3	426792.780	359207.797	466.98	22.2	11.1	South
CPT-4	426331.101	360108.800	482.55	18.9	21.7	South
CPT-5	427485.256	357913.863	482.55	49.2	34.4	South, Central, North
CPT-5A	427607.598	357920.844	483.00	53.2	35.9	South, Central, North
CPT-5B	427147.684	358343.061	479.90	39.7	28.0	South, Central, North
CPT-6	427450.461	358992.616	457.78	22.6	9.2	Central
CPT-7	427450.884	359850.004	457.83	16.7	9.2	Central
CPT-8	429006.116	358034.037	444.45	17.9	6.6	Central, North
CPT-9	429077.690	359026.204	445.68	22.0	7.8	Central, North
CPT-10	428965.827	359998.444	442.09	26.1	3.4	Central, North
CPT-11	430316.815	358810.964	440.59	27.6	11.4	North
CPT-12	430141.831	359852.299	442.08	22.6	11.7	North

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 3 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY TJK DATE 1/23/08

Note: CPT coordinates and ground surface elevations were provided by Williamson Energy.

Determining the dynamic response of the Pond Creek facility and that of the coarse coal refuse and subgrade residual soils requires knowledge of the subsurface material's dynamic properties to accurately predict the horizontal shear stresses and strains induced in the material by a given earthquake loading. Of particular significance in the dynamic evaluation is the distribution of density of the coal refuse materials with depth. The low-amplitude, small strain shear modulus (G) with depth is an important parameter for characterizing the behavior and response of a soil column during earthquake shaking. It is a function of the in-situ shear wave velocity estimated at the site with depth and was obtained in the field utilizing PS-CPT.

The main purpose of the PS-CPT was to measure in-situ shear wave (S-wave) travel times for subsequent calculation of shear wave velocity (V_S) and G. Concurrently, CPT was also performed which provides nearly continuous, index-type information which can be correlated to classification and in-situ strength values based on established procedures such as those outlined in Robertson and Campanella (1988). Further, cone data is typically utilized to evaluate liquefaction potential based on Robertson and Campanella (1985) similar to the procedures described in Seed and Idriss (1983) and to compare with the results using steady-state principles; however, only permanent deformations are evaluated in response to regulatory comments.

The seismic wave form portion of the PS-CPT was conducted by ConeTec at about 3-foot intervals throughout the soil profile to the maximum depths indicated. The down-hole seismic survey is a reliable technique for obtaining shear wave and compression wave velocities accounting for the subsurface material's attenuation and anisotropic effect with depth (Hoar and Stokoe, 1978) (Dobry et al., 1981) (Stokoe and Nazarian, 1985). Only S-wave travel times were measured for each sounding with depth which was used to calculate the corresponding V_S and G used in the dynamic analyses of the Pond Creek facility.

RESULTS:

A total of 15 PS-CPT soundings were performed at the Pond Creek site in October 2007, at approximate locations shown in Figure 2. ConeTec measured tip stress, sleeve stress and pore water pressure, and shear wave velocities at the locations CPT-1 through CPT-12 from the existing ground surface through coarse coal refuse, where available and through residual soil materials.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 4 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

Shear wave velocities per material type were measured and the minimum, maximum and weighted averages are summarized as follows:

CPT No.	Shear Wave Velocity Max./Min./Avg. Coarse Coal Refuse (ft/sec)	Shear Wave Velocity Max./Min./Avg. Residual Soil (ft/sec)
CPT-1	NA	1402 645 905
CPT-2	1284 1029 1120	1173 795 957
CPT-2A	1169 895 1042	1256 780 918
CPT-3	NA	1058 569 765
CPT-4	NA	1242 476 817
CPT-5	1190 936 1063	1599 780 947
CPT-5A	1396 779 1064	1580 728 1005
CPT-5B	1517 818 1080	1649 686 978
CPT-6	NA	1022 514 796
CPT-7	NA	894 514 682
CPT-8	NA	1036 541 783
CPT-9	NA	1484 415 835
CPT-10	NA	1217 478 828
CPT-11	NA	1387 471 925
CPT-12	NA	1230 530 763

In general, shear wave velocities in coarse refuse ranged from about 779 to 1517 fps with an average value of about 1074 fps. For subgrade residual soils, Vs ranged from 415 to 1599 fps with an approximate average value of 860 fps. Measured values of V_S for coarse refuse and residual soil materials and the density of the respective material with depth are used to estimate the initial shear modulus, G, for use in the one dimensional, dynamic SHAKE (Schnabel, et al., 1972) analysis of the embankment. G-values estimated from the four soundings are used in the calculation of induced cyclic shear stress at the SHAKE soil column locations (e.g. PCSC300) shown in Figure 3. Appendix A, Attachment A-2 presents the complete ConeTec report and Appendix B, Attachment B-1 presents the computations of G for the various SHAKE columns

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PROJECT Williamson Energy Pond Creek Deformation Evaluation PROJECT NO. 072046

Summary of PS-CPT PAGE 5 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

from in-situ measurements of V_S for the coarse refuse, residual soil and bedrock materials including plots of V_S and G with depth for both SHAKE columns.

CONCLUSIONS:

Summarizing, the PS-CPT field testing was performed as part of the subsurface exploration at the Pond Creek facility. The information gathered from the testing will be used to correlate index and strength parameters, as well as shear modulus for use in subsequent permanent deformation analyses.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 6 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY RJ DATE 1/23/08

SHEAR WAVE VELOCITY DATA REDUCTION MINIMUM, MAXIMUM AND AVERAGE VELOCITY PER MATERIAL

7/17 R13144

Williamson Energy - Pond Creek - South Cell
Shear Wave Velocity versus Depth

CEC Project No. 072-046

'T-1

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
4.26	645	
7.54	656	
10.82	808	CLAY
14.1	1013	
16.73	1402	

CPT-1

	Max	Min	avg
Clay	1402	645	905

CPT-2

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	1204	
10.82	1284	
14.1	1152	
17.39	1085	CCR
20.67	1029	
23.95	1039	
27.23	1050	
30.51	1114	
33.79	950	
37.07	795	CLAY
40.35	908	
43.31	1173	

CPT-2

	Max	Min	avg
CCR	1284	1029	1120
CLAY	1173	795	957

CPT-2A

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	977	
10.82	973	
14.1	1121	
17.39	1051	CCR
20.67	1105	
23.95	1169	
27.23	895	
30.51	780	
33.79	845	CLAY
37.07	790	
39.86	1256	

CPT-2A

	Max	Min	avg
CCR	1169	895	1042
CLAY	1256	780	918

CPT-3

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.21	577	
10.50	569	CLAY
13.78	738	
17.06	883	
20.10	1058	

CPT-3

	Max	Min	avg
CLAY	1058	569	765

8 7 14 R13145

CPT-4

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
3.93	476	CLAY
7.21	673	
10.50	781	
13.78	913	
16.81	1242	

	CPT-4		
	Max	Min	avg
CLAY	1242	476	817

Williamson Energy - Pond Creek - North Central Cell
Shear Wave Velocity versus Depth CEC Project No. 072-046

PT-5

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	1030	
10.82	1076	
14.10	991	
17.39	936	CCR
20.67	1148	
23.95	1190	
27.23	1067	
30.51	780	
33.79	780	
37.07	821	CLAY
40.35	780	
43.63	923	
46.91	1599	

CPT-5

	Max	Min	avg
CCR	1190	936	1063
CLAY	1599	780	947

CPT-5A

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.21	844	
10.50	779	
13.78	1164	
17.06	1396	CCR
20.34	994	
23.63	1077	
26.90	1195	
30.18	1021	
33.46	784	
36.74	784	
40.02	728	CLAY
43.30	768	
46.67	961	
49.95	1411	
52.00	1580	

CPT-5A

	Max	Min	avg
CCR	1396	779	1064
CLAY	1580	728	1005

CPT-5B

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	818	
10.82	900	
14.10	1517	CCR
17.39	1085	
20.67	856	
23.95	732	
27.23	686	CLAY
30.59	762	
33.79	1014	
37.07	1150	
38.88	1649	

CPT-5B

	Max	Min	avg
CCR	1517	818	1080
CLAY	1649	686	978

CPT-6

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	514
7.54	769
10.82	706
14.10	945
17.39	819
20.51	1022

CLAY

	CPT-6 Max	CPT-6 Min	CPT-6 avg
CLAY	1022	514	796

CPT-7

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	514
7.54	575
10.82	745
14.10	894

CLAY

	CPT-7 Max	CPT-7 Min	CPT-7 avg
CLAY	894	514	682

CPT-8

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	541
7.54	652
10.82	708
14.10	979
16.48	1036

	CPT-8 Max	CPT-8 Min	CPT-8 avg
CLAY	1036	541	783

CPT-9

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
3.93	415
7.21	904
10.50	757
13.78	647
17.06	805
20.01	1484

	CPT-9 Max	CPT-9 Min	CPT-9 avg
CLAY	1484	415	835

CPT-10

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	478
7.54	617
10.82	656
14.10	803
17.36	945
20.67	1080
23.87	1217

	CPT-10 Max	CPT-10 Min	CPT-10 avg
CLAY	1217	478	828

11 7 17
R13148

Williamson Energy - Pond Creek - North Cell
Shear Wave Velocity versus Depth CEC Project No. 072-046

CPT-8

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	541
7.54	652
10.82	708
14.10	979
16.48	1036

CLAY

		CPT-8		
		Max	Min	avg
CLAY	CLAY	1036	541	783

CPT-9

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
3.93	415
7.21	904
10.50	757
13.78	647
17.06	805
20.01	1484

CLAY

		CPT-9		
		Max	Min	avg
CLAY	CLAY	1484	415	835

CPT-10

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	478
7.54	617
10.82	656
14.10	803
17.36	945
20.67	1080
23.87	1217

CLAY

		CPT-10		
		Max	Min	avg
CLAY	CLAY	1217	478	828

CPT-11

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	471
7.54	628
10.82	719
14.10	817
17.36	926
20.67	1207
23.95	1387
26.25	1246

CLAY

		CPT-11		
		Max	Min	avg
CLAY	CLAY	1387	471	925

CPT-12

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.02	530
7.30	596
10.50	601
13.78	748
17.06	871
20.34	1230

CLAY

		CPT-12		
		Max	Min	avg
CLAY	CLAY	1230	530	763

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO 072046

Summary of PS-CPT

PAGE 13 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY ZM DATE 1/23/08

GROUNDWATER WELL DATA (PROVIDED BY WILLIAMSON)

072-046

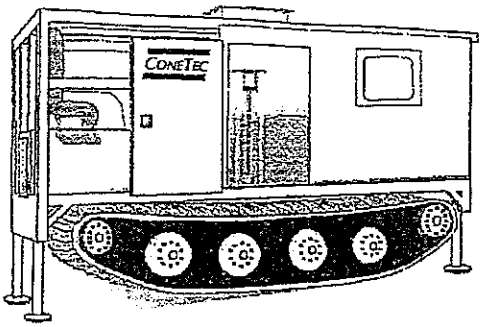
14 of R43150

Pond Creek #1 Ground Water Sampling
Permit #375 NPDES# IL007766

Date	Sample Pnt	Easting	Northing	Stand Pipe Elevation	Water Elev.	Zinc mg/L	Antimony mg/L	Beryllium mg/L	Cobalt mg/L	MANGANESE mg/L	Phenolics mg/L	Cyanide mg/L	Chlorides mg/L
12/29/05	GW-1	354,988	430,899	441.82	435.44	0.012	0.303	<.001	0.014	0.027	<.050	<0.010	20
12/29/05	GW-2	357,681	430,962	435.73	428.51	0.024	0.240	<.001	0.013	0.087	<.050	<0.010	42
12/29/05	GW-3	360,278	430,669	438.46	432.61	0.001	0.299	<.001	0.012	0.124	<.050	<0.010	26
12/29/05	GW 4	354,923	425,980	464.03	456.01	0.009	0.270	<.001	0.017	0.031	<.050	<0.010	17
12/29/05	GW-5	357,632	425,618	482.23	470.52	0.01	0.276	<.001	0.007	0.891	<.050	<0.010	40
12/29/05	GW-6	360,211	425,416	434.9	No Water	No				n/a			n/a
12/29/05	GW-7A	358,306	427,592	454.7	444.99	0.029	0.285	<.001	0.024	0.052	<.050	<0.010	33
2/24/06	GW-1	354,988	430,899	441.82	438.34	0.012	<0.002	<.001	<0.005	0.024	<.050	<0.010	<10
2/24/06	GW 2	357,681	430,962	435.73	431.31	0.016	<0.002	<.002	<0.002	0.027	<.050	<0.010	<10
2/24/06	GW-3	360,278	430,669	438.46	434.29	0.014	<0.002	<.001	<0.005	0.023	<.050	<0.010	<10
2/24/06	GW-4	354,923	425,980	464.03	459.45	0.01	<0.002	<.001	<0.005	0.03	<.050	<0.010	<10
2/24/06	GW-5	357,632	425,618	482.23	471.33	0.01	<0.002	<.001	<0.005	0.4	<.050	<0.010	<10
2/24/06	GW-6	360,211	425,416	434.9	No Water	No				n/a			n/a
2/24/06	GW-7A	358,306	427,592	454.7	447.05	0.018	<.002	<.001	<.005	0.045	<.050	<0.010	<10
6/28/06	GW-1	354,988	430,899	441.82	435.70	0.002	0.006	<.001	<.005	<.002	<.050	<0.010	33
6/28/06	GW-2	357,681	430,962	435.73	427.72	0.023	0.050	<.001	<.005	0.002	<.050	<0.010	44
6/28/06	GW-3	360,278	430,669	438.46	430.10	0.006	0.060	<.001	<.005	0.145	<.050	<0.010	75
6/28/06	GW-4	354,923	425,980	464.03	458.03	0.003	0.070	0.001	<.005	<.002	<.050	<0.010	122
6/28/06	GW-5	357,632	425,618	482.23	470.85	<.002	0.050	<.001	<.005	<.002	<.050	<0.010	160
6/28/06	GW-6	360,211	425,416	434.9	No Water	No							n/a
6/28/06	GW-7A	358,306	427,592	454.7	446.30	0.002	0.090	<.001	<.005	0.003	<.050	<0.010	75
7/31/06	GW-1	354,988	430,899	441.82	435.08	0.001	0.206	0.003	<.005	0.012	<.050	<0.010	37.5
7/31/06	GW-2	357,681	430,962	435.73	429.31	0.001	0.184	0.002	<.005	<.002	<.050	<0.010	50
7/31/06	GW-3	360,278	430,669	438.46	428.63	0.001	0.129	0.001	<.005	0.024	<.050	<0.010	88
7/31/06	GW-4	354,923	425,980	464.03	457.03	0.001	0.153	0.002	<.005	0.026	<.050	<0.010	139
7/31/06	GW-5	357,632	425,618	482.23	469.43	0.006	0.153	0.002	<.005	0.012	<.050	<0.010	150
7/31/06	GW-6	360,211	425,416	434.9	No Water	No							n/a
7/31/06	GW-7A	358,306	427,592	454.7	445.55	0.003	0.269	0.001	<.005	0.026	<.050	<0.010	85
8/31/06	GW-1	354,988	430,899	441.82	434.92	0.001	<.002	<.001	<.005	0.019	<.050	<0.010	20
8/31/06	GW-2	357,681	430,962	435.73	424.51	0.001	<.002	<.001	<.005	0.021	<.050	<0.010	22
8/31/06	GW-3	360,278	430,669	438.46	426.86	0.013	<.002	<.001	<.005	0.045	<.050	<0.010	44
8/31/06	GW-4	354,923	425,980	464.03	456.79	0.006	<.002	<.001	<.005	0.081	<.050	<0.010	42
8/31/06	GW-5	357,632	425,618	482.23	468.32	0.02	<.002	<.001	<.005	3.05	<.050	<0.010	105
8/31/06	GW-6	360,211	425,416	434.9	No Water	No							n/a
8/31/06	GW-7A	358,306	427,592	454.7	444.18	0.018	<.002	<.001	<.005	0.093	<.050	<0.010	8.7
10/2/06	GW-1	354,988	430,899	441.82	435.08	0.001	<.002	<.001	0.015	<.002	<.050	<0.010	14
10/2/06	GW-2	357,681	430,962	435.73	425.76	0.001	<.002	<.001	0.013	<.002	<.050	<0.010	38
10/2/06	GW-3	360,278	430,669	438.46	427.14	0.009	<.002	<.001	0.006	2.105	<.050	<0.010	28
10/2/06	GW-4	354,923	425,980	464.03	455.42	0.001	<.002	0.002	0.014	0.028	<.050	<0.010	84
10/2/06	GW-5	357,632	425,618	482.23	No Water	No							
10/2/06	GW-6	360,211	425,416	434.9	No Water	No							
10/2/06	GW-7A	358,306	427,592	454.7	443.95	0.001	<.002	<.001	0.005	0.181	<.050	<0.010	368
3/7/07	GW-1	354,988	430,899	441.82	438.62	0.001	<.002	<.001	<.005	0.005	<.050	<0.010	26
3/7/07	GW-2	357,681	430,962	435.73	431.41	0.001	<.002	<.001	<.005	0.003	<.050	<0.010	42
3/7/07	GW-3	360,278	430,669	438.46	434.29	0.001	<.002	0.001	<.005	0.028	<.050	<0.010	66
3/7/07	GW-4	354,923	425,980	464.03	458.05	0.001	<.002	<.001	<.005	0.005	<.050	<0.010	109
3/7/07	GW-5	357,632	425,618	482.23	473.86	0.001	<.002	<.001	0.013	0.007	<.050	<0.010	91
3/7/07	GW-6	360,211	425,416	434.9	No Water	No							
3/7/07	GW-7A	358,306	427,592	454.7	448.63	0.001	<.002	<.001	<.005	0.007	<.050	<0.010	86
5/21/07	GW-1	354,988	430,899	441.82	436.55	0.002	<.002	<.001	0.034	<.002	<.050	<0.010	42
5/21/07	GW-2	357,681	430,962	435.73	428.93	0.001	<.002	0.001	0.011	0.007	<.050	<0.010	46
5/21/07	GW-3	360,278	430,669	438.46	432.08	0.001	<.002	0.001	0.013	0.002	<.050	<0.010	62
5/21/07	GW-4	354,923	425,980	464.03	459.93	0.001	<.002	0.002	0.009	<.002	<.050	<0.010	100
5/21/07	GW-5	357,632	425,618	482.23	471.74	0.001	<.002	0.002	0.020	<.002	<.050	<0.010	132
5/21/07	GW-6	360,211	425,416	434.9	No Water	No							
5/21/07	GW-7A	358,306	427,592	454.7	448.05	0.001	<.002	<.001	0.017	0.002	<.050	<0.010	82
5/21/07	GW-8	359,568	426,786	467.85	462.23	0.001	<.002	<.001	0.020	0.544	<.050	<0.010	88
8/1/07	GW-1	354,988	430,899	441.82	433.29	0.003	<.002	0.001	<.005	0.007	<.050	<0.010	26
8/1/07	GW-2	357,681	430,962	435.73	424.74	0.009	0.105	0.001	<.005	0.196	<.050	<0.010	34
8/1/07	GW-3	360,278	430,669	438.46	426.09	0.01	0.370	0.001	<.005	0.524	<.050	<0.010	66
8/1/07	GW-4	354,923	425,980	464.03	458.16	0.002	0.141	0.001	<.005	0.003	<.050	<0.010	100
8/1/07	GW-5	357,632	425,618	482.23	469.06	0.005	0.080	0.002	<.005	0.198	<.050	<0.010	120
8/1/07	GW-6	360,211	425,416	434.9	No Water	No							
8/1/07	GW-7A	358,306	427,592	454.7	447.11	0.018	0.137	0.002	<.005	1.180	<.050	<0.010	108
8/1/07	GW-8	359,568	426,786	467.85	462.70	0.005	0.200	0.002	<.005	0.042	<.050	<0.010	112

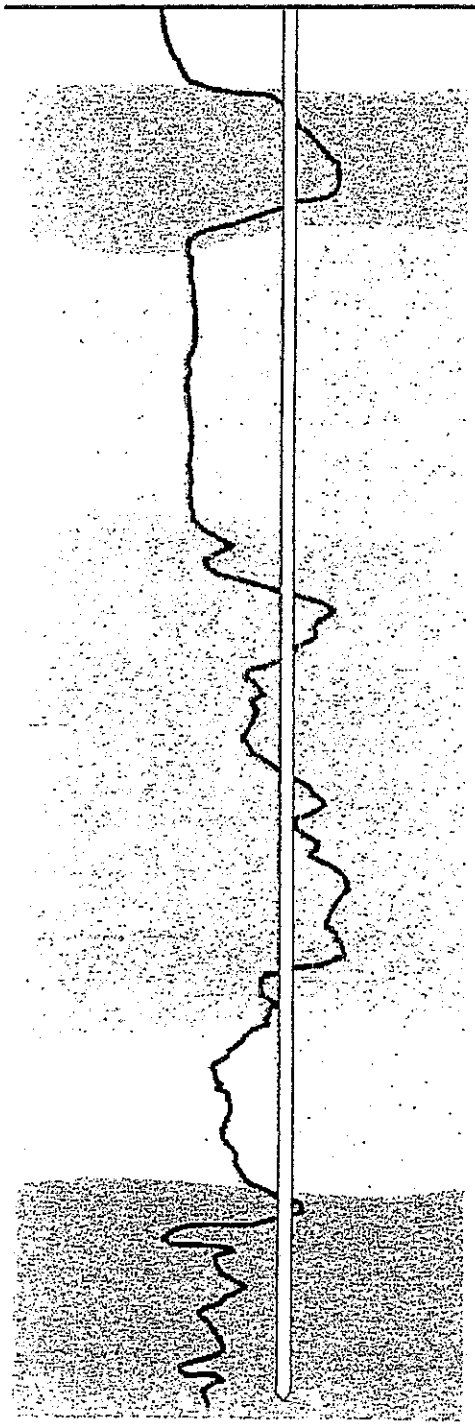
APPENDIX A-2

CONETEC, INC. FIELD REPORT



ConeTec

Geotechnical and Environmental In Situ Testing Contractors



ConeTec Field Report

Presentation of CPTU Test Results for:

Pond Creek Mine
Williamson County, Illinois

Presented to:	C.E.C.
Date:	December 10th, 2007
Presented by:	ConeTec, Inc. 436 Commerce Lane, Unit C West Berlin, NJ (856) 767-8600

PRESENTATION OF IN SITU TESTING PROGRAM RESULTS

Pond Creek Mine
Williamson County, Illinois

October 30th, & 31st, 2007

Prepared for:

Civil & Environmental Consultants, Inc
Export, Pennsylvania

Prepared by:

ConeTec Inc.
West Berlin, NJ

December 10th, 2007

TABLE OF CONTENTS

1.0 INTRODUCTION **3**

2.0 FIELD EQUIPMENT AND PROCEDURES **4**

2.1 CONE PENETRATION TESTING 4
2.2 PORE PRESSURE DISSIPATION TESTS 6

3.0 CONE PENETRATION TEST DATA AND INTERPRETATION **8**

3.1 ANALYSIS OF PIEZOCONE DATA - GENERAL 8
3.2 CONE PLOTS 9
3.3 PORE PRESSURE DISSIPATION TEST RESULTS 9
3.4 SHEAR WAVE VELOCITY MEASUREMENTS 10
3.5 CPTSUMM DATA PROCESSING 10
3.6 DATA CD 10

5.0 REFERENCES **11**

TABLES

TABLE 1 Summary of CPT Soundings

FIGURES

FIGURE 1 Typical Cone Penetrometer
FIGURE 2 Schematic of Shear Wave Testing Configuration
FIGURE 3 Typical Dissipation Tests

APPENDICES

APPENDIX A CPT Plots (shear wave, non-normalized)
APPENDIX B CPT Data Interpretation Summery
APPENDIX C Shear Wave Velocity Data
APPENDIX D Dissipation Test Data
APPENDIX E Data CD

1.0 INTRODUCTION

This report presents the results of a piezo cone penetrometer testing (CPTU) program carried out at Pond Creek Mine located in Williamson County, Illinois. The work was performed under subcontract to Civil & Environmental Consultants, Inc. of Export, Pennsylvania. The CPTU program took place on October 30th, and 31st, 2007.

A total of fifteen soundings were completed at twelve different sounding locations. The CPT testing was performed to evaluate in situ geotechnical as well as seismic criteria relative to the proposed expansion.

While completing the CPT soundings, seismic shear wave velocity testing was conducted in all of the soundings. Seismic testing involved collecting shear wave velocity data at one-meter depth intervals.

CPT sounding locations were selected and numbered under the direction and supervision of C.E.C. Personnel.

2.0 FIELD EQUIPMENT AND PROCEDURES

2.1 CONE PENETRATION TESTING

The cone penetrometer tests were carried out using an integrated electronic piezo cone manufactured by ConeTec in Vancouver, Canada. The piezo cone used was a compression model cone penetrometer with a 15 cm^2 tip and a 225 cm^2 friction sleeve. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.80. The piezo cone dimensions and the operating procedure were in accordance with ASTM Standard D-5778-95. A diagram of the cone penetrometer used for this project is shown as Figure 1.

Pore pressure filter elements, made of porous plastic, were saturated under a vacuum using glycerin as the saturating fluid. The pore pressure element was six millimeters thick and was located immediately behind the tip (the u_2 location) for all soundings.

The cone was advanced using a 20 ton, unitized, track-mounted cone penetration rig. The following data were recorded onto magnetic media every five centimeters (approximately every two inches) as the cone was advanced into the ground:

- Tip Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (ut)

The field data recorded is included on the attached CD (appendix E).

Before each sounding a complete set of analog baseline readings are taken with a multi-meter and compared with the digitized value on the computer screen. This provides a check on the analog to digital conversion board.

Evaluation of the analog baselines is key to consistent readings. The baseline data should be stable and should not wander excessively during the course of a sounding. Baseline data can be used to apply corrections to the cone data where necessary. For this project, the baseline shift from sounding to sounding was small, typically less than 0.1% of full scale, and no data corrections were applied.

During seismic testing, the seismic signals were recorded using a geophone mounted in the cone as shown in Figure 1 and an up-hole digital oscilloscope. A sledge hammer hit against a beam was used for the seismic source. Normal reaction for the beam was provided by the dead weight of the rig placed upon the beam. A schematic of the shear wave testing configuration is shown in Figure 2.

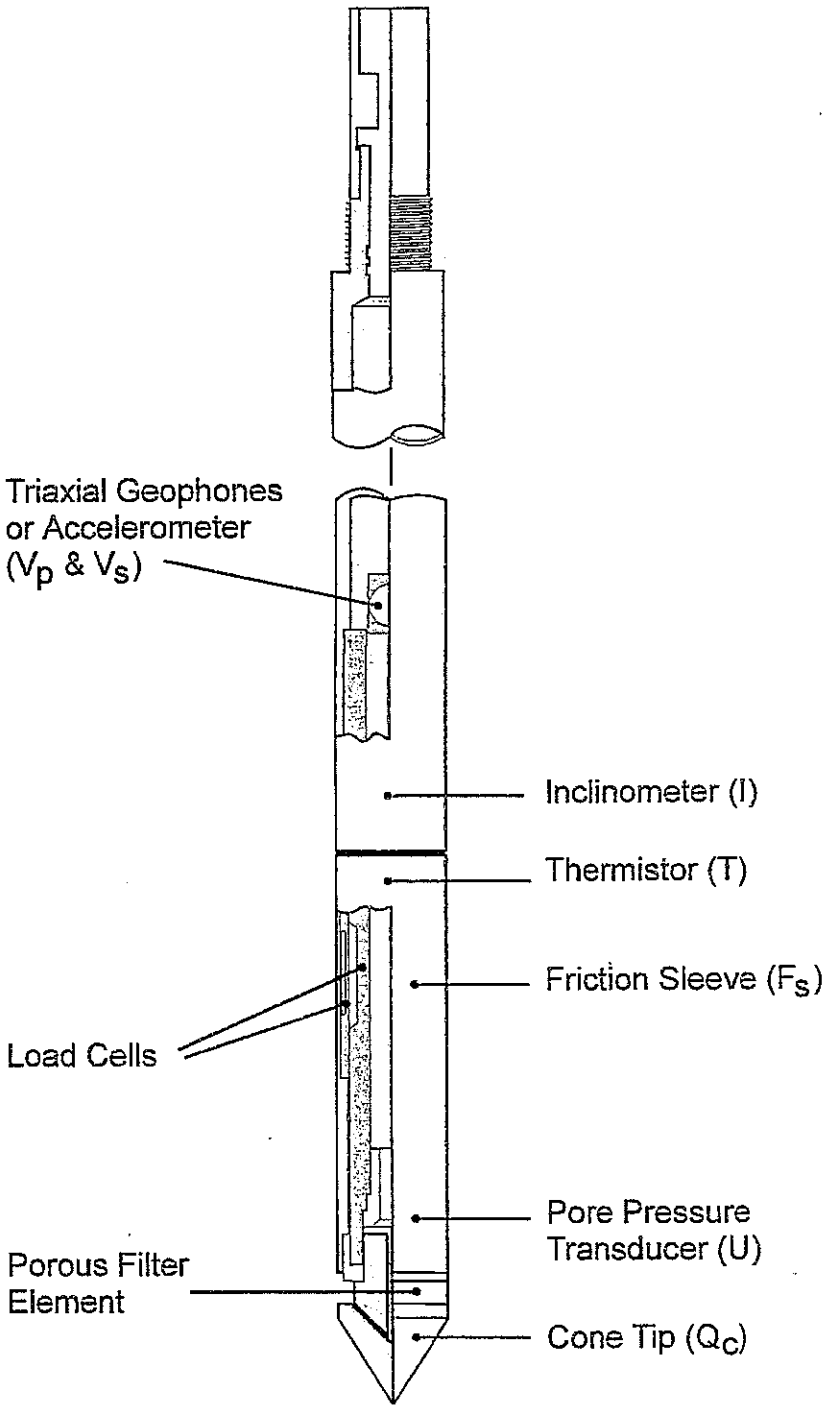


FIGURE 1 - TYPICAL CONE PENETROMETER

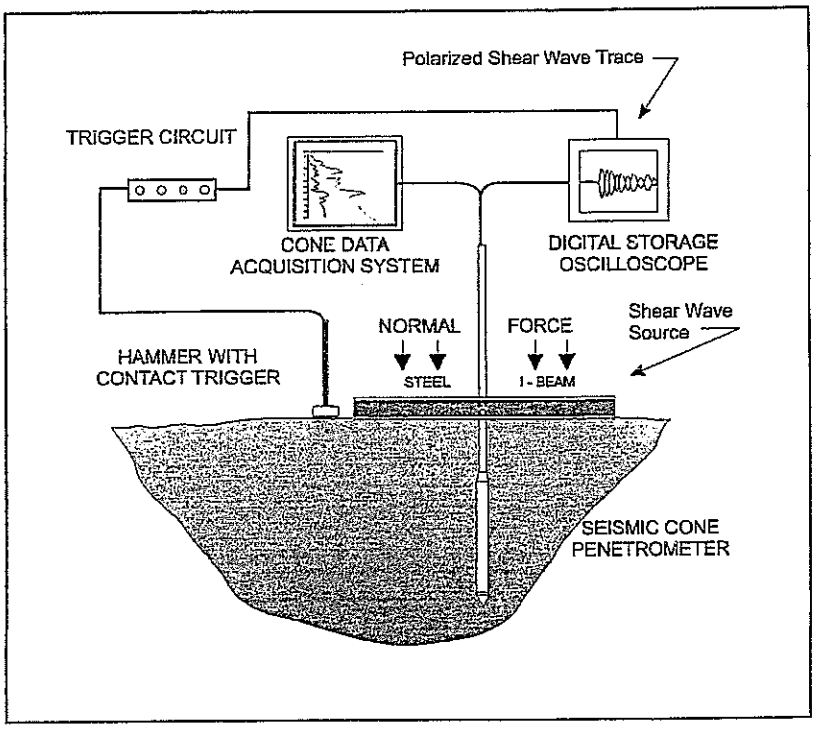


FIGURE 2 - SCHEMATIC OF SHEAR WAVE TESTING CONFIGURATION

2.2 PORE PRESSURE DISSIPATION TESTS

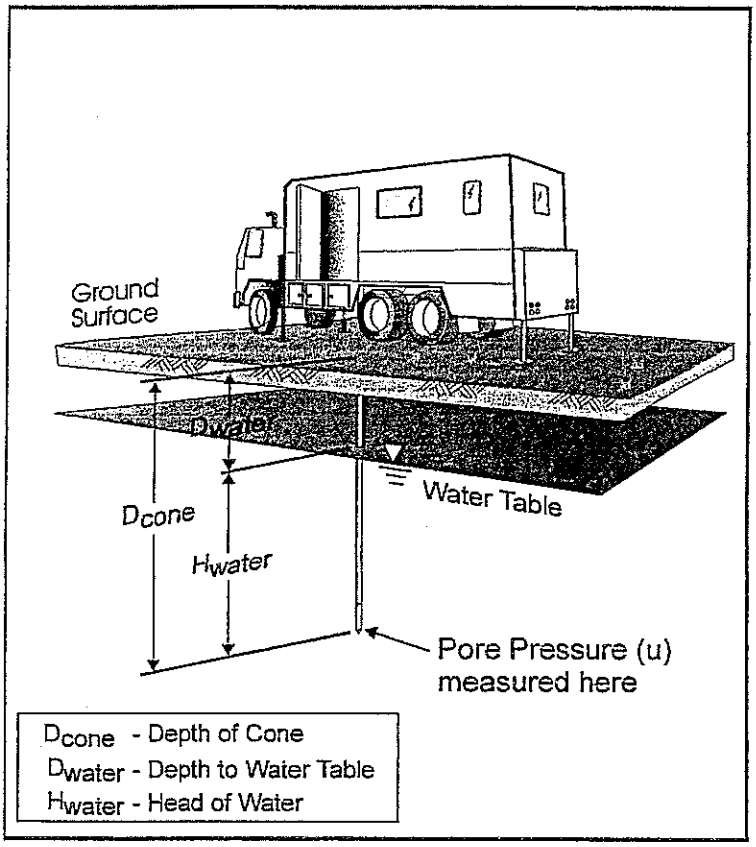
When cone penetration is stopped, the piezo cone essentially becomes a piezometer. While stopped, pore water pressures are automatically recorded at five-second intervals and the readings are stored in a dissipation file (.ppd). Dissipation data can then be plotted onto a dissipation curve consisting of pore water pressure (u) verses time (t). The shapes of dissipation curves are very useful in evaluating soil type, drainage and in situ static water level.

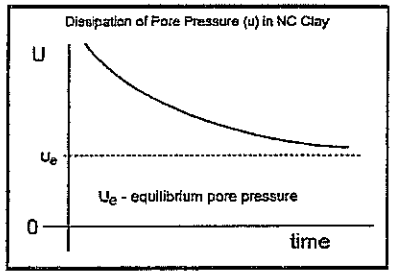
A flat curve that stabilizes quickly (i.e. less than 30 seconds) is typical of a free draining sand. In this case, the final measured pore water pressure is the static in situ water pressure.

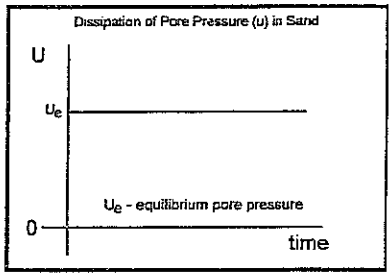
Soils that generate excess dynamic pore water pressure during penetration will dissipate this excess pressure when penetration stops. The shape of the dissipation curve and the time of dissipation can be used to estimate C_h, the coefficient of consolidation that can in turn be used to calculate K_h, the horizontal permeability.

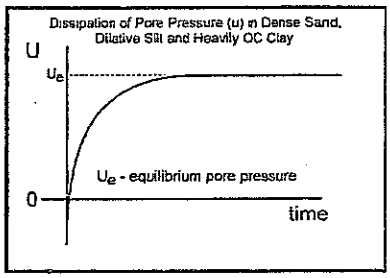
Figure 3 shows some idealized shapes of various pore water pressure dissipation curves. The reader is referred Robertson et. al., 1992 to reference dissipation test data analytical techniques.

Estimation of Ground Water Table from CPT Dissipation Tests









Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

Useful Conversion Factors: 1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

FIGURE 3 - TYPICAL DISSIPATION TESTS

3.0 CONE PENETRATION TEST DATA AND INTERPRETATION

3.1 ANALYSIS OF PIEZOCONE DATA - GENERAL

A total of fifteen CPT sounding involving 443.90 feet of testing, were completed.

The interpretation of cone data is based on the relationship between cone bearing, qc, sleeve friction, fs, and penetration pore water pressure, u. The friction ratio, Rf , (sleeve friction divided by cone bearing) is a calculated parameter which is used to infer soil behavior type. Generally, saturated cohesive soils have low tip resistance, high friction ratios and generate large excess pore water pressures. Cohesionless soils have higher tip resistances, lower friction ratios and do not generate significant excess pore water pressure.

The interpretation of soils encountered on this project was carried out using correlations developed by Robertson et al., 1992. It should be noted that it is not always possible to clearly identify a soil type based on qc, fs and ut. Occasionally soils will fall within different soil categories on the classification charts. In these situations, experience and judgment and an assessment of the pore pressure dissipation data should be used to infer the soil behavior type. Computer tabulations of the interpreted soil types along with certain other geotechnical parameters for each cone hole is presented in Appendix B.

Each of the parameters measured in the sounding is discussed briefly below. A detailed explanation of CPTU testing and interpretation of the results can be found in Robertson, 1989.

TIP RESISTANCE (q_c): The resistance to penetration, measured at the cone tip, provides an accurate profile of subsurface strata. The recorded tip resistance is a composite of the penetration resistance of the soils located five to ten cone diameters (7 to 14 inches) in front of and behind the tip. The actual resistance "sensed" by the tip depends on the soil properties and on the relative stiffness of the layers encountered. Tip resistance is often corrected for pore pressure effects when testing in soft saturated cohesive soils.

For this project the correction was made and the tip resistance shown, q_t is the corrected tip resistance.

The correction used is: $q_t = q_c + (1-a)u$

Where:
- q_t = corrected tip resistance
- q_c = measured tip resistance
- a = net area ratio for cone (0.80 for this project)
- u = dynamic pore water pressure measured behind tip

SLEEVE FRICTION (f_s) The resistance recorded on the friction sleeve, is a measure of the remolded strength of the soil. Values of sleeve friction in very soft soils (such as peat) may fluctuate due to the measured force being small relative to the capacity of the measuring load cell.

FRICTION RATIO (R_f) The ratio of sleeve friction to tip resistance expressed as a percentage, is an indicator of soil type. Cohesive soils generally have friction ratios that are greater than two, while sands and non-plastic silts have friction ratios that are lower than two.

PORE PRESSURE (u) Dynamic pore water pressure is measured during penetration. (dynamic pore water pressure data can be found in the .cor, .xls files. Static pore water pressure is measured when cone penetration is stopped (static pore water pressure data can be found in the .ppd files). The measured dynamic pore water pressure changes with the location of the porous filter and negative readings are possible when the filter is located behind the tip.

It is important to note that the CPT classifies soil by physical behavior, not by grain size; therefore, the CPT classification should be verified against samples obtained from a conventional drilling program. While the CPT soil classification may not always be accurate in terms of the actual label it applies to a particular soil, it is very accurate in grouping soils with similar mechanical properties.

Table 1 presents a summary of CPT soundings, including sounding depths.

3.2 CONE PLOTS

The data from each sounding was plotted using the computer program ScreenZ. The plots are included in Appendix A. ScreenZ was developed by ConeTec Inc. and it incorporates soil behavior type (SBT) classification as part of the plot. The soil classification is based on the classification chart reproduced chart in Appendix B.

3.3 PORE PRESSURE DISSIPATION TEST RESULTS

When conducting CPT investigations, pore water pressure dissipations are automatically recorded during pauses in penetration. The pore water pressure data is recorded at five second intervals. Dynamic and static pore pressure dissipation data for each CPT is included on the data CD. No dissipation tests were completed during this project. Water table depths used in the data interpretations were given to us by the client.

3.4 SHEAR WAVE VELOCITY MEASUREMENTS

Shear wave velocity measurements were conducted during all of the CPT soundings. Shear wave velocity measurements were recorded approximately every meter. The shear wave velocity data can be found in Appendix C.

3.5 CPTSUMM DATA PROCESSING

The electronic data files were processed using the program CPTSUMM. CPTSUMM is a program developed by ConeTec to calculate common engineering parameters from CPT data. The data files (xls) can be found on the data CD. The calculations used are summarized in the table found in Appendix B. Each calculation is derived according to the referenced article.

For this project, the depth to ground water was given to us by the client. The exact depth used is noted in the header of each CPTSUMM file.

3.6 DATA CD

One data CD is included in Appendix E. The CD includes all of the CPT, dynamic and static pore water pressure and CPTSUMM data.

5.0 REFERENCES

Robertson, P.K., 1989, "Soil Classification using the Cone Penetration Test", Canadian Geotechnical Journal, vol. 27, pages 151-158.

Robertson, P.K., Sully, J., Woeller, D.G., Lunne, T., Powell, J.M., and Gillespie, D.J., 1992, "Estimating Coefficient of Consolidation from Piezocone Tests", Canadian Geotechnical Journal, vol. 29, pages 539-550.

CONETEC

TABLE 1 - SUMMARY OF CPTU SOUNDINGS

Job No.: 07-804
Location: Pond Creek Mine - Williamson County, Illinois
Client: Civil & Environmental Consultants
Date: October 30, 31, 2007

Date	CPTU Sounding	File Name	CPT Total Depth (ft)	Shear wave Velocity Tests	Comments
31-Oct-07	CPT-1	804cp01.cor	18.37	6	
30-Oct-07	CPT-2	804cp02.cor	45.28	13	
30-Oct-07	CPT-2A	804cp02a.cor	41.67	12	
31-Oct-07	CPT-3	804cp03.cor	22.15	6	
31-Oct-07	CPT-4	804cp04.cor	18.86	6	
30-Oct-07	CPT-5	804cp05.cor	49.21	14	
30-Oct-07	CPT-5A	804cp05a.cor	53.15	16	
30-Oct-07	CPT-5B	804cp05b.cor	39.70	12	
31-Oct-07	CPT-6	804cp06.cor	22.64	7	
31-Oct-07	CPT-7	804cp07.cor	16.73	5	
31-Oct-07	CPT-8	804cp08.cor	17.88	6	
31-Oct-07	CPT-9	804cp09.cor	21.98	7	
31-Oct-07	CPT-10	804cp10.cor	26.08	8	
31-Oct-07	CPT-11	804cp11.cor	27.56	9	
31-Oct-07	CPT-12	804cp12.cor	22.64	7	
Job Totals:		15	443.90	134	

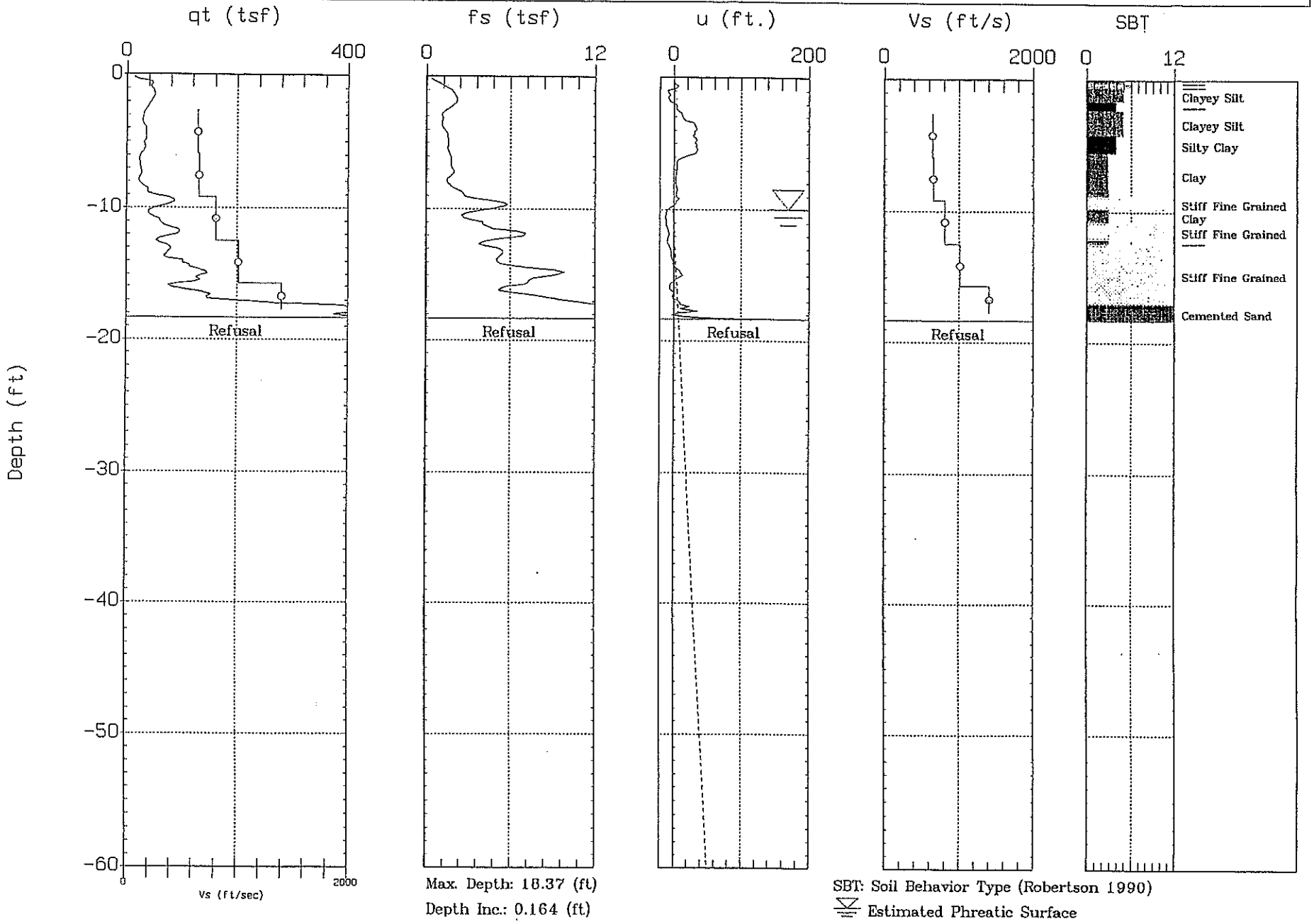
Shearwave CPT plots

CONETEC

C.E.C.

Sounding:CPT-1
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 13:23



Max. Depth: 18.37 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

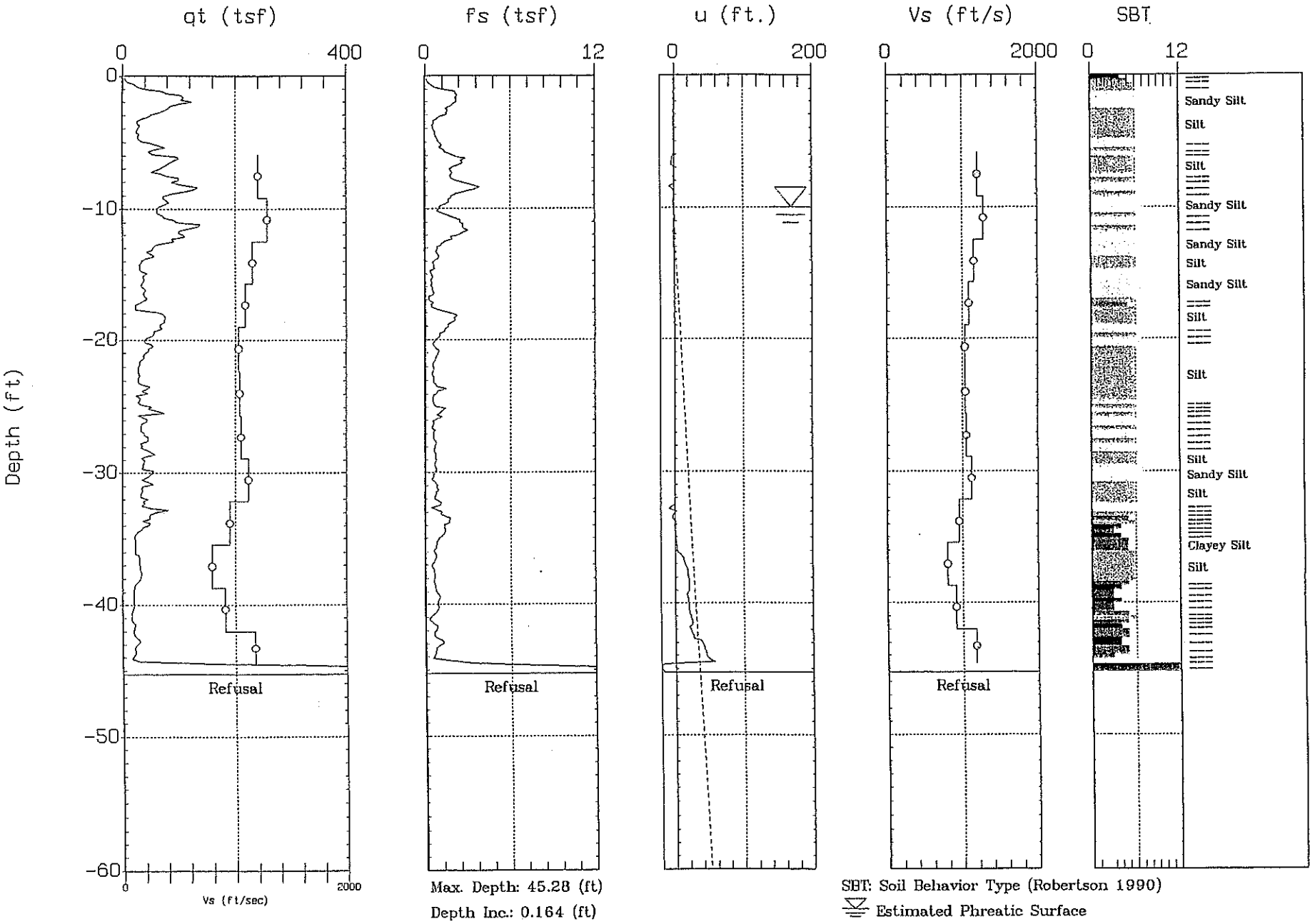
R13166

CONETEC

C.E.C.

Sounding:CPT-2
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 13:46



Max. Depth: 45.28 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

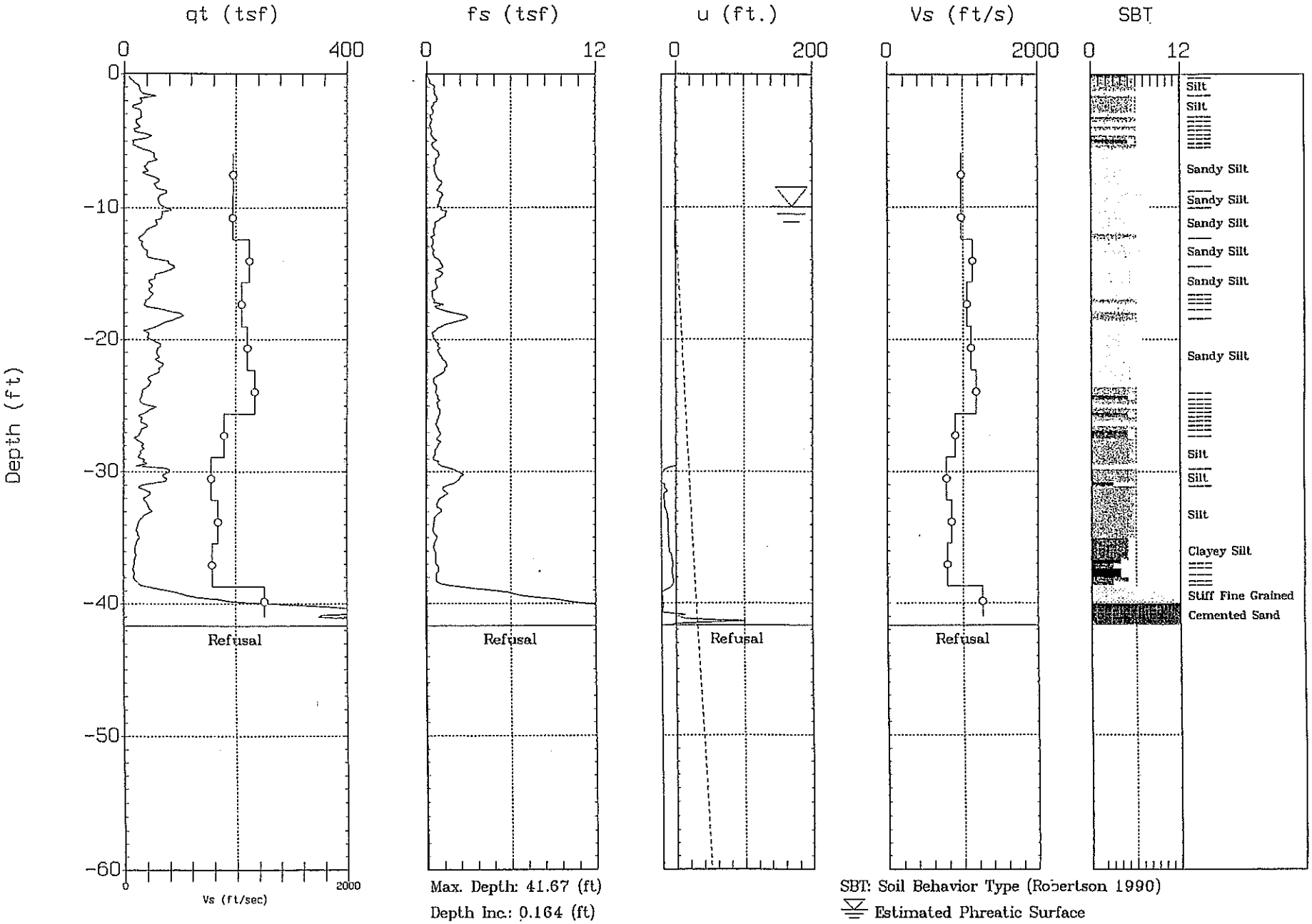
R13167

CONETEC

C.E.C.

Sounding:CPT-2A
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 14:50



Max. Depth: 41.67 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

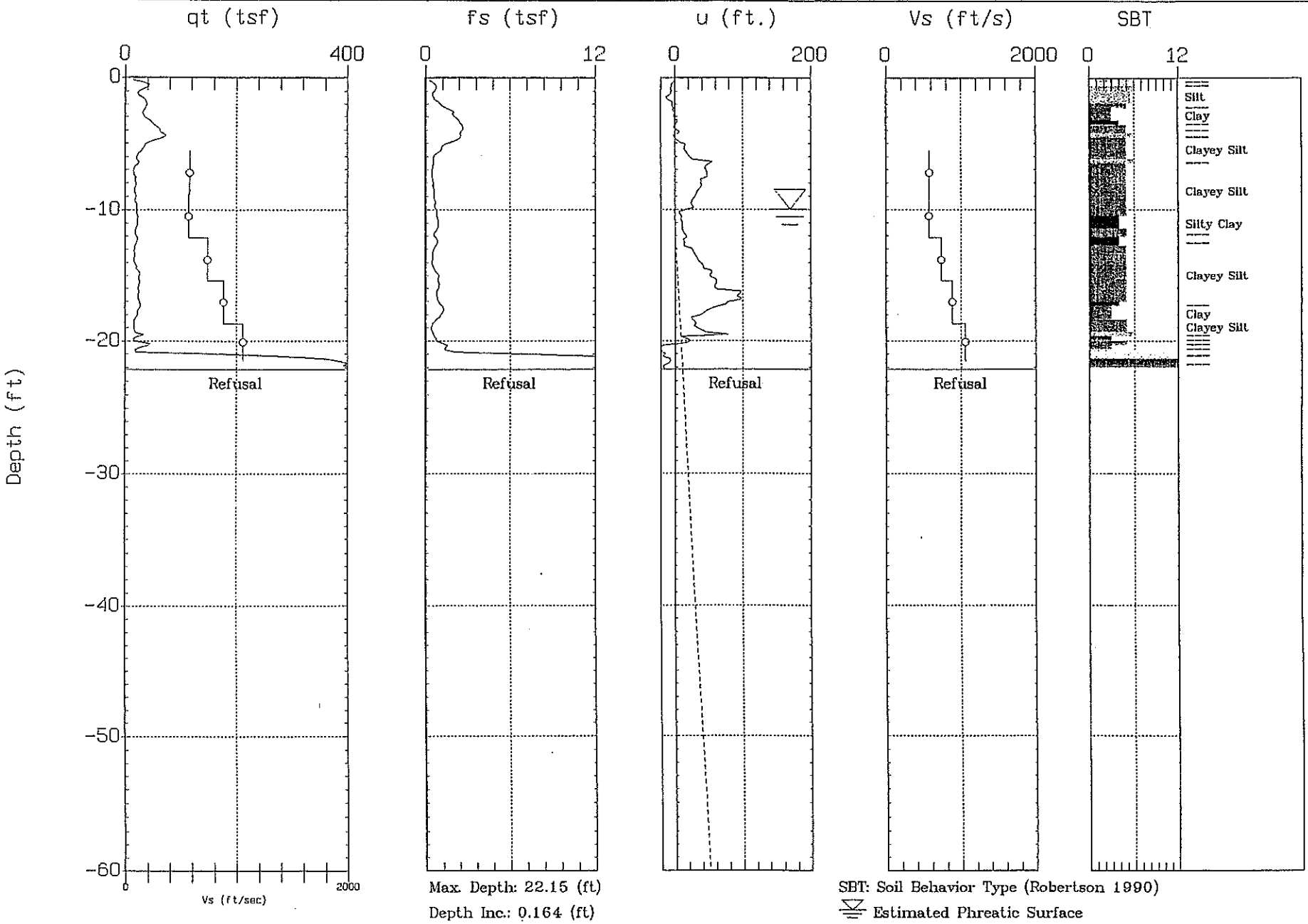
R13168

CONETEC

C.E.C.

Sounding:CPT-3
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:09



Max. Depth: 22.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

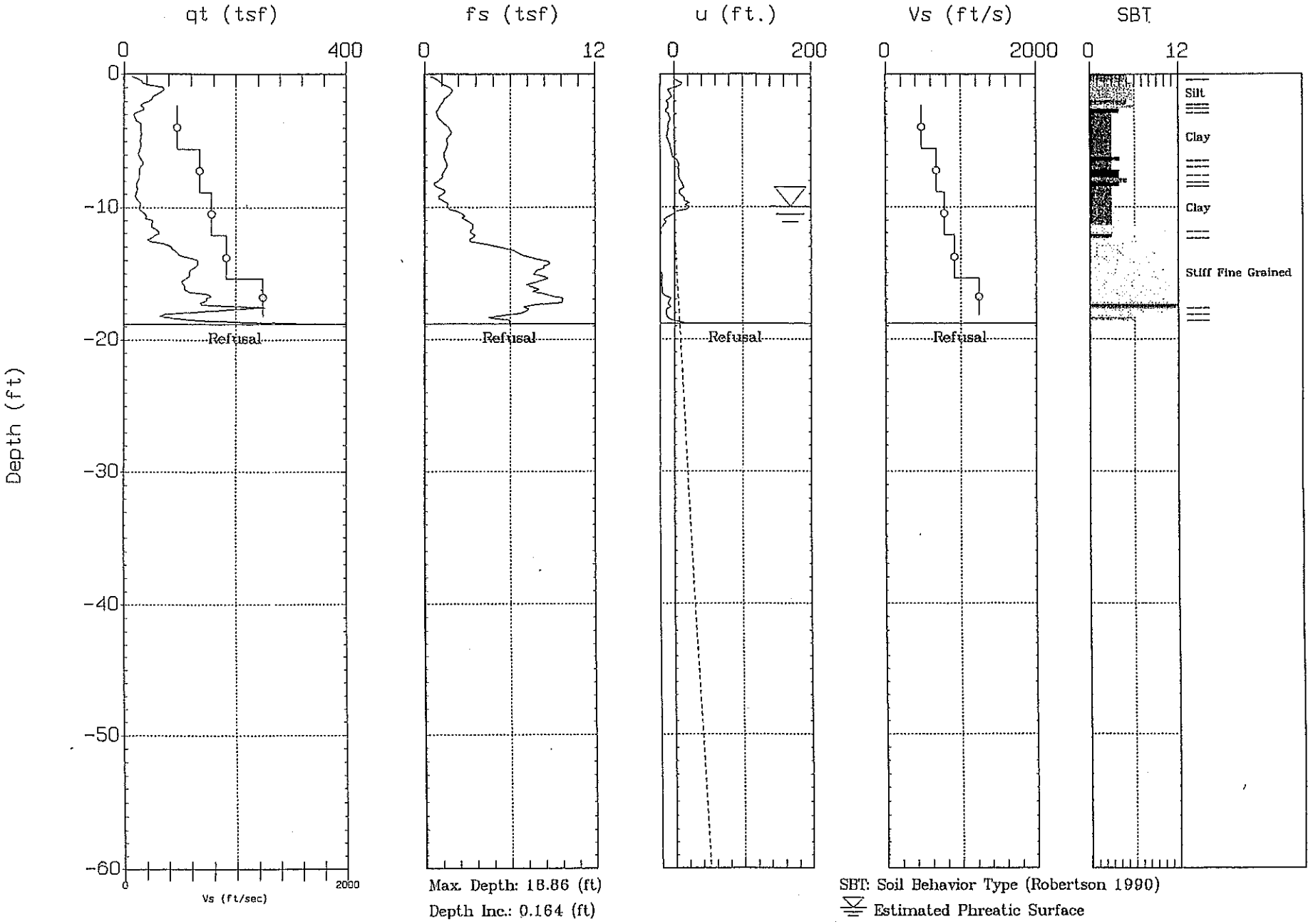
R13169

CONETEC

C.E.C.

Sounding:CPT-4
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:51



Max. Depth: 18.86 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

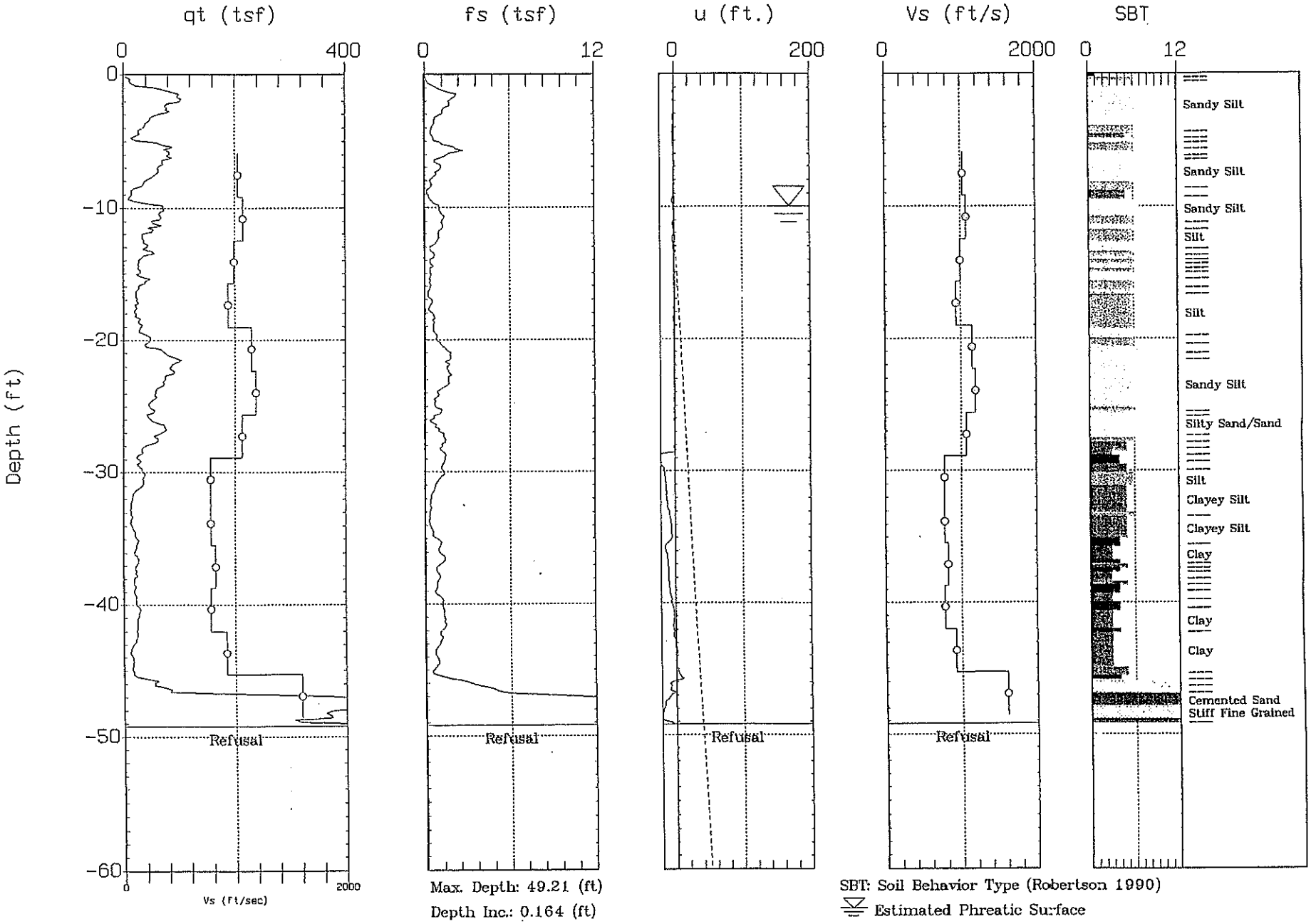
R13170

CONETEC

C.E.C.

Sounding:CPT-5
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 12:34



Max. Depth: 49.21 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

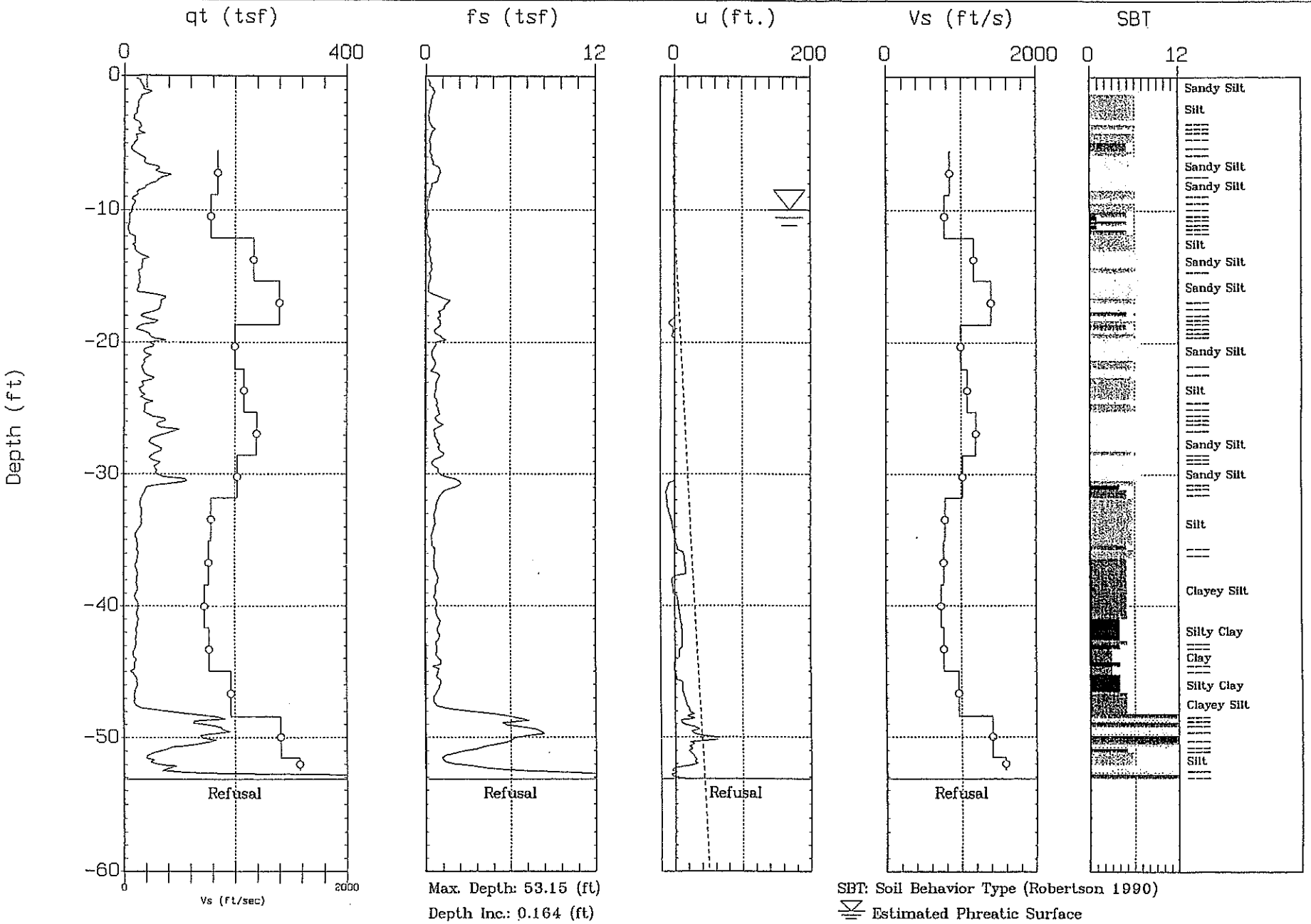
R13171

CONETEC

C.E.C.

Sounding:CPT-5A
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 10:44



Max. Depth: 53.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

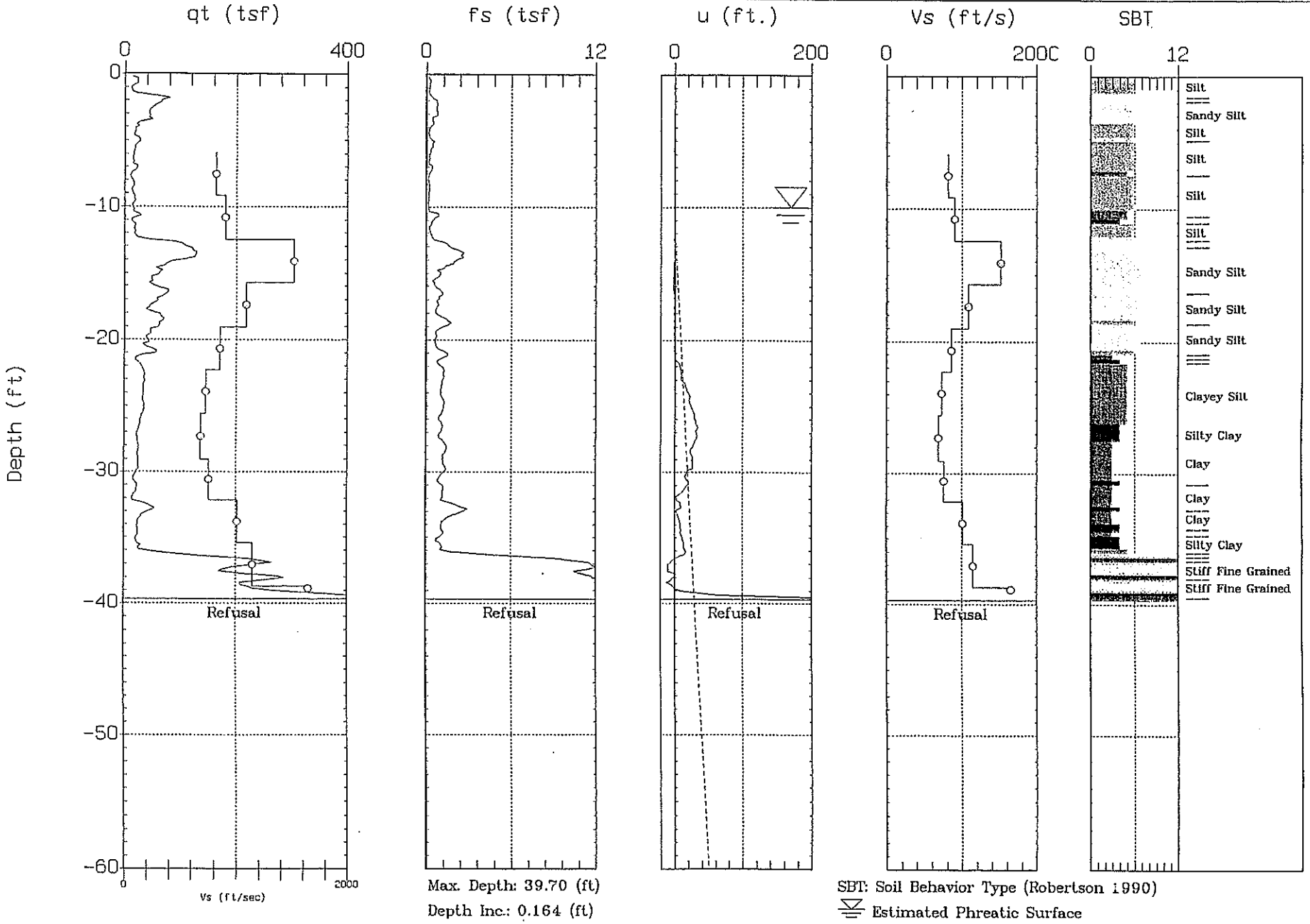
R13172

CONETEC

C.E.C.

Sounding:CPT-5B
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 15:44



Max. Depth: 39.70 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

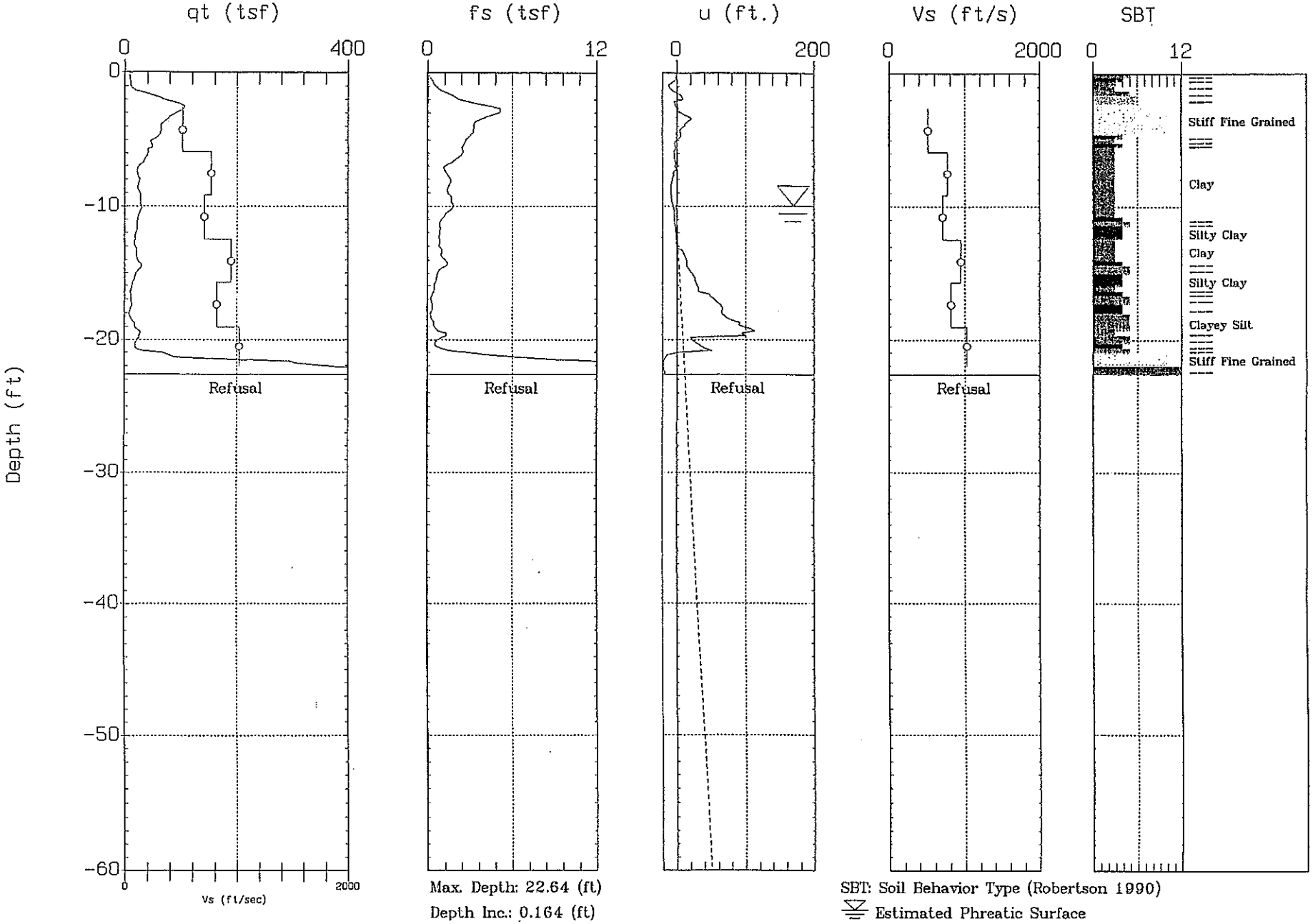
R13173

CONETEC

C.E.C.

Sounding:CPT-6
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:00



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

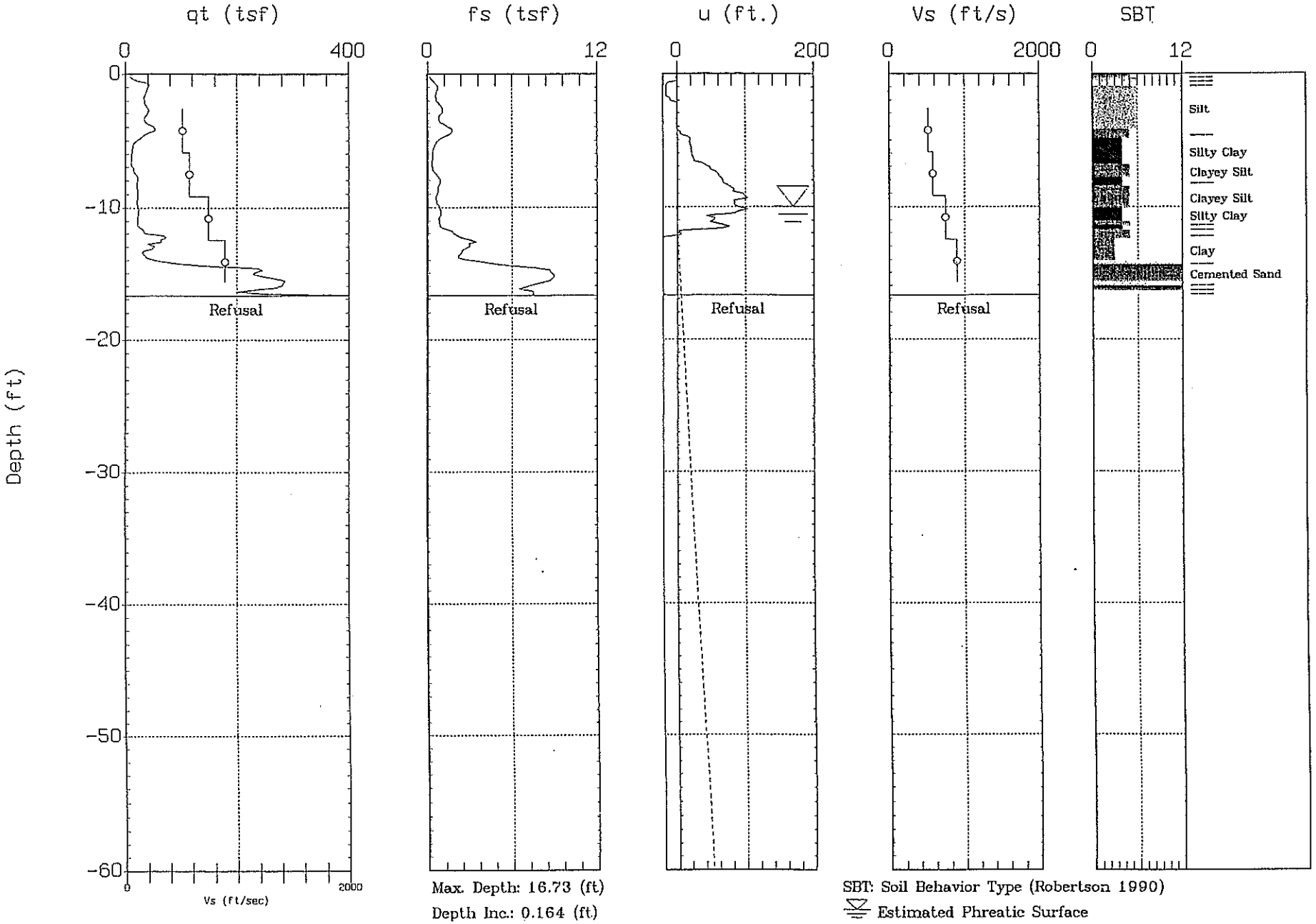
R13174

CONETEC

C.E.C.

Sounding:CPT-7
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:58



Max. Depth: 16.73 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

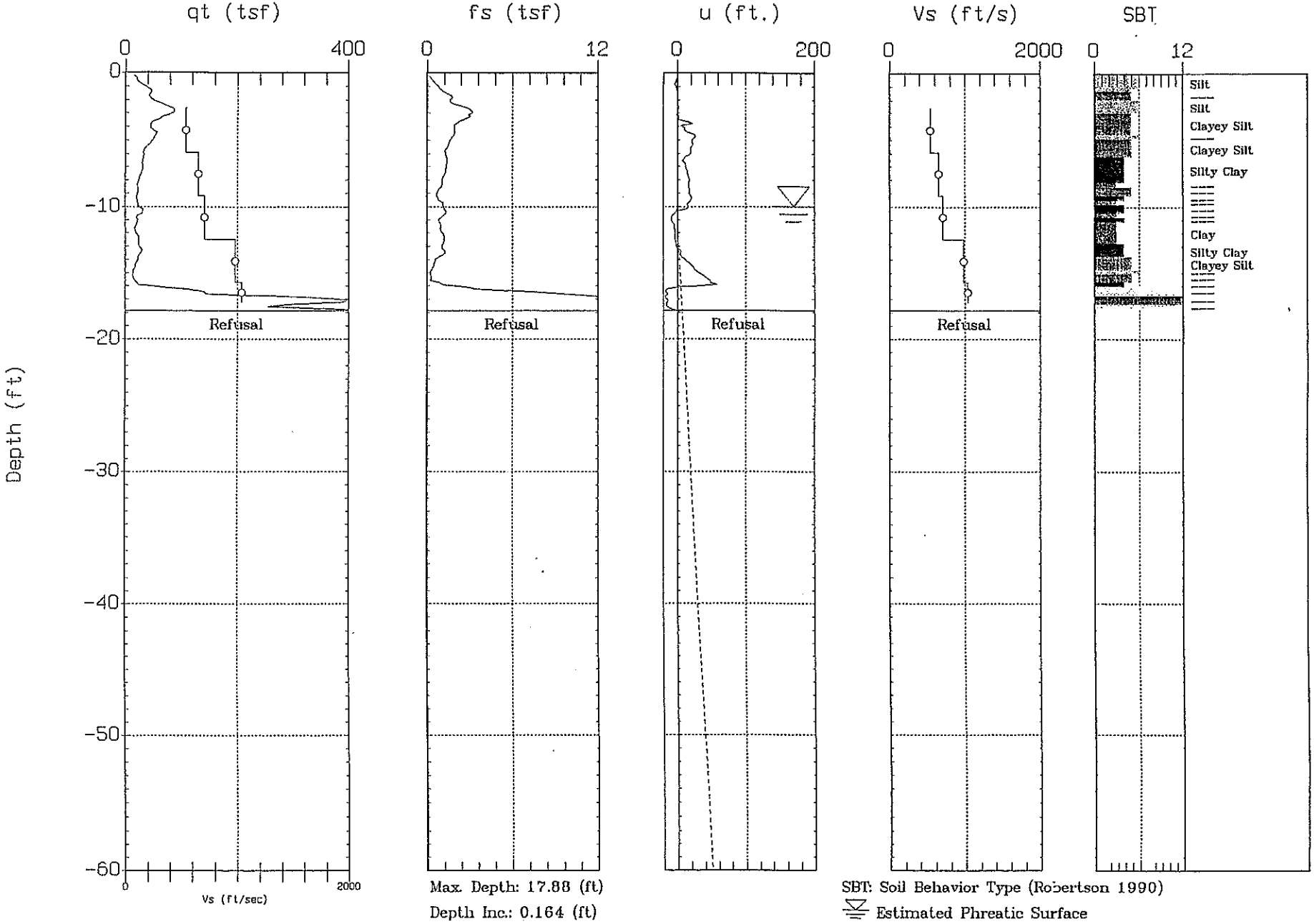
R13175

CONETEC

C.E.C.

Sounding:CPT-8
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:53



Max. Depth: 17.88 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

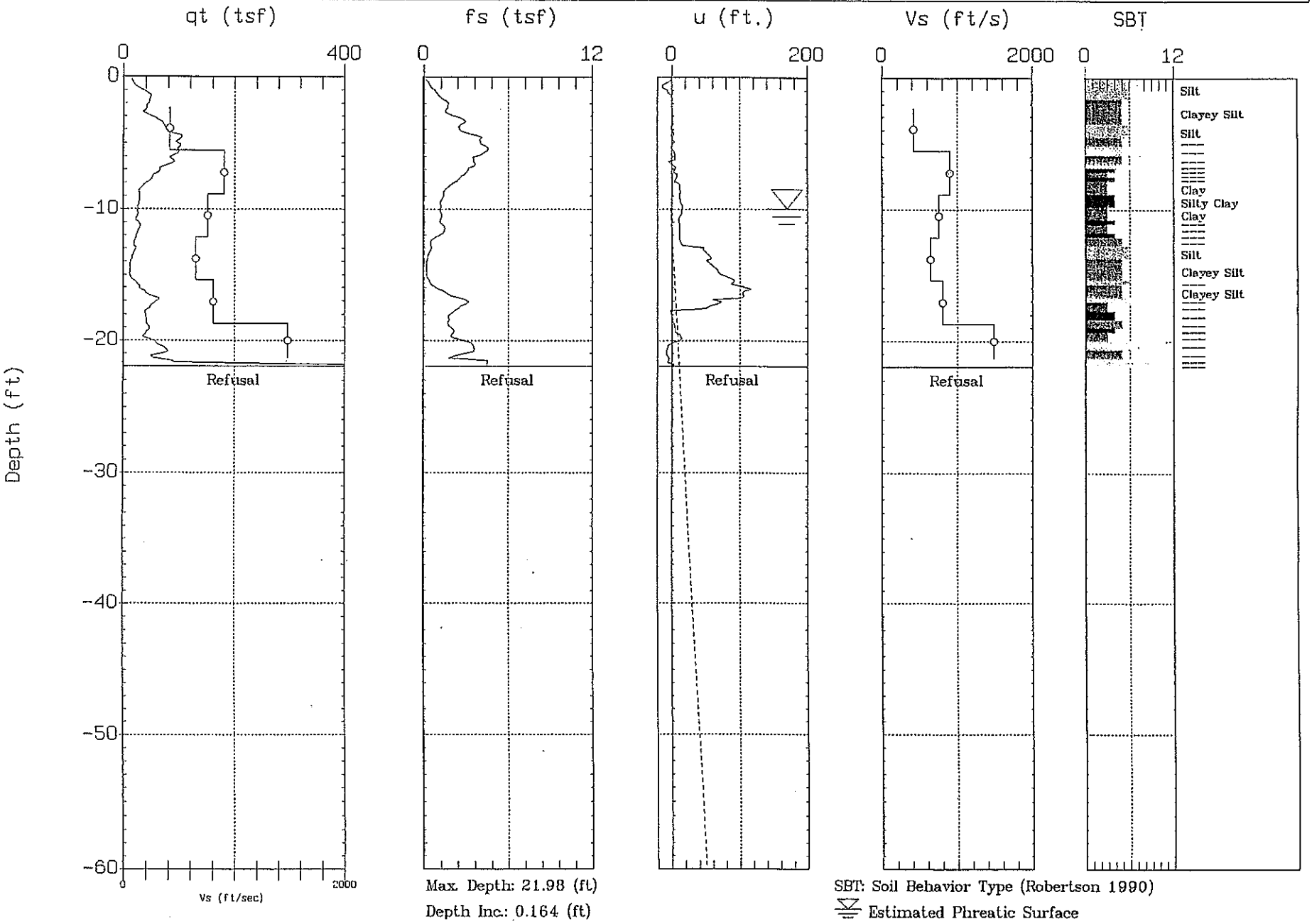
R13176

CONETEC

C.E.C.

Sounding:CPT-9
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:17



Max. Depth: 21.98 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

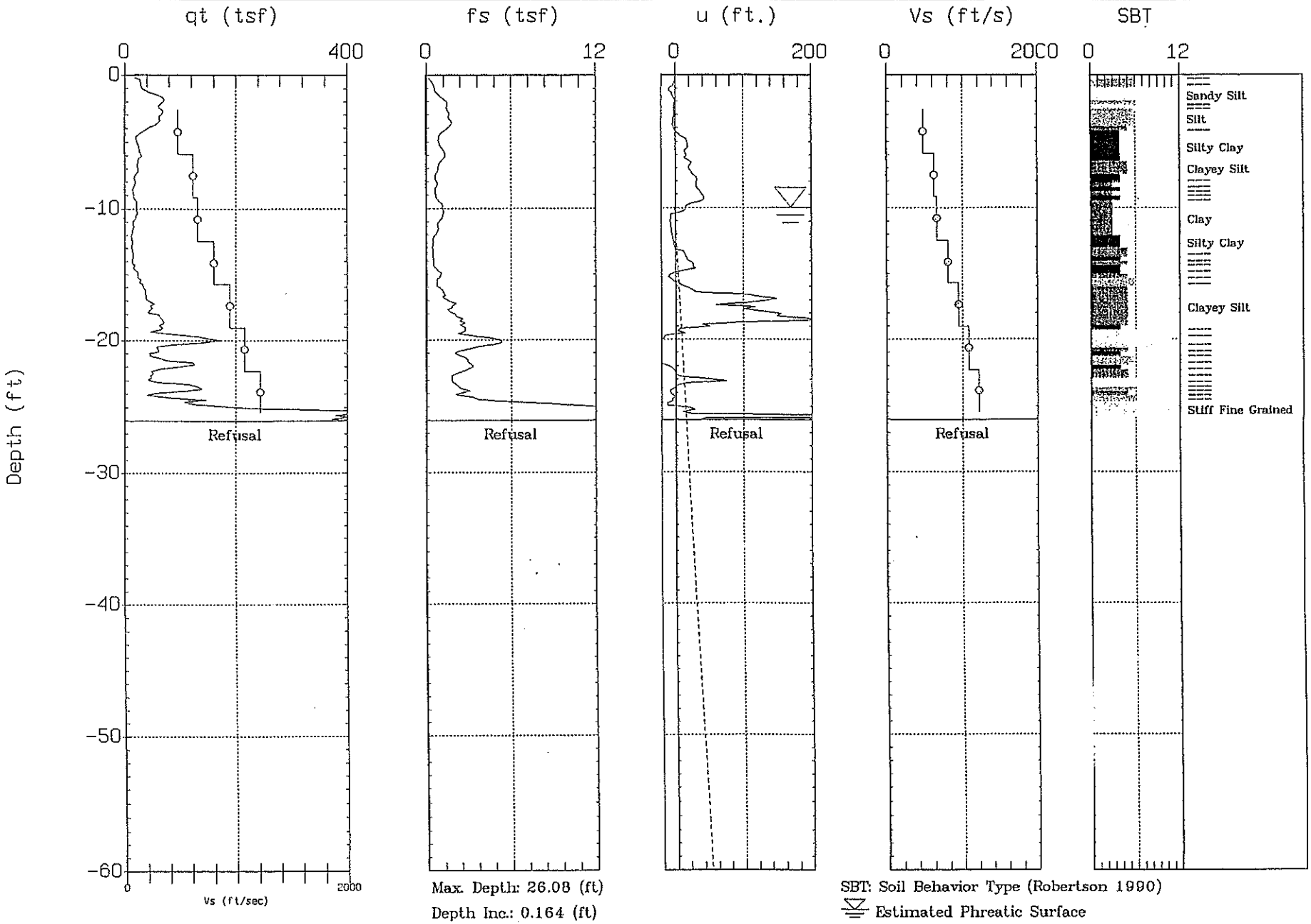
R13177

CONETEC

C.E.C.

Sounding:CPT-10
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 08:35



Max. Depth: 26.08 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

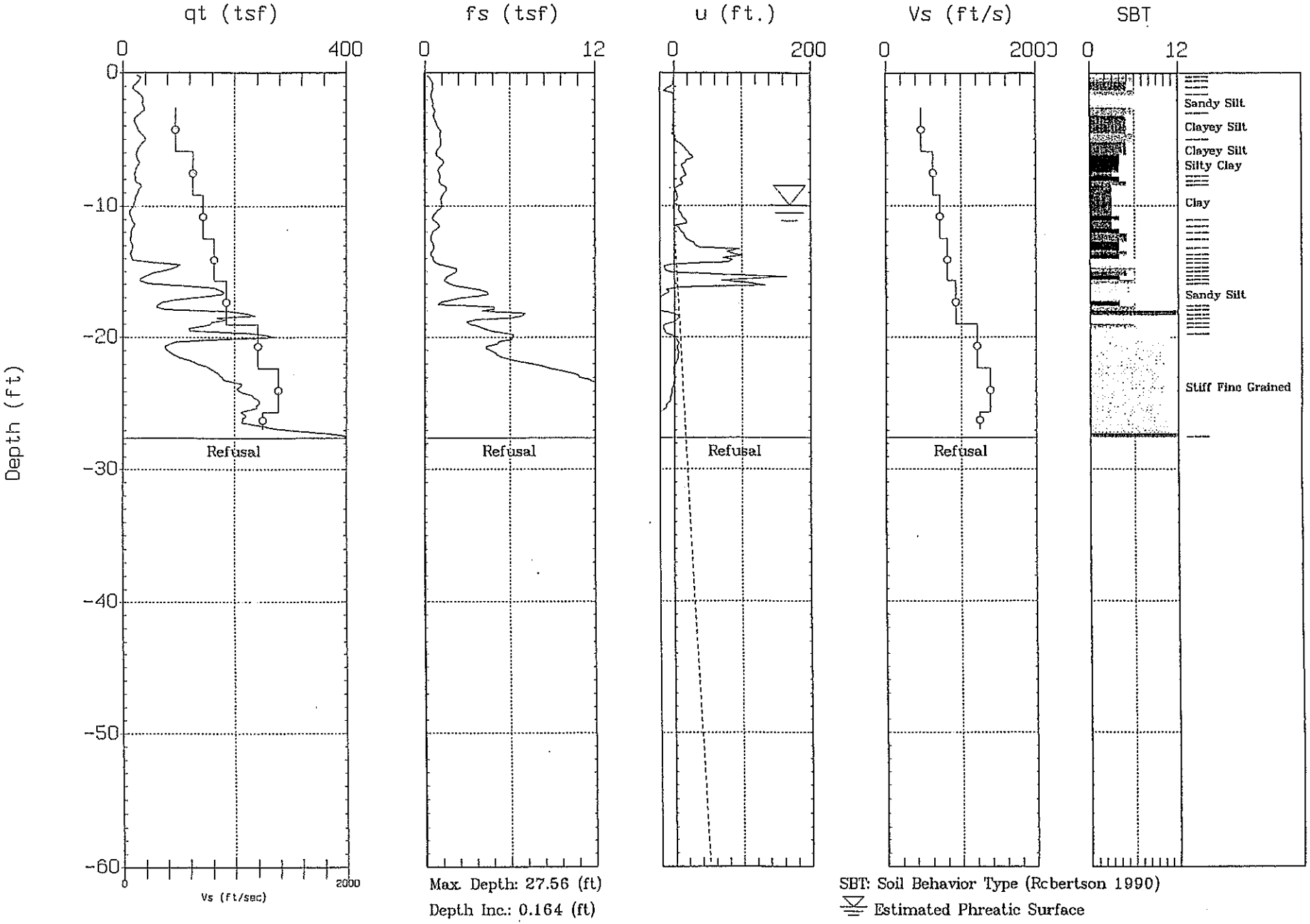
R13178

CONETEC

C.E.C.

Sounding:CPT-11
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 10:31



Max. Depth: 27.56 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

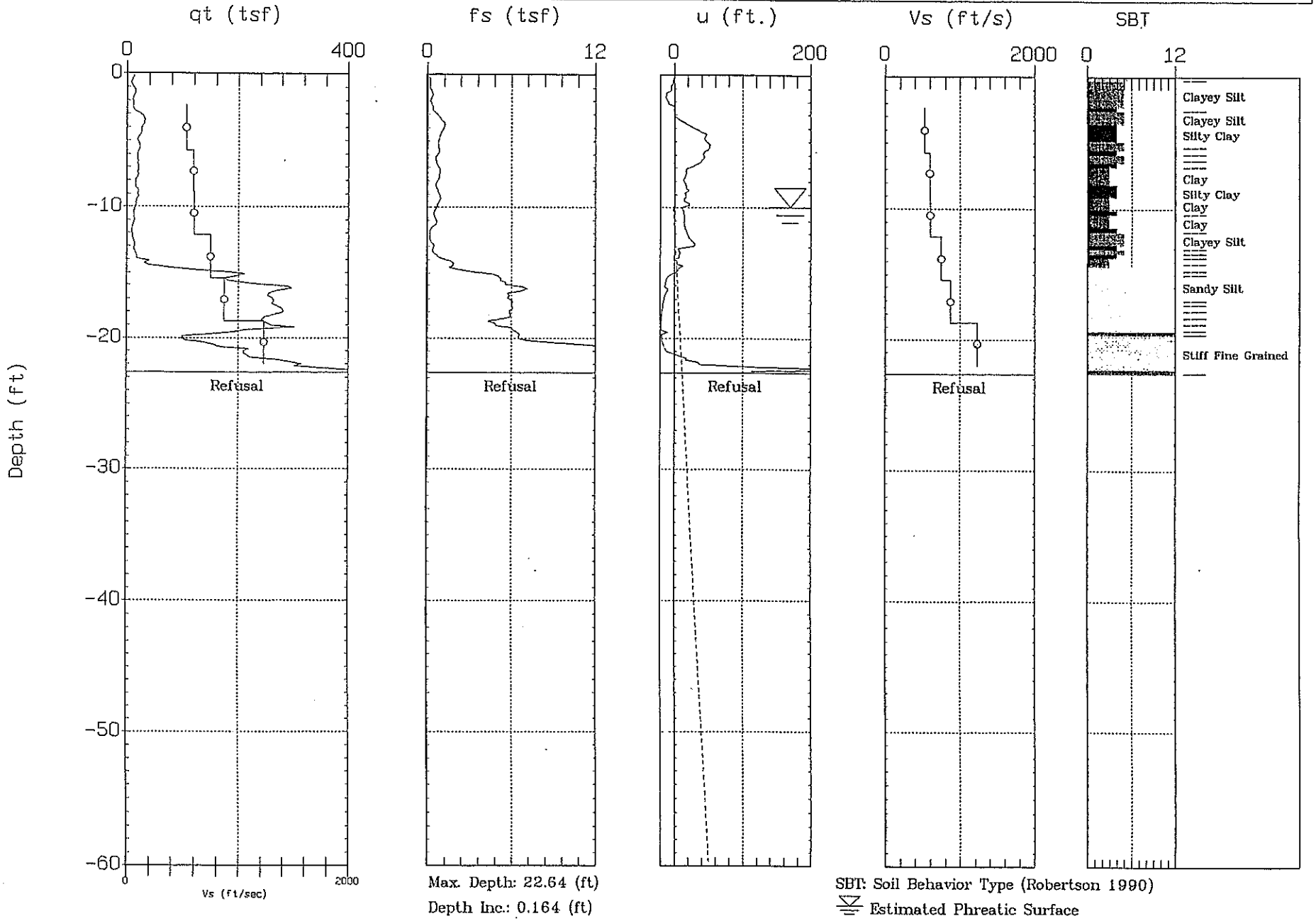
R13179

CONETEC

C.E.C.

Sounding:CPT-12
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 11:15



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

R13180

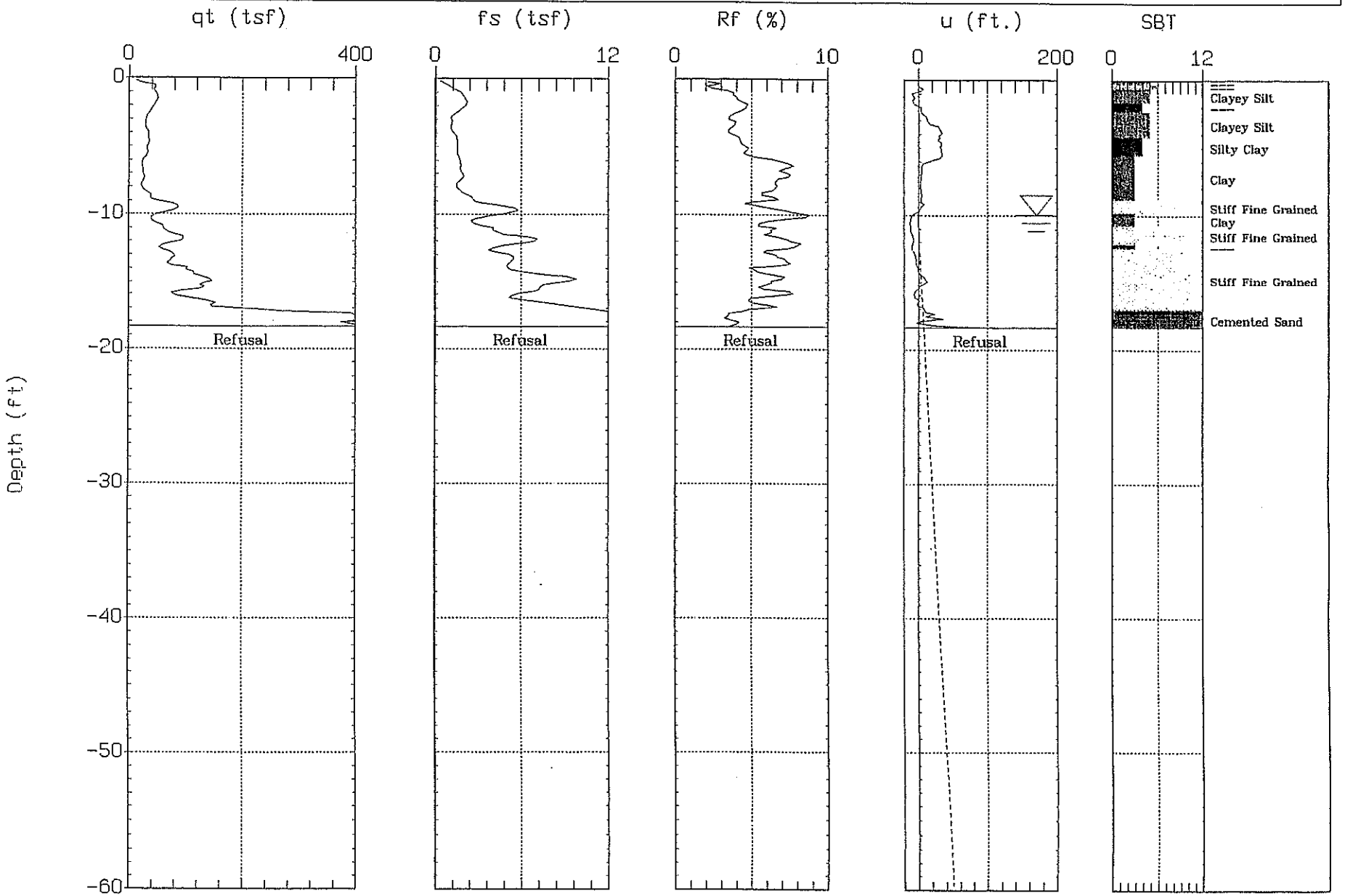
Non-normalized CPT plots

CONETEC

C.E.C.

Sounding:CPT-1
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 13:23



Max. Depth: 18.37 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

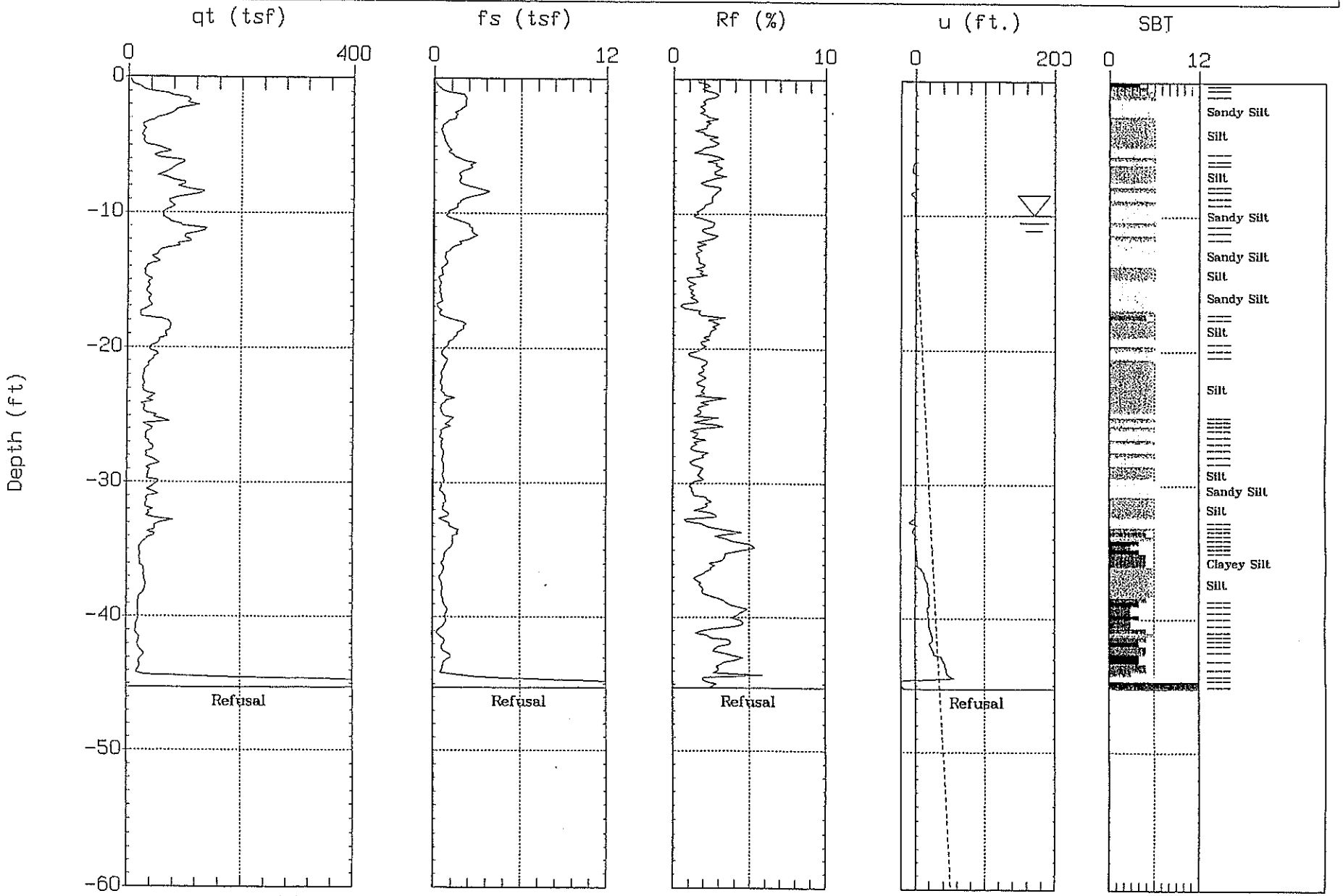
R13182

CONETEC

C.E.C.

Sounding:CPT-2
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 13:46



Max. Depth: 45.28 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

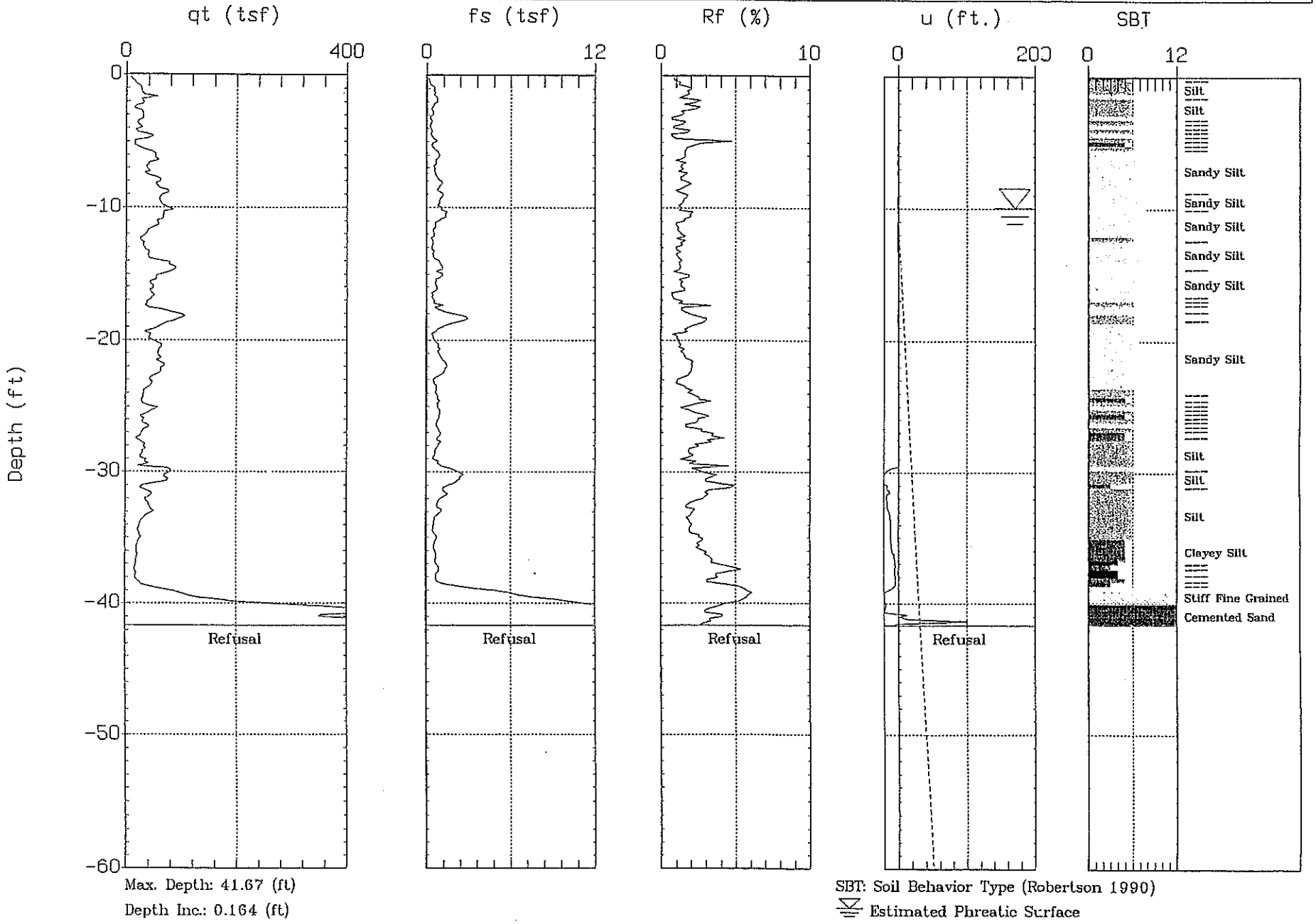
R13183

CONETEC

C.E.C.

Sounding:CPT-2A
Site:Pond Creek Mine

Piezocone:20 TCN AD211
Date:10:30:07 14:50



Max. Depth: 41.67 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

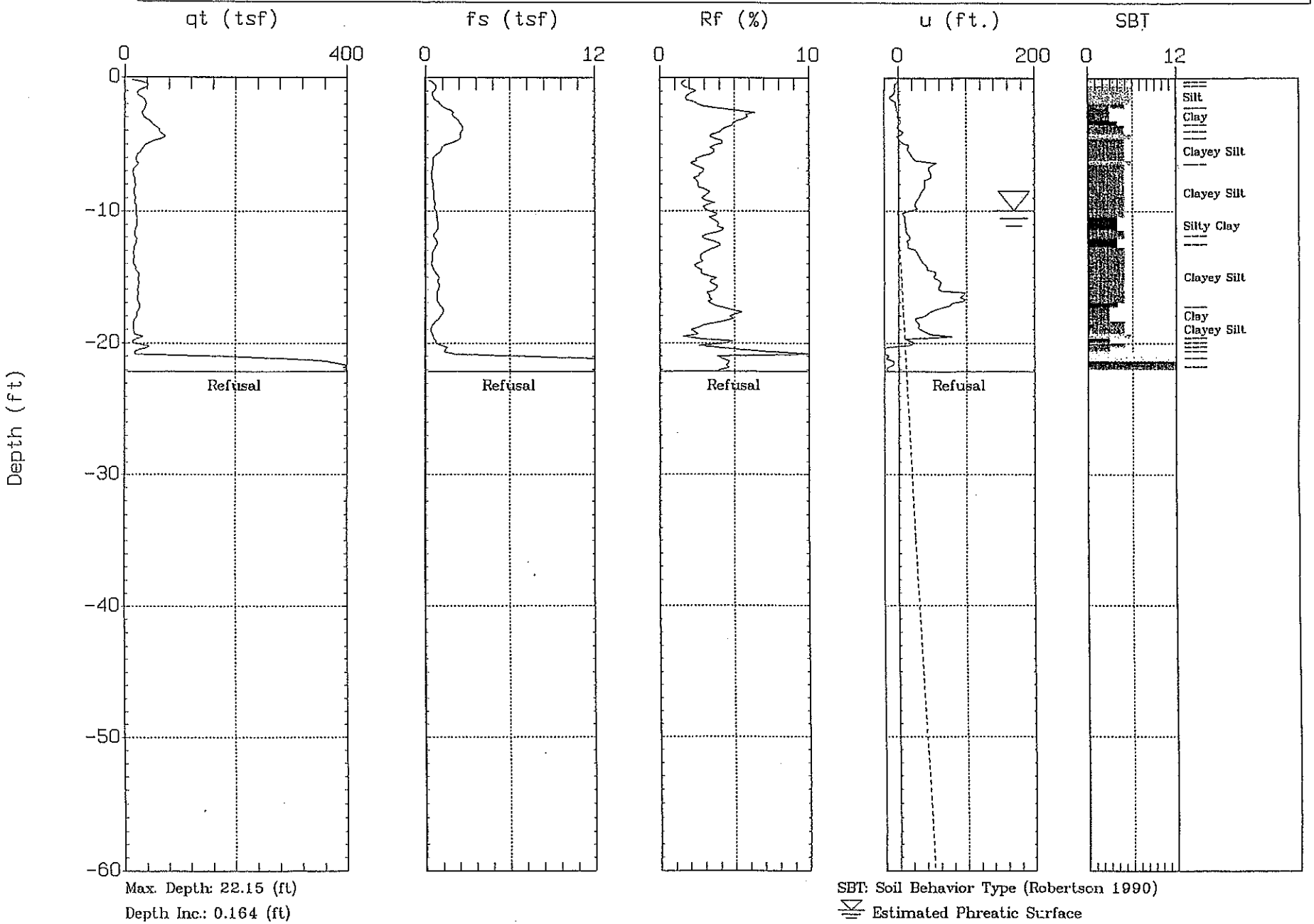
R13184

CONETEC

C.E.C.

Sounding:CPT-3
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:09



Max. Depth: 22.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

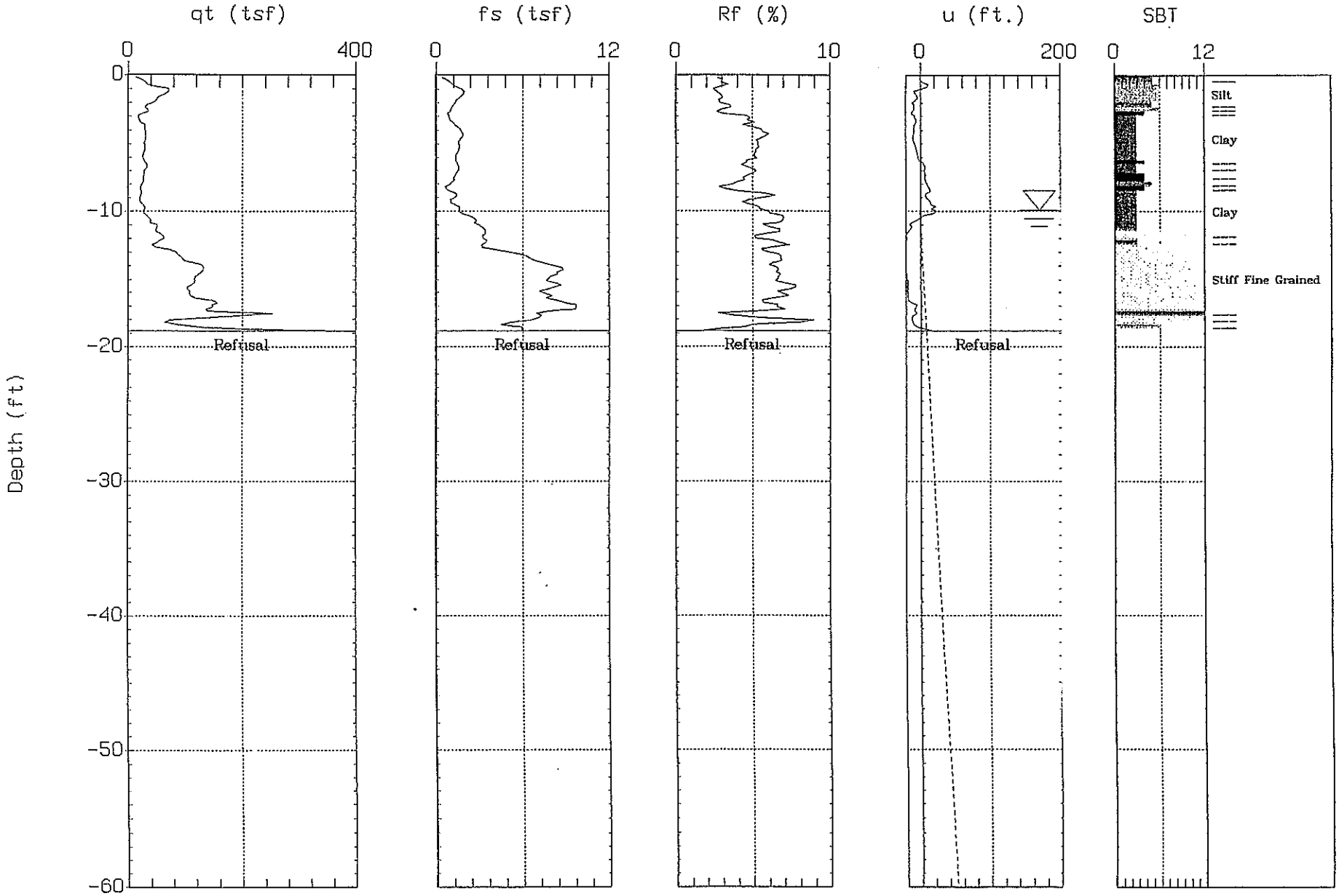
R13185

CONETEC

C.E.C.

Sounding:CPT-4
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:51



Max. Depth: 18.86 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

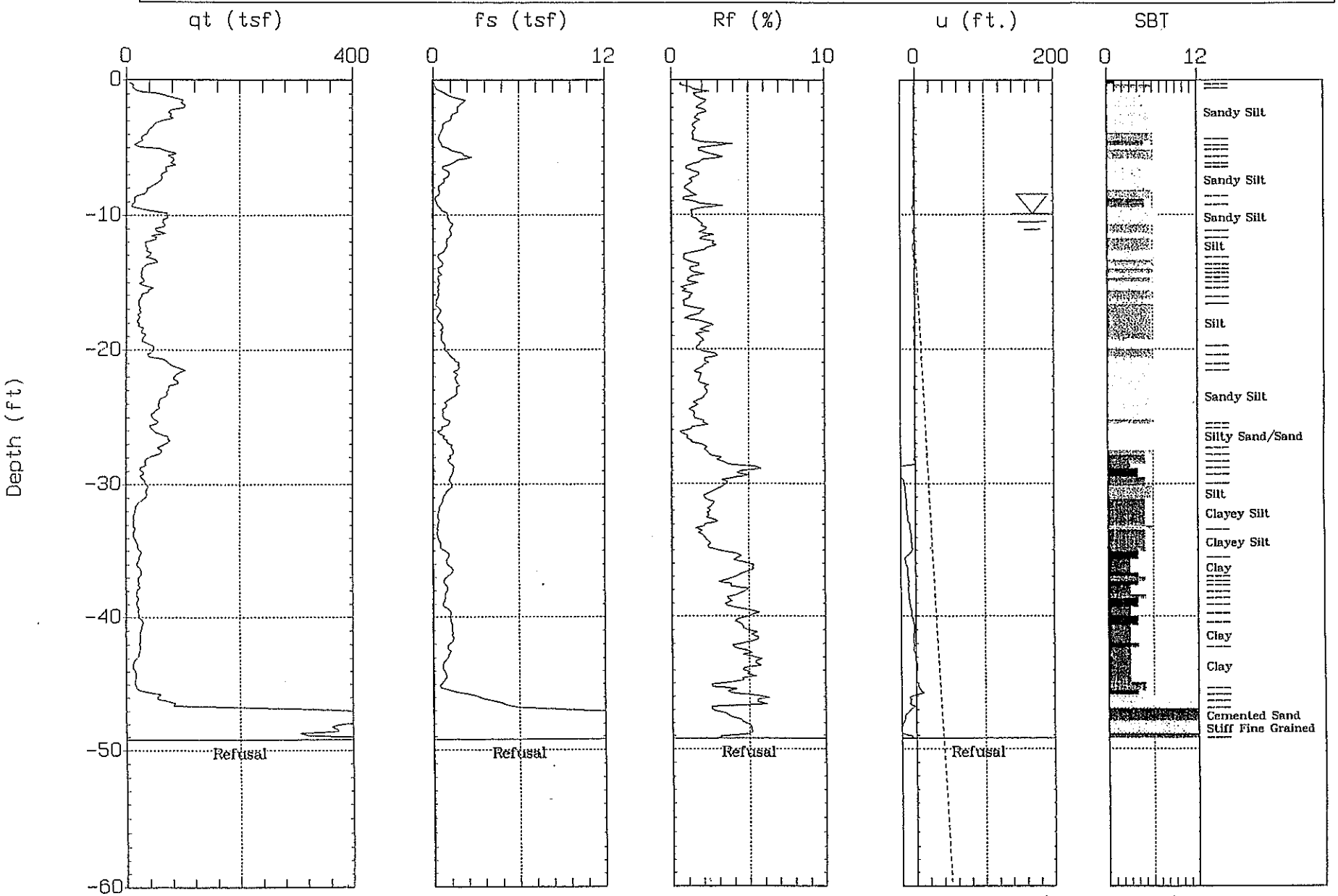
R13186

CONETEC

C.E.C.

Sounding:CPT-5
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 12:34



Max. Depth: 49.21 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

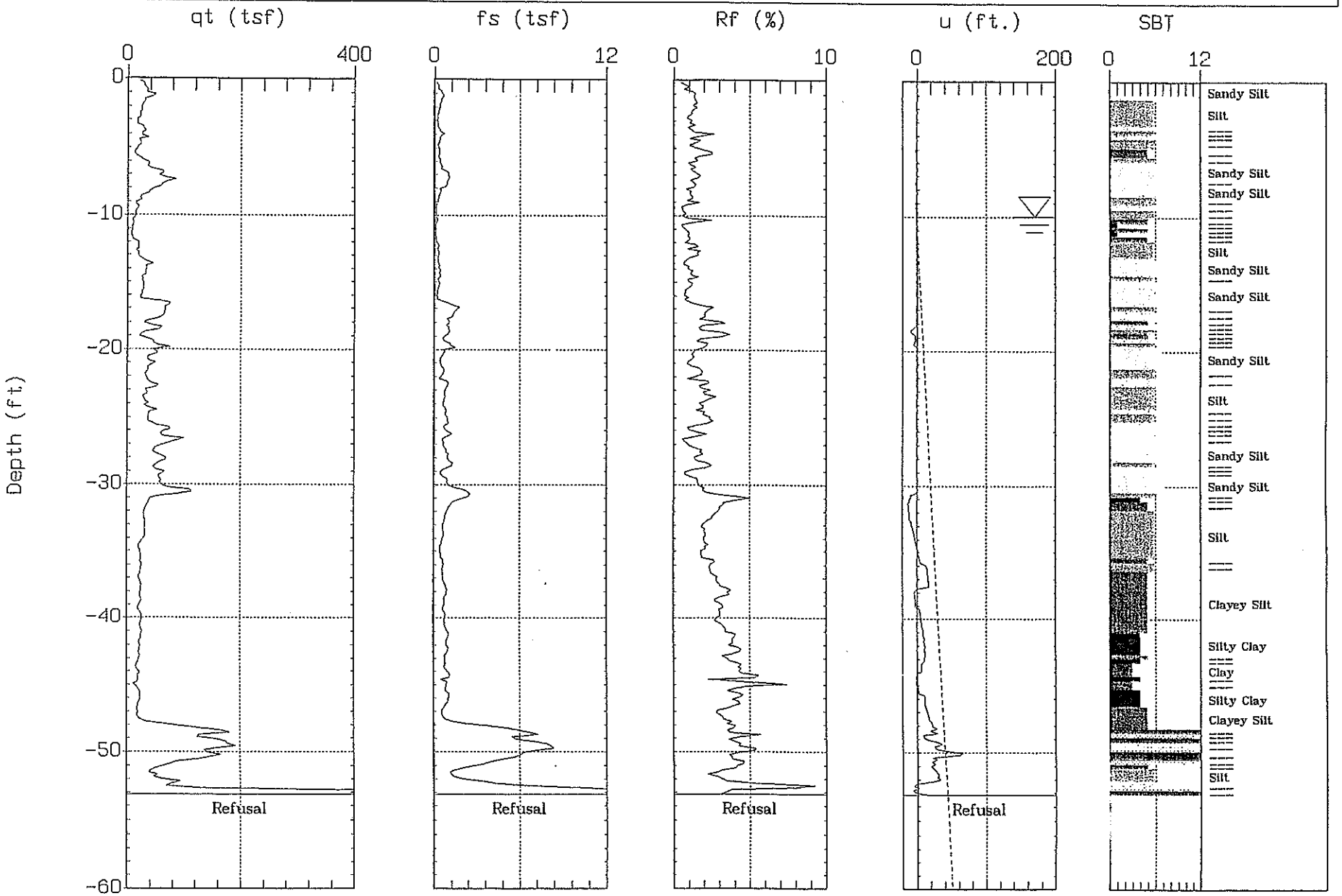
R13187

CONETEC

C.E.C.

Sounding:CPT-5A
Site:Pond Creek Mine

Piezocone:20 TCN AD211
Date:10:30:07 10:44



Max. Depth: 53.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

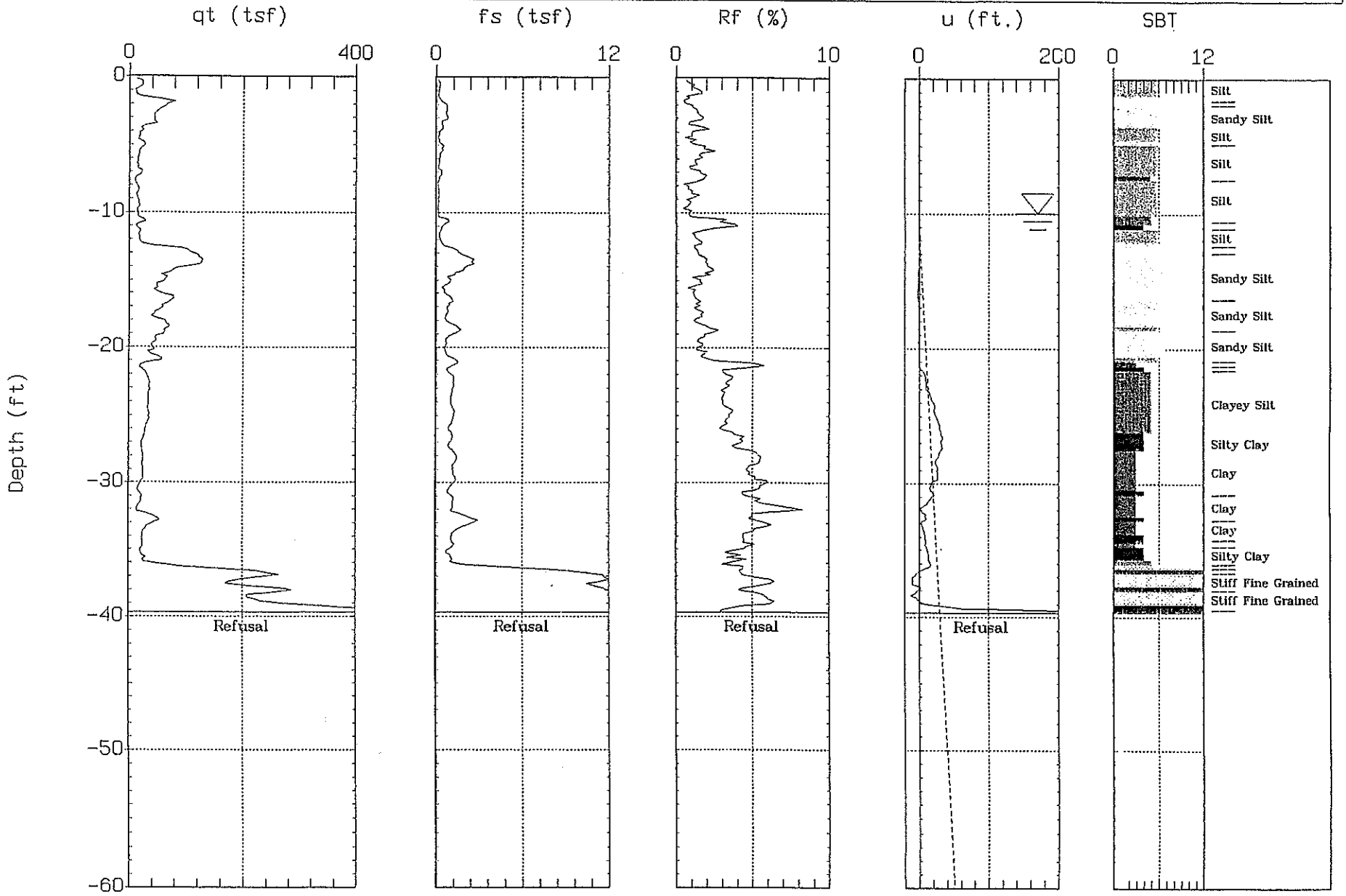
R13188

CONETEC

C.E.C.

Sounding:CPT-5B
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 15:44



Max. Depth: 39.70 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

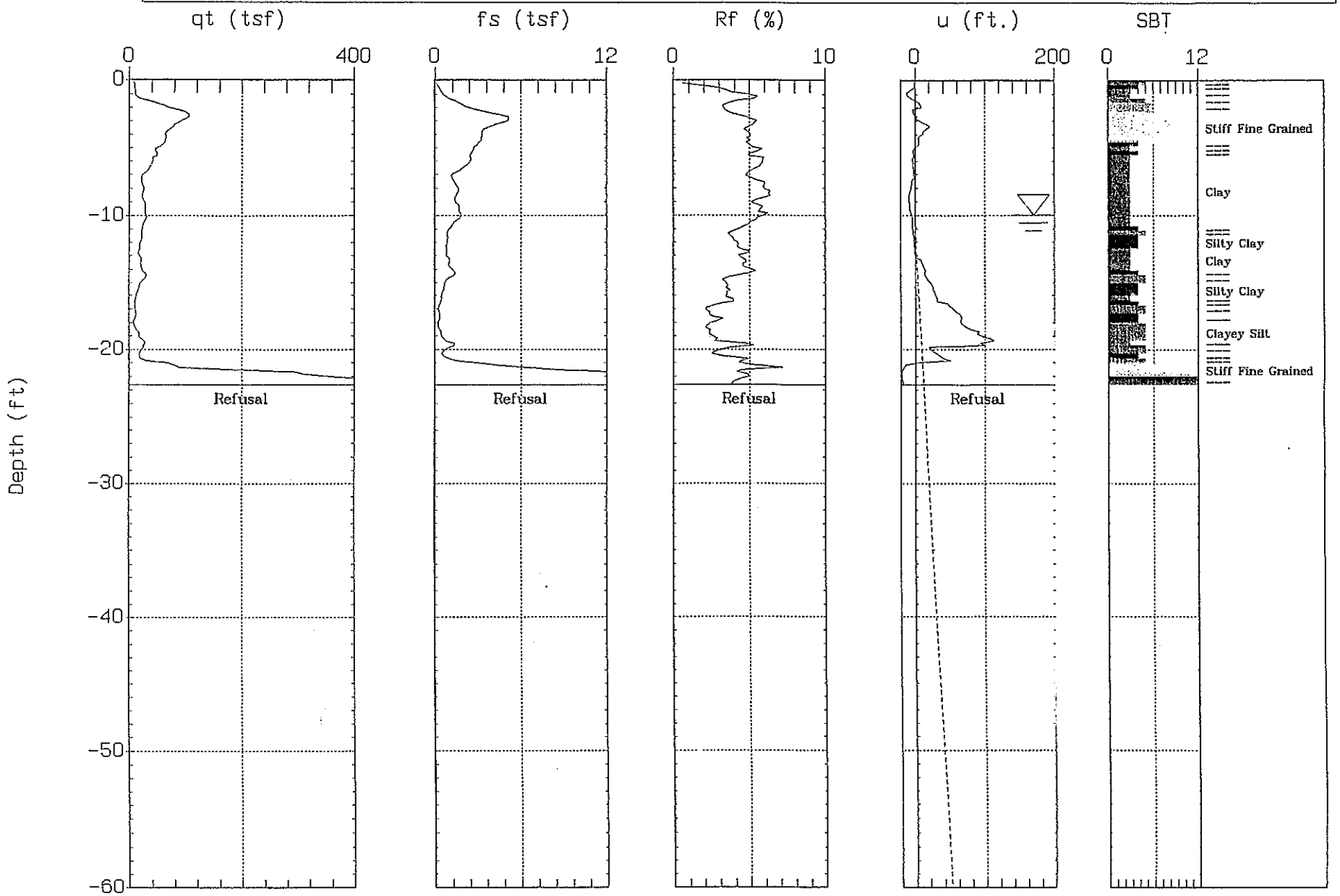
R13189

CONETEC

C.E.C.

Sounding:CPT-6
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:00



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

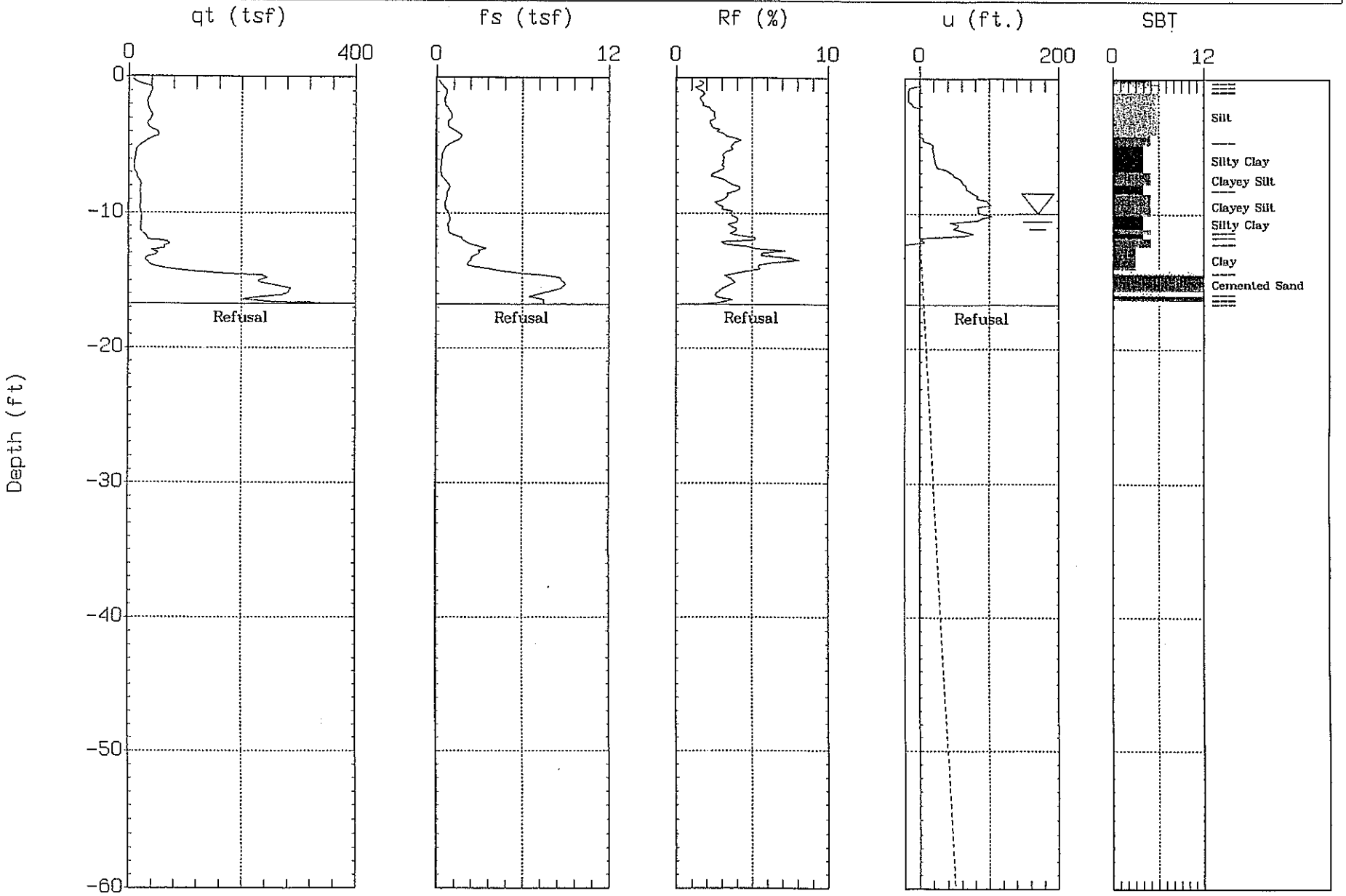
R13190

CONETEC

C.E.C.

Sounding:CPT-7
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:58



Max. Depth: 16.73 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

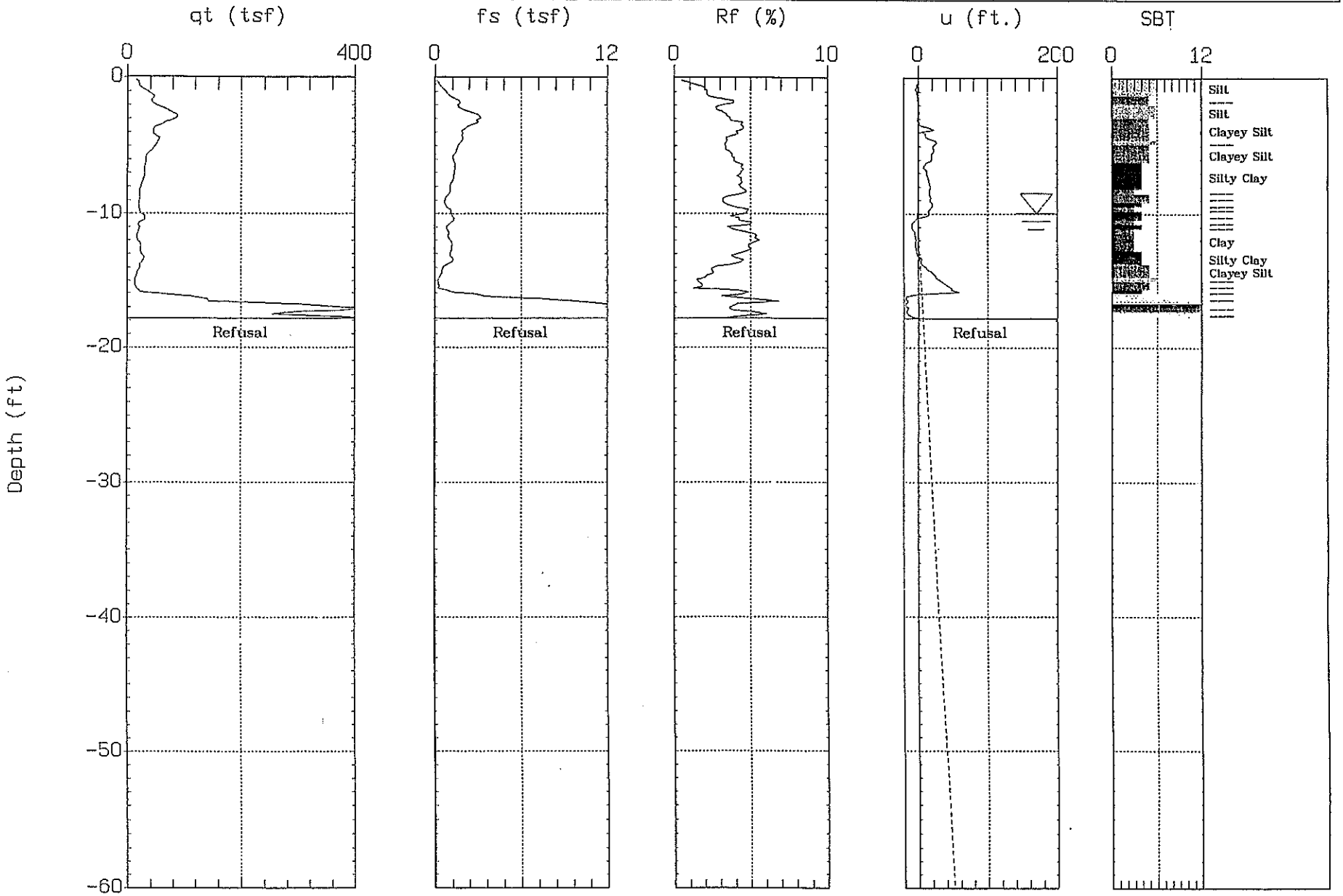
R13191

CONETEC

C.E.C.

Sounding:CPT-8
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:53



Max. Depth: 17.88 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

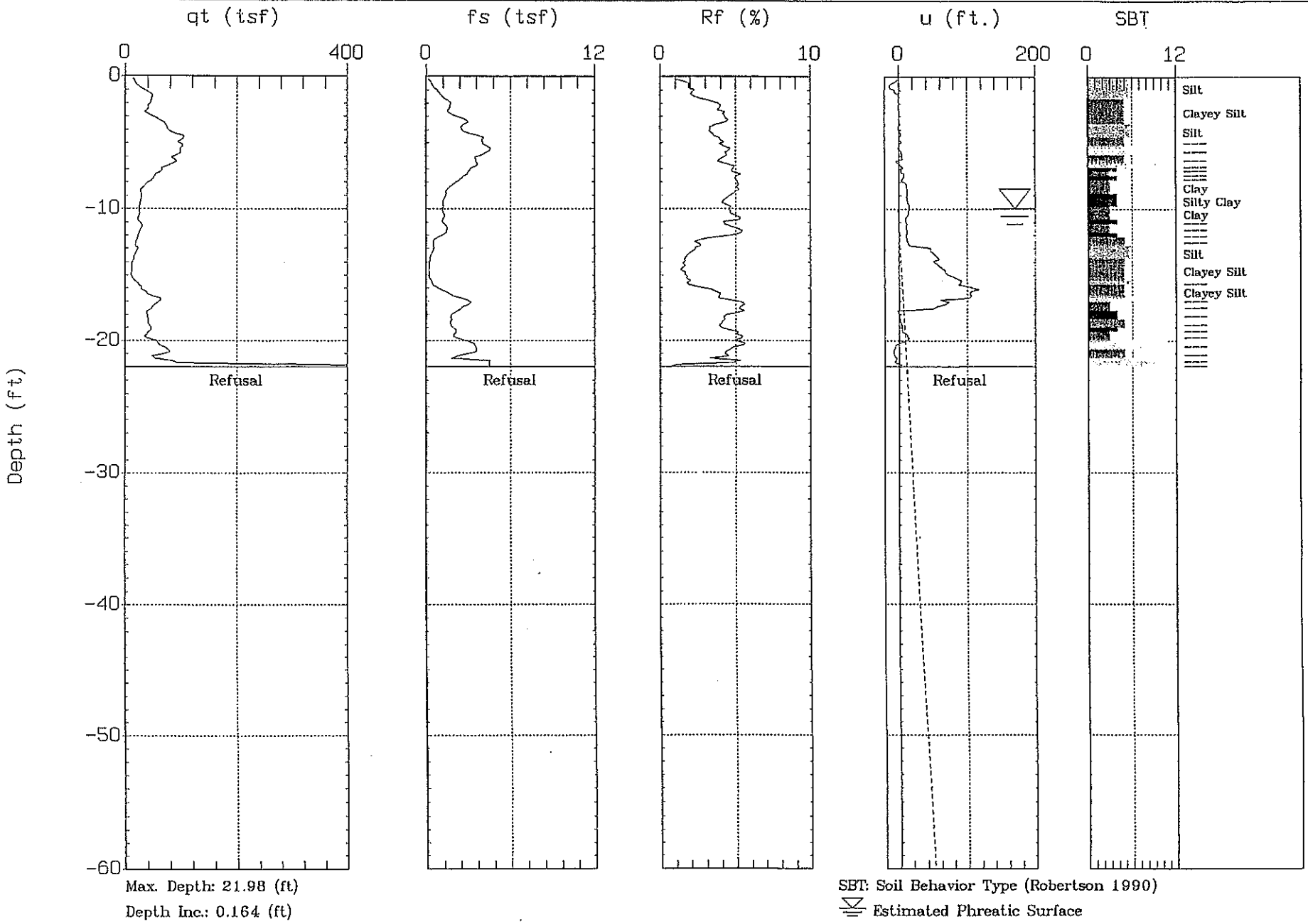
R13192

CONETEC

C.E.C.

Sounding:CPT-9
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:17



Max. Depth: 21.98 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

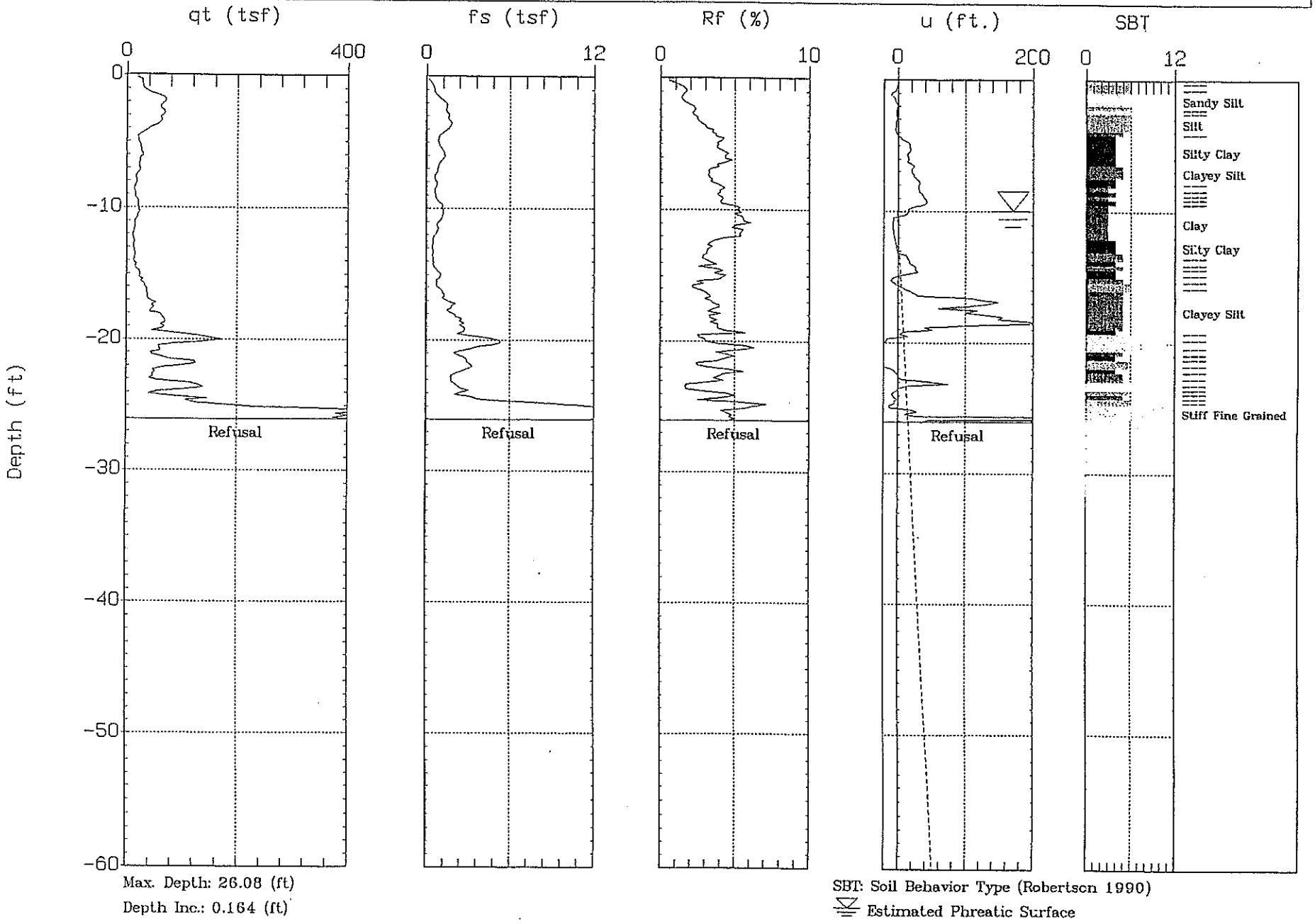
R13193

CONETEC

C.E.C.

Sounding:CPT-10
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 08:35



Max. Depth: 26.08 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

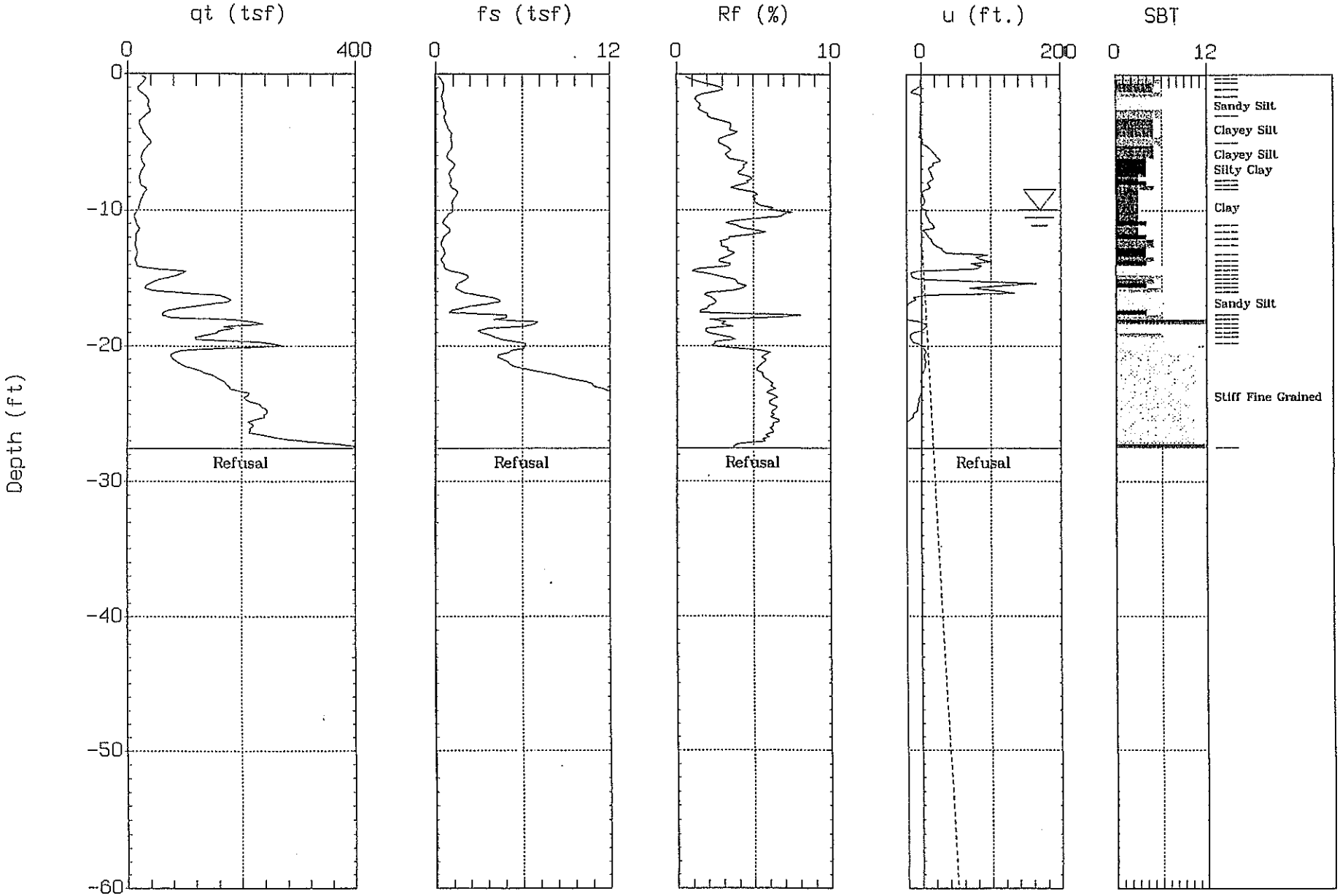
R13194

CONETEC

C.E.C.

Sounding:CPT-11
Site:Pond Creek Mine

Piezocone:20 TCN AD211
Date:10:31:07 10:31



Max. Depth: 27.56 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

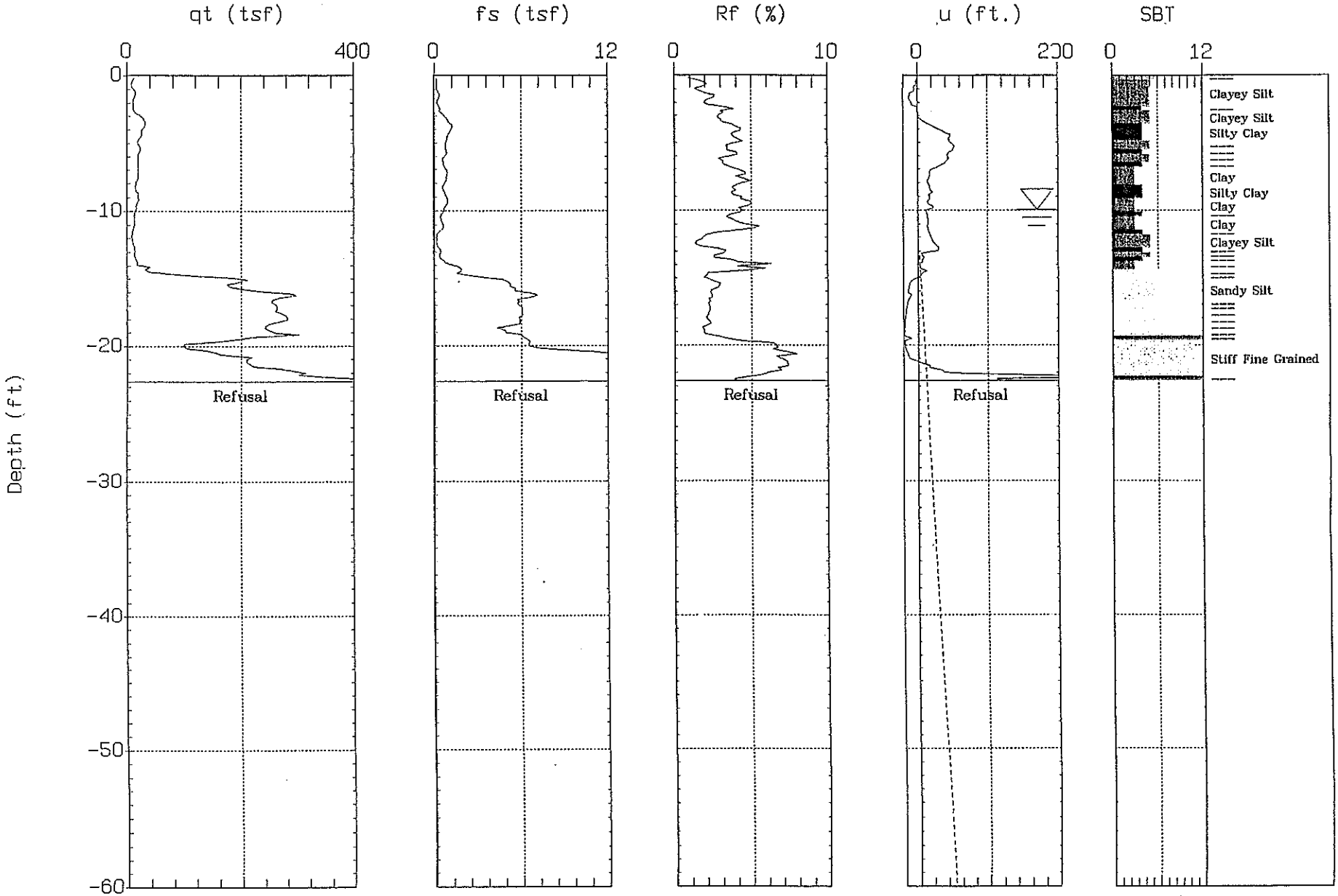
R13195

CONETEC

C.E.C.

Sounding:CPT-12
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 11:15



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

R13196

CONETEC ConeTec
Environmental and Geotechnical Site Investigation Contractors

ConeTec Interpretations as of June 30, 2004 (Release 1.22A)

ConeTec's interpretation routine provides a tabular output of geotechnical parameters based on current published CPT correlations and is subject to change to reflect the current state of practice. The interpreted values are not considered valid for all soil types. The interpretations are presented only as a guide for geotechnical use and should be carefully scrutinized for consideration in any geotechnical design. Reference to current literature is strongly recommended. ConeTec does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the program and does not assume liability for any use of the results in any design or review. Representative hand calculations should be made for any parameter that is critical for design purposes. The end user of the interpreted output should also be fully aware of the techniques and the limitations of any method used in this program. The purpose of this document is to inform the user as to which methods were used and what the appropriate papers and/or publications are for further reference.

The CPT interpretations are based on values of tip, sleeve friction and pore pressure averaged over a user specified interval (e.g. 0.20m). Note that q_t is the tip resistance corrected for pore pressure effects and q_c is the recorded tip resistance. Since all ConeTec cones have equal end area friction sleeves, pore pressure corrections to sleeve friction, f_s, are not required.

The tip correction is: $q_t = q_c + (1-a) \bullet u_2$

where: q_t is the corrected tip resistance
q_c is the recorded tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the cone (typically 0.85 for ConeTec cones)

The total stress calculations are based on soil unit weights that have been assigned to the Soil Behavior Type zones, from a user defined unit weight profile or by using a single value throughout the profile. Effective vertical overburden stresses are calculated based on a hydrostatic distribution of equilibrium pore pressures below the water table or from a user defined equilibrium pore pressure profile (this can be obtained from CPT dissipation tests). For over water projects the effects of the column of water have been taken into account as has the appropriate unit weight of water. How this is done depends on where the instruments were zeroed (i.e. on deck or at mud line).

Details regarding the interpretation methods for all of the interpreted parameters are provided in Table 1. The appropriate references cited in Table 1 are listed in Table 2. Where methods are based on charts or techniques that are too complex to describe in this summary the user should refer to the cited material.

The estimated Soil Behavior Types (normalized and non-normalized) are based on the charts developed by Robertson and Campanella shown in Figures 1 and 2. The Bq classification charts are not reproduced in this document but can be reviewed in Lunne, Robertson and Powell (1997) or Robertson (1990).

Where the results of a calculation/interpretation are declared *'invalid'* the value will be represented by the text strings "-9999" or "-9999.0". In some cases the value 0 will be used. Invalid results will occur because of (and not limited to) one or a combination of:

1. Invalid or undefined CPT data (e.g. drilled out section or data gap).

2. Where the interpretation method is inappropriate, for example, drained parameters in an undrained material (and vice versa).

3. Where interpretation input values are beyond the range of the referenced charts or specified limitations of the interpretation method.

4. Where pre-requisite or intermediate interpretation calculations are invalid.

The parameters selected for output from the program are often specific to a particular project. As such, not all of the interpreted parameters listed in Table 1 may be included in the output files delivered with this report.

The output files are often delivered in one (or more) of the following three formats:

File Type	Typical Extensions	Description
Printable	IFP, NLP	ASCII files formatted for direct printing either by copying to a printer port, through a text editor or through a dedicated printing routine (such as ConeTec's CTPRINT). Typically formatted for 132 columns wide and 70 lines per page. Any printer would need to be set to have a compressed font (16cpi) as its default.
Importable	IFI, NLI	Tab delimited ASCII files (not for use with text editors) meant for importing into spreadsheet and database applications (e.g. Excel, Lotus, Quattro, Access). Some column and cell formatting maybe required depending on the quality of the application's import utility.
Spreadsheet	XLS	IFI, NLI files exported directly to Excel format. Column and cell formatting has been done. Header information is exported to start in Column C allowing the depth columns A and/or B to be duplicated on each printed page without repetition of part of the header information.

Table 1
CPT Interpretation Methods

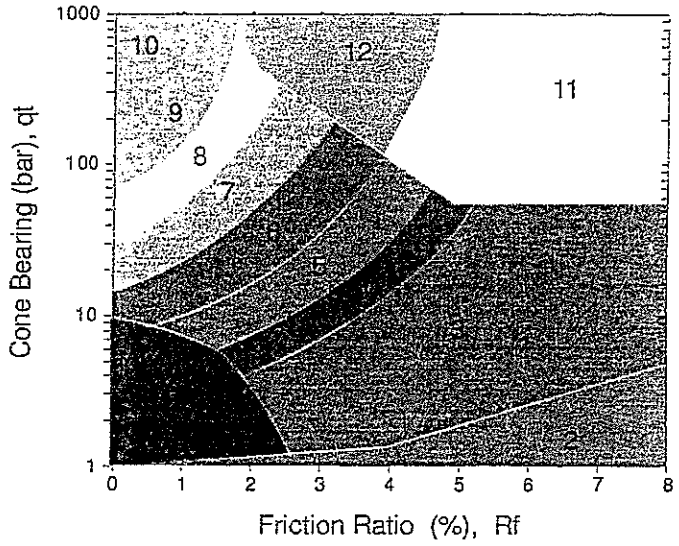
Interpreted Parameter	Description	Equation	Ref
Depth	Mid Layer Depth *(where interpretations are done at each point then Mid Layer Depth = Recorded Depth)*	*Depth (Layer Top) + Depth (Layer Bottom) / 2.0*	
Elevation	Elevation of Mid Layer based on sounding collar elevation supplied by client	Elevation = Collar Elevation - Depth	
Avgqc	Averaged recorded tip value (q_c)	$Avgqc = \frac{1}{n}\sum_{i=1}^{n} q_c$ *n=1 when interpretations are done at each point*	
Avgqt	Averaged corrected tip (q_t) where: $q_t = q_c + (1-a) \bullet u$	$Avgqt = \frac{1}{n}\sum_{i=1}^{n} q_t$ *n=1 when interpretations are done at each point*	
Avgfs	Averaged sleeve friction (f_s)	$Avgfs = \frac{1}{n}\sum_{i=1}^{n} fs$ *n=1 when interpretations are done at each point*	
AvgRf	Averaged friction ratio (Rf) where friction ratio is defined as: $Rf = 100\% \bullet \frac{fs}{qt}$	$AvgRf = 100\% \bullet \frac{Avgfs}{Avgqt}$ *n=1 when interpretations are done at each point*	
Avgu	Averaged dynamic pore pressure *(u)*	$Avgu = \frac{1}{n}\sum_{i=1}^{n} u_i$ *n=1 when interpretations are done at each point*	
AvgRes	Averaged Resistivity (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} RESISTIVITY_i$ *n=1 when interpretations are done at each point*	

Interpreted Parameter	Description	Equation	Ref
AvgUVIF	Averaged UVIF ultra-violet induced fluorescence (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} UVIF_i$ *n=1 when interpretations are done at each point*	
AvgTemp	Averaged Temperature (this data is not always available since it is a specialized test)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} TEMPERATURE_i$ *n=1 when interpretations are done at each point*	
AvgGamma	Averaged Gamma Counts (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} GAMMA_i$ *n=1 when interpretations are done at each point*	
SBT	Soil Behavior Type as defined by Robertson and Campanella	See Figure 1	2, 5
U.Wt.	Unit Weight of soil determined from one of the following user selectable options: 1) uniform value 2) value assigned to each SBT zone 3) user supplied unit weight profile	See references	5
T. Stress σ_V	Total vertical overburden stress at Mid Layer Depth. *A layer is defined as the averaging interval specified by the user. For data interpreted at each point the Mid Layer Depth is the same as the recorded depth.*	$TStress = \sum_{i=1}^{n} \gamma_i h_i$ where γ_i is layer unit weight h_i is layer thickness	
E. Stress σ_V'	Effective vertical overburden stress at Mid Layer Depth	$Estress = Tstress - u_{eq}$	
Ueq	Equilibrium pore pressure determined from one of the following user selectable options: 1) hydrostatic from water table depth 2) user supplied profile	For hydrostatic option: $u_{eq} = \gamma_w \bullet (D - D_{wt})$ where u_{eq} is equilibrium pore pressure γ_w is unit weight of water D is the current depth D_{wt} is the depth to the water table	
Cn	SPT N_{60} overburden correction factor	$Cn=(\sigma_V')^{-0.5}$ where σ_V' *is in tsf* $0.5 < C_n < 2.0$	
N_{60}	SPT N value at 60% energy calculated from qt/N ratios assigned to each SBT zone. This method has abrupt N value changes at zone boundaries.	*See Figure 1*	4, 5
$(N_1)_{60}$	SPT N_{60} value corrected for overburden pressure	$(N_1)_{60} = Cn \bullet N_{60}$	4
$N_{60}I_c$	SPT N_{60} values based on the Ic parameter	(qt/pa)/ N_{60} = 8.5 (1 – Ic/4.6)	5
$(N_1)_{60}Ic$	SPT N_{60} value corrected for overburden pressure (using N_{60} I_c). User has 2 options.	1) $(N_1)_{60}Ic = Cn \bullet (N_{60}Ic)$ 2) $q_{c1n}/(N_1)_{60}Ic$ = 8.5 (1 – Ic/4.6)	4 5
$(N_1)_{60cs}Ic$	Clean sand equivalent SPT $(N_1)_{60}Ic$. User has 3 options.	1) $(N_1)_{60cs}Ic = \alpha + \beta((N_1)_{60}Ic)$ 2) $(N_1)_{60cs}Ic = K_{SPT} * ((N_1)_{60}Ic)$ 3) $q_{c1ncs}/(N_1)_{60cs}Ic$ = 8.5 (1 – Ic/4.6) FC ≤ 5%: $\alpha = 0$, $\beta = 1.0$ FC ≥ 35% $\alpha = 5.0$, $\beta = 1.2$ 5% < FC < 35% $\alpha = \exp[1.76 - (190/FC^2)]$ $\beta = [0.99 + (FC^{1.5}/1000)]$	10 10 5
Su	Undrained shear strength - N_{kt} is user selectable	$Su = \frac{qt - \sigma_v}{N_{kt}}$	1, 5
k	Coefficient of permeability (assigned to each SBT zone)		5

Interpreted Parameter	Description	Equation	Ref
Bq	Pore pressure parameter	$Bq = \frac{\Delta u}{qt - \sigma_v}$ where: $\Delta u = u - u_{eq}$ and u = dynamic pore pressure u_{eq} = equilibrium pore pressure	1, 5
Q_t	Normalized q_t for Soil Behavior Type classification as defined by Robertson, 1990	$Qt = \frac{qt - \sigma_v}{\sigma'_v}$	2, 5
F_r	Normalized Friction Ratio for Soil Behavior Type classification as defined by Robertson, 1990	$Fr = 100\% \bullet \frac{fs}{qt - \sigma_v}$	2, 5
SBTn	Normalized Soil Behavior Type as defined by Robertson and Campanella	See Figure 2	2, 5
SBT-BQ	Non-normalized soil behavior type based on the Bq parameter	See Figure 5.7 (reference 5)	2, 5
SBT-BQn	Normalized Soil Behavior base on the Bq parameter	See Figure 5.8 (reference 5) or Figure 3 (reference 2)	2, 5
I_c	Soil index for estimating grain characteristics	$Ic = [(3.47 - \log_{10}Q)^2 + (\log_{10} Fr + 1.22)^2]^{0.5}$ Where: $Q = \left(\frac{qt - \sigma_v}{P_{a2}}\right)\left(\frac{P_a}{\sigma'_v}\right)^n$ And Fr is in percent P_a = atmospheric pressure P_{a2} = atmospheric pressure n varies from 0.5 to 1.0 and is selected in an iterative manner based on the resulting I_c	3, 8
FC	Apparent fines content (%)	$FC = 1.75(Ic^{3.25}) - 3.7$ $FC = 100$ for $Ic > 3.5$ $FC = 0$ for $Ic < 1.26$ $FC = 5\%$ if $1.64 < Ic < 2.6$ AND $F_r < 0.5$	3
Ic Zone	This parameter is the Soil Behavior Type zone based on the Ic parameter (valid for zones 2 through 7 on SBTn chart)	Ic < 1.31 Zone = 7 1.31 < Ic < 2.05 Zone = 6 2.05 < Ic < 2.60 Zone = 5 2.60 < Ic < 2.95 Zone = 4 2.95 < Ic < 3.60 Zone = 3 Ic > 3.60 Zone = 2	3
PHI ϕ	Friction Angle determined from one of the following user selectable options: a) Campanella and Robertson b) Durgunoglu and Mitchel c) Janbu	See reference	5
Dr	Relative Density determined from one of the following user selectable options: a) Ticino Sand b) Hokksund Sand c) Schmertmann 1976 d) Jamiolkowski - All Sands	See reference	5

Interpreted Parameter	Description	Equation	Ref
OCR	Over Consolidation Ratio	a) Based on Schmertmann's method involving a plot of $S_u/\sigma_v' / (S_u/\sigma_v')_{NC}$ and OCR where the Su/p' ratio for NC clay is user selectable	9
State Parameter	The state parameter is used to describe whether a soil is contractive (SP is positive) or dilative (SP is negative) at large strains based on the work by Been and Jefferies	See reference	8, 6, 5
Es/qt	Intermediate parameter for calculating Youngs Modulus, E, in sands. It is the Y axis of the reference chart.	Based on Figure 5.59 in the reference	5
Youngs Modulus E	Youngs Modulus based on the work by Baldi. There are three types of sands considered in this technique. The user selects the appropriate type for the site from: a) OC Sands b) Aged NC Sands c) Recent NC Sands Each sand type has a family of curves that depend on mean normal stress. The program calculates mean normal stress and linearly interpolates between the two extremes provided in Baldi's chart.	Mean normal stress is evaluated from: $\sigma_m' = \frac{1}{3} \cdot (\sigma_v' + \sigma_h' + \sigma_h')$ where σ_v'= vertical effective stress σ_h'= horizontal effective stress and $\sigma_h = K_o * \sigma_v'$ with Ko assumed to be 0.5	5
q_{c1}	q_t normalized for overburden stress used for seismic analysis	$q_{c1} = q_t \cdot (Pa/\sigma_v')^{0.5}$ where: Pa = atm. Pressure q_t is in Mpa	3
q_{c1n}	q_{c1} in dimensionless form used for seismic analysis	$q_{c1n} = (q_{c1} / Pa)(Pa/\sigma_v')$ where: Pa = atm. Pressure and n ranges from 0.5 to 0.75 based on Ic.	3
K_{SPT}	Equivalent clean sand factor for $(N_1)60$	$K_{SPT} = 1 + ((0.75/30) * (FC - 5))$	10
K_{CPT}	Equivalent clean sand correction for q_{c1N}	$K_{cpt} = 1.0$ for $I_c \leq 1.64$ $K_{cpt} = f(I_c)$ for $I_c > 1.64$ *(see reference)*	10
q_{c1ncs}	Clean sand equivalent q_{c1n}	$q_{c1ncs} = q_{c1n} \cdot K_{cpt}$	3
CRR	Cyclic Resistance Ratio (for Magnitude 7.5)	$q_{c1ncs} < 50$: $CRR_{7.5} = 0.833 [(q_{c1ncs}/1000] + 0.05$ $50 \leq q_{c1ncs} < 160$: $CRR_{7.5} = 93 [(q_{c1ncs}/1000]^3 + 0.08$	10
CSR	Cyclic Stress Ratio	$CSR = (\tau_{av}/\sigma_v') = 0.65 (a_{max} / g) (\sigma_v/ \sigma_v') r_d$ $r_d = 1.0 - 0.00765\ z$ $z \leq 9.15m$ $r_d = 1.174 - 0.0267\ z$ $9.15 < z \leq 23m$ $r_d = 0.744 - 0.008\ z$ $23 < z \leq 30m$ $r_d = 0.50$ $z > 30m$	10

Interpreted Parameter	Description	Equation	Ref
MSF	Magnitude Scaling Factor	See Reference	10
FofS	Factor of Safety against Liquefaction	FS = ($CRR_{7.5}$ / CSR) MSF	10
Liquefaction Status	Statement indicating possible liquefaction	Takes into account FofS and limitations based I_c and q_{c1ncs}.	10



Zone	qt / N	Soil Behavior Type
1	2	sensitive fine grained
2	1	organic material
3	1	clay
4	1.5	silty clay to clay
5	2	clayey silt to silty clay
6	2.5	sandy silt to clayey silt
7	3	silty sand to sandy silt
8	4	sand to silty sand
9	5	sand
10	6	gravelly sand to sand
11	1	very stiff fine grained *
12	2	sand to clayey sand *

* overconsolidated or cemented

Figure 1 Non-Normalized Behavior Type Classification Chart

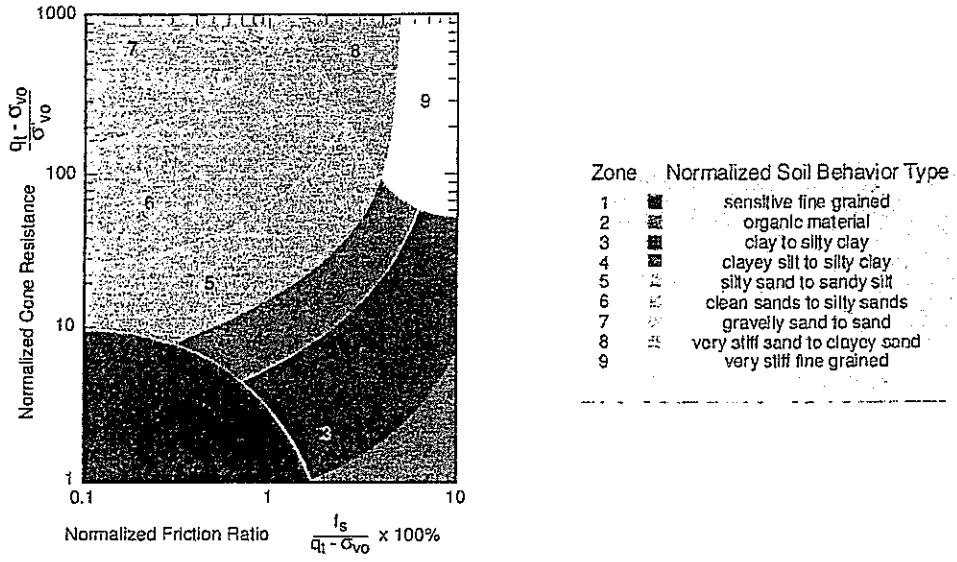


Figure 2 Normalized Behavior Type Classification Chart

Table 2 References

No.	References
1	Robertson, P.K., Campanella, R.G., Gillespie, D. and Greig, J., 1986, "Use of Piezometer Cone Data", Proceedings of InSitu 86, ASCE Specialty Conference, Blacksburg, Virginia.
2	Robertson, P.K., 1990, "Soil Classification Using the Cone Penetration Test", Canadian Geotechnical Journal, Volume 27.
3	Robertson, P.K. and Fear, C.E., 1998, "Evaluating cyclic liquefaction potential using the cone penetration test", Canadian Geotechnical Journal, 35: 442-459.
4	Robertson, P.K. and Wride, C.E., 1998, "Cyclic Liquefaction and its Evaluation Based on SPT and CPT", NCEER Workshop Paper, January 22, 1997
5	Lunne, T., Robertson, P.K. and Powell, J. J. M., 1997, " Cone Penetration Testing in Geotechnical Practice," Blackie Academic and Professional.
6	Plewes, H.D., Davies, M.P. and Jefferies, M.G., 1992, "CPT Based Screening Procedure for Evaluating Liquefaction Susceptibility", 45th Canadian Geotechnical Conference, Toronto, Ontario, October 1992.
7	Jefferies, M.G. and Davies, M.P., 1993. "Use of CPTu to Estimate equivalent N_{60}", Geotechnical Testing Journal, 16(4): 458-467.
8	Been, K. and Jefferies, M.P., 1985, "A state parameter for sands", Geotechnique, 35(2), 99-112.
9	Schmertmann, 1977, "Guidelines for Cone Penetration Test Performance and Design", Federal Highway Administration Report FHWA-TS-78-209, U.S. Department of Transportation
10	Proceedings of theNCEER Workshop on Evaluation of Liquefaction Resistance of Soils, Salt LakeCity, 1996. Chaired by Leslie Youd.

CONETEC

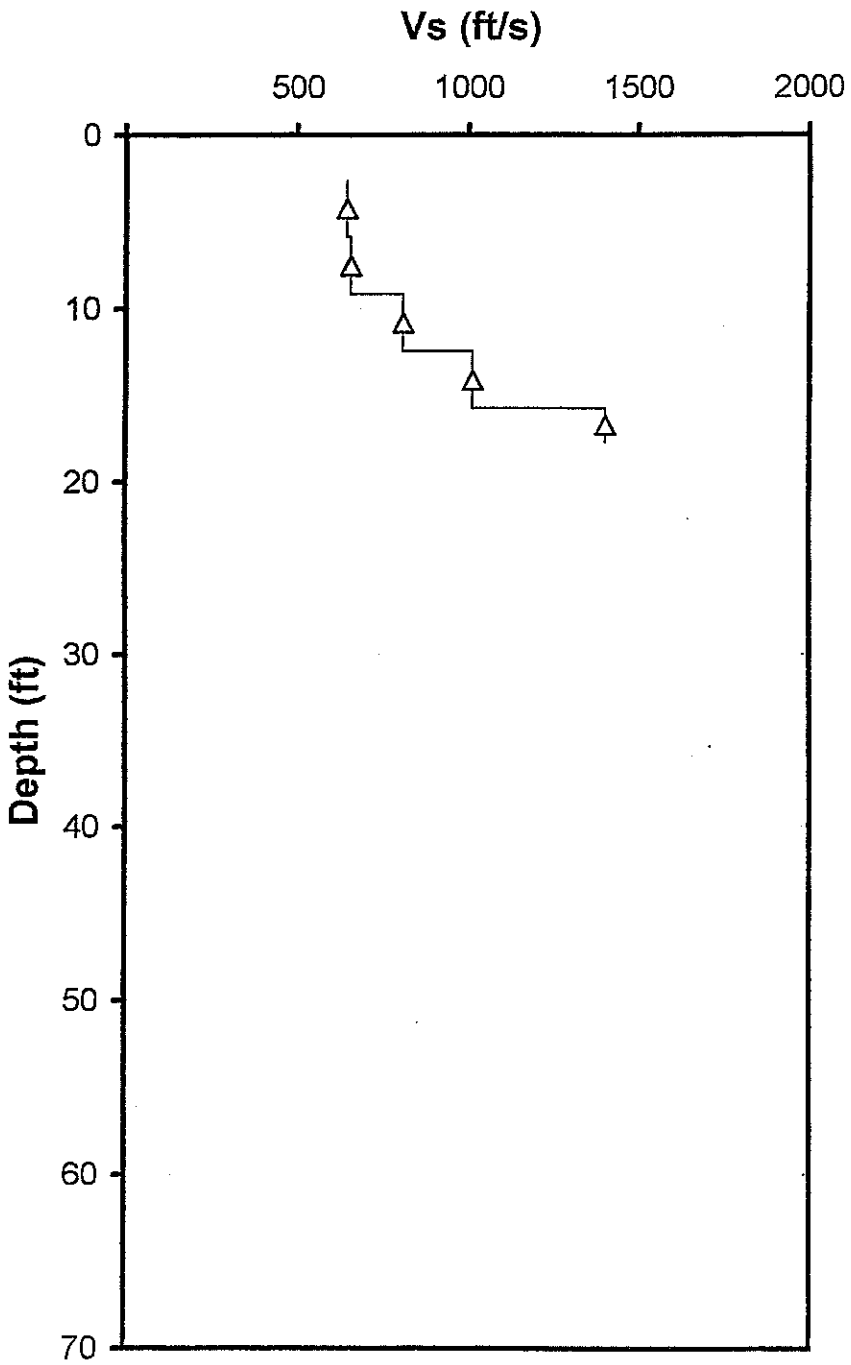
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-1
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	4.76	4.26	645
9.84	9.18	9.31	3.21	4.90	7.54	656
13.12	12.46	12.55	3.25	4.02	10.82	808
16.40	15.74	15.82	3.26	3.22	14.10	1013
18.37	17.71	17.78	1.96	1.40	16.73	1402

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-1
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-2
Site	Williamson County, Illinois
Date	10/30/2007

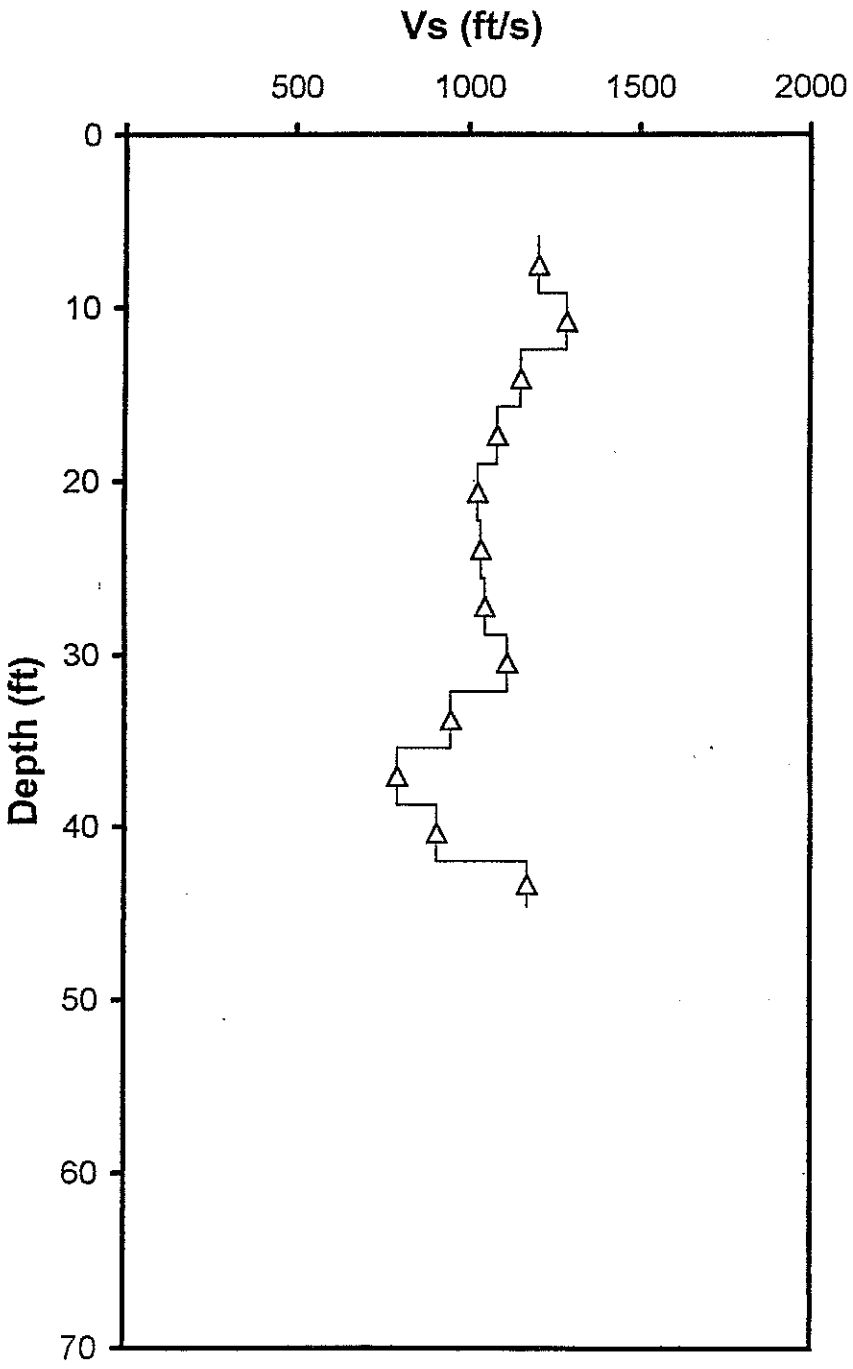
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	2.67	7.54	1204
13.12	12.46	12.55	3.25	2.53	10.82	1284
16.40	15.74	15.82	3.26	2.83	14.10	1152
19.69	19.03	19.09	3.28	3.02	17.39	1085
22.97	22.31	22.36	3.27	3.18	20.67	1029
26.25	25.59	25.64	3.27	3.15	23.95	1039
29.53	28.87	28.91	3.28	3.12	27.23	1050
32.81	32.15	32.19	3.28	2.94	30.51	1114
36.09	35.43	35.47	3.28	3.45	33.79	950
39.37	38.71	38.74	3.28	4.12	37.07	795
42.65	41.99	42.02	3.28	3.61	40.35	908
45.28	44.62	44.65	2.63	2.24	43.31	1173

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-2
Date: October 30, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-2A
Site	Williamson County, Illinois
Date	10/30/2007

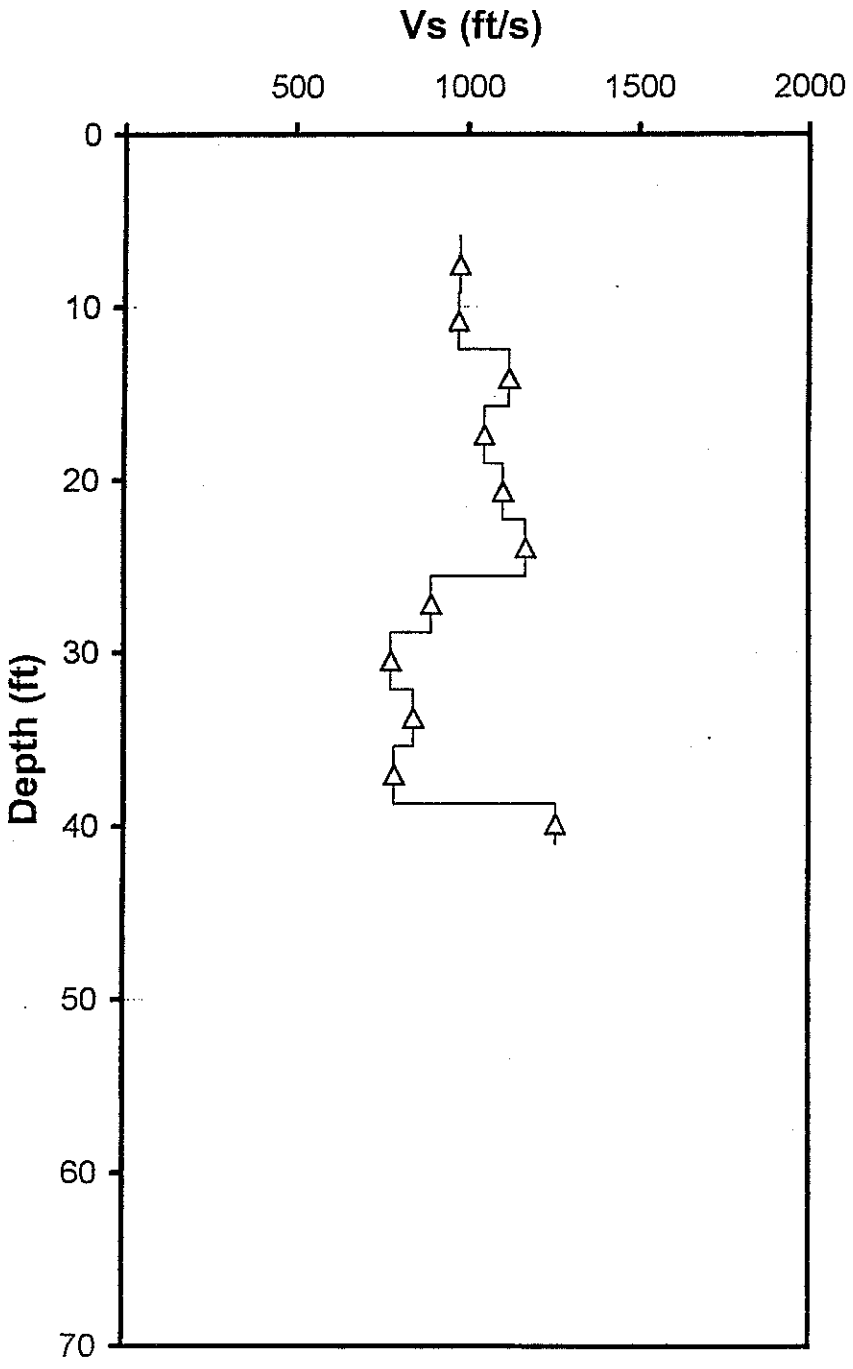
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	3.29	7.54	977
13.12	12.46	12.55	3.25	3.34	10.82	973
16.40	15.74	15.82	3.26	2.91	14.10	1121
19.69	19.03	19.09	3.28	3.12	17.39	1051
22.97	22.31	22.36	3.27	2.96	20.67	1105
26.25	25.59	25.64	3.27	2.80	23.95	1169
29.53	28.87	28.91	3.28	3.66	27.23	895
32.81	32.15	32.19	3.28	4.20	30.51	780
36.09	35.43	35.47	3.28	3.88	33.79	845
39.37	38.71	38.74	3.28	4.15	37.07	790
41.67	41.01	41.04	2.30	1.83	39.86	1256

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-2A
Date: October 30, 2007



CONETEC

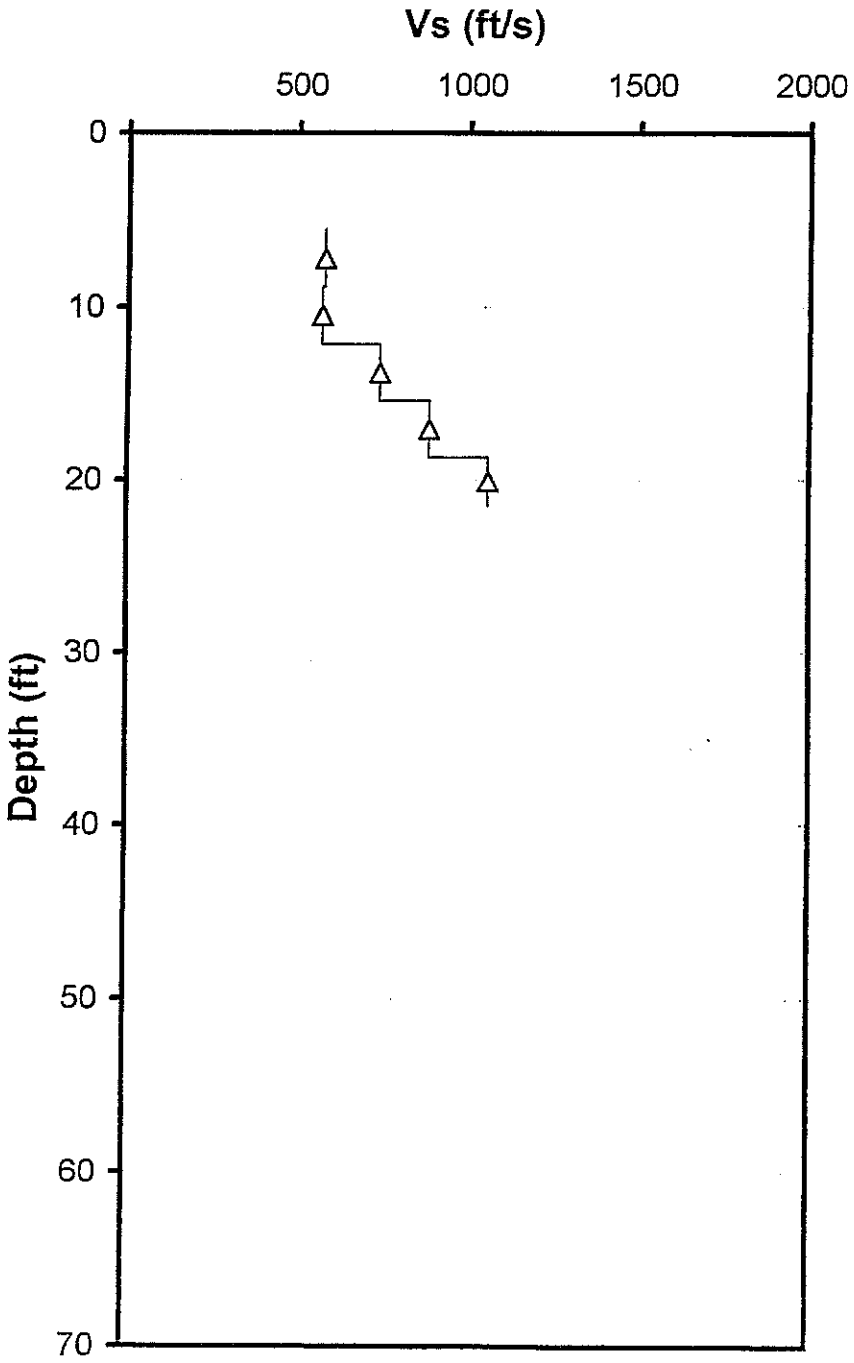
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-3
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.23	5.57	5.77				
9.51	8.85	8.98	3.21	5.56	7.21	577
12.80	12.14	12.24	3.26	5.72	10.50	569
16.08	15.42	15.50	3.26	4.42	13.78	738
19.36	18.70	18.76	3.27	3.70	17.06	883
22.15	21.49	21.55	2.78	2.63	20.10	1058

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-3
Date: October 31, 2007



CONETEC

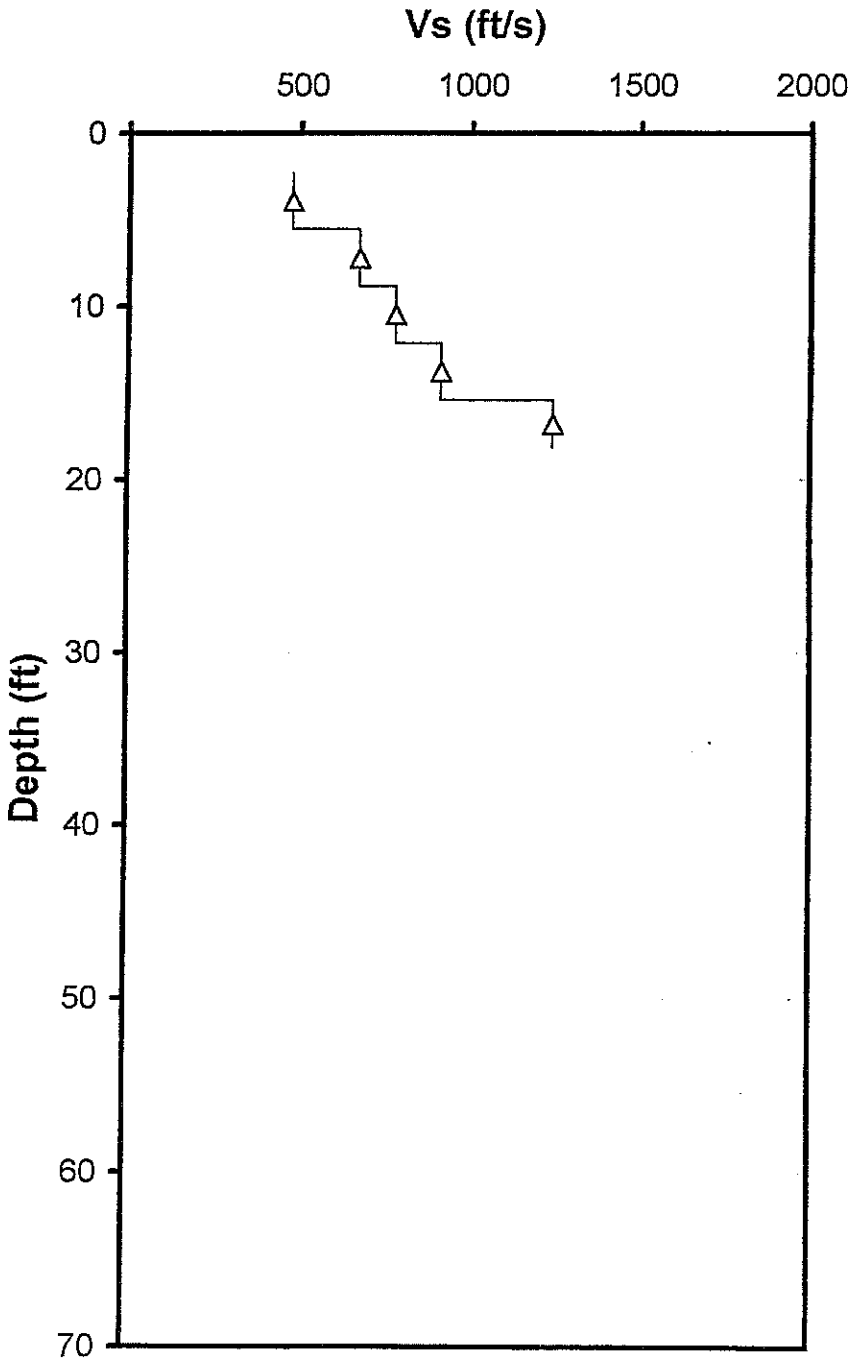
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-4
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
2.95	2.29	2.74				
6.23	5.57	5.77	3.03	6.37	3.93	476
9.51	8.85	8.98	3.21	4.77	7.21	673
12.80	12.14	12.24	3.26	4.17	10.50	781
16.08	15.42	15.50	3.26	3.57	13.78	913
18.86	18.20	18.27	2.77	2.23	16.81	1242

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-4
Date: October 31, 2007



CONETEC

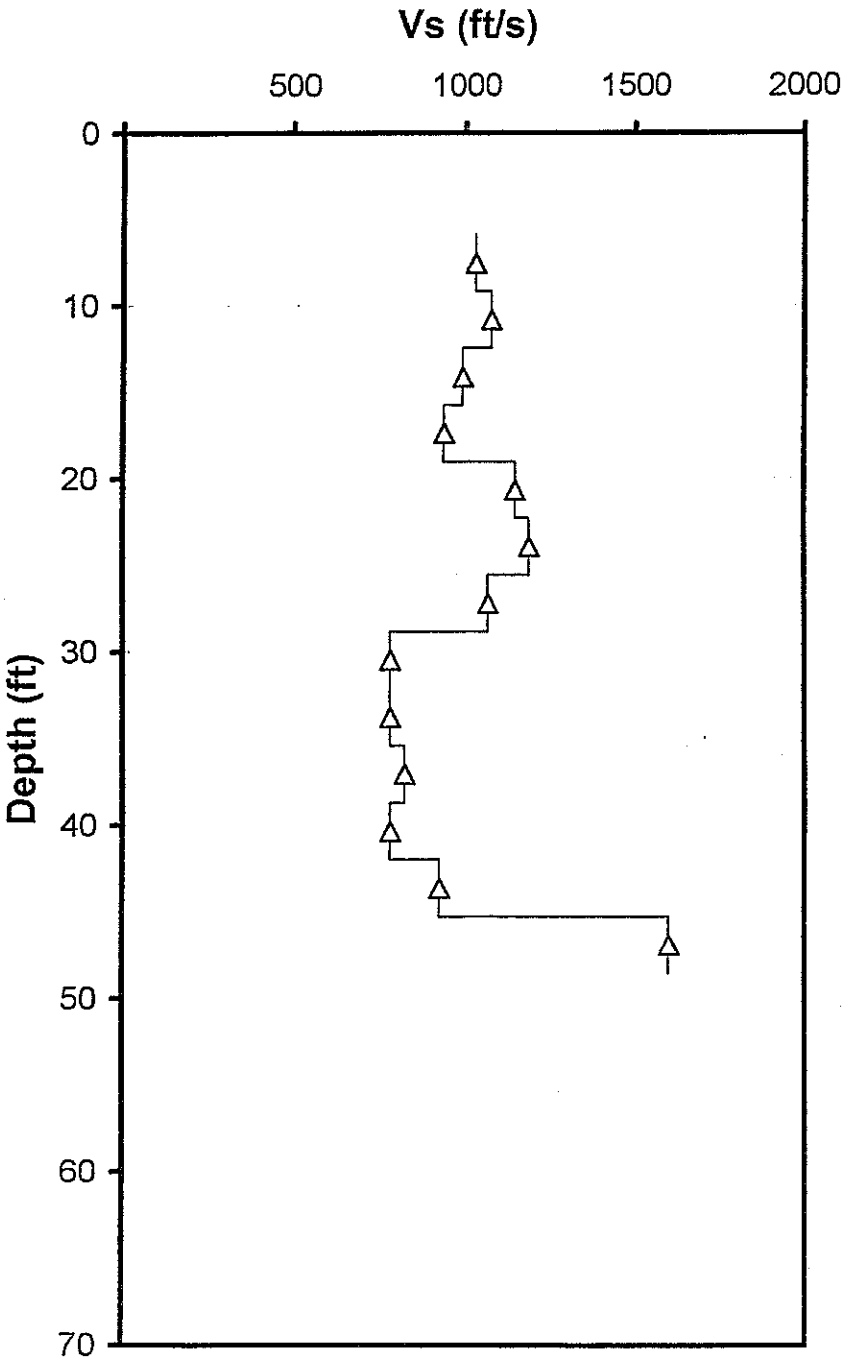
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-5
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	3.12	7.54	1030
13.12	12.46	12.55	3.25	3.02	10.82	1076
16.40	15.74	15.82	3.26	3.29	14.10	991
19.69	19.03	19.09	3.28	3.50	17.39	936
22.97	22.31	22.36	3.27	2.85	20.67	1148
26.25	25.59	25.64	3.27	2.75	23.95	1190
29.53	28.87	28.91	3.28	3.07	27.23	1067
32.81	32.15	32.19	3.28	4.20	30.51	780
36.09	35.43	35.47	3.28	4.20	33.79	780
39.37	38.71	38.74	3.28	3.99	37.07	821
42.65	41.99	42.02	3.28	4.20	40.35	780
45.93	45.27	45.30	3.28	3.55	43.63	923
49.21	48.55	48.58	3.28	2.05	46.91	1599

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-5
Date: October 30, 2007



CONETEC

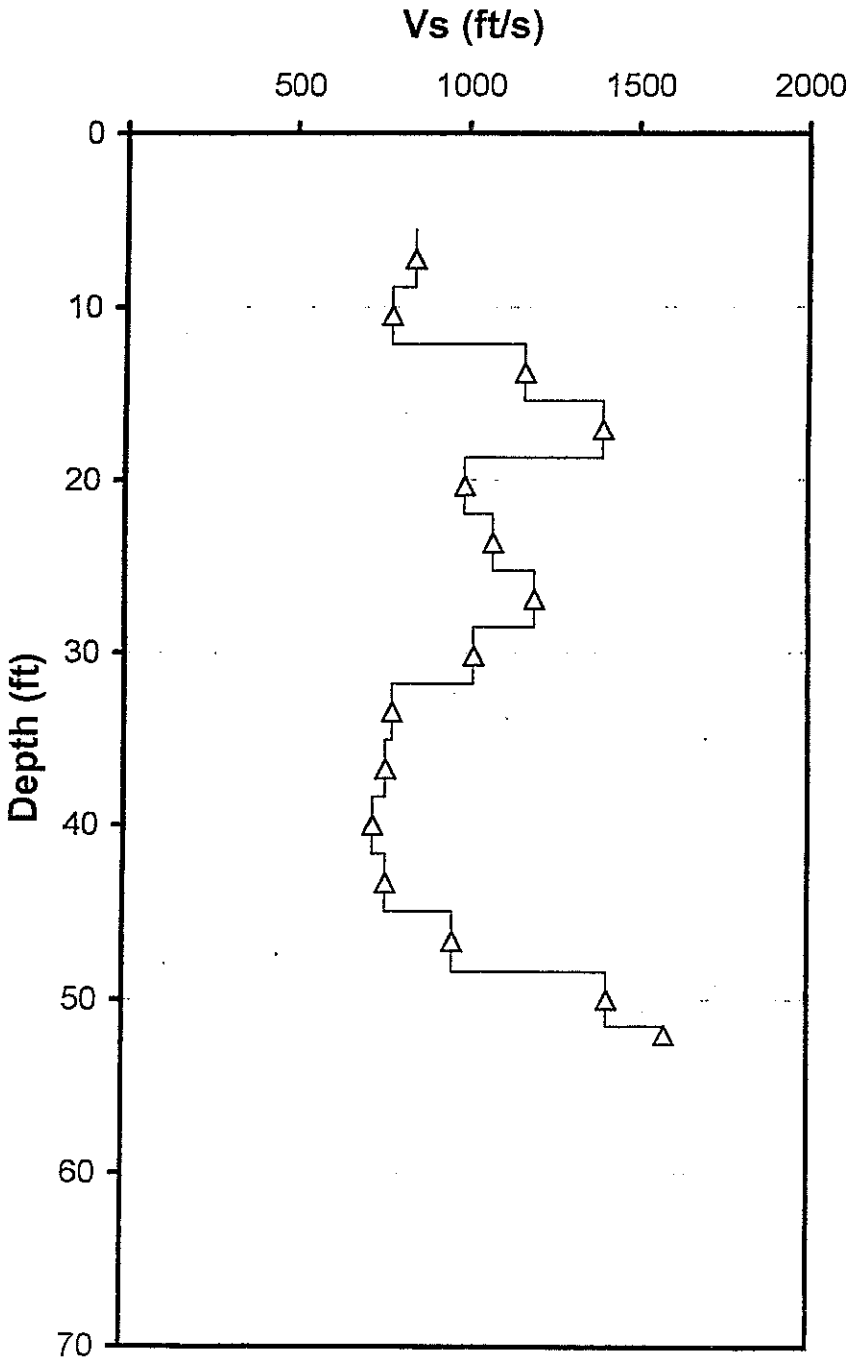
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-5A
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.23	5.57	5.77				
9.51	8.85	8.98	3.21	3.80	7.21	844
12.80	12.14	12.24	3.26	4.18	10.50	779
16.08	15.42	15.50	3.26	2.80	13.78	1164
19.36	18.70	18.76	3.27	2.34	17.06	1396
22.64	21.98	22.03	3.27	3.29	20.34	994
25.92	25.26	25.31	3.27	3.04	23.62	1077
29.20	28.54	28.58	3.27	2.74	26.90	1195
32.48	31.82	31.86	3.28	3.21	30.18	1021
35.76	35.10	35.14	3.28	4.18	33.46	784
39.04	38.38	38.41	3.28	4.29	36.74	764
42.32	41.66	41.69	3.28	4.50	40.02	728
45.60	44.94	44.97	3.28	4.27	43.30	768
49.05	48.39	48.42	3.45	3.59	46.67	961
52.17	51.51	51.54	3.12	2.21	49.95	1411
53.15	52.49	52.52	0.98	0.62	52.00	1580

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-5A
Date: October 30, 2007



CONETEC

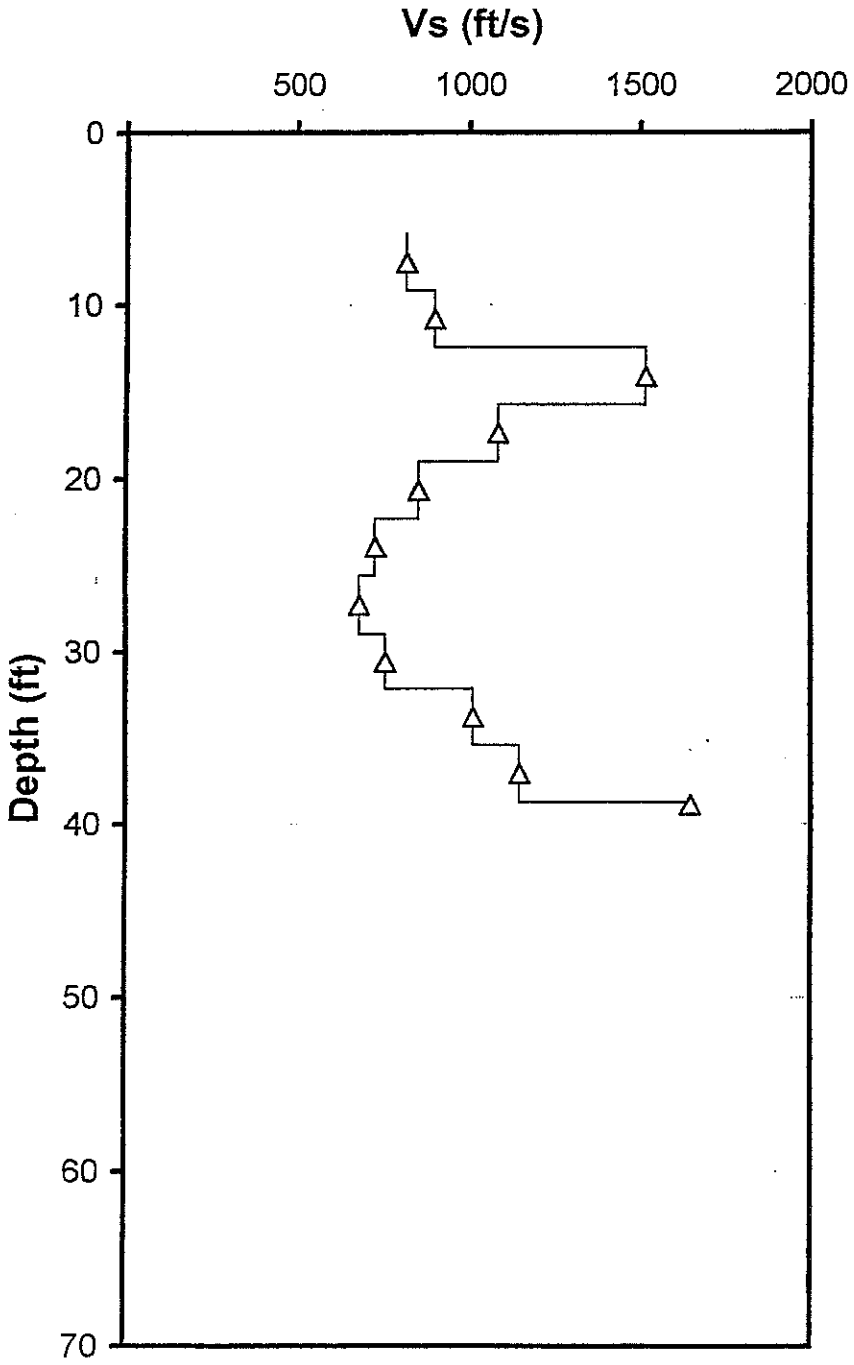
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-5B
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	3.93	7.54	818
13.12	12.46	12.55	3.25	3.61	10.82	900
16.40	15.74	15.82	3.26	2.15	14.10	1517
19.69	19.03	19.09	3.28	3.02	17.39	1085
22.97	22.31	22.36	3.27	3.82	20.67	856
26.25	25.59	25.64	3.27	4.47	23.95	732
29.69	29.03	29.07	3.43	5.01	27.31	686
32.81	32.15	32.19	3.12	4.09	30.59	762
36.09	35.43	35.47	3.28	3.23	33.79	1014
39.37	38.71	38.74	3.28	2.85	37.07	1150
39.70	39.04	39.07	0.33	0.20	38.88	1649

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-5B
Date: October 30, 2007



CONETEC

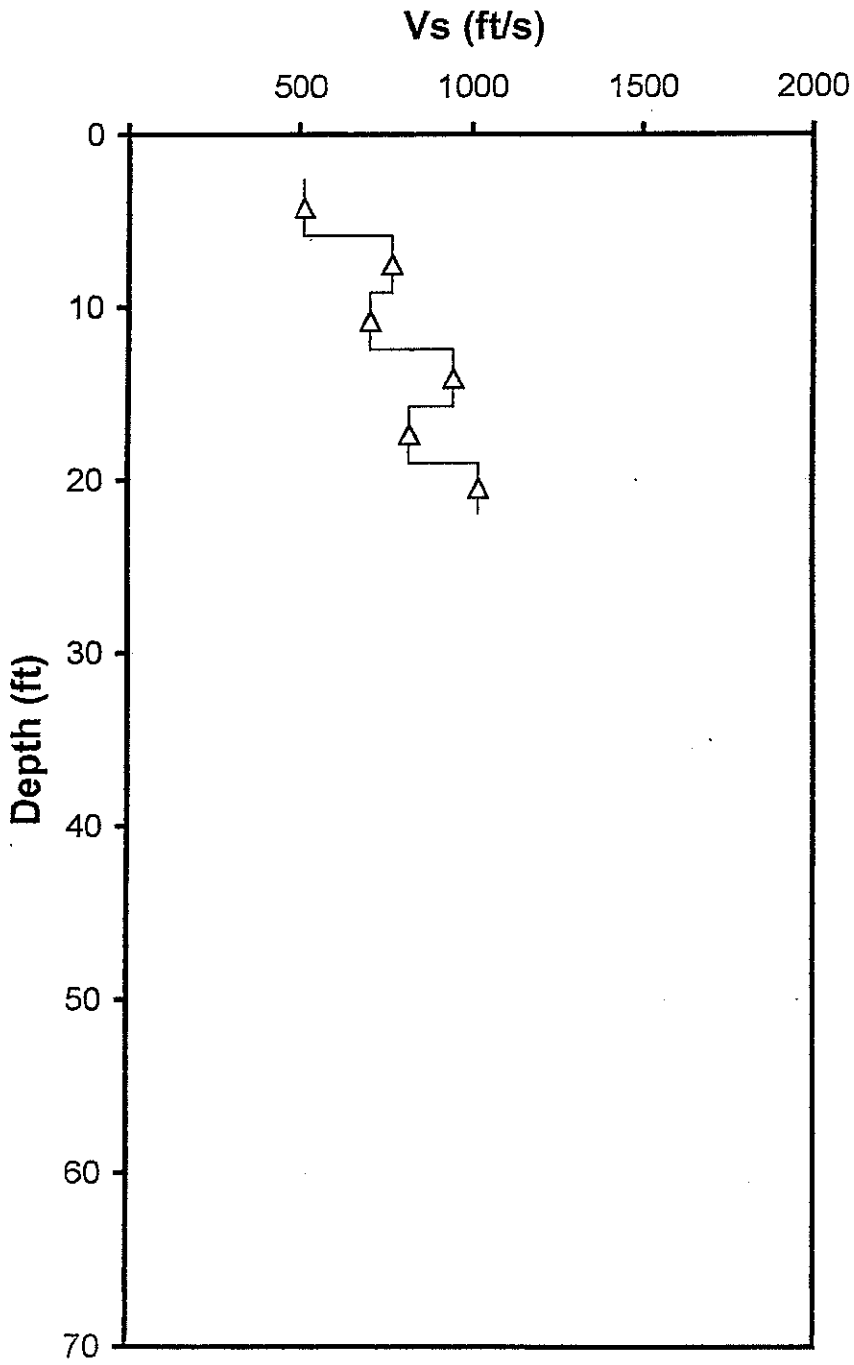
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-6
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	5.97	4.26	514
9.84	9.18	9.31	3.21	4.18	7.54	769
13.12	12.46	12.55	3.25	4.60	10.82	706
16.40	15.74	15.82	3.26	3.45	14.10	945
19.69	19.03	19.09	3.28	4.00	17.39	819
22.64	21.98	22.03	2.94	2.88	20.51	1022

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-6
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-7
Site	Williamson County, Illinois
Date	10/31/2007

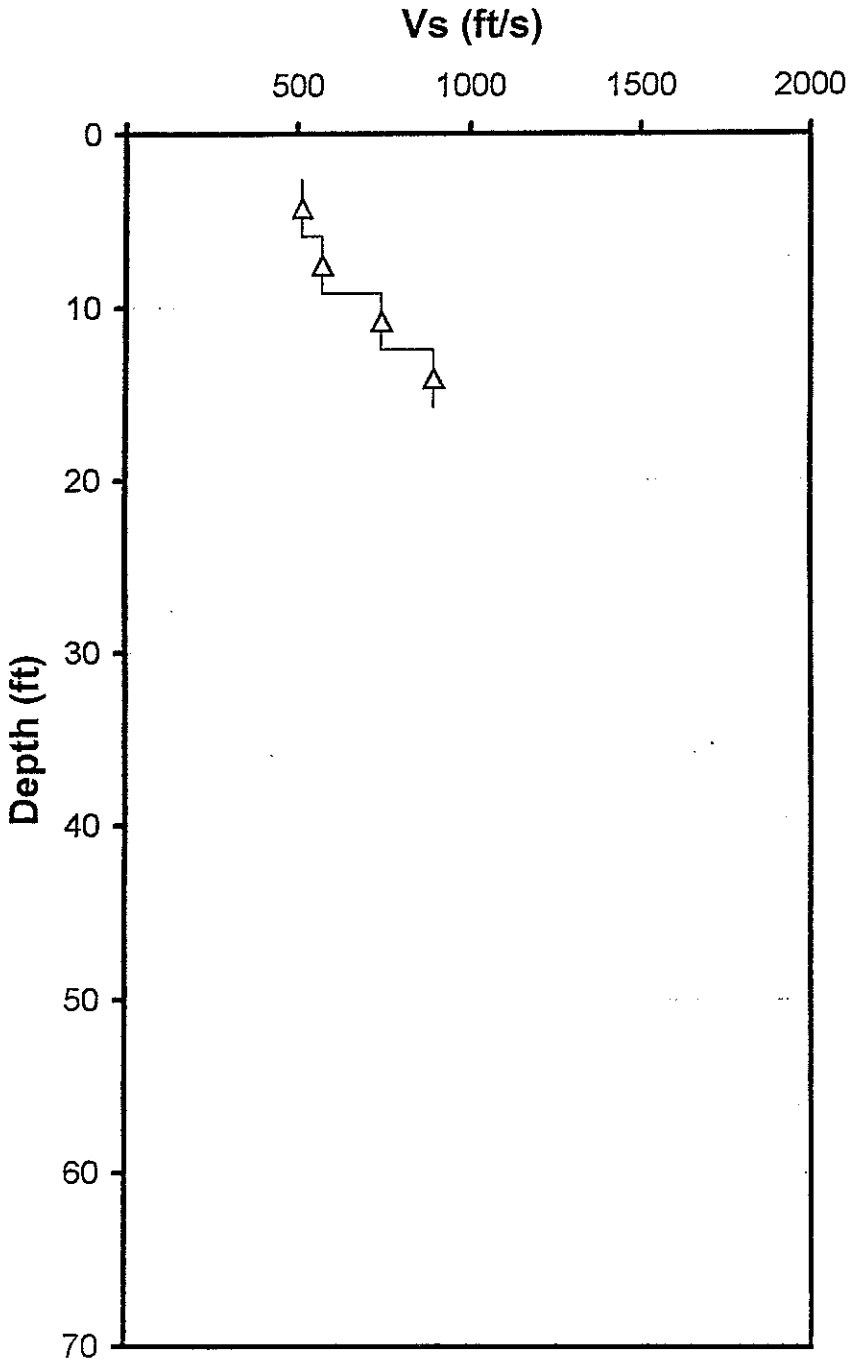
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	5.97	4.26	514
9.84	9.18	9.31	3.21	5.59	7.54	575
13.12	12.46	12.55	3.25	4.36	10.82	745
16.40	15.74	15.82	3.26	3.65	14.10	894

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-7
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-8
Site	Williamson County, Illinois
Date	10/31/2007

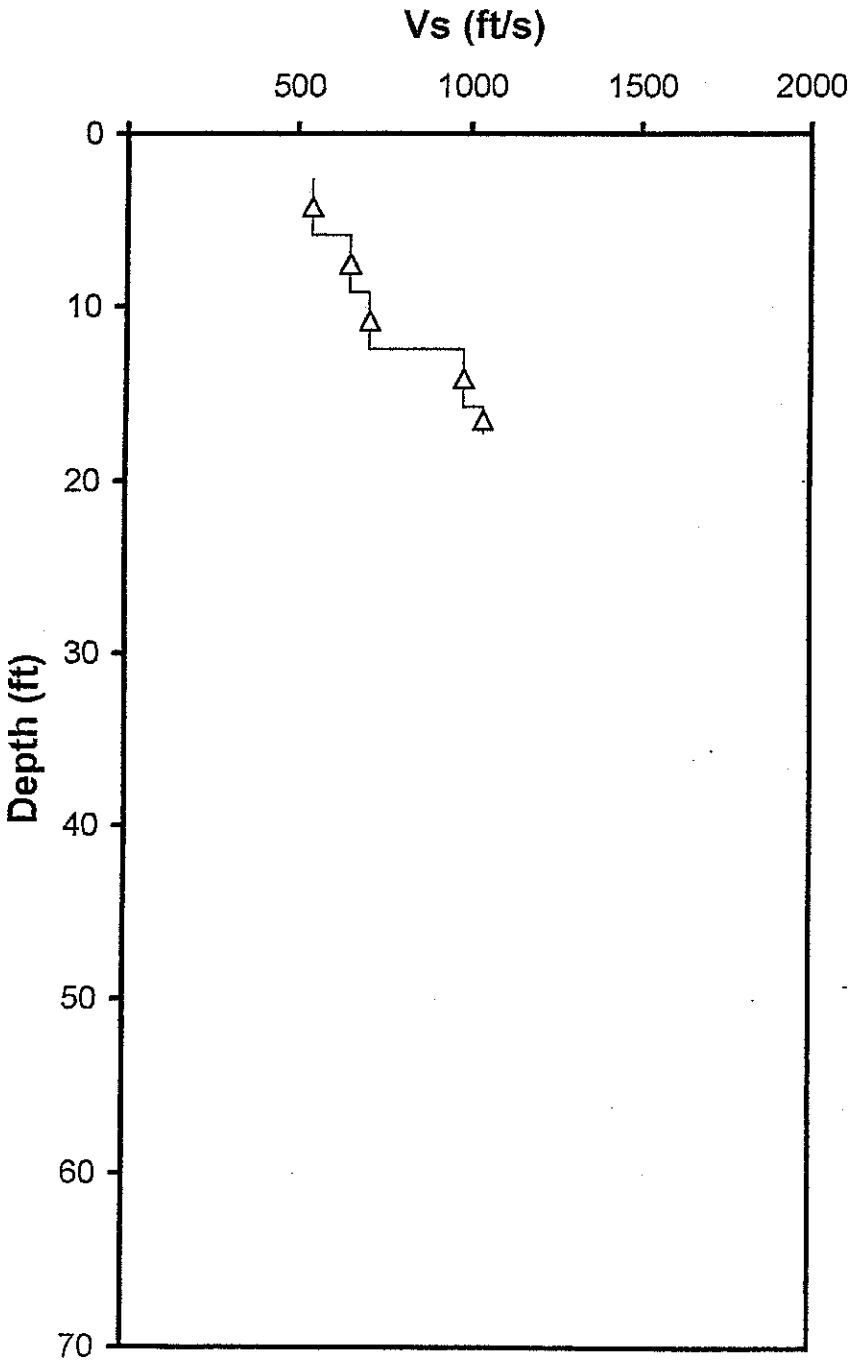
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	5.67	4.26	541
9.84	9.18	9.31	3.21	4.93	7.54	652
13.12	12.46	12.55	3.25	4.59	10.82	708
16.40	15.74	15.82	3.26	3.33	14.10	979
17.88	17.22	17.29	1.47	1.42	16.48	1038

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-8
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-9
Site	Williamson County, Illinois
Date	10/31/2007

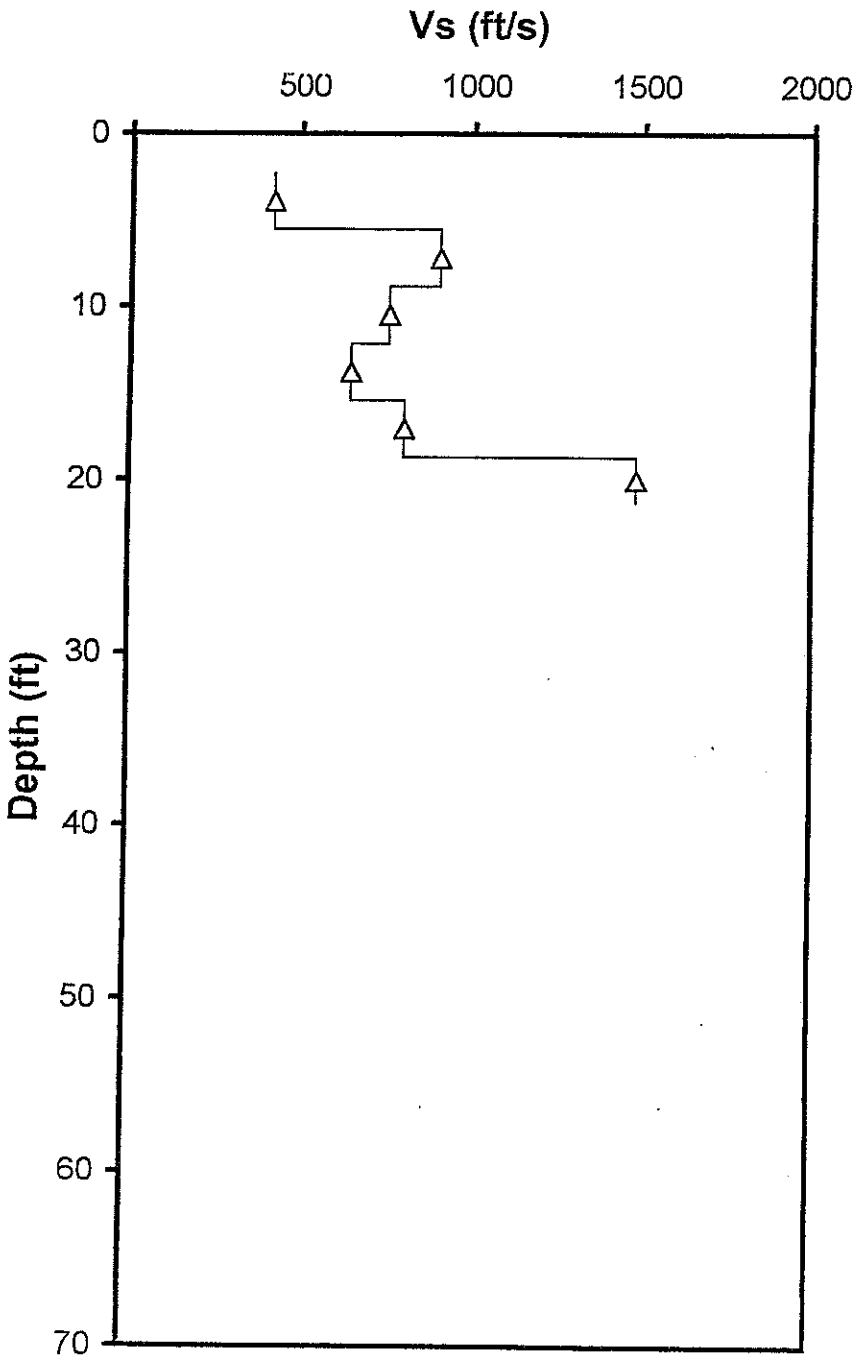
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
2.95	2.29	2.74				
6.23	5.57	5.77	3.03	7.30	3.93	415
9.51	8.85	8.98	3.21	3.55	7.21	904
12.80	12.14	12.24	3.26	4.30	10.50	757
16.08	15.42	15.50	3.26	5.04	13.78	647
19.36	18.70	18.76	3.27	4.06	17.06	805
21.98	21.32	21.38	2.61	1.76	20.01	1484

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-9
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-10
Site	Williamson County, Illinois
Date	10/31/2007

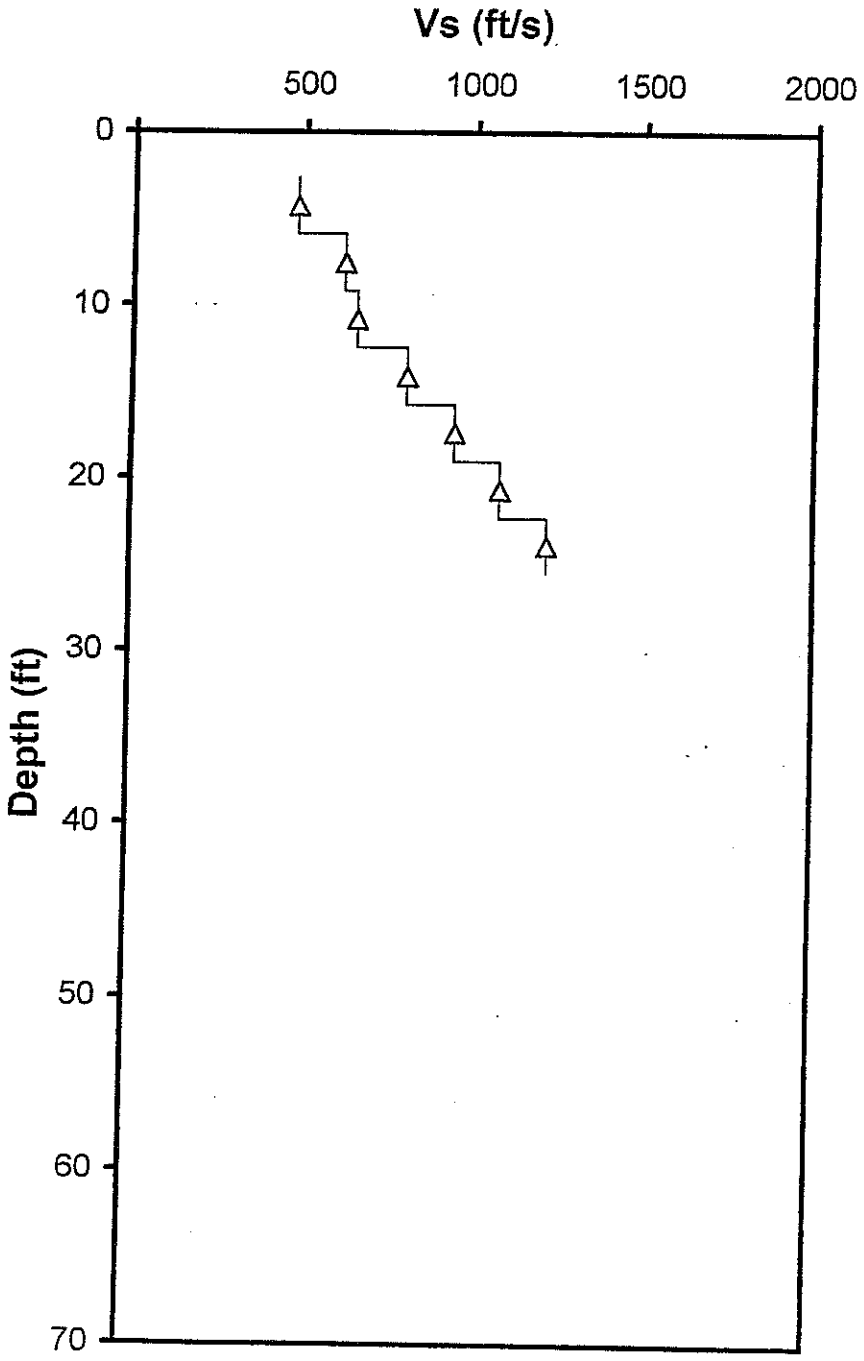
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	6.42	4.26	478
9.84	9.18	9.31	3.21	5.21	7.54	617
13.12	12.46	12.55	3.25	4.95	10.82	656
16.40	15.74	15.82	3.26	4.06	14.10	803
19.69	19.03	19.09	3.28	3.47	17.39	945
22.97	22.31	22.36	3.27	3.03	20.67	1080
26.08	25.42	25.47	3.10	2.55	23.87	1217

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-10
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-11
Site	Williamson County, Illinois
Date	10/31/2007

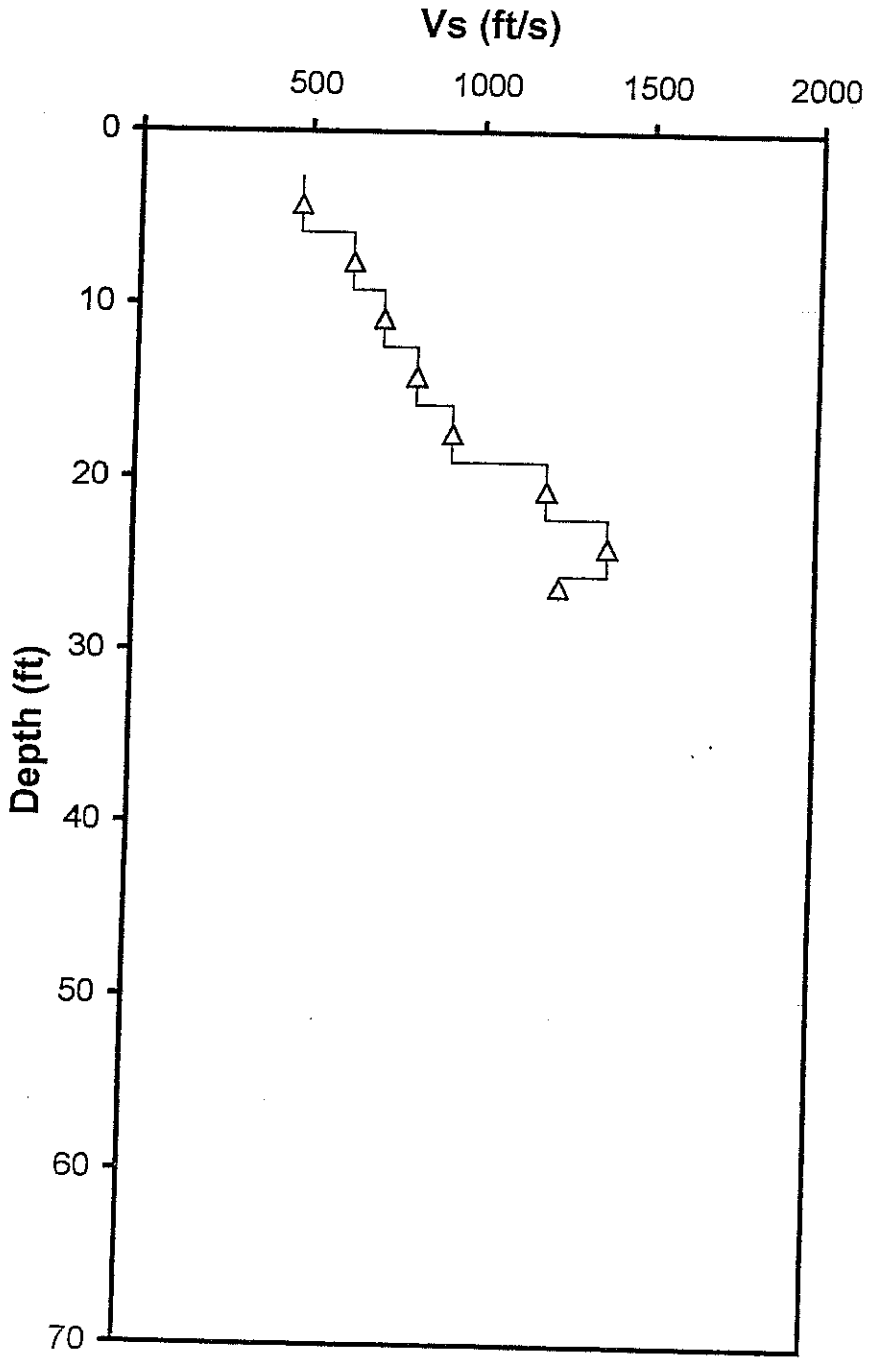
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	6.51	4.26	471
9.84	9.18	9.31	3.21	5.12	7.54	628
13.12	12.46	12.55	3.25	4.52	10.82	719
16.40	15.74	15.82	3.26	3.99	14.10	817
19.69	19.03	19.09	3.28	3.54	17.39	926
22.97	22.31	22.36	3.27	2.71	20.67	1207
26.25	25.59	25.64	3.27	2.36	23.95	1387
27.56	26.90	26.95	1.31	1.05	26.25	1246

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-11
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-12
Site	Williamson County, Illinois
Date	10/31/2007

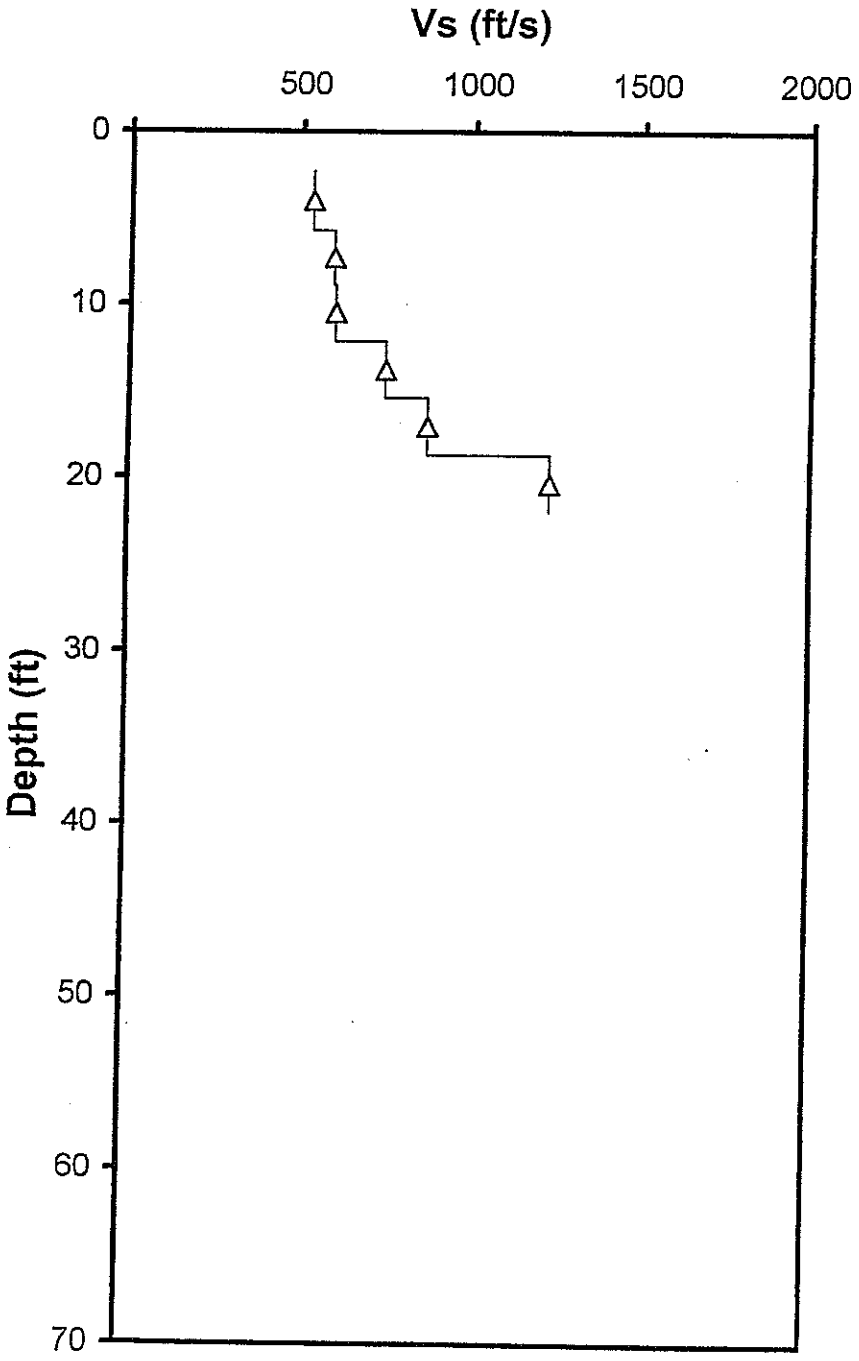
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
2.95	2.29	2.74				
6.40	5.74	5.94	3.20	6.03	4.02	530
9.51	8.85	8.98	3.04	5.11	7.30	596
12.80	12.14	12.24	3.26	5.42	10.50	601
16.08	15.42	15.50	3.26	4.36	13.78	748
19.36	18.70	18.76	3.27	3.75	17.06	871
22.64	21.98	22.03	3.27	2.66	20.34	1230

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-12
Date: October 31, 2007



7225-11
part 14

No Dissipation Tests were performed

ConeTec Digital File Formats

CPT Data Files (COR Extension)

ConeTec CPT data files are named such that the first 3 characters contain the job number, the next two characters are CP followed by two characters indicating the sounding number. The last DOS character position is reserved for the letters a, b, c, d etc to uniquely identify multiple soundings at the same location. The CPT sounding file has the extensions COR, and pore pressure dissipation files have the extension PPD. As an example, for job number 99-127 the first sounding will have file names 127CP01.COR and 127CP01.PPD.

The CPT (COR) file consists of the following components:

1. Two lines of header information
2. Data records
3. End of data marker
4. Units information

Header Lines

Line 1: Columns 1-6 are blank (future use)
Columns 7-21 contain the sounding Date and Time
Columns 22-36 contain the sounding Operator

Line 2: Columns 1-16 contain the Job Location
Columns 17-31 contain the Cone ID
Columns 32-47 contain the sounding number

Data Records

The data records contain 4 or more columns of data in floating point format. A comma (and spaces) separates each data item:

Column 1:	Sounding Depth (meters)
Column 2:	Tip (q_c) data uncorrected for pore pressure effects. Recorded in units selected by the operator.
Column 3:	Sleeve (f_s) data. Recorded in units selected by the operator
Column 4:	Dynamic pore pressure readings. Recorded in units selected by the operator
Column 5:	UVIF Data. See UVIF section.

End of Data Marker

After the last line of data a line containing ASCII 26 (CTL-Z) and a newline (carriage return/ line feed) character. This is used to mark the end of data.

Units Information

The last section of the file contains information about the units that were selected for the sounding. A separator bar makes up the first line. The second line contains the type of units used for depth, q_c, f_s and u. The third line contains the conversion values required for ConeTec's software to convert the recorded data to an internal set of base units (bar for q_c, bar for f_s and meters for u).

CPT Dissipation Files (PPD Extension)

CPT Dissipation files have the same naming convention as the CPT sounding files and have the extension PPD. PPD files consist of the following components:

1. Two lines of header information
2. Data records

Header Lines (same as COR file):

Line 1: Columns 1-6 are blank (future use)
Columns 7-21 contain the sounding Date and Time
Columns 22-36 contain the sounding Operator

Line 2: Columns 1-16 contain the Job Location
Columns 17-31 contain the Cone ID
Columns 32-47 contain the sounding number

Data Records

The data records immediately follow the header lines. Each data record can occupy several lines in the file and is a complete record of a dissipation test at a particular depth. Each data record starts with a line containing two values separated by spaces; the first value being an index number (not currently used by the Software) and the second being the dissipation test depth in meters. Following this line are the dissipation pore pressure values stored at 5 second intervals with a maximum of 12 entries per line. The last line of the dissipation record may not contain a full 12 entries. The data record is terminated with an ASCII 30 character (appears as a triangle in some editors).

This sequence is repeated for every dissipation test in the sounding. No marker is used to indicate end of file. Units information is not stored in this file. Users would have to check the CPT file for the units that were used.

CPT Basic Interpretations (TBL Extension)

ConeTec's basic CPT interpretation output files are generally delivered in text files with a TBL extension. The root file name is the same as the COR files. A number of calculated geotechnical parameters are presented in these files. The files are stored as ASCII text files that can be viewed using any text editor such as Notepad or Wordpad. The files do not contain any page formatting. These files are not distributed if the enhanced interpretation files are provided.

CPT Enhanced Interpretations (NLI, NLP, XLS Extension)

ConeTec's enhanced CPT interpretation output files are delivered in several formats, each file type containing the exact same information but formatted slightly differently. The files typically have any of the following file extensions:

1. NLI an importable TAB delimited ASCII text file containing approximately 36 data columns of geotechnical interpretations. The file is designed for easy import to Excel. A companion document describes the techniques used for the interpretations (usually reproduced at the beginning of the Interpretation Appendix). Text editors can be used to view the file contents, however, they may remove the tabs or replace the tabs with spaces upon saving the file destroying the feature that makes them easy to import into Excel.

2. NLP a printable ASCII text file containing the same 36 columns of geotechnical interpretations as the NLI file. This file type has been formatted as a multi-page document with up to 132 characters per line and up to 68 lines per page. Each page has been separated into multiple sections to accommodate all the data fields. Each physical page has a header section and a page/section number. The file is designed for direct printing to laser printers set into compressed font mode. This output is typically provided in the Interpretation Appendix.

3. XLS an Excel format file that has been generated directly from the corresponding NLI file.

In each case root file name is the same as the COR files.

APPENDIX A-3

NORMALIZED PS-CPT DATA AND PARAMETER CORRELATIONS

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 1 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

CALCULATION BRIEF FOR NORMALIZED PS-CPT DATA AND PARAMETER CORRELATIONS

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE:

Use data recorded during the piezo-seismic cone penetration testing (PS-CPT) at the Williamson Energy, Pond Creek Coal Refuse Disposal facility located in Williamson County, Illinois to correlate various index and strength properties. Also, nearly continuous profiles with depth of various applicable engineering properties of the refuse and subgrade soil materials in the fifteen (15) soundings tested at the Pond Creek facility are tabulated and attached.

REFERENCES:

1. Bowles, Joseph E. (1984) "Physical and Geotechnical Properties of Soils," Mc-Graw Hill. New York: 367-369 and 393-396.

2. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Piezo-Cone Penetration Testing," Pond Creek Coal Refuse Disposal Site, BEG, dated 12/21/07.

3. ConeTec, Inc. (2007), Field Report Entitled "Presentation of CPTU Test Results for: Pond Creek Mine – Williamson County, Illinois, December 10, 2007.

4. Robertson, P.K (1998), "Applications Guide – CPT" **Fax**

5. Robertson, P.K., et.al. (1992) "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE 109 (11): 1449-1459.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 2 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

6. Robertson, P.K and Campanella, R.G, (1989), "Guidelines for Geotechnical Design Using CPT and CPTU", UBC Soil Mechanics Series No. 120, Civil Eng. Dept., Vancouver, B.C., Canada

7. Robertson, P.K and Campanella, R.G, (1983), "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE Vol. 109 No. 11, pp. 1449-1459.

8. Civil and Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak Undrained Shear Strength for Refuse and Subgrade Materials," Pond Creek Coal Refusal Site, BEG 12/28/07.

METHODOLOGY:

Using laboratory-derived unit weights for the coarse coal refuse and residual soil layers, provided by Alliance Consulting, Inc. (Alliance), the following parameters are correlated based on established CPT correlations (References 2, 3, 4, 5, 6 and 7) and the data collected during the Pond Creek Piezo-Seismic Cone Penetration Testing subsurface investigation (Ref. 2):

- Total stress (σ_v)
- Effective stress (σ_{vo}')
- Pore pressure (U_{eq})
- SPT N_{60} correction factor (C_n)
- SPT blow counts at 60% energy (N_{60})
- N_{60} corrected for overburden ($(N_1)_{60}$)
- Corrected tip resistance (q_c)
- Fines content (F_c)
- Effective friction angle (ϕ)
- Soil Behavior Index (I_c)

Undrained shear strength (S_u) was also correlated, and is discussed separately in the calculation brief entitled Estimation and Summary of Engineering Properties Including Peak Undrained Shear Strength for Refuse and Subgrade Materials," (Reference 8).

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 3 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

ANALYSIS:

ConeTec, Inc. (ConeTec) performed the PS-CPT and correlated the above noted parameters based on various unit weights that were correlated directly from the Soil Behavior Type (SBT) (Robertson and Campanella, 1989). The unit weights used by ConeTec were based on data interpolation and thus require modification to reflect the laboratory derived unit weights of the coarse refuse and residual soil, which were provided by Alliance. Therefore, laboratory-derived unit weight for each of the layers was used to correlate the applicable parameters, particularly total and effective stresses, which are used throughout the calculations.

PSCPT correlations were based on much of the work described by Robertson and Campanella (1998, 1992, 1989, 1988, 1983). During field testing, ConeTec measured four parameters insitu, which were not correlated. They include the recorded tip resistance (AvgQt), the recorded side friction (AvgFs), the recorded friction ratio (AvgRf) and the pore pressure generated by the CPT probe (AvgUd), all of which were used in subsequent correlations. The soil behavior type (SBT) was also determined by the ConeTec, and was based on observations and readings of the four parameters just listed.

The following paragraphs briefly describe the parameters as well as providing a definition of the parameter and any additional calculations needed: Total stress and effective stress are both used in many of the correlations, and are related to each other by the presence of water in the form of pore water pressure. Total stress was defined as:

$$\sigma_v = (\gamma * H) / 2000 \text{ (lb/ton)}$$

where: σ_v = total stress (tsf)
γ = unit weight (pcf)
H = depth of the sample (ft)

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 4 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

Pore pressure is defined as:

$$U_{eq} = (\gamma_w * H) / 2000 \text{ (lb/ton)}$$

where: U_{eq} = pore pressure (tsf)
γ_w = unit weight of water (pcf)
= 62.5 pcf
H = depth of the sample (ft)

The difference between the two determines the effective stress:

$$\sigma_{vo}' = \sigma_v - U_{eq}$$

where: U_{eq} = pore pressure (tsf)
σ_v = total stress (tsf)

The PS-CPT sampler correlated the number of blows per foot, without the overburden correction, to the tip resistance measured as the probe was advanced. This gave measurements of N_{60} every 0.2 meters. Corrected for overburden, the measured tip resistance was then calculated:

$$q_c = \text{AvgQt} - (1 - 0.85) * U$$

where: AvgQt = measured tip resistance (tsf)
0.85 = area ratio of the PS-CPT probe
U = measured pore pressure (tsf)

This corrected tip resistance (q_c) was used along with the soil behavior type index (Ic) and atmospheric pressure to give the recorded N_{60} value by the equation:

$$N_{60} = (q_c / Pa) / 8.5 * (1 - (Ic / 4.6))$$

where: q_c = corrected tip resistance (tsf)
Pa = atmospheric pressure (tsf)
= 1.058 tsf
Ic = soil behavior type index (dim)

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 5 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

and: $Ic = ((3.47 - Log_{10}(Q))^2 + (Log_{10}(F) + 1.22)^2)^{0.5}$

where: Q = normalized cone penetration resistance (dim)
F = normalized friction ratio (pct)

and: $Q = (q_c - \sigma_v) / \sigma_{vo}'$

where: q_c = corrected tip resistance (tsf)
σ_v = total stress = (γ * H) / 2000(lb/ton) (tsf)
σ_{vo}' = vertical effective overburden (tsf)

and: $F = 100\% * AvgFs / (q_c - \sigma_{vo}')$

where: AvgFs= recorded side friction (tsf)
q_c = corrected tip resistance (tsf)
σ_{vo}' = vertical effective overburden (tsf)

Once N_{60} and σ_{vo}' had been calculated, a correction factor (Cn) was applied to N_{60} to give $(N_1)_{60}$:

$(N_1)_{60} = N_{60} * Cn$

where N_{60} = Number of blows/foot to advance 1.5 feet
Cn = $(\sigma_{vo}')^{-0.5}$ (dim)

Using tip resistance, corrected for overburden, and effective overburden the effective friction of the material in the Pond Creek facility could be calculated (Robertson, 1989). This was done using the following calculation:

$$\phi' = \tan^{-1}[(1/2.68) * (Log_{10}(q_c / \sigma_{vo}') + 0.29)]$$

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 6 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

where: q_c = corrected tip resistance (tsf)
σ_{vo}' = effective vertical stress (tsf)

Similarly, the fines content was correlated from PS-CPT data but was not used in any further analysis. The fines content was correlated using the soil behavior type index, I_c, as defined above. To determine the fines content of the material, the following relationship was used:

$$F_c = (1.75 * I_c^{3.25} - 3.7)$$

where: F_c = fines content (%)
I_c = soil behavior type index (dim)

RESULTS:

The results of the correlations between PS-CPT data recorded during field testing yield a profile of geotechnical parameters at the 15 sounding locations tested at the Pond Creek facility. Effective and total stresses provide an indication of the stresses being experienced insitu, and generally will increase as material is placed on top of the existing materials to the lines and grades of the proposed final geometry.

In-situ effective friction values were correlated using in-situ corrected tip resistance and effective overburden pressures for the 15 soundings tested at the Pond Creek facility.

CONCLUSIONS:

Summarizing, data recorded during PS-CPT field testing was used to correlate index and strength parameters for comparison to limited laboratory testing at discrete sample locations and to develop nearly continuous profile(s) of engineering properties with depth to model the variability of the insitu conditions at the Pond Creek facility.

Based on modified results, the correlated parameters from PS-CPT are generally consistent with each other and similar parameters determined from similar materials at other refuse facilities, and from laboratory testing of discrete samples. Therefore, in general, a reasonably high confidence level exists applying/using the results of the PS-CPT correlations to the 15 profiles shown in the attached tables.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 7 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-1

ConeTec Inc. Interpretation
Interpretation Release 1.22 Rev. Format: NLI Imperial
Run No. 07-1210-1008-4622
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-1
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 13:23
CPT File: 804CP01.COR
Northing (m): 0.000000
Easting (m): 0.000000
Elevation (m): 482.2

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	41.95	2.43	78.91	26.81	2.38

User Inputs:
Assumed: Water Table Depth (ft): 15.3
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 482.2
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.026	16.61	0.44	2.66	0.11	1619.49	2.651	1.66	1619.49	2.65	5	125.00	0.010	0.010	0.000	2.000	2.89	5.79	0.514	16.61	5.45572	52.56
0.492	481.698	45.67	1.03	2.25	4.37	1484.2	2.257	1.60	1483.55	2.26	6	125.00	0.031	0.031	0.000	2.000	7.79	15.57	1.413	45.65	4.391	52.25
0.82	481.370	44.31	1.6	3.61	-3.26	863.585	3.615	1.86	863.98	3.61	5	125.00	0.051	0.051	0.000	2.000	8.26	16.52	1.370	44.33	9.36475	50.29
1.148	481.042	49.34	1.93	3.91	-6.42	686.666	3.917	1.92	687.22	3.91	5	125.00	0.072	0.072	0.000	2.000	9.42	18.84	1.525	49.38	10.8792	49.41
1.476	480.714	50.64	2.12	4.19	-7.64	547.943	4.194	1.98	548.49	4.19	5	125.00	0.092	0.092	0.000	2.000	9.90	19.80	1.565	50.69	12.4636	48.51
1.804	480.386	45.45	2.14	4.71	-0.65	402.104	4.720	2.08	402.10	4.72	4	125.00	0.113	0.113	0.000	2.000	9.23	18.46	1.404	45.45	15.2837	47.21
2.133	480.057	40.4	1.81	4.48	3.83	302.047	4.495	2.12	301.82	4.50	4	125.00	0.133	0.133	0.000	2.000	8.32	16.64	1.247	40.37	16.3803	45.96
2.461	479.729	34.96	1.32	3.76	8.22	226.29	3.792	2.12	225.96	3.80	5	125.00	0.154	0.154	0.000	2.000	7.19	14.38	1.078	34.91	16.3424	44.63
2.789	479.401	31.18	1.1	3.52	11.83	177.874	3.548	2.15	177.47	3.56	5	125.00	0.174	0.174	0.000	2.000	6.50	12.99	0.960	31.11	17.3915	43.48
3.117	479.073	29.29	1.15	3.92	14.97	149.35	3.953	2.23	148.89	3.96	5	125.00	0.195	0.195	0.000	2.000	6.31	12.62	0.901	29.2	20.1364	42.62
3.445	478.745	29.06	1.09	3.74	29.44	133.967	3.779	2.25	133.13	3.80	5	125.00	0.215	0.215	0.000	2.000	6.28	12.55	0.893	28.88	20.6255	42.05
3.773	478.417	32.91	1.15	3.49	32.84	138.56	3.520	2.21	137.67	3.54	5	125.00	0.236	0.236	0.000	2.000	7.01	14.02	1.012	32.7	19.4713	42.22
4.101	478.089	34.84	1.39	4	29.66	134.928	4.019	2.27	134.19	4.04	5	125.00	0.256	0.256	0.000	1.975	7.59	15.00	1.071	34.65	21.3078	42.09
4.429	477.761	35.38	1.49	4.22	29.72	126.812	4.245	2.30	126.16	4.27	4	125.00	0.277	0.277	0.000	1.901	7.83	14.88	1.087	35.2	22.5787	41.78
4.757	477.433	34.51	1.53	4.44	31.68	115.073	4.472	2.35	114.40	4.50	4	125.00	0.297	0.297	0.000	1.834	7.78	14.27	1.059	34.31	24.2407	41.27
5.085	477.105	32.05	1.52	4.75	32.73	99.8456	4.790	2.41	99.18	4.82	4	125.00	0.318	0.318	0.000	1.774	7.42	13.17	0.982	31.84	26.6972	40.52
5.413	476.777	33.07	1.53	4.62	33.65	96.7499	4.674	2.41	96.13	4.70	4	125.00	0.338	0.338	0.000	1.719	7.66	13.17	1.013	32.86	26.6937	40.36
5.741	476.449	28.11	1.63	5.81	25.35	77.3418	5.874	2.54	76.90	5.91	3	125.00	0.359	0.359	0.000	1.669	6.95	11.61	0.859	27.95	32.7178	39.15
6.069	476.121	23.82	1.72	7.24	8.62	61.7978	7.338	2.66	61.67	7.35	3	125.00	0.379	0.379	0.000	1.624	6.33	10.27	0.726	23.77	39.3343	37.91
6.398	475.792	23.35	1.75	7.49	4.73	57.3932	7.625	2.71	57.32	7.64	3	125.00	0.400	0.400	0.000	1.581	6.31	9.98	0.711	23.32	41.0639	37.49
6.726	475.464	25.01	1.76	7.04	4.71	58.4945	7.157	2.68	58.42	7.17	3	125.00	0.420	0.420	0.000	1.542	6.67	10.29	0.761	24.98	39.6542	37.60
7.054	475.136	26.32	1.96	7.47	4.23	58.6995	7.574	2.70	58.63	7.58	3	125.00	0.441	0.441	0.000	1.506	7.09	10.67	0.801	26.29	40.6073	37.62
7.382	474.808	26.5	1.77	6.7	3.32	56.437	6.798	2.68	56.39	6.80	3	125.00	0.461	0.461	0.000	1.472	7.04	10.37	0.806	26.48	39.2566	37.40
7.71	474.480	22.44	1.48	6.61	3	45.5681	6.740	2.74	45.53	6.75	3	125.00	0.482	0.482	0.000	1.441	6.15	8.86	0.680	22.42	42.3496	36.15
8.038	474.152	24.71	1.6	6.49	3.7	48.1864	6.609	2.71	48.15	6.61	3	125.00	0.502	0.502	0.000	1.411	6.69	9.44	0.749	24.69	41.1319	36.48
8.366	473.824	35.83	2.03	5.68	4.8	67.525	5.750	2.57	67.47	5.75	3	125.00	0.523	0.523	0.000	1.383	9.02	12.48	1.093	35.8	33.9863	38.42
8.694	473.496	39.18	2.59	6.61	3.46	71.1049	6.703	2.61	71.07	6.71	3	125.00	0.543	0.543	0.000	1.357	10.06	13.64	1.196	39.16	35.8018	38.71
9.022	473.168	64.62	3.1	4.8	6.26	113.6	4.840	2.37	113.53	4.84	11	125.00	0.564	0.564	0.000	1.332	14.83	19.75	1.983	64.58	25.3247	41.23
9.35	472.840	86.36	5.07	5.87	3.14	146.765	5.911	2.38	146.73	5.91	11	125.00	0.584	0.584	0.000	1.308	19.89	26.02	2.665	86.33	25.6191	42.54
9.678	472.512	73.23	5.54	7.56	-2.24	120.066	7.628	2.52	120.08	7.63	11	125.00	0.605	0.605	0.000	1.286	18.01	23.16	2.248	73.24	31.6127	41.52
10.006	472.184	46.41	4.03	8.68	-9.82	73.2115	8.802	2.69	73.31	8.79	0	126.00	0.625	0.625	0.000	1.265	12.47	15.77	1.417	46.47	40.1446	38.88
10.335	471.855	39.89	2.66	6.66	-11.18	60.7552	6.778	2.65	60.86	6.77	3	125.00	0.646	0.646	0.000	1.244	10.50	13.07	1.215	39.96	38.0706	37.83
10.663	471.527	54.17	2.97	5.48	-11.18	80.2829	5.551	2.51	80.39	5.54	3	125.00	0.666	0.666	0.000	1.225	13.28	16.26	1.656	54.24	31.1774	39.39
10.991	471.199	62.34	4.01	6.44	-10.85	89.7506	6.504	2.54	89.85	6.50	11	125.00	0.687	0.687	0.000	1.207	15.46	18.65	1.909	62.41	32.3205	39.99
11.319	470.871	75.65	4.58	6.06	-9.15	105.935	6.111	2.47	106.01	6.11	11	125.00	0.707	0.707	0.000	1.189	18.19	21.63	2.320	75.7	29.4445	40.87
11.647	470.543	96	6.72	7	-6.93	130.879	7.053	2.47	130.93	7.05	11	125.00	0.728	0.728	0.000	1.172	23.07	27.04	2.950	96.04	29.4226	41.97
11.975	470.215	83.38	6.59	7.9	-7.87	110.405	7.975	2.56	110.47	7.97	11	125.00	0.748	0.748	0.000	1.156	20.88	24.13	2.558	83.43	33.2785	41.09
12.303	469.887	57.02	4.42	7.74	-9.36	73.1543	7.858	2.66	73.23	7.85	3	125.00	0.769	0.769	0.000	1.140	15.01	17.11	1.742	57.08	38.1113	38.88
12.631	469.559	67.48	3.97	5.89	-6.63	84.4766	5.953	2.52	84.53	5.95	11	125.00	0.789	0.789	0.000	1.125	16.61	18.70	2.065	67.52	31.6601	39.66
12.959	469.231	79.63	5.29	6.64	-4.3	97.3162	6.711	2.53	97.36	6.71	11	125.00	0.810	0.810	0.000	1.111	19.65	21.83	2.440	79.66	31.8895	40.42
13.287	468.903	74.37	5.39	7.24	-3.35	88.5552	7.329	2.58	88.58	7.33	11	125.00	0.830	0.830	0.000	1.097	18.86	20.68	2.277	74.39	34.4742	39.92
13.615	468.575	71.75	5.08	7.08	-2.33	83.3188	7.165	2.59	83.34	7.16	11	125.00	0.851	0.851	0.000	1.084	18.25	19.79	2.195	71.77	34.8502	39.59
13.943	468.247	102.33	5.18	5.06	-0.78	116.427	5.106	2.38	116.44	5.11	11	125.00	0.871	0.871	0.000	1.071	23.62	25.31	3.141	102.34	25.8028	41.36
14.271	467.919	114.91	6.8	5.91	2.36	127.832	5.964	2.42	127.81	5.97	11	125.00	0.892	0.892	0.000	1.059	26.91	28.49	3.530	114.89	27.1057	41.84
14.6	467.590	134.53	9.49	7.06	8.8	146.43	7.102	2.45	146.36	7.11	11	125.00	0.913	0.913	0.000	1.047	31.95	33.45	4.137	134.47	28.4187	42.53
14.928	467.262	140.8	8.87	6.3	10.72	149.911	6.342	2.40	149.84	6.34	11	125.00	0.933	0.933	0.000	1.035	32.73	33.88	4.330	140.73	26.4588	42.65
15.256	466.934	130.39	7.43	5.7	2.1	135.749	5.740	2.39	135.74	5.74	11	125.00	0.954	0.954	0.000	1.024	30.14	30.87	4.007	130.38	25.9423	42.15

R13246

Depth (ft)	Sa (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.606	108.6	7.14	6.56	-4.18	111.721	6.622	2.49	111.74	6.62	11	135.00	0.974	0.965	0.009	1.018	26.34	26.81	3.338	108.82	30.1191	41.15
15.912	466.278	78.99	5.55	7.03	-5.77	79.8262	7.116	2.60	79.86	7.11	11	135.00	0.996	0.977	0.019	1.012	20.18	20.42	2.415	79.02	35.2737	39.35
16.24	465.950	119.1	5.81	4.88	-0.48	119.401	4.920	2.37	119.40	4.92	11	135.00	1.018	0.989	0.029	1.006	27.25	27.41	3.656	119.1	25.0315	41.50
16.568	465.622	148.8	8.34	5.6	-1.5	147.633	5.644	2.36	147.64	5.64	11	135.00	1.040	1.001	0.040	1.000	34.00	33.98	4.575	148.81	24.89	42.58
16.896	465.294	185.21	10.35	5.59	7.64	181.826	5.620	2.31	181.78	5.62	11	135.00	1.063	1.013	0.050	0.994	41.38	41.12	5.701	185.16	22.9713	43.60
17.224	464.966	333.69	12.91	3.87	16.63	324.597	3.881	2.05	324.50	3.88	12	135.00	1.085	1.025	0.060	0.988	66.82	66.01	10.297	333.59	14.2684	46.28
17.552	464.638	421.41	14.07	3.34	22.43	405.472	3.348	1.95	405.34	3.35	12	135.00	1.107	1.037	0.070	0.982	81.17	79.72	13.012	421.27	11.5386	47.25
17.88	464.310	395.49	15.59	3.94	0.37	376.125	3.953	2.03	376.12	3.95	12	135.00	1.129	1.048	0.080	0.977	78.54	76.70	12.209	395.49	13.6425	46.93

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R13247

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 10 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-2

ConeTec Inc. erpretation
Interpretation C. Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4589
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-2
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 13:46
CPT File: 804CP02.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 494.21

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.31	1.83	53.64	24.15	2.90
125	Residual Soil	27.01	1.39	47.18	59.75	2.99

User Inputs:
Water Table Depth (ft): 38.8
Ground Surface Elev. 494.2
Assumed: Nk: 32.3
State Parameter: 1.2
CPT area ratio: 0.85
Unit Weight of Soil (pcf): Varies See Below
See Below
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	494.046	4.44	0.09	1.92	0.14	416.51	2.032	1.75	415.51	2.03	4	130.00	0.011	0.011	0.000	2.000	0.80	1.59	0.137	4.44	7.06955	47.35
0.492	493.718	15.27	0.31	2	0	476.486	2.034	1.72	476.49	2.03	5	130.00	0.032	0.032	0.000	2.000	2.71	5.42	0.472	15.27	6.5252	47.93
0.82	493.390	32.2	0.81	2.51	0.41	603.128	2.520	1.76	603.13	2.52	6	130.00	0.053	0.053	0.000	2.000	5.80	11.60	0.995	32.2	7.82769	48.89
1.148	493.062	74.45	2.09	2.81	0.25	998.722	2.810	1.73	996.86	2.81	6	130.00	0.075	0.075	0.000	2.000	13.28	26.57	2.303	74.46	8.76918	50.83
1.476	492.734	107.36	2.18	2.03	0.28	1118.03	2.032	1.69	1118.03	2.03	7	130.00	0.096	0.096	0.000	2.000	19.21	34.42	3.021	107.36	7.12002	51.28
1.804	492.406	114.67	2.19	1.91	0.11	976.912	1.912	1.66	976.91	1.91	7	130.00	0.117	0.117	0.000	2.000	19.38	38.76	3.647	114.67	5.88073	50.76
2.133	492.077	93.71	1.85	1.98	0.3	674.699	1.977	1.65	674.90	1.98	7	130.00	0.139	0.139	0.000	2.000	16.22	32.44	2.897	93.71	5.19754	49.34
2.461	491.749	78.08	1.6	1.92	0.23	488.982	1.926	1.70	488.98	1.93	7	130.00	0.160	0.160	0.000	2.000	13.74	27.49	2.412	78.08	4.04007	48.02
2.789	491.421	58.8	1.47	2.61	0.67	323.351	2.500	1.88	323.35	2.61	6	130.00	0.181	0.181	0.000	2.000	11.06	22.13	1.816	58.8	3.97805	48.26
3.117	491.093	40.69	0.92	2.26	0.68	199.341	2.278	1.96	199.39	2.28	6	130.00	0.203	0.203	0.000	2.000	7.88	15.75	1.250	40.69	3.08985	44.04
3.445	490.765	28.44	0.57	2.16	0.21	117.076	2.174	2.10	117.08	2.17	5	130.00	0.224	0.224	0.000	2.000	5.40	10.79	0.812	28.44	2.16626	41.39
3.773	490.437	29.6	0.6	1.68	0.56	119.696	1.703	2.01	119.74	1.70	5	130.00	0.245	0.245	0.000	2.000	5.85	11.69	0.909	29.61	1.92397	41.61
4.101	490.109	25.33	0.62	2.43	0.39	94.0237	2.474	2.20	94.02	2.47	5	130.00	0.267	0.267	0.000	1.937	5.20	10.46	0.776	25.33	2.10154	40.24
4.429	489.781	28.49	0.71	2.6	0.44	97.9631	2.518	2.19	97.96	2.52	5	130.00	0.288	0.288	0.000	1.884	5.66	11.29	0.873	28.49	2.18026	40.46
4.757	489.453	31.04	0.87	2.79	0.58	99.3865	2.831	2.23	99.42	2.83	5	130.00	0.309	0.309	0.000	1.798	6.69	12.04	0.951	31.05	2.19408	40.54
5.085	489.125	58.32	1.1	1.88	0.53	175.447	1.897	1.94	175.45	1.90	7	130.00	0.331	0.331	0.000	1.739	11.19	19.47	1.795	58.32	1.12709	44.43
5.413	488.797	64.77	1.14	1.76	0.39	183.087	1.770	1.90	183.12	1.77	7	130.00	0.352	0.352	0.000	1.686	12.27	20.69	1.994	64.78	1.0454	43.83
5.741	488.469	49.99	1.55	3.1	0.19	132.662	3.124	2.16	132.98	3.12	6	130.00	0.373	0.373	0.000	1.637	10.56	17.29	1.536	49.99	1.83323	42.05
6.069	488.141	98.86	2.6	2.63	1.89	249.658	2.536	1.95	249.68	2.64	7	130.00	0.394	0.394	0.000	1.593	19.06	30.34	3.049	98.86	1.16492	46.10
6.398	487.812	86.03	2.55	2.97	3.23	205.868	2.978	2.05	205.92	2.98	6	130.00	0.416	0.416	0.000	1.551	17.26	26.77	2.651	86.05	1.43668	44.20
6.726	487.484	74.12	2.06	2.82	2.77	168.537	2.836	2.08	168.56	2.84	6	130.00	0.437	0.437	0.000	1.512	16.07	22.79	2.281	74.13	1.6835	43.23
7.054	487.156	57.9	1.75	3.03	0.39	125.279	3.047	2.19	125.30	3.05	6	130.00	0.459	0.459	0.000	1.477	12.27	18.13	1.778	57.91	1.67782	41.74
7.382	486.828	73.94	1.79	2.42	0.32	153.096	2.457	2.06	153.10	2.44	6	130.00	0.480	0.480	0.000	1.444	14.87	21.47	2.274	73.94	1.45542	42.75
7.71	486.500	100.23	1.95	1.85	0.48	199	1.955	1.91	199.00	1.96	7	130.00	0.501	0.501	0.000	1.413	19.07	28.93	3.098	100.23	1.06813	44.03
8.038	486.172	98.56	2.95	3.06	0.34	183.814	3.072	2.09	183.81	3.07	6	130.00	0.522	0.522	0.000	1.383	19.67	27.21	2.973	98.56	1.61535	43.65
8.366	485.844	130.73	3.63	2.78	5.11	239.405	2.786	1.99	239.46	2.79	7	130.00	0.544	0.544	0.000	1.356	25.62	34.76	4.031	130.76	1.2696	44.90
8.694	485.516	98.21	2.49	2.54	0.94	172.789	2.550	2.04	172.81	2.55	7	130.00	0.565	0.565	0.000	1.330	19.62	26.10	3.023	98.22	1.47052	43.35
9.022	485.188	72.31	1.82	2.52	0.92	122.305	2.539	2.13	122.32	2.54	6	130.00	0.586	0.586	0.000	1.306	14.59	19.57	2.221	72.32	1.85248	41.62
9.35	484.860	80.45	1.62	2.02	0.93	131.374	2.029	2.04	131.39	2.03	7	130.00	0.608	0.608	0.000	1.283	16.07	20.81	2.472	80.46	1.54063	41.99
9.678	484.532	69.64	1.16	1.66	0.99	110.18	1.674	2.03	110.20	1.67	7	130.00	0.629	0.629	0.000	1.261	13.92	17.65	2.146	69.65	1.37885	41.08
10.006	484.204	61.74	0.9	1.45	0.35	93.9277	1.473	2.04	93.93	1.47	7	130.00	0.650	0.650	0.000	1.240	12.34	15.80	1.891	61.74	1.41065	40.23
10.335	483.875	66.65	1.35	2.02	0.53	98.2148	2.046	2.13	98.23	2.05	7	130.00	0.672	0.672	0.000	1.220	13.79	16.82	2.043	66.66	1.66601	40.47
10.663	483.547	83.84	2.23	2.65	0.46	119.965	2.682	2.16	119.96	2.68	6	130.00	0.693	0.693	0.000	1.201	17.55	21.06	2.574	83.84	1.75802	41.62
10.991	483.219	117.25	2.55	2.17	0.83	163.12	2.188	2.00	163.12	2.19	7	130.00	0.714	0.714	0.000	1.183	23.09	27.32	3.608	117.25	1.0514	43.07
11.319	482.891	126.97	2.65	2.08	0.44	171.576	2.099	1.98	171.59	2.10	7	130.00	0.736	0.736	0.000	1.166	24.74	28.84	3.906	126.97	1.23081	43.32
11.647	482.563	100.73	2.81	2.79	1.16	132.055	2.811	2.15	132.07	2.81	6	130.00	0.757	0.757	0.000	1.149	20.99	24.12	3.095	100.74	1.72321	42.01
11.975	482.235	110.03	2.03	1.85	0.79	140.359	1.858	1.99	140.37	1.86	7	130.00	0.778	0.778	0.000	1.133	21.57	24.45	3.382	110.04	1.27249	42.32
12.303	481.907	89.84	1.64	1.83	0.58	111.343	1.842	2.06	111.36	1.84	7	130.00	0.800	0.800	0.000	1.118	18.07	20.20	2.757	89.85	1.54535	41.13
12.631	481.579	64.26	1.13	1.75	1.04	77.269	1.781	2.16	77.28	1.78	7	130.00	0.821	0.821	0.000	1.104	13.47	14.86	1.964	64.27	1.67781	39.17
12.959	481.251	53.66	0.81	1.5	0.76	62.7039	1.534	2.18	62.70	1.53	7	130.00	0.842	0.842	0.000	1.090	11.36	12.38	1.635	53.66	1.84929	38.00
13.287	480.923	47.49	0.8	1.68	0.14	53.9872	1.716	2.27	54.00	1.72	7	130.00	0.864	0.864	0.000	1.076	10.41	11.20	1.444	47.5	2.12802	37.16
13.615	480.595	49.6	0.9	1.82	0.26	55.0468	1.847	2.28	55.06	1.85	7	130.00	0.886	0.886	0.000	1.063	10.93	11.62	1.508	49.6	2.16026	37.26
13.943	480.267	33.73	0.59	1.74	0.11	36.2175	1.797	2.41	36.22	1.80	6	130.00	0.906	0.906	0.000	1.050	7.89	8.29	1.018	33.73	26.9811	34.77
14.271	479.939	30.54	0.56	1.82	0.3	31.9231	1.891	2.47	31.92	1.89	6	130.00	0.928	0.928	0.000	1.038	7.83	7.81	0.917	30.54	29.3952	34.00
14.6	479.610	31.88	0.48	1.49	0.09	32.5933	1.552	2.41	32.59	1.55	6	130.00	0.949	0.949	0.000	1.027	7.45	7.65	0.958	31.88	26.9209	34.13
14.928	479.282	41.36	0.41	0.98	0.28	41.6251	1.015	2.22	41.63	1.02	7	130.00	0.970	0.970	0.000	1.015	8.69	9.02	1.250	41.36	19.6777	35.61
15.256	478.954	37.15	0.45	1.21	0.14	36.4932	1.245	2.32	36.46	1.24	7	130.00	0.992	0.992	0.000	1.004	8.32	8.36	1.119	37.15	23.1707	34.81

Depth (ft)	Sa... (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...tress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	478.626	35.51	0.42	1.19	0.23	34.0557	1.217	2.34	34.07	1.22	7	130.00	1.013	1.013	0.000	0.994	8.02	7.97	1.068	35.52	23.8923	34.40
15.912	478.298	35.52	0.45	1.28	0.07	33.3427	1.305	2.36	33.34	1.30	7	130.00	1.034	1.034	0.000	0.983	8.11	7.98	1.048	35.52	24.8516	34.27
16.24	477.970	39.22	0.5	1.28	-0.18	36.1542	1.310	2.33	36.16	1.31	7	130.00	1.056	1.056	0.000	0.973	8.85	8.61	1.182	39.23	23.7831	34.76
16.568	477.642	38.39	0.42	1.08	0	34.648	1.126	2.31	34.65	1.13	7	130.00	1.077	1.077	0.000	0.964	8.53	8.27	1.155	38.39	22.946	34.50
16.896	477.314	40.69	0.25	0.6	0.04	36.0502	0.631	2.17	36.05	0.63	7	130.00	1.098	1.098	0.000	0.954	8.56	8.16	1.226	40.69	17.9445	34.74
17.224	476.986	26.93	0.46	1.71	0.18	23.0541	1.782	2.57	23.05	1.78	6	130.00	1.120	1.120	0.000	0.946	6.75	6.41	0.799	26.93	33.9054	31.96
17.552	476.658	23.41	0.62	2.63	0.25	19.5192	2.784	2.74	19.52	2.78	5	130.00	1.141	1.141	0.000	0.936	6.44	6.03	0.889	23.41	42.7557	30.87
17.88	476.330	55.32	1.62	2.49	0.04	55.2038	2.525	2.37	55.20	2.53	6	130.00	1.162	1.162	0.000	0.928	14.96	13.86	1.988	55.32	25.2127	37.27
18.208	476.002	75.56	2.12	2.8	0.99	82.9279	2.84654	2.36561	82.9279	2.84654	6	130.00	1.18362	1.18362	0	0.9192	17.81894	16.61506	2.30577	75.56	25.0311	38.024
18.537	475.673	74.29	1.97	2.66	0.05	80.6563	2.69549	2.36029	80.6563	2.69549	6	130.00	1.20491	1.204905	0	0.9111	16.98011	15.45684	2.22827	74.29	24.8219	37.815
18.865	475.345	66.95	1.16	2.4	0.05	53.5985	2.43443	2.36877	53.5985	2.43443	6	130.00	1.22623	1.226225	0	0.9031	16.34246	13.85513	2.03479	66.95	25.159	37.104
19.193	475.017	83.56	1.37	2.16	0.04	49.9481	2.1986	2.36187	49.9481	2.1986	7	130.00	1.24755	1.247545	0	0.8953	14.52072	18.0005	1.82918	83.56	24.8839	36.693
19.521	474.689	54.9	1.01	1.84	0.12	42.267	1.88323	2.37383	42.267	1.88323	7	130.00	1.26857	1.268985	0	0.8878	12.60965	11.19426	1.66041	54.9	25.3569	35.705
19.849	474.361	41.75	0.84	2.02	0.51	31.3697	2.07613	2.50167	31.3697	2.07613	6	130.00	1.29019	1.290165	0	0.8804	10.17354	8.955661	1.52203	41.75	30.7577	33.887
20.177	474.033	46.14	0.57	1.25	0.28	33.4185	1.30052	2.35955	33.4185	1.30052	7	130.00	1.31161	1.311605	0	0.8732	10.29658	8.903624	1.35603	46.13	24.7928	34.278
20.505	473.705	50.75	0.66	1.29	0.28	37.077	1.33557	2.329	37.077	1.33557	7	130.00	1.33283	1.332825	0	0.8662	11.42434	9.873387	1.52964	50.75	23.6109	34.016
20.833	473.377	43.95	0.53	2.11	0.21	31.4559	2.18331	2.70117	31.4559	2.18331	5	130.00	1.35416	1.354145	0	0.8593	10.77855	9.258159	1.31875	43.95	31.8161	33.906
21.161	473.049	37.62	0.78	2	0.18	26.4962	2.08536	2.56096	26.4962	2.08536	6	130.00	1.37547	1.375465	0	0.8527	9.483875	8.086509	1.12831	37.62	33.4834	32.832
21.489	472.721	31.66	0.63	1.99	0.12	21.6663	2.08174	2.6309	21.6663	2.08174	6	130.00	1.39679	1.396785	0	0.8461	8.221135	6.956119	0.93694	31.66	36.986	31.548
21.817	472.393	29.28	0.51	1.75	0.11	19.6332	1.83177	2.63406	19.6332	1.83177	6	130.00	1.41811	1.418105	0	0.8397	7.810153	6.590564	0.86198	29.28	37.0448	30.91
22.145	472.065	27.79	0.57	2.04	0.16	18.3063	2.16314	2.70017	18.3063	2.16314	6	130.00	1.43943	1.439425	0	0.8335	7.479318	6.234011	0.81581	27.79	40.4629	30.453
22.473	471.737	29.87	0.47	1.58	0.21	19.4485	1.65439	2.61264	19.4485	1.65439	6	130.00	1.46075	1.460745	0	0.8274	7.685847	6.35923	0.87954	29.87	35.9877	30.848
22.802	471.408	28.42	0.58	2.03	0.16	18.1751	2.1531	2.70156	18.1751	2.1531	6	130.00	1.48213	1.48213	0	0.8214	7.454487	6.287497	0.83399	28.42	40.5369	30.406
23.13	471.080	31.05	0.62	1.99	0.28	19.6525	2.09838	2.66738	19.6525	2.09838	6	130.00	1.50345	1.503455	0	0.8156	8.214939	6.988788	0.91475	31.05	38.7438	30.016
23.458	470.752	46.22	1.11	2.4	0.37	29.3128	2.48349	2.67298	29.3128	2.48349	6	130.00	1.52477	1.52477	0	0.8098	11.85897	9.441869	1.38375	46.22	34.0532	33.467
23.786	470.424	39.92	0.83	2.08	0.37	24.82	2.16293	2.59318	24.82	2.16293	6	130.00	1.54609	1.54609	0	0.8042	10.17212	8.160027	1.18805	39.92	35.0255	32.418
24.114	470.096	27.63	0.53	1.93	0.37	16.564	2.0414	2.72167	16.564	2.0414	6	130.00	1.56741	1.56741	0	0.7987	7.493763	5.985518	0.8035	27.63	41.5107	29.796
24.442	469.768	29.77	0.61	1.72	0.37	17.7382	1.80971	2.66769	17.7382	1.80971	6	130.00	1.58873	1.588735	0	0.7934	7.877848	6.240799	0.87249	29.77	38.7598	30.247
24.77	469.440	42.36	0.65	1.63	0.32	25.3097	1.59509	2.50911	25.3097	1.59509	7	130.00	1.61005	1.610055	0	0.7881	10.35859	8.163824	1.26161	42.36	31.0917	32.642
25.098	469.112	53.82	1.13	2.41	0.39	31.8907	2.49096	2.64436	31.8907	2.49096	6	130.00	1.63137	1.63137	0	0.7829	13.66709	10.48117	1.61675	53.82	32.7057	34.01
25.426	468.784	51.08	0.9	1.77	0.53	29.9072	1.82066	2.4837	29.9011	1.82122	7	130.00	1.65269	1.65269	0	0.7778	12.63893	9.59802	1.53206	51.07	29.9596	33.591
25.754	468.456	40.34	0.96	2.39	0.39	23.0978	2.4828	2.65426	23.0978	2.4828	6	130.00	1.67401	1.674015	0	0.7729	10.60082	8.133331	1.19709	40.34	38.0669	31.959
26.082	468.128	38.33	0.52	1.36	0.09	21.6092	1.41942	2.5382	21.6092	1.41942	7	130.00	1.69533	1.695335	0	0.768	9.50564	7.300528	1.1342	38.33	32.4199	31.591
26.41	467.800	33.19	0.47	1.42	0.42	18.3342	1.49333	2.61024	18.3342	1.49333	7	130.00	1.71665	1.716655	0	0.7632	8.528906	6.508614	0.97441	33.19	35.8566	30.463
26.739	467.471	35.49	0.61	1.72	0.44	19.4196	1.8073	2.63471	19.4196	1.8073	6	130.00	1.73804	1.738035	0	0.7585	9.233542	7.003886	1.04496	35.49	37.0774	30.839
27.067	467.143	42.19	0.58	1.38	0.21	22.9804	1.43456	2.51828	22.9804	1.43456	7	130.00	1.75936	1.759355	0	0.7539	10.36277	7.812684	1.26172	42.19	31.5067	31.926
27.395	466.815	45.33	0.59	1.3	0.28	24.4566	1.35479	2.4822	24.461	1.3551	7	130.00	1.78066	1.780675	0	0.7494	10.94193	8.199766	1.34828	45.42	29.6936	32.323
27.723	466.487	34.11	0.71	2.09	0.25	17.929	2.1976	2.71161	17.929	2.1976	6	130.00	1.802	1.801995	0	0.7449	9.235424	6.879867	1.00025	34.11	41.0689	30.317
28.051	466.159	38.11	0.64	1.67	0.16	19.9015	1.76373	2.61995	19.9015	1.76373	7	130.00	1.82332	1.823315	0	0.7406	9.84101	7.228823	1.12343	38.11	36.3399	30.998
28.379	465.831	54.66	0.64	1.17	0.14	28.6427	1.21181	2.39804	28.6427	1.21181	7	130.00	1.84464	1.844635	0	0.7363	12.69719	9.346228	1.63577	54.66	26.531	33.322
28.707	465.503	38.3	0.68	1.78	0.12	19.6257	1.86639	2.64081	19.5257	1.86639	6	130.00	1.86596	1.865955	0	0.7321	9.594856	7.316784	1.12799	38.3	37.3751	30.874
29.035	465.175	39.55	0.71	1.8	0.09	19.9561	1.88515	2.63527	19.9561	1.88515	6	130.00	1.88728	1.887275	0	0.7279	10.29276	7.892285	1.18603	39.55	37.1054	31.016
29.363	464.847	36.83	0.63	1.71	-0.04	18.2969	1.80405	2.65573	18.2969	1.80405	6	130.00	1.9086	1.908595	0	0.7238	9.465775	7.01096	1.08116	36.83	38.1443	30.45
29.691	464.519	45.2	0.78	1.62	0.32	22.4207	1.68708	2.56645	22.4155	1.68747	7	130.00	1.92992	1.929915	0	0.7198	11.56246	8.179056	1.33863	45.19	33.742	31.767
30.019	464.191	50.69	0.68	1.15	0.3	24.9784	1.19002	2.44406	24.9784	1.19002	7	130.00	1.95124	1.951235	0	0.7159	12.62196	8.608361	1.50894	50.69	28.245	32.458
30.347	463.863	39.45	0.49	1.23	0.32	18.9994	1.30745	2.56664	18.9994	1.30745	7	130.00	1.97256	1.972555	0	0.712	9.920241	7.0633	1.16029	39.45	33.752	30.696
30.675	463.535	51.05	0.69	1.36	0.21	24.6034	1.40655	2.48892	24.5984	1.40684	7	130.00	1.99388	1.993875	0	0.7082	12.66216	8.754796	1.61877	51.04	30.1901	32.381
31.004	463.206	35.96	0.8	2.22	0.25	18.8439	2.35677	2.75119	18.8439	2.35677	6	130.00	2.01526	2.015265	0	0.7044	9.945252	7.005679	1.05092	35.96	43.233	29.907
31.332	462.878	34.69	0.81	2.33	0.23	18.0335	2.4806	2.78153	18.0335	2.4806	6	130.00	2.03659	2.03655	0	0.7007	9.754086	6.834958	1.01094	34.69	44.9361	29.581
31.66	462.550	32.8	0.69	2.11	0.04	14.9386	2.24448	2.78183	14.9386	2.24448	6	130.00	2.0579	2.0579	0	0.6971	9.224214	6.430093	0.96177	32.8	44.9535	29.113
31.996	462.222	41.84	0.77	1.83	0.11	19.1229	1.93656	2.65715	19.1229	1.93656	6	130.00	2.07922	2.079225	0	0.6935	11.01138	7.638449	1.23099	41.84	38.2174	30.736
32.316	461.894	37.05	1.05	2.83	0.04	16.6383	3.00434	2.81778	16.6383	3.00434	6	125.00	2.10054	2.10054	0	0.69	10.62955	7.334144	1.08203	37.05	47.0264	29.828
32.644	461.566	67.03	0.55	0.82	-6.6	30.6024	0.84734	2.29207	30.6213	0.84682	8	125.00	2.12104	2.12104	0	0.6866	14.85918	10.20282	2.00957	67.07	22.2286	33.739
32.972	461.238	54.68	1.11	2.03	0.21	24.533	2.11274	2.59114	24.533	2.11274	7	125.00	2.14154	2.14154	0	0.6833	13.91768	9.510511	1.62658	54.68	34.9261	32.344
33.3	460.910	49.23	1.53	3.11	-2.91	21.7702	3.25062	2.74669	21.7794	3.24924	6	125.00	2.16204	2.16204	0	0.6801	13.58773	9.240913	1.45721	49.25	42.984	31.581
33.628	460.582	42.89	1.67	3.9	-0.53	18.6514	4.10244	2.86303	18.6514	4.10244	5	125.00	2.18254	2.18254	0	0.6769	12.62559	8.54615	1.26029	42.89	49.722	30.575
33.956	460.254	42.8	1.32	3.09	0.12	18.4277	3.25147	2.80358	18.4277	3.25147	6	125.00	2.20304	2.20304	0	0.6737	12.18217	8.207546	1.25687	42.8	46.2004	30.497
34.284	459.926	30.89	1.35	4.37	0.37	12.8923	4.70934	3.02533	12.8878	4.71098	4	125.00	2.22354	2.22354	0	0.6706	10.02714	6.72442	0.88751	30.88	60.2073	28.127
34.612	459.598	24.22	1.28	5.28	0.81	9.79303	5.82455	3.1763	9.78858	5.8272	3	125.00	2.24404	2.24404	0	0.6676	8.694916	5.804303	0.68037	24.21	71.1657	26.273
34.941	459.269	21.73	0.96	4.43	1.31	8.5955	4.93183	3.17671	8.59109	4.93436	4	125.00	2.2646	2.264603	0	0.6645	7.802906	5.185139	0.60264	21.72	71.1974	25.388
35.269	458.941	23.04	0.79	3.42	1.73	9.0827	3.80633	3.09074	9.07832	3.80817	5	125.00	2.2851	2.285103	0	0.6615	7.80225	5.161394	0.64257	23.03	64.8082	25.762
35.597	458.613	22.63	0.74	3.26	2.47	8.81522	3.64094	3.09045	8.80655	3.64453	5	125.00	2.3056	2.305603	0	0.6586	7.658449	5.043693	0.62924	22.61	64.7868	25.556
35.925	458.285	23.37	0.6	2.57	3.4	9.04685	2.85118	3.02107	9.03825	2.8539	5	125.00	2.3261	2.326103	0	0.6557	7.56159	4.95791	0.65151	23.35	59.9152	25.732
36.253	457.957	29.16	0.73	2.49	9.07	11.4265	2.72252	2.9266	11.4009	2.72863	6	125.00	2.3466	2.346603	0	0.6528	8.891671	5.804484	0.83014	29.1	53.6748	27.303
36.581	457.629	30.74	0.64	2.07	12.21	11.9863	2.25567	2.86414	11.9525	2.26205	6	125.00	2.3671	2.367103	0	0.65	9.031228	5.870002	0.87842	30.66	49.7897	27.622
36.909	457.301	30.69	0.47	1.52	13.92	11.8539	1.66064	2.79759	11.8162	1.66593	6	125.00	2.3876	2.387603	0	0.6472	8.680726	5.617913	0.87624	30.6	45.8547	27.544
37.237	456.973	31.76	0.55	1.72	16.67	12.1888	1.87381	2.81505	12.1431	1.88098	6	125.00	2.4081	2.408103	0	0.6444	9.066453	5.842516	0.90873	31.65	46.8672	27.728
37.565	456.645	33.62	0.61	1.8	17.92	12.8434	1.95567	2.80566	12.7981	1.96259	6	125.00	2.4286	2.428603	0	0.6417	9.549031	6.127466	0.96568	33.61	46.321	28.081

R13250

Depth (ft)	San (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	.Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	456.317	32.15	0.63	1.95	18.64	12.1273	2.12115	2.84602	12.0783	2.12975	6	125.00	2.4491	2.449103	0	0.639	9.337317	5.966486	0.91953	32.03	48.6978	27.692
38.221	455.989	25.87	0.58	2.25	19.84	9.47537	2.47659	2.97339	9.42678	2.49137	6	125.00	2.4696	2.469603	0	0.6363	8.094387	5.15075	0.72447	25.75	56.71	26.018
38.549	455.661	21.3	0.67	3.13	19.56	7.55386	3.56195	3.14336	7.50567	3.58482	5	125.00	2.4901	2.490103	0	0.6337	7.434711	4.711459	0.58235	21.18	68.672	24.471
38.877	455.333	19.83	0.72	3.64	19.54	6.90511	4.15719	3.21395	6.85727	4.18619	4	135.00	2.5106	2.5082	0.0024	0.6314	7.271031	4.591081	0.5362	19.71	74.0883	23.859
39.206	455.004	19.78	0.91	4.59	17.32	6.84374	5.27622	3.27716	6.80009	5.31009	3	135.00	2.53281	2.520143	0.0127	0.6299	7.602996	4.789302	0.53397	19.67	79.1712	23.806
39.534	454.676	20.68	0.93	4.48	18.01	7.15825	5.13102	3.25407	7.11481	5.16235	3	135.00	2.55495	2.532049	0.0229	0.6284	7.614492	4.91094	0.56115	20.57	77.2888	24.117
39.862	454.348	20.78	0.84	4.03	18.73	7.16536	4.81465	3.22705	7.11212	4.6427	4	135.00	2.57709	2.543956	0.0331	0.627	7.69793	4.826354	0.56356	20.67	75.1234	24.118
40.19	454.020	19.42	0.88	4.52	19.38	6.58125	5.23163	3.28913	6.5343	5.26922	3	135.00	2.59923	2.555862	0.0434	0.6255	7.526098	4.708868	0.52077	19.3	80.159	23.549
40.518	453.692	16.99	0.73	4.28	19.84	5.59577	5.08051	3.33962	5.54903	5.1233	3	135.00	2.62137	2.567768	0.0536	0.6241	6.843878	4.270948	0.44485	16.87	84.4156	22.454
40.846	453.364	16.52	0.38	2.28	21.46	5.37916	2.73844	3.20777	5.32489	2.76635	5	135.00	2.64351	2.579675	0.0638	0.6226	6.015767	3.745486	0.42961	16.38	73.6031	22.183
41.174	453.036	17.43	0.34	1.93	23.46	5.69704	2.30284	3.14792	5.63916	2.32648	6	135.00	2.66565	2.591581	0.0741	0.6212	6.084749	3.779725	0.4571	17.28	69.0136	22.571
41.502	452.708	22.29	0.68	3.06	24.25	7.52921	3.469	3.13915	7.46776	3.49754	5	135.00	2.68779	2.603468	0.0843	0.6198	7.745791	4.800517	0.60688	22.13	68.3574	24.466
41.83	452.380	19.58	0.73	3.74	20.72	6.4503	4.32719	3.24865	6.40059	4.36079	4	135.00	2.70993	2.615394	0.0945	0.6183	7.359357	4.560628	0.52229	19.45	76.8511	23.43
42.158	452.052	20.78	0.6	2.87	23.56	6.86938	3.32448	3.1617	6.8161	3.35047	5	135.00	2.73207	2.6273	0.1048	0.6169	7.337513	4.526828	0.55676	20.64	70.053	23.857
42.486	451.724	27.89	0.85	3.06	26.14	9.52399	3.38163	3.04802	9.45958	3.40466	5	135.00	2.75421	2.639207	0.115	0.6155	9.132647	5.6216	0.7782	27.72	61.7782	26.072
42.814	451.396	28.69	1.21	4.23	37.12	9.77463	4.66935	3.12299	9.68787	4.71117	4	135.00	2.77635	2.651113	0.1252	0.6142	9.862356	6.050983	0.80228	28.46	67.1585	26.236
43.143	451.067	21.75	0.81	3.73	40.41	7.11643	4.27408	3.214	7.02255	4.33122	4	135.00	2.79856	2.663056	0.1355	0.6128	7.931649	4.860416	0.58673	21.5	74.0922	24.069
43.471	450.739	22.78	0.69	3.01	41.96	7.46153	3.45703	3.14483	7.36059	3.50444	5	135.00	2.8207	2.674962	0.1457	0.6114	7.909522	4.836057	0.61794	22.51	68.7816	24.389
43.799	450.411	20.59	0.61	2.97	43.95	6.60515	3.43717	3.18878	6.50094	3.49227	5	135.00	2.84284	2.686869	0.156	0.6101	7.35876	4.489329	0.54945	20.31	72.126	23.557
44.127	450.083	23.42	1.1	4.71	47.39	7.61643	5.35149	3.24833	7.50897	5.42807	3	135.00	2.86498	2.698775	0.1662	0.6087	8.749722	5.32612	0.63638	23.13	76.8256	24.529
44.455	449.755	253.58	4.98	1.96	20.09	92.4833	1.98649	2.13724	92.4354	1.98753	8	135.00	2.88712	2.710682	0.1764	0.6074	52.62093	31.96092	7.76139	253.45	16.9566	40.151
44.783	449.427	555.99	13.9	2.5	-21.27	203.145	2.5132	1.99381	203.193	2.5126	12	135.00	2.90926	2.722588	0.1867	0.6061	109.1065	66.12409	17.1232	556.12	12.7819	44.134

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 14 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-2A

ConeTec Inc. Interpretation
Interpretation C Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4556
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-2A
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 14:50
CPT File: 804CP02A.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 492.4

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.34	1.38	45.43	22.11	2.23
125	Residual Soil	30.69	2.60	86.31	48.14	2.80

User Inputs:
Assumed: Water Table Depth (ft): 37
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 492.4
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	492.236	8.72	0.06	0.66	0.23	817.011	0.919	1.31	817.01	0.92	6	130.00	0.011	0.011	0.000	2.000	1.36	2.71	0.270	8.72	0.48799	50.08
0.492	491.908	16.38	0.2	1.22	-0.05	511.195	1.223	1.51	511.20	1.22	6	130.00	0.032	0.032	0.000	2.000	2.71	5.43	0.506	16.38	0.92371	48.22
0.82	491.580	25.84	0.5	1.94	-0.39	483.803	1.939	1.70	483.80	1.94	6	130.00	0.053	0.053	0.000	2.000	4.56	9.11	0.798	25.84	1.1479	47.09
1.148	491.252	28.08	0.51	1.82	-0.21	375.307	1.821	1.73	375.31	1.82	6	130.00	0.075	0.075	0.000	2.000	5.00	10.01	0.867	28.08	1.1981	46.92
1.476	490.924	44.3	0.61	1.37	-0.25	460.747	1.380	1.68	460.75	1.38	7	130.00	0.096	0.096	0.000	2.000	7.50	15.01	1.369	44.3	1.05565	47.79
1.804	490.596	29.51	0.72	2.43	-0.14	250.663	2.450	1.93	250.66	2.45	6	130.00	0.117	0.117	0.000	2.000	5.66	11.31	0.910	29.51	1.12006	45.12
2.133	490.267	24.15	0.47	1.95	0.02	173.186	1.957	1.95	173.19	1.96	6	130.00	0.139	0.139	0.000	2.000	4.66	9.33	0.743	24.15	1.16289	43.36
2.461	489.939	20.89	0.35	1.67	-0.39	128.341	1.705	1.99	128.40	1.70	6	130.00	0.160	0.160	0.000	2.000	4.06	8.11	0.636	20.7	1.2808	41.87
2.789	489.611	29.8	0.44	1.48	-0.02	163.382	1.488	1.88	163.38	1.49	6	130.00	0.181	0.181	0.000	2.000	5.59	11.18	0.817	29.8	0.80656	43.08
3.117	489.283	30.73	0.22	0.72	0.05	150.674	0.721	1.68	150.67	0.72	7	130.00	0.203	0.203	0.000	2.000	5.39	10.77	0.845	30.73	0.70201	42.68
3.445	488.955	21.3	0.33	1.56	-0.07	94.1211	1.566	2.06	94.12	1.57	6	130.00	0.224	0.224	0.000	2.000	4.23	8.57	0.663	21.8	1.4682	40.24
3.773	488.627	26.89	0.22	0.82	-0.09	108.646	0.826	1.83	108.65	0.83	7	130.00	0.245	0.245	0.000	2.000	4.98	9.93	0.825	26.9	0.76744	41.01
4.101	488.299	18.81	0.35	1.84	0.07	69.5844	1.887	2.21	69.56	1.89	6	130.00	0.267	0.267	0.000	2.000	4.03	7.80	0.674	18.81	1.3616	38.59
4.429	487.971	43.41	0.31	0.72	0.16	149.789	0.719	1.68	149.79	0.72	7	130.00	0.288	0.288	0.000	1.864	7.61	14.16	1.335	43.41	0.8155	42.65
4.757	487.643	28.43	0.59	2.06	0.16	90.9456	2.098	2.16	90.95	2.10	6	130.00	0.309	0.309	0.000	1.708	5.58	10.71	0.871	28.43	1.7646	40.06
5.085	487.315	16	0.39	2.44	0.49	47.4078	2.469	2.41	47.41	2.49	5	130.00	0.331	0.331	0.000	1.739	3.74	8.51	0.485	16	2.0118	36.39
5.413	486.987	29.13	0.49	1.69	0.72	61.7921	1.703	2.16	61.79	1.70	6	130.00	0.352	0.352	0.000	1.586	8.03	10.16	0.831	29.13	1.6865	39.49
5.741	486.659	49.67	0.79	1.59	0.87	132.106	1.603	1.96	132.10	1.60	7	130.00	0.373	0.373	0.000	1.637	9.63	15.76	1.526	49.67	1.547	42.01
6.069	486.331	50.37	0.83	1.65	0.05	134.29	1.567	1.95	134.29	1.57	7	130.00	0.394	0.394	0.000	1.592	10.30	16.40	1.640	50.37	1.16376	42.10
6.398	486.002	49.98	0.63	1.26	-1.39	119.182	1.271	1.92	119.21	1.27	7	130.00	0.416	0.416	0.000	1.561	9.55	14.90	1.634	49.99	1.0396	41.49
6.726	485.674	88.17	0.52	1.35	-0.66	86.3078	1.378	2.05	86.31	1.38	7	130.00	0.437	0.437	0.000	1.512	7.65	11.67	1.168	88.17	14.3272	39.78
7.054	485.346	40.75	0.54	1.32	0.74	87.8748	1.340	2.04	87.87	1.34	7	130.00	0.459	0.459	0.000	1.477	8.13	12.00	1.047	40.75	13.4337	39.87
7.382	485.018	37.01	0.8	1.62	-0.79	76.1315	1.642	2.14	76.15	1.64	7	130.00	0.480	0.480	0.000	1.444	7.70	11.11	1.141	37.02	17.0681	38.09
7.71	484.690	59.19	0.77	1.3	0.23	117.108	1.312	1.94	117.11	1.31	7	130.00	0.501	0.501	0.000	1.413	11.37	16.96	1.817	59.19	1.13174	41.39
8.038	484.362	57.04	1.06	1.85	-0.25	108.174	1.876	2.07	108.17	1.88	7	130.00	0.522	0.522	0.000	1.383	11.153	16.96	1.750	57.04	14.9626	40.06
8.366	484.034	57.87	0.86	1.48	-0.53	105.42	1.500	2.01	105.44	1.50	7	130.00	0.544	0.544	0.000	1.358	11.48	16.50	1.775	57.86	13.2395	40.85
8.694	483.706	75.82	0.88	1.16	-0.74	133.169	1.169	1.86	133.19	1.17	8	130.00	0.565	0.565	0.000	1.330	14.18	18.84	2.330	75.83	0.50987	42.05
9.022	483.378	63.21	1.11	1.75	-0.44	106.786	1.772	2.06	106.79	1.77	7	130.00	0.586	0.586	0.000	1.306	12.71	16.90	1.939	63.21	14.5845	40.81
9.35	483.050	60.49	0.91	1.51	-0.93	98.631	1.620	2.04	98.65	1.62	7	130.00	0.608	0.608	0.000	1.283	12.06	16.47	1.884	60.5	13.0359	40.49
9.678	482.722	64.51	0.83	1.28	-1.11	101.548	1.289	1.98	101.56	1.30	7	130.00	0.629	0.629	0.000	1.261	12.59	16.87	1.978	64.52	12.4063	40.66
10.006	482.394	80.55	1.03	1.28	-0.85	122.849	1.289	1.92	122.86	1.29	8	130.00	0.650	0.650	0.000	1.240	15.35	19.94	2.474	80.56	10.8105	41.64
10.335	482.065	67.71	1.38	2.04	-0.64	99.7927	2.059	2.12	99.79	2.06	7	130.00	0.672	0.672	0.000	1.220	16.99	17.07	2.075	67.71	16.5727	40.56
10.663	481.737	68.47	1.17	1.76	-0.6	94.9032	1.779	2.10	94.90	1.78	7	130.00	0.693	0.693	0.000	1.201	13.57	16.30	2.036	68.47	15.6821	40.29
10.991	481.409	68.44	0.72	1.28	-0.88	78.0017	1.292	2.06	78.00	1.29	7	130.00	0.714	0.714	0.000	1.183	11.38	16.47	1.725	68.44	14.7573	39.22
11.319	481.081	53.65	0.58	1.08	-0.95	71.6208	1.096	2.05	71.63	1.10	7	130.00	0.736	0.736	0.000	1.166	10.75	12.83	1.638	53.66	14.246	38.78
11.647	480.753	39.63	0.46	1.15	-1.11	51.3476	1.163	2.18	51.36	1.18	7	130.00	0.757	0.757	0.000	1.149	8.39	9.64	1.203	39.64	18.4421	36.86
11.975	480.425	34.17	0.51	1.48	-1.16	42.8991	1.527	2.91	42.91	1.53	7	130.00	0.778	0.778	0.000	1.133	7.64	8.98	1.034	34.18	23.9801	35.80
12.303	480.097	28.98	0.35	1.33	-1.02	31.9875	1.369	2.99	31.99	1.37	6	130.00	0.800	0.800	0.000	1.118	6.51	6.82	0.792	28.98	25.9089	34.01
12.631	479.769	31.58	0.43	1.35	-1.16	37.4846	1.398	2.94	37.48	1.40	7	130.00	0.821	0.821	0.000	1.104	7.14	7.88	0.962	31.59	23.9035	34.98
12.959	479.441	33.86	0.34	0.99	-1.04	39.2215	1.029	2.24	39.23	1.03	7	130.00	0.842	0.842	0.000	1.090	7.36	8.02	1.023	33.86	20.5322	35.26
13.287	479.113	40.62	0.47	1.14	-0.55	46.2642	1.178	2.22	46.26	1.18	7	130.00	0.864	0.864	0.000	1.078	8.76	9.48	1.237	40.62	19.6264	36.24
13.615	478.785	40.68	0.48	1.18	-0.62	45.1934	1.200	2.23	45.19	1.20	7	130.00	0.885	0.885	0.000	1.065	8.83	9.68	1.238	40.68	20.0656	36.10
13.943	478.457	67.39	0.84	1.25	-0.51	73.3577	1.263	2.08	73.36	1.26	7	130.00	0.906	0.906	0.000	1.050	13.67	14.36	2.058	67.39	15.1748	38.88
14.271	478.129	63.33	1.08	1.27	-0.49	68.6325	1.288	2.02	68.63	1.29	8	130.00	0.928	0.928	0.000	1.038	16.52	17.15	2.561	63.33	13.6068	39.93
14.6	477.800	64.96	0.68	1.03	-0.44	68.5258	1.047	1.96	68.53	1.05	8	130.00	0.949	0.949	0.000	1.027	16.48	16.92	2.601	64.96	11.0944	39.91
14.928	477.472	62.57	1.08	1.72	-0.55	63.4839	1.753	2.22	63.48	1.75	7	130.00	0.970	0.970	0.000	1.018	13.44	13.84	1.907	62.57	19.6287	38.07
15.256	477.144	64.17	0.79	1.46	-0.62	63.6267	1.486	2.23	63.64	1.49	7	130.00	0.992	0.992	0.000	1.004	11.56	11.79	1.646	64.18	19.9668	37.11

R13253

Depth (ft)	Samp... (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	478.816	44.07	0.61	1.38	-0.69	42.5062	1.417	2.30	42.52	1.42	7	130.00	1.013	1.013	0.000	0.984	9.78	9.72	1.333	44.08	22.369	35.74
15.912	478.488	48.55	0.7	1.46	-0.68	45.9409	1.473	2.28	45.94	1.47	7	130.00	1.034	1.034	0.000	0.983	10.70	10.62	1.47	48.55	21.7838	36.20
16.24	478.160	44.39	0.49	1.14	-0.51	41.0519	1.181	2.25	41.06	1.18	7	130.00	1.056	1.056	0.000	0.978	9.67	9.41	1.342	44.4	20.767	35.63
16.568	475.832	49.03	0.37	0.75	-0.55	44.626	0.772	2.13	44.63	0.77	8	130.00	1.077	1.077	0.000	0.984	10.16	9.79	1.486	49.03	16.7795	36.02
16.896	475.504	41.64	0.47	1.13	-0.34	37.0973	1.154	2.29	37.10	1.15	7	130.00	1.098	1.098	0.000	0.954	9.07	8.85	1.261	41.64	22.2493	34.92
17.224	475.176	36.67	0.81	2.21	-0.18	31.7539	2.278	2.52	31.75	2.28	6	130.00	1.120	1.120	0.000	0.946	9.03	8.63	1.101	36.67	31.6967	33.96
17.552	474.848	53.97	0.73	1.35	-0.44	46.3056	1.392	2.20	46.31	1.38	7	130.00	1.141	1.141	0.000	0.935	11.79	11.04	1.634	53.96	21.0557	36.25
17.88	474.520	91.09	1.58	1.85	-0.68	77.3772	1.868	2.17	77.38	1.87	7	130.00	1.162	1.162	0.000	0.928	19.20	17.81	2.784	91.09	18.1251	39.16
18.208	474.192	100.69	2.86	2.82	-1.27	84.2457	2.85839	2.27913	84.2542	2.8581	6	130.00	1.18352	1.18352	0	0.9192	22.22949	20.43845	3.05689	100.9	21.7559	39.649
18.537	473.863	79.53	2.28	2.84	-0.71	66.0052	2.88641	2.35986	66.0082	2.88541	6	130.00	1.20491	1.204905	0	0.911	18.16282	16.63742	2.42493	79.53	24.8046	38.206
18.865	473.535	60.94	1.12	1.97	-0.49	48.6972	2.00959	2.3446	48.6972	2.00868	7	130.00	1.22828	1.226225	0	0.9031	13.81564	12.47821	1.84672	60.94	24.2101	36.645
19.193	473.207	41.14	0.68	1.66	-0.56	31.9768	1.70458	2.44317	31.9788	1.70458	7	130.00	1.24755	1.247545	0	0.8958	9.752974	8.781904	1.23506	41.14	29.207	34.008
19.521	472.879	43.98	0.41	0.92	-0.65	33.8608	0.95994	2.28476	33.6609	0.95994	7	130.00	1.26887	1.268865	0	0.8878	9.712804	8.622663	1.32253	43.98	21.9609	34.324
19.849	472.551	44.49	0.6	1.35	-0.23	33.4834	1.15741	2.33048	33.4834	1.15741	7	130.00	1.29019	1.290165	0	0.8804	10.02395	8.884457	1.33748	44.49	25.6686	34.892
20.177	472.223	60.56	0.75	1.23	-0.23	45.1781	1.26585	2.24572	45.178	1.26585	7	130.00	1.31181	1.311605	0	0.8732	13.15476	11.48602	1.83432	60.56	20.583	36.102
20.505	471.895	62.15	0.84	1.35	-0.37	46.6303	1.38119	2.26465	46.6378	1.38096	7	130.00	1.33283	1.332825	0	0.8662	13.50969	11.78859	1.88288	62.16	21.234	36.162
20.833	471.567	58.16	0.81	1.4	-0.14	41.9496	1.42591	2.30229	41.9496	1.42591	7	130.00	1.35415	1.354145	0	0.8593	12.64251	11.12207	1.7587	58.16	22.6082	36.86
21.161	471.239	61.14	0.98	1.6	-0.23	43.4504	1.63977	2.62698	43.4504	1.63977	7	130.00	1.37547	1.375465	0	0.8527	13.75345	11.7727	1.8503	61.14	23.5343	36.67
21.489	470.911	58.39	1.21	2.08	-0.09	40.8031	2.12306	2.41187	40.8031	2.12306	7	130.00	1.39679	1.396785	0	0.8461	13.68713	11.58104	1.7545	58.39	27.1802	35.464
21.817	470.583	68.58	1.4	2.05	-0.21	47.3603	2.08452	2.36412	47.3603	2.08452	7	130.00	1.41811	1.418105	0	0.8397	16.08334	13.16695	2.07932	68.58	24.9726	36.361
22.145	470.255	82.38	1.87	2.03	-0.14	42.3367	2.064	2.40123	42.3367	2.064	7	130.00	1.43943	1.439425	0	0.8336	14.50822	12.09093	1.8967	82.38	28.4611	35.715
22.473	469.927	56.41	1.04	1.85	-0.23	37.6173	1.89268	2.4147	37.6173	1.89268	7	130.00	1.46075	1.460745	0	0.8274	13.18879	10.92061	1.70123	56.41	27.0146	35.003
22.802	469.598	43.25	0.65	1.27	-0.21	28.181	1.13168	2.42382	28.181	1.3168	7	130.00	1.48218	1.48218	0	0.8214	10.16202	8.347122	1.29312	43.25	27.393	33.22
23.13	469.270	47.18	0.49	1.04	-0.09	30.3812	1.07276	2.34808	30.3812	1.07276	7	130.00	1.50345	1.503455	0	0.8156	10.7126	8.796759	1.41413	47.18	24.3461	33.69
23.458	468.942	41.56	0.66	1.58	-0.04	26.2566	1.64855	2.50417	26.2566	1.64855	7	130.00	1.52477	1.52477	0	0.8098	10.13933	8.21121	1.23948	41.56	30.8699	32.776
23.786	468.614	33	0.65	1.96	0.16	20.3442	2.06652	2.65128	20.3442	2.06652	6	130.00	1.54609	1.54609	0	0.8042	8.058731	6.563648	0.9748	33	37.0166	31.141
24.114	468.286	31.46	0.73	2.33	0.09	19.0713	2.44208	2.71649	19.0713	2.44208	6	130.00	1.56741	1.56741	0	0.7987	8.504338	6.821639	0.92547	31.46	41.3366	30.721
24.442	467.958	28.46	0.84	2.94	-0.07	16.9137	3.12602	2.82253	16.9137	3.12602	6	130.00	1.58878	1.58878	0	0.7934	8.186954	6.485271	0.83183	28.46	47.3052	29.934
24.77	467.630	36.73	0.78	2.06	0.19	21.813	2.16401	2.63841	21.813	2.16401	6	130.00	1.61005	1.61005	0	0.7881	9.574187	7.545399	1.0673	36.73	27.2838	31.591
25.098	467.302	53.09	0.84	1.58	-0.04	31.5432	1.63238	2.48564	31.5432	1.63238	7	130.00	1.63137	1.63137	0	0.7829	12.54912	9.885696	1.55315	53.09	27.8392	33.923
25.426	466.974	37.37	0.93	2.48	0.02	21.6116	2.60378	2.68975	21.6116	2.60378	6	130.00	1.65269	1.65269	0	0.7779	10.00281	7.880441	1.1056	37.37	29.9116	31.631
25.754	466.646	29.67	0.83	2.8	0.05	16.7239	2.96471	2.81252	16.7239	2.96471	5	130.00	1.67401	1.67401	0	0.7728	8.487242	6.690754	0.86675	29.67	35.7196	29.88
26.082	466.318	29.89	0.72	2.4	0.04	16.6308	2.55367	2.77598	16.6308	2.55367	6	130.00	1.69533	1.69533	0	0.768	8.378885	6.605141	0.8729	29.89	44.8215	29.823
26.41	465.990	40.76	0.67	1.65	0.51	22.7439	1.71604	2.56534	22.7439	1.71604	7	130.00	1.71665	1.71665	0	0.7632	10.24312	7.817922	1.20877	40.76	33.6906	31.86
26.739	465.661	31.14	0.85	2.72	0.6	16.9168	2.89096	2.80197	16.9168	2.89096	6	130.00	1.73804	1.738035	0	0.7585	8.555459	6.7171	0.91028	31.14	46.1075	29.935
27.067	465.333	27.6	0.95	3.45	0.11	14.6876	3.67638	2.91406	14.6876	3.67638	5	130.00	1.75936	1.759355	0	0.7539	8.370608	6.510738	0.80002	27.6	52.8796	29
27.395	465.005	20.8	0.75	3.59	0.09	10.661	3.94336	3.04266	10.661	3.94336	5	130.00	1.78068	1.780675	0	0.7494	6.829167	5.117707	0.5883	20.8	61.4048	28.663
27.723	464.677	32.07	0.92	2.78	0.41	17.2984	2.95174	2.79991	17.2908	2.95269	6	130.00	1.802	1.801995	0	0.7449	9.362277	6.974365	0.90495	32.96	45.9884	30.079
28.051	464.349	34.02	0.75	2.2	0.56	17.6583	2.32943	2.73173	17.6528	2.33016	6	130.00	1.82332	1.823315	0	0.7406	9.50799	6.893266	0.9068	34.01	42.1626	30.215
28.379	464.021	30.25	0.56	1.86	0.39	15.3989	1.97146	2.73942	15.3989	1.97146	6	130.00	1.84464	1.844635	0	0.7365	8.813189	6.120845	0.87942	30.26	42.5639	29.814
28.707	463.693	26.45	0.54	2.03	0.44	13.175	2.19655	2.82207	13.1697	2.19744	6	130.00	1.86596	1.865955	0	0.7321	7.603492	5.56654	0.78112	26.44	47.2781	29.272
29.035	463.365	35.65	0.64	1.79	0.42	17.8697	1.89558	2.67583	17.8897	1.89558	6	125.00	1.88728	1.887275	0	0.7279	9.473402	6.895859	1.04529	35.65	39.1825	30.303
29.363	463.037	31.91	0.9	2.81	0.93	15.7263	2.99978	2.83696	15.7263	2.99978	6	125.00	1.90778	1.907775	0	0.724	9.254513	6.700235	0.92886	31.91	48.1674	29.453
29.691	462.709	78.81	1.79	2.27	-13.37	39.8707	2.32825	2.45145	39.9174	2.32653	7	125.00	1.92828	1.928275	0	0.7201	18.77676	13.52185	2.38024	78.9	28.5599	35.362
30.019	462.381	75.42	2.46	3.26	-19.88	37.7012	3.34825	2.57393	37.7628	3.34279	6	125.00	1.94878	1.948775	0	0.7163	19.06391	13.65524	2.27465	75.54	34.0985	35.027
30.347	462.053	73.52	2.38	3.23	-21.24	36.3335	3.32631	2.58372	36.3996	3.32028	6	125.00	1.96928	1.969276	0	0.7126	18.67716	13.30937	2.21619	73.65	34.5679	34.803
30.675	461.725	61.35	2.05	3.35	-21.62	29.8326	3.45349	2.65802	29.903	3.44537	6	125.00	1.98978	1.989775	0	0.7089	16.19004	11.47746	1.83778	61.49	38.2614	33.591
31.004	461.396	28.32	1.36	4.8	-15.93	13.0872	5.1692	3.04324	13.1369	5.14963	3	125.00	2.01034	2.010338	0	0.7053	9.334539	6.583523	0.81454	28.42	61.4455	28.256
31.332	461.068	40.8	1.24	3.05	-12.77	19.0902	3.19842	2.78585	19.1296	3.19183	6	125.00	2.03084	2.030838	0	0.7017	11.52195	8.085156	1.20028	40.88	45.182	30.741
31.66	460.740	44.64	1.36	3.05	-16.6	20.7614	3.19334	2.75656	20.815	3.18511	6	125.00	2.05134	2.051338	0	0.6982	12.41234	8.66633	1.31853	44.75	43.5317	31.289
31.988	460.412	35.89	0.92	2.56	-16.6	16.3228	2.72043	2.79674	16.3759	2.71161	6	125.00	2.07184	2.071838	0	0.6947	10.20784	7.091796	1.047	36	45.8061	29.721
32.316	460.084	41.49	0.76	1.84	-15.52	18.8295	1.92905	2.6602	18.8773	1.92416	6	125.00	2.09234	2.092338	0	0.6913	10.96277	7.578869	1.21974	41.69	38.3734	30.654
32.644	459.756	44.62	0.87	1.94	-15.36	20.1185	2.04671	2.6514	20.1658	2.04191	6	125.00	2.11284	2.112838	0	0.688	11.73457	8.072984	1.31601	44.72	37.9227	31.084
32.972	459.428	46.81	0.97	2.07	-12.68	20.9421	2.17116	2.65248	20.9796	2.16728	6	125.00	2.13334	2.133338	0	0.6847	12.31082	8.428633	1.38318	46.89	37.976	31.34
33.3	459.100	34.78	0.63	1.82	-11.57	15.1479	1.93097	2.73912	15.1804	1.92683	6	125.00	2.15384	2.153838	0	0.6814	9.575763	6.524796	1.0101	34.85	42.5673	29.219
33.628	458.772	27.97	0.53	1.88	-11.11	11.8637	2.05461	2.84249	11.8959	2.04905	6	125.00	2.17434	2.174338	0	0.6782	8.167752	5.532317	0.79863	28.04	48.487	27.59
33.956	458.444	25.2	0.51	2.03	-10.93	10.4815	2.21689	2.90541	10.5134	2.21017	6	125.00	2.19484	2.194838	0	0.675	7.62481	5.146688	0.71223	25.27	52.3352	26.756
34.284	458.116	23.12	0.44	1.91	-10.81	9.43633	2.10479	2.93186	9.46793	2.09777	6	125.00	2.21534	2.215338	0	0.6719	7.108146	4.775693	0.6472	23.19	54.0101	26.047
34.612	457.788	24.88	0.56	2.24	-10.49	10.1278	2.47304	2.94368	10.1591	2.46542	6	125.00	2.23584	2.235838	0	0.6688	7.702224	5.151053	0.70106	24.95	54.7701	26.525
34.941	457.459	27.6	0.74	2.67	-10.42	11.2319	2.91967	2.94724	11.2585	2.91297	6	125.00	2.2564	2.2564	0	0.6657	8.557203	5.696706	0.78463	27.65	55.0001	27.219
35.269	457.131	22.71	0.58	2.56	-10.21	8.97409	2.83653	3.02029	9.00483	2.82884	5	125.00	2.2769	2.2769	0	0.6627	7.373349	4.886443	0.6326	22.78	59.8616	26.707
35.597	456.803	20.39	0.5	2.46	-9.49	7.87525	2.76356	3.06177	7.89701	2.75594	5	125.00	2.2974	2.2974	0	0.6598	6.794369	4.482609	0.56014	20.44	62.7431	24.816
35.925	456.475	20.1	0.58	2.89	-8.89	7.67164	3.26171	3.1108	7.69321	3.25256	5	125.00	2.3179	2.3179	0	0.6568	6.918507	4.54428	0.56053	20.15	66.264	24.639
36.253	456.147	21.46	0.65	3.04	-5.91	8.17722	3.3993	3.09836	8.19432	3.3922	5	125.00	2.3384	2.3384	0	0.6539	7.320835	4.787417	0.592	21.5	65.3582	25.057
36.581	455.819	18.81	0.64	3.38	-5.48	6.97406	3.89032	3.18867	6.98677	3.88324	5	125.00	2.3589	2.3589	0	0.6511	6.8256	4.444123	0.50932	18.84	72.1173	23.985
36.909	455.491	18.56	0.68	3.67	-4.62	6.80029	4.20256	3.21677	6.81289	4.19479	4	125.00	2.3794	2.3794	0	0.6483	6.871849	4.45492	0.50095	18.59	74.3104	23.814
37.237	455.163	16.65	0.84	5.06	-4.85	5.95614	5.8947	3.34912	5.96868	5.88231	3	135.00	2.3999	2.392506	0.0074	0.6465	6.818186	4.408008	0.44118	16.68	85.2328	22.923
37.565	454.835	18.46	0.76	4.13	-5.01	6.67022	4.73876	3.25373	6.6827	4.72991	4	135.00	2.42204	2.404412	0.0176	0.6449	7.022524	4.528859	0.49653	18.49	77.2612	23.691

R13254

Depth (ft)	Samp... ... (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	454.507	17.57	0.66	3.77	-4.48	6.25986	4.3634	3.25552	6.27228	4.35476	4	135.00	2.44418	2.416318	0.0279	0.6433	6.693405	4.30596	0.46829	17.6	77.4062	23.267
38.221	454.179	23.26	0.72	3.08	-3.6	8.56333	3.46259	3.08679	8.57568	3.4576	5	135.00	2.46632	2.428225	0.0381	0.6417	7.869741	5.050286	0.64377	23.29	64.5241	25.388
38.549	453.851	35.17	1.71	4.86	-4.65	13.3934	5.23231	3.04061	13.4056	5.22751	3	135.00	2.48846	2.440131	0.0483	0.6402	11.54187	7.388724	1.01181	35.2	61.2619	28.401
38.877	453.523	74.79	4.27	5.7	-12.75	29.4773	5.90763	2.62205	29.5099	5.9011	11	135.00	2.5106	2.452038	0.0586	0.6386	21.5316	13.75032	2.23775	74.87	47.2766	33.514
39.206	453.194	104.68	6.22	5.94	-19.79	41.4562	6.08925	2.72869	41.5049	6.09211	11	135.00	2.53281	2.46398	0.0688	0.6371	28.63555	18.24261	3.16245	104.8	41.9974	35.6
39.534	452.866	152.53	8.46	5.55	-19.17	60.5743	5.64094	2.59462	60.6227	5.63643	11	135.00	2.55495	2.475887	0.0791	0.6355	38.92148	24.73568	4.64319	152.65	35.0952	37.815
39.862	452.538	232.67	10.79	4.64	-19.12	92.4888	4.68941	2.41592	92.533	4.68717	11	135.00	2.57709	2.487793	0.0893	0.634	54.49616	34.65087	7.12362	232.78	27.0646	40.155
40.19	452.210	391.32	13.96	3.57	-18.27	155.507	3.59127	2.18739	155.551	3.59025	12	135.00	2.59923	2.4997	0.0996	0.6325	82.95759	52.47014	12.0347	391.43	18.574	42.835
40.518	451.882	504.54	14.95	2.96	-19.14	199.84	2.97857	2.05825	199.888	2.97786	12	135.00	2.62137	2.511606	0.1098	0.631	101.5206	64.05876	15.5393	504.66	14.5769	44.055
40.846	451.554	352.83	14.47	4.1	7.69	138.769	4.13208	2.26597	138.754	4.13256	12	135.00	2.64351	2.523512	0.12	0.6295	77.28576	48.65156	10.8417	352.79	21.2814	42.264
41.174	451.226	428.29	14.1	3.29	55.96	167.871	3.31278	2.14021	167.733	3.31551	12	135.00	2.66565	2.535419	0.1302	0.628	88.95563	55.86613	13.1772	427.94	17.0501	43.207

17 of 70

R13255

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 18 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY TJS DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-3

ConeTec Inc. Interpretation
Interpretation Ou., Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4528
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-3
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 07:09
CPT File: 804CP03.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 466.98

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	36.95	1.32	43.13	32.39	2.49

User Inputs:
Assumed: Water Table Depth (ft): 11.1
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 467.0
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	466.816	22.8	0.36	1.56	-0.74	2223.39	1.580	1.42	2224.37	1.58	6	125.00	0.010	0.010	0.000	2.000	3.67	7.34	0.706	22.81	1.81602	53.62
0.492	466.488	42.45	0.67	1.58	-5.17	1379.49	1.579	1.46	1380.46	1.58	7	125.00	0.031	0.031	0.000	2.000	6.91	13.82	1.313	42.48	2.23467	52.00
0.82	466.160	28.94	0.66	2.29	-5.45	563.683	2.285	1.73	564.27	2.28	6	125.00	0.051	0.051	0.000	2.000	5.17	10.34	0.894	28.97	6.77422	48.62
1.148	465.832	23.43	0.46	1.97	-7.27	325.551	1.969	1.79	326.25	1.97	6	125.00	0.072	0.072	0.000	2.000	4.27	8.55	0.723	23.48	7.91659	46.30
1.476	465.504	32.54	0.58	1.77	-11.34	351.737	1.787	1.74	352.50	1.78	6	125.00	0.092	0.092	0.000	2.000	5.82	11.65	1.005	32.61	6.82459	46.64
1.804	465.176	38.02	0.94	2.47	-4.06	336.206	2.480	1.87	336.38	2.48	6	125.00	0.113	0.113	0.000	2.000	7.12	14.25	1.174	38.04	9.67104	46.44
2.133	464.847	36.81	1.27	3.46	-2.93	275.118	3.463	2.04	275.27	3.46	5	125.00	0.133	0.133	0.000	2.000	7.35	14.70	1.136	36.83	14.0176	45.54
2.461	464.519	32.44	1.88	5.81	-1.76	209.906	5.823	2.29	209.97	5.82	3	125.00	0.154	0.154	0.000	2.000	7.19	14.38	1.000	32.45	22.2623	44.29
2.789	464.191	33.21	1.93	5.82	-0.93	169.52	5.842	2.32	169.58	5.84	3	125.00	0.174	0.174	0.000	2.000	7.44	14.88	1.023	33.22	23.1469	43.80
3.117	463.863	41.98	2.26	5.38	1.78	214.489	5.409	2.26	214.44	5.41	3	125.00	0.195	0.195	0.000	2.000	9.17	18.35	1.294	41.97	21.0994	44.39
3.445	463.535	51.02	2.5	4.89	1.36	235.958	4.921	2.20	235.91	4.92	4	125.00	0.215	0.215	0.000	2.000	10.89	21.78	1.573	51.01	19.1479	44.83
3.773	463.207	61.43	2.63	4.28	0.26	259.504	4.298	2.13	259.46	4.30	5	125.00	0.236	0.236	0.000	2.000	12.73	25.46	1.895	61.42	16.8244	45.27
4.101	462.879	66.35	2.47	3.72	5.77	257.864	3.737	2.08	257.71	3.74	5	125.00	0.256	0.256	0.000	1.975	13.47	26.60	2.046	66.31	15.2758	45.24
4.429	462.551	70.01	2.46	3.51	-1.2	251.915	3.528	2.07	251.91	3.53	6	125.00	0.277	0.277	0.000	1.901	14.12	26.84	2.159	70.01	14.7869	45.14
4.757	462.223	47.34	1.98	4.19	4.97	158.226	4.209	2.24	158.09	4.21	5	125.00	0.297	0.297	0.000	1.834	10.25	18.80	1.456	47.3	20.3659	42.91
5.085	461.895	35.26	1.25	3.54	14.76	109.946	3.577	2.28	109.66	3.59	5	125.00	0.318	0.318	0.000	1.774	7.75	13.74	1.082	35.17	21.7542	41.05
5.413	461.567	29.45	1.07	3.63	14.25	86.0497	3.675	2.36	85.78	3.69	5	125.00	0.338	0.338	0.000	1.719	6.69	11.50	0.901	29.36	24.6747	39.74
5.741	461.239	22.73	0.72	3.15	18.2	62.3478	3.216	2.41	62.01	3.24	5	125.00	0.359	0.359	0.000	1.669	5.28	8.81	0.693	22.61	28.8102	37.94
6.069	460.911	20.62	0.5	2.43	23.72	53.3615	2.470	2.38	52.97	2.49	5	125.00	0.379	0.379	0.000	1.624	4.71	7.85	0.627	20.47	25.5653	37.04
6.398	460.582	23.44	0.52	2.22	51.64	57.6183	2.257	2.33	56.82	2.29	6	125.00	0.400	0.400	0.000	1.581	5.21	8.24	0.713	23.12	23.7246	37.44
6.726	460.254	16.44	0.47	2.64	44.02	38.1079	2.934	2.54	37.44	2.99	5	125.00	0.420	0.420	0.000	1.542	4.02	6.20	0.498	16.16	32.6769	34.97
7.054	459.926	14.75	0.41	2.79	45.61	32.4562	2.865	2.59	31.82	2.92	5	125.00	0.441	0.441	0.000	1.506	3.68	5.55	0.443	14.47	34.9073	33.98
7.382	459.598	17.36	0.43	2.45	47.02	36.67	2.542	2.52	36.04	2.59	6	125.00	0.461	0.461	0.000	1.472	4.19	6.17	0.524	17.09	31.3627	34.74
7.71	459.270	18.54	0.47	2.51	37.83	37.4747	2.603	2.51	36.98	2.64	5	125.00	0.482	0.482	0.000	1.441	4.48	6.46	0.559	18.3	31.2347	34.90
8.038	458.942	19.4	0.5	2.58	37.94	37.6166	2.646	2.52	37.16	2.68	5	125.00	0.502	0.502	0.000	1.411	4.70	6.63	0.585	19.17	31.3584	34.93
8.366	458.614	17.21	0.55	3.2	34.73	31.9142	3.296	2.63	31.49	3.34	5	125.00	0.523	0.523	0.000	1.383	4.41	6.11	0.517	16.99	36.9521	33.91
8.694	458.286	17.95	0.56	3.1	31.31	32.0343	3.217	2.62	31.68	3.25	5	125.00	0.543	0.543	0.000	1.357	4.59	6.23	0.539	17.76	36.4732	33.95
9.022	457.958	19.33	0.57	2.93	27.69	33.2806	3.037	2.59	32.98	3.07	5	125.00	0.564	0.564	0.000	1.332	4.88	6.50	0.581	19.16	34.995	34.20
9.35	457.630	18.87	0.64	3.4	23.97	31.2909	3.500	2.65	31.03	3.53	5	125.00	0.584	0.584	0.000	1.308	4.92	6.43	0.566	18.72	37.9977	33.82
9.678	457.302	20.7	0.61	2.95	26.23	33.2219	3.036	2.59	32.94	3.06	6	125.00	0.605	0.605	0.000	1.286	5.23	6.72	0.622	20.53	34.9967	34.19
10.006	456.974	20.8	0.74	3.57	10.97	32.26	3.668	2.65	32.15	3.68	5	125.00	0.625	0.625	0.000	1.265	5.45	6.89	0.625	20.73	38.0423	34.04
10.335	456.645	22.06	0.78	3.52	8.13	33.1519	3.642	2.64	33.07	3.65	5	125.00	0.646	0.646	0.000	1.244	5.75	7.15	0.663	22.01	37.4577	34.22
10.663	456.317	22.26	0.84	3.76	9.06	32.4015	3.890	2.67	32.31	3.90	4	125.00	0.666	0.666	0.000	1.225	5.88	7.20	0.669	22.2	38.8361	34.07
10.991	455.989	22.23	0.86	3.89	10.07	31.361	3.992	2.69	31.27	4.00	4	135.00	0.687	0.687	0.000	1.207	5.93	7.15	0.667	22.17	39.7776	33.87
11.319	455.661	19.23	0.81	4.2	10.53	26.3739	4.373	2.77	26.27	4.39	4	135.00	0.709	0.702	0.007	1.193	5.35	6.39	0.573	19.16	44.2873	32.76
11.647	455.333	18	0.62	3.43	12.28	24.1809	3.590	2.74	24.07	3.61	5	135.00	0.731	0.714	0.017	1.183	4.93	5.84	0.535	17.92	42.7427	32.23
11.975	455.005	21.25	0.62	2.92	16.42	28.2301	3.025	2.64	28.09	3.04	5	135.00	0.753	0.726	0.027	1.174	5.53	6.49	0.635	21.15	37.4988	33.21
12.303	454.677	21.1	0.8	3.8	12.7	27.5413	3.936	2.73	27.43	3.95	4	135.00	0.775	0.738	0.038	1.164	5.73	6.67	0.629	21.02	41.8264	33.06
12.631	454.349	17.94	0.7	3.88	13.37	22.8604	4.083	2.80	22.74	4.11	4	135.00	0.798	0.750	0.048	1.155	5.06	5.85	0.531	17.85	45.8564	31.88
12.959	454.021	16.67	0.53	3.19	25.01	20.8069	3.344	2.78	20.60	3.38	5	135.00	0.820	0.762	0.058	1.146	4.63	5.30	0.491	16.51	44.6307	31.24
13.287	453.693	17.08	0.47	2.76	28.87	20.988	2.894	2.73	20.76	2.93	5	135.00	0.842	0.774	0.068	1.137	4.63	5.27	0.503	16.9	42.3273	31.30
13.615	453.365	15.98	0.45	2.79	32.33	19.2415	2.977	2.77	18.99	3.02	5	135.00	0.864	0.786	0.078	1.128	4.42	4.98	0.468	15.78	44.472	30.73
13.943	453.037	17	0.42	2.45	36.95	20.2055	2.606	2.72	19.92	2.64	6	135.00	0.886	0.797	0.089	1.120	4.57	5.11	0.499	16.77	41.6351	31.04
14.271	452.709	20.35	0.53	2.61	41.32	24.0198	2.726	2.67	23.70	2.76	5	135.00	0.908	0.809	0.099	1.112	5.33	5.93	0.602	20.09	39.0883	32.16
14.6	452.380	24.99	0.7	2.79	53.19	29.2928	2.909	2.63	28.89	2.95	5	135.00	0.931	0.821	0.109	1.103	6.39	7.05	0.745	24.66	36.6088	33.40
14.928	452.052	25.84	0.92	3.55	51.01	29.8677	3.697	2.69	29.48	3.74	5	135.00	0.953	0.833	0.119	1.095	6.82	7.47	0.771	25.52	39.7482	33.63
15.256	451.724	25.35	0.86	3.38	59.49	28.641	3.526	2.69	28.40	3.58	5	135.00	0.975	0.845	0.130	1.088	6.67	7.26	0.755	24.98	39.714	33.30

R13257

Depth (ft)	Sam (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	451.396	25.2	0.94	3.72	60.14	28.2395	3.884	2.72	27.80	3.95	5	135.00	0.997	0.857	0.140	1.080	6.75	7.29	0.749	24.82	41.5723	33.17
15.912	451.068	23.53	0.87	3.69	59.12	25.9052	3.865	2.75	25.48	3.93	5	135.00	1.019	0.869	0.150	1.073	6.39	6.86	0.697	23.16	43.0523	32.63
16.24	450.740	24.42	0.79	3.22	95.41	26.5403	3.379	2.71	25.87	3.47	5	135.00	1.041	0.881	0.160	1.065	6.44	6.86	0.724	23.83	40.8417	32.73
16.568	450.412	23.13	0.79	3.4	93.16	24.7167	3.580	2.75	24.07	3.68	5	135.00	1.063	0.893	0.171	1.058	6.22	6.59	0.683	22.55	43.0416	32.27
16.896	450.084	25.8	0.86	3.32	86.21	27.3182	3.480	2.70	26.73	3.56	5	135.00	1.086	0.905	0.181	1.051	6.81	7.16	0.765	25.27	40.6511	32.94
17.224	449.756	27.36	1.09	3.99	68.75	28.6411	4.152	2.74	28.17	4.22	4	135.00	1.108	0.917	0.191	1.045	7.39	7.72	0.813	26.93	42.4068	33.26
17.552	449.428	23.92	1.23	5.16	49.52	24.5451	5.397	2.86	24.21	5.47	3	135.00	1.130	0.929	0.201	1.038	6.94	7.20	0.706	23.61	49.6011	32.32
17.88	449.100	22.38	1.09	4.86	39.24	22.5732	5.135	2.87	22.31	5.20	3	135.00	1.152	0.940	0.212	1.031	6.55	6.75	0.657	22.13	50.2616	31.80
18.208	448.772	17.75	0.82	4.63	24.36	17.4059	4.947	2.94	17.25	4.99	3	135.00	1.174	0.952	0.222	1.025	5.43	5.57	0.513	17.6	54.7916	30.15
18.537	448.443	16.18	0.53	3.25	29.47	15.5391	3.537	2.89	15.35	3.58	5	135.00	1.196	0.964	0.232	1.018	4.79	4.88	0.464	16	51.4876	29.40
18.865	448.115	16.38	0.38	2.32	30.44	15.5318	2.506	2.80	15.34	2.54	5	135.00	1.218	0.976	0.242	1.012	4.61	4.66	0.469	16.19	46.1677	29.39
19.193	447.787	17.22	0.42	2.44	41.84	16.1723	2.628	2.80	15.91	2.67	5	135.00	1.241	0.988	0.253	1.006	4.83	4.86	0.495	16.96	46.1732	29.64
19.521	447.459	27.26	0.55	2.02	43.37	25.9979	2.116	2.58	25.73	2.14	6	135.00	1.263	1.000	0.263	1.000	6.82	6.82	0.805	26.99	34.2771	32.71
19.849	447.131	15.42	0.71	4.62	19.56	13.9691	5.023	3.02	13.85	5.07	3	135.00	1.285	1.012	0.273	0.994	4.95	4.93	0.438	15.3	59.9097	28.74
20.177	446.803	42.76	1.36	3.19	-1.64	40.4898	3.281	2.55	40.50	3.28	5	135.00	1.307	1.024	0.283	0.988	10.65	10.52	1.283	42.77	32.7842	35.49
20.505	446.475	21.33	1.36	6.39	-21.13	19.3115	6.800	2.99	19.44	6.76	3	135.00	1.329	1.036	0.293	0.983	6.83	6.71	0.619	21.46	58.031	30.94
20.833	446.147	94.63	4.34	4.59	-16.03	89.0402	4.653	2.42	89.14	4.65	11	135.00	1.351	1.048	0.304	0.977	22.25	21.74	2.888	94.73	27.3675	39.97
21.161	445.819	325.72	14.52	4.46	-12.24	306.129	4.477	2.11	306.20	4.48	11	135.00	1.373	1.060	0.314	0.972	67.01	65.10	10.042	325.8	16.2306	46.03
21.489	445.491	395.71	17.73	4.48	-7.11	368.031	4.496	2.08	368.07	4.50	12	135.00	1.396	1.071	0.324	0.966	80.29	77.56	12.208	395.75	15.201	46.84
21.817	445.163	424.33	18.21	4.29	-16.47	390.385	4.306	2.05	390.48	4.30	12	135.00	1.418	1.083	0.334	0.961	85.16	81.82	13.093	424.43	14.3837	47.09

R13258

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 21 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-4

ConeTec Inc. Interpretation
Interpretation Of Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4501
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-4
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 12:51
CPT File: 804CP04.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 482.55

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	40.98	1.95	63.49	28.02	2.41

User Inputs:
Assumed: Water Table Depth (ft): 21.7
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 482.6
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.386	18.72	0.55	2.92	-0.12	1825.34	2.940	1.70	1825.34	2.94	6	125.00	0.010	0.010	0.000	2.000	3.30	6.60	0.579	18.72	6.13882	52.96
0.492	482.058	32.37	1.04	3.2	7.35	1051.68	3.216	1.79	1050.36	3.22	5	125.00	0.031	0.031	0.000	2.000	5.87	11.75	1.001	32.33	7.80728	51.02
0.82	481.730	59.25	1.53	2.69	5.03	1155.1	2.585	1.68	1154.51	2.59	6	125.00	0.051	0.051	0.000	2.000	10.36	20.76	1.833	59.22	5.79663	51.36
1.148	481.402	69.32	1.89	2.73	-7.9	965.132	2.729	1.73	965.83	2.73	6	125.00	0.072	0.072	0.000	2.000	12.34	24.68	2.144	69.37	6.60102	50.71
1.476	481.074	55.93	1.68	3.01	-4.6	605.287	3.009	1.83	605.61	3.01	6	125.00	0.092	0.092	0.000	2.000	10.34	20.68	1.729	55.96	6.8217	48.91
1.804	480.746	47.44	1.34	2.62	-9.26	419.754	2.831	1.87	420.29	2.83	6	125.00	0.113	0.113	0.000	2.000	8.91	17.82	1.465	47.5	9.76493	47.40
2.133	480.417	31.92	1.13	3.53	-8.69	238.437	3.555	2.06	238.81	3.55	5	125.00	0.133	0.133	0.000	2.000	6.49	12.97	0.984	31.97	15.2078	44.89
2.461	480.089	34.91	0.98	2.81	-9.96	225.965	2.820	2.01	226.35	2.81	6	125.00	0.154	0.154	0.000	2.000	6.90	13.80	1.076	34.97	13.1573	44.64
2.789	479.761	22.26	0.83	3.71	-10	126.702	3.758	2.25	127.05	3.75	4	125.00	0.174	0.174	0.000	2.000	4.67	9.73	0.684	22.32	20.8802	41.81
3.117	479.433	18.96	0.9	4.76	-6.79	96.3244	4.796	2.41	96.58	4.78	3	125.00	0.195	0.195	0.000	2.000	4.44	8.88	0.581	19.01	26.8756	40.38
3.445	479.105	26.28	1.23	4.69	-6.97	121.055	4.719	2.35	121.24	4.71	3	125.00	0.215	0.215	0.000	2.000	5.97	11.94	0.807	26.32	24.2842	41.67
3.773	478.777	29.78	1.59	5.34	-8.66	125.287	5.382	2.39	125.50	5.37	3	125.00	0.236	0.236	0.000	2.000	6.88	13.77	0.915	29.83	25.7669	41.75
4.101	478.449	30.45	1.78	5.86	-8.64	117.8	5.895	2.43	118.00	5.89	3	125.00	0.256	0.256	0.000	1.975	7.19	14.21	0.936	30.5	27.7303	41.43
4.429	478.121	31.27	1.79	5.72	-10.05	111.965	5.775	2.44	112.22	5.76	3	125.00	0.277	0.277	0.000	1.901	7.41	14.08	0.960	31.34	27.9465	41.17
4.757	477.793	29.3	1.55	5.3	-9.47	97.5495	5.344	2.45	97.75	5.33	3	125.00	0.297	0.297	0.000	1.834	6.97	12.78	0.898	29.36	28.3092	40.45
5.085	477.465	29.53	1.58	5.36	-6.95	91.9164	5.409	2.47	92.07	5.40	3	125.00	0.318	0.318	0.000	1.774	7.09	12.67	0.904	29.58	29.17	40.13
5.413	477.137	29.07	1.51	5.21	-5.13	84.9265	5.256	2.48	85.02	5.25	3	125.00	0.338	0.338	0.000	1.719	7.01	12.05	0.890	29.1	29.6819	39.69
5.741	476.809	26.51	1.35	5.1	-4.32	72.8826	5.162	2.51	72.97	5.16	3	125.00	0.359	0.359	0.000	1.669	6.50	10.86	0.810	26.54	31.275	38.66
6.069	476.481	27.29	1.35	4.94	-2.56	70.946	5.017	2.51	71.00	5.01	3	125.00	0.379	0.379	0.000	1.624	6.69	10.86	0.833	27.31	31.1947	38.70
6.398	476.152	32.7	1.45	4.43	4.16	80.7756	4.489	2.44	80.70	4.49	4	125.00	0.400	0.400	0.000	1.581	7.73	12.23	1.000	32.67	28.0404	39.41
6.726	475.824	32.33	1.57	4.85	6.33	75.9075	4.920	2.49	75.81	4.93	3	125.00	0.420	0.420	0.000	1.542	7.61	12.05	0.988	32.29	30.1186	39.07
7.054	475.496	27.79	1.42	5.1	5.89	62.0337	5.192	2.56	61.97	5.20	3	125.00	0.441	0.441	0.000	1.506	6.96	10.49	0.847	27.76	33.5207	37.94
7.382	475.168	27.6	1.26	4.54	6.3	59.2547	4.609	2.54	59.17	4.62	4	125.00	0.461	0.461	0.000	1.472	6.88	10.13	0.846	27.76	32.3359	37.67
7.71	474.840	26.97	1.13	4.2	7.16	54.9689	4.266	2.53	54.89	4.27	4	125.00	0.482	0.482	0.000	1.441	6.66	9.60	0.820	26.93	32.2137	37.24
8.038	474.512	23.35	0.77	3.28	9.98	45.4792	3.370	2.52	45.36	3.38	5	125.00	0.502	0.502	0.000	1.411	5.72	8.07	0.707	23.29	31.5492	36.13
8.366	474.184	23.34	0.89	3.8	13.65	43.6378	3.901	2.58	43.47	3.92	4	125.00	0.523	0.523	0.000	1.383	5.86	8.13	0.706	23.25	34.2563	35.87
8.694	473.856	23.05	1.41	6.13	7.81	41.4201	6.265	2.74	41.33	6.26	3	125.00	0.543	0.543	0.000	1.357	6.32	8.58	0.697	23	42.6219	35.57
9.022	473.528	21.04	1.1	5.22	9.84	36.3132	5.372	2.73	36.21	5.39	3	125.00	0.564	0.564	0.000	1.332	5.74	7.65	0.634	20.98	42.147	34.77
9.35	473.200	24.56	1.13	4.61	14	41.0278	4.713	2.65	40.87	4.73	3	125.00	0.584	0.584	0.000	1.308	6.43	8.41	0.742	24.47	38.0684	35.50
9.678	472.872	29.72	1.6	5.4	18.45	48.1341	5.495	2.66	47.95	5.52	3	125.00	0.605	0.605	0.000	1.286	7.78	10.01	0.901	29.61	38.1091	36.45
10.006	472.544	27.78	1.68	6.06	20.23	43.4213	6.187	2.72	43.23	6.21	3	125.00	0.625	0.625	0.000	1.265	7.54	9.53	0.841	27.66	41.7217	35.84
10.335	472.215	35.02	2.44	6.96	1.71	53.2158	7.098	2.71	53.20	7.10	3	125.00	0.646	0.646	0.000	1.244	9.46	11.77	1.064	35.01	40.8687	37.06
10.663	471.887	39.84	2.72	6.82	-8.71	58.7805	6.943	2.67	58.66	6.93	3	125.00	0.666	0.666	0.000	1.225	10.58	12.96	1.213	39.89	38.9729	37.64
10.991	471.559	51.44	3.01	5.85	-13.44	73.8831	5.931	2.56	74.00	5.92	3	125.00	0.687	0.687	0.000	1.207	12.89	15.55	1.571	51.52	33.2411	38.93
11.319	471.231	49.73	3.35	6.74	-15.68	69.296	6.834	2.62	69.44	6.82	3	125.00	0.707	0.707	0.000	1.189	12.87	15.31	1.518	49.83	36.392	38.68
11.647	470.903	59.48	3.27	5.5	-19.93	80.7103	5.566	2.51	80.88	5.55	11	125.00	0.728	0.728	0.000	1.172	14.58	17.09	1.819	59.6	31.1331	39.42
11.975	470.575	59.84	3.39	5.67	-19.21	78.9532	5.737	2.53	79.11	5.73	11	125.00	0.748	0.748	0.000	1.156	14.78	17.09	1.829	59.96	31.8713	39.30
12.303	470.247	46.27	3.26	7.05	-21.45	59.1739	7.165	2.68	59.36	7.14	3	125.00	0.769	0.769	0.000	1.140	12.36	14.09	1.409	46.41	39.3681	37.69
12.631	469.919	60.74	3.55	5.84	-21.71	75.9409	5.922	2.55	76.12	5.91	11	125.00	0.789	0.789	0.000	1.125	15.17	17.07	1.856	60.88	32.8461	39.09
12.959	469.591	85.44	5.35	6.27	-21.04	104.49	6.322	2.49	104.65	6.31	11	125.00	0.810	0.810	0.000	1.111	20.71	23.01	2.620	86.57	30.0976	40.81
13.287	469.263	93.83	6.4	6.82	-21.32	111.989	6.882	2.50	112.16	6.87	11	125.00	0.830	0.830	0.000	1.097	22.88	25.10	2.879	93.97	30.668	41.17
13.615	468.935	109.07	7.14	6.54	-21.2	127.176	6.598	2.45	127.33	6.59	11	125.00	0.851	0.851	0.000	1.084	26.01	28.20	3.350	109.2	28.6543	41.83
13.943	468.607	131.31	8.27	6.3	-20.49	149.682	6.340	2.40	149.83	6.33	11	125.00	0.871	0.871	0.000	1.071	30.56	32.73	4.038	131.44	26.4331	42.65
14.271	468.279	130.51	8.58	6.57	-20.11	145.322	6.619	2.42	145.47	6.61	11	125.00	0.892	0.892	0.000	1.059	30.69	32.49	4.013	130.64	27.3685	42.50
14.6	467.950	121.15	8.14	6.72	-19.98	131.767	6.770	2.45	131.91	6.76	11	125.00	0.913	0.913	0.000	1.047	28.90	30.26	3.723	121.28	28.6919	42.01
14.928	467.622	117.27	7.69	6.56	-18.71	124.691	6.610	2.46	124.81	6.60	11	125.00	0.933	0.933	0.000	1.035	28.04	29.03	3.602	117.38	28.8952	41.72
15.256	467.294	114.14	8.49	7.43	-17.94	118.706	7.501	2.52	118.82	7.49	11	125.00	0.954	0.954	0.000	1.024	28.04	28.72	3.504	114.25	31.4374	41.47

R13260

Depth (ft)	San... (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	.Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.966	104.36	7.93	7.6	-18.2	106.146	7.670	2.55	106.27	7.66	11	125.00	0.974	0.974	0.000	1.013	26.08	26.43	3.201	104.48	33.0563	40.89
15.912	466.638	108.46	7.37	6.8	-18.02	108.06	6.858	2.51	108.17	6.85	11	125.00	0.995	0.995	0.000	1.003	26.53	26.60	3.327	108.57	31.0225	40.98
16.24	466.310	113.79	7.8	6.86	-17.9	111.108	6.916	2.50	111.22	6.91	11	125.00	1.015	1.015	0.000	0.993	27.78	27.58	3.491	113.9	30.8499	41.13
16.568	465.982	153.77	8.7	5.66	-14.55	147.498	5.696	2.37	147.59	5.69	11	125.00	1.036	1.036	0.000	0.983	35.20	34.59	4.729	153.86	25.0169	42.57
16.896	465.654	147.94	9.72	6.57	-6	139.095	6.617	2.43	139.13	6.62	11	125.00	1.056	1.056	0.000	0.973	34.93	33.99	4.547	147.98	27.8141	42.26
17.224	465.326	138.28	8.74	6.32	-8.2	127.453	6.370	2.44	127.51	6.37	11	125.00	1.077	1.077	0.000	0.964	32.76	31.58	4.248	138.34	28.1122	41.83
17.562	464.998	221.55	7.13	3.22	-7.74	200.96	3.234	2.09	201.01	3.23	12	125.00	1.097	1.097	0.000	0.955	45.08	43.04	6.825	221.6	15.4029	44.06
17.88	464.670	100.12	6.85	6.84	-12.15	88.5928	6.919	2.56	88.66	6.91	11	125.00	1.118	1.118	0.000	0.946	25.13	23.77	3.065	100.2	33.4931	39.92
18.208	464.342	76.59	4.86	6.34	-10.09	66.3023	6.441	2.61	66.36	6.44	11	125.00	1.138	1.138	0.000	0.937	19.73	18.50	2.336	76.66	36.0279	38.32
18.537	464.013	175.62	5.94	3.38	2.08	150.584	3.405	2.18	150.58	3.40	6	125.00	1.159	1.159	0.000	0.929	37.06	34.43	5.401	175.61	18.2365	42.67

R13261

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 24 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5

ConeTec Inc. .erpretation
Interpretation - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4462
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 12:34
CPT File: 804CP05.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 482.55

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.49	1.51	49.57	22.61	2.24
125	Soil Embankment	27.37	1.95	65.50	63.68	3.04

User Inputs:
Water Table Depth (ft): 34.4
Assumed: Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 482.6
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.386	8.56	0.05	0.59	0.16	802.002	0.585	1.14	802.00	0.58	1	130.00	0.011	0.011	0.000	2.000	1.26	2.53	0.265	8.56	1.10364	50.01
0.492	482.058	13.08	0.18	1.38	0.41	407.38	1.382	1.61	407.69	1.38	6	130.00	0.032	0.032	0.000	2.000	1.29	4.47	0.403	13.07	4.50658	47.27
0.82	481.730	39.92	0.69	1.73	0.58	747.968	1.731	1.66	748.16	1.73	7	130.00	0.053	0.053	0.000	2.000	6.76	16.50	1.234	39.93	3.96522	49.74
1.146	481.402	81.09	1.41	1.72	0.71	1085.71	1.728	1.52	1086.84	1.73	7	130.00	0.075	0.075	0.000	2.000	13.47	26.93	2.508	81.11	3.13579	51.14
1.476	481.074	98.28	2.17	2.21	0.39	1023.39	2.210	1.63	1023.39	2.21	7	130.00	0.096	0.096	0.000	2.000	16.62	33.85	3.040	98.28	4.87426	50.92
1.804	480.746	102.52	1.75	1.71	0.72	873.296	1.709	1.55	873.38	1.71	7	130.00	0.117	0.117	0.000	2.000	17.17	34.33	3.170	102.53	5.50958	50.83
2.133	480.417	78.33	1.69	2.22	0.46	649.643	2.218	1.73	649.61	2.22	7	130.00	0.139	0.139	0.000	2.000	13.58	27.16	2.369	78.34	6.87691	48.62
2.461	480.089	77.26	1.61	1.77	0.51	481.981	1.699	1.65	481.98	1.70	7	130.00	0.160	0.160	0.000	2.000	13.39	26.78	2.347	77.26	6.20939	47.98
2.789	479.761	73.62	1.23	1.67	0.64	405.101	1.675	1.66	405.10	1.67	7	130.00	0.181	0.181	0.000	2.000	12.90	25.80	2.274	73.62	6.78223	47.24
3.117	479.433	51.07	0.77	1.5	0.71	251.067	1.514	1.76	251.07	1.51	7	130.00	0.203	0.203	0.000	2.000	9.20	18.40	1.575	51.07	7.33445	46.12
3.445	479.105	43.47	0.65	1.49	0.99	193.127	1.503	1.83	193.12	1.50	7	130.00	0.224	0.224	0.000	2.000	8.03	16.06	1.369	43.48	8.00619	45.69
3.773	478.777	37.71	0.63	1.14	1.27	152.765	1.416	1.88	152.81	1.41	7	130.00	0.246	0.245	0.000	2.000	7.09	14.18	1.160	37.72	9.80686	45.75
4.101	478.449	27.27	0.39	1.43	1.04	101.302	1.444	2.01	101.34	1.44	6	130.00	0.267	0.267	0.000	1.937	5.58	10.44	0.838	27.28	13.2875	40.64
4.429	478.121	26.38	0.42	1.6	1.23	90.6338	1.610	2.08	90.83	1.61	6	130.00	0.288	0.288	0.000	1.864	5.39	9.97	0.809	26.38	15.1944	40.04
4.757	477.793	18.86	0.68	3.17	1.09	58.3781	3.213	2.43	58.38	3.21	5	130.00	0.309	0.309	0.000	1.798	4.32	7.77	0.559	18.86	27.4805	37.60
5.085	477.465	64.13	1.14	1.77	1.48	193.025	1.767	1.89	193.05	1.79	7	130.00	0.331	0.331	0.000	1.739	12.40	21.04	1.975	64.14	10.1662	43.89
5.413	477.137	80.68	2.1	2.6	1.02	228.306	2.614	1.98	228.33	2.61	6	130.00	0.352	0.352	0.000	1.686	15.74	26.64	2.487	80.69	12.3846	44.68
5.741	476.809	82.6	2.19	2.65	0.19	220.082	2.667	2.00	220.08	2.67	6	130.00	0.373	0.373	0.000	1.637	16.10	26.61	2.543	82.6	12.8155	44.61
6.069	476.481	82.21	1.32	1.6	0.88	207.396	1.613	1.84	207.40	1.61	7	130.00	0.394	0.394	0.000	1.592	16.20	24.21	2.533	82.21	8.94156	44.93
6.398	476.152	89.65	0.67	0.96	0.92	166.48	0.966	1.74	166.50	0.97	8	130.00	0.416	0.416	0.000	1.551	12.44	18.28	2.243	89.66	6.80329	43.17
6.726	475.824	87.23	1.03	1.54	0.51	152.778	1.542	1.91	152.78	1.54	7	130.00	0.437	0.437	0.000	1.512	12.76	19.31	2.068	87.23	10.5604	42.74
7.054	475.496	82.5	1.02	1.64	0.74	135.311	1.644	1.96	135.33	1.64	7	130.00	0.459	0.459	0.000	1.477	12.12	17.90	1.921	82.51	11.9624	42.14
7.382	475.168	58.83	0.75	1.27	0.63	121.606	1.285	1.92	121.61	1.29	7	130.00	0.480	0.480	0.000	1.444	11.22	16.20	1.807	58.83	10.669	41.66
7.71	474.840	46.66	0.49	1.05	1.29	92.1059	1.062	1.95	92.11	1.06	7	130.00	0.501	0.501	0.000	1.410	9.03	12.74	1.429	46.66	11.7456	40.16
8.038	474.512	37.02	0.37	0.99	0.74	69.8557	1.014	2.04	69.86	1.01	7	130.00	0.522	0.522	0.000	1.383	7.36	10.21	1.130	37.02	13.0486	39.61
8.366	474.184	26.15	0.38	1.46	1.04	47.0884	1.484	2.27	47.11	1.48	6	130.00	0.544	0.544	0.000	1.356	5.75	7.79	0.793	26.16	21.8182	36.35
8.694	473.856	16.2	0.12	0.79	0.81	26.8974	0.820	2.35	26.90	0.82	6	130.00	0.565	0.565	0.000	1.330	3.45	4.69	0.453	16.2	24.3641	32.83
9.022	473.528	13.51	0.23	1.67	1.09	22.0377	1.780	2.69	22.04	1.78	5	130.00	0.586	0.586	0.000	1.306	2.93	3.98	0.400	13.51	34.0597	31.66
9.35	473.200	16.76	0.4	2.39	2.31	26.6771	2.476	2.61	26.69	2.47	5	130.00	0.608	0.608	0.000	1.283	4.00	5.61	0.500	16.77	35.6054	32.86
9.678	472.872	59.24	0.78	1.29	1.66	93.1705	1.297	2.01	93.19	1.30	7	130.00	0.629	0.629	0.000	1.261	10.68	14.73	1.016	59.25	10.14	40.19
10.006	472.544	72.22	0.96	1.33	0.79	110.041	1.341	1.98	110.04	1.34	7	130.00	0.650	0.650	0.000	1.240	14.01	17.37	2.218	72.23	11.9961	41.07
10.335	472.215	64.71	1.11	1.72	0.51	96.3269	1.733	2.09	96.33	1.73	7	130.00	0.672	0.672	0.000	1.220	13.16	16.09	1.943	64.71	15.3858	40.31
10.663	471.887	67.23	1.33	1.98	0.56	95.9997	1.998	2.13	96.00	2.00	7	130.00	0.693	0.693	0.000	1.201	13.90	16.70	2.060	67.24	16.8516	40.36
10.991	471.559	52.16	1.16	2.22	1.01	72.0106	2.255	2.25	72.01	2.25	6	130.00	0.714	0.714	0.000	1.183	11.06	13.44	1.598	52.16	20.8129	38.78
11.319	471.231	50.64	1.24	2.17	1.8	76.392	2.206	2.23	76.41	2.21	6	130.00	0.736	0.736	0.000	1.166	12.20	14.01	1.740	50.65	19.9382	39.11
11.647	470.903	52.44	1.04	1.99	1.08	68.2684	2.012	2.24	68.28	2.01	7	130.00	0.757	0.757	0.000	1.149	11.34	13.03	1.600	52.45	20.2016	38.48
11.975	470.575	33.75	0.91	2.69	0.92	42.3596	2.760	2.48	42.37	2.76	6	130.00	0.778	0.778	0.000	1.133	8.16	9.23	1.021	33.76	29.8333	35.72
12.303	470.247	85.95	0.93	2.58	2.38	43.9548	2.546	2.46	43.98	2.54	6	130.00	0.800	0.800	0.000	1.118	8.56	9.69	1.088	85.97	28.7746	36.94
12.631	469.919	39.85	0.73	1.84	1.87	47.5375	1.878	2.33	47.55	1.87	6	130.00	0.821	0.821	0.000	1.104	8.99	9.92	1.208	39.85	23.739	36.40
12.959	469.591	38.57	0.32	0.82	1.46	44.7894	0.846	2.15	44.80	0.85	7	130.00	0.842	0.842	0.000	1.090	8.05	8.78	1.168	38.58	17.8896	36.06
13.287	469.263	63.21	0.49	0.91	0.83	60.6102	0.936	2.07	60.61	0.94	7	130.00	0.864	0.864	0.000	1.076	10.74	11.65	1.621	63.21	14.7302	37.81
13.615	468.935	34.3	0.61	1.77	0.69	37.7582	1.626	2.40	37.77	1.82	6	130.00	0.885	0.885	0.000	1.063	7.69	8.40	1.035	34.31	26.8559	35.03
13.943	468.607	28.16	0.33	1.17	0.69	30.0716	1.211	2.38	30.08	1.21	7	130.00	0.906	0.906	0.000	1.050	6.49	6.82	0.844	28.17	25.6033	33.63
14.271	468.279	28.64	0.48	1.79	0.69	27.7186	1.867	2.52	27.72	1.87	6	130.00	0.928	0.928	0.000	1.038	6.84	6.79	0.796	28.64	31.4282	33.12
14.6	467.950	28.1	0.34	1.19	0.97	26.6101	1.262	2.41	26.62	1.25	7	130.00	0.949	0.949	0.000	1.027	6.65	6.73	0.841	28.11	26.6807	33.32
14.928	467.622	26.73	0.38	1.33	0.67	26.5476	1.398	2.46	26.55	1.40	6	130.00	0.970	0.970	0.000	1.015	6.49	6.48	0.798	26.73	28.915	32.84
15.256	467.294	39.64	0.32	0.81	0.79	38.6733	0.830	2.20	39.88	0.83	7	130.00	0.992	0.992	0.000	1.004	9.42	9.46	1.193	39.65	18.9383	35.20

R13263

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	vStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.966	38.96	0.32	0.81	0.78	37.4615	0.845	2.22	37.46	0.84	7	130.00	1.013	1.013	0.000	0.994	8.36	8.30	1.175	38.96	19.527	34.98
15.912	466.638	27.47	0.35	1.28	0.74	26.5595	1.324	2.48	25.56	1.32	6	130.00	1.034	1.034	0.000	0.983	6.67	6.46	0.818	27.47	28.9506	32.60
16.24	466.310	23.18	0.23	0.99	0.74	20.9591	1.040	2.48	20.97	1.04	6	130.00	1.056	1.056	0.000	0.973	5.69	5.44	0.685	23.19	29.75	31.54
16.568	465.982	22.71	0.18	0.77	0.46	20.0879	0.832	2.46	20.09	0.83	7	130.00	1.077	1.077	0.000	0.964	5.40	5.20	0.670	22.71	28.4423	31.09
16.896	465.654	24.05	0.41	1.71	0.53	20.8997	1.786	2.61	20.90	1.79	6	130.00	1.098	1.098	0.000	0.954	6.17	5.88	0.711	24.05	35.6268	31.31
17.224	465.326	23.09	0.43	1.87	0.51	19.6242	1.957	2.65	19.63	1.96	6	130.00	1.120	1.120	0.000	0.945	6.06	5.78	0.680	23.1	37.8541	30.91
17.552	464.998	22.68	0.23	1.02	0.74	18.8794	1.058	2.52	18.88	1.07	6	130.00	1.141	1.141	0.000	0.936	6.59	6.23	0.667	22.68	41.7842	30.65
17.88	464.670	21.11	0.44	2.07	0.46	17.1638	2.206	2.73	17.16	2.21	6	130.00	1.162	1.162	0.000	0.928	5.77	5.36	0.618	21.11	41.6564	30.03
18.208	464.342	25.83	0.62	2.41	1.27	20.6247	2.51657	2.89328	20.6332	2.51455	6	130.00	1.18352	1.18352	0	0.919274	6.925377	6.398815	0.76305	25.84	40.0978	31.295
18.537	464.013	26.98	0.58	2.14	1.5	21.3918	2.25023	2.66803	21.4001	2.24836	6	130.00	1.20491	1.204905	0	0.9132	7.035644	6.744653	0.797795	26.98	38.1085	31.468
18.886	463.686	32.84	0.54	1.65	0.37	25.7814	1.70812	2.61963	25.7814	1.70812	6	130.00	1.22823	1.228225	0	0.9031	8.074106	7.588623	0.97875	32.84	31.6536	32.659
19.193	463.357	28.01	0.56	2	0.64	21.4521	2.09248	2.63571	21.4621	2.09248	6	130.00	1.24765	1.247545	0	0.8953	7.011148	6.627614	0.82858	28.01	37.1278	31.484
19.521	463.029	42.38	0.77	1.81	1.09	32.3999	1.87297	2.4463	32.4078	1.87252	7	130.00	1.268865	1.268865	0	0.8878	10.18259	9.0041	1.52127	42.39	29.0567	34.09
19.849	462.701	48.13	0.77	1.59	0.46	36.8047	1.8439	2.38956	36.8047	1.8439	7	130.00	1.290015	1.290185	0	0.8804	11.56334	9.801857	1.45016	48.13	25.9872	34.787
20.177	462.373	40.56	1.01	2.5	0.3	29.9263	2.57335	2.57572	29.9263	2.57335	6	130.00	1.311451	1.311505	0	0.8732	10.24612	8.946068	1.21812	40.56	34.1844	33.696
20.505	462.045	53.08	1.3	2.45	0.41	38.8252	2.61221	2.4824	38.8252	2.61221	6	130.00	1.33283	1.332826	0	0.8662	12.81671	11.1017	1.60206	53.08	20.0025	35.195
20.833	461.717	72.65	1.56	2.28	0.37	52.7976	2.32161	2.35982	52.8052	2.32149	7	130.00	1.35446	1.354145	0	0.8593	16.82862	14.28977	2.21849	72.66	24.7953	37.018
21.161	461.389	86.66	1.75	2.02	0.53	61.9969	2.0522	2.27196	62.0041	2.05195	7	130.00	1.37547	1.375466	0	0.8527	19.03346	16.22904	2.64008	86.66	21.4969	37.941
21.489	461.061	99.74	1.53	1.53	0.42	70.4068	1.55578	2.15069	70.414	1.55562	8	130.00	1.39679	1.396786	0	0.8461	20.8937	17.61948	3.04468	99.75	17.3921	38.657
21.817	460.733	66.18	1.62	2.68	0.46	59.7712	1.91124	2.26316	59.7712	1.91124	7	130.00	1.41811	1.418105	0	0.8397	16.85477	15.53462	2.62427	66.18	21.1809	37.732
22.145	460.405	66.68	1.53	1.77	0.55	59.1351	1.79745	2.24908	59.1351	1.79745	7	130.00	1.43943	1.439425	0	0.8335	16.82842	15.85181	2.63581	66.68	20.691	37.67
22.473	460.077	83.42	1.78	2.08	0.6	56.1078	2.1108	2.3123	56.1147	2.11055	7	130.00	1.46075	1.460745	0	0.8274	16.64714	15.42865	2.63744	83.43	22.0783	37.868
22.802	459.748	74.32	1.6	2.15	0.97	49.144	2.19666	2.36883	49.1508	2.19636	7	130.00	1.48213	1.48213	0	0.8214	14.91887	13.97937	2.25504	74.38	24.0782	38.699
23.13	459.420	71.29	1.63	2.28	0.64	46.4178	2.33569	2.40319	46.4178	2.33569	7	130.00	1.50345	1.503455	0	0.8158	16.58253	13.63219	2.16057	71.29	26.5396	38.262
23.458	459.092	64.8	1.34	2.07	0.5	41.4982	2.11773	2.41227	41.5048	2.1174	7	130.00	1.52477	1.524775	0	0.8098	15.14767	12.26691	1.95866	64.81	25.9142	38.596
23.786	458.764	67.97	0.87	1.5	0.49	38.4948	1.5419	2.37112	38.4946	1.5419	7	130.00	1.54609	1.54609	0	0.8042	13.2986	10.69519	1.74587	67.97	29.2493	34.819
24.114	458.436	67.68	0.89	1.65	0.56	35.7996	1.5861	2.38513	35.7996	1.5861	7	130.00	1.56741	1.56741	0	0.7987	13.3157	10.53563	1.75723	67.68	25.809	34.702
24.442	458.108	61.01	0.85	1.27	0.53	31.1074	1.31522	2.38788	31.1074	1.31522	7	130.00	1.58873	1.588735	0	0.7934	11.79061	9.354301	1.53007	61.01	25.0157	33.837
24.77	457.780	45.04	0.65	1.45	0.56	26.9743	1.49666	2.47065	26.9743	1.49666	7	130.00	1.61005	1.61005	0	0.7881	10.81533	8.523542	1.34456	45.04	29.3882	32.945
25.098	457.452	61.99	0.93	1.79	0.67	30.8689	1.84676	2.47811	30.875	1.84639	7	130.00	1.63137	1.631875	0	0.7829	12.61872	9.801315	1.65909	152	29.0264	33.79
25.426	457.124	48.03	1.05	2.18	0.67	28.0617	2.28404	2.58273	28.0678	2.26355	8	130.00	1.65269	1.652685	0	0.7779	12.05714	9.878831	1.48583	48.04	33.567	33.196
25.764	456.796	45.32	0.69	1.29	0.49	26.0727	1.35179	2.45627	26.0727	1.35179	7	130.00	1.67401	1.67401	0	0.7729	10.81069	8.362451	1.35127	45.32	28.6526	32.73
26.082	456.468	55.38	0.94	0.62	0.74	31.6662	0.63333	2.21862	31.6662	0.63333	8	130.00	1.69533	1.69533	0	0.7686	11.89086	9.182429	1.66206	55.39	19.6243	33.947
26.41	456.140	73.15	0.78	0.99	0.28	41.6121	1.02193	2.22191	41.6121	1.02193	8	130.00	1.71855	1.71855	0	0.7632	15.72803	12.00421	2.21156	73.16	19.7647	35.612
26.739	455.811	74.69	0.95	1.27	0.07	41.9163	1.30401	2.27962	41.9163	1.30401	8	130.00	1.73804	1.738035	0	0.7586	16.43855	12.46759	2.25548	74.69	21.7737	35.856
27.067	455.483	55.6	1.26	2.11	0.34	32.8761	2.1784	2.49849	32.8761	2.1784	7	130.00	1.75936	1.759355	0	0.7539	14.50122	10.93271	1.97073	59.6	30.8157	34.179
27.395	455.155	62.45	1.36	2.18	0.02	34.071	2.24166	2.4942	34.071	2.24166	7	130.00	1.78066	1.780675	0	0.7494	15.16362	11.48551	2.07831	62.45	30.4245	34.399
27.723	454.827	50.82	1.25	2.47	0.46	27.2021	2.55008	2.60548	27.2021	2.55008	8	130.00	1.802	1.801995	0	0.7449	15.02823	9.705259	1.51759	50.82	35.8264	32.998
28.051	454.499	35	1.06	3.06	1.09	18.1858	3.2553	2.80604	18.2013	3.25432	6	130.00	1.82332	1.823315	0	0.7406	9.986877	7.396114	1.04774	35.01	48.4587	30.416
28.379	454.171	33.92	1.21	3.68	0.14	17.9885	3.77237	2.88349	17.9885	3.77237	6	130.00	1.84464	1.844635	0	0.7363	9.98773	7.353796	0.99305	33.92	140.75	30.116
28.707	453.843	24.82	1.39	5.69	20.74	12.3015	6.05658	3.10673	12.3712	6.02148	3	130.00	1.86598	1.865955	0	0.7321	8.543187	6.254165	0.72005	24.95	84.9682	27.863
29.035	453.515	30.38	1.32	4.36	-20.28	15.0973	4.63276	2.96484	15.1609	4.61333	4	125.00	1.88728	1.887275	0	0.7279	9.53739	6.942437	0.88213	30.5	56.1472	29.211
29.363	453.187	26.39	1.19	4.5	-19.63	12.8329	4.86067	3.03231	12.8958	4.83696	4	125.00	1.90778	1.907775	0	0.724	8.646449	6.259998	0.75796	26.51	60.6874	28.132
29.691	452.859	32.99	1.13	3.43	-15.73	16.1086	3.63792	2.87768	16.1604	3.62624	5	125.00	1.92828	1.928275	0	0.7201	9.823652	7.074381	0.96186	33.09	50.616	29.634
30.019	452.531	38.04	1.29	3.39	-14.99	18.52	3.57428	2.82578	18.5713	3.5644	5	125.00	1.94878	1.948775	0	0.7163	10.99164	7.873748	1.11738	38.14	47.4962	30.547
30.347	452.203	35.49	1.02	2.88	-14.16	17.0219	3.04269	2.8116	17.0676	3.03475	6	125.00	1.96928	1.969275	0	0.7126	10.17256	7.248986	1.03779	35.58	46.666	29.994
30.675	451.875	36.01	0.81	2.24	-13.42	17.0975	2.38094	2.74704	17.1377	2.37535	6	125.00	1.98978	1.989776	0	0.7089	9.958869	7.060069	1.05326	36.09	43.0037	30.021
31.004	451.546	30.49	0.67	2.19	-12.68	14.1666	2.35256	2.81069	14.2084	2.34597	6	125.00	2.01034	2.010336	0	0.7053	8.735748	6.161203	0.88172	30.57	46.6132	28.778
31.332	451.218	20.88	0.57	2.71	-12.47	9.28147	3.02401	3.02299	9.32087	3.01123	5	125.00	2.03084	2.030838	0	0.7017	6.795869	4.768761	0.68357	20.96	60.0464	25.941
31.66	450.890	16.5	0.4	2.43	-12.06	7.04353	2.76842	3.10136	7.08253	2.75318	5	125.00	2.05134	2.051338	0	0.6982	5.656888	3.949654	0.44733	16.58	65.5763	24.077
31.988	450.562	15.2	0.37	2.41	-11.71	6.33648	2.81837	3.1445	6.37027	2.80342	5	125.00	2.07184	2.071838	0	0.6947	5.364346	3.726824	0.40644	15.27	68.7573	23.359
32.316	450.234	13.42	0.31	2.32	-10.81	5.41388	2.73666	3.19603	5.44256	2.72224	5	125.00	2.09234	2.092338	0	0.6913	4.909323	3.393962	0.3507	13.48	72.6878	22.298
32.644	449.906	13.41	0.39	2.88	-10.09	5.34691	3.45219	3.25342	5.38005	3.43094	5	125.00	2.11284	2.112838	0	0.688	5.118563	3.521397	0.34976	13.48	77.2368	22.221
32.972	449.578	13.24	0.28	2.12	-7.72	5.20624	2.52101	3.19282	5.22968	2.50971	5	125.00	2.13334	2.133338	0	0.6847	4.829065	3.306232	0.34386	13.29	72.4383	22.031
33.3	449.250	15.29	0.27	1.74	-7.34	6.09896	2.05539	3.08974	6.11753	2.04916	6	125.00	2.15384	2.153838	0	0.6814	5.190141	3.536492	0.40669	15.33	64.7359	23.086
33.628	448.922	12.74	0.24	1.85	-6.3	4.85926	2.27151	3.19655	4.87765	2.26294	5	125.00	2.17434	2.174338	0	0.6782	4.656115	3.157623	0.32711	12.78	72.7263	21.665
33.956	448.594	15.46	0.33	2.14	-5.57	6.0438	2.48772	3.13551	6.05747	2.48211	5	125.00	2.19484	2.194838	0	0.675	5.408217	3.650504	0.41069	15.49	68.066	23.019
34.284	448.266	19.07	0.47	2.44	-5.31	7.60817	2.78855	3.07707	7.62171	2.78359	5	125.00	2.21534	2.215338	0	0.6719	6.41274	4.308476	0.52182	19.1	63.8284	24.575
34.612	447.938	20.99	0.5	2.36	-4.73	8.41287	2.66607	3.02992	8.42633	2.66182	5	135.00	2.23584	2.229223	0.0068	0.6698	6.845399	4.584817	0.58062	21.02	60.5225	25.259
34.941	447.609	25.65	0.82	3.18	-4.43	10.4374	3.50548	3.01977	10.4508	3.50099	5	135.00	2.25805	2.241166	0.0169	0.668	8.309312	5.550448	0.72421	25.68	59.8266	26.721
35.269	447.281	24.21	1.06	4.37	-9.81	9.73329	4.8336	3.12648	9.75992	4.82041	4	135.00	2.28019	2.253072	0.0271	0.6662	8.421758	5.610676	0.67894	24.27	67.4162	26.261
35.597	446.953	22.27	0.91	4.1	-14.16	8.81583	4.55737	3.14431	8.85557	4.53692	4	135.00	2.30233	2.264979	0.0373	0.6645	7.854004	5.218661	0.61819	22.36	68.7426	25.606
35.925	446.625	19.46	0.98	5.05	-13.21	7.52587	5.71911	3.25807	7.5654	5.68923	3	135.00	2.32447	2.276885	0.0476	0.6627	7.449111	4.936668	0.53051	19.55	77.6125	24.544
36.253	446.297	24.68	1.3	5.26	-11.24	9.75772	5.82088	3.17489	9.79268	5.8001	3	135.00	2.34661	2.288791	0.0578	0.661	8.883668	5.872043	0.69144	24.76	71.058	26.293
36.581	445.969	26.57	1.26	4.75	-10.88	10.5191	5.20534	3.11986	10.5452	5.19347	3	135.00	2.36875	2.300698	0.068	0.6593	9.199371	6.064966	0.74926	26.63	66.9282	26.796
36.909	445.641	22.11	0.92	4.17	-10.16	8.5268	4.66552	3.16289	8.55275	4.65137	4	135.00	2.39089	2.312604	0.0783	0.6576	7.887958	5.186973	0.6105	22.17	70.1433	25.384
37.237	445.313	21.91	0.71	3.22	-9.52	8.38756	3.64159	3.10571	8.41337	3.63042	5	135.00	2.41303	2.324511	0.0885	0.6559	7.517677	4.930806	0.60362	21.97	65.8921	25.277
37.565	444.985	23	0.88	3.81	-9.38	8.80187	4.27915	3.12957	8.82755	4.2667	4	135.00	2.43517	2.336417	0.0987	0.6542	8.018715	5.246016	0.63668	23.06	67.6451	25.605

Depth (ft)	San.. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	444.657	19.45	0.95	4.9	-10	7.2361	5.59064	3.26674	7.26165	5.57097	3	135.00	2.45731	2.348323	0.109	0.6526	7.482229	4.88261	0.52609	19.51	78.3181	24.29
38.221	444.329	18.24	0.79	4.34	-9.37	6.67755	5.01251	3.26644	6.70297	4.9935	3	135.00	2.47945	2.36023	0.1192	0.6509	7.016591	4.567189	0.48794	18.3	78.2934	23.755
38.549	444.001	21.57	0.78	3.6	-8.87	8.0385	4.09053	3.14988	8.06379	4.0777	5	135.00	2.50159	2.372136	0.1294	0.6493	7.626794	4.951904	0.59035	21.63	69.1606	25.004
38.877	443.673	18.25	0.67	3.65	-8.11	6.59647	4.26039	3.2302	6.61745	4.24688	4	135.00	2.52373	2.384043	0.1397	0.6477	6.83099	4.424117	0.48688	18.3	75.3741	23.677
39.206	443.344	20.75	0.81	3.91	-7.44	7.59774	4.44956	3.19132	7.61861	4.43737	4	135.00	2.54593	2.395985	0.1499	0.646	7.549899	4.87752	0.56359	20.8	72.3227	24.628
39.534	443.016	21.68	1.16	5.34	-5.68	7.9372	6.06951	3.25744	7.95382	6.05683	3	135.00	2.56807	2.407892	0.1602	0.6444	8.272102	5.330862	0.5917	21.72	77.562	24.921
39.862	442.688	22.71	1.16	5.1	-5.2	8.31466	5.76547	3.22788	8.33119	5.75403	3	135.00	2.59021	2.419796	0.1704	0.6429	8.477683	5.449889	0.6229	22.75	76.1893	25.237
40.19	442.360	28.63	1.19	4.17	-3.31	10.6993	4.57382	3.08047	10.7076	4.57031	4	135.00	2.61235	2.431705	0.1806	0.6413	9.640815	6.18229	0.8055	28.65	64.071	26.927
40.518	442.032	28.19	1.27	4.52	-2.28	10.4581	4.96957	3.11062	10.4622	4.96763	4	135.00	2.63449	2.443611	0.1909	0.6397	9.6813	6.193237	0.79119	28.2	66.2507	26.774
40.646	441.704	26.69	1.27	4.77	-1.8	9.7875	5.28432	3.14971	9.79157	5.28212	3	135.00	2.65663	2.455517	0.2011	0.6382	9.413383	6.007229	0.74407	26.7	69.148	26.331
41.174	441.376	24.58	1.31	5.34	-1.94	8.87615	5.9814	3.21633	8.8802	5.97867	3	135.00	2.67877	2.467424	0.2113	0.6366	9.086886	6.784866	0.67806	24.59	74.2759	25.678
41.502	441.048	24.83	1.39	5.59	-2.79	8.92543	6.28133	3.22741	8.9335	6.27565	3	135.00	2.70091	2.47933	0.2216	0.6351	9.257119	5.879071	0.68511	24.85	75.1625	25.721
41.83	440.720	23.62	1.17	4.95	-2.61	8.38818	5.5989	3.21797	8.3922	5.59623	3	135.00	2.72305	2.491237	0.2318	0.6336	8.742523	6.538974	0.64696	23.63	74.4055	25.304
42.158	440.392	24.48	0.98	4.01	-1.99	8.68301	4.5089	3.14929	8.687	4.50682	4	135.00	2.74519	2.503143	0.242	0.6321	8.631702	5.455739	0.6729	24.49	69.1162	25.538
42.486	440.064	22.76	1.14	5	-2.06	7.94921	5.70209	3.24129	7.95319	5.69924	3	135.00	2.76733	2.516049	0.2523	0.6306	8.568914	5.403219	0.61897	22.77	76.2596	24.949
42.814	439.736	20.25	0.99	4.9	-0.12	6.90971	5.66993	3.28858	6.90971	5.66993	3	135.00	2.78947	2.526956	0.2625	0.6291	7.69536	4.96676	0.54057	20.25	80.1137	24.011
43.143	439.407	14.05	0.79	5.63	-0.05	4.42646	7.02952	3.49955	4.42646	7.02952	3	135.00	2.81168	2.538898	0.2728	0.6276	6.528217	4.097056	0.34794	14.05	98.8834	21.08
43.471	439.079	11.7	0.65	5.57	1.64	3.47584	7.33123	3.59605	3.47192	7.33951	3	135.00	2.83382	2.550805	0.283	0.6261	5.953759	3.7278	0.27449	11.69	100	19.54
43.799	438.751	14.29	0.66	4.63	1.87	4.4617	5.77224	3.4474	4.45779	5.77729	3	135.00	2.85596	2.562711	0.2932	0.6247	6.334906	3.957221	0.354	14.28	93.9984	21.135
44.127	438.423	16.74	0.83	4.94	0.9	5.38406	5.98764	3.38977	5.38406	5.98764	3	135.00	2.8781	2.574618	0.3035	0.6232	7.072565	4.407787	0.42916	16.74	88.7893	22.371
44.455	438.095	16.83	0.84	5	0.58	5.38551	6.03025	3.39149	5.38551	6.03025	3	135.00	2.90024	2.586524	0.3137	0.6218	7.120717	4.427571	0.43126	16.83	88.9421	22.377
44.783	437.767	14.82	0.61	4.12	1.29	4.57877	5.12708	3.40827	4.57877	5.12708	3	135.00	2.92238	2.59843	0.3239	0.6204	6.358557	3.9446	0.36835	14.82	90.4396	21.323
45.111	437.439	17.14	0.44	2.57	3.14	5.43816	3.09958	3.22672	5.43052	3.10395	6	135.00	2.94452	2.610337	0.3342	0.6189	6.374336	3.94536	0.43949	17.12	75.0978	22.44
45.439	437.111	33.51	1.27	3.8	6.51	11.6478	4.16803	3.02727	11.6325	4.16348	5	135.00	2.95668	2.622243	0.3444	0.6175	10.88157	6.719778	0.94561	33.47	50.3408	27.515
45.767	436.783	58.12	2.69	4.62	3.76	20.9294	4.87927	2.87443	20.9218	4.88104	4	135.00	2.9888	2.63415	0.3547	0.6161	17.21601	10.60748	1.70685	58.1	50.4166	31.363
46.095	436.455	62.78	3.68	5.86	-7.46	22.588	6.15703	2.91763	22.6069	6.15189	11	135.00	3.01094	2.646056	0.3649	0.6148	19.09563	11.73909	1.85044	62.83	53.1048	31.86
46.423	436.127	83.6	4.9	5.86	-7.76	30.3115	6.0819	2.82272	30.3303	6.07813	11	135.00	3.03308	2.657962	0.3751	0.6134	24.06568	14.76127	2.49433	83.65	47.316	33.709
46.751	435.799	294.51	7.43	2.52	-2.96	109.164	2.54928	2.16692	109.168	2.54919	7	135.00	3.05522	2.669859	0.3854	0.612	61.8938	37.87932	9.02337	294.52	17.9036	41.036
47.079	435.471	443.15	13.54	3.06	-9.68	164.098	3.07676	2.11943	164.12	3.07635	12	135.00	3.07736	2.681775	0.3956	0.6106	91.3583	55.78749	13.6245	443.21	16.4026	43.103
47.408	435.142	441.36	16.48	3.73	-14.99	162.697	3.76032	2.19234	162.734	3.75946	12	135.00	3.09957	2.693718	0.4058	0.6093	93.75299	57.12275	13.5684	441.46	18.7382	43.062
47.736	434.814	430.27	19.31	4.49	-16.14	157.874	4.52068	2.2656	157.911	4.51962	12	135.00	3.12171	2.705624	0.4161	0.6079	94.26613	57.30888	13.2244	430.37	21.268	42.913
48.064	434.486	369.54	18.25	4.94	-18.24	134.827	4.98095	2.33911	134.867	4.97945	11	135.00	3.14385	2.717531	0.4263	0.6066	83.59886	50.71228	11.3435	369.65	23.9983	42.124
48.392	434.158	373.72	19.14	5.12	-23.12	135.762	5.16524	2.35029	135.817	5.16315	11	135.00	3.16599	2.729437	0.4366	0.6053	84.97333	51.4335	11.4723	373.87	24.4307	42.16
48.72	433.830	313.66	15.82	5.04	-20.02	113.255	5.09547	2.39117	113.303	5.09334	11	135.00	3.18813	2.741344	0.4468	0.604	72.63847	43.87175	9.61213	313.79	26.0525	41.23

R13265

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 28 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5A

ConeTec Inc. - [illegible]pretation
Interpretation Output [illegible]elease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4429
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5A
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 10:44
CPT File: 804CP05A.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 483

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	35.73	1.41	38.82	24.15	2.29
125	Soil Embankment	28.29	1.43	48.95	56.29	2.94

User Inputs:
Water Table Depth (ft): 35.9
Ground Surface Elev. 483.0
Assumed: Nk: 32.3
State Parameter: 1.2
CPT area ratio: 0.85
Unit Weight of Soil (pcf): Varies See Below
See Below
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.836	25.42	0.16	0.61	0.04	2383.62	0.630	1.02	2383.62	0.63	7	130.00	0.011	0.011	0.000	2.000	8.63	7.27	0.787	25.42	18.197	53.84
0.492	482.508	30.63	0.26	0.83	0.09	956.786	0.850	1.25	956.79	0.85	7	130.00	0.032	0.032	0.000	2.000	4.67	9.35	0.947	30.63	0.0848	50.67
0.82	482.180	34.85	0.47	1.34	0.02	852.848	1.351	1.50	852.85	1.35	7	130.00	0.053	0.053	0.000	2.000	5.76	11.50	1.077	34.85	2.85184	49.21
1.148	481.852	45.55	0.61	1.33	0.55	609.426	1.341	1.51	609.43	1.34	7	130.00	0.075	0.075	0.000	2.000	7.54	15.08	1.408	45.55	3.00348	49.93
1.476	481.524	30.69	0.48	1.49	0.19	318.578	1.505	1.70	318.57	1.51	6	130.00	0.096	0.096	0.000	2.000	5.40	10.81	0.948	30.69	6.10537	46.20
1.804	481.196	25.49	0.36	1.41	0.21	216.38	1.419	1.78	216.38	1.42	6	130.00	0.117	0.117	0.000	2.000	4.62	9.24	0.786	25.49	7.770844	44.40
2.133	480.867	24.98	0.31	1.22	0.07	179.172	1.246	1.78	179.17	1.25	6	130.00	0.139	0.139	0.000	2.000	4.55	9.10	0.769	24.98	7.960547	43.83
2.461	480.539	22	0.24	1.07	0.37	136.53	1.099	1.84	136.53	1.10	6	130.00	0.160	0.160	0.000	2.000	4.02	8.14	0.676	22	16.91183	42.16
2.789	480.211	19.96	0.2	1	0.25	109.103	1.011	1.88	109.10	1.01	6	130.00	0.181	0.181	0.000	2.000	3.78	7.64	0.612	19.96	13.0021	41.03
3.117	479.883	16.87	0.21	1.22	0.14	82.2655	1.260	2.04	82.27	1.26	6	130.00	0.203	0.203	0.000	2.000	3.37	6.74	0.516	16.87	13.0402	39.62
3.445	479.555	27.63	0.29	1.05	0.61	122.39	1.058	1.86	122.39	1.06	7	130.00	0.224	0.224	0.000	2.000	5.16	10.31	0.848	27.63	9.46561	41.62
3.773	479.227	28.29	0.55	1.95	0.9	114.354	1.961	2.07	114.39	1.96	6	130.00	0.245	0.245	0.000	2.000	5.572	11.43	0.868	28.3	14.3825	41.87
4.101	478.899	31.49	0.42	1.32	0.58	117.133	1.345	1.94	117.17	1.34	7	130.00	0.267	0.267	0.000	2.000	6.07	11.75	0.967	31.54	11.9005	41.40
4.429	478.571	21.53	0.34	1.58	0.25	737869	1.601	2.14	73.79	1.60	6	130.00	0.288	0.288	0.000	1.864	4.49	8.35	0.658	21.53	17.1574	38.92
4.757	478.243	20.69	0.25	1.19	1.01	65.9135	1.227	2.11	65.95	1.23	6	130.00	0.309	0.309	0.000	1.798	4.24	7.83	0.631	207	16.0088	38.20
5.085	477.915	15.26	0.33	2.14	1.98	45.169	2.210	2.40	45.20	2.21	5	130.00	0.331	0.331	0.000	1.739	3.64	6.16	0.462	15.27	26.2447	36.70
5.413	477.587	14.21	0.29	2.05	1.25	39.3871	2.093	2.43	39.39	2.09	5	130.00	0.352	0.352	0.000	1.688	3.64	6.64	0.429	14.21	27.5061	36.28
5.741	477.259	24.82	0.37	1.47	0.26	65.6121	1.518	2.12	65.61	1.51	6	130.00	0.373	0.373	0.000	1.637	5.22	8.54	0.757	24.82	17.8986	38.25
6.069	476.931	37.84	0.39	1.02	1.27	95.176	1.039	1.94	95.20	1.04	7	130.00	0.394	0.394	0.000	1.592	7.26	14.50	1.162	37.95	11.3095	40.30
6.398	476.602	38.71	0.45	1.26	0.12	92.082	1.280	2.01	92.08	1.28	7	130.00	0.416	0.416	0.000	1.551	7.63	15.26	1.188	38.71	13.1428	40.13
6.726	476.274	82.69	0.91	1.45	0.74	142.893	1.462	1.91	142.42	1.46	7	130.00	0.437	0.437	0.000	1.512	11.92	18.03	1.927	82.72	10.8517	42.89
7.054	475.946	61.98	1.01	1.63	0.87	104.133	1.642	1.97	104.16	1.64	7	130.00	0.459	0.459	0.000	1.477	12.03	17.76	1.904	61.97	12.0278	42.09
7.382	475.618	77.1	0.92	1.19	1.34	159.682	1.201	1.81	159.70	1.20	8	130.00	0.480	0.480	0.000	1.444	14.16	20.33	2.672	77.1	6.43681	42.96
7.71	475.290	80.49	0.84	1.38	0.67	119.702	1.400	1.95	119.72	1.40	7	130.00	0.501	0.501	0.000	1.413	11.87	18.49	1957	80.5	11.8404	41.61
8.038	474.962	43.56	0.42	0.96	0.41	82.3732	0.976	1.97	82.39	0.98	7	130.00	0.522	0.522	0.000	1.383	8.47	13.72	1.632	43.57	12.1295	39.62
8.366	474.634	31.78	0.35	1.09	0.72	67.4417	1.120	2.13	67.44	1.12	7	130.00	0.544	0.544	0.000	1.356	6.58	8.92	0.967	31.78	16.7393	37.50
8.694	474.306	23.44	0.25	1.07	0.83	40.4787	1.093	2.25	40.50	1.09	6	130.00	0.565	0.565	0.000	1.330	5.10	6.78	0.708	23.45	20.6375	36.45
9.022	473.978	14.76	0.2	1.39	1.86	24.1522	1.412	2.50	24.17	1.41	6	130.00	0.586	0.586	0.000	1.305	3.59	4.68	0.439	14.76	30.5056	32.25
9.35	473.650	18.93	0.1	0.53	1.34	30.1477	0.546	2.21	30.16	0.55	7	130.00	0.608	0.608	0.000	1.283	4.05	5.19	0.567	18.94	19.2809	33.65
9.678	473.322	14.31	0.1	0.7	0.39	217479	0.731	2.39	21.75	0.73	6	130.00	0.629	0.629	0.000	1.261	3.31	4.16	0.424	14.31	28.0048	31.67
10.006	472.994	13.41	0.1	0.76	0.53	19.6184	0.784	2.46	19.63	0.78	6	130.00	0.650	0.650	0.000	1.240	3.18	3.98	0.395	13.42	28.4016	30.91
10.335	472.665	9.07	0.17	1.82	0.74	12.6015	2.024	2.82	12.60	2.02	5	130.00	0.672	0.672	0.000	1.220	2.61	3.13	0.280	9.07	47.2437	27.92
10.663	472.337	9.3	0.05	0.54	0.39	12.4181	0.581	2.57	12.42	0.58	5	130.00	0.693	0.693	0.000	1.201	2.34	2.62	0.286	9.3	33.9922	27.86
10.991	472.009	8.69	0.07	0.81	0.45	11.1638	0.878	2.69	11.16	0.88	5	130.00	0.714	0.714	0.000	1.183	2.62	2.75	0.247	8.69	39.7705	27.16
11.319	471.681	6.9	0.07	0.94	0.74	8.97858	1.168	2.85	8.98	1.14	5	130.00	0.736	0.736	0.000	1.166	2.01	2.35	0.191	6.9	48.3516	25.22
11.647	471.353	8.91	0.09	1.01	0.43	10.7693	1.104	2.75	10.77	1.10	5	130.00	0.757	0.757	0.000	1.149	2.46	2.82	0.258	8.91	42.9197	26.62
11.976	471.025	19.87	0.21	1.09	0.26	23.2428	1.161	2.46	23.26	1.16	6	130.00	0.778	0.778	0.000	1.133	4.52	5.12	0.560	19.88	29.1282	32.00
12.303	470.697	19.57	0.24	1.23	0.51	23.4718	1.279	2.48	23.48	1.28	6	130.00	0.800	0.800	0.000	1.118	4.73	6.29	0.581	19.58	29.9383	32.07
12.631	470.369	17.34	0.28	1.62	0.61	20.1202	1.695	2.61	20.13	1.69	6	130.00	0.821	0.821	0.000	1.104	4.45	4.81	0.514	17.35	35.652	31.07
12.959	470.041	19.9	0.26	1.28	0.3	22.6248	1.364	2.51	22.62	1.36	6	130.00	0.843	0.843	0.000	1.090	4.87	5.31	0.590	19.9	31.2276	31.83
13.287	469.713	30.28	0.23	0.76	0.3	34.0603	0.782	2.23	34.06	0.78	7	130.00	0.864	0.864	0.000	1.076	6.65	7.04	0.811	30.28	20.1787	34.40
13.615	469.385	38.96	0.31	0.78	0.41	43.0238	0.814	2.16	43.02	0.81	7	130.00	0.885	0.885	0.000	1.063	8.15	8.67	1.179	38.96	12.5679	36.91
13.943	469.057	33.22	0.36	1.07	0.44	35.6647	1.114	2.30	35.65	1.11	7	130.00	0.906	0.906	0.000	1.050	7.38	7.76	1.000	33.22	22.4677	34.68
14.271	468.729	32.32	0.37	1.18	0.62	33.842	1.179	2.33	33.84	1.18	7	130.00	0.928	0.928	0.000	1.038	7.28	7.66	0.972	32.32	23.6956	34.36
14.6	468.400	25.81	0.32	1.24	0.3	26.197	1.267	2.44	26.20	1.29	6	130.00	0.949	0.949	0.000	1.027	6.12	6.29	0.770	25.81	28.2811	32.76
14.928	468.072	26.82	0.29	1.08	0.87	26.6404	1.122	2.41	26.65	1.12	7	130.00	0.970	0.970	0.000	1.016	6.25	6.35	0.800	26.83	26.8786	32.87
15.256	467.744	27.97	0.29	1.06	0.63	26.6007	1.099	2.40	26.61	1.10	7	130.00	0.992	0.992	0.000	1.004	6.37	6.40	0.817	27.98	25.6119	32.86

R13267

Depth (ft)	Samp.. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	..tress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	467.416	27.05	0.21	0.76	-0.81	25.7039	0.807	2.35	25.71	0.81	7	130.00	1.013	1.013	0.000	0.994	6.14	6.10	0.808	27.09	24.3913	32.64
15.912	467.088	23.69	0.19	0.78	-0.58	21.9048	0.839	2.42	21.91	0.84	7	130.00	1.034	1.034	0.000	0.983	5.55	5.45	0.701	23.7	27.1101	31.62
16.24	466.760	89.67	0.36	0.87	-0.32	36.4858	0.809	2.24	36.50	0.91	7	130.00	1.056	1.056	0.000	0.973	8.58	8.35	1.192	89.68	20.444	34.62
16.568	466.432	74.07	1.13	1.62	0	67.7795	1.648	2.16	67.78	1.65	7	130.00	1.077	1.077	0.000	0.964	13.53	13.37	2.280	74.07	17.7853	33.44
16.896	466.104	66.69	1.62	2.43	-0.62	59.7244	2.470	2.34	59.72	2.47	6	130.00	1.098	1.098	0.000	0.954	15.06	14.39	2.031	66.69	23.0849	37.73
17.224	465.776	65.22	1.33	2.04	-0.58	57.255	2.076	2.30	57.26	2.07	7	130.00	1.120	1.120	0.000	0.945	14.50	13.71	1.985	65.22	22.6559	37.49
17.552	465.448	57.68	1.09	1.89	-0.39	49.5575	1.928	2.33	49.56	1.93	7	130.00	1.141	1.141	0.000	0.936	12.68	12.15	1.760	57.68	23.5356	38.85
17.88	465.120	32	1.01	3.16	-0.49	28.534	3.276	2.68	28.53	3.28	5	130.00	1.162	1.162	0.000	0.928	8.53	7.92	0.955	32	30.5519	32.84
18.208	464.792	51.85	0.91	1.76	-0.51	42.81	1.79606	2.36635	42.8269	1.79535	7	130.00	1.183352	1.183352	0	0.9192	11.0208	10.08694	1.568862	51.87	24.0674	36.784
18.537	464.463	43.9	1.02	2.33	-0.82	35.4344	2.36603	2.49787	35.4769	2.36624	6	130.00	1.204851	1.204905	0	0.911	10.65025	9.738928	1.332163	43.96	30.6977	34.646
18.865	464.135	23.27	0.79	3.4	-2.63	17.9769	3.58378	2.83772	17.9933	3.58053	5	130.00	1.22523	1.226225	0	0.9031	6.757446	6.102354	0.68247	23.29	48.2023	30.34
19.193	463.807	89.72	0.64	1.82	-1.94	30.6385	1.66353	2.44929	30.8546	1.66266	7	130.00	1.24765	1.247645	0	0.8953	9.447888	8.458758	1.1911	89.74	28.4675	33.788
19.521	463.479	60.04	1.09	2.17	-2.24	39.4068	2.23493	2.45278	39.4447	2.23447	6	130.00	1.2688734	1.268865	0	0.8878	7.191889	6.458958	0.80964	60.05	28.617	36.135
19.849	463.151	60.08	1.06	1.76	-0.18	45.667	1.80303	2.33857	45.667	1.80303	7	130.00	1.290019	1.290185	0	0.8804	10.57227	9.459866	1.82012	60.09	23.0008	36.153
20.177	462.823	52.92	0.66	1.24	-0.07	39.3506	1.27886	2.29701	39.3506	1.27886	7	130.00	1.311511	1.311508	0	0.8732	9.174944	8.259856	1.59779	52.92	23.4107	36.276
20.505	462.495	38.79	0.47	1.27	-0.14	26.603	1.32554	2.44629	26.603	1.32554	7	130.00	1.332831	1.332825	0	0.8662	6.734868	6.065528	1.09776	38.79	28.3387	32.868
20.833	462.167	44.24	0.4	0.91	-0.16	31.6701	0.93271	2.30063	31.6701	0.93271	7	130.00	1.35416	1.354148	0	0.8593	8.338818	8.454762	1.82774	44.24	22.8522	33.948
21.161	461.839	38.42	0.52	1.36	-0.21	26.9324	1.40372	2.45559	26.9324	1.40372	7	130.00	1.37547	1.375466	0	0.8527	9.160019	7.811157	1.14869	38.42	25.7374	32.935
21.489	461.511	36.09	0.66	1.83	-0.49	24.8379	1.90239	2.55989	24.8379	1.90239	6	130.00	1.396779	1.396785	0	0.846	9.048288	7.653463	1.07409	36.09	29.4329	32.423
21.817	461.183	32.39	0.61	1.88	-0.46	21.8403	1.84665	2.5608	21.8403	1.84665	6	130.00	1.41811	1.418105	0	0.8397	8.157855	6.850268	0.95868	32.39	33.5021	31.599
22.145	460.855	35.62	0.56	1.58	-0.65	23.6765	1.64316	2.54029	23.6765	1.64316	7	130.00	1.439435	1.439425	0	0.8335	8.817705	7.496555	1.05818	35.62	32.9166	32.117
22.473	460.527	46.51	0.94	1.93	-0.44	32.2091	1.99791	2.48214	32.2159	1.99748	7	130.00	1.46075	1.460745	0	0.8274	11.71422	9.952253	1.45663	46.52	29.6912	34.054
22.802	460.198	40.72	0.8	1.97	-0.09	26.474	2.03685	2.55538	26.474	2.03685	6	130.00	1.48213	1.48213	0	0.8214	10.1832	8.364521	1.21479	40.72	33.2206	32.827
23.13	459.870	34.78	0.69	1.97	-0.11	22.1336	2.07353	2.62238	22.1336	2.07353	6	130.00	1.50345	1.50345	0	0.8155	8.69242	7.33361	1.03023	34.78	38.4807	31.885
23.458	459.542	27.96	0.71	2.63	-0.02	17.3503	2.68378	2.77367	17.3503	2.68378	6	130.00	1.52477	1.52477	0	0.8095	7.52439	6.344562	0.81905	27.96	44.6023	30.102
23.786	459.214	34.86	0.84	1.83	-0.21	21.5601	1.91997	2.61226	21.5601	1.91997	6	130.00	1.54609	1.54609	0	0.8042	8.972893	7.215851	1.03201	34.86	39.9857	31.616
24.114	458.886	34.14	0.66	1.92	-0.04	20.7812	2.02624	2.63861	20.7812	2.02624	6	130.00	1.56741	1.56741	0	0.798738	9.000875	7.109538	1.00944	34.14	37.264	31.278
24.442	458.558	46.63	0.8	1.71	-0.12	28.3505	1.77615	2.49588	28.3505	1.77615	7	130.00	1.58873	1.58873	0	0.7934	11.83749	8.965997	1.39447	46.63	30.4903	33.258
24.77	458.230	37.3	0.79	2.12	-0.44	22.187	2.21351	2.63941	22.1782	2.21289	6	130.00	1.61005	1.61005	0	0.7881	9.725356	7.664543	1.10495	37.31	37.2698	31.697
25.098	457.902	36.41	0.69	2.45	-0.32	21.3187	2.55904	2.6899	21.3187	2.55904	6	130.00	1.63137	1.63137	0	0.7829	9.748595	7.630917	1.07874	36.41	39.8193	31.443
25.426	457.574	48.8	0.86	1.76	-0.18	28.5276	1.82407	2.50053	28.5276	1.82407	7	130.00	1.65269	1.65269	0	0.7779	11.68499	9.244918	1.45987	48.8	30.7065	33.297
25.754	457.246	74.39	0.71	0.96	-0.07	43.4362	0.9764	2.16543	43.4362	0.9764	8	130.00	1.67401	1.67401	0	0.7729	15.81851	12.22606	2.251278	74.39	18.841	36.669
26.082	456.918	60.47	1.1	1.82	-0.18	34.6686	1.87165	2.43963	34.6686	1.87165	7	130.00	1.69533	1.69533	0	0.7686	14.31208	10.99105	1.891065	60.47	28.0573	34.605
26.41	456.590	80.94	0.74	0.91	-0.04	46.16	0.93407	2.16287	46.16	0.93407	8	130.00	1.71665	1.71665	0	0.7642	19.58142	12.06064	2.45274	80.94	17.7728	36.228
26.739	456.261	80.42	0.62	0.77	-0.07	45.2768	0.78798	2.18015	45.2764	0.78788	8	130.00	1.73804	1.738035	0	0.7585	19.65087	12.83012	2.43697	80.43	16.7349	36.116
27.067	455.933	55.83	0.67	1.2	-0.09	30.7332	1.23912	2.37784	30.7332	1.23912	7	130.00	1.75938	1.759355	0	0.7539	12.84643	9.85518	1.674013	55.83	25.5169	33.762
27.395	455.605	46.5	0.82	1.77	-0.14	25.1137	1.83366	2.54667	25.1137	1.83366	7	130.00	1.78065	1.780575	0	0.7494	11.15793	8.677407	1.38451	46.5	33.8129	32.493
27.723	455.277	57.67	0.96	1.65	-0.23	31.1699	1.70916	2.45279	31.1699	1.70916	7	130.00	1.8002	1.801995	0	0.7449	15.80444	10.28362	1.738895	57.67	28.6174	33.849
28.051	454.949	68	0.97	1.43	-0.32	36.2947	1.46577	2.36006	36.2947	1.46577	7	130.00	1.82333	1.823315	0	0.7406	18.52249	11.48557	2.04681	68	24.8126	34.786
28.379	454.621	63.43	1.28	2.35	-0.41	27.9651	2.44255	2.58442	27.9651	2.44255	6	130.00	1.84464	1.844635	0	0.7363	18.55423	9.979782	1.697077	63.43	34.8019	29.172
28.707	454.293	48.18	0.76	1.62	-0.58	24.8098	1.66488	2.52977	24.8098	1.66488	7	130.00	1.86586	1.865955	0	0.7321	13.89481	8.707768	1.433325	48.18	32.0316	32.416
29.035	453.965	64.33	0.45	0.69	-0.6	33.0862	0.72066	2.22831	33.0862	0.72066	8	125.00	1.88728	1.887275	0	0.7279	13.86901	10.0955	1.93321	64.33	19.9571	34.218
29.363	453.637	56.15	0.73	1.3	-0.09	28.4322	1.34581	2.42586	28.4322	1.34581	7	125.00	1.90778	1.907775	0	0.724	13.20537	9.560844	1.67933	56.15	27.4761	33.276
29.691	453.309	58.81	0.91	1.54	0.09	29.4988	1.59981	2.45535	29.4988	1.59981	7	125.00	1.92828	1.928275	0	0.7201	14.02117	10.09717	1.76104	58.81	28.7271	33.506
30.019	452.981	67.14	1.23	1.84	-0.11	33.4524	1.88676	2.45406	33.4524	1.88676	7	125.00	1.94878	1.948775	0	0.7163	15.99754	11.45968	2.0183	67.14	28.6717	34.286
30.347	452.653	112.05	2.2	1.96	-0.41	55.8991	1.99853	2.2978	55.8991	1.99863	7	125.00	1.96928	1.969275	0	0.7126	24.88619	17.73394	3.40807	112.05	22.4389	37.347
30.675	452.325	73.06	2.44	3.34	-8.34	35.7177	3.43322	2.59915	35.7428	3.43081	6	125.00	1.98978	1.989775	0	0.7089	16.6832	13.24492	2.20032	73.11	35.3158	34.692
31.004	451.996	39.96	1.78	4.47	-10.67	18.8773	4.69042	2.89568	18.9071	4.68302	4	125.00	2.01034	2.010338	0	0.7053	12.00648	8.468011	1.17491	40.02	51.728	30.664
31.332	451.668	36.72	1.19	3.25	-12.47	17.0812	3.43047	2.84264	17.1157	3.42356	5	125.00	2.03084	2.030838	0	0.7017	10.70429	7.511391	1.07397	36.79	48.4956	30.012
31.66	451.340	32.6	0.98	3	-11.92	14.8921	3.208	2.87199	14.9262	3.20066	5	125.00	2.05134	2.051338	0	0.6982	9.666982	6.749511	0.94578	32.67	50.2673	29.107
31.988	451.012	30.21	0.84	2.79	-11.04	13.5813	2.98527	2.8855	13.615	2.97786	6	125.00	2.07184	2.071838	0	0.6947	9.030418	6.27379	0.87115	30.26	51.0971	28.495
32.316	450.684	30.02	0.75	2.5	-10.81	13.3476	2.68551	2.86492	13.381	2.6788	6	125.00	2.09234	2.092338	0	0.6913	8.867287	6.130203	0.86463	30.09	49.8367	28.379
32.644	450.356	32.56	0.7	2.16	-8.52	14.4106	2.29906	2.79963	14.4342	2.2953	6	125.00	2.11284	2.112838	0	0.688	9.261455	6.371566	0.94264	32.61	45.9727	28.884
32.972	450.028	32.57	0.61	1.86	-7.05	14.2672	2.00416	2.77023	14.2859	2.00153	6	125.00	2.13334	2.133338	0	0.6847	9.112641	6.238993	0.94231	32.61	44.2973	28.816
33.3	449.700	31.3	0.63	2.02	-5.48	13.5322	2.16152	2.80746	13.5508	2.15856	6	125.00	2.15384	2.153838	0	0.6814	8.939627	6.091342	0.90236	31.34	46.4254	28.463
33.628	449.372	31.82	0.66	2.08	-3.97	13.6343	2.2263	2.81229	13.6435	2.22479	6	125.00	2.17434	2.174338	0	0.6782	9.106774	6.175912	0.91782	31.84	46.706	28.509
33.956	449.044	28.86	0.57	1.98	-2.68	12.149	2.13762	2.84432	12.1581	2.13602	6	125.00	2.19484	2.194838	0	0.675	8.41085	5.677259	0.82555	28.88	48.5957	27.736
34.284	448.716	23.21	0.5	2.14	-1.27	9.47696	2.38156	2.96057	9.48147	2.38042	6	125.00	2.21534	2.215338	0	0.6719	7.241997	4.865622	0.64999	23.22	55.8673	26.057
34.612	448.388	20.41	0.42	2.06	0.02	8.12857	2.31097	3.0103	8.12857	2.31097	6	125.00	2.23584	2.235838	0	0.6688	6.564749	4.390339	0.56267	20.41	59.1814	25.012
34.941	448.059	23.17	0.41	1.77	0.71	9.26857	1.96045	2.92469	9.26414	1.96138	6	125.00	2.2564	2.2564	0	0.6657	7.068599	4.705711	0.64748	23.16	53.6531	25.9
35.269	447.731	24.74	0.45	1.82	2.5	9.86565	2.00329	2.90667	9.85687	2.00507	6	125.00	2.2769	2.2769	0	0.6627	7.464431	4.946804	0.69545	24.72	52.4146	26.32
35.597	447.403	23.56	0.62	2.64	4.16	9.25607	2.91592	3.01828	9.24637	2.91866	5	125.00	2.2974	2.2974	0	0.6598	7.609666	5.020503	0.65828	23.54	59.7243	25.887
35.925	447.075	26.46	0.63	2.39	12.8	10.419	2.60955	2.95013	10.3845	2.61823	6	135.00	2.3179	2.31712	0.0008	0.6569	8.175519	5.370826	0.74743	26.38	55.1876	26.673
36.253	446.747	24.52	0.58	2.37	14.27	9.52328	2.61497	2.98363	9.48463	2.62563	6	135.00	2.34004	2.329026	0.011	0.6553	7.72807	5.063885	0.68669	24.43	57.3863	26.063
36.581	446.419	23.35	0.59	2.53	14.8	8.96558	2.81115	3.02295	8.92713	2.82326	5	135.00	2.36218	2.340933	0.0212	0.6536	7.541419	4.928997	0.64978	23.26	60.0438	25.655
36.909	446.091	20.73	0.59	2.83	15.59	7.79725	3.21602	3.10619	7.759	3.23187	5	135.00	2.38432	2.352839	0.0315	0.6519	7.084855	4.605822	0.56798	20.64	65.9272	24.708
37.237	445.763	23.32	0.68	2.92	16.49	8.84389	3.25148	3.06352	8.8016	3.2671	5	135.00	2.40646	2.364746	0.0417	0.6503	7.727244	5.024958	0.64748	23.22	62.8665	25.566
37.565	445.435	24.74	0.81	3.26	8.36	9.38774	3.63043	3.06819	9.36671	3.63859	5	135.00	2.4286	2.376652	0.0519	0.6487	8.24148	5.34592	0.69076	24.69	63.1968	25.99

Depth (ft)	Sa... (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	445.107	23.87	0.87	3.63	-3.35	8.96744	4.06176	3.11089	8.97582	4.05798	5	135.00	2.45074	2.388558	0.0622	0.647	6.203105	5.307748	0.66313	23.89	66.2702	25.705
38.221	444.779	22.91	0.77	3.37	-3.42	8.51382	3.76765	3.10987	8.52632	3.76213	5	135.00	2.47288	2.400465	0.0724	0.6454	7.871536	5.080563	0.63273	22.94	66.196	25.361
38.549	444.451	25.19	0.68	2.69	-2.47	9.40775	2.99526	3.01817	9.41189	2.99494	5	135.00	2.49502	2.412371	0.0826	0.6438	8.145735	5.24455	0.70263	25.2	69.717	26.032
38.877	444.123	22.12	0.7	3.15	-2.17	8.08605	3.57091	3.11545	8.09018	3.56909	5	135.00	2.51716	2.424278	0.0929	0.6423	7.62211	4.895353	0.6069	22.13	66.604	25.012
39.206	443.794	19.76	0.61	3.07	-3.07	7.06859	3.54226	3.1627	7.06038	3.54638	5	135.00	2.53937	2.43622	0.1031	0.6407	7.022462	4.499157	0.53315	19.74	70.1291	24.097
39.534	443.466	24.4	0.75	3.06	4.32	8.92049	3.4343	3.07189	8.90824	3.43903	5	135.00	2.56151	2.448127	0.1134	0.6391	8.154368	5.211628	0.67611	24.37	63.4594	25.669
39.862	443.138	25.59	0.74	2.9	5.43	9.35205	3.2165	3.03903	9.33579	3.22211	5	135.00	2.58365	2.460033	0.1236	0.6376	8.369236	5.335994	0.71227	25.55	61.1526	25.988
40.19	442.810	25.05	0.72	2.86	6.14	9.0796	3.20795	3.04897	9.06341	3.21368	5	135.00	2.60579	2.47194	0.1338	0.636	8.244866	5.244024	0.69487	25.01	61.8447	25.792
40.518	442.482	23.27	0.76	3.25	7.14	8.31053	3.6818	3.11505	8.2904	3.69074	5	135.00	2.62793	2.483846	0.1441	0.6345	7.995391	5.073146	0.63907	23.22	66.5748	25.193
40.846	442.154	25.96	0.88	3.4	8.43	9.33984	3.77521	3.08008	9.3158	3.78496	5	135.00	2.65007	2.495752	0.1543	0.633	8.713036	5.515295	0.72167	25.9	64.0434	25.982
41.174	441.826	25.09	1.01	4.03	8.59	8.93973	4.50535	3.14056	8.91979	4.51542	4	135.00	2.67221	2.507659	0.1645	0.6315	8.772768	5.539906	0.69406	25.04	68.4623	25.693
41.502	441.498	23.31	0.9	3.85	10.14	8.18223	4.36561	3.16384	8.15841	4.37636	4	135.00	2.69436	2.519565	0.1748	0.63	8.27767	5.214892	0.63826	23.25	70.2152	25.095
41.83	441.170	22.11	0.83	3.76	10.72	7.66096	4.27978	3.18239	7.63331	4.29529	4	135.00	2.71649	2.531472	0.185	0.6286	7.949599	4.996417	0.60042	22.04	71.6336	24.65
42.158	440.842	22.65	0.97	4.29	10.46	7.82871	4.87159	3.20785	7.80119	4.88877	4	135.00	2.73863	2.543378	0.1952	0.627	8.293291	5.200217	0.61646	22.58	73.6096	24,8
42.486	440.514	21.66	0.88	4.07	10.99	7.39614	4.65627	3.21626	7.36874	4.67358	4	135.00	2.76077	2.555284	0.2055	0.6256	7.977884	4.990776	0.58512	21.69	74.2704	24.42
42.814	440.186	22.04	0.74	3.34	10.67	7.50123	3.84274	3.16291	7.47396	3.85676	5	135.00	2.78291	2.567191	0.2157	0.6241	7.6169	4.878716	0.59619	21.97	70.1447	24.618
43.143	439.857	19.95	0.77	3.87	8.24	6.64754	4.49114	3.24432	6.62815	4.50427	4	135.00	2.80512	2.579133	0.226	0.6227	7.505574	4.673551	0.5308	19.9	76.5026	23.717
43.471	439.529	17	0.74	4.34	6.35	5.46991	5.22129	3.35118	5.45447	5.23607	3	135.00	2.82726	2.59104	0.2362	0.6212	6.944066	4.313967	0.43878	16.96	85.4106	22.424
43.799	439.201	19.37	0.84	4.35	6.47	6.34689	5.08456	3.29171	6.33152	5.0969	3	135.00	2.8494	2.602946	0.2464	0.6198	7.554698	4.682673	0.51147	19.33	80.3734	23.418
44.127	438.873	21.4	1.06	4.94	0.86	7.08585	5.72093	3.28218	7.08585	5.72093	3	135.00	2.87154	2.614853	0.2567	0.6184	8.303236	5.134803	0.57364	21.4	79.585	24.174
44.455	438.545	19.64	0.74	3.78	-0.78	6.37528	4.41888	3.25299	6.37909	4.41624	4	135.00	2.89368	2.626759	0.2669	0.617	7.458995	4.60225	0.51846	19.65	77.2014	23.476
44.783	438.217	15.29	0.89	5.83	-1.04	4.68956	7.19239	3.48477	4.69335	7.18659	3	135.00	2.91582	2.638665	0.2771	0.6156	7.014831	4.318422	0.3831	15.3	97.4824	21.456
45.111	437.889	18.24	0.81	4.42	1.23	5.77311	5.29341	3.33425	5.76934	5.29687	3	135.00	2.93796	2.650572	0.2874	0.6142	7.364226	4.52332	0.47375	18.23	83.9559	22.816
45.439	437.561	23.11	0.9	3.9	2.4	7.5681	4.46652	3.19593	7.56059	4.47096	4	135.00	2.9601	2.662478	0.2976	0.6129	8.408624	5.153258	0.62384	23.09	72.6801	24.62
45.767	437.233	23.58	1.04	4.42	10.81	7.70187	5.04909	3.22274	7.6757	5.06631	4	135.00	2.98224	2.674385	0.3079	0.6115	8.728223	5.337205	0.6377	23.51	74.782	24.724
46.095	436.905	23.42	0.95	4.05	11.02	7.59993	4.6533	3.20639	7.57387	4.66931	4	135.00	3.00438	2.686291	0.3181	0.6101	8.56709	5.227052	0.63208	23.35	73.495	24.639
46.423	436.577	19.68	0.81	4.12	11.46	6.17208	4.86385	3.29142	6.14613	4.88438	4	135.00	3.02652	2.698197	0.3283	0.6086	7.662429	4.664783	0.51559	19.61	80.3493	23.25
46.751	436.249	16.67	0.6	3.22	13.05	5.76411	3.8409	3.25826	5.73459	3.86067	5	135.00	3.04866	2.710104	0.3386	0.6074	7.084343	4.303349	0.46363	16.59	77.6282	22.795
47.079	435.921	19.1	0.56	2.91	15.36	5.68874	3.49362	3.22851	5.652	3.51556	5	135.00	3.0709	2.72201	0.3486	0.6061	7.083552	4.293448	0.49626	19	75.2399	22.932
47.408	435.592	21.41	0.69	3.23	16.88	6.69982	3.76699	3.19955	6.66324	3.78767	5	135.00	3.093	2.733953	0.359	0.6048	7.780455	4.70554	0.56709	21.31	72.9615	23.796
47.736	435.264	49.22	1.77	3.6	20.42	16.7907	3.83907	2.88182	16.7433	3.84993	5	135.00	3.11514	2.745869	0.3693	0.6035	14.60876	8.816054	1.42739	49.09	50.6702	29.92
48.064	434.936	108.31	4.31	3.98	24.9	38.1369	4.09802	2.63254	38.0789	4.10426	6	135.00	3.13728	2.757766	0.3795	0.6022	28.10668	16.92509	3.25612	108.15	36.9683	35.099
48.392	434.608	174.86	6.35	3.63	23.46	61.9931	3.6983	2.45237	61.9389	3.70153	12	135.00	3.15942	2.769672	0.3898	0.6009	41.59558	24.99384	5.31581	174.71	28.5992	37.947
48.72	434.280	126.51	6.37	5.04	9.36	44.3376	5.16507	2.65754	44.316	5.16758	11	135.00	3.18156	2.781579	0.4	0.5996	33.2856	19.95771	3.81822	126.45	38.2371	36.007
49.048	433.952	166.9	6.34	3.8	22.06	58.5993	3.87303	2.48371	58.5492	3.87634	12	135.00	3.2037	2.793485	0.4102	0.5983	40.29083	24.10644	5.068	166.76	29.9602	37.628
49.376	433.624	185.28	8	4.32	29.84	64.8944	4.3943	2.49436	64.8267	4.39889	11	135.00	3.22584	2.805391	0.4205	0.597	44.94566	26.83435	5.63635	185.09	30.4315	38.206
49.704	433.296	146.4	7.86	5.37	33.05	50.8118	5.49067	2.63756	50.7373	5.49873	11	135.00	3.24798	2.817298	0.4307	0.5958	36.08988	22.69306	4.43195	146.19	37.2207	36.803
50.032	432.968	154.76	6.18	3.99	62.54	53.5451	4.07948	2.52808	53.4072	4.09001	12	135.00	3.27012	2.829204	0.4409	0.5945	38.09591	22.64885	4.69009	154.37	31.9538	37.1
50.36	432.640	137.82	5.3	3.84	25.31	47.3504	3.93971	2.55363	47.2941	3.9444	12	135.00	3.29226	2.841111	0.4512	0.5933	34.39466	20.40549	4.16496	137.66	33.1337	36.392
50.688	432.312	83.38	3.81	4.57	22.91	28.0635	4.7586	2.77386	28.0144	4.76693	11	135.00	3.3144	2.853017	0.4614	0.592	23.30703	13.79859	2.47881	83.24	44.5017	33.219
51.016	431.984	58.49	2.41	4.12	21.11	19.2513	4.36963	2.87161	19.2059	4.37995	5	135.00	3.33654	2.864923	0.4716	0.5908	17.26493	10.20013	1.70754	58.36	50.2442	30.822
51.345	431.655	40.89	1.24	3.03	26.95	13.0459	3.30391	2.92987	12.9868	3.31895	6	135.00	3.35875	2.876866	0.4819	0.5896	12.46659	7.350011	1.18196	40.72	53.8834	28.264
51.673	431.327	51.35	1.29	2.52	29.37	16.6054	2.68923	2.79202	16.5431	2.69936	6	135.00	3.38089	2.888772	0.4921	0.5884	14.47144	8.514418	1.48511	51.17	45.5351	29.856
52.001	430.999	79.13	2.66	3.36	27.12	26.1066	3.51262	2.70938	26.048	3.52052	6	135.00	3.40303	2.900679	0.5024	0.5872	21.35463	12.5384	2.34449	78.96	40.9545	32.766
52.329	430.671	74.91	5.41	7.23	-2.71	24.5434	7.56804	2.95469	24.5503	7.56592	11	135.00	3.42517	2.912585	0.5126	0.586	23.28897	13.64618	2.21315	74.93	55.4968	32.394
52.657	430.343	267.69	12.98	4.85	-1.85	90.3551	4.91215	2.43928	90.3585	4.91197	11	135.00	3.44731	2.924492	0.5228	0.5848	63.31944	37.02643	8.18089	267.7	27.9998	40.035

51 of 48
R13269

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 24 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5B

ConeTec Inc. Interpretation

Interpretation Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4397
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5B
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 15:44
CPT File: 804CP05B.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 479.9

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	38.10	1.25	40.93	19.30	2.15
125	Soil Embankment	31.26	1.88	62.63	50.48	2.64

User Inputs:

Assumed: Water Table Depth (ft): 28
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 479.9
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	479.736	18.44	0.14	0.76	0.34	1726.83	0.760	1.13	1727.69	0.75	6	130.00	0.011	0.011	0.000	2.000	8.71	5.42	0.671	18.43	1.1328	52.78
0.492	479.408	23.22	0.26	1.12	0.21	725.079	1.121	1.41	725.06	1.12	6	130.00	0.032	0.032	0.000	2.000	9.72	7.44	0.718	23.22	1.62884	49.62
0.82	479.080	13.82	0.2	1.51	0.32	248.906	1.508	1.78	248.91	1.51	6	130.00	0.053	0.053	0.000	2.000	5.40	4.80	0.411	13.82	2.85209	46.08
1.148	478.752	12.84	0.15	1.17	0.16	171.072	1.175	1.79	171.07	1.18	6	130.00	0.075	0.075	0.000	2.000	5.53	4.67	0.395	12.84	2.84977	43.30
1.476	478.424	38.97	0.24	0.62	0.89	405.191	0.617	1.33	405.09	0.62	7	130.00	0.096	0.096	0.000	2.000	8.09	12.38	1.204	38.98	0.7066	47.24
1.804	478.096	74.14	0.56	0.78	0.09	631.27	0.784	1.30	631.18	0.78	8	130.00	0.117	0.117	0.000	2.000	11.49	22.07	2.293	74.16	0.4522	49.07
2.133	477.767	60.91	0.73	1.2	0.11	438.323	1.201	1.54	438.32	1.20	7	130.00	0.139	0.139	0.000	2.000	10.18	20.36	1.881	60.91	0.43854	47.56
2.461	477.439	48.52	0.69	1.42	0.23	302.316	1.427	1.69	302.32	1.43	7	130.00	0.160	0.160	0.000	2.000	9.54	17.07	1.497	48.52	0.99658	45.97
2.789	477.111	43.89	0.75	1.7	0.09	241.105	1.716	1.82	241.10	1.72	7	130.00	0.181	0.181	0.000	2.000	9.06	16.12	1.363	43.89	0.8724	44.94
3.117	476.783	44.62	0.67	1.28	0.05	219.281	1.283	1.74	219.23	1.28	7	130.00	0.203	0.203	0.000	2.000	9.09	16.97	1.375	44.62	0.9579	44.49
3.445	476.455	38.58	0.44	1.13	0.02	171.29	1.147	1.78	171.29	1.15	7	130.00	0.224	0.224	0.000	2.000	8.09	15.09	1.187	38.58	1.09456	43.81
3.773	476.127	23.25	0.37	1.57	0.61	93.8032	1.608	2.07	93.80	1.61	6	130.00	0.245	0.245	0.000	2.000	4.70	9.80	0.712	23.25	1.89891	40.23
4.101	475.799	18.59	0.19	1.02	0.32	68.7391	1.037	2.05	68.74	1.04	6	130.00	0.267	0.267	0.000	1.937	3.72	7.31	0.567	18.59	2.14275	38.62
4.429	475.471	17.34	0.16	0.92	0.21	59.2324	0.938	2.07	59.23	0.94	6	130.00	0.288	0.288	0.000	1.864	3.61	6.84	0.528	17.34	2.0462	37.68
4.757	475.143	25.81	0.28	1.09	0.09	82.4721	1.098	2.00	82.47	1.10	7	130.00	0.309	0.309	0.000	1.798	5.06	9.43	0.759	25.81	2.0596	39.53
5.085	474.815	24.43	0.46	1.87	0.41	72.8127	1.909	2.20	72.81	1.91	6	130.00	0.331	0.331	0.000	1.760	4.80	9.05	0.716	24.43	2.9585	38.85
5.413	474.487	18.48	0.38	2.06	0.64	51.4663	2.099	2.34	51.47	2.10	6	130.00	0.352	0.352	0.000	1.686	4.17	7.04	0.561	18.48	3.9842	36.87
5.741	474.159	16.54	0.27	1.61	0.67	43.3236	1.670	2.33	43.35	1.67	6	130.00	0.373	0.373	0.000	1.637	3.73	6.11	0.501	16.55	3.7454	35.88
6.069	473.831	16.2	0.19	1.22	0.62	37.5312	1.283	2.31	37.53	1.28	6	130.00	0.394	0.394	0.000	1.592	3.40	5.41	0.468	16.2	3.0604	34.09
6.396	473.503	15.29	0.17	1.06	0.48	35.7663	1.145	2.30	35.79	1.14	6	130.00	0.416	0.416	0.000	1.551	3.41	5.28	0.460	15.29	2.82384	34.70
6.726	473.174	18.36	0.25	1.34	0.09	40.9955	1.395	2.30	41.00	1.39	6	130.00	0.437	0.437	0.000	1.512	4.09	6.18	0.555	18.36	2.6937	35.52
7.054	472.846	20.73	0.37	1.77	0.23	44.2117	1.825	2.35	44.21	1.83	6	130.00	0.459	0.459	0.000	1.477	4.71	6.98	0.626	20.73	2.4234	35.97
7.382	472.518	11.94	0.22	1.18	0.14	23.5838	1.020	2.65	23.98	1.02	6	130.00	0.480	0.480	0.000	1.444	3.04	4.35	0.356	11.94	3.1078	32.17
7.71	472.190	11.14	0.1	0.85	0.85	21.2289	0.940	2.45	21.25	0.94	6	130.00	0.501	0.501	0.000	1.418	2.85	4.16	0.329	11.15	2.8942	31.42
8.038	471.862	15.69	0.13	0.81	0.41	28.839	0.863	2.32	28.84	0.86	6	130.00	0.522	0.522	0.000	1.393	3.49	4.83	0.468	15.69	2.2196	33.06
8.366	471.534	15.96	0.17	1.04	0.67	28.3496	1.103	2.38	28.37	1.10	6	130.00	0.544	0.544	0.000	1.356	3.68	4.99	0.477	15.97	2.6636	33.26
8.694	471.206	18.31	0.18	1.32	0.46	32.5528	1.412	2.52	32.57	1.41	6	130.00	0.565	0.565	0.000	1.330	3.28	4.30	0.555	18.32	3.0281	33.61
9.022	470.878	16.16	0.14	0.84	0.04	28.8586	0.899	2.38	28.89	0.90	6	130.00	0.586	0.586	0.000	1.306	3.89	4.81	0.482	16.16	2.4756	32.85
9.35	470.550	17.98	0.14	0.78	0.6	28.8352	0.807	2.31	28.84	0.81	6	130.00	0.608	0.608	0.000	1.283	4.01	5.14	0.537	17.98	2.8351	33.30
9.678	470.222	14.69	0.11	0.72	0.61	22.3519	0.782	2.39	22.37	0.78	6	130.00	0.629	0.629	0.000	1.261	3.41	4.30	0.435	14.7	2.81982	31.75
10.006	469.894	15.18	0.18	0.83	0.82	22.263	0.898	2.42	22.28	0.90	6	130.00	0.650	0.650	0.000	1.240	3.56	4.41	0.448	15.18	3.87487	31.73
10.335	469.565	19.67	0.46	2.45	0.05	28.2806	2.627	2.69	28.26	2.53	5	130.00	0.672	0.672	0.000	1.220	5.00	6.10	0.688	19.67	4.8607	33.24
10.663	469.237	22.81	0.74	3.23	0.67	31.9104	3.346	2.63	31.91	3.35	5	130.00	0.693	0.693	0.000	1.201	5.69	7.01	0.858	23.81	4.87839	33.93
10.991	468.909	13.41	0.42	3.14	0.42	17.7706	3.308	2.82	17.77	3.31	4	130.00	0.714	0.714	0.000	1.183	3.85	4.56	0.569	13.41	4.71932	30.28
11.319	468.581	19.13	0.26	1.36	0.67	25.0012	1.418	2.48	25.00	1.41	6	130.00	0.736	0.736	0.000	1.166	4.62	6.39	0.669	19.13	2.97052	32.46
11.647	468.253	17.76	0.22	1.21	0.62	22.4461	1.295	2.50	22.46	1.29	6	130.00	0.757	0.757	0.000	1.149	4.88	6.88	0.626	17.76	2.7642	31.78
11.975	467.925	18.83	0.28	1.53	0.32	22.5491	1.695	2.65	22.55	1.60	6	130.00	0.778	0.778	0.000	1.133	4.57	6.16	0.643	18.83	3.92471	31.60
12.303	467.597	33.79	0.45	1.32	0.56	41.2536	1.364	2.30	41.25	1.36	7	130.00	0.800	0.800	0.000	1.118	7.50	10.99	1.021	33.79	2.8995	35.56
12.631	467.269	97.39	1.27	1.31	0.35	117.621	1.315	1.94	117.62	1.32	8	130.00	0.821	0.821	0.000	1.104	19.70	20.64	2.990	97.39	1.3008	41.42
12.959	466.941	115.69	0.89	1.46	0.69	166.344	1.472	1.93	166.34	1.47	8	130.00	0.842	0.842	0.000	1.090	22.12	24.10	3.556	115.69	1.0264	42.17
13.287	466.613	126.13	2.46	1.95	0.69	145.042	1.964	2.00	145.04	1.96	7	130.00	0.864	0.864	0.000	1.078	24.61	26.70	3.878	126.13	1.9601	42.49
13.615	466.285	126.8	2.52	1.98	0.67	142.281	2.001	2.01	142.28	2.00	7	130.00	0.885	0.885	0.000	1.065	25.06	26.83	3.898	126.8	1.9784	42.39
13.943	465.957	96.74	2.09	2.16	0.69	105.742	2.181	2.13	105.74	2.18	7	130.00	0.906	0.906	0.000	1.052	19.99	21.00	2.967	96.74	2.6031	40.66
14.271	465.629	74.23	1.62	2.18	0.2	79.0224	2.210	2.22	79.03	2.21	7	130.00	0.928	0.928	0.000	1.038	15.54	16.55	2.269	74.24	2.9585	39.30
14.6	465.300	62.31	1	1.61	0.99	64.6586	1.630	2.19	64.67	1.63	7	130.00	0.949	0.949	0.000	1.027	13.23	13.58	1.900	62.32	2.7205	38.18
14.928	464.972	62.68	1	1.59	0.92	63.9034	1.615	2.19	63.81	1.61	7	130.00	0.970	0.970	0.000	1.015	13.38	13.67	1.917	62.69	2.7825	38.10
15.256	464.644	49.08	0.73	1.48	1.5	48.4938	1.516	2.27	48.50	1.52	7	130.00	0.992	0.992	0.000	1.004	10.77	10.81	1.489	49.09	2.8776	36.52

R13271

Depth (ft)	San (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	ress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	464.316	46.97	0.47	1	1.55	45.3691	1.023	2.19	45.38	1.02	7	130.00	1.013	1.013	0.000	0.994	8.97	8.91	1.423	46.98	18.8866	38.13
15.912	463.988	56.81	0.64	1.12	0.15	55.9277	1.147	2.16	55.94	1.15	7	130.00	1.034	1.034	0.000	0.983	10.90	10.72	1.727	56.82	17.6279	37.141
16.24	463.660	78.21	1	1.28	0.17	77.0908	1.296	2.09	78.10	1.31	6	130.00	1.056	1.056	0.000	0.973	15.91	15.49	2.389	78.22	15.4178	38.87
16.568	463.332	70.07	1.01	1.44	-0.58	64.0662	1.464	2.18	64.07	1.46	7	130.00	1.077	1.077	0.000	0.964	14.71	14.18	2.138	70.08	17.8531	38.18
16.896	463.004	58.9	0.8	1.36	-0.56	52.6318	1.504	2.22	52.63	1.38	7	130.00	1.098	1.098	0.000	0.954	12.53	12.05	1.796	58.9	19.5365	37.00
17.224	462.676	49.84	0.81	1.64	-0.21	43.3388	1.669	2.33	43.34	1.67	7	130.00	1.120	1.120	0.000	0.945	11.19	10.58	1.602	49.85	23.1509	36.65
17.552	462.348	41.77	0.69	1.64	-0.86	35.6121	1.668	2.40	35.62	1.70	7	130.00	1.141	1.141	0.000	0.936	9.734	9.11	1.358	41.78	28.6986	36.167
17.881	462.020	66.88	0.68	1.19	-0.42	47.69	1.222	2.22	47.69	1.22	7	130.00	1.162	1.162	0.000	0.928	12.19	11.61	1.724	66.82	16.8406	38.45
18.206	461.692	67.56	1.17	1.74	-0.42	56.0755	1.76294	2.26106	56.0755	1.76294	7	130.00	1.18362	1.18362	0	0.9182	14.76722	13.57409	2.05489	67.53	21.1064	37.386
18.537	461.363	65.8	1.63	2.48	-0.64	53.6101	2.52341	2.3793	53.6101	2.52341	6	130.00	1.20491	1.204996	0	0.91	14.51548	13.20231	1.99985	65.8	25.575	37.106
18.865	461.035	61.85	1.3	2.11	-0.87	49.2763	2.15147	2.36009	49.2763	2.15147	7	130.00	1.22823	1.226825	0	0.903	14.07313	12.70883	1.87071	61.85	24.8187	36.614
19.193	460.707	47.05	0.79	1.67	-0.53	36.7141	1.7248	2.39828	36.7141	1.7248	7	125.00	1.24755	1.247545	0	0.8953	10.92664	9.782697	1.41603	47.05	26.3409	34.856
19.521	460.379	44.52	0.68	1.53	-0.9	34.1092	1.57218	2.39964	34.1171	1.57182	7	125.00	1.26805	1.268045	0	0.888	10.3478	9.189267	1.33907	44.53	26.3963	34.407
19.849	460.051	40.76	0.63	1.55	-0.25	30.6326	1.59609	2.44144	30.6326	1.59609	7	125.00	1.28855	1.288545	0	0.8809	9.665144	8.605678	1.22203	40.76	28.1337	33.741
20.177	459.723	38.62	0.63	1.64	-0.16	28.5024	1.68851	2.48112	28.5024	1.68851	7	125.00	1.30905	1.309045	0	0.874	9.319563	8.145509	1.15514	38.62	29.8483	33.291
20.505	459.395	44.39	0.75	1.69	-0.51	32.3674	1.74174	2.44416	32.3949	1.74133	7	125.00	1.32955	1.329545	0	0.8673	10.53065	9.132793	1.33314	44.4	28.2491	34.088
20.833	459.067	57.91	1.33	2.3	-0.41	41.8949	2.35149	2.43862	41.8949	2.35149	6	125.00	1.35005	1.350045	0	0.8606	13.69973	11.79066	1.75108	57.91	28.0145	35.652
21.161	458.739	25.08	1.34	5.36	-0.07	17.2993	5.65175	2.97846	17.2993	5.65175	3	125.00	1.37055	1.370545	0	0.8542	7.90839	6.76525	0.73404	25.08	57.0445	30.082
21.489	458.411	21.57	0.8	3.69	2.73	14.5063	3.96453	2.93879	14.4991	3.96649	4	125.00	1.39105	1.391045	0	0.8479	6.636117	5.626566	0.62474	21.56	54.455	28.914
21.817	458.083	29.59	0.95	3.2	6.9	19.9628	3.37137	2.78704	19.9345	3.37616	5	125.00	1.41155	1.411545	0	0.8417	8.334097	7.014733	0.8724	29.55	45.2501	31.009
22.145	457.755	33.08	1.22	3.68	8.57	22.0998	3.85491	2.79022	22.0649	3.86101	5	125.00	1.43205	1.432045	0	0.8356	9.331922	7.798171	0.97981	33.03	45.4317	31.665
22.473	457.427	36.31	1.19	3.29	9.54	23.9975	3.4139	2.72893	23.9562	3.41979	5	125.00	1.45255	1.452545	0	0.8297	9.906188	8.219431	1.07916	36.25	42.0101	32.192
22.802	457.098	35.83	1.22	3.4	9.26	23.3227	3.55096	2.74942	23.282	3.55717	5	125.00	1.47311	1.473108	0	0.8239	9.883284	8.142993	1.06368	35.77	43.1354	32.01
23.13	456.770	36.3	1.11	3.07	13.63	23.3036	3.18907	2.7202	23.25	3.19642	5	125.00	1.49361	1.493608	0	0.8182	9.852044	8.061356	1.0776	36.22	41.5366	32.001
23.458	456.442	34.31	1.06	3.08	15.82	21.6602	3.23211	2.74896	21.5942	3.242	5	125.00	1.51411	1.514108	0	0.8127	9.449872	7.679769	1.01535	34.21	43.1096	31.526
23.786	456.114	34.28	1.04	3.03	17.95	21.338	3.17602	2.74944	21.2663	3.18672	5	125.00	1.53461	1.534608	0	0.8072	9.441263	7.621342	1.01379	34.17	43.136	31.428
24.114	455.786	34.12	1.05	3.07	21.34	20.9406	3.22433	2.7603	20.857	3.23725	5	125.00	1.55511	1.555108	0	0.8019	9.44696	7.57551	1.0082	33.99	43.7395	31.302
24.442	455.458	33.09	1.19	3.59	20.71	20.0014	3.77605	2.8192	19.9189	3.79169	5	125.00	1.57561	1.575608	0	0.7967	9.463703	7.539408	0.97568	32.96	47.1096	31.004
24.77	455.130	35.21	1.24	3.53	21.94	21.0599	3.68895	2.79552	20.9722	3.70438	5	125.00	1.59611	1.596108	0	0.7915	9.937404	7.865781	1.04068	35.07	45.7358	31.338
25.098	454.802	35.32	1.2	3.39	24.9	20.8482	3.56047	2.78926	20.7554	3.57639	5	125.00	1.61661	1.616608	0	0.7865	9.93126	7.810917	1.04345	35.17	45.3767	31.27
25.426	454.474	33.07	1.09	3.29	27.37	19.2003	3.46771	2.81033	19.0964	3.48656	5	125.00	1.63711	1.637108	0	0.7816	9.399677	7.346396	0.97315	32.9	46.5923	30.729
25.754	454.146	30.14	0.89	2.96	28.13	17.1828	3.12474	2.82084	17.0742	3.14461	5	125.00	1.65761	1.657608	0	0.7767	8.610264	6.687682	0.88181	29.96	47.206	29.996
26.082	453.818	28.04	0.96	3.41	30.18	15.7093	3.64162	2.8929	15.5961	3.66806	5	125.00	1.67811	1.678108	0	0.772	8.341715	6.439401	0.81616	27.85	51.555	29.398
26.41	453.490	27.22	1.12	4.12	32.24	15.0249	4.38848	2.95894	14.9071	4.42314	4	125.00	1.69861	1.698608	0	0.7673	8.418813	6.459581	0.79014	27.02	55.761	29.099
26.739	453.161	25.07	1.08	4.3	31.06	13.5828	4.6251	3.00754	13.4721	4.66305	4	125.00	1.71917	1.71917	0	0.7627	7.988621	6.092736	0.72294	24.88	58.9941	28.424
27.067	452.833	22.62	0.88	3.89	31.69	11.945	4.23477	3.02853	11.83	4.27593	4	125.00	1.73967	1.73967	0	0.7582	7.262348	5.506094	0.64335	22.32	60.4271	27.552
27.395	452.505	23.13	1	4.33	31.09	12.1408	4.67949	3.04924	12.0328	4.72147	4	125.00	1.76017	1.76017	0	0.7537	7.563768	5.70113	0.6616	22.94	61.8634	27.667
27.723	452.177	24.42	1.29	5.28	27.74	12.7139	5.69805	3.08711	12.6129	5.74372	3	125.00	1.78067	1.78067	0	0.7494	8.192462	6.139354	0.70091	24.24	64.5466	27.983
28.051	451.849	25.99	1.44	5.53	25.13	13.4414	5.95316	3.07983	13.358	5.99031	3	135.00	1.80117	1.799579	0.0016	0.7454	8.691388	6.478936	0.74888	25.84	64.0251	28.368
28.379	451.521	24.42	1.32	5.42	22.7	12.4741	5.84156	3.09958	12.3913	5.8806	3	135.00	1.82331	1.811485	0.0118	0.743	8.270747	6.145077	0.69959	24.27	66.4465	27.867
28.707	451.193	24.47	1.16	4.75	25.24	12.4079	5.12717	3.06558	12.3202	5.16369	3	135.00	1.84545	1.823392	0.0221	0.7406	8.100847	5.99916	0.70045	24.31	63.0122	27.832
29.035	450.865	24.85	1.17	4.72	24.97	12.5224	5.09085	3.06047	12.4353	5.12664	3	135.00	1.86759	1.835298	0.0323	0.7382	8.200162	6.052979	0.71153	24.69	62.6514	27.897
29.363	450.537	25.04	1.24	4.96	25.89	12.5326	5.35631	3.07414	12.446	5.39359	3	135.00	1.88973	1.847204	0.0425	0.7358	8.337266	6.134317	0.71673	24.88	63.6191	27.906
29.691	450.209	24.64	1.36	5.51	22.33	12.2253	5.98377	3.1127	12.15	6.02086	3	135.00	1.91187	1.859111	0.0526	0.7334	8.422769	6.177365	0.70366	24.5	66.4024	27.747
30.019	449.881	19.78	1.13	5.7	16.6	9.53812	6.33195	3.21114	9.48467	6.36764	3	135.00	1.93401	1.871017	0.063	0.7311	7.245293	5.296842	0.55251	19.68	73.8677	26.083
30.347	449.553	16.42	0.88	5.37	15.59	7.68159	6.08413	3.27481	7.62848	6.12649	3	135.00	1.95615	1.882924	0.0732	0.7288	6.296958	4.588962	0.4478	16.32	78.9785	24.616
30.675	449.225	20.02	0.87	4.36	20.02	9.52155	4.82216	3.13916	9.45822	4.85445	4	135.00	1.97829	1.89483	0.0835	0.7265	6.965318	5.050062	0.55857	19.9	68.3583	26.072
31.004	448.896	23.04	1.19	5.16	16.63	11.0341	5.65603	3.1308	10.9816	5.68304	3	135.00	2.0005	1.906773	0.0937	0.7242	7.982538	5.780848	0.65138	22.94	67.7209	27.081
31.332	448.568	21.44	1.16	5.4	11.94	10.1202	5.97403	3.17402	10.0837	5.99565	3	135.00	2.02264	1.918679	0.104	0.7219	7.662654	5.531947	0.60116	21.37	70.991	26.51
31.66	448.240	16.83	1.16	6.88	4.5	7.65841	7.84567	3.34165	7.64287	7.86162	3	135.00	2.04478	1.930586	0.1142	0.7197	6.626488	4.913068	0.45775	16.8	84.69	24.646
31.988	447.912	14.1	1.08	7.64	2.65	6.19466	8.97526	3.44974	6.18437	8.9902	3	135.00	2.06692	1.942492	0.1244	0.7175	6.258887	4.490736	0.37254	14.08	94.2141	23.229
32.316	447.584	36.85	1.84	4.99	8.52	17.786	5.2933	2.95167	17.7553	5.30245	3	135.00	2.08906	1.954398	0.1347	0.7153	11.41236	8.183359	1.07619	36.79	55.2875	30.278
32.644	447.256	53.58	2.7	5.03	7.3	26.1754	5.2459	2.82443	26.15	5.251	4	135.00	2.1112	1.966305	0.1449	0.7131	15.41519	10.99318	1.59346	53.53	47.4168	32.767
32.972	446.928	41.03	2.46	5.99	2.4	19.6625	6.32445	2.97035	19.6524	6.3277	3	135.00	2.13334	1.978211	0.1551	0.711	12.86718	9.148439	1.20423	41.01	56.5089	30.942
33.3	446.600	30.73	1.67	5.43	5.52	14.3582	5.84437	3.04968	14.3431	5.85051	3	135.00	2.15548	1.990118	0.1654	0.7089	10.12526	7.177398	0.88468	30.7	61.8941	28.881
33.628	446.272	25.44	1.21	4.77	7.23	11.6194	5.20159	3.0884	11.5995	5.21049	3	135.00	2.17762	2.002024	0.1756	0.7067	8.591848	6.072283	0.7202	25.4	64.6397	27.47
33.956	445.944	24.48	1.07	4.38	8.06	11.0631	4.80246	3.08384	11.0382	4.81326	4	135.00	2.19976	2.01393	0.1858	0.7047	8.238887	5.80559	0.68979	24.43	64.3124	27.142
34.284	445.616	24.3	1.08	4.43	9.26	10.8983	4.89172	3.0942	10.8686	4.90505	4	135.00	2.2219	2.025837	0.1961	0.7028	8.231024	5.782979	0.68353	24.24	65.0574	27.041
34.612	445.288	25.03	1.22	4.87	9.17	11.182	5.35417	3.10955	11.1674	5.36595	3	135.00	2.24404	2.037743	0.2063	0.7005	8.569686	6.003302	0.70545	24.98	66.1725	27.219
34.941	444.959	21.34	0.88	4.11	11.34	9.3057	4.61367	3.13367	9.27155	4.63066	4	135.00	2.26625	2.049686	0.2166	0.6985	7.41695	5.180619	0.59052	21.27	67.9493	25.982
35.269	444.631	22.16	0.83	3.76	13.05	9.63896	4.17681	3.0961	9.59531	4.19562	4	135.00	2.28839	2.061592	0.2268	0.6965	7.503638	5.226013	0.61522	22.07	65.1947	26.215
35.597	444.303	27.65	1.08	3.92	12.93	12.2206	4.26212	3.01644	12.1821	4.27562	4	135.00	2.31053	2.073499	0.237	0.6945	8.913341	6.189971	0.7845	27.57	59.7354	27.812
35.925	443.975	41.71	1.36	3.26	15.45	18.8823	3.45376	2.61298	18.8392	3.46168	5	135.00	2.33267	2.085405	0.2473	0.6925	11.90861	8.246427	1.21911	41.62	46.7462	30.682
36.253	443.647	119.94	5.26	4.39	10.53	56.0647	4.47335	2.54245	56.0314	4.47602	11	135.00	2.35481	2.097311	0.2575	0.6905	29.76849	20.56918	3.64041	119.67	32.6167	37.373
36.581	443.319	232.84	9.81	4.21	-2.08	109.265	4.25665	2.33841	109.269	4.25646	12	135.00	2.37695	2.109218	0.2677	0.6886	52.64439	36.24861	7.13508	232.85	23.9715	41.04
36.909	442.991	245.39	11.65	4.75	-7.92	114.558	4.79442	2.36708	114.581	4.79343	11	135.00	2.39909	2.121124	0.278	0.6866	56.20318	38.59027	7.52294	245.44	25.0892	41.287
37.237	442.663	185.81	11.73	6.31	-9.21	85.9757	6.39625	2.54195	86.0038	6.39416	11	135.00	2.42123	2.133031	0.2882	0.6847	46.17875	31.61867	5.67767	185.87	32.5936	39.766
37.565	442.335	190.28	10.73	5.64	-3.88	87.5721	5.71241	2.49823	87.5814	5.7118	11	135.00	2.44337	2.144937	0.2984	0.6828	46.29593	31.61081	5.81538	190.3	30.6039	39.865

R13272

Depth (ft)	Samp. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...ess (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	442.007	280.56	11.76	4.19	-0.79	128.936	4.22878	2.29281	128.941	4.22863	12	135.00	2.46551	2.156843	0.3087	0.6809	62.17955	42.33877	8.60974	280.57	22.2559	41.895
38.221	441.679	230.05	12.58	5.47	-8.43	104.928	5.52816	2.43946	104.951	5.52694	11	135.00	2.48765	2.16875	0.3189	0.679	54.45582	36.97767	7.04527	230.1	28.0501	40.829
38.549	441.351	214.58	12.79	5.96	-3.42	97.2506	6.03102	2.48953	97.2644	6.03017	11	135.00	2.50979	2.180656	0.3291	0.6772	51.99489	35.21008	6.56564	214.61	30.2173	40.427
38.877	441.023	252.97	15.89	6.28	5.22	114.222	6.34488	2.46678	114.208	6.34564	11	135.00	2.53193	2.192563	0.3394	0.6753	60.62771	40.94446	7.7535	252.94	29.2202	41.271
39.206	440.694	369.1	14.5	3.93	49.56	166.271	3.95585	2.20569	165.131	3.9592	12	135.00	2.55413	2.204505	0.3496	0.6735	78.75678	53.04353	11.3482	368.79	19.1854	43.163

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 28 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-6

ConeTec Inc. Interpretation
Interpretation C - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4364
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-6
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 12:00
CPT File: 804CP06.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 457.8

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	37.16	1.38	45.31	35.45	2.55

User Inputs:
Assumed:
Water Table Depth (ft): 9.2
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 457.8
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	457.636	8.56	0.1	1.11	-0.53	834.122	1.170	1.40	834.12	1.17	5	125.00	0.010	0.010	0.000	2.000	1.37	2.74	0.265	8.56	1.52433	50.16
0.492	457.308	9.31	0.29	3.12	-2.93	301.764	3.125	1.98	302.41	3.12	4	125.00	0.031	0.031	0.000	2.000	1.82	3.64	0.287	9.33	12.388	45.97
0.82	456.980	10.89	0.47	4.33	-10.58	211.488	4.336	2.18	212.85	4.31	3	125.00	0.051	0.051	0.000	2.000	2.31	4.63	0.336	10.96	18.2558	44.35
1.148	456.652	15.32	0.83	5.4	-7.37	212.519	5.443	2.26	213.08	5.43	3	125.00	0.072	0.072	0.000	2.000	3.36	6.72	0.472	15.38	21.1963	44.36
1.476	456.324	38.89	1.49	3.84	3.12	420.572	3.840	1.99	420.36	3.84	5	125.00	0.092	0.092	0.000	2.000	7.62	15.25	1.201	38.87	12.7664	47.40
1.804	455.996	64.95	2.12	3.26	8.39	575.053	3.270	1.87	574.61	3.27	6	125.00	0.113	0.113	0.000	2.000	12.18	24.35	2.007	64.9	9.79283	48.70
2.133	455.667	91.43	3.22	3.53	-3.19	684.832	3.527	1.86	684.98	3.53	6	125.00	0.133	0.133	0.000	2.000	17.18	34.36	2.827	91.45	9.86183	49.40
2.461	455.339	106.27	4.78	4.5	0.53	689.906	4.604	1.98	689.84	4.50	11	125.00	0.154	0.154	0.000	2.000	20.72	41.43	3.285	106.26	12.339	49.42
2.789	455.011	97.06	5.09	5.25	3.16	555.816	5.254	2.07	555.70	5.25	11	125.00	0.174	0.174	0.000	2.000	19.62	39.25	3.000	97.04	14.9656	48.56
3.117	454.683	83.61	4.4	5.26	13.6	428.182	5.275	2.12	427.72	5.28	11	125.00	0.195	0.195	0.000	2.000	17.19	34.38	2.583	83.52	16.2983	47.48
3.445	454.355	75.27	3.59	4.77	18.34	348.585	4.783	2.11	348.07	4.79	11	125.00	0.215	0.215	0.000	2.000	15.46	30.93	2.324	75.16	16.2656	46.69
3.773	454.027	65.07	3.24	4.98	11.57	274.94	4.997	2.18	274.64	5.00	11	125.00	0.236	0.236	0.000	2.000	13.73	27.45	2.007	65	18.2882	45.53
4.101	453.699	64.94	3.2	4.93	6.12	252.363	4.947	2.19	252.21	4.95	11	125.00	0.256	0.256	0.000	1.975	13.78	27.23	2.003	64.9	18.7426	45.14
4.429	453.371	63.37	3.12	4.93	5.33	227.928	4.945	2.21	227.82	4.95	11	125.00	0.277	0.277	0.000	1.901	13.67	25.80	1.953	63.34	19.4706	44.67
4.757	453.043	55.6	2.82	5.07	3.75	186.009	5.099	2.27	185.91	5.10	4	125.00	0.297	0.297	0.000	1.834	12.20	22.38	1.712	55.57	21.4653	43.71
5.085	452.715	46.31	2.63	5.68	-1.89	144.715	5.718	2.37	144.75	5.72	3	125.00	0.318	0.318	0.000	1.774	10.63	18.85	1.424	46.32	25.262	42.47
5.413	452.387	49.15	2.45	4.98	-2.28	144.28	5.019	2.33	144.31	5.02	4	125.00	0.338	0.338	0.000	1.719	11.05	19.00	1.511	49.16	23.4659	42.46
5.741	452.059	41.44	2.45	5.91	-3.05	114.492	5.964	2.44	114.55	5.96	3	125.00	0.359	0.359	0.000	1.669	9.63	16.41	1.272	41.46	28.2345	41.28
6.069	451.731	40.26	2.34	5.81	-3.23	105.139	5.868	2.46	105.19	5.86	3	125.00	0.379	0.379	0.000	1.624	9.62	15.62	1.235	40.28	28.9115	40.83
6.398	451.402	35.34	1.94	5.49	-2.66	87.3776	5.552	2.49	87.43	5.55	3	125.00	0.400	0.400	0.000	1.581	8.56	13.64	1.082	35.36	30.1842	39.85
6.726	451.074	29.43	1.47	4.99	-1.85	69.0089	5.067	2.52	69.06	5.06	3	125.00	0.420	0.420	0.000	1.542	7.25	11.18	0.898	29.45	31.6997	38.55
7.054	450.746	22.96	1.12	4.89	-1.15	51.0783	4.974	2.60	51.10	4.97	3	125.00	0.441	0.441	0.000	1.506	5.88	8.86	0.697	22.97	35.6076	36.83
7.382	450.418	22.39	1.27	5.66	-4.08	47.5289	5.792	2.67	47.59	5.78	3	125.00	0.461	0.461	0.000	1.472	5.96	8.76	0.679	22.42	39.0065	36.41
7.71	450.090	24.72	1.47	5.94	-5.27	50.2996	6.065	2.67	50.38	6.05	3	125.00	0.482	0.482	0.000	1.441	6.66	9.46	0.750	24.76	38.9216	36.74
8.038	449.762	25.96	1.6	6.18	-6.42	50.6745	6.285	2.68	50.75	6.28	3	125.00	0.502	0.502	0.000	1.411	6.93	9.77	0.788	26	39.4189	36.79
8.366	449.434	23.65	1.49	6.3	-8.13	44.2307	6.443	2.73	44.33	6.43	3	125.00	0.523	0.523	0.000	1.383	6.47	8.95	0.716	23.7	41.9185	35.99
8.694	449.106	24.35	1.37	5.64	-8.36	43.8126	5.755	2.69	43.90	5.74	3	125.00	0.543	0.543	0.000	1.357	6.55	8.86	0.737	24.4	40.1268	35.93
9.022	448.778	28.28	1.49	5.26	-7.83	49.153	5.376	2.64	49.24	5.37	3	125.00	0.564	0.564	0.000	1.332	7.38	9.83	0.858	28.33	37.2649	36.61
9.35	448.450	28.51	1.65	5.78	-7.81	48.173	5.909	2.67	48.24	5.90	3	135.00	0.584	0.580	0.005	1.313	7.56	9.96	0.865	28.55	39.1366	36.49
9.678	448.122	28.8	1.69	5.86	-6.77	47.6562	5.994	2.68	47.72	5.99	3	135.00	0.607	0.592	0.016	1.300	7.69	10.00	0.873	28.84	39.5436	36.43
10.006	447.794	30.8	1.76	5.68	-4.18	49.9933	5.800	2.66	50.03	5.80	3	135.00	0.629	0.604	0.025	1.287	8.12	10.45	0.934	30.82	38.2961	36.71
10.335	447.465	27.19	1.42	5.23	-3.86	43.1215	5.351	2.68	43.17	5.34	3	135.00	0.651	0.615	0.035	1.275	7.23	9.22	0.822	27.22	39.1905	35.84
10.663	447.137	24.41	1.15	4.72	-3.58	37.8365	4.845	2.68	37.87	4.84	3	135.00	0.673	0.627	0.046	1.263	6.52	8.23	0.735	24.43	39.6428	35.06
10.991	446.809	22.72	0.94	4.13	-3.23	34.4535	4.268	2.68	34.48	4.26	4	135.00	0.695	0.639	0.056	1.251	6.04	7.55	0.682	22.74	39.1418	34.49
11.319	446.481	22.41	0.82	3.65	-2.63	33.3135	3.780	2.65	33.33	3.78	5	135.00	0.717	0.651	0.066	1.239	5.88	7.28	0.672	22.42	37.6448	34.28
11.647	446.153	22.09	0.86	3.9	-2.01	32.1993	4.028	2.68	32.21	4.03	4	135.00	0.739	0.663	0.076	1.228	5.88	7.23	0.661	22.1	39.3712	34.08
11.975	445.825	19.57	0.82	4.2	-1.41	27.6651	4.360	2.75	27.68	4.36	4	135.00	0.762	0.676	0.087	1.217	5.41	6.56	0.582	19.58	43.1036	33.18
12.303	445.497	18.59	0.79	4.26	-0.78	25.9231	4.437	2.78	25.92	4.44	4	135.00	0.784	0.687	0.097	1.207	5.22	6.29	0.551	18.59	44.7056	32.73
12.631	445.169	16.32	0.81	4.95	-0.6	22.2013	5.221	2.87	22.20	5.22	3	135.00	0.806	0.699	0.107	1.196	4.84	5.79	0.480	16.32	50.4414	31.75
12.959	444.841	19.07	0.83	4.36	0.74	25.6676	4.550	2.79	25.67	4.55	3	135.00	0.828	0.711	0.117	1.186	5.39	6.38	0.565	19.07	45.3058	32.67
13.287	444.513	21.2	1	4.73	8.36	28.1617	4.914	2.78	28.09	4.93	3	135.00	0.850	0.723	0.128	1.176	5.95	7.00	0.630	21.15	45.0064	33.24
13.615	444.185	20.7	0.95	4.58	10.95	26.9943	4.791	2.79	26.91	4.81	3	135.00	0.872	0.735	0.138	1.167	5.83	6.80	0.614	20.64	45.3618	32.97
13.943	443.857	23.12	1.2	5.2	13.55	29.7762	5.399	2.79	29.66	5.42	3	135.00	0.894	0.746	0.148	1.157	6.52	7.56	0.688	23.03	45.6865	33.58
14.271	443.529	29.53	1.34	4.53	13.72	37.7323	4.683	2.68	37.63	4.70	4	135.00	0.917	0.758	0.158	1.148	7.83	8.99	0.886	29.45	39.2582	35.04
14.6	443.200	26.74	0.91	3.39	16.67	33.4964	3.527	2.63	33.37	3.54	5	135.00	0.939	0.770	0.168	1.139	6.92	7.88	0.799	26.64	36.8625	34.31
14.928	442.872	20.25	0.7	3.44	21.11	24.6608	3.629	2.74	24.49	3.65	5	135.00	0.961	0.782	0.179	1.131	5.53	6.25	0.597	20.12	42.6233	32.39
15.256	442.544	17.79	0.62	3.49	24.51	21.1653	3.689	2.80	20.96	3.72	4	135.00	0.983	0.794	0.189	1.122	5.00	5.61	0.520	17.63	45.8297	31.41

R13275

Depth (ft)	Sam, (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	..ress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.564	442.216	15.28	0.55	3.61	26.19	17.7109	3.853	2.87	17.50	3.90	4	135.00	1.005	0.806	0.199	1.114	4.47	4.98	0.442	15.11	50.169	30.25
15.912	441.868	12.73	0.44	3.46	28.8	14.3083	3.760	2.94	14.09	3.82	4	135.00	1.027	0.818	0.209	1.108	3.86	4.27	0.362	12.55	54.4336	28.84
16.24	441.560	10.89	0.43	3.91	30.79	11.8589	4.370	3.05	11.63	4.46	3	135.00	1.049	0.830	0.220	1.098	3.62	3.86	0.305	10.7	61.5912	27.59
16.568	441.232	10.9	0.3	2.76	46.79	11.6767	3.052	2.96	11.33	3.15	4	135.00	1.072	0.842	0.230	1.090	3.32	3.61	0.304	10.61	56.0979	27.42
16.896	440.904	10.8	0.23	2.13	52.75	11.3708	2.370	2.91	11.00	2.45	5	135.00	1.094	0.854	0.240	1.082	3.18	3.44	0.301	10.48	52.8446	27.23
17.224	440.576	11.97	0.28	2.35	59.86	12.5406	2.580	2.90	12.10	2.67	5	135.00	1.116	0.866	0.250	1.075	3.49	3.75	0.336	11.59	52.0107	27.86
17.552	440.248	10.88	0.31	2.86	64.85	11.1029	3.182	3.00	10.65	3.32	4	135.00	1.138	0.877	0.261	1.068	3.35	3.57	0.302	10.48	58.4614	27.03
17.88	439.920	8.13	0.21	2.59	64.13	7.63716	3.013	3.12	7.39	3.20	4	135.00	1.160	0.889	0.271	1.060	2.67	2.83	0.216	7.73	67.0317	24.64
18.208	439.592	9.83	0.21	2.14	70.88	9.59534	2.428	2.99	9.11	2.56	5	135.00	1.182	0.901	0.281	1.053	2.99	3.15	0.268	9.39	57.9642	26.01
18.537	439.263	14.59	0.35	2.37	85.33	14.6681	2.615	2.86	14.07	2.72	5	135.00	1.204	0.913	0.291	1.046	4.11	4.30	0.414	14.05	49.0242	28.86
18.865	438.935	17.47	0.43	2.47	91.82	17.5587	2.647	2.79	16.94	2.74	5	135.00	1.227	0.925	0.302	1.040	4.77	4.96	0.503	16.9	45.2968	30.07
19.193	438.607	23.8	0.66	2.76	108.66	24.0676	2.927	2.70	23.34	3.02	5	135.00	1.249	0.937	0.312	1.033	6.23	6.44	0.698	23.12	40.6187	32.12
19.521	438.279	26.5	1.31	4.94	95.15	26.5877	5.192	2.83	25.97	5.32	3	135.00	1.271	0.949	0.322	1.027	7.49	7.69	0.781	25.91	47.7672	32.79
19.849	437.951	23.66	0.83	3.52	20.44	23.2793	3.711	2.76	23.15	3.73	5	135.00	1.293	0.961	0.332	1.020	6.66	6.69	0.692	23.54	43.9821	32.07
20.177	437.623	18.99	0.49	2.56	28.01	18.1706	2.772	2.77	18.00	2.80	5	135.00	1.315	0.973	0.342	1.014	5.26	5.34	0.547	18.82	44.4019	30.47
20.505	437.295	18.95	0.78	4.1	37.55	17.8877	4.429	2.91	17.65	4.49	4	135.00	1.337	0.985	0.353	1.008	5.65	5.70	0.545	18.72	52.3926	30.35
20.833	436.967	49.87	2.16	4.32	27.3	48.6795	4.453	2.58	48.51	4.47	5	135.00	1.359	0.997	0.363	1.002	12.61	12.63	1.502	49.7	34.6157	36.57
21.161	436.639	83.66	5.29	6.33	-14.43	81.5902	6.429	2.56	81.68	6.42	11	135.00	1.382	1.008	0.373	0.996	20.96	20.87	2.547	83.75	33.2996	39.50
21.489	436.311	243.98	10.44	4.28	-17.83	237.74	4.304	2.15	237.85	4.30	11	135.00	1.404	1.020	0.383	0.990	50.99	50.48	7.510	244.09	17.4322	44.88
21.817	435.983	336.34	16.44	4.89	-19.33	324.451	4.909	2.14	324.57	4.91	11	135.00	1.426	1.032	0.394	0.984	69.87	68.77	10.369	336.46	16.9751	46.29
22.145	435.655	423.23	17.94	4.24	-18.68	403.946	4.253	2.04	404.05	4.25	12	135.00	1.448	1.044	0.404	0.979	84.57	82.76	13.058	423.34	14.0663	47.24

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 31 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-7

ConeTec Inc. Interpretation
Interpretation C - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4331
Job No: 07-804
Client: Civil & Environmental Consultants
Projec:: Pond Creek Mine - Williamson County, Illinois
Site: CPT-7
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 07:58
CPT File: 804CP07.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 457.8

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	39.96	1.80	58.51	25.19	2.31

User Inputs:
Assumed:
Water Table Depth (ft): 9.2
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 457.8
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	457.636	9.8	0.17	1.69	-0.53	955.098	1.737	1.54	955.10	1.74	5	125.00	0.010	0.010	0.000	2.000	1.64	3.27	0.303	9.8	3.41567	50.67
0.492	457.308	30.91	0.44	1.41	-5.98	1004.2	1.425	1.45	1005.50	1.42	6	125.00	0.031	0.031	0.000	2.000	5.02	10.05	0.956	30.95	2.16306	50.86
0.82	456.980	42	0.69	1.65	-14.97	818.512	1.645	1.54	820.46	1.64	7	125.00	0.051	0.051	0.000	2.000	7.03	14.07	1.299	42.1	3.40523	50.09
1.148	456.652	38.42	0.68	1.76	-15.08	634.47	1.773	1.64	535.86	1.77	6	125.00	0.072	0.072	0.000	2.000	6.66	13.33	1.187	38.52	5.10589	48.41
1.476	456.324	35.13	0.57	1.61	-15.89	379.813	1.627	1.68	380.90	1.62	6	125.00	0.092	0.092	0.000	2.000	6.18	12.36	1.085	35.23	5.82026	46.98
1.804	455.996	33.61	0.6	1.77	-9.56	297.093	1.791	1.76	297.63	1.79	6	125.00	0.113	0.113	0.000	2.000	6.10	12.20	1.037	33.67	7.65399	45.90
2.133	455.667	35.29	0.79	2.24	-0.3	263.716	2.247	1.89	263.79	2.25	6	125.00	0.133	0.133	0.000	2.000	6.66	13.32	1.088	35.3	10.1362	45.36
2.461	455.339	39.86	1	2.5	-0.42	258.147	2.518	1.94	258.15	2.52	6	125.00	0.154	0.154	0.000	2.000	7.65	15.30	1.229	39.86	11.2767	45.25
2.789	455.011	41.14	1.05	2.55	-0.46	235.013	2.563	1.96	235.01	2.56	6	125.00	0.174	0.174	0.000	2.000	7.98	15.97	1.268	41.14	12.0156	44.82
3.117	454.683	36.47	0.82	2.25	-0.6	186.206	2.260	1.98	186.26	2.26	6	125.00	0.195	0.195	0.000	2.000	7.12	14.23	1.123	36.48	12.3943	43.72
3.445	454.355	34.59	0.81	2.35	-0.76	159.65	2.366	2.03	159.65	2.36	6	125.00	0.215	0.215	0.000	2.000	6.89	13.79	1.064	34.59	13.9069	42.96
3.773	454.027	45.16	1.24	2.75	-0.76	190.508	2.760	2.04	190.51	2.76	6	125.00	0.236	0.236	0.000	2.000	9.03	18.06	1.391	45.16	14.1489	43.82
4.101	453.699	52.95	1.71	3.23	-0.23	205.584	3.245	2.08	205.58	3.25	6	125.00	0.256	0.256	0.000	1.976	10.75	21.24	1.631	52.95	15.2795	44.19
4.429	453.371	39.45	1.59	4.04	4.97	141.515	4.059	2.26	141.41	4.06	5	125.00	0.277	0.277	0.000	1.901	8.60	16.34	1.213	39.42	20.8937	42.36
4.757	453.043	25.66	0.97	3.77	17.39	85.3065	3.825	2.37	84.94	3.84	5	125.00	0.297	0.297	0.000	1.834	5.67	10.76	0.785	25.55	25.3185	39.69
5.085	452.715	16.21	0.6	3.68	17.83	50.0049	3.775	2.53	49.63	3.80	4	125.00	0.318	0.318	0.000	1.774	3.97	7.04	0.492	16.09	31.9342	36.66
5.413	452.387	12.96	0.42	3.21	19.31	37.3078	3.328	2.58	36.95	3.36	4	125.00	0.338	0.338	0.000	1.719	3.25	5.59	0.391	12.84	34.5011	34.90
5.741	452.059	11.65	0.37	3.13	19.93	32.0256	3.220	2.62	31.66	3.26	4	125.00	0.359	0.359	0.000	1.669	3.03	5.06	0.366	11.72	36.5018	33.95
6.069	451.731	10.67	0.33	3.1	21.39	27.1298	3.207	2.68	26.79	3.25	4	125.00	0.379	0.379	0.000	1.624	2.80	4.55	0.319	10.54	39.2642	32.90
6.398	451.402	9.96	0.31	3.07	23.76	23.9078	3.243	2.72	23.53	3.29	4	125.00	0.400	0.400	0.000	1.581	2.67	4.23	0.296	9.81	41.7687	32.08
6.726	451.074	9.7	0.29	2.95	38.8	22.0746	3.125	2.75	21.50	3.21	4	125.00	0.420	0.420	0.000	1.542	2.61	4.03	0.287	9.46	43.0291	31.50
7.054	450.746	14.29	0.34	2.35	47.48	31.4128	2.455	2.56	30.73	2.51	5	125.00	0.441	0.441	0.000	1.506	3.51	5.28	0.429	13.99	33.4317	33.76
7.382	450.418	16.68	0.5	3	56.9	35.1528	3.003	2.59	34.37	3.15	5	125.00	0.461	0.461	0.000	1.472	4.15	6.10	0.502	16.32	34.7346	34.45
7.71	450.090	21.63	0.76	3.61	62.19	43.8972	3.688	2.57	43.08	3.76	5	125.00	0.482	0.482	0.000	1.441	5.34	7.70	0.655	21.24	33.769	35.82
8.038	449.762	21.3	0.89	4.19	65.68	41.3986	4.279	2.63	40.58	4.37	4	125.00	0.502	0.502	0.000	1.411	5.43	7.66	0.644	20.89	36.9226	35.46
8.366	449.434	20.62	0.75	3.62	74.41	38.4358	3.732	2.62	37.54	3.82	4	125.00	0.523	0.523	0.000	1.383	5.19	7.18	0.622	20.15	36.1207	34.99
8.694	449.106	21.71	0.73	3.35	81.34	38.954	3.449	2.59	38.03	3.53	5	125.00	0.543	0.543	0.000	1.357	5.39	7.31	0.655	21.21	34.7719	35.07
9.022	448.778	22.26	0.62	2.79	96.35	38.4766	2.858	2.54	37.41	2.94	5	125.00	0.564	0.564	0.000	1.332	5.37	7.16	0.672	21.66	32.4751	34.97
9.35	448.450	20.7	0.61	2.93	91.74	34.7004	3.032	2.59	33.70	3.12	5	135.00	0.584	0.580	0.005	1.313	5.12	6.73	0.623	20.12	34.9106	34.33
9.678	448.122	20.96	0.7	3.35	82.7	34.4041	3.439	2.63	33.53	3.53	5	135.00	0.607	0.592	0.015	1.300	5.30	6.89	0.630	20.44	36.7405	34.30
10.006	447.794	23.37	0.86	3.67	95.38	37.6819	3.782	2.63	36.70	3.88	5	135.00	0.629	0.604	0.025	1.287	5.90	7.60	0.704	22.76	36.7081	34.86
10.335	447.465	23.21	0.93	4.02	86.47	36.6547	4.122	2.66	35.79	4.22	4	135.00	0.651	0.615	0.036	1.275	5.98	7.62	0.698	22.68	38.3828	34.71
10.663	447.137	22.31	0.82	3.68	48.55	34.4891	3.790	2.65	34.01	3.84	4	135.00	0.673	0.627	0.046	1.263	5.77	7.28	0.670	22.01	37.7717	34.40
10.991	446.809	21.94	0.83	3.79	50.34	33.2333	3.907	2.67	32.73	3.97	4	135.00	0.695	0.639	0.056	1.251	5.73	7.16	0.658	21.62	38.8777	34.17
11.319	446.481	23.94	0.89	3.73	69.05	35.6631	3.832	2.64	35.00	3.90	5	135.00	0.717	0.651	0.066	1.239	6.15	7.62	0.719	23.51	37.5467	34.58
11.647	446.153	31.54	1.47	4.66	33.07	46.451	4.773	2.62	46.13	4.81	4	135.00	0.739	0.663	0.076	1.228	8.10	9.95	0.954	31.33	36.4723	36.24
11.975	445.825	52.03	1.94	3.73	5.47	75.9552	3.784	2.40	75.91	3.79	5	135.00	0.762	0.675	0.087	1.217	12.09	14.71	1.587	52	26.4167	39.08
12.303	445.497	68.4	2.67	3.91	-22.86	98.4385	3.949	2.34	98.66	3.94	5	135.00	0.784	0.687	0.097	1.207	15.51	18.71	2.093	68.55	24.0213	40.50
12.631	445.169	53.25	3.19	6	-25.04	75.0494	6.083	2.56	75.26	6.07	3	135.00	0.806	0.699	0.107	1.198	13.38	16.01	1.624	53.4	33.4063	39.04
12.959	444.841	50.44	2.84	5.63	-25.2	69.8071	5.724	2.56	70.03	5.71	3	135.00	0.828	0.711	0.117	1.186	12.67	15.03	1.536	50.6	33.3638	38.64
13.287	444.513	31.23	2.43	7.77	-27.34	42.042	7.999	2.81	42.28	7.95	3	135.00	0.850	0.723	0.126	1.176	8.97	10.55	0.941	31.4	46.5809	35.73
13.615	444.185	36.66	2.18	5.95	-26.55	48.723	6.091	2.68	48.94	6.06	3	135.00	0.872	0.735	0.136	1.167	9.80	11.44	1.108	36.82	39.3865	36.60
13.943	443.857	56.53	3.08	5.44	-25.93	74.5365	5.536	2.53	74.75	5.52	3	135.00	0.894	0.746	0.148	1.157	14.00	16.20	1.722	56.69	32.013	39.00
14.271	443.529	129.14	5.32	4.12	-25.68	169.087	4.149	2.22	169.30	4.14	11	135.00	0.917	0.758	0.158	1.148	27.75	31.86	3.970	129.3	19.5856	43.26
14.6	443.200	241.69	8.13	3.37	-25.73	312.554	3.377	2.00	312.76	3.37	12	135.00	0.939	0.770	0.168	1.139	47.59	54.23	7.454	241.65	12.9951	46.12
14.928	442.872	231.67	8.83	3.81	-25.66	294.958	3.827	2.06	295.16	3.82	12	135.00	0.961	0.782	0.179	1.131	46.69	52.80	7.143	231.83	14.6671	45.86
15.256	442.544	258.78	8.95	3.46	-26.07	324.647	3.472	2.00	324.85	3.47	12	135.00	0.983	0.794	0.189	1.122	51.01	57.24	7.981	258.94	13.0637	46.29

R13278

Depth (ft)	Sa... (sf)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...tress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	442.216	285.8	8.43	2.95	-26.9	353.348	2.960	1.93	353.55	2.96	12	135.00	1.005	0.806	0.199	1.114	54.68	60.90	8.817	285.96	11.0253	46.66
15.912	441.888	277.04	7.22	2.61	-28.01	337.467	2.616	1.89	337.67	2.61	7	135.00	1.027	0.818	0.209	1.108	52.28	57.81	8.545	277.21	10.1227	46.46
16.24	441.560	219.73	6.99	3.18	-28.89	263.533	3.196	2.02	263.75	3.19	12	135.00	1.049	0.830	0.220	1.098	43.55	47.81	6.770	219.91	13.4471	45.35

R13279

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 34 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-8

ConeTec Inc. Interpretation
Interpretation Out. Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4303
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-8
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 09:53
CPT File: 804CP08.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 445

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	39.90	1.70	55.34	26.74	2.35

User Inputs:
Assumed: Water Table Depth (ft): 6.6; Nk: 32.3; State Parameter: 1.2; Unit Weight of Soil (pcf): Varies See Below; CPT area ratio: 0.85 See Below; Ground Surface Elev. 445.0; Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	444.836	17.37	0.13	0.75	0.35	1693.63	0.749	1.12	1693.63	0.75	6	125.00	0.010	0.010	0.000	2.000	2.55	5.11	0.537	17.37	-1.1659	52.71
0.492	444.508	21.17	0.35	1.66	-1.57	687.455	1.656	1.57	687.78	1.65	6	125.00	0.031	0.031	0.000	2.000	3.58	7.15	0.654	21.18	3.90719	49.41
0.82	444.180	31.35	0.66	2.09	-3.09	610.707	2.109	1.69	611.10	2.11	6	125.00	0.051	0.051	0.000	2.000	5.51	11.02	0.969	31.37	5.90214	48.94
1.148	443.852	43.85	0.95	2.17	-1.25	610.15	2.170	1.70	610.29	2.17	6	125.00	0.072	0.072	0.000	2.000	7.73	15.47	1.355	43.86	6.12164	48.94
1.476	443.524	44.4	1.46	3.29	-0.37	480.301	3.295	1.91	480.30	3.30	5	125.00	0.092	0.092	0.000	2.000	8.43	16.87	1.372	44.4	10.5955	47.96
1.804	443.196	47.24	1.66	3.51	0.21	417.98	3.522	1.96	417.98	3.52	5	125.00	0.113	0.113	0.000	2.000	9.15	18.30	1.459	47.24	11.8951	47.36
2.133	442.867	63.62	1.74	2.74	-0.23	476.225	2.741	1.64	476.22	2.74	6	125.00	0.133	0.133	0.000	2.000	11.78	23.55	1.966	63.62	8.93891	47.93
2.461	442.539	81.01	2.67	3.29	1.8	525.68	3.302	1.89	525.62	3.30	6	125.00	0.154	0.164	0.000	2.000	15.30	30.60	2.503	81	10.2349	48.33
2.789	442.211	87.64	3.13	3.57	-0.02	501.775	3.579	1.93	501.78	3.58	6	125.00	0.174	0.174	0.000	2.000	16.80	33.61	2.708	87.64	11.2144	48.14
3.117	441.883	72.36	2.94	4.06	0.81	370.434	4.074	2.04	370.38	4.07	5	125.00	0.195	0.195	0.000	2.000	14.45	28.90	2.234	72.35	14.0558	46.86
3.445	441.555	54.96	2.44	4.43	7.57	254.257	4.457	2.15	254.02	4.46	5	125.00	0.215	0.215	0.000	2.000	11.47	22.93	1.695	54.91	17.4107	45.18
3.773	441.227	45.6	1.94	4.26	13.4	192.374	4.277	2.20	192.03	4.28	5	125.00	0.236	0.236	0.000	2.000	9.70	19.39	1.404	45.52	18.9745	43.86
4.101	440.899	47.91	1.89	3.94	10.16	185.92	3.966	2.18	185.69	3.97	5	125.00	0.256	0.256	0.000	1.975	10.11	19.97	1.475	47.85	18.3226	43.70
4.429	440.571	55.66	1.91	3.43	18.45	200.075	3.449	2.11	199.64	3.46	5	125.00	0.277	0.277	0.000	1.901	11.41	21.70	1.715	55.64	16.1775	44.05
4.757	440.243	51.39	1.71	3.33	24.18	171.848	3.347	2.14	171.31	3.36	6	125.00	0.297	0.297	0.000	1.834	10.65	19.52	1.582	51.23	17.0225	43.31
5.085	439.915	45.68	1.53	3.36	21.34	142.733	3.373	2.19	142.32	3.38	5	125.00	0.318	0.318	0.000	1.774	9.66	17.14	1.404	45.55	18.6417	42.89
5.413	439.587	37.97	1.4	3.7	20.16	111.234	3.720	2.29	110.88	3.73	5	125.00	0.338	0.338	0.000	1.719	8.38	14.40	1.165	37.85	22.1372	41.11
5.741	439.259	32.73	1.25	3.83	18.96	90.2176	3.861	2.36	89.86	3.88	5	125.00	0.359	0.359	0.000	1.669	7.44	12.43	1.002	32.61	24.8088	40.00
6.069	438.931	32.51	1.3	3.99	14.67	84.7077	4.046	2.39	84.47	4.06	5	125.00	0.379	0.379	0.000	1.624	7.51	12.19	0.995	32.42	26.1077	39.66
6.398	438.602	30.81	1.37	4.44	8.27	76.0491	4.505	2.46	75.92	4.51	4	125.00	0.400	0.400	0.000	1.581	7.34	11.61	0.941	30.76	28.6283	39.08
6.726	438.274	30.16	1.35	4.47	11.29	71.4133	4.539	2.48	71.25	4.55	4	135.00	0.420	0.416	0.004	1.550	7.25	11.24	0.921	30.09	29.7266	38.72
7.054	437.946	30.78	1.3	4.22	12.22	70.624	4.285	2.46	70.64	4.30	4	135.00	0.443	0.428	0.014	1.528	7.34	11.22	0.939	30.7	29.0142	38.68
7.382	437.618	28.58	1.25	4.38	14.3	63.8613	4.446	2.50	63.66	4.46	4	135.00	0.466	0.440	0.024	1.507	6.95	10.48	0.870	28.49	30.8671	38.09
7.71	437.290	25.37	1.1	4.35	16	55.0315	4.421	2.55	54.81	4.44	4	135.00	0.487	0.452	0.035	1.487	6.29	9.36	0.770	25.27	32.7937	37.24
8.038	436.962	23.17	1.04	4.48	16.81	48.8312	4.589	2.59	48.59	4.61	4	135.00	0.509	0.464	0.045	1.468	5.88	8.63	0.702	23.06	35.0715	36.54
8.366	436.634	21.72	0.99	4.55	15.7	44.5168	4.672	2.63	44.31	4.69	3	135.00	0.531	0.476	0.055	1.449	5.60	8.12	0.656	21.62	36.7119	36.00
8.694	436.306	22.5	0.76	3.39	17	44.9838	3.463	2.53	44.76	3.48	5	135.00	0.553	0.488	0.065	1.432	5.54	7.93	0.679	22.39	32.1478	36.06
9.022	435.978	20.87	0.66	3.17	17.39	40.6065	3.252	2.55	40.41	3.27	5	135.00	0.575	0.500	0.076	1.415	5.17	7.31	0.628	20.77	32.7685	35.46
9.35	435.650	20.28	0.77	3.78	19.44	38.4653	3.912	2.62	38.23	3.94	4	135.00	0.597	0.512	0.086	1.398	5.20	7.27	0.609	20.16	36.2763	35.13
9.678	435.322	22.23	1.07	4.83	14.64	41.2726	4.951	2.67	41.08	4.97	3	135.00	0.620	0.524	0.096	1.382	5.88	8.10	0.669	22.13	38.7923	35.56
10.006	434.994	27.84	1.15	4.14	14.22	50.7896	4.228	2.56	50.62	4.24	4	135.00	0.642	0.536	0.106	1.367	6.94	9.48	0.842	27.76	33.2318	36.79
10.335	434.665	30.49	1.3	4.26	-2.51	54.4817	4.359	2.54	54.50	4.36	4	135.00	0.664	0.547	0.117	1.352	7.58	10.24	0.923	30.5	32.5983	37.22
10.663	434.337	20.58	1.04	5.04	-8.43	35.5656	5.228	2.73	35.67	5.21	3	135.00	0.686	0.559	0.127	1.337	5.63	7.53	0.616	20.64	41.8344	34.72
10.991	434.009	21.64	0.79	3.66	-8.2	36.6411	3.774	2.62	36.73	3.77	4	135.00	0.708	0.571	0.137	1.323	5.60	7.40	0.648	21.69	36.2422	34.90
11.319	433.681	18.91	0.92	4.85	-4.78	31.1739	5.061	2.76	31.23	5.05	3	135.00	0.730	0.583	0.147	1.309	5.26	6.88	0.563	18.94	43.5695	33.91
11.647	433.353	17	0.91	5.34	-3.97	27.3032	5.601	2.83	27.35	5.59	3	135.00	0.753	0.595	0.157	1.296	4.92	6.37	0.503	17.03	47.693	33.09
11.975	433.025	20.2	1.09	5.41	-3.4	32.0031	5.611	2.78	32.04	5.61	3	135.00	0.775	0.607	0.168	1.284	5.68	7.30	0.601	20.22	44.908	34.07
12.303	432.697	23.77	1.16	4.87	-3.74	37.12	5.049	2.70	37.15	5.04	3	135.00	0.797	0.619	0.178	1.271	6.41	8.15	0.711	23.79	40.6258	34.97
12.631	432.369	23.53	1.14	4.86	-2.66	36.0038	5.020	2.71	36.02	5.02	3	135.00	0.819	0.631	0.188	1.259	6.37	8.02	0.703	23.54	41.0417	34.79
12.959	432.041	25.86	1.03	3.99	-1.59	38.9277	4.117	2.63	38.94	4.12	4	135.00	0.841	0.643	0.198	1.247	6.70	8.36	0.775	25.87	36.659	35.26
13.287	431.713	28.74	1.22	4.25	4.68	42.5854	4.376	2.62	42.54	4.38	4	135.00	0.863	0.655	0.209	1.236	7.41	9.16	0.863	28.71	36.2582	35.79
13.615	431.385	23.7	0.95	4.02	4.69	34.2297	4.164	2.67	34.18	4.17	4	135.00	0.885	0.667	0.219	1.225	6.27	7.69	0.706	23.67	38.9352	34.48
13.943	431.057	21.82	0.56	2.55	10.93	30.8252	2.678	2.58	30.72	2.69	5	135.00	0.908	0.678	0.229	1.214	5.50	6.68	0.647	21.75	34.3343	33.83
14.271	430.729	17.59	0.45	2.54	19.05	24.134	2.701	2.67	23.96	2.72	5	135.00	0.930	0.690	0.239	1.204	4.62	5.66	0.516	17.47	38.6783	32.28
14.6	430.400	15.35	0.32	2.09	24.25	20.5023	2.223	2.67	20.29	2.25	5	135.00	0.952	0.702	0.250	1.193	4.03	4.81	0.446	15.2	39.0527	31.24
14.928	430.072	13.48	0.21	1.62	31.31	17.5111	1.679	2.66	17.25	1.71	6	135.00	0.974	0.714	0.260	1.183	3.51	4.15	0.387	13.29	38.6544	30.20
15.256	429.744	13.47	0.25	1.82	40.37	17.1797	2.004	2.72	16.84	2.05	5	135.00	0.996	0.726	0.270	1.174	3.59	4.21	0.386	13.22	41.3202	30.05

R13281

Depth (ft)	Samp. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...tress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	429.416	18.28	0.5	2.74	47	23.3902	2.897	2.70	22.98	2.95	5	135.00	1.018	0.738	0.280	1.164	4.84	5.64	0.534	17.98	40.5576	32.03
15.912	429.088	44.7	2.02	4.53	28.04	58.2209	4.627	2.54	57.98	4.65	4	135.00	1.040	0.750	0.291	1.155	11.07	12.79	1.352	44.52	32.7068	37.60
16.24	428.760	126.44	5.34	4.22	-16.4	164.58	4.259	2.23	164.72	4.26	11	135.00	1.063	0.762	0.301	1.146	27.34	31.33	3.882	126.55	20.1417	43.13
16.568	428.432	213.9	10.81	5.05	-15.7	275.059	5.080	2.18	275.19	5.08	11	136.00	1.085	0.774	0.311	1.137	45.29	51.49	6.589	214	18.4606	45.55
16.896	428.104	378.56	14.03	3.71	-15.73	480.355	3.717	1.96	480.48	3.72	12	137.00	1.107	0.786	0.321	1.128	73.23	82.61	11.686	378.66	11.787	47.97
17.224	427.776	341.19	15.02	4.4	-15.91	426.134	4.417	2.05	426.26	4.42	12	138.00	1.129	0.798	0.331	1.119	68.32	76.47	10.528	341.29	14.2134	47.46
17.552	427.448	312.91	15.43	4.93	-12.1	384.691	4.949	2.11	384.79	4.95	11	139.00	1.152	0.810	0.342	1.111	64.25	71.37	9.652	312.99	16.0829	47.03

R13282

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 37 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY TJS DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-9

ConeTec Inc. rpretation
Interpretation Ob. lelease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4276
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-9
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 09:17
CPT File: 804CP09.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 445.7

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	39.25	1.38	45.19	28.02	2.40

User Inputs:
Assumed:
Water Table Depth (ft): 7.8
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 445.7
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	446.536	15.38	0.2	1.27	-2.59	1499.49	1.301	1.37	1501.44	1.30	6	125.00	0.010	0.010	0.000	2.000	2.43	4.87	0.476	15.4	1.11893	52.29
0.492	445.208	19.82	0.38	1.92	-12.01	643.553	1.920	1.64	646.15	1.91	6	125.00	0.031	0.031	0.000	2.000	3.44	6.88	0.613	19.9	5.03728	49.17
0.82	444.880	30.1	0.63	2.1	-9.01	586.317	2.097	1.69	587.29	2.09	6	125.00	0.051	0.051	0.000	2.000	5.30	10.61	0.930	30.15	5.98332	48.78
1.148	444.552	43.87	0.91	2.07	-3.21	610.429	2.078	1.66	610.71	2.08	6	125.00	0.072	0.072	0.000	2.000	7.69	15.39	1.356	43.89	5.7973	48.94
1.476	444.224	47.66	1.19	2.49	0.07	515.64	2.502	1.79	515.64	2.50	6	125.00	0.092	0.092	0.000	2.000	8.66	17.33	1.473	47.66	7.8425	48.25
1.804	443.896	45.87	1.66	3.62	0.07	405.829	3.628	1.98	405.83	3.63	5	125.00	0.113	0.113	0.000	2.000	8.94	17.89	1.417	45.87	12.3418	47.25
2.133	443.567	41.72	1.68	3.98	0.25	311.949	3.992	2.07	311.95	3.99	5	125.00	0.133	0.133	0.000	2.000	8.42	16.84	1.288	41.72	14.8053	46.11
2.461	443.239	37.44	1.52	4.06	0.39	242.413	4.077	2.13	242.41	4.08	5	125.00	0.154	0.154	0.000	2.000	7.74	15.49	1.154	37.44	16.6653	44.96
2.789	442.911	44.47	1.87	4.2	0.86	254.117	4.222	2.13	254.06	4.22	5	125.00	0.174	0.174	0.000	2.000	9.21	18.41	1.371	44.46	16.7557	45.18
3.117	442.583	59.57	2.65	4.44	0.23	304.781	4.463	2.11	304.76	4.46	5	125.00	0.196	0.195	0.000	2.000	12.25	24.50	1.838	59.57	16.2258	46.00
3.445	442.255	70.47	2.79	3.95	1.85	326.292	3.971	2.06	326.25	3.97	5	125.00	0.215	0.215	0.000	2.000	14.16	28.31	2.175	70.46	14.487	46.30
3.773	441.927	74.67	2.46	3.29	-0.62	315.65	3.305	1.99	315.69	3.30	6	125.00	0.236	0.236	0.000	2.000	14.64	29.28	2.304	74.68	12.725	46.16
4.101	441.599	84.53	2.85	3.37	1.85	328.793	3.382	1.99	328.75	3.38	6	125.00	0.256	0.256	0.000	1.975	16.57	32.73	2.609	84.52	12.7342	46.34
4.429	441.271	104.33	3.88	3.72	1.8	375.898	3.729	2.00	375.86	3.73	6	125.00	0.277	0.277	0.000	1.901	20.54	39.03	3.221	104.32	13.0225	46.92
4.757	440.943	96.44	3.96	4.11	2.45	323.373	4.119	2.07	323.34	4.12	5	125.00	0.297	0.297	0.000	1.834	19.50	35.76	2.977	96.43	14.9462	46.26
5.085	440.615	102.25	4.19	4.1	0.62	320.731	4.111	2.07	320.70	4.11	5	125.00	0.318	0.318	0.000	1.774	20.68	36.68	3.156	102.24	14.9718	46.23
5.413	440.287	98.2	4.51	4.59	1.13	289.264	4.609	2.14	289.23	4.61	11	126.00	0.338	0.338	0.000	1.719	20.38	35.04	3.030	98.19	16.9403	45.77
5.741	439.959	94.73	4.11	4.34	4.32	263.01	4.355	2.14	262.93	4.36	11	125.00	0.359	0.359	0.000	1.669	19.65	32.80	2.922	94.7	16.894	45.33
6.069	439.631	84.93	3.46	4.08	5.01	222.905	4.092	2.15	222.83	4.09	5	125.00	0.379	0.379	0.000	1.624	17.71	28.75	2.618	84.9	17.3092	44.57
6.398	439.302	87.66	3.56	4.07	-2.24	218.219	4.080	2.15	218.24	4.08	5	125.00	0.400	0.400	0.000	1.581	18.31	28.96	2.702	87.67	17.4182	44.47
6.726	438.974	69.12	3.37	4.87	4.69	163.425	4.905	2.29	163.35	4.91	11	125.00	0.420	0.420	0.000	1.542	15.27	23.58	2.127	69.09	22.0488	43.08
7.054	438.646	63.77	3.03	4.76	3.08	143.644	4.785	2.31	143.60	4.79	4	125.00	0.441	0.441	0.000	1.506	14.23	21.43	1.961	63.75	22.6724	42.43
7.382	438.318	53.39	2.77	5.19	7.53	114.719	5.233	2.40	114.61	5.24	3	125.00	0.461	0.461	0.000	1.472	12.39	18.24	1.639	53.34	26.3327	41.28
7.71	437.990	48.17	2.41	4.99	4.9	98.9637	5.054	2.42	98.90	5.06	4	125.00	0.482	0.482	0.000	1.441	11.31	16.30	1.476	48.14	27.4055	40.51
8.038	437.662	38.46	1.98	5.15	10.26	76.6899	5.216	2.50	76.55	5.23	3	135.00	0.502	0.495	0.007	1.421	9.37	13.31	1.175	38.39	30.8807	39.12
8.366	437.334	30.22	1.55	5.12	11.57	58.5876	5.220	2.58	58.45	5.23	3	135.00	0.525	0.507	0.018	1.405	7.63	10.72	0.919	30.15	34.4169	37.61
8.694	437.006	28.4	1.39	4.89	12.03	53.6919	4.990	2.59	53.56	5.00	3	135.00	0.547	0.519	0.028	1.388	7.21	10.01	0.862	28.33	34.9372	37.11
9.022	436.678	29.4	1.32	4.5	11.46	54.33	4.578	2.56	54.20	4.59	4	135.00	0.569	0.531	0.038	1.373	7.35	10.09	0.893	29.33	33.449	37.16
9.35	436.350	28.31	1.17	4.14	11.67	51.088	4.221	2.55	50.94	4.23	4	135.00	0.591	0.543	0.048	1.358	7.05	9.57	0.858	28.23	33.1117	36.82
9.678	436.022	26.35	1.19	4.53	15.1	46.4162	4.624	2.61	46.24	4.64	4	135.00	0.613	0.554	0.059	1.343	6.75	9.06	0.797	26.25	35.9001	36.25
10.006	435.694	25.07	1.15	4.6	14.55	43.1414	4.706	2.64	42.98	4.72	3	135.00	0.635	0.566	0.069	1.329	6.51	8.65	0.756	24.98	37.2699	35.82
10.335	435.365	25.89	1.24	4.78	13.4	43.63	4.914	2.65	43.49	4.93	3	135.00	0.657	0.578	0.079	1.315	6.76	8.89	0.781	25.81	37.7669	35.89
10.663	435.037	22.8	1.2	5.28	9.91	37.4772	5.425	2.72	37.38	5.44	3	135.00	0.680	0.590	0.089	1.302	6.20	8.07	0.685	22.74	41.7846	34.99
10.991	434.709	27.92	1.18	4.22	10.86	45.2024	4.335	2.60	45.09	4.35	4	135.00	0.702	0.602	0.100	1.289	7.11	9.17	0.843	27.85	35.267	36.11
11.319	434.381	29.42	1.45	4.92	10.88	46.7326	5.053	2.64	46.62	5.07	3	135.00	0.724	0.614	0.110	1.276	7.64	9.75	0.868	29.35	37.1499	36.31
11.647	434.053	26.23	1.41	5.39	11.38	40.7121	5.533	2.71	40.60	5.55	3	135.00	0.746	0.626	0.120	1.264	7.06	8.93	0.789	26.16	40.7787	35.49
11.975	433.725	23.16	0.99	4.29	10.95	35.1046	4.421	2.68	34.99	4.44	4	135.00	0.768	0.638	0.130	1.252	6.16	7.71	0.693	23.09	39.5208	34.60
12.303	433.397	20.42	0.52	2.55	11.83	30.2103	2.649	2.58	30.10	2.66	5	135.00	0.790	0.650	0.140	1.241	5.16	6.40	0.608	20.35	34.5204	33.68
12.631	433.069	18.58	0.49	2.64	14.43	26.8524	2.758	2.63	26.72	2.77	5	135.00	0.812	0.662	0.151	1.229	4.81	5.91	0.550	18.49	37.0571	32.94
12.959	432.741	22.2	0.51	2.28	45.47	31.7192	2.387	2.54	31.29	2.42	6	135.00	0.835	0.674	0.161	1.218	5.45	6.64	0.661	21.91	32.6826	33.92
13.287	432.413	18.14	0.35	1.91	50.26	25.2132	2.025	2.58	24.75	2.06	6	135.00	0.857	0.685	0.171	1.208	4.52	5.45	0.535	17.82	34.4648	32.46
13.615	432.085	15.81	0.26	1.65	56.56	21.4099	1.741	2.60	20.91	1.76	6	135.00	0.879	0.697	0.181	1.197	3.96	4.74	0.462	15.46	35.5971	31.40
13.943	431.757	12.95	0.21	1.59	52.01	16.9872	1.743	2.69	16.52	1.79	5	135.00	0.901	0.709	0.192	1.187	3.38	4.01	0.373	12.62	39.9618	29.89
14.271	431.429	11.94	0.19	1.55	59.86	15.2756	1.725	2.73	14.75	1.79	5	135.00	0.923	0.721	0.202	1.178	3.16	3.73	0.341	11.56	42.1627	29.15
14.5	431.100	12.26	0.19	1.51	66.28	15.433	1.679	2.72	14.87	1.74	5	135.00	0.945	0.733	0.212	1.168	3.23	3.77	0.350	11.85	41.679	29.21
14.928	430.772	11.19	0.19	1.7	73.44	13.7205	1.859	2.80	13.10	1.95	5	135.00	0.967	0.745	0.222	1.159	3.04	3.52	0.316	10.73	45.7108	28.39
15.256	430.444	15.59	0.3	1.9	87.39	19.2881	2.055	2.69	18.56	2.14	5	135.00	0.990	0.757	0.233	1.149	4.03	4.63	0.452	15.04	40.03	30.65

R13284

Depth (ft)	Samp (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...ress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	430.116	23.74	0.44	1.84	87.72	29.5606	1.936	2.52	28.85	1.98	6	135.00	1.012	0.769	0.243	1.140	5.70	6.50	0.704	23.19	31.5153	33.43
15.912	429.788	29.33	0.85	2.89	108.61	36.2411	3.004	2.57	35.37	3.08	5	135.00	1.034	0.781	0.253	1.132	7.22	8.17	0.876	28.65	33.9566	34.68
16.24	429.460	38.72	1.48	3.83	103.37	47.5146	3.929	2.56	46.71	4.00	5	135.00	1.056	0.793	0.263	1.123	9.55	10.73	1.166	38.08	33.507	36.34
16.568	429.132	56.19	2.18	3.88	102.93	68.4969	3.956	2.45	67.69	4.00	5	136.00	1.078	0.805	0.274	1.115	13.22	14.73	1.706	55.54	28.5536	38.46
16.896	428.804	60.78	3.03	4.98	65.61	73.0777	5.077	2.51	72.58	5.11	11	137.00	1.100	0.817	0.284	1.107	14.78	16.36	1.846	60.37	31.2128	38.85
17.224	428.476	50.94	2.78	5.46	60.44	60.1007	5.580	2.60	59.64	5.62	3	138.00	1.123	0.829	0.294	1.098	12.92	14.19	1.542	50.56	35.2823	37.75
17.552	428.148	43.07	2.33	5.4	23.93	49.8334	5.558	2.65	49.66	5.58	3	139.00	1.146	0.841	0.304	1.090	11.25	12.26	1.298	42.92	37.7709	36.70
17.88	427.820	39.51	1.86	4.71	-0.56	44.9042	4.851	2.63	44.90	4.86	4	140.00	1.168	0.854	0.314	1.082	10.27	11.12	1.187	39.51	37.026	36.11
18.208	427.492	41.11	1.74	4.23	0.62	46.0646	4.359	2.59	46.06	4.36	4	141.00	1.191	0.867	0.325	1.074	10.47	11.25	1.236	41.11	34.9935	36.27
18.537	427.163	41.12	1.68	4.1	2.12	45.3724	4.210	2.59	45.35	4.21	5	142.00	1.215	0.880	0.335	1.066	10.44	11.13	1.235	41.1	34.7064	36.17
18.865	426.835	45.7	1.83	4	4.37	49.814	4.116	2.55	49.79	4.12	5	143.00	1.238	0.893	0.345	1.058	11.40	12.07	1.377	45.68	33.0275	36.72
19.193	426.507	43.86	2.11	4.81	4.87	47.0298	4.953	2.63	47.00	4.96	4	144.00	1.261	0.906	0.355	1.051	11.36	11.93	1.319	43.83	36.6851	36.38
19.521	426.179	36.52	1.92	5.26	11.85	38.3338	5.449	2.72	38.25	5.46	3	145.00	1.285	0.919	0.366	1.043	9.91	10.33	1.091	36.44	41.4759	35.17
19.849	425.851	49.37	2.52	5.1	12.88	51.5286	5.243	2.62	51.43	5.25	3	146.00	1.309	0.933	0.376	1.035	12.72	13.17	1.488	49.28	36.286	36.91
20.177	425.523	60.49	3.37	5.58	-1.34	62.5064	5.597	2.59	62.52	5.70	11	147.00	1.333	0.946	0.386	1.028	15.39	15.82	1.831	60.5	34.8428	38.02
20.505	425.195	75.15	3.54	4.72	-5.82	76.8443	4.797	2.47	76.89	4.79	11	148.00	1.357	0.960	0.396	1.020	18.09	18.46	2.285	75.19	29.5495	39.17
20.833	424.867	74.98	3.23	4.31	-7.5	75.5377	4.389	2.45	75.59	4.39	5	149.00	1.381	0.974	0.407	1.013	17.84	18.07	2.279	75.03	28.4777	39.08
21.161	424.539	51.59	2	3.88	-4.69	50.7665	3.985	2.53	50.80	3.98	5	150.00	1.405	0.989	0.417	1.006	12.78	12.85	1.554	51.62	32.2646	36.84
21.489	424.211	88.98	4.5	5.06	-4.99	87.2965	5.140	2.46	87.34	5.14	11	151.00	1.430	1.003	0.427	0.999	21.30	21.27	2.711	89.02	29.0451	39.87

R13285

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 40 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-10

ConeTec Inc. Interpretation
Interpretation - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4243
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-10
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 08:35
CPT File: 804CP10.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 442.1

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.49	1.77	57.88	26.87	2.36

User Inputs:
Assumed: Water Table Depth (ft): 3.4
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 442.1
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	441.936	22.84	0.17	0.75	0.53	2227.29	0.745	1.10	2227.29	0.74	7	125.00	0.010	0.010	0.000	2.000	3.34	6.67	0.707	22.84	-1.3233	53.62
0.492	441.608	28.68	0.4	1.4	-1.45	931.683	1.396	1.45	931.68	1.40	6	125.00	0.031	0.031	0.000	2.000	4.66	9.32	0.887	28.68	2.20569	50.57
0.82	441.280	30.14	0.52	1.73	-6.33	587.098	1.728	1.62	587.88	1.73	6	125.00	0.051	0.051	0.000	2.000	5.17	10.35	0.932	30.18	4.63942	48.79
1.148	440.952	41.08	0.62	1.5	-7.39	571.265	1.513	1.57	571.96	1.51	7	125.00	0.072	0.072	0.000	2.000	6.94	13.88	1.269	41.11	3.88432	48.68
1.476	440.624	62.23	0.9	1.44	-3.79	673.58	1.446	1.52	673.91	1.45	7	125.00	0.092	0.092	0.000	2.000	10.34	20.69	1.924	62.26	3.15876	49.33
1.804	440.296	70.49	1.29	1.83	-0.76	624.188	1.833	1.63	624.28	1.83	7	125.00	0.113	0.113	0.000	2.000	12.13	24.27	2.179	70.5	4.85186	49.03
2.133	439.967	63.39	1.44	2.28	-1.34	474.499	2.276	1.77	474.57	2.28	6	125.00	0.133	0.133	0.000	2.000	11.44	22.87	1.958	63.4	7.40369	47.91
2.461	439.639	64.76	1.42	2.19	-1.66	420.032	2.198	1.78	420.10	2.20	7	125.00	0.154	0.154	0.000	2.000	11.73	23.46	2.000	64.77	7.63043	47.40
2.789	439.311	67.64	1.58	2.34	-1.64	387.039	2.342	1.82	387.10	2.34	6	125.00	0.174	0.174	0.000	2.000	12.43	24.87	2.089	67.65	8.50804	47.05
3.117	438.983	62.08	1.55	2.49	-2.26	317.665	2.505	1.89	317.77	2.50	6	125.00	0.195	0.195	0.000	2.000	11.70	23.40	1.916	62.1	10.0559	46.19
3.445	438.655	61.6	1.76	2.86	-2.61	286.967	2.867	1.96	287.01	2.87	6	125.00	0.215	0.214	0.001	2.000	11.93	23.86	1.900	61.61	11.8668	45.73
3.773	438.327	49.8	1.64	3.29	-3.46	221.096	3.309	2.07	221.23	3.31	6	125.00	0.236	0.224	0.012	2.000	10.08	20.16	1.634	49.83	14.9652	44.54
4.101	437.999	35.16	1.26	3.59	-0.53	148.88	3.610	2.20	148.92	3.61	5	125.00	0.256	0.234	0.022	2.000	7.49	14.99	1.081	35.17	19.0045	42.62
4.429	437.671	23.8	0.94	3.96	5.47	96.1277	3.996	2.35	95.96	4.00	4	125.00	0.277	0.245	0.032	2.000	5.41	10.81	0.728	23.76	24.5219	40.35
4.757	437.343	20.99	0.83	3.94	15.36	81.156	4.011	2.40	80.76	4.03	4	125.00	0.297	0.255	0.042	1.980	4.86	9.63	0.641	20.89	26.5321	39.43
5.085	437.015	23.58	0.9	3.8	17.32	87.7022	3.869	2.37	87.29	3.89	4	125.00	0.318	0.265	0.053	1.942	5.38	10.45	0.720	23.47	25.1707	39.85
5.413	436.687	26.07	1.08	4.15	16.35	93.3976	4.197	2.38	93.03	4.21	4	125.00	0.338	0.276	0.063	1.905	5.98	11.39	0.797	25.97	25.5391	40.19
5.741	436.359	28	1.25	4.46	13.72	96.7242	4.522	2.39	96.44	4.54	4	125.00	0.359	0.286	0.073	1.871	6.47	12.10	0.856	27.92	26.1485	40.39
6.069	436.031	27.78	1.26	4.55	13.97	92.5575	4.598	2.41	92.25	4.61	4	125.00	0.379	0.296	0.083	1.838	6.47	11.89	0.848	27.69	26.8768	40.15
6.398	435.702	23.67	0.97	4.09	20.99	75.9624	4.168	2.43	75.54	4.19	4	125.00	0.400	0.306	0.094	1.807	5.56	10.04	0.720	23.54	27.8545	39.07
6.726	435.374	22.65	0.83	3.65	20.09	70.2128	3.734	2.42	69.80	3.76	5	125.00	0.420	0.317	0.104	1.777	5.29	9.40	0.688	22.52	27.3099	38.63
7.054	435.046	23.86	0.78	3.26	20.76	71.6466	3.331	2.38	71.25	3.35	5	125.00	0.441	0.327	0.114	1.749	5.46	9.56	0.725	23.73	25.568	38.75
7.382	434.718	19.8	0.64	3.24	24.65	57.3614	3.309	2.45	56.89	3.34	5	125.00	0.461	0.337	0.124	1.722	4.66	8.03	0.599	19.64	28.3064	37.49
7.71	434.390	17.31	0.59	3.42	30.58	46.4398	3.506	2.52	47.89	3.55	4	125.00	0.482	0.347	0.134	1.697	4.20	7.13	0.521	17.12	31.4473	36.49
8.038	434.062	18.65	0.73	3.9	29.81	50.7385	4.023	2.54	50.21	4.07	4	135.00	0.502	0.358	0.145	1.672	4.59	7.68	0.562	18.46	32.7232	36.77
8.366	433.734	15.11	0.63	4.15	30.69	39.4655	4.319	2.65	38.95	4.38	3	135.00	0.526	0.370	0.155	1.645	3.90	6.42	0.452	14.92	37.5988	35.28
8.694	433.406	14.94	0.58	3.89	35.5	37.7301	4.030	2.64	37.15	4.09	4	135.00	0.547	0.381	0.165	1.619	3.84	6.22	0.446	14.72	37.3103	35.00
9.022	433.078	15.71	0.65	4.15	39.67	38.4892	4.293	2.65	37.85	4.36	3	135.00	0.569	0.393	0.175	1.594	4.06	6.47	0.469	15.46	38.0083	35.11
9.35	432.750	20.24	0.82	4.06	39.19	48.4809	4.173	2.57	47.86	4.23	4	135.00	0.591	0.405	0.186	1.571	5.04	7.91	0.608	19.99	33.9763	36.50
9.678	432.422	21.26	1.1	5.19	18.66	49.4891	5.328	2.64	49.23	5.36	3	135.00	0.613	0.417	0.196	1.548	5.61	8.53	0.639	21.15	37.2394	36.66
10.006	432.094	21.52	1.14	5.29	14.2	48.6703	5.459	2.65	48.46	5.48	3	135.00	0.635	0.429	0.206	1.527	5.62	8.56	0.647	21.43	37.8499	36.57
10.335	431.765	22.36	1.16	5.2	0.19	49.2066	5.345	2.64	49.21	5.34	3	135.00	0.657	0.441	0.216	1.506	5.83	8.77	0.672	22.36	37.2112	36.66
10.663	431.437	18.99	1.06	5.57	-6.84	40.4242	5.789	2.72	40.53	5.77	3	135.00	0.680	0.453	0.227	1.486	5.18	7.69	0.567	19.04	41.4795	35.53
10.991	431.109	14.81	0.82	5.55	-7.21	30.3493	5.812	2.81	30.44	5.80	3	135.00	0.702	0.465	0.237	1.467	4.23	6.21	0.437	14.85	46.4001	33.80
11.319	430.781	15.17	0.79	5.19	-6.65	30.3001	5.469	2.79	30.38	5.45	3	135.00	0.724	0.477	0.247	1.448	4.29	6.22	0.447	15.2	45.3583	33.80
11.647	430.453	13.83	0.74	5.37	-5.98	26.7744	5.656	2.84	26.84	5.64	3	135.00	0.746	0.489	0.257	1.431	4.02	5.75	0.405	13.86	48.2129	33.04
11.975	430.125	11.53	0.56	4.82	-4.81	21.4987	5.204	2.88	21.56	5.19	3	135.00	0.768	0.501	0.268	1.413	3.44	4.86	0.333	11.56	50.9108	31.67
12.303	429.797	12.82	0.45	3.52	-3.23	23.4732	3.741	2.76	23.51	3.73	4	135.00	0.790	0.512	0.278	1.397	3.57	4.98	0.372	12.84	43.714	32.22
12.631	429.469	13.05	0.43	3.3	-2.06	23.3366	3.514	2.74	23.37	3.51	4	135.00	0.812	0.524	0.288	1.381	3.60	4.97	0.379	13.07	42.8475	32.18
12.959	429.141	13.03	0.41	3.16	-0.78	22.7399	3.362	2.74	22.74	3.36	4	135.00	0.835	0.536	0.298	1.366	3.58	4.90	0.378	13.03	42.7021	32.01
13.287	428.813	14.48	0.43	2.98	12.21	24.8506	3.156	2.70	24.70	3.17	5	135.00	0.857	0.548	0.308	1.351	3.87	5.23	0.422	14.4	40.3482	32.53
13.615	428.485	14.54	0.43	2.97	15.45	24.39	3.148	2.70	24.21	3.17	5	135.00	0.879	0.560	0.319	1.336	3.90	5.20	0.423	14.44	40.6879	32.41
13.943	428.157	13.29	0.47	3.55	20.09	21.6584	3.794	2.80	21.43	3.83	4	135.00	0.901	0.572	0.329	1.322	3.73	4.94	0.384	13.16	45.8728	31.65
14.271	427.829	16.42	0.51	3.08	25.66	26.5391	3.291	2.69	26.27	3.33	5	135.00	0.923	0.584	0.339	1.309	4.35	5.70	0.480	16.26	39.9534	32.91
14.6	427.500	19.35	0.75	3.86	19.79	30.8671	4.075	2.70	30.69	4.10	4	135.00	0.945	0.596	0.349	1.295	5.18	6.71	0.570	19.23	40.477	33.87
14.928	427.172	23.7	1.01	4.25	-5.33	37.4028	4.443	2.66	37.45	4.44	4	135.00	0.967	0.608	0.360	1.283	6.26	8.03	0.704	23.73	38.4335	35.07
15.256	426.844	26.27	0.82	3.11	-8.01	40.7957	3.244	2.54	40.88	3.24	5	135.00	0.990	0.620	0.370	1.270	6.53	8.30	0.783	26.32	32.4669	35.59

R13287

Depth (ft)	Samp. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	..tress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	426.516	28.43	0.71	2.5	1.06	43.4116	2.590	2.45	43.40	2.59	6	135.00	1.012	0.632	0.380	1.258	6.77	8.52	0.849	28.42	28.7045	35.94
15.912	426.188	34.11	0.83	2.42	14.23	51.4007	2.509	2.39	51.26	2.52	6	135.00	1.034	0.643	0.390	1.247	7.88	9.82	1.024	34.02	26.1157	36.91
16.24	425.860	36.87	1.15	3.11	26.79	54.6443	3.211	2.45	54.38	3.23	5	135.00	1.056	0.655	0.401	1.235	8.72	10.78	1.109	36.7	28.4501	37.25
16.568	425.532	38.02	1.21	3.18	114.11	55.3595	3.275	2.46	54.30	3.34	5	136.00	1.078	0.667	0.411	1.224	8.91	10.91	1.144	37.31	28.9263	37.24
16.896	425.204	42.17	1.45	3.45	136.77	60.4516	3.531	2.46	59.17	3.61	5	137.00	1.100	0.679	0.421	1.213	9.86	11.96	1.272	41.3	28.8349	37.73
17.224	424.876	49.75	1.96	3.95	80.34	70.3096	4.031	2.45	69.59	4.07	5	138.00	1.123	0.692	0.431	1.202	11.71	14.08	1.505	49.25	28.4507	38.64
17.552	424.548	47.56	1.6	3.37	107.39	65.9285	3.447	2.42	64.98	3.50	5	139.00	1.146	0.704	0.442	1.192	11.00	13.11	1.437	46.89	27.2425	38.26
17.88	424.220	51.6	1.85	3.59	140.27	70.3788	3.668	2.42	69.15	3.73	5	140.00	1.168	0.717	0.452	1.181	11.91	14.07	1.561	50.72	27.3444	38.61
18.208	423.892	65.03	2.32	3.57	168.7	87.5341	3.634	2.36	86.09	3.69	5	141.00	1.191	0.729	0.462	1.171	14.58	17.07	1.976	63.98	24.6627	39.80
18.537	423.563	70.02	2.53	3.61	155.08	92.701	3.677	2.34	91.39	3.73	5	142.00	1.215	0.742	0.472	1.161	15.64	18.15	2.130	69.05	24.1286	40.12
18.865	423.235	65.59	2.53	3.86	43.83	85.2026	3.931	2.38	84.85	3.95	5	143.00	1.238	0.755	0.483	1.151	15.06	17.33	1.992	65.32	25.6929	39.72
19.193	422.907	55.6	2.73	4.9	4.71	70.7073	5.024	2.51	70.67	5.03	4	144.00	1.261	0.769	0.493	1.141	13.62	15.54	1.682	55.57	31.2954	38.73
19.521	422.579	110.1	2.81	2.55	-0.67	139.17	2.582	2.10	139.17	2.58	7	145.00	1.285	0.782	0.503	1.131	22.55	25.50	3.369	110.1	15.903	42.30
19.849	422.251	160.51	4.84	3.02	-18.41	200.145	3.040	2.06	200.30	3.04	7	146.00	1.309	0.795	0.513	1.121	32.40	36.33	4.929	160.65	14.7692	44.08
20.177	421.923	111.07	5.1	4.59	-23.58	135.622	4.647	2.31	135.79	4.64	11	147.00	1.333	0.809	0.523	1.112	24.86	27.63	3.397	111.21	22.9849	42.18
20.505	421.595	58.81	3.39	5.76	-23.83	69.8082	5.900	2.57	69.99	5.89	11	148.00	1.357	0.823	0.534	1.102	14.84	16.36	1.779	58.96	33.8626	38.67
20.833	421.267	53.52	2.16	4.03	-22.7	62.2887	4.143	2.48	62.46	4.13	5	149.00	1.381	0.837	0.544	1.093	12.97	14.18	1.614	53.66	30.0156	38.04
21.161	420.939	55.22	2.52	4.56	-21.43	63.2178	4.683	2.52	63.37	4.67	4	150.00	1.405	0.851	0.554	1.084	13.61	14.75	1.666	55.35	31.6051	38.12
21.489	420.611	99.33	2.92	2.94	-20.71	113.098	2.983	2.21	113.25	2.98	6	151.00	1.430	0.866	0.564	1.075	21.26	22.85	3.031	99.46	19.2589	41.25
21.817	420.283	112.37	3.22	2.86	-15.47	126.018	2.903	2.17	126.13	2.90	6	152.00	1.455	0.880	0.575	1.066	23.66	25.22	3.434	112.47	17.9771	41.80
22.145	419.955	57.05	2.85	4.99	-4.13	62.1002	5.129	2.56	62.13	5.13	4	153.00	1.480	0.895	0.585	1.057	14.28	15.10	1.720	57.08	33.269	38.01
22.473	419.627	49.22	2.02	4.1	-0.05	52.4512	4.233	2.54	52.45	4.23	5	154.00	1.505	0.910	0.595	1.048	12.24	12.84	1.477	49.22	32.7044	37.05
22.802	419.298	45.2	1.76	3.89	26.33	47.2222	4.030	2.56	47.04	4.05	5	155.00	1.530	0.925	0.605	1.040	11.30	11.75	1.352	45.03	33.5817	36.42
23.13	418.970	86.55	1.89	2.18	44.16	90.4233	2.224	2.18	90.13	2.23	7	156.00	1.556	0.940	0.616	1.031	18.23	18.81	2.631	86.27	18.3567	40.05
23.458	418.642	135.75	2.31	1.7	0.11	140.445	1.722	1.97	140.43	1.72	8	157.00	1.581	0.955	0.626	1.023	26.36	26.97	4.154	135.74	12.0719	42.35
23.786	418.314	80.31	2.82	3.51	-7.76	81.0682	3.583	2.36	81.12	3.56	6	158.00	1.607	0.971	0.636	1.015	16.37	18.64	2.437	80.36	24.9247	39.46
24.114	417.986	60.5	2.64	4.36	-3.63	59.6725	4.485	2.52	59.70	4.46	5	159.00	1.633	0.987	0.646	1.007	14.91	15.01	1.823	60.53	31.782	37.79
24.442	417.658	127.06	4.56	3.59	-4.92	125.108	3.636	2.25	125.14	3.64	6	160.00	1.659	1.002	0.657	0.999	27.63	27.60	3.882	127.09	20.6606	41.76
24.77	417.330	149.98	9.93	6.62	-11.87	145.622	6.696	2.43	145.70	6.69	11	161.00	1.685	1.018	0.667	0.991	35.31	34.99	4.591	150.06	27.5358	42.53
25.098	417.002	328.34	15.26	4.65	23.26	315.728	4.672	2.12	315.58	4.67	11	162.00	1.712	1.035	0.677	0.983	67.79	66.65	10.112	328.19	16.5598	46.17
25.426	416.674	419.75	19.4	4.62	18.11	397.781	4.641	2.08	397.68	4.64	11	163.00	1.738	1.051	0.687	0.976	85.07	82.99	12.942	419.64	15.1458	47.17
25.754	416.346	389.73	18.71	4.8	438.91	363.482	4.823	2.11	360.92	4.86	11	164.00	1.765	1.067	0.697	0.968	79.58	77.03	12.011	386.99	16.2214	46.75

R13288

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 43 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-11

ConeTec Inc. Interpretation
Interpretation Software - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4215
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-11
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 10:31
CPT File: 804CP11.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 440.6

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	39.88	2.75	89.72	26.76	2.35

User Inputs:
Assumed
Water Table Depth (ft): 11.4
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85
Ground Surface Elev. 440.6
See Below
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	440.436	28.5	0.22	0.76	0.16	2779.49	0.772	1.11	2778.51	0.77	7	125.00	0.010	0.010	0.000	2.000	4.17	8.34	0.882	28.49	-1.2563	54.33
0.492	440.108	28.29	0.44	1.56	-0.67	919	1.557	1.50	919.33	1.56	6	125.00	0.031	0.031	0.000	2.000	4.67	9.34	0.875	28.3	2.83968	50.52
0.82	439.780	20.17	0.54	2.66	-2.66	392.561	2.684	1.87	392.76	2.68	5	125.00	0.051	0.051	0.000	2.000	3.78	7.55	0.623	20.16	9.60794	47.11
1.148	439.452	19.6	0.52	2.63	-12.35	272.171	2.663	1.94	273.29	2.65	5	125.00	0.072	0.072	0.000	2.000	3.79	7.57	0.605	19.66	11.4161	45.51
1.476	439.124	28.99	0.42	1.43	-1.13	313.255	1.453	1.69	313.36	1.45	6	125.00	0.092	0.092	0.000	2.000	5.10	10.19	0.895	29	5.94772	46.13
1.804	438.796	36.06	0.45	1.25	-0.07	318.823	1.252	1.63	318.82	1.25	7	125.00	0.113	0.113	0.000	2.000	6.22	12.43	1.113	36.06	4.93192	46.20
2.133	438.467	35.17	0.54	1.52	-0.16	262.816	1.541	1.76	262.82	1.54	7	125.00	0.133	0.133	0.000	2.000	6.32	12.65	1.085	35.17	7.21626	45.33
2.461	438.139	37.91	0.65	1.44	-0.05	245.469	1.457	1.76	245.47	1.46	7	125.00	0.154	0.154	0.000	2.000	6.81	13.63	1.169	37.91	7.18838	45.02
2.789	437.811	36.47	0.68	1.87	-0.34	208.222	1.874	1.89	208.22	1.87	6	125.00	0.174	0.174	0.000	2.000	6.87	13.74	1.124	36.47	10.0384	44.25
3.117	437.483	27.44	0.59	2.16	-0.37	139.853	2.166	2.04	139.85	2.17	6	125.00	0.195	0.195	0.000	2.000	5.49	10.97	0.844	27.44	14.139	42.30
3.445	437.155	20.54	0.66	3.22	-0.44	94.3962	3.247	2.29	94.40	3.25	5	125.00	0.215	0.215	0.000	2.000	4.54	9.08	0.629	20.54	22.0663	40.26
3.773	436.827	22.61	0.8	3.52	-1.01	94.8813	3.576	2.32	94.88	3.58	5	125.00	0.236	0.236	0.000	2.000	5.07	10.13	0.693	22.61	23.1951	40.29
4.101	436.499	26.22	0.98	3.73	-1.36	101.297	3.775	2.32	101.30	3.77	5	125.00	0.256	0.256	0.000	1.975	5.88	11.60	0.804	26.22	23.1946	40.63
4.429	436.171	31.36	1.08	3.46	-1.09	112.29	3.475	2.26	112.33	3.47	5	125.00	0.277	0.277	0.000	1.901	6.86	13.04	0.962	31.37	21.1287	41.18
4.757	435.843	38.92	1.07	2.74	1.76	129.906	2.770	2.15	129.84	2.77	6	125.00	0.297	0.297	0.000	1.834	8.11	14.86	1.196	38.9	17.2319	41.92
5.085	435.515	38.04	1.11	2.93	4.37	118.693	2.943	2.19	118.60	2.94	6	125.00	0.318	0.318	0.000	1.774	8.07	14.31	1.168	38.01	18.7018	41.46
5.413	435.187	30.78	1.06	3.45	13.37	89.981	3.482	2.33	89.71	3.49	5	125.00	0.338	0.338	0.000	1.719	6.90	11.86	0.942	30.65	23.4971	39.99
5.741	434.859	25.89	0.85	3.29	18.5	71.1547	3.329	2.38	70.85	3.34	5	125.00	0.359	0.359	0.000	1.669	5.94	9.91	0.790	25.76	25.6136	38.69
6.069	434.531	23.4	0.79	3.36	23.9	60.6906	3.432	2.44	60.30	3.45	5	125.00	0.379	0.379	0.000	1.624	5.50	8.93	0.713	23.25	28.015	37.78
6.398	434.202	25.75	1.15	4.46	22.01	63.3951	4.536	2.51	63.07	4.56	4	125.00	0.400	0.400	0.000	1.581	6.28	9.93	0.785	25.62	31.3104	38.04
6.726	433.874	29.09	1.27	4.36	14.11	69.2001	4.430	2.48	68.01	4.44	4	125.00	0.420	0.420	0.000	1.542	7.01	10.81	0.888	29.01	29.9625	38.46
7.054	433.546	24	1	4.16	11.96	53.4372	4.245	2.54	53.28	4.26	4	125.00	0.441	0.441	0.000	1.506	5.94	8.95	0.729	23.93	32.5699	37.07
7.382	433.218	21.53	0.94	4.35	14.92	45.6649	4.462	2.61	45.45	4.48	4	125.00	0.461	0.461	0.000	1.472	5.49	8.09	0.652	21.43	35.6188	36.14
7.71	432.890	22.03	1.05	4.75	14.57	44.7173	4.873	2.64	44.53	4.89	3	125.00	0.482	0.482	0.000	1.441	5.72	8.24	0.667	21.94	37.2891	36.02
8.038	432.562	22.77	0.99	4.34	10.23	44.3247	4.446	2.61	44.21	4.46	4	125.00	0.502	0.502	0.000	1.411	5.84	8.24	0.689	22.71	35.9462	35.97
8.366	432.234	32.54	1.27	3.9	8.77	61.2328	3.967	2.48	61.12	3.97	5	125.00	0.523	0.523	0.000	1.383	7.83	10.83	0.991	32.48	29.7484	37.66
8.694	431.906	28.72	1.47	5.13	1.57	51.8548	5.217	2.61	51.84	5.22	3	125.00	0.543	0.543	0.000	1.357	7.39	10.03	0.872	28.71	36.0689	36.91
9.022	431.578	25.38	1.28	5.04	3.58	44.01	5.158	2.66	43.97	5.16	3	125.00	0.564	0.564	0.000	1.332	6.68	8.90	0.768	25.36	38.3383	35.94
9.35	431.250	21.81	1.12	5.12	4.5	36.3219	5.277	2.72	36.27	5.28	3	125.00	0.584	0.584	0.000	1.308	5.94	7.77	0.657	21.78	41.7898	34.78
9.678	430.922	19.77	1.16	5.88	0.32	31.6844	6.053	2.81	31.68	6.05	3	125.00	0.605	0.605	0.000	1.286	5.64	7.25	0.593	19.77	46.4618	33.95
10.006	430.594	16.91	1.13	6.7	7.09	26.0398	6.939	2.91	25.98	6.96	3	125.00	0.625	0.625	0.000	1.265	5.11	6.46	0.504	16.87	52.7324	32.71
10.335	430.265	12.18	0.84	6.91	7.27	17.8563	7.283	3.05	17.78	7.31	3	125.00	0.646	0.646	0.000	1.244	3.99	4.96	0.357	12.13	61.5745	30.26
10.663	429.937	13.61	0.58	4.27	11.11	19.422	4.481	2.88	19.32	4.51	3	125.00	0.666	0.666	0.000	1.225	4.02	4.92	0.401	13.54	50.6152	30.80
10.991	429.609	16.16	0.58	3.6	16.15	22.5247	3.748	2.78	22.38	3.77	4	125.00	0.687	0.687	0.000	1.207	4.51	5.44	0.479	16.06	44.7951	31.76
11.319	429.281	20.35	0.95	4.66	10.23	27.7658	4.836	2.78	27.67	4.85	3	125.00	0.707	0.707	0.000	1.189	5.71	6.79	0.608	20.26	45.0299	33.10
11.647	428.953	15.41	0.83	5.37	7.37	20.3862	5.653	2.93	20.33	5.67	3	135.00	0.728	0.720	0.008	1.178	4.70	5.54	0.455	15.37	53.7104	31.14
11.975	428.625	15.03	0.51	3.4	12.31	19.5044	3.571	2.81	19.40	3.59	4	135.00	0.750	0.732	0.018	1.169	4.28	5.00	0.442	14.95	46.7592	30.84
12.303	428.297	13.48	0.39	2.86	16.05	17.0793	3.069	2.82	16.94	3.09	5	135.00	0.772	0.744	0.028	1.159	3.84	4.45	0.393	13.36	47.1053	29.96
12.631	427.969	14.27	0.45	3.13	24.68	17.8261	3.339	2.83	17.61	3.38	5	135.00	0.794	0.756	0.038	1.150	4.07	4.69	0.417	14.1	47.7069	30.22
12.959	427.641	16.62	0.59	3.53	32.75	20.5813	3.733	2.81	20.31	3.78	4	135.00	0.816	0.768	0.049	1.141	4.69	5.36	0.489	16.47	46.6978	31.15
13.287	427.313	15.45	0.53	3.41	85.75	18.7382	3.627	2.85	18.06	3.76	4	135.00	0.839	0.780	0.059	1.132	4.36	4.94	0.452	14.92	48.9421	30.39
13.615	426.985	14.31	0.4	2.77	92.79	16.9884	2.974	2.83	16.26	3.11	5	135.00	0.861	0.792	0.069	1.124	3.98	4.47	0.416	13.73	48.0254	29.71
13.943	426.657	16.27	0.56	3.45	78.04	19.1483	3.639	2.84	18.54	3.76	4	135.00	0.883	0.804	0.079	1.116	4.59	5.12	0.476	15.76	48.3929	30.57
14.271	426.329	75.29	0.83	1.1	37.25	91.2159	1.116	1.97	90.93	1.12	8	135.00	0.905	0.815	0.090	1.107	14.61	16.18	2.303	75.06	12.2389	40.07
14.6	426.000	92.32	1.92	2.08	-13.9	110.454	2.101	2.10	110.65	2.10	7	135.00	0.927	0.827	0.100	1.099	18.90	20.78	2.829	92.4	15.8278	41.10
14.928	425.672	64.03	2.18	3.4	-6.84	75.1558	3.456	2.37	75.22	3.45	6	135.00	0.949	0.839	0.110	1.092	14.71	16.06	1.953	64.08	25.3244	39.03
15.256	425.344	42.81	1.68	3.92	119.63	49.1501	4.015	2.56	48.27	4.09	5	135.00	0.972	0.851	0.120	1.084	10.53	11.42	1.295	42.06	33.3652	36.51

R13290

Depth (ft)	San.. ..r. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	.Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	425.016	31.18	1.38	4.44	88.96	34.9725	4.572	2.70	34.34	4.66	4	135.00	0.994	0.863	0.131	1.076	8.26	8.89	0.935	30.63	40.6127	34.47
15.912	424.688	74.08	1.85	2.5	119.6	83.4971	2.532	2.25	82.64	2.56	6	135.00	1.016	0.875	0.141	1.069	15.95	17.05	2.262	73.33	20.7052	39.55
16.24	424.360	168.1	3.39	2.02	-0.74	188.354	2.029	1.94	188.35	2.03	7	135.00	1.038	0.887	0.151	1.062	32.30	34.30	5.172	168.1	11.3615	43.77
16.568	424.032	179.25	4.43	2.47	-10.55	198.239	2.486	2.00	198.32	2.49	7	136.00	1.060	0.899	0.161	1.055	35.21	37.14	5.517	179.32	12.8438	44.02
16.896	423.704	134.23	3.06	2.28	-18.82	146.166	2.298	2.05	146.30	2.30	7	137.00	1.082	0.911	0.171	1.048	26.94	28.22	4.122	134.25	14.3363	42.53
17.224	423.376	78.48	1.39	1.78	-20.86	83.8148	1.796	2.14	83.96	1.79	7	138.00	1.105	0.923	0.182	1.041	16.31	16.98	2.398	78.61	16.912	39.64
17.552	423.048	61.76	2.91	4.71	-21.8	64.8083	4.799	2.62	64.96	4.79	4	139.00	1.128	0.936	0.192	1.034	15.23	15.74	1.877	61.9	31.6498	38.22
17.88	422.720	131.97	4.46	3.38	-22.01	137.977	3.409	2.20	138.12	3.41	6	140.00	1.150	0.948	0.202	1.027	28.14	28.90	4.050	132.11	16.9817	42.25
18.208	422.392	229.79	6.98	3.04	1.89	237.93	3.053	2.03	237.92	3.05	12	141.00	1.173	0.961	0.212	1.020	46.63	46.55	7.078	229.78	13.6451	44.88
18.537	422.063	178.23	4.87	2.73	5.5	181.799	2.751	2.05	181.77	2.75	7	142.00	1.196	0.974	0.223	1.013	35.79	36.27	5.461	178.2	14.4578	43.60
18.865	421.735	158.32	3.05	1.93	-5.91	159.195	1.941	1.97	159.24	1.94	8	143.00	1.220	0.987	0.233	1.007	30.79	31.00	4.864	158.36	12.157	42.96
19.193	421.407	129.65	3.89	3	-15.68	128.399	3.029	2.18	128.49	3.03	6	144.00	1.243	1.000	0.243	1.000	27.40	27.40	3.975	129.74	18.2843	41.88
19.521	421.079	173.42	5.09	2.94	-12.86	169.87	2.957	2.10	169.95	2.96	7	145.00	1.267	1.013	0.253	0.993	35.43	35.20	5.330	173.5	15.7016	43.28
19.849	420.751	263.85	6.2	2.35	-1.66	255.66	2.361	1.91	255.67	2.36	7	146.00	1.291	1.027	0.264	0.987	50.25	49.56	8.129	263.86	10.7536	45.21
20.177	420.423	128.37	5.69	4.43	4.11	122.087	4.478	2.33	122.06	4.48	11	147.00	1.315	1.041	0.274	0.980	28.87	28.30	3.934	128.34	23.5384	41.62
20.505	420.095	79.4	4.72	5.95	5.06	74.0219	6.047	2.56	73.99	6.05	11	148.00	1.339	1.055	0.284	0.974	19.92	19.40	2.417	79.37	33.6824	38.95
20.833	419.767	78.64	4.44	5.65	4.76	72.3155	5.746	2.55	72.29	5.75	11	149.00	1.363	1.069	0.294	0.967	19.63	18.99	2.392	78.61	33.0698	38.82
21.161	419.439	89.37	5.02	5.61	5.8	81.2538	5.706	2.52	81.23	5.71	11	150.00	1.387	1.083	0.305	0.961	21.94	21.09	2.724	89.34	31.4994	39.47
21.489	419.111	108.25	5.71	5.27	5.22	97.3752	5.345	2.45	97.35	5.35	11	151.00	1.412	1.097	0.315	0.955	25.71	24.54	3.308	108.22	28.3906	40.44
21.817	418.783	132	7.15	5.41	2.48	117.444	5.476	2.41	117.43	5.48	11	152.00	1.437	1.112	0.325	0.948	30.78	29.19	4.042	131.98	26.7224	41.42
22.145	418.455	152.55	8.54	5.6	-0.62	134.133	5.652	2.39	134.13	5.65	11	153.00	1.462	1.126	0.335	0.942	35.23	33.19	4.678	152.55	25.8345	42.10
22.473	418.127	166.92	10.03	6.01	-0.81	144.956	6.063	2.39	144.96	6.06	11	154.00	1.487	1.141	0.345	0.936	38.66	36.19	5.122	166.92	26.1022	42.49
22.802	417.798	175.61	10.85	6.18	-0.16	150.561	6.232	2.39	150.56	6.23	11	155.00	1.512	1.156	0.356	0.930	40.69	37.84	5.390	175.61	26.1461	42.68
23.13	417.470	186.83	11.72	6.27	0.3	158.165	6.325	2.39	158.16	6.33	11	156.00	1.537	1.172	0.366	0.924	43.17	39.89	5.737	186.82	25.9033	42.93
23.458	417.142	212.47	12.86	6.05	-0.81	177.701	6.097	2.35	177.70	6.10	11	157.00	1.563	1.187	0.376	0.918	46.23	44.27	6.530	212.47	24.3144	43.50
23.786	416.814	206.47	13.26	6.42	-3.42	170.396	6.472	2.38	170.42	6.47	11	158.00	1.589	1.202	0.386	0.912	47.54	43.35	6.343	206.5	25.5551	43.29
24.114	416.486	224.17	13.55	6.04	-3.65	182.713	6.088	2.34	182.73	6.09	11	159.00	1.615	1.218	0.397	0.906	50.73	45.97	6.890	224.19	24.049	43.63
24.442	416.158	237.64	15.41	6.48	-5.54	191.262	6.530	2.36	191.29	6.53	11	160.00	1.641	1.234	0.407	0.900	54.17	48.78	7.306	237.67	24.6695	43.85
24.77	415.830	244.94	15.19	6.2	-7.81	194.633	6.244	2.34	194.66	6.24	11	161.00	1.667	1.250	0.417	0.894	55.32	49.46	7.532	244.98	23.8705	43.94
25.098	415.502	239.96	14.94	6.23	-11.57	188.192	6.270	2.34	188.25	6.27	11	162.00	1.693	1.266	0.427	0.889	54.42	48.36	7.377	240.03	24.2139	43.78
25.426	415.174	217.85	14.42	6.62	-17.67	168.534	6.672	2.39	168.62	6.67	11	163.00	1.720	1.282	0.436	0.883	50.48	44.58	6.691	217.96	26.1001	43.24
25.754	414.846	219.37	13.74	6.26	-20.97	167.543	6.314	2.37	167.64	6.31	11	164.00	1.747	1.299	0.448	0.877	50.40	44.22	6.738	219.5	25.3516	43.21
26.082	414.518	214.66	13.21	6.15	-22.49	161.82	6.205	2.37	161.93	6.20	11	165.00	1.774	1.316	0.458	0.872	49.36	43.03	6.591	214.8	25.3928	43.04
26.41	414.190	225.44	13.56	6.01	-24.85	167.847	6.063	2.36	167.97	6.06	11	166.00	1.801	1.332	0.468	0.866	51.45	44.57	6.924	225.6	24.7228	43.22
26.739	413.861	268.44	15.56	5.8	-24.92	197.572	5.836	2.31	197.68	5.83	11	167.00	1.828	1.349	0.479	0.861	59.89	51.56	8.254	268.59	22.7602	44.01
27.067	413.533	344.83	16.55	4.8	-25.2	250.97	4.825	2.18	251.09	4.82	11	168.00	1.855	1.367	0.489	0.855	73.00	62.45	10.618	344.99	18.4477	45.13

R13291

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 46 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-12

ConeTec Inc. erpretation
Interpretation O telease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4182
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-12
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 11:15
CPT File: 804CP12.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 442.1

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg %	Ic Avg. %
125	Residual Soil	39.01	2.80	91.11	27.69	2.37

User Inputs:
Assumed: Water Table Depth (ft): 11.7
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 442.1
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	441.936	11.62	0.14	1.16	-0.32	1132.66	1.206	1.37	1132.66	1.21	6	125.00	0.010	0.010	0.000	2.000	1.84	3.67	0.359	11.62	1.12402	51.29
0.492	441.608	7.94	0.16	2.02	-1.8	257.211	2.023	1.86	257.54	2.02	5	125.00	0.031	0.031	0.000	2.000	1.48	2.96	0.245	7.95	9.3841	45.24
0.82	441.280	9.78	0.15	1.54	-4.83	189.829	1.542	1.84	190.41	1.54	5	125.00	0.051	0.051	0.000	2.000	1.82	3.64	0.301	9.81	9.05791	43.82
1.148	440.952	14.93	0.28	1.85	-7.94	207.084	1.884	1.89	207.78	1.88	5	125.00	0.072	0.072	0.000	2.000	2.82	5.65	0.460	14.98	10.0719	44.24
1.476	440.624	13.35	0.35	2.59	-11.59	143.715	2.640	2.10	144.47	2.63	5	125.00	0.092	0.092	0.000	2.000	2.74	5.49	0.410	13.42	15.7665	42.47
1.804	440.296	10.42	0.21	2.02	-9.49	91.4169	2.037	2.14	91.95	2.03	5	125.00	0.113	0.113	0.000	2.000	2.18	4.36	0.319	10.48	17.1922	40.12
2.133	439.967	11.15	0.3	2.65	-4.09	82.6381	2.723	2.27	82.86	2.72	5	125.00	0.133	0.133	0.000	2.000	2.45	4.90	0.341	11.18	21.347	39.56
2.461	439.639	11.4	0.39	3.39	-0.6	73.1162	3.468	2.38	73.12	3.47	4	125.00	0.154	0.154	0.000	2.000	2.63	5.26	0.348	11.4	25.7091	38.87
2.789	439.311	19.33	0.58	3.01	0.23	109.893	3.028	2.22	109.89	3.03	5	125.00	0.174	0.174	0.000	2.000	4.16	8.31	0.593	19.33	19.7298	41.06
3.117	438.983	28.95	0.84	2.89	2.91	147.604	2.921	2.13	147.55	2.92	5	125.00	0.195	0.195	0.000	2.000	5.99	11.98	0.890	28.94	16.7116	42.57
3.445	438.655	31.92	1.09	3.41	12.38	147.25	3.438	2.19	146.92	3.45	5	125.00	0.215	0.215	0.000	2.000	6.75	13.50	0.982	31.85	18.5805	42.55
3.773	438.327	29.03	1.2	4.13	24.36	122.106	4.168	2.31	121.47	4.19	4	125.00	0.236	0.236	0.000	2.000	6.43	12.87	0.891	28.88	22.7083	41.58
4.101	437.999	26.16	1.06	4.04	36.19	101.063	4.092	2.35	100.20	4.13	4	125.00	0.256	0.256	0.000	1.975	5.90	11.65	0.802	25.94	24.4642	40.58
4.429	437.671	24.24	0.91	3.76	45.54	86.5683	3.797	2.37	85.56	3.84	4	125.00	0.277	0.277	0.000	1.901	5.50	10.45	0.742	23.96	25.2412	39.73
4.757	437.343	19.02	0.82	4.29	43.88	62.9731	4.360	2.51	62.06	4.44	4	125.00	0.297	0.297	0.000	1.834	4.59	8.41	0.580	18.75	31.1432	37.95
5.085	437.015	21.3	0.75	3.53	49.65	66.0206	3.574	2.43	65.05	3.63	5	125.00	0.318	0.318	0.000	1.774	4.95	8.78	0.650	20.99	27.7143	38.21
5.413	436.687	23.02	0.78	3.4	49.79	67.0436	3.439	2.41	66.13	3.49	5	125.00	0.338	0.338	0.000	1.719	5.31	9.13	0.702	22.71	26.9846	38.30
5.741	436.359	19.94	0.81	4.05	42.61	54.5722	4.137	2.53	53.82	4.19	4	125.00	0.359	0.359	0.000	1.669	4.87	8.13	0.606	19.67	32.2135	37.13
6.059	436.031	19.3	0.6	3.12	42.66	49.8815	3.171	2.48	49.20	3.22	5	125.00	0.379	0.379	0.000	1.624	4.59	7.45	0.586	19.04	29.7477	36.60
6.398	435.702	19.44	0.61	3.15	38.64	47.6152	3.204	2.50	47.02	3.24	5	125.00	0.400	0.400	0.000	1.581	4.67	7.38	0.589	19.2	30.4945	36.34
6.726	435.374	19.51	0.69	3.55	28.89	45.4109	3.615	2.55	44.98	3.65	4	125.00	0.420	0.420	0.000	1.542	4.81	7.42	0.591	19.33	32.7392	36.08
7.054	435.046	19.87	0.87	4.39	16.93	44.0695	4.478	2.62	43.84	4.50	3	125.00	0.441	0.441	0.000	1.506	5.10	7.68	0.602	19.77	36.2176	35.92
7.382	434.718	19.53	0.85	4.34	16.6	41.33	4.458	2.64	41.09	4.48	3	125.00	0.461	0.461	0.000	1.472	5.06	7.44	0.590	19.42	37.1432	35.54
7.71	434.390	17.5	0.83	4.73	14.09	35.3165	4.877	2.71	35.13	4.90	3	125.00	0.482	0.482	0.000	1.441	4.71	6.79	0.527	17.41	41.076	34.59
8.038	434.062	15.42	0.64	4.16	15.08	29.6942	4.290	2.73	29.52	4.32	3	125.00	0.502	0.502	0.000	1.411	4.19	5.91	0.462	15.33	41.9523	33.51
8.366	433.734	15.44	0.6	3.86	17.32	28.529	4.022	2.72	28.32	4.05	4	125.00	0.523	0.523	0.000	1.383	4.18	5.77	0.462	15.33	41.6655	33.25
8.694	433.406	19.79	0.74	3.75	18.06	35.4205	3.845	2.64	35.22	3.87	4	125.00	0.543	0.543	0.000	1.357	5.13	6.96	0.596	19.68	37.304	34.60
9.022	433.078	19.84	0.86	4.34	16.61	34.1851	4.461	2.69	34.01	4.48	4	125.00	0.564	0.564	0.000	1.332	5.30	7.05	0.597	19.74	40.1678	34.39
9.35	432.750	17.62	0.88	4.98	13.99	29.1519	5.166	2.79	29.01	5.19	3	125.00	0.584	0.584	0.000	1.308	4.95	6.48	0.527	17.54	45.3203	33.40
9.678	432.422	16.33	0.72	4.42	21.5	25.9973	4.579	2.79	25.77	4.62	3	125.00	0.605	0.605	0.000	1.286	4.58	5.88	0.487	16.19	45.491	32.66
10.006	432.094	13.67	0.59	4.33	11.13	20.8589	4.523	2.86	20.75	4.55	3	125.00	0.625	0.625	0.000	1.265	3.99	5.04	0.404	13.6	49.3482	31.27
10.335	431.765	12.63	0.44	3.49	13.16	18.553	3.672	2.84	18.43	3.70	4	125.00	0.646	0.646	0.000	1.244	3.64	4.53	0.371	12.55	48.2363	30.50
10.663	431.437	12.67	0.5	3.92	14.21	18.0115	4.165	2.88	17.89	4.19	3	125.00	0.666	0.666	0.000	1.225	3.75	4.59	0.372	12.59	50.9429	30.30
10.991	431.109	12.7	0.63	4.97	13.9	17.4879	5.244	2.96	17.37	5.28	3	125.00	0.687	0.687	0.000	1.207	3.93	4.74	0.372	12.62	55.6721	30.11
11.319	430.781	10.22	0.46	4.51	14.5	13.4465	4.636	3.02	13.31	4.89	3	125.00	0.707	0.707	0.000	1.189	3.28	3.91	0.295	10.12	60.1556	28.34
11.647	430.453	8.57	0.2	2.34	16.35	10.773	2.550	2.94	10.64	2.58	4	125.00	0.728	0.728	0.000	1.172	2.61	3.05	0.243	8.47	54.4211	26.83
11.975	430.125	9.06	0.17	1.83	18.91	11.234	2.045	2.87	11.07	2.08	5	135.00	0.748	0.740	0.009	1.163	2.64	3.08	0.257	8.94	50.2538	27.11
12.303	429.797	10.52	0.15	1.38	22.7	12.9687	1.539	2.75	12.78	1.56	5	135.00	0.771	0.752	0.019	1.153	2.87	3.32	0.302	10.38	43.3766	28.09
12.631	429.469	13.05	0.29	2.23	28.38	16.0505	2.366	2.78	15.81	2.40	5	135.00	0.793	0.764	0.029	1.144	3.61	4.13	0.379	12.87	44.7486	29.51
12.959	429.141	13.23	0.43	3.26	16.7	16.0076	3.464	2.87	15.88	3.49	4	135.00	0.815	0.776	0.039	1.136	3.89	4.42	0.384	13.13	50.3648	29.54
13.287	428.813	13.91	0.36	2.66	7.57	16.601	2.754	2.80	16.54	2.76	5	135.00	0.837	0.787	0.050	1.127	3.93	4.43	0.405	13.86	45.8936	29.81
13.615	428.485	17.32	0.69	3.96	6.49	20.5918	4.192	2.84	20.54	4.20	4	135.00	0.859	0.799	0.060	1.118	5.01	5.61	0.510	17.28	48.2013	31.23
13.943	428.157	28.85	1.37	4.74	1.25	34.4741	4.898	2.72	34.46	4.90	3	135.00	0.881	0.811	0.070	1.110	7.83	8.70	0.666	28.84	41.3835	34.48
14.271	427.829	35.76	1.81	5.06	8.08	42.3427	5.193	2.67	42.28	5.20	3	135.00	0.903	0.823	0.080	1.102	9.48	10.45	1.079	35.71	39.0642	35.72
14.6	427.500	93.11	1.97	2.12	5.47	110.381	2.137	2.11	110.35	2.14	7	135.00	0.926	0.835	0.090	1.094	19.09	20.89	2.854	93.08	16.0213	41.09
14.928	427.172	198.6	4.08	2.06	-1.59	233.341	2.064	1.89	233.35	2.06	8	135.00	0.948	0.847	0.101	1.087	37.46	40.71	6.119	198.61	10.1363	44.79
15.256	426.844	186.18	5.12	2.75	-9.91	215.622	2.764	2.01	215.70	2.76	7	135.00	0.970	0.859	0.111	1.079	36.81	39.72	5.734	186.25	13.2966	44.42

R13293

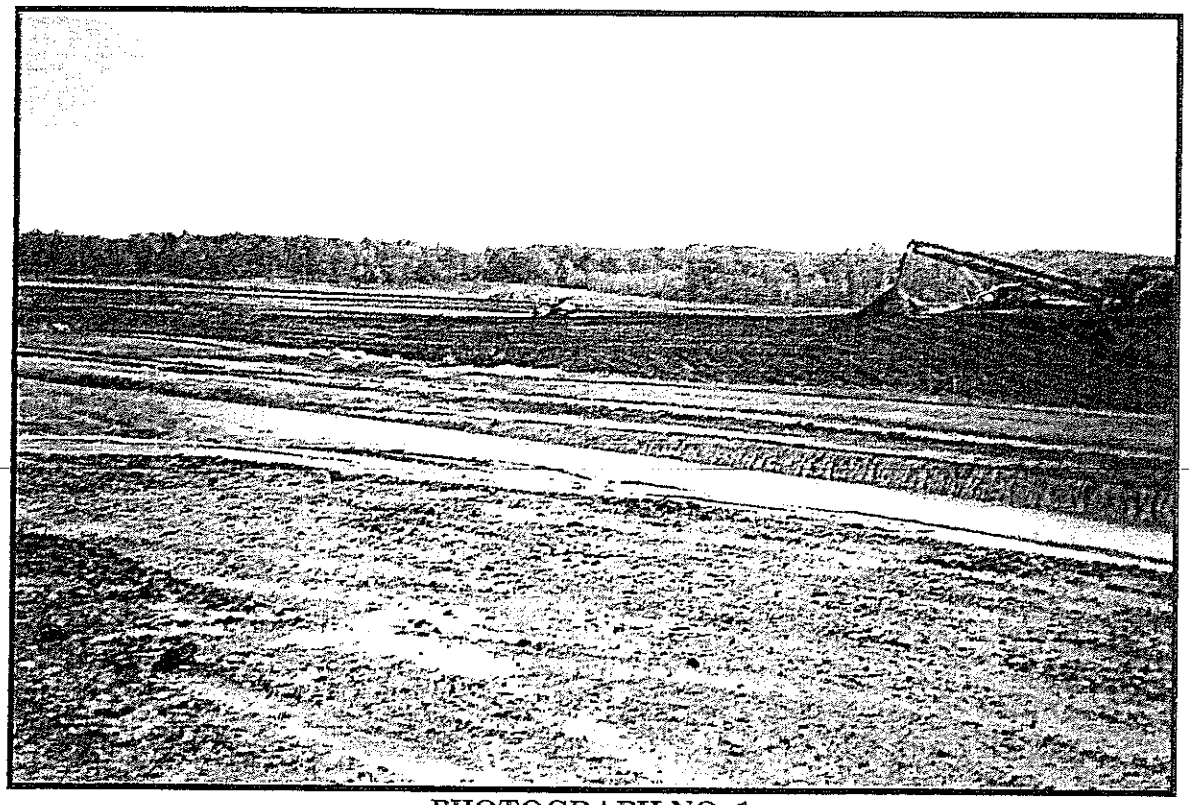
Depth (ft)	Samp... (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	426.516	190.04	5.38	2.83	-11.83	217.081	2.846	2.02	217.16	2.84	7	135.00	0.992	0.871	0.121	1.072	37.70	40.40	5.853	190.11	13.5387	44.45
15.912	426.188	263.65	6.16	2.34	-13.14	297.513	2.345	1.88	297.60	2.34	7	135.00	1.014	0.883	0.131	1.064	49.51	52.70	8.131	263.73	9.83312	45.90
16.24	425.860	284.27	6.89	2.42	-9.63	316.576	2.433	1.88	316.64	2.43	7	135.00	1.036	0.895	0.142	1.057	53.37	56.42	8.769	284.33	9.8196	46.17
16.568	425.532	255.09	5.78	2.27	-12.84	280.208	2.275	1.86	280.30	2.27	7	136.00	1.058	0.907	0.152	1.050	47.96	50.37	7.865	255.17	9.90035	45.63
16.896	425.204	262.69	5.83	2.22	-14.73	284.775	2.229	1.87	284.87	2.23	8	137.00	1.081	0.919	0.162	1.043	49.18	51.31	8.099	262.78	9.63384	45.70
17.224	424.876	262.49	6.06	2.31	-15.84	280.793	2.318	1.89	280.90	2.32	7	138.00	1.103	0.931	0.172	1.036	49.47	51.27	8.092	262.59	10.0493	45.64
17.552	424.548	275.92	6.07	2.2	-16.9	291.316	2.209	1.86	291.43	2.21	8	139.00	1.126	0.943	0.183	1.030	51.50	53.02	8.508	276.03	9.43529	45.80
17.88	424.220	282.44	5.86	2.07	-17.67	294.284	2.083	1.84	294.40	2.08	8	140.00	1.149	0.956	0.193	1.023	52.26	53.45	8.709	282.55	8.89764	45.85
18.208	423.892	257.04	5.91	2.3	-18.27	264.17	2.310	1.90	264.28	2.31	7	141.00	1.172	0.969	0.203	1.016	48.68	49.46	7.922	257.15	10.3624	45.36
18.537	423.563	242.82	4.68	1.93	-18.43	246.178	1.937	1.85	246.30	1.94	6	142.00	1.195	0.982	0.213	1.009	45.22	45.65	7.481	242.94	9.29281	45.04
18.865	423.235	257.45	4.85	1.88	-18.64	257.634	1.893	1.83	257.75	1.89	8	143.00	1.218	0.995	0.224	1.003	47.61	47.74	7.933	257.67	8.85195	45.25
19.193	422.907	260.77	6.02	2.31	-18.77	257.525	2.320	1.91	257.64	2.32	7	144.00	1.242	1.008	0.234	0.998	49.52	49.33	8.035	260.69	10.5471	45.25
19.521	422.579	170.7	6.5	3.81	-14.05	165.924	3.836	2.19	166.01	3.83	12	145.00	1.265	1.021	0.244	0.990	36.30	35.92	5.246	170.79	18.807	43.16
19.849	422.251	99.48	6.5	6.53	-18.39	94.8975	6.620	2.53	95.00	6.61	11	146.00	1.289	1.035	0.254	0.983	24.57	24.16	3.040	99.59	31.9422	40.31
20.177	421.923	121.55	7.95	6.54	-17.74	114.684	6.612	2.48	114.80	6.61	11	147.00	1.313	1.048	0.264	0.977	29.34	28.66	3.723	121.67	29.7686	41.30
20.505	421.595	160.73	12.29	7.65	-14.95	150.046	7.711	2.47	150.13	7.71	11	148.00	1.337	1.062	0.275	0.970	38.65	37.50	4.935	160.82	29.4577	42.67
20.833	421.267	215.14	14.59	6.78	-12.33	198.618	6.825	2.36	198.69	6.82	11	149.00	1.361	1.076	0.285	0.964	49.23	47.45	6.619	215.22	24.995	44.03
21.161	420.939	213.16	15.63	7.33	2.1	194.194	7.380	2.40	194.18	7.38	11	150.00	1.386	1.091	0.295	0.958	49.52	47.42	6.556	213.14	26.385	43.92
21.489	420.611	245.28	17.26	7.04	16.49	220.717	7.078	2.36	220.62	7.08	11	151.00	1.410	1.105	0.305	0.951	55.86	53.16	7.550	245.17	24.68	44.53
21.817	420.283	304.39	19.87	6.53	34.99	270.633	6.559	2.29	270.44	6.56	11	152.00	1.435	1.119	0.316	0.945	67.22	63.53	9.379	304.17	22.0175	45.47
22.145	419.955	331.65	17.77	5.36	221.32	291.141	5.382	2.20	289.92	5.40	11	153.00	1.460	1.134	0.326	0.939	70.29	66.00	10.223	330.27	18.9079	45.78

R13294

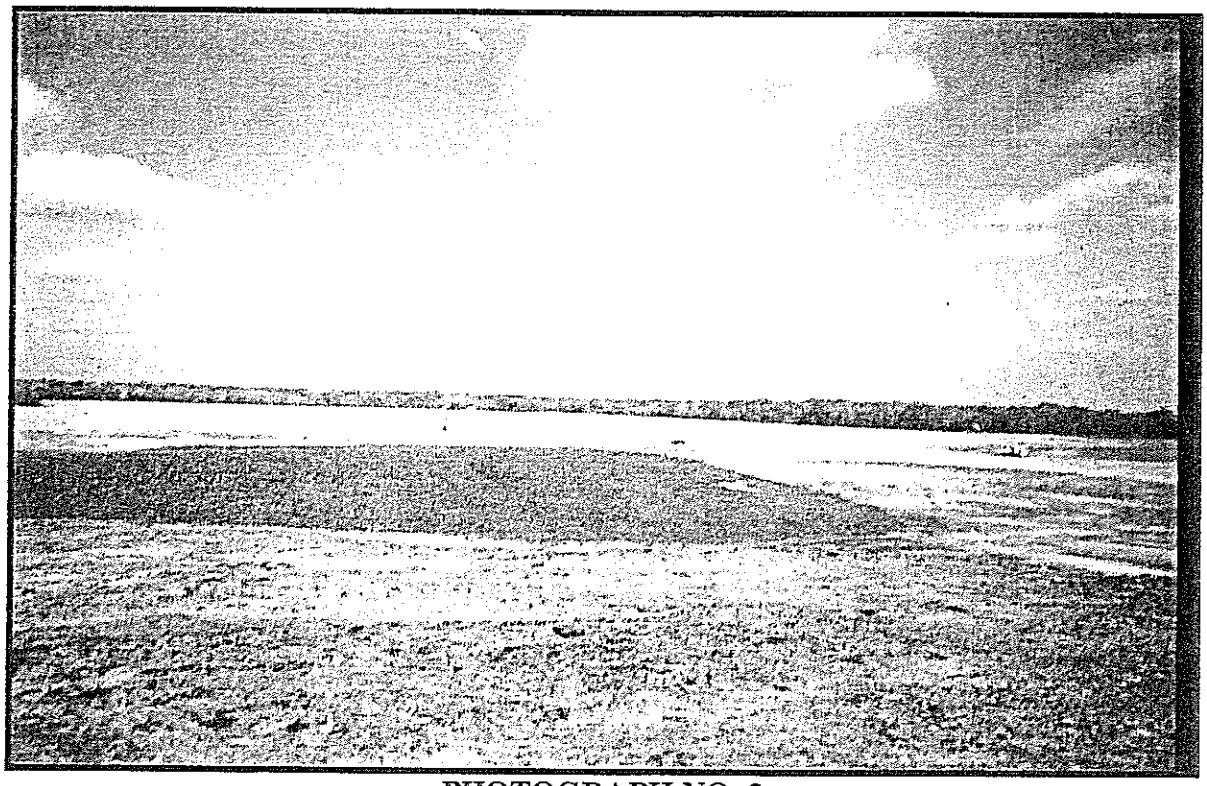
APPENDIX A-4

PHOTOGRAPHS OF OCTOBER 2007 FIELD TESTING

PHOTOGRAPHS

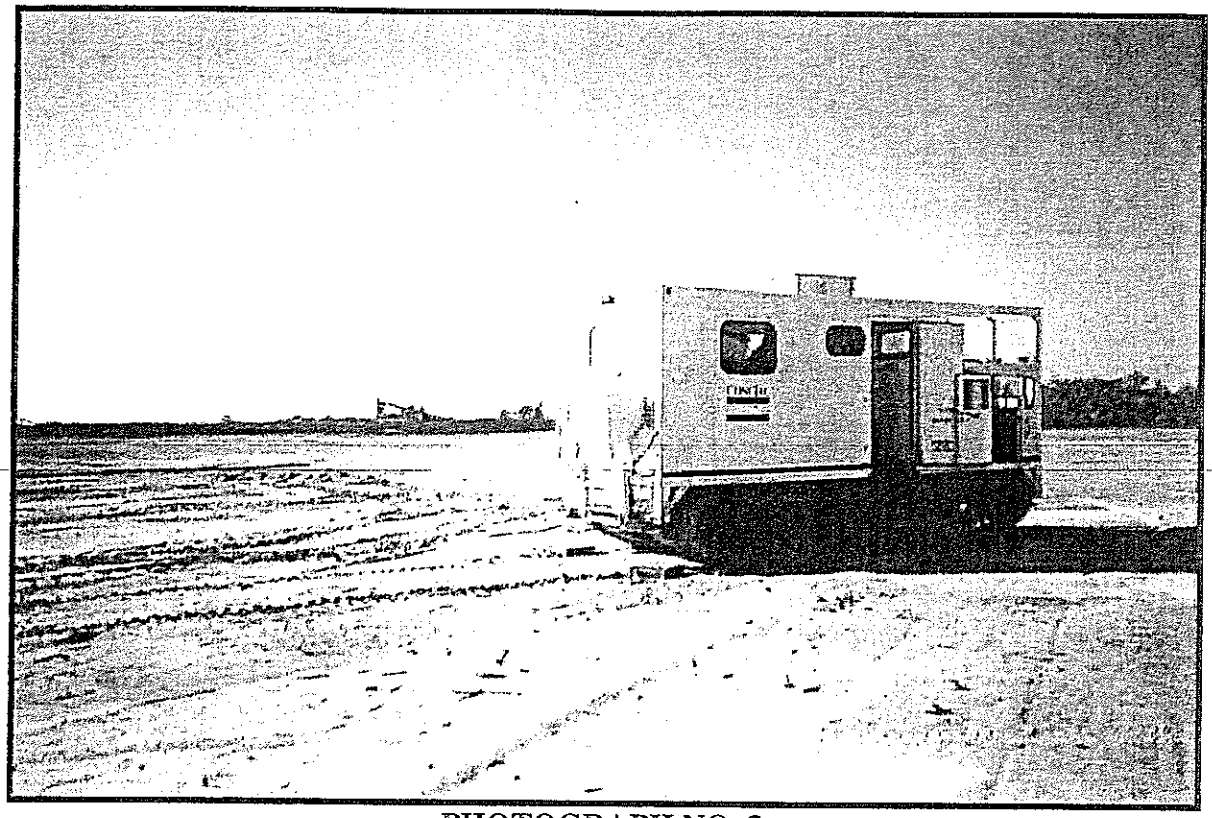


PHOTOGRAPH NO. 1
View of the Pond Creek facility and South Cell refuse looking southeast. (October 2007)

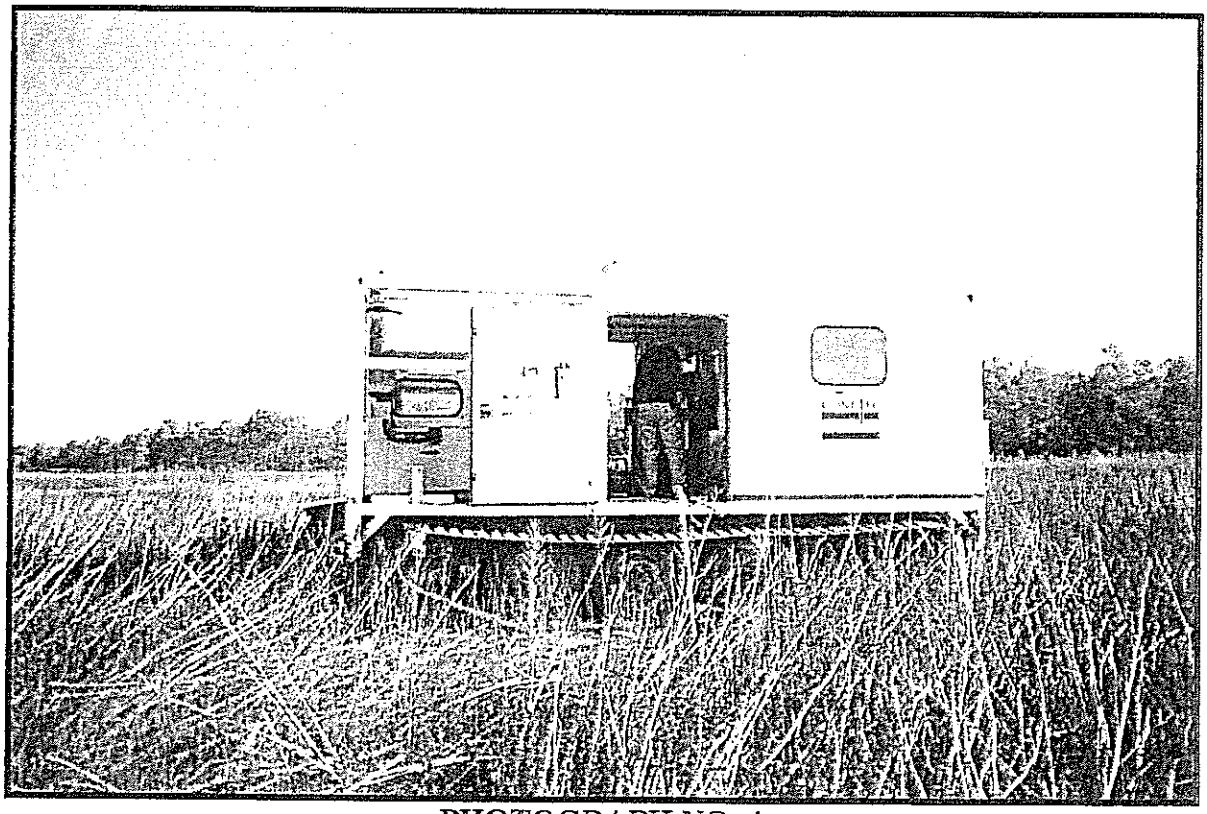


PHOTOGRAPH NO. 2
View of Pond Creek facility from existing coarse refuse crest at El. 482± looking north toward proposed Central and North Cells. ConeTec rig at CPT-6 middle right. (October 2007)

PHOTOGRAPHS

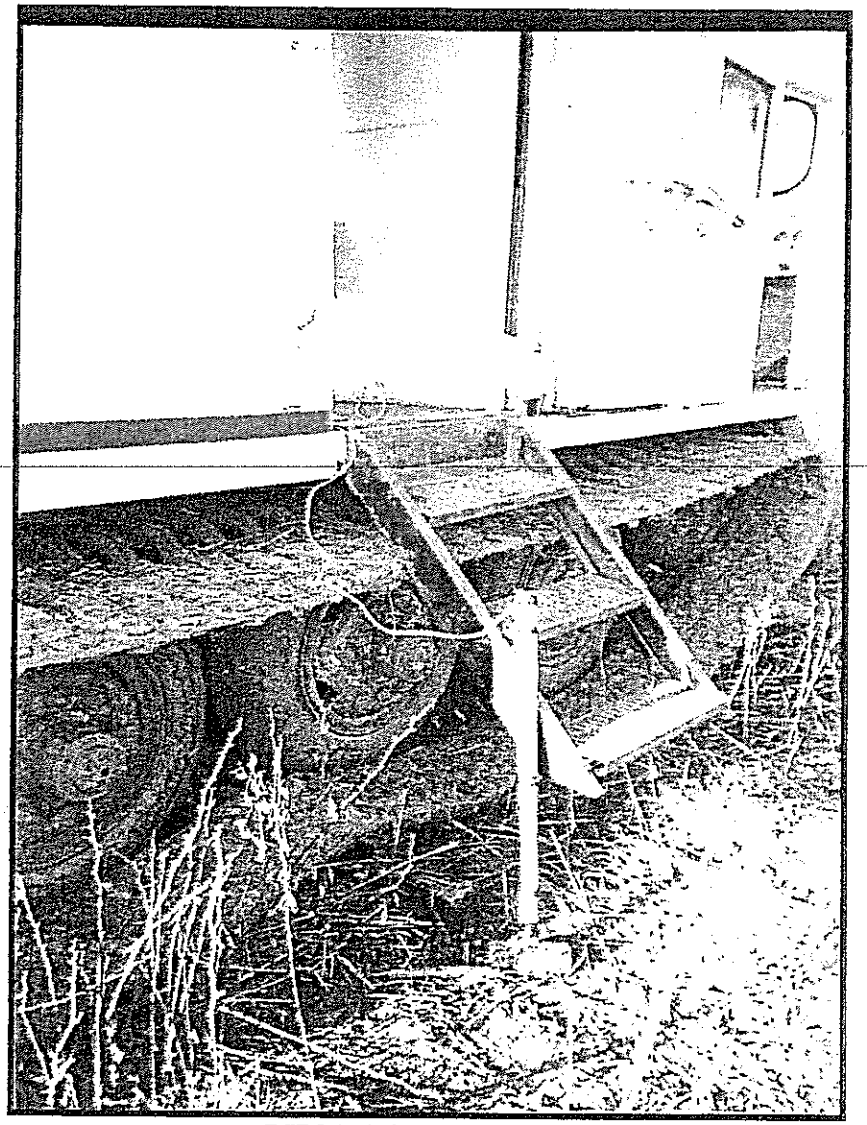


PHOTOGRAPH NO. 3
ConeTec CPT track rig at CPT-9 and proposed Central/North Cells
looking south. (October 2007)



PHOTOGRAPH NO. 4
ConeTec CPT track rig at CPT-7 and proposed Central Cell
looking northeast. (October 2007)

PHOTOGRAPHS



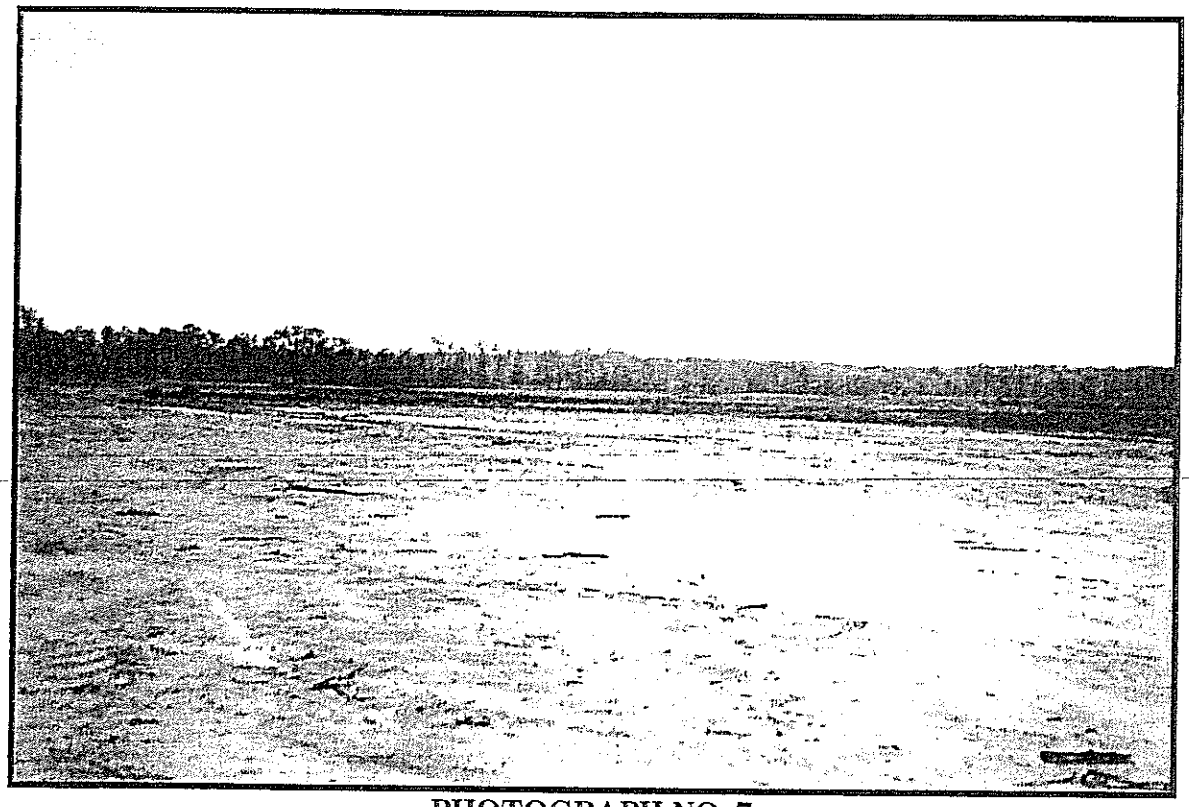
PHOTOGRAPH NO. 5
View of ConeTec seismic source beam beneath track and hammer with grounding cable. (October 2007)

PHOTOGRAPHS

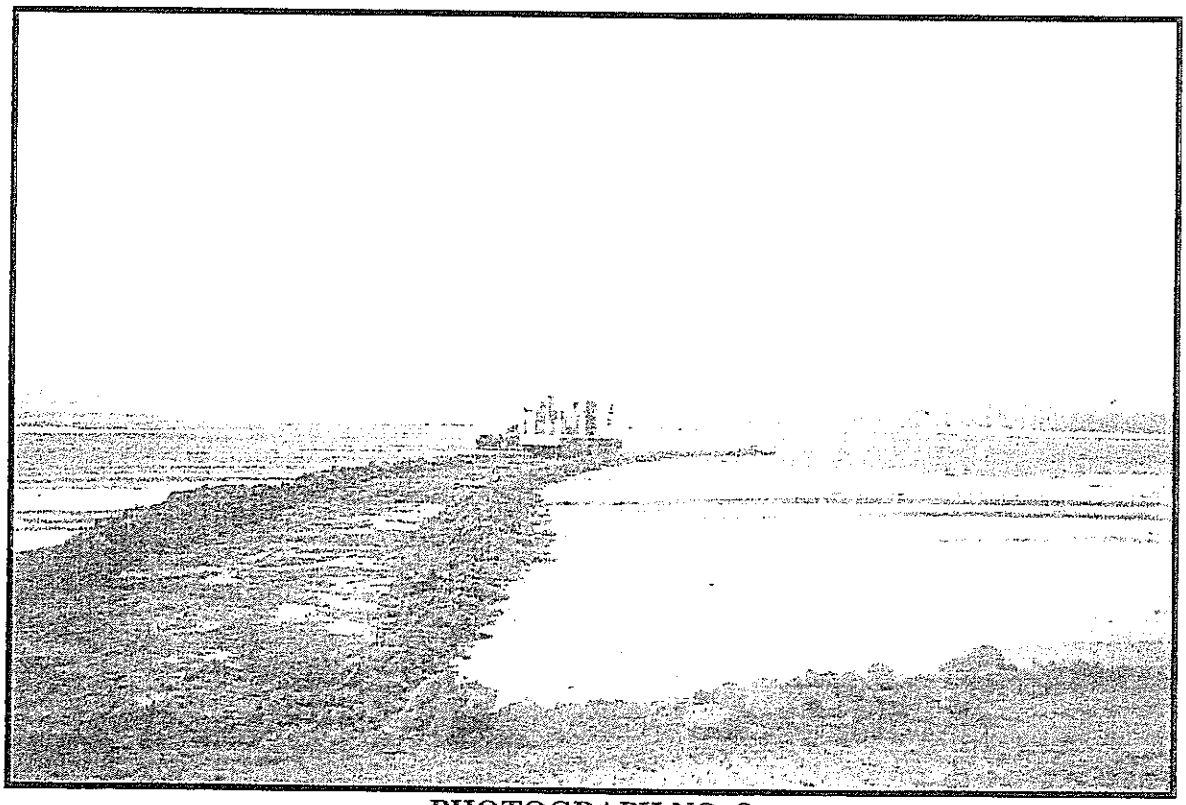


PHOTOGRAPH NO. 6
View of ConeTec CPT ram, rods and instrumentation cable from inside track rig.
(October 2007)

PHOTOGRAPHS



PHOTOGRAPH NO. 7
View of ConeTec track rig (in far left background) at CPT-8 looking northwest toward proposed North Cell. (October 2007)



PHOTOGRAPH NO. 8
View of ConeTec track rig at CPT-11 and proposed North Cell looking south. (October 2007)

7225-11
pert 13

ATTACHMENT 1
Reference No. 1

Civil & Environmental Consultants, Inc., Calculation Brief Entitled "Characterization of Sand-Like and Clay-Like Subsurface Materials," Pond Creek Coal Refuse Disposal Site – South Cell, BEG, dated 7/11/08.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

PAGE 1 OF 12

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CALCULATION BRIEF
FOR
CHARACTERIZATION OF SAND-LIKE AND CLAY-LIKE SUBSURFACE MATERIALS

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH CELL

OBJECTIVE: To characterize subsurface materials including coarse coal refuse, fine coal refuse and residual soils encountered at the Pond Creek South Cell refuse disposal facility. Materials are characterized as either sand-like or clay-like in accordance with various pertinent references shown below and included within the "Draft" Mine Health and Safety Administration (MSHA) Engineering and Design Manual, specifically Chapter 7: Seismic Design: Stability and Deformation Analyses, March 2007.

REFERENCES:

1. Illinois Department of Natural Resources, Office of Water Resources, Construction and Maintenance of Dams, Part 3702, Chapter IX.

2. Mine Safety and Health Administration, "Draft - Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 – Seismic Design: Stability and Deformation Analyses," dated, March 13, 2007.

3. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Piezo-Cone Penetration Testing," Pond Creed Coal Refuse Disposal Site, BEG, dated 12/21/07.

4. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Normalized PS-CPT Data and Parameter Correlations," Pond Creek Coal Refuse Disposal Site, BEG, dated 12/28/07.

5. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Laboratory Testing," Pond Coal Refuse Disposal Site – South Pond, BEG, dated 7/8/08.

6. Boulanger, R.W. and Idriss, I.M. (2004). "Evaluating the Potential for Liquefaction or Cyclic Failure of Silts and Clays," Report No. UCD/CGM-04/01, Center for Geotechnical Modeling, Department of Civil and Environmental Engineering, University of California, Davis, California.

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8. Youd, T. L. et al. (2001). "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 127, No. 10, pp. 817-833.

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GENERAL:

Reference (Ref.) Number (No.) 1 presents the following guidelines regarding the methods of testing, analyses and computations which must be completed and submitted with an application to support an owner's request for abandonment of a disposal impoundment dam:

1. The classification of the existing condition of the impounded material with respect to its fluid nature;
2. The liquefaction potential of the impounded material and the related stability of the containing dam;
3. The final surface configuration for the impounded materials, especially from any surface water impounding characteristics and the erosion potential of the surface material; and
4. The establishment of a follow-up inspection schedule to ensure the proposed plans have been effective and the submittal of record drawings.

This, and subsequent calculation briefs prepared by Civil & Environmental Consultants, Inc. (CEC), address the characterization of the impounded fine coal refuse and the liquefaction potential of the fine coal refuse and related stability (i.e., Requirements 1 and 2 above). Alliance Consulting, Inc. (Alliance) will provide the final surface configuration and the follow-up inspection schedule.

From Ref. No. 2, the basic elements for seismic design and analysis are:

1. Characterize the subsurface materials;
2. Evaluate if design earthquake will trigger strength loss;
3. Evaluate seismic stability using post-earthquake strength parameters; and
4. Evaluate deformations.

Therefore, the first step for both abandonment and seismic design and analysis is to characterize the subsurface conditions to evaluate the fluid nature and whether any zones have the potential for strength loss due to earthquake shaking (i.e., liquefaction potential). Previously, the materials making up the coarse refuse dike and underlying residual soils were evaluated using piezo-seismic cone penetration testing (PSCPT) (Ref. Nos. 3 and 4) as part of the deformation analyses of the South Pond. Subsequently, and as part of the abandonment evaluation, laboratory testing (Ref. No. 5) and characterization of the fine coal refuse retained behind the embankment was performed as described below.

For many aspects of seismic stability analyses described in Ref. No. 2, coal refuse and natural soils are referred to as sand-like or clay-like depending on whether they exhibit monotonic and cyclic undrained shear loading behavior that is fundamentally more similar to that of either sand or clay. This differentiation is significant primarily if the material is loose enough (sands) or soft enough (clays) that it is potentially susceptible to strength loss.

SUMMARY OF POND CREEK FIELD AND LABORATORY TESTING/RESULTS:

CEC developed, implemented and oversaw a detailed and thorough field testing program consisting of performing PS-CPT at several sounding locations throughout the Pond Creek site, including the ongoing South Pond impoundment. PS-CPT was executed at Pond Creek by ConeTec, Inc. (ConeTec) of West Berlin, New Jersey. Also, Alliance provided bulk (bucket) samples of fine coal refuse, which were obtained for subsequent laboratory testing. Geotechnics, Inc. (Geotechnics) of Pittsburgh, Pennsylvania performed consolidated undrained triaxial shear strength laboratory testing of the fine coal refuse materials. Ref. Nos. 3 -5 present summaries of the field and laboratory testing programs and Appendixes A - C of the Pond Creek abandonment report present the results of the field and laboratory testing.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 4 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

PIEZO-SEISMIC CONE PENETRATION TEST RESULTS SUMMARY:

Generalized South Cell CPT Profiles from the October 2007 field testing presented in Ref. Nos. 3 and 4 indicated the following:

CPT-1	CPT-2
El. 482.19 – Surface Elevation	El. 494.21 – Surface Elevation
15.3 feet – Depth to Static Ground Water	38.8 feet – Depth to Static Ground Water
0 – 18.4 feet – Residual Soil	0 – 32 feet – Coarse Refuse
Refusal at 18.4 feet - Bedrock	32 – 45.3 feet – Residual Soil
	Refusal at 45.3 feet - Bedrock

CPT-2A	CPT-3
El. 492.40 – Surface Elevation	El. 466.98 – Surface Elevation
37.0 feet – Depth to Static Ground Water	11.1 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 22.2 feet – Residual Soil
29 – 41.7 feet – Residual Soil	Refusal at 22.2 feet – Bedrock
Refusal at 41.7 feet - Bedrock	

CPT-4	CPT-5
El. 482.55 – Surface Elevation	El. 482.55 – Surface Elevation
21.7 feet – Depth to Static Ground Water	34.4 feet – Depth to Static Ground Water
0 – 18.9 feet – Residual Soil	0 – 29 feet – Coarse Refuse
Refusal at 18.9 feet – Bedrock	29 – 49.2feet – Residual Soil
	Refusal at 49.2 feet - Bedrock

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

PAGE 5 OF 12

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-5A	CPT-5B
El. 483.00 – Surface Elevation	El. 479.90 – Surface Elevation
35.9 feet – Depth to Static Ground Water	28.0 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 19 feet – Coarse Refuse
29 – 53.2 feet – Residual Soil	19 – 39.7 feet – Residual Soil
Refusal at 53.2 feet - Bedrock	Refusal at 39.7 feet - Bedrock

Cone penetration testing results for CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A AND CPT-5B presented in Ref. Nos. 3 and 4 indicated the following:

CPT-1	CPT-3
Residual Soil (Layer Thickness = 18.4)	**Residual Soil (Layer Thickness = 22.2)**
Avg. Tip Stress, Qc avg. = 79 tsf	Avg. Tip Stress, Qc avg. = 43 tsf
Avg. Fines Content, FC avg. = 27%	Avg. Fines Content, FC avg. = 32%
Avg. SBT Index, Ic = 2.38	Avg. SBT Index, Ic = 2.49

CPT-4
Residual Soil (Layer Thickness = 18.9)
Avg. Tip Stress, Qc avg. = 64 tsf
Avg. Fines Content, FC avg. = 28%
Avg. SBT Index, Ic = 2.41

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

PAGE 6 OF 12

MADE BY BEG DATE 7/11/08 CHECKED BY MRS DATE 7/23/08

CPT-2	CPT-2A
Coarse Coal Refuse (Layer Thickness = 32')	**Coarse Coal Refuse (Layer Thickness = 29')**
Avg. Tip Stress, Qc avg. = 54 tsf	Avg. Tip Stress, Qc avg. = 45 tsf
Avg. Fines Content, FC avg. = 24%	Avg. Fines Content, FC avg. = 22%
Avg. SBT Index, Ic = 2.30	Avg. SBT Index, Ic = 2.23

Residual Soil (Layer Thickness = 13.3')	**Residual Soil (Layer Thickness = 12.7')**
Avg. Tip Stress, Qc avg. = 47 tsf	Avg. Tip Stress, Qc avg. = 86 tsf
Avg. Fines Content, FC avg. = 60%	Avg. Fines Content, FC avg. = 48%
Avg. SBT Index, Ic = 2.99	Avg. SBT Index, Ic = 2.80

CPT-5	CPT-5A
Coarse Coal Refuse (Layer Thickness = 29')	**Coarse Coal Refuse (Layer Thickness = 29')**
Avg. Tip Stress, Qc avg. = 50 tsf	Avg. Tip Stress, Qc avg. = 37 tsf
Avg. Fines Content, FC avg. = 23%	Avg. Fines Content, FC avg. = 24%
Avg. SBT Index, Ic = 2.24	Avg. SBT Index, Ic = 2.29

Residual Soil (Layer Thickness = 20.2')	**Residual Soil (Layer Thickness = 24.2')**
Avg. Tip Stress, Qc avg. = 66 tsf	Avg. Tip Stress, Qc avg. = 49 tsf
Avg. Fines Content, FC avg. = 64%	Avg. Fines Content, FC avg. = 56%
Avg. SBT Index, Ic = 3.04	Avg. SBT Index, Ic = 2.94

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 7 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-5B
Coarse Coal Refuse (Layer Thickness = 19')
Avg. Tip Stress, Qc avg. = 41 tsf
Avg. Fines Content, FC avg. = 19%
Avg. SBT Index, Ic = 2.15

Residual Soil (Layer Thickness = 20.7')
Avg. Tip Stress, Qc avg. = 63 tsf
Avg. Fines Content, FC avg. = 51%
Avg. SBT Index, Ic = 2.84

Cone Penetration Testing Results – Shear Wave Velocities

CPT No.	Shear Wave Velocity Coarse Coal Refuse (ft/sec)			Shear Wave Velocity Residual Soil (ft/sec)		
	Max.	Min.	Avg.	Max.	Min.	Avg.
CPT-1	NA			1402	645	905
CPT-2	1284	1029	1120	1173	795	957
CPT-2A	1169	895	1042	1256	780	918
CPT-3	NA			1058	569	765
CPT-4	NA			1242	476	817
CPT-5	1190	936	1063	1599	780	947
CPT-5A	1396	779	1064	1580	728	1005
CPT-5B	1517	818	1080	1649	686	978

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 8 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

LABORATORY TESTING RESULTS SUMMARY:

Ref. No. 4 and Appendix A present the details and results of the June 2008 laboratory testing program performed by Geotechnics. The following summarizes laboratory testing results of each of 2 buckets of fine coal refuse sampled from the South Pond impoundment.

Bucket 1	Bucket 2
Fine Coal Refuse	Fine Coal Refuse
Moisture = 85.8 %	Moisture = 94.4 %
Passing No. 200 = 92.8 %	Passing No. 200 = 92.6 %
Passing No. 40 = 99.4 %	Passing No. 40 = 99.3%
Plasticity Index = 17 %	Plasticity Index = 17 %
Avg. Strain to Peak = 15.1 %	Avg. Strain to Peak = 11.0 %

Normalized tip stress and fines content with depth for CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B including a summary of pertinent average field and laboratory test results for each material layer are attached.

CRITERIA AND METHODOLOGY:

From Ref. No. 2, the first step common to all approaches is to review the subsurface conditions at the embankment to evaluate whether any zones have the potential for strength loss. For this initial screening step, saturated to nearly saturated sand-like materials with $N_{1,60}$ values less than 15 blows per foot (bpf), or q_{c1} (or Qc) values less than 75 tons per square foot (tsf), should be considered potentially susceptible to strength loss. Ref. No. 2 noted these values are likely too conservative and apply only to clean sands. Their application to silty sands and sands with high fines content, which are more representative of fine coal refuse, will likely be overly conservative.

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 9 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MCS DATE 7/23/08

Generalized field-related CPT-derived criteria noted in various references within Reference 2 include:

Sand-like:	Fines content < 50% or PI < 12%
Loose:	SPT $N_{1,60}$ < 15 or CPT q_{c1} > 75 tsf, & SBT Ic < 2.6 or F_r < 2%).
Clay-like:	Fines content > 50% and PI >12%
Soft:	OCR < 5, S_u/σ'_v < 1.0, CPT Q_t < 20 tsf & SBT Ic > 2.6, SPT $N_{1,60}$ < 8

CPT data may be used in conjunction with Atterberg limit data (criteria shown below) to differentiate sand-like from clay-like material. CPT Soil Behavior Type Index (I_c), as described in Robertson and Wride 1998 and reproduced in Youd et al. 2001, values below 2.6 should be considered sand-like. I_c values above 2.6 may be considered clay-like.

Generalized laboratory results criteria noted in various references within and in Ref. No. 1 include the following Atterberg Limit and sieve criteria:

Atterberg Limits.

- Material should be considered sand-like if any of the following three (3) criteria apply:

  1. The material has less than 35% particles by dry weight passing the No. 40 sieve and less than 20% by dry weight passing the No. 200 sieve; or

  2. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 12%; or

  3. The material has 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 20%.

The material may be considered clay-like if any of the following two (2) criteria apply:

1. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 12% or higher; or

2. The material has 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 20% or higher.

Atterberg limit criteria include as sand-like some materials that are considered clay-like by some investigators (e.g. Boulanger and Idriss, 2004, who suggested a break between sand-like and clay-like behavior at a PI of 7%). The intent is to classify borderline materials as sand-like to be conservative.

Another key factor in differentiating loose sand-like material from soft or medium clay-like material, for the purposes of seismic stability and deformation analyses, are the strain at peak undrained strength and the abruptness of the drop-off in shearing resistance as strains increase beyond the strain at peak. Loose sands and highly sensitive clays can reach S_{up} at small strains, and experience abrupt drop-off in resistance at higher strains. Most clays tend to reach S_{up} at higher strains, and tend to experience more gradual and limited drop-off in shearing resistance at higher strains. Fine coal refuse deposits often include materials falling within both classifications, and near the boundary of these two types of behavior.

Loose materials with shear strain at peak strength of less than 2% in an undrained monotonic (non-cyclic) test, and a rapid drop-off in resistance after reaching peak strength, are considered sand-like. Loose or soft materials with shear strain at peak strength of more than about 5%, and a gradual drop-off in resistance after reaching peak strength are considered clay-like. Materials with strain behavior between these descriptions are considered borderline and, to be conservative, should generally be analyzed as sand-like. (Note that shear strain in an undrained triaxial test is 1.5 times axial strain.)

Soil, rock, and mixtures of soil and rock that are not coal refuse such as the underlying starter embankment will be referred to as natural soils. Natural soils may be described as sand-like, or clay-like, using the same general criteria as refuse.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 11 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A AND CPT-5B AVG. WEIGHTED AVERAGE FIELD AND LAB RESULTS SUMMARY
Coarse Coal Refuse (138')
Avg. Tip Stress, Qc avg. = 46 tsf
Avg. Fines Content, FC avg. = 23%
Avg. SBT Index, Ic = 2.25

Fine Coal Refuse
Avg. % Passing No. 200 = 92.7%
Avg. % Passing No. 40 = 99.4 %
Avg. Plasticity Index = 17%
Avg. Strain to Peak = 13.1 %

Residual Soil (150.6')
Avg. Tip Stress, Qc avg. = 61 tsf
Avg. Fines Content, FC avg. = 46%
Avg. SBT Index, Ic = 2.73

Plots of individual and average normalized tip stress with depth are included with an attached complete copy of Ref. No. 4.

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 12 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CONCLUSION

Based on the information presented in this calculation brief, the following material characteristic designations were determined for the coarse coal refuse, fine coal refuse and residual soil:

Coarse Coal Refuse: Medium Dense Sand-Like;

Fine Coal Refuse: Medium Stiff Clay-Like;

Residual Soil: Medium Dense Sand-Like and Medium Stiff Clay-Like.

Further, the results of the laboratory testing indicate that the fine coal refuse is clay-like based on an average 93% passing the No. 200 sieve and plasticity index of 17%. Peak and steady-state undrained strengths presented in Appendix A were reached at generally high strains (between 8 and 18%), and there was very little drop off from peak to steady-state with increasing strain. The results generally indicated a higher resistance to strength loss (and flow) due to the large strains required to exceed the peak strength and correspondingly small decrease to the steady-state strength at higher strains. Further, previous deformation analyses results indicated induced shear strains from the PGA at less than 0.1%, which is well below a threshold (peak) triggering strain of the material.

The susceptibility of the embankment and impoundment to a liquefaction flow failure is a function of both the undrained strength (worst case steady-state strength) and the in-situ driving shear stress on a critical failure plane passing through the critical layer fine coal refuse material, which is further addressed in subsequent calculation briefs.

ATTACHMENT 2

Reference Nos. 3 and 4 of Reference No. 1

APPENDIX A-1

SUMMARY OF PIEZO-SEISMIC CONE PENETRATION TESTING

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 1 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY ZJS DATE 1/25/08

CALCULATION BRIEF
FOR
SUMMARY OF PIEZO-SEISMIC CONE PENETRATION TESTING

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE:

Summarize the piezo-seismic cone penetration testing (PS-CPT) activities performed by ConeTec, Inc. (ConeTec), West Berlin, in October 2007 as part of the subsurface exploration at the Williamson Energy Pond Creek facility, Williamson County, Illinois.

REFERENCES:

1. ConeTec, Inc. (2007), Field Report Entitled "Presentation of CPTU Test Results for: Pond Creek Mine – Williamson County, Illinois, December 10, 2007.

2. Robertson, P.K., et.al. (1992) "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE 109 (11): 1449-1459.

3. Robertson, P.K and Campanella, R.G, (1989), "Guidelines for Geotechnical Design Using CPT and CPTU", UBC Soil Mechanics Series No. 120, Civil Eng. Dept., Vancouver, B.C., Canada

4. Robertson, P.K and Campanella, R.G, (1983), "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE Vol. 109 No. 11, pp. 1449-1459.

METHODOLOGY:

As part of the subsurface exploration, a total of 15 PS-CPT soundings were performed at the Pond Creek site on October 30 and 31, 2007, at approximate locations shown in Figure 2 of the Pond Creek Deformation Evaluation report. PS-CPT exploration was performed under the full-time observation and guidance of CEC personnel. PS-CPT locations designated as CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A, CPT-5B, CPT-6, CPT-7, CPT-8, CPT-9, CPT-10, CPT-11 and CPT-12 were located by CEC within areas that included existing coarse coal refuse and the proposed South Cell, North Central Cell and North Cell impoundments. CPT-2, CPT-

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 2 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

2A, CPT-5, CPT-5A and CPT-5B soundings were located on the existing coarse coal refuse embankment crest, and were pushed through coarse refuse and the underlying subgrade residual soil. CPT-1, CPT-3, CPT-4, CPT-6, CPT-7, CPT-8, CPT-9, CPT-10, CPT-11 and CPT-12 were located throughout the facility at approximate existing ground surface and pushed exclusively through residual soil. The following presents the CPT sounding, site coordinates, existing ground surface elevation, total depth, interpolated ground water depth and applicable slurry cell.

CPT No.	Northing (ft)	Easting (ft)	Ground Surface Elev.(ft)	Total Depth (ft)	GWT Interpolated (ft)	Applicable Slurry Cell
CPT-1	425784.316	358548.865	482.19	18.4	15.3	South
CPT-2	426832.420	357857.498	494.21	45.3	38.8	South, Central, North
CPT-2A	426828.920	358156.731	492.40	41.7	37.0	South, Central, North
CPT-3	426792.780	359207.797	466.98	22.2	11.1	South
CPT-4	426331.101	360108.800	482.55	18.9	21.7	South
CPT-5	427485.256	357913.863	482.55	49.2	34.4	South, Central, North
CPT-5A	427607.598	357920.844	483.00	53.2	35.9	South, Central, North
CPT-5B	427147.684	358343.061	479.90	39.7	28.0	South, Central, North
CPT-6	427450.461	358992.616	457.78	22.6	9.2	Central
CPT-7	427450.884	359850.004	457.83	16.7	9.2	Central
CPT-8	429006.116	358034.037	444.45	17.9	6.6	Central, North
CPT-9	429077.690	359026.204	445.68	22.0	7.8	Central, North
CPT-10	428965.827	359998.444	442.09	26.1	3.4	Central, North
CPT-11	430316.815	358810.964	440.59	27.6	11.4	North
CPT-12	430141.831	359852.299	442.08	22.6	11.7	North

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 3 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY TJK DATE 1/23/08

Note: CPT coordinates and ground surface elevations were provided by Williamson Energy.

Determining the dynamic response of the Pond Creek facility and that of the coarse coal refuse and subgrade residual soils requires knowledge of the subsurface material's dynamic properties to accurately predict the horizontal shear stresses and strains induced in the material by a given earthquake loading. Of particular significance in the dynamic evaluation is the distribution of density of the coal refuse materials with depth. The low-amplitude, small strain shear modulus (G) with depth is an important parameter for characterizing the behavior and response of a soil column during earthquake shaking. It is a function of the in-situ shear wave velocity estimated at the site with depth and was obtained in the field utilizing PS-CPT.

The main purpose of the PS-CPT was to measure in-situ shear wave (S-wave) travel times for subsequent calculation of shear wave velocity (V_S) and G. Concurrently, CPT was also performed which provides nearly continuous, index-type information which can be correlated to classification and in-situ strength values based on established procedures such as those outlined in Robertson and Campanella (1988). Further, cone data is typically utilized to evaluate liquefaction potential based on Robertson and Campanella (1985) similar to the procedures described in Seed and Idriss (1983) and to compare with the results using steady-state principles; however, only permanent deformations are evaluated in response to regulatory comments.

The seismic wave form portion of the PS-CPT was conducted by ConeTec at about 3-foot intervals throughout the soil profile to the maximum depths indicated. The down-hole seismic survey is a reliable technique for obtaining shear wave and compression wave velocities accounting for the subsurface material's attenuation and anisotropic effect with depth (Hoar and Stokoe, 1978) (Dobry et al., 1981) (Stokoe and Nazarian, 1985). Only S-wave travel times were measured for each sounding with depth which was used to calculate the corresponding V_S and G used in the dynamic analyses of the Pond Creek facility.

RESULTS:

A total of 15 PS-CPT soundings were performed at the Pond Creek site in October 2007, at approximate locations shown in Figure 2. ConeTec measured tip stress, sleeve stress and pore water pressure, and shear wave velocities at the locations CPT-1 through CPT-12 from the existing ground surface through coarse coal refuse, where available and through residual soil materials.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 4 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

Shear wave velocities per material type were measured and the minimum, maximum and weighted averages are summarized as follows:

CPT No.	Shear Wave Velocity Max./Min./Avg. Coarse Coal Refuse (ft/sec)	Shear Wave Velocity Max./Min./Avg. Residual Soil (ft/sec)
CPT-1	NA	1402 645 905
CPT-2	1284 1029 1120	1173 795 957
CPT-2A	1169 895 1042	1256 780 918
CPT-3	NA	1058 569 765
CPT-4	NA	1242 476 817
CPT-5	1190 936 1063	1599 780 947
CPT-5A	1396 779 1064	1580 728 1005
CPT-5B	1517 818 1080	1649 686 978
CPT-6	NA	1022 514 796
CPT-7	NA	894 514 682
CPT-8	NA	1036 541 783
CPT-9	NA	1484 415 835
CPT-10	NA	1217 478 828
CPT-11	NA	1387 471 925
CPT-12	NA	1230 530 763

In general, shear wave velocities in coarse refuse ranged from about 779 to 1517 fps with an average value of about 1074 fps. For subgrade residual soils, Vs ranged from 415 to 1599 fps with an approximate average value of 860 fps. Measured values of V_S for coarse refuse and residual soil materials and the density of the respective material with depth are used to estimate the initial shear modulus, G, for use in the one dimensional, dynamic SHAKE (Schnabel, et al., 1972) analysis of the embankment. G-values estimated from the four soundings are used in the calculation of induced cyclic shear stress at the SHAKE soil column locations (e.g. PCSC300) shown in Figure 3. Appendix A, Attachment A-2 presents the complete ConeTec report and Appendix B, Attachment B-1 presents the computations of G for the various SHAKE columns

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation PROJECT NO. 072046

Summary of PS-CPT PAGE 5 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

from in-situ measurements of V_S for the coarse refuse, residual soil and bedrock materials including plots of V_S and G with depth for both SHAKE columns.

CONCLUSIONS:

Summarizing, the PS-CPT field testing was performed as part of the subsurface exploration at the Pond Creek facility. The information gathered from the testing will be used to correlate index and strength parameters, as well as shear modulus for use in subsequent permanent deformation analyses.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 6 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY RJ DATE 1/23/08

SHEAR WAVE VELOCITY DATA REDUCTION MINIMUM, MAXIMUM AND AVERAGE VELOCITY PER MATERIAL

7 of 17 R13323

Williamson Energy - Pond Creek - South Cell
Shear Wave Velocity versus Depth

CEC Project No. 072-046

'T-1

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
4.26	645	
7.54	656	
10.82	808	CLAY
14.1	1013	
16.73	1402	

CPT-1

	Max	Min	avg
Clay	1402	645	905

CPT-2

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	1204	
10.82	1284	
14.1	1152	
17.39	1085	CCR
20.67	1029	
23.95	1039	
27.23	1050	
30.51	1114	
33.79	950	
37.07	795	CLAY
40.35	908	
43.31	1173	

CPT-2

	Max	Min	avg
CCR	1284	1029	1120
CLAY	1173	795	957

CPT-2A

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	977	
10.82	973	
14.1	1121	
17.39	1051	CCR
20.67	1105	
23.95	1169	
27.23	895	
30.51	780	
33.79	845	CLAY
37.07	790	
39.86	1256	

CPT-2A

	Max	Min	avg
CCR	1169	895	1042
CLAY	1256	780	918

CPT-3

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.21	577	
10.50	569	CLAY
13.78	738	
17.06	883	
20.10	1058	

CPT-3

	Max	Min	avg
CLAY	1058	569	765

8 7 14 R13324

CPT-4

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
3.93	476	CLAY
7.21	673	
10.50	781	
13.78	913	
16.81	1242	

	CPT-4 Max	CPT-4 Min	CPT-4 avg
CLAY	1242	476	817

Williamson Energy - Pond Creek - North Central Cell
Shear Wave Velocity versus Depth CEC Project No. 072-046

PT-5

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	1030	
10.82	1076	
14.10	991	
17.39	936	CCR
20.67	1148	
23.95	1190	
27.23	1067	
30.51	780	
33.79	780	
37.07	821	CLAY
40.35	780	
43.63	923	
46.91	1599	

CPT-5

	Max	Min	avg
CCR	1190	936	1063
CLAY	1599	780	947

CPT-5A

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.21	844	
10.50	779	
13.78	1164	
17.06	1396	CCR
20.34	994	
23.63	1077	
26.90	1195	
30.18	1021	
33.46	784	
36.74	784	
40.02	728	CLAY
43.30	768	
46.67	961	
49.95	1411	
52.00	1580	

CPT-5A

	Max	Min	avg
CCR	1396	779	1064
CLAY	1580	728	1005

CPT-5B

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	818	
10.82	900	
14.10	1517	CCR
17.39	1085	
20.67	856	
23.95	732	
27.23	686	CLAY
30.59	762	
33.79	1014	
37.07	1150	
38.88	1649	

CPT-5B

	Max	Min	avg
CCR	1517	818	1080
CLAY	1649	686	978

CPT-6

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	514
7.54	769
10.82	706
14.10	945
17.39	819
20.51	1022

CLAY

	CPT-6 Max	CPT-6 Min	CPT-6 avg
CLAY	1022	514	796

CPT-7

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	514
7.54	575
10.82	745
14.10	894

CLAY

	CPT-7 Max	CPT-7 Min	CPT-7 avg
CLAY	894	514	682

CPT-8

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	541
7.54	652
10.82	708
14.10	979
16.48	1036

	CPT-8 Max	CPT-8 Min	CPT-8 avg
CLAY	1036	541	783

CPT-9

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
3.93	415
7.21	904
10.50	757
13.78	647
17.06	805
20.01	1484

	CPT-9 Max	CPT-9 Min	CPT-9 avg
CLAY	1484	415	835

CPT-10

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	478
7.54	617
10.82	656
14.10	803
17.36	945
20.67	1080
23.87	1217

	CPT-10 Max	CPT-10 Min	CPT-10 avg
CLAY	1217	478	828

Williamson Energy - Pond Creek - North Cell
Shear Wave Velocity versus Depth CEC Project No. 072-046

CPT-8

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	541
7.54	652
10.82	708
14.10	979
16.48	1036

CLAY

		CPT-8		
		Max	Min	avg
CLAY	CLAY	1036	541	783

CPT-9

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
3.93	415
7.21	904
10.50	757
13.78	647
17.06	805
20.01	1484

CLAY

		CPT-9		
		Max	Min	avg
CLAY	CLAY	1484	415	835

CPT-10

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	478
7.54	617
10.82	656
14.10	803
17.36	945
20.67	1080
23.87	1217

CLAY

		CPT-10		
		Max	Min	avg
CLAY	CLAY	1217	478	828

CPT-11

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	471
7.54	628
10.82	719
14.10	817
17.36	926
20.67	1207
23.95	1387
26.25	1246

CLAY

		CPT-11		
		Max	Min	avg
CLAY	CLAY	1387	471	925

CPT-12

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.02	530
7.30	596
10.50	601
13.78	748
17.06	871
20.34	1230

CLAY

		CPT-12		
		Max	Min	avg
CLAY	CLAY	1230	530	763

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO 072046

Summary of PS-CPT

PAGE 13 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY ZM DATE 1/23/08

GROUNDWATER WELL DATA (PROVIDED BY WILLIAMSON)

072-046

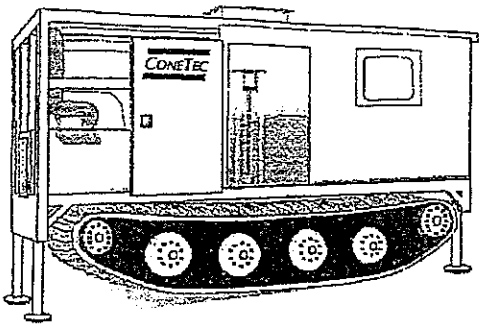
14 of R43329

Pond Creek #1 Ground Water Sampling
Permit #375 NPDES# IL007766

Date	Sample Pnt	Easting	Northing	Stand Pipe Elevation	Water Elev.	Zinc mg/L	Antimony mg/L	Beryllium mg/L	Cobalt mg/L	MANGANESE mg/L	Phenolics mg/L	Cyanide mg/L	Chlorides mg/L
12/29/05	GW-1	354,988	430,899	441.82	435.44	0.012	0.303	<.001	0.014	0.027	<.050	<0.010	20
12/29/05	GW-2	357,681	430,962	435.73	428.51	0.024	0.240	<.001	0.013	0.087	<.050	<0.010	42
12/29/05	GW-3	360,278	430,669	438.46	432.61	0.001	0.299	<.001	0.012	0.124	<.050	<0.010	26
12/29/05	GW 4	354,923	425,980	464.03	456.01	0.009	0.270	<.001	0.017	0.031	<.050	<0.010	17
12/29/05	GW-5	357,632	425,618	482.23	470.52	0.01	0.276	<.001	0.007	0.891	<.050	<0.010	40
12/29/05	GW-6	360,211	425,416	434.9	No Water	No				n/a			n/a
12/29/05	GW-7A	358,306	427,592	454.7	444.99	0.029	0.285	<.001	0.024	0.052	<.050	<0.010	33
2/24/06	GW-1	354,988	430,899	441.82	438.34	0.012	<0.002	<.001	<0.005	0.024	<.050	<0.010	<10
2/24/06	GW 2	357,681	430,962	435.73	431.31	0.016	<0.002	<.002	<0.002	0.027	<.050	<0.010	<10
2/24/06	GW-3	360,278	430,669	438.46	434.29	0.014	<0.002	<.001	<0.005	0.023	<.050	<0.010	<10
2/24/06	GW-4	354,923	425,980	464.03	459.45	0.01	<0.002	<.001	<0.005	0.03	<.050	<0.010	<10
2/24/06	GW-5	357,632	425,618	482.23	471.33	0.01	<0.002	<.001	<0.005	0.4	<.050	<0.010	<10
2/24/06	GW-6	360,211	425,416	434.9	No Water	No				n/a			n/a
2/24/06	GW-7A	358,306	427,592	454.7	447.05	0.018	<.002	<.001	<.005	0.045	<.050	<0.010	<10
6/28/06	GW-1	354,988	430,899	441.82	435.70	0.002	0.006	<.001	<.005	<.002	<.050	<0.010	33
6/28/06	GW-2	357,681	430,962	435.73	427.72	0.023	0.050	<.001	<.005	0.002	<.050	<0.010	44
6/28/06	GW-3	360,278	430,669	438.46	430.10	0.006	0.060	<.001	<.005	0.145	<.050	<0.010	75
6/28/06	GW-4	354,923	425,980	464.03	458.03	0.003	0.070	0.001	<.005	<.002	<.050	<0.010	122
6/28/06	GW-5	357,632	425,618	482.23	470.85	<.002	0.050	<.001	<.005	<.002	<.050	<0.010	160
6/28/06	GW-6	360,211	425,416	434.9	No Water	No							n/a
6/28/06	GW-7A	358,306	427,592	454.7	446.30	0.002	0.090	<.001	<.005	0.003	<.050	<0.010	75
7/31/06	GW-1	354,988	430,899	441.82	435.08	0.001	0.206	0.003	<.005	0.012	<.050	<0.010	37.5
7/31/06	GW-2	357,681	430,962	435.73	429.31	0.001	0.184	0.002	<.005	<.002	<.050	<0.010	50
7/31/06	GW-3	360,278	430,669	438.46	428.63	0.001	0.129	0.001	<.005	0.024	<.050	<0.010	88
7/31/06	GW-4	354,923	425,980	464.03	457.03	0.001	0.153	0.002	<.005	0.026	<.050	<0.010	139
7/31/06	GW-5	357,632	425,618	482.23	469.43	0.006	0.153	0.002	<.005	0.012	<.050	<0.010	150
7/31/06	GW-6	360,211	425,416	434.9	No Water	No							n/a
7/31/06	GW-7A	358,306	427,592	454.7	445.55	0.003	0.269	0.001	<.005	0.026	<.050	<0.010	85
8/31/06	GW-1	354,988	430,899	441.82	434.92	0.001	<.002	<.001	<.005	0.019	<.050	<0.010	20
8/31/06	GW-2	357,681	430,962	435.73	424.51	0.001	<.002	<.001	<.005	0.021	<.050	<0.010	22
8/31/06	GW-3	360,278	430,669	438.46	426.86	0.013	<.002	<.001	<.005	0.045	<.050	<0.010	44
8/31/06	GW-4	354,923	425,980	464.03	456.79	0.006	<.002	<.001	<.005	0.081	<.050	<0.010	42
8/31/06	GW-5	357,632	425,618	482.23	468.32	0.02	<.002	<.001	<.005	3.05	<.050	<0.010	105
8/31/06	GW-6	360,211	425,416	434.9	No Water	No							n/a
8/31/06	GW-7A	358,306	427,592	454.7	444.18	0.018	<.002	<.001	<.005	0.093	<.050	<0.010	8.7
10/2/06	GW-1	354,988	430,899	441.82	435.08	0.001	<.002	<.001	0.015	<.002	<.050	<0.010	14
10/2/06	GW-2	357,681	430,962	435.73	425.76	0.001	<.002	<.001	0.013	<.002	<.050	<0.010	38
10/2/06	GW-3	360,278	430,669	438.46	427.14	0.009	<.002	<.001	0.006	2.105	<.050	<0.010	28
10/2/06	GW-4	354,923	425,980	464.03	455.42	0.001	<.002	0.002	0.014	0.028	<.050	<0.010	84
10/2/06	GW-5	357,632	425,618	482.23	No Water	No							
10/2/06	GW-6	360,211	425,416	434.9	No Water	No							
10/2/06	GW-7A	358,306	427,592	454.7	443.95	0.001	<.002	<.001	0.005	0.181	<.050	<0.010	368
3/7/07	GW-1	354,988	430,899	441.82	438.62	0.001	<.002	<.001	<.005	0.005	<.050	<0.010	26
3/7/07	GW-2	357,681	430,962	435.73	431.41	0.001	<.002	<.001	<.005	0.003	<.050	<0.010	42
3/7/07	GW-3	360,278	430,669	438.46	434.29	0.001	<.002	0.001	<.005	0.028	<.050	<0.010	66
3/7/07	GW-4	354,923	425,980	464.03	458.05	0.001	<.002	<.001	<.005	0.005	<.050	<0.010	109
3/7/07	GW-5	357,632	425,618	482.23	473.86	0.001	<.002	<.001	0.013	0.007	<.050	<0.010	91
3/7/07	GW-6	360,211	425,416	434.9	No Water	No							
3/7/07	GW-7A	358,306	427,592	454.7	448.63	0.001	<.002	<.001	<.005	0.007	<.050	<0.010	86
5/21/07	GW-1	354,988	430,899	441.82	436.55	0.002	<.002	<.001	0.034	<.002	<.050	<0.010	42
5/21/07	GW-2	357,681	430,962	435.73	428.93	0.001	<.002	0.001	0.011	0.007	<.050	<0.010	46
5/21/07	GW-3	360,278	430,669	438.46	432.08	0.001	<.002	0.001	0.013	0.002	<.050	<0.010	62
5/21/07	GW-4	354,923	425,980	464.03	459.93	0.001	<.002	0.002	0.009	<.002	<.050	<0.010	100
5/21/07	GW-5	357,632	425,618	482.23	471.74	0.001	<.002	0.002	0.020	<.002	<.050	<0.010	132
5/21/07	GW-6	360,211	425,416	434.9	No Water	No							
5/21/07	GW-7A	358,306	427,592	454.7	448.05	0.001	<.002	<.001	0.017	0.002	<.050	<0.010	82
5/21/07	GW-8	359,568	426,786	467.85	462.23	0.001	<.002	<.001	0.020	0.544	<.050	<0.010	88
8/1/07	GW-1	354,988	430,899	441.82	433.29	0.003	<.002	0.001	<.005	0.007	<.050	<0.010	26
8/1/07	GW-2	357,681	430,962	435.73	424.74	0.009	0.105	0.001	<.005	0.196	<.050	<0.010	34
8/1/07	GW-3	360,278	430,669	438.46	426.09	0.01	0.370	0.001	<.005	0.524	<.050	<0.010	66
8/1/07	GW-4	354,923	425,980	464.03	458.16	0.002	0.141	0.001	<.005	0.003	<.050	<0.010	100
8/1/07	GW-5	357,632	425,618	482.23	469.06	0.005	0.080	0.002	<.005	0.198	<.050	<0.010	120
8/1/07	GW-6	360,211	425,416	434.9	No Water	No							
8/1/07	GW-7A	358,306	427,592	454.7	447.11	0.018	0.137	0.002	<.005	1.180	<.050	<0.010	108
8/1/07	GW-8	359,568	426,786	467.85	462.70	0.005	0.200	0.002	<.005	0.042	<.050	<0.010	112

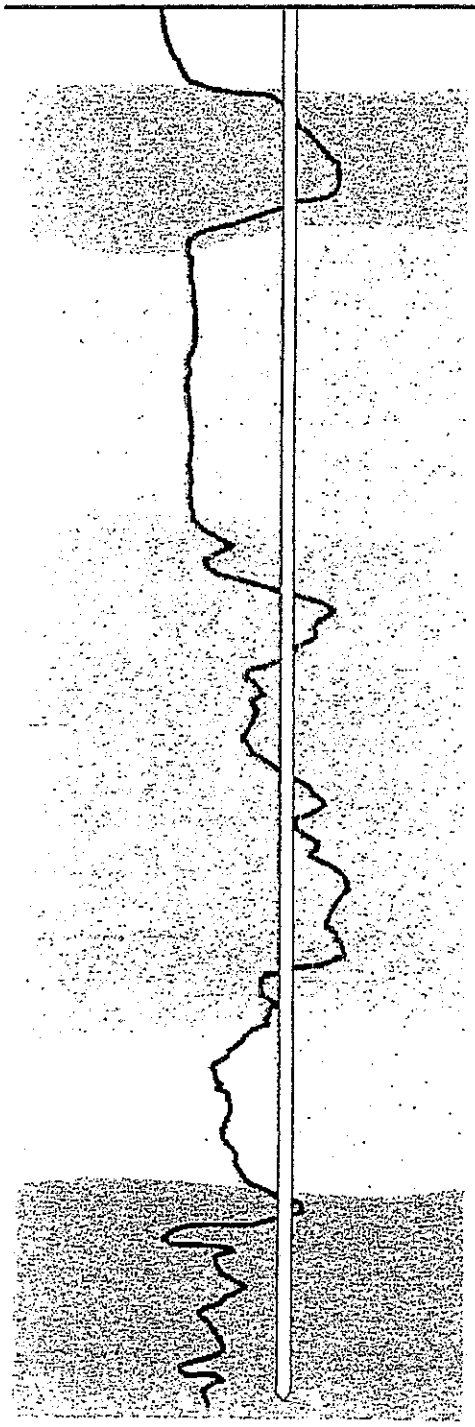
APPENDIX A-2

CONETEC, INC. FIELD REPORT



ConeTec

Geotechnical and Environmental In Situ Testing Contractors



ConeTec Field Report

Presentation of CPTU Test Results for:

Pond Creek Mine
Williamson County, Illinois

Presented to: C.E.C.

Date: December 10th, 2007

Presented by: ConeTec, Inc.
436 Commerce Lane, Unit C
West Berlin, NJ
(856) 767-8600

PRESENTATION OF IN SITU TESTING PROGRAM RESULTS

Pond Creek Mine
Williamson County, Illinois

October 30th, & 31st, 2007

Prepared for:

Civil & Environmental Consultants, Inc
Export, Pennsylvania

Prepared by:

ConeTec Inc.
West Berlin, NJ

December 10th, 2007

TABLE OF CONTENTS

1.0 INTRODUCTION **3**

2.0 FIELD EQUIPMENT AND PROCEDURES **4**

2.1 CONE PENETRATION TESTING 4
2.2 PORE PRESSURE DISSIPATION TESTS 6

3.0 CONE PENETRATION TEST DATA AND INTERPRETATION **8**

3.1 ANALYSIS OF PIEZOCONE DATA - GENERAL 8
3.2 CONE PLOTS 9
3.3 PORE PRESSURE DISSIPATION TEST RESULTS 9
3.4 SHEAR WAVE VELOCITY MEASUREMENTS 10
3.5 CPTSUMM DATA PROCESSING 10
3.6 DATA CD 10

5.0 REFERENCES **11**

TABLES

TABLE 1 Summary of CPT Soundings

FIGURES

FIGURE 1 Typical Cone Penetrometer
FIGURE 2 Schematic of Shear Wave Testing Configuration
FIGURE 3 Typical Dissipation Tests

APPENDICES

APPENDIX A CPT Plots (shear wave, non-normalized)
APPENDIX B CPT Data Interpretation Summery
APPENDIX C Shear Wave Velocity Data
APPENDIX D Dissipation Test Data
APPENDIX E Data CD

1.0 INTRODUCTION

This report presents the results of a piezo cone penetrometer testing (CPTU) program carried out at Pond Creek Mine located in Williamson County, Illinois. The work was performed under subcontract to Civil & Environmental Consultants, Inc. of Export, Pennsylvania. The CPTU program took place on October 30th, and 31st, 2007.

A total of fifteen soundings were completed at twelve different sounding locations. The CPT testing was performed to evaluate in situ geotechnical as well as seismic criteria relative to the proposed expansion.

While completing the CPT soundings, seismic shear wave velocity testing was conducted in all of the soundings. Seismic testing involved collecting shear wave velocity data at one-meter depth intervals.

CPT sounding locations were selected and numbered under the direction and supervision of C.E.C. Personnel.

2.0 FIELD EQUIPMENT AND PROCEDURES

2.1 CONE PENETRATION TESTING

The cone penetrometer tests were carried out using an integrated electronic piezo cone manufactured by ConeTec in Vancouver, Canada. The piezo cone used was a compression model cone penetrometer with a 15 cm^2 tip and a 225 cm^2 friction sleeve. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.80. The piezo cone dimensions and the operating procedure were in accordance with ASTM Standard D-5778-95. A diagram of the cone penetrometer used for this project is shown as Figure 1.

Pore pressure filter elements, made of porous plastic, were saturated under a vacuum using glycerin as the saturating fluid. The pore pressure element was six millimeters thick and was located immediately behind the tip (the u_2 location) for all soundings.

The cone was advanced using a 20 ton, unitized, track-mounted cone penetration rig. The following data were recorded onto magnetic media every five centimeters (approximately every two inches) as the cone was advanced into the ground:

- Tip Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (ut)

The field data recorded is included on the attached CD (appendix E).

Before each sounding a complete set of analog baseline readings are taken with a multi-meter and compared with the digitized value on the computer screen. This provides a check on the analog to digital conversion board.

Evaluation of the analog baselines is key to consistent readings. The baseline data should be stable and should not wander excessively during the course of a sounding. Baseline data can be used to apply corrections to the cone data where necessary. For this project, the baseline shift from sounding to sounding was small, typically less than 0.1% of full scale, and no data corrections were applied.

During seismic testing, the seismic signals were recorded using a geophone mounted in the cone as shown in Figure 1 and an up-hole digital oscilloscope. A sledge hammer hit against a beam was used for the seismic source. Normal reaction for the beam was provided by the dead weight of the rig placed upon the beam. A schematic of the shear wave testing configuration is shown in Figure 2.

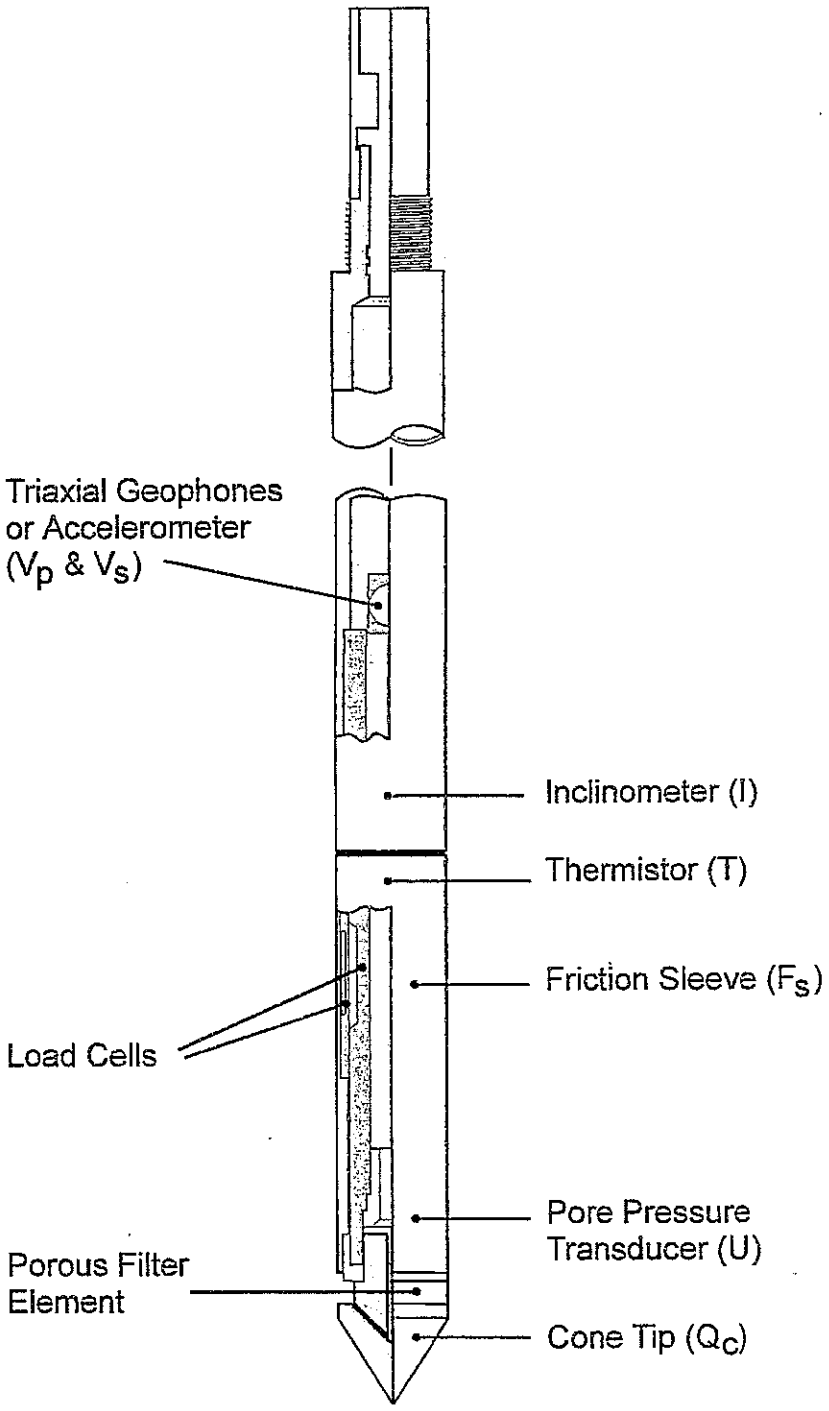


FIGURE 1 - TYPICAL CONE PENETROMETER

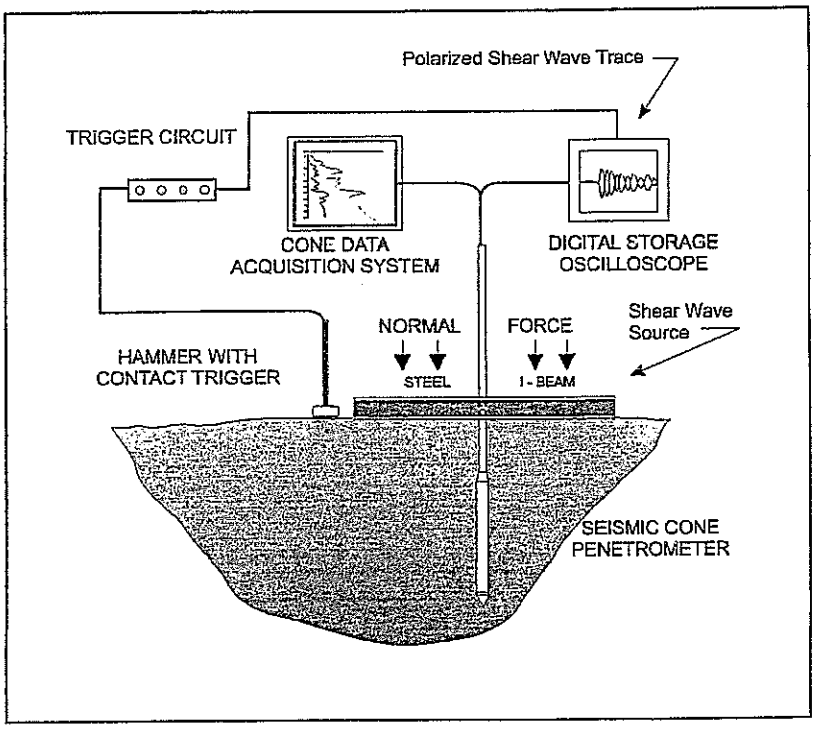


FIGURE 2 - SCHEMATIC OF SHEAR WAVE TESTING CONFIGURATION

2.2 PORE PRESSURE DISSIPATION TESTS

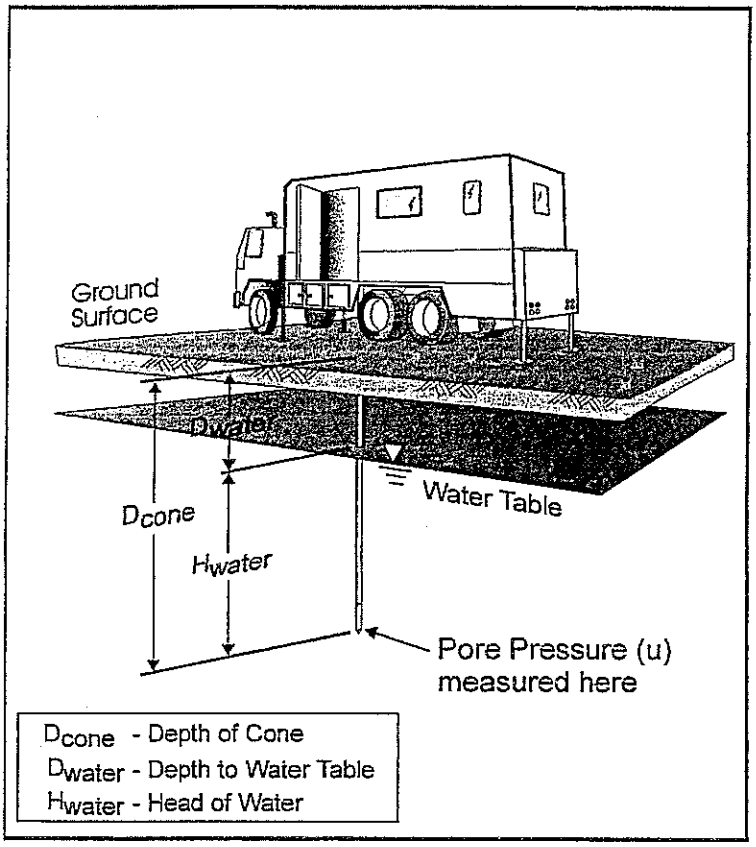
When cone penetration is stopped, the piezo cone essentially becomes a piezometer. While stopped, pore water pressures are automatically recorded at five-second intervals and the readings are stored in a dissipation file (.ppd). Dissipation data can then be plotted onto a dissipation curve consisting of pore water pressure (u) verses time (t). The shapes of dissipation curves are very useful in evaluating soil type, drainage and in situ static water level.

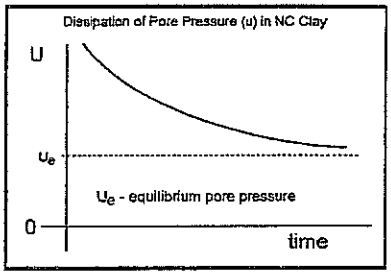
A flat curve that stabilizes quickly (i.e. less than 30 seconds) is typical of a free draining sand. In this case, the final measured pore water pressure is the static in situ water pressure.

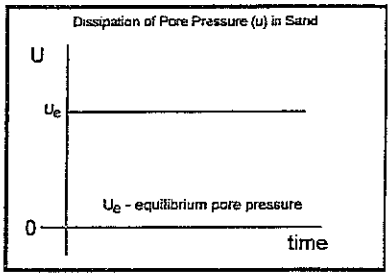
Soils that generate excess dynamic pore water pressure during penetration will dissipate this excess pressure when penetration stops. The shape of the dissipation curve and the time of dissipation can be used to estimate C_h, the coefficient of consolidation that can in turn be used to calculate K_h, the horizontal permeability.

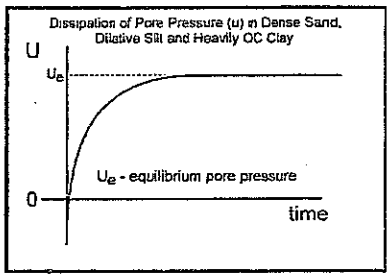
Figure 3 shows some idealized shapes of various pore water pressure dissipation curves. The reader is referred Robertson et. al., 1992 to reference dissipation test data analytical techniques.

Estimation of Ground Water Table from CPT Dissipation Tests









Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

Useful Conversion Factors:
1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

FIGURE 3 - TYPICAL DISSIPATION TESTS

3.0 CONE PENETRATION TEST DATA AND INTERPRETATION

3.1 ANALYSIS OF PIEZOCONE DATA - GENERAL

A total of fifteen CPT sounding involving 443.90 feet of testing, were completed.

The interpretation of cone data is based on the relationship between cone bearing, qc, sleeve friction, fs, and penetration pore water pressure, u. The friction ratio, Rf , (sleeve friction divided by cone bearing) is a calculated parameter which is used to infer soil behavior type. Generally, saturated cohesive soils have low tip resistance, high friction ratios and generate large excess pore water pressures. Cohesionless soils have higher tip resistances, lower friction ratios and do not generate significant excess pore water pressure.

The interpretation of soils encountered on this project was carried out using correlations developed by Robertson et al., 1992. It should be noted that it is not always possible to clearly identify a soil type based on qc, fs and ut. Occasionally soils will fall within different soil categories on the classification charts. In these situations, experience and judgment and an assessment of the pore pressure dissipation data should be used to infer the soil behavior type. Computer tabulations of the interpreted soil types along with certain other geotechnical parameters for each cone hole is presented in Appendix B.

Each of the parameters measured in the sounding is discussed briefly below. A detailed explanation of CPTU testing and interpretation of the results can be found in Robertson, 1989.

TIP RESISTANCE (q_c): The resistance to penetration, measured at the cone tip, provides an accurate profile of subsurface strata. The recorded tip resistance is a composite of the penetration resistance of the soils located five to ten cone diameters (7 to 14 inches) in front of and behind the tip. The actual resistance "sensed" by the tip depends on the soil properties and on the relative stiffness of the layers encountered. Tip resistance is often corrected for pore pressure effects when testing in soft saturated cohesive soils.

For this project the correction was made and the tip resistance shown, q_t is the corrected tip resistance.

The correction used is: $q_t = q_c + (1-a)u$

Where:
- q_t = corrected tip resistance
- q_c = measured tip resistance
- a = net area ratio for cone (0.80 for this project)
- u = dynamic pore water pressure measured behind tip

SLEEVE FRICTION (f_s) The resistance recorded on the friction sleeve, is a measure of the remolded strength of the soil. Values of sleeve friction in very soft soils (such as peat) may fluctuate due to the measured force being small relative to the capacity of the measuring load cell.

FRICTION RATIO (R_f) The ratio of sleeve friction to tip resistance expressed as a percentage, is an indicator of soil type. Cohesive soils generally have friction ratios that are greater than two, while sands and non-plastic silts have friction ratios that are lower than two.

PORE PRESSURE (u) Dynamic pore water pressure is measured during penetration. (dynamic pore water pressure data can be found in the .cor, .xls files. Static pore water pressure is measured when cone penetration is stopped (static pore water pressure data can be found in the .ppd files). The measured dynamic pore water pressure changes with the location of the porous filter and negative readings are possible when the filter is located behind the tip.

It is important to note that the CPT classifies soil by physical behavior, not by grain size; therefore, the CPT classification should be verified against samples obtained from a conventional drilling program. While the CPT soil classification may not always be accurate in terms of the actual label it applies to a particular soil, it is very accurate in grouping soils with similar mechanical properties.

Table 1 presents a summary of CPT soundings, including sounding depths.

3.2 CONE PLOTS

The data from each sounding was plotted using the computer program ScreenZ. The plots are included in Appendix A. ScreenZ was developed by ConeTec Inc. and it incorporates soil behavior type (SBT) classification as part of the plot. The soil classification is based on the classification chart reproduced chart in Appendix B.

3.3 PORE PRESSURE DISSIPATION TEST RESULTS

When conducting CPT investigations, pore water pressure dissipations are automatically recorded during pauses in penetration. The pore water pressure data is recorded at five second intervals. Dynamic and static pore pressure dissipation data for each CPT is included on the data CD. No dissipation tests were completed during this project. Water table depths used in the data interpretations were given to us by the client.

3.4 SHEAR WAVE VELOCITY MEASUREMENTS

Shear wave velocity measurements were conducted during all of the CPT soundings. Shear wave velocity measurements were recorded approximately every meter. The shear wave velocity data can be found in Appendix C.

3.5 CPTSUMM DATA PROCESSING

The electronic data files were processed using the program CPTSUMM. CPTSUMM is a program developed by ConeTec to calculate common engineering parameters from CPT data. The data files (xls) can be found on the data CD. The calculations used are summarized in the table found in Appendix B. Each calculation is derived according to the referenced article.

For this project, the depth to ground water was given to us by the client. The exact depth used is noted in the header of each CPTSUMM file.

3.6 DATA CD

One data CD is included in Appendix E. The CD includes all of the CPT, dynamic and static pore water pressure and CPTSUMM data.

5.0 REFERENCES

Robertson, P.K., 1989, "Soil Classification using the Cone Penetration Test", Canadian Geotechnical Journal, vol. 27, pages 151-158.

Robertson, P.K., Sully, J., Woeller, D.G., Lunne, T., Powell, J.M., and Gillespie, D.J., 1992, "Estimating Coefficient of Consolidation from Piezocone Tests", Canadian Geotechnical Journal, vol. 29, pages 539-550.

CONETEC

TABLE 1 - SUMMARY OF CPTU SOUNDINGS

Job No.: 07-804
Location: Pond Creek Mine - Williamson County, Illinois
Client: Civil & Environmental Consultants
Date: October 30, 31, 2007

Date	CPTU Sounding	File Name	CPT Total Depth (ft)	Shear wave Velocity Tests	Comments
31-Oct-07	CPT-1	804cp01.cor	18.37	6	
30-Oct-07	CPT-2	804cp02.cor	45.28	13	
30-Oct-07	CPT-2A	804cp02a.cor	41.67	12	
31-Oct-07	CPT-3	804cp03.cor	22.15	6	
31-Oct-07	CPT-4	804cp04.cor	18.86	6	
30-Oct-07	CPT-5	804cp05.cor	49.21	14	
30-Oct-07	CPT-5A	804cp05a.cor	53.15	16	
30-Oct-07	CPT-5B	804cp05b.cor	39.70	12	
31-Oct-07	CPT-6	804cp06.cor	22.64	7	
31-Oct-07	CPT-7	804cp07.cor	16.73	5	
31-Oct-07	CPT-8	804cp08.cor	17.88	6	
31-Oct-07	CPT-9	804cp09.cor	21.98	7	
31-Oct-07	CPT-10	804cp10.cor	26.08	8	
31-Oct-07	CPT-11	804cp11.cor	27.56	9	
31-Oct-07	CPT-12	804cp12.cor	22.64	7	
Job Totals:		15	443.90	134	

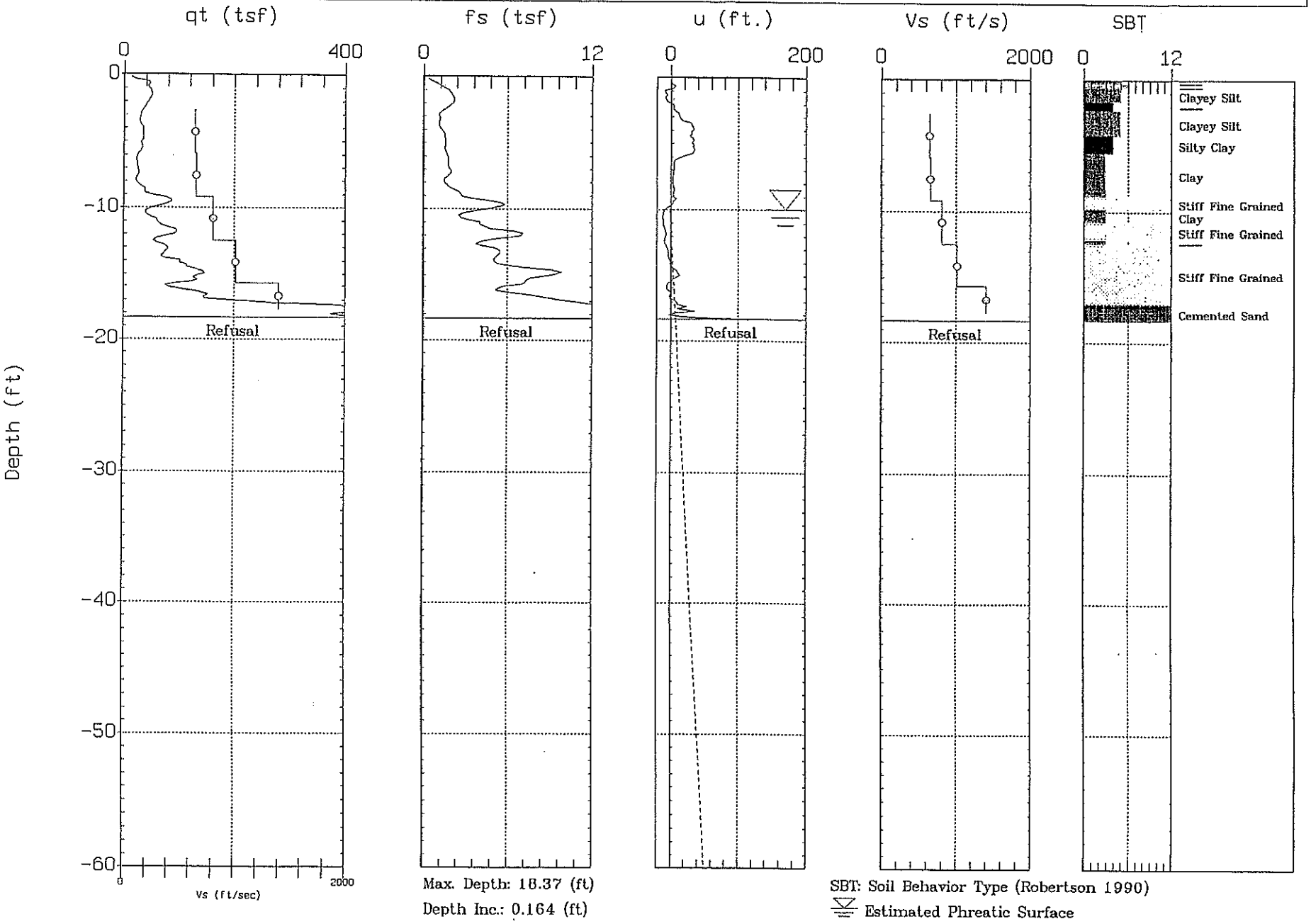
Shearwave CPT plots

CONETEC

C.E.C.

Sounding:CPT-1
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 13:23



Max. Depth: 18.37 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

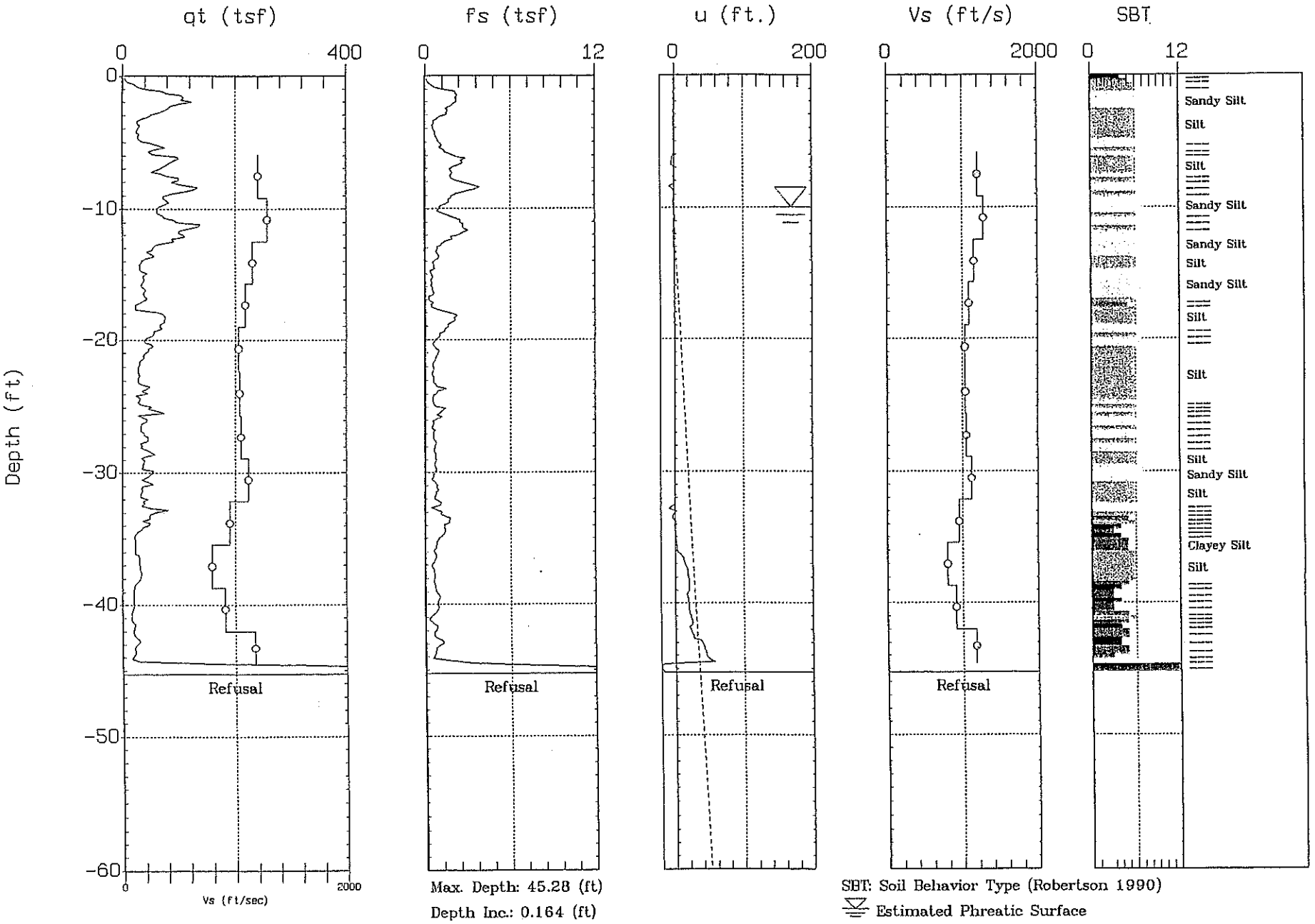
R13345

CONETEC

C.E.C.

Sounding:CPT-2
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 13:46



Max. Depth: 45.28 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

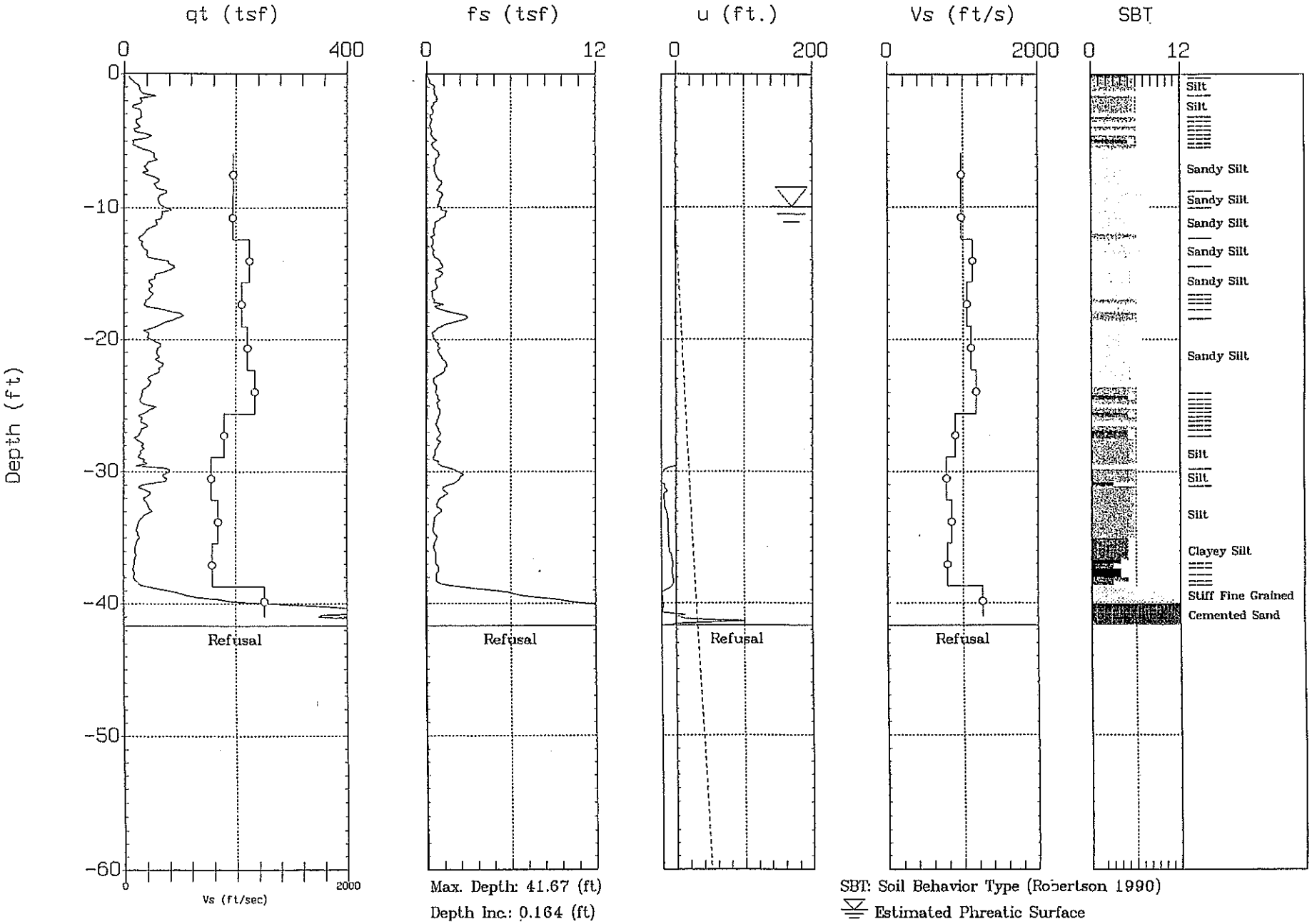
R13346

CONETEC

C.E.C.

Sounding:CPT-2A
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 14:50



Max. Depth: 41.67 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

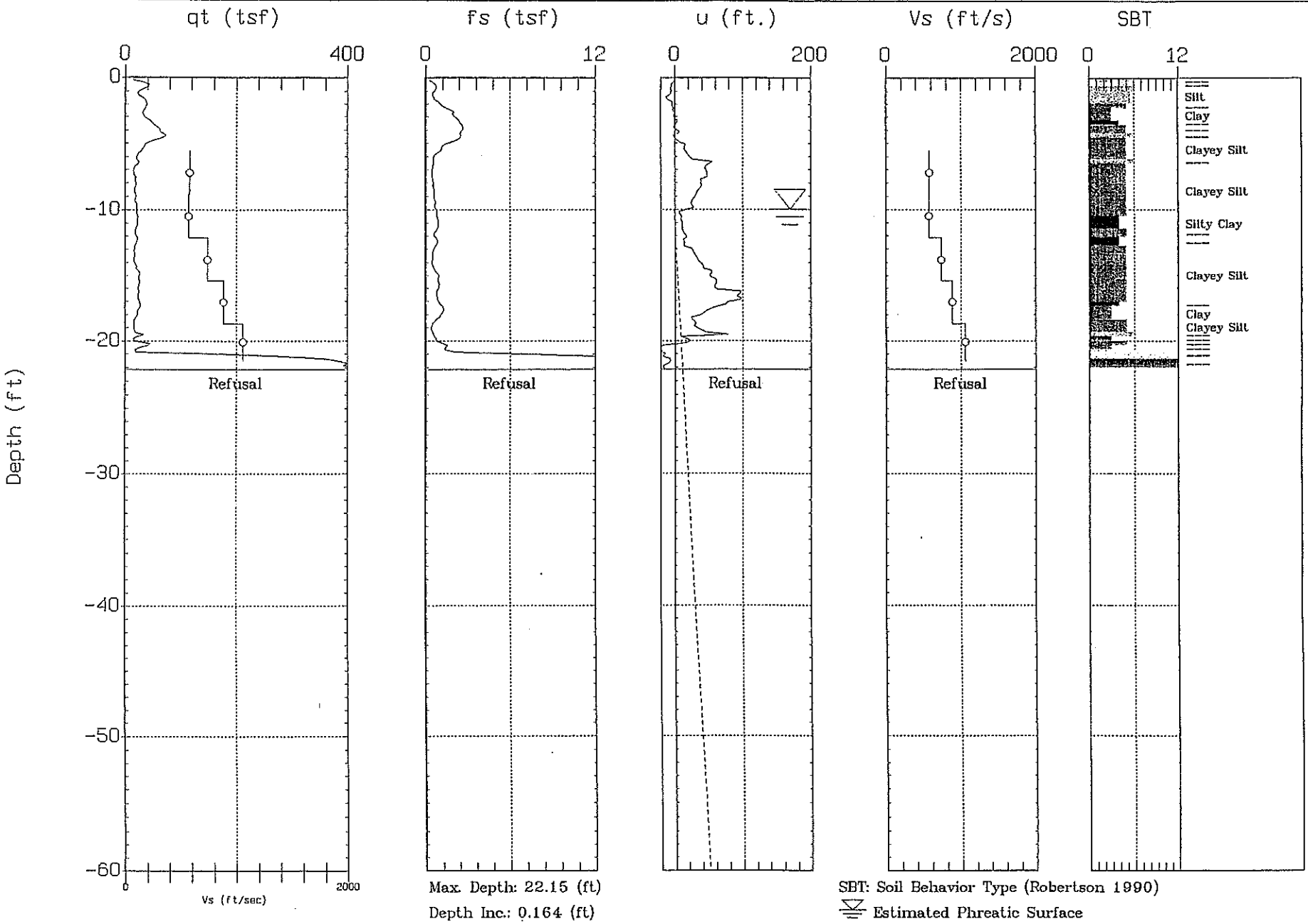
R13347

CONETEC

C.E.C.

Sounding:CPT-3
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:09



Max. Depth: 22.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

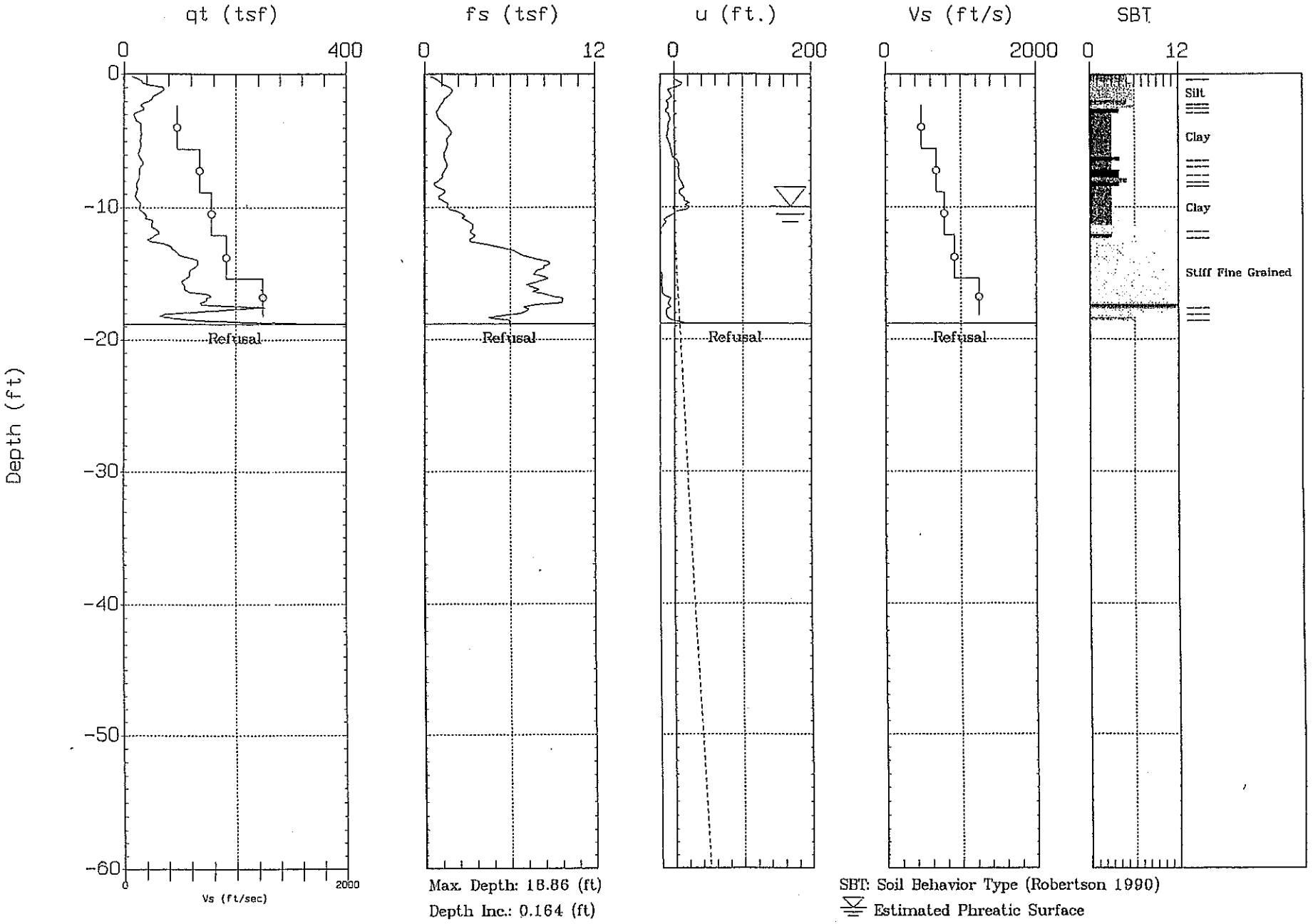
R13348

CONETEC

C.E.C.

Sounding:CPT-4
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:51



Max. Depth: 18.86 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

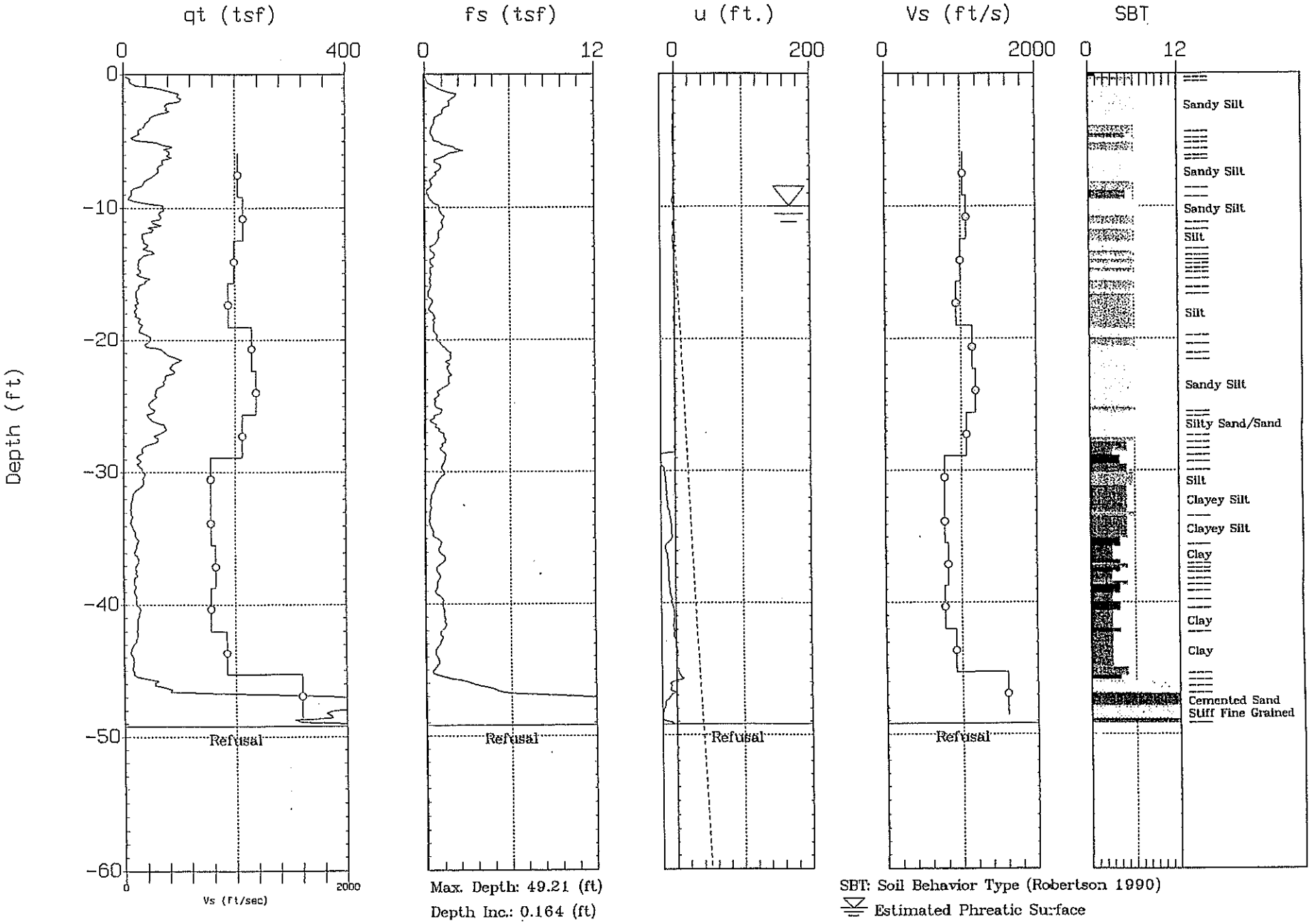
R13349

CONETEC

C.E.C.

Sounding:CPT-5
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 12:34



Max. Depth: 49.21 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

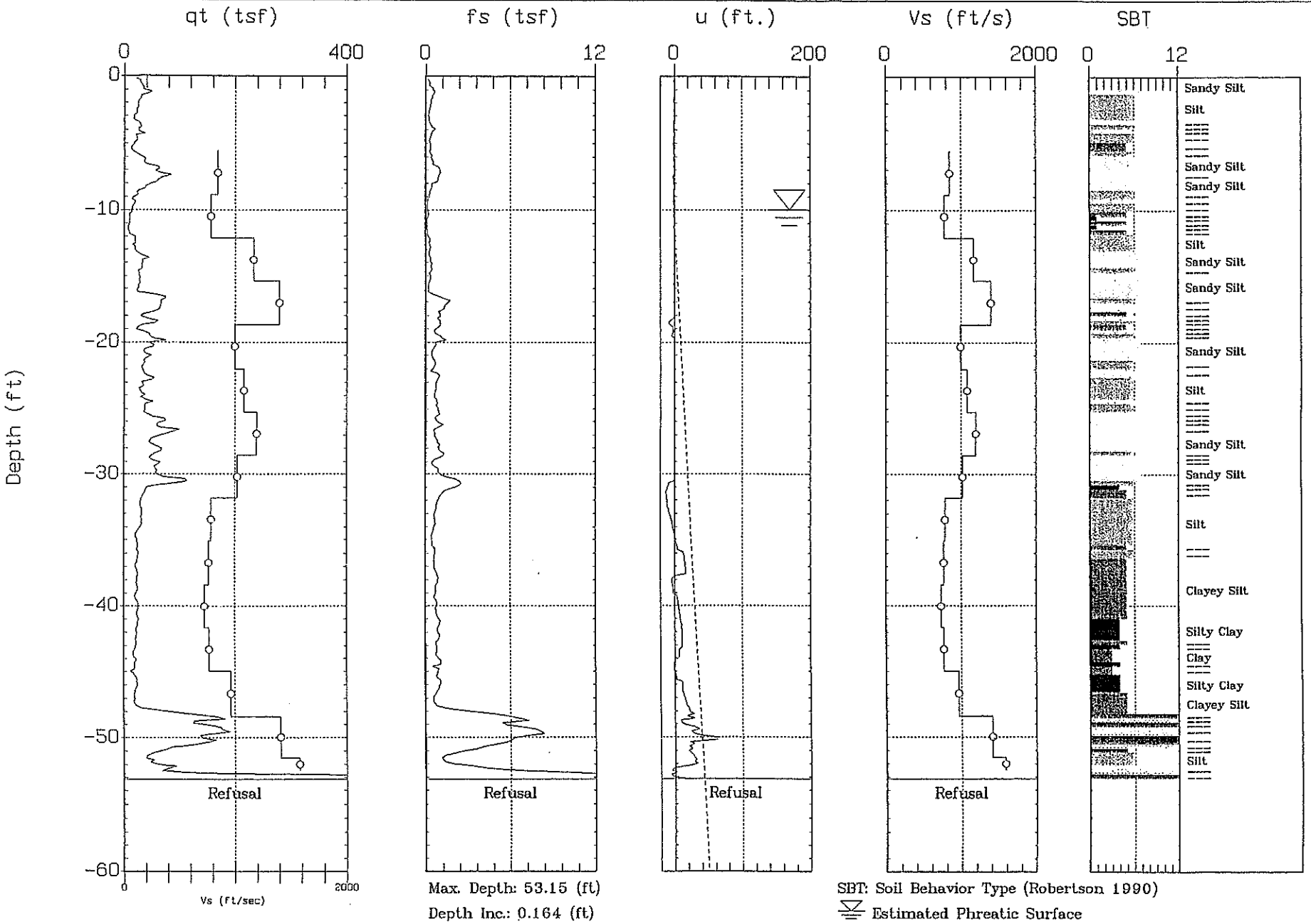
R13350

CONETEC

C.E.C.

Sounding:CPT-5A
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 10:44



Max. Depth: 53.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

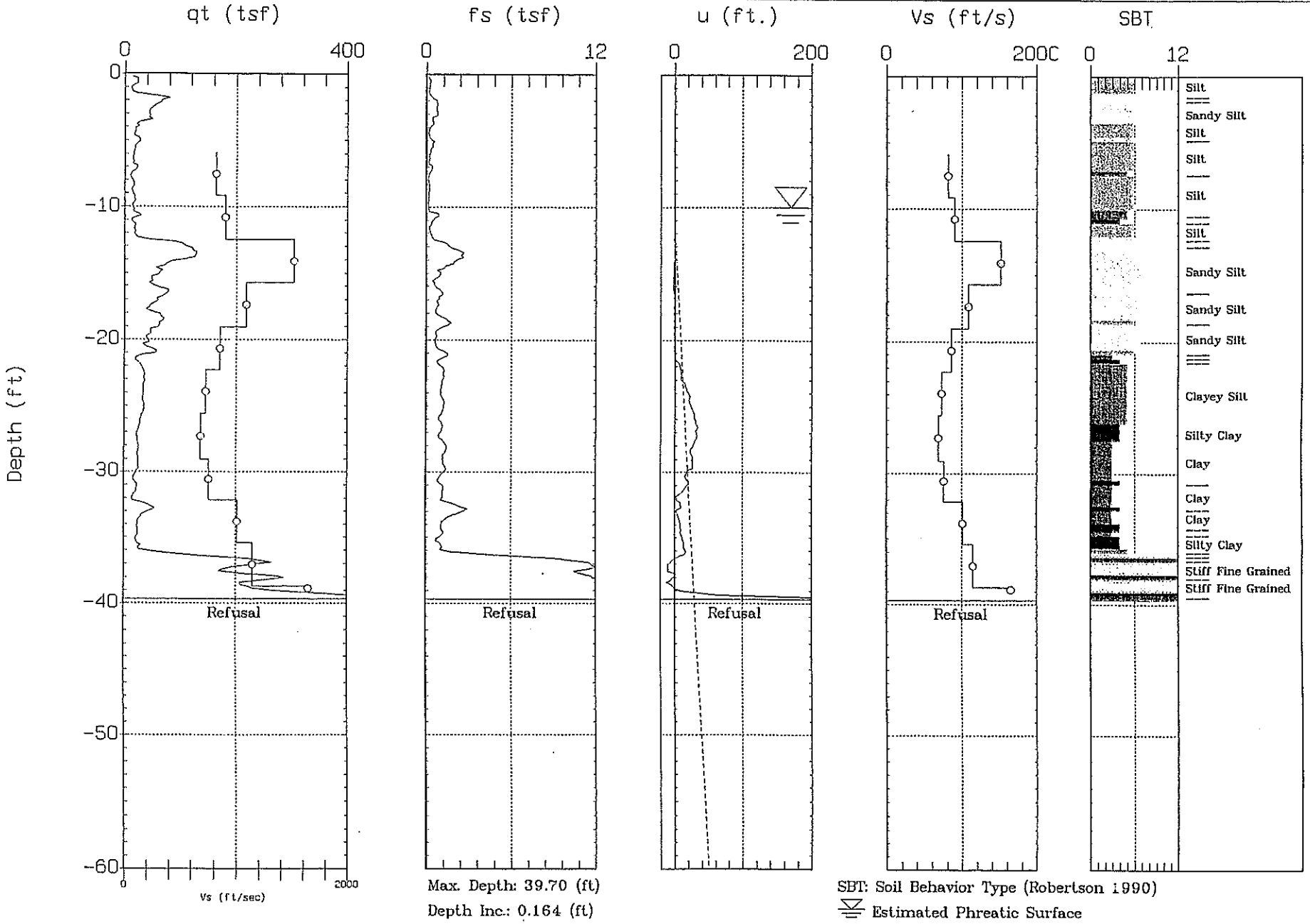
R13351

CONETEC

C.E.C.

Sounding:CPT-5B
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 15:44



Max. Depth: 39.70 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

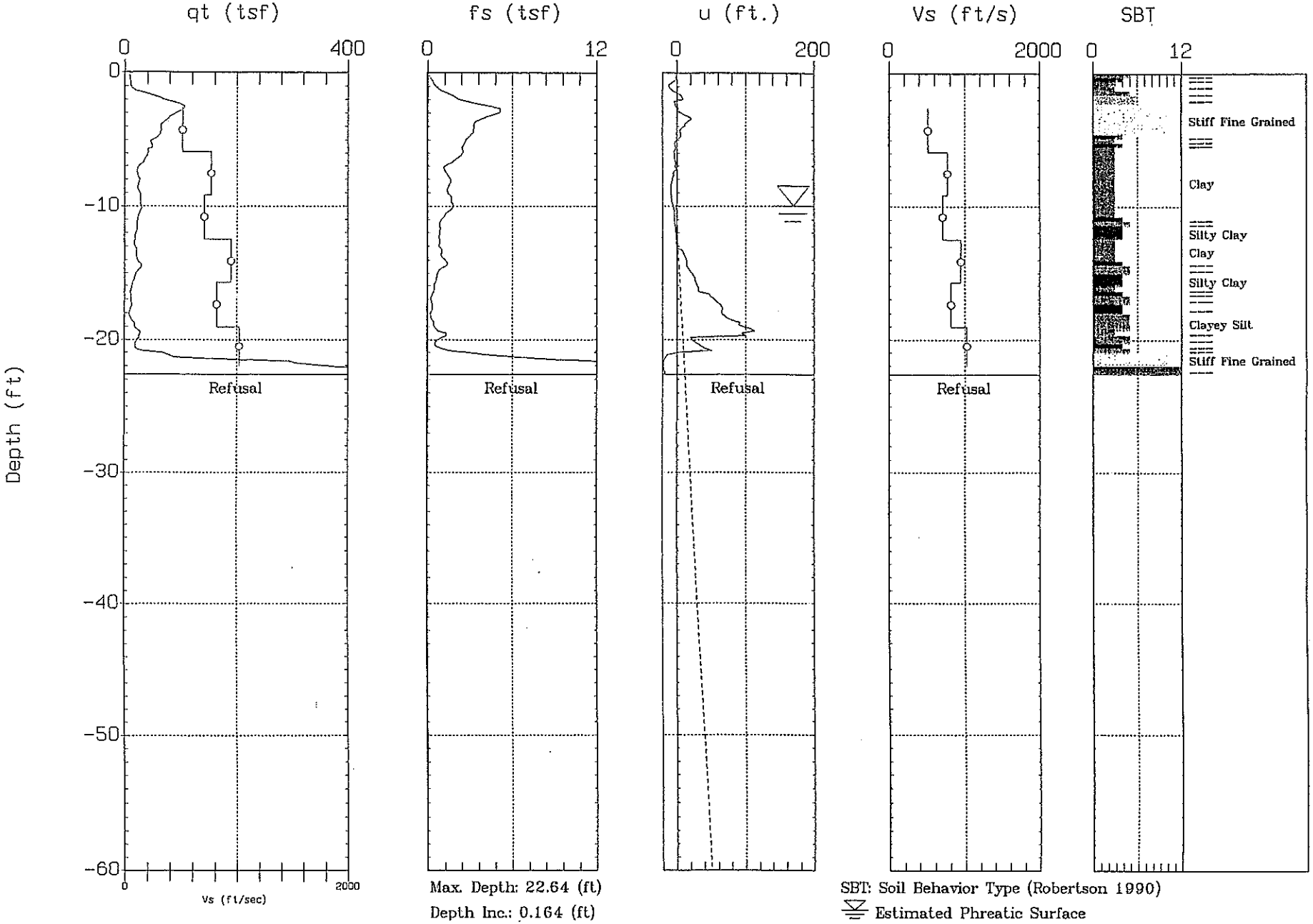
R13352

CONETEC

C.E.C.

Sounding:CPT-6
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:00



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

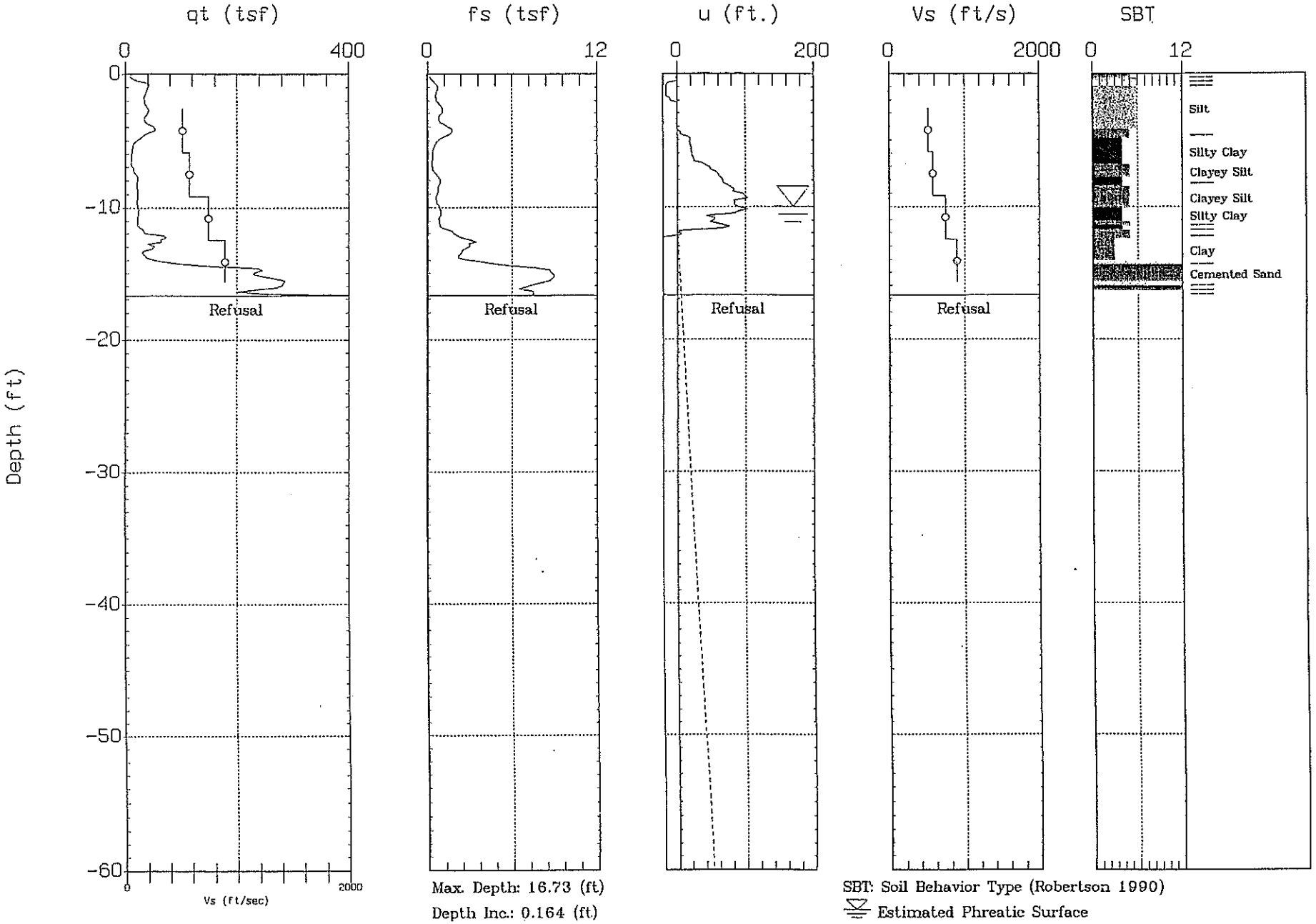
R13353

CONETEC

C.E.C.

Sounding:CPT-7
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:58



Max. Depth: 16.73 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

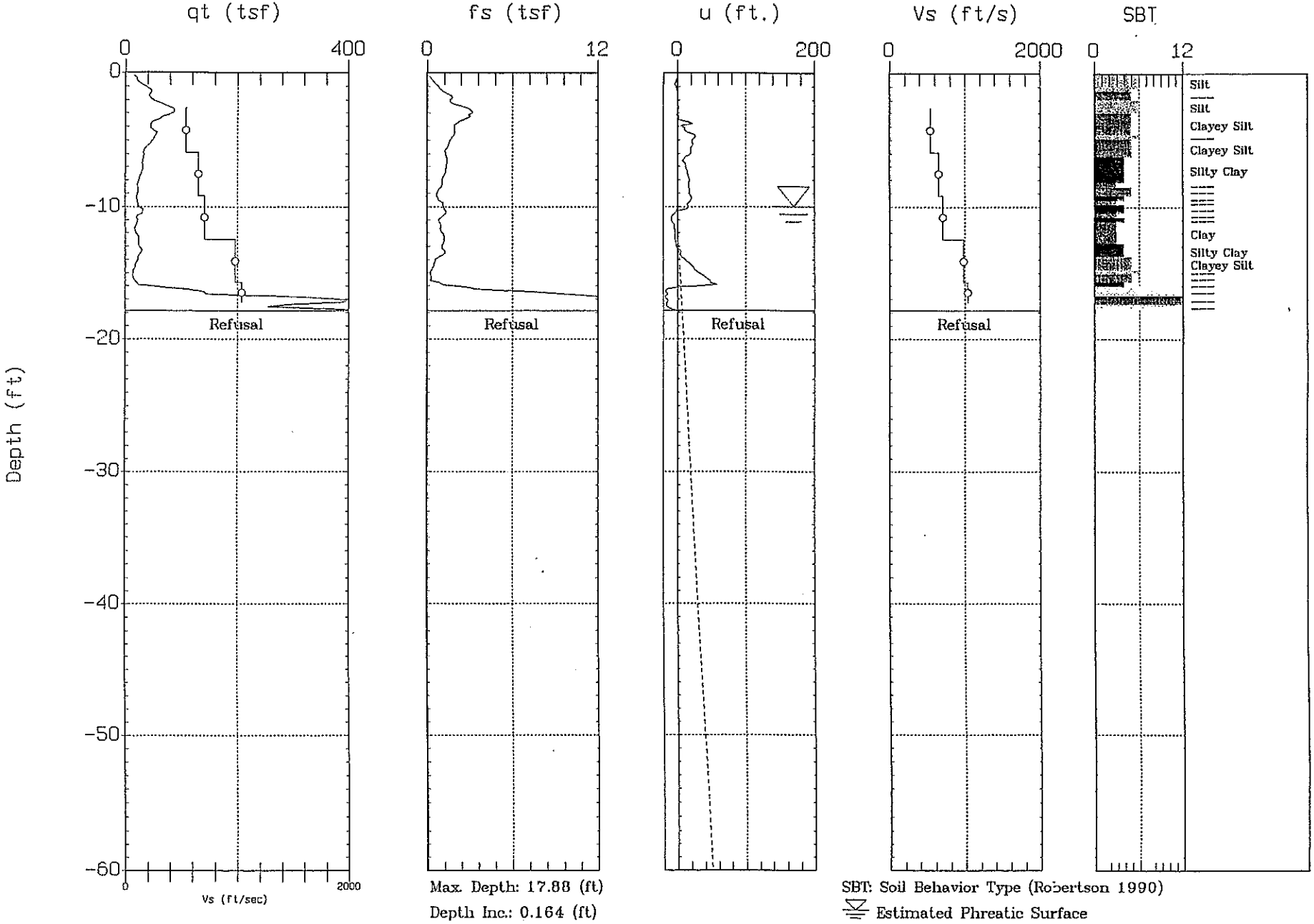
R13354

CONETEC

C.E.C.

Sounding:CPT-8
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:53



Max. Depth: 17.88 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

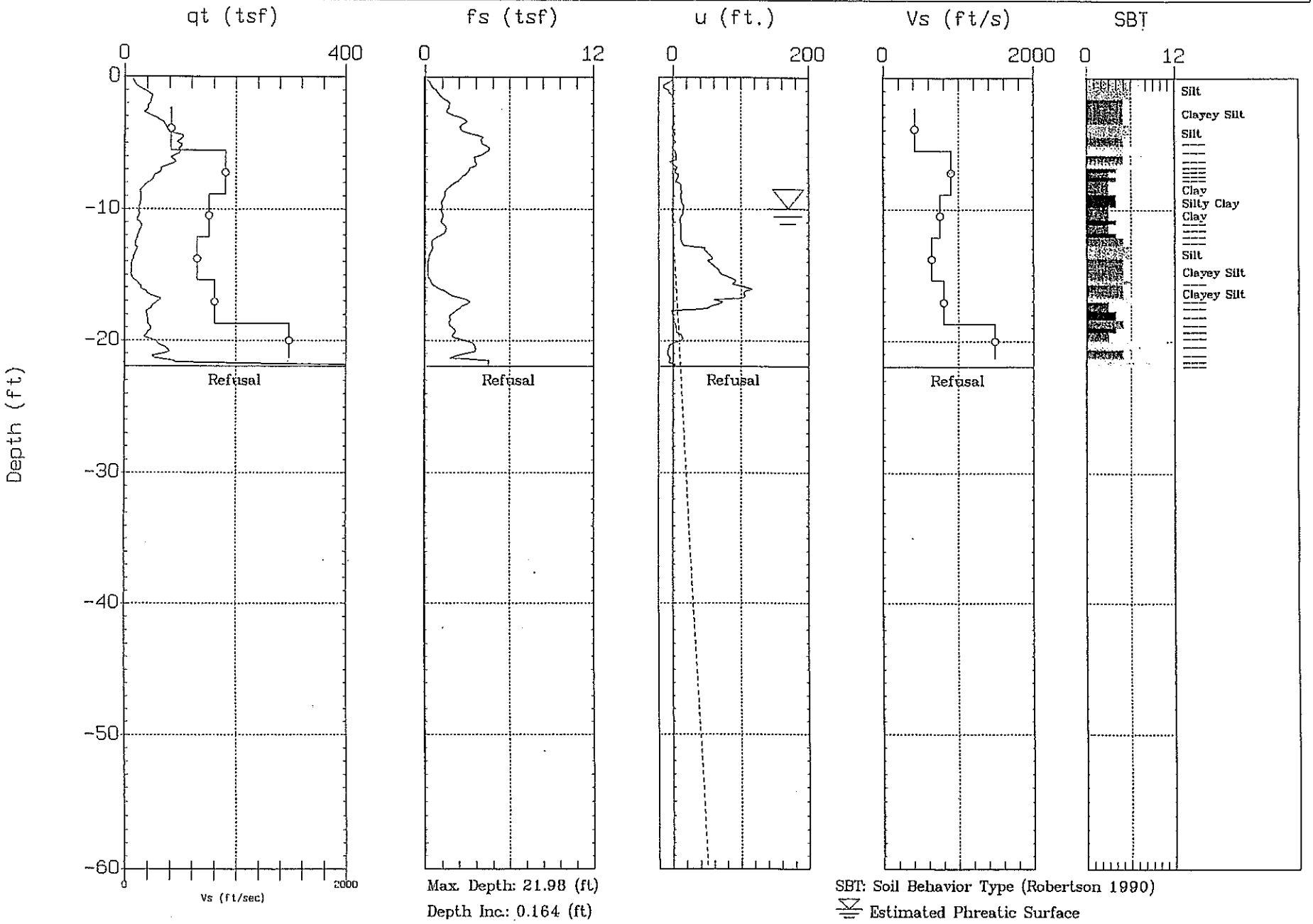
R13355

CONETEC

C.E.C.

Sounding:CPT-9
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:17



Max. Depth: 21.98 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

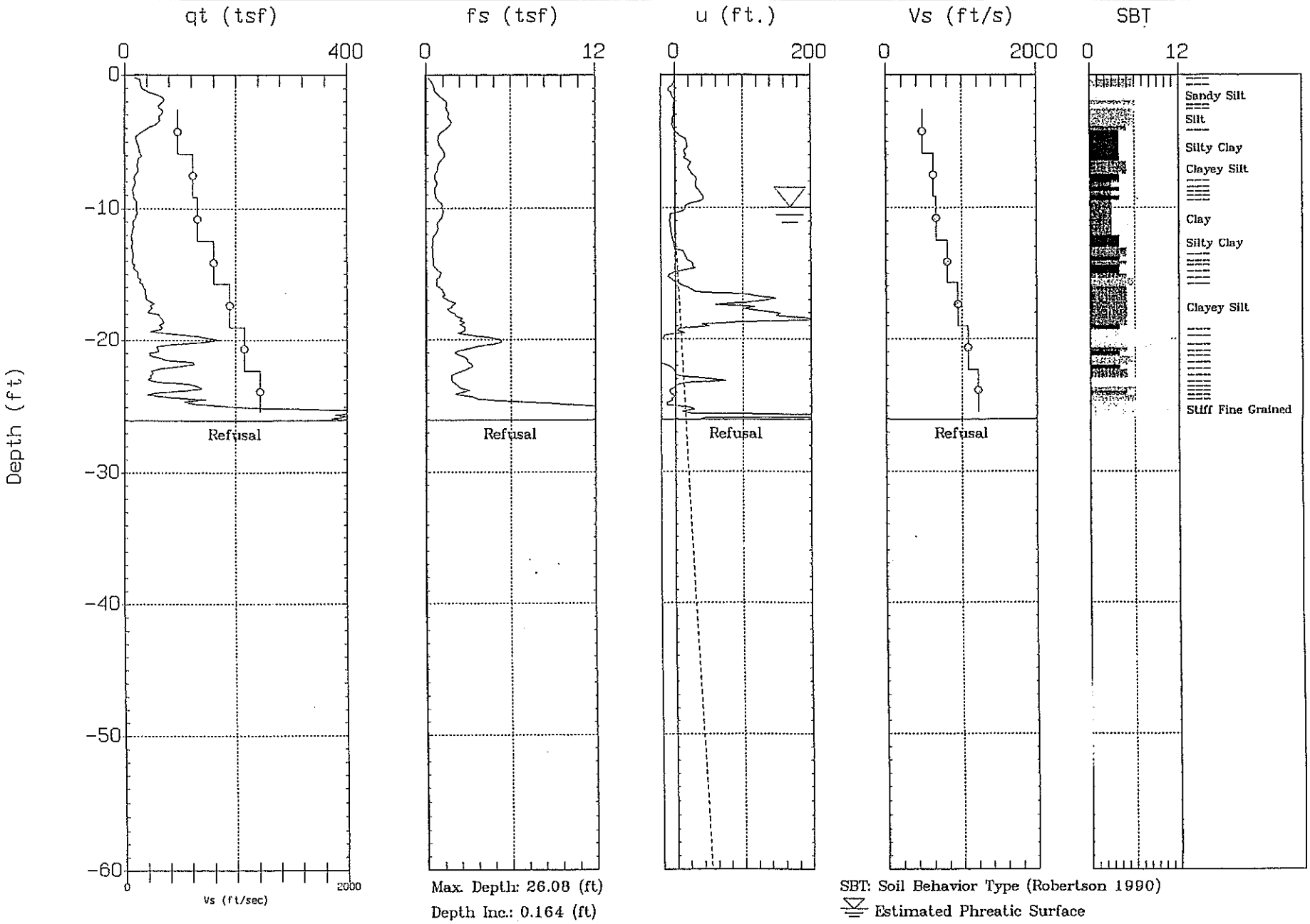
R13356

CONETEC

C.E.C.

Sounding:CPT-10
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 08:35



Max. Depth: 26.08 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

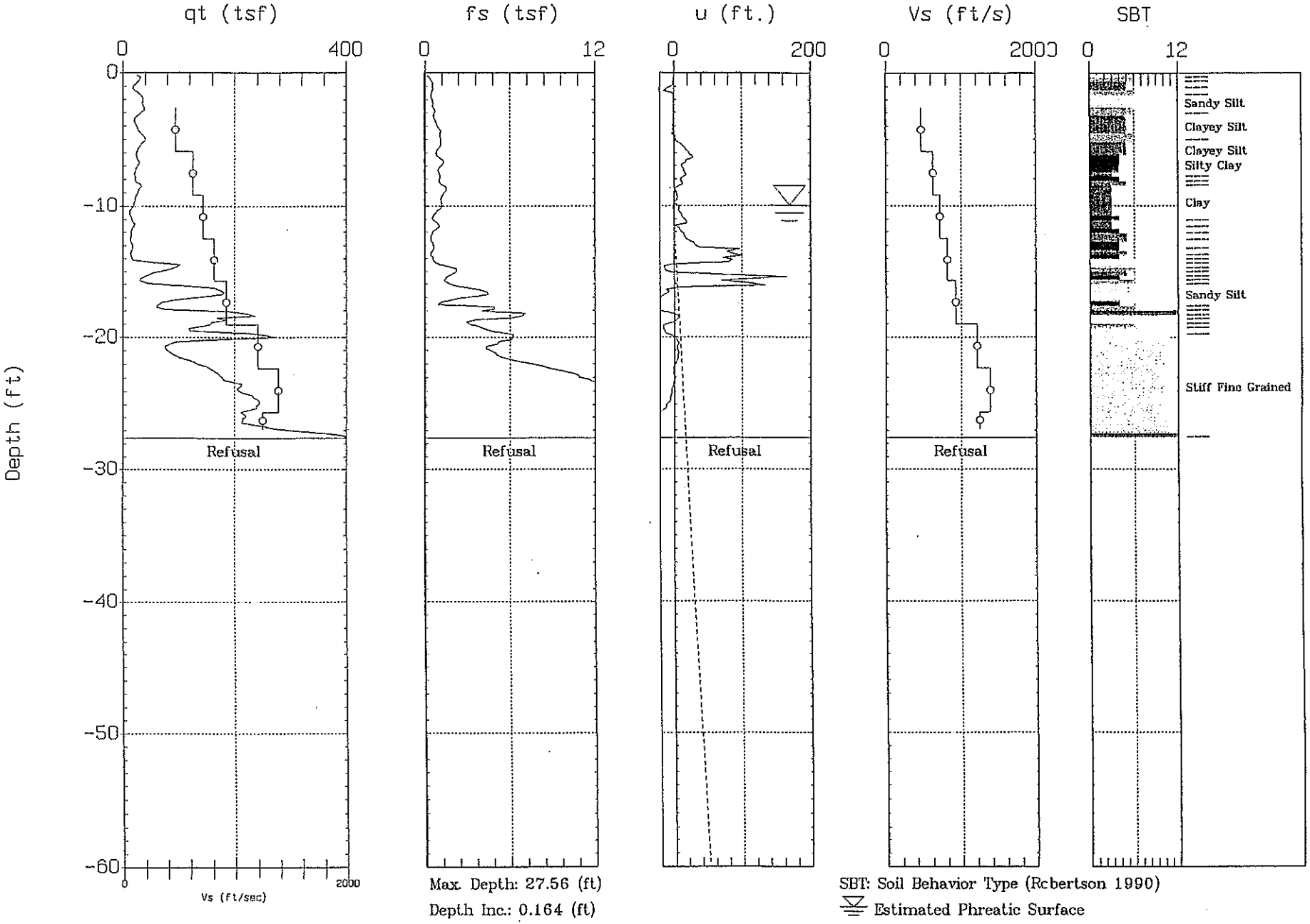
R13357

CONETEC

C.E.C.

Sounding:CPT-11
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 10:31



Max. Depth: 27.56 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

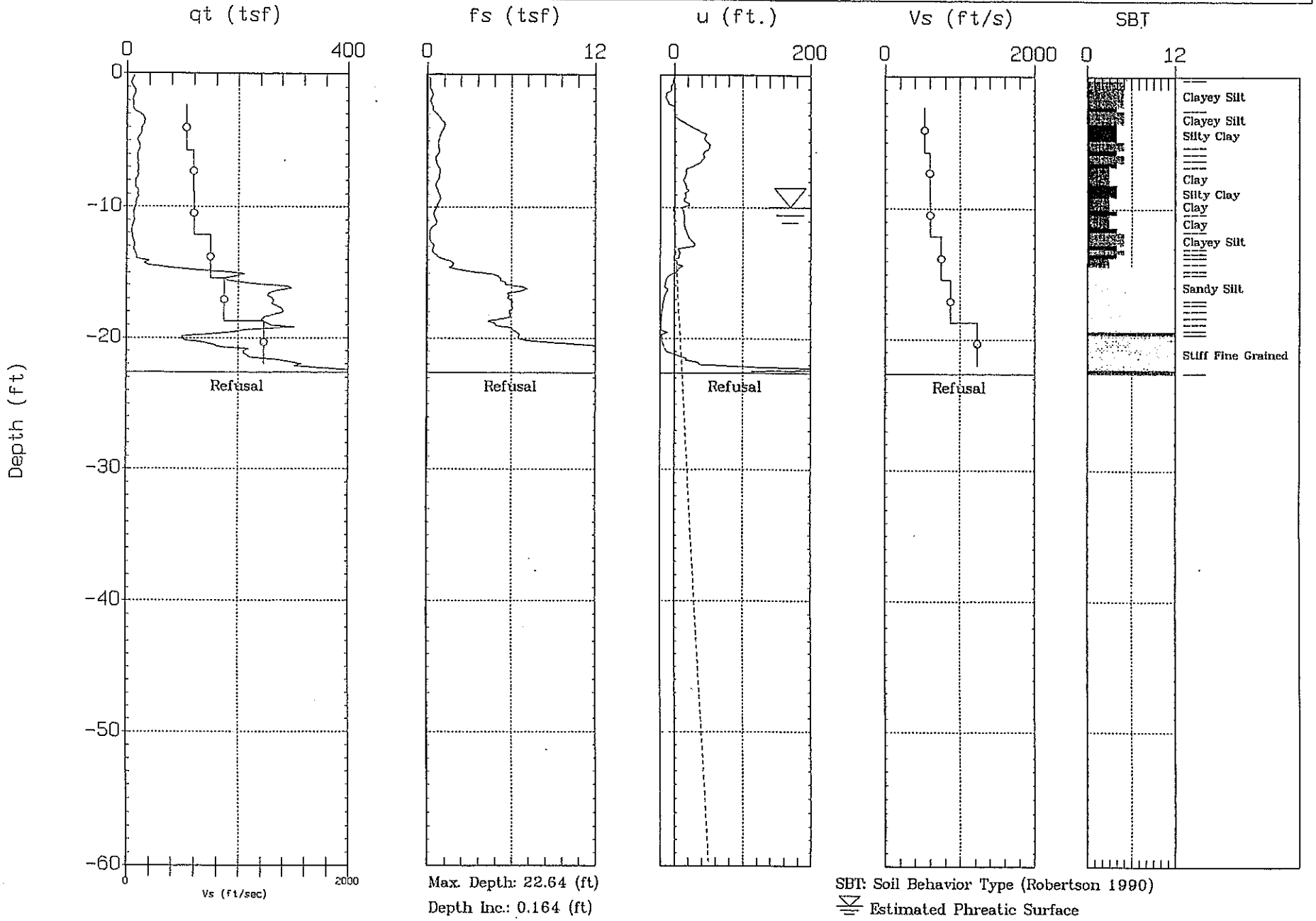
R13358

CONETEC

C.E.C.

Sounding:CPT-12
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 11:15



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

R13359

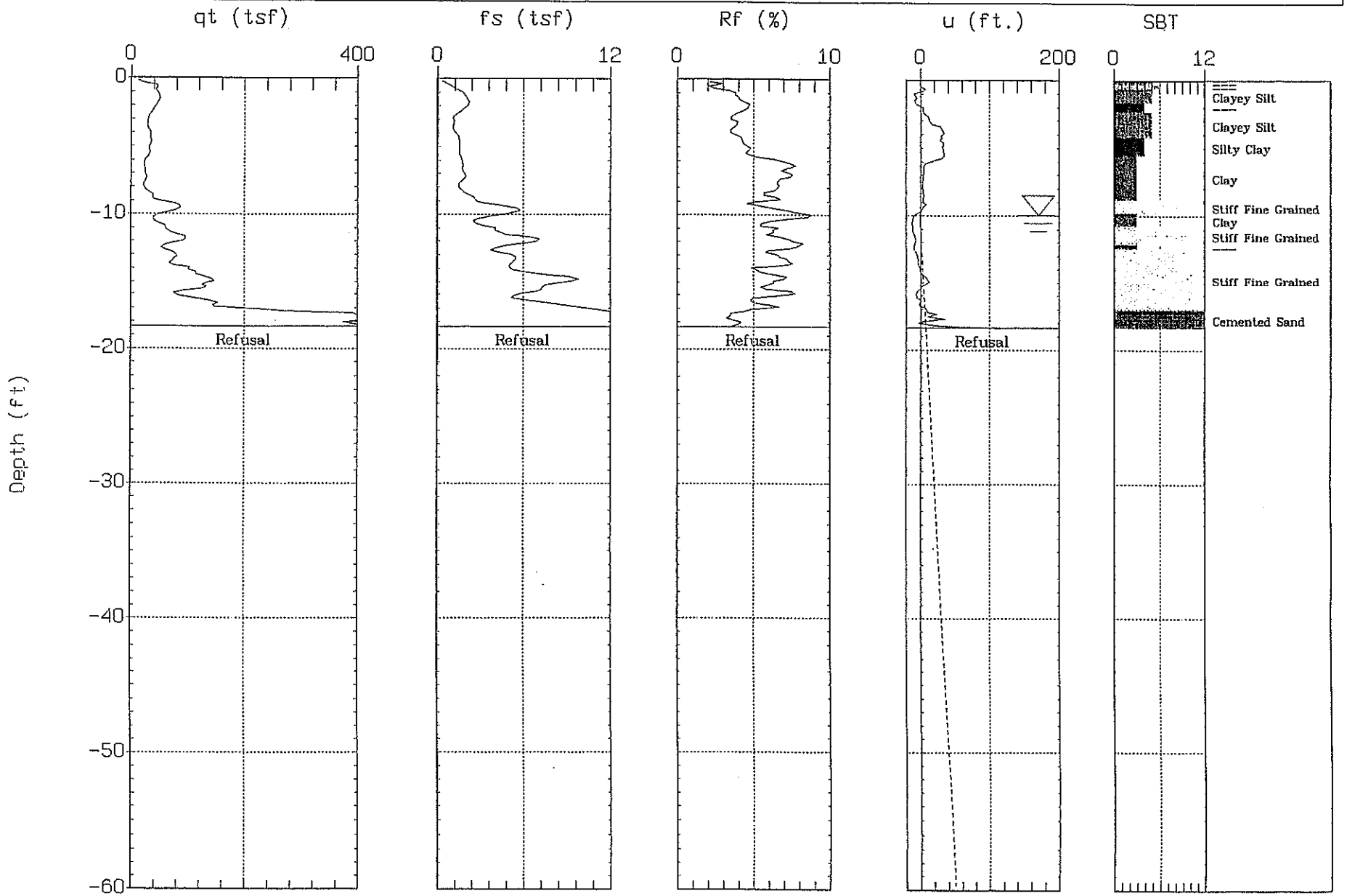
Non-normalized CPT plots

CONETEC

C.E.C.

Sounding:CPT-1
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 13:23



Max. Depth: 18.37 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

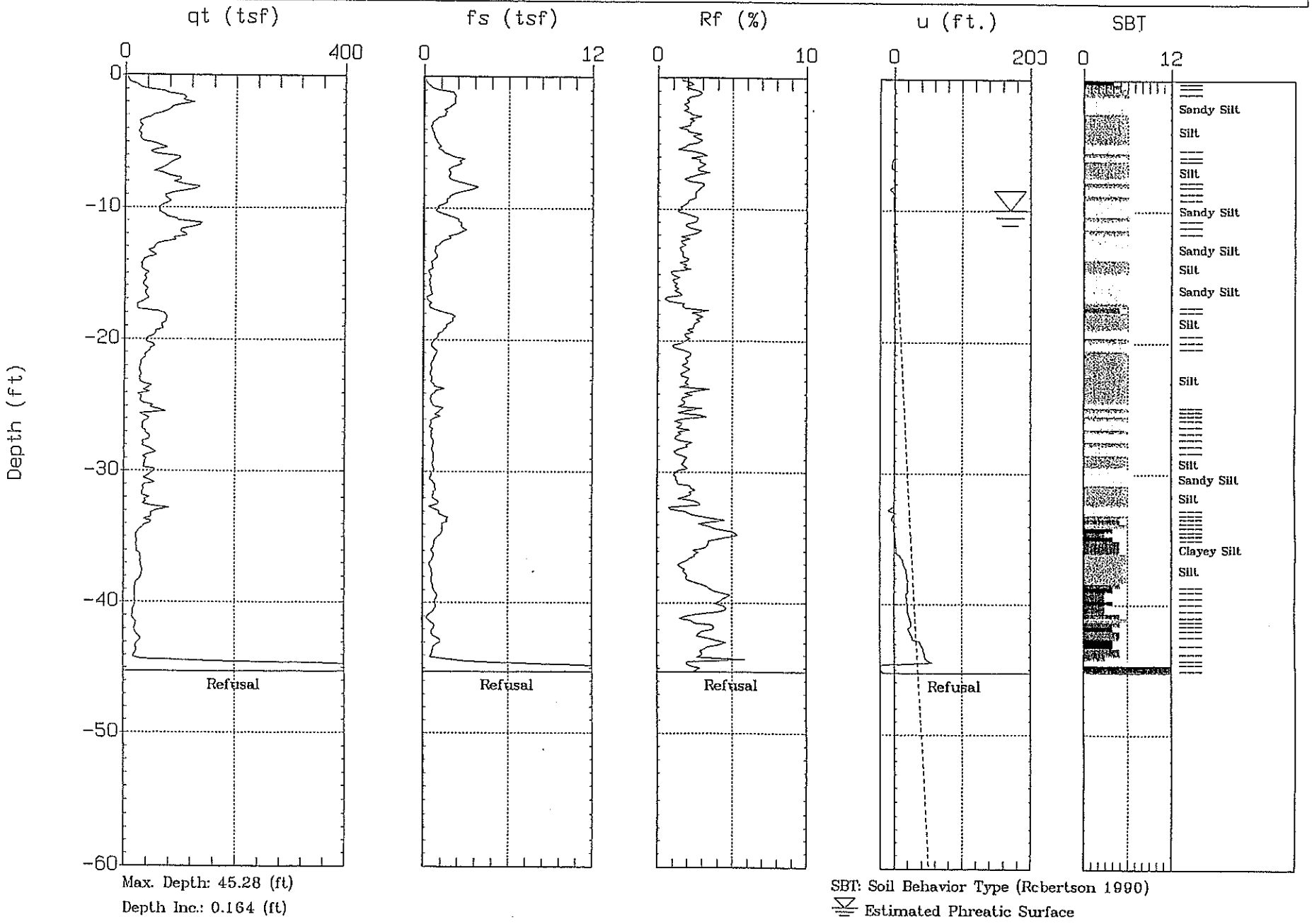
R13361

CONETEC

C.E.C.

Sounding:CPT-2
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 13:46



Max. Depth: 45.28 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

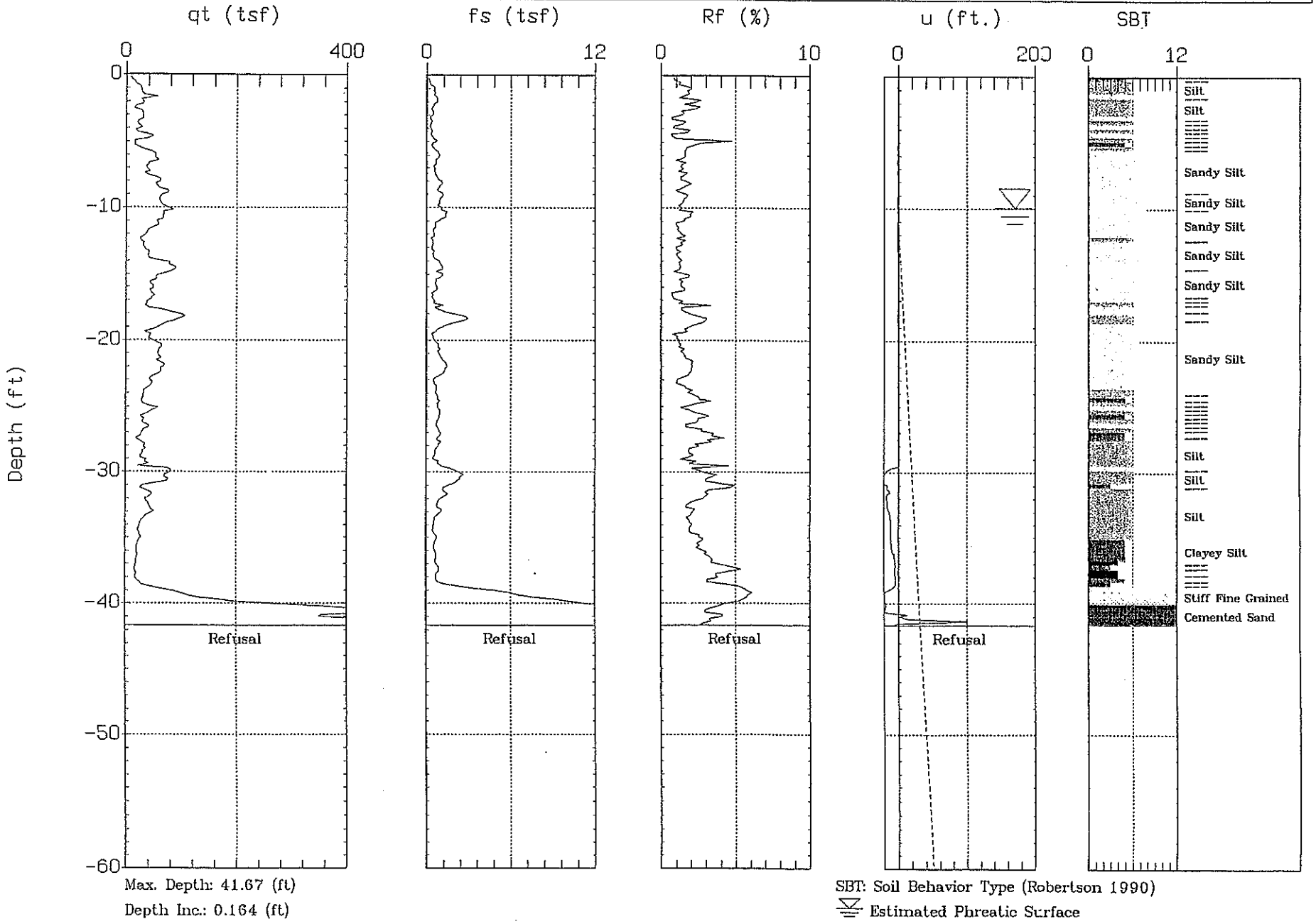
R13362

CONETEC

C.E.C.

Sounding:CPT-2A
Site:Pond Creek Mine

Piezocone:20 TCN AD211
Date:10:30:07 14:50



Max. Depth: 41.67 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

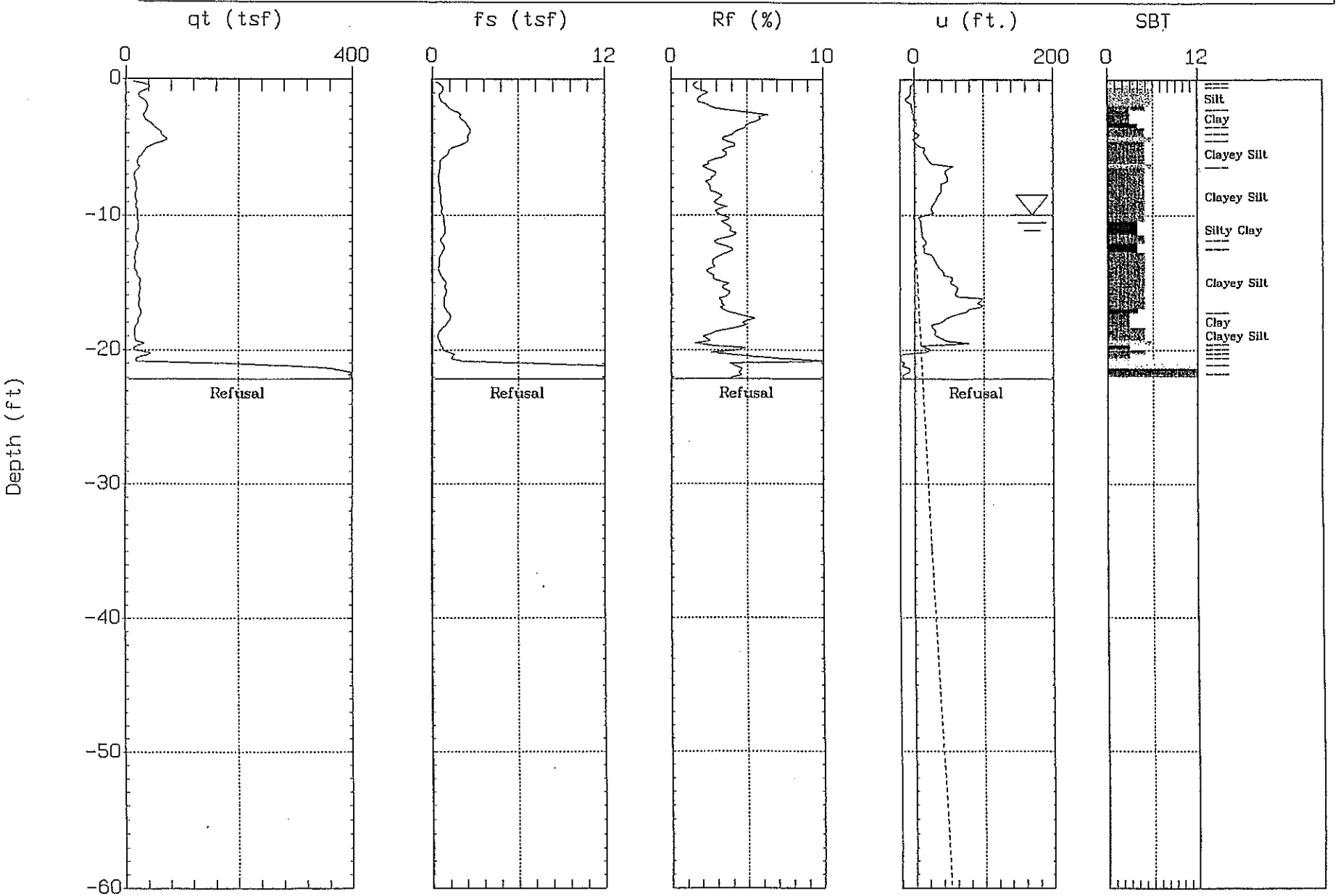
R13363

CONETEC

C.E.C.

Sounding:CPT-3
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:09



Max. Depth: 22.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

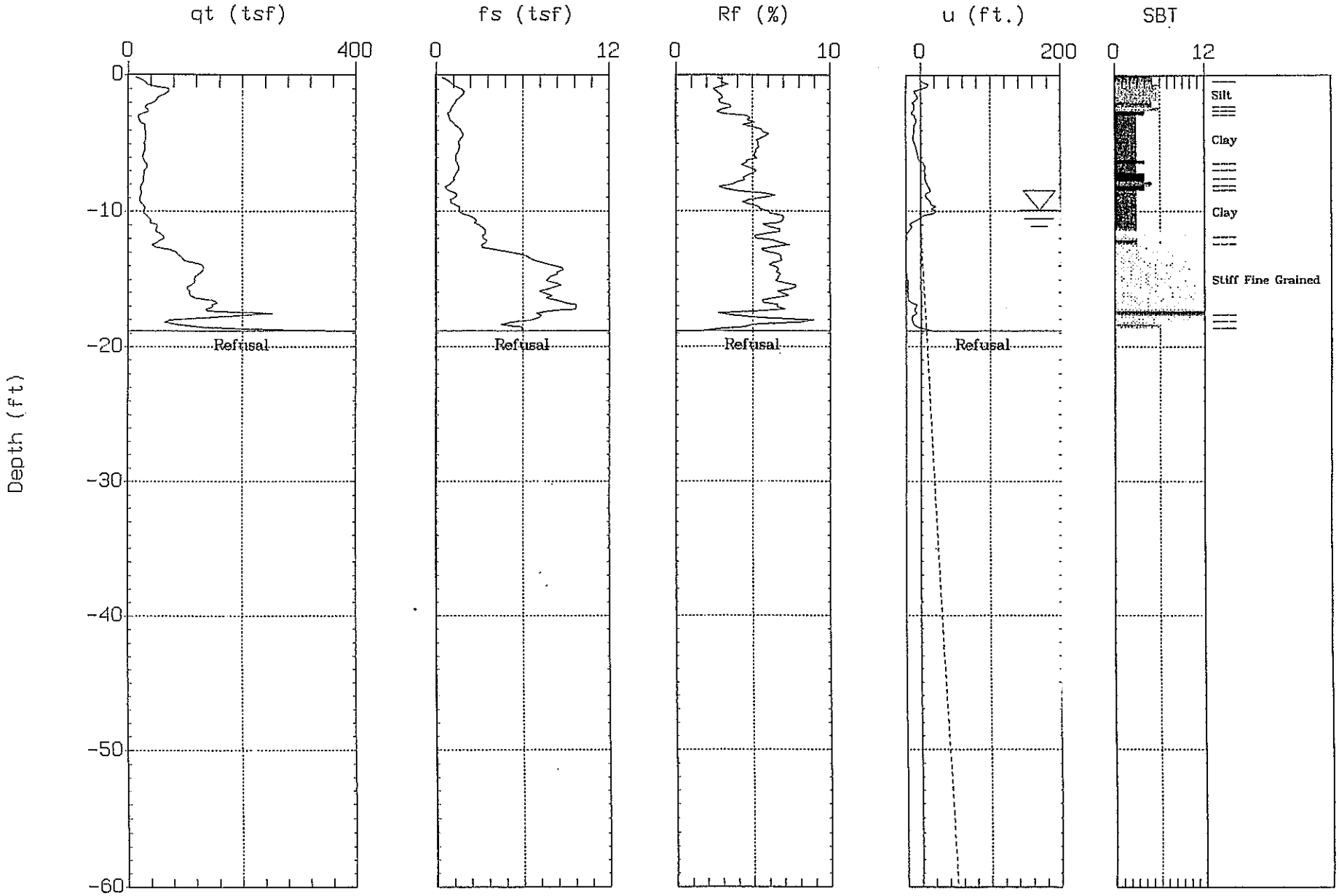
R13364

CONETEC

C.E.C.

Sounding:CPT-4
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:51



Max. Depth: 18.86 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

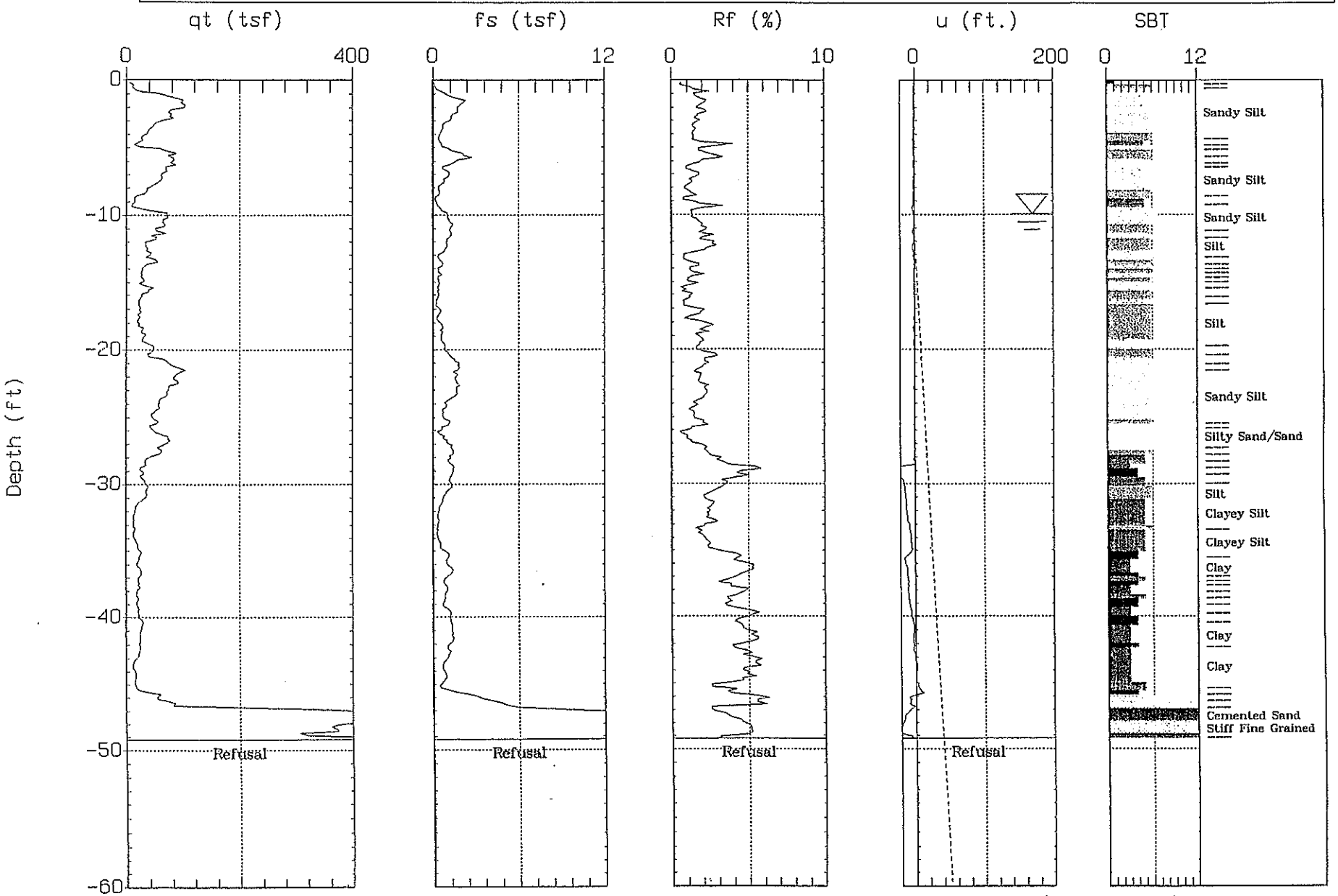
R13365

CONETEC

C.E.C.

Sounding:CPT-5
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 12:34



Max. Depth: 49.21 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

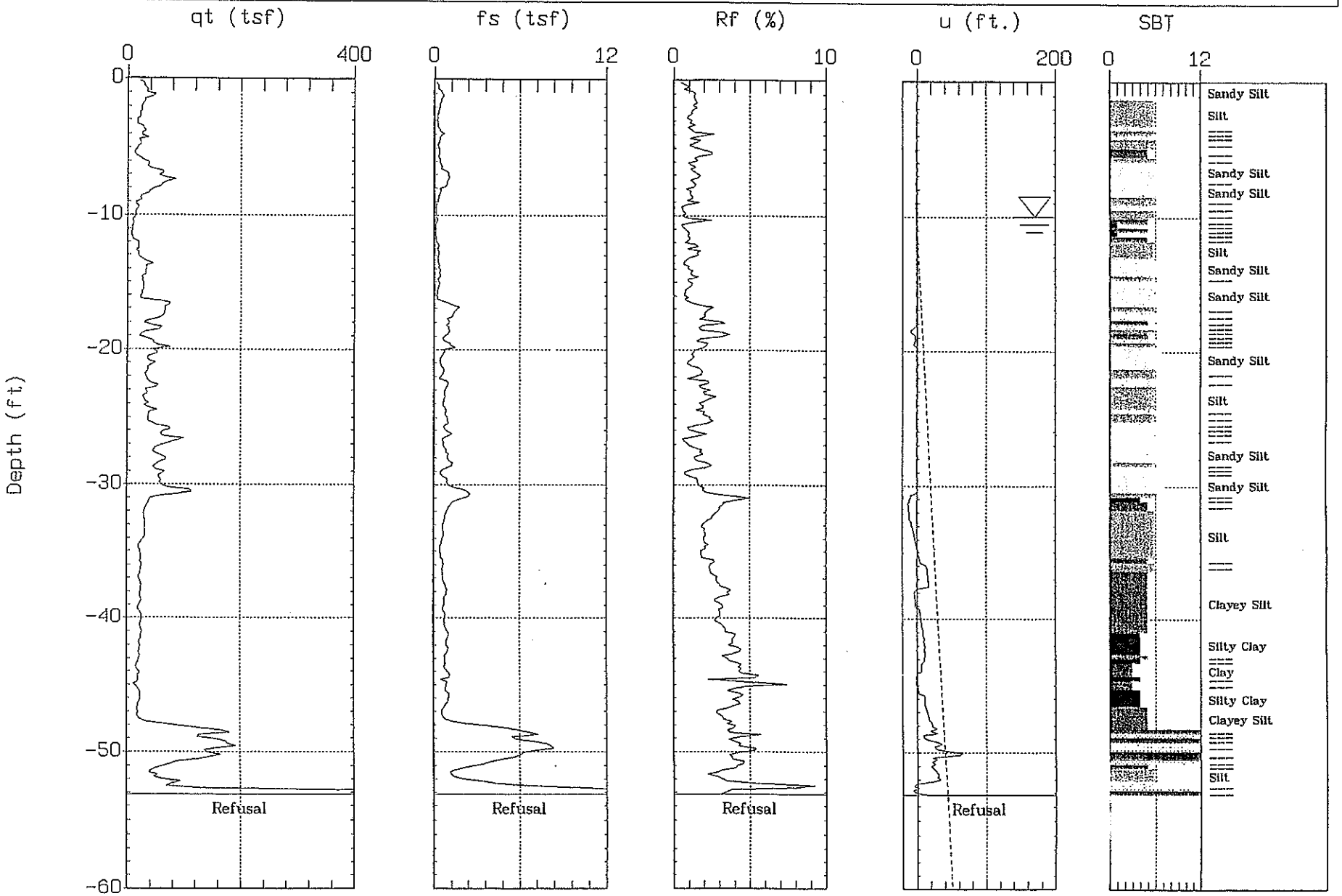
R13366

CONETEC

C.E.C.

Sounding:CPT-5A
Site:Pond Creek Mine

Piezocone:20 TCN AD211
Date:10:30:07 10:44



Max. Depth: 53.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

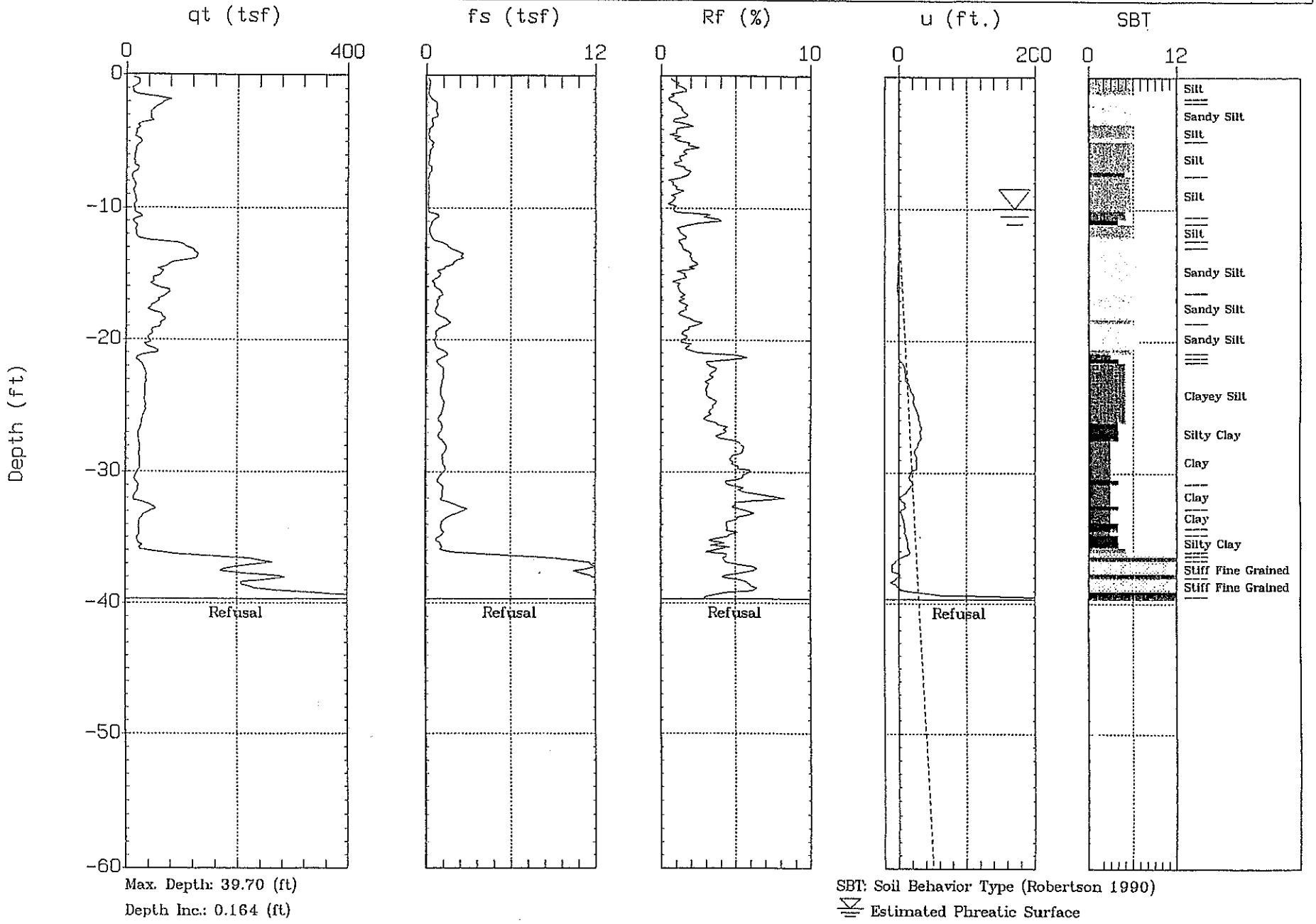
R13367

CONETEC

C.E.C.

Sounding:CPT-5B
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 15:44



Max. Depth: 39.70 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

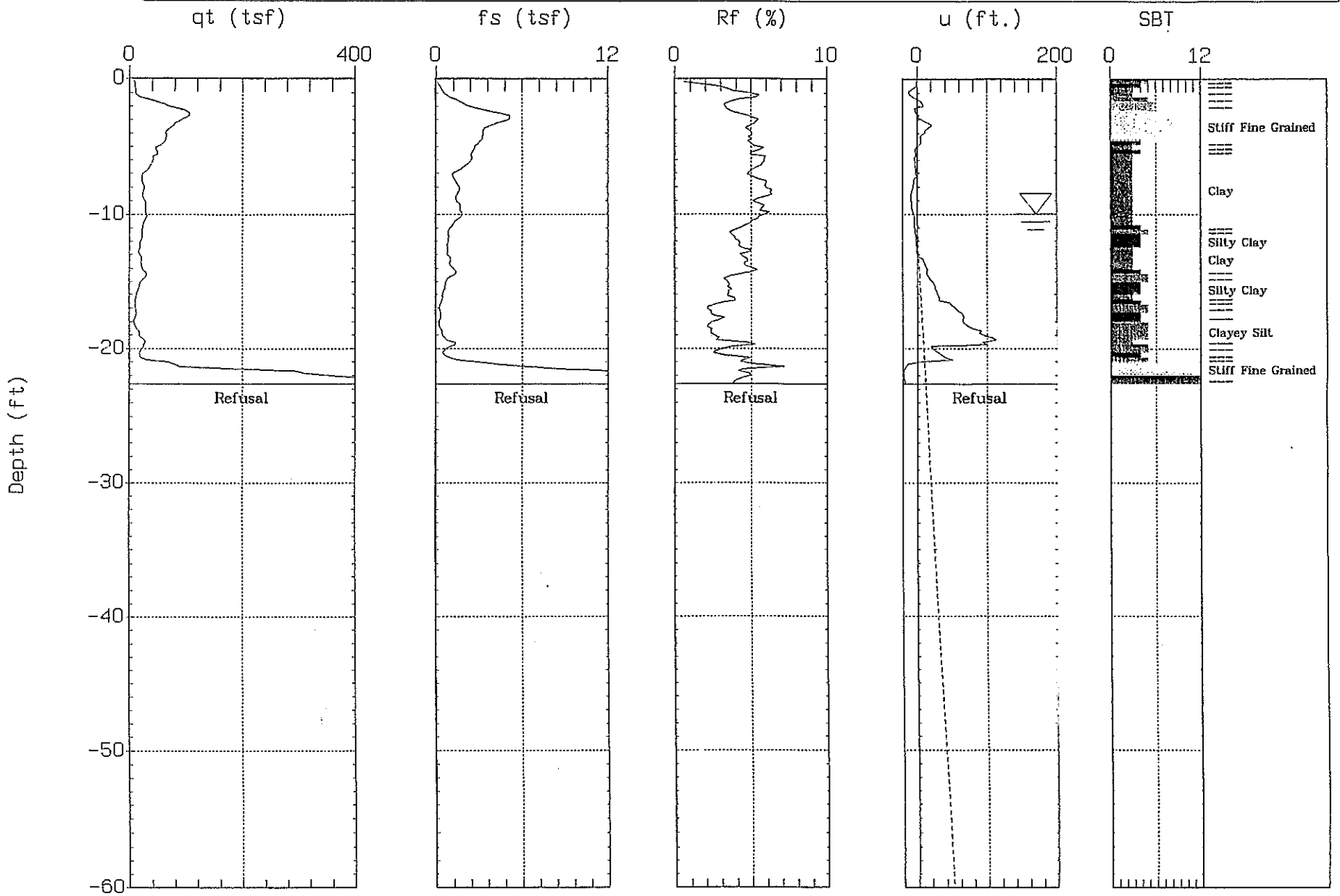
R13368

CONETEC

C.E.C.

Sounding:CPT-6
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:00



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

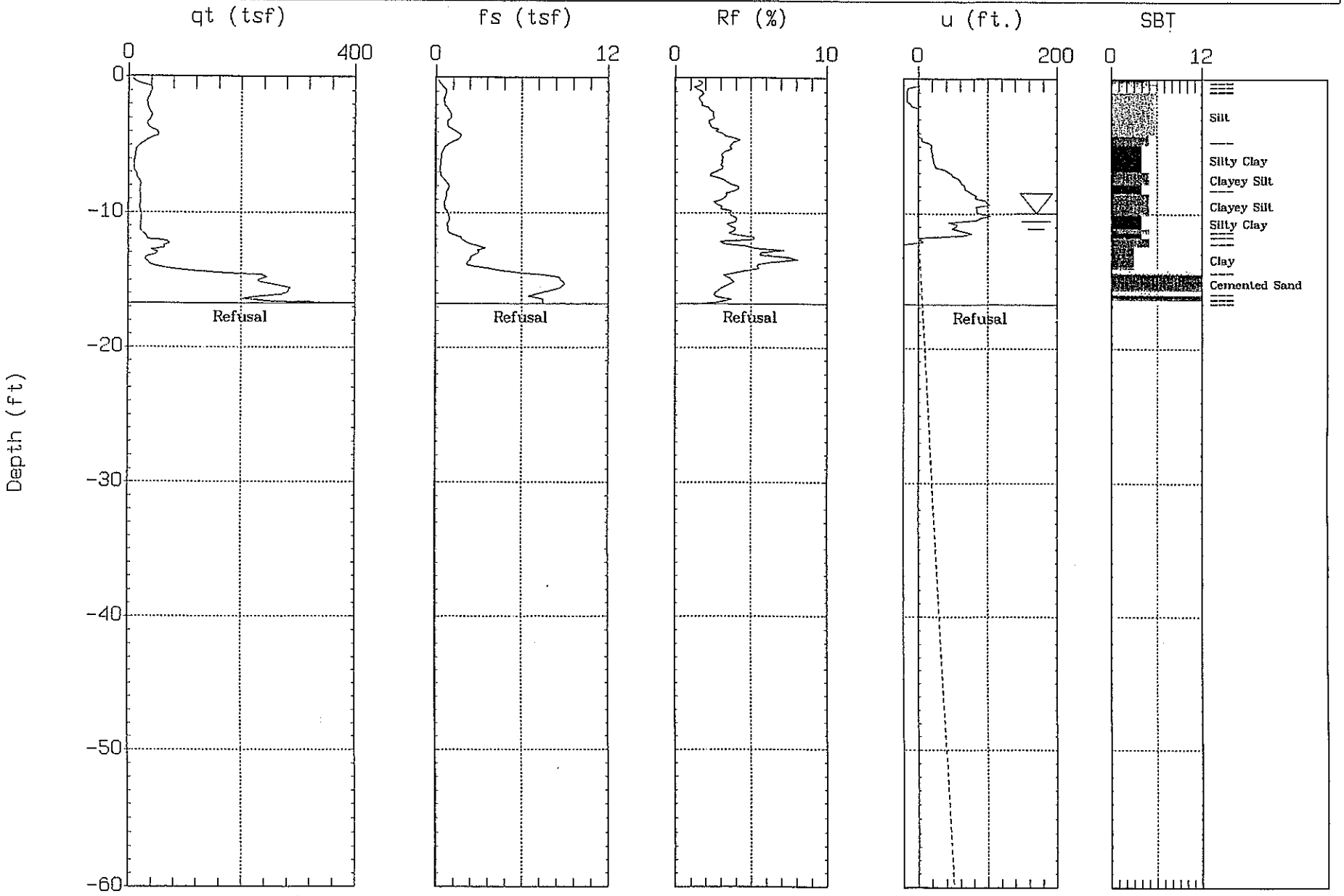
R13369

CONETEC

C.E.C.

Sounding:CPT-7
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:58



Max. Depth: 16.73 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

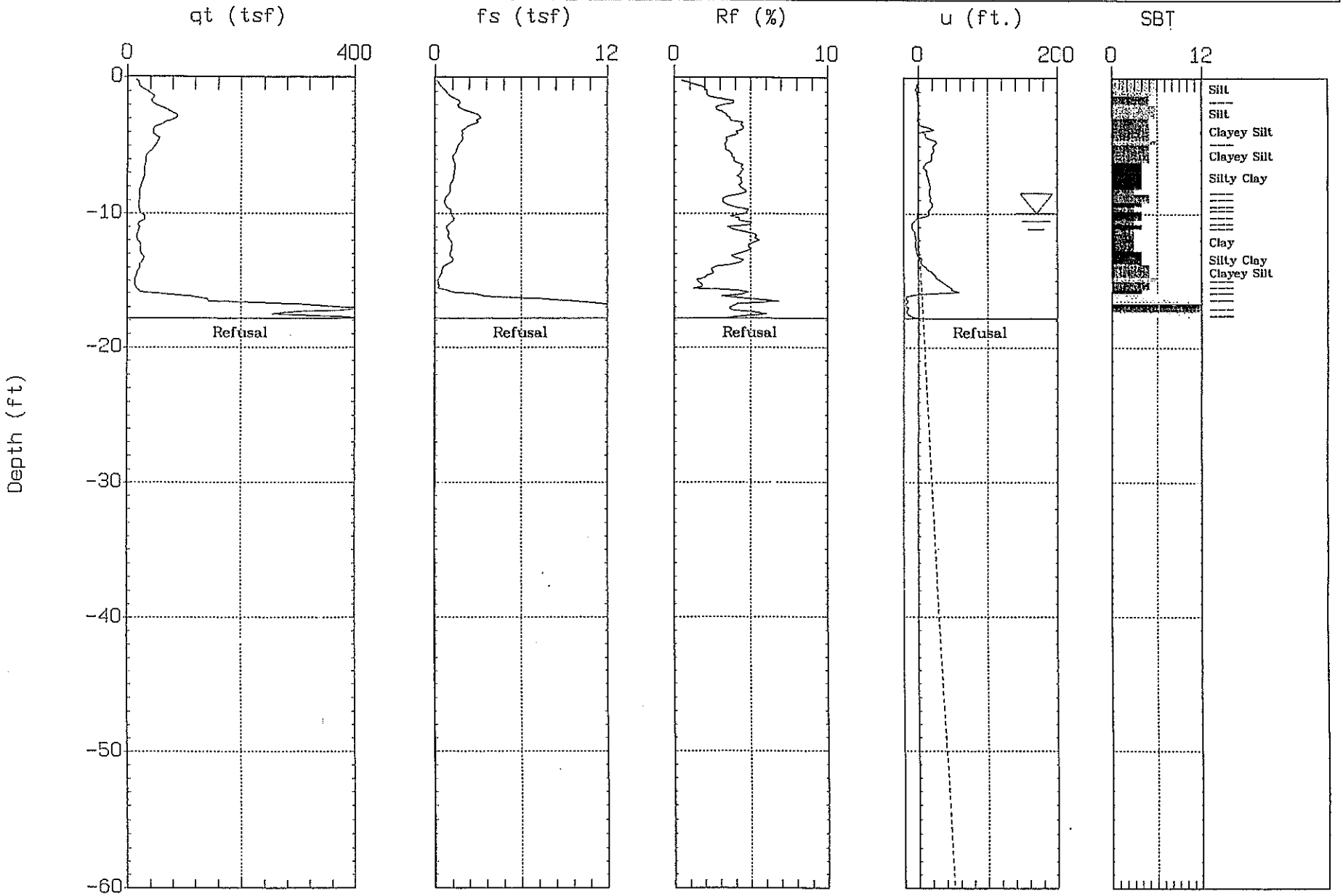
R13370

CONETEC

C.E.C.

Sounding:CPT-8
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:53



Max. Depth: 17.88 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

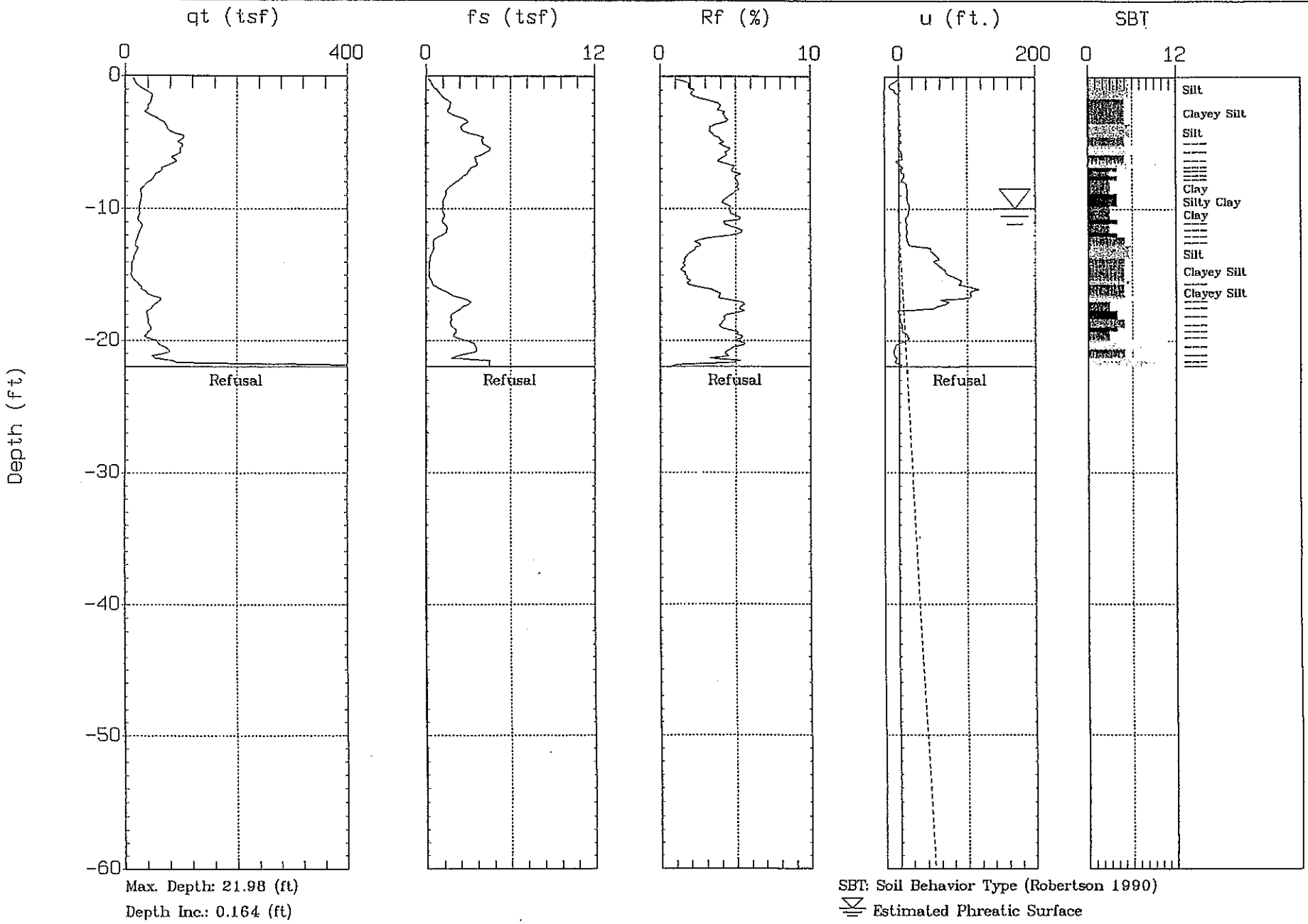
R13371

CONETEC

C.E.C.

Sounding:CPT-9
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:17



Max. Depth: 21.98 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

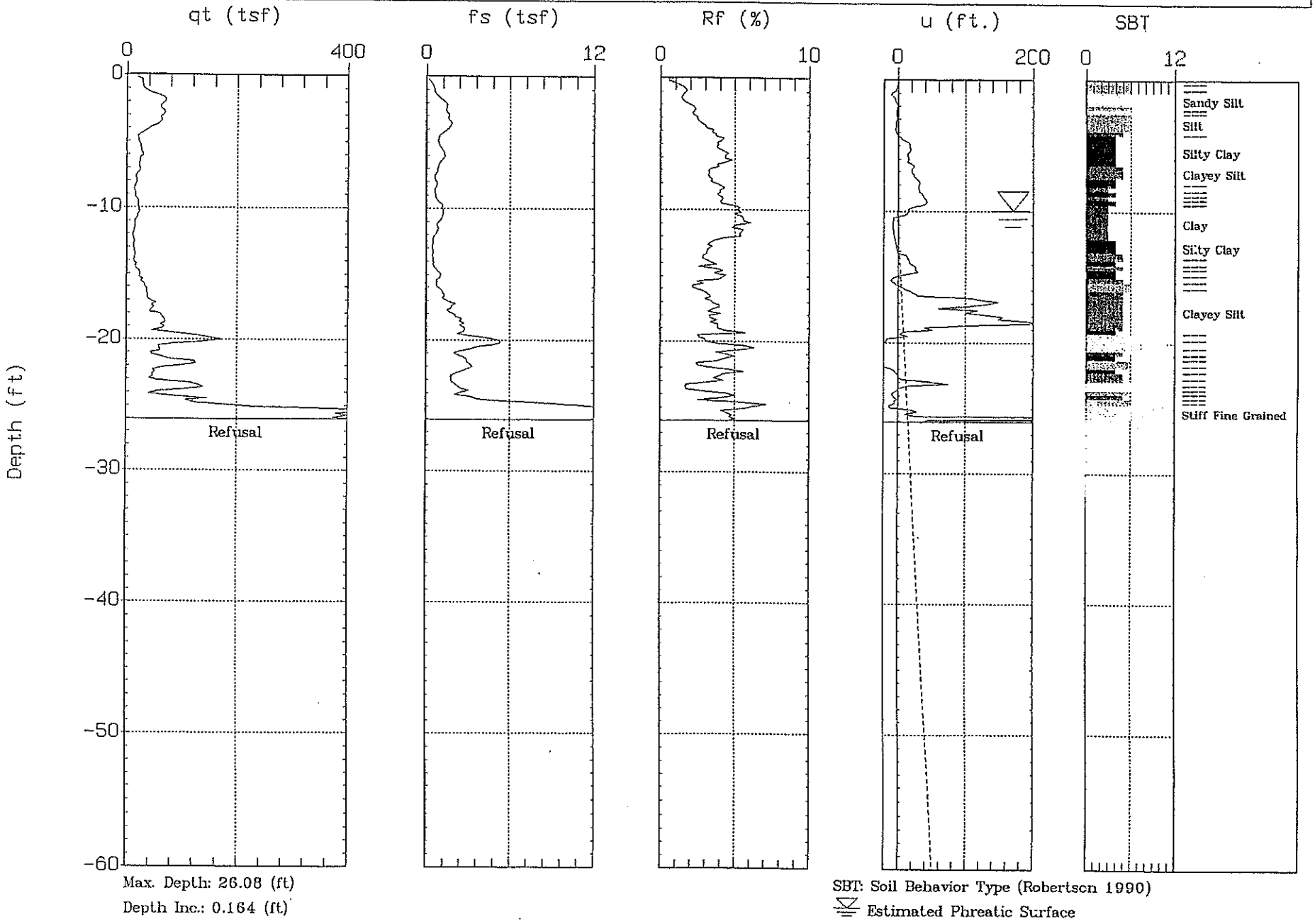
R13372

CONETEC

C.E.C.

Sounding:CPT-10
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 08:35



Max. Depth: 26.08 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

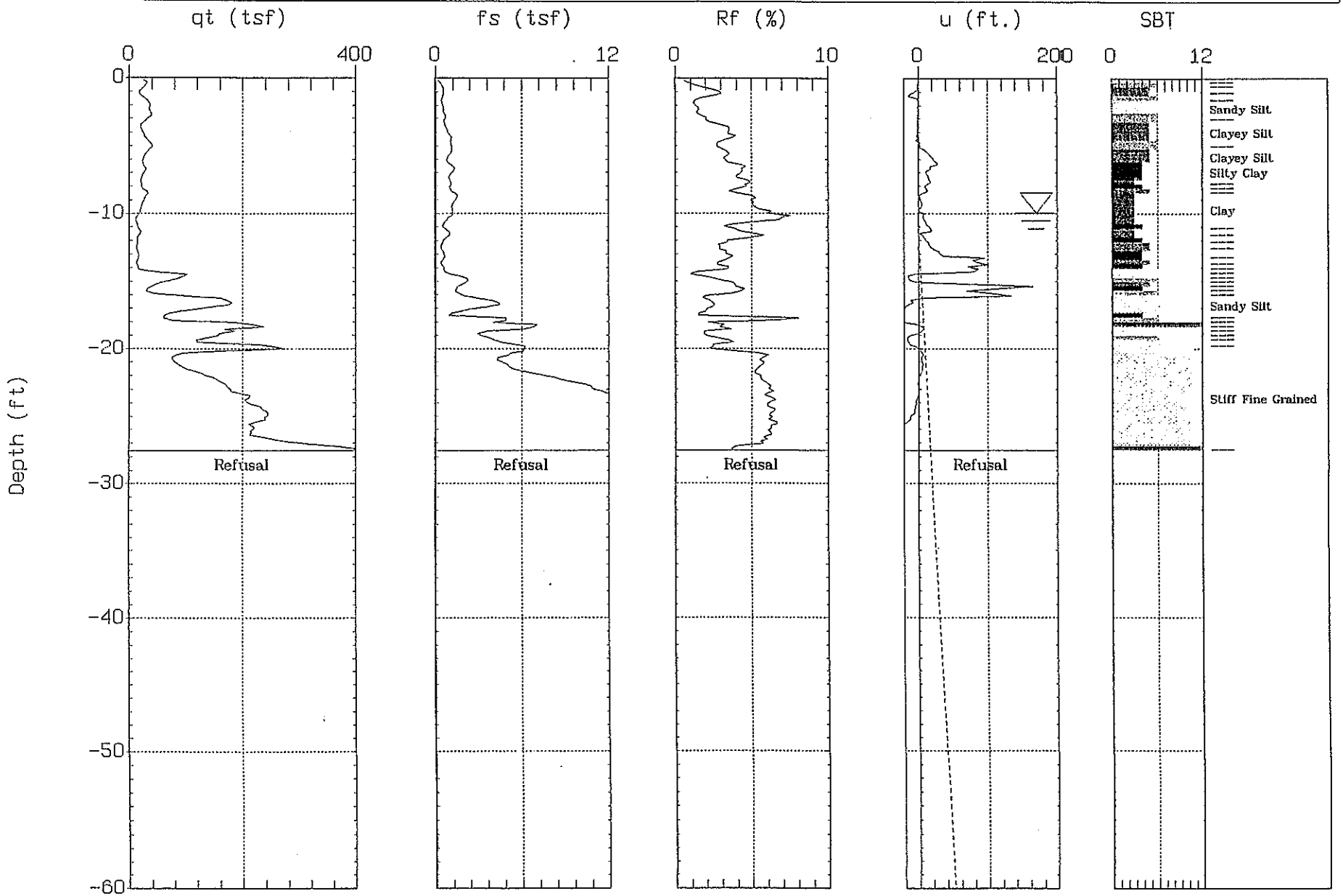
R13373

CONETEC

C.E.C.

Sounding:CPT-11
Site:Pond Creek Mine

Piezocone:20 TCN AD211
Date:10:31:07 10:31



Max. Depth: 27.56 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

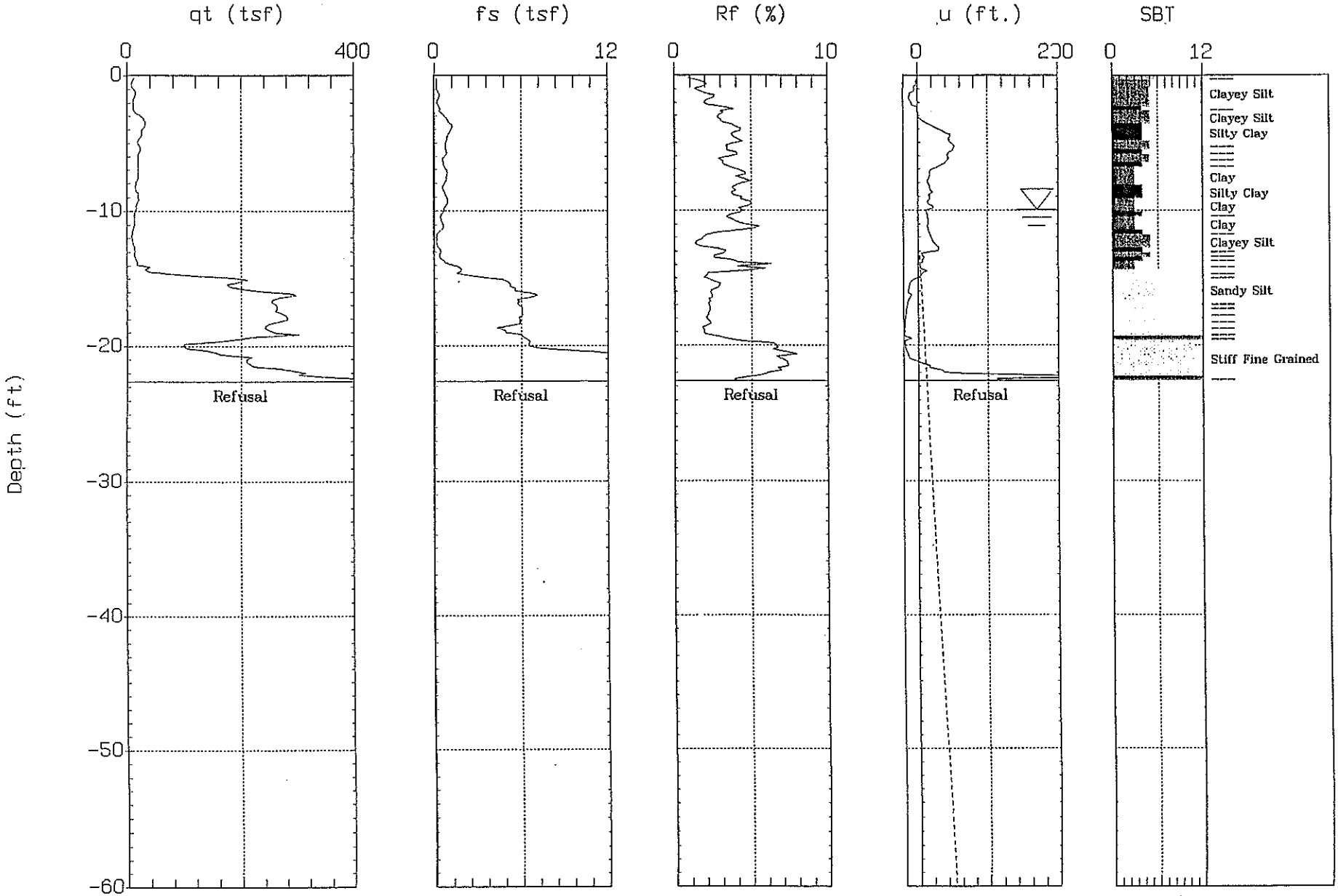
R13374

CONETEC

C.E.C.

Sounding:CPT-12
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 11:15



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

R13375

ConeTec
Environmental and Geotechnical Site Investigation Contractors

ConeTec Interpretations as of June 30, 2004 (Release 1.22A)

ConeTec's interpretation routine provides a tabular output of geotechnical parameters based on current published CPT correlations and is subject to change to reflect the current state of practice. The interpreted values are not considered valid for all soil types. The interpretations are presented only as a guide for geotechnical use and should be carefully scrutinized for consideration in any geotechnical design. Reference to current literature is strongly recommended. ConeTec does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the program and does not assume liability for any use of the results in any design or review. Representative hand calculations should be made for any parameter that is critical for design purposes. The end user of the interpreted output should also be fully aware of the techniques and the limitations of any method used in this program. The purpose of this document is to inform the user as to which methods were used and what the appropriate papers and/or publications are for further reference.

The CPT interpretations are based on values of tip, sleeve friction and pore pressure averaged over a user specified interval (e.g. 0.20m). Note that q_t is the tip resistance corrected for pore pressure effects and q_c is the recorded tip resistance. Since all ConeTec cones have equal end area friction sleeves, pore pressure corrections to sleeve friction, f_s, are not required.

The tip correction is: $q_t = q_c + (1-a) \bullet u_2$

where: q_t is the corrected tip resistance
q_c is the recorded tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the cone (typically 0.85 for ConeTec cones)

The total stress calculations are based on soil unit weights that have been assigned to the Soil Behavior Type zones, from a user defined unit weight profile or by using a single value throughout the profile. Effective vertical overburden stresses are calculated based on a hydrostatic distribution of equilibrium pore pressures below the water table or from a user defined equilibrium pore pressure profile (this can be obtained from CPT dissipation tests). For over water projects the effects of the column of water have been taken into account as has the appropriate unit weight of water. How this is done depends on where the instruments were zeroed (i.e. on deck or at mud line).

Details regarding the interpretation methods for all of the interpreted parameters are provided in Table 1. The appropriate references cited in Table 1 are listed in Table 2. Where methods are based on charts or techniques that are too complex to describe in this summary the user should refer to the cited material.

The estimated Soil Behavior Types (normalized and non-normalized) are based on the charts developed by Robertson and Campanella shown in Figures 1 and 2. The Bq classification charts are not reproduced in this document but can be reviewed in Lunne, Robertson and Powell (1997) or Robertson (1990).

Where the results of a calculation/interpretation are declared *'invalid'* the value will be represented by the text strings "-9999" or "-9999.0". In some cases the value 0 will be used. Invalid results will occur because of (and not limited to) one or a combination of:

1. Invalid or undefined CPT data (e.g. drilled out section or data gap).

2. Where the interpretation method is inappropriate, for example, drained parameters in an undrained material (and vice versa).

3. Where interpretation input values are beyond the range of the referenced charts or specified limitations of the interpretation method.

4. Where pre-requisite or intermediate interpretation calculations are invalid.

The parameters selected for output from the program are often specific to a particular project. As such, not all of the interpreted parameters listed in Table 1 may be included in the output files delivered with this report.

The output files are often delivered in one (or more) of the following three formats:

File Type	Typical Extensions	Description
Printable	IFP, NLP	ASCII files formatted for direct printing either by copying to a printer port, through a text editor or through a dedicated printing routine (such as ConeTec's CTPRINT). Typically formatted for 132 columns wide and 70 lines per page. Any printer would need to be set to have a compressed font (16cpi) as its default.
Importable	IFI, NLI	Tab delimited ASCII files (not for use with text editors) meant for importing into spreadsheet and database applications (e.g. Excel, Lotus, Quattro, Access). Some column and cell formatting maybe required depending on the quality of the application's import utility.
Spreadsheet	XLS	IFI, NLI files exported directly to Excel format. Column and cell formatting has been done. Header information is exported to start in Column C allowing the depth columns A and/or B to be duplicated on each printed page without repetition of part of the header information.

Table 1
CPT Interpretation Methods

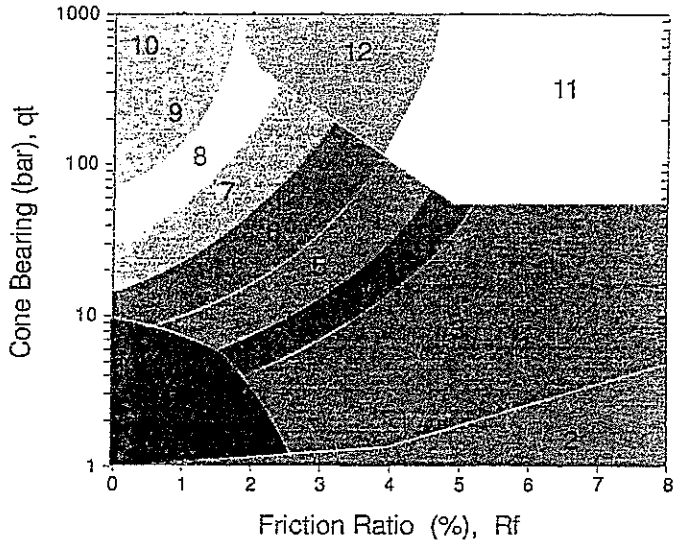
Interpreted Parameter	Description	Equation	Ref
Depth	Mid Layer Depth *(where interpretations are done at each point then Mid Layer Depth = Recorded Depth)*	*Depth (Layer Top) + Depth (Layer Bottom) / 2.0*	
Elevation	Elevation of Mid Layer based on sounding collar elevation supplied by client	Elevation = Collar Elevation - Depth	
Avgqc	Averaged recorded tip value (q_c)	$Avgqc = \frac{1}{n}\sum_{i=1}^{n} q_c$ *n=1 when interpretations are done at each point*	
Avgqt	Averaged corrected tip (q_t) where: $q_t = q_c + (1-a) \bullet u$	$Avgqt = \frac{1}{n}\sum_{i=1}^{n} q_t$ *n=1 when interpretations are done at each point*	
Avgfs	Averaged sleeve friction (f_s)	$Avgfs = \frac{1}{n}\sum_{i=1}^{n} fs$ *n=1 when interpretations are done at each point*	
AvgRf	Averaged friction ratio (Rf) where friction ratio is defined as: $Rf = 100\% \bullet \frac{fs}{qt}$	$AvgRf = 100\% \bullet \frac{Avgfs}{Avgqt}$ *n=1 when interpretations are done at each point*	
Avgu	Averaged dynamic pore pressure *(u)*	$Avgu = \frac{1}{n}\sum_{i=1}^{n} u_i$ *n=1 when interpretations are done at each point*	
AvgRes	Averaged Resistivity (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} RESISTIVITY_i$ *n=1 when interpretations are done at each point*	

Interpreted Parameter	Description	Equation	Ref
AvgUVIF	Averaged UVIF ultra-violet induced fluorescence (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} UVIF_i$ *n=1 when interpretations are done at each point*	
AvgTemp	Averaged Temperature (this data is not always available since it is a specialized test)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} TEMPERATURE_i$ *n=1 when interpretations are done at each point*	
AvgGamma	Averaged Gamma Counts (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} GAMMA_i$ *n=1 when interpretations are done at each point*	
SBT	Soil Behavior Type as defined by Robertson and Campanella	See Figure 1	2, 5
U.Wt.	Unit Weight of soil determined from one of the following user selectable options: 1) uniform value 2) value assigned to each SBT zone 3) user supplied unit weight profile	See references	5
T. Stress σ_V	Total vertical overburden stress at Mid Layer Depth. *A layer is defined as the averaging interval specified by the user. For data interpreted at each point the Mid Layer Depth is the same as the recorded depth.*	$TStress = \sum_{i=1}^{n} \gamma_i h_i$ where γ_i is layer unit weight h_i is layer thickness	
E. Stress σ_V'	Effective vertical overburden stress at Mid Layer Depth	$Estress = Tstress - u_{eq}$	
Ueq	Equilibrium pore pressure determined from one of the following user selectable options: 1) hydrostatic from water table depth 2) user supplied profile	For hydrostatic option: $u_{eq} = \gamma_w \bullet (D - D_{wt})$ where u_{eq} is equilibrium pore pressure γ_w is unit weight of water D is the current depth D_{wt} is the depth to the water table	
Cn	SPT N_{60} overburden correction factor	$Cn=(\sigma_V')^{-0.5}$ where σ_V' *is in tsf* $0.5 < C_n < 2.0$	
N_{60}	SPT N value at 60% energy calculated from qt/N ratios assigned to each SBT zone. This method has abrupt N value changes at zone boundaries.	*See Figure 1*	4, 5
$(N_1)_{60}$	SPT N_{60} value corrected for overburden pressure	$(N_1)_{60} = Cn \bullet N_{60}$	4
$N_{60}I_c$	SPT N_{60} values based on the Ic parameter	(qt/pa)/ N_{60} = 8.5 (1 – Ic/4.6)	5
$(N_1)_{60}Ic$	SPT N_{60} value corrected for overburden pressure (using N_{60} I_c). User has 2 options.	1) $(N_1)_{60}Ic = Cn \bullet (N_{60}Ic)$ 2) $q_{c1n}/(N_1)_{60}Ic$ = 8.5 (1 – Ic/4.6)	4 5
$(N_1)_{60cs}Ic$	Clean sand equivalent SPT $(N_1)_{60}Ic$. User has 3 options.	1) $(N_1)_{60cs}Ic = \alpha + \beta((N_1)_{60}Ic)$ 2) $(N_1)_{60cs}Ic = K_{SPT} * ((N_1)_{60}Ic)$ 3) $q_{c1ncs}/(N_1)_{60cs}Ic$ = 8.5 (1 – Ic/4.6) FC ≤ 5%: $\alpha = 0$, $\beta = 1.0$ FC ≥ 35% $\alpha = 5.0$, $\beta = 1.2$ 5% < FC < 35% $\alpha = \exp[1.76 - (190/FC^2)]$ $\beta = [0.99 + (FC^{1.5}/1000)]$	10 10 5
Su	Undrained shear strength - N_{kt} is user selectable	$Su = \frac{qt - \sigma_v}{N_{kt}}$	1, 5
k	Coefficient of permeability (assigned to each SBT zone)		5

Interpreted Parameter	Description	Equation	Ref
Bq	Pore pressure parameter	$Bq = \frac{\Delta u}{qt - \sigma_v}$ where: $\Delta u = u - u_{eq}$ and u = dynamic pore pressure u_{eq} = equilibrium pore pressure	1, 5
Q_t	Normalized q_t for Soil Behavior Type classification as defined by Robertson, 1990	$Qt = \frac{qt - \sigma_v}{\sigma'_v}$	2, 5
F_r	Normalized Friction Ratio for Soil Behavior Type classification as defined by Robertson, 1990	$Fr = 100\% \bullet \frac{fs}{qt - \sigma_v}$	2, 5
SBTn	Normalized Soil Behavior Type as defined by Robertson and Campanella	See Figure 2	2, 5
SBT-BQ	Non-normalized soil behavior type based on the Bq parameter	See Figure 5.7 (reference 5)	2, 5
SBT-BQn	Normalized Soil Behavior base on the Bq parameter	See Figure 5.8 (reference 5) or Figure 3 (reference 2)	2, 5
I_c	Soil index for estimating grain characteristics	$Ic = [(3.47 - \log_{10}Q)^2 + (\log_{10} Fr + 1.22)^2]^{0.5}$ Where: $Q = \left(\frac{qt - \sigma_v}{P_{a2}}\right)\left(\frac{P_a}{\sigma'_v}\right)^n$ And Fr is in percent P_a = atmospheric pressure P_{a2} = atmospheric pressure n varies from 0.5 to 1.0 and is selected in an iterative manner based on the resulting I_c	3, 8
FC	Apparent fines content (%)	$FC = 1.75(Ic^{3.25}) - 3.7$ $FC = 100$ for $Ic > 3.5$ $FC = 0$ for $Ic < 1.26$ $FC = 5\%$ if $1.64 < Ic < 2.6$ AND $F_r < 0.5$	3
Ic Zone	This parameter is the Soil Behavior Type zone based on the Ic parameter (valid for zones 2 through 7 on SBTn chart)	Ic < 1.31 Zone = 7 1.31 < Ic < 2.05 Zone = 6 2.05 < Ic < 2.60 Zone = 5 2.60 < Ic < 2.95 Zone = 4 2.95 < Ic < 3.60 Zone = 3 Ic > 3.60 Zone = 2	3
PHI ϕ	Friction Angle determined from one of the following user selectable options: a) Campanella and Robertson b) Durgunoglu and Mitchel c) Janbu	See reference	5
Dr	Relative Density determined from one of the following user selectable options: a) Ticino Sand b) Hokksund Sand c) Schmertmann 1976 d) Jamiolkowski - All Sands	See reference	5

Interpreted Parameter	Description	Equation	Ref
OCR	Over Consolidation Ratio	a) Based on Schmertmann's method involving a plot of $S_u/\sigma_v' / (S_u/\sigma_v')_{NC}$ and OCR where the Su/p' ratio for NC clay is user selectable	9
State Parameter	The state parameter is used to describe whether a soil is contractive (SP is positive) or dilative (SP is negative) at large strains based on the work by Been and Jefferies	See reference	8, 6, 5
Es/qt	Intermediate parameter for calculating Youngs Modulus, E, in sands. It is the Y axis of the reference chart.	Based on Figure 5.59 in the reference	5
Youngs Modulus E	Youngs Modulus based on the work by Baldi. There are three types of sands considered in this technique. The user selects the appropriate type for the site from: a) OC Sands b) Aged NC Sands c) Recent NC Sands Each sand type has a family of curves that depend on mean normal stress. The program calculates mean normal stress and linearly interpolates between the two extremes provided in Baldi's chart.	Mean normal stress is evaluated from: $\sigma_m' = \frac{1}{3} \cdot (\sigma_v' + \sigma_h' + \sigma_h')$ where σ_v'= vertical effective stress σ_h'= horizontal effective stress and $\sigma_h = K_o * \sigma_v'$ with Ko assumed to be 0.5	5
q_{c1}	q_t normalized for overburden stress used for seismic analysis	$q_{c1} = q_t \cdot (Pa/\sigma_v')^{0.5}$ where: Pa = atm. Pressure q_t is in Mpa	3
q_{c1n}	q_{c1} in dimensionless form used for seismic analysis	$q_{c1n} = (q_{c1} / Pa)(Pa/\sigma_v')$ where: Pa = atm. Pressure and n ranges from 0.5 to 0.75 based on Ic.	3
K_{SPT}	Equivalent clean sand factor for $(N_1)60$	$K_{SPT} = 1 + ((0.75/30) * (FC - 5))$	10
K_{CPT}	Equivalent clean sand correction for q_{c1N}	$K_{cpt} = 1.0$ for $I_c \leq 1.64$ $K_{cpt} = f(I_c)$ for $I_c > 1.64$ *(see reference)*	10
q_{c1ncs}	Clean sand equivalent q_{c1n}	$q_{c1ncs} = q_{c1n} \cdot K_{cpt}$	3
CRR	Cyclic Resistance Ratio (for Magnitude 7.5)	$q_{c1ncs} < 50$: $CRR_{7.5} = 0.833 [(q_{c1ncs}/1000] + 0.05$ $50 \leq q_{c1ncs} < 160$: $CRR_{7.5} = 93 [(q_{c1ncs}/1000]^3 + 0.08$	10
CSR	Cyclic Stress Ratio	$CSR = (\tau_{av}/\sigma_v') = 0.65 (a_{max} / g) (\sigma_v/ \sigma_v') r_d$ $r_d = 1.0 - 0.00765\ z$ $z \leq 9.15m$ $r_d = 1.174 - 0.0267\ z$ $9.15 < z \leq 23m$ $r_d = 0.744 - 0.008\ z$ $23 < z \leq 30m$ $r_d = 0.50$ $z > 30m$	10

Interpreted Parameter	Description	Equation	Ref
MSF	Magnitude Scaling Factor	See Reference	10
FofS	Factor of Safety against Liquefaction	FS = ($CRR_{7.5}$ / CSR) MSF	10
Liquefaction Status	Statement indicating possible liquefaction	Takes into account FofS and limitations based I_c and q_{c1ncs}.	10



Zone	qt / N	Soil Behavior Type
1	2	sensitive fine grained
2	1	organic material
3	1	clay
4	1.5	silty clay to clay
5	2	clayey silt to silty clay
6	2.5	sandy silt to clayey silt
7	3	silty sand to sandy silt
8	4	sand to silty sand
9	5	sand
10	6	gravelly sand to sand
11	1	very stiff fine grained *
12	2	sand to clayey sand *

* overconsolidated or cemented

Figure 1 Non-Normalized Behavior Type Classification Chart

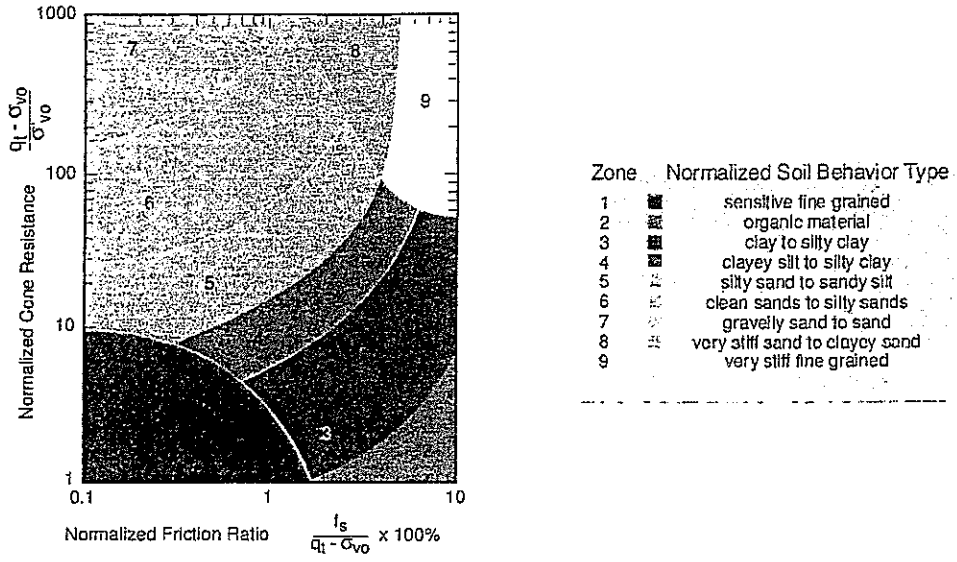


Figure 2 Normalized Behavior Type Classification Chart

Table 2 References

No.	References
1	Robertson, P.K., Campanella, R.G., Gillespie, D. and Greig, J., 1986, "Use of Piezometer Cone Data", Proceedings of InSitu 86, ASCE Specialty Conference, Blacksburg, Virginia.
2	Robertson, P.K., 1990, "Soil Classification Using the Cone Penetration Test", Canadian Geotechnical Journal, Volume 27.
3	Robertson, P.K. and Fear, C.E., 1998, "Evaluating cyclic liquefaction potential using the cone penetration test", Canadian Geotechnical Journal, 35: 442-459.
4	Robertson, P.K. and Wride, C.E., 1998, "Cyclic Liquefaction and its Evaluation Based on SPT and CPT", NCEER Workshop Paper, January 22, 1997
5	Lunne, T., Robertson, P.K. and Powell, J. J. M., 1997, " Cone Penetration Testing in Geotechnical Practice," Blackie Academic and Professional.
6	Plewes, H.D., Davies, M.P. and Jefferies, M.G., 1992, "CPT Based Screening Procedure for Evaluating Liquefaction Susceptibility", 45th Canadian Geotechnical Conference, Toronto, Ontario, October 1992.
7	Jefferies, M.G. and Davies, M.P., 1993. "Use of CPTu to Estimate equivalent N_{60}", Geotechnical Testing Journal, 16(4): 458-467.
8	Been, K. and Jefferies, M.P., 1985, "A state parameter for sands", Geotechnique, 35(2), 99-112.
9	Schmertmann, 1977, "Guidelines for Cone Penetration Test Performance and Design", Federal Highway Administration Report FHWA-TS-78-209, U.S. Department of Transportation
10	Proceedings of theNCEER Workshop on Evaluation of Liquefaction Resistance of Soils, Salt LakeCity, 1996. Chaired by Leslie Youd.

CONETEC

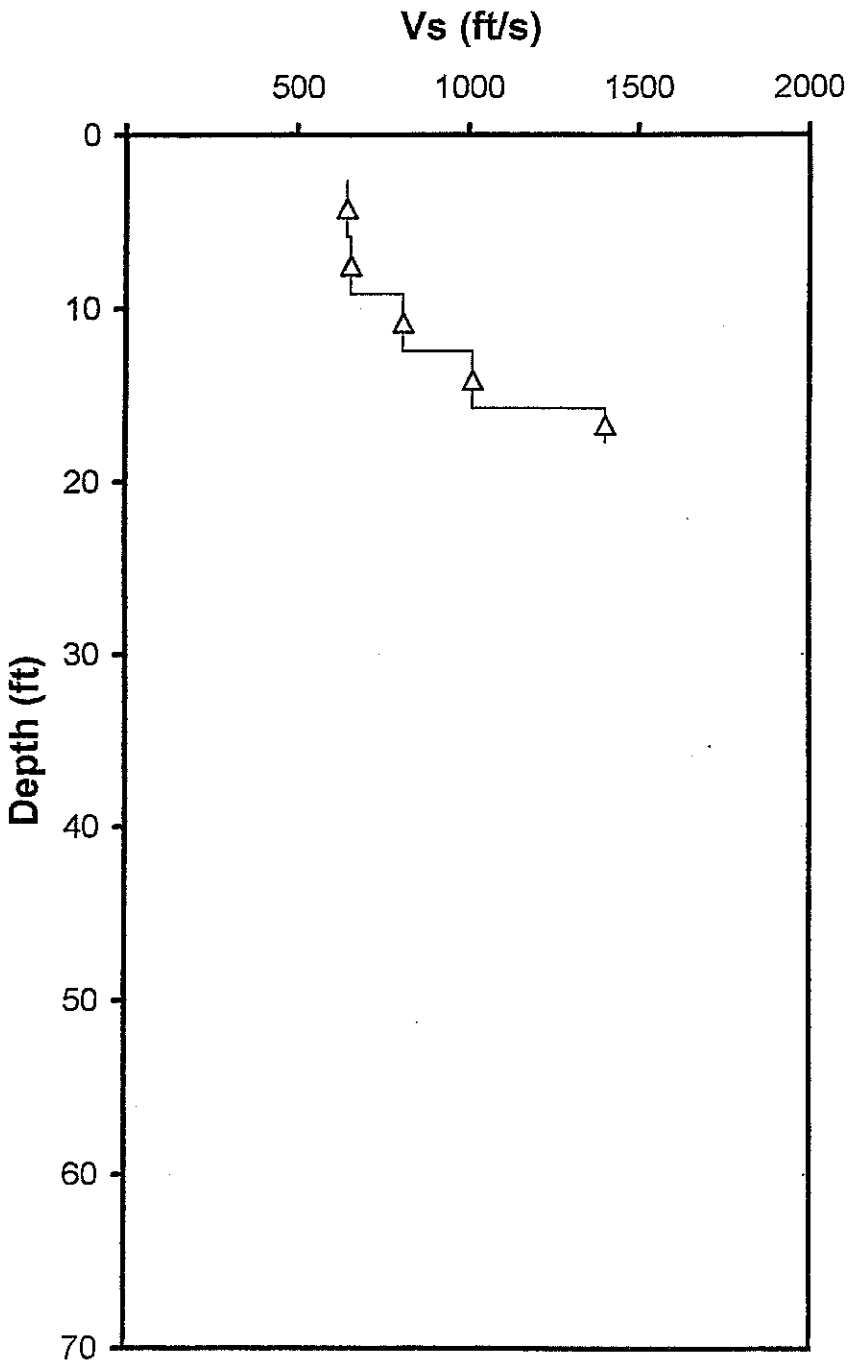
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-1
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	4.76	4.26	645
9.84	9.18	9.31	3.21	4.90	7.54	656
13.12	12.46	12.55	3.25	4.02	10.82	808
16.40	15.74	15.82	3.26	3.22	14.10	1013
18.37	17.71	17.78	1.96	1.40	16.73	1402

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-1
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-2
Site	Williamson County, Illinois
Date	10/30/2007

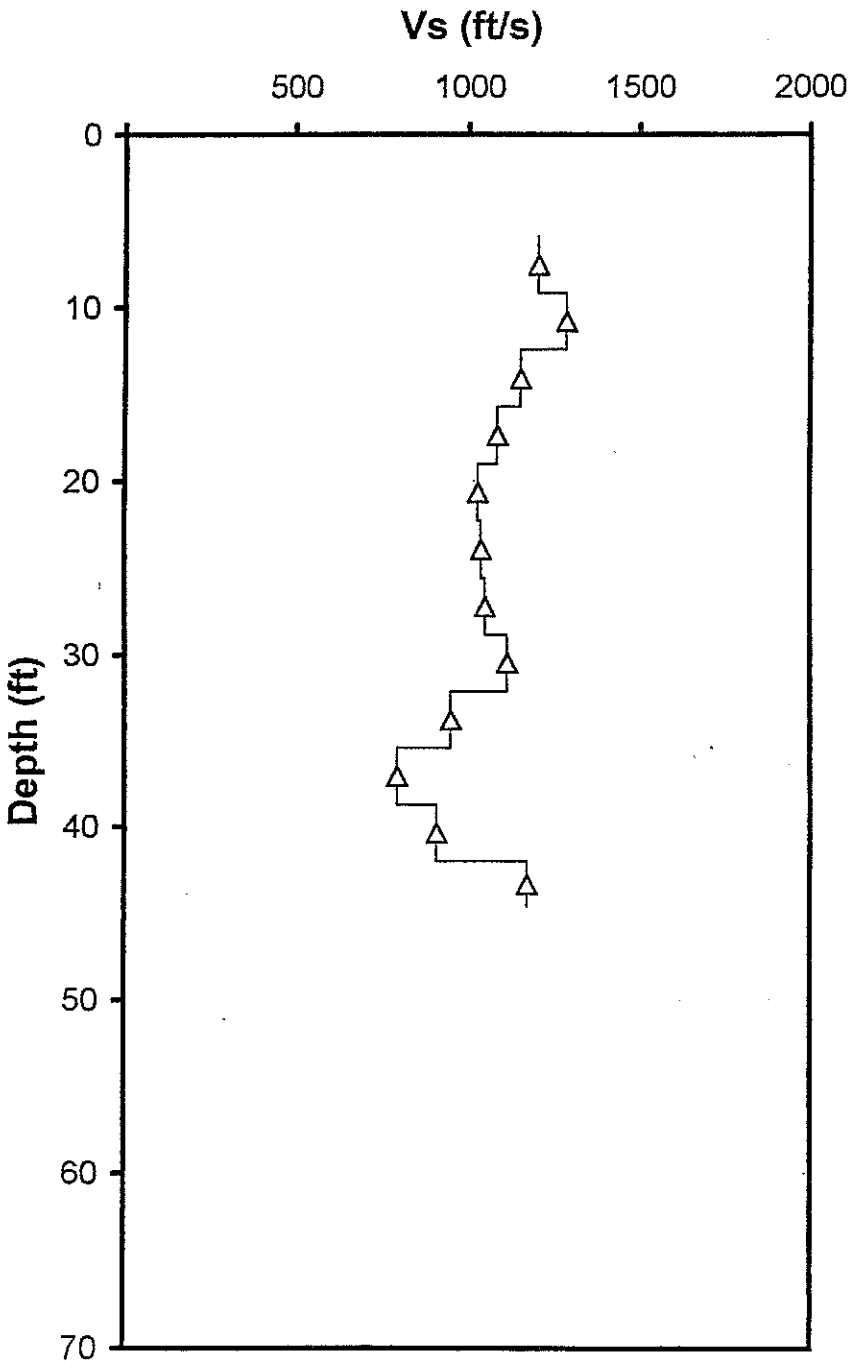
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	2.67	7.54	1204
13.12	12.46	12.55	3.25	2.53	10.82	1284
16.40	15.74	15.82	3.26	2.83	14.10	1152
19.69	19.03	19.09	3.28	3.02	17.39	1085
22.97	22.31	22.36	3.27	3.18	20.67	1029
26.25	25.59	25.64	3.27	3.15	23.95	1039
29.53	28.87	28.91	3.28	3.12	27.23	1050
32.81	32.15	32.19	3.28	2.94	30.51	1114
36.09	35.43	35.47	3.28	3.45	33.79	950
39.37	38.71	38.74	3.28	4.12	37.07	795
42.65	41.99	42.02	3.28	3.61	40.35	908
45.28	44.62	44.65	2.63	2.24	43.31	1173

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-2
Date: October 30, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-2A
Site	Williamson County, Illinois
Date	10/30/2007

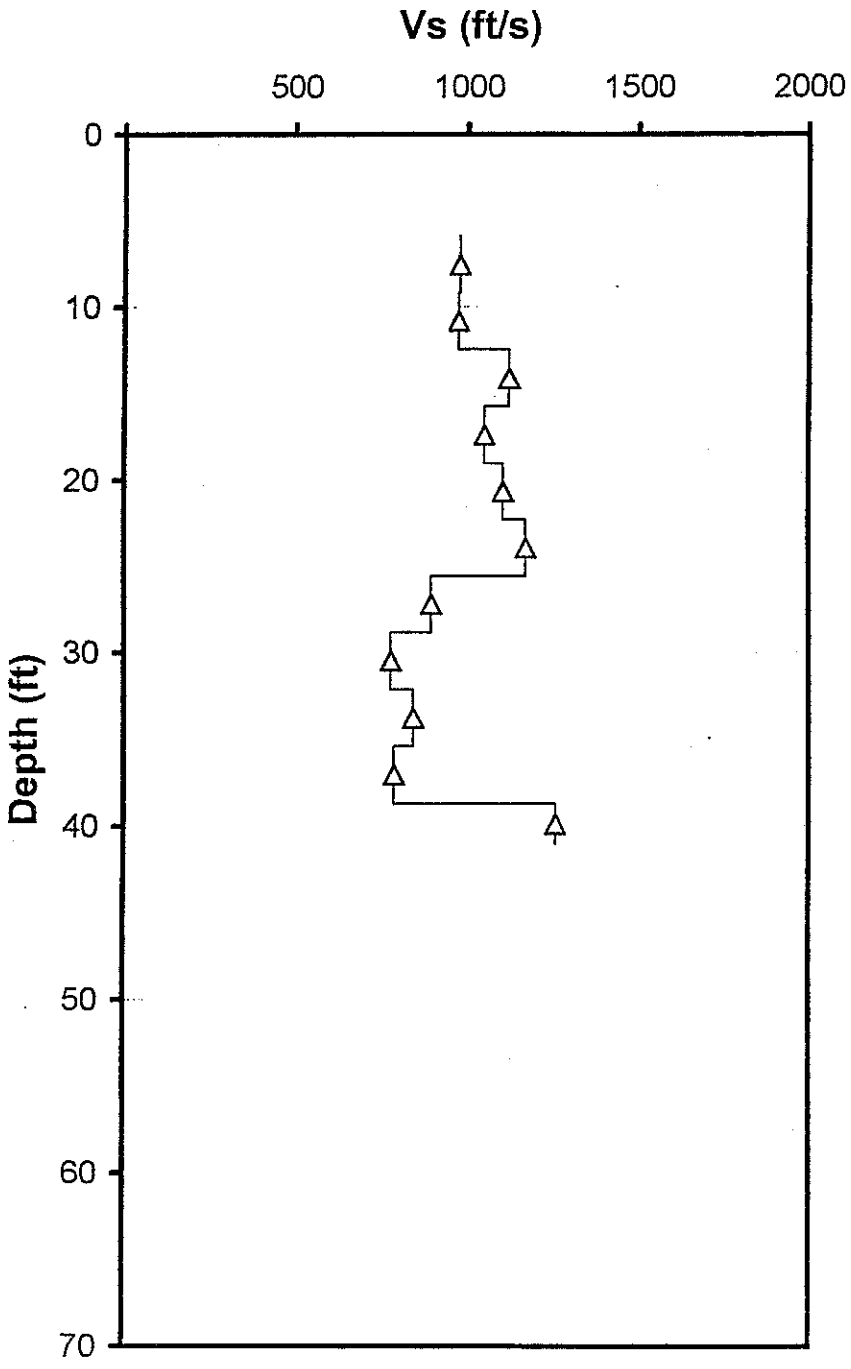
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	3.29	7.54	977
13.12	12.46	12.55	3.25	3.34	10.82	973
16.40	15.74	15.82	3.26	2.91	14.10	1121
19.69	19.03	19.09	3.28	3.12	17.39	1051
22.97	22.31	22.36	3.27	2.96	20.67	1105
26.25	25.59	25.64	3.27	2.80	23.95	1169
29.53	28.87	28.91	3.28	3.66	27.23	895
32.81	32.15	32.19	3.28	4.20	30.51	780
36.09	35.43	35.47	3.28	3.88	33.79	845
39.37	38.71	38.74	3.28	4.15	37.07	790
41.67	41.01	41.04	2.30	1.83	39.86	1256

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-2A
Date: October 30, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-3
Site	Williamson County, Illinois
Date	10/31/2007

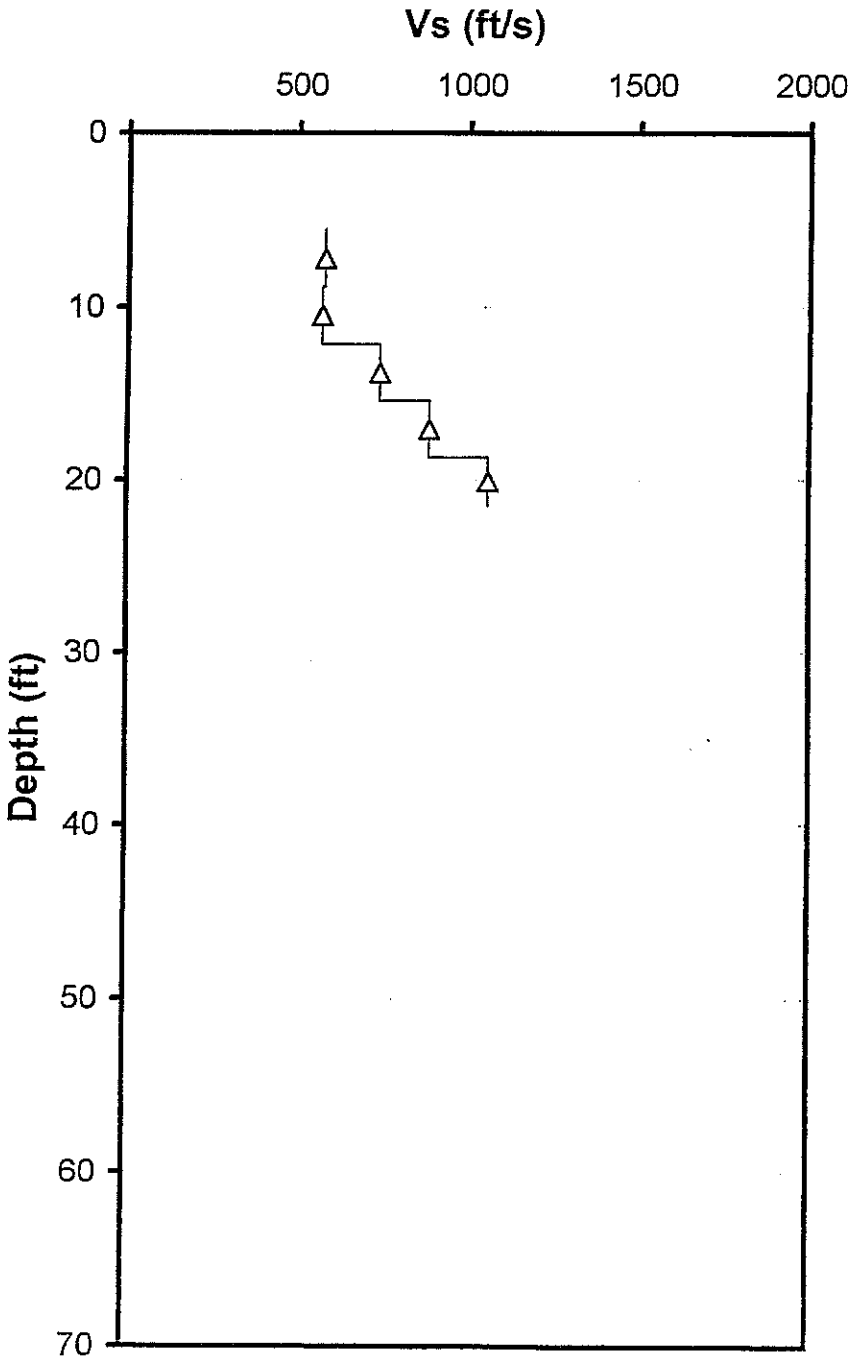
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.23	5.57	5.77				
9.51	8.85	8.98	3.21	5.56	7.21	577
12.80	12.14	12.24	3.26	5.72	10.50	569
16.08	15.42	15.50	3.26	4.42	13.78	738
19.36	18.70	18.76	3.27	3.70	17.06	883
22.15	21.49	21.55	2.78	2.63	20.10	1058

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-3
Date: October 31, 2007



CONETEC

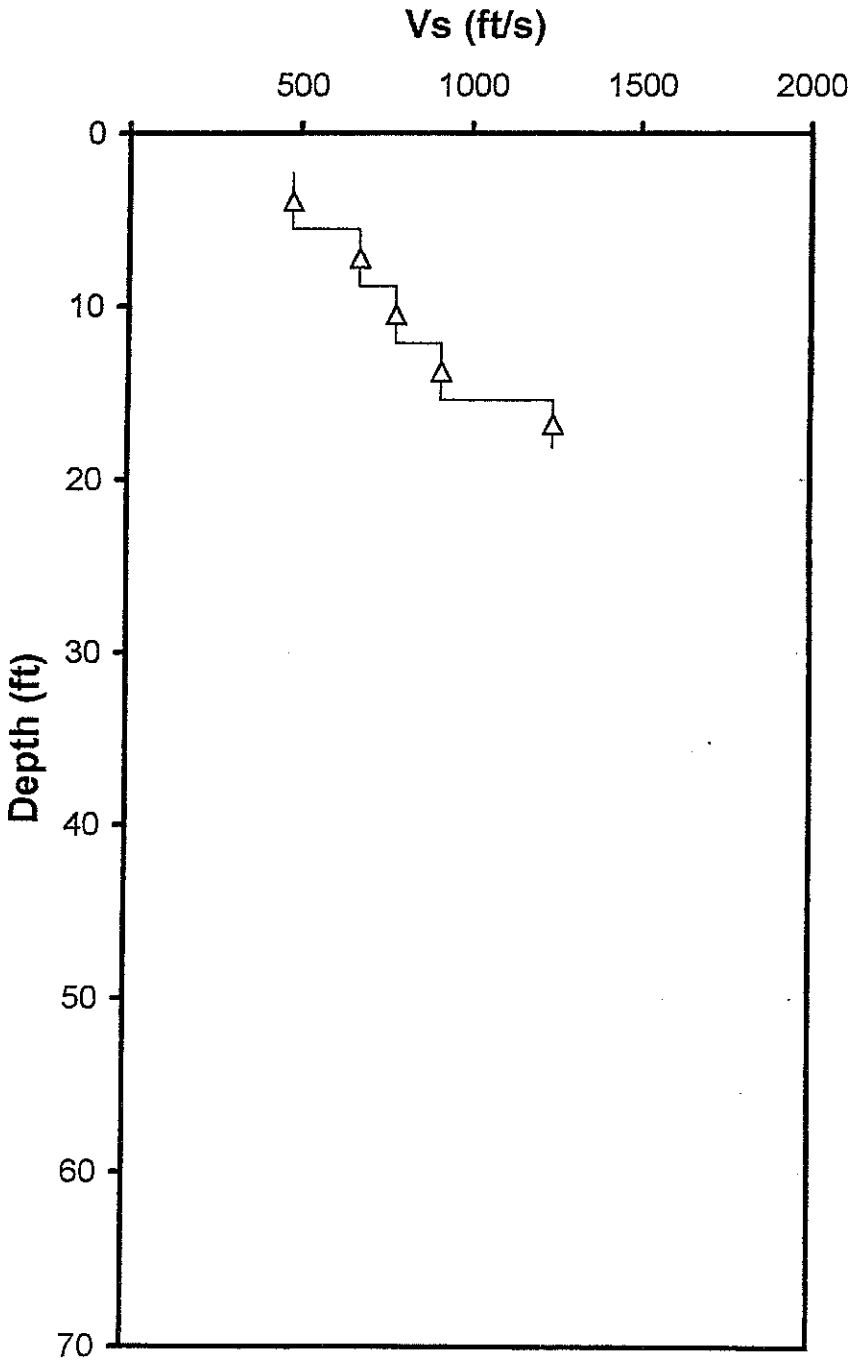
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-4
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
2.95	2.29	2.74				
6.23	5.57	5.77	3.03	6.37	3.93	476
9.51	8.85	8.98	3.21	4.77	7.21	673
12.80	12.14	12.24	3.26	4.17	10.50	781
16.08	15.42	15.50	3.26	3.57	13.78	913
18.86	18.20	18.27	2.77	2.23	16.81	1242

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-4
Date: October 31, 2007



CONETEC

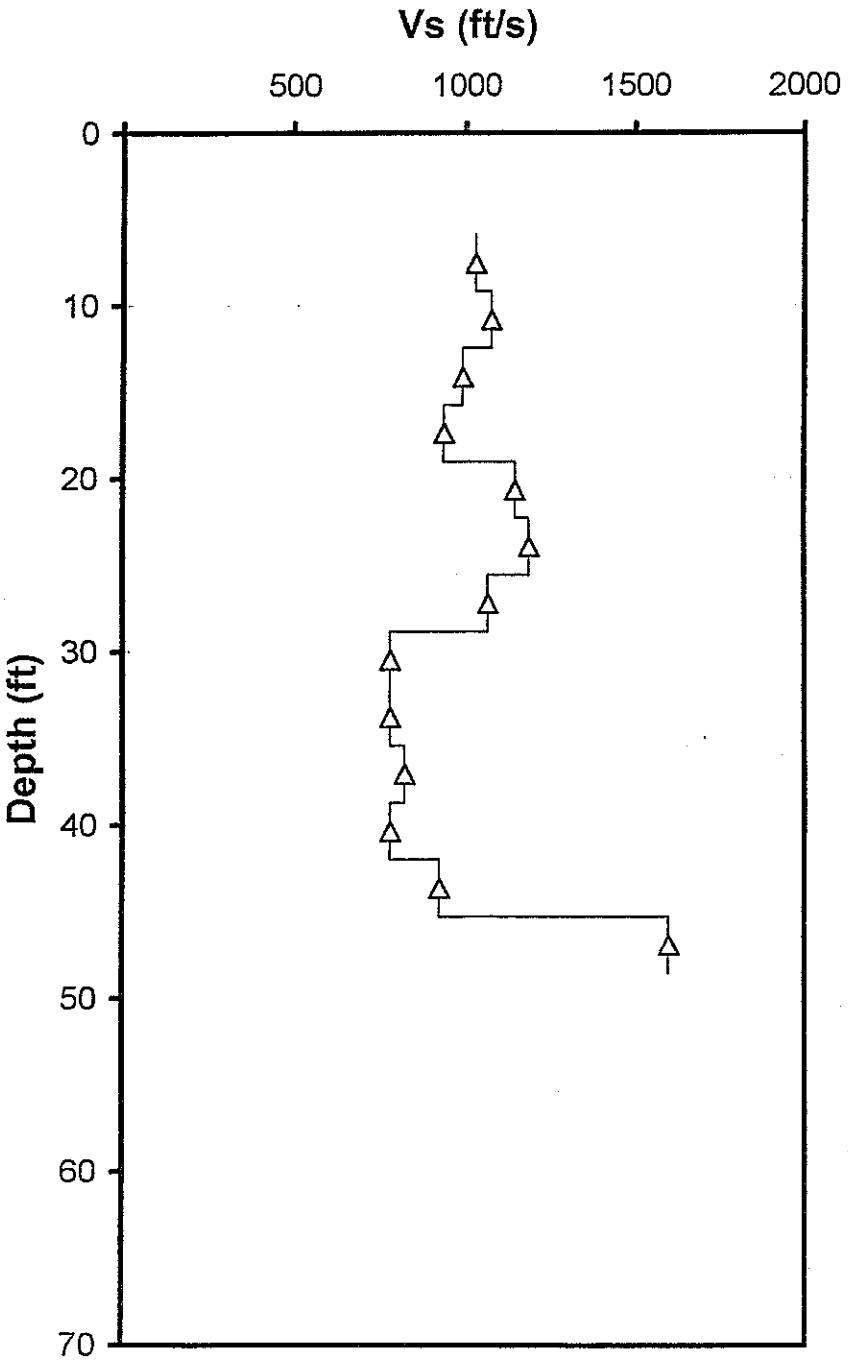
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-5
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	3.12	7.54	1030
13.12	12.46	12.55	3.25	3.02	10.82	1076
16.40	15.74	15.82	3.26	3.29	14.10	991
19.69	19.03	19.09	3.28	3.50	17.39	936
22.97	22.31	22.36	3.27	2.85	20.67	1148
26.25	25.59	25.64	3.27	2.75	23.95	1190
29.53	28.87	28.91	3.28	3.07	27.23	1067
32.81	32.15	32.19	3.28	4.20	30.51	780
36.09	35.43	35.47	3.28	4.20	33.79	780
39.37	38.71	38.74	3.28	3.99	37.07	821
42.65	41.99	42.02	3.28	4.20	40.35	780
45.93	45.27	45.30	3.28	3.55	43.63	923
49.21	48.55	48.58	3.28	2.05	46.91	1599

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-5
Date: October 30, 2007



CONETEC

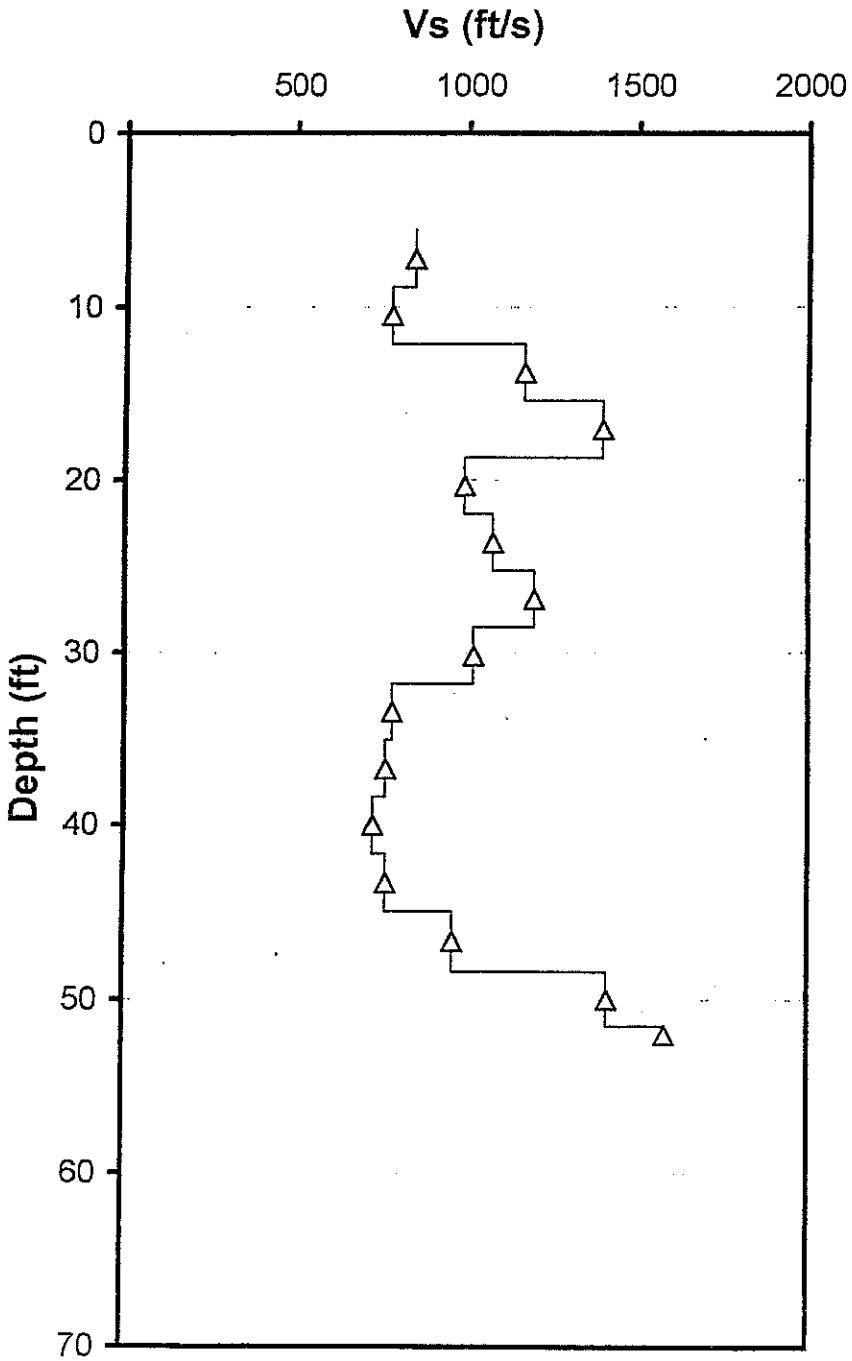
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-5A
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.23	5.57	5.77				
9.51	8.85	8.98	3.21	3.80	7.21	844
12.80	12.14	12.24	3.26	4.18	10.50	779
16.08	15.42	15.50	3.26	2.80	13.78	1164
19.36	18.70	18.76	3.27	2.34	17.06	1396
22.64	21.98	22.03	3.27	3.29	20.34	994
25.92	25.26	25.31	3.27	3.04	23.62	1077
29.20	28.54	28.58	3.27	2.74	26.90	1195
32.48	31.82	31.86	3.28	3.21	30.18	1021
35.76	35.10	35.14	3.28	4.18	33.46	784
39.04	38.38	38.41	3.28	4.29	36.74	764
42.32	41.66	41.69	3.28	4.50	40.02	728
45.60	44.94	44.97	3.28	4.27	43.30	768
49.05	48.39	48.42	3.45	3.59	46.67	961
52.17	51.51	51.54	3.12	2.21	49.95	1411
53.15	52.49	52.52	0.98	0.62	52.00	1580

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-5A
Date: October 30, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-5B
Site	Williamson County, Illinois
Date	10/30/2007

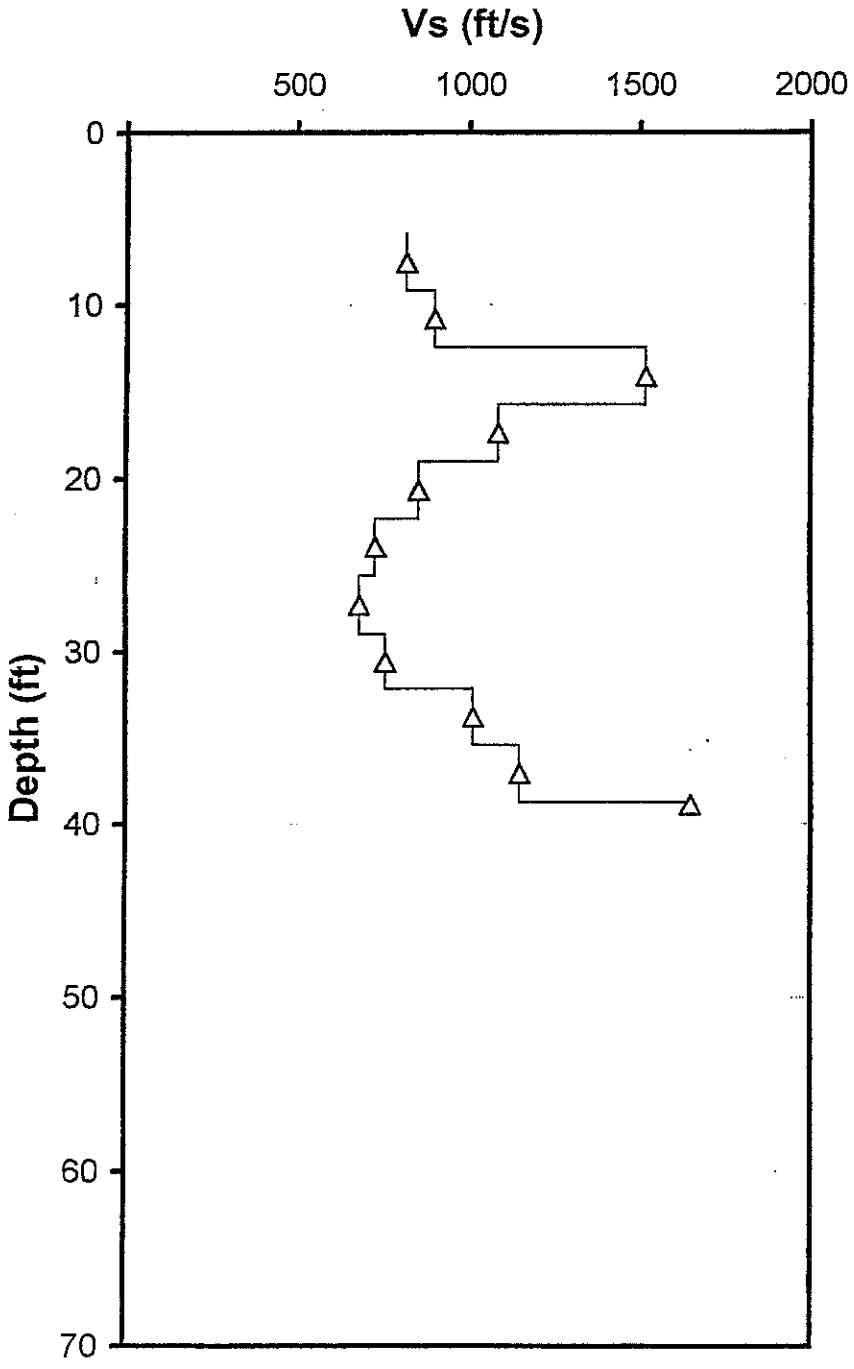
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	3.93	7.54	818
13.12	12.46	12.55	3.25	3.61	10.82	900
16.40	15.74	15.82	3.26	2.15	14.10	1517
19.69	19.03	19.09	3.28	3.02	17.39	1085
22.97	22.31	22.36	3.27	3.82	20.67	856
26.25	25.59	25.64	3.27	4.47	23.95	732
29.69	29.03	29.07	3.43	5.01	27.31	686
32.81	32.15	32.19	3.12	4.09	30.59	762
36.09	35.43	35.47	3.28	3.23	33.79	1014
39.37	38.71	38.74	3.28	2.85	37.07	1150
39.70	39.04	39.07	0.33	0.20	38.88	1649

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-5B
Date: October 30, 2007



CONETEC

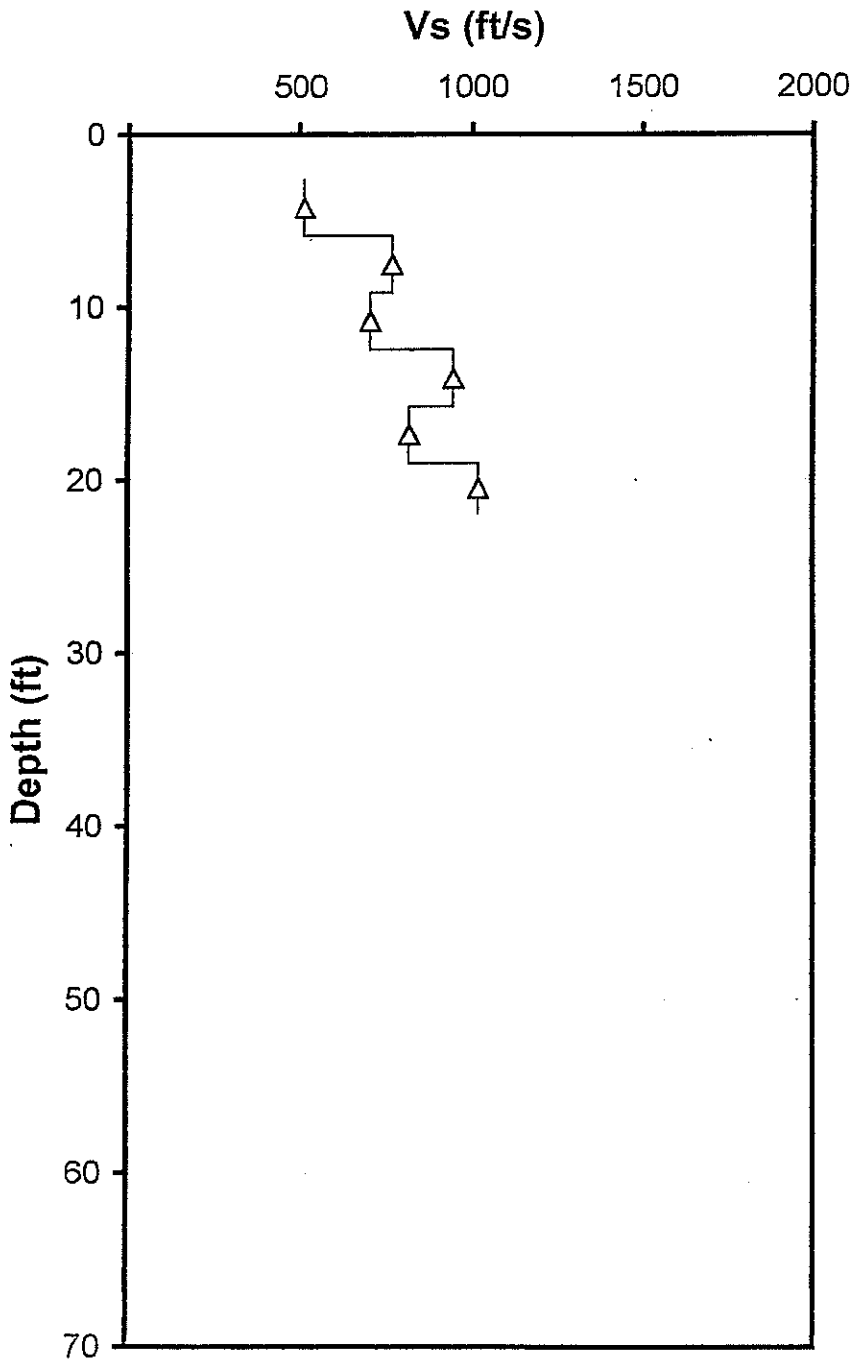
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-6
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	5.97	4.26	514
9.84	9.18	9.31	3.21	4.18	7.54	769
13.12	12.46	12.55	3.25	4.60	10.82	706
16.40	15.74	15.82	3.26	3.45	14.10	945
19.69	19.03	19.09	3.28	4.00	17.39	819
22.64	21.98	22.03	2.94	2.88	20.51	1022

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-6
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-7
Site	Williamson County, Illinois
Date	10/31/2007

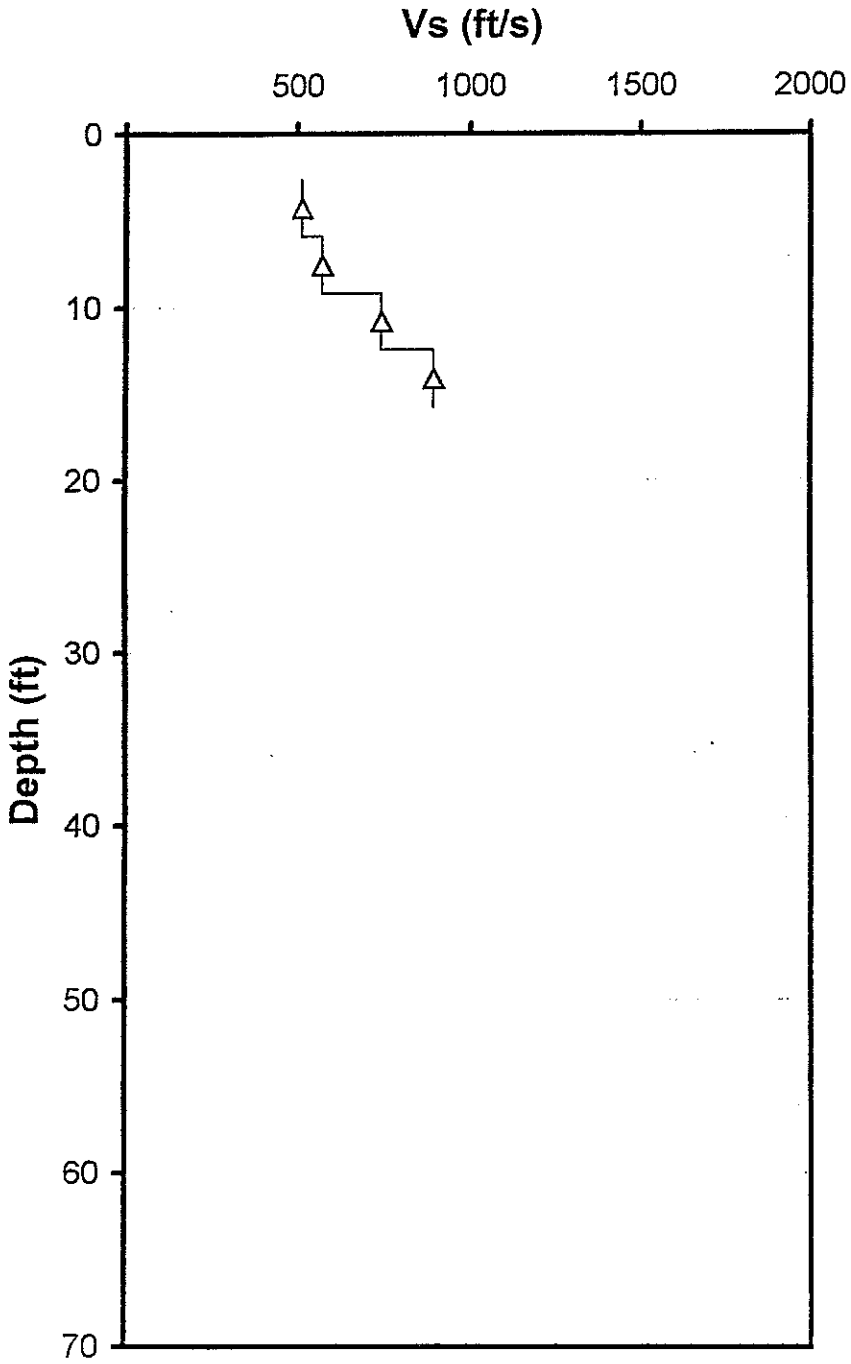
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	5.97	4.26	514
9.84	9.18	9.31	3.21	5.59	7.54	575
13.12	12.46	12.55	3.25	4.36	10.82	745
16.40	15.74	15.82	3.26	3.65	14.10	894

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-7
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-8
Site	Williamson County, Illinois
Date	10/31/2007

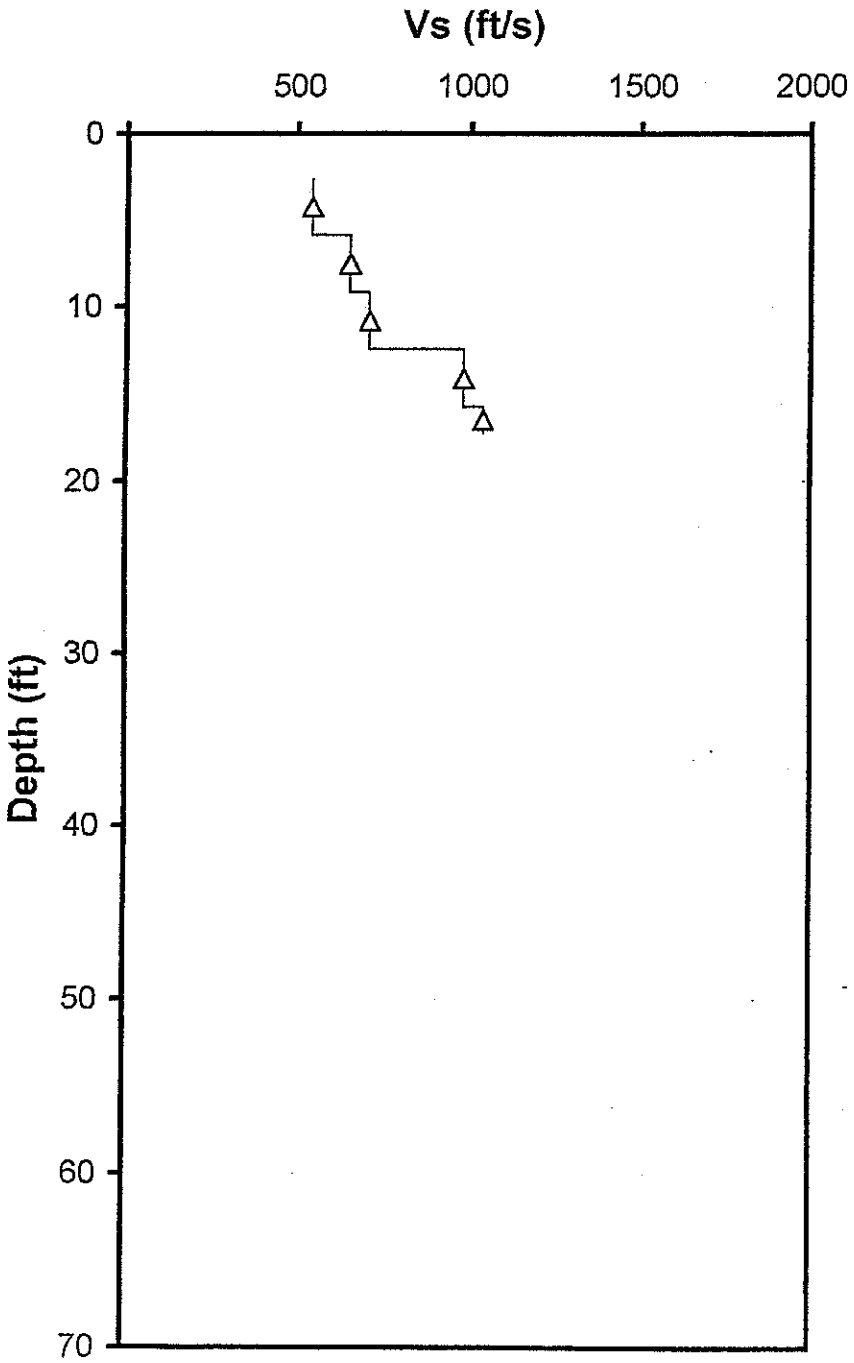
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	5.67	4.26	541
9.84	9.18	9.31	3.21	4.93	7.54	652
13.12	12.46	12.55	3.25	4.59	10.82	708
16.40	15.74	15.82	3.26	3.33	14.10	979
17.88	17.22	17.29	1.47	1.42	16.48	1038

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-8
Date: October 31, 2007



CONETEC

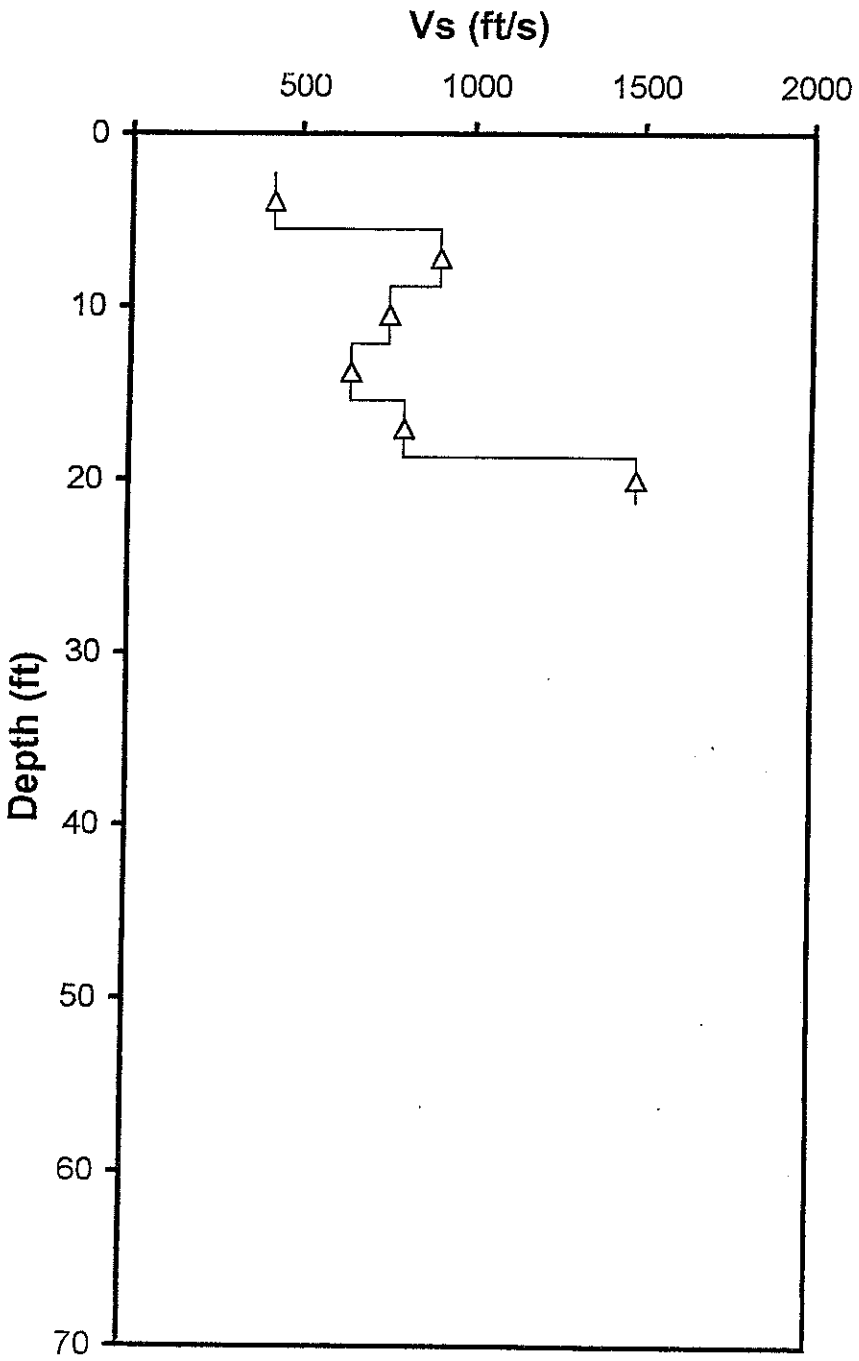
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-9
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
2.95	2.29	2.74				
6.23	5.57	5.77	3.03	7.30	3.93	415
9.51	8.85	8.98	3.21	3.55	7.21	904
12.80	12.14	12.24	3.26	4.30	10.50	757
16.08	15.42	15.50	3.26	5.04	13.78	647
19.36	18.70	18.76	3.27	4.06	17.06	805
21.98	21.32	21.38	2.61	1.76	20.01	1484

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-9
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-10
Site	Williamson County, Illinois
Date	10/31/2007

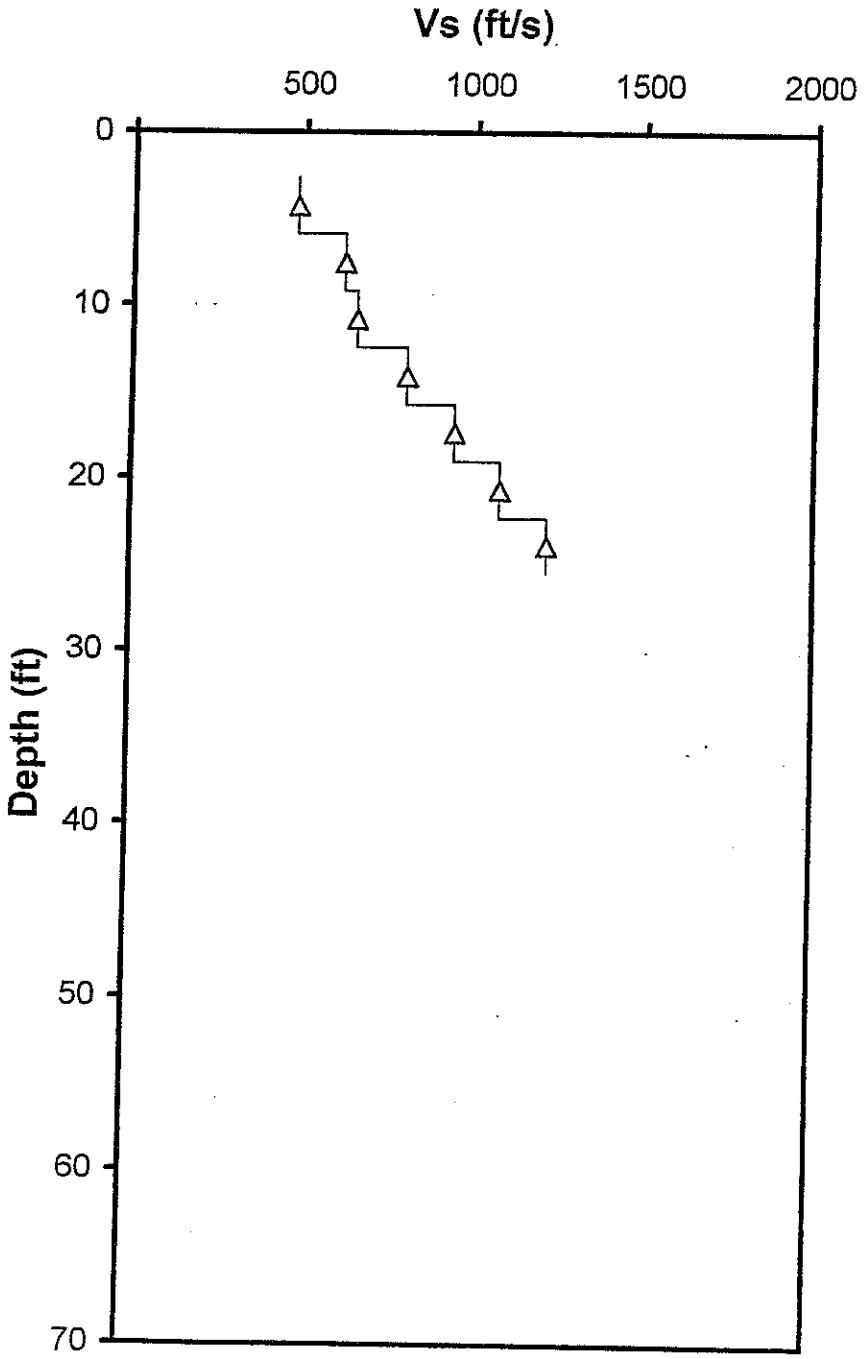
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	6.42	4.26	478
9.84	9.18	9.31	3.21	5.21	7.54	617
13.12	12.46	12.55	3.25	4.95	10.82	656
16.40	15.74	15.82	3.26	4.06	14.10	803
19.69	19.03	19.09	3.28	3.47	17.39	945
22.97	22.31	22.36	3.27	3.03	20.67	1080
26.08	25.42	25.47	3.10	2.55	23.87	1217

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-10
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-11
Site	Williamson County, Illinois
Date	10/31/2007

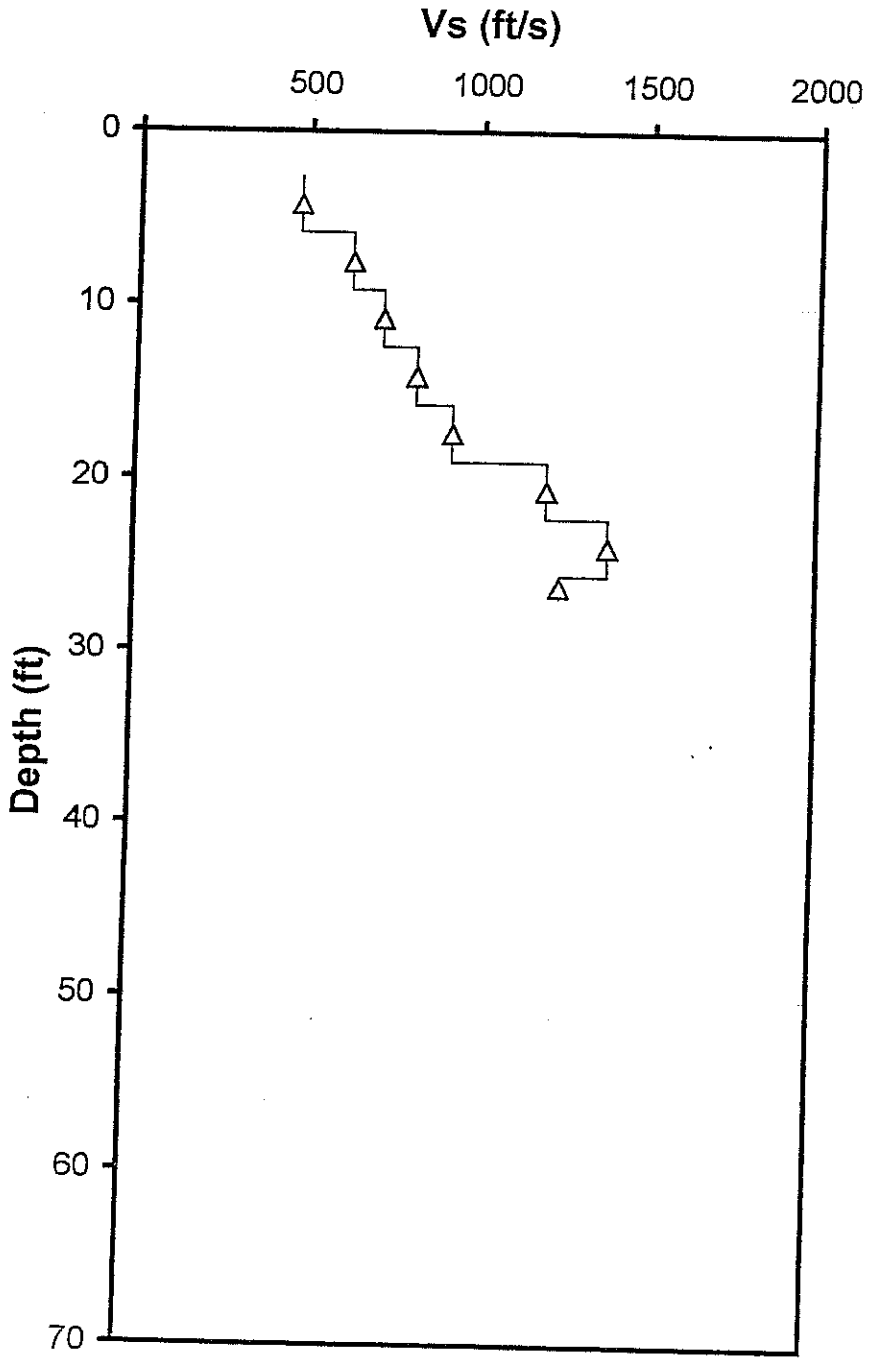
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	6.51	4.26	471
9.84	9.18	9.31	3.21	5.12	7.54	628
13.12	12.46	12.55	3.25	4.52	10.82	719
16.40	15.74	15.82	3.26	3.99	14.10	817
19.69	19.03	19.09	3.28	3.54	17.39	926
22.97	22.31	22.36	3.27	2.71	20.67	1207
26.25	25.59	25.64	3.27	2.36	23.95	1387
27.56	26.90	26.95	1.31	1.05	26.25	1246

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-11
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-12
Site	Williamson County, Illinois
Date	10/31/2007

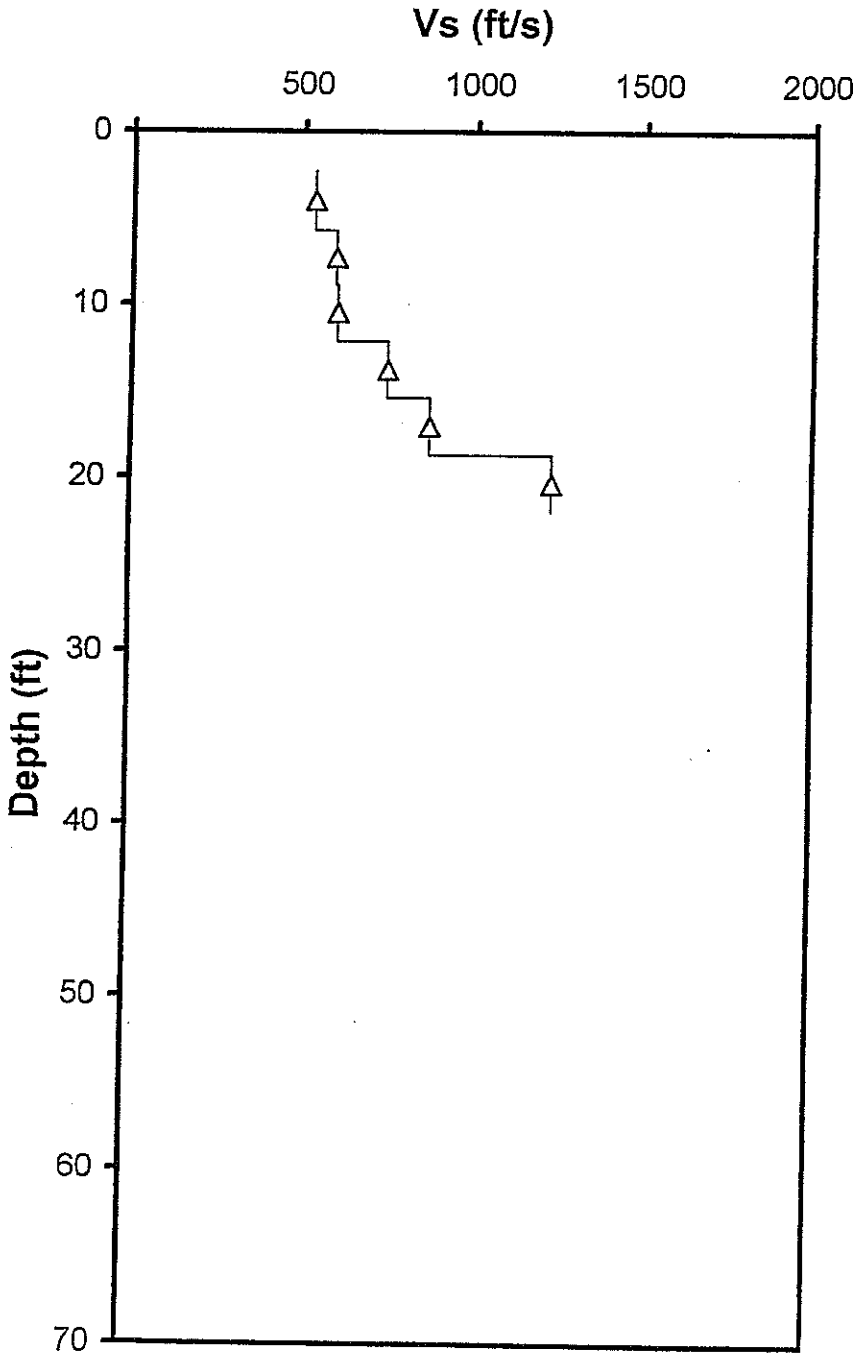
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
2.95	2.29	2.74				
6.40	5.74	5.94	3.20	6.03	4.02	530
9.51	8.85	8.98	3.04	5.11	7.30	596
12.80	12.14	12.24	3.26	5.42	10.50	601
16.08	15.42	15.50	3.26	4.36	13.78	748
19.36	18.70	18.76	3.27	3.75	17.06	871
22.64	21.98	22.03	3.27	2.66	20.34	1230

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-12
Date: October 31, 2007



7225-11
part 15

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APPENDIX C

SUPPLEMENTAL SUMMARY OF ENGINEERING PROPERTIES PREPARED BY GAI AND SUMMARY OF ENGINEERING PROPERTIES PREPARED BY CEC

gai consultants
transforming ideas into reality

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Summary of Engineering Properties and Coarse Refuse Tensile Strength

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY AmH DATE 5-12-09 SHEET NO. 1 OF 5

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CALCULATION BRIEF
FOR

SUPPLEMENTAL SUMMARY OF ENGINEERING PROPERTIES AND COARSE REFUSE TENSILE STRENGTH FOR SUBSIDENCE LIQUEFACTION AND EMBANKMENT CRACKING EVALUATIONS

POND CREEK COAL REFUSE DISPOSAL SITE – PHASE 3

OBJECTIVE: Summarize engineering properties for coarse and fine coal refuse and residual soil materials at the Pond Creek Coal Refuse Disposal site including unit weight (γ), specific gravity (G_s), effective strength, i.e., angle of internal friction (ϕ') and cohesion (c'), total strength, peak undrained shear strength (S_{up}), and steady-state undrained shear strength (S_{us}) (for fine coal refuse). Also, derive a tensile strength to effective stress relationship for coarse coal refuse from laboratory testing to subsequently evaluate potential post-subsidence embankment cracking. The various strengths will be used in the Pond Creek Phase 3 subsidence/stability analyses model(s).

REFERENCES:

1. Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Estimation and Summary of Engineering Properties Including Peak and Steady-State Undrained Shear Strength for Refuse and Subgrade Materials," Pond Creek Coal Refuse Disposal Site – South Pond Stage 2," BEG, 07/12/08.

2. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Characterization of Sand-Like and Clay-Like Subsurface Materials," Pond Creek Coal Refuse Disposal Site – South Cell, BEG, dated 7/11/08.

3. GAI Consultants, Inc. Calculation Brief Entitled "Supplemental Characterization of Subsurface Materials – Coarse Refuse and Residual Soil," Pond Creek Coal Refuse Disposal Site, BEG, dated 3/31/09.

4. GAI Consultants, Inc. Calculation Brief Entitled "Summary of Laboratory Testing," Pond Creek Coal Refuse Disposal Site, BEG, dated 3/30/09.

5. Civil & Environmental Consultants, Inc. Report Entitled "Abandonment Evaluation, Pond Creek No. 1 Coal Refuse Disposal Facility, Phase 2 South Pond Slurry Impoundment, Johnston City, Williamson County, Illinois," dated July 23, 2008.

6. Civil & Environmental Consultants, Inc. Report Entitled "Permanent Deformation Evaluation, Pond Creek No. 1 Coal Refuse Disposal Facility, South Cell Slurry Impoundment, Johnston City, Williamson County, Illinois," dated January 23, 2008.

7. Mine Safety and Health Administration, "Draft - Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 – Seismic Design: Stability and Deformation Analyses," dated, December 2007 (Updated August 2008).

8. Poulos, S.J., Castro, G., France, J.W. (1985), "Liquefaction Evaluation Procedure," Journal of Geotechnical Engineering, ASCE, 111(6), pp. 772-791.

9. Almes, R. A. and Butail, A. (1976) "Coal Refuse: Its Behavior Related to the Design and Operation of Coal Refuse Disposal Facilities," Proceedings of the Ohio River Valley Soils Seminar, Lexington, Kentucky, October, 1976.

10. Winterkorn, Hans F. and Fang, Hsai-Yang. (1975) "Foundation Engineering Handbook," Van Nostrand Reinhold Company. New York, page 116.

SOIL PROPERTIES:

From Reference (Ref.) Number (No.) 1, the following soil properties were estimated based on laboratory testing performed for previous permanent deformation (Ref. No. 5) and abandonment (Ref. No. 4) analyses, and/or provided by Alliance Consulting, Inc. (Alliance), which were used in the various slope stability analyses. These properties will subsequently be used in subsidence-related analyses, where appropriate, supplemented by additional engineering properties as necessary and described below.

Summary of Coarse and Fine Coal Refuse and Residual Soil Engineering Properties

Description	Unit Weight (γ) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion (c) (psf)	Comment
Coarse Refuse	130	33.7	0	Effective Strength (Drained)
		18.0	736	Total Strength (Undrained)
		0	$\sigma t/\sigma'v=0.15$ (See Below)	Tensile Strength
Fine Coal Refuse	80	36.9	0	Effective Strength (Drained)
		18.8	0	Total Strength (Undrained)
		0	$Sus/\sigma'v=0.24$ (See Ref. No. 1)	Steady-State (Undrained)
Residual Soil	125	26.8	0	Effective Strength (Drained)
		19.5	416	Total Strength (Undrained)
		0	3000	80% Peak Undrained

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CHKD. BY AMH DATE 5-12-09 SHEET NO. 3 OF 5

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LABORATORY-DERIVED TENSILE STRENGTH OF COARSE COAL REFUSE, σ_t:

As presented in Ref. No. 4, two (2) consolidated–undrained (CU) triaxial series tests (3 points each) were performed by Holcolm Foundation Engineering Company, Inc. (Holcolm) on remolded coarse coal refuse to determine effective and total strength (undrained) parameters. CU tests were performed by Holcolm in November 2006 and April 2007 from site specific samples of coarse coal refuse. Remolded samples were prepared in the laboratory to approximately 95 percent of the standard Proctor maximum dry density at near optimum moisture conditions. Samples were consolidated to a range of vertical effective stresses of about 70, 90 and 110 pounds per square inch (psi) [or 10,080 to 15,840 pounds per square foot (psf)]. All specimens exhibited contractive behavior when sheared under undrained conditions. In general, all specimens reached, or nearly reached, a steady-state of deformation within the strain limits of the test equipment.

To evaluate the susceptibility of the Phase 3 compacted coarse refuse embankment to cracking during and following longwall mining beneath the Phase 3 impoundment, coarse refuse tensile strengths will be estimated from CU testing, and a relationship of tensile strength to effective stress developed to vary the strength in the stability model. A total of 6 CU points comprise the (2) series from which peak shear strength state failure conditions will be evaluated and a corresponding tensile strength calculated for each based on the tensile strength formula from Winterkorn and Fang (Ref. No. 10). Therefore, the following equation (Ref. No. 10) was used to calculate tensile strength (σ_t) from laboratory test specimens of coarse coal refuse:

Tensile Strength (σ_t):

$\sigma_t = P/\pi(KbH-a^2)$
Where,
P = Load at failure
K = Constant = 1.0 (per Ref. No. 10)
b = Radius of test specimen
H = Height of test specimen
a = Radius of disks/platens

The following tensile strength data is presented from CU testing on two (2) remolded coarse coal refuse samples (Ref. No. 4) and applying the equation above. CU laboratory test results are attached.

Sample No.	November 2006 Coarse Coal Refuse			April 2007 Coarse Coal Refuse		
CU Test No. (Confining Pressure)	1 (70 psi)	2 (90 psi)	3 (110 psi)	1 (70 psi)	2 (90 psi)	3 (105 psi)
Parameter						
P (lbs.) @ Failure Failure Strain (%)	278.8 14.4	383.7 14.7	682.4 15.3	185.6 14.6	243.0 12.5	560.1 15.3
b (in.)	1.4	1.4	1.4	1.4	1.4	1.4
H (in.)	5.65	5.57	5.60	5.59	5.58	5.58
a (in.)	1.4	1.4	1.4	1.4	1.4	1.4
σ_t (psi) σ_t (psf)	14.9 2146	20.9 3010	36.9 5314	10.1 1454	13.2 1901	30.5 4392

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Summary of Engineering Properties and Coarse Refuse Tensile Strength

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Each CU test tensile strength (σ_t) is subsequently normalized to its confining (isotropic) pressure, which is converted to equivalent vertical pressure. σ_t is plotted versus equivalent vertical effective stress ($\sigma'v$), and is presented in the attached Figure 1. The purpose of developing an effective stress relationship is to model the variation in tensile strength with depth, i.e., effective stress within the Phase 3 coarse refuse embankment, and estimate a factor of safety against embankment cracking due to the longwall mining beneath the impoundment.

The equivalent effective vertical stress ($\sigma'v$), is estimated at 1.5 times the isotropic effective consolidation stress (i.e., 1.5 * $\sigma3$). The all-around isotropic consolidation stress, $\sigma3$ is considered to be the mean effective stress (σ_m), which is converted to $\sigma'v$ utilizing Ko = 0.5, and the equation:

$\sigma3 = \sigma_m = (1+2Ko)/3 * \sigma'v$,

and thus equivalent vertical stress, $\sigma'v$ is:

$\sigma'v = 1.5 * \sigma3$.

EQUIVALENT VERTICAL STRESS:

Sample No.	November 2006 Coarse Coal Refuse			April 2007 Coarse Coal Refuse		
CU Test No. (Confining Pressure, $\sigma3$)	1 (70 psi)	2 (90 psi)	3 (110 psi)	1 (70 psi)	2 (90 psi)	3 (105 psi)
$\sigma'v$ (psf)	15120	19440	23760	15120	19440	22680
σ_t (psf)	2146	3010	5314	1454	1901	4392
$\sigma_t/\sigma'v$ (dim)	0.142	0.155	0.224	0.096	0.098	0.194

A 2/3 – 1/3 relationship of the data, as shown in the attached Figure 1, was employed to yield a conservative representation of the Pond Creek coarse refuse tensile strength-to-effective stress (σ_t to $\sigma'v$) relationship of $\sigma_t = 0.15\ \sigma'v$.

Since site specific testing was performed, and a relationship of $\sigma_t = 0.15\ \sigma'v$ is considered realistic with some conservatism, based on the various testing conditions and conversions to effective stress. The Phase 3 coarse coal refuse embankment will be modeled utilizing this relationship to evaluate the potential for cracking. The results of post-subsidence slope stability analyses will subsequently be evaluated in another calculation brief to assess the likelihood of cracking of the coarse refuse embankment and liquefaction (flow) potential during/following longwall mining beneath the embankment/impoundment.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Summary of Engineering Properties and Coarse Refuse Tensile Strength

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

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POND CREEK PHASE 3 CCR AVERAGE EFFECTIVE VERTICAL STRESS AND COARSE COAL REFUSE (CCR) AVERAGE TENSILE STRENGTH:

AVERAGE EFFECTIVE VERTICAL STRESSES (KSF):

INPUT:		DEPTH BELOW GROUND SURFACE							
STA	150	200	230	255	300	360	0	0	0
GWT	0	30	20	16	5	5	0	0	0
CCR	0	35	45	45	30	5	0	0	0
BCCR	0	35	45	45	45	45	0	0	0

OUTPUT:		AVERAGE EFFECTIVE VERTICAL STRESSES (ksf)							
STA	150	200	230	255	300	360	0	0	0
DEPTH									
10	NA	1.30	1.30	1.30	1.04	0.79	NA	NA	NA
20	NA	2.60	2.60	2.39	1.81	1.06	NA	NA	NA
30	NA	3.90	3.38	3.17	2.59	1.34	NA	NA	NA
40	NA	NA	4.15	3.94	2.62	1.62	NA	NA	NA
45	NA	NA	4.54	4.33	2.75	1.75	NA	NA	NA

Average Effective Vertical Stress:

WT. AVG. = 3.18 ksf

= **3184 psf**

Average CCR Tensile Strength:

WT. AVG. = $\sigma t = 0.15\ \sigma'v$ = 0.478 ksf

= **478 psf**

CONCLUSIONS:

Laboratory undrained shear strength data from CU triaxial tests of coarse coal refuse were determined. Procedures were performed to estimate tensile strength (σ_t) and a reasonable σ_t to $\sigma'v$ relationship of $\sigma_t = 0.15\ \sigma'v$ was estimated. As shown above, the average effective vertical stress within the Phase 3 embankment is 3184 psf and the corresponding coarse refuse tensile strength is 478 psf.

The susceptibility of the embankment to cracking and the impounded fine coal refuse to a liquefaction flow failure is a function of both the tensile strength of the coarse refuse, the total undrained strength of the fine refuse, and the in-situ driving shear stress on a critical failure plane through the Phase 3 embankment/impoundment. The likelihood of a flow failure and embankment cracking will be assessed in a subsequent calculation brief by evaluating the driving shear stress and factor of safety against liquefaction/cracking.

FIGURE 1

TENSILE STRENGTH (σ_t) TO EFFECTIVE STRESS (σ'_V) – COARSE COAL REFUSE
2/3 – 1/3 Relationship of Holcolm CU Data to Yield a σ_t to $\sigma'v$ Relationship

Pond Creek Phase 3 Coarse Refuse Embankment
Tensile Strength (σt) vs. Vertical Effective Stress (σ'v)

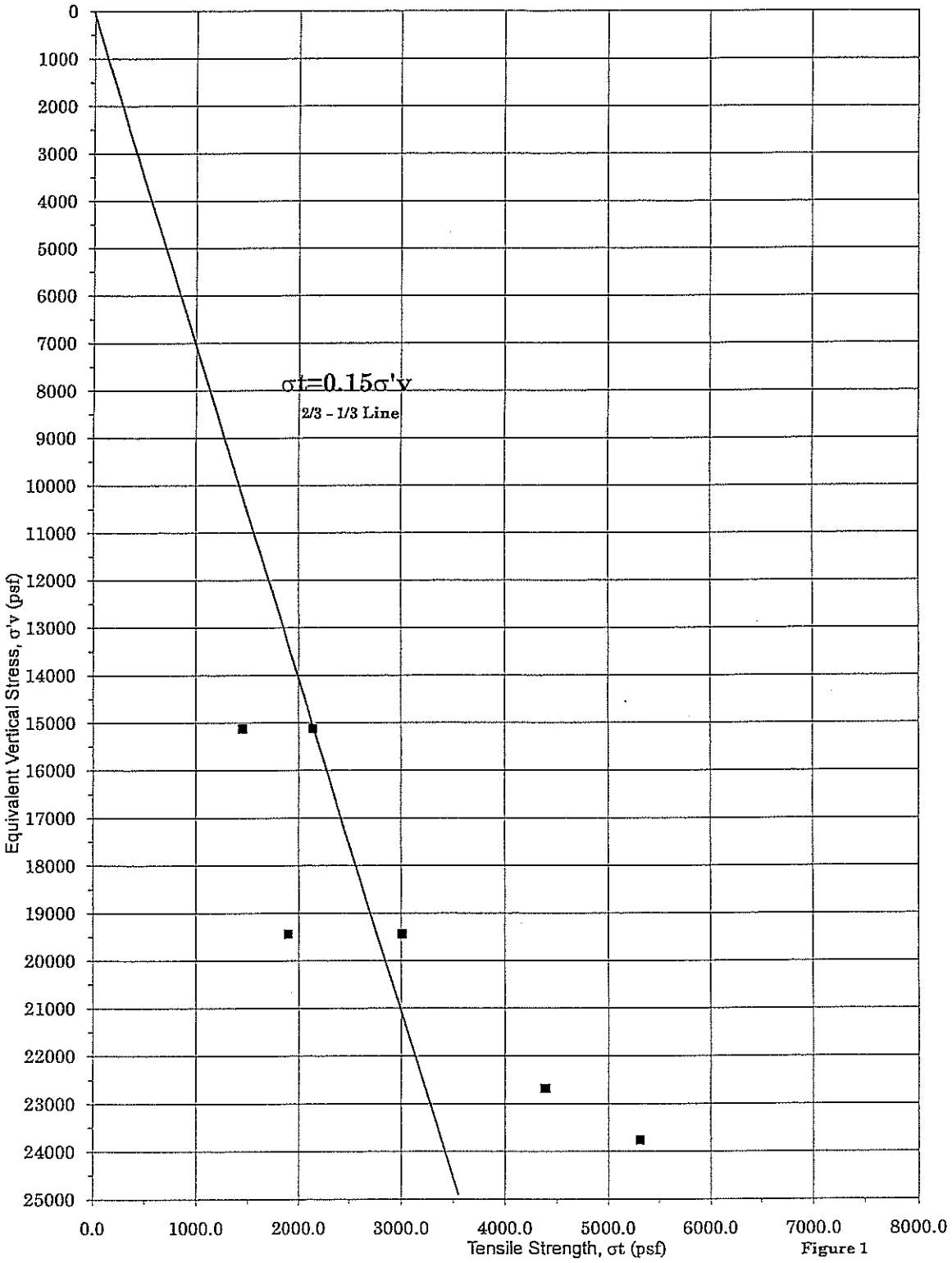

Figure 1

Coarse Refuse Tensile Strength vs. Equivalent Effectvie Stress

σt v σ'v σ'v	σt
15120	2146
19440	3010
23760	5314
15120	1454
19440	1901
22680	4302

R13422

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

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Box 393 Wood Road
Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

February 10, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Soil Boring and Laboratory Tests
Boring #8874
Mach Mine #1
Johnston City, Illinois
HFE File H-05278
Mach Mining Purchase Order No. _____

Dear Sir:

In accordance with your instructions, on February 1, 2006, we drilled one soil boring and sampled the subsoils with Shelby tubes. The soil sample taken from 10 to 12 feet in depth was subjected to laboratory tests. Results of the tests are as follows:

Boring No.:	8874
Depth:	8.0-10.0'
Visual Classification:	Silty CLAY (CL)
Atterberg Limits:	LL = 41.8% PL = 17.7% PI = 24.1
Unit Weight:	105.3 PCF
Moisture Content:	21.5%
Effective Cohesion:	0 PSF
Effective Phi Angle:	26.8 Degrees

All Tubes From Boring 8874

The Boring Log and test results are enclosed. If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

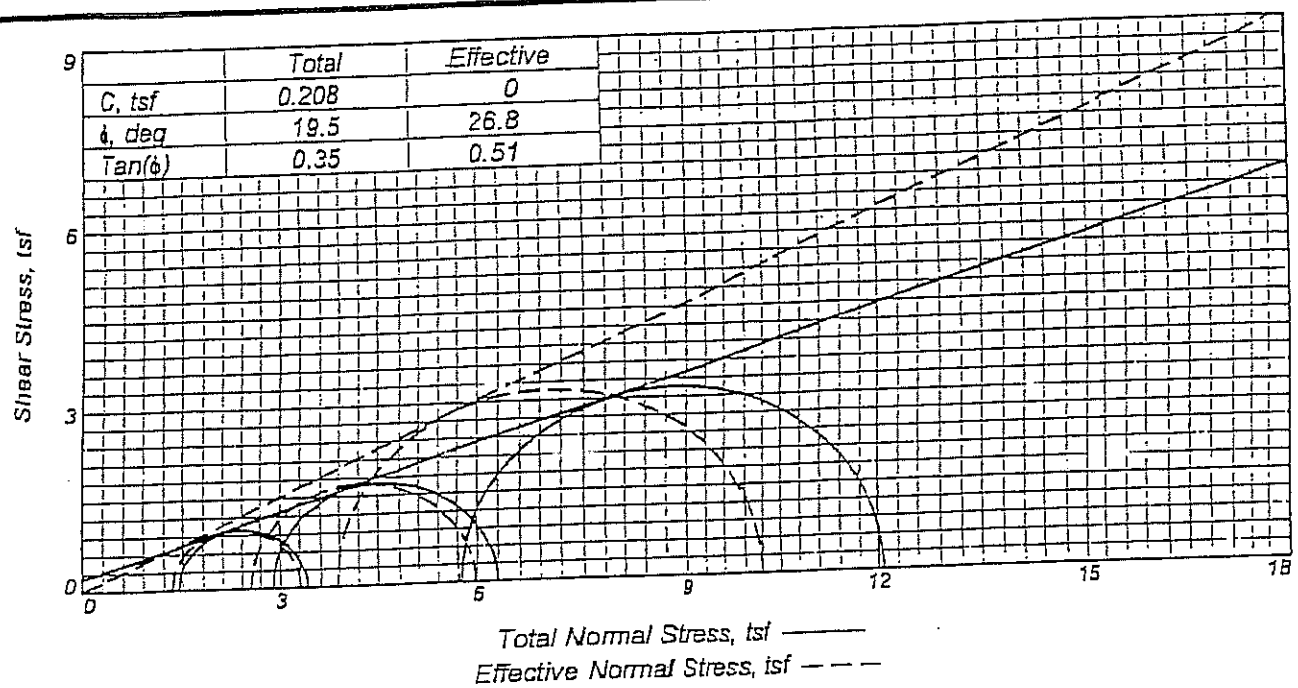
Timothy J. Holcomb, P.E.

REGISTERED PROFESSIONAL ENGINEER
TIMOTHY J.
HOLCOMB
062-042149
2-10-06
ILLINOIS

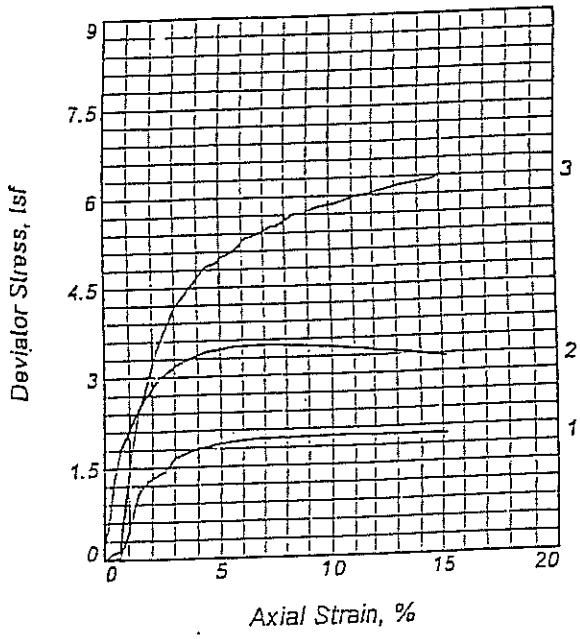
1 copy: Fred Vass - Alliance Consulting

R13424

3



	Total	Effective
C, tsf	0.208	0
ϕ, deg	19.5	26.8
Tan(ϕ)	0.35	0.51



Sample No.		1	2	3
Initial	Water Content,	21.5	20.8	17.6
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	99.7	98.9
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
At Test	Water Content,	21.5	20.9	17.8
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.6	3.6	2.2
Cell Pressure, tsf		5.0	6.5	7.9
Fail. Stress, tsf		2.0	3.4	6.3
Total Pore Pr., tsf		3.7	3.9	4.1
Ult. Stress, tsf		2.0	3.2	6.3
Total Pore Pr., tsf		3.6	3.8	4.1
$\bar{\sigma}_1$ Failure, tsf		3.3	6.0	10.2
$\bar{\sigma}_3$ Failure, tsf		1.3	2.6	3.9

Type of Test:
CU with Pore Pressures
Sample Type: Shelby Tube - Undisturbed
Description: Gray Mottled Brown Silty CLAY

LL= 41.8 PL= 17.7 PI= 24.1
Assumed Specific Gravity= 2.65
Remarks:

Client: Alliance Consulting

Project: Triaxial Test
Mach Mine #1
Location: Boring #8874
Sample Number: 3 Depth: 10.0-12.0'
Proj. No.: H-05278 Date: 2-1-05

TRIAXIAL SHEAR TEST REPORT

HOLCOMB FOUNDATION ENGINEERING CO.

Plate _____

Tested By: LC Checked By: TH

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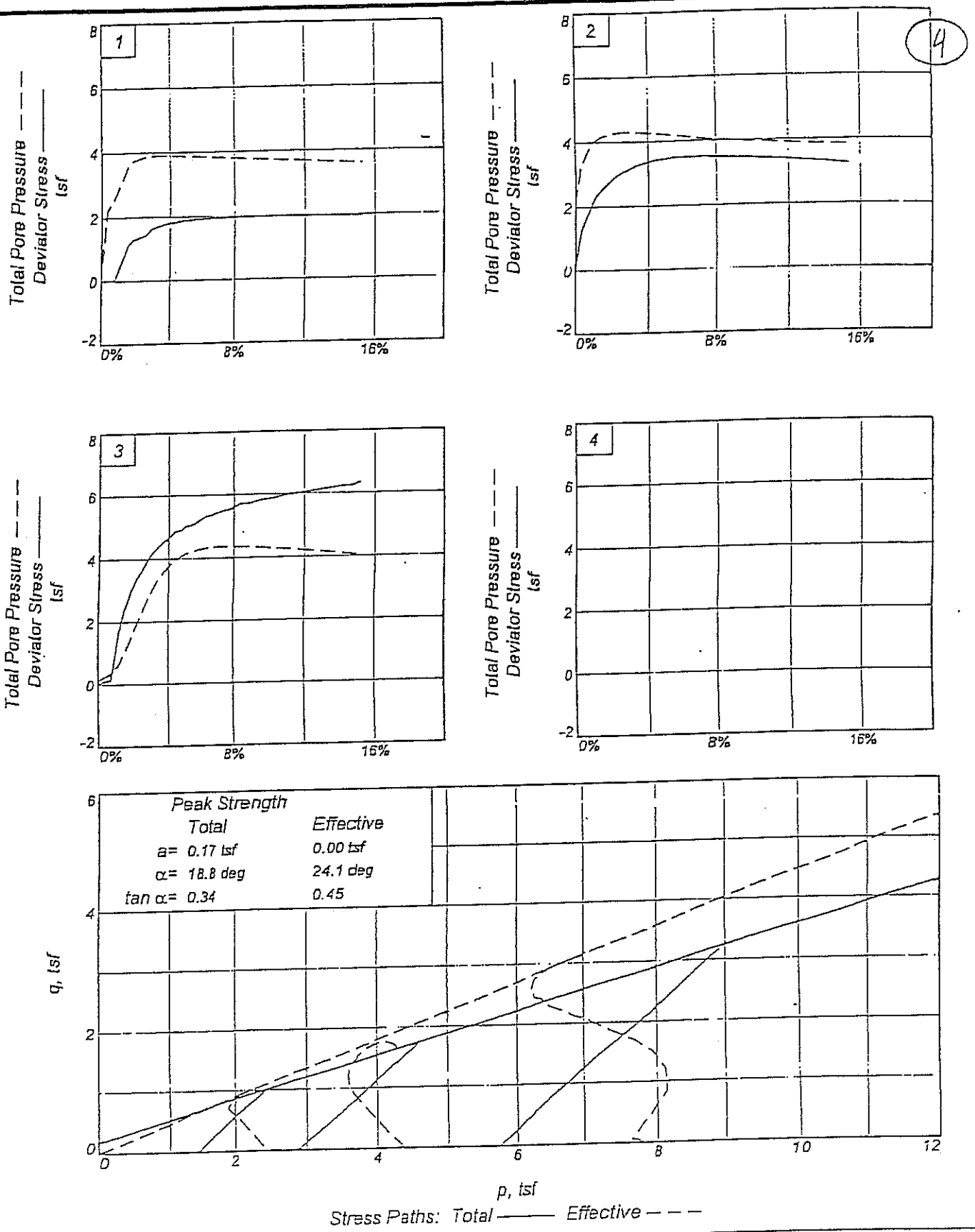
(4)



Client: Alliance Consulting
Project: Triaxial Test
Location: Boring #8874
Project No.: H-05278

Depth: 10.0-12.0'
Plate _____

Sample Number: 3

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC _____ Checked By: TH _____

2/9/2006 5
8:50 PM

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

Date:	2-1-05
Client:	Alliance Consulting
Project:	Triaxial Test Mach Mine #1 Johnston City, Illinois
Location:	Boring #8874
Depth:	10.0-12.0'
Sample Number:	3
Description:	Gray Mottled Brown Silty CLAY
Remarks:	
Type of Sample:	Shelby Tube - Undisturbed
Assumed Specific Gravity=2.65	LL=41.8 PL=17.7 PI=24.1
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	189.100			1279.000
Moisture content: Dry soil+tare, gms.	176.100			1072.200
Moisture content: Tare, gms.	115.700			103.200
Moisture, %	21.5	21.5	21.5	21.3
Moist specimen weight, gms.	1140.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.51	5.51	5.51	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.0	128.0	128.0	
Dry density, pcf	105.3	105.3	105.3	
Void ratio	0.5706	0.5706	0.5706	
Saturation, %	100.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.981 tsf at reading no. 24
Ult. Stress = 1.955 tsf at reading no. 30

(6)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	18.30	0.0	0.0	0.000	5.112	5.112	1.00	-1.00	5.112	0.000
1	0.0190	20.00	1.7	0.3	0.014	2.830	2.844	1.00	30.70	2.837	0.007
2	0.0400	21.60	3.3	0.7	0.026	2.426	2.452	1.01	36.30	2.439	0.013
3	0.0810	113.20	94.9	1.5	1.093	1.505	2.598	1.73	49.10	2.051	0.547
4	0.1010	129.80	111.5	1.8	1.280	1.318	2.597	1.97	51.70	1.958	0.640
5	0.1420	143.10	124.8	2.6	1.422	1.181	2.602	2.20	53.60	1.892	0.711
6	0.1620	161.50	143.2	2.9	1.625	1.159	2.784	2.40	53.90	1.972	0.813
7	0.1830	168.90	150.6	3.3	1.702	1.145	2.847	2.49	54.10	1.996	0.851
8	0.2030	174.80	156.5	3.7	1.763	1.138	2.900	2.55	54.20	2.019	0.881
9	0.2240	178.90	160.6	4.1	1.802	1.145	2.946	2.57	54.10	2.046	0.901
10	0.2440	182.30	164.0	4.4	1.833	1.145	2.978	2.60	54.10	2.061	0.916
11	0.2650	186.40	168.1	4.8	1.871	1.152	3.023	2.62	54.00	2.088	0.936
12	0.2850	188.10	169.8	5.2	1.883	1.166	3.049	2.61	53.80	2.108	0.941
13	0.3060	191.40	173.1	5.6	1.912	1.166	3.078	2.64	53.80	2.122	0.956
14	0.3260	193.10	174.8	5.9	1.923	1.181	3.104	2.63	53.60	2.142	0.962
15	0.3460	194.70	176.4	6.3	1.933	1.188	3.121	2.63	53.50	2.155	0.967
16	0.3670	196.40	178.1	6.7	1.944	1.202	3.146	2.62	53.30	2.174	0.972
17	0.3870	198.10	179.8	7.0	1.955	1.210	3.164	2.62	53.20	2.187	0.977
18	0.4080	198.10	179.8	7.4	1.947	1.224	3.171	2.59	53.00	2.197	0.973
19	0.4280	200.60	182.3	7.8	1.966	1.231	3.197	2.60	52.90	2.214	0.983
20	0.4490	200.60	182.3	8.1	1.958	1.238	3.196	2.58	52.80	2.217	0.979
21	0.4890	203.10	184.8	8.9	1.969	1.267	3.236	2.55	52.40	2.252	0.985
22	0.5300	204.70	186.4	9.6	1.970	1.289	3.259	2.53	52.10	2.274	0.985
23	0.5710	207.20	188.9	10.4	1.980	1.310	3.290	2.51	51.80	2.300	0.990
24	0.6120	208.90	190.6	11.1	1.981	1.332	3.313	2.49	51.50	2.323	0.991
25	0.6520	209.10	190.8	11.8	1.967	1.346	3.313	2.46	51.30	2.330	0.983
26	0.6940	211.40	193.1	12.6	1.974	1.361	3.334	2.45	51.10	2.348	0.987
27	0.7350	212.20	193.9	13.3	1.965	1.390	3.354	2.41	50.70	2.372	0.982
28	0.7790	213.90	195.6	14.1	1.964	1.404	3.368	2.40	50.50	2.386	0.982
29	0.8170	215.50	197.2	14.8	1.964	1.426	3.390	2.38	50.20	2.408	0.982
30	0.8380	215.50	197.2	15.2	1.955	1.433	3.388	2.36	50.10	2.410	0.978

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	154.800			1347.900
Moisture content: Dry soil+tare, gms.	145.800			1154.100
Moisture content: Tare, gms.	102.600			135.100
Moisture, %	20.8	20.9	20.9	19.0
Moist specimen weight, gms.	1142.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.49	5.49	5.49	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.7	128.7	128.7	
Dry density, pcf	106.5	106.5	106.5	
Void ratio	0.5536	0.5536	0.5536	
Saturation, %	99.7	100.0	100.0	

7

Membrane modulus = 0.124105 kN/cm^2

Membrane thickness = 0.02 cm

Filter paper coefficient = 0.001926 kN/cm

Filter paper coverage = 30%

Consolidation cell pressure = 90.00 psi (6.480 tsf)

Consolidation back pressure = 50.00 psi (3.600 tsf)

Consolidation effective confining stress = 2.880 tsf

Strain rate, in./min. = 0.00

Fail. Stress = 3.418 tsf at reading no. 24

Ult. Stress = 3.250 tsf at reading no. 29

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	27.50	0.0	0.0	0.000	4.385	4.385	1.00	29.10	4.385	0.000
1	0.0190	134.00	106.5	0.3	1.241	3.254	4.495	1.38	44.80	3.875	0.620
2	0.0400	183.10	155.6	0.7	1.806	2.750	4.557	1.66	51.80	3.653	0.903
3	0.0600	218.90	191.4	1.1	2.214	2.484	4.698	1.89	55.50	3.591	1.107
4	0.0810	243.80	216.3	1.5	2.492	2.340	4.832	2.06	57.50	3.586	1.246
5	0.1010	264.60	237.1	1.8	2.721	2.254	4.975	2.21	58.70	3.614	1.361
6	0.1220	282.10	254.6	2.2	2.911	2.210	5.121	2.32	59.30	3.666	1.455
7	0.1420	295.40	267.9	2.6	3.052	2.182	5.233	2.40	59.70	3.707	1.526
8	0.1620	305.40	277.9	2.9	3.154	2.182	5.335	2.45	59.70	3.758	1.577
9	0.1830	314.60	287.1	3.3	3.245	2.189	5.434	2.48	59.60	3.811	1.623
10	0.2030	322.10	294.6	3.7	3.317	2.196	5.513	2.51	59.50	3.855	1.659
11	0.2240	327.10	299.6	4.1	3.360	2.218	5.578	2.52	59.20	3.898	1.680
12	0.2440	332.90	305.4	4.4	3.412	2.232	5.644	2.53	59.00	3.938	1.706
13	0.2650	336.20	308.7	4.8	3.435	2.254	5.689	2.52	58.70	3.971	1.718
14	0.2850	339.50	312.0	5.2	3.459	2.275	5.734	2.52	58.40	4.005	1.729
15	0.3060	343.70	316.2	5.6	3.491	2.297	5.788	2.52	58.10	4.042	1.746
16	0.3260	345.40	317.9	5.9	3.497	2.318	5.815	2.51	57.80	4.067	1.748
17	0.3670	348.70	321.2	6.7	3.505	2.369	5.874	2.48	57.10	4.121	1.752
18	0.4080	352.00	324.5	7.4	3.512	2.412	5.924	2.46	56.50	4.168	1.756
19	0.4490	353.70	326.2	8.2	3.502	2.441	5.943	2.43	56.10	4.192	1.751
20	0.4890	354.50	327.0	8.9	3.483	2.470	5.953	2.41	55.70	4.211	1.742
21	0.5300	355.40	327.9	9.7	3.464	2.498	5.963	2.39	55.30	4.230	1.732

(8)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.5510	357.00	329.5	10.0	3.466	2.513	5.979	2.38	55.10	4.246	1.733
23	0.5920	356.20	328.7	10.8	3.429	2.534	5.964	2.35	54.80	4.249	1.715
24	0.6330	357.90	330.4	11.5	3.418	2.556	5.974	2.34	54.50	4.265	1.709
25	0.6730	357.00	329.5	12.3	3.381	2.585	5.966	2.31	54.10	4.275	1.690
26	0.7140	357.90	330.4	13.0	3.361	2.599	5.960	2.29	53.90	4.280	1.681
27	0.7550	357.90	330.4	13.7	3.332	2.614	5.946	2.27	53.70	4.280	1.666
28	0.7960	356.20	328.7	14.5	3.286	2.628	5.914	2.25	53.50	4.271	1.643
29	0.8370	355.40	327.9	15.2	3.250	2.635	5.885	2.23	53.40	4.260	1.625

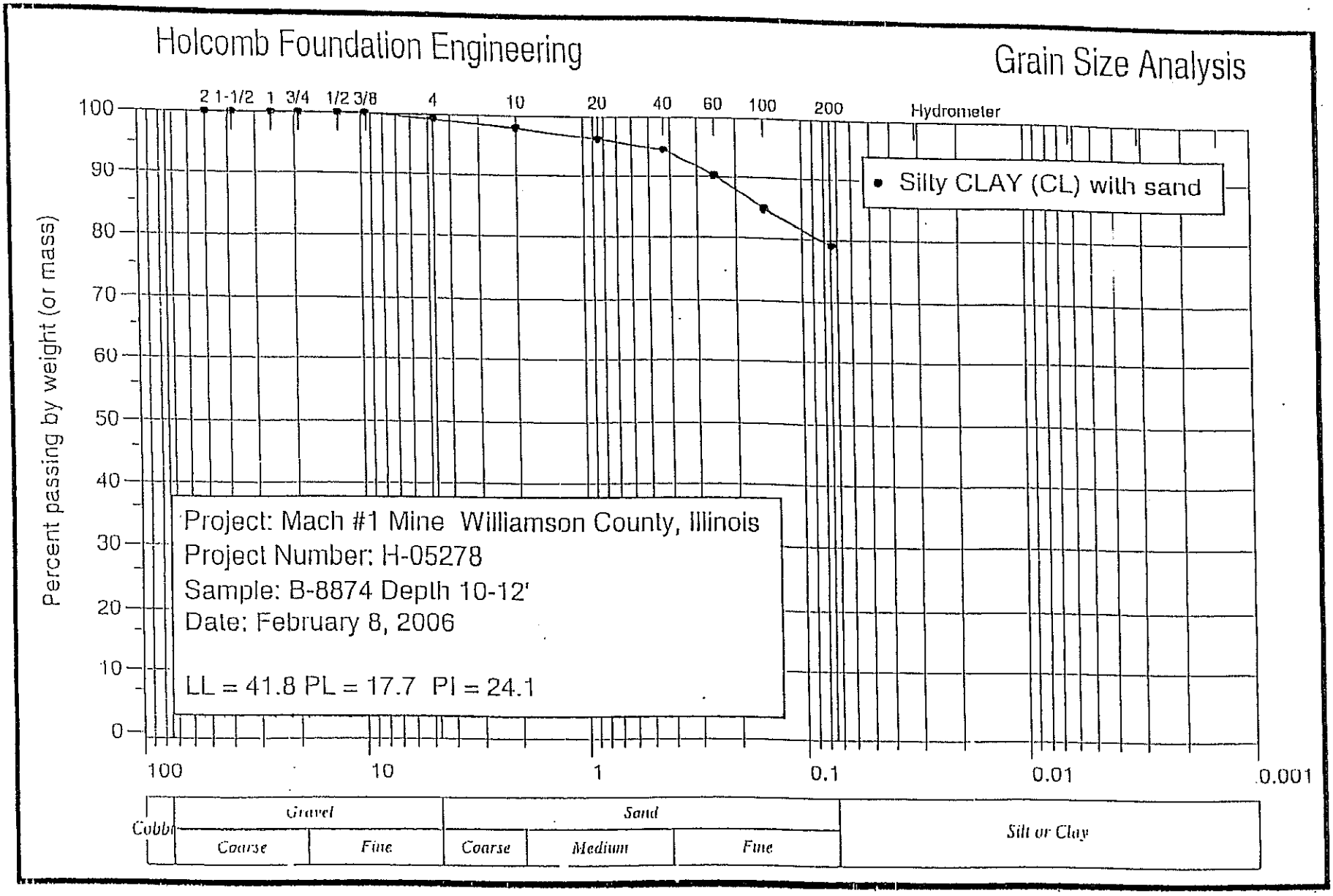
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	248.400			1374.500
Moisture content: Dry soil+tare, gms.	226.700			1195.400
Moisture content: Tare, gms.	103.200			127.700
Moisture, %	17.6	17.8	17.8	16.8
Moist specimen weight, gms.	1184.7			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.54	5.54	5.54	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	132.3	132.5	132.5	
Dry density, pcf	112.5	112.5	112.5	
Void ratio	0.4707	0.4707	0.4707	
Saturation, %	98.9	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 6.334 tsf at reading no. 33
Ult. Stress = 6.334 tsf at reading no. 33

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	31.60	0.0	0.0	0.000	7.812	7.812	1.00	1.50	7.812	0.000
1	0.0190	39.90	8.3	0.3	0.091	7.690	7.781	1.01	3.20	7.735	0.045
2	0.0400	44.10	12.5	0.7	0.133	7.574	7.707	1.02	4.80	7.641	0.066
3	0.0600	175.60	144.0	1.1	1.666	7.308	8.974	1.23	8.50	8.141	0.833
4	0.0810	240.50	208.9	1.5	2.407	6.926	9.333	1.35	13.80	8.130	1.203
5	0.1010	291.30	259.7	1.8	2.981	6.466	9.447	1.46	20.20	7.956	1.491
6	0.1220	329.60	298.0	2.2	3.408	5.983	9.391	1.57	26.90	7.687	1.704
7	0.1420	362.00	330.4	2.6	3.764	5.479	9.244	1.69	33.90	7.361	1.882
8	0.1620	392.00	360.4	2.9	4.091	5.040	9.131	1.81	40.00	7.085	2.045
9	0.1830	412.80	381.2	3.3	4.310	4.666	8.976	1.92	45.20	6.821	2.155

(9)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
10	0.2030	432.80	401.2	3.7	4.519	4.363	8.883	2.04	49.40	6.623	2.260
11	0.2240	446.90	415.3	4.0	4.660	4.140	8.800	2.13	52.50	6.470	2.330
12	0.2440	465.20	433.6	4.4	4.847	3.982	8.828	2.22	54.70	6.405	2.423
13	0.2650	471.00	439.4	4.8	4.892	3.852	8.744	2.27	56.50	6.298	2.446
14	0.2850	483.50	451.9	5.1	5.012	3.766	8.778	2.33	57.70	6.272	2.506
15	0.3060	490.20	458.6	5.5	5.066	3.694	8.760	2.37	58.70	6.227	2.533
16	0.3260	503.50	471.9	5.9	5.193	3.643	8.837	2.43	59.40	6.240	2.597
17	0.3460	516.80	485.2	6.2	5.319	3.607	8.926	2.47	59.90	6.267	2.660
18	0.3670	521.80	490.2	6.6	5.352	3.586	8.938	2.49	60.20	6.262	2.676
19	0.3870	530.10	498.5	7.0	5.422	3.571	8.993	2.52	60.40	6.282	2.711
20	0.4080	538.40	506.8	7.4	5.490	3.564	9.054	2.54	60.50	6.309	2.745
21	0.4280	543.40	511.8	7.7	5.522	3.564	9.086	2.55	60.50	6.325	2.761
22	0.4490	554.30	522.7	8.1	5.617	3.571	9.188	2.57	60.40	6.380	2.808
23	0.4690	565.90	534.3	8.5	5.719	3.578	9.297	2.60	60.30	6.438	2.859
24	0.4890	567.60	536.0	8.8	5.714	3.578	9.293	2.60	60.30	6.436	2.857
25	0.5300	581.70	550.1	9.6	5.817	3.600	9.417	2.62	60.00	6.509	2.909
26	0.5710	591.70	560.1	10.3	5.874	3.636	9.510	2.62	59.50	6.573	2.937
27	0.6120	605.00	573.4	11.0	5.964	3.665	9.629	2.63	59.10	6.647	2.982
28	0.6530	615.00	583.4	11.8	6.018	3.701	9.719	2.63	58.60	6.710	3.009
29	0.6940	626.70	595.1	12.5	6.087	3.737	9.824	2.63	58.10	6.780	3.044
30	0.7350	638.30	606.7	13.3	6.153	3.773	9.926	2.63	57.60	6.849	3.077
31	0.7760	649.10	617.5	14.0	6.209	3.816	10.025	2.63	57.00	6.921	3.105
32	0.8170	657.50	625.9	14.7	6.240	3.852	10.092	2.62	56.50	6.972	3.120
33	0.8390	669.90	638.3	15.1	6.334	3.866	10.200	2.64	56.30	7.033	3.167


Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
• Silty CLAY (CL) with sand
Project: Mach #1 Mine Williamson County, Illinois
Project Number: H-05278
Sample: B-8874 Depth 10-12'
Date: February 8, 2006
LL = 41.8 PL = 17.7 PI = 24.1
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

17 of 57

R13432

Holcomb Foundation Engineering Company

Laboratory Testing Results

2/8/2006

Project: Mach #1 Mine

Project No: H-05278

Sieve Analysis - ASTM C136-96a

Sample: Silty CLAY (CL)

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
1.5000	38.1000	1 -1/2"	0.0	0.0	100.0
1.0000	25.4000	1"	0.0	0.0	100.0
0.7500	19.1000	3/4"	0.0	0.0	100.0
0.5000	12.7000	1/2"	0.0	0.0	100.0
3.7500	9.5200	3/8"	0.0	0.0	100.0
0.1870	4.7600	No. 4	2.1	0.9	99.1
0.0790	2.0000	No. 10	4.6	2.0	98.0
0.0469	1.1800	No. 16	4.6	2.0	98.0
0.0331	0.8500	No. 20	8.6	3.8	96.2
0.0165	0.4200	No. 40	12.6	5.5	94.5
0.0117	0.2980	No. 50	12.6	5.5	94.5
0.0083	0.2500	No. 60	22.2	9.8	90.2
0.0059	0.1490	No. 100	34.6	15.2	84.8
0.0029	0.0740	No. 200	47.7	21.0	79.0

Total Weight in Grams 227.20

Holcomb Foundation Engineering Company

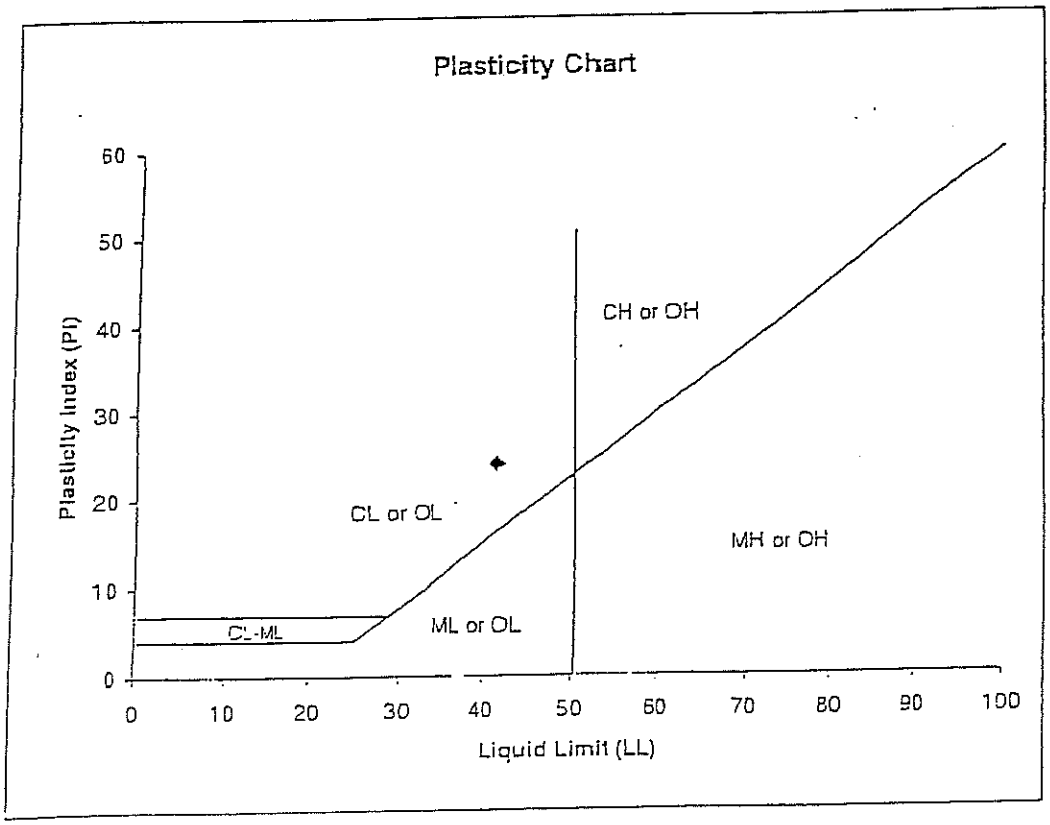
Laboratory Testing Results

Project: Mach #1 Mine
Project No: H-05278

Sample	1	2	3
Dish Number	LL_1	LL_2	LL_3
Mass of can, W_1 (g)	34.70		
Mass of can + moist soil, W_2 (g)	62.84		
Mass of can + dry soil, W_3 (g)	54.52		
Moisture content, w (%)	41.98		
Number of blows, N	24		
Liquid Limit, LL	41.8		

Dish Number	PL_1
Mass of can, W_1 (g)	39.76
Mass of can + moist soil, W_2 (g)	54.79
Mass of can + dry soil, W_3 (g)	52.53
Plastic Limit, PL	17.7

PI = 24.1



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R13434

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SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

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Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

November 30, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Pond Creek Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on November 17, 2006, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification:	Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)
Proctor Test Results:	
Maximum Dry Unit Weight:	124.6 PCF
Optimum Moisture Content:	9.3 %
Specific Gravity:	2.37
Triaxial Test Results:	
Effective Cohesion:	0 PSF
Effective Phi Angle:	33.7 Degrees
Permeability:	2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

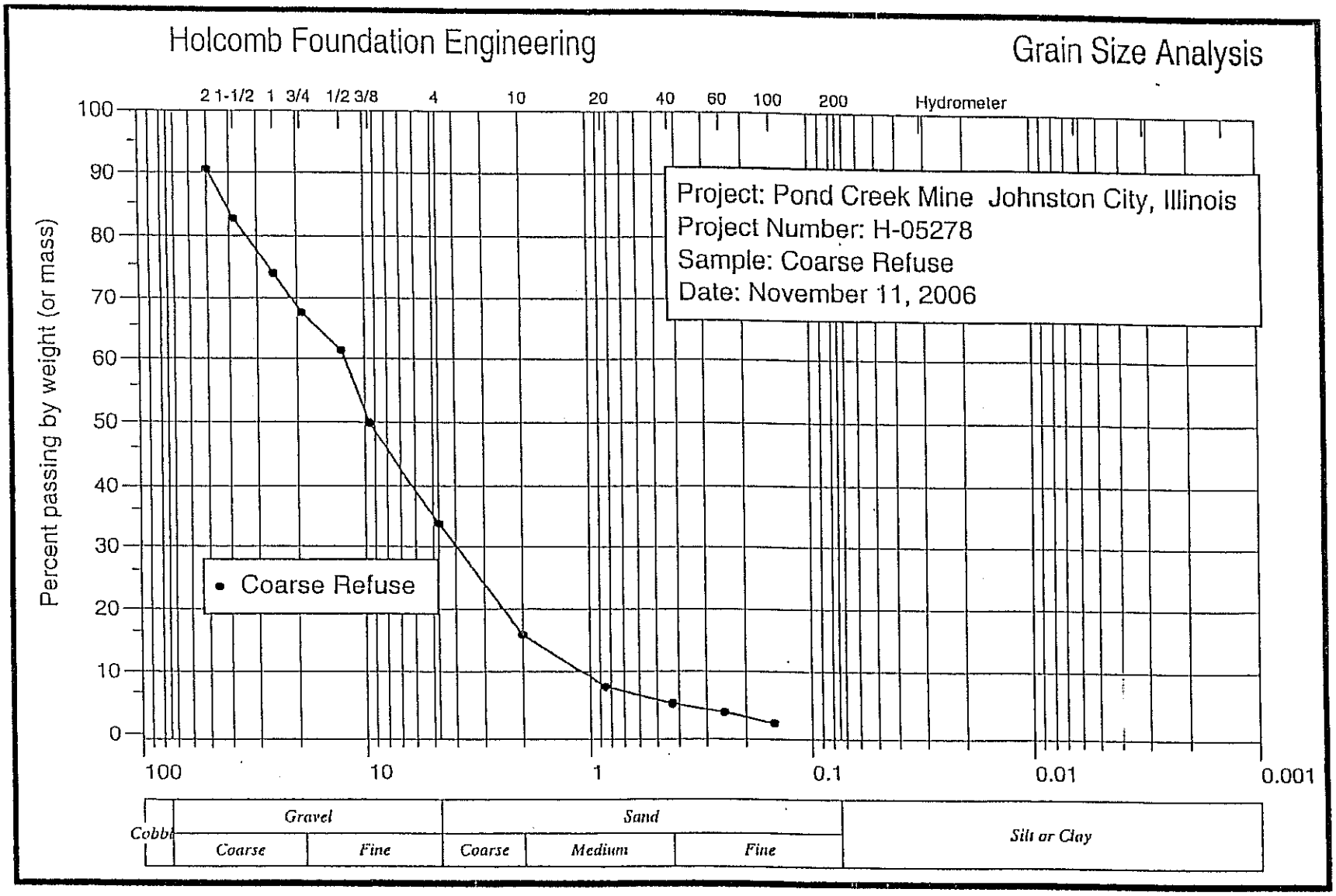
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting


Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
Project: Pond Creek Mine Johnston City, Illinois
Project Number: H-05278
Sample: Coarse Refuse
Date: November 11, 2006
• Coarse Refuse
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

R13486

22 7 21 (16) R13487

Holcomb Foundation Engineering Company

Laboratory Testing Results

11/30/2006

Project: Coarse Refuse Disposal Area
Pond Creek Mine Johnston City, Illinois

Project No: H-05317

Sieve Analysis - ASTM C136-96a

Sample: Coarse Refuse

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
3	76.2	3"	0.0	0.0	100.0
2.0000	50.8100	2"	619.6	9.5	90.5
1.5000	38.1000	1 -1/2"	1124.0	17.2	82.8
1.0000	25.4000	1"	1696.2	25.9	74.1
0.7500	19.1000	3/4"	2110.9	32.3	67.7
0.5000	12.7000	1/2"	2513.0	38.4	61.6
3.7500	9.5200	3/8"	3263.7	49.9	50.1
0.1870	4.7600	No. 4	4310.7	65.9	34.1
0.0790	2.0000	No. 10	5470.5	83.6	16.4
0.0469	1.1800	No. 16			
0.0331	0.8500	No. 20	6004.4	91.8	8.2
0.0165	0.4200	No. 40	6178.9	94.4	5.6
0.0117	0.2980	No. 50			
0.0083	0.2500	No. 60	6267.8	95.8	4.2
0.0059	0.1490	No. 100			
0.0029	0.0740	No. 200	6372.4	97.4	2.6

Total Weight in Grams 6542.80

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

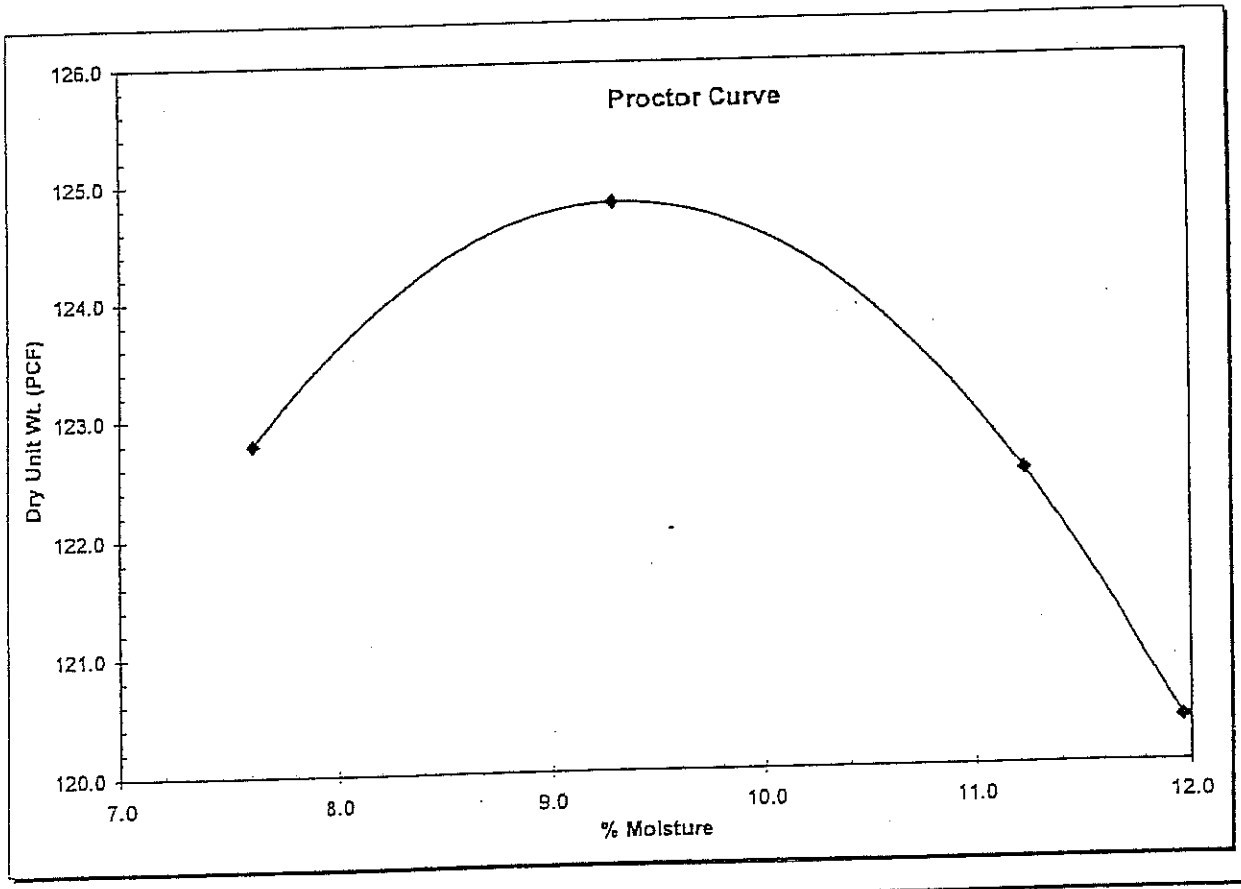
Date: 11/30/2006

Proctor Test Results

Soil Classification:	Gray Coarse Refuse
Maximum Dry Density (PCF)	124.8
Optimum Moisture Content (%)	9.3

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
7.6	122.8
11.2	122.5
12.0	120.4
9.3	124.8



R13439

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Permeability Tests Results

Laboratory Tests
Coarse Refuse
Pond Creek Mine - Johnston City, Illinois

Date: 11/30/2006

Client: Pond Creek Mine
Johnston City, Illinois

Project No.: H-05278

Sample	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse		7.7	11.8	119.3	2 x 10-4

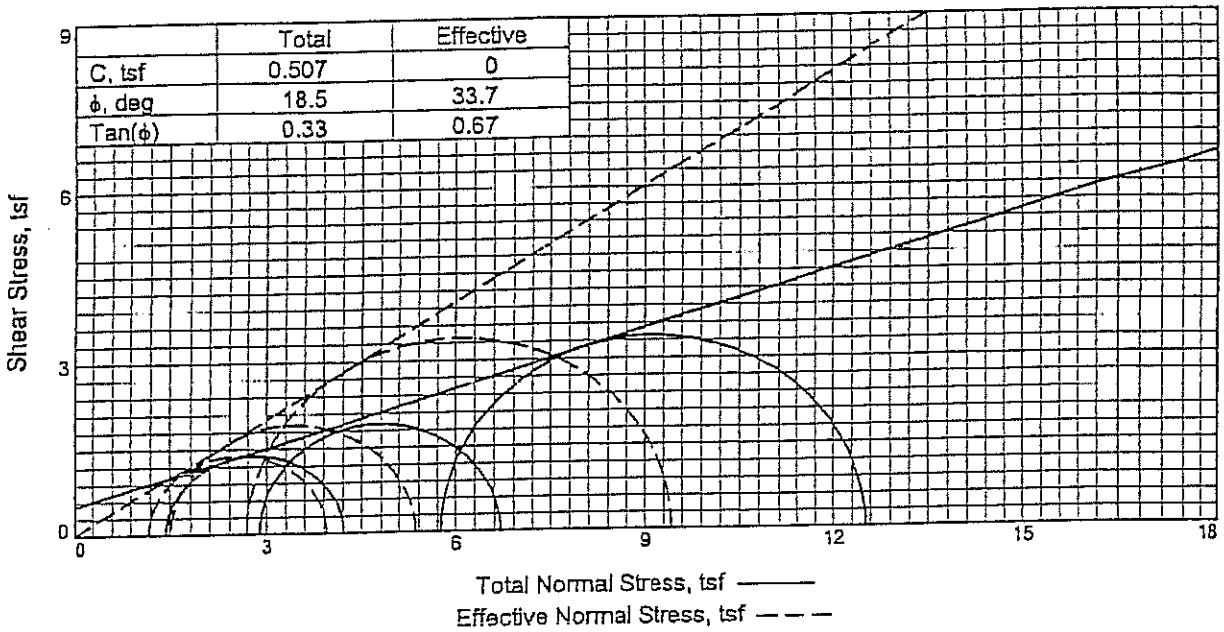
Permeability Tests performed in accordance with ASTM D-5084

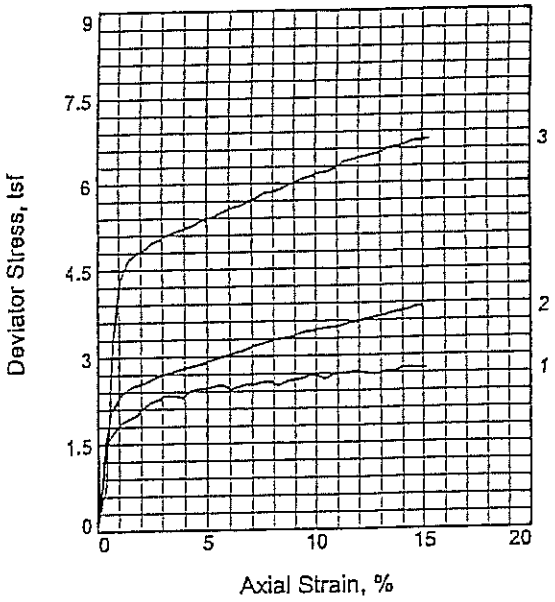
PERMEABILITY TEST RESULTS

Project	Pond Creek Mine	Boring/Sample	Coarse Refuse
		Depth	
t #	H-05278	Classification	
Date	11/30/2006	Diameter	2.8 Inch
		Length	5.6 Inch

In Place Mc		After Test Mc		Unit Weight (PCF)	
Wet Wt.	195.3	Wet Wt.	1300.4	Sample Wt.	1161.8
Pan	94.2	Pan	103.1		
Dry Wt.	188.1	Dry Wt.	1173.6	Wet UW=	128.5
Mc (%)	7.7	Mc (%)	11.8	Dry UW=	119.3

Time(hrs)	Time(min)	Quantity (cc)	Head (psi)	Permeability (cm/sec)
7	26	24.7		
7	34	8.2	1	1.75E-04
7	33	24.5		
7	45	2.7	1	1.54E-04
7	47	0.8	1	1.44E-04
9	16	24.4		
9	23	9.6	1	1.79E-04
9	30	0.9	1	1.43E-04
			Average Permeability	1.63E-04





Sample No.		1	2	3
Initial	Water Content,	10.1	10.8	10.3
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	97.0	99.8	99.3
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
At Test	Water Content,	10.4	10.8	10.4
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
Strain rate, in./min.		0.01	0.01	0.01
Back Pressure, tsf		3.60	3.60	2.16
Cell Pressure, tsf		5.04	6.48	7.92
Fail. Stress, tsf		2.78	3.83	6.76
Total Pore Pr., tsf		3.86	4.96	5.23
Ult. Stress, tsf		2.77	3.83	6.76
Total Pore Pr., tsf		3.85	4.95	5.23
$\bar{\sigma}_1$ Failure, tsf		3.96	5.35	9.44
$\bar{\sigma}_3$ Failure, tsf		1.18	1.52	2.69

Type of Test: CU with Pore Pressures

Sample Type: Remolded

Description: Coarse Coal Refuse

Assumed Specific Gravity= 2.37

Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

Location: Coarse Refuse Stockpile

Sample Number: Coarse Refuse

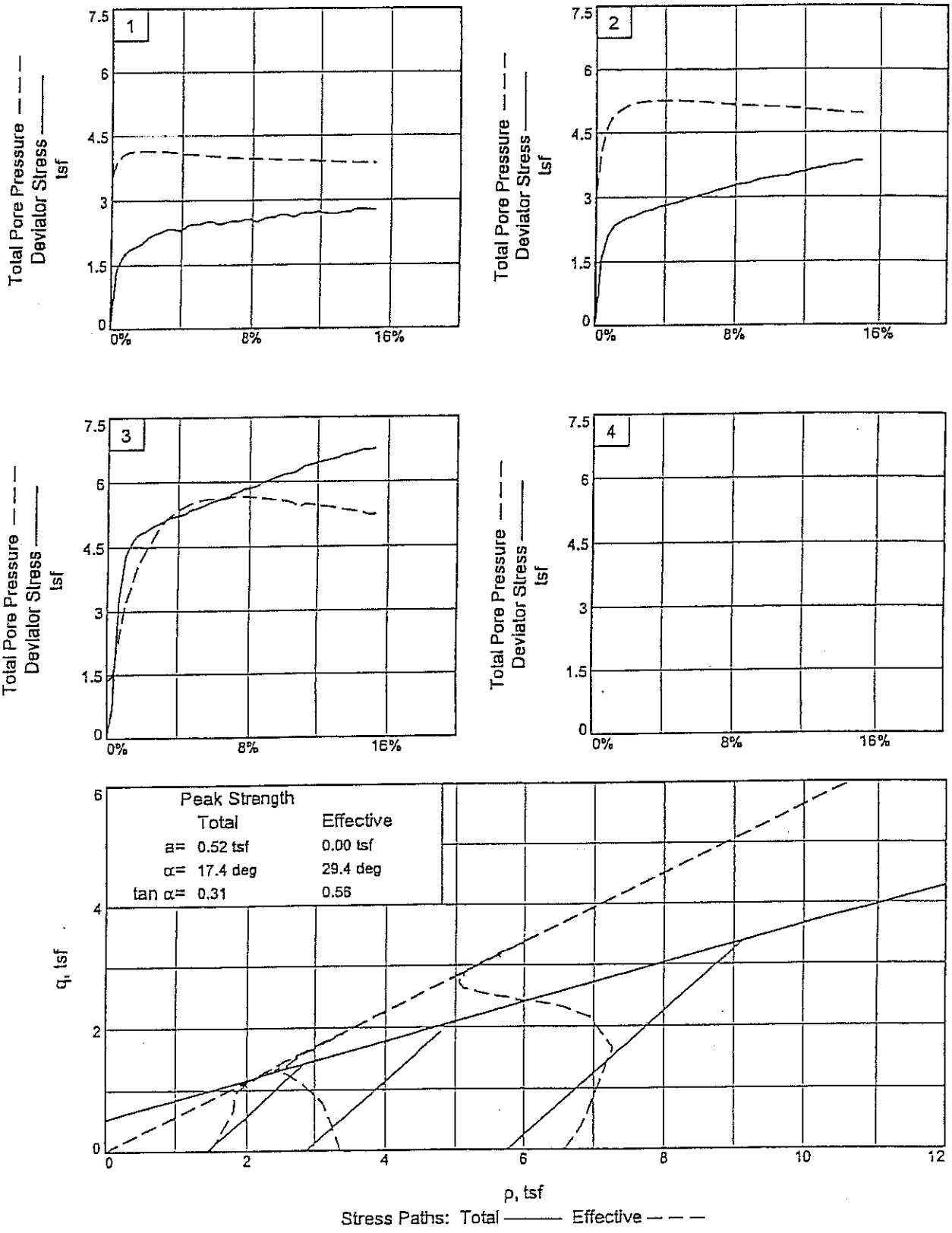
Proj. No.: H-05278 **Date:** 11/17/06

TRIAXIAL SHEAR TEST REPORT

HOLCOMB FOUNDATION ENGINEERING CO.

Plate _____

Tested By: LC **Checked By:** TH



Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Coarse Refuse Stockpile
Project No.: H-05278

Sample Number: Coarse Refuse
Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

11/30/2006
10:19 AM

Date:	11/17/06
Client:	Pond Creek Mine
Project:	Coarse Refuse Laboratory Tests
Location:	Coarse Refuse Stockpile
Sample Number:	Coarse Refuse
Description:	Coarse Coal Refuse
Remarks:	
Type of Sample:	Remolded
Assumed Specific Gravity=2.37	LL= PL= PI=
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	226.800			1320.700
Moisture content: Dry soil+tare, gms.	218.600			1195.800
Moisture content: Tare, gms.	137.500			107.600
Moisture, %	10.1	10.4	10.4	11.5
Moist specimen weight, gms.	1193.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.65	5.65	5.65	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.6	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2470	0.2470	0.2470	
Saturation, %	97.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 2.778 tsf at reading no. 41
Ult. Stress = 2.767 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0010	46.60	0.0	0.0	0.000	1.498	1.498	1.00	49.20	1.498	0.000
1	0.0180	160.60	114.0	0.3	1.329	1.152	2.481	2.15	54.00	1.816	0.664
2	0.0390	189.70	143.1	0.7	1.662	1.001	2.663	2.66	56.10	1.832	0.831
3	0.0590	205.60	159.0	1.0	1.840	0.929	2.769	2.98	57.10	1.849	0.920
4	0.0800	212.20	165.6	1.4	1.909	0.907	2.816	3.10	57.40	1.862	0.955
5	0.1000	218.90	172.3	1.8	1.979	0.900	2.879	3.20	57.50	1.890	0.990
6	0.1200	232.20	185.6	2.1	2.125	0.900	3.025	3.36	57.50	1.962	1.062
7	0.1410	240.50	193.9	2.5	2.211	0.907	3.118	3.44	57.40	2.013	1.106
8	0.1610	245.50	198.9	2.8	2.260	0.914	3.174	3.47	57.30	2.044	1.130
9	0.1820	252.20	205.6	3.2	2.327	0.922	3.249	3.53	57.20	2.085	1.164
10	0.2020	253.80	207.2	3.6	2.337	0.936	3.273	3.50	57.00	2.104	1.168
11	0.2230	250.50	203.9	3.9	2.291	0.958	3.248	3.39	56.70	2.103	1.145
12	0.2430	261.30	214.7	4.3	2.403	0.972	3.375	3.47	56.50	2.173	1.201
13	0.2630	266.30	219.7	4.6	2.450	0.979	3.429	3.50	56.40	2.204	1.225
14	0.2840	266.30	219.7	5.0	2.440	0.994	3.434	3.46	56.20	2.214	1.220
15	0.3040	272.10	225.5	5.4	2.495	1.008	3.503	3.48	56.00	2.256	1.248
16	0.3250	274.60	228.0	5.7	2.513	1.022	3.536	3.46	55.80	2.279	1.257
17	0.3450	268.00	221.4	6.1	2.431	1.037	3.468	3.34	55.60	2.252	1.216
18	0.3660	273.00	226.4	6.5	2.476	1.051	3.527	3.36	55.40	2.289	1.238
19	0.3860	278.00	231.4	6.8	2.521	1.058	3.580	3.38	55.30	2.319	1.261
20	0.4070	278.00	231.4	7.2	2.511	1.066	3.577	3.36	55.20	2.321	1.256
21	0.4270	283.00	236.4	7.5	2.556	1.073	3.629	3.38	55.10	2.351	1.278
22	0.4470	284.60	238.0	7.9	2.563	1.080	3.643	3.37	55.00	2.362	1.282
23	0.4680	278.80	232.2	8.3	2.491	1.087	3.578	3.29	54.90	2.333	1.245
24	0.4880	286.30	239.7	8.6	2.561	1.087	3.648	3.36	54.90	2.368	1.281
25	0.5090	290.40	243.8	9.0	2.594	1.094	3.689	3.37	54.80	2.392	1.297
26	0.5290	292.10	245.5	9.3	2.602	1.102	3.704	3.36	54.70	2.403	1.301
27	0.5500	298.80	252.2	9.7	2.662	1.109	3.771	3.40	54.60	2.440	1.331
28	0.5700	299.60	253.0	10.1	2.660	1.116	3.776	3.38	54.50	2.446	1.330
29	0.5910	294.60	248.0	10.4	2.597	1.116	3.713	3.33	54.50	2.415	1.299
30	0.6110	302.10	255.5	10.8	2.665	1.123	3.788	3.37	54.40	2.456	1.333
31	0.6310	306.30	259.7	11.2	2.698	1.130	3.828	3.39	54.30	2.479	1.349
32	0.6520	306.30	259.7	11.5	2.687	1.130	3.817	3.38	54.30	2.474	1.343
33	0.6720	312.10	265.5	11.9	2.736	1.145	3.881	3.39	54.10	2.513	1.368
34	0.6930	309.60	263.0	12.2	2.699	1.145	3.843	3.36	54.10	2.494	1.349
35	0.7130	308.80	262.2	12.6	2.680	1.152	3.832	3.33	54.00	2.492	1.340
36	0.7340	309.60	263.0	13.0	2.676	1.159	3.835	3.31	53.90	2.497	1.338
37	0.7540	315.40	268.8	13.3	2.724	1.166	3.891	3.34	53.80	2.528	1.362
38	0.7750	316.20	269.6	13.7	2.721	1.166	3.887	3.33	53.80	2.527	1.360
39	0.7950	323.70	277.1	14.1	2.785	1.181	3.966	3.36	53.60	2.573	1.392
40	0.8150	325.40	278.8	14.4	2.790	1.181	3.971	3.36	53.60	2.576	1.395
41	0.8360	325.40	278.8	14.8	2.778	1.181	3.959	3.35	53.60	2.570	1.389
42	0.8560	325.40	278.8	15.1	2.767	1.188	3.955	3.33	53.50	2.571	1.383

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	211.600			1335.900
Moisture content: Dry soil+tare, gms.	203.200			1222.200
Moisture content: Tare, gms.	125.200			134.800
Moisture, %	10.8	10.8	10.8	10.5
Moist specimen weight, gms.	1175.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.57	5.57	5.57	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.5	130.5	130.5	
Dry density, pcf	117.8	117.8	117.8	
Void ratio	0.2558	0.2558	0.2558	
Saturation, %	99.8	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 3.829 tsf at reading no. 40
Ult. Stress = 3.828 tsf at reading no. 41

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	51.60	0.0	0.0	0.000	3.377	3.377	1.00	43.10	3.377	0.000
1	0.0190	185.60	134.0	0.3	1.562	2.340	3.902	1.67	57.50	3.121	0.781
2	0.0400	233.00	181.4	0.7	2.106	1.814	3.920	2.16	64.80	2.867	1.053
3	0.0600	253.00	201.4	1.1	2.330	1.562	3.892	2.49	68.30	2.727	1.165
4	0.0810	263.80	212.2	1.5	2.445	1.433	3.878	2.71	70.10	2.655	1.223
5	0.1010	270.50	218.9	1.8	2.513	1.346	3.860	2.87	71.30	2.603	1.257
6	0.1220	274.60	223.0	2.2	2.550	1.289	3.839	2.98	72.10	2.564	1.275
7	0.1420	281.30	229.7	2.5	2.617	1.260	3.877	3.08	72.50	2.569	1.309
8	0.1620	287.10	235.5	2.9	2.674	1.238	3.912	3.16	72.80	2.575	1.337
9	0.1830	291.30	239.7	3.3	2.711	1.231	3.942	3.20	72.90	2.587	1.355
10	0.2030	297.10	245.5	3.6	2.766	1.224	3.990	3.26	73.00	2.607	1.383
11	0.2240	301.30	249.7	4.0	2.802	1.224	4.026	3.29	73.00	2.625	1.401
12	0.2440	305.40	253.8	4.4	2.838	1.224	4.062	3.32	73.00	2.643	1.419
13	0.2650	309.60	258.0	4.8	2.873	1.224	4.097	3.35	73.00	2.661	1.437
14	0.2850	315.40	263.8	5.1	2.927	1.231	4.158	3.38	72.90	2.695	1.463
15	0.3060	320.40	268.8	5.5	2.970	1.238	4.209	3.40	72.80	2.724	1.485
16	0.3260	326.20	274.6	5.9	3.023	1.246	4.269	3.43	72.70	2.757	1.512
17	0.3460	330.40	278.8	6.2	3.058	1.253	4.310	3.44	72.60	2.782	1.529
18	0.3670	334.60	283.0	6.6	3.091	1.267	4.358	3.44	72.40	2.813	1.546
19	0.3870	341.20	289.6	6.9	3.151	1.282	4.433	3.46	72.20	2.857	1.576
20	0.4080	346.20	294.6	7.3	3.192	1.296	4.488	3.46	72.00	2.892	1.596
21	0.4280	351.20	299.6	7.7	3.234	1.310	4.544	3.47	71.80	2.927	1.617

No.	Def. Dial In.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	357.00	305.4	8.1	3.283	1.318	4.601	3.49	71.70	2.959	1.642
23	0.4690	359.50	307.9	8.4	3.297	1.332	4.629	3.48	71.50	2.981	1.649
24	0.4890	362.80	311.2	8.8	3.319	1.339	4.659	3.48	71.40	2.999	1.660
25	0.5100	368.70	317.1	9.2	3.368	1.346	4.715	3.50	71.30	3.031	1.684
26	0.5300	374.50	322.9	9.5	3.416	1.361	4.777	3.51	71.10	3.069	1.708
27	0.5510	377.00	325.4	9.9	3.429	1.368	4.797	3.51	71.00	3.082	1.714
28	0.5710	381.20	329.6	10.2	3.459	1.368	4.827	3.53	71.00	3.098	1.730
29	0.5920	384.50	332.9	10.6	3.479	1.382	4.861	3.52	70.80	3.122	1.739
30	0.6120	386.20	334.6	11.0	3.483	1.390	4.872	3.51	70.70	3.131	1.741
31	0.6330	392.00	340.4	11.4	3.528	1.397	4.925	3.53	70.60	3.161	1.764
32	0.6530	397.00	345.4	11.7	3.565	1.411	4.977	3.53	70.40	3.194	1.783
33	0.6730	400.30	348.7	12.1	3.585	1.426	5.010	3.51	70.20	3.218	1.792
34	0.6940	406.10	354.5	12.5	3.629	1.440	5.069	3.52	70.00	3.254	1.814
35	0.7140	410.30	358.7	12.8	3.657	1.454	5.111	3.51	69.80	3.283	1.828
36	0.7350	413.60	362.0	13.2	3.674	1.469	5.143	3.50	69.60	3.306	1.837
37	0.7550	420.30	368.7	13.6	3.727	1.483	5.210	3.51	69.40	3.347	1.863
38	0.7760	423.60	372.0	13.9	3.744	1.498	5.242	3.50	69.20	3.370	1.872
39	0.7960	427.80	376.2	14.3	3.770	1.505	5.275	3.51	69.10	3.390	1.885
40	0.8170	435.30	383.7	14.7	3.829	1.519	5.348	3.52	68.90	3.434	1.914
41	0.8370	436.90	385.3	15.0	3.828	1.526	5.355	3.51	68.80	3.441	1.914

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	184.300			1333.800
Moisture content: Dry soil+tare, gms.	177.100			1230.400
Moisture content: Tare, gms.	107.500			135.300
Moisture, %	10.3	10.4	10.4	9.4
Moist specimen weight, gms.	1185.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.60	5.60	5.60	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.9	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2468	0.2468	0.2468	
Saturation, %	99.3	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 6.758 tsf at reading no. 42
Ult. Stress = 6.758 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	25.00	0.0	0.0	0.000	6.588	6.588	1.00	18.50	6.588	0.000
1	0.0190	88.20	63.2	0.3	0.736	6.458	7.195	1.11	20.30	6.827	0.368
2	0.0400	309.60	284.6	0.7	3.304	5.623	8.927	1.59	31.90	7.275	1.652
3	0.0600	397.00	372.0	1.1	4.303	4.795	9.098	1.90	43.40	6.947	2.152
4	0.0810	428.60	403.6	1.4	4.651	4.234	8.885	2.10	51.20	6.559	2.326
5	0.1010	441.90	416.9	1.8	4.787	3.830	8.617	2.25	56.80	6.224	2.393
6	0.1220	449.40	424.4	2.2	4.854	3.521	8.375	2.38	61.10	5.948	2.427
7	0.1420	460.20	435.2	2.5	4.960	3.283	8.243	2.51	64.40	5.763	2.480
8	0.1620	467.70	442.7	2.9	5.027	3.017	8.044	2.67	68.10	5.530	2.513
9	0.1830	476.00	451.0	3.3	5.101	2.837	7.938	2.80	70.60	5.387	2.551
10	0.2030	483.50	458.5	3.6	5.167	2.693	7.860	2.92	72.60	5.276	2.583
11	0.2240	489.30	464.3	4.0	5.212	2.585	7.797	3.02	74.10	5.191	2.606
12	0.2440	495.20	470.2	4.4	5.258	2.491	7.750	3.11	75.40	5.120	2.629
13	0.2650	505.20	480.2	4.7	5.349	2.419	7.768	3.21	76.40	5.094	2.675
14	0.2850	511.00	486.0	5.1	5.394	2.369	7.762	3.28	77.10	5.066	2.697
15	0.3060	518.50	493.5	5.5	5.455	2.333	7.788	3.34	77.60	5.060	2.728
16	0.3260	526.80	501.8	5.8	5.526	2.304	7.830	3.40	78.00	5.067	2.763
17	0.3460	533.50	508.5	6.2	5.579	2.297	7.875	3.43	78.10	5.086	2.789
18	0.3670	539.30	514.3	6.6	5.620	2.326	7.945	3.42	77.70	5.135	2.810
19	0.3870	548.40	523.4	6.9	5.697	2.275	7.972	3.50	78.40	5.124	2.849
20	0.4080	555.90	530.9	7.3	5.756	2.261	8.016	3.55	78.60	5.139	2.878
21	0.4280	565.90	540.9	7.6	5.841	2.261	8.102	3.58	78.60	5.181	2.921

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	569.20	544.2	8.0	5.853	2.268	8.121	3.58	78.50	5.195	2.927
23	0.4690	575.10	550.1	8.4	5.894	2.282	8.176	3.58	78.30	5.229	2.947
24	0.4890	584.20	559.2	8.7	5.968	2.297	8.265	3.60	78.10	5.281	2.984
25	0.5100	592.50	567.5	9.1	6.031	2.311	8.343	3.61	77.90	5.327	3.016
26	0.5300	599.20	574.2	9.5	6.079	2.333	8.411	3.61	77.60	5.372	3.039
27	0.5510	605.90	580.9	9.8	6.124	2.354	8.479	3.60	77.30	5.416	3.062
28	0.5710	613.30	588.3	10.2	6.178	2.362	8.539	3.62	77.20	5.450	3.089
29	0.5920	617.50	592.5	10.6	6.196	2.405	8.601	3.58	76.60	5.503	3.098
30	0.6120	626.70	601.7	10.9	6.267	2.527	8.794	3.48	74.90	5.661	3.133
31	0.6330	638.30	613.3	11.3	6.361	2.426	8.787	3.62	76.30	5.607	3.180
32	0.6530	644.10	619.1	11.7	6.395	2.448	8.843	3.61	76.00	5.646	3.198
33	0.6730	650.80	625.8	12.0	6.438	2.477	8.915	3.60	75.60	5.696	3.219
34	0.6940	656.60	631.6	12.4	6.470	2.498	8.968	3.59	75.30	5.733	3.235
35	0.7140	662.50	637.5	12.8	6.504	2.506	9.009	3.60	75.20	5.758	3.252
36	0.7350	669.10	644.1	13.1	6.543	2.542	9.085	3.57	74.70	5.813	3.271
37	0.7550	678.30	653.3	13.5	6.609	2.563	9.172	3.58	74.40	5.868	3.305
38	0.7760	684.10	659.1	13.9	6.639	2.585	9.224	3.57	74.10	5.904	3.319
39	0.7960	690.70	665.7	14.2	6.678	2.614	9.291	3.55	73.70	5.952	3.339
40	0.8170	699.10	674.1	14.6	6.732	2.635	9.367	3.55	73.40	6.001	3.366
41	0.8370	701.60	676.6	14.9	6.729	2.700	9.429	3.49	72.50	6.065	3.365
42	0.8570	707.40	682.4	15.3	6.758	2.686	9.444	3.52	72.70	6.065	3.379

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

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Box 393 Wood Road
Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

April 9, 2007

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Mach Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on March 29, 2007, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification:	Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)
Proctor Test Results:	
Maximum Dry Unit Weight:	120.3 PCF
Optimum Moisture Content:	10.7 %
Specific Gravity:	2.50
Triaxial Test Results:	
Effective Cohesion:	152 PSF
Effective Phi Angle:	29.3 Degrees
Permeability (2 tests):	3 x 10-4 cm./sec.
	2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

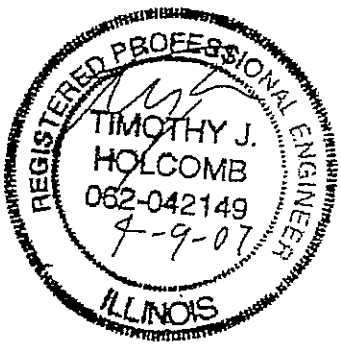
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting



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Permeability Tests Results

Mach Mine
Johnston City, Illinois

Date: 4/9/2007 Client: Williamson Energy

Project No.: H-05278

Boring No.	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse Sample #1		10.9	14.6	115.7	3 x 10-4
Coarse Refuse Sample #2		10.1	14.3	114.7	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

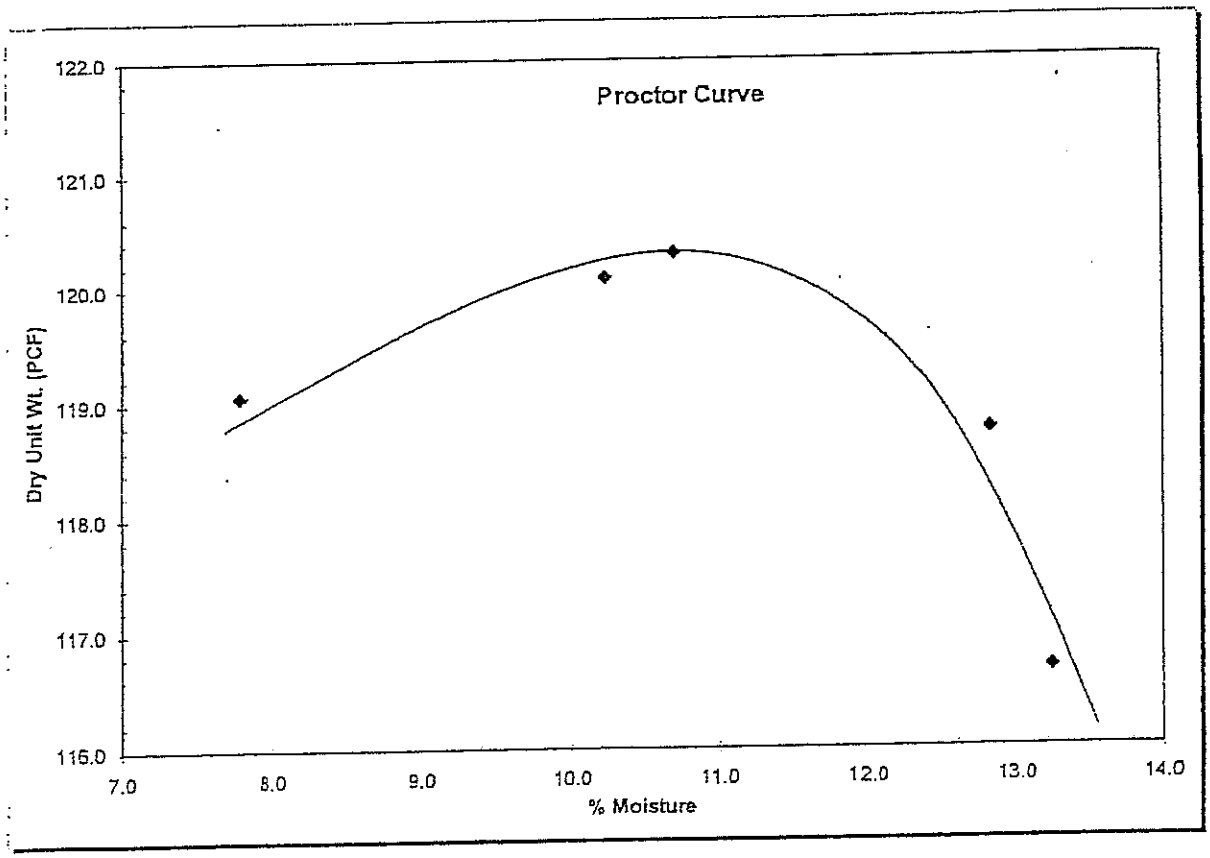
Date: 4/9/2007

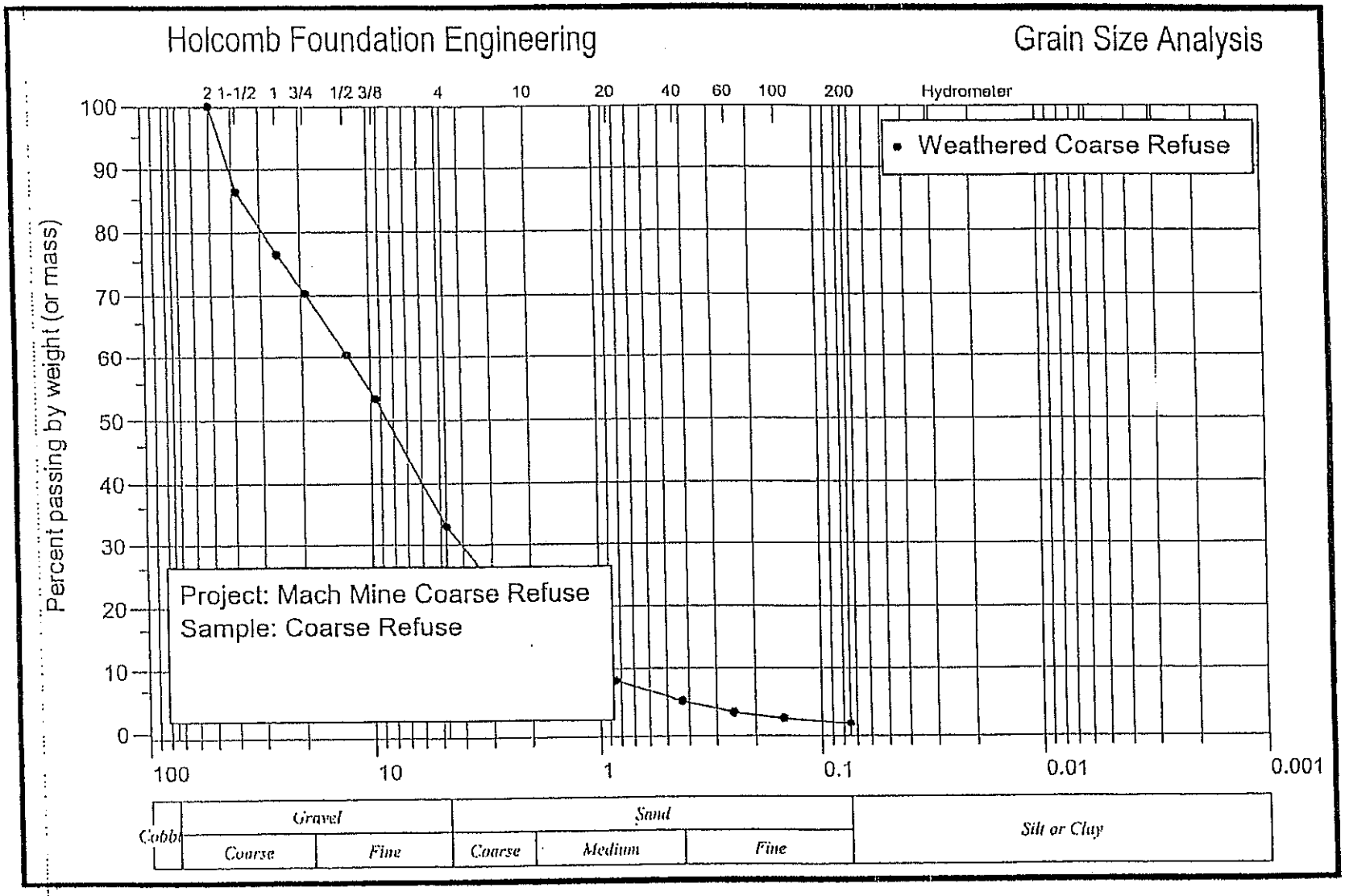
Proctor Test Results

Soil Classification:	Weathered Coarse Refuse
Maximum Dry Density (PCF)	120.3
Optimum Moisture Content (%)	10.7

Test Data: ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
12.8	118.7
13.2	116.7
10.2	120.1
7.8	119.1
10.7	120.3




Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
Weathered Coarse Refuse
Project: Mach Mine Coarse Refuse
Sample: Coarse Refuse
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

R13453

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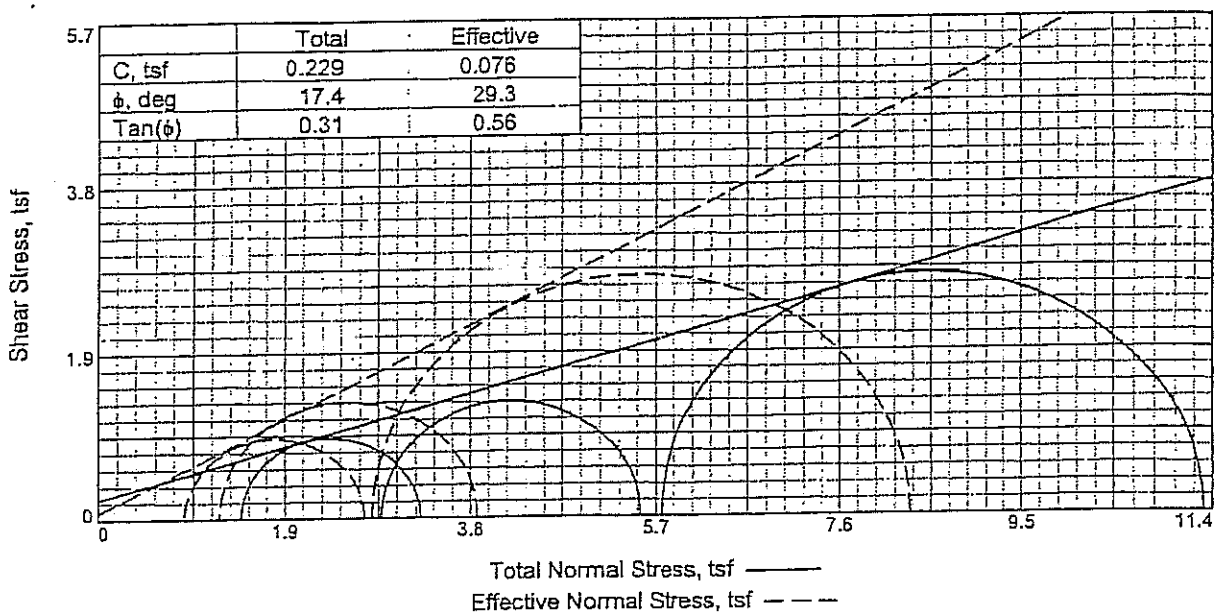
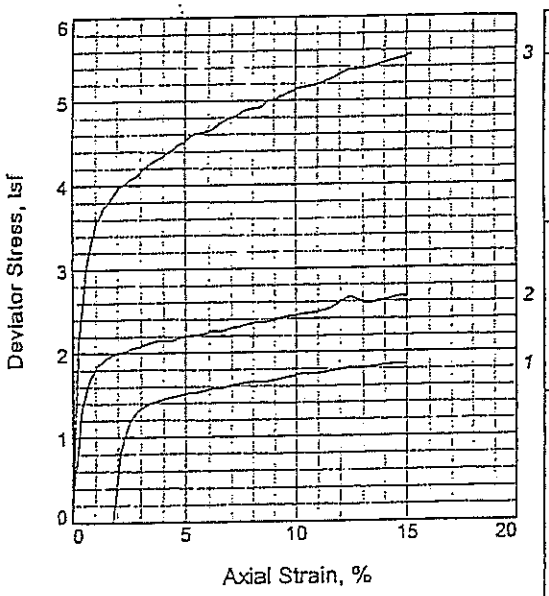
Grain Size Analysis

Project:	Mach Mine	Client:	Mach Mine
Project No.:	H-05278	Date:	4/9/2007
Sample No.	Coarse Refuse	Total Weight:	2290.30

Sieve	Wt. Retained	% Ret.	% Passing
2"	0.0	0.0	100.0
1.5"	314.4	13.7	86.3
1"	536.7	23.4	76.6
3/4"	674.8	29.5	70.5
1/2"	901.6	39.4	60.6
3/8"	1061.2	46.3	53.7
#4	1522.1	66.5	33.5
#10	1911.6	83.5	16.5
#20	2091.9	91.3	8.7
#40	2166.2	94.6	5.4
#60	2202.2	96.2	3.8
#100	2223.7	97.1	2.9
#200	2245.2	98.0	2.0





Sample No.		1	2	3
Initial	Water Content,	14.4	12.7	13.1
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	95.1	89.0	90.4
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
At Test	Water Content,	15.2	14.2	14.5
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.60	3.60	1.80
Cell Pressure, tsf		5.04	6.48	7.56
Fail. Stress, tsf		1.85	2.67	5.55
Total Pore Pr., tsf		4.18	5.27	4.77
Ult. Stress, tsf		1.85	2.66	5.55
Total Pore Pr., tsf		4.18	5.22	4.77
$\bar{\sigma}_1$ Failure, tsf		2.71	3.88	8.34
$\bar{\sigma}_3$ Failure, tsf		0.86	1.21	2.79

Type of Test:
CU with Pore Pressures
Sample Type: Coarse Refuse
Description:

Assumed Specific Gravity= 2.50
Remarks:

Plate _____

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

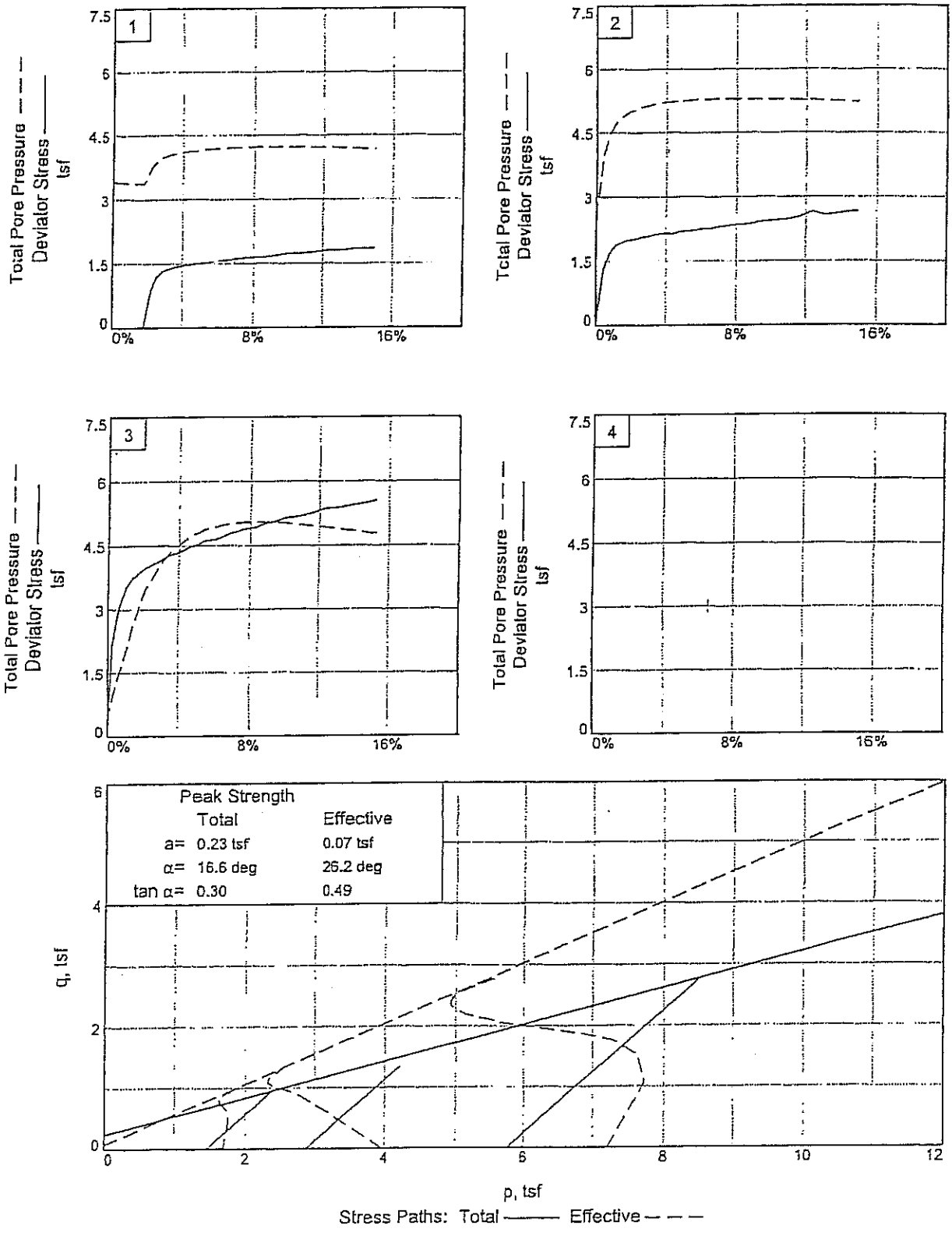
Location: Weathered Coarse Refuse

Proj. No.: H-05278 Date: 4/2/07

TRIAXIAL SHEAR TEST REPORT

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH



Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Weathered Coarse Refuse
Project No.: H-05278
Plate _____
HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

4/9/2007
11:10 AM

Date: 4/2/07
Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Weathered Coarse Refuse
Description:
Remarks:
Type of Sample: Coarse Refuse
Assumed Specific Gravity=2.50 LL= PL= PI=
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	179.300			1255.500
Moisture content: Dry soil+tare, gms.	165.700			1117.500
Moisture content: Tare, gms.	71.400			79.600
Moisture, %	14.4	15.2	15.2	13.3
Moist specimen weight, gms.	1170.0			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.59	5.59	5.59	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.5	130.3	130.3	
Dry density, pcf	113.2	113.2	113.2	
Void ratio	0.3793	0.3793	0.3793	
Saturation, %	95.1	100.0	100.0	

Test Results for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.845 tsf at reading no. 31
Ult. Stress = 1.845 tsf at reading no. 31

Test Readings for Specimen No.

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	19.10	0.0	0.0	0.000	1.627	1.627	1.00	47.40	1.627	0.000
1	0.0190	20.00	0.9	0.3	0.001	1.642	1.642	1.00	47.20	1.642	0.000
2	0.0400	20.00	0.9	0.7	0.000	1.656	1.656	1.00	47.00	1.656	0.000
3	0.0600	20.00	0.9	1.1	0.000	1.663	1.663	1.00	46.90	1.663	0.000
4	0.0810	20.00	0.9	1.4	0.000	1.678	1.678	1.00	46.70	1.678	0.000
5	0.1010	25.00	5.9	1.8	0.017	1.678	1.694	1.01	46.70	1.686	0.008
6	0.1220	99.00	79.9	2.2	0.857	1.318	2.175	1.65	51.70	1.746	0.429
7	0.1420	124.00	104.9	2.5	1.195	1.152	2.347	2.04	54.00	1.750	0.598
8	0.1620	134.80	115.7	2.9	1.314	1.058	2.372	2.24	55.30	1.715	0.657
9	0.1830	140.60	121.5	3.3	1.374	1.001	2.375	2.37	56.10	1.688	0.687
10	0.2030	144.80	125.7	3.6	1.416	0.965	2.381	2.47	56.60	1.673	0.708
11	0.2240	148.10	129.0	4.0	1.448	0.936	2.384	2.55	57.00	1.660	0.724
12	0.2440	150.60	131.5	4.4	1.471	0.914	2.385	2.61	57.30	1.650	0.735
13	0.2650	153.10	134.0	4.7	1.493	0.900	2.393	2.66	57.50	1.646	0.746
14	0.2850	155.60	136.5	5.1	1.515	0.878	2.393	2.72	57.80	1.636	0.757
15	0.3060	157.30	138.2	5.5	1.528	0.864	2.392	2.77	58.00	1.628	0.764
16	0.3260	159.80	140.7	5.8	1.549	0.857	2.406	2.81	58.10	1.631	0.775
17	0.3460	162.30	143.2	6.2	1.571	0.850	2.420	2.85	58.20	1.635	0.785
18	0.3670	163.10	144.0	6.6	1.573	0.835	2.408	2.88	58.40	1.622	0.787
19	0.3870	166.40	147.3	6.9	1.603	0.828	2.431	2.94	58.50	1.630	0.802
20	0.4080	168.90	149.8	7.3	1.624	0.821	2.445	2.98	58.60	1.633	0.812
21	0.4490	172.30	153.2	8.0	1.648	0.814	2.461	3.02	58.70	1.637	0.824
22	0.4890	173.90	154.8	8.7	1.652	0.806	2.458	3.05	58.80	1.632	0.826
23	0.5300	178.90	159.8	9.5	1.691	0.806	2.498	3.10	58.80	1.652	0.846
24	0.5710	184.80	165.7	10.2	1.740	0.814	2.553	3.14	58.70	1.683	0.870
25	0.6120	186.40	167.3	10.9	1.742	0.806	2.549	3.16	58.80	1.677	0.871
26	0.6530	190.60	171.5	11.7	1.771	0.821	2.592	3.16	58.60	1.706	0.886
27	0.6940	195.60	176.5	12.4	1.808	0.821	2.628	3.20	58.60	1.725	0.904
28	0.7350	197.20	178.1	13.1	1.809	0.835	2.644	3.17	58.40	1.740	0.904
29	0.7760	201.40	182.3	13.9	1.836	0.842	2.678	3.18	58.30	1.760	0.918
30	0.8170	204.70	185.6	14.6	1.853	0.857	2.710	3.16	58.10	1.783	0.927
31	0.8370	204.70	185.6	15.0	1.845	0.864	2.709	3.14	58.00	1.787	0.923

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	169.900			1238.700
Moisture content: Dry soil+tare, gms.	158.800			1117.200
Moisture content: Tare, gms.	71.200			73.100
Moisture, %	12.7	14.2	14.2	11.6
Moist specimen weight, gms.	1169.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.7	131.5	131.5	
Dry density, pcf	115.1	115.1	115.1	
Void ratio	0.3560	0.3560	0.3560	
Saturation, %	89.0	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 2.666 tsf at reading no. 27
Ult. Stress = 2.663 tsf at reading no. 31

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	62.40	0.0	0.0	0.000	3.967	3.967	1.00	34.90	3.967	0.000
1	0.0220	173.10	110.7	0.4	1.289	2.484	3.773	1.52	55.50	3.129	0.645
2	0.0420	206.40	144.0	0.8	1.671	2.016	3.687	1.83	62.00	2.852	0.836
3	0.0620	223.00	160.6	1.1	1.857	1.764	3.621	2.05	65.50	2.693	0.929
4	0.0830	230.50	168.1	1.5	1.936	1.613	3.549	2.20	67.60	2.581	0.968
5	0.1030	235.50	173.1	1.8	1.987	1.512	3.499	2.31	69.00	2.505	0.993
6	0.1240	238.00	175.6	2.2	2.008	1.447	3.455	2.39	69.90	2.451	1.004
7	0.1440	242.20	179.8	2.6	2.048	1.390	3.438	2.47	70.70	2.414	1.024
8	0.1650	245.50	183.1	3.0	2.078	1.346	3.424	2.54	71.30	2.385	1.039
9	0.1850	248.80	186.4	3.3	2.107	1.310	3.418	2.61	71.80	2.364	1.054
10	0.2060	252.20	189.8	3.7	2.137	1.289	3.426	2.66	72.10	2.358	1.069
11	0.2260	254.70	192.3	4.0	2.158	1.267	3.425	2.70	72.40	2.346	1.079
12	0.2460	253.80	191.4	4.4	2.139	1.253	3.392	2.71	72.60	2.322	1.070
13	0.2670	258.80	196.4	4.8	2.187	1.238	3.425	2.77	72.80	2.332	1.093
14	0.2870	260.50	198.1	5.1	2.197	1.231	3.428	2.78	72.90	2.330	1.099
15	0.3080	263.00	200.6	5.5	2.216	1.217	3.433	2.82	73.10	2.325	1.108
16	0.3280	265.50	203.1	5.9	2.235	1.210	3.445	2.85	73.20	2.327	1.118
17	0.3490	268.80	206.4	6.3	2.263	1.210	3.472	2.87	73.20	2.341	1.131
18	0.3690	268.80	206.4	6.6	2.254	1.202	3.456	2.87	73.30	2.329	1.127
19	0.3900	273.00	210.6	7.0	2.290	1.195	3.486	2.92	73.40	2.340	1.145
20	0.4100	275.50	213.1	7.3	2.309	1.195	3.504	2.93	73.40	2.350	1.154
21	0.4510	281.30	218.9	8.1	2.353	1.188	3.541	2.98	73.50	2.364	1.176

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4920	284.60	222.2	8.8	2.369	1.195	3.564	2.98	73.40	2.380	1.185
23	0.5330	292.10	229.7	9.6	2.429	1.195	3.625	3.03	73.40	2.410	1.215
24	0.5740	296.30	233.9	10.3	2.454	1.202	3.656	3.04	73.30	2.429	1.227
25	0.6140	300.40	238.0	11.0	2.477	1.202	3.679	3.06	73.30	2.441	1.238
26	0.6440	305.40	243.0	11.5	2.514	1.217	3.730	3.07	73.10	2.474	1.257
27	0.6960	322.90	260.5	12.5	2.666	1.210	3.876	3.20	73.20	2.543	1.333
28	0.7370	316.20	253.8	13.2	2.576	1.238	3.814	3.08	72.80	2.526	1.288
29	0.7780	322.10	259.7	13.9	2.613	1.238	3.852	3.11	72.80	2.545	1.307
30	0.8190	328.70	266.3	14.7	2.657	1.253	3.910	3.12	72.60	2.581	1.328
31	0.8390	330.40	268.0	15.0	2.663	1.260	3.923	3.11	72.50	2.591	1.331

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	171.400			1284.500
Moisture content: Dry soil+tare, gms.	160.000			1180.500
Moisture content: Tare, gms.	72.800			134.900
Moisture, %	13.1	14.5	14.5	9.9
Moist specimen weight, gms.	1168.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.6	131.2	131.2	
Dry density, pcf	114.6	114.6	114.6	
Void ratio	0.3615	0.3615	0.3615	
Saturation, %	90.4	100.0	100.0	

Test Readings for Specimen No. 3

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 105.00 psi (7.560 tsf)
Consolidation back pressure = 25.00 psi (1.800 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 5.549 tsf at reading no. 35
Ult. Stress = 5.549 tsf at reading no. 35

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0020	102.40	0.0	0.0	0.000	7.207	7.207	1.00	4.90	7.207	0.000
1	0.0170	286.30	183.9	0.3	2.145	6.674	8.819	1.32	12.30	7.747	1.072
2	0.0370	364.50	262.1	0.6	3.046	6.113	9.158	1.50	20.10	7.636	1.523
3	0.0580	407.00	304.6	1.0	3.526	5.537	9.063	1.64	28.10	7.300	1.763
4	0.0780	426.10	323.7	1.4	3.733	4.997	8.730	1.75	35.60	6.864	1.867
5	0.0990	437.70	335.3	1.7	3.853	4.536	8.389	1.85	42.00	6.462	1.926
6	0.1190	449.40	347.0	2.1	3.972	4.133	8.105	1.96	47.60	6.119	1.986
7	0.1400	457.70	355.3	2.5	4.052	3.838	7.889	2.06	51.70	5.863	2.026

Test Reading for Specimen No.

No.	Def. Dial In.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
8	0.1600	464.40	362.0	2.8	4.113	3.593	7.706	2.14	55.10	5.649	2.056
9	0.1810	474.40	372.0	3.2	4.210	3.384	7.594	2.24	58.00	5.489	2.105
10	0.2010	481.90	379.5	3.6	4.279	3.211	7.490	2.33	60.40	5.351	2.140
11	0.2210	487.70	385.3	3.9	4.328	3.074	7.403	2.41	62.30	5.239	2.164
12	0.2420	495.20	392.8	4.3	4.395	2.959	7.355	2.49	63.90	5.157	2.198
13	0.2620	503.50	401.1	4.7	4.471	2.851	7.323	2.57	65.40	5.087	2.236
14	0.2830	509.30	406.9	5.0	4.518	2.772	7.290	2.63	66.50	5.031	2.259
15	0.3030	519.30	416.9	5.4	4.612	2.693	7.305	2.71	67.60	4.999	2.306
16	0.3240	522.60	420.2	5.8	4.630	2.650	7.279	2.75	68.20	4.965	2.315
17	0.3440	526.00	423.6	6.1	4.650	2.621	7.270	2.77	68.60	4.946	2.325
18	0.3650	534.30	431.9	6.5	4.722	2.578	7.299	2.83	69.20	4.938	2.361
19	0.3850	541.80	439.4	6.9	4.785	2.549	7.334	2.88	69.60	4.941	2.393
20	0.4050	546.80	444.4	7.2	4.821	2.534	7.355	2.90	69.80	4.945	2.411
21	0.4260	553.40	451.0	7.6	4.873	2.520	7.393	2.93	70.00	4.956	2.436
22	0.4460	558.40	456.0	8.0	4.908	2.506	7.413	2.96	70.20	4.959	2.454
23	0.4670	560.90	458.5	8.3	4.914	2.506	7.420	2.96	70.20	4.963	2.457
24	0.4870	569.20	466.8	8.7	4.984	2.506	7.489	2.99	70.20	4.997	2.492
25	0.5080	574.20	471.8	9.1	5.016	2.513	7.529	3.00	70.10	5.021	2.508
26	0.5280	580.10	477.7	9.4	5.059	2.520	7.579	3.01	70.00	5.050	2.530
27	0.5690	592.50	490.1	10.2	5.148	2.534	7.683	3.03	69.80	5.109	2.574
28	0.6100	600.00	497.6	10.9	5.184	2.570	7.755	3.02	69.30	5.163	2.592
29	0.6510	610.90	508.5	11.6	5.254	2.599	7.853	3.02	68.90	5.226	2.627
30	0.6920	625.80	523.4	12.4	5.363	2.628	7.991	3.04	68.50	5.310	2.682
31	0.7330	631.70	529.3	13.1	5.378	2.671	8.049	3.01	67.90	5.360	2.689
32	0.7730	641.60	539.2	13.8	5.434	2.707	8.141	3.01	67.40	5.424	2.717
33	0.8140	651.60	549.2	14.6	5.487	2.750	8.238	3.00	66.80	5.494	2.744
34	0.8350	656.60	554.2	14.9	5.513	2.772	8.285	2.99	66.50	5.528	2.756
35	0.8540	662.50	560.1	15.3	5.549	2.786	8.335	2.99	66.30	5.561	2.775

ATTACHMENT

HOLCOLM FOUNDATION ENGINEERING COMPANY, INC.
COARSE COAL REFUSE LABORATORY TESTING RESULTS
NOVEMBER 2006 AND APRIL 2007

ATTACHMENT

Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Estimation and Summary of Engineering Properties Including Peak and Steady-State Undrained Shear Strength for Refuse and Subgrade Materials," Pond Creek Coal Refuse Disposal Site – South Pond Stage 2," BEG, 07/12/08.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation
Estimation and Summary of Engineering Properties for Fine Coal Refuse

PROJECT NO. 080851

PAGE 1 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

CALCULATION BRIEF
FOR

ESTIMATION AND SUMMARY OF ENGINEERING PROPERTIES INCLUDING PEAK AND STEADY-STATE UNDRAINED SHEAR STRENGTH FOR REFUSE AND SUBGRADE MATERIALS

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH POND STAGE 2

OBJECTIVE: To estimate and summarize engineering properties for fine coal refuse materials samples obtained at the Pond Creek Coal Refuse Disposal site including unit weight (γ), specific gravity (G_s), effective strength, i.e., angle of internal friction (ϕ') and cohesion (c'), total strength, peak undrained shear strength (S_{up}), and steady-state undrained shear strength (S_{us}). The various strengths will be used in the South Pond abandonment analyses model(s).

REFERENCES:

1. Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Summary of Piezo-Seismic Cone Penetration Testing," Pond Creek Coal Refuse Disposal Site," BEG, 12/21/07.

2. Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Summary of Laboratory Testing – Fine Coal Refuse," Pond Creek Coal Refuse Disposal Site – South Pond," BEG, 7/10/08.

3. Alliance Consulting, Inc., "Appendix C Laboratory Testing, Proposed Coal Refuse Disposal Facility No. 2, Pond Creek Mine No. 1, Williamson County, Illinois."

4. Poulos, S.J., Castro, G., France, J.W. (1985), "Liquefaction Evaluation Procedure," Journal of Geotechnical Engineering, ASCE, 111(6), pp. 772-791.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation
Estimation and Summary of Engineering Properties for Fine Coal Refuse

PROJECT NO. 080851

PAGE 2 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

5. Genes, B.E., Keller, T.O., and Laird, J.P. (2000) "Steady State Liquefaction Susceptibility of High Hazard Upstream-Constructed Coal Refuse Disposal Facilities," Proceedings of Tailings Dams 2000, ASDSO/USCOLD, Las Vegas, NV, March 28-30, pp. 47-58.

6. Almes, R. A. and Butail, A. (1976) "Coal Refuse: Its Behavior Related to the Design and Operation of Coal Refuse Disposal Facilities," Proceedings of the Ohio River Valley Soils Seminar, Lexington, Kentucky, October, 1976.

7. Bowles, Joseph E. (1984) "Physical and Geotechnical Properties of Soils," Mc-Graw Hill. New York: 367-369 and 393-396.

SOIL PROPERTIES:

The following soil properties were estimated based on laboratory testing [Reference Numbers (Ref. Nos.) 2 and 3] performed for abandonment analyses and/or provided by Alliance Consulting, Inc. for previous deformation analyses, which are used in the various slope stability analyses and attached for information:

Refuse/Soil Properties

Description	Unit Weight (γ) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion [1] (c) (psf)	Comment
Coarse Refuse	130	36	0	Frictional
Fine Coal Refuse	85	36.9	0	Effective Strength (Drained)
		18.8	0	Total Strength (Undrained)
		0	Varies (See Below)	Steady-State (Undrained)
Residual Soil	125	19.5	400	Total Strength (Undrained)
		0	3000	80% Peak Undrained

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PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation — PROJECT NO. 080851

Estimation and Summary of Engineering Properties for Fine Coal Refuse — PAGE 3 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

LABORATORY-DERIVED S_{up} and S_{us}:

Two (2) consolidated – undrained (CU) triaxial series tests (3 points each) were performed on reconstituted bulk fine coal refuse slurry to determine effective and total strength parameters as well as peak (S_{up}) and steady-state (S_{us}) undrained shear strengths. Samples were prepared in the laboratory to simulate in-situ placement and consolidation. Samples were consolidated to a range of vertical effective stresses of about 5, 10 and 20 pounds per square inch (psi) [or 720 to 2880 pounds per square foot (psf)]. All specimens exhibited contractive behavior when sheared under undrained conditions. In general, all specimens reached, or nearly reached, a steady-state of deformation within the strain limits of the test equipment.

A total of 6 CU points comprise the (2) series from which peak and steady-state shear strength state. S_{us} represents the liquefied shear strength [i.e., the minimum (residual) strength available following a rapid loading event, such as an earthquake].

The following equations (Ref. No. 4) were used to calculate peak (S_{up}) and steady-state (S_{us}) shear strengths from laboratory test specimens:

Peak:

$$S_{up} = q_{up} \cos \phi_p$$

Or

$$S_{up} = \sigma'_{3p} [\cos \phi_p \sin \phi_p] / (1 - \sin \phi_p)$$

Steady-State:

$$S_{us} = q_{us} \cos \phi_{us}$$

Or

$$S_{us} = \sigma'_{3s} [\cos \phi_{us} \sin \phi_{us}] / (1 - \sin \phi_{us})$$

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PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Estimation and Summary of Engineering Properties
for Fine Coal Refuse

PROJECT NO. 080851

PAGE 4 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

Where,

q_{up} = shear stress on 45-degree plane at peak strain

ϕ_p = friction angle at peak = arcsin (q/p) at peak strain

σ'_{3p} = lateral effective stress at peak strain

q_{us} = shear stress on 45-degree plane at steady-state (max) strain

ϕ_{us} = friction angle at steady-state = arcsin (q/p) at max strain

σ'_{3us} = lateral effective stress at steady-state (max) strain

The following peak and steady-state data is presented from CU testing on bulk fine coal refuse samples Bucket 1 and Bucket 2 and applying the equations above. CU laboratory test results are attached.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation — PROJECT NO. 080851

Estimation and Summary of Engineering Properties for Fine Coal Refuse — PAGE 5 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

Sample No.	Bucket 1 – Fine Coal Refuse			Bucket 2 – Fine Coal Refuse		
CU Test No. (Confining Pressure)	1 (5.2 psi)	2 (10.2 psi)	3 (20.4 psi)	1 (5.2 psi)	2 (10.4 psi)	3 (20.4 psi)
Parameter						
q_{up} (psi) @	4.61	7.54	10.82	3.37	5.73	11.67
Peak Strain (%)	18.4	13.4	13.5	10.3	14.2	8.4
ϕ_p (deg)	40.4	39.6	37.8	38.3	39.2	37.5
σ'_{3p} (psi)	2.5	4.3	6.8	2.1	3.3	7.5
S_{up} (psi)	3.51	5.81	8.55	2.64	4.44	9.26
q_{us} (psi) @	4.59	7.33	10.02	3.28	5.4	10.61
Max. Strain (%)	21.5	21.67	21.74	17.29	21.32	21.42
ϕ_{us} (deg)	40.4	39.0	36.7	36.3	38.6	35.7
σ'_{3us} (psi)	2.4	4.3	6.7	2.1	3.3	7.6
S_{us} (psi)	3.37	5.67	7.98	2.46	4.28	8.65

A plot of the S_{us} of the reconstituted coal refuse slurry samples versus vertical effective stress ($\sigma'v$) is presented in the attached Figure 1. The equivalent effective vertical stress was assumed to be 1.5 times the isotropic effective consolidation stress (i.e., 1.5*$\sigma'3$). A 2/3 – 1/3 relationship of the data was employed to yield an S_{us} to $\sigma'v$ relationship of $S_{us} = 0.28\ \sigma'v$. Ref. No. 5 and recent undisturbed/remolded fine coal refuse testing on other projects yielded a range of $S_{us} = 0.06$ to $0.28\ \sigma'v$, with an average of about $S_{us} = 0.22\ \sigma'v$. Since site specific testing was performed, a reasonable S_{us} to $\sigma'v$ relationship of $S_{us} = 0.24\ \sigma'v$ is considered realistic with some conservatism. The impounded/abandoned fine coal refuse in the South Pond will be modeled utilizing this relationship.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation Estimation and Summary of Engineering Properties for Fine Coal Refuse

PROJECT NO. 080851

PAGE 6 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

Subsequent slope stability analyses determine the magnitude of driving shear stress on a failure plane through the fine coal refuse impoundment to assess the required S_{us} to maintain equilibrium and assess the likelihood of a (liquefaction) flow failure. Post-earthquake slope stability of the embankment/impoundment is evaluated as well to assess the failure potential of the South Pond embankment using the abandonment geometry.

CONCLUSIONS

Laboratory undrained shear strength data from consolidated undrained triaxial tests of fine coal refuse were determined. Procedures were performed to estimate S_{up}, S_{us}, and a reasonable S_{us} to $\sigma'v$ relationship of $S_{us} = 0.24\ \sigma'v$ for the material. The results of the laboratory testing indicated Sup and Sus reach their peak and steady-state strength at high strains, and there is very little drop off with increasing strain. Further, Sup and Sus values generally indicated resistance to flow. Thus, the results suggest undrained strengths of the fine coal refuse will be maintained at or near peak levels during an undrained event such as an earthquake, and the susceptibility of the impounded fine coal refuse to a liquefaction flow failure is a function of both the undrained strength (worst case steady-state strength) and the in-situ driving shear stress on a critical failure plane through the fine refuse material.

Based on this information, the properties evaluated/developed in Ref. No. 2 for fine coal refuse, as well as coarse refuse and residual soil, indicated the South Pond fine coal refuse has sufficient steady-state shear strength to limit the flowability of the material. The likelihood of a flow failure associated with the abandonment scenario will be assessed in a subsequent calculation brief by evaluating the driving shear stress and factor of safety against liquefaction in the fine coal refuse.

POND CREEK PHASE 2 SOUTH POND
STEADY-STATE UNDRAINED SHEAR STRENGTH-TO-EFFECTIVE STRESS RELATIONSHIP

Pond Creek Phase 2 South Pond
Steady-State Undrained Strength vs. Vertical Effective Stress

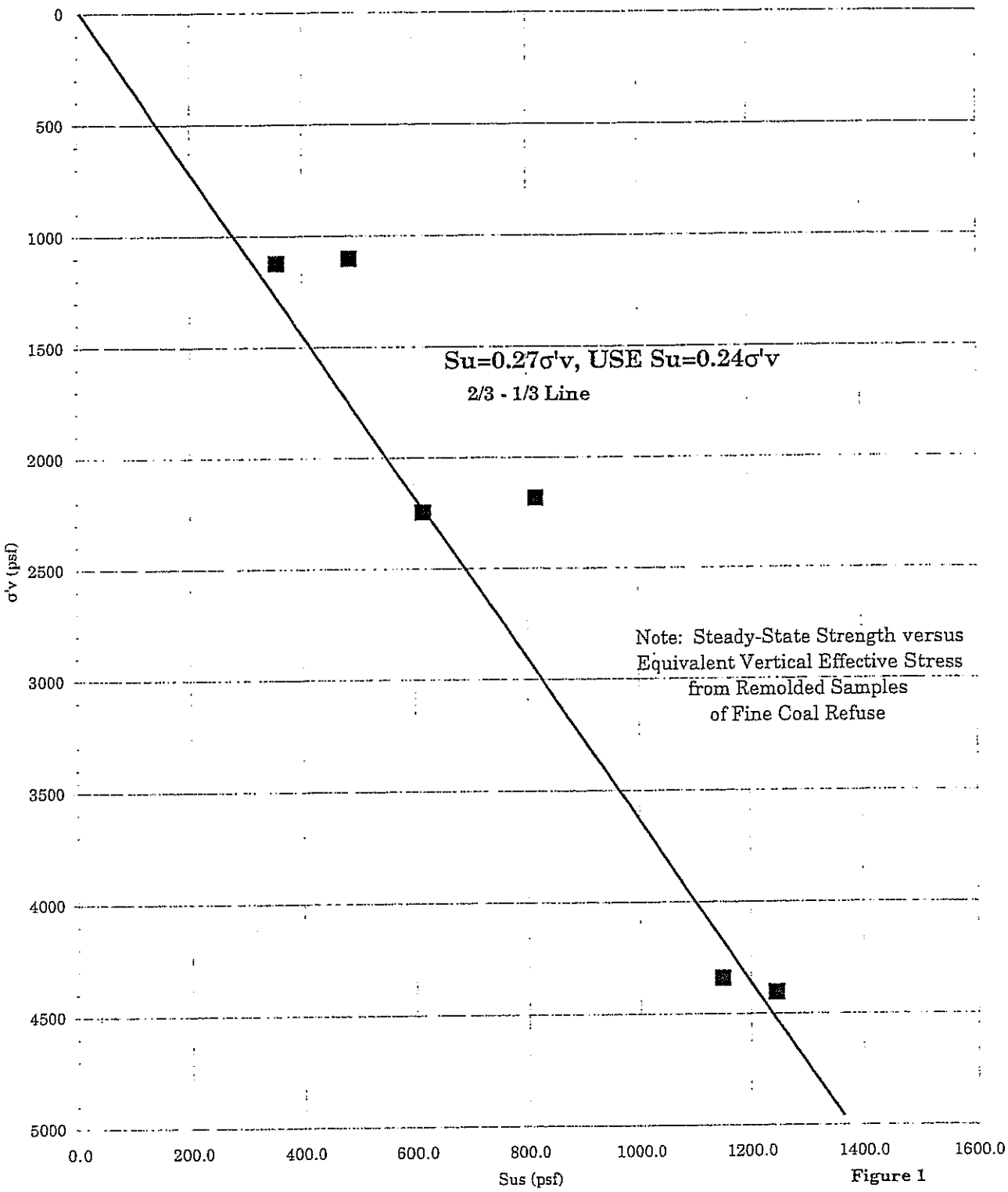

Figure 1

POND CREEK – SOUTH POND
CONSOLIDATED – UNDRAINED TRIAXIAL LABORATORY TESTING RESULTS FOR FINE COAL REFUSE

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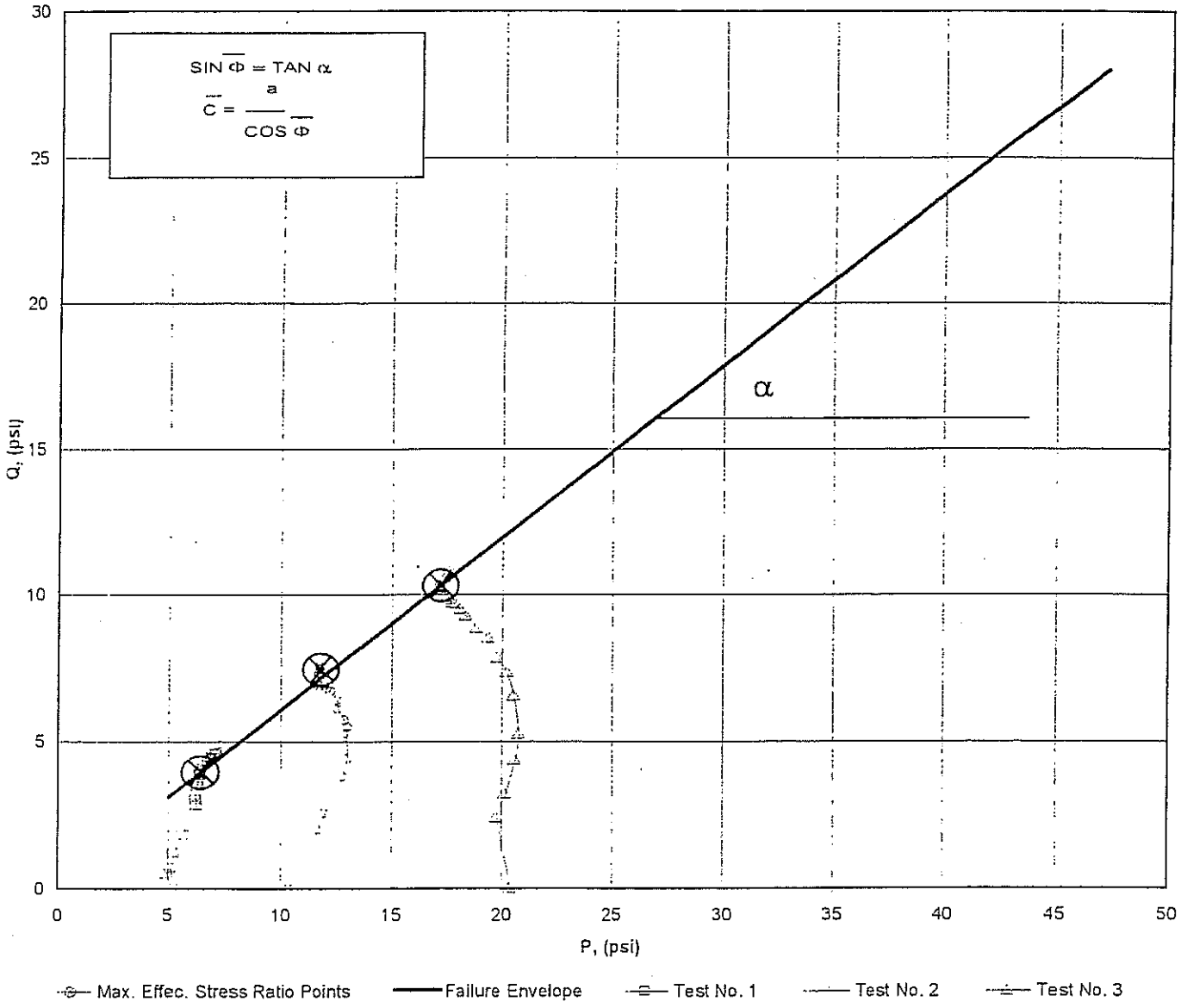
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	30.5	$\bar{\Phi}$	=	36.14

Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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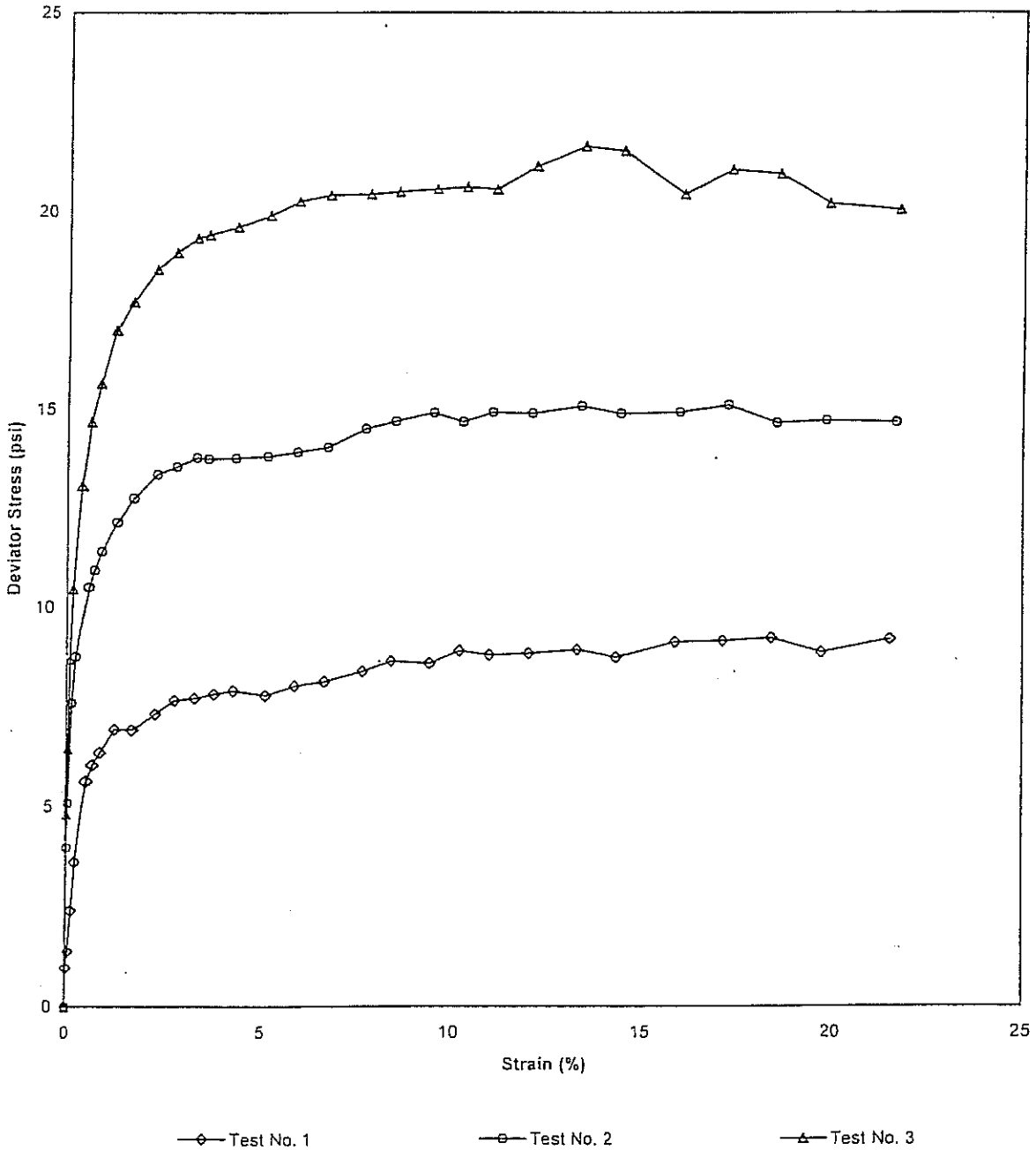
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		
Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	1

PRESSURES (psi)

Cell Pressure(psi)	36.6
Back Pressure(psi)	31.4
Eff. Cons. Pressure(psi)	5.2
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	6.41
Q	=	3.95

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.140	Diameter 1	1.375
Length 2	3.148	Diameter 2	1.389
Length 3	3.151	Diameter 3	1.399
Avg Leng.=	3.146	Avg. Diam.=	1.388

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.7
Final Change (ml)	2.3

Initial Dial Reading (D.R.), mils	235
D.R. After Saturation, mils	250
D.R. After Consolidation, mils	294

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.4
8.2	0.001	32.1
8.8	0.002	32.1
10.3	0.005	32.5
12.1	0.008	32.8
15.1	0.016	33.2
15.8	0.020	33.4
16.2	0.026	33.6
17.1	0.038	33.7
17.2	0.051	33.8
17.8	0.069	33.9
18.4	0.085	34.0
18.5	0.101	34.0
18.8	0.116	34.1
19.0	0.132	34.1
18.9	0.158	34.1
19.4	0.182	34.2
19.6	0.205	34.2
20.2	0.236	34.2
20.7	0.260	34.2
20.8	0.292	34.1
21.4	0.316	34.3
21.4	0.340	34.1
21.6	0.371	34.1
22.0	0.411	34.1
21.8	0.443	34.1
22.8	0.490	34.1
23.1	0.530	34.2
23.5	0.569	34.1
23.1	0.610	34.1
24.0	0.664	34.2

Tested By JCM Date 05/21/08 Input Checked By MB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.2	*Stage No.*	1
		Test No	1

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.51
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.55
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.474

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	0.98	0.73	5.45	4.5	1.219	0.76	4.96	0.49
0.07	1.39	0.75	5.84	4.5	1.311	0.55	5.14	0.69
0.15	2.40	1.15	6.46	4.1	1.593	0.49	5.25	1.20
0.25	3.62	1.36	7.46	3.8	1.941	0.38	5.65	1.81
0.52	5.63	1.79	9.04	3.4	2.649	0.32	6.23	2.81
0.66	6.03	2.01	9.22	3.2	2.893	0.34	6.20	3.02
0.84	6.35	2.21	9.34	3.0	3.125	0.36	6.16	3.18
1.22	6.92	2.33	9.79	2.9	3.417	0.34	6.33	3.46
1.64	6.91	2.40	9.71	2.8	3.469	0.35	6.26	3.46
2.25	7.31	2.55	9.96	2.7	3.753	0.36	6.31	3.65
2.75	7.66	2.61	10.25	2.6	3.961	0.35	6.42	3.83
3.27	7.71	2.64	10.26	2.6	4.017	0.35	6.41	3.85
3.77	7.81	2.68	10.34	2.5	4.098	0.35	6.43	3.91
4.28	7.90	2.74	10.37	2.5	4.208	0.35	6.41	3.95
5.11	7.78	2.71	10.27	2.5	4.124	0.36	6.38	3.89
5.89	8.02	2.84	10.38	2.4	4.400	0.36	6.37	4.01
6.65	8.13	2.78	10.56	2.4	4.359	0.35	6.49	4.07
7.66	8.39	2.83	10.76	2.4	4.538	0.34	6.56	4.19
8.42	8.64	2.76	11.09	2.4	4.536	0.33	6.77	4.32
9.45	8.59	2.72	11.07	2.5	4.464	0.32	6.77	4.29
10.23	8.90	2.86	11.25	2.3	4.797	0.33	6.79	4.45
11.00	8.80	2.67	11.33	2.5	4.474	0.31	6.93	4.40
12.03	8.83	2.74	11.29	2.5	4.594	0.32	6.87	4.42
13.30	8.93	2.72	11.41	2.5	4.601	0.31	6.94	4.46
14.34	8.73	2.69	11.25	2.5	4.477	0.31	6.88	4.37
15.88	9.12	2.66	11.66	2.5	4.587	0.30	7.10	4.56
17.15	9.15	2.77	11.59	2.4	4.762	0.31	7.01	4.58
18.44	9.22	2.70	11.72	2.5	4.691	0.30	7.11	4.61
19.74	8.86	2.70	11.36	2.5	4.536	0.31	6.93	4.43
21.51	9.19	2.82	11.56	2.4	4.864	0.31	6.97	4.59

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	2

PRESSURES (psi)

Cell Pressure(psi)	46.5
Back Pressure(psi)	36.1
Eff. Cons. Pressure(ps	10.4
Pore Pressure Response (%)	100

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	11.84
Q	=	7.45

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.120	Diameter 1	1.396
Length 2	3.137	Diameter 2	1.398
Length 3	3.135	Diameter 3	1.344
Avg Leng.=	3.131	Avg. Diam.=	1.379

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	18.4
Final Change (ml)	5.6
Initial Dial Reading (D.R.), mils	77
D.R. After Saturation, mils	112
D.R. After Consolidation, mils	166

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.9	0.000	36.1
13.4	0.001	36.8
14.9	0.002	37.0
18.3	0.005	37.4
20.0	0.008	37.8
22.4	0.017	38.7
23.0	0.020	38.9
23.7	0.026	39.3
24.8	0.038	39.9
25.7	0.051	40.3
26.7	0.069	40.9
27.1	0.085	41.1
27.5	0.100	41.3
27.5	0.110	41.5
27.7	0.131	41.6
27.9	0.157	41.8
28.2	0.181	41.9
28.6	0.204	41.9
29.5	0.235	42.0
30.0	0.259	42.1
30.5	0.290	42.1
30.4	0.313	42.0
31.0	0.337	42.1
31.2	0.368	42.0
31.8	0.408	42.2
31.8	0.439	42.1
32.3	0.486	42.1
33.0	0.526	42.2
32.6	0.565	42.1
33.1	0.604	42.2
33.6	0.659	42.2

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.4	*Stage No.*	1
		Test No	2

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.49
Initial Sample Volume (in^3)	4.68

VOLUME CHANGE

Volume After Consolidation (in^3)	4.18
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	Δ U	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.03	3.98	0.65	13.73	9.7	1.408	0.16	11.74	1.99
0.06	5.09	0.89	14.59	9.5	1.535	0.18	12.05	2.54
0.15	7.59	1.34	16.65	9.1	1.838	0.18	12.85	3.79
0.25	8.76	1.72	17.44	8.7	2.010	0.20	13.06	4.38
0.54	10.51	2.62	18.29	7.8	2.351	0.25	13.04	5.26
0.67	10.94	2.79	18.56	7.6	2.438	0.25	13.08	5.47
0.86	11.42	3.19	18.64	7.2	2.584	0.28	12.92	5.71
1.25	12.16	3.85	18.71	6.6	2.856	0.32	12.63	6.08
1.67	12.77	4.19	18.98	6.2	3.055	0.33	12.60	6.38
2.28	13.37	4.77	19.00	5.6	3.373	0.36	12.32	6.68
2.79	13.56	5.04	18.92	5.4	3.530	0.37	12.14	6.78
3.30	13.79	5.25	18.94	5.2	3.675	0.38	12.05	6.89
3.60	13.76	5.40	18.76	5.0	3.751	0.39	11.88	6.88
4.32	13.77	5.50	18.67	4.9	3.812	0.40	11.79	6.89
5.16	13.82	5.69	18.52	4.7	3.934	0.41	11.62	6.91
5.95	13.93	5.80	18.52	4.6	4.029	0.42	11.56	6.96
6.72	14.04	5.83	18.61	4.6	4.072	0.42	11.59	7.02
7.73	14.51	5.87	19.04	4.5	4.205	0.40	11.78	7.26
8.52	14.69	6.01	19.08	4.4	4.349	0.41	11.73	7.35
9.54	14.91	6.01	19.30	4.4	4.397	0.40	11.84	7.45
10.30	14.68	5.94	19.15	4.5	4.289	0.40	11.80	7.34
11.07	14.93	6.00	19.33	4.4	4.390	0.40	11.87	7.46
12.10	14.89	5.95	19.34	4.5	4.346	0.40	11.90	7.45
13.40	15.08	6.10	19.38	4.3	4.506	0.40	11.84	7.54
14.44	14.89	6.03	19.25	4.4	4.410	0.41	11.81	7.44
15.98	14.92	5.99	19.34	4.4	4.381	0.40	11.88	7.46
17.28	15.10	6.12	19.38	4.3	4.528	0.41	11.83	7.55
18.58	14.65	5.96	19.09	4.4	4.303	0.41	11.76	7.33
19.86	14.71	6.07	19.04	4.3	4.398	0.41	11.68	7.35
21.67	14.66	6.08	18.99	4.3	4.393	0.41	11.65	7.33

Tested By JCM Date 05/21/08 Input Checked By KB Date 10-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	3

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	20.4
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	17.19
Q	=	10.31

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.130	Diameter 1	1.404
Length 2	3.121	Diameter 2	1.373
Length 3	3.136	Diameter 3	1.371
Avg Leng.=	3.129	Avg. Diam.=	1.383

VOLUME CHANGE

Initial Burette Reading (ml)	48.0
Final Burette Reading (ml)	40.5
Final Change (ml)	7.5
Initial Dial Reading (D.R.), mils	60
D.R. After Saturation, mils	68
D.R. After Consolidation, mils	154

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.0
13.5	0.001	34.0
15.7	0.002	34.5
18.9	0.003	35.2
21.3	0.005	35.9
25.0	0.011	37.4
27.3	0.017	38.5
28.7	0.024	39.4
30.6	0.036	40.5
31.7	0.049	41.4
33.1	0.067	42.3
33.8	0.083	42.8
34.5	0.099	43.2
34.7	0.108	43.4
35.2	0.131	43.7
35.9	0.157	44.0
36.6	0.180	44.2
37.1	0.204	44.3
37.5	0.236	44.4
37.8	0.260	44.4
38.3	0.290	44.5
38.7	0.314	44.5
38.8	0.337	44.5
40.1	0.369	44.6
41.4	0.408	44.6
41.7	0.440	44.6
40.5	0.488	44.6
42.1	0.527	44.6
42.5	0.566	44.6
41.7	0.605	44.6
42.3	0.660	44.7

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.4	*Stage No.*	1
		Test No	3

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.20
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.385

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma}_1$	$\overline{\sigma}_3$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	4.82	3.04	22.17	17.4	1.278	0.64	19.76	2.41
0.05	6.44	3.45	23.39	16.9	1.380	0.54	20.17	3.22
0.10	8.70	4.15	24.95	16.2	1.536	0.48	20.60	4.35
0.17	10.46	4.86	26.01	15.5	1.673	0.47	20.77	5.23
0.37	13.09	6.38	27.10	14.0	1.934	0.49	20.56	6.54
0.58	14.68	7.49	27.59	12.9	2.137	0.52	20.25	7.34
0.80	15.66	8.40	27.66	12.0	2.305	0.54	19.83	7.83
1.18	17.01	9.52	27.89	10.9	2.563	0.57	19.38	8.50
1.61	17.71	10.40	27.71	10.0	2.772	0.59	18.85	8.86
2.22	18.54	11.31	27.63	9.1	3.039	0.62	18.36	9.27
2.74	18.96	11.76	27.60	8.6	3.196	0.63	18.12	9.48
3.26	19.34	12.21	27.53	8.2	3.361	0.64	17.86	9.67
3.57	19.40	12.35	27.45	8.0	3.411	0.64	17.75	9.70
4.31	19.60	12.73	27.27	7.7	3.556	0.66	17.47	9.80
5.17	19.89	12.96	27.33	7.4	3.676	0.66	17.38	9.95
5.94	20.25	13.15	27.50	7.2	3.795	0.66	17.37	10.13
6.73	20.42	13.27	27.54	7.1	3.864	0.66	17.34	10.21
7.78	20.44	13.38	27.46	7.0	3.912	0.66	17.24	10.22
8.55	20.50	13.40	27.50	7.0	3.928	0.66	17.25	10.25
9.57	20.57	13.48	27.49	6.9	3.973	0.66	17.20	10.28
10.34	20.62	13.52	27.50	6.9	3.995	0.66	17.19	10.31
11.11	20.56	13.51	27.45	6.9	3.982	0.66	17.17	10.28
12.15	21.14	13.55	27.99	6.8	4.088	0.65	17.42	10.57
13.45	21.64	13.57	28.47	6.8	4.170	0.63	17.65	10.82
14.49	21.53	13.56	28.36	6.8	4.149	0.64	17.60	10.76
16.07	20.44	13.58	27.26	6.8	3.997	0.67	17.04	10.22
17.35	21.06	13.58	27.88	6.8	4.086	0.65	17.35	10.53
18.64	20.95	13.63	27.72	6.8	4.094	0.66	17.25	10.48
19.92	20.20	13.64	26.96	6.8	3.988	0.68	16.86	10.10
21.74	20.03	13.67	26.77	6.7	3.975	0.69	16.75	10.02

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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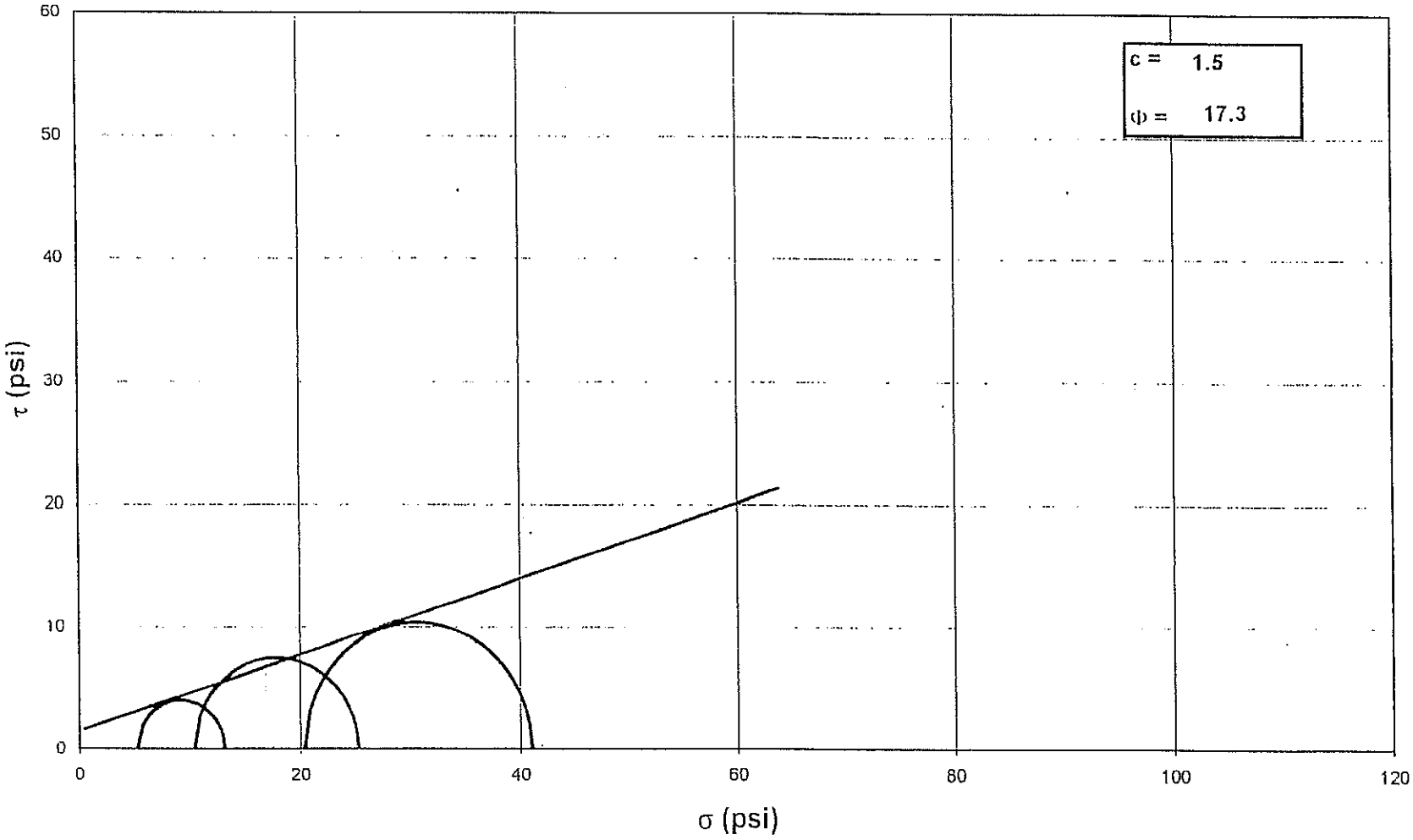
MOHR TOTAL STRENGTH ENVELOPE

Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/19/08

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	82.6	82.7	79.5
Total Unit Weight (pcf)	76.6	84.2	80.5
Dry Unit Weight (pcf)	42.0	46.1	44.8
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	2.333	2.035	2.119

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

DCN CT-S28 DATE 6-25-98 REVISION 1

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	41.7	43.3	42.4
Total Unit Weight (pcf)	102.0	102.5	101.8
Dry Unit Weight (pcf)	71.9	71.5	71.5
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	0.944	0.955	0.956

Tested By JCM Date 05/21/08 Input Checked By VB Date 6-3-08

DCN: GT-S28 DATE 6-25-98 REVISION: 1

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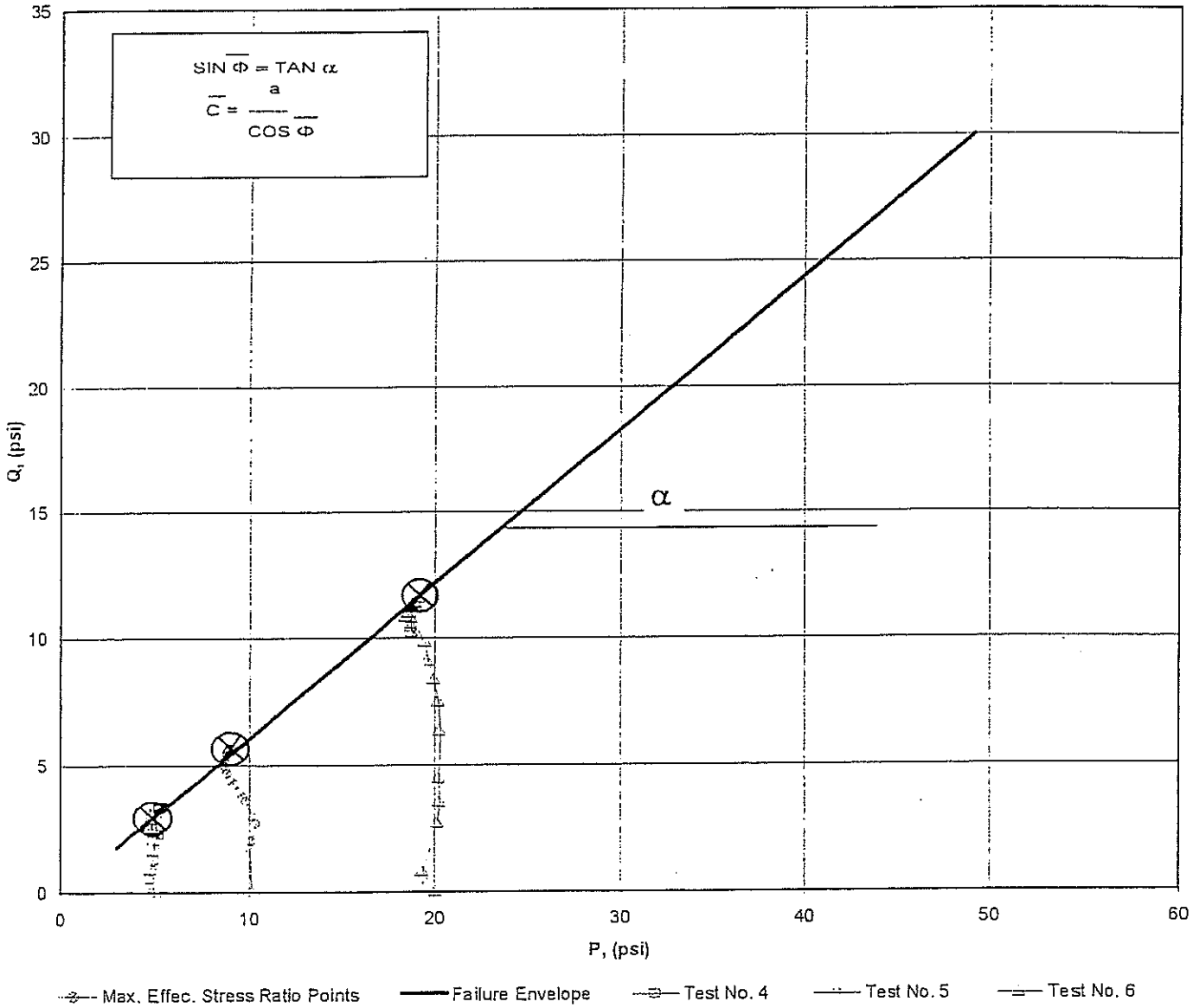
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	31.5	$\bar{\Phi}$	=	37.71

Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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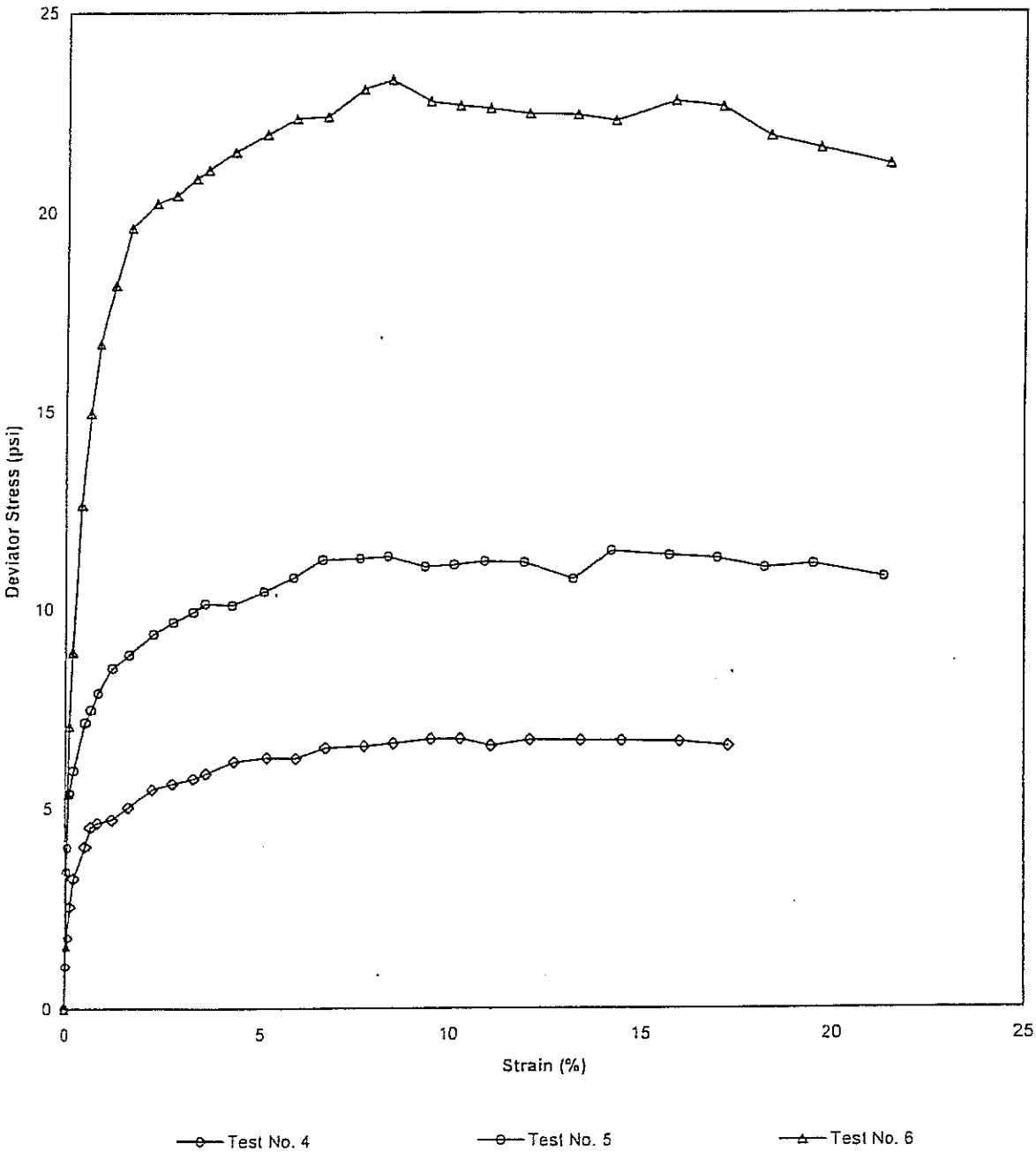
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	4

PRESSURES (psi)

Cell Pressure(psi)	36.3
Back Pressure(psi)	31.2
Eff. Cons. Pressure(psi)	5.1
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	4.92
Q	=	2.94

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.150	Diameter 1	1.453
Length 2	3.142	Diameter 2	1.463
Length 3	3.147	Diameter 3	1.461
Avg Leng.=	3.146	Avg. Diam.=	1.459

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.9
Final Change (ml)	2.1

Initial Dial Reading (D.R.), mils	54
D.R. After Saturation, mils	110
D.R. After Consolidation, mils	130

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.6	0.000	31.2
9.3	0.001	32.1
10.4	0.002	32.3
11.6	0.005	32.6
12.8	0.008	32.9
14.0	0.016	33.3
14.8	0.020	33.3
15.0	0.025	33.6
15.2	0.037	33.8
15.7	0.050	33.9
16.5	0.068	34.2
16.7	0.084	34.2
17.0	0.100	34.2
17.2	0.110	34.3
17.8	0.133	34.2
18.1	0.159	34.3
18.1	0.182	34.3
18.6	0.205	34.2
18.8	0.237	34.2
19.0	0.261	34.3
19.3	0.293	34.3
19.5	0.316	34.2
19.3	0.340	34.3
19.7	0.372	34.2
19.8	0.412	34.3
19.9	0.445	34.3
20.1	0.491	34.2
20.1	0.531	34.2

Tested By JCM Date 05/27/08 Input Checked By HKS Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.1	*Stage No.*	1
		Test No	4

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.46
Initial Sample Area (in^2)	1.67
Initial Sample Volume (in^3)	5.26

VOLUME CHANGE

Volume After Consolidation (in^3)	4.85
Length After Consolidation (in)	3.07
Area After Consolidation (in^2)	1.580

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	1.06	0.90	5.26	4.2	1.253	0.86	4.73	0.53
0.07	1.77	1.15	5.72	4.0	1.449	0.66	4.84	0.89
0.15	2.55	1.44	6.21	3.7	1.698	0.58	4.94	1.28
0.25	3.26	1.71	6.65	3.4	1.959	0.53	5.02	1.63
0.53	4.05	2.11	7.04	3.0	2.358	0.53	5.01	2.03
0.65	4.54	2.14	7.50	3.0	2.531	0.48	5.23	2.27
0.82	4.65	2.39	7.36	2.7	2.712	0.52	5.04	2.32
1.21	4.72	2.58	7.25	2.5	2.873	0.56	4.89	2.36
1.62	5.03	2.72	7.42	2.4	3.112	0.55	4.90	2.52
2.22	5.48	2.95	7.63	2.1	3.550	0.55	4.89	2.74
2.74	5.62	3.02	7.70	2.1	3.705	0.55	4.89	2.81
3.27	5.75	3.04	7.81	2.1	3.790	0.54	4.93	2.87
3.59	5.88	3.12	7.86	2.0	3.968	0.54	4.92	2.94
4.33	6.18	3.02	8.27	2.1	3.967	0.50	5.17	3.09
5.17	6.27	3.08	8.30	2.0	4.101	0.50	5.16	3.14
5.93	6.25	3.13	8.22	2.0	4.176	0.51	5.10	3.13
6.69	6.51	3.03	8.58	2.1	4.152	0.48	5.32	3.26
7.73	6.56	3.04	8.62	2.1	4.176	0.47	5.34	3.28
8.50	6.63	3.14	8.59	2.0	4.380	0.48	5.27	3.31
9.53	6.72	3.14	8.68	2.0	4.436	0.48	5.32	3.36
10.30	6.74	3.03	8.81	2.1	4.256	0.46	5.44	3.37
11.09	6.56	3.07	8.59	2.0	4.235	0.48	5.31	3.28
12.10	6.71	3.03	8.78	2.1	4.233	0.46	5.43	3.35
13.42	6.69	3.06	8.74	2.0	4.281	0.47	5.39	3.35
14.49	6.68	3.10	8.68	2.0	4.342	0.47	5.34	3.34
16.00	6.66	3.02	8.74	2.1	4.204	0.46	5.41	3.33
17.29	6.55	3.03	8.62	2.1	4.171	0.47	5.34	3.28

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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R13488

CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics — INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	5

PRESSURES (psi)

Cell Pressure(psi)	41.1
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	10.1
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	9.00
Q	=	5.66

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.138	Diameter 1	1.407
Length 2	3.138	Diameter 2	1.383
Length 3	3.137	Diameter 3	1.378
Avg Leng.=	3.138	Avg. Diam.=	1.389

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	20.2
Final Change (ml)	3.8

Initial Dial Reading (D.R.), mils	88
D.R. After Saturation, mils	94
D.R. After Consolidation, mils	124

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
8.5	0.000	31.0
13.5	0.001	32.8
14.3	0.002	33.0
16.3	0.004	33.4
17.2	0.007	33.9
18.9	0.016	34.9
19.4	0.020	35.2
20.0	0.025	35.6
21.0	0.038	36.1
21.5	0.051	36.6
22.4	0.070	37.0
22.9	0.085	37.2
23.4	0.101	37.4
23.7	0.110	37.4
23.8	0.132	37.5
24.5	0.158	37.6
25.1	0.181	37.7
26.0	0.205	37.7
26.2	0.236	37.7
26.4	0.259	37.8
26.2	0.290	37.7
26.4	0.314	37.8
26.7	0.338	37.8
26.9	0.370	37.8
26.5	0.410	37.8
27.9	0.441	37.8
28.0	0.488	37.8
28.2	0.527	37.8
28.1	0.566	37.8
28.5	0.605	37.8
28.4	0.661	37.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.1	*Stage No.*	1
		Test No	5

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.52
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.50
Length After Consolidation (in)	3.10
Area After Consolidation (in^2)	1.450

Strain (%)	Deviation Stress	Δ U	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	3.42	1.75	11.77	8.3	1.410	0.52	10.06	1.71
0.06	4.03	2.01	12.12	8.1	1.497	0.50	10.11	2.01
0.13	5.39	2.43	13.05	7.7	1.703	0.46	10.36	2.69
0.23	5.96	2.92	13.13	7.2	1.830	0.50	10.16	2.98
0.51	7.15	3.87	13.37	6.2	2.148	0.55	9.80	3.57
0.64	7.46	4.19	13.37	5.9	2.262	0.57	9.64	3.73
0.82	7.88	4.57	13.41	5.5	2.427	0.59	9.47	3.94
1.21	8.51	5.13	13.48	5.0	2.714	0.61	9.22	4.26
1.63	8.84	5.57	13.38	4.5	2.950	0.64	8.96	4.42
2.24	9.37	5.97	13.50	4.1	3.271	0.64	8.81	4.69
2.75	9.67	6.18	13.59	3.9	3.468	0.65	8.75	4.84
3.25	9.92	6.35	13.66	3.7	3.648	0.65	8.70	4.96
3.56	10.14	6.40	13.83	3.7	3.741	0.64	8.76	5.07
4.26	10.10	6.55	13.65	3.6	3.843	0.66	8.60	5.05
5.08	10.44	6.59	13.95	3.5	3.978	0.64	8.73	5.22
5.85	10.80	6.68	14.21	3.4	4.161	0.63	8.81	5.40
6.60	11.25	6.70	14.65	3.4	4.304	0.60	9.03	5.62
7.60	11.27	6.75	14.63	3.4	4.363	0.60	8.99	5.64
8.34	11.32	6.76	14.66	3.3	4.395	0.60	9.00	5.66
9.36	11.06	6.74	14.42	3.4	4.292	0.62	8.89	5.53
10.13	11.11	6.76	14.46	3.3	4.323	0.61	8.90	5.56
10.91	11.20	6.81	14.49	3.3	4.401	0.61	8.89	5.60
11.94	11.17	6.80	14.47	3.3	4.383	0.62	8.88	5.58
13.21	10.75	6.76	14.09	3.3	4.214	0.64	8.72	5.37
14.21	11.47	6.77	14.80	3.3	4.445	0.60	9.06	5.73
15.72	11.35	6.78	14.67	3.3	4.418	0.60	9.00	5.68
16.98	11.28	6.79	14.59	3.3	4.411	0.61	8.95	5.64
18.25	11.04	6.80	14.33	3.3	4.350	0.62	8.81	5.52
19.51	11.13	6.82	14.40	3.3	4.397	0.62	8.84	5.56
21.32	10.80	6.85	14.05	3.3	4.318	0.64	8.65	5.40

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	6

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.3
Eff. Cons. Pressure(ps	20.1
Pore Pressure Response (%)	97

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	19.19
Q	=	11.67

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.142	Diameter 1	1.379
Length 2	3.130	Diameter 2	1.377
Length 3	3.141	Diameter 3	1.386
Avg Leng.=	3.138	Avg. Diam.=	1.381

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	17.7
Final Change (ml)	6.3

Initial Dial Reading (D.R.), mils	40
D.R. After Saturation, mils	56
D.R. After Consolidation, mils	91

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
4.3	0.000	31.3
6.5	0.001	32.8
11.7	0.002	33.9
14.0	0.004	34.7
16.6	0.006	35.6
21.7	0.012	37.4
25.0	0.019	38.7
27.5	0.026	39.8
29.6	0.038	40.9
31.7	0.051	41.7
32.8	0.070	42.4
33.2	0.085	42.8
33.9	0.101	43.1
34.3	0.110	43.2
35.2	0.132	43.4
36.1	0.157	43.7
37.0	0.181	43.7
37.3	0.205	43.8
38.7	0.236	43.8
39.3	0.259	43.9
38.9	0.291	43.8
39.0	0.316	43.9
39.2	0.340	43.9
39.4	0.371	43.8
39.9	0.410	43.8
40.1	0.441	43.9
41.5	0.489	43.8
41.9	0.528	43.7
41.2	0.568	43.8
41.3	0.608	43.8
41.4	0.663	43.8

Tested By JCM Date 05/27/08 Input Checked By WR Date 6-19-08

DCN: CT-S28 DATE 5-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.1	*Stage No.*	1
		Test No	6

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.24
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	1.58	1.52	20.16	18.6	1.085	0.99	19.37	0.79
0.07	5.38	2.62	22.86	17.5	1.308	0.50	20.17	2.69
0.12	7.06	3.36	23.80	16.7	1.422	0.49	20.27	3.53
0.19	8.92	4.30	24.73	15.8	1.565	0.50	20.26	4.46
0.40	12.65	6.12	26.62	14.0	1.905	0.50	20.30	6.32
0.61	14.97	7.35	27.72	12.7	2.174	0.51	20.23	7.48
0.85	16.72	8.47	28.36	11.6	2.438	0.52	19.99	8.36
1.24	18.18	9.56	28.72	10.5	2.724	0.54	19.63	9.09
1.64	19.63	10.41	29.32	9.7	3.025	0.55	19.51	9.81
2.26	20.24	11.15	29.19	9.0	3.262	0.57	19.07	10.12
2.77	20.44	11.54	29.00	8.6	3.388	0.58	18.78	10.22
3.26	20.87	11.82	29.15	8.3	3.521	0.58	18.71	10.43
3.58	21.09	11.94	29.25	8.2	3.584	0.58	18.70	10.54
4.27	21.54	12.14	29.50	8.0	3.705	0.58	18.73	10.77
5.09	21.97	12.38	29.69	7.7	3.846	0.58	18.71	10.99
5.86	22.37	12.43	30.04	7.7	3.918	0.57	18.85	11.19
6.64	22.41	12.54	29.98	7.6	3.962	0.58	18.77	11.21
7.63	23.10	12.49	30.71	7.6	4.034	0.56	19.16	11.55
8.39	23.33	12.58	30.85	7.5	4.102	0.56	19.19	11.67
9.43	22.79	12.55	30.34	7.6	4.018	0.57	18.95	11.39
10.22	22.67	12.59	30.18	7.5	4.021	0.57	18.84	11.34
11.00	22.61	12.56	30.14	7.5	4.001	0.57	18.84	11.30
12.01	22.49	12.53	30.05	7.6	3.973	0.57	18.81	11.24
13.28	22.46	12.52	30.04	7.6	3.961	0.57	18.81	11.23
14.28	22.30	12.63	29.77	7.5	3.986	0.58	18.62	11.15
15.84	22.80	12.50	30.40	7.6	4.001	0.57	19.00	11.40
17.12	22.66	12.41	30.35	7.7	3.948	0.56	19.02	11.33
18.40	21.92	12.46	29.57	7.6	3.868	0.59	18.61	10.96
19.69	21.62	12.51	29.21	7.6	3.846	0.60	18.40	10.81
21.49	21.21	12.54	28.77	7.6	3.805	0.61	18.17	10.61

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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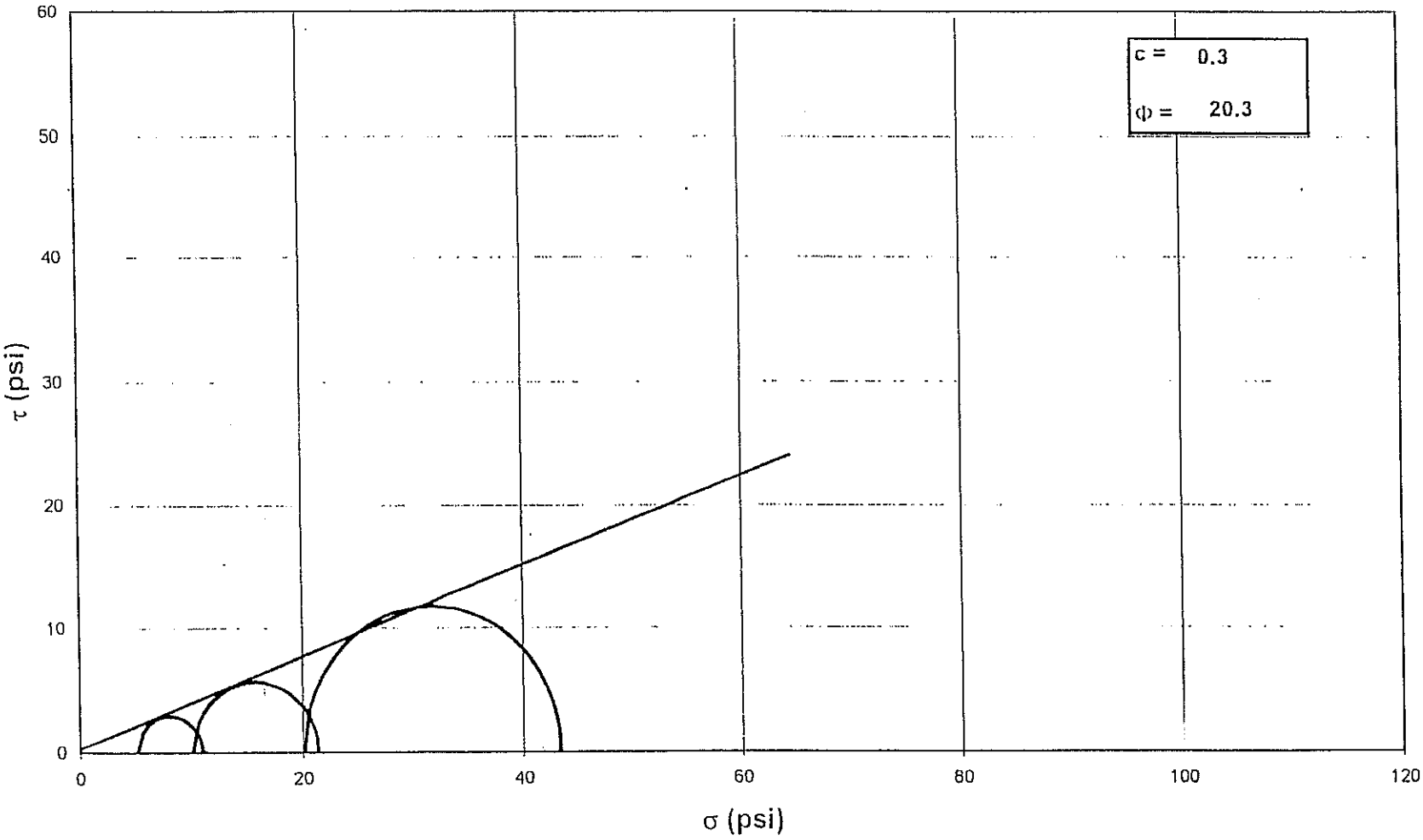
MOHR TOTAL STRENGTH ENVELOPE

Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/19/08

#N/A

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R13492

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	82.9	85.7	83.0
Total Unit Weight (pcf)	82.6	82.2	84.5
Dry Unit Weight (pcf)	45.2	44.3	46.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	2.095	2.159	2.029

Tested By JCM Date 05/27/08 Input Checked By [illegible] Date 6-5-08

DCN: CT-S28 DATE 6-25-98 REVISION: 1 C:\MSOFFICE\Excel\Printq\[F186.xls]Sheet1

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	41.5	41.5	40.9
Total Unit Weight (pcf)	92.9	102.5	103.2
Dry Unit Weight (pcf)	65.7	72.4	73.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	1.129	0.931	0.910

Tested By JCM Date 05/27/08 Input Checked By Date

DCN: CT-S28 DATE 6-25-98 REVISION: 1

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REFERENCE 5 AND OTHER PERTINENT FINE COAL REFUSE DATA EFFECTIVE STRESS – TO – STEADY STATE STRENGTH RELATIONSHIPS

R13496



PROCEEDINGS

Association of State Dam Safety Officials • U.S. Committee on Large Dams

March 28-30, 2000 • Las Vegas, Nevada

STEADY STATE LIQUEFACTION SUSCEPTIBILITY OF HIGH HAZARD UPSTREAM-CONSTRUCTED COAL REFUSE DISPOSAL FACILITIES

Blaise E. Genes[1], Thomas O. Keller, P.E.[2] and Joseph P. Laird, P.E.[3]

1.0 Introduction

Coal refuse disposal facilities are manifestations of deep mining and surface mining activities and the resulting need for the disposal of waste materials. Due to the massive volumes of materials produced annually by mining operations, these "tailings dams" are among the largest earth structures in the world and consequently, receive intense regulatory and public scrutiny. Coal refuse disposal facilities, their design, construction and operation are regulated by the U.S. Department of Labor, Mine Safety and Health Administration (MSHA). The concern for refuse disposal safety and environmental control by MSHA, the coal industry, engineering consultants and the public has led to the development of design procedures that address these concerns, particularly siting, material handling and placement techniques.

For the most part, tailings dams evaluations are similar to those of water retention dams and address geotechnical issues such as foundation materials, hydrology, hydraulics, seepage control, slope stability (static and seismic), construction practices and long-term monitoring. In the past, pseudo-static analyses were performed to address seismic stability using regional, historic seismic acceleration values and a slightly lowered factor of safety limit to assess adequacy. Empirical evaluations are sometimes performed to address seismic stability with adequacy based on comparison of limited field and laboratory test data with historical performance data of liquefaction and non-liquefaction sites from around the world. During the initial to intermediate stages of a refuse facility design, simplified analytical methods may be appropriate, such as those based on pseudo-static and cone penetration testing (CPT) or standard penetration testing (SPT). However, given the uniqueness and complexity of moderate to high hazard tailings dams, which are significantly influenced by factors such as the number and geometry of upstream stages, deposition history and cross-valley topography, simplified analyses are often inadequate to effectively address safety and cost issues. They often do not account for critical site-specific conditions and may either over-predict strengths leading to a potentially unconservative analysis or under-predict strengths leading to costly remediation efforts.

The focus of this paper is on the application of established steady-state liquefaction evaluation procedures to high hazard tailings dams, assessing liquefaction susceptibility using site-specific data to estimate the factor of safety against a liquefaction flow slide failure. A significant emphasis is placed on obtaining in-situ samples and developing

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properties of the hydraulically placed, fine coal refuse consolidated beneath multiple, upstream-constructed stages of coarse coal refuse. Detailed evaluations have been performed at five Appalachian coal refuse disposal facilities in southern West Virginia as part of the permitting process for the various facilities.

2.0 Analytical Approach

Coal refuse disposal facilities are generally constructed by three methods, either separately or in combination, and include upstream, downstream, and centerline construction. Downstream and centerline constructed facilities typically pose only minor liquefaction concerns since critical failure surfaces pass mainly through the compacted coarse refuse embankments. A typical high hazard, upstream constructed coal refuse facility, such as the one shown in Figure 1, is constructed over long periods of time (up to 25 to 30 years) to heights of 400-plus feet and includes multiple upstream stages "pushed out" into the previous stage's tailings pond. Fine coal refuse consolidated under upstream stages typically is loose to very loose, silty sand to sandy silt- and clay-sized particles, saturated and usually highly contractive. Thus, the potential exists for excess pore pressure generation and significant loss of strength during and following a rapid (undrained) loading event, such as an earthquake.

All five facilities evaluated and discussed in the context of this paper were all moderate to high hazard structures with downstream toe to crest heights varying from 300 to 440 feet. Detailed studies of liquefaction susceptibility were performed using the methodology presented by Poulos, Castro, and France (1985) to estimate in-situ void ratio and undrained steady-state strength of the critical layer, fine coal refuse. Presented below are the generalized results of field and laboratory testing at the various sites. Field testing included performing fixed-piston undisturbed sampling to measure in-situ void ratio and piezo-seismic cone penetration testing (PS-CPT) to evaluate stratigraphy and estimate shear wave velocity with depth. Laboratory strength testing of undisturbed, remolded and slurry fine coal refuse samples was performed to estimate in-situ, undrained steady-state shear strength (S_{us}) and develop a site-specific S_{us}-to-effective stress relationship.

Liquefaction susceptibility was assessed based on the results of limit-equilibrium slope stability analyses. Post-earthquake deformations were estimated using one-dimensional wave propagation and sliding block analysis techniques and the results compared to the available freeboard to assess the likelihood of overtopping. Based on the regional database of information related to S_{us}, various trends regarding the general behavior of fine coal refuse during undrained loading and the practical implications affecting liquefaction susceptibility of upstream-constructed coal refuse impoundments are discussed. Detailed discussions regarding post-earthquake deformation analyses and the seismic response of coal refuse facilities to acceleration time-histories from stochastic simulations of eastern North America earthquakes are reserved for another paper.

3.0 Field Investigations

Fixed Piston Sampling

The main purpose of the subsurface exploration program at the various sites was to obtain high quality "undisturbed" fine coal refuse samples of a character suitable for

laboratory steady-state strength testing. Multiple undisturbed samples were obtained at each site at various depths using a hydraulically actuated Gregory Undisturbed Sampler (GUS) fixed piston sampler. The GUS fixed piston sampler was used to advance a thin-wall galvanized steel sampling tube by delivering drilling fluid pressure to the top of the sampler, which subsequently advanced the tube around a fixed piston. Penetration of the tube into the soil was accurately measured to within ½ to 1 millimeter when "full penetration" of the sampler was achieved. Full penetration of the sampling tube was confirmed by observation of the fluid level in the borehole casing which would dramatically rise when fluid pressure applied to the top of the sampler vented through ports in the sampler. The technique used for undisturbed fixed piston sampling allowed samples to be obtained to depths as great as 344 feet below the ground surface.

Detailed measurements of the tube inside, outside and cutting edge diameters and length were made and volume changes that occurred during sampling calculated in the field from tube penetration and sample recovery measurements. Samples were selected for subsequent laboratory testing based on the quality of the "undisturbed" sample using a criteria for the change in soil volume ($\Delta V/V$). For the fine coal refuse, minimizing the tube clearance ratio [(ID-CE)/CE] minimized sample volume changes, which typically ranged from zero to 2.5 percent. All undisturbed samples were stored in specially designed padded wooden boxes and changes in volume routinely monitored during storage and prior to and following shipment. Prior to laboratory testing, the tube samples were x-rayed and reviewed to select portions of the sample that had a minimum amount of stratification.

Piezo-Seismic/Cone Penetrometer Testing

PS-CPT soundings were performed prior to or concurrently with undisturbed sampling to help delineate the depth to the top and bottom of fine coal refuse. As shown in Figure 2, fine coal refuse layers are characterized by significantly lower tip stresses and elevated pore pressure generation, while the coarse and coarse-fine mix typically yield much higher tip stresses and lower pore pressure generation. Using seismic downhole techniques, estimates of shear wave velocity were obtained at each site to correlate small strain shear modulus (G) with depth. These tests were generally conducted at 5-foot intervals throughout the soil profile to depths of 365 feet at one site. Shear wave velocities for coarse, coarse-fines mix and fine coal refuse ranged from about 1,000 to 2,300 feet per second (fps), 800 to 2,000 fps and 800 to 1,200 fps, respectively. These velocities were based on data from 14 PS-CPT soundings. Velocities varied dramatically with depth, consistent with variations in placement techniques and the micro-layering associated with the deposition history of the facility.

Stratification

Much of the coarse refuse embankment drilled and sampled was dense to very dense as expected due to the structural placement of the material. Loose deposits of fine coal refuse were typically encountered below a dense mixed zone of coarse and fine coal refuse. The fines were characterized by corrected cone tip resistance values between 300 to 1,000 pounds per square inch (psi). The CPT soundings (and visually verified in SPT samples) have shown that there are significantly thick zones of mixed coarse and fine coal refuse. Mixing apparently occurred during the various push-out phases of upstream embankment construction into the tailings pond and possibly from the "pumping" of fines

up into the coarse refuse during subsequent stage construction. Due to the infusion of coarse refuse into the fines, the mix zones typically exhibited significantly higher average cone tip resistance, as well as lower pore pressure generation during cone advancement.

In-Situ Void Ratio

A total of 34 undisturbed fine coal refuse samples were obtained from the various sites. In-situ void ratio was calculated for each based on the field measurements described previously combined with laboratory measurements of the volume of solids in the tube. Table 1 presents a summary of sample depth and calculated in-situ void ratio at each site. Samples were obtained from beneath about 65 to 344 feet of overlying refuse and in-situ void ratios varied from about 0.39 to 0.79, with most (82 percent) of the values between 0.43 and 0.59. While in-situ void ratio is influenced by mean effective stress and time rate of consolidation, the range of values is relatively narrow. Direct correlation between estimated mean effective stress and in-situ void ratio can not be inferred due to the unique and complex nature of each site's geometric constraints and deposition history.

4.0 Laboratory Testing

Steady-state liquefaction-related laboratory test programs of the coal refuse materials sampled from the five sites included performing index tests such as grain size distributions, Atterberg limits, and specific gravity, as well as triaxial shear strength tests on undisturbed, remolded and slurry samples of fine coal refuse. Table 1 presents a summary of laboratory test results from Sites 1 through 5.

Index Tests

Fine coal refuse particles vary in size from about 2 mm (No. 10 sieve) to 0.0005 mm (finer than clay fraction). It is analogous to silty sand to silty clay-sized material. Fines content (passing a No. 200 sieve) for fine coal refuse from the five sites varied from 35 to 76 percent. Fine refuse generally has a low plasticity, ranging from nonplastic to Plasticity Indices of 12 percent or less. Values are affected by the parent rock formation from which the coal was extracted and from clay layers near the coal seam that get mixed within the coal. The specific gravity of fine coal refuse is low and generally varied from about 1.4 to 2.4 for the sites tested. As a result, densities are also relatively low, with in-place total unit weight ranging from about 75 to 90 pounds per cubic foot (pcf).

Steady-State Strength Of Undisturbed Samples

Isotropically consolidated, undrained triaxial compression ($\overline{CU}$) tests were performed on undisturbed, remolded and slurry samples of fine coal refuse. The main purpose of the triaxial tests was to measure the undrained steady-state shear strength of the samples in the laboratory to allow in-situ steady-state shear strengths to be estimated based on void ratio corrections (from laboratory to field). A total of 34 $\overline{CU}$ tests were performed on undisturbed samples of fine coal refuse from the five sites. Specimens were typically consolidated to an isotropic, effective consolidation stress ($\overline{\sigma}_{3c}$) ranging from 8 to 16 kilograms per square centimeter (kg/cm^2) [16.3 to 32.7 kips per square foot (ksf)]. These relatively high confining pressures were used to ensure contractive behavior,

particularly since most samples were obtained from 200 to 344 feet below the ground surface. The samples exhibited contractive behavior and reached or approximately reached a steady-state of deformation within the strain limits of the test. Laboratory values of S_{us} were corrected to represent steady-state strengths at in-situ void ratios.

Steady-State Line and In-Situ Steady-State Strength

Triaxial tests were performed on compacted specimens to determine the steady-state line (SSL) of the fine coal refuse representative for each site. Samples of each batch mix were formed using two methods: 1) by placing layers of fine coal refuse in a split mold and compacting each layer to a target void ratio; and 2) by placing the material in a mold as a slurry subject to one-dimensional consolidation to simulate in-situ placement conditions. The various SSL's for each batch mix are shown in Figure 3 where the slope ($\Delta e/\Delta \log S_{us}$) varies from 0.11 to 0.13 for moist tamped batch samples with additional slurry prepared samples of the batch mix shown for comparison. As discussed by Poulos et. al (1985), the slope of the steady state line is dependent on the shape of the grains and the vertical position is affected by slight differences in grain-size distribution. In general, the variation of the fine refuse coal particle shape from site to site would not be expected to vary significantly since the coal was mined from the same region using generally similar cleaning techniques. However, the fines content of the coal refuse sampled from the region varies widely. Thus, the SSL's in Figure 3 are consistent with the above observations.

In-situ S_{us} for each site was estimated by "correcting" the steady-state strengths at laboratory void ratios to their respective in-situ void ratio along the slope of the SSL as defined by Poulos et. al (1985). In-situ S_{us} values ranged from 0.06 to 4.62 kg/cm^2 (0.122 ksf to 9.42 ksf) with 74 percent of the data falling between 0.25 and 2.1 kg/cm^2 (0.51 ksf to 4.28 ksf). Figure 4 presents correlated S_{us} versus in-situ void ratio for 34 tested samples at the 5 sites. Note that S_{us} values can vary by more than a factor of 10 for a given void ratio.

S_{us} Versus Effective Stress Relationship

The estimation of S_{us} values for fine coal refuse layers that are at in-situ conditions different from the samples obtained and tested were estimated using a correlation between S_{us} and effective vertical stress (σ'_v) determined for each site. This includes proposed upstream stages where sampling is not yet feasible or existing portions of the embankment not sampled due to budgetary constraints. By generally assuming that S_{us} values vary linearly with σ'_v, and estimating the in-situ effective stress conditions for proposed layers of fine coal refuse, the in-situ S_{us} values for the proposed additional zones of fine coal refuse can be approximated. Site-specific S_{us} /σ'_v relationships are presented in Figure 5 and varied from 0.06 to 0.27. The various relationships were approximated by conservatively drawing a line from zero through the location at which two-thirds of the data points at a particular site lie above the line.

The lowest strength relationship was achieved at a narrow valley fill with over 200 feet of coarse and mixed refuse placed above the fine coal refuse. It is deduced that significant arching may be occurring within the coarse refuse preventing the full height of

verburden from consolidating the critical fine coal refuse layer. Therefore, factors such as cross-valley topography and deposition history are significantly relevant to the S_{us}/σ'_v relationship. Similarly, the database of S_{us}/σ'_v relationships obtained from bulk fine coal refuse samples prepared as slurried samples may be used to investigate what kind of relationship with depth (or effective stress) may be expected in the slurry pond prior to any encroachment of coarse embankments. The effective consolidation stresses at which the laboratory tests were performed were converted into equivalent vertical effective stresses in the field, assuming that the lateral stresses are equal to one-half of the vertical stresses. As shown in Figure 6, an S_{us}/σ'_v ratio of 0.18 extends from the zero intercept to the point where two-thirds of the data falls above the straight line.

5.0 Liquefaction Susceptibility Evaluations

Liquefaction susceptibility depends on the S_{us} of all the soils along the potential failure surface compared to the driving stress along that failure surface. Zones of loose (contractive) cohesionless soils are critical to analyzing liquefaction potential because they can have an undrained strength that is significantly lower than their drained strength. Therefore, the embankment geometry was evaluated to assess the liquefaction potential of each stage of construction estimating the average driving shear stresses along the critical failure surface at each of the high hazard sites. Generally, as the construction of future upstream staging progresses, there is a corresponding increase in driving stress. For layers in which fixed-piston samples were obtained and tested, or layers where similar effective stresses are present, a weighted average of steady-state strength, such as the Two-Thirds Strength Method, was utilized. This method, utilized by Castro et. al. (1989) and recommended by the U.S. Army Corps of Engineers (1970) in their manual for analyzing the stability of earth dams, involves using a design shear strength value that is lower than two-thirds of the total test values selected. S_{us} values for fine coal refuse layers at in-situ σ'_v values that significantly differ from the σ'_v values at sample locations were estimated using the site specific S_{us}/σ'_v relationship as previously discussed. Limit equilibrium slope stability analyses were performed at each site with S_{us} values applied to fine coal refuse layers and frictional (drained) strengths applied to coarse and mixed refuse layers. Factors of safety against liquefaction (F_L) along the critical failure surfaces for the various sites ranged from 1.02 to 1.32.

6.0 Notable Trends From Completed Studies

Liquefaction evaluations have been performed at five different sites using steady-state techniques as well as other complementary analyses. Since most of the sites are in the same geographical region, it is useful to compare the results of the fine coal refuse tested to identify trends in its engineering properties. A discussion of notable trends for the presented data is discussed below.

1. Consistent with the sensitivity of S_{us} to void ratio, S_{us} values can vary over 10 times at the same void ratio illustrating the need for site specific testing. In-situ void ratios varied between 0.39 and 0.79, however, most ranged from 0.43 to 0.59.

2. In-situ S_{us} values for unsampled fine coal refuse layers can be estimated based on S_{us} versus σ'_v correlations developed for a particular site. S_{us}/σ'_v relationships used for the coal refuse impoundment sites have ranged from 0.06 to 0.27 also illustrating the need for site specific testing, particularly at facilities with proposed multiple upstream stages.
3. S_{us} and S_{us}/σ'_v are significantly influenced by factors such as cross-valley topography, deposition history, upstream embankment geometry and construction sequencing.

7.0 Conclusions

Steady-state methodology can be effectively applied for the detailed evaluation of the liquefaction susceptibility of high hazard coal refuse disposal facilities. The evaluation needs to be based on site specific geometry and subsurface conditions, and properties developed accounting for the uniqueness and complexity of each site. While it is often useful to express the steady-state strength with respect to an estimated vertical stress, proper caution should be exercised during its development. The database of slurried samples has shown that the behavior of newly deposited fine coal refuse can be reasonably predicted. The S_{us}/σ'_v ratio of fine coal refuse consolidated beneath multiple upstream embankment stages can vary significantly with age, loading history, arching, and geometric constraints. For initial or preliminary liquefaction assessments, it is recommended that a range of S_{us}/σ'_v ratios be used to investigate the sensitivity of the critical layer to liquefaction susceptibility. For detailed evaluations where significant driving stresses are present for multiple upstream stages, site-specific shear strength testing of high quality undisturbed samples is recommended to develop the site's S_{us}/σ'_v relationship and each individual stage evaluated to estimate the factor of safety against liquefaction susceptibility. In general, factors of safety against liquefaction susceptibility were above 1.0 for the existing and proposed staging at the various high hazard sites. Factors of safety below 1.0 indicated the need for remedial design of existing embankments or redesign of the staging for proposed expansions to lower driving stresses.

References

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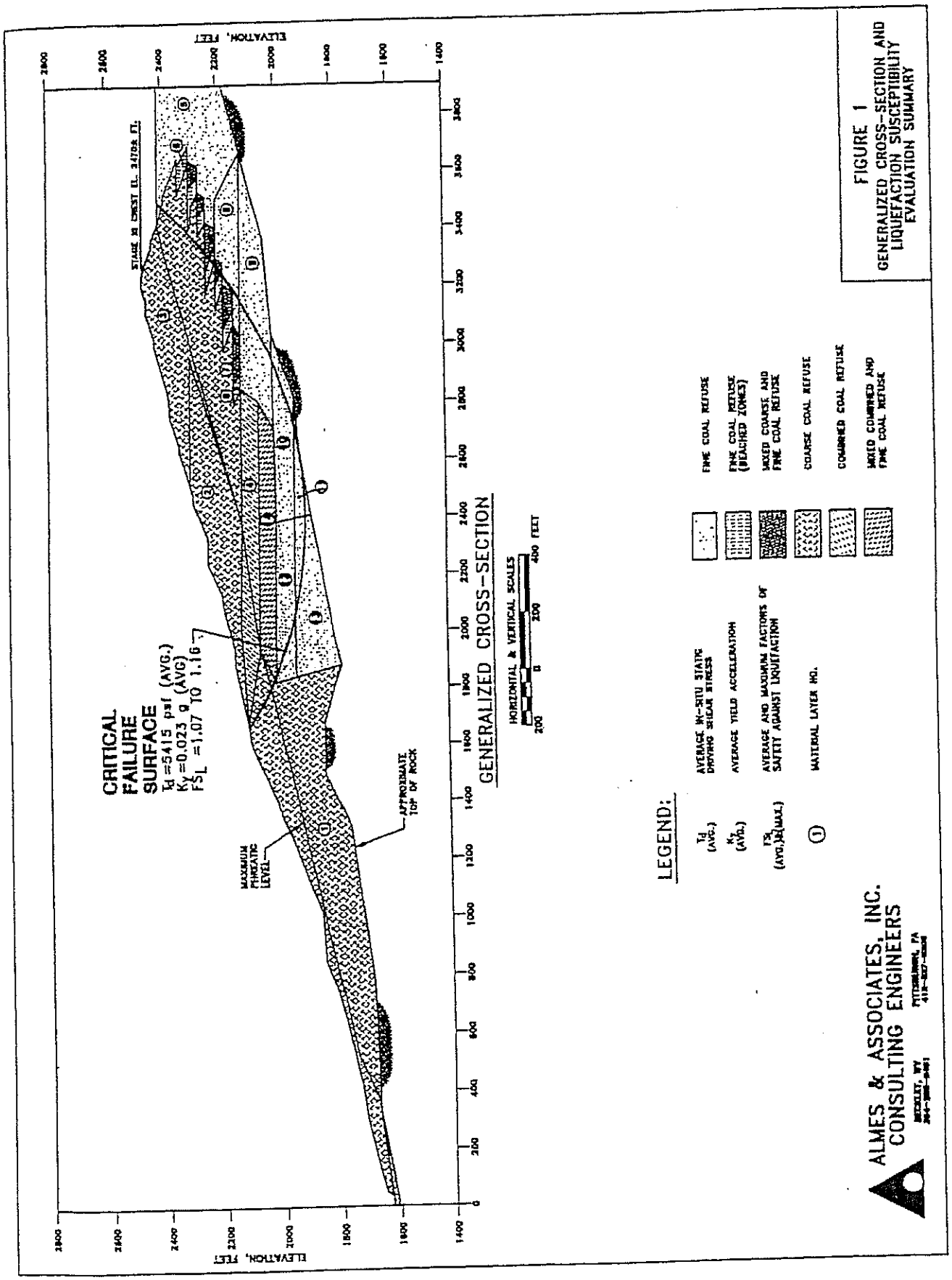
Table 1: Summary of Strength and Index Tests Performed on Fine Coal Refuse Samples

					Field Data			Laboratory Data												
												(CU) Triaxial Results at Peak			Consolidated-Undrained (CU) Triaxial Results at Steady-State (SS)					
Site No.	Sample Type	Percent Passing No. 200 Sieve	PI %	Specific Gravity	Depth to Top of Sample, Feet	Estimated In-Situ Vert. Effective Stress, kg/cm²	Void Ratio In-Situ (Sampled)	Void Ratio In Tube/Mold	Void Ratio During Shear	Lab Effective Consol Stress, kg/cm²	Estimated Equiv. Vert. Effect. Stress In Field [1], kg/cm²	Shear Stress at Peak, q, kg/cm²	Axial Strain, %	Peak Friction Angle	Shear Stress at SS, q, kg/cm²	Minor Principal Stress, kg/cm²	Axial Strain, %	Undrained SS Strength Sus, kg/cm²	SS Friction Friction Angle	Sus at In-Situ Void Ratio, kg/cm²
1	FP	29.4	NA	2.28	90.7	3.45	0.494	0.497	0.402	8.00	12.00	2.70	12.5	34.6	2.68	2.15	17.6	2.23	33.7	0.44
	FP	40.4	NA	2.02	70.3	3.19	0.511	0.615	0.397	8.00	12.00	2.81	12.2	34.7	2.71	2.22	22.6	2.26	33.4	0.19
	FP	44.7	NA	2.37	80.6	3.30	0.488	0.489	0.390	8.00	12.00	2.79	13.2	36.3	2.59	2.17	25.9	2.17	32.0	0.42
	FP	43.8	NA	1.94	76.8	3.25	0.496	0.502	0.384	8.00	12.00	3.38	16.0	33.7	3.29	2.93	22.6	2.79	32.0	0.63
2	FP	47.2	NP	1.76	100.3	4.61	0.665	0.587	0.443	8.00	12.00	3.60	17.9	35.3	3.38	2.76	24.5	2.81	33.4	0.36
	FP	38.8	7	2.01	105.8	4.68	0.468	0.402	0.414	8.00	12.00	3.20	15.1	34.2	3.00	2.65	24.4	2.64	32.1	1.39
	FP	63.9	11	1.63	65.0	4.10	0.553	0.543	0.454	8.00	12.00	2.95	14.2	32.7	2.88	2.58	22.9	2.46	31.9	0.53
	FP	87.0	4	1.64	75.6	4.27	0.541	0.629	0.421	8.00	12.00	3.41	16.7	34.1	3.29	2.78	23.3	2.77	32.8	0.30
1 & 2	BM	34.7	NP	1.98	NA	NA	NA	0.732	0.390	4.00	6.00	0.99	1.8	24.7	0.96	0.81	26.0	0.80	32.8	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.746	0.331	10.00	15.00	2.39	1.6	25.2	2.42	2.03	25.2	2.03	32.9	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.975	0.466	1.00	1.50	0.23	1.2	23.8	0.18	0.14	26.3	0.15	34.1	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.973	0.433	2.00	3.00	0.46	1.3	23.2	0.41	0.35	23.0	0.34	32.9	NA
3	FP	97.7	NA	1.88	310.5	11.02	0.514	0.562	0.510	16.10	24.15	5.67	6.3	30.1	5.67	5.84	6.3	4.91	30.1	4.65
	FP	76.5	NA	1.89	269.5	10.07	0.444	0.488	0.424	16.20	24.30	5.40	7.9	28.1	5.21	5.13	16.5	4.62	27.4	3.15
	FP	78.7	NA	1.85	329.4	11.17	0.443	0.482	0.439	16.10	24.15	5.87	9.4	29.8	5.69	5.12	19.1	4.09	29.8	4.62
	FP	91.7	11	1.88	343.3	11.62	0.641	0.605	0.545	12.00	18.00	4.87	10.2	30.9	4.81	4.68	18.0	4.14	30.5	4.47
	FP	66.6	NA	1.61	290.6	10.65	0.682	0.588	0.405	12.00	18.00	5.67	16.7	33.7	5.57	5.27	16.7	5.47	33.7	0.85
	FP	21.3	NA	1.49	275.8	10.37	0.789	0.780	0.681	8.00	12.00	3.77	19.8	35.0	3.77	2.81	19.8	3.09	35.0	0.06
3	BM	70.1	8	1.80	NA	NA	NA	0.513	0.363	16.20	24.30	5.44	19.3	29.7	5.44	5.56	19.7	4.72	29.7	NA
	BM	70.1	8	1.80	NA	NA	NA	0.483	0.390	8.00	12.00	3.06	20.3	31.2	3.06	2.84	20.3	2.81	31.2	NA
	BM	70.1	8	1.80	NA	NA	NA	0.633	0.479	2.00	3.00	0.85	18.8	33.4	0.85	0.63	16.8	0.54	33.4	NA
	BM	70.1	8	1.80	NA	NA	NA	0.618	0.456	3.00	4.50	1.00	18.5	33.0	1.00	0.83	16.5	0.84	33.0	NA
	BM/S	70.1	8	1.80	NA	NA	NA	1.270	0.407	7.00	10.50	2.31	12.8	32.2	2.31	2.02	12.8	1.95	32.2	NA
	BM/S	37.0	4	2.28	NA	NA	NA	1.070	0.362	7.00	10.50	2.52	17.9	33.4	2.52	2.05	17.9	2.10	33.4	NA
	BM/S	23.8	NA	1.48	NA	NA	NA	0.840	0.504	7.00	10.50	3.71	19.7	35.2	3.71	2.72	19.7	3.03	35.2	NA
4	FP	24.9	NA	1.45	210.0	7.47	0.557	0.695	0.517	12.00	18.00	4.74	19.9	36.1	4.74	3.30	19.9	3.83	36.1	1.78
	FP	15.7	NA	1.48	222.2	7.68	0.640	0.671	0.466	12.00	18.00	4.85	18.7	36.2	4.85	3.45	18.7	3.91	36.2	0.95
	FP	72.0	NA	1.76	135.6	5.49	0.486	0.520	0.458	8.00	12.00	3.41	13.9	33.3	3.37	2.89	18.2	2.84	32.6	1.60
	FP	39.1	NA	1.58	150.2	5.75	0.389	0.400	0.360	8.00	12.00	3.02	14.1	35.2	3.90	3.09	17.6	3.24	33.9	1.60
	FP	71.3	NA	1.70	170.2	6.08	0.487	0.498	0.446	8.00	12.00	3.86	17.3	33.6	3.84	3.30	18.9	3.24	32.5	2.18
	FP	81.0	NA	1.65	218.3	7.74	0.491	0.619	0.453	12.00	18.00	4.94	14.2	33.8	4.89	4.17	17.7	4.11	32.7	1.98
	FP	72.7	NA	1.71	223.3	7.83	0.485	0.482	0.415	12.00	18.00	4.75	13.1	32.4	4.60	4.23	18.3	3.93	31.4	1.50
	FP	75.6	NA	1.73	213.2	7.65	0.484	0.507	0.428	12.00	18.00	5.00	12.8	35.2	4.68	3.77	19.7	3.90	33.6	1.33
4	BM	75.1	12	1.72	NA	NA	NA	0.676	0.419	8.00	12.00	2.99	20.8	32.4	2.82	2.58	18.0	2.47	32.3	NA
	BM	75.1	12	1.72	NA	NA	NA	0.795	0.450	4.00	6.00	1.41	17.3	33.2	1.42	1.18	18.0	1.18	33.0	NA
	BM	75.1	12	1.72	NA	NA	NA	0.804	0.387	11.00	17.85	4.31	19.3	31.8	4.26	3.86	18.0	3.63	31.6	NA
	BM	75.1	12	1.72	NA	NA	NA	0.805	0.481	2.00	3.00	0.66	21.4	32.6	0.62	0.53	18.0	0.52	32.8	NA
	BM/S	75.1	12	1.72	NA	NA	NA	NA	0.455	5.00	7.50	1.88	19.0	34.3	1.85	3.46	18.0	1.55	33.3	NA
	BM/S	52.2	4	1.56	NA	NA	NA	NA	0.380	5.00	7.50	2.48	23.4	37.2	2.48	1.81	23.4	2.02	35.3	NA
5	FP	81.0	NA	1.77	219.9	9.54	0.582	0.660	0.460	12.00	18.00	4.43	10.9	32.9	4.14	3.76	22.2	3.53	31.6	0.63
	FP	48.8	NA	1.64	234.3	9.72	0.546	0.661	0.446	12.00	18.00	5.34	16.7	35.8	5.33	3.66	17.3	4.34	35.4	0.53
	FP	90.5	NA	1.95	260.0	9.93	0.560	0.586	0.505	12.00	18.00	4.33	8.7	28.8	4.22	4.62	13.9	3.71	28.5	1.15
	FP	87.8	NA	1.79	188.3	8.63	0.622	0.615	0.440	12.00	18.00	4.58	8.5	32.8	4.23	3.98	20.7	3.62	31.0	0.64
	FP	88.9	NA	1.96	194.0	8.81	0.558	0.605	0.547	12.00	18.00	4.00	3.5	26.7	3.97	4.79	4.0	3.63	27.1	0.33
	FP	35.5	NA	1.65	233.3	11.02	0.509	0.525	0.421	12.00	18.00	4.63	20.3	35.6	4.63	3.35	20.3	3.77	35.5	0.69
	FP	22.5	NA	1.41	241.8	11.12	0.547	0.551	0.483	12.00	18.00	4.58	20.5	33.7	4.58	3.67	20.8	3.79	33.7	0.08
	FP	34.4	NA	1.64	180.4	8.67	0.620	0.608	0.444	12.00	18.00	4.37	19.8	35.5	4.36	3.21	21.6	3.67	35.1	0.08
	FP	79.5	NA	1.87	186.0	8.05	0.612	0.600	0.448	12.00	18.00	4.37	9.0	32.0	4.01	3.88	21.3	3.46	30.5	0.11
	FP	74.0	NA	1.88	183.3	8.46	0.618	0.588	0.450	12.00	18.00	5.12	8.8	33.7	4.78	4.20	19.4	4.05	32.1	0.12
	FP	60.7	NA	1.66	200.4	10.13	0.562	0.576	0.466	12.00	18.00	4.04	11.0	33.8	3.85	3.21	21.7	3.23	33.0	0.43
	FP	25.5	NA	1.57	210.3	10.63	0.588	0.599	0.460	12.00	18.00	4.88	17.9	36.3	4.75	3.55	24.4	3.90	34.9	0.20
5	BM	62.0	9	1.70	NA	NA	NA	0.545	0.401	8.00	12.00	2.56	19.2	32.9	2.56	2.17	19.2	2.15	32.7	NA
	BM	62.0	9	1.70	NA	NA	NA	0.544	0.473	2.00	3.00	0.58	20.2	34.8	0.58	0.46	20.3	0.46	33.9	NA
	BM	62.0	9	1.70	NA	NA	NA	0.648	0.512	1.00	1.50	0.28	1.7	35.2	0.27	0.21	19.8	0.22	33.7	NA
	BM/S	62.0	9	1.70	NA	NA	NA	0.763	0.358	6.50	9.75	2.32	18.6	32.0	2.32	2.10	19.8	1.88	31.6	NA
	BM/S	85.1	NP	1.88	NA	NA	NA	NA	0.633	6.50	9.75	3.08	18.3	34.8	3.08	2.32	18.3	2.53	34.8	NA

NOTES: FP - Fixed Piston, Undisturbed Sample
BM - Reconstituted Batch Mix Sample Prepared by Moist Tamping
[1] $K_o = 0.5$ (Ratio of Horizontal to Vertical Effective Stress)
BM/S - Reconstituted Batch Mix Sample Prepared as Slurry
NA - Not Applicable
NP - Non-Plastic
PI - Plasticity Index
$q = (\sigma_1 - \sigma_3)/2$

R13504


CRITICAL
FAILURE
SURFACE
τ_d =5415 psf (AVG.)
K_y =0.023 g (AVG)
FS_L =1.07 TO 1.16
STAGE XI CREST EL. 2470± FT.
MAXIMUM PHREATIC LEVEL
APPROXIMATE TOP OF ROCK
ELEVATION, FEET
GENERALIZED CROSS-SECTION
HORIZONTAL & VERTICAL SCALES
200 0 200 400 FEET
LEGEND:
τ_d (AVG.) AVERAGE IN-SITU STATIC DRIVING SHEAR STRESS
K_y (AVG.) AVERAGE YIELD ACCELERATION
FS_L (AVG.)(MAX.) AVERAGE AND MAXIMUM FACTORS OF SAFETY AGAINST LIQUEFACTION
① MATERIAL LAYER NO.
FINE COAL REFUSE
FINE COAL REFUSE (BEACHED ZONES)
MIXED COARSE AND FINE COAL REFUSE
COARSE COAL REFUSE
COMBINED COAL REFUSE
MIXED COMBINED AND FINE COAL REFUSE
ALMES & ASSOCIATES, INC.
CONSULTING ENGINEERS
FIGURE 1
GENERALIZED CROSS-SECTION AND LIQUEFACTION SUSCEPTIBILITY EVALUATION SUMMARY

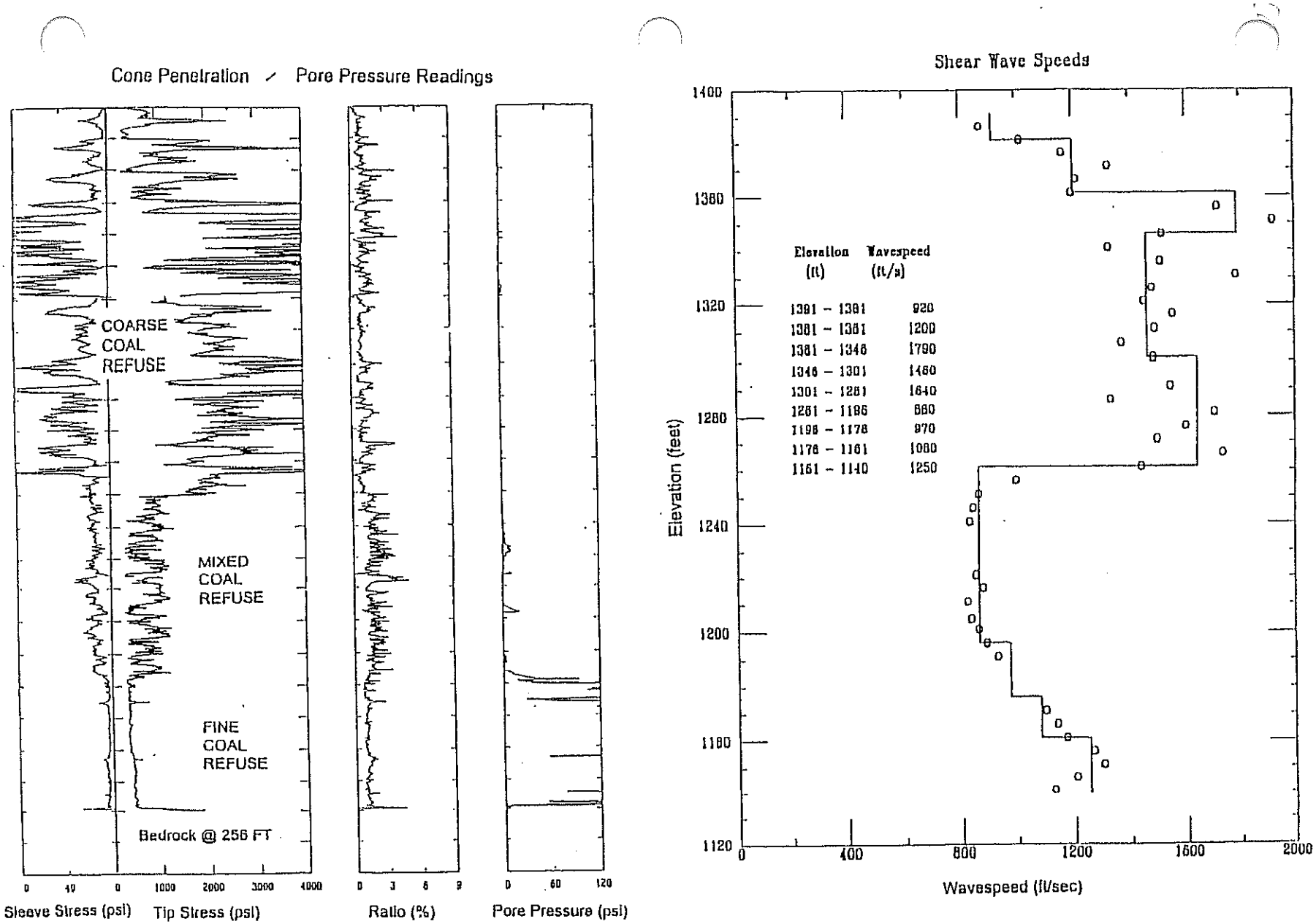


Figure 2 – CPT Log and Shear Wave Velocity Profile

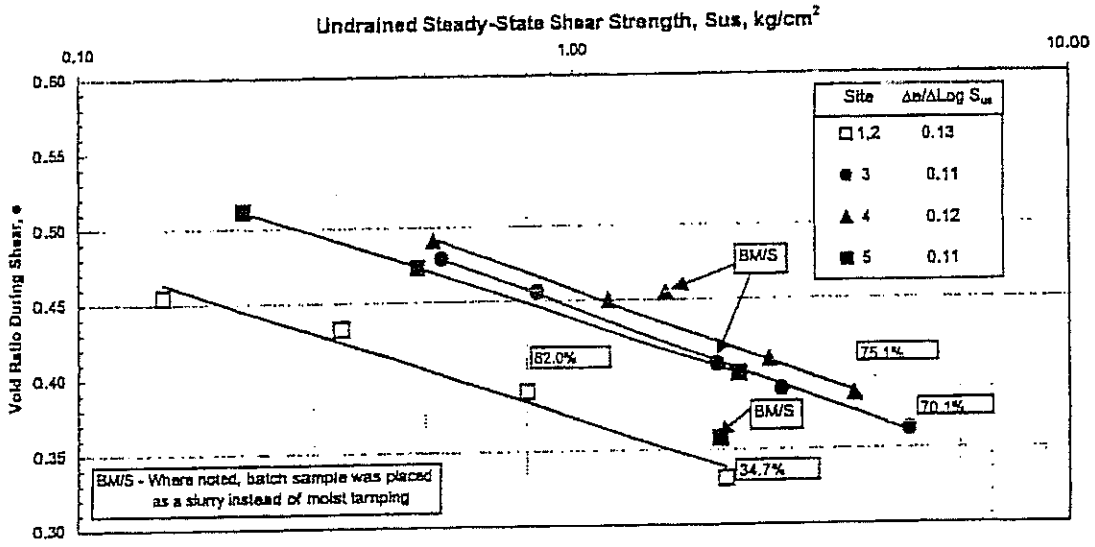


FIGURE 3 - Steady State Lines of Fine Coal Refuse Batch Samples

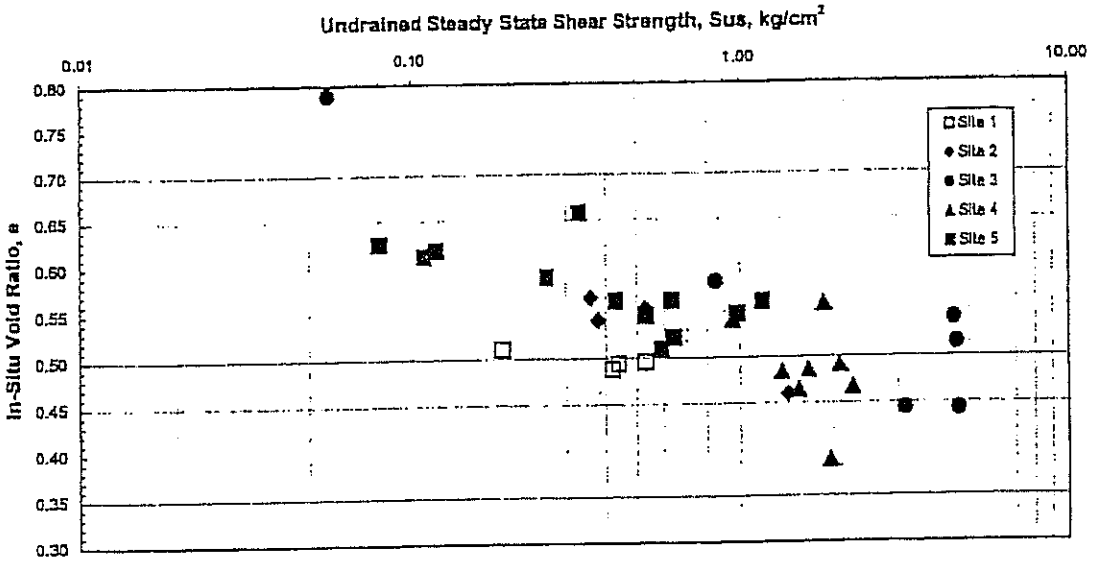


FIGURE 4 - S_{us} of Fixed Piston Samples at In-Situ Void Ratio, After Correction of Lab Void Ratio

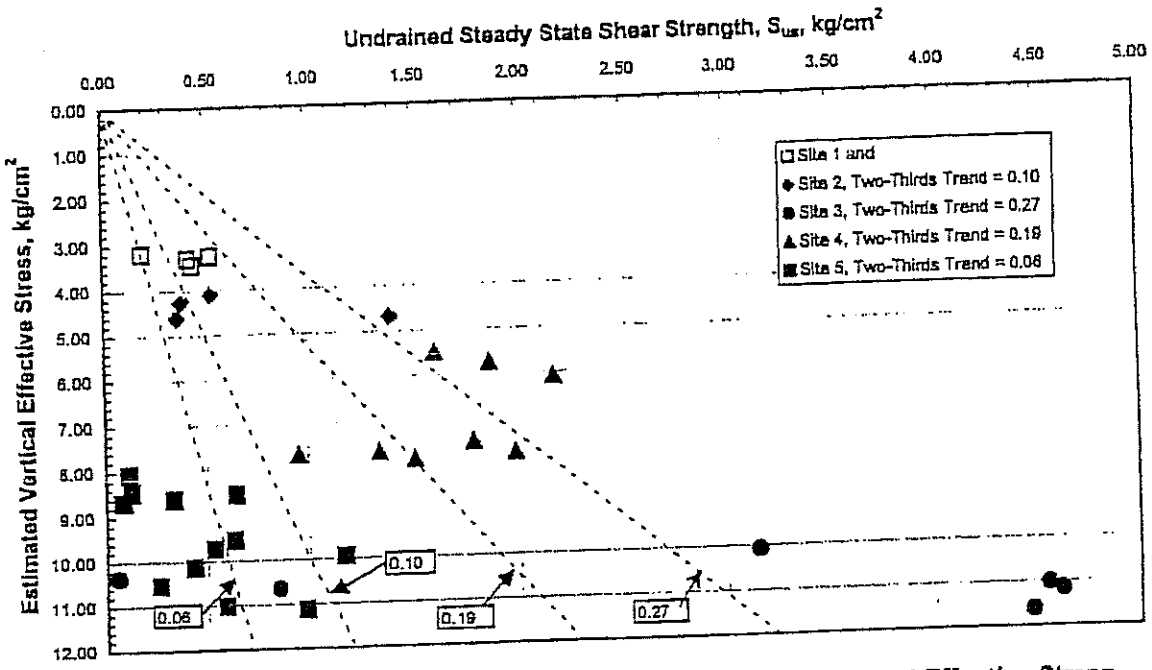


FIGURE 5 - S_{us} of Fixed Piston Samples Versus Estimated Vertical Effective Stress

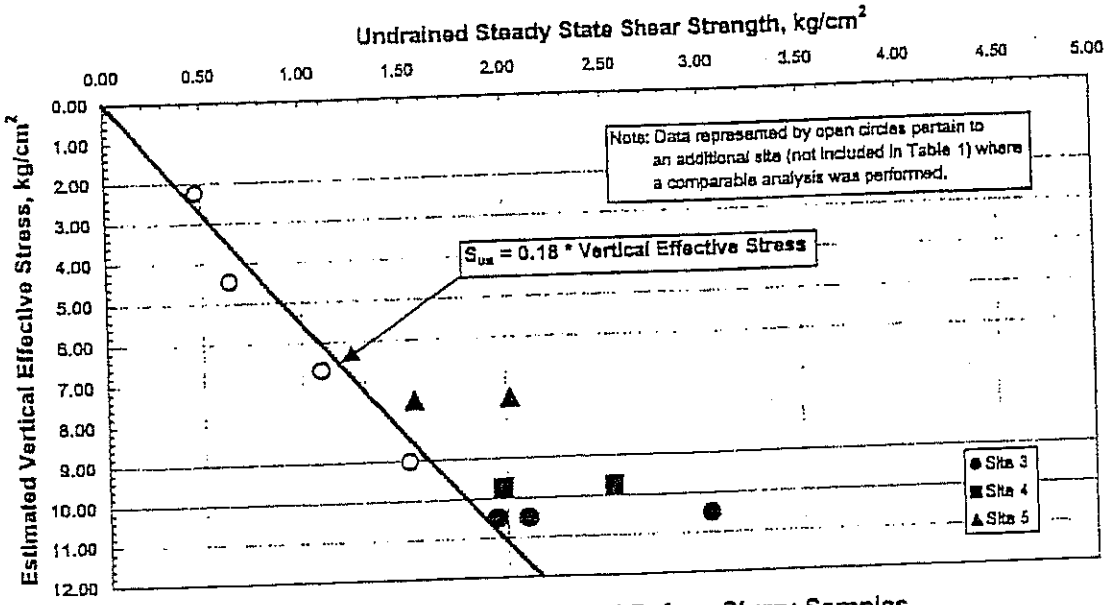
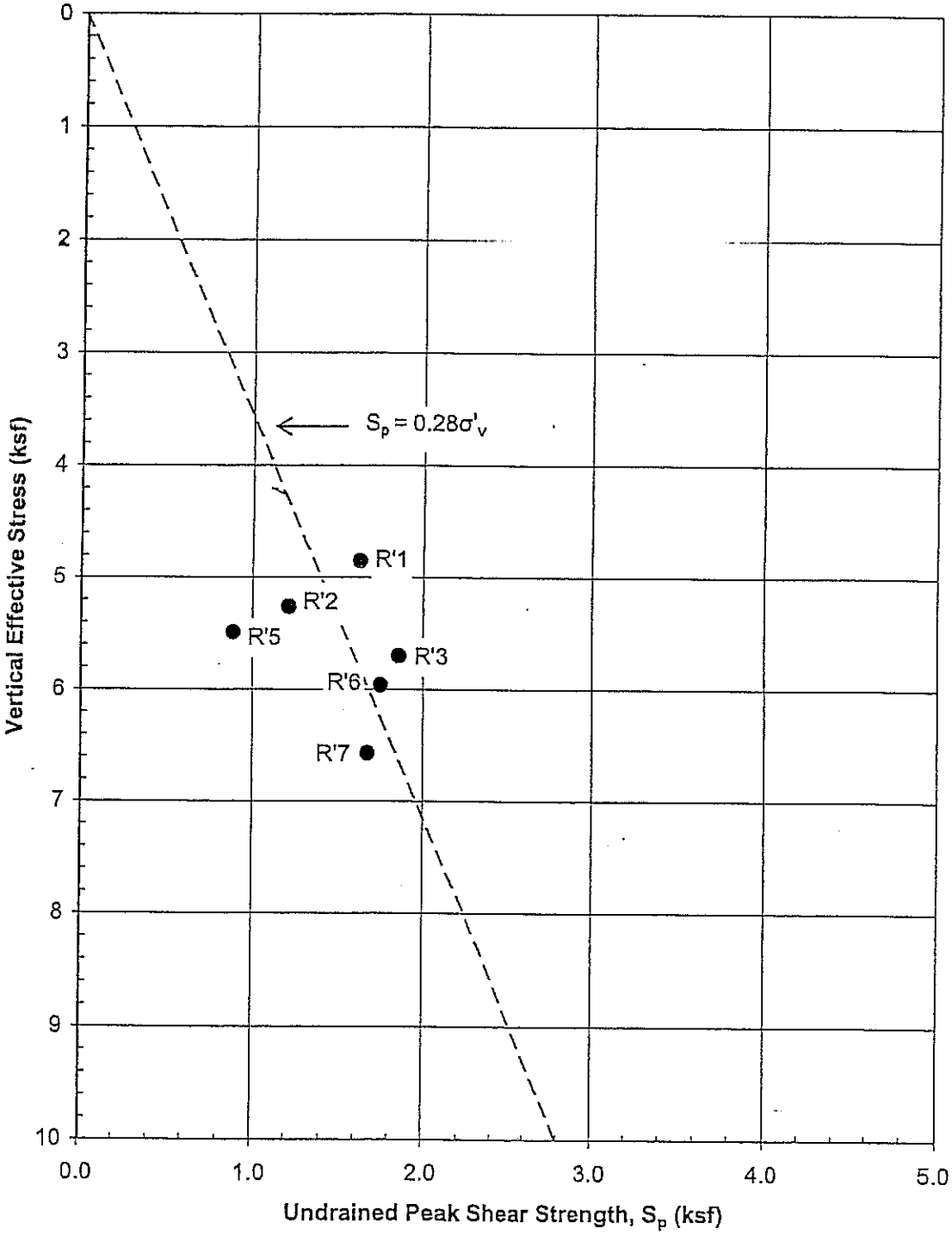
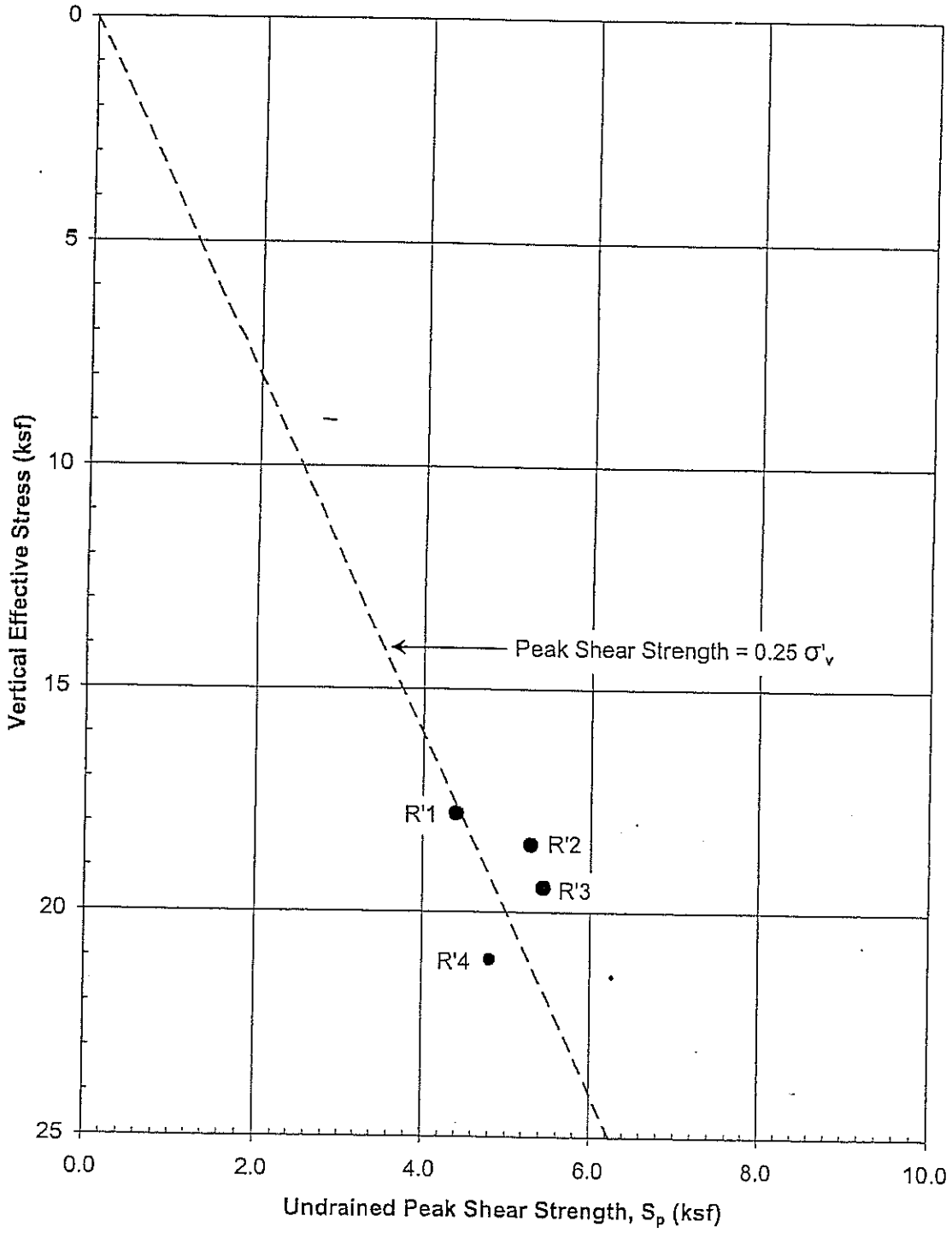


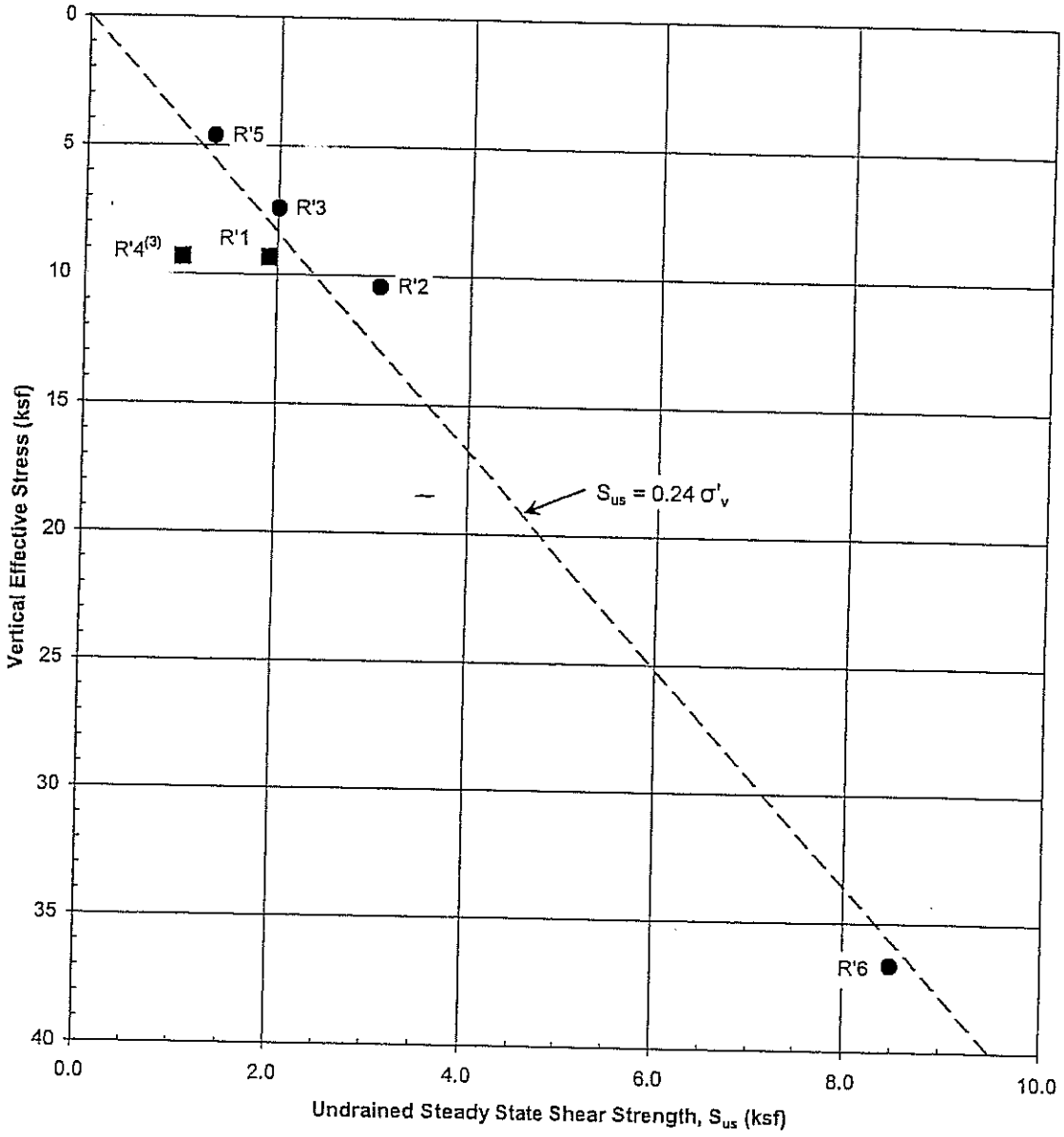
FIGURE 6 - S_{us} of Fine Coal Refuse Slurry Samples Versus Estimated In-Situ Vertical Effective Stress



Harvey Run No. 1 Slurry Impoundment Monongalia County, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_p VERSUS VERTICAL EFFECTIVE STRESS
Consolidation Coal Company Pittsburgh, Pennsylvania	Project 070810	June 2007 Figure 6



Wallace Cabin Branch Slurry Impoundment Wyoming County, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_p VERSUS VERTICAL EFFECTIVE STRESS
Kepler Processing Company Pineville, West Virginia	Project 063560	April 2007 Figure 4



LEGEND
- ● Reconstituted Coal Refuse Slurry Sample
- ■ Undisturbed Tube Sample

NOTES
1. Vertical effective stress for reconstituted coal refuse samples assumed to be 1.5 times the isotropic effective consolidation stress.
2. Vertical effective stress of undisturbed tube samples estimated by CEC, Inc.
3. R'4 composed of two different soil types. S_{us} shown is uncertain.

Hughes Hollow Slurry Impoundment Wana, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_{us} VERSUS VERTICAL EFFECTIVE STRESS
Consolidation Coal Company Pittsburgh, Pennsylvania	Project 063570	February 2007 Figure 3

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part 16

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APPENDIX D

SLOPE STABILITY ANALYSES RESULTS
IN-SITU DRIVING SHEAR STRESS

gai consultants
transforming ideas into reality

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – In-Situ Driving Shear Stress Stability Analyses

BY AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY [illegible] DATE 5/6/09 SHEET NO. 1 OF 3

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Environmental Specialists

CALCULATION BRIEF
FOR
DETERMINATION OF DOWNSTREAM AND UPSTREAM IN-SITU DRIVING SHEAR STRESS BY ELASTIC (PCSTABL) SOLUTION

POND CREEK COAL REFUSE DISPOSAL SITE – PHASE 3 IMPOUNDMENT

OBJECTIVE: To determine the initial state of static stress (a.k.a., "driving shear stress") for the Phase 3 fine coal refuse (FCR) impoundment in both downstream and upstream directions. The critical failure, in-situ driving shear stress will be used to evaluate the potential for a liquefaction (flow slide) failure of the Phase 3 FCR as part of the overall evaluation of the impact of longwall mining beneath the Phase 3 impoundment.

METHODOLOGY: Use limit equilibrium analyses to estimate the driving shear stress acting on the most critical circular failure surface passing through the Phase 3 impoundment and embankment geometry shown in Figure 1. Failure planes in both the upstream and downstream directions will be evaluated.

REFERENCES:

1. Gregory, P.E., Garry H., "PCSTABL5M with STEDwin Slope Stability Analysis System, Version 2.0," dated September 2001.

2. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak and Steady-State Undrained Shear Strengths For Refuse and Subgrade Materials, Pond Creek Coal Refuse Disposal Site – South Pond", BEG, 7/12/08.

3. GAI Consultants, Inc. Calculation, "Supplemental Summary of Engineering Properties and Coarse Refuse Tensile Strength for Subsidence Liquefaction and Embankment Cracking Evaluations, Pond Creek Coal Refuse Disposal Site – Phase 3," BEG, 3/31/09.

4. GAI Consultants, Inc. Calculation Brief Entitled "Summary of Laboratory Testing," Pond Creek Coal Refuse Disposal Site, BEG, dated 3/30/09.

5. Poulos, S.J., Castro, G., and France, J.W. (1985a) "Liquefaction Evaluation Procedure," Journal of the Geotechnical Engineering Division, ASCE, Vol. 111, No. GT6, pp. 772-792.

ANALYSIS:

Liquefaction (flow slide) susceptibility was determined by evaluating whether or not the Phase 3 FCR would resist triggering a loss of strength, and subsequently estimating the factor of safety against post-subsidence instability. The analysis requires the in-situ static driving shear stress be determined in the

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – In-Situ Driving Shear Stress Stability Analyses

BY AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY BEG DATE 5/6/09 SHEET NO. 2 OF 3

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critical layer FCR and based on the results of the characterization and triggering evaluations, a "zero-strength" analysis of the FCR is performed.

Poulos, et al (1985) states a soil mass susceptible to liquefaction will only experience a flow slide failure when a sufficiently large triggering event causes the strength of the soil to decrease to the undrained steady-state strength. Conversely, a soil mass which is not susceptible to liquefaction physically cannot fail by liquefaction since the minimum undrained strength exceeds the in-situ driving shear stress along the critical failure surface.

The driving shear stress in a critical soil layer is equal to the minimum shear resistance the layer must have to just maintain stability of the slope. This assumes fully mobilized shear strengths in the other soil layers comprising the slope. The fully mobilized strengths are those that would act while deformation of the slope is occurring and, thus, would be available to resist a massive flow slide. These shear strengths can be quantified by performing a stability analysis for the slope in question.

When evaluating slope stability by means of circular failure surface analysis (using the limit equilibrium approach), the driving shear stress (τ_d) acting along the failure surface analyzed can be determined by assuming that the shearing resistance (i.e., shear strength) of the material through which the failure surface passes is provided solely by cohesion [i.e., angle of internal friction ($\phi = 0$]. The driving stress is determined by varying the cohesion value used in the analysis until a factor of safety (F.S.) of 1.0 is obtained. For this condition (F.S. = 1.0), the driving stress acting along the failure surface analyzed is equal to the cohesion value used for the material.

The following soil properties were estimated based on previous field and laboratory testing as well as current FCR testing for use in the various slope stability analyses as noted in Reference Nos. 3 and 4:

Material Type	Total Unit Weight (γ_t) (pcf)	Saturated Unit Weight (γ_s) (pcf)	Effective Friction (ϕ') (deg)	Effective Cohesion (c') (psf)
Coarse Refuse	130	140	33.7	0
Fine Refuse	80	90	0	0
Residual Soil	125	135	19	400
Soil Cap	130	135	30	0

Results of Driving Shear Stress Slope Stability Analyses:

Phase 3 Impoundment (Crest El. 500 ft)	Top of Fines Elevation (ft)	Top of Cap Elevation[1] (ft)	Driving Shear Stress in Fine Coal Refuse (τ_d)[2] (psf)	Additional Factor of Safety Including Zero-Strength FCR (dim)
Downstream	495	500	0	2.2
Upstream	495	500	0	1.3

(1) Cap includes 5-foot coarse refuse layer above top of fines elevation as shown in Figure 1.
(2) Zero-strength driving shear stress analyses yielded additional factors of safety in downstream and upstream directions of 2.2 and 1.3, respectively.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – In-Situ Driving Shear Stress Stability Analyses

BY AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY BEG DATE 5/6/09 SHEET NO. 3 OF 3

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CONCLUSION:

Based on the information presented in this calculation brief, GAI determined that the Pond Creek – Phase 3 impoundment geometry has ZERO (0) psf in-situ driving shear stress through the fine coal refuse in both the upstream and downstream directions.

Zero-strength driving shear stress analyses yielded additional factors of safety in downstream and upstream directions of 2.2 and 1.3, respectively.

The results indicate that a rapid loading event such as subsidence-related disturbance will not trigger a strength loss in FCR, and is therefore NOT susceptible to a flow slide failure.

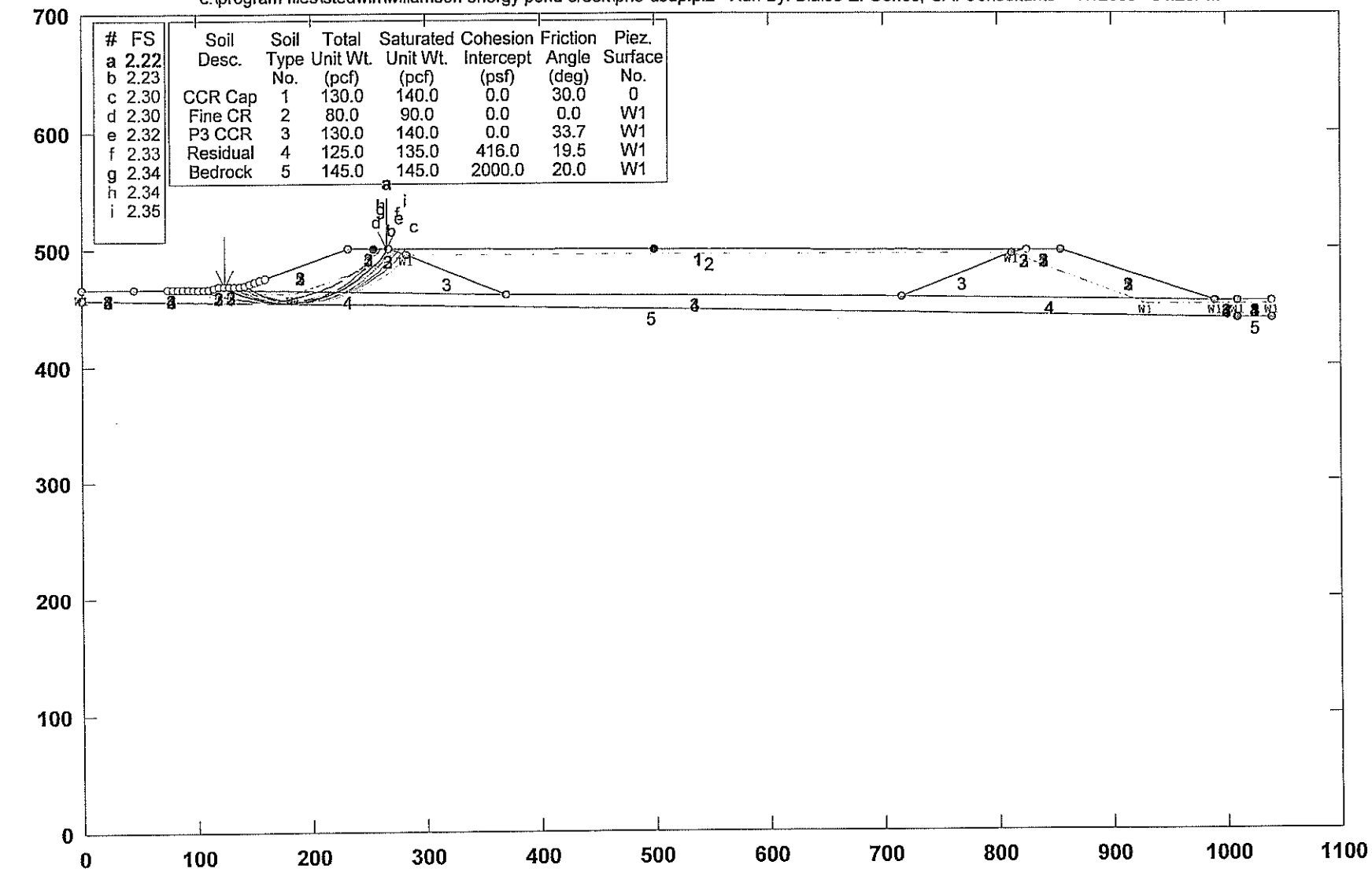
Hard copies of the Phase 3 driving shear stress downstream and upstream slope stability analyses are attached.

ATTACHMENT 1

IN-SITU DRIVING SHEAR STRESS PCSTABL SLOPE STABILITY ANALYSES
PHASE 3 – DOWNSTREAM

Pond Creek, Phase 3 Downstream Driving Stress, Zero-Strength - Deep

c:\program files\stedwin\wiliamson energy pond creek\ph3-dsdp.pl2 Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:20PM



PCSTABL5M/si FSmin=2.22

Safety Factors Are Calculated By The Modified Bishop Method

STED



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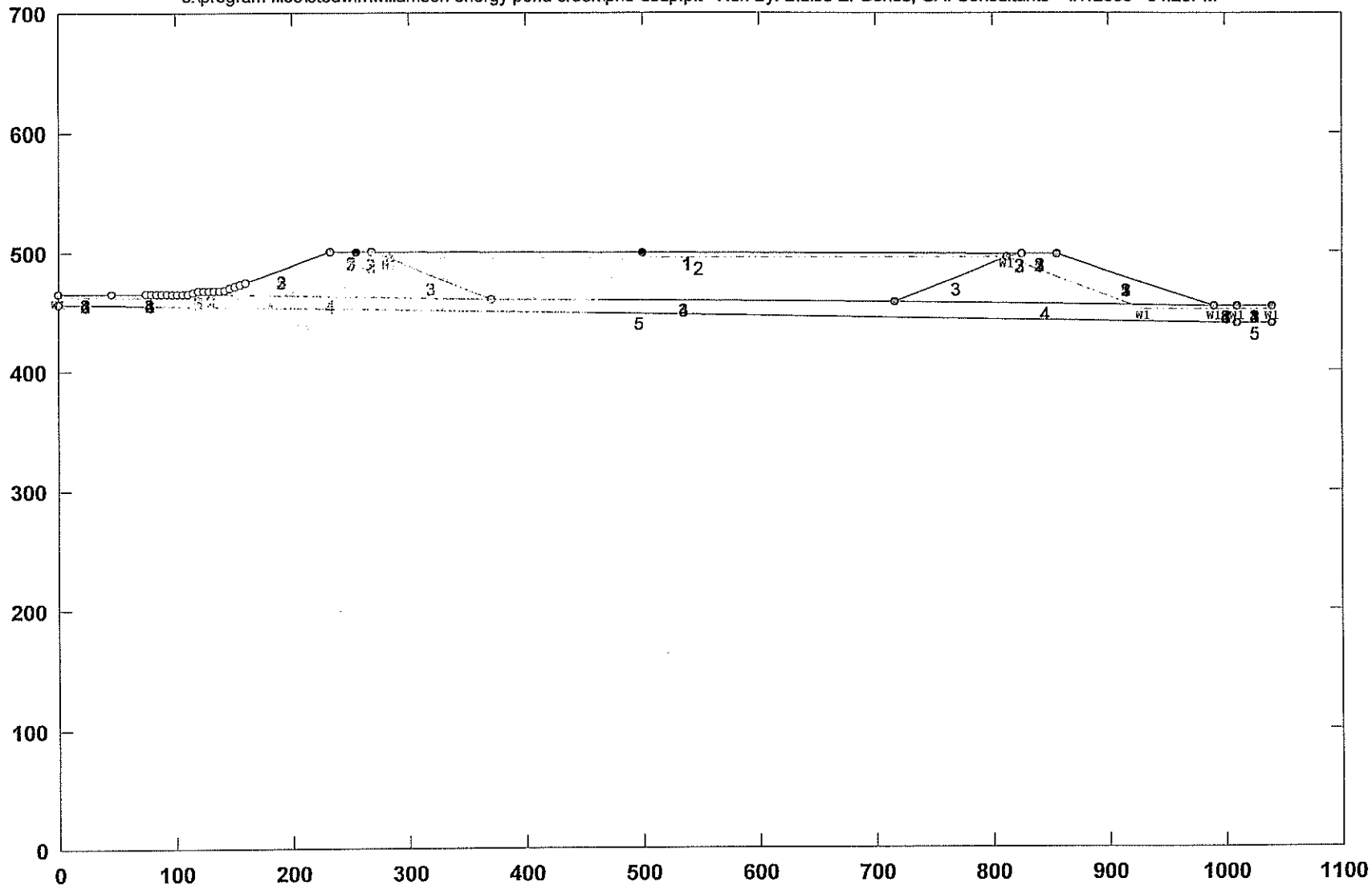
Pond Creek, Phase 3 Downstream Driving Stress, Zero-Strength - Deep

c:\program files\stedwin\wiliamson energy pond creek\ph3-dsdp.plt Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:20PM



STED



R13518

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 4/7/2009
Time of Run: 04:20PM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph3-dsdp.in
Output Filename: C:ph3-dsdp.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3-dsdp.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 3 Downstream Driving S
tress, Zero-Strength - Deep

BOUNDARY COORDINATES
10 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1
5	140.00	468.00	233.00	500.00	1
6	233.00	500.00	268.00	500.00	1
7	268.00	500.00	825.00	498.00	1
8	825.00	498.00	855.00	498.00	1
9	855.00	498.00	990.00	454.00	1
10	990.00	454.00	1010.00	454.00	1
11	1010.00	454.00	1040.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1040.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1040.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4
46	1010.00	454.00	1040.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1040.00	439.00	5

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	30.0	.00	.0	0
2	80.0	90.0	.0	.0	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 75.00 ft.
and X = 160.00 ft.
Each Surface Terminates Between X = 255.00 ft.
and X = 500.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
5.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.21	468.00
2	128.62	465.65
3	133.14	463.49
4	137.74	461.55
5	142.43	459.82
6	147.20	458.31
7	152.03	457.02
8	156.91	455.95
9	161.84	455.10
10	166.80	454.48
11	171.79	454.08
12	176.78	453.92
13	181.78	453.98
14	186.78	454.28
15	191.75	454.80
16	196.69	455.54
17	201.60	456.51
18	206.45	457.71
19	211.25	459.13
20	215.97	460.76
21	220.62	462.61
22	225.18	464.67
23	229.63	466.93
24	233.98	469.40
25	238.21	472.06
26	242.32	474.91

27	246.29	477.95
28	250.12	481.17
29	253.80	484.56
30	257.31	488.11
31	260.67	491.82
32	263.85	495.68
33	266.85	499.68
34	267.06	500.00

Circle Center At X = 177.9 ; Y = 563.2 and Radius, 109.3

*** 2.222 ***

Individual data on the 41 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	4.4	675.1	.0	.0	.0	.0	.0	.0	.0
2	2.2	820.9	.0	.0	.0	.0	.0	.0	.0
3	2.3	1185.7	.0	.0	.0	.0	.0	.0	.0
4	4.6	3234.4	.0	.0	.0	.0	.0	.0	.0
5	.1	96.6	.0	.0	.0	.0	.0	.0	.0
6	2.1	1887.8	.0	54.5	.0	.0	.0	.0	.0
7	2.4	2557.5	.0	194.5	.0	.0	.0	.0	.0
8	4.8	6548.6	.0	738.6	.0	.0	.0	.0	.0
9	4.8	8588.0	.0	1160.2	.0	.0	.0	.0	.0
10	4.9	10524.5	.0	1512.7	.0	.0	.0	.0	.0
11	4.9	12338.2	.0	1795.4	.0	.0	.0	.0	.0
12	5.0	14010.7	.0	2007.7	.0	.0	.0	.0	.0
13	5.0	15525.9	.0	2149.1	.0	.0	.0	.0	.0
14	5.0	16869.3	.0	2219.3	.0	.0	.0	.0	.0
15	5.0	18028.8	.0	2218.2	.0	.0	.0	.0	.0
16	3.2	12131.8	.0	1394.8	.0	.0	.0	.0	.0
17	1.8	6861.7	.0	744.1	.0	.0	.0	.0	.0
18	5.0	19813.8	.0	2345.1	.0	.0	.0	.0	.0
19	.2	962.5	.0	120.9	.0	.0	.0	.0	.0
20	4.7	19494.1	.0	2545.0	.0	.0	.0	.0	.0
21	4.9	20888.9	.0	2916.6	.0	.0	.0	.0	.0
22	4.9	21110.0	.0	3096.4	.0	.0	.0	.0	.0
23	4.8	21121.5	.0	3205.1	.0	.0	.0	.0	.0
24	4.7	20927.4	.0	3242.5	.0	.0	.0	.0	.0
25	4.6	20534.4	.0	3208.4	.0	.0	.0	.0	.0
26	.6	2468.9	.0	389.4	.0	.0	.0	.0	.0
27	4.0	17463.6	.0	2713.6	.0	.0	.0	.0	.0
28	4.5	19120.9	.0	2926.4	.0	.0	.0	.0	.0
29	3.4	14095.7	.0	2098.7	.0	.0	.0	.0	.0
30	1.0	4024.1	.0	580.3	.0	.0	.0	.0	.0
31	4.2	16423.9	.0	2361.3	.0	.0	.0	.0	.0
32	4.1	14411.2	.0	1974.1	.0	.0	.0	.0	.0
33	4.0	12359.5	.0	1518.1	.0	.0	.0	.0	.0
34	3.8	10293.7	.0	994.3	.0	.0	.0	.0	.0
35	3.7	8239.4	.0	403.7	.0	.0	.0	.0	.0
36	.5	928.6	.0	6.1	.0	.0	.0	.0	.0
37	3.0	5322.9	.0	.0	.0	.0	.0	.0	.0
38	3.4	4373.3	.0	.0	.0	.0	.0	.0	.0
39	3.2	2583.4	.0	.0	.0	.0	.0	.0	.0
40	3.0	905.0	.0	.0	.0	.0	.0	.0	.0
41	.2	4.6	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.16	468.00
2	137.49	465.50
3	141.94	463.23
4	146.50	461.17
5	151.16	459.35
6	155.90	457.76
7	160.71	456.40
8	165.58	455.29

9	170.51	454.42
10	175.47	453.79
11	180.45	453.42
12	185.45	453.29
13	190.45	453.41
14	195.44	453.78
15	200.40	454.39
16	205.32	455.25
17	210.20	456.35
18	215.02	457.70
19	219.76	459.28
20	224.42	461.10
21	228.98	463.14
22	233.44	465.41
23	237.77	467.90
24	241.98	470.60
25	246.05	473.50
26	249.97	476.61
27	253.73	479.90
28	257.32	483.38
29	260.74	487.03
30	263.97	490.85
31	267.01	494.82
32	269.84	498.94
33	270.49	499.99

Circle Center At X = 185.6 ; Y = 553.9 and Radius, 100.6

*** 2.233 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	128.68	468.00
2	133.17	465.80
3	137.74	463.76
4	142.38	461.90
5	147.09	460.22
6	151.86	458.72
7	156.68	457.40
8	161.55	456.26
9	166.46	455.31
10	171.40	454.55
11	176.37	453.97
12	181.35	453.58
13	186.35	453.39
14	191.35	453.38
15	196.35	453.56
16	201.33	453.93
17	206.30	454.48
18	211.25	455.23
19	216.16	456.16
20	221.03	457.28
21	225.86	458.58
22	230.63	460.07
23	235.35	461.73
24	240.00	463.57
25	244.57	465.59
26	249.07	467.78
27	253.48	470.13
28	257.79	472.66
29	262.01	475.34
30	266.13	478.18
31	270.13	481.18
32	274.02	484.32
33	277.78	487.61
34	281.42	491.04
35	284.92	494.61
36	288.29	498.31
37	289.65	499.92

Circle Center At X = 189.1 ; Y = 585.3 and Radius, 131.9
*** 2.300 ***
Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	142.11	468.72
2	146.39	466.15
3	150.83	463.85
4	155.40	461.83
5	160.09	460.09
6	164.88	458.65
7	169.75	457.52
8	174.68	456.68
9	179.65	456.16
10	184.65	455.94
11	189.65	456.04
12	194.63	456.45
13	199.58	457.16
14	204.47	458.19
15	209.30	459.51
16	214.03	461.13
17	218.64	463.05
18	223.14	465.24
19	227.48	467.71
20	231.67	470.45
21	235.67	473.44
22	239.49	476.68
23	243.09	480.14
24	246.47	483.83
25	249.62	487.71
26	252.51	491.79
27	255.15	496.04
28	257.29	500.00

Circle Center At X = 185.6 ; Y = 536.3 and Radius, 80.3
*** 2.302 ***
Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	137.63	468.00
2	142.10	465.75
3	146.66	463.71
4	151.32	461.89
5	156.05	460.27
6	160.85	458.88
7	165.71	457.71
8	170.62	456.76
9	175.57	456.04
10	180.55	455.55
11	185.54	455.28
12	190.54	455.24
13	195.54	455.44
14	200.52	455.86
15	205.48	456.51
16	210.40	457.39
17	215.27	458.49
18	220.10	459.81
19	224.85	461.35
20	229.53	463.11
21	234.13	465.09
22	238.63	467.27
23	243.02	469.65
24	247.30	472.24
25	251.46	475.02
26	255.48	477.98
27	259.37	481.13
28	263.11	484.45
29	266.69	487.94

30	270.10	491.59
31	273.35	495.39
32	276.42	499.34
33	276.86	499.97

Circle Center At X = 188.8 ; Y = 564.2 and Radius, 109.0

*** 2.319 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.79	465.24
2	115.46	463.46
3	120.19	461.84
4	124.97	460.38
5	129.80	459.07
6	134.67	457.92
7	139.57	456.93
8	144.50	456.11
9	149.46	455.45
10	154.43	454.95
11	159.42	454.61
12	164.42	454.44
13	169.42	454.44
14	174.41	454.59
15	179.40	454.92
16	184.38	455.40
17	189.34	456.05
18	194.27	456.87
19	199.18	457.84
20	204.05	458.97
21	208.88	460.27
22	213.66	461.72
23	218.39	463.33
24	223.07	465.09
25	227.69	467.01
26	232.24	469.08
27	236.72	471.29
28	241.13	473.66
29	245.46	476.16
30	249.70	478.81
31	253.85	481.60
32	257.91	484.52
33	261.87	487.57
34	265.73	490.75
35	269.48	494.05
36	273.12	497.48
37	275.60	499.97

Circle Center At X = 167.1 ; Y = 606.4 and Radius, 152.0

*** 2.331 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	106.32	465.06
2	111.00	463.30
3	115.74	461.70
4	120.53	460.28
5	125.37	459.03
6	130.25	457.95
7	135.17	457.04
8	140.11	456.30
9	145.08	455.75
10	150.07	455.36
11	155.06	455.16
12	160.06	455.13
13	165.06	455.28
14	170.05	455.60
15	175.03	456.10
16	179.98	456.78

17	184.91	457.63
18	189.80	458.66
19	194.65	459.86
20	199.46	461.23
21	204.22	462.76
22	208.92	464.47
23	213.56	466.34
24	218.12	468.38
25	222.62	470.57
26	227.03	472.92
27	231.36	475.43
28	235.59	478.09
29	239.73	480.89
30	243.77	483.84
31	247.70	486.93
32	251.51	490.16
33	255.21	493.53
34	258.79	497.02
35	261.64	500.00

Circle Center At X = 158.4 ; Y = 596.4 and Radius, 141.3

*** 2.340 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.37	465.19
2	102.02	463.35
3	106.73	461.67
4	111.49	460.14
5	116.30	458.78
6	121.15	457.59
7	126.04	456.55
8	130.97	455.68
9	135.92	454.98
10	140.89	454.45
11	145.88	454.09
12	150.87	453.89
13	155.87	453.87
14	160.87	454.01
15	165.86	454.32
16	170.84	454.80
17	175.80	455.45
18	180.73	456.27
19	185.63	457.25
20	190.50	458.40
21	195.32	459.71
22	200.10	461.18
23	204.83	462.82
24	209.49	464.61
25	214.10	466.56
26	218.63	468.67
27	223.09	470.92
28	227.48	473.33
29	231.78	475.88
30	235.99	478.58
31	240.10	481.42
32	244.12	484.40
33	248.04	487.51
34	251.84	490.75
35	255.54	494.11
36	259.12	497.61
37	261.41	500.00

Circle Center At X = 154.1 ; Y = 601.7 and Radius, 147.8

*** 2.343 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	137.63	468.00

2	142.13	465.81
3	146.71	463.82
4	151.38	462.02
5	156.12	460.43
6	160.92	459.04
7	165.78	457.86
8	170.68	456.88
9	175.63	456.12
10	180.60	455.58
11	185.58	455.25
12	190.58	455.13
13	195.58	455.22
14	200.57	455.54
15	205.54	456.06
16	210.49	456.80
17	215.40	457.75
18	220.26	458.91
19	225.07	460.28
20	229.82	461.86
21	234.49	463.63
22	239.08	465.61
23	243.59	467.78
24	247.99	470.14
25	252.30	472.69
26	256.48	475.43
27	260.55	478.33
28	264.49	481.42
29	268.29	484.66
30	271.95	488.07
31	275.45	491.64
32	278.81	495.35
33	282.00	499.20
34	282.57	499.95

Circle Center At X = 190.8 ; Y = 571.4 and Radius, 116.3

*** 2.346 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.16	468.00
2	137.67	465.85
3	142.27	463.87
4	146.93	462.07
5	151.65	460.43
6	156.43	458.97
7	161.27	457.69
8	166.14	456.59
9	171.06	455.67
10	176.00	454.93
11	180.97	454.37
12	185.96	454.00
13	190.96	453.81
14	195.96	453.80
15	200.95	453.99
16	205.94	454.35
17	210.91	454.90
18	215.85	455.63
19	220.77	456.55
20	225.65	457.64
21	230.48	458.92
22	235.27	460.37
23	240.00	462.00
24	244.66	463.80
25	249.25	465.77
26	253.77	467.91
27	258.21	470.22
28	262.56	472.68
29	266.81	475.31

30	270.97	478.09
31	275.01	481.03
32	278.95	484.11
33	282.77	487.33
34	286.47	490.70
35	290.05	494.20
36	293.49	497.82
37	295.32	499.90

Circle Center At X = 193.6 ; Y = 589.2 and Radius, 135.4

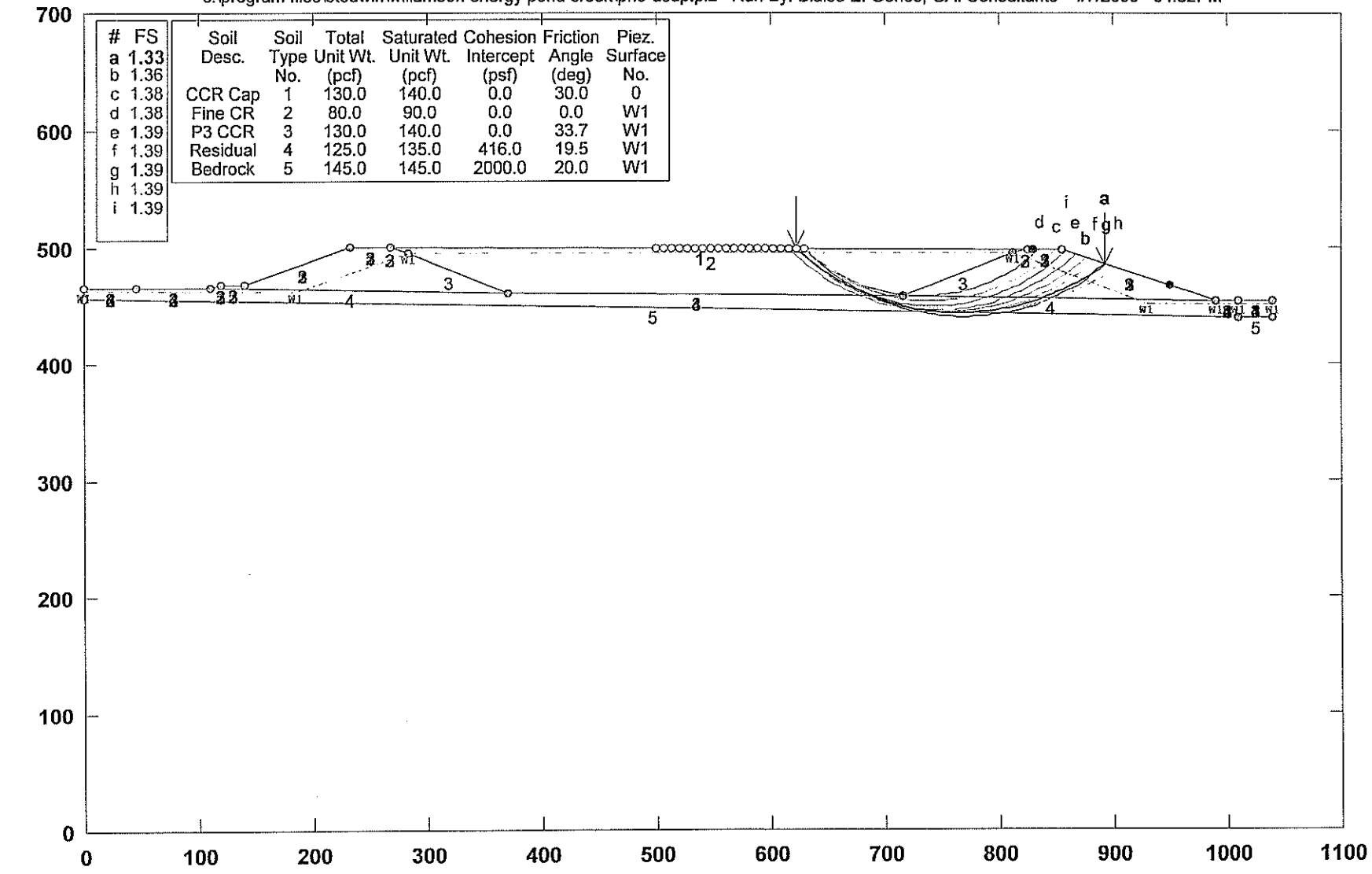
*** 2.350 ***

ATTACHMENT 2

IN-SITU DRIVING SHEAR STRESS PCSTABL SLOPE STABILITY ANALYSES
PHASE 3 – UPSTREAM

Pond Creek, Phase 3 Upstream Driving Stress, Zero-Strength - Deep

c:\program files\stedwin\wiliamson energy pond creek\ph3-usdp.pl2 Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:32PM



#	FS
a	1.33
b	1.36
c	1.38
d	1.38
e	1.39
f	1.39
g	1.39
h	1.39
i	1.39

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR Cap	1	130.0	140.0	0.0	30.0	0
Fine CR	2	80.0	90.0	0.0	0.0	W1
P3 CCR	3	130.0	140.0	0.0	33.7	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1

PCSTABL5M/si FSmin=1.33

Safety Factors Are Calculated By The Modified Bishop Method

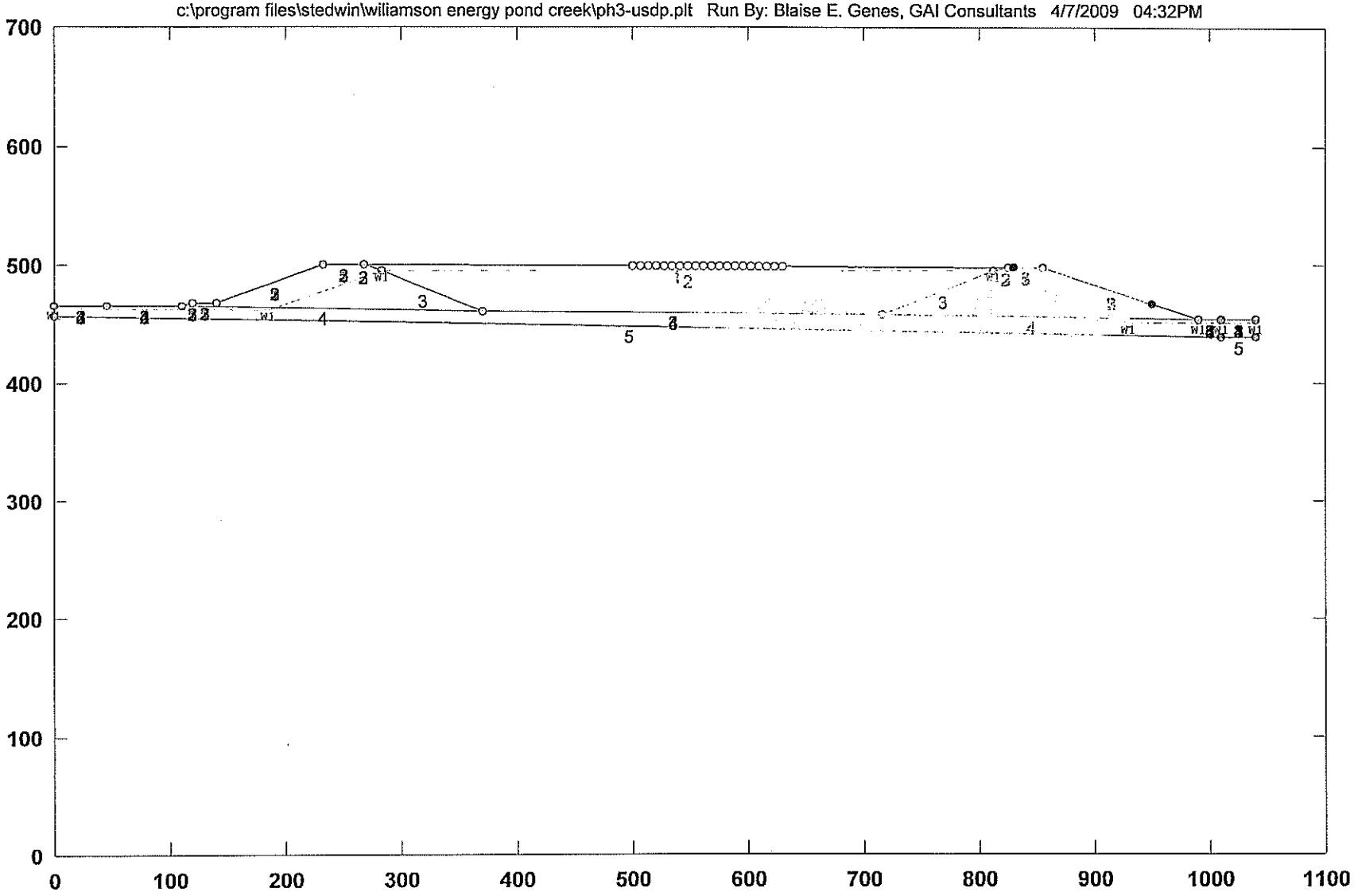
STED



R13529

Pond Creek, Phase 3 Upstream Driving Stress, Zero-Strength - Deep

c:\program files\stedwin\wiliamson energy pond creek\ph3-usdp.plt Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:32PM



STED



R13530

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4/7/2009
Time of Run: 04:32PM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph3-usdp.in
Output Filename: C:ph3-usdp.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3-usdp.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 3 Upstream Driving Str
ess, Zero-Strength - Deep

BOUNDARY COORDINATES
10 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1
5	140.00	468.00	233.00	500.00	1
6	233.00	500.00	268.00	500.00	1
7	268.00	500.00	825.00	498.00	1
8	825.00	498.00	855.00	498.00	1
9	855.00	498.00	990.00	454.00	1
10	990.00	454.00	1010.00	454.00	1
11	1010.00	454.00	1040.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1040.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1040.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4
46	1010.00	454.00	1040.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1040.00	439.00	5

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	30.0	.00	.0	0
2	80.0	90.0	.0	.0	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 500.00 ft.
and X = 630.00 ft.
Each Surface Terminates Between X = 830.00 ft.
and X = 950.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
5.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 60 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	623.16	498.72
2	626.89	495.40
3	630.71	492.17
4	634.60	489.02
5	638.56	485.97
6	642.59	483.01
7	646.69	480.15
8	650.85	477.39
9	655.08	474.72
10	659.37	472.15
11	663.72	469.69
12	668.13	467.33
13	672.59	465.07
14	677.10	462.92
15	681.67	460.87
16	686.28	458.93
17	690.93	457.10
18	695.62	455.38
19	700.36	453.77
20	705.13	452.27
21	709.93	450.89
22	714.77	449.62
23	719.63	448.46
24	724.52	447.41
25	729.43	446.48
26	734.37	445.67

27	739.32	444.97
28	744.28	444.39
29	749.26	443.93
30	754.25	443.58
31	759.25	443.35
32	764.24	443.24
33	769.24	443.25
34	774.24	443.37
35	779.24	443.61
36	784.22	443.96
37	789.20	444.44
38	794.17	445.03
39	799.12	445.74
40	804.05	446.56
41	808.96	447.50
42	813.85	448.55
43	818.71	449.72
44	823.54	451.00
45	828.34	452.40
46	833.11	453.90
47	837.84	455.52
48	842.53	457.25
49	847.18	459.09
50	851.79	461.04
51	856.34	463.10
52	860.85	465.26
53	865.31	467.53
54	869.71	469.90
55	874.06	472.37
56	878.34	474.95
57	882.57	477.62
58	886.73	480.39
59	890.82	483.26
60	893.70	485.39

Circle Center At X = 766.5 ; Y = 656.1 and Radius, 212.9

*** 1.329 ***

Individual data on the 67 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.7	803.7	.0	.0	.0	.0	.0	.0	.0
2	.5	216.2	.0	.0	.0	.0	.0	.0	.0
3	3.3	2033.4	.0	386.9	.0	.0	.0	.0	.0
4	3.9	3406.5	.0	1374.0	.0	.0	.0	.0	.0
5	4.0	4567.2	.0	2340.5	.0	.0	.0	.0	.0
6	4.0	5731.2	.0	3278.0	.0	.0	.0	.0	.0
7	4.1	6894.3	.0	4185.9	.0	.0	.0	.0	.0
8	4.2	8052.3	.0	5063.8	.0	.0	.0	.0	.0
9	4.2	9201.1	.0	5911.2	.0	.0	.0	.0	.0
10	4.3	10336.7	.0	6727.5	.0	.0	.0	.0	.0
11	4.4	11455.3	.0	7512.5	.0	.0	.0	.0	.0
12	4.4	12552.9	.0	8265.6	.0	.0	.0	.0	.0
13	4.5	13625.8	.0	8986.4	.0	.0	.0	.0	.0
14	4.5	14670.1	.0	9674.5	.0	.0	.0	.0	.0
15	4.6	15682.9	.0	10329.6	.0	.0	.0	.0	.0
16	4.6	16660.4	.0	10951.3	.0	.0	.0	.0	.0
17	4.3	16427.9	.0	10768.8	.0	.0	.0	.0	.0
18	.3	1172.3	.0	770.4	.0	.0	.0	.0	.0
19	4.7	18698.9	.0	12093.0	.0	.0	.0	.0	.0
20	4.7	19899.3	.0	12612.4	.0	.0	.0	.0	.0
21	4.8	21033.9	.0	13097.1	.0	.0	.0	.0	.0
22	4.8	22098.3	.0	13546.8	.0	.0	.0	.0	.0
23	4.8	23089.5	.0	13961.5	.0	.0	.0	.0	.0
24	1.2	6013.4	.0	3600.3	.0	.0	.0	.0	.0
25	3.6	18123.4	.0	10740.3	.0	.0	.0	.0	.0
26	4.9	25438.8	.0	14684.3	.0	.0	.0	.0	.0

27	4.9	26680.0	.0	14991.9	.0	.0	.0	.0	.0
28	4.9	27841.8	.0	15263.6	.0	.0	.0	.0	.0
29	5.0	28921.0	.0	15499.3	.0	.0	.0	.0	.0
30	5.0	29914.3	.0	15698.7	.0	.0	.0	.0	.0
31	5.0	30818.9	.0	15861.7	.0	.0	.0	.0	.0
32	5.0	31632.6	.0	15988.2	.0	.0	.0	.0	.0
33	5.0	32353.0	.0	16078.1	.0	.0	.0	.0	.0
34	5.0	32978.2	.0	16131.3	.0	.0	.0	.0	.0
35	5.0	33507.3	.0	16148.1	.0	.0	.0	.0	.0
36	5.0	33938.3	.0	16128.1	.0	.0	.0	.0	.0
37	5.0	34271.2	.0	16071.8	.0	.0	.0	.0	.0
38	5.0	34504.6	.0	15978.7	.0	.0	.0	.0	.0
39	5.0	34638.4	.0	15849.0	.0	.0	.0	.0	.0
40	5.0	34672.9	.0	15682.9	.0	.0	.0	.0	.0
41	4.9	34608.7	.0	15480.6	.0	.0	.0	.0	.0
42	4.9	34445.7	.0	15241.7	.0	.0	.0	.0	.0
43	4.9	34185.5	.0	14966.9	.0	.0	.0	.0	.0
44	3.0	21070.2	.0	9155.2	.0	.0	.0	.0	.0
45	1.8	12719.3	36192.7	5127.1	.0	.0	.0	.0	.0
46	4.9	32858.1	95248.0	12968.9	.0	.0	.0	.0	.0
47	4.8	31721.1	94688.9	12080.4	.0	.0	.0	.0	.0
48	1.5	9374.9	28570.0	3488.4	.0	.0	.0	.0	.0
49	3.3	21147.2	65506.5	7673.6	.0	.0	.0	.0	.0
50	4.8	29294.2	93409.2	10214.3	.0	.0	.0	.0	.0
51	4.7	27997.5	92690.5	9237.6	.0	.0	.0	.0	.0
52	.4	2169.3	7339.2	694.7	.0	.0	.0	.0	.0
53	4.3	24446.2	84581.1	7537.7	.0	.0	.0	.0	.0
54	4.6	25145.2	91098.8	7199.5	.0	.0	.0	.0	.0
55	4.6	23614.8	90228.1	6139.3	.0	.0	.0	.0	.0
56	3.2	15672.0	62954.5	3676.0	.0	.0	.0	.0	.0
57	1.3	6318.3	27735.3	1376.4	.0	.0	.0	.0	.0
58	4.5	19705.2	93256.8	3939.4	.0	.0	.0	.0	.0
59	4.5	17185.9	92608.4	2801.0	.0	.0	.0	.0	.0
60	4.4	14658.6	91894.1	1637.7	.0	.0	.0	.0	.0
61	3.8	10747.4	79736.2	459.5	.0	.0	.0	.0	.0
62	.5	1384.0	11376.9	.0	.0	.0	.0	.0	.0
63	4.3	9712.6	90266.0	.0	.0	.0	.0	.0	.0
64	4.2	7369.8	89352.1	.0	.0	.0	.0	.0	.0
65	4.2	5045.7	88370.9	.0	.0	.0	.0	.0	.0
66	4.1	2747.6	87325.6	.0	.0	.0	.0	.0	.0
67	2.9	572.8	61636.2	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 57 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	623.16	498.72
2	626.75	495.25
3	630.43	491.86
4	634.21	488.58
5	638.07	485.41
6	642.01	482.33
7	646.04	479.37
8	650.14	476.51
9	654.32	473.77
10	658.57	471.14
11	662.89	468.62
12	667.28	466.22
13	671.73	463.94
14	676.24	461.78
15	680.81	459.75
16	685.43	457.83
17	690.10	456.05
18	694.81	454.38
19	699.57	452.85
20	704.37	451.45
21	709.20	450.17
22	714.07	449.02
23	718.97	448.01

24	723.89	447.13
25	728.83	446.38
26	733.79	445.77
27	738.77	445.28
28	743.76	444.94
29	748.75	444.72
30	753.75	444.65
31	758.75	444.70
32	763.75	444.89
33	768.74	445.22
34	773.72	445.68
35	778.68	446.27
36	783.63	447.00
37	788.55	447.86
38	793.45	448.85
39	798.33	449.98
40	803.17	451.23
41	807.97	452.61
42	812.74	454.13
43	817.46	455.77
44	822.14	457.54
45	826.77	459.43
46	831.34	461.45
47	835.86	463.59
48	840.32	465.85
49	844.72	468.22
50	849.05	470.72
51	853.31	473.33
52	857.50	476.06
53	861.62	478.90
54	865.66	481.85
55	869.62	484.90
56	873.49	488.06
57	876.78	490.90

Circle Center At X = 754.2 ; Y = 630.4 and Radius, 185.7

*** 1.356 ***

Failure Surface Specified By 50 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	630.00	498.70
2	633.61	495.24
3	637.32	491.89
4	641.14	488.67
5	645.07	485.57
6	649.08	482.59
7	653.20	479.75
8	657.40	477.03
9	661.68	474.46
10	666.05	472.02
11	670.49	469.72
12	675.00	467.57
13	679.58	465.56
14	684.22	463.70
15	688.92	461.98
16	693.67	460.42
17	698.46	459.01
18	703.30	457.75
19	708.18	456.65
20	713.09	455.71
21	718.03	454.92
22	722.99	454.29
23	727.97	453.82
24	732.96	453.51
25	737.95	453.36
26	742.95	453.37
27	747.95	453.54
28	752.94	453.87

29	757.92	454.35
30	762.87	455.00
31	767.81	455.80
32	772.72	456.76
33	777.59	457.88
34	782.43	459.15
35	787.22	460.58
36	791.96	462.15
37	796.65	463.88
38	801.29	465.76
39	805.86	467.79
40	810.36	469.96
41	814.80	472.27
42	819.15	474.72
43	823.43	477.31
44	827.62	480.04
45	831.72	482.90
46	835.73	485.89
47	839.65	489.00
48	843.46	492.24
49	847.16	495.60
50	849.65	498.00

Circle Center At X = 740.2 ; Y = 609.9 and Radius, 156.5

*** 1.378 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	630.00	498.70
2	633.68	495.32
3	637.48	492.06
4	641.38	488.93
5	645.38	485.94
6	649.48	483.08
7	653.67	480.35
8	657.96	477.77
9	662.32	475.33
10	666.77	473.04
11	671.28	470.90
12	675.87	468.91
13	680.52	467.07
14	685.23	465.39
15	689.99	463.87
16	694.80	462.51
17	699.66	461.30
18	704.55	460.26
19	709.47	459.39
20	714.42	458.68
21	719.39	458.13
22	724.37	457.75
23	729.37	457.53
24	734.37	457.49
25	739.37	457.60
26	744.36	457.89
27	749.34	458.34
28	754.30	458.96
29	759.24	459.74
30	764.15	460.68
31	769.02	461.79
32	773.86	463.06
33	778.65	464.49
34	783.39	466.08
35	788.08	467.83
36	792.70	469.73
37	797.26	471.79
38	801.75	473.99
39	806.16	476.35
40	810.49	478.85

41	814.73	481.49
42	818.89	484.27
43	822.95	487.19
44	826.91	490.24
45	830.76	493.43
46	834.51	496.74
47	835.85	498.00

Circle Center At X = 733.3 ; Y = 607.6 and Radius, 150.1

*** 1.380 ***

Failure Surface Specified By 57 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	616.32	498.75
2	619.89	495.25
3	623.56	491.86
4	627.32	488.56
5	631.17	485.37
6	635.11	482.29
7	639.13	479.32
8	643.23	476.46
9	647.41	473.72
10	651.67	471.09
11	655.99	468.58
12	660.39	466.20
13	664.84	463.93
14	669.36	461.79
15	673.94	459.78
16	678.57	457.89
17	683.25	456.13
18	687.98	454.50
19	692.75	453.00
20	697.56	451.64
21	702.40	450.41
22	707.28	449.31
23	712.19	448.35
24	717.12	447.53
25	722.07	446.84
26	727.04	446.29
27	732.03	445.88
28	737.02	445.60
29	742.02	445.47
30	747.02	445.47
31	752.01	445.61
32	757.01	445.89
33	761.99	446.31
34	766.96	446.86
35	771.91	447.55
36	776.84	448.38
37	781.75	449.35
38	786.62	450.45
39	791.47	451.68
40	796.28	453.05
41	801.05	454.55
42	805.77	456.18
43	810.45	457.95
44	815.08	459.84
45	819.66	461.86
46	824.17	464.00
47	828.63	466.27
48	833.02	468.66
49	837.34	471.17
50	841.59	473.80
51	845.77	476.55
52	849.87	479.41
53	853.89	482.39
54	857.83	485.47
55	861.68	488.66

56	865.43	491.96
57	867.54	493.91

Circle Center At X = 744.4 ; Y = 626.1 and Radius, 180.6

*** 1.389 ***

Failure Surface Specified By 59 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	623.16	498.72
2	626.72	495.22
3	630.38	491.81
4	634.12	488.49
5	637.95	485.28
6	641.86	482.16
7	645.85	479.15
8	649.92	476.24
9	654.06	473.44
10	658.28	470.75
11	662.56	468.17
12	666.91	465.70
13	671.32	463.35
14	675.79	461.11
15	680.32	458.99
16	684.90	456.99
17	689.53	455.11
18	694.21	453.35
19	698.94	451.71
20	703.70	450.20
21	708.51	448.81
22	713.34	447.54
23	718.21	446.41
24	723.11	445.40
25	728.03	444.51
26	732.97	443.76
27	737.94	443.14
28	742.91	442.64
29	747.90	442.27
30	752.89	442.04
31	757.89	441.94
32	762.89	441.96
33	767.89	442.12
34	772.88	442.40
35	777.86	442.82
36	782.83	443.36
37	787.79	444.04
38	792.72	444.84
39	797.63	445.78
40	802.52	446.84
41	807.38	448.02
42	812.20	449.34
43	816.99	450.77
44	821.74	452.34
45	826.45	454.02
46	831.11	455.83
47	835.72	457.76
48	840.28	459.81
49	844.79	461.97
50	849.24	464.26
51	853.62	466.66
52	857.95	469.17
53	862.20	471.79
54	866.39	474.53
55	870.50	477.37
56	874.54	480.32
57	878.50	483.37
58	882.38	486.52
59	884.54	488.37

Circle Center At X = 759.4 ; Y = 633.8 and Radius, 191.8

*** 1.390 ***
Failure Surface Specified By 60 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	630.00	498.70
2	633.54	495.16
3	637.16	491.72
4	640.87	488.37
5	644.67	485.12
6	648.55	481.96
7	652.51	478.91
8	656.54	475.96
9	660.65	473.11
10	664.84	470.37
11	669.09	467.74
12	673.41	465.22
13	677.79	462.81
14	682.23	460.51
15	686.73	458.33
16	691.28	456.26
17	695.88	454.31
18	700.54	452.48
19	705.23	450.77
20	709.97	449.18
21	714.75	447.71
22	719.57	446.37
23	724.42	445.15
24	729.30	444.06
25	734.20	443.09
26	739.13	442.24
27	744.08	441.53
28	749.05	440.94
29	754.02	440.48
30	759.01	440.14
31	764.01	439.94
32	769.01	439.86
33	774.01	439.91
34	779.00	440.09
35	784.00	440.40
36	788.98	440.83
37	793.94	441.40
38	798.90	442.09
39	803.83	442.91
40	808.74	443.85
41	813.62	444.92
42	818.48	446.11
43	823.30	447.43
44	828.09	448.87
45	832.84	450.44
46	837.55	452.12
47	842.21	453.93
48	846.82	455.85
49	851.39	457.90
50	855.90	460.06
51	860.35	462.33
52	864.74	464.72
53	869.07	467.22
54	873.34	469.83
55	877.53	472.55
56	881.66	475.37
57	885.71	478.30
58	889.68	481.34
59	893.58	484.47
60	894.39	485.16

Circle Center At X = 769.5 ; Y = 634.7 and Radius, 194.8

*** 1.390 ***
Failure Surface Specified By 60 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	630.00	498.70
2	633.88	495.54
3	637.82	492.47
4	641.83	489.48
5	645.90	486.58
6	650.04	483.77
7	654.23	481.05
8	658.48	478.41
9	662.79	475.87
10	667.15	473.43
11	671.56	471.08
12	676.02	468.82
13	680.53	466.66
14	685.09	464.60
15	689.69	462.64
16	694.33	460.77
17	699.01	459.01
18	703.72	457.35
19	708.47	455.79
20	713.26	454.33
21	718.07	452.98
22	722.91	451.73
23	727.78	450.58
24	732.67	449.54
25	737.58	448.60
26	742.51	447.78
27	747.46	447.05
28	752.42	446.44
29	757.39	445.93
30	762.38	445.53
31	767.37	445.23
32	772.36	445.05
33	777.36	444.97
34	782.36	445.00
35	787.36	445.13
36	792.36	445.38
37	797.34	445.73
38	802.32	446.19
39	807.29	446.75
40	812.25	447.43
41	817.18	448.21
42	822.10	449.09
43	827.01	450.08
44	831.88	451.18
45	836.74	452.38
46	841.56	453.69
47	846.36	455.10
48	851.13	456.61
49	855.86	458.23
50	860.55	459.94
51	865.21	461.76
52	869.83	463.68
53	874.41	465.69
54	878.94	467.81
55	883.42	470.02
56	887.86	472.33
57	892.24	474.73
58	896.57	477.23
59	900.85	479.81
60	904.22	481.96

Circle Center At X = 778.5 ; Y = 677.1 and Radius, 232.1

*** 1.391 ***

Failure Surface Specified By 54 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	623.16	498.72
2	626.75	495.24
3	630.44	491.87
4	634.23	488.61
5	638.11	485.46
6	642.09	482.43
7	646.15	479.52
8	650.30	476.73
9	654.53	474.06
10	658.84	471.52
11	663.22	469.11
12	667.67	466.83
13	672.19	464.69
14	676.76	462.67
15	681.40	460.80
16	686.09	459.06
17	690.83	457.47
18	695.61	456.01
19	700.44	454.70
20	705.30	453.53
21	710.19	452.51
22	715.11	451.63
23	720.06	450.90
24	725.03	450.32
25	730.01	449.88
26	735.00	449.59
27	740.00	449.45
28	745.00	449.46
29	749.99	449.62
30	754.98	449.93
31	759.96	450.38
32	764.93	450.98
33	769.87	451.73
34	774.79	452.62
35	779.68	453.66
36	784.54	454.85
37	789.36	456.17
38	794.14	457.64
39	798.87	459.26
40	803.55	461.01
41	808.18	462.90
42	812.75	464.93
43	817.26	467.09
44	821.71	469.38
45	826.08	471.81
46	830.38	474.36
47	834.60	477.04
48	838.74	479.84
49	842.79	482.77
50	846.76	485.82
51	850.63	488.98
52	854.41	492.25
53	858.09	495.64
54	859.13	496.65

Circle Center At X = 742.2 ; Y = 617.8 and Radius, 168.4

*** 1.392 ***

Failure Surface Specified By 46 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	630.00	498.70
2	633.73	495.37
3	637.57	492.17
4	641.51	489.09
5	645.56	486.15
6	649.70	483.35
7	653.93	480.69
8	658.25	478.17

9	662.65	475.80
10	667.13	473.57
11	671.68	471.50
12	676.29	469.58
13	680.97	467.82
14	685.71	466.21
15	690.49	464.76
16	695.33	463.48
17	700.20	462.36
18	705.11	461.40
19	710.04	460.60
20	715.00	459.98
21	719.98	459.51
22	724.97	459.22
23	729.97	459.09
24	734.97	459.13
25	739.97	459.34
26	744.95	459.72
27	749.92	460.26
28	754.87	460.97
29	759.80	461.84
30	764.69	462.88
31	769.54	464.08
32	774.35	465.45
33	779.11	466.97
34	783.82	468.65
35	788.47	470.49
36	793.06	472.49
37	797.57	474.63
38	802.01	476.93
39	806.38	479.37
40	810.65	481.96
41	814.84	484.69
42	818.94	487.56
43	822.93	490.57
44	826.83	493.70
45	830.61	496.97
46	831.73	498.00

Circle Center At X = 731.2 ; Y = 608.3 and Radius, 149.2

*** 1.394 ***

APPENDIX E

SLOPE STABILITY ANALYSES RESULTS AND FACTORS OF SAFETY SUBSIDENCE-INDUCED EMBANKMENT CRACKING AND EMBANKMENT FAILURE

gai consultants
transforming ideas into reality

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Post-Subsidence Evaluation – Embankment Cracking and Total Embankment Failure Slope Stability Analyses

BY AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY BEG DATE 5/2/09 SHEET NO. 1 OF 5

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CALCULATION BRIEF
FOR
POST-SUBSIDENCE EMBANKMENT CRACKING AND TOTAL EMBANKMENT FAILURE SLOPE STABILITY ANALYSES AND FACTORS OF SAFETY

POND CREEK COAL REFUSE DISPOSAL SITE – PHASE 3 IMPOUNDMENT

OBJECTIVE: To evaluate the susceptibility of the Phase 3 coarse coal refuse (CCR) embankment to cracking from subsidence-induced disturbance, and failure of the embankment due to elevated hydrostatic (pore) pressures from water in embankment cracks.

METHODOLOGY: Use PCSTABL limit equilibrium analyses, coarse coal refuse (CCR) tensile strength and zero-strength for fine coal refuse (FCR) estimated in Reference No. 3 to determine the factor of safety against embankment cracking. Also, utilize a total undrained and zero-strength approach to determine the factor of safety against a total strength embankment failure due to elevated hydrostatic (pore) pressures from the rapid loading, subsidence-induced longwall mining beneath the Pond Creek Phase 3 impoundment.

REFERENCES:

1. GAI Consultants, Inc. Calculation, "Determination of Downstream and Upstream In-Situ Driving Shear Stress By Elastic (PCSTABL) Solution, Pond Creek Coal Refuse Disposal Site – Phase 3 Impoundment," BEG, 4/08/09.

2. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak and Steady-State Undrained Shear Strengths For Refuse and Subgrade Materials, Pond Creek Coal Refuse Disposal Site – South Pond", BEG, 7/12/08.

3. GAI Consultants, Inc. Calculation, "Supplemental Summary of Engineering Properties and Coarse Refuse Tensile Strength for Subsidence Liquefaction and Embankment Cracking Evaluations, Pond Creek Coal Refuse Disposal Site – Phase 3," BEG, 3/31/09.

4. U.S. Department of Labor, Mine Safety and Health Administration, "Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 Seismic Design: Stability and Deformation Analyses," Final Draft Dated December 2007, Updated August 1, 2008.

5. Winterkorn and Fang, (1975), "Foundation Engineering Handbook," Van Nostrand Reinhold Publishers.

6. Gregory, P.E., Garry H., "PCSTABL5M with STEDwin Slope Stability Analysis System, Version 2.0," dated September 2001.

7. Poulos, S.J., Castro, G., and France, J.W. (1985a) "Liquefaction Evaluation Procedure," Journal of the Geotechnical Engineering Division, ASCE, Vol. 111, No. GT6, pp. 772-792.

ANALYSIS:

As previously discussed in Reference No. 1, GAI evaluated the possibility of a flow slide failure of the Phase 3 FCR impoundment following the loingwall mining beneath the Phase 3 impoundment and the resulting subsidence-induced disturbance. Based on the results of analyses, triggering an FCR strength loss and/or flow slide failure is not a feasible failure mode since there is zero (0) driving shear stress along the critical failure surface through the Phase 3 impoundment FCR.

Additionally, and as requested by the Mine Safety and Health Administration (MSHA), the susceptibility of the Phase 3 CCR embankment to cracking from subsidence-induced disturbance, and failure of the embankment due to elevated hydrostatic (pore) pressures from water in embankment cracks is evaluated herein.

GAI's analysis of embankment cracking included evaluating the tensile strength (σ_t) of site-specific CCR material was based on Winterkorn and Fang, (1975), from six (6) consolidated-undrained (CU) triaxial test points of compacted CCR at various confining pressures. Reference No. 3 presents the detailed calculations of σ_t.

The following equation was used to calculate tensile strength (σ_t) from laboratory test specimens of coarse coal refuse:

Tensile Strength (σ_t):

$\sigma_t = P/\pi(KbH-a^2)$
Where,
P = Load at failure
K = Constant = 1.0 (per Ref. No. 10)
b = Radius of test specimen
H = Height of test specimen
a = Radius of disks/platens

CCR tensile strength was subsequently normalized to equivalent vertical effective stress (σ'_v), also presented in Reference No. 3, and a conservative 2/3-1/3 relationship of σ_t-to-σ'_v (σ_t/σ'_v) estimated at 0.15, and the corresponding average CCR σ_t for the Phase 3 embankment was estimated at 475 psf.

This σ_t is considered to be a reasonable, low tensile strength value for the Phase 3 structurally-placed CCR embankment.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Post-Subsidence Evaluation – Embankment Cracking and Total Embankment Failure Slope Stability Analyses

BY AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY BDG DATE 5/7/09 SHEET NO. 3 OF 5

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As presented herein, Phase 3 post-subsidence slope stability analyses were performed to evaluate the potential for embankment cracking, and included using the conservatively-derived CCR σ_t value as cohesion (ϕ=0, c=475 psf) for the embankment, a conservative zero (0) strength value for the FCR, and the total undrained shear strength parameters for residual soil. The minimum factor of safety against embankment cracking was estimated at 1.1.

Additional Phase 3 post-subsidence, undrained slope stability analyses were performed to evaluate the possibility of a total failure of the Phase 3 embankment due to the subsidence event. The analyses include using undrained total strength parameters for the CCR embankment and residual soil, which assumes an increase in pore pressure of the saturated portions of the embankment and underlying soil due to the rapid subsidence loading and corresponding decrease in strength from drained to undrained, and a conservative zero (0) strength cohesion value for the FCR. The minimum factor of safety against post-subsidence embankment failure was estimated at 2.4.

The following soil properties were estimated based on previous field and laboratory testing as well as current FCR testing for use in the various slope stability analyses as noted in Reference Nos. 2 and 3:

Description	Unit Weights (γ_t,γ_s) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion (c) (psf)	Strength
Coarse Coal Refuse (CCR)	130, 140	18.0 0	736 σ_t/σ'_v=0.15	Total Strength Tensile Strength
Fine Coal Refuse (FCR)	80, 90	0	S_u/σ'_v=0	Zero-Strength
Residual Soil	125, 135	19.5	416	Total Strength

Results of Embankment Cracking and Embankment Failure Slope Stability Analyses:

Phase 3 Impoundment (Crest/Cap El. 500 ft) (Top of Fines El. 496 ft)	Post-Subsidence Factor of Safety Including Zero-Strength FCR (dim)
Embankment Cracking – CCR Tensile Strength FCR Zero-Strength Residual Total Strength	1.1
Embankment Failure – CCR Total Strength FCR Zero-Strength Residual Total Strength	2.4

(1) Cap includes 5-foot coarse refuse layer above top of fines elevation.

Hard copies of the input and output files for the embankment cracking and embankment failure slope stability analyses are presented in Attachments 1 and 2, respectively.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Post-Subsidence Evaluation – Embankment Cracking and Total Embankment Failure Slope Stability Analyses

BY AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY BEG DATE 5/7/09 SHEET NO. 4 OF 5

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GAI notes the following conservatisms inherent in the engineering properties used in these post-subsidence stability analyses, particularly the embankment cracking analyses, which will increase the estimated factor of safety:

- CCR strength estimates discount negative pore pressures that will undoubtedly develop during the initial stages of the subsidence rapid loading event due to the compacted, dense initial state of stress of the CCR;
- CU testing results of all six (6) CCR points suggest that the peak strain for the CCR material ranges from about 12.5 to 15.3 percent, which attributed to the claystone and shale rock materials in the CCR; and
- Peak strain for the CCR material is significantly higher than the range of anticipated subsidence threshold strains of about 1 to 3 percent.

CONCLUSIONS

GAI has completed stability analyses to evaluate the potential for embankment cracking and embankment failure due to subsidence-related disturbance. Based on conservatively-derived strength parameters, adequate factor of safety exists relative to a total failure of the Phase 3 embankment. Marginal factor of safety exists relative to Phase 3 embankment cracking; however, conservatisms in the analyses exist as noted above. The following conclusions are noted:

- FCR was characterized as clay-like, which typically is more resistant to strength loss (or flow) than sand-like materials;
- In-situ driving shear stresses through the FCR are 0 psf;
- Phase 3 minimum factors of safety against flow slide susceptibility, with zero-strength FCR in the downstream and upstream directions were estimated at 2.2 and 1.3, respectively, as presented in Ref. No. 3;
- The Phase 3 factor of safety against embankment failure of 2.4; and
- The Phase 3 factor of safety against embankment cracking of 1.1.

Recommendations for instrumentation of the embankment prior to, during and following longwall mining beneath the Phase 3 impoundment are presented below.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Post-Subsidence Evaluation – Embankment Cracking and Total Embankment Failure Slope Stability Analyses

BY AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY TJH DATE 5/7/09 SHEET NO. 5 OF 5

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RECOMMENDATIONS

Based on the results of the Phase 3 subsidence-related stability analyses, adequate factors of safety exist relative to catastrophic failure scenarios including a potential flow slide and embankment failure. Marginal stability exists relative to potential cracking of the Phase 3 embankment due to the proposed longwall mining beneath the impoundment; however, some conservatism exists in the analyses as previously noted, including derivation of tensile strength properties, negative pore pressure and increased strength during loading, and high strain capability of the CCR embankment materials relative to estimated induced subsidence strain. Consequently, GAI does not anticipate significant embankment cracking, if any. However, there are various unknowns relative to the actual performance of the impoundment that require attention.

Therefore, GAI recommends that instrumentation installations and monitoring of the Phase 3 embankment be performed prior to, during and following longwall mining beneath the Phase 3 impoundment including installing pore pressure transducers and inclinometers. Also, GAI recommends that detailed inspections of the embankment, cap, toe areas and outlet structures be performed two (2) times/days prior to, daily during, and daily following longwall mining beneath the Phase 3 impoundment for a period of two (2) weeks following completion of mining, and any deviations noted.

Further, GAI recommends that a CCR buttress or sealing layer remedial alternative, such as that proposed for the southern slope of the Phase 7 impoundment (Phase 7B) be designed, and construction implementation provisions made based on the results of the Phase 3 detailed inspections and instrumentation monitoring. If extensive cracking, seepage and/or other noticeable surface features are noted, and the magnitude of pore pressure and deformation are deemed potentially detrimental to the short- or long-term performance of the Phase 3 impoundment, then the implementation of the buttress/seal remedial alternative should be employed.

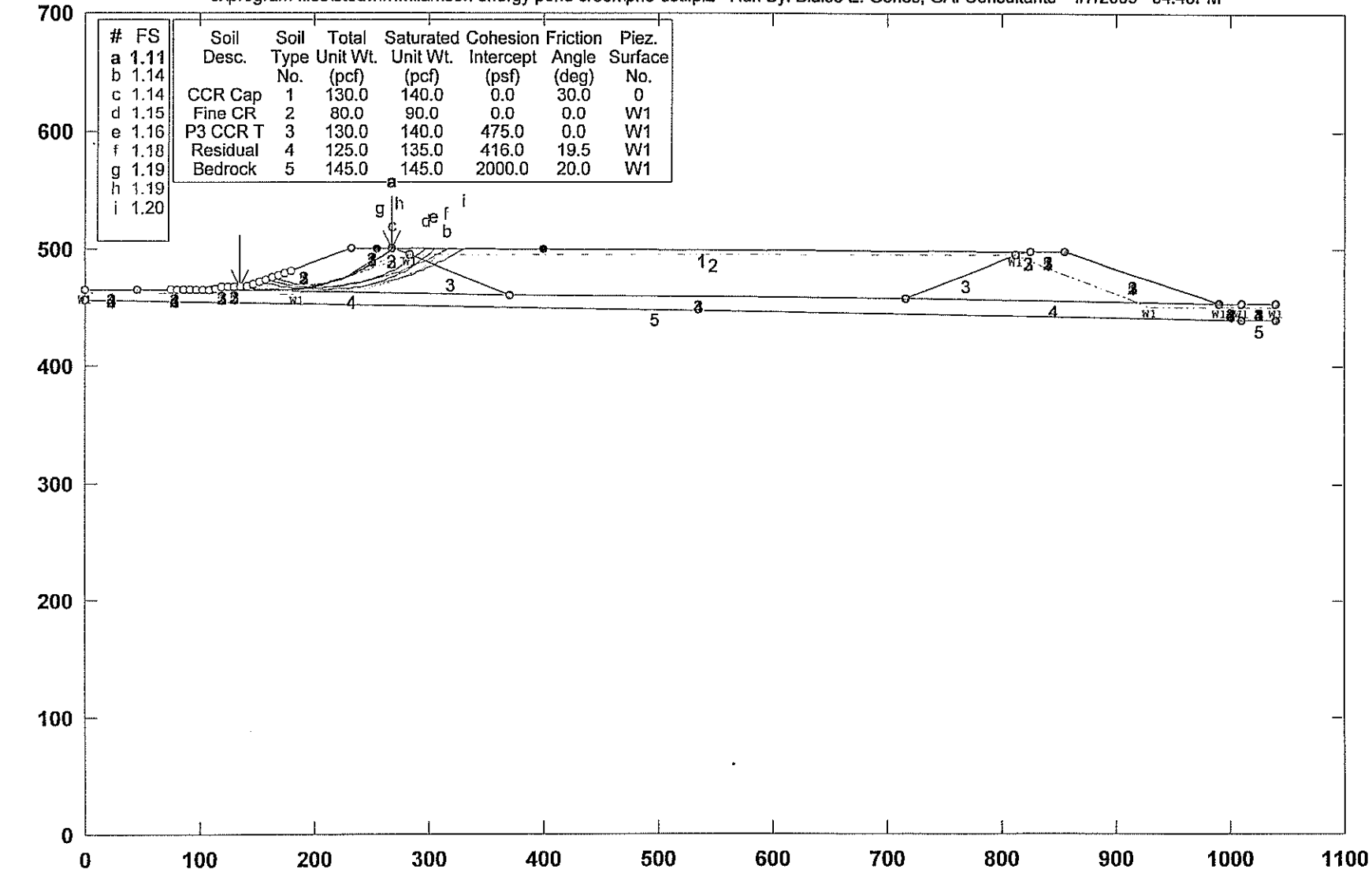
If the post-subsidence instrumentation monitoring and inspection results indicate that the Phase 3 embankment/impoundment distress is not a concern, i.e., no adverse cracking, seepage, excess pore pressure or deformation, then monitoring of the Phase 3 should continue twice a week for a period of two (2) months. If after an additional two (2) months of satisfactory monitoring results, and the embankment/impoundment continues to exhibit adequate performance characteristics, i.e., the magnitudes of pore pressure and deformation decrease, level off, or approach normal operating levels, and no increased seepage conditions or cracking exist, then monitoring of the Phase 3 embankment could be discontinued.

ATTACHMENT 1

PHASE 3 POST-SUBSIDENCE
EMBANKMENT CRACKING PCSTABL SLOPE STABILITY ANALYSES

Pond Creek, Phase 3 Embankment Tensile Strength CCR, Zero-Strength FCR

c:\program files\stedwin\wiliamson energy pond creek\ph3-dstl.pl2 Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:43PM



#	FS
a	1.11
b	1.14
c	1.14
d	1.15
e	1.16
f	1.18
g	1.19
h	1.19
i	1.20

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR Cap	1	130.0	140.0	0.0	30.0	0
Fine CR	2	80.0	90.0	0.0	0.0	W1
P3 CCR T	3	130.0	140.0	475.0	0.0	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1

PCSTABL5M/si FSmin=1.11

Safety Factors Are Calculated By The Modified Bishop Method

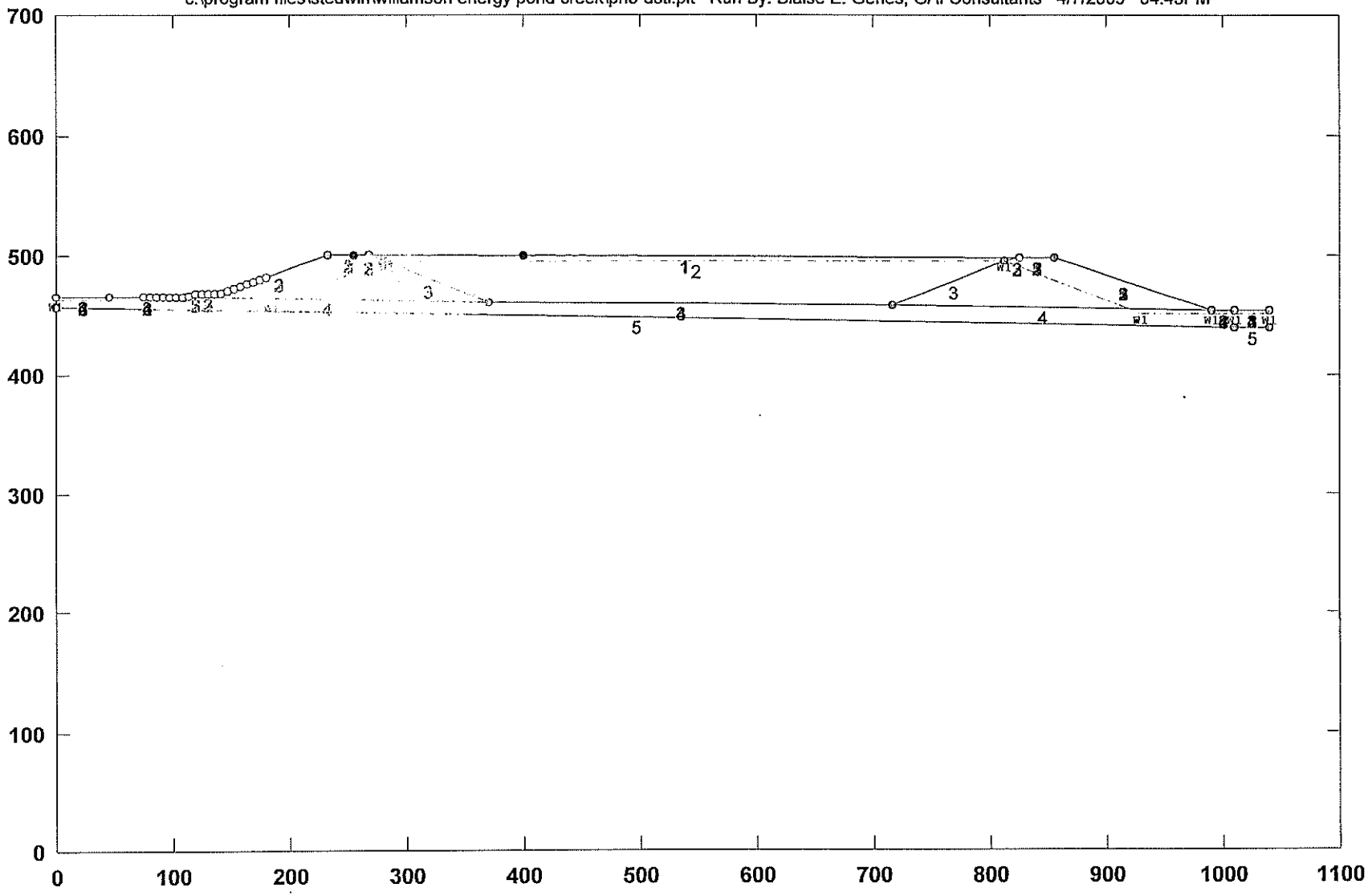
STED



R13550

Pond Creek, Phase 3 Embankment Tensile Strength CCR, Zero-Strength FCR

c:\program files\stedwin\wiliamson energy pond creek\ph3-dstl.plt Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:43PM



STED



R13551

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4/7/2009
Time of Run: 04:43PM
Run By: Blaise E. Gencs, GAI Consultants
Input Data Filename: C:ph3-dstl.in
Output Filename: C:ph3-dstl.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3-dstl.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 3 Embankment Tensile Strength CCR, Zero-Strength FCR

BOUNDARY COORDINATES
10 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1
5	140.00	468.00	233.00	500.00	1
6	233.00	500.00	268.00	500.00	1
7	268.00	500.00	825.00	498.00	1
8	825.00	498.00	855.00	498.00	1
9	855.00	498.00	990.00	454.00	1
10	990.00	454.00	1010.00	454.00	1
11	1010.00	454.00	1040.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1040.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1040.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4
46	1010.00	454.00	1040.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1040.00	439.00	5

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	30.0	.00	.0	0
2	80.0	90.0	.0	.0	.00	.0	1
3	130.0	140.0	475.0	.0	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 75.00 ft.
and X = 180.00 ft.
Each Surface Terminates Between X = 255.00 ft.
and X = 400.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
5.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.79	468.00
2	140.70	467.07
3	145.64	466.29
4	150.60	465.67
5	155.58	465.21
6	160.57	464.90
7	165.57	464.75
8	170.57	464.76
9	175.57	464.92
10	180.56	465.24
11	185.53	465.72
12	190.49	466.35
13	195.43	467.14
14	200.34	468.08
15	205.22	469.18
16	210.06	470.43
17	214.86	471.83
18	219.61	473.38
19	224.32	475.08
20	228.96	476.93
21	233.55	478.92
22	238.07	481.05
23	242.52	483.33
24	246.90	485.74
25	251.20	488.29
26	255.42	490.98

27	259.56	493.79
28	263.60	496.73
29	267.54	499.80
30	267.78	500.00

Circle Center At X = 167.9 ; Y = 623.9 and Radius, 159.2

*** 1.108 ***

Individual data on the 31 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	4.2	218.1	.0	.0	.0	.0	.0	.0	.0
2	.7	89.9	.0	.0	.0	.0	.0	.0	.0
3	4.9	1547.2	.0	.0	.0	.0	.0	.0	.0
4	5.0	3102.8	.0	.0	.0	.0	.0	.0	.0
5	5.0	4570.9	.0	.0	.0	.0	.0	.0	.0
6	5.0	5944.9	.0	.0	.0	.0	.0	.0	.0
7	5.0	7218.7	.0	.0	.0	.0	.0	.0	.0
8	5.0	8386.8	.0	.0	.0	.0	.0	.0	.0
9	5.0	9444.4	.0	.0	.0	.0	.0	.0	.0
10	5.0	10387.7	.0	.0	.0	.0	.0	.0	.0
11	5.0	11213.2	.0	.0	.0	.0	.0	.0	.0
12	5.0	11918.4	.0	.0	.0	.0	.0	.0	.0
13	4.9	12501.6	.0	.0	.0	.0	.0	.0	.0
14	4.9	12961.6	.0	.0	.0	.0	.0	.0	.0
15	4.9	13298.3	.0	.0	.0	.0	.0	.0	.0
16	4.8	13512.1	.0	.0	.0	.0	.0	.0	.0
17	4.8	13604.1	.0	.0	.0	.0	.0	.0	.0
18	4.8	13576.4	.0	.0	.0	.0	.0	.0	.0
19	4.7	13431.7	.0	.0	.0	.0	.0	.0	.0
20	4.6	13173.5	.0	.0	.0	.0	.0	.0	.0
21	4.0	11281.8	.0	.0	.0	.0	.0	.0	.0
22	.6	1517.2	.0	.0	.0	.0	.0	.0	.0
23	4.5	11765.0	.0	.0	.0	.0	.0	.0	.0
24	4.5	10308.8	.0	.0	.0	.0	.0	.0	.0
25	4.4	8803.8	.0	.0	.0	.0	.0	.0	.0
26	4.3	7259.4	.0	.0	.0	.0	.0	.0	.0
27	4.2	5685.5	.0	.0	.0	.0	.0	.0	.0
28	4.1	4092.1	.0	.0	.0	.0	.0	.0	.0
29	4.0	2489.7	.0	.0	.0	.0	.0	.0	.0
30	3.9	888.9	.0	.0	.0	.0	.0	.0	.0
31	.2	3.1	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.32	468.45
2	146.28	467.84
3	151.25	467.30
4	156.23	466.86
5	161.22	466.50
6	166.21	466.22
7	171.21	466.03
8	176.20	465.92
9	181.20	465.90
10	186.20	465.97
11	191.20	466.12
12	196.20	466.36
13	201.19	466.68
14	206.17	467.09
15	211.14	467.58
16	216.11	468.16
17	221.07	468.82
18	226.01	469.57
19	230.94	470.40
20	235.86	471.32
21	240.75	472.32
22	245.64	473.41

23	250.50	474.57
24	255.34	475.82
25	260.16	477.16
26	264.95	478.57
27	269.72	480.07
28	274.47	481.65
29	279.18	483.31
30	283.87	485.05
31	288.53	486.87
32	293.15	488.77
33	297.75	490.75
34	302.30	492.80
35	306.82	494.94
36	311.31	497.15
37	315.75	499.44
38	316.48	499.83

Circle Center At X = 179.8 ; Y = 758.0 and Radius, 292.1

*** 1.137 ***

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.79	468.00
2	140.72	467.18
3	145.68	466.50
4	150.65	465.97
5	155.63	465.59
6	160.63	465.36
7	165.63	465.28
8	170.63	465.35
9	175.62	465.56
10	180.61	465.93
11	185.58	466.44
12	190.54	467.10
13	195.47	467.91
14	200.38	468.87
15	205.26	469.97
16	210.10	471.22
17	214.90	472.61
18	219.66	474.14
19	224.37	475.81
20	229.03	477.63
21	233.64	479.58
22	238.18	481.67
23	242.66	483.89
24	247.07	486.25
25	251.41	488.73
26	255.67	491.35
27	259.85	494.09
28	263.95	496.95
29	267.96	499.93
30	268.05	500.00

Circle Center At X = 165.9 ; Y = 633.0 and Radius, 167.7

*** 1.143 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	157.90	474.16
2	162.69	472.74
3	167.53	471.49
4	172.41	470.39
5	177.32	469.45
6	182.26	468.68
7	187.22	468.07
8	192.20	467.62
9	197.19	467.34
10	202.19	467.22
11	207.19	467.27

12	212.19	467.48
13	217.17	467.86
14	222.15	468.40
15	227.10	469.11
16	232.02	469.97
17	236.91	471.00
18	241.77	472.19
19	246.58	473.54
20	251.35	475.05
21	256.07	476.71
22	260.72	478.53
23	265.32	480.50
24	269.85	482.62
25	274.30	484.89
26	278.68	487.30
27	282.98	489.86
28	287.19	492.55
29	291.31	495.39
30	295.33	498.36
31	297.28	499.89

Circle Center At X = 203.2 ; Y = 619.0 and Radius, 151.7

*** 1.150 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	163.42	476.06
2	168.05	474.17
3	172.75	472.47
4	177.51	470.94
5	182.33	469.59
6	187.19	468.42
7	192.09	467.44
8	197.03	466.65
9	201.99	466.04
10	206.97	465.62
11	211.97	465.39
12	216.97	465.35
13	221.97	465.49
14	226.95	465.83
15	231.93	466.35
16	236.88	467.06
17	241.80	467.96
18	246.68	469.04
19	251.51	470.31
20	256.30	471.76
21	261.03	473.39
22	265.69	475.19
23	270.28	477.17
24	274.79	479.32
25	279.22	481.65
26	283.56	484.13
27	287.80	486.78
28	291.94	489.59
29	295.96	492.55
30	299.88	495.66
31	303.67	498.92
32	304.69	499.87

Circle Center At X = 215.6 ; Y = 597.6 and Radius, 132.2

*** 1.157 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	163.42	476.06
2	168.04	474.13
3	172.72	472.37
4	177.45	470.78
5	182.25	469.35

6	187.08	468.09
7	191.96	467.00
8	196.88	466.08
9	201.82	465.34
10	206.79	464.77
11	211.78	464.37
12	216.77	464.15
13	221.77	464.11
14	226.77	464.24
15	231.76	464.54
16	236.74	465.02
17	241.69	465.68
18	246.62	466.51
19	251.52	467.51
20	256.38	468.68
21	261.20	470.03
22	265.96	471.54
23	270.68	473.22
24	275.32	475.06
25	279.90	477.06
26	284.41	479.23
27	288.84	481.55
28	293.19	484.02
29	297.44	486.65
30	301.60	489.42
31	305.66	492.34
32	309.62	495.39
33	313.46	498.59
34	314.86	499.83

Circle Center At X = 220.5 ; Y = 606.4 and Radius, 142.3

*** 1.180 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	163.42	476.06
2	168.07	474.22
3	172.83	472.68
4	177.67	471.44
5	182.58	470.50
6	187.54	469.88
7	192.53	469.57
8	197.53	469.57
9	202.52	469.88
10	207.48	470.51
11	212.40	471.45
12	217.24	472.69
13	221.99	474.24
14	226.64	476.08
15	231.17	478.20
16	235.55	480.61
17	239.77	483.29
18	243.82	486.23
19	247.67	489.41
20	251.32	492.84
21	254.74	496.48
22	257.66	500.00

Circle Center At X = 195.0 ; Y = 549.2 and Radius, 79.6

*** 1.188 ***

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	146.84	470.35
2	151.78	469.58
3	156.74	468.96
4	161.72	468.48
5	166.71	468.15
6	171.71	467.97

7	176.71	467.93
8	181.71	468.04
9	186.70	468.30
10	191.68	468.71
11	196.65	469.26
12	201.60	469.96
13	206.53	470.80
14	211.43	471.79
15	216.30	472.92
16	221.14	474.20
17	225.93	475.62
18	230.68	477.18
19	235.38	478.88
20	240.03	480.72
21	244.63	482.69
22	249.16	484.80
23	253.63	487.04
24	258.03	489.41
25	262.36	491.91
26	266.62	494.54
27	270.79	497.29
28	274.62	499.98

Circle Center At X = 175.4 ; Y = 637.4 and Radius, 169.5

*** 1.190 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	152.37	472.26
2	157.25	471.17
3	162.15	470.18
4	167.07	469.30
5	172.01	468.52
6	176.97	467.84
7	181.93	467.27
8	186.91	466.79
9	191.90	466.43
10	196.89	466.16
11	201.89	466.00
12	206.89	465.94
13	211.89	465.99
14	216.88	466.14
15	221.88	466.39
16	226.86	466.75
17	231.84	467.21
18	236.81	467.78
19	241.77	468.45
20	246.71	469.22
21	251.63	470.09
22	256.53	471.06
23	261.42	472.14
24	266.28	473.32
25	271.11	474.60
26	275.92	475.97
27	280.69	477.45
28	285.44	479.03
29	290.15	480.70
30	294.82	482.48
31	299.46	484.35
32	304.06	486.31
33	308.61	488.37
34	313.13	490.53
35	317.59	492.77
36	322.01	495.11
37	326.38	497.55
38	330.20	499.78

Circle Center At X = 207.1 ; Y = 706.7 and Radius, 240.7

*** 1.197 ***

Failure Surface Specified By 48 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.26	468.00
2	135.22	467.32
3	140.18	466.70
4	145.15	466.13
5	150.12	465.63
6	155.10	465.19
7	160.09	464.80
8	165.08	464.48
9	170.07	464.22
10	175.07	464.02
11	180.06	463.88
12	185.06	463.79
13	190.06	463.77
14	195.06	463.81
15	200.06	463.91
16	205.06	464.07
17	210.05	464.29
18	215.05	464.57
19	220.03	464.91
20	225.02	465.31
21	230.00	465.77
22	234.97	466.29
23	239.94	466.87
24	244.90	467.51
25	249.85	468.21
26	254.79	468.97
27	259.72	469.79
28	264.64	470.67
29	269.55	471.61
30	274.45	472.61
31	279.34	473.66
32	284.21	474.78
33	289.07	475.95
34	293.92	477.18
35	298.75	478.47
36	303.57	479.82
37	308.36	481.23
38	313.14	482.69
39	317.91	484.22
40	322.65	485.80
41	327.38	487.43
42	332.08	489.13
43	336.76	490.88
44	341.43	492.68
45	346.07	494.54
46	350.68	496.46
47	355.28	498.44
48	358.07	499.68

Circle Center At X = 189.3 ; Y = 878.3 and Radius, 414.5

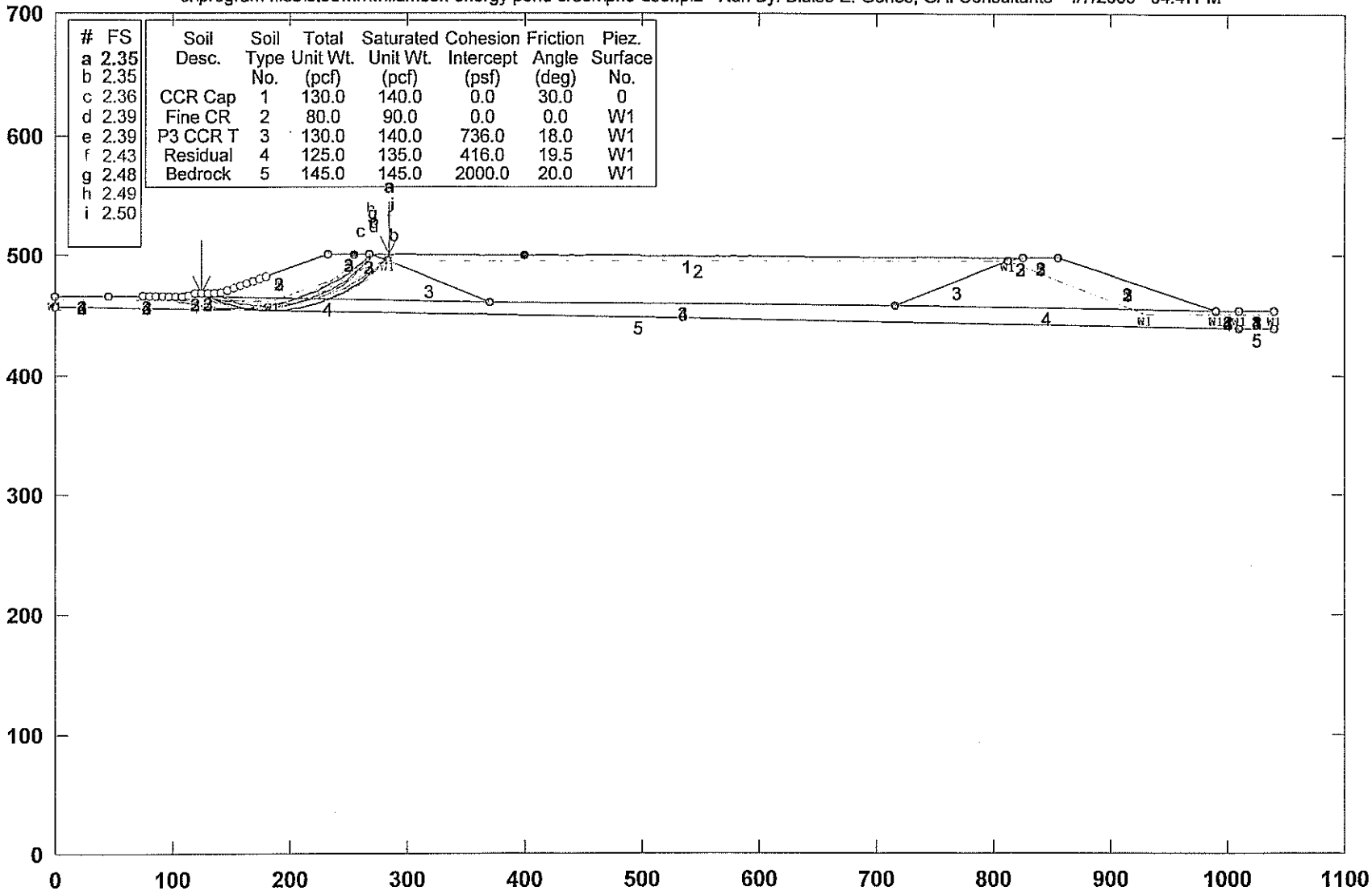
*** 1.200 ***

ATTACHMENT 2

PHASE 3 POST-SUBSIDENCE
EMBANKMENT FAILURE PCSTABL SLOPE STABILITY ANALSES

Pond Creek, Phase 3 Embankment Total S trength CCR, Zero-Strength FCR

c:\program files\stedwin\wiliamson energy pond creek\ph3-dsef.pl2 Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:47PM



#	FS
a	2.35
b	2.35
c	2.36
d	2.39
e	2.39
f	2.43
g	2.48
h	2.49
i	2.50

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR Cap	1	130.0	140.0	0.0	30.0	0
Fine CR	2	80.0	90.0	0.0	0.0	W1
P3 CCR T	3	130.0	140.0	736.0	18.0	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1

PCSTABL5M/si FSmin=2.35

Safety Factors Are Calculated By The Modified Bishop Method

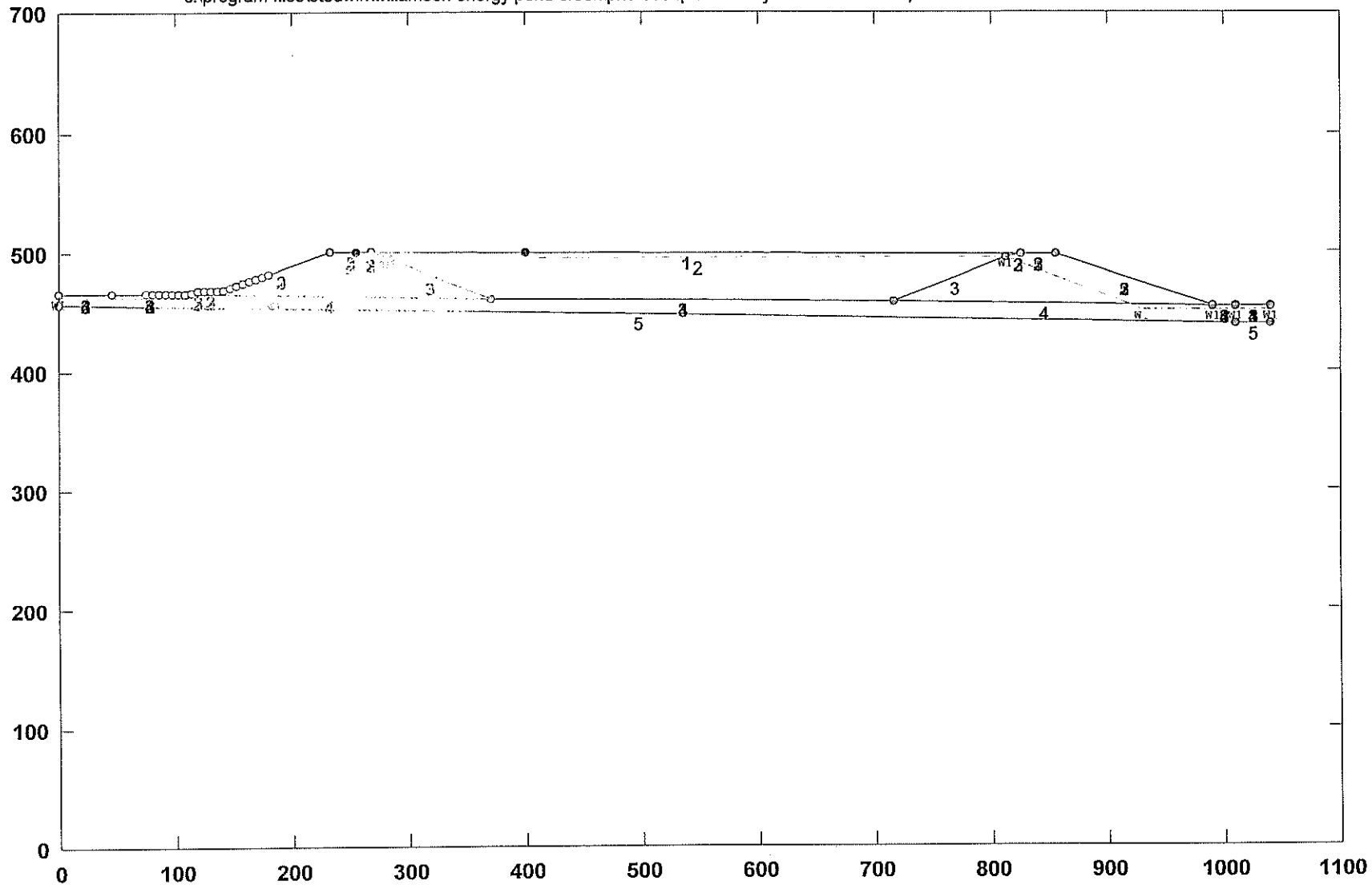
STED



R13561

Pond Creek, Phase 3 Embankment Total S trength CCR, Zero-Strength FCR

c:\program files\stedwin\wiliamson energy pond creek\ph3-dsef.plt Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:47PM



STED



R13562

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4/7/2009
Time of Run: 04:47PM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph3-dsef.in
Output Filename: C:ph3-dsef.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3-dsef.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 3 Embankment Total S
trength CCR, Zero-Strength FCR

BOUNDARY COORDINATES
10 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1
5	140.00	468.00	233.00	500.00	1
6	233.00	500.00	268.00	500.00	1
7	268.00	500.00	825.00	498.00	1
8	825.00	498.00	855.00	498.00	1
9	855.00	498.00	990.00	454.00	1
10	990.00	454.00	1010.00	454.00	1
11	1010.00	454.00	1040.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1040.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1040.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4
46	1010.00	454.00	1040.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1040.00	439.00	5

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	30.0	.00	.0	0
2	80.0	90.0	.0	.0	.00	.0	1
3	130.0	140.0	736.0	18.0	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 75.00 ft.
and X = 180.00 ft.
Each Surface Terminates Between X = 255.00 ft.
and X = 400.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
5.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.74	468.00
2	129.24	465.82
3	133.82	463.82
4	138.47	461.99
5	143.19	460.33
6	147.97	458.86
7	152.80	457.56
8	157.67	456.45
9	162.59	455.53
10	167.53	454.79
11	172.50	454.23
12	177.49	453.87
13	182.48	453.69
14	187.48	453.70
15	192.48	453.90
16	197.46	454.29
17	202.43	454.86
18	207.37	455.62
19	212.28	456.57
20	217.15	457.70
21	221.98	459.02
22	226.75	460.52
23	231.46	462.19
24	236.10	464.04
25	240.68	466.07
26	245.17	468.26

27	249.57	470.62
28	253.89	473.15
29	258.10	475.84
30	262.21	478.69
31	266.21	481.69
32	270.10	484.83
33	273.86	488.12
34	277.50	491.56
35	281.01	495.12
36	284.37	498.82
37	285.32	499.94

Circle Center At X = 184.7 ; Y = 586.3 and Radius, 132.6

*** 2.348 ***

Individual data on the 46 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	4.5	636.8	.0	.0	.0	.0	.0	.0	.0
2	2.9	1038.5	.0	.0	.0	.0	.0	.0	.0
3	1.7	851.1	.0	.0	.0	.0	.0	.0	.0
4	4.7	3045.6	.0	.0	.0	.0	.0	.0	.0
5	1.4	1142.7	.0	.0	.0	.0	.0	.0	.0
6	.1	83.9	.0	.1	.0	.0	.0	.0	.0
7	3.2	3137.9	.0	121.5	.0	.0	.0	.0	.0
8	4.8	6386.3	.0	570.9	.0	.0	.0	.0	.0
9	4.8	8396.3	.0	986.7	.0	.0	.0	.0	.0
10	4.9	10324.4	.0	1345.5	.0	.0	.0	.0	.0
11	4.9	12156.8	.0	1646.7	.0	.0	.0	.0	.0
12	4.9	13880.9	.0	1890.2	.0	.0	.0	.0	.0
13	5.0	15485.0	.0	2075.3	.0	.0	.0	.0	.0
14	5.0	16958.6	.0	2202.0	.0	.0	.0	.0	.0
15	5.0	18292.2	.0	2269.9	.0	.0	.0	.0	.0
16	2.5	9663.9	.0	1149.5	.0	.0	.0	.0	.0
17	2.5	9814.5	.0	1134.1	.0	.0	.0	.0	.0
18	4.5	18488.9	.0	2354.8	.0	.0	.0	.0	.0
19	.5	2084.2	.0	281.1	.0	.0	.0	.0	.0
20	5.0	21527.7	.0	3060.5	.0	.0	.0	.0	.0
21	5.0	22316.9	.0	3428.1	.0	.0	.0	.0	.0
22	4.9	22937.2	.0	3738.1	.0	.0	.0	.0	.0
23	4.9	23386.6	.0	3990.3	.0	.0	.0	.0	.0
24	4.9	23664.5	.0	4184.1	.0	.0	.0	.0	.0
25	4.8	23771.6	.0	4319.4	.0	.0	.0	.0	.0
26	4.8	23710.1	.0	4395.9	.0	.0	.0	.0	.0
27	4.7	23483.4	.0	4413.5	.0	.0	.0	.0	.0
28	1.1	5660.5	.0	1076.0	.0	.0	.0	.0	.0
29	.4	2016.5	.0	382.7	.0	.0	.0	.0	.0
30	3.1	15191.0	.0	2913.5	.0	.0	.0	.0	.0
31	4.6	21395.5	.0	4272.1	.0	.0	.0	.0	.0
32	4.5	19767.9	.0	4113.2	.0	.0	.0	.0	.0
33	4.4	18053.2	.0	3895.9	.0	.0	.0	.0	.0
34	4.3	16265.6	.0	3620.4	.0	.0	.0	.0	.0
35	4.2	14420.3	.0	3287.2	.0	.0	.0	.0	.0
36	4.1	12532.9	.0	2896.6	.0	.0	.0	.0	.0
37	4.0	10619.7	.0	2449.4	.0	.0	.0	.0	.0
38	1.8	4201.7	.0	960.1	.0	.0	.0	.0	.0
39	2.1	4494.6	.0	985.9	.0	.0	.0	.0	.0
40	3.8	6775.9	.0	1387.2	.0	.0	.0	.0	.0
41	3.6	4880.7	.0	773.8	.0	.0	.0	.0	.0
42	2.3	2173.4	.0	148.2	.0	.0	.0	.0	.0
43	1.2	860.0	.0	.0	.0	.0	.0	.0	.0
44	.4	228.1	.0	.0	.0	.0	.0	.0	.0
45	3.0	1075.7	.0	.0	.0	.0	.0	.0	.0
46	.9	69.2	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	119.21	467.76
2	123.76	465.68
3	128.37	463.76
4	133.05	462.00
5	137.79	460.39
6	142.58	458.95
7	147.41	457.68
8	152.29	456.57
9	157.20	455.63
10	162.14	454.85
11	167.10	454.25
12	172.08	453.82
13	177.07	453.56
14	182.07	453.47
15	187.07	453.55
16	192.07	453.80
17	197.05	454.22
18	202.01	454.81
19	206.95	455.58
20	211.87	456.51
21	216.75	457.61
22	221.58	458.87
23	226.37	460.30
24	231.11	461.89
25	235.80	463.65
26	240.41	465.56
27	244.97	467.63
28	249.44	469.86
29	253.84	472.24
30	258.16	474.76
31	262.38	477.44
32	266.51	480.25
33	270.55	483.21
34	274.48	486.30
35	278.30	489.52
36	282.00	492.88
37	285.60	496.36
38	289.04	499.92

Circle Center At X = 182.2 ; Y = 599.5 and Radius, 146.0

*** 2.354 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.63	465.11
2	107.28	463.27
3	111.99	461.60
4	116.76	460.09
5	121.58	458.76
6	126.44	457.59
7	131.34	456.61
8	136.28	455.79
9	141.24	455.16
10	146.21	454.70
11	151.21	454.42
12	156.21	454.31
13	161.20	454.39
14	166.20	454.64
15	171.18	455.08
16	176.14	455.69
17	181.08	456.47
18	185.99	457.43
19	190.86	458.57
20	195.68	459.88
21	200.46	461.36
22	205.18	463.01
23	209.84	464.83
24	214.43	466.81

25	218.94	468.95
26	223.38	471.26
27	227.73	473.72
28	231.99	476.34
29	236.16	479.10
30	240.22	482.01
31	244.18	485.07
32	248.03	488.26
33	251.76	491.59
34	255.37	495.05
35	258.85	498.64
36	260.08	500.00

Circle Center At X = 156.6 ; Y = 594.4 and Radius, 140.1

*** 2.360 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	119.21	467.76
2	123.79	465.75
3	128.44	463.92
4	133.16	462.27
5	137.94	460.80
6	142.77	459.52
7	147.65	458.42
8	152.57	457.51
9	157.52	456.80
10	162.49	456.27
11	167.48	455.94
12	172.48	455.80
13	177.48	455.85
14	182.47	456.09
15	187.45	456.53
16	192.41	457.15
17	197.34	457.97
18	202.24	458.98
19	207.10	460.18
20	211.90	461.56
21	216.65	463.12
22	221.33	464.87
23	225.95	466.80
24	230.48	468.90
25	234.94	471.18
26	239.30	473.62
27	243.56	476.24
28	247.72	479.01
29	251.77	481.94
30	255.70	485.03
31	259.51	488.27
32	263.20	491.65
33	266.75	495.17
34	270.16	498.82
35	271.17	499.99

Circle Center At X = 173.6 ; Y = 585.5 and Radius, 129.7

*** 2.385 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.79	468.00
2	140.31	465.87
3	144.93	463.95
4	149.63	462.24
5	154.40	460.75
6	159.24	459.48
7	164.13	458.44
8	169.06	457.62
9	174.02	457.02
10	179.01	456.66

11	184.01	456.53
12	189.01	456.62
13	194.00	456.95
14	198.97	457.50
15	203.91	458.28
16	208.80	459.29
17	213.65	460.52
18	218.43	461.97
19	223.15	463.64
20	227.78	465.53
21	232.32	467.62
22	236.76	469.92
23	241.08	472.43
24	245.29	475.13
25	249.37	478.02
26	253.32	481.09
27	257.12	484.34
28	260.76	487.76
29	264.24	491.35
30	267.56	495.09
31	270.70	498.98
32	271.44	499.99

Circle Center At X = 184.4 ; Y = 565.3 and Radius, 108.8

*** 2.393 ***

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	91.58	465.28
2	96.32	463.69
3	101.10	462.22
4	105.91	460.87
5	110.76	459.65
6	115.64	458.54
7	120.54	457.56
8	125.46	456.70
9	130.41	455.96
10	135.37	455.35
11	140.35	454.86
12	145.34	454.50
13	150.33	454.27
14	155.33	454.16
15	160.33	454.17
16	165.33	454.31
17	170.32	454.58
18	175.30	454.97
19	180.28	455.49
20	185.24	456.13
21	190.18	456.89
22	195.10	457.78
23	199.99	458.80
24	204.86	459.93
25	209.70	461.19
26	214.51	462.57
27	219.28	464.07
28	224.01	465.69
29	228.70	467.43
30	233.34	469.28
31	237.94	471.25
32	242.48	473.34
33	246.97	475.53
34	251.40	477.84
35	255.78	480.27
36	260.09	482.80
37	264.34	485.44
38	268.52	488.18
39	272.63	491.03
40	276.66	493.98

41	280.63	497.03
42	284.22	499.94

Circle Center At X = 157.2 ; Y = 653.1 and Radius, 199.0

*** 2.434 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	91.58	465.28
2	96.31	463.66
3	101.08	462.17
4	105.89	460.82
5	110.74	459.60
6	115.62	458.51
7	120.53	457.57
8	125.47	456.76
9	130.42	456.10
10	135.40	455.57
11	140.38	455.18
12	145.38	454.93
13	150.37	454.83
14	155.37	454.86
15	160.37	455.04
16	165.36	455.35
17	170.34	455.81
18	175.31	456.40
19	180.25	457.13
20	185.17	458.01
21	190.07	459.02
22	194.94	460.17
23	199.77	461.45
24	204.56	462.87
25	209.32	464.43
26	214.02	466.11
27	218.68	467.93
28	223.28	469.88
29	227.83	471.96
30	232.32	474.17
31	236.74	476.50
32	241.10	478.95
33	245.38	481.53
34	249.60	484.22
35	253.73	487.03
36	257.78	489.96
37	261.75	493.00
38	265.64	496.15
39	269.43	499.41
40	270.07	499.99

Circle Center At X = 151.7 ; Y = 632.6 and Radius, 177.8

*** 2.478 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.79	468.00
2	140.45	466.20
3	145.19	464.60
4	149.99	463.21
5	154.85	462.02
6	159.75	461.04
7	164.69	460.27
8	169.66	459.71
9	174.65	459.37
10	179.65	459.24
11	184.65	459.32
12	189.64	459.62
13	194.61	460.13
14	199.56	460.85
15	204.47	461.79

16	209.34	462.93
17	214.15	464.28
18	218.91	465.84
19	223.59	467.59
20	228.19	469.55
21	232.70	471.70
22	237.12	474.04
23	241.43	476.57
24	245.63	479.28
25	249.72	482.17
26	253.67	485.23
27	257.49	488.46
28	261.17	491.85
29	264.70	495.39
30	268.07	499.08
31	268.84	500.00

Circle Center At X = 180.2 ; Y = 576.1 and Radius, 116.8

*** 2.486 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.74	468.00
2	129.44	466.30
3	134.19	464.75
4	138.99	463.35
5	143.84	462.11
6	148.72	461.02
7	153.63	460.09
8	158.57	459.31
9	163.53	458.69
10	168.51	458.23
11	173.50	457.93
12	178.50	457.79
13	183.50	457.81
14	188.49	457.99
15	193.48	458.32
16	198.46	458.82
17	203.42	459.47
18	208.35	460.28
19	213.26	461.25
20	218.13	462.37
21	222.96	463.65
22	227.75	465.08
23	232.49	466.66
24	237.18	468.40
25	241.82	470.28
26	246.39	472.31
27	250.89	474.48
28	255.32	476.80
29	259.68	479.25
30	263.95	481.85
31	268.14	484.58
32	272.24	487.44
33	276.25	490.43
34	280.16	493.54
35	283.97	496.78
36	287.44	499.93

Circle Center At X = 180.4 ; Y = 614.7 and Radius, 156.9

*** 2.502 ***

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.11	465.20
2	101.92	463.85
3	106.76	462.60
4	111.63	461.46
5	116.52	460.43

6	121.44	459.51
7	126.37	458.69
8	131.32	457.99
9	136.28	457.39
10	141.26	456.91
11	146.25	456.53
12	151.24	456.27
13	156.24	456.12
14	161.24	456.07
15	166.24	456.14
16	171.23	456.32
17	176.23	456.61
18	181.21	457.01
19	186.18	457.51
20	191.15	458.13
21	196.09	458.86
22	201.02	459.70
23	205.93	460.65
24	210.82	461.70
25	215.68	462.86
26	220.52	464.13
27	225.32	465.51
28	230.10	466.99
29	234.84	468.58
30	239.55	470.27
31	244.21	472.07
32	248.84	473.97
33	253.42	475.97
34	257.96	478.07
35	262.45	480.27
36	266.89	482.57
37	271.27	484.97
38	275.61	487.46
39	279.88	490.05
40	284.10	492.73
41	288.26	495.51
42	292.36	498.38
43	294.44	499.91

Circle Center At X = 160.7 ; Y = 682.1 and Radius, 226.1

*** 2.511 ***

APPENDIX F

SLOPE STABILITY ANALYSES RESULTS AND FACTORS OF SAFETY END-OF-CONSTRUCTION AND STEADY-STATE STATIC AND POST-EARTHQUAKE SEISMIC CONDITIONS

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 7 End-of-Construction and Steady-State Static, and Post-Earthquake Seismic Slope Stability Analyses

AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY TDG DATE 5/6/09 SHEET NO. 1 OF 4

gai consultants

Engineers • Geologists • Planners
Environmental Specialists

CALCULATION BRIEF
FOR
SHORT-TERM END OF-CONSTRUCTION AND LONG-TERM STEADY-STATE STATIC, AND POST-EARTHQUAKE SEISMIC SLOPE STABILITY ANALYSES AND FACTORS OF SAFETY

POND CREEK COAL REFUSE DISPOSAL SITE – PHASE 7 SOUTH SLOPE

OBJECTIVE: To determine the static and seismic factors of safety for the Pond Creek, Phase 7 South slope (Phase 7C) embankment and impoundment.

METHODOLOGY: Use PCSTABL limit equilibrium analyses and a "zero-strength" fine coal refuse (FCR) approach to determine the short-term end-of-construction and long-term steady-state static factors of safety, as well as the post-earthquake seismic factor of safety for the Phase 7 South slope (Phase 7C) embankment/impoundment geometry presented in Figure 2.

REFERENCES:

1. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak and Steady-State Undrained Shear Strengths For Refuse and Subgrade Materials, Pond Creek Coal Refuse Disposal Site – South Pond", BEG, 7/12/08.

2. GAI Consultants, Inc. Calculation, "Supplemental Summary of Engineering Properties and Coarse Refuse Tensile Strength for Subsidence Liquefaction and Embankment Cracking Evaluations, Pond Creek Coal Refuse Disposal Site – Phase 3," BEG, 3/31/09.

3. GAI Consultants, Inc. Calculation, "Determination of Downstream and Upstream In-Situ Driving Shear Stress By Elastic (PCSTABL) Solution, Pond Creek Coal Refuse Disposal Site – Phase 3 Impoundment," BEG, 4/08/09.

4. U.S. Department of Labor, Mine Safety and Health Administration, "Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 Seismic Design: Stability and Deformation Analyses," Final Draft Dated December 2007, Updated August 1, 2008.

5. Winterkorn and Fang, (1975), "Foundation Engineering Handbook," Van Nostrand Reinhold Publishers.

6. Gregory, P.E., Garry H., "PCSTABL5M with STEDwin Slope Stability Analysis System, Version 2.0," dated September 2001.

7. Poulos, S.J., Castro, G., and France, J.W. (1985a) "Liquefaction Evaluation Procedure," Journal of the Geotechnical Engineering Division, ASCE, Vol. 111, No. GT6, pp. 772-792.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 7 End-of-Construction and Steady-State Static, and Post-Earthquake Seismic Slope Stability Analyses

AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY TBY DATE 5/8/09 SHEET NO. 2 OF 4

REVISED BY: TBY 7/11/09

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ANALYSIS:

END-OF-CONSTRUCTION AND STEADY-STATE STATIC SLOPE STABILITY ANALYSES

Static slope stability analyses were performed for the Phase 7 South slope geometry (Phase 7C), which includes the underlying Phase 3 impoundment FCR. The short-term, end-of-construction (EOC)analysis condition includes using effective strength parameters for the CCR, total undrained shear strengths for the residual soil, and zero (0) strength for the FCR. For the long-term, steady-state (SS) conditions stability analyses of the Phase 7C slope geometry, effective strength for CCR and total undrained strength for FCR and residual soil are utilized. The following soil properties were estimated based on previous field and laboratory testing as noted in Reference Nos. 1 and 2 and used in the various slope stability analyses:

Description	Unit Weights (γ_t,γ_s) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion (c) (psf)	Strength
Coarse Coal Refuse (CCR)	130, 140	33.7	0	Effective Strength
Fine Coal Refuse (FCR)	80, 90	0 18.8	0, 260 0	Zero Strength, Sus=0.05 Total Strength
Residual Soil	125, 135	19.5	416	Total Strength

The results of the Phase 7C slope stability analyses indicate the Phase 7C embankment and underlying Phase 3 impoundment geometry is stable under both short-term, EOC and long-term, SS conditions. Utilizing conservative strength parameters for the various materials including "zero-strength" for FCR, the EOC and SS static factors of safety are 1.6 and 1.8, respectively.

Results of Static Slope Stability Analyses:

Phase 7C Impoundment (Crest El. 538 ft) (Top of Fines El. 496 ft)	Factor of Safety (dim)
End-Of-Construction – CCR Effective Strength FCR Zero-Strength Residual Total Strength	1.6
Steady-State – CCR Effective Strength FCR Total-Strength Residual Total Strength	1.8

Hard copies of the input and output files for the Phase 7C end-of-construction and long-term steady-state slope stability analyses are presented in Attachment 1.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 7 End-of-Construction and Steady-State Static, and Post-Earthquake Seismic Slope Stability Analyses

AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY TBG DATE 5/8/09 SHEET NO. 3 OF 4

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POST-EARTHQUAKE SEISMIC SLOPE STABILITY ANALYSES

Liquefaction susceptibility of the proposed Phase 7C slope geometry and the FCR hydraulically placed beneath the Phase 7 CCR embankment depends on the strength of all the soils along the critical failure surface. Zones of loose (contractive) soils are critical to analyzing liquefaction potential since only loose soils can have an undrained strength that is significantly lower than their drained strength. For the purpose of this evaluation, a conservative, simplified approach was employed, and assumes the FCR will lose strength during an earthquake, which changes the condition from drained to undrained.

Therefore, liquefaction susceptibility was determined by evaluating the Phase 7C embankment and underlying Phase 3 FCR utilizing a "zero-strength" approach for the FCR to evaluate the post-earthquake factors of safety. A "zero-strength" type analysis of the FCR, if stable, is considered the most conservative analysis because a true zero-strength condition physically cannot occur. Some minimum strength, i.e., steady-state undrained exists even if the material is susceptible to a strength loss triggering event such as an earthquake.

The post-earthquake analyses included using effective strength parameters for the CCR, total undrained shear strengths for the residual soil, and zero (0) strength for the FCR for a deep failure surface and 260 psf for a shallow failure surface equating to Sus/σ'v=0.05, which is far less than the site specific laboratory testing Sus/σ'v=0.24. Engineering soil parameters used in the post-earthquake stability analyses are presented above.

The results of the Phase 7C post-earthquake stability analyses indicate the Phase 7C embankment and underlying Phase 3 impoundment geometry is stable. Utilizing conservative strength parameters for the various materials including "zero-strength" for FCR, the post-earthquake factor of safety is 1.6 for a deep failure, and 1.2 for a shallow failure with Sus=260 psf.

Results of Post-Earthquake Seismic Slope Stability Analyses:

Phase 7C Impoundment (Crest El. 538 ft) (Top of Fines El. 496 ft)	**Factor of Safety (dim)**
Post-Earthquake – CCR Effective Strength FCR Zero-Strength Deep, Sus=260 psf Residual Total Strength	1.6 Deep 1.2 Shallow

Hard copies of the input and output files for the Phase 7C post-earthquake slope stability analyses are also presented in Attachment 2.

Poulos, et al (1985) states a soil mass that is not susceptible to liquefaction physically cannot fail by liquefaction since the minimum undrained strength exceeds the in-situ driving shear stress along the critical failure surface. Permanent deformation analyses were not considered pertinent to the Phase 7C geometry since there is no impounded FCR or freeboard. Therefore, permanent deformation analyses were not performed.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 7 End-of-Construction and Steady-State Static, and Post-Earthquake Seismic Slope Stability Analyses

AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY BEG DATE 5/8/09 SHEET NO. 4 OF 4

REVISED BY: BEG 7/11/09

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CONCLUSIONS

GAI has completed static stability analyses to evaluate the end-of-construction and steady-state conditions of the proposed Phase 7 South (Phase7C) slope. GAI has also completed seismic stability analyses to evaluate the post-earthquake condition of the Phase 7C slope. Based on conservatively-derived strength parameters, including a zero-strength approach for the FCR, adequate static and seismic factors of safety exist for the Phase 7C slope. The conclusions are based on the following:

- Phase 7 minimum factor of safety for the short-term end-of-construction static condition, with zero-strength FCR in was estimated at 1.6 for a deep failure, and 1.2 for a shallow failure with Sus=260 psf;
- Phase 7 minimum factor of safety for the long-term, steady-state static condition was estimated at 1.8; and
- The Phase 7 factor of safety against a post-earthquake, seismic condition, with zero-strength FCR was estimated at 1.6

Hard copies of the input and output files for the Phase 7C end-of-construction and long-term steady-state slope stability analyses are presented in Attachment 1. Hard copies of the input and output files for the Phase 7C post-earthquake slope stability analyses are also presented in Attachment 2

ATTACHMENT 1

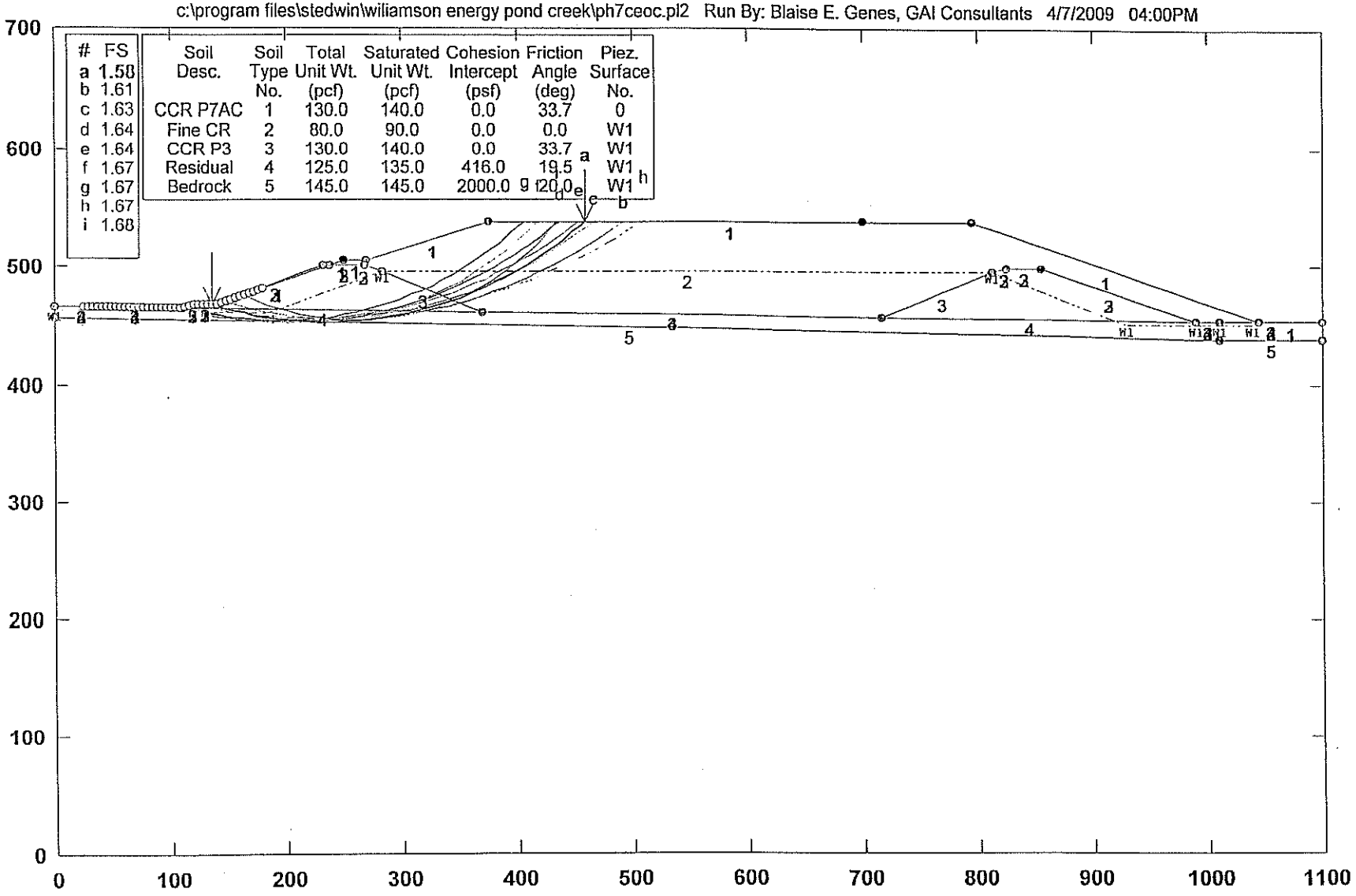
PHASE 7 SOUTH (PHASE 7C) SLOPE
SHORT-TERM END-OF-CONSTRUCTION AND LONG-TERM STEADY-STATE CONDITIONS
PCSTABL SLOPE STABILITY ANALYSES

Pond Creek, Phase 7C South - Zero Strength FCR Static EOC

c:\program files\stedwin\wiliamson energy pond creek\ph7ceoc.pl2 Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:00PM

#	FS
a	1.58
b	1.61
c	1.63
d	1.64
e	1.64
f	1.67
g	1.67
h	1.67
i	1.68

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR P7AC	1	130.0	140.0	0.0	33.7	0
Fine CR	2	80.0	90.0	0.0	0.0	W1
CCR P3	3	130.0	140.0	0.0	33.7	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1



PCSTABL5M/si FSmin=1.58

Safety Factors Are Calculated By The Modified Bishop Method

STED



R13578

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4/7/2009
Time of Run: 04:00PM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph7ceoc.in
Output Filename: C:ph7ceoc.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph7ceoc.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 7C South - Zero Streng th FCR Static EOC

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

11 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1
5	140.00	468.00	238.00	500.00	1
6	238.00	500.00	250.00	505.00	1
7	250.00	505.00	270.00	505.00	1
8	270.00	505.00	375.00	538.00	1
9	375.00	538.00	795.00	538.00	1
10	795.00	538.00	1045.00	454.00	1
11	1045.00	454.00	1100.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1100.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1100.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4

46	1010.00	454.00	1100.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1100.00	439.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	0
2	80.0	90.0	.0	.0	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

1600 Trial Surfaces Have Been Generated.

40 Surfaces Initiate From Each Of 40 Points Equally Spaced Along The Ground Surface Between X = 25.00 ft.
and X = 180.00 ft.

Each Surface Terminates Between X = 250.00 ft.
and X = 700.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.28	468.00
2	145.87	465.16
3	155.54	462.61
4	165.28	460.35
5	175.09	458.38
6	184.94	456.71
7	194.85	455.32
8	204.79	454.24
9	214.76	453.44
10	224.75	452.95
11	234.74	452.75
12	244.74	452.86
13	254.74	453.25
14	264.71	453.95
15	274.66	454.94
16	284.58	456.23
17	294.45	457.82
18	304.27	459.69
19	314.04	461.86
20	323.73	464.32
21	333.35	467.06
22	342.88	470.09
23	352.31	473.40

24	361.64	477.00
25	370.87	480.86
26	379.97	485.01
27	388.94	489.42
28	397.78	494.09
29	406.48	499.03
30	415.03	504.22
31	423.41	509.67
32	431.63	515.36
33	439.68	521.29
34	447.55	527.46
35	455.23	533.87
36	459.90	538.00

Circle Center At X = 236.3 ; Y = 788.5 and Radius, 335.8

*** 1.578 ***

Individual data on the 50 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.7	265.7	.0	.0	.0	.0	.0	.0	.0
2	5.9	2234.1	.0	.0	.0	.0	.0	.0	.0
3	3.5	2624.7	.0	.0	.0	.0	.0	.0	.0
4	6.2	6914.7	.0	.0	.0	.0	.0	.0	.0
5	5.9	9142.2	.0	.0	.0	.0	.0	.0	.0
6	3.9	7443.0	.0	107.1	.0	.0	.0	.0	.0
7	9.8	23519.9	.0	1118.2	.0	.0	.0	.0	.0
8	9.9	30190.0	.0	2189.7	.0	.0	.0	.0	.0
9	.1	187.0	.0	14.9	.0	.0	.0	.0	.0
10	7.0	25226.2	.0	2499.2	.0	.0	.0	.0	.0
11	2.9	11253.1	.0	1433.7	.0	.0	.0	.0	.0
12	9.9	42973.5	.0	6709.0	.0	.0	.0	.0	.0
13	10.0	48901.1	.0	9302.9	.0	.0	.0	.0	.0
14	10.0	54425.2	.0	11726.5	.0	.0	.0	.0	.0
15	8.3	48792.6	.0	11383.6	.0	.0	.0	.0	.0
16	1.7	10731.4	.0	2593.9	.0	.0	.0	.0	.0
17	3.3	20409.9	.0	5009.2	.0	.0	.0	.0	.0
18	6.7	44035.0	.0	11044.7	.0	.0	.0	.0	.0
19	5.3	36042.6	.0	9219.4	.0	.0	.0	.0	.0
20	4.7	33096.4	.0	8734.6	.0	.0	.0	.0	.0
21	10.0	69375.5	.0	19676.0	.0	.0	.0	.0	.0
22	3.3	22719.0	.0	6852.3	.0	.0	.0	.0	.0
23	2.0	13762.9	.0	4244.6	.0	.0	.0	.0	.0
24	4.7	32367.8	.0	10121.5	.0	.0	.0	.0	.0
25	8.3	59423.8	.0	18900.9	.0	.0	.0	.0	.0
26	1.6	11461.8	.0	3860.6	.0	.0	.0	.0	.0
27	9.9	71688.1	.0	23697.4	.0	.0	.0	.0	.0
28	9.8	71036.3	.0	22618.0	.0	.0	.0	.0	.0
29	6.5	46775.6	.0	14406.0	.0	.0	.0	.0	.0
30	3.2	23145.9	.0	6950.2	.0	.0	.0	.0	.0
31	9.7	68270.8	.0	19913.0	.0	.0	.0	.0	.0
32	9.6	66148.8	.0	18289.7	.0	.0	.0	.0	.0
33	9.5	63597.2	.0	16487.8	.0	.0	.0	.0	.0
34	1.1	7121.3	.0	1778.6	.0	.0	.0	.0	.0
35	8.3	54824.8	.0	12730.3	.0	.0	.0	.0	.0
36	9.3	61927.6	.0	12354.8	.0	.0	.0	.0	.0
37	9.2	61590.4	.0	10027.3	.0	.0	.0	.0	.0
38	4.1	27672.2	.0	3739.8	.0	.0	.0	.0	.0
39	5.0	32744.4	.0	3788.6	.0	.0	.0	.0	.0
40	9.0	56462.6	.0	4860.6	.0	.0	.0	.0	.0
41	8.8	51997.6	.0	2026.0	.0	.0	.0	.0	.0
42	1.6	9018.9	.0	52.2	.0	.0	.0	.0	.0
43	7.1	37804.0	.0	.0	.0	.0	.0	.0	.0
44	8.5	40413.1	.0	.0	.0	.0	.0	.0	.0
45	8.4	33864.3	.0	.0	.0	.0	.0	.0	.0
46	8.2	27242.9	.0	.0	.0	.0	.0	.0	.0
47	8.0	20586.5	.0	.0	.0	.0	.0	.0	.0

48	7.9	13933.9	.0	.0	.0	.0	.0	.0	.0
49	7.7	7324.2	.0	.0	.0	.0	.0	.0	.0
50	4.7	1254.2	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.36	468.00
2	134.04	465.51
3	143.78	463.24
4	153.57	461.21
5	163.41	459.40
6	173.28	457.82
7	183.19	456.47
8	193.13	455.36
9	203.09	454.47
10	213.07	453.82
11	223.06	453.41
12	233.06	453.22
13	243.06	453.27
14	253.06	453.56
15	263.04	454.07
16	273.01	454.82
17	282.97	455.81
18	292.89	457.02
19	302.79	458.47
20	312.65	460.14
21	322.46	462.05
22	332.23	464.18
23	341.95	466.55
24	351.61	469.13
25	361.20	471.95
26	370.73	474.98
27	380.19	478.24
28	389.56	481.72
29	398.85	485.42
30	408.06	489.33
31	417.17	493.46
32	426.18	497.79
33	435.08	502.34
34	443.88	507.09
35	452.57	512.05
36	461.13	517.21
37	469.58	522.57
38	477.89	528.12
39	486.08	533.87
40	491.68	538.00

Circle Center At X = 235.9 ; Y = 881.4 and Radius, 428.1

*** 1.613 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.31	468.00
2	142.00	465.55
3	151.76	463.35
4	161.57	461.42
5	171.43	459.74
6	181.33	458.32
7	191.26	457.17
8	201.22	456.27
9	211.20	455.64
10	221.19	455.27
11	231.19	455.17
12	241.19	455.33
13	251.18	455.76
14	261.16	456.44
15	271.11	457.39
16	281.04	458.60

17	290.93	460.08
18	300.78	461.81
19	310.58	463.80
20	320.32	466.06
21	330.00	468.56
22	339.61	471.32
23	349.15	474.34
24	358.60	477.60
25	367.96	481.11
26	377.23	484.87
27	386.40	488.87
28	395.45	493.11
29	404.39	497.59
30	413.21	502.30
31	421.91	507.24
32	430.47	512.42
33	438.89	517.81
34	447.16	523.43
35	455.29	529.26
36	463.25	535.30
37	466.62	538.00

Circle Center At X = 230.1 ; Y = 834.4 and Radius, 379.2

*** 1.625 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.46	465.02
2	118.16	462.58
3	127.92	460.40
4	137.73	458.48
5	147.60	456.84
6	157.50	455.47
7	167.44	454.36
8	177.41	453.53
9	187.39	452.98
10	197.39	452.69
11	207.39	452.68
12	217.38	452.95
13	227.37	453.48
14	237.34	454.29
15	247.28	455.37
16	257.19	456.72
17	267.05	458.35
18	276.87	460.24
19	286.64	462.40
20	296.34	464.82
21	305.97	467.52
22	315.52	470.47
23	324.99	473.68
24	334.37	477.15
25	343.65	480.88
26	352.83	484.86
27	361.89	489.08
28	370.83	493.56
29	379.65	498.27
30	388.34	503.23
31	396.88	508.42
32	405.28	513.84
33	413.53	519.49
34	421.63	525.37
35	429.56	531.46
36	437.32	537.77
37	437.58	538.00

Circle Center At X = 202.8 ; Y = 818.4 and Radius, 365.7

*** 1.635 ***

Failure Surface Specified By 38 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	108.46	465.02
2	118.20	462.73
3	127.98	460.68
4	137.82	458.88
5	147.70	457.31
6	157.61	455.99
7	167.55	454.92
8	177.52	454.09
9	187.50	453.50
10	197.49	453.17
11	207.49	453.08
12	217.49	453.23
13	227.48	453.64
14	237.46	454.28
15	247.42	455.18
16	257.36	456.32
17	267.26	457.70
18	277.13	459.33
19	286.95	461.20
20	296.72	463.32
21	306.44	465.67
22	316.10	468.26
23	325.69	471.10
24	335.21	474.16
25	344.65	477.46
26	354.01	480.99
27	363.27	484.75
28	372.44	488.74
29	381.51	492.96
30	390.47	497.39
31	399.32	502.05
32	408.06	506.92
33	416.67	512.01
34	425.15	517.30
35	433.50	522.81
36	441.71	528.52
37	449.77	534.43
38	454.40	538.00

Circle Center At X = 206.2 ; Y = 858.3 and Radius, 405.3

*** 1.640 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.21	470.68
2	157.72	467.59
3	167.34	464.88
4	177.07	462.55
5	186.87	460.60
6	196.75	459.04
7	206.68	457.87
8	216.65	457.09
9	226.65	456.71
10	236.65	456.72
11	246.64	457.12
12	256.61	457.92
13	266.53	459.11
14	276.41	460.69
15	286.21	462.66
16	295.93	465.01
17	305.55	467.74
18	315.06	470.85
19	324.43	474.33
20	333.66	478.18
21	342.73	482.39
22	351.63	486.95
23	360.34	491.86

24	368.85	497.11
25	377.15	502.69
26	385.23	508.59
27	393.06	514.81
28	400.64	521.33
29	407.96	528.14
30	415.01	535.24
31	417.54	538.00

Circle Center At X = 231.4 ; Y = 710.5 and Radius, 253.9

*** 1.668 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	112.44	465.73
2	122.09	463.11
3	131.82	460.82
4	141.62	458.84
5	151.49	457.19
6	161.40	455.86
7	171.35	454.86
8	181.32	454.19
9	191.32	453.85
10	201.32	453.83
11	211.31	454.15
12	221.29	454.79
13	231.24	455.77
14	241.16	457.07
15	251.03	458.69
16	260.83	460.65
17	270.57	462.92
18	280.23	465.51
19	289.80	468.42
20	299.27	471.64
21	308.62	475.17
22	317.85	479.01
23	326.96	483.15
24	335.92	487.59
25	344.73	492.32
26	353.38	497.34
27	361.86	502.64
28	370.16	508.22
29	378.27	514.07
30	386.19	520.18
31	393.89	526.55
32	401.39	533.17
33	406.51	538.00

Circle Center At X = 196.7 ; Y = 757.4 and Radius, 303.6

*** 1.673 ***

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	128.33	468.00
2	138.10	465.87
3	147.92	463.94
4	157.76	462.20
5	167.65	460.67
6	177.56	459.34
7	187.49	458.22
8	197.45	457.29
9	207.43	456.57
10	217.41	456.06
11	227.41	455.75
12	237.41	455.64
13	247.41	455.73
14	257.40	456.03
15	267.39	456.54
16	277.36	457.24

17	287.32	458.15
18	297.26	459.27
19	307.17	460.58
20	317.06	462.10
21	326.91	463.82
22	336.72	465.74
23	346.50	467.86
24	356.22	470.18
25	365.90	472.70
26	375.53	475.41
27	385.09	478.32
28	394.60	481.42
29	404.04	484.72
30	413.41	488.21
31	422.71	491.89
32	431.93	495.76
33	441.07	499.82
34	450.13	504.06
35	459.09	508.48
36	467.97	513.09
37	476.75	517.88
38	485.43	522.85
39	494.00	527.99
40	502.47	533.30
41	509.63	538.00

Circle Center At X = 237.7 ; Y = 945.7 and Radius, 490.1

*** 1.674 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.10	475.87
2	173.23	471.77
3	182.52	468.09
4	191.97	464.82
5	201.56	461.98
6	211.26	459.56
7	221.07	457.59
8	230.95	456.05
9	240.89	454.96
10	250.87	454.31
11	260.87	454.11
12	270.86	454.35
13	280.84	455.04
14	290.77	456.17
15	300.65	457.75
16	310.44	459.76
17	320.14	462.21
18	329.71	465.10
19	339.15	468.40
20	348.43	472.12
21	357.54	476.26
22	366.45	480.80
23	375.15	485.73
24	383.62	491.04
25	391.85	496.72
26	399.81	502.77
27	407.50	509.17
28	414.89	515.90
29	421.98	522.96
30	428.74	530.33
31	435.17	537.99
32	435.18	538.00

Circle Center At X = 260.4 ; Y = 678.1 and Radius, 224.0

*** 1.684 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	128.33	468.00
2	138.12	465.95
3	147.94	464.05
4	157.79	462.32
5	167.66	460.74
6	177.56	459.32
7	187.48	458.07
8	197.42	456.97
9	207.38	456.04
10	217.35	455.27
11	227.33	454.66
12	237.32	454.21
13	247.32	453.92
14	257.32	453.80
15	267.32	453.84
16	277.31	454.03
17	287.31	454.40
18	297.29	454.92
19	307.27	455.60
20	317.23	456.45
21	327.18	457.46
22	337.11	458.62
23	347.03	459.95
24	356.91	461.44
25	366.78	463.09
26	376.61	464.90
27	386.42	466.87
28	396.19	468.99
29	405.92	471.28
30	415.62	473.72
31	425.28	476.32
32	434.89	479.07
33	444.46	481.98
34	453.98	485.05
35	463.45	488.27
36	472.86	491.64
37	482.22	495.16
38	491.52	498.83
39	500.76	502.66
40	509.94	506.63
41	519.05	510.75
42	528.09	515.02
43	537.06	519.44
44	545.96	524.00
45	554.79	528.70
46	563.54	533.54
47	571.28	538.00

Circle Center At X = 260.0 ; Y = 1071.2 and Radius, 617.4

*** 1.689 ***

Pond Creek, Phase 7C South - Zero Strength FCR Static Long-Term SS

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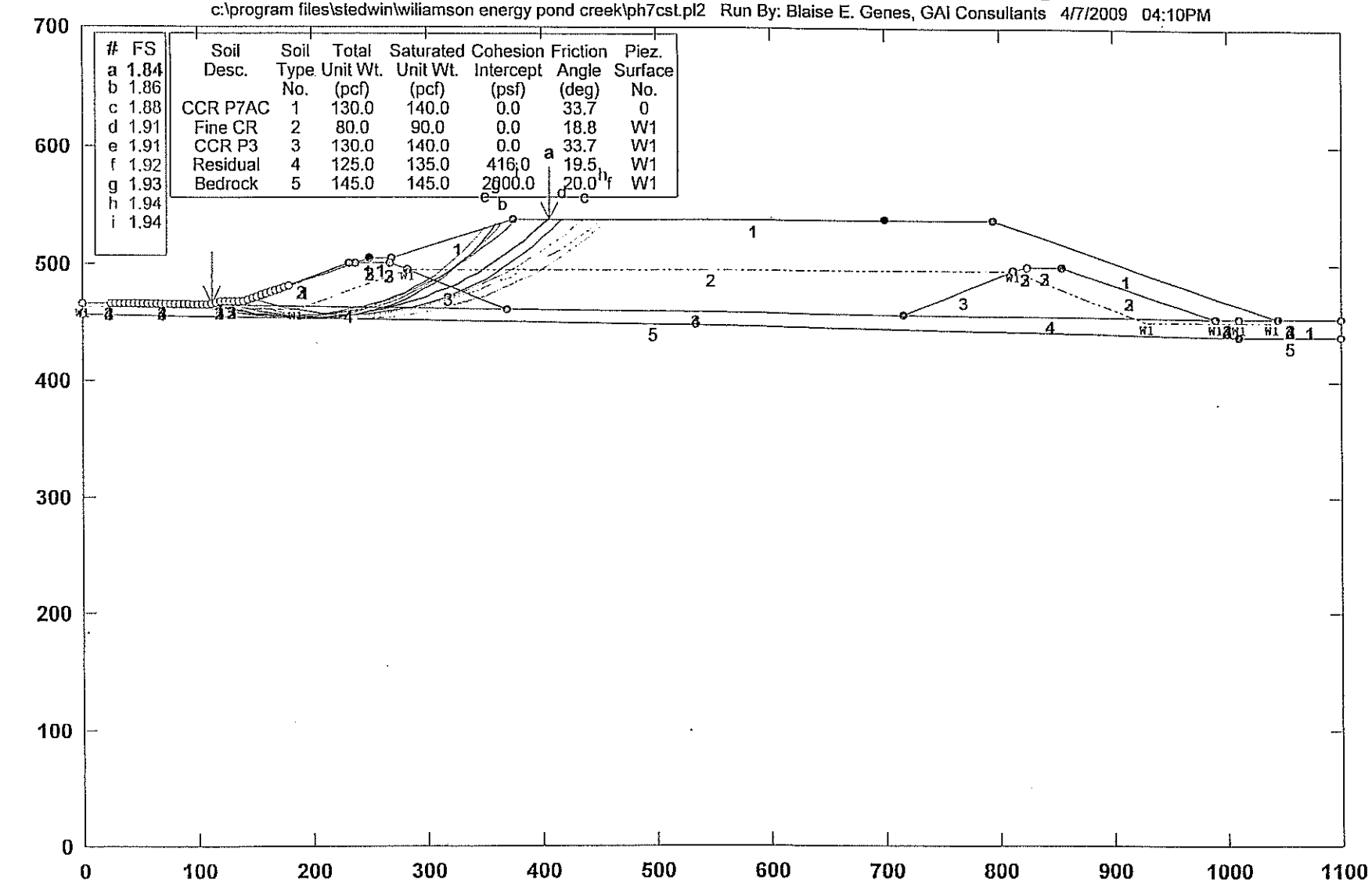
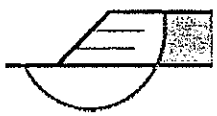


PCSTABL5M/si FSmin=1.84

Safety Factors Are Calculated By The Modified Bishop Method

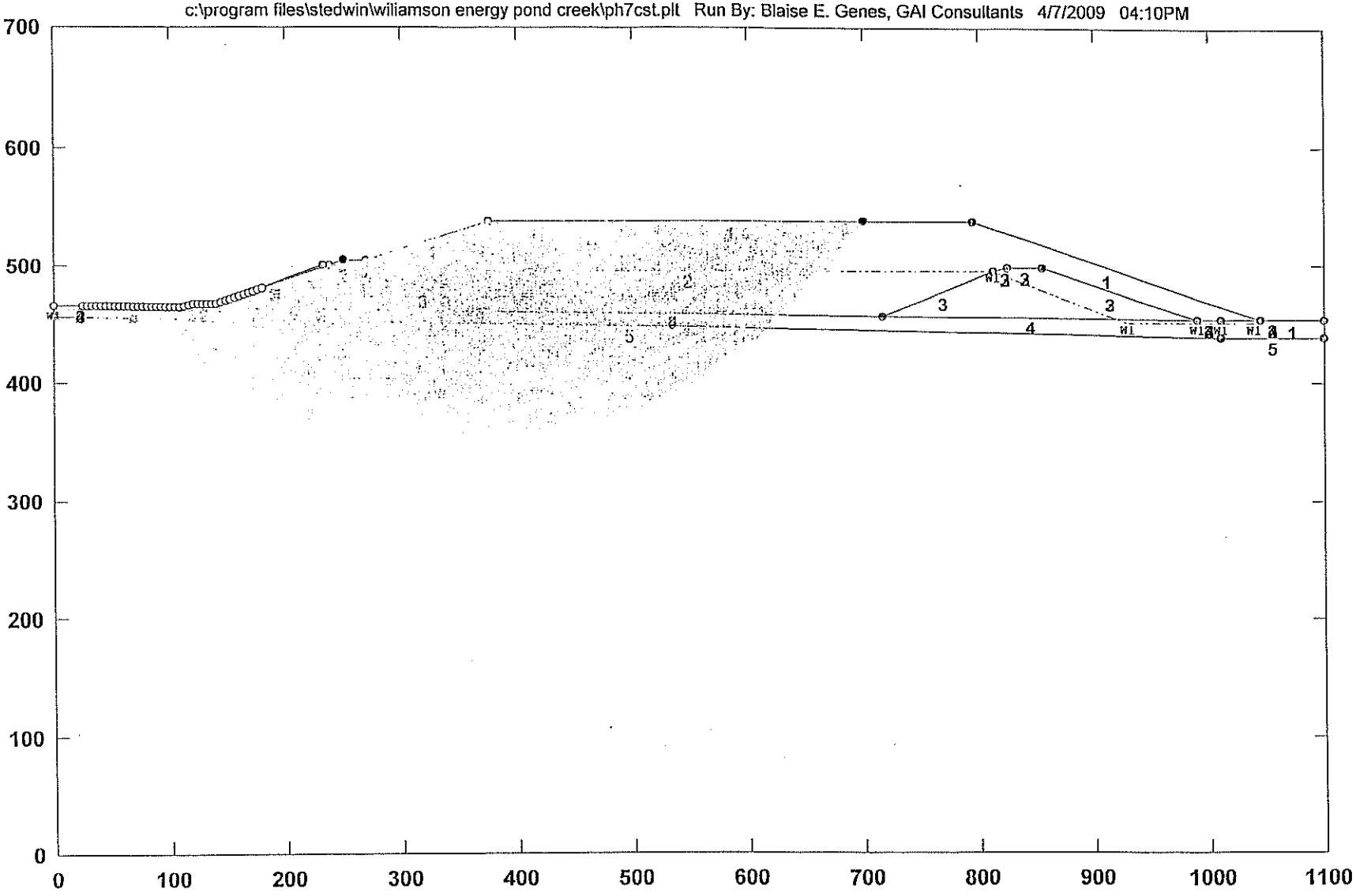
STED



R13588

Pond Creek, Phase 7C South - Zero Strength FCR Static Long-Term SS

c:\program files\stedwin\wiliamson energy pond creek\ph7cst.plt Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:10PM



STED



R13589

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4/7/2009
Time of Run: 04:10PM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph7cst.in
Output Filename: C:ph7cst.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph7cst.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 7C South - Zero Streng
th FCR Static Long-Term SS
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

11 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1
5	140.00	468.00	238.00	500.00	1
6	238.00	500.00	250.00	505.00	1
7	250.00	505.00	270.00	505.00	1
8	270.00	505.00	375.00	538.00	1
9	375.00	538.00	795.00	538.00	1
10	795.00	538.00	1045.00	454.00	1
11	1045.00	454.00	1100.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1100.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1100.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4

46	1010.00	454.00	1100.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1100.00	439.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	0
2	80.0	90.0	.0	18.8	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

1600 Trial Surfaces Have Been Generated.

40 Surfaces Initiate From Each Of 40 Points Equally Spaced Along The Ground Surface Between X = 25.00 ft.
and X = 180.00 ft.

Each Surface Terminates Between X = 250.00 ft.
and X = 700.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	112.44	465.73
2	122.09	463.11
3	131.82	460.82
4	141.62	458.84
5	151.49	457.19
6	161.40	455.86
7	171.35	454.86
8	181.32	454.19
9	191.32	453.85
10	201.32	453.83
11	211.31	454.15
12	221.29	454.79
13	231.24	455.77
14	241.16	457.07
15	251.03	458.69
16	260.83	460.65
17	270.57	462.92
18	280.23	465.51
19	289.80	468.42
20	299.27	471.64
21	308.62	475.17
22	317.85	479.01
23	326.96	483.15

24	335.92	487.59
25	344.73	492.32
26	353.38	497.34
27	361.86	502.64
28	370.16	508.22
29	378.27	514.07
30	386.19	520.18
31	393.89	526.55
32	401.39	533.17
33	406.51	538.00

Circle Center At X = 196.7 ; Y = 757.4 and Radius, 303.6

*** 1.840 ***

Individual data on the 48 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.1	353.7	.0	.0	.0	.0	.0	.0	.0
2	4.5	1757.7	.0	.0	.0	.0	.0	.0	.0
3	2.1	1234.9	.0	.0	.0	.0	.0	.0	.0
4	6.4	4586.9	.0	.0	.0	.0	.0	.0	.0
5	3.4	2930.5	.0	82.1	.0	.0	.0	.0	.0
6	8.2	8458.9	.0	802.0	.0	.0	.0	.0	.0
7	1.6	1950.4	.0	255.7	.0	.0	.0	.0	.0
8	9.9	15575.1	.0	2123.6	.0	.0	.0	.0	.0
9	9.9	21804.6	.0	2986.4	.0	.0	.0	.0	.0
10	9.9	27644.7	.0	3645.3	.0	.0	.0	.0	.0
11	10.0	33065.4	.0	4099.4	.0	.0	.0	.0	.0
12	3.7	13444.6	.0	1582.3	.0	.0	.0	.0	.0
13	6.3	24639.2	.0	3039.6	.0	.0	.0	.0	.0
14	.7	2716.5	.0	372.5	.0	.0	.0	.0	.0
15	9.3	40173.7	.0	6174.6	.0	.0	.0	.0	.0
16	10.0	47244.4	.0	8505.8	.0	.0	.0	.0	.0
17	10.0	51091.9	.0	10267.9	.0	.0	.0	.0	.0
18	10.0	54417.7	.0	11831.6	.0	.0	.0	.0	.0
19	1.8	9925.0	.0	2243.7	.0	.0	.0	.0	.0
20	5.0	28751.4	.0	6609.0	.0	.0	.0	.0	.0
21	3.2	18592.7	.0	4342.5	.0	.0	.0	.0	.0
22	8.8	53952.7	.0	12813.6	.0	.0	.0	.0	.0
23	1.0	6417.4	.0	1543.5	.0	.0	.0	.0	.0
24	9.8	60080.5	.0	15316.2	.0	.0	.0	.0	.0
25	5.8	34135.3	.0	9420.1	.0	.0	.0	.0	.0
26	1.4	8216.4	.0	2341.6	.0	.0	.0	.0	.0
27	2.0	11558.9	.0	3346.1	.0	.0	.0	.0	.0
28	.6	3296.8	.0	963.7	.0	.0	.0	.0	.0
29	9.7	55913.6	.0	16621.9	.0	.0	.0	.0	.0
30	2.8	16126.0	.0	4885.4	.0	.0	.0	.0	.0
31	6.8	39212.7	.0	12244.6	.0	.0	.0	.0	.0
32	9.5	52691.9	.0	15581.1	.0	.0	.0	.0	.0
33	9.4	49475.2	.0	13473.6	.0	.0	.0	.0	.0
34	9.2	45848.8	.0	11173.8	.0	.0	.0	.0	.0
35	2.3	10875.7	.0	2431.0	.0	.0	.0	.0	.0
36	6.8	31961.2	.0	6253.2	.0	.0	.0	.0	.0
37	9.0	41908.2	.0	6007.6	.0	.0	.0	.0	.0
38	8.8	40765.1	.0	3146.9	.0	.0	.0	.0	.0
39	4.6	21080.3	.0	445.7	.0	.0	.0	.0	.0
40	4.0	18043.1	.0	.0	.0	.0	.0	.0	.0
41	8.5	35876.4	.0	.0	.0	.0	.0	.0	.0
42	8.3	32094.7	.0	.0	.0	.0	.0	.0	.0
43	4.8	17169.6	.0	.0	.0	.0	.0	.0	.0
44	3.3	10674.9	.0	.0	.0	.0	.0	.0	.0
45	7.9	21483.1	.0	.0	.0	.0	.0	.0	.0
46	7.7	14670.9	.0	.0	.0	.0	.0	.0	.0
47	7.5	7935.8	.0	.0	.0	.0	.0	.0	.0
48	5.1	1610.1	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 29 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	112.44	465.73
2	121.96	462.67
3	131.60	460.03
4	141.35	457.80
5	151.19	455.99
6	161.09	454.61
7	171.04	453.66
8	181.03	453.13
9	191.03	453.03
10	201.02	453.37
11	210.99	454.13
12	220.92	455.33
13	230.79	456.94
14	240.58	458.98
15	250.27	461.44
16	259.85	464.32
17	269.30	467.60
18	278.59	471.29
19	287.72	475.37
20	296.66	479.85
21	305.41	484.70
22	313.93	489.93
23	322.23	495.51
24	330.27	501.45
25	338.06	507.73
26	345.56	514.34
27	352.78	521.26
28	359.69	528.49
29	365.37	534.97

Circle Center At X = 188.3 ; Y = 685.5 and Radius, 232.4

*** 1.855 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.46	465.02
2	118.16	462.58
3	127.92	460.40
4	137.73	458.48
5	147.60	456.84
6	157.50	455.47
7	167.44	454.36
8	177.41	453.53
9	187.39	452.98
10	197.39	452.69
11	207.39	452.68
12	217.38	452.95
13	227.37	453.48
14	237.34	454.29
15	247.28	455.37
16	257.19	456.72
17	267.05	458.35
18	276.87	460.24
19	286.64	462.40
20	296.34	464.82
21	305.97	467.52
22	315.52	470.47
23	324.99	473.68
24	334.37	477.15
25	343.65	480.88
26	352.83	484.86
27	361.89	489.08
28	370.83	493.56
29	379.65	498.27
30	388.34	503.23
31	396.88	508.42
32	405.28	513.84

33	413.53	519.49
34	421.63	525.37
35	429.56	531.46
36	437.32	537.77
37	437.58	538.00

Circle Center At X = 202.8 ; Y = 818.4 and Radius, 365.7

*** 1.882 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.21	470.68
2	157.72	467.59
3	167.34	464.88
4	177.07	462.55
5	186.87	460.60
6	196.75	459.04
7	206.68	457.87
8	216.65	457.09
9	226.65	456.71
10	236.65	456.72
11	246.64	457.12
12	256.61	457.92
13	266.53	459.11
14	276.41	460.69
15	286.21	462.66
16	295.93	465.01
17	305.55	467.74
18	315.06	470.85
19	324.43	474.33
20	333.66	478.18
21	342.73	482.39
22	351.63	486.95
23	360.34	491.86
24	368.85	497.11
25	377.15	502.69
26	385.23	508.59
27	393.06	514.81
28	400.64	521.33
29	407.96	528.14
30	415.01	535.24
31	417.54	538.00

Circle Center At X = 231.4 ; Y = 710.5 and Radius, 253.9

*** 1.908 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.36	468.00
2	133.81	464.74
3	143.42	461.95
4	153.15	459.64
5	162.98	457.83
6	172.89	456.51
7	182.86	455.69
8	192.85	455.37
9	202.85	455.56
10	212.83	456.24
11	222.76	457.42
12	232.62	459.09
13	242.38	461.26
14	252.02	463.92
15	261.52	467.05
16	270.85	470.66
17	279.98	474.72
18	288.90	479.24
19	297.58	484.21
20	306.01	489.60
21	314.15	495.40

22	321.99	501.61
23	329.51	508.20
24	336.69	515.16
25	343.52	522.47
26	349.97	530.11
27	349.99	530.14

Circle Center At X = 194.2 ; Y = 655.0 and Radius, 199.6

*** 1.909 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.28	468.00
2	145.87	465.16
3	155.54	462.61
4	165.28	460.35
5	175.09	458.38
6	184.94	456.71
7	194.85	455.32
8	204.79	454.24
9	214.76	453.44
10	224.75	452.95
11	234.74	452.75
12	244.74	452.86
13	254.74	453.25
14	264.71	453.95
15	274.66	454.94
16	284.58	456.23
17	294.45	457.82
18	304.27	459.69
19	314.04	461.86
20	323.73	464.32
21	333.35	467.06
22	342.88	470.09
23	352.31	473.40
24	361.64	477.00
25	370.87	480.86
26	379.97	485.01
27	388.94	489.42
28	397.78	494.09
29	406.48	499.03
30	415.03	504.22
31	423.41	509.67
32	431.63	515.36
33	439.68	521.29
34	447.55	527.46
35	455.23	533.87
36	459.90	538.00

Circle Center At X = 236.3 ; Y = 788.5 and Radius, 335.8

*** 1.924 ***

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.36	468.00
2	133.67	464.36
3	143.16	461.19
4	152.79	458.51
5	162.55	456.31
6	172.40	454.61
7	182.33	453.42
8	192.31	452.72
9	202.30	452.53
10	212.30	452.85
11	222.27	453.67
12	232.18	454.99
13	242.01	456.81
14	251.74	459.13
15	261.34	461.93

16	270.78	465.22
17	280.05	468.97
18	289.11	473.20
19	297.95	477.87
20	306.55	482.99
21	314.87	488.53
22	322.90	494.49
23	330.62	500.84
24	338.01	507.50
25	345.05	514.68
26	351.73	522.13
27	358.01	529.90
28	360.62	533.48

Circle Center At X = 201.1 ; Y = 650.2 and Radius, 197.7

*** 1.926 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.46	465.02
2	118.20	462.73
3	127.98	460.68
4	137.82	458.88
5	147.70	457.31
6	157.61	455.99
7	167.55	454.92
8	177.52	454.09
9	187.50	453.50
10	197.49	453.17
11	207.49	453.08
12	217.49	453.23
13	227.48	453.64
14	237.46	454.28
15	247.42	455.18
16	257.36	456.32
17	267.26	457.70
18	277.13	459.33
19	286.95	461.20
20	296.72	463.32
21	306.44	465.67
22	316.10	468.26
23	325.69	471.10
24	335.21	474.16
25	344.65	477.46
26	354.01	480.99
27	363.27	484.75
28	372.44	488.74
29	381.51	492.96
30	390.47	497.39
31	399.32	502.05
32	408.06	506.92
33	416.67	512.01
34	425.15	517.30
35	433.50	522.81
36	441.71	528.52
37	449.77	534.43
38	454.40	538.00

Circle Center At X = 206.2 ; Y = 858.3 and Radius, 405.3

*** 1.936 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	96.54	465.21
2	106.24	462.77
3	116.01	460.66
4	125.85	458.88
5	135.75	457.43
6	145.68	456.32

7	155.66	455.55
8	165.65	455.12
9	175.65	455.02
10	185.64	455.26
11	195.63	455.85
12	205.58	456.77
13	215.50	458.02
14	225.38	459.61
15	235.19	461.54
16	244.93	463.79
17	254.59	466.38
18	264.16	469.29
19	273.62	472.52
20	282.97	476.07
21	292.19	479.93
22	301.28	484.11
23	310.22	488.59
24	319.00	493.37
25	327.62	498.44
26	336.06	503.81
27	344.31	509.46
28	352.37	515.38
29	360.22	521.57
30	367.86	528.02
31	375.28	534.73
32	378.65	538.00

Circle Center At X = 173.5 ; Y = 750.2 and Radius, 295.2

*** 1.943 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.36	468.00
2	133.58	464.13
3	143.03	460.85
4	152.66	458.17
5	162.45	456.11
6	172.34	454.66
7	182.31	453.84
8	192.31	453.65
9	202.30	454.08
10	212.24	455.15
11	222.10	456.83
12	231.83	459.14
13	241.39	462.05
14	250.76	465.56
15	259.88	469.65
16	268.73	474.31
17	277.27	479.51
18	285.46	485.25
19	293.28	491.48
20	300.69	498.20
21	307.66	505.37
22	314.17	512.96
23	320.02	520.72

Circle Center At X = 190.4 ; Y = 612.5 and Radius, 158.8

*** 1.950 ***

ATTACHMENT 2

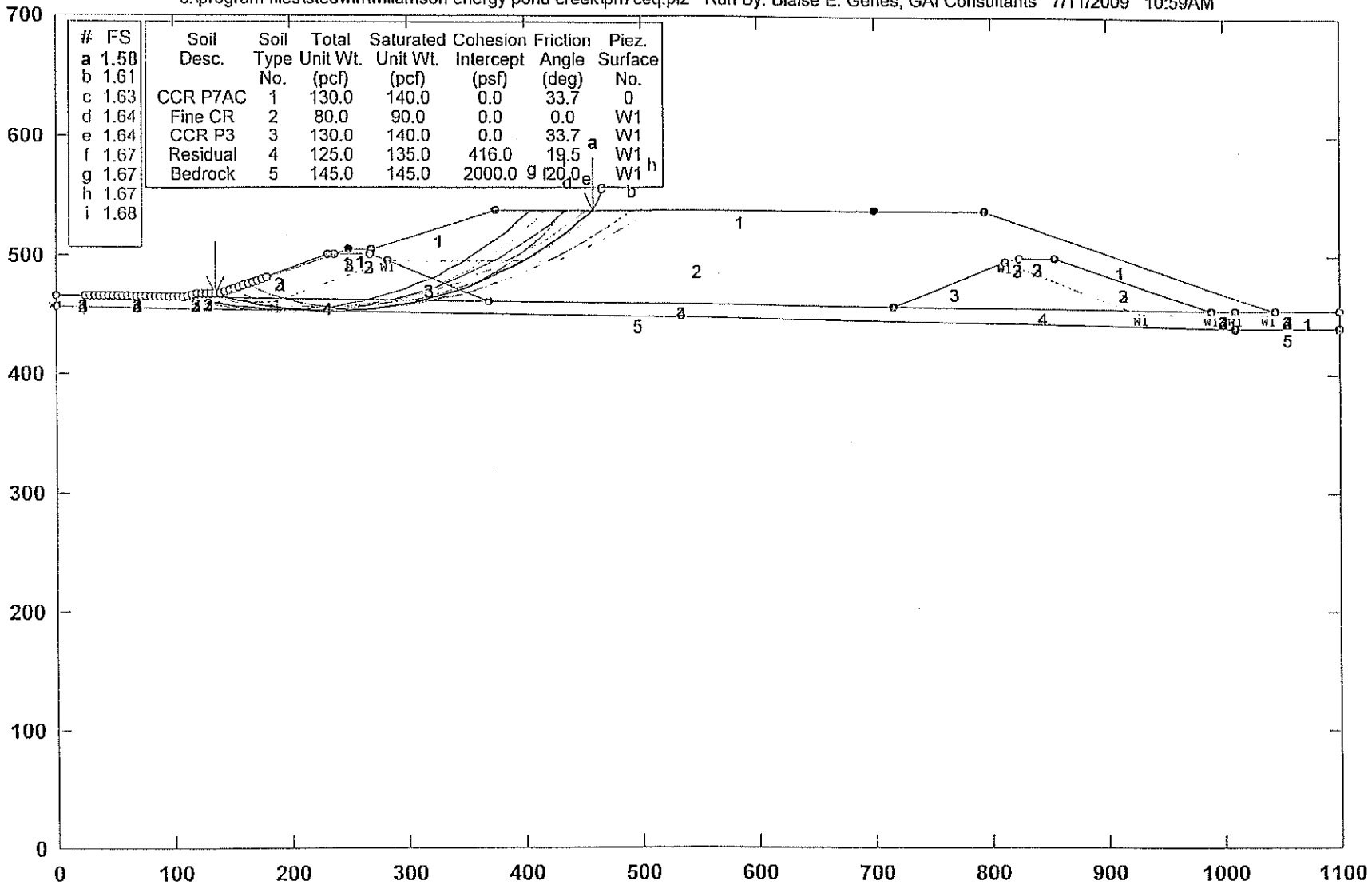
PHASE 7 SOUTH (PHASE 7C) SLOPE
POST-EARTHQUAKE SEISMIC CONDITIONS
PCSTABL SLOPE STABILITY ANALYSES

Pond Creek, Phase 7C South - Zero Strength FCR Post-EQ Deep

c:\program files\stedwin\wiliamson energy pond creek\ph7ceq.pl2 Run By: Blaise E. Genes, GAI Consultants 7/11/2009 10:59AM

#	FS
a	1.58
b	1.61
c	1.63
d	1.64
e	1.64
f	1.67
g	1.67
h	1.67
i	1.68

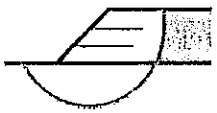
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR P7AC	1	130.0	140.0	0.0	33.7	0
Fine CR	2	80.0	90.0	0.0	0.0	W1
CCR P3	3	130.0	140.0	0.0	33.7	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1



PCSTABL5M/si FSmin=1.58

Safety Factors Are Calculated By The Modified Bishop Method

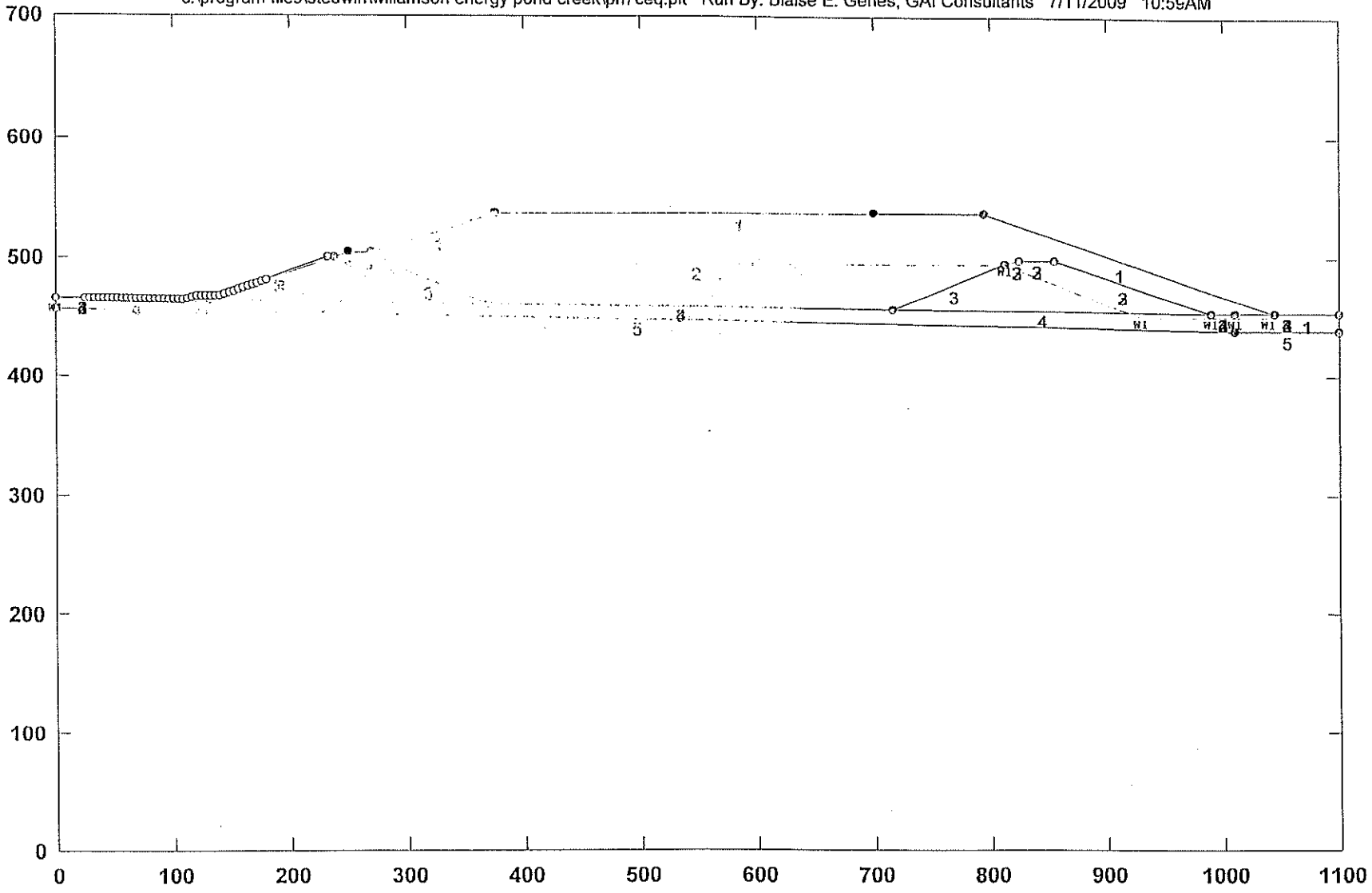
STED



R13599

Pond Creek, Phase 7C South - Zero Strength FCR Post-EQ Deep

c:\program files\stedwin\wiliamson energy pond creek\ph7ceq.plt Run By: Blaise E. Genes, GAI Consultants 7/11/2009 10:59AM



STED



R13600

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 7/11/2009
Time of Run: 10:59AM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph7ceq.in
Output Filename: C:ph7ceq.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph7ceq.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 7C South - Zero Streng th FCR Post-EQ Deep

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

11 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1

5	140.00	468.00	238.00	500.00	1
6	238.00	500.00	250.00	505.00	1
7	250.00	505.00	270.00	505.00	1
8	270.00	505.00	375.00	538.00	1
9	375.00	538.00	795.00	538.00	1
10	795.00	538.00	1045.00	454.00	1
11	1045.00	454.00	1100.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1100.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1100.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4
46	1010.00	454.00	1100.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1100.00	439.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	0
2	80.0	90.0	.0	.0	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
1600 Trial Surfaces Have Been Generated.
40 Surfaces Initiate From Each Of 40 Points Equally Spaced Along The Ground Surface Between X = 25.00 ft.
and X = 180.00 ft.
Each Surface Terminates Between X = 250.00 ft.
and X = 700.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.28	468.00
2	145.87	465.16
3	155.54	462.61
4	165.28	460.35
5	175.09	458.38
6	184.94	456.71
7	194.85	455.32
8	204.79	454.24
9	214.76	453.44
10	224.75	452.95
11	234.74	452.75
12	244.74	452.86
13	254.74	453.25
14	264.71	453.95
15	274.66	454.94
16	284.58	456.23
17	294.45	457.82
18	304.27	459.69
19	314.04	461.86
20	323.73	464.32
21	333.35	467.06
22	342.88	470.09
23	352.31	473.40
24	361.64	477.00
25	370.87	480.86
26	379.97	485.01
27	388.94	489.42
28	397.78	494.09
29	406.48	499.03
30	415.03	504.22
31	423.41	509.67
32	431.63	515.36
33	439.68	521.29
34	447.55	527.46
35	455.23	533.87
36	459.90	538.00

Circle Center At X = 236.3 ; Y = 788.5 and Radius, 335.8
*** 1.578 ***
Individual data on the 50 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.7	265.7	.0	.0	.0	.0	.0	.0	.0
2	5.9	2234.1	.0	.0	.0	.0	.0	.0	.0
3	3.5	2624.7	.0	.0	.0	.0	.0	.0	.0
4	6.2	6914.7	.0	.0	.0	.0	.0	.0	.0
5	5.9	9142.2	.0	.0	.0	.0	.0	.0	.0
6	3.9	7443.0	.0	107.1	.0	.0	.0	.0	.0

7	9.8	23519.9	.0	1118.2	.0	.0	.0	.0	.0
8	9.9	30190.0	.0	2189.7	.0	.0	.0	.0	.0
9	.1	187.0	.0	14.9	.0	.0	.0	.0	.0
10	7.0	25226.2	.0	2499.2	.0	.0	.0	.0	.0
11	2.9	11253.1	.0	1433.7	.0	.0	.0	.0	.0
12	9.9	42973.5	.0	6709.0	.0	.0	.0	.0	.0
13	10.0	48901.1	.0	9302.9	.0	.0	.0	.0	.0
14	10.0	54425.2	.0	11726.5	.0	.0	.0	.0	.0
15	8.3	48792.6	.0	11383.6	.0	.0	.0	.0	.0
16	1.7	10731.4	.0	2593.9	.0	.0	.0	.0	.0
17	3.3	20409.9	.0	5009.2	.0	.0	.0	.0	.0
18	6.7	44035.0	.0	11044.7	.0	.0	.0	.0	.0
19	5.3	36042.6	.0	9219.4	.0	.0	.0	.0	.0
20	4.7	33096.4	.0	8734.6	.0	.0	.0	.0	.0
21	10.0	69375.5	.0	19676.0	.0	.0	.0	.0	.0
22	3.3	22719.0	.0	6852.3	.0	.0	.0	.0	.0
23	2.0	13762.9	.0	4244.6	.0	.0	.0	.0	.0
24	4.7	32367.8	.0	10121.5	.0	.0	.0	.0	.0
25	8.3	59423.8	.0	18900.9	.0	.0	.0	.0	.0
26	1.6	11461.8	.0	3860.6	.0	.0	.0	.0	.0
27	9.9	71688.1	.0	23697.4	.0	.0	.0	.0	.0
28	9.8	71036.3	.0	22618.0	.0	.0	.0	.0	.0
29	6.5	46775.6	.0	14406.0	.0	.0	.0	.0	.0
30	3.2	23145.9	.0	6950.2	.0	.0	.0	.0	.0
31	9.7	68270.8	.0	19913.0	.0	.0	.0	.0	.0
32	9.6	66148.8	.0	18289.7	.0	.0	.0	.0	.0
33	9.5	63597.2	.0	16487.8	.0	.0	.0	.0	.0
34	1.1	7121.3	.0	1778.6	.0	.0	.0	.0	.0
35	8.3	54824.8	.0	12730.3	.0	.0	.0	.0	.0
36	9.3	61927.6	.0	12354.8	.0	.0	.0	.0	.0
37	9.2	61590.4	.0	10027.3	.0	.0	.0	.0	.0
38	4.1	27672.2	.0	3739.8	.0	.0	.0	.0	.0
39	5.0	32744.4	.0	3788.6	.0	.0	.0	.0	.0
40	9.0	56462.6	.0	4860.6	.0	.0	.0	.0	.0
41	8.8	51997.6	.0	2026.0	.0	.0	.0	.0	.0
42	1.6	9018.9	.0	52.2	.0	.0	.0	.0	.0
43	7.1	37804.0	.0	.0	.0	.0	.0	.0	.0
44	8.5	40413.1	.0	.0	.0	.0	.0	.0	.0
45	8.4	33864.3	.0	.0	.0	.0	.0	.0	.0
46	8.2	27242.9	.0	.0	.0	.0	.0	.0	.0
47	8.0	20586.5	.0	.0	.0	.0	.0	.0	.0
48	7.9	13933.9	.0	.0	.0	.0	.0	.0	.0
49	7.7	7324.2	.0	.0	.0	.0	.0	.0	.0
50	4.7	1254.2	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.36	468.00
2	134.04	465.51
3	143.78	463.24
4	153.57	461.21
5	163.41	459.40
6	173.28	457.82
7	183.19	456.47
8	193.13	455.36
9	203.09	454.47
10	213.07	453.82
11	223.06	453.41
12	233.06	453.22
13	243.06	453.27
14	253.06	453.56
15	263.04	454.07
16	273.01	454.82
17	282.97	455.81
18	292.89	457.02
19	302.79	458.47
20	312.65	460.14

21	322.46	462.05
22	332.23	464.18
23	341.95	466.55
24	351.61	469.13
25	361.20	471.95
26	370.73	474.98
27	380.19	478.24
28	389.56	481.72
29	398.85	485.42
30	408.06	489.33
31	417.17	493.46
32	426.18	497.79
33	435.08	502.34
34	443.88	507.09
35	452.57	512.05
36	461.13	517.21
37	469.58	522.57
38	477.89	528.12
39	486.08	533.87
40	491.68	538.00

Circle Center At X = 235.9 ; Y = 881.4 and Radius, 428.1

*** 1.613 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.31	468.00
2	142.00	465.55
3	151.76	463.35
4	161.57	461.42
5	171.43	459.74
6	181.33	458.32
7	191.26	457.17
8	201.22	456.27
9	211.20	455.64
10	221.19	455.27
11	231.19	455.17
12	241.19	455.33
13	251.18	455.76
14	261.16	456.44
15	271.11	457.39
16	281.04	458.60
17	290.93	460.08
18	300.78	461.81
19	310.58	463.80
20	320.32	466.06
21	330.00	468.56
22	339.61	471.32
23	349.15	474.34
24	358.60	477.60
25	367.96	481.11
26	377.23	484.87
27	386.40	488.87
28	395.45	493.11
29	404.39	497.59
30	413.21	502.30
31	421.91	507.24
32	430.47	512.42
33	438.89	517.81
34	447.16	523.43
35	455.29	529.26
36	463.25	535.30
37	466.62	538.00

Circle Center At X = 230.1 ; Y = 834.4 and Radius, 379.2

*** 1.625 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	108.46	465.02
2	118.16	462.58
3	127.92	460.40
4	137.73	458.48
5	147.60	456.84
6	157.50	455.47
7	167.44	454.36
8	177.41	453.53
9	187.39	452.98
10	197.39	452.69
11	207.39	452.68
12	217.38	452.95
13	227.37	453.48
14	237.34	454.29
15	247.28	455.37
16	257.19	456.72
17	267.05	458.35
18	276.87	460.24
19	286.64	462.40
20	296.34	464.82
21	305.97	467.52
22	315.52	470.47
23	324.99	473.68
24	334.37	477.15
25	343.65	480.88
26	352.83	484.86
27	361.89	489.08
28	370.83	493.56
29	379.65	498.27
30	388.34	503.23
31	396.88	508.42
32	405.28	513.84
33	413.53	519.49
34	421.63	525.37
35	429.56	531.46
36	437.32	537.77
37	437.58	538.00

Circle Center At X = 202.8 ; Y = 818.4 and Radius, 365.7

*** 1.635 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.46	465.02
2	118.20	462.73
3	127.98	460.68
4	137.82	458.88
5	147.70	457.31
6	157.61	455.99
7	167.55	454.92
8	177.52	454.09
9	187.50	453.50
10	197.49	453.17
11	207.49	453.08
12	217.49	453.23
13	227.48	453.64
14	237.46	454.28
15	247.42	455.18
16	257.36	456.32
17	267.26	457.70
18	277.13	459.33
19	286.95	461.20
20	296.72	463.32
21	306.44	465.67
22	316.10	468.26
23	325.69	471.10
24	335.21	474.16
25	344.65	477.46

26	354.01	480.99
27	363.27	484.75
28	372.44	488.74
29	381.51	492.96
30	390.47	497.39
31	399.32	502.05
32	408.06	506.92
33	416.67	512.01
34	425.15	517.30
35	433.50	522.81
36	441.71	528.52
37	449.77	534.43
38	454.40	538.00

Circle Center At X = 206.2 ; Y = 858.3 and Radius, 405.3

*** 1.640 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.21	470.68
2	157.72	467.59
3	167.34	464.88
4	177.07	462.55
5	186.87	460.60
6	196.75	459.04
7	206.68	457.87
8	216.65	457.09
9	226.65	456.71
10	236.65	456.72
11	246.64	457.12
12	256.61	457.92
13	266.53	459.11
14	276.41	460.69
15	286.21	462.66
16	295.93	465.01
17	305.55	467.74
18	315.06	470.85
19	324.43	474.33
20	333.66	478.18
21	342.73	482.39
22	351.63	486.95
23	360.34	491.86
24	368.85	497.11
25	377.15	502.69
26	385.23	508.59
27	393.06	514.81
28	400.64	521.33
29	407.96	528.14
30	415.01	535.24
31	417.54	538.00

Circle Center At X = 231.4 ; Y = 710.5 and Radius, 253.9

*** 1.668 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	112.44	465.73
2	122.09	463.11
3	131.82	460.82
4	141.62	458.84
5	151.49	457.19
6	161.40	455.86
7	171.35	454.86
8	181.32	454.19
9	191.32	453.85
10	201.32	453.83
11	211.31	454.15
12	221.29	454.79
13	231.24	455.77

14	241.16	457.07
15	251.03	458.69
16	260.83	460.65
17	270.57	462.92
18	280.23	465.51
19	289.80	468.42
20	299.27	471.64
21	308.62	475.17
22	317.85	479.01
23	326.96	483.15
24	335.92	487.59
25	344.73	492.32
26	353.38	497.34
27	361.86	502.64
28	370.16	508.22
29	378.27	514.07
30	386.19	520.18
31	393.89	526.55
32	401.39	533.17
33	406.51	538.00

Circle Center At X = 196.7 ; Y = 757.4 and Radius, 303.6

*** 1.673 ***

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	128.33	468.00
2	138.10	465.87
3	147.92	463.94
4	157.76	462.20
5	167.65	460.67
6	177.56	459.34
7	187.49	458.22
8	197.45	457.29
9	207.43	456.57
10	217.41	456.06
11	227.41	455.75
12	237.41	455.64
13	247.41	455.73
14	257.40	456.03
15	267.39	456.54
16	277.36	457.24
17	287.32	458.15
18	297.26	459.27
19	307.17	460.58
20	317.06	462.10
21	326.91	463.82
22	336.72	465.74
23	346.50	467.86
24	356.22	470.18
25	365.90	472.70
26	375.53	475.41
27	385.09	478.32
28	394.60	481.42
29	404.04	484.72
30	413.41	488.21
31	422.71	491.89
32	431.93	495.76
33	441.07	499.82
34	450.13	504.06
35	459.09	508.48
36	467.97	513.09
37	476.75	517.88
38	485.43	522.85
39	494.00	527.99
40	502.47	533.30
41	509.63	538.00

Circle Center At X = 237.7 ; Y = 945.7 and Radius, 490.1

*** 1.674 ***
Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.10	475.87
2	173.23	471.77
3	182.52	468.09
4	191.97	464.82
5	201.56	461.98
6	211.26	459.56
7	221.07	457.59
8	230.95	456.05
9	240.89	454.96
10	250.87	454.31
11	260.87	454.11
12	270.86	454.35
13	280.84	455.04
14	290.77	456.17
15	300.65	457.75
16	310.44	459.76
17	320.14	462.21
18	329.71	465.10
19	339.15	468.40
20	348.43	472.12
21	357.54	476.26
22	366.45	480.80
23	375.15	485.73
24	383.62	491.04
25	391.85	496.72
26	399.81	502.77
27	407.50	509.17
28	414.89	515.90
29	421.98	522.96
30	428.74	530.33
31	435.17	537.99
32	435.18	538.00

Circle Center At X = 260.4 ; Y = 678.1 and Radius, 224.0

*** 1.684 ***
Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	128.33	468.00
2	138.12	465.95
3	147.94	464.05
4	157.79	462.32
5	167.66	460.74
6	177.56	459.32
7	187.48	458.07
8	197.42	456.97
9	207.38	456.04
10	217.35	455.27
11	227.33	454.66
12	237.32	454.21
13	247.32	453.92
14	257.32	453.80
15	267.32	453.84
16	277.31	454.03
17	287.31	454.40
18	297.29	454.92
19	307.27	455.60
20	317.23	456.45
21	327.18	457.46
22	337.11	458.62
23	347.03	459.95
24	356.91	461.44
25	366.78	463.09
26	376.61	464.90

27	386.42	466.87
28	396.19	468.99
29	405.92	471.28
30	415.62	473.72
31	425.28	476.32
32	434.89	479.07
33	444.46	481.98
34	453.98	485.05
35	463.45	488.27
36	472.86	491.64
37	482.22	495.16
38	491.52	498.83
39	500.76	502.66
40	509.94	506.63
41	519.05	510.75
42	528.09	515.02
43	537.06	519.44
44	545.96	524.00
45	554.79	528.70
46	563.54	533.54
47	571.28	538.00

Circle Center At X = 260.0 ; Y = 1071.2 and Radius, 617.4

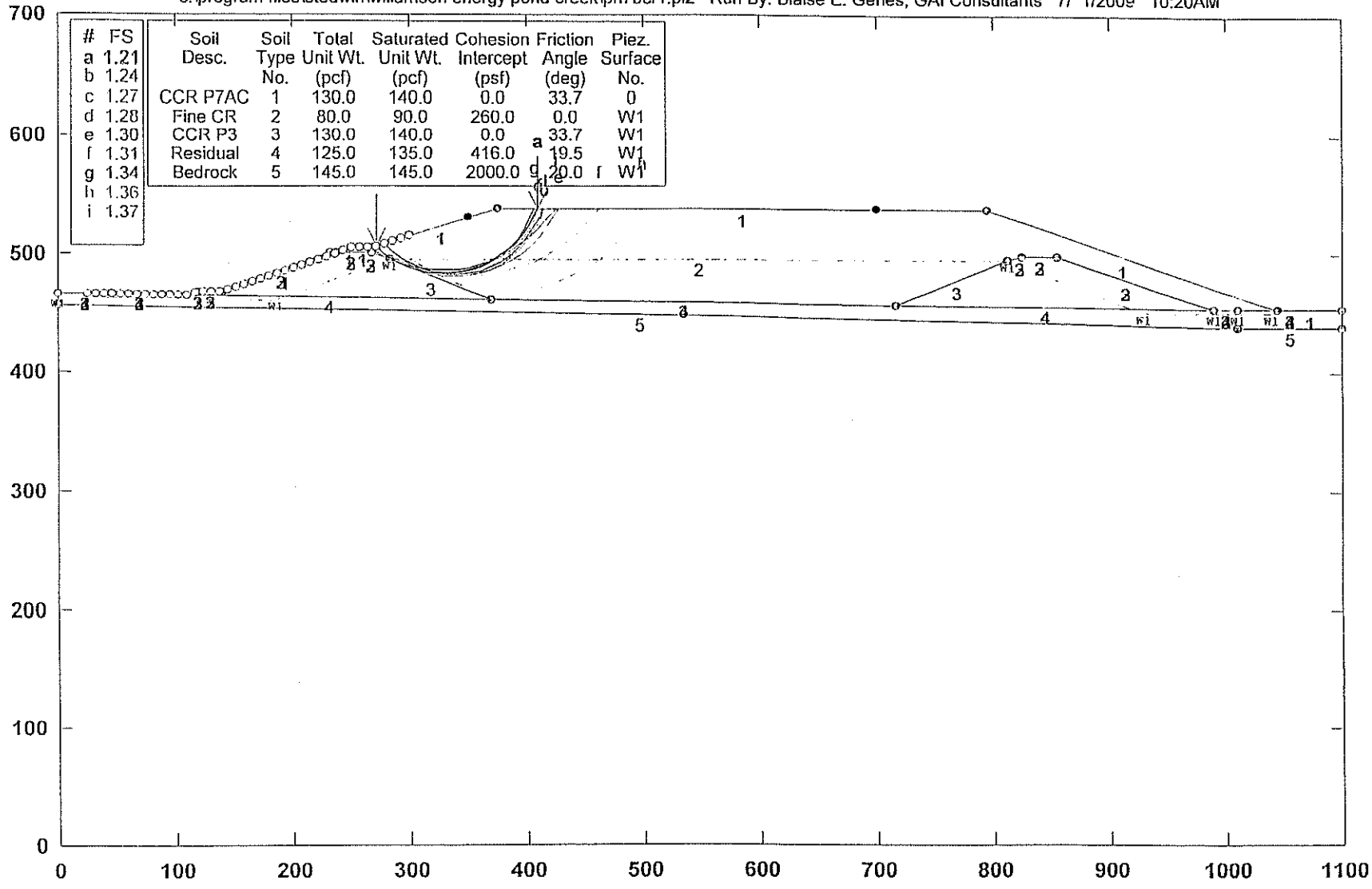
*** 1.689 ***

Pond Creek, Phase 7C South - Sus/sig=.05FCR Post-EQ Shallow

c:\program files\stedwin\wiliamson energy pond creek\ph7bcr1.pl2 Run By: Blaise E. Genes, GAI Consultants 7/1/2009 10:20AM

#	FS
a	1.21
b	1.24
c	1.27
d	1.28
e	1.30
f	1.31
g	1.34
h	1.36
i	1.37

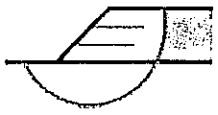
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR P7AC	1	130.0	140.0	0.0	33.7	0
Fine CR	2	80.0	90.0	260.0	0.0	W1
CCR P3	3	130.0	140.0	0.0	33.7	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1



PCSTABL5M/si FSmin=1.21

Safety Factors Are Calculated By The Modified Bishop Method

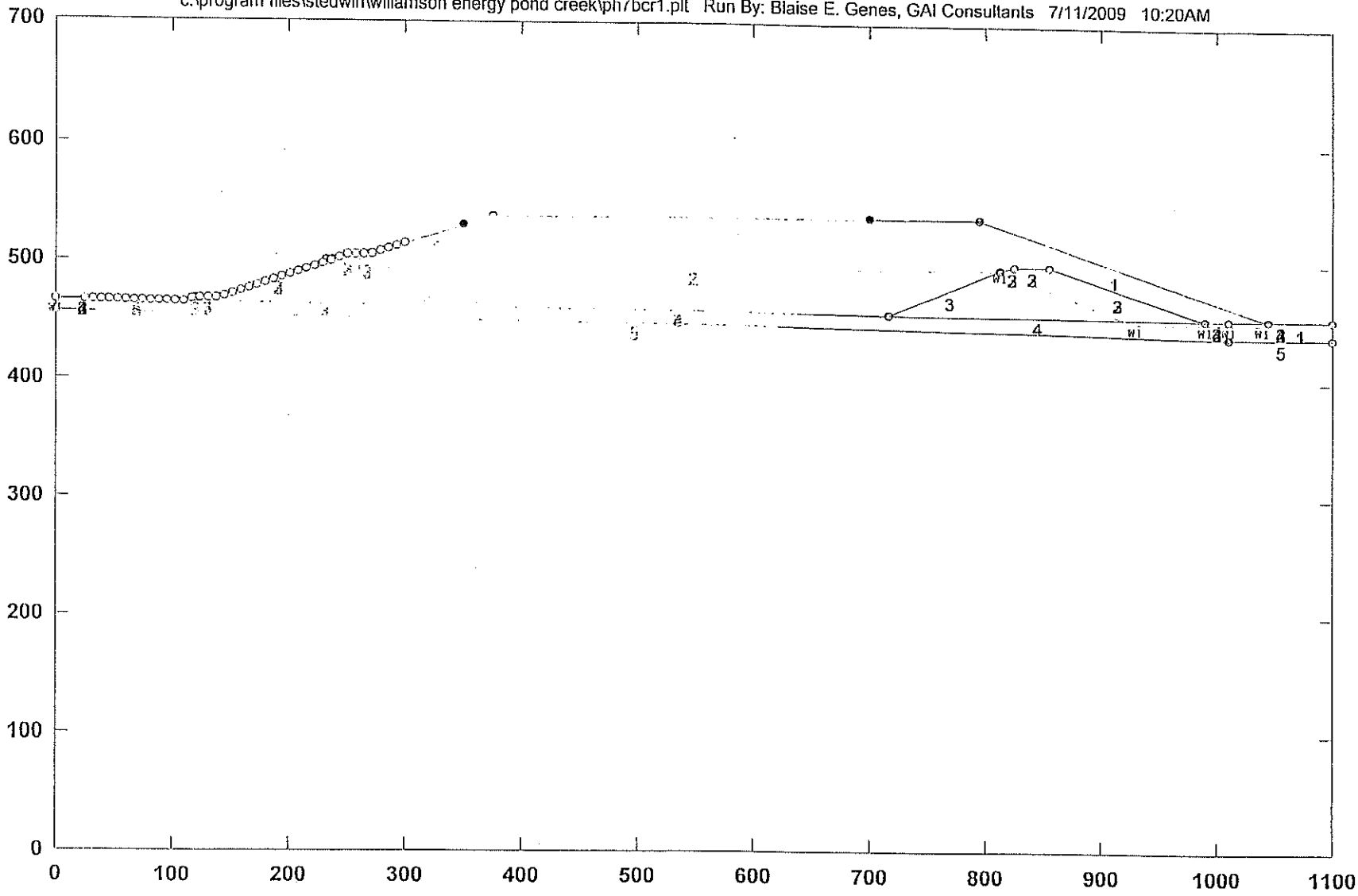
STED



R13611

Pond Creek, Phase 7C South - Sus/sig=.05FCR Post-EQ Shallow

c:\program files\stedwin\wiliamson energy pond creek\ph7bcr1.plt Run By: Blaise E. Genes, GAI Consultants 7/11/2009 10:20AM



STED



R13612

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 7/11/2009
Time of Run: 10:20AM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph7bcr1.in
Output Filename: C:ph7bcr1.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph7bcr1.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 7C South - Sus/sig=.05
FCR Post-EQ Shallow

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

11 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1
5	140.00	468.00	238.00	500.00	1
6	238.00	500.00	250.00	505.00	1
7	250.00	505.00	270.00	505.00	1
8	270.00	505.00	375.00	538.00	1
9	375.00	538.00	795.00	538.00	1
10	795.00	538.00	1045.00	454.00	1
11	1045.00	454.00	1100.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1100.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1100.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4

46	1010.00	454.00	1100.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1100.00	439.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	0
2	80.0	90.0	260.0	.0	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

1600 Trial Surfaces Have Been Generated.

40 Surfaces Initiate From Each Of 40 Points Equally Spaced Along The Ground Surface Between X = 25.00 ft.
and X = 300.00 ft.

Each Surface Terminates Between X = 350.00 ft.
and X = 700.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	271.80	505.56
2	279.64	499.36
3	288.14	494.10
4	297.19	489.84
5	306.67	486.65
6	316.45	484.57
7	326.41	483.63
8	336.40	483.84
9	346.31	485.18
10	356.00	487.66
11	365.34	491.23
12	374.21	495.85
13	382.49	501.46
14	390.07	507.98
15	396.86	515.33
16	402.75	523.40
17	407.69	532.10
18	410.19	538.00

Circle Center At X = 329.6 ; Y = 570.4 and Radius, 86.9

*** 1.206 ***

Individual data on the 20 slices

	Water Force	Water Force	Tie Force	Tie Force	Earthquake Force	Surcharge

Slice No.	Width (ft)	Weight (lbs)	Top (lbs)	Bot (lbs)	Norm (lbs)	Tan (lbs)	Hor (lbs)	Ver (lbs)	Load (lbs)
1	7.8	4419.2	.0	.0	.0	.0	.0	.0	.0
2	7.0	10945.3	.0	.0	.0	.0	.0	.0	.0
3	1.5	2996.5	.0	48.4	.0	.0	.0	.0	.0
4	9.1	22614.7	.0	1891.4	.0	.0	.0	.0	.0
5	9.5	30446.4	.0	4213.2	.0	.0	.0	.0	.0
6	9.8	37586.9	.0	5856.6	.0	.0	.0	.0	.0
7	10.0	43623.8	.0	6799.9	.0	.0	.0	.0	.0
8	10.0	48218.5	.0	7030.7	.0	.0	.0	.0	.0
9	9.9	51123.8	.0	6545.8	.0	.0	.0	.0	.0
10	9.7	52197.6	.0	5351.8	.0	.0	.0	.0	.0
11	9.3	51410.1	.0	3464.4	.0	.0	.0	.0	.0
12	7.2	39848.3	.0	957.6	.0	.0	.0	.0	.0
13	1.6	8968.7	.0	.0	.0	.0	.0	.0	.0
14	.8	4292.9	.0	.0	.0	.0	.0	.0	.0
15	7.5	38044.0	.0	.0	.0	.0	.0	.0	.0
16	7.6	32804.2	.0	.0	.0	.0	.0	.0	.0
17	6.8	23237.6	.0	.0	.0	.0	.0	.0	.0
18	5.9	14286.4	.0	.0	.0	.0	.0	.0	.0
19	4.9	6570.2	.0	.0	.0	.0	.0	.0	.0
20	2.5	958.1	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	278.85	507.78
2	285.92	500.71
3	293.82	494.58
4	302.42	489.48
5	311.59	485.49
6	321.18	482.67
7	331.06	481.07
8	341.05	480.72
9	351.01	481.61
10	360.78	483.74
11	370.21	487.07
12	379.15	491.55
13	387.47	497.10
14	395.02	503.65
15	401.70	511.09
16	407.40	519.31
17	412.04	528.17
18	415.53	537.54
19	415.64	538.00

Circle Center At X = 338.9 ; Y = 560.8 and Radius, 80.1

*** 1.236 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	278.85	507.78
2	285.95	500.74
3	293.91	494.69
4	302.59	489.72
5	311.83	485.92
6	321.50	483.35
7	331.42	482.06
8	341.42	482.07
9	351.33	483.38
10	360.99	485.97
11	370.23	489.78
12	378.90	494.77
13	386.84	500.84
14	393.93	507.90
15	400.05	515.81
16	405.08	524.45
17	408.95	533.68
18	410.13	538.00

Circle Center At X = 336.3 ; Y = 558.5 and Radius, 76.6
*** 1.267 ***
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	278.85	507.78
2	286.11	500.91
3	294.17	494.99
4	302.90	490.12
5	312.17	486.35
6	321.83	483.77
7	331.74	482.40
8	341.73	482.26
9	351.67	483.36
10	361.40	485.68
11	370.77	489.18
12	379.63	493.82
13	387.85	499.51
14	395.30	506.18
15	401.87	513.72
16	407.46	522.01
17	411.98	530.93
18	414.53	538.00

Circle Center At X = 337.8 ; Y = 562.8 and Radius, 80.6
*** 1.284 ***
Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	278.85	507.78
2	286.39	501.22
3	294.61	495.52
4	303.40	490.74
5	312.65	486.96
6	322.26	484.20
7	332.12	482.50
8	342.10	481.89
9	352.09	482.37
10	361.97	483.93
11	371.61	486.56
12	380.92	490.23
13	389.77	494.88
14	398.06	500.47
15	405.69	506.93
16	412.58	514.19
17	418.63	522.15
18	423.78	530.72
19	427.14	538.00

Circle Center At X = 342.7 ; Y = 573.6 and Radius, 91.7
*** 1.296 ***
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	271.80	505.56
2	280.26	500.24
3	289.08	495.54
4	298.22	491.47
5	307.63	488.08
6	317.25	485.36
7	327.05	483.35
8	336.96	482.03
9	346.94	481.44
10	356.94	481.55
11	366.91	482.39
12	376.79	483.93
13	386.53	486.18
14	396.09	489.12
15	405.41	492.73

16	414.45	497.01
17	423.16	501.92
18	431.50	507.44
19	439.42	513.54
20	446.89	520.20
21	453.85	527.37
22	460.29	535.03
23	462.45	538.00

Circle Center At X = 350.3 ; Y = 621.0 and Radius, 139.6

*** 1.309 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	278.85	507.78
2	286.08	500.88
3	294.17	495.00
4	302.97	490.25
5	312.32	486.71
6	322.06	484.44
7	332.02	483.48
8	342.01	483.85
9	351.87	485.55
10	361.41	488.54
11	370.47	492.77
12	378.89	498.17
13	386.52	504.63
14	393.22	512.05
15	398.88	520.30
16	403.39	529.22
17	406.45	538.00

Circle Center At X = 334.2 ; Y = 558.6 and Radius, 75.2

*** 1.337 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	285.90	510.00
2	292.99	502.95
3	300.59	496.45
4	308.67	490.55
5	317.16	485.27
6	326.03	480.66
7	335.23	476.72
8	344.69	473.49
9	354.37	470.99
10	364.21	469.22
11	374.16	468.21
12	384.16	467.94
13	394.15	468.44
14	404.07	469.68
15	413.87	471.68
16	423.49	474.40
17	432.88	477.85
18	441.98	482.00
19	450.74	486.82
20	459.11	492.29
21	467.04	498.37
22	474.49	505.04
23	481.42	512.25
24	487.78	519.97
25	493.54	528.14
26	498.67	536.73
27	499.31	538.00

Circle Center At X = 382.6 ; Y = 600.2 and Radius, 132.3

*** 1.364 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	264.74	505.00
2	273.38	499.95
3	282.41	495.66
4	291.77	492.15
5	301.40	489.45
6	311.23	487.58
7	321.17	486.56
8	331.17	486.39
9	341.15	487.07
10	351.03	488.59
11	360.75	490.96
12	370.23	494.14
13	379.40	498.12
14	388.20	502.87
15	396.57	508.34
16	404.44	514.52
17	411.75	521.34
18	418.46	528.75
19	424.51	536.72
20	425.32	538.00

Circle Center At X = 328.2 ; Y = 603.5 and Radius, 117.2

*** 1.374 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	271.80	505.56
2	280.41	500.48
3	289.24	495.79
4	298.27	491.50
5	307.48	487.61
6	316.86	484.13
7	326.38	481.08
8	336.03	478.45
9	345.78	476.25
10	355.63	474.48
11	365.54	473.16
12	375.50	472.28
13	385.49	471.84
14	395.49	471.85
15	405.48	472.30
16	415.44	473.19
17	425.35	474.52
18	435.19	476.30
19	444.95	478.51
20	454.59	481.15
21	464.11	484.22
22	473.48	487.70
23	482.69	491.60
24	491.71	495.91
25	500.54	500.61
26	509.15	505.70
27	517.52	511.17
28	525.64	517.00
29	533.50	523.19
30	541.07	529.72
31	548.34	536.58
32	549.72	538.00

Circle Center At X = 390.3 ; Y = 696.7 and Radius, 224.9

*** 1.385 ***

7225 / 11
part 17

Alliance Consulting, Inc.
Engineers • Constructors • Scientists

ILLINOIS DEPARTMENT OF NATURAL RESOURCES
PERMIT NO. 375
REPORT
PERMANENT DEFORMATION EVALUATION
VOLUME 5 OF 7

POND CREEK NO. 1 COAL REFUSE DISPOSAL SITE
SOUTH CELL SLURRY IMPOUNDMENT
JOHNSTON CITY, WILLIAMSON COUNTY, ILLINOIS

Prepared for

WILLIAMSON ENERGY, LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B10-148-1413
NOVEMBER 2010

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ILLINOIS DEPARTMENT OF NATURAL RESOURCES
PERMIT NO. 375
REPORT
PERMANENT DEFORMATION EVALUATION
VOLUME 5 OF 7

POND CREEK NO. 1 COAL REFUSE DISPOSAL SITE
SOUTH CELL SLURRY IMPOUNDMENT
JOHNSTON CITY, WILLIAMSON COUNTY, ILLINOIS

Prepared for

WILLIAMSON ENERGY, LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B10-148-1413
NOVEMBER 2010

REPORT
PERMANENT DEFORMATION EVALUATION

POND CREEK NO. 1 COAL REFUSE DISPOSAL SITE
SOUTH CELL SLURRY IMPOUNDMENT
JOHNSTON CITY, WILLIAMSON COUNTY, ILLINOIS

Prepared For:

WILLIAMSON ENERGY, LLC
BECKLEY, WEST VIRGINIA

Prepared By:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
EXPORT, PENNSYLVANIA

CEC Project 072-046

January 23, 2008

EXECUTIVE SUMMARY

Plans have been developed for the construction of a coarse and fine coal refuse disposal facility to be located near Johnston City in Williamson County, Illinois. The proposed Pond Creek facility will provide disposal capacity for both coarse and fine coal refuse produced by the Pond Creek Mine No. 1 coal preparation plant located approximately 0.25 mile to the west. The location of the site is just southwest of the intersection of Dwina Road and Dean Road and is shown on Figure 1.

The design plans for the Phase 2 expansion of the Pond Creek facility, submitted under separate cover by Alliance Consulting, Inc. (Alliance) of Beckley, West Virginia, includes raising the embankment crest to Elevation (El.) 502 by constructing a coarse coal refuse embankment cell (South Cell). The corresponding minimum and maximum fine coal refuse slurry impoundment levels for the proposed South Cell are El. 474 and El. 496, respectively (along the Section A-A line shown in Figure 3).

The Illinois Department of Natural Resources (IDNR) has required that a revised (seismic) slope stability analysis be performed for the South Cell using equivalent static load methods and the appropriate peak acceleration based on the Peak Ground Acceleration (PGA) for the 2% Probability of Exceedance in 50 Years maps from the USGS. If the required factor of safety is not met, i.e., a minimum factor of safety of 1.0 with seismic forces for the steady seepage condition, a permanent deformation evaluation should be completed and submitted for review before an IDNR/OWR permit can be issued. Accordingly, Civil & Environmental Consultants, Inc. (CEC) has revised the seismic slope stability analyses and the minimum factors of safety do not meet the required 1.0 safety factor criteria. Subsequently, CEC has performed and completed a detailed deformation evaluation of the proposed Pond Creek South Cell impoundment addressing relevant issues such as material characterizations, seismic hazard, induced cyclic shear stresses and permanent deformations. CEC was authorized and performed this evaluation in accordance with the Williamson Energy, LLC (Williamson) Purchase Order (P.O.) Number 4175.

Permanent deformation analyses indicated that the South Cell is **NOT** susceptible to adverse post-earthquake permanent deformations. These conclusions are based on the results of high quality field testing and detailed seismically-related engineering and deformation analyses in both the upstream and downstream directions.

CEC, in cooperation with ConeTec, Inc. (ConeTec) developed and implemented a detailed field testing program, which utilized the most recent advances in piezo-seismic cone penetration testing (PS-CPT) to obtain a significant volume of credible field test results of the existing coarse coal refuse and residual soil materials at depth.

A probabilistic seismic hazard assessment (PSHA) was performed utilizing the 2002 USGS Earthquake Hazards Program, Interactive Deaggregation Maps (Frankel, 2002), specifically the 2% Probability of Exceedance in 50 Years recurrence interval to select the maximum design earthquake (MDE) and estimate the corresponding PGA for the Pond Creek site. A PGA value of 0.54g was estimated for two (2) controlling maximum design earthquake (MDE) events, including a magnitude (M) 8.0 New Madrid, Missouri regional earthquake located 83 kilometers (km) from the site, and a M6.8 Background earthquake located 13.5 km from the site, respectively.

Post-earthquake permanent deformation analyses were performed to estimate the anticipated maximum crest settlements for the two (2) MDE events. Based on the results of these analyses, the estimated maximum deformations are about 17 inches (1.4 feet) for both MDE scenarios. The relatively small deformations are attributable to the low frequency embankment response as compared to the predominantly higher frequency content of the applicable synthetic MDE acceleration time histories created for the Pond Creek site from eastern North American (ENA) earthquake ground motion attenuation (GMA) relationships. Given the minimum available freeboard of 6 feet, the post-earthquake deformations of 1.4 feet do not pose a threat to the integrity of the South Cell geometry.

Therefore, it is CEC's opinion the Pond Creek South Cell impoundment can be operated up to the proposed geometry with no appreciable risk of a release of tailings downstream or upstream due to permanent deformations expected from any site specific MDE event. It is also understood the Pond Creek facility will be operated with an impoundment level at the lowest practical elevation except during periods of intense rainfall. Analyses were not performed for the simultaneous occurrence of intense rainfall and an MDE due to the low probability of both events occurring at the same time.

TABLE OF CONTENTS

Page

Executive Summary

1.0 Introduction 1
1.1 Background and Authorization 1
1.2 Seismic Design and Analysis Methodology 2
1.3 Scope of Services 2

2.0 Existing Conditions and Coal Refuse Disposal Plan 5
2.1 Existing Conditions 5
2.2 Coal Refuse Expansion Plan 5

3.0 Geotechnical Field Investigations 6
3.1 General 6
3.2 Field Testing Procedures and Results Summary 8
3.2.1 In-Situ Piezo-Seismic Cone Penetration Testing 8
3.2.2 Shear Wave Velocity Measurements 8

4.0 Subsurface Conditions 11
4.1 Refuse and Residual Soil Boundaries 11
4.2 Groundwater Conditions 13

5.0 Seismic Hazard Assessment 14
5.1 Methodology 14
5.2 Pond Creek Probabilistic Seismic Hazard Assessment 15
5.2.1 Selection of Maximum Design Earthquake Events and Peak Ground Acceleration 15
5.3 Creation of Pond Creek Synthetic Acceleration-Time Histories 17
5.3.1 Stochastic Modeling 17
5.3.2 Source Spectrum Input 18
5.4 Comparative Assessment of Synthetic Eastern U.S. and Actual Western U.S. Earthquake Response Spectra 20
5.4.1 SHAKE Input Model 20
5.4.2 Discussion of SHAKE Output 21

6.0 Permanent Deformation Analyses 23
6.1 Analytical Approach 23
6.1.1 Newmark Analysis of Permanent Deformations 23
6.2 Determination of the Revised Pseudo-Static Seismic Factors of Safety and Yield Accelerations 24
6.3 SHAKE2000 Analyses 26
6.3.1 SHAKE2000 Input Summary 26

Table of Contents (Continued)
Page ii

Page

6.3.2 SHAKE2000 Results Summary 27
6.4 Analyses to Define Time-Histories of Acceleration 27
6.5 Critical Mass Displacements 28

7.0 Summary and Conclusions 30

References

TABLES

Table 1 – Source Zone Maximum Magnitude, Intensity and Depth
Table 2 – Source Zone Maximum Magnitude, Depth and PGA
Table 3 – Summary of Engineering Properties
Table 4 – Refuse/Soil Properties Used in Revised Pseudo-Static and Yield Acceleration Slope Stability Analyses

FIGURES

Figure 1 – Site Location Map
Figure 2 – CPT Sounding Location Plan
Figure 3 – Pseudo-Static and Yield Acceleration Slope Stability Analyses Results

APPENDICES

Appendix A – Piezo-Seismic Cone Penetration Testing (PS-CPT) and Results
A-1 – Summary of Piezo-Seismic Cone Penetration Testing
A-2 – ConeTec, Inc. Field Report
A-3 – Normalized PS-CPT Data and Parameter Correlations
A-4 – Photographs of October 2007 Field Testing

Appendix B – Characterization of Subsurface Conditions
B-1 – Shear Modulus Correlations for SHAKE Columns PCSC300E and PCSC300M
B-2 – Estimation and Summary of Engineering Properties including Peak Undrained Shear Strength for Refuse and Residual Soil Materials
B-3 – Laboratory Test Results Provided by Alliance Consulting, Inc.

Table of Contents (Continued)
Page iii

Appendix C – Seismic Hazard Assessment
C-1 – Probabilistic Seismic Hazard Assessment
C-2 – Simulation of Acceleration-Time Histories Using Stochastic Modeling and Comparative Assessment of Synthetic Eastern U.S. and PEER Database (Actual) Western U.S. Earthquake Records, Acceleration Time-Histories and Response Spectra

Appendix D – Permanent Deformation Analyses
D-1 – Estimation of the Pseudo-Static Seismic Factors of Safety and Yield Accelerations for the Downstream and Upstream Slope Geometries
D-2 – Estimating the Induced Cyclic Shear Stresses and Strains, and Time-Histories of Cyclic Shear Stress, SHAKE Columns PCSC300E and PCSC300M
D-3 – Estimates of Potential Embankment Settlements (Permanent Deformations)

1.0 INTRODUCTION

Plans have been developed for the construction of a coarse and fine coal refuse disposal facility to be located near Johnston City in Williamson County, Illinois. The proposed Pond Creek facility will provide disposal capacity for both coarse and fine coal refuse produced by the Pond Creek Mine No. 1 coal preparation plant located approximately 0.25 mile to the west. The location of the site is just southwest of the intersection of Dwina Road and Dean Road and is shown on Figure 1.

The design plans for the Phase 2 expansion of the Pond Creek facility, submitted under separate cover by Alliance Consulting, Inc. (Alliance) of Beckley, West Virginia, includes raising the embankment crest to Elevation (El.) 502 by constructing a coarse coal refuse embankment cell (South Cell). The corresponding minimum and maximum fine coal refuse slurry impoundment levels for the proposed South Cell are El. 474 and El. 496, respectively (along the Section A-A line shown in Figures 2 and 3).

1.1 BACKGROUND AND AUTHORIZATION

The Illinois Department of Natural Resources (IDNR) has required that a revised (seismic) slope stability analysis be performed for the South Cell using equivalent static load methods and the appropriate peak acceleration based on the Peak Ground Acceleration (PGA) for the 2% Probability of Exceedance in 50 Years maps from the USGS. If the required factor of safety is not met, i.e., a minimum factor of safety of 1.0 with seismic forces for the steady seepage condition, a permanent deformation evaluation should be completed and submitted for review before an IDNR/OWR permit can be issued.

Accordingly, Civil & Environmental Consultants, Inc. (CEC) has revised the seismic slope stability analyses and the minimum factors of safety do not meet the required 1.0 safety factor criteria. Subsequently, CEC performed and completed a detailed deformation evaluation of the proposed South Cell impoundment addressing relevant issues such as material characterizations,

seismic hazard, induced cyclic shear stresses and permanent deformations. CEC was authorized and performed this evaluation in accordance with the Williamson Energy, LLC (Williamson) Purchase Order (P.O.) Number 4175.

1.2 SEISMIC DESIGN AND ANALYSIS METHODOLOGY

The permanent deformation analyses performed by CEC for the proposed South Cell facility uses well-established field testing and analytical procedures developed by highly specialized and experienced authors. Pertinent references are cited throughout this report and a list of references is attached.

1.3 SCOPE OF SERVICES

In general, the scope of services performed by CEC for the South Cell included performing highly specialized cone penetration field testing, characterizing the coal refuse and residual soil materials, assessing seismic hazard, estimating induced cyclic shear stresses, evaluating yield accelerations, and estimating permanent deformations. More specifically, CEC's scope of services included:

1. Developing and implementing a detailed field testing program, which utilized the most recent advances in cone penetration testing (CPT) to obtain a significant volume of credible field test results of the available coarse refuse and underlying clayey/sandy residual soil materials, including:

    a. Piezo-seismic cone penetration testing (PS-CPT) at 15 sounding locations shown in Figure 2. PS-CPT obtains a continuous profile of tip stress, sleeve stress and pore-pressure to measure in-situ the consistency of the existing materials, and correlate field data to numerous in-situ static parameters. Also, PS-CPT measures shear wave velocities (at approximate 3-foot intervals) to correlate in-situ dynamic properties of the refuse and soil materials with depth;

2. A probabilistic seismic hazard assessment (PSHA) developed specifically for the Pond Creek site, which utilized the 2002 USGS Earthquake Hazards Program, Interactive Deaggregation Maps (Frankel, 2002) and the 2% Probability of Exceedance in 50 Years recurrence interval for the site coordinates, and evaluated both local and regional seismic source contributions. Based on the interactive deaggregation plots, the PSHA for the Pond Creek facility included contributions from two (2) Maximum Design Earthquake (MDE) scenarios: a high magnitude (M) 8.0 earthquake associated with a New Madrid, Missouri earthquake event located approximately 83 kilometers (km) from the site, and a smaller, M6.8 Background earthquake located about 13.5 km from the site. The USGS M8.0 and M6.8 MDE earthquake scenarios yielded a corresponding PGA of 0.54g for the site. Time histories and PGAs from both MDE events were used in the various seismic shear stress and deformation analyses to evaluate the response of the Pond Creek facility to the PGA, duration and frequency content.

3. Revising pseudo-static seismic slope stability analyses, and estimating yield accelerations and permanent deformations (crest settlements) as a function of time-history horizontal shear stresses generated within the embankment mass due to the anticipated MDE events and shear moduli developed from in-situ shear wave velocities measured during PS-CPT.

   Permanent deformation analyses included the use of stochastic modeling based on the published predictive relations of Atkinson and Boore (1995) and the program SIMSM (Boore, 1996) to create a synthetic acceleration-time history for each MDE scenario consistent with the most recent advances in development of eastern North American (ENA) earthquake response. The source ground motion was estimated using published criteria, such as moment magnitude, epicentral distance, focal depth, etc. The resulting synthetic time-histories are representative of the current state-of-the-art understanding for ENA earthquakes, as opposed to the previously used western United States (U.S.) earthquakes, which drastically differ in frequency content and source-distance attenuation relationships. Additionally, as a comparison, a western U.S. earthquake record from a

1989 Loma Prieta, California M6.9 earthquake and corresponding acceleration time-history was used to evaluate the site response (response spectra). Both the M6.8 Background and M6.9 Loma Prieta earthquakes response spectra were compared to five (5) published ENA and Central United States (CEUS) ground motion attenuation (GMA) relationships and corresponding response spectra to assess the reasonableness of the ENA/CEUS versus western U.S. earthquake record response.

4. Finally, based on the results of the aforementioned analyses, drawing conclusions regarding the likelihood of excessive downstream or upstream deformations resulting in overtopping of the South Cell crest due to the MDE events at the Pond Creek facility.

The following sections of this report include generalized descriptions of the existing conditions, CEC's understanding of the proposed coal refuse disposal plan, detailed descriptions of the field testing programs and subsurface conditions encountered at the Pond Creek site. Also presented are summaries of the analytical techniques and results of the material characterizations and various permanent deformation analyses. Figure 1 presents a site location map, Figure 2 presents the PS-CPT sounding plan and Figure 3 presents the Cross-Section A-A, Pond Creek South Cell embankment geometry and results of the yield acceleration analysis. Appendices A through D present supporting information including detailed calculation briefs for the various field and analytical procedures discussed herein.

2.0 EXISTING CONDITIONS AND COAL REFUSE DISPOSAL PLAN

2.1 EXISTING CONDITIONS

The proposed coal refuse disposal facility is located approximately seven (7) miles northeast of Johnston City, Illinois. The embankment is situated southwest of the intersection of Dwina Road and Dean Road. The Pond Creek Mine No. 1 coal preparation plant is located approximately 0.25 mile west of the embankment.

CEC understands the proposed South Cell impoundment area was previously used for agricultural purposes. Based on our observations, the area has relatively flat to mild slopes to the ridgeline at approximate El. 572. The surrounding landscape is characterized by extensive agricultural and rural residential land use.

2.2 COAL REFUSE EXPANSION PLAN

The Pond Creek disposal plan, as prepared by Alliance, provides for the disposal of approximately 1.6 years of coarse coal refuse and 3.2 years of fine coal refuse based on production rates provided by Williamson. The facility shall be constructed in two (2) phases consisting of an excavated starter cell (Phase 1) and a downstream coarse coal refuse embankment (Phase 2).

CEC understands, based on information provided by Alliance, that the proposed plan raises the crest to El. 502 by constructing a coarse coal refuse embankment. CEC also understands that the proposed plan was prepared in accordance with prudent engineering principles and practices, and interpretation of current Mine Safety and Health Administration (MSHA) and IDNR design criteria for coal refuse disposal facilities.

3.0 GEOTECHNICAL FIELD INVESTIGATIONS

3.1 GENERAL

CEC developed and implemented a subsurface exploration plan including performing a total of 15 PS-CPT soundings at the Pond Creek site on October 30 and 31, 2007 at the approximate locations shown in Figure 2. PS-CPT was performed by ConeTec, Inc. (ConeTec) of West Berlin, New Jersey using a 25-ton, unitized, track-mounted cone penetration rig. PS-CPT was also performed under the observation and guidance of experienced CEC personnel.

PS-CPT locations designated as CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A, CPT-5B, CPT-6, CPT-7, CPT-8, CPT-9, CPT-10, CPT-11 and CPT-12 were located by CEC within areas that included the proposed South Cell, North Central Cell and North Cell impoundment areas. CPT-2, CPT-2A, CPT-5, CPT-5A and CPT-5B soundings were located on an existing coarse coal refuse embankment, and were pushed through coarse refuse and the underlying residual soil. CPT-1, CPT-3, CPT-4, CPT-6, CPT-7, CPT-8, CPT-9, CPT-10, CPT-11 and CPT-12 were located throughout the facility at the approximate existing ground surface and were pushed exclusively through residual soil.

A total of eight (8) soundings were considered most applicable to the Pond Creek South Cell including CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B. Ground surface elevations of the soundings were provided by Williamson. The following presents a summary of the field testing, including the CPT sounding number, site coordinates, existing ground surface elevation, total depth, interpolated ground water depth and applicable slurry cell.

Table 1: Summary of October 2007 CPT Soundings – Pond Creek Coal Refuse Disposal Site

CPT No.	Northing (ft)	Easting (ft)	Ground Surface Elev.(ft)	Total Depth (ft)	GWT Interpolated (ft)	Applicable Slurry Cell
CPT-1	425784.32	358548.87	482.19	18.4	15.3	South
CPT-2	426832.42	357857.50	494.21	45.3	38.8	South, Central, North
CPT-2A	426828.92	358156.73	492.40	41.7	37.0	South, Central, North
CPT-3	426792.78	359207.80	466.98	22.2	11.1	South
CPT-4	426331.10	360108.80	482.55	18.9	21.7	South
CPT-5	427485.26	357913.86	482.55	49.2	34.4	South, Central, North
CPT-5A	427607.60	357920.84	483.00	53.2	35.9	South, Central, North
CPT-5B	427147.68	358343.06	479.90	39.7	28.0	South, Central, North
CPT-6	427450.46	358992.62	457.78	22.6	9.2	Central
CPT-7	427450.88	359850.00	457.83	16.7	9.2	Central
CPT-8	429006.12	358034.04	444.45	17.9	6.6	Central, North
CPT-9	429077.69	359026.20	445.68	22.0	7.8	Central, North
CPT-10	428965.83	359998.44	442.09	26.1	3.4	Central, North
CPT-11	430316.82	358810.96	440.59	27.6	11.4	North
CPT-12	430141.83	359852.30	442.08	22.6	11.7	North

A summary of the PS-CPT operations prepared by CEC and the complete report of field test data and various parameter correlations prepared by ConeTec are presented in Appendix A, Attachments A-1 and A-2, respectively. Groundwater depths were interpolated by CEC between groundwater well data provided by Williamson.

3.2 FIELD TESTING PROCEDURES AND RESULTS SUMMARY

3.2.1 In-Situ Piezo-Seismic Cone Penetration Testing

Determining the dynamic response of the South Cell embankment and underlying residual soils requires knowledge of the subsurface material's dynamic properties to accurately predict the horizontal shear stresses and strains induced in the various materials by a given earthquake loading. Of particular significance in the dynamic evaluation is the distribution of density of the coal refuse materials with depth. The low-amplitude, small strain shear modulus (G) with depth is an important parameter for characterizing the behavior and response of a soil column during earthquake shaking. The shear modulus is a function of the in-situ shear wave velocity estimated at the site with depth and was obtained in the field utilizing PS-CPT.

The main purpose of the PS-CPT was to measure in-situ shear wave (S-wave) travel times for subsequent calculation of shear wave velocity (V_S) and G; however, tip resistance (q_t), sleeve friction (f_s) and dynamic pore pressure (u_t) were also measured. CPT provides nearly continuous in-situ field data, which was correlated to classification and in-situ strength values based on established procedures such as those outlined in Robertson and Campanella (1988).

3.2.2 Shear Wave Velocity Measurements

The seismic wave form portion of the PS-CPT was conducted by ConeTec at about 3-foot intervals throughout the soil profile to the maximum depths indicated. The down-hole seismic survey is a reliable technique for obtaining shear wave and compression wave velocities accounting for the subsurface material's attenuation and anisotropic effect with depth (Hoar and Stokoe, 1978) (Dobry et al., 1981) (Stokoe and Nazarian, 1985). Only S-wave travel times were measured for each sounding with depth. These travel times were used to calculate the corresponding V_S and G used in the dynamic analyses of the Pond Creek facility. The in-situ seismic survey measured shear wave velocities at locations CPT-1 through CPT-12 from the

existing ground surface through coarse coal refuse, where applicable, and also through residual soil materials. Shear wave velocities in feet per second (fps) per material type were estimated by ConeTec and the minimum, maximum and weighted averages are summarized as follows:

Table 2: Summary of CPT Shear Wave Velocity Summary – Pond Coal Refuse Disposal Site

CPT No.	Shear Wave Velocity Max./Min./Avg. Coarse Coal Refuse (fps)	Shear Wave Velocity Max./Min./Avg. Residual Soil (fps)
CPT-1	NA	1402 645 905
CPT-2	1284 1029 1120	1173 795 957
CPT-2A	1169 895 1042	1256 780 918
CPT-3	NA	1058 569 765
CPT-4	NA	1242 476 817
CPT-5	1190 936 1063	1599 780 947
CPT-5A	1396 779 1064	1580 728 1005
CPT-5B	1517 818 1080	1649 686 978
CPT-6	NA	1022 514 796
CPT-7	NA	894 514 682
CPT-8	NA	1036 541 783
CPT-9	NA	1484 415 835
CPT-10	NA	1217 478 828
CPT-11	NA	1387 471 925
CPT-12	NA	1230 530 763

In general, shear wave velocities in coarse refuse ranged from about 779 to 1,517 fps with an average value of about 1,074 fps. For the residual soils, Vs ranged from 415 to 1,649 fps with an average value of about 860 fps. Measured values of V_S for coarse refuse and residual soil materials and the density of the respective material with depth are used to estimate the initial shear modulus, G, for use in the one-dimensional, dynamic SHAKE2000 (Ordonez, 2006) analysis of the embankment. G-values estimated are subsequently used in the calculation of

induced cyclic shear stress at a SHAKE soil column location (e.g., PCSC300) shown in Figure 3. Appendix A, Attachment A-2 presents the complete ConeTec report, and Appendix B, Attachment B-1 presents the computations of G for the SHAKE columns from in-situ measurements of V_S for the coarse refuse, residual soil and bedrock materials, and includes plots of V_S and G with depth.

4.0 SUBSURFACE CONDITIONS

4.1 REFUSE AND RESIDUAL SOIL BOUNDARIES

Figure 2 depicts the location of the 15 PS-CPT soundings conducted at the site in October 2007. Figure 3 presents a generalized cross-section (A-A) of the South Cell impoundment. In general, CPT-2, CPT-2A, CPT-5, CPT-5A and CPT-5B were advanced from the existing crest between approximately El. 480 and 495 through approximately 19 to 32 feet of coarse coal refuse. Residual soil materials were encountered in all CPT soundings below approximate El. 440 to 482. All CPT soundings were advanced until refusal at depths ranging from 16.4 to 53.2 feet below the existing ground surface.

The stratification lines at the various depths corresponding to the generalized cross-section described herein and as shown in Figure 3 were adjusted to account for conditions encountered in the field. Refuse and residual soil properties based on the Alliance expansion plan submittal and static stability analyses were reviewed by CEC and considered to be reasonably consistent with the observed field data, and as such, were used throughout our analyses. Site-specific refuse/soil profiles based on the October 2007 PSCPT data for the applicable South Cell CPT soundings are as follows:

CPT-1	CPT-2
El. 482.19 – Surface Elevation	El. 494.21 – Surface Elevation
15.3 feet – Depth to Static Ground Water	38.8 feet – Depth to Static Ground Water
0 – 18.4 feet – Residual Soil	0 – 32 feet – Coarse Refuse
Refusal at 18.4 feet – Bedrock	32 – 45.3 feet – Residual Soil
	Refusal at 45.3 feet – Bedrock

CPT-2A	CPT-3
El. 492.40 – Surface Elevation	El. 466.98 – Surface Elevation
37.0 feet – Depth to Static Ground Water	11.1 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 22.2 feet – Residual Soil
29 – 41.7feet – Residual Soil	Refusal at 22.2 feet – Bedrock
Refusal at 41.7feet – Bedrock	

CPT-4	CPT-5
El. 482.55 – Surface Elevation	El. 482.55 – Surface Elevation
21.7 feet – Depth to Static Ground Water	34.4 feet – Depth to Static Ground Water
0 – 18.9 feet – Residual Soil	0 – 29 feet – Coarse Refuse
Refusal at 18.9 feet – Bedrock	29 – 49.2feet – Residual Soil
	Refusal at 49.2 feet – Bedrock

CPT-5A	CPT-5B
El. 483.00 – Surface Elevation	El. 479.90 – Surface Elevation
35.9 feet – Depth to Static Ground Water	28.0 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 19 feet – Coarse Refuse
29 – 53.2 feet – Residual Soil	19 – 39.7 feet – Residual Soil
Refusal at 53.2 feet – Bedrock	Refusal at 39.7 feet – Bedrock

A generalized profile at Station (STA) 300 shown below was created based on the individual layer designations shown above for which data were weight averaged, and the critical South Cell embankment geometry shown in Figure 3 was correspondingly accounted for (including the maximum and minimum phreatic surface) to create the generalized profile.

GENERALIZED PROFILE FOR POND CREEK SOUTH CELL
El. 502 – Surface Elevation
14 to 32 feet – Depth to Ground Water Table
0 – 32 feet – Coarse Refuse
32 – 50 feet – Residual Soil

Figure 3 presents the generalized embankment Cross-Section A-A, which includes the surface and subsurface geometry, and incorporates variations in stratigraphy estimated during field testing and subsequent review of available data. The description of the subsurface conditions at the site, as presented herein, is generalized from the available plan submittal information and interpolated between the soundings pushed during this subsurface exploration. The boundary lines between soil types are also estimated based on existing plan information, available field test data, and the samples recovered from the borings (by others).

4.2 GROUNDWATER CONDITIONS

Groundwater levels were provided by Williamson for existing groundwater wells installed throughout the Pond Creek site and are presented in Appendix A, Attachment A-1. Groundwater levels at the various CPT soundings were estimated based on the latest groundwater information. Groundwater levels are typically also estimated from static pore pressure readings and pore pressure dissipation tests performed by ConeTec during PS-CPT; however, long-term pore pressure dissipation in the clayey residual soils was not fully realized due to the relative impermeability of the materials. Consequently, groundwater levels were interpolated between wells based on the piezometric levels measured in the field. The groundwater conditions noted represent conditions only at the actual time and location observed and may fluctuate with time and/or location.

5.0 SEISMIC HAZARD ASSESSMENT

5.1 METHODOLOGY

A probabilistic seismic hazard assessment (PSHA) was performed for the Pond Creek site located near Johnston City, Williamson County, Illinois. PSHA involved utilizing the 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps (Frankel, 2002), particularly the 2% Probability of Exceedance in 50 Years recurrence interval for the site coordinates and the development of a particular seismic scenario upon which the ground motion hazard evaluation was based. The scenario consisted of the postulated occurrence of an earthquake (i.e., 2% Probability of Exceedance in 50 Years) of a specified size based on the latest USGS hazard mapping surrounding the Pond Creek site. In general, PSHA involved four (4) basic elements:

1. Evaluate earthquake sources;
2. Determine controlling earthquake(s): the maximum magnitude and maximum design earthquake;
3. Determination of GMA relationships or distance from the site; and
4. Determination the peak ground acceleration (PGA).

PSHA, utilizing the deaggregation maps, determines the earthquakes that have the most significant impacts at the site, and for engineering design and analyses of tailing dams, a design earthquake is desired.

Stochastic modeling, based on the published predictive relations of Atkinson and Boore (1995), was subsequently used to create synthetic acceleration-time histories for the critical earthquake scenarios. The required input parameters for the critical earthquake source spectra, including moment magnitude, epicentral distance and focal depth were developed from the published information discussed above and summarized below.

Subsequently discussed below is a comparison of input parameters and site response made by CEC using both eastern U.S. synthetic earthquake time histories and actual western U.S. earthquake time histories. Available records were scaled in SHAKE to the Pond Creek site PGA and the site response compared to published eastern U.S. GMA response spectra to assess the reasonableness of the various time histories.

5.2 POND CREEK PROBABILISTIC SEISMIC HAZARD ASSESSMENT

The PSHA methodology chosen for this evaluation represents a more refined approach to previous methods which solely used empirical, pseudo-static embankment analyses. Similarly, the PSHA developed specifically for the Pond Creek site also attempts to eliminate the potential for over-conservative, unrealistic strong ground motion associated with the "floating earthquake" concept. This approach is generally applied in regions where active earthquake-generating surface faults exist and the intensity-based peak acceleration relationships are from only long-period western U.S. and Japanese seismic activity and more importantly, the peak acceleration does not account for distance.

5.2.1 Selection of Maximum Design Earthquake Events and Peak Ground Acceleration

Based on the most critical regional and local seismic events to the Pond Creek site as identified by the USGS deaggregation mapping, two (2) MDE scenarios were selected for analysis including a magnitude (M) 8.0, which has boundary limits of about 83 km from the site and the potential to generate a high intensity earthquake. The Pond Creek site also has the potential to be impacted by a smaller magnitude earthquake or a comparable local "background" earthquake at a closer epicentral distance to the site, which based on the USGS seismic hazard program is an M6.8 at 13.5 km. The PGA associated with this hazard was defined at 0.54g. Several other potential regional and local events were identified by the USGS deaggregation mapping; however, these two (2) MDE scenarios were considered the most critical and were subsequently used to evaluate their impact on the Pond Creek impoundments since the maximum ground

accelerations, frequency contents and durations of effective cycles will be notably different. The 2002 USGS Interactive Deaggregation Maps including the 2% Probability of Exceedance in 50 Years maps are presented in Appendix C, Attachment C-1.

The rate at which the strength of earthquake ground motion attenuates and the amount of geometric spreading with distance from the epicenter is required for seismic hazard analyses. The focal depth of the earthquake and the near surface geological conditions have a significant influence on the intensity attenuation relationship. Information on earthquakes occurring in the eastern U.S. suggests that surface faulting does not occur and the center of energy release is deeper than the average of California earthquakes. The earthquake energy is therefore radiated over a larger area than is experienced in California, and California data cannot be extrapolated directly to this region. Several ENA and CEUS GMA relationships including Toro, et.al. (1997), Atkinson & Boore (1997), Campbell (2003), Atkinson (2001) and Tavakoli & Pezeshk (2005) were used to compare the USGS PGA for the Pond Creek site to that of other ENA and CEUS ground motion relationships.

As previously discussed, CEC utilized the Atkinson and Boore (1995) empirically-derived earthquake source spectra model for ENA hard rock sites, and created quality synthetic acceleration-time histories for the bedrock motions. Subsequently, the various input parameters from these ENA synthetic earthquake records were compared to the input and time histories scaled accordingly to the PGA anticipated at the Pond Creek site. Also, selection of an earthquake time history record from the Pacific Earthquake Engineering Record (PEER) Strong Motion Database for western U.S. and Japanese earthquake records, scaled to the Pond Creek site PGA was performed. Finally, the corresponding response spectra curves of the South Cell site response due to the ENA synthetic and PEER earthquake time histories were compared to various ENA and CEUS GMA response spectra to assess the reasonableness of the time histories, and is described in Section 7.4.

5.3 CREATION OF POND CREEK SYNTHETIC ACCELERATION-TIME HISTORIES

Recent studies (Atkinson and Boore, 1995 and 1998) have also shown that the high frequency ground motions observed from a database of low to moderate magnitude earthquakes in the eastern U.S. and Canada can reasonably be predicted using stochastic modeling. In this method, synthetic time histories are characterized as finite-duration, bandlimited Gaussian noise, while known regional source and propagation parameters are utilized to identify the underlying amplitude spectrum.

Synthetic acceleration-time histories were created for the two (2) MDE events affecting the Pond Creek facility. The seismological computer program "SMSIM – Fortran Programs for Simulating Ground Motions from Earthquakes: Version 1.0," written by David Boore (1996), was utilized to predict ENA earthquake ground motions from stochastic modeling and empirically derived source spectra relationships. The calculation brief detailing the stochastic modeling methodology and the creation of acceleration-time histories for the design MDE scenarios is presented in Appendix C, Attachment C-2.

As discussed by Atkinson and Boore (1995 and 1998), recent understandings in the behavior of ENA earthquakes have resulted in a decrease in intermediate-frequency [$f \leq 1$ Hertz (Hz)] ground motions and a shift in expected motions toward the higher frequency range. Based on the comparison of simulated values with published values of Atkinson and Boore (1995), the use of these synthetic records as base motion provided reliable input for SHAKE trials in the permanent deformation analyses of the impoundment (described in detail in Chapter 8.0).

5.3.1 Stochastic Modeling

The stochastic method is initiated by defining the Fourier amplitude spectrum of ground acceleration with respect to seismic moment and distance. The amplitude spectrum also includes a diminution function which models the geometric and an elastic attenuation as a function of

hypocentral distance (R) and frequency (f), as well as filters to reduce high-frequency amplitudes and shape the response spectrum. The time series is a windowed Gaussian noise sequence with a zero mean amplitude. The duration of this window is limited as a function of earthquake magnitude and distance from the source. Once the windowed time series has been defined, its spectrum is multiplied by the amplitude spectrum then transformed back into the time domain, thus resulting in the simulated earthquake record.

5.3.2 Source Spectrum Input

The source spectrum model used to characterize the amplitude of ground motions for the two (2) critical earthquake scenarios represents the Atkinson source model. As discussed in Atkinson and Boore (1998), which compares the results of several source models with the ground motion database of ENA earthquakes and other earthquakes with similar geologic settings, the Atkinson source model provides the most accurate ground motion estimates over the frequency range of interest (0.1 to 10 Hz) for most engineered facilities. Atkinson and Boore conclude that most other ENA models tend to overpredict long-period motion. The use of the Atkinson model was also recommended by seismologist Dr. Martin Chapman of the Virginia Polytechnical Institute Seismological Observatory, in Blacksburg, Virginia, who previously consulted with CEC on similar projects in West Virginia and Kentucky. The source spectrum data used as input for two (2) MDE scenarios, including a M8.0 New Madrid, Missouri event at 83 km and a M6.8 Background event at 13.5 km, were taken directly from the input parameter file for Atkinson and Boore (1995), AB95.dat, which is presented as Appendix F of the SMSIM Open Report. These parameters, as well as the input magnitudes and attenuation distances, are summarized below.

MDE No. 1 – M6.8 Background Earthquake:

- Moment Magnitude, M = 6.8 based on Frankel (2002)
- Shear Wave Velocity, V_S = 3.8 km/sec
- Density of Rock Mass, ρ (Between Source and Site) = 2.8 g/cm^2
- Cutoff Frequency = 50 Hz

- Maximum Frequency, *f*max = 40 Hz
- Hypocenter Distance, R = 16.8 km, assuming Epicenter Distance = 13.5 km
- Focal Depth = 10 km
- Quality Factor, $Q = C * f^n$ where C = 680, $n = 0.36$, f = frequency
- Seed (Random Number) = 3
- Time Step = 0.01 seconds

MDE No. 2 - M8.0 New Madrid Earthquake:

- Moment Magnitude, M = 8.0 based on Frankel (2002)
- Shear Wave Velocity, V_S = 3.8 km/sec
- Density of Rock Mass, ρ (Between Source and Site) = 2.8 g/cm^2
- Cutoff Frequency = 50 Hz
- Maximum Frequency, *f*max = 40 Hz
- Hypocenter Distance, R = 83.6 km, assuming Epicenter Distance = 83 km
- Focal Depth = 10 km
- Quality Factor, $Q = C * f^n$ where C = 680, $n = 0.36$, f = frequency
- Seed (Random Number) = 3
- Time Step = 0.01 seconds

The PGA for the M6.8 Background and M8.0 New Madrid earthquake are 739 cm/sec^2 (0.754g) and 181 cm/sec^2 (0.184g), respectively. Higher acceleration values were expected for the Background MDE since there is less attenuation from the hypocenter to the site (13.5 km compared to 83 km). However, it is important to note that the duration of the acceleration record for the M8.0 earthquake is about 80 seconds, compared to about 15 seconds for the lower M6.8 Background earthquake. Additionally, the frequency contents of the two (2) simulations are quite different.

5.4 COMPARATIVE ASSESSMENT OF SYNTHETIC EASTERN U.S. AND ACTUAL WESTERN U.S. EARTHQUAKE RESPONSE SPECTRA

A comparison of site response (spectra) was made between synthetic acceleration time histories using SMSIM (Boore, 1996), based on the eastern U.S. Atkinson & Boore (1995) GMA relationship, and an actual time history record from the western U.S., PEER strong motion database. Response spectra from each earthquake time history are generated at the base and top of the South Cell embankment crest column PCSC300M using the one-dimensional wave propagation program SHAKE2000 (Ordonez, 2006), and the compatibility of each response spectra is assessed relative to response spectra for five (5) eastern U.S. GMA relationships. The eastern U.S. ground motion spectra should envelope the South Cell site response yielding similar frequency content and eliminating potential resonance effects.

Synthetic time histories were used to represent the Pond Creek PSHA MDE earthquakes including the M6.8 (13.5 km), which was scaled to USGS-derived PGA value of 0.54g for the site. Alternatively, a search of the PEER strong motion database of western U.S. earthquakes was performed for a range of magnitudes between M5.5 and M7.2, a radial distance between 10 km and 50 km and PGA between 0.40g and 0.65g to represent the Pond Creek M6.8 source. Three (3) earthquake records were reviewed and the 1989 Loma Prieta earthquake, LOMAP/G01000 record (M6.9 at 11 km) was chosen, with PGA of 0.41g, as a comparative time history. The LOMAP/G01000 record was subsequently converted in SHAKE2000 and scaled to 0.54g (from 0.41g), and the resulting response spectra was compared to the corresponding synthetic time history and eastern U.S. GMA response spectra.

5.4.1 SHAKE Input Model

To compare the Pond Creek site response from both the eastern U.S. synthetic time histories and the PEER database western U.S. time history, SHAKE was used to calculate the response spectra for each time history using the Pond Creek embankment (crest) SHAKE column PCSC300M. Analyses were performed using SHAKE2000 (Ordonez, 2006). SHAKE2000 integrates SHAKE

(Schnabel et al., 1972) and SHAKE91 (Idriss, I.M. and Sun, J.I., 1992) with ShakEdit (Ordonez, G., 2006) a pre- and post-processor for SHAKE and SHAKE91. SHAKE2000 utilizes a one-dimensional analysis for the vertical propagation of shear waves from the bedrock layer up through the soil profile, which is modeled as a series of horizontal layers, to estimate the maximum cyclic shear stress and strain with depth.

A layered SHAKE model was generated utilizing field and laboratory test data, and input information including layer thickness, unit weight and (small strain) shear modulus (Gmax). Time histories for the M6.8 (at 13.5 km) earthquake scenario, from both the Pond Creek synthetic eastern U.S. records and the western U.S. Loma Prieta PEER database time histories represent the respective eastern and western U.S. frequency content and PGA. Time histories associated with the M6.8 and M6.9 events were scaled to 0.54 g and input into SHAKE at the base of the PCSC300M SHAKE column.

5.4.2 Discussion of SHAKE Output

SHAKE output included generating and plotting response spectra curves for the Pond Creek site response for Layer 1 – at the top of the PCSC300M column, and Layer 17 – at the base of the same column. Additionally, the response spectra curves for five (5) published eastern U.S. GMA relationships were plotted, and are compared to the Pond Creek site response spectra due to the eastern and western U.S. time histories. The response spectra curves for the site response and comparative ground motion spectra are presented in Appendix C, Attachment C-2.

As shown in Attachment C-2 response spectra comparison, the eastern U.S. synthetic time history produced a frequency response (predominant period) within a range of periods between 0.01 and 0.1 seconds, as defined by the eastern U.S. GMA relationships. The western U.S. PEER database time history produced predominant periods about 5 to 10 times that of the eastern U.S. GMA relationships, between 0.1 and 1 second, and consistent with published information in Atkinson & Boore (1995 and 1998). Thus, the response spectra due to the western U.S. time history is not consistent with the anticipated eastern U.S. ground motion response spectra and

should not be used to represent eastern U.S. earthquake records or time histories. The eastern U.S. synthetic earthquake record and site response from the synthetic time histories input into SHAKE fell directly within the predominate period range of the multiple eastern U.S. GMA relationships as evidenced by the site response spectra curves for the M6.8 Background earthquake presented in Attachment C-2.

Therefore, eastern U.S. synthetic time histories for the M6.8 and M8.0 earthquakes, scaled to the Pond Creek MDE PGA of 0.54g were used in supplemental SHAKE analyses to estimate cyclic shear stresses/strains and time histories of horizontal cyclic shear stress for the SHAKE crest column.

6.0 PERMANENT DEFORMATION ANALYSES

6.1 ANALYTICAL APPROACH

As previously discussed, IDNR has required that a revised (seismic) slope stability analysis be performed for the South Cell using equivalent static load methods and the appropriate peak acceleration based on the PGA for 2% Probability of Exceedance in 50 Years maps from the USGS. If the required factor of safety is not met, i.e., a minimum factor of safety of 1.0 with seismic forces for the steady seepage condition, a permanent deformation evaluation should be completed. As described below, revised seismic stability analyses using a PGA value of 0.54g yielded factors of safety less than 1.0. Therefore, permanent deformations or crest settlement are evaluated, which can occur depending upon the acceleration levels above a defined yield acceleration, below which embankment response is assumed to behave elastic-plastic (Newmark, 1965). If crest settlements eliminate the available freeboard below the maximum tailings impoundment level, overtopping of the dam could result posing a threat to the embankment and ultimately downstream safety.

6.1.1 Newmark Analysis of Permanent Deformations

In a Newmark analysis (Newmark, 1965), deformations are analyzed by considering movements of a sliding mass over a sliding surface caused by yielding of the soil at its available strength. The basic assumption is that movement (or yielding) occurs when the sum of the static plus the seismic shear stresses along the sliding surface reaches the value of the available shear strength. Thus, the acceleration that can be transmitted to the sliding mass is limited to a value referred to as the yield acceleration.

The basic steps of the Newmark analysis involved the following:

1. For the critical failure surface associated with the proposed South Cell geometry, determine from a pseudo-static stability analysis the horizontal acceleration which produces a factor of safety of 1.0. This is referred to as the yield acceleration (K_y) with units of g. The results are presented in Appendix D, Attachment D-1;

2. Using the computer program SHAKE2000, determine a time history of horizontal shear stresses for the two (2) MDE scenarios. The time history of accelerations of the failure mass is computed from the time history of stresses and the total mass above the critical layer; and

3. Using the computer program SHAKE2000 and the Newmark analysis option (Houston et al., 1989), displacements are estimated and added each time the earthquake accelerations exceed the yield acceleration during the time history to obtain the accumulated displacements caused by the various earthquake loadings.

6.2 DETERMINATION OF THE REVISED PSEUDO-STATIC SEISMIC FACTORS OF SAFETY AND YIELD ACCELERATIONS

Pseudo-static stability analyses were performed for the proposed South Cell downstream and upstream geometries including the maximum fines (El. 496) and minimum fines (El. 474) conditions respectively using a PGA of 0.54g (as required by IDNR) to assess the revised seismic factor of safety (Fs), and to determine the yield acceleration (Ky).

The yield acceleration is the acceleration level:

- Below which yielding of the embankment (soil mass) does not occur and the soil mass deforms elastic-plastic; and/or

- Above which yielding occurs causing permanent deformation.

The yield acceleration is used as input to subsequent Newmark permanent deformation analyses performed within the computer program SHAKE2000.

Drained and undrained strengths were developed for the various coal refuse materials including coarse coal refuse and residual soil in the GSTABL analysis to obtain Fs and Ky.

Table 3: Refuse/Soil Properties Used in Revised Pseudo-Static and Yield Acceleration Slope Stability Analyses

Description	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Yield Strength (psf)
Coarse Refuse	130	33.7	0	Frictional
Fine Refuse	90	30	0	Frictional
Residual Soil	125	19.5 0	400 3000	Total (Undrained) Strength 80% Peak Undrained

Note: Refuse properties provided by Alliance Consulting, Inc. based on laboratory testing and/or literature values noted in the Alliance static/seismic slope stability analyses.

A horizontal acceleration corresponding to the PGA value of 0.54g was input into GSTABL to assess the revised seismic stability analyses safety factors. Revised Fs values less than 1.0 were determined for both the downstream and upstream slope conditions, thus permanent deformation analyses are required.

Additionally, the horizontal acceleration was subsequently varied in GSTABL until a Factor of Safety equal to 1.0 was achieved. Consequently, yield accelerations of 0.184g and 0.192g were iteratively determined for the soil mass corresponding to the downstream (maximum fines) and upstream (minimum fines) critical failure surfaces.

The revised seismic stability and yield acceleration GSTABL analyses runs and outputs files are presented in Appendix D, Attachment D-1. Finally, a yield acceleration of 0.18g was conservatively assumed for all downstream and upstream slope conditions, which was used as input for estimating the corresponding permanent deformations.

6.3 SHAKE2000 ANALYSES

6.3.1 SHAKE2000 Input Summary

Analyses were performed using SHAKE2000 (Ordonez, 2006), a computer program for the one-dimensional wave propagation analysis of geotechnical earthquake engineering problems. For the South Cell impoundment, a user-defined crest column (PCSC300) along an approximate centerline cross-section of the embankment was utilized. A total of one (1) SHAKE2000 column was chosen to analyze the induced acceleration of the coarse coal refuse and residual soil materials along the critical failure surface in the downstream and upstream directions. SHAKE2000 columns PCSC300E and PCSC300M were created based on shear wave velocities from eight (8) PS-CPT soundings performed within and surrounding the existing/proposed South Cell impoundment. The crest column location PCSC300 also included two (2) phreatic levels associated with: 1) the "end" (E) of construction, i.e., minimum fines El. 474; and 2) "maximum" (M) fines El. 496. Columns PCSC300E and PCSC300M were utilized for evaluating the permanent deformations in the upstream and downstream directions, respectively.

The modulus and damping reduction curves used in the analyses were from published references/relationships presented in Appendix D, Attachment D-2, and available curves from SHAKE2000 were utilized for the coarse refuse, residual soils and bedrock materials.

6.3.2 SHAKE2000 Results Summary

SHAKE2000 output files for the MDE events, including an M6.8 Background (at 13.5 km) and M8.0 (at 83 km) are presented in Appendix D, Attachment D-2. SHAKE2000 summaries of maximum shear stress and strain with depth for crest column PCSC300E/M, which become the input for permanent deformation analyses, are also presented in Appendix D, Attachment D-2.

Figure 3 presents the relative location of the crest SHAKE column PCSC300E/M. Appendix B, Attachment B-1 presents the corresponding layer geometry and input information, including material type, unit weight, groundwater depth, sub-layer thickness, and average initial G values. The maximum induced horizontal cyclic shear stresses estimated at the midpoint of each layer are plotted with depth for the Pond Creek – South Cell SHAKE2000 column and MDE scenario, and are presented in Appendix D, Attachment D-2.

SHAKE2000 analyses results allow for estimating the deformations accumulated at the interface of each layer within the crest column model, which were used to represent the downstream and upstream conditions during MDE loadings. Therefore, time histories of horizontal shear stresses (SHAKE2000 Option 7) at all soil layer interfaces were saved for subsequent permanent deformation analyses to envelope potential upstream and downstream failure surface scenarios. Plots of time histories of (horizontal) shear stress for each column and critical layer are presented in Appendix D, Attachment D-2.

6.4 ANALYSES TO DEFINE TIME-HISTORIES OF ACCELERATION

Analyses were performed to estimate the time history of horizontal shear stress at all of the layer interfaces. The (stress) time history data was subsequently converted to acceleration time histories in SHAKE2000 and subsequently used to estimate the maximum displacement associated with the respective sublayer within the crest column.

The analysis technique for determining time histories of accelerations corresponds to the techniques used by Castro et al., (1989) and Houston et al., (1989). The time histories of earthquake accelerations on the potential sliding mass were converted in SHAKE2000 by dividing each time step by the effective vertical stress on each layer, based on the equation Force (F) = mass (m) times acceleration (a) (F = ma) and solving for a at each time step. These time histories of acceleration become the input for the computer program SHAKE2000 (Houston et al., 1989 displacement option), which computes the layer specific displacement.

6.5 CRITICAL MASS DISPLACEMENTS

Horizontal displacements of the proposed South Cell geometry were computed in SHAKE2000, which double integrates the difference between the estimated accelerations and yield accelerations for the duration of the time history. The integration is performed assuming that movements of the sliding block can only occur in the downhill direction for estimated values of acceleration which exceed the yield acceleration. Movements in the uphill direction are not likely since the value of yield acceleration is notably higher due to the additive static weight resistance against pushing the sliding block uphill.

The anticipated maximum displacements of the soil mass were estimated as a function of earthquake acceleration for all layers in the soil column. A summary of ground motion response parameters and ground displacements estimated for the various layers within the South Cell crest column geometry is presented in Appendix D, Attachment D-3.

As shown in Appendix D, Attachment D-2, the mean square frequency of the M6.8 Background earthquake is 20.4 Hz, which is greater than the M8.0 New Madrid earthquake frequency of 14.6 Hz. The average fundamental frequencies of the SHAKE2000 columns are similar, ranging from about 3.70 to 4.35 Hertz. Due to the variation in frequency content between the low frequency South Cell SHAKE2000 column to the high frequency ENA earthquake scenarios, only moderate shear stresses and strains are induced into the soil column. The percentage of acceleration within the critical layer to that of the base acceleration is lower for the M6.8 and higher for the M8.0

earthquakes due to their higher mean square frequency. In other words, while the input acceleration is high, particularly for the Background M6.8 MDE (Amax = 0.54g), most of its energy is in the high frequency range and only a portion of the induced base acceleration affects the critical layer.

Based on the Newmark method, maximum permanent deformations in any layer within the soil column due to both MDE scenarios were estimated at about 17 inches. The resulting maximum deformation was due to the estimated acceleration values in the critical layers, as compared to the yield acceleration value of 0.18g. Since the maximum accelerations vary above and below the Ky value, there were displacements accumulated by performing the double integration of (Ay – A) of the Newmark method. The South Cell SHAKE2000 files presented in Appendix D-3 illustrate the sublayer acceleration-time history.

Finally, the proposed crest elevation for the South Cell is about El. 502 feet, while the maximum fines level is El. 496 feet. Therefore, given the amount of freeboard (about 6 feet), maximum permanent deformations of 17 inches (or about 1.4 feet) will <u>not</u> pose a threat to the integrity of the impoundment or adversely affect the South Cell impoundment.

7.0 SUMMARY AND CONCLUSIONS

The IDNR has required that a revised (seismic) slope stability analysis be performed for the Pond Creek facility using equivalent static load methods and the appropriate peak acceleration based on the PGA for 2% Probability of Exceedance in 50 Years maps from the USGS. CEC revised the seismic slope stability analyses and the minimum factors of safety do not meet the required 1.0 safety factor criteria.

CEC subsequently completed a permanent deformation evaluation of the proposed South Cell embankment geometry, and determined that the facility is **NOT** susceptible to adverse post-earthquake permanent deformations. These conclusions were based on the results of high quality field testing and detailed seismically-related engineering and deformation analyses in both the upstream and downstream directions.

CEC, in cooperation with ConeTec developed and implemented a detailed field testing program, which utilized the most recent advances in PS-CPT to obtain a significant volume of credible field test results of the existing coarse coal refuse and residual soil materials at depth.

A PSHA was performed utilizing the 2002 USGS Earthquake Hazards Program, Interactive Deaggregation Maps, specifically the 2% Probability of Exceedance in 50 Years recurrence interval to select the MDE and estimate the corresponding PGA for the Pond Creek site. A PGA value of 0.54g was estimated for the two (2) controlling MDE events, including an M8.0 New Madrid, Missouri regional earthquake located 83 km from the site and an M6.8 Background earthquake located 13.5 km from the site.

Post-earthquake permanent deformation analyses were performed to estimate the anticipated maximum crest settlement for the two (2) MDE events. Based on the results of the permanent deformation analyses, the estimated maximum deformations are about 1.4 feet. The relatively small deformations are attributable to the low frequency embankment response as compared to the predominantly higher frequency content of the applicable synthetic MDE acceleration time

histories created for the Pond Creek site from ENA earthquake GMA relationships. Given the minimum available freeboard of 6 feet, the 1.4 feet of post-earthquake deformations do not pose a threat to the integrity of the South Cell geometry.

Therefore, it is CEC's opinion the Pond Creek South Cell impoundment can be operated up to the proposed geometry with no appreciable risk of a release of tailings downstream or upstream due to permanent deformations expected from any site specific MDE event. It is also understood the Pond Creek facility will be operated with an impoundment level at the lowest practical elevation except during periods of intense rainfall. Analyses were not performed for the simultaneous occurrence of intense rainfall and an MDE due to the low probability of both events occurring at the same time.

In preparing this report, CEC's professional services have been performed, findings obtained and conclusions prepared in accordance with generally accepted engineering principles and practices. No warranty, expressed or implied is made or intended by rendering of these services or by furnishing oral or written reports of our findings. This report was prepared for the exclusive use of Williamson.

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FIGURES

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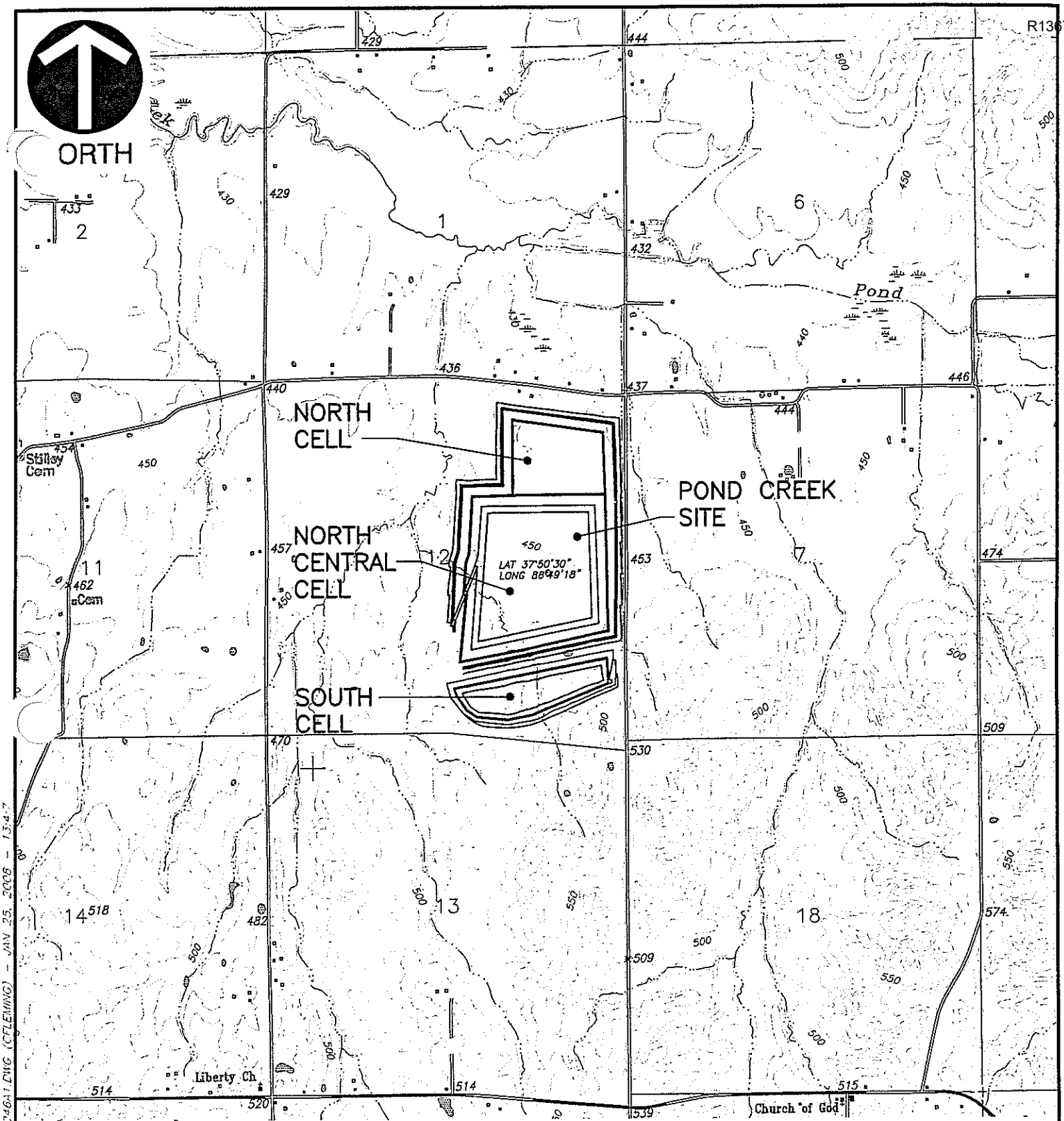

REFERENCE
U.S.G.S. 7.5 MINUTE TOPOGRAPHIC
QUADRANGLE MAP OF PITTSBURG, IL
DATE: 1963

SCALE IN FEET
0 2000 4000

Civil & Environmental Consultants, Inc.
Four Triangle Lane, Suite 200, Export, PA 15632-9522
(724) 327-5200 · (800) 899-3610
...urgh, PA
...innati, OH
Columbus, OH
Indianapolis, IN
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SITE LOCATION MAP
POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY LLC.

QUALITY MANAGER APPROVAL:	BEG*	*HAND SIGNATURE ON FILE	PROJECT NO:	072-046	FIGURE NO:	1	
DRAWN BY:	CAF	CHKD BY: RJS	DWG SCALE:	1"=2000'	LAST EDIT DATE:	JAN. 21, 2008	

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NORTH

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

REVISION RECORD		
NO	DATE	DESCRIPTION
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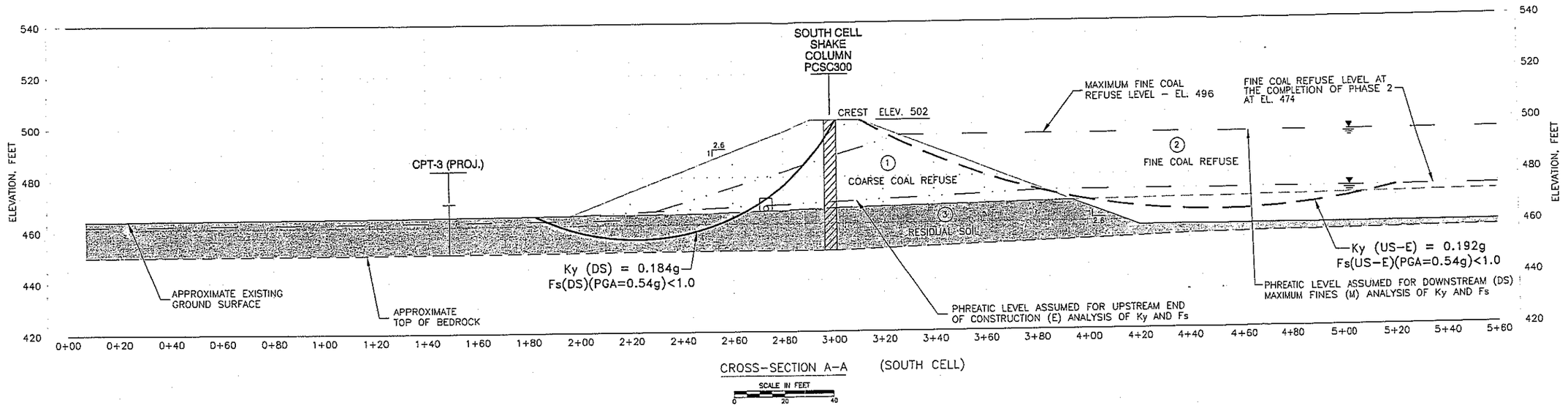
2		
3		



CROSS-SECTION A–A (SOUTH CELL)

SCALE IN FEET
0 20 40

MATERIAL PROPERTIES USED IN REVISED PSEUDO–STATIC (SEISMIC) FACTOR OF SAFETY (Fs) AND YIELD ACCELERATION (Ky) SLOPE STABILITY ANALYSES

SOIL TYPE NO.	MATERIAL	TOTAL UNIT WEIGHT, (PCF)	EFFECTIVE SHEAR STRENGTH PARAMETERS	
			FRICTION ANGLE, (DEGREES)	COHESION, (PSF)
(1)	COARSE COAL REFUSE	130	33.7	0
(2)	FINE COAL REFUSE	80	30	0
(3)	RESIDUAL SOIL	135	19.5 (TOTAL STRENGTH) 0 (80% PEAK STRENGTH)	400 (TOTAL STRENGTH) 3000 (80% PEAK STRENGTH)

NOTES

1. REVISED DOWNSTREAM (DS) AND UPSTREAM (US) PSEUDO–STATIC SLOPE STABILITY ANALYSES USING A PEAK GROUND ACCELERATION (PGA) OF 0.54g YIELDED FACTORS OF SAFETY (Fs) LESS THAN 1.0. THEREFORE, DETAILED PERMANENT DEFORMATION ANALYSES WERE PERFORMED.
2. MATERIAL PROPERTIES USED IN THE YIELD ACCELERATION SLOPE STABILITY ANALYSES ARE BASED ON LABORATORY TEST DATA AND WERE PROVIDED BY ALLIANCE CONSULTING, INC.
3. PEAK STRENGTHS WERE DEVELOPED BASED ON LABORATORY TEST DATA AND PRESENTED IN APPENDIX B–2.
4. MINIMUM YIELD ACCELERATIONS WERE BASED ON YIELD STRENGTHS OF RESIDUAL SOIL MODELED AS TOTAL STRENGTH OR 80 PERCENT OF PEAK STRENGTH. TOTAL STRENGTH PROPERTIES CONTROLLED AND PROVIDED THE MINIMUM ACCELERATIONS SHOWN.
5. CPT–1, CPT–2, CPT–2A, CPT–3, CPT–4, CPT–5, CPT–5A AND CPT–5B WERE USED IN THE DEVELOPMENT OF SOUTH CELL SHAKE COLUMN PCSC300. SEE FIGURE NO. 2 FOR CPT LOCATIONS.

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POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY LLC.

QUALITY MANAGER APPROVAL:	HARD SIGNATURE ON FILE		BEC*
LAST EDIT DATE:	JAN. 25, 2008	DWG SCALE:	AS SHOWN
DRAWN BY: CAF	CHECKED BY: RJS	PROJECT NO:	072-048

PSEUDO-STATIC AND YIELD ACCELERATION SLOPE STABILITY ANALYSES RESULTS

SHEET NO OF NO

DWG NO.

FIG. 3

(FIG3.DWG) - JAN 25, 2008 - 12:09:3

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NORTH

E 358,000 E 359,000 E 360,000 E 361,000

N 430,000 N 429,000 N 428,000 N 427,000 N 426,000 N 425,000

GW-2 GW-3 GW-5 GW-7A

8293 8295 8294 8874 8297 8299 8298

CPT-11 CPT-12 CPT-8 CPT-9 CPT-10 CPT-5A CPT-5 CPT-6 CPT-7 CPT-5B CPT-2 CPT-2A CPT-3 CPT-4 CPT-1

NORTH CELL

NORTH CENTRAL CELL

SOUTH CELL

CREST EL. 488

CREST EL. 538

EL. 500

100-FOOT (MIN.) WIDE CREST AT ELEVATION 538

ESTIMATED SLURRY ELEVATION AT COMPLETION OF PHASE 7 – EL. 466±

APPROXIMATE LIMITS OF PHASE 7 COARSE COAL REFUSE EMBANKMENT CONSTRUCTION (2.43 MILLION CU. YDS.)

ESTIMATED SLURRY ELEVATION AT COMPLETION – EL. 496±

PERMIT AREA

HERRIN NO. 6 COAL SEAM MINE PROJECTIONS

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

R13674

REVISION RECORD

NO	DATE	DESCRIPTION
1		
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CPT SOUNDING LOCATIONS

	NORTHING	EASTING	ELEVATION
CPT-1	425784.16	358548.87	482.19
CPT-2	426832.42	357857.50	494.21
CPT-2A	426828.92	358156.73	492.40
CPT-3	426792.78	359207.80	466.98
CPT-4	426331.10	360108.80	482.55
CPT-5	427485.26	357913.86	482.55
CPT-5A	427607.60	357920.84	483.00
CPT-6	427450.46	358992.62	457.78
CPT-7	427450.88	359850.00	457.83
CPT-8	429006.12	358034.04	444.95
CPT-9	429077.69	359026.20	445.68
CPT-10	428965.83	359998.45	442.09
CPT-11	430316.82	358810.96	440.59
CPT-12	430141.83	359852.30	442.08

PREVIOUS BORING / WELL LOCATIONS

	NORTHING	EASTING
GW-6	425414.53	360201.23
GW-5	425806.61	357626.97
8299	426148.35	358205.38
8298	426471.27	359601.55
GW-1A	427584.82	358263.84
8294	428248.64	358131.20
8874	428255.56	358150.19
8297	428029.69	359955.38
8293	430064.93	358579.92
8295	430077.80	359978.43

NOTES

1. SITE LAYOUT PROVIDED BY ALLIANCE CONSULTING INC.
2. CPT SOUNDING AND PREVIOUS BORING/WELL LOCATIONS AND ELEVATIONS PROVIDED BY WILLIAMSON ENERGY LLC.
3. REFER TO FIGURE 3 FOR REVISED PSEUDO-STATIC (PGA=0.54g) AND YIELD ACCELERATION SLOPE STABILITY ANALYSES RESULTS FOR CROSS SECTION A–A.

LEGEND

8874 PREVIOUS BORINGS (BY OTHERS)

GW-6 PREVIOUS WELLS (BY OTHERS)

CPT-3 CPT SOUNDING LOCATIONS (OCT. 2007)

SCALE IN FEET
0 200 400

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POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY LLC.

QUALITY MANAGER APPROVAL:	* HAND SIGNATURE ON FILE		BE
LAST EDIT DATE:	JAN. 22, 2008	DWG SCALE:	1"=2
DRAWN BY: CAF	CHECKED BY: RJS	PROJECT NO:	D72-(
		SHEET NO	OF N

CPT SOUNDING LOCATION PLAN

DWG NO.: FIG. 2

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APPENDIX A

PIEZO-SEISMIC CONE PENETRATION TESTING (PS-CPT) AND RESULTS

APPENDIX A-1

SUMMARY OF PIEZO-SEISMIC CONE PENETRATION TESTING

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 1 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY ZJK DATE 1/23/08

CALCULATION BRIEF
FOR
SUMMARY OF PIEZO-SEISMIC CONE PENETRATION TESTING

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE:

Summarize the piezo-seismic cone penetration testing (PS-CPT) activities performed by ConeTec, Inc. (ConeTec), West Berlin, in October 2007 as part of the subsurface exploration at the Williamson Energy Pond Creek facility, Williamson County, Illinois.

REFERENCES:

1. ConeTec, Inc. (2007), Field Report Entitled "Presentation of CPTU Test Results for: Pond Creek Mine – Williamson County, Illinois, December 10, 2007.

2. Robertson, P.K., et.al. (1992) "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE 109 (11): 1449-1459.

3. Robertson, P.K and Campanella, R.G, (1989), "Guidelines for Geotechnical Design Using CPT and CPTU", UBC Soil Mechanics Series No. 120, Civil Eng. Dept., Vancouver, B.C., Canada

4. Robertson, P.K and Campanella, R.G, (1983), "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE Vol. 109 No. 11, pp. 1449-1459.

METHODOLOGY:

As part of the subsurface exploration, a total of 15 PS-CPT soundings were performed at the Pond Creek site on October 30 and 31, 2007, at approximate locations shown in Figure 2 of the Pond Creek Deformation Evaluation report. PS-CPT exploration was performed under the full-time observation and guidance of CEC personnel. PS-CPT locations designated as CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A, CPT-5B, CPT-6, CPT-7, CPT-8, CPT-9, CPT-10, CPT-11 and CPT-12 were located by CEC within areas that included existing coarse coal refuse and the proposed South Cell, North Central Cell and North Cell impoundments. CPT-2, CPT-

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 2 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

2A, CPT-5, CPT-5A and CPT-5B soundings were located on the existing coarse coal refuse embankment crest, and were pushed through coarse refuse and the underlying subgrade residual soil. CPT-1, CPT-3, CPT-4, CPT-6, CPT-7, CPT-8, CPT-9, CPT-10, CPT-11 and CPT-12 were located throughout the facility at approximate existing ground surface and pushed exclusively through residual soil. The following presents the CPT sounding, site coordinates, existing ground surface elevation, total depth, interpolated ground water depth and applicable slurry cell.

CPT No.	Northing (ft)	Easting (ft)	Ground Surface Elev.(ft)	Total Depth (ft)	GWT Interpolated (ft)	Applicable Slurry Cell
CPT-1	425784.316	358548.865	482.19	18.4	15.3	South
CPT-2	426832.420	357857.498	494.21	45.3	38.8	South, Central, North
CPT-2A	426828.920	358156.731	492.40	41.7	37.0	South, Central, North
CPT-3	426792.780	359207.797	466.98	22.2	11.1	South
CPT-4	426331.101	360108.800	482.55	18.9	21.7	South
CPT-5	427485.256	357913.863	482.55	49.2	34.4	South, Central, North
CPT-5A	427607.598	357920.844	483.00	53.2	35.9	South, Central, North
CPT-5B	427147.684	358343.061	479.90	39.7	28.0	South, Central, North
CPT-6	427450.461	358992.616	457.78	22.6	9.2	Central
CPT-7	427450.884	359850.004	457.83	16.7	9.2	Central
CPT-8	429006.116	358034.037	444.45	17.9	6.6	Central, North
CPT-9	429077.690	359026.204	445.68	22.0	7.8	Central, North
CPT-10	428965.827	359998.444	442.09	26.1	3.4	Central, North
CPT-11	430316.815	358810.964	440.59	27.6	11.4	North
CPT-12	430141.831	359852.299	442.08	22.6	11.7	North

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 3 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY TJA DATE 1/23/08

Note: CPT coordinates and ground surface elevations were provided by Williamson Energy.

Determining the dynamic response of the Pond Creek facility and that of the coarse coal refuse and subgrade residual soils requires knowledge of the subsurface material's dynamic properties to accurately predict the horizontal shear stresses and strains induced in the material by a given earthquake loading. Of particular significance in the dynamic evaluation is the distribution of density of the coal refuse materials with depth. The low-amplitude, small strain shear modulus (G) with depth is an important parameter for characterizing the behavior and response of a soil column during earthquake shaking. It is a function of the in-situ shear wave velocity estimated at the site with depth and was obtained in the field utilizing PS-CPT.

The main purpose of the PS-CPT was to measure in-situ shear wave (S-wave) travel times for subsequent calculation of shear wave velocity (V_S) and G. Concurrently, CPT was also performed which provides nearly continuous, index-type information which can be correlated to classification and in-situ strength values based on established procedures such as those outlined in Robertson and Campanella (1988). Further, cone data is typically utilized to evaluate liquefaction potential based on Robertson and Campanella (1985) similar to the procedures described in Seed and Idriss (1983) and to compare with the results using steady-state principles; however, only permanent deformations are evaluated in response to regulatory comments.

The seismic wave form portion of the PS-CPT was conducted by ConeTec at about 3-foot intervals throughout the soil profile to the maximum depths indicated. The down-hole seismic survey is a reliable technique for obtaining shear wave and compression wave velocities accounting for the subsurface material's attenuation and anisotropic effect with depth (Hoar and Stokoe, 1978) (Dobry et al., 1981) (Stokoe and Nazarian, 1985). Only S-wave travel times were measured for each sounding with depth which was used to calculate the corresponding V_S and G used in the dynamic analyses of the Pond Creek facility.

RESULTS:

A total of 15 PS-CPT soundings were performed at the Pond Creek site in October 2007, at approximate locations shown in Figure 2. ConeTec measured tip stress, sleeve stress and pore water pressure, and shear wave velocities at the locations CPT-1 through CPT-12 from the existing ground surface through coarse coal refuse, where available and through residual soil materials.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 4 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

Shear wave velocities per material type were measured and the minimum, maximum and weighted averages are summarized as follows:

CPT No.	Shear Wave Velocity Max./Min./Avg. Coarse Coal Refuse (ft/sec)	Shear Wave Velocity Max./Min./Avg. Residual Soil (ft/sec)
CPT-1	NA	1402 645 905
CPT-2	1284 1029 1120	1173 795 957
CPT-2A	1169 895 1042	1256 780 918
CPT-3	NA	1058 569 765
CPT-4	NA	1242 476 817
CPT-5	1190 936 1063	1599 780 947
CPT-5A	1396 779 1064	1580 728 1005
CPT-5B	1517 818 1080	1649 686 978
CPT-6	NA	1022 514 796
CPT-7	NA	894 514 682
CPT-8	NA	1036 541 783
CPT-9	NA	1484 415 835
CPT-10	NA	1217 478 828
CPT-11	NA	1387 471 925
CPT-12	NA	1230 530 763

In general, shear wave velocities in coarse refuse ranged from about 779 to 1517 fps with an average value of about 1074 fps. For subgrade residual soils, Vs ranged from 415 to 1599 fps with an approximate average value of 860 fps. Measured values of V_S for coarse refuse and residual soil materials and the density of the respective material with depth are used to estimate the initial shear modulus, G, for use in the one dimensional, dynamic SHAKE (Schnabel, et al., 1972) analysis of the embankment. G-values estimated from the four soundings are used in the calculation of induced cyclic shear stress at the SHAKE soil column locations (e.g. PCSC300) shown in Figure 3. Appendix A, Attachment A-2 presents the complete ConeTec report and Appendix B, Attachment B-1 presents the computations of G for the various SHAKE columns

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 5 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

from in-situ measurements of V_S for the coarse refuse, residual soil and bedrock materials including plots of V_S and G with depth for both SHAKE columns.

CONCLUSIONS:

Summarizing, the PS-CPT field testing was performed as part of the subsurface exploration at the Pond Creek facility. The information gathered from the testing will be used to correlate index and strength parameters, as well as shear modulus for use in subsequent permanent deformation analyses.

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PROJECT Williamson Energy Pond Creek
Deformation Evaluation
Summary of PS-CPT

PROJECT NO. 072046

PAGE 6 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

SHEAR WAVE VELOCITY DATA REDUCTION
MINIMUM, MAXIMUM AND AVERAGE VELOCITY
PER MATERIAL

Williamson Energy - Pond Creek - South Cell
Shear Wave Velocity versus Depth

CEC Project No. 072-046

CPT-1

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
4.26	645	
7.54	656	
10.82	808	CLAY
14.1	1013	
16.73	1402	

CPT-1	Max	Min	avg
Clay	1402	645	905

CPT-2

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	1204	
10.82	1284	
14.1	1152	
17.39	1085	CCR
20.67	1029	
23.95	1039	
27.23	1050	
30.51	1114	
33.79	950	
37.07	795	CLAY
40.35	908	
43.31	1173	

CPT-2	Max	Min	avg
CCR	1284	1029	1120
CLAY	1173	795	957

CPT-2A

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	977	
10.82	973	
14.1	1121	
17.39	1051	CCR
20.67	1105	
23.95	1169	
27.23	895	
30.51	780	
33.79	845	CLAY
37.07	790	
39.86	1256	

CPT-2A	Max	Min	avg
CCR	1169	895	1042
CLAY	1256	780	918

CPT-3

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.21	577	
10.50	569	CLAY
13.78	738	
17.06	883	
20.10	1058	

CPT-3	Max	Min	avg
CLAY	1058	569	765

R13684

CPT-4

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
3.93	476	
7.21	673	CLAY
10.50	781	
13.78	913	
16.81	1242	

	CPT-4 Max	CPT-4 Min	CPT-4 avg
CLAY	1242	476	817

Williamson Energy - Pond Creek - North Central Cell
Shear Wave Velocity versus Depth CEC Project No. 072-046

'T-5

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	1030	
10.82	1076	
14.10	991	
17.39	936	CCR
20.67	1148	
23.95	1190	
27.23	1067	
30.51	780	
33.79	780	
37.07	821	CLAY
40.35	780	
43.63	923	
46.91	1599	

CPT-5

	Max	Min	avg
CCR	1190	936	1063
CLAY	1599	780	947

CPT-5A

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.21	844	
10.50	779	
13.78	1164	
17.06	1396	CCR
20.34	994	
23.63	1077	
26.90	1195	
30.18	1021	
33.46	784	
36.74	784	
40.02	728	CLAY
43.30	768	
46.67	961	
49.95	1411	
52.00	1580	

CPT-5A

	Max	Min	avg
CCR	1396	779	1064
CLAY	1580	728	1005

CPT-5B

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	818	
10.82	900	
14.10	1517	CCR
17.39	1085	
20.67	856	
23.95	732	
27.23	686	CLAY
30.59	762	
33.79	1014	
37.07	1150	
38.88	1649	

CPT-5B

	Max	Min	avg
CCR	1517	818	1080
CLAY	1649	686	978

CPT-6

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	514
7.54	769
10.82	706
14.10	945
17.39	819
20.51	1022

CLAY

	CPT-6 Max	CPT-6 Min	CPT-6 avg
CLAY	1022	514	796

CPT-7

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	514
7.54	575
10.82	745
14.10	894

CLAY

	CPT-7 Max	CPT-7 Min	CPT-7 avg
CLAY	894	514	682

CPT-8

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	541
7.54	652
10.82	708
14.10	979
16.48	1036

	CPT-8 Max	CPT-8 Min	CPT-8 avg
CLAY	1036	541	783

CPT-9

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
3.93	415
7.21	904
10.50	757
13.78	647
17.06	805
20.01	1484

	CPT-9 Max	CPT-9 Min	CPT-9 avg
CLAY	1484	415	835

CPT-10

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	478
7.54	617
10.82	656
14.10	803
17.36	945
20.67	1080
23.87	1217

	CPT-10 Max	CPT-10 Min	CPT-10 avg
CLAY	1217	478	828

Williamson Energy - Pond Creek - North Cell
Shear Wave Velocity versus Depth CEC Project No. 072-046

T-8

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	541
7.54	652
10.82	708
14.10	979
16.48	1036

CLAY

	CPT-8 Max	CPT-8 Min	CPT-8 avg
CLAY	1036	541	783

CPT-9

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
3.93	415
7.21	904
10.50	757
13.78	647
17.06	805
20.01	1484

CLAY

	CPT-9 Max	CPT-9 Min	CPT-9 avg
CLAY	1484	415	835

CPT-10

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	478
7.54	617
10.82	656
14.10	803
17.36	945
20.67	1080
23.87	1217

CLAY

	CPT-10 Max	CPT-10 Min	CPT-10 avg
CLAY	1217	478	828

CPT-11

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	471
7.54	628
10.82	719
14.10	817
17.36	926
20.67	1207
23.95	1387
26.25	1246

CLAY

	CPT-11 Max	CPT-11 Min	CPT-11 avg
CLAY	1387	471	925

CPT-12

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.02	530
7.30	596
10.50	601
13.78	748
17.06	871
20.34	1230

CLAY

	CPT-12 Max	CPT-12 Min	CPT-12 avg
CLAY	1230	530	763

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO 072046

Summary of PS-CPT

PAGE 13 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY ZM DATE 1/23/08

GROUNDWATER WELL DATA (PROVIDED BY WILLIAMSON)

072-046

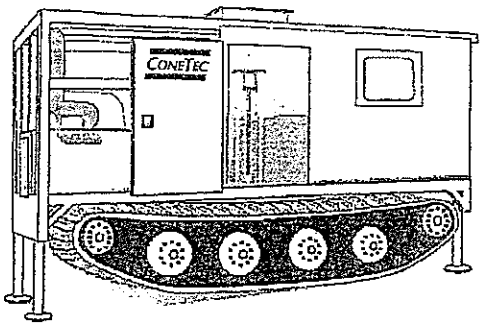
Pond Creek #1 Ground Water Sampling
Permit #375 NPDES# IL007766

Date	Sample Pnt	Easting	Northing	Stand Pipe Elevation	Water Elev.	inc g/L	Antimony mg/L	Beryllium mg/L	Cobalt mg/L	MANGANESE mg/L	Phenolics mg/L	Cyanide mg/L	Chlorides mg/L
12/29/05	GW-1	354,988	430,899	441.82	435.44	012	0.303	<.001	0.014	0.027	<.050	<0.010	20
12/29/05	GW-2	357,681	430,962	435.73	428.51	024	0.240	<.001	0.013	0.087	<.050	<0.010	42
12/29/05	GW-3	360,278	430,669	438.46	432.61	001	0.299	<.001	0.012	0.124	<.050	<0.010	26
12/29/05	GW-4	354,923	425,980	464.03	456.01	009	0.270	<.001	0.017	0.031	<.050	<0.010	17
12/29/05	GW-5	357,632	425,618	482.23	470.52	01	0.276	<.001	0.007	0.891	<.050	<0.010	40
12/29/05	GW-6	360,211	425,416	434.9	No Water	N				n/a			n/a
12/29/05	GW-7A	358,306	427,592	454.7	444.99	029	0.285	<.001	0.024	0.052	<.050	<0.010	33
2/24/06	GW-1	354,988	430,899	441.82	438.34	012	<0.002	<.001	<0.005	0.024	<.050	<0.010	<10
2/24/06	GW-2	357,681	430,962	435.73	431.31	016	<0.002	<.002	<0.002	0 027	<.050	<0.010	<10
2/24/06	GW-3	360,278	430,669	438.46	434.29	014	<0.002	<.001	<0.005	0.023	<.050	<0.010	<10
2/24/06	GW-4	354,923	425,980	464.03	459.45	01	<0.002	<.001	<0.005	0.03	<.050	<0.010	<10
2/24/06	GW-5	357,632	425,618	482.23	471.33	01	<0.002	<.001	<0.005	0.4	<.050	<0.010	<10
2/24/06	GW-6	360,211	425,416	434.9	No Water	N				n/a			n/a
2/24/06	GW-7A	358,306	427,592	454.7	447.05	018	<.002	<.001	<.005	0.045	<.050	<0.010	<10
6/28/06	GW-1	354,988	430,899	441.82	435.70	002	0.006	<.001	<.005	<.002	<.050	<0.010	33
6/28/06	GW-2	357,681	430,962	435.73	427.72	023	0.050	<.001	<.005	0.002	<.050	<0.010	44
6/28/06	GW-3	360,278	430,669	438.46	430.10	006	0.060	<.001	<.005	0.145	<.050	<0.010	75
6/28/06	GW-4	354,923	425,980	464.03	458.03	003	0.070	0.001	<.005	<.002	<.050	<0.010	122
6/28/06	GW-5	357,632	425,618	482.23	470.85	002	0.050	<.001	<.005	<.002	<.050	<0.010	160
6/28/06	GW-6	360,211	425,416	434.9	No Water	N							n/a
6/28/06	GW-7A	358,306	427,592	454.7	446.30	002	0.090	<.001	<.005	0.003	<.050	<0.010	75
7/31/06	GW-1	354,988	430,899	441.82	435.08	001	0.206	0.003	<.005	0.012	<.050	<0.010	37.5
7/31/06	GW-2	357,681	430,962	435.73	429.31	001	0.184	0.002	<.005	<.002	<.050	<0.010	50
7/31/06	GW-3	360,278	430,669	438.46	428.63	001	0.129	0.001	<.005	0.024	<.050	<0.010	88
7/31/06	GW-4	354,923	425,980	464.03	457.03	001	0.153	0.002	<.005	0.026	<.050	<0.010	139
7/31/06	GW-5	357,632	425,618	482.23	469.43	006	0.153	0.002	<.005	0.012	<.050	<0.010	150
7/31/06	GW-6	360,211	425,416	434.9	No Water	N							n/a
7/31/06	GW-7A	358,306	427,592	454.7	445.55	003	0.269	0.001	<.005	0.026	<.050	<0.010	85
8/31/06	GW-1	354,988	430,899	441.82	434.92	001	<.002	<.001	<.005	0.019	<.050	<0.010	20
8/31/06	GW-2	357,681	430,962	435.73	424.51	001	<.002	<.001	<.005	0.021	<.050	<0.010	22
8/31/06	GW-3	360,278	430,669	438.46	426.86	013	<.002	<.001	<.005	0.045	<.050	<0.010	44
8/31/06	GW-4	354,923	425,980	464.03	456.79	006	<.002	<.001	<.005	0.081	<.050	<0.010	42
8/31/06	GW-5	357,632	425,618	482.23	468.32	02	<.002	<.001	<.005	3.05	<.050	<0.010	105
8/31/06	GW-6	360,211	425,416	434.9	No Water	Nc							n/a
8/31/06	GW-7A	358,306	427,592	454.7	444.18	018	<.002	<.001	<.005	0.093	<.050	<0.010	8.7
10/2/06	GW-1	354,988	430,899	441.82	435.08	001	<.002	<.001	0.015	<.002	<.050	<0.010	14
10/2/06	GW-2	357,681	430,962	435.73	425.76	001	<.002	<.001	0.013	<.002	<.050	<0.010	38
10/2/06	GW-3	360,278	430,669	438.46	427.14	009	<.002	<.001	0.006	2.105	<.050	<0.010	28
10/2/06	GW-4	354,923	425,980	464.03	455.42	001	<.002	0.002	0.014	0.028	<.050	<0.010	84
10/2/06	GW-5	357,632	425,618	482.23	No Water	No							
10/2/06	GW-6	360,211	425,416	434.9	No Water	No							
10/2/06	GW-7A	358,306	427,592	454.7	443.95	001	<.002	<.001	0.005	0.181	<.050	<0.010	368
3/7/07	GW-1	354,988	430,899	441.82	438.62	001	<.002	<.001	<.005	0.005	<.050	<0.010	26
3/7/07	GW-2	357,681	430,962	435.73	431.41	001	<.002	<.001	<.005	0.003	<.050	<0.010	42
3/7/07	GW-3	360,278	430,669	438.46	434.29	01	<.002	0.001	<.005	0.028	<.050	<0.010	66
3/7/07	GW-4	354,923	425,980	464.03	458.05	001	<.002	<.001	<.005	0.005	<.050	<0.010	109
3/7/07	GW-5	357,632	425,618	482.23	473.86	001	<.002	<.001	0.013	0.007	<.050	<0.010	91
3/7/07	GW-6	360,211	425,416	434.9	No Water	No							
3/7/07	GW-7A	358,306	427,592	454.7	448.63	001	<.002	<.001	<.005	0.007	<.050	<0.010	86
5/21/07	GW-1	354,988	430,899	441.82	436.55	02	<.002	<.001	0.034	<.002	<.050	<0.010	42
5/21/07	GW-2	357,681	430,962	435.73	428.93	001	<.002	0.001	0.011	0.007	<.050	<0.010	46
5/21/07	GW-3	360,278	430,669	438.46	432.08	001	<.002	0.001	0.013	0.002	<.050	<0.010	62
5/21/07	GW-4	354,923	425,980	464.03	459.93	001	<.002	0.002	0.009	<.002	<.050	<0.010	100
5/21/07	GW-5	357,632	425,618	482.23	471.74	001	<.002	0.002	0.020	<.002	<.050	<0.010	132
5/21/07	GW-6	360,211	425,416	434.9	No Water	No							
5/21/07	GW-7A	358,306	427,592	454.7	448.05	001	<.002	<.001	0.017	0.002	<.050	<0.010	82
5/21/07	GW-8	359,568	426,786	467.85	462.23	001	<.002	<.001	0.020	0.544	<.050	<0.010	88
8/1/07	GW-1	354,988	430,899	441.82	433.29	03	<.002	0.001	<.005	0.007	<.050	<0.010	26
8/1/07	GW-2	357,681	430,962	435.73	424.74	09	0.105	0.001	<.005	0.196	<.050	<0.010	34
8/1/07	GW-3	360,278	430,669	438.46	426.09	01	0.370	0.001	<.005	0.524	<.050	<0.010	66
8/1/07	GW-4	354,923	425,980	464.03	458.16	02	0.141	0.001	<.005	0.003	<.050	<0.010	100
8/1/07	GW-5	357,632	425,618	482.23	469.06	05	0.080	0.002	<.005	0.198	<.050	<0.010	120
8/1/07	GW-6	360,211	425,416	434.9	No Water	No							
8/1/07	GW-7A	358,306	427,592	454.7	447.11	18	0.137	0.002	<.005	1.180	<.050	<0.010	108
8/1/07	GW-8	359,568	426,786	467.85	462.70	05	0.200	0.002	<.005	0.042	<.050	<0.010	112

7225-11
part 18

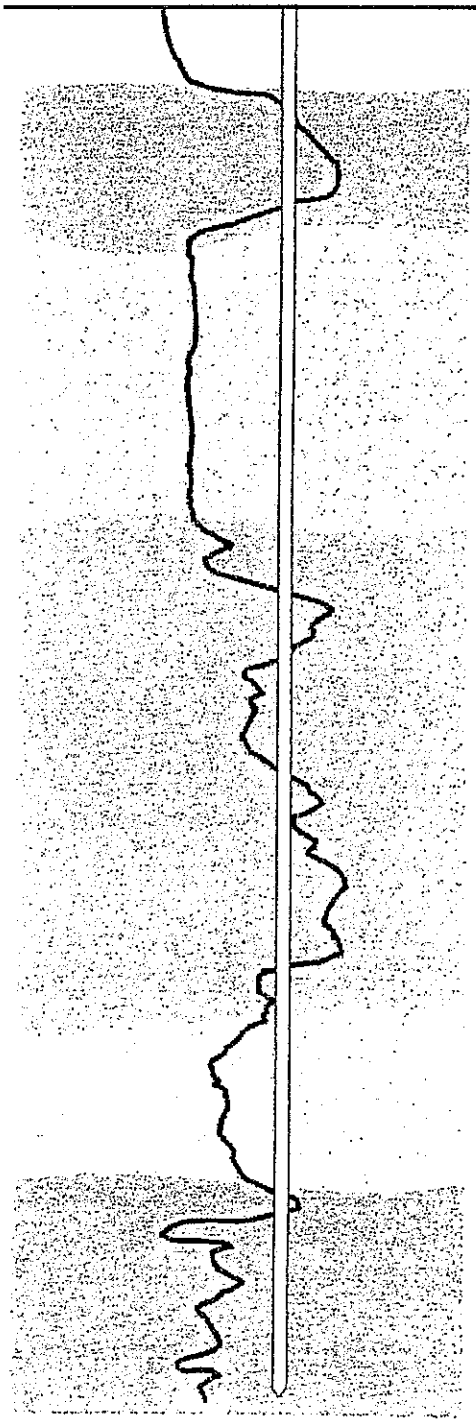
APPENDIX A-2

CONETEC, INC. FIELD REPORT



ConeTec

Geotechnical and Environmental In Situ Testing Contractors



ConeTec Field Report

Presentation of CPTU Test Results for:

Pond Creek Mine
Williamson County, Illinois

Presented to: C.E.C.

Date: December 10th, 2007

Presented by: ConeTec, Inc.
436 Commerce Lane, Unit C
West Berlin, NJ
(856) 767-8600

PRESENTATION OF IN SITU TESTING PROGRAM RESULTS

Pond Creek Mine
Williamson County, Illinois

October 30th, & 31st, 2007

Prepared for:

Civil & Environmental Consultants, Inc
Export, Pennsylvania

Prepared by:

ConeTec Inc.
West Berlin, NJ

December 10th, 2007

TABLE OF CONTENTS

1.0 INTRODUCTION 3

2.0 FIELD EQUIPMENT AND PROCEDURES 4

2.1 CONE PENETRATION TESTING 4
2.2 PORE PRESSURE DISSIPATION TESTS 6

3.0 CONE PENETRATION TEST DATA AND INTERPRETATION 8

3.1 ANALYSIS OF PIEZOCONE DATA - GENERAL 8
3.2 CONE PLOTS 9
3.3 PORE PRESSURE DISSIPATION TEST RESULTS 9
3.4 SHEAR WAVE VELOCITY MEASUREMENTS 10
3.5 CPTSUMM DATA PROCESSING 10
3.6 DATA CD 10

5.0 REFERENCES 11

TABLES

TABLE 1 Summary of CPT Soundings

FIGURES

FIGURE 1 Typical Cone Penetrometer
FIGURE 2 Schematic of Shear Wave Testing Configuration
FIGURE 3 Typical Dissipation Tests

APPENDICES

APPENDIX A CPT Plots (shear wave, non-normalized)
APPENDIX B CPT Data Interpretation Summery
APPENDIX C Shear Wave Velocity Data
APPENDIX D Dissipation Test Data
APPENDIX E Data CD

1.0 INTRODUCTION

This report presents the results of a piezo cone penetrometer testing (CPTU) program carried out at Pond Creek Mine located in Williamson County, Illinois. The work was performed under subcontract to Civil & Environmental Consultants, Inc. of Export, Pennsylvania. The CPTU program took place on October 30th, and 31st, 2007.

A total of fifteen soundings were completed at twelve different sounding locations. The CPT testing was performed to evaluate in situ geotechnical as well as seismic criteria relative to the proposed expansion.

While completing the CPT soundings, seismic shear wave velocity testing was conducted in all of the soundings. Seismic testing involved collecting shear wave velocity data at one-meter depth intervals.

CPT sounding locations were selected and numbered under the direction and supervision of C.E.C. Personnel.

2.0 FIELD EQUIPMENT AND PROCEDURES

2.1 CONE PENETRATION TESTING

The cone penetrometer tests were carried out using an integrated electronic piezo cone manufactured by ConeTec in Vancouver, Canada. The piezo cone used was a compression model cone penetrometer with a 15 cm^2 tip and a 225 cm^2 friction sleeve. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.80. The piezo cone dimensions and the operating procedure were in accordance with ASTM Standard D-5778-95. A diagram of the cone penetrometer used for this project is shown as Figure 1.

Pore pressure filter elements, made of porous plastic, were saturated under a vacuum using glycerin as the saturating fluid. The pore pressure element was six millimeters thick and was located immediately behind the tip (the u_2 location) for all soundings.

The cone was advanced using a 20 ton, unitized, track-mounted cone penetration rig. The following data were recorded onto magnetic media every five centimeters (approximately every two inches) as the cone was advanced into the ground:

- Tip Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (ut)

The field data recorded is included on the attached CD (appendix E).

Before each sounding a complete set of analog baseline readings are taken with a multi-meter and compared with the digitized value on the computer screen. This provides a check on the analog to digital conversion board.

Evaluation of the analog baselines is key to consistent readings. The baseline data should be stable and should not wander excessively during the course of a sounding. Baseline data can be used to apply corrections to the cone data where necessary. For this project, the baseline shift from sounding to sounding was small, typically less than 0.1% of full scale, and no data corrections were applied.

During seismic testing, the seismic signals were recorded using a geophone mounted in the cone as shown in Figure 1 and an up-hole digital oscilloscope. A sledge hammer hit against a beam was used for the seismic source. Normal reaction for the beam was provided by the dead weight of the rig placed upon the beam. A schematic of the shear wave testing configuration is shown in Figure 2.

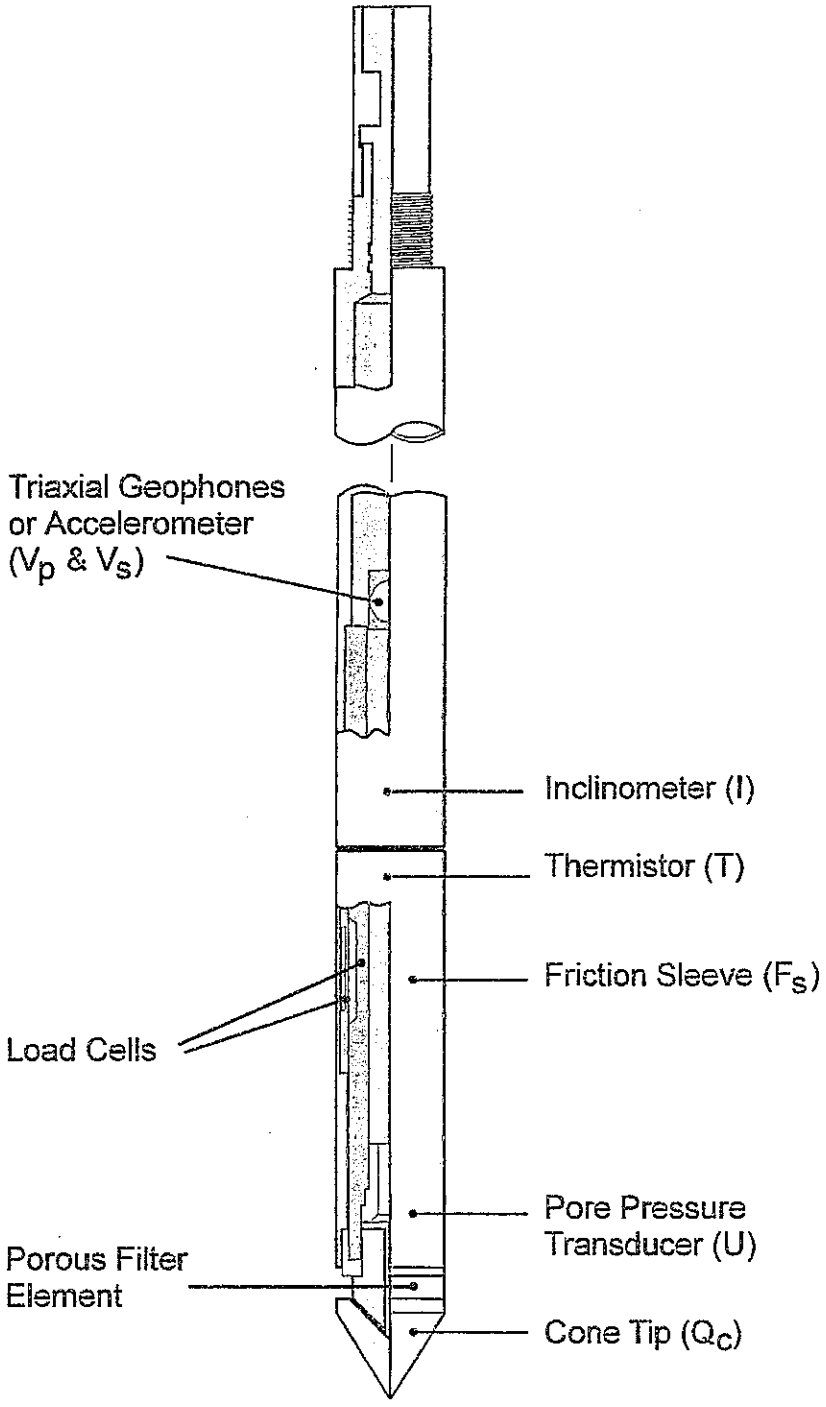


FIGURE 1 - TYPICAL CONE PENETROMETER

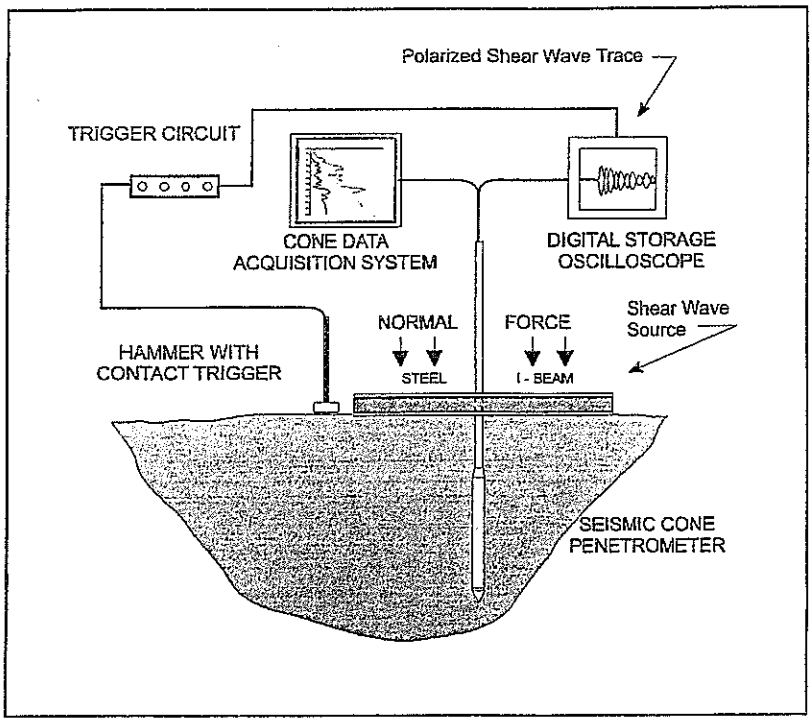


FIGURE 2 - SCHEMATIC OF SHEAR WAVE TESTING CONFIGURATION

2.2 PORE PRESSURE DISSIPATION TESTS

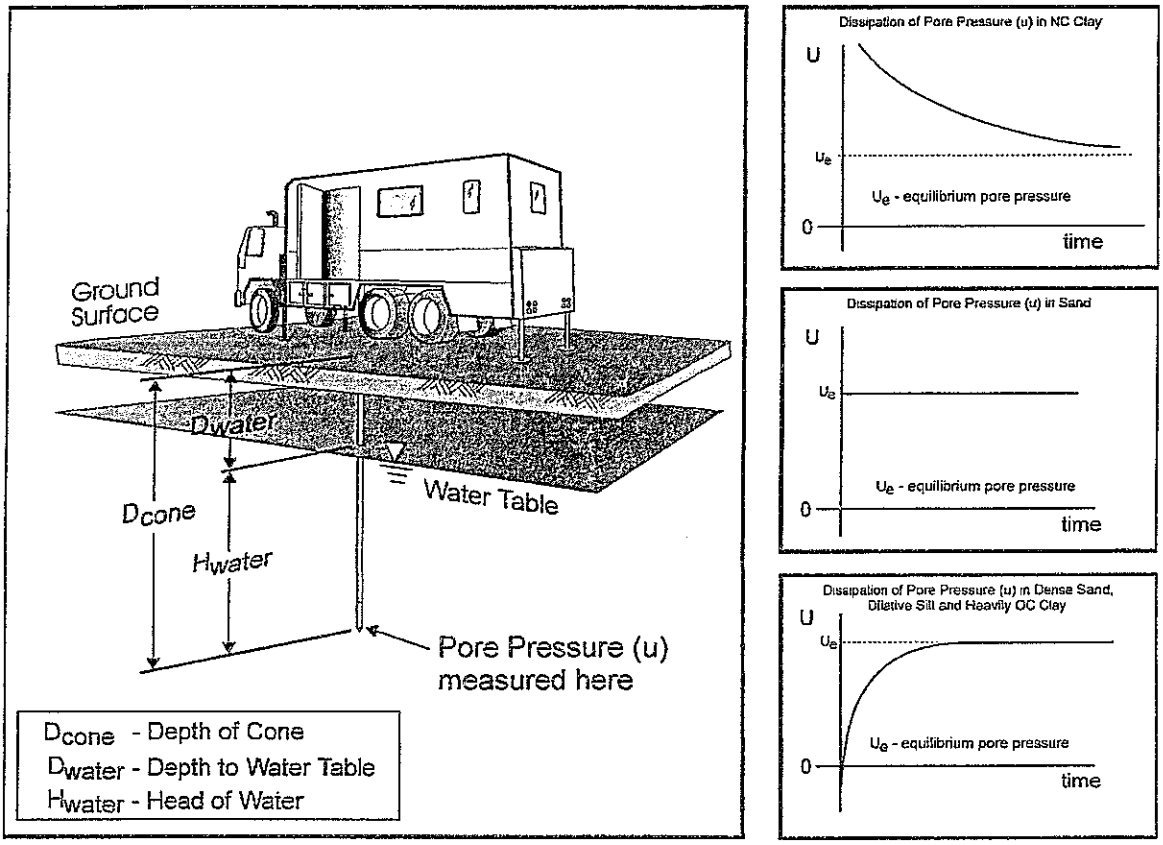
When cone penetration is stopped, the piezo cone essentially becomes a piezometer. While stopped, pore water pressures are automatically recorded at five-second intervals and the readings are stored in a dissipation file (.ppd). Dissipation data can then be plotted onto a dissipation curve consisting of pore water pressure (u) verses time (t). The shapes of dissipation curves are very useful in evaluating soil type, drainage and in situ static water level.

A flat curve that stabilizes quickly (i.e. less than 30 seconds) is typical of a free draining sand. In this case, the final measured pore water pressure is the static in situ water pressure.

Soils that generate excess dynamic pore water pressure during penetration will dissipate this excess pressure when penetration stops. The shape of the dissipation curve and the time of dissipation can be used to estimate C_h, the coefficient of consolidation that can in turn be used to calculate K_h, the horizontal permeability.

Figure 3 shows some idealized shapes of various pore water pressure dissipation curves. The reader is referred Robertson et. al., 1992 to reference dissipation test data analytical techniques.

Estimation of Ground Water Table from CPT Dissipation Tests



Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

Useful Conversion Factors:
1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

FIGURE 3 - TYPICAL DISSIPATION TESTS

3.0 CONE PENETRATION TEST DATA AND INTERPRETATION

3.1 ANALYSIS OF PIEZOCONE DATA - GENERAL

A total of fifteen CPT sounding involving 443.90 feet of testing, were completed.

The interpretation of cone data is based on the relationship between cone bearing, qc, sleeve friction, fs, and penetration pore water pressure, u. The friction ratio, Rf , (sleeve friction divided by cone bearing) is a calculated parameter which is used to infer soil behavior type. Generally, saturated cohesive soils have low tip resistance, high friction ratios and generate large excess pore water pressures. Cohesionless soils have higher tip resistances, lower friction ratios and do not generate significant excess pore water pressure.

The interpretation of soils encountered on this project was carried out using correlations developed by Robertson et al., 1992. It should be noted that it is not always possible to clearly identify a soil type based on qc, fs and ut. Occasionally soils will fall within different soil categories on the classification charts. In these situations, experience and judgment and an assessment of the pore pressure dissipation data should be used to infer the soil behavior type. Computer tabulations of the interpreted soil types along with certain other geotechnical parameters for each cone hole is presented in Appendix B.

Each of the parameters measured in the sounding is discussed briefly below. A detailed explanation of CPTU testing and interpretation of the results can be found in Robertson, 1989.

TIP RESISTANCE (q_c): The resistance to penetration, measured at the cone tip, provides an accurate profile of subsurface strata. The recorded tip resistance is a composite of the penetration resistance of the soils located five to ten cone diameters (7 to 14 inches) in front of and behind the tip. The actual resistance "sensed" by the tip depends on the soil properties and on the relative stiffness of the layers encountered. Tip resistance is often corrected for pore pressure effects when testing in soft saturated cohesive soils.

For this project the correction was made and the tip resistance shown, q_t is the corrected tip resistance.

The correction used is: $q_t = q_c + (1-a)u$

Where: q_t = corrected tip resistance
q_c = measured tip resistance
a = net area ratio for cone (0.80 for this project)
u = dynamic pore water pressure measured behind tip

SLEEVE FRICTION (f_s) The resistance recorded on the friction sleeve, is a measure of the remolded strength of the soil. Values of sleeve friction in very soft soils (such as peat) may fluctuate due to the measured force being small relative to the capacity of the measuring load cell.

FRICTION RATIO (R_f) The ratio of sleeve friction to tip resistance expressed as a percentage, is an indicator of soil type. Cohesive soils generally have friction ratios that are greater than two, while sands and non-plastic silts have friction ratios that are lower than two.

PORE PRESSURE (u) Dynamic pore water pressure is measured during penetration. (dynamic pore water pressure data can be found in the .cor, .xls files. Static pore water pressure is measured when cone penetration is stopped (static pore water pressure data can be found in the .ppd files). The measured dynamic pore water pressure changes with the location of the porous filter and negative readings are possible when the filter is located behind the tip.

It is important to note that the CPT classifies soil by physical behavior, not by grain size; therefore, the CPT classification should be verified against samples obtained from a conventional drilling program. While the CPT soil classification may not always be accurate in terms of the actual label it applies to a particular soil, it is very accurate in grouping soils with similar mechanical properties.

Table 1 presents a summary of CPT soundings, including sounding depths.

3.2 CONE PLOTS

The data from each sounding was plotted using the computer program ScreenZ. The plots are included in Appendix A. ScreenZ was developed by ConeTec Inc. and it incorporates soil behavior type (SBT) classification as part of the plot. The soil classification is based on the classification chart reproduced chart in Appendix B.

3.3 PORE PRESSURE DISSIPATION TEST RESULTS

When conducting CPT investigations, pore water pressure dissipations are automatically recorded during pauses in penetration. The pore water pressure data is recorded at five second intervals. Dynamic and static pore pressure dissipation data for each CPT is included on the data CD. No dissipation tests were completed during this project. Water table depths used in the data interpretations were given to us by the client.

3.4 SHEAR WAVE VELOCITY MEASUREMENTS

Shear wave velocity measurements were conducted during all of the CPT soundings. Shear wave velocity measurements were recorded approximately every meter. The shear wave velocity data can be found in Appendix C.

3.5 CPTSUMM DATA PROCESSING

The electronic data files were processed using the program CPTSUMM. CPTSUMM is a program developed by ConeTec to calculate common engineering parameters from CPT data. The data files (xls) can be found on the data CD. The calculations used are summarized in the table found in Appendix B. Each calculation is derived according to the referenced article.

For this project, the depth to ground water was given to us by the client. The exact depth used is noted in the header of each CPTSUMM file.

3.6 DATA CD

One data CD is included in Appendix E. The CD includes all of the CPT, dynamic and static pore water pressure and CPTSUMM data.

5.0 REFERENCES

Robertson, P.K., 1989, "Soil Classification using the Cone Penetration Test", Canadian Geotechnical Journal, vol. 27, pages 151-158.

Robertson, P.K., Sully, J., Woeller, D.G., Lunne, T., Powell, J.M., and Gillespie, D.J., 1992, "Estimating Coefficient of Consolidation from Piezocone Tests", Canadian Geotechnical Journal, vol. 29, pages 539-550.

CONETEC

TABLE 1 - SUMMARY OF CPTU SOUNDINGS

Job No.: 07-804
Location: Pond Creek Mine - Williamson County, Illinois
Client: Civil & Environmental Consultants
Date: October 30, 31, 2007

Date	CPTU Sounding	File Name	CPT Total Depth (ft)	Shear wave Velocity Tests	Comments
31-Oct-07	CPT-1	804cp01.cor	18.37	6	
30-Oct-07	CPT-2	804cp02.cor	45.28	13	
30-Oct-07	CPT-2A	804cp02a.cor	41.67	12	
31-Oct-07	CPT-3	804cp03.cor	22.15	6	
31-Oct-07	CPT-4	804cp04.cor	18.86	6	
30-Oct-07	CPT-5	804cp05.cor	49.21	14	
30-Oct-07	CPT-5A	804cp05a.cor	53.15	16	
30-Oct-07	CPT-5B	804cp05b.cor	39.70	12	
31-Oct-07	CPT-6	804cp06.cor	22.64	7	
31-Oct-07	CPT-7	804cp07.cor	16.73	5	
31-Oct-07	CPT-8	804cp08.cor	17.88	6	
31-Oct-07	CPT-9	804cp09.cor	21.98	7	
31-Oct-07	CPT-10	804cp10.cor	26.08	8	
31-Oct-07	CPT-11	804cp11.cor	27.56	9	
31-Oct-07	CPT-12	804cp12.cor	22.64	7	
Job Totals:		15	443.90	134	

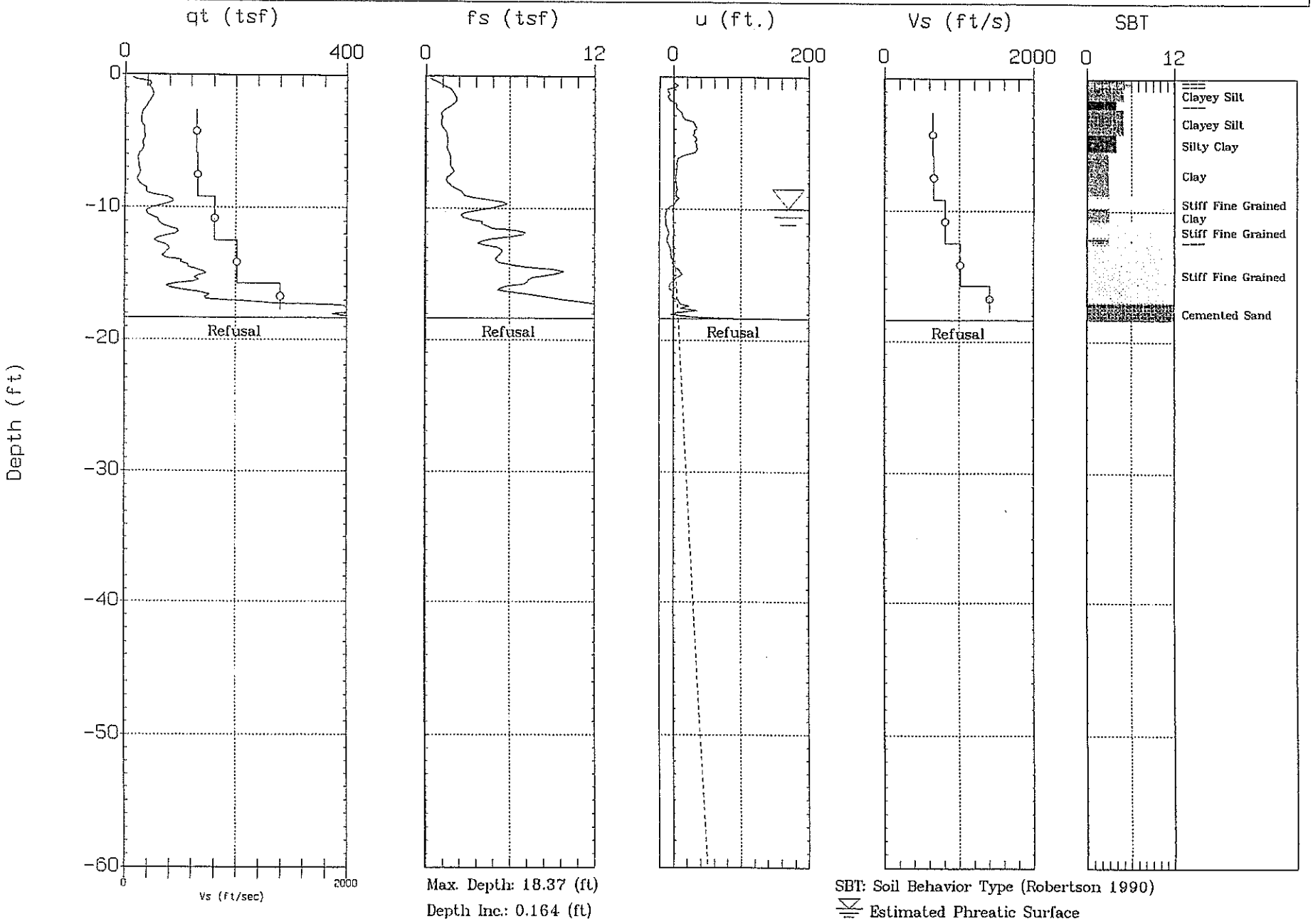
Shearwave CPT plots

CONETEC

C.E.C.

Sounding:CPT-1
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 13:23



Max. Depth: 18.37 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

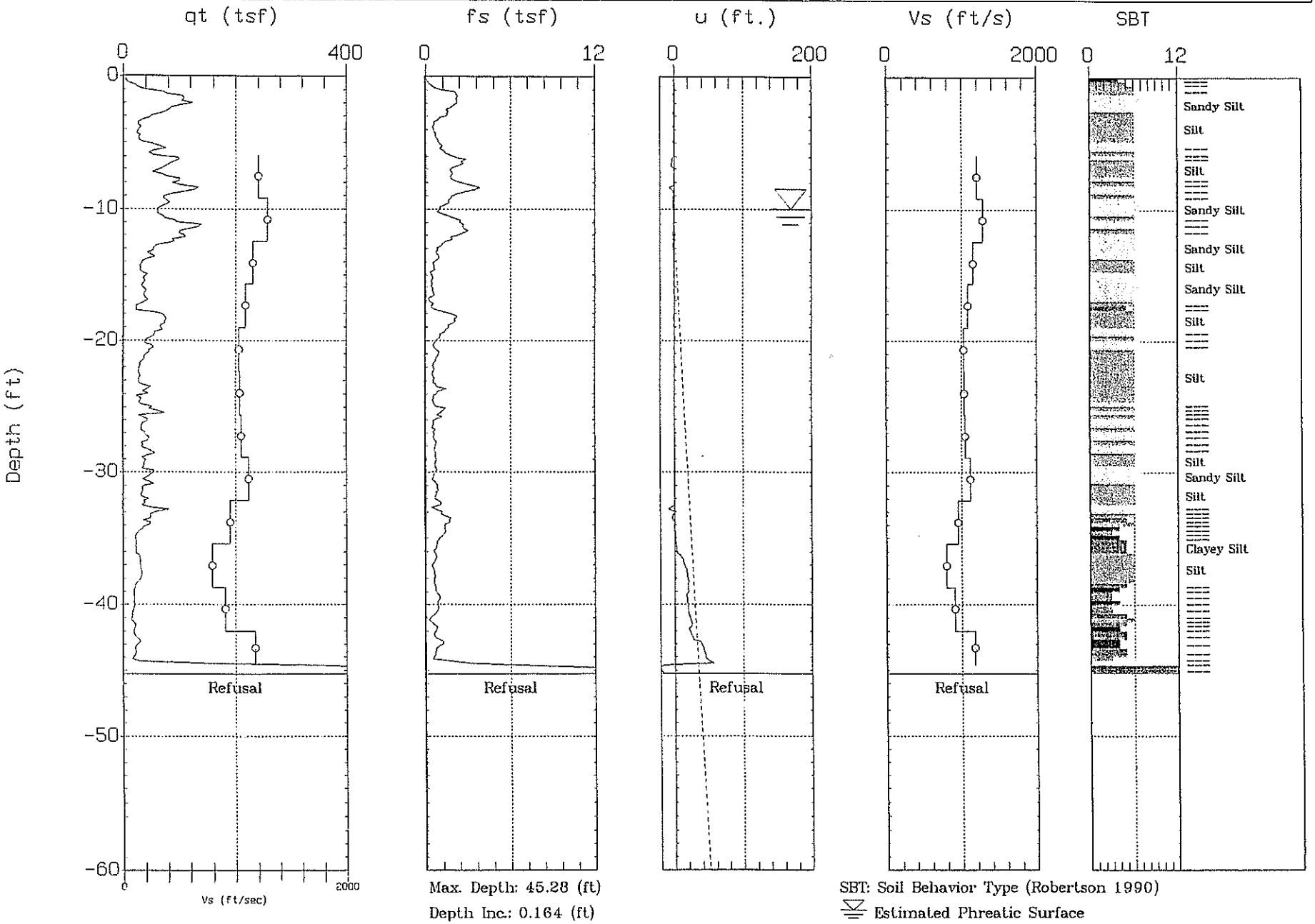
R13705

CONETEC

C.E.C.

Sounding:CPT-2
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 13:46



Max. Depth: 45.28 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

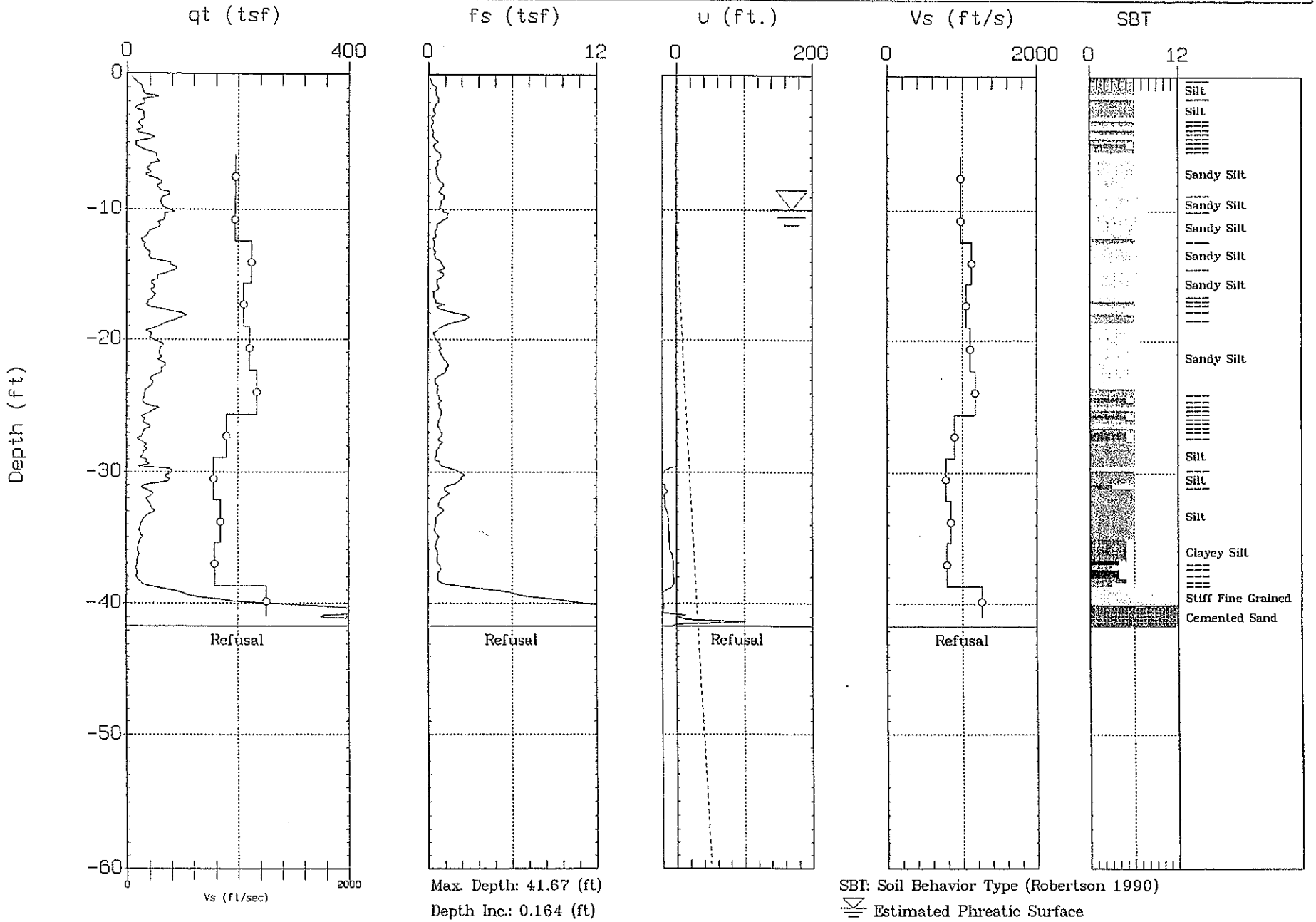
R13706

CONETEC

C.E.C.

Sounding:CPT-2A
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 14:50



Max. Depth: 41.67 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

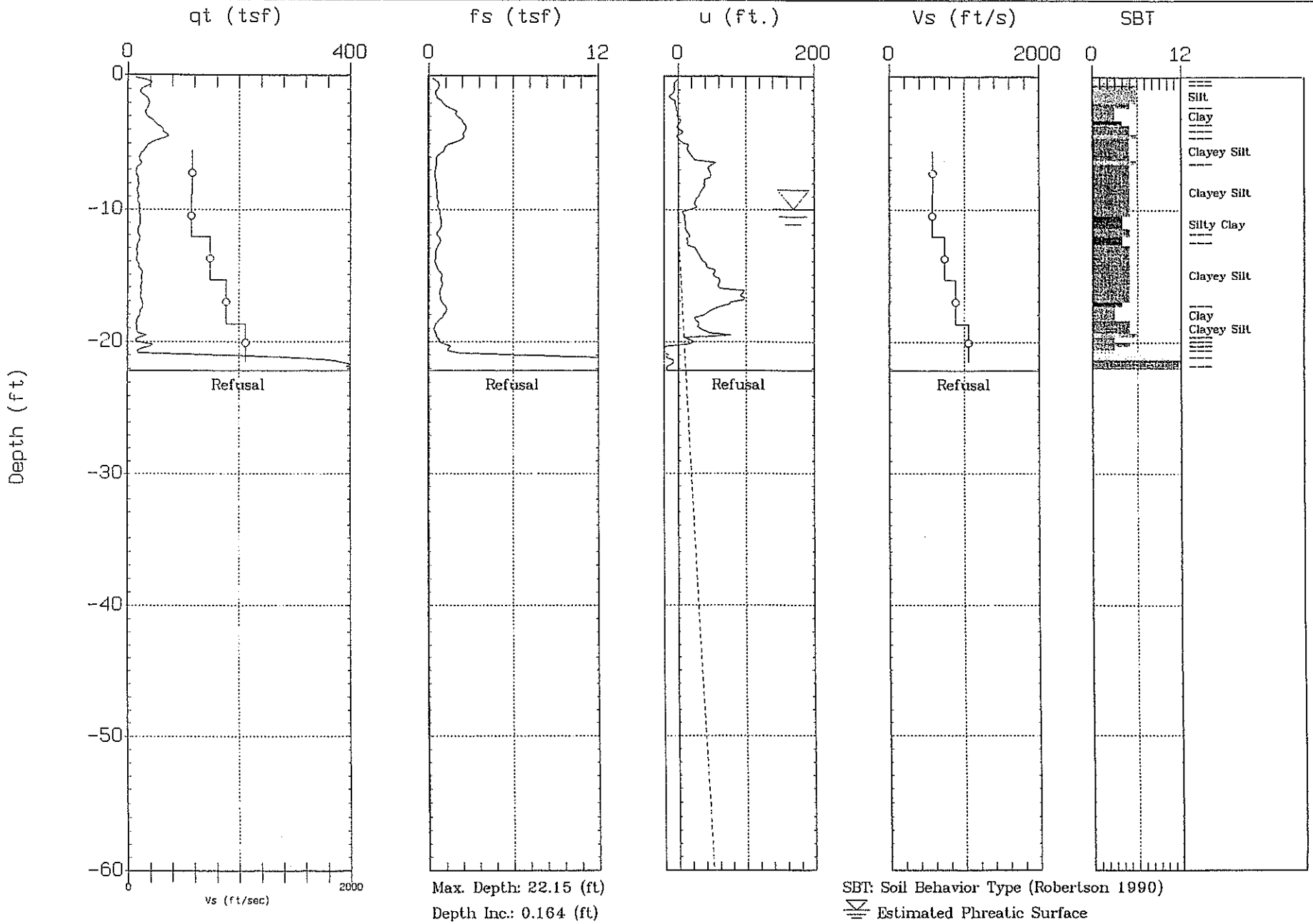
R13707

CONETEC

C.E.C.

Sounding:CPT-3
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:09



Max. Depth: 22.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

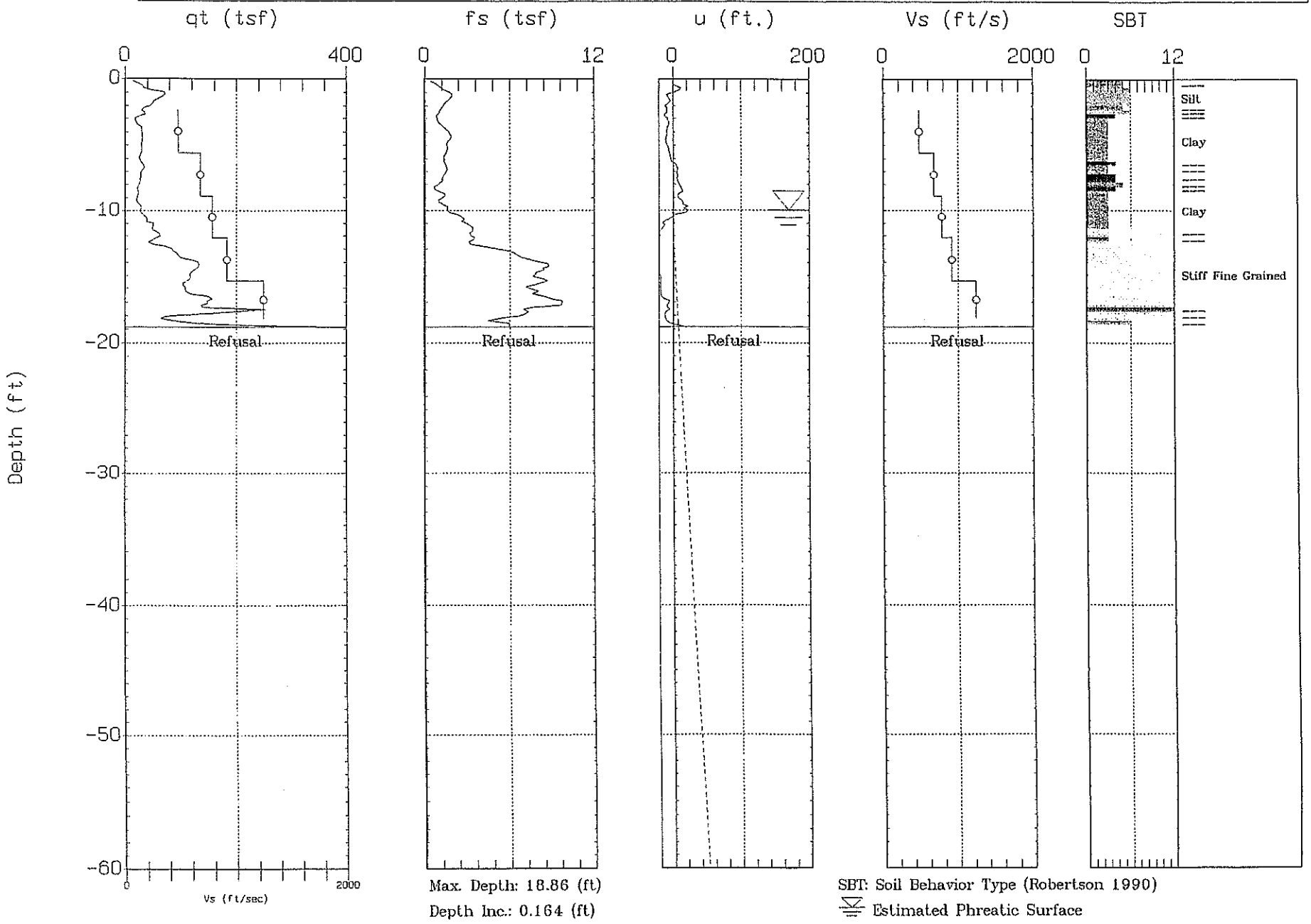
R13708

CONETEC

C.E.C.

Sounding:CPT-4
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:51



Max. Depth: 18.86 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

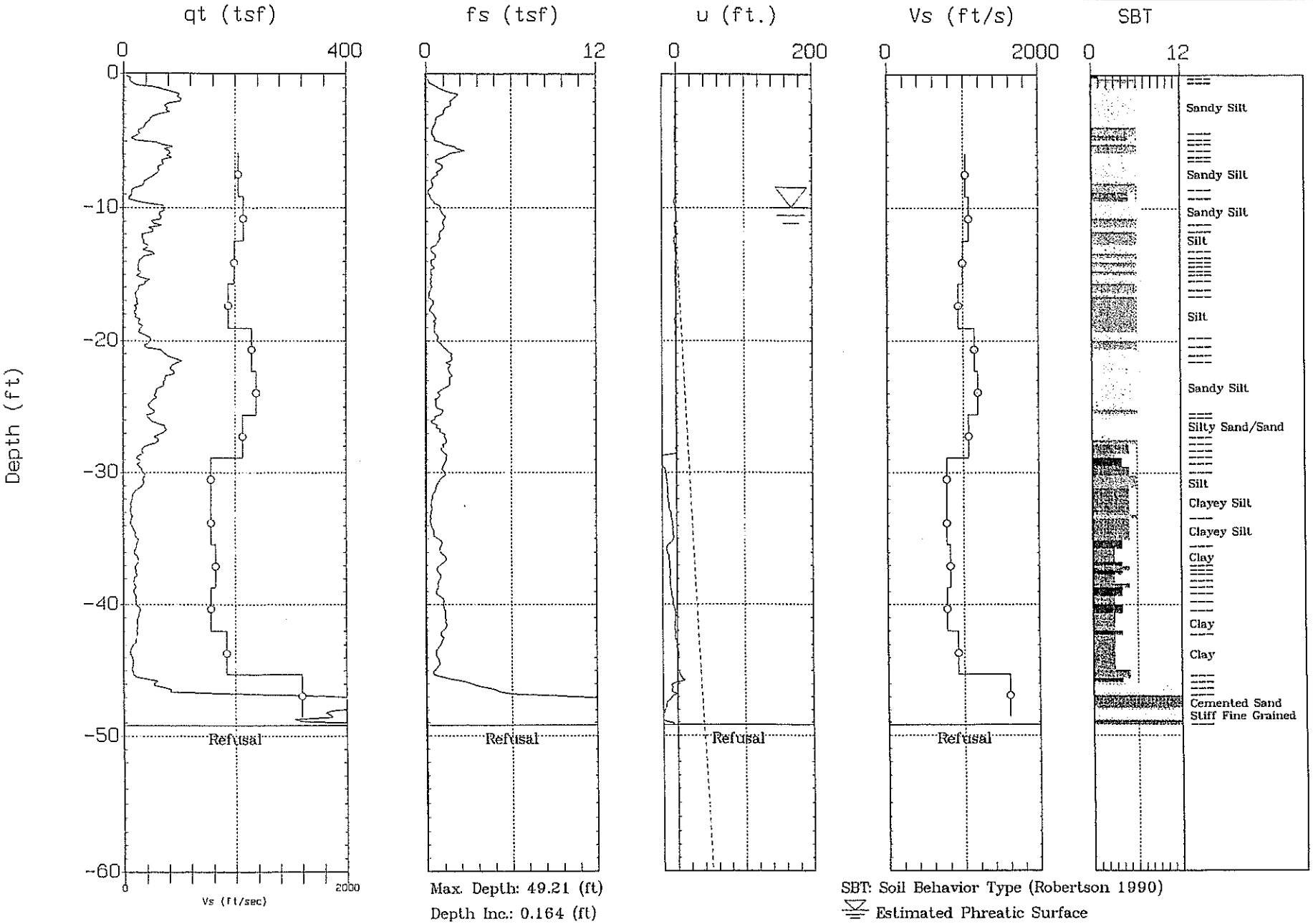
R13709

CONETEC

C.E.C.

Sounding:CPT-5
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 12:34



Max. Depth: 49.21 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

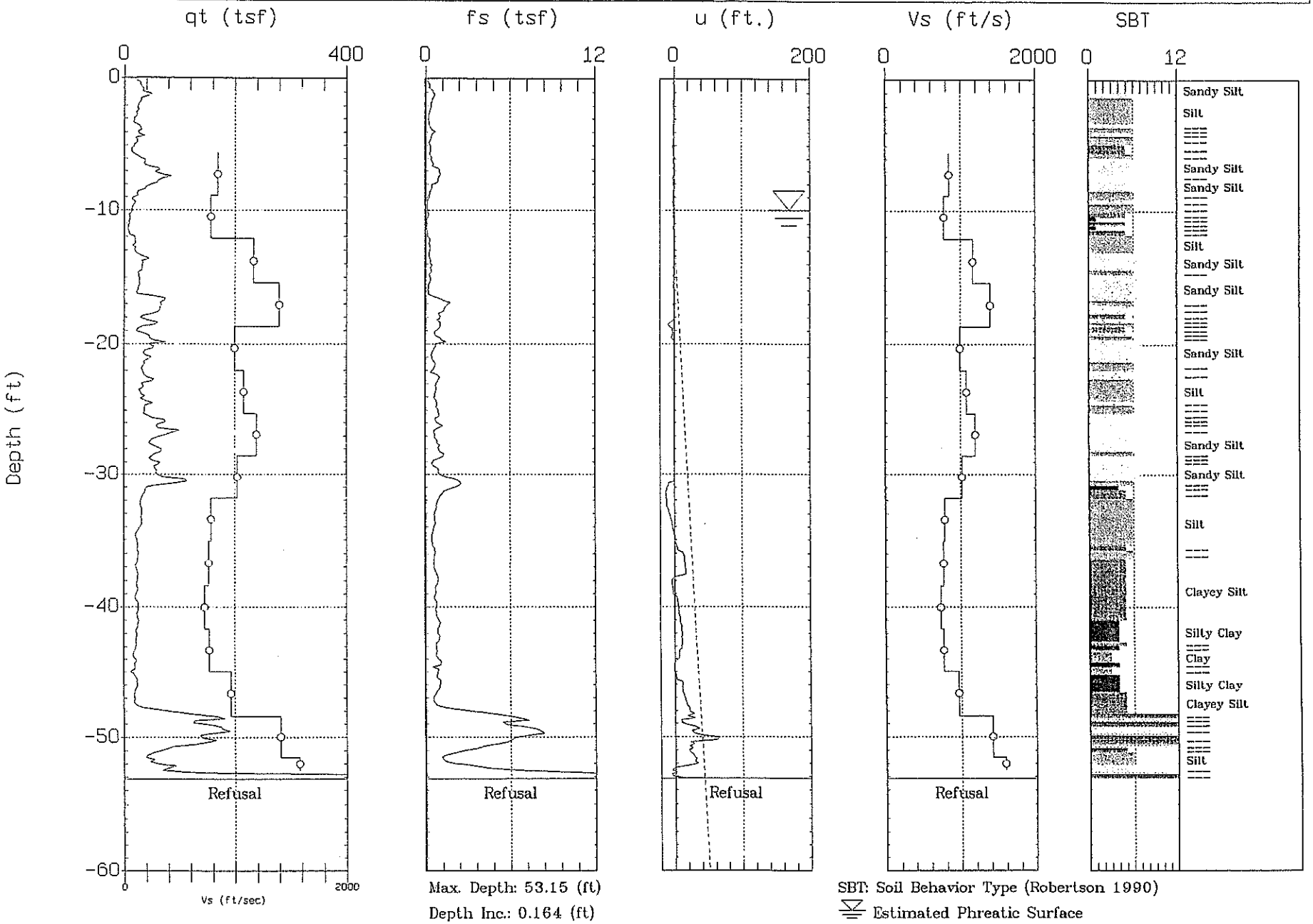
R13710

CONETEC

C.E.C.

Sounding:CPT-5A
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 10:44



Max. Depth: 53.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

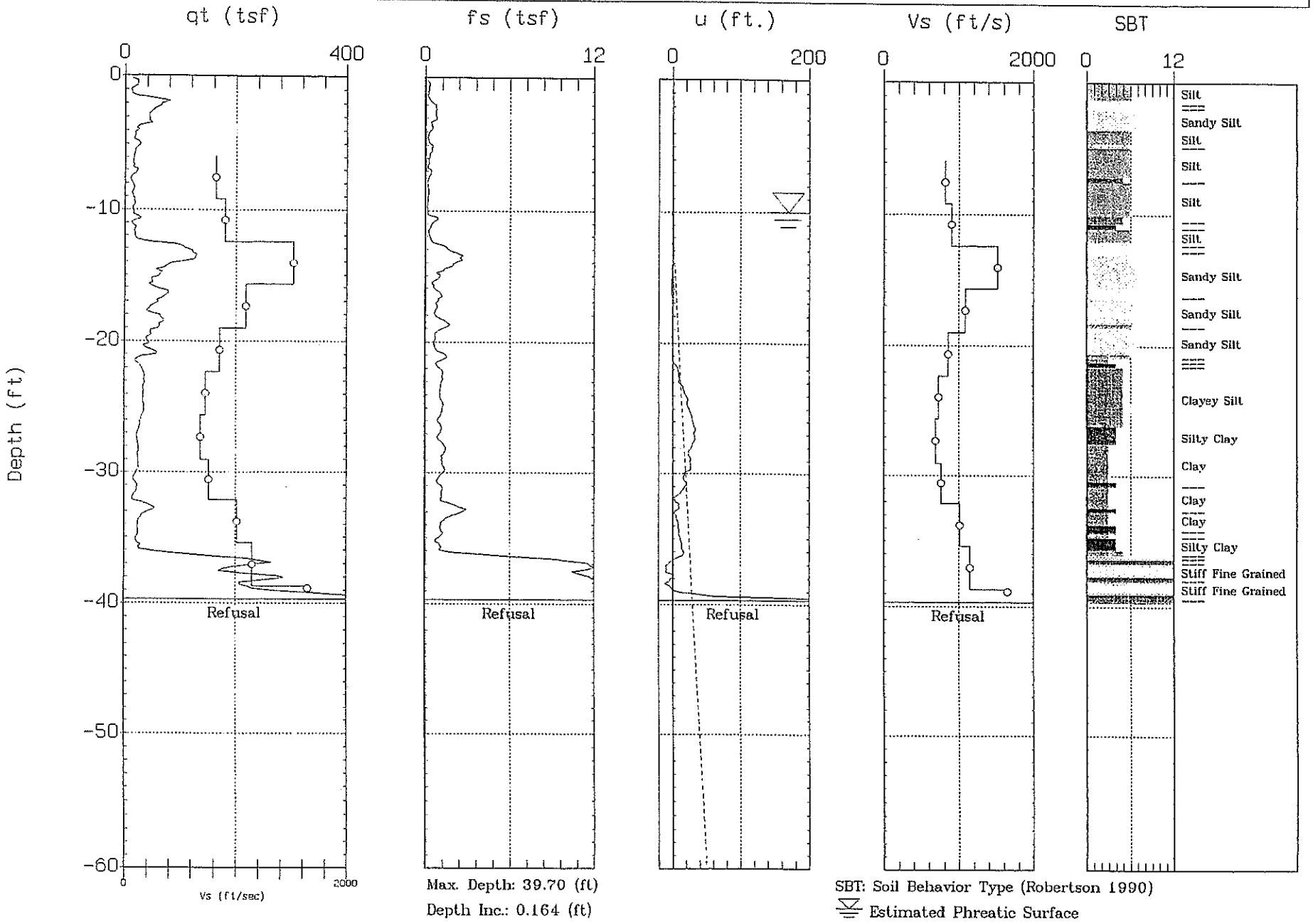
R13711

CONETEC

C.E.C.

Sounding:CPT-5B
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 15:44



Max. Depth: 39.70 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

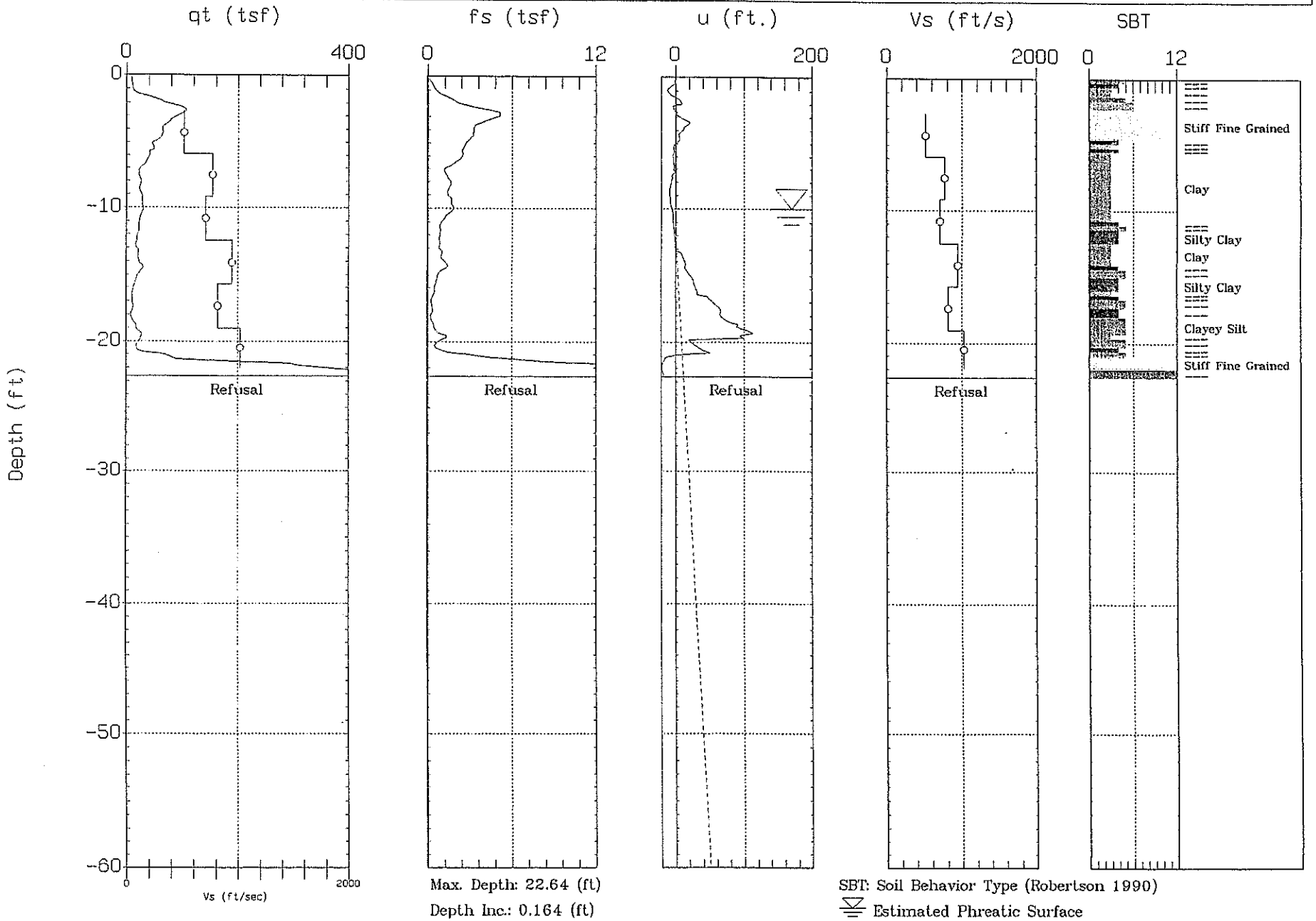
R13712

CONETEC

C.E.C.

Sounding:CPT-6
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:00



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

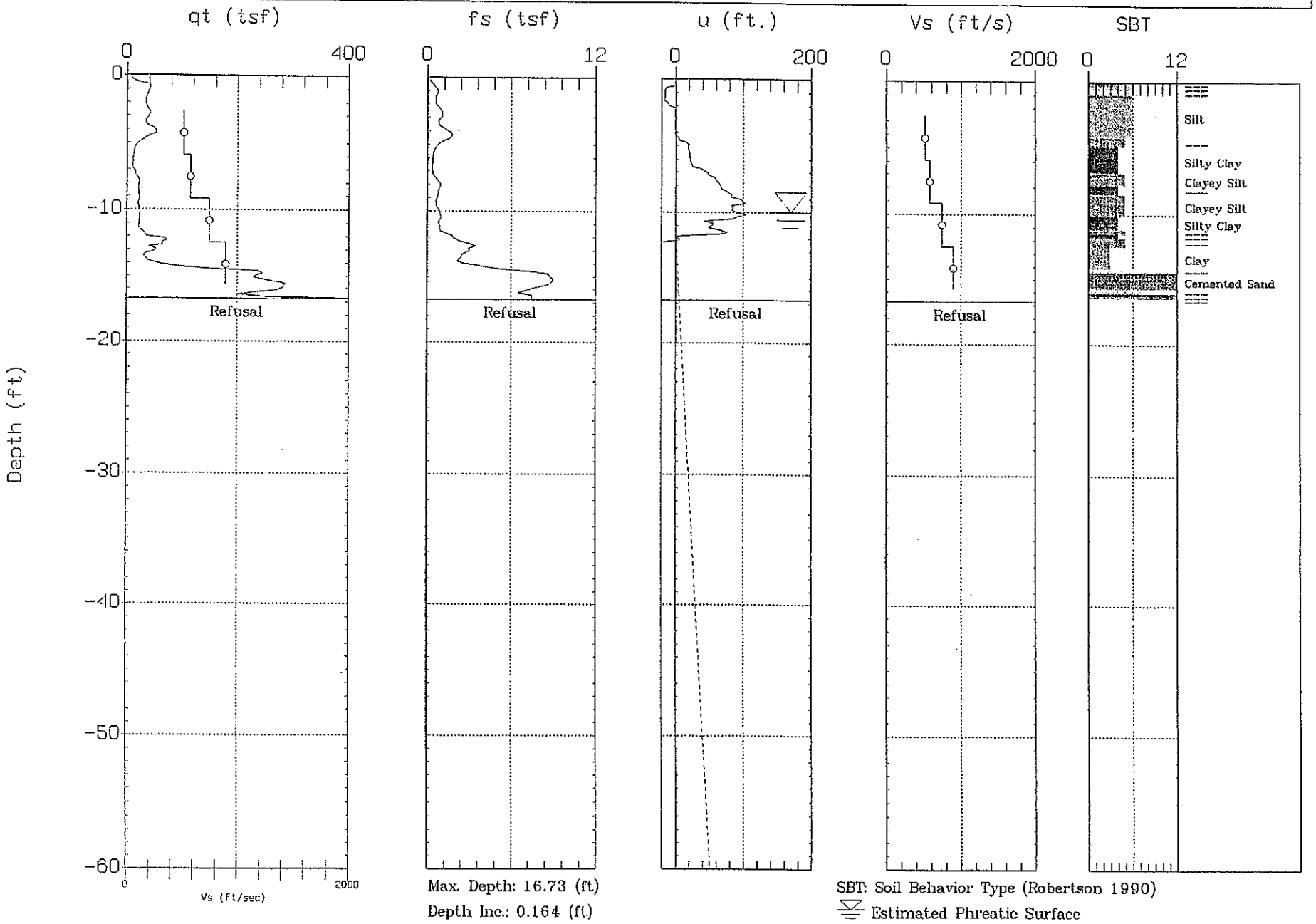
R13713

CONETEC

C.E.C.

Sounding:CPT-7
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:58



Max. Depth: 16.73 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

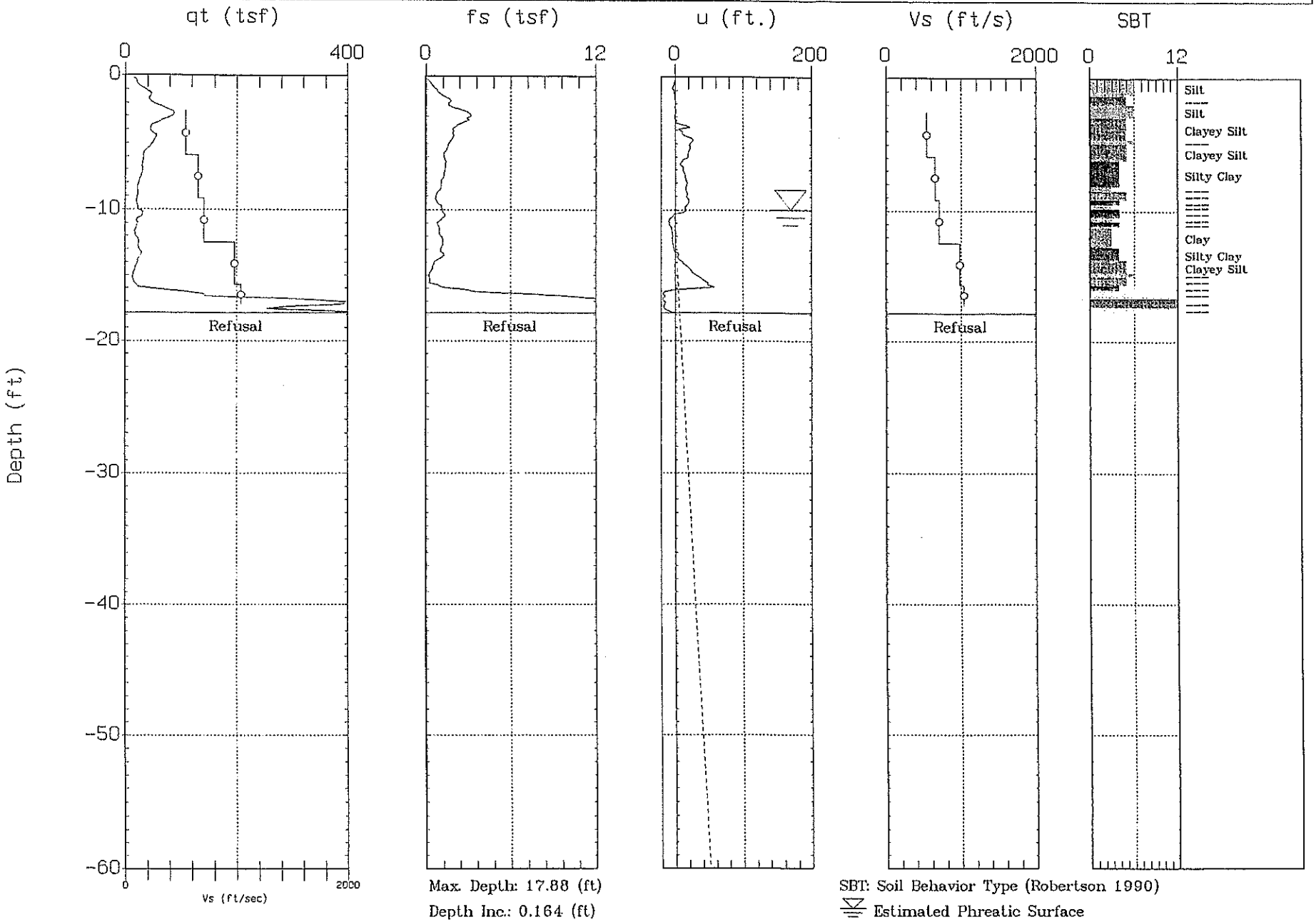
R13714

CONETEC

C.E.C.

Sounding:CPT-8
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:53



Max. Depth: 17.88 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

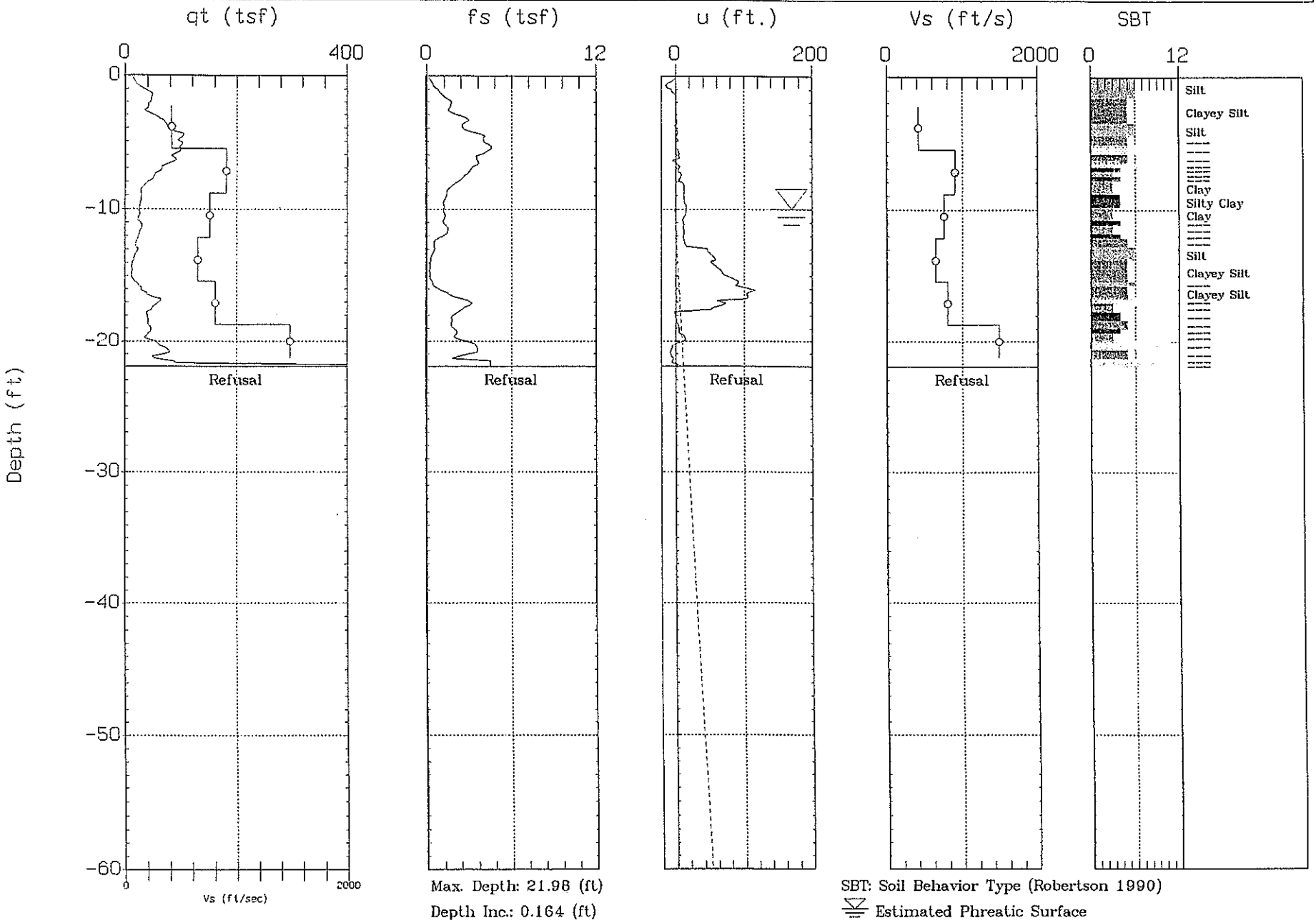
R13715

CONETEC

C.E.C.

Sounding:CPT-9
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:17



Max. Depth: 21.98 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

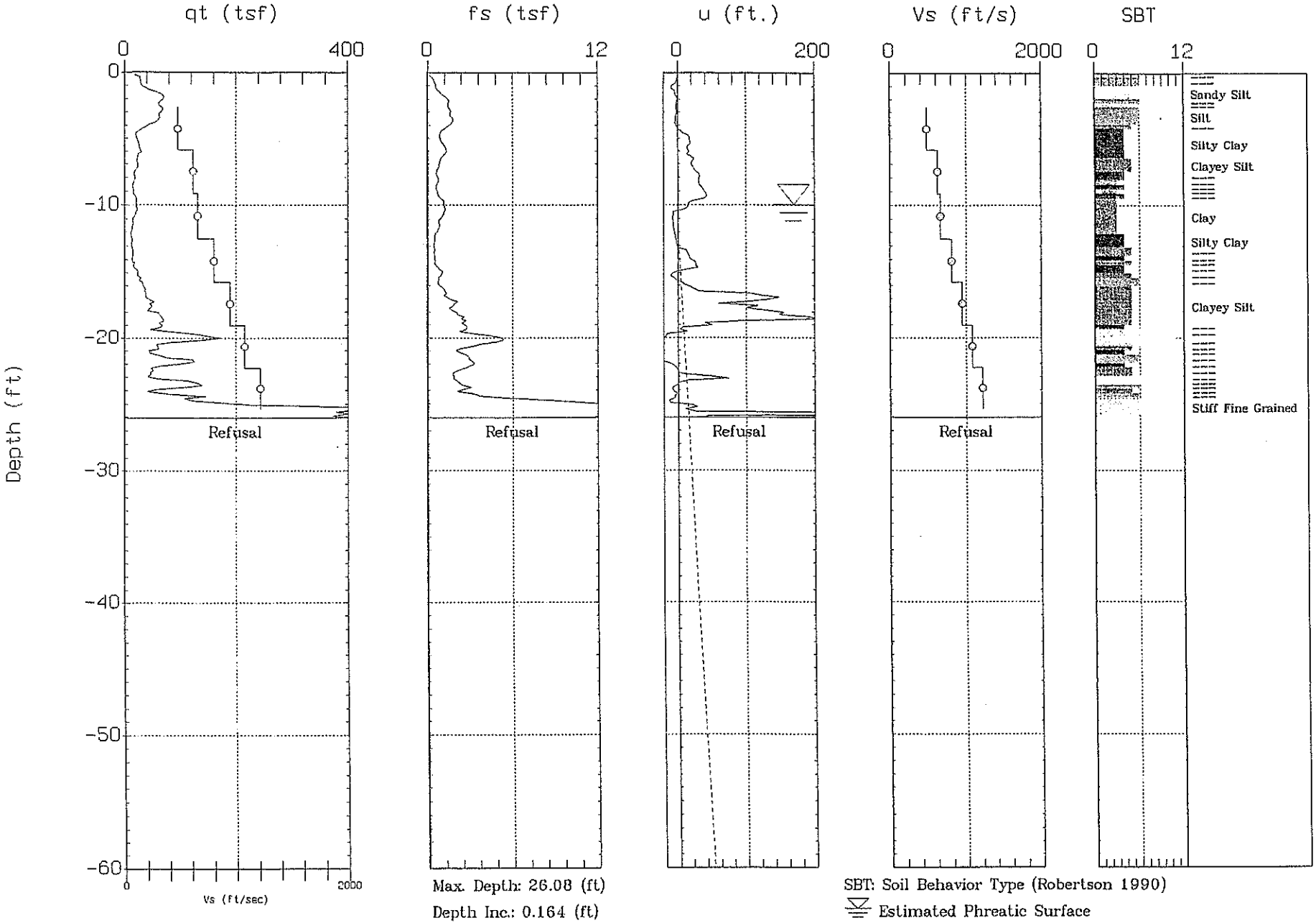
R13716

CONETEC

C.E.C.

Sounding:CPT-10
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 08:35



Max. Depth: 26.08 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

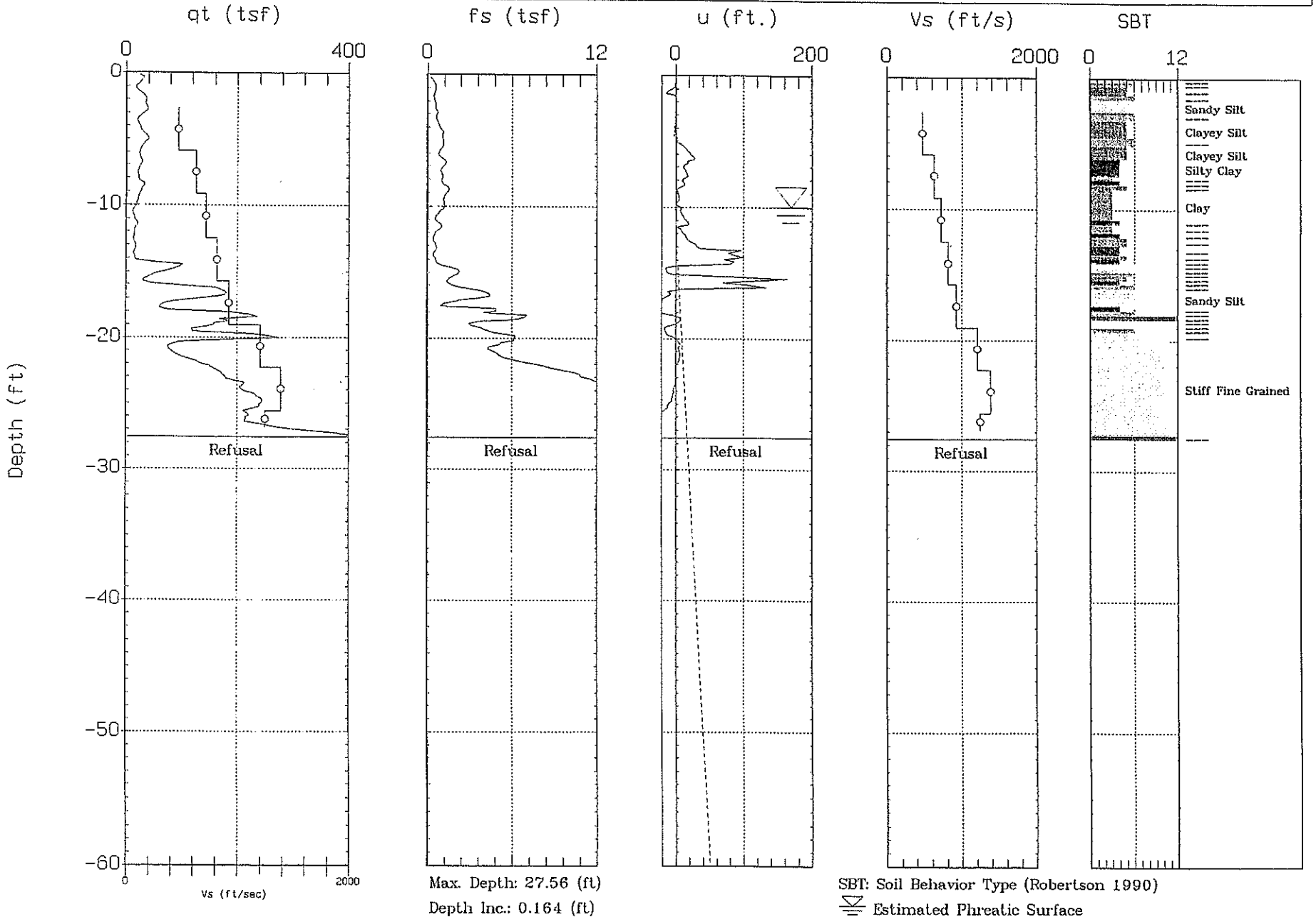
R13717

CONETEC

C.E.C.

Sounding:CPT-11
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 10:31



Max. Depth: 27.56 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

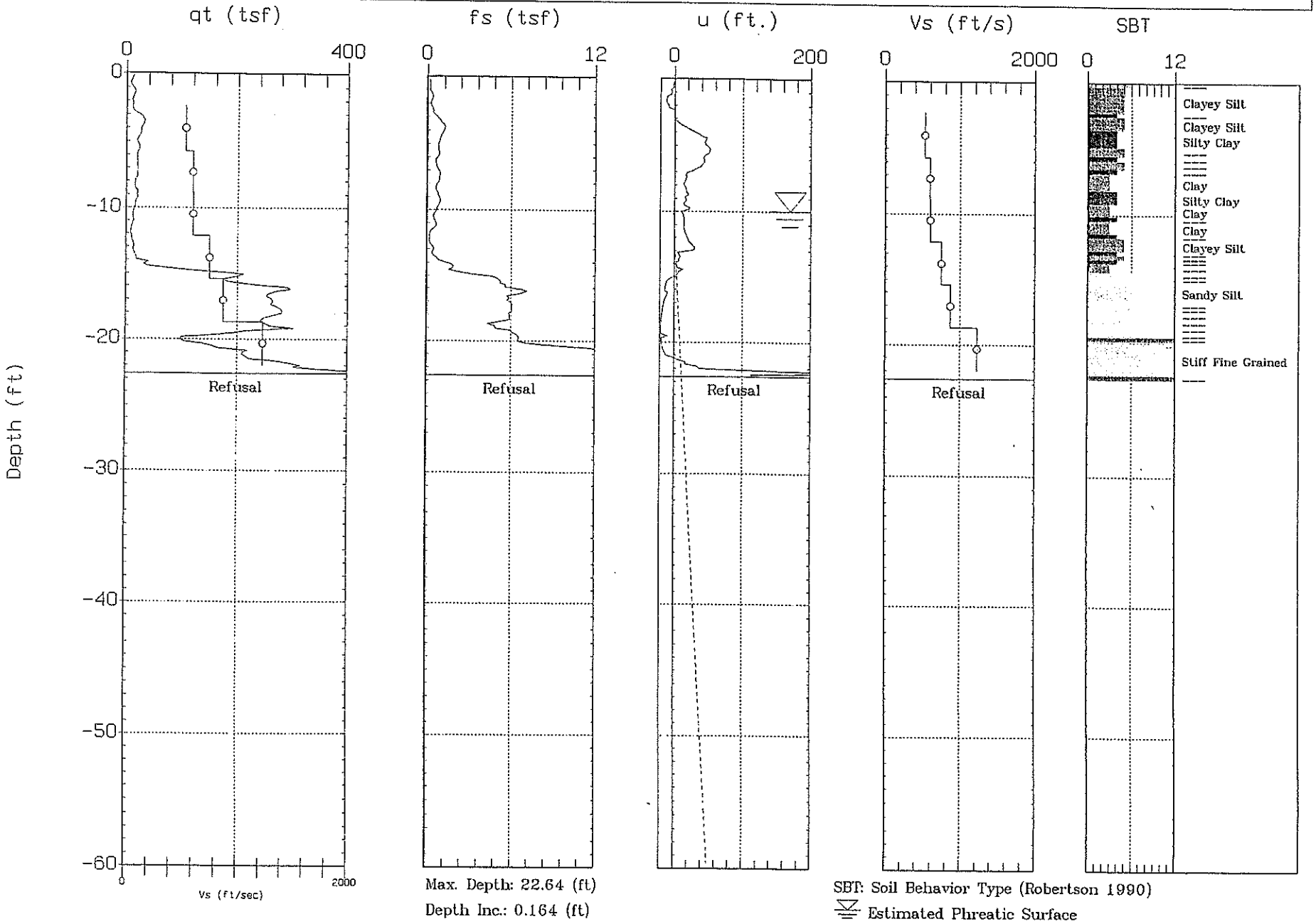
R13718

CONETEC

C.E.C.

Sounding:CPT-12
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 11:15



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

R13719

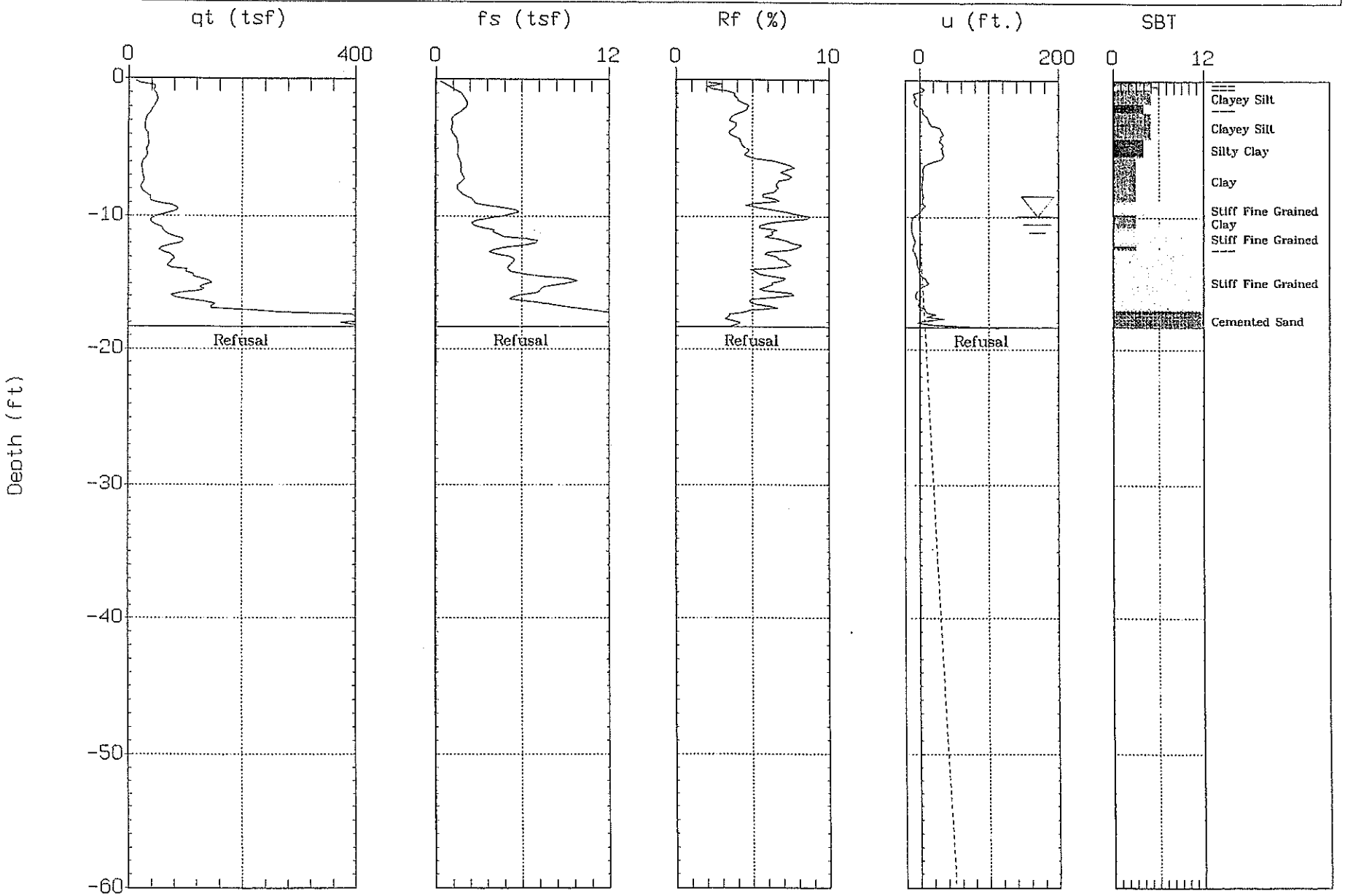
Non-normalized CPT plots

CONETEC

C.E.C.

Sounding:CPT-1
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 13:23



Max. Depth: 18.37 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

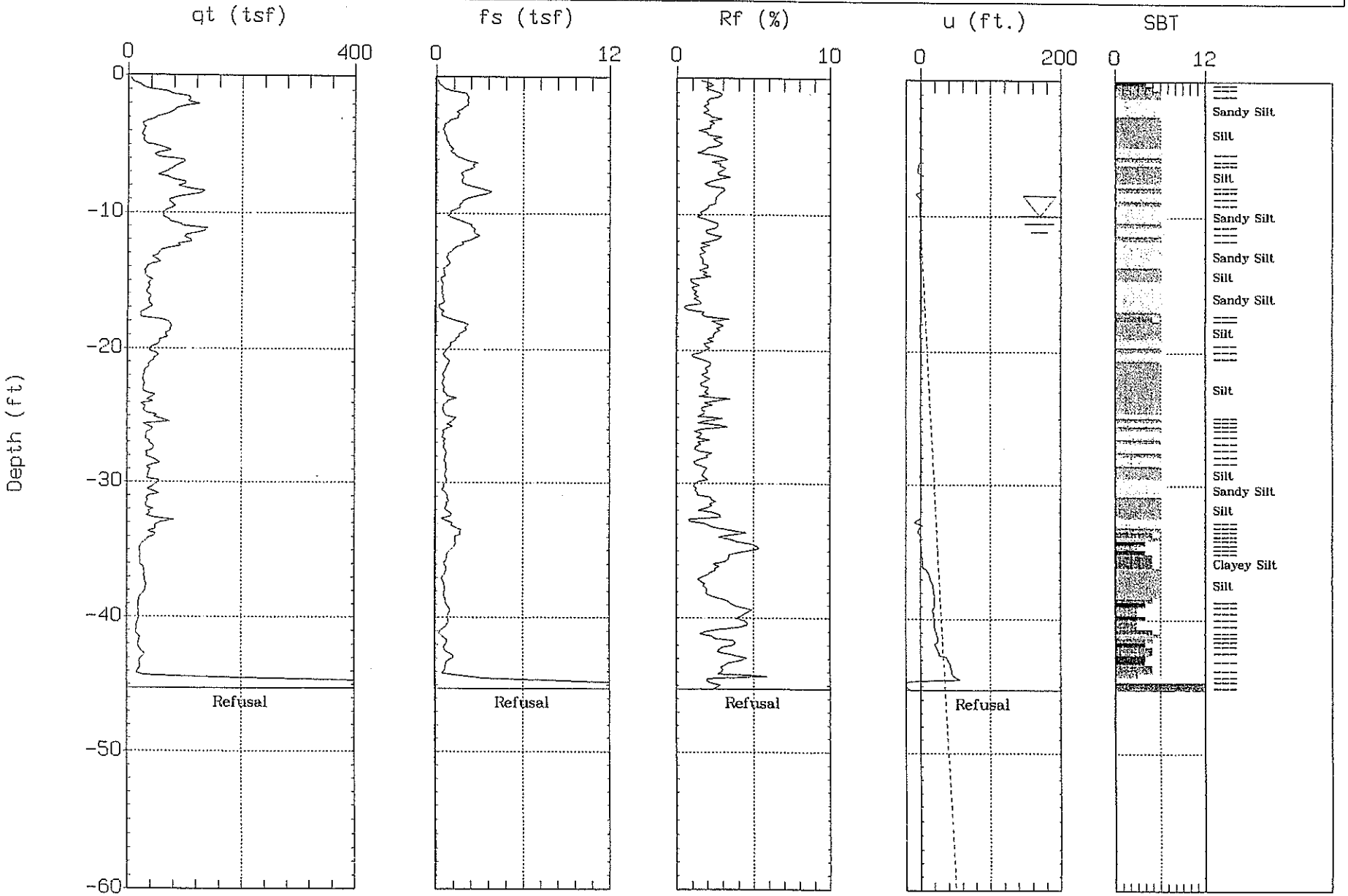
R13721

CONETEC

C.E.C.

Sounding:CPT-2
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 13:46



Max. Depth: 45.28 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

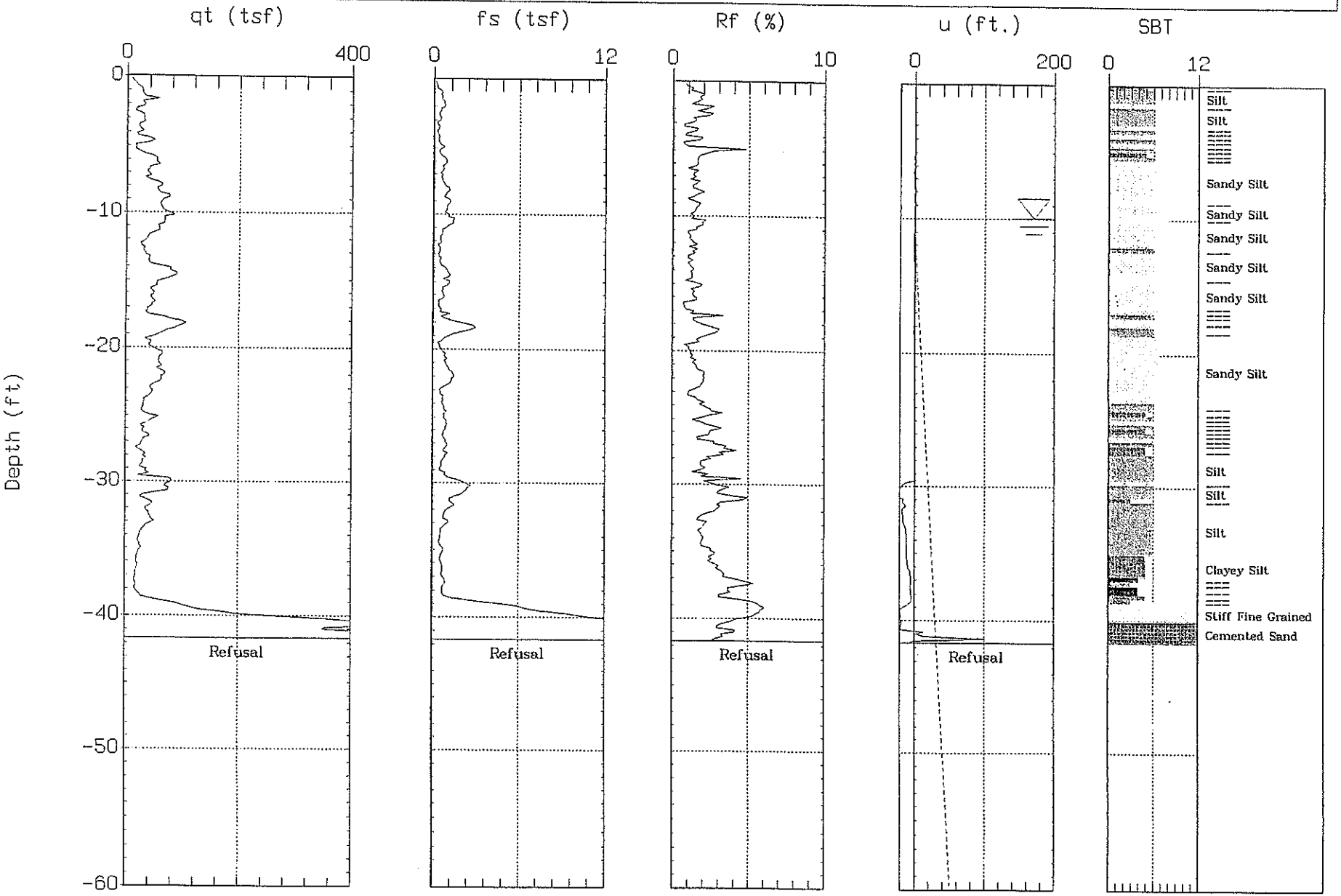
R13722

CONETEC

C.E.C.

Sounding:CPT-2A
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 14:50



Max. Depth: 41.67 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

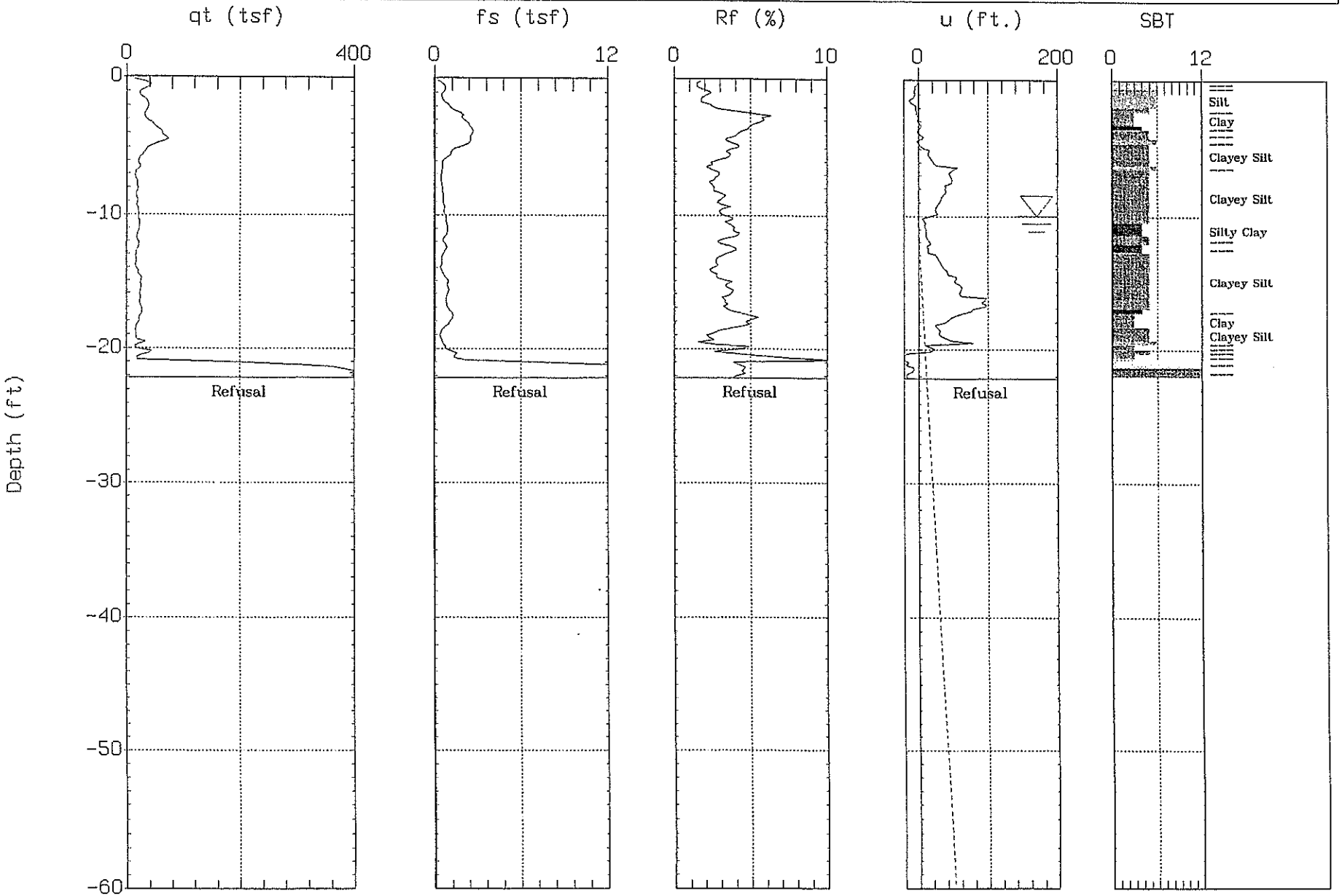
R13723

CONETEC

C.E.C.

Sounding:CPT-3
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:09



Max. Depth: 22.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

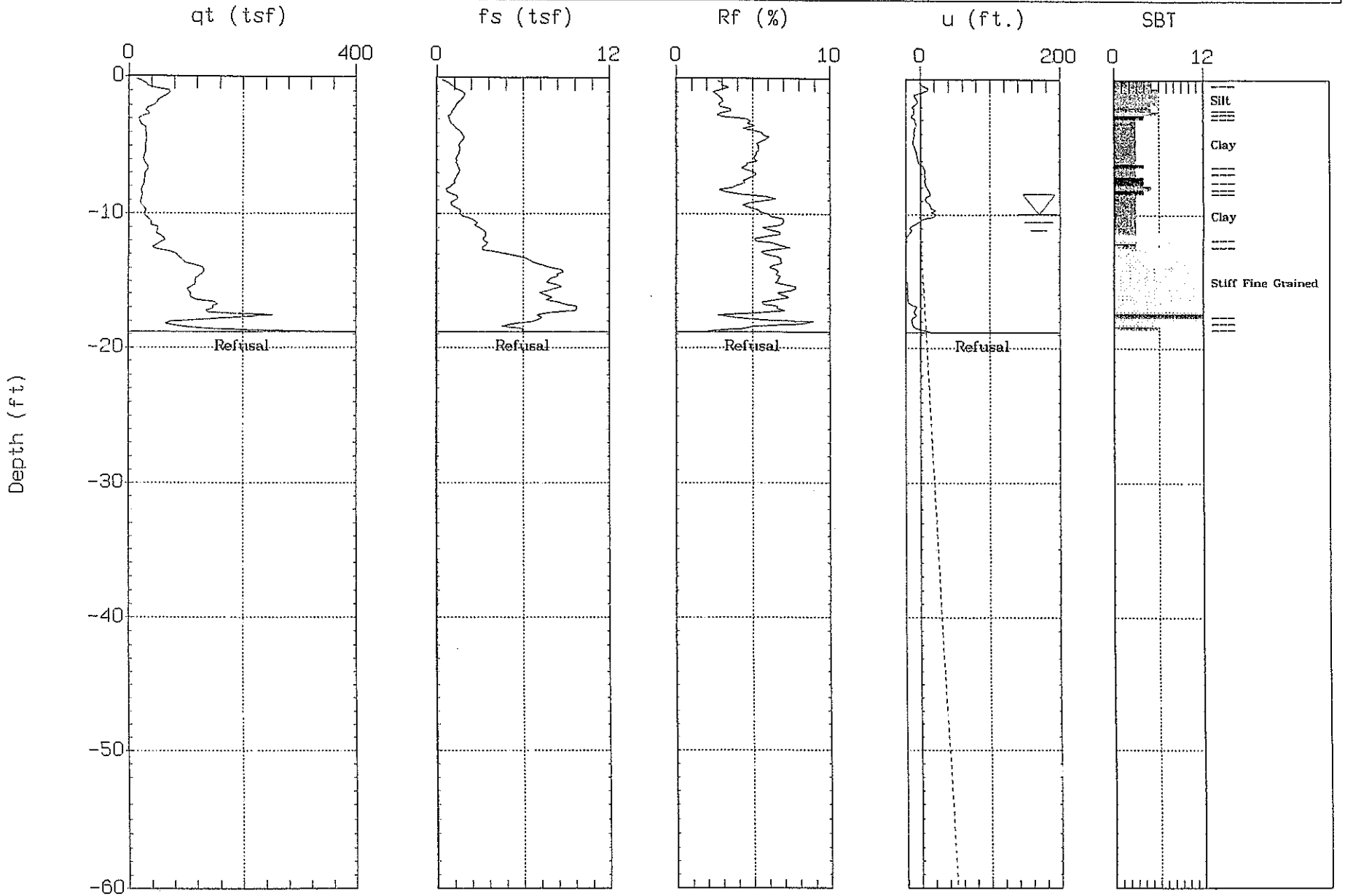
R13724

CONETEC

C.E.C.

Sounding:CPT-4
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:51



Max. Depth: 18.86 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

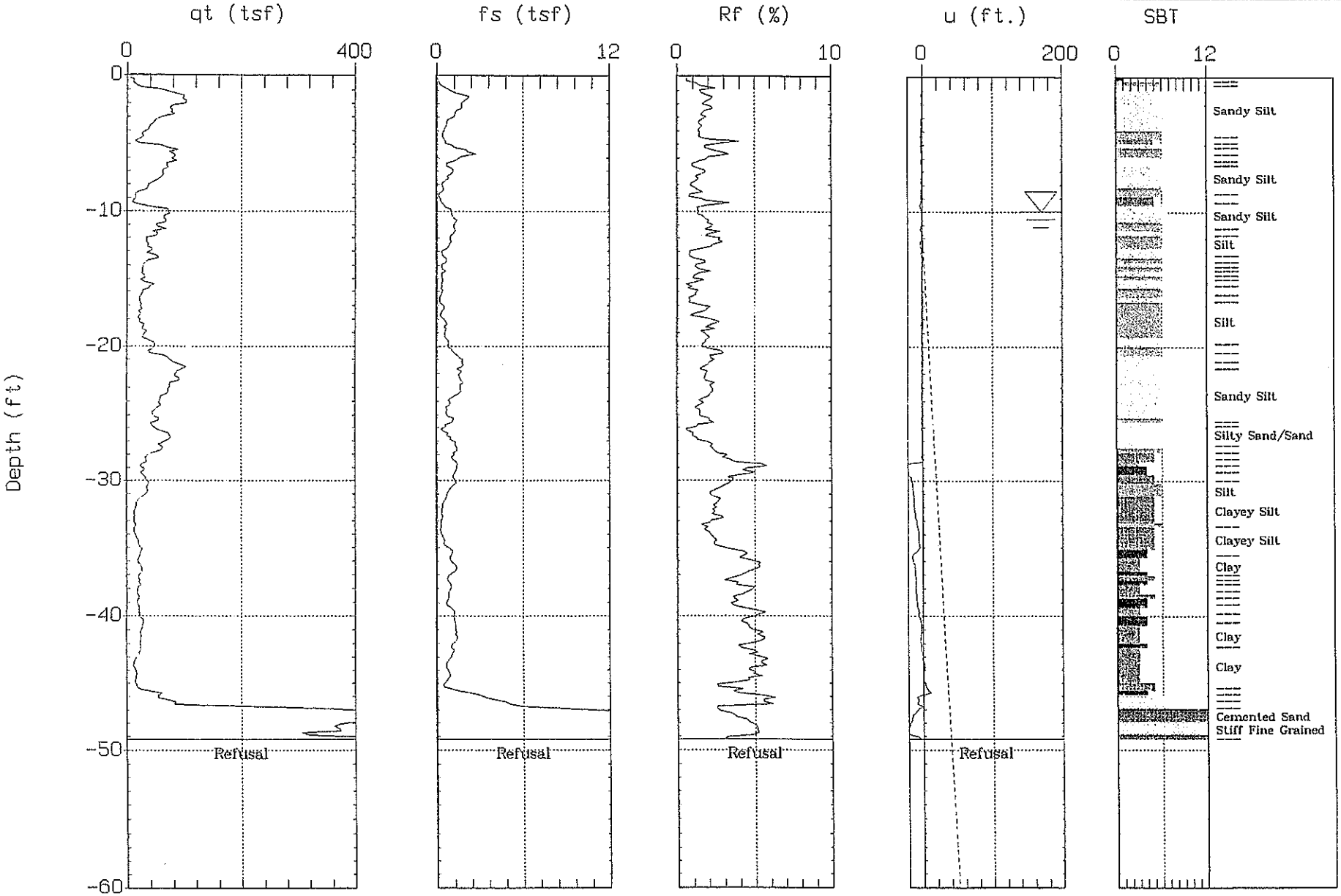
R13725

CONETEC

C.E.C.

Sounding:CPT-5
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 12:34



Max. Depth: 49.21 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

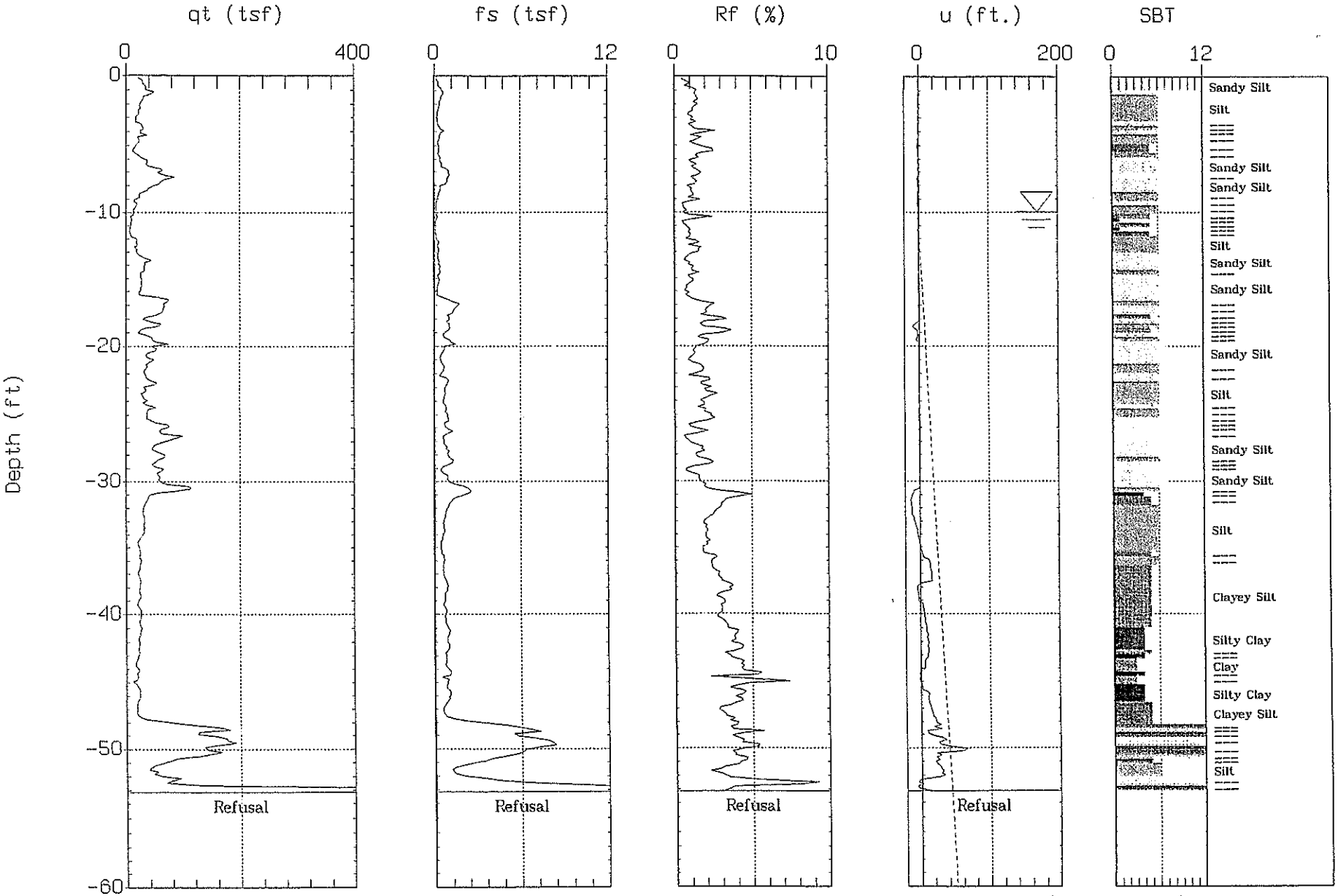
R13726

CONETEC

C.E.C.

Sounding:CPT-5A
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 10:44



Max. Depth: 53.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

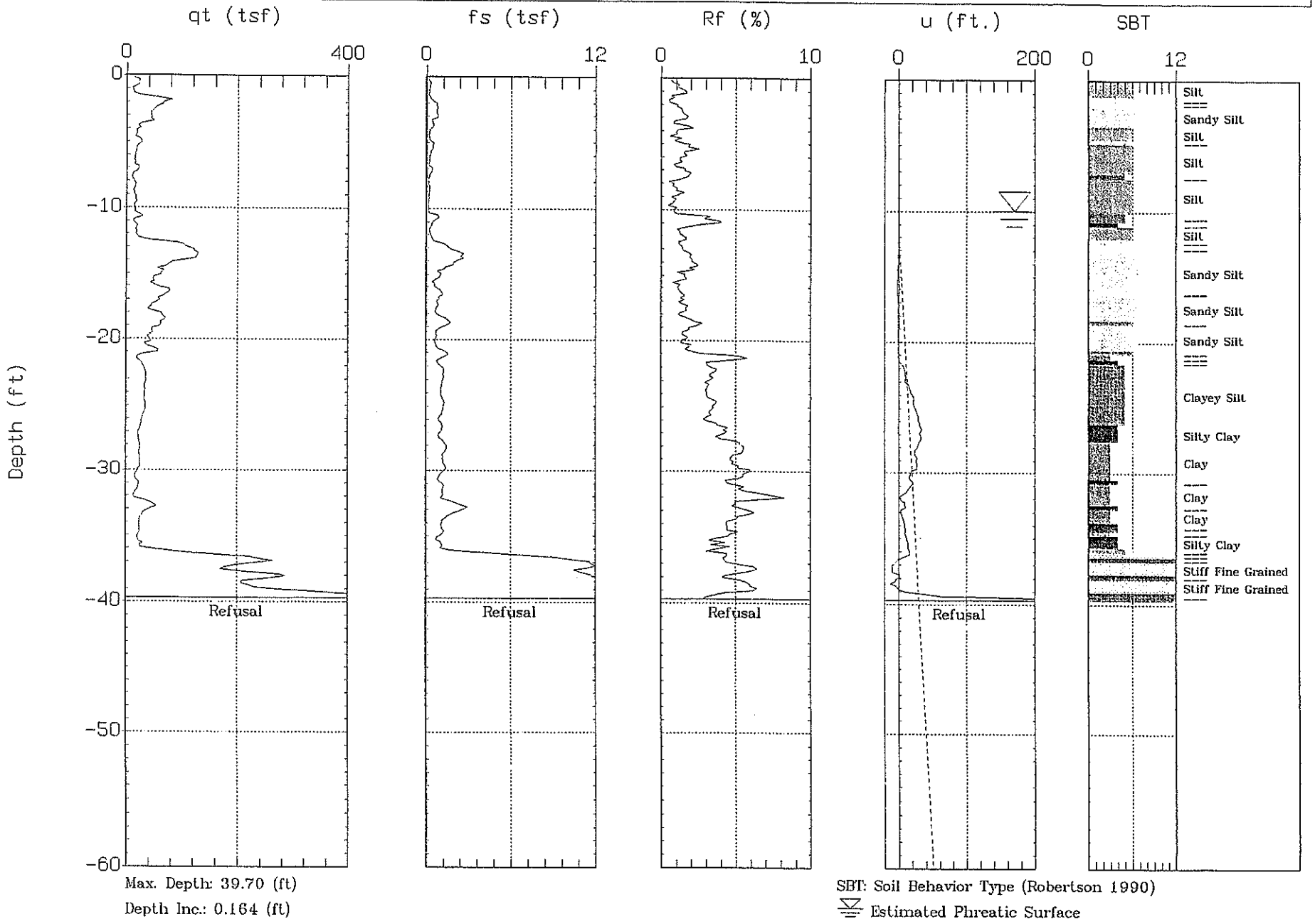
R13727

CONETEC

C.E.C.

Sounding:CPT-5B
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 15:44



Max. Depth: 39.70 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

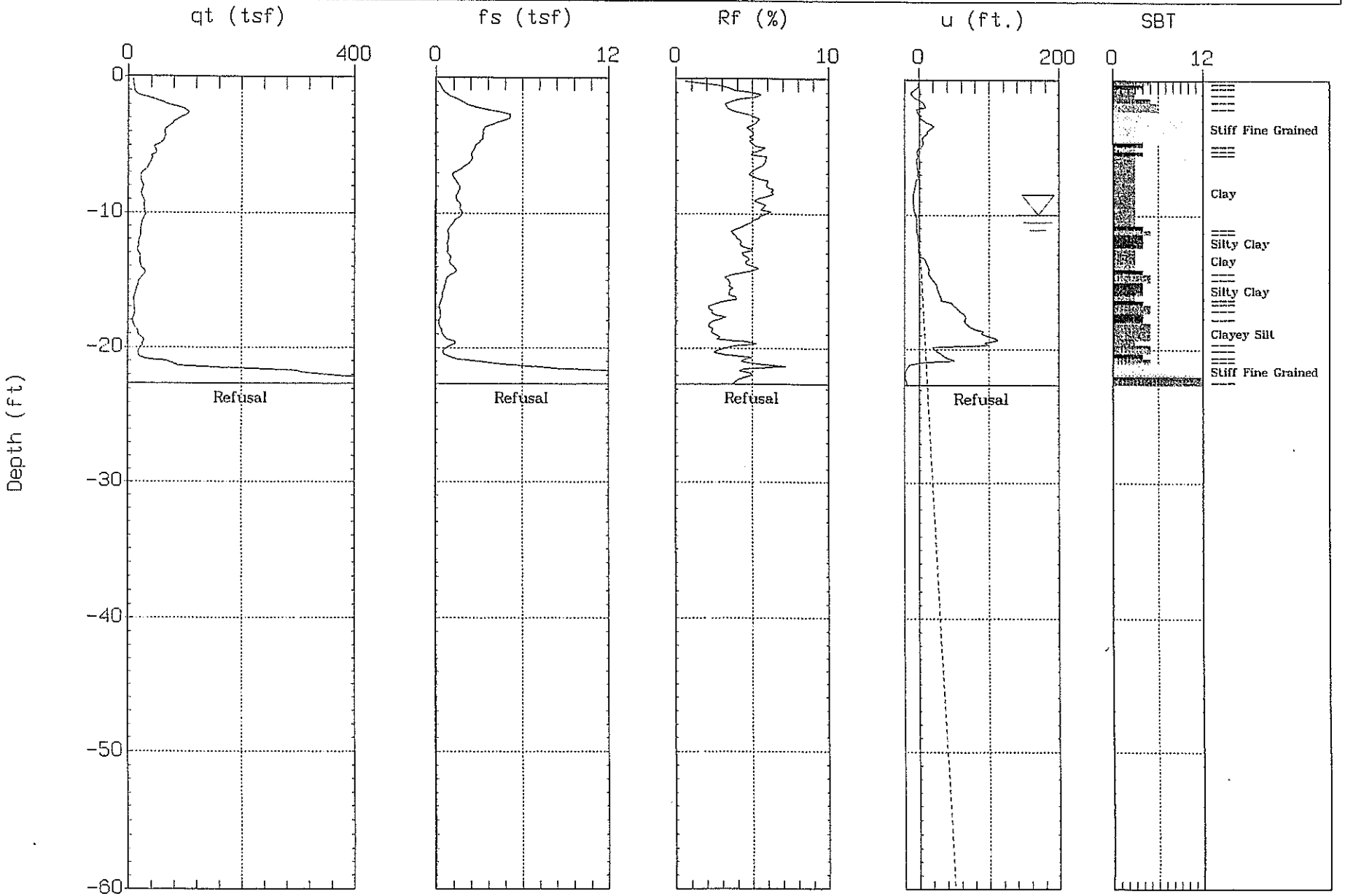
R13728

CONETEC

C.E.C.

Sounding:CPT-6
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:00



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

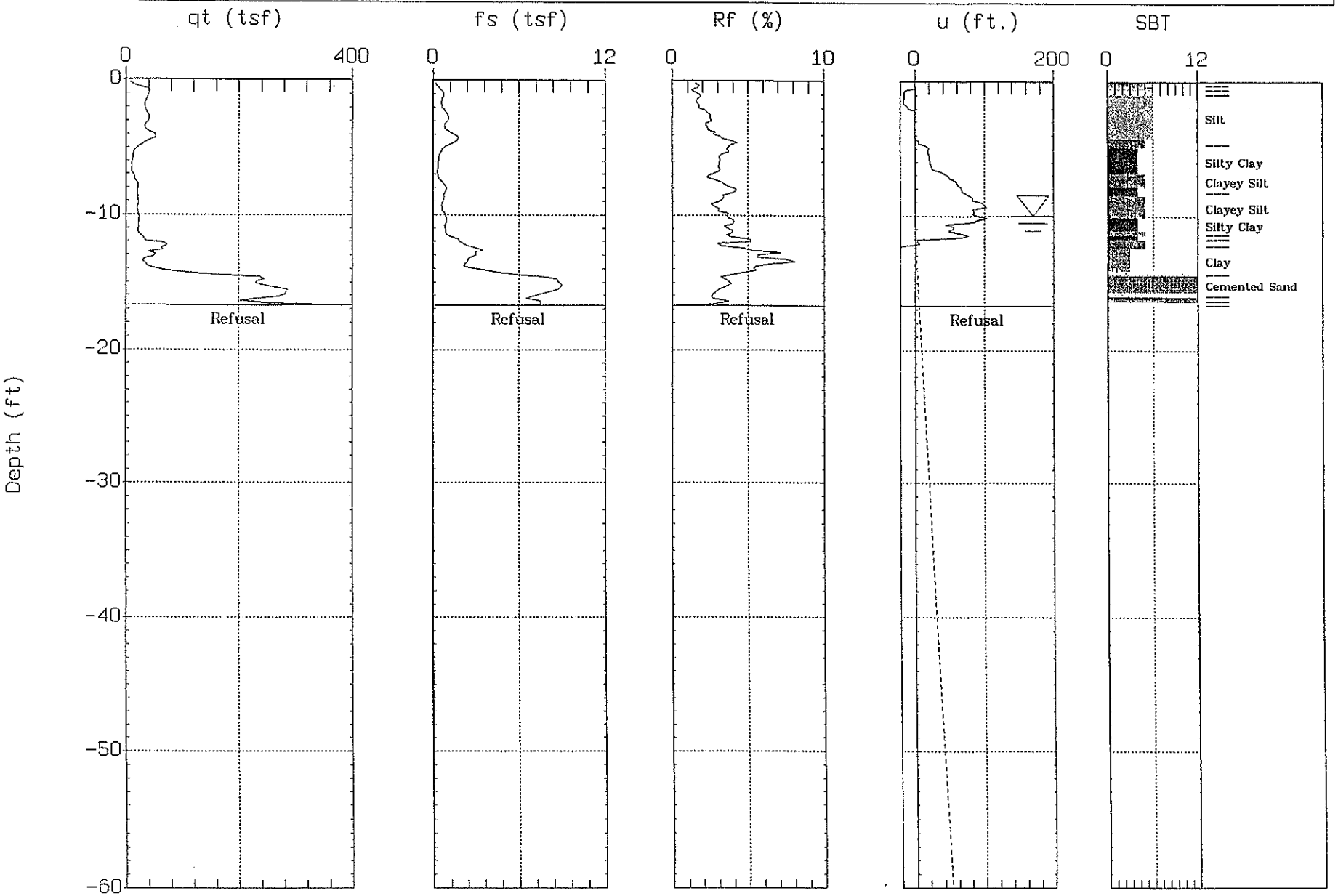
R13729

CONETEC

C.E.C.

Sounding:CPT-7
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:58



Max. Depth: 16.73 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

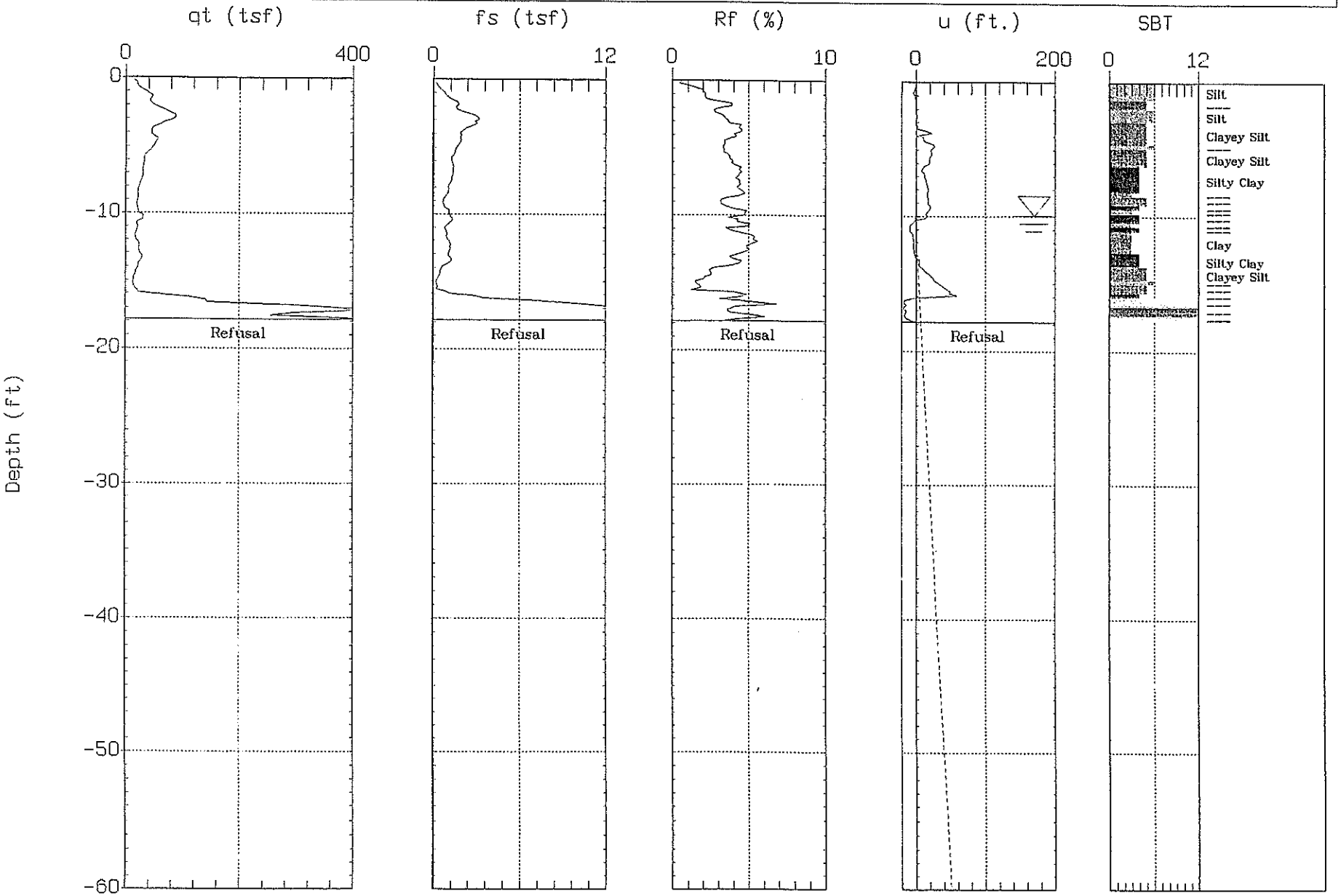
R13730

CONETEC

C.E.C.

Sounding:CPT-8
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:53



Max. Depth: 17.88 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

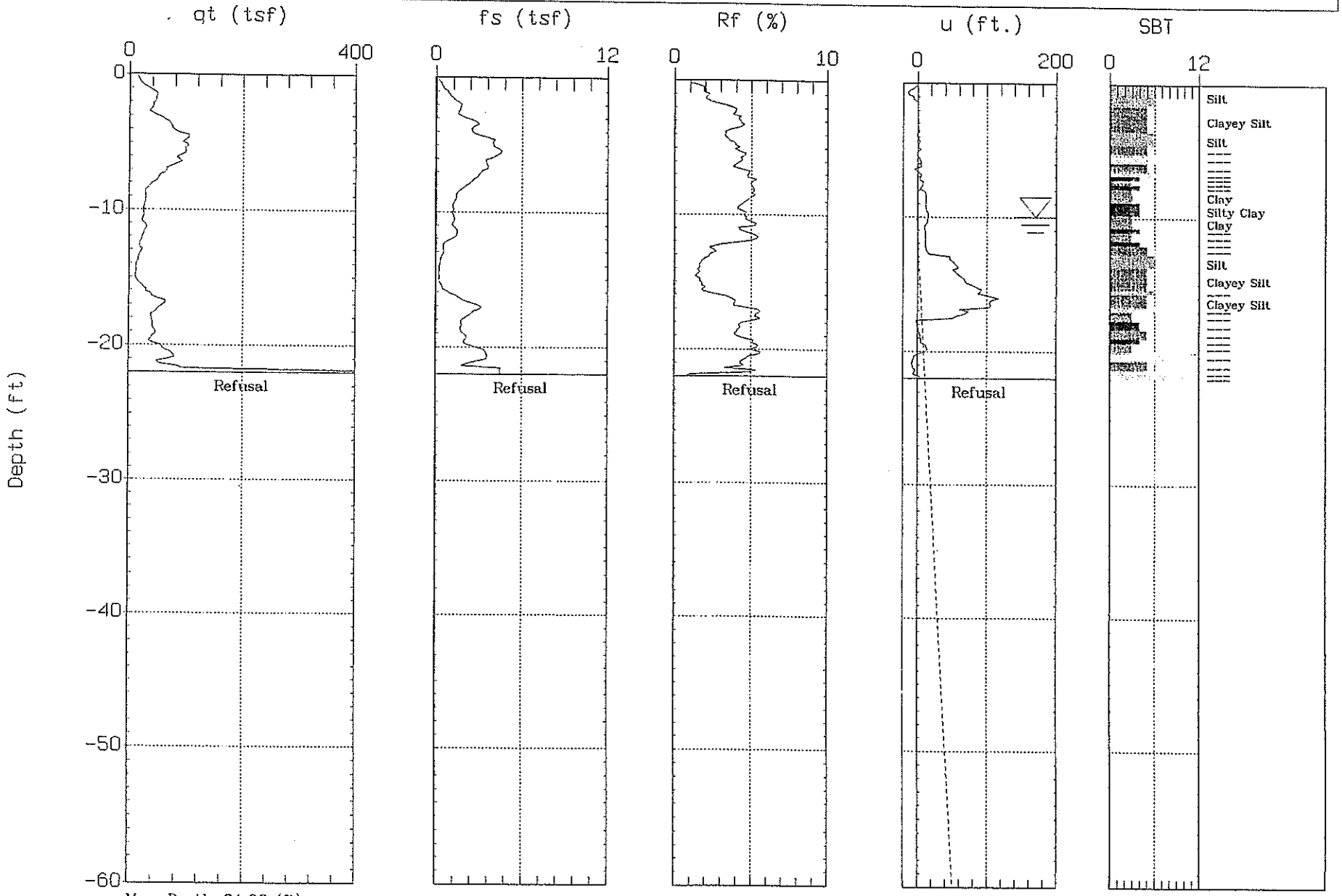
R13731

CONETEC

C.E.C.

Sounding:CPT-9
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:17



Max. Depth: 21.98 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

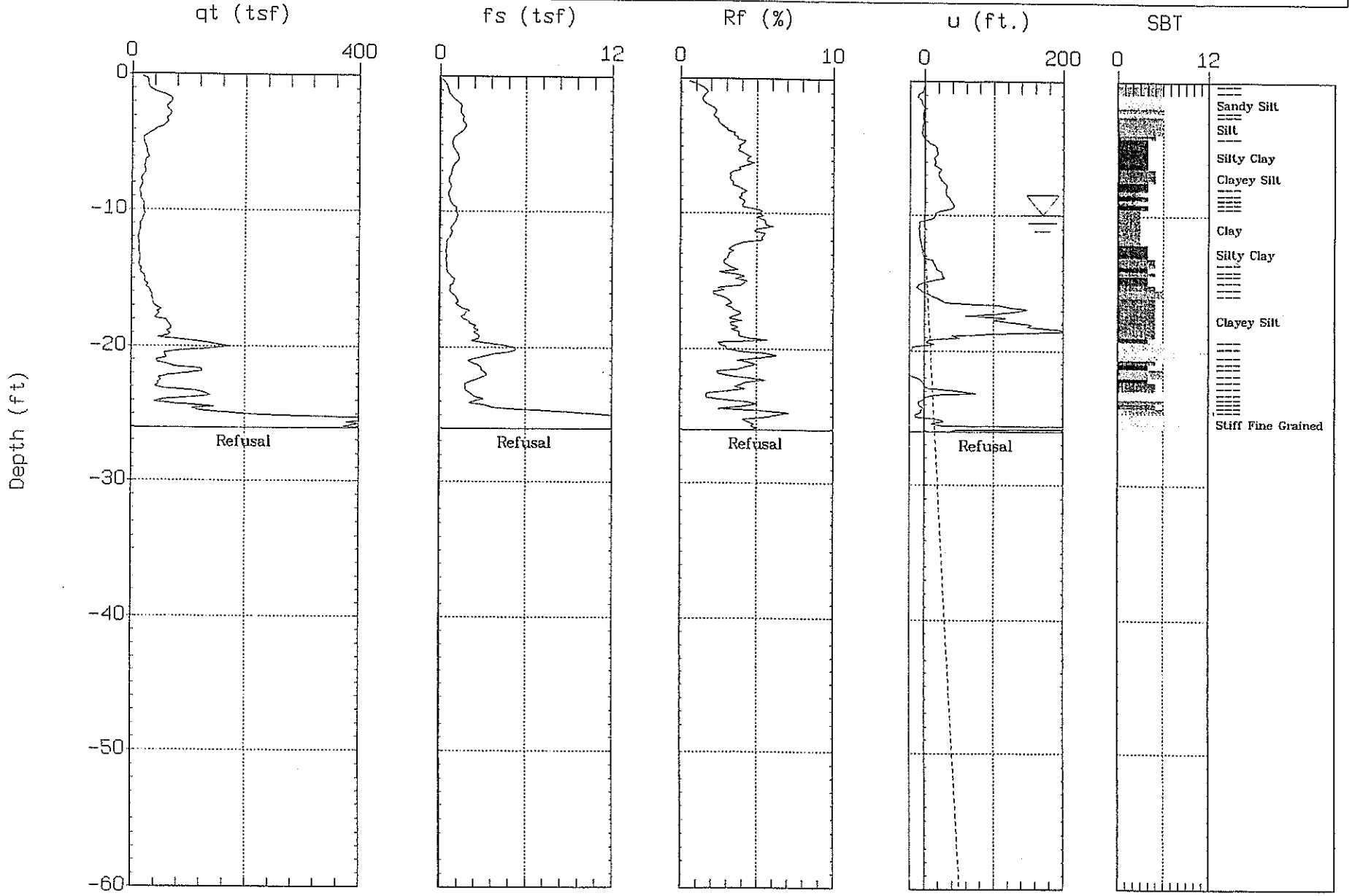
R13732

CONETEC

C.E.C.

Sounding:CPT-10
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 08:35



Max. Depth: 26.08 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

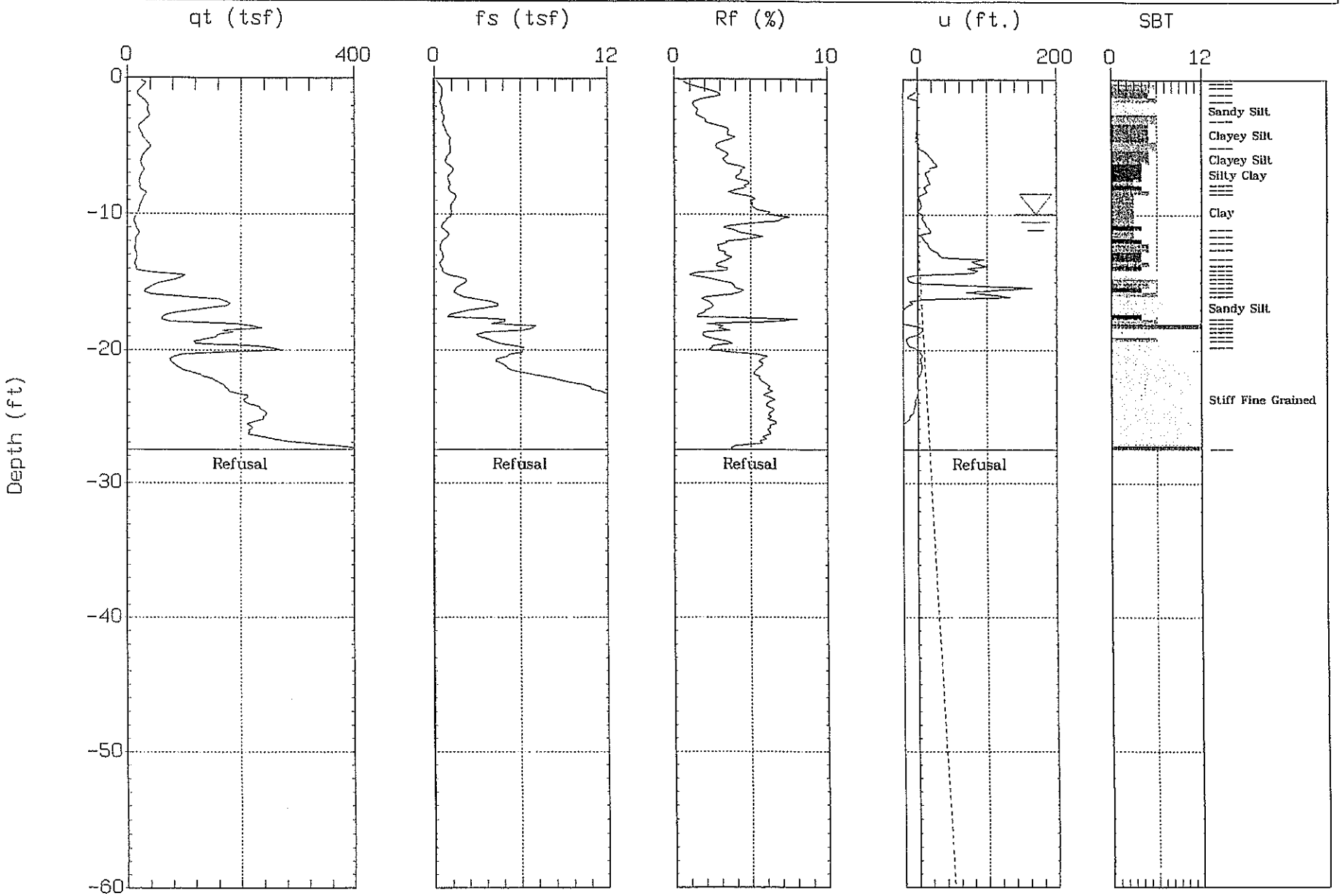
R13733

CONETEC

C.E.C.

Sounding:CPT-11
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 10:31



Max. Depth: 27.56 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

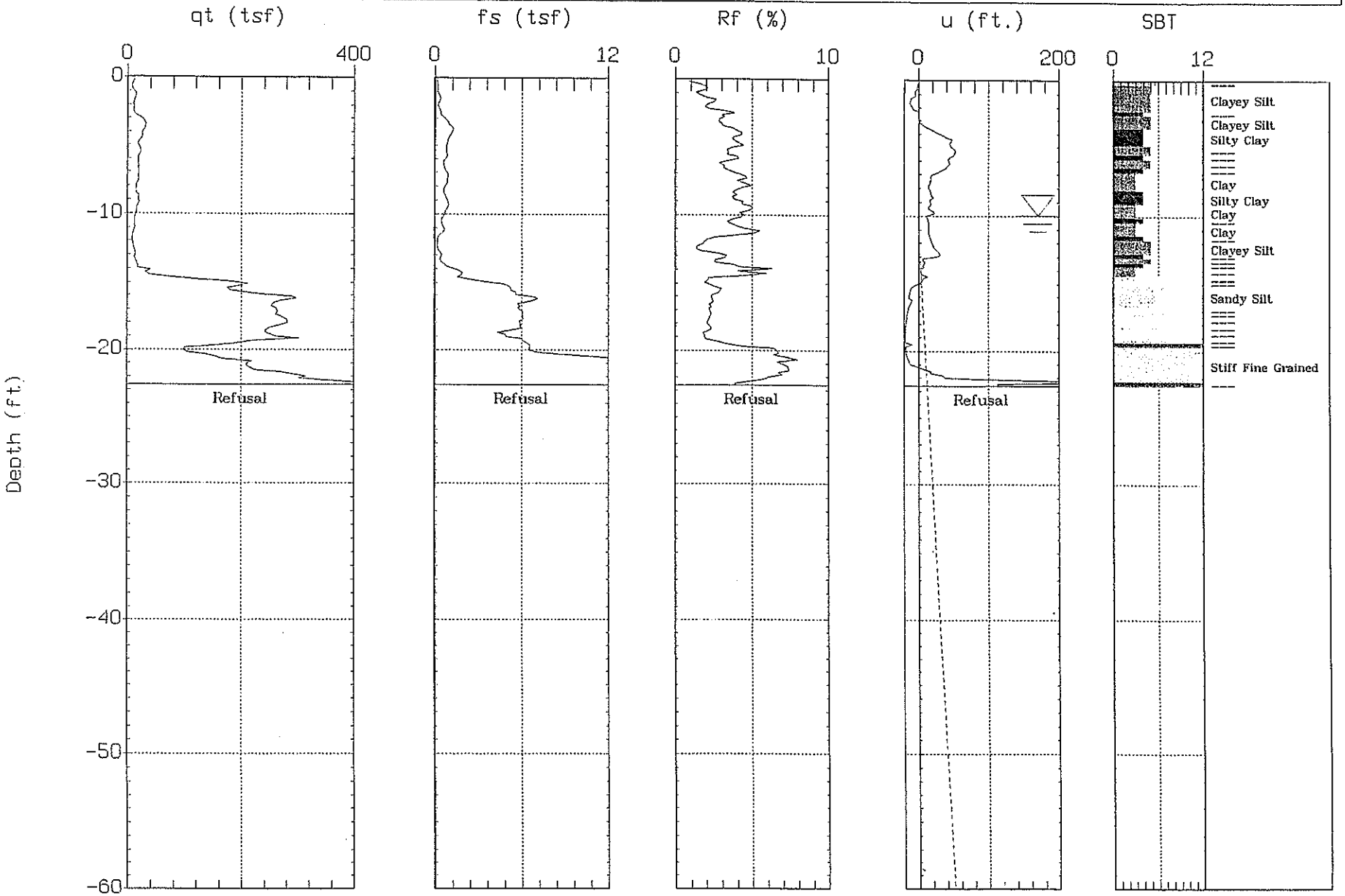
R13734

CONETEC

C.E.C.

Sounding:CPT-12
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 11:15



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

R13735

ConeTec
Environmental and Geotechnical Site Investigation Contractors

ConeTec Interpretations as of June 30, 2004 (Release 1.22A)

ConeTec's interpretation routine provides a tabular output of geotechnical parameters based on current published CPT correlations and is subject to change to reflect the current state of practice. The interpreted values are not considered valid for all soil types. The interpretations are presented only as a guide for geotechnical use and should be carefully scrutinized for consideration in any geotechnical design. Reference to current literature is strongly recommended. ConeTec does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the program and does not assume liability for any use of the results in any design or review. Representative hand calculations should be made for any parameter that is critical for design purposes. The end user of the interpreted output should also be fully aware of the techniques and the limitations of any method used in this program. The purpose of this document is to inform the user as to which methods were used and what the appropriate papers and/or publications are for further reference.

The CPT interpretations are based on values of tip, sleeve friction and pore pressure averaged over a user specified interval (e.g. 0.20m). Note that q_t is the tip resistance corrected for pore pressure effects and q_c is the recorded tip resistance. Since all ConeTec cones have equal end area friction sleeves, pore pressure corrections to sleeve friction, f_s, are not required.

The tip correction is: $q_t = q_c + (1-a) \bullet u_2$

where: q_t is the corrected tip resistance
q_c is the recorded tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the cone (typically 0.85 for ConeTec cones)

The total stress calculations are based on soil unit weights that have been assigned to the Soil Behavior Type zones, from a user defined unit weight profile or by using a single value throughout the profile. Effective vertical overburden stresses are calculated based on a hydrostatic distribution of equilibrium pore pressures below the water table or from a user defined equilibrium pore pressure profile (this can be obtained from CPT dissipation tests). For over water projects the effects of the column of water have been taken into account as has the appropriate unit weight of water. How this is done depends on where the instruments were zeroed (i.e. on deck or at mud line).

Details regarding the interpretation methods for all of the interpreted parameters are provided in Table 1. The appropriate references cited in Table 1 are listed in Table 2. Where methods are based on charts or techniques that are too complex to describe in this summary the user should refer to the cited material.

The estimated Soil Behavior Types (normalized and non-normalized) are based on the charts developed by Robertson and Campanella shown in Figures 1 and 2. The Bq classification charts are not reproduced in this document but can be reviewed in Lunne, Robertson and Powell (1997) or Robertson (1990).

Where the results of a calculation/interpretation are declared *'invalid'* the value will be represented by the text strings "-9999" or "-9999.0". In some cases the value 0 will be used. Invalid results will occur because of (and not limited to) one or a combination of:

1. Invalid or undefined CPT data (e.g. drilled out section or data gap).

2. Where the interpretation method is inappropriate, for example, drained parameters in an undrained material (and vice versa).

3. Where interpretation input values are beyond the range of the referenced charts or specified limitations of the interpretation method.

4. Where pre-requisite or intermediate interpretation calculations are invalid.

The parameters selected for output from the program are often specific to a particular project. As such, not all of the interpreted parameters listed in Table 1 may be included in the output files delivered with this report.

The output files are often delivered in one (or more) of the following three formats:

File Type	Typical Extensions	Description
Printable	IFP, NLP	ASCII files formatted for direct printing either by copying to a printer port, through a text editor or through a dedicated printing routine (such as ConeTec's CTPRINT). Typically formatted for 132 columns wide and 70 lines per page. Any printer would need to be set to have a compressed font (16cpi) as its default.
Importable	IFI, NLI	Tab delimited ASCII files (not for use with text editors) meant for importing into spreadsheet and database applications (e.g. Excel, Lotus, Quattro, Access). Some column and cell formatting maybe required depending on the quality of the application's import utility.
Spreadsheet	XLS	IFI, NLI files exported directly to Excel format. Column and cell formatting has been done. Header information is exported to start in Column C allowing the depth columns A and/or B to be duplicated on each printed page without repetition of part of the header information.

Table 1
CPT Interpretation Methods

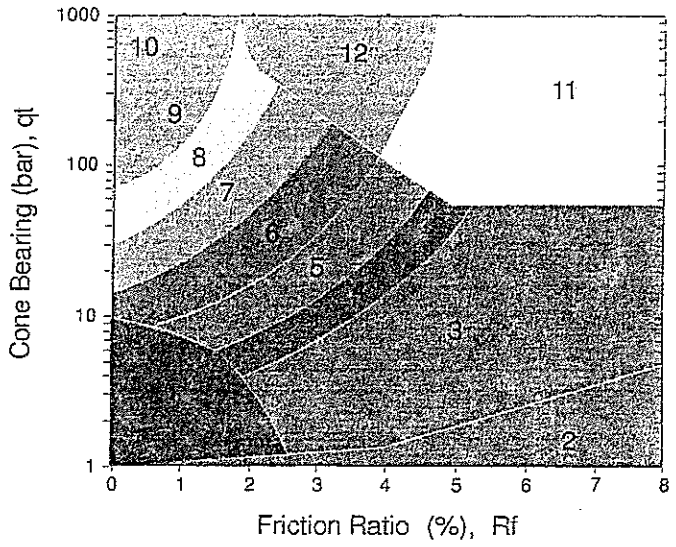
Interpreted Parameter	Description	Equation	Ref
Depth	Mid Layer Depth *(where interpretations are done at each point then Mid Layer Depth = Recorded Depth)*	*Depth (Layer Top) + Depth (Layer Bottom) / 2.0*	
Elevation	Elevation of Mid Layer based on sounding collar elevation supplied by client	Elevation = Collar Elevation - Depth	
Avgqc	Averaged recorded tip value (q_c)	$Avgqc = \frac{1}{n}\sum_{i=1}^{n} q_c$ *n=1 when interpretations are done at each point*	
Avgqt	Averaged corrected tip (q_t) where: $q_t = q_c + (1-a) \bullet u$	$Avgqt = \frac{1}{n}\sum_{i=1}^{n} q_t$ *n=1 when interpretations are done at each point*	
Avgfs	Averaged sleeve friction (f_s)	$Avgfs = \frac{1}{n}\sum_{i=1}^{n} fs$ *n=1 when interpretations are done at each point*	
AvgRf	Averaged friction ratio (Rf) where friction ratio is defined as: $Rf = 100\% \bullet \frac{fs}{qt}$	$AvgRf = 100\% \bullet \frac{Avgfs}{Avgqt}$ *n=1 when interpretations are done at each point*	
Avgu	Averaged dynamic pore pressure *(u)*	$Avgu = \frac{1}{n}\sum_{i=1}^{n} u_i$ *n=1 when interpretations are done at each point*	
AvgRes	Averaged Resistivity (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} RESISTIVITY_i$ *n=1 when interpretations are done at each point*	

Interpreted Parameter	Description	Equation	Ref
AvgUVIF	Averaged UVIF ultra-violet induced fluorescence (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} UVIF_i$ *n=1 when interpretations are done at each point*	
AvgTemp	Averaged Temperature (this data is not always available since it is a specialized test)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} TEMPERATURE_i$ *n=1 when interpretations are done at each point*	
AvgGamma	Averaged Gamma Counts (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} GAMMA_i$ *n=1 when interpretations are done at each point*	
SBT	Soil Behavior Type as defined by Robertson and Campanella	See Figure 1	2, 5
U.Wt.	Unit Weight of soil determined from one of the following user selectable options: 1) uniform value 2) value assigned to each SBT zone 3) user supplied unit weight profile	See references	5
T. Stress σ_V	Total vertical overburden stress at Mid Layer Depth. *A layer is defined as the averaging interval specified by the user. For data interpreted at each point the Mid Layer Depth is the same as the recorded depth.*	$TStress = \sum_{i=1}^{n} \gamma_i h_i$ where γ_i is layer unit weight h_i is layer thickness	
E. Stress σ_V'	Effective vertical overburden stress at Mid Layer Depth	$Estress = Tstress - u_{eq}$	
Ueq	Equilibrium pore pressure determined from one of the following user selectable options: 1) hydrostatic from water table depth 2) user supplied profile	For hydrostatic option: $u_{eq} = \gamma_w * (D - D_{wt})$ where u_{eq} is equilibrium pore pressure γ_w is unit weight of water D is the current depth D_{wt} is the depth to the water table	
Cn	SPT N_{60} overburden correction factor	$Cn = (\sigma_V')^{-0.5}$ where σ_V' *is in tsf* $0.5 < C_n < 2.0$	
N_{60}	SPT N value at 60% energy calculated from qt/N ratios assigned to each SBT zone. This method has abrupt N value changes at zone boundaries.	*See Figure 1*	4, 5
$(N_1)_{60}$	SPT N_{60} value corrected for overburden pressure	$(N_1)_{60} = Cn * N_{60}$	4
$N_{60}Ic$	SPT N_{60} values based on the Ic parameter	$(qt/pa)/ N_{60} = 8.5 (1 - Ic/4.6)$	5
$(N_1)_{60}Ic$	SPT N_{60} value corrected for overburden pressure (using N_{60} I_c). User has 2 options.	1) $(N_1)_{60}Ic = Cn * (N_{60}\ Ic)$ 2) $q_{c1n}/ (N_1)_{60}Ic = 8.5 (1 - Ic/4.6)$	4 5
$(N_1)_{60cs}Ic$	Clean sand equivalent SPT $(N_1)_{60}Ic$. User has 3 options.	1) $(N_1)_{60cs}Ic = \alpha + \beta((N_1)_{60}Ic)$ 2) $(N_1)_{60cs}Ic = K_{SPT} * ((N_1)_{60}Ic)$ 3) $q_{c1ncs})/ (N_1)_{60cs}Ic = 8.5 (1 - Ic/4.6)$ $FC \le 5\%$: $\alpha = 0$, $\beta = 1.0$ $FC \ge 35\%$ $\alpha = 5.0$, $\beta = 1.2$ $5\% < FC < 35\%$ $\alpha = \exp[1.76 - (190/FC^2)]$ $\beta = [0.99 + (FC^{1.5}/1000)]$	10 10 5
Su	Undrained shear strength - N_{kt} is user selectable	$Su = \frac{qt - \sigma_v}{N_{kt}}$	1, 5
k	Coefficient of permeability (assigned to each SBT zone)		5

Interpreted Parameter	Description	Equation	Ref
Bq	Pore pressure parameter	$Bq = \frac{\Delta u}{qt - \sigma_v}$ where: $\Delta u = u - u_{eq}$ and u = dynamic pore pressure u_{eq} = equilibrium pore pressure	1, 5
Q_t	Normalized q_t for Soil Behavior Type classification as defined by Robertson, 1990	$Qt = \frac{qt - \sigma_v}{\sigma_v}$	2, 5
F_r	Normalized Friction Ratio for Soil Behavior Type classification as defined by Robertson, 1990	$Fr = 100\% \bullet \frac{fs}{qt - \sigma_v}$	2, 5
SBTn	Normalized Soil Behavior Type as defined by Robertson and Campanella	See Figure 2	2, 5
SBT-BQ	Non-normalized soil behavior type based on the Bq parameter	See Figure 5.7 (reference 5)	2, 5
SBT-BQn	Normalized Soil Behavior base on the Bq parameter	See Figure 5.8 (reference 5) or Figure 3 (reference 2)	2, 5
I_c	Soil index for estimating grain characteristics	$Ic = [(3.47 - \log_{10} Q)^2 + (\log_{10} Fr + 1.22)^2]^{0.5}$ Where: $Q = \left(\frac{qt - \sigma_v}{P_{a2}}\right)\left(\frac{P_a}{\sigma_v}\right)^n$ And Fr is in percent P_a = atmospheric pressure P_{a2} = atmospheric pressure n varies from 0.5 to 1.0 and is selected in an iterative manner based on the resulting I_c	3, 8
FC	Apparent fines content (%)	$FC = 1.75(Ic^{3.25}) - 3.7$ FC=100 for Ic > 3.5 FC=0 for Ic < 1.26 FC = 5% if 1.64 < Ic < 2.6 AND F_r<0.5	3
Ic Zone	This parameter is the Soil Behavior Type zone based on the Ic parameter (valid for zones 2 through 7 on SBTn chart)	Ic < 1.31 Zone = 7 1.31 < Ic < 2.05 Zone = 6 2.05 < Ic < 2.60 Zone = 5 2.60 < Ic < 2.95 Zone = 4 2.95 < Ic < 3.60 Zone = 3 Ic > 3.60 Zone = 2	3
PHI ϕ	Friction Angle determined from one of the following user selectable options: a) Campanella and Robertson b) Durgunoglu and Mitchel c) Janbu	See reference	5
Dr	Relative Density determined from one of the following user selectable options: a) Ticino Sand b) Hokksund Sand c) Schmertmann 1976 d) Jamiolkowski - All Sands	See reference	5

Interpreted Parameter	Description	Equation	Ref
OCR	Over Consolidation Ratio	a) Based on Schmertmann's method involving a plot of $S_u/\sigma_v' / (S_u/\sigma_v')_{NC}$ and OCR where the Su/p' ratio for NC clay is user selectable	9
State Parameter	The state parameter is used to describe whether a soil is contractive (SP is positive) or dilative (SP is negative) at large strains based on the work by Been and Jefferies	See reference	8, 6, 5
Es/qt	Intermediate parameter for calculating Youngs Modulus, E, in sands. It is the Y axis of the reference chart.	Based on Figure 5.59 in the reference	5
Youngs Modulus E	Youngs Modulus based on the work by Baldi. There are three types of sands considered in this technique. The user selects the appropriate type for the site from: a) OC Sands b) Aged NC Sands c) Recent NC Sands Each sand type has a family of curves that depend on mean normal stress. The program calculates mean normal stress and linearly interpolates between the two extremes provided in Baldi's chart.	Mean normal stress is evaluated from: $\sigma'_m = \frac{1}{3} \bullet (\sigma'_v + \sigma'_h + \sigma'_h)$ where σ_v'= vertical effective stress σ_h'= horizontal effective stress and $\sigma_h = K_o * \sigma_v'$ with Ko assumed to be 0.5	5
q_{c1}	q_t normalized for overburden stress used for seismic analysis	$q_{c1} = q_t \bullet (Pa/\sigma_v')^{0.5}$ where: Pa = atm. Pressure q_t is in Mpa	3
q_{c1n}	q_{c1} in dimensionless form used for seismic analysis	$q_{c1n} = (q_{c1} / Pa)(Pa/\sigma_v')$ where: Pa = atm. Pressure and n ranges from 0.5 to 0.75 based on Ic.	3
K_{SPT}	Equivalent clean sand factor for $(N_1)60$	$K_{SPT} = 1 + ((0.75/30) * (FC - 5))$	10
K_{CPT}	Equivalent clean sand correction for q_{c1N}	$K_{cpt} = 1.0$ for $I_c \leq 1.64$ $K_{cpt} = f(I_c)$ for $I_c > 1.64$ (see reference)	10
q_{c1ncs}	Clean sand equivalent q_{c1n}	$q_{c1ncs} = q_{c1n} \bullet K_{cpt}$	3
CRR	Cyclic Resistance Ratio (for Magnitude 7.5)	$q_{c1ncs} < 50$: $CRR_{7.5} = 0.833 [(q_{c1ncs}/1000] + 0.05$ $50 \leq q_{c1ncs} < 160$: $CRR_{7.5} = 93 [(q_{c1ncs}/1000]^3 + 0.08$	10
CSR	Cyclic Stress Ratio	$CSR = (\tau_{av}/\sigma_v') = 0.65 (a_{max} / g) (\sigma_v/ \sigma_v') r_d$ $r_d = 1.0 - 0.00765\ z$ $z \leq 9.15m$ $r_d = 1.174 - 0.0267\ z$ $9.15 < z \leq 23m$ $r_d = 0.744 - 0.008\ z$ $23 < z \leq 30m$ $r_d = 0.50$ $z > 30m$	10

Interpreted Parameter	Description	Equation	Ref
MSF	Magnitude Scaling Factor	See Reference	10
FofS	Factor of Safety against Liquefaction	FS = ($CRR_{7.5}$ / CSR) MSF	10
Liquefaction Status	Statement indicating possible liquefaction	Takes into account FofS and limitations based I_c and q_{c1ncs}.	10



Zone	qt / N	Soil Behavior Type
1	2	sensitive fine grained
2	1	organic material
3	1	clay
4	1.5	silty clay to clay
5	2	clayey silt to silty clay
6	2.5	sandy silt to clayey silt
7	3	silty sand to sandy silt
8	4	sand to silty sand
9	5	sand
10	6	gravelly sand to sand
11	1	very stiff fine grained *
12	2	sand to clayey sand *

* overconsolidated or cemented

Figure 1 Non-Normalized Behavior Type Classification Chart

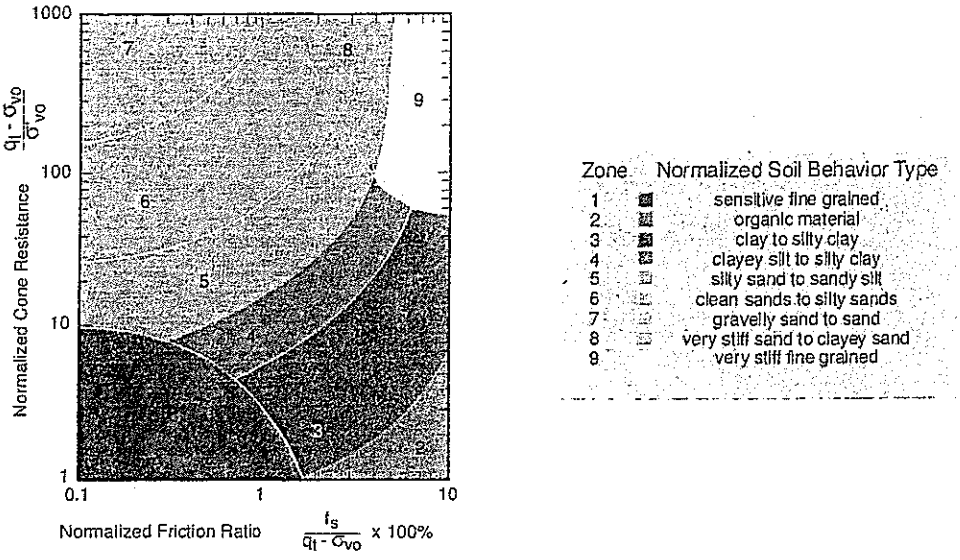


Figure 2 Normalized Behavior Type Classification Chart

Table 2 References

No.	References
1	Robertson, P.K., Campanella, R.G., Gillespie, D. and Greig, J., 1986, "Use of Piezometer Cone Data", Proceedings of InSitu 86, ASCE Specialty Conference, Blacksburg, Virginia.
2	Robertson, P.K., 1990, "Soil Classification Using the Cone Penetration Test", Canadian Geotechnical Journal, Volume 27.
3	Robertson, P.K. and Fear, C.E., 1998, "Evaluating cyclic liquefaction potential using the cone penetration test", Canadian Geotechnical Journal, 35: 442-459.
4	Robertson, P.K. and Wride, C.E., 1998, "Cyclic Liquefaction and its Evaluation Based on SPT and CPT", NCEER Workshop Paper, January 22, 1997
5	Lunne, T., Robertson, P.K. and Powell, J. J. M., 1997, " Cone Penetration Testing in Geotechnical Practice," Blackie Academic and Professional.
6	Plewes, H.D., Davies, M.P. and Jefferies, M.G., 1992, "CPT Based Screening Procedure for Evaluating Liquefaction Susceptibility", 45th Canadian Geotechnical Conference, Toronto, Ontario, October 1992.
7	Jefferies, M.G. and Davies, M.P., 1993. "Use of CPTu to Estimate equivalent N_{60}", Geotechnical Testing Journal, 16(4): 458-467.
8	Been, K. and Jefferies, M.P., 1985, "A state parameter for sands", Geotechnique, 35(2), 99-112.
9	Schmertmann, 1977, "Guidelines for Cone Penetration Test Performance and Design", Federal Highway Administration Report FHWA-TS-78-209, U.S. Department of Transportation
10	Proceedings of theNCEER Workshop on Evaluation of Liquefaction Resistance of Soils, Salt LakeCity, 1996. Chaired by Leslie Youd.

CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-1
Site	Williamson County, Illinois
Date	10/31/2007

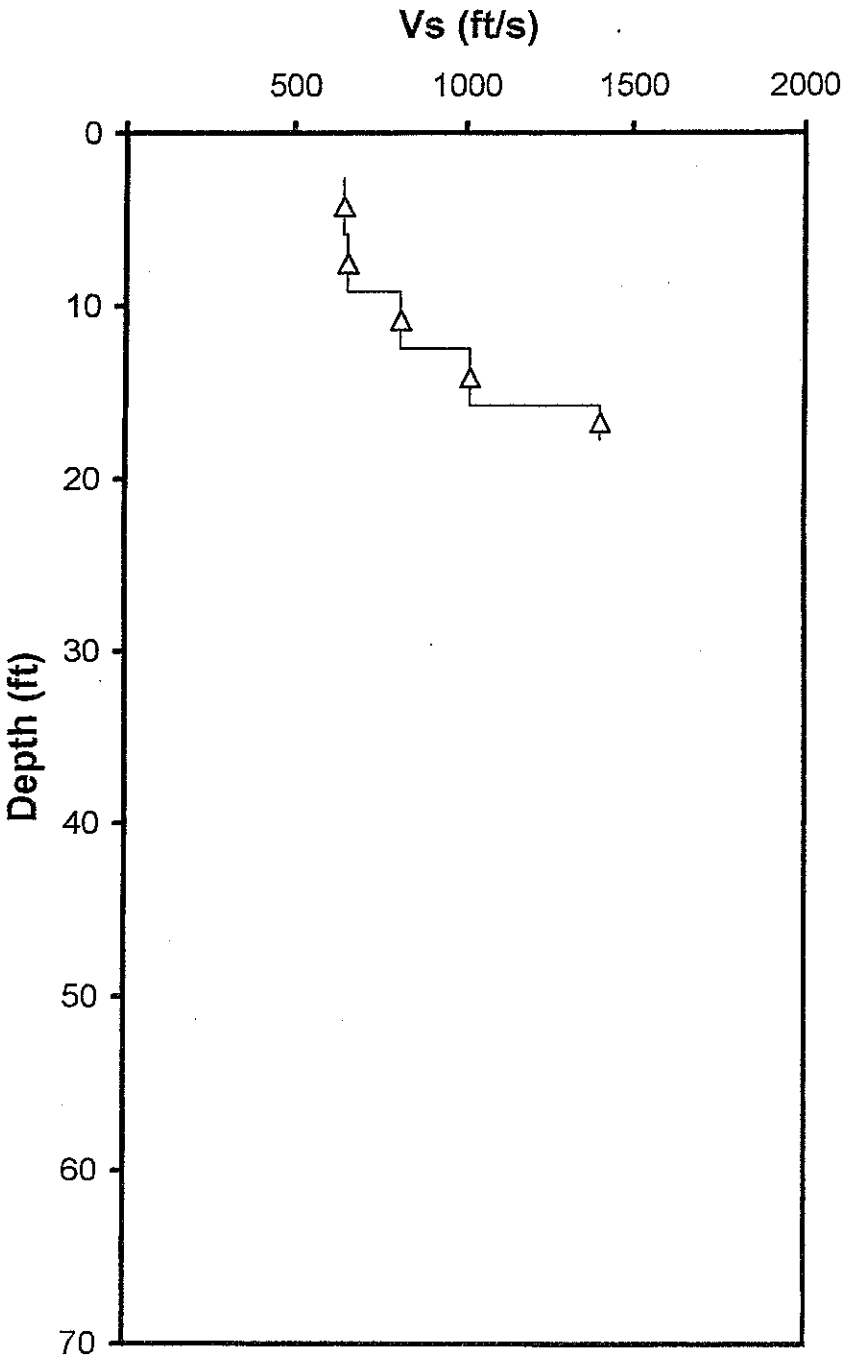
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	4.76	4.26	645
9.84	9.18	9.31	3.21	4.90	7.54	656
13.12	12.46	12.55	3.25	4.02	10.82	808
16.40	15.74	15.82	3.26	3.22	14.10	1013
18.37	17.71	17.78	1.96	1.40	16.73	1402

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-1
Date: October 31, 2007



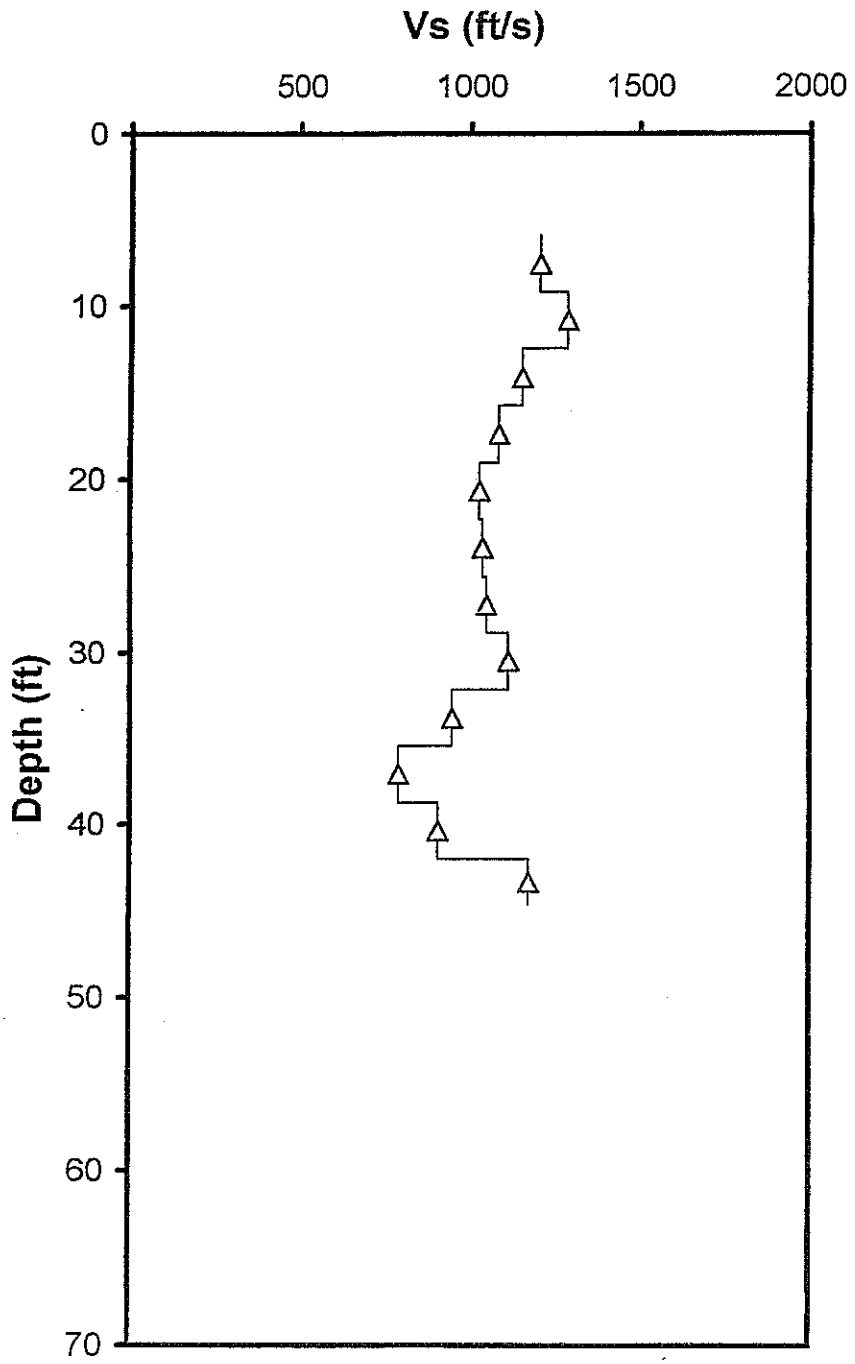
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-2
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	2.67	7.54	1204
13.12	12.46	12.55	3.25	2.53	10.82	1284
16.40	15.74	15.82	3.26	2.83	14.10	1152
19.69	19.03	19.09	3.28	3.02	17.39	1085
22.97	22.31	22.36	3.27	3.18	20.67	1029
26.25	25.59	25.64	3.27	3.15	23.95	1039
29.53	28.87	28.91	3.28	3.12	27.23	1050
32.81	32.15	32.19	3.28	2.94	30.51	1114
36.09	35.43	35.47	3.28	3.45	33.79	950
39.37	38.71	38.74	3.28	4.12	37.07	795
42.65	41.99	42.02	3.28	3.61	40.35	908
45.28	44.62	44.65	2.63	2.24	43.31	1173

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-2
Date: October 30, 2007



CONETEC

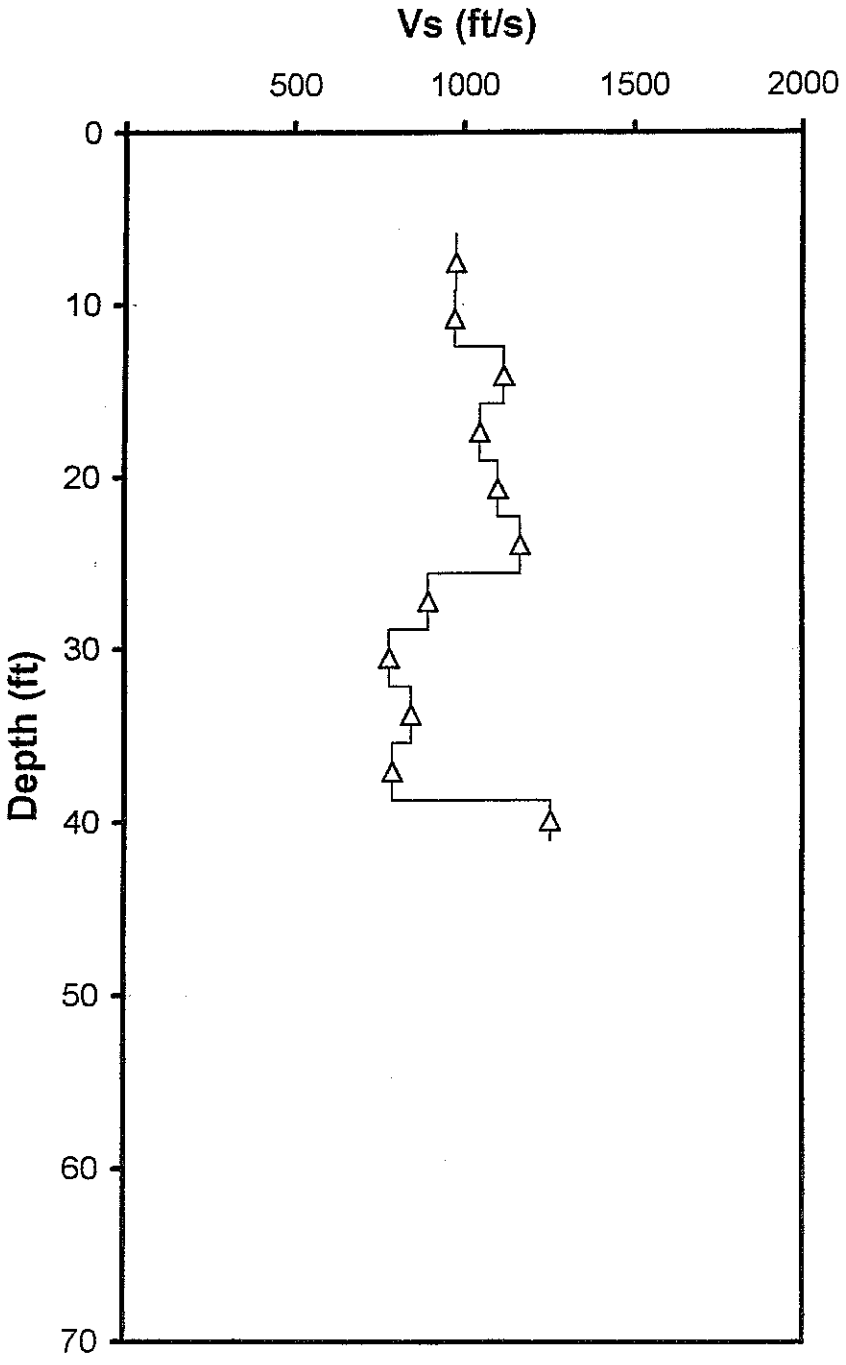
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-2A
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	3.29	7.54	977
13.12	12.46	12.55	3.25	3.34	10.82	973
16.40	15.74	15.82	3.26	2.91	14.10	1121
19.69	19.03	19.09	3.28	3.12	17.39	1051
22.97	22.31	22.36	3.27	2.96	20.67	1105
26.25	25.59	25.64	3.27	2.80	23.95	1169
29.53	28.87	28.91	3.28	3.66	27.23	895
32.81	32.15	32.19	3.28	4.20	30.51	780
36.09	35.43	35.47	3.28	3.88	33.79	845
39.37	38.71	38.74	3.28	4.15	37.07	790
41.67	41.01	41.04	2.30	1.83	39.86	1256

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-2A
Date: October 30, 2007



CONETEC

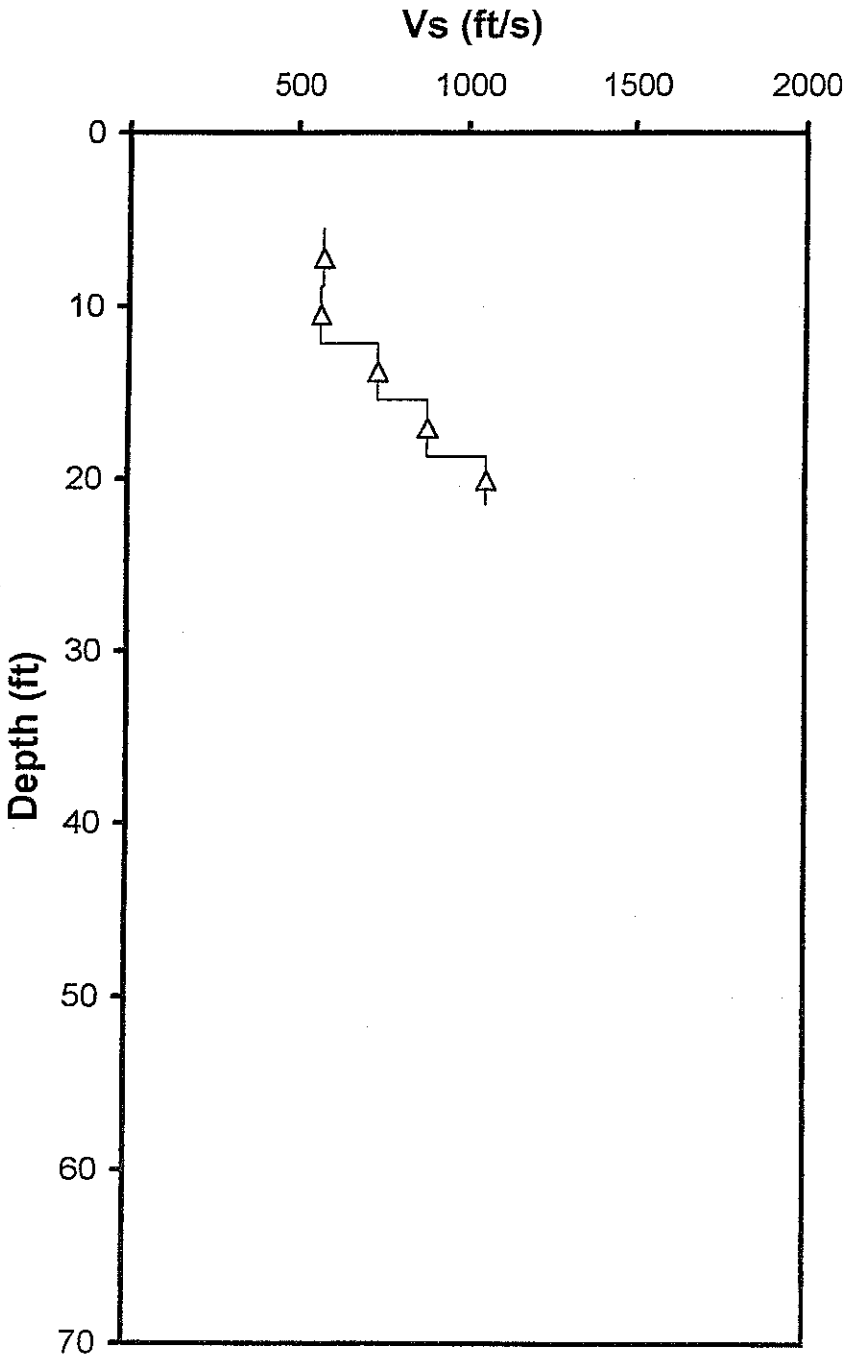
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-3
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.23	5.57	5.77				
9.51	8.85	8.98	3.21	5.56	7.21	577
12.80	12.14	12.24	3.26	5.72	10.50	569
16.08	15.42	15.50	3.26	4.42	13.78	738
19.36	18.70	18.76	3.27	3.70	17.06	883
22.15	21.49	21.55	2.78	2.63	20.10	1058

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-3
Date: October 31, 2007



CONETEC

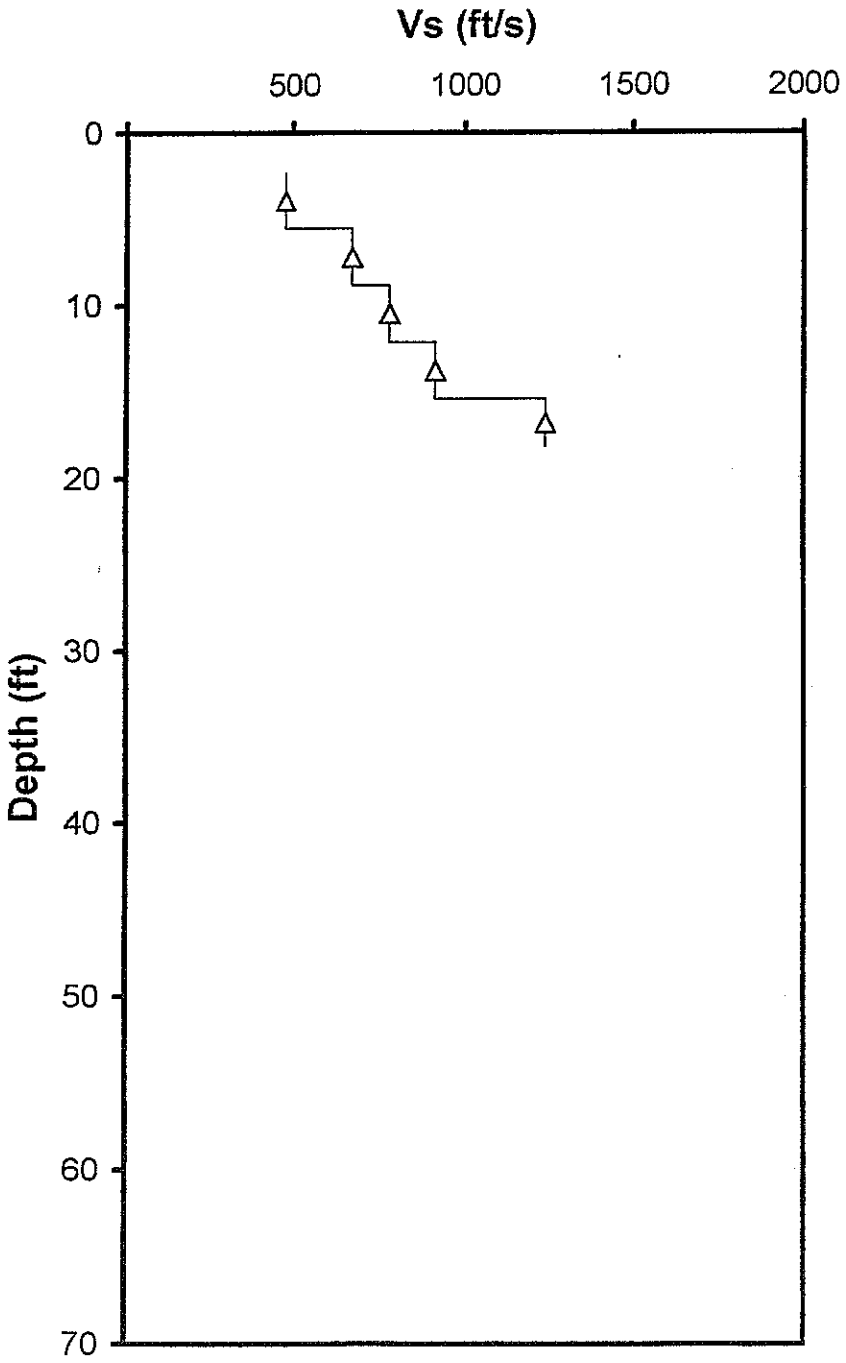
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-4
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
2.95	2.29	2.74				
6.23	5.57	5.77	3.03	6.37	3.93	476
9.51	8.85	8.98	3.21	4.77	7.21	673
12.80	12.14	12.24	3.26	4.17	10.50	781
16.08	15.42	15.50	3.26	3.57	13.78	913
18.86	18.20	18.27	2.77	2.23	16.81	1242

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-4
Date: October 31, 2007



CONETEC

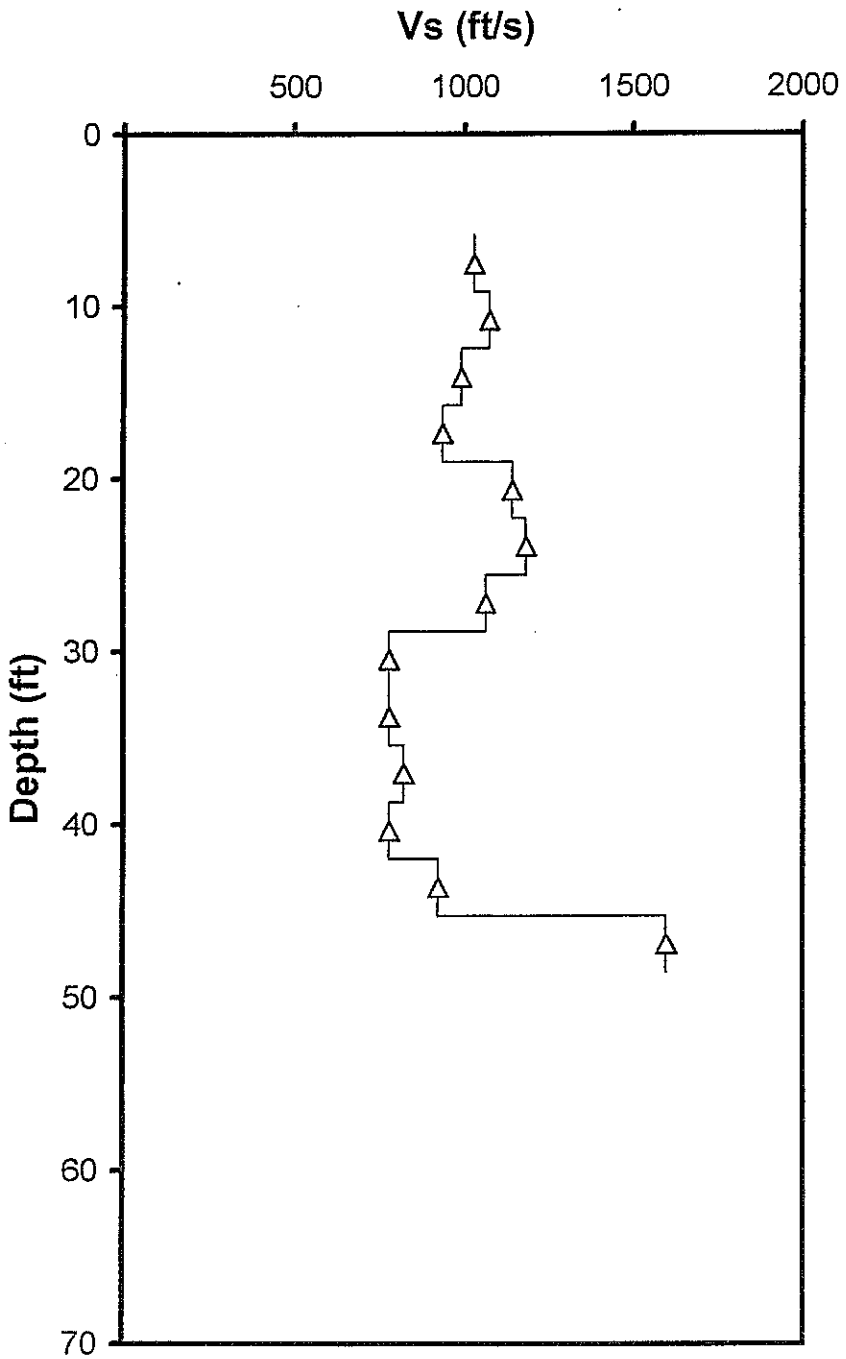
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-5
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	3.12	7.54	1030
13.12	12.46	12.55	3.25	3.02	10.82	1076
16.40	15.74	15.82	3.26	3.29	14.10	991
19.69	19.03	19.09	3.28	3.50	17.39	936
22.97	22.31	22.36	3.27	2.85	20.67	1148
26.25	25.59	25.64	3.27	2.75	23.95	1190
29.53	28.87	28.91	3.28	3.07	27.23	1067
32.81	32.15	32.19	3.28	4.20	30.51	780
36.09	35.43	35.47	3.28	4.20	33.79	780
39.37	38.71	38.74	3.28	3.99	37.07	821
42.65	41.99	42.02	3.28	4.20	40.35	780
45.93	45.27	45.30	3.28	3.55	43.63	923
49.21	48.55	48.58	3.28	2.05	46.91	1599

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-5
Date: October 30, 2007



CONETEC

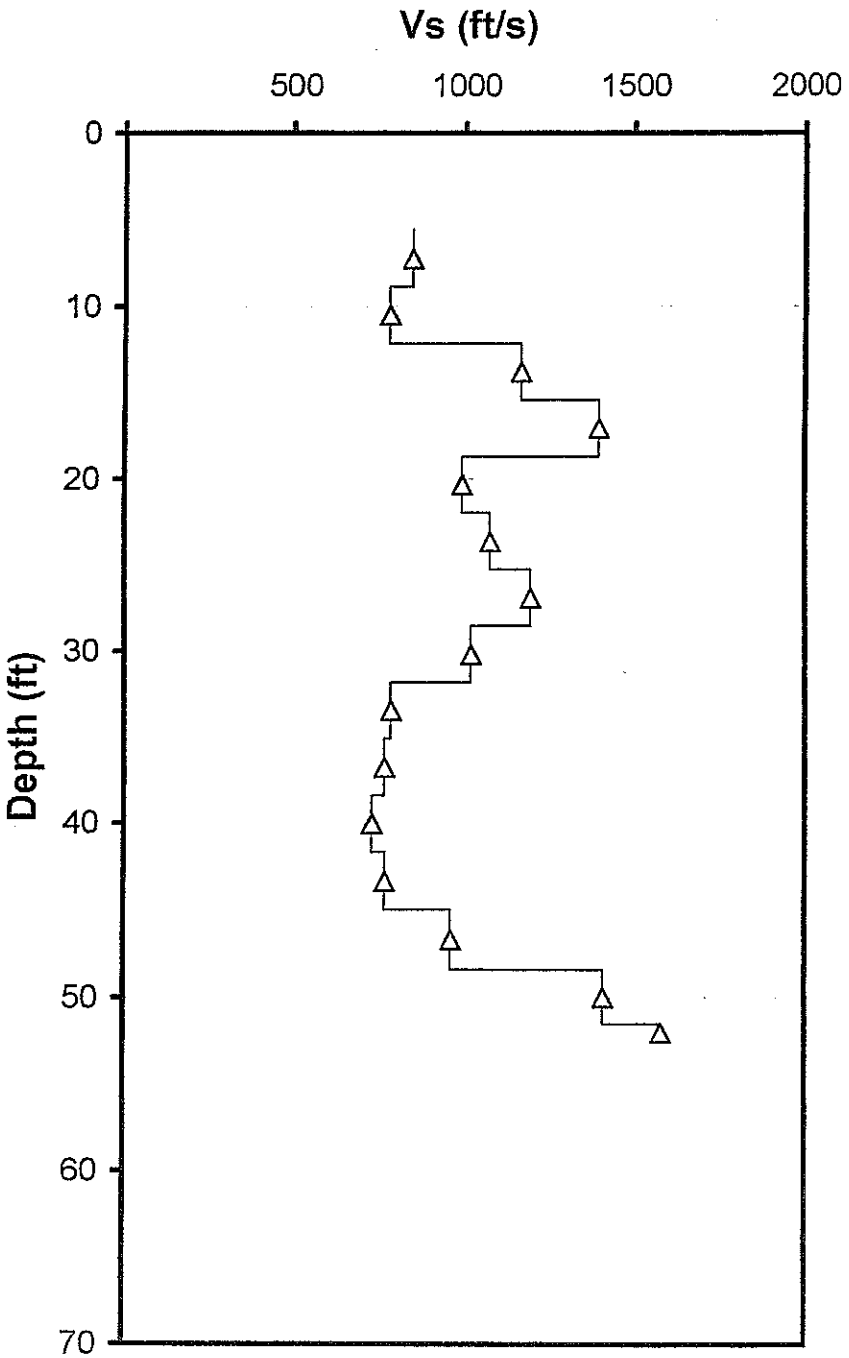
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-5A
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.23	5.57	5.77				
9.51	8.85	8.98	3.21	3.80	7.21	844
12.80	12.14	12.24	3.26	4.18	10.50	779
16.08	15.42	15.50	3.26	2.80	13.78	1164
19.36	18.70	18.76	3.27	2.34	17.06	1396
22.64	21.98	22.03	3.27	3.29	20.34	994
25.92	25.26	25.31	3.27	3.04	23.62	1077
29.20	28.54	28.58	3.27	2.74	26.90	1195
32.48	31.82	31.86	3.28	3.21	30.18	1021
35.76	35.10	35.14	3.28	4.18	33.46	784
39.04	38.38	38.41	3.28	4.29	36.74	764
42.32	41.66	41.69	3.28	4.50	40.02	728
45.60	44.94	44.97	3.28	4.27	43.30	768
49.05	48.39	48.42	3.45	3.59	46.67	961
52.17	51.51	51.54	3.12	2.21	49.95	1411
53.15	52.49	52.52	0.98	0.62	52.00	1580

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-5A
Date: October 30, 2007



CONETEC

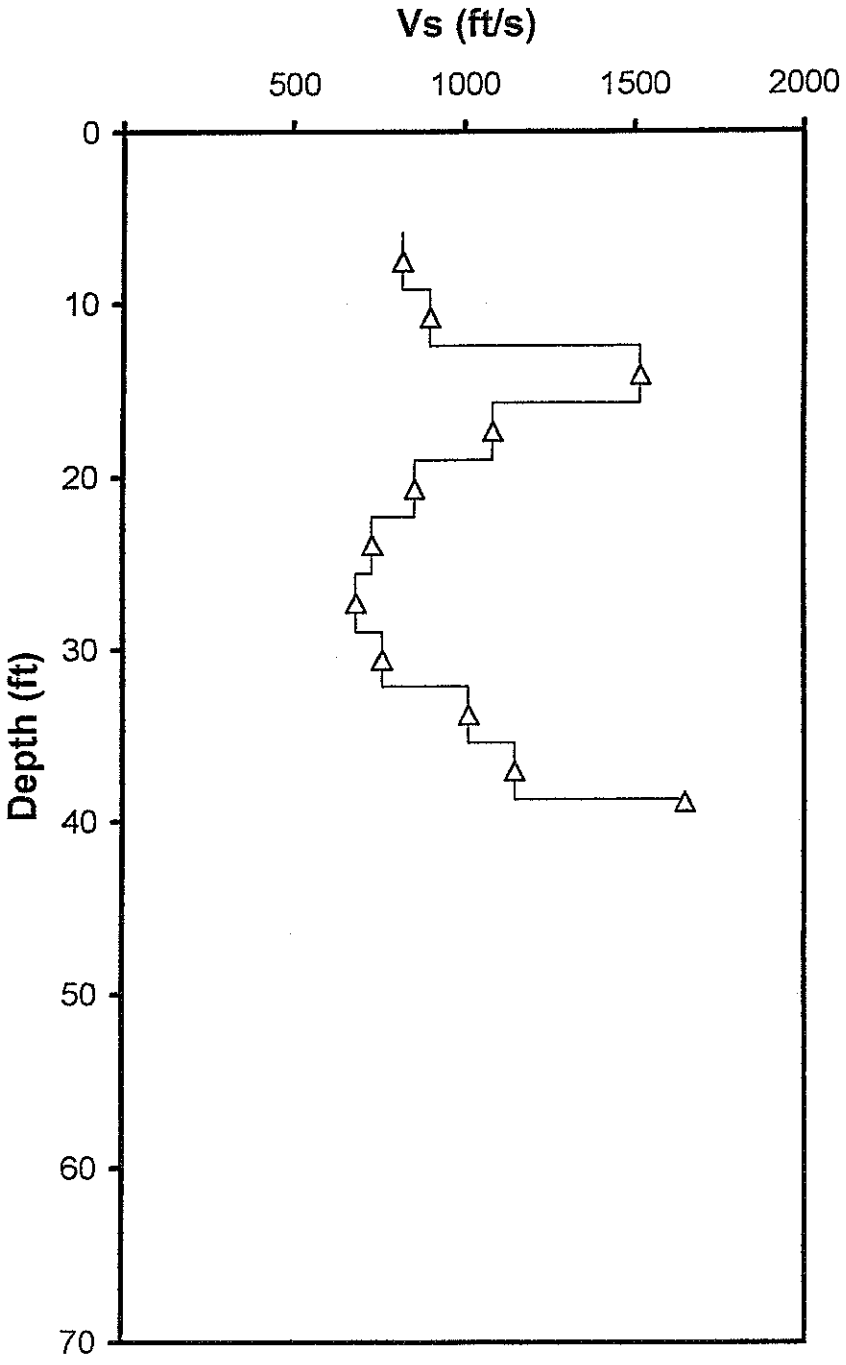
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-5B
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	3.93	7.54	818
13.12	12.46	12.55	3.25	3.61	10.82	900
16.40	15.74	15.82	3.26	2.15	14.10	1517
19.69	19.03	19.09	3.28	3.02	17.39	1085
22.97	22.31	22.36	3.27	3.82	20.67	856
26.25	25.59	25.64	3.27	4.47	23.95	732
29.69	29.03	29.07	3.43	5.01	27.31	686
32.81	32.15	32.19	3.12	4.09	30.59	762
36.09	35.43	35.47	3.28	3.23	33.79	1014
39.37	38.71	38.74	3.28	2.85	37.07	1150
39.70	39.04	39.07	0.33	0.20	38.88	1649

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-5B
Date: October 30, 2007



CONETEC

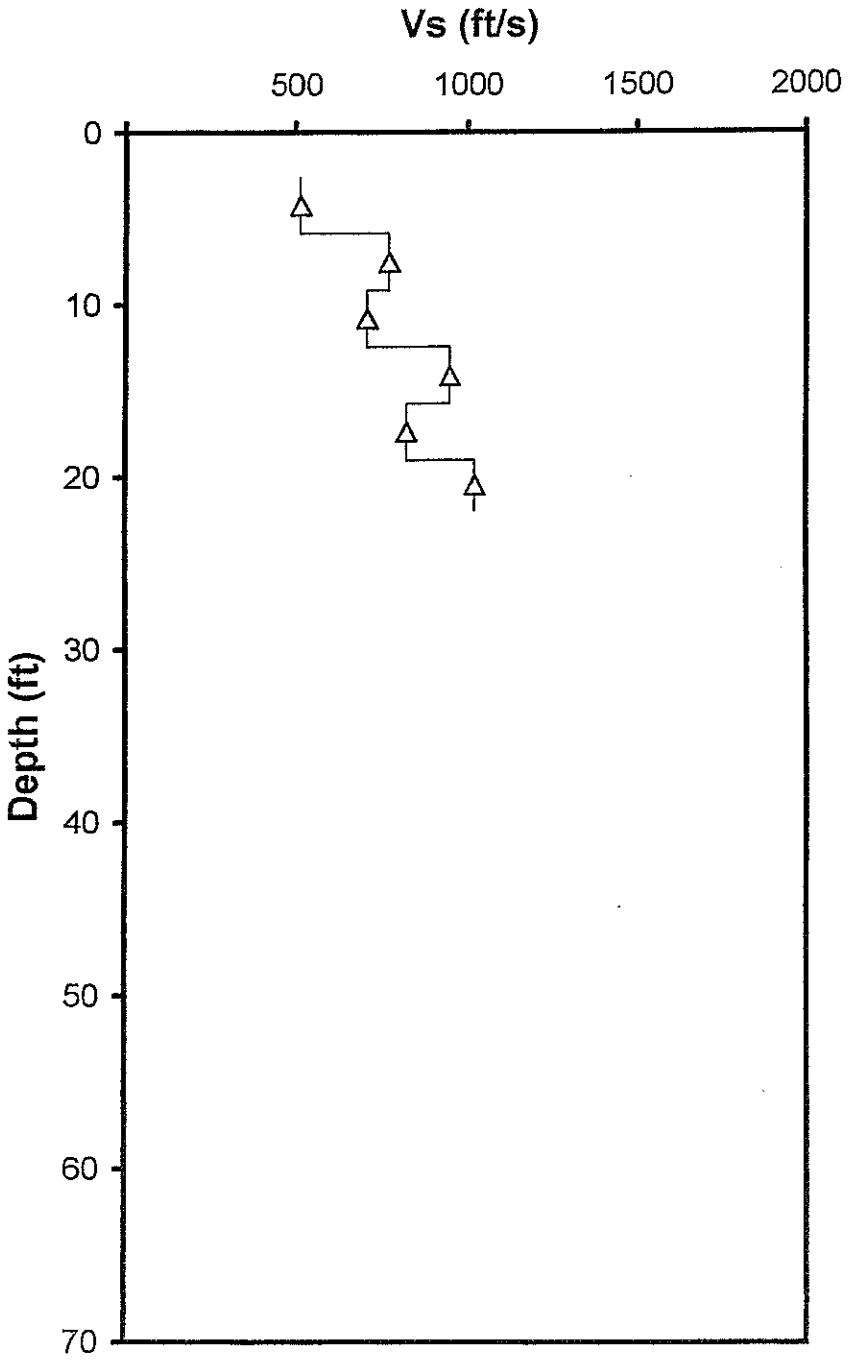
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-6
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	5.97	4.26	514
9.84	9.18	9.31	3.21	4.18	7.54	769
13.12	12.46	12.55	3.25	4.60	10.82	706
16.40	15.74	15.82	3.26	3.45	14.10	945
19.69	19.03	19.09	3.28	4.00	17.39	819
22.64	21.98	22.03	2.94	2.88	20.51	1022

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-6
Date: October 31, 2007



CONETEC

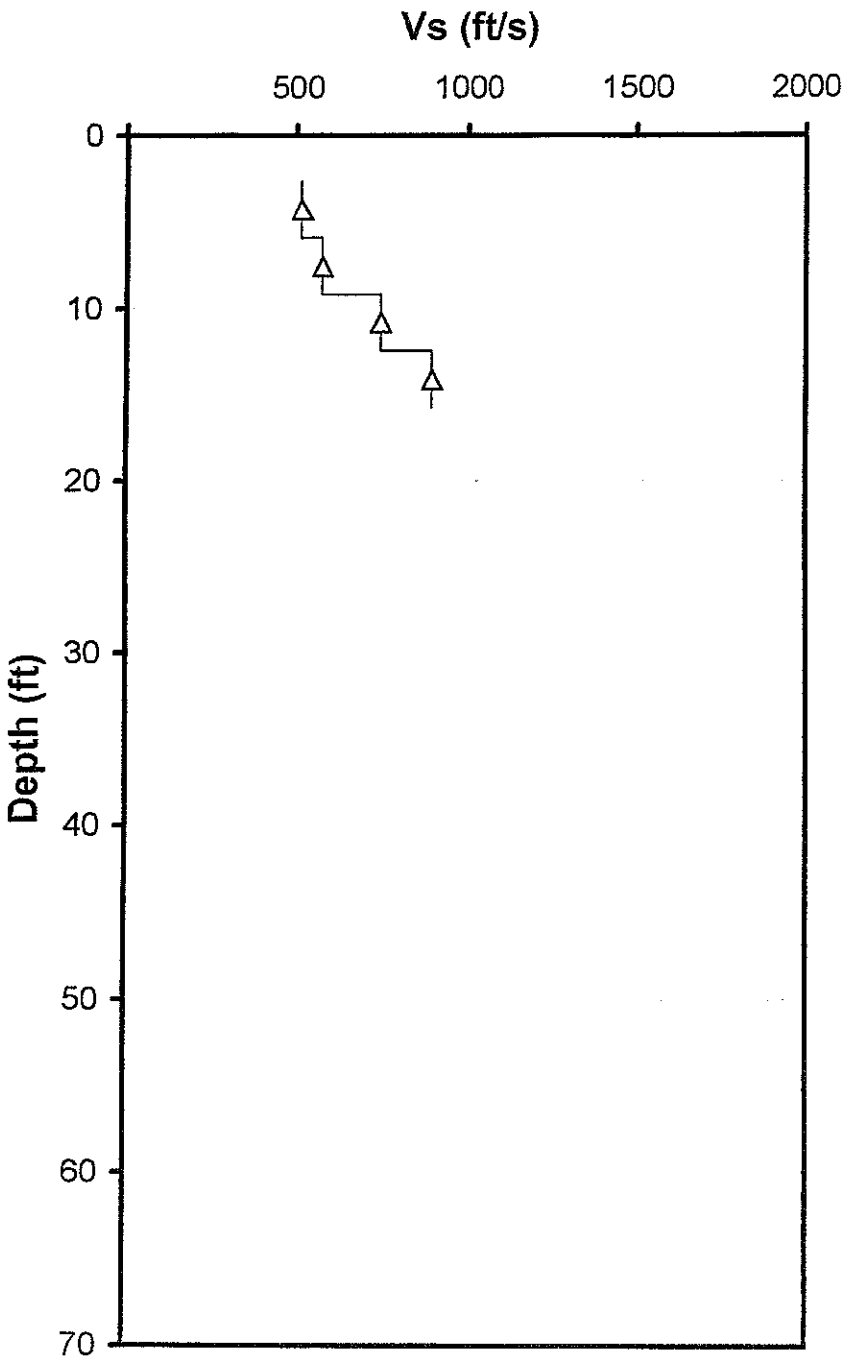
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-7
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	5.97	4.26	514
9.84	9.18	9.31	3.21	5.59	7.54	575
13.12	12.46	12.55	3.25	4.36	10.82	745
16.40	15.74	15.82	3.26	3.65	14.10	894

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-7
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-8
Site	Williamson County, Illinois
Date	10/31/2007

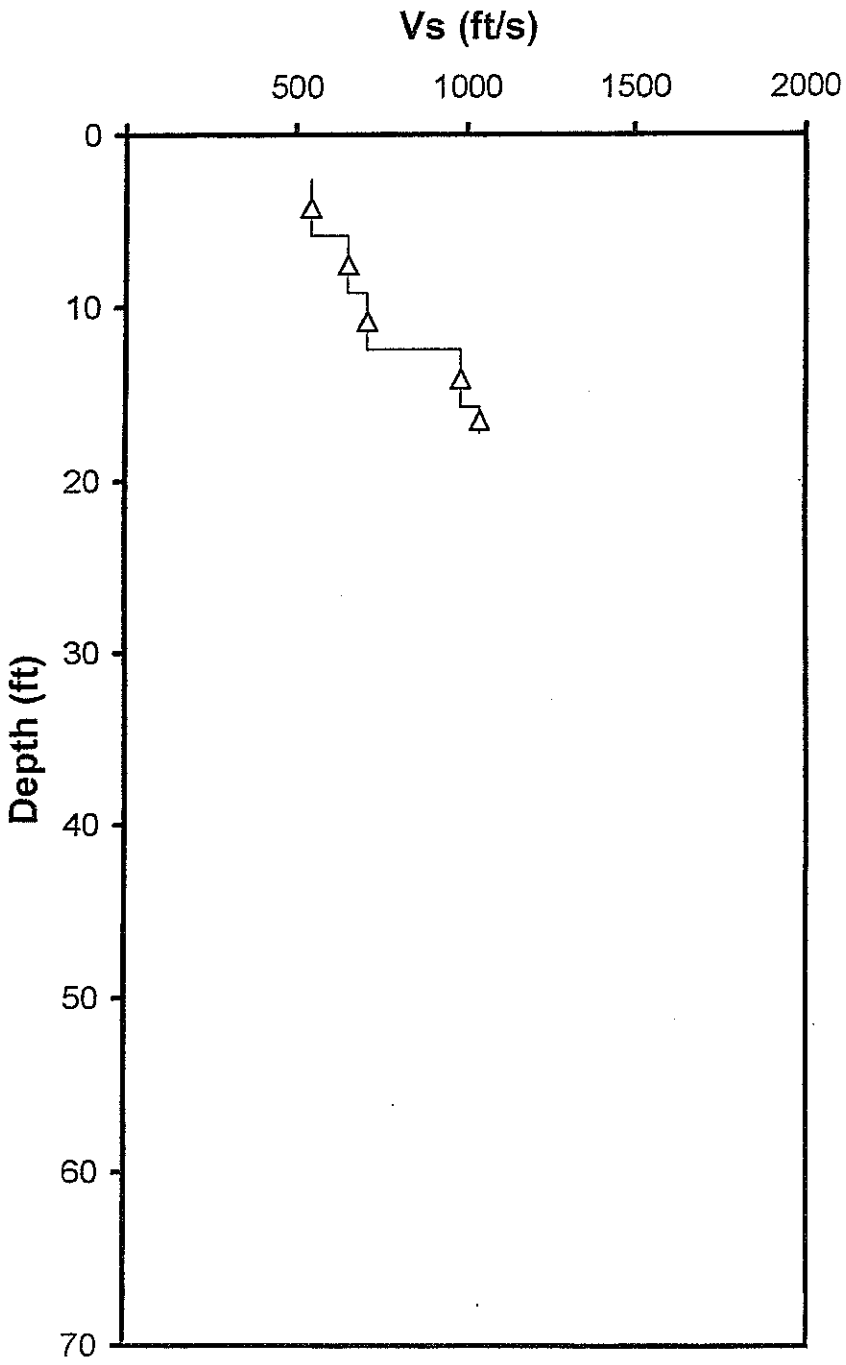
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	5.67	4.26	541
9.84	9.18	9.31	3.21	4.93	7.54	652
13.12	12.46	12.55	3.25	4.59	10.82	708
16.40	15.74	15.82	3.26	3.33	14.10	979
17.88	17.22	17.29	1.47	1.42	16.48	1038

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-8
Date: October 31, 2007



CONETEC

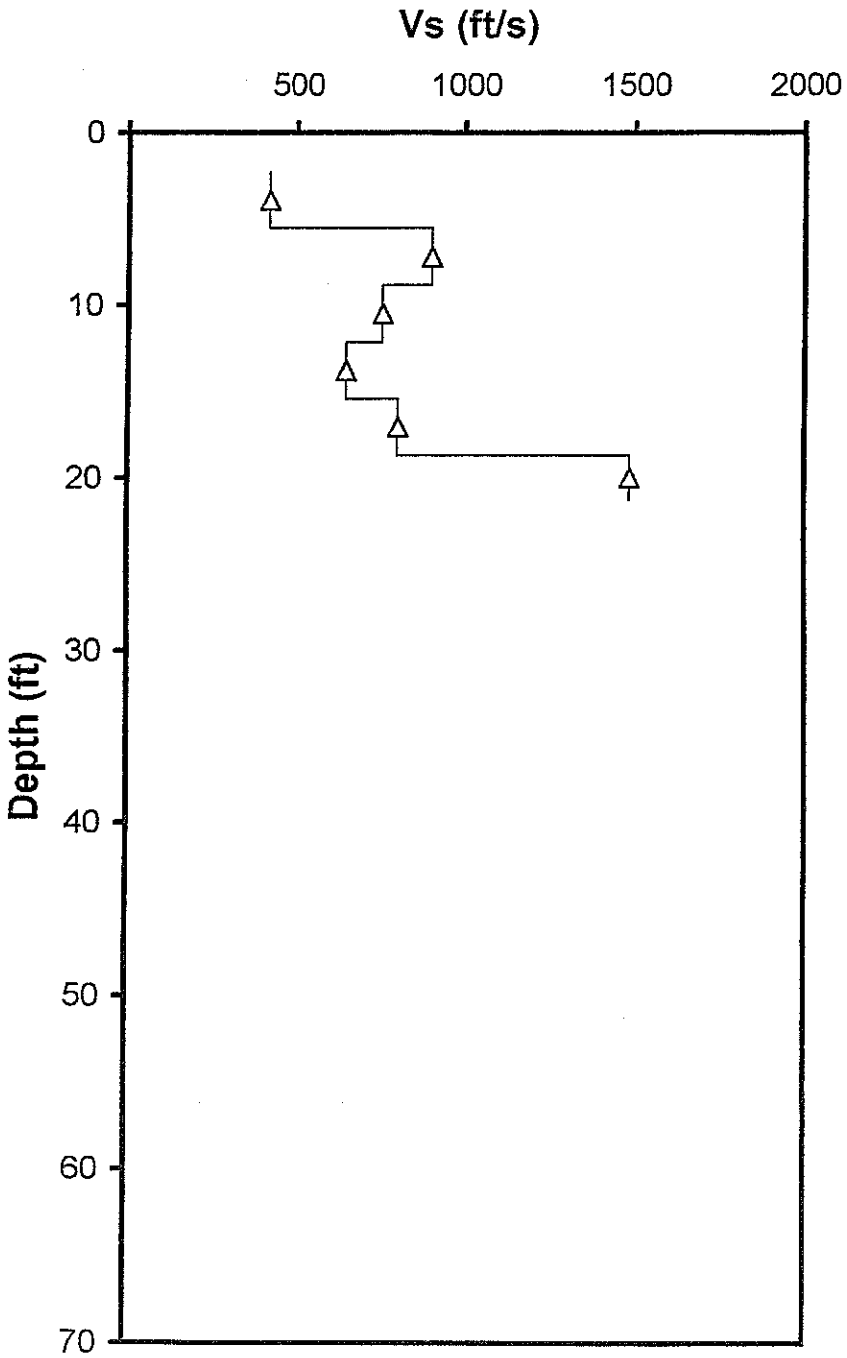
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-9
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - V6

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
2.95	2.29	2.74				
6.23	5.57	5.77	3.03	7.30	3.93	415
9.51	8.85	8.98	3.21	3.55	7.21	904
12.80	12.14	12.24	3.26	4.30	10.50	757
16.08	15.42	15.50	3.26	5.04	13.78	647
19.36	18.70	18.76	3.27	4.06	17.06	805
21.98	21.32	21.38	2.61	1.76	20.01	1484

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-9
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-10
Site	Williamson County, Illinois
Date	10/31/2007

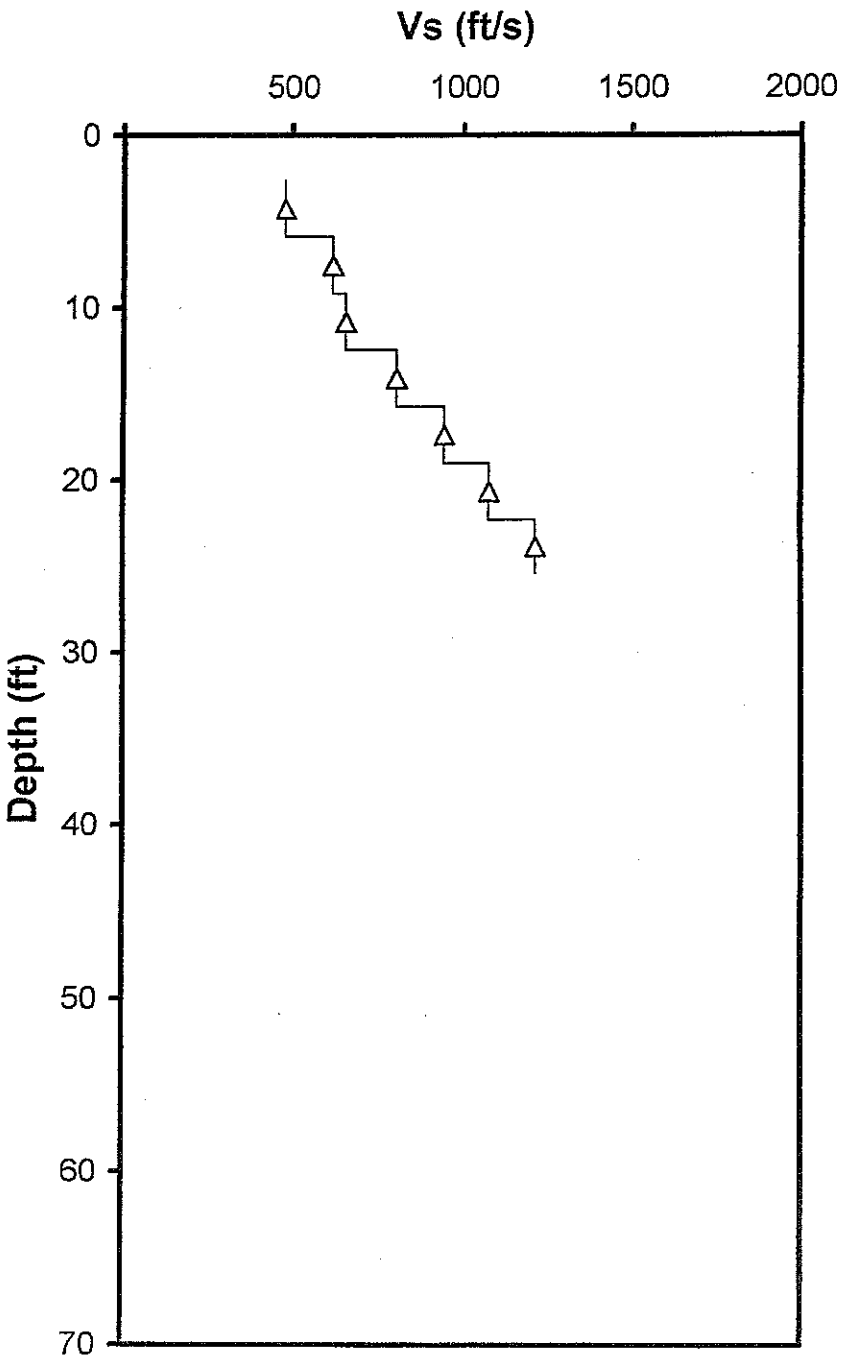
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	6.42	4.26	478
9.84	9.18	9.31	3.21	5.21	7.54	617
13.12	12.46	12.55	3.25	4.95	10.82	656
16.40	15.74	15.82	3.26	4.06	14.10	803
19.69	19.03	19.09	3.28	3.47	17.39	945
22.97	22.31	22.36	3.27	3.03	20.67	1080
26.08	25.42	25.47	3.10	2.55	23.87	1217

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-10
Date: October 31, 2007



CONETEC

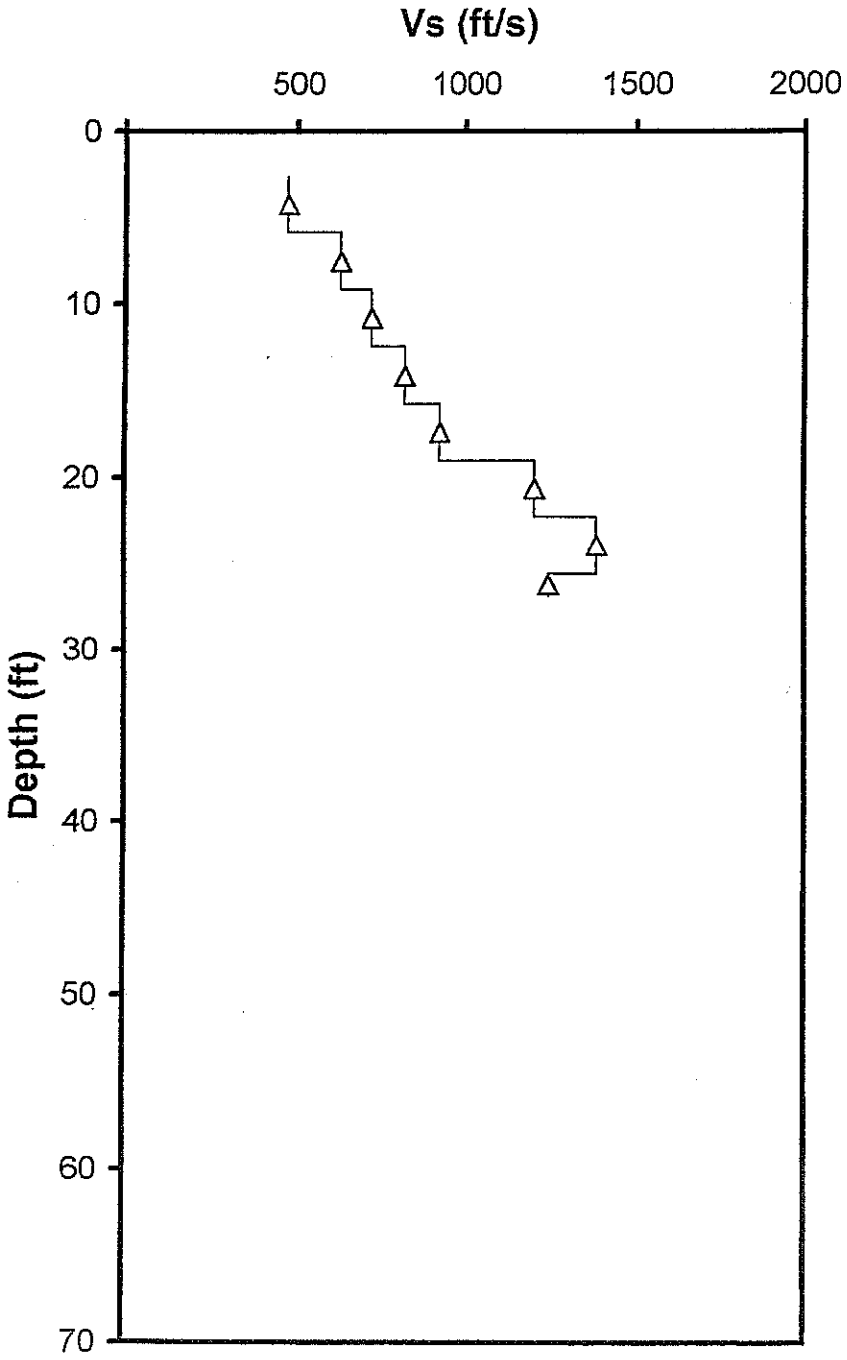
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-11
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	6.51	4.26	471
9.84	9.18	9.31	3.21	5.12	7.54	628
13.12	12.46	12.55	3.25	4.52	10.82	719
16.40	15.74	15.82	3.26	3.99	14.10	817
19.69	19.03	19.09	3.28	3.54	17.39	926
22.97	22.31	22.36	3.27	2.71	20.67	1207
26.25	25.59	25.64	3.27	2.36	23.95	1387
27.56	26.90	26.95	1.31	1.05	26.25	1246

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-11
Date: October 31, 2007



CONETEC

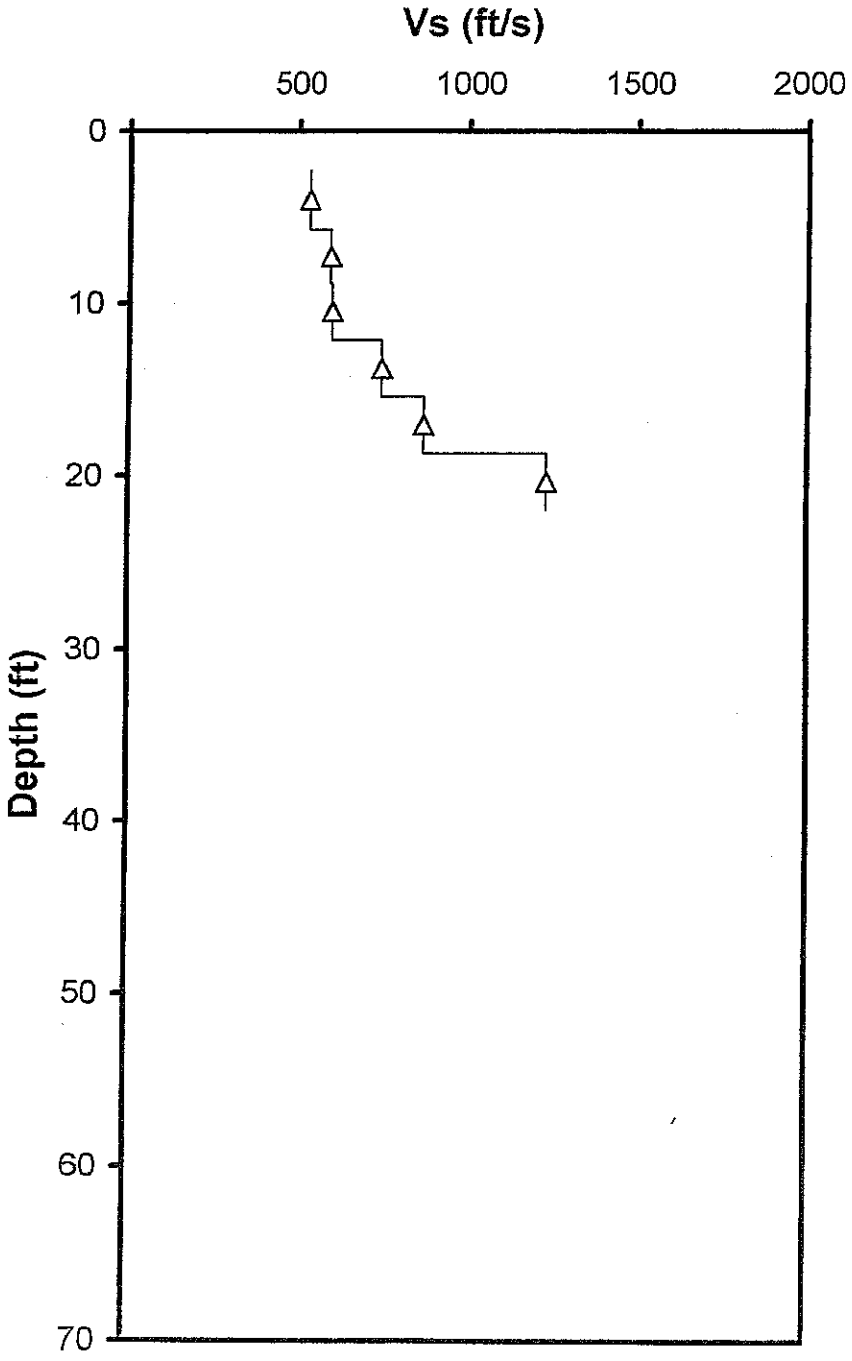
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-12
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
2.95	2.29	2.74				
6.40	5.74	5.94	3.20	6.03	4.02	530
9.51	8.85	8.98	3.04	5.11	7.30	596
12.80	12.14	12.24	3.26	5.42	10.50	601
16.08	15.42	15.50	3.26	4.36	13.78	748
19.36	18.70	18.76	3.27	3.75	17.06	871
22.64	21.98	22.03	3.27	2.66	20.34	1230

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-12
Date: October 31, 2007



No Dissipation Tests were performed

ConeTec Digital File Formats

CPT Data Files (COR Extension)

ConeTec CPT data files are named such that the first 3 characters contain the job number, the next two characters are CP followed by two characters indicating the sounding number. The last DOS character position is reserved for the letters a, b, c, d etc to uniquely identify multiple soundings at the same location. The CPT sounding file has the extensions COR, and pore pressure dissipation files have the extension PPD. As an example, for job number 99-127 the first sounding will have file names 127CP01.COR and 127CP01.PPD.

The CPT (COR) file consists of the following components:

1. Two lines of header information
2. Data records
3. End of data marker
4. Units information

Header Lines

Line 1: Columns 1-6 are blank (future use)
Columns 7-21 contain the sounding Date and Time
Columns 22-36 contain the sounding Operator

Line 2: Columns 1-16 contain the Job Location
Columns 17-31 contain the Cone ID
Columns 32-47 contain the sounding number

Data Records

The data records contain 4 or more columns of data in floating point format. A comma (and spaces) separates each data item:

Column 1:	Sounding Depth (meters)
Column 2:	Tip (q_c) data uncorrected for pore pressure effects. Recorded in units selected by the operator.
Column 3:	Sleeve (f_s) data. Recorded in units selected by the operator
Column 4:	Dynamic pore pressure readings. Recorded in units selected by the operator
Column 5:	UVIF Data. See UVIF section.

End of Data Marker

After the last line of data a line containing ASCII 26 (CTL-Z) and a newline (carriage return/ line feed) character. This is used to mark the end of data.

Units Information

The last section of the file contains information about the units that were selected for the sounding. A separator bar makes up the first line. The second line contains the type of units used for depth, q_c, f_s and u. The third line contains the conversion values required for ConeTec's software to convert the recorded data to an internal set of base units (bar for q_c, bar for $_{fs}$ and meters for u).

CPT Dissipation Files (PPD Extension)

CPT Dissipation files have the same naming convention as the CPT sounding files and have the extension PPD. PPD files consist of the following components:

1. Two lines of header information
2. Data records

Header Lines (same as COR file):

Line 1: Columns 1-6 are blank (future use)
Columns 7-21 contain the sounding Date and Time
Columns 22-36 contain the sounding Operator

Line 2: Columns 1-16 contain the Job Location
Columns 17-31 contain the Cone ID
Columns 32-47 contain the sounding number

Data Records

The data records immediately follow the header lines. Each data record can occupy several lines in the file and is a complete record of a dissipation test at a particular depth. Each data record starts with a line containing two values separated by spaces; the first value being an index number (not currently used by the Software) and the second being the dissipation test depth in meters. Following this line are the dissipation pore pressure values stored at 5 second intervals with a maximum of 12 entries per line. The last line of the dissipation record may not contain a full 12 entries. The data record is terminated with an ASCII 30 character (appears as a triangle in some editors).

This sequence is repeated for every dissipation test in the sounding. No marker is used to indicate end of file. Units information is not stored in this file. Users would have to check the CPT file for the units that were used.

CPT Basic Interpretations (TBL Extension)

ConeTec's basic CPT interpretation output files are generally delivered in text files with a TBL extension. The root file name is the same as the COR files. A number of calculated geotechnical parameters are presented in these files. The files are stored as ASCII text files that can be viewed using any text editor such as Notepad or Wordpad. The files do not contain any page formatting. These files are not distributed if the enhanced interpretation files are provided.

CPT Enhanced Interpretations (NLI, NLP, XLS Extension)

ConeTec's enhanced CPT interpretation output files are delivered in several formats, each file type containing the exact same information but formatted slightly differently. The files typically have any of the following file extensions:

1. NLI — an importable TAB delimited ASCII text file containing approximately 36 data columns of geotechnical interpretations. The file is designed for easy import to Excel. A companion document describes the techniques used for the interpretations (usually reproduced at the beginning of the Interpretation Appendix). Text editors can be used to view the file contents, however, they may remove the tabs or replace the tabs with spaces upon saving the file destroying the feature that makes them easy to import into Excel.

2. NLP — a printable ASCII text file containing the same 36 columns of geotechnical interpretations as the NLI file. This file type has been formatted as a multi-page document with up to 132 characters per line and up to 68 lines per page. Each page has been separated into multiple sections to accommodate all the data fields. Each physical page has a header section and a page/section number. The file is designed for direct printing to laser printers set into compressed font mode. This output is typically provided in the Interpretation Appendix.

3. XLS — an Excel format file that has been generated directly from the corresponding NLI file.

In each case root file name is the same as the COR files.

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part 19

APPENDIX A-3

NORMALIZED PS-CPT DATA AND PARAMETER CORRELATIONS

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 1 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY TJS DATE 1/23/08

CALCULATION BRIEF
FOR
NORMALIZED PS-CPT DATA AND PARAMETER CORRELATIONS

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE:

Use data recorded during the piezo-seismic cone penetration testing (PS-CPT) at the Williamson Energy, Pond Creek Coal Refuse Disposal facility located in Williamson County, Illinois to correlate various index and strength properties. Also, nearly continuous profiles with depth of various applicable engineering properties of the refuse and subgrade soil materials in the fifteen (15) soundings tested at the Pond Creek facility are tabulated and attached.

REFERENCES:

1. Bowles, Joseph E. (1984) "Physical and Geotechnical Properties of Soils," Mc-Graw Hill. New York: 367-369 and 393-396.

2. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Piezo-Cone Penetration Testing," Pond Creek Coal Refuse Disposal Site, BEG, dated 12/21/07.

3. ConeTec, Inc. (2007), Field Report Entitled "Presentation of CPTU Test Results for: Pond Creek Mine – Williamson County, Illinois, December 10, 2007.

4. Robertson, P.K (1998), "Applications Guide – CPT" **Fax**

5. Robertson, P.K., et.al. (1992) "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE 109 (11): 1449-1459.

6. Robertson, P.K and Campanella, R.G, (1989), "Guidelines for Geotechnical Design Using CPT and CPTU", UBC Soil Mechanics Series No. 120, Civil Eng. Dept., Vancouver, B.C., Canada

7. Robertson, P.K and Campanella, R.G, (1983), "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE Vol. 109 No. 11, pp. 1449-1459.

8. Civil and Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak Undrained Shear Strength for Refuse and Subgrade Materials," Pond Creek Coal Refusal Site, BEG 12/28/07.

METHODOLOGY:

Using laboratory-derived unit weights for the coarse coal refuse and residual soil layers, provided by Alliance Consulting, Inc. (Alliance), the following parameters are correlated based on established CPT correlations (References 2, 3, 4, 5, 6 and 7) and the data collected during the Pond Creek Piezo-Seismic Cone Penetration Testing subsurface investigation (Ref. 2):

- Total stress (σ_v)
- Effective stress (σ_{vo}')
- Pore pressure (U_{eq})
- SPT N_{60} correction factor (C_n)
- SPT blow counts at 60% energy (N_{60})
- N_{60} corrected for overburden ($(N_1)_{60}$)
- Corrected tip resistance (q_c)
- Fines content (F_c)
- Effective friction angle (ϕ)
- Soil Behavior Index (I_c)

Undrained shear strength (S_u) was also correlated, and is discussed separately in the calculation brief entitled Estimation and Summary of Engineering Properties Including Peak Undrained Shear Strength for Refuse and Subgrade Materials," (Reference 8).

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 3 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY RJ DATE 1/23/08

ANALYSIS:

ConeTec, Inc. (ConeTec) performed the PS-CPT and correlated the above noted parameters based on various unit weights that were correlated directly from the Soil Behavior Type (SBT) (Robertson and Campanella, 1989). The unit weights used by ConeTec were based on data interpolation and thus require modification to reflect the laboratory derived unit weights of the coarse refuse and residual soil, which were provided by Alliance. Therefore, laboratory-derived unit weight for each of the layers was used to correlate the applicable parameters, particularly total and effective stresses, which are used throughout the calculations.

PSCPT correlations were based on much of the work described by Robertson and Campanella (1998, 1992, 1989, 1988, 1983). During field testing, ConeTec measured four parameters insitu, which were not correlated. They include the recorded tip resistance (AvgQt), the recorded side friction (AvgFs), the recorded friction ratio (AvgRf) and the pore pressure generated by the CPT probe (AvgUd), all of which were used in subsequent correlations. The soil behavior type (SBT) was also determined by the ConeTec, and was based on observations and readings of the four parameters just listed.

The following paragraphs briefly describe the parameters as well as providing a definition of the parameter and any additional calculations needed: Total stress and effective stress are both used in many of the correlations, and are related to each other by the presence of water in the form of pore water pressure. Total stress was defined as:

$$\sigma_v = (\gamma * H) / 2000 \text{ (lb/ton)}$$

where: σ_v = total stress (tsf)
γ = unit weight (pcf)
H = depth of the sample (ft)

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 4 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

Pore pressure is defined as:

$$U_{eq} = (\gamma_w * H) / 2000 \text{ (lb/ton)}$$

where: U_{eq} = pore pressure (tsf)
γ_w = unit weight of water (pcf)
= 62.5 pcf
H = depth of the sample (ft)

The difference between the two determines the effective stress:

$$\sigma_{vo}' = \sigma_v - U_{eq}$$

where: U_{eq} = pore pressure (tsf)
σ_v = total stress (tsf)

The PS-CPT sampler correlated the number of blows per foot, without the overburden correction, to the tip resistance measured as the probe was advanced. This gave measurements of N_{60} every 0.2 meters. Corrected for overburden, the measured tip resistance was then calculated:

$$q_c = AvgQt - (1 - 0.85) * U$$

where: AvgQt = measured tip resistance (tsf)
0.85 = area ratio of the PS-CPT probe
U = measured pore pressure (tsf)

This corrected tip resistance (q_c) was used along with the soil behavior type index (Ic) and atmospheric pressure to give the recorded N_{60} value by the equation:

$$N_{60} = (q_c / Pa) / 8.5 * (1 - (Ic / 4.6))$$

where: q_c = corrected tip resistance (tsf)
Pa = atmospheric pressure (tsf)
= 1.058 tsf
Ic = soil behavior type index (dim)

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PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 5 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

and: $Ic = ((3.47 - Log_{10}(Q))^2 + (Log_{10}(F) + 1.22)^2)^{0.5}$

where: Q = normalized cone penetration resistance (dim)
F = normalized friction ratio (pct)

and: $Q = (q_c - \sigma_v) / \sigma_{vo}'$

where: q_c = corrected tip resistance (tsf)
σ_v = total stress = (γ * H) / 2000(lb/ton) (tsf)
σ_{vo}' = vertical effective overburden (tsf)

and: $F = 100\% * AvgFs / (q_c - \sigma_{vo}')$

where: AvgFs= recorded side friction (tsf)
q_c = corrected tip resistance (tsf)
σ_{vo}' = vertical effective overburden (tsf)

Once N_{60} and σ_{vo}' had been calculated, a correction factor (Cn) was applied to N_{60} to give $(N_1)_{60}$:

$(N_1)_{60} = N_{60} * Cn$

where N_{60} = Number of blows/foot to advance 1.5 feet
Cn = $(\sigma_{vo}')^{-0.5}$ (dim)

Using tip resistance, corrected for overburden, and effective overburden the effective friction of the material in the Pond Creek facility could be calculated (Robertson, 1989). This was done using the following calculation:

$$\phi' = \tan^{-1}[(1/2.68) * (Log_{10}(q_c / \sigma_{vo}') + 0.29)]$$

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 6 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

where: q_c = corrected tip resistance (tsf)
σ_{vo}' = effective vertical stress (tsf)

Similarly, the fines content was correlated from PS-CPT data but was not used in any further analysis. The fines content was correlated using the soil behavior type index, I_c, as defined above. To determine the fines content of the material, the following relationship was used:

$$F_c = (1.75 * I_c^{3.25} - 3.7)$$

where: F_c = fines content (%)
I_c = soil behavior type index (dim)

RESULTS:

The results of the correlations between PS-CPT data recorded during field testing yield a profile of geotechnical parameters at the 15 sounding locations tested at the Pond Creek facility. Effective and total stresses provide an indication of the stresses being experienced insitu, and generally will increase as material is placed on top of the existing materials to the lines and grades of the proposed final geometry.

In-situ effective friction values were correlated using in-situ corrected tip resistance and effective overburden pressures for the 15 soundings tested at the Pond Creek facility.

CONCLUSIONS:

Summarizing, data recorded during PS-CPT field testing was used to correlate index and strength parameters for comparison to limited laboratory testing at discrete sample locations and to develop nearly continuous profile(s) of engineering properties with depth to model the variability of the insitu conditions at the Pond Creek facility.

Based on modified results, the correlated parameters from PS-CPT are generally consistent with each other and similar parameters determined from similar materials at other refuse facilities, and from laboratory testing of discrete samples. Therefore, in general, a reasonably high confidence level exists applying/using the results of the PS-CPT correlations to the 15 profiles shown in the attached tables.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 7 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-1

ConeTec Inc. Interpretation
Interpretation Release 1.22 Rev. Format: NLI Imperial

Run No: 07-1210-1008-4622
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-1
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 13:23
CPT File: 804CP01.COR
Northing (m): 0.000000
Easting (m): 0.000000
Elevation (m): 482.2

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	41.95	2.43	78.91	26.81	2.38

User Inputs:

Assumed:
Water Table Depth (ft): 15.3
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 482.2
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.026	16.61	0.44	2.66	0.11	1619.49	2.651	1.66	1619.49	2.65	5	125.00	0.010	0.010	0.000	2.000	2.89	5.79	0.514	16.61	5.45572	52.56
0.492	481.698	45.67	1.03	2.25	4.37	1484.2	2.257	1.60	1483.55	2.26	6	125.00	0.031	0.031	0.000	2.000	7.79	15.57	1.413	45.65	4.391	52.25
0.82	481.370	44.31	1.6	3.61	-3.26	863.585	3.615	1.86	863.98	3.61	5	125.00	0.051	0.051	0.000	2.000	8.26	16.52	1.370	44.33	9.36475	50.29
1.148	481.042	49.34	1.93	3.91	-6.42	686.668	3.917	1.92	687.22	3.91	5	125.00	0.072	0.072	0.000	2.000	9.42	18.84	1.525	49.38	10.8792	49.41
1.476	480.714	50.64	2.12	4.19	-7.64	547.943	4.194	1.98	548.49	4.19	5	125.00	0.092	0.092	0.000	2.000	9.90	19.80	1.565	50.69	12.4636	48.51
1.804	480.386	45.45	2.14	4.71	-0.65	402.104	4.720	2.08	402.10	4.72	4	125.00	0.113	0.113	0.000	2.000	9.23	18.46	1.404	45.45	15.2837	47.21
2.133	480.057	40.4	1.81	4.48	3.83	302.047	4.495	2.12	301.82	4.50	4	125.00	0.133	0.133	0.000	2.000	8.32	16.64	1.247	40.37	16.3803	45.96
2.461	479.729	34.96	1.32	3.78	8.22	226.29	3.792	2.12	225.96	3.80	5	125.00	0.154	0.154	0.000	2.000	7.19	14.38	1.078	34.91	16.3424	44.63
2.789	479.401	31.18	1.1	3.52	11.83	177.874	3.548	2.15	177.47	3.56	5	125.00	0.174	0.174	0.000	2.000	6.50	12.99	0.960	31.11	17.3915	43.48
3.117	479.073	29.29	1.15	3.92	14.97	149.35	3.953	2.23	148.89	3.96	5	125.00	0.195	0.195	0.000	2.000	6.31	12.62	0.901	29.2	20.1364	42.62
3.445	478.745	29.06	1.09	3.74	29.44	133.967	3.779	2.25	133.13	3.80	5	125.00	0.215	0.215	0.000	2.000	6.28	12.55	0.893	28.88	20.6255	42.05
3.773	478.417	32.91	1.15	3.49	32.84	138.56	3.520	2.21	137.67	3.54	5	125.00	0.236	0.236	0.000	2.000	7.01	14.02	1.012	32.7	19.4713	42.22
4.101	478.089	34.84	1.39	4	29.66	134.928	4.019	2.27	134.19	4.04	5	125.00	0.256	0.256	0.000	1.975	7.59	15.00	1.071	34.65	21.3078	42.09
4.429	477.761	35.38	1.49	4.22	29.72	126.812	4.245	2.30	126.16	4.27	4	125.00	0.277	0.277	0.000	1.901	7.83	14.88	1.087	35.2	22.5787	41.78
4.757	477.433	34.51	1.53	4.44	31.68	115.073	4.472	2.35	114.40	4.50	4	125.00	0.297	0.297	0.000	1.834	7.78	14.27	1.059	34.31	24.2407	41.27
5.085	477.105	32.05	1.52	4.75	32.73	99.8456	4.790	2.41	99.16	4.82	4	125.00	0.318	0.318	0.000	1.774	7.42	13.17	0.982	31.84	26.6972	40.52
5.413	476.777	33.07	1.53	4.62	33.55	96.7499	4.674	2.41	96.13	4.70	4	125.00	0.338	0.338	0.000	1.719	7.66	13.17	1.013	32.86	26.6937	40.36
5.741	476.449	28.11	1.63	5.81	25.35	77.3418	5.874	2.54	76.90	5.91	3	125.00	0.359	0.359	0.000	1.669	6.95	11.61	0.859	27.95	32.7178	39.15
6.069	476.121	23.82	1.72	7.24	8.62	61.7978	7.338	2.68	61.67	7.35	3	125.00	0.379	0.379	0.000	1.624	6.33	10.27	0.726	23.77	39.3343	37.91
6.398	475.792	23.35	1.75	7.49	4.73	57.3932	7.625	2.71	57.32	7.64	3	125.00	0.400	0.400	0.000	1.581	6.31	9.98	0.711	23.32	41.0639	37.49
6.726	475.464	25.01	1.76	7.04	4.71	58.4945	7.157	2.68	58.42	7.17	3	125.00	0.420	0.420	0.000	1.542	6.67	10.29	0.761	24.98	39.6542	37.60
7.054	475.136	26.32	1.96	7.47	4.23	58.6995	7.574	2.70	58.63	7.58	3	125.00	0.441	0.441	0.000	1.506	7.09	10.67	0.801	26.29	40.6073	37.62
7.382	474.808	26.5	1.77	6.7	3.32	56.437	6.798	2.68	56.39	6.80	3	125.00	0.461	0.461	0.000	1.472	7.04	10.37	0.806	26.48	39.2566	37.40
7.71	474.480	22.44	1.48	6.61	3	45.5681	6.740	2.74	45.53	6.75	3	125.00	0.482	0.482	0.000	1.441	6.15	8.86	0.680	22.42	42.3496	36.15
8.038	474.152	24.71	1.6	6.49	3.7	48.1864	6.609	2.71	48.15	6.61	3	125.00	0.502	0.502	0.000	1.411	6.69	9.44	0.749	24.69	41.1319	36.48
8.366	473.824	35.83	2.03	5.68	4.8	67.525	5.750	2.57	67.47	5.75	3	125.00	0.523	0.523	0.000	1.383	9.02	12.48	1.093	35.8	33.9863	38.42
8.694	473.496	39.18	2.59	6.61	3.46	71.1049	6.703	2.61	71.07	6.71	3	125.00	0.543	0.543	0.000	1.357	10.06	13.64	1.196	39.16	35.8018	38.71
9.022	473.168	64.62	3.1	4.8	6.26	113.6	4.840	2.37	113.53	4.84	11	125.00	0.564	0.564	0.000	1.332	14.83	19.75	1.983	64.58	25.3247	41.23
9.35	472.840	86.35	5.07	5.87	3.14	146.765	5.911	2.38	146.73	5.91	11	125.00	0.584	0.584	0.000	1.308	19.89	26.02	2.655	86.33	25.6191	42.54
9.678	472.512	73.23	5.54	7.56	-2.24	120.066	7.628	2.52	120.08	7.63	11	125.00	0.605	0.605	0.000	1.286	18.01	23.18	2.248	73.24	31.6127	41.52
10.006	472.184	46.41	4.03	8.68	-9.82	73.2115	8.802	2.69	73.31	8.79	0	125.00	0.625	0.625	0.000	1.265	12.47	15.77	1.417	46.47	40.1446	38.88
10.335	471.855	39.89	2.66	6.66	-11.18	60.7552	6.778	2.66	60.86	6.77	3	125.00	0.646	0.646	0.000	1.244	10.50	13.07	1.215	39.96	38.0706	37.63
10.663	471.527	54.17	2.97	5.48	-11.18	80.2829	5.551	2.51	80.39	5.54	3	125.00	0.666	0.666	0.000	1.225	13.28	16.26	1.656	54.24	31.1774	39.39
10.991	471.199	62.34	4.01	6.44	-10.65	89.7506	6.504	2.54	89.85	6.50	11	125.00	0.687	0.687	0.000	1.207	15.46	18.65	1.909	62.41	32.3205	39.99
11.319	470.871	75.65	4.58	6.06	-9.15	105.935	6.111	2.47	106.01	6.11	11	125.00	0.707	0.707	0.000	1.189	18.19	21.63	2.320	75.7	29.4445	40.87
11.647	470.543	96	6.72	7	-6.93	130.879	7.053	2.47	130.93	7.05	11	125.00	0.728	0.728	0.000	1.172	23.07	27.04	2.950	96.04	29.4226	41.97
11.975	470.215	83.38	6.59	7.9	-7.87	110.405	7.975	2.56	110.47	7.97	11	125.00	0.748	0.748	0.000	1.156	20.88	24.13	2.558	83.43	33.2785	41.09
12.303	469.887	57.02	4.42	7.74	-9.36	73.1543	7.858	2.66	73.23	7.85	3	125.00	0.769	0.769	0.000	1.140	15.01	17.11	1.742	57.08	38.1113	39.88
12.631	469.559	67.48	3.97	5.89	-6.63	84.4786	5.953	2.52	84.53	5.95	11	125.00	0.789	0.789	0.000	1.125	16.61	18.70	2.065	67.52	31.6601	39.66
12.959	469.231	79.63	5.29	6.64	-4.3	97.3162	6.711	2.53	97.35	6.71	11	125.00	0.810	0.810	0.000	1.111	19.65	21.83	2.440	79.66	31.8895	40.42
13.287	468.903	74.37	5.39	7.24	-3.35	88.5552	7.329	2.58	88.58	7.33	11	125.00	0.830	0.830	0.000	1.097	18.85	20.68	2.277	74.39	34.4742	39.92
13.615	468.575	71.75	5.08	7.08	-2.33	83.3188	7.165	2.59	83.34	7.16	11	125.00	0.851	0.851	0.000	1.084	18.25	19.79	2.195	71.77	34.8502	39.59
13.943	468.247	102.33	5.18	5.06	-0.78	116.427	5.106	2.38	116.44	5.11	11	125.00	0.871	0.871	0.000	1.071	23.62	25.31	3.141	102.34	25.8028	41.36
14.271	467.919	114.91	6.8	5.91	2.36	127.832	5.964	2.42	127.81	5.97	11	125.00	0.892	0.892	0.000	1.059	26.91	28.49	3.530	114.89	27.1057	41.84
14.6	467.590	134.53	9.49	7.06	8.8	146.43	7.102	2.45	146.36	7.11	11	125.00	0.913	0.913	0.000	1.047	31.95	33.45	4.137	134.47	28.4187	42.53
14.928	467.262	140.8	8.87	6.3	10.72	149.911	6.342	2.40	149.84	6.34	11	125.00	0.933	0.933	0.000	1.035	32.73	33.86	4.330	140.73	26.4588	42.65
15.256	466.934	130.39	7.43	5.7	2.1	135.749	5.740	2.39	135.74	5.74	11	125.00	0.954	0.954	0.000	1.024	30.14	30.87	4.007	130.38	25.9423	42.15

R13785

Depth (ft)	El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.606	108.8	7.14	6.56	-4.18	111.721	6.622	2.49	111.74	6.62	11	135.00	0.974	0.965	0.009	1.018	26.34	26.81	3.338	108.82	30.1191	41.15
15.912	466.278	78.99	5.55	7.03	-5.77	79.8262	7.116	2.60	79.86	7.11	11	135.00	0.996	0.977	0.019	1.012	20.16	20.42	2.415	79.02	35.2737	39.35
16.24	465.950	119.1	5.81	4.88	-0.48	119.401	4.920	2.37	119.40	4.92	11	135.00	1.018	0.989	0.029	1.006	27.25	27.41	3.656	119.1	25.0315	41.50
16.568	465.622	148.8	8.34	5.6	-1.5	147.633	5.644	2.36	147.64	5.64	11	135.00	1.040	1.001	0.040	1.000	34.00	33.98	4.575	148.81	24.89	42.58
16.896	465.294	185.21	10.35	5.59	7.64	181.826	5.620	2.31	181.78	5.62	11	135.00	1.063	1.013	0.050	0.994	41.38	41.12	5.701	185.16	22.9713	43.60
17.224	464.966	333.69	12.91	3.87	16.63	324.597	3.881	2.05	324.50	3.88	12	135.00	1.085	1.025	0.060	0.988	66.82	66.01	10.297	333.59	14.2684	46.28
17.552	464.638	421.41	14.07	3.34	22.43	405.472	3.348	1.95	405.34	3.35	12	136.00	1.107	1.037	0.070	0.982	81.17	79.72	13.012	421.27	11.5386	47.25
17.88	464.310	395.49	15.59	3.94	0.37	376.125	3.953	2.03	376.12	3.95	12	135.00	1.129	1.048	0.080	0.977	78.54	76.70	12.209	395.49	13.6425	46.93

R13786

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 10 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/09

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-2

ConeTec Interpretation
Interpreta ut - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4589
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-2
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 13:46
CPT File: 804CP02.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 494.21

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.31	1.63	53.64	24.15	2.30
125	Residual Soil	27.01	1.39	47.18	59.75	2.99

User Inputs:
Assumed:
Water Table Depth (ft): 38.8
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 494.2
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	494.046	4.44	0.09	1.92	0.14	415.51	2.032	1.75	415.51	2.03	4	130.00	0.011	0.011	0.000	2.000	0.80	1.59	0.137	4.44	7.06955	47.35
0.492	493.718	15.27	0.31	2	0	476.486	2.034	1.72	476.49	2.03	5	130.00	0.032	0.032	0.000	2.000	2.771	5.42	0.472	15.27	6.6252	47.93
0.82	493.390	32.23	0.81	2.51	0.41	603.128	2.520	1.76	603.13	2.52	6	130.00	0.053	0.053	0.000	2.000	5.80	11.60	0.995	32.23	7.32759	48.89
1.149	493.062	74.45	2.09	2.81	0.26	996.722	2.810	1.73	996.86	2.81	6	130.00	0.075	0.075	0.000	2.000	13.28	26.57	2.303	74.45	6.78819	50.83
1.478	492.734	107.36	2.18	2.03	0.28	1118.03	2.032	1.69	1118.03	2.03	7	130.00	0.096	0.096	0.000	2.000	18.21	36.42	3.321	107.36	4.12002	51.25
1.804	492.406	114.67	2.13	1.91	0.11	976.912	1.912	1.58	976.91	1.91	7	130.00	0.1178	0.117	0.000	2.000	19.39	38.78	3.547	114.67	3.56073	50.75
2.133	492.077	93.71	1.85	1.98	0.3	674.899	1.977	1.65	674.90	1.98	7	130.00	0.099	0.139	0.000	2.000	16.22	32.44	2.897	93.71	5.13754	49.34
2.46	491.749	78.06	1.5	1.92	0.23	486.982	1.926	1.70	486.98	1.93	7	130.00	0.160	0.160	0.000	2.000	13.74	27.48	2.412	78.06	6.04007	48.02
2.788	491.421	58.8	1.47	2.61	0.67	323.351	2.508	1.98	323.35	2.61	6	130.00	0.181	0.181	0.000	2.000	11.06	22.13	1.816	58.8	9.97805	46.26
3.117	491.093	40.59	0.92	2.26	0.62	199.341	2.278	1.96	199.39	2.28	6	130.00	0.203	0.203	0.000	2.000	7.86	15.75	1.250	40.6	11.8985	44.04
3.445	490.765	26.44	0.57	2.16	0.21	117.075	2.174	2.10	117.08	2.17	6	130.00	0.224	0.224	0.000	2.000	5.40	10.79	0.812	26.44	16.6626	41.39
3.773	490.437	29.6	0.6	1.68	0.56	119.696	1.703	2.01	119.74	1.70	6	130.00	0.245	0.245	0.000	2.000	5.85	11.69	0.909	29.61	13.2397	41.61
4.101	490.109	25.33	0.62	2.43	0.39	94.0237	2.474	2.20	94.02	2.47	6	130.00	0.267	0.267	0.000	1.97	5.40	10.46	0.776	25.33	19.0184	40.24
4.429	489.781	28.49	0.71	2.5	0.44	97.9631	2.518	2.19	97.96	2.52	6	130.00	0.288	0.288	0.000	1.864	5.06	11.29	0.873	28.49	18.8026	40.46
4.757	489.453	31.04	0.87	2.79	0.56	99.3665	2.831	2.23	99.42	2.83	6	130.00	0.309	0.309	0.000	1.758	5.69	12.04	0.961	31.05	19.5406	40.64
5.083	489.125	58.32	1.11	1.88	0.53	175.447	1.897	1.94	175.45	1.90	7	130.00	0.331	0.331	0.000	1.739	11.00	19.47	1.795	58.32	11.2709	43.43
5.411	488.797	64.77	1.14	1.78	0.39	183.087	1.770	1.90	183.12	1.77	7	130.00	0.352	0.352	0.000	1.686	12.27	20.59	1.994	64.78	10.4054	43.63
5.74	488.469	49.99	1.56	3.14	0.19	132.962	3.124	2.18	132.96	3.12	6	130.00	0.373	0.373	0.000	1.637	10.58	17.29	1.536	49.99	18.3323	42.09
6.068	488.141	99.88	2.64	2.53	1.89	249.656	2.538	1.95	249.66	2.54	7	130.00	0.394	0.394	0.000	1.592	18.08	30.34	3.049	99.89	11.5492	45.10
6.393	487.812	86.03	2.65	2.97	3.23	205.869	2.978	2.05	205.92	2.98	6	130.00	0.416	0.416	0.000	1.551	17.29	26.77	2.657	86.05	14.3668	44.20
6.721	487.484	74.12	2.09	2.82	2.27	169.537	2.836	2.08	168.56	2.84	6	130.00	0.437	0.437	0.000	1.512	15.07	22.78	2.291	74.13	15.335	43.23
7.05	487.156	57.9	1.75	3.03	0.39	125.279	3.047	2.19	125.30	3.05	6	130.00	0.459	0.459	0.000	1.477	12.27	18.13	1.778	57.91	18.5782	41.74
7.382	486.828	73.94	1.79	2.42	0.32	163.096	2.437	2.06	163.10	2.44	6	130.00	0.480	0.480	0.000	1.443	14.87	21.47	2.274	73.94	14.5542	42.75
7.71	486.500	100.23	1.95	1.95	0.48	199	1.955	1.91	199.00	1.96	7	130.00	0.501	0.501	0.000	1.418	19.07	26.93	3.088	100.23	10.6818	44.03
8.038	486.172	96.56	2.95	3.06	0.34	183.814	3.072	2.09	183.81	3.07	6	130.00	0.522	0.522	0.000	1.393	18.67	27.21	2.973	96.56	15.5105	43.65
8.366	485.844	130.73	3.63	2.78	5.11	239.405	2.788	1.99	239.41	2.79	7	130.00	0.544	0.544	0.000	1.369	25.62	34.75	4.031	130.76	12.899	44.90
8.69	485.516	98.21	2.49	2.54	0.94	172.769	2.550	2.04	172.81	2.55	7	130.00	0.565	0.565	0.000	1.330	18.62	26.10	3.031	98.22	14.0752	43.35
9.022	485.188	72.31	1.82	2.52	0.92	122.305	2.538	2.13	122.32	2.54	6	130.00	0.586	0.586	0.000	1.306	14.99	19.67	2.221	72.32	18.8248	41.62
9.35	484.860	80.45	1.62	2.02	0.93	131.974	2.029	2.04	131.99	2.03	7	130.00	0.608	0.608	0.000	1.283	16.07	20.61	2.472	80.46	14.0333	41.99
9.677	484.532	69.94	1.16	1.66	0.99	110.18	1.674	2.03	110.20	1.67	7	130.00	0.629	0.629	0.000	1.264	13.92	17.55	2.146	69.95	13.7865	41.08
10.006	484.204	61.74	0.9	1.45	0.39	93.9277	1.473	2.04	93.93	1.47	7	130.00	0.650	0.650	0.000	1.240	12.34	15.30	1.89	61.74	14.1065	40.23
10.335	483.875	68.65	1.35	2.02	0.53	98.2149	2.046	2.13	98.23	2.05	7	130.00	0.672	0.672	0.000	1.220	13.73	16.82	2.043	68.66	16.6601	40.47
10.663	483.547	83.84	2.23	2.65	0.46	119.965	2.682	2.16	119.96	2.68	6	130.00	0.693	0.693	0.000	1.201	17.55	21.08	2.674	83.84	17.5809	41.52
10.991	483.219	117.25	2.55	2.17	0.83	163.12	2.188	2.00	163.12	2.19	7	130.00	0.714	0.714	0.000	1.183	23.09	27.32	3.668	117.25	15.0514	43.07
11.319	482.891	126.97	2.65	2.08	0.44	171.576	2.099	1.98	171.59	2.10	7	130.00	0.736	0.736	0.000	1.166	24.74	28.84	3.908	126.97	12.3061	43.32
11.647	482.563	100.73	2.81	2.79	1.16	132.055	2.813	2.15	132.07	2.81	6	130.00	0.757	0.757	0.000	1.149	20.99	24.12	3.096	100.74	17.2321	42.01
11.975	482.235	110.03	2.03	1.85	0.79	140.959	1.858	1.99	140.97	1.86	7	130.00	0.778	0.778	0.000	1.133	21.57	24.46	3.382	110.04	12.7249	42.32
12.303	481.907	89.84	1.64	1.83	0.58	111.343	1.842	2.06	111.36	1.84	7	130.00	0.800	0.800	0.000	1.118	18.07	20.20	2.767	89.85	14.5435	41.13
12.631	481.579	84.26	1.13	1.75	1.04	77.269	1.781	2.16	77.28	1.78	7	130.00	0.821	0.821	0.000	1.104	13.47	14.86	1.964	84.27	17.6781	39.17
12.959	481.251	53.66	0.81	1.5	0.76	52.7039	1.534	2.18	52.70	1.53	7	130.00	0.842	0.842	0.000	1.090	11.36	12.38	1.635	53.66	18.4929	38.00
13.287	480.923	47.49	0.8	1.68	0.14	53.9872	1.716	2.27	54.00	1.72	7	130.00	0.864	0.864	0.000	1.076	10.41	11.20	1.444	47.5	21.2802	37.15
13.615	480.595	49.6	0.9	1.82	0.26	55.0468	1.847	2.28	55.05	1.85	7	130.00	0.885	0.885	0.000	1.063	10.93	11.62	1.508	49.6	21.8026	37.26
13.943	480.267	33.73	0.59	1.74	0.11	36.2175	1.797	2.41	36.22	1.80	6	130.00	0.906	0.906	0.000	1.050	7.89	8.29	1.016	33.73	26.98	34.77
14.271	479.939	30.54	0.58	1.82	0.8	31.9231	1.891	2.47	31.92	1.89	6	130.00	0.928	0.928	0.000	1.038	7.33	7.61	0.917	30.54	29.3952	34.00
14.6	479.610	31.88	0.49	1.49	0.09	32.5933	1.552	2.41	32.59	1.55	6	130.00	0.949	0.949	0.000	1.027	7.45	7.65	0.958	31.88	26.9209	34.13
14.928	479.282	41.36	0.41	0.98	0.26	41.625	1.016	2.22	41.63	1.02	7	130.00	0.970	0.970	0.000	1.015	8.89	9.02	1.260	41.36	19.6777	35.61
15.256	478.954	37.15	0.45	1.21	0.14	36.4632	1.245	2.32	36.46	1.24	7	130.00	0.992	0.992	0.000	1.004	8.32	8.36	1.119	37.15	23.1707	34.81

R13788

Depth (ft)	El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	γ (pcf)	σ'vo (tsf)	σvo (tsf)	u (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.514	476.626	35.51	0.42	1.19	0.23	34.0557	1.217	2.34	34.07	1.22	7	130.00	1.018	1.018	0.000	0.994	8.02	7.97	1.068	35.52	23.8923	34.40
15.912	476.298	35.52	0.45	1.26	0.07	33.3427	1.305	2.36	33.84	1.30	7	130.00	1.034	1.034	0.000	0.983	8.11	7.98	1.068	35.52	24.8516	34.27
16.24	477.970	39.22	0.5	1.28	0.18	36.1542	1.310	2.33	36.18	1.31	7	130.00	1.056	1.056	0.000	0.973	8.85	8.61	1.182	39.23	23.7631	34.76
16.568	477.642	38.39	0.42	1.08	0	34.648	1.126	2.201	34.65	1.13	7	130.00	1.077	1.077	0.000	0.964	8.58	8.27	1.155	38.39	22.946	34.50
16.880	477.314	40.69	0.25	0.6	0.04	36.0502	0.631	2.17	36.05	0.63	7	130.00	1.098	1.098	0.000	0.954	8.66	8.26	1.226	40.69	17.9445	34.74
17.224	476.986	26.93	0.46	1.71	0.18	23.0541	1.782	2.57	23.05	1.78	6	130.00	1.120	1.120	0.000	0.945	6.78	6.41	0.799	26.93	33.9054	31.95
17.652	476.658	23.41	0.62	2.63	0.25	19.5192	2.784	2.74	19.52	2.78	5	130.00	1.141	1.141	0.000	0.936	6.44	6.09	0.689	23.41	42.7657	30.87
17.88	476.330	65.32	1.62	2.49	0.04	55.2036	2.525	2.87	55.20	2.53	6	130.00	1.162	1.162	0.000	0.928	14.96	13.89	0.998	65.32	25.2127	37.27
18.208	476.002	75.66	2.12	2.8	0.99	62.9279	2.84654	2.36661	62.9279	2.84654	6	130.00	1.18352	1.18352	0	0.9192	17.31694	15.91506	1.30577	75.66	25.0811	38.024
18.537	475.673	74.29	1.97	2.66	0.05	60.6563	2.69549	2.36029	60.6563	2.69549	6	130.00	1.20491	1.204905	0	0.913	16.98011	15.45084	1.26275	74.29	24.8219	37.815
18.868	475.345	68.95	1.8	2.4	0.05	53.5985	2.43443	2.36877	53.5985	2.43443	6	130.00	1.22623	1.226225	0	0.9031	16.34246	14.8651	1.09479	68.95	25.156	37.104
19.189	475.017	63.56	1.37	2.16	0.04	49.9481	2.1986	2.36187	49.9481	2.1986	7	130.00	1.24765	1.247645	0	0.8953	14.52072	13.0005	0.92918	63.56	24.8839	36.693
19.521	474.689	54.9	1.01	1.84	0.12	42.2673	1.88323	2.37383	42.2673	1.88323	7	130.00	1.26887	1.268865	0	0.8878	12.60965	11.19426	1.66041	54.9	25.3569	35.705
19.849	474.361	41.75	0.84	2.02	0.51	31.3597	2.07613	2.50167	31.3597	2.07613	6	130.00	1.29019	1.290185	0	0.8804	10.97354	9.956661	1.25263	41.75	30.7677	33.887
20.177	474.033	45.14	0.57	1.25	0.28	33.4185	1.30052	2.35955	33.4106	1.30082	7	130.00	1.31151	1.311505	0	0.8732	10.29958	9.993624	1.35693	45.13	24.7928	34.278
20.505	473.705	50.75	0.66	1.29	0.28	37.077	1.33557	2.329	37.077	1.33557	7	130.00	1.332284	1.332825	0	0.8662	11.42634	9.897387	1.52994	50.75	23.6109	34.915
20.833	473.377	43.95	0.93	2.11	0.21	31.4559	2.18331	2.61412	31.4559	2.18331	6	130.00	1.35415	1.354145	0	0.8593	10.77355	9.2581951	1.51876	43.95	31.3181	33.906
21.161	473.049	97.82	0.76	2	0.18	26.4962	2.08536	2.56096	26.4962	2.08536	16	130.00	1.3754	1.375465	0	0.8527	9.483875	8.066506	1.112631	97.82	33.4834	32.832
21.489	472.721	31.66	0.63	1.99	0.12	21.6663	2.08174	2.6309	21.6663	2.08174	6	130.00	1.39679	1.396785	0	0.8451	8.221935	6.956179	0.93694	31.66	36.886	31.648
21.817	472.393	29.26	0.51	1.75	0.11	19.8332	1.83177	2.63406	19.8332	1.83177	6	130.00	1.41811	1.418105	0	0.8397	7.610153	6.390564	0.86199	29.26	37.0446	30.91
22.145	472.065	27.79	0.57	2.04	0.16	18.3063	2.16314	2.70017	18.3063	2.16314	6	130.00	1.43943	1.439425	0	0.8335	7.478319	6.234011	0.81581	27.79	40.4629	30.453
22.473	471.737	29.87	0.47	1.58	0.21	19.4485	1.65439	2.61284	19.4485	1.65439	6	130.00	1.46076	1.460745	0	0.8274	7.685847	6.35923	0.87954	29.87	35.9877	30.848
22.802	471.408	28.42	0.58	2.03	0.16	18.1751	2.1531	2.70166	18.1751	2.1531	6	130.00	1.48213	1.482135	0	0.8214	7.454487	6.287427	0.83399	28.42	40.5369	30.406
23.13	471.080	31.05	0.62	1.99	0.28	19.6525	2.09838	2.66738	19.6525	2.09838	6	130.00	1.50345	1.503455	0	0.8156	8.214039	6.899769	0.91475	31.05	38.7439	30.916
23.458	470.752	46.22	1.11	2.4	0.37	29.3128	2.48349	2.57298	29.3128	2.48349	6	130.00	1.52477	1.524775	0	0.8098	11.65589	9.441869	1.38376	46.22	34.0532	33.467
23.786	470.424	39.92	0.83	2.08	0.37	24.82	2.16293	2.59318	24.82	2.16293	6	130.00	1.54609	1.546095	0	0.8042	10.16712	8.184026	1.08805	39.92	35.0255	32.418
24.114	470.096	27.53	0.53	1.93	0.97	16.564	2.0414	2.72157	16.564	2.0414	6	130.00	1.56741	1.56741	0	0.7987	7.493763	5.985619	0.8038	27.53	41.8107	29.796
24.442	469.768	29.77	0.51	1.72	0.97	17.7382	1.80971	2.66769	17.7382	1.80971	6	130.00	1.58873	1.58873	0	0.7934	7.877548	6.249799	0.87249	29.77	38.7598	30.247
24.77	469.440	42.36	0.65	1.53	0.32	25.3097	1.59509	2.50911	25.3097	1.59509	16	130.00	1.61005	1.61005	0	0.788	10.35889	8.163824	1.26161	42.36	31.0917	32.542
25.098	469.112	53.82	1.31	2.41	0.39	31.9907	2.49096	2.54436	31.9907	2.49096	6	130.00	1.63137	1.631375	0	0.7829	13.38709	10.48137	1.61575	53.82	32.7057	34.01
25.426	468.784	51.08	0.9	1.77	0.53	29.9072	1.82086	2.4837	29.9011	1.82122	7	130.00	1.65269	1.65269	0	0.7779	12.33883	9.59823	1.53026	51.07	29.9596	33.591
26.754	468.456	40.34	0.96	2.39	0.39	23.0978	2.4828	2.65426	23.0978	2.4828	6	130.00	1.67401	1.67401	0	0.7729	10.60082	8.193331	1.19709	40.34	38.0689	31.959
26.082	468.128	38.33	0.52	1.36	0.09	21.6092	1.41942	2.5382	21.6092	1.41942	7	130.00	1.69533	1.69533	0	0.7688	9.60564	7.330528	1.11342	38.33	32.4199	31.591
26.41	467.800	33.19	0.47	1.42	0.42	18.3342	1.49333	2.61024	18.3342	1.49333	7	130.00	1.71665	1.171665	0	0.7632	8.52896	6.509614	0.97441	33.19	35.8595	30.463
26.739	467.471	35.49	0.61	1.72	0.44	19.4196	1.8073	2.63471	19.4196	1.8073	6	130.00	1.73804	1.738035	0	0.758519.233542		7.003886	1.04495	35.49	37.0774	30.839
27.067	467.143	42.19	0.58	1.38	0.21	22.9804	1.43456	2.51828	22.9804	1.43456	7	130.00	1.75936	1.759355	0	0.7539	10.36277	7.8126645	1.25172	42.19	31.5067	31.926
27.395	466.815	45.33	0.59	1.3	0.28	24.4566	1.35479	2.4822	24.451	1.3551	7	130.00	1.78069	1.780675	0	0.7494	10.84193	8.1997665	1.34628	45.32	29.8936	32.323
27.723	466.487	34.11	0.71	2.09	0.25	17.929	2.1976	2.71151	17.929	2.1976	6	130.00	1.80202	1.801995	0	0.7449	9.235424	6.879867	1.00025	34.11	41.0689	30.317
28.05	466.159	38.11	0.64	1.67	0.16	19.9015	1.76373	2.61995	19.9015	1.76373	7	130.00	1.82332	1.823315	0	0.7406	9.84151	7.28823	1.12349	38.11	36.3399	30.998
28.379	465.831	54.68	0.64	1.17	0.14	28.6427	1.21131	2.39804	28.6427	1.21131	7	130.00	1.84464	1.844635	0	0.7363	12.89719	9.846728	1.63577	54.68	26.331	33.322
28.707	465.503	38.3	0.69	1.78	0.12	19.5257	1.86639	2.64061	19.5257	1.86639	6	130.00	1.86596	1.865955	0	0.7321	9.994656	7.316704	1.12709	38.3	37.3751	30.874
29.035	465.175	39.55	0.71	1.8	0.09	19.9561	1.88515	2.63527	19.9561	1.88515	6	130.00	1.88728	1.887275	0	0.7279	10.29276	7.492285	1.16603	39.55	37.1054	31.016
29.363	464.847	36.83	0.63	1.71	0.04	18.2969	1.80405	2.65573	18.2969	1.80405	6	130.00	1.90086	1.900585	0	0.7238	9.885775	7.01096	1.08118	36.83	38.1443	30.945
29.691	464.519	45.2	0.73	1.62	0.32	22.4207	1.68709	2.66643	22.4155	1.68747	7	130.00	1.92992	1.929915	0	0.7195	11.26246	8.179056	1.33963	45.19	33.742	31.767
30.019	464.191	50.69	0.58	1.15	0.9	24.9784	1.19002	2.44406	24.9784	1.19002	7	130.00	1.95124	1.951235	0	0.7159	12.02196	8.606381	1.50894	50.69	26.245	32.456
30.347	463.863	99.45	0.49	1.23	0.32	18.9994	1.30745	2.56664	18.9994	1.30745	7	130.00	1.97256	1.972555	0	0.712	9.920241	7.0653	1.16029	99.45	33.752	30.896
30.675	463.535	51.05	0.69	1.36	0.21	24.6034	1.40655	2.48892	24.5984	1.40684	7	130.00	1.99388	1.993875	0	0.7082	12.96218	8.754796	1.51877	51.04	30.1901	32.361
31.003	463.207	95.96	0.84	2.22	0.25	16.8439	2.35677	2.75119	16.8439	2.35677	6	130.00	2.01526	2.015255	0	0.7044	9.945252	7.005677	1.05092	95.96	43.233	29.907
31.332	462.878	34.69	0.81	2.33	0.23	16.0335	2.4806	2.78153	16.0335	2.4806	6	130.00	2.03658	2.03658	0	0.7007	9.754086	6.834958	1.01094	34.69	44.9361	29.581
31.66	462.550	32.8	0.69	2.11	0.04	14.9386	2.24448	2.78183	14.9386	2.24448	8	130.00	2.0579	2.0579	0	0.697	9.224214	6.430093	0.96177	32.8	44.9535	29.113
31.983	462.222	41.84	0.77	1.83	0.11	19.1229	1.93658	2.65715	19.1229	1.93658	6	130.00	2.07922	2.07922	0	0.6935	11.01139	7.636449	1.23098	41.84	38.2171	30.798
32.313	461.894	37.05	1.05	2.83	0.04	16.6383	3.00434	2.81778	16.6383	3.00434	6	125.00	2.10054	2.10054	0	0.69	10.62955	7.334144	1.08203	37.05	47.0264	29.826
32.641	461.566	67.03	0.55	0.82	-6.6	30.6024	0.84734	2.29207	30.6213	0.84682	8	125.00	2.12104	2.12104	0	0.6866	14.85918	10.20282	2.00957	67.07	22.2286	33.739
32.972	461.238	54.68	1.11	2.03	0.21	24.533	2.11274	2.59114	24.533	2.11274	7	125.00	2.14154	2.14154	0	0.6833	13.91768	9.510511	1.62658	54.68	34.9261	32.344
33.3	460.910	49.23	1.53	3.11	-2.91	21.7702	3.25062	2.74669	21.7794	3.24924	6	125.00	2.16204	2.16204	0	0.6801	13.58773	9.240913	1.45721	49.25	42.984	31.681
33.623	460.582	42.89	1.67	3.9	-0.53	18.6514	4.10244	2.86303	18.6514	4.10244	5	125.00	2.18254	2.18254	0	0.6769	12.62559	8.54615	1.26029	42.89	49.722	30.575
33.953	460.254	42.8	1.32	3.09	0.12	18.4277	3.25147	2.80358	18.4277	3.25147	6	125.00	2.20304	2.20304	0	0.6737	12.18217	8.207546	1.25687	42.8	46.2004	30.497
34.281	459.926	30.89	1.35	4.37	0.37	12.8923	4.70934	3.02533	12.8878	4.71098	4	125.00	2.22354	2.22354	0	0.6706	10.02714	6.72442	0.88751	30.88	60.2073	28.127
34.612	459.598	24.22	1.28	5.28	0.81	9.79303	5.82455	3.1763	9.78858	5.8272	3	125.00	2.24404	2.24404	0	0.6676	8.894916	5.804303	0.68037	24.21	71.1657	26.273
34.941	459.269	21.73	0.96	4.43	1.31	8.5955	4.93183	3.17671	8.59109	4.93438	4	125.00	2.2646	2.264603	0	0.6645	7.902906	5.185139	0.60264	21.72	71.1974	25.388
35.269	458.941	23.04	0.79	3.42	1.73	9.0827	3.80633	3.09074	9.07832	3.80817	5	125.00	2.2851	2.285103	0	0.6615	7.80225	5.161394	0.64257	23.03	64.8082	25.762
35.597	458.613	22.63	0.74	3.26	2.47	8.81522	3.64094	3.09045	8.80655	3.64453	5	125.00	2.3056	2.305603	0	0.6586	7.668449	5.043693	0.62924	22.61	64.7868	25.556
35.925	458.285	23.37	0.6	2.57	3.4	9.04685	2.85118	3.02107	9.03825	2.8539	5	125.00	2.3261	2.326103	0	0.6557	7.56159	4.95791	0.65151	23.35	59.9152	25.732
36.253	457.957	29.16	0.73	2.49	9.07	11.4265	2.72252	2.9266	11.4009	2.72863	6	125.00	2.3466	2.346603	0	0.6528	8.891671	5.804484	0.83014	29.1	53.6748	27.303
36.581	457.629	30.74	0.64	2.07	12.21	11.9863	2.25567	2.86414	11.9525	2.26205	6	125.00	2.3671	2.367103	0	0.65	9.031228	5.870002	0.87842	30.66	49.7897	27.622
36.909	457.301	30.69	0.47	1.52	13.92	11.8539	1.66064	2.79759	11.8162	1.66593	6	125.00	2.3876	2.387603	0	0.6472	8.680726	5.617913	0.87624	30.6	45.8547	27.544
37.237	456.973	31.76	0.55	1.72	16.67	12.1888	1.87381	2.81505	12.1431	1.88086	6	125.00	2.4081	2.408103	0	0.6444	9.066453	5.842516	0.90873	31.65	46.8672	27.728
37.565	456.645	33.62	0.61	1.8	17.92	12.8434	1.95567	2.80566	12.7981	1.96259	6	125.00	2.4286	2.428603	0	0.6417	9.549031	6.127468	0.96568	33.51	46.3211	28.081

R13789

Depth (ft)	El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	(lbs/ft³)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	456.317	32.15	0.63	1.95	18.64	12.1273	2.12115	2.84602	12.0783	2.12975	6	125.00	2.4491	2.449103	0	0.639	9.337317	5.966486	0.91953	32.03	48.6978	27.692
38.221	455.989	25.87	0.58	2.25	19.84	9.47537	2.47859	2.97339	9.42678	2.49137	6	125.00	2.4696	2.469603	0	0.6363	8.094387	5.15075	0.72447	25.75	56.71	26.018
38.549	455.661	21.3	0.67	3.13	19.56	7.55386	3.56195	3.14336	7.50567	3.58482	5	125.00	2.4901	2.490103	0	0.6337	7.434711	4.711459	0.58235	21.18	68.672	24.471
38.877	455.333	19.83	0.72	3.64	19.54	6.90511	4.15719	3.21395	6.85727	4.16619	4	135.00	2.5106	2.5082	0.0024	0.6314	7.271031	4.591081	0.5362	19.71	74.0883	23.859
39.206	455.004	19.78	0.91	4.59	17.32	6.84374	5.27622	3.27716	6.80009	5.31009	3	135.00	2.53281	2.520143	0.0127	0.6299	7.602996	4.789302	0.53397	19.67	79.1712	23.806
39.534	454.676	20.68	0.93	4.48	18.01	7.15825	5.13102	3.25407	7.11481	5.16235	3	135.00	2.55495	2.532049	0.0229	0.6284	7.814492	4.91094	0.58115	20.57	77.2888	24.117
39.862	454.348	20.78	0.84	4.03	18.73	7.15536	4.61465	3.22705	7.11212	4.6427	4	135.00	2.57709	2.543956	0.0331	0.627	7.69793	4.826354	0.56356	20.67	75.1234	24.118
40.19	454.020	19.42	0.88	4.52	19.38	6.58125	5.23163	3.28913	6.5343	5.26922	3	135.00	2.59923	2.555862	0.0434	0.6255	7.528098	4.708868	0.62077	19.3	80.159	23.549
40.518	453.692	16.99	0.73	4.28	19.84	5.59577	5.08051	3.33962	5.54903	5.1233	3	135.00	2.62137	2.567768	0.0536	0.6241	6.843878	4.270948	0.44485	16.87	84.4156	22.454
40.846	453.364	16.52	0.38	2.28	21.46	5.37916	2.73844	3.20777	5.32489	2.76635	5	135.00	2.64351	2.579676	0.0638	0.6226	6.015767	3.745489	0.42961	16.38	73.6031	22.183
41.174	453.036	17.43	0.34	1.93	23.46	5.69704	2.30284	3.14792	5.63916	2.32648	6	135.00	2.66565	2.591581	0.0741	0.6212	6.084749	3.779725	0.4571	17.28	69.0136	22.571
41.502	452.708	22.29	0.68	3.06	24.25	7.52921	3.469	3.13916	7.46776	3.49754	5	135.00	2.68779	2.603488	0.0843	0.6198	7.745791	4.800517	0.60688	22.13	66.3574	24.466
41.83	452.380	19.58	0.73	3.74	20.72	6.4503	4.32719	3.24865	6.40059	4.36079	4	135.00	2.70993	2.615394	0.0945	0.6183	7.359357	4.550628	0.52229	19.45	76.8511	23.43
42.158	452.052	20.78	0.6	2.87	23.56	6.86938	3.32448	3.1617	6.8161	3.35047	5	135.00	2.73207	2.6273	0.1048	0.6169	7.337513	4.526828	0.55876	20.64	70.053	23.857
42.486	451.724	27.89	0.85	3.06	26.14	9.52399	3.38163	3.04802	9.45958	3.40466	5	135.00	2.75421	2.639207	0.115	0.6155	9.132647	5.6216	0.7782	27.72	61.7782	26.072
42.814	451.396	28.69	1.21	4.23	37.12	9.77463	4.66935	3.12299	9.68787	4.71117	4	135.00	2.77635	2.651113	0.1252	0.6142	9.852356	6.050983	0.80228	28.46	67.1585	26.236
43.143	451.067	21.75	0.81	3.73	40.41	7.11643	4.27408	3.214	7.02255	4.33122	4	135.00	2.79856	2.663056	0.1355	0.6128	7.931649	4.860415	0.58673	21.5	74.0922	24.069
43.471	450.739	22.78	0.69	3.01	41.96	7.46153	3.45703	3.14483	7.36059	3.50444	5	135.00	2.8207	2.674962	0.1457	0.6114	7.909522	4.836057	0.61794	22.51	68.7816	24.389
43.799	450.411	20.59	0.61	2.97	43.95	6.60515	3.43717	3.18878	6.50094	3.49227	5	135.00	2.84284	2.686869	0.156	0.6101	7.35876	4.489329	0.54945	20.31	72.126	23.557
44.127	450.083	23.42	1.1	4.71	47.39	7.61643	5.35149	3.24833	7.50897	5.42807	3	135.00	2.86498	2.698775	0.1662	0.6087	8.749722	5.32612	0.63638	23.13	76.8256	24.529
44.455	449.755	253.58	4.98	1.96	20.09	92.4833	1.98649	2.13724	92.4354	1.98753	8	135.00	2.88712	2.710682	0.1764	0.6074	52.62093	31.96092	7.76139	253.45	16.9566	40.151
44.783	449.427	555.99	13.9	2.5	-21.27	203.145	2.5132	1.99381	203.193	2.5126	12	135.00	2.90926	2.722588	0.1867	0.6061	109.1065	66.12409	17.1232	556.12	12.7819	44.134

R13790

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 14 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-2A

ConeTec In[illegible]terpretation
Interpretati[illegible] - Release 1.22 Rev. Format: NLI Imperial

Run No: 07-1210-1008-4556
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-2A
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 14:50
CPT File: 804CP02A.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 492.4

Material Types and Unit Weight (pcl)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.34	1.36	45.43	22.11	2.23
125	Residual Soil	30.69	2.60	86.31	48.14	2.60

User Inputs:

Assumed: Water Table Depth (ft): 37 | Nk: 32.3 | State Parameter: 1.2 | Unit Weight of Soil (pcl): Varies See Below

Ground Surface Elev. 492.4

CPT area ratio: 0.85 See Below

Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	492.236	8.72	0.08	0.86	0.23	817.011	0.919	1.31	817.01	0.92	5	130.00	0.011	0.011	0.000	2.000	1.35	2.71	0.270	8.72	0.48798	50.08
0.492	491.908	16.38	0.2	1.22	0.05	1511.105	1.223	1.51	1511.20	1.22	6	130.00	0.032	0.032	0.000	2.000	2.71	5.43	0.508	16.38	3.02371	48.22
0.821	491.580	25.84	0.5	1.94	0.39	483.803	1.939	1.70	483.80	1.94	6	130.00	0.053	0.053	0.000	2.000	4.58	9.11	0.798	25.84	6.11479	47.99
1.149	491.252	28.06	0.61	2.62	0.21	375.307	1.821	1.73	375.31	1.82	6	130.00	0.076	0.075	0.000	2.000	5.00	10.01	0.867	28.08	6.6951	46.92
1.478	490.924	44.3	0.61	1.37	0.26	460.747	1.380	1.58	460.75	1.38	7	130.00	0.096	0.096	0.000	2.000	7.50	15.01	1.369	44.3	4.06565	47.79
1.804	490.596	29.51	0.72	2.43	0.14	250.663	2.450	1.93	250.66	2.45	6	130.00	0.117	0.117	0.000	2.000	5.66	11.31	0.910	29.51	11.2006	45.12
2.133	490.267	24.15	0.47	1.95	0.02	173.186	1.957	1.95	173.19	1.96	6	130.00	0.139	0.139	0.000	2.000	4.66	9.32	0.743	24.15	11.6289	43.36
2.46	489.939	20.69	0.35	1.67	0.39	128.341	1.705	1.99	128.40	1.70	6	130.00	0.160	0.160	0.000	2.000	4.06	8.11	0.636	20.7	12.6808	41.87
2.789	489.611	29.8	0.44	1.45	0.02	163.382	1.486	1.88	163.38	1.49	6	130.00	0.181	0.181	0.000	2.000	5.59	11.18	0.917	29.8	9.80456	43.08
3.117	489.283	30.73	0.22	0.72	0.05	150.674	0.721	1.68	150.67	0.72	7	130.00	0.203	0.203	0.000	2.000	5.39	10.77	0.945	30.73	5.79201	42.68
3.445	488.955	21.3	0.33	1.55	0.07	94.121	1.566	2.06	94.12	1.57	6	130.00	0.224	0.224	0.000	2.000	4.29	8.57	0.653	21.3	14.6052	40.24
3.773	488.627	26.89	0.22	0.82	0.09	108.645	0.826	1.83	106.69	0.83	7	130.00	0.245	0.245	0.000	2.000	4.96	9.93	0.825	26.9	8.76744	41.01
4.101	488.299	18.81	0.35	1.84	0.07	69.5644	1.887	2.21	69.56	1.89	6	130.00	0.267	0.267	0.000	1.937	4.03	7.80	0.674	18.81	19.3515	38.69
4.429	487.971	43.41	0.31	0.72	0.16	149.789	0.719	1.68	149.79	0.72	7	130.00	0.288	0.288	0.000	1.864	7.61	14.78	1.335	43.41	5.8155	42.65
4.757	487.643	28.43	0.59	2.08	0.16	90.9455	2.098	2.16	90.95	2.10	6	130.00	0.309	0.309	0.000	1.796	5.96	10.71	0.871	28.43	17.648	40.06
5.085	487.315	16	0.39	2.44	0.49	47.4078	2.489	2.41	47.41	2.49	5	130.00	0.331	0.331	0.000	1.730	4.74	6.51	0.485	16	27.0118	38.38
5.413	486.987	29.13	0.49	1.69	0.72	81.7921	1.703	2.13	81.79	1.70	6	130.00	0.352	0.352	0.000	1.669	8.03	10.16	0.691	29.13	16.6365	39.48
5.741	486.659	49.67	0.79	1.59	0.67	132.105	1.603	1.96	132.10	1.60	7	130.00	0.373	0.373	0.000	1.637	9.53	15.76	1.526	49.67	11.947	42.01
6.069	486.331	53.37	0.83	1.55	0.05	134.29	1.567	1.95	134.29	1.57	7	130.00	0.394	0.394	0.000	1.592	10.90	16.40	1.640	53.37	11.6376	42.10
6.398	486.002	49.98	0.63	1.26	1.39	119.182	1.271	1.92	119.21	1.27	7	130.00	0.416	0.416	0.000	1.555	9.55	14.80	1.534	49.99	10.9396	41.48
6.726	485.674	38.17	0.52	1.35	0.56	86.3076	1.378	2.05	86.31	1.38	7	130.00	0.437	0.437	0.000	1.512	7.65	11.57	1.168	38.17	14.3272	39.78
7.054	485.346	40.75	0.64	1.32	0.74	87.6748	1.340	2.04	87.67	1.34	7	130.00	0.459	0.458	0.000	1.477	8.13	12.00	1.247	40.75	13.9337	39.87
7.382	485.018	37.01	0.6	1.62	0.79	76.1315	1.642	2.14	76.15	1.64	7	130.00	0.480	0.480	0.000	1.444	7.70	11.11	1.181	37.02	17.0881	39.09
7.711	484.690	69.19	0.77	1.3	0.23	117.108	1.312	1.94	117.11	1.31	7	130.00	0.501	0.501	0.000	1.413	10.37	15.06	1.517	69.19	11.3174	41.39
8.039	484.362	57.04	1.08	1.85	0.25	108.174	1.876	2.07	108.17	1.88	7	130.00	0.522	0.522	0.000	1.383	11.53	15.96	1.760	57.04	14.9628	40.98
8.366	484.034	57.87	0.86	1.48	0.53	105.42	1.500	2.01	105.44	1.50	7	130.00	0.544	0.544	0.000	1.356	11.43	15.60	1.776	57.88	13.2385	40.85
8.694	483.706	75.82	0.88	1.16	0.74	133.169	1.169	1.86	133.19	1.17	8	130.00	0.566	0.565	0.000	1.330	14.16	18.84	2.330	75.83	9.50987	42.05
9.022	483.378	63.21	1.11	1.75	0.44	106.788	1.772	2.06	106.79	1.77	7	130.00	0.586	0.586	0.000	1.306	12.71	16.60	2.939	63.21	14.5845	40.91
9.35	483.050	60.49	0.91	1.51	0.93	98.531	1.520	2.04	98.55	1.52	7	130.00	0.608	0.608	0.000	1.283	12.06	15.47	1.854	60.5	13.9359	40.49
9.678	482.722	64.51	0.83	1.28	1.14	101.548	1.299	1.98	101.56	1.30	7	130.00	0.629	0.629	0.000	1.261	12.59	15.87	1.978	64.52	12.4063	40.65
10.006	482.394	80.55	1.03	1.28	0.85	122.849	1.289	1.92	122.86	1.29	8	130.00	0.650	0.650	0.000	1.240	15.35	19.04	2.474	80.56	10.6105	41.64
10.335	482.065	67.71	1.38	2.04	0.64	99.7927	2.059	2.12	99.79	2.06	7	130.00	0.672	0.672	0.000	1.220	13.99	17.07	2.075	67.71	16.5727	40.56
10.663	481.737	66.47	1.17	1.76	0.6	94.9032	1.779	2.10	94.90	1.78	7	130.00	0.693	0.693	0.000	1.201	13.57	16.30	2.036	66.47	15.8621	40.29
10.991	481.409	56.44	0.72	1.28	0.88	78.0017	1.292	2.06	78.00	1.29	7	130.00	0.714	0.714	0.000	1.183	11.96	13.47	1.725	56.44	14.7573	39.22
11.319	481.081	53.65	0.58	1.08	0.95	71.9203	1.096	2.05	71.93	1.10	7	130.00	0.736	0.736	0.000	1.168	10.75	12.63	1.638	53.68	14.2461	38.78
11.647	480.753	39.63	0.46	1.15	1.11	51.3476	1.163	2.18	51.36	1.18	7	130.00	0.757	0.757	0.000	1.149	8.39	9.64	1.203	39.64	18.4421	36.86
11.975	480.425	34.17	0.51	1.48	1.16	42.8991	1.527	2.31	42.91	1.53	7	130.00	0.778	0.778	0.000	1.133	7.64	8.66	1.034	34.18	22.9801	35.80
12.303	480.097	26.38	0.35	1.33	1.02	31.9876	1.369	2.39	31.99	1.37	6	130.00	0.800	0.800	0.000	1.118	6.10	6.82	0.792	26.38	25.9069	34.01
12.631	479.769	91.58	0.43	1.35	1.16	37.4648	1.398	2.34	37.48	1.40	7	130.00	0.821	0.821	0.000	1.104	7.14	7.88	0.952	91.59	23.9035	34.98
12.959	479.441	33.88	0.34	0.99	1.04	39.2215	1.029	2.24	39.23	1.03	7	130.00	0.842	0.842	0.000	1.090	7.36	8.02	1.023	33.89	20.5322	35.26
13.287	479.113	40.82	0.47	1.14	0.55	46.2642	1.176	2.22	46.26	1.16	7	130.00	0.864	0.864	0.000	1.078	8.76	9.43	1.237	40.82	19.6264	36.24
13.615	478.785	40.88	0.48	1.18	0.62	45.1934	1.200	2.23	45.19	1.20	7	130.00	0.885	0.885	0.000	1.063	8.83	9.38	1.238	40.88	20.0856	36.10
13.943	478.457	67.39	0.84	1.25	0.51	73.3577	1.263	2.08	73.36	1.26	7	130.00	0.906	0.906	0.000	1.050	13.67	14.36	2.058	67.39	15.3748	38.88
14.271	478.129	83.33	1.06	1.27	0.49	88.8325	1.288	2.02	88.83	1.29	8	130.00	0.928	0.928	0.000	1.038	16.52	17.16	2.551	83.33	13.5066	39.93
14.6	477.800	84.96	0.88	1.03	0.44	88.5258	1.047	1.96	88.53	1.05	18	130.00	0.949	0.949	0.000	1.027	16.48	16.92	2.601	84.96	11.9944	39.91
14.928	477.472	82.57	1.08	1.72	0.55	63.4839	1.753	2.22	63.48	1.75	7	130.00	0.970	0.970	0.000	1.015	13.44	13.64	1.907	82.57	19.6287	38.07
15.256	477.144	54.17	0.79	1.46	0.62	53.6267	1.486	2.23	53.64	1.49	7	130.00	0.992	0.992	0.000	1.004	11.68	11.73	1.646	54.18	19.9666	37.11

R13792

Depth (ft)	[illegible] (m)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U. (pcf)	Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	476.816	44.07	0.61	1.38	-0.69	42.5062	1.417	2.30	42.52	1.42	7	130.00	1.013	1.013	0.000	0.994	0.78	0.72	1.333	44.08	22.369	35.74
15.912	476.488	48.55	0.7	1.45	-0.58	45.9409	1.473	2.28	45.94	1.47	7	130.00	1.034	1.034	0.000	0.983	10.76	10.53	1.471	48.55	21.7636	36.207
16.2	476.160	44.39	0.49	1.11	-0.51	41.0519	1.181	2.25	41.06	1.113	7	130.00	1.056	1.056	0.000	0.973	9.67	9.418	1.342	44.4	20.767	36.53
16.568	475.832	49.03	0.37	0.75	-0.55	44.528	0.772	2.13	44.53	0.777	8	130.00	1.077	1.077	0.000	0.962	10.16	9.79	1.485	49.03	16.7798	36.02
16.896	475.504	41.84	0.47	1.13	-0.34	37.0973	1.154	2.29	37.10	1.15	7	130.00	1.098	1.098	0.000	0.954	9.27	8.85	1.261	41.84	22.2493	34.92
17.224	475.176	36.67	0.81	2.21	-0.18	31.7539	2.278	2.52	31.75	2.28	6	130.00	1.120	1.120	0.000	0.944	9.03	8.53	1.101	36.67	31.6967	33.96
17.552	474.848	53.97	0.73	1.35	-0.44	46.3056	1.382	2.26	46.31	1.38	7	130.00	1.141	1.141	0.000	0.936	10.79	10.04	1.636	53.98	21.0557	36.25
17.88	474.520	91.09	1.68	1.85	-0.98	77.3772	1.868	2.17	77.38	1.87	7	130.00	1.162	1.162	0.000	0.928	19.20	17.85	2.784	91.09	18.1251	39.18
18.208	474.192	100.89	2.85	2.82	-1.27	84.2457	2.85839	2.27913	84.2542	2.8561	6	130.00	1.18352	1.18352	0	0.9192	22.22949	20.43345	3.08689	100.9	21.7659	39.646
18.537	473.863	79.53	2.26	2.84	-0.71	65.0052	2.88541	2.35986	65.0052	2.88641	6	130.00	1.2048	1.204805	0	0.9113	18.15282	16.53742	2.42193	79.53	24.8045	38.208
18.865	473.535	60.94	1.2	1.97	-0.49	49.6972	2.00959	2.3446	49.6972	2.00959	7	130.00	1.22623	1.226225	0	0.9031	13.81554	12.47621	1.84872	60.94	24.2101	36.545
19.193	473.207	41.14	0.68	1.66	-0.56	31.9768	1.70458	2.44317	31.9768	1.70458	7	130.00	1.24755	1.247545	0	0.8953	9.752874	8.731904	1.23506	41.14	28.207	34.008
19.521	472.879	43.98	0.41	0.924	-0.65	33.6609	0.95994	2.28476	33.6609	0.95994	7	130.00	1.26887	1.268865	0	0.8878	9.712904	8.622668	1.32339	43.98	21.9609	34.324
19.849	472.551	44.49	0.5	1.13	-0.23	33.4834	1.15741	2.33046	33.4834	1.15741	7	130.00	1.29019	1.290185	0	0.8804	10.02335	8.824437	1.33748	44.49	23.6666	34.292
20.177	472.223	60.56	0.75	1.23	-0.23	45.176	1.26585	2.24572	45.176	1.26585	7	130.00	1.31151	1.311505	0	0.8732	13.15278	11.48502	1.83482	60.56	20.563	36.102
20.505	471.895	82.15	0.84	1.35	-0.37	45.6303	1.38119	2.26466	45.6378	1.38096	7	130.00	1.33283	1.332825	0	0.8662	3.80969	3.178858	1.86288	62.16	21.234	36.162
20.833	471.567	58.16	0.81	1.4	-0.14	41.9496	1.42591	2.30229	41.9496	1.42591	7	130.00	1.35416	1.354145	0	0.8593	12.94251	11.12207	1.87587	58.16	22.6062	35.66
21.161	471.239	61.14	0.98	1.6	-0.23	43.4504	1.63977	2.32696	43.4504	1.63977	7	130.00	1.37547	1.375465	0	0.8527	13.78346	11.727	1.8503	61.14	23.6343	35.87
21.489	470.911	58.39	1.21	2.08	-0.09	40.8031	2.12306	2.4167	40.8031	2.12306	7	130.00	1.39679	1.396785	0	0.8461	13.68713	11.56104	1.77645	58.39	27.1802	35.494
21.817	470.583	68.68	1.4	2.05	-0.21	47.3603	2.08452	2.36412	47.3603	2.08452	7	130.00	1.4181	1.418105	0	0.8397	15.68334	13.16995	2.07932	68.68	24.9725	36.381
22.145	470.255	62.98	1.27	2.03	-0.14	42.3367	2.084	2.40123	42.3367	2.0841	7	130.00	1.43943	1.439425	0	0.8335	14.50622	12.09093	1.88671	62.98	26.4611	35.715
22.473	469.927	58.41	1.04	1.85	-0.23	37.6173	1.89266	2.4147	37.6173	1.89266	7	130.00	1.46075	1.460745	0	0.8274	13.39879	10.9206	1.70122	58.41	27.0145	35.003
22.802	469.598	43.25	0.55	1.27	-0.21	28.181	1.3166	2.42382	28.181	1.3166	7	130.00	1.48213	1.48213	0	0.8214	10.18202	8.347122	1.29312	43.25	27.393	33.22
23.13	469.270	47.16	0.49	1.04	-0.09	30.3812	1.07276	2.34808	30.3812	1.07276	7	130.00	1.50345	1.503445	0	0.8158	10.7126	8.736759	1.41413	47.16	24.3451	33.69
23.458	468.942	41.56	0.66	1.58	-0.04	26.2566	1.64855	2.50417	26.2566	1.64855	7	130.00	1.52477	1.52477	0	0.8098	10.13933	8.211181	1.89486	41.56	30.8699	32.775
23.786	468.614	33	0.65	1.96	0.16	20.3442	2.06652	2.65128	20.3442	2.06652	6	130.00	1.54609	1.546095	0	0.8042	8.65873	6.963436	0.9738	33	37.9169	31.141
24.114	468.286	31.46	0.73	2.33	0.09	19.0713	2.44208	2.71649	19.0713	2.44208	5	130.00	1.56741	1.56741	0	0.7987	8.540438	6.821639	0.92547	31.46	41.3365	30.721
24.442	467.958	28.46	0.84	2.94	-0.07	16.9137	3.12602	2.82253	16.9137	3.12602	5	130.00	1.58873	1.588735	0	0.7934	8.186954	6.495271	0.83193	28.46	47.3052	29.934
24.77	467.630	36.73	0.76	2.06	0.19	21.813	2.16401	2.63841	21.813	2.16401	5	130.00	1.61005	1.610055	0	0.7881	9.574187	7.545399	1.10873	36.73	37.2639	31.591
25.098	467.302	53.09	0.84	1.58	-0.04	31.5432	1.63238	2.43684	31.5432	1.63238	7	130.00	1.63177	1.631765	0	0.7829	12.54912	9.825098	1.59316	53.09	27.9392	33.923
25.426	466.974	37.97	0.93	2.48	0.02	21.6116	2.60378	2.68975	21.6116	2.60378	6	130.00	1.65263	1.65263	0	0.7779	10.00281	7.780841	1.31058	37.97	39.9116	31.631
25.754	466.646	29.67	0.83	2.8	0.05	16.7239	2.96471	2.81252	16.7239	2.96471	5	130.00	1.67401	1.67401	0	0.7729	8.487242	6.569754	0.88675	29.67	46.2195	29.86
26.082	466.318	29.89	0.72	2.4	0.04	16.6308	2.55367	2.77598	16.6308	2.55367	5	130.00	1.69533	1.695335	0	0.768	8.378865	6.485141	0.8729	29.89	44.6215	29.823
26.4	465.990	40.76	0.67	1.65	0.51	22.7439	1.71604	2.56534	22.7439	1.71604	7	130.00	1.71665	1.716655	0	0.7632	10.24317	8.179229	1.20877	40.76	33.8906	31.86
26.739	465.661	31.14	0.85	2.72	0.6	16.9168	2.89096	2.80197	16.9168	2.89096	5	130.00	1.73804	1.738035	0	0.7585	8.855459	6.7471	0.91028	31.14	46.1075	29.935
27.067	465.333	27.6	0.95	3.45	0.11	14.6876	3.67638	2.91406	14.6876	3.67638	5	130.00	1.75936	1.759355	0	0.7539	8.370606	6.310736	0.90002	27.6	52.8796	29
27.396	465.005	20.8	0.75	3.59	0.09	10.681	3.94336	3.04266	10.681	3.94336	5	130.00	1.78068	1.780675	0	0.7494	6.329167	5.117707	0.68883	20.8	61.4043	28.863
27.723	464.677	32.97	0.92	2.78	0.41	17.2964	2.95174	2.79991	17.2908	2.95269	5	130.00	1.802	1.801995	0	0.7449	9.362277	6.974365	0.96495	32.96	45.9884	30.079
28.051	464.349	34.02	0.75	2.2	0.56	17.6583	2.32943	2.73173	17.6528	2.33016	6	130.00	1.82332	1.823315	0	0.7406	9.30799	6.893268	0.9968	34.01	42.1628	30.215
28.379	464.021	30.25	0.56	1.86	0.39	15.3989	1.97146	2.79942	15.3989	1.97146	5	130.00	1.84464	1.844635	0	0.7363	8.313189	6.210845	0.87942	30.25	42.6839	29.314
28.707	463.693	26.45	0.54	2.03	0.44	13.175	2.19655	2.82207	13.1697	2.19744	6	130.00	1.86596	1.865955	0	0.7321	7.503982	5.566541	0.78142	26.44	47.278	29.272
29.035	463.365	35.65	0.64	1.79	0.42	17.8897	1.89558	2.67583	17.8897	1.89558	6	125.00	1.88726	1.887275	0	0.7279	9.473402	6.896859	1.04529	35.65	39.1825	30.303
29.363	463.037	31.91	0.9	2.81	0.93	15.7263	2.99978	2.83696	15.7263	2.99978	6	125.00	1.90778	1.907775	0	0.724	9.254513	6.700235	0.92886	31.91	48.1574	29.453
29.691	462.709	78.81	1.79	2.27	-13.37	39.8707	2.32825	2.45145	39.9174	2.32553	7	125.00	1.92828	1.928275	0	0.7201	18.77676	13.52185	2.38024	78.9	28.5599	35.362
30.019	462.381	75.42	2.46	3.26	-19.88	37.7012	3.34825	2.57393	37.7628	3.34279	6	125.00	1.94878	1.948775	0	0.7163	19.06391	13.65624	2.27465	75.54	34.0988	35.027
30.347	462.053	73.52	2.38	3.23	-21.24	36.3335	3.32631	2.58372	36.3996	3.32028	6	125.00	1.96928	1.969275	0	0.7126	18.67716	13.30937	2.21519	73.65	34.5679	34.803
30.675	461.725	61.35	2.05	3.35	-21.62	29.8326	3.45349	2.65802	29.903	3.44537	6	125.00	1.98978	1.989775	0	0.7089	16.19004	11.47746	1.83778	61.49	38.2614	33.591
31.004	461.396	28.32	1.36	4.8	-15.93	13.0872	5.1692	3.04324	13.1369	5.14963	3	125.00	2.01034	2.010338	0	0.7053	9.334539	6.583523	0.81454	28.42	61.4453	28.256
31.332	461.068	40.8	1.24	3.05	-12.77	19.0902	3.19842	2.78585	19.1296	3.19183	6	125.00	2.03084	2.030838	0	0.7017	11.52195	8.085156	1.20028	40.88	45.182	30.741
31.66	460.740	44.64	1.36	3.05	-16.6	20.7614	3.19334	2.75656	20.815	3.18511	6	125.00	2.05134	2.051338	0	0.6982	12.41234	8.66633	1.31853	44.75	43.5317	31.289
31.988	460.412	35.89	0.92	2.56	-16.6	16.3228	2.72043	2.79674	16.3759	2.71161	6	125.00	2.07184	2.071838	0	0.6947	10.20784	7.091796	1.047	36	45.8061	29.721
32.316	460.084	41.49	0.76	1.84	-15.52	18.8295	1.92905	2.6602	18.8773	1.92416	6	125.00	2.09234	2.092338	0	0.6913	10.96277	7.578869	1.21974	41.59	38.3734	30.654
32.644	459.756	44.62	0.87	1.94	-15.36	20.1185	2.04671	2.6514	20.1658	2.04191	6	125.00	2.11284	2.112838	0	0.688	11.73457	8.072984	1.31601	44.72	37.9227	31.084
32.972	459.428	46.81	0.97	2.07	-12.68	20.9421	2.17116	2.65248	20.9796	2.16728	6	125.00	2.13334	2.133338	0	0.6847	12.31082	8.428633	1.38318	46.89	37.978	31.34
33.3	459.100	34.78	0.63	1.82	-11.57	15.1479	1.93097	2.73912	15.1804	1.92683	6	125.00	2.15384	2.153838	0	0.6814	9.575763	6.524796	1.0101	34.85	42.5673	29.219
33.628	458.772	27.97	0.53	1.88	-11.11	11.8637	2.05461	2.84249	11.8959	2.04905	6	125.00	2.17434	2.174338	0	0.6782	8.157752	5.532317	0.79863	28.04	48.487	27.59
33.956	458.444	25.2	0.51	2.03	-10.93	10.4815	2.21689	2.90541	10.5134	2.21017	6	125.00	2.19484	2.194838	0	0.675	7.62481	5.146688	0.71223	25.27	52.3352	26.756
34.284	458.116	23.12	0.44	1.91	-10.81	9.43633	2.10479	2.93186	9.46793	2.09777	6	125.00	2.21534	2.215338	0	0.6719	7.108146	4.775693	0.6472	23.19	54.0101	26.047
34.612	457.788	24.88	0.56	2.24	-10.49	10.1278	2.47904	2.94368	10.1591	2.46542	6	125.00	2.23584	2.235838	0	0.6688	7.702224	5.151053	0.70108	24.95	54.7701	26.525
34.941	457.459	27.6	0.74	2.67	-10.42	11.2319	2.91987	2.94724	11.2585	2.91297	6	125.00	2.2564	2.2564	0	0.6657	8.557203	5.696706	0.78463	27.66	55.0001	27.219
35.269	457.131	22.71	0.58	2.56	-10.21	8.97409	2.83653	3.02029	9.00483	2.82884	5	125.00	2.2769	2.2769	0	0.6627	7.373349	4.886443	0.6326	22.78	59.8616	25.707
35.597	456.803	20.39	0.5	2.46	-9.49	7.87525	2.76356	3.06177	7.89701	2.75594	5	125.00	2.2974	2.2974	0	0.6598	6.794369	4.482609	0.56014	20.44	62.7431	24.816
35.925	456.475	20.1	0.58	2.89	-8.89	7.67164	3.26171	3.1108	7.69321	3.25256	5	125.00	2.3179	2.3179	0	0.6568	6.918507	4.54428	0.55053	20.15	66.264	24.639
36.253	456.147	21.46	0.65	3.04	-5.91	8.17722	3.3993	3.09836	8.19432	3.3922	5	125.00	2.3384	2.3384	0	0.6539	7.320835	4.787417	0.592	21.5	65.3582	25.067
36.581	455.819	18.81	0.64	3.38	-5.48	6.97406	3.89032	3.18867	6.98677	3.88324	5	125.00	2.3589	2.3589	0	0.6511	6.8256	4.444123	0.50932	18.84	72.1173	23.985
36.909	455.491	18.56	0.68	3.67	-4.62	6.80029	4.20256	3.21677	6.81289	4.19479	4	125.00	2.3794	2.3794	0	0.6483	6.871849	4.45492	0.50095	18.59	74.3104	23.814
37.237	455.163	16.65	0.84	5.06	-4.85	5.95614	5.8947	3.34912	5.96868	5.88231	3	135.00	2.3999	2.392506	0.0074	0.6465	6.816186	4.408008	0.44118	16.68	85.2328	22.923
37.565	454.835	18.46	0.76	4.13	-5.01	6.67022	4.73876	3.25373	6.6827	4.72991	4	135.00	2.42204	2.404412	0.0176	0.6449	7.022524	4.528859	0.49653	18.49	77.2612	23.691

R13793

Depth (ft)	El.	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	454.507	17.57	0.66	3.77	-4.48	6.25986	4.3634	3.25552	6.27228	4.35476	4	135.00	2.44418	2.416318	0.0279	0.6433	6.693405	4.30596	0.46829	17.6	77.4062	23.267
38.221	454.179	23.26	0.72	3.08	-3.6	8.56333	3.46259	3.08679	8.57568	3.4576	5	135.00	2.46632	2.428225	0.0381	0.6417	7.869741	5.050286	0.64377	23.29	64.5241	25.388
38.549	453.851	35.17	1.71	4.86	-4.65	13.3934	5.23231	3.04061	13.4056	5.22751	3	135.00	2.48846	2.440131	0.0483	0.6402	11.54187	7.388724	1.01181	35.2	61.2619	28.401
38.877	453.523	74.79	4.27	5.7	-12.75	29.4773	5.90763	2.82205	29.5099	5.9011	11	135.00	2.5106	2.452038	0.0586	0.6386	21.5316	13.75032	2.23775	74.87	47.2766	33.514
39.206	453.194	104.68	6.22	5.94	-19.79	41.4562	6.08925	2.72869	41.5049	6.08211	11	135.00	2.53281	2.46398	0.0688	0.6371	28.63555	18.24261	3.16245	104.8	41.9974	35.6
39.534	452.866	152.53	8.46	5.55	-19.17	60.5743	5.64094	2.59462	60.6227	5.63643	11	135.00	2.55495	2.475867	0.0791	0.6355	38.92148	24.73568	4.64319	152.65	35.0952	37.815
39.862	452.538	232.67	10.79	4.64	-19.12	92.4888	4.68941	2.41592	92.533	4.68717	11	135.00	2.57709	2.487793	0.0893	0.634	54.49618	34.65087	7.12862	232.78	27.0649	40.155
40.19	452.210	391.32	13.96	3.57	-18.27	155.507	3.59127	2.18739	155.551	3.59025	12	135.00	2.59923	2.4997	0.0995	0.6325	82.95769	52.47014	12.0347	391.43	18.574	42.835
40.518	451.882	504.54	14.95	2.96	-19.14	199.84	2.97657	2.05825	199.888	2.97786	12	135.00	2.62137	2.511606	0.1098	0.631	101.5206	64.05876	15.5393	504.66	14.5769	44.055
40.846	451.554	352.83	14.47	4.1	7.69	138.769	4.13208	2.26597	138.754	4.13256	12	135.00	2.64351	2.523512	0.12	0.6295	77.28576	48.65156	10.8417	352.79	21.2814	42.264
41.174	451.226	428.29	14.1	3.29	55.96	167.871	3.31278	2.14021	167.733	3.31551	12	135.00	2.66565	2.535419	0.1302	0.628	88.95563	55.86613	13.1772	427.94	17.0501	43.207

R13794

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 18 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY TJS DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-3

ConeTec In[illegible]lerpretation
Interpretati[illegible] - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4528
Job No 07-804
Client: Civil & Environmental Consultants
Project Pond Creek Mine - Williamson County, Illinois
Site: CPT-3
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 07:09
CPT File: 804CP03.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 466.98

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	36.95	1.132	43.13	32.39	2.49

User Inputs:

Assumed:
Water Table Depth (ft): 11.1
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 467.0
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	466.816	22.8	0.36	1.56	-0.74	2223.39	1.580	1.42	2224.37	1.58	6	125.00	0.010	0.010	0.000	2.000	3.67	7.34	0.706	22.81	1.81602	53.62
0.492	466.488	42.45	0.67	1.58	-5.17	1379.49	1.579	1.46	1380.46	1.58	7	125.00	0.031	0.031	0.000	2.000	6.91	13.82	1.313	42.48	2.23467	52.00
0.82	466.160	28.94	0.66	2.29	-5.45	563.683	2.285	1.73	564.27	2.28	6	125.00	0.051	0.051	0.000	2.000	5.17	10.34	0.894	28.97	6.77422	48.62
1.148	465.832	23.43	0.46	1.97	-7.27	325.551	1.969	1.79	326.25	1.97	6	125.00	0.072	0.072	0.000	2.000	4.27	8.55	0.723	23.49	7.91559	46.80
1.476	465.504	32.54	0.58	1.77	-11.34	351.737	1.787	1.74	352.50	1.78	6	125.00	0.092	0.092	0.000	2.000	5.82	11.65	1.005	32.61	6.82459	46.64
1.804	465.176	38.02	0.94	2.47	-4.06	336.206	2.480	1.87	336.38	2.48	6	125.00	0.113	0.113	0.000	2.000	7.12	14.25	1.174	38.04	9.67104	46.44
2.133	464.847	36.81	1.27	3.46	-2.93	275.118	3.463	2.04	275.27	3.46	5	125.00	0.133	0.133	0.000	2.000	7.35	14.70	1.136	36.83	14.0176	45.54
2.461	464.519	32.44	1.88	5.81	-1.76	209.906	5.823	2.29	209.97	5.82	3	125.00	0.154	0.154	0.000	2.000	7.19	14.38	1.000	32.45	22.2623	44.29
2.789	464.191	33.21	1.93	5.82	-0.93	189.52	5.842	2.32	189.58	5.84	3	125.00	0.174	0.174	0.000	2.000	7.44	14.88	1.023	33.22	23.1469	43.80
3.117	463.863	41.98	2.26	5.38	1.78	214.489	5.409	2.26	214.44	5.41	3	125.00	0.195	0.195	0.000	2.000	9.17	18.35	1.294	41.97	21.0994	44.39
3.445	463.535	51.02	2.5	4.89	1.36	235.958	4.921	2.20	235.91	4.92	4	125.00	0.215	0.215	0.000	2.000	10.89	21.78	1.573	51.01	19.1479	44.83
3.773	463.207	61.43	2.63	4.28	0.26	259.504	4.298	2.13	259.46	4.30	5	125.00	0.236	0.236	0.000	2.000	12.73	25.46	1.895	61.42	16.8244	45.27
4.101	462.879	66.35	2.47	3.72	5.77	257.864	3.737	2.08	257.71	3.74	5	125.00	0.256	0.256	0.000	1.975	13.47	26.60	2.048	66.31	15.2758	45.24
4.429	462.551	70.01	2.46	3.51	-1.2	251.915	3.528	2.07	251.91	3.53	6	125.00	0.277	0.277	0.000	1.901	14.12	28.84	2.159	70.01	14.7869	45.14
4.757	462.223	47.34	1.98	4.19	4.97	158.226	4.209	2.24	158.09	4.21	5	125.00	0.297	0.297	0.000	1.834	10.25	18.80	1.456	47.3	20.3659	42.91
5.085	461.895	35.26	1.25	3.54	14.76	109.946	3.577	2.28	109.66	3.59	5	125.00	0.318	0.318	0.000	1.774	7.75	13.74	1.082	35.17	21.7542	41.05
5.413	461.567	29.45	1.07	3.63	14.25	86.0497	3.675	2.36	85.78	3.69	5	125.00	0.338	0.338	0.000	1.719	6.69	11.50	0.901	29.36	24.6747	39.74
5.741	461.239	22.73	0.72	3.15	18.2	62.3478	3.218	2.41	62.01	3.24	5	125.00	0.359	0.359	0.000	1.669	5.28	8.81	0.693	22.61	26.8102	37.94
6.069	460.911	20.62	0.5	2.43	23.72	53.3615	2.470	2.38	52.97	2.49	5	125.00	0.379	0.379	0.000	1.624	4.71	7.65	0.627	20.47	25.5653	37.04
6.398	460.582	23.44	0.52	2.22	51.64	57.6183	2.257	2.33	56.82	2.29	6	125.00	0.400	0.400	0.000	1.581	5.21	8.24	0.713	23.12	23.7246	37.44
6.726	460.254	16.44	0.47	2.84	44.02	38.1079	2.934	2.54	37.44	2.99	5	125.00	0.420	0.420	0.000	1.542	4.02	6.20	0.496	16.16	32.6769	34.97
7.054	459.926	14.75	0.41	2.79	45.61	32.4562	2.865	2.59	31.82	2.92	5	125.00	0.441	0.441	0.000	1.506	3.68	5.56	0.443	14.47	34.9073	33.98
7.382	459.598	17.38	0.43	2.45	47.02	36.67	2.542	2.52	36.04	2.59	5	125.00	0.461	0.461	0.000	1.472	4.19	6.17	0.524	17.09	31.3627	34.74
7.71	459.270	18.54	0.47	2.51	37.83	37.4747	2.603	2.51	36.98	2.64	5	125.00	0.482	0.482	0.000	1.441	4.48	6.46	0.559	18.3	31.2347	34.90
8.038	458.942	19.4	0.5	2.58	37.94	37.6166	2.646	2.52	37.16	2.68	5	125.00	0.502	0.502	0.000	1.411	4.70	6.63	0.585	19.17	31.3584	34.93
8.366	458.614	17.21	0.55	3.2	34.73	31.9142	3.296	2.63	31.49	3.34	5	125.00	0.523	0.523	0.000	1.383	4.41	6.11	0.517	16.99	36.9521	33.91
8.694	458.286	17.95	0.56	3.1	31.31	32.0343	3.217	2.62	31.68	3.25	5	125.00	0.543	0.543	0.000	1.357	4.59	6.23	0.539	17.76	36.4732	33.95
9.022	457.958	19.33	0.57	2.93	27.69	33.2806	3.037	2.59	32.98	3.07	5	125.00	0.564	0.564	0.000	1.332	4.88	6.60	0.581	19.16	34.995	34.20
9.35	457.630	18.87	0.64	3.4	23.97	31.2909	3.500	2.65	31.03	3.53	5	125.00	0.584	0.584	0.000	1.308	4.92	6.43	0.566	18.72	37.9977	33.82
9.678	457.302	20.7	0.61	2.95	26.23	33.2219	3.036	2.59	32.94	3.06	5	125.00	0.605	0.605	0.000	1.286	5.23	6.72	0.622	20.53	34.9967	34.19
10.006	456.974	20.8	0.74	3.57	10.97	32.26	3.668	2.65	32.15	3.68	5	125.00	0.625	0.625	0.000	1.265	5.45	6.89	0.625	20.73	38.0423	34.04
10.335	456.645	22.06	0.78	3.52	8.13	33.1519	3.642	2.64	33.07	3.65	5	125.00	0.646	0.646	0.000	1.244	5.75	7.15	0.663	22.01	37.4577	34.22
10.663	456.317	22.26	0.84	3.76	9.06	32.4015	3.890	2.67	32.31	3.90	4	125.00	0.666	0.666	0.000	1.225	5.88	7.20	0.669	22.2	38.8361	34.07
10.991	455.989	22.23	0.86	3.88	10.07	31.361	3.992	2.69	31.27	4.00	4	135.00	0.687	0.687	0.000	1.207	5.93	7.15	0.667	22.17	39.7776	33.87
11.319	455.661	19.23	0.81	4.2	10.53	26.3739	4.373	2.77	26.27	4.39	4	135.00	0.709	0.702	0.007	1.193	5.35	6.89	0.573	19.16	44.2873	32.78
11.647	455.333	18	0.62	3.43	12.28	24.1809	3.590	2.74	24.07	3.61	5	135.00	0.731	0.714	0.017	1.183	4.93	5.84	0.535	17.92	42.7427	32.23
11.975	455.005	21.25	0.62	2.92	16.42	28.2301	3.025	2.64	28.09	3.04	5	135.00	0.753	0.726	0.027	1.174	5.53	6.49	0.635	21.15	37.4988	33.21
12.303	454.677	21.1	0.8	3.8	12.7	27.5413	3.936	2.73	27.43	3.95	4	135.00	0.775	0.738	0.038	1.164	5.73	6.67	0.629	21.02	41.8264	33.06
12.631	454.349	17.94	0.7	3.88	13.37	22.8604	4.083	2.80	22.74	4.11	4	135.00	0.798	0.750	0.048	1.155	5.06	5.85	0.531	17.85	45.8564	31.88
12.959	454.021	16.67	0.53	3.19	25.01	20.8069	3.344	2.78	20.60	3.38	5	135.00	0.820	0.762	0.058	1.146	4.63	5.30	0.491	16.51	44.6307	31.24
13.287	453.693	17.08	0.47	2.76	28.87	20.988	2.894	2.73	20.76	2.93	5	135.00	0.842	0.774	0.068	1.137	4.63	5.27	0.503	16.9	42.3273	31.30
13.615	453.365	15.98	0.45	2.79	32.33	19.2415	2.977	2.77	18.99	3.02	5	135.00	0.864	0.786	0.078	1.128	4.42	4.98	0.468	15.78	44.472	30.73
13.943	453.037	17	0.42	2.45	36.95	20.2055	2.606	2.72	19.92	2.64	5	135.00	0.886	0.797	0.089	1.120	4.57	5.11	0.499	16.77	41.6351	31.04
14.271	452.709	20.35	0.53	2.61	41.32	24.0198	2.726	2.67	23.70	2.76	5	135.00	0.908	0.809	0.099	1.112	5.33	5.93	0.602	20.09	39.0883	32.16
14.6	452.380	24.99	0.7	2.79	53.19	29.2928	2.909	2.63	28.89	2.95	5	135.00	0.931	0.821	0.109	1.103	6.39	7.05	0.745	24.66	36.6088	33.40
14.928	452.052	25.84	0.92	3.55	51.01	29.8677	3.697	2.69	29.48	3.74	5	135.00	0.953	0.833	0.119	1.095	6.82	7.47	0.771	25.52	39.7482	33.53
15.255	451.724	25.35	0.86	3.38	59.49	28.841	3.528	2.69	28.40	3.58	5	135.00	0.975	0.845	0.130	1.088	6.67	7.26	0.755	24.98	39.714	33.30

R13796

Depth (ft)	[illegible]	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U. (pcf)	Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	451.396	25.2	0.94	3.72	60.14	28.2395	3.884	2.72	27.80	3.95	5	135.00	0.997	0.857	0.140	1.080	6.75	7.29	0.749	24.82	41.5723	33.17
15.912	451.068	23.53	0.87	3.69	59.12	25.9052	3.865	2.75	25.48	3.93	5	135.00	1.019	0.869	0.150	1.073	6.39	6.86	0.697	23.16	43.0523	32.63
16.24	450.740	24.42	0.79	3.22	95.41	26.5403	3.379	2.71	25.67	3.47	5	135.00	1.041	0.881	0.160	1.065	6.44	6.86	0.724	23.83	40.8417	32.73
16.568	450.412	23.13	0.79	3.4	93.16	24.7167	3.580	2.75	24.07	3.68	5	135.00	1.063	0.893	0.171	1.059	6.22	6.59	0.683	22.55	43.0416	32.27
16.896	450.084	25.8	0.86	3.32	86.21	27.3182	3.480	2.70	26.73	3.56	5	135.00	1.086	0.905	0.181	1.051	6.81	7.16	0.765	25.27	40.6511	32.94
17.224	449.756	27.36	1.09	3.99	68.75	28.6411	4.152	2.74	28.17	4.22	4	135.00	1.108	0.917	0.191	1.045	7.39	7.72	0.813	26.93	42.4068	33.26
17.552	449.428	23.92	1.23	5.16	49.52	24.5451	5.397	2.86	24.21	5.47	3	135.00	1.130	0.929	0.201	1.038	6.94	7.20	0.708	23.61	49.6011	32.32
17.88	449.100	22.38	-1.09	4.86	39.24	22.5732	5.135	2.87	22.31	5.20	3	135.00	1.152	0.940	0.212	1.031	6.55	6.75	0.657	22.13	50.2616	31.80
18.208	448.772	17.75	0.82	4.63	24.36	17.4059	4.947	2.94	17.25	4.99	3	135.00	1.174	0.952	0.222	1.025	5.43	5.57	0.513	17.6	54.7916	30.15
18.537	448.443	16.18	0.53	3.25	29.47	15.5391	3.537	2.89	15.35	3.58	5	135.00	1.196	0.964	0.232	1.018	4.79	4.88	0.464	16	51.4876	29.40
18.865	448.115	16.38	0.38	2.32	30.44	15.5318	2.506	2.80	15.34	2.54	5	135.00	1.218	0.976	0.242	1.012	4.61	4.66	0.469	16.19	46.1677	29.39
19.193	447.787	17.22	0.42	2.44	41.84	16.1723	2.628	2.80	15.91	2.67	5	135.00	1.241	0.988	0.253	1.006	4.83	4.86	0.495	16.96	46.1732	29.64
19.521	447.459	27.26	0.55	2.02	43.37	25.9979	2.116	2.58	25.73	2.14	6	135.00	1.263	1.000	0.263	1.000	6.82	6.82	0.605	26.99	34.2771	32.71
19.849	447.131	15.42	0.71	4.62	19.56	13.9691	5.023	3.02	13.85	5.07	3	135.00	1.285	1.012	0.273	0.994	4.95	4.93	0.438	15.3	59.9097	28.74
20.177	446.803	42.76	1.36	3.19	-1.64	40.4898	3.281	2.55	40.50	3.28	5	135.00	1.307	1.024	0.283	0.988	10.65	10.52	1.283	42.77	32.7842	35.49
20.505	446.475	21.33	1.36	6.39	-21.13	19.3115	6.800	2.99	19.44	6.76	3	135.00	1.329	1.036	0.293	0.983	6.83	6.71	0.619	21.46	58.031	30.94
20.833	446.147	94.63	4.34	4.59	-16.03	89.0402	4.653	2.42	89.14	4.65	11	135.00	1.351	1.048	0.304	0.977	22.25	21.74	2.888	94.73	27.3675	39.97
21.161	445.819	325.72	14.52	4.46	-12.24	306.129	4.477	2.11	306.20	4.48	11	135.00	1.373	1.060	0.314	0.972	67.01	65.10	10.042	325.8	16.2306	46.03
21.489	445.491	395.71	17.73	4.48	-7.11	368.031	4.496	2.08	368.07	4.50	12	135.00	1.396	1.071	0.324	0.966	80.29	77.56	12.208	395.75	15.201	46.84
21.817	445.163	424.33	18.21	4.29	-16.47	390.385	4.306	2.05	390.48	4.30	12	135.00	1.418	1.083	0.334	0.961	85.18	81.82	13.093	424.43	14.3837	47.09

R13797

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 21 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-4

ConeTec Inc nterpretation
Interpretation - Release 1.22 Rev. Format: NLI Imperial
Run No 07-1210-1008-4501
Job No 07-804
Client: Civil & Environmental Consultants
Project Pond Creek Mine - Williamson County, Illinois
Site: CPT-4
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 12:51
CPT File: 804CP04.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 482.55

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	40.98	1.95	63.49	28.02	2.41

User Inputs:

Assumed: Water Table Depth (ft): 21.7 Ground Surface Elev. 482.6
Nk: 32.3
State Parameter: 1.2 CPT area ratio: 0.85
Unit Weight of Soil (pcf): Varies See Below See Below Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.386	18.72	0.55	2.92	-0.12	1825.34	2.940	1.70	1825.34	2.94	5	125.00	0.010	0.010	0.000	2.000	3.30	6.60	0.579	18.72	6.13882	52.96
0.492	482.058	32.37	1.04	3.2	7.35	1051.68	3.216	1.79	1050.38	3.22	5	125.00	0.031	0.031	0.000	2.000	5.67	11.75	1.001	32.33	7.80728	51.02
0.82	481.730	59.25	1.53	2.59	5.03	1155.1	2.585	1.68	1154.51	2.59	6	125.00	0.051	0.051	0.000	2.000	10.38	20.76	1.833	59.22	5.79663	51.36
1.148	481.402	69.32	1.89	2.73	-7.9	965.132	2.729	1.73	965.63	2.73	6	125.00	0.072	0.072	0.000	2.000	12.34	24.68	2.144	69.37	6.60102	50.71
1.476	481.074	55.93	1.68	3.01	-4.6	605.287	3.009	1.83	605.61	3.01	6	125.00	0.092	0.092	0.000	2.000	10.34	20.68	1.729	55.96	8.8217	48.91
1.804	480.746	47.44	1.34	2.82	-9.26	419.754	2.831	1.87	420.29	2.83	6	125.00	0.113	0.113	0.000	2.000	8.91	17.82	1.465	47.5	9.76493	47.40
2.133	480.417	31.92	1.13	3.53	-8.69	238.437	3.555	2.08	238.81	3.55	5	125.00	0.133	0.133	0.000	2.000	6.49	12.97	0.984	31.97	15.2078	44.89
2.461	480.089	34.91	0.98	2.81	-9.96	225.965	2.820	2.01	226.35	2.81	6	125.00	0.154	0.154	0.000	2.000	6.90	13.80	1.076	34.97	13.1573	44.64
2.789	479.761	22.26	0.83	3.71	-10	126.702	3.758	2.25	127.05	3.75	4	125.00	0.174	0.174	0.000	2.000	4.87	9.73	0.684	22.32	20.8802	41.81
3.117	479.433	18.96	0.9	4.76	-6.79	96.3244	4.796	2.41	96.58	4.78	3	125.00	0.195	0.195	0.000	2.000	4.44	8.88	0.581	19.01	26.8756	40.38
3.445	479.105	26.28	1.23	4.69	-6.97	121.055	4.719	2.35	121.24	4.71	3	125.00	0.215	0.215	0.000	2.000	5.97	11.94	0.807	26.32	24.2842	41.57
3.773	478.777	29.78	1.59	5.34	-6.66	125.287	5.382	2.38	125.50	5.37	3	125.00	0.236	0.236	0.000	2.000	6.88	13.77	0.915	29.83	25.7669	41.75
4.101	478.449	30.45	1.78	5.86	-6.64	117.8	5.895	2.43	118.00	5.89	3	125.00	0.256	0.256	0.000	1.975	7.19	14.21	0.935	30.5	27.7303	41.43
4.429	478.121	31.27	1.79	5.72	-10.05	111.965	5.775	2.44	112.22	5.76	3	125.00	0.277	0.277	0.000	1.901	7.41	14.08	0.960	31.34	27.9465	41.17
4.757	477.793	29.3	1.55	5.3	-9.47	97.5495	5.344	2.45	97.75	5.33	3	125.00	0.297	0.297	0.000	1.834	6.97	12.78	0.898	29.36	28.3092	40.45
5.085	477.465	29.53	1.58	5.36	-6.95	91.9164	5.409	2.47	92.07	5.40	3	125.00	0.318	0.318	0.000	1.774	7.09	12.57	0.904	29.58	29.17	40.13
5.413	477.137	29.07	1.51	5.21	-5.13	84.9265	5.256	2.48	85.02	5.25	3	125.00	0.338	0.338	0.000	1.719	7.01	12.05	0.890	29.1	29.6819	39.69
5.741	476.809	26.51	1.35	5.1	-4.32	72.8826	5.162	2.51	72.97	5.16	3	125.00	0.359	0.359	0.000	1.669	6.50	10.86	0.810	26.54	31.275	38.86
6.069	476.481	27.29	1.35	4.94	-2.56	70.946	5.017	2.51	71.00	5.01	3	125.00	0.379	0.379	0.000	1.624	6.69	10.86	0.833	27.31	31.1947	38.70
6.398	476.152	32.7	1.45	4.43	4.16	80.7756	4.489	2.44	80.70	4.49	4	125.00	0.400	0.400	0.000	1.581	7.73	12.23	1.000	32.67	28.0404	39.41
6.726	475.824	32.33	1.57	4.85	6.33	75.9075	4.920	2.49	75.81	4.93	3	125.00	0.420	0.420	0.000	1.542	7.81	12.05	0.988	32.29	30.1186	39.07
7.054	475.496	27.79	1.42	5.1	5.89	62.0337	5.192	2.56	61.97	5.20	3	125.00	0.441	0.441	0.000	1.506	6.96	10.49	0.847	27.76	33.5207	37.94
7.382	475.168	27.8	1.26	4.54	6.3	59.2547	4.609	2.54	59.17	4.62	4	125.00	0.461	0.461	0.000	1.472	6.68	10.13	0.846	27.76	32.9359	37.67
7.71	474.840	25.97	1.13	4.2	7.16	54.9689	4.266	2.53	54.89	4.27	4	125.00	0.482	0.482	0.000	1.441	6.66	9.60	0.820	26.93	32.2137	37.24
8.038	474.512	23.35	0.77	3.28	9.98	45.4792	3.370	2.52	45.36	3.38	5	125.00	0.502	0.502	0.000	1.411	5.72	8.07	0.707	23.29	31.5492	36.13
8.366	474.184	23.34	0.89	3.8	13.65	43.6378	3.901	2.58	43.47	3.92	4	125.00	0.523	0.523	0.000	1.383	5.88	8.13	0.708	23.25	34.2563	35.87
8.694	473.856	23.05	1.41	6.13	7.61	41.4201	6.265	2.74	41.33	6.28	3	125.00	0.543	0.543	0.000	1.357	6.32	8.58	0.697	23	42.6219	35.57
9.022	473.528	21.04	1.1	5.22	9.84	36.3132	5.372	2.73	36.21	5.39	3	125.00	0.564	0.564	0.000	1.332	5.74	7.65	0.634	20.98	42.147	34.77
9.35	473.200	24.56	1.13	4.61	14	41.0278	4.713	2.65	40.87	4.73	3	125.00	0.584	0.584	0.000	1.308	6.43	8.41	0.742	24.47	38.0684	35.50
9.678	472.872	29.72	1.6	5.4	18.45	48.1341	5.495	2.66	47.95	5.52	3	125.00	0.605	0.605	0.000	1.286	7.76	10.01	0.901	29.61	38.1091	36.45
10.006	472.544	27.78	1.68	6.06	20.23	43.4213	6.187	2.72	43.23	6.21	3	125.00	0.625	0.625	0.000	1.265	7.54	9.53	0.841	27.66	41.7217	35.84
10.335	472.215	35.02	2.44	6.96	1.71	53.2158	7.098	2.71	53.20	7.10	3	125.00	0.646	0.646	0.000	1.244	9.46	11.77	1.064	35.01	40.8687	37.06
10.663	471.887	39.84	2.72	6.82	8.71	58.7805	6.943	2.67	58.86	6.93	3	125.00	0.666	0.666	0.000	1.225	10.58	12.96	1.213	39.89	38.9729	37.64
10.991	471.559	51.44	3.01	5.85	-13.44	73.8831	5.931	2.56	74.00	5.92	3	125.00	0.687	0.687	0.000	1.207	12.89	15.55	1.571	51.52	33.2411	38.93
11.319	471.231	49.73	3.35	6.74	-15.68	69.296	6.834	2.62	69.44	6.82	3	125.00	0.707	0.707	0.000	1.189	12.87	15.31	1.518	49.83	36.392	38.58
11.647	470.903	59.48	3.27	5.5	-19.93	80.7103	5.566	2.51	80.88	5.55	11	125.00	0.728	0.728	0.000	1.172	14.58	17.09	1.819	59.6	31.1331	39.42
11.975	470.575	59.84	3.39	5.67	-19.21	78.9532	5.737	2.53	79.11	5.73	11	125.00	0.748	0.748	0.000	1.156	14.78	17.09	1.829	59.96	31.8713	39.30
12.303	470.247	46.27	3.26	7.05	-21.45	59.1739	7.165	2.68	59.36	7.14	3	125.00	0.769	0.769	0.000	1.140	12.36	14.09	1.409	46.41	39.3681	37.69
12.631	469.919	60.74	3.55	5.84	-21.71	75.9409	5.922	2.55	76.12	5.91	11	125.00	0.789	0.789	0.000	1.125	15.17	17.07	1.856	60.88	32.6461	39.09
12.959	469.591	85.44	5.35	6.27	-21.04	104.49	6.322	2.49	104.65	6.31	11	125.00	0.810	0.810	0.000	1.111	20.71	23.01	2.620	85.57	30.0976	40.81
13.287	469.263	93.83	6.4	6.82	-21.32	111.989	6.862	2.50	112.16	6.87	11	125.00	0.830	0.830	0.000	1.097	22.88	25.10	2.879	93.97	30.668	41.17
13.615	468.935	109.07	7.14	6.54	-21.2	127.176	6.598	2.45	127.33	6.59	11	125.00	0.851	0.851	0.000	1.084	26.01	28.20	3.350	109.2	28.6543	41.83
13.943	468.607	131.31	8.27	6.3	-20.49	149.682	6.340	2.40	149.83	6.33	11	125.00	0.871	0.871	0.000	1.071	30.56	32.73	4.038	131.44	26.4331	42.65
14.271	468.279	130.51	8.58	6.57	-20.11	145.322	6.619	2.42	145.47	6.61	11	125.00	0.892	0.892	0.000	1.059	30.69	32.49	4.013	130.64	27.3685	42.50
14.6	467.950	121.15	8.14	6.72	-19.98	131.767	6.770	2.45	131.91	6.76	11	125.00	0.913	0.913	0.000	1.047	28.90	30.26	3.723	121.28	28.6919	42.01
14.928	467.622	117.27	7.69	6.56	-18.71	124.691	6.610	2.46	124.81	6.60	11	125.00	0.933	0.933	0.000	1.035	28.04	29.03	3.602	117.38	28.8952	41.72
15.256	467.294	114.14	8.49	7.43	-17.94	118.706	7.501	2.52	118.82	7.49	11	125.00	0.954	0.954	0.000	1.024	28.04	28.72	3.504	114.25	31.4374	41.47

R13799

Depth (ft)	El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	γ (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.966	104.36	7.93	7.6	-18.2	106.146	7.670	2.55	106.27	7.66	11	125.00	0.974	0.974	0.000	1.013	26.08	26.43	3.201	104.48	33.0563	40.89
15.912	466.638	108.46	7.37	6.8	-18.02	108.06	6.858	2.51	108.17	6.85	11	125.00	0.995	0.995	0.000	1.003	26.53	26.60	3.327	108.57	31.0225	40.98
16.21	466.310	113.79	7.8	6.86	-17.9	111.108	6.916	2.50	111.22	6.91	11	125.00	1.015	1.015	0.000	0.993	27.78	27.58	3.491	113.9	30.8499	41.13
16.568	465.982	153.77	8.7	5.66	-14.55	147.498	5.696	2.37	147.59	5.69	11	125.00	1.036	1.036	0.000	0.983	35.20	34.59	4.729	153.86	25.0169	42.57
16.896	465.654	147.94	9.72	6.57	-6	139.095	6.617	2.43	139.13	6.62	11	125.00	1.056	1.056	0.000	0.973	34.93	33.99	4.547	147.98	27.8141	42.28
17.224	465.326	138.28	8.74	6.32	-8.2	127.453	6.370	2.44	127.51	6.37	11	125.00	1.077	1.077	0.000	0.964	32.76	31.58	4.248	138.34	28.1122	41.83
17.552	464.998	221.55	7.13	3.22	-7.74	200.96	3.234	2.09	201.01	3.23	12	125.00	1.097	1.097	0.000	0.955	45.08	43.04	6.825	221.6	15.4029	44.08
17.88	464.670	100.12	6.85	6.84	-12.15	88.5928	6.919	2.56	88.66	6.91	11	125.00	1.118	1.118	0.000	0.946	25.13	23.77	3.065	100.2	33.4931	39.92
18.208	464.342	76.59	4.86	6.34	-10.09	66.3023	6.441	2.61	66.36	6.44	11	125.00	1.138	1.138	0.000	0.937	19.73	18.50	2.336	76.66	36.0279	38.32
18.537	464.013	175.62	5.94	3.38	2.08	150.584	3.405	2.18	150.58	3.40	6	125.00	1.159	1.159	0.000	0.929	37.06	34.43	5.401	175.61	18.2355	42.67

R13800

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 24 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5

ConeTec In[illegible]nterpretation
Interpretati[illegible]t - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4462
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 12:34
CPT File: 804CP05.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 482.55

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.49	1.51	49.57	22.51	2.24
125	Soil Embankment	27.37	1.95	65.50	63.68	3.04

User Inputs:

Assumed:
Water Table Depth (ft): 34.4
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 482.6
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.16	482.388	8.56	0.05	0.59	-0.18	802.002	0.585	1.14	802.00	0.58	1	130.00	0.011	0.01	0.000	2.000	17.26	2.53	0.265	8.56	1.0364	50.01
0.492	482.058	13.06	0.18	1.38	-0.41	407.38	1.382	1.61	407.69	1.38	6	130.00	0.032	0.032	0.000	2.000	2.23	4.47	0.403	13.07	4.50958	47.27
0.82	481.730	39.92	0.69	1.73	-0.58	747.968	1.731	1.58	748.16	1.73	7	130.00	0.053	0.053	0.000	2.000	6.75	13.50	1.234	39.93	3.96322	49.74
1.148	481.402	81.09	1.4	1.72	-0.71	1085.74	1.728	1.52	1085.84	1.73	7	130.00	0.096	0.096	0.000	2.000	13.47	26.93	2.506	81.1	3.13579	51.14
1.476	481.074	98.28	2.17	2.21	-0.39	1023.39	2.210	1.69	1023.89	2.21	7	130.00	0.096	0.096	0.000	2.000	16.92	33.85	3.040	98.28	3.07426	50.92
1.804	480.746	102.52	1.75	1.71	-0.72	873.296	1.709	1.55	873.38	1.71	7	130.00	0.117	0.117	0.000	2.000	17.17	34.33	3.170	102.53	3.50958	50.83
2.133	480.417	76.33	1.69	2.22	-0.49	649.543	2.218	1.73	649.61	2.22	7	130.00	0.139	0.139	0.000	2.000	12.69	27.18	2.359	76.34	6.64681	48.52
2.46	480.089	77.26	1.91	2.47	-0.53	481.981	1.699	1.65	481.98	1.70	7	130.00	0.160	0.160	0.000	2.000	13.89	26.76	2.387	77.26	5.20939	47.98
2.788	479.761	73.62	1.23	1.67	-0.64	405.101	1.675	1.68	405.10	1.67	7	130.00	0.181	0.181	0.000	2.000	12.90	25.80	2.274	73.62	5.78223	47.24
3.117	479.433	51.07	0.77	1.5	-1.11	251.067	1.514	1.76	251.07	1.51	7	130.00	0.203	0.203	0.000	2.000	8.20	16.40	1.576	51.07	7.33445	45.12
3.445	479.105	43.47	0.65	1.49	-0.99	193.127	1.503	1.83	193.17	1.50	7	130.00	0.224	0.224	0.000	2.000	16.03	16.06	1.639	43.48	9.80013	43.89
3.771	478.777	37.71	0.63	1.4	-1.27	152.765	1.415	1.88	152.81	1.41	7	130.00	0.246	0.246	0.000	2.000	7.09	14.18	1.360	37.72	9.89985	42.78
4.10	478.448	27.27	0.39	1.43	-1.04	101.302	1.444	2.01	101.34	1.44	6	130.00	0.267	0.267	0.000	1.847	5.39	10.44	0.836	27.28	13.2675	40.64
4.428	478.120	25.38	0.42	1.6	-1.23	90.6338	1.610	2.06	90.83	1.61	6	130.00	0.288	0.288	0.000	1.864	5.68	9.97	0.808	25.38	15.1944	40.04
4.75	477.793	18.36	0.68	3.17	-1.09	58.3781	3.213	2.43	158.38	3.21	5	130.00	0.309	0.309	0.000	1.708	4.12	7	0.559	18.36	27.4805	37.60
5.08	477.465	64.15	1.14	1.77	-1.43	193.025	1.787	1.89	193.05	1.79	7	130.00	0.331	0.331	0.000	2.000	7.39	12.10	1.025	64.14	10.1862	43.89
5.41	477.137	80.68	2.21	2.6	-1.02	228.806	2.614	1.99	228.83	2.61	6	130.00	0.352	0.352	0.000	1.686	16.74	26.54	2.457	80.69	11.3846	44.88
5.74	476.809	82.6	2.19	2.65	-0.19	220.082	2.667	2.00	220.08	2.674	6	130.00	0.373	0.373	0.000	1.697	16.19	26.51	2.543	82.6	12.8165	44.51
6.06	476.481	62.21	1.32	2.16	-0.58	207.396	2.163	1.94	207.40	2.161	6	130.00	0.394	0.394	0.000	1.592	12.20	24.21	2.533	62.21	8.89156	44.23
6.39	476.152	69.65	0.67	0.96	-0.92	166.48	0.968	1.74	166.50	0.97	6	130.00	0.416	0.416	0.000	1.551	12.44	19.23	2.043	69.66	6.80329	43.17
6.72	475.824	67.23	1.03	1.54	-0.51	152.778	1.542	1.91	152.78	1.54	6	130.00	0.437	0.437	0.000	1.512	12.76	19.31	2.068	67.23	10.5604	42.74
7.056	475.496	62.5	1.02	1.64	-0.74	135.311	1.644	1.95	135.33	1.64	6	130.00	0.459	0.459	0.000	1.477	12.12	17.90	1.921	62.51	11.9694	42.14
7.38	475.168	58.83	0.75	1.27	-0.83	121.606	1.285	1.92	121.61	1.29	7	130.00	0.480	0.480	0.000	1.444	11.22	16.20	1.807	58.83	10.869	41.59
7.71	474.840	46.66	0.49	1.05	-1.29	92.9059	1.062	1.95	92.11	1.06	7	130.00	0.501	0.501	0.000	1.413	9.02	12.74	1.423	46.66	11.7456	40.13
8.038	474.512	37.02	0.37	0.99	-0.74	69.8557	1.014	2.04	69.86	1.01	7	130.00	0.522	0.522	0.000	1.383	7.86	10.21	1.130	37.02	13.6486	38.61
8.366	474.184	26.15	0.38	1.46	-1.04	47.0884	1.464	2.27	47.11	1.48	6	130.00	0.544	0.544	0.000	1.356	5.76	7.79	0.793	26.16	21.6182	36.85
8.694	473.856	15.2	0.12	0.79	-0.81	25.8974	0.820	2.55	25.90	0.82	6	130.00	0.565	0.565	0.000	1.330	3.45	4.59	0.463	15.21	24.3631	32.69
9.022	473.528	13.51	0.23	1.67	-1.09	22.0377	1.780	2.59	22.04	1.78	5	130.00	0.586	0.586	0.000	1.306	3.43	4.48	0.460	13.51	34.6567	31.66
9.35	473.200	16.76	0.4	2.39	-1.31	26.577	2.476	2.61	26.59	2.47	5	130.00	0.608	0.608	0.000	1.283	4.30	5.51	0.590	16.77	35.6064	32.66
9.678	472.872	59.24	0.76	1.29	-1.66	93.1708	1.297	2.01	93.19	1.30	6	130.00	0.629	0.629	0.000	1.261	11.68	14.73	1.815	59.25	13.14	40.19
10.006	472.544	72.22	0.96	1.33	-0.79	110.041	1.341	1.96	110.04	1.34	6	130.00	0.650	0.650	0.000	1.240	14.01	17.97	2.216	72.23	11.988	41.07
10.335	472.215	64.71	1.11	1.72	-0.61	95.3269	1.733	2.09	95.33	1.73	6	130.00	0.672	0.672	0.000	1.220	13.18	16.06	1.983	64.71	16.3858	40.31
10.663	471.887	67.23	1.33	1.98	-0.56	95.9997	1.999	2.13	96.00	2.00	6	130.00	0.693	0.693	0.000	1.200	13.90	16.70	2.060	67.23	16.6515	40.35
10.991	471.559	52.16	1.16	2.22	-1.01	72.0158	2.255	2.25	72.01	2.25	6	130.00	0.714	0.714	0.000	1.182	11.04	13.44	1.593	52.16	20.6129	38.78
11.319	471.231	56.94	1.24	2.17	-1.18	76.392	2.206	2.23	76.41	2.21	6	130.00	0.736	0.736	0.000	1.166	12.28	14.91	1.740	56.95	19.9382	39.11
11.647	470.903	52.44	1.04	1.99	-1.09	68.2684	2.012	2.24	68.28	2.01	6	130.00	0.757	0.757	0.000	1.149	11.34	13.03	1.600	52.45	20.2051	38.46
11.975	470.575	33.75	0.91	2.69	-0.92	42.3596	2.760	2.48	42.37	2.75	6	130.00	0.778	0.778	0.000	1.133	8.56	9.69	1.068	33.76	29.8333	35.72
12.303	470.247	35.95	0.93	2.58	-2.38	43.9546	2.646	2.46	43.98	2.64	6	130.00	0.800	0.800	0.000	1.118	8.56	9.69	1.068	35.97	28.7745	35.94
12.631	469.919	39.85	0.73	1.84	-1.87	47.5375	1.870	2.33	47.55	1.87	6	130.00	0.821	0.821	0.000	1.104	8.99	9.92	1.206	39.86	23.739	36.40
12.959	469.591	38.57	0.32	0.82	-1.48	44.7894	0.848	2.15	44.80	0.85	7	130.00	0.842	0.842	0.000	1.090	8.05	8.78	1.168	38.58	17.4806	36.05
13.287	469.263	53.21	0.49	0.91	-0.83	60.6102	0.936	2.07	60.61	0.94	7	130.00	0.864	0.864	0.000	1.076	10.74	11.55	1.521	53.21	14.7902	37.81
13.615	468.935	54.3	0.61	1.77	-0.69	37.7582	1.826	2.40	37.77	1.82	6	130.00	0.885	0.885	0.000	1.063	7.99	8.49	1.035	54.31	26.6559	35.03
13.943	468.607	28.16	0.33	1.17	-0.69	30.0716	1.211	2.58	30.08	1.21	7	130.00	0.906	0.906	0.000	1.050	6.49	6.82	0.844	28.17	25.6033	33.53
14.271	468.279	26.64	0.48	1.79	-0.69	27.7188	1.867	2.52	27.72	1.87	6	130.00	0.928	0.928	0.000	1.039	6.54	6.79	0.796	26.64	31.4282	33.12
14.6	467.950	28.1	0.34	1.19	-0.97	28.6101	1.252	2.41	28.62	1.25	7	130.00	0.949	0.949	0.000	1.027	6.55	6.73	0.841	28.11	28.6607	33.82
14.928	467.622	26.73	0.36	1.33	-0.67	26.5476	1.398	2.46	26.55	1.40	6	130.00	0.970	0.970	0.000	1.015	6.39	6.48	0.798	26.73	28.915	32.84
15.256	467.294	39.54	0.92	0.81	-0.79	38.8733	0.830	2.20	38.88	0.83	7	130.00	0.992	0.992	0.000	1.004	8.42	8.46	1.193	39.55	18.0383	35.20

R13802

Depth (ft)	El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.. (pcf)	Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.966	38.96	0.32	0.81	0.76	37.4615	0.843	2.22	37.46	0.84	7	130.00	1.013	1.013	0.000	0.994	8.36	8.30	1.175	38.96	19.527	34.98
15.912	466.638	27.47	0.35	1.28	0.74	25.5595	1.324	2.46	25.56	1.32	6	130.00	1.034	1.034	0.000	0.983	6.67	6.46	0.818	27.47	28.9508	32.60
16.24	466.310	23.19	0.23	0.99	0.74	20.9593	1.040	2.48	20.97	1.04	6	130.00	1.056	1.056	0.000	0.973	5.59	5.44	0.685	23.19	29.75	31.94
16.568	465.982	22.71	0.18	0.77	0.46	20.0679	0.832	2.45	20.09	0.83	7	130.00	1.077	1.077	0.000	0.964	5.40	5.20	0.670	22.71	28.4423	31.06
16.896	465.654	24.05	0.41	1.71	0.53	20.8987	1.788	2.61	20.90	1.79	6	130.00	1.098	1.098	0.000	0.954	5.67	5.58	0.711	24.05	35.6265	31.41
17.224	465.326	23.09	0.43	1.87	0.51	19.6242	1.957	2.65	19.63	1.96	6	130.00	1.120	1.120	0.000	0.945	6.06	5.73	0.680	23.1	37.8641	30.91
17.552	464.998	22.66	0.23	1.02	0.74	18.8794	1.068	2.52	18.88	1.07	6	130.00	1.141	1.141	0.000	0.936	5.59	5.23	0.667	22.66	31.7842	30.65
17.88	464.670	21.11	0.44	2.07	0.46	17.1638	2.2066	2.73	17.16	2.21	6	130.00	1.162	1.162	0.000	0.928	5.77	5.35	0.618	21.11	41.9564	30.03
18.208	464.342	25.83	0.62	2.41	1.27	20.8247	2.51557	2.69328	20.8332	2.51455	6	130.00	1.18352	1.18352	0	0.9182	6.929377	6.369516	0.76305	25.84	40.0978	31.295
18.537	464.013	26.98	0.58	2.14	1.5	21.3918	2.25023	2.65503	21.4001	2.24936	6	130.00	1.204901	1.204905	0	0.911	7.09544	6.464023	0.79799	26.99	38.1085	31.468
18.865	463.685	32.84	0.54	1.65	0.97	25.7814	1.70812	2.51953	25.7814	1.70812	6	130.00	1.22623	1.226225	0	0.9031	8.07106	7.288623	0.97875	32.84	31.5636	32.659
19.193	463.357	28.01	0.56	2	0.64	21.4521	2.09248	2.63571	21.4521	2.09248	6	130.00	1.24765	1.247645	0	0.8963	7.291149	6.527847	0.82856	28.01	37.1270	31.484
19.521	463.029	42.38	0.77	1.81	1.09	32.3999	1.87297	2.463	32.4078	1.87252	7	130.00	1.26887	1.269865	0	0.8878	10.14259	9.004116	1.27278	42.39	29.0567	34.09
19.849	462.701	46.13	0.77	1.69	0.46	36.3047	1.6439	2.38956	36.3047	1.6439	7	130.00	1.29018	1.290185	0	0.8804	11.13334	9.861657	1.45015	46.13	25.9872	34.787
20.177	462.373	40.56	1.01	2.5	0.3	29.9263	2.57335	2.57572	29.9263	2.57335	6	130.00	1.31151	1.311505	0	0.8742	9.024512	8.046066	1.2812	40.56	34.1844	33.596
20.505	462.045	53.08	1.13	2.45	0.41	38.8252	2.51221	2.4824	38.8252	2.51221	6	130.00	1.33283	1.332825	0	0.8662	12.61671	11.10171	1.60206	53.08	29.9025	35.195
20.833	461.717	72.85	1.66	2.29	0.37	52.7978	2.32181	2.35962	52.8052	2.32149	7	130.00	1.35416	1.354145	0	0.8583	16.62862	14.89771	2.21349	72.86	24.7953	37.018
21.161	461.389	66.65	1.75	2.62	0.63	61.9969	2.0522	2.27196	62.0041	2.05195	7	130.00	1.37547	1.375485	0	0.8527	19.03348	16.22904	2.64008	88.68	21.4966	37.941
21.489	461.061	99.74	1.53	1.53	0.42	70.4068	1.55578	2.15069	70.4141	1.55562	8	130.00	1.39679	1.396785	0	0.8461	20.85237	17.61948	3.04468	99.75	17.3821	38.657
21.817	460.733	86.18	1.62	1.88	0.48	59.7712	1.91124	2.26316	59.7712	1.91124	7	130.00	1.41815	1.418105	0	0.8397	18.85677	15.83482	2.62421	86.18	21.1809	37.702
22.145	460.405	86.56	1.53	1.77	0.55	59.1351	1.79745	2.24908	59.1351	1.79745	7	130.00	1.43943	1.439425	0	0.8335	18.82842	15.69161	2.63581	86.56	20.681	37.67
22.473	460.077	83.42	1.73	2.08	0.6	56.1078	2.1108	2.31231	56.1147	2.11055	7	130.00	1.46075	1.460745	0	0.8274	18.6471	15.4428552	2.58744	83.43	22.9798	37.969
22.802	459.748	74.32	1.6	2.15	0.97	49.1442	2.19666	2.36583	49.1508	2.19636	7	130.00	1.48213	1.482135	0	0.8214	17.01887	13.97937	2.26504	74.33	25.0792	38.599
23.13	459.420	73.29	1.63	2.28	0.64	46.4176	2.33569	2.40313	46.4176	2.33569	7	130.00	1.50345	1.503455	0	0.8156	16.69253	13.53219	2.16057	73.29	26.5396	38.262
23.459	459.092	64.8	1.34	2.07	0.51	41.4982	2.11773	2.41227	41.5046	2.1174	7	130.00	1.52477	1.524775	0	0.8099	15.14737	12.25891	1.95899	64.81	26.0142	38.596
23.788	458.764	57.97	0.87	1.5	0.49	36.4946	1.5419	2.37112	36.4946	1.5419	7	130.00	1.54609	1.546095	0	0.8042	13.2566	10.69519	1.74587	57.97	25.2483	34.819
24.116	458.436	57.68	0.89	1.55	0.56	35.7996	1.5861	2.38513	35.7996	1.5861	7	130.00	1.56741	1.567415	0	0.7987	13.31578	10.63593	1.78723	57.68	25.809	34.702
24.442	458.108	61.01	0.65	1.27	0.53	31.1074	1.3522	2.38788	31.1074	1.3522	7	130.00	1.58873	1.588735	0	0.7934	11.79061	9.354013	1.53007	61.01	25.9197	33.837
24.77	457.780	45.04	0.65	1.45	0.56	26.9743	1.49666	2.47065	26.9743	1.49666	7	130.00	1.61005	1.610055	0	0.7881	10.81533	8.563542	1.34456	45.04	29.3662	32.945
25.098	457.452	51.99	0.93	1.79	0.67	30.8639	1.84675	2.47611	30.875	1.84639	7	130.00	1.63137	1.631375	0	0.7829	12.51872	9.80137	1.66909	52	29.6264	33.79
25.426	457.124	48.03	1.05	2.18	0.67	28.0617	2.26404	2.56273	28.0678	2.26355	6	130.00	1.65269	1.65269	0	0.7779	12.0574	9.576831	1.63683	48.04	33.567	33.195
25.754	456.796	45.32	0.59	1.29	0.49	26.0727	1.35179	2.45827	26.0727	1.35179	7	130.00	1.67401	1.674015	0	0.7729	11.31969	8.982491	1.35127	45.32	28.8526	32.73
26.082	456.468	55.38	0.34	0.62	0.74	31.6662	0.63333	2.21862	31.6662	0.63333	8	130.00	1.69533	1.695335	0	0.7681	13.89086	10.32429	1.66206	55.38	19.6243	33.947
26.4	456.140	73.15	0.73	0.99	0.26	41.6121	1.02193	2.22191	41.6121	1.02193	8	130.00	1.71665	1.716655	0	0.7632	18.27803	12.00421	2.22456	73.15	19.7367	35.612
26.739	455.811	74.59	0.95	1.27	0.07	41.9163	1.30401	2.27962	41.9163	1.30401	8	130.00	1.73804	1.738035	0	0.7585	18.43655	12.48756	2.25546	74.59	21.7737	35.656
27.067	455.483	69.6	1.26	2.11	0.94	32.6761	2.1784	2.49849	32.6761	2.1784	7	130.00	1.75936	1.759355	0	0.7539	14.50122	10.93271	1.90772	69.6	30.8157	34.179
27.395	455.155	62.45	1.36	2.18	0.02	34.071	2.24166	2.4942	34.071	2.24166	7	130.00	1.78069	1.780675	0	0.7494	15.16369	11.36351	1.9783	62.45	30.4245	34.399
27.723	454.827	50.82	1.25	2.47	0.46	27.2021	2.55008	2.60548	27.2021	2.55008	6	130.00	1.802	1.801995	0	0.7448	13.02823	9.705289	1.51759	50.82	35.6254	32.998
28.051	454.499	85	1.08	3.08	1.09	18.1958	3.2563	2.80604	18.2013	3.25432	6	130.00	1.82332	1.823315	0	0.7405	7.586687	7.398114	1.02714	85.01	46.4587	30.416
28.379	454.171	33.92	1.21	3.56	0.14	17.3885	3.77237	2.86349	17.3885	3.77237	6	130.00	1.84464	1.844635	0	0.7363	9.08773	7.353799	0.99305	33.924	49.75	30.116
28.707	453.843	24.82	1.39	6.59	20.74	12.3015	6.05558	3.10673	12.3742	6.02148	3	130.00	1.86596	1.865955	0	0.7322	6.643187	6.264165	0.72685	24.95	64.9662	27.853
29.035	453.515	30.38	1.32	4.36	-20.28	15.0973	4.63276	2.96484	16.1609	4.61333	4	125.00	1.88728	1.887275	0	0.7279	9.53739	6.942437	0.88213	30.5	56.1472	29.211
29.363	453.187	26.39	1.19	4.5	-19.63	12.8329	4.86067	3.03231	12.8958	4.83696	4	125.00	1.90778	1.907775	0	0.724	8.646449	6.259998	0.76796	26.51	60.6874	28.132
29.691	452.859	32.99	1.13	3.43	-15.73	16.1086	3.63792	2.87768	16.1604	3.62624	5	125.00	1.92828	1.928275	0	0.7201	9.829652	7.074381	0.96166	33.09	50.616	29.634
30.019	452.531	38.04	1.29	3.39	-14.99	18.52	3.57428	2.82578	18.5713	3.5644	5	125.00	1.94878	1.948775	0	0.7163	10.99164	7.873748	1.11738	38.14	47.4962	30.547
30.347	452.203	35.49	1.02	2.88	-14.16	17.0219	3.04289	2.8116	17.0676	3.03475	6	125.00	1.96928	1.969275	0	0.7126	10.17256	7.248986	1.03779	35.58	46.666	29.994
30.675	451.875	36.01	0.81	2.24	-13.42	17.0975	2.38094	2.74704	17.1377	2.37535	6	125.00	1.98978	1.989775	0	0.7089	9.958889	7.060069	1.05326	36.09	43.0037	30.021
31.004	451.546	30.49	0.67	2.19	-12.68	14.1666	2.35256	2.81069	14.2084	2.34597	6	125.00	2.01034	2.010338	0	0.7053	8.735746	6.161203	0.88172	30.57	46.6132	28.778
31.332	451.218	20.88	0.57	2.71	-12.47	9.28147	3.02401	3.02299	9.32087	3.01123	5	125.00	2.03084	2.030838	0	0.7017	6.795869	4.768781	0.58357	20.96	60.0464	25.941
31.66	450.890	16.5	0.4	2.43	-12.06	7.04353	2.76842	3.10136	7.08253	2.75316	5	125.00	2.05134	2.051338	0	0.6982	5.656888	3.949654	0.44733	-16.58	65.5763	24.077
31.988	450.562	15.2	0.37	2.41	-11.71	6.33648	2.81837	3.1445	6.37027	2.80342	5	125.00	2.07184	2.071838	0	0.6947	5.364346	3.726824	0.40644	15.27	68.7573	23.359
32.316	450.234	13.42	0.31	2.32	-10.81	5.41388	2.73666	3.19603	5.44256	2.72224	5	125.00	2.09234	2.092338	0	0.6913	4.909323	3.393952	0.3607	13.48	72.6878	22.299
32.644	449.906	13.41	0.39	2.88	-10.09	5.34691	3.45219	3.25342	5.38005	3.43094	5	125.00	2.11284	2.112838	0	0.688	5.118563	3.521397	0.34976	13.48	77.2366	22.221
32.972	449.578	13.24	0.28	2.12	-7.72	5.20624	2.52101	3.19282	5.22968	2.50971	5	125.00	2.13334	2.133338	0	0.6847	4.829065	3.305232	0.34386	13.29	72.4383	22.031
33.3	449.250	15.29	0.27	1.74	-7.34	6.09896	2.05539	3.08974	6.11753	2.04916	6	125.00	2.15384	2.153838	0	0.6814	5.190141	3.536492	0.40669	15.33	64.7859	23.086
33.628	448.922	12.74	0.24	1.85	-6.3	4.85926	2.27151	3.19655	4.87765	2.26294	5	125.00	2.17434	2.174338	0	0.6782	4.656115	3.157623	0.32711	12.76	72.7263	21.565
33.956	448.594	15.46	0.33	2.14	-5.57	6.0439	2.48772	3.13551	6.05747	2.48211	5	125.00	2.19484	2.194838	0	0.675	5.408217	3.650504	0.41069	15.49	68.086	23.019
34.284	448.266	19.07	0.47	2.44	-5.31	7.60817	2.78655	3.07707	7.62171	2.78359	5	125.00	2.21534	2.215338	0	0.6719	6.41274	4.308476	0.52182	19.1	63.8284	24.575
34.612	447.938	20.99	0.5	2.36	-4.73	8.41287	2.66607	3.02992	8.42633	2.66162	5	135.00	2.23584	2.229223	0.0056	0.6698	6.845399	4.584817	0.58062	21.02	60.5225	25.259
34.941	447.609	25.65	0.82	3.18	-4.43	10.4374	3.50548	3.01977	10.4508	3.50099	5	135.00	2.25805	2.241166	0.0169	0.668	8.309312	5.550448	0.72421	25.68	59.8266	26.721
35.269	447.281	24.21	1.06	4.37	-9.81	9.73329	4.8336	3.12648	9.75992	4.82041	4	135.00	2.28019	2.253076	0.0271	0.6662	8.421758	5.626076	0.67894	24.27	67.4162	26.261
35.597	446.953	22.27	0.91	4.1	-14.16	8.81583	4.55737	3.14431	8.85557	4.53692	4	135.00	2.30233	2.264979	0.0373	0.6645	7.854004	5.218661	0.61819	22.36	68.7426	25.606
35.925	446.625	19.46	0.98	5.05	-13.21	7.52587	5.71911	3.25807	7.5654	5.68923	3	135.00	2.32447	2.276885	0.0476	0.6627	7.449111	4.936668	0.53051	19.55	77.6125	24.544
36.253	446.297	24.68	1.3	5.26	-11.24	9.75772	5.82088	3.17489	9.79268	5.8001	3	135.00	2.34661	2.288791	0.0578	0.661	8.883668	5.872043	0.69144	24.76	71.058	26.293
36.581	445.969	26.57	1.26	4.75	-10.88	10.5191	5.20834	3.11986	10.5452	5.19347	3	135.00	2.36875	2.300698	0.068	0.6593	9.199371	6.064966	0.74926	26.63	66.9282	26.796
36.909	445.641	22.11	0.92	4.17	-10.16	8.5268	4.66552	3.16289	8.55275	4.65137	4	135.00	2.39089	2.312604	0.0783	0.6576	7.887958	5.166973	0.6105	22.17	70.1433	25.384
37.237	445.313	21.91	0.71	3.22	-9.52	8.38756	3.64159	3.10571	8.41337	3.63042	5	135.00	2.41303	2.324511	0.0885	0.6559	7.517677	4.930806	0.60362	21.97	65.8921	25.277
37.565	444.985	23	0.88	3.81	-9.38	8.80187	4.27915	3.12957	8.82755	4.2667	4	135.00	2.43517	2.336417	0.0987	0.6542	8.018715	5.246016	0.63668	23.06	67.6451	25.605

R13803

Depth (ft)	Sa...	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.W (pcf)	...tress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	444.657	19.45	0.95	4.9	-10	7.2361	5.59064	3.26674	7.26165	5.57097	3	135.00	2.45731	2.348323	0.109	0.6526	7.482229	4.88261	0.52609	19.51	78.3181	24.29
38.221	444.329	18.24	0.79	4.34	-9.37	6.67755	5.01251	3.26644	6.70297	4.9935	3	135.00	2.47945	2.36023	0.1192	0.6509	7.016591	4.567189	0.48794	18.3	78.2934	23.755
38.549	444.001	21.57	0.78	3.6	-8.87	8.0385	4.09053	3.14988	8.06379	4.0777	5	135.00	2.50159	2.372136	0.1294	0.6493	7.626794	4.951904	0.59035	21.63	69.1608	25.004
38.877	443.673	18.25	0.67	3.65	-8.11	6.59647	4.26039	3.2302	6.61745	4.24688	4	135.00	2.52373	2.384043	0.1397	0.6477	6.83099	4.424117	0.48688	18.3	75.3741	23.677
39.206	443.344	20.75	0.81	3.91	-7.44	7.59774	4.44956	3.19132	7.61861	4.43737	4	135.00	2.54593	2.395985	0.1499	0.646	7.549899	4.87752	0.56359	20.8	72.3227	24.628
39.534	443.016	21.68	1.16	5.34	-5.68	7.9372	6.06951	3.25744	7.95382	6.05683	3	135.00	2.56807	2.407892	0.1602	0.6444	8.272102	5.330862	0.5917	21.72	77.562	24.921
39.862	442.688	22.71	1.16	5.1	-5.2	8.31466	5.76547	3.22788	8.33119	5.75403	3	135.00	2.59021	2.419798	0.1704	0.6429	8.477683	5.449889	0.6229	22.75	75.1893	25.237
40.19	442.360	28.63	1.19	4.17	-3.31	10.6993	4.57382	3.08047	10.7076	4.57031	4	135.00	2.61235	2.431705	0.1806	0.6413	9.640615	6.18229	0.8055	28.65	64.071	26.927
40.518	442.032	28.19	1.27	4.52	-2.28	10.4581	4.96957	3.11062	10.4622	4.96763	4	135.00	2.63449	2.443611	0.1909	0.6397	9.6813	6.193237	0.79119	28.2	66.2507	26.774
40.846	441.704	26.69	1.27	4.77	-1.8	9.7875	5.28432	3.14971	9.79157	5.26212	3	135.00	2.65663	2.455517	0.2011	0.6382	9.413383	6.007229	0.74407	26.7	69.148	26.331
41.174	441.376	24.58	1.31	5.34	-1.94	8.87615	5.9814	3.21633	8.8802	5.97667	3	135.00	2.67877	2.467424	0.2113	0.6366	9.086888	5.784866	0.67806	24.59	74.2759	25.678
41.502	441.048	24.83	1.39	5.59	-2.79	8.92543	6.28133	3.22741	8.9335	6.27565	3	135.00	2.70091	2.47933	0.2216	0.6351	9.257119	5.87907	0.68511	24.85	75.1525	25.721
41.83	440.720	23.62	1.17	4.95	-2.61	8.38818	5.5989	3.21797	8.3922	5.59523	3	135.00	2.72305	2.491237	0.2318	0.6336	8.742523	5.538974	0.64696	23.63	74.4055	25.304
42.158	440.392	24.48	0.98	4.01	-1.99	8.68301	4.5089	3.14929	8.687	4.50682	4	135.00	2.74519	2.503143	0.242	0.6321	8.631702	5.455739	0.6729	24.49	69.1162	25.538
42.486	440.064	22.76	1.14	5	-2.06	7.94921	5.70209	3.24129	7.95319	5.69924	3	135.00	2.76733	2.515049	0.2523	0.6306	8.568914	5.403219	0.61897	22.77	76.2598	24.949
42.814	439.736	20.25	0.99	4.9	-0.12	6.90971	5.66993	3.28858	6.90971	5.66993	3	135.00	2.78947	2.526956	0.2625	0.6291	7.69536	4.96676	0.54057	20.25	80.1137	24.011
43.143	439.407	14.05	0.79	5.63	0.05	4.42646	7.02952	3.49955	4.42646	7.02952	3	135.00	2.81168	2.538898	0.2728	0.6276	6.528217	4.097056	0.34794	14.05	98.8834	21.08
43.471	439.079	11.7	0.65	5.57	1.64	3.47584	7.33123	3.59605	3.47192	7.33951	3	135.00	2.83382	2.550805	0.283	0.6261	5.953759	3.7278	0.27449	11.69	100	19.54
43.799	438.751	14.29	0.66	4.63	1.87	4.4617	5.77224	3.4474	4.45779	5.77729	3	135.00	2.85596	2.562711	0.2932	0.6247	6.334906	3.957221	0.354	14.28	93.9984	21.135
44.127	438.423	16.74	0.83	4.94	0.9	5.38406	5.98764	3.38977	5.38406	5.98764	3	135.00	2.8781	2.574618	0.3035	0.6232	7.072565	4.407787	0.42916	16.74	88.7893	22.371
44.455	438.095	16.83	0.84	5	0.58	5.38551	6.03025	3.39149	5.38551	6.03025	3	135.00	2.90024	2.586524	0.3137	0.6216	7.120717	4.427571	0.43126	16.83	88.9421	22.377
44.783	437.767	14.82	0.61	4.12	1.29	4.57877	5.12708	3.40827	4.57877	5.12708	3	135.00	2.92238	2.59843	0.3239	0.6204	6.358557	3.9446	0.36835	14.82	90.4396	21.323
45.111	437.439	17.14	0.44	2.57	3.14	5.43818	3.09958	3.22672	5.43052	3.10395	5	135.00	2.94452	2.610337	0.3342	0.6189	6.374336	3.94536	0.43949	17.12	75.0978	22.44
45.439	437.111	33.51	1.27	3.8	6.51	11.6478	4.15803	3.02727	11.6325	4.16348	5	135.00	2.96666	2.622249	0.3444	0.6175	10.88157	6.719778	0.94561	33.47	60.3406	27.515
45.767	436.783	58.12	2.69	4.62	3.76	20.9294	4.87927	2.87443	20.9218	4.88104	4	135.00	2.9888	2.63415	0.3547	0.6161	17.21601	10.60748	1.70685	58.1	50.4166	31.363
46.095	436.455	62.78	3.68	5.86	-7.46	22.588	6.15703	2.91763	22.6069	6.15189	11	135.00	3.01094	2.646056	0.3649	0.6148	19.09563	11.73909	1.85044	62.83	53.1048	31.86
46.423	436.127	83.6	4.9	5.86	-7.76	30.3115	6.0819	2.82272	30.3303	6.07813	11	135.00	3.03308	2.657962	0.3751	0.6134	24.06568	14.76127	2.49433	83.65	47.316	33.709
46.751	435.799	294.51	7.43	2.52	-2.96	109.164	2.54928	2.16692	109.168	2.54919	7	135.00	3.05522	2.669869	0.3854	0.612	61.8938	37.87932	9.02337	294.52	17.9036	41.036
47.079	435.471	443.15	13.54	3.06	-9.68	164.098	3.07676	2.11943	164.12	3.07635	12	135.00	3.07736	2.681775	0.3956	0.6106	91.3583	55.76749	13.6245	443.21	16.4026	43.103
47.408	435.142	441.36	16.48	3.73	-14.99	162.697	3.76032	2.19234	162.734	3.75946	12	135.00	3.09957	2.693718	0.4058	0.6093	93.75299	57.12275	13.5684	441.46	18.7382	43.062
47.736	434.814	430.27	19.31	4.49	-16.14	157.874	4.52068	2.2656	157.911	4.51962	12	135.00	3.12171	2.705624	0.4161	0.6079	94.26613	57.30888	13.2244	430.37	21.268	42.913
48.064	434.486	369.54	18.25	4.94	-18.24	134.827	4.98095	2.33911	134.867	4.97945	11	135.00	3.14385	2.717531	0.4263	0.6066	83.59686	50.71228	11.3435	369.65	23.9983	42.124
48.392	434.158	373.72	19.14	5.12	-23.12	135.762	5.16524	2.35029	135.817	5.16315	11	135.00	3.16599	2.729437	0.4366	0.6053	84.97333	51.4935	11.4723	373.87	24.4907	42.16
48.72	433.830	313.66	15.82	5.04	-20.02	113.255	5.09547	2.39117	113.303	5.09334	11	135.00	3.18813	2.741344	0.4468	0.604	72.63847	43.87175	9.61213	313.79	26.0526	41.23

R13804

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 28 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5A

ConeTec Inc. Interpretation

Interpretation Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4429
Job No 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5A
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 10:44
CPT File: 804CP05A.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 483

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	35.73	1.111	36.82	24.15	2.29
125	Soil Embankment	28.29	1.43	48.95	56.29	2.94

User Inputs:

Water Table Depth (ft): 35.9 Ground Surface Elev. 483.0

Assumed: Nk: 32.3
State Parameter: 1.2 CPT area ratio: 0.85
Unit Weight of Soil (pcf): Varies See Below See Below Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.836	25.42	0.16	0.61	-0.04	2383.62	0.630	1.02	2383.62	0.63	7	130.00	0.011	0.011	0.000	2.000	3.63	7.27	0.787	25.42	1.8137	53.84
0.492	482.508	30.63	0.28	0.93	-0.09	956.784	0.950	1.25	956.79	0.95	7	130.00	0.032	0.032	0.000	2.000	4.37	9.35	0.947	30.63	0.0948	50.67
0.820	482.180	34.85	0.47	1.34	-0.02	652.846	1.351	1.50	652.85	1.35	7	130.00	0.053	0.053	0.000	2.000	5.75	11.50	1.077	34.85	2.85185	49.21
1.148	481.852	45.55	0.61	1.33	0.05	609.426	1.341	1.51	609.43	1.34	7	130.00	0.075	0.075	0.000	2.000	7.54	15.08	1.408	45.55	3.00348	48.93
1.476	481.524	30.66	0.46	1.49	-0.16	318.576	1.506	1.70	318.57	1.51	6	130.00	0.096	0.096	0.000	2.000	5.40	10.81	0.948	30.66	6.10537	46.20
1.804	481.196	25.49	0.36	1.4	-0.21	216.38	1.419	1.79	216.38	1.42	6	130.00	0.117	0.117	0.000	2.000	4.62	9.24	0.786	25.49	7.70694	44.43
2.133	480.867	24.98	0.31	1.22	-0.07	179.172	1.248	1.79	179.17	1.25	6	130.00	0.139	0.139	0.000	2.000	4.85	9.70	0.759	24.98	7.90054	43.53
2.461	480.539	22	0.24	1.07	0.37	136.53	1.099	1.84	136.53	1.10	6	130.00	0.160	0.160	0.000	2.000	4.07	8.14	0.676	22	8.91183	42.18
2.789	480.211	19.96	0.3	1.5	-0.25	109.103	1.501	1.98	109.10	1.51	6	130.00	0.181	0.181	0.000	2.000	3.78	7.52	0.612	19.96	10.022	41.03
3.117	479.883	16.87	0.21	1.22	-0.14	82.2655	1.260	2.04	82.27	1.26	6	130.00	0.203	0.203	0.000	2.000	3.37	6.74	0.516	16.87	11.0492	39.52
3.445	479.555	27.63	0.29	1.05	-0.812	122.39	1.058	1.86	122.39	1.06	7	130.00	0.224	0.224	0.000	2.000	5.58	10.31	0.849	27.63	9.45051	41.62
3.773	479.227	28.29	0.55	1.95	-0.9	114.354	1.961	2.07	114.39	1.96	6	130.00	0.245	0.245	0.000	2.000	5.72	11.43	0.869	28.4	9.8825	41.27
4.101	478.899	31.49	0.42	1.32	-0.58	117.133	1.345	1.94	117.17	1.34	7	130.00	0.267	0.267	0.000	1.937	6.07	11.75	0.967	31.6	11.5005	41.40
4.429	478.571	21.53	0.34	1.58	-0.26	73.7868	1.601	2.14	73.79	1.60	6	130.00	0.288	0.288	0.000	1.884	4.46	8.35	0.658	21.53	17.574	38.92
4.757	478.243	20.69	0.25	1.19	-0.01	66.9135	1.227	2.11	65.85	1.23	6	130.00	0.309	0.309	0.000	1.798	4.24	7.63	0.631	20.7	18.0068	38.29
5.086	477.915	16.26	0.33	2.14	-1.58	45.169	2.210	2.40	45.20	2.21	5	130.00	0.331	0.331	0.000	1.759	3.54	6.18	0.462	16.27	26.2447	36.10
5.414	477.587	14.21	0.29	2.05	-1.25	39.3871	2.093	2.43	39.39	2.08	5	130.00	0.352	0.352	0.000	1.698	3.34	5.84	0.429	14.21	27.5061	35.28
5.742	477.259	24.82	0.37	1.47	-0.26	65.5121	1.513	2.17	65.51	1.51	6	130.00	0.373	0.373	0.000	1.637	5.22	8.54	0.747	24.82	17.6048	38.25
6.070	476.931	37.94	0.39	1.02	-0.27	95.178	1.039	1.94	95.20	1.04	7	130.00	0.394	0.394	0.000	1.592	7.29	11.90	1.102	37.95	11.3095	40.30
6.398	476.602	38.71	0.49	1.28	-0.12	92.082	1.280	2.01	92.08	1.28	7	130.00	0.416	0.416	0.000	1.551	7.83	11.84	1.186	38.71	13.1428	40.13
6.726	476.274	62.69	0.91	1.45	-0.74	142.393	1.462	1.91	142.43	1.46	7	130.00	0.437	0.437	0.000	1.512	11.92	18.03	1.927	62.7	10.6517	42.99
7.054	475.946	61.96	1.01	1.63	-0.67	134.133	1.642	1.97	134.16	1.64	7	130.00	0.459	0.459	0.000	1.477	12.03	17.75	1.904	61.97	12.0278	42.09
7.382	475.618	77.1	0.92	1.19	-1.34	159.682	1.201	1.81	159.70	1.20	8	130.00	0.480	0.480	0.000	1.444	14.16	20.43	2.372	77.1	9.43681	42.96
7.71	475.290	60.49	0.84	1.38	-0.67	119.702	1.400	1.95	119.72	1.40	7	130.00	0.501	0.501	0.000	1.413	11.67	16.49	1.857	60.5	11.6404	41.61
8.038	474.962	43.56	0.42	0.95	-0.41	82.3732	0.976	1.97	82.38	0.98	7	130.00	0.522	0.522	0.000	1.383	8.47	11.72	1.332	43.57	12.1295	39.52
8.366	474.634	31.78	0.35	1.09	-0.72	57.4417	1.120	2.13	57.44	1.12	7	130.00	0.544	0.544	0.000	1.356	6.59	9.22	0.967	31.78	16.7393	37.50
8.694	474.306	23.44	0.25	1.07	-0.83	40.4787	1.093	2.25	40.50	1.09	6	130.00	0.565	0.565	0.000	1.330	5.10	8.78	0.709	23.45	20.6373	35.45
9.022	473.978	14.75	0.2	1.33	-1.36	24.1522	1.412	2.50	24.17	1.41	6	130.00	0.586	0.586	0.000	1.306	4.59	4.68	0.439	14.76	30.5056	32.25
9.35	473.650	18.93	0.1	0.53	-1.64	30.1477	0.546	2.21	30.16	0.55	7	130.00	0.606	0.606	0.000	1.283	5.05	7.03	0.567	18.94	19.2809	33.65
9.678	473.322	14.31	0.1	0.7	-0.99	21.7479	0.731	2.39	21.75	0.73	6	130.00	0.628	0.629	0.000	1.261	3.31	4.18	0.464	14.31	26.0948	31.57
10.006	472.994	13.41	0.1	0.75	-0.53	19.6184	0.784	2.45	19.63	0.78	6	130.00	0.650	0.650	0.000	1.240	3.10	3.95	0.396	13.42	28.3018	30.91
10.335	472.665	9.07	0.17	1.88	-0.74	12.5015	2.024	2.82	12.50	2.02	6	130.00	0.672	0.672	0.000	1.220	2.61	3.19	0.269	9.07	47.2437	27.92
10.663	472.337	9.3	0.05	0.54	-0.39	12.4181	0.581	2.57	12.42	0.58	6	130.00	0.693	0.693	0.000	1.201	2.34	2.82	0.266	9.3	33.0422	27.88
10.991	472.009	8.69	0.07	0.81	-0.46	11.1636	0.878	2.69	11.16	0.88	5	130.00	0.714	0.714	0.000	1.183	2.62	2.75	0.247	8.69	39.7705	27.16
11.319	471.681	6.9	0.07	0.94	-0.74	8.37838	1.136	2.85	8.38	1.14	5	130.00	0.736	0.736	0.000	1.166	2.01	2.35	0.191	6.9	48.9316	25.22
11.647	471.353	8.91	0.09	1.01	-0.44	10.7693	1.104	2.75	10.77	1.10	5	130.00	0.757	0.757	0.000	1.149	2.46	2.82	0.233	8.91	42.9199	26.92
11.975	471.025	18.87	0.21	1.09	-0.26	23.2428	1.161	2.46	23.26	1.16	6	130.00	0.778	0.778	0.000	1.133	4.52	5.12	0.500	18.88	29.1282	32.00
12.303	470.697	19.57	0.24	1.23	-0.51	23.4718	1.279	2.48	23.48	1.28	6	130.00	0.800	0.800	0.000	1.118	4.73	6.29	0.581	19.58	29.9383	32.07
12.631	470.369	17.34	0.28	1.62	-0.5	20.1202	1.695	2.61	20.13	1.69	6	130.00	0.821	0.821	0.000	1.104	4.45	4.91	0.511	17.35	35.652	31.07
12.959	470.041	19.9	0.26	1.28	-0.3	22.6248	1.364	2.51	22.62	1.36	6	130.00	0.842	0.842	0.000	1.090	4.87	5.31	0.590	19.9	31.2276	31.83
13.287	469.713	30.28	0.23	0.76	-0.3	34.0603	0.782	2.23	34.06	0.78	7	130.00	0.864	0.864	0.000	1.076	6.56	7.04	0.811	30.28	20.1787	34.40
13.615	469.385	38.96	0.31	0.78	-0.41	43.0238	0.814	2.16	43.02	0.81	7	130.00	0.885	0.885	0.000	1.063	8.15	(4.67)	1.170	38.96	17.5079	35.81
13.943	469.057	33.22	0.36	1.07	-0.44	35.6547	1.114	2.30	35.65	1.11	7	130.00	0.906	0.906	0.000	1.050	7.38	7.75	1.000	33.22	22.4577	34.68
14.27	468.729	32.32	0.57	1.13	-0.62	33.842	1.179	2.33	33.84	1.18	7	130.00	0.928	0.928	0.000	1.038	7.26	7.56	0.972	32.33	23.6456	34.36
14.6	468.400	25.81	0.32	1.24	-0.3	26.197	1.287	2.44	26.20	1.29	6	130.00	0.949	0.949	0.000	1.027	6.12	6.29	0.770	25.81	28.2811	32.76
14.928	468.072	26.82	0.29	1.08	-0.97	26.6404	1.122	2.41	26.65	1.12	7	130.00	0.970	0.970	0.000	1.015	6.25	6.55	0.800	26.83	26.6788	32.87
15.256	467.744	27.37	0.29	1.06	-0.53	26.6007	1.099	2.40	26.61	1.10	7	130.00	0.992	0.992	0.000	1.004	6.37	6.40	0.817	27.38	26.6119	32.88

R13806

Depth (ft)	SL (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.W (pcf)	tress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.564	467.416	27.05	0.21	0.76	-0.81	25.7039	0.807	2.35	25.71	0.81	7	130.00	1.013	1.013	0.000	0.994	6.14	6.110	0.806	27.06	24.3313	32.64
15.912	467.068	23.69	0.19	0.78	-0.58	21.9048	0.839	2.42	21.91	0.84	7	130.00	1.034	1.034	0.000	0.983	5.55	5.465	0.701	23.7	27.1103	31.62
16.241	466.760	39.57	0.35	0.87	-0.32	36.4858	0.903	2.24	36.50	0.91	7	130.00	1.056	1.056	0.000	0.973	8.58	8.35	1.192	39.58	20.444	34.82
16.569	466.432	74.07	1.51	1.52	0	67.7795	1.548	2.16	67.78	1.55	7	130.00	1.077	1.077	0.000	0.964	15.53	14.97	2.260	74.07	12.7393	38.44
16.898	466.104	68.69	1.62	2.45	-0.62	59.7244	2.470	2.34	59.72	2.47	6	130.00	1.098	1.098	0.000	0.954	15.06	14.39	2.031	68.69	13.9849	37.73
17.226	465.776	65.22	1.33	2.04	-0.58	57.255	2.075	2.30	57.26	2.07	7	130.00	1.120	1.120	0.000	0.945	13.501	12.91	1.785	65.22	22.5529	37.49
17.553	465.448	57.68	1.09	1.89	-0.39	49.6575	1.928	2.33	49.66	1.93	7	130.00	1.141	1.141	0.000	0.936	12.98	12.15	1.750	57.68	23.5396	36.65
17.881	465.120	32	1.01	3.16	-0.09	26.534	3.275	2.68	26.53	3.28	5	130.00	1.162	1.162	0.000	0.929	6.33	7.62	0.955	32	39.5519	32.84
18.209	464.792	51.86	0.91	1.76	-0.51	42.81	1.79606	2.35635	42.8268	1.795355	7	130.00	1.18352	1.183522	0	0.9192	11.82991	10.86583	1.568852	51.87	24.6074	35.784
18.537	464.463	43.9	1.02	2.33	-7.82	35.4344	2.38903	2.49787	35.4759	2.38624	6	130.00	1.20491	1.204905	0	0.911	10.59025	9.738938	1.32184	43.95	30.5877	34.646
18.865	464.135	23.27	0.79	3.4	2.83	17.9769	3.58378	2.83772	17.9933	3.60054	5	130.00	1.22623	1.226225	0	0.903	7.757445	6.102354	0.68247	23.28	48.2023	30.34
19.193	463.807	39.72	0.64	1.62	1.94	30.6385	1.66356	2.44929	30.6546	1.66266	7	130.00	1.24755	1.247545	0	0.8953	9.447888	8.458758	1.19811	39.74	28.4675	33.786
19.521	463.479	50.04	1.09	2.17	2.24	38.4368	2.23493	2.45278	38.4447	2.23447	6	130.00	1.26887	1.268865	0	0.8878	11.91836	10.65059	1.509694	50.05	28.617	35.135
19.849	463.151	60.08	1.06	1.76	-0.18	45.567	1.80303	2.33657	45.567	1.80303	7	130.00	1.29018	1.290185	0	0.8804	13.57227	11.94886	1.82015	60.08	23.9008	36.153
20.177	462.823	52.92	0.86	1.64	0.07	39.3506	1.67886	2.29701	39.3506	1.677886	7	130.00	1.31151	1.311505	0	0.8732	11.74944	10.25965	1.59779	52.92	122.4107	35.276
20.505	462.495	36.79	0.47	1.27	-0.14	26.603	1.32554	2.44629	26.603	1.32564	7	130.00	1.33283	1.332825	0	0.8662	8.24366	7.165625	1.09175	36.79	29.3397	32.958
20.833	462.167	44.24	0.4	0.91	-0.16	31.5701	0.93271	2.30063	31.5701	0.93271	7	130.00	1.35415	1.354145	0	0.8593	9.838815	8.547624	1.32774	44.24	22.5522	33.948
21.161	461.839	38.42	0.52	1.36	-0.21	26.9324	1.40372	2.45559	26.9324	1.40372	7	130.00	1.37547	1.375485	0	0.8527	9.160015	7.961137	1.14680	38.42	26.7374	32.935
21.489	461.511	36.09	0.66	1.83	-0.49	24.6379	1.90239	2.55089	24.6379	1.90239	6	130.00	1.39679	1.396785	0	0.846	9.046296	7.863483	1.07409	36.09	33.4329	32.423
21.817	461.183	32.39	0.51	1.56	-0.46	21.8403	1.64665	2.5698	21.8403	1.64666	6	130.00	1.41811	1.418105	0	0.8397	8.157686	6.950266	0.95888	32.39	33.9021	31.599
22.145	460.855	35.52	0.56	1.58	-0.65	23.5765	1.64316	2.64029	23.5765	1.64316	7	130.00	1.43943	1.439425	0	0.8335	8.817705	7.549565	1.05413	35.52	32.5168	32.117
22.473	460.527	48.51	0.94	1.93	-0.44	32.2091	1.99781	2.48214	32.2159	1.997481	7	130.00	1.46075	1.460745	0	0.8277	11.7422	9.693283	1.45563	48.52	29.8912	34.054
22.802	460.198	40.72	0.8	1.97	-0.09	26.474	2.03865	2.55538	26.474	2.03886	6	130.00	1.48214	1.48213	0	0.8214	10.1632	8.364201	1.21470	40.72	33.2206	32.827
23.1	459.870	34.78	0.69	1.97	0.11	22.1335	2.07353	2.62238	22.1335	2.07353	6	130.00	1.50345	1.503455	0	0.8156	8.86242	7.333651	1.08023	34.78	36.4607	31.685
23.428	459.542	27.98	0.71	2.53	0.02	17.3503	2.68378	2.77387	17.8503	2.68378	6	130.00	1.52477	1.524775	0	0.8098	7.134393	6.344582	0.81905	27.98	44.5023	30.102
23.756	459.214	34.69	0.84	2.43	0.21	21.5601	2.61969	2.61226	21.5601	2.61969	6	130.00	1.54609	1.546095	0	0.8043	8.972323	7.921651	1.03201	34.98	35.0587	31.516
24.114	458.886	34.14	0.66	1.92	-0.04	20.7812	2.02624	2.63981	20.7812	2.02624	6	130.00	1.56741	1.56741	0	0.7987	8.900875	7.909538	1.00844	34.14	37.2284	31.278
24.442	458.558	46.63	0.8	1.71	-0.12	28.3505	1.77615	2.49568	28.3505	1.77615	7	130.00	1.58873	1.588735	0	0.7934	11.33143	9.969097	1.39447	46.63	30.4993	33.258
24.77	458.230	37.3	0.79	2.12	-0.44	22.167	2.2135	2.63841	22.1732	2.21289	6	130.00	1.61005	1.61005	0	0.788	9.725396	7.664543	1.10495	37.31	37.2638	31.697
25.098	457.902	36.41	0.89	2.45	-0.32	21.9187	2.55904	2.6899	21.9187	2.55904	6	130.00	1.63137	1.631357	0	0.7829	9.748596	7.690917	1.07674	36.41	39.9183	31.443
25.426	457.574	48.8	0.86	1.76	-0.18	28.5276	1.82407	2.50053	28.5276	1.82407	7	130.00	1.65269	1.65269	0	0.7779	11.88499	9.244918	1.45967	48.8	30.7065	33.297
25.754	457.246	74.39	0.71	0.96	-0.07	43.4382	0.9764	2.19543	43.4382	0.9764	8	130.00	1.67401	1.67401	0	0.7729	15.81851	12.22606	2.26127	74.39	18.641	35.889
26.082	456.918	60.47	1.11	1.82	-0.18	34.6686	1.87155	2.43963	34.6686	1.87155	7	130.00	1.69533	1.695333	0	0.768	14.31205	10.99195	1.81966	60.47	28.0573	34.505
26.41	456.590	80.94	0.74	0.91	-0.04	46.15	0.93407	2.16287	46.15	0.93407	8	130.00	1.71665	1.71665	0	0.7632	16.98142	12.96084	2.46274	80.94	17.7728	36.228
26.739	456.261	80.42	0.62	0.77	-0.07	45.2706	0.78798	2.19015	45.2764	0.78788	8	130.00	1.73804	1.738035	0	0.7585	16.65087	12.63012	2.43597	80.43	16.7349	36.115
27.067	455.933	55.83	0.67	1.2	-0.09	30.7332	1.23912	2.37784	30.7332	1.23912	7	130.00	1.75935	1.759355	0	0.7538	12.64642	9.655131	1.67401	55.83	25.5163	33.762
27.395	455.605	46.5	0.82	1.77	-0.14	25.1137	1.83366	2.54667	25.1137	1.83366	7	130.00	1.78066	1.780675	0	0.7494	11.5793	8.877407	1.38455	46.5	32.8129	32.493
27.723	455.277	57.97	0.96	1.65	0.23	31.1699	1.70916	2.45279	31.1699	1.70916	7	130.00	1.802	1.801995	0	0.7449	13.80444	10.28352	1.72895	57.97	28.6174	33.849
28.051	454.949	68	0.97	1.43	-0.32	36.2947	1.46577	2.36006	36.2947	1.46577	7	130.00	1.82332	1.823315	0	0.7408	15.62249	11.49657	2.04981	68	24.8126	34.786
28.379	454.621	53.43	1.26	2.35	-0.41	27.9651	2.44255	2.68442	27.9651	2.44255	6	130.00	1.84464	1.844635	0	0.7363	13.55423	8.979762	1.69707	53.43	34.6019	33.172
28.707	454.293	48.16	0.76	1.62	-0.58	24.8098	1.68488	2.52977	24.8098	1.68488	7	130.00	1.86595	1.865955	0	0.7321	11.89481	8.707769	1.43325	48.16	32.0316	32.415
29.035	453.965	64.33	0.45	0.69	-0.6	33.0862	0.72066	2.22831	33.0862	0.72066	8	125.00	1.88726	1.887275	0	0.7279	13.86901	10.0955	1.93321	64.33	19.9571	34.218
29.363	453.637	56.15	0.73	1.3	-0.09	28.4322	1.34581	2.42586	28.4322	1.34581	7	125.00	1.90776	1.907775	0	0.724	13.20537	9.560644	1.67933	56.15	27.4781	33.276
29.691	453.309	58.81	0.91	1.54	0.09	29.4988	1.59981	2.45535	29.4988	1.59981	7	125.00	1.92828	1.928275	0	0.7201	14.02117	10.09717	1.76104	58.81	28.7271	33.506
30.019	452.981	67.14	1.23	1.84	-0.11	33.4524	1.88676	2.45406	33.4524	1.88676	7	125.00	1.94878	1.948775	0	0.7163	15.99754	11.45968	2.0183	67.14	28.6717	34.286
30.347	452.653	112.05	2.2	1.96	-0.41	55.8991	1.99853	2.2978	55.8991	1.99853	7	125.00	1.96928	1.969275	0	0.7126	24.88819	17.73394	3.40807	112.05	22.4399	37.347
30.675	452.325	73.06	2.44	3.34	-8.34	35.7177	3.43322	2.59915	35.7426	3.43081	6	125.00	1.98978	1.989775	0	0.7089	16.6832	13.24492	2.20032	73.11	35.3158	34.692
31.004	451.996	39.96	1.78	4.47	-10.67	18.8773	4.69042	2.69568	18.9071	4.68302	4	125.00	2.01034	2.010338	0	0.7053	12.00648	8.468011	1.17491	40.02	51.728	30.664
31.332	451.668	36.72	1.19	3.25	-12.47	17.0812	3.43047	2.84264	17.1157	3.42356	5	125.00	2.03084	2.030838	0	0.7017	10.70429	7.511391	1.07397	36.79	48.4956	30.012
31.66	451.340	32.6	0.98	3	-11.92	14.8921	3.208	2.87199	14.9262	3.20066	5	125.00	2.05134	2.051338	0	0.6982	9.666982	6.749511	0.94578	32.67	50.2673	29.107
31.988	451.012	30.21	0.84	2.79	-11.04	13.5813	2.98527	2.8855	13.615	2.97786	6	125.00	2.07184	2.071838	0	0.6947	9.030418	6.27979	0.87115	30.28	51.0971	28.495
32.316	450.684	30.02	0.75	2.5	-10.81	13.3476	2.68551	2.86492	13.381	2.6788	6	125.00	2.09234	2.092338	0	0.6913	8.867287	6.130203	0.86463	30.09	49.8367	28.379
32.644	450.356	32.56	0.7	2.16	-8.52	14.4106	2.29905	2.79963	14.4342	2.2953	6	125.00	2.11284	2.112838	0	0.688	9.261455	6.371566	0.94264	32.61	45.9727	28.684
32.972	450.028	32.57	0.61	1.86	-7.05	14.2672	2.00416	2.77023	14.2859	2.00153	6	125.00	2.13334	2.133338	0	0.6847	9.112641	6.238993	0.94231	32.61	44.2973	28.816
33.3	449.700	31.3	0.63	2.02	-5.48	13.5322	2.16152	2.80746	13.5508	2.15856	6	125.00	2.15384	2.153838	0	0.6814	8.939627	6.091342	0.90236	31.34	46.4254	28.463
33.628	449.372	31.82	0.66	2.08	-3.97	13.6943	2.2263	2.81229	13.6435	2.22479	6	125.00	2.17434	2.174338	0	0.6782	9.106774	6.175912	0.91782	31.84	46.706	28.509
33.956	449.044	28.86	0.57	1.98	-2.68	12.149	2.13762	2.84432	12.1581	2.13602	6	125.00	2.19484	2.194838	0	0.675	8.41085	5.677259	0.82555	28.88	48.5957	27.736
34.284	448.716	23.21	0.5	2.14	-1.27	9.47696	2.38156	2.96057	9.48147	2.38042	6	125.00	2.21534	2.215338	0	0.6719	7.241997	4.865622	0.64999	23.22	55.8673	26.057
34.612	448.388	20.41	0.42	2.06	0.02	8.12857	2.31097	3.0103	8.12857	2.31097	6	125.00	2.23584	2.235838	0	0.6688	6.564749	4.390339	0.56267	20.41	59.1814	25.012
34.941	448.059	23.17	0.41	1.77	0.71	9.26857	1.96045	2.92469	9.26414	1.96138	6	125.00	2.2564	2.2564	0	0.6657	7.068599	4.705711	0.64748	23.16	53.5531	25.9
35.269	447.731	24.74	0.45	1.82	2.5	9.86566	2.00329	2.90687	9.85687	2.00507	6	125.00	2.2769	2.2769	0	0.6627	7.464431	4.946804	0.69545	24.72	52.4146	26.32
35.597	447.403	23.56	0.62	2.64	4.16	9.25507	2.91592	3.01828	9.24637	2.91866	5	125.00	2.2974	2.2974	0	0.6596	7.609665	5.020503	0.65828	23.54	59.7243	25.887
35.925	447.075	26.46	0.63	2.39	12.8	10.419	2.60955	2.95013	10.3845	2.61823	6	135.00	2.3179	2.31712	0.0008	0.6569	8.175519	5.370828	0.74743	26.88	55.1876	26.673
36.253	446.747	24.52	0.58	2.37	14.27	9.52328	2.61497	2.98363	9.48463	2.62563	6	135.00	2.34004	2.329026	0.011	0.6553	7.72807	5.063885	0.68669	24.43	57.3883	26.063
36.581	446.419	23.35	0.59	2.53	14.8	8.96558	2.81115	3.02295	8.92713	2.82326	5	135.00	2.36218	2.340933	0.0212	0.6536	7.541419	4.928997	0.64978	23.26	60.0436	25.655
36.909	446.091	20.73	0.59	2.83	15.59	7.79725	3.21602	3.10619	7.759	3.23187	5	135.00	2.38432	2.352839	0.0315	0.6519	7.064655	4.605822	0.66799	20.64	65.9272	24.708
37.237	445.763	23.32	0.68	2.92	16.49	8.84389	3.25148	3.06352	8.8016	3.2671	5	135.00	2.40646	2.364746	0.0417	0.6503	7.727244	5.024958	0.64748	23.22	62.8665	25.566
37.565	445.435	24.74	0.81	3.26	8.36	9.38774	3.63043	3.06819	9.36671	3.63859	5	135.00	2.4286	2.376652	0.0519	0.6487	8.24148	5.34592	0.69076	24.69	63.1968	25.99

R13807

Depth (ft)	El. (...)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U. (pct)	Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	445.107	23.87	0.87	3.63	-3.35	8.96744	4.06176	3.11089	8.97582	4.05798	5	135.00	2.45074	2.388558	0.0622	0.647	8.203105	5.307748	0.66313	23.89	66.2702	25.705
38.221	444.779	22.91	0.77	3.37	-3.42	8.51382	3.76765	3.10987	8.52632	3.76213	5	135.00	2.47288	2.400465	0.0724	0.6454	7.871536	5.090563	0.63273	22.94	66.196	25.361
38.549	444.451	25.19	0.68	2.69	-2.47	9.40775	2.99626	3.01817	9.41189	2.99494	5	135.00	2.49502	2.412371	0.0826	0.6438	8.145735	5.24455	0.70263	25.2	59.717	26.032
38.877	444.123	22.12	0.7	3.15	-2.17	8.08605	3.57091	3.11545	8.09018	3.56909	5	135.00	2.51716	2.424278	0.0929	0.6423	7.62211	4.895353	0.6069	22.13	66.604	25.012
39.206	443.794	19.76	0.61	3.07	3.07	7.06859	3.54226	3.1627	7.06036	3.54638	5	135.00	2.53937	2.436222	0.1031	0.6407	7.022462	4.499157	0.53315	19.74	70.1291	24.097
39.862	443.138	25.59	0.74	2.9	5.43	9.35205	3.2165	3.03903	9.33579	3.22211	5	135.00	2.56151	2.448127	0.1134	0.6391	8.154366	5.211628	0.67611	24.37	63.4594	25.669
40.19	442.810	25.05	0.72	2.86	6.14	9.0796	3.20795	3.04697	9.06341	3.21368	5	135.00	2.58365	2.460033	0.1236	0.6376	8.369236	5.335994	0.71227	25.55	61.1526	25.988
40.518	442.482	23.27	0.76	3.25	7.14	8.31053	3.6818	3.11505	8.2904	3.69074	5	135.00	2.60579	2.47194	0.1339	0.636	8.244666	5.244024	0.69467	25.01	61.6447	25.792
40.846	442.154	25.96	0.68	3.4	8.43	9.33984	3.77521	3.08008	9.3158	3.78496	5	135.00	2.62793	2.483646	0.1441	0.6345	7.995391	5.073146	0.63907	23.22	66.5748	25.193
41.174	441.826	25.09	1.01	4.03	8.59	8.93973	4.50535	3.14056	8.91979	4.51542	4	135.00	2.65007	2.495762	0.1543	0.633	8.713036	5.515295	0.72167	25.9	64.0434	25.982
41.502	441.498	23.31	0.9	3.85	10.14	8.18223	4.36561	3.16384	8.15841	4.37636	4	135.00	2.67221	2.507659	0.1645	0.6315	8.772768	5.539906	0.69405	25.04	68.4623	25.693
41.83	441.170	22.11	0.83	3.76	10.72	7.66096	4.27978	3.18239	7.63331	4.29529	4	135.00	2.69435	2.519565	0.1746	0.63	8.27767	5.214892	0.63826	23.25	70.2152	25.096
42.158	440.842	22.65	0.97	4.29	10.46	7.82871	4.87159	3.20785	7.80119	4.88877	4	135.00	2.71649	2.531472	0.185	0.6285	7.949599	4.998417	0.60042	22.04	71.6336	24.65
42.486	440.514	21.66	0.88	4.07	10.99	7.39614	4.65627	3.21626	7.36874	4.67358	4	135.00	2.73863	2.543378	0.1952	0.627	8.293291	5.200217	0.61645	22.58	73.6096	24.8
42.814	440.186	22.04	0.74	3.34	10.67	7.50123	3.84274	3.16291	7.47396	3.85676	5	135.00	2.76077	2.555284	0.2055	0.6256	7.977884	4.990776	0.58512	21.59	74.2704	24.42
43.143	439.857	19.95	0.77	3.87	8.24	6.64754	4.49114	3.24432	6.62815	4.50427	4	135.00	2.78291	2.567191	0.2157	0.6241	7.8169	4.878716	0.59619	21.97	70.1447	24.518
43.471	439.529	17	0.74	4.34	6.35	5.46991	5.22129	3.35118	5.45447	5.23607	3	135.00	2.80512	2.579133	0.226	0.6227	7.505574	4.673551	0.5308	19.9	76.6026	23.717
43.799	439.201	19.37	0.84	4.35	6.47	6.34689	5.08456	3.29171	6.33152	5.0969	3	135.00	2.8494	2.602946	0.2464	0.6198	7.554698	4.682573	0.61147	19.33	80.3734	23.418
44.127	438.873	21.4	1.06	4.94	0.66	7.08585	5.72093	3.28218	7.08585	5.72093	3	135.00	2.87154	2.614853	0.2567	0.6184	8.303236	5.134803	0.57364	21.4	79.585	24.174
44.455	438.545	19.64	0.74	3.78	-0.78	6.37528	4.41888	3.25299	6.37909	4.41624	4	135.00	2.89368	2.626759	0.2669	0.617	7.458995	4.60225	0.51846	19.65	77.2014	23.476
44.783	438.217	15.29	0.89	5.83	-1.04	4.68956	7.19239	3.48477	4.69335	7.18669	3	135.00	2.91582	2.638665	0.2771	0.6156	7.014831	4.318422	0.3831	15.3	97.4824	21.456
45.111	437.889	18.24	0.81	4.42	1.23	5.77311	5.29341	3.33425	5.76934	5.29687	3	135.00	2.93796	2.650572	0.2874	0.6142	7.364226	4.52332	0.47375	18.23	83.9559	22.816
45.439	437.561	23.11	0.9	3.9	2.4	7.5681	4.46652	3.19593	7.56059	4.47096	4	135.00	2.9601	2.662478	0.2976	0.6129	8.408624	5.153258	0.62384	23.09	72.6801	24.62
45.767	437.233	23.58	1.04	4.42	10.81	7.70187	5.04909	3.22274	7.67757	5.06631	4	135.00	2.98224	2.674385	0.3079	0.6115	8.728223	5.337205	0.6377	23.51	74.782	24.724
46.095	436.905	23.42	0.95	4.05	11.02	7.59993	4.6533	3.20639	7.57387	4.66931	4	135.00	3.00438	2.686291	0.3181	0.6101	8.56709	5.227052	0.63206	23.35	73.495	24.638
46.423	436.577	19.68	0.81	4.12	11.46	6.17208	4.86385	3.29142	6.14613	4.88438	4	135.00	3.02652	2.698197	0.3283	0.6088	7.662429	4.664763	0.51559	19.61	80.3493	23.25
46.751	436.249	18.67	0.6	3.22	13.05	5.76411	3.8409	3.25826	5.73459	3.86067	5	135.00	3.04866	2.710104	0.3386	0.6074	7.084343	4.303349	0.48363	18.59	77.6282	22.795
47.079	435.921	19.1	0.56	2.91	15.36	5.88874	3.49362	3.22851	5.852	3.51556	5	135.00	3.0708	2.72201	0.3488	0.6061	7.083552	4.293448	0.49626	19	75.2399	22.932
47.408	435.592	21.41	0.69	3.23	16.88	6.69982	3.76699	3.19955	6.66324	3.78767	5	135.00	3.093	2.733953	0.359	0.6048	7.780455	4.70554	0.56709	21.31	72.9615	23.796
47.736	435.264	49.22	1.77	3.6	20.42	16.7907	3.83907	2.88182	16.7433	3.84993	5	135.00	3.11514	2.745859	0.3693	0.6035	14.60876	8.816054	1.42739	49.09	50.8702	29.92
48.064	434.936	108.31	4.31	3.98	24.9	38.1369	4.09802	2.63254	38.0789	4.10426	5	135.00	3.13728	2.757766	0.3795	0.6022	28.10868	16.92509	3.25612	108.15	36.9683	35.099
48.392	434.608	174.86	6.35	3.63	23.46	61.9931	3.6983	2.45237	61.9389	3.70153	12	135.00	3.15942	2.769672	0.3898	0.6009	41.59558	24.99384	5.31581	174.71	28.5992	37.947
48.72	434.280	126.51	6.37	5.04	9.38	44.3376	5.16507	2.65754	44.316	5.16758	11	135.00	3.18156	2.781579	0.4	0.5996	33.2856	19.95771	3.81822	126.45	38.2371	36.007
49.048	433.952	166.9	6.34	3.8	22.06	58.5993	3.87303	2.48371	58.5492	3.87634	12	135.00	3.2037	2.793486	0.4102	0.5983	40.29083	24.10844	5.068	166.76	29.9602	37.628
49.376	433.624	185.28	8	4.32	29.84	64.8944	4.3943	2.49436	64.8267	4.39889	11	135.00	3.22584	2.805391	0.4205	0.597	44.94566	26.83435	5.69635	185.09	30.4315	38.206
49.704	433.296	146.4	7.86	5.37	33.05	50.8118	5.49067	2.63756	50.7373	5.49873	11	135.00	3.24798	2.817298	0.4307	0.5958	38.08986	22.69306	4.43195	146.19	37.2207	36.803
50.032	432.968	154.76	6.18	3.99	62.54	53.5451	4.07948	2.52808	53.4072	4.09001	12	135.00	3.27012	2.829204	0.4409	0.5945	38.09591	22.64885	4.69009	154.37	31.9538	37.1
50.36	432.640	137.82	5.3	3.84	25.31	47.3504	3.93971	2.55353	47.2941	3.9444	12	135.00	3.29226	2.841111	0.4512	0.5933	34.39466	20.40549	4.16495	137.66	33.1337	36.392
50.688	432.312	63.38	3.81	4.57	22.91	28.0635	4.7586	2.77386	28.0144	4.76693	11	135.00	3.3144	2.853017	0.4614	0.592	23.30703	13.79869	2.47881	83.24	44.5017	33.219
51.016	431.984	58.49	2.41	4.12	21.11	19.2513	4.36963	2.87161	19.2059	4.37996	5	135.00	3.33654	2.864923	0.4716	0.5908	17.26483	10.20013	1.70764	58.36	50.2442	30.822
51.345	431.655	40.89	1.24	3.03	26.95	13.0459	3.30391	2.92987	12.9868	3.31895	6	135.00	3.35875	2.876866	0.4819	0.5896	12.46659	7.350011	1.16196	40.72	53.8834	28.264
51.673	431.327	51.35	1.29	2.52	29.37	16.6054	2.68923	2.79202	16.5431	2.69936	6	135.00	3.38089	2.888772	0.4921	0.5884	14.47144	8.514418	1.48511	51.17	45.5351	29.656
52.001	430.999	79.13	2.66	3.36	27.12	26.1066	3.51262	2.70938	26.048	3.52052	6	135.00	3.40303	2.900679	0.5024	0.5872	21.35463	12.5384	2.34449	78.96	40.9545	32.766
52.329	430.671	74.91	5.41	7.23	-2.71	24.5434	7.56804	2.95489	24.5503	7.56592	11	135.00	3.42517	2.912585	0.5126	0.586	23.28897	13.64618	2.21315	74.93	55.4968	32.394
52.657	430.343	267.69	12.98	4.85	-1.85	90.3551	4.91215	2.43828	90.3585	4.91197	11	135.00	3.44731	2.924492	0.5228	0.5848	63.31944	37.02643	8.18089	267.7	27.9998	40.035

R13808

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 24 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5B

ConeTec Ir Interpretation
Interpretatic - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4397
Job No: 07-804
Client: Civil & Environmental Consultants
Project Pond Creek Mine - Williamson County, Illinois
Site: CPT-5B
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 15:44
CPT File: 804CP05B.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 479.9

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	38.10	1.25	40.93	19.30	2.15
125	Soil Embankment	31.26	1.88	62.63	50.48	2.64

User Inputs:

Assumed:
Water Table Depth (ft): 28
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 479.9
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	479.736	18.44	0.14	0.76	0.34	1728.83	0.760	1.13	1727.89	0.76	8	130.00	0.011	0.011	0.000	2.000	2.71	5.42	0.571	18.43	1.1328	32.78
0.492	479.408	23.22	0.26	1.12	0.21	725.079	1.121	1.41	725.08	1.12	6	130.00	0.032	0.032	0.000	2.000	3.72	7.44	0.718	23.22	1.62684	49.62
0.821	479.080	13.32	0.2	1.51	0.32	248.906	1.506	1.763	248.91	1.51	6	130.00	0.053	0.053	0.000	2.000	2.40	4.80	0.411	13.32	1.85209	45.09
1.149	478.752	12.84	0.15	1.17	0.16	171.072	1.175	1.79	171.07	1.18	6	130.00	0.075	0.075	0.000	2.000	2.33	4.67	0.395	12.84	1.84987	43.30
1.477	478.424	38.97	0.24	0.62	0.39	405.191	0.617	1.33	405.09	0.62	7	130.00	0.096	0.096	0.000	2.000	6.09	12.18	1.204	38.96	0.70668	47.24
1.805	478.096	74.14	0.58	0.78	0.09	831.27	0.784	1.30	831.18	0.78	8	130.00	0.117	0.117	0.000	2.000	11.49	22.97	2.292	74.13	0.40522	49.07
2.133	477.767	60.91	0.73	1.2	0.14	436.323	1.201	1.54	436.32	1.20	7	130.00	0.139	0.139	0.000	2.000	10.15	20.30	1.881	60.91	0.43634	47.56
2.46	477.439	48.52	0.69	1.42	0.23	302.316	1.427	1.69	302.32	1.43	7	130.00	0.160	0.160	0.000	2.000	8.54	17.07	1.497	48.52	0.99653	45.97
2.788	477.111	43.89	0.75	1.7	0.09	241.105	1.716	1.82	241.10	1.72	7	130.00	0.181	0.181	0.000	2.000	8.06	16.12	1.353	43.89	0.9724	44.94
3.116	476.783	44.62	0.57	1.28	0.05	219.231	1.283	1.74	219.23	1.28	7	130.00	0.203	0.203	0.000	2.000	7.95	15.97	1.375	44.62	0.95479	44.49
3.445	476.455	38.58	0.44	1.13	0.02	171.29	1.147	1.76	171.29	1.15	7	130.00	0.224	0.224	0.000	2.000	6.93	13.89	1.187	38.58	0.88488	43.91
3.773	476.127	23.25	0.37	1.57	0.61	93.8032	1.608	2.07	93.80	1.61	6	130.00	0.245	0.245	0.000	2.000	4.70	9.39	0.712	23.25	1.46861	40.23
4.101	475.799	18.59	0.19	1.02	0.32	68.7391	1.037	2.05	68.74	1.04	6	130.00	0.267	0.267	0.000	2.000	3.72	7.44	0.567	18.59	1.27455	38.52
4.429	475.471	17.34	0.16	0.92	0.21	59.2324	0.933	2.07	59.23	0.94	6	130.00	0.288	0.288	0.000	1.964	3.51	6.64	0.526	17.34	1.14482	37.68
4.757	475.143	25.81	0.28	1.09	0.09	82.4721	1.098	2.00	82.47	1.10	7	130.00	0.309	0.309	0.000	1.708	5.09	9.13	0.789	25.81	1.24999	39.53
5.085	474.815	24.43	0.46	1.87	0.41	72.9127	1.909	2.20	72.91	1.91	6	130.00	0.331	0.331	0.000	1.739	4.89	9.08	0.746	21.43	1.95685	38.85
5.413	474.487	18.46	0.38	2.06	0.64	51.4663	2.099	2.34	51.47	2.10	6	130.00	0.352	0.352	0.000	1.586	4.17	7.04	0.561	18.46	2.34042	35.87
5.741	474.159	16.54	0.27	1.61	0.67	43.3238	1.870	2.33	43.35	1.87	6	130.00	0.373	0.373	0.000	1.437	3.78	6.11	0.501	16.54	2.37454	35.86
6.069	473.831	15.21	0.19	1.22	0.62	37.5312	1.283	2.31	37.53	1.28	6	130.00	0.394	0.394	0.000	1.302	3.40	5.41	0.456	15.2	2.06944	34.99
6.398	473.502	15.29	0.17	1.08	0.48	35.7663	1.143	2.30	35.79	1.14	6	130.00	0.416	0.416	0.000	1.251	3.41	5.28	0.460	15.29	2.26364	34.70
6.726	473.174	18.38	0.25	1.34	0.09	40.9655	1.395	2.30	41.00	1.39	6	130.00	0.437	0.437	0.000	1.512	4.09	6.13	0.555	18.36	2.26837	35.52
7.054	472.846	20.73	0.37	1.77	0.23	44.2117	1.825	2.35	44.21	1.83	6	130.00	0.459	0.459	0.000	1.477	4.71	6.99	0.628	20.73	2.48234	36.97
7.382	472.518	11.94	0.22	1.8	0.14	23.8838	1.920	2.58	23.88	1.92	5	130.00	0.480	0.480	0.000	1.444	3.02	4.35	0.375	11.94	3.41773	32.17
7.71	472.190	11.14	0.1	0.85	0.35	21.2289	0.940	2.45	21.25	0.94	6	130.00	0.501	0.501	0.000	1.413	2.65	3.75	0.329	11.15	2.58942	31.42
8.038	471.862	16.59	0.13	0.8	0.44	28.839	0.863	2.32	28.84	0.86	6	130.00	0.522	0.522	0.000	1.383	3.40	4.83	0.466	16.59	2.32198	33.36
8.366	471.534	15.96	0.17	1.04	0.67	28.3496	1.103	2.38	28.37	1.10	6	130.00	0.544	0.544	0.000	1.356	3.68	4.99	0.477	15.97	2.55638	33.26
8.694	471.206	13.31	0.18	1.32	0.46	22.5529	1.412	2.52	22.57	1.41	6	130.00	0.565	0.565	0.000	1.330	3.28	4.38	0.395	13.32	2.91621	31.81
9.022	470.878	16.16	0.14	0.84	0.64	26.6566	0.899	2.36	26.66	0.90	6	130.00	0.586	0.586	0.000	1.306	3.69	4.81	0.482	16.16	2.47768	32.85
9.36	470.550	12.95	0.14	0.78	0.6	28.5352	0.807	2.31	28.54	0.81	6	130.00	0.608	0.608	0.000	1.283	4.01	5.14	0.537	17.95	2.83351	33.30
9.678	470.222	14.69	0.11	0.72	0.61	22.3619	0.782	2.39	22.37	0.78	6	130.00	0.629	0.629	0.000	1.261	3.41	4.30	0.436	14.7	2.61982	31.75
10.006	469.894	15.13	0.13	0.83	0.32	22.269	0.898	2.42	22.28	0.90	6	130.00	0.650	0.650	0.000	1.240	3.56	4.41	0.448	15.14	2.74287	31.73
10.335	469.565	19.67	0.48	2.45	0.05	28.2806	2.627	2.59	28.28	2.63	5	130.00	0.672	0.672	0.000	1.220	5.00	6.10	0.568	19.67	3.18607	33.24
10.663	469.237	22.81	0.74	3.23	0.67	31.9104	3.346	2.63	31.91	3.35	5	130.00	0.693	0.693	0.000	1.201	5.82	7.11	0.685	22.81	3.76632	33.99
10.99	468.909	13.41	0.42	3.14	0.42	17.7706	3.308	2.82	17.77	3.31	4	130.00	0.714	0.714	0.000	1.183	3.85	4.68	0.393	13.41	4.19432	30.26
11.319	468.581	19.13	0.26	1.36	0.67	25.0012	1.413	2.48	25.00	1.41	6	130.00	0.736	0.736	0.000	1.166	4.62	6.39	0.589	19.13	2.09799	32.46
11.647	468.253	17.75	0.22	1.21	0.62	22.4461	1.295	2.50	22.46	1.29	6	130.00	0.757	0.757	0.000	1.149	4.39	5.98	0.526	17.76	2.00742	31.78
11.975	467.925	18.33	0.28	1.53	0.32	22.5491	1.595	2.55	22.55	1.60	6	130.00	0.778	0.778	0.000	1.133	4.67	6.18	0.543	18.33	2.12997	31.80
12.303	467.597	33.79	0.45	1.32	0.58	41.2536	1.364	2.90	41.25	1.36	7	130.00	0.800	0.800	0.000	1.118	7.60	8.69	1.021	33.79	2.38958	35.58
12.631	467.269	97.39	1.27	1.31	0.35	117.621	1.315	1.94	117.62	1.32	8	130.00	0.821	0.821	0.000	1.104	18.70	20.94	2.990	97.39	1.18008	41.42
12.959	466.941	115.69	1.69	1.46	0.39	136.344	1.472	1.93	136.34	1.47	8	130.00	0.842	0.842	0.000	1.090	22.12	24.10	3.566	115.69	1.12641	42.17
13.287	466.613	126.13	2.46	1.95	0.69	145.042	1.964	2.00	145.04	1.96	7	130.00	0.864	0.864	0.000	1.076	24.91	26.70	3.878	126.13	1.29801	42.49
13.615	466.285	126.81	2.52	1.98	0.67	142.261	2.001	2.01	142.26	2.00	7	130.00	0.885	0.885	0.000	1.063	25.05	26.63	3.898	126.8	1.32784	42.39
13.943	465.957	96.74	2.09	2.16	0.09	105.742	2.181	2.13	105.74	2.18	7	130.00	0.906	0.906	0.000	1.050	19.99	21.00	2.967	96.74	1.59035	40.86
14.271	465.629	74.23	1.62	2.18	1.2	79.0224	2.210	2.22	79.03	2.21	7	130.00	0.926	0.926	0.000	1.038	15.94	16.55	2.269	74.24	1.9585	39.30
14.599	465.300	62.31	1.1	1.61	0.99	64.6586	1.630	2.19	64.67	1.63	7	130.00	0.949	0.949	0.000	1.027	13.23	13.58	1.900	62.32	1.87205	38.18
14.928	464.972	62.88	1	1.59	0.92	63.8034	1.615	2.19	63.81	1.61	7	130.00	0.970	0.970	0.000	1.015	13.36	13.57	1.917	62.89	1.87825	38.10
15.256	464.644	49.08	0.73	1.48	1.61	48.4938	1.518	2.27	48.50	1.52	7	130.00	0.992	0.992	0.000	1.004	10.77	10.81	1.489	49.09	1.21776	36.52

R13810

Depth (ft)	El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U. (pcf)	VStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	464.316	46.97	0.47	1	-1.55	45.3691	1.023	2.19	45.38	1.02	7	130.00	1.018	1.013	0.000	0.964	6.97	9.91	1.1233	46.98	18.6866	36.13
15.912	463.988	56.81	0.64	1.21	-1.6	53.9271	1.147	2.16	53.94	1.15	7	130.00	1.034	1.034	0.000	0.943	8.40	11.70	1.3715	56.82	20.6279	37.41
16.21	463.660	78.21	0.7	1.28	-1.70	73.0906	1.296	2.09	73.10	1.30	8	130.00	1.056	1.056	0.000	0.923	15.91	15.49	2.2895	78.22	25.4178	38.67
16.568	463.332	70.07	1.01	1.44	-0.59	64.0652	1.464	2.16	64.07	1.46	7	130.00	1.077	1.077	0.000	0.904	13.47	14.18	2.0496	70.08	24.0331	38.13
16.868	463.004	58.0	0.78	1.36	-0.59	52.6313	1.364	2.22	52.63	1.38	7	130.00	1.098	1.098	0.000	0.884	11.63	12.05	1.7001	58.0	19.6365	37.00
17.224	462.676	49.64	0.81	1.64	-0.21	43.3388	1.669	2.33	43.34	1.67	7	130.00	1.120	1.120	0.000	0.865	11.19	10.68	1.502	49.64	23.7509	35.65
17.552	462.348	41.77	0.69	1.64	-0.36	35.6121	1.699	2.40	35.62	1.70	6	130.00	1.141	1.141	0.000	0.938	9.73	9.11	1.258	41.78	26.6988	34.67
17.84	462.020	66.82	0.68	1.19	-0.42	47.8935	1.222	2.22	47.89	1.22	7	130.00	1.162	1.162	0.000	0.928	12.19	11.31	1.723	66.82	19.5408	36.45
18.208	461.692	67.55	1.17	1.74	-0.42	56.0755	1.76294	2.26108	56.0755	1.76294	7	130.00	1.18352	1.18352	0	0.8192	14.76722	13.67409	2.05469	67.55	21.1064	37.385
18.567	461.363	65.8	1.63	2.48	-0.64	53.6101	2.52341	2.3793	53.6101	2.52341	6	130.00	1.20491	1.204905	0	0.811	15.15043	13.80221	1.99985	65.8	25.6761	37.106
18.86	461.035	91.05	1.9	2.11	-0.67	49.2763	2.15147	2.36009	49.2763	2.15147	7	130.00	1.22623	1.226225	0	0.803	14.40719	12.70883	1.87071	91.05	29.8137	36.614
19.193	460.707	47.05	0.79	1.67	-0.53	36.7141	1.7248	2.39828	36.7141	1.7248	7	125.00	1.24755	1.247545	0	0.8953	10.92664	9.782697	1.41803	47.05	26.3409	34.856
19.521	460.379	44.52	0.68	1.53	-0.9	34.1092	1.57218	2.39964	34.1171	1.57182	7	125.00	1.26805	1.268045	0	0.888	10.3478	9.189267	1.33907	44.53	26.3963	34.407
19.849	460.051	40.76	0.63	1.55	-0.25	30.6326	1.59609	2.44144	30.6326	1.59609	7	125.00	1.28855	1.288545	0	0.8809	9.655144	8.505678	1.22203	40.76	28.1937	33.741
20.177	459.723	38.62	0.63	1.64	-0.16	28.5024	1.68851	2.48112	28.5024	1.68851	7	125.00	1.30905	1.309045	0	0.874	9.319563	8.145509	1.16514	38.62	29.8463	33.291
20.505	459.395	44.39	0.75	1.69	-0.51	32.3874	1.74174	2.44416	32.3949	1.74133	7	125.00	1.32955	1.329545	0	0.8673	10.53065	9.132793	1.33314	44.4	28.2491	34.088
20.833	459.067	57.91	1.33	2.3	-0.41	41.8949	2.35149	2.43862	41.8949	2.35149	6	125.00	1.35005	1.350045	0	0.8608	13.69973	11.79066	1.75108	57.91	28.0145	35.652
21.161	458.739	25.08	1.34	5.36	-0.07	17.2993	5.65175	2.97846	17.2993	5.65175	3	125.00	1.37055	1.370545	0	0.8542	7.90839	6.76625	0.73404	25.08	57.0449	30.082
21.489	458.411	21.57	0.8	3.69	2.73	14.5063	3.96453	2.93879	14.4991	3.96649	4	125.00	1.39105	1.391045	0	0.8479	6.636117	5.626566	0.62474	21.56	54.455	28.914
21.817	458.083	29.59	0.95	3.2	6.9	19.9628	3.37137	2.78704	19.9345	3.37616	5	125.00	1.41155	1.411545	0	0.8417	8.334097	7.014733	0.8724	29.55	45.2501	31.009
22.145	457.755	33.08	1.22	3.68	8.57	22.0998	3.65491	2.79022	22.0649	3.66101	5	125.00	1.43205	1.432045	0	0.8356	9.331922	7.798171	0.97981	33.03	45.4317	31.665
22.473	457.427	36.31	1.19	3.29	9.54	23.9975	3.4139	2.72893	23.9562	3.41979	5	125.00	1.45255	1.452545	0	0.8297	9.906188	8.219431	1.07918	36.25	42.0101	32.192
22.802	457.098	35.83	1.22	3.4	9.26	23.3227	3.55098	2.74942	23.282	3.55717	5	125.00	1.47311	1.473105	0	0.8239	9.883264	8.142993	1.06368	35.77	43.1354	32.01
23.13	456.770	36.3	1.11	3.07	13.63	23.3036	3.18907	2.7202	23.25	3.19642	5	125.00	1.49361	1.493608	0	0.8182	9.852044	8.061356	1.0776	36.22	41.5368	32.001
23.458	456.442	34.31	1.06	3.08	15.62	21.6602	3.23211	2.74896	21.5942	3.242	5	125.00	1.51411	1.514108	0	0.8127	9.449872	7.679759	1.01535	34.21	43.1096	31.526
23.786	456.114	34.28	1.04	3.03	17.95	21.338	3.17602	2.74944	21.2663	3.18672	5	125.00	1.53461	1.534608	0	0.8072	9.441263	7.621342	1.01379	34.17	43.136	31.428
24.114	455.786	34.12	1.05	3.07	21.34	20.9406	3.22433	2.7603	20.857	3.23725	5	125.00	1.55511	1.555108	0	0.8019	9.44696	7.57551	1.0082	33.99	43.7399	31.302
24.442	455.458	33.09	1.19	3.59	20.71	20.0014	3.77605	2.8192	19.9189	3.79169	5	125.00	1.57561	1.575608	0	0.7967	9.463703	7.539406	0.97568	32.96	47.1098	31.004
24.77	455.130	35.21	1.24	3.53	21.94	21.0599	3.68895	2.79552	20.9722	3.70438	5	125.00	1.59611	1.596108	0	0.7915	9.937404	7.865781	1.04068	35.07	45.7358	31.338
25.098	454.802	35.32	1.2	3.39	24.9	20.8482	3.56047	2.78926	20.7554	3.57639	5	125.00	1.61661	1.616608	0	0.7865	9.93126	7.810917	1.04345	35.17	45.3767	31.27
25.426	454.474	33.07	1.09	3.29	27.37	19.2003	3.46771	2.81033	19.0964	3.48656	5	125.00	1.63711	1.637108	0	0.7816	9.399677	7.346396	0.97315	32.9	46.5923	30.729
25.754	454.146	30.14	0.89	2.96	28.13	17.1628	3.12474	2.82084	17.0742	3.14461	5	125.00	1.65761	1.657608	0	0.7767	8.610264	6.687682	0.88181	29.96	47.206	29.996
26.082	453.818	28.04	0.96	3.41	30.18	15.7093	3.64162	2.8929	15.5961	3.66806	5	125.00	1.67811	1.678108	0	0.772	8.341715	6.439401	0.81616	27.85	51.555	29.398
26.41	453.490	27.22	1.12	4.12	32.24	15.0249	4.36848	2.95894	14.9071	4.42314	4	125.00	1.69861	1.698608	0	0.7673	8.418813	6.459581	0.79014	27.02	55.761	29.099
26.738	453.161	25.07	1.08	4.3	31.06	13.5826	4.6251	3.00754	13.4721	4.66305	4	125.00	1.71917	1.71917	0	0.7627	7.988621	6.092736	0.72294	24.88	58.9941	28.424
27.067	452.833	22.52	0.88	3.89	31.69	11.945	4.23477	3.02853	11.83	4.27593	4	125.00	1.73967	1.73967	0	0.7582	7.262848	5.606094	0.64335	22.32	60.4271	27.552
27.395	452.505	23.13	1	4.33	31.09	12.1408	4.67949	3.04924	12.0328	4.72147	4	125.00	1.76017	1.76017	0	0.7537	7.563768	5.70113	0.6616	22.94	61.8634	27.667
27.723	452.177	24.42	1.29	5.28	27.74	12.7139	5.69805	3.08711	12.6129	5.74372	3	125.00	1.78067	1.78067	0	0.7494	8.192462	6.139354	0.70091	24.24	64.5468	27.983
28.051	451.849	25.99	1.44	5.53	25.13	13.4414	5.95316	3.07983	13.358	5.99031	3	135.00	1.80117	1.799579	0.0016	0.7454	8.691388	6.478936	0.74888	25.84	64.0251	28.368
28.379	451.521	24.42	1.32	5.42	22.7	12.4741	5.64156	3.09958	12.3913	5.6806	3	135.00	1.82331	1.811485	0.0118	0.743	8.270747	6.145077	0.69959	24.27	65.4465	27.867
28.707	451.193	24.47	1.16	4.75	25.24	12.4079	5.12717	3.06558	12.3202	5.16369	3	135.00	1.84545	1.823392	0.0221	0.7406	8.100847	5.99916	0.70045	24.31	63.0122	27.832
29.035	450.865	24.85	1.17	4.72	24.97	12.5224	5.09085	3.06047	12.4353	5.12654	3	135.00	1.86759	1.835299	0.0323	0.7382	8.200162	6.052979	0.71153	24.69	62.6514	27.897
29.363	450.537	25.04	1.24	4.96	25.89	12.5326	5.35631	3.07414	12.446	5.39359	3	135.00	1.88973	1.847204	0.0425	0.7358	8.337266	6.134317	0.71673	24.88	63.6191	27.906
29.691	450.209	24.64	1.36	5.51	22.33	12.2253	5.98377	3.1127	12.15	6.02086	3	135.00	1.91187	1.859111	0.0528	0.7334	8.422789	6.177365	0.70366	24.5	66.4024	27.747
30.019	449.881	19.78	1.13	5.7	16.6	9.53812	6.33195	3.21114	9.48467	6.36764	3	135.00	1.93401	1.871017	0.063	0.7311	7.245293	5.296842	0.55251	19.68	73.8677	26.083
30.347	449.553	16.42	0.88	5.37	15.59	7.68159	6.08413	3.27481	7.62848	6.12649	3	135.00	1.95615	1.882924	0.0732	0.7288	6.296958	4.588962	0.4478	16.32	78.9765	24.616
30.676	449.225	20.02	0.87	4.36	20.02	9.52155	4.82216	3.13916	9.45822	4.85445	4	135.00	1.97829	1.89483	0.0895	0.7265	6.965316	5.060062	0.55857	19.9	69.3583	26.072
31.004	448.896	23.04	1.19	5.16	16.63	11.0341	5.65603	3.1306	10.9816	5.68304	3	135.00	2.0005	1.906773	0.0937	0.7242	7.982538	5.780848	0.65138	22.94	67.7209	27.081
31.332	448.568	21.44	1.16	5.4	11.94	10.1202	5.97403	3.17402	10.0837	5.99565	3	135.00	2.02264	1.918679	0.104	0.7219	7.662654	5.531947	0.60116	21.37	70.991	26.51
31.66	448.240	16.83	1.16	6.88	4.5	7.65841	7.84587	3.34165	7.64287	7.86162	3	135.00	2.04478	1.930586	0.1142	0.7197	6.626488	4.913086	0.45775	16.8	84.59	24.646
31.988	447.912	14.1	1.08	7.64	2.65	6.19466	8.97526	3.44974	6.16437	8.9902	3	135.00	2.06692	1.942492	0.1244	0.7175	6.258887	4.490736	0.37254	14.08	94.2141	23.229
32.316	447.584	36.85	1.84	4.99	8.52	17.786	5.2933	2.95167	17.7553	5.30245	3	135.00	2.08905	1.954398	0.1347	0.7153	11.41236	8.163359	1.07619	36.79	55.2875	30.278
32.644	447.256	53.58	2.7	5.03	7.3	26.1754	5.2459	2.82443	26.15	5.251	4	135.00	2.1112	1.966305	0.1449	0.7131	15.41519	10.99318	1.59346	53.53	47.4168	32.767
32.972	446.928	41.03	2.46	5.99	2.4	19.6625	6.32445	2.97035	19.6524	6.3277	3	135.00	2.13334	1.978211	0.1551	0.711	12.66718	9.148439	1.20423	41.01	56.5089	30.942
33.3	446.600	30.73	1.67	5.43	5.52	14.3582	5.84437	3.04968	14.3431	5.85051	3	135.00	2.15548	1.990118	0.1654	0.7089	10.12526	7.177398	0.88466	30.7	61.8941	28.881
33.628	446.272	25.44	1.21	4.77	7.23	11.6194	5.20153	3.0884	11.5995	5.21049	3	135.00	2.17762	2.002024	0.1756	0.7067	8.691848	6.072283	0.7202	25.4	64.6397	27.47
33.956	445.944	24.48	1.07	4.38	8.05	11.0631	4.80246	3.08384	11.0382	4.81326	4	135.00	2.19976	2.013993	0.1858	0.7047	8.238887	5.80559	0.69879	24.43	64.8124	27.142
34.284	445.616	24.3	1.08	4.43	9.26	10.8983	4.89172	3.0942	10.8686	4.90505	4	135.00	2.2219	2.025837	0.1961	0.7026	8.231024	5.782979	0.68353	24.24	65.0574	27.041
34.612	445.288	25.03	1.22	4.87	9.17	11.182	5.35417	3.10955	11.1574	5.36595	3	135.00	2.24404	2.037743	0.2063	0.7005	8.569686	6.003302	0.70545	24.98	66.1725	27.219
34.941	444.959	21.34	0.88	4.11	11.34	9.3057	4.61367	3.13367	9.27155	4.63066	4	135.00	2.26625	2.049686	0.2166	0.6985	7.41695	5.180619	0.59052	21.27	67.9493	25.982
35.269	444.631	22.16	0.83	3.76	13.05	9.63896	4.17681	3.0961	9.59531	4.19582	4	135.00	2.28839	2.061592	0.2268	0.6965	7.503638	5.226013	0.61522	22.07	65.1947	26.215
35.597	444.303	27.65	1.08	3.92	12.93	12.2206	4.26212	3.01844	12.1821	4.27562	4	135.00	2.31053	2.073499	0.237	0.6945	8.913341	6.189971	0.7845	27.57	59.7354	27.812
35.926	443.975	41.71	1.36	3.26	15.45	18.8823	3.45376	2.81298	18.8392	3.46168	5	135.00	2.33267	2.085405	0.2473	0.6925	11.90861	8.246427	1.21911	41.62	46.7462	30.682
36.253	443.647	119.94	5.26	4.39	10.53	56.0647	4.47335	2.54245	56.0314	4.47602	11	135.00	2.35481	2.097311	0.2575	0.6905	29.78849	20.56918	3.64041	119.67	32.6167	37.373
36.581	443.319	232.84	9.81	4.21	-2.08	109.265	4.25665	2.33841	109.269	4.25646	12	135.00	2.37695	2.109218	0.2677	0.6886	52.64439	36.24861	7.13508	232.85	23.9715	41.04
36.909	442.991	245.39	11.65	4.75	-7.92	114.558	4.79442	2.38708	114.581	4.79343	11	135.00	2.39909	2.121124	0.278	0.6866	56.20316	38.59027	7.52294	245.44	25.0892	41.287
37.237	442.663	185.81	11.73	6.31	-9.21	85.9757	6.39625	2.54195	86.0038	6.39416	11	135.00	2.42123	2.133031	0.2882	0.6847	46.17875	31.51867	5.67767	185.87	32.5936	39.766
37.565	442.335	190.28	10.73	5.64	-3.88	87.5721	5.71241	2.49823	87.5814	5.7118	11	135.00	2.44337	2.144937	0.2984	0.6828	46.29593	31.61081	5.81538	190.3	30.6039	39.865

Depth (ft)	El.	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	442.007	280.56	11.76	4.19	-0.79	128.936	4.22878	2.29281	128.941	4.22863	12	135.00	2.46551	2.156843	0.3087	0.6809	62.17955	42.33877	8.60974	280.57	22.2559	41.895
38.221	441.679	230.05	12.58	5.47	-8.43	104.928	5.52816	2.43946	104.951	5.52694	11	135.00	2.48765	2.16875	0.3189	0.679	54.45582	36.97767	7.04527	230.1	28.0501	40.829
38.549	441.351	214.58	12.79	5.96	-3.42	97.2506	6.03102	2.48953	97.2644	6.03017	11	135.00	2.50979	2.180656	0.3291	0.6772	51.99489	35.21008	6.56564	214.61	30.2173	40.427
38.877	441.023	252.97	15.89	6.28	-5.22	114.222	6.34488	2.46678	114.208	6.34564	11	135.00	2.53193	2.192563	0.3394	0.6753	60.62771	40.94446	7.7535	252.94	29.2202	41.271
39.206	440.694	369.1	14.5	3.93	49.56	166.271	3.95585	2.20569	166.131	3.9592	12	135.00	2.55413	2.204505	0.3496	0.6735	78.75678	53.04353	11.3482	368.79	19.1854	43.163

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 28 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-6

ConeTec In nterpretation
Interpretati t - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4364
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-6
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 12:00
CPT File: 804CP06.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 457.8

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	37.16	1.38	45.31	35.45	2.55

User Inputs:

Assumed: Water Table Depth (ft): 9.2 Ground Surface Elev. 457.8
Nk: 32.3
State Parameter: 1.2 CPT area ratio: 0.85
Unit Weight of Soil (pcf): Varies See Below See Below Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	457.636	8.56	0.1	1.11	-0.53	834.122	1.170	1.40	834.12	1.17	5	125.00	0.010	0.010	0.000	2.000	1.37	2.74	0.265	8.56	1.52433	50.16
0.492	457.308	9.31	0.29	3.12	-2.93	301.764	3.125	1.98	302.41	3.12	4	125.00	0.031	0.031	0.000	2.000	1.92	3.84	0.287	9.33	12.388	45.97
0.82	456.980	10.69	0.47	4.33	-10.58	211.486	4.336	2.18	212.85	4.31	3	125.00	0.051	0.051	0.000	2.000	2.31	4.63	0.336	10.96	18.2558	44.35
1.148	456.652	15.32	0.83	5.4	-7.37	212.519	5.443	2.26	213.08	5.43	3	125.00	0.072	0.072	0.000	2.000	3.36	6.72	0.472	15.36	21.1963	44.36
1.476	456.324	38.89	1.49	3.84	3.12	420.572	3.840	1.99	420.36	3.84	5	125.00	0.092	0.092	0.000	2.000	7.62	15.25	1.201	38.87	12.7664	47.40
1.804	455.996	64.95	2.12	3.26	8.39	575.053	3.270	1.87	574.61	3.27	6	125.00	0.113	0.113	0.000	2.000	12.18	24.35	2.007	64.9	9.79283	48.70
2.133	455.667	91.43	3.22	3.53	-3.19	684.832	3.527	1.88	684.98	3.53	6	125.00	0.133	0.133	0.000	2.000	17.18	34.35	2.827	91.45	9.86183	49.40
2.461	455.339	106.27	4.78	4.5	0.53	689.906	4.504	1.98	689.84	4.50	11	125.00	0.154	0.154	0.000	2.000	20.72	41.43	3.285	106.26	12.339	49.42
2.789	455.011	97.06	5.09	5.25	3.16	555.816	5.254	2.07	555.70	5.25	11	125.00	0.174	0.174	0.000	2.000	19.62	39.25	3.000	97.04	14.9656	48.56
3.117	454.683	83.61	4.4	5.26	13.6	428.182	5.275	2.12	427.72	5.28	11	125.00	0.195	0.195	0.000	2.000	17.19	34.38	2.583	83.52	16.2983	47.48
3.445	454.355	75.27	3.59	4.77	18.34	348.585	4.783	2.11	348.07	4.79	11	125.00	0.215	0.215	0.000	2.000	15.46	30.93	2.324	75.16	16.2656	46.59
3.773	454.027	65.07	3.24	4.98	11.57	274.94	4.997	2.18	274.64	5.00	11	125.00	0.236	0.236	0.000	2.000	13.73	27.45	2.007	65	18.2882	45.53
4.101	453.699	64.94	3.2	4.93	6.12	252.363	4.947	2.19	252.21	4.95	11	125.00	0.256	0.256	0.000	1.975	13.78	27.23	2.003	64.9	18.7426	45.14
4.429	453.371	69.37	3.12	4.93	5.33	227.928	4.945	2.21	227.82	4.95	11	125.00	0.277	0.277	0.000	1.901	13.57	25.80	1.953	69.34	19.4706	44.67
4.757	453.043	55.6	2.82	5.07	3.75	186.009	5.099	2.27	185.91	5.10	4	125.00	0.297	0.297	0.000	1.834	12.20	22.38	1.712	55.57	21.4653	43.71
5.085	452.715	46.31	2.63	5.68	-1.89	144.715	5.718	2.37	144.75	5.72	3	125.00	0.318	0.318	0.000	1.774	10.63	18.85	1.424	46.32	25.262	42.47
5.413	452.387	49.15	2.45	4.98	-2.28	144.28	5.019	2.33	144.31	5.02	4	125.00	0.338	0.338	0.000	1.719	11.05	19.00	1.511	49.16	23.4659	42.46
5.741	452.059	41.44	2.45	5.91	-3.05	114.492	5.964	2.44	114.55	5.96	3	125.00	0.359	0.359	0.000	1.669	9.83	16.41	1.272	41.46	28.2345	41.28
6.069	451.731	40.26	2.34	5.81	-3.23	105.139	5.868	2.46	105.19	5.86	3	125.00	0.379	0.379	0.000	1.624	9.62	15.62	1.235	40.28	28.9115	40.83
6.398	451.402	35.34	1.94	5.49	-2.68	87.3776	5.552	2.49	87.43	5.55	3	125.00	0.400	0.400	0.000	1.581	8.56	13.54	1.082	35.36	30.1842	39.85
6.726	451.074	29.43	1.47	4.99	-1.85	69.0089	5.067	2.52	69.06	5.06	3	125.00	0.420	0.420	0.000	1.542	7.25	11.18	0.898	29.45	31.6997	38.55
7.054	450.746	22.96	1.12	4.89	-1.15	51.0783	4.974	2.60	51.10	4.97	3	125.00	0.441	0.441	0.000	1.506	5.88	8.86	0.697	22.97	35.5076	36.83
7.382	450.418	22.39	1.27	5.66	-4.08	47.5289	5.792	2.67	47.59	5.78	3	125.00	0.461	0.461	0.000	1.472	5.95	8.76	0.679	22.42	39.0065	36.41
7.71	450.090	24.72	1.47	5.94	-5.27	50.2996	6.065	2.67	50.38	6.05	3	125.00	0.482	0.482	0.000	1.441	6.56	9.45	0.750	24.76	38.9216	36.74
8.038	449.762	25.96	1.6	6.18	-6.42	50.6745	6.285	2.68	50.75	6.28	3	125.00	0.502	0.502	0.000	1.411	6.93	9.77	0.788	26	39.4189	36.79
8.366	449.434	23.65	1.49	6.3	-8.13	44.2307	6.443	2.73	44.33	6.43	3	125.00	0.523	0.523	0.000	1.383	6.47	8.95	0.716	23.7	41.9186	35.99
8.694	449.106	24.35	1.37	5.64	-8.36	43.8125	5.755	2.69	43.90	5.74	3	125.00	0.543	0.543	0.000	1.357	6.55	8.88	0.737	24.4	40.1258	35.93
9.022	448.778	28.28	1.49	5.28	-7.63	49.153	5.376	2.64	49.24	5.37	3	125.00	0.564	0.564	0.000	1.332	7.38	9.83	0.858	28.33	37.2649	36.61
9.35	448.450	28.51	1.65	5.78	-7.81	48.173	5.909	2.67	48.24	5.90	3	135.00	0.584	0.580	0.005	1.313	7.58	9.96	0.865	28.55	39.1366	36.49
9.678	448.122	28.8	1.69	5.86	-6.77	47.6562	5.994	2.68	47.72	5.99	3	135.00	0.607	0.592	0.015	1.300	7.69	10.00	0.873	28.84	39.5436	36.43
10.006	447.794	30.8	1.75	5.68	-4.18	49.9933	5.800	2.66	50.03	5.80	3	135.00	0.629	0.604	0.025	1.287	8.12	10.45	0.934	30.82	38.2961	36.71
10.335	447.465	27.19	1.42	5.23	-3.86	43.1215	5.351	2.68	43.17	5.34	3	135.00	0.651	0.615	0.035	1.275	7.23	9.22	0.822	27.22	39.1905	35.84
10.663	447.137	24.41	1.15	4.72	-3.58	37.8365	4.845	2.68	37.87	4.84	3	135.00	0.673	0.627	0.046	1.263	6.52	8.23	0.735	24.43	39.6428	35.06
10.991	446.809	22.72	0.94	4.13	-3.23	34.4535	4.268	2.68	34.48	4.26	4	135.00	0.695	0.639	0.056	1.251	6.04	7.55	0.682	22.74	39.1418	34.49
11.319	446.481	22.41	0.82	3.65	-2.63	33.3135	3.780	2.65	33.33	3.78	5	135.00	0.717	0.651	0.066	1.239	5.88	7.28	0.672	22.42	37.8448	34.28
11.647	446.153	22.09	0.86	3.9	-2.01	32.1993	4.028	2.68	32.21	4.03	4	135.00	0.739	0.663	0.076	1.228	5.88	7.23	0.661	22.1	39.3712	34.08
11.975	445.825	19.57	0.82	4.2	-1.41	27.8651	4.360	2.75	27.88	4.36	4	135.00	0.762	0.675	0.087	1.217	5.41	6.58	0.582	19.58	43.1036	33.18
12.303	445.497	18.59	0.79	4.26	-0.78	25.9231	4.437	2.78	25.92	4.44	4	135.00	0.784	0.687	0.097	1.207	5.22	6.29	0.551	18.59	44.7056	32.73
12.631	445.169	16.32	0.81	4.95	-0.6	22.2013	5.221	2.87	22.20	5.22	3	135.00	0.806	0.699	0.107	1.196	4.84	5.79	0.480	16.32	50.4414	31.75
12.959	444.841	19.07	0.83	4.36	0.74	25.6676	4.550	2.79	25.67	4.55	3	135.00	0.828	0.711	0.117	1.186	5.38	6.38	0.565	19.07	45.3058	32.67
13.287	444.513	21.2	1	4.73	8.36	28.1617	4.914	2.78	28.09	4.93	3	135.00	0.850	0.723	0.128	1.176	5.95	7.00	0.630	21.15	45.0064	33.24
13.615	444.185	20.7	0.95	4.58	10.95	26.9943	4.791	2.79	26.91	4.81	3	135.00	0.872	0.735	0.138	1.167	5.83	6.80	0.614	20.64	45.3618	32.97
13.943	443.857	23.12	1.2	5.2	13.55	29.7762	5.399	2.79	29.66	5.42	3	135.00	0.894	0.746	0.148	1.157	6.52	7.55	0.688	23.03	45.6855	33.58
14.271	443.529	29.53	1.34	4.53	13.72	37.7323	4.683	2.68	37.63	4.70	4	135.00	0.917	0.758	0.158	1.148	7.83	8.99	0.886	29.45	39.2582	35.04
14.6	443.200	26.74	0.91	3.39	16.67	33.4964	3.527	2.63	33.37	3.54	5	135.00	0.939	0.770	0.168	1.139	6.92	7.88	0.799	26.64	36.8635	34.31
14.928	442.872	20.25	0.7	3.44	21.11	24.6608	3.629	2.74	24.49	3.65	5	135.00	0.961	0.782	0.179	1.131	5.53	6.25	0.597	20.12	42.6233	32.39
15.256	442.544	17.79	0.62	3.49	24.51	21.1653	3.689	2.80	20.96	3.72	4	135.00	0.983	0.794	0.189	1.122	5.00	5.61	0.520	17.63	45.8297	31.41

R13814

Depth (ft)	S...	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.W (pcf)	...tress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	442.216	15.28	0.55	3.61	26.19	17.7109	3.853	2.87	17.50	3.90	4	135.00	1.005	0.806	0.199	1.114	4.47	4.98	0.442	15.11	50.169	30.25
15.912	441.888	12.73	0.44	3.46	28.8	14.3083	3.760	2.94	14.09	3.82	4	135.00	1.027	0.818	0.209	1.106	3.86	4.27	0.362	12.55	54.4336	28.84
16.24	441.560	10.89	0.43	3.91	30.79	11.8589	4.370	3.05	11.63	4.46	3	135.00	1.049	0.830	0.220	1.098	3.52	3.86	0.305	10.7	61.5912	27.59
16.568	441.232	10.9	0.3	2.76	46.79	11.6767	3.052	2.96	11.33	3.15	4	135.00	1.072	0.842	0.230	1.090	3.32	3.61	0.304	10.61	56.0979	27.42
16.896	440.904	10.8	0.23	2.13	52.75	11.3708	2.370	2.91	11.00	2.46	5	135.00	1.094	0.854	0.240	1.082	3.18	3.44	0.301	10.48	52.8448	27.23
17.224	440.576	11.97	0.28	2.35	59.86	12.5406	2.580	2.90	12.10	2.67	5	135.00	1.116	0.866	0.250	1.075	3.49	3.75	0.336	11.59	52.0107	27.86
17.552	440.248	10.88	0.31	2.86	64.85	11.1029	3.182	3.00	10.65	3.32	4	135.00	1.138	0.877	0.261	1.068	3.35	3.57	0.302	10.48	58.4614	27.03
17.88	439.920	8.13	0.21	2.59	64.13	7.83716	3.013	3.12	7.39	3.20	4	135.00	1.160	0.889	0.271	1.060	2.67	2.83	0.216	7.73	67.0317	24.64
18.208	439.592	9.83	0.21	2.14	70.88	9.59534	2.428	2.99	9.11	2.56	5	135.00	1.182	0.901	0.281	1.053	2.99	3.15	0.268	9.39	57.9642	26.01
18.537	439.263	14.59	0.35	2.37	85.33	14.6581	2.615	2.85	14.07	2.72	5	135.00	1.204	0.913	0.291	1.046	4.11	4.30	0.414	14.05	49.0242	28.86
18.865	438.935	17.47	0.43	2.47	91.82	17.5587	2.647	2.79	16.94	2.74	5	135.00	1.227	0.925	0.302	1.040	4.77	4.96	0.503	16.9	45.2968	30.07
19.193	438.607	23.8	0.66	2.76	108.66	24.0676	2.927	2.70	23.34	3.02	5	135.00	1.249	0.937	0.312	1.033	6.23	6.44	0.698	23.12	40.6187	32.12
19.521	438.279	26.5	1.31	4.94	95.15	26.5877	5.192	2.83	25.97	5.32	3	135.00	1.271	0.949	0.322	1.027	7.49	7.69	0.781	25.91	47.7672	32.79
19.849	437.951	23.66	0.83	3.52	20.44	23.2793	3.711	2.76	23.15	3.73	5	135.00	1.293	0.961	0.332	1.020	6.56	6.69	0.692	23.54	43.9821	32.07
20.177	437.623	18.99	0.49	2.56	28.01	18.1706	2.772	2.77	18.00	2.80	5	135.00	1.315	0.973	0.342	1.014	5.26	5.34	0.547	18.82	44.4019	30.47
20.505	437.295	18.95	0.78	4.1	37.55	17.8877	4.429	2.91	17.65	4.49	4	135.00	1.337	0.985	0.353	1.008	5.65	5.70	0.545	18.72	52.3926	30.35
20.833	436.967	49.87	2.16	4.32	27.3	48.6795	4.453	2.58	48.51	4.47	5	135.00	1.359	0.997	0.363	1.002	12.61	12.63	1.502	49.7	34.6157	36.57
21.161	436.639	83.66	5.29	6.33	-14.43	81.5902	6.429	2.56	81.68	6.42	11	135.00	1.382	1.008	0.373	0.998	20.96	20.87	2.547	83.75	33.2996	39.50
21.489	436.311	243.98	10.44	4.28	-17.83	237.74	4.304	2.15	237.85	4.30	11	135.00	1.404	1.020	0.383	0.990	50.99	50.48	7.510	244.09	17.4322	44.88
21.817	435.983	336.34	16.44	4.89	-19.33	324.451	4.909	2.14	324.57	4.91	11	135.00	1.426	1.032	0.394	0.984	69.87	68.77	10.369	336.46	16.9751	46.29
22.145	435.655	423.23	17.94	4.24	-18.68	403.946	4.253	2.04	404.05	4.25	12	135.00	1.448	1.044	0.404	0.979	84.57	82.76	13.058	423.34	14.0663	47.24

R13815

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 31 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY JJS DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-7

ConeTec Inc nterpretation
Interpretation - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4331
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-7
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 07:58
CPT File: 804CP07.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 457.8

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.96	1.80	58.51	25.19	2.31

User Inputs:

Assumed: Water Table Depth (ft): 9.2 Ground Surface Elev. 457.8
Nk: 32.3
State Parameter: 1.2 CPT area ratio: 0.85
Unit Weight of Soil (pcf): Varies See Below See Below Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (lb)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	457.636	9.8	0.17	1.69	-0.53	955.098	1.737	1.54	955.10	1.74	5	125.00	0.010	0.010	0.000	2.000	1.64	3.27	0.303	9.8	3.41567	50.67
0.492	457.308	30.91	0.44	1.41	-5.98	1004.2	1.425	1.45	1005.50	1.42	6	125.00	0.031	0.031	0.000	2.000	5.02	10.05	0.956	30.95	2.16306	50.86
0.82	456.980	42	0.69	1.65	-14.97	818.512	1.645	1.54	820.46	1.64	7	125.00	0.051	0.051	0.000	2.000	7.03	14.07	1.299	42.1	3.40523	50.09
1.148	456.652	38.42	0.68	1.76	-15.08	634.47	1.773	1.64	635.86	1.77	6	125.00	0.072	0.072	0.000	2.000	6.66	13.33	1.187	38.52	5.10589	48.41
1.475	456.324	35.13	0.57	1.61	-15.89	379.813	1.627	1.68	380.90	1.62	6	125.00	0.092	0.092	0.000	2.000	6.18	12.36	1.085	35.23	5.82028	46.98
1.804	455.996	33.61	0.6	1.77	-9.56	297.093	1.791	1.78	297.63	1.79	6	125.00	0.113	0.113	0.000	2.000	6.10	12.20	1.037	33.67	7.65399	45.90
2.133	455.667	35.29	0.79	2.24	-0.3	263.716	2.247	1.89	263.79	2.25	6	125.00	0.133	0.133	0.000	2.000	6.66	13.32	1.088	35.3	10.1362	45.35
2.461	455.339	39.86	1	2.5	-0.42	258.147	2.518	1.94	258.15	2.52	6	125.00	0.154	0.154	0.000	2.000	7.65	15.30	1.229	39.86	11.2767	45.25
2.789	455.011	41.14	1.05	2.55	-0.46	235.013	2.563	1.96	235.01	2.56	6	125.00	0.174	0.174	0.000	2.000	7.98	15.97	1.268	41.14	12.0156	44.82
3.117	454.683	36.47	0.82	2.25	-0.6	186.206	2.260	1.98	186.26	2.26	6	125.00	0.195	0.195	0.000	2.000	7.12	14.23	1.123	36.48	12.3943	43.72
3.445	454.355	34.59	0.81	2.35	-0.76	159.65	2.356	2.03	159.65	2.36	6	125.00	0.215	0.215	0.000	2.000	6.89	13.79	1.064	34.59	13.9069	42.96
3.773	454.027	45.16	1.24	2.75	-0.76	190.508	2.760	2.04	190.51	2.76	6	125.00	0.236	0.236	0.000	2.000	9.03	18.06	1.391	45.16	14.1489	43.82
4.101	453.699	52.95	1.71	3.23	-0.23	205.584	3.245	2.08	205.58	3.25	6	125.00	0.256	0.256	0.000	1.975	10.75	21.24	1.631	52.95	15.2795	44.19
4.429	453.371	39.45	1.59	4.04	4.97	141.615	4.059	2.26	141.41	4.06	5	125.00	0.277	0.277	0.000	1.901	8.60	16.34	1.213	39.42	20.8937	42.36
4.757	453.043	25.66	0.97	3.77	17.39	85.3065	3.825	2.37	84.94	3.84	5	125.00	0.297	0.297	0.000	1.834	5.87	10.76	0.785	25.65	25.3185	39.69
5.085	452.715	16.21	0.6	3.68	17.83	50.0049	3.775	2.53	49.63	3.80	4	125.00	0.318	0.318	0.000	1.774	3.97	7.04	0.492	16.09	31.9342	36.66
5.413	452.387	12.96	0.42	3.21	19.31	37.3078	3.328	2.58	36.95	3.36	4	125.00	0.338	0.338	0.000	1.719	3.25	5.59	0.391	12.84	34.5011	34.90
5.741	452.059	11.85	0.37	3.13	19.93	32.0256	3.220	2.62	31.66	3.26	4	125.00	0.359	0.359	0.000	1.669	3.03	5.06	0.356	11.72	36.5018	33.95
6.069	451.731	10.67	0.33	3.1	21.39	27.1298	3.207	2.68	26.79	3.25	4	125.00	0.379	0.379	0.000	1.624	2.80	4.55	0.319	10.54	39.2642	32.90
6.398	451.402	9.96	0.31	3.07	23.76	23.9078	3.243	2.72	23.53	3.29	4	125.00	0.400	0.400	0.000	1.581	2.67	4.23	0.296	9.81	41.7687	32.08
6.726	451.074	9.7	0.29	2.95	38.6	22.0746	3.125	2.75	21.50	3.21	4	125.00	0.420	0.420	0.000	1.542	2.61	4.03	0.287	9.46	43.0291	31.50
7.054	450.746	14.29	0.34	2.35	47.48	31.4128	2.455	2.56	30.73	2.51	5	125.00	0.441	0.441	0.000	1.506	3.51	5.28	0.429	13.99	33.4317	33.76
7.382	450.418	16.66	0.5	3	56.9	35.1528	3.083	2.59	34.37	3.15	5	125.00	0.461	0.461	0.000	1.472	4.15	6.10	0.502	16.32	34.7346	34.45
7.71	450.090	21.63	0.78	3.61	62.19	43.8872	3.688	2.57	43.08	3.76	5	125.00	0.482	0.482	0.000	1.441	5.34	7.70	0.655	21.24	33.789	35.82
8.038	449.762	21.3	0.89	4.19	65.68	41.3986	4.279	2.63	40.58	4.37	4	125.00	0.502	0.502	0.000	1.411	5.43	7.66	0.644	20.89	36.9226	35.46
8.366	449.434	20.62	0.75	3.62	74.41	38.4358	3.732	2.62	37.54	3.82	4	125.00	0.523	0.523	0.000	1.383	5.19	7.18	0.622	20.15	36.1207	34.99
8.694	449.106	21.71	0.73	3.35	61.34	38.954	3.449	2.59	38.03	3.53	5	125.00	0.543	0.543	0.000	1.357	5.39	7.31	0.655	21.21	34.7719	35.07
9.022	448.778	22.26	0.62	2.79	96.35	38.4768	2.858	2.54	37.41	2.94	5	125.00	0.564	0.564	0.000	1.332	5.37	7.16	0.672	21.66	32.4751	34.97
9.35	448.450	20.7	0.61	2.93	91.74	34.7004	3.032	2.59	33.70	3.12	5	135.00	0.584	0.580	0.005	1.313	5.12	6.73	0.623	20.12	34.9106	34.33
9.678	448.122	20.96	0.7	3.35	82.7	34.4041	3.439	2.63	33.53	3.53	5	135.00	0.607	0.592	0.015	1.300	5.30	6.89	0.630	20.44	36.7405	34.30
10.006	447.794	23.37	0.86	3.67	95.38	37.6819	3.782	2.63	36.70	3.88	5	135.00	0.629	0.604	0.025	1.287	5.90	7.60	0.704	22.78	36.7081	34.86
10.335	447.465	23.21	0.93	4.02	86.47	36.6547	4.122	2.66	35.79	4.22	4	135.00	0.651	0.615	0.035	1.275	5.98	7.62	0.698	22.68	38.3828	34.71
10.663	447.137	22.31	0.82	3.68	48.55	34.4891	3.790	2.65	34.01	3.84	4	135.00	0.673	0.627	0.046	1.263	5.77	7.28	0.670	22.01	37.7717	34.40
10.991	446.809	21.94	0.83	3.79	50.34	33.2333	3.907	2.67	32.73	3.97	4	135.00	0.695	0.639	0.056	1.251	5.73	7.16	0.656	21.62	38.6777	34.17
11.319	446.481	23.94	0.89	3.73	69.05	35.6631	3.832	2.64	35.00	3.90	5	135.00	0.717	0.651	0.066	1.239	6.15	7.62	0.719	23.51	37.5487	34.58
11.647	446.153	31.54	1.47	4.66	33.07	46.451	4.773	2.62	46.13	4.81	4	135.00	0.739	0.663	0.076	1.228	8.10	9.95	0.954	31.33	36.4723	36.24
11.975	445.825	52.03	1.94	3.73	5.47	75.9652	3.784	2.40	75.91	3.79	5	135.00	0.762	0.675	0.087	1.217	12.09	14.71	1.587	52	26.4167	39.08
12.303	445.497	68.4	2.67	3.91	-22.86	98.4385	3.949	2.34	98.66	3.94	5	135.00	0.784	0.687	0.097	1.207	15.51	18.71	2.093	68.55	24.0213	40.50
12.631	445.169	53.25	3.19	6	-25.04	75.0494	6.083	2.56	75.25	6.07	3	135.00	0.806	0.699	0.107	1.196	13.38	16.01	1.624	53.4	33.4083	39.04
12.959	444.841	50.44	2.84	5.63	-25.2	69.8071	5.724	2.56	70.03	5.71	3	135.00	0.828	0.711	0.117	1.186	12.67	15.03	1.536	50.6	33.3638	38.64
13.287	444.513	31.23	2.43	7.77	-27.34	42.042	7.999	2.81	42.28	7.95	3	135.00	0.850	0.723	0.128	1.176	8.97	10.55	0.941	31.4	46.5809	35.73
13.615	444.185	36.66	2.18	5.95	-26.55	48.723	6.091	2.68	48.94	6.06	3	135.00	0.872	0.735	0.138	1.167	9.80	11.44	1.108	36.82	39.3835	36.60
13.943	443.857	56.53	3.08	5.44	-25.93	74.5365	5.536	2.53	74.75	5.52	3	135.00	0.894	0.746	0.148	1.157	14.00	16.20	1.722	56.69	32.013	39.00
14.271	443.529	129.14	5.32	4.12	-25.68	169.087	4.149	2.22	169.30	4.14	11	135.00	0.917	0.758	0.158	1.148	27.75	31.86	3.970	129.3	19.5836	43.26
14.6	443.200	241.69	8.13	3.37	-25.73	312.554	3.377	2.00	312.76	3.37	12	135.00	0.939	0.770	0.168	1.139	47.59	54.28	7.454	241.85	12.9931	46.12
14.928	442.872	231.67	8.83	3.81	-26.66	294.958	3.827	2.06	295.16	3.82	12	135.00	0.961	0.782	0.179	1.131	46.69	52.80	7.143	231.83	14.6671	45.86
15.256	442.544	258.78	8.95	3.46	-26.07	324.647	3.472	2.00	324.85	3.47	12	135.00	0.983	0.794	0.189	1.122	51.01	57.24	7.981	258.94	13.0637	46.29

R13817

Depth (ft)	El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.594	442.216	285.8	8.43	2.95	-26.9	353.348	2.960	1.93	353.55	2.96	12	135.00	1.005	0.806	0.199	1.114	54.68	60.90	6.817	285.86	11.0253	46.66
15.912	441.888	277.04	7.22	2.61	-28.01	337.467	2.616	1.89	337.67	2.61	7	135.00	1.027	0.818	0.209	1.108	52.28	57.81	6.545	277.21	10.1227	46.46
16.24	441.560	219.73	6.99	3.18	-28.89	263.533	3.196	2.02	263.75	3.19	12	135.00	1.049	0.830	0.220	1.098	43.55	47.81	6.770	219.91	13.4471	45.35

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 34 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-8

ConeTec In Interpretation
Interpretatio - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4303
Job No 07-804
Client: Civil & Environmental Consultants
Project Pond Creek Mine - Williamson County, Illinois
Site: CPT-8
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 09:53
CPT File: 804CP08.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 445

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.90	1.70	55.34	26.74	2.35

User Inputs:

Assumed:
Water Table Depth (ft): 6.6
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 445.0
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rin (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	444.836	17.37	0.13	0.75	0.35	1693.63	0.749	1.12	1693.63	0.75	6	125.00	0.010	0.010	0.000	2.000	2.55	5.11	0.537	17.37	1.1659	52.71
0.492	444.508	21.17	0.35	1.66	-1.57	687.455	1.656	1.57	687.78	1.65	6	125.00	0.031	0.031	0.000	2.000	3.58	7.15	0.654	21.18	3.90719	49.41
0.82	444.180	31.35	0.66	2.09	-3.09	610.707	2.109	1.69	611.10	2.11	6	125.00	0.051	0.051	0.000	2.000	5.51	11.02	0.969	31.37	5.90214	48.94
1.148	443.852	43.85	0.95	2.17	-1.25	610.15	2.170	1.70	610.29	2.17	6	125.00	0.072	0.072	0.000	2.000	7.73	15.47	1.355	43.86	6.12164	48.94
1.475	443.524	44.4	1.46	3.29	-0.37	480.301	3.295	1.91	480.30	3.30	5	125.00	0.092	0.092	0.000	2.000	8.43	16.87	1.372	44.4	10.5965	47.96
1.804	443.196	47.24	1.66	3.51	0.21	417.98	3.522	1.96	417.98	3.52	5	125.00	0.113	0.113	0.000	2.000	9.15	18.30	1.459	47.24	11.8951	47.38
2.133	442.867	63.62	1.74	2.74	-0.23	476.225	2.741	1.84	476.22	2.74	6	125.00	0.133	0.133	0.000	2.000	11.78	23.55	1.966	63.62	8.93891	47.93
2.461	442.539	81.01	2.67	3.29	1.8	525.68	3.302	1.89	525.62	3.30	6	125.00	0.154	0.154	0.000	2.000	15.30	30.60	2.503	81	10.2349	48.33
2.789	442.211	87.64	3.13	3.57	0.02	501.775	3.579	1.93	501.78	3.58	6	125.00	0.174	0.174	0.000	2.000	16.80	33.61	2.708	87.64	11.2144	48.14
3.117	441.883	72.36	2.94	4.06	0.81	370.434	4.074	2.04	370.38	4.07	5	125.00	0.195	0.195	0.000	2.000	14.45	28.90	2.234	72.35	14.0558	46.86
3.445	441.555	54.96	2.44	4.43	7.57	254.257	4.457	2.15	254.02	4.46	5	125.00	0.215	0.215	0.000	2.000	11.47	22.93	1.695	54.91	17.4107	45.18
3.773	441.227	45.6	1.94	4.26	13.4	192.374	4.277	2.20	192.03	4.28	5	125.00	0.236	0.236	0.000	2.000	9.70	19.39	1.404	45.52	18.9745	43.86
4.101	440.899	47.91	1.89	3.94	10.16	185.92	3.968	2.18	185.69	3.97	5	125.00	0.256	0.256	0.000	1.975	10.11	19.97	1.475	47.85	18.3226	43.70
4.429	440.571	55.66	1.91	3.43	18.45	200.075	3.449	2.11	199.64	3.46	5	125.00	0.277	0.277	0.000	1.901	11.41	21.70	1.715	55.54	16.1775	44.05
4.757	440.243	51.39	1.71	3.33	24.18	171.848	3.347	2.14	171.31	3.36	6	125.00	0.297	0.297	0.000	1.834	10.65	19.52	1.582	51.23	17.0225	43.31
5.085	439.915	45.68	1.53	3.36	21.34	142.733	3.373	2.19	142.32	3.38	5	125.00	0.318	0.318	0.000	1.774	9.66	17.14	1.404	45.55	18.6417	42.39
5.413	439.587	37.97	1.4	3.7	20.18	111.234	3.720	2.29	110.88	3.78	5	125.00	0.338	0.338	0.000	1.719	8.38	14.40	1.165	37.85	22.1372	41.11
5.741	439.259	32.73	1.25	3.83	18.96	90.2176	3.861	2.36	89.88	3.88	5	125.00	0.359	0.359	0.000	1.669	7.44	12.43	1.002	32.61	24.8088	40.00
6.069	438.931	32.51	1.3	3.99	14.67	84.7077	4.046	2.39	84.47	4.06	5	125.00	0.379	0.379	0.000	1.624	7.51	12.19	0.995	32.42	26.1077	39.66
6.398	438.602	30.81	1.37	4.44	8.27	76.0491	4.505	2.46	75.92	4.51	4	125.00	0.400	0.400	0.000	1.581	7.34	11.61	0.941	30.76	28.8283	39.08
6.726	438.274	30.16	1.35	4.47	11.29	71.4133	4.539	2.48	71.25	4.55	4	135.00	0.420	0.416	0.004	1.550	7.25	11.24	0.921	30.09	29.7266	38.72
7.054	437.946	30.78	1.3	4.22	12.22	70.824	4.285	2.46	70.64	4.30	4	135.00	0.443	0.428	0.014	1.528	7.34	11.22	0.939	30.7	29.0142	38.68
7.382	437.618	28.58	1.25	4.38	14.3	63.8613	4.446	2.50	63.66	4.46	4	135.00	0.465	0.440	0.024	1.507	6.95	10.48	0.870	28.49	30.8671	38.09
7.71	437.290	25.37	1.1	4.35	16	55.0315	4.421	2.55	54.81	4.44	4	135.00	0.487	0.452	0.035	1.487	6.29	9.36	0.770	25.27	32.7937	37.24
8.039	436.962	23.17	1.04	4.48	16.81	48.8312	4.589	2.59	48.59	4.61	4	135.00	0.509	0.464	0.045	1.468	5.86	8.63	0.702	23.06	35.0715	36.54
8.368	436.634	21.72	0.99	4.55	15.7	44.5168	4.672	2.63	44.31	4.69	3	135.00	0.531	0.476	0.055	1.449	5.60	8.12	0.656	21.62	36.7119	36.00
8.694	436.306	22.5	0.76	3.39	17	44.9838	3.463	2.53	44.76	3.48	5	135.00	0.553	0.488	0.065	1.432	5.54	7.93	0.679	22.39	32.1478	36.06
9.022	435.978	20.87	0.66	3.17	17.39	40.6065	3.252	2.55	40.41	3.27	5	135.00	0.575	0.500	0.076	1.415	5.17	7.31	0.628	20.77	32.7685	35.46
9.35	435.650	20.28	0.77	3.78	19.44	38.4653	3.912	2.62	38.23	3.94	4	135.00	0.597	0.512	0.086	1.398	5.20	7.27	0.609	20.16	36.2763	35.13
9.678	435.322	22.23	1.07	4.83	14.64	41.2726	4.951	2.67	41.08	4.97	3	135.00	0.620	0.524	0.096	1.382	5.66	8.10	0.669	22.13	38.7923	35.56
10.006	434.994	27.84	1.15	4.14	14.22	50.7896	4.228	2.56	50.62	4.24	4	135.00	0.642	0.536	0.106	1.367	6.94	9.48	0.842	27.75	33.2318	36.79
10.335	434.665	30.49	1.3	4.26	2.51	54.4817	4.359	2.54	54.50	4.36	4	135.00	0.664	0.547	0.117	1.352	7.58	10.24	0.923	30.5	32.5983	37.22
10.663	434.337	20.58	1.04	5.04	-8.43	35.5656	5.228	2.73	35.67	5.21	3	135.00	0.686	0.559	0.127	1.337	5.63	7.53	0.616	20.64	41.8344	34.72
10.991	434.009	21.64	0.79	3.66	-8.2	36.6411	3.774	2.62	36.73	3.77	4	135.00	0.708	0.571	0.137	1.323	5.60	7.40	0.648	21.69	36.2422	34.90
11.319	433.681	18.91	0.92	4.85	-4.78	31.1738	5.061	2.76	31.23	5.05	3	135.00	0.730	0.583	0.147	1.309	5.26	6.88	0.563	18.94	43.5695	33.91
11.647	433.353	17	0.91	5.34	-3.97	27.3032	5.601	2.83	27.35	5.59	3	135.00	0.753	0.595	0.157	1.296	4.92	6.37	0.503	17.03	47.693	33.09
11.975	433.025	20.2	1.09	5.41	-3.4	32.0031	5.611	2.78	32.04	5.61	3	135.00	0.775	0.607	0.168	1.284	5.68	7.30	0.601	20.22	44.908	34.07
12.303	432.697	23.77	1.16	4.87	-3.74	37.12	5.049	2.70	37.15	5.04	3	135.00	0.797	0.619	0.178	1.271	6.41	8.15	0.711	23.79	40.6258	34.97
12.631	432.369	23.53	1.14	4.86	-2.66	36.0038	5.020	2.71	36.02	5.02	3	135.00	0.819	0.631	0.188	1.259	6.37	8.02	0.703	23.54	41.0417	34.79
12.959	432.041	25.86	1.03	3.99	-1.59	38.9277	4.117	2.63	38.94	4.12	4	135.00	0.841	0.643	0.198	1.247	6.70	8.36	0.775	25.87	36.659	35.26
13.287	431.713	28.74	1.22	4.25	4.68	42.5854	4.376	2.62	42.54	4.38	4	135.00	0.863	0.655	0.209	1.236	7.41	9.16	0.863	28.71	36.2582	35.79
13.615	431.385	23.7	0.95	4.02	4.89	34.2297	4.164	2.67	34.18	4.17	4	135.00	0.885	0.667	0.219	1.225	6.27	7.69	0.706	23.67	38.9362	34.48
13.943	431.057	21.82	0.56	2.55	10.93	30.8252	2.676	2.58	30.72	2.69	5	135.00	0.908	0.678	0.229	1.214	5.50	6.68	0.647	21.75	34.3343	33.83
14.271	430.729	17.59	0.45	2.54	19.05	24.134	2.701	2.67	23.96	2.72	5	135.00	0.930	0.690	0.239	1.204	4.62	5.56	0.516	17.47	38.6783	32.28
14.6	430.400	15.35	0.32	2.09	24.25	20.5023	2.223	2.67	20.29	2.25	5	135.00	0.952	0.702	0.250	1.193	4.03	4.81	0.446	15.2	39.0527	31.24
14.928	430.072	13.48	0.21	1.52	31.31	17.5111	1.679	2.66	17.25	1.71	6	135.00	0.974	0.714	0.260	1.183	3.51	4.15	0.387	13.29	38.6544	30.20
15.256	429.744	13.47	0.25	1.82	40.37	17.1797	2.004	2.72	16.84	2.05	6	135.00	0.996	0.726	0.270	1.174	3.59	4.21	0.386	13.22	41.3202	30.05

R13820

Depth (ft)	El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U (pct)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.581	429.416	18.28	0.5	2.74	47	23.3902	2.897	2.70	22.98	2.95	5	135.00	1.018	0.738	0.280	1.164	4.84	5.64	0.534	17.98	40.5576	32.03
15.912	429.088	44.7	2.02	4.53	28.04	58.2209	4.627	2.54	57.98	4.65	4	135.00	1.040	0.750	0.291	1.155	11.07	12.79	1.352	44.52	32.7068	37.60
16.24	428.760	126.44	5.34	4.22	-16.4	164.58	4.259	2.23	164.72	4.26	11	135.00	1.063	0.762	0.301	1.146	27.34	31.33	3.882	126.55	20.1417	43.13
16.568	428.432	213.9	10.81	5.05	-15.7	275.059	5.080	2.18	275.19	5.08	11	136.00	1.085	0.774	0.311	1.137	45.29	51.49	6.589	214	18.4606	45.55
16.896	428.104	378.56	14.03	3.71	-15.73	480.355	3.717	1.96	480.48	3.72	12	137.00	1.107	0.786	0.321	1.128	73.23	82.61	11.686	378.66	11.787	47.97
17.224	427.776	341.19	15.02	4.4	-15.91	426.134	4.417	2.05	426.26	4.42	12	138.00	1.129	0.798	0.331	1.119	68.32	76.47	10.528	341.29	14.2134	47.46
17.552	427.448	312.91	15.43	4.93	-12.1	384.691	4.949	2.11	384.79	4.95	11	139.00	1.152	0.810	0.342	1.111	64.25	71.37	9.652	312.99	16.0829	47.03

R13821

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 37 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY TJS DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-9

ConeTec I Interpretation
Interpretatic - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4276
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-9
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 09:17
CPT File: 804CP09.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 445.7

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.25	1.38	45.19	28.02	2.40

User Inputs:
Assumed: Water Table Depth (ft): 7.8
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 445.7
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	445.636	15.38	0.2	1.27	-2.59	1499.49	1.301	1.37	1501.44	1.30	6	125.00	0.010	0.010	0.000	2.000	2.43	4.87	0.476	15.4	1.11893	52.29
0.492	445.208	19.82	0.38	1.92	-12.01	643.553	1.920	1.64	646.15	1.91	6	125.00	0.031	0.031	0.000	2.000	3.44	6.88	0.613	19.9	5.03728	49.17
0.82	444.880	30.1	0.63	2.1	-9.01	586.317	2.097	1.69	587.29	2.09	6	125.00	0.051	0.051	0.000	2.000	5.30	10.61	0.930	30.15	5.98332	48.78
1.148	444.552	43.87	0.91	2.07	-3.21	610.429	2.078	1.68	610.71	2.08	6	125.00	0.072	0.072	0.000	2.000	7.69	15.39	1.356	43.89	5.7973	48.94
1.476	444.224	47.66	1.19	2.49	0.07	515.64	2.502	1.79	515.64	2.50	6	125.00	0.092	0.092	0.000	2.000	8.66	17.33	1.473	47.66	7.8425	48.25
1.804	443.896	45.87	1.66	3.62	0.07	405.829	3.628	1.98	405.83	3.63	5	125.00	0.113	0.113	0.000	2.000	8.94	17.89	1.417	45.87	12.3418	47.25
2.133	443.567	41.72	1.66	3.98	0.25	311.949	3.992	2.07	311.95	3.99	5	125.00	0.133	0.133	0.000	2.000	8.42	16.84	1.288	41.72	14.8063	46.11
2.461	443.239	37.44	1.52	4.06	0.39	242.413	4.077	2.13	242.41	4.08	5	125.00	0.154	0.154	0.000	2.000	7.74	15.49	1.154	37.44	16.6663	44.96
2.789	442.911	44.47	1.87	4.2	0.66	254.117	4.222	2.13	254.06	4.22	5	125.00	0.174	0.174	0.000	2.000	9.21	18.41	1.371	44.46	16.7567	45.18
3.117	442.583	59.57	2.65	4.44	0.23	304.781	4.463	2.11	304.78	4.46	5	125.00	0.195	0.195	0.000	2.000	12.25	24.50	1.838	59.57	16.2268	46.00
3.445	442.255	70.47	2.79	3.95	1.85	326.292	3.971	2.06	326.25	3.97	5	125.00	0.215	0.215	0.000	2.000	14.16	28.31	2.175	70.46	14.487	46.30
3.773	441.927	74.67	2.46	3.29	0.62	315.65	3.305	1.99	315.69	3.30	6	125.00	0.236	0.236	0.000	2.000	14.64	29.28	2.304	74.68	12.725	46.16
4.101	441.599	84.53	2.85	3.37	1.85	328.793	3.382	1.99	328.75	3.38	6	125.00	0.256	0.256	0.000	1.975	16.57	32.73	2.609	84.52	12.7342	46.34
4.429	441.271	104.33	3.88	3.72	1.8	375.898	3.729	2.00	376.86	3.73	6	125.00	0.277	0.277	0.000	1.901	20.54	39.03	3.221	104.32	13.0225	46.92
4.757	440.943	96.44	3.96	4.11	2.45	323.373	4.119	2.07	323.34	4.12	5	125.00	0.297	0.297	0.000	1.834	19.50	36.76	2.977	96.43	14.9462	46.26
5.085	440.615	102.25	4.19	4.1	0.62	320.731	4.111	2.07	320.70	4.11	5	125.00	0.318	0.318	0.000	1.774	20.68	38.68	3.156	102.24	14.9718	46.23
5.413	440.287	98.2	4.51	4.59	1.13	289.264	4.609	2.14	289.23	4.61	11	125.00	0.338	0.338	0.000	1.719	20.38	35.04	3.030	98.19	16.9403	45.77
5.741	439.959	94.73	4.11	4.34	4.32	263.01	4.355	2.14	262.98	4.36	11	125.00	0.359	0.359	0.000	1.669	19.65	32.80	2.922	94.7	16.894	45.33
6.069	439.631	84.93	3.46	4.08	5.01	222.905	4.092	2.15	222.83	4.09	5	125.00	0.379	0.379	0.000	1.624	17.71	28.75	2.618	84.9	17.3092	44.57
6.398	439.302	87.66	3.56	4.07	2.24	218.219	4.080	2.15	218.24	4.08	5	125.00	0.400	0.400	0.000	1.581	18.31	28.96	2.702	87.67	17.4182	44.47
6.726	438.974	69.12	3.37	4.87	4.69	163.425	4.905	2.29	163.35	4.91	11	125.00	0.420	0.420	0.000	1.542	15.27	23.56	2.127	69.09	22.0488	43.08
7.054	438.646	63.77	3.03	4.76	3.08	143.644	4.785	2.31	143.60	4.79	4	125.00	0.441	0.441	0.000	1.506	14.23	21.43	1.961	63.75	22.8724	42.43
7.382	438.318	53.39	2.77	5.19	7.53	114.719	5.233	2.40	114.61	5.24	3	125.00	0.461	0.461	0.000	1.472	12.39	18.24	1.639	53.34	26.3327	41.28
7.71	437.990	48.17	2.41	4.99	4.9	98.9637	5.054	2.42	98.90	5.06	4	125.00	0.482	0.482	0.000	1.441	11.31	16.30	1.476	48.14	27.4055	40.51
8.038	437.662	38.46	1.98	5.15	10.26	76.6899	5.216	2.50	76.55	5.23	3	135.00	0.502	0.495	0.007	1.421	9.37	13.31	1.175	38.39	30.8807	39.12
8.366	437.334	30.22	1.55	5.12	11.57	58.5876	5.220	2.58	58.45	5.23	3	135.00	0.525	0.507	0.018	1.405	7.63	10.72	0.919	30.16	34.4169	37.61
8.694	437.006	29.4	1.39	4.89	12.03	53.6919	4.990	2.59	53.55	5.00	3	135.00	0.547	0.519	0.028	1.388	7.21	10.01	0.862	28.33	34.9372	37.11
9.022	436.678	29.4	1.32	4.5	11.46	54.33	4.578	2.56	54.20	4.59	4	135.00	0.569	0.531	0.038	1.373	7.35	10.09	0.893	29.33	33.449	37.18
9.35	436.350	28.31	1.17	4.14	11.87	51.088	4.221	2.55	50.94	4.23	4	135.00	0.591	0.543	0.049	1.358	7.05	9.57	0.858	28.23	33.1117	36.82
9.678	436.022	26.35	1.19	4.53	15.1	46.4162	4.624	2.61	46.24	4.64	4	135.00	0.613	0.554	0.059	1.343	6.75	9.06	0.797	26.25	35.9001	36.25
10.006	435.694	25.07	1.15	4.6	14.55	43.1414	4.706	2.64	42.98	4.72	3	135.00	0.635	0.566	0.069	1.329	6.51	8.65	0.756	24.98	37.2699	35.82
10.335	435.365	25.89	1.24	4.78	13.4	43.63	4.914	2.65	43.49	4.93	3	135.00	0.657	0.578	0.079	1.315	6.76	8.89	0.781	25.81	37.7669	35.89
10.663	435.037	22.8	1.2	5.28	9.91	37.4772	5.425	2.72	37.38	5.44	3	135.00	0.680	0.590	0.089	1.302	6.20	8.07	0.685	22.74	41.7846	34.99
10.991	434.709	27.92	1.18	4.22	10.86	45.2024	4.335	2.60	45.09	4.35	4	135.00	0.702	0.602	0.100	1.289	7.11	9.17	0.843	27.65	35.267	36.11
11.319	434.381	29.42	1.45	4.92	10.88	46.7326	5.053	2.64	46.62	5.07	3	135.00	0.724	0.614	0.110	1.276	7.64	9.75	0.888	29.35	37.1499	36.31
11.647	434.053	26.23	1.41	5.39	11.38	40.7121	5.533	2.71	40.60	5.55	3	135.00	0.746	0.626	0.120	1.264	7.06	8.93	0.789	26.16	40.7787	35.49
11.975	433.725	23.16	0.99	4.29	10.95	35.1046	4.421	2.68	34.99	4.44	4	135.00	0.768	0.638	0.130	1.252	6.16	7.71	0.693	23.09	39.5208	34.60
12.303	433.397	20.42	0.52	2.55	11.83	30.2103	2.649	2.58	30.10	2.66	5	135.00	0.790	0.650	0.140	1.241	5.16	6.40	0.608	20.35	34.5204	33.68
12.631	433.069	16.58	0.49	2.64	14.43	26.8524	2.758	2.63	26.72	2.77	5	135.00	0.812	0.662	0.151	1.229	4.81	5.91	0.550	18.49	37.0571	32.94
12.959	432.741	22.2	0.51	2.28	45.47	31.7192	2.387	2.54	31.29	2.42	6	135.00	0.835	0.674	0.161	1.218	5.45	6.64	0.661	21.91	32.6826	33.92
13.287	432.413	18.14	0.35	1.91	50.26	25.2132	2.025	2.58	24.75	2.06	6	135.00	0.857	0.685	0.171	1.208	4.52	5.45	0.535	17.82	34.4848	32.46
13.615	432.085	15.81	0.26	1.65	56.56	21.4099	1.741	2.60	20.91	1.78	6	135.00	0.879	0.697	0.181	1.197	3.96	4.74	0.462	15.48	36.5971	31.40
13.943	431.757	12.95	0.21	1.59	52.01	16.9872	1.743	2.69	16.52	1.79	5	135.00	0.901	0.709	0.192	1.187	3.38	4.01	0.373	12.62	39.9818	29.89
14.271	431.429	11.94	0.19	1.55	59.86	15.2756	1.725	2.73	14.75	1.79	5	135.00	0.923	0.721	0.202	1.178	3.16	3.73	0.341	11.56	42.1627	29.15
14.6	431.100	12.26	0.19	1.51	66.28	15.433	1.679	2.72	14.87	1.74	5	135.00	0.945	0.733	0.212	1.168	3.23	3.77	0.350	11.85	41.679	29.21
14.928	430.772	11.19	0.19	1.7	73.44	13.7205	1.859	2.80	13.10	1.95	5	135.00	0.967	0.745	0.222	1.159	3.04	3.52	0.316	10.73	45.7108	28.39
15.256	430.444	15.59	0.3	1.9	87.39	19.2881	2.055	2.69	18.56	2.14	5	135.00	0.990	0.757	0.233	1.149	4.03	4.63	0.452	15.04	40.03	30.65

R13823

Depth (ft)	El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	(pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	430.116	23.74	0.44	1.84	87.72	29.5606	1.936	2.52	28.85	1.98	6	135.00	1.012	0.769	0.243	1.140	5.70	6.50	0.704	23.19	31.5153	33.43
15.912	429.788	29.33	0.85	2.89	108.61	36.2411	3.004	2.57	35.37	3.08	5	135.00	1.034	0.781	0.253	1.132	7.22	8.17	0.876	28.65	33.9566	34.68
16.24	429.460	38.72	1.48	3.83	103.37	47.5146	3.929	2.56	46.71	4.00	5	135.00	1.056	0.793	0.263	1.123	9.55	10.73	1.166	38.08	33.507	36.34
16.569	429.132	56.19	2.16	3.88	102.93	68.4969	3.956	2.45	67.69	4.00	5	136.00	1.078	0.805	0.274	1.115	13.22	14.73	1.705	55.54	28.5538	38.46
16.896	428.804	60.78	3.03	4.98	65.61	73.0777	5.077	2.51	72.58	5.11	11	137.00	1.100	0.817	0.284	1.107	14.78	16.36	1.848	60.37	31.2128	38.85
17.224	428.476	50.94	2.78	5.46	60.44	60.1007	5.580	2.60	59.64	5.62	3	138.00	1.123	0.829	0.294	1.098	12.92	14.19	1.542	50.56	35.2823	37.75
17.552	428.148	43.07	2.33	5.4	23.93	49.8334	5.558	2.65	49.66	5.58	3	139.00	1.146	0.841	0.304	1.090	11.25	12.26	1.298	42.92	37.7709	36.70
17.88	427.820	39.51	1.86	4.71	-0.56	44.9042	4.851	2.63	44.90	4.85	4	140.00	1.168	0.854	0.314	1.082	10.27	11.12	1.187	39.51	37.026	36.11
18.208	427.492	41.11	1.74	4.23	0.62	46.0646	4.359	2.59	46.06	4.36	4	141.00	1.191	0.867	0.325	1.074	10.47	11.25	1.238	41.11	34.9935	36.27
18.537	427.163	41.12	1.68	4.1	2.12	45.3724	4.210	2.59	45.35	4.21	5	142.00	1.215	0.880	0.335	1.066	10.44	11.13	1.236	41.1	34.7084	36.17
18.865	426.835	45.7	1.83	4	4.37	49.814	4.116	2.55	49.79	4.12	5	143.00	1.238	0.893	0.345	1.058	11.40	12.07	1.377	45.68	33.0275	36.72
19.193	426.507	43.86	2.11	4.81	4.87	47.0298	4.953	2.63	47.00	4.96	4	144.00	1.261	0.906	0.355	1.051	11.36	11.93	1.319	43.83	36.6851	36.38
19.521	426.179	36.52	1.92	5.26	11.85	38.3338	5.449	2.72	38.25	5.46	3	145.00	1.285	0.919	0.366	1.043	9.91	10.33	1.091	36.44	41.4759	35.17
19.849	425.851	49.37	2.52	5.1	12.88	51.5286	5.243	2.62	51.43	5.25	3	146.00	1.309	0.933	0.376	1.035	12.72	13.17	1.488	49.28	36.286	36.91
20.177	425.523	60.49	3.37	5.58	-1.34	62.5064	5.697	2.59	62.52	5.70	11	147.00	1.333	0.946	0.386	1.028	15.39	15.82	1.831	60.5	34.8428	38.02
20.505	425.195	75.15	3.54	4.72	-5.82	76.8443	4.797	2.47	76.89	4.79	11	148.00	1.357	0.960	0.396	1.020	18.09	18.46	2.285	75.19	29.5495	39.17
20.833	424.867	74.98	3.23	4.31	-7.5	75.5377	4.389	2.45	75.59	4.39	5	149.00	1.381	0.974	0.407	1.013	17.84	18.07	2.279	75.03	28.4777	39.08
21.161	424.539	51.59	2	3.88	-4.69	50.7665	3.985	2.53	50.80	3.98	5	150.00	1.405	0.989	0.417	1.006	12.78	12.85	1.554	51.62	32.2646	36.84
21.489	424.211	88.98	4.5	5.06	-4.99	87.2965	5.140	2.46	87.34	5.14	11	151.00	1.430	1.003	0.427	0.999	21.30	21.27	2.711	89.02	29.0451	39.87

R13824

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 40 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-10

ConeTec Interpretation
Interpretation Output - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4243
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-10
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 08:35
CPT File: 804CP10.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 442.1

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.49	1.77	57.88	26.87	2.36

User Inputs:
Assumed:
Water Table Depth (ft): 3.4
Nk: 32.3
Ground Surface Elev. 442.1
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	441.936	22.84	0.17	0.75	0.53	2227.29	0.745	1.10	2227.29	0.74	7	125.00	0.010	0.010	0.000	2.000	3.34	6.67	0.707	22.84	1.3233	53.62
0.492	441.608	28.68	0.4	1.4	-1.45	931.683	1.396	1.46	931.68	1.40	6	125.00	0.031	0.031	0.000	2.000	4.66	9.32	0.887	28.68	2.20569	50.57
0.82	441.280	30.14	0.52	1.73	-6.33	597.098	1.728	1.62	597.68	1.73	6	125.00	0.051	0.051	0.000	2.000	5.17	10.35	0.932	30.18	4.63942	48.79
1.148	440.952	41.06	0.62	1.5	-7.39	571.265	1.513	1.57	571.96	1.51	7	125.00	0.072	0.072	0.000	2.000	6.94	13.88	1.269	41.11	3.68432	48.68
1.476	440.624	62.23	0.9	1.44	-3.79	673.58	1.448	1.52	673.91	1.45	7	125.00	0.092	0.092	0.000	2.000	10.34	20.69	1.924	62.26	3.15876	49.33
1.804	440.296	70.49	1.29	1.83	-0.76	624.188	1.833	1.63	624.28	1.83	7	125.00	0.113	0.113	0.000	2.000	12.13	24.27	2.179	70.5	4.85185	49.03
2.133	439.967	63.39	1.44	2.28	-1.34	474.499	2.276	1.77	474.57	2.28	6	125.00	0.133	0.133	0.000	2.000	11.44	22.87	1.959	63.4	7.40369	47.91
2.461	439.639	64.76	1.42	2.19	-1.66	420.032	2.198	1.78	420.10	2.20	7	125.00	0.154	0.154	0.000	2.000	11.73	23.46	2.000	64.77	7.63043	47.40
2.789	439.311	67.64	1.58	2.34	-1.64	387.039	2.342	1.82	387.10	2.34	6	125.00	0.174	0.174	0.000	2.000	12.43	24.87	2.089	67.65	8.50804	47.05
3.117	438.983	62.08	1.55	2.49	-2.26	317.665	2.505	1.89	317.77	2.50	6	125.00	0.195	0.195	0.000	2.000	11.70	23.40	1.916	62.1	10.0559	46.19
3.445	438.655	61.6	1.76	2.86	-2.61	286.967	2.867	1.96	287.01	2.87	6	125.00	0.215	0.214	0.001	2.000	11.93	23.86	1.900	61.61	11.8668	45.73
3.773	438.327	49.8	1.64	3.29	-3.46	221.096	3.309	2.07	221.23	3.31	6	125.00	0.236	0.224	0.012	2.000	10.08	20.15	1.534	49.83	14.9652	44.54
4.101	437.999	35.16	1.26	3.59	-0.53	148.68	3.610	2.20	148.92	3.61	5	125.00	0.256	0.234	0.022	2.000	7.49	14.99	1.081	35.17	19.0045	42.62
4.429	437.671	23.8	0.94	3.96	5.47	96.1277	3.996	2.35	95.96	4.00	4	125.00	0.277	0.245	0.032	2.000	5.41	10.81	0.728	23.76	24.5219	40.35
4.757	437.343	20.99	0.83	3.94	15.36	81.1156	4.011	2.40	80.76	4.03	4	125.00	0.297	0.255	0.042	1.980	4.86	9.63	0.641	20.89	26.5321	39.43
5.085	437.015	23.58	0.9	3.8	17.32	87.7022	3.869	2.37	87.29	3.89	4	125.00	0.318	0.266	0.053	1.942	5.38	10.45	0.720	23.47	25.1707	39.85
5.413	436.687	26.07	1.08	4.15	16.35	93.3976	4.197	2.38	93.03	4.21	4	125.00	0.338	0.276	0.063	1.905	5.98	11.39	0.797	25.97	25.5391	40.19
5.741	436.359	28	1.25	4.46	13.72	96.7242	4.522	2.39	96.44	4.54	4	125.00	0.359	0.286	0.073	1.871	6.47	12.10	0.856	27.92	26.1485	40.39
6.069	436.031	27.78	1.26	4.55	13.97	92.5575	4.598	2.41	92.25	4.61	4	125.00	0.379	0.296	0.083	1.838	6.47	11.89	0.848	27.69	26.8768	40.15
6.398	435.702	23.67	0.97	4.09	20.99	75.9624	4.168	2.43	75.54	4.19	4	125.00	0.400	0.306	0.094	1.807	5.56	10.04	0.720	23.54	27.8545	39.07
6.726	435.374	22.65	0.83	3.65	20.09	70.2128	3.734	2.42	69.80	3.76	5	125.00	0.420	0.317	0.104	1.777	5.29	9.40	0.668	22.52	27.3099	38.63
7.054	435.046	23.86	0.78	3.26	20.76	71.6466	3.331	2.38	71.25	3.35	5	125.00	0.441	0.327	0.114	1.749	5.46	9.56	0.725	23.73	25.568	38.75
7.382	434.718	19.8	0.64	3.24	24.65	57.3614	3.309	2.45	56.89	3.34	5	125.00	0.461	0.337	0.124	1.722	4.66	8.03	0.599	19.64	28.3064	37.49
7.71	434.390	17.31	0.59	3.42	30.58	48.4398	3.506	2.52	47.89	3.65	4	125.00	0.482	0.347	0.134	1.697	4.20	7.13	0.521	17.12	31.4473	36.49
8.038	434.062	18.65	0.73	3.9	29.81	50.7385	4.023	2.54	50.21	4.07	4	135.00	0.502	0.358	0.145	1.672	4.59	7.68	0.562	18.46	32.7232	36.77
8.366	433.734	15.11	0.63	4.15	30.69	39.4655	4.319	2.65	38.95	4.38	3	135.00	0.525	0.370	0.155	1.645	3.90	6.42	0.452	14.92	37.5988	35.28
8.694	433.406	14.94	0.58	3.89	35.5	37.7301	4.030	2.64	37.15	4.09	4	135.00	0.547	0.381	0.165	1.619	3.84	6.22	0.446	14.72	37.3103	35.00
9.022	433.078	15.71	0.65	4.15	39.67	38.4892	4.293	2.65	37.85	4.36	3	135.00	0.569	0.393	0.175	1.594	4.06	6.47	0.469	15.46	38.0083	35.11
9.35	432.750	20.24	0.82	4.06	39.19	48.4809	4.173	2.57	47.86	4.23	4	135.00	0.591	0.405	0.186	1.574	5.04	7.91	0.608	19.99	33.9763	36.50
9.678	432.422	21.26	1.1	5.19	18.66	49.4891	5.328	2.64	49.23	5.36	3	135.00	0.613	0.417	0.196	1.548	5.51	8.53	0.639	21.15	37.2394	36.66
10.006	432.094	21.52	1.14	5.29	14.2	48.6703	5.459	2.65	48.46	5.48	3	135.00	0.635	0.429	0.206	1.527	5.62	8.58	0.647	21.43	37.8499	36.57
10.335	431.765	22.36	1.16	5.2	0.19	49.2066	5.345	2.64	49.21	5.34	3	135.00	0.657	0.441	0.216	1.506	5.83	8.77	0.672	22.36	37.2112	36.66
10.663	431.437	18.99	1.06	5.57	-6.84	40.4242	5.789	2.72	40.53	5.77	3	135.00	0.680	0.453	0.227	1.486	5.18	7.69	0.567	19.04	41.4795	35.53
10.991	431.109	14.81	0.82	5.55	-7.21	30.3493	5.812	2.81	30.44	5.80	3	135.00	0.702	0.465	0.237	1.467	4.23	6.21	0.437	14.85	46.4001	33.80
11.319	430.781	15.17	0.79	5.19	-6.65	30.3001	5.469	2.79	30.38	5.45	3	135.00	0.724	0.477	0.247	1.448	4.29	6.22	0.447	15.21	45.3583	33.80
11.647	430.453	13.83	0.74	5.37	-5.98	26.7744	5.656	2.84	26.84	5.64	3	135.00	0.746	0.489	0.257	1.431	4.02	5.75	0.405	13.86	46.2129	33.04
11.975	430.125	11.53	0.56	4.82	-4.81	21.4987	5.204	2.88	21.56	5.19	3	135.00	0.768	0.501	0.268	1.413	3.44	4.86	0.333	11.56	50.9108	31.67
12.303	429.797	12.82	0.45	3.52	-3.23	23.4732	3.741	2.76	23.51	3.73	4	135.00	0.790	0.512	0.278	1.397	3.57	4.98	0.372	12.84	43.714	32.22
12.631	429.469	13.05	0.43	3.3	-2.06	23.3366	3.514	2.74	23.37	3.51	4	135.00	0.812	0.524	0.288	1.381	3.60	4.97	0.379	13.07	42.8475	32.18
12.959	429.141	13.03	0.41	3.16	-0.78	22.7399	3.362	2.74	22.74	3.36	4	135.00	0.835	0.536	0.298	1.366	3.58	4.90	0.378	13.03	42.7021	32.01
13.287	428.813	14.48	0.43	2.98	12.21	24.8506	3.156	2.70	24.70	3.17	5	135.00	0.857	0.548	0.308	1.351	3.87	5.23	0.422	14.4	40.3482	32.53
13.615	428.485	14.54	0.43	2.97	15.45	24.39	3.148	2.70	24.21	3.17	5	135.00	0.879	0.560	0.319	1.336	3.90	5.20	0.423	14.44	40.6879	32.41
13.943	428.157	13.29	0.47	3.55	20.09	21.6584	3.794	2.80	21.43	3.83	4	135.00	0.901	0.572	0.329	1.322	3.73	4.94	0.384	13.16	45.8728	31.65
14.271	427.829	16.42	0.51	3.08	25.66	26.5391	3.291	2.69	26.27	3.33	5	135.00	0.923	0.584	0.339	1.309	4.35	5.70	0.480	16.26	39.9534	32.91
14.6	427.500	19.35	0.75	3.86	19.79	30.8871	4.075	2.70	30.69	4.10	4	135.00	0.945	0.596	0.349	1.295	5.18	6.71	0.570	19.23	40.477	33.87
14.928	427.172	23.7	1.01	4.25	5.33	37.4028	4.443	2.66	37.45	4.44	4	135.00	0.967	0.608	0.360	1.283	6.26	8.03	0.704	23.73	38.4335	35.07
15.256	426.844	26.27	0.82	3.11	-8.01	40.7957	3.244	2.54	40.88	3.24	5	135.00	0.990	0.620	0.370	1.270	6.53	8.30	0.783	26.32	32.4669	35.59

R13826

Depth (ft)	El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	(pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	426.516	28.43	0.71	2.5	1.06	43.4116	2.590	2.45	43.40	2.59	6	135.00	1.012	0.632	0.380	1.258	6.77	8.52	0.849	28.42	28.7045	35.94
15.912	426.188	34.11	0.83	2.42	14.23	51.4007	2.509	2.39	51.26	2.52	6	135.00	1.034	0.643	0.390	1.247	7.88	9.82	1.024	34.02	26.1157	36.91
16.24	425.860	36.87	1.15	3.11	26.79	54.6443	3.211	2.45	54.38	3.23	5	135.00	1.056	0.655	0.401	1.235	8.72	10.78	1.109	36.7	28.4501	37.25
16.568	425.532	38.02	1.21	3.18	114.11	55.3595	3.275	2.46	54.30	3.34	5	136.00	1.078	0.667	0.411	1.224	8.91	10.91	1.144	37.31	28.9263	37.24
16.896	425.204	42.17	1.45	3.45	138.77	60.4516	3.531	2.46	59.17	3.61	5	137.00	1.100	0.679	0.421	1.213	9.86	11.96	1.272	41.3	28.8349	37.73
17.224	424.876	49.75	1.96	3.95	80.34	70.3096	4.031	2.45	69.59	4.07	5	138.00	1.123	0.692	0.431	1.202	11.71	14.08	1.505	49.25	28.4507	38.64
17.88	424.220	51.6	1.85	3.59	140.27	70.3788	3.668	2.42	64.98	3.50	5	139.00	1.146	0.704	0.442	1.192	11.00	13.11	1.437	46.89	27.2425	38.26
18.208	423.892	65.03	2.32	3.57	168.7	87.5341	3.634	2.36	86.09	3.69	5	141.00	1.168	0.717	0.452	1.181	11.91	14.07	1.561	50.72	27.3444	38.61
18.537	423.563	70.02	2.63	3.61	155.08	92.701	3.677	2.34	91.39	3.73	5	141.00	1.191	0.729	0.462	1.171	14.58	17.07	1.976	63.98	24.6627	39.80
18.865	423.235	65.59	2.53	3.86	43.83	85.2026	3.931	2.38	84.85	3.95	5	142.00	1.215	0.742	0.472	1.161	15.64	18.15	2.130	69.05	24.1296	40.12
19.193	422.907	55.6	2.73	4.9	4.71	70.7073	5.024	2.51	70.67	5.03	4	143.00	1.238	0.755	0.483	1.151	15.06	17.33	1.992	65.32	25.6929	39.72
19.521	422.579	110.1	2.81	2.55	-0.67	139.17	2.582	2.10	139.17	2.58	7	145.00	1.285	0.782	0.503	1.131	22.55	25.50	3.369	110.1	15.903	42.30
19.849	422.251	160.51	4.84	3.02	-18.41	200.145	3.040	2.06	200.30	3.04	7	146.00	1.309	0.795	0.513	1.121	32.40	36.33	4.929	160.63	14.7692	44.08
20.505	421.595	58.81	3.39	5.76	-23.83	69.8082	5.900	2.57	69.99	5.89	11	148.00	1.333	0.809	0.523	1.112	24.86	27.63	3.397	111.21	22.9849	42.18
20.833	421.267	53.52	2.16	4.03	-22.7	62.2887	4.143	2.48	62.46	4.13	5	149.00	1.381	0.837	0.544	1.093	12.97	14.18	1.614	53.66	30.0156	38.04
21.161	420.939	55.22	2.52	4.56	-21.43	63.2178	4.683	2.52	63.37	4.67	4	150.00	1.405	0.851	0.554	1.084	13.61	14.75	1.666	55.35	31.6051	38.12
21.489	420.611	99.33	2.92	2.94	-20.71	113.098	2.983	2.21	113.25	2.98	6	151.00	1.430	0.866	0.564	1.075	21.26	22.85	3.031	99.46	19.2589	41.25
21.817	420.283	112.37	3.22	2.86	-15.47	126.018	2.903	2.17	126.13	2.90	6	152.00	1.455	0.880	0.575	1.066	23.66	25.22	3.434	112.47	17.9771	41.80
22.145	419.955	57.05	2.85	4.99	-4.13	62.1002	5.129	2.56	62.13	5.13	4	153.00	1.480	0.895	0.585	1.057	14.28	15.10	1.720	57.08	33.269	38.01
22.473	419.627	49.22	2.02	4.1	-0.05	52.4512	4.233	2.54	52.45	4.23	5	154.00	1.505	0.910	0.595	1.048	12.24	12.84	1.477	49.22	32.7044	37.05
22.802	419.298	45.2	1.76	3.89	26.33	47.2222	4.030	2.56	47.04	4.05	5	155.00	1.530	0.925	0.605	1.040	11.30	11.75	1.352	45.03	33.5817	36.42
23.13	418.970	86.55	1.89	2.18	-44.16	90.4233	2.224	2.18	90.13	2.23	7	156.00	1.556	0.940	0.616	1.031	18.23	18.81	2.631	86.27	18.3567	40.05
23.458	418.642	135.75	2.31	1.7	0.11	140.445	1.722	1.97	140.43	1.72	8	157.00	1.581	0.955	0.626	1.023	26.36	26.97	4.154	135.74	12.0719	42.35
23.786	418.314	80.31	2.82	3.51	-7.76	81.0682	3.583	2.36	81.12	3.58	6	158.00	1.607	0.971	0.636	1.015	18.37	18.64	2.437	80.36	24.9247	39.48
24.114	417.986	60.5	2.64	4.36	-3.63	59.6725	4.485	2.52	59.70	4.48	5	159.00	1.633	0.987	0.646	1.007	14.91	15.01	1.823	60.53	31.782	37.79
24.442	417.658	127.06	4.56	3.59	-4.92	125.109	3.636	2.25	125.14	3.64	6	160.00	1.659	1.002	0.657	0.999	27.63	27.60	3.882	127.09	20.6506	41.76
24.77	417.330	149.98	9.93	6.62	-11.87	145.622	6.696	2.43	146.70	6.69	11	161.00	1.685	1.018	0.667	0.991	35.31	34.99	4.591	150.06	27.5358	42.53
25.098	417.002	328.34	15.26	4.65	23.26	315.728	4.672	2.12	315.58	4.67	11	162.00	1.712	1.035	0.677	0.983	67.79	66.65	10.112	328.19	16.5598	46.17
25.426	416.674	419.75	19.4	4.62	18.11	397.781	4.641	2.08	397.68	4.64	11	163.00	1.738	1.051	0.687	0.976	85.07	82.99	12.942	419.64	15.1488	47.17
25.754	416.346	389.73	18.71	4.8	438.91	363.482	4.823	2.11	360.92	4.86	11	164.00	1.765	1.067	0.697	0.968	79.58	77.03	12.011	386.99	16.2214	46.75

R13827

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 43 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-11

ConeTec In Interpretation
Interpretatic ıt - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4215
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-11
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 10:31
CPT File: 804CP11.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 440.6

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.88	2.75	89.72	26.76	2.35

User Inputs:

Assumed:
Water Table Depth (ft): 11.4
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 440.6
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	440.436	28.5	0.22	0.76	0.16	2779.49	0.772	1.11	2778.51	0.77	7	125.00	0.010	0.010	0.000	2.000	4.17	8.34	0.882	28.49	-1.2563	54.33
0.492	440.108	28.29	0.44	1.56	-0.67	919	1.557	1.50	919.33	1.56	6	125.00	0.031	0.031	0.000	2.000	4.67	9.34	0.875	28.3	2.83968	50.52
0.82	439.780	20.17	0.54	2.66	2.66	392.561	2.694	1.87	392.76	2.68	5	125.00	0.051	0.051	0.000	2.000	3.78	7.55	0.623	20.18	9.60794	47.11
1.149	439.452	19.6	0.52	2.63	12.35	272.171	2.663	1.94	273.29	2.65	5	125.00	0.072	0.072	0.000	2.000	3.79	7.57	0.605	19.69	11.4161	45.51
1.478	439.124	28.99	0.42	1.43	-1.13	313.255	1.453	1.69	313.36	1.45	6	125.00	0.092	0.092	0.000	2.000	5.10	10.19	0.895	29	6.94772	46.13
1.804	438.796	36.06	0.45	1.25	-0.07	318.823	1.252	1.63	318.82	1.25	7	125.00	0.113	0.113	0.000	2.000	6.22	12.43	1.113	36.06	4.93192	46.20
2.133	438.467	35.17	0.54	1.52	-0.16	262.816	1.541	1.76	262.82	1.54	7	125.00	0.133	0.133	0.000	2.000	6.32	12.65	1.085	35.17	7.21826	45.33
2.461	438.139	37.91	0.55	1.44	-0.05	245.469	1.457	1.76	245.47	1.46	7	125.00	0.154	0.154	0.000	2.000	6.81	13.63	1.169	37.91	7.18838	45.02
2.789	437.811	36.47	0.68	1.87	-0.34	208.222	1.874	1.89	208.22	1.87	6	125.00	0.174	0.174	0.000	2.000	6.87	13.74	1.124	36.47	10.0384	44.25
3.117	437.483	27.44	0.59	2.16	-0.37	139.853	2.166	2.04	139.85	2.17	6	125.00	0.195	0.195	0.000	2.000	5.49	10.97	0.844	27.44	14.139	42.30
3.445	437.155	20.54	0.66	3.22	-0.44	94.3962	3.247	2.29	94.40	3.25	5	125.00	0.215	0.215	0.000	2.000	4.54	9.08	0.629	20.54	22.0663	40.26
3.773	436.827	22.61	0.8	3.52	-1.01	94.8813	3.576	2.32	94.88	3.58	5	125.00	0.236	0.236	0.000	2.000	5.07	10.13	0.693	22.61	23.1951	40.29
4.101	436.499	26.22	0.98	3.73	-1.36	101.297	3.775	2.32	101.30	3.77	6	125.00	0.256	0.256	0.000	1.975	5.88	11.60	0.804	26.22	23.1946	40.63
4.429	436.171	31.36	1.08	3.45	-1.09	112.29	3.475	2.26	112.33	3.47	5	125.00	0.277	0.277	0.000	1.901	6.86	13.04	0.962	31.37	21.1287	41.18
4.757	435.843	38.92	1.07	2.74	1.76	129.906	2.770	2.15	129.84	2.77	6	125.00	0.297	0.297	0.000	1.834	8.11	14.86	1.196	38.9	17.2319	41.92
5.085	435.515	38.04	1.11	2.93	4.37	118.693	2.943	2.19	118.60	2.94	6	125.00	0.318	0.318	0.000	1.774	8.07	14.31	1.168	38.01	18.7018	41.46
5.413	435.187	30.78	1.06	3.45	13.37	89.981	3.482	2.33	89.71	3.49	5	125.00	0.338	0.338	0.000	1.719	6.90	11.86	0.942	30.69	23.4971	39.99
5.741	434.859	25.89	0.85	3.29	18.5	71.1547	3.329	2.38	70.85	3.34	5	125.00	0.359	0.359	0.000	1.669	5.94	9.91	0.790	25.78	25.6136	38.69
6.069	434.531	23.4	0.79	3.36	23.9	60.6906	3.432	2.44	60.30	3.45	5	125.00	0.379	0.379	0.000	1.624	5.50	8.93	0.713	23.25	28.015	37.78
6.398	434.202	25.75	1.15	4.46	22.01	63.3951	4.536	2.51	63.07	4.56	4	125.00	0.400	0.400	0.000	1.581	6.28	9.93	0.785	25.62	31.3104	38.04
6.726	433.874	29.09	1.27	4.36	14.11	68.2001	4.430	2.46	68.01	4.44	4	125.00	0.420	0.420	0.000	1.542	7.01	10.81	0.888	29.01	29.9625	38.46
7.054	433.546	24	1	4.16	11.96	53.4372	4.245	2.54	53.28	4.26	4	125.00	0.441	0.441	0.000	1.506	5.94	8.95	0.729	23.93	32.5699	37.07
7.382	433.218	21.53	0.94	4.35	14.92	45.6649	4.462	2.61	45.45	4.48	4	125.00	0.461	0.461	0.000	1.472	5.49	8.09	0.652	21.43	35.6188	36.14
7.71	432.890	22.03	1.05	4.75	14.57	44.7173	4.873	2.64	44.53	4.89	3	125.00	0.482	0.482	0.000	1.441	5.72	8.24	0.667	21.94	37.2691	36.02
8.038	432.562	22.77	0.99	4.34	10.23	44.3247	4.446	2.61	44.21	4.46	4	125.00	0.502	0.502	0.000	1.411	5.84	8.24	0.689	22.71	35.9462	35.97
8.366	432.234	32.54	1.27	3.9	8.77	61.2328	3.967	2.48	61.12	3.97	5	125.00	0.523	0.523	0.000	1.383	7.83	10.83	0.991	32.48	29.7484	37.86
8.694	431.906	28.72	1.47	5.13	1.57	51.8548	5.217	2.61	51.84	5.22	3	125.00	0.543	0.543	0.000	1.357	7.39	10.03	0.872	28.71	36.0689	36.91
9.022	431.578	25.38	1.28	5.04	3.56	44.01	5.158	2.66	43.97	5.16	3	125.00	0.564	0.564	0.000	1.332	6.68	8.90	0.768	25.36	38.3383	35.94
9.35	431.250	21.81	1.12	5.12	4.5	36.3219	5.277	2.72	36.27	5.28	3	125.00	0.584	0.584	0.000	1.308	5.94	7.77	0.657	21.78	41.7898	34.78
9.678	430.922	19.77	1.16	5.88	0.32	31.6844	6.053	2.81	31.68	6.05	3	125.00	0.605	0.605	0.000	1.286	5.64	7.25	0.593	19.77	46.4618	33.95
10.006	430.594	16.91	1.13	6.7	7.09	26.0398	6.939	2.91	25.98	6.96	3	125.00	0.625	0.625	0.000	1.265	5.11	6.46	0.504	16.87	52.7324	32.71
10.335	430.265	12.18	0.84	6.91	7.27	17.8563	7.283	3.05	17.78	7.31	3	125.00	0.646	0.646	0.000	1.244	3.99	4.96	0.357	12.13	61.5745	30.26
10.663	429.937	13.61	0.58	4.27	11.11	19.422	4.481	2.88	19.32	4.51	3	125.00	0.666	0.666	0.000	1.225	4.02	4.92	0.401	13.54	50.6152	30.80
10.991	429.609	16.16	0.58	3.6	16.15	22.5247	3.748	2.79	22.38	3.77	4	125.00	0.687	0.687	0.000	1.207	4.51	5.44	0.479	16.06	44.7951	31.76
11.319	429.281	20.35	0.95	4.66	10.23	27.7658	4.836	2.78	27.67	4.85	3	125.00	0.707	0.707	0.000	1.189	5.71	6.79	0.608	20.28	45.0299	33.10
11.647	428.953	15.41	0.83	5.37	7.37	20.3852	5.653	2.93	20.33	5.67	3	135.00	0.728	0.720	0.008	1.178	4.70	5.54	0.465	15.37	53.7104	31.14
11.975	428.625	15.03	0.51	3.4	12.31	19.5044	3.571	2.81	19.40	3.59	4	135.00	0.750	0.732	0.018	1.169	4.28	5.00	0.442	14.95	46.7592	30.84
12.303	428.297	13.48	0.39	2.86	16.05	17.0793	3.069	2.62	16.94	3.09	5	135.00	0.772	0.744	0.028	1.159	3.84	4.45	0.393	13.38	47.1053	29.96
12.631	427.969	14.27	0.45	3.13	24.68	17.8261	3.339	2.83	17.61	3.36	5	135.00	0.794	0.756	0.038	1.150	4.07	4.69	0.417	14.11	47.7069	30.22
12.959	427.641	16.62	0.59	3.53	32.75	20.5813	3.733	2.81	20.31	3.78	4	135.00	0.816	0.768	0.049	1.141	4.69	5.36	0.489	16.41	46.6976	31.15
13.287	427.313	15.45	0.53	3.41	85.75	18.7382	3.627	2.85	18.06	3.76	4	135.00	0.839	0.780	0.059	1.132	4.36	4.94	0.452	14.92	46.9421	30.39
13.615	426.985	14.31	0.4	2.77	92.79	16.9884	2.974	2.83	16.26	3.11	5	135.00	0.861	0.792	0.069	1.124	3.98	4.47	0.416	13.73	48.0254	29.71
13.943	426.657	16.27	0.56	3.45	78.04	19.1483	3.639	2.84	18.54	3.76	4	135.00	0.883	0.804	0.079	1.116	4.59	5.12	0.476	15.78	48.3929	30.57
14.271	426.329	75.29	0.83	1.1	37.25	91.2159	1.116	1.97	90.93	1.12	8	135.00	0.905	0.815	0.090	1.107	14.61	16.18	2.303	75.06	12.2389	40.07
14.6	426.000	92.32	1.92	2.08	-13.9	110.454	2.101	2.10	110.55	2.10	7	135.00	0.927	0.827	0.100	1.099	18.90	20.78	2.829	92.4	15.8278	41.10
14.928	425.672	64.03	2.18	3.4	-6.84	75.1558	3.456	2.37	75.22	3.45	6	135.00	0.949	0.839	0.110	1.092	14.71	16.06	1.953	64.08	25.3244	39.03
15.256	425.344	42.81	1.68	3.92	119.63	49.1501	4.015	2.56	48.27	4.09	5	135.00	0.972	0.851	0.120	1.084	10.53	11.42	1.295	42.06	33.3652	36.51

R13829

Depth (ft)	El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	425.016	31.18	1.38	4.44	88.96	34.9725	4.572	2.70	34.34	4.66	4	135.00	0.994	0.863	0.131	1.076	8.26	8.89	0.935	30.63	40.6127	34.47
15.912	424.688	74.08	1.85	2.5	119.6	83.4971	2.532	2.25	82.64	2.56	6	135.00	1.016	0.875	0.141	1.069	15.95	17.05	2.262	73.33	20.7052	39.55
16.24	424.360	168.1	3.39	2.02	-0.74	188.354	2.029	1.94	188.35	2.03	7	135.00	1.039	0.887	0.151	1.062	32.30	34.30	5.172	168.1	11.3615	43.77
16.568	424.032	179.25	4.43	2.47	-10.55	198.239	2.486	2.00	198.32	2.49	7	136.00	1.060	0.899	0.161	1.055	35.21	37.14	5.517	179.32	12.8438	44.02
16.896	423.704	134.23	3.06	2.28	-18.82	146.166	2.299	2.05	146.30	2.30	7	137.00	1.082	0.911	0.171	1.048	26.94	28.22	4.122	134.35	14.3363	42.53
17.224	423.376	78.48	1.39	1.78	-20.86	83.8148	1.796	2.14	83.96	1.79	7	138.00	1.105	0.923	0.182	1.041	16.31	16.98	2.396	78.61	16.912	39.64
17.552	423.048	61.76	2.91	4.71	-21.8	64.8083	4.799	2.52	64.96	4.79	4	139.00	1.128	0.936	0.192	1.034	15.23	16.74	1.877	61.9	31.6498	38.22
17.88	422.720	131.97	4.46	3.38	-22.01	137.977	3.409	2.20	138.12	3.41	6	140.00	1.150	0.948	0.202	1.027	28.14	28.90	4.050	132.11	18.9817	42.25
18.208	422.392	229.79	6.98	3.04	1.89	237.93	3.053	2.03	237.92	3.05	12	141.00	1.173	0.961	0.212	1.020	45.63	46.55	7.078	229.78	13.6451	44.88
18.537	422.063	178.23	4.87	2.73	5.5	181.799	2.751	2.05	181.77	2.75	7	142.00	1.196	0.974	0.223	1.013	35.79	36.27	5.481	178.2	14.4578	43.60
18.865	421.735	158.32	3.05	1.93	-5.91	159.195	1.941	1.97	159.24	1.94	8	143.00	1.220	0.987	0.233	1.007	30.79	31.00	4.864	158.36	12.157	42.96
19.193	421.407	129.65	3.69	3	-15.68	128.399	3.029	2.18	128.49	3.03	6	144.00	1.243	1.000	0.243	1.000	27.40	27.40	3.975	129.74	18.2843	41.88
19.521	421.079	173.42	5.09	2.94	-12.86	169.87	2.957	2.10	169.95	2.96	7	145.00	1.267	1.013	0.253	0.993	85.48	35.20	5.330	173.5	15.7016	43.28
19.849	420.751	263.85	6.2	2.35	-1.66	255.66	2.361	1.91	255.67	2.36	7	146.00	1.291	1.027	0.264	0.987	50.25	49.58	8.129	263.66	10.7536	45.21
20.177	420.423	128.37	5.69	4.43	4.11	122.087	4.478	2.33	122.08	4.48	11	147.00	1.315	1.041	0.274	0.980	28.87	28.30	3.934	128.34	23.5384	41.62
20.505	420.095	79.4	4.72	5.95	5.06	74.0219	6.047	2.56	73.99	6.05	11	148.00	1.339	1.055	0.284	0.974	19.92	19.40	2.417	79.37	33.5824	38.95
20.833	419.767	78.64	4.44	5.65	4.76	72.3155	5.746	2.55	72.29	5.75	11	149.00	1.363	1.069	0.294	0.967	19.63	18.99	2.392	78.61	33.0698	38.82
21.161	419.439	89.37	5.02	5.61	5.8	81.2538	5.706	2.52	81.23	5.71	11	150.00	1.387	1.083	0.305	0.961	21.94	21.09	2.724	89.34	31.4994	39.47
21.489	419.111	108.25	5.71	5.27	5.22	97.3752	5.345	2.45	97.35	5.35	11	151.00	1.412	1.097	0.315	0.955	25.71	24.54	3.308	108.22	28.3906	40.44
21.817	418.783	132	7.15	5.41	2.48	117.444	5.476	2.41	117.43	5.48	11	152.00	1.437	1.112	0.325	0.948	30.78	29.19	4.042	131.98	26.7224	41.42
22.145	418.455	152.55	8.54	5.6	-0.62	134.133	5.652	2.39	134.13	5.65	11	153.00	1.462	1.126	0.335	0.942	35.23	33.19	4.678	152.55	25.8345	42.10
22.473	418.127	166.92	10.03	6.01	-0.81	144.956	6.063	2.39	144.96	6.06	11	154.00	1.487	1.141	0.345	0.936	38.66	36.19	5.122	166.92	26.1022	42.49
22.802	417.798	175.61	10.85	6.18	-0.16	150.561	6.232	2.39	150.56	6.23	11	155.00	1.512	1.156	0.356	0.930	40.69	37.84	5.390	175.61	26.1461	42.68
23.13	417.470	186.83	11.72	6.27	0.3	159.165	6.325	2.39	159.16	6.33	11	156.00	1.537	1.172	0.366	0.924	43.17	39.89	5.737	186.82	25.9033	42.93
23.458	417.142	212.47	12.86	6.05	-0.81	177.701	6.097	2.35	177.70	6.10	11	157.00	1.563	1.187	0.376	0.918	48.23	44.27	6.530	212.47	24.3144	43.50
23.786	416.814	206.47	13.26	6.42	-3.42	170.396	6.472	2.38	170.42	6.47	11	158.00	1.589	1.202	0.386	0.912	47.54	43.35	6.343	206.5	25.5551	43.29
24.114	416.486	224.17	13.55	6.04	-3.65	182.713	6.088	2.34	182.73	6.09	11	159.00	1.615	1.218	0.397	0.906	50.73	45.97	6.890	224.19	24.049	43.63
24.442	416.158	237.64	15.41	6.48	-5.54	191.262	6.530	2.36	191.29	6.53	11	160.00	1.641	1.234	0.407	0.900	54.17	48.76	7.306	237.67	24.6695	43.85
24.77	415.830	244.94	15.19	6.2	-7.81	194.633	6.244	2.34	194.66	6.24	11	161.00	1.667	1.250	0.417	0.894	55.32	49.48	7.532	244.98	23.8705	43.94
25.098	415.502	239.96	14.94	6.23	-11.57	188.192	6.270	2.34	188.25	6.27	11	162.00	1.693	1.266	0.427	0.889	54.42	48.36	7.377	240.03	24.2139	43.78
25.426	415.174	217.85	14.42	6.62	-17.67	168.534	6.672	2.39	168.62	6.67	11	163.00	1.720	1.282	0.438	0.883	50.48	44.58	6.691	217.96	26.1001	43.24
25.754	414.846	219.37	13.74	6.26	-20.97	167.543	6.314	2.37	167.64	6.31	11	164.00	1.747	1.299	0.448	0.877	50.40	44.22	6.738	219.5	25.3316	43.21
26.082	414.518	214.66	13.21	6.15	-22.49	161.62	6.205	2.37	161.93	6.20	11	165.00	1.774	1.316	0.458	0.872	49.36	43.03	6.591	214.8	25.3928	43.04
26.41	414.190	225.44	13.56	6.01	-24.85	167.847	6.063	2.36	167.97	6.06	11	166.00	1.801	1.332	0.468	0.866	51.45	44.57	6.924	225.6	24.7228	43.22
26.739	413.861	268.44	15.56	5.8	-24.92	197.572	5.836	2.31	197.68	5.83	11	167.00	1.828	1.349	0.479	0.861	59.89	51.56	8.254	268.59	22.7802	44.01
27.067	413.533	344.83	16.55	4.8	-25.2	250.97	4.825	2.18	251.09	4.82	11	168.00	1.855	1.367	0.489	0.855	73.00	62.45	10.618	344.99	18.4477	45.13

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 46 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-12

ConeTec Interpretation
Interpreta put - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1006-4182
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-12
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 11:15
CPT File: 804CP12.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 442.1

Material Types and Unit Weight (pcf)		Phi Avg.	Su Avg.	Qc Avg.	Fc Avg.	Ic Avg.
		deg	tsf	tsf	%	%
125	Residual Soil	39.01	2.80	91.11	27.69	2.37

User Inputs:

Assumed: Water Table Depth (ft): 11.7 Ground Surface Elev. 442.1
Nk: 32.3
State Parameter: 1.2 CPT area ratio: 0.85
Unit Weight of Soil (pcf): Varies See Below See Below Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	441.936	11.62	0.14	1.16	-0.32	1132.66	1.206	1.37	1132.66	1.21	6	125.00	0.010	0.010	0.000	2.000	1.84	3.67	0.359	11.62	1.12402	51.29
0.492	441.608	7.94	0.16	2.02	-1.8	257.211	2.023	1.86	257.54	2.02	5	125.00	0.031	0.031	0.000	2.000	1.48	2.96	0.245	7.95	9.3841	45.24
0.82	441.280	9.78	0.15	1.54	-4.83	189.829	1.542	1.84	190.41	1.54	5	125.00	0.051	0.051	0.000	2.000	1.82	3.64	0.301	9.81	9.05791	43.82
1.148	440.952	14.93	0.28	1.85	-7.94	207.084	1.884	1.89	207.78	1.88	5	125.00	0.072	0.072	0.000	2.000	2.82	5.65	0.460	14.98	10.0719	44.24
1.475	440.624	13.35	0.35	2.59	-11.59	143.715	2.640	2.10	144.47	2.63	5	125.00	0.092	0.092	0.000	2.000	2.74	5.49	0.410	13.42	15.7665	42.47
1.801	440.296	10.42	0.21	2.02	-9.49	91.4169	2.037	2.14	91.95	2.03	5	125.00	0.113	0.113	0.000	2.000	2.18	4.36	0.319	10.48	17.1922	40.12
2.133	439.967	11.15	0.3	2.65	-4.09	82.6381	2.723	2.27	82.86	2.72	5	125.00	0.133	0.133	0.000	2.000	2.45	4.90	0.341	11.18	21.347	39.56
2.46	439.639	11.4	0.39	3.39	-0.6	73.1162	3.468	2.38	73.12	3.47	4	125.00	0.154	0.154	0.000	2.000	2.63	5.26	0.348	11.4	25.7091	38.87
2.789	439.311	19.33	0.58	3.01	0.23	109.893	3.028	2.22	109.89	3.03	5	125.00	0.174	0.174	0.000	2.000	4.16	8.31	0.593	19.33	19.7298	41.06
3.117	438.983	28.95	0.84	2.89	2.91	147.604	2.921	2.13	147.55	2.92	5	125.00	0.195	0.195	0.000	2.000	5.99	11.98	0.890	28.94	16.7116	42.57
3.445	438.655	31.92	1.09	3.41	12.38	147.25	3.438	2.19	146.92	3.45	5	125.00	0.215	0.215	0.000	2.000	6.75	13.50	0.982	31.85	18.5805	42.55
3.773	438.327	29.03	1.2	4.13	24.36	122.106	4.168	2.31	121.47	4.19	4	125.00	0.236	0.236	0.000	2.000	6.43	12.87	0.891	28.88	22.7083	41.58
4.101	437.999	26.16	1.06	4.04	36.19	101.063	4.092	2.35	100.20	4.13	4	125.00	0.256	0.256	0.000	1.975	5.90	11.65	0.802	25.94	24.4642	40.58
4.429	437.671	24.24	0.91	3.76	45.54	86.5683	3.797	2.37	85.56	3.84	4	125.00	0.277	0.277	0.000	1.901	5.50	10.45	0.742	23.96	25.2412	39.73
4.757	437.343	19.02	0.82	4.29	43.88	62.9731	4.380	2.51	62.06	4.44	4	125.00	0.297	0.297	0.000	1.834	4.59	8.41	0.580	18.75	31.1432	37.95
5.085	437.015	21.3	0.75	3.53	49.65	66.0206	3.574	2.43	65.05	3.63	5	125.00	0.318	0.318	0.000	1.774	4.95	8.78	0.650	20.99	27.7143	38.21
5.413	436.687	23.02	0.78	3.4	49.79	67.0436	3.439	2.41	66.13	3.49	5	125.00	0.338	0.338	0.000	1.719	5.31	9.13	0.702	22.71	26.9846	38.30
5.74	436.359	19.94	0.81	4.05	42.61	54.5722	4.137	2.53	53.82	4.19	4	125.00	0.359	0.359	0.000	1.669	4.87	8.13	0.606	19.67	32.2135	37.13
6.069	436.031	19.3	0.6	3.12	42.66	49.8815	3.171	2.48	49.20	3.22	5	125.00	0.379	0.379	0.000	1.624	4.59	7.45	0.586	19.04	29.7477	36.60
6.398	435.702	19.44	0.61	3.15	38.64	47.6152	3.204	2.50	47.02	3.24	5	125.00	0.400	0.400	0.000	1.581	4.67	7.38	0.589	19.2	30.4945	36.34
6.726	435.374	19.51	0.69	3.55	28.89	45.4109	3.615	2.55	44.96	3.65	4	125.00	0.420	0.420	0.000	1.542	4.81	7.42	0.591	19.33	32.7892	36.08
7.054	435.046	19.87	0.87	4.39	16.93	44.0695	4.478	2.62	43.84	4.50	3	125.00	0.441	0.441	0.000	1.506	5.10	7.68	0.602	19.77	36.2175	35.92
7.382	434.718	19.53	0.85	4.34	16.6	41.33	4.458	2.64	41.09	4.48	3	125.00	0.461	0.461	0.000	1.472	5.06	7.44	0.590	19.42	37.1432	35.54
7.71	434.390	17.5	0.83	4.73	14.09	35.3165	4.877	2.71	35.13	4.90	3	125.00	0.482	0.482	0.000	1.441	4.71	6.79	0.527	17.41	41.075	34.59
8.038	434.062	15.42	0.64	4.16	15.08	29.6942	4.290	2.73	29.52	4.32	3	125.00	0.502	0.502	0.000	1.411	4.19	5.91	0.462	15.33	41.9523	33.51
8.366	433.734	15.44	0.6	3.86	17.32	28.529	4.022	2.72	28.32	4.05	4	125.00	0.523	0.523	0.000	1.383	4.18	5.77	0.462	15.33	41.6655	33.25
8.694	433.406	19.79	0.74	3.75	18.08	35.4205	3.845	2.64	35.22	3.87	4	125.00	0.543	0.543	0.000	1.357	5.13	6.96	0.596	19.68	37.304	34.60
9.022	433.078	19.84	0.66	4.34	16.61	34.1851	4.461	2.69	34.01	4.48	4	125.00	0.564	0.564	0.000	1.332	5.30	7.05	0.597	19.74	40.1678	34.39
9.35	432.750	17.62	0.88	4.98	13.99	29.1519	5.166	2.79	29.01	5.19	3	125.00	0.584	0.584	0.000	1.308	4.95	6.48	0.527	17.54	45.3203	33.40
9.678	432.422	16.33	0.72	4.42	21.5	25.9973	4.579	2.79	25.77	4.62	3	125.00	0.605	0.605	0.000	1.286	4.58	5.88	0.487	16.19	45.491	32.66
10.006	432.094	13.67	0.59	4.33	11.13	20.8589	4.523	2.86	20.75	4.55	3	125.00	0.625	0.625	0.000	1.265	3.99	5.04	0.404	13.6	49.3482	31.27
10.335	431.765	12.63	0.44	3.49	13.16	18.553	3.672	2.84	18.43	3.70	4	125.00	0.646	0.646	0.000	1.244	3.64	4.53	0.371	12.55	48.2363	30.50
10.663	431.437	12.67	0.5	3.92	14.21	18.0115	4.165	2.88	17.89	4.19	3	125.00	0.666	0.666	0.000	1.225	3.75	4.59	0.372	12.59	50.9429	30.30
10.991	431.109	12.7	0.63	4.97	13.9	17.4879	5.244	2.96	17.37	5.28	3	125.00	0.687	0.687	0.000	1.207	3.93	4.74	0.372	12.62	55.6721	30.11
11.319	430.781	10.22	0.46	4.51	14.5	13.4465	4.836	3.02	13.31	4.89	3	125.00	0.707	0.707	0.000	1.189	3.28	3.91	0.295	10.12	60.1558	28.34
11.647	430.453	8.57	0.2	2.34	16.35	10.773	2.550	2.94	10.64	2.58	4	125.00	0.728	0.728	0.000	1.172	2.61	3.05	0.243	8.47	54.4211	26.83
11.975	430.125	9.06	0.17	1.83	18.91	11.234	2.045	2.87	11.07	2.08	5	135.00	0.748	0.740	0.009	1.163	2.64	3.08	0.257	8.94	50.2538	27.11
12.303	429.797	10.52	0.15	1.38	22.7	12.9687	1.539	2.75	12.78	1.56	5	135.00	0.771	0.762	0.019	1.153	2.87	3.32	0.302	10.38	43.3766	28.09
12.631	429.469	13.05	0.29	2.23	28.38	16.0505	2.366	2.78	15.81	2.40	5	135.00	0.793	0.764	0.029	1.144	3.61	4.13	0.379	12.87	44.7486	29.51
12.959	429.141	13.23	0.43	3.26	16.7	16.0076	3.464	2.87	15.86	3.49	4	135.00	0.815	0.776	0.039	1.136	3.89	4.42	0.384	13.18	50.3648	29.54
13.287	428.813	13.91	0.36	2.56	7.57	16.601	2.754	2.80	16.54	2.76	5	135.00	0.837	0.787	0.050	1.127	3.93	4.43	0.405	13.86	45.8936	29.81
13.615	428.485	17.32	0.69	3.96	6.49	20.5918	4.192	2.84	20.54	4.20	4	135.00	0.859	0.799	0.060	1.118	5.01	5.61	0.510	17.28	48.2013	31.23
13.943	428.157	28.85	1.37	4.74	1.25	34.4741	4.898	2.72	34.46	4.90	3	135.00	0.881	0.811	0.070	1.110	7.83	8.70	0.866	28.84	41.3835	34.48
14.271	427.829	35.76	1.81	5.06	8.08	42.3427	5.193	2.67	42.28	5.20	3	135.00	0.903	0.823	0.080	1.102	9.48	10.45	1.079	35.71	39.0642	35.72
14.6	427.500	93.11	1.97	2.12	5.47	110.381	2.137	2.11	110.35	2.14	7	135.00	0.926	0.835	0.090	1.094	19.09	20.89	2.854	93.08	16.0213	41.09
14.928	427.172	198.6	4.08	2.06	-1.59	233.341	2.064	1.89	233.35	2.06	8	135.00	0.948	0.847	0.101	1.087	37.46	40.71	6.119	198.61	10.1383	44.79
15.256	426.844	186.18	5.12	2.75	-9.91	215.622	2.764	2.01	215.70	2.76	7	135.00	0.970	0.859	0.111	1.079	36.81	39.72	5.734	186.25	13.2966	44.42

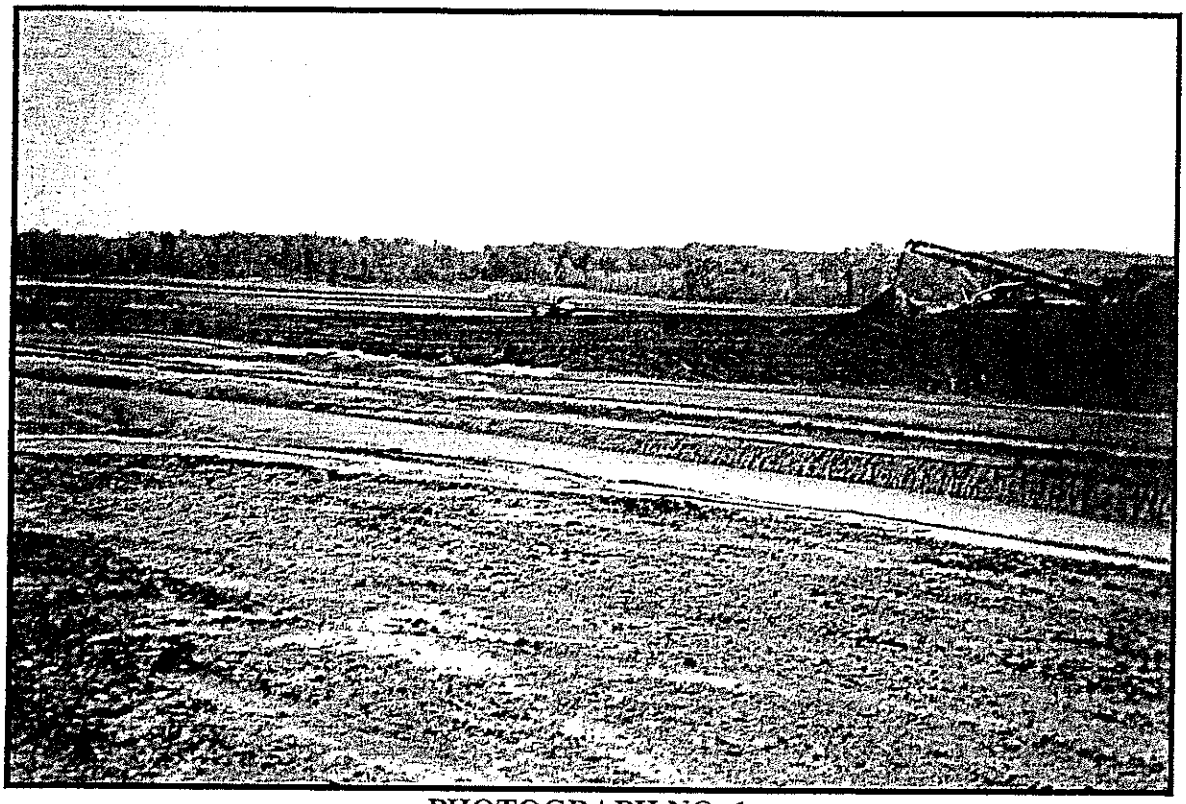
R13832

Depth (ft)	S... (m)	...l.	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.V. (pcf)	Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	426.516		190.04	5.38	2.83	-11.83	217.081	2.846	2.02	217.16	2.84	7	135.00	0.992	0.871	0.121	1.072	37.70	40.40	5.653	190.11	13.5387	44.45
15.912	426.188		263.65	6.16	2.34	-13.14	297.513	2.345	1.88	297.60	2.34	7	135.00	1.014	0.883	0.131	1.064	49.51	52.70	8.131	263.73	9.63312	45.90
16.24	425.860		284.27	6.89	2.42	-9.63	316.576	2.433	1.88	316.64	2.43	7	135.00	1.036	0.895	0.142	1.057	53.37	56.42	8.769	284.33	9.81964	46.17
16.568	425.532		255.09	5.78	2.27	-12.84	280.208	2.275	1.88	280.30	2.27	7	136.00	1.058	0.907	0.152	1.050	47.96	50.37	7.865	255.17	9.90035	45.63
16.896	425.204		262.69	5.83	2.22	-14.73	284.775	2.229	1.87	284.87	2.23	8	137.00	1.081	0.919	0.162	1.043	49.18	51.31	8.099	262.78	9.63384	45.70
17.224	424.876		262.49	6.06	2.31	-15.84	280.793	2.318	1.89	280.90	2.32	7	138.00	1.103	0.931	0.172	1.036	49.47	51.27	8.092	262.59	10.0493	45.64
17.552	424.548		275.92	6.07	2.2	-16.9	291.316	2.209	1.86	291.43	2.21	8	139.00	1.126	0.943	0.183	1.030	51.50	53.02	8.508	276.03	9.43529	45.80
17.88	424.220		282.44	5.86	2.07	-17.67	294.284	2.083	1.84	294.40	2.08	8	140.00	1.149	0.956	0.193	1.023	52.26	53.45	8.709	282.55	8.89784	45.85
18.208	423.892		257.04	5.91	2.3	-18.27	264.17	2.310	1.90	264.28	2.31	7	141.00	1.172	0.969	0.203	1.016	48.68	49.46	7.922	257.15	10.3624	45.36
18.537	423.563		242.82	4.68	1.93	-18.43	246.178	1.937	1.85	246.30	1.94	8	142.00	1.195	0.982	0.213	1.009	45.22	45.65	7.481	242.94	8.29281	45.04
18.865	423.235		257.45	4.85	1.88	-18.64	257.634	1.893	1.83	257.75	1.89	8	143.00	1.218	0.995	0.224	1.003	47.61	47.74	7.933	257.67	8.85195	45.25
19.193	422.907		260.77	6.02	2.31	-18.77	257.525	2.320	1.91	257.64	2.32	7	144.00	1.242	1.008	0.234	0.996	49.52	49.33	8.035	260.89	10.5471	45.25
19.521	422.579		170.7	6.5	3.81	-14.05	165.924	3.836	2.19	166.01	3.83	12	145.00	1.265	1.021	0.244	0.990	36.30	35.92	5.246	170.79	18.807	43.16
19.849	422.251		99.48	6.5	6.53	-18.39	94.8975	6.620	2.53	95.00	6.61	11	146.00	1.289	1.035	0.254	0.983	24.57	24.16	3.040	99.59	31.9422	40.31
20.177	421.923		121.55	7.95	6.54	-17.74	114.684	6.612	2.48	114.80	6.61	11	147.00	1.313	1.048	0.264	0.977	29.34	28.66	3.723	121.67	29.7886	41.30
20.505	421.595		160.73	12.29	7.65	-14.95	150.046	7.711	2.47	150.13	7.71	11	148.00	1.337	1.062	0.275	0.970	38.65	37.50	4.935	160.82	29.4577	42.67
20.833	421.267		215.14	14.59	6.78	-12.33	198.618	6.825	2.36	198.69	6.82	11	149.00	1.361	1.076	0.285	0.964	49.23	47.45	6.619	215.22	24.995	44.03
21.161	420.939		213.16	15.63	7.33	2.1	194.194	7.380	2.40	194.18	7.38	11	150.00	1.386	1.091	0.295	0.958	49.52	47.42	6.556	213.14	26.385	43.92
21.489	420.611		245.28	17.26	7.04	16.49	220.717	7.078	2.36	220.62	7.08	11	151.00	1.410	1.105	0.305	0.951	55.88	53.16	7.650	245.17	24.68	44.53
21.817	420.283		304.39	19.87	6.53	34.99	270.633	6.559	2.29	270.44	6.56	11	152.00	1.435	1.119	0.316	0.945	67.22	63.53	9.379	304.17	22.0175	45.47
22.145	419.955		331.65	17.77	5.36	221.32	291.141	5.382	2.20	289.92	5.40	11	153.00	1.460	1.134	0.326	0.939	70.29	66.00	10.223	330.27	18.9079	45.78

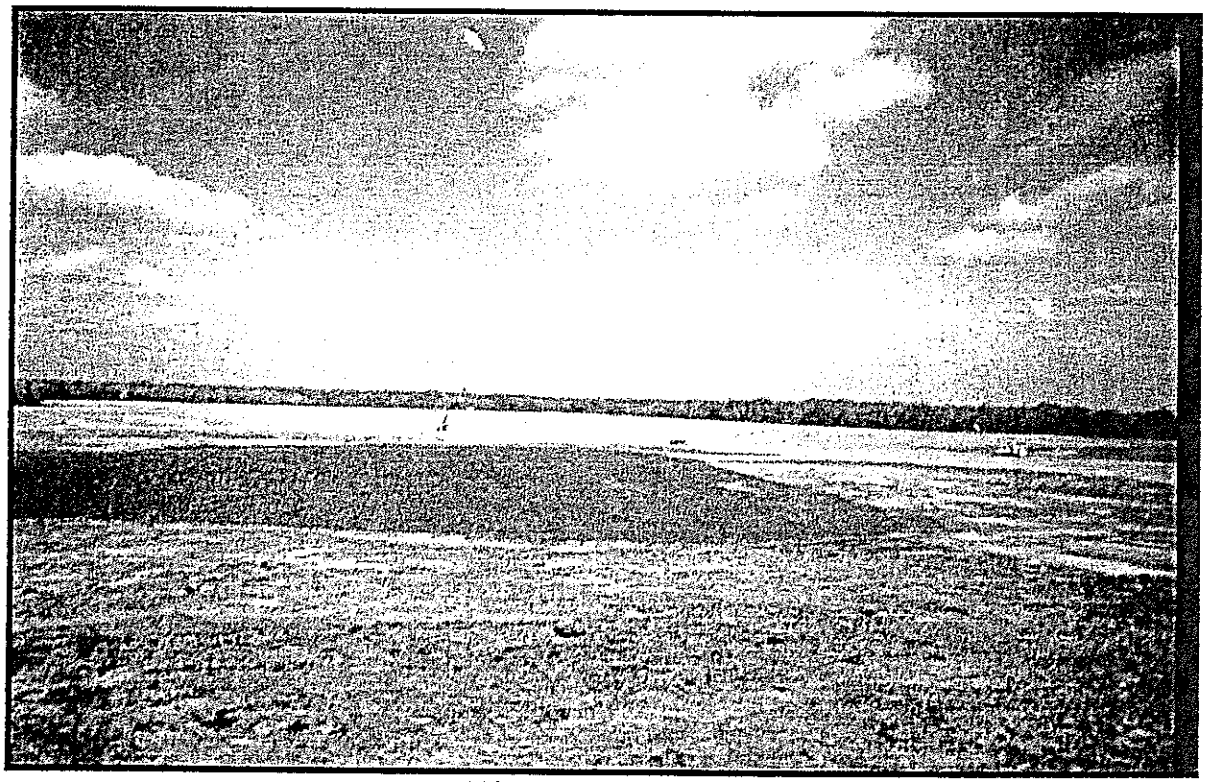
APPENDIX A-4

PHOTOGRAPHS OF OCTOBER 2007 FIELD TESTING

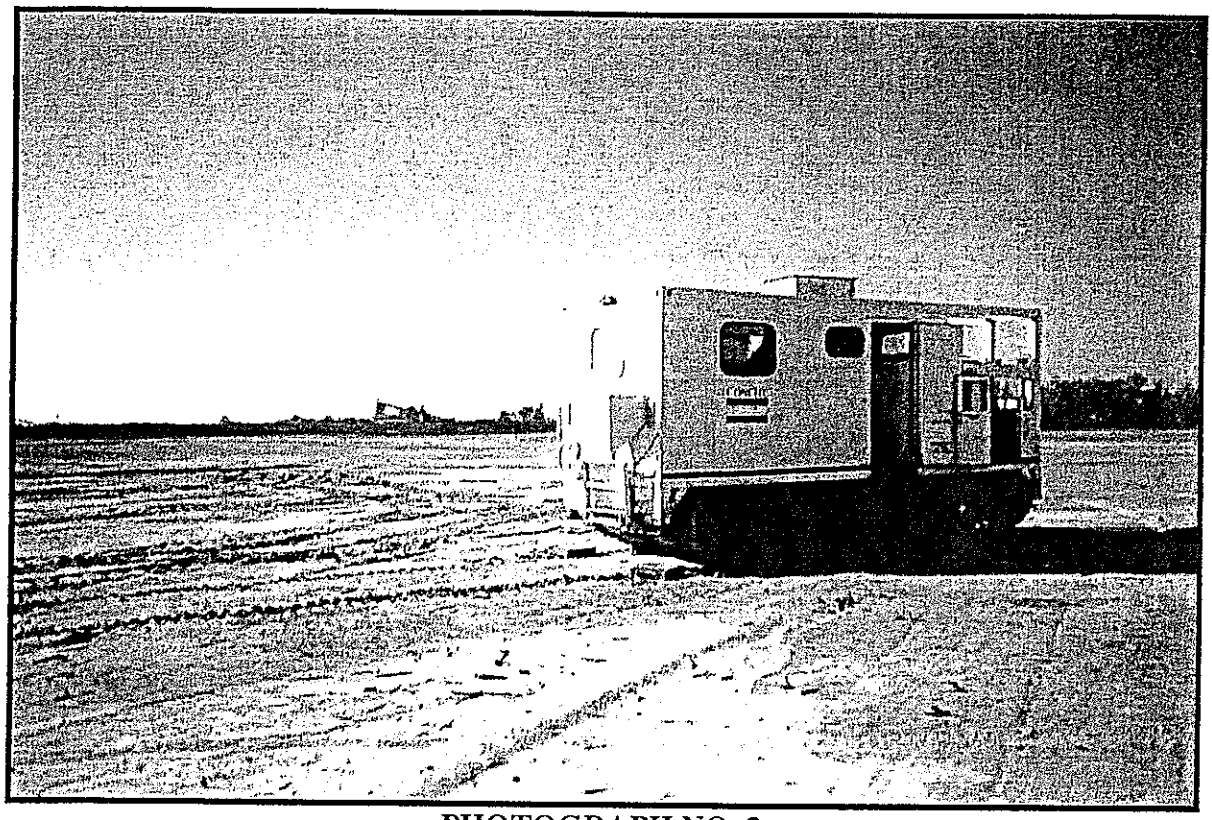
R13835



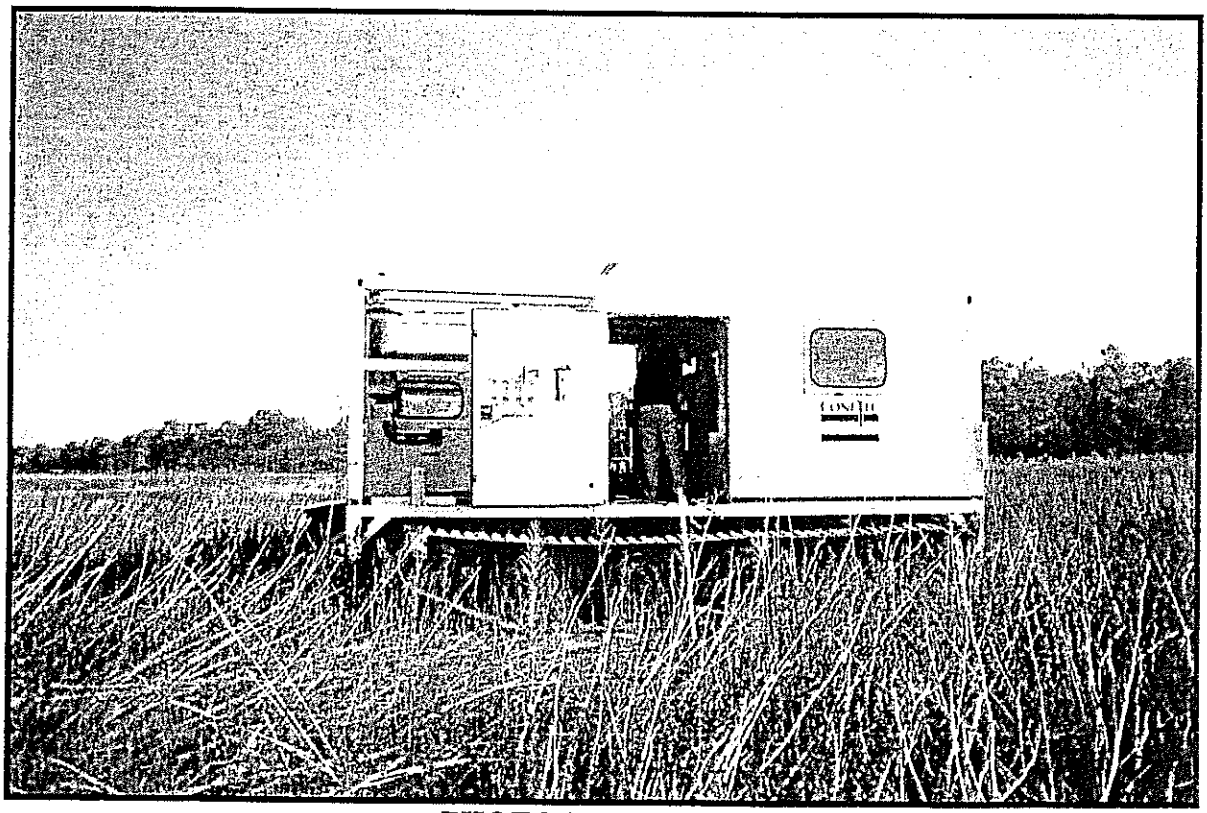
PHOTOGRAPH NO. 1
View of the Pond Creek facility and South Cell refuse looking southeast. (October 2007)



PHOTOGRAPH NO. 2
View of Pond Creek facility from existing coarse refuse crest at El. 482± looking north toward proposed Central and North Cells. ConeTec rig at CPT-6 middle right. (October 2007)

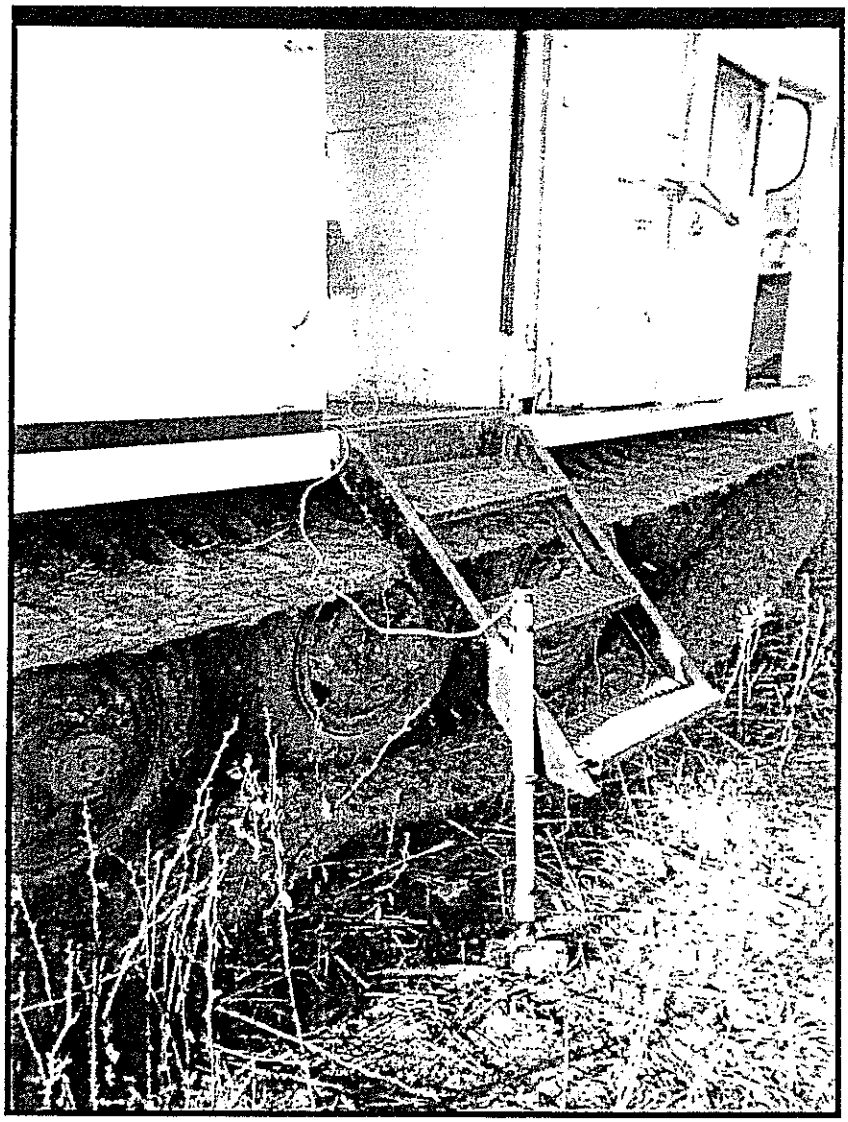


PHOTOGRAPH NO. 3
ConeTec CPT track rig at CPT-9 and proposed Central/North Cells
looking south. (October 2007)



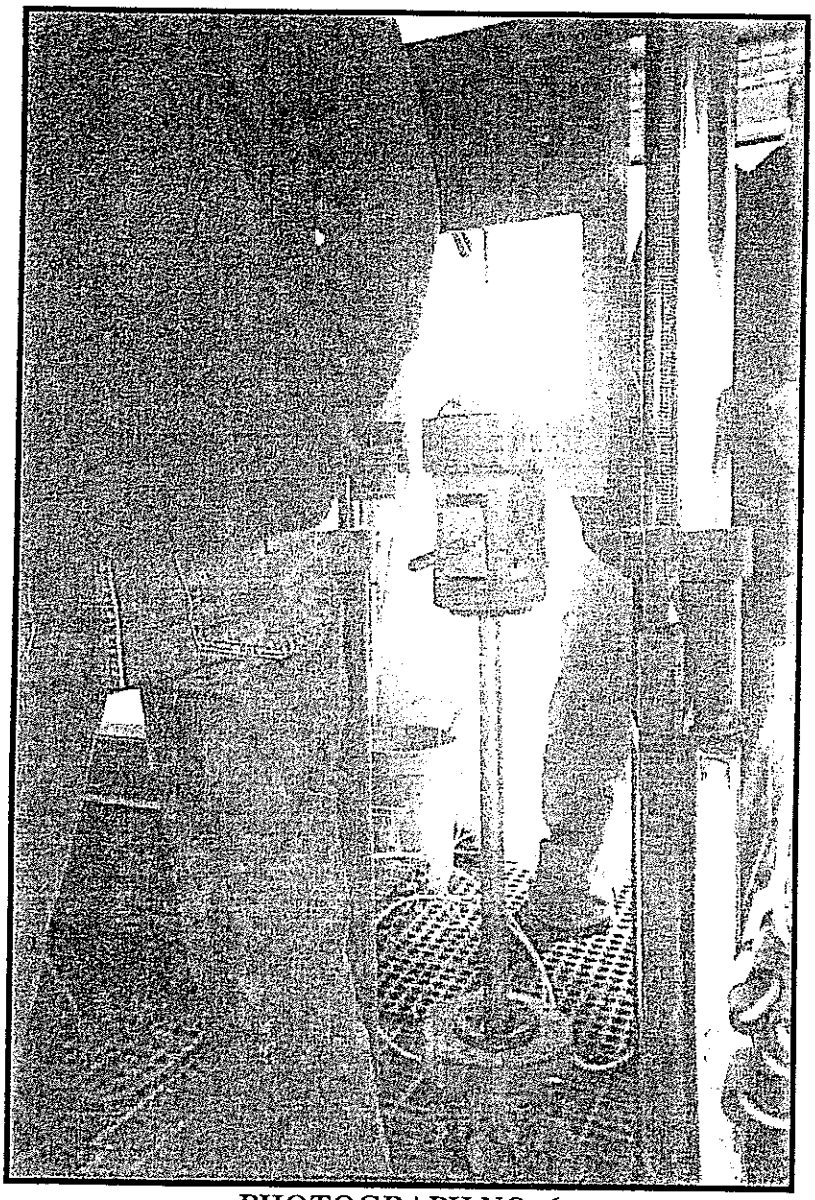
PHOTOGRAPH NO. 4
ConeTec CPT track rig at CPT-7 and proposed Central Cell
looking northeast. (October 2007)

R13837



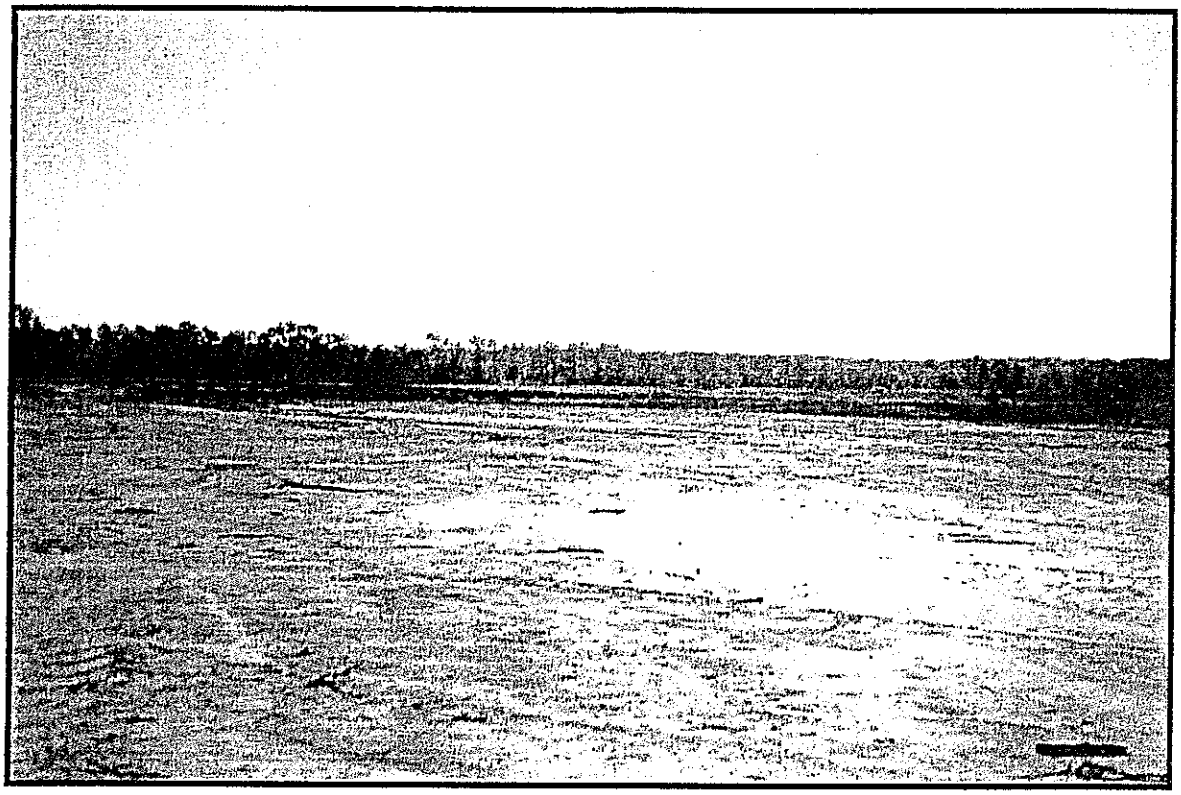
PHOTOGRAPH NO. 5
View of ConeTec seismic source beam beneath track and hammer with grounding cable. (October 2007)

R13838

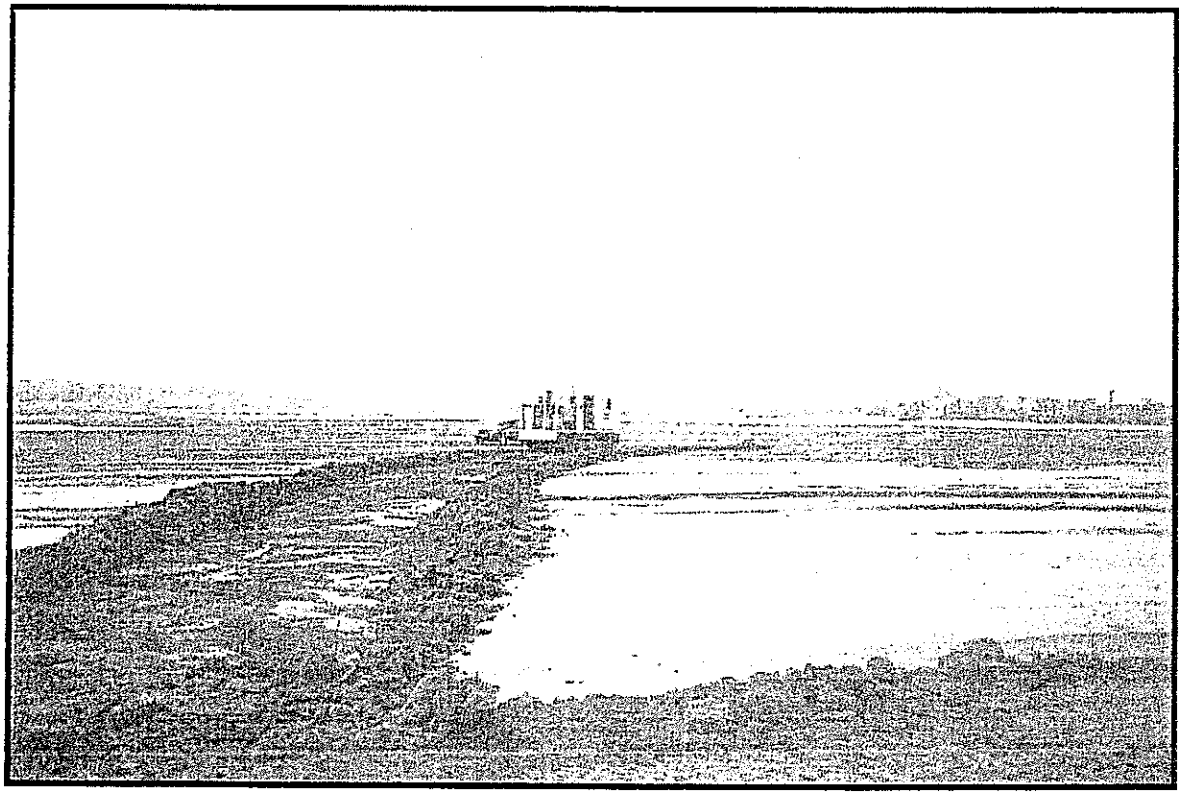


PHOTOGRAPH NO. 6
View of ConeTec CPT ram, rods and instrumentation cable from inside track rig.
(October 2007)

R13839



PHOTOGRAPH NO. 7
View of ConeTec track rig (in far left background) at CPT-8
looking northwest toward proposed North Cell. (October 2007)



PHOTOGRAPH NO. 8
View of ConeTec track rig at CPT-11 and proposed North Cell
looking south. (October 2007)

APPENDIX B-1

SHEAR MODULUS CORRELATIONS FOR SHAKE COLUMNS PCSC300E AND PCSC300M

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation

PROJECT NO. 072046

Shear Modulus Calculations for SHAKE Columns PCSC300E and PCSC300M

PAGE 1 OF 29

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CALCULATION BRIEF FOR SHEAR MODULUS CORRELATIONS FOR SHAKE COLUMNS PCSC300E AND PCSC300M

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH CELL

OBJECTIVE: Calculate elastic shear modulus (G_{max}) values for coarse coal refuse, coarse/fine mixed refuse, and fine coal refuse at the Pond Creek site from shear wave velocities measured at the site. Also, correlate these shear modulus values for SHAKE modeling of the proposed Pond Creek – South Cell embankment cross section, as shown in Figure 3.

METHODOLOGY: From the measured shear wave velocities (V_S) with depth at Piezo-Seismic Cone Penetrometer Test (PSCPT) sounding locations CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B, shear modulus is determined using the relationship $G = \gamma/g\ V_S^2$. To estimate induced cyclic shear stresses in the South Cell impoundment at the final geometry, SHAKE analyses are performed in which shear modulus and/or shear wave velocity are input parameters.

The seismic data from CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B were utilized and modified according to the projected cross-section of the future South Cell embankment/fines elevations. Columns PCSC300E/M were created from the CPT data at STA 300 along the South Cell cross-section shown in Figure 3. The SHAKE columns account for proposed maximum South Cell geometry by translating data of corresponding material types to the projected embankment geometry. The translated shear modulus data was modified according to the change in vertical effective stress (σ'_v) of the new column profile using Log G_{max} versus Log σ'_v relationships. Further, shear modulus correlations were performed accounting for changes in effective stress due to variations in ground water levels at the End of Construction (E) and Maximum fines elevation (M) conditions, which model the worst case upstream and downstream embankment scenarios, respectively. Finally, shear wave velocities were correlated from the literature (Reference 2) for bedrock as necessary input to SHAKE.

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Shear Modulus Calculations for SHAKE PAGE 2 OF 29

Columns PCSC300E and PCSC300M

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REFERENCES:

1. ConeTec, Inc. (2007), Field Report Entitled "Presentation of CPTU Test Results for: Pond Creek Mine – Williamson County, Illinois, December 10, 2007.

2. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Piezo-Cone Penetration Testing," Pond Creek Coal Refuse Disposal Site, BEG, dated 12/21/07.

3. Hunt, R. E., 1984, "Geotechnical Engineering Investigation Manual," McGraw Hill Book Company, Copyright 1984.

4. Schnabel, P. B., Lysmer, J. and Seed, H. B. (1972) "SHAKE: A Computer Program for Earthquake Response Analysis of Horizontally Layered Sites," Report No. EERC 72-12, University of California, Berkeley.

5. Hardin, B.O. (1978) The Nature of Stress-Strain Behavior in Soils," Proceedings, Geotechnical Engineering Division Specialty Conference on Earthquake Engineering and Soil Dynamics, Vol. 1, ASCE,. Pasadena, CA., June, p.p. 3-90.

SHEAR MODULUS CORRELATION FOR EXISTING REFUSE MATERIALS

ConeTec, Inc. (ConeTec) performed PS-CPT at 15 locations throughout the Pond Creek site as shown in Figure 2 of the report, with locations associated with the South Cell, designated as CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B also as shown in Figure 2. Based on the information provided by ConeTec which is presented in Appendix A, Attachment A-1, measured shear wave velocities were used to determine shear modulus (G) values with depth using the relationship:

$$G = (V_S^2 * \gamma)/g$$

Since low-amplitude (less than 0.001 %) shear strains were measured during seismic downhole testing, the shear modulus values obtained from the equation above equal the elastic shear modulus, G_{max}. The G_{max} - values estimated by ConeTec in their report were subsequently modified by CEC, due to our interpretations of the applicable unit weights for the strata encountered during the piezo-seismic cone penetrometer tests. The refuse/soil material properties and the generalized subsurface profile, based on the results of the continuous CPT profile as well as the seismic downhole tests which were completed at every three-foot depth interval, are tabulated below. The field measured shear wave velocities and modified initial shear modulus data (Modulus Calculations From Field Geophysical Data) for each South Cell CPT sounding are attached.

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PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation

PROJECT NO. 072046

Shear Modulus Calculations for SHAKE

PAGE 3 OF 29

Columns PCSC300E and PCSC300M

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Generalized South Cell CPT Profiles from 10/2007 Field Testing:

CPT-1	CPT-2
El. 482.19 – Surface Elevation	El. 494.21 – Surface Elevation
15.3 feet – Depth to Static Ground Water	38.8 feet – Depth to Static Ground Water
0 – 18.4 feet – Residual Soil	0 – 32 feet – Coarse Refuse
Refusal at 18.4 feet - Bedrock	32 – 45.3 feet – Residual Soil
	Refusal at 45.3 feet - Bedrock

CPT-2A	CPT-3
El. 492.40 – Surface Elevation	El. 466.98 – Surface Elevation
37.0 feet – Depth to Static Ground Water	11.1 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 22.2 feet – Residual Soil
29 – 41.7feet – Residual Soil	Refusal at 22.2 feet - Bedrock
Refusal at 41.7feet - Bedrock	

CPT-4	CPT-5
El. 482.55 – Surface Elevation	El. 482.55 – Surface Elevation
21.7 feet – Depth to Static Ground Water	34.4 feet – Depth to Static Ground Water
0 – 18.9 feet – Residual Soil	0 – 29 feet – Coarse Refuse
Refusal at 18.9 feet - Bedrock	29 – 49.2feet – Residual Soil
	Refusal at 49.2 feet - Bedrock

CPT-5A	CPT-5B
El. 483.00 – Surface Elevation	El. 479.90 – Surface Elevation
35.9 feet – Depth to Static Ground Water	28.0 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 19 feet – Coarse Refuse
29 – 53.2 feet – Residual Soil	19 – 39.7 feet – Residual Soil
Refusal at 53.2 feet - Bedrock	Refusal at 39.7 feet - Bedrock

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Shear Modulus Calculations for SHAKE PAGE 4 OF 29

Columns PCSC300E and PCSC300M

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Refuse/Soil Properties (Provided by Alliance Consulting, Inc. based on laboratory testing)

Description	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Comment
Coarse Refuse	130	36	0	Frictional
Fine Coal Refuse	80	30		Frictional
Residual Soil	125	19.5 0	400 3000	Total Strength 80% Peak Undrained

SHEAR MODULUS CORRELATION FOR MATERIALS AT PROPOSED SOUTH CELL

Based on the generalized impoundment profiles of the applicable CPT soundings and the existing site topographic conditions, initial moduli were calculated. However, there will be an additional 25 to 55 feet of coarse coal refuse that will be placed above the existing South Cell ground surface. Therefore, PSCPT data was "transformed" to represent the proposed conditions. This was accomplished by translating data (grouped by strata) to the crest location using the respective strata thicknesses for the future South Cell geometry. Further, translations were performed as described below for the effective stress variations due to ground water levels associated with the End of Construction (E) and the Maximum fines (M) conditions. SHAKE column PSCS300E/M were created from CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B data based on the generalized profiles presented in the following table.

Generalized Profile of the South Cell SHAKE column PSCS300E and PSCS300M:

PCSC300E (Upstream Min Fines)

El. 502 - Surface Elevation

32 feet – Depth to Ground Water Table

(Min. Fines Elevation - 474)

0 – 32 feet - Coarse Refuse

32 – 50 feet - Residual Soil

Below 50 feet - Bedrock

PCSC300M (Downstream Max Fines)

El. 502 - Surface Elevation

14 feet – Depth to Ground Water Table

(Max. Fines Elevation - 496)

0 – 32 feet - Coarse Refuse

32 – 50 feet - Residual Soil

Below 50 feet - Bedrock

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PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation PROJECT NO. 072046

Shear Modulus Calculations for SHAKE PAGE 5 OF 29

Columns PCSC300E and PCSC300M

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Due to the changes in the South Cell embankment profile from the existing conditions to the final geometry conditions, as well as the change in the piezometric surface associated with the upstream min. fines and downstream max. fines conditions and the corresponding change in vertical effective stress. The change in shear modulus with variations in vertical effective stress has been well documented for most types of soils. Hardin (1978) presented a design equation which relates Log G_{max} versus Log σ'_v for sands. The isotropic stress component, *n*, (or slope) of this relationship was developed for the coarse coal refuse and residual soil based on the recorded seismic data from CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B with respect to their corresponding σ'_v values and Vs, and was used to modify G_{max} for PSCS300. This relationship is illustrated graphically presented in this calculation brief.

The resulting shear modulus values of PCSC300 modified for the proposed maximum South Cell effective stresses are presented herein.

SHEAR VELOCITY CORRELATION FOR "OTHER" MATERIALS

ased on the boring logs and generalized cross section shown in Figure 3, weathered rock to competent rock (bedrock) exists beneath the bottom of the site and South Cell. The bedrock layer is accounted for in the SHAKE columns and shear wave velocities are correlated from Hunt, R. E., 1984 (Reference 3).

SHAKE column input parameters for each, including the soil type, depth, layer thickness, layer number and initial shear modulus and/or correlated shear wave velocity are attached to this calculation brief. The latter information (shear wave velocity) correlated from Hunt for bedrock was estimated as follows:

> From Table 2.9, Hunt presents compression wave velocity (V_p) ranges for various materials including Colluvium (firm to medium coarse), Shale (soft to hard) and Sandstone (soft to hard). It is assumed that the shale and sandstone sedimentary rock ranges are assumed for the bedrock beneath the site. Further, Hunt correlates V_p to shear wave velocity (V_S) using the relationships:
>
> $$V_S = 0.45 \text{ to } 0.58\ V_p \quad \text{(poorly to well consolidated soils, respectively)}$$

Consequently, the following values are correlated. Note, it is assumed that the rock stratum is medium hard.

Material	V_p Range Hunt (1984)	V_p Assumed	V_S Factor Hunt (1984)	V_S Used in SHAKE
Bedrock	4,000 to 10,000 fps	7,000 fps	0.58	4,000 fps

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Shear Modulus Calculations for SHAKE PAGE 6 OF 29

Columns PCSC300E and PCSC300M

MADE BY BEG DATE 1/3/08 CHECKED BY TM DATE 1/23/08

SHAKE DYNAMIC PROFILES

In order to utilize the correlated and assumed dynamic properties of the impoundment for SHAKE analyses, the tabulated data was separated into common material types with a total of sixteen (16) layers. Average shear modulus values were obtained by averaging the values for each newly created layer, as shown on the attached spreadsheets. In addition, the assumed shear velocity value for bedrock (presented above) was utilized for the basal layer (17). The averaged dynamic profiles and tabulated SHAKE input are attached to this calculation brief.

CONCLUSION

Based on the information presented in this calculation brief, estimates of shear modulus from measured shear wave velocities for the Pond Creek – South Cell impoundment were performed. SHAKE columns PCSC300E (Crest Column – Upstream Min. Fines) and PCSC300M (Crest Column – Downstream Max. Fines) were created by translating the initial shear modulus values from CPT-1 through CPT-5B and modifying them with respect to changes in vertical effective stress associated with the final South Cell geometry. The Log G_{max} versus Log σ'_v relationships for coarse refuse and residual soil were developed from the downhole seismic data from this study. Additionally, correlations presented for "other" materials not directly tested were utilized. The correlated shear modulus values subdivided into layers and averaged for use as SHAKE input. The created dynamic profiles will be utilized to estimate induced cyclic shear stress with depth for the proposed maximum South Cell geometry.

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PROJECT NO. 072046

Shear Modulus Calculations for SHAKE Columns PCSC300E and PCSC300M

PAGE 7 OF 29

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CORRELATED CPT-1 THROUGH CPT-5B SHEAR WAVE VELOCITY DATA MODIFIED BY CEC TO OBTAIN SHEAR MODULUS BASED ON REFUSE/SOIL DENSITIES AND SOUTH POND VERTICAL EFFECTIVE STRESS FOR SHAKE COLUMNS PCSC300E AND PCSC300M

Project: Williamson Energy - Pond Creek South Cell Deformation Analysis
Subject: Determination of Shear Moduli for Coarse Refuse and Soil - PCSC300M (StageVII Crest Column)
South Cell - Crest at El. 502; Fines at El. 496 (MAXIMUM FINES LEVEL)

Objective: Calculate in-situ values of Shear Modulus for coarse refuse and subgrade soils at the Williamson Energy Pond Creek South Cell coal refuse disposal site from shear wave velocities measured in various CPT soundinds conducted at the site.

Pond Creek Refuse Properties: (provided by Alliance Consulting Inc. from slope stability analyses)	Coarse Refuse	Residual Soil
Total Unit Weight (pcf) =	130.0	125.0
Total Sat. Unit Weight (pcf) =	140.0	135.0
Effective Unit Weight (pcf) =	77.6	72.6

Generalized Subsurface Profiles: Cone Penetration Testing (CPT) performed by ConeTec, Inc. and CEC November 2007.

CPT-1

Generalized Profile - CPT-1 Sounding 11/07

482.2	Surface Elev.,ft
15.3	Depth to Groundwater Table, ft
0 - 18.4 ft	Clay
18.40	Refusal

CPT-2

Generalized Profile - CPT-2 Sounding 11/07

484.2	Surface Elev.,ft
38.8	Depth to Groundwater Table, ft
0 - 32.0 ft	Coarse Refuse
32.0 - 45.3 ft	Clay
45.30	Refusal

CPT-2A

Generalized Profile - CPT-2A Sounding 11/07

492.4	Surface Elev.,ft
37.0	Depth to Groundwater Table, ft
0 - 29.0 ft	Coarse Refuse
29.0 - 41.7 ft	Clay
41.70	Refusal

CPT-3

Generalized Profile - CPT-3 Sounding 11/07

467.0	Surface Elev.,ft
11.1	Depth to Groundwater Table, ft
0 - 22.2.0 ft	Coarse Refuse
22.20	Refusal

CPT-4

Generalized Profile - CPT-4 Sounding 11/07

482.6	Surface Elev.,ft
21.7	Depth to Groundwater Table, ft
0 - 18.4 ft	Coarse Refuse
18.40	Refusal

CPT-5

Generalized Profile - CPT-5 Sounding 11/07

482.6	Surface Elev.,ft
34.4	Depth to Groundwater Table, ft
0 - 29.0 ft	Coarse Refuse
29.0 - 49.2 ft	Clay
49.20	Refusal

CPT-5A

Generalized Profile - CPT-5A Sounding 11/07

484.2	Surface Elev.,ft
38.8	Depth to Groundwater Table, ft
0 - 29.0 ft	Coarse Refuse
29.0 - 53.2 ft	Clay
53.20	Refusal

CPT-5B

Generalized Profile - CPT-5B Sounding 11/07

484.2	Surface Elev.,ft
38.8	Depth to Groundwater Table, ft
0 - 19.0 ft	Coarse Refuse
19.0 - 39.7 ft	Clay
39.10	Refusal

Generalized Profile For PCSC300M Stage VII CREST COLUMN (Crest El. 502, Max. Fines El. 496)

502.0	Surface Elev.,ft
14.0	Depth to Groundwater Table, ft
0 - 32 ft	Coarse Refuse
32 - 50 ft	Residual Soil
Below 50 ft	Bedrock

WILLIAMSON ENERGY - POND CREEK SOUTH CELL IMPOUNDMENT
SHAKE CREST COLUMN PCSC300M (CREST EL. 502, MAX. FINES EL. 496)
CPT-1, 2, 2A, 3, 4, 5, 5A, 5B

MODULUS CALCULATIONS FROM FIELD GEOPHYSICAL DATA:

CCR AND SOIL
CPT-1, 2, 2A, 3, 4, 5, 5A, 5B

			Ex. Surf. El:	482.2	484.2	492.4	467.0	482.6	482.6	484.2	484.2							
			GWT:	466.9	445.4	455.4	455.9	460.9	448.2	445.4	445.4							
	CPT Mid Layer Depth z (ft)	Stage VII Depth z (ft)	Stage VII Elevation El. (ft)	CPT-1 Shear Wave Velocity Vs (fps)	CPT-2 Shear Wave Velocity Vs (fps)	CPT-2A Shear Wave Velocity Vs (fps)	CPT-3 Shear Wave Velocity Vs (fps)	CPT-4 Shear Wave Velocity Vs (fps)	CPT-5 Shear Wave Velocity Vs (fps)	CPT-5A Shear Wave Velocity Vs (fps)	CPT-5B Shear Wave Velocity Vs (fps)	Average Shear Wave Velocity Vs (fps)	Average Initial Effective Stress σ' (psf)	Average Stage VII Effective Stress σ' (psf)	Average Initial SHEAR MODULUS Gmax (ksf)	Based 10X Corr SHEAR MODULUS Gmax dim	Based Corrected SHEAR MODULUS Gmax (ksf)	Average Stage VII Gmax For Layer Gmax (ksf)	LAYER NO.
	7.54	4.00	498.0	NA	1204	977	NA	NA	1030	844	818	975	980.2	520.0	3913	3.54	3454	3454	1
	7.54	7.00	495.0	NA	1204	977	NA	NA	1030	844	818	975	980.2	910.0	3913	3.59	3856	3856	2
	10.82	10.00	492.0	NA	1284	973	NA	NA	1076	779	900	1002	1406.6	1300.0	4175	3.61	4110	4110	3
	14.10	13.00	489.0	NA	1152	1121	NA	NA	991	1164	1517	1189	1833.0	1690.0	5831	3.76	5739	5739	4
	17.39	16.00	486.0	NA	1085	1051	NA	NA	936	1396	1085	1111	2260.7	1975.2	5074	3.69	4941	4941	5
	20.67	19.00	483.0	NA	1029	1105	NA	NA	1148	994	NA	1069	2687.1	2208.0	4629	3.65	4453	4453	6
CCR	23.95	22.00	480.0	NA	1039	1169	NA	NA	1190	1077	NA	1119	3113.5	2440.8	5069	3.68	4832	4832	7
	27.23	25.00	477.0	NA	1050	895	NA	NA	1067	1195	NA	1052	3539.9	2673.6	4512	3.63	4269	4269	8
	30.51	28.00	474.0	NA	1114	NA	NA	NA	NA	NA	NA	1114	3966.4	2906.4	5010	3.67	4713	4713	9
	30.51	32.00	470.0	NA	1114	NA	NA	NA	NA	NA	NA	1114	3966.4	3216.8	5010	3.68	4808	4808	10
	4.26	35.00	467.0	645	NA	NA	NA	476	NA	NA	NA	561	532.5	3344.6	1220	3.41	2570		
	33.79	35.00	467.0	NA	950	845	NA	NA	780	784	1014	875	4223.8	3344.6	2969	3.43	2701	2635	11
	7.54	38.00	464.0	656	NA	NA	577	673	NA	NA	NA	635	942.5	3562.4	1567	3.43	2687		
	37.07	38.00	464.0	NA	795	790	NA	NA	821	784	1150	868	4605.0	3562.4	2925	3.42	2636	2661	12
	10.82	41.00	461.0	808	NA	NA	569	781	NA	NA	NA	719	1352.5	3780.2	2009	3.48	3048		
SOIL	40.35	41.00	461.0	NA	908	1256	NA	NA	780	728	NA	918	4881.3	3780.2	3271	3.47	2949	2998	13
	14.10	44.00	458.0	1013	NA	NA	738	913	NA	NA	NA	888	1710.1	3998.0	3061	3.64	4320		
	43.30	44.00	458.0	NA	1173	NA	NA	NA	923	768	NA	955	5099.8	3998.0	3538	3.51	3205	3763	14
	17.06	47.00	455.0	1402	NA	NA	883	1242	NA	NA	NA	1176	1997.7	4215.8	5366	3.86	7264		
	46.67	47.00	455.0	NA	NA	NA	NA	NA	1599	961	NA	1280	5306.1	4215.8	6360	3.76	5794	6529	15
	20.10	50.00	452.0	NA	NA	NA	1058	NA	NA	NA	NA	1058	2040.9	4433.6	4345	3.77	5952		
	49.95	50.00	452.0	NA	NA	NA	NA	NA	NA	1411	NA	1411	5659.5	4433.6	7729	3.85	7000	6476	16

R1250

INITIAL EFFECTIVE STRESS CALCULATION:

			CPT-1	CPT-2	CPT-2A	CPT-3	CPT-4	CPT-5	CPT-5A	CPT-5B	Average
		Ex. Surf. El:	482.2	484.2	492.4	467.0	482.6	482.6	484.2	484.2	
		GWT:	466.9	445.4	455.4	455.9	460.9	448.2	445.4	445.4	
	CPT Mid Layer Depth z (ft)	Stage VII Depth z (ft)	Stage VII Elevation El. (ft)	Initial Effective Stress σ' (psf)	Initial Effective Stress σ' (psf)	Initial Effective Stress σ' (psf)	Initial Effective Stress σ' (psf)	Initial Effective Stress σ' (psf)	Initial Effective Stress σ' (psf)	Initial Effective Stress σ' (psf)	Initial Effective Stress σ' (psf)	Initial Effective Stress σ' (psf)
CCR	7.54	4.00	498.0	NA	980.2	980.2	NA	NA	980.2	980.2	980.2	980.2
	7.54	7.00	495.0	NA	980.2	980.2	NA	NA	980.2	980.2	980.2	980.2
	10.82	10.00	492.0	NA	1406.6	1406.6	NA	NA	1406.6	1406.6	1406.6	1406.6
	14.10	13.00	489.0	NA	1833.0	1833.0	NA	NA	1833.0	1833.0	1833.0	1833.0
	17.39	16.00	486.0	NA	2260.7	2260.7	NA	NA	2260.7	2260.7	2260.7	2260.7
	20.67	19.00	483.0	NA	2687.1	2687.1	NA	NA	2687.1	2687.1	NA	2687.1
	23.95	22.00	480.0	NA	3113.5	3113.5	NA	NA	3113.5	3113.5	NA	3113.5
	27.23	25.00	477.0	NA	3539.9	3539.9	NA	NA	3539.9	3539.9	NA	3539.9
	30.51	28.00	474.0	NA	3966.3	NA	NA	NA	NA	NA	NA	3966.3
	30.51	32.00	470.0	NA	3966.3	NA	NA	NA	NA	NA	NA	3966.3
SOIL	4.26	35.00	467.0	532.5	NA	NA	NA	532.5	NA	NA	NA	532.5
	33.79	35.00	467.0	NA	4223.8	4223.8	NA	NA	4223.8	4223.8	4223.8	4223.8
	7.54	38.00	464.0	942.5	NA	NA	942.5	942.5	NA	NA	NA	942.5
	37.07	38.00	464.0	NA	4633.8	4630.1	NA	NA	4493.8	4633.8	4633.8	4605.0
	10.82	41.00	461.0	1352.5	NA	NA	1352.5	1352.5	NA	NA	NA	1352.5
	40.35	41.00	461.0	NA	4962.5	4868.2	NA	NA	4732.0	4962.5	NA	4881.3
	14.10	44.00	458.0	1762.5	NA	NA	1605.3	1762.5	NA	NA	NA	1710.1
	43.30	44.00	458.0	NA	5176.7	NA	NA	NA	4946.1	5176.7	NA	5099.8
	17.06	47.00	455.0	2040.3	NA	NA	1820.2	2132.5	NA	NA	NA	1997.7
	46.67	47.00	455.0	NA	NA	NA	NA	NA	5190.8	5421.4	NA	5306.1
	20.10	50.00	452.0	NA	NA	NA	2040.9	NA	NA	NA	NA	2040.9
	49.95	50.00	452.0	NA	NA	NA	NA	NA	NA	5659.5	NA	5659.5

R13851

INITIAL SHEAR MODULUS CALCULATION:

	CPT Mid Layer Depth z (ft)	Stage VII Depth z (ft)	Stage VII Elevation El. (ft)	CPT-1 Initial Shear Modulus Gmax (ksf)	CPT-2 Initial Shear Modulus Gmax (ksf)	CPT-2A Initial Shear Modulus Gmax (ksf)	CPT-3 Initial Shear Modulus Gmax (ksf)	CPT-4 Initial Shear Modulus Gmax (ksf)	CPT-5 Initial Shear Modulus Gmax (ksf)	CPT-5A Initial Shear Modulus Gmax (ksf)	CPT-5B Initial Shear Modulus Gmax (ksf)	Average Initial Shear Modulus Gmax (ksf)
CCR	7.54	4.00	498.0	NA	5852	3854	NA	NA	4283	2876	2701	3913
	7.54	7.00	495.0	NA	5852	3854	NA	NA	4283	2876	2701	3913
	10.82	10.00	492.0	NA	6656	5822	NA	NA	4674	2450	3270	4175
	14.10	13.00	489.0	NA	5358	5073	NA	NA	3965	5470	9291	5831
	17.39	16.00	486.0	NA	4753	4460	NA	NA	3537	7868	4753	5074
	20.67	19.00	483.0	NA	4275	4930	NA	NA	5321	3989	NA	4629
	23.95	22.00	480.0	NA	4358	5517	NA	NA	5717	4683	NA	5069
	27.23	25.00	477.0	NA	4451	3234	NA	NA	4596	5765	NA	4512
	30.51	28.00	474.0	NA	5010	NA	NA	NA	NA	NA	NA	5010
	30.51	32.00	470.0	NA	5010	NA	NA	NA	NA	NA	NA	5010
SOIL	4.26	35.00	467.0	1615	NA	NA	NA	880	NA	NA	NA	1220
	33.79	35.00	467.0	NA	3503	2772	NA	NA	2362	2386	3991	2969
	7.54	38.00	464.0	1671	NA	NA	1292	1758	NA	NA	NA	1567
	37.07	38.00	464.0	NA	2454	2423	NA	NA	2617	2386	5134	2925
	10.82	41.00	461.0	2534	NA	NA	1257	2368	NA	NA	NA	2009
	40.35	41.00	461.0	NA	3201	6124	NA	NA	2362	2057	NA	3271
	14.10	44.00	458.0	3984	NA	NA	2114	3236	NA	NA	NA	3061
	43.30	44.00	458.0	NA	5341	NA	NA	NA	3307	2290	NA	3538
	17.06	47.00	455.0	7630	NA	NA	3027	5988	NA	NA	NA	5366
	46.67	47.00	455.0	NA	NA	NA	NA	NA	9925	3585	NA	6360
	20.10	50.00	452.0	NA	NA	NA	4345	NA	NA	NA	NA	4345
	49.95	50.00	452.0	NA	NA	NA	NA	NA	NA	7729	NA	7729

Project: Williamson Energy - Pond Creek South Cell Deformation Analysis
Subject: Determination of Shear Moduli for Coarse Refuse and Soil - PCSC300E (StageVII Crest Column)
South Cell - Crest at El. 502; Fines at El. 474 (MINIMUM FINES LEVEL)

Objective: Calculate in-situ values of Shear Modulus for coarse refuse and subgrade soils at the Williamson Energy Pond Creek South Cell coal refuse disposal site from shear wave velocities measured in various CPT soundinds conducted at the site.

Pond Creek Refuse Properties: **(provided by Alliance Consulting Inc. from slope stability analyses)**	Coarse Refuse	Residual Soil
Total Unit Weight (pcf) =	130.0	125.0
Total Sat. Unit Weight (pcf) =	140.0	135.0
Effective Unit Weight (pcf) =	77.6	72.6

Generalized Subsurface Profiles: Cone Penetration Testing (CPT) performed by ConeTec, Inc. and CEC November 2007.

CPT-1

Generalized Profile - CPT-1 Sounding 11/07

482.2	Surface Elev.,ft
15.3	Depth to Groundwater Table, ft
0 - 18.4 ft	Clay
18.40	Refusal

CPT-2

Generalized Profile - CPT-2 Sounding 11/07

484.2	Surface Elev.,ft
38.8	Depth to Groundwater Table, ft
0 - 32.0 ft	Coarse Refuse
32.0 - 45.3 ft	Clay
45.30	Refusal

CPT-2A

Generalized Profile - CPT-2A Sounding 11/07

492.4	Surface Elev.,ft
37.0	Depth to Groundwater Table, ft
0 - 29.0 ft	Coarse Refuse
29.0 - 41.7 ft	Clay
41.70	Refusal

CPT-3

Generalized Profile - CPT-3 Sounding 11/07

467.0	Surface Elev.,ft
11.1	Depth to Groundwater Table, ft
0 - 22.2.0 ft	Coarse Refuse
22.20	Refusal

CPT-4

Generalized Profile - CPT-4 Sounding 11/07

482.6	Surface Elev.,ft
21.7	Depth to Groundwater Table, ft
0 - 18.4 ft	Coarse Refuse
18.40	Refusal

CPT-5

Generalized Profile - CPT-5 Sounding 11/07

482.6	Surface Elev.,ft
34.4	Depth to Groundwater Table, ft
0 - 29.0 ft	Coarse Refuse
29.0 - 49.2 ft	Clay
49.20	Refusal

CPT-5A

Generalized Profile - CPT-5A Sounding 11/07

484.2	Surface Elev.,ft
38.8	Depth to Groundwater Table, ft
0 - 29.0 ft	Coarse Refuse
29.0 - 53.2 ft	Clay
53.20	Refusal

CPT-5B

Generalized Profile - CPT-5B Sounding 11/07

484.2	Surface Elev.,ft
38.8	Depth to Groundwater Table, ft
0 - 19.0 ft	Coarse Refuse
19.0 - 39.7 ft	Clay
39.10	Refusal

Generalized Profile For PCSC300E Stage VII CREST COLUMN (Crest El. 502, Max. Fines El. 474)

502.0	Surface Elev.,ft
32.0	Depth to Groundwater Table, ft
0 - 32 ft	Coarse Refuse
32 - 50 ft	Residual Soil
Below 50 ft	Bedrock

WILLIAMSON ENERGY - POND CREEK SOUTH CELL IMPOUNDMENT
SHAKE CREST COLUMN PCSC300E (CREST EL. 502, MIN FINES EL. 474)
CPT-1, 2, 2A, 3, 4, 5, 5A, 5B

MODULUS CALCULATIONS FROM FIELD GEOPHYSICAL DATA:

CCR AND SOIL
CPT-1, 2, 2A, 3, 4, 5, 5A, 5B

			Ex. Surf. El:	482.2	484.2	492.4	467.0	482.6	482.6	484.2	484.2							
			GWT:	466.9	445.4	455.4	455.9	460.9	448.2	445.4	445.4							
	CPT Mid Layer Depth z (ft)	Stage VII Depth z (ft)	Stage VII Elevation El. (ft)	CPT-1 Shear Wave Velocity Vs (fps)	CPT-2 Shear Wave Velocity Vs (fps)	CPT-2A Shear Wave Velocity Vs (fps)	CPT-3 Shear Wave Velocity Vs (fps)	CPT-4 Shear Wave Velocity Vs (fps)	CPT-5 Shear Wave Velocity Vs (fps)	CPT-5A Shear Wave Velocity Vs (fps)	CPT-5B Shear Wave Velocity Vs (fps)	Average Shear Wave Velocity Vs (fps)	Average Initial Effective Stress σ' (psf)	Average Stage VII Effective Stress σ' (psf)	Average Initial SHEAR MODULUS Gmax (ksf)	Based 10X Corr SHEAR MODULUS Gmax dim	Corrected SHEAR MODULUS Gmax (ksf)	Average Stage VII Gmax For Layer Gmax (ksf)	LAYER NO.
	7.54	4.00	498.0	NA	1204	977	NA	NA	1030	844	818	975	980.2	520.0	3913	3.54	3454	3454	1
	7.54	7.00	495.0	NA	1204	977	NA	NA	1030	844	818	975	980.2	910.0	3913	3.59	3856	3856	2
	10.82	10.00	492.0	NA	1284	973	NA	NA	1076	779	900	1002	1406.6	1300.0	4175	3.61	4110	4110	3
	14.10	13.00	489.0	NA	1152	1121	NA	NA	991	1164	1517	1189	1833.0	1690.0	5831	3.76	5739	5739	4
	17.39	16.00	486.0	NA	1085	1051	NA	NA	936	1396	1085	1111	2260.7	2080.0	5074	3.70	4991	4991	5
CCR	20.67	19.00	483.0	NA	1029	1105	NA	NA	1148	994	NA	1069	2687.1	2470.0	4629	3.66	4552	4552	6
	23.95	22.00	480.0	NA	1039	1169	NA	NA	1190	1077	NA	1119	3113.5	2860.0	5069	3.70	4985	4985	7
	27.23	25.00	477.0	NA	1050	895	NA	NA	1067	1195	NA	1052	3539.9	3250.0	4512	3.65	4436	4436	8
	30.51	28.00	474.0	NA	1114	NA	NA	NA	NA	NA	NA	1114	3966.3	3640.0	5010	3.69	4926	4926	9
	30.51	32.00	470.0	NA	1114	NA	NA	NA	NA	NA	NA	1114	3966.3	4160.0	5010	3.70	5058	5058	10
	4.26	35.00	467.0	645	NA	NA	NA	476	NA	NA	NA	561	532.5	4377.8	1220	3.46	2866		
	33.79	35.00	467.0	NA	950	845	NA	NA	780	784	1014	875	4223.8	4377.8	2969	3.48	3013	2940	11
	7.54	38.00	464.0	656	NA	NA	577	673	NA	NA	NA	635	942.5	4595.6	1567	3.47	2979		
	37.07	38.00	464.0	NA	795	790	NA	NA	821	784	1150	868	4605.0	4595.6	2925	3.47	2922	2951	12
	10.82	41.00	461.0	808	NA	NA	569	781	NA	NA	NA	719	1352.5	4813.4	2009	3.53	3361		
SOIL	40.35	41.00	461.0	NA	908	1256	NA	NA	780	728	NA	918	4881.3	4813.4	3271	3.51	3253	3307	13
	14.10	44.00	458.0	1013	NA	NA	738	913	NA	NA	NA	888	1710.1	5031.2	3061	3.68	4742		
	43.30	44.00	458.0	NA	1173	NA	NA	NA	923	768	NA	955	5099.8	5031.2	3538	3.55	3519	4130	14
	17.06	47.00	455.0	1402	NA	NA	883	1242	NA	NA	NA	1176	1997.7	5249.0	5366	3.90	7940		
	46.67	47.00	455.0	NA	NA	NA	NA	NA	1599	961	NA	1280	5306.1	5249.0	6360	3.80	6332	7136	15
	20.10	50.00	452.0	NA	NA	NA	1058	NA	NA	NA	NA	1058	2040.9	5466.8	4345	3.81	6480		
	49.95	50.00	452.0	NA	NA	NA	NA	NA	NA	1411	NA	1411	5659.5	5466.8	7729	3.88	7621	7051	16

R13854

INITIAL EFFECTIVE STRESS CALCULATION:

		Ex. Surf. El:	482.2	484.2	492.4	467.0	482.6	482.6	484.2	484.2	
		GWT:	466.9	445.4	455.4	455.9	460.9	448.2	445.4	445.4	
	CPT Mid Layer Depth z (ft)	Stage VII Depth z (ft)	Stage VII Elevation El. (ft)	CPT-1 Initial Effective Stress σ' (psf)	CPT-2 Initial Effective Stress σ' (psf)	CPT-2A Initial Effective Stress σ' (psf)	CPT-3 Initial Effective Stress σ' (psf)	CPT-4 Initial Effective Stress σ' (psf)	CPT-5 Initial Effective Stress σ' (psf)	CPT-5A Initial Effective Stress σ' (psf)	CPT-5B Initial Effective Stress σ' (psf)	Average Initial Effective Stress σ' (psf)
CCR	7.54	4.00	498.0	NA	980.2	980.2	NA	NA	980.2	980.2	980.2	980.2
	7.54	7.00	495.0	NA	980.2	980.2	NA	NA	980.2	980.2	980.2	980.2
	10.82	10.00	492.0	NA	1406.6	1406.6	NA	NA	1406.6	1406.6	1406.6	1406.6
	14.10	13.00	489.0	NA	1833.0	1833.0	NA	NA	1833.0	1833.0	1833.0	1833.0
	17.39	16.00	486.0	NA	2260.7	2260.7	NA	NA	2260.7	2260.7	2260.7	2260.7
	20.67	19.00	483.0	NA	2687.1	2687.1	NA	NA	2687.1	2687.1	NA	2687.1
	23.95	22.00	480.0	NA	3113.5	3113.5	NA	NA	3113.5	3113.5	NA	3113.5
	27.23	25.00	477.0	NA	3539.9	3539.9	NA	NA	3539.9	3539.9	NA	3539.9
	30.51	28.00	474.0	NA	3966.3	NA	NA	NA	NA	NA	NA	3966.3
	30.51	32.00	470.0	NA	3966.3	NA	NA	NA	NA	NA	NA	3966.3
SOIL	4.26	35.00	467.0	532.5	NA	NA	NA	532.5	NA	NA	NA	532.5
	33.79	35.00	467.0	NA	4223.8	4223.8	NA	NA	4223.8	4223.8	4223.8	4223.8
	7.54	38.00	464.0	942.5	NA	NA	942.5	942.5	NA	NA	NA	942.5
	37.07	38.00	464.0	NA	4633.8	4630.1	NA	NA	4493.8	4633.8	4633.8	4605.0
	10.82	41.00	461.0	1352.5	NA	NA	1352.5	1352.5	NA	NA	NA	1352.5
	40.35	41.00	461.0	NA	4962.5	4868.2	NA	NA	4732.0	4962.5	NA	4881.3
	14.10	44.00	458.0	1762.5	NA	NA	1605.3	1762.5	NA	NA	NA	1710.1
	43.30	44.00	458.0	NA	5176.7	NA	NA	NA	4946.1	5176.7	NA	5099.8
	17.06	47.00	455.0	2040.3	NA	NA	1820.2	2132.5	NA	NA	NA	1997.7
	46.67	47.00	455.0	NA	NA	NA	NA	NA	5190.8	5421.4	NA	5306.1
	20.10	50.00	452.0	NA	NA	NA	2040.9	NA	NA	NA	NA	2040.9
	49.95	50.00	452.0	NA	NA	NA	NA	NA	NA	5659.5	NA	5659.5

R13855

INITIAL SHEAR MODULUS CALCULATION:

	CPT Mid Layer Depth z (ft)	Stage VII Depth z (ft)	Stage VII Elevation El. (ft)	CPT-1 Initial Shear Modulus Gmax (ksf)	CPT-2 Initial Shear Modulus Gmax (ksf)	CPT-2A Initial Shear Modulus Gmax (ksf)	CPT-3 Initial Shear Modulus Gmax (ksf)	CPT-4 Initial Shear Modulus Gmax (ksf)	CPT-5 Initial Shear Modulus Gmax (ksf)	CPT-5A Initial Shear Modulus Gmax (ksf)	CPT-5B Initial Shear Modulus Gmax (ksf)	Average Initial Shear Modulus Gmax (ksf)
CCR	7.54	4.00	498.0	NA	5852	3854	NA	NA	4283	2876	2701	3913
	7.54	7.00	495.0	NA	5852	3854	NA	NA	4283	2876	2701	3913
	10.82	10.00	492.0	NA	6656	3822	NA	NA	4674	2450	3270	4175
	14.10	13.00	489.0	NA	5358	5073	NA	NA	3965	5470	929	5831
	17.39	16.00	486.0	NA	4753	4460	NA	NA	3537	7868	4753	5074
	20.67	19.00	483.0	NA	4275	4980	NA	NA	5321	3989	NA	4629
	23.95	22.00	480.0	NA	4358	5517	NA	NA	5747	4683	NA	5069
	27.23	25.00	477.0	NA	4451	3234	NA	NA	4596	5765	NA	4512
	30.51	28.00	474.0	NA	5010	NA	NA	NA	NA	NA	NA	5010
	30.51	32.00	470.0	NA	5010	NA	NA	NA	NA	NA	NA	5010
SOIL	4.26	35.00	467.0	1615	NA	NA	NA	880	NA	NA	NA	1220
	33.79	35.00	467.0	NA	3503	2772	NA	NA	2362	2386	3991	2969
	7.54	38.00	464.0	1671	NA	NA	1292	1758	NA	NA	NA	1567
	37.07	38.00	464.0	NA	2454	2423	NA	NA	2617	2386	5134	2925
	10.82	41.00	461.0	2534	NA	NA	1257	2368	NA	NA	NA	2009
	40.35	41.00	461.0	NA	3201	6124	NA	NA	2362	2057	NA	3271
	14.10	44.00	458.0	3984	NA	NA	2114	3236	NA	NA	NA	3061
	43.30	44.00	458.0	NA	5341	NA	NA	NA	3307	2290	NA	3538
	17.06	47.00	455.0	7630	NA	NA	3027	5988	NA	NA	NA	5366
	46.67	47.00	455.0	NA	NA	NA	NA	NA	9925	3585	NA	6360
	20.10	50.00	452.0	NA	NA	NA	4345	NA	NA	NA	NA	4345
	49.95	50.00	452.0	NA	NA	NA	NA	NA	NA	7729	NA	7729

Project: WILLIAMSON ENERGY - POND CREEK SOUTH CELL DEFORMATION ANALYSES

Subject: Determination of Shear Moduli for Coarse Refuse and Soil Materials, and Regression Analyses Relationships

Objective: Calculate in-situ values of Shear Modulus for coarse refuse and soils at the Williamson Energy Pond Creek site, and perform regression analyses to develop regression relationships for each material for extrapolating shear modulus at different effective stresses.

Pond Creek Refuse Properties:	Coarse	Residual
(provided by Alliance Consulting, Inc.)	Refuse	Soil
Total Unit Weight (pcf) =	130.0	125.0
Total Sat. Unit Weight (pcf) =	140.0	135.0
Effective Unit Weight (pcf) =	77.6	72.6

WILLIAMSON ENERGY - POND CREEK SOUTH CELL IMPOUNDMENT
SHAKE CREST COLUMN PCSC300 (CREST EL. 502, MAX. FINES EL. 496)
CPT-1, 2, 2A, 3, 4, 5, 5A, 5B
MODULUS CALCULATIONS FROM FIELD GEOPHYSICAL DATA:

Gmax vs. Vertical Effective Stress
CPT-1 Coarse Refuse
+
Gmax vs. Vertical Effective Stress
CPT-2 Coarse Refuse
+
Gmax vs. Vertical Effective Stress
CPT-2A Coarse Refuse
+
Gmax vs. Vertical Effective Stress
CPT-3 Coarse Refuse

Gmax vs. Vertical Effective Stress
CPT-1 Residual Soil
+
Gmax vs. Vertical Effective Stress
CPT-2 Residual Soil
+
Gmax vs. Vertical Effective Stress
CPT-2A Residual Soil
+
Gmax vs. Vertical Effective Stress
CPT-3 Residual Soil

Gmax vs. Vertical Effective Stress
CPT-4 Coarse Refuse
+
Gmax vs. Vertical Effective Stress
CPT-5 Coarse Refuse
+
Gmax vs. Vertical Effective Stress
CPT-5A Coarse Refuse
+
Gmax vs. Vertical Effective Stress
CPT-5B Coarse Refuse

Gmax vs. Vertical Effective Stress
CPT-4 Residual Soil
+
Gmax vs. Vertical Effective Stress
CPT-5 Residual Soil
+
Gmax vs. Vertical Effective Stress
CPT-5A Residual Soil
+
Gmax vs. Vertical Effective Stress
CPT-5B Residual Soil

WILLIAMSON ENERGY - POND CREEK SOUTH CELL IMPOUNDMENT
SHAKE CREST COLUMN PCSC300 (CREST EL. 502, MAX. FINES EL. 496)
CPT-1, 2, 2A, 3, 4, 5, 5A, 5B
'ODULUS CALCULATIONS FROM FIELD GEOPHYSICAL DATA:

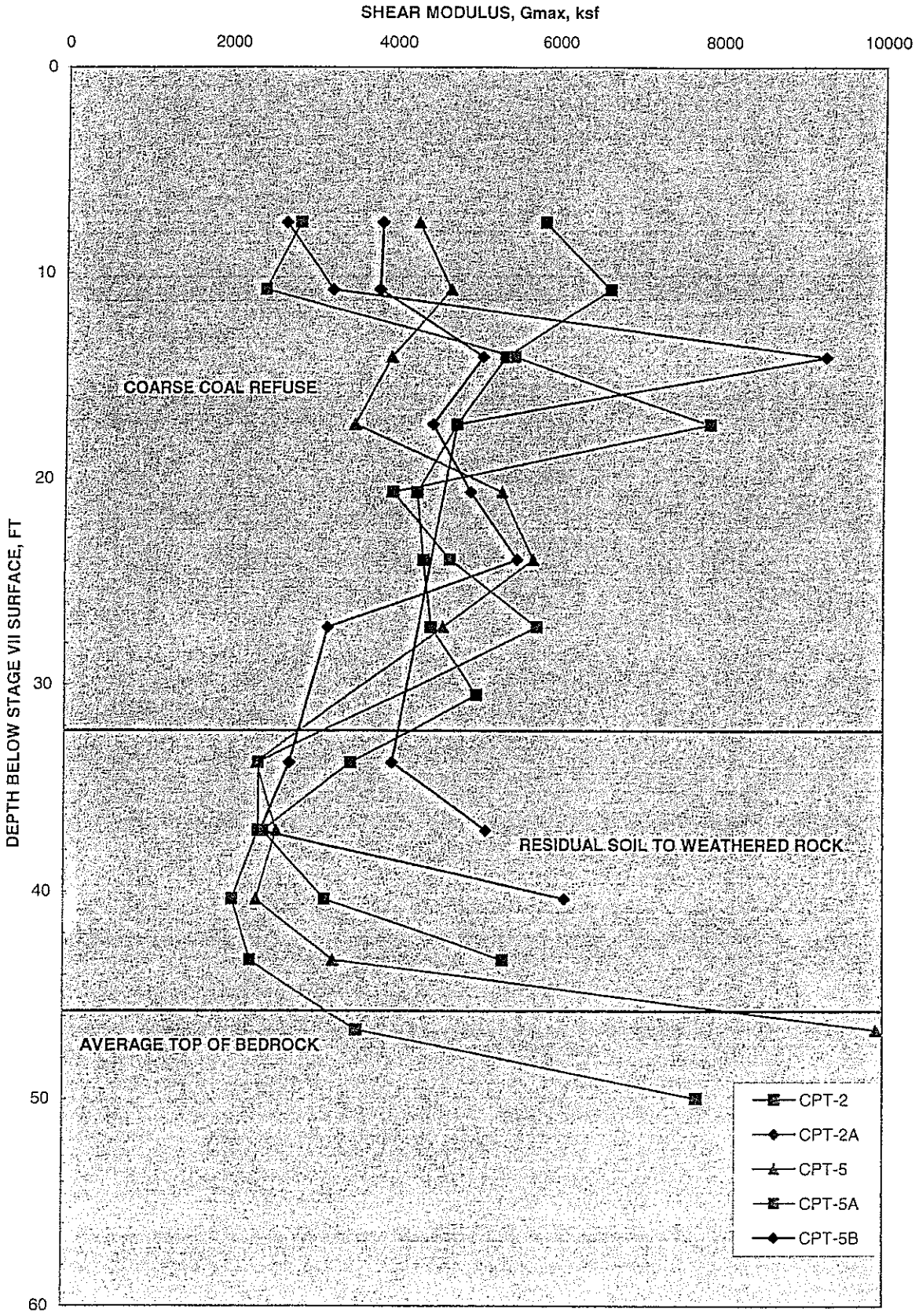
COARSE COAL REFUSE

Initial Effective Stress σ' (ksf)	Initial Effective Stress σ' (psf)	S-Wave Velocity Vs (fps)	Initial SHEAR MODULUS Gmax (ksf)
NA	NA	NA	NA
0.98	980.2	1204	5852
0.98	980.2	1204	5852
1.41	1406.6	1284	6656
1.83	1833.0	1152	5358
2.26	2260.7	1085	4753
2.69	2687.1	1029	4275
3.11	3113.5	1039	4358
3.54	3539.9	1050	4451
3.97	3966.3	1114	5010
3.97	3966.3	1114	5010
0.98	980.2	977	3854
0.98	980.2	977	3854
1.41	1406.6	973	3822
1.83	1833.0	1121	5073
2.26	2260.7	1051	4460
2.69	2687.1	1105	4930
3.11	3113.5	1169	5517
3.54	3539.9	895	3234
NA	NA	NA	NA
NA	NA	NA	NA
0.98	980.2	1030.0	4283.1
0.98	980.2	1030.0	4283.1
1.41	1406.6	1076.0	4674.3
1.83	1833.0	991.0	3964.9
2.26	2260.7	936.0	3537.0
2.69	2687.1	1148.0	5320.7
3.11	3113.5	1190.0	5717.2
3.54	3539.9	1067.0	4596.4
0.98	980.2	844.0	2875.9
0.98	980.2	844.0	2875.9
1.41	1406.6	779.0	2450.0
1.83	1833.0	1164.0	5470.1
2.26	2260.7	1396.0	7867.9
2.69	2687.1	994.0	3989.0
3.11	3113.5	1077.0	4682.9
3.54	3539.9	1195.0	5765.3
0.98	980.2	818.0	2701.4
0.98	980.2	818.0	2701.4
1.41	1406.6	900.0	3270.2
1.83	1833.0	1517.0	9290.9
2.26	2260.7	1085.0	4752.8

RESIDUAL SOIL

Initial Effective Stress σ' (ksf)	Initial Effective Stress σ' (psf)	S-Wave Velocity Vs (fps)	Initial SHEAR MODULUS Gmax (ksf)
0.53	532.5	645.0	1615.0
0.94	942.5	656.0	1670.6
1.35	1352.5	808.0	2534.4
1.76	1762.5	1013.0	3983.6
1.35	1352.5	808.0	2534.4
2.04	2040.3	1402.0	7630.5
4.22	4223.8	950.0	3503.5
4.63	4633.8	795.0	2453.5
4.96	4962.5	908.0	3200.6
5.18	5176.7	1173.0	5341.3
4.22	4223.8	845.0	2771.8
4.63	4630.1	790.0	2422.7
4.87	4868.2	1256.0	6124.0
0.94	942.5	577.0	1292.4
1.35	1352.5	569.0	1256.8
1.61	1605.3	738.0	2114.3
1.82	1820.2	883.0	3026.7
1.35	1352.5	569.0	1256.8
0.53	532.5	476.0	879.6
0.94	942.5	673.0	1758.3
1.35	1352.5	781.0	2367.9
1.76	1762.5	913.0	3235.9
2.13	2132.5	1242.0	5988.2
4.22	4223.8	780.0	2361.8
4.49	4493.8	821.0	2616.6
4.73	4732.0	780.0	2361.8
4.95	4946.1	923.0	3307.2
5.19	5190.8	1599.0	9925.5
4.22	4223.8	784.0	2386.1
4.63	4633.8	784.0	2386.1
4.96	4962.5	728.0	2057.4
5.18	5176.7	768.0	2289.7
5.42	5421.4	961.0	3585.1
4.2	4223.8	1014.0	3991.4
4.6	4633.8	1150.0	5133.9

INITIAL SHEAR MODULUS VS. DEPTH
WILLIAMSON ENERGY - POND CREEK SOUTH CELL
CPT-2, CPT-2A, CPT-5, CPT-5A AND CPT-5B



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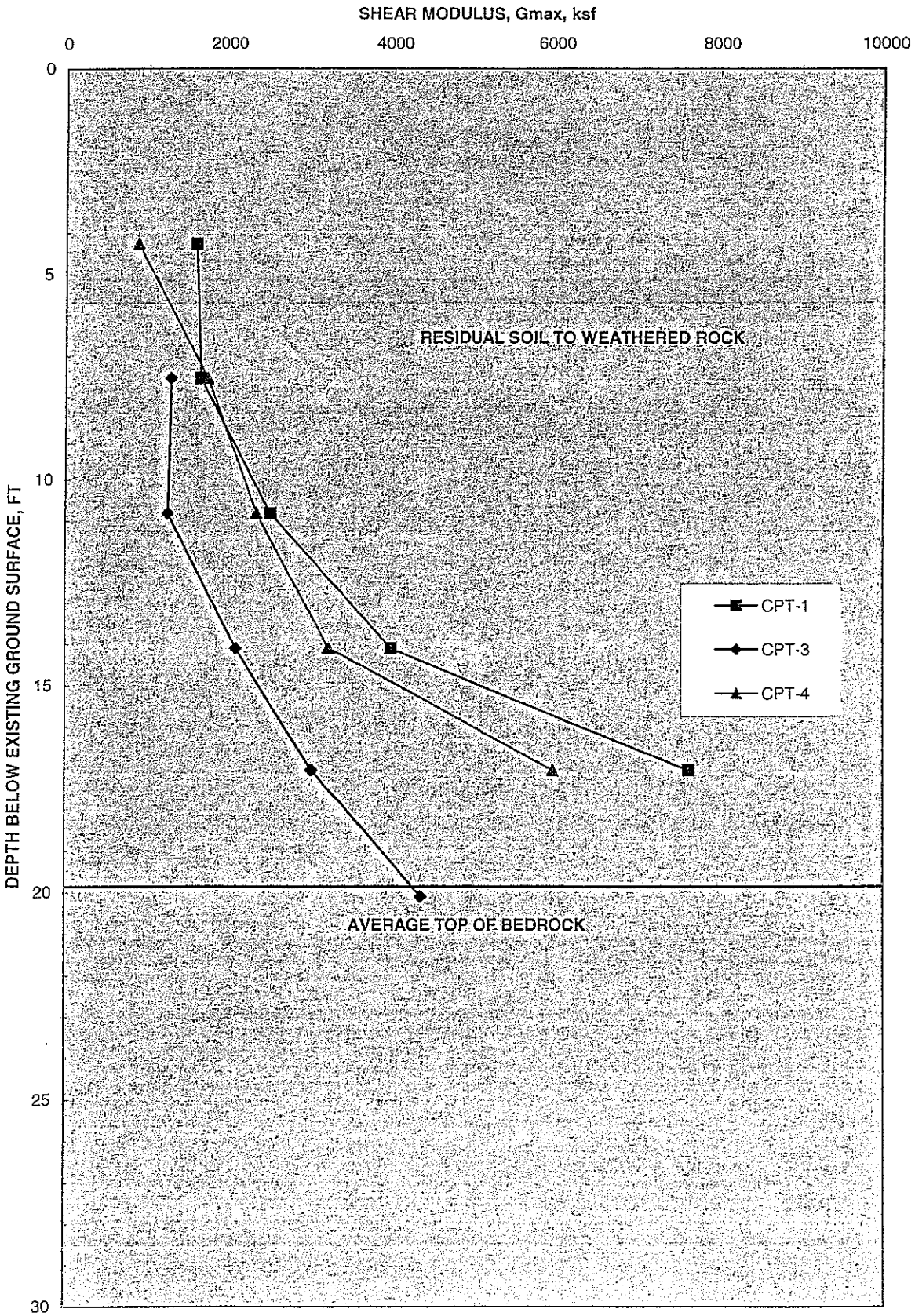
INITIAL SHEAR MODULUS VS. DEPTH
WILLIAMSON ENERGY - POND CREEK SOUTH CELL
CPT-1, CPT-3 AND CPT-4



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PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation

PROJECT NO. 072046

Shear Modulus Calculations for SHAKE

PAGE 21 OF 29

Columns PCSC300E and PCSC300M

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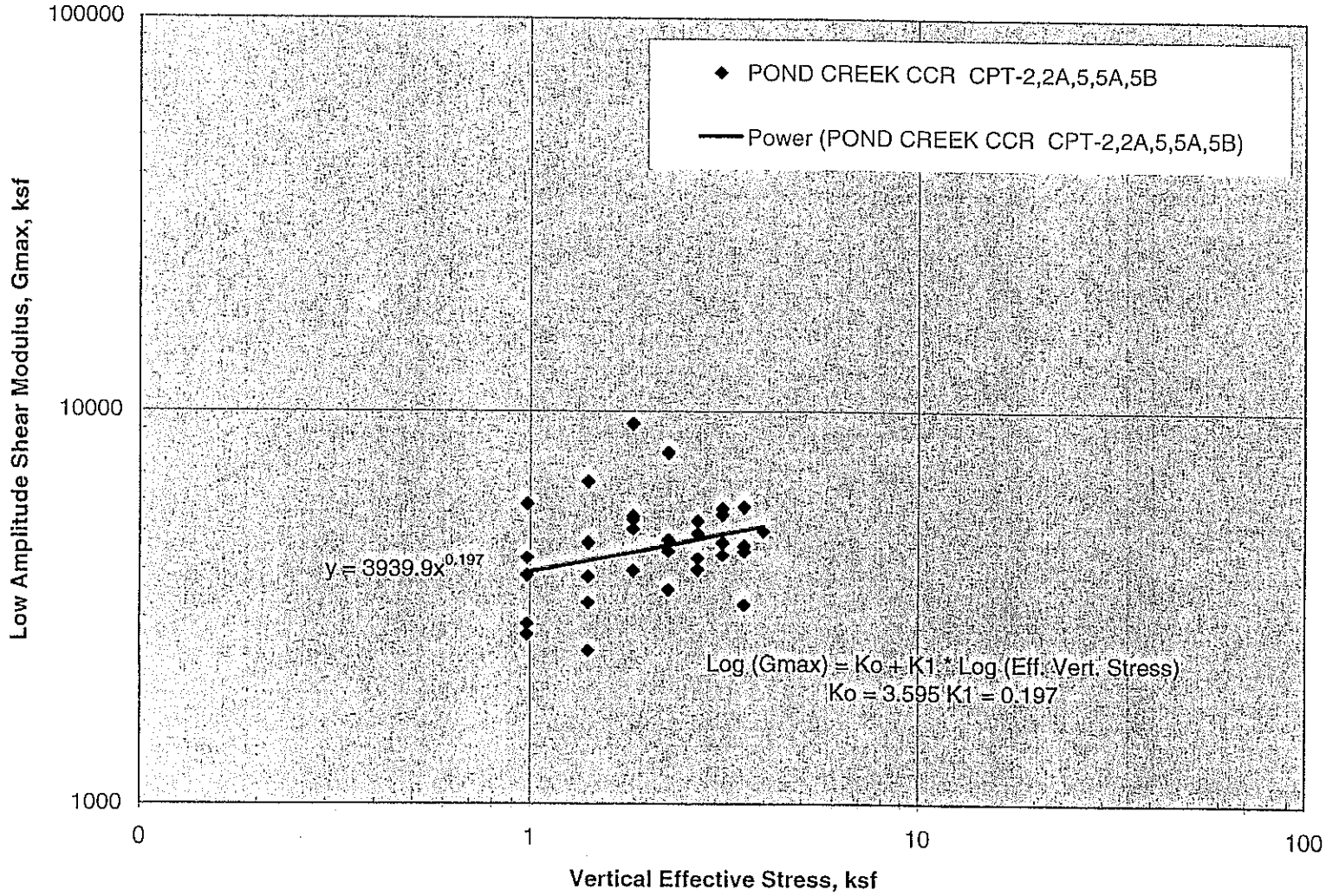
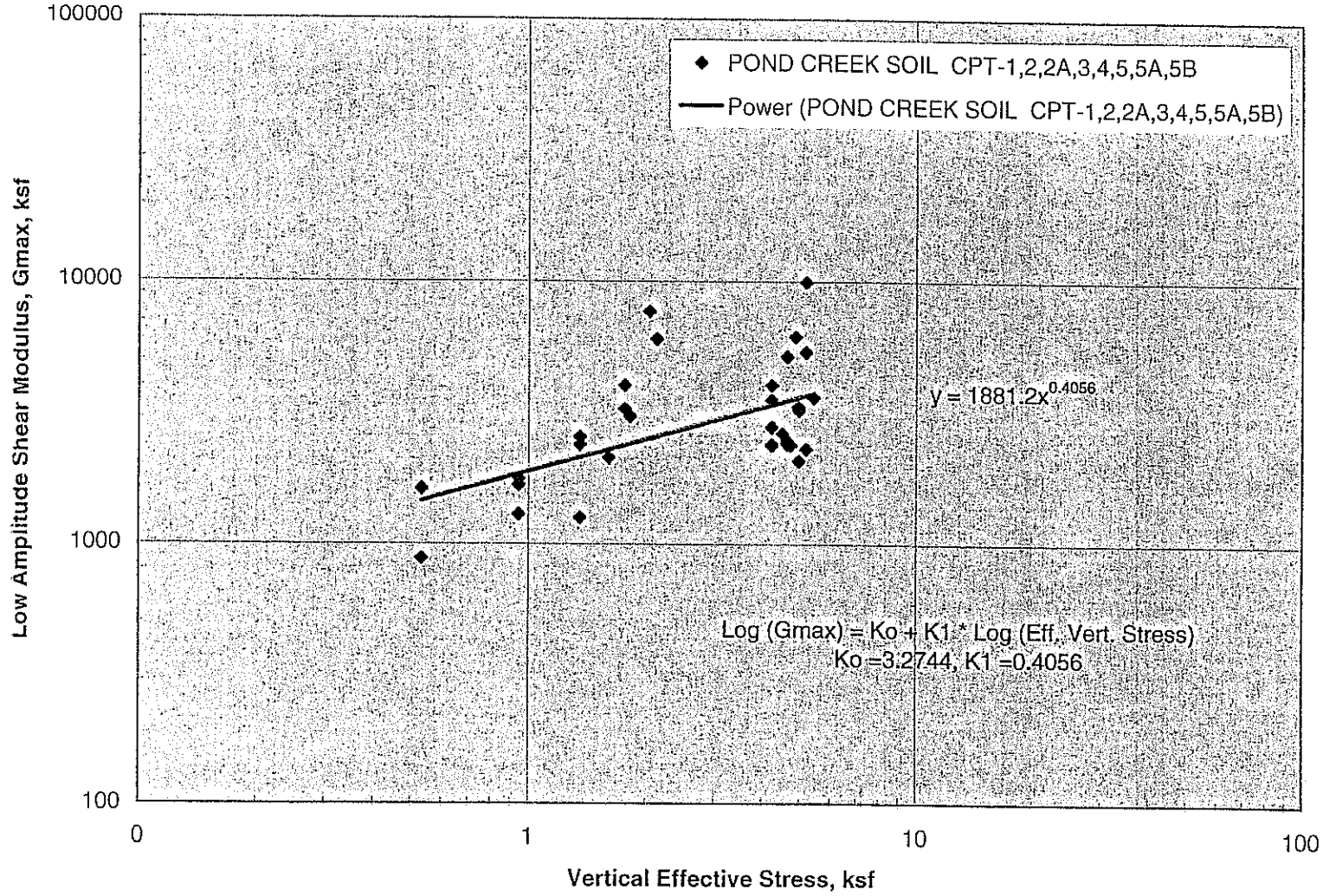
ELASTIC SHEAR MODULUS VERSUS EFFECTIVE CONFINING PRESSURE RELATIONSHIPS USED IN GMAX CORRELATIONS FOR COARSE REFUSE AND RESIDUAL SOIL MATERIALS

SHEAR MODULUS VS. VERTICAL EFFECTIVE STRESS
POND CREEK SOUTH CELL - COARSE REFUSE - CPT- 2, 2A, 5, 5A AND 5B



SHEAR MODULUS VS. VERTICAL EFFECTIVE STRESS
POND CREEK SOUTH CELL - RESIDUAL SOIL - CPT- 1, 2, 2A, 3, 4, 5, 5A AND 5B



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PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation PROJECT NO. 072046

Shear Modulus Calculations for SHAKE PAGE 24 OF 29

Columns PCSC300E and PCSC300M

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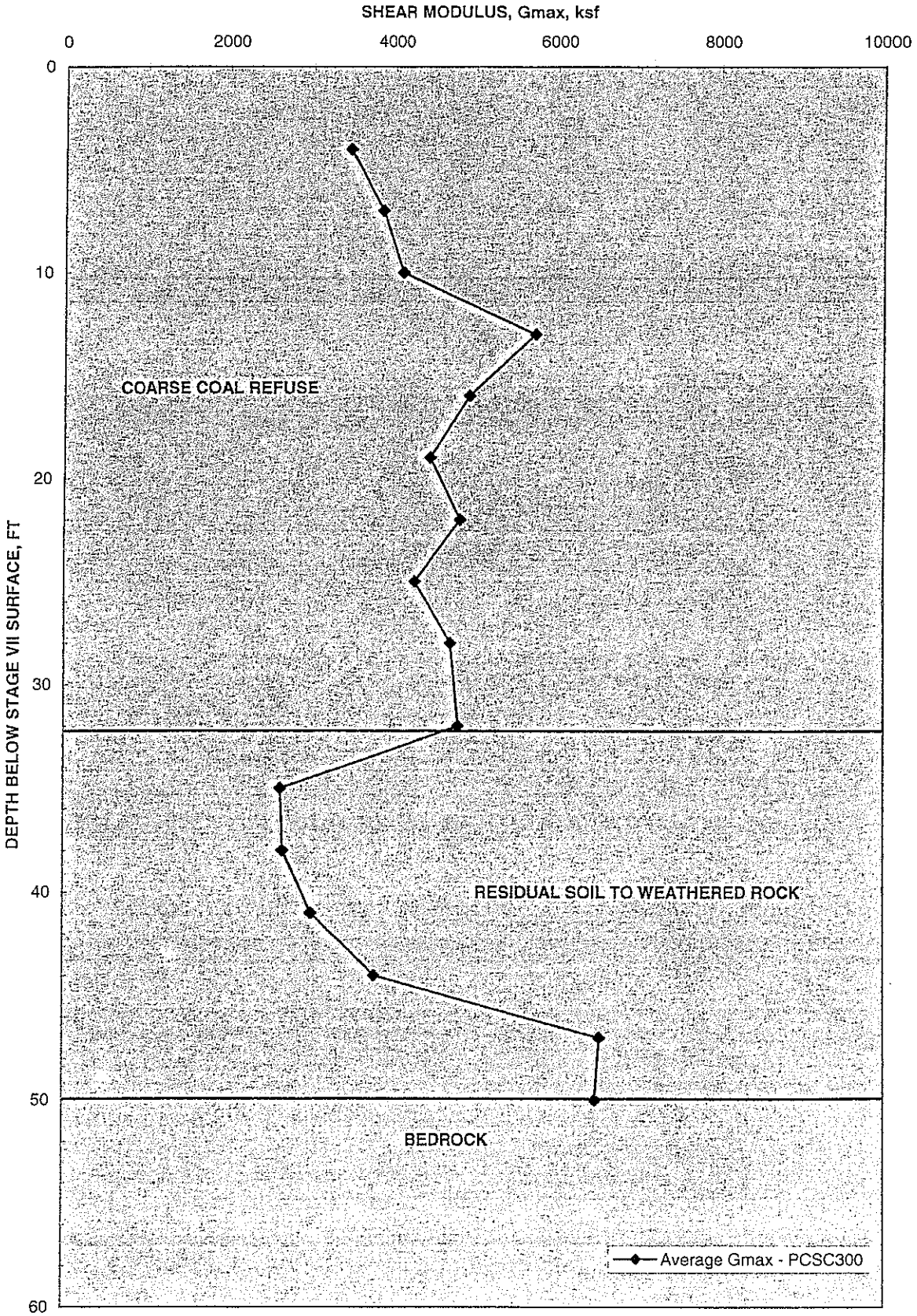
CORRELATED AVERAGE GMAX PROFILES FOR PCSC300E AND PCSC300M SHAKE COLUMNS

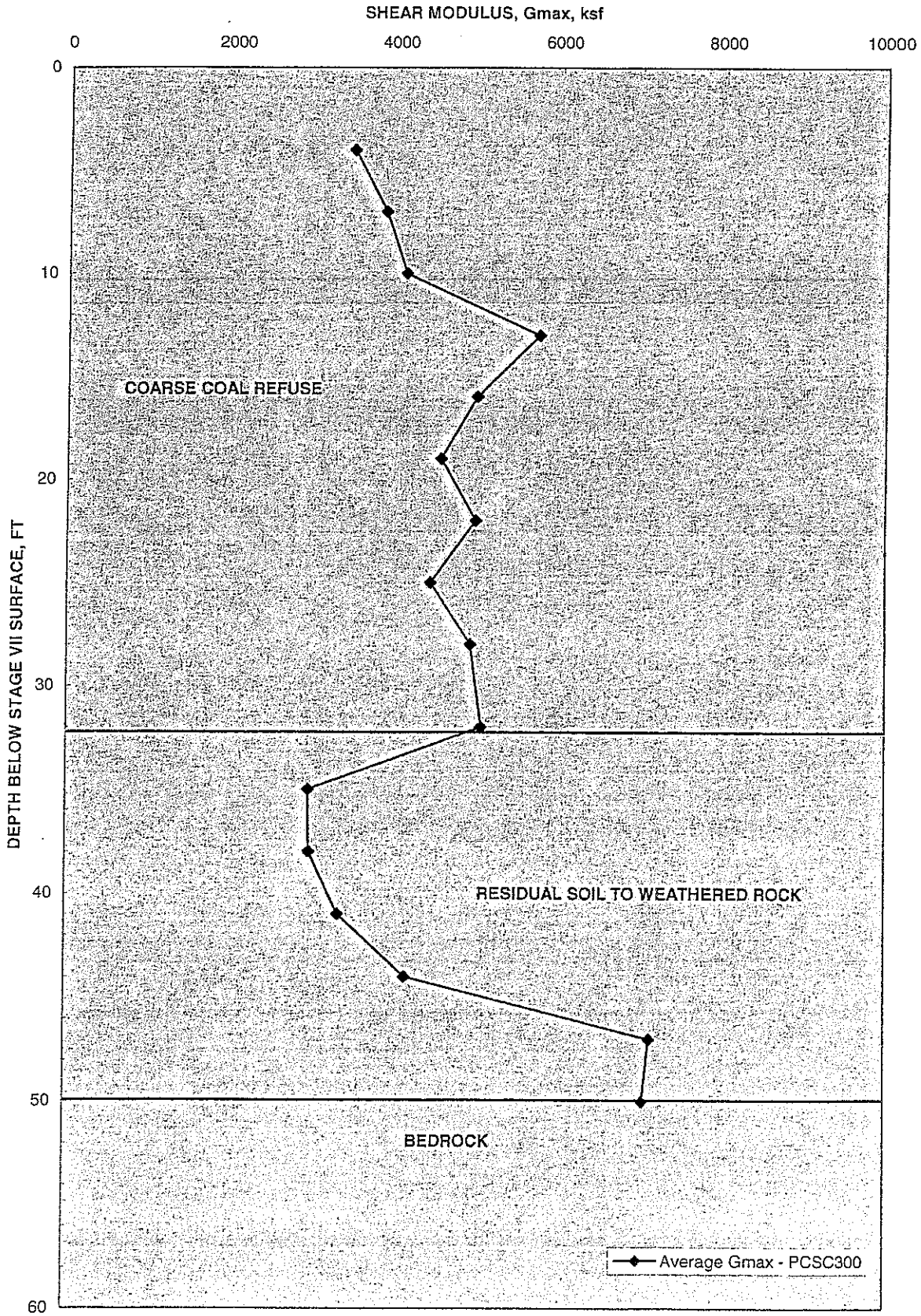
25 of 27

R13864

AVERAGE SHEAR MODULUS VS. DEPTH
WILLIAMSON ENERGY - POND CREEK SOUTH CELL
SHAKE CREST COLUMN PCSC300M - STAGE VII MAX FINES EL. 496



AVERAGE SHEAR MODULUS VS. DEPTH
WILLIAMSON ENERGY - POND CREEK SOUTH CELL
SHAKE CREST COLUMN PCSC300E - STAGE VII MIN FINES EL. 474



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Shear Modulus Calculations for SHAKE PAGE 27 OF 29

Columns PCSC300E and PCSC300M

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SHAKE COLUMN INPUT FOR PCSC300E AND PCSC300M

WILLIAMSON ENERGY - POND CREEK SOUTH CELL IMPOUNDMENT
SUMMARY OF SHAKE INPUT PARAMETERS
STAGE VII CREST SHAKE COLUMN PCSC300E - MIN FINES EL. 474
SURFACE EL. = 502 FT; GWT DEPTH = 32 FEET; 5% DAMPING

MATERIAL TYPE	LAYER THICKNESS (FT)	LAYER NO.	DEPTH BELOW GROUND SURFACE (FT)	LAYER AVERAGE SHEAR MODULUS, G (KSF)	AVG. LAYER DEPTH (FT)
COARSE COAL REFUSE (Total Unit Wt.=130 pcf) (Saturated Unit Wt.=140 pcf)	4	1	4	3454	2.0
	3	2	7	3856	5.5
	3	3	10	4110	8.5
	3	4	13	5739	11.5
	3	5	16	4991	14.5
	3	6	19	4552	17.5
	3	7	22	4985	20.5
	3	8	25	4436	23.5
	3	9	28	4926	26.5
	4	10	32	5058	30.0
RESIDUAL SOIL (Total Unit Wt.=125 pcf) (Saturated Unit Wt.=135 pcf)	3	11	35	2940	33.5
	3	12	38	2951	36.5
	3	13	41	3307	39.5
	3	14	44	4130	42.5
	3	15	47	7136	45.5
	3	16	50	7051	48.5
BEDROCK		17		Vs=4000 fps	

R13868

WILLIAMSON ENERGY - POND CREEK SOUTH CELL IMPOUNDMENT
SUMMARY OF SHAKE INPUT PARAMETERS
STAGE VII CREST SHAKE COLUMN PCSC300M - MAX FINES EL. 496
SURFACE EL. = 502 FT; GWT DEPTH = 14 FEET; 5% DAMPING

MATERIAL TYPE	LAYER THICKNESS (FT)	LAYER NO.	DEPTH BELOW GROUND SURFACE (FT)	LAYER AVERAGE SHEAR MODULUS, G (KSF)	AVG. LAYER DEPTH (FT)
COARSE COAL REFUSE (Total Unit Wt.=130 pcf) (Saturated Unit Wt.=140 pcf)	4	1	4	3454	2.0
	3	2	7	3856	5.5
	3	3	10	4110	8.5
	3	4	13	5739	11.5
	3	5	16	4941	14.5
	3	6	19	4453	17.5
	3	7	22	4832	20.5
	3	8	25	4269	23.5
	3	9	28	4713	26.5
	4	10	32	4808	30.0
RESIDUAL SOIL (Total Unit Wt.=125 pcf) (Saturated Unit Wt.=135 pcf)	3	11	35	2635	33.5
	3	12	38	2661	36.5
	3	13	41	2998	39.5
	3	14	44	3763	42.5
	3	15	47	6529	45.5
	3	16	50	6476	48.5
BEDROCK		17		Vs=4000 fps	

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part 20

APPENDIX B-2

ESTIMATION AND SUMMARY OF ENGINEERING PROPERTIES INCLUDING PEAK UNDRAINED SHEAR STRENGTH FOR REFUSE AND RESIDUAL SOIL MATERIALS

Civil & Environmental Consultants, Inc.

Williamson Energy Pond Creek – South Cell
JECT Deformation Evaluation PROJECT NO. 072046

Estimation and Summary of Engineering Properties PAGE 1 OF 8.

for Refuse and Subgrade Materials

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

CALCULATION BRIEF
FOR

ESTIMATION AND SUMMARY OF ENGINEERING PROPERTIES INCLUDING PEAK UNDRAINED SHEAR STRENGTH FOR REFUSE AND SUBGRADE MATERIALS

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH CELL

OBJECTIVE: Summarize engineering properties for the various coal refuse materials encountered at the Pond Creek Coal Refuse Disposal site including unit weight (γ), specific gravity (G_s), effective angle of internal friction (ϕ') and cohesion (c') and peak undrained shear strength (S_{up}). The various strengths will be used in the Pond Creek deformation analyses model(s) were provided by Alliance Consulting, Inc. (Alliance) based on laboratory testing or derived herein.

REFERENCES:

1. Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Summary of Piezo-Seismic Cone Penetration Testing," Pond Creek Coal Refuse Disposal Site," BEG, 12/21/07.

2. Alliance Consulting, Inc., "Appendix C Laboratory Testing, Proposed Coal Refuse Disposal Facility No. 2, Pond Creek Mine No. 1, Williamson County, Illinois"

3. Almes, R. A. and Butail, A. (1976) "Coal Refuse: Its Behavior Related to the Design and Operation of Coal Refuse Disposal Facilities," Proceedings of the Ohio River Valley Soils Seminar, Lexington, Kentucky, October, 1976.

4. Bowles, Joseph E. (1984) "Physical and Geotechnical Properties of Soils," Mc-Graw Hill. New York: 367-369 and 393-396.

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Estimation and Summary of Engineering Properties PAGE 2 OF 8

for Refuse and Subgrade Materials

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

5. Mayne, Paul W., (2001) "Stress-Strain-Strength-Flow Parameters from Enhanced In-Situ Tests", Proceedings - International Conference on In-Situ Measurement of Soil Properties & Case Histories, 21-24 May 2001, Bali, Indonesia.

6. Robertson, P.K (1998), "Applications Guide – CPT" **Fax**

7. Robertson, P.K., et.al. (1992) "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE 109 (11): 1449-1459.

METHODOLOGY AND ANALYSES:

A significant volume of field data was obtained from the various refuse and subgrade materials. Field and laboratory data is summarized in References 1 and 2, which was reduced and analyzed in accordance with established procedures for estimating and correlating field and laboratory parameters as described below and in the corresponding references shown above.

- Total (γ_t) and saturated (γ_s) unit weight;
- Effective strength parameters, friction angle (ϕ') and cohesion (c'); and
- Peak undrained shear strength (Sup).

SOIL PROPERTIES

The following soil properties were estimated based on laboratory testing (Reference 2) provided by Alliance Consulting, Inc., and/or derived herein, which are used in the various seismic/liquefaction slope stability analyses:

Refuse/Soil Properties

Description	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion [1] (psf)	Comment
Coarse Refuse	130	36	0	Frictional
Fine Coal Refuse	85	39	0	Frictional
Residual Soil	125	19.5 0	400 3000	Total Strength 80% Peak Undrained

Villiamson Pond Creek Clay Subgrade Nk (Peak Strength) PT - CU

CEC: Project No. 072046
BEG 1/7/08

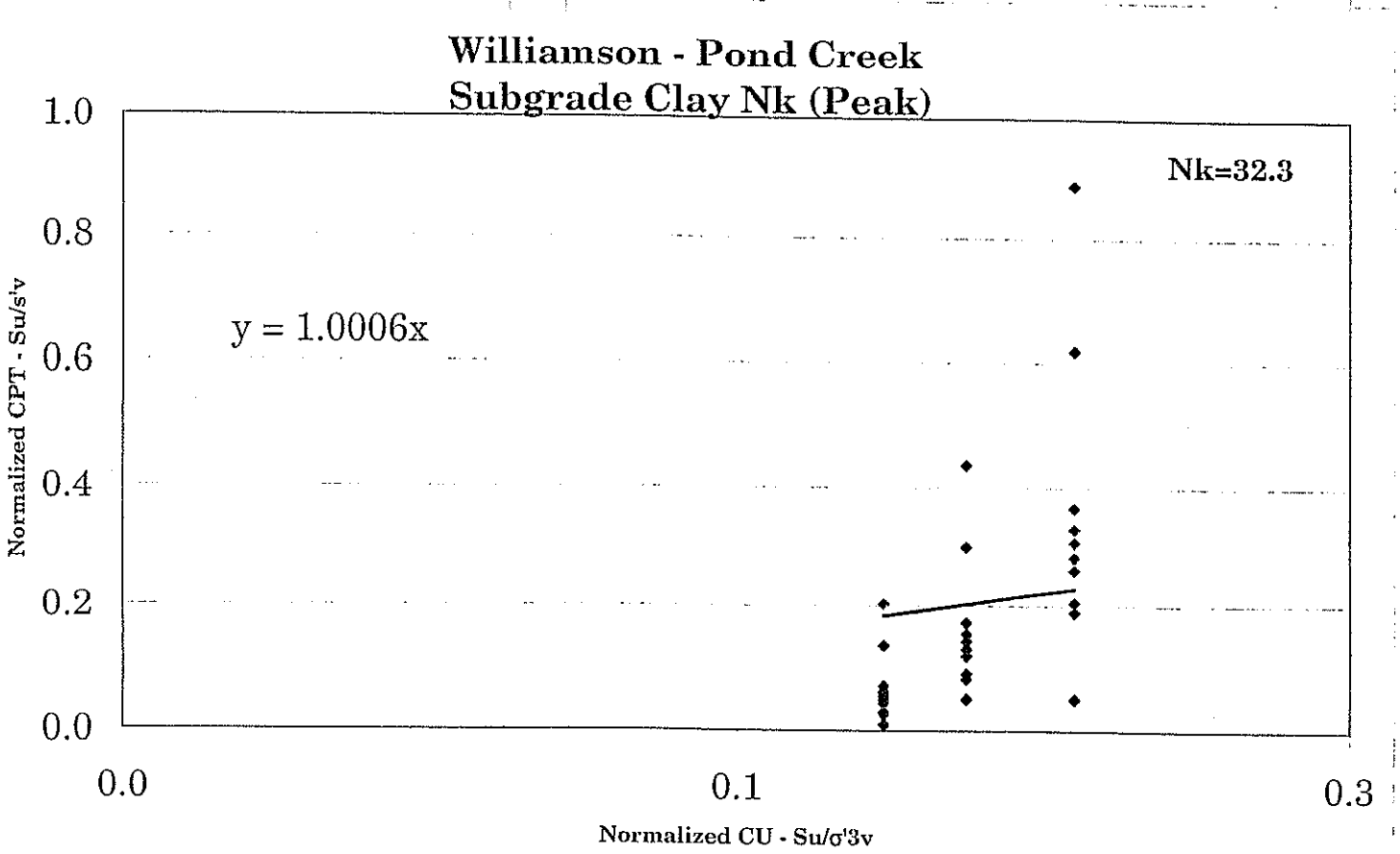
Use Su/σ'v data from CPT-1, CPT-3, CPT-4, CPT-6, CPT-7, CPT-8, CPT-9, CPT-10, CPT-11, CPT-12 at 10' TO 12' depth. Su/σ'v data from respective Normalized CPT data files. Sup=Q/2 at max deviator stress from CU point. σ'v =1.5*σ3.

CPT No	Su/σ'v	Qt	CU σt	CU σ'v	PSCPT Depth	CU Sup/σ'v	CU Test Depth	CU TEST POINT NO.
1	0.889	65.40	2.2	2.2	10 - 12	0.229	10 - 12	1
3	0.262	20.8	2.2	2.2	10 - 12	0.229	10 - 12	1
4	0.619	46.2	2.2	2.2	10 - 12	0.229	10 - 12	1
6	0.310	24.20	2.2	2.2	10 - 12	0.229	10 - 12	1
7	0.367	28.30	2.2	2.2	10 - 12	0.229	10 - 12	1
8	0.284	22.40	2.2	2.2	10 - 12	0.229	10 - 12	1
9	0.332	25.8	2.2	2.2	10 - 12	0.229	10 - 12	1
10	0.207	16.90	2.2	2.2	10 - 12	0.229	10 - 12	1
11	0.190	15.70	2.2	2.2	10 - 12	0.229	10 - 12	1
12	0.051	11.40	4.3	4.3	10 - 12	0.229	10 - 12	1
1	0.440	65.40	4.3	4.3	10 - 12	0.203	10 - 12	2
3	0.119	20.8	4.3	4.3	10 - 12	0.203	10 - 12	2
4	0.302	46.2	4.3	4.3	10 - 12	0.203	10 - 12	2
6	0.143	24.20	4.3	4.3	10 - 12	0.203	10 - 12	2
7	0.173	28.30	4.3	4.3	10 - 12	0.203	10 - 12	2
8	0.130	22.40	4.3	4.3	10 - 12	0.203	10 - 12	2
9	0.155	25.8	4.3	4.3	10 - 12	0.203	10 - 12	2
10	0.091	16.90	4.3	4.3	10 - 12	0.203	10 - 12	2
11	0.082	15.70	4.3	4.3	10 - 12	0.203	10 - 12	2
12	0.051	11.40	4.3	4.3	10 - 12	0.203	10 - 12	2
1	0.204	65.40	8.6	8.6	10 - 12	0.183	10 - 12	3
3	0.044	20.8	8.6	8.6	10 - 12	0.183	10 - 12	3
4	0.135	46.2	8.6	8.6	10 - 12	0.183	10 - 12	3
6	0.056	24.20	8.6	8.6	10 - 12	0.183	10 - 12	3
7	0.071	28.30	8.6	8.6	10 - 12	0.183	10 - 12	3
8	0.050	22.40	8.6	8.6	10 - 12	0.183	10 - 12	3
9	0.062	25.8	8.6	8.6	10 - 12	0.183	10 - 12	3
10	0.030	16.90	8.6	8.6	10 - 12	0.183	10 - 12	3
11	0.026	15.70	8.6	8.6	10 - 12	0.183	10 - 12	3
12	0.010	11.40	8.6	8.6	10 - 12	0.183	10 - 12	3

R13872

Nk= 32.3

PSCPT	FCR LAB
0.889	0.229
0.262	0.229
0.619	0.229
0.310	0.229
0.367	0.229
0.284	0.229
0.332	0.229
0.207	0.229
0.190	0.229
0.051	0.229
0.440	0.203
0.119	0.203
0.302	0.203
0.143	0.203
0.173	0.203
0.130	0.203
0.155	0.203
0.091	0.203
0.082	0.203
0.051	0.203
0.204	0.183
0.044	0.183
0.135	0.183
0.056	0.183
0.071	0.183
0.050	0.183
0.062	0.183
0.030	0.183
0.026	0.183
0.010	0.183



R13873

APPENDIX B-3

LABORATORY TEST RESULTS
PROVIDED BY ALLIANCE CONSULTING, INC.

APPENDIX C

LABORATORY TESTING
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY, LLC
BECKLEY, WEST VIRGINIA

TABLE OF CONTENTS

	PAGE
SOIL TESTING	
Summary	1
Strength Test	3
Grain Size	10
Atterberg Limits Test Results	12
COARSE COAL REFUSE TESTING	
Summary	13
Grain Size	15
Proctor Test	17
Permeability Test	18
Strength Test	20

R13876

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

SHIPPING ADDRESS
Box 393 Wood Road
Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

February 10, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Soil Boring and Laboratory Tests
Boring #8874
Mach Mine #1
Johnston City, Illinois
HFE File H-05278
Mach Mining Purchase Order No. _____

Dear Sir:

In accordance with your instructions, on February 1, 2006, we drilled one soil boring and sampled the subsoils with Shelby tubes. The soil sample taken from 10 to 12 feet in depth was subjected to laboratory tests. Results of the tests are as follows:

Boring No.:	8874
Depth:	8.0-10.0'
Visual Classification:	Silty CLAY (CL)
Atterberg Limits:	LL = 41.8% PL = 17.7% PI = 24.1
Unit Weight:	105.3 PCF
Moisture Content:	21.5%
Effective Cohesion:	0 PSF
Effective Phi Angle:	26.8 Degrees

All Tubes From Boring 8874

The Boring Log and test results are enclosed. If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

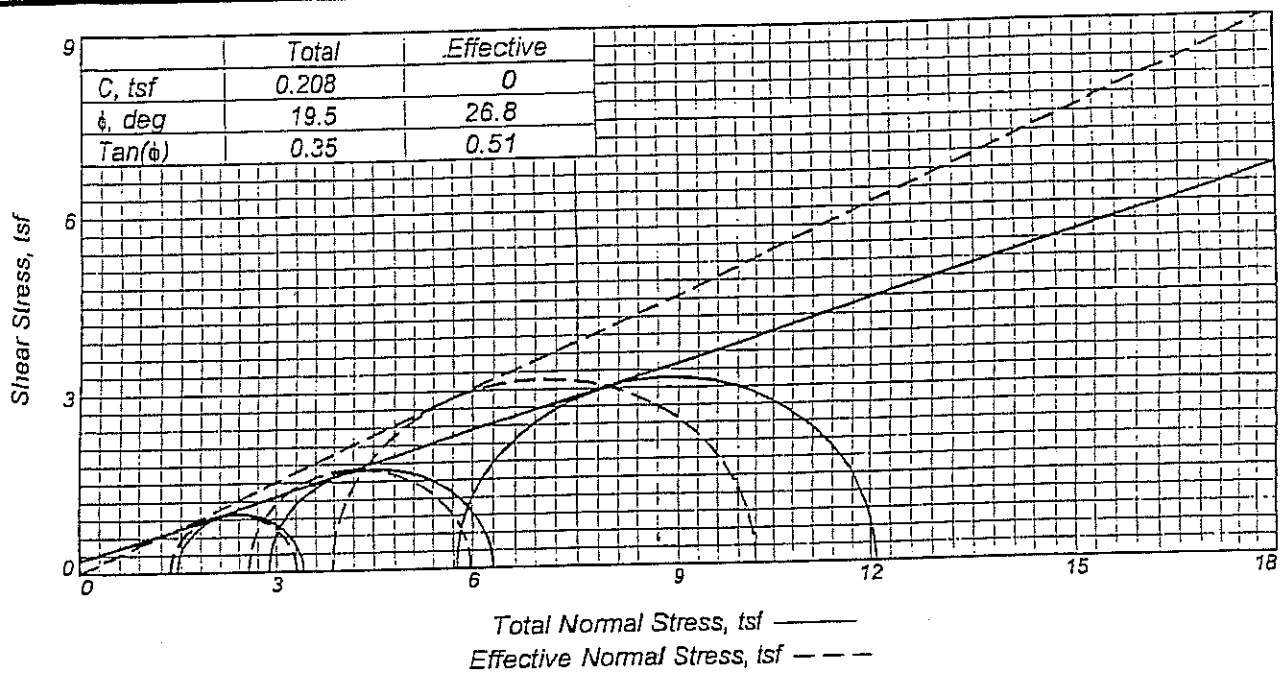
HOLCOMB FOUNDATION ENGINEERING CO.

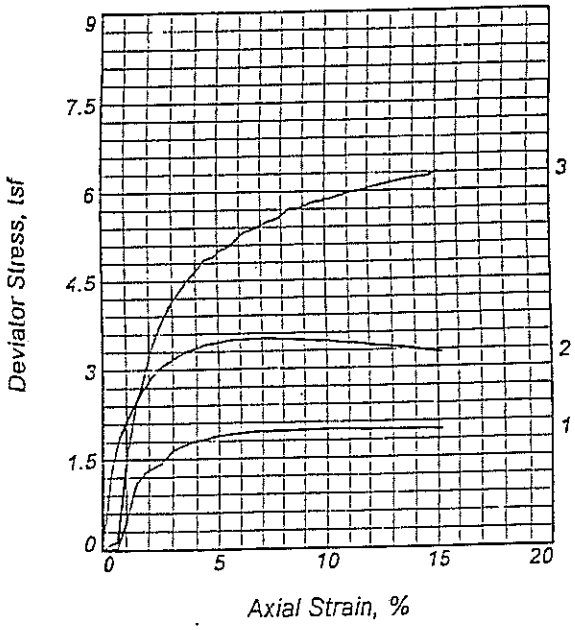
Timothy J. Holcomb, P.E.

REGISTERED PROFESSIONAL ENGINEER
TIMOTHY J.
HOLCOMB
062-042149
2-10-06
ILLINOIS

1 copy: Fred Vass - Alliance Consulting

3 R13878





Sample No.		1	2	3
Initial	Water Content,	21.5	20.8	17.6
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	99.7	98.9
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
At Test	Water Content,	21.5	20.9	17.8
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.6	3.6	2.2
Cell Pressure, tsf		5.0	6.5	7.9
Fail. Stress, tsf		2.0	3.4	6.3
Total Pore Pr., tsf		3.7	3.9	4.1
Ult. Stress, tsf		2.0	3.2	6.3
Total Pore Pr., tsf		3.6	3.8	4.1
$\bar{\sigma}_1$ Failure, tsf		3.3	6.0	10.2
$\bar{\sigma}_3$ Failure, tsf		1.3	2.6	3.9

Type of Test:
CU with Pore Pressures
Sample Type: Shelby Tube - Undisturbed
Description: Gray Mottled Brown Silty CLAY

LL= 41.8 PL= 17.7 PI= 24.1
Assumed Specific Gravity= 2.65
Remarks:

Client: Alliance Consulting

Project: Triaxial Test
Mach Mine #1
Location: Boring #8874
Sample Number: 3 **Depth:** 10.0-12.0'
Proj. No.: H-05278 **Date:** 2-1-05

TRIAXIAL SHEAR TEST REPORT

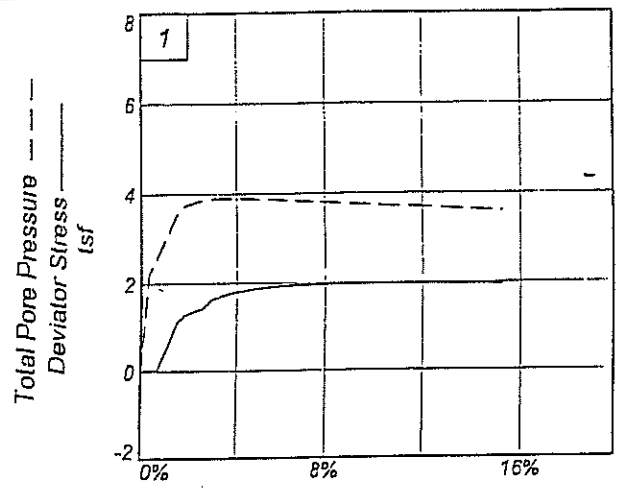
HOLCOMB FOUNDATION ENGINEERING CO.

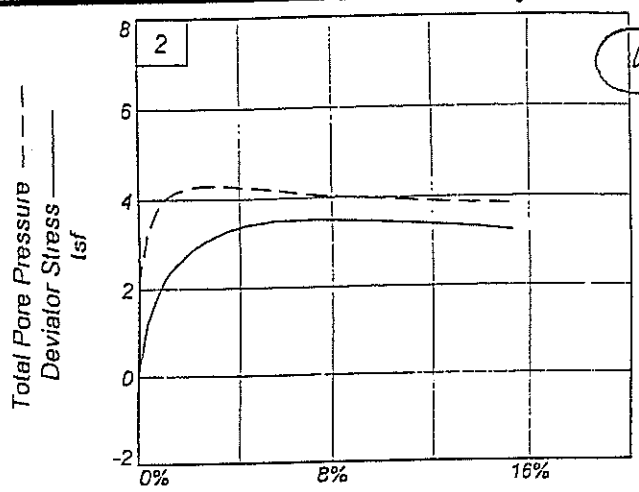
Plate _____

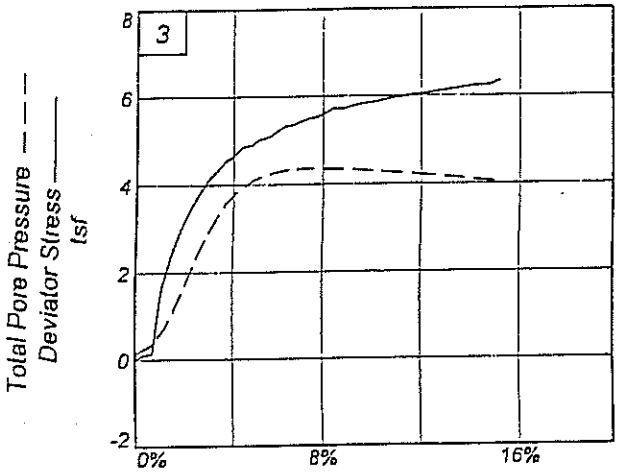
Tested By: LC Checked By: TH

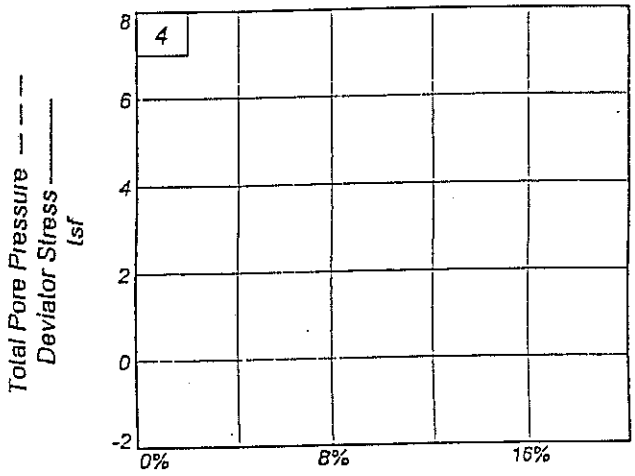
R13879

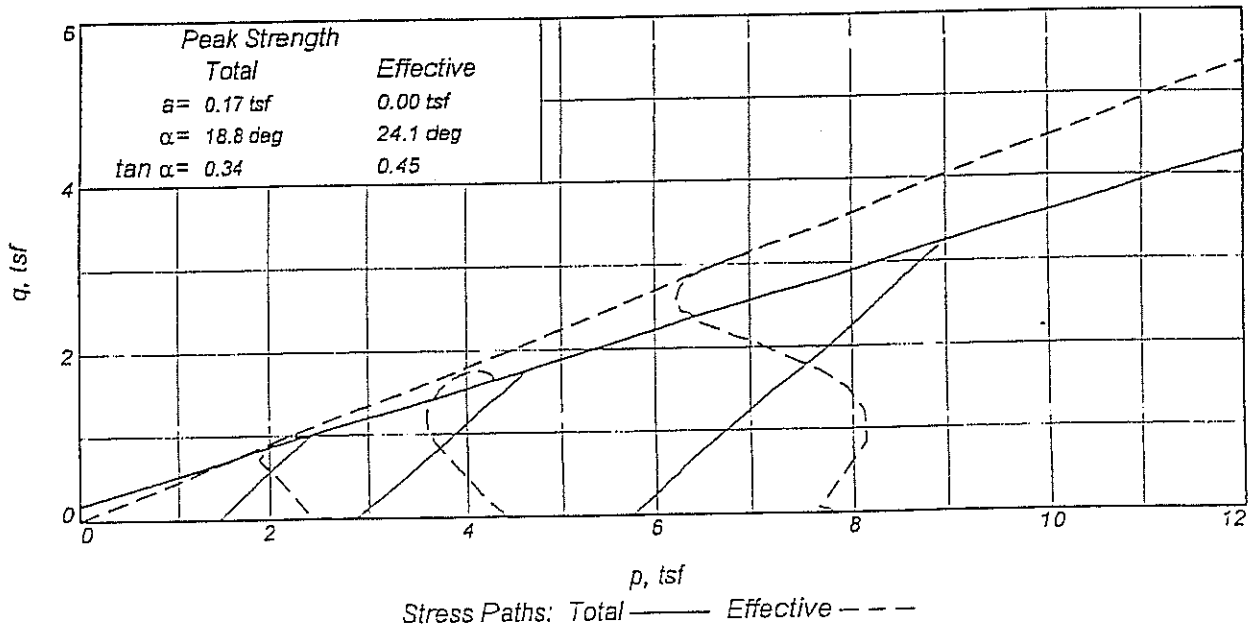
4











Client: Alliance Consulting
Project: Triaxial Test
Location: Boring #8874
Project No.: H-05278

Depth: 10.0-12.0'
Plate _____

Sample Number: 3

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC

Checked By: TH

R13880

2/9/2006 5
8:50 PM

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

Date: 2-1-05
Client: Alliance Consulting
Project: Triaxial Test
Mach Mine #1
Johnston City, Illinois
Location: Boring #8874
Depth: 10.0-12.0' Sample Number: 3
Description: Gray Mottled Brown Silty CLAY
Remarks:
Type of Sample: Shelby Tube - Undisturbed
Assumed Specific Gravity=2.65 LL=41.8 PL=17.7 PI=24.1
Test Method: COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	189.100			1279.000
Moisture content: Dry soil+tare, gms.	176.100			1072.200
Moisture content: Tare, gms.	115.700			103.200
Moisture, %	21.5	21.5	21.5	21.3
Moist specimen weight, gms.	1140.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.51	5.51	5.51	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.0	128.0	128.0	
Dry density, pcf	105.3	105.3	105.3	
Void ratio	0.5706	0.5706	0.5706	
Saturation, %	100.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.981 tsf at reading no. 24
Ult. Stress = 1.955 tsf at reading no. 30

(6)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	18.30	0.0	0.0	0.000	5.112	5.112	1.00	-1.00	5.112	0.000
1	0.0190	20.00	1.7	0.3	0.014	2.830	2.844	1.00	30.70	2.837	0.007
2	0.0400	21.60	3.3	0.7	0.026	2.426	2.452	1.01	36.30	2.439	0.013
3	0.0810	113.20	94.9	1.5	1.093	1.505	2.598	1.73	49.10	2.051	0.547
4	0.1010	129.80	111.5	1.8	1.280	1.318	2.597	1.97	51.70	1.958	0.640
5	0.1420	143.10	124.8	2.6	1.422	1.181	2.602	2.20	53.60	1.892	0.711
6	0.1620	161.50	143.2	2.9	1.625	1.159	2.784	2.40	53.90	1.972	0.813
7	0.1830	168.90	150.6	3.3	1.702	1.145	2.847	2.49	54.10	1.996	0.851
8	0.2030	174.80	156.5	3.7	1.763	1.138	2.900	2.55	54.20	2.019	0.881
9	0.2240	178.90	160.6	4.1	1.802	1.145	2.946	2.57	54.10	2.046	0.901
10	0.2440	182.30	164.0	4.4	1.833	1.145	2.978	2.60	54.10	2.061	0.916
11	0.2650	186.40	168.1	4.8	1.871	1.152	3.023	2.62	54.00	2.088	0.936
12	0.2850	188.10	169.8	5.2	1.883	1.166	3.049	2.61	53.80	2.108	0.941
13	0.3060	191.40	173.1	5.6	1.912	1.166	3.078	2.64	53.80	2.122	0.956
14	0.3260	193.10	174.8	5.9	1.923	1.181	3.104	2.63	53.60	2.142	0.962
15	0.3460	194.70	176.4	6.3	1.933	1.188	3.121	2.63	53.50	2.155	0.967
16	0.3670	196.40	178.1	6.7	1.944	1.202	3.146	2.62	53.30	2.174	0.972
17	0.3870	198.10	179.8	7.0	1.955	1.210	3.164	2.62	53.20	2.187	0.977
18	0.4080	198.10	179.8	7.4	1.947	1.224	3.171	2.59	53.00	2.197	0.973
19	0.4280	200.60	182.3	7.8	1.966	1.231	3.197	2.60	52.90	2.214	0.983
20	0.4490	200.60	182.3	8.1	1.958	1.238	3.196	2.58	52.80	2.217	0.979
21	0.4890	203.10	184.8	8.9	1.969	1.267	3.236	2.55	52.40	2.252	0.985
22	0.5300	204.70	186.4	9.6	1.970	1.289	3.259	2.53	52.10	2.274	0.985
23	0.5710	207.20	188.9	10.4	1.980	1.310	3.290	2.51	51.80	2.300	0.990
24	0.6120	208.90	190.6	11.1	1.981	1.332	3.313	2.49	51.50	2.323	0.991
25	0.6520	209.10	190.8	11.8	1.967	1.346	3.313	2.46	51.30	2.330	0.983
26	0.6940	211.40	193.1	12.6	1.974	1.361	3.334	2.45	51.10	2.348	0.987
27	0.7350	212.20	193.9	13.3	1.965	1.390	3.354	2.41	50.70	2.372	0.982
28	0.7790	213.90	195.6	14.1	1.964	1.404	3.368	2.40	50.50	2.386	0.982
29	0.8170	215.50	197.2	14.8	1.964	1.426	3.390	2.38	50.20	2.408	0.982
30	0.8380	215.50	197.2	15.2	1.955	1.433	3.388	2.36	50.10	2.410	0.978

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	154.800			1347.900
Moisture content: Dry soil+tare, gms.	145.800			1154.100
Moisture content: Tare, gms.	102.600			135.100
Moisture, %	20.8	20.9	20.9	19.0
Moist specimen weight, gms.	1142.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.49	5.49	5.49	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.7	128.7	128.7	
Dry density, pcf	106.5	106.5	106.5	
Void ratio	0.5536	0.5536	0.5536	
Saturation, %	99.7	100.0	100.0	

7

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 3.418 tsf at reading no. 24
Ult. Stress = 3.250 tsf at reading no. 29

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	27.50	0.0	0.0	0.000	4.385	4.385	1.00	29.10	4.385	0.000
1	0.0190	134.00	106.5	0.3	1.241	3.254	4.495	1.38	44.80	3.875	0.620
2	0.0400	183.10	155.6	0.7	1.806	2.750	4.557	1.66	51.80	3.653	0.903
3	0.0600	218.90	191.4	1.1	2.214	2.484	4.698	1.89	55.50	3.591	1.107
4	0.0810	243.80	216.3	1.5	2.492	2.340	4.832	2.06	57.50	3.586	1.246
5	0.1010	264.60	237.1	1.8	2.721	2.254	4.975	2.21	58.70	3.614	1.361
6	0.1220	282.10	254.6	2.2	2.911	2.210	5.121	2.32	59.30	3.666	1.455
7	0.1420	295.40	267.9	2.6	3.052	2.182	5.233	2.40	59.70	3.707	1.526
8	0.1620	305.40	277.9	2.9	3.154	2.182	5.335	2.45	59.70	3.758	1.577
9	0.1830	314.60	287.1	3.3	3.245	2.189	5.434	2.48	59.60	3.811	1.623
10	0.2030	322.10	294.6	3.7	3.317	2.196	5.513	2.51	59.50	3.855	1.659
11	0.2240	327.10	299.6	4.1	3.360	2.218	5.578	2.52	59.20	3.898	1.680
12	0.2440	332.90	305.4	4.4	3.412	2.232	5.644	2.53	59.00	3.938	1.706
13	0.2650	336.20	308.7	4.8	3.435	2.254	5.689	2.52	58.70	3.971	1.718
14	0.2850	339.50	312.0	5.2	3.459	2.275	5.734	2.52	58.40	4.005	1.729
15	0.3060	343.70	316.2	5.6	3.491	2.297	5.788	2.52	58.10	4.042	1.746
16	0.3260	345.40	317.9	5.9	3.497	2.318	5.815	2.51	57.80	4.067	1.748
17	0.3670	348.70	321.2	6.7	3.505	2.369	5.874	2.48	57.10	4.121	1.752
18	0.4080	352.00	324.5	7.4	3.512	2.412	5.924	2.46	56.50	4.168	1.756
19	0.4490	353.70	326.2	8.2	3.502	2.441	5.943	2.43	56.10	4.192	1.751
20	0.4890	354.50	327.0	8.9	3.483	2.470	5.953	2.41	55.70	4.211	1.742
21	0.5300	355.40	327.9	9.7	3.464	2.498	5.963	2.39	55.30	4.230	1.732

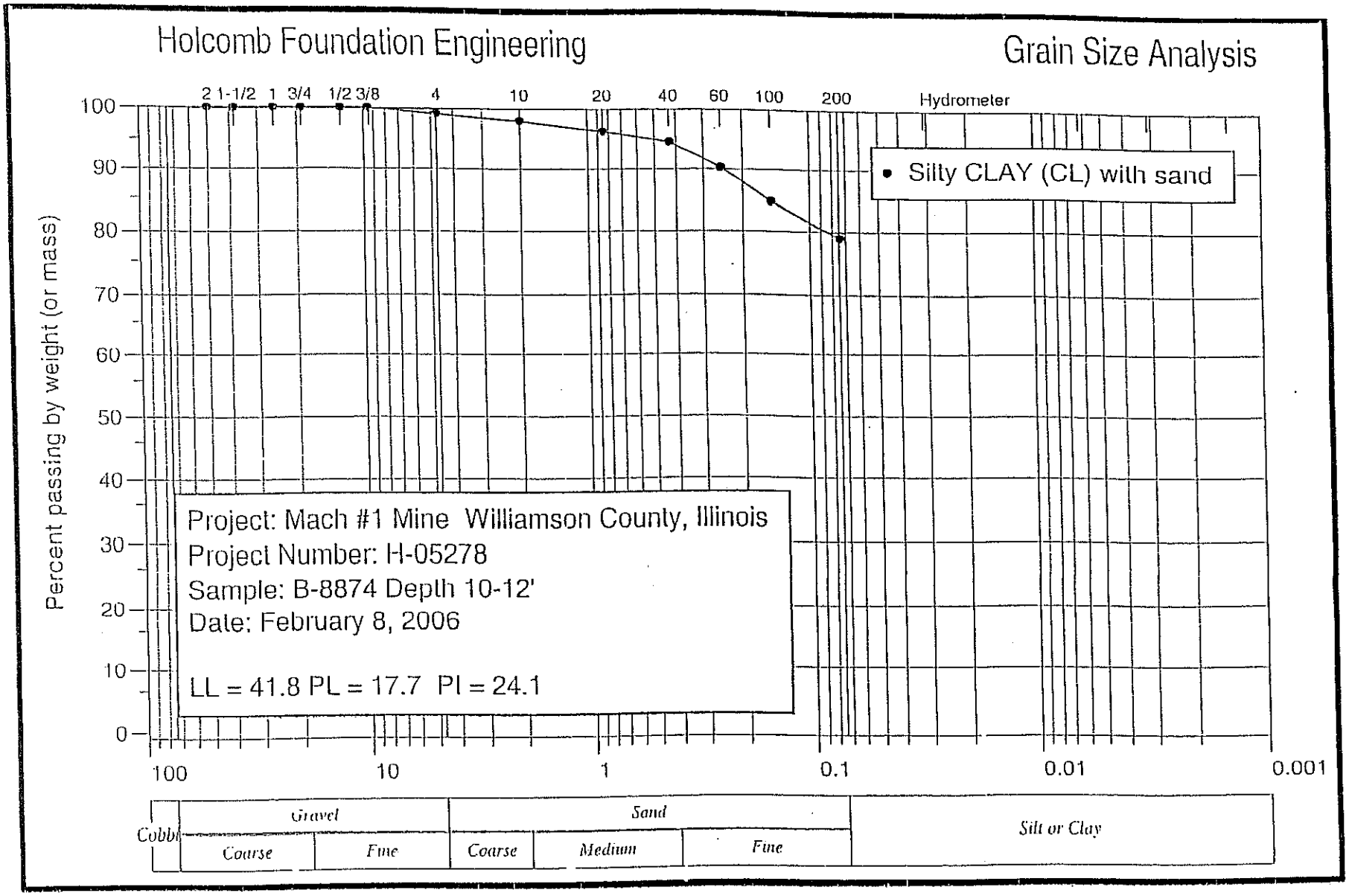
No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.5510	357.00	329.5	10.0	3.466	2.513	5.979	2.38	55.10	4.246	1.733
23	0.5920	356.20	328.7	10.8	3.429	2.534	5.964	2.35	54.80	4.249	1.715
24	0.6330	357.90	330.4	11.5	3.418	2.556	5.974	2.34	54.50	4.265	1.709
25	0.6730	357.00	329.5	12.3	3.381	2.585	5.966	2.31	54.10	4.275	1.690
26	0.7140	357.90	330.4	13.0	3.361	2.599	5.960	2.29	53.90	4.280	1.681
27	0.7550	357.90	330.4	13.7	3.332	2.614	5.946	2.27	53.70	4.280	1.666
28	0.7960	356.20	328.7	14.5	3.286	2.628	5.914	2.25	53.50	4.271	1.643
29	0.8370	355.40	327.9	15.2	3.250	2.635	5.885	2.23	53.40	4.260	1.625

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	248.400			1374.500
Moisture content: Dry soil+tare, gms.	226.700			1195.400
Moisture content: Tare, gms.	103.200			127.700
Moisture, %	17.6	17.8	17.8	16.8
Moist specimen weight, gms.	1184.7			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.54	5.54	5.54	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	132.3	132.5	132.5	
Dry density, pcf	112.5	112.5	112.5	
Void ratio	0.4707	0.4707	0.4707	
Saturation, %	98.9	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 6.334 tsf at reading no. 33
Ult. Stress = 6.334 tsf at reading no. 33

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	31.60	0.0	0.0	0.000	7.812	7.812	1.00	1.50	7.812	0.000
1	0.0190	39.90	8.3	0.3	0.091	7.690	7.781	1.01	3.20	7.735	0.045
2	0.0400	44.10	12.5	0.7	0.133	7.574	7.707	1.02	4.80	7.641	0.066
3	0.0600	175.60	144.0	1.1	1.666	7.308	8.974	1.23	8.50	8.141	0.833
4	0.0810	240.50	208.9	1.5	2.407	6.926	9.333	1.35	13.80	8.130	1.203
5	0.1010	291.30	259.7	1.8	2.981	6.466	9.447	1.46	20.20	7.956	1.491
6	0.1220	329.60	298.0	2.2	3.408	5.983	9.391	1.57	26.90	7.687	1.704
7	0.1420	362.00	330.4	2.6	3.764	5.479	9.244	1.69	33.90	7.361	1.882
8	0.1620	392.00	360.4	2.9	4.091	5.040	9.131	1.81	40.00	7.085	2.045
9	0.1830	412.80	381.2	3.3	4.310	4.666	8.976	1.92	45.20	6.821	2.155

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
10	0.2030	432.80	401.2	3.7	4.519	4.363	8.883	2.04	49.40	6.623	2.260
11	0.2240	446.90	415.3	4.0	4.660	4.140	8.800	2.13	52.50	6.470	2.330
12	0.2440	465.20	433.6	4.4	4.847	3.982	8.828	2.22	54.70	6.405	2.423
13	0.2650	471.00	439.4	4.8	4.892	3.852	8.744	2.27	56.50	6.298	2.446
14	0.2850	483.50	451.9	5.1	5.012	3.766	8.778	2.33	57.70	6.272	2.506
15	0.3060	490.20	458.6	5.5	5.066	3.694	8.760	2.37	58.70	6.227	2.533
16	0.3260	503.50	471.9	5.9	5.193	3.643	8.837	2.43	59.40	6.240	2.597
17	0.3460	516.80	485.2	6.2	5.319	3.607	8.926	2.47	59.90	6.267	2.660
18	0.3670	521.80	490.2	6.6	5.352	3.586	8.938	2.49	60.20	6.262	2.676
19	0.3870	530.10	498.5	7.0	5.422	3.571	8.993	2.52	60.40	6.282	2.711
20	0.4080	538.40	506.8	7.4	5.490	3.564	9.054	2.54	60.50	6.309	2.745
21	0.4280	543.40	511.8	7.7	5.522	3.564	9.086	2.55	60.50	6.325	2.761
22	0.4490	554.30	522.7	8.1	5.617	3.571	9.188	2.57	60.40	6.380	2.808
23	0.4690	565.90	534.3	8.5	5.719	3.578	9.297	2.60	60.30	6.438	2.859
24	0.4890	567.60	536.0	8.8	5.714	3.578	9.293	2.60	60.30	6.436	2.857
25	0.5300	581.70	550.1	9.6	5.817	3.600	9.417	2.62	60.00	6.509	2.909
26	0.5710	591.70	560.1	10.3	5.874	3.636	9.510	2.62	59.50	6.573	2.937
27	0.6120	605.00	573.4	11.0	5.964	3.665	9.629	2.63	59.10	6.647	2.982
28	0.6530	615.00	583.4	11.8	6.018	3.701	9.719	2.63	58.60	6.710	3.009
29	0.6940	626.70	595.1	12.5	6.087	3.737	9.824	2.63	58.10	6.780	3.044
30	0.7350	638.30	606.7	13.3	6.153	3.773	9.926	2.63	57.60	6.849	3.077
31	0.7760	649.10	617.5	14.0	6.209	3.816	10.025	2.63	57.00	6.921	3.105
32	0.8170	657.50	625.9	14.7	6.240	3.852	10.092	2.62	56.50	6.972	3.120
33	0.8390	669.90	638.3	15.1	6.334	3.866	10.200	2.64	56.30	7.033	3.167


Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
Silty CLAY (CL) with sand
Project: Mach #1 Mine Williamson County, Illinois
Project Number: H-05278
Sample: B-8874 Depth 10-12'
Date: February 8, 2006
LL = 41.8 PL = 17.7 PI = 24.1
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

17 of 57

R18886

Holcomb Foundation Engineering Company

Laboratory Testing Results

2/8/2006

Project: Mach #1 Mine

Project No: H-05278

Sieve Analysis - ASTM C136-96a

Sample: Silty CLAY (CL)

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
1.5000	38.1000	1 -1/2"	0.0	0.0	100.0
1.0000	25.4000	1"	0.0	0.0	100.0
0.7500	19.1000	3/4"	0.0	0.0	100.0
0.5000	12.7000	1/2"	0.0	0.0	100.0
3.7500	9.5200	3/8"	0.0	0.0	100.0
0.1870	4.7600	No. 4	2.1	0.9	99.1
0.0790	2.0000	No. 10	4.6	2.0	98.0
0.0469	1.1800	No. 16	4.6	2.0	98.0
0.0331	0.8500	No. 20	8.6	3.8	96.2
0.0165	0.4200	No. 40	12.6	5.5	94.5
0.0117	0.2980	No. 50	12.6	5.5	94.5
0.0083	0.2500	No. 60	22.2	9.8	90.2
0.0059	0.1490	No. 100	34.6	15.2	84.8
0.0029	0.0740	No. 200	47.7	21.0	79.0

Total Weight in Grams 227.20

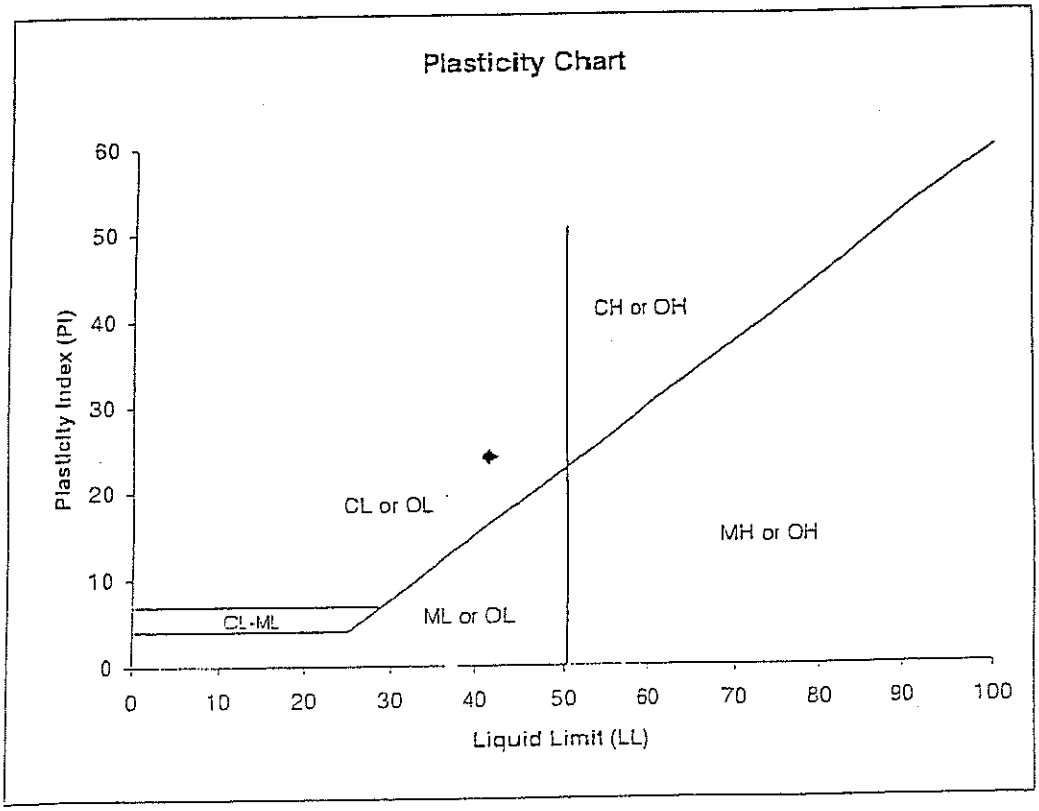
Holcomb Foundation Engineering Company

Laboratory Testing Results

Project: Mach #1 Mine
Project No: H-05278

Sample	1	2	3
Dish Number	LL_1	LL_2	LL_3
Mass of can, W_1 (g)	34.70		
Mass of can + moist soil, W_2 (g)	62.84		
Mass of can + dry soil, W_3 (g)	54.52		
Moisture content, w (%)	41.98		
Number of blows, N	24		
Liquid Limit, LL	41.8		

Dish Number	PL_1
Mass of can, W_1 (g)	39.76
Mass of can + moist soil, W_2 (g)	54.79
Mass of can + dry soil, W_3 (g)	52.53
Plastic Limit, PL	17.7
PI =	24.1



(13) R13886

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SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

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Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

November 30, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Pond Creek Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on November 17, 2006, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification: Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)

Proctor Test Results:
- Maximum Dry Unit Weight: 124.6 PCF
- Optimum Moisture Content: 9.3 %

Specific Gravity: 2.37

Triaxial Test Results:
- Effective Cohesion: 0 PSF
- Effective Phi Angle: 33.7 Degrees

Permeability: 2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

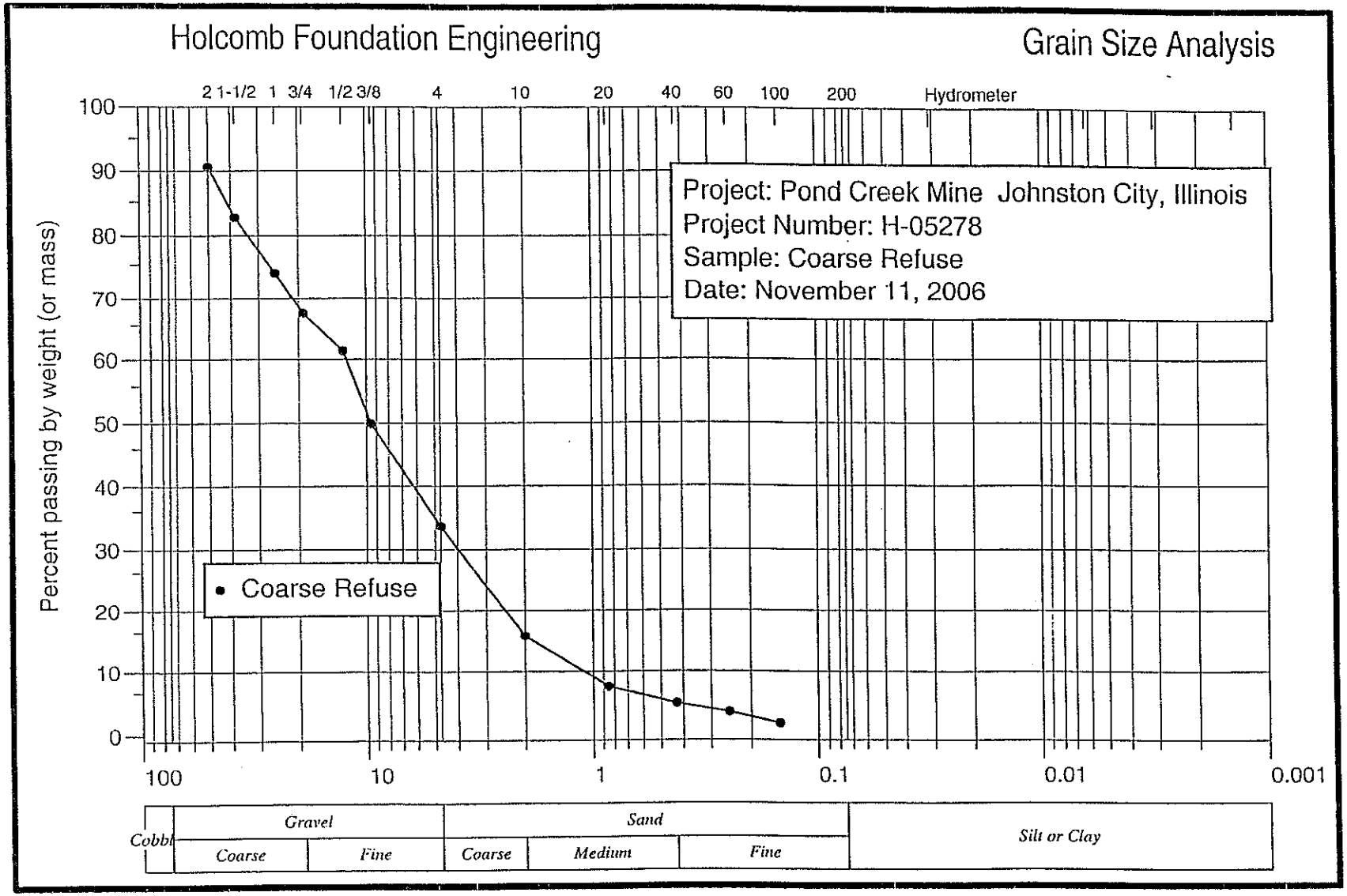
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting


Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
Project: Pond Creek Mine Johnston City, Illinois
Project Number: H-05278
Sample: Coarse Refuse
Date: November 11, 2006
Coarse Refuse
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

R18890

Holcomb Foundation Engineering Company

Laboratory Testing Results

11/30/2006

Project: Coarse Refuse Disposal Area
Pond Creek Mine Johnston City, Illinois

Project No: H-05317

Sieve Analysis - ASTM C136-96a

Sample: Coarse Refuse

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
3	76.2	3"	0.0	0.0	100.0
2.0000	50.8100	2"	619.6	9.5	90.5
1.5000	38.1000	1 -1/2"	1124.0	17.2	82.8
1.0000	25.4000	1"	1696.2	25.9	74.1
0.7500	19.1000	3/4"	2110.9	32.3	67.7
0.5000	12.7000	1/2"	2513.0	38.4	61.6
3.7500	9.5200	3/8"	3263.7	49.9	50.1
0.1870	4.7600	No. 4	4310.7	65.9	34.1
0.0790	2.0000	No. 10	5470.5	83.6	16.4
0.0469	1.1800	No. 16			
0.0331	0.8500	No. 20	6004.4	91.8	8.2
0.0165	0.4200	No. 40	6178.9	94.4	5.6
0.0117	0.2980	No. 50			
0.0083	0.2500	No. 60	6267.8	95.8	4.2
0.0059	0.1490	No. 100			
0.0029	0.0740	No. 200	6372.4	97.4	2.6

Total Weight in Grams **6542.80**

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

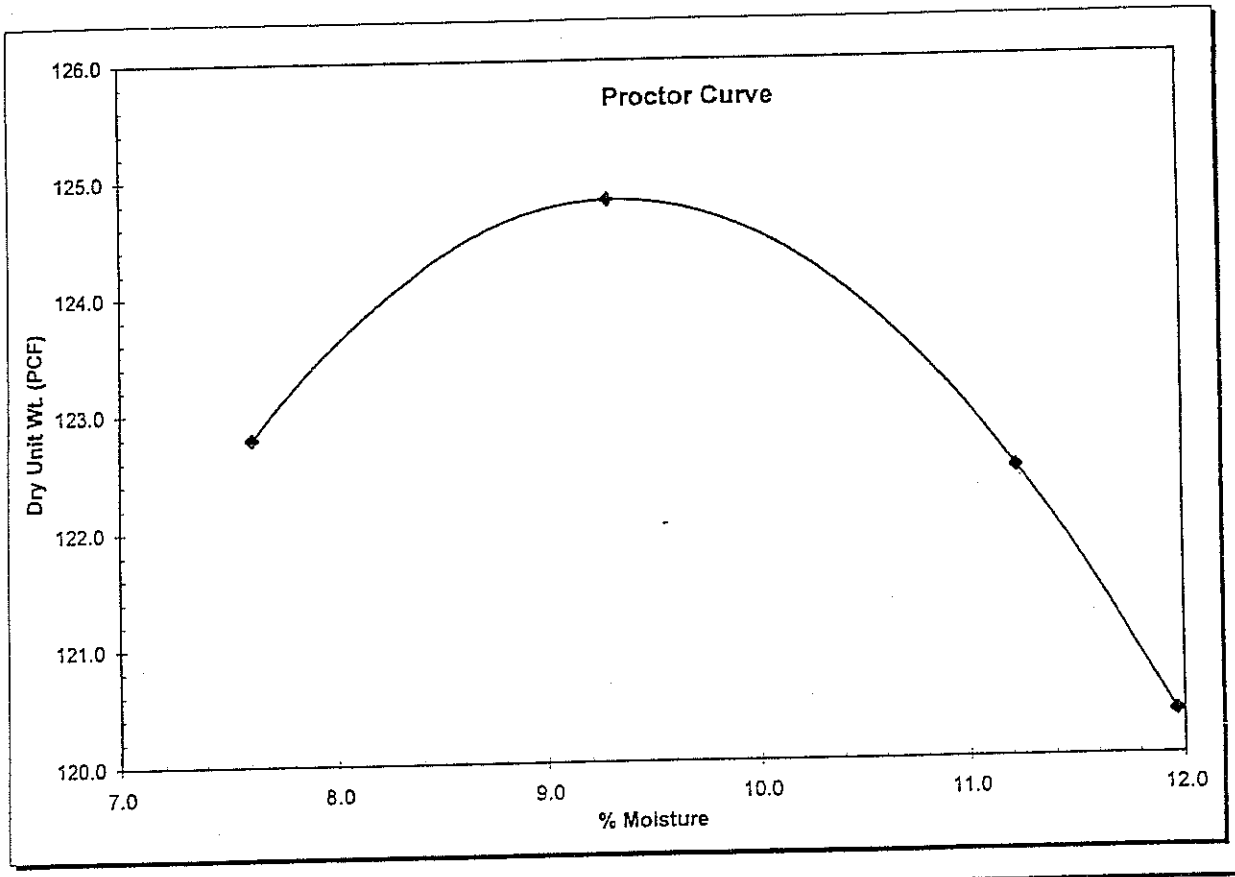
Date: 11/30/2006

Proctor Test Results

Soil Classification:	Gray Coarse Refuse
Maximum Dry Density (PCF)	124.8
Optimum Moisture Content (%)	9.3

Test Data: ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
7.6	122.8
11.2	122.5
12.0	120.4
9.3	124.8



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Permeability Tests Results

Laboratory Tests
Coarse Refuse
Pond Creek Mine - Johnston City, Illinois

Date: 11/30/2006

Client: Pond Creek Mine
Johnston City, Illinois

Project No.: H-05278

Sample	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse		7.7	11.8	119.3	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

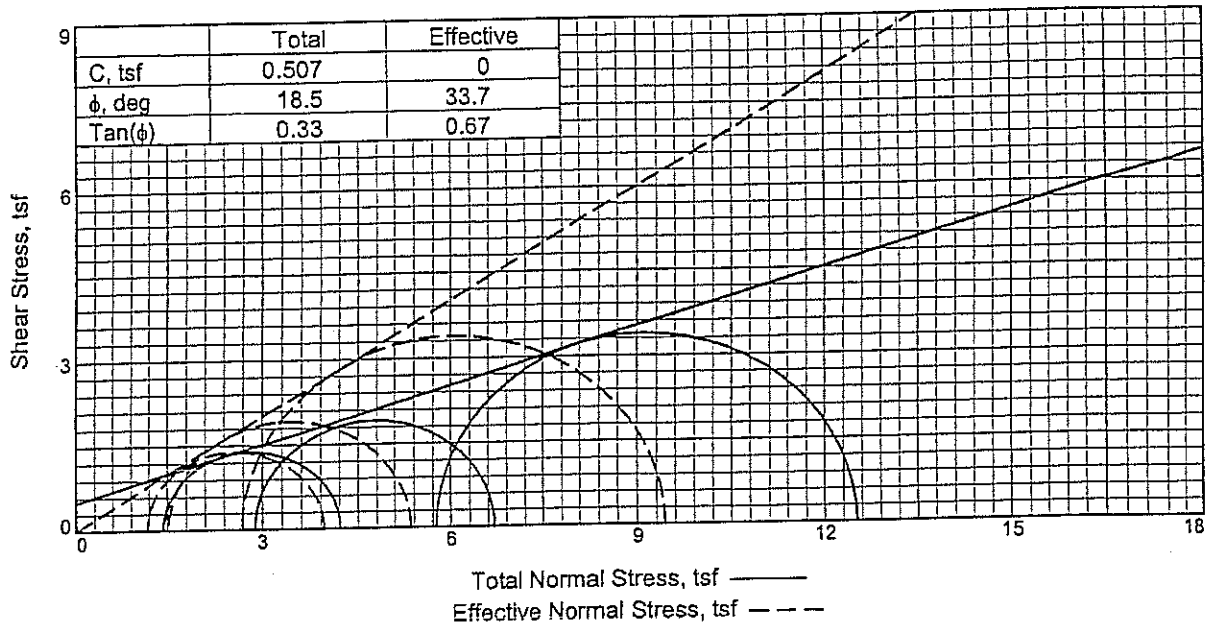
(19)
RT3894

PERMEABILITY TEST RESULTS

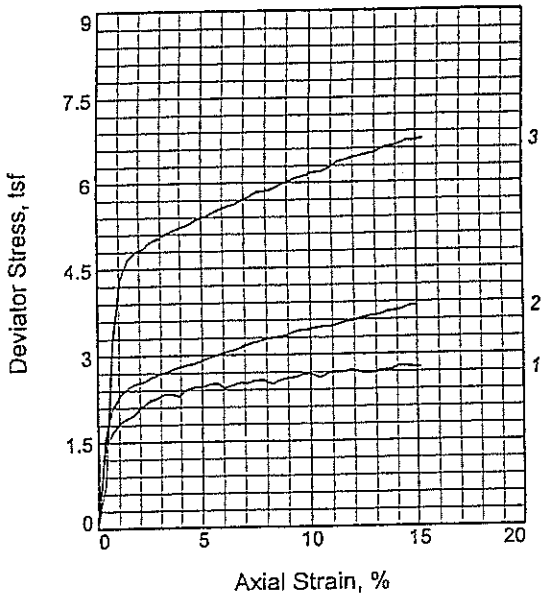
Project	Pond Creek Mine	Boring/Sample Depth	Coarse Refuse
Project #	H-05278	Classification	
Date	11/30/2006	Diameter	2.8 Inch
		Length	5.6 Inch

In Place Mc		After Test Mc		Unit Weight (PCF)	
Wet Wt.	195.3	Wet Wt.	1300.4	Sample Wt.	1161.8
Pan	94.2	Pan	103.1		
Dry Wt.	188.1	Dry Wt.	1173.6	Wet UW=	128.5
Mc (%)	7.7	Mc (%)	11.8	Dry UW=	119.3

Time(hrs)	Time(min)	Quantity (cc)	Head (psi)	Permeability (cm/sec)
7	26	24.7		
7	34	8.2	1	1.75E-04
7	33	24.5		
7	45	2.7	1	1.54E-04
7	47	0.8	1	1.44E-04
9	16	24.4		
9	23	9.6	1	1.79E-04
9	30	0.9	1	1.43E-04
			Average Permeability	1.63E-04



	Total	Effective
C, tsf	0.507	0
ϕ, deg	18.5	33.7
Tan(ϕ)	0.33	0.67



Sample No.		1	2	3
Initial	Water Content,	10.1	10.8	10.3
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	97.0	99.8	99.3
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
At Test	Water Content,	10.4	10.8	10.4
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
Strain rate, in./min.		0.01	0.01	0.01
Back Pressure, tsf		3.60	3.60	2.16
Cell Pressure, tsf		5.04	6.48	7.92
Fail. Stress, tsf		2.78	3.83	6.76
Total Pore Pr., tsf		3.86	4.96	5.23
Ult. Stress, tsf		2.77	3.83	6.76
Total Pore Pr., tsf		3.85	4.95	5.23
$\bar{\sigma}_1$ Failure, tsf		3.96	5.35	9.44
$\bar{\sigma}_3$ Failure, tsf		1.18	1.52	2.69

Type of Test: CU with Pore Pressures
Sample Type: Remolded
Description: Coarse Coal Refuse

Assumed Specific Gravity= 2.37
Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

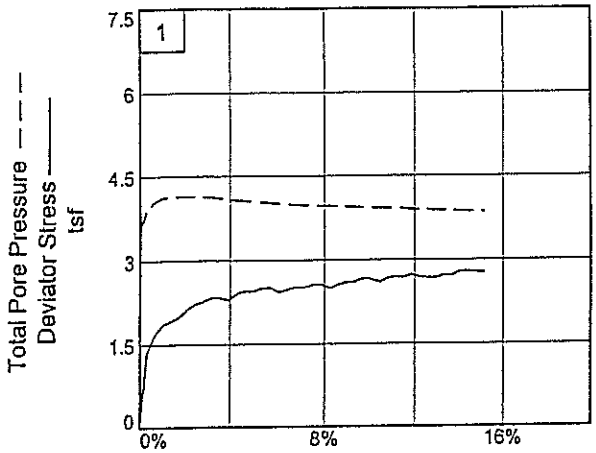
Location: Coarse Refuse Stockpile
Sample Number: Coarse Refuse
Proj. No.: H-05278 **Date:** 11/17/06

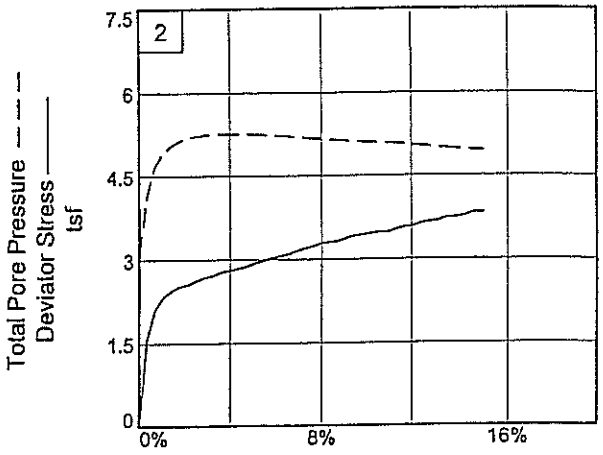
TRIAXIAL SHEAR TEST REPORT

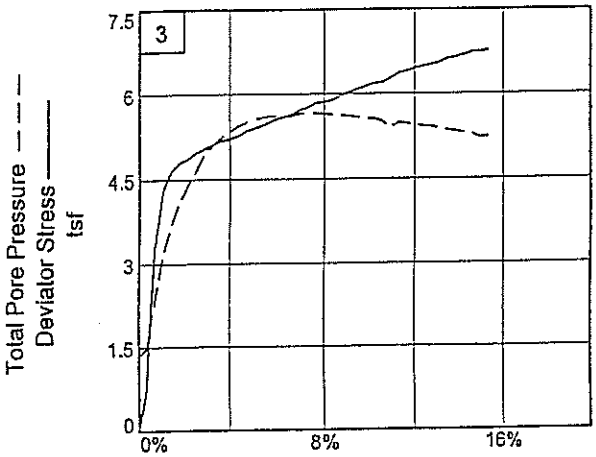
HOLCOMB FOUNDATION ENGINEERING CO.

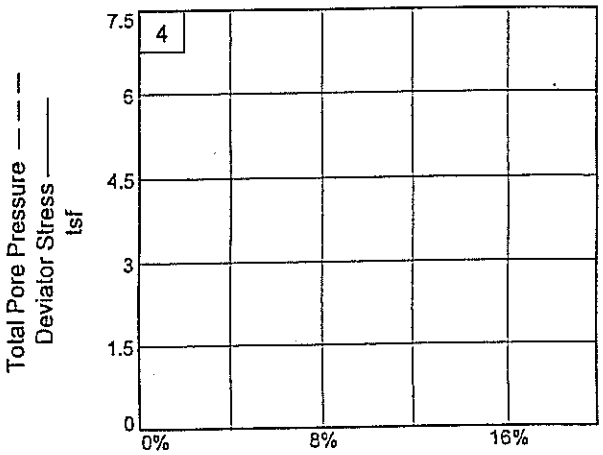
Plate _____

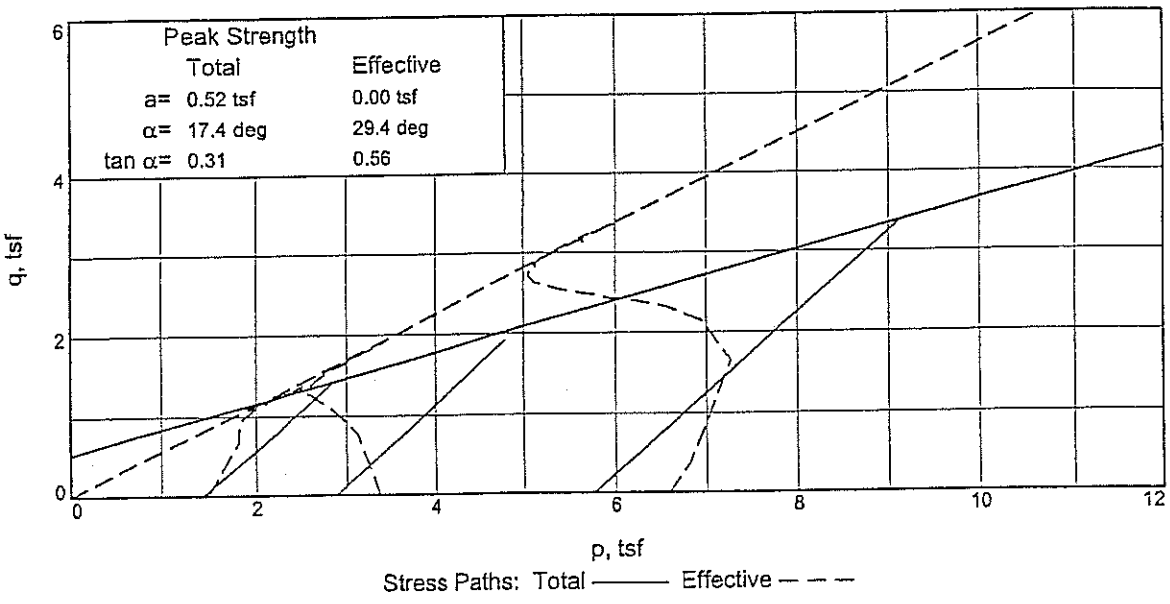
Tested By: LC _____ Checked By: TH _____











Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Coarse Refuse Stockpile
Project No.: H-05278

Sample Number: Coarse Refuse
Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

11/30/2006
10:19 AM

Date:	11/17/06
Client:	Pond Creek Mine
Project:	Coarse Refuse Laboratory Tests
Location:	Coarse Refuse Stockpile
Sample Number:	Coarse Refuse
Description:	Coarse Coal Refuse
Remarks:	
Type of Sample:	Remolded
Assumed Specific Gravity=2.37	LL= PL= PI=
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	226.800			1320.700
Moisture content: Dry soil+tare, gms.	218.600			1195.800
Moisture content: Tare, gms.	137.500			107.600
Moisture, %	10.1	10.4	10.4	11.5
Moist specimen weight, gms.	1193.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.65	5.65	5.65	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.6	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2470	0.2470	0.2470	
Saturation, %	97.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 2.778 tsf at reading no. 41
Ult. Stress = 2.767 tsf at reading no. 42

23 R13898

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0010	46.60	0.0	0.0	0.000	1.498	1.498	1.00	49.20	1.498	0.000
1	0.0180	160.60	114.0	0.3	1.329	1.152	2.481	2.15	54.00	1.816	0.664
2	0.0390	189.70	143.1	0.7	1.662	1.001	2.663	2.66	56.10	1.832	0.831
3	0.0590	205.60	159.0	1.0	1.840	0.929	2.769	2.98	57.10	1.849	0.920
4	0.0800	212.20	165.6	1.4	1.909	0.907	2.816	3.10	57.40	1.862	0.955
5	0.1000	218.90	172.3	1.8	1.979	0.900	2.879	3.20	57.50	1.890	0.990
6	0.1200	232.20	185.6	2.1	2.125	0.900	3.025	3.36	57.50	1.962	1.062
7	0.1410	240.50	193.9	2.5	2.211	0.907	3.118	3.44	57.40	2.013	1.106
8	0.1610	245.50	198.9	2.8	2.260	0.914	3.174	3.47	57.30	2.044	1.130
9	0.1820	252.20	205.6	3.2	2.327	0.922	3.249	3.53	57.20	2.085	1.164
10	0.2020	253.80	207.2	3.6	2.337	0.936	3.273	3.50	57.00	2.104	1.168
11	0.2230	250.50	203.9	3.9	2.291	0.958	3.248	3.39	56.70	2.103	1.145
12	0.2430	261.30	214.7	4.3	2.403	0.972	3.375	3.47	56.50	2.173	1.201
13	0.2630	266.30	219.7	4.6	2.450	0.979	3.429	3.50	56.40	2.204	1.225
14	0.2840	266.30	219.7	5.0	2.440	0.994	3.434	3.46	56.20	2.214	1.220
15	0.3040	272.10	225.5	5.4	2.495	1.008	3.503	3.48	56.00	2.256	1.248
16	0.3250	274.60	228.0	5.7	2.513	1.022	3.536	3.46	55.80	2.279	1.257
17	0.3450	268.00	221.4	6.1	2.431	1.037	3.468	3.34	55.60	2.252	1.216
18	0.3660	273.00	226.4	6.5	2.476	1.051	3.527	3.36	55.40	2.289	1.238
19	0.3860	278.00	231.4	6.8	2.521	1.058	3.580	3.38	55.30	2.319	1.261
20	0.4070	278.00	231.4	7.2	2.511	1.066	3.577	3.36	55.20	2.321	1.256
21	0.4270	283.00	236.4	7.5	2.556	1.073	3.629	3.38	55.10	2.351	1.278
22	0.4470	284.60	238.0	7.9	2.563	1.080	3.643	3.37	55.00	2.362	1.282
23	0.4680	278.80	232.2	8.3	2.491	1.087	3.578	3.29	54.90	2.333	1.245
24	0.4880	286.30	239.7	8.6	2.561	1.087	3.648	3.36	54.90	2.368	1.281
25	0.5090	290.40	243.8	9.0	2.594	1.094	3.689	3.37	54.80	2.392	1.297
26	0.5290	292.10	245.5	9.3	2.602	1.102	3.704	3.36	54.70	2.403	1.301
27	0.5500	298.80	252.2	9.7	2.662	1.109	3.771	3.40	54.60	2.440	1.331
28	0.5700	299.60	253.0	10.1	2.660	1.116	3.776	3.38	54.50	2.446	1.330
29	0.5910	294.60	248.0	10.4	2.597	1.116	3.713	3.33	54.50	2.415	1.299
30	0.6110	302.10	255.5	10.8	2.665	1.123	3.788	3.37	54.40	2.456	1.333
31	0.6310	306.30	259.7	11.2	2.698	1.130	3.828	3.39	54.30	2.479	1.349
32	0.6520	306.30	259.7	11.5	2.687	1.130	3.817	3.38	54.30	2.474	1.343
33	0.6720	312.10	265.5	11.9	2.736	1.145	3.881	3.39	54.10	2.513	1.368
34	0.6930	309.60	263.0	12.2	2.699	1.145	3.843	3.36	54.10	2.494	1.349
35	0.7130	308.80	262.2	12.6	2.680	1.152	3.832	3.33	54.00	2.492	1.340
36	0.7340	309.60	263.0	13.0	2.676	1.159	3.835	3.31	53.90	2.497	1.338
37	0.7540	315.40	268.8	13.3	2.724	1.166	3.891	3.34	53.80	2.528	1.362
38	0.7750	316.20	269.6	13.7	2.721	1.166	3.887	3.33	53.80	2.527	1.360
39	0.7950	323.70	277.1	14.1	2.785	1.181	3.966	3.36	53.60	2.573	1.392
40	0.8150	325.40	278.8	14.4	2.790	1.181	3.971	3.36	53.60	2.576	1.395
41	0.8360	325.40	278.8	14.8	2.778	1.181	3.959	3.35	53.60	2.570	1.389
42	0.8560	325.40	278.8	15.1	2.767	1.188	3.955	3.33	53.50	2.571	1.383

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	211.600			1335.900
Moisture content: Dry soil+tare, gms.	203.200			1222.200
Moisture content: Tare, gms.	125.200			134.800
Moisture, %	10.8	10.8	10.8	10.5
Moist specimen weight, gms.	1175.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.57	5.57	5.57	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.5	130.5	130.5	
Dry density, pcf	117.8	117.8	117.8	
Void ratio	0.2558	0.2558	0.2558	
Saturation, %	99.8	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 3.829 tsf at reading no. 40
Ult. Stress = 3.828 tsf at reading no. 41

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	51.60	0.0	0.0	0.000	3.377	3.377	1.00	43.10	3.377	0.000
1	0.0190	185.60	134.0	0.3	1.562	2.340	3.902	1.67	57.50	3.121	0.781
2	0.0400	233.00	181.4	0.7	2.106	1.814	3.920	2.16	64.80	2.867	1.053
3	0.0600	253.00	201.4	1.1	2.330	1.562	3.892	2.49	68.30	2.727	1.165
4	0.0810	263.80	212.2	1.5	2.445	1.433	3.878	2.71	70.10	2.655	1.223
5	0.1010	270.50	218.9	1.8	2.513	1.346	3.860	2.87	71.30	2.603	1.257
6	0.1220	274.60	223.0	2.2	2.550	1.289	3.839	2.98	72.10	2.564	1.275
7	0.1420	281.30	229.7	2.5	2.617	1.260	3.877	3.08	72.50	2.569	1.309
8	0.1620	287.10	235.5	2.9	2.674	1.238	3.912	3.16	72.80	2.575	1.337
9	0.1830	291.30	239.7	3.3	2.711	1.231	3.942	3.20	72.90	2.587	1.355
10	0.2030	297.10	245.5	3.6	2.766	1.224	3.990	3.26	73.00	2.607	1.383
11	0.2240	301.30	249.7	4.0	2.802	1.224	4.026	3.29	73.00	2.625	1.401
12	0.2440	305.40	253.8	4.4	2.838	1.224	4.062	3.32	73.00	2.643	1.419
13	0.2650	309.60	258.0	4.8	2.873	1.224	4.097	3.35	73.00	2.661	1.437
14	0.2850	315.40	263.8	5.1	2.927	1.231	4.158	3.38	72.90	2.695	1.463
15	0.3060	320.40	268.8	5.5	2.970	1.238	4.209	3.40	72.80	2.724	1.485
16	0.3260	326.20	274.6	5.9	3.023	1.246	4.269	3.43	72.70	2.757	1.512
17	0.3460	330.40	278.8	6.2	3.058	1.253	4.310	3.44	72.60	2.782	1.529
18	0.3670	334.60	283.0	6.6	3.091	1.267	4.358	3.44	72.40	2.813	1.546
19	0.3870	341.20	289.6	6.9	3.151	1.282	4.433	3.46	72.20	2.857	1.576
20	0.4080	346.20	294.6	7.3	3.192	1.296	4.488	3.46	72.00	2.892	1.596
21	0.4280	351.20	299.6	7.7	3.234	1.310	4.544	3.47	71.80	2.927	1.617

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	357.00	305.4	8.1	3.283	1.318	4.601	3.49	71.70	2.959	1.642
23	0.4690	359.50	307.9	8.4	3.297	1.332	4.629	3.48	71.50	2.981	1.649
24	0.4890	362.80	311.2	8.8	3.319	1.339	4.659	3.48	71.40	2.999	1.660
25	0.5100	368.70	317.1	9.2	3.368	1.346	4.715	3.50	71.30	3.031	1.684
26	0.5300	374.50	322.9	9.5	3.416	1.361	4.777	3.51	71.10	3.069	1.708
27	0.5510	377.00	325.4	9.9	3.429	1.368	4.797	3.51	71.00	3.082	1.714
28	0.5710	381.20	329.6	10.2	3.459	1.368	4.827	3.53	71.00	3.098	1.730
29	0.5920	384.50	332.9	10.6	3.479	1.382	4.861	3.52	70.80	3.122	1.739
30	0.6120	386.20	334.6	11.0	3.483	1.390	4.872	3.51	70.70	3.131	1.741
31	0.6330	392.00	340.4	11.4	3.528	1.397	4.925	3.53	70.60	3.161	1.764
32	0.6530	397.00	345.4	11.7	3.565	1.411	4.977	3.53	70.40	3.194	1.783
33	0.6730	400.30	348.7	12.1	3.585	1.426	5.010	3.51	70.20	3.218	1.792
34	0.6940	406.10	354.5	12.5	3.629	1.440	5.069	3.52	70.00	3.254	1.814
35	0.7140	410.30	358.7	12.8	3.657	1.454	5.111	3.51	69.80	3.283	1.828
36	0.7350	413.60	362.0	13.2	3.674	1.469	5.143	3.50	69.60	3.306	1.837
37	0.7550	420.30	368.7	13.6	3.727	1.483	5.210	3.51	69.40	3.347	1.863
38	0.7760	423.60	372.0	13.9	3.744	1.498	5.242	3.50	69.20	3.370	1.872
39	0.7960	427.80	376.2	14.3	3.770	1.505	5.275	3.51	69.10	3.390	1.885
40	0.8170	435.30	383.7	14.7	3.829	1.519	5.348	3.52	68.90	3.434	1.914
41	0.8370	436.90	385.3	15.0	3.828	1.526	5.355	3.51	68.80	3.441	1.914

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	184.300			1333.800
Moisture content: Dry soil+tare, gms.	177.100			1230.400
Moisture content: Tare, gms.	107.500			135.300
Moisture, %	10.3	10.4	10.4	9.4
Moist specimen weight, gms.	1185.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.60	5.60	5.60	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.9	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2468	0.2468	0.2468	
Saturation, %	99.3	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 6.758 tsf at reading no. 42
Ult. Stress = 6.758 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	25.00	0.0	0.0	0.000	6.588	6.588	1.00	18.50	6.588	0.000
1	0.0190	88.20	63.2	0.3	0.736	6.458	7.195	1.11	20.30	6.827	0.368
2	0.0400	309.60	284.6	0.7	3.304	5.623	8.927	1.59	31.90	7.275	1.652
3	0.0600	397.00	372.0	1.1	4.303	4.795	9.098	1.90	43.40	6.947	2.152
4	0.0810	428.60	403.6	1.4	4.651	4.234	8.885	2.10	51.20	6.559	2.326
5	0.1010	441.90	416.9	1.8	4.787	3.830	8.617	2.25	56.80	6.224	2.393
6	0.1220	449.40	424.4	2.2	4.854	3.521	8.375	2.38	61.10	5.948	2.427
7	0.1420	460.20	435.2	2.5	4.960	3.283	8.243	2.51	64.40	5.763	2.480
8	0.1620	467.70	442.7	2.9	5.027	3.017	8.044	2.67	68.10	5.530	2.513
9	0.1830	476.00	451.0	3.3	5.101	2.837	7.938	2.80	70.60	5.387	2.551
10	0.2030	483.50	458.5	3.6	5.167	2.693	7.860	2.92	72.60	5.276	2.583
11	0.2240	489.30	464.3	4.0	5.212	2.585	7.797	3.02	74.10	5.191	2.606
12	0.2440	495.20	470.2	4.4	5.258	2.491	7.750	3.11	75.40	5.120	2.629
13	0.2650	505.20	480.2	4.7	5.349	2.419	7.768	3.21	76.40	5.094	2.675
14	0.2850	511.00	486.0	5.1	5.394	2.369	7.762	3.28	77.10	5.066	2.697
15	0.3060	518.50	493.5	5.5	5.455	2.333	7.788	3.34	77.60	5.060	2.728
16	0.3260	526.80	501.8	5.8	5.526	2.304	7.830	3.40	78.00	5.067	2.763
17	0.3460	533.50	508.5	6.2	5.579	2.297	7.875	3.43	78.10	5.086	2.789
18	0.3670	539.30	514.3	6.6	5.620	2.326	7.945	3.42	77.70	5.135	2.810
19	0.3870	548.40	523.4	6.9	5.697	2.275	7.972	3.50	78.40	5.124	2.849
20	0.4080	555.90	530.9	7.3	5.756	2.261	8.016	3.55	78.60	5.139	2.878
21	0.4280	565.90	540.9	7.6	5.841	2.261	8.102	3.58	78.60	5.181	2.921

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	569.20	544.2	8.0	5.853	2.268	8.121	3.58	78.50	5.195	2.927
23	0.4690	575.10	550.1	8.4	5.894	2.282	8.176	3.58	78.30	5.229	2.947
24	0.4890	584.20	559.2	8.7	5.968	2.297	8.265	3.60	78.10	5.281	2.984
25	0.5100	592.50	567.5	9.1	6.031	2.311	8.343	3.61	77.90	5.327	3.016
26	0.5300	599.20	574.2	9.5	6.079	2.333	8.411	3.61	77.60	5.372	3.039
27	0.5510	605.90	580.9	9.8	6.124	2.354	8.479	3.60	77.30	5.416	3.062
28	0.5710	613.30	588.3	10.2	6.178	2.362	8.539	3.62	77.20	5.450	3.089
29	0.5920	617.50	592.5	10.6	6.196	2.405	8.601	3.58	76.60	5.503	3.098
30	0.6120	626.70	601.7	10.9	6.267	2.527	8.794	3.48	74.90	5.661	3.133
31	0.6330	638.30	613.3	11.3	6.361	2.426	8.787	3.62	76.30	5.607	3.180
32	0.6530	644.10	619.1	11.7	6.395	2.448	8.843	3.61	76.00	5.646	3.198
33	0.6730	650.80	625.8	12.0	6.438	2.477	8.915	3.60	75.60	5.696	3.219
34	0.6940	656.60	631.6	12.4	6.470	2.498	8.968	3.59	75.30	5.733	3.235
35	0.7140	662.50	637.5	12.8	6.504	2.506	9.009	3.60	75.20	5.758	3.252
36	0.7350	669.10	644.1	13.1	6.543	2.542	9.085	3.57	74.70	5.813	3.271
37	0.7550	678.30	653.3	13.5	6.609	2.563	9.172	3.58	74.40	5.868	3.305
38	0.7760	684.10	659.1	13.9	6.639	2.585	9.224	3.57	74.10	5.904	3.319
39	0.7960	690.70	665.7	14.2	6.678	2.614	9.291	3.55	73.70	5.952	3.339
40	0.8170	699.10	674.1	14.6	6.732	2.635	9.367	3.55	73.40	6.001	3.366
41	0.8370	701.60	676.6	14.9	6.729	2.700	9.429	3.49	72.50	6.065	3.365
42	0.8570	707.40	682.4	15.3	6.758	2.686	9.444	3.52	72.70	6.065	3.379

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

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800-333-1740
FAX 618-457-8991

April 9, 2007

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Mach Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on March 29, 2007, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification:	Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)
Proctor Test Results:	
Maximum Dry Unit Weight:	120.3 PCF
Optimum Moisture Content:	10.7 %
Specific Gravity:	2.50
Triaxial Test Results:	
Effective Cohesion:	152 PSF
Effective Phi Angle:	29.3 Degrees
Permeability (2 tests):	3 x 10-4 cm./sec.
	2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting



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Permeability Tests Results

Mach Mine
Johnston City, Illinois

Date: 4/9/2007 Client: Williamson Energy

Project No.: H-05278

Boring No.	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse Sample #1		10.9	14.6	115.7	3 x 10-4
Coarse Refuse Sample #2		10.1	14.3	114.7	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

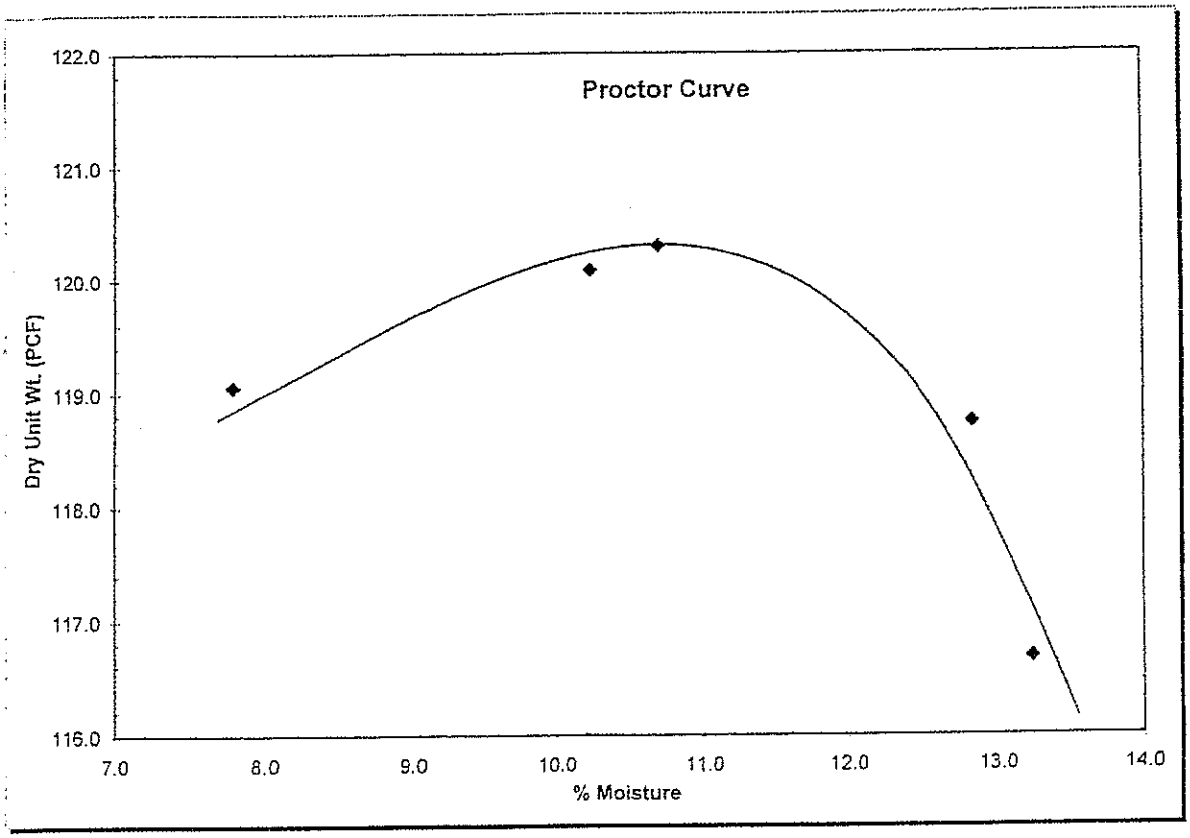
Date: 4/9/2007

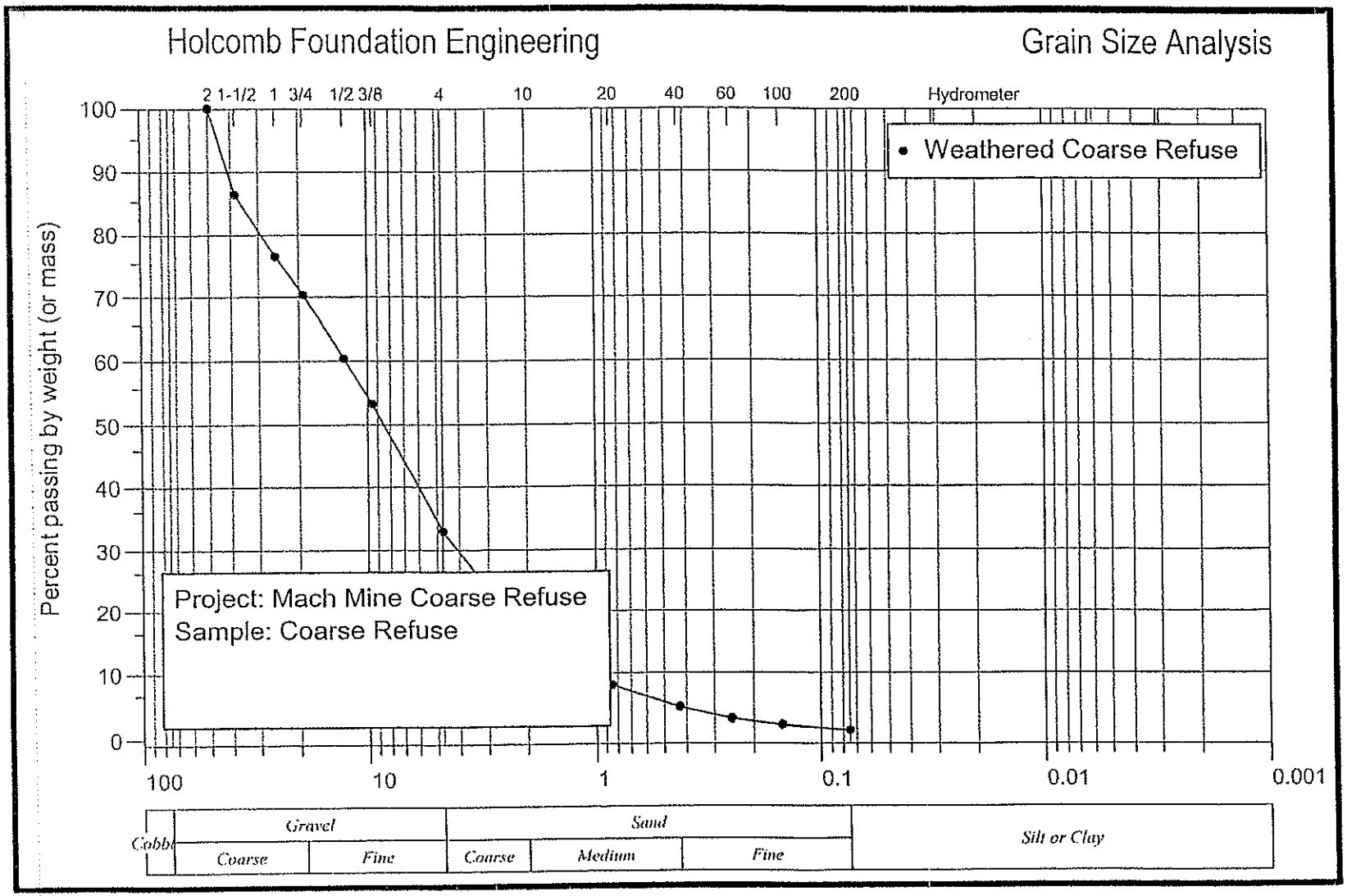
Proctor Test Results

Soil Classification:	Weathered Coarse Refuse
Maximum Dry Density (PCF)	120.3
Optimum Moisture Content (%)	10.7

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
12.8	118.7
13.2	116.7
10.2	120.1
7.8	119.1
10.7	120.3




Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
• Weathered Coarse Refuse
Project: Mach Mine Coarse Refuse
Sample: Coarse Refuse
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

R13907

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

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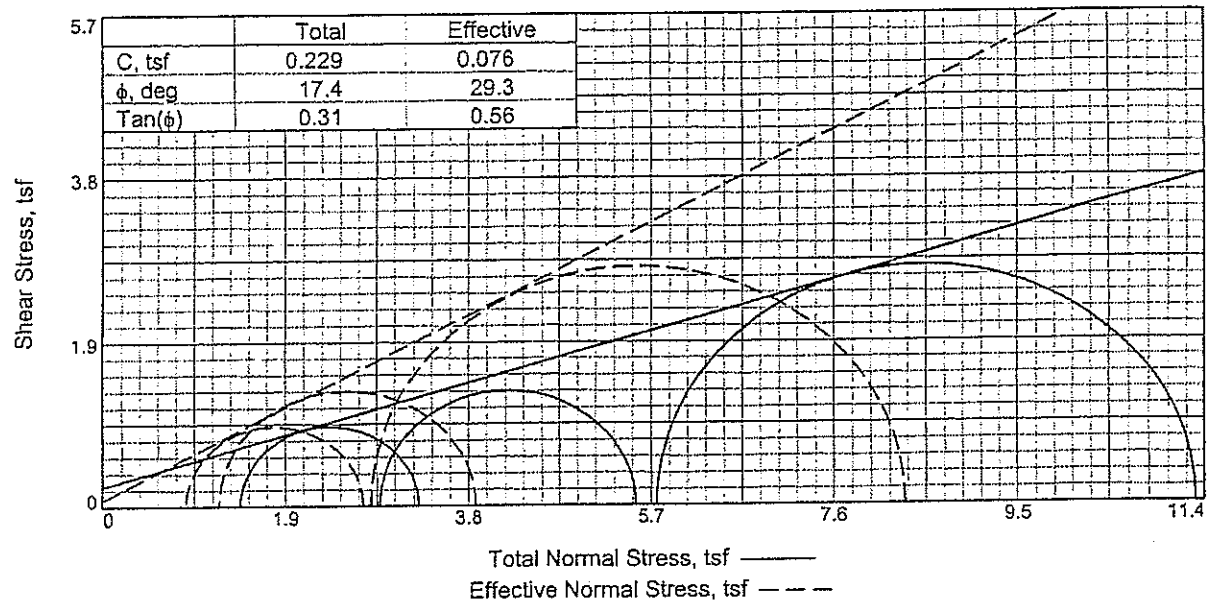
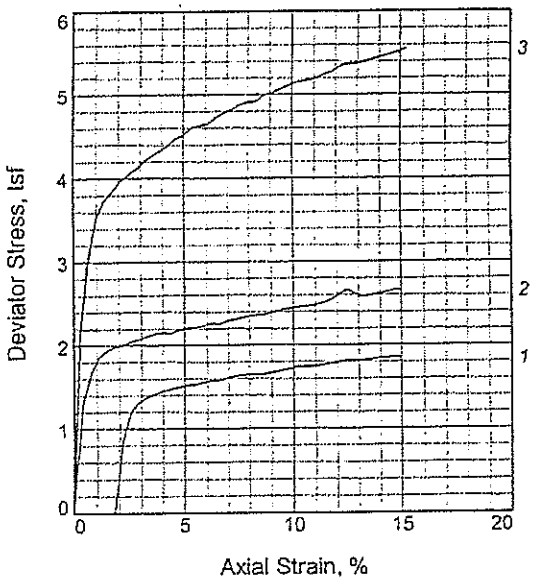
Grain Size Analysis

Project:	Mach Mine	Client:	Mach Mine
Project No.:	H-05278	Date:	4/9/2007
Sample No.	Coarse Refuse	Total Weight:	2290.30

Sieve	Wt. Retained	% Ret.	% Passing
2"	0.0	0.0	100.0
1.5"	314.4	13.7	86.3
1"	536.7	23.4	76.6
3/4"	674.8	29.5	70.5
1/2"	901.6	39.4	60.6
3/8"	1061.2	46.3	53.7
#4	1522.1	66.5	33.5
#10	1911.6	83.5	16.5
#20	2091.9	91.3	8.7
#40	2166.2	94.6	5.4
#60	2202.2	96.2	3.8
#100	2223.7	97.1	2.9
#200	2245.2	98.0	2.0





Sample No.		1	2	3
Initial	Water Content,	14.4	12.7	13.1
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	95.1	89.0	90.4
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
At Test	Water Content,	15.2	14.2	14.5
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.60	3.60	1.80
Cell Pressure, tsf		5.04	6.48	7.56
Fail. Stress, tsf		1.85	2.67	5.55
Total Pore Pr., tsf		4.18	5.27	4.77
Ult. Stress, tsf		1.85	2.66	5.55
Total Pore Pr., tsf		4.18	5.22	4.77
$\bar{\sigma}_1$ Failure, tsf		2.71	3.88	8.34
$\bar{\sigma}_3$ Failure, tsf		0.86	1.21	2.79

Type of Test:
CU with Pore Pressures
Sample Type: Coarse Refuse
Description:

Assumed Specific Gravity= 2.50
Remarks:

Plate _____

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

Location: Weathered Coarse Refuse

Proj. No.: H-05278 **Date:** 4/2/07

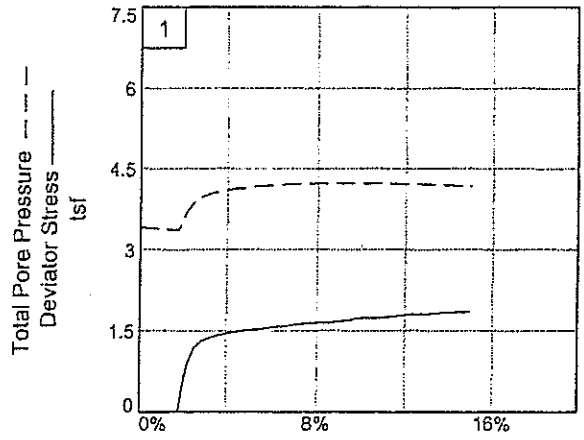
TRIAXIAL SHEAR TEST REPORT

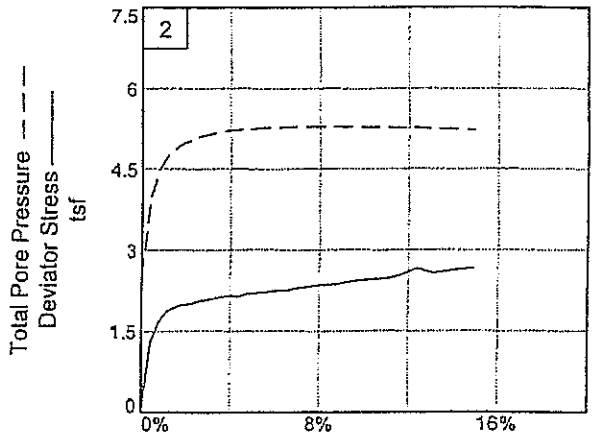
HOLCOMB FOUNDATION ENGINEERING CO.

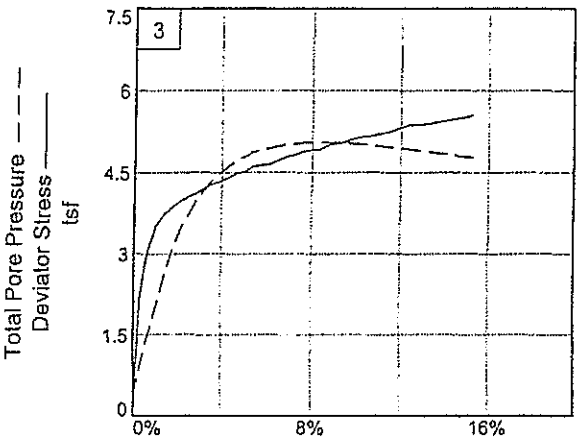
Tested By: LC Checked By: TH

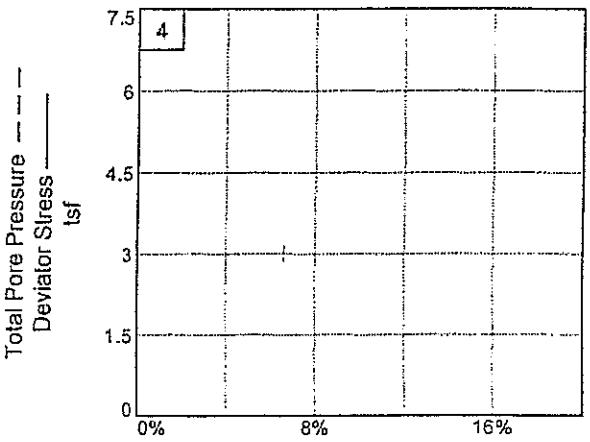
41 of 51

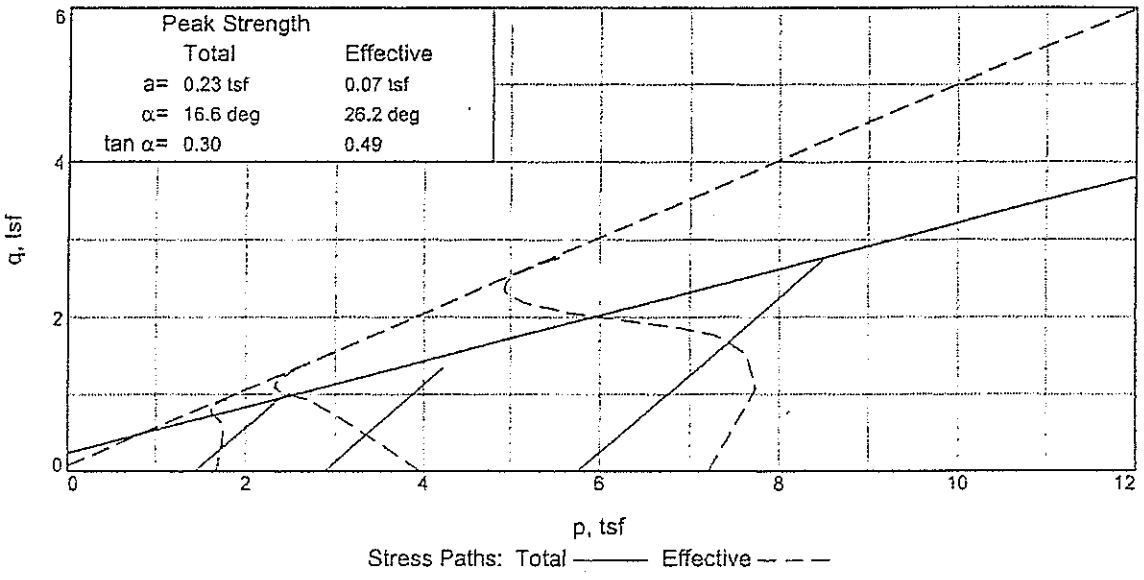
R13910











Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Weathered Coarse Refuse
Project No.: H-05278

Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

4/9/2007
11:10 AM

Date:	4/2/07
Client:	Pond Creek Mine
Project:	Coarse Refuse Laboratory Tests
Location:	Weathered Coarse Refuse
Description:	
Remarks:	
Type of Sample:	Coarse Refuse
Assumed Specific Gravity=2.50	LL= PL= PI=
Test Method:	COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	179.300			1255.500
Moisture content: Dry soil+tare, gms.	165.700			1117.500
Moisture content: Tare, gms.	71.400			79.600
Moisture, %	14.4	15.2	15.2	13.3
Moist specimen weight, gms.	1170.0			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.59	5.59	5.59	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.5	130.3	130.3	
Dry density, pcf	113.2	113.2	113.2	
Void ratio	0.3793	0.3793	0.3793	
Saturation, %	95.1	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.845 tsf at reading no. 31
Ult. Stress = 1.845 tsf at reading no. 31

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	19.10	0.0	0.0	0.000	1.627	1.627	1.00	47.40	1.627	0.000
1	0.0190	20.00	0.9	0.3	0.001	1.642	1.642	1.00	47.20	1.642	0.000
2	0.0400	20.00	0.9	0.7	0.000	1.656	1.656	1.00	47.00	1.656	0.000
3	0.0600	20.00	0.9	1.1	0.000	1.663	1.663	1.00	46.90	1.663	0.000
4	0.0810	20.00	0.9	1.4	0.000	1.678	1.678	1.00	46.70	1.678	0.000
5	0.1010	25.00	5.9	1.8	0.017	1.678	1.694	1.01	46.70	1.686	0.008
6	0.1220	99.00	79.9	2.2	0.857	1.318	2.175	1.65	51.70	1.746	0.429
7	0.1420	124.00	104.9	2.5	1.195	1.152	2.347	2.04	54.00	1.750	0.598
8	0.1620	134.80	115.7	2.9	1.314	1.058	2.372	2.24	55.30	1.715	0.657
9	0.1830	140.60	121.5	3.3	1.374	1.001	2.375	2.37	56.10	1.688	0.687
10	0.2030	144.80	125.7	3.6	1.416	0.965	2.381	2.47	56.60	1.673	0.708
11	0.2240	148.10	129.0	4.0	1.448	0.936	2.384	2.55	57.00	1.660	0.724
12	0.2440	150.60	131.5	4.4	1.471	0.914	2.385	2.61	57.30	1.650	0.735
13	0.2650	153.10	134.0	4.7	1.493	0.900	2.393	2.66	57.50	1.646	0.746
14	0.2850	155.60	136.5	5.1	1.515	0.878	2.393	2.72	57.80	1.636	0.757
15	0.3060	157.30	138.2	5.5	1.528	0.864	2.392	2.77	58.00	1.628	0.764
16	0.3260	159.80	140.7	5.8	1.549	0.857	2.406	2.81	58.10	1.631	0.775
17	0.3460	162.30	143.2	6.2	1.571	0.850	2.420	2.85	58.20	1.635	0.785
18	0.3670	163.10	144.0	6.6	1.573	0.835	2.408	2.88	58.40	1.622	0.787
19	0.3870	166.40	147.3	6.9	1.603	0.828	2.431	2.94	58.50	1.630	0.802
20	0.4080	168.90	149.8	7.3	1.624	0.821	2.445	2.98	58.60	1.633	0.812
21	0.4490	172.30	153.2	8.0	1.648	0.814	2.461	3.02	58.70	1.637	0.824
22	0.4890	173.90	154.8	8.7	1.652	0.806	2.458	3.05	58.80	1.632	0.826
23	0.5300	178.90	159.8	9.5	1.691	0.806	2.498	3.10	58.80	1.652	0.846
24	0.5710	184.80	165.7	10.2	1.740	0.814	2.553	3.14	58.70	1.683	0.870
25	0.6120	186.40	167.3	10.9	1.742	0.806	2.549	3.16	58.80	1.677	0.871
26	0.6530	190.60	171.5	11.7	1.771	0.821	2.592	3.16	58.60	1.706	0.886
27	0.6940	195.60	176.5	12.4	1.808	0.821	2.628	3.20	58.60	1.725	0.904
28	0.7350	197.20	178.1	13.1	1.809	0.835	2.644	3.17	58.40	1.740	0.904
29	0.7760	201.40	182.3	13.9	1.836	0.842	2.678	3.18	58.30	1.760	0.918
30	0.8170	204.70	185.6	14.6	1.853	0.857	2.710	3.16	58.10	1.783	0.927
31	0.8370	204.70	185.6	15.0	1.845	0.864	2.709	3.14	58.00	1.787	0.923

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	169.900			1238.700
Moisture content: Dry soil+tare, gms.	158.800			1117.200
Moisture content: Tare, gms.	71.200			73.100
Moisture, %	12.7	14.2	14.2	11.6
Moist specimen weight, gms.	1169.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.7	131.5	131.5	
Dry density, pcf	115.1	115.1	115.1	
Void ratio	0.3560	0.3560	0.3560	
Saturation, %	89.0	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²

Membrane thickness = 0.02 cm

Filter paper coefficient = 0.001926 kN/cm

Filter paper coverage = 50%

Consolidation cell pressure = 90.00 psi (6.480 tsf)

Consolidation back pressure = 50.00 psi (3.600 tsf)

Consolidation effective confining stress = 2.880 tsf

Strain rate, in./min. = 0.00

Fail. Stress = 2.666 tsf at reading no. 27

Ult. Stress = 2.663 tsf at reading no. 31

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	62.40	0.0	0.0	0.000	3.967	3.967	1.00	34.90	3.967	0.000
1	0.0220	173.10	110.7	0.4	1.289	2.484	3.773	1.52	55.50	3.129	0.645
2	0.0420	206.40	144.0	0.8	1.671	2.016	3.687	1.83	62.00	2.852	0.836
3	0.0620	223.00	160.6	1.1	1.857	1.764	3.621	2.05	65.50	2.693	0.929
4	0.0830	230.50	168.1	1.5	1.936	1.613	3.549	2.20	67.60	2.581	0.968
5	0.1030	235.50	173.1	1.8	1.987	1.512	3.499	2.31	69.00	2.505	0.993
6	0.1240	238.00	175.6	2.2	2.008	1.447	3.455	2.39	69.90	2.451	1.004
7	0.1440	242.20	179.8	2.6	2.048	1.390	3.438	2.47	70.70	2.414	1.024
8	0.1650	245.50	183.1	3.0	2.078	1.346	3.424	2.54	71.30	2.385	1.039
9	0.1850	248.80	186.4	3.3	2.107	1.310	3.418	2.61	71.80	2.364	1.054
10	0.2060	252.20	189.8	3.7	2.137	1.289	3.426	2.66	72.10	2.358	1.069
11	0.2260	254.70	192.3	4.0	2.158	1.267	3.425	2.70	72.40	2.346	1.079
12	0.2460	253.80	191.4	4.4	2.139	1.253	3.392	2.71	72.60	2.322	1.070
13	0.2670	258.80	196.4	4.8	2.187	1.238	3.425	2.77	72.80	2.332	1.093
14	0.2870	260.50	198.1	5.1	2.197	1.231	3.428	2.78	72.90	2.330	1.099
15	0.3080	263.00	200.6	5.5	2.216	1.217	3.433	2.82	73.10	2.325	1.108
16	0.3280	265.50	203.1	5.9	2.235	1.210	3.445	2.85	73.20	2.327	1.118
17	0.3490	268.80	206.4	6.3	2.263	1.210	3.472	2.87	73.20	2.341	1.131
18	0.3690	268.80	206.4	6.6	2.254	1.202	3.456	2.87	73.30	2.329	1.127
19	0.3900	273.00	210.6	7.0	2.290	1.195	3.486	2.92	73.40	2.340	1.145
20	0.4100	275.50	213.1	7.3	2.309	1.195	3.504	2.93	73.40	2.350	1.154
21	0.4510	281.30	218.9	8.1	2.353	1.188	3.541	2.98	73.50	2.364	1.176

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4920	284.60	222.2	8.8	2.369	1.195	3.564	2.98	73.40	2.380	1.185
23	0.5330	292.10	229.7	9.6	2.429	1.195	3.625	3.03	73.40	2.410	1.215
24	0.5740	296.30	233.9	10.3	2.454	1.202	3.656	3.04	73.30	2.429	1.227
25	0.6140	300.40	238.0	11.0	2.477	1.202	3.679	3.06	73.30	2.441	1.238
26	0.6440	305.40	243.0	11.5	2.514	1.217	3.730	3.07	73.10	2.474	1.257
27	0.6960	322.90	260.5	12.5	2.666	1.210	3.876	3.20	73.20	2.543	1.333
28	0.7370	316.20	253.8	13.2	2.576	1.238	3.814	3.08	72.80	2.526	1.288
29	0.7780	322.10	259.7	13.9	2.613	1.238	3.852	3.11	72.80	2.545	1.307
30	0.8190	328.70	266.3	14.7	2.657	1.253	3.910	3.12	72.60	2.581	1.328
31	0.8390	330.40	268.0	15.0	2.663	1.260	3.923	3.11	72.50	2.591	1.331

Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	171.400			1284.500
Moisture content: Dry soil+tare, gms.	160.000			1180.500
Moisture content: Tare, gms.	72.800			134.900
Moisture, %	13.1	14.5	14.5	9.9
Moist specimen weight, gms.	1168.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.6	131.2	131.2	
Dry density, pcf	114.6	114.6	114.6	
Void ratio	0.3615	0.3615	0.3615	
Saturation, %	90.4	100.0	100.0	

Test Readings for Specimen No. 3

Membrane modulus = 0.124105 kN/cm^2

Membrane thickness = 0.02 cm

Filter paper coefficient = 0.001926 kN/cm

Filter paper coverage = 50%

Consolidation cell pressure = 105.00 psi (7.560 tsf)

Consolidation back pressure = 25.00 psi (1.800 tsf)

Consolidation effective confining stress = 5.760 tsf

Strain rate, in./min. = 0.00

Fail. Stress = 5.549 tsf at reading no. 35

Ult. Stress = 5.549 tsf at reading no. 35

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0020	102.40	0.0	0.0	0.000	7.207	7.207	1.00	4.90	7.207	0.000
1	0.0170	286.30	183.9	0.3	2.145	6.674	8.819	1.32	12.30	7.747	1.072
2	0.0370	364.50	262.1	0.6	3.046	6.113	9.158	1.50	20.10	7.636	1.523
3	0.0580	407.00	304.6	1.0	3.526	5.537	9.063	1.64	28.10	7.300	1.763
4	0.0780	426.10	323.7	1.4	3.733	4.997	8.730	1.75	35.60	6.864	1.867
5	0.0990	437.70	335.3	1.7	3.853	4.536	8.389	1.85	42.00	6.462	1.926
6	0.1190	449.40	347.0	2.1	3.972	4.133	8.105	1.96	47.60	6.119	1.986
7	0.1400	457.70	355.3	2.5	4.052	3.838	7.889	2.06	51.70	5.863	2.026

Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
8	0.1600	464.40	362.0	2.8	4.113	3.593	7.706	2.14	55.10	5.649	2.056
9	0.1810	474.40	372.0	3.2	4.210	3.384	7.594	2.24	58.00	5.489	2.105
10	0.2010	481.90	379.5	3.6	4.279	3.211	7.490	2.33	60.40	5.351	2.140
11	0.2210	487.70	385.3	3.9	4.328	3.074	7.403	2.41	62.30	5.239	2.164
12	0.2420	495.20	392.8	4.3	4.395	2.959	7.355	2.49	63.90	5.157	2.198
13	0.2620	503.50	401.1	4.7	4.471	2.851	7.323	2.57	65.40	5.087	2.236
14	0.2830	509.30	406.9	5.0	4.518	2.772	7.290	2.63	66.50	5.031	2.259
15	0.3030	519.30	416.9	5.4	4.612	2.693	7.305	2.71	67.60	4.999	2.306
16	0.3240	522.60	420.2	5.8	4.630	2.650	7.279	2.75	68.20	4.965	2.315
17	0.3440	526.00	423.6	6.1	4.650	2.621	7.270	2.77	68.60	4.946	2.325
18	0.3650	534.30	431.9	6.5	4.722	2.578	7.299	2.83	69.20	4.938	2.361
19	0.3850	541.80	439.4	6.9	4.785	2.549	7.334	2.88	69.60	4.941	2.393
20	0.4050	546.80	444.4	7.2	4.821	2.534	7.355	2.90	69.80	4.945	2.411
21	0.4260	553.40	451.0	7.6	4.873	2.520	7.393	2.93	70.00	4.956	2.436
22	0.4460	558.40	456.0	8.0	4.908	2.506	7.413	2.96	70.20	4.959	2.454
23	0.4670	560.90	458.5	8.3	4.914	2.506	7.420	2.96	70.20	4.963	2.457
24	0.4870	569.20	466.8	8.7	4.984	2.506	7.489	2.99	70.20	4.997	2.492
25	0.5080	574.20	471.8	9.1	5.016	2.513	7.529	3.00	70.10	5.021	2.508
26	0.5280	580.10	477.7	9.4	5.059	2.520	7.579	3.01	70.00	5.050	2.530
27	0.5690	592.50	490.1	10.2	5.148	2.534	7.683	3.03	69.80	5.109	2.574
28	0.6100	600.00	497.6	10.9	5.184	2.570	7.755	3.02	69.30	5.163	2.592
29	0.6510	610.90	508.5	11.6	5.254	2.599	7.853	3.02	68.90	5.226	2.627
30	0.6920	625.80	523.4	12.4	5.363	2.628	7.991	3.04	68.50	5.310	2.682
31	0.7330	631.70	529.3	13.1	5.378	2.671	8.049	3.01	67.90	5.360	2.689
32	0.7730	641.60	539.2	13.8	5.434	2.707	8.141	3.01	67.40	5.424	2.717
33	0.8140	651.60	549.2	14.6	5.487	2.750	8.238	3.00	66.80	5.494	2.744
34	0.8350	656.60	554.2	14.9	5.513	2.772	8.285	2.99	66.50	5.528	2.756
35	0.8540	662.50	560.1	15.3	5.549	2.786	8.335	2.99	66.30	5.561	2.775

APPENDIX D

Boring Logs

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 8874

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6
Water Content (%)
Standard N Penetration, Blows/Ft.
10 20 30 40 50 60

Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Brown Silty CLAY (CL) with sand and pebbles.
5	1	st		
	2	st		
10	3	st		Gray Mottled Brown Silty CLAY (CL)
15	4	st		
	5	st		
20				End of Boring @ -20.0'
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling and None Upon Completion.

Mach #1 Mine Soils Investigation
Mach #1 Mine Williamson County Illinois

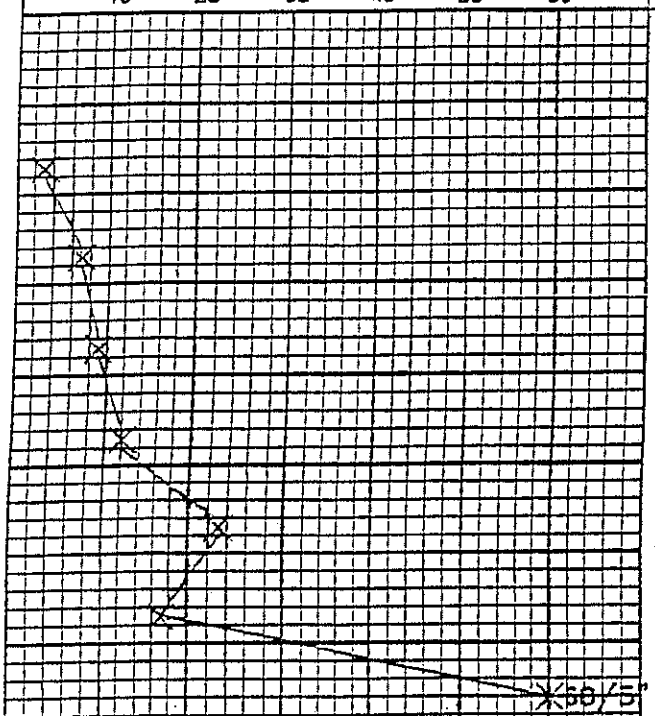
Date of Boring
February 1, 2006

Client: Alliance Consulting, Inc.
Beaver, West Virginia

Project No.
H-05278

LOG of BORING 8293

Holcomb Foundation Engineering Co.



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				7" Topsoil
				Gray Mottled Brown Silty CLAY (CL) with trace of sand
5	1	ss		
	2	ss		
10	3	ss		Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
	4	ss		
15	5	ss		
	6	ss		
20	7	ss		Gray SHALE
				End of Boring @ −19.0'
25				
30				
35				

Ground Water Data
Ground Water Encountered @ −12.0' During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

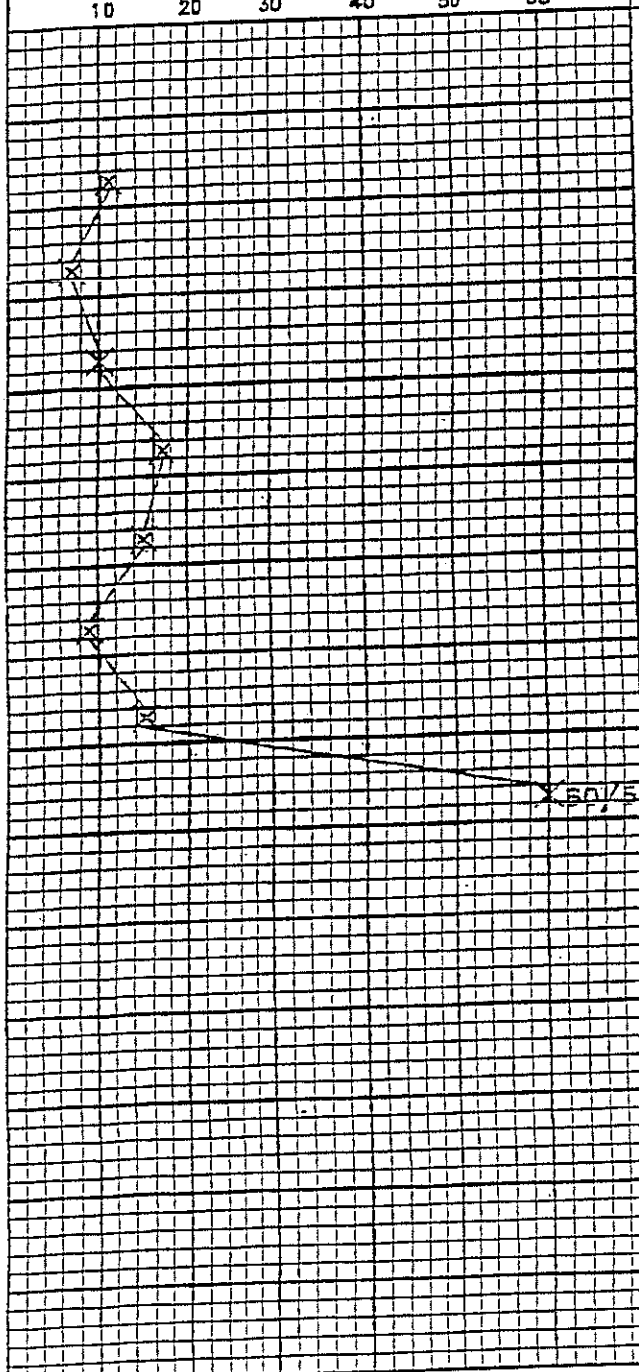
Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

R13919

LOG of BORING B294

Holcomb Foundation Engineering Co.



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				7" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
10	3	ss		
	4	ss		
15	5	ss		
	6	ss		
20	7	ss		
	8	ss		Brown SHALE
				End of Boring @ -22.5'
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

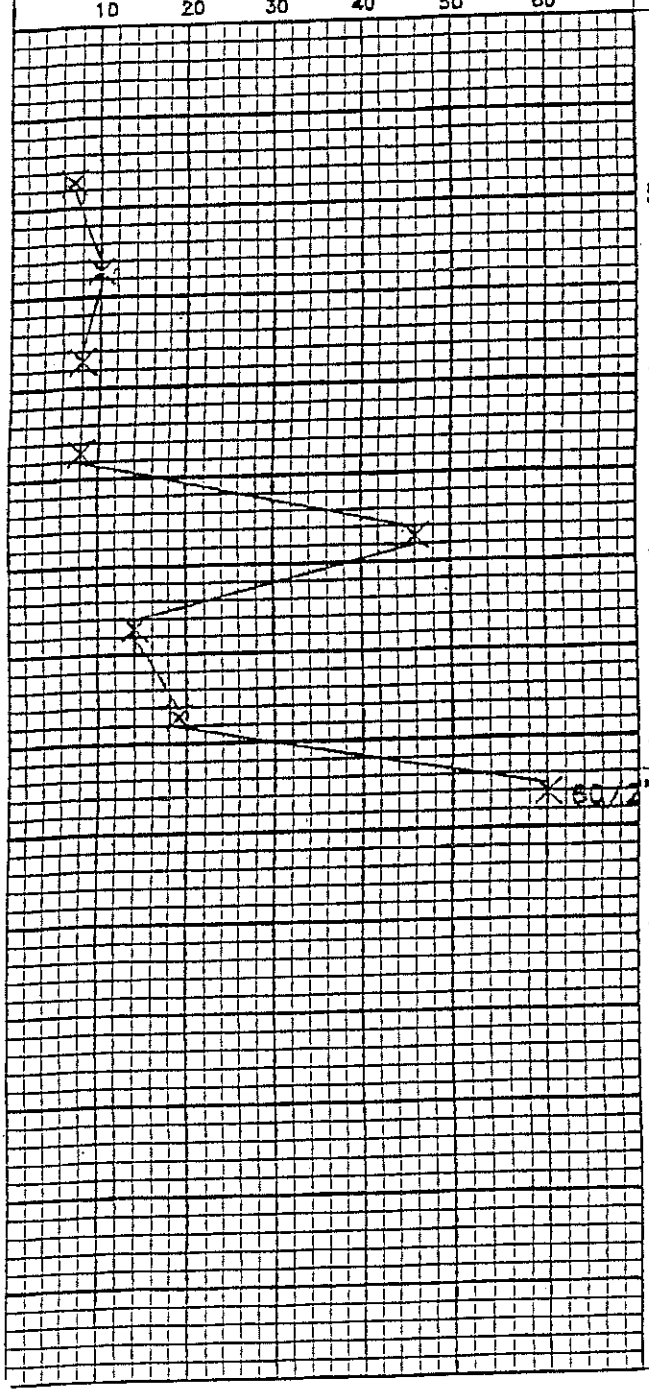
Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

LOG of BORING B295

Holcomb Foundation Engineering Co.



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				9" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
10	3	ss		
	4	ss		
15	5	ss		Brown SILT (ML)
	6	ss		Brown Medium to Coarse SAND (SC-SP)
20	7	ss		
	8	ss		Gray Mottled Brown SHALE
				End of Boring @ -22.0'
25				
30				
35				

Ground Water Data
Ground Water Encountered @ -16.0' During Drilling/ @ -10.0' Upon Completion.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

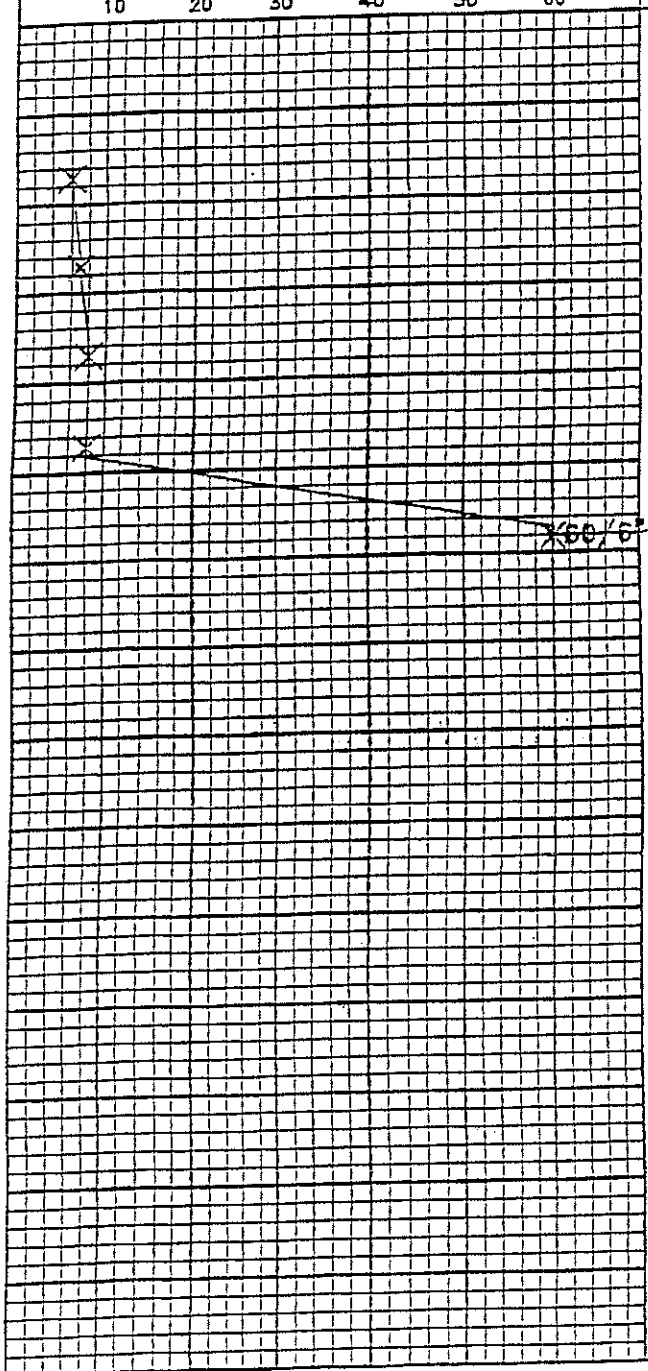
Date of Boring: December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.: H-05278

LOG of BORING 8297

Holcomb Foundation Engineering Co.



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				9" Topsoil
				Gray Mottled Brown Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
	3	ss		Brown Mottled Gray Silty CLAY (CL) with trace of sand
10	4	ss		Gray Mottled Brown Silty CLAY (CL) with trace of sand
15	5	ss		Brown SHALE
				End of Boring @ -15.5'
20				
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

55 7 51
R13922

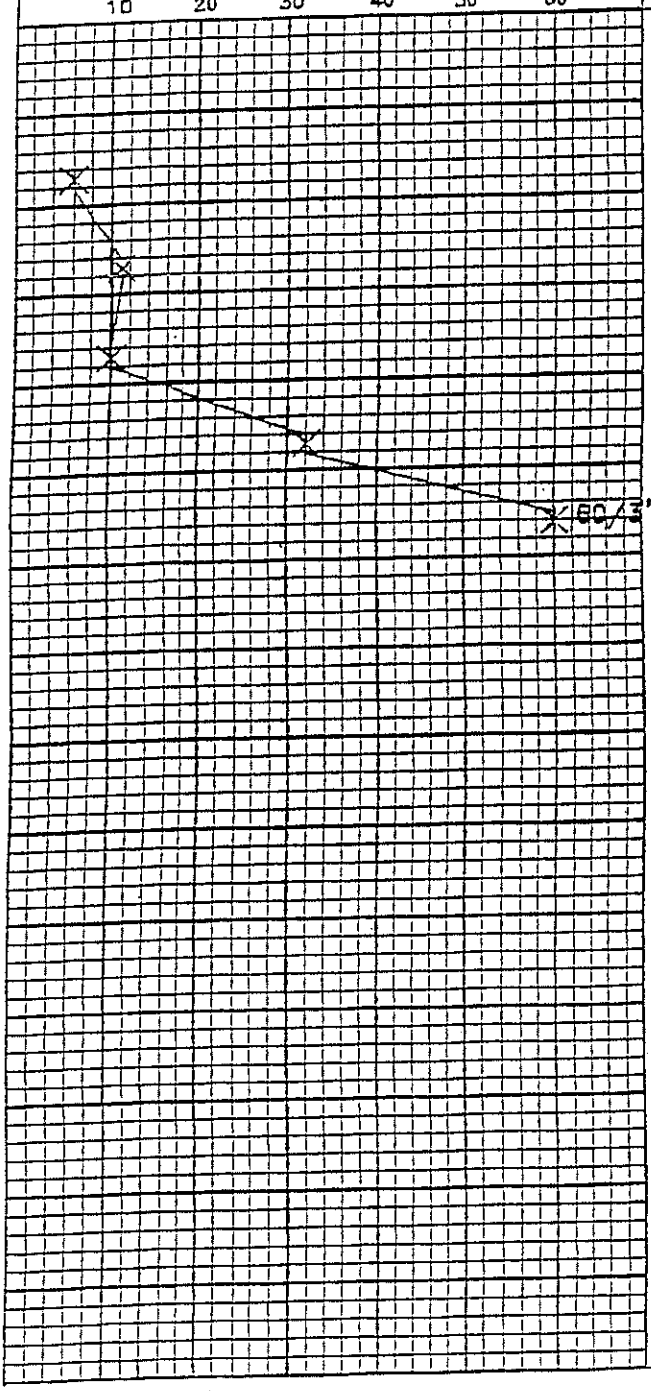
LOG of BORING 8298

Holcomb Foundation Engineering Co.

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				6" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
	1	ss		
5				
	2	ss		
	3	ss		Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
10				
	4	ss		Brown Mottled Gray SHALE
	5	ss		Gray SHALE
15				End of Boring @ −14.5'
20				
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

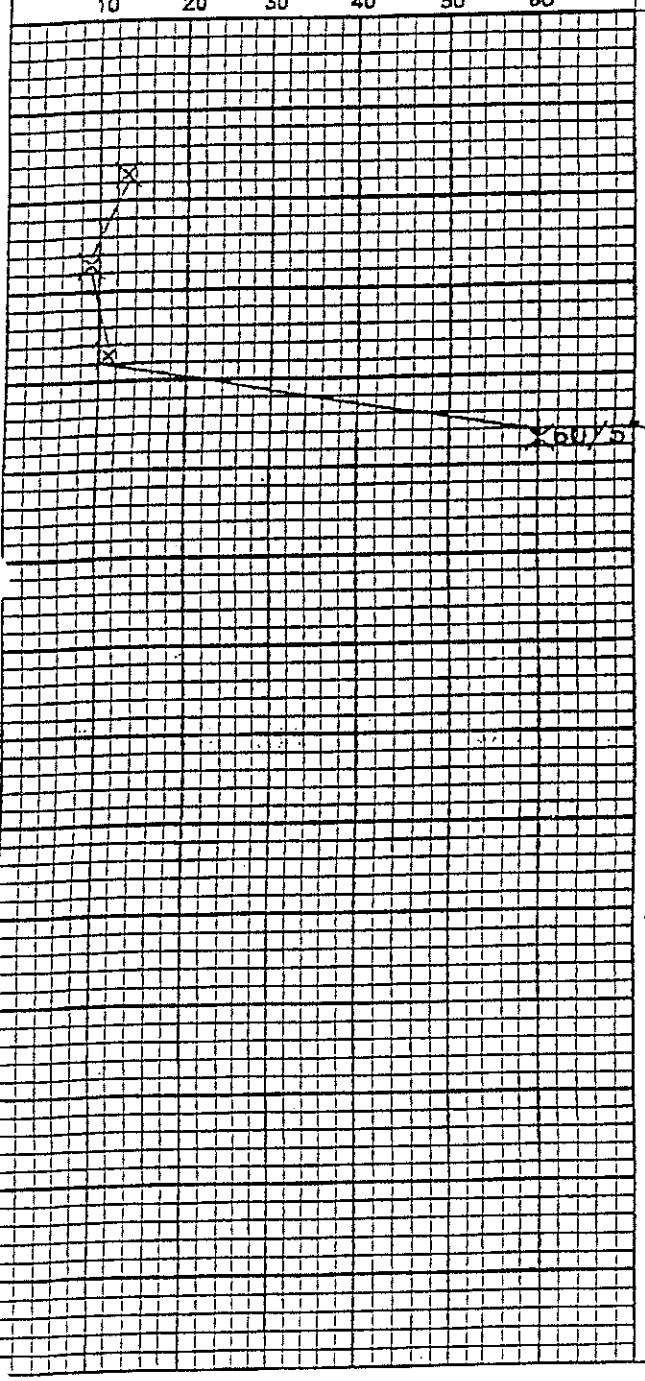
Date of Boring: December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.: H-05278

LOG of BORING B299

Holcomb Foundation Engineering Co.



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	SS		
	2	SS		
10	3	SS		
	4	SS		Brown SHALE
				End of Boring @ -12.5'
15				
20				
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

APPENDIX C

SEISMIC HAZARD ASSESSMENT

APPENDIX C-1

PROBABILISTIC SEISMIC HAZARD ASSESSMENT

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation PROJECT NO. 072046

Probabilistic Seismic Hazard Assessment – Source, Maximum Magnitude and Peak Ground Acceleration PAGE 1 OF 11

MADE BY BEG DATE 1/3/08 CHECKED BY TJS DATE 1/23/08

CALCULATION BRIEF FOR PROBABILISTIC SEISMIC HAZARD ASSESSMENT – SOURCE, MAXIMUM MAGNITUDE, DISTANCE AND PEAK GROUND ACCELERATION

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE: Utilizing the 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps (Frankel, 2002), particularly the 2% Probability of Exceedance in 50 years recurrence interval, define the local and regional seismic events, maximum earthquake magnitudes, focal depths, epicentral distances and peak ground accelerations potentially impacting the Williamson Energy, Pond Creek coal refuse disposal site, Williamson County, Illinois.

METHODOLOGY: A probabilistic seismic hazard assessment (PSHA) is performed for the Pond Creek site located near Johnston City, Williamson County, Illinois. PSHA involves utilizing the 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps (Frankel, 2002), particularly the 2% Probability of Exceedance in 50 years maps for the site coordinates and the development of a particular seismic scenario upon which a ground motion hazard evaluation is based. The scenario consists of the postulated occurrence of an earthquake (i.e., 2% Probability of Exceedance in 50 years) of a specified size based on the latest USGS hazard mapping for the Pond Creek site. In general, PSHA involves four basic elements:

1. Evaluate earthquake sources;
2. Determine controlling earthquake(s): the maximum magnitude, maximum credible, or maximum considered earthquake;
3. Determination of ground motion attenuation relationships or distance from the site; and
4. Determination the peak ground acceleration (PGA).

PSHA determines the earthquakes that have the most significant impacts, and for engineering design and analyses of tailing dams, a design earthquake is desired.

Stochastic modeling, based on the published predictive relations of Atkinson and Boore (1995) is subsequently used to create synthetic acceleration-time histories

for the critical earthquake scenarios. The required input parameters for the critical earthquake source spectra, including moment magnitude, epicentral distance, and focal depth are developed from the published information discussed above, and summarized below.

Subsequently discussed in a separate calculation brief, a comparison of input parameters and site response will be made using both eastern US synthetic earthquake time histories and actual western US earthquake time histories. Available records are scaled in SHAKE (Schnabel, 1971) to the Pond Creek site PGA and the site response compared to published eastern US ground motion attenuation (GMA) response spectra to assess the reasonableness of the various time histories.

REFERENCES:

1. Nuttli, O. W. and Herrmann, R, B (1978) "State-of-the-Art for Assessing Earthquake Hazards in the United States, Report 12, Credible Earthquakes for the Central United States," U.S. Army Corp of Engineers Miscellaneous Paper S-73-1, December, 1978.

2. Boore, D. M. (1983). "Stochastic Simulation of High-Frequency Ground Motions based on Seismological Models of the Radiated Spectra Bulletin of the Seismological Society of America (BSSA), Vol. 73, No. 6, p.p. 1865-1894, December, 1983.

3. Atkinson, G. M. and Boore, D. M. (1995) "Ground-Motion Relationships for Eastern North America," Bulletin of the Seismological Society of America (BSSA), Vol. 85, No. 1 p.p. 17-30, February, 1995.

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5. Toro, G.R., Abrahamson, N.A., and Schneider, J.F.(1997). "Model of Strong Ground Motions from Earthquakes in Central and Eastern North America: Best Estimates and Uncertainties," Seismological Research Letters, Vol. 68, No. 1, January/February 1997.

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7. Campbell, Kenneth W. (2003) "Erratum: Prediction of Strong Ground Motion Using the Hybrid Empirical Method and Its Use in the Development of Ground Motion (Attenuation) Relations in

Eastern North America," Bulletin of the Seismological Society of America (BSSA), Vol. 93, No. 3, pp. 1012-1033, June, 2003.

8. Atkinson, G. M. (2001) "An Alternative to Stochastic Ground-Motion Relations in Seismic Hazard Analysis in Eastern North America," Seismological Research Letters, Vol. 72, No. 2, March/April 2001, p.p. 299-306.

9. Tavakoli, B., and Pezeshk, S. (2005) "Empirical-Stochastic Ground-Motion Prediction for Eastern North America," Bulletin of the Seismological Society of America (BSSA), Vol. 95, No. 6, pp. 2283-2296, December, 2005.

10. Frankel, A.D., et.al, (2002) "Documentation for the 2002 Update of the National Seismic Hazard Maps," U.S. Geological Survey Open File Report 02-420.

11. Wang (2004) "Ground Motion Parameters and Time Histories," Kentucky Geological Survey, University of Kentucky.

12. Schnabel, P. B., Lysmer, J. and Seed, H. B. (1972) "SHAKE88: A Computer Program Earthquake Response Analysis of Horizontally Layered Sites," Report No. EERC 72-12, University of California, Berkeley.

SEISMIC HAZARD ASSESSMENT

General

Nuttli and Herrmann (1978) outline the input necessary for performing either a deterministic or probabilistic method of assessing seismic hazard, which requires that the seismic source zones be identified, that the maximum-magnitude earthquake for each source zone be estimated, that the magnitude-frequency recurrence rate for each source zone be determined, and that the attenuation of seismic wave energy with distance be known.

Based on the current ability to generate synthetic earthquake acceleration-time histories for eastern North American (ENA) earthquakes using the stochastic modeling techniques developed by Boore (1983) and Atkinson and Boore (1995), a PSHA approach was chosen to generate a design earthquake(s). Using this approach, the Maximum Design Earthquake (MDE) for the 2% Probability of Exceedance in 50 years was chosen, which for the Pond Creek site has a PGA of 0.54g. As discussed in Atkinson and Boore (1995 and 1998), the utilized ground motion relationships compared well to the limited database of recorded Eastern North America (ENA) earthquakes and large earthquakes from analogous intra-plate, hard rock sites. In a separate calculation brief, a comparison is made of the PGA from the various

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation PROJECT NO. 072046

Probabilistic Seismic Hazard Assessment – Source, Maximum Magnitude and Peak Ground Acceleration PAGE 4 OF 11

MADE BY BEG DATE 1/3/08 CHECKED BY TJL DATE 1/23/08

ground motion attenuation relationships and the synthetic time-histories, as well as a comparison of the site response and response spectra of both the synthetic earthquake acceleration time histories and a scaled western U.S. acceleration-time history record to evaluate the consistency and results of the eastern and western time histories relative to the embankment response, i.e., frequency content, spectral acceleration, etc.

The PSHA methodology chosen for this evaluation represents a more refined approach to previous methods which used empirical, pseudostatic embankment analyses. Similarly, the PSHA developed specifically for the Pond Creek site also attempts to eliminate the potential for over-conservative, unrealistic strong ground motion associated with the "floating earthquake" concept. This approach is generally applied in regions where active earthquake-generating surface faults exist and the intensity-based peak acceleration relationships are from only long-period western U.S. and Japanese seismic activity and more importantly, the peak acceleration does not account for distance.

Selection of Maximum Credible Earthquake Scenarios and Peak Ground Acceleration

Based on the most critical regional and local seismic sources to the Pond Creek site as identified in the USGS Interactive Deaggregation Maps, two MDE scenarios have been selected for analysis including a magnitude (M) 8.0, which has boundary limits of about 83 km from the site and the potential to generate a high intensity earthquake. The Pond Creek site also has the potential to be impacted by a smaller magnitude earthquake or a comparable local "background" earthquake at a closer epicentral distance to the site, which based on the USGS seismic hazard program is an M6.8 at 13.5 km. The PGA associated with this hazard was defined at 0.54g. The 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps (Frankel, 2002), particularly the 2% Probability of Exceedance in 50 years maps are attached.

The rate at which the strength of earthquake ground motion attenuates and the amount of geometric spreading with distance from the epicenter are required for seismic hazard analyses. The focal depth of the earthquake and the near surface geological conditions have a significant influence on the intensity attenuation relationship. Information on earthquakes occurring in the eastern United States suggests that surface faulting does not occur and the center of energy release is deeper than the average of California earthquakes. The earthquake energy is therefore radiated over a larger area than is experienced in California, and California data cannot be extrapolated directly to this region. Several ENA and CEUS ground motion attenuation relationships including Toro, et.al. (1997), Atkinson & Boore (1997), Campbell (2003), Atkinson (2001) and Tavakoli & Pezeshk (2005) are used to compare the USGS PGA for the Pond Creek site to that of other ENA and CEUS ground motion relationships.

Therefore, these two MDE scenarios will be evaluated for their impact on the Pond Creek impoundment since the maximum ground accelerations, frequency contents, and durations of effective cycles will be notably different.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation PROJECT NO. 072046

Probabilistic Seismic Hazard Assessment – Source, Maximum Magnitude and Peak Ground Acceleration PAGE 5 OF 11

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

As previously discussed, utilizing the Atkinson and Boore (1995) empirically-derived earthquake source spectra model for eastern North American hard rock sites, quality synthetic acceleration-time histories have been created for the bedrock motions. Subsequently, the various input parameters from these synthetic earthquake records are compared to the Pond Creek site input and the time histories scaled accordingly to the PGA anticipated at the Pond Creek site. Also, selection of an earthquake time history record from the PEER Strong Motion Database for western U.S. and Japanese earthquake records, scaled to the PGA is performed. Finally (in another calculation brief), the corresponding response spectra curves of the site response due to the ENA/CEUS synthetic and PEER earthquake time histories are compared to the ENA and CEUS ground motion attenuation response spectra to assess the reasonableness of the time history.

CONCLUSION

A Probabilistic Seismic Hazard Assessment (PSHA) which utilized the 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps indicated local and regional seismic scenarios of potential impact to the Pond Creek coal refuse disposal site located in Williamson County, Illinois. Two MDE scenarios were chosen for analysis including M8.0 earthquake located at a epicentral distance of 83 km from the site was chosen for potential for a large intensity earthquake with a corresponding PGA of 0.54g. Additionally, an M6.8 earthquake at an epicentral distance of 13.5 km from the site was identified and will be used to model an earthquake that could "occur anywhere" with a PGA of 0.54g. These scenarios will be used to scale existing eastern U.S. synthetic acceleration-time histories, based on the source spectra models defined by Atkinson and Boore (1995) and a western U.S., PEER earthquake record. A comparison of the various input time histories, site response (spectra) and published eastern U.S. ground motion attenuation relationships spectra performed in a separate calculation brief.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Probabilistic Seismic Hazard Assessment – Source, Maximum Magnitude and Peak Ground Acceleration

PAGE 6 OF 11

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

FIGURES
2002 USGS EARTHQUAKE HAZARDS PROGRAM – PEAK GROUND ACCELERATION AND INTERACTIVE DEAGGRAGATION MAPS FOR 2% PROBABILITY OF EXCEEDANCE IN 50 YEARS RECURRENCE INTERVAL

POND CREEK SITE
WILLIAMSON COUNTY, ILLINOIS

7 of 11

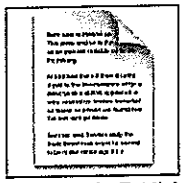
R13932

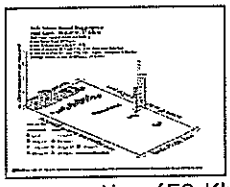
USGS
science for a changing world

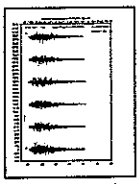
Earthquake Hazards Program

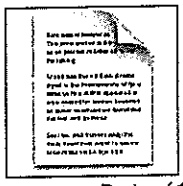
Interactive Deaggragations

Generated Output:
Click a link below to view the output file.


Report (15 Kb)


Deagregation (59 Kb)


Seismograms (62 Kb)


Seismogram Data (1 Mb)

On this page you may select a return time, SA frequency, specify a latitude and longitude and request seismograms. Links to the following information will be returned:

- A plot of deaggregated distance, magnitude and ground-motion uncertainty for the specified parameters.
- An ascii text file of the hazard matrices, containing, but not limited to, the frequency selected.
- Geographic deaggregation plot may also be specified (for designated frequencies only - see below). This is in addition to the plot mentioned above.
- An ascii text file and graph of the seismograms for the modal or mean event (if requested).

Please read the README file before trying to use this site. The README explains about the input parameters and also describes how the deaggregation is done. Stochastic Seismograms and What is Epsilon? are articles which discuss the theory behind the seismograms.

Choose parameters and click "Generate Output"

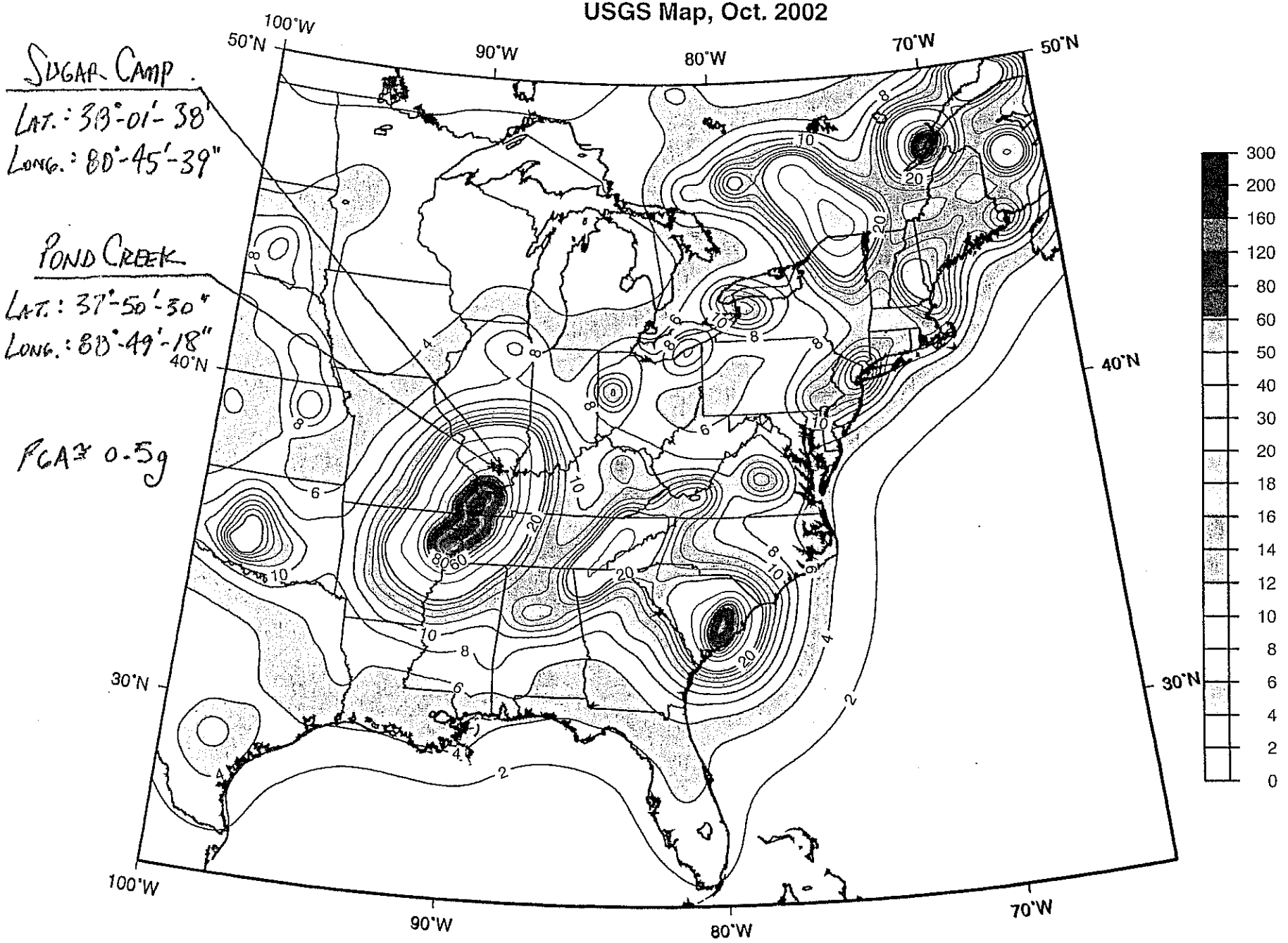
Site Name: (Help)	Pond_Creek
Latitude: (Help)	37.84
Longitude: (Help)	-88.82
Return Period: (Help)	2475 years (2% in 50 years)
Frequency: (Help)	PGA
Geographic Deaggs: (Help)	None
Stochastic Seismograms: (Help)	Modal, One-Corner Source

Start Over | Generate Output

U.S. Department of the Interior | U.S. Geological Survey
URL: http://earthquake.usgs.gov/research/hazmaps/interactive/wrapper.php
Page Contact Information: Web Team
Page Last Modified: June 28, 2007 1:14:52 PM.

Department of the Interior | U.S. Geological Survey
URL: http://earthquake.usgs.gov/research/hazmaps/interactive/wrapper.php
Page Contact Information: Web Team
Page Last Modified: June 28, 2007 1:14:52 PM.

Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002



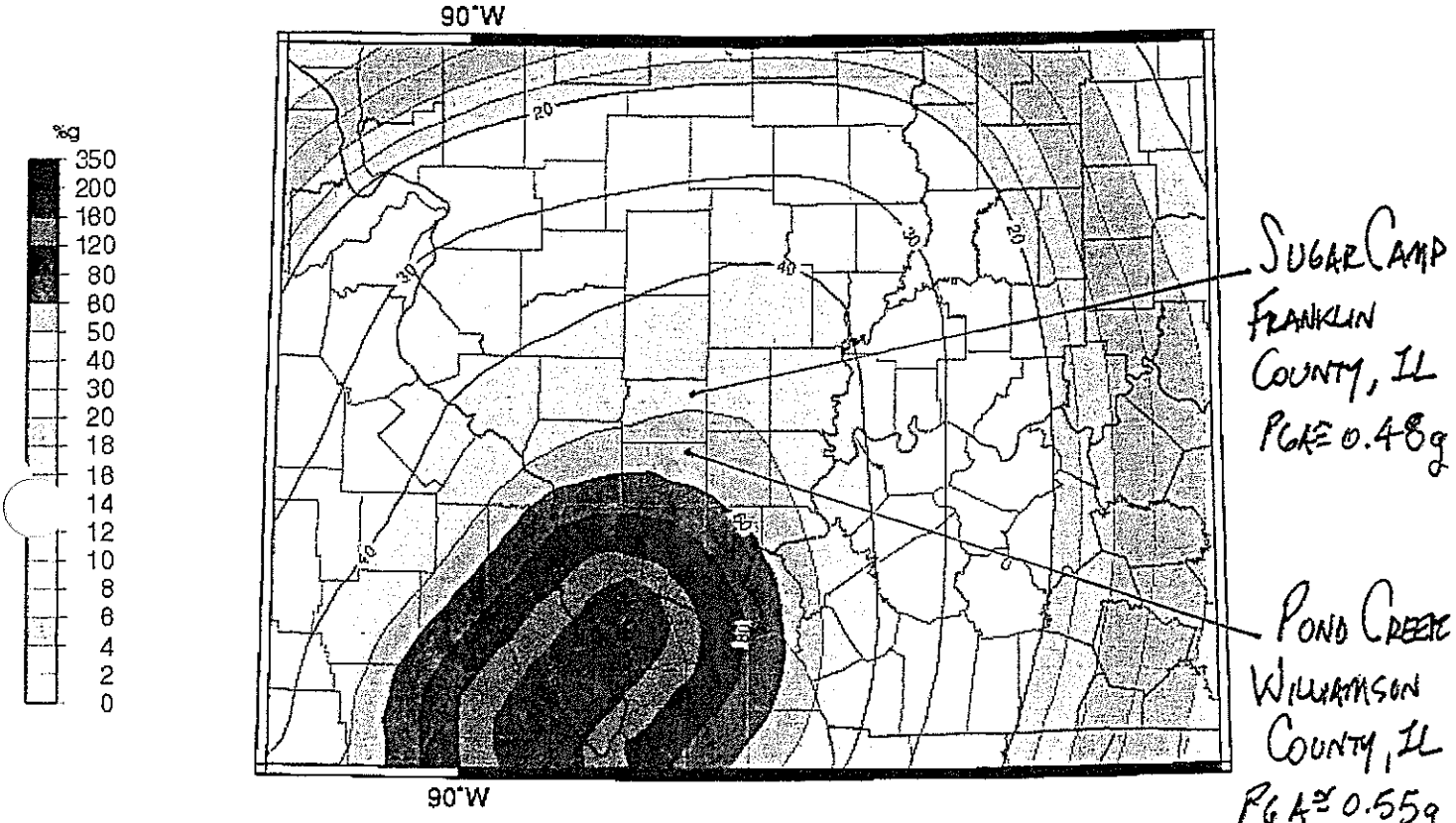
R13933

USGS
science for a changing world

Earthquake Hazards Program

NSHMP Hazard Mapping

Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years



Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
site: NEHRP B-C boundary
U.S. Geological Survey
National Seismic Hazard Mapping Project

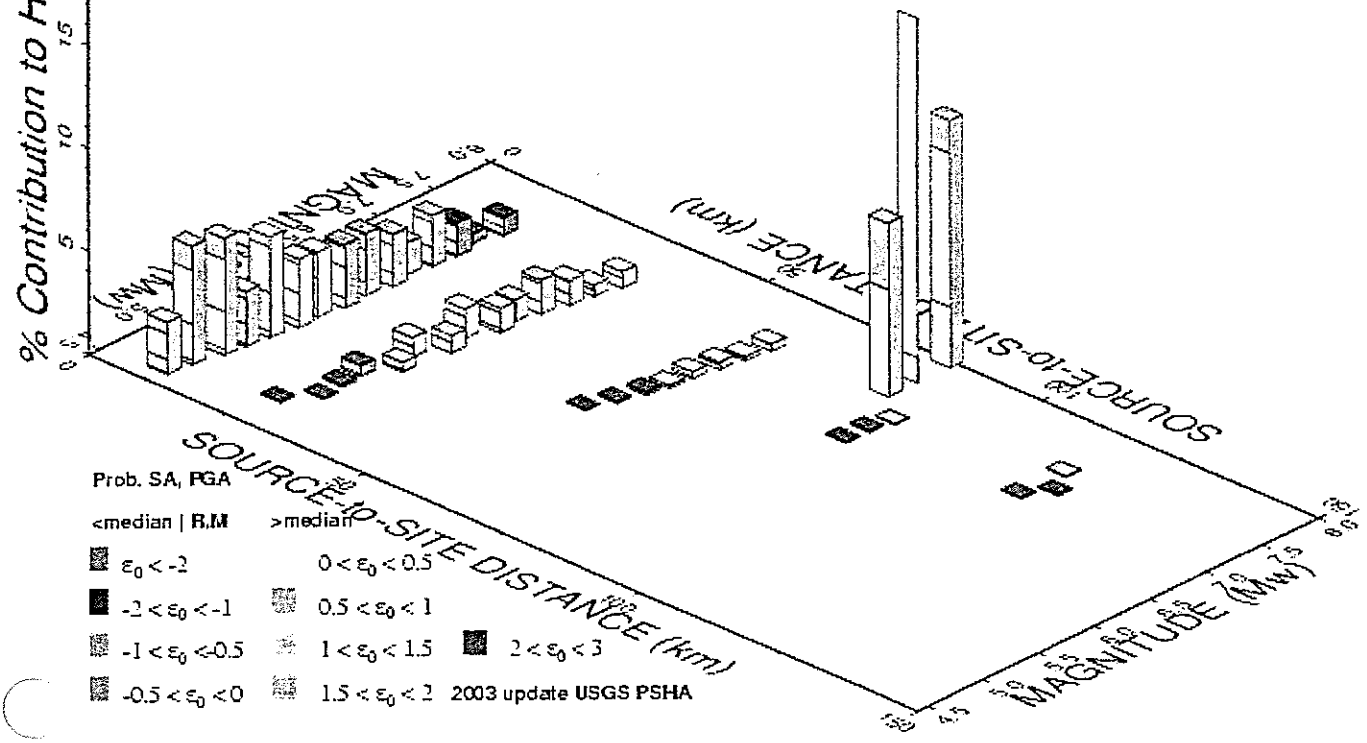
Albers Conic Equal-Area Projection
Standard Parallels 29.5 and 45.5 degrees

PDF Version
Postscript Version

The above files will be deleted every hour on the hour.

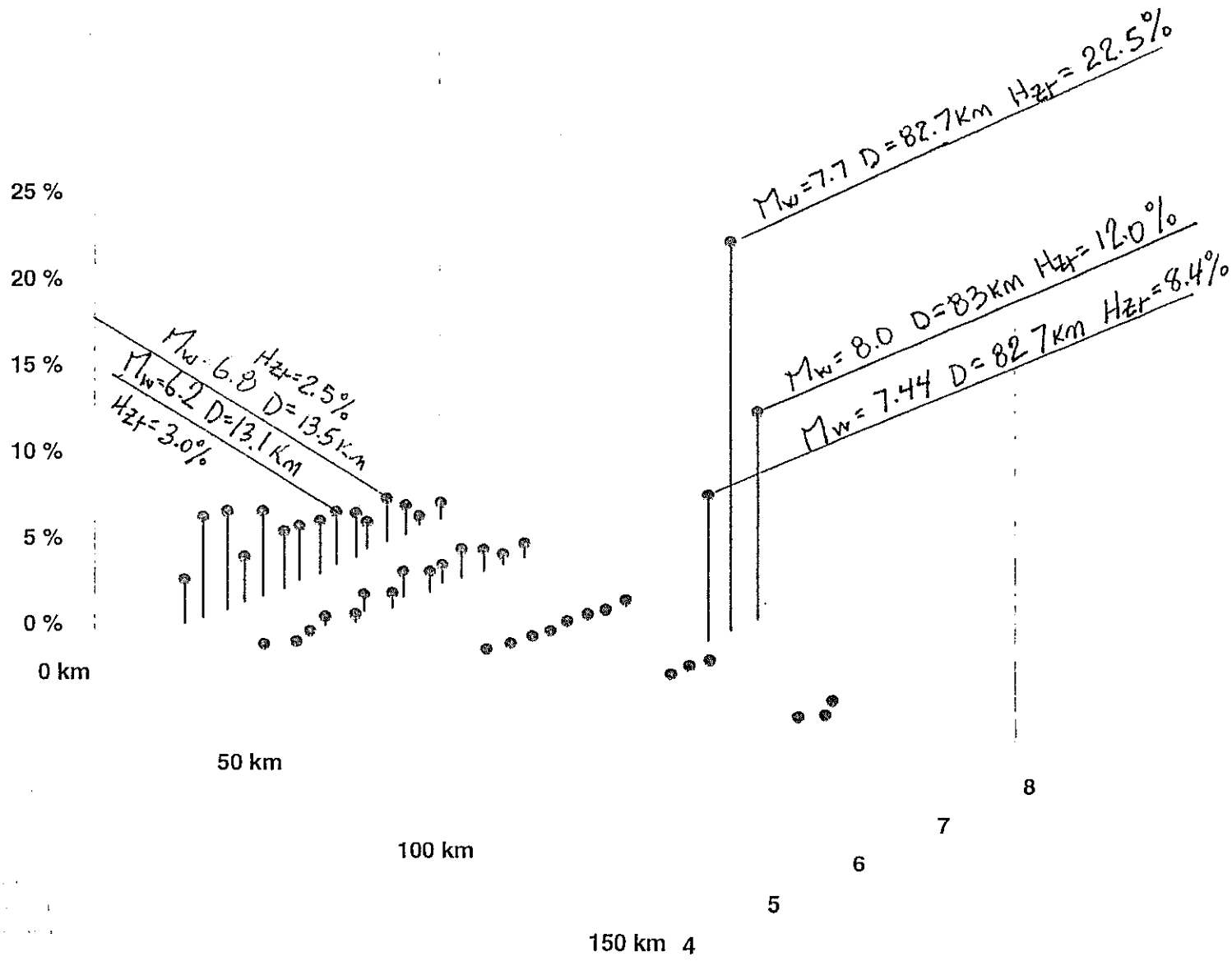
Prob. Seismic Hazard Deaggregation
Pond_Creek 88.820° W, 37.840 N.

Peak Horiz. Ground Accel.>=0.5401 g
Mean Return Time 2475 years
Mean (R,M,ε_0) 46.4 km, 6.67, 0.70
Modal (R,M,ε_0) = 82.7 km, 7.70, 1.19 (from peak R,M bin)
Modal (R,M,ε^*) = 82.7 km, 7.70, 1 to 2 sigma (from peak R,M,ε bin)
Binning: DeltaR 25. km, deltaM=0.2, Deltaε=1.0



GMT 2007 Dec 5 09:50:52 Distance (R), magnitude (M), epsilon (ε0,E) deaggregation for a site on ROCK avg Vs=760 m/s top 30 m USGS CGHT PSHA2002v3 UPDATE Bins with ll 0.05% contrib. omitted

Probabilistic Seismic Hazard Deaggregation - Pond Creek (88.820° W , 37.840° N)



USE, M8.0 @ 83KM
AND M6.2 @ 13KM
OR
M6.8 @ 13.5KM

Deaggregation of the PGA >= .5401 g for a 2475 year return period

R13936

APPENDIX C-2

SIMULATION OF ACCELERATION-TIME HISTORIES USING STOCHASTIC MODELING AND COMPARATIVE ASSESSMENT OF SYNTHETIC EASTERN U.S. AND PEER DATABASE (ACTUAL) WESTERN U.S. EARTHQUAKE RECORDS, ACCELERATION TIME-HISTORIES AND RESPONSE SPECTRA

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PROJECT Williamson Energy Pond Creek Deformation Evaluation Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PROJECT NO. 072046

PAGE 1 OF 131

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

CALCULATION BRIEF FOR SIMULATION OF ACCELERATION-TIME HISTORIES USING STOCHASTIC MODELING AND COMPARATIVE ASSESSMENT OF SYNTHETIC EASTERN U.S. AND PEER DATABASE (ACTUAL) WESTERN U.S. EARTHQUAKE RECORDS, ACCELERATION TIME HISTORIES AND RESPONSE SPECTRA

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE: Create synthetic acceleration-time histories for two maximum design earthquake (MDE) sources, and evaluate synthetic eastern U.S. and an actual western U.S. earthquake acceleration time histories, the site response spectra of each, and determine the appropriate time history to be used to evaluate the Pond Creek coal refuse disposal facility.

METHODOLOGY: Utilize the seismological computer program SMSIM written by David Boore of the U.S. Geological Survey (Reference 3). This program is based on the stochastic modeling method described in Reference 4, in which the radiation from a fault is assumed to be distributed randomly over a time interval and whose duration is related to the source size and the distance from the source to the site.

A comparison of site response (spectra) is also made between synthetic acceleration time histories using SMSIM (Boore, 1996), based on the eastern U.S. Atkinson & Boore (1995) ground motion attenuation relationship, and an actual time history record from the western U.S., Pacific Earthquake Engineering Research (PEER) strong motion database. Response spectra from each earthquake time history are generated at the base and top of the Pond Creek embankment crest using the 1-dimensional wave propagation program SHAKE 2000 (Schnabel, et.al., 1972), and the compatibility of each spectra is assessed relative to response spectra for five (5) eastern U.S. ground motion attenuation relationships.

Reference 1 presents the PSHA for the proposed Pond Creek coal refuse disposal facility located near Johnston City, Williamson County, Illinois, which indicated two MDE scenarios including a magnitude (M) 8.0 source (83 km from the site) and an "occur anywhere" M6.8 Background source (13.5 km from the site). The

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Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PROJECT NO. 072046

MADE BY BEG DATE 1/3/08 CHECKED BY TJS DATE 1/23/08

Pond Creek PSHA also generated average peak ground accelerations (PGA) of 0.54g

Recent advances in ground-motion prediction for eastern North America (ENA) include the ability to generate synthetic earthquake acceleration-time history records, based on the stochastic simulation of high-frequency ground motions such as the method developed by Boore, 1983. Several recent studies, including Atkinson and Boore (1995) and Hwang and Huo (1997), have discussed the findings of numerous earthquake simulations and expanded the knowledge of ENA earthquake ground behavior which generally has a higher frequency content than western United States earthquakes.

Synthetic time histories are used to represent the Pond Creek PSHA MDE scenarios including the M6.8 (13.5 km), which will be scaled to Pond Creek PGA value of 0.54g. Alternatively, a search of the PEER strong motion database of western U.S. earthquakes was performed for a range of magnitudes between M5.5 and M7.2, a radial distance between 10 km and 50 km and PGA between 0.4g and 0.65g to represent the Pond Creek M6.8 source. Three (3) earthquake records were reviewed and the 1989 Loma Prieta earthquake, LOMAP/G01000 record (M6.9 @11km) was chosen, with PGA of 0.41g, as a comparative time history. The LOMAP/G01000 record will be scaled to 0.54g (from 0.41g) and response spectra compared to the corresponding synthetic time history and eastern U.S. ground motion attenuation response spectra.

SHAKE analyses were performed for the PCSC300M crest column and response spectra at the base and top of the Pond Creek – South cell embankment are compared to the response spectra for five (5) eastern U.S. ground motion attenuation relationships, which represent regional ground motion response. Site response spectra should fall within the envelope of response spectra of the ground motion relationships indicating similar frequency content and eliminating overly conservative resonance effects.

REFERENCES:

1. Civil & Environmental Consultants, Inc., "Calculation Brief for Probabilistic Seismic Hazard Assessment – Pond Creek Coal Refuse Disposal Site," BEG, 1/03/08.

2. Civil & Environmental Consultants, Inc., "Calculation Brief for Shear Modulus Correlations for SHAKE Columns PCSC300E and PCSC300M – Pond Creek – Coal Refuse Disposal Site – South Cell," BEG, 1/02/08.

3. Boore, D. M., "SMSIM – Fortran Programs for Simulating Ground Motions from Earthquakes: Version 1.0,"U.S.G.S. Open-File report 96-80-A, 1996

4. Boore, D. M. (1983). "Stochastic Simulation of High-Frequency Ground Motions based on Seismological Models of the Radiated Spectra," Bull. Seis. Soc. Am. 73, No. 6, p.p. 1865-1894, December

5. Atkinson, G. M. and Boore, D. M. (1995) "Ground-Motion Relationships for Eastern North America," Bull. Seis. Soc. Am. 85, No. 1 p.p. 17-30, February

6. Atkinson, G. M. and Boore, D. M. (1998) "Evaluation of Models for Earthquake Source Spectra in Eastern North America," Bull. Seis. Soc. Am. 88, No. 4 p.p. 917-934, August.

7. Schnabel, P. B., Lysmer, J. and Seed, H. B. (1972) "SHAKE88: A Computer Program Earthquake Response Analysis of Horizontally Layered Sites," Report No. EERC 72-12, University of California, Berkeley.

8. Hwang, Howard and Huo, Jun-Rong. (1997) "Attenuation Relations of Ground Motion for Rock and Soil Sites in Eastern United States," Soil Dynamics and Earthquake Engineering," 16, p.p. 363-372.

9. Hanks, T.C. and Kanamori, H. (1979) "A Moment Magnitude Scale," Journal of Geophysical Research, 84, p.p. 2348-2350.

STOCHASTIC MODELING

From Reference 4, recent studies have shown that the high frequency ground motions observed from a database of low to moderate magnitude earthquakes in the eastern United States and Canada can reasonably be predicted using stochastic modeling. In the stochastic ground motion model, synthetic time histories are characterized as finite-duration bandlimited Gaussian noise, while known regional source and propagation parameters are utilized to identify the underlying amplitude spectrum.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PROJECT NO. 072046

PAGE 4 OF 131

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

The stochastic method is initiated by defining the Fourier amplitude spectrum of ground acceleration with respect to seismic moment and distance. The amplitude spectrum also includes a diminuation function which models the geometric and anelastic attenuation as a function of hypocentral distance (R) and frequency (f), as well as filters to reduce high-frequency amplitudes and shape the response spectrum as required. The time series is a windowed Gaussian noise sequence with a zero mean amplitude. The duration of this window is limited as a function of earthquake magnitude and distance from the source. Once the windowed time series has been defined, it's spectrum is multiplied by the amplitude spectrum, then transformed back into the time domain, thus resulting in the simulated earthquake record.

SOURCE SPECTRUM INPUT

From Reference 4, the source spectrum model used to characterize the amplitude of ground motions for two critical earthquake scenarios is the Atkinson source model (Reference 5). As discussed in Atkinson and Boore (1998) which compares the results of several source models with the ground motion database of ENA earthquakes and other earthquakes with similar geologic settings, the Atkinson source model provides the most accurate ground motion estimates over the frequency of interest (0.1 to 10 Hertz) for most engineered facilities. They conclude that most other ENA models tend to overpredict long-period motion. The use of the Atkinson model was also recommended by Seismologist Dr. Martin Chapman of the Virginia Polytechnical Institute Seismological Observatory, in Blacksburg, VA, who consulted with CEC on this and similar projects in West Virginia and Kentucky. The source spectrum data used in Reference 3 as input for two MDE scenarios, including a M6.8 Background source at 13.5 km and M8.0 New Madrid @ 83km were taken directly from the input parameter file for Atkinson and Boore (1995), AB95.dat, which is presented as Appendix F of the SMSIM open report (Reference 3). These parameters, as well as the input magnitudes and attenuation distances are summarized below.

MDE No. 1) M6.8 Background Earthquake Source

Moment Magnitude, M = 6.8 based on Frankel (2002)

Shear Wave Velocity, V_S = 3.8 km/sec

Density of Rock Mass, ρ (Between Source and Site) = 2.8 g/cm^2

Cutoff Frequency = 50 Hertz

Maximum Frequency, $f$max = 40 Hertz

Hypocenter Distance, R = 16.8 km Assuming Epicenter Distance = 13.5 km

Focal Depth = 10 km

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PROJECT Williamson Energy Pond Creek Deformation Evaluation Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PROJECT NO. 072046

PAGE 5 OF 131

MADE BY BEG DATE 1/3/08 CHECKED BY [signature] DATE 1/23/08

Quality Factor, $Q = C * f^n$ where C = 680, n = 0.36, f = frequency

Seed (Random Number) = 3

Time Step = 0.01 seconds

MDE No. 2) M8.0 New Madrid Earthquake Source

Moment Magnitude, M = 6.8 based on Frankel (2002)

Shear Wave Velocity, V_S = 3.8 km/sec

Density of Rock Mass, ρ (Between Source and Site) = 2.8 g/cm^2

Cutoff Frequency = 50 Hertz

Maximum Frequency, $f$max = 40 Hertz

Hypocenter Distance, R = 83.6 km Assuming Epicenter Distance = 83 km

Focal Depth = 10 km

Quality Factor, $Q = C * f^n$ where C = 680, n = 0.36, f = frequency

Seed (Random Number) = 3

Time Step = 0.01 seconds

DISCUSSION OF SMSIM OUTPUT

The output summaries from SMSIM, which include the simulation results such as peak ground acceleration and frequencies for the M6.8 and M8.0 earthquakes are attached. Acceleration – time histories were created for theses earthquakes using SMSIM and are illustrated graphically.

The peak amplitude accelerations for the M6.8 Background and M8.0 New Madrid earthquake are 739 cm/sec^2 (0.754g) and 181 cm/sec^2 (0.184g), respectively. Higher acceleration values were expected for the background MDE since there is less attenuation from the hypocenter to the site (13.5 km compared to 83 km). However, it is important to note that the duration of the acceleration record for the New Madrid earthquake is about 80 seconds, compared to about 15 seconds for the lower moment magnitude Background earthquake. Additionally, the frequency contents of the two simulations are quite different.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation
Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PROJECT NO. 072046

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

SHAKE MODEL INPUT

To compare the Pond Creek site response from both the eastern U.S. synthetic time histories and the PEER database western U.S. time history, the 1-dimensional wave propagation program, SHAKE, was used to calculate the response spectra for each time history using the Pond Creek embankment (crest) SHAKE column PSCS300M. A layered SHAKE model was generated utilizing field and laboratory test data, and input information including layer thickness, unit weight and (small strain) shear modulus (Gmax), which are presented in Reference 2. Time histories for the M6.8 (at 13.5 km) earthquake scenario, from both the synthetic eastern U.S. record (Reference 4) and the western U.S. Loma Prieta PEER database time histories represent the respective eastern and western U.S. frequency content and PGA. Time histories associated with the M6.8 source were scaled to 0.54 g and input into SHAKE at the base of the PSCS300M SHAKE column.

DISCUSSION OF SHAKE OUTPUT

SHAKE output included generating and plotting response spectra curves for the Pond Creek site response for Layer 1 – at the top of the PCSC300M column, and Layer 17 – at the base of the same column. Additionally, the response spectra curves for five (5) published eastern U.S. ground motion attenuation relationships (Reference 4) were plotted, and are compared to the Pond Creek site response spectra due to the eastern and western U.S. time histories. The response spectra curves for the site response and comparative ground motion spectra are attached to this calculation brief.

POND CREEK SITE RESPONSE SPECTRA COMPARISON OF EASTERN U.S. (SYNTHETIC) AND WESTERN U.S. (PEER DATABASE)

As previously discussed, an existing eastern U.S. synthetic and western U.S. PEER database time history, scaled to 0.54g was used as input to evaluate the site response spectra at the top and bottom of the Pond Creek crest SHAKE column PCSC300M. Each site response spectra was compared to published response spectra from five (5) eastern U.S. ground motion attenuation relationships to assess the frequency content and spectral accelerations for each. As shown in the attached response spectra comparison, the eastern U.S. synthetic time history produced a frequency response (predominant period) within a range of periods between 0.01 and 0.1 seconds, as defined by the eastern U.S. ground motion attenuation relationships. The western U.S., PEER database time history produced predominant periods about 10 times that of the eastern U.S. ground motion attenuation relationships, between 0.1 and 1 second, and consistent with published information in Atkinson & Boore (1995 and 1998). Thus, the response spectra due to the western U.S. time history is not consistent with the anticipated eastern U.S. ground motion response spectra and should not be used to represent eastern U.S. earthquake records or

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PROJECT Williamson Energy Pond Creek Deformation Evaluation
Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PROJECT NO. 072046

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

time histories. The eastern U.S. synthetic earthquake record and site response from the synthetic time histories input into SHAKE fell directly within the predominate period range of the multiple eastern U.S. ground motion attenuation relationships as evidenced by the attached site response spectra curves for the M6.8 earthquake. Therefore, available eastern U.S. synthetic time histories from the M6.8 and M8.0 earthquakes, scaled to the Pond Creek MDE PGA of 0.54g will be used in supplemental SHAKE analyses to estimate cyclic shear stresses and strains for the SHAKE crest column.

CONCLUSION

Based on the information presented in this calculation brief, synthetic earthquake records were created for the M6.8 Background and M8.0 New Madrid earthquake sources. The resulting acceleration-time histories are based on stochastic modeling using the Atkinson 1995 source model, which is considered the most accurate model currently available to characterize ground motions for Eastern North America earthquakes. Further, the eastern U.S. synthetic earthquake record created from the M6.8 earthquake source and resulting acceleration-time history (Reference 4) scaled to the Pond Creek MDE PGA of 0.54g is considered the more accurate model (as compared to a western U.S. earthquake record) to characterize ground motions for Eastern North America earthquakes and the Pond Creek site response. The site response of the synthetic earthquake records also correlated well when compared to the work of five (5) published ground motion attenuation relationships specifically corresponding to the anticipated eastern U.S. response spectra. Therefore, the use of these synthetic records as base motion input for SHAKE trials should provide reliable results for determining induced cyclic shear stresses and strains and permanent deformation analyses for seismic analyses of the Pond Creek impoundment.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation
Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PROJECT NO. 072046

PAGE 8 OF 131

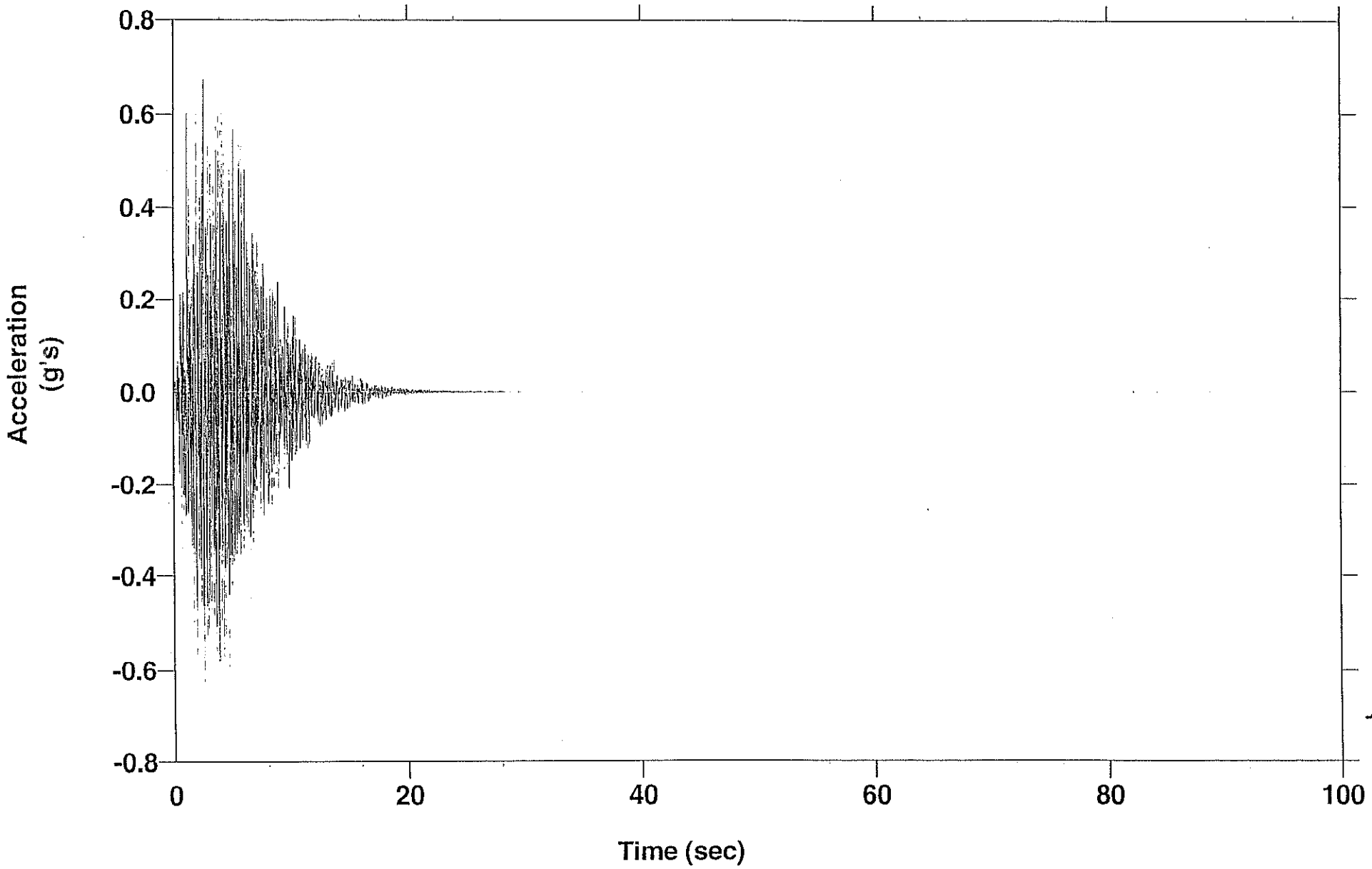
MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

ENA/POND CREEK SYNTHETIC RECORD FOR AN M6.8 BACKGROUND EARTHQUAKE AT 13.5 KM

AND

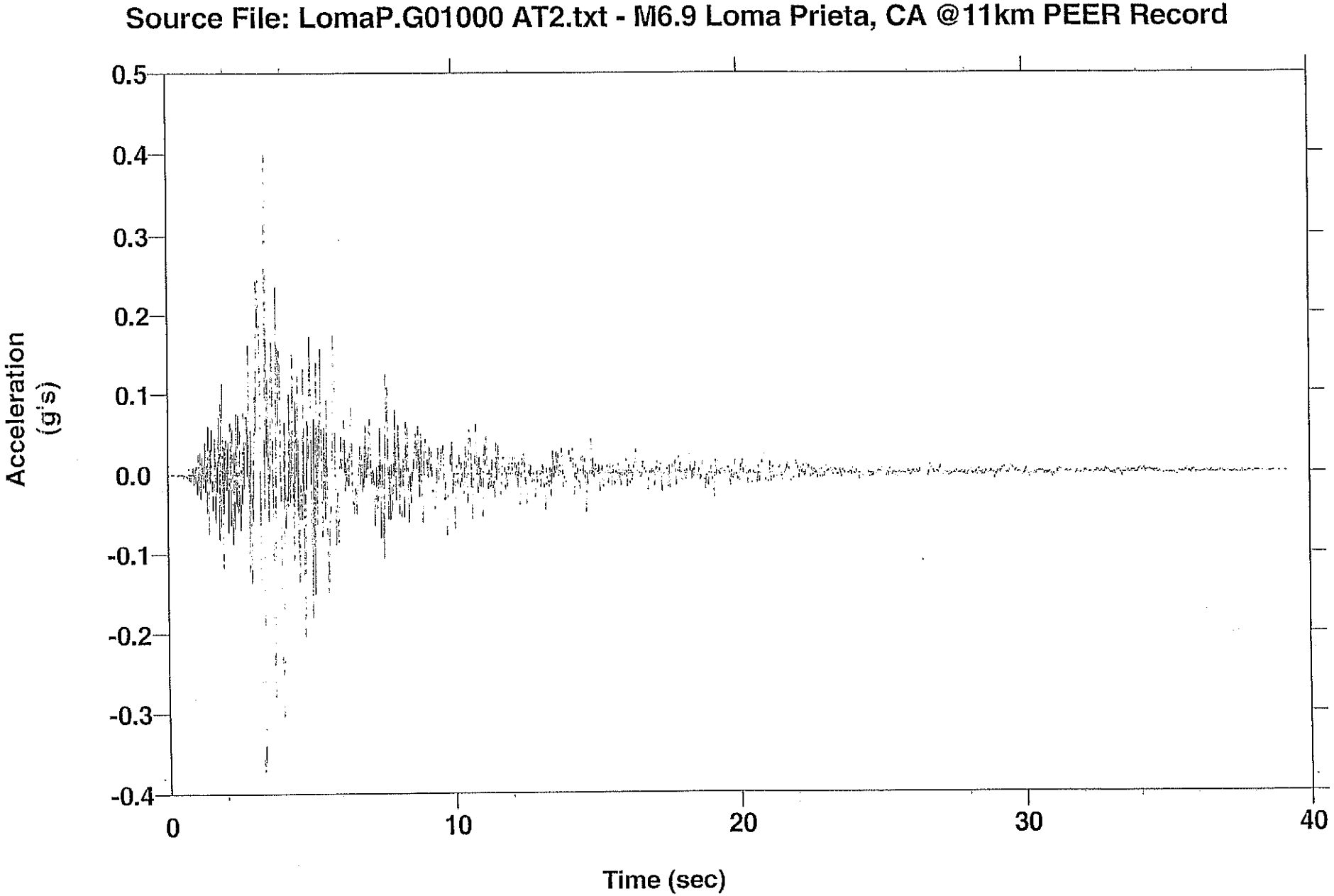
PEER DATABASE EARTHQUAKE RECORD FOR AN M6.9 EARTHQUAKE AT 11 KM LOMA PRIETA, CALIFORNIA, G01000

Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt



131

R13946


Source File: LomaP.G01000 AT2.txt - M6.9 Loma Prieta, CA @11km PEER Record
Acceleration (g's)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
10
20
30
40
Time (sec)

R13947

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PROJECT Williamson Energy Pond Creek Deformation Evaluation Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PROJECT NO. 072046

PAGE 11 OF 131

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

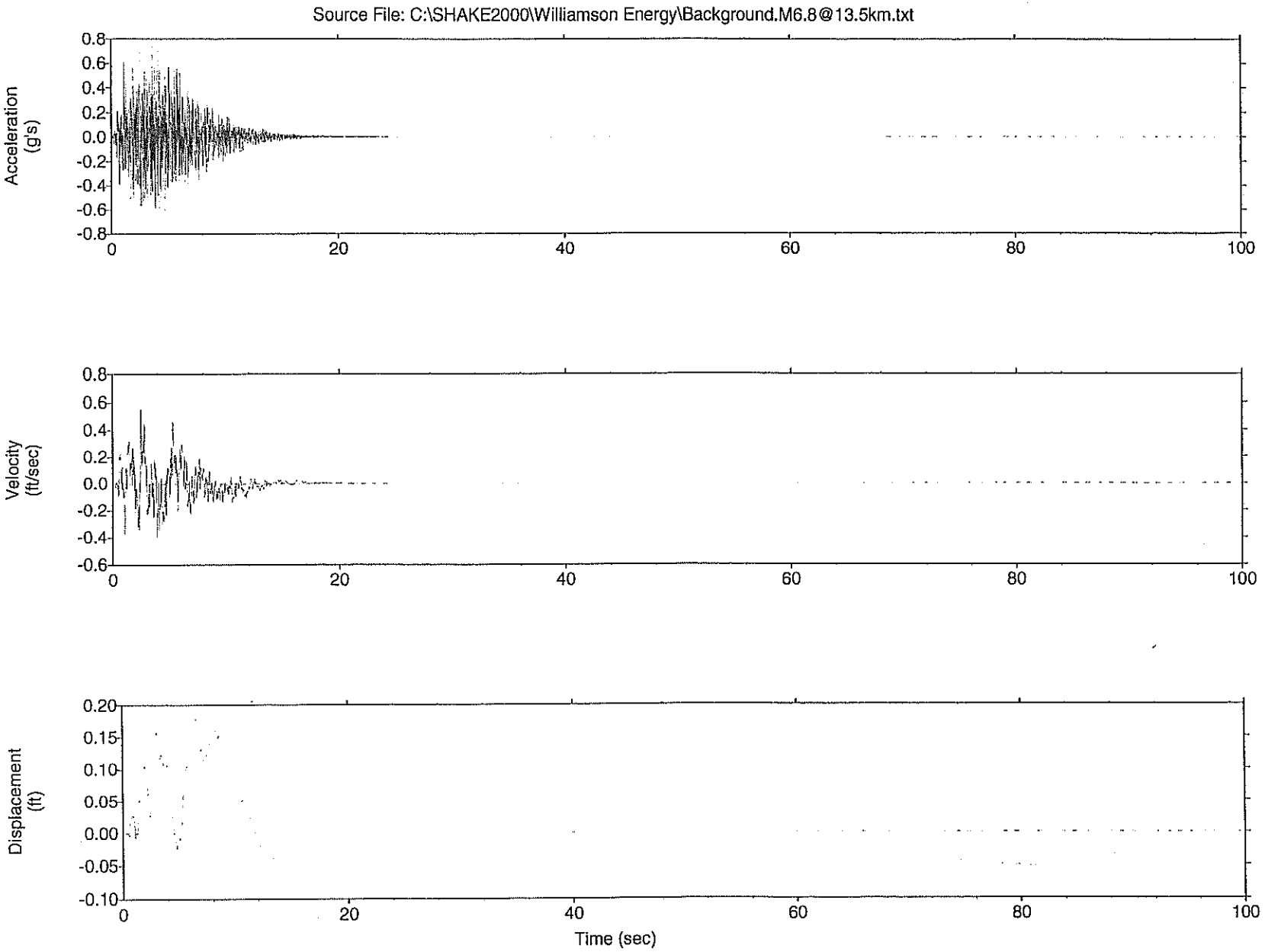
COMPARISON OF POND CREEK CREST SHAKE COLUMN RESPSONSE SPECTRA, PREDOMINANT PERIOD AND SPECTRAL ACCELERATION VALUES (AT 5 % DAMPING) FROM THE M6.8 BACKGROUND EASTERN U.S. SYNTHETIC TIME HISTORY AND THE WESTERN U.S. PEER DATABASE LOMA PRIETA, CA EARTHQUAKE TIME HISTORY

PCSC300M Crest Column
Williamson - Pond Creek South Cell - Surf. El. 502, GWT 14ft., Fines El. 496
M8.0 New Madrid Synthetic @83km, PGA=0.54g - Atkinson & Boore (1995)

Layer	Depth to Middle of Layer (ft)	Total Unit Weight (kcf)	Damping Used (%)	Shear Modulus (ksf)	Maximum Shear Strain (%)	Maximum Shear Stress (psf)	Shear Wave Velocity (fps)	Depth to Top of Layer (ft)	Peak Acceleration (g)	G/Gmax Curve	Damping Curve
1	2	.13	2.6	3011.9	.00656	197.47	863.7271	0	.75475	Coarse	Coarse
2	5.5	.13	4.4	2764.1	.019	525.07	827.4336	4	.70138	Coarse	Coarse
3	8.5	.13	5.3	2634.9	.02891	761.69	807.8641	7	.65623	Coarse	Coarse
4	11.5	.13	5.1	3768.3	.02654	1000	966.1154	10	.63991	Coarse	Coarse
5	14.5	.14	6.5	2764.2	.04445	1228.7	797.3494	13	.65636	Coarse	Coarse
6	17.5	.14	7.8	2154.6	.06592	1420.3	703.9588	16	.64637	Coarse	Coarse
7	20.5	.14	8.2	2228.9	.07416	1653.05	715.9937	19	.59333	Coarse	Coarse
8	23.5	.14	9.700001	1617.7	.11434	1849.71	609.9762	22	.57039	Coarse	Coarse
9	26.5	.14	9.5	1841.1	.10723	1974.16	650.7327	25	.55506	Coarse	Coarse
10	30	.14	9.6	1848.3	.11091	2050.01	652.0038	28	.59901	Coarse	Coarse
11	33.5	.135	10.7	1056.3	.19765	2087.75	501.9433	32	.6765	Residual	Residual
12	36.5	.135	11.3	998.5	.22343	2230.89	488.0172	35	.64739	Residual	Residual
13	39.5	.135	10.7	1207	.19636	2370.16	536.5555	38	.71677	Residual	Residual
14	42.5	.135	8.7	1853.6	.12973	2404.61	664.9195	41	.59839	Residual	Residual
15	45.5	.135	5.3	4401	.05567	2449.9	1024.558	44	.52211	Residual	Residual
16	48.5	.135	5.4	4313.4	.05803	2503.04	1014.31	47	.51594	Residual	Residual
17	Base							50	.52906		
17	Outcrop							50	.57825		

Notes:
Period for Soil Column: .27 sec
Average Shear Wave Velocity for Soil Column: 740 ft/sec

12 of 131
R13949


Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt
Acceleration (g's)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0
20
40
60
80
100
Velocity (ft/sec)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
0
20
40
60
80
100
Displacement (ft)
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
0
20
40
60
80
100
Time (sec)

R13950

```
************************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*   LAYERED SITES by Per Schnable & John Lysmer - 1970 *
* ---------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
* ---------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added  *
*    using results from Sun et al (1988) by J. I. Sun  *
*    & Ramin Golesorkhi February 26, 1988          *
* ----------------------------------------------------*
* SHAKE90/91: Adjust last iteration; Input now is either  *
*    Gmax or max Vs; up to 13 materials can be specified*
*    by user; up to 50 Layers can be specified; object  *
*    motion can be read in from a separate file and can *
*    user specified format; Different periods for res-  *
*    ponse spectral calculations;options are renumbered;*
*    and general cleanup by: J. I. Sun, I. M. Idriss &  *
*    P. Dirrim June 1990 - February 1991          *
* ---------------------------------------------------- *
* SHAKE91: General cleanup and finalization of input out- *
*    output format ... etc by: I. M. Idriss Dec. 1991  *
* ---------------------------------------------------- *
* SHAKE2000: Fix the incorrect output of Tot. Stress in  *
* Option 2. Changed path of ground motion file in       *
* SHAKE91.  Control file to input file names.  Modified  *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
*       RUN DATE  1/02/2008                    *
*       RUN TIME 11:01                        *
************************************************************
MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =    32768
NECESSARY LENGTH OF BLANK COMMON X       =   204819

|******  OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

**********************
 MATERIAL TYPE NO. 1
**********************

CURVE NO.  1:   Coarse    G/Gmax - Gravel (Mean) - Rollins et al. JGGE
CURVE NO.  2:   Coarse    Damping for Gravel (Mean) - Rollins et al. J
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.90
0.0002	0.995	0.0003	1.11
0.0005	0.980	0.0006	1.30
0.0008	0.970	0.0010	1.50
0.0010	0.960	0.0020	1.91
0.0020	0.930	0.0030	2.24
0.0030	0.905	0.0040	2.54
0.0040	0.880	0.0060	3.05
0.0070	0.810	0.0080	3.50
0.0100	0.755	0.0100	3.89
0.0200	0.630	0.0200	5.45
0.0700	0.390	0.0300	6.61
0.1000	0.325	0.0500	8.28
0.2000	0.205	0.1000	10.79
0.3000	0.150	0.2000	13.23

0.4000	0.115	0.3000	14.47
0.5000	0.095	0.4000	15.24
0.6000	0.080	0.6000	16.14
0.8000	0.070	0.8000	16.66
1.0000	0.050	1.0000	17.01

****
MATERIAL TYPE NO. 2
****

CURVE NO. 3: Fine Refuse Moduli for Fine Refuse (Ellison & Cho, 1976)
CURVE NO. 4: Fine Refuse Damping Values for Fine Refuse (Ellison & Ch

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.75
0.0004	1.000	0.0004	0.65
0.0010	0.995	0.0010	0.70
0.0020	0.992	0.0020	0.80
0.0040	0.989	0.0040	0.90
0.0060	0.981	0.0060	1.10
0.0080	0.965	0.0080	1.30
0.0100	0.955	0.0100	1.40
0.0200	0.905	0.0200	2.00
0.0400	0.828	0.0400	3.10
0.0600	0.750	0.0600	4.00
0.0800	0.670	0.0800	5.20
0.1000	0.610	0.1000	6.00
0.2000	0.610	0.2000	6.00

****
MATERIAL TYPE NO. 3
****

CURVE NO. 5: Residual G/Gmax PI=15% - Effective Confining Pressure
CURVE NO. 6: Residual Damping PI=15% - Effective Confining Pressur

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0000	1.000	0.0000	0.67
0.0000	1.000	0.0000	0.67
0.0000	0.999	0.0000	0.68
0.0001	0.998	0.0001	0.68
0.0002	0.996	0.0002	0.70
0.0005	0.991	0.0005	0.75
0.0010	0.983	0.0010	0.83
0.0022	0.965	0.0022	1.02
0.0048	0.931	0.0048	1.43
0.0100	0.873	0.0100	2.17
0.0220	0.770	0.0220	3.68
0.0484	0.618	0.0484	6.24
0.1000	0.454	0.1000	9.48
0.2200	0.287	0.2200	13.40
0.4840	0.163	0.4840	16.87
1.0000	0.091	1.0000	19.16

****
MATERIAL TYPE NO. 4
****

CURVE NO. 7: Rock G/Gmax - ROCK (Schnabel 1973)
CURVE NO. 8: Rock Damping for ROCK (Schnabel 1973)

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.40
0.0003	1.000	0.0010	0.80
0.0010	0.990	0.0100	1.50
0.0030	0.950	0.1000	3.00
0.0100	0.900	1.0000	4.60
0.0300	0.810	0.0000	0.00
0.1000	0.725	0.0000	0.00
1.0000	0.550	0.0000	0.00

1****** OPTION 2 *** READ SOIL PROFILE
NEW SOIL PROFILE NO. 1 IDENTIFICATION PSCS300E Crest Column
NUMBER OF LAYERS 17 DEPTH TO BEDROCK 50.00

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	1	4.0000	2.0000	0.26	3454.	0.050	0.130	924.9
2	1	3.0000	5.5000	0.71	3856.	0.050	0.130	977.3
3	1	3.0000	8.5000	1.11	4110.	0.050	0.130	1009.0
4	1	3.0000	11.5000	1.50	5739.	0.050	0.130	1192.3
5	1	3.0000	14.5000	1.90	4941.	0.050	0.140	1066.0
6	1	3.0000	17.5000	2.32	4453.	0.050	0.140	1012.0
7	1	3.0000	20.5000	2.74	4832.	0.050	0.140	1054.2
8	1	3.0000	23.5000	3.16	4269.	0.050	0.140	990.9
9	1	3.0000	26.5000	3.58	4713.	0.050	0.140	1041.1
10	1	4.0000	30.0000	4.07	4808.	0.050	0.140	1051.6
11	3	3.0000	33.5000	4.55	2635.	0.050	0.135	792.8
12	3	3.0000	36.5000	4.96	2661.	0.050	0.135	796.7
13	3	3.0000	39.5000	5.36	2998.	0.050	0.135	845.6
14	3	3.0000	42.5000	5.77	3763.	0.050	0.135	947.4
15	3	3.0000	45.5000	6.17	6529.	0.050	0.135	1247.9
16	3	3.0000	48.5000	6.58	6476.	0.050	0.135	1242.8
17	BASE				74534.	0.050	0.150	4000.0

PERIOD = 0.20 FROM AVERAGE SHEAR VEL. = 1011.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 12.34
FOR FREQUENCY = 4.85 C/SEC.
PERIOD = 0.21 SEC.

1****** OPTION 3 *** READ INPUT MOTION

FILE NAME FOR INPUT MOTION = C:\SHAKE2000\Williamson Energy\Background6.8.eq
NO. OF INPUT ACC. POINTS = 8192
NO. OF POINTS USED IN FFT = 16384
NO. OF HEADING LINES = 4
NO. OF POINTS PER LINE = 8

TIME STEP FOR INPUT MOTION = 0.0100
FORMAT FOR TIME HISTORY = (8f9.6)

*****HEADER*****
Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt
SHAKE2000 Conversion: 8192 .01 4 8 9 (8f9.6
Acceleration Units: (g's) - No. Values: 8192 - Time Step: .01 (secs)
Data Format: (8f9.6) - No. Header Lines: 4
** FIRST AND LAST 5 LINES OF INPUT MOTION *****

1 0.000068-0.000484 0.004440-0,000089 0.002476-0.002297-0.001876 0.007725
2 0.009680 0.020998-0.014349-0.012924 0.018874-0.019831-0.000946 0.024811
3 -0.016894-0.002461 0.007682-0.006573-0.008604-0.018410 0.024194-0.064656
4 -0.017516 0.023926-0.061566 0.003326 0.022873 0.052730 0.049159 0.008778
5 -0.041034 0.029324-0.005991 0.066674-0.051336 0.029966-0.067257 0.001274
.....INPUT MOTION READ NOT ECHOED.....
1020 -0.000017 0.000017-0.000018 0.000017-0.000019 0.000019-0.000020 0.000020
1021 -0.000021 0.000021-0.000022 0.000022-0.000024 0.000023-0.000025 0.000025
1022 -0.000027 0.000027-0.000028 0.000028-0.000030 0.000030-0.000032 0.000032
1023 -0.000034 0.000034-0.000035 0.000035-0.000037 0.000037-0.000038 0.000038
1024 -0.000038 0.000037-0.000036 0.000032-0.000026 0.000014 0.000006-0.000045

MAXIMUM ACCELERATION = 0.75473
AT TIME = 3.64 SEC
THE VALUES WILL BE MULTIPLIED BY A FACTOR = 0.715
TO GIVE NEW MAXIMUM ACCELERATION = 0.54000
MEAN SQUARE FREQUENCY = 20.41 C/SEC.
MAX ACCELERATION = 0.55791 FOR FREQUENCIES REMOVED ABOVE 40.00 C/SEC.
1****** OPTION 4 *** READ WHERE OBJECT MOTION IS GIVEN
OBJECT MOTION IN LAYER NUMBER 17 OUTCROPPING

1****** OPTION 5 *** OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
MAXIMUM NUMBER OF ITERATIONS = 10
FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN = 0.65

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 1

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00351	0.024	0.050	-108.1	3078.9	3454.0	-12.2	1.000
2	1	5.5	0.00785	0.035	0.050	-44.1	3055.2	3856.0	-26.2	1.000
3	1	8.5	0.00986	0.039	0.050	-29.4	3112.0	4110.0	-32.1	1.000
4	1	11.5	0.00805	0.035	0.050	-42.5	4525.4	5739.0	-26.8	1.000
5	1	14.5	0.01151	0.042	0.050	-18.9	3605.0	4941.0	-37.1	1.000
6	1	17.5	0.01524	0.048	0.050	-3.3	3023.5	4453.0	-47.3	1.000
7	1	20.5	0.01605	0.050	0.050	-0.9	3235.9	4832.0	-49.3	1.000
8	1	23.5	0.02052	0.055	0.050	9.5	2668.7	4269.0	-60.0	1.000
9	1	26.5	0.02025	0.055	0.050	8.8	2958.1	4713.0	-59.3	1.000
10	1	30.0	0.02107	0.056	0.050	10.7	2980.8	4808.0	-61.3	1.000
11	3	33.5	0.03946	0.056	0.050	10.3	1732.1	2635.0	-52.1	1.000
12	3	36.5	0.03887	0.055	0.050	9.5	1756.9	2661.0	-51.5	1.000
13	3	39.5	0.03374	0.051	0.050	1.3	2061.4	2998.0	-45.4	1.000
14	3	42.5	0.02773	0.044	0.050	-12.8	2729.6	3763.0	-37.9	1.000
15	3	45.5	0.01672	0.032	0.050	-58.3	5261.4	6529.0	-24.1	1.000

16 3 48.5 0.01790 0.033 0.050 -52.0 5160.9 6476.0 -25.5 1.000

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00433	0.026	0.024	8.9	3005.7	3078.9	-2.4	0.891
2	1	5.5	0.01076	0.041	0.035	14.4	2860.4	3055.2	-6.8	0.792
3	1	8.5	0.01356	0.046	0.039	15.5	2877.3	3112.0	-8.2	0.757
4	1	11.5	0.01116	0.041	0.035	15.2	4219.2	4525.4	-7.3	0.789
5	1	14.5	0.01611	0.050	0.042	15.2	3305.5	3605.0	-9.1	0.730
6	1	17.5	0.02293	0.058	0.048	17.2	2688.9	3023.5	-12.4	0.679
7	1	20.5	0.02391	0.060	0.050	16.9	2878.8	3235.9	-12.4	0.670
8	1	23.5	0.03112	0.067	0.055	17.9	2328.0	2668.7	-14.6	0.625
9	1	26.5	0.02861	0.065	0.055	15.3	2646.0	2958.1	-11.8	0.628
10	1	30.0	0.02760	0.064	0.056	12.1	2732.5	2980.8	-9.1	0.620
11	3	33.5	0.04460	0.060	0.056	6.6	1669.9	1732.1	-3.7	0.657
12	3	36.5	0.04332	0.059	0.055	6.0	1701.4	1756.9	-3.3	0.660
13	3	39.5	0.03826	0.055	0.051	7.4	1988.7	2061.4	-3.7	0.688
14	3	42.5	0.03202	0.049	0.044	9.5	2625.2	2729.6	-4.0	0.725
15	3	45.5	0.01907	0.034	0.032	7.4	5149.3	5261.4	-2.2	0.806
16	3	48.5	0.02074	0.036	0.033	7.9	5036.3	5160.9	-2.5	0.797

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00460	0.027	0.026	2.9	2979.0	3005.7	-0.9	0.870
2	1	5.5	0.01185	0.043	0.041	5.1	2793.0	2860.4	-2.4	0.742
3	1	8.5	0.01514	0.048	0.046	5.1	2795.6	2877.3	-2.9	0.700
4	1	11.5	0.01171	0.042	0.041	2.5	4169.5	4219.2	-1.2	0.735
5	1	14.5	0.01732	0.051	0.050	3.2	3241.1	3305.5	-2.0	0.669
6	1	17.5	0.02575	0.062	0.058	5.4	2589.8	2688.9	-3.8	0.604
7	1	20.5	0.02687	0.063	0.060	5.3	2770.8	2878.8	-3.9	0.596
8	1	23.5	0.03516	0.071	0.067	5.6	2228.1	2328.0	-4.5	0.545
9	1	26.5	0.03072	0.067	0.065	3.2	2581.7	2646.0	-2.5	0.561
10	1	30.0	0.02818	0.064	0.064	0.9	2713.3	2732.5	-0.7	0.568
11	3	33.5	0.04444	0.060	0.060	-0.2	1671.8	1669.9	0.1	0.634
12	3	36.5	0.04493	0.060	0.059	2.0	1682.6	1701.4	-1.1	0.639
13	3	39.5	0.04084	0.057	0.055	3.7	1950.9	1988.7	-1.9	0.663
14	3	42.5	0.03430	0.051	0.049	4.3	2575.4	2625.2	-1.9	0.698
15	3	45.5	0.01855	0.034	0.034	-1.6	5173.0	5149.3	0.5	0.789
16	3	48.5	0.02042	0.035	0.036	-0.8	5049.4	5036.3	0.3	0.778

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00456	0.027	0.027	-0.4	2982.5	2979.0	0.1	0.862
2	1	5.5	0.01191	0.043	0.043	0.3	2789.6	2793.0	-0.1	0.724
3	1	8.5	0.01531	0.048	0.048	0.5	2787.6	2795.6	-0.3	0.680
4	1	11.5	0.01166	0.042	0.042	-0.2	4174.2	4169.5	0.1	0.727
5	1	14.5	0.01740	0.051	0.051	0.2	3236.7	3241.1	-0.1	0.656
6	1	17.5	0.02642	0.062	0.062	1.2	2567.9	2589.8	-0.9	0.582
7	1	20.5	0.02762	0.064	0.063	1.2	2745.2	2770.8	-0.9	0.573
8	1	23.5	0.03637	0.072	0.071	1.5	2200.3	2228.1	-1.3	0.522
9	1	26.5	0.03115	0.067	0.067	0.7	2569.2	2581.7	-0.5	0.548
10	1	30.0	0.02787	0.064	0.064	-0.5	2723.4	2713.3	0.4	0.564
11	3	33.5	0.04402	0.059	0.060	-0.5	1676.6	1671.8	0.3	0.634
12	3	36.5	0.04564	0.060	0.060	0.8	1674.6	1682.6	-0.5	0.632
13	3	39.5	0.04189	0.058	0.057	1.4	1936.2	1950.9	-0.8	0.651
14	3	42.5	0.03519	0.052	0.051	1.6	2556.7	2575.4	-0.7	0.684
15	3	45.5	0.01837	0.033	0.034	-0.5	5181.0	5173.0	0.2	0.792
16	3	48.5	0.02016	0.035	0.035	-0.7	5060.6	5049.4	0.2	0.780

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00455	0.027	0.027	-0.2	2984.2	2982.5	0.1	0.863
2	1	5.5	0.01189	0.043	0.043	-0.1	2790.6	2789.6	0.0	0.723
3	1	8.5	0.01532	0.048	0.048	0.0	2787.0	2787.6	0.0	0.678
4	1	11.5	0.01161	0.042	0.042	-0.2	4178.3	4174.2	0.1	0.727
5	1	14.5	0.01735	0.051	0.051	-0.1	3239.3	3236.7	0.1	0.655
6	1	17.5	0.02655	0.063	0.062	0.2	2563.6	2567.9	-0.2	0.577
7	1	20.5	0.02780	0.064	0.064	0.3	2739.2	2745.2	-0.2	0.568
8	1	23.5	0.03675	0.073	0.072	0.5	2191.9	2200.3	-0.4	0.515
9	1	26.5	0.03122	0.067	0.067	0.1	2567.1	2569.2	-0.1	0.545
10	1	30.0	0.02767	0.064	0.064	-0.3	2730.0	2723.4	0.2	0.566
11	3	33.5	0.04382	0.059	0.059	-0.2	1678.9	1676.6	0.1	0.636
12	3	36.5	0.04592	0.061	0.060	0.3	1671.5	1674.6	-0.2	0.629
13	3	39.5	0.04225	0.058	0.058	0.5	1931.3	1936.2	-0.3	0.646
14	3	42.5	0.03545	0.052	0.052	0.5	2551.4	2556.7	-0.2	0.679
15	3	45.5	0.01834	0.033	0.033	-0.1	5182.3	5181.0	0.0	0.794
16	3	48.5	0.02008	0.035	0.035	-0.2	5063.8	5060.6	0.1	0.781

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 6

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.2	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.9	2790.6	0.0	0.724

3	1	8.5	0.01532	0.049	0.048	0.0	2786.7	2787.0	0.0	0.678
4	1	11.5	0.01160	0.042	0.042	-0.1	4179.6	4178.3	0.0	0.728
5	1	14.5	0.01732	0.051	0.051	-0.1	3241.0	3239.3	0.1	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.8	2563.6	0.0	0.576
7	1	20.5	0.02785	0.064	0.064	0.1	2737.8	2739.2	-0.1	0.567
8	1	23.5	0.03687	0.073	0.073	0.2	2189.2	2191.9	-0.1	0.513
9	1	26.5	0.03123	0.067	0.067	0.0	2566.9	2567.1	0.0	0.545
10	1	30.0	0.02758	0.064	0.064	-0.1	2732.9	2730.0	0.1	0.568
11	3	33.5	0.04375	0.059	0.059	-0.1	1679.7	1678.9	0.0	0.637
12	3	36.5	0.04602	0.061	0.061	0.1	1670.4	1671.5	-0.1	0.628
13	3	39.5	0.04237	0.058	0.058	0.2	1929.7	1931.3	-0.1	0.644
14	3	42.5	0.03552	0.052	0.052	0.1	2550.0	2551.4	-0.1	0.678
15	3	45.5	0.01834	0.033	0.033	0.0	5182.7	5182.3	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.5	5063.8	0.0	0.782

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 7

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.4	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.9	2790.9	0.0	0.724
3	1	8.5	0.01533	0.049	0.049	0.0	2786.5	2786.7	0.0	0.678
4	1	11.5	0.01159	0.042	0.042	0.0	4180.0	4179.6	0.0	0.728
5	1	14.5	0.01731	0.051	0.051	0.0	3241.7	3241.0	0.0	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.7	2562.8	0.0	0.576
7	1	20.5	0.02786	0.064	0.064	0.0	2737.5	2737.8	0.0	0.567
8	1	23.5	0.03692	0.073	0.073	0.1	2188.2	2189.2	0.0	0.513
9	1	26.5	0.03122	0.067	0.067	0.0	2567.0	2566.9	0.0	0.545
10	1	30.0	0.02755	0.064	0.064	-0.1	2734.0	2732.9	0.0	0.568
11	3	33.5	0.04373	0.059	0.059	0.0	1680.0	1679.7	0.0	0.637
12	3	36.5	0.04605	0.061	0.061	0.0	1670.0	1670.4	0.0	0.628
13	3	39.5	0.04240	0.058	0.058	0.0	1929.3	1929.7	0.0	0.644
14	3	42.5	0.03554	0.052	0.052	0.0	2549.7	2550.0	0.0	0.678
15	3	45.5	0.01833	0.033	0.033	0.0	5182.8	5182.7	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.7	5064.5	0.0	0.782

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 8

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.4	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.8	2790.9	0.0	0.724
3	1	8.5	0.01533	0.049	0.049	0.0	2786.4	2786.5	0.0	0.678
4	1	11.5	0.01159	0.042	0.042	0.0	4180.1	4180.0	0.0	0.728
5	1	14.5	0.01730	0.051	0.051	0.0	3242.0	3241.7	0.0	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.8	2562.7	0.0	0.576
7	1	20.5	0.02786	0.064	0.064	0.0	2737.4	2737.5	0.0	0.567
8	1	23.5	0.03693	0.073	0.073	0.0	2187.9	2188.2	0.0	0.513
9	1	26.5	0.03122	0.067	0.067	0.0	2567.1	2567.0	0.0	0.545

10	1	30.0	0.02754	0.064	0.064	0.0	2734.4	2734.0	0.0	0.569
11	3	33.5	0.04372	0.059	0.059	0.0	1680.1	1680.0	0.0	0.638
12	3	36.5	0.04606	0.061	0.061	0.0	1669.9	1670.0	0.0	0.628
13	3	39.5	0.04241	0.058	0.058	0.0	1929.1	1929.3	0.0	0.644
14	3	42.5	0.03554	0.052	0.052	0.0	2549.6	2549.7	0.0	0.678
15	3	45.5	0.01833	0.033	0.033	0.0	5182.9	5182.8	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.7	5064.7	0.0	0.782

1

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 9

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.4	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.8	2790.8	0.0	0.724
3	1	8.5	0.01533	0.049	0.049	0.0	2786.4	2786.4	0.0	0.678
4	1	11.5	0.01159	0.042	0.042	0.0	4180.1	4180.1	0.0	0.728
5	1	14.5	0.01730	0.051	0.051	0.0	3242.1	3242.0	0.0	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.8	2562.8	0.0	0.576
7	1	20.5	0.02786	0.064	0.064	0.0	2737.4	2737.4	0.0	0.567
8	1	23.5	0.03694	0.073	0.073	0.0	2187.7	2187.9	0.0	0.513
9	1	26.5	0.03122	0.067	0.067	0.0	2567.1	2567.1	0.0	0.545
10	1	30.0	0.02753	0.064	0.064	0.0	2734.6	2734.4	0.0	0.569
11	3	33.5	0.04372	0.059	0.059	0.0	1680.1	1680.1	0.0	0.638
12	3	36.5	0.04607	0.061	0.061	0.0	1669.8	1669.9	0.0	0.628
13	3	39.5	0.04241	0.058	0.058	0.0	1929.1	1929.1	0.0	0.643
14	3	42.5	0.03554	0.052	0.052	0.0	2549.6	2549.6	0.0	0.678
15	3	45.5	0.01833	0.033	0.033	0.0	5182.9	5182.9	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.7	5064.7	0.0	0.782

1

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 10

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.4	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.8	2790.8	0.0	0.724
3	1	8.5	0.01533	0.049	0.049	0.0	2786.4	2786.4	0.0	0.678
4	1	11.5	0.01159	0.042	0.042	0.0	4180.1	4180.1	0.0	0.728
5	1	14.5	0.01730	0.051	0.051	0.0	3242.1	3242.1	0.0	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.8	2562.8	0.0	0.576
7	1	20.5	0.02786	0.064	0.064	0.0	2737.4	2737.4	0.0	0.567
8	1	23.5	0.03694	0.073	0.073	0.0	2187.7	2187.7	0.0	0.512
9	1	26.5	0.03122	0.067	0.067	0.0	2567.1	2567.1	0.0	0.545
10	1	30.0	0.02753	0.064	0.064	0.0	2734.6	2734.6	0.0	0.569
11	3	33.5	0.04372	0.059	0.059	0.0	1680.1	1680.1	0.0	0.638
12	3	36.5	0.04607	0.061	0.061	0.0	1669.8	1669.8	0.0	0.628
13	3	39.5	0.04241	0.058	0.058	0.0	1929.1	1929.1	0.0	0.643
14	3	42.5	0.03554	0.052	0.052	0.0	2549.6	2549.6	0.0	0.678
15	3	45.5	0.01833	0.033	0.033	0.0	5182.9	5182.9	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.7	5064.7	0.0	0.782

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	1	4.0000	2.0000	0.00699	208.65	2.66
2	1	3.0000	5.5000	0.01829	510.56	2.66
3	1	3.0000	8.5000	0.02359	657.19	2.66
4	1	3.0000	11.5000	0.01783	745.46	3.70
5	1	3.0000	14.5000	0.02661	862.84	2.53
6	1	3.0000	17.5000	0.04089	1047.93	2.53
7	1	3.0000	20.5000	0.04286	1173.22	2.53
8	1	3.0000	23.5000	0.05683	1243.29	2.53
9	1	3.0000	26.5000	0.04803	1232.98	2.53
10	1	4.0000	30.0000	0.04236	1158.30	2.52
11	3	3.0000	33.5000	0.06726	1130.04	2.52
12	3	3.0000	36.5000	0.07088	1183.52	2.51
13	3	3.0000	39.5000	0.06525	1258.79	2.50
14	3	3.0000	42.5000	0.05468	1394.02	2.62
15	3	3.0000	45.5000	0.02820	1461.76	2.62
16	3	3.0000	48.5000	0.03086	1562.90	2.49

PERIOD = 0.24 FROM AVERAGE SHEAR VEL. = 823.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 10.74
FOR FREQUENCY = 3.87 C/SEC.
PERIOD = 0.26 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE	TH SAVED ACC. RECORD
OUTCR.	0.0000	0.82118	2.66	15.92	0.000	2048
WITHIN	4.0000	0.66221	2.66	12.85	0.000	2048
WITHIN	7.0000	0.45724	2.53	9.08	0.000	2048
WITHIN	10.0000	0.49140	2.53	12.60	0.001	2048
WITHIN	13.0000	0.47695	2.53	15.09	0.001	2048
WITHIN	16.0000	0.48874	2.64	14.93	0.000	2048
WITHIN	19.0000	0.46491	2.64	15.27	0.001	2048
WITHIN	22.0000	0.51703	2.60	16.98	0.001	2048
WITHIN	25.0000	0.52919	2.63	16.94	0.000	2048
WITHIN	28.0000	0.52041	2.63	16.49	0.001	2048
WITHIN	32.0000	0.76846	2.62	17.02	0.000	2048
WITHIN	35.0000	0.80342	2.62	18.94	0.000	2048
WITHIN	38.0000	0.73631	2.61	20.52	0.001	2048
WITHIN	41.0000	0.65050	2.59	20.50	0.001	2048
WITHIN	44.0000	0.53855	3.91	20.21	0.001	2048

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE	TH SAVED ACC. RECORD
WITHIN	47.0000	0.52173	3.91	19.79	0.001	2048
WITHIN	50.0000	0.49204	2.58	19.33	0.001	2048

OUTCR.	50.0000	0.55791	2.58	20.41	0.001	2048

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 1 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 1 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 2 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 2 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 3 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 3 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 4 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 4 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 5 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 5 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC330M Layer 6 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PSCS300M Layer 6 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 7 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 7 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 8 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 8 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 9 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PSCS300E Layer 9 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 10 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 10 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 11 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 11 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 12 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 12 Strain

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1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   13
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 13 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   13
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 13 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   14
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 14 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   14
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 14 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   15
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 15 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   15
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 15 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   16
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 16 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   16
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 16 Strain

1******  OPTION  9  ***  COMPUTE RESPONSE SPECTRUM
 RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER      1
CALCULATED FOR DAMPING      0.050

  TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
     TD = TIME FOR MAX. RELATIVE DISP.
     TV = TIME FOR MAX. RELATIVE VEL.
     TA = TIME FOR MAX. ABSOLUTE ACC.
  DAMPING RATIO = 0.050
  PER = 0.01    TIMES FOR MAXIMA --  TD =  2.6500  TV =  2.6500  TA =  2.6500
  PER = 0.02    TIMES FOR MAXIMA --  TD =  2.6500  TV =  2.6400  TA =  2.6500
  PER = 0.03    TIMES FOR MAXIMA --  TD =  3.0100  TV =  3.0200  TA =  3.0100
  PER = 0.04    TIMES FOR MAXIMA --  TD =  2.6600  TV =  2.6700  TA =  3.6900
  PER = 0.05    TIMES FOR MAXIMA --  TD =  4.9300  TV =  4.9400  TA =  4.9000
  PER = 0.06    TIMES FOR MAXIMA --  TD =  4.3800  TV =  4.3900  TA =  4.3800
  PER = 0.07    TIMES FOR MAXIMA --  TD =  5.2600  TV =  5.2800  TA =  5.2600
  PER = 0.08    TIMES FOR MAXIMA --  TD =  5.2700  TV =  5.2900  TA =  5.2700
  PER = 0.09    TIMES FOR MAXIMA --  TD =  2.5900  TV =  2.7000  TA =  2.7200
  PER = 0.10    TIMES FOR MAXIMA --  TD =  2.6000  TV =  2.6600  TA =  2.5900
  PER = 0.11    TIMES FOR MAXIMA --  TD =  2.6000  TV =  2.5800  TA =  2.6000
  PER = 0.12    TIMES FOR MAXIMA --  TD =  2.6100  TV =  2.5800  TA =  2.6100
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PER = 0.13 TIMES FOR MAXIMA -- TD = 3.7200 TV = 5.1900 TA = 3.7200
PER = 0.14 TIMES FOR MAXIMA -- TD = 3.7300 TV = 2.5800 TA = 3.7300
PER = 0.15 TIMES FOR MAXIMA -- TD = 4.1600 TV = 2.5800 TA = 4.1600
PER = 0.16 TIMES FOR MAXIMA -- TD = 2.6200 TV = 2.5800 TA = 2.6100
PER = 0.17 TIMES FOR MAXIMA -- TD = 4.2800 TV = 4.3200 TA = 4.2800
PER = 0.18 TIMES FOR MAXIMA -- TD = 1.4300 TV = 2.5900 TA = 1.4300
PER = 0.19 TIMES FOR MAXIMA -- TD = 2.7500 TV = 2.7100 TA = 2.7500
PER = 0.20 TIMES FOR MAXIMA -- TD = 7.1100 TV = 6.7400 TA = 7.1100
PER = 0.21 TIMES FOR MAXIMA -- TD = 7.1400 TV = 7.0900 TA = 7.1300
PER = 0.22 TIMES FOR MAXIMA -- TD = 7.2700 TV = 7.1000 TA = 7.1500
PER = 0.23 TIMES FOR MAXIMA -- TD = 7.4200 TV = 2.3500 TA = 7.4100
PER = 0.24 TIMES FOR MAXIMA -- TD = 7.5600 TV = 2.3700 TA = 7.5600
PER = 0.25 TIMES FOR MAXIMA -- TD = 1.6100 TV = 6.3700 TA = 1.6100
PER = 0.26 TIMES FOR MAXIMA -- TD = 6.3200 TV = 6.3800 TA = 6.3200
PER = 0.27 TIMES FOR MAXIMA -- TD = 1.6400 TV = 1.7100 TA = 1.6300
PER = 0.28 TIMES FOR MAXIMA -- TD = 1.6500 TV = 1.3200 TA = 1.6500
PER = 0.29 TIMES FOR MAXIMA -- TD = 5.2100 TV = 5.1500 TA = 5.2100
PER = 0.30 TIMES FOR MAXIMA -- TD = 5.2400 TV = 5.1600 TA = 5.2300
PER = 0.31 TIMES FOR MAXIMA -- TD = 2.9800 TV = 2.9000 TA = 2.9700
PER = 0.32 TIMES FOR MAXIMA -- TD = 3.0000 TV = 2.9100 TA = 2.9900
PER = 0.33 TIMES FOR MAXIMA -- TD = 3.0100 TV = 2.9100 TA = 3.0000
PER = 0.34 TIMES FOR MAXIMA -- TD = 3.0100 TV = 2.7900 TA = 3.0100
PER = 0.35 TIMES FOR MAXIMA -- TD = 3.0200 TV = 2.7900 TA = 3.0200
PER = 0.36 TIMES FOR MAXIMA -- TD = 2.8800 TV = 2.7900 TA = 2.8700
PER = 0.37 TIMES FOR MAXIMA -- TD = 2.7200 TV = 2.7900 TA = 2.7100
PER = 0.38 TIMES FOR MAXIMA -- TD = 2.7300 TV = 2.6600 TA = 2.7200
PER = 0.39 TIMES FOR MAXIMA -- TD = 2.7300 TV = 2.6600 TA = 4.1300
PER = 0.40 TIMES FOR MAXIMA -- TD = 4.1500 TV = 2.6600 TA = 4.1400
PER = 0.41 TIMES FOR MAXIMA -- TD = 4.1600 TV = 4.0900 TA = 4.1600
PER = 0.42 TIMES FOR MAXIMA -- TD = 3.9900 TV = 4.0900 TA = 3.9800
PER = 0.43 TIMES FOR MAXIMA -- TD = 4.0000 TV = 4.0900 TA = 3.9900
PER = 0.44 TIMES FOR MAXIMA -- TD = 4.6800 TV = 4.1000 TA = 4.6700
PER = 0.45 TIMES FOR MAXIMA -- TD = 4.6900 TV = 4.1000 TA = 4.6800
PER = 0.46 TIMES FOR MAXIMA -- TD = 4.7100 TV = 4.1000 TA = 4.7100
PER = 0.47 TIMES FOR MAXIMA -- TD = 4.7300 TV = 4.6400 TA = 4.7200
PER = 0.48 TIMES FOR MAXIMA -- TD = 4.7400 TV = 4.6500 TA = 4.7300
PER = 0.49 TIMES FOR MAXIMA -- TD = 5.5500 TV = 4.6500 TA = 5.5400
PER = 0.50 TIMES FOR MAXIMA -- TD = 5.5700 TV = 2.6700 TA = 5.5600
PER = 0.51 TIMES FOR MAXIMA -- TD = 5.5800 TV = 2.6700 TA = 5.5700
PER = 0.52 TIMES FOR MAXIMA -- TD = 5.5800 TV = 2.6700 TA = 5.5700
PER = 0.53 TIMES FOR MAXIMA -- TD = 2.7600 TV = 2.6700 TA = 2.7500
PER = 0.54 TIMES FOR MAXIMA -- TD = 2.7700 TV = 2.6700 TA = 2.7600
PER = 0.55 TIMES FOR MAXIMA -- TD = 2.7700 TV = 2.6700 TA = 2.7600
PER = 0.56 TIMES FOR MAXIMA -- TD = 2.5700 TV = 2.6700 TA = 2.5600
PER = 0.57 TIMES FOR MAXIMA -- TD = 2.5700 TV = 2.6700 TA = 2.5600
PER = 0.58 TIMES FOR MAXIMA -- TD = 2.5700 TV = 2.6700 TA = 2.5600
PER = 0.60 TIMES FOR MAXIMA -- TD = 2.5800 TV = 2.6700 TA = 2.5700
PER = 0.62 TIMES FOR MAXIMA -- TD = 2.5900 TV = 2.6700 TA = 2.5800
PER = 0.64 TIMES FOR MAXIMA -- TD = 2.6100 TV = 2.5400 TA = 2.6000
PER = 0.66 TIMES FOR MAXIMA -- TD = 2.6200 TV = 2.5400 TA = 2.6100
PER = 0.68 TIMES FOR MAXIMA -- TD = 2.6400 TV = 2.5400 TA = 2.6200
PER = 0.70 TIMES FOR MAXIMA -- TD = 3.4700 TV = 2.5500 TA = 3.4600
PER = 0.72 TIMES FOR MAXIMA -- TD = 3.4800 TV = 2.5500 TA = 3.4700
PER = 0.74 TIMES FOR MAXIMA -- TD = 3.4900 TV = 2.5500 TA = 3.4800
PER = 0.76 TIMES FOR MAXIMA -- TD = 3.4900 TV = 1.6100 TA = 3.4800
PER = 0.78 TIMES FOR MAXIMA -- TD = 1.8200 TV = 1.6100 TA = 1.8000
PER = 0.80 TIMES FOR MAXIMA -- TD = 1.5200 TV = 1.2700 TA = 1.5100
PER = 0.82 TIMES FOR MAXIMA -- TD = 1.5300 TV = 1.2700 TA = 1.5100
PER = 0.84 TIMES FOR MAXIMA -- TD = 3.5000 TV = 6.3000 TA = 3.4800
PER = 0.86 TIMES FOR MAXIMA -- TD = 3.5000 TV = 5.9400 TA = 3.4800
PER = 0.88 TIMES FOR MAXIMA -- TD = 3.5100 TV = 5.9400 TA = 3.4900

PER = 0.90	TIMES FOR MAXIMA --	TD = 4.0300	TV = 3.3000	TA = 4.0200
PER = 0.92	TIMES FOR MAXIMA --	TD = 4.0600	TV = 4.2900	TA = 4.0500
PER = 0.94	TIMES FOR MAXIMA --	TD = 4.0700	TV = 4.3500	TA = 4.0600
PER = 0.96	TIMES FOR MAXIMA --	TD = 4.0700	TV = 4.3500	TA = 4.0600
PER = 0.98	TIMES FOR MAXIMA --	TD = 3.1800	TV = 4.3500	TA = 3.1700
PER = 1.00	TIMES FOR MAXIMA --	TD = 3.1900	TV = 3.9700	TA = 3.1800
PER = 1.05	TIMES FOR MAXIMA --	TD = 3.2100	TV = 3.9700	TA = 3.1900
PER = 1.10	TIMES FOR MAXIMA --	TD = 3.2500	TV = 2.5500	TA = 3.2400
PER = 1.15	TIMES FOR MAXIMA --	TD = 3.2700	TV = 2.5500	TA = 3.2500
PER = 1.20	TIMES FOR MAXIMA --	TD = 3.3500	TV = 2.5500	TA = 3.2800
PER = 1.25	TIMES FOR MAXIMA --	TD = 3.3900	TV = 2.5500	TA = 3.3800
PER = 1.30	TIMES FOR MAXIMA --	TD = 2.8800	TV = 2.5500	TA = 2.8700
PER = 1.35	TIMES FOR MAXIMA --	TD = 2.8900	TV = 2.5500	TA = 2.8700
PER = 1.40	TIMES FOR MAXIMA --	TD = 2.8900	TV = 2.5500	TA = 2.8700
PER = 1.45	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5500	TA = 2.8700
PER = 1.50	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5500	TA = 2.8700
PER = 1.55	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5500	TA = 2.8700
PER = 1.60	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5500	TA = 2.8700
PER = 1.65	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.5500	TA = 2.8700
PER = 1.70	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.5500	TA = 2.8700
PER = 1.75	TIMES FOR MAXIMA --	TD = 5.9000	TV = 2.5500	TA = 5.8900
PER = 1.80	TIMES FOR MAXIMA --	TD = 5.9100	TV = 2.5500	TA = 5.8900
PER = 1.85	TIMES FOR MAXIMA --	TD = 5.9200	TV = 2.5500	TA = 5.8900
PER = 1.90	TIMES FOR MAXIMA --	TD = 6.1200	TV = 2.5500	TA = 6.1000
PER = 1.95	TIMES FOR MAXIMA --	TD = 6.1200	TV = 2.5500	TA = 6.1100
PER = 2.00	TIMES FOR MAXIMA --	TD = 5.4200	TV = 2.5500	TA = 5.4100
PER = 2.05	TIMES FOR MAXIMA --	TD = 5.4300	TV = 2.5500	TA = 5.4100
PER = 2.10	TIMES FOR MAXIMA --	TD = 5.4300	TV = 2.5500	TA = 5.4100
PER = 2.15	TIMES FOR MAXIMA --	TD = 8.7600	TV = 2.5500	TA = 5.4100
PER = 2.20	TIMES FOR MAXIMA --	TD = 8.7700	TV = 2.5500	TA = 5.4100
PER = 2.25	TIMES FOR MAXIMA --	TD = 8.9500	TV = 2.5500	TA = 8.9400
PER = 2.30	TIMES FOR MAXIMA --	TD = 8.9700	TV = 2.5500	TA = 8.9400
PER = 2.35	TIMES FOR MAXIMA --	TD = 7.9000	TV = 2.5500	TA = 7.8800
PER = 2.40	TIMES FOR MAXIMA --	TD = 7.9400	TV = 2.5500	TA = 7.8800
PER = 2.50	TIMES FOR MAXIMA --	TD = 8.0900	TV = 2.5500	TA = 7.9400
PER = 2.60	TIMES FOR MAXIMA --	TD = 8.1100	TV = 2.5500	TA = 8.0800
PER = 2.70	TIMES FOR MAXIMA --	TD = 6.9700	TV = 2.5500	TA = 6.9400
PER = 2.80	TIMES FOR MAXIMA --	TD = 7.0000	TV = 2.5500	TA = 6.9400
PER = 2.90	TIMES FOR MAXIMA --	TD = 7.0000	TV = 2.5500	TA = 6.9400
PER = 3.00	TIMES FOR MAXIMA --	TD = 7.0100	TV = 2.5500	TA = 6.9400
PER = 3.10	TIMES FOR MAXIMA --	TD = 7.2400	TV = 2.5500	TA = 7.1900
PER = 3.20	TIMES FOR MAXIMA --	TD = 7.2500	TV = 2.5500	TA = 7.2000
PER = 3.30	TIMES FOR MAXIMA --	TD = 7.2500	TV = 2.5500	TA = 7.2000
PER = 3.40	TIMES FOR MAXIMA --	TD = 7.2600	TV = 2.5500	TA = 7.2000
PER = 3.50	TIMES FOR MAXIMA --	TD = 7.2600	TV = 2.5500	TA = 7.2400
PER = 3.60	TIMES FOR MAXIMA --	TD = 7.5200	TV = 2.5500	TA = 7.2400
PER = 3.70	TIMES FOR MAXIMA --	TD = 7.5200	TV = 2.5500	TA = 7.5000
PER = 3.80	TIMES FOR MAXIMA --	TD = 7.5200	TV = 2.5500	TA = 7.5000
PER = 3.90	TIMES FOR MAXIMA --	TD = 7.5300	TV = 2.5500	TA = 7.5000
PER = 4.00	TIMES FOR MAXIMA --	TD = 7.5300	TV = 2.5500	TA = 7.5000
PER = 4.10	TIMES FOR MAXIMA --	TD = 6.2300	TV = 2.5500	TA = 6.0000
PER = 4.20	TIMES FOR MAXIMA --	TD = 6.2400	TV = 2.5500	TA = 6.2100
PER = 4.30	TIMES FOR MAXIMA --	TD = 6.2400	TV = 2.5500	TA = 6.2100
PER = 4.40	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5500	TA = 6.2100
PER = 4.50	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5500	TA = 6.2100
PER = 4.60	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5500	TA = 6.2100
PER = 4.70	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5500	TA = 6.2100
PER = 4.80	TIMES FOR MAXIMA --	TD = 6.2600	TV = 2.5500	TA = 6.2100
PER = 4.90	TIMES FOR MAXIMA --	TD = 6.2600	TV = 2.5500	TA = 6.2100
PER = 5.00	TIMES FOR MAXIMA --	TD = 6.2600	TV = 2.5500	TA = 6.2100
PER = 5.10	TIMES FOR MAXIMA --	TD = 6.2600	TV = 2.5500	TA = 6.2200

PER = 5.20 TIMES FOR MAXIMA -- TD = 6.2600 TV = 2.5500 TA = 6.2200
PER = 5.40 TIMES FOR MAXIMA -- TD = 6.2600 TV = 2.5500 TA = 6.2200
PER = 5.60 TIMES FOR MAXIMA -- TD = 6.4700 TV = 2.5500 TA = 6.2200
PER = 5.80 TIMES FOR MAXIMA -- TD = 6.4700 TV = 2.5500 TA = 6.2200
PER = 6.00 TIMES FOR MAXIMA -- TD = 6.4800 TV = 2.5500 TA = 6.2200
PER = 6.20 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.5300
PER = 6.40 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 6.60 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 6.80 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 7.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 7.30 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 7.60 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 8.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 8.50 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 9.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 9.50 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER =10.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900

SPECTRAL VALUES--

(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00007	0.00171	0.04195	0.82192	0.81858	100.00
2	0.02	0.00027	0.04335	0.08336	0.82243	0.81328	50.00
3	0.03	0.00110	0.18379	0.22974	1.51822	1.49432	33.33
4	0.04	0.00217	0.31642	0.34155	1.74493	1.66617	25.00
5	0.05	0.00366	0.44677	0.45974	1.82459	1.79417	20.00
6	0.06	0.00428	0.41585	0.44797	1.42638	1.45686	16.67
7	0.07	0.00581	0.47802	0.52194	1.47018	1.45494	14.29
8	0.08	0.01091	0.79906	0.85696	2.13704	2.09023	12.50
9	0.09	0.01380	0.91960	0.96375	2.07701	2.08952	11.11
10	0.10	0.01203	0.70258	0.75557	1.50682	1.47435	10.00
11	0.11	0.01243	0.73464	0.71011	1.28682	1.25967	9.09
12	0.12	0.01009	0.54647	0.52809	0.85116	0.85872	8.33
13	0.13	0.01069	0.46673	0.51688	0.78573	0.77583	7.69
14	0.14	0.01281	0.55624	0.57507	0.81192	0.80152	7.14
15	0.15	0.01487	0.56239	0.62302	0.80252	0.81046	6.67
16	0.16	0.01884	0.75229	0.73986	0.91472	0.90230	6.25
17	0.17	0.02303	0.86039	0.85120	0.97551	0.97703	5.88
18	0.18	0.02485	0.86020	0.86750	0.93942	0.94042	5.56
19	0.19	0.02857	0.87770	0.94490	0.97165	0.97042	5.26
20	0.20	0.02938	0.95448	0.92312	0.90821	0.90064	5.00
21	0.21	0.03784	1.14946	1.13222	1.05638	1.05204	4.76
22	0.22	0.03804	1.12843	1.08630	0.97513	0.96349	4.55
23	0.23	0.04244	1.13944	1.15933	0.98812	0.98357	4.35
24	0.24	0.04588	1.22517	1.20103	0.98291	0.97648	4.17
25	0.25	0.05505	1.45180	1.38356	1.07767	1.07990	4.00
26	0.26	0.06352	1.64419	1.53498	1.15887	1.15200	3.85
27	0.27	0.06397	1.49739	1.48854	1.07894	1.07578	3.70
28	0.28	0.06108	1.44705	1.37074	0.96463	0.95526	3.57
29	0.29	0.06330	1.50041	1.37148	0.92871	0.92282	3.45
30	0.30	0.06799	1.58132	1.42398	0.92831	0.92621	3.33
31	0.31	0.07450	1.56110	1.50998	0.95436	0.95046	3.23
32	0.32	0.07866	1.60487	1.54449	0.94665	0.94180	3.13
33	0.33	0.07637	1.45088	1.45416	0.86887	0.85985	3.03
34	0.34	0.07200	1.33968	1.33047	0.77205	0.76357	2.94
35	0.35	0.06812	1.34283	1.22295	0.68539	0.68181	2.86
36	0.36	0.06715	1.33822	1.17200	0.64080	0.63526	2.78
37	0.37	0.06656	1.28137	1.13028	0.60109	0.59609	2.70
38	0.38	0.06468	1.25981	1.06944	0.55415	0.54916	2.63
39	0.39	0.06068	1.23910	0.97764	0.49358	0.48915	2.56
40	0.40	0.06370	1.17128	1.00062	0.49250	0.48813	2.50

41	0.41	0.06256	1.18616	0.95865	0.45808	0.45625	2.44
42	0.42	0.06037	1.19616	0.90309	0.42280	0.41957	2.38
43	0.43	0.05966	1.15192	0.87180	0.39751	0.39561	2.33
44	0.44	0.05930	1.07742	0.84685	0.37888	0.37556	2.27
45	0.45	0.05866	0.99663	0.81904	0.35661	0.35515	2.22
46	0.46	0.05718	0.90387	0.78104	0.33309	0.33131	2.17
47	0.47	0.05473	0.84874	0.73170	0.30536	0.30378	2.13
48	0.48	0.05130	0.84985	0.67155	0.27399	0.27300	2.08
49	0.49	0.05240	0.81367	0.67192	0.26905	0.26757	2.04
50	0.50	0.05402	0.80880	0.67886	0.26657	0.26493	2.00
51	0.51	0.05288	0.83519	0.65150	0.25161	0.24927	1.96
52	0.52	0.05027	0.87985	0.60736	0.22945	0.22791	1.92
53	0.53	0.05172	0.93855	0.61319	0.22691	0.22576	1.89
54	0.54	0.05617	1.00433	0.65351	0.23851	0.23615	1.85
55	0.55	0.06000	1.06884	0.68548	0.24516	0.24320	1.82
56	0.56	0.06644	1.12386	0.74544	0.26427	0.25974	1.79
57	0.57	0.07374	1.16245	0.81287	0.28269	0.27827	1.75
58	0.58	0.08007	1.17982	0.86741	0.29612	0.29182	1.72
59	0.60	0.08866	1.14420	0.92849	0.30613	0.30196	1.67
60	0.62	0.09140	1.02596	0.92630	0.29378	0.29153	1.61
61	0.64	0.08974	1.03125	0.88106	0.26991	0.26863	1.56
62	0.66	0.08366	1.08019	0.79642	0.23773	0.23546	1.52
63	0.68	0.07428	1.06790	0.68631	0.19773	0.19694	1.47
64	0.70	0.06678	1.00885	0.59944	0.16771	0.16710	1.43
65	0.72	0.06933	0.92792	0.60506	0.16570	0.16398	1.39
66	0.74	0.06680	0.83311	0.56721	0.15157	0.14957	1.35
67	0.76	0.06220	0.75200	0.51422	0.13421	0.13203	1.32
68	0.78	0.05906	0.72919	0.47575	0.12066	0.11902	1.28
69	0.80	0.06091	0.71267	0.47839	0.11739	0.11669	1.25
70	0.82	0.06283	0.70235	0.48142	0.11542	0.11456	1.22
71	0.84	0.06816	0.71704	0.50982	0.12036	0.11843	1.19
72	0.86	0.07687	0.74262	0.56162	0.12907	0.12743	1.16
73	0.88	0.08600	0.77734	0.61406	0.13751	0.13616	1.14
74	0.90	0.09759	0.79993	0.68129	0.14881	0.14771	1.11
75	0.92	0.10954	0.86595	0.74812	0.15920	0.15868	1.09
76	0.94	0.11962	0.95982	0.79954	0.16788	0.16597	1.06
77	0.96	0.12541	1.02877	0.82083	0.16974	0.16684	1.04
78	0.98	0.12810	1.05347	0.82127	0.16447	0.16353	1.02
79	1.00	0.13647	1.06090	0.85746	0.16889	0.16732	1.00
80	1.05	0.14854	1.12673	0.88885	0.16702	0.16518	0.95
81	1.10	0.15387	1.13175	0.87890	0.15746	0.15591	0.91
82	1.15	0.14959	1.17120	0.81732	0.14084	0.13868	0.87
83	1.20	0.14036	1.18130	0.73495	0.12010	0.11951	0.83
84	1.25	0.13601	1.17059	0.68368	0.10739	0.10672	0.80
85	1.30	0.13061	1.14666	0.63128	0.09671	0.09475	0.77
86	1.35	0.12893	1.11542	0.60008	0.08915	0.08674	0.74
87	1.40	0.12537	1.08104	0.56265	0.08085	0.07842	0.71
88	1.45	0.12030	1.04630	0.52129	0.07258	0.07015	0.69
89	1.50	0.11476	1.01286	0.48069	0.06478	0.06253	0.67
90	1.55	0.10878	0.98162	0.44095	0.05766	0.05551	0.65
91	1.60	0.10271	0.95297	0.40335	0.05129	0.04919	0.63
92	1.65	0.09704	0.92697	0.36955	0.04565	0.04370	0.61
93	1.70	0.09180	0.90352	0.33927	0.04070	0.03894	0.59
94	1.75	0.09076	0.88242	0.32585	0.03720	0.03633	0.57
95	1.80	0.09549	0.86342	0.33334	0.03725	0.03614	0.56
96	1.85	0.09582	0.84627	0.32543	0.03556	0.03432	0.54
97	1.90	0.09635	0.83074	0.31862	0.03353	0.03272	0.53
98	1.95	0.09936	0.81662	0.32016	0.03318	0.03204	0.51
99	2.00	0.10823	0.80374	0.34003	0.03435	0.03317	0.50
100	2.05	0.11706	0.79193	0.35877	0.03544	0.03415	0.49
101	2.10	0.12401	0.78107	0.37104	0.03586	0.03448	0.48

102	2.15	0.12967	0.77105	0.37894	0.03573	0.03439	0.47
103	2.20	0.13671	0.76177	0.39044	0.03518	0.03463	0.45
104	2.25	0.14201	0.75315	0.39657	0.03481	0.03439	0.44
105	2.30	0.14953	0.74515	0.40849	0.03535	0.03466	0.43
106	2.35	0.15353	0.73769	0.41049	0.03452	0.03408	0.43
107	2.40	0.15782	0.73074	0.41317	0.03399	0.03359	0.42
108	2.50	0.16052	0.71820	0.40344	0.03180	0.03149	0.40
109	2.60	0.16493	0.70726	0.39857	0.03037	0.02991	0.38
110	2.70	0.16824	0.69772	0.39151	0.02956	0.02829	0.37
111	2.80	0.17313	0.68944	0.38851	0.02827	0.02707	0.36
112	2.90	0.17573	0.68225	0.38075	0.02670	0.02562	0.34
113	3.00	0.17624	0.67604	0.36911	0.02498	0.02401	0.33
114	3.10	0.18240	0.67068	0.36968	0.02391	0.02327	0.32
115	3.20	0.18800	0.66610	0.36914	0.02315	0.02251	0.31
116	3.30	0.19088	0.66221	0.36343	0.02213	0.02149	0.30
117	3.40	0.19114	0.65890	0.35323	0.02089	0.02027	0.29
118	3.50	0.18855	0.65614	0.33849	0.01960	0.01887	0.29
119	3.60	0.18358	0.65386	0.32040	0.01815	0.01737	0.28
120	3.70	0.18463	0.65196	0.31354	0.01716	0.01654	0.27
121	3.80	0.18252	0.65044	0.30178	0.01623	0.01550	0.26
122	3.90	0.17770	0.64924	0.28629	0.01514	0.01432	0.26
123	4.00	0.17042	0.64831	0.26769	0.01393	0.01306	0.25
124	4.10	0.17053	0.64762	0.26134	0.01297	0.01244	0.24
125	4.20	0.17579	0.64713	0.26299	0.01273	0.01222	0.24
126	4.30	0.17994	0.64684	0.26293	0.01248	0.01193	0.23
127	4.40	0.18295	0.64670	0.26125	0.01217	0.01159	0.23
128	4.50	0.18495	0.64668	0.25824	0.01180	0.01120	0.22
129	4.60	0.18589	0.64682	0.25391	0.01140	0.01077	0.22
130	4.70	0.18585	0.64703	0.24845	0.01096	0.01032	0.21
131	4.80	0.18495	0.64733	0.24209	0.01050	0.00984	0.21
132	4.90	0.18336	0.64771	0.23511	0.01004	0.00936	0.20
133	5.00	0.18105	0.64813	0.22752	0.00956	0.00888	0.20
134	5.10	0.17813	0.64865	0.21946	0.00909	0.00840	0.20
135	5.20	0.17468	0.64916	0.21107	0.00862	0.00792	0.19
136	5.40	0.16651	0.65031	0.19375	0.00771	0.00700	0.19
137	5.60	0.16025	0.65159	0.17980	0.00686	0.00627	0.18
138	5.80	0.15264	0.65291	0.16536	0.00607	0.00556	0.17
139	6.00	0.14415	0.65430	0.15096	0.00536	0.00491	0.17
140	6.20	0.14369	0.65562	0.14562	0.00501	0.00458	0.16
141	6.40	0.14541	0.65698	0.14276	0.00478	0.00435	0.16
142	6.60	0.14651	0.65833	0.13947	0.00455	0.00412	0.15
143	6.80	0.14706	0.65959	0.13588	0.00433	0.00390	0.15
144	7.00	0.14716	0.66086	0.13209	0.00411	0.00368	0.14
145	7.30	0.14656	0.66269	0.12615	0.00380	0.00337	0.14
146	7.60	0.14526	0.66446	0.12009	0.00351	0.00308	0.13
147	8.00	0.14272	0.66661	0.11209	0.00316	0.00273	0.13
148	8.50	0.13864	0.66906	0.10248	0.00277	0.00235	0.12
149	9.00	0.13396	0.67127	0.09352	0.00243	0.00203	0.11
150	9.50	0.12900	0.67322	0.08532	0.00214	0.00175	0.11
151	10.00	0.12397	0.67505	0.07789	0.00190	0.00152	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.
AREA OF ACC. RESPONSE SPECTRUM = 0.495
AREA OF VEL. RESPONSE SPECTRUM = 2.289
MAX. ACCELERATION RESPONSE VALUE = 1.507
MAX. VELOCITY RESPONSE VALUE = 1.644

1****** OPTION 9 *** COMPUTE RESPONSE SPECTRUM
RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER 17
CALCULATED FOR DAMPING 0.050

TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
TD = TIME FOR MAX. RELATIVE DISP.
TV = TIME FOR MAX. RELATIVE VEL.
TA = TIME FOR MAX. ABSOLUTE ACC.
DAMPING RATIO = 0.050

PER = 0.01	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5700	TA = 2.5700
PER = 0.02	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5800	TA = 2.5700
PER = 0.03	TIMES FOR MAXIMA --	TD = 2.9500	TV = 2.9400	TA = 2.9500
PER = 0.04	TIMES FOR MAXIMA --	TD = 3.6300	TV = 2.6100	TA = 3.6300
PER = 0.05	TIMES FOR MAXIMA --	TD = 4.8700	TV = 4.8300	TA = 4.8400
PER = 0.06	TIMES FOR MAXIMA --	TD = 4.3200	TV = 4.3300	TA = 1.9700
PER = 0.07	TIMES FOR MAXIMA --	TD = 4.3300	TV = 4.3100	TA = 4.3300
PER = 0.08	TIMES FOR MAXIMA --	TD = 2.5200	TV = 2.5400	TA = 2.5200
PER = 0.09	TIMES FOR MAXIMA --	TD = 2.5300	TV = 2.6000	TA = 2.5300
PER = 0.10	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.6100	TA = 2.5900
PER = 0.11	TIMES FOR MAXIMA --	TD = 2.5500	TV = 2.5800	TA = 2.5500
PER = 0.12	TIMES FOR MAXIMA --	TD = 4.8000	TV = 2.5800	TA = 4.8000
PER = 0.13	TIMES FOR MAXIMA --	TD = 3.6600	TV = 4.7900	TA = 3.6600
PER = 0.14	TIMES FOR MAXIMA --	TD = 3.6700	TV = 3.7100	TA = 3.6700
PER = 0.15	TIMES FOR MAXIMA --	TD = 3.6800	TV = 3.7200	TA = 3.6800
PER = 0.16	TIMES FOR MAXIMA --	TD = 4.1800	TV = 4.1500	TA = 4.1800
PER = 0.17	TIMES FOR MAXIMA --	TD = 4.1100	TV = 4.1500	TA = 4.1100
PER = 0.18	TIMES FOR MAXIMA --	TD = 2.5600	TV = 2.5200	TA = 2.5600
PER = 0.19	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5300	TA = 2.5700
PER = 0.20	TIMES FOR MAXIMA --	TD = 6.6100	TV = 2.5300	TA = 6.6000
PER = 0.21	TIMES FOR MAXIMA --	TD = 2.5800	TV = 2.5300	TA = 7.0500
PER = 0.22	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5500	TA = 2.5000
PER = 0.23	TIMES FOR MAXIMA --	TD = 3.4200	TV = 7.0400	TA = 6.9800
PER = 0.24	TIMES FOR MAXIMA --	TD = 2.2400	TV = 2.2900	TA = 2.2300
PER = 0.25	TIMES FOR MAXIMA --	TD = 6.2400	TV = 6.3100	TA = 6.2400
PER = 0.26	TIMES FOR MAXIMA --	TD = 1.5600	TV = 6.3200	TA = 6.2500
PER = 0.27	TIMES FOR MAXIMA --	TD = 1.1900	TV = 1.2600	TA = 1.1900
PER = 0.28	TIMES FOR MAXIMA --	TD = 1.2100	TV = 1.2600	TA = 1.2000
PER = 0.29	TIMES FOR MAXIMA --	TD = 1.2100	TV = 5.1000	TA = 1.2100
PER = 0.30	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.8400	TA = 2.9100
PER = 0.31	TIMES FOR MAXIMA --	TD = 2.9400	TV = 2.8500	TA = 2.9400
PER = 0.32	TIMES FOR MAXIMA --	TD = 2.9500	TV = 2.5600	TA = 2.9500
PER = 0.33	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5600	TA = 2.5000
PER = 0.34	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5600	TA = 2.5000
PER = 0.35	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.5600	TA = 2.5000
PER = 0.36	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.9300	TA = 2.5000
PER = 0.37	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6000	TA = 2.5000
PER = 0.38	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.8000	TA = 2.5100
PER = 0.39	TIMES FOR MAXIMA --	TD = 2.5200	TV = 4.0300	TA = 2.5100
PER = 0.40	TIMES FOR MAXIMA --	TD = 3.9400	TV = 4.0300	TA = 3.9400
PER = 0.41	TIMES FOR MAXIMA --	TD = 3.9500	TV = 4.0400	TA = 3.9500
PER = 0.42	TIMES FOR MAXIMA --	TD = 3.9600	TV = 4.0400	TA = 3.9500
PER = 0.43	TIMES FOR MAXIMA --	TD = 3.9700	TV = 4.0500	TA = 3.9600
PER = 0.44	TIMES FOR MAXIMA --	TD = 3.9800	TV = 3.9100	TA = 3.9700
PER = 0.45	TIMES FOR MAXIMA --	TD = 4.6900	TV = 3.9100	TA = 4.6900
PER = 0.46	TIMES FOR MAXIMA --	TD = 4.7000	TV = 3.9100	TA = 4.6900
PER = 0.47	TIMES FOR MAXIMA --	TD = 4.7100	TV = 3.9100	TA = 4.7000
PER = 0.48	TIMES FOR MAXIMA --	TD = 4.7100	TV = 3.9100	TA = 4.7000
PER = 0.49	TIMES FOR MAXIMA --	TD = 5.5200	TV = 5.4100	TA = 5.5100
PER = 0.50	TIMES FOR MAXIMA --	TD = 5.5500	TV = 5.4100	TA = 5.5400
PER = 0.51	TIMES FOR MAXIMA --	TD = 5.5600	TV = 5.4100	TA = 5.5600
PER = 0.52	TIMES FOR MAXIMA --	TD = 2.5100	TV = 5.4400	TA = 2.5000
PER = 0.53	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6100	TA = 2.5000
PER = 0.54	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6300	TA = 2.5000
PER = 0.55	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6400	TA = 2.5000
PER = 0.56	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6400	TA = 2.5000

PER = 0.57	TIMES FOR MAXIMA --	TD = 2.5200	TV = 2.6400	TA = 2.5100
PER = 0.58	TIMES FOR MAXIMA --	TD = 2.5200	TV = 2.6400	TA = 2.5100
PER = 0.60	TIMES FOR MAXIMA --	TD = 2.5400	TV = 2.4800	TA = 2.5300
PER = 0.62	TIMES FOR MAXIMA --	TD = 2.5600	TV = 2.4800	TA = 2.5500
PER = 0.64	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.4800	TA = 2.5800
PER = 0.66	TIMES FOR MAXIMA --	TD = 2.6000	TV = 2.4900	TA = 2.5900
PER = 0.68	TIMES FOR MAXIMA --	TD = 3.4100	TV = 2.4900	TA = 3.4000
PER = 0.70	TIMES FOR MAXIMA --	TD = 3.4200	TV = 2.4900	TA = 3.4100
PER = 0.72	TIMES FOR MAXIMA --	TD = 3.4300	TV = 3.6100	TA = 3.4200
PER = 0.74	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.6100	TA = 3.4300
PER = 0.76	TIMES FOR MAXIMA --	TD = 1.8100	TV = 3.6100	TA = 1.7500
PER = 0.78	TIMES FOR MAXIMA --	TD = 1.4700	TV = 3.6100	TA = 1.8100
PER = 0.80	TIMES FOR MAXIMA --	TD = 1.4700	TV = 3.6100	TA = 1.4600
PER = 0.82	TIMES FOR MAXIMA --	TD = 1.4900	TV = 3.6100	TA = 1.4700
PER = 0.84	TIMES FOR MAXIMA --	TD = 6.4900	TV = 3.6200	TA = 6.4800
PER = 0.86	TIMES FOR MAXIMA --	TD = 3.4700	TV = 4.2200	TA = 3.4700
PER = 0.88	TIMES FOR MAXIMA --	TD = 4.0000	TV = 4.2200	TA = 3.9700
PER = 0.90	TIMES FOR MAXIMA --	TD = 4.0100	TV = 4.2200	TA = 4.0000
PER = 0.92	TIMES FOR MAXIMA --	TD = 4.0100	TV = 4.2900	TA = 4.0000
PER = 0.94	TIMES FOR MAXIMA --	TD = 3.1200	TV = 4.2900	TA = 3.1100
PER = 0.96	TIMES FOR MAXIMA --	TD = 3.1200	TV = 3.9100	TA = 3.1100
PER = 0.98	TIMES FOR MAXIMA --	TD = 3.1300	TV = 3.9100	TA = 3.1200
PER = 1.00	TIMES FOR MAXIMA --	TD = 3.1500	TV = 3.9100	TA = 3.1200
PER = 1.05	TIMES FOR MAXIMA --	TD = 3.2000	TV = 3.9100	TA = 3.1800
PER = 1.10	TIMES FOR MAXIMA --	TD = 3.2300	TV = 2.4900	TA = 3.2200
PER = 1.15	TIMES FOR MAXIMA --	TD = 3.3000	TV = 2.4900	TA = 3.2900
PER = 1.20	TIMES FOR MAXIMA --	TD = 3.3300	TV = 2.4900	TA = 3.3100
PER = 1.25	TIMES FOR MAXIMA --	TD = 3.3500	TV = 2.4900	TA = 3.3300
PER = 1.30	TIMES FOR MAXIMA --	TD = 3.3700	TV = 2.4900	TA = 3.3600
PER = 1.35	TIMES FOR MAXIMA --	TD = 2.8400	TV = 2.4900	TA = 2.8200
PER = 1.40	TIMES FOR MAXIMA --	TD = 2.8700	TV = 2.4900	TA = 2.8300
PER = 1.45	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.4900	TA = 2.8600
PER = 1.50	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.4900	TA = 2.8900
PER = 1.55	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.4900	TA = 2.9100
PER = 1.60	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.4900	TA = 2.9100
PER = 1.65	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.4900	TA = 2.9100
PER = 1.70	TIMES FOR MAXIMA --	TD = 2.9900	TV = 2.4900	TA = 2.3700
PER = 1.75	TIMES FOR MAXIMA --	TD = 2.3900	TV = 2.4900	TA = 2.3700
PER = 1.80	TIMES FOR MAXIMA --	TD = 5.9300	TV = 2.4900	TA = 5.9200
PER = 1.85	TIMES FOR MAXIMA --	TD = 6.0000	TV = 2.4900	TA = 5.9900
PER = 1.90	TIMES FOR MAXIMA --	TD = 6.0500	TV = 5.7600	TA = 6.0400
PER = 1.95	TIMES FOR MAXIMA --	TD = 5.3500	TV = 5.7600	TA = 5.3400
PER = 2.00	TIMES FOR MAXIMA --	TD = 5.3600	TV = 5.7600	TA = 5.3400
PER = 2.05	TIMES FOR MAXIMA --	TD = 5.3600	TV = 5.7600	TA = 5.3400
PER = 2.10	TIMES FOR MAXIMA --	TD = 5.3600	TV = 5.7600	TA = 5.3400
PER = 2.15	TIMES FOR MAXIMA --	TD = 8.7100	TV = 5.7600	TA = 5.3400
PER = 2.20	TIMES FOR MAXIMA --	TD = 8.8100	TV = 5.7600	TA = 7.6700
PER = 2.25	TIMES FOR MAXIMA --	TD = 8.8900	TV = 5.7600	TA = 8.8800
PER = 2.30	TIMES FOR MAXIMA --	TD = 7.8200	TV = 5.7600	TA = 8.8800
PER = 2.35	TIMES FOR MAXIMA --	TD = 7.8800	TV = 5.7600	TA = 7.7900
PER = 2.40	TIMES FOR MAXIMA --	TD = 7.9100	TV = 5.7600	TA = 7.8800
PER = 2.50	TIMES FOR MAXIMA --	TD = 8.0300	TV = 7.3100	TA = 8.0100
PER = 2.60	TIMES FOR MAXIMA --	TD = 8.0600	TV = 7.6400	TA = 8.0200
PER = 2.70	TIMES FOR MAXIMA --	TD = 6.9400	TV = 7.6400	TA = 6.8800
PER = 2.80	TIMES FOR MAXIMA --	TD = 6.9400	TV = 7.6500	TA = 6.8800
PER = 2.90	TIMES FOR MAXIMA --	TD = 7.0600	TV = 7.6500	TA = 6.9300
PER = 3.00	TIMES FOR MAXIMA --	TD = 7.1500	TV = 7.6500	TA = 7.0400
PER = 3.10	TIMES FOR MAXIMA --	TD = 7.1900	TV = 5.3000	TA = 7.1400
PER = 3.20	TIMES FOR MAXIMA --	TD = 7.2000	TV = 5.3000	TA = 7.1400
PER = 3.30	TIMES FOR MAXIMA --	TD = 7.2100	TV = 5.3000	TA = 7.1800
PER = 3.40	TIMES FOR MAXIMA --	TD = 7.2100	TV = 5.3000	TA = 7.1800

PER = 3.50 TIMES FOR MAXIMA -- TD = 7.2200 TV = 5.3000 TA = 7.1900
PER = 3.60 TIMES FOR MAXIMA -- TD = 7.4500 TV = 5.3000 TA = 7.3800
PER = 3.70 TIMES FOR MAXIMA -- TD = 7.4600 TV = 5.3000 TA = 7.3900
PER = 3.80 TIMES FOR MAXIMA -- TD = 7.5000 TV = 5.3000 TA = 7.4400
PER = 3.90 TIMES FOR MAXIMA -- TD = 7.5100 TV = 5.3000 TA = 7.4500
PER = 4.00 TIMES FOR MAXIMA -- TD = 7.6200 TV = 5.3000 TA = 7.4500
PER = 4.10 TIMES FOR MAXIMA -- TD = 6.1600 TV = 5.3000 TA = 6.0900
PER = 4.20 TIMES FOR MAXIMA -- TD = 6.1600 TV = 5.3000 TA = 6.1400
PER = 4.30 TIMES FOR MAXIMA -- TD = 6.1700 TV = 5.3000 TA = 6.1500
PER = 4.40 TIMES FOR MAXIMA -- TD = 6.1900 TV = 5.3000 TA = 6.1500
PER = 4.50 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.60 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.70 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.80 TIMES FOR MAXIMA -- TD = 6.3400 TV = 5.3000 TA = 6.1500
PER = 4.90 TIMES FOR MAXIMA -- TD = 6.3400 TV = 5.3000 TA = 6.1500
PER = 5.00 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.10 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.20 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.40 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.60 TIMES FOR MAXIMA -- TD = 6.5400 TV = 5.3000 TA = 6.3200
PER = 5.80 TIMES FOR MAXIMA -- TD = 6.5500 TV = 5.3000 TA = 6.5000
PER = 6.00 TIMES FOR MAXIMA -- TD = 6.5500 TV = 5.3000 TA = 6.5000
PER = 6.20 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.5200
PER = 6.40 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.7300
PER = 6.60 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.7300
PER = 6.80 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.30 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.60 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 8.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 8.50 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 9.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 9.50 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER =10.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300

SPECTRAL VALUES--
(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00005	0.00136	0.02849	0.55850	0.55584	100.00
2	0.02	0.00018	0.04499	0.05569	0.55907	0.54337	50.00
3	0.03	0.00100	0.17299	0.21036	1.35502	1.36825	33.33
4	0.04	0.00178	0.23944	0.27972	1.41661	1.36454	25.00
5	0.05	0.00238	0.31660	0.29913	1.19625	1.16738	20.00
6	0.06	0.00324	0.37402	0.33931	1.11290	1.10350	16.67
7	0.07	0.00410	0.42586	0.36768	1.00192	1.02494	14.29
8	0.08	0.00662	0.49285	0.51989	1.30592	1.26808	12.50
9	0.09	0.01058	0.74261	0.73891	1.61391	1.60203	11.11
10	0.10	0.00992	0.62974	0.62356	1.19459	1.21675	10.00
11	0.11	0.00945	0.61752	0.53978	0.94469	0.95753	9.09
12	0.12	0.00955	0.45760	0.49991	0.83422	0.81289	8.33
13	0.13	0.00942	0.48076	0.45526	0.67574	0.68335	7.69
14	0.14	0.01238	0.51781	0.55546	0.77129	0.77420	7.14
15	0.15	0.01197	0.53788	0.50127	0.65502	0.65209	6.67
16	0.16	0.01428	0.62039	0.56072	0.68796	0.68383	6.25
17	0.17	0.01619	0.69957	0.59823	0.69353	0.68666	5.88
18	0.18	0.01573	0.57102	0.54919	0.60640	0.59536	5.56
19	0.19	0.01745	0.63990	0.57695	0.59795	0.59253	5.26
20	0.20	0.01613	0.56661	0.50682	0.50024	0.49448	5.00
21	0.21	0.01674	0.60435	0.50091	0.46688	0.46544	4.76
22	0.22	0.01774	0.54424	0.50670	0.46072	0.44942	4.55
23	0.23	0.01530	0.47636	0.41797	0.35437	0.35460	4.35

24	0.24	0.01639	0.46797	0.42917	0.35591	0.34893	4.17
25	0.25	0.01736	0.48167	0.43619	0.34254	0.34046	4.00
26	0.26	0.01916	0.51490	0.46302	0.35118	0.34750	3.85
27	0.27	0.02110	0.53368	0.49104	0.35711	0.35488	3.70
28	0.28	0.02280	0.53679	0.51153	0.35936	0.35648	3.57
29	0.29	0.02363	0.56432	0.51192	0.34832	0.34445	3.45
30	0.30	0.02424	0.55960	0.50764	0.33261	0.33018	3.33
31	0.31	0.02969	0.62717	0.60171	0.38143	0.37875	3.23
32	0.32	0.03087	0.64924	0.60610	0.37197	0.36959	3.13
33	0.33	0.02956	0.62054	0.56290	0.33676	0.33284	3.03
34	0.34	0.02988	0.59171	0.55227	0.32331	0.31695	2.94
35	0.35	0.03145	0.58062	0.56451	0.32000	0.31472	2.86
36	0.36	0.03369	0.56893	0.58806	0.32211	0.31875	2.78
37	0.37	0.03527	0.58074	0.59894	0.31687	0.31587	2.70
38	0.38	0.03518	0.57848	0.58166	0.30335	0.29868	2.63
39	0.39	0.03387	0.62913	0.54565	0.27671	0.27301	2.56
40	0.40	0.03589	0.68918	0.56383	0.27621	0.27505	2.50
41	0.41	0.03816	0.69282	0.58485	0.27999	0.27835	2.44
42	0.42	0.03860	0.65645	0.57750	0.26954	0.26830	2.38
43	0.43	0.03804	0.60516	0.55578	0.25364	0.25221	2.33
44	0.44	0.03681	0.59581	0.52568	0.23464	0.23313	2.27
45	0.45	0.03653	0.60067	0.51004	0.22154	0.22117	2.22
46	0.46	0.03729	0.59047	0.50937	0.21665	0.21607	2.17
47	0.47	0.03606	0.57052	0.48207	0.20332	0.20014	2.13
48	0.48	0.03349	0.54379	0.43835	0.18014	0.17820	2.08
49	0.49	0.03413	0.51793	0.43769	0.17566	0.17430	2.04
50	0.50	0.03500	0.52157	0.43985	0.17218	0.17165	2.00
51	0.51	0.03473	0.49075	0.42793	0.16499	0.16373	1.96
52	0.52	0.03363	0.45429	0.40638	0.15517	0.15249	1.92
53	0.53	0.03853	0.46746	0.45674	0.17096	0.16816	1.89
54	0.54	0.04389	0.51448	0.51070	0.18737	0.18454	1.85
55	0.55	0.04926	0.55886	0.56278	0.20245	0.19966	1.82
56	0.56	0.05415	0.59863	0.60760	0.21441	0.21172	1.79
57	0.57	0.05848	0.62378	0.64468	0.22381	0.22070	1.75
58	0.58	0.06184	0.63106	0.66986	0.22829	0.22536	1.72
59	0.60	0.06544	0.70068	0.68529	0.22393	0.22287	1.67
60	0.62	0.06573	0.79556	0.66617	0.21124	0.20966	1.61
61	0.64	0.06527	0.83826	0.64083	0.19701	0.19538	1.56
62	0.66	0.06037	0.83336	0.57472	0.17238	0.16992	1.52
63	0.68	0.05937	0.78867	0.54857	0.15814	0.15742	1.47
64	0.70	0.06308	0.71314	0.56623	0.15969	0.15784	1.43
65	0.72	0.06124	0.63612	0.53441	0.14674	0.14483	1.39
66	0.74	0.05637	0.58189	0.47867	0.12760	0.12622	1.35
67	0.76	0.05182	0.52189	0.42839	0.11039	0.10999	1.32
68	0.78	0.05224	0.48141	0.42084	0.10620	0.10528	1.28
69	0.80	0.05347	0.46947	0.41997	0.10299	0.10244	1.25
70	0.82	0.05454	0.48106	0.41789	0.09999	0.09944	1.22
71	0.84	0.05857	0.50396	0.43810	0.10258	0.10177	1.19
72	0.86	0.06521	0.56033	0.47640	0.10880	0.10809	1.16
73	0.88	0.07540	0.63272	0.53836	0.11994	0.11938	1.14
74	0.90	0.08642	0.69483	0.60330	0.13206	0.13080	1.11
75	0.92	0.09546	0.73421	0.65194	0.14025	0.13828	1.09
76	0.94	0.10261	0.79469	0.68589	0.14302	0.14238	1.06
77	0.96	0.11124	0.85758	0.72810	0.14917	0.14799	1.04
78	0.98	0.11832	0.92962	0.75859	0.15264	0.15105	1.02
79	1.00	0.12378	0.97242	0.77774	0.15296	0.15176	1.00
80	1.05	0.13543	0.94462	0.81038	0.15223	0.15060	0.95
81	1.10	0.13936	0.91425	0.79602	0.14229	0.14121	0.91
82	1.15	0.13942	0.92776	0.76173	0.12990	0.12925	0.87
83	1.20	0.13742	0.91717	0.71955	0.11796	0.11700	0.83
84	1.25	0.13052	0.89112	0.65605	0.10342	0.10241	0.80

85	1.30	0.12014	0.85653	0.58064	0.08786	0.08715	0.77
86	1.35	0.11483	0.81840	0.53443	0.07843	0.07725	0.74
87	1.40	0.11078	0.78000	0.49719	0.06994	0.06930	0.71
88	1.45	0.10667	0.74332	0.46222	0.06255	0.06220	0.69
89	1.50	0.10247	0.70939	0.42921	0.05627	0.05583	0.67
90	1.55	0.09800	0.67864	0.39727	0.05054	0.05001	0.65
91	1.60	0.09315	0.65110	0.36578	0.04533	0.04461	0.63
92	1.65	0.08827	0.62659	0.33614	0.04056	0.03975	0.61
93	1.70	0.08406	0.60485	0.31070	0.03642	0.03566	0.59
94	1.75	0.08232	0.58554	0.29557	0.03416	0.03296	0.57
95	1.80	0.08511	0.56835	0.29710	0.03252	0.03221	0.56
96	1.85	0.09046	0.55299	0.30724	0.03299	0.03241	0.54
97	1.90	0.09369	0.55264	0.30982	0.03228	0.03182	0.53
98	1.95	0.09719	0.57669	0.31317	0.03199	0.03134	0.51
99	2.00	0.10618	0.59049	0.33357	0.03334	0.03254	0.50
100	2.05	0.11329	0.59503	0.34724	0.03395	0.03305	0.49
101	2.10	0.11848	0.59178	0.35449	0.03395	0.03294	0.48
102	2.15	0.12507	0.58239	0.36551	0.03345	0.03317	0.47
103	2.20	0.13231	0.56849	0.37788	0.03396	0.03352	0.45
104	2.25	0.14127	0.55156	0.39451	0.03461	0.03421	0.44
105	2.30	0.14555	0.53286	0.39762	0.03432	0.03373	0.43
106	2.35	0.15032	0.51341	0.40191	0.03358	0.03337	0.43
107	2.40	0.15378	0.49399	0.40260	0.03307	0.03273	0.42
108	2.50	0.16045	0.47493	0.40326	0.03175	0.03148	0.40
109	2.60	0.16086	0.46775	0.38874	0.02958	0.02918	0.38
110	2.70	0.16244	0.48295	0.37802	0.02799	0.02732	0.37
111	2.80	0.16553	0.48384	0.37144	0.02643	0.02589	0.36
112	2.90	0.16738	0.47446	0.36265	0.02483	0.02440	0.34
113	3.00	0.17264	0.45662	0.36159	0.02380	0.02352	0.33
114	3.10	0.17811	0.44595	0.36099	0.02309	0.02272	0.32
115	3.20	0.18202	0.45345	0.35740	0.02213	0.02179	0.31
116	3.30	0.18346	0.46135	0.34931	0.02109	0.02065	0.30
117	3.40	0.18236	0.46940	0.33701	0.01986	0.01934	0.29
118	3.50	0.17866	0.47735	0.32073	0.01848	0.01788	0.29
119	3.60	0.17795	0.48496	0.31058	0.01717	0.01683	0.28
120	3.70	0.17716	0.49200	0.30084	0.01615	0.01587	0.27
121	3.80	0.17389	0.49830	0.28752	0.01510	0.01476	0.26
122	3.90	0.16892	0.50375	0.27215	0.01394	0.01362	0.26
123	4.00	0.16257	0.50827	0.25536	0.01270	0.01246	0.25
124	4.10	0.16720	0.51183	0.25624	0.01240	0.01220	0.24
125	4.20	0.17130	0.51442	0.25627	0.01215	0.01191	0.24
126	4.30	0.17439	0.51608	0.25482	0.01186	0.01156	0.23
127	4.40	0.17660	0.51685	0.25219	0.01151	0.01118	0.23
128	4.50	0.17784	0.51679	0.24832	0.01111	0.01077	0.22
129	4.60	0.17820	0.51597	0.24340	0.01069	0.01033	0.22
130	4.70	0.17762	0.51446	0.23745	0.01023	0.00986	0.21
131	4.80	0.17619	0.51234	0.23064	0.00976	0.00938	0.21
132	4.90	0.17586	0.50969	0.22550	0.00929	0.00898	0.20
133	5.00	0.17475	0.50658	0.21959	0.00889	0.00857	0.20
134	5.10	0.17300	0.50308	0.21314	0.00850	0.00815	0.20
135	5.20	0.17062	0.49924	0.20616	0.00810	0.00774	0.19
136	5.40	0.16427	0.49084	0.19114	0.00731	0.00691	0.19
137	5.60	0.15767	0.48179	0.17690	0.00653	0.00616	0.18
138	5.80	0.15136	0.47242	0.16397	0.00581	0.00552	0.17
139	6.00	0.14395	0.46299	0.15074	0.00521	0.00490	0.17
140	6.20	0.14150	0.45370	0.14340	0.00485	0.00451	0.16
141	6.40	0.14276	0.44470	0.14015	0.00459	0.00427	0.16
142	6.60	0.14344	0.43607	0.13655	0.00436	0.00404	0.15
143	6.80	0.14364	0.42789	0.13273	0.00413	0.00381	0.15
144	7.00	0.14346	0.42018	0.12877	0.00392	0.00359	0.14
145	7.30	0.14249	0.40956	0.12264	0.00361	0.00328	0.14

146	7.60	0.14087	0.40837	0.11646	0.00332	0.00299	0.13
147	8.00	0.13798	0.41060	0.10837	0.00297	0.00264	0.13
148	8.50	0.13357	0.41312	0.09873	0.00259	0.00227	0.12
149	9.00	0.12865	0.41537	0.08981	0.00226	0.00195	0.11
150	9.50	0.12352	0.41738	0.08169	0.00198	0.00168	0.11
151	10.00	0.11835	0.41917	0.07436	0.00175	0.00145	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.

AREA OF ACC. RESPONSE SPECTRUM = 0.331

AREA OF VEL. RESPONSE SPECTRUM = 1.567

MAX. ACCELERATION RESPONSE VALUE = 1.195

MAX. VELOCITY RESPONSE VALUE = 0.972

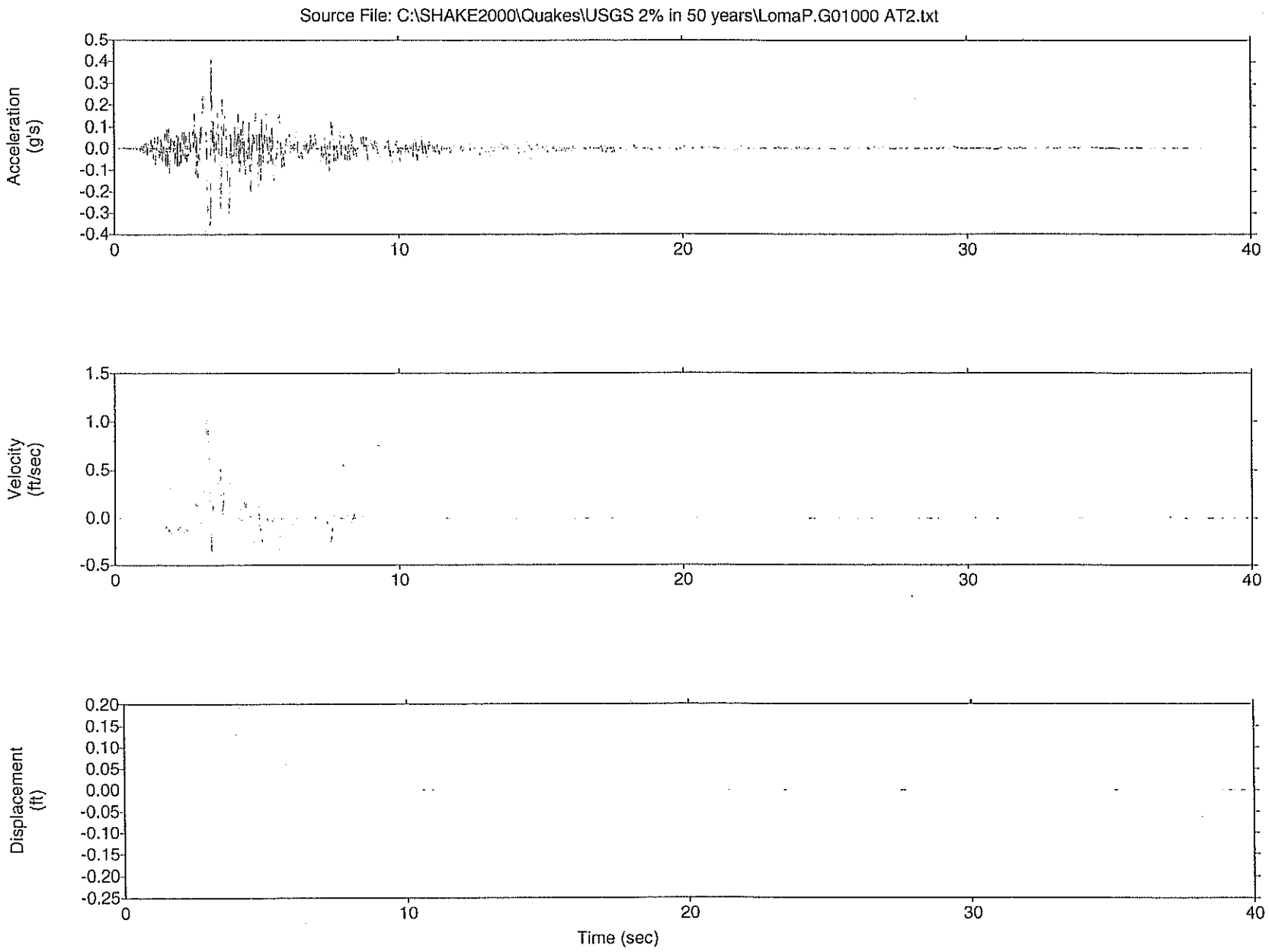
*** End of Output File No. 1 ***

PCSC300M Crest Column
Williamson - Pond Creek South Cell - Surf. El. 502, GWT 14ft., Fines El. 496
M6.9 Loma Prieta, CA PEER Record @11km Scaled to 0.54g

Layer	Depth to Middle of Layer (ft)	Total Unit Weight (kcf)	Damping Used (%)	Shear Modulus (ksf)	Maximum Shear Strain (%)	Maximum Shear Stress (psf)	Shear Wave Velocity (fps)	Depth to Top of Layer (ft)	Peak Acceleration (g)	G/Gmax Curve	Damping Curve
1	2	.13	2.9	2930.6	.00792	232.15	851.9901	0	.87811	Coarse	Coarse
2	5.5	.13	5	2573.9	.025	643.55	798.4581	4	.87436	Coarse	Coarse
3	8.5	.13	6.4	2332.2	.04267	995.07	760.0447	7	.86558	Coarse	Coarse
4	11.5	.13	6.2	3325.9	.04006	1332.31	907.6342	10	.85627	Coarse	Coarse
5	14.5	.14	8.2	2281.9	.07402	1688.99	724.4564	13	.84551	Coarse	Coarse
6	17.5	.14	10.1	1593.9	.12834	2045.62	605.4725	16	.82977	Coarse	Coarse
7	20.5	.14	10.7	1600.6	.14858	2378.17	606.7438	19	.80559	Coarse	Coarse
8	23.5	.14	13	923.9	.29079	2686.52	460.974	22	.7816	Coarse	Coarse
9	26.5	.14	12.9	1038.1	.28336	2941.63	488.6338	25	.74268	Coarse	Coarse
10	30	.14	13.7	892	.35757	3189.67	452.9459	28	.69783	Coarse	Coarse
11	33.5	.135	17.2	406	.82045	3330.7	311.1889	32	.61347	Residual	Residual
12	36.5	.135	17.1	412	.80875	3332.28	313.4799	35	.50219	Residual	Residual
13	39.5	.135	14.9	699.1	.46907	3279.36	408.3482	38	.43122	Residual	Residual
14	42.5	.135	11.9	1327.4	.24441	3244.31	562.6806	41	.50765	Residual	Residual
15	45.5	.135	6.9	3820.1	.08596	3283.76	954.5494	44	.51826	Residual	Residual
16	48.5	.135	6.9	3776.5	.08675	3275.96	949.0865	47	.50559	Residual	Residual
17	Base							50	.49907		
17	Outcrop							50	.53173		

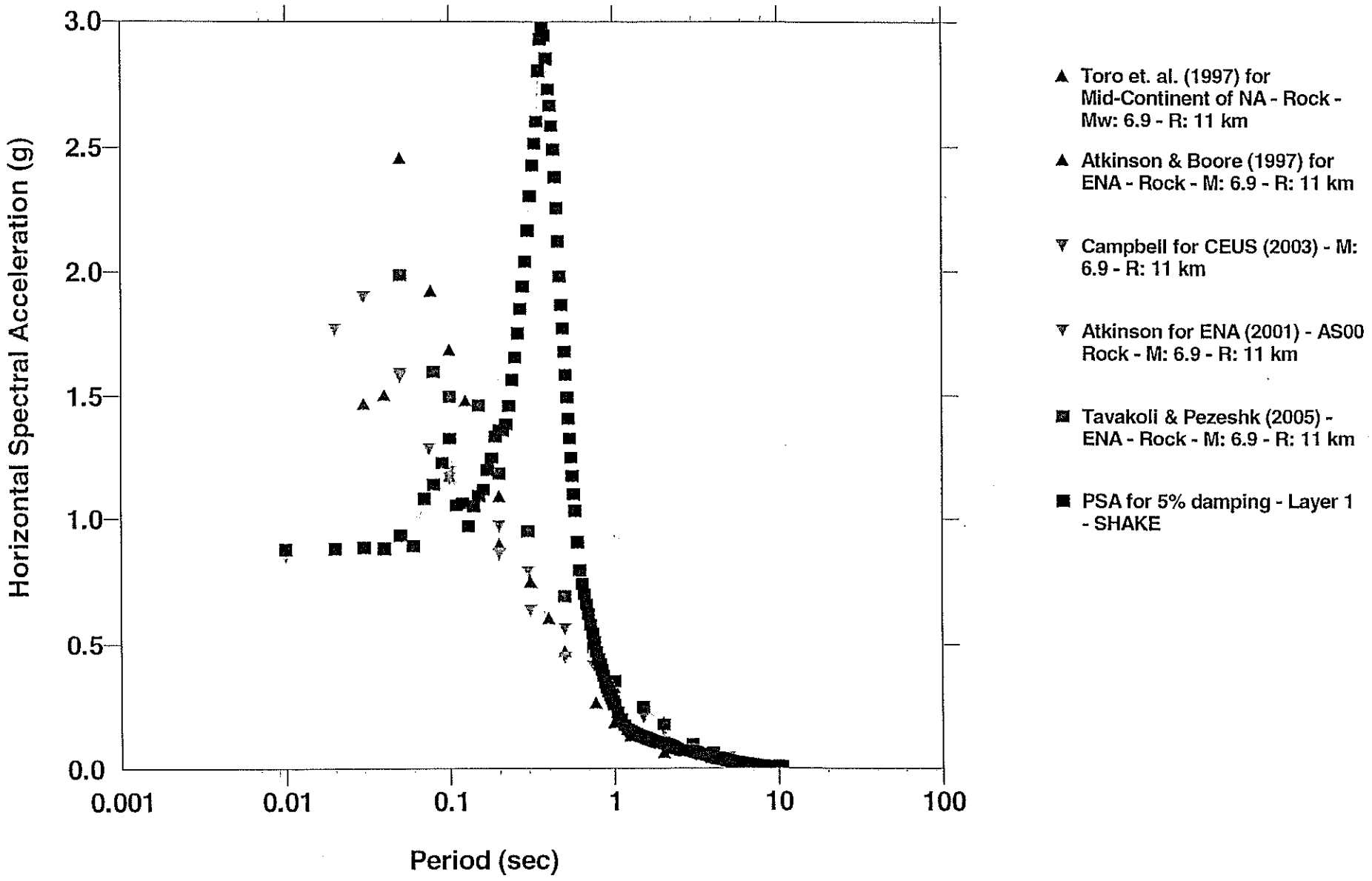
Notes:
Period for Soil Column: .31 sec
Average Shear Wave Velocity for Soil Column: 636 ft/sec

37 of 131
R13974

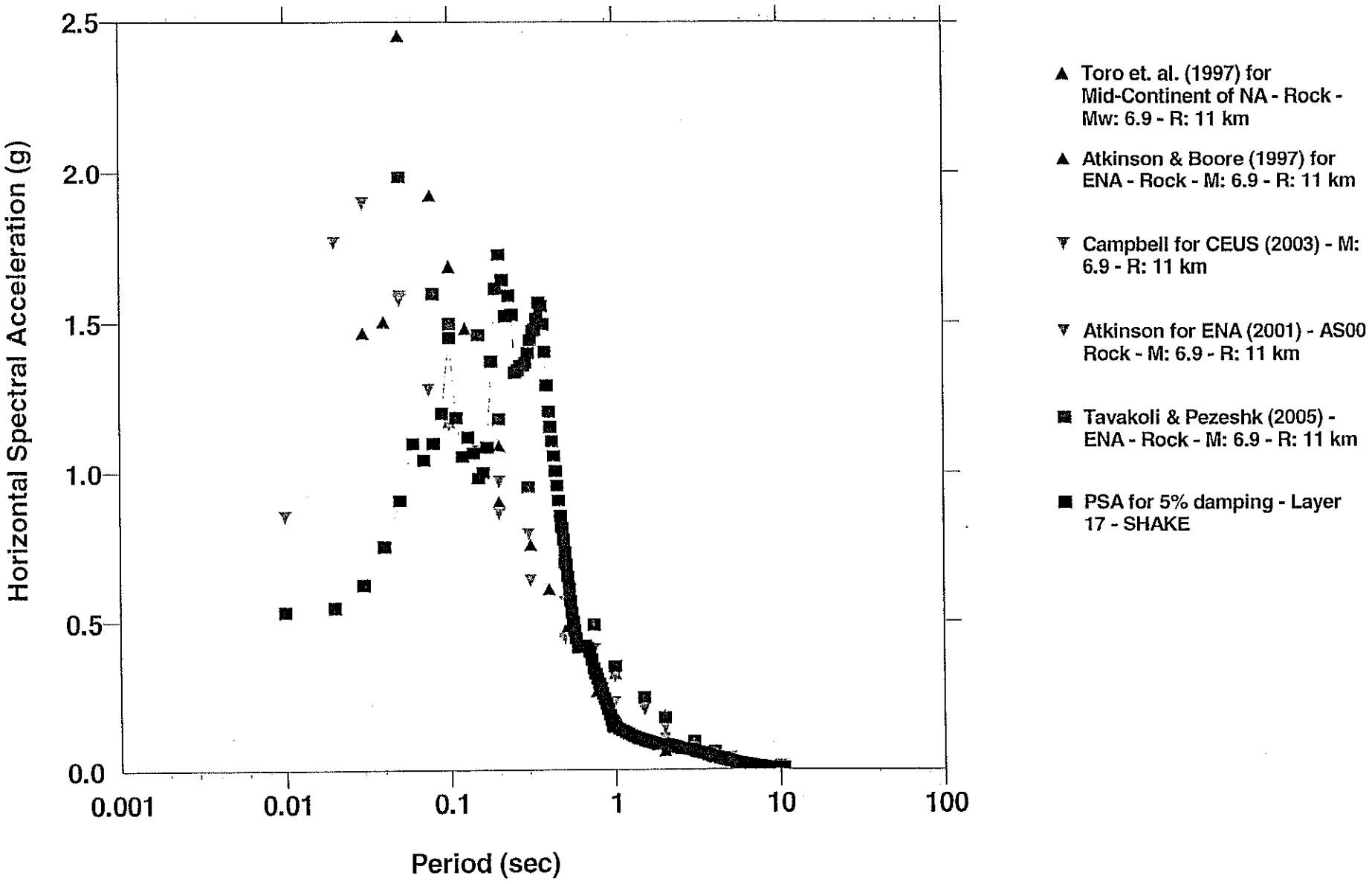

Source File: C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.G01000 AT2.txt
Acceleration (g's)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
10
20
30
40
Velocity (ft/sec)
1.5
1.0
0.5
0.0
-0.5
0
10
20
30
40
Displacement (ft)
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
-0.25
0
10
20
30
40
Time (sec)

R13975

PCSC300M Crest Column - M6.9 Loma Prieta, CA PEER Record @11km



PCSC300M Crest Column - M6.9 Loma Prieta, CA PEER Record @11km



R13977

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************************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*   LAYERED SITES by Per Schnable & John Lysmer - 1970  *
* ---------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
* ---------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added  *
*    using results from Sun et al (1988) by J. I. Sun  *
*    & Ramin Golesorkhi February 26, 1988          *
* ----------------------------------------------------*
* SHAKE90/91: Adjust last iteration; Input now is either  *
*    Gmax or max Vs; up to 13 materials can be specified*
*    by user; up to 50 Layers can be specified; object  *
*    motion can be read in from a separate file and can *
*    user specified format; Different periods for res-  *
*    ponse spectral calculations;options are renumbered;*
*    and general cleanup by: J. I. Sun, I. M. Idriss &  *
*    P. Dirrim June 1990 - February 1991          *
* ---------------------------------------------------- *
* SHAKE91: General cleanup and finalization of input out- *
*    output format ... etc by: I. M. Idriss Dec. 1991  *
* ---------------------------------------------------- *
* SHAKE2000: Fix the incorrect output of Tot. Stress in  *
* Option 2. Changed path of ground motion file in       *
* SHAKE91.  Control file to input file names.  Modified  *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
*       RUN DATE  1/17/2008                    *
*       RUN TIME 11:27                        *
************************************************************
MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =    32768
NECESSARY LENGTH OF BLANK COMMON X       =   204819

1******  OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

**********************
 MATERIAL TYPE NO. 1
**********************

CURVE NO.  1:   Coarse    G/Gmax - Gravel (Mean) - Rollins et al. JGGE
CURVE NO.  2:   Coarse    Damping for Gravel (Mean) - Rollins et al. J
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.90
0.0002	0.995	0.0003	1.11
0.0005	0.980	0.0006	1.30
0.0008	0.970	0.0010	1.50
0.0010	0.960	0.0020	1.91
0.0020	0.930	0.0030	2.24
0.0030	0.905	0.0040	2.54
0.0040	0.880	0.0060	3.05
0.0070	0.810	0.0080	3.50
0.0100	0.755	0.0100	3.89
0.0200	0.630	0.0200	5.45
0.0700	0.390	0.0300	6.61
0.1000	0.325	0.0500	8.28
0.2000	0.205	0.1000	10.79
0.3000	0.150	0.2000	13.23

0.4000	0.115	0.3000	14.47
0.5000	0.095	0.4000	15.24
0.6000	0.080	0.6000	16.14
0.8000	0.070	0.8000	16.66
1.0000	0.050	1.0000	17.01

****
MATERIAL TYPE NO. 2
****

CURVE NO. 3: Fine Refuse Moduli for Fine Refuse (Ellison & Cho, 1976)
CURVE NO. 4: Fine Refuse Damping Values for Fine Refuse (Ellison & Ch

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.75
0.0004	1.000	0.0004	0.65
0.0010	0.995	0.0010	0.70
0.0020	0.992	0.0020	0.80
0.0040	0.989	0.0040	0.90
0.0060	0.981	0.0060	1.10
0.0080	0.965	0.0080	1.30
0.0100	0.955	0.0100	1.40
0.0200	0.905	0.0200	2.00
0.0400	0.828	0.0400	3.10
0.0600	0.750	0.0600	4.00
0.0800	0.670	0.0800	5.20
0.1000	0.610	0.1000	6.00
0.2000	0.610	0.2000	6.00

****
MATERIAL TYPE NO. 3
****

CURVE NO. 5: Residual G/Gmax PI=15% - Effective Confining Pressure
CURVE NO. 6: Residual Damping PI=15% - Effective Confining Pressur

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0000	1.000	0.0000	0.67
0.0000	1.000	0.0000	0.67
0.0000	0.999	0.0000	0.68
0.0001	0.998	0.0001	0.68
0.0002	0.996	0.0002	0.70
0.0005	0.991	0.0005	0.75
0.0010	0.983	0.0010	0.83
0.0022	0.965	0.0022	1.02
0.0048	0.931	0.0048	1.43
0.0100	0.873	0.0100	2.17
0.0220	0.770	0.0220	3.68
0.0484	0.618	0.0484	6.24
0.1000	0.454	0.1000	9.48
0.2200	0.287	0.2200	13.40
0.4840	0.163	0.4840	16.87
1.0000	0.091	1.0000	19.16

****
MATERIAL TYPE NO. 4
****

CURVE NO. 7: Rock G/Gmax - ROCK (Schnabel 1973)
CURVE NO. 8: Rock Damping for ROCK (Schnabel 1973)

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.40
0.0003	1.000	0.0010	0.80
0.0010	0.990	0.0100	1.50
0.0030	0.950	0.1000	3.00
0.0100	0.900	1.0000	4.60
0.0300	0.810	0.0000	0.00
0.1000	0.725	0.0000	0.00
1.0000	0.550	0.0000	0.00

1****** OPTION 2 *** READ SOIL PROFILE
NEW SOIL PROFILE NO. 1 IDENTIFICATION PCSC300M Crest Column
NUMBER OF LAYERS 17 DEPTH TO BEDROCK 50.00

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	1	4.0000	2.0000	0.26	3454.	0.050	0.130	924.9
2	1	3.0000	5.5000	0.71	3856.	0.050	0.130	977.3
3	1	3.0000	8.5000	1.11	4110.	0.050	0.130	1009.0
4	1	3.0000	11.5000	1.50	5739.	0.050	0.130	1192.3
5	1	3.0000	14.5000	1.90	4941.	0.050	0.140	1066.0
6	1	3.0000	17.5000	2.32	4453.	0.050	0.140	1012.0
7	1	3.0000	20.5000	2.74	4832.	0.050	0.140	1054.2
8	1	3.0000	23.5000	3.16	4269.	0.050	0.140	990.9
9	1	3.0000	26.5000	3.58	4713.	0.050	0.140	1041.1
10	1	4.0000	30.0000	4.07	4808.	0.050	0.140	1051.6
11	3	3.0000	33.5000	4.55	2635.	0.050	0.135	792.8
12	3	3.0000	36.5000	4.96	2661.	0.050	0.135	796.7
13	3	3.0000	39.5000	5.36	2998.	0.050	0.135	845.6
14	3	3.0000	42.5000	5.77	3763.	0.050	0.135	947.4
15	3	3.0000	45.5000	6.17	6529.	0.050	0.135	1247.9
16	3	3.0000	48.5000	6.58	6476.	0.050	0.135	1242.8
17	BASE				74534.	0.050	0.150	4000.0

PERIOD = 0.20 FROM AVERAGE SHEAR VEL. = 1011.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 12.34
FOR FREQUENCY = 4.85 C/SEC.
PERIOD = 0.21 SEC.

1****** OPTION 3 *** READ INPUT MOTION

FILE NAME FOR INPUT MOTION = C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
NO. OF INPUT ACC. POINTS = 7986
NO. OF POINTS USED IN FFT = 16384
NO. OF HEADING LINES = 8
NO. OF POINTS PER LINE = 6

TIME STEP FOR INPUT MOTION = 0.0050
FORMAT FOR TIME HISTORY = (6F15.8)

*****HEADER*****
Source File: C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.G01000_AT2.txt
SHAKE2000 Conversion: 7986 .005 8 6 15 (6F15.
Acceleration Units: (g's) - No. Values: 7986 - Time Step: .005 (secs)
Data Format: (6F15.8) - No. Header Lines: 8
PEER STRONG MOTION DATABASE RECORD. PROCESSING BY PACIFIC ENGINEERING.
LOMA PRIETA 10/18/89 00:05, GILROY ARRAY #1, 000 (CDMG STATION 47379)
ACCELERATION TIME HISTORY IN UNITS OF G. FILTER POINTS: HP=0.2 Hz LP=50.0 Hz
NPTS= 7989, DT= .00500 SEC
** FIRST AND LAST 5 LINES OF INPUT MOTION *****

1 0.005126 0.005640 0.002756-0.001308-0.000650-0.000681
2 -0.000754-0.000848-0.000917-0.000943-0.000964-0.001005
3 -0.001043-0.001062-0.001089-0.001142-0.001196-0.001236
4 -0.001261-0.001274-0.001273-0.001242-0.001152-0.001012
5 -0.000888-0.000801-0.000713-0.000637-0.000622-0.000652
.....INPUT MOTION READ NOT ECHOED.....
1327 -0.000097-0.000099-0.000100-0.000101-0.000102-0.000103
1328 -0.000105-0.000106-0.000107-0.000108-0.000109-0.000110
1329 -0.000111-0.000112-0.000113-0.000114-0.000115-0.000116
1330 -0.000117-0.000118-0.000119-0.000120-0.000121-0.000122
1331 -0.000123-0.000124-0.000125-0.000126-0.000127-0.000128

MAXIMUM ACCELERATION = 0.41088
AT TIME = 3.42 SEC
THE VALUES WILL BE MULTIPLIED BY A FACTOR = 1.314
TO GIVE NEW MAXIMUM ACCELERATION = 0.54000
MEAN SQUARE FREQUENCY = 5.52 C/SEC.
MAX ACCELERATION = 0.53173 FOR FREQUENCIES REMOVED ABOVE 40.00 C/SEC.
1****** OPTION 4 *** READ WHERE OBJECT MOTION IS GIVEN
OBJECT MOTION IN LAYER NUMBER 17 OUTCROPPING

1****** OPTION 5 *** OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
MAXIMUM NUMBER OF ITERATIONS = 10
FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN = 0.65

EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 1

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00564	0.030	0.050	-68.2	2890.9	3454.0	-19.5	1.000
2	1	5.5	0.01387	0.046	0.050	-8.1	2683.6	3856.0	-43.7	1.000
3	1	8.5	0.02004	0.055	0.050	8.4	2587.7	4110.0	-58.8	1.000
4	1	11.5	0.01929	0.054	0.050	6.9	3653.0	5739.0	-57.1	1.000
5	1	14.5	0.02822	0.064	0.050	22.3	2786.9	4941.0	-77.3	1.000
6	1	17.5	0.03765	0.074	0.050	32.0	2265.6	4453.0	-96.5	1.000
7	1	20.5	0.04005	0.076	0.050	33.8	2401.4	4832.0	-101.2	1.000
8	1	23.5	0.05070	0.083	0.050	40.0	1928.8	4269.0	-121.3	1.000
9	1	26.5	0.05013	0.083	0.050	39.7	2139.5	4713.0	-120.3	1.000
10	1	30.0	0.05330	0.085	0.050	41.3	2126.2	4808.0	-126.1	1.000
11	3	33.5	0.10337	0.096	0.050	48.2	1177.8	2635.0	-123.7	1.000

12	3	36.5	0.10650	0.098	0.050	49.0	1172.6	2661.0	-126.9	1.000
13	3	39.5	0.09785	0.094	0.050	46.7	1375.8	2998.0	-117.9	1.000
14	3	42.5	0.08030	0.085	0.050	41.2	1895.0	3763.0	-98.6	1.000
15	3	45.5	0.04738	0.062	0.050	18.9	4061.6	6529.0	-60.7	1.000
16	3	48.5	0.04902	0.063	0.050	20.5	3983.6	6476.0	-62.6	1.000

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EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00590	0.030	0.030	1.9	2871.5	2890.9	-0.7	0.837
2	1	5.5	0.01732	0.051	0.046	9.7	2529.5	2683.6	-6.1	0.696
3	1	8.5	0.02777	0.064	0.055	14.6	2331.0	2587.7	-11.0	0.630
4	1	11.5	0.02651	0.063	0.054	14.2	3305.8	3653.0	-10.5	0.637
5	1	14.5	0.04412	0.079	0.064	18.2	2363.9	2786.9	-17.9	0.564
6	1	17.5	0.06609	0.093	0.074	20.9	1785.7	2265.6	-26.9	0.509
7	1	20.5	0.07318	0.097	0.076	21.8	1845.3	2401.4	-30.1	0.497
8	1	23.5	0.10458	0.109	0.083	23.9	1354.3	1928.8	-42.4	0.452
9	1	26.5	0.10599	0.110	0.083	24.6	1484.3	2139.5	-44.1	0.454
10	1	30.0	0.12003	0.114	0.085	25.6	1410.6	2126.2	-50.7	0.442
11	3	33.5	0.23995	0.138	0.096	30.0	720.3	1177.8	-63.5	0.447
12	3	36.5	0.25725	0.141	0.098	30.5	698.3	1172.6	-67.9	0.441
13	3	39.5	0.23094	0.136	0.094	31.1	837.6	1375.8	-64.3	0.459
14	3	42.5	0.17437	0.122	0.085	30.6	1265.2	1895.0	-49.8	0.504
15	3	45.5	0.08367	0.087	0.062	29.0	3227.2	4061.6	-25.9	0.622
16	3	48.5	0.08815	0.089	0.063	29.4	3124.6	3983.6	-27.5	0.615

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EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00587	0.030	0.030	-0.2	2873.9	2871.5	0.1	0.831
2	1	5.5	0.01856	0.053	0.051	3.0	2481.3	2529.5	-1.9	0.656
3	1	8.5	0.03133	0.068	0.064	5.4	2235.8	2331.0	-4.3	0.567
4	1	11.5	0.02978	0.066	0.063	5.0	3178.0	3305.8	-4.0	0.576
5	1	14.5	0.05319	0.085	0.079	7.4	2186.9	2363.9	-8.1	0.478
6	1	17.5	0.08607	0.102	0.093	9.3	1569.0	1785.7	-13.8	0.401
7	1	20.5	0.09759	0.107	0.097	9.7	1591.9	1845.3	-15.9	0.382
8	1	23.5	0.15202	0.123	0.109	10.7	1077.9	1354.3	-25.6	0.317
9	1	26.5	0.15440	0.123	0.110	10.7	1177.3	1484.3	-26.1	0.315
10	1	30.0	0.18007	0.129	0.114	11.1	1073.0	1410.6	-31.5	0.293
11	3	33.5	0.38412	0.159	0.138	13.0	525.3	720.3	-37.1	0.273
12	3	36.5	0.41343	0.162	0.141	12.9	499.7	698.3	-39.7	0.262
13	3	39.5	0.35298	0.155	0.136	12.0	637.5	837.6	-31.4	0.279
14	3	42.5	0.23683	0.137	0.122	10.8	1036.3	1265.2	-22.1	0.336
15	3	45.5	0.09394	0.092	0.087	5.6	3056.4	3227.2	-5.6	0.494
16	3	48.5	0.09792	0.094	0.089	5.0	2970.9	3124.6	-5.2	0.482

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EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq

SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00543	0.029	0.030	-3.3	2907.1	2873.9	1.1	0.832
2	1	5.5	0.01747	0.051	0.053	-2.6	2523.3	2481.3	1.7	0.643
3	1	8.5	0.03004	0.066	0.068	-2.1	2269.0	2235.8	1.5	0.544
4	1	11.5	0.02839	0.065	0.066	-2.1	3230.3	3178.0	1.6	0.554
5	1	14.5	0.05244	0.085	0.085	-0.6	2200.4	2186.9	0.6	0.443
6	1	17.5	0.08875	0.104	0.102	1.1	1544.0	1569.0	-1.6	0.352
7	1	20.5	0.10154	0.108	0.107	1.3	1557.6	1591.9	-2.2	0.329
8	1	23.5	0.17016	0.127	0.123	3.1	994.6	1077.9	-8.4	0.252
9	1	26.5	0.17134	0.127	0.123	2.9	1092.4	1177.3	-7.8	0.250
10	1	30.0	0.20582	0.133	0.129	3.4	966.9	1073.0	-11.0	0.223
11	3	33.5	0.44716	0.165	0.159	4.0	462.3	525.3	-13.6	0.199
12	3	36.5	0.47875	0.168	0.162	3.8	438.3	499.7	-14.0	0.188
13	3	39.5	0.37345	0.157	0.155	1.6	610.9	637.5	-4.3	0.213
14	3	42.5	0.22666	0.135	0.137	-1.4	1062.3	1036.3	2.4	0.275
15	3	45.5	0.07710	0.083	0.092	-10.6	3347.9	3056.4	8.7	0.468
16	3	48.5	0.07874	0.084	0.094	-11.6	3290.0	2970.9	9.7	0.459

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EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00519	0.029	0.029	-2.0	2926.9	2907.1	0.7	0.842
2	1	5.5	0.01659	0.050	0.051	-2.3	2559.1	2523.3	1.4	0.654
3	1	8.5	0.02855	0.065	0.066	-2.3	2309.0	2269.0	1.7	0.552
4	1	11.5	0.02686	0.063	0.065	-2.5	3291.2	3230.3	1.9	0.563
5	1	14.5	0.05002	0.083	0.085	-2.1	2245.1	2200.4	2.0	0.445
6	1	17.5	0.08633	0.103	0.104	-1.0	1566.6	1544.0	1.4	0.347
7	1	20.5	0.09947	0.108	0.108	-0.7	1575.1	1557.6	1.1	0.322
8	1	23.5	0.17592	0.128	0.127	0.9	970.0	994.6	-2.5	0.233
9	1	26.5	0.17582	0.128	0.127	0.7	1071.3	1092.4	-2.0	0.232
10	1	30.0	0.21609	0.135	0.133	1.1	935.2	966.9	-3.4	0.201
11	3	33.5	0.47499	0.168	0.165	1.6	437.3	462.3	-5.7	0.175
12	3	36.5	0.50503	0.170	0.168	1.1	422.5	438.3	-3.7	0.165
13	3	39.5	0.35695	0.155	0.157	-1.3	632.2	610.9	3.4	0.204
14	3	42.5	0.20113	0.130	0.135	-4.5	1151.5	1062.3	7.7	0.282
15	3	45.5	0.06423	0.075	0.083	-10.9	3617.4	3347.9	7.5	0.513
16	3	48.5	0.06484	0.075	0.084	-11.5	3574.2	3290.0	8.0	0.508

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EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 6

VALUES IN TIME DOMAIN

NO TYPE DEPTH UNIFRM. <---- DAMPING ----> <---- SHEAR MODULUS -----> G/Go

		(FT)	STRAIN NEW	USED	ERROR	NEW	USED	ERROR	RATIO
1	1	2.0	0.00514	0.029	0.029	-0.4	2930.9	2926.9	0.1	0.847
2	1	5.5	0.01631	0.050	0.050	-0.8	2571.0	2559.1	0.5	0.664
3	1	8.5	0.02796	0.064	0.065	-0.9	2325.5	2309.0	0.7	0.562
4	1	11.5	0.02627	0.062	0.063	-1.0	3315.7	3291.2	0.7	0.573
5	1	14.5	0.04883	0.082	0.083	-1.0	2267.8	2245.1	1.0	0.454
6	1	17.5	0.08477	0.102	0.103	-0.6	1581.3	1566.6	0.9	0.352
7	1	20.5	0.09798	0.107	0.108	-0.5	1588.3	1575.1	0.8	0.326
8	1	23.5	0.17968	0.129	0.128	0.6	954.3	970.0	-1.6	0.227
9	1	26.5	0.17836	0.128	0.128	0.4	1059.6	1071.3	-1.1	0.227
10	1	30.0	0.22194	0.135	0.135	0.6	917.7	935.2	-1.9	0.195
11	3	33.5	0.49749	0.170	0.168	1.0	422.3	437.3	-3.5	0.166
12	3	36.5	0.51712	0.171	0.170	0.4	416.3	422.5	-1.5	0.159
13	3	39.5	0.34000	0.153	0.155	-1.4	655.2	632.2	3.5	0.211
14	3	42.5	0.18350	0.125	0.130	-3.6	1224.6	1151.5	6.0	0.306
15	3	45.5	0.05899	0.071	0.075	-5.3	3743.0	3617.4	3.4	0.554
16	3	48.5	0.05939	0.072	0.075	-5.5	3702.7	3574.2	3.5	0.552

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EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 7

VALUES IN TIME DOMAIN

NO TYPE DEPTH UNIFRM. <---- DAMPING ----> <---- SHEAR MODULUS -----> G/Go

		(FT)	STRAIN NEW	USED	ERROR	NEW	USED	ERROR	RATIO
1	1	2.0	0.00514	0.029	0.029	0.0	2931.3	2930.9	0.0	0.849
2	1	5.5	0.01624	0.050	0.050	-0.2	2574.1	2571.0	0.1	0.667
3	1	8.5	0.02777	0.064	0.064	-0.3	2331.0	2325.5	0.2	0.566
4	1	11.5	0.02608	0.062	0.062	-0.3	3323.9	3315.7	0.2	0.578
5	1	14.5	0.04834	0.082	0.082	-0.4	2277.5	2267.8	0.4	0.459
6	1	17.5	0.08396	0.102	0.102	-0.3	1589.1	1581.3	0.5	0.355
7	1	20.5	0.09716	0.107	0.107	-0.3	1595.8	1588.3	0.5	0.329
8	1	23.5	0.18264	0.129	0.129	0.4	942.3	954.3	-1.3	0.224
9	1	26.5	0.18025	0.129	0.128	0.3	1051.0	1059.6	-0.8	0.225
10	1	30.0	0.22587	0.136	0.135	0.4	906.3	917.7	-1.3	0.191
11	3	33.5	0.51365	0.171	0.170	0.6	414.0	422.3	-2.0	0.160
12	3	36.5	0.52230	0.171	0.171	0.2	413.6	416.3	-0.6	0.156
13	3	39.5	0.32649	0.151	0.153	-1.2	674.3	655.2	2.8	0.219
14	3	42.5	0.17218	0.122	0.125	-2.6	1275.3	1224.6	4.0	0.325
15	3	45.5	0.05699	0.070	0.071	-2.2	3793.9	3743.0	1.3	0.573
16	3	48.5	0.05739	0.070	0.072	-2.2	3752.9	3702.7	1.3	0.572

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EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 8

VALUES IN TIME DOMAIN

NO TYPE DEPTH UNIFRM. <---- DAMPING ----> <---- SHEAR MODULUS -----> G/Go

		(FT)	STRAIN NEW	USED	ERROR	NEW	USED	ERROR	RATIO
1	1	2.0	0.00514	0.029	0.029	0.0	2930.9	2931.3	0.0	0.849
2	1	5.5	0.01624	0.050	0.050	0.0	2574.3	2574.1	0.0	0.668
3	1	8.5	0.02772	0.064	0.064	-0.1	2332.2	2331.0	0.1	0.567
4	1	11.5	0.02603	0.062	0.062	-0.1	3325.8	3323.9	0.1	0.579
5	1	14.5	0.04816	0.082	0.082	-0.1	2280.9	2277.5	0.1	0.461

6	1	17.5	0.08360	0.101	0.102	-0.2	1592.6	1589.1	0.2	0.357
7	1	20.5	0.09678	0.107	0.107	-0.1	1599.2	1595.8	0.2	0.330
8	1	23.5	0.18513	0.130	0.129	0.4	932.2	942.3	-1.1	0.221
9	1	26.5	0.18182	0.129	0.129	0.2	1043.9	1051.0	-0.7	0.223
10	1	30.0	0.22875	0.136	0.136	0.3	898.0	906.3	-0.9	0.188
11	3	33.5	0.52355	0.171	0.171	0.4	409.0	414.0	-1.2	0.157
12	3	36.5	0.52457	0.171	0.171	0.1	412.5	413.6	-0.3	0.155
13	3	39.5	0.31668	0.150	0.151	-0.9	688.7	674.3	2.1	0.225
14	3	42.5	0.16536	0.120	0.122	-1.7	1307.5	1275.3	2.5	0.339
15	3	45.5	0.05626	0.069	0.070	-0.8	3812.9	3793.9	0.5	0.581
16	3	48.5	0.05670	0.069	0.070	-0.8	3770.5	3752.9	0.5	0.580

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EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 9

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00515	0.029	0.029	0.0	2930.6	2930.9	0.0	0.849
2	1	5.5	0.01624	0.050	0.050	0.0	2573.9	2574.3	0.0	0.668
3	1	8.5	0.02772	0.064	0.064	0.0	2332.2	2332.2	0.0	0.567
4	1	11.5	0.02603	0.062	0.062	0.0	3325.9	3325.8	0.0	0.580
5	1	14.5	0.04811	0.082	0.082	0.0	2281.9	2280.9	0.0	0.462
6	1	17.5	0.08346	0.101	0.101	-0.1	1593.9	1592.6	0.1	0.358
7	1	20.5	0.09663	0.107	0.107	-0.1	1600.6	1599.2	0.1	0.331
8	1	23.5	0.18724	0.130	0.130	0.3	923.9	932.2	-0.9	0.218
9	1	26.5	0.18312	0.129	0.129	0.2	1038.1	1043.9	-0.6	0.222
10	1	30.0	0.23087	0.137	0.136	0.2	892.0	898.0	-0.7	0.187
11	3	33.5	0.52961	0.172	0.171	0.2	406.0	409.0	-0.7	0.155
12	3	36.5	0.52549	0.171	0.171	0.0	412.0	412.5	-0.1	0.155
13	3	39.5	0.30975	0.149	0.150	-0.7	699.1	688.7	1.5	0.230
14	3	42.5	0.16129	0.119	0.120	-1.0	1327.4	1307.5	1.5	0.347
15	3	45.5	0.05599	0.069	0.069	-0.3	3820.1	3812.9	0.2	0.584
16	3	48.5	0.05647	0.069	0.069	-0.3	3776.5	3770.5	0.2	0.582

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EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 10

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00515	0.029	0.029	0.0	2930.4	2930.6	0.0	0.848
2	1	5.5	0.01625	0.050	0.050	0.0	2573.6	2573.9	0.0	0.668
3	1	8.5	0.02773	0.064	0.064	0.0	2331.9	2332.2	0.0	0.567
4	1	11.5	0.02604	0.062	0.062	0.0	3325.5	3325.9	0.0	0.580
5	1	14.5	0.04811	0.082	0.082	0.0	2281.9	2281.9	0.0	0.462
6	1	17.5	0.08342	0.101	0.101	0.0	1594.3	1593.9	0.0	0.358
7	1	20.5	0.09658	0.107	0.107	0.0	1601.1	1600.6	0.0	0.331
8	1	23.5	0.18901	0.130	0.130	0.3	916.9	923.9	-0.8	0.216
9	1	26.5	0.18419	0.129	0.129	0.2	1033.4	1038.1	-0.5	0.220
10	1	30.0	0.23242	0.137	0.137	0.1	887.7	892.0	-0.5	0.186
11	3	33.5	0.53330	0.172	0.172	0.1	404.1	406.0	-0.4	0.154
12	3	36.5	0.52569	0.171	0.171	0.0	411.9	412.0	0.0	0.155

13	3	39.5	0.30490	0.148	0.149	-0.5	706.6	699.1	1.1	0.233
14	3	42.5	0.15887	0.118	0.119	-0.6	1339.5	1327.4	0.9	0.353
15	3	45.5	0.05587	0.069	0.069	-0.1	3823.0	3820.1	0.1	0.585
16	3	48.5	0.05638	0.069	0.069	-0.1	3778.7	3776.5	0.1	0.583

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	1	4.0000	2.0000	0.00792	232.15	3.44
2	1	3.0000	5.5000	0.02500	643.55	3.44
3	1	3.0000	8.5000	0.04267	995.07	3.44
4	1	3.0000	11.5000	0.04006	1332.31	3.44
5	1	3.0000	14.5000	0.07402	1688.99	3.44
6	1	3.0000	17.5000	0.12834	2045.62	3.44
7	1	3.0000	20.5000	0.14858	2378.17	3.44
8	1	3.0000	23.5000	0.29079	2686.52	3.44
9	1	3.0000	26.5000	0.28336	2941.63	3.43
10	1	4.0000	30.0000	0.35757	3189.67	3.43
11	3	3.0000	33.5000	0.82045	3330.70	3.43
12	3	3.0000	36.5000	0.80875	3332.28	3.42
13	3	3.0000	39.5000	0.46907	3279.36	3.41
14	3	3.0000	42.5000	0.24441	3244.31	3.40
15	3	3.0000	45.5000	0.08596	3283.76	3.39
16	3	3.0000	48.5000	0.08675	3275.96	3.39

PERIOD = 0.31 FROM AVERAGE SHEAR VEL. = 636.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 3.98
FOR FREQUENCY = 2.32 C/SEC.
PERIOD = 0.43 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL DEPOSIT - PCSC300M Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE	TH SAVED ACC. RECORD
OUTCR.	0.0000	0.87811	3.44	3.10	0.000	2048
WITHIN	4.0000	0.87436	3.44	3.04	0.000	2048
WITHIN	7.0000	0.86558	3.44	2.93	0.000	2048
WITHIN	10.0000	0.85627	3.43	2.79	0.000	2048
WITHIN	13.0000	0.84551	3.43	2.70	0.000	2048
WITHIN	16.0000	0.82977	3.43	2.64	0.000	2048
WITHIN	19.0000	0.80559	3.42	2.70	0.000	2048
WITHIN	22.0000	0.78160	3.42	2.90	0.000	2048
WITHIN	25.0000	0.74268	3.41	3.39	0.000	2048
WITHIN	28.0000	0.69783	3.41	3.78	0.000	2048
WITHIN	32.0000	0.61347	3.40	4.28	0.000	2048
WITHIN	35.0000	0.50219	3.39	6.13	0.000	2048
WITHIN	38.0000	0.43122	3.42	7.25	0.000	2048
WITHIN	41.0000	0.50765	3.42	6.76	0.000	2048
WITHIN	44.0000	0.51826	3.41	6.19	0.000	2048

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL DEPOSIT - PCSC300M Crest Column

LAYER	DEPTH FT	G	MAX. ACC. SEC	TIME C/SEC	MEAN SQ. FR. QUIET ZONE	ACC. RATIO ACC. RECORD	TH SAVED
WITHIN	47.0000		0.50559	3.41	5.86	0.000	2048
WITHIN	50.0000		0.49907	3.42	5.46	0.000	2048
OUTCR.	50.0000		0.53173	3.42	5.52	0.000	2048

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 1 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 1 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 2 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 2 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 3 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 3 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 4 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 4 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 5 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 5 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC330M Layer 6 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PSCS300M Layer 6 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 7 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 7 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 8 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 8 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 9 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PSCS300E Layer 9 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 10 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 10 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 11 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 11 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 12 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 12 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 13
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 13 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 13
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 13 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 14
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 14 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 14
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 14 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 15
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 15 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 15
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 15 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 16
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 16 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 16
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 16 Strain

1****** OPTION 9 *** COMPUTE RESPONSE SPECTRUM
RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER 1
CALCULATED FOR DAMPING 0.050

TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
TD = TIME FOR MAX. RELATIVE DISP.
TV = TIME FOR MAX. RELATIVE VEL.
TA = TIME FOR MAX. ABSOLUTE ACC.
DAMPING RATIO = 0.050

PER = 0.01	TIMES FOR MAXIMA --	TD = 3.4350	TV = 3.4700	TA = 3.4350
PER = 0.02	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.4700	TA = 3.4400
PER = 0.03	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.4750	TA = 3.4400
PER = 0.04	TIMES FOR MAXIMA --	TD = 3.4250	TV = 3.4750	TA = 3.4250
PER = 0.05	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.4800	TA = 3.4400
PER = 0.06	TIMES FOR MAXIMA --	TD = 3.4200	TV = 2.0150	TA = 3.4200
PER = 0.07	TIMES FOR MAXIMA --	TD = 3.4400	TV = 2.0600	TA = 3.4400
PER = 0.08	TIMES FOR MAXIMA --	TD = 3.5900	TV = 3.5700	TA = 3.5900

PER = 0.09	TIMES FOR MAXIMA --	TD = 3.6000	TV = 3.5800	TA = 3.6000
PER = 0.10	TIMES FOR MAXIMA --	TD = 3.6150	TV = 3.4950	TA = 3.6150
PER = 0.11	TIMES FOR MAXIMA --	TD = 3.8000	TV = 3.7650	TA = 3.7950
PER = 0.12	TIMES FOR MAXIMA --	TD = 3.8150	TV = 3.5000	TA = 3.8150
PER = 0.13	TIMES FOR MAXIMA --	TD = 3.4050	TV = 3.5050	TA = 3.4000
PER = 0.14	TIMES FOR MAXIMA --	TD = 3.4050	TV = 3.5050	TA = 3.4050
PER = 0.15	TIMES FOR MAXIMA --	TD = 3.4150	TV = 3.5050	TA = 3.4150
PER = 0.16	TIMES FOR MAXIMA --	TD = 3.4150	TV = 3.5050	TA = 3.4150
PER = 0.17	TIMES FOR MAXIMA --	TD = 3.4200	TV = 3.5050	TA = 3.4200
PER = 0.18	TIMES FOR MAXIMA --	TD = 3.4250	TV = 3.5050	TA = 3.4200
PER = 0.19	TIMES FOR MAXIMA --	TD = 3.4300	TV = 3.8950	TA = 3.4250
PER = 0.20	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.5100	TA = 3.4350
PER = 0.21	TIMES FOR MAXIMA --	TD = 3.4450	TV = 3.5150	TA = 3.4400
PER = 0.22	TIMES FOR MAXIMA --	TD = 3.4450	TV = 3.5150	TA = 3.4400
PER = 0.23	TIMES FOR MAXIMA --	TD = 3.5850	TV = 3.5200	TA = 3.5850
PER = 0.24	TIMES FOR MAXIMA --	TD = 3.5950	TV = 3.5200	TA = 3.5900
PER = 0.25	TIMES FOR MAXIMA --	TD = 3.6000	TV = 3.5250	TA = 3.5950
PER = 0.26	TIMES FOR MAXIMA --	TD = 3.6050	TV = 3.5250	TA = 3.6000
PER = 0.27	TIMES FOR MAXIMA --	TD = 3.6150	TV = 3.5300	TA = 3.6100
PER = 0.28	TIMES FOR MAXIMA --	TD = 3.6200	TV = 3.5350	TA = 3.6150
PER = 0.29	TIMES FOR MAXIMA --	TD = 3.6250	TV = 3.5400	TA = 3.6200
PER = 0.30	TIMES FOR MAXIMA --	TD = 3.6300	TV = 3.5450	TA = 3.6250
PER = 0.31	TIMES FOR MAXIMA --	TD = 3.6400	TV = 3.5550	TA = 3.6350
PER = 0.32	TIMES FOR MAXIMA --	TD = 3.6450	TV = 3.5650	TA = 3.6400
PER = 0.33	TIMES FOR MAXIMA --	TD = 3.6550	TV = 3.5700	TA = 3.6500
PER = 0.34	TIMES FOR MAXIMA --	TD = 4.2100	TV = 4.1250	TA = 4.2050
PER = 0.35	TIMES FOR MAXIMA --	TD = 4.2250	TV = 4.1350	TA = 4.2200
PER = 0.36	TIMES FOR MAXIMA --	TD = 4.2400	TV = 4.1500	TA = 4.2350
PER = 0.37	TIMES FOR MAXIMA --	TD = 4.2600	TV = 4.1650	TA = 4.2500
PER = 0.38	TIMES FOR MAXIMA --	TD = 4.2750	TV = 4.1800	TA = 4.2700
PER = 0.39	TIMES FOR MAXIMA --	TD = 4.2900	TV = 4.0050	TA = 4.2850
PER = 0.40	TIMES FOR MAXIMA --	TD = 3.9200	TV = 4.0150	TA = 3.9150
PER = 0.41	TIMES FOR MAXIMA --	TD = 3.9300	TV = 4.0300	TA = 3.9250
PER = 0.42	TIMES FOR MAXIMA --	TD = 3.9400	TV = 4.0400	TA = 3.9350
PER = 0.43	TIMES FOR MAXIMA --	TD = 3.9500	TV = 4.0450	TA = 3.9400
PER = 0.44	TIMES FOR MAXIMA --	TD = 3.9600	TV = 3.8550	TA = 3.9500
PER = 0.45	TIMES FOR MAXIMA --	TD = 3.9650	TV = 3.8600	TA = 3.9600
PER = 0.46	TIMES FOR MAXIMA --	TD = 3.9750	TV = 3.8700	TA = 3.9700
PER = 0.47	TIMES FOR MAXIMA --	TD = 3.9850	TV = 3.8750	TA = 3.9750
PER = 0.48	TIMES FOR MAXIMA --	TD = 3.7750	TV = 3.8800	TA = 3.7700
PER = 0.49	TIMES FOR MAXIMA --	TD = 3.7850	TV = 3.8900	TA = 3.7750
PER = 0.50	TIMES FOR MAXIMA --	TD = 3.7900	TV = 3.8950	TA = 3.7800
PER = 0.51	TIMES FOR MAXIMA --	TD = 3.7950	TV = 3.9000	TA = 3.7850
PER = 0.52	TIMES FOR MAXIMA --	TD = 3.8000	TV = 3.9100	TA = 3.7900
PER = 0.53	TIMES FOR MAXIMA --	TD = 3.8000	TV = 3.9150	TA = 3.7950
PER = 0.54	TIMES FOR MAXIMA --	TD = 3.8050	TV = 3.7000	TA = 3.8000
PER = 0.55	TIMES FOR MAXIMA --	TD = 3.8100	TV = 3.7050	TA = 3.8000
PER = 0.56	TIMES FOR MAXIMA --	TD = 3.8150	TV = 3.7050	TA = 3.8050
PER = 0.57	TIMES FOR MAXIMA --	TD = 3.8200	TV = 3.7100	TA = 3.8100
PER = 0.58	TIMES FOR MAXIMA --	TD = 3.8200	TV = 3.7150	TA = 3.8100
PER = 0.60	TIMES FOR MAXIMA --	TD = 3.8300	TV = 3.7200	TA = 3.8200
PER = 0.62	TIMES FOR MAXIMA --	TD = 3.8350	TV = 3.7200	TA = 3.8250
PER = 0.64	TIMES FOR MAXIMA --	TD = 5.1850	TV = 3.7250	TA = 5.1750
PER = 0.66	TIMES FOR MAXIMA --	TD = 5.2100	TV = 3.7300	TA = 5.2000
PER = 0.68	TIMES FOR MAXIMA --	TD = 4.9250	TV = 3.7300	TA = 4.9150
PER = 0.70	TIMES FOR MAXIMA --	TD = 4.9500	TV = 3.7300	TA = 4.9350
PER = 0.72	TIMES FOR MAXIMA --	TD = 4.9700	TV = 3.7350	TA = 4.9600
PER = 0.74	TIMES FOR MAXIMA --	TD = 4.6500	TV = 3.4800	TA = 4.6350
PER = 0.76	TIMES FOR MAXIMA --	TD = 4.6650	TV = 3.4800	TA = 4.6500
PER = 0.78	TIMES FOR MAXIMA --	TD = 4.6750	TV = 3.4800	TA = 4.6650
PER = 0.80	TIMES FOR MAXIMA --	TD = 4.3500	TV = 3.4800	TA = 4.3400

PER = 0.82	TIMES FOR MAXIMA --	TD = 4.3600	TV = 3.4800	TA = 4.3500
PER = 0.84	TIMES FOR MAXIMA --	TD = 4.3700	TV = 3.4850	TA = 4.3600
PER = 0.86	TIMES FOR MAXIMA --	TD = 4.3800	TV = 3.4850	TA = 4.3650
PER = 0.88	TIMES FOR MAXIMA --	TD = 4.3900	TV = 3.4850	TA = 4.3750
PER = 0.90	TIMES FOR MAXIMA --	TD = 3.6200	TV = 3.4850	TA = 3.6100
PER = 0.92	TIMES FOR MAXIMA --	TD = 3.6250	TV = 3.4850	TA = 3.6100
PER = 0.94	TIMES FOR MAXIMA --	TD = 3.6250	TV = 3.4850	TA = 3.6100
PER = 0.96	TIMES FOR MAXIMA --	TD = 3.6300	TV = 3.4850	TA = 3.6150
PER = 0.98	TIMES FOR MAXIMA --	TD = 3.6300	TV = 3.4850	TA = 3.6150
PER = 1.00	TIMES FOR MAXIMA --	TD = 3.6350	TV = 3.4850	TA = 3.6150
PER = 1.05	TIMES FOR MAXIMA --	TD = 3.6400	TV = 3.4850	TA = 3.6200
PER = 1.10	TIMES FOR MAXIMA --	TD = 3.6400	TV = 3.4850	TA = 3.6250
PER = 1.15	TIMES FOR MAXIMA --	TD = 3.6450	TV = 3.4850	TA = 3.6250
PER = 1.20	TIMES FOR MAXIMA --	TD = 3.3950	TV = 3.4850	TA = 3.3750
PER = 1.25	TIMES FOR MAXIMA --	TD = 3.3950	TV = 3.4850	TA = 3.3750
PER = 1.30	TIMES FOR MAXIMA --	TD = 3.3950	TV = 3.4900	TA = 3.3750
PER = 1.35	TIMES FOR MAXIMA --	TD = 3.3950	TV = 3.4900	TA = 3.3750
PER = 1.40	TIMES FOR MAXIMA --	TD = 3.3950	TV = 3.4900	TA = 3.3750
PER = 1.45	TIMES FOR MAXIMA --	TD = 3.4000	TV = 3.4900	TA = 3.3750
PER = 1.50	TIMES FOR MAXIMA --	TD = 3.4000	TV = 3.4900	TA = 3.3750
PER = 1.55	TIMES FOR MAXIMA --	TD = 3.4000	TV = 3.4900	TA = 3.3750
PER = 1.60	TIMES FOR MAXIMA --	TD = 3.4000	TV = 3.4900	TA = 3.3750
PER = 1.65	TIMES FOR MAXIMA --	TD = 3.4000	TV = 3.4900	TA = 3.3750
PER = 1.70	TIMES FOR MAXIMA --	TD = 3.4000	TV = 3.4900	TA = 3.3750
PER = 1.75	TIMES FOR MAXIMA --	TD = 3.4050	TV = 3.4900	TA = 3.3800
PER = 1.80	TIMES FOR MAXIMA --	TD = 3.4050	TV = 3.4900	TA = 3.3800
PER = 1.85	TIMES FOR MAXIMA --	TD = 3.4050	TV = 3.4900	TA = 3.3800
PER = 1.90	TIMES FOR MAXIMA --	TD = 4.4100	TV = 3.4900	TA = 3.3800
PER = 1.95	TIMES FOR MAXIMA --	TD = 4.4150	TV = 3.4900	TA = 4.3850
PER = 2.00	TIMES FOR MAXIMA --	TD = 4.4200	TV = 3.4900	TA = 4.3900
PER = 2.05	TIMES FOR MAXIMA --	TD = 4.4250	TV = 3.4900	TA = 4.3950
PER = 2.10	TIMES FOR MAXIMA --	TD = 4.4300	TV = 3.4900	TA = 4.4000
PER = 2.15	TIMES FOR MAXIMA --	TD = 4.4350	TV = 3.4900	TA = 4.4050
PER = 2.20	TIMES FOR MAXIMA --	TD = 4.4400	TV = 3.4900	TA = 4.4100
PER = 2.25	TIMES FOR MAXIMA --	TD = 4.4500	TV = 3.4900	TA = 4.4150
PER = 2.30	TIMES FOR MAXIMA --	TD = 4.4550	TV = 3.4900	TA = 3.3800
PER = 2.35	TIMES FOR MAXIMA --	TD = 4.4650	TV = 3.3200	TA = 3.3800
PER = 2.40	TIMES FOR MAXIMA --	TD = 3.4150	TV = 3.3200	TA = 3.3800
PER = 2.50	TIMES FOR MAXIMA --	TD = 3.4150	TV = 3.3200	TA = 3.3800
PER = 2.60	TIMES FOR MAXIMA --	TD = 4.9200	TV = 3.3200	TA = 3.3800
PER = 2.70	TIMES FOR MAXIMA --	TD = 4.9600	TV = 3.3200	TA = 4.9150
PER = 2.80	TIMES FOR MAXIMA --	TD = 4.9950	TV = 3.3200	TA = 4.9500
PER = 2.90	TIMES FOR MAXIMA --	TD = 5.0200	TV = 3.3200	TA = 4.9850
PER = 3.00	TIMES FOR MAXIMA --	TD = 5.0300	TV = 3.3200	TA = 5.0000
PER = 3.10	TIMES FOR MAXIMA --	TD = 5.0450	TV = 3.3200	TA = 5.0100
PER = 3.20	TIMES FOR MAXIMA --	TD = 5.0550	TV = 3.3200	TA = 5.0150
PER = 3.30	TIMES FOR MAXIMA --	TD = 5.3700	TV = 3.3200	TA = 5.0200
PER = 3.40	TIMES FOR MAXIMA --	TD = 5.3850	TV = 3.3200	TA = 5.3450
PER = 3.50	TIMES FOR MAXIMA --	TD = 5.3950	TV = 3.3200	TA = 5.3550
PER = 3.60	TIMES FOR MAXIMA --	TD = 5.4100	TV = 3.3200	TA = 5.3600
PER = 3.70	TIMES FOR MAXIMA --	TD = 5.4200	TV = 3.3200	TA = 5.3700
PER = 3.80	TIMES FOR MAXIMA --	TD = 5.4250	TV = 3.3200	TA = 5.3800
PER = 3.90	TIMES FOR MAXIMA --	TD = 5.4350	TV = 3.3200	TA = 5.3850
PER = 4.00	TIMES FOR MAXIMA --	TD = 5.4450	TV = 3.3200	TA = 5.3900
PER = 4.10	TIMES FOR MAXIMA --	TD = 5.8750	TV = 3.3200	TA = 5.8350
PER = 4.20	TIMES FOR MAXIMA --	TD = 5.8850	TV = 3.3200	TA = 5.8400
PER = 4.30	TIMES FOR MAXIMA --	TD = 5.8900	TV = 3.3200	TA = 5.8400
PER = 4.40	TIMES FOR MAXIMA --	TD = 5.8950	TV = 3.3200	TA = 5.8450
PER = 4.50	TIMES FOR MAXIMA --	TD = 5.9000	TV = 3.3200	TA = 5.8450
PER = 4.60	TIMES FOR MAXIMA --	TD = 5.9050	TV = 3.3200	TA = 5.8500
PER = 4.70	TIMES FOR MAXIMA --	TD = 5.9100	TV = 3.3200	TA = 5.8500

PER = 4.80 TIMES FOR MAXIMA -- TD = 5.9150 TV = 3.3200 TA = 5.8500
PER = 4.90 TIMES FOR MAXIMA -- TD = 5.9200 TV = 3.3200 TA = 5.8550
PER = 5.00 TIMES FOR MAXIMA -- TD = 6.2650 TV = 3.3200 TA = 5.8550
PER = 5.10 TIMES FOR MAXIMA -- TD = 6.2750 TV = 3.3200 TA = 6.2150
PER = 5.20 TIMES FOR MAXIMA -- TD = 6.2900 TV = 3.3200 TA = 6.2200
PER = 5.40 TIMES FOR MAXIMA -- TD = 6.3050 TV = 3.3200 TA = 6.2250
PER = 5.60 TIMES FOR MAXIMA -- TD = 9.4150 TV = 3.3200 TA = 9.3550
PER = 5.80 TIMES FOR MAXIMA -- TD = 9.4450 TV = 3.3200 TA = 9.3800
PER = 6.00 TIMES FOR MAXIMA -- TD = 9.8250 TV = 3.3200 TA = 9.3950
PER = 6.20 TIMES FOR MAXIMA -- TD = 9.8450 TV = 3.3200 TA = 9.7900
PER = 6.40 TIMES FOR MAXIMA -- TD = 9.8600 TV = 3.3200 TA = 9.8050
PER = 6.60 TIMES FOR MAXIMA -- TD = 9.8750 TV = 3.3200 TA = 9.8100
PER = 6.80 TIMES FOR MAXIMA -- TD = 9.8900 TV = 3.3200 TA = 4.0850
PER = 7.00 TIMES FOR MAXIMA -- TD = 4.1650 TV = 3.3200 TA = 4.0850
PER = 7.30 TIMES FOR MAXIMA -- TD = 4.1700 TV = 3.3200 TA = 4.0850
PER = 7.60 TIMES FOR MAXIMA -- TD = 4.1700 TV = 3.3200 TA = 4.0850
PER = 8.00 TIMES FOR MAXIMA -- TD = 4.1700 TV = 3.3200 TA = 4.0850
PER = 8.50 TIMES FOR MAXIMA -- TD = 4.1750 TV = 3.3200 TA = 4.0800
PER = 9.00 TIMES FOR MAXIMA -- TD = 4.1750 TV = 3.3200 TA = 4.0800
PER = 9.50 TIMES FOR MAXIMA -- TD = 4.1750 TV = 3.3200 TA = 4.0800
PER =10.00 TIMES FOR MAXIMA -- TD = 4.1750 TV = 3.3200 TA = 4.0800

SPECTRAL VALUES--
(Acceleration of gravity used = 32.20)

PCSC300M Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00007	0.00243	0.04499	0.87812	0.87795	100.00
2	0.02	0.00029	0.01005	0.09040	0.88173	0.88201	50.00
3	0.03	0.00065	0.02393	0.13620	0.88577	0.88592	33.33
4	0.04	0.00115	0.05153	0.18085	0.88219	0.88225	25.00
5	0.05	0.00190	0.07594	0.23891	0.93242	0.93237	20.00
6	0.06	0.00262	0.13350	0.27438	0.89308	0.89233	16.67
7	0.07	0.00432	0.16955	0.38766	1.08359	1.08064	14.29
8	0.08	0.00594	0.27142	0.46618	1.14800	1.13708	12.50
9	0.09	0.00810	0.34570	0.56517	1.23523	1.22535	11.11
10	0.10	0.01081	0.45652	0.67920	1.32316	1.32532	10.00
11	0.11	0.01040	0.41880	0.59377	1.05933	1.05329	9.09
12	0.12	0.01246	0.41769	0.65253	1.06229	1.06106	8.33
13	0.13	0.01336	0.44921	0.64585	0.97111	0.96942	7.69
14	0.14	0.01678	0.45214	0.75311	1.05235	1.04967	7.14
15	0.15	0.02002	0.52306	0.83874	1.09125	1.09109	6.67
16	0.16	0.02332	0.59111	0.91564	1.11793	1.11668	6.25
17	0.17	0.02817	0.69869	1.04127	1.19624	1.19519	5.88
18	0.18	0.03290	0.82484	1.14853	1.24650	1.24507	5.56
19	0.19	0.03929	1.01323	1.29920	1.33534	1.33427	5.26
20	0.20	0.04443	1.18464	1.39568	1.36488	1.36170	5.00
21	0.21	0.04883	1.29725	1.46109	1.36109	1.35763	4.76
22	0.22	0.05468	1.41508	1.56153	1.38742	1.38501	4.55
23	0.23	0.06297	1.56972	1.72017	1.46297	1.45937	4.35
24	0.24	0.07347	1.72462	1.92347	1.56973	1.56386	4.17
25	0.25	0.08429	1.86265	2.11835	1.65858	1.65342	4.00
26	0.26	0.09651	2.01865	2.33227	1.75548	1.75037	3.85
27	0.27	0.10992	2.18626	2.55791	1.85639	1.84861	3.70
28	0.28	0.12402	2.34934	2.78310	1.94708	1.93952	3.57
29	0.29	0.13987	2.54595	3.03050	2.04689	2.03911	3.45
30	0.30	0.15888	2.80154	3.32759	2.17268	2.16437	3.33
31	0.31	0.18053	3.10612	3.65906	2.31266	2.30320	3.23
32	0.32	0.20256	3.41352	3.97727	2.43554	2.42527	3.13
33	0.33	0.22331	3.68939	4.25178	2.52502	2.51409	3.03
34	0.34	0.24551	4.35903	4.53707	2.61538	2.60388	2.94
35	0.35	0.28073	4.90942	5.03964	2.82297	2.80967	2.86
36	0.36	0.30976	5.30060	5.40637	2.94543	2.93040	2.78

37	0.37	0.33192	5.53497	5.63658	2.98673	2.97261	2.70
38	0.38	0.34673	5.66923	5.73313	2.95711	2.94396	2.63
39	0.39	0.35413	5.74610	5.70522	2.86789	2.85451	2.56
40	0.40	0.35665	5.83915	5.60225	2.74508	2.73292	2.50
41	0.41	0.36587	5.85423	5.60690	2.68064	2.66847	2.44
42	0.42	0.37218	5.79615	5.56780	2.59871	2.58677	2.38
43	0.43	0.37547	5.67023	5.48638	2.50225	2.48967	2.33
44	0.44	0.37552	5.55088	5.36239	2.39208	2.37810	2.27
45	0.45	0.37235	5.47675	5.19900	2.26852	2.25440	2.22
46	0.46	0.36612	5.36397	5.00085	2.13348	2.12134	2.17
47	0.47	0.35679	5.21569	4.76976	1.99183	1.98026	2.13
48	0.48	0.35027	5.03775	4.58507	1.87540	1.86393	2.08
49	0.49	0.34654	4.84383	4.44368	1.78143	1.76958	2.04
50	0.50	0.34182	4.64679	4.29538	1.68753	1.67631	2.00
51	0.51	0.33611	4.44590	4.14086	1.59516	1.58433	1.96
52	0.52	0.32964	4.24761	3.98307	1.50522	1.49465	1.92
53	0.53	0.32258	4.04926	3.82416	1.41825	1.40794	1.89
54	0.54	0.31520	3.87757	3.66757	1.33451	1.32528	1.85
55	0.55	0.30747	3.79424	3.51252	1.25467	1.24618	1.82
56	0.56	0.29943	3.71004	3.35964	1.17918	1.17065	1.79
57	0.57	0.29115	3.62987	3.20944	1.10715	1.09870	1.75
58	0.58	0.28289	3.54806	3.06454	1.03859	1.03101	1.72
59	0.60	0.26632	3.38849	2.78894	0.91428	0.90701	1.67
60	0.62	0.25023	3.23379	2.53585	0.80461	0.79810	1.61
61	0.64	0.24833	3.09058	2.43796	0.74726	0.74331	1.56
62	0.66	0.24925	2.95681	2.37287	0.70611	0.70154	1.52
63	0.68	0.24904	2.83915	2.30113	0.66374	0.66032	1.47
64	0.70	0.24895	2.73437	2.23457	0.62626	0.62290	1.43
65	0.72	0.24507	2.64613	2.13864	0.58275	0.57960	1.39
66	0.74	0.24349	2.56927	2.06739	0.54828	0.54515	1.35
67	0.76	0.23957	2.53474	1.98059	0.51182	0.50852	1.32
68	0.78	0.23272	2.50849	1.87466	0.47229	0.46898	1.28
69	0.80	0.22889	2.48866	1.79770	0.44166	0.43848	1.25
70	0.82	0.22905	2.47371	1.75505	0.42067	0.41764	1.22
71	0.84	0.22728	2.46278	1.70002	0.39776	0.39491	1.19
72	0.86	0.22364	2.45497	1.63393	0.37341	0.37073	1.16
73	0.88	0.21818	2.44903	1.55780	0.34815	0.34543	1.14
74	0.90	0.21437	2.44421	1.49662	0.32858	0.32448	1.11
75	0.92	0.21414	2.43985	1.46250	0.31418	0.31019	1.09
76	0.94	0.21346	2.43534	1.42685	0.30011	0.29619	1.06
77	0.96	0.21244	2.43019	1.39040	0.28640	0.28261	1.04
78	0.98	0.21101	2.42402	1.35285	0.27311	0.26937	1.02
79	1.00	0.20912	2.41660	1.31394	0.26007	0.25639	1.00
80	1.05	0.20298	2.39236	1.21460	0.22923	0.22572	0.95
81	1.10	0.19527	2.36176	1.11538	0.20115	0.19786	0.91
82	1.15	0.18682	2.32853	1.02072	0.17626	0.17319	0.87
83	1.20	0.18307	2.29597	0.95853	0.15994	0.15586	0.83
84	1.25	0.18991	2.26583	0.95461	0.15305	0.14902	0.80
85	1.30	0.19702	2.23837	0.95224	0.14693	0.14293	0.77
86	1.35	0.20454	2.21332	0.95195	0.14159	0.13760	0.74
87	1.40	0.21247	2.18898	0.95355	0.13690	0.13290	0.71
88	1.45	0.22075	2.16445	0.95654	0.13272	0.12872	0.69
89	1.50	0.22930	2.13915	0.96049	0.12891	0.12495	0.67
90	1.55	0.23791	2.11287	0.96439	0.12534	0.12141	0.65
91	1.60	0.24644	2.08564	0.96777	0.12195	0.11803	0.63
92	1.65	0.25482	2.05767	0.97036	0.11868	0.11476	0.61
93	1.70	0.26300	2.02921	0.97206	0.11551	0.11158	0.59
94	1.75	0.27104	2.00055	0.97314	0.11244	0.10851	0.57
95	1.80	0.27891	1.97192	0.97358	0.10947	0.10554	0.56
96	1.85	0.28657	1.94349	0.97328	0.10658	0.10266	0.54
97	1.90	0.29765	1.91537	0.98430	0.10379	0.10109	0.53

98	1.95	0.31087	1.88762	1.00166	0.10182	0.10023	0.51
99	2.00	0.32234	1.86027	1.01267	0.10042	0.09880	0.50
100	2.05	0.33208	1.83331	1.01780	0.09853	0.09688	0.49
101	2.10	0.34007	1.80672	1.01747	0.09624	0.09454	0.48
102	2.15	0.34634	1.78047	1.01214	0.09361	0.09186	0.47
103	2.20	0.35092	1.75453	1.00222	0.09069	0.08889	0.45
104	2.25	0.35387	1.72887	0.98819	0.08752	0.08570	0.44
105	2.30	0.35529	1.70347	0.97059	0.08472	0.08234	0.43
106	2.35	0.35524	1.70482	0.94980	0.08267	0.07887	0.43
107	2.40	0.36057	1.72110	0.94396	0.08067	0.07675	0.42
108	2.50	0.37164	1.75318	0.93404	0.07682	0.07290	0.40
109	2.60	0.38908	1.78445	0.94025	0.07313	0.07057	0.38
110	2.70	0.42250	1.81464	0.98321	0.07159	0.07106	0.37
111	2.80	0.45139	1.84353	1.01292	0.07117	0.07059	0.36
112	2.90	0.47536	1.87093	1.02992	0.06991	0.06930	0.34
113	3.00	0.49292	1.89670	1.03237	0.06801	0.06715	0.33
114	3.10	0.50371	1.92071	1.02093	0.06537	0.06426	0.32
115	3.20	0.50807	1.94293	0.99760	0.06211	0.06083	0.31
116	3.30	0.50776	1.96335	0.96677	0.05842	0.05717	0.30
117	3.40	0.53200	1.98197	0.98314	0.05726	0.05642	0.29
118	3.50	0.55000	1.99886	0.98735	0.05601	0.05505	0.29
119	3.60	0.56202	2.01408	0.98091	0.05422	0.05317	0.28
120	3.70	0.56836	2.02771	0.96516	0.05203	0.05090	0.27
121	3.80	0.56955	2.03985	0.94173	0.04956	0.04836	0.26
122	3.90	0.56610	2.05058	0.91203	0.04690	0.04563	0.26
123	4.00	0.55862	2.06001	0.87748	0.04412	0.04281	0.25
124	4.10	0.57600	2.06825	0.88271	0.04322	0.04201	0.24
125	4.20	0.59158	2.07537	0.88500	0.04245	0.04112	0.24
126	4.30	0.60227	2.08149	0.88004	0.04135	0.03994	0.23
127	4.40	0.60843	2.08669	0.86884	0.04002	0.03853	0.23
128	4.50	0.61057	2.09105	0.85252	0.03851	0.03697	0.22
129	4.60	0.60914	2.09465	0.83203	0.03688	0.03529	0.22
130	4.70	0.60459	2.09756	0.80824	0.03517	0.03356	0.21
131	4.80	0.59730	2.09985	0.78187	0.03341	0.03178	0.21
132	4.90	0.58769	2.10159	0.75359	0.03164	0.03001	0.20
133	5.00	0.58727	2.10283	0.73799	0.02988	0.02880	0.20
134	5.10	0.58886	2.10362	0.72547	0.02852	0.02776	0.20
135	5.20	0.58804	2.10402	0.71054	0.02745	0.02666	0.19
136	5.40	0.58028	2.10379	0.67519	0.02520	0.02440	0.19
137	5.60	0.57713	2.10243	0.64754	0.02295	0.02256	0.18
138	5.80	0.58561	2.10021	0.63440	0.02185	0.02134	0.17
139	6.00	0.57892	2.09731	0.60624	0.02015	0.01972	0.17
140	6.20	0.58678	2.09392	0.59465	0.01911	0.01872	0.16
141	6.40	0.57837	2.09015	0.56782	0.01782	0.01731	0.16
142	6.60	0.55721	2.08612	0.53046	0.01627	0.01568	0.15
143	6.80	0.52675	2.08193	0.48671	0.01525	0.01397	0.15
144	7.00	0.51511	2.07761	0.46237	0.01435	0.01289	0.14
145	7.30	0.50802	2.07106	0.43726	0.01313	0.01169	0.14
146	7.60	0.50047	2.06450	0.41376	0.01205	0.01062	0.13
147	8.00	0.49001	2.05598	0.38485	0.01078	0.00939	0.13
148	8.50	0.47683	2.04578	0.35247	0.00945	0.00809	0.12
149	9.00	0.46398	2.03630	0.32392	0.00835	0.00702	0.11
150	9.50	0.45166	2.02751	0.29872	0.00743	0.00614	0.11
151	10.00	0.44008	2.01943	0.27651	0.00665	0.00540	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.

AREA OF ACC. RESPONSE SPECTRUM = 1.283

AREA OF VEL. RESPONSE SPECTRUM = 5.706

MAX. ACCELERATION RESPONSE VALUE = 2.987

MAX. VELOCITY RESPONSE VALUE = 5.854

1****** OPTION 9 *** COMPUTE RESPONSE SPECTRUM
RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER 17
CALCULATED FOR DAMPING 0.050

TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
TD = TIME FOR MAX. RELATIVE DISP.
TV = TIME FOR MAX. RELATIVE VEL.
TA = TIME FOR MAX. ABSOLUTE ACC.
DAMPING RATIO = 0.050

PER = 0.01	TIMES FOR MAXIMA --	TD = 3.4150	TV = 3.3850	TA = 3.4150
PER = 0.02	TIMES FOR MAXIMA --	TD = 3.4200	TV = 3.3850	TA = 3.4200
PER = 0.03	TIMES FOR MAXIMA --	TD = 3.4000	TV = 2.2250	TA = 3.4000
PER = 0.04	TIMES FOR MAXIMA --	TD = 3.4050	TV = 3.3900	TA = 3.4050
PER = 0.05	TIMES FOR MAXIMA --	TD = 3.4100	TV = 3.3950	TA = 3.4100
PER = 0.06	TIMES FOR MAXIMA --	TD = 3.4150	TV = 1.9300	TA = 3.4150
PER = 0.07	TIMES FOR MAXIMA --	TD = 3.4150	TV = 1.9750	TA = 3.4150
PER = 0.08	TIMES FOR MAXIMA --	TD = 3.4250	TV = 3.5250	TA = 3.4250
PER = 0.09	TIMES FOR MAXIMA --	TD = 3.4300	TV = 3.4550	TA = 3.4250
PER = 0.10	TIMES FOR MAXIMA --	TD = 3.4350	TV = 3.4600	TA = 3.4300
PER = 0.11	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.4650	TA = 3.4400
PER = 0.12	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.4700	TA = 3.4400
PER = 0.13	TIMES FOR MAXIMA --	TD = 4.0200	TV = 5.1100	TA = 4.0150
PER = 0.14	TIMES FOR MAXIMA --	TD = 4.0350	TV = 4.0750	TA = 4.0300
PER = 0.15	TIMES FOR MAXIMA --	TD = 3.4450	TV = 4.0850	TA = 3.4400
PER = 0.16	TIMES FOR MAXIMA --	TD = 4.0500	TV = 4.0900	TA = 4.0500
PER = 0.17	TIMES FOR MAXIMA --	TD = 3.8300	TV = 4.1050	TA = 3.8300
PER = 0.18	TIMES FOR MAXIMA --	TD = 3.8400	TV = 3.7950	TA = 3.8350
PER = 0.19	TIMES FOR MAXIMA --	TD = 3.8500	TV = 3.8050	TA = 3.8450
PER = 0.20	TIMES FOR MAXIMA --	TD = 3.8650	TV = 3.8150	TA = 3.8600
PER = 0.21	TIMES FOR MAXIMA --	TD = 3.8800	TV = 3.8300	TA = 3.8800
PER = 0.22	TIMES FOR MAXIMA --	TD = 4.0200	TV = 3.8400	TA = 4.0150
PER = 0.23	TIMES FOR MAXIMA --	TD = 4.0400	TV = 4.1000	TA = 4.0350
PER = 0.24	TIMES FOR MAXIMA --	TD = 4.0600	TV = 4.1150	TA = 4.0550
PER = 0.25	TIMES FOR MAXIMA --	TD = 3.4850	TV = 3.4300	TA = 3.4850
PER = 0.26	TIMES FOR MAXIMA --	TD = 3.4900	TV = 3.4300	TA = 3.4900
PER = 0.27	TIMES FOR MAXIMA --	TD = 3.5000	TV = 3.4350	TA = 3.4950
PER = 0.28	TIMES FOR MAXIMA --	TD = 3.5050	TV = 3.4350	TA = 3.5000
PER = 0.29	TIMES FOR MAXIMA --	TD = 3.5100	TV = 3.4350	TA = 3.5050
PER = 0.30	TIMES FOR MAXIMA --	TD = 3.5150	TV = 3.4400	TA = 3.5100
PER = 0.31	TIMES FOR MAXIMA --	TD = 3.5200	TV = 3.4400	TA = 3.5150
PER = 0.32	TIMES FOR MAXIMA --	TD = 3.5300	TV = 3.4450	TA = 3.5250
PER = 0.33	TIMES FOR MAXIMA --	TD = 3.5350	TV = 3.4500	TA = 3.5300
PER = 0.34	TIMES FOR MAXIMA --	TD = 4.0850	TV = 3.4600	TA = 4.0800
PER = 0.35	TIMES FOR MAXIMA --	TD = 4.1000	TV = 4.0200	TA = 4.0950
PER = 0.36	TIMES FOR MAXIMA --	TD = 4.1150	TV = 4.0350	TA = 4.1100
PER = 0.37	TIMES FOR MAXIMA --	TD = 4.1300	TV = 4.0450	TA = 4.1250
PER = 0.38	TIMES FOR MAXIMA --	TD = 4.1500	TV = 4.0550	TA = 4.1400
PER = 0.39	TIMES FOR MAXIMA --	TD = 4.1650	TV = 4.0600	TA = 4.1600
PER = 0.40	TIMES FOR MAXIMA --	TD = 3.8050	TV = 3.9050	TA = 3.8000
PER = 0.41	TIMES FOR MAXIMA --	TD = 3.4150	TV = 3.9150	TA = 3.4100
PER = 0.42	TIMES FOR MAXIMA --	TD = 3.4200	TV = 3.7400	TA = 3.4150
PER = 0.43	TIMES FOR MAXIMA --	TD = 3.4250	TV = 3.7500	TA = 3.4150
PER = 0.44	TIMES FOR MAXIMA --	TD = 3.4250	TV = 3.7550	TA = 3.4200
PER = 0.45	TIMES FOR MAXIMA --	TD = 3.4300	TV = 3.7600	TA = 3.4250
PER = 0.46	TIMES FOR MAXIMA --	TD = 3.4350	TV = 3.7650	TA = 3.4250
PER = 0.47	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.7700	TA = 3.4300
PER = 0.48	TIMES FOR MAXIMA --	TD = 3.6850	TV = 3.3700	TA = 3.6800
PER = 0.49	TIMES FOR MAXIMA --	TD = 3.6950	TV = 3.3700	TA = 3.6850
PER = 0.50	TIMES FOR MAXIMA --	TD = 3.7000	TV = 3.3750	TA = 3.6900
PER = 0.51	TIMES FOR MAXIMA --	TD = 3.7050	TV = 3.3750	TA = 3.6950
PER = 0.52	TIMES FOR MAXIMA --	TD = 3.7100	TV = 3.3750	TA = 3.7000

PER = 0.53 TIMES FOR MAXIMA -- TD = 3.7150 TV = 3.3750 TA = 3.7050
PER = 0.54 TIMES FOR MAXIMA -- TD = 3.7200 TV = 3.3750 TA = 3.7100
PER = 0.55 TIMES FOR MAXIMA -- TD = 3.7250 TV = 3.3750 TA = 3.7150
PER = 0.56 TIMES FOR MAXIMA -- TD = 3.4750 TV = 3.3800 TA = 3.4650
PER = 0.57 TIMES FOR MAXIMA -- TD = 3.4750 TV = 3.3800 TA = 3.4700
PER = 0.58 TIMES FOR MAXIMA -- TD = 3.4800 TV = 3.3800 TA = 3.4700
PER = 0.60 TIMES FOR MAXIMA -- TD = 5.0650 TV = 3.3800 TA = 5.0550
PER = 0.62 TIMES FOR MAXIMA -- TD = 5.0950 TV = 3.3800 TA = 5.0850
PER = 0.64 TIMES FOR MAXIMA -- TD = 4.8400 TV = 3.3800 TA = 4.8300
PER = 0.66 TIMES FOR MAXIMA -- TD = 4.8650 TV = 3.3800 TA = 4.8550
PER = 0.68 TIMES FOR MAXIMA -- TD = 4.8850 TV = 3.3800 TA = 4.8750
PER = 0.70 TIMES FOR MAXIMA -- TD = 4.9100 TV = 3.3800 TA = 4.9000
PER = 0.72 TIMES FOR MAXIMA -- TD = 4.9350 TV = 3.3800 TA = 4.9200
PER = 0.74 TIMES FOR MAXIMA -- TD = 4.9500 TV = 3.3800 TA = 4.9400
PER = 0.76 TIMES FOR MAXIMA -- TD = 4.2600 TV = 3.3800 TA = 4.2500
PER = 0.78 TIMES FOR MAXIMA -- TD = 4.2750 TV = 3.3800 TA = 4.2600
PER = 0.80 TIMES FOR MAXIMA -- TD = 4.2950 TV = 3.3800 TA = 4.2800
PER = 0.82 TIMES FOR MAXIMA -- TD = 4.3100 TV = 3.3800 TA = 4.2950
PER = 0.84 TIMES FOR MAXIMA -- TD = 4.3250 TV = 3.3800 TA = 4.3100
PER = 0.86 TIMES FOR MAXIMA -- TD = 4.3350 TV = 3.3800 TA = 4.3200
PER = 0.88 TIMES FOR MAXIMA -- TD = 4.3450 TV = 3.3800 TA = 4.3300
PER = 0.90 TIMES FOR MAXIMA -- TD = 4.3500 TV = 3.3800 TA = 4.3350
PER = 0.92 TIMES FOR MAXIMA -- TD = 4.3550 TV = 3.3800 TA = 4.3450
PER = 0.94 TIMES FOR MAXIMA -- TD = 4.3650 TV = 3.3850 TA = 4.3500
PER = 0.96 TIMES FOR MAXIMA -- TD = 4.3700 TV = 3.3850 TA = 4.3500
PER = 0.98 TIMES FOR MAXIMA -- TD = 3.2900 TV = 3.3850 TA = 3.2750
PER = 1.00 TIMES FOR MAXIMA -- TD = 3.2900 TV = 3.3850 TA = 3.2750
PER = 1.05 TIMES FOR MAXIMA -- TD = 3.2900 TV = 3.3850 TA = 3.2750
PER = 1.10 TIMES FOR MAXIMA -- TD = 3.2900 TV = 3.3850 TA = 3.2750
PER = 1.15 TIMES FOR MAXIMA -- TD = 3.2900 TV = 3.3850 TA = 3.2750
PER = 1.20 TIMES FOR MAXIMA -- TD = 3.2950 TV = 3.3850 TA = 3.2750
PER = 1.25 TIMES FOR MAXIMA -- TD = 3.2950 TV = 3.3850 TA = 3.2750
PER = 1.30 TIMES FOR MAXIMA -- TD = 3.2950 TV = 3.3850 TA = 3.2750
PER = 1.35 TIMES FOR MAXIMA -- TD = 3.2950 TV = 3.3850 TA = 3.2750
PER = 1.40 TIMES FOR MAXIMA -- TD = 3.3000 TV = 3.3850 TA = 3.2750
PER = 1.45 TIMES FOR MAXIMA -- TD = 3.3000 TV = 3.3850 TA = 3.2750
PER = 1.50 TIMES FOR MAXIMA -- TD = 3.3000 TV = 3.3850 TA = 3.2750
PER = 1.55 TIMES FOR MAXIMA -- TD = 3.3000 TV = 3.3850 TA = 3.2750
PER = 1.60 TIMES FOR MAXIMA -- TD = 3.3000 TV = 3.3850 TA = 3.2800
PER = 1.65 TIMES FOR MAXIMA -- TD = 3.3050 TV = 3.3850 TA = 3.2800
PER = 1.70 TIMES FOR MAXIMA -- TD = 3.3050 TV = 3.3850 TA = 3.2800
PER = 1.75 TIMES FOR MAXIMA -- TD = 3.3050 TV = 3.3850 TA = 3.2800
PER = 1.80 TIMES FOR MAXIMA -- TD = 4.3450 TV = 3.3850 TA = 3.2800
PER = 1.85 TIMES FOR MAXIMA -- TD = 4.3500 TV = 3.3850 TA = 4.3300
PER = 1.90 TIMES FOR MAXIMA -- TD = 4.3600 TV = 3.3850 TA = 4.3350
PER = 1.95 TIMES FOR MAXIMA -- TD = 4.3650 TV = 3.2250 TA = 4.3400
PER = 2.00 TIMES FOR MAXIMA -- TD = 4.4400 TV = 3.2250 TA = 4.3450
PER = 2.05 TIMES FOR MAXIMA -- TD = 4.4500 TV = 3.2250 TA = 4.4350
PER = 2.10 TIMES FOR MAXIMA -- TD = 4.4600 TV = 3.2250 TA = 4.4400
PER = 2.15 TIMES FOR MAXIMA -- TD = 4.4750 TV = 3.2250 TA = 4.4450
PER = 2.20 TIMES FOR MAXIMA -- TD = 4.4950 TV = 3.2250 TA = 4.4500
PER = 2.25 TIMES FOR MAXIMA -- TD = 4.5100 TV = 3.2250 TA = 4.4550
PER = 2.30 TIMES FOR MAXIMA -- TD = 4.5200 TV = 3.2250 TA = 4.5000
PER = 2.35 TIMES FOR MAXIMA -- TD = 4.5300 TV = 3.2250 TA = 4.5050
PER = 2.40 TIMES FOR MAXIMA -- TD = 4.5400 TV = 3.2250 TA = 4.5100
PER = 2.50 TIMES FOR MAXIMA -- TD = 4.7200 TV = 3.2250 TA = 4.7000
PER = 2.60 TIMES FOR MAXIMA -- TD = 4.8750 TV = 3.2250 TA = 4.8550
PER = 2.70 TIMES FOR MAXIMA -- TD = 4.9050 TV = 3.2250 TA = 4.8600
PER = 2.80 TIMES FOR MAXIMA -- TD = 4.9350 TV = 3.2300 TA = 4.8850
PER = 2.90 TIMES FOR MAXIMA -- TD = 4.9550 TV = 3.2300 TA = 4.9250
PER = 3.00 TIMES FOR MAXIMA -- TD = 4.9650 TV = 3.2300 TA = 4.9350

PER = 3.10 TIMES FOR MAXIMA -- TD = 4.9800 TV = 3.2300 TA = 4.9400
PER = 3.20 TIMES FOR MAXIMA -- TD = 5.1950 TV = 3.2300 TA = 5.1650
PER = 3.30 TIMES FOR MAXIMA -- TD = 5.2650 TV = 3.2300 TA = 5.1700
PER = 3.40 TIMES FOR MAXIMA -- TD = 5.2900 TV = 3.2300 TA = 5.2500
PER = 3.50 TIMES FOR MAXIMA -- TD = 5.3200 TV = 3.2300 TA = 5.2600
PER = 3.60 TIMES FOR MAXIMA -- TD = 5.3350 TV = 3.2300 TA = 5.3050
PER = 3.70 TIMES FOR MAXIMA -- TD = 5.3450 TV = 3.2300 TA = 5.3100
PER = 3.80 TIMES FOR MAXIMA -- TD = 7.3550 TV = 3.2300 TA = 7.3100
PER = 3.90 TIMES FOR MAXIMA -- TD = 7.4500 TV = 3.2300 TA = 7.4250
PER = 4.00 TIMES FOR MAXIMA -- TD = 5.7750 TV = 3.2300 TA = 5.7450
PER = 4.10 TIMES FOR MAXIMA -- TD = 5.7850 TV = 3.2300 TA = 5.7500
PER = 4.20 TIMES FOR MAXIMA -- TD = 5.7900 TV = 3.2300 TA = 5.7550
PER = 4.30 TIMES FOR MAXIMA -- TD = 5.8000 TV = 3.2300 TA = 5.7600
PER = 4.40 TIMES FOR MAXIMA -- TD = 5.8100 TV = 3.2300 TA = 5.7600
PER = 4.50 TIMES FOR MAXIMA -- TD = 5.8150 TV = 3.2300 TA = 5.7650
PER = 4.60 TIMES FOR MAXIMA -- TD = 5.8250 TV = 3.2300 TA = 5.7650
PER = 4.70 TIMES FOR MAXIMA -- TD = 6.0800 TV = 3.2300 TA = 5.7650
PER = 4.80 TIMES FOR MAXIMA -- TD = 6.1150 TV = 3.2300 TA = 6.0300
PER = 4.90 TIMES FOR MAXIMA -- TD = 6.1350 TV = 3.2300 TA = 6.0350
PER = 5.00 TIMES FOR MAXIMA -- TD = 6.1500 TV = 3.2300 TA = 6.1000
PER = 5.10 TIMES FOR MAXIMA -- TD = 6.1650 TV = 3.2300 TA = 6.1100
PER = 5.20 TIMES FOR MAXIMA -- TD = 6.1800 TV = 3.2300 TA = 6.1200
PER = 5.40 TIMES FOR MAXIMA -- TD = 6.2900 TV = 3.2300 TA = 6.1350
PER = 5.60 TIMES FOR MAXIMA -- TD = 9.3450 TV = 3.2300 TA = 9.2800
PER = 5.80 TIMES FOR MAXIMA -- TD = 9.4000 TV = 3.2300 TA = 9.3050
PER = 6.00 TIMES FOR MAXIMA -- TD = 9.7200 TV = 3.2300 TA = 9.6600
PER = 6.20 TIMES FOR MAXIMA -- TD = 9.7600 TV = 3.2300 TA = 9.6750
PER = 6.40 TIMES FOR MAXIMA -- TD = 9.7800 TV = 3.2300 TA = 9.7250
PER = 6.60 TIMES FOR MAXIMA -- TD = 9.9900 TV = 3.2300 TA = 9.7350
PER = 6.80 TIMES FOR MAXIMA -- TD = 10.0350 TV = 3.2300 TA = 3.9750
PER = 7.00 TIMES FOR MAXIMA -- TD = 10.0550 TV = 3.2300 TA = 3.9750
PER = 7.30 TIMES FOR MAXIMA -- TD = 4.0400 TV = 3.2300 TA = 3.9700
PER = 7.60 TIMES FOR MAXIMA -- TD = 4.0450 TV = 3.2300 TA = 3.9700
PER = 8.00 TIMES FOR MAXIMA -- TD = 4.0450 TV = 3.2300 TA = 3.9700
PER = 8.50 TIMES FOR MAXIMA -- TD = 4.0450 TV = 3.2300 TA = 3.9700
PER = 9.00 TIMES FOR MAXIMA -- TD = 4.0450 TV = 3.2300 TA = 3.9700
PER = 9.50 TIMES FOR MAXIMA -- TD = 4.0500 TV = 3.2300 TA = 3.9700
PER =10.00 TIMES FOR MAXIMA -- TD = 4.0500 TV = 3.2300 TA = 3.9700

SPECTRAL VALUES--

(Acceleration of gravity used = 32.20)

PCSC300M Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00004	0.00344	0.02723	0.53173	0.53137	100.00
2	0.02	0.00018	0.01498	0.05597	0.54644	0.54604	50.00
3	0.03	0.00046	0.04299	0.09541	0.62698	0.62058	33.33
4	0.04	0.00098	0.07450	0.15339	0.74265	0.74829	25.00
5	0.05	0.00185	0.11438	0.23188	0.90186	0.90494	20.00
6	0.06	0.00323	0.21636	0.33796	1.09325	1.09910	16.67
7	0.07	0.00417	0.26957	0.37428	1.04604	1.04334	14.29
8	0.08	0.00574	0.36004	0.45084	1.09593	1.09966	12.50
9	0.09	0.00793	0.46547	0.55381	1.20729	1.20072	11.11
10	0.10	0.01184	0.65897	0.74391	1.45586	1.45159	10.00
11	0.11	0.01171	0.58300	0.66872	1.18724	1.18625	9.09
12	0.12	0.01240	0.55739	0.64908	1.06784	1.05547	8.33
13	0.13	0.01544	0.57856	0.74634	1.12466	1.12025	7.69
14	0.14	0.01706	0.68136	0.76544	1.06872	1.06686	7.14
15	0.15	0.01801	0.70930	0.75423	0.98064	0.98116	6.67
16	0.16	0.02089	0.80674	0.82053	1.00651	1.00069	6.25
17	0.17	0.02562	0.81415	0.94686	1.08817	1.08683	5.88
18	0.18	0.03629	1.14590	1.26681	1.37972	1.37329	5.56
19	0.19	0.04746	1.50605	1.56961	1.61717	1.61199	5.26

20	0.20	0.05622	1.76231	1.76627	1.72911	1.72326	5.00
21	0.21	0.05900	1.77538	1.76536	1.64688	1.64036	4.76
22	0.22	0.06011	1.66750	1.71685	1.52662	1.52277	4.55
23	0.23	0.06855	1.77125	1.87279	1.59324	1.58885	4.35
24	0.24	0.07171	1.75936	1.87725	1.53512	1.52628	4.17
25	0.25	0.06812	1.64597	1.71210	1.34162	1.33632	4.00
26	0.26	0.07414	1.74473	1.79156	1.35117	1.34456	3.85
27	0.27	0.08077	1.85374	1.87951	1.36525	1.35833	3.70
28	0.28	0.08697	1.94060	1.95166	1.36680	1.36010	3.57
29	0.29	0.09386	2.02854	2.03354	1.37519	1.36829	3.45
30	0.30	0.10278	2.16374	2.15263	1.40737	1.40014	3.33
31	0.31	0.11314	2.31754	2.29317	1.45097	1.44344	3.23
32	0.32	0.12301	2.45521	2.41523	1.48044	1.47276	3.13
33	0.33	0.13119	2.54419	2.49779	1.48493	1.47695	3.03
34	0.34	0.14271	2.59575	2.63735	1.52138	1.51360	2.94
35	0.35	0.15651	2.68723	2.80967	1.57393	1.56643	2.86
36	0.36	0.16429	2.90887	2.86740	1.56142	1.55421	2.78
37	0.37	0.16698	3.00594	2.83558	1.50270	1.49542	2.70
38	0.38	0.16550	2.97128	2.73644	1.41208	1.40516	2.63
39	0.39	0.16053	2.81259	2.58633	1.29996	1.29402	2.56
40	0.40	0.15743	2.60673	2.47295	1.21458	1.20637	2.50
41	0.41	0.15845	2.55928	2.42821	1.16465	1.15565	2.44
42	0.42	0.15930	2.55244	2.38318	1.11507	1.10721	2.38
43	0.43	0.15941	2.57190	2.32929	1.06456	1.05701	2.33
44	0.44	0.15879	2.55400	2.26755	1.01406	1.00561	2.27
45	0.45	0.15773	2.50222	2.20231	0.96199	0.95497	2.22
46	0.46	0.15595	2.42166	2.13016	0.90953	0.90361	2.17
47	0.47	0.15361	2.31736	2.05350	0.85825	0.85255	2.13
48	0.48	0.15256	2.28031	1.99700	0.81642	0.81182	2.08
49	0.49	0.15098	2.26787	1.93595	0.77628	0.77094	2.04
50	0.50	0.14885	2.24825	1.87049	0.73500	0.72998	2.00
51	0.51	0.14607	2.22793	1.79955	0.69341	0.68852	1.96
52	0.52	0.14275	2.20266	1.72490	0.65210	0.64727	1.92
53	0.53	0.13899	2.17393	1.64778	0.61147	0.60666	1.89
54	0.54	0.13486	2.14284	1.56913	0.57181	0.56701	1.85
55	0.55	0.13040	2.11020	1.48967	0.53328	0.52851	1.82
56	0.56	0.12738	2.07877	1.42920	0.50120	0.49800	1.79
57	0.57	0.12463	2.04816	1.37386	0.47333	0.47032	1.75
58	0.58	0.12200	2.01723	1.32169	0.44768	0.44466	1.72
59	0.60	0.12140	1.95582	1.27134	0.41666	0.41346	1.67
60	0.62	0.13002	1.89681	1.31761	0.41668	0.41469	1.61
61	0.64	0.13822	1.84194	1.35697	0.41587	0.41373	1.56
62	0.66	0.14955	1.79284	1.42367	0.42321	0.42091	1.52
63	0.68	0.15620	1.75093	1.44329	0.41665	0.41416	1.47
64	0.70	0.15867	1.71699	1.42420	0.39922	0.39701	1.43
65	0.72	0.15780	1.69088	1.37709	0.37538	0.37321	1.39
66	0.74	0.15343	1.67168	1.30274	0.34603	0.34352	1.35
67	0.76	0.15320	1.65801	1.26652	0.32713	0.32518	1.32
68	0.78	0.15301	1.64842	1.23255	0.30987	0.30834	1.28
69	0.80	0.15226	1.64164	1.19583	0.29295	0.29168	1.25
70	0.82	0.15089	1.63668	1.15619	0.27649	0.27513	1.22
71	0.84	0.14873	1.63281	1.11252	0.25978	0.25844	1.19
72	0.86	0.14558	1.62945	1.06365	0.24283	0.24134	1.16
73	0.88	0.14112	1.62616	1.00756	0.22519	0.22341	1.14
74	0.90	0.13537	1.62256	0.94504	0.20669	0.20490	1.11
75	0.92	0.12834	1.61831	0.87653	0.18783	0.18591	1.09
76	0.94	0.12036	1.61322	0.80451	0.16882	0.16700	1.06
77	0.96	0.11165	1.60771	0.73076	0.15011	0.14853	1.04
78	0.98	0.11349	1.60100	0.72764	0.14794	0.14488	1.02
79	1.00	0.11644	1.59306	0.73164	0.14580	0.14277	1.00
80	1.05	0.12348	1.56865	0.73890	0.14033	0.13732	0.95

81	1.10	0.12986	1.54016	0.74176	0.13461	0.13158	0.91
82	1.15	0.13570	1.51097	0.74142	0.12886	0.12580	0.87
83	1.20	0.14142	1.48339	0.74049	0.12341	0.12041	0.83
84	1.25	0.14724	1.45826	0.74011	0.11850	0.11553	0.80
85	1.30	0.15335	1.43523	0.74118	0.11420	0.11125	0.77
86	1.35	0.15983	1.41340	0.74390	0.11047	0.10752	0.74
87	1.40	0.16665	1.39181	0.74794	0.10720	0.10425	0.71
88	1.45	0.17378	1.36977	0.75301	0.10425	0.10133	0.69
89	1.50	0.18098	1.34690	0.75810	0.10151	0.09862	0.67
90	1.55	0.18816	1.32314	0.76273	0.09890	0.09602	0.65
91	1.60	0.19520	1.29861	0.76656	0.09637	0.09349	0.63
92	1.65	0.20214	1.27355	0.76975	0.09391	0.09103	0.61
93	1.70	0.20890	1.24823	0.77208	0.09149	0.08862	0.59
94	1.75	0.21543	1.22290	0.77348	0.08911	0.08624	0.57
95	1.80	0.22339	1.19773	0.77979	0.08679	0.08453	0.56
96	1.85	0.23776	1.17287	0.80752	0.08626	0.08517	0.54
97	1.90	0.25054	1.14839	0.82851	0.08632	0.08509	0.53
98	1.95	0.26172	1.13281	0.84331	0.08571	0.08439	0.51
99	2.00	0.27257	1.14823	0.85631	0.08452	0.08355	0.50
100	2.05	0.28498	1.16341	0.87345	0.08373	0.08314	0.49
101	2.10	0.29601	1.17839	0.88566	0.08310	0.08229	0.48
102	2.15	0.30571	1.19320	0.89342	0.08200	0.08108	0.47
103	2.20	0.31441	1.20787	0.89794	0.08049	0.07964	0.45
104	2.25	0.32242	1.22239	0.90038	0.07866	0.07808	0.44
105	2.30	0.32923	1.23679	0.89939	0.07693	0.07630	0.43
106	2.35	0.33460	1.25103	0.89462	0.07510	0.07428	0.43
107	2.40	0.33846	1.26513	0.88609	0.07300	0.07204	0.42
108	2.50	0.35730	1.29276	0.89799	0.07057	0.07009	0.40
109	2.60	0.38457	1.31949	0.92934	0.07027	0.06975	0.38
110	2.70	0.41352	1.34513	0.96229	0.07028	0.06955	0.37
111	2.80	0.43768	1.36969	0.98216	0.06906	0.06845	0.36
112	2.90	0.45613	1.39299	0.98826	0.06726	0.06650	0.34
113	3.00	0.46805	1.41472	0.98027	0.06477	0.06376	0.33
114	3.10	0.47360	1.43479	0.95991	0.06160	0.06042	0.32
115	3.20	0.48779	1.45321	0.95778	0.05918	0.05840	0.31
116	3.30	0.50549	1.46998	0.96244	0.05761	0.05691	0.30
117	3.40	0.52070	1.48510	0.96226	0.05576	0.05523	0.29
118	3.50	0.53182	1.49866	0.95472	0.05380	0.05323	0.29
119	3.60	0.53822	1.51072	0.93938	0.05148	0.05092	0.28
120	3.70	0.53955	1.52137	0.91625	0.04909	0.04832	0.27
121	3.80	0.54419	1.53070	0.89980	0.04663	0.04620	0.26
122	3.90	0.54414	1.53879	0.87665	0.04412	0.04386	0.26
123	4.00	0.54512	1.54575	0.85627	0.04232	0.04177	0.25
124	4.10	0.55984	1.55166	0.85795	0.04157	0.04083	0.24
125	4.20	0.56968	1.55662	0.85224	0.04048	0.03959	0.24
126	4.30	0.57511	1.56072	0.84036	0.03913	0.03813	0.23
127	4.40	0.57652	1.56402	0.82327	0.03759	0.03651	0.23
128	4.50	0.57443	1.56661	0.80206	0.03592	0.03478	0.22
129	4.60	0.56932	1.56857	0.77764	0.03416	0.03299	0.22
130	4.70	0.57317	1.56996	0.76624	0.03235	0.03181	0.21
131	4.80	0.57662	1.57082	0.75479	0.03103	0.03068	0.21
132	4.90	0.57803	1.57124	0.74120	0.02981	0.02952	0.20
133	5.00	0.57721	1.57124	0.72535	0.02862	0.02831	0.20
134	5.10	0.57417	1.57088	0.70738	0.02743	0.02706	0.20
135	5.20	0.56916	1.57020	0.68772	0.02621	0.02581	0.19
136	5.40	0.55830	1.56804	0.64961	0.02377	0.02347	0.19
137	5.60	0.56648	1.56501	0.63559	0.02245	0.02215	0.18
138	5.80	0.56912	1.56134	0.61654	0.02111	0.02074	0.17
139	6.00	0.57671	1.55717	0.60393	0.01986	0.01964	0.17
140	6.20	0.57675	1.55267	0.58449	0.01867	0.01840	0.16
141	6.40	0.56236	1.54794	0.55210	0.01720	0.01683	0.16

142	6.60	0.54027	1.54307	0.51434	0.01554	0.01521	0.15
143	6.80	0.51948	1.53813	0.48000	0.01439	0.01377	0.15
144	7.00	0.49104	1.53316	0.44075	0.01351	0.01229	0.14
145	7.30	0.46985	1.52577	0.40441	0.01231	0.01081	0.14
146	7.60	0.46077	1.51853	0.38094	0.01126	0.00978	0.13
147	8.00	0.44872	1.50926	0.35242	0.01004	0.00860	0.13
148	8.50	0.43399	1.49836	0.32080	0.00877	0.00736	0.12
149	9.00	0.41998	1.48832	0.29320	0.00772	0.00636	0.11
150	9.50	0.40682	1.47913	0.26907	0.00684	0.00553	0.11
151	10.00	0.39463	1.47073	0.24796	0.00611	0.00484	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.
AREA OF ACC. RESPONSE SPECTRUM = 0.827
AREA OF VEL. RESPONSE SPECTRUM = 3.619
MAX. ACCELERATION RESPONSE VALUE = 1.729
MAX. VELOCITY RESPONSE VALUE = 3.006

*** End of Output File No. 1 ***

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

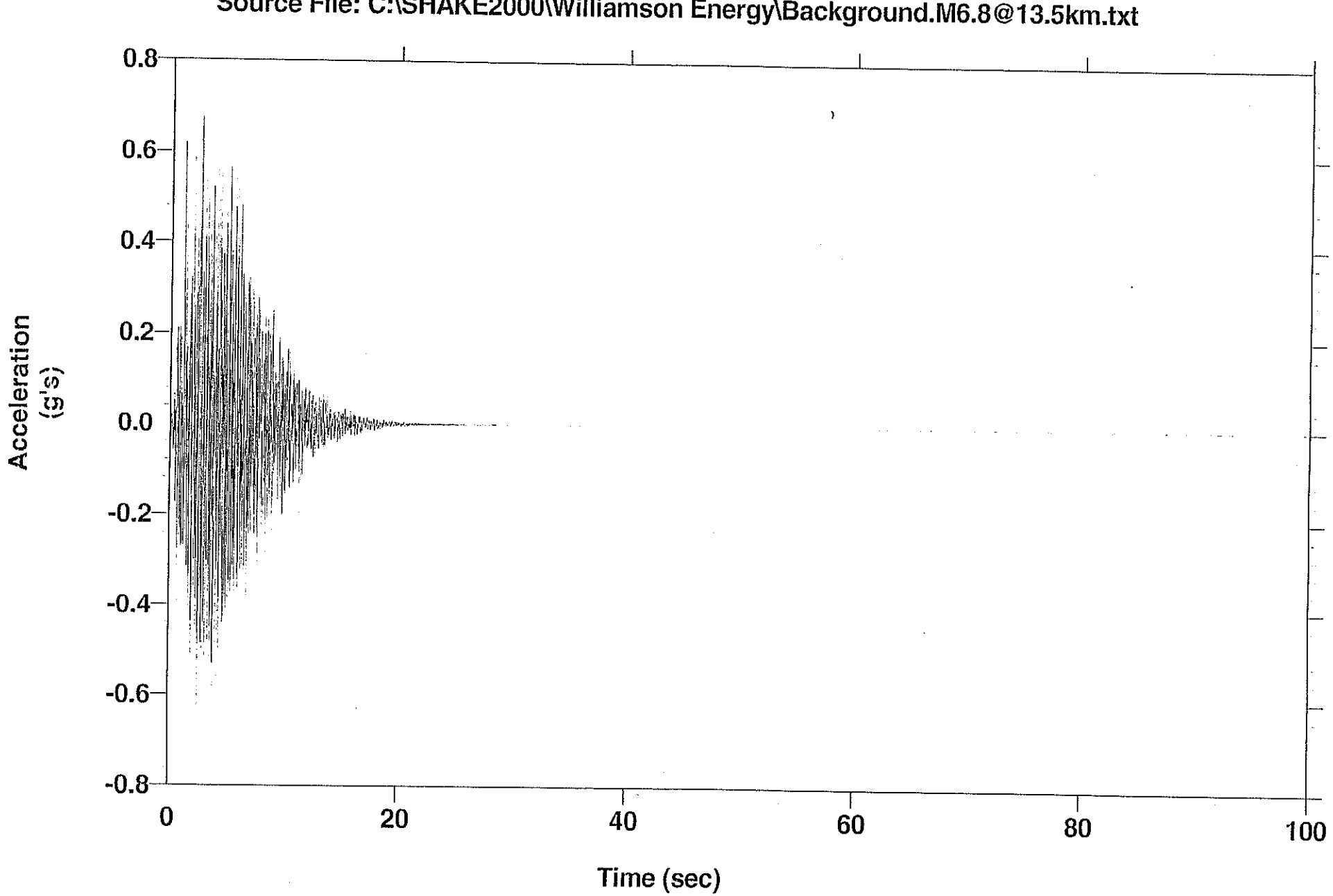
PROJECT NO. 072046

PAGE 64 OF 131

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

SIMSIM OUTPUT AND SHAKE PLOTS OF ACCELERATION TIME HISTORY M6.8 BACKGROUND EARTHQUAKE AT 13.5KM

Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt



R14002

6 YA OF 131

Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt
SHAKE2000 Conversion: 8192 .01 4 8 9 (8f9.6)
Acceleration Units: (g's) - No. Values: 8192 - Time Step: .01 (secs)
Data Format: (8f9.6) - No. Header Lines: 4

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Civil & Environmental Consultants, Inc.

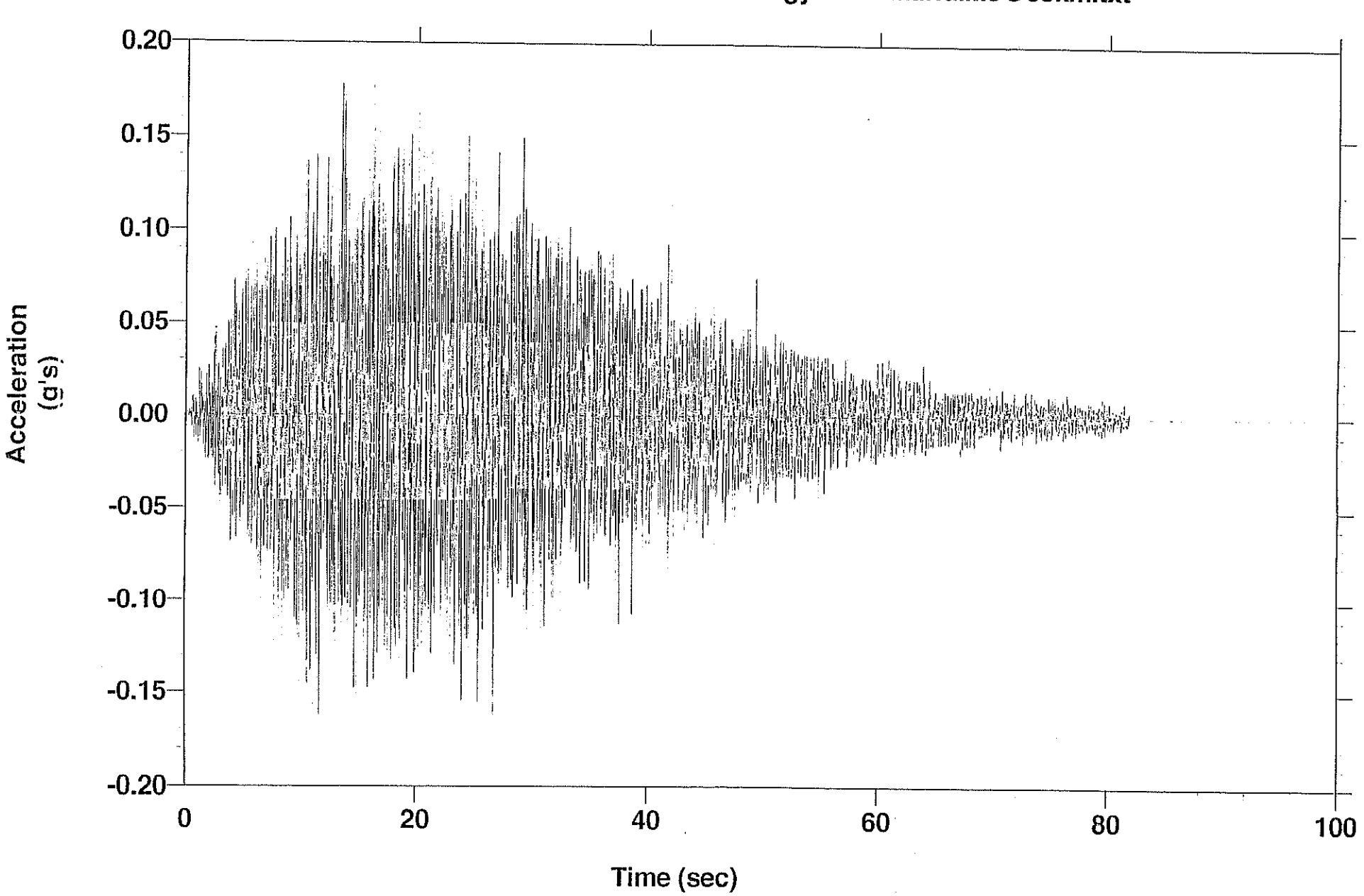
PROJECT Williamson Energy Pond Creek Deformation Evaluation
Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PROJECT NO. 072046

PAGE 85 OF 131

MADE BY BEG DATE 1/3/08 CHECKED BY [signature] DATE 1/23/08

SIMSIM OUTPUT AND SHAKE PLOTS OF ACCELERATION -IME HISTORY M8.0 NEW MADRID EARTHQUAKE AT 83 KM


Source File: C:\SHAKE2000\Williamson Energy\NewMadrid.M8@83km.txt
Acceleration (g's)
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0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
0
20
40
60
80
100
Time (sec)

Source File: C:\SHAKE2000\Williamson Energy\NewMadrid.M8@83km.txt
SHAKE2000 Conversion: 8184 .01 4 8 9 (8f9.6)
Acceleration Units: (g's) - No. Values: 8184 - Time Step: .01 (secs)
Data Format: (8f9.6) - No. Header Lines: 4

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0.001471 0.001823-0.000479-0.000738-0.002774-0.005429-0.002747 0.002040
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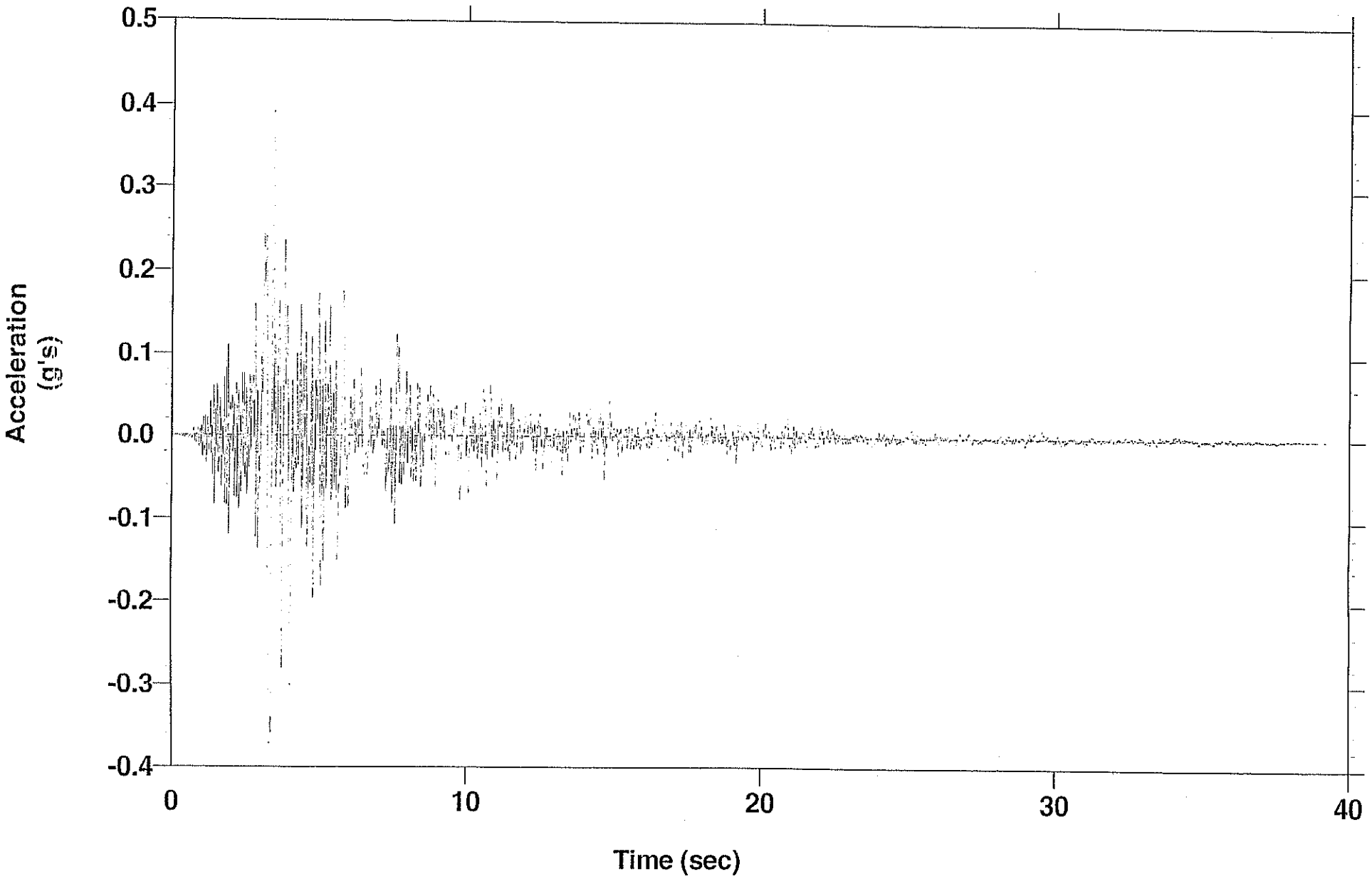
0.000569-0.002711-0.002134-0.001855 0.001529 0.003698 0.004083-0.003032

PEER DATABASE EARTHQUAKE RECORD FOR A M6.8 BACKGROUND EARTHQUAKE LOMA PRIETA, CALIFORNIA, G01000


Source File: C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.G01000 AT2.txt
Acceleration (g's)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
10
20
30
40
Time (sec)

R14046

PEER Strong Motion Database

P0733 : Earthquake and Station Details

Loma Prieta 1989/10/18 00:05 Magnitude: M (6.9) Ml ( ) Ms (7.1)	Station: 47379 Gilroy Array #1 Data Source: CDMG
Distance (km): Closest to fault rupture (11.2) Hypocentral ( ) Closest to surface projection of rupture (10.5)	Site conditions: Geomatrix or CWB (A) USGS (A)

A newer version of this record is available in the PEER NGA database: NGA0765

Download Files

Record/Component	HP (Hz)	LP (Hz)	PGA (g)	PGV (cm/s)	PGD (cm)	Acceleration	Velocity	Displacement	Spectra
\P/G01-UP	0.2	52.0	0.209	14.0	5.59	ATH	VTH	DTH	0.5% 1% 2% 3% 5% 7% 10% 15% 20%
LOMAP/G01000	0.2	50.0	0.411	31.6	6.38	ATH	VTH	DTH	0.5% 1% 2% 3% 5% 7% 10% 15% 20%
LOMAP/G01090	0.2	50.0	0.473	33.9	8.03	ATH	VTH	DTH	0.5% 1% 2% 3% 5% 7% 10% 15% 20%

HP = High Pass and LP = Low Pass Filters
Spectra are available for 0.5 - 20% damping.
Source record processed by Pacific Engineering.

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PEER STRONG MOTION DATABASE RECORD. PROCESSING BY PACIFIC ENGINEERING.
LOMA PRIETA 10/18/89 00:05, GILROY ARRAY #1, 000 (CDMG STATION 47379)
ACCELERATION TIME HISTORY IN UNITS OF G. FILTER POINTS: HP=0.2 Hz LP=50.0 Hz
NPTS= 7989, DT= .00500 SEC

.5125658E-02	.5639719E-02	.2755924E-02	-.1308377E-02	-.6497958E-03
-.6811371E-03	-.7538926E-03	-.8475488E-03	-.9173378E-03	-.9434138E-03
-.9635164E-03	-.1004710E-02	-.1043088E-02	-.1061912E-02	-.1089371E-02
-.1141796E-02	-.1196213E-02	-.1235792E-02	-.1261259E-02	-.1273984E-02
-.1272698E-02	-.1241747E-02	-.1151629E-02	-.1012129E-02	-.8881325E-03
-.8013140E-03	-.7128263E-03	-.6367177E-03	-.6215747E-03	-.6518230E-03
-.6744452E-03	-.6714483E-03	-.6665677E-03	-.6838576E-03	-.7250981E-03
-.7833623E-03	-.8349094E-03	-.8274965E-03	-.7657347E-03	-.7127825E-03
-.6735743E-03	-.6272384E-03	-.5851568E-03	-.5727393E-03	-.6276804E-03
-.7287261E-03	-.7572802E-03	-.6633190E-03	-.5231322E-03	-.3785896E-03
-.2485315E-03	-.2725700E-03	-.5362648E-03	-.8637757E-03	-.1114311E-02
-.1345029E-02	-.1548192E-02	-.1633081E-02	-.1617579E-02	-.1554284E-02
-.1360931E-02	-.9552759E-03	-.3975566E-03	.1272311E-03	.3948125E-03
.3623343E-03	.1441276E-03	-.2276718E-03	-.8038015E-03	-.1599270E-02
-.2418264E-02	-.2781967E-02	-.2412678E-02	-.1595949E-02	-.7727762E-03
-.1980250E-03	-.1440375E-05	-.1020799E-03	-.2278426E-03	-.3753702E-03
-.8163438E-03	-.1491490E-02	-.1959093E-02	-.2003623E-02	-.1992603E-02
-.2378156E-02	-.3074140E-02	-.3533091E-02	-.3109064E-02	-.1845726E-02
-.8006441E-03	-.5999215E-03	-.5917658E-03	-.3574144E-03	-.5275683E-03
-.1368800E-02	-.2188474E-02	-.2374888E-02	-.1814372E-02	-.7505837E-03
.2511738E-03	.8185070E-03	.1096188E-02	.1463359E-02	.1907826E-02
.1774600E-02	.7432509E-03	-.6648917E-03	-.1942745E-02	-.2922394E-02
-.3528983E-02	-.4058257E-02	-.4687263E-02	-.4786290E-02	-.3998003E-02
-.2917729E-02	-.2080907E-02	-.1631922E-02	-.1801217E-02	-.2302014E-02
-.2169823E-02	-.1255318E-02	-.4421582E-03	-.9180594E-04	.2793393E-03
.8368755E-03	.8820577E-03	-.1586407E-03	-.1415350E-02	-.1700737E-02
-.1699340E-02	-.2811499E-02	-.4604466E-02	-.5189655E-02	-.3774773E-02
-.1922089E-02	-.1687603E-02	-.3093448E-02	-.4510621E-02	-.5001234E-02
-.4590599E-02	-.3410452E-02	-.1865622E-02	-.9869928E-04	.2252749E-02
.5035301E-02	.7264725E-02	.7970343E-02	.7035095E-02	.4845384E-02
.1623738E-02	-.2958739E-02	-.6772649E-02	-.8030651E-02	-.6118226E-02
-.3982881E-02	-.1392657E-02	-.1602103E-02	-.2172011E-02	-.3105521E-02
-.5026245E-02	-.7543124E-02	-.9869120E-02	-.1021539E-01	-.7006410E-02
-.2239940E-02	.6974296E-03	.1183379E-02	.5525251E-03	-.2363542E-03
-.8632735E-03	-.6855988E-03	.7895015E-03	.2879021E-02	.4943918E-02
.6854554E-02	.7845768E-02	.7026399E-02	.4621499E-02	.1926546E-02
-.6250647E-03	-.4147868E-02	-.8845942E-02	-.1319724E-01	-.1520589E-01
-.1334065E-01	-.8154208E-02	-.2611079E-02	.1016914E-02	.2855542E-02
.4362354E-02	.6531307E-02	.7119703E-02	.2974634E-02	-.4245701E-02
-.9967761E-02	-.1182740E-01	-.9724923E-02	-.4857154E-02	.1174191E-02
.7407392E-02	.1153188E-01	.1015557E-01	.4165014E-02	-.2097721E-02
-.8009654E-02	-.1523047E-01	-.2223572E-01	-.2586513E-01	-.2387724E-01
-.1571059E-01	-.3077338E-02	.1091336E-01	.2159266E-01	.2433431E-01
.1974344E-01	.1191444E-01	.1992727E-02	-.9534817E-02	-.1903953E-01
-.2306971E-01	-.2060402E-01	-.1334942E-01	-.3787695E-02	.8474556E-02
.2134887E-01	.2670266E-01	.2084258E-01	.9530165E-02	-.1633075E-02
-.1175162E-01	-.2086357E-01	-.2864376E-01	-.3321546E-01	-.3193953E-01
-.2490916E-01	-.1533524E-01	-.5834230E-02	.3879780E-02	.1382384E-01
.2055917E-01	.2058104E-01	.1580416E-01	.1136313E-01	.8987288E-02
.6087777E-02	.4066025E-05	-.7805318E-02	-.1303716E-01	-.1358425E-01
-.1142873E-01	-.1181730E-01	-.1647496E-01	-.1980215E-01	-.1663775E-01
-.8247962E-02	.5869280E-03	.8387722E-02	.1832358E-01	.3126759E-01
.4038436E-01	.3639467E-01	.1949170E-01	-.7524456E-03	-.1643482E-01
-.2357293E-01	-.2127010E-01	-.1278945E-01	-.2117584E-02	.7682110E-02
.1198931E-01	.7515619E-02	-.2273565E-02	-.1358142E-01	-.2737444E-01
-.4147919E-01	-.4970335E-01	-.4735488E-01	-.3228677E-01	-.6988422E-02
.2178978E-01	.4678145E-01	.6065952E-01	.5867988E-01	.4340249E-01
.2004549E-01	-.1026451E-01	-.4428341E-01	-.7177387E-01	-.8466389E-01
-.1176499E-01	-.6543902E-01	-.3984424E-01	-.9631271E-02	.1769249E-01
.3164720E-01	.2799117E-01	.1301762E-01	-.2909330E-02	-.1246066E-01
-.1493594E-01	-.1281991E-01	-.4389901E-02	.1494136E-01	.4184680E-01
.6157112E-01	.6402520E-01	.5389987E-01	.3777703E-01	.1875162E-01
.3409031E-02	-.3638216E-02	-.7795400E-02	-.1714506E-01	-.3205433E-01
-.4500285E-01	-.4710574E-01	-.3695246E-01	-.2575499E-01	-.2588813E-01

-.3503004E-01	-.4113824E-01	-.3799995E-01	-.2758160E-01	-.1147221E-01
.1107723E-01	.3443361E-01	.4527485E-01	.3664327E-01	.1718283E-01
.3416817E-02	.4866374E-02	.1585682E-01	.1990909E-01	.4410211E-02
-.2607778E-01	-.5312333E-01	-.6203763E-01	-.5280853E-01	-.3551196E-01
-.2197128E-01	-.1782226E-01	-.1633164E-01	-.7222827E-02	.5985070E-02
.9628084E-02	-.2272187E-04	-.1401016E-01	-.2400017E-01	-.2600482E-01
-.[illegible]20651E-01	-.1619851E-03	.1812167E-01	.3436954E-01	.4892407E-01
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-.[illegible]205532E-01	-.7595828E-01	-.8391897E-01	-.7131610E-01	-.5081690E-01
-.2607265E-01	.4794165E-02	.4173632E-01	.7701724E-01	.9392400E-01
.7948653E-01	.3618234E-01	-.2098816E-01	-.6961925E-01	-.8860621E-01
-.7732077E-01	-.5254559E-01	-.2166231E-01	.1705729E-01	.5785907E-01
.9255739E-01	.1144478E+00	.1137465E+00	.8528413E-01	.3386947E-01
-.2612903E-01	-.7537390E-01	-.1048997E+00	-.1188033E+00	-.1221478E+00
-.1156009E+00	-.9640803E-01	-.6253752E-01	-.2218374E-01	.1229767E-01
.3742891E-01	.4525786E-01	.2803095E-01	.2878859E-02	-.8358122E-02
-.6396497E-02	-.1983018E-02	-.5992373E-03	-.1224378E-02	.2852739E-02
.1690905E-01	.3621772E-01	.4847387E-01	.4564861E-01	.3313862E-01
.2143216E-01	.9613697E-02	-.7770024E-02	-.2150211E-01	-.1690799E-01
.4339163E-02	.2601860E-01	.3205580E-01	.2040983E-01	.1028042E-01
.2078047E-01	.3944945E-01	.3281532E-01	-.1014694E-01	-.5968678E-01
-.7511426E-01	-.5166947E-01	-.2358670E-01	-.1839634E-01	-.3162369E-01
-.4450320E-01	-.4515351E-01	-.2950721E-01	.2319312E-02	.3934058E-01
.6252475E-01	.6423025E-01	.5592225E-01	.5367169E-01	.5798386E-01
.4810072E-01	.3695715E-02	-.5803016E-01	-.8661109E-01	-.5971426E-01
-.7446642E-02	.3053094E-01	.4227499E-01	.4312180E-01	.4877743E-01
.5624182E-01	.5500660E-01	.3916605E-01	.8632082E-02	-.2798630E-01
-.6067625E-01	-.8435490E-01	-.9266820E-01	-.8185204E-01	-.5812940E-01
-.3374675E-01	-.1868642E-01	-.9778843E-02	.5254853E-02	.2490308E-01
.3089813E-01	.1244118E-01	-.2250883E-01	-.5608071E-01	-.7023061E-01
-.6065565E-01	-.4140402E-01	-.2509881E-01	-.9359383E-02	.1266537E-01
.3998106E-01	.6340751E-01	.7648174E-01	.7838243E-01	.6564323E-01
.3732377E-01	.9544122E-03	-.3018104E-01	-.4105437E-01	-.2995762E-01
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-.[illegible]d98654E-01	-.4820985E-01	-.5232231E-01	-.4867576E-01	-.3083319E-01
-.7249775E-04	.3359637E-01	.5586047E-01	.5999055E-01	.5192764E-01
.3516172E-01	.6105879E-02	-.3197619E-01	-.6334495E-01	-.7464692E-01
-.6530901E-01	-.4135250E-01	-.1407149E-01	.3585182E-02	.9210412E-02
.7519446E-02	.1173072E-02	-.7012098E-02	-.1560304E-01	-.2517153E-01
-.3408632E-01	-.3945326E-01	-.3650949E-01	-.2181446E-01	.3491662E-02
.3561631E-01	.6449327E-01	.7751025E-01	.7472482E-01	.6599943E-01
.5337513E-01	.3398717E-01	.1063361E-01	-.1002812E-01	-.2050520E-01
-.1546481E-01	.4336795E-02	.3156021E-01	.5581452E-01	.6858681E-01
.7076939E-01	.7130272E-01	.7213963E-01	.6745251E-01	.5615061E-01
.4371806E-01	.3602875E-01	.3396750E-01	.3614668E-01	.4416091E-01
.5867040E-01	.7359940E-01	.7929953E-01	.7081037E-01	.4922386E-01
.2062450E-01	-.1160624E-02	-.3408077E-02	.1371420E-01	.4486223E-01
.8199749E-01	.1147312E+00	.1410844E+00	.1600842E+00	.1648001E+00
.1530482E+00	.1268229E+00	.7903970E-01	.7325626E-02	-.6300868E-01
-.1060111E+00	-.1235446E+00	-.1270688E+00	-.1178266E+00	-.8939264E-01
-.4362795E-01	.3032529E-02	.3673582E-01	.5499202E-01	.5348391E-01
.2898651E-01	-.9179883E-02	-.5150568E-01	-.9256645E-01	-.1232825E+00
-.1389070E+00	-.1412176E+00	-.1300519E+00	-.1068725E+00	-.7844377E-01
-.5111112E-01	-.3137067E-01	-.2541619E-01	-.3113390E-01	-.3907946E-01
-.4424133E-01	-.4888173E-01	-.5475634E-01	-.5942794E-01	-.5689106E-01
-.4184190E-01	-.1616177E-01	.1302904E-01	.4083060E-01	.6554587E-01
.8547562E-01	.9678312E-01	.9745688E-01	.9181002E-01	.8462018E-01
.7527133E-01	.6288253E-01	.5168245E-01	.5014454E-01	.6432728E-01
.8980871E-01	.1150010E+00	.1355448E+00	.1586534E+00	.1892860E+00
[illegible]10128E+00	.2410335E+00	.2447635E+00	.2403852E+00	.2334284E+00
[illegible]07670E+00	.2021997E+00	.1870124E+00	.1836716E+00	.1898067E+00
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.2418585E+00	.2378745E+00	.2297327E+00	.2122439E+00	.1933033E+00
.1827946E+00	.1777906E+00	.1698315E+00	.1548354E+00	.1317887E+00
.1003514E+00	.6114395E-01	.1189380E-01	-.4854695E-01	-.1115099E+00
-.1629876E+00	-.1958231E+00	-.2203029E+00	-.2505217E+00	-.2847479E+00
-.3152785E+00	-.3405943E+00	-.3609469E+00	-.3733924E+00	-.3762266E+00

-.3735915E+00	-.3715657E+00	-.3719672E+00	-.3728036E+00	-.3720089E+00
-.3685211E+00	-.3624413E+00	-.3539077E+00	-.3446139E+00	-.3403036E+00
-.3451498E+00	-.3550808E+00	-.3623037E+00	-.3585851E+00	-.3350472E+00
-.2836262E+00	-.1966876E+00	-.7631155E-01	.6516815E-01	.2142496E+00
.3376959E+00	.3922531E+00	.3903307E+00	.3901161E+00	.4085181E+00
.4108756E+00	.3689534E+00	.2867989E+00	.1893281E+00	.1038614E+00
633249E-01	.2159356E-01	.2839419E-01	.5627371E-01	.8860796E-01
115440E+00	.1208181E+00	.1223982E+00	.1212060E+00	.1142751E+00
9706649E-01	.6802372E-01	.2845511E-01	-.1210836E-01	-.4007021E-01
-.5385511E-01	-.6190498E-01	-.6568776E-01	-.5851398E-01	-.4017646E-01
-.1988928E-01	-.5441263E-02	.1340079E-02	-.2207173E-03	-.7941803E-02
-.7723233E-02	.1509580E-01	.5402198E-01	.8974393E-01	.1115044E+00
.1208059E+00	.1254634E+00	.1323428E+00	.1428455E+00	.1543474E+00
.1632082E+00	.1665947E+00	.1612345E+00	.1455056E+00	.1236066E+00
.1010738E+00	.8104994E-01	.6261324E-01	.4033604E-01	.1151218E-01
-.2116775E-01	-.5449790E-01	-.8907994E-01	-.1277150E+00	-.1695753E+00
-.2079882E+00	-.2355067E+00	-.2531874E+00	-.2671965E+00	-.2782577E+00
-.2838719E+00	-.2827316E+00	-.2717632E+00	-.2486081E+00	-.2153821E+00
-.1761237E+00	-.1359254E+00	-.9693761E-01	-.5917950E-01	-.2356201E-01
.1383020E-01	.6032339E-01	.1179149E+00	.1774086E+00	.2220029E+00
.2374799E+00	.2230500E+00	.1930742E+00	.1658513E+00	.1523309E+00
.1472396E+00	.1344381E+00	.1086081E+00	.8133839E-01	.6354121E-01
.5812326E-01	.6629055E-01	.8376524E-01	.1017766E+00	.1177421E+00
.1327006E+00	.1446439E+00	.1520546E+00	.1559078E+00	.1567145E+00
.1548921E+00	.1498166E+00	.1362006E+00	.1107982E+00	.8213038E-01
.6180578E-01	.5060945E-01	.4109808E-01	.2696020E-01	.6951661E-02
-.1476798E-01	-.3333975E-01	-.5068027E-01	-.7363002E-01	-.1032283E+00
-.1363847E+00	-.1742666E+00	-.2141033E+00	-.2485836E+00	-.2744646E+00
-.2914816E+00	-.3014937E+00	-.3059514E+00	-.3053388E+00	-.3021701E+00
-.2982009E+00	-.2912392E+00	-.2773441E+00	-.2555571E+00	-.2260397E+00
-.1872356E+00	-.1401572E+00	-.8450057E-01	-.2025258E-01	.3729813E-01
.6708103E-01	.6886938E-01	.5915089E-01	.4876461E-01	.3711562E-01
.2012306E-01	-.5097756E-03	-.1965806E-01	-.3485714E-01	-.4706687E-01
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078085E-01	-.3524517E-01	-.3267304E-01	-.3209702E-01	-.3302325E-01
396123E-01	-.3178211E-01	-.2739235E-01	-.2756221E-01	-.3306049E-01
-.3771546E-01	-.3965226E-01	-.4081125E-01	-.3782656E-01	-.2220099E-01
.1204305E-01	.5996324E-01	.9726937E-01	.9970879E-01	.7684695E-01
.5811584E-01	.5242707E-01	.4671534E-01	.3116045E-01	.8878903E-02
-.1205691E-01	-.2867600E-01	-.3841675E-01	-.3582854E-01	-.2386494E-01
-.1176157E-01	-.4332887E-02	-.2671479E-02	-.5079799E-02	-.2744225E-02
.1399909E-01	.4323151E-01	.7317844E-01	.9639142E-01	.1175171E+00
.1410694E+00	.1595321E+00	.1577872E+00	.1283804E+00	.8604733E-01
.5338797E-01	.3206300E-01	.8179300E-02	-.2557127E-01	-.6449406E-01
-.9502696E-01	-.1096468E+00	-.1136658E+00	-.1110299E+00	-.1009372E+00
-.8223131E-01	-.5419801E-01	-.2049765E-01	.1456036E-01	.4886615E-01
.7528595E-01	.8826939E-01	.9095065E-01	.8441607E-01	.6870932E-01
.5040492E-01	.3423613E-01	.1982707E-01	.6912268E-02	-.2557232E-02
-.3493166E-02	.8022316E-02	.3045160E-01	.5772163E-01	.8305942E-01
.1023658E+00	.1163961E+00	.1255661E+00	.1248033E+00	.1109933E+00
.8443331E-01	.4831596E-01	.1134763E-01	-.2226236E-01	-.5322170E-01
-.7975127E-01	-.1033012E+00	-.1234763E+00	-.1344971E+00	-.1363165E+00
-.1342891E+00	-.1297283E+00	-.1185059E+00	-.9986155E-01	-.7852308E-01
-.5688731E-01	-.3621759E-01	-.2132525E-01	-.1452778E-01	-.1309953E-01
-.1604497E-01	-.2324841E-01	-.3155619E-01	-.3750664E-01	-.3978023E-01
-.4098554E-01	-.4542132E-01	-.5290628E-01	-.5832492E-01	-.5598862E-01
-.4140870E-01	-.1519145E-01	.1474079E-01	.4260019E-01	.6940821E-01
.9697072E-01	.1214067E+00	.1308885E+00	.1168274E+00	.8474715E-01
.4251352E-01	-.5013410E-02	-.4579961E-01	-.7601049E-01	-.1064544E+00
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97254E-01	-.4463066E-02	.9666643E-02	.1347566E-01	.2530500E-02
481795E-01	-.1995881E-01	.1927937E-02	.4146232E-01	.7026333E-01
.7227234E-01	.5779339E-01	.4713979E-01	.4953720E-01	.5852717E-01
.6120568E-01	.5054284E-01	.3245619E-01	.1942394E-01	.1728835E-01
.2481169E-01	.3875190E-01	.5655658E-01	.7716705E-01	.9744902E-01
.1167785E+00	.1381994E+00	.1598013E+00	.1734530E+00	.1710893E+00
.1542172E+00	.1346020E+00	.1201930E+00	.1102173E+00	.1010843E+00

.8889968E-01	.6997448E-01	.4209122E-01	.1075250E-01	-.1811760E-01
-.4613425E-01	-.7455248E-01	-.1021268E+00	-.1285270E+00	-.1548629E+00
-.1761871E+00	-.1842308E+00	-.1815638E+00	-.1758511E+00	-.1658350E+00
-.1439241E+00	-.1077145E+00	-.6322283E-01	-.1601777E-01	.2959094E-01
.6192588E-01	.6861311E-01	.4789670E-01	.4850562E-02	-.4493540E-01
-.7822443E-01	-.9459144E-01	-.1124649E+00	-.1359633E+00	-.1537640E+00
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819481E-01	.1205658E+00	.1394328E+00	.1354569E+00	.1146395E+00
.8131627E-01	.4543947E-01	.1655703E-01	-.1097243E-01	-.3875447E-01
-.5650902E-01	-.6370176E-01	-.6410550E-01	-.5581182E-01	-.3821198E-01
-.1370111E-01	.1289610E-01	.3647776E-01	.5342008E-01	.6181599E-01
.6332456E-01	.5880640E-01	.4703052E-01	.3236575E-01	.2240268E-01
.1828258E-01	.1912158E-01	.2743191E-01	.4258669E-01	.6098021E-01
.8276384E-01	.1099397E+00	.1390418E+00	.1594632E+00	.1641540E+00
.1538603E+00	.1287383E+00	.9618770E-01	.7164896E-01	.5658959E-01
.3998958E-01	.1766263E-01	-.7765841E-02	-.3466262E-01	-.5976910E-01
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.1025957E-01	.3368359E-01	.5168451E-01	.5802205E-01	.5416033E-01
.4041537E-01	.1862883E-01	-.4923710E-02	-.2406568E-01	-.3752270E-01
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.8110376E-02	.3651696E-01	.6248435E-01	.8122147E-01	.9164771E-01
.9417608E-01	.8301973E-01	.5720316E-01	.2430048E-01	-.8618394E-02
-.3934104E-01	-.6913186E-01	-.9604654E-01	-.1154301E+00	-.1291972E+00
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-.7825331E-01	-.6966738E-01	-.6146456E-01	-.5911000E-01	-.6067237E-01
-.5815649E-01	-.4905537E-01	-.4054484E-01	-.4061793E-01	-.4687991E-01
-.5024263E-01	-.4684782E-01	-.3865335E-01	-.2847060E-01	-.2031677E-01
-.1673057E-01	-.1423218E-01	-.7529723E-02	.4971649E-02	.1965941E-01
.3254999E-01	.4705470E-01	.6853634E-01	.9539459E-01	.1218987E+00
.1450180E+00	.1627351E+00	.1722210E+00	.1751156E+00	.1758691E+00
.1752573E+00	.1705600E+00	.1603514E+00	.1473236E+00	.1361884E+00
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-.8539464E-01	-.6911164E-01	-.4952355E-01	-.3617029E-01	-.3020179E-01
-.2846815E-01	-.2808022E-01	-.2611700E-01	-.2373021E-01	-.2784218E-01
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-.4841246E-01	-.3593898E-01	-.2378046E-01	-.1137278E-01	.1002687E-02
.1240744E-01	.2233782E-01	.3251067E-01	.4220962E-01	.4713146E-01
.4508139E-01	.3784002E-01	.2946368E-01	.2268721E-01	.1679187E-01
.1032170E-01	.5995623E-02	.6864971E-02	.1047849E-01	.1250673E-01
.1310529E-01	.1530690E-01	.1965933E-01	.2502233E-01	.2997687E-01
.3173864E-01	.2995498E-01	.3077268E-01	.3889405E-01	.5038789E-01
.5942675E-01	.6519994E-01	.6869219E-01	.6822578E-01	.6181326E-01
.4982589E-01	.3437798E-01	.1871436E-01	.4974908E-02	-.8315939E-02
-.2040187E-01	-.2608102E-01	-.2387013E-01	-.1652780E-01	-.6100010E-02
.5003755E-02	.1274910E-01	.1467472E-01	.1130464E-01	.4765464E-02
-.2346337E-02	-.8135305E-02	-.1019844E-01	-.6090158E-02	.5156119E-03
.2990368E-02	.2400724E-02	.4276353E-02	.9156121E-02	.1499480E-01
.1983937E-01	.1855987E-01	.8089818E-02	-.5145110E-02	-.1292476E-01
-.1490916E-01	-.1394138E-01	-.9524814E-02	-.9290045E-03	.8842226E-02
.1605043E-01	.2069367E-01	.2546146E-01	.3051269E-01	.3431541E-01
.3742608E-01	.4223167E-01	.5066722E-01	.6199624E-01	.7329365E-01
.8108575E-01	.8300827E-01	.7979830E-01	.7503887E-01	.7114474E-01
.6676522E-01	.5859880E-01	.4537485E-01	.2867206E-01	.1089183E-01
-.5203818E-02	-.1842008E-01	-.2788346E-01	-.3227513E-01	-.3371696E-01
-.3493091E-01	-.3616031E-01	-.3741450E-01	-.3814741E-01	-.3709091E-01
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-.4048660E-01	-.3007032E-01	-.2300381E-01	-.2092534E-01	-.2040095E-01
-.1779080E-01	-.1339424E-01	-.1017908E-01	-.9297311E-02	-.8694569E-02
-.6410199E-02	-.2838122E-02	.1962326E-02	.9454871E-02	.1890664E-01

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.2132865E-01	.9771023E-02	-.1734663E-02	-.1036153E-01	-.1432470E-01
-.1113628E-01	-.6697374E-03	.1110248E-01	.1812777E-01	.2106563E-01
.2298579E-01	.2360746E-01	.2086150E-01	.1404770E-01	.4085430E-02
-.6491852E-02	-.1581104E-01	-.2319324E-01	-.2489585E-01	-.1808601E-01
-.8779522E-02	-.5231547E-02	-.7854980E-02	-.1250039E-01	-.1558033E-01
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.04423E-02	.8977057E-02	.2208078E-01	.3550351E-01	.4790315E-01
.796790E-01	.6350474E-01	.6211946E-01	.5625524E-01	.4956306E-01
.4057951E-01	.2821462E-01	.1506747E-01	.3621027E-02	-.4761452E-02
-.7042198E-02	-.1086272E-02	.8366367E-02	.1521806E-01	.1847036E-01
.1946798E-01	.2006932E-01	.2044967E-01	.1764912E-01	.1161610E-01
.6729579E-02	.5139045E-02	.6729085E-02	.1216813E-01	.2162954E-01
.3499030E-01	.4889339E-01	.5675765E-01	.5957931E-01	.6387712E-01
.6858877E-01	.6849972E-01	.6350072E-01	.5696833E-01	.5089837E-01
.4503651E-01	.3932581E-01	.3409582E-01	.2820829E-01	.2051745E-01
.1258421E-01	.6811207E-02	.3211397E-02	-.3582795E-03	-.5147857E-02
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.3306334E-02	.1140500E-02	.8374803E-03	.1437084E-02	-.5681907E-03
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.1811534E-01	-.2127064E-02	-.1730803E-01	-.2906030E-01	-.4378471E-01
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-.5012821E-01	-.3024275E-01	-.1494393E-01	-.7026748E-02	-.9062746E-03
.6133282E-02	.1098264E-01	.1208142E-01	.9243225E-02	.1372534E-02
-.745539E-01	-.3102184E-01	-.5035283E-01	-.6763823E-01	-.8326018E-01
.02149E-01	-.1038556E+00	-.1071087E+00	-.1058361E+00	-.9810546E-01
.052354E-01	-.5228968E-01	-.1764206E-01	.1992895E-01	.5549729E-01
.8167728E-01	.1000719E+00	.1153432E+00	.1241700E+00	.1237564E+00
.1170957E+00	.1077225E+00	.9537702E-01	.7962750E-01	.6651363E-01
.6208966E-01	.6541427E-01	.7429291E-01	.8677751E-01	.9813735E-01
.1051801E+00	.1082241E+00	.1064917E+00	.9793820E-01	.8172624E-01
.5786303E-01	.2822920E-01	-.2835653E-02	-.3043665E-01	-.4985099E-01
-.5881307E-01	-.5779534E-01	-.4755744E-01	-.3193779E-01	-.1734854E-01
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-.1958129E-01	-.3655850E-01	-.5194059E-01	-.6047924E-01	-.5735612E-01
-.4306182E-01	-.2430303E-01	-.8101107E-02	.3815317E-02	.1111497E-01
.1165662E-01	.6614650E-02	-.7868955E-03	-.9799984E-02	-.2025724E-01
-.3161469E-01	-.4211055E-01	-.4779031E-01	-.4666443E-01	-.4088325E-01
-.3385752E-01	-.2803908E-01	-.2387542E-01	-.2031024E-01	-.1724022E-01
-.1468737E-01	-.9694055E-02	.1176641E-02	.1580522E-01	.2932379E-01
.4195871E-01	.5518093E-01	.6652711E-01	.7463630E-01	.7986295E-01
.8007395E-01	.7175558E-01	.5335842E-01	.2977670E-01	.7058912E-02
-.1434305E-01	-.3011264E-01	-.3421209E-01	-.2867747E-01	-.1726594E-01
-.3241647E-02	.7223519E-02	.1185621E-01	.1588727E-01	.2231769E-01
.2729469E-01	.2902764E-01	.3209396E-01	.3885445E-01	.4569715E-01
.5040831E-01	.5471109E-01	.5908905E-01	.6153280E-01	.5927613E-01
.4989549E-01	.3418961E-01	.1558797E-01	-.3831028E-02	-.2300372E-01
-.3846487E-01	-.4752019E-01	-.5138573E-01	-.5081232E-01	-.4572659E-01
-.3799463E-01	-.2857771E-01	-.1655471E-01	-.3155638E-02	.7235869E-02
.8502782E-02	-.6912824E-03	-.1382983E-01	-.2549110E-01	-.3429561E-01
-.4082792E-01	-.4748949E-01	-.5374123E-01	-.5640653E-01	-.5463937E-01
-.499721E-01	-.4477414E-01	-.3880481E-01	-.2924247E-01	-.1573924E-01
.7613E-02	.1045078E-01	.1802666E-01	.1938850E-01	.1195837E-01
.26273E-02	-.2172701E-01	-.3506581E-01	-.4416554E-01	-.5152116E-01
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.1166919E-01	.3254082E-01	.5054817E-01	.6440021E-01	.7035687E-01
.6633838E-01	.5452786E-01	.3774205E-01	.2169783E-01	.1103856E-01
.4514069E-02	.1836108E-02	.5304611E-02	.1383756E-01	.2522222E-01
.3811574E-01	.4993915E-01	.5804052E-01	.6026690E-01	.5569534E-01

.4520105E-01	.2893055E-01	.7684094E-02	-.1230838E-01	-.2647529E-01
-.3818116E-01	-.5010936E-01	-.5938177E-01	-.6252953E-01	-.6013936E-01
-.5443582E-01	-.4532571E-01	-.3347530E-01	-.2154387E-01	-.1126718E-01
-.4232082E-02	-.2124644E-02	-.4731381E-02	-.1001922E-01	-.1652653E-01
-.2271807E-01	-.2762467E-01	-.3254733E-01	-.3726681E-01	-.3755037E-01
-.2986688E-01	-.1802839E-01	-.8329764E-02	-.1511397E-02	.2733511E-02
57038E-02	-.3716269E-02	-.8940834E-02	-.9282224E-02	-.4962399E-02
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.6588688E-02	.6302412E-02	.9246061E-02	.1600631E-01	.2222378E-01
.2465678E-01	.2463060E-01	.2457414E-01	.2587617E-01	.2922510E-01
.3379768E-01	.3861394E-01	.4421703E-01	.4912229E-01	.5019883E-01
.4726718E-01	.4254177E-01	.3725894E-01	.3062712E-01	.2238073E-01
.1473721E-01	.1029650E-01	.7985188E-02	.5519019E-02	.4758402E-02
.9689443E-02	.2079705E-01	.3337259E-01	.4387888E-01	.5280018E-01
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.4857011E-01	.5221632E-01	.5137483E-01	.4670694E-01	.3862793E-01
.2920228E-01	.1847441E-01	.4497444E-02	-.1202036E-01	-.2618788E-01
-.3540518E-01	-.4274025E-01	-.4943741E-01	-.5417956E-01	-.5840003E-01
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-.1985170E-01	-.1118296E-01	-.3246366E-02	.3840424E-02	.1076706E-01
.1711372E-01	.2207546E-01	.2670491E-01	.3190154E-01	.3659387E-01
.3985042E-01	.4183256E-01	.4299575E-01	.4324914E-01	.4091815E-01
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.1607188E-01	.1297224E-01	.1102899E-01	.1048529E-01	.1235316E-01
.1614250E-01	.1848004E-01	.1616893E-01	.9508624E-02	.2469338E-02
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.3334727E-01	.3400231E-01	.2948991E-01	.2122236E-01	.1329644E-01
.9907878E-02	.9736251E-02	.6910417E-02	.2293196E-02	.3352369E-02
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-.3813979E-01	-.3287047E-01	-.2712582E-01	-.2295229E-01	-.1817215E-01
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.2847837E-01	.2646138E-01	.2531350E-01	.2488434E-01	.2468018E-01
.2455312E-01	.2713328E-01	.3303078E-01	.3724129E-01	.3478319E-01
.2511450E-01	.1234335E-01	.1428767E-02	-.7101753E-02	-.1566903E-01
-.2383917E-01	-.2939019E-01	-.3243231E-01	-.3427626E-01	-.3384990E-01
-.2938237E-01	-.2246127E-01	-.1599733E-01	-.1152176E-01	-.1047601E-01
-.1443285E-01	-.2265326E-01	-.3205257E-01	-.4043302E-01	-.4798359E-01
-.5535689E-01	-.6184443E-01	-.6702126E-01	-.7219754E-01	-.7761640E-01
-.8013981E-01	-.7597419E-01	-.6507414E-01	-.5169548E-01	-.3976832E-01
-.2957619E-01	-.2054477E-01	-.1302700E-01	-.6508010E-02	-.4592956E-03
.3801691E-02	.4904164E-02	.4358538E-02	.4678761E-02	.5584338E-02
.5575150E-02	.5497993E-02	.7876928E-02	.1298598E-01	.1851654E-01
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29490E-01	.1442050E-01	.1955791E-01	.2413239E-01	.2819152E-01
22446E-01	.3667879E-01	.3972504E-01	.3674738E-01	.2662781E-01
.1380354E-01	.1394686E-02	-.1093614E-01	-.2151097E-01	-.2663983E-01
-.2511414E-01	-.1815315E-01	-.9063756E-02	-.2212557E-02	.4074769E-03
-.2271420E-03	-.2938129E-02	-.7795112E-02	-.1486150E-01	-.2366416E-01
-.3306999E-01	-.4228245E-01	-.5125271E-01	-.5948961E-01	-.6621960E-01
-.7024071E-01	-.7084340E-01	-.6721774E-01	-.5819997E-01	-.4575619E-01
-.3242926E-01	-.1858880E-01	-.6512159E-02	.1061322E-02	.4818142E-02

.6910548E-02	.8770682E-02	.1034182E-01	.1045292E-01	.8804491E-02
.7193980E-02	.6448881E-02	.4034470E-02	-.1560797E-02	-.7904354E-02
-.1192108E-01	-.1347164E-01	-.1344912E-01	-.1154520E-01	-.7779410E-02
-.2382010E-02	.4364814E-02	.1200379E-01	.1944099E-01	.2416594E-01
.2386543E-01	.1766102E-01	.7785477E-02	-.1276903E-02	-.7890868E-02
-.1343059E-01	-.1800962E-01	-.1932083E-01	-.1507873E-01	-.6037995E-02
[illegible]088884E-02	.1153916E-01	.1452199E-01	.1408923E-01	.1209214E-01
[illegible]511864E-02	-.1382973E-03	-.7610628E-02	-.1113707E-01	-.1103557E-01
[illegible]0025015E-02	-.5907995E-02	-.2135436E-02	.7389091E-03	.5510989E-03
-.2936576E-02	-.8169432E-02	-.1333654E-01	-.1720148E-01	-.2056605E-01
-.2442911E-01	-.2729651E-01	-.2813924E-01	-.2773541E-01	-.2556721E-01
-.2015380E-01	-.1178178E-01	-.2387210E-02	.6436757E-02	.1415201E-01
.2066450E-01	.2628009E-01	.3117481E-01	.3399421E-01	.3415380E-01
.3334282E-01	.3129645E-01	.2647082E-01	.2044761E-01	.1541656E-01
.1074947E-01	.5281427E-02	-.5195006E-03	-.5422203E-02	-.9598339E-02
-.1430073E-01	-.1925923E-01	-.2476087E-01	-.3173986E-01	-.3772061E-01
-.3883065E-01	-.3394865E-01	-.2434786E-01	-.1123283E-01	.4572993E-02
.2056444E-01	.3394076E-01	.4480029E-01	.5349467E-01	.5763889E-01
.5590864E-01	.5110709E-01	.4640592E-01	.4269685E-01	.4019539E-01
.3964931E-01	.4147947E-01	.4357520E-01	.4370555E-01	.4240928E-01
.4017383E-01	.3597266E-01	.2851537E-01	.1799945E-01	.6605743E-02
-.4453245E-02	-.1614076E-01	-.2858475E-01	-.3984751E-01	-.4902318E-01
-.5727767E-01	-.6280406E-01	-.6107206E-01	-.5335150E-01	-.4469141E-01
-.3616519E-01	-.2774471E-01	-.2033984E-01	-.1348745E-01	-.7871855E-02
-.6221494E-02	-.8000118E-02	-.8819336E-02	-.7326990E-02	-.6313371E-02
-.6699139E-02	-.6350026E-02	-.4299782E-02	-.9032966E-03	.4908731E-02
.1355511E-01	.2324863E-01	.3266577E-01	.4115640E-01	.4841390E-01
.5489180E-01	.5999650E-01	.6234185E-01	.6087521E-01	.5518189E-01
.4717741E-01	.4002456E-01	.3428729E-01	.2836880E-01	.2175625E-01
.1442824E-01	.6259395E-02	-.2112162E-02	-.1035407E-01	-.1786238E-01
-.2315422E-01	-.2560877E-01	-.2572355E-01	-.2282053E-01	-.1536121E-01
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.1854555E-01	.1071361E-01	.2321836E-03	-.8820343E-02	-.1456584E-01
-[illegible]76346E-01	-.1552150E-01	-.1103171E-01	-.4633273E-02	.1574043E-02
[illegible].32877E-02	.8645564E-02	.7453606E-02	.1515112E-02	-.7414636E-02
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-.4586938E-01	-.4914899E-01	-.5235384E-01	-.5448915E-01	-.5460497E-01
-.5051010E-01	-.4073884E-01	-.2813046E-01	-.1651373E-01	-.5861861E-02
.5258294E-02	.1648800E-01	.2712165E-01	.3520831E-01	.3706296E-01
.3249530E-01	.2571091E-01	.2021096E-01	.1640362E-01	.1313259E-01
.1028669E-01	.9399521E-02	.1204366E-01	.1830845E-01	.2618197E-01
.3322746E-01	.3942388E-01	.4471217E-01	.4653756E-01	.4504173E-01
.4285492E-01	.3956478E-01	.3431505E-01	.2872350E-01	.2387132E-01
.1831003E-01	.1066796E-01	.2660823E-02	-.3443182E-02	-.8186754E-02
-.1297125E-01	-.1732025E-01	-.1956069E-01	-.1884928E-01	-.1573963E-01
-.1093578E-01	-.5253623E-02	-.4604340E-03	.2683918E-02	.4557837E-02
.4338234E-02	.2202014E-02	-.3749565E-03	-.3556698E-02	-.8279831E-02
-.1400623E-01	-.1776821E-01	-.1765454E-01	-.1571738E-01	-.1489174E-01
-.1580715E-01	-.1685636E-01	-.1673262E-01	-.1584588E-01	-.1367284E-01
-.8621749E-02	-.1842570E-02	.4095081E-02	.8682743E-02	.1311723E-01
.1689167E-01	.1608646E-01	.9440153E-02	.1175740E-02	-.6299832E-02
-.1308026E-01	-.1753944E-01	-.1914479E-01	-.1895101E-01	-.1729421E-01
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-.1300920E-01	-.2016736E-01	-.2727057E-01	-.3127790E-01	-.3117747E-01
-.2590700E-01	-.1491471E-01	-.1736581E-02	.9134776E-02	.1825627E-01
.2760075E-01	.3551163E-01	.3893108E-01	.3645539E-01	.2877890E-01
.1822021E-01	.7275437E-02	-.2532654E-02	-.9299024E-02	-.1002525E-01
-.4390530E-02	.4188414E-02	.1308697E-01	.2120629E-01	.2755253E-01
.3219618E-01	.3480146E-01	.3327036E-01	.2783871E-01	.2213295E-01
.1727481E-01	.1077682E-01	.2461697E-02	-.4390548E-02	-.7879621E-02
-[illegible]03914E-02	-.1112000E-01	-.1409596E-01	-.1686399E-01	-.1857893E-01
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-.2052435E-01	-.1600984E-01	-.1011476E-01	-.4485098E-02	-.1231097E-02
-.7930399E-04	.2452772E-02	.7558229E-02	.1251576E-01	.1637736E-01
.1979262E-01	.2084312E-01	.1902271E-01	.1765633E-01	.1845217E-01
.1970402E-01	.1949724E-01	.1830577E-01	.1735371E-01	.1642243E-01
.1516099E-01	.1348499E-01	.1133046E-01	.7960736E-02	.1314147E-02

-.7733708E-02	-.1462536E-01	-.1816645E-01	-.2103475E-01	-.2329364E-01
-.2197161E-01	-.1649521E-01	-.1039296E-01	-.6303762E-02	-.3632735E-02
-.1304578E-02	.7645595E-03	.7103060E-03	-.4229843E-02	-.1288901E-01
-.1895254E-01	-.1813957E-01	-.1315488E-01	-.8801943E-02	-.6279872E-02
-.3534582E-02	.6204412E-03	.4714876E-02	.7349359E-02	.8154762E-02
.6562512E-02	.3729143E-02	.2836485E-02	.4630447E-02	.7287384E-02
.072494E-01	.1572046E-01	.2069417E-01	.2339863E-01	.2376112E-01
.317662E-01	.2201778E-01	.1979754E-01	.1769886E-01	.1665707E-01
.1528925E-01	.1389551E-01	.1366594E-01	.1327952E-01	.1237532E-01
.1166554E-01	.1009583E-01	.8074901E-02	.7603209E-02	.7156321E-02
.4784397E-02	.2628373E-02	.2982196E-02	.6142134E-02	.1096428E-01
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.2998023E-01	.2865565E-01	.2661337E-01	.2415762E-01	.2027608E-01
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.1072999E-02	-.1004485E-02	-.4375756E-02	-.9824641E-02	-.1563806E-01
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.1833772E-01	.1945333E-01	.1849455E-01	.1569491E-01	.1281117E-01
.1153490E-01	.1146346E-01	.1136273E-01	.1172559E-01	.1418657E-01
.1911648E-01	.2434187E-01	.2703512E-01	.2711390E-01	.2618552E-01
.2408091E-01	.1922801E-01	.1185002E-01	.5180538E-02	.1079997E-02
-.2375487E-02	-.6835433E-02	-.1079522E-01	-.1098915E-01	-.7481120E-02
-.4763966E-02	-.5536675E-02	-.8848882E-02	-.1363962E-01	-.1966540E-01
-.2599804E-01	-.3100833E-01	-.3459987E-01	-.3782896E-01	-.4008756E-01
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-.1942836E-01	-.1783616E-01	-.1600244E-01	-.1361647E-01	-.1106326E-01
63762E-02	-.1025125E-02	.5858345E-02	.1045626E-01	.1183166E-01
.27785E-01	.9665209E-02	.7476242E-02	.4674010E-02	.1210853E-02
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-.1023041E-02	-.4738336E-02	-.8587340E-02	-.1098221E-01	-.1178935E-01
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-.5314606E-03	.2091969E-03	-.4502857E-03	-.3066370E-02	-.6415737E-02
-.9634532E-02	-.1298265E-01	-.1645556E-01	-.1907393E-01	-.2011159E-01
-.2118516E-01	-.2454181E-01	-.2966150E-01	-.3326092E-01	-.3255185E-01
-.2784351E-01	-.2165688E-01	-.1699466E-01	-.1482146E-01	-.1187855E-01
-.6054106E-02	-.1367956E-02	-.4193646E-03	.3069990E-03	.2677690E-02
.2215053E-02	-.4174190E-02	-.1097163E-01	-.1228584E-01	-.9943534E-02
-.7755383E-02	-.6762642E-02	-.5997532E-02	-.3130137E-02	.1665146E-02
.4891672E-02	.6068591E-02	.7396658E-02	.8630414E-02	.8635457E-02
.7698158E-02	.6104490E-02	.3543477E-02	.8642541E-03	-.5708015E-03
-.1498951E-02	-.4075798E-02	-.8408725E-02	-.1184389E-01	-.1347353E-01
-.1498521E-01	-.1666603E-01	-.1754661E-01	-.1677538E-01	-.1369779E-01
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.8889031E-02	.6134843E-02	.1588455E-02	-.3520195E-02	-.7847673E-02
-.1217904E-01	-.1588409E-01	-.1775244E-01	-.1878510E-01	-.1892413E-01
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.1062798E-01	.1734899E-01	.2307309E-01	.2774119E-01	.2923586E-01
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.3209353E-03	-.5250226E-02	-.7560709E-02	-.7521802E-02	-.4893211E-02
-.9628385E-03	.2177951E-02	.5274239E-02	.8169917E-02	.8621390E-02
.5862099E-02	.1873346E-02	-.7318176E-03	-.7827997E-03	.1093618E-02
.3529415E-02	.6568339E-02	.1113550E-01	.1677192E-01	.2216043E-01
.2618631E-01	.2724112E-01	.2422893E-01	.1883451E-01	.1277247E-01
.6409639E-02	.2922757E-02	.5319134E-02	.1071360E-01	.1471466E-01
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-.6105795E-03	.3555110E-02	.7497413E-02	.9488780E-02	.9892932E-02
.9009678E-02	.6595410E-02	.3869864E-02	.2144339E-02	.5740727E-03
-.7535699E-03	.1330267E-02	.6817867E-02	.1152748E-01	.1496787E-01
.1912581E-01	.2367541E-01	.2778777E-01	.3075357E-01	.3102677E-01
.2773402E-01	.2249779E-01	.1756296E-01	.1314635E-01	.7951279E-02
.4650855E-03	-.8769966E-02	-.1651341E-01	-.2036673E-01	-.2070268E-01
-.1873573E-01	-.1496084E-01	-.1058084E-01	-.7780952E-02	-.6682956E-02
-.5872711E-02	-.4922745E-02	-.4172315E-02	-.4616816E-02	-.6760126E-02
-.9661080E-02	-.1169446E-01	-.1201908E-01	-.1167342E-01	-.1145325E-01
-.1091303E-01	-.1045411E-01	-.1100576E-01	-.1221553E-01	-.1272392E-01
-.1157265E-01	-.9562638E-02	-.7643269E-02	-.4648257E-02	-.4817269E-03
.2614450E-02	.4423297E-02	.6853252E-02	.9592195E-02	.1089030E-01
.1123006E-01	.1161627E-01	.1258168E-01	.1484951E-01	.1742543E-01
.1887272E-01	.1965511E-01	.2093460E-01	.2274286E-01	.2472892E-01
.2690620E-01	.2780636E-01	.2609913E-01	.2340618E-01	.2124346E-01
.1947414E-01	.1771964E-01	.1557014E-01	.1371153E-01	.1382213E-01
.1647253E-01	.1912391E-01	.1948432E-01	.1914578E-01	.1821753E-01
.1481069E-01	.1211290E-01	.1517281E-01	.2130319E-01	.2470227E-01
.2613882E-01	.2903577E-01	.3280586E-01	.3462693E-01	.3346743E-01
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-.1642984E-02	-.7148126E-02	-.1096354E-01	-.1348634E-01	-.1643798E-01
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-.1955134E-01	-.1345758E-01	-.6654736E-02	-.3872195E-03	.4878954E-02
.8369585E-02	.1045006E-01	.1168078E-01	.1004692E-01	.5677694E-02
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-.9596075E-02	-.9463433E-02	-.1021655E-01	-.1188676E-01	-.1420326E-01
-.1655151E-01	-.1931019E-01	-.2177196E-01	-.2089789E-01	-.1638725E-01
-.1033917E-01	-.3374983E-02	.3942996E-02	.1036387E-01	.1556182E-01
.2050189E-01	.2511686E-01	.2810714E-01	.2918260E-01	.2921215E-01
.2933329E-01	.3044864E-01	.3255511E-01	.3314622E-01	.2977691E-01
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.1897470E-01	.1773791E-01	.1104242E-01	.2171240E-02	-.5662654E-02
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-.4878102E-01	-.5369113E-01	-.5356047E-01	-.4663402E-01	-.3638306E-01
-.2609034E-01	-.1697359E-01	-.1039055E-01	-.5958436E-02	-.2156434E-02
-.6259048E-04	-.2380175E-02	-.7523073E-02	-.1146910E-01	-.1381036E-01
-.1520638E-01	-.1465072E-01	-.1233532E-01	-.9642977E-02	-.7287883E-02
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-.3120803E-03	.3425922E-02	.8651796E-02	.1410240E-01	.2077002E-01
.2820321E-01	.3378477E-01	.3761716E-01	.4110455E-01	.4305141E-01
.4128969E-01	.3597381E-01	.2949648E-01	.2271304E-01	.1449496E-01
.5772943E-02	-.6123251E-03	-.3327627E-02	-.2534701E-02	.9194886E-03
.5459870E-02	.1012647E-01	.1453653E-01	.1782247E-01	.1850226E-01
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.3195000E-02	.4797708E-02	.7099637E-02	.8106074E-02	.7790118E-02
.7710519E-02	.9088179E-02	.1074944E-01	.1047275E-01	.8309000E-02
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.5409132E-02	.6492329E-02	.8509405E-02	.9828688E-02	.8371217E-02
.4723981E-02	.1093828E-03	-.5135071E-02	-.1038325E-01	-.1542671E-01
-.2018822E-01	-.2384038E-01	-.2516481E-01	-.2297853E-01	-.1677082E-01
-.9281443E-02	-.4871596E-02	-.2830442E-02	.2466774E-03	.3684990E-02
.5289761E-02	.5109808E-02	.4371949E-02	.3855609E-02	.3228022E-02

.3005724E-02	.4576363E-02	.7224287E-02	.8717947E-02	.8025297E-02
.5400789E-02	.1290146E-02	-.3130109E-02	-.7250069E-02	-.1167327E-01
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.1125925E-02	.3621327E-02	.5391694E-02	.6482043E-02	.7042345E-02
)44555E-02	.7033384E-02	.7692408E-02	.8113682E-02	.7185136E-02
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.1036429E-01	.9271744E-02	.5404720E-02	.1365970E-02	-.1325128E-02
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.7979283E-02	.1063683E-01	.1142567E-01	.9898598E-02	.6838830E-02
.2213712E-02	-.3790765E-02	-.8911087E-02	-.1153779E-01	-.1127826E-01
-.7918385E-02	-.3775503E-02	-.1205021E-02	.4176813E-04	-.6719844E-04
-.1799503E-02	-.4325336E-02	-.7366272E-02	-.1138595E-01	-.1517629E-01
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-.6532803E-02	-.5924658E-02	-.4851405E-02	-.3480571E-02	-.3513893E-02
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-.8615763E-02	-.1222503E-01	-.1382666E-01	-.1326525E-01	-.1304639E-01
-.1372137E-01	-.1270642E-01	-.8472629E-02	-.3254751E-02	.4235933E-03
.2072302E-02	.1273555E-02	-.2096483E-02	-.6355010E-02	-.9139531E-02
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.4461907E-02	.2356622E-02	.1451206E-02	.2873120E-02	.5318243E-02
.8599189E-02	.1222675E-01	.1534557E-01	.1802432E-01	.1929503E-01
.1785638E-01	.1359873E-01	.7158327E-02	.2402842E-03	-.6115167E-02
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-.2156336E-01	-.1697133E-01	-.1133329E-01	-.5817756E-02	-.2634794E-02
-.1589484E-02	-.1479791E-02	-.2182220E-02	-.2916881E-02	-.2429248E-02
-.2107136E-02	-.3468328E-02	-.3978154E-02	-.1751958E-02	.1701802E-02
.6062862E-02	.1103472E-01	.1389014E-01	.1442146E-01	.1473917E-01
.1469370E-01	.1431883E-01	.1447633E-01	.1425385E-01	.1346055E-01
.1295610E-01	.1169259E-01	.9336409E-02	.7679388E-02	.6893366E-02
.5890629E-02	.5119299E-02	.5280115E-02	.5356048E-02	.4132872E-02
.2276132E-02	.1008124E-03	-.4433588E-02	-.1057394E-01	-.1434469E-01
-.1620502E-01	-.1857668E-01	-.1939659E-01	-.1648672E-01	-.1123086E-01
-.4774953E-02	.2461001E-02	.7946098E-02	.9282142E-02	.6676122E-02
.1343261E-02	-.5157872E-02	-.1103336E-01	-.1554806E-01	-.1879604E-01
-.1980517E-01	-.1765386E-01	-.1370743E-01	-.9530901E-02	-.5809926E-02
-.3801033E-02	-.3624397E-02	-.2883903E-02	-.4382451E-03	.2151776E-02
.3811705E-02	.4167670E-02	.3522845E-02	.3580422E-02	.5484775E-02
.8651626E-02	.1134939E-01	.1249024E-01	.1282558E-01	.1317355E-01
.1347237E-01	.1372816E-01	.1392798E-01	.1396425E-01	.1337909E-01
16191E-01	.7723305E-02	.5510619E-02	.5505160E-02	.5231683E-02
991275E-02	.5260979E-02	.1013259E-01	.1394237E-01	.1494971E-01
.1532384E-01	.1491777E-01	.1184382E-01	.7206851E-02	.2295485E-02
-.4114642E-02	-.1028151E-01	-.1327273E-01	-.1512406E-01	-.1714936E-01
-.1693501E-01	-.1455556E-01	-.1181949E-01	-.9056765E-02	-.7158241E-02
-.6516854E-02	-.4999674E-02	-.1330190E-02	.2743912E-02	.6304096E-02
.1047962E-01	.1470874E-01	.1794411E-01	.2022087E-01	.2032725E-01
.1780024E-01	.1449028E-01	.1194053E-01	.9591226E-02	.5513686E-02
.4986404E-03	-.1521336E-02	.5901664E-03	.4106568E-02	.6813259E-02
.8576337E-02	.1067835E-01	.1270679E-01	.1128758E-01	.6433923E-02
.2803757E-02	.1743632E-02	-.8985066E-04	-.4255987E-02	-.8180835E-02
-.9374343E-02	-.8510154E-02	-.7483939E-02	-.7694548E-02	-.9458871E-02
-.1145157E-01	-.1236685E-01	-.1252956E-01	-.1288504E-01	-.1286571E-01
-.1124844E-01	-.8742961E-02	-.7028637E-02	-.6471570E-02	-.6208816E-02
-.5179112E-02	-.3746136E-02	-.3582063E-02	-.4043202E-02	-.3525274E-02
-.2779837E-02	-.1815332E-02	.4471397E-03	.2868428E-02	.3564126E-02
.2399399E-02	.1686015E-03	-.2795675E-02	-.5755122E-02	-.7329654E-02
-.7783483E-02	-.8260442E-02	-.8224891E-02	-.7051789E-02	-.6327064E-02
-.6546871E-02	-.5334143E-02	-.2081303E-02	.1211574E-02	.3845960E-02
.6455113E-02	.8142771E-02	.8517662E-02	.9561507E-02	.1175337E-01
.1331577E-01	.1333829E-01	.1322191E-01	.1503024E-01	.1814860E-01
.2043029E-01	.2160152E-01	.2273658E-01	.2366194E-01	.2262462E-01
.1986091E-01	.1700593E-01	.1349248E-01	.9631991E-02	.6642384E-02
.3237517E-02	.1955241E-03	.1203157E-02	.5961997E-02	.1060685E-01
.1304676E-01	.1308799E-01	.1075280E-01	.6889822E-02	.3032364E-02
-.4899155E-03	-.4449464E-02	-.7914041E-02	-.8544539E-02	-.6549949E-02
-.4313792E-02	-.2547009E-02	-.1896225E-03	.3212383E-02	.5934881E-02
52840E-02	.3006897E-02	.7470209E-03	-.1704197E-02	-.4771408E-02
66370E-02	-.5023643E-02	-.3758920E-02	-.2125975E-02	.2022634E-02
.8026285E-02	.1232513E-01	.1359317E-01	.1290512E-01	.1017553E-01
.6546811E-02	.5028582E-02	.6029164E-02	.7883827E-02	.9611419E-02
.1109051E-01	.1248712E-01	.1287290E-01	.1116019E-01	.8662793E-02
.6609409E-02	.3290877E-02	-.1132279E-02	-.3325243E-02	-.3157408E-02
-.2966916E-02	-.3547875E-02	-.4732988E-02	-.5687816E-02	-.5233618E-02
-.3437622E-02	-.2212919E-02	-.1936043E-02	-.1692221E-03	.3414281E-02

.5874562E-02	.5627510E-02	.3950348E-02	.1971083E-02	-.2255673E-03
-.2150458E-02	-.3807431E-02	-.5717064E-02	-.7474215E-02	-.8741800E-02
-.9270504E-02	-.8107340E-02	-.5297764E-02	-.2779152E-02	-.2309632E-02
-.3400494E-02	-.4816862E-02	-.6581658E-02	-.7924890E-02	-.7105034E-02
-.4645602E-02	-.2095175E-02	.9468157E-03	.4969994E-02	.9376832E-02
.1368542E-01	.1608612E-01	.1466110E-01	.1117325E-01	.8637722E-02
[illegible]95762E-02	.6244270E-02	.5816208E-02	.5848082E-02	.4606124E-02
[illegible].29351E-02	-.6135936E-03	-.1288967E-02	-.1847855E-02	-.3431513E-02
[illegible]3455601E-02	-.7938940E-02	-.1145501E-01	-.1507407E-01	-.1784949E-01
-.2005619E-01	-.2145509E-01	-.2138765E-01	-.1987929E-01	-.1682368E-01
-.1179100E-01	-.6471727E-02	-.3888964E-02	-.3944003E-02	-.4111545E-02
-.3355252E-02	-.2806404E-02	-.3466114E-02	-.4252311E-02	-.3687250E-02
-.2716899E-02	-.3568417E-02	-.5982715E-02	-.7671685E-02	-.8594708E-02
-.1042815E-01	-.1262940E-01	-.1414015E-01	-.1559045E-01	-.1650331E-01
-.1550903E-01	-.1280869E-01	-.9779826E-02	-.7266634E-02	-.5186149E-02
-.3705859E-02	-.2625919E-02	-.1485769E-02	-.5202964E-03	.5894654E-03
.1866518E-02	.2457261E-02	.2249690E-02	.1604856E-02	.1659266E-02
.3768368E-02	.6700269E-02	.7648548E-02	.5858303E-02	.3188429E-02
.1398657E-02	-.1887107E-03	-.2451123E-02	-.5051972E-02	-.7858964E-02
-.9888438E-02	-.9588891E-02	-.7610663E-02	-.6130222E-02	-.5606981E-02
-.5573314E-02	-.5857290E-02	-.6644714E-02	-.9220032E-02	-.1331204E-01
-.1759904E-01	-.2273315E-01	-.2825682E-01	-.3167400E-01	-.3254668E-01
-.3163571E-01	-.2750281E-01	-.1957182E-01	-.1088464E-01	-.3631280E-02
.2946372E-02	.9216254E-02	.1415835E-01	.1643913E-01	.1557289E-01
.1260254E-01	.8255748E-02	.2601453E-02	-.2338406E-02	-.4037767E-02
-.3376802E-02	-.1713550E-02	.1190480E-02	.4101204E-02	.6087319E-02
.8320386E-02	.1130939E-01	.1380724E-01	.1455258E-01	.1406459E-01
.1342060E-01	.1256407E-01	.1167997E-01	.1080144E-01	.9384550E-02
.7677221E-02	.5811664E-02	.3555135E-02	.9129695E-03	-.1437531E-02
-.2519931E-02	-.2212252E-02	-.1259292E-02	-.6938295E-03	-.1169797E-02
-.2689515E-02	-.3976216E-02	-.4172448E-02	-.4258691E-02	-.4301708E-02
-.2626774E-02	.1096341E-02	.4406959E-02	.6375440E-02	.8294139E-02
.9351409E-02	.8881570E-02	.7896686E-02	.6232026E-02	.4187505E-02
[illegible]50273E-02	.3557162E-02	.2906268E-02	.2305770E-02	.3025837E-02
[illegible]84146E-02	.3879350E-02	.2650611E-02	.1782125E-02	.1543109E-02
.346051E-02	.1312181E-02	.1305763E-02	.4897230E-03	-.6386535E-03
-.5891560E-03	.6095071E-03	.1557327E-02	.1731118E-02	.1216072E-02
-.2428931E-03	-.1956625E-02	-.2937003E-02	-.3054819E-02	-.2745156E-02
-.2498892E-02	-.1891018E-02	-.2344273E-03	.2063003E-02	.4003838E-02
.5537764E-02	.6584419E-02	.6762775E-02	.6969613E-02	.7190653E-02
.6737260E-02	.6553511E-02	.6760011E-02	.5919607E-02	.4177496E-02
.3505521E-02	.4422183E-02	.5763966E-02	.6761003E-02	.6686337E-02
.5384701E-02	.4277883E-02	.4291498E-02	.4782044E-02	.4873250E-02
.4561716E-02	.3977822E-02	.2363691E-02	-.2900058E-03	-.3509789E-02
-.7597852E-02	-.1151078E-01	-.1386653E-01	-.1573387E-01	-.1754738E-01
-.1721631E-01	-.1380555E-01	-.9094802E-02	-.5447322E-02	-.2795640E-02
.5180368E-03	.3314459E-02	.3376773E-02	.1484655E-02	-.5004743E-03
-.1722034E-02	-.2681348E-02	-.4683000E-02	-.6975725E-02	-.7444925E-02
-.6410583E-02	-.5579269E-02	-.5853904E-02	-.7173309E-02	-.8314390E-02
-.8676333E-02	-.8123370E-02	-.5369698E-02	-.6702012E-03	.3919511E-02
.8357430E-02	.1311970E-01	.1661016E-01	.1842012E-01	.1873422E-01
.1616017E-01	.1188908E-01	.8496740E-02	.5707025E-02	.2840677E-02
.4102780E-03	-.1263455E-02	-.2282369E-02	-.2710139E-02	-.2383970E-02
-.1545546E-02	-.1246976E-02	-.2078722E-02	-.3523182E-02	-.5243506E-02
-.7269294E-02	-.8631780E-02	-.8431696E-02	-.7827545E-02	-.8135734E-02
-.8468260E-02	-.7359800E-02	-.5326630E-02	-.4116839E-02	-.4596656E-02
-.6583405E-02	-.9030072E-02	-.1046796E-01	-.1106191E-01	-.1165540E-01
-.1115920E-01	-.9281079E-02	-.7551557E-02	-.5764285E-02	-.3002513E-02
.1119058E-04	.2894470E-02	.6302155E-02	.9460871E-02	.1036533E-01
.8298885E-02	.4406873E-02	.1210236E-02	.4057901E-03	.7474102E-03
[illegible]2861E-03	.1639808E-02	.3519000E-02	.6627387E-02	.1075903E-01
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[illegible]983146E-02	.3185388E-02	.1273901E-02	-.5512902E-03	-.1238354E-02
-.9894390E-04	.2031028E-02	.4015684E-02	.6028917E-02	.8282628E-02
.9591306E-02	.9843634E-02	.9916301E-02	.9169926E-02	.7462955E-02
.6100382E-02	.5609241E-02	.5298997E-02	.4964822E-02	.5350073E-02
.6296405E-02	.6919998E-02	.6765261E-02	.5924070E-02	.5229263E-02
.5422642E-02	.5402288E-02	.3385285E-02	-.4471912E-04	-.3037200E-02

-.5659410E-02	-.8730717E-02	-.1195558E-01	-.1454488E-01	-.1573607E-01
-.1519033E-01	-.1280688E-01	-.9176760E-02	-.5975841E-02	-.3762622E-02
-.1164149E-02	.1009644E-02	.3200092E-03	-.1356431E-02	-.8721790E-03
.4047248E-03	.2808556E-03	-.3855633E-03	-.3840649E-03	.3924882E-04
.8549209E-03	.2202750E-02	.3036449E-02	.2331946E-02	.1166295E-04
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.112960E-01	-.1262141E-01	-.1150441E-01	-.9456237E-02	-.7928797E-02
.6961527E-02	-.5743049E-02	-.4191405E-02	-.2451419E-02	-.1801533E-03
.1821793E-02	.2057778E-02	.9862314E-03	-.1478188E-03	-.1211681E-02
-.2070535E-02	-.2180752E-02	-.1885389E-02	-.1689168E-02	-.1196587E-02
-.7317076E-03	-.9896946E-03	-.1324232E-02	-.1146314E-02	-.9381865E-03
-.1014082E-02	-.1083686E-02	-.1049139E-02	-.1055765E-02	-.1337153E-02
-.2412164E-02	-.4410676E-02	-.6656857E-02	-.8546691E-02	-.1030826E-01
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-.4644135E-02	-.4249347E-03	.2794444E-02	.5251984E-02	.7815978E-02
.9268247E-02	.7541509E-02	.3970126E-02	.9355444E-03	-.2081113E-02
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-.1114830E-01	-.8796775E-02	-.5690060E-02	-.2806190E-02	.2648500E-03
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.1123710E-01	.1264361E-01	.1331028E-01	.1241720E-01	.1176036E-01
.1315264E-01	.1599349E-01	.1829650E-01	.1963853E-01	.2073372E-01
.2196798E-01	.2305152E-01	.2365760E-01	.2370917E-01	.2257005E-01
.2013835E-01	.1678783E-01	.1276624E-01	.9149518E-02	.6272638E-02
.3098864E-02	-.1569602E-03	-.2358647E-02	-.4127939E-02	-.6912785E-02
-.9682688E-02	-.9961712E-02	-.8816159E-02	-.9336997E-02	-.1071544E-01
-.1136433E-01	-.1292203E-01	-.1555234E-01	-.1701016E-01	-.1746979E-01
-.1814372E-01	-.1862058E-01	-.1898217E-01	-.1907296E-01	-.1766903E-01
-.1489771E-01	-.1214359E-01	-.1060183E-01	-.1059624E-01	-.1109793E-01
-.1077425E-01	-.9497344E-02	-.8430795E-02	-.7731761E-02	-.5382763E-02
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.1384267E-01	.1151708E-01	.7519213E-02	.3539184E-02	-.2722036E-03
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.70809E-01	-.1155551E-01	-.9182416E-02	-.6337227E-02	-.3842160E-02
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.6093462E-02	.4594882E-02	.2906073E-02	.2505127E-03	-.2800540E-02
-.5524190E-02	-.7928222E-02	-.9400050E-02	-.8526924E-02	-.5978991E-02
-.4483537E-02	-.4212207E-02	-.3719819E-02	-.2972796E-02	-.1615890E-02
.2847915E-03	.1791656E-02	.2430878E-02	.2116475E-02	.1816387E-02
.2250897E-02	.2471593E-02	.1432253E-02	-.6715746E-03	-.2709844E-02
-.3848847E-02	-.4733236E-02	-.5768912E-02	-.6033545E-02	-.5480229E-02
-.4844762E-02	-.4377738E-02	-.3710721E-02	-.1646876E-02	.1976897E-02
.4632338E-02	.5161615E-02	.5581237E-02	.6374847E-02	.6515360E-02
.6061831E-02	.5279207E-02	.5062960E-02	.5835028E-02	.6103124E-02
.5491851E-02	.5168919E-02	.6035645E-02	.7652386E-02	.8444906E-02
.8544442E-02	.8572187E-02	.7628131E-02	.5919248E-02	.4378304E-02
.2335544E-02	-.6849103E-03	-.3437978E-02	-.4881209E-02	-.5125888E-02
-.4892117E-02	-.5102941E-02	-.5037859E-02	-.3785044E-02	-.2665775E-02
-.2628163E-02	-.3933505E-02	-.6516848E-02	-.8808156E-02	-.1031766E-01
-.1153759E-01	-.1154232E-01	-.1033067E-01	-.9974721E-02	-.1064934E-01
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-.2885938E-03	.2150016E-02	.4719726E-02	.5905723E-02	.5832316E-02
.5498722E-02	.4511377E-02	.2977806E-02	.1421426E-02	.3265358E-03
.4282917E-03	.1367270E-02	.2441126E-02	.3598559E-02	.5222771E-02
.7473595E-02	.9216544E-02	.8591453E-02	.5843632E-02	.3930136E-02
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-.6792717E-02	-.8842851E-02	-.9959582E-02	-.9815993E-02	-.9545963E-02
-.9420426E-02	-.7952106E-02	-.4629132E-02	-.1339485E-02	.1107568E-02
.4562623E-02	.9199215E-02	.1256442E-01	.1387947E-01	.1436269E-01

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.6420922E-02	.6616691E-02	.5251011E-02	.3590182E-02	.4497295E-02
.7262938E-02	.8504639E-02	.7579947E-02	.6409038E-02	.5191586E-02
.2782390E-02	-.3107068E-03	-.2929499E-02	-.4884155E-02	-.6274392E-02
-.6740439E-02	-.5668720E-02	-.3416480E-02	-.9518772E-03	.1099757E-02
[illegible]406629E-02	.3412248E-02	.4470070E-02	.4940277E-02	.4816812E-02
[illegible].34269E-02	.6557306E-02	.6622987E-02	.5219793E-02	.4263406E-02
.4133974E-02	.3204552E-02	.1310517E-02	.7543799E-04	-.5911349E-03
-.1317920E-02	-.5287671E-03	.2020215E-02	.3845286E-02	.4865964E-02
.7199444E-02	.9579130E-02	.9439791E-02	.7199945E-02	.4033690E-02
.1201138E-02	-.3342818E-03	-.2032926E-02	-.4167997E-02	-.4660614E-02
-.3958439E-02	-.4018377E-02	-.4089210E-02	-.2857216E-02	-.2029260E-02
-.3213030E-02	-.4614106E-02	-.4191094E-02	-.2690664E-02	-.1606238E-02
-.1058319E-03	.2825856E-02	.5960451E-02	.8106365E-02	.9060073E-02
.9505396E-02	.1074939E-01	.1214887E-01	.1203349E-01	.1070442E-01
.9135337E-02	.7213820E-02	.5490603E-02	.5366896E-02	.5432855E-02
.4109846E-02	.3633605E-02	.4626700E-02	.5054788E-02	.5750605E-02
.7895807E-02	.9049789E-02	.8095685E-02	.7051940E-02	.6019526E-02
.4009929E-02	.2060781E-02	.9263088E-03	-.2184313E-03	-.1762287E-02
-.2944941E-02	-.3409031E-02	-.4272698E-02	-.6070286E-02	-.6974964E-02
-.5902392E-02	-.4570803E-02	-.3502674E-02	-.1274605E-02	.1069889E-02
.1988210E-02	.3120206E-02	.4906525E-02	.5295826E-02	.4193090E-02
.2882108E-02	.1376388E-02	-.5877916E-03	-.2203506E-02	-.3153017E-02
-.3877497E-02	-.3762328E-02	-.2674006E-02	-.1852513E-02	-.1176514E-02
.1733202E-03	.1421344E-02	.2293691E-02	.3498619E-02	.4145230E-02
.3643381E-02	.3350257E-02	.3762643E-02	.4084875E-02	.3885450E-02
.2623963E-02	.2803260E-03	-.1400226E-02	-.1541976E-02	-.1593604E-02
-.1963027E-02	-.1177918E-02	.2294415E-03	.6604181E-03	.7000442E-03
.9413798E-03	.1037929E-02	.9436930E-03	-.1577290E-03	-.3123054E-02
-.6488566E-02	-.8228274E-02	-.8345252E-02	-.7965954E-02	-.7115472E-02
-.5362456E-02	-.3727940E-02	-.2914921E-02	-.2385115E-02	-.1619053E-02
-.2361169E-03	.1011434E-02	.1058184E-02	.1085896E-02	.2184062E-02
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.4791109E-02	.4280780E-02	.3771174E-02	.3299075E-02	.1943150E-02
-.8483659E-03	-.3343696E-02	-.4177784E-02	-.4779795E-02	-.5616223E-02
-.5358988E-02	-.4844044E-02	-.4982301E-02	-.4249978E-02	-.2693386E-02
-.1417257E-02	-.3009461E-03	.3660555E-03	-.8335253E-04	-.1662715E-02
-.3300191E-02	-.4259293E-02	-.5114878E-02	-.5734345E-02	-.5001726E-02
-.3216641E-02	-.1736707E-02	-.1869994E-03	.2512208E-02	.5680334E-02
.8207000E-02	.9783470E-02	.1027499E-01	.9854214E-02	.8440504E-02
.5746969E-02	.2936254E-02	.1424137E-02	.8107068E-03	.2397088E-03
.1373880E-04	.5882376E-03	.1314605E-02	.1845293E-02	.2689252E-02
.2875692E-02	.1851118E-02	.1487759E-02	.1945887E-02	.1613847E-02
.1506206E-02	.3217072E-02	.5081643E-02	.5355251E-02	.5051228E-02
.4703152E-02	.3401933E-02	.1868461E-02	.1469941E-02	.1649727E-02
.1823704E-02	.2153234E-02	.2368080E-02	.3004790E-02	.4440144E-02
.4989573E-02	.3489805E-02	.1413701E-02	.3089955E-03	-.7569303E-03
-.2777613E-02	-.4016597E-02	-.3119182E-02	-.1483681E-02	-.3485555E-03
.6230456E-03	.1894980E-02	.3089350E-02	.3090341E-02	.1577415E-02
-.5031417E-03	-.2482218E-02	-.3651954E-02	-.3450878E-02	-.2669331E-02
-.1831775E-02	-.6328103E-03	.7505050E-03	.1697147E-02	.2089633E-02
.2958715E-02	.4527687E-02	.4808719E-02	.3618110E-02	.3415035E-02
.3656971E-02	.2803195E-02	.2748501E-02	.3533918E-02	.2805646E-02
.1684127E-02	.2386942E-02	.3467009E-02	.2725484E-02	.1096215E-02
-.3319658E-04	-.1101990E-02	-.2071404E-02	-.2187043E-02	-.2262599E-02
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-.2256547E-02	-.2272141E-02	-.2331685E-02	-.2332945E-02	-.1802890E-02
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-.1955803E-02	-.2567642E-02	-.4436584E-02	-.5684247E-02	-.5278512E-02
-.4776225E-02	-.5631696E-02	-.6459030E-02	-.5122041E-02	-.2719863E-02
-.1451614E-02	-.8752403E-03	.3106949E-03	.2015909E-02	.3506925E-02
.4114121E-02	.3387020E-02	.2200757E-02	.1744971E-02	.1656760E-02
.1509913E-02	.1483193E-02	.1514185E-02	.1474949E-02	.8249279E-03

-.5810371E-03	-.9745406E-03	.2962259E-03	.8940413E-03	-.8036958E-04
-.1351734E-02	-.2609637E-02	-.3839478E-02	-.4424310E-02	-.4831193E-02
-.6395630E-02	-.8924004E-02	-.1036776E-01	-.9758590E-02	-.8969641E-02
-.9283120E-02	-.9254063E-02	-.8384673E-02	-.8037956E-02	-.7908928E-02
-.7369047E-02	-.7578542E-02	-.8076746E-02	-.7438255E-02	-.6523270E-02
-.5538219E-02	-.4170443E-02	-.4121174E-02	-.5615405E-02	-.6455555E-02
)26829E-02	-.5855542E-02	-.5643548E-02	-.4291587E-02	-.3029786E-02
291433E-02	-.1041236E-02	.4880659E-03	.1132766E-02	.7696756E-03
.5132843E-03	.8553023E-03	.1170341E-02	.1097096E-02	.9582912E-03
.9549451E-03	.7663010E-03	.2155810E-04	-.8663986E-03	-.1677545E-02
-.2790032E-02	-.3253502E-02	-.2190105E-02	-.7908946E-03	.4431426E-03
.2348160E-02	.4656004E-02	.6420603E-02	.7523240E-02	.8293721E-02
.7807693E-02	.5153469E-02	.1832644E-02	-.3183426E-03	-.1427572E-02
-.2130711E-02	-.2017030E-02	-.1366406E-02	-.1502833E-02	-.1891747E-02
-.1078905E-02	-.1881661E-03	-.1044022E-02	-.2536330E-02	-.3073875E-02
-.2830575E-02	-.1792688E-02	-.1617012E-03	.1154900E-02	.1868983E-02
.2298551E-02	.2967714E-02	.3489232E-02	.2613453E-02	.6933252E-03
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.7135983E-02	.6410516E-02	.5751416E-02	.4312028E-02	.1509722E-02
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-.9962882E-03	.9906452E-03	.2160917E-02	.3102448E-02	.3824809E-02
.3855731E-02	.3723826E-02	.3728005E-02	.2953245E-02	.1434042E-02
.8788242E-03	.1365902E-02	.7388534E-03	-.1198971E-02	-.2330489E-02
-.2141375E-02	-.1788658E-02	-.2394221E-02	-.4067145E-02	-.5029524E-02
-.4391401E-02	-.4013588E-02	-.5132085E-02	-.6228776E-02	-.5951190E-02
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-.1070904E-02	-.1389062E-02	-.2845049E-02	-.4335610E-02	-.4636216E-02
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-.6799994E-03	.1715838E-02	.2675236E-02	.3369505E-02	.4668488E-02
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.4208954E-02	.4456026E-02	.3022543E-02	.9554610E-03	-.1978221E-03
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930444E-04	.8229019E-03	.1224612E-02	.1037619E-02	.4357753E-03
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-.1628002E-02	-.1939521E-02	-.2554454E-02	-.3247797E-02	-.4431848E-02
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.2339752E-02	.2077780E-02	.1837797E-02	.2061589E-02	.2276148E-02
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.5504530E-03	.7808062E-03	.1512820E-02	.2410781E-02	.3426194E-02
.5421178E-02	.7683863E-02	.8840273E-02	.9610305E-02	.1087862E-01
.1166600E-01	.1140700E-01	.1116134E-01	.1145951E-01	.1148973E-01
.1042230E-01	.8838318E-02	.8327439E-02	.8944369E-02	.9182306E-02
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56367E-02	-.2205681E-03	.1036507E-02	.9966753E-03	.4089572E-03
42291E-04	-.1680746E-02	-.4312060E-02	-.5753232E-02	-.5270210E-02
-.4622620E-02	-.4442489E-02	-.2702095E-02	.5051218E-03	.2362669E-02
.2708514E-02	.3738463E-02	.5472560E-02	.5757929E-02	.4018407E-02
.1775042E-02	.2463161E-03	-.2926290E-03	-.8333125E-03	-.2131521E-02
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.1891480E-02	.1354816E-02	.7542645E-03	.1541165E-03	-.8347052E-03
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.5214660E-03	-.1180337E-03	-.5005875E-03	-.1268149E-02	-.2741943E-02
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.2216332E-03	.1372309E-03	.8985699E-04	.1119004E-03	-.2153643E-03
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.3458012E-02	.4805569E-02	.5427939E-02	.5389965E-02	.4833737E-02
.3196651E-02	.7907158E-03	-.4179627E-03	.1907740E-03	.3546225E-03
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-.2940676E-02	-.3600206E-02	-.3578871E-02	-.3285575E-02	-.3407388E-02
-.3636359E-02	-.3243682E-02	-.2204247E-02	-.1022658E-02	-.5292719E-03
-.9990600E-03	-.9740260E-03	-.5332997E-03	-.8588630E-03	-.1210356E-02
-.1390688E-02	-.1314285E-02	-.4767054E-04	.1006515E-02	.4894061E-03
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.7359105E-02	.6129050E-02	.4447975E-02	.2921207E-02	.1029186E-02
-.3552505E-03	-.1454746E-03	.8638872E-03	.1874185E-02	.2631882E-02
.3006673E-02	.3501638E-02	.4000552E-02	.3526789E-02	.1619731E-02
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-.4830098E-02	-.6129575E-02	-.5630849E-02	-.3635007E-02	-.1976520E-02
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.4490223E-02	.3715519E-02	.2397088E-02	.1473510E-02	.3295147E-03
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-.1153658E-02	-.1374711E-02	-.8312979E-03	-.2661730E-03	-.5276977E-03
-.2802572E-03	.1341192E-02	.2707400E-02	.2972993E-02	.3727274E-02
.5042202E-02	.5229872E-02	.4620360E-02	.4617846E-02	.5050781E-02
.5155276E-02	.4995961E-02	.4942518E-02	.5028364E-02	.5080734E-02
.5146082E-02	.5665689E-02	.6004252E-02	.4681230E-02	.2496848E-02
.1229379E-02	.4933409E-03	-.8027019E-03	-.2405240E-02	-.3239252E-02
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-.3861728E-02	-.4832651E-02	-.6147107E-02	-.6411655E-02	-.6299058E-02
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-.3429281E-02	-.3922578E-02	-.4421480E-02	-.2096555E-02	.1301931E-02
.2516410E-02	.2634303E-02	.3775475E-02	.5257094E-02	.6622415E-02
.8617664E-02	.1031770E-01	.1052915E-01	.9760876E-02	.8530893E-02
.7195690E-02	.6081950E-02	.5187837E-02	.5077353E-02	.5336607E-02
.4671226E-02	.4022487E-02	.4866351E-02	.6379023E-02	.7381594E-02
.7017130E-02	.5206722E-02	.4146894E-02	.4971433E-02	.5622179E-02
.4717202E-02	.3931166E-02	.4206546E-02	.4118077E-02	.3497778E-02
.2923247E-02	.2218715E-02	.1343894E-02	-.5810313E-05	-.1422026E-02
-.1306760E-02	-.1617591E-03	-.5375513E-03	-.1622967E-02	-.1044774E-02
.1064899E-03	.5810497E-03	.8322237E-03	.6031872E-03	-.3341061E-03
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[illegible]93061E-02	.1058635E-02	.6410685E-03	.7048217E-03	.1049615E-02
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-.3029487E-03	-.9297810E-03	-.3654301E-03	.8405645E-03	.1517449E-02
.1926426E-02	.3441602E-02	.5399899E-02	.5004933E-02	.3091961E-02
.3649850E-02	.5806984E-02	.5945381E-02	.4951167E-02	.5745162E-02
.7851776E-02	.8366458E-02	.6499474E-02	.4580241E-02	.4631292E-02
.5510195E-02	.4757063E-02	.2475648E-02	.7004877E-03	.7849484E-04

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.1533004E-03	-.1024222E-03	.9597073E-03	.1314703E-02	.3371690E-03
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-.3343483E-02	-.3017072E-02	-.2936721E-02	-.2330984E-02	-.1371094E-02
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-.1146902E-02	.7712018E-04	.8692042E-03	.8024961E-03	.4682535E-03
.1916071E-03	-.3533026E-03	-.7932881E-03	-.5729899E-03	-.3241282E-03
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.1944638E-02	.1570978E-02	.1663928E-02	.2515750E-02	.2640357E-02
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-.1388893E-02	-.1263659E-02	-.1502750E-02	-.2141305E-02	-.2363611E-02
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.1667597E-02	.1974489E-02	.2444132E-02	.2861953E-02	.3277806E-02
.2994164E-02	.1510495E-02	.3469331E-03	.3956335E-03	.8665670E-03
.9643162E-03	.9439490E-03	.1224359E-02	.1594808E-02	.2280475E-02
.2623774E-02	.1624192E-02	.7605492E-03	.1288215E-02	.1898953E-02
.1656097E-02	.1311361E-02	.1071628E-02	.6832953E-03	.7345279E-03
.5118692E-03	-.1191332E-02	-.3144902E-02	-.4512031E-02	-.6312660E-02
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-.2197309E-02	-.1024086E-02	-.9240686E-03	-.1608397E-02	-.1382794E-02
.2499876E-04	.1127923E-02	.9952964E-03	.3468100E-04	-.4094174E-03
.5495110E-03	.1948414E-02	.2926478E-02	.4065226E-02	.5581869E-02
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.3597710E-02	.3762720E-02	.3686580E-02	.4596793E-02	.6097298E-02
.7299560E-02	.7473764E-02	.6946430E-02	.6833855E-02	.7497275E-02
.8898023E-02	.1031002E-01	.1045197E-01	.9778401E-02	.9065811E-02
.7738075E-02	.6813619E-02	.7066861E-02	.6344688E-02	.4859152E-02
.5252145E-02	.6424474E-02	.5790233E-02	.4559143E-02	.4720361E-02
.5065832E-02	.4530559E-02	.3778757E-02	.2687668E-02	.1516958E-02
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.3591615E-02	.3791443E-02	.3669581E-02	.2227306E-02	.8914415E-03
.5735823E-03	-.1795832E-03	-.1413255E-02	-.1557445E-02	-.1014490E-02
-.1057627E-02	-.1465130E-02	-.1466337E-02	-.5332931E-03	.9701475E-03
.1287731E-02	.4256828E-03	.1029283E-03	-.5859012E-05	-.6361091E-03
-.7083297E-03	.1886338E-03	.3987302E-03	-.8446094E-03	-.1763941E-02
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.1758122E-02	.9078081E-03	.3145437E-03	.3056337E-04	-.1057923E-04
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-.6419522E-02	-.6924219E-02	-.6673209E-02	-.6182134E-02	-.5322920E-02
-.3841822E-02	-.2363406E-02	-.1539805E-02	-.1537280E-02	-.1845321E-02
-.1774378E-02	-.1447855E-02	-.1343576E-02	-.1480467E-02	-.1573780E-02
-.1507016E-02	-.1434553E-02	-.1451900E-02	-.1453611E-02	-.1722780E-02
-.2905043E-02	-.4398435E-02	-.4948169E-02	-.5369256E-02	-.6684572E-02
-.[illegible]159769E-02	-.5530029E-02	-.3548042E-02	-.2569341E-02	-.2065407E-02
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-.1175914E-02	-.1421768E-03	.9106335E-03	.1222200E-02	.8444025E-03
.3436352E-03	-.6586295E-03	-.1529045E-02	-.1089195E-02	-.4772936E-03
-.1370171E-03	.8563834E-03	.1437010E-02	.8347750E-03	.4785302E-03

.1303950E-02	.2053893E-02	.9639645E-03	-.4887446E-03	.2659596E-03
.1656878E-02	.1396512E-02	.9606554E-03	.1528355E-02	.1439285E-02
.5836997E-03	.5857808E-03	.1131306E-02	.1140119E-02	.8171940E-03
.3649656E-03	-.3960072E-04	.1046959E-03	.4037703E-03	.7023559E-03
.1397443E-02	.2122189E-02	.2292880E-02	.2004042E-02	.1499260E-02
.8599257E-03	.6691327E-03	.1394132E-02	.1995115E-02	.1280066E-02
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-.2802332E-02	-.2500658E-02	-.1915271E-02	-.2043620E-02	-.2358988E-02
-.2190610E-02	-.1503455E-02	-.1137072E-02	-.1920216E-02	-.2601337E-02
-.2159242E-02	-.1722126E-02	-.1890321E-02	-.1652105E-02	-.1254096E-02
-.1866828E-02	-.1993370E-02	-.3271824E-03	.6948917E-03	-.4153676E-04
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-.8163913E-04	-.9978302E-03	-.1696048E-02	-.2002943E-02	-.1976828E-02
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-.3813782E-02	-.3087888E-02	-.2609524E-02	-.3534796E-02	-.3933608E-02
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.1205625E-02	-.5450903E-03	-.7227389E-03	-.7818247E-03	-.2153840E-02
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.7177610E-03	.3796160E-04	-.4523100E-03	.2622848E-03	.1155568E-02
.1292128E-02	.1647994E-02	.2567298E-02	.2927594E-02	.1725257E-02
.1260580E-03	.1443234E-03	.1071533E-02	.1116155E-02	.5617997E-03
.4563585E-03	.7417714E-03	.7657613E-03	-.3191222E-03	-.2210872E-02
-.3194204E-02	-.3096727E-02	-.3004743E-02	-.3103767E-02	-.2796989E-02
-.1977225E-02	-.1109231E-02	-.5491867E-04	.8866141E-03	.8623449E-03
.4116563E-03	.4860273E-03	.7454017E-03	.2862525E-03	-.7212058E-03
-.1041701E-02	-.5149614E-03	.2075510E-03	.8302119E-03	.8582572E-03
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-.2142475E-02	-.2290064E-02	-.2318329E-02	-.2127326E-02	-.2032342E-02
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.1156759E-02	.6727187E-03	.3487354E-03	.1031790E-02	.2107602E-02
.2788274E-02	.2795565E-02	.2566023E-02	.2990943E-02	.3314399E-02
.2779732E-02	.2478379E-02	.2448315E-02	.2521353E-02	.3328621E-02
.3865111E-02	.3414040E-02	.3166659E-02	.3458470E-02	.3238261E-02
.2235662E-02	.1301638E-02	.4678956E-03	-.4761119E-03	-.7275419E-03
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-.[illegible]215422E-02	-.2034780E-02	-.2010778E-02	-.2112155E-02	-.2211829E-02
-.1613558E-02	.1929583E-03	.1361841E-02	.5942035E-03	.1509447E-03
.1515045E-02	.2573933E-02	.2055333E-02	.1152642E-02	.8569688E-03
.1239435E-02	.1553797E-02	.1647493E-02	.1950272E-02	.2019092E-02
.1445881E-02	.7995543E-03	.1257103E-02	.2054066E-02	.1212274E-02
-.8737997E-04	.1754755E-03	.7143918E-03	-.1687225E-03	-.1295041E-02

-.1372725E-02	-.1371099E-02	-.1482238E-02	-.1016247E-02	-.8219583E-03
-.9744276E-03	-.5719306E-03	-.2508894E-03	-.2499998E-03	.1646904E-03
.4896040E-03	.5142422E-04	-.8619462E-03	-.1416970E-02	-.1130864E-02
-.7382132E-03	-.9034775E-03	-.1473856E-02	-.2048526E-02	-.1591189E-02
.7877737E-04	.9453307E-03	.1859195E-03	-.4221954E-03	-.2733604E-04
.6213119E-03	.1283753E-02	.2027203E-02	.2413926E-02	.2192006E-02
.191896E-02	.2921225E-02	.3274005E-02	.3093077E-02	.3503606E-02
.932381E-02	.3825272E-02	.4035464E-02	.3878098E-02	.2735680E-02
.1827222E-02	.1530926E-02	.8927788E-03	-.5402359E-03	-.1521911E-02
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-.4758822E-03	.4911055E-03	.8920460E-04	-.3441980E-03	.4975156E-03
.1202891E-02	.8057132E-03	.3004528E-03	.1166592E-04	-.7241350E-04
.1508113E-03	.2263995E-03	.3244843E-04	.1908239E-04	.7871661E-03
.2437529E-02	.3830746E-02	.3510852E-02	.2068086E-02	.1284542E-02
.1341467E-02	.1556550E-02	.1568317E-02	.1366656E-02	.1316409E-02
.1906417E-02	.2832727E-02	.2869740E-02	.1782438E-02	.8557196E-03
.9132319E-03	.5165862E-03	-.8031921E-03	-.1209698E-02	-.9940166E-03
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-.4634186E-03	.1192565E-03	.2890059E-03	.5074666E-03	.1250177E-02
.1492667E-02	.1030771E-02	.4859229E-03	-.1129715E-03	-.3805691E-03
-.4536121E-03	-.1128157E-02	-.1746233E-02	-.1499438E-02	-.8252306E-03
-.5321577E-03	-.8558704E-03	-.1143781E-02	-.1335191E-02	-.1624094E-02
-.1550344E-02	-.9535168E-03	-.1880583E-03	.4366608E-03	.1378326E-02
.2958858E-02	.4477661E-02	.4817752E-02	.3852112E-02	.3598564E-02
.4650692E-02	.4319429E-02	.2408430E-02	.1884961E-02	.2834192E-02
.2747868E-02	.1679663E-02	.1485690E-02	.1997206E-02	.2454367E-02
.2743145E-02	.2590495E-02	.2331932E-02	.2426592E-02	.2619196E-02
.2619725E-02	.2571741E-02	.2272568E-02	.1393508E-02	.8033396E-03
.1151513E-02	.1845867E-02	.2202455E-02	.1609142E-02	.7031417E-03
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-.5471461E-03	-.1877330E-02	-.1330847E-02	-.7680822E-03	-.2282847E-02
-.3729233E-02	-.3212403E-02	-.2582405E-02	-.3578620E-02	-.4764157E-02
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.1621379E-03	-.3374728E-03	.7006161E-03	.2124117E-02	.2587317E-02
.2271003E-02	.2037566E-02	.2266381E-02	.2388777E-02	.1817670E-02
.1540763E-02	.2414400E-02	.2936134E-02	.2485011E-02	.2630678E-02
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-.2127700E-02	-.1161264E-02	-.5298151E-03	-.3257044E-03	-.5762902E-03
-.6709228E-03	-.3029361E-04	.5799610E-03	-.1157025E-04	-.9077527E-03
-.6860897E-03	-.1117355E-03	-.1982557E-03	-.5352378E-03	-.2781170E-03
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.5662650E-02	.5499482E-02	.4607044E-02	.3489680E-02	.2523936E-02
.1997114E-02	.1250575E-02	-.1323876E-03	-.7739976E-03	.4326109E-04
.1169926E-02	.1672521E-02	.1615503E-02	.1360923E-02	.1674694E-02
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.38428E-03	-.6374434E-03	-.6251412E-03	-.6896120E-03	-.3273852E-03
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.1205445E-02	.1208182E-02	.1468767E-02	.1676882E-02	.2162690E-02
.2242197E-02	.1531263E-02	.9429332E-03	.1590336E-02	.2605908E-02
.2458349E-02	.1820103E-02	.1835699E-02	.2190316E-02	.2216607E-02
.2072732E-02	.1750504E-02	.9002777E-03	.3844883E-03	.4900718E-03
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-.1026287E-02	-.6849928E-03	-.5802506E-03	-.8517932E-03	-.8916931E-03
-.7020407E-03	-.6356421E-03	-.7021550E-03	-.7278639E-03	-.6761189E-03
-.9037755E-03	-.1527571E-02	-.1453766E-02	-.2533826E-03	.7464864E-03
.7405962E-03	.6090888E-03	.1353221E-02	.2500166E-02	.3529810E-02
.4339864E-02	.3976828E-02	.2878912E-02	.2876718E-02	.3904186E-02
.4856956E-02	.5114035E-02	.4653648E-02	.4383507E-02	.4677414E-02
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.2157022E-02	.2407586E-02	.1803573E-02	.1621262E-02	.1991115E-02
.2151959E-02	.1948366E-02	.2044700E-02	.2915428E-02	.3679457E-02
.3635187E-02	.3951690E-02	.4864581E-02	.4992511E-02	.4210656E-02
.3351946E-02	.2760391E-02	.2258083E-02	.1958824E-02	.1833897E-02
.7485386E-03	-.9973724E-03	-.1024090E-02	.6790868E-03	.1389327E-02
.7953028E-03	.1101766E-02	.2090234E-02	.2061475E-02	.1592680E-02
.1720156E-02	.2027552E-02	.1977371E-02	.1792731E-02	.1802084E-02
.1853572E-02	.2130689E-02	.2658131E-02	.2405300E-02	.1538048E-02
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.1854529E-02	.2156353E-02	.2944046E-02	.3489321E-02	.3153788E-02
.2800893E-02	.3038878E-02	.3301171E-02	.3250291E-02	.2843877E-02
.1923930E-02	.1625831E-02	.2534679E-02	.2592874E-02	.1414922E-02
.1461118E-02	.2671101E-02	.2456365E-02	.1440716E-02	.1907862E-02
.2417630E-02	.1559602E-02	.1122826E-02	.1331627E-02	.9045972E-03
.5382417E-03	.7975286E-03	.1288858E-02	.1691443E-02	.1541255E-02
.1496236E-02	.2093908E-02	.2045027E-02	.8528973E-03	-.5207239E-03
-.1152760E-02	-.8861540E-04	.1466235E-02	.1151089E-02	.3795531E-03
.9960041E-03	.1537469E-02	.1559843E-02	.2263178E-02	.2707379E-02
.1898310E-02	.1447332E-02	.1687505E-02	.1403629E-02	.1100109E-02
.9954737E-03	.5167311E-03	.5929337E-03	.1370470E-02	.1750192E-02
.2165150E-02	.2405237E-02	.1702653E-02	.1731518E-02	.2596520E-02
.1658546E-02	-.7630671E-03	-.1976824E-02	-.1457903E-02	-.8455863E-03
-.8248060E-03	-.4078361E-03	-.1387051E-03	-.8959265E-03	-.1222872E-02
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.1223323E-03	-.4895270E-03	-.8540625E-03	-.1511169E-02	-.2544056E-02
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.7363935E-04	.6742254E-03	.5041790E-03	-.3297686E-03	-.5969110E-03
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-.1505134E-02	-.1552108E-03	.6450692E-03	.7827970E-03	.5526193E-03
.3622404E-04	-.1754261E-03	-.3681599E-03	-.1172209E-02	-.2065029E-02
-.2571511E-02	-.2374301E-02	-.1479875E-02	-.6930390E-03	-.3328056E-03
.2521535E-04	.4585331E-04	-.7902257E-03	-.1611440E-02	-.1421601E-02
-.8542847E-03	-.1066018E-02	-.1974624E-02	-.2331980E-02	-.1894842E-02
-.1580128E-02	-.1359642E-02	-.1209708E-02	-.1431551E-02	-.1415733E-02
-.6285173E-03	.2209159E-03	.1380489E-03	-.4044377E-03	-.5067035E-03
-.8632012E-03	-.1714771E-02	-.1826818E-02	-.1484798E-02	-.1971359E-02
-.2621774E-02	-.2610966E-02	-.2832990E-02	-.3222415E-02	-.3252363E-02
-.3806326E-02	-.4759814E-02	-.4866756E-02	-.4179363E-02	-.3463898E-02
-.3109246E-02	-.3327400E-02	-.3499541E-02	-.2735654E-02	-.1696406E-02
-.1828329E-02	-.3122005E-02	-.4020959E-02	-.3653404E-02	-.3052428E-02
-.3210512E-02	-.3612703E-02	-.3634219E-02	-.3268345E-02	-.2513992E-02
-[illegible]12251E-02	-.9305864E-03	.2219087E-03	.8585992E-03	.4198667E-03
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.732828E-03	.5621292E-03	.5708451E-03	.5483548E-03	.3493680E-03
-.5809599E-03	-.2031542E-02	-.2615850E-02	-.2081334E-02	-.1508163E-02
-.1318317E-02	-.1484305E-02	-.1480939E-02	-.9050220E-03	-.3854464E-03
.8505453E-05	.7307061E-03	.1355490E-02	.1022949E-02	-.1082975E-03
-.9654678E-03	-.1003230E-02	-.6563073E-03	-.6463739E-03	-.1002045E-02
-.9087117E-03	-.1968672E-03	.1588777E-04	-.4121292E-03	-.7815137E-03

-.1101677E-02	-.8995802E-03	.1800253E-03	.9123971E-03	.4525363E-03
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.2081534E-02	.1337822E-02	.1444870E-02	.1227108E-02	.3561486E-03
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.3983404E-02	.4605104E-02	.4504530E-02	.4252653E-02	.4194314E-02
.3683071E-02	.2813745E-02	.1894666E-02	.7542633E-03	.1519865E-03
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.2949581E-02	.2893994E-02	.2437141E-02	.2685237E-02	.3297952E-02
.2753573E-02	.2100769E-02	.2077576E-02	.1831696E-02	.1757006E-02
.1653981E-02	.1068384E-02	.9202584E-03	.9495749E-03	.9464322E-04
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.1707346E-03	.4758024E-03	.6321071E-03	.4061178E-03	.1722326E-03
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.9866854E-03	.1457548E-02	.1717413E-02	.2038861E-02	.2353082E-02
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.1688754E-02	.1956849E-02	.1959493E-02	.1880451E-02	.1852405E-02
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-.2515047E-02	-.2197384E-02	-.2339094E-02	-.2329470E-02	-.1853487E-02
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.2706257E-03	-.8978826E-04	.3629786E-04	-.5049869E-04	-.8043422E-03
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-.5235863E-06	-.3939178E-03	-.1192799E-02	-.2070427E-02	-.1655266E-02
-.5396266E-03	-.5841455E-03	-.1146233E-02	-.5876179E-03	.5762013E-03
.1028761E-02	.4882341E-03	-.2108033E-03	-.2610628E-03	-.5131833E-03
-.1835221E-02	-.3154970E-02	-.3471944E-02	-.3369680E-02	-.3244532E-02
58165E-02	-.1907846E-02	-.8122632E-03	.1508436E-03	.5247467E-03
45901E-03	.1295197E-02	.1489416E-02	.1196663E-02	.5063546E-03
-.4875993E-03	-.1084596E-02	-.1308417E-02	-.1579316E-02	-.1233027E-02
-.4472028E-03	-.4605568E-03	-.9946919E-03	-.1038616E-02	-.6100844E-03
-.1136359E-03	-.2794781E-04	-.2406052E-03	.3092258E-04	.4038440E-03
.2566263E-03	.8710776E-04	.1221730E-03	-.3487463E-03	-.1531377E-02
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-.1245725E-02	-.1455982E-02	-.1810004E-02	-.2413575E-02	-.2831557E-02
-.2770721E-02	-.2479621E-02	-.2048578E-02	-.1607825E-02	-.1569949E-02
-.1276153E-02	-.1479754E-03	.7374191E-03	.8836055E-03	.1065091E-02
.1328007E-02	.1242093E-02	.7295859E-03	.2036462E-03	.3170712E-03
.6273685E-03	.1355636E-03	-.7167725E-03	-.8038437E-03	-.3624998E-03
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-.6843542E-03	-.5885772E-03	-.1119909E-02	-.1189770E-02	-.8507842E-03
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.2253098E-02	-.2022257E-02	-.1879974E-02	-.2651599E-02	-.3338215E-02
-.3161673E-02	-.2441567E-02	-.1915232E-02	-.1738023E-02	-.1749486E-02
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-.1632300E-02	-.9551957E-03	-.8174847E-03	-.1103984E-02	-.8619097E-03
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.1667930E-04	.5899139E-04	.3357547E-03	.8111312E-03	.1161133E-02
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.1151302E-03	.1109345E-03	.9049395E-04	.7714371E-04	.8810088E-04
.1088169E-03	.1341598E-03	.1414797E-03	.1254671E-03	.1276906E-03
.1440006E-03	.1412726E-03	.1289863E-03	.1268103E-03	.1383383E-03
.1516533E-03	.1479204E-03	.1311690E-03	.1157113E-03	.1023857E-03
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-.2253098E-02	-.2022257E-02	-.1879974E-02	-.2651599E-02	-.3338215E-02
-.3161673E-02	-.2441567E-02	-.1915232E-02	-.1738023E-02	-.1749486E-02
-.1778166E-02	-.1414829E-02	-.9888304E-03	-.1142306E-02	-.1692711E-02
-.1834499E-02	-.1214094E-02	-.8059590E-03	-.1079742E-02	-.1031573E-02
-.6059811E-03	-.5498897E-03	-.4513498E-03	-.1638785E-03	-.1402615E-03
-.6094720E-05	.3115806E-03	.6317666E-03	.1303221E-02	.1674685E-02
.9558840E-03	-.1528649E-03	-.5954521E-03	-.5899748E-03	-.1181399E-02
-.2050547E-02	-.2101996E-02	-.1677208E-02	-.1693406E-02	-.1937061E-02
-.1632300E-02	-.9551957E-03	-.8174847E-03	-.1103984E-02	-.8619097E-03
-.4427473E-03	-.7396794E-03	-.8984601E-03	-.5047764E-03	-.6355590E-03
-.1126068E-02	-.1379618E-02	-.1578176E-02	-.1421628E-02	-.1045825E-02
-.1065522E-02	-.1038545E-02	-.7850095E-03	-.7336765E-03	-.5807742E-03
-.3200446E-03	-.3187052E-03	-.1805927E-03	.9735340E-04	.6252568E-04
-.8223116E-04	-.3845454E-04	.5782793E-04	.5135776E-04	.2192990E-04
.1667930E-04	.5899139E-04	.3357547E-03	.8111312E-03	.1161133E-02
.1130645E-02	.9810430E-03	.1233014E-02	.1300710E-02	.7243327E-03
.4399942E-03	.7474553E-03	.9103529E-03	.7263168E-03	.6063190E-03
.6475700E-03	.4469870E-03	-.2931570E-04	-.4079607E-03	-.6377736E-03
-.6866462E-03	-.5793677E-03	-.5701672E-03	-.6700565E-03	-.6996955E-03
-.6587163E-03	-.5980240E-03	-.3514921E-03	.4857149E-04	.1176997E-03
-.3302556E-03	-.7917667E-03	-.1026092E-02	-.1423232E-02	-.1631410E-02
-.9362957E-03	-.1293109E-03	-.6531411E-04	-.1473461E-03	.1156289E-04
.1041710E-03	.6534801E-04	.8010620E-04	.3700105E-03	.7967061E-03
.8710878E-03	.6764800E-03	.8224427E-03	.1103006E-02	.8629422E-03
.4989771E-03	.3901886E-03	.2017027E-03	.6239873E-04	.1600934E-03
.2423126E-03	.4143387E-03	.9736180E-03	.1461700E-02	.1320446E-02
.46499E-03	.5007083E-03	.6011517E-03	.7823386E-03	.5264517E-03
.1217870E-04	-.6435113E-04	.4160810E-03	.8344501E-03	.7287580E-03
.4444658E-03	.4736750E-03	.6617673E-03	.6279814E-03	.3347062E-03
.1802879E-03	.3296460E-03	.4614515E-03	.6012745E-03	.9087575E-03
.1139561E-02	.1071393E-02	.9276293E-03	.9683844E-03	.1066592E-02
.1057477E-02	.9933562E-03	.9786441E-03	.9885488E-03	.9792590E-03
.9734015E-03	.9212582E-03	.6892604E-03	.4113484E-03	.4207570E-03
.5372919E-03	.3584676E-03	.1986773E-03	.4331759E-03	.6154974E-03
.5099842E-03	.6077303E-03	.9351416E-03	.9718334E-03	.7747393E-03
.7058109E-03	.6070767E-03	.4277123E-03	.5441113E-03	.7135690E-03
.4720705E-03	.2377398E-03	.3605862E-03	.4957021E-03	.4038701E-03
.1567850E-03	-.3934286E-04	-.1790665E-05	.1625406E-03	.2905678E-03
.2840869E-03	.2312163E-03	.3603386E-03	.4767416E-03	.4313562E-03
.5055231E-03	.6325497E-03	.5890669E-03	.4913606E-03	.3528311E-03
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-.3468954E-04	.1439433E-03	.2403472E-03	.1386187E-03	.1364936E-03
.3049276E-03	.3727768E-03	.2930548E-03	.2156977E-03	.1611081E-03
.1599799E-03	.2525762E-03	.4165393E-03	.5314015E-03	.4436911E-03
.2306716E-03	.1414831E-03	.2334630E-03	.3088913E-03	.2624457E-03
.2015039E-03	.2011530E-03	.2652967E-03	.4028273E-03	.5057353E-03
.4690711E-03	.3995533E-03	.4650253E-03	.6505142E-03	.7320682E-03
.6439445E-03	.5820646E-03	.6186898E-03	.6539238E-03	.6346734E-03
.6041120E-03	.6016375E-03	.6107973E-03	.5709785E-03	.4446033E-03
.3577735E-03	.4015794E-03	.4040488E-03	.2973484E-03	.3068203E-03
.3921655E-03	.3293263E-03	.2904401E-03	.3952630E-03	.4332180E-03
.41113E-03	.3722171E-03	.5009385E-03	.6108250E-03	.6472245E-03
.440867E-03	.6197439E-03	.6092327E-03	.6188149E-03	.5774870E-03
.4721050E-03	.4256192E-03	.5046665E-03	.6018279E-03	.5636438E-03
.4513742E-03	.4362643E-03	.4190085E-03	.3001140E-03	.2482439E-03
.3042163E-03	.2908359E-03	.1785270E-03	.1298553E-03	.2148439E-03
.3126569E-03	.2785727E-03	.1843271E-03	.1859267E-03	.2182845E-03
.2191367E-03	.2309565E-03	.2351604E-03	.2434246E-03	.2713162E-03

.2617687E-03	.3076635E-03	.3039400E-03	.2746395E-03	.2895607E-03
.3260078E-03	.3219435E-03	.3254392E-03	.3675817E-03	.3800812E-03
.3444917E-03	.3009526E-03	.2621325E-03	.2292799E-03	.2017737E-03
.1905605E-03	.1998915E-03	.2195265E-03	.2460163E-03	.2718555E-03
.2879912E-03	.2840725E-03	.2682946E-03	.2630453E-03	.2623737E-03
.2358445E-03	.1756620E-03	.1357638E-03	.1655318E-03	.2118451E-03
037830E-03	.1693212E-03	.1603189E-03	.1554960E-03	.1299732E-03
151302E-03	.1109345E-03	.9049395E-04	.7714371E-04	.8810088E-04
.1088169E-03	.1341598E-03	.1414797E-03	.1254671E-03	.1276906E-03
.1440006E-03	.1412726E-03	.1289863E-03	.1268103E-03	.1383383E-03
.1516533E-03	.1479204E-03	.1311690E-03	.1157113E-03	.1023857E-03
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.9073235E-04	.8342004E-04	.7167270E-04	.6201869E-04	.5407196E-04
.6040423E-04	.7129714E-04	.6079571E-04	.4505936E-04	.4504752E-04
.4496838E-04	.3833397E-04	.3582892E-04	.3743281E-04	.4117971E-04
.4461992E-04	.4112373E-04	.3474445E-04	.3285954E-04	.3250776E-04
.2980741E-04	.2649393E-04	.2343279E-04	.1713109E-04	.9667681E-05
.7627507E-05	.8975292E-05	.7227012E-05	.3154811E-05	.1616089E-05
.4105343E-05	.6913436E-05	.4411590E-05	-.6474796E-07	.9739749E-06
.3430582E-05	-.1890629E-05	-.1075370E-04	-.1261679E-04	-.8840835E-05
-.8287555E-05	-.1282144E-04	-.1580680E-04	-.1675057E-04	-.2045216E-04
-.2421562E-04	-.2572351E-04	-.2883767E-04	-.3328060E-04	-.3587711E-04
-.3815382E-04	-.4116004E-04	-.4227766E-04	-.4273443E-04	-.4570324E-04
-.4860330E-04	-.4960323E-04	-.5129780E-04	-.5339391E-04	-.5453642E-04
-.5606525E-04	-.5709907E-04	-.5664363E-04	-.5760764E-04	-.6028728E-04
-.6173734E-04	-.6275546E-04	-.6444782E-04	-.6560606E-04	-.6673972E-04
-.6853524E-04	-.7022042E-04	-.7176411E-04	-.7360489E-04	-.7541839E-04
-.7681074E-04	-.7798783E-04	-.7943102E-04	-.8092974E-04	-.8205383E-04
-.8297635E-04	-.8424060E-04	-.8579765E-04	-.8720172E-04	-.8854859E-04
-.8994515E-04	-.9126441E-04	-.9256936E-04	-.9392450E-04	-.9518164E-04
-.9631622E-04	-.9748876E-04	-.9871316E-04	-.9992773E-04	-.1011540E-03
-.1023351E-03	-.1034848E-03	-.1047100E-03	-.1059258E-03	-.1070485E-03
1081053E-03	-.1091734E-03	-.1102880E-03	-.1113566E-03	-.1123732E-03
134095E-03	-.1144486E-03	-.1154686E-03	-.1164802E-03	-.1174830E-03
.84790E-03	-.1194673E-03	-.1204493E-03	-.1214214E-03	-.1223872E-03
-.1233473E-03	-.1242975E-03	-.1252421E-03	-.1261778E-03	-.1271036E-03
-.1280205E-03	-.1289285E-03	-.1298269E-03	-.1307154E-03	

APPENDIX D

PERMANENT DEFORMATION ANALYSES

APPENDIX D-1

ESTIMATION OF THE SEISMIC PSEUDO-STATIC FACTORS OF SAFETY AND YIELD ACCELERATIONS FOR THE DOWNSTREAM AND UPSTREAM SLOPE GEOMETRIES

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Estimation of the Seismic Pseudo-Static Factors of Safety and Yield Accelerations for the South Cell Downstream and Upstream Slope Geometries PAGE 1 OF 65

MADE BY BEG DATE 1/22/08 CHECKED BY [illegible] DATE 1/23/08

CALCULATION BRIEF FOR

ESTIMATION OF THE SEISMIC PSEUDO-STATIC FACTORS OF SAFETY AND YIELD ACCELERATIONS FOR THE DOWNSTREAM AND UPSTREAM SLOPE GEOMETRIES

POND CREEK COAL REFUSE DISPOSAL SITE - SOUTH CELL

OBJECTIVE: Estimate downstream and upstream seismic factors of safety and yield accelerations for the Pond Creek – South Cell embankment and impoundment.

METHODOLOGY: In accordance with Reference 1, use GSTABL slope stability computer software (Reference 2) to revise the Alliance Consulting, Inc. pseudo-static (seismic) stability analyses and, based on the results, approximate yield accelerations of the Pond Creek – South Cell embankment for both downstream and upstream critical failure surfaces.

REFERENCES:

1. Illinois Department of Natural Resources Letter "Application No. 20061019, Pond Creek Mine No. 1, Phase 2 Refuse Disposal Dam," dated September 19, 2007.

2. Gregory, P.E., Garry H., "GSTABL7 with STEDwin Slope Stability Analysis System, Version 2.0," dated September 2001.

3. Ordonez, Gustavo A.(2006) "SHAKE2000: A Computer Program for the 1-D Analysis of Geotechnical Earthquake Engineering Problems," February 2006.

4. Newmark, N. M. (1965) "Effects of Earthquake on Dams and Embankments," Geotechnique, London, Vol. 5, No. 2, June, 1965.

5. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak

Undrained Shear Strengths For Refuse and Subgrade Materials, Pond Creek Coal Refuse Disposal Site", BEG, 12/28/07.

ANALYSIS:

The Illinois Department of Natural Resources (IDNR) has required that a revised (seismic) slope stability analysis be performed for the Pond Creek facility using equivalent static load (pseudo-static) methods and the appropriate peak acceleration based on the Peak Ground Acceleration (PGA) for 2% Probability of Exceedance in 50 Years map from the USGS. If the required factor of safety is not met, i.e., a minimum factor of safety of 1.0 with seismic forces for the steady seepage condition, a permanent deformation evaluation should be completed and submitted for review before an IDNR/OWR permit can be issued. Accordingly, CEC revised the seismic slope stability analyses and as shown below, the minimum factor of safety does not meet the required 1.0 safety factor criteria. Therefore, CEC will perform a detailed deformation evaluation of the proposed Pond Creek South Cell impoundment addressing relevant issues such as material characterizations, seismic hazard, induced cyclic shear stresses and permanent deformations.

Permanent deformations or crest settlement can occur depending upon the acceleration levels above a defined yield acceleration, below which embankment response is assumed to behave elastic-plastic (Newmark, 1965). If crest settlements are large enough resulting in the loss of freeboard below the maximum tailings impoundment level, overtopping of the dam could result posing a threat to the embankment and ultimately downstream safety. Appendix D, Attachments D-2 and D-3 present analyses to estimate induced cyclic shear stresses, settlements along for the proposed South Cell embankment geometry and determine the potential for overtopping as a result of permanent deformations.

Revised Pseudo-Static (Seismic) Stability Analyses and Estimation of Yield Accelerations:

Pseudo-static stability analyses were performed for the proposed South Cell downstream and upstream geometries including the maximum fines (El. 496) and minimum fines (El. 474) conditions respectively using a PGA of 0.54g (as required by IDNR) to assess the revised seismic factor of safety (Fs), and to determine the yield acceleration (Ky) of the critical soil mass.

The yield acceleration is the acceleration level:

- Below which yielding of the embankment (soil mass) does not occur and the soil mass deforms elastic-plastic; and/or,

- Above which yielding occurs causing permanent deformation.

The yield acceleration is used as input to subsequent Newmark-type permanent deformation analyses. The following graphically illustrates the concept of the Newmark analysis and the relative significance of the yield acceleration (Note, $K_y = N_d$ in the attached figure).

Yield strengths for the various materials included drained strengths for coarse and fine refuse and undrained strength (both total strength and 80% peak undrained) for residual soil in the GSTABL analysis to obtain Ky.

Refuse/Soil Properties Used in Revised Pseudo-Static and Yield Acceleration Slope Stability Analyses

Description	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Yield Strength (psf)
Coarse Refuse	130	33.7	0	Frictional
Fine Refuse	90	30	0	Frictional
Residual Soil	125	19.5 0	400 3000	Total (Undrained) Strength 80% Peak Undrained

Note: Refuse properties provided by Alliance Consulting, Inc. based on laboratory testing and/or literature values noted in the Alliance static/seismic slope stability analyses.

A horizontal acceleration corresponding to the PGA value of 0.54g was input into GSTABL to assess the revised seismic stability analyses safety factors. Revised Fs values less than 1.0 were determined for both the downstream and upstream slope conditions, thus permanent deformation analyses are required, which are presented in Appendices D-2 and D-3.

Additionally, a horizontal acceleration was subsequently varied in GSTABL until a Factor of Safety equal to 1.0 was achieved. Consequently, yield accelerations of 0.184g and 0.24g were iteratively determined for the soil mass corresponding to the downstream (maximum fines) critical failure surface using total strength and 80% peak strength, respectively, and 0.19g for the upstream (minimum fines) failure surface for both strength parameters.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Estimation of the Seismic Pseudo-Static Factors of Safety and Yield Accelerations for the South Cell Downstream and Upstream Slope Geometries

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CONCLUSION

Based on the information presented in this calculation brief, the minimum factors of safety for the revised pseudo-static (seismic) analyses (with PGA=0.54g) are less than 1.0. Therefore, per the IDNR September 19, 2007 comment, a permanent deformation analysis is required. Additionally, the minimum yield acceleration for the Pond Creek – South Cell embankment in the downstream and upstream directions was estimated at 0.18g. The revised seismic stability and yield acceleration GSTABL analyses runs and outputs files are attached. Finally, a yield acceleration of 0.018g is conservatively assumed for all downstream and upstream slope conditions, which will be used as input for estimating the corresponding permanent deformations.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Estimation of the Seismic Pseudo-Static Factors of Safety and Yield Accelerations for the South Cell Downstream and Upstream Slope Geometries PAGE 5 OF 65

MADE BY BEG DATE 1/22/08 CHECKED BY [signature] DATE 1/23/08

POND CREEK – SOUTH CELL IMPOUNDMENT
GSTABL PSEUDO-STATIC (SEISMIC)
STABILITY ANALYSIS OUTPUT FILES
DOWNSTREAM (MAXIMUM FINES CONDITION)
UPSTREAM (MINIMUM FINES CONDITION)

Pond Creek, South Cell, DS (PGA = 0.54g)CEC Project No. 072-046 (Total Strength)

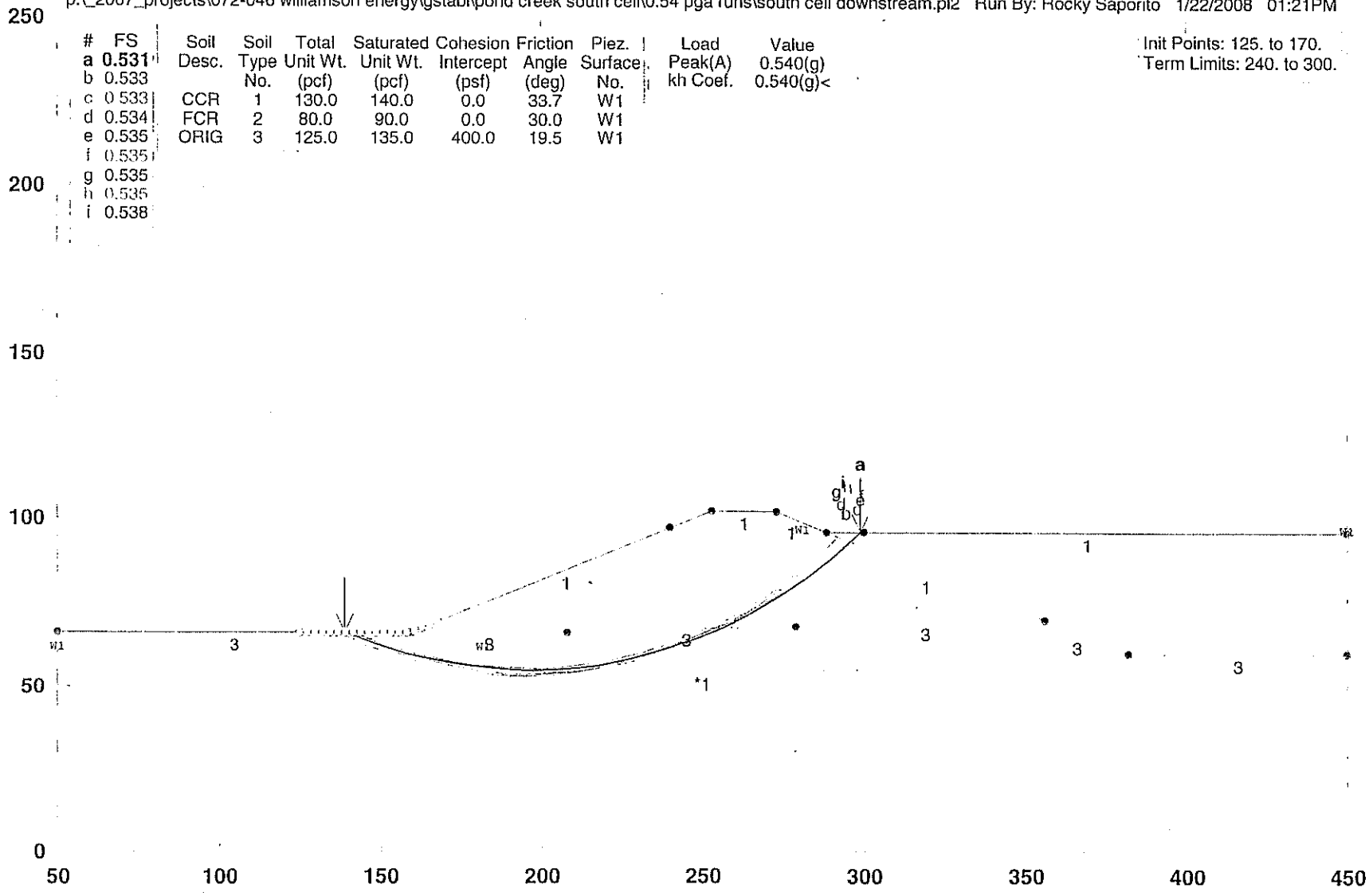
p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\0.54 pga runs\south cell downstream.pl2 Run By: Rocky Saporito 1/22/2008 01:21PM

#	FS	Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
a	**0.531**							
b	0.533							
c	0.533	CCR	1	130.0	140.0	0.0	33.7	W1
d	0.534	FCR	2	80.0	90.0	0.0	30.0	W1
e	0.535	ORIG	3	125.0	135.0	400.0	19.5	W1
f	0.535							
g	0.535							
h	0.535							
i	0.538							

Load: Peak(A) kh Coef.

Value: 0.540(g) 0.540(g)<

Init Points: 125. to 170.
Term Limits: 240. to 300.



GSTABL7 v.2 FSmin=0.531

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R14082

```
                    ***  GSTABL7  ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
              (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                    SLOPE STABILITY ANALYSIS SYSTEM
        Modified Bishop, Simplified Janbu, or GLE Method of Slices.
        (Includes Spencer & Morgenstern-Price Type Analysis)
        Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
        Nonlinear Undrained Shear Strength, Curved Phi Envelope,
        Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
        Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
   Analysis Run Date:        1/22/2008
   Time of Run:              01:21PM
   Run By:                   Rocky Saporito
   Input Data Filename:      P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\0.54 PGA Runs\south cell downstream.in
   Output Filename:          P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\0.54 PGA Runs\south cell downstream.OUT
   Unit System:              English
   Plotted Output Filename:  P:\_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek South
Cell\0.54 PGA Runs\south cell downstream.PLT
   PROBLEM DESCRIPTION:  Pond Creek, South Cell, DS (PGA = 0.54g)
                         CEC Project No. 072-046 (Total Strength)
   BOUNDARY COORDINATES
       5 Top   Boundaries
      11 Total Boundaries
```

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	50.00	66.00	159.40	66.00	3
2	159.40	66.00	253.00	102.00	1
3	253.00	102.00	273.00	102.00	1
4	273.00	102.00	288.60	96.00	1
5	288.60	96.00	450.00	96.00	1
6	159.40	66.00	208.00	66.00	3
7	208.00	66.00	279.00	68.00	3
8	288.60	96.00	356.20	70.00	1
9	279.00	68.00	356.20	70.00	3
10	356.20	70.00	382.20	60.00	3
11	382.20	60.00	450.00	60.00	3

```
   Default Y-Origin = 0.00(ft)
   Default X-Plus Value = 0.00(ft)
   Default Y-Plus Value = 0.00(ft)
  ISOTROPIC SOIL PARAMETERS
    3 Type(s) of Soil
```

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	0.0	30.0	0.00	0.0	1
3	125.0	135.0	400.0	19.5	0.00	0.0	1

```
   1 PIEZOMETRIC SURFACE(S) SPECIFIED
   Unit Weight of Water =  62.40 (pcf)
   Piezometric Surface No.  1 Specified by  4 Coordinate Points
   Pore Pressure Inclination Factor =  0.50
```

Point No.	X-Water (ft)	Y-Water (ft)
1	50.00	64.00
2	182.00	64.00
3	280.80	99.00
4	450.00	99.00

```
  Searching Routine Will Be Limited To An Area Defined By  1 Boundaries
   Of Which The First  1 Boundaries Will Deflect Surfaces Upward
```

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	50.00	50.00	450.00	58.00

Specified Peak Ground Acceleration Coefficient (A) = 0.540(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.540(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 125.00(ft)
and X = 170.00(ft)
Each Surface Terminates Between X = 240.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Statistical Data On All Valid FS Values:
FS Max = 0.876 FS Min = 0.531 FS Ave = 0.650
Standard Deviation = 0.076 Coefficient of Variation = 11.64 %
Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	139.21	66.00
2	148.57	62.48
3	158.14	59.59
4	167.89	57.36
5	177.77	55.78
6	187.73	54.87
7	197.72	54.63
8	207.71	55.06
9	217.65	56.17
10	227.49	57.93
11	237.20	60.36
12	246.71	63.43
13	256.00	67.13
14	265.02	71.45
15	273.73	76.36
16	282.09	81.85
17	290.07	87.88
18	297.62	94.44
19	299.19	96.00

Circle Center At X = 196.28 ; Y = 203.49 ; and Radius = 148.86
Factor of Safety
*** 0.531 ***
Individual data on the 29 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	5.3	664.5	0.0	0.0	0.	0.	358.8	0.0	0.0
2	4.0	1426.2	0.0	205.1	0.	0.	770.2	0.0	0.0
3	9.6	6224.9	0.0	1849.5	0.	0.	3361.5	0.0	0.0
4	1.3	1084.9	0.0	365.7	0.	0.	585.9	0.0	0.0
5	8.5	10423.7	0.0	3081.6	0.	0.	5628.8	0.0	0.0
6	9.9	19005.1	0.0	4636.6	0.	0.	10262.8	0.0	0.0
7	4.2	10201.7	0.0	2231.4	0.	0.	5508.9	0.0	0.0
8	5.6	15368.7	0.0	3294.7	0.	0.	8299.1	0.0	0.0
9	0.1	231.1	0.0	52.3	0.	0.	124.8	0.0	0.0
10	10.0	31944.8	0.0	7687.4	0.	0.	17250.2	0.0	0.0
11	10.0	37120.4	0.0	9716.5	0.	0.	20045.0	0.0	0.0
12	0.3	1136.4	0.0	307.7	0.	0.	613.7	0.0	0.0
13	9.7	40043.5	0.0	11036.5	0.	0.	21623.5	0.0	0.0
14	9.8	44061.4	0.0	12563.3	0.	0.	23793.1	0.0	0.0

15	9.7	45741.7	0.0	13368.3	0.	0.	24700.5	0.0	0.0
16	9.5	46222.2	0.0	13755.6	0.	0.	24960.0	0.0	0.0
17	6.3	30818.9	0.0	9313.5	0.	0.	16642.2	0.0	0.0
18	3.0	14491.5	0.0	4409.9	0.	0.	7825.4	0.0	0.0
19	0.5	2333.6	0.0	742.2	0.	0.	1260.2	0.0	0.0
20	8.5	37941.9	0.0	12529.5	0.	0.	20488.6	0.0	0.0
21	8.0	30941.2	0.0	11400.5	0.	0.	16708.2	0.0	0.0
22	0.7	2589.3	0.0	1002.2	0.	0.	1398.2	0.0	0.0
23	7.1	21189.7	0.0	9497.4	0.	0.	11442.5	0.0	0.0
24	1.3	3137.6	21.5	1696.8	0.	0.	1694.3	0.0	0.0
25	6.5	11788.6	760.7	7480.6	0.	0.	6365.8	0.0	0.0
26	1.5	1780.4	274.5	1339.6	0.	0.	961.4	0.0	0.0
27	6.0	4640.6	1128.3	4234.1	0.	0.	2505.9	0.0	0.0
28	1.5	473.4	285.0	657.1	0.	0.	255.7	0.0	0.0
29	1.6	171.3	293.8	521.8	0.	0.	92.5	0.0	0.0

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.11	66.00
2	141.36	62.21
3	150.85	59.07
4	160.54	56.59
5	170.38	54.78
6	180.31	53.65
7	190.30	53.21
8	200.30	53.46
9	210.26	54.39
10	220.12	56.01
11	229.86	58.30
12	239.41	61.26
13	248.74	64.87
14	257.80	69.11
15	266.54	73.96
16	274.93	79.40
17	282.92	85.41
18	290.48	91.95
19	294.56	96.00

Circle Center At X = 191.71 ; Y = 198.47 ; and Radius = 145.26

Factor of Safety

*** 0.533 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.84	66.00
2	146.23	62.55
3	155.82	59.72
4	165.57	57.52
5	175.45	55.97
6	185.41	55.07
7	195.41	54.83
8	205.40	55.24
9	215.34	56.31
10	225.20	58.03
11	234.91	60.39
12	244.45	63.38
13	253.78	66.99
14	262.85	71.20
15	271.62	76.01
16	280.06	81.37
17	288.13	87.28
18	295.79	93.71
19	298.18	96.00

Circle Center At X = 194.12 ; Y = 207.18 ; and Radius = 152.35

Factor of Safety

*** 0.533 ***

Failure Surface Specified By 18 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	141.58	66.00
2	150.76	62.05
3	160.23	58.81
4	169.91	56.32
5	179.76	54.59
6	189.71	53.61
7	199.71	53.42
8	209.69	53.99
9	219.60	55.33
10	229.38	57.43
11	238.96	60.29
12	248.30	63.87
13	257.33	68.16
14	266.00	73.14
15	274.27	78.78
16	282.07	85.03
17	289.37	91.87
18	293.14	96.00

Circle Center At X = 197.26 ; Y = 182.55 ; and Radius = 129.17

Factor of Safety

*** 0.534 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.05	66.00
2	160.25	62.06
3	169.72	58.87
4	179.42	56.45
5	189.29	54.80
6	199.25	53.94
7	209.25	53.88
8	219.22	54.61
9	229.11	56.14
10	238.84	58.44
11	248.35	61.52
12	257.59	65.34
13	266.50	69.88
14	275.02	75.12
15	283.09	81.02
16	290.67	87.54
17	297.71	94.65
18	298.85	96.00

Circle Center At X = 205.01 ; Y = 179.24 ; and Radius = 125.44

Factor of Safety

*** 0.535 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	134.47	66.00
2	143.92	62.71
3	153.55	60.01
4	163.32	57.92
5	173.21	56.43
6	183.17	55.55
7	193.17	55.29
8	203.16	55.64
9	213.12	56.62
10	222.99	58.20
11	232.75	60.39
12	242.35	63.18
13	251.76	66.56
14	260.95	70.51
15	269.87	75.03
16	278.50	80.08
17	286.80	85.66
18	294.74	91.74

19 299.65 96.00

Circle Center At X = 192.39 ; Y = 217.19 ; and Radius = 161.91

Factor of Safety

*** 0.535 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.84	66.00
2	146.04	62.07
3	155.50	58.85
4	165.19	56.34
5	175.03	54.56
6	184.97	53.53
7	194.97	53.24
8	204.96	53.70
9	214.88	54.91
10	224.69	56.86
11	234.33	59.53
12	243.74	62.92
13	252.86	67.01
14	261.66	71.76
15	270.08	77.16
16	278.07	83.18
17	285.58	89.78
18	291.68	96.00

Circle Center At X = 193.80 ; Y = 186.64 ; and Radius = 133.41

Factor of Safety

*** 0.535 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	143.95	66.00
2	153.25	62.33
3	162.80	59.37
4	172.54	57.11
5	182.43	55.59
6	192.40	54.81
7	202.40	54.76
8	212.37	55.46
9	222.27	56.90
10	232.03	59.06
11	241.61	61.95
12	250.94	65.53
13	259.98	69.80
14	268.69	74.73
15	277.00	80.29
16	284.87	86.45
17	292.27	93.18
18	294.95	96.00

Circle Center At X = 197.95 ; Y = 189.19 ; and Radius = 134.51

Factor of Safety

*** 0.535 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.58	66.00
2	150.93	62.46
3	160.51	59.60
4	170.28	57.44
5	180.17	55.99
6	190.15	55.25
7	200.15	55.24
8	210.12	55.94
9	220.02	57.36
10	229.79	59.48
11	239.38	62.31
12	248.75	65.81

13	257.84	69.98
14	266.60	74.80
15	275.00	80.23
16	282.98	86.25
17	290.51	92.83
18	293.65	96.00

Circle Center At X = 195.36 ; Y = 193.80 ; and Radius = 138.66

Factor of Safety

*** 0.538 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	153.42	66.00
2	162.89	62.79
3	172.57	60.28
4	182.41	58.47
5	192.35	57.38
6	202.34	57.00
7	212.33	57.35
8	222.28	58.41
9	232.12	60.19
10	241.80	62.68
11	251.29	65.85
12	260.51	69.70
13	269.44	74.21
14	278.02	79.35
15	286.20	85.10
16	293.95	91.42
17	298.81	96.00

Circle Center At X = 202.55 ; Y = 195.58 ; and Radius = 138.58

Factor of Safety

*** 0.539 ***

**** END OF GSTABL7 OUTPUT ****

Pond Creek, South Cell, DS (PGA = 0.54g)CEC Project No. 072-046 (80% Peak Str.)

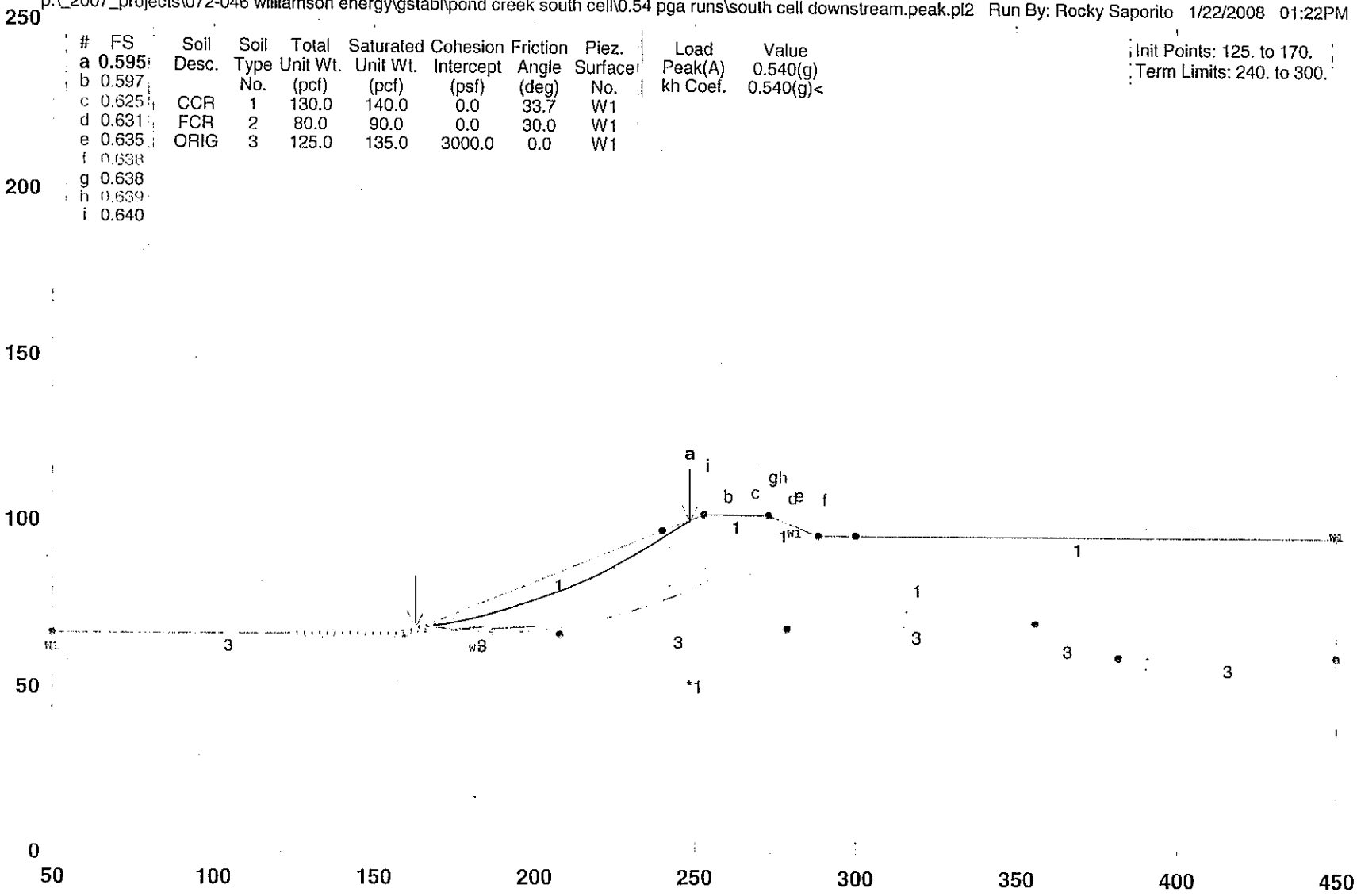
p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\0.54 pga runs\south cell downstream.peak.pl2 Run By: Rocky Saporito 1/22/2008 01:22PM

#	FS
a	0.595
b	0.597
c	0.625
d	0.631
e	0.635
f	0.638
g	0.638
h	0.639
i	0.640

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	30.0	W1
ORIG	3	125.0	135.0	3000.0	0.0	W1

Load	Value
Peak(A)	0.540(g)
kh Coef.	0.540(g)<

Init Points: 125. to 170.
Term Limits: 240. to 300.



GSTABL7 v.2 FSmin=0.595

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R14089

```
                    ***  GSTABL7  ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
              (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                    SLOPE STABILITY ANALYSIS SYSTEM
        Modified Bishop, Simplified Janbu, or GLE Method of Slices.
        (Includes Spencer & Morgenstern-Price Type Analysis)
        Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
        Nonlinear Undrained Shear Strength, Curved Phi Envelope,
        Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
        Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
   Analysis Run Date:        1/22/2008
   Time of Run:              01:22PM
   Run By:                   Rocky Saporito
   Input Data Filename:      P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\0.54 PGA Runs\south cell downstream.peak.in
   Output Filename:          P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\0.54 PGA Runs\south cell downstream.peak.OUT
   Unit System:              English
   Plotted Output Filename:  P:\_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek South
Cell\0.54 PGA Runs\south cell downstream.peak.PLT
   PROBLEM DESCRIPTION:  Pond Creek, South Cell, DS (PGA = 0.54g)
                         CEC Project No. 072-046 (80% Peak Str.)
   BOUNDARY COORDINATES
        Note: User origin value specified.
        Add 50.00 to X-values and 0.00 to Y-values listed.

      5 Top   Boundaries
     11 Total Boundaries
```

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	50.00	66.00	159.40	66.00	3
2	159.40	66.00	253.00	102.00	1
3	253.00	102.00	273.00	102.00	1
4	273.00	102.00	288.60	96.00	1
5	288.60	96.00	450.00	96.00	1
6	159.40	66.00	208.00	66.00	3
7	208.00	66.00	279.00	68.00	3
8	288.60	96.00	356.20	70.00	1
9	279.00	68.00	356.20	70.00	3
10	356.20	70.00	382.20	60.00	3
11	382.20	60.00	450.00	60.00	3

```
   Default Y-Origin = 0.00(ft)
   Default X-Plus Value = 0.00(ft)
   Default Y-Plus Value = 0.00(ft)
  ISOTROPIC SOIL PARAMETERS
    3 Type(s) of Soil
```

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	0.0	30.0	0.00	0.0	1
3	125.0	135.0	3000.0	0.0	0.00	0.0	1

```
   1 PIEZOMETRIC SURFACE(S) SPECIFIED
   Unit Weight of Water =  62.40 (pcf)
   Piezometric Surface No.  1 Specified by  4 Coordinate Points
   Pore Pressure Inclination Factor =  0.50
```

Point No.	X-Water (ft)	Y-Water (ft)
1	50.00	64.00
2	182.00	64.00
3	280.80	99.00
4	450.00	99.00

```
  Searching Routine Will Be Limited To An Area Defined By  1 Boundaries
   Of Which The First  1 Boundaries Will Deflect Surfaces Upward
```

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	50.00	50.00	450.00	58.00

Specified Peak Ground Acceleration Coefficient (A) = 0.540(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.540(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 125.00(ft)
and X = 170.00(ft)
Each Surface Terminates Between X = 240.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Statistical Data On All Valid FS Values:
FS Max = 2.529 FS Min = 0.595 FS Ave = 1.539
Standard Deviation = 0.367 Coefficient of Variation = 23.82 %
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	162.89	67.34
2	172.77	68.90
3	182.56	70.97
4	192.22	73.52
5	201.75	76.57
6	211.11	80.10
7	220.27	84.10
8	229.22	88.56
9	237.93	93.47
10	246.38	98.82
11	248.35	100.21

Circle Center At X = 137.21 ; Y = 261.94 ; and Radius = 196.28
Factor of Safety
*** 0.595 ***
Individual data on the 10 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.9	1437.0	0.0	0.0	0.	0.	776.0	0.0	0.0
2	9.8	3929.4	0.0	0.0	0.	0.	2121.9	0.0	0.0
3	9.7	5680.8	0.0	0.0	0.	0.	3067.6	0.0	0.0
4	9.5	6697.2	0.0	0.0	0.	0.	3616.5	0.0	0.0
5	9.4	6997.8	0.0	0.0	0.	0.	3778.8	0.0	0.0
6	9.2	6614.0	0.0	0.0	0.	0.	3571.5	0.0	0.0
7	8.9	5589.4	0.0	0.0	0.	0.	3018.3	0.0	0.0
8	8.7	3979.3	0.0	0.0	0.	0.	2148.8	0.0	0.0
9	8.4	1849.8	0.0	0.0	0.	0.	998.9	0.0	0.0
10	2.0	81.2	0.0	0.0	0.	0.	43.9	0.0	0.0

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	170.00	70.08
2	179.69	72.54
3	189.33	75.20
4	198.91	78.06
5	208.43	81.12
6	217.89	84.38

7	227.27	87.84
8	236.58	91.49
9	245.81	95.33
10	254.96	99.36
11	260.62	102.00

Circle Center At X = 56.68 ; Y = 536.71 ; and Radius = 480.20

Factor of Safety

*** 0.597 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	162.89	67.34
2	172.55	69.94
3	182.18	72.63
4	191.78	75.43
5	201.36	78.32
6	210.90	81.32
7	220.40	84.42
8	229.88	87.62
9	239.32	90.92
10	248.72	94.32
11	258.09	97.81
12	267.42	101.41
13	268.91	102.00

Circle Center At X = -77.81 ; Y = 983.35 ; and Radius = 947.10

Factor of Safety

*** 0.625 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	165.26	68.26
2	175.19	67.08
3	185.18	66.57
4	195.18	66.74
5	205.14	67.59
6	215.03	69.11
7	224.79	71.29
8	234.38	74.13
9	243.75	77.61
10	252.87	81.71
11	261.69	86.42
12	270.17	91.72
13	278.28	97.57
14	280.25	99.21

Circle Center At X = 187.67 ; Y = 214.08 ; and Radius = 147.53

Factor of Safety

*** 0.631 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	167.63	69.17
2	177.57	68.06
3	187.56	67.59
4	197.56	67.76
5	207.52	68.58
6	217.42	70.05
7	227.19	72.14
8	236.82	74.87
9	246.24	78.20
10	255.44	82.14
11	264.35	86.66
12	272.96	91.75
13	281.23	97.38
14	282.48	98.36

Circle Center At X = 189.83 ; Y = 222.34 ; and Radius = 154.77

Factor of Safety

*** 0.635 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	167.63	69.17
2	177.51	67.59
3	187.46	66.64
4	197.46	66.31
5	207.45	66.60
6	217.41	67.52
7	227.29	69.05
8	237.06	71.20
9	246.67	73.95
10	256.10	77.30
11	265.29	81.22
12	274.23	85.72
13	282.86	90.76
14	290.68	96.00

Circle Center At X = 197.76 ; Y = 226.55 ; and Radius = 160.24

Factor of Safety

*** 0.638 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	165.26	68.26
2	175.23	67.43
3	185.23	67.31
4	195.21	67.88
5	205.13	69.15
6	214.94	71.10
7	224.59	73.73
8	234.03	77.03
9	243.22	80.97
10	252.11	85.55
11	260.66	90.73
12	268.83	96.50
13	274.75	101.33

Circle Center At X = 182.02 ; Y = 210.81 ; and Radius = 143.54

Factor of Safety

*** 0.638 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	165.26	68.26
2	175.25	67.77
3	185.25	67.87
4	195.23	68.58
5	205.14	69.88
6	214.96	71.77
7	224.65	74.24
8	234.18	77.28
9	243.50	80.89
10	252.60	85.04
11	261.43	89.74
12	269.96	94.95
13	277.57	100.24

Circle Center At X = 178.44 ; Y = 235.26 ; and Radius = 167.52

Factor of Safety

*** 0.639 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.53	66.43
2	170.53	66.51
3	180.49	67.35
4	190.36	68.95
5	200.08	71.29
6	209.60	74.37

7	218.85	78.17
8	227.78	82.66
9	236.35	87.82
10	244.50	93.61
11	252.19	100.01
12	254.23	102.00

Circle Center At X = 164.58 ; Y = 196.97 ; and Radius = 130.60

Factor of Safety

*** 0.640 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	170.00	70.08
2	179.90	71.46
3	189.75	73.20
4	199.53	75.28
5	209.24	77.70
6	218.85	80.46
7	228.36	83.55
8	237.75	86.98
9	247.02	90.73
10	256.15	94.81
11	265.13	99.21
12	270.36	102.00

Circle Center At X = 135.72 ; Y = 351.56 ; and Radius = 283.56

Factor of Safety

*** 0.642 ***

**** END OF GSTABL7 OUTPUT ****

Pond Creek, South Cell, US (PGA = 0.54g)CEC Project No. 072-046 (Total Strength)

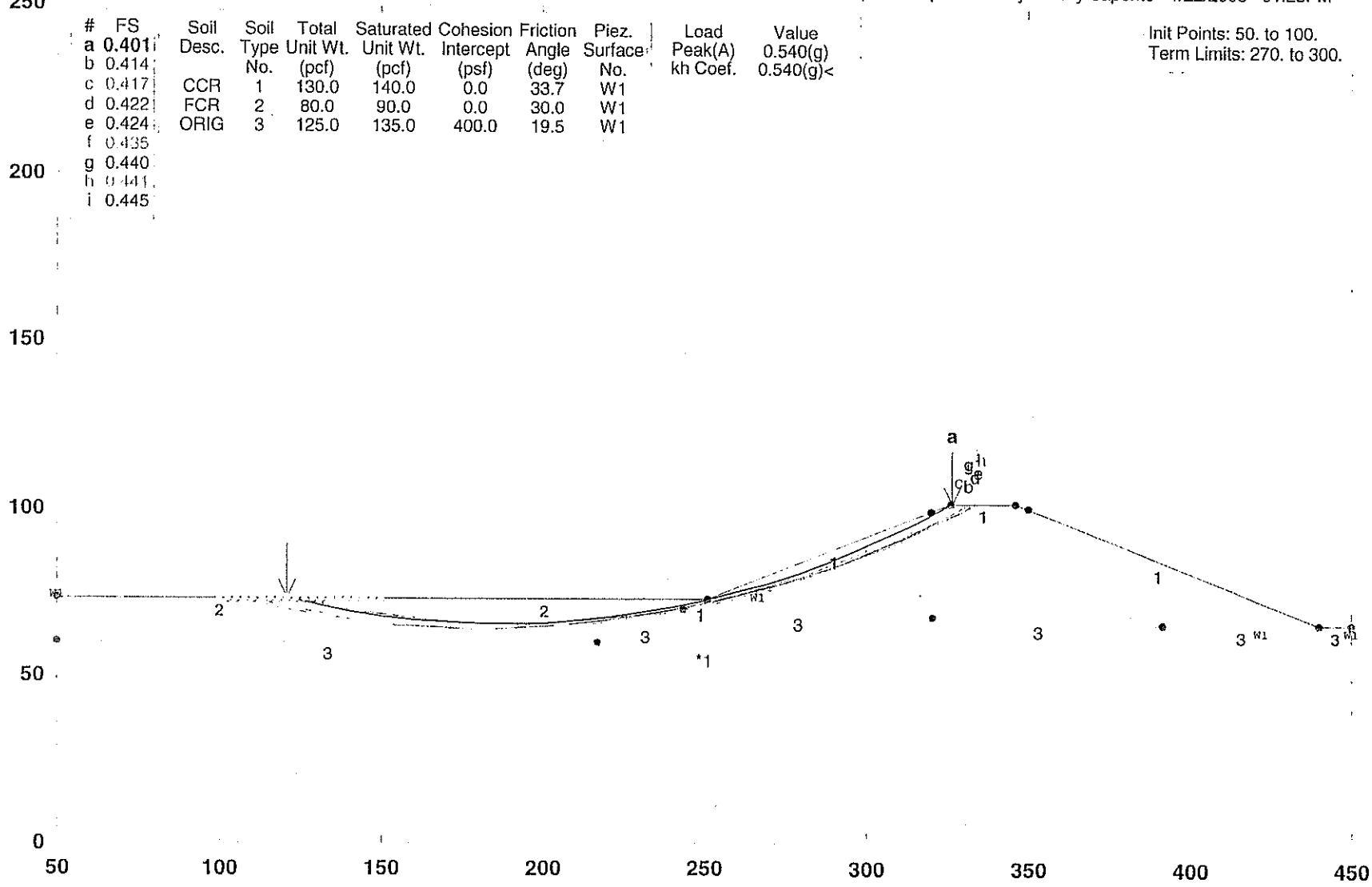
p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\0.54 pga runs\south cell upstream.pl2 Run By: Rocky Saporito 1/22/2008 01:23PM

#	FS	Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
a	0.401							
b	0.414							
c	0.417	CCR	1	130.0	140.0	0.0	33.7	W1
d	0.422	FCR	2	80.0	90.0	0.0	30.0	W1
e	0.424	ORIG	3	125.0	135.0	400.0	19.5	W1
f	0.435							
g	0.440							
h	0.441							
i	0.445							

Load: Peak(A) kh Coef.

Value: 0.540(g) 0.540(g)<

Init Points: 50. to 100.
Term Limits: 270. to 300.



GSTABL7 v.2 FSmin=0.401

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R14095

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                    ***  GSTABL7  ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
              (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                    SLOPE STABILITY ANALYSIS SYSTEM
        Modified Bishop, Simplified Janbu, or GLE Method of Slices.
        (Includes Spencer & Morgenstern-Price Type Analysis)
        Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
        Nonlinear Undrained Shear Strength, Curved Phi Envelope,
        Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
        Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
   Analysis Run Date:        1/22/2008
   Time of Run:              01:23PM
   Run By:                   Rocky Saporito
   Input Data Filename:      P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\0.54 PGA Runs\south cell upstream.in
   Output Filename:          P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\0.54 PGA Runs\south cell upstream.OUT
   Unit System:              English
   Plotted Output Filename:  P:\_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek South
Cell\0.54 PGA Runs\south cell upstream.PLT
   PROBLEM DESCRIPTION:  Pond Creek, South Cell, US (PGA = 0.54g)
                         CEC Project No. 072-046 (Total Strength)
   BOUNDARY COORDINATES
        Note: User origin value specified.
        Add 50.00 to X-values and 0.00 to Y-values listed.

       6 Top   Boundaries
      12 Total Boundaries
   Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
      No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
       1         0.00      73.00     100.00      73.00        2
       2       100.00      73.00     200.84      73.00        2
       3       200.84      73.00     276.24     102.00        1
       4       276.24     102.00     296.24     102.00        1
       5       296.24     102.00     389.84      66.00        1
       6       389.84      66.00     400.00      66.00        3
       7         0.00      60.00     167.04      60.00        3
       8       167.04      60.00     193.46      70.16        3
       9       193.46      70.16     200.84      73.00        1
      10       193.46      70.16     270.39      68.00        3
      11       270.39      68.00     341.70      66.00        3
      12       341.70      66.00     389.84      66.00        3
   Default Y-Origin = 0.00(ft)
   Default X-Plus Value = 0.00(ft)
   Default Y-Plus Value = 0.00(ft)
  ISOTROPIC SOIL PARAMETERS
    3 Type(s) of Soil
   Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
   Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
    No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
     1   130.0    140.0       0.0     33.7    0.00       0.0      1
     2    80.0     90.0       0.0     30.0    0.00       0.0      1
     3   125.0    135.0     400.0     19.5    0.00       0.0      1
   1 PIEZOMETRIC SURFACE(S) SPECIFIED
   Unit Weight of Water =  62.40 (pcf)
   Piezometric Surface No.  1 Specified by  4 Coordinate Points
   Pore Pressure Inclination Factor =  0.50
     Point      X-Water     Y-Water
      No.         (ft)        (ft)
       1          0.00       76.00
       2        216.44       76.00
       3        371.84       66.00
       4        400.00       66.00
  Searching Routine Will Be Limited To An Area Defined By  1 Boundaries
```

Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	0.00	58.00	400.00	58.00

Specified Peak Ground Acceleration Coefficient (A) = 0.540(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.540(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00(ft)
and X = 100.00(ft)
Each Surface Terminates Between X = 270.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Statistical Data On All Valid FS Values:
FS Max = 0.677 FS Min = 0.401 FS Ave = 0.581
Standard Deviation = 0.056 Coefficient of Variation = 9.62 %
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	71.05	73.00
2	80.83	70.88
3	90.67	69.11
4	100.56	67.68
5	110.51	66.59
6	120.48	65.86
7	130.47	65.47
8	140.47	65.44
9	150.47	65.75
10	160.44	66.41
11	170.39	67.42
12	180.30	68.78
13	190.15	70.49
14	199.94	72.54
15	209.65	74.92
16	219.27	77.65
17	228.79	80.71
18	238.20	84.11
19	247.48	87.83
20	256.63	91.87
21	265.63	96.23
22	274.47	100.90
23	276.39	102.00

Circle Center At X = 136.50 ; Y = 351.34 ; and Radius = 285.93
Factor of Safety
*** 0.401 ***
Individual data on the 27 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Surcharge Ver (lbs)	Surcharge Load (lbs)
1	9.8	931.6	1829.5	2532.9	0.	0.	503.1	0.0	0.0
2	9.8	2662.5	1842.3	3747.8	0.	0.	1437.7	0.0	0.0
3	9.3	3837.1	1747.2	4453.3	0.	0.	2072.0	0.0	0.0
4	0.6	268.2	105.6	294.6	0.	0.	144.8	0.0	0.0
5	9.9	5247.9	1861.0	5532.1	0.	0.	2833.8	0.0	0.0
6	10.0	6080.6	1866.9	6099.3	0.	0.	3283.5	0.0	0.0

7	10.0	6596.4	1870.6	6448.9	0.	0.	3562.1	0.0	0.0
8	10.0	6791.0	1872.0	6580.5	0.	0.	3667.2	0.0	0.0
9	10.0	6662.9	1871.1	6493.9	0.	0.	3598.0	0.0	0.0
10	10.0	6213.0	1867.9	6189.2	0.	0.	3355.0	0.0	0.0
11	9.9	5445.1	1862.4	5666.7	0.	0.	2940.3	0.0	0.0
12	9.9	4365.7	1854.6	4927.2	0.	0.	2357.5	0.0	0.0
13	9.9	2983.8	1844.6	3971.5	0.	0.	1611.2	0.0	0.0
14	9.1	1278.6	1705.8	2648.5	0.	0.	690.5	0.0	0.0
15	0.7	34.6	126.5	152.3	0.	0.	18.7	0.0	0.0
16	0.9	36.8	168.2	193.7	0.	0.	19.8	0.0	0.0
17	8.8	1053.6	769.1	1222.8	0.	0.	569.0	0.0	0.0
18	3.8	837.6	0.0	132.3	0.	0.	452.3	0.0	0.0
19	5.8	1623.5	0.0	0.0	0.	0.	876.7	0.0	0.0
20	9.5	3388.3	0.0	0.0	0.	0.	1829.7	0.0	0.0
21	9.4	3852.5	0.0	0.0	0.	0.	2080.3	0.0	0.0
22	9.3	3847.2	0.0	0.0	0.	0.	2077.5	0.0	0.0
23	9.1	3390.5	0.0	0.0	0.	0.	1830.9	0.0	0.0
24	9.0	2504.2	0.0	0.0	0.	0.	1352.3	0.0	0.0
25	8.8	1213.9	0.0	0.0	0.	0.	655.5	0.0	0.0
26	1.8	58.3	0.0	0.0	0.	0.	31.5	0.0	0.0
27	0.1	0.8	0.0	0.0	0.	0.	0.4	0.0	0.0

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.26	73.00
2	65.03	70.84
3	74.85	68.98
4	84.73	67.42
5	94.65	66.17
6	104.61	65.23
7	114.59	64.60
8	124.58	64.27
9	134.58	64.26
10	144.58	64.55
11	154.56	65.15
12	164.52	66.06
13	174.44	67.28
14	184.33	68.81
15	194.16	70.64
16	203.93	72.77
17	213.63	75.20
18	223.25	77.93
19	232.78	80.96
20	242.21	84.28
21	251.54	87.89
22	260.75	91.78
23	269.83	95.96
24	278.78	100.42
25	281.72	102.00

Circle Center At X = 130.09 ; Y = 387.75 ; and Radius = 323.52

Factor of Safety

*** 0.414 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.32	73.00
2	86.09	70.88
3	95.93	69.12
4	105.83	67.70
5	115.78	66.65
6	125.75	65.94
7	135.74	65.60
8	145.74	65.61
9	155.74	65.98
10	165.71	66.71
11	175.65	67.79
12	185.55	69.23

13	195.39	71.03
14	205.15	73.17
15	214.84	75.66
16	224.43	78.49
17	233.91	81.67
18	243.27	85.18
19	252.51	89.03
20	261.59	93.20
21	270.53	97.70
22	278.37	102.00

Circle Center At X = 140.38 ; Y = 345.04 ; and Radius = 279.48

Factor of Safety

*** 0.417 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.26	73.00
2	65.02	70.83
3	74.85	68.95
4	84.72	67.38
5	94.64	66.11
6	104.60	65.15
7	114.57	64.50
8	124.57	64.15
9	134.57	64.10
10	144.56	64.37
11	154.55	64.94
12	164.51	65.82
13	174.44	67.00
14	184.33	68.49
15	194.17	70.28
16	203.94	72.37
17	213.65	74.76
18	223.29	77.45
19	232.83	80.44
20	242.28	83.71
21	251.62	87.27
22	260.85	91.12
23	269.96	95.25
24	278.94	99.66
25	283.36	102.00

Circle Center At X = 130.94 ; Y = 389.72 ; and Radius = 325.64

Factor of Safety

*** 0.422 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	73.00
2	59.77	70.87
3	69.60	69.02
4	79.48	67.46
5	89.39	66.19
6	99.35	65.21
7	109.32	64.52
8	119.31	64.13
9	129.31	64.02
10	139.31	64.21
11	149.30	64.70
12	159.27	65.47
13	169.21	66.54
14	179.12	67.89
15	188.99	69.54
16	198.80	71.47
17	208.55	73.69
18	218.23	76.19
19	227.83	78.98
20	237.35	82.04

21	246.78	85.38
22	256.10	89.00
23	265.31	92.89
24	274.41	97.04
25	283.38	101.46
26	284.40	102.00

Circle Center At X = 127.83 ; Y = 405.74 ; and Radius = 341.72

Factor of Safety

*** 0.424 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.68	73.00
2	83.45	70.87
3	93.29	69.08
4	103.19	67.62
5	113.12	66.51
6	123.09	65.74
7	133.09	65.32
8	143.09	65.24
9	153.08	65.50
10	163.06	66.11
11	173.02	67.06
12	182.93	68.36
13	192.80	69.99
14	202.60	71.96
15	212.33	74.28
16	221.98	76.92
17	231.52	79.89
18	240.96	83.20
19	250.28	86.82
20	259.47	90.77
21	268.52	95.02
22	277.42	99.59
23	281.73	102.00

Circle Center At X = 140.42 ; Y = 355.48 ; and Radius = 290.25

Factor of Safety

*** 0.435 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.53	73.00
2	70.27	70.74
3	80.08	68.79
4	89.94	67.17
5	99.86	65.88
6	109.81	64.91
7	119.79	64.27
8	129.79	63.96
9	139.79	63.97
10	149.78	64.32
11	159.76	64.99
12	169.71	65.99
13	179.62	67.32
14	189.48	68.97
15	199.29	70.95
16	209.02	73.25
17	218.67	75.86
18	228.23	78.79
19	237.69	82.04
20	247.04	85.59
21	256.26	89.45
22	265.36	93.61
23	274.31	98.06
24	281.61	102.00

Circle Center At X = 134.27 ; Y = 368.02 ; and Radius = 304.10

Factor of Safety

*** 0.440 ***
Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.53	73.00
2	70.32	70.96
3	80.16	69.21
4	90.06	67.76
5	99.99	66.61
6	109.95	65.75
7	119.94	65.20
8	129.93	64.95
9	139.93	65.01
10	149.93	65.36
11	159.91	66.01
12	169.86	66.97
13	179.78	68.22
14	189.66	69.78
15	199.49	71.63
16	209.25	73.77
17	218.95	76.21
18	228.57	78.94
19	238.11	81.96
20	247.54	85.27
21	256.88	88.86
22	266.10	92.72
23	275.20	96.87
24	284.17	101.28
25	285.52	102.00

Circle Center At X = 133.21 ; Y = 396.63 ; and Radius = 331.69

Factor of Safety
*** 0.441 ***
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.68	73.00
2	83.47	70.95
3	93.32	69.22
4	103.22	67.82
5	113.17	66.76
6	123.14	66.02
7	133.13	65.61
8	143.13	65.54
9	153.13	65.80
10	163.11	66.39
11	173.07	67.31
12	182.99	68.56
13	192.86	70.14
14	202.68	72.05
15	212.43	74.28
16	222.09	76.84
17	231.67	79.71
18	241.15	82.91
19	250.52	86.41
20	259.76	90.22
21	268.87	94.34
22	277.84	98.76
23	283.90	102.00

Circle Center At X = 140.34 ; Y = 366.57 ; and Radius = 301.05

Factor of Safety
*** 0.445 ***
Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.16	73.00
2	72.92	70.83
3	82.75	68.97

4	92.63	67.43
5	102.55	66.20
6	112.51	65.30
7	122.49	64.71
8	132.49	64.44
9	142.49	64.49
10	152.48	64.87
11	162.46	65.56
12	172.41	66.57
13	182.32	67.91
14	192.18	69.55
15	201.99	71.52
16	211.72	73.79
17	221.38	76.38
18	230.95	79.27
19	240.43	82.47
20	249.80	85.98
21	259.04	89.78
22	268.17	93.87
23	277.16	98.25
24	284.25	102.00

Circle Center At X = 135.81 ; Y = 376.36 ; and Radius = 311.94

Factor of Safety

*** 0.452 ***

**** END OF GSTABL7 OUTPUT ****

Pond Creek, South Cell, US (PGA = 0.54g)CEC Project No. 072-046 (80% Peak Str.)

p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\0.54 pga runs\south cell upstream.peak.pl2 Run By: Rocky Saporito 1/22/2008 01:24PM

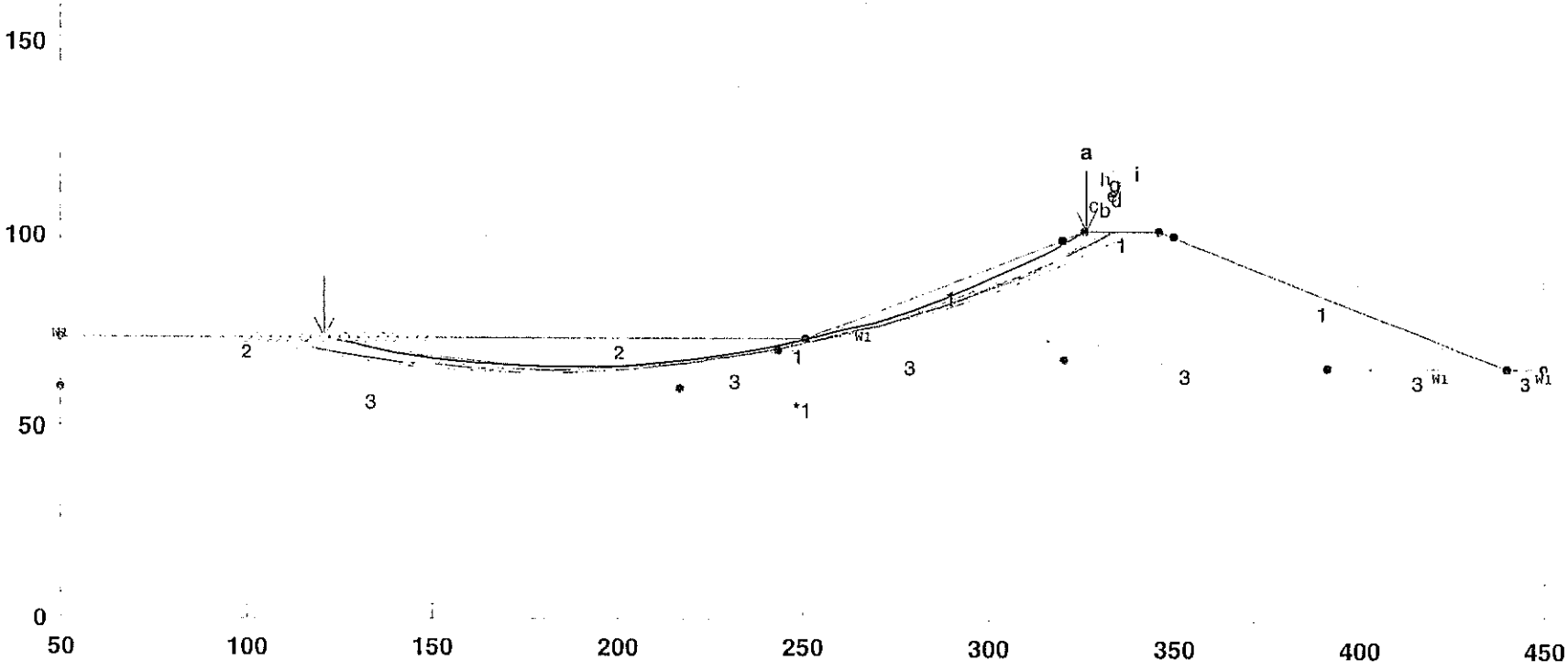
#	FS
a	0.401
b	0.414
c	0.417
d	0.424
e	0.425
f	0.441
g	0.445
h	0.453
i	0.454

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	30.0	W1
ORIG	3	125.0	135.0	3000.0	0.0	W1

Load: Peak(A) kh Coef.

Value: 0.540(g) 0.540(g)<

Init Points: 50. to 100.
Term Limits: 270. to 300.



GSTABL7 v.2 FSmin=0.401

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R14103

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
(All Rights Reserved-Unauthorized Use Prohibited)
****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
****

Analysis Run Date: 1/22/2008
Time of Run: 01:24PM
Run By: Rocky Saporito
Input Data Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek South Cell\0.54 PGA Runs\south cell upstream.peak.in
Output Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek South Cell\0.54 PGA Runs\south cell upstream.peak.OUT
Unit System: English
Plotted Output Filename: P:_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek South Cell\0.54 PGA Runs\south cell upstream.peak.PLT
PROBLEM DESCRIPTION: Pond Creek, South Cell, US (PGA = 0.54g)
CEC Project No. 072-046 (80% Peak Str.)
BOUNDARY COORDINATES
Note: User origin value specified.
Add 50.00 to X-values and 0.00 to Y-values listed.

6 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	73.00	100.00	73.00	2
2	100.00	73.00	200.84	73.00	2
3	200.84	73.00	276.24	102.00	1
4	276.24	102.00	296.24	102.00	1
5	296.24	102.00	389.84	66.00	1
6	389.84	66.00	400.00	66.00	3
7	0.00	60.00	167.04	60.00	3
8	167.04	60.00	193.46	70.16	3
9	193.46	70.16	200.84	73.00	1
10	193.46	70.16	270.39	68.00	3
11	270.39	68.00	341.70	66.00	3
12	341.70	66.00	389.84	66.00	3

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	0.0	30.0	0.00	0.0	1
3	125.0	135.0	3000.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 4 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	76.00
2	216.44	76.00
3	371.84	66.00
4	400.00	66.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries

Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	0.00	58.00	400.00	58.00

Specified Peak Ground Acceleration Coefficient (A) = 0.540(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.540(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00(ft)
and X = 100.00(ft)
Each Surface Terminates Between X = 270.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Statistical Data On All Valid FS Values:
FS Max = 2.730 FS Min = 0.401 FS Ave = 1.535
Standard Deviation = 0.636 Coefficient of Variation = 41.41 %
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	71.05	73.00
2	80.83	70.88
3	90.67	69.11
4	100.56	67.68
5	110.51	66.59
6	120.48	65.86
7	130.47	65.47
8	140.47	65.44
9	150.47	65.75
10	160.44	66.41
11	170.39	67.42
12	180.30	68.78
13	190.15	70.49
14	199.94	72.54
15	209.65	74.92
16	219.27	77.65
17	228.79	80.71
18	238.20	84.11
19	247.48	87.83
20	256.63	91.87
21	265.63	96.23
22	274.47	100.90
23	276.39	102.00

Circle Center At X = 136.50 ; Y = 351.34 ; and Radius = 285.93
Factor of Safety
*** 0.401 ***
Individual data on the 27 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Surcharge Force Ver (lbs)	Surcharge Load (lbs)
1	9.8	931.6	1829.5	2532.9	0.	0.	503.1	0.0	0.0
2	9.8	2662.5	1842.3	3747.8	0.	0.	1437.7	0.0	0.0
3	9.3	3837.1	1747.2	4453.3	0.	0.	2072.0	0.0	0.0
4	0.6	268.2	105.6	294.6	0.	0.	144.8	0.0	0.0
5	9.9	5247.9	1861.0	5532.1	0.	0.	2833.8	0.0	0.0
6	10.0	6080.6	1866.9	6099.3	0.	0.	3283.5	0.0	0.0

7	10.0	6596.4	1870.6	6448.9	0.	0.	3562.1	0.0	0.0
8	10.0	6791.0	1872.0	6580.5	0.	0.	3667.2	0.0	0.0
9	10.0	6662.9	1871.1	6493.9	0.	0.	3598.0	0.0	0.0
10	10.0	6213.0	1867.9	6189.2	0.	0.	3355.0	0.0	0.0
11	9.9	5445.1	1862.4	5666.7	0.	0.	2940.3	0.0	0.0
12	9.9	4365.7	1854.6	4927.2	0.	0.	2357.5	0.0	0.0
13	9.9	2983.8	1844.6	3971.5	0.	0.	1611.2	0.0	0.0
14	9.1	1278.6	1705.8	2648.5	0.	0.	690.5	0.0	0.0
15	0.7	34.6	126.5	152.3	0.	0.	18.7	0.0	0.0
16	0.9	36.8	168.2	193.7	0.	0.	19.8	0.0	0.0
17	8.8	1053.6	769.1	1222.8	0.	0.	569.0	0.0	0.0
18	3.8	837.6	0.0	132.3	0.	0.	452.3	0.0	0.0
19	5.8	1623.5	0.0	0.0	0.	0.	876.7	0.0	0.0
20	9.5	3388.3	0.0	0.0	0.	0.	1829.7	0.0	0.0
21	9.4	3852.5	0.0	0.0	0.	0.	2080.3	0.0	0.0
22	9.3	3847.2	0.0	0.0	0.	0.	2077.5	0.0	0.0
23	9.1	3390.5	0.0	0.0	0.	0.	1830.9	0.0	0.0
24	9.0	2504.2	0.0	0.0	0.	0.	1352.3	0.0	0.0
25	8.8	1213.9	0.0	0.0	0.	0.	655.5	0.0	0.0
26	1.8	58.3	0.0	0.0	0.	0.	31.5	0.0	0.0
27	0.1	0.8	0.0	0.0	0.	0.	0.4	0.0	0.0

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.26	73.00
2	65.03	70.84
3	74.85	68.98
4	84.73	67.42
5	94.65	66.17
6	104.61	65.23
7	114.59	64.60
8	124.58	64.27
9	134.58	64.26
10	144.58	64.55
11	154.56	65.15
12	164.52	66.06
13	174.44	67.28
14	184.33	68.81
15	194.16	70.64
16	203.93	72.77
17	213.63	75.20
18	223.25	77.93
19	232.78	80.96
20	242.21	84.28
21	251.54	87.89
22	260.75	91.78
23	269.83	95.96
24	278.78	100.42
25	281.72	102.00

Circle Center At X = 130.09 ; Y = 387.75 ; and Radius = 323.52

Factor of Safety

*** 0.414 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.32	73.00
2	86.09	70.88
3	95.93	69.12
4	105.83	67.70
5	115.78	66.65
6	125.75	65.94
7	135.74	65.60
8	145.74	65.61
9	155.74	65.98
10	165.71	66.71
11	175.65	67.79
12	185.55	69.23

13	195.39	71.03
14	205.15	73.17
15	214.84	75.66
16	224.43	78.49
17	233.91	81.67
18	243.27	85.18
19	252.51	89.03
20	261.59	93.20
21	270.53	97.70
22	278.37	102.00

Circle Center At X = 140.38 ; Y = 345.04 ; and Radius = 279.48

Factor of Safety

*** 0.417 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	73.00
2	59.77	70.87
3	69.60	69.02
4	79.48	67.46
5	89.39	66.19
6	99.35	65.21
7	109.32	64.52
8	119.31	64.13
9	129.31	64.02
10	139.31	64.21
11	149.30	64.70
12	159.27	65.47
13	169.21	66.54
14	179.12	67.89
15	188.99	69.54
16	198.80	71.47
17	208.55	73.69
18	218.23	76.19
19	227.83	78.98
20	237.35	82.04
21	246.78	85.38
22	256.10	89.00
23	265.31	92.89
24	274.41	97.04
25	283.38	101.46
26	284.40	102.00

Circle Center At X = 127.83 ; Y = 405.74 ; and Radius = 341.72

Factor of Safety

*** 0.424 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.26	73.00
2	65.02	70.83
3	74.85	68.95
4	84.72	67.38
5	94.64	66.11
6	104.60	65.15
7	114.57	64.50
8	124.57	64.15
9	134.57	64.10
10	144.56	64.37
11	154.55	64.94
12	164.51	65.82
13	174.44	67.00
14	184.33	68.49
15	194.17	70.28
16	203.94	72.37
17	213.65	74.76
18	223.29	77.45
19	232.83	80.44

20	242.28	83.71
21	251.62	87.27
22	260.85	91.12
23	269.96	95.25
24	278.94	99.66
25	283.36	102.00

Circle Center At X = 130.94 ; Y = 389.72 ; and Radius = 325.64

Factor of Safety

*** 0.425 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.53	73.00
2	70.32	70.96
3	80.16	69.21
4	90.06	67.76
5	99.99	66.61
6	109.95	65.75
7	119.94	65.20
8	129.93	64.95
9	139.93	65.01
10	149.93	65.36
11	159.91	66.01
12	169.86	66.97
13	179.78	68.22
14	189.66	69.78
15	199.49	71.63
16	209.25	73.77
17	218.95	76.21
18	228.57	78.94
19	238.11	81.96
20	247.54	85.27
21	256.88	88.86
22	266.10	92.72
23	275.20	96.87
24	284.17	101.28
25	285.52	102.00

Circle Center At X = 133.21 ; Y = 396.63 ; and Radius = 331.69

Factor of Safety

*** 0.441 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.68	73.00
2	83.47	70.95
3	93.32	69.22
4	103.22	67.82
5	113.17	66.76
6	123.14	66.02
7	133.13	65.61
8	143.13	65.54
9	153.13	65.80
10	163.11	66.39
11	173.07	67.31
12	182.99	68.56
13	192.86	70.14
14	202.68	72.05
15	212.43	74.28
16	222.09	76.84
17	231.67	79.71
18	241.15	82.91
19	250.52	86.41
20	259.76	90.22
21	268.87	94.34
22	277.84	98.76
23	283.90	102.00

Circle Center At X = 140.34 ; Y = 366.57 ; and Radius = 301.05

Factor of Safety
*** 0.445 ***
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.68	73.00
2	83.45	70.87
3	93.29	69.08
4	103.19	67.62
5	113.12	66.51
6	123.09	65.74
7	133.09	65.32
8	143.09	65.24
9	153.08	65.50
10	163.06	66.11
11	173.02	67.06
12	182.93	68.36
13	192.80	69.99
14	202.60	71.96
15	212.33	74.28
16	221.98	76.92
17	231.52	79.89
18	240.96	83.20
19	250.28	86.82
20	259.47	90.77
21	268.52	95.02
22	277.42	99.59
23	281.73	102.00

Circle Center At X = 140.42 ; Y = 355.48 ; and Radius = 290.25

Factor of Safety
*** 0.453 ***
Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	52.63	73.00
2	62.43	71.01
3	72.28	69.29
4	82.18	67.84
5	92.11	66.66
6	102.07	65.76
7	112.05	65.14
8	122.04	64.79
9	132.04	64.71
10	142.04	64.91
11	152.03	65.39
12	162.00	66.15
13	171.95	67.17
14	181.86	68.48
15	191.74	70.05
16	201.56	71.90
17	211.34	74.02
18	221.05	76.40
19	230.69	79.06
20	240.25	81.98
21	249.73	85.16
22	259.12	88.60
23	268.41	92.30
24	277.60	96.26
25	286.67	100.46
26	289.75	102.00

Circle Center At X = 129.70 ; Y = 426.73 ; and Radius = 362.03

Factor of Safety
*** 0.454 ***
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	78.95	73.00

2	88.78	71.19
3	98.67	69.70
4	108.60	68.52
5	118.56	67.67
6	128.55	67.14
7	138.55	66.93
8	148.55	67.04
9	158.54	67.48
10	168.51	68.23
11	178.45	69.31
12	188.35	70.71
13	198.20	72.43
14	208.00	74.46
15	217.72	76.81
16	227.36	79.47
17	236.90	82.44
18	246.35	85.71
19	255.69	89.29
20	264.91	93.17
21	274.00	97.34
22	282.95	101.80
23	283.31	102.00

Circle Center At X = 140.04 ; Y = 377.13 ; and Radius = 310.21

Factor of Safety

*** 0.454 ***

**** END OF GSTABL7 OUTPUT ****

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation

PROJECT NO. 072046

Estimation of the Seismic Pseudo-Static Factors of Safety and Yield Accelerations for the South Cell Downstream and Upstream Slope Geometries

PAGE 35 OF 65

MADE BY BEG DATE 1/22/08 CHECKED BY [signature] DATE 1/23/08

POND CREEK – SOUTH CELL IMPOUNDMENT
GSTABL YIELD ACCELERATION
STABILITY ANALYSIS OUTPUT FILES
DOWNSTREAM (MAXIMUM FINES CONDITION)

Pond Creek, South Cell, Downstream CEC Project No. 072-046 (Total Strength)

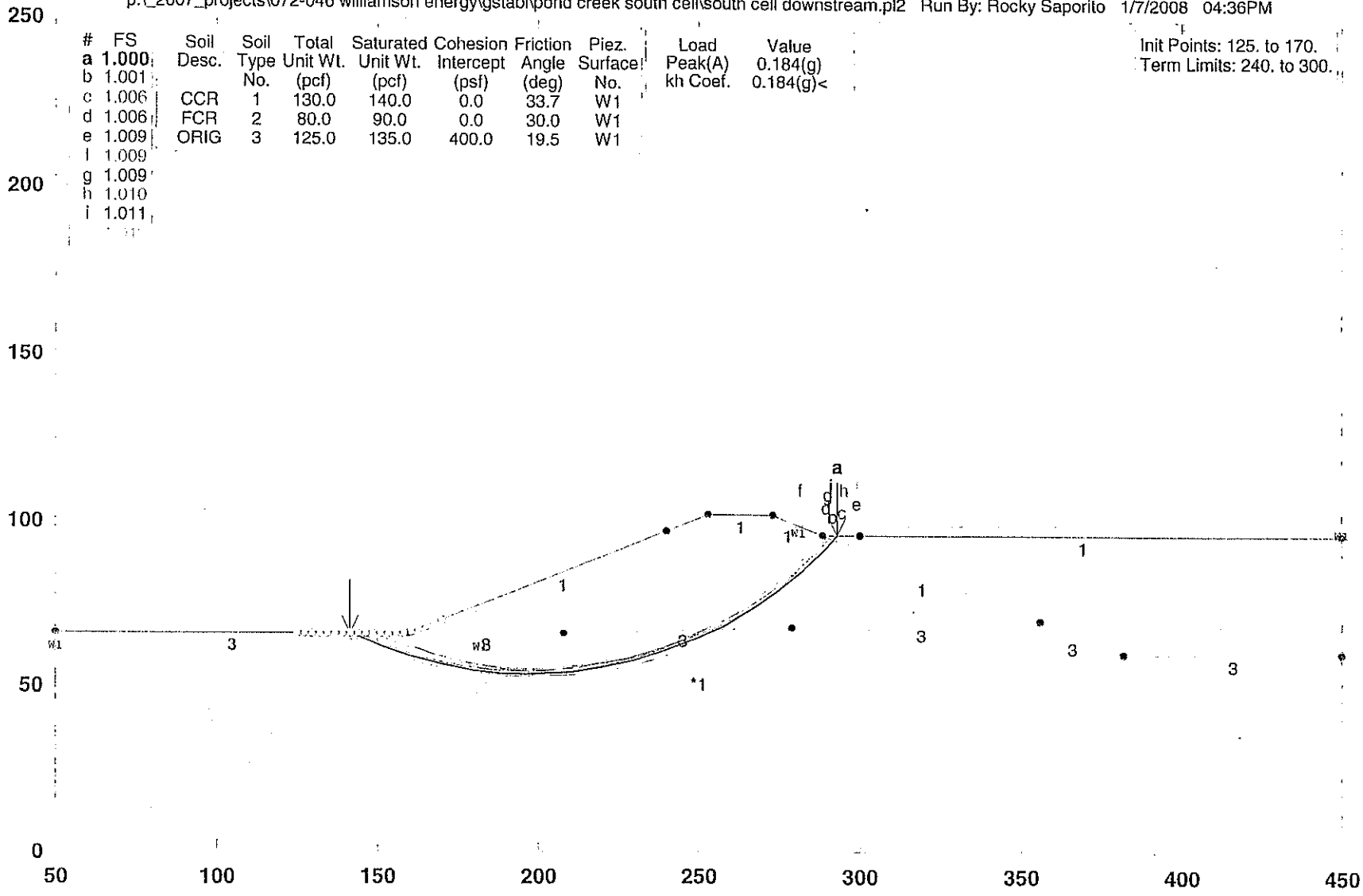
p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\south cell downstream.pl2 Run By: Rocky Saporito 1/7/2008 04:36PM

#	FS	Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
a	1.000							
b	1.001							
c	1.006	CCR	1	130.0	140.0	0.0	33.7	W1
d	1.006	FCR	2	80.0	90.0	0.0	30.0	W1
e	1.009	ORIG	3	125.0	135.0	400.0	19.5	W1
f	1.009							
g	1.009							
h	1.010							
i	1.011							

Load: Peak(A) kh Coef.

Value: 0.184(g) 0.184(g)<

Init Points: 125. to 170.
Term Limits: 240. to 300.



GSTABL7 v.2 FSmin=1.000
Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

36 of 65

R14112

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
(All Rights Reserved-Unauthorized Use Prohibited)
****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
****

Analysis Run Date: 1/7/2008
Time of Run: 04:36PM
Run By: Rocky Saporito
Input Data Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek South Cell\south cell downstream.in
Output Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek South Cell\south cell downstream.OUT
Unit System: English
Plotted Output Filename: P:_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek South Cell\south cell downstream.PLT
PROBLEM DESCRIPTION: Pond Creek, South Cell, Downstream
CEC Project No. 072-046 (Total Strength)
BOUNDARY COORDINATES
Note: User origin value specified.
Add 50.00 to X-values and 0.00 to Y-values listed.

5 Top Boundaries
11 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	50.00	66.00	159.40	66.00	3
2	159.40	66.00	253.00	102.00	1
3	253.00	102.00	273.00	102.00	1
4	273.00	102.00	288.60	96.00	1
5	288.60	96.00	450.00	96.00	1
6	159.40	66.00	208.00	66.00	3
7	208.00	66.00	279.00	68.00	3
8	288.60	96.00	356.20	70.00	1
9	279.00	68.00	356.20	70.00	3
10	356.20	70.00	382.20	60.00	3
11	382.20	60.00	450.00	60.00	3

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	0.0	30.0	0.00	0.0	1
3	125.0	135.0	400.0	19.5	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 4 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	50.00	64.00
2	182.00	64.00
3	280.80	99.00
4	450.00	99.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	50.00	50.00	450.00	58.00

Specified Peak Ground Acceleration Coefficient (A) = 0.184(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.184(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 125.00(ft)
and X = 170.00(ft)
Each Surface Terminates Between X = 240.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Statistical Data On All Valid FS Values:
FS Max = 1.559 FS Min = 1.000 FS Ave = 1.175
Standard Deviation = 0.114 Coefficient of Variation = 9.73 %
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.58	66.00
2	150.76	62.05
3	160.23	58.81
4	169.91	56.32
5	179.76	54.59
6	189.71	53.61
7	199.71	53.42
8	209.69	53.99
9	219.60	55.33
10	229.38	57.43
11	238.96	60.29
12	248.30	63.87
13	257.33	68.16
14	266.00	73.14
15	274.27	78.78
16	282.07	85.03
17	289.37	91.87
18	293.14	96.00

Circle Center At X = 197.26 ; Y = 182.55 ; and Radius = 129.17
Factor of Safety
*** 1.000 ***
Individual data on the 28 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Surcharge Ver (lbs)	Surcharge Load (lbs)
1	4.6	580.9	0.0	0.0	0.	0.	106.6	0.0	0.0
2	4.5	1733.1	0.0	301.1	0.	0.	318.0	0.0	0.0
3	8.6	6155.6	0.0	1952.1	0.	0.	1129.5	0.0	0.0
4	0.8	787.5	0.0	275.3	0.	0.	144.5	0.0	0.0
5	9.7	13575.4	0.0	4013.3	0.	0.	2491.1	0.0	0.0
6	9.8	21424.4	0.0	5332.6	0.	0.	3931.4	0.0	0.0
7	2.2	5845.3	0.0	1337.4	0.	0.	1072.6	0.0	0.0
8	5.6	16161.7	0.0	3645.8	0.	0.	2965.7	0.0	0.0
9	2.1	6447.4	0.0	1548.1	0.	0.	1183.1	0.0	0.0
10	10.0	34670.5	0.0	8831.2	0.	0.	6362.0	0.0	0.0
11	8.3	32633.6	0.0	8849.3	0.	0.	5988.3	0.0	0.0
12	1.7	7056.7	0.0	1957.2	0.	0.	1294.9	0.0	0.0

13	9.9	43368.7	0.0	12318.3	0.	0.	7958.2	0.0	0.0
14	9.8	45640.6	0.0	13357.6	0.	0.	8375.1	0.0	0.0
15	9.6	46489.6	0.0	13918.2	0.	0.	8530.8	0.0	0.0
16	9.3	45942.3	0.0	13996.7	0.	0.	8430.4	0.0	0.0
17	4.7	23043.0	0.0	7153.6	0.	0.	4228.4	0.0	0.0
18	2.6	12476.9	0.0	3882.4	0.	0.	2289.5	0.0	0.0
19	1.7	8081.1	0.0	2556.8	0.	0.	1482.9	0.0	0.0
20	8.7	37107.4	0.0	12708.6	0.	0.	6809.2	0.0	0.0
21	7.0	25360.9	0.0	9713.3	0.	0.	4653.7	0.0	0.0
22	1.3	4071.6	0.0	1636.4	0.	0.	747.1	0.0	0.0
23	6.5	17034.6	0.0	8114.9	0.	0.	3125.8	0.0	0.0
24	1.3	2529.2	20.7	1469.5	0.	0.	464.1	0.0	0.0
25	6.5	8379.3	761.5	6092.8	0.	0.	1537.6	0.0	0.0
26	0.8	481.1	143.3	490.3	0.	0.	88.3	0.0	0.0
27	2.6	984.8	485.7	1370.5	0.	0.	180.7	0.0	0.0
28	1.2	106.8	221.1	398.3	0.	0.	19.6	0.0	0.0

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.84	66.00
2	146.04	62.07
3	155.50	58.85
4	165.19	56.34
5	175.03	54.56
6	184.97	53.53
7	194.97	53.24
8	204.96	53.70
9	214.88	54.91
10	224.69	56.86
11	234.33	59.53
12	243.74	62.92
13	252.86	67.01
14	261.66	71.76
15	270.08	77.16
16	278.07	83.18
17	285.58	89.78
18	291.68	96.00

Circle Center At X = 193.80 ; Y = 186.64 ; and Radius = 133.41

Factor of Safety

*** 1.001 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.11	66.00
2	141.36	62.21
3	150.85	59.07
4	160.54	56.59
5	170.38	54.78
6	180.31	53.65
7	190.30	53.21
8	200.30	53.46
9	210.26	54.39
10	220.12	56.01
11	229.86	58.30
12	239.41	61.26
13	248.74	64.87
14	257.80	69.11
15	266.54	73.96
16	274.93	79.40
17	282.92	85.41
18	290.48	91.95
19	294.56	96.00

Circle Center At X = 191.71 ; Y = 198.47 ; and Radius = 145.26

Factor of Safety

*** 1.006 ***

Failure Surface Specified By 17 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	143.95	66.00
2	153.18	62.15
3	162.68	59.05
4	172.41	56.72
5	182.29	55.18
6	192.26	54.44
7	202.26	54.49
8	212.22	55.36
9	222.08	57.01
10	231.78	59.46
11	241.25	62.67
12	250.43	66.63
13	259.27	71.32
14	267.70	76.70
15	275.67	82.74
16	283.13	89.40
17	289.42	96.00

Circle Center At X = 196.52 ; Y = 178.92 ; and Radius = 124.56

Factor of Safety

*** 1.006 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.05	66.00
2	160.25	62.06
3	169.72	58.87
4	179.42	56.45
5	189.29	54.80
6	199.25	53.94
7	209.25	53.88
8	219.22	54.61
9	229.11	56.14
10	238.84	58.44
11	248.35	61.52
12	257.59	65.34
13	266.50	69.88
14	275.02	75.12
15	283.09	81.02
16	290.67	87.54
17	297.71	94.65
18	298.85	96.00

Circle Center At X = 205.01 ; Y = 179.24 ; and Radius = 125.44

Factor of Safety

*** 1.009 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	139.21	66.00
2	148.30	61.83
3	157.72	58.48
4	167.40	55.97
5	177.27	54.33
6	187.24	53.56
7	197.24	53.67
8	207.19	54.67
9	217.01	56.53
10	226.63	59.26
11	235.98	62.82
12	244.97	67.19
13	253.54	72.34
14	261.63	78.22
15	269.17	84.80
16	276.09	92.01
17	281.50	98.73

Circle Center At X = 190.96 ; Y = 166.86 ; and Radius = 113.36

Factor of Safety

*** 1.009 ***
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	153.42	66.00
2	162.43	61.67
3	171.81	58.19
4	181.47	55.60
5	191.33	53.92
6	201.30	53.17
7	211.30	53.35
8	221.23	54.45
9	231.03	56.48
10	240.59	59.41
11	249.83	63.22
12	258.69	67.88
13	267.07	73.33
14	274.90	79.55
15	282.12	86.46
16	288.67	94.02
17	290.09	96.00

Circle Center At X = 204.39 ; Y = 160.43 ; and Radius = 107.30

Factor of Safety
*** 1.009 ***
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	143.95	66.00
2	153.25	62.33
3	162.80	59.37
4	172.54	57.11
5	182.43	55.59
6	192.40	54.81
7	202.40	54.76
8	212.37	55.46
9	222.27	56.90
10	232.03	59.06
11	241.61	61.95
12	250.94	65.53
13	259.98	69.80
14	268.69	74.73
15	277.00	80.29
16	284.87	86.45
17	292.27	93.18
18	294.95	96.00

Circle Center At X = 197.95 ; Y = 189.19 ; and Radius = 134.51

Factor of Safety
*** 1.010 ***
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.68	66.00
2	157.95	62.25
3	167.50	59.26
4	177.25	57.05
5	187.15	55.65
6	197.13	55.05
7	207.13	55.26
8	217.08	56.28
9	226.91	58.10
10	236.56	60.72
11	245.97	64.11
12	255.07	68.25
13	263.81	73.12
14	272.12	78.68
15	279.96	84.89
16	287.26	91.72

```
   17        291.16       96.00
Circle Center At X =   199.53 ; Y =   178.26 ; and Radius =   123.23
      Factor of Safety
     ***    1.011   ***
Failure Surface Specified By 19 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        139.21       66.00
    2        148.57       62.48
    3        158.14       59.59
    4        167.89       57.36
    5        177.77       55.78
    6        187.73       54.87
    7        197.72       54.63
    8        207.71       55.06
    9        217.65       56.17
   10        227.49       57.93
   11        237.20       60.36
   12        246.71       63.43
   13        256.00       67.13
   14        265.02       71.45
   15        273.73       76.36
   16        282.09       81.85
   17        290.07       87.88
   18        297.62       94.44
   19        299.19       96.00
Circle Center At X =   196.28 ; Y =   203.49 ; and Radius =   148.86
      Factor of Safety
     ***    1.012   ***
         **** END OF GSTABL7 OUTPUT ****
```

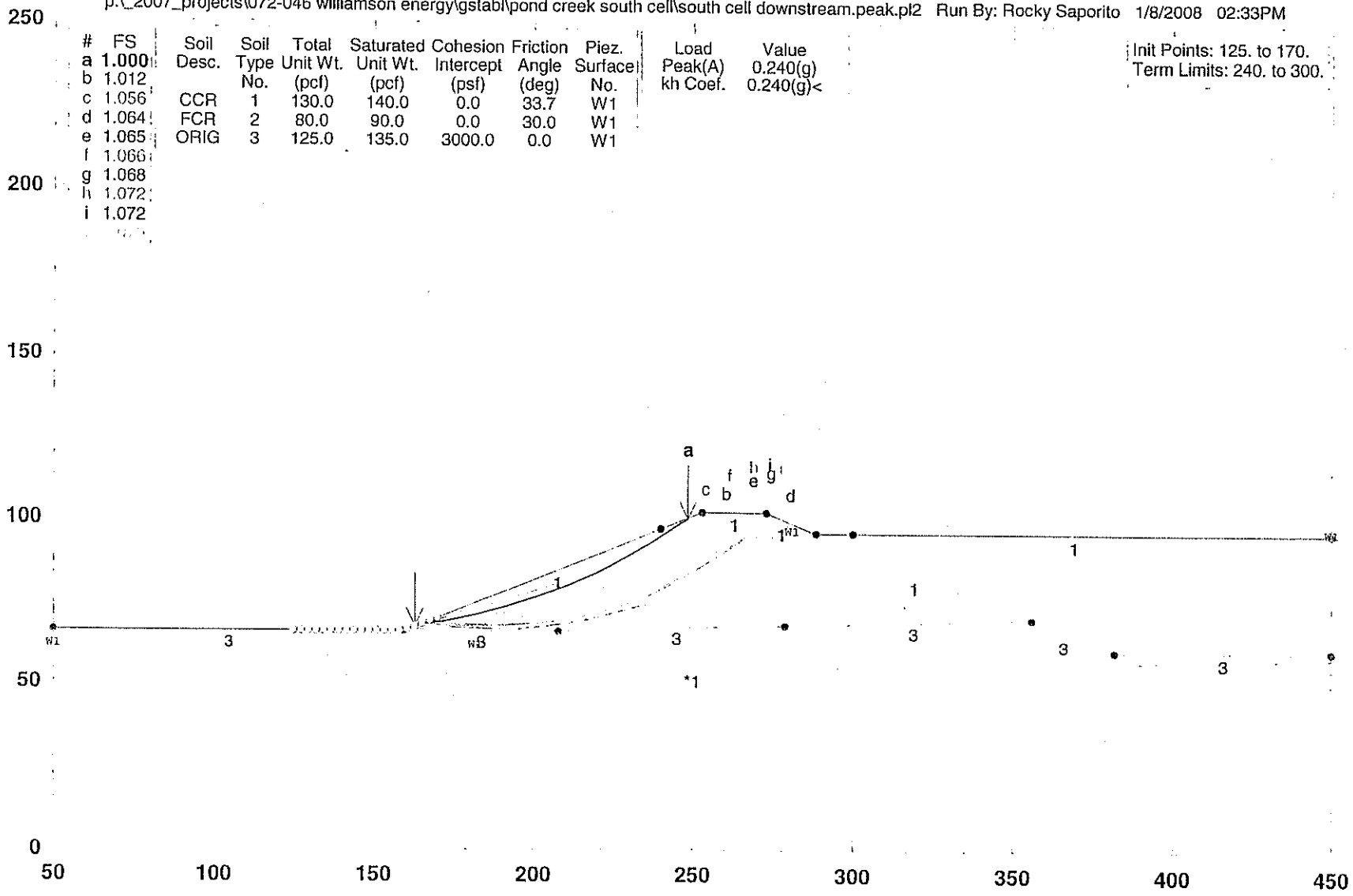
Pond Creek, South Cell, Downstream CEC Project No. 072-046 (80% Peak Str.)

p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\south cell downstream.peak.pl2 Run By: Rocky Saporito 1/8/2008 02:33PM

#	FS	Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
a	1.000							
b	1.012							
c	1.056	CCR	1	130.0	140.0	0.0	33.7	W1
d	1.064	FCR	2	80.0	90.0	0.0	30.0	W1
e	1.065	ORIG	3	125.0	135.0	3000.0	0.0	W1
f	1.066							
g	1.068							
h	1.072							
i	1.072							

Load Peak(A) kh Coef. Value 0.240(g) 0.240(g)<

Init Points: 125. to 170.
Term Limits: 240. to 300.



GSTABL7 v.2 FSmin=1.000

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R14119

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                    ***  GSTABL7  ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
              (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                  SLOPE STABILITY ANALYSIS SYSTEM
       Modified Bishop, Simplified Janbu, or GLE Method of Slices.
       (Includes Spencer & Morgenstern-Price Type Analysis)
       Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
   Analysis Run Date:        1/8/2008
   Time of Run:              02:33PM
   Run By:                   Rocky Saporito
   Input Data Filename:      P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\south cell downstream.peak.in
   Output Filename:          P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\south cell downstream.peak.OUT
   Unit System:              English
   Plotted Output Filename:  P:\_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek South
Cell\south cell downstream.peak.PLT
   PROBLEM DESCRIPTION:  Pond Creek, South Cell, Downstream
                         CEC Project No. 072-046 (80% Peak Str.)
   BOUNDARY COORDINATES
       5 Top   Boundaries
      11 Total Boundaries
   Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
      No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
       1         50.00      66.00     159.40      66.00        3
       2        159.40      66.00     253.00     102.00        1
       3        253.00     102.00     273.00     102.00        1
       4        273.00     102.00     288.60      96.00        1
       5        288.60      96.00     450.00      96.00        1
       6        159.40      66.00     208.00      66.00        3
       7        208.00      66.00     279.00      68.00        3
       8        288.60      96.00     356.20      70.00        1
       9        279.00      68.00     356.20      70.00        3
      10        356.20      70.00     382.20      60.00        3
      11        382.20      60.00     450.00      60.00        3
   Default Y-Origin = 0.00(ft)
   Default X-Plus Value = 0.00(ft)
   Default Y-Plus Value = 0.00(ft)
  ISOTROPIC SOIL PARAMETERS
    3 Type(s) of Soil
   Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
   Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
    No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
     1   130.0    140.0       0.0     33.7    0.00       0.0      1
     2    80.0     90.0       0.0     30.0    0.00       0.0      1
     3   125.0    135.0    3000.0      0.0    0.00       0.0      1
   1 PIEZOMETRIC SURFACE(S) SPECIFIED
   Unit Weight of Water =  62.40 (pcf)
   Piezometric Surface No.  1 Specified by  4 Coordinate Points
   Pore Pressure Inclination Factor =  0.50
     Point      X-Water     Y-Water
      No.         (ft)        (ft)
       1         50.00       64.00
       2        182.00       64.00
       3        280.80       99.00
       4        450.00       99.00
  Searching Routine Will Be Limited To An Area Defined By  1 Boundaries
   Of Which The First  1 Boundaries Will Deflect Surfaces Upward
   Boundary     X-Left     Y-Left    X-Right    Y-Right
      No.        (ft)       (ft)       (ft)       (ft)
       1         50.00      50.00     450.00      58.00
```

Specified Peak Ground Acceleration Coefficient (A) = 0.240(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.240(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 125.00(ft)
and X = 170.00(ft)
Each Surface Terminates Between X = 240.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Statistical Data On All Valid FS Values:
FS Max = 3.868 FS Min = 1.000 FS Ave = 2.379
Standard Deviation = 0.521 Coefficient of Variation = 21.88 %
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	162.89	67.34
2	172.77	68.90
3	182.56	70.97
4	192.22	73.52
5	201.75	76.57
6	211.11	80.10
7	220.27	84.10
8	229.22	88.56
9	237.93	93.47
10	246.38	98.82
11	248.35	100.21

Circle Center At X = 137.21 ; Y = 261.94 ; and Radius = 196.28
Factor of Safety
*** 1.000 ***
Individual data on the 10 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Surcharge Force Ver (lbs)	Surcharge Load (lbs)
1	9.9	1437.0	0.0	0.0	0.	0.	344.6	0.0	0.0
2	9.8	3929.4	0.0	0.0	0.	0.	942.3	0.0	0.0
3	9.7	5680.8	0.0	0.0	0.	0.	1362.2	0.0	0.0
4	9.5	6697.2	0.0	0.0	0.	0.	1606.0	0.0	0.0
5	9.4	6997.8	0.0	0.0	0.	0.	1678.1	0.0	0.0
6	9.2	6614.0	0.0	0.0	0.	0.	1586.0	0.0	0.0
7	8.9	5589.4	0.0	0.0	0.	0.	1340.3	0.0	0.0
8	8.7	3979.3	0.0	0.0	0.	0.	954.2	0.0	0.0
9	8.4	1849.8	0.0	0.0	0.	0.	443.6	0.0	0.0
10	2.0	81.2	0.0	0.0	0.	0.	19.5	0.0	0.0

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	170.00	70.08
2	179.69	72.54
3	189.33	75.20
4	198.91	78.06
5	208.43	81.12
6	217.89	84.38
7	227.27	87.84
8	236.58	91.49
9	245.81	95.33

10	254.96	99.36
11	260.62	102.00

Circle Center At X = 56.68 ; Y = 536.71 ; and Radius = 480.20

Factor of Safety

*** 1.012 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.53	66.43
2	170.53	66.51
3	180.49	67.35
4	190.36	68.95
5	200.08	71.29
6	209.60	74.37
7	218.85	78.17
8	227.78	82.66
9	236.35	87.82
10	244.50	93.61
11	252.19	100.01
12	254.23	102.00

Circle Center At X = 164.58 ; Y = 196.97 ; and Radius = 130.60

Factor of Safety

*** 1.056 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	165.26	68.26
2	175.19	67.08
3	185.18	66.57
4	195.18	66.74
5	205.14	67.59
6	215.03	69.11
7	224.79	71.29
8	234.38	74.13
9	243.75	77.61
10	252.87	81.71
11	261.69	86.42
12	270.17	91.72
13	278.28	97.57
14	280.25	99.21

Circle Center At X = 187.67 ; Y = 214.08 ; and Radius = 147.53

Factor of Safety

*** 1.064 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	162.89	67.34
2	172.55	69.94
3	182.18	72.63
4	191.78	75.43
5	201.36	78.32
6	210.90	81.32
7	220.40	84.42
8	229.88	87.62
9	239.32	90.92
10	248.72	94.32
11	258.09	97.81
12	267.42	101.41
13	268.91	102.00

Circle Center At X = -77.81 ; Y = 983.35 ; and Radius = 947.10

Factor of Safety

*** 1.065 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	170.00	70.08
2	179.99	70.40

3	189.94	71.41
4	199.80	73.09
5	209.52	75.45
6	219.06	78.46
7	228.36	82.12
8	237.40	86.40
9	246.12	91.30
10	254.49	96.77
11	261.39	102.00

Circle Center At X = 170.24 ; Y = 216.35 ; and Radius = 146.28

Factor of Safety

*** 1.066 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	165.26	68.26
2	175.23	67.43
3	185.23	67.31
4	195.21	67.88
5	205.13	69.15
6	214.94	71.10
7	224.59	73.73
8	234.03	77.03
9	243.22	80.97
10	252.11	85.55
11	260.66	90.73
12	268.83	96.50
13	274.75	101.33

Circle Center At X = 182.02 ; Y = 210.81 ; and Radius = 143.54

Factor of Safety

*** 1.068 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	167.63	69.17
2	177.47	67.37
3	187.43	66.53
4	197.43	66.66
5	207.37	67.75
6	217.16	69.81
7	226.70	72.80
8	235.91	76.71
9	244.69	81.48
10	252.97	87.09
11	260.67	93.47
12	267.72	100.57
13	268.89	102.00

Circle Center At X = 191.10 ; Y = 169.57 ; and Radius = 103.11

Factor of Safety

*** 1.072 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	167.63	69.17
2	177.56	67.95
3	187.55	67.52
4	197.54	67.89
5	207.47	69.05
6	217.28	70.99
7	226.91	73.70
8	236.29	77.17
9	245.36	81.37
10	254.08	86.27
11	262.38	91.85
12	270.21	98.07
13	274.00	101.61

Circle Center At X = 187.93 ; Y = 193.60 ; and Radius = 126.08

```
      Factor of Safety
     ***    1.072   ***
Failure Surface Specified By 13 Coordinate Points
  Point       X-Surf      Y-Surf
   No.         (ft)        (ft)
    1         165.26       68.26
    2         175.25       67.77
    3         185.25       67.87
    4         195.23       68.58
    5         205.14       69.88
    6         214.96       71.77
    7         224.65       74.24
    8         234.18       77.28
    9         243.50       80.89
   10         252.60       85.04
   11         261.43       89.74
   12         269.96       94.95
   13         277.57      100.24
Circle Center At X =   178.44 ; Y =   235.26 ; and Radius =   167.52
      Factor of Safety
     ***    1.079   ***
         **** END OF GSTABL7 OUTPUT ****
```

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation

PROJECT NO. 072046

Estimation of the Seismic Pseudo-Static Factors of Safety and Yield Accelerations for the South Cell Downstream and Upstream Slope Geometries

PAGE 49 OF 65

MADE BY BEG DATE 1/22/08 CHECKED BY [signature] DATE 1/23/08

POND CREEK – SOUTH CELL IMPOUNDMENT
GSTABL YIELD ACCELERATION
STABILITY ANALYSIS OUTPUT FILES
UPSTREAM (MINIMUM FINES CONDITION)

Pond Creek, South Cell, Upstream CEC Project No. 072-046 (Total Strength)

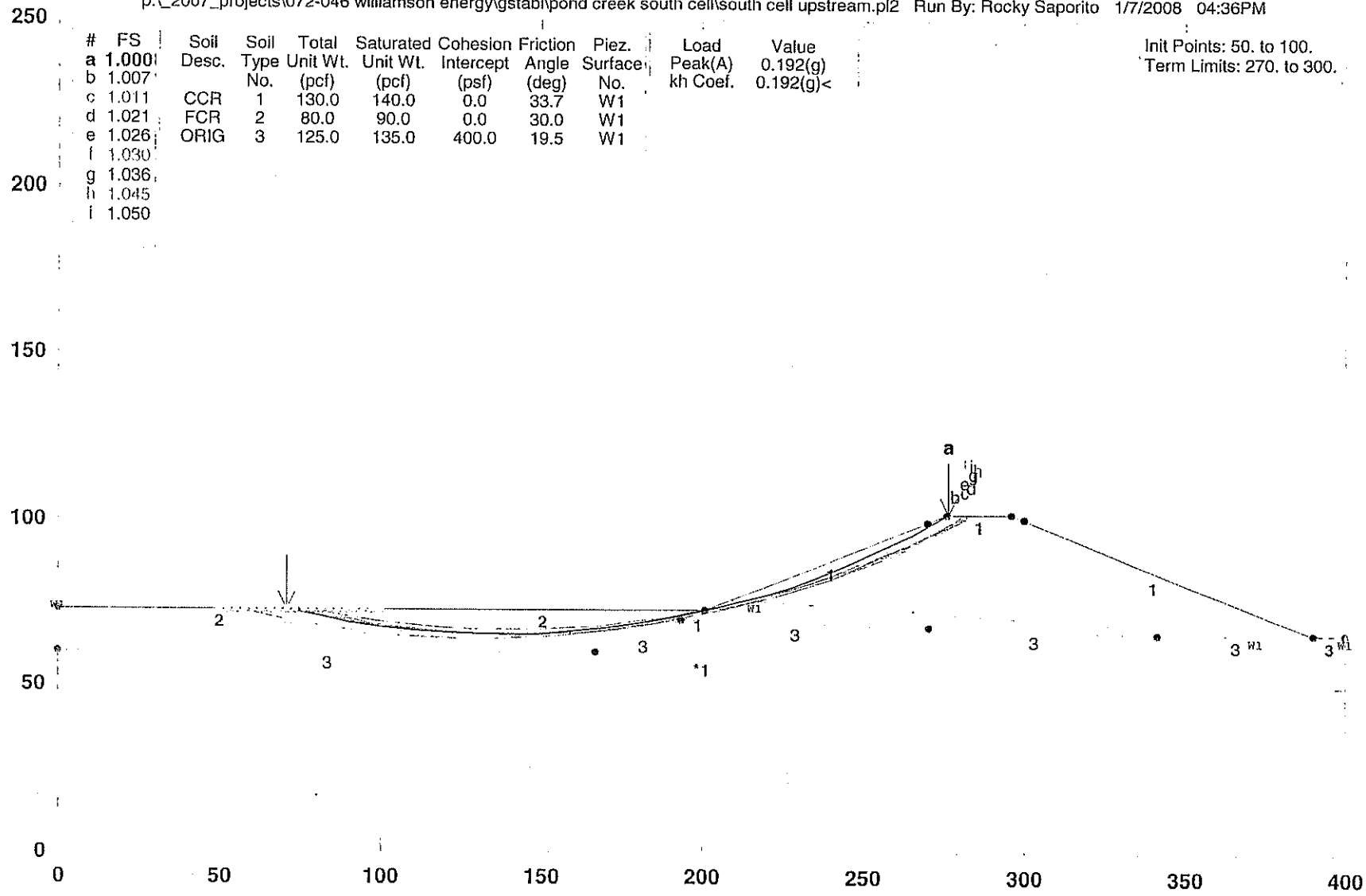
p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\south cell upstream.pl2 Run By: Rocky Saporito 1/7/2008 04:36PM

#	FS	Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
a	1.000							
b	1.007							
c	1.011	CCR	1	130.0	140.0	0.0	33.7	W1
d	1.021	FCR	2	80.0	90.0	0.0	30.0	W1
e	1.026	ORIG	3	125.0	135.0	400.0	19.5	W1
f	1.030							
g	1.036							
h	1.045							
i	1.050							

Load Peak(A) kh Coef.

Value 0.192(g) 0.192(g)<

Init Points: 50. to 100.
Term Limits: 270. to 300.



GSTABL7 v.2 FSmin=1.000

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R14126

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
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****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 1/7/2008
Time of Run: 04:36PM
Run By: Rocky Saporito
Input Data Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek South Cell\south cell upstream.in
Output Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek South Cell\south cell upstream.OUT
Unit System: English
Plotted Output Filename: P:_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek South Cell\south cell upstream.PLT
PROBLEM DESCRIPTION: Pond Creek, South Cell, Upstream
CEC Project No. 072-046 (Total Strength)

BOUNDARY COORDINATES
6 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	73.00	100.00	73.00	2
2	100.00	73.00	200.84	73.00	2
3	200.84	73.00	276.24	102.00	1
4	276.24	102.00	296.24	102.00	1
5	296.24	102.00	389.84	66.00	1
6	389.84	66.00	400.00	66.00	3
7	0.00	60.00	167.04	60.00	3
8	167.04	60.00	193.46	70.16	3
9	193.46	70.16	200.84	73.00	1
10	193.46	70.16	270.39	68.00	3
11	270.39	68.00	341.70	66.00	3
12	341.70	66.00	389.84	66.00	3

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	0.0	30.0	0.00	0.0	1
3	125.0	135.0	400.0	19.5	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 4 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	76.00
2	216.44	76.00
3	371.84	66.00
4	400.00	66.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)

1 0.00 58.00 400.00 58.00

Specified Peak Ground Acceleration Coefficient (A) = 0.192(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.192(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00(ft)
and X = 100.00(ft)
Each Surface Terminates Between X = 270.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Statistical Data On All Valid FS Values:
FS Max = 1.575 FS Min = 1.000 FS Ave = 1.269
Standard Deviation = 0.114 Coefficient of Variation = 8.99 %
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	71.05	73.00
2	80.83	70.88
3	90.67	69.11
4	100.56	67.68
5	110.51	66.59
6	120.48	65.86
7	130.47	65.47
8	140.47	65.44
9	150.47	65.75
10	160.44	66.41
11	170.39	67.42
12	180.30	68.78
13	190.15	70.49
14	199.94	72.54
15	209.65	74.92
16	219.27	77.65
17	228.79	80.71
18	238.20	84.11
19	247.48	87.83
20	256.63	91.87
21	265.63	96.23
22	274.47	100.90
23	276.39	102.00

Circle Center At X = 136.50 ; Y = 351.34 ; and Radius = 285.93
Factor of Safety
*** 1.000 ***
Individual data on the 27 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.8	931.6	1829.5	2532.9	0.	0.	178.5	0.0	0.0
2	9.8	2662.5	1842.3	3747.8	0.	0.	510.1	0.0	0.0
3	9.3	3837.1	1747.2	4453.3	0.	0.	735.2	0.0	0.0
4	0.6	268.2	105.6	294.6	0.	0.	51.4	0.0	0.0
5	9.9	5247.9	1861.0	5532.1	0.	0.	1005.5	0.0	0.0
6	10.0	6080.6	1866.9	6099.3	0.	0.	1165.0	0.0	0.0
7	10.0	6596.4	1870.6	6448.9	0.	0.	1263.9	0.0	0.0
8	10.0	6791.0	1872.0	6580.5	0.	0.	1301.2	0.0	0.0
9	10.0	6662.9	1871.1	6493.9	0.	0.	1276.6	0.0	0.0

10	10.0	6213.0	1867.9	6189.2	0.	0.	1190.4	0.0	0.0
11	9.9	5445.1	1862.4	5666.7	0.	0.	1043.3	0.0	0.0
12	9.9	4365.7	1854.6	4927.2	0.	0.	836.5	0.0	0.0
13	9.9	2983.8	1844.6	3971.5	0.	0.	571.7	0.0	0.0
14	9.1	1278.6	1705.8	2648.5	0.	0.	245.0	0.0	0.0
15	0.7	34.6	126.5	152.3	0.	0.	6.6	0.0	0.0
16	0.9	36.8	168.2	193.7	0.	0.	7.0	0.0	0.0
17	8.8	1053.6	769.1	1222.8	0.	0.	201.9	0.0	0.0
18	3.8	837.6	0.0	132.3	0.	0.	160.5	0.0	0.0
19	5.8	1623.5	0.0	0.0	0.	0.	311.1	0.0	0.0
20	9.5	3388.3	0.0	0.0	0.	0.	649.2	0.0	0.0
21	9.4	3852.5	0.0	0.0	0.	0.	738.1	0.0	0.0
22	9.3	3847.2	0.0	0.0	0.	0.	737.1	0.0	0.0
23	9.1	3390.5	0.0	0.0	0.	0.	649.6	0.0	0.0
24	9.0	2504.2	0.0	0.0	0.	0.	479.8	0.0	0.0
25	8.8	1213.9	0.0	0.0	0.	0.	232.6	0.0	0.0
26	1.8	58.3	0.0	0.0	0.	0.	11.2	0.0	0.0
27	0.1	0.8	0.0	0.0	0.	0.	0.2	0.0	0.0

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.32	73.00
2	86.09	70.88
3	95.93	69.12
4	105.83	67.70
5	115.78	66.65
6	125.75	65.94
7	135.74	65.60
8	145.74	65.61
9	155.74	65.98
10	165.71	66.71
11	175.65	67.79
12	185.55	69.23
13	195.39	71.03
14	205.15	73.17
15	214.84	75.66
16	224.43	78.49
17	233.91	81.67
18	243.27	85.18
19	252.51	89.03
20	261.59	93.20
21	270.53	97.70
22	278.37	102.00

Circle Center At X = 140.38 ; Y = 345.04 ; and Radius = 279.48

Factor of Safety

*** 1.007 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.26	73.00
2	65.03	70.84
3	74.85	68.98
4	84.73	67.42
5	94.65	66.17
6	104.61	65.23
7	114.59	64.60
8	124.58	64.27
9	134.58	64.26
10	144.58	64.55
11	154.56	65.15
12	164.52	66.06
13	174.44	67.28
14	184.33	68.81
15	194.16	70.64
16	203.93	72.77
17	213.63	75.20
18	223.25	77.93

19	232.78	80.96
20	242.21	84.28
21	251.54	87.89
22	260.75	91.78
23	269.83	95.96
24	278.78	100.42
25	281.72	102.00

Circle Center At X = 130.09 ; Y = 387.75 ; and Radius = 323.52

Factor of Safety

*** 1.011 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.26	73.00
2	65.02	70.83
3	74.85	68.95
4	84.72	67.38
5	94.64	66.11
6	104.60	65.15
7	114.57	64.50
8	124.57	64.15
9	134.57	64.10
10	144.56	64.37
11	154.55	64.94
12	164.51	65.82
13	174.44	67.00
14	184.33	68.49
15	194.17	70.28
16	203.94	72.37
17	213.65	74.76
18	223.29	77.45
19	232.83	80.44
20	242.28	83.71
21	251.62	87.27
22	260.85	91.12
23	269.96	95.25
24	278.94	99.66
25	283.36	102.00

Circle Center At X = 130.94 ; Y = 389.72 ; and Radius = 325.64

Factor of Safety

*** 1.021 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.68	73.00
2	83.45	70.87
3	93.29	69.08
4	103.19	67.62
5	113.12	66.51
6	123.09	65.74
7	133.09	65.32
8	143.09	65.24
9	153.08	65.50
10	163.06	66.11
11	173.02	67.06
12	182.93	68.36
13	192.80	69.99
14	202.60	71.96
15	212.33	74.28
16	221.98	76.92
17	231.52	79.89
18	240.96	83.20
19	250.28	86.82
20	259.47	90.77
21	268.52	95.02
22	277.42	99.59
23	281.73	102.00

Circle Center At X = 140.42 ; Y = 355.48 ; and Radius = 290.25

Factor of Safety

*** 1.026 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	73.00
2	59.77	70.87
3	69.60	69.02
4	79.48	67.46
5	89.39	66.19
6	99.35	65.21
7	109.32	64.52
8	119.31	64.13
9	129.31	64.02
10	139.31	64.21
11	149.30	64.70
12	159.27	65.47
13	169.21	66.54
14	179.12	67.89
15	188.99	69.54
16	198.80	71.47
17	208.55	73.69
18	218.23	76.19
19	227.83	78.98
20	237.35	82.04
21	246.78	85.38
22	256.10	89.00
23	265.31	92.89
24	274.41	97.04
25	283.38	101.46
26	284.40	102.00

Circle Center At X = 127.83 ; Y = 405.74 ; and Radius = 341.72

Factor of Safety

*** 1.030 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.68	73.00
2	83.47	70.95
3	93.32	69.22
4	103.22	67.82
5	113.17	66.76
6	123.14	66.02
7	133.13	65.61
8	143.13	65.54
9	153.13	65.80
10	163.11	66.39
11	173.07	67.31
12	182.99	68.56
13	192.86	70.14
14	202.68	72.05
15	212.43	74.28
16	222.09	76.84
17	231.67	79.71
18	241.15	82.91
19	250.52	86.41
20	259.76	90.22
21	268.87	94.34
22	277.84	98.76
23	283.90	102.00

Circle Center At X = 140.34 ; Y = 366.57 ; and Radius = 301.05

Factor of Safety

*** 1.036 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	60.53	73.00
2	70.32	70.96
3	80.16	69.21
4	90.06	67.76
5	99.99	66.61
6	109.95	65.75
7	119.94	65.20
8	129.93	64.95
9	139.93	65.01
10	149.93	65.36
11	159.91	66.01
12	169.86	66.97
13	179.78	68.22
14	189.66	69.78
15	199.49	71.63
16	209.25	73.77
17	218.95	76.21
18	228.57	78.94
19	238.11	81.96
20	247.54	85.27
21	256.88	88.86
22	266.10	92.72
23	275.20	96.87
24	284.17	101.28
25	285.52	102.00

Circle Center At X = 133.21 ; Y = 396.63 ; and Radius = 331.69

Factor of Safety

*** 1.045 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	78.95	73.00
2	88.78	71.19
3	98.67	69.70
4	108.60	68.52
5	118.56	67.67
6	128.55	67.14
7	138.55	66.93
8	148.55	67.04
9	158.54	67.48
10	168.51	68.23
11	178.45	69.31
12	188.35	70.71
13	198.20	72.43
14	208.00	74.46
15	217.72	76.81
16	227.36	79.47
17	236.90	82.44
18	246.35	85.71
19	255.69	89.29
20	264.91	93.17
21	274.00	97.34
22	282.95	101.80
23	283.31	102.00

Circle Center At X = 140.04 ; Y = 377.13 ; and Radius = 310.21

Factor of Safety

*** 1.050 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.53	73.00
2	70.27	70.74
3	80.08	68.79
4	89.94	67.17
5	99.86	65.88
6	109.81	64.91
7	119.79	64.27

8	129.79	63.96
9	139.79	63.97
10	149.78	64.32
11	159.76	64.99
12	169.71	65.99
13	179.62	67.32
14	189.48	68.97
15	199.29	70.95
16	209.02	73.25
17	218.67	75.86
18	228.23	78.79
19	237.69	82.04
20	247.04	85.59
21	256.26	89.45
22	265.36	93.61
23	274.31	98.06
24	281.61	102.00

Circle Center At X = 134.27 ; Y = 368.02 ; and Radius = 304.10

Factor of Safety

*** 1.058 ***

**** END OF GSTABL7 OUTPUT ****

Pond Creek, South Cell, Upstream CEC Project No. 072-046 (80% Peak Str.)

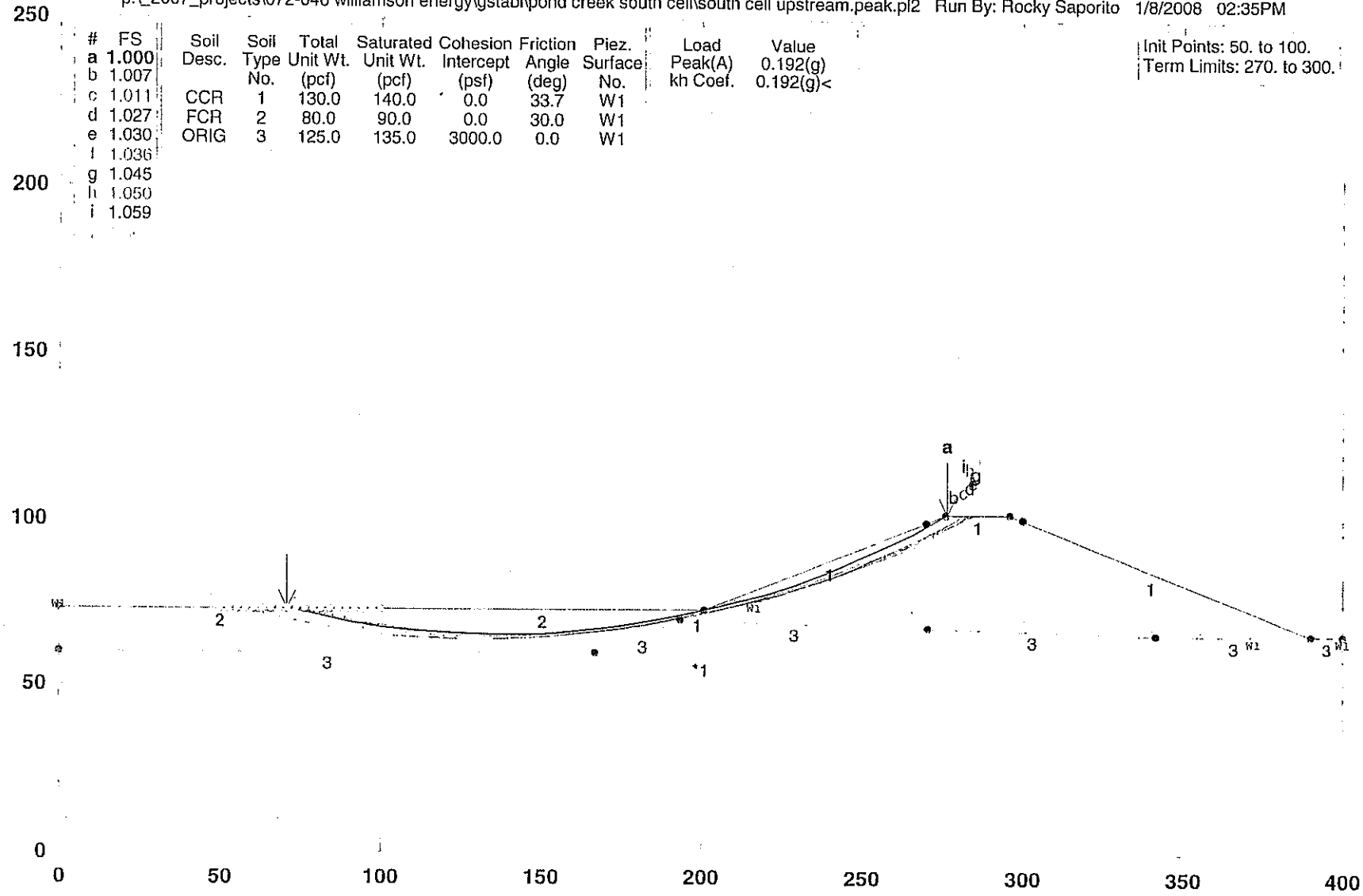
p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\south cell upstream.peak.pl2 Run By: Rocky Saporito 1/8/2008 02:35PM

#	FS
a	1.000
b	1.007
c	1.011
d	1.027
e	1.030
f	1.036
g	1.045
h	1.050
i	1.059

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	30.0	W1
ORIG	3	125.0	135.0	3000.0	0.0	W1

Load	Value
Peak(A)	0.192(g)
kh Coef.	0.192(g)<

Init Points: 50. to 100.
Term Limits: 270. to 300.



GSTABL7 v.2 FSmin=1.000

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R14134

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
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****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 1/8/2008
Time of Run: 02:35PM
Run By: Rocky Saporito
Input Data Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek South Cell\south cell upstream.peak.in
Output Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek South Cell\south cell upstream.peak.OUT
Unit System: English
Plotted Output Filename: P:_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek South Cell\south cell upstream.peak.PLT
PROBLEM DESCRIPTION: Pond Creek, South Cell, Upstream
CEC Project No. 072-046 (80% Peak Str.)

BOUNDARY COORDINATES
6 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	73.00	100.00	73.00	2
2	100.00	73.00	200.84	73.00	2
3	200.84	73.00	276.24	102.00	1
4	276.24	102.00	296.24	102.00	1
5	296.24	102.00	389.84	66.00	1
6	389.84	66.00	400.00	66.00	3
7	0.00	60.00	167.04	60.00	3
8	167.04	60.00	193.46	70.16	3
9	193.46	70.16	200.84	73.00	1
10	193.46	70.16	270.39	68.00	3
11	270.39	68.00	341.70	66.00	3
12	341.70	66.00	389.84	66.00	3

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	0.0	30.0	0.00	0.0	1
3	125.0	135.0	3000.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 4 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	76.00
2	216.44	76.00
3	371.84	66.00
4	400.00	66.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)

1 0.00 58.00 400.00 58.00

Specified Peak Ground Acceleration Coefficient (A) = 0.192(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.192(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00(ft)
and X = 100.00(ft)
Each Surface Terminates Between X = 270.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Statistical Data On All Valid FS Values:
FS Max = 6.036 FS Min = 1.000 FS Ave = 3.117
Standard Deviation = 1.310 Coefficient of Variation = 42.04 %
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	71.05	73.00
2	80.83	70.88
3	90.67	69.11
4	100.56	67.68
5	110.51	66.59
6	120.48	65.86
7	130.47	65.47
8	140.47	65.44
9	150.47	65.75
10	160.44	66.41
11	170.39	67.42
12	180.30	68.78
13	190.15	70.49
14	199.94	72.54
15	209.65	74.92
16	219.27	77.65
17	228.79	80.71
18	238.20	84.11
19	247.48	87.83
20	256.63	91.87
21	265.63	96.23
22	274.47	100.90
23	276.39	102.00

Circle Center At X = 136.50 ; Y = 351.34 ; and Radius = 285.93
Factor of Safety
*** 1.000 ***
Individual data on the 27 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Surcharge Force Ver (lbs)	Surcharge Load (lbs)
1	9.8	931.6	1829.5	2532.9	0.	0.	178.5	0.0	0.0
2	9.8	2662.5	1842.3	3747.8	0.	0.	510.1	0.0	0.0
3	9.3	3837.1	1747.2	4453.3	0.	0.	735.2	0.0	0.0
4	0.6	268.2	105.6	294.6	0.	0.	51.4	0.0	0.0
5	9.9	5247.9	1861.0	5532.1	0.	0.	1005.5	0.0	0.0
6	10.0	6080.6	1866.9	6099.3	0.	0.	1165.0	0.0	0.0
7	10.0	6596.4	1870.6	6448.9	0.	0.	1263.9	0.0	0.0
8	10.0	6791.0	1872.0	6580.5	0.	0.	1301.2	0.0	0.0
9	10.0	6662.9	1871.1	6493.9	0.	0.	1276.6	0.0	0.0

10	10.0	6213.0	1867.9	6189.2	0.	0.	1190.4	0.0	0.0
11	9.9	5445.1	1862.4	5666.7	0.	0.	1043.3	0.0	0.0
12	9.9	4365.7	1854.6	4927.2	0.	0.	836.5	0.0	0.0
13	9.9	2983.8	1844.6	3971.5	0.	0.	571.7	0.0	0.0
14	9.1	1278.6	1705.8	2648.5	0.	0.	245.0	0.0	0.0
15	0.7	34.6	126.5	152.3	0.	0.	6.6	0.0	0.0
16	0.9	36.8	168.2	193.7	0.	0.	7.0	0.0	0.0
17	8.8	1053.6	769.1	1222.8	0.	0.	201.9	0.0	0.0
18	3.8	837.6	0.0	132.3	0.	0.	160.5	0.0	0.0
19	5.8	1623.5	0.0	0.0	0.	0.	311.1	0.0	0.0
20	9.5	3388.3	0.0	0.0	0.	0.	649.2	0.0	0.0
21	9.4	3852.5	0.0	0.0	0.	0.	738.1	0.0	0.0
22	9.3	3847.2	0.0	0.0	0.	0.	737.1	0.0	0.0
23	9.1	3390.5	0.0	0.0	0.	0.	649.6	0.0	0.0
24	9.0	2504.2	0.0	0.0	0.	0.	479.8	0.0	0.0
25	8.8	1213.9	0.0	0.0	0.	0.	232.6	0.0	0.0
26	1.8	58.3	0.0	0.0	0.	0.	11.2	0.0	0.0
27	0.1	0.8	0.0	0.0	0.	0.	0.2	0.0	0.0

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.32	73.00
2	86.09	70.88
3	95.93	69.12
4	105.83	67.70
5	115.78	66.65
6	125.75	65.94
7	135.74	65.60
8	145.74	65.61
9	155.74	65.98
10	165.71	66.71
11	175.65	67.79
12	185.55	69.23
13	195.39	71.03
14	205.15	73.17
15	214.84	75.66
16	224.43	78.49
17	233.91	81.67
18	243.27	85.18
19	252.51	89.03
20	261.59	93.20
21	270.53	97.70
22	278.37	102.00

Circle Center At X = 140.38 ; Y = 345.04 ; and Radius = 279.48

Factor of Safety

*** 1.007 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.26	73.00
2	65.03	70.84
3	74.85	68.98
4	84.73	67.42
5	94.65	66.17
6	104.61	65.23
7	114.59	64.60
8	124.58	64.27
9	134.58	64.26
10	144.58	64.55
11	154.56	65.15
12	164.52	66.06
13	174.44	67.28
14	184.33	68.81
15	194.16	70.64
16	203.93	72.77
17	213.63	75.20
18	223.25	77.93

24	274.41	97.04
25	283.38	101.46
26	284.40	102.00

Circle Center At X = 127.83 ; Y = 405.74 ; and Radius = 341.72

Factor of Safety

*** 1.030 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.68	73.00
2	83.47	70.95
3	93.32	69.22
4	103.22	67.82
5	113.17	66.76
6	123.14	66.02
7	133.13	65.61
8	143.13	65.54
9	153.13	65.80
10	163.11	66.39
11	173.07	67.31
12	182.99	68.56
13	192.86	70.14
14	202.68	72.05
15	212.43	74.28
16	222.09	76.84
17	231.67	79.71
18	241.15	82.91
19	250.52	86.41
20	259.76	90.22
21	268.87	94.34
22	277.84	98.76
23	283.90	102.00

Circle Center At X = 140.34 ; Y = 366.57 ; and Radius = 301.05

Factor of Safety

*** 1.036 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.53	73.00
2	70.32	70.96
3	80.16	69.21
4	90.06	67.76
5	99.99	66.61
6	109.95	65.75
7	119.94	65.20
8	129.93	64.95
9	139.93	65.01
10	149.93	65.36
11	159.91	66.01
12	169.86	66.97
13	179.78	68.22
14	189.66	69.78
15	199.49	71.63
16	209.25	73.77
17	218.95	76.21
18	228.57	78.94
19	238.11	81.96
20	247.54	85.27
21	256.88	88.86
22	266.10	92.72
23	275.20	96.87
24	284.17	101.28
25	285.52	102.00

Circle Center At X = 133.21 ; Y = 396.63 ; and Radius = 331.69

Factor of Safety

*** 1.045 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	78.95	73.00
2	88.78	71.19
3	98.67	69.70
4	108.60	68.52
5	118.56	67.67
6	128.55	67.14
7	138.55	66.93
8	148.55	67.04
9	158.54	67.48
10	168.51	68.23
11	178.45	69.31
12	188.35	70.71
13	198.20	72.43
14	208.00	74.46
15	217.72	76.81
16	227.36	79.47
17	236.90	82.44
18	246.35	85.71
19	255.69	89.29
20	264.91	93.17
21	274.00	97.34
22	282.95	101.80
23	283.31	102.00

Circle Center At X = 140.04 ; Y = 377.13 ; and Radius = 310.21

Factor of Safety

*** 1.050 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.68	73.00
2	83.45	70.87
3	93.29	69.08
4	103.19	67.62
5	113.12	66.51
6	123.09	65.74
7	133.09	65.32
8	143.09	65.24
9	153.08	65.50
10	163.06	66.11
11	173.02	67.06
12	182.93	68.36
13	192.80	69.99
14	202.60	71.96
15	212.33	74.28
16	221.98	76.92
17	231.52	79.89
18	240.96	83.20
19	250.28	86.82
20	259.47	90.77
21	268.52	95.02
22	277.42	99.59
23	281.73	102.00

Circle Center At X = 140.42 ; Y = 355.48 ; and Radius = 290.25

Factor of Safety

*** 1.059 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	84.21	73.00
2	94.05	71.22
3	103.94	69.76
4	113.88	68.62
5	123.85	67.80
6	133.83	67.31
7	143.83	67.15

8	153.83	67.30
9	163.82	67.78
10	173.79	68.59
11	183.72	69.72
12	193.62	71.17
13	203.46	72.94
14	213.24	75.03
15	222.94	77.43
16	232.57	80.15
17	242.10	83.18
18	251.52	86.52
19	260.84	90.16
20	270.03	94.10
21	279.08	98.34
22	286.28	102.00

Circle Center At X = 143.98 ; Y = 375.04 ; and Radius = 307.90

Factor of Safety

*** 1.067 ***

**** END OF GSTABL7 OUTPUT ****

7225-11
part 21

APPENDIX D-2

ESTIMATING THE INDUCED CYCLIC SHEAR STRESSES AND STRAINS, AND TIME-HISTORY OF CYCLIC SHEAR STRESS, SHAKE COLUMNS PCSC300E AND PCSC300M

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation

PROJECT NO. 072046

Induced Cyclic Shear Stresses and Strains, and Time Histories of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M

PAGE 1 OF 187

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CALCULATION BRIEF FOR INDUCED CYCLIC SHEAR STRESSES AND STRAINS, AND TIME-HISTORIES OF CYCLIC SHEAR STRESS SHAKE COLUMNS PCSC300E AND PCSC300M

POND CREEK COAL REFUSE DISPOSAL SITE - SOUTH CELL

OBJECTIVE: Estimate the induced cyclic shear stresses and shear strains for the proposed Pond Creek South Cell crest SHAKE2000 (Ordonez G., 2006) column location (PCSC300). Also, generate time histories of cyclic shear stress for the various layers which will be used as input for estimating permanent deformations.

METHODOLOGY: Induced cyclic shear stresses with depth are estimated using program SHAKE (Schnabel et al., 1972) and SHAKE2000. Input to each SHAKE2000 column includes layer stratigraphy and unit weights, initial shear modulus (G) with depth, which were obtained/correlated from site specific, in-situ field testing (Reference 2), correlated modulus and damping degradation curves (Reference 3) for coarse, refuse and residual soil, and synthetic acceleration-time earthquake records (Reference 5) representing maximum design earthquake (MDE) scenarios.

As shown in Figure 3 of the permanent deformation evaluation report, maximum induced cyclic shear stresses are estimated at a crest column location, designated PCSC300, for the critical South Cell embankment/impoundment cross-section geometry and for two (2) MDE scenarios. The crest column location PCSC300 includes phreatic levels associated with the end of construction (E) condition, i.e., minimum fines elevation (El.) at 474, and the maximum fines (M) condition at El. 496.

Attached to this calculation brief are hard copies of the SHAKE2000 output files and plots of cyclic shear stress time histories (for all layers within the SHAKE column) for each of the (synthetic) MDE earthquakes scenarios including an M6.8 Background (at 13.5 km) and M8.0 New Madrid (at 83 km). Synthetic time histories were scaled to the Pond Creek peak ground accelerations (PGA) of 0.54g (References 5 and 6). The SHAKE2000 time histories of shear stress for each column become the input for (Newmark, 1965) permanent deformation analyses subsequently described in Appendix D, Attachment D-3.

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Induced Cyclic Shear Stresses and Strains, and Time Histories PAGE 2 OF 187

of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M

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REFERENCES: 1. Schnabel, P. B., Lysmer, J. and Seed, H. B. (1972) "SHAKE: A Computer Program for Earthquake Response Analysis of Horizontally Layered Sites," Report No. EERC 72-12, University of California, Berkeley.

2. Ordonez, Gustavo A.(2006) "SHAKE2000: A Computer Program for the 1-D Analysis of Geotechnical Earthquake Engineering Problems," February 2006.

3. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Shear Modulus Calculations for SHAKE Columns PCSC300E and PCSC300M," Pond Creek Coal Refuse Disposal Site – South Cell " BEG, 12/28/07.

4. Ellison, R. D. and Cho, Y. Y. (1976) "Dynamic Design Considerations of Loose Fine Coal Refuse," E. D'Appolonia Consulting Engineers, Inc., Proceedings of the Ohio River Soils Seminar, Lexington, Kentucky, October, 1976.

5. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Deterministic Seismic Hazard Assessment, Pond Creek Coal Refuse Disposal Site," BEG, 1/2/08.

6. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Comparative Assessment of Synthetic Eastern U.S. and PEER Database (Actual) Western U.S. Earthquake Records, Acceleration Time Histories and Response Spectra," Pond Creek Coal Refuse Disposal Site," BEG, 1/3/08.

7. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimating Shear Modulus and Damping Versus Shear Strain (Modulus and Damping Degradation) for Refuse, Soil and Rock," BEG, 1/2/08.

8. Castro, G. (1987) "On the Behavior of Soils During Earthquakes – Liquefaction,' Soil Dynamics and Liquefaction, A.S. Cakmak, Editor, Elsevier.

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Induced Cyclic Shear Stresses and Strains, and Time Histories of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M PAGE 3 OF 187

MADE BY BEG DATE 1/7/08 CHECKED BY [illegible] DATE 1/23/08

INDUCED CYCLIC SHEAR STRESSES AND STRAINS

SHAKE 2000 INPUT SUMMARY:

Analyses were performed using the computer program SHAKE2000 (Ordonez, 2006), a computer program for the 1-dimensional analysis of geotechnical earthquake engineering problems, which integrates SHAKE (Schnabel et al., 1972) and SHAKE91 (Idriss, I.M. and Sun, J.I., 1992) with ShakEdit (Ordonez, G., 2006) a pre- and post-processor for SHAKE and SHAKE91. SHAKE2000 utilizes a one-dimensional analysis for the vertical propagation of shear waves from the bedrock layer up through the soil profile, which is modeled as a series of horizontal layers, to estimate the maximum cyclic shear stress and strain with depth for the Pond Creek South Cell impoundment at a user-defined (PCSC300) column location along a maximum cross section of the embankment.

Synthetic acceleration-time histories of the MDE scenarios, an M6.8 Background (at 13.5 km) and M8.0 New Madrid, Missouri (at 83 km) generated in Reference 6 were scaled to the Pond Creek MDE PGA of 0.54 g determined in Reference 5. Initial shear modulus (G) values determined as a function of the measured shear wave velocities with depth (Reference 3) were used to simulate the ground shaking and embankment response.

The modulus and damping reduction curves used in the analyses were from published references/relationships presented in Reference 7 for the coarse refuse, residual soil and rock materials. The shear modulus and damping ratios versus cyclic shear strain curves from SHAKE2000 were utilized for the coarse (gravel) and residual soil (clay) materials.

Regarding pore pressures, it should be noted that at strains above approximately 0.01 percent, there are pore pressure increases in the resonant column tests (see Castro, 1987, Figure 3), and the measured values of shear modulus do reflect the pore pressure increase. Since the pore pressure increases are a function of the number of cycles, the modulus reduction curves are also a function of the number of cycles that are applied before the modulus is measured. Although pore pressures are not explicitly modeled in SHAKE, they are implicitly accounted for in the shear modulus degradation relationships used as input.

RESULTS SUMMARY:

Figure 3 presents the relative location of the South Cell crest (PCSC300) SHAKE column. Reference 3 presents the corresponding layer geometry and input information, including material type, unit weight, ground water depth, sub-layer thicknesses, and average initial G-value for each sub-layer. The maximum induced horizontal cyclic shear stresses estimated at the midpoint of each layer are presented with depth for the Pond Creek SHAKE2000 columns PCSC300E and PCSC300M and MDE scenarios,

and are attached to this calculation brief. SHAKE2000 output files for each of these columns and each of the MDEs are also attached. Again note that the E and M designation for the crest Pond Creek SHAKE2000 column location correspond to "End of construction," i.e., minimum fines level, and "Maximum" fines level for the proposed South Cell impoundment.

In general, the maximum induced cyclic shear stresses for all materials estimated at the midpoint of each layer varying from about 204 to 1562 psf for the M6.8 Background MDE, and are similar for the M8.0 New Madrid MDE, varying from about 198 to 2503 psf. The estimated induced cyclic strains are generally low from less than 0.1 to 0.22 percent. The cyclic strain threshold, conservatively assumed to be about 0.25 percent, is the lowest threshold strain anticipated for a "clean sand." (Reference 9). Therefore, the estimated maximum induced strains do not exceed the most conservative threshold strain for both MDE earthquake scenarios.

The mean square frequency of the M6.8 Background earthquake is 20.4 and 14.6 Hz for the M8.0 MDE scenario. The average fundamental frequencies of the SHAKE2000 columns are similar, ranging from about 3.70 to 4.35 Hertz for each columns and MDE scenario. Values for each of the 10 trials are tabulated in the attached SHAKE2000 results summary. Due to the large difference in frequency content between the low frequency SHAKE columns to the high frequency Eastern North American earthquake scenarios, low cyclic shear stresses and strains are induced to the soil columns and corresponding low accelerations within the critical layers. The percentage of acceleration within the critical layer to that of the base acceleration is lower for the M6.8 earthquake due to its higher mean square frequency. In other words, while the input acceleration is high for the "Background" MDE (Amax = 0.54 g), most of its energy is in the high frequency range and only a fraction of the induced base acceleration affects the critical layer.

Maximum cyclic shear stresses induced at any time during the time history by the input acceleration range following iterations to achieve strain compatible properties are shown in the attached plots for each of the soil columns. A comparison of the average cyclic shear stress (taken as 0.65 times the maximum cyclic shear stress) using the initial shear modulus values was evaluated, and there is good agreement in the stress magnitudes between the maximum and average shear stress values for the initial and final iterations, respectively.

SHAKE2000 analyses results also allow for estimating the deformations accumulated in the coarse refuse and residual soil layers. All layers were evaluated to envelope representing downstream, crest and upstream conditions during MDE earthquake loadings. A Newmark-type analysis (Newmark, 1965) will subsequently be performed to estimate permanent deformations of the potential sliding mass in all layers. The basic assumption in this type of analysis is that displacements are initiated only when the earthquake-induced accelerations of the potential sliding mass exceed the yield acceleration of the mass. Consequently, time histories of horizontal shear stresses (Option 7) at all layers are saved for subsequent

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PROJECT NO. 072046

Induced Cyclic Shear Stresses and Strains, and Time Histories of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M

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permanent deformation analyses. Plots of time histories of (horizontal) shear stress for each column and critical layer are attached for information.

CONCLUSION

Based on the information presented in this calculation brief, maximum induced cyclic shear stresses and strains for SHAKE2000 columns PCSC300E and PCSC300M, with depth were estimated from 1-D wave propagation analyses, which utilized shear modulus and damping degradation curves for coarse coal refuse, residual soils and rock, and acceleration-time histories for the two (2) synthetic MDE scenarios including the M6.8 Background and M8.0 New Madrid earthquakes. Copies of the SHAKE2000 output and plots of shear stress time histories are presented herein.

Based on the results of these analyses, a separate analysis will be performed using the time histories of shear stresses at the various layers to estimate the earthquake-induced deformation of the South Cell embankment (Appendix D, Attachments D-1 and D-3).

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PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation

PROJECT NO. 072046

Induced Cyclic Shear Stresses and Strains, and Time Histories of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M

PAGE 6 OF 187

MADE BY BEG DATE 1/7/08 CHECKED BY TJS DATE 1/28/08

CALCULATION BRIEF
FOR

ESTIMATING SHEAR MODULUS AND DAMPING VERSUS SHEAR STRAIN (MODULUS AND DAMPING DEGREDATION) FOR REFUSE, SOIL AND ROCK

POND CREEK COAL REFUSE DISPOSAL SITE - SOUTH CELL (IN ITS ENTIRETY)

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PROJECT NO. 072046

Estimating Shear Modulus and Damping Versus Shear Strain (Modulus and Damping Degradation)

PAGE 7 OF 187

MADE BY BEG DATE 1/2/08 CHECKED BY [illegible] DATE 1/23/08

CALCULATION BRIEF FOR

ESTIMATING SHEAR MODULUS AND DAMPING VERSUS SHEAR STRAIN (MODULUS AND DAMPING DEGREDATION) FOR REFUSE, SOIL AND ROCK

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE:

Present shear modulus (G) and damping (D) versus shear strain (γ) degradation relationships normalized to small strain shear modulus (Gmax) at $\gamma = 0.001$ percent and damping for use in SHAKE2000 for the following materials:

- Fine coal refuse, as defined by Ellison and Cho (1976);
- Coarse coal refuse and coarse/fine coal refuse mix: Gravel (Mean), as defined by Rollins et al. JGGE, Vol. 124, No. 5, May 1998;
- Embankment soil with assumed PI=15% and Effective Confining Pressure = 4 atm., as defined by Darendeli, M. (2001); and
- Rock, as defined by Schnabel, 1973.

Coarse coal refuse, coarse/fine refuse mix, embankment soils and rock degradation relationships from cited references and contained as input within SHAKE2000.

REFERENCES:

1. Ellison, R. D. and Cho, Y. Y. (1976) "Dynamic Design Considerations of Loose Fine Coal Refuse," E. D'Appolonia Consulting Engineers, Inc., Proceedings of the Ohio River Soils Seminar, Lexington, Kentucky, October, 1976.

2. Rollins, K.M.; Evens, M.D.; Diehl, N.B. and Daily, W.D. III. (1998) "Shear Modulus and Damping Relationships for Gravels," Journal of Geotechnical and Geoenvironmental Engineering, Vol. 124, No. 5, pp. 396 – 405, May 1998.

3. Darendeli, M. (2001) "Development of a New Family of Normalized Modulus Reduction and Material Damping Curves," Ph.D. Dissertation, The University of Texas at Austin, August 2001.

4. Schnabel, P.B. (1973) "Effects of Local Geology and Distance From Source on Earthquake Ground Motions," Ph.D. Thesis, University of California, Berkeley, California.

5. Schnabel, P. B., Lysmer, J. and Seed, H. B. (1972) "SHAKE: A Computer Program for Earthquake Response Analysis of Horizontally Layered Sites," Report No. EERC 72-12, University of California, Berkeley.

6. Ordonez, Gustavo A.(2006) "SHAKE2000: A Computer Program for the 1-D Analysis of Geotechnical Earthquake Engineering Problems," February 2006.

SHAKE2000 allows for the use of existing shear modulus and damping degradation relationships for various materials from corresponding published references. Also, SHAKE2000 allows for the input of material specific shear modulus and damping degradation relationships. Therefore, as previously noted, coarse coal refuse, coarse/fine coal refuse mix, embankment soils and rock material types encountered at the site utilize existing published degradation relationships contained within SHAKE2000.

Shear modulus and damping degradation relationships for fine coal refuse were input into SHAKE2000 based on resonant column laboratory testing defined by Ellison & Cho (1976) and shown on the following pages. Finally, all shear modulus and damping degradation curves were plotted in SHAKE2000 and attached to this calculation brief.

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PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Induced Cyclic Shear Stresses and Strains, and Time Histories PAGE 9 OF 187

of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M

MADE BY BEG DATE 1/7/08 CHECKED BY [illegible] DATE 1/23/08

MDE SYNTHETIC TIME HISTORIES FROM REFERENCE 6

M6.8 BACKGROUND (AT 13.5 KM) AND M8.0 NEW MADRID, MISSOURI (AT 83 KM)

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Induced Cyclic Shear Stresses and Strains, and Time Histories of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M

MADE BY BEG DATE 1/7/08 CHECKED BY [illegible] DATE 1/23/08

SUMMARY OF EARTHQUAKE INDUCED CYCLIC SHEAR STRESS AND STRAIN SHAKE2000 ANALYSES OUTPUT FILES FOR M6.8 BACKGROUND MDE AT 13.5 KM SHAKE2000 COLUMN PCSC300E

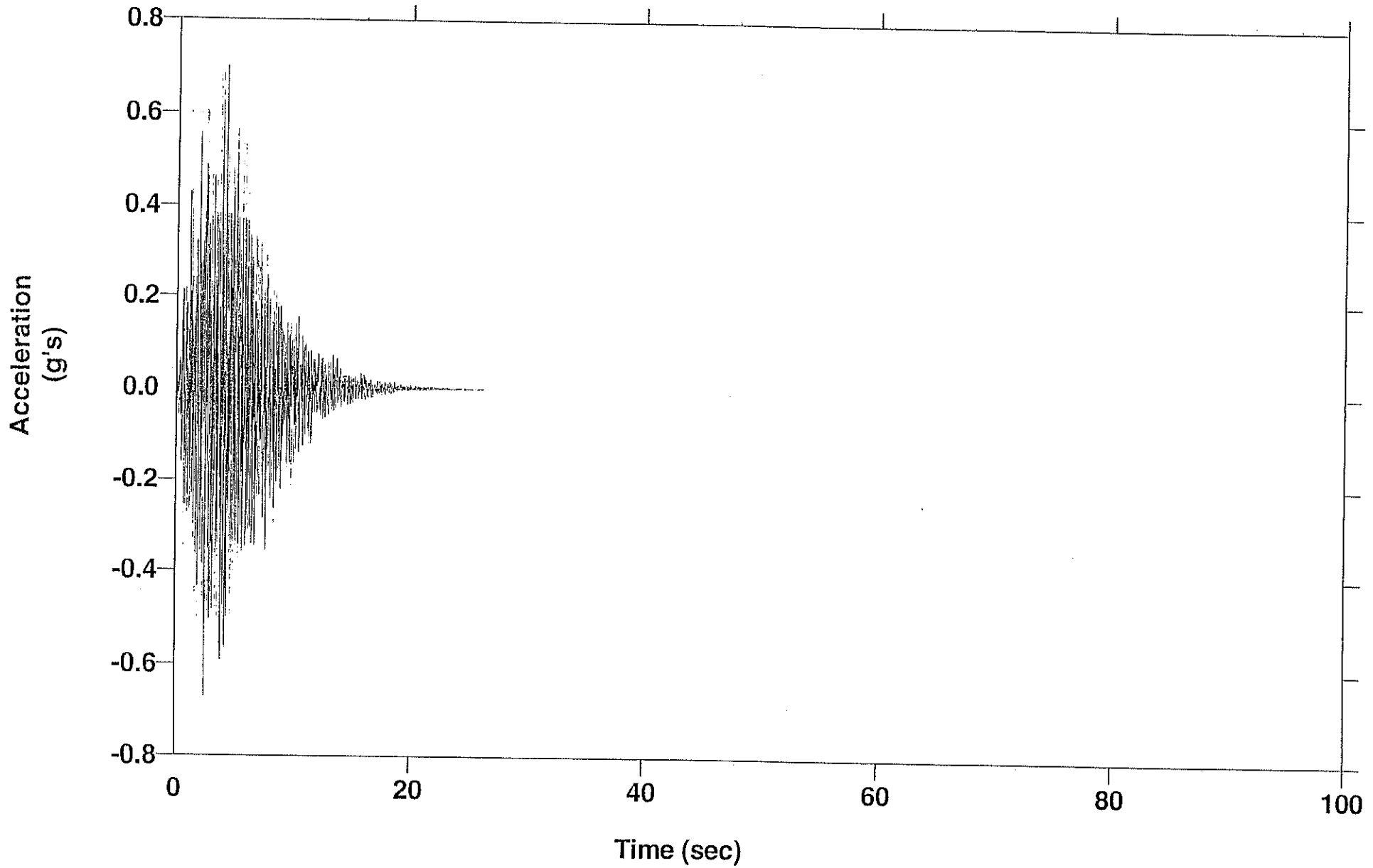
PSCS300E Crest Column
Williamson - Pond Creek South Cell - Surf. El. 502, GWT 32 ft., Fines El. 474
M6.8 Background Synthetic @13.5km, PGA=0.54g, Atkinson & Boore (1995)

Layer	Depth to Middle of Layer (ft)	Total Unit Weight (kcf)	Damping Used (%)	Shear Modulus (ksf)	Maximum Shear Strain (%)	Maximum Shear Stress (psf)	Shear Wave Velocity (fps)	Depth to Top of Layer (ft)	Peak Acceleration (g)	G/Gmax Curve	Damping Curve
1	2	.13	2.7	2996.3	.0068	203.83	861.4874	0	.78263	Coarse	Coarse
2	5.5	.13	4.2	2804.3	.01795	503.32	833.4288	4	.62639	Coarse	Coarse
3	8.5	.13	4.8	2812.7	.02277	640.4	834.6761	7	.49396	Coarse	Coarse
4	11.5	.13	4.3	4166.6	.01607	752.8	1015.891	10	.51802	Coarse	Coarse
5	14.5	.13	5.3	3185	.02941	936.76	888.2004	13	.56972	Coarse	Coarse
6	17.5	.13	6.4	2588.7	.04238	1097.16	800.7504	16	.59373	Coarse	Coarse
7	20.5	.13	6.4	2834	.04242	1202.23	837.8306	19	.52701	Coarse	Coarse
8	23.5	.13	7.2	2302.3	.05493	1264.58	755.157	22	.56754	Coarse	Coarse
9	26.5	.13	6.6	2719.3	.04621	1256.7	820.7007	25	.50592	Coarse	Coarse
10	30	.13	6.4	2870.6	.04262	1223.56	843.2233	28	.54159	Coarse	Coarse
11	33.5	.135	5.5	1945.3	.05937	1154.87	681.1682	32	.72089	Residual	Residual
12	36.5	.135	5.6	1928.5	.06194	1194.58	678.2205	35	.6694	Residual	Residual
13	39.5	.135	5.4	2210.5	.05733	1267.25	726.1165	38	.81377	Residual	Residual
14	42.5	.135	4.7	2928	.04645	1360.19	835.6926	41	.68058	Residual	Residual
15	45.5	.135	3.3	5695.1	.0273	1554.78	1165.499	44	.53553	Residual	Residual
16	48.5	.135	3.4	5544.8	.02986	1655.45	1150.016	47	.48479	Residual	Residual
17	Base							50	.48665		
17	Outcrop							50	.55791		

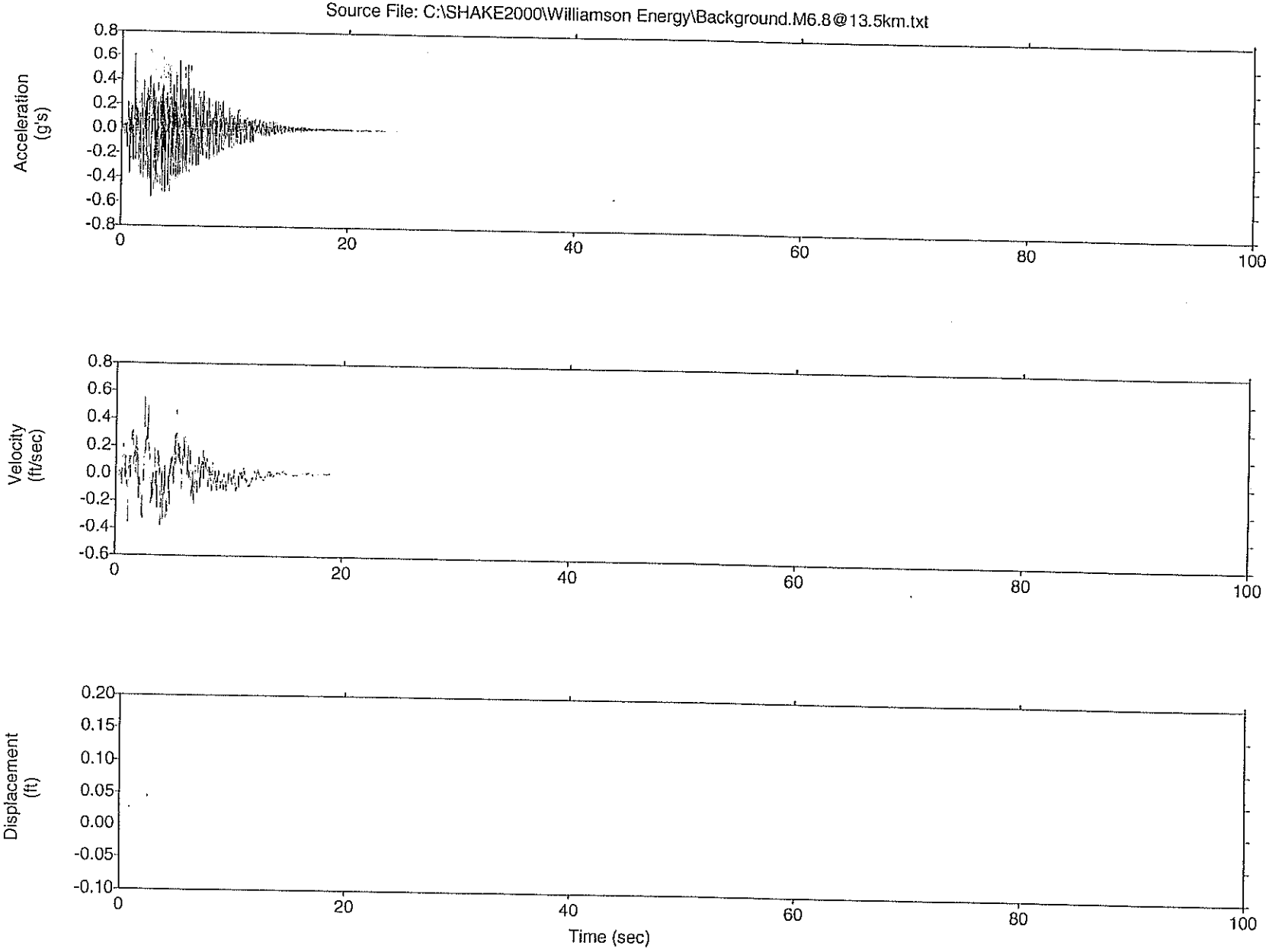
Notes:
Period for Soil Column: .23 sec
Average Shear Wave Velocity for Soil Column: 858 ft/sec

R14152

M6.8 Background Synthetic @13.5 km

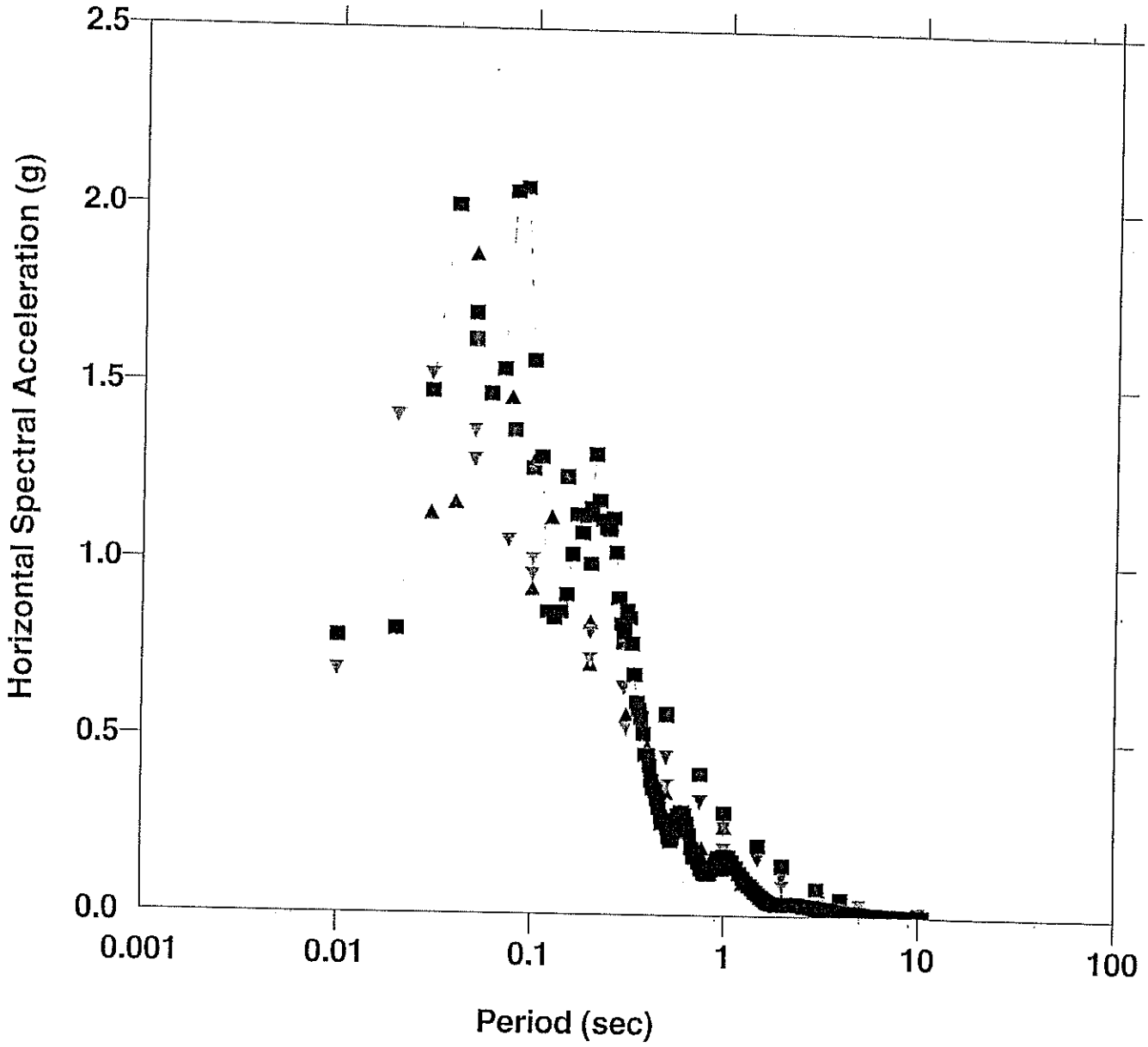


R14153


Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt
Acceleration (g's)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0
20
40
60
80
100
Velocity (ft/sec)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
0
20
40
60
80
100
Displacement (ft)
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
0
20
40
60
80
100
Time (sec)

R14154

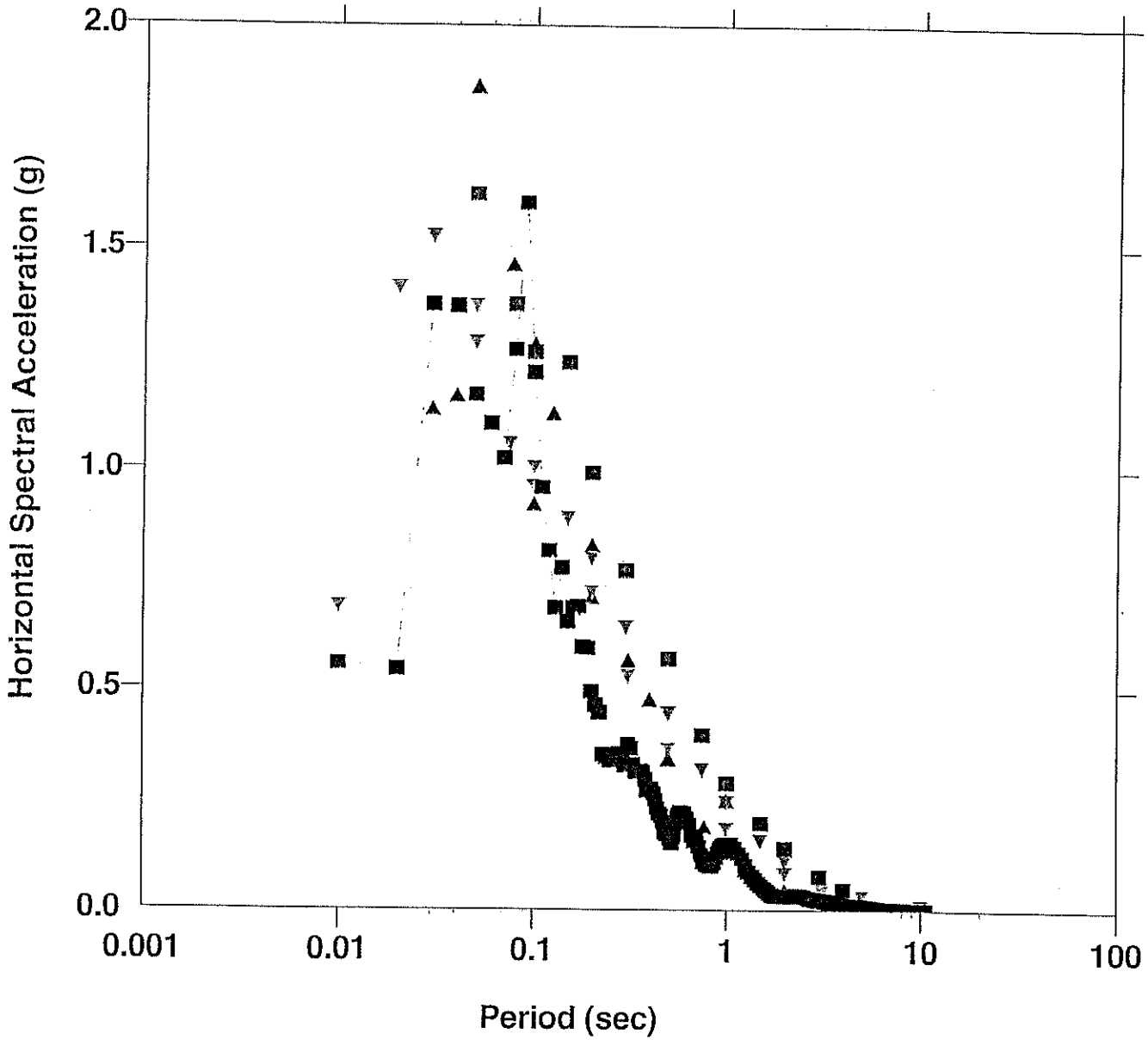
PSCS300E Crest Column - M6.8 Background Synthetic @13.5km



- ▲ Toro et. al. (1997) for Mid-Continent of NA - Rock - Mw: 6.8 - R: 13.5 km
- ▲ Atkinson & Boore (1997) for ENA - Rock - M: 6.8 - R: 13.5 km
- ▼ Campbell for CEUS (2003) - M: 6.8 - R: 13.5 km
- ▼ Atkinson for ENA (2001) - AS00 Rock - M: 6.8 - R: 13.5 km
- ■ Tavakoli & Pezeshk (2005) - ENA - Rock - M: 6.8 - R: 13.5 km
- ■ PSA for 5% damping - Layer 1 - SHAKE

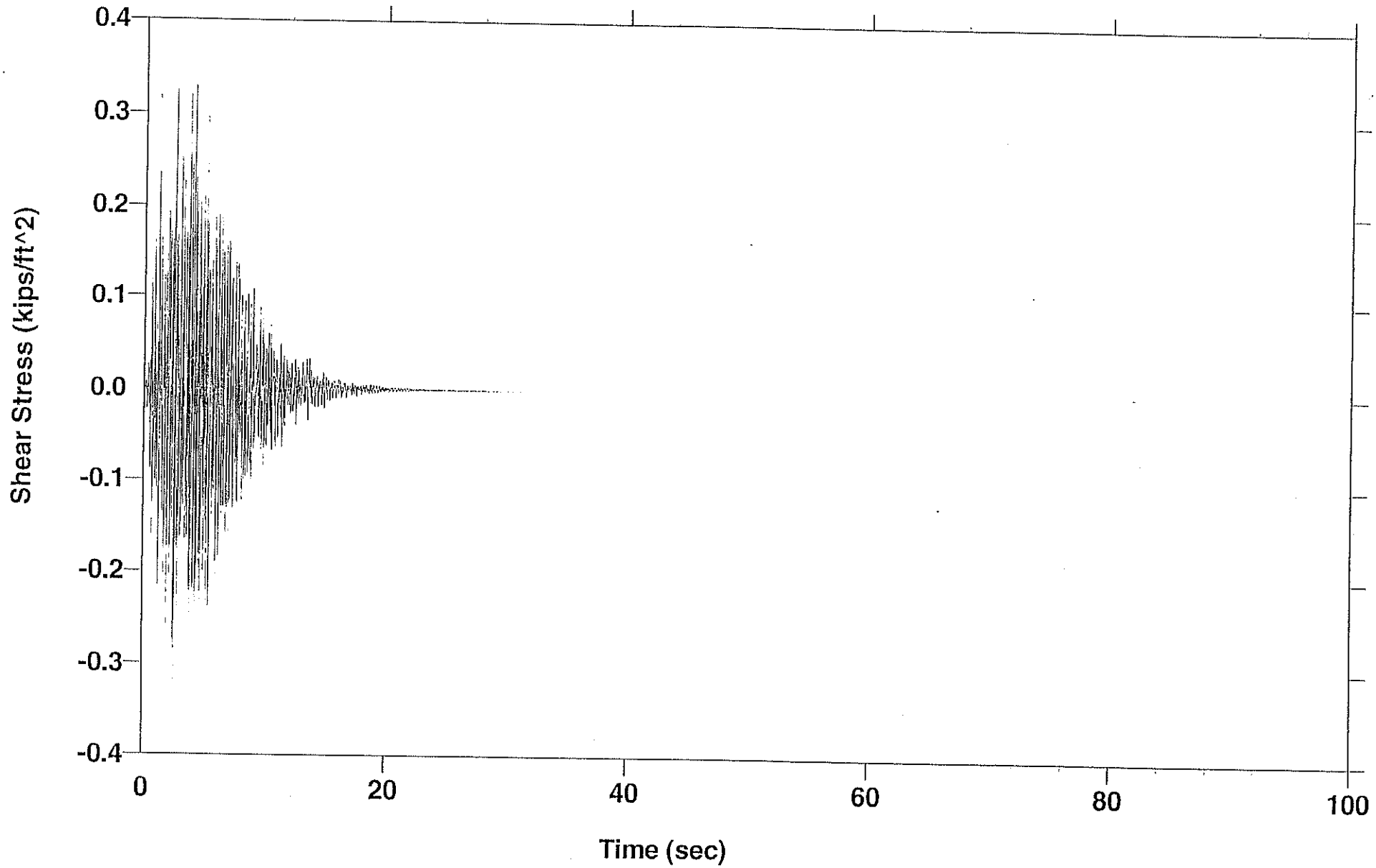
R14155

PSCS300E Crest Column - M6.8 Background Synthetic @13.5km

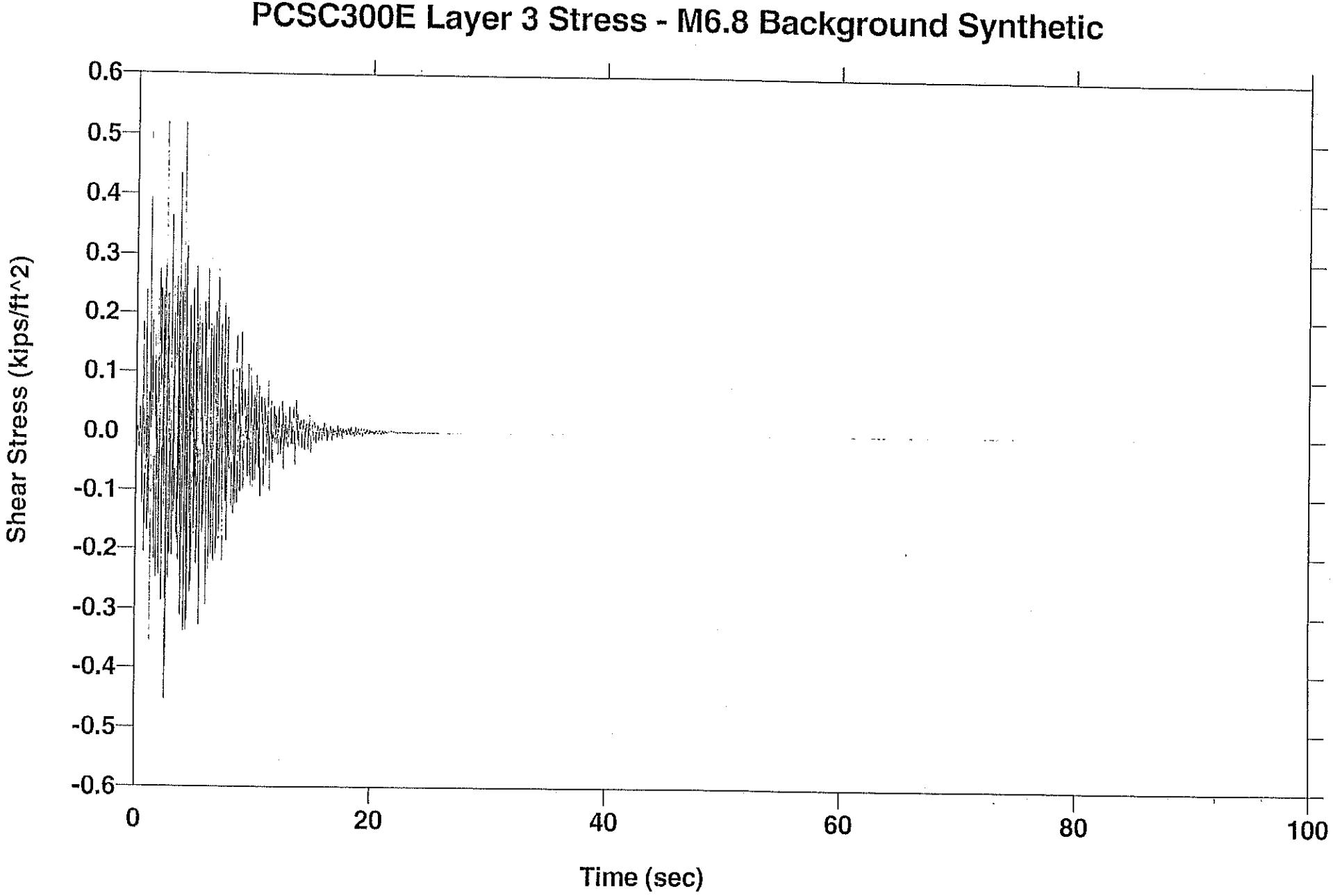


- ▲ Toro et. al. (1997) for Mid-Continent of NA - Rock - Mw: 6.8 - R: 13.5 km
- ▲ Atkinson & Boore (1997) for ENA - Rock - M: 6.8 - R: 13.5 km
- ▼ Campbell for CEUS (2003) - M: 6.8 - R: 13.5 km
- ▼ Atkinson for ENA (2001) - AS00 Rock - M: 6.8 - R: 13.5 km
- ■ Tavakoli & Pezeshk (2005) - ENA - Rock - M: 6.8 - R: 13.5 km
- ■ PSA for 5% damping - Layer 17 - SHAKE

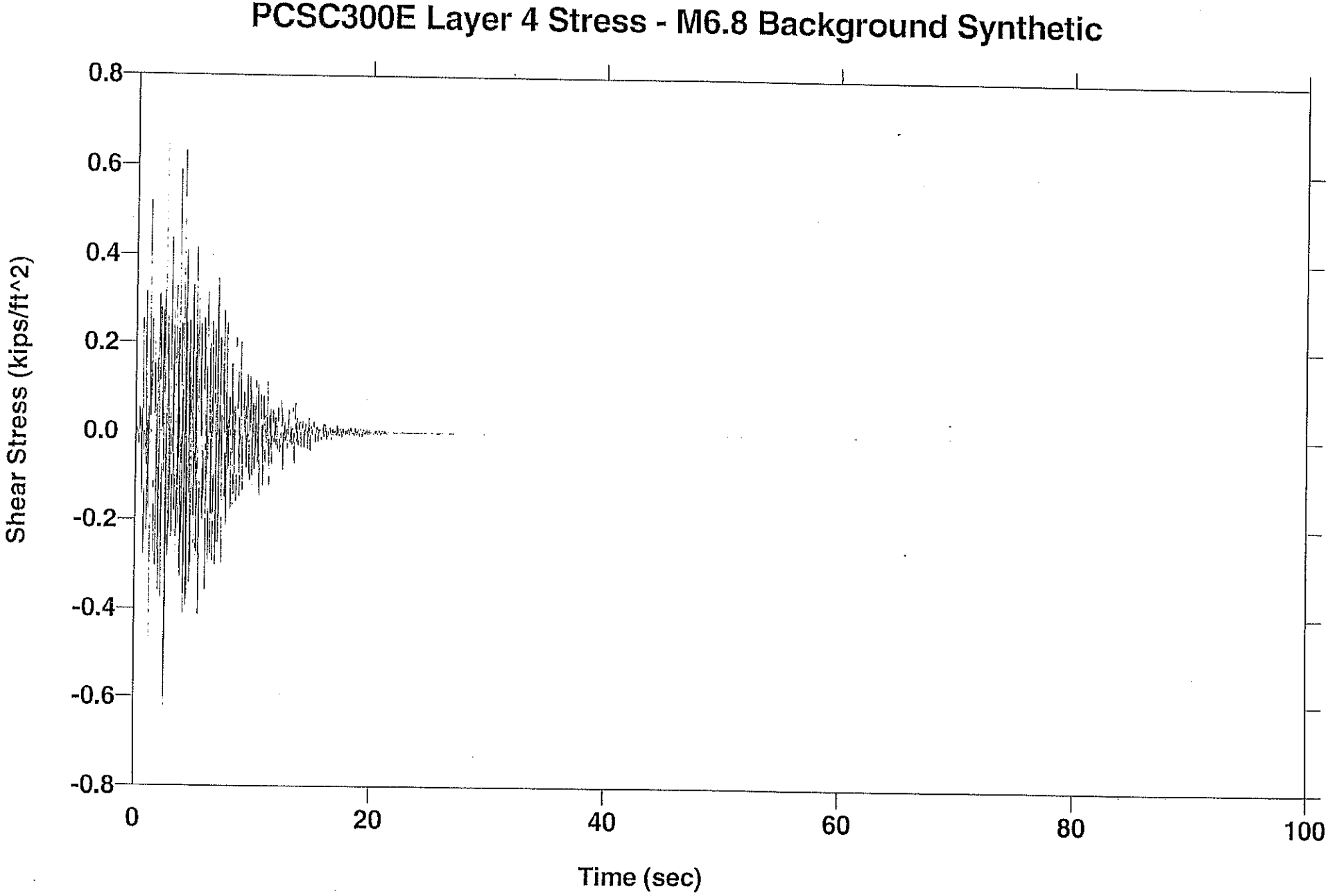
R14156


PCSC300E Layer 2 Stress - M6.8 Background Synthetic @13.5km
Shear Stress (kips/ft^2)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
20
40
60
80
100
Time (sec)

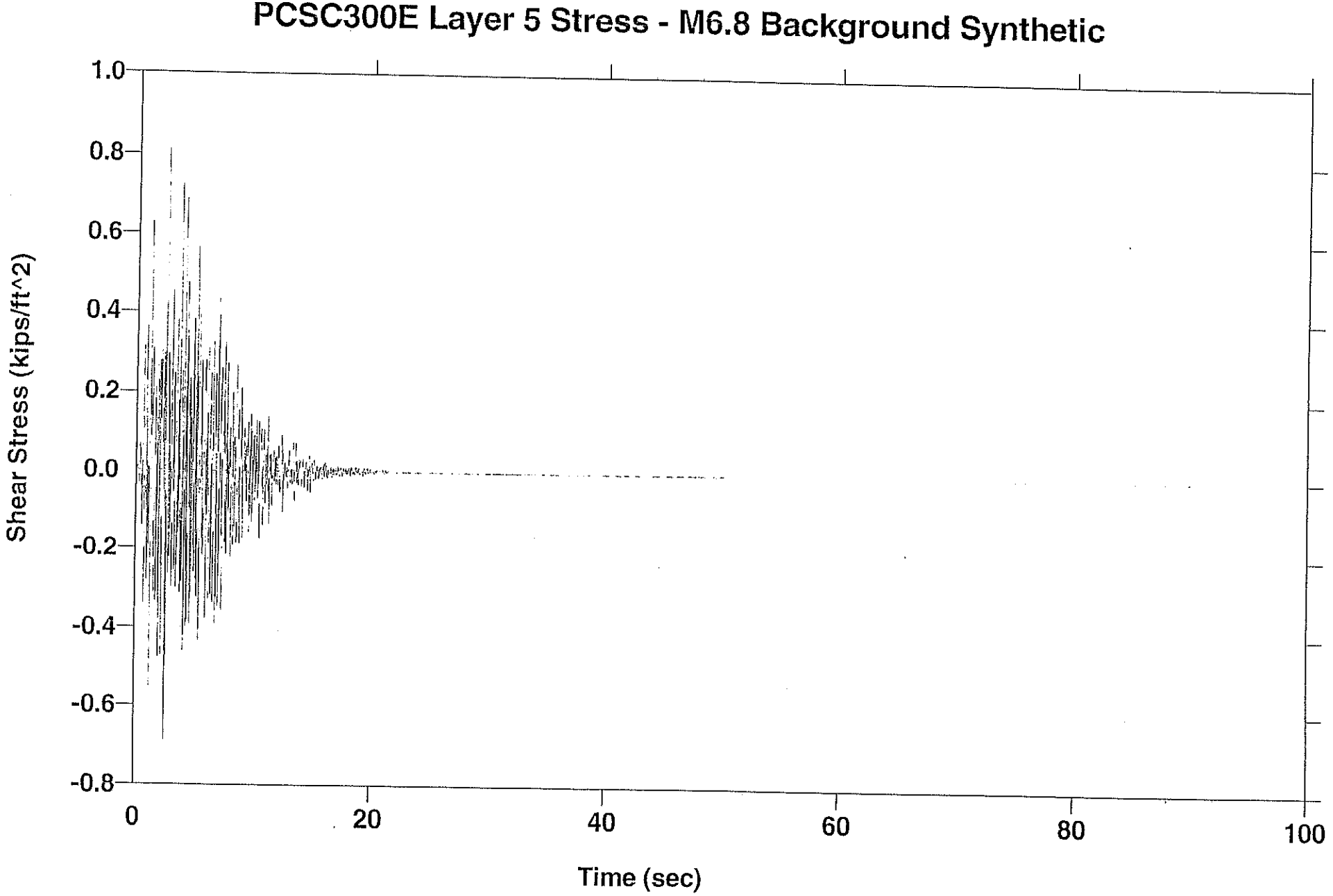
R14157


PCSC300E Layer 3 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
0
20
40
60
80
100
Time (sec)

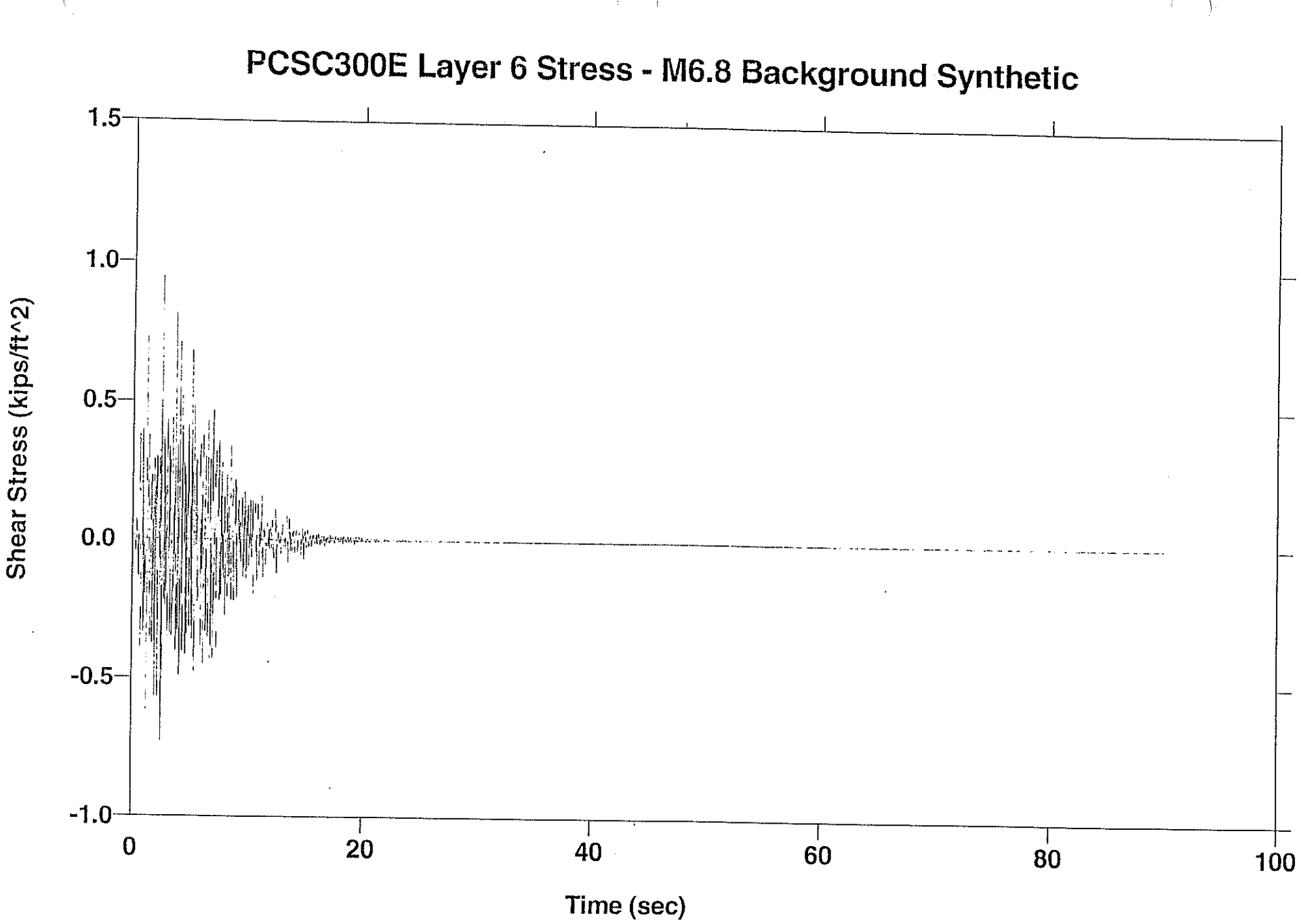
R14158


PCSC300E Layer 4 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0
20
40
60
80
100
Time (sec)

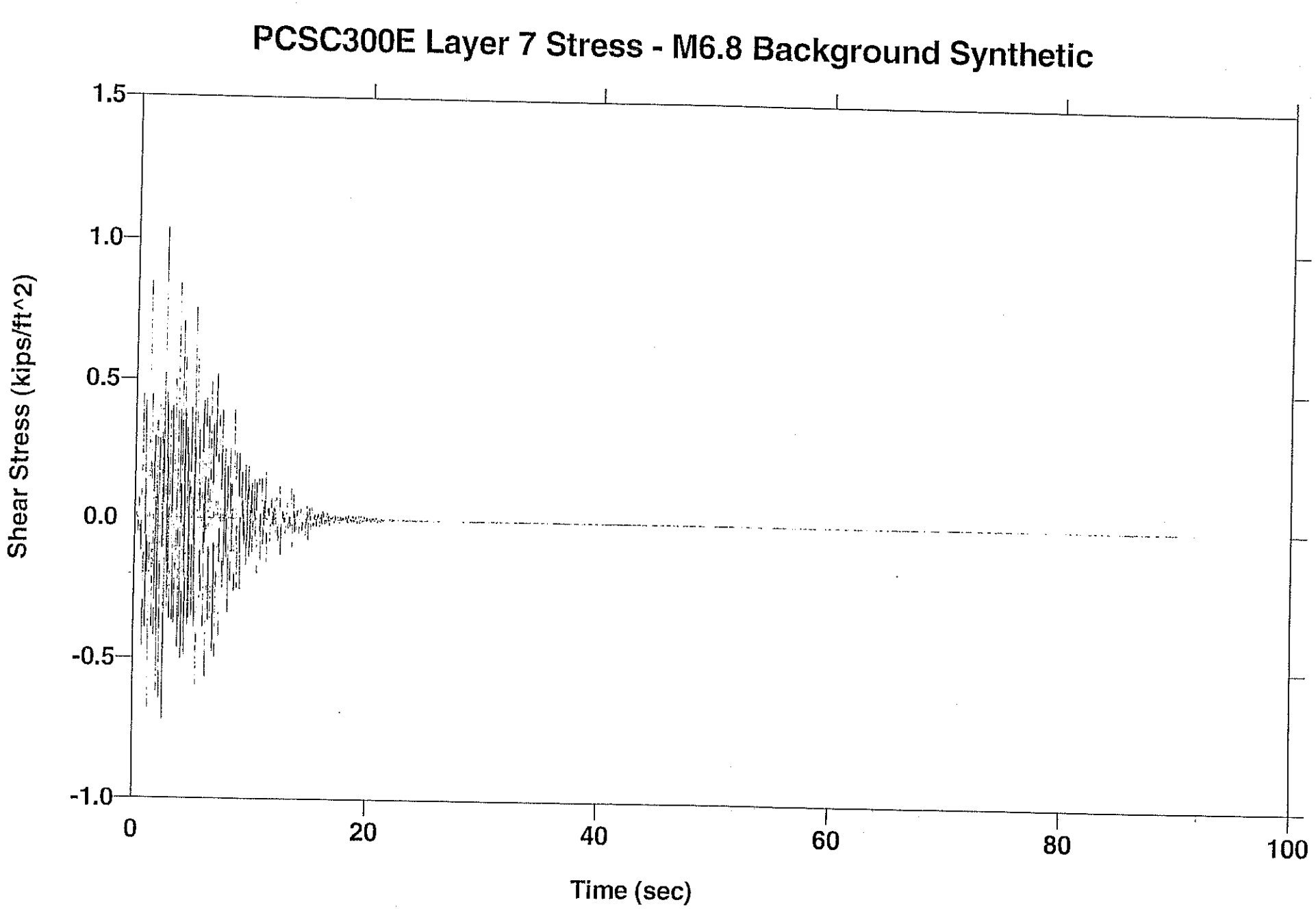
R14159

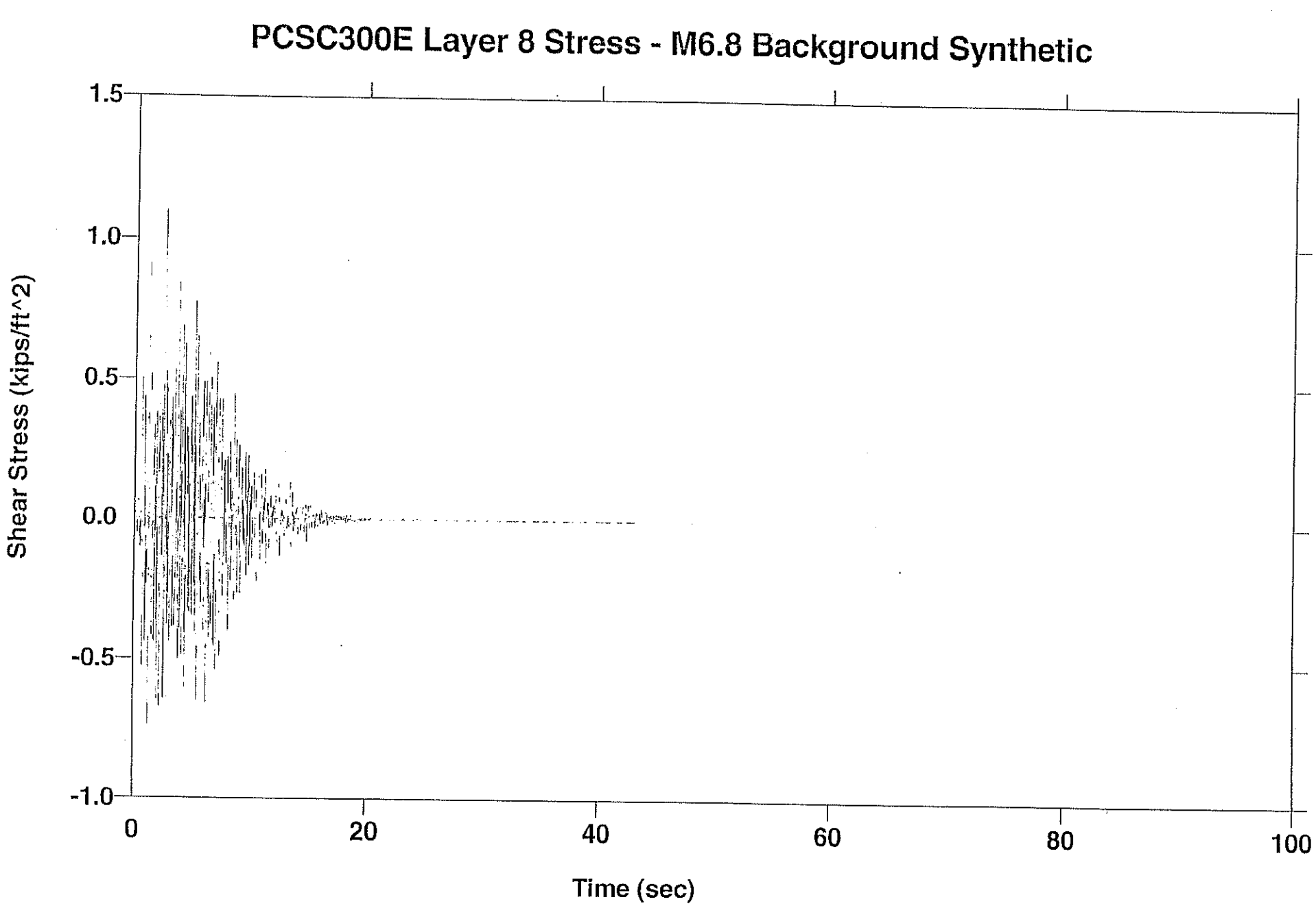

PCSC300E Layer 5 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0
20
40
60
80
100
Time (sec)

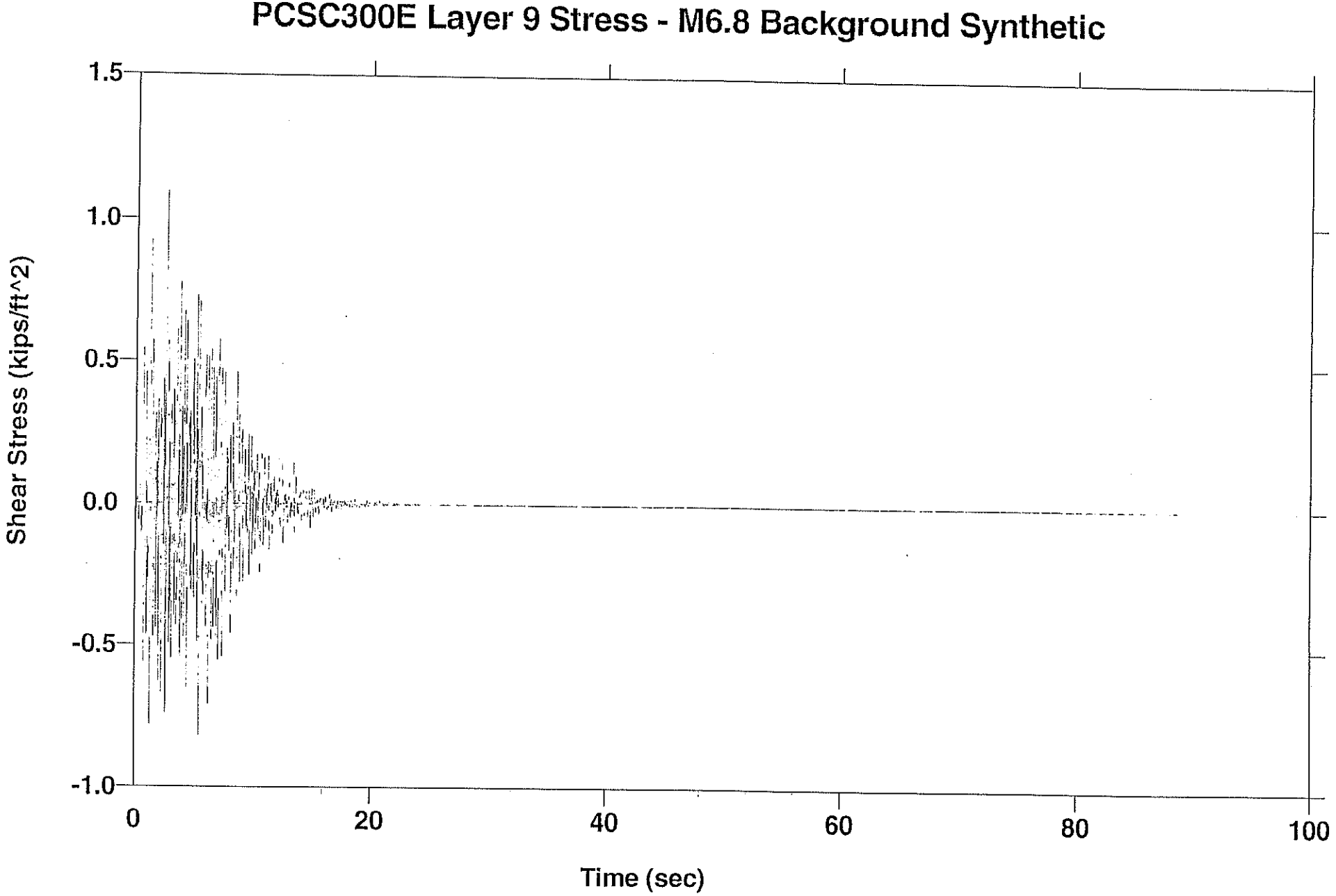
R14160


PCSC300E Layer 6 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
0
20
40
60
80
100
Time (sec)

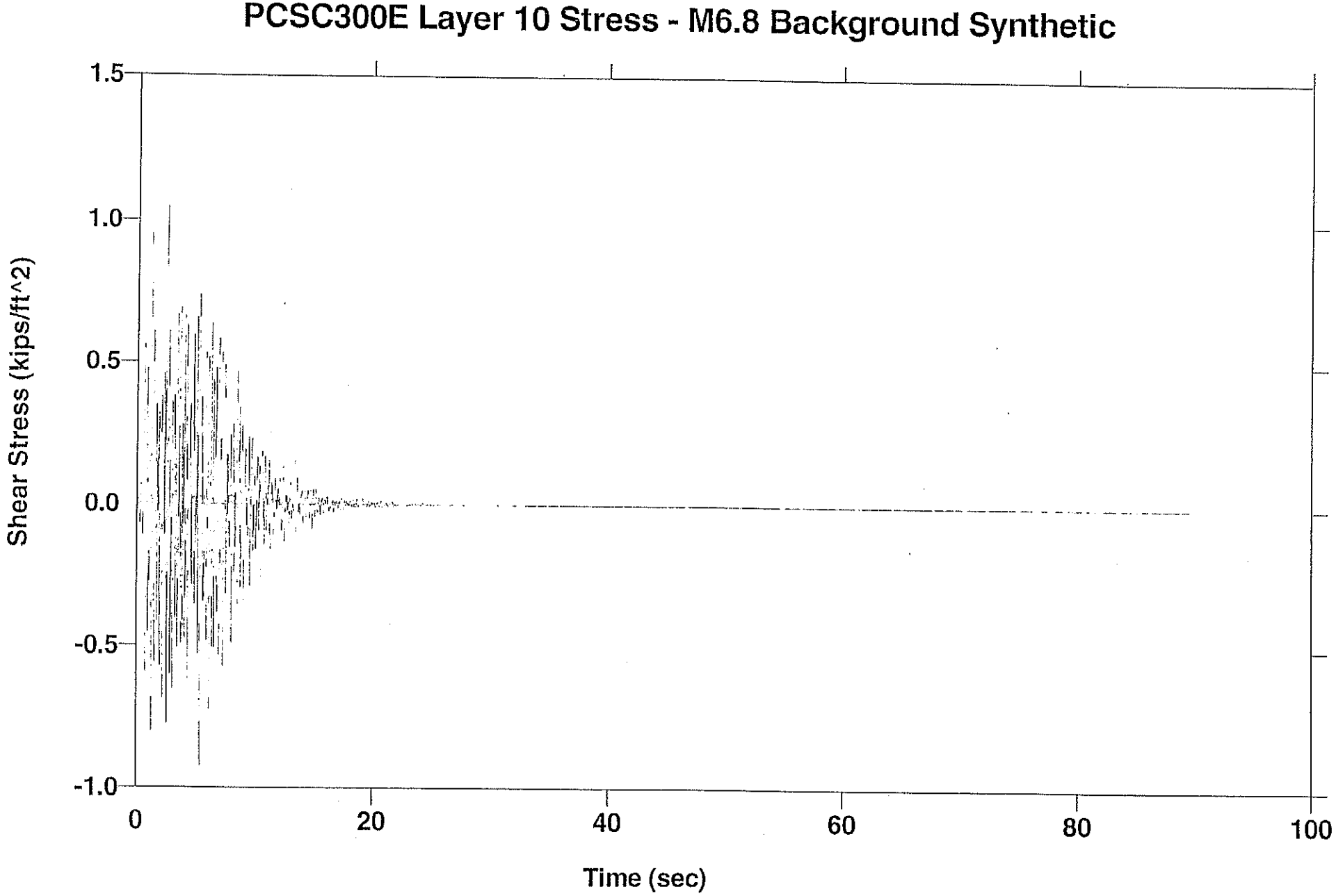
R14161


PCSC300E Layer 7 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
0
20
40
60
80
100
Time (sec)

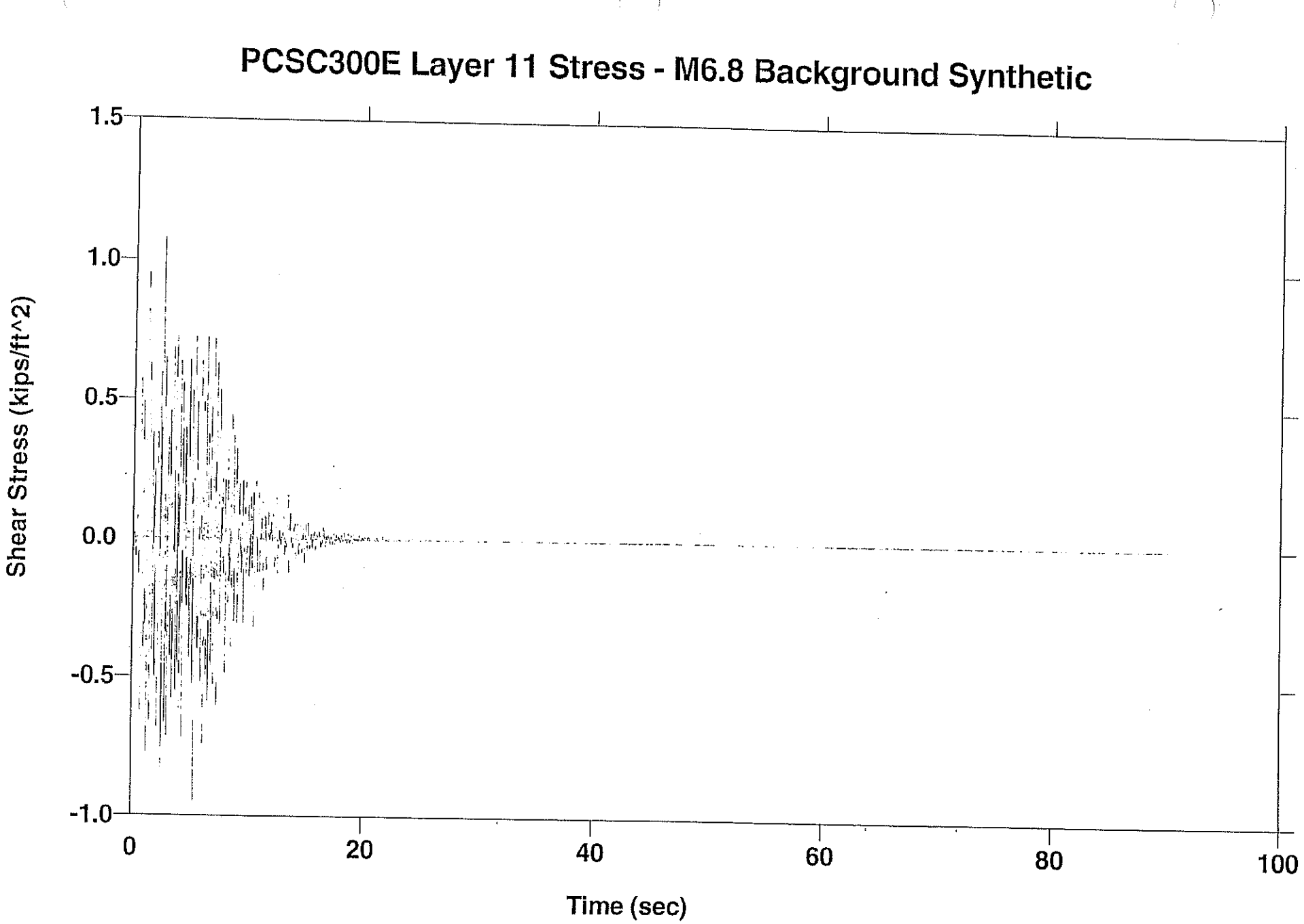

PCSC300E Layer 8 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
0
20
40
60
80
100
Time (sec)


PCSC300E Layer 9 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
0
20
40
60
80
100
Time (sec)

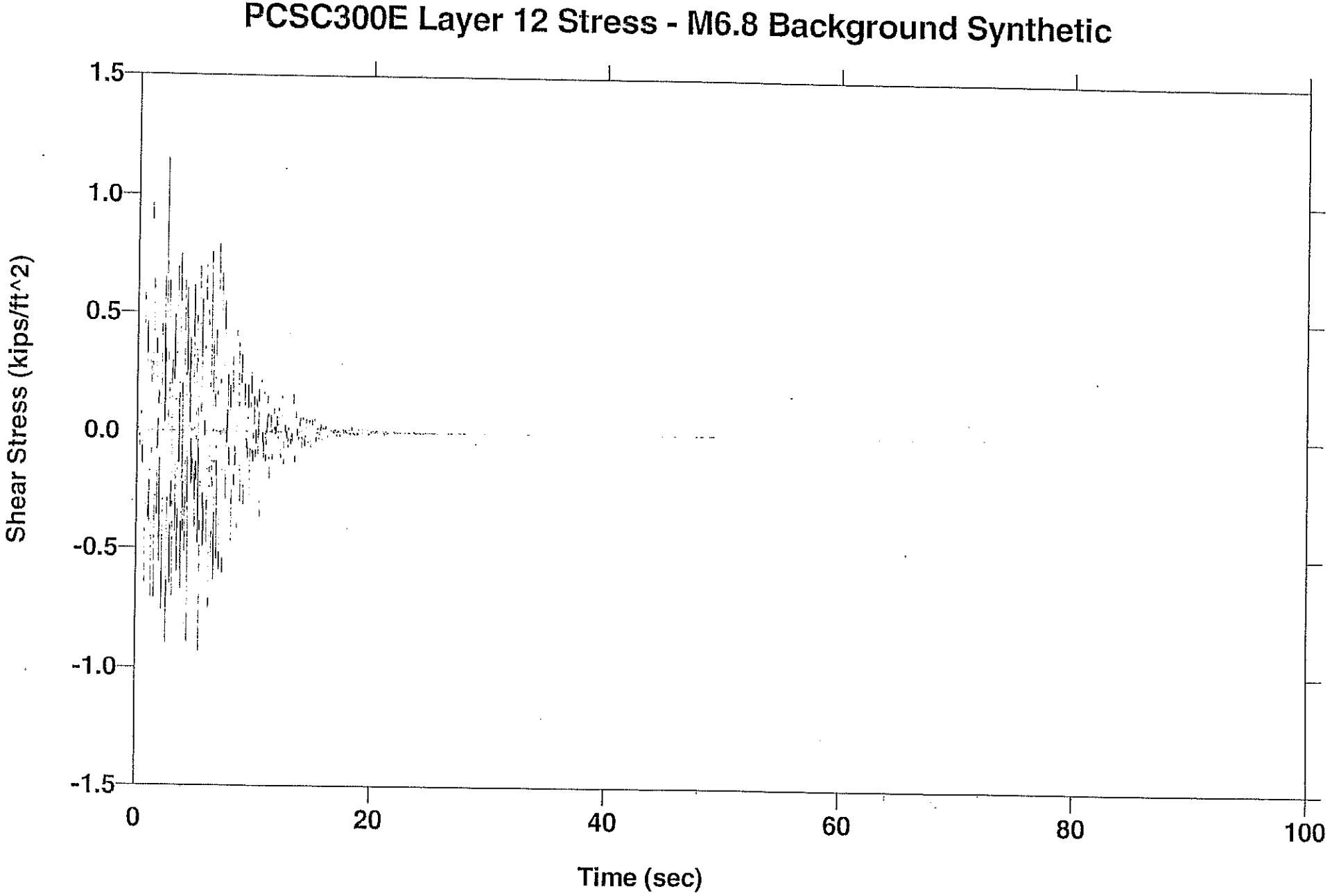
R14164


PCSC300E Layer 10 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
0
20
40
60
80
100
Time (sec)

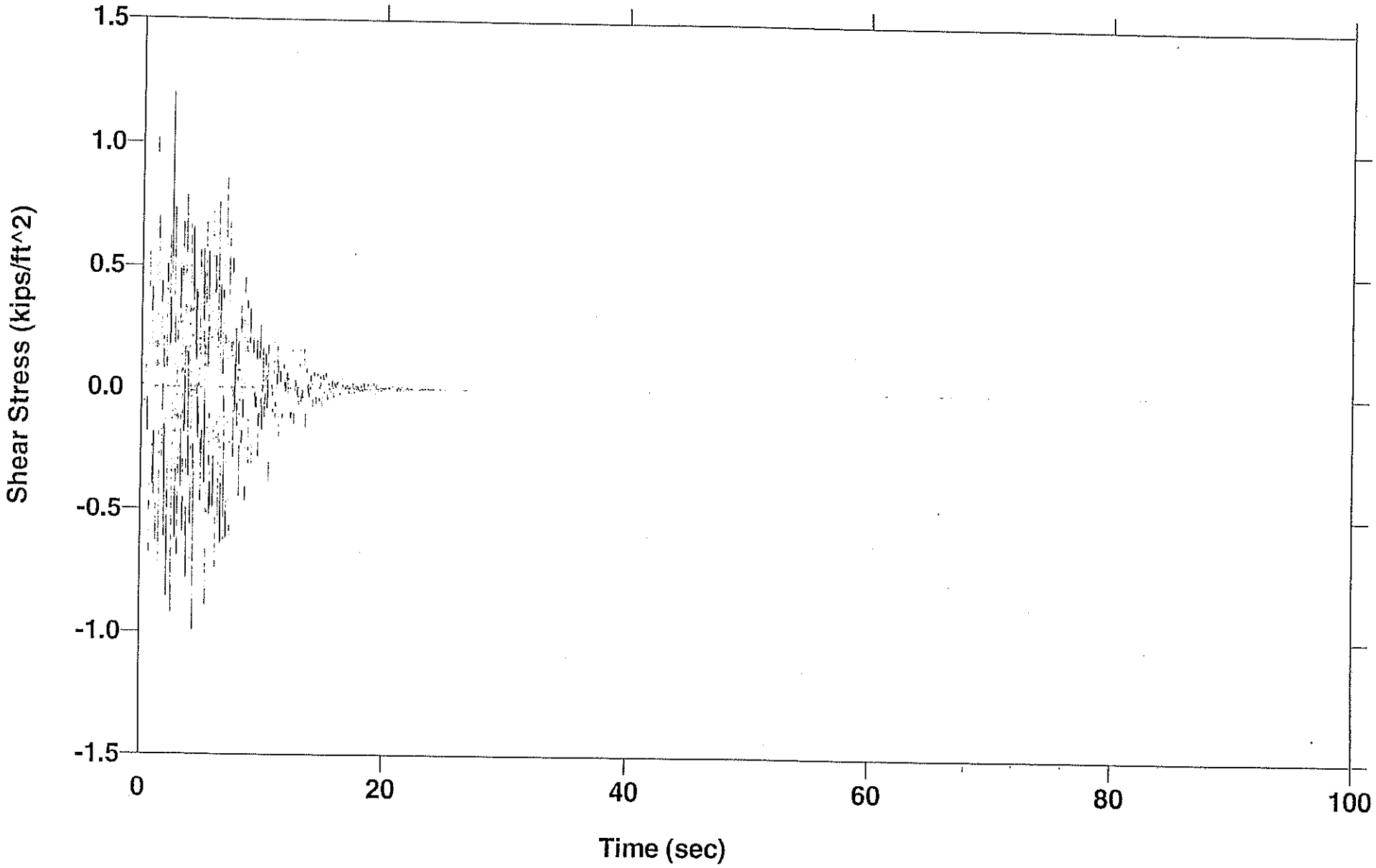
R14165

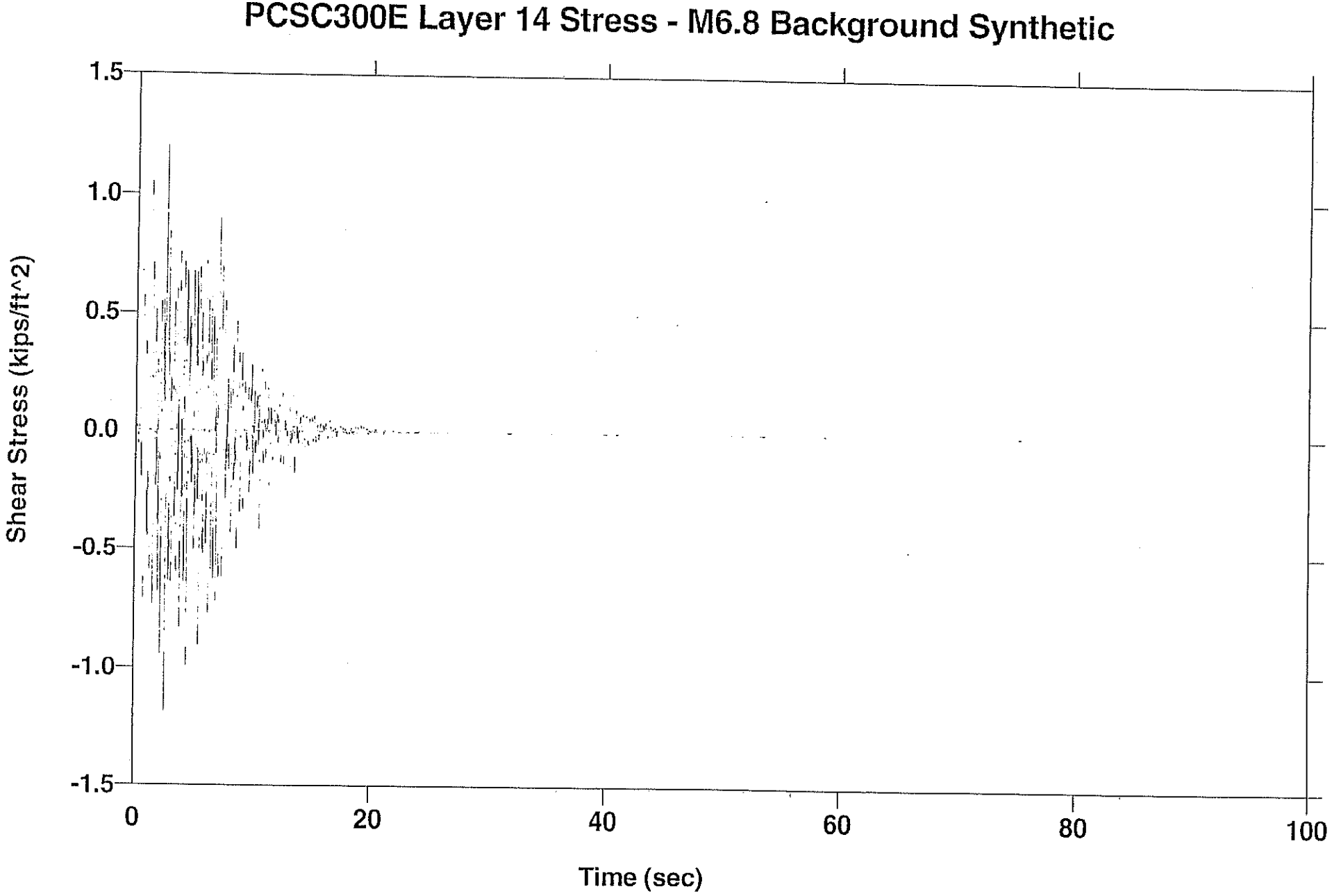

PCSC300E Layer 11 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
0
20
40
60
80
100
Time (sec)

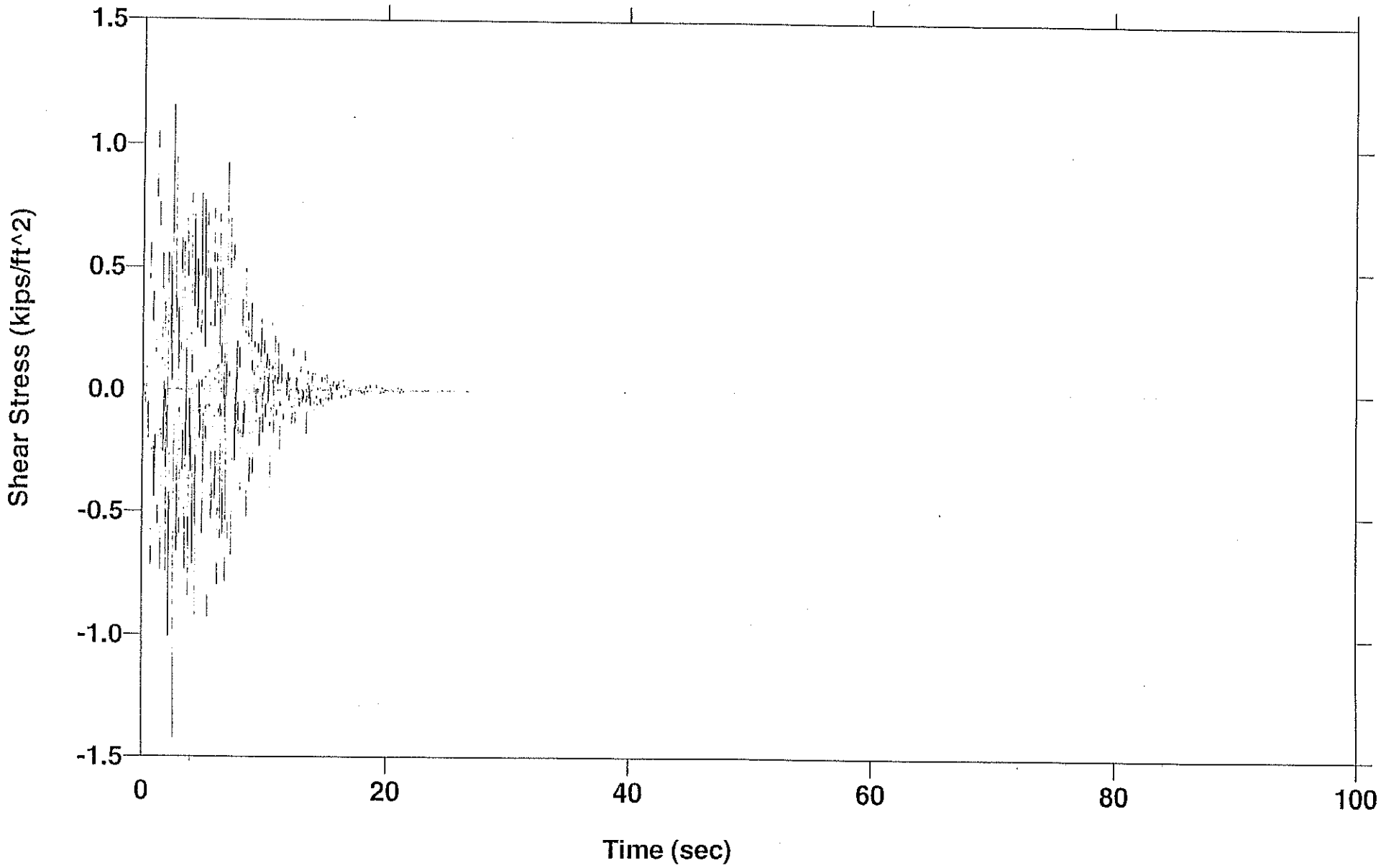
R14166


PCSC300E Layer 12 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0
20
40
60
80
100
Time (sec)

R14167

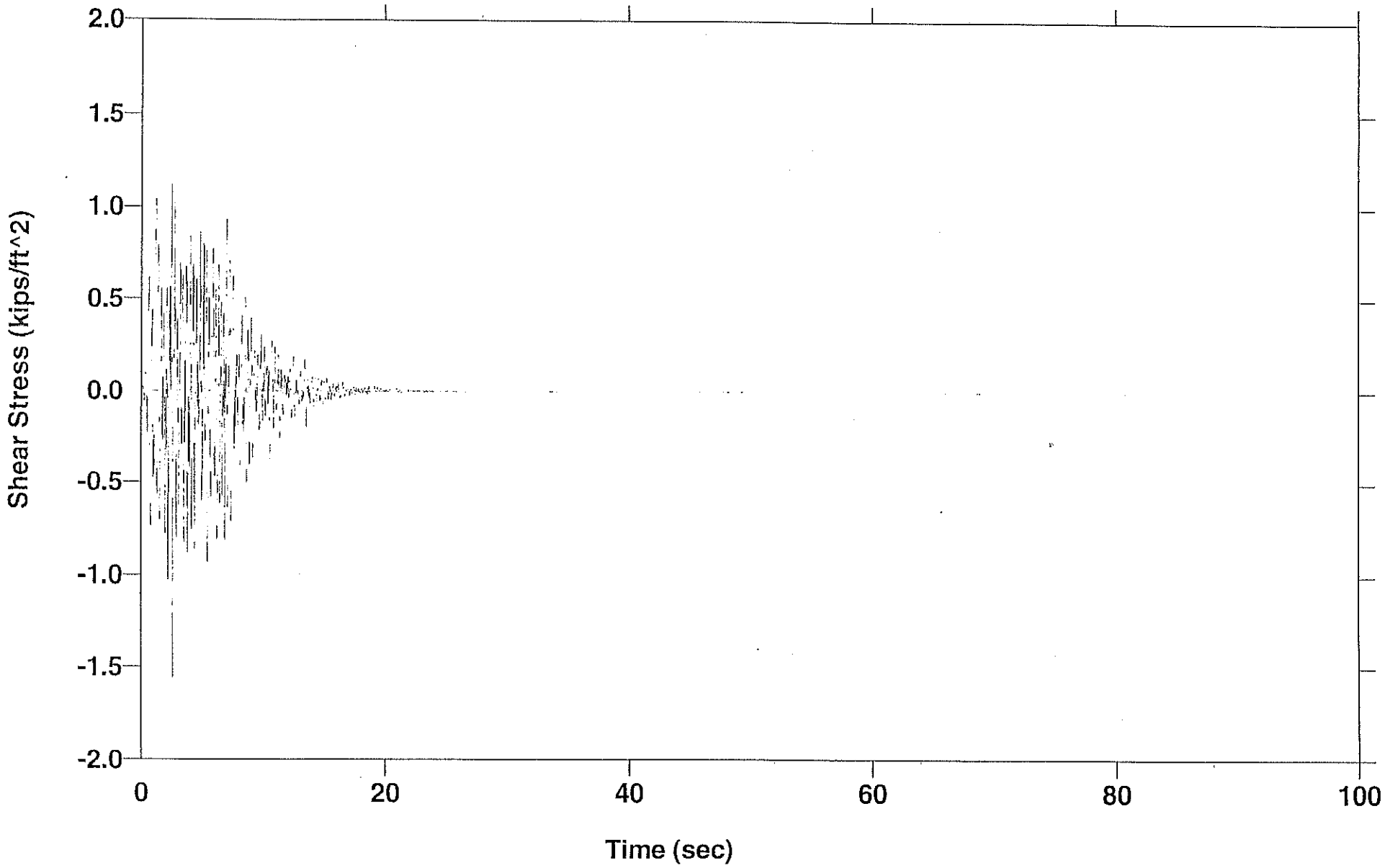

PCSC300E Layer 13 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0
20
40
60
80
100
Time (sec)


PCSC300E Layer 14 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0
20
40
60
80
100
Time (sec)


PCSC300E Layer 15 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0
20
40
60
80
100
Time (sec)

R14170

PCSC300E Layer 16 Stress - M6.8 Background Synthetic



R14171

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************************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*    LAYERED SITES by Per Schnable & John Lysmer - 1970  *
* ------------------------------------------------------ *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
* ------------------------------------------------------ *
* SHAKE88 :New modulus reduction curves for clays added   *
*     using results from Sun et al (1988) by J. I. Sun    *
*     & Ramin Golesorkhi February 26, 1988                *
* ------------------------------------------------------*
* SHAKE90/91: Adjust last iteration; Input now is either  *
*     Gmax or max Vs; up to 13 materials can be specified*
*     by user; up to 50 Layers can be specified; object   *
*     motion can be read in from a separate file and can  *
*     user specified format; Different periods for res-   *
*     ponse spectral calculations;options are renumbered;*
*     and general cleanup by: J. I. Sun, I. M. Idriss &   *
*     P. Dirrim June 1990 - February 1991                 *
* ------------------------------------------------------ *
* SHAKE91: General cleanup and finalization of input out- *
*     output format ... etc by: I. M. Idriss Dec. 1991    *
* ------------------------------------------------------ *
* SHAKE2000: Fix the incorrect output of Tot. Stress in   *
* Option 2. Changed path of ground motion file in         *
* SHAKE91.  Control file to input file names.  Modified   *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
*         RUN DATE  1/02/2008                             *
*         RUN TIME 11:10                                  *
************************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =    32768
 NECESSARY LENGTH OF BLANK COMMON X       =   204819

1****** OPTION  1  *** READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

**********************
 MATERIAL TYPE NO. 1
**********************

CURVE NO.  1:   Coarse    G/Gmax - Gravel (Mean) - Rollins et al. JGGE
CURVE NO.  2:   Coarse    Damping for Gravel (Mean) - Rollins et al. J
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.90
0.0002	0.995	0.0003	1.11
0.0005	0.980	0.0006	1.30
0.0008	0.970	0.0010	1.50
0.0010	0.960	0.0020	1.91
0.0020	0.930	0.0030	2.24
0.0030	0.905	0.0040	2.54
0.0040	0.880	0.0060	3.05
0.0070	0.810	0.0080	3.50
0.0100	0.755	0.0100	3.89
0.0200	0.630	0.0200	5.45
0.0700	0.390	0.0300	6.61
0.1000	0.325	0.0500	8.28
0.2000	0.205	0.1000	10.79
0.3000	0.150	0.2000	13.23

0.4000	0.115	0.3000	14.47
0.5000	0.095	0.4000	15.24
0.6000	0.080	0.6000	16.14
0.8000	0.070	0.8000	16.66
1.0000	0.050	1.0000	17.01

****
MATERIAL TYPE NO. 2
****

CURVE NO. 3: Fine Refuse Moduli for Fine Refuse (Ellison & Cho, 1976)
CURVE NO. 4: Fine Refuse Damping Values for Fine Refuse (Ellison & Ch

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.75
0.0004	1.000	0.0004	0.65
0.0010	0.995	0.0010	0.70
0.0020	0.992	0.0020	0.80
0.0040	0.989	0.0040	0.90
0.0060	0.981	0.0060	1.10
0.0080	0.965	0.0080	1.30
0.0100	0.955	0.0100	1.40
0.0200	0.905	0.0200	2.00
0.0400	0.828	0.0400	3.10
0.0600	0.750	0.0600	4.00
0.0800	0.670	0.0800	5.20
0.1000	0.610	0.1000	6.00
0.2000	0.610	0.2000	6.00

****
MATERIAL TYPE NO. 3
****

CURVE NO. 5: Residual G/Gmax PI=15% - Effective Confining Pressure
CURVE NO. 6: Residual Damping PI=15% - Effective Confining Pressur

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0000	1.000	0.0000	0.67
0.0000	1.000	0.0000	0.67
0.0000	0.999	0.0000	0.68
0.0001	0.998	0.0001	0.68
0.0002	0.996	0.0002	0.70
0.0005	0.991	0.0005	0.75
0.0010	0.983	0.0010	0.83
0.0022	0.965	0.0022	1.02
0.0048	0.931	0.0048	1.43
0.0100	0.873	0.0100	2.17
0.0220	0.770	0.0220	3.68
0.0484	0.618	0.0484	6.24
0.1000	0.454	0.1000	9.48
0.2200	0.287	0.2200	13.40
0.4840	0.163	0.4840	16.87
1.0000	0.091	1.0000	19.16

****
MATERIAL TYPE NO. 4
****

CURVE NO. 7: Rock G/Gmax - ROCK (Schnabel 1973)
CURVE NO. 8: Rock Damping for ROCK (Schnabel 1973)

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.40
0.0003	1.000	0.0010	0.80
0.0010	0.990	0.0100	1.50
0.0030	0.950	0.1000	3.00
0.0100	0.900	1.0000	4.60
0.0300	0.810	0.0000	0.00
0.1000	0.725	0.0000	0.00
1.0000	0.550	0.0000	0.00

1****** OPTION 2 *** READ SOIL PROFILE
NEW SOIL PROFILE NO. 1 IDENTIFICATION PSCS300E Crest Column
NUMBER OF LAYERS 17 DEPTH TO BEDROCK 50.00

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	1	4.0000	2.0000	0.26	3454.	0.050	0.130	924.9
2	1	3.0000	5.5000	0.71	3856.	0.050	0.130	977.3
3	1	3.0000	8.5000	1.11	4110.	0.050	0.130	1009.0
4	1	3.0000	11.5000	1.50	5739.	0.050	0.130	1192.3
5	1	3.0000	14.5000	1.88	4991.	0.050	0.130	1111.9
6	1	3.0000	17.5000	2.28	4552.	0.050	0.130	1061.8
7	1	3.0000	20.5000	2.66	4985.	0.050	0.130	1111.2
8	1	3.0000	23.5000	3.05	4436.	0.050	0.130	1048.2
9	1	3.0000	26.5000	3.44	4926.	0.050	0.130	1104.6
10	1	4.0000	30.0000	3.90	5058.	0.050	0.130	1119.3
11	3	3.0000	33.5000	4.36	2940.	0.050	0.135	837.4
12	3	3.0000	36.5000	4.77	2951.	0.050	0.135	839.0
13	3	3.0000	39.5000	5.17	3307.	0.050	0.135	888.1
14	3	3.0000	42.5000	5.58	4130.	0.050	0.135	992.5
15	3	3.0000	45.5000	5.98	7136.	0.050	0.135	1304.6
16	3	3.0000	48.5000	6.39	7051.	0.050	0.135	1296.8
17	BASE				74534.	0.050	0.150	4000.0

PERIOD = 0.19 FROM AVERAGE SHEAR VEL. = 1050.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 12.49
FOR FREQUENCY = 5.15 C/SEC.
PERIOD = 0.19 SEC.

1****** OPTION 3 *** READ INPUT MOTION

FILE NAME FOR INPUT MOTION = C:\SHAKE2000\Williamson Energy\Background6.8.eq
NO. OF INPUT ACC. POINTS = 8192
NO. OF POINTS USED IN FFT = 16384
NO. OF HEADING LINES = 4
NO. OF POINTS PER LINE = 8

```
 TIME STEP FOR INPUT MOTION = 0.0100
   FORMAT FOR TIME HISTORY =     (8f9.6)


 *****HEADER*****
Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt
SHAKE2000 Conversion:  8192    .01     4       8       9      (8f9.6
Acceleration Units: (g's) - No. Values: 8192 - Time Step: .01 (secs)
Data Format: (8f9.6) - No. Header Lines:  4
 ** FIRST AND LAST 5 LINES OF INPUT MOTION *****

   1  0.000068-0.000484 0.004440-0.000089 0.002476-0.002297-0.001876 0.007725
   2  0.009680 0.020998-0.014349-0.012924 0.018874-0.019831-0.000946 0.024811
   3 -0.016894-0.002461 0.007682-0.006573-0.008604-0.018410 0.024194-0.064656
   4 -0.017516 0.023926-0.061566 0.003326 0.022873 0.052730 0.049159 0.008778
   5 -0.041034 0.029324-0.005991 0.066674-0.051336 0.029966-0.067257 0.001274
  .....INPUT MOTION READ NOT ECHOED.....
1020 -0.000017 0.000017-0.000018 0.000017-0.000019 0.000019-0.000020 0.000020
1021 -0.000021 0.000021-0.000022 0.000022-0.000024 0.000023-0.000025 0.000025
1022 -0.000027 0.000027-0.000028 0.000028-0.000030 0.000030-0.000032 0.000032
1023 -0.000034 0.000034-0.000035 0.000035-0.000037 0.000037-0.000038 0.000038
1024 -0.000038 0.000037-0.000036 0.000032-0.000026 0.000014 0.000006-0.000045

 MAXIMUM ACCELERATION =  0.75473
 AT TIME              =  3.64 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  0.715
 TO GIVE NEW MAXIMUM ACCELERATION         =  0.54000
 MEAN SQUARE FREQUENCY =     20.41 C/SEC.
 MAX ACCELERATION =    0.55791 FOR FREQUENCIES REMOVED ABOVE     40.00 C/SEC.
1******  OPTION  4  ***  READ WHERE OBJECT MOTION IS GIVEN
 OBJECT MOTION IN LAYER NUMBER   17 OUTCROPPING

1******  OPTION  5  ***  OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
 MAXIMUM NUMBER OF ITERATIONS             =  10
 FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN =   0.65

    EARTHQUAKE   - C:\SHAKE2000\Williamson Energy\Background6.8.eq
    SOIL PROFILE - PSCS300E Crest Column

 ITERATION NUMBER  1

 VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ----> <---- SHEAR MODULUS -----> G/Go
      (FT)  STRAIN NEW   USED  ERROR     NEW    USED   ERROR  RATIO
--- ---- ---- --------- ----- ------ ------  -------  ------  ------  -----
 1  1    2.0 0.00356 0.024  0.050  -106.7   3074.5   3454.0   -12.3  1.000
 2  1    5.5 0.00786 0.035  0.050   -44.0   3054.2   3856.0   -26.3  1.000
 3  1    8.5 0.00966 0.038  0.050   -30.5   3124.7   4110.0   -31.5  1.000
 4  1   11.5 0.00814 0.035  0.050   -41.7   4515.4   5739.0   -27.1  1.000
 5  1   14.5 0.01168 0.042  0.050   -18.0   3628.7   4991.0   -37.5  1.000
 6  1   17.5 0.01477 0.048  0.050    -4.9   3116.7   4552.0   -46.1  1.000
 7  1   20.5 0.01539 0.049  0.050    -2.9   3376.1   4985.0   -47.7  1.000
 8  1   23.5 0.01948 0.054  0.050     7.2   2815.8   4436.0   -57.5  1.000
 9  1   26.5 0.01902 0.053  0.050     6.3   3148.1   4926.0   -56.5  1.000
10  1   30.0 0.01960 0.054  0.050     7.5   3204.8   5058.0   -57.8  1.000
11  3   33.5 0.03457 0.051  0.050     2.9   2007.6   2940.0   -46.4  1.000
12  3   36.5 0.03572 0.053  0.050     4.8   1996.5   2951.0   -47.8  1.000
13  3   39.5 0.03387 0.051  0.050     1.6   2271.4   3307.0   -45.6  1.000
14  3   42.5 0.02722 0.044  0.050   -14.3   3010.5   4130.0   -37.2  1.000
15  3   45.5 0.01592 0.031  0.050   -63.2   5796.4   7136.0   -23.1  1.000
```

16 3 48.5 0.01718 0.032 0.050 -55.7 5656.9 7051.0 -24.6 1.000

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00418	0.026	0.024	6.8	3020.9	3074.5	-1.8	0.890
2	1	5.5	0.01024	0.039	0.035	11.9	2895.1	3054.2	-5.5	0.792
3	1	8.5	0.01293	0.045	0.038	14.3	2912.8	3124.7	-7.3	0.760
4	1	11.5	0.01090	0.041	0.035	13.6	4244.1	4515.4	-6.4	0.787
5	1	14.5	0.01643	0.050	0.042	15.3	3321.5	3628.7	-9.2	0.727
6	1	17.5	0.02367	0.059	0.048	19.6	2721.0	3116.7	-14.5	0.685
7	1	20.5	0.02492	0.061	0.049	20.1	2930.4	3376.1	-15.2	0.677
8	1	23.5	0.03198	0.068	0.054	21.0	2395.7	2815.8	-17.5	0.635
9	1	26.5	0.02894	0.065	0.053	18.0	2754.8	3148.1	-14.3	0.639
10	1	30.0	0.02759	0.064	0.054	15.1	2875.0	3204.8	-11.5	0.634
11	3	33.5	0.04145	0.057	0.051	10.2	1904.8	2007.6	-5.4	0.683
12	3	36.5	0.03989	0.056	0.053	6.4	1933.8	1996.5	-3.2	0.677
13	3	39.5	0.03636	0.053	0.051	4.3	2226.2	2271.4	-2.0	0.687
14	3	42.5	0.02969	0.047	0.044	6.0	2941.4	3010.5	-2.4	0.729
15	3	45.5	0.01743	0.032	0.031	5.4	5711.9	5796.4	-1.5	0.812
16	3	48.5	0.01905	0.034	0.032	5.8	5562.0	5656.9	-1.7	0.802

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00420	0.026	0.026	0.2	3018.9	3020.9	-0.1	0.875
2	1	5.5	0.01085	0.041	0.039	3.2	2854.6	2895.1	-1.4	0.751
3	1	8.5	0.01386	0.046	0.045	3.4	2861.3	2912.8	-1.8	0.709
4	1	11.5	0.01148	0.042	0.041	2.8	4189.7	4244.1	-1.3	0.740
5	1	14.5	0.01816	0.052	0.050	4.3	3231.1	3321.5	-2.8	0.665
6	1	17.5	0.02586	0.062	0.059	4.1	2643.5	2721.0	-2.9	0.598
7	1	20.5	0.02639	0.062	0.061	2.6	2875.6	2930.4	-1.9	0.588
8	1	23.5	0.03446	0.071	0.068	3.5	2332.4	2395.7	-2.7	0.540
9	1	26.5	0.03034	0.066	0.065	2.1	2710.2	2754.8	-1.6	0.559
10	1	30.0	0.02815	0.064	0.064	0.9	2855.2	2875.0	-0.7	0.568
11	3	33.5	0.03977	0.056	0.057	-2.4	1928.3	1904.8	1.2	0.648
12	3	36.5	0.03991	0.056	0.056	0.0	1933.4	1933.8	0.0	0.655
13	3	39.5	0.03668	0.053	0.053	0.5	2220.5	2226.2	-0.3	0.673
14	3	42.5	0.03012	0.047	0.047	1.0	2930.1	2941.4	-0.4	0.712
15	3	45.5	0.01771	0.033	0.032	0.9	5697.1	5711.9	-0.3	0.800
16	3	48.5	0.01938	0.034	0.034	1.0	5545.9	5562.0	-0.3	0.789

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00431	0.026	0.026	1.3	3006.9	3018.9	-0.4	0.874
2	1	5.5	0.01129	0.042	0.041	2.1	2827.1	2854.6	-1.0	0.740
3	1	8.5	0.01437	0.047	0.046	1.8	2834.1	2861.3	-1.0	0.696
4	1	11.5	0.01168	0.042	0.042	0.9	4172.6	4189.7	-0.4	0.730
5	1	14.5	0.01877	0.053	0.052	1.4	3201.4	3231.1	-0.9	0.647
6	1	17.5	0.02683	0.063	0.062	1.7	2611.6	2643.5	-1.2	0.581
7	1	20.5	0.02706	0.063	0.062	1.1	2851.8	2875.6	-0.8	0.577
8	1	23.5	0.03519	0.071	0.071	1.0	2314.6	2332.4	-0.8	0.526
9	1	26.5	0.03040	0.067	0.066	0.1	2708.4	2710.2	-0.1	0.550
10	1	30.0	0.02802	0.064	0.064	-0.2	2859.8	2855.2	0.2	0.565
11	3	33.5	0.03893	0.055	0.056	-1.2	1940.4	1928.3	0.6	0.656
12	3	36.5	0.04001	0.056	0.056	0.1	1932.0	1933.4	-0.1	0.655
13	3	39.5	0.03696	0.054	0.053	0.5	2215.6	2220.5	-0.2	0.671
14	3	42.5	0.03018	0.047	0.047	0.1	2928.5	2930.1	-0.1	0.709
15	3	45.5	0.01774	0.033	0.033	0.1	5695.6	5697.1	0.0	0.798
16	3	48.5	0.01941	0.034	0.034	0.1	5544.8	5545.9	0.0	0.787

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00438	0.027	0.026	0.7	3000.8	3006.9	-0.2	0.871
2	1	5.5	0.01150	0.042	0.042	1.0	2814.1	2827.1	-0.5	0.733
3	1	8.5	0.01462	0.047	0.047	0.8	2821.6	2834.1	-0.4	0.690
4	1	11.5	0.01173	0.042	0.042	0.2	4167.9	4172.6	-0.1	0.727
5	1	14.5	0.01899	0.053	0.053	0.5	3191.0	3201.4	-0.3	0.641
6	1	17.5	0.02725	0.063	0.063	0.7	2598.1	2611.6	-0.5	0.574
7	1	20.5	0.02736	0.063	0.063	0.5	2841.4	2851.8	-0.4	0.572
8	1	23.5	0.03549	0.072	0.071	0.4	2307.2	2314.6	-0.3	0.522
9	1	26.5	0.03027	0.066	0.067	-0.2	2712.4	2708.4	0.1	0.550
10	1	30.0	0.02787	0.064	0.064	-0.2	2864.8	2859.8	0.2	0.565
11	3	33.5	0.03868	0.055	0.055	-0.4	1944.0	1940.4	0.2	0.660
12	3	36.5	0.04013	0.056	0.056	0.2	1930.3	1932.0	-0.1	0.655
13	3	39.5	0.03713	0.054	0.054	0.3	2212.7	2215.6	-0.1	0.670
14	3	42.5	0.03019	0.047	0.047	0.0	2928.2	2928.5	0.0	0.709
15	3	45.5	0.01774	0.033	0.033	0.0	5695.3	5695.6	0.0	0.798
16	3	48.5	0.01941	0.034	0.034	0.0	5544.8	5544.8	0.0	0.786

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 6

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00440	0.027	0.027	0.3	2998.1	3000.8	-0.1	0.869
2	1	5.5	0.01160	0.042	0.042	0.4	2808.3	2814.1	-0.2	0.730

3	1	8.5	0.01472	0.048	0.047	0.3	2816.3	2821.6	-0.2	0.687
4	1	11.5	0.01174	0.043	0.042	0.1	4166.8	4167.9	0.0	0.726
5	1	14.5	0.01907	0.053	0.053	0.2	3187.2	3191.0	-0.1	0.639
6	1	17.5	0.02742	0.064	0.063	0.3	2592.5	2598.1	-0.2	0.571
7	1	20.5	0.02748	0.064	0.063	0.2	2837.0	2841.4	-0.2	0.570
8	1	23.5	0.03562	0.072	0.072	0.2	2304.2	2307.2	-0.1	0.520
9	1	26.5	0.03016	0.066	0.066	-0.2	2715.8	2712.4	0.1	0.551
10	1	30.0	0.02779	0.064	0.064	-0.1	2867.9	2864.8	0.1	0.566
11	3	33.5	0.03861	0.055	0.055	-0.1	1945.0	1944.0	0.1	0.661
12	3	36.5	0.04020	0.056	0.056	0.1	1929.3	1930.3	-0.1	0.654
13	3	39.5	0.03721	0.054	0.054	0.1	2211.4	2212.7	-0.1	0.669
14	3	42.5	0.03019	0.047	0.047	0.0	2928.1	2928.2	0.0	0.709
15	3	45.5	0.01774	0.033	0.033	0.0	5695.2	5695.3	0.0	0.798
16	3	48.5	0.01941	0.034	0.034	0.0	5544.8	5544.8	0.0	0.786

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 7

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00441	0.027	0.027	0.1	2996.9	2998.1	0.0	0.868
2	1	5.5	0.01164	0.042	0.042	0.2	2805.8	2808.3	-0.1	0.728
3	1	8.5	0.01477	0.048	0.048	0.1	2814.0	2816.3	-0.1	0.685
4	1	11.5	0.01174	0.043	0.043	0.0	4166.6	4166.8	0.0	0.726
5	1	14.5	0.01910	0.053	0.053	0.1	3185.8	3187.2	0.0	0.639
6	1	17.5	0.02750	0.064	0.064	0.1	2590.1	2592.5	-0.1	0.570
7	1	20.5	0.02754	0.064	0.064	0.1	2835.1	2837.0	-0.1	0.569
8	1	23.5	0.03567	0.072	0.072	0.1	2303.0	2304.2	-0.1	0.519
9	1	26.5	0.03009	0.066	0.066	-0.1	2717.8	2715.8	0.1	0.551
10	1	30.0	0.02774	0.064	0.064	-0.1	2869.5	2867.9	0.1	0.567
11	3	33.5	0.03859	0.055	0.055	0.0	1945.3	1945.0	0.0	0.662
12	3	36.5	0.04023	0.056	0.056	0.1	1928.8	1929.3	0.0	0.654
13	3	39.5	0.03724	0.054	0.054	0.1	2210.8	2211.4	0.0	0.669
14	3	42.5	0.03019	0.047	0.047	0.0	2928.0	2928.1	0.0	0.709
15	3	45.5	0.01774	0.033	0.033	0.0	5695.1	5695.2	0.0	0.798
16	3	48.5	0.01941	0.034	0.034	0.0	5544.8	5544.8	0.0	0.786

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 8

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00442	0.027	0.027	0.1	2996.5	2996.9	0.0	0.868
2	1	5.5	0.01166	0.042	0.042	0.1	2804.7	2805.8	0.0	0.728
3	1	8.5	0.01479	0.048	0.048	0.1	2813.1	2814.0	0.0	0.685
4	1	11.5	0.01174	0.043	0.043	0.0	4166.5	4166.6	0.0	0.726
5	1	14.5	0.01911	0.053	0.053	0.0	3185.3	3185.8	0.0	0.638
6	1	17.5	0.02753	0.064	0.064	0.1	2589.1	2590.1	0.0	0.569
7	1	20.5	0.02756	0.064	0.064	0.0	2834.3	2835.1	0.0	0.569
8	1	23.5	0.03569	0.072	0.072	0.0	2302.5	2303.0	0.0	0.519
9	1	26.5	0.03006	0.066	0.066	-0.1	2718.8	2717.8	0.0	0.552

10	1	30.0	0.02772	0.064	0.064	0.0	2870.3	2869.5	0.0	0.567
11	3	33.5	0.03859	0.055	0.055	0.0	1945.3	1945.3	0.0	0.662
12	3	36.5	0.04025	0.056	0.056	0.0	1928.6	1928.8	0.0	0.654
13	3	39.5	0.03726	0.054	0.054	0.0	2210.6	2210.8	0.0	0.669
14	3	42.5	0.03019	0.047	0.047	0.0	2928.0	2928.0	0.0	0.709
15	3	45.5	0.01774	0.033	0.033	0.0	5695.1	5695.1	0.0	0.798
16	3	48.5	0.01941	0.034	0.034	0.0	5544.8	5544.8	0.0	0.786

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 9

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00442	0.027	0.027	0.0	2996.3	2996.5	0.0	0.868
2	1	5.5	0.01166	0.042	0.042	0.0	2804.3	2804.7	0.0	0.727
3	1	8.5	0.01480	0.048	0.048	0.0	2812.7	2813.1	0.0	0.684
4	1	11.5	0.01174	0.043	0.043	0.0	4166.6	4166.5	0.0	0.726
5	1	14.5	0.01912	0.053	0.053	0.0	3185.0	3185.3	0.0	0.638
6	1	17.5	0.02754	0.064	0.064	0.0	2588.7	2589.1	0.0	0.569
7	1	20.5	0.02757	0.064	0.064	0.0	2834.0	2834.3	0.0	0.569
8	1	23.5	0.03570	0.072	0.072	0.0	2302.3	2302.5	0.0	0.519
9	1	26.5	0.03005	0.066	0.066	0.0	2719.3	2718.8	0.0	0.552
10	1	30.0	0.02771	0.064	0.064	0.0	2870.6	2870.3	0.0	0.567
11	3	33.5	0.03859	0.055	0.055	0.0	1945.3	1945.3	0.0	0.662
12	3	36.5	0.04026	0.056	0.056	0.0	1928.5	1928.6	0.0	0.654
13	3	39.5	0.03726	0.054	0.054	0.0	2210.5	2210.6	0.0	0.668
14	3	42.5	0.03020	0.047	0.047	0.0	2928.0	2928.0	0.0	0.709
15	3	45.5	0.01775	0.033	0.033	0.0	5695.1	5695.1	0.0	0.798
16	3	48.5	0.01941	0.034	0.034	0.0	5544.8	5544.8	0.0	0.786

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 10

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00442	0.027	0.027	0.0	2996.2	2996.3	0.0	0.867
2	1	5.5	0.01167	0.042	0.042	0.0	2804.1	2804.3	0.0	0.727
3	1	8.5	0.01480	0.048	0.048	0.0	2812.5	2812.7	0.0	0.684
4	1	11.5	0.01174	0.043	0.043	0.0	4166.6	4166.6	0.0	0.726
5	1	14.5	0.01912	0.053	0.053	0.0	3185.0	3185.0	0.0	0.638
6	1	17.5	0.02755	0.064	0.064	0.0	2588.5	2588.7	0.0	0.569
7	1	20.5	0.02757	0.064	0.064	0.0	2833.9	2834.0	0.0	0.569
8	1	23.5	0.03570	0.072	0.072	0.0	2302.2	2302.3	0.0	0.519
9	1	26.5	0.03004	0.066	0.066	0.0	2719.5	2719.3	0.0	0.552
10	1	30.0	0.02771	0.064	0.064	0.0	2870.7	2870.6	0.0	0.568
11	3	33.5	0.03859	0.055	0.055	0.0	1945.3	1945.3	0.0	0.662
12	3	36.5	0.04026	0.056	0.056	0.0	1928.4	1928.5	0.0	0.653
13	3	39.5	0.03726	0.054	0.054	0.0	2210.4	2210.5	0.0	0.668
14	3	42.5	0.03020	0.047	0.047	0.0	2928.0	2928.0	0.0	0.709
15	3	45.5	0.01775	0.033	0.033	0.0	5695.1	5695.1	0.0	0.798
16	3	48.5	0.01941	0.034	0.034	0.0	5544.8	5544.8	0.0	0.786

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	1	4.0000	2.0000	0.00680	203.83	2.66
2	1	3.0000	5.5000	0.01795	503.32	2.66
3	1	3.0000	8.5000	0.02277	640.40	2.66
4	1	3.0000	11.5000	0.01807	752.80	3.70
5	1	3.0000	14.5000	0.02941	936.76	2.53
6	1	3.0000	17.5000	0.04238	1097.16	2.53
7	1	3.0000	20.5000	0.04242	1202.23	2.53
8	1	3.0000	23.5000	0.05493	1264.58	2.53
9	1	3.0000	26.5000	0.04621	1256.70	2.52
10	1	4.0000	30.0000	0.04262	1223.56	2.52
11	3	3.0000	33.5000	0.05937	1154.87	2.51
12	3	3.0000	36.5000	0.06194	1194.58	2.51
13	3	3.0000	39.5000	0.05733	1267.25	2.50
14	3	3.0000	42.5000	0.04645	1360.19	2.61
15	3	3.0000	45.5000	0.02730	1554.78	2.61
16	3	3.0000	48.5000	0.02986	1655.45	2.61

PERIOD = 0.23 FROM AVERAGE SHEAR VEL. = 858.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 11.36
FOR FREQUENCY = 4.16 C/SEC.
PERIOD = 0.24 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	QUIET ZONE	ACC. RATIO ACC. RECORD	TH SAVED
OUTCR.	0.0000	0.78263	2.66	16.34	0.000	2048	
WITHIN	4.0000	0.62639	2.66	13.00	0.000	2048	
WITHIN	7.0000	0.49396	2.53	9.03	0.000	2048	
WITHIN	10.0000	0.51802	2.52	13.18	0.001	2048	
WITHIN	13.0000	0.56972	2.64	15.80	0.001	2048	
WITHIN	16.0000	0.59373	2.64	15.62	0.000	2048	
WITHIN	19.0000	0.52701	2.60	15.73	0.001	2048	
WITHIN	22.0000	0.56754	2.60	17.30	0.001	2048	
WITHIN	25.0000	0.50592	5.10	17.66	0.000	2048	
WITHIN	28.0000	0.54159	5.10	17.27	0.001	2048	
WITHIN	32.0000	0.72089	2.62	17.70	0.001	2048	
WITHIN	35.0000	0.66940	2.62	19.11	0.000	2048	
WITHIN	38.0000	0.81377	2.61	20.61	0.001	2048	
WITHIN	41.0000	0.68058	2.61	21.13	0.001	2048	
WITHIN	44.0000	0.53553	2.59	20.65	0.001	2048	

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	QUIET ZONE	ACC. RATIO ACC. RECORD	TH SAVED
WITHIN	47.0000	0.48479	3.91	19.81	0.001	2048	
WITHIN	50.0000	0.48665	2.58	19.10	0.001	2048	

OUTCR.	50.0000	0.55791	2.58	20.41	0.001	2048

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 1 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 1 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 2 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 2 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 3 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 3 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 4 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 4 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 5 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 5 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 6 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC3005 Layer 6 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 7 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 7 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 8 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 8 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 9 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 9 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 10 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 10 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 11 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 11 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 12 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 12 Strain

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1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  13
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 13 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  13
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 13 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  14
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 14 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  14
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 14 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  15
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 15 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  15
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 15 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  16
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 16 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  16
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 16 Strain

1******  OPTION  9  ***  COMPUTE RESPONSE SPECTRUM
 RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER      1
CALCULATED FOR DAMPING      0.050

  TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
     TD = TIME FOR MAX. RELATIVE DISP.
     TV = TIME FOR MAX. RELATIVE VEL.
     TA = TIME FOR MAX. ABSOLUTE ACC.
  DAMPING RATIO = 0.050
  PER = 0.01    TIMES FOR MAXIMA --  TD =  2.6500  TV =  2.5600  TA =  2.6500
  PER = 0.02    TIMES FOR MAXIMA --  TD =  2.6500  TV =  2.6400  TA =  2.6500
  PER = 0.03    TIMES FOR MAXIMA --  TD =  3.0100  TV =  2.6600  TA =  3.6900
  PER = 0.04    TIMES FOR MAXIMA --  TD =  3.6900  TV =  2.6700  TA =  3.6900
  PER = 0.05    TIMES FOR MAXIMA --  TD =  4.9000  TV =  4.9100  TA =  4.9000
  PER = 0.06    TIMES FOR MAXIMA --  TD =  4.3800  TV =  4.3900  TA =  4.3700
  PER = 0.07    TIMES FOR MAXIMA --  TD =  2.5200  TV =  4.3700  TA =  2.5200
  PER = 0.08    TIMES FOR MAXIMA --  TD =  5.2700  TV =  2.9200  TA =  5.2700
  PER = 0.09    TIMES FOR MAXIMA --  TD =  2.5900  TV =  2.6100  TA =  2.5800
  PER = 0.10    TIMES FOR MAXIMA --  TD =  2.5900  TV =  2.5700  TA =  2.5900
  PER = 0.11    TIMES FOR MAXIMA --  TD =  2.6000  TV =  2.5800  TA =  2.6000
  PER = 0.12    TIMES FOR MAXIMA --  TD =  2.6100  TV =  2.5800  TA =  2.6000
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PER = 0.13	TIMES FOR MAXIMA --	TD = 5.4500	TV = 3.7500	TA = 5.4500
PER = 0.14	TIMES FOR MAXIMA --	TD = 2.6000	TV = 3.7700	TA = 2.6000
PER = 0.15	TIMES FOR MAXIMA --	TD = 4.1500	TV = 4.2000	TA = 4.1500
PER = 0.16	TIMES FOR MAXIMA --	TD = 2.6100	TV = 4.2100	TA = 2.6100
PER = 0.17	TIMES FOR MAXIMA --	TD = 4.2800	TV = 4.3200	TA = 4.2700
PER = 0.18	TIMES FOR MAXIMA --	TD = 1.4300	TV = 2.5800	TA = 1.4200
PER = 0.19	TIMES FOR MAXIMA --	TD = 2.7500	TV = 2.7000	TA = 2.7400
PER = 0.20	TIMES FOR MAXIMA --	TD = 6.6800	TV = 6.7400	TA = 6.6800
PER = 0.21	TIMES FOR MAXIMA --	TD = 7.1300	TV = 7.0800	TA = 7.1300
PER = 0.22	TIMES FOR MAXIMA --	TD = 7.1500	TV = 7.0900	TA = 7.1400
PER = 0.23	TIMES FOR MAXIMA --	TD = 7.2800	TV = 3.4400	TA = 7.2800
PER = 0.24	TIMES FOR MAXIMA --	TD = 2.4100	TV = 2.3500	TA = 2.2900
PER = 0.25	TIMES FOR MAXIMA --	TD = 6.4100	TV = 6.4800	TA = 6.4100
PER = 0.26	TIMES FOR MAXIMA --	TD = 6.3100	TV = 6.3700	TA = 6.3100
PER = 0.27	TIMES FOR MAXIMA --	TD = 1.6200	TV = 6.2700	TA = 1.6200
PER = 0.28	TIMES FOR MAXIMA --	TD = 1.6400	TV = 1.3200	TA = 1.6400
PER = 0.29	TIMES FOR MAXIMA --	TD = 5.2000	TV = 1.3200	TA = 5.2000
PER = 0.30	TIMES FOR MAXIMA --	TD = 5.2300	TV = 5.1500	TA = 5.2200
PER = 0.31	TIMES FOR MAXIMA --	TD = 2.9700	TV = 2.9000	TA = 2.9600
PER = 0.32	TIMES FOR MAXIMA --	TD = 2.9900	TV = 2.9000	TA = 2.9800
PER = 0.33	TIMES FOR MAXIMA --	TD = 3.0000	TV = 2.9100	TA = 3.0000
PER = 0.34	TIMES FOR MAXIMA --	TD = 3.0100	TV = 2.7800	TA = 3.0000
PER = 0.35	TIMES FOR MAXIMA --	TD = 3.0100	TV = 2.7800	TA = 3.0100
PER = 0.36	TIMES FOR MAXIMA --	TD = 2.7100	TV = 2.7800	TA = 2.7000
PER = 0.37	TIMES FOR MAXIMA --	TD = 2.7100	TV = 2.7900	TA = 2.7100
PER = 0.38	TIMES FOR MAXIMA --	TD = 2.7200	TV = 2.6600	TA = 2.7100
PER = 0.39	TIMES FOR MAXIMA --	TD = 4.1300	TV = 2.6600	TA = 2.7200
PER = 0.40	TIMES FOR MAXIMA --	TD = 4.1400	TV = 2.6600	TA = 4.1300
PER = 0.41	TIMES FOR MAXIMA --	TD = 4.1600	TV = 4.0800	TA = 4.1500
PER = 0.42	TIMES FOR MAXIMA --	TD = 4.1700	TV = 4.0900	TA = 3.9800
PER = 0.43	TIMES FOR MAXIMA --	TD = 4.0000	TV = 4.0900	TA = 3.9900
PER = 0.44	TIMES FOR MAXIMA --	TD = 4.6700	TV = 4.0900	TA = 4.6600
PER = 0.45	TIMES FOR MAXIMA --	TD = 4.6900	TV = 4.1000	TA = 4.6800
PER = 0.46	TIMES FOR MAXIMA --	TD = 4.7100	TV = 4.1000	TA = 4.7000
PER = 0.47	TIMES FOR MAXIMA --	TD = 4.5100	TV = 2.6600	TA = 4.5000
PER = 0.48	TIMES FOR MAXIMA --	TD = 4.5200	TV = 2.6600	TA = 5.5300
PER = 0.49	TIMES FOR MAXIMA --	TD = 5.5500	TV = 2.6600	TA = 5.5400
PER = 0.50	TIMES FOR MAXIMA --	TD = 5.5600	TV = 2.6600	TA = 5.5500
PER = 0.51	TIMES FOR MAXIMA --	TD = 5.5700	TV = 2.6600	TA = 5.5600
PER = 0.52	TIMES FOR MAXIMA --	TD = 5.5700	TV = 2.6600	TA = 5.5700
PER = 0.53	TIMES FOR MAXIMA --	TD = 2.7500	TV = 2.6600	TA = 2.7500
PER = 0.54	TIMES FOR MAXIMA --	TD = 2.7600	TV = 2.6600	TA = 2.7500
PER = 0.55	TIMES FOR MAXIMA --	TD = 2.5600	TV = 2.6600	TA = 2.5600
PER = 0.56	TIMES FOR MAXIMA --	TD = 2.5600	TV = 2.6600	TA = 2.5600
PER = 0.57	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.6600	TA = 2.5600
PER = 0.58	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.6600	TA = 2.5600
PER = 0.60	TIMES FOR MAXIMA --	TD = 2.5800	TV = 2.6600	TA = 2.5700
PER = 0.62	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.6600	TA = 2.5700
PER = 0.64	TIMES FOR MAXIMA --	TD = 2.6100	TV = 2.5400	TA = 2.6000
PER = 0.66	TIMES FOR MAXIMA --	TD = 2.6200	TV = 2.5400	TA = 2.6100
PER = 0.68	TIMES FOR MAXIMA --	TD = 2.6300	TV = 2.5400	TA = 2.6100
PER = 0.70	TIMES FOR MAXIMA --	TD = 3.4700	TV = 2.5400	TA = 3.4600
PER = 0.72	TIMES FOR MAXIMA --	TD = 3.4800	TV = 2.5400	TA = 3.4700
PER = 0.74	TIMES FOR MAXIMA --	TD = 3.4900	TV = 2.5400	TA = 3.4800
PER = 0.76	TIMES FOR MAXIMA --	TD = 3.4900	TV = 1.6000	TA = 3.4800
PER = 0.78	TIMES FOR MAXIMA --	TD = 1.5000	TV = 1.6000	TA = 1.4900
PER = 0.80	TIMES FOR MAXIMA --	TD = 1.5100	TV = 1.6000	TA = 1.5000
PER = 0.82	TIMES FOR MAXIMA --	TD = 1.5100	TV = 6.2900	TA = 1.5000
PER = 0.84	TIMES FOR MAXIMA --	TD = 3.5000	TV = 6.2900	TA = 3.4800
PER = 0.86	TIMES FOR MAXIMA --	TD = 3.5000	TV = 6.3000	TA = 3.4800
PER = 0.88	TIMES FOR MAXIMA --	TD = 3.5100	TV = 5.9400	TA = 3.4900

PER = 0.90	TIMES FOR MAXIMA --	TD = 4.0400	TV = 4.2900	TA = 4.0200
PER = 0.92	TIMES FOR MAXIMA --	TD = 4.0600	TV = 4.2900	TA = 4.0500
PER = 0.94	TIMES FOR MAXIMA --	TD = 4.0600	TV = 4.2900	TA = 4.0600
PER = 0.96	TIMES FOR MAXIMA --	TD = 4.0700	TV = 4.3500	TA = 4.0600
PER = 0.98	TIMES FOR MAXIMA --	TD = 3.1800	TV = 4.3500	TA = 3.1700
PER = 1.00	TIMES FOR MAXIMA --	TD = 3.1800	TV = 3.4600	TA = 3.1700
PER = 1.05	TIMES FOR MAXIMA --	TD = 3.2100	TV = 3.4600	TA = 3.1800
PER = 1.10	TIMES FOR MAXIMA --	TD = 3.2500	TV = 2.5400	TA = 3.2400
PER = 1.15	TIMES FOR MAXIMA --	TD = 3.2700	TV = 2.5400	TA = 3.2400
PER = 1.20	TIMES FOR MAXIMA --	TD = 3.3700	TV = 2.5400	TA = 3.3500
PER = 1.25	TIMES FOR MAXIMA --	TD = 3.4000	TV = 2.5400	TA = 3.3800
PER = 1.30	TIMES FOR MAXIMA --	TD = 3.4100	TV = 2.5400	TA = 2.8600
PER = 1.35	TIMES FOR MAXIMA --	TD = 2.8800	TV = 2.5400	TA = 2.8600
PER = 1.40	TIMES FOR MAXIMA --	TD = 2.8800	TV = 2.5400	TA = 2.8700
PER = 1.45	TIMES FOR MAXIMA --	TD = 2.8900	TV = 2.5400	TA = 2.8700
PER = 1.50	TIMES FOR MAXIMA --	TD = 2.8900	TV = 2.5400	TA = 2.8700
PER = 1.55	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5400	TA = 2.8700
PER = 1.60	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5400	TA = 2.8700
PER = 1.65	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.5400	TA = 2.8700
PER = 1.70	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.5400	TA = 2.8700
PER = 1.75	TIMES FOR MAXIMA --	TD = 5.9000	TV = 2.5400	TA = 5.8600
PER = 1.80	TIMES FOR MAXIMA --	TD = 5.9000	TV = 2.5400	TA = 5.8900
PER = 1.85	TIMES FOR MAXIMA --	TD = 5.9200	TV = 2.5400	TA = 5.8900
PER = 1.90	TIMES FOR MAXIMA --	TD = 6.1100	TV = 2.5400	TA = 6.1000
PER = 1.95	TIMES FOR MAXIMA --	TD = 6.1200	TV = 2.5400	TA = 6.1000
PER = 2.00	TIMES FOR MAXIMA --	TD = 5.4200	TV = 2.5400	TA = 5.4000
PER = 2.05	TIMES FOR MAXIMA --	TD = 5.4200	TV = 2.5400	TA = 5.4000
PER = 2.10	TIMES FOR MAXIMA --	TD = 5.4300	TV = 2.5400	TA = 5.4000
PER = 2.15	TIMES FOR MAXIMA --	TD = 5.4300	TV = 2.5400	TA = 5.4100
PER = 2.20	TIMES FOR MAXIMA --	TD = 8.7600	TV = 2.5400	TA = 5.4100
PER = 2.25	TIMES FOR MAXIMA --	TD = 8.9500	TV = 2.5400	TA = 8.9400
PER = 2.30	TIMES FOR MAXIMA --	TD = 8.9600	TV = 2.5400	TA = 8.9400
PER = 2.35	TIMES FOR MAXIMA --	TD = 7.8900	TV = 2.5400	TA = 8.9400
PER = 2.40	TIMES FOR MAXIMA --	TD = 7.9300	TV = 2.5400	TA = 7.8800
PER = 2.50	TIMES FOR MAXIMA --	TD = 8.0900	TV = 2.5400	TA = 8.0700
PER = 2.60	TIMES FOR MAXIMA --	TD = 8.1100	TV = 2.5400	TA = 6.9300
PER = 2.70	TIMES FOR MAXIMA --	TD = 6.9600	TV = 2.5400	TA = 6.9300
PER = 2.80	TIMES FOR MAXIMA --	TD = 6.9900	TV = 2.5400	TA = 6.9300
PER = 2.90	TIMES FOR MAXIMA --	TD = 7.0000	TV = 2.5400	TA = 6.9400
PER = 3.00	TIMES FOR MAXIMA --	TD = 7.2100	TV = 2.5400	TA = 6.9400
PER = 3.10	TIMES FOR MAXIMA --	TD = 7.2100	TV = 2.5400	TA = 7.1900
PER = 3.20	TIMES FOR MAXIMA --	TD = 7.2400	TV = 2.5400	TA = 7.1900
PER = 3.30	TIMES FOR MAXIMA --	TD = 7.2400	TV = 2.5400	TA = 7.2000
PER = 3.40	TIMES FOR MAXIMA --	TD = 7.2500	TV = 2.5400	TA = 7.2000
PER = 3.50	TIMES FOR MAXIMA --	TD = 7.2500	TV = 2.5400	TA = 7.2000
PER = 3.60	TIMES FOR MAXIMA --	TD = 7.5100	TV = 2.5400	TA = 7.2000
PER = 3.70	TIMES FOR MAXIMA --	TD = 7.5100	TV = 2.5400	TA = 7.4500
PER = 3.80	TIMES FOR MAXIMA --	TD = 7.5100	TV = 2.5400	TA = 7.4500
PER = 3.90	TIMES FOR MAXIMA --	TD = 7.5200	TV = 2.5400	TA = 7.5000
PER = 4.00	TIMES FOR MAXIMA --	TD = 7.5200	TV = 2.5400	TA = 7.5000
PER = 4.10	TIMES FOR MAXIMA --	TD = 6.2200	TV = 2.5400	TA = 6.2100
PER = 4.20	TIMES FOR MAXIMA --	TD = 6.2300	TV = 2.5400	TA = 6.2100
PER = 4.30	TIMES FOR MAXIMA --	TD = 6.2300	TV = 2.5400	TA = 6.2100
PER = 4.40	TIMES FOR MAXIMA --	TD = 6.2300	TV = 2.5400	TA = 6.2100
PER = 4.50	TIMES FOR MAXIMA --	TD = 6.2300	TV = 2.5400	TA = 6.2100
PER = 4.60	TIMES FOR MAXIMA --	TD = 6.2400	TV = 2.5400	TA = 6.2100
PER = 4.70	TIMES FOR MAXIMA --	TD = 6.2400	TV = 2.5400	TA = 6.2100
PER = 4.80	TIMES FOR MAXIMA --	TD = 6.2400	TV = 2.5400	TA = 6.2100
PER = 4.90	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5400	TA = 6.2100
PER = 5.00	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5400	TA = 6.2100
PER = 5.10	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5400	TA = 6.2100

PER = 5.20 TIMES FOR MAXIMA -- TD = 6.2500 TV = 2.5400 TA = 6.2100
PER = 5.40 TIMES FOR MAXIMA -- TD = 6.4600 TV = 2.5400 TA = 6.2100
PER = 5.60 TIMES FOR MAXIMA -- TD = 6.4600 TV = 2.5400 TA = 6.3900
PER = 5.80 TIMES FOR MAXIMA -- TD = 6.4600 TV = 2.5400 TA = 6.3900
PER = 6.00 TIMES FOR MAXIMA -- TD = 6.4600 TV = 2.5400 TA = 6.3900
PER = 6.20 TIMES FOR MAXIMA -- TD = 4.8300 TV = 2.5400 TA = 6.3900
PER = 6.40 TIMES FOR MAXIMA -- TD = 4.8300 TV = 2.5400 TA = 4.7900
PER = 6.60 TIMES FOR MAXIMA -- TD = 4.8300 TV = 2.5400 TA = 4.7900
PER = 6.80 TIMES FOR MAXIMA -- TD = 4.8300 TV = 2.5400 TA = 4.7900
PER = 7.00 TIMES FOR MAXIMA -- TD = 4.8300 TV = 2.5400 TA = 4.7900
PER = 7.30 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5400 TA = 4.7900
PER = 7.60 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5400 TA = 4.7900
PER = 8.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5400 TA = 4.7900
PER = 8.50 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5400 TA = 4.7900
PER = 9.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5400 TA = 4.7900
PER = 9.50 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5400 TA = 4.7900
PER =10.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5400 TA = 4.7900

SPECTRAL VALUES--

(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00006	0.00167	0.03999	0.78322	0.78033	100.00
2	0.02	0.00026	0.05122	0.08202	0.78382	0.80027	50.00
3	0.03	0.00108	0.18078	0.22704	1.46295	1.47675	33.33
4	0.04	0.00261	0.33750	0.41034	2.03526	2.00174	25.00
5	0.05	0.00346	0.43096	0.43462	1.70397	1.69616	20.00
6	0.06	0.00431	0.46003	0.45174	1.47295	1.46914	16.67
7	0.07	0.00615	0.54324	0.55221	1.55899	1.53933	14.29
8	0.08	0.01065	0.80833	0.83680	2.02947	2.04107	12.50
9	0.09	0.01356	0.85832	0.94684	2.01865	2.05284	11.11
10	0.10	0.01276	0.74314	0.80165	1.59232	1.56426	10.00
11	0.11	0.01277	0.71906	0.72965	1.30370	1.29433	9.09
12	0.12	0.01000	0.54267	0.52376	0.86058	0.85167	8.33
13	0.13	0.01151	0.49621	0.55634	0.82406	0.83507	7.69
14	0.14	0.01363	0.58469	0.61172	0.86870	0.85261	7.14
15	0.15	0.01657	0.60758	0.69410	0.92263	0.90293	6.67
16	0.16	0.02129	0.85233	0.83605	1.02896	1.01962	6.25
17	0.17	0.02672	1.01990	0.98753	1.14421	1.13351	5.88
18	0.18	0.02858	0.97764	0.99756	1.09703	1.08141	5.56
19	0.19	0.03328	1.01787	1.10039	1.13696	1.13010	5.26
20	0.20	0.03758	1.20226	1.18046	1.16338	1.15172	5.00
21	0.21	0.04688	1.39571	1.40259	1.29816	1.30327	4.76
22	0.22	0.04632	1.35634	1.32282	1.17897	1.17328	4.55
23	0.23	0.04824	1.31203	1.31791	1.12619	1.11811	4.35
24	0.24	0.05152	1.41194	1.34885	1.10178	1.09667	4.17
25	0.25	0.05566	1.43482	1.39900	1.10188	1.09195	4.00
26	0.26	0.06195	1.64751	1.49710	1.12229	1.12357	3.85
27	0.27	0.06099	1.45329	1.41927	1.03721	1.02571	3.70
28	0.28	0.05723	1.37387	1.28419	0.89448	0.89494	3.57
29	0.29	0.05611	1.36106	1.21572	0.81849	0.81801	3.45
30	0.30	0.05850	1.40043	1.22528	0.79896	0.79696	3.33
31	0.31	0.06736	1.44272	1.36525	0.85946	0.85936	3.23
32	0.32	0.06993	1.46762	1.37298	0.83833	0.83722	3.13
33	0.33	0.06795	1.34520	1.29370	0.76518	0.76497	3.03
34	0.34	0.06392	1.24361	1.18127	0.68514	0.67794	2.94
35	0.35	0.05989	1.23583	1.07521	0.60655	0.59945	2.86
36	0.36	0.06142	1.21751	1.07195	0.58678	0.58103	2.78
37	0.37	0.06228	1.17271	1.05757	0.56103	0.55774	2.70
38	0.38	0.06054	1.19764	1.00098	0.51705	0.51400	2.63
39	0.39	0.05648	1.19037	0.90989	0.45839	0.45525	2.56
40	0.40	0.05927	1.13687	0.93100	0.45649	0.45417	2.50

41	0.41	0.05807	1.11252	0.88994	0.42508	0.42354	2.44
42	0.42	0.05475	1.11034	0.81908	0.38329	0.38054	2.38
43	0.43	0.05411	1.07704	0.79066	0.36065	0.35879	2.33
44	0.44	0.05536	1.01131	0.79050	0.35287	0.35057	2.27
45	0.45	0.05402	0.93265	0.75428	0.32910	0.32707	2.22
46	0.46	0.05219	0.84886	0.71285	0.30333	0.30239	2.17
47	0.47	0.05029	0.81371	0.67236	0.28053	0.27914	2.13
48	0.48	0.04866	0.79753	0.63693	0.26020	0.25893	2.08
49	0.49	0.05246	0.79265	0.67269	0.26992	0.26788	2.04
50	0.50	0.05342	0.80355	0.67134	0.26334	0.26200	2.00
51	0.51	0.05180	0.83231	0.63818	0.24561	0.24417	1.96
52	0.52	0.04865	0.87758	0.58785	0.22337	0.22059	1.92
53	0.53	0.04809	0.93468	0.57015	0.21116	0.20991	1.89
54	0.54	0.05221	0.99654	0.60750	0.22103	0.21952	1.85
55	0.55	0.05734	1.05505	0.65507	0.23612	0.23241	1.82
56	0.56	0.06460	1.10247	0.72476	0.25724	0.25254	1.79
57	0.57	0.07177	1.13256	0.79118	0.27543	0.27085	1.75
58	0.58	0.07805	1.14124	0.84547	0.28887	0.28444	1.72
59	0.60	0.08629	1.09042	0.90361	0.29756	0.29387	1.67
60	0.62	0.08911	0.96299	0.90302	0.28616	0.28421	1.61
61	0.64	0.08740	1.03335	0.85802	0.26334	0.26160	1.56
62	0.66	0.08103	1.08367	0.77141	0.23066	0.22807	1.52
63	0.68	0.07125	1.07394	0.65838	0.19145	0.18893	1.47
64	0.70	0.06624	1.01706	0.59460	0.16660	0.16575	1.43
65	0.72	0.06915	0.93131	0.60346	0.16570	0.16354	1.39
66	0.74	0.06691	0.83529	0.56812	0.15191	0.14981	1.35
67	0.76	0.06248	0.74695	0.51658	0.13491	0.13263	1.32
68	0.78	0.06052	0.72138	0.48750	0.12300	0.12196	1.28
69	0.80	0.06240	0.69158	0.49011	0.12056	0.11954	1.25
70	0.82	0.06393	0.68875	0.48986	0.11777	0.11657	1.22
71	0.84	0.06860	0.72531	0.51310	0.12115	0.11919	1.19
72	0.86	0.07725	0.73539	0.56441	0.12974	0.12806	1.16
73	0.88	0.08634	0.75330	0.61647	0.13813	0.13669	1.14
74	0.90	0.09561	0.82006	0.66746	0.14571	0.14471	1.11
75	0.92	0.10819	0.90389	0.73890	0.15775	0.15672	1.09
76	0.94	0.11793	0.95555	0.78826	0.16560	0.16363	1.06
77	0.96	0.12368	1.00369	0.80949	0.16762	0.16454	1.04
78	0.98	0.12910	1.02913	0.82769	0.16611	0.16480	1.02
79	1.00	0.13715	1.02909	0.86174	0.17011	0.16815	1.00
80	1.05	0.14851	1.09174	0.88866	0.16757	0.16515	0.95
81	1.10	0.15169	1.14814	0.86643	0.15494	0.15370	0.91
82	1.15	0.14667	1.18178	0.80136	0.13795	0.13597	0.87
83	1.20	0.13956	1.18699	0.73072	0.11941	0.11882	0.83
84	1.25	0.13697	1.17242	0.68849	0.10845	0.10748	0.80
85	1.30	0.12986	1.14560	0.62762	0.09566	0.09421	0.77
86	1.35	0.12730	1.11229	0.59250	0.08769	0.08564	0.74
87	1.40	0.12316	1.07650	0.55275	0.07933	0.07704	0.71
88	1.45	0.11805	1.04084	0.51153	0.07117	0.06884	0.69
89	1.50	0.11217	1.00684	0.46984	0.06347	0.06112	0.67
90	1.55	0.10598	0.97530	0.42959	0.05643	0.05408	0.65
91	1.60	0.09997	0.94654	0.39258	0.05013	0.04788	0.63
92	1.65	0.09422	0.92055	0.35879	0.04455	0.04243	0.61
93	1.70	0.08902	0.89719	0.32901	0.03966	0.03776	0.59
94	1.75	0.08824	0.87622	0.31683	0.03614	0.03533	0.57
95	1.80	0.09274	0.85738	0.32372	0.03612	0.03509	0.56
96	1.85	0.09291	0.84041	0.31557	0.03449	0.03328	0.54
97	1.90	0.09713	0.82507	0.32121	0.03378	0.03299	0.53
98	1.95	0.09974	0.81115	0.32139	0.03327	0.03216	0.51
99	2.00	0.11000	0.79846	0.34557	0.03500	0.03372	0.50
100	2.05	0.11860	0.78684	0.36350	0.03599	0.03460	0.49
101	2.10	0.12550	0.77617	0.37549	0.03631	0.03489	0.48

102	2.15	0.13066	0.76632	0.38184	0.03615	0.03466	0.47
103	2.20	0.13623	0.75722	0.38908	0.03558	0.03451	0.45
104	2.25	0.14321	0.74877	0.39992	0.03514	0.03468	0.44
105	2.30	0.15035	0.74093	0.41073	0.03568	0.03485	0.43
106	2.35	0.15338	0.73362	0.41008	0.03466	0.03405	0.43
107	2.40	0.15665	0.72682	0.41012	0.03379	0.03334	0.42
108	2.50	0.16142	0.71456	0.40569	0.03190	0.03167	0.40
109	2.60	0.16553	0.70389	0.40001	0.03065	0.03002	0.38
110	2.70	0.16897	0.69461	0.39320	0.02977	0.02842	0.37
111	2.80	0.17331	0.68654	0.38890	0.02840	0.02710	0.36
112	2.90	0.17569	0.67956	0.38066	0.02681	0.02561	0.34
113	3.00	0.17608	0.67353	0.36878	0.02508	0.02399	0.33
114	3.10	0.18292	0.66836	0.37074	0.02395	0.02334	0.32
115	3.20	0.18759	0.66394	0.36832	0.02314	0.02246	0.31
116	3.30	0.19006	0.66019	0.36188	0.02208	0.02140	0.30
117	3.40	0.18998	0.65703	0.35108	0.02084	0.02015	0.29
118	3.50	0.18704	0.65439	0.33578	0.01942	0.01872	0.29
119	3.60	0.18307	0.65219	0.31952	0.01787	0.01732	0.28
120	3.70	0.18376	0.65042	0.31206	0.01699	0.01646	0.27
121	3.80	0.18131	0.64898	0.29979	0.01592	0.01539	0.26
122	3.90	0.17627	0.64785	0.28398	0.01480	0.01421	0.26
123	4.00	0.16871	0.64700	0.26501	0.01360	0.01293	0.25
124	4.10	0.17178	0.64637	0.26325	0.01297	0.01253	0.24
125	4.20	0.17688	0.64596	0.26462	0.01280	0.01229	0.24
126	4.30	0.18085	0.64571	0.26426	0.01254	0.01199	0.23
127	4.40	0.18364	0.64563	0.26224	0.01223	0.01163	0.23
128	4.50	0.18531	0.64568	0.25874	0.01186	0.01122	0.22
129	4.60	0.18596	0.64581	0.25400	0.01145	0.01077	0.22
130	4.70	0.18577	0.64607	0.24835	0.01101	0.01031	0.21
131	4.80	0.18472	0.64641	0.24179	0.01055	0.00983	0.21
132	4.90	0.18295	0.64680	0.23459	0.01008	0.00934	0.20
133	5.00	0.18053	0.64728	0.22687	0.00960	0.00885	0.20
134	5.10	0.17752	0.64776	0.21870	0.00912	0.00837	0.20
135	5.20	0.17397	0.64834	0.21021	0.00865	0.00789	0.19
136	5.40	0.16800	0.64955	0.19547	0.00773	0.00706	0.19
137	5.60	0.16164	0.65082	0.18135	0.00692	0.00632	0.18
138	5.80	0.15390	0.65217	0.16672	0.00620	0.00561	0.17
139	6.00	0.14528	0.65349	0.15214	0.00554	0.00495	0.17
140	6.20	0.14320	0.65491	0.14512	0.00493	0.00457	0.16
141	6.40	0.14484	0.65625	0.14219	0.00467	0.00434	0.16
142	6.60	0.14586	0.65757	0.13886	0.00445	0.00411	0.15
143	6.80	0.14635	0.65892	0.13523	0.00423	0.00388	0.15
144	7.00	0.14639	0.66019	0.13140	0.00401	0.00366	0.14
145	7.30	0.14572	0.66202	0.12542	0.00371	0.00335	0.14
146	7.60	0.14443	0.66371	0.11940	0.00342	0.00307	0.13
147	8.00	0.14189	0.66588	0.11144	0.00307	0.00272	0.13
148	8.50	0.13782	0.66835	0.10188	0.00268	0.00234	0.12
149	9.00	0.13316	0.67056	0.09296	0.00235	0.00202	0.11
150	9.50	0.12821	0.67256	0.08480	0.00207	0.00174	0.11
151	10.00	0.12318	0.67429	0.07740	0.00183	0.00151	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.
AREA OF ACC. RESPONSE SPECTRUM = 0.499
AREA OF VEL. RESPONSE SPECTRUM = 2.275
MAX. ACCELERATION RESPONSE VALUE = 1.592
MAX. VELOCITY RESPONSE VALUE = 1.648

1****** OPTION 9 *** COMPUTE RESPONSE SPECTRUM
RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER 17
CALCULATED FOR DAMPING 0.050

TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
TD = TIME FOR MAX. RELATIVE DISP.
TV = TIME FOR MAX. RELATIVE VEL.
TA = TIME FOR MAX. ABSOLUTE ACC.
DAMPING RATIO = 0.050

PER = 0.01	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5700	TA = 2.5700
PER = 0.02	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5800	TA = 2.5700
PER = 0.03	TIMES FOR MAXIMA --	TD = 2.9500	TV = 2.9400	TA = 2.9500
PER = 0.04	TIMES FOR MAXIMA --	TD = 3.6300	TV = 2.6100	TA = 3.6300
PER = 0.05	TIMES FOR MAXIMA --	TD = 4.8700	TV = 4.8300	TA = 4.8400
PER = 0.06	TIMES FOR MAXIMA --	TD = 4.3200	TV = 4.3300	TA = 1.9700
PER = 0.07	TIMES FOR MAXIMA --	TD = 4.3300	TV = 4.3100	TA = 4.3300
PER = 0.08	TIMES FOR MAXIMA --	TD = 2.5200	TV = 2.5400	TA = 2.5200
PER = 0.09	TIMES FOR MAXIMA --	TD = 2.5300	TV = 2.6000	TA = 2.5300
PER = 0.10	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.6100	TA = 2.5900
PER = 0.11	TIMES FOR MAXIMA --	TD = 2.5500	TV = 2.5800	TA = 2.5500
PER = 0.12	TIMES FOR MAXIMA --	TD = 4.8000	TV = 2.5800	TA = 4.8000
PER = 0.13	TIMES FOR MAXIMA --	TD = 3.6600	TV = 4.7900	TA = 3.6600
PER = 0.14	TIMES FOR MAXIMA --	TD = 3.6700	TV = 3.7100	TA = 3.6700
PER = 0.15	TIMES FOR MAXIMA --	TD = 3.6800	TV = 3.7200	TA = 3.6800
PER = 0.16	TIMES FOR MAXIMA --	TD = 4.1800	TV = 4.1500	TA = 4.1800
PER = 0.17	TIMES FOR MAXIMA --	TD = 4.1100	TV = 4.1500	TA = 4.1100
PER = 0.18	TIMES FOR MAXIMA --	TD = 2.5600	TV = 2.5200	TA = 2.5600
PER = 0.19	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5300	TA = 2.5700
PER = 0.20	TIMES FOR MAXIMA --	TD = 6.6100	TV = 2.5300	TA = 6.6000
PER = 0.21	TIMES FOR MAXIMA --	TD = 2.5800	TV = 2.5300	TA = 7.0500
PER = 0.22	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5500	TA = 2.5000
PER = 0.23	TIMES FOR MAXIMA --	TD = 3.4200	TV = 7.0400	TA = 6.9800
PER = 0.24	TIMES FOR MAXIMA --	TD = 2.2400	TV = 2.2900	TA = 2.2300
PER = 0.25	TIMES FOR MAXIMA --	TD = 6.2400	TV = 6.3100	TA = 6.2400
PER = 0.26	TIMES FOR MAXIMA --	TD = 1.5600	TV = 6.3200	TA = 6.2500
PER = 0.27	TIMES FOR MAXIMA --	TD = 1.1900	TV = 1.2600	TA = 1.1900
PER = 0.28	TIMES FOR MAXIMA --	TD = 1.2100	TV = 1.2600	TA = 1.2000
PER = 0.29	TIMES FOR MAXIMA --	TD = 1.2100	TV = 5.1000	TA = 1.2100
PER = 0.30	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.8400	TA = 2.9100
PER = 0.31	TIMES FOR MAXIMA --	TD = 2.9400	TV = 2.8500	TA = 2.9400
PER = 0.32	TIMES FOR MAXIMA --	TD = 2.9500	TV = 2.5600	TA = 2.9500
PER = 0.33	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5600	TA = 2.5000
PER = 0.34	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5600	TA = 2.5000
PER = 0.35	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.5600	TA = 2.5000
PER = 0.36	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.9300	TA = 2.5000
PER = 0.37	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6000	TA = 2.5000
PER = 0.38	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.8000	TA = 2.5100
PER = 0.39	TIMES FOR MAXIMA --	TD = 2.5200	TV = 4.0300	TA = 2.5100
PER = 0.40	TIMES FOR MAXIMA --	TD = 3.9400	TV = 4.0300	TA = 3.9400
PER = 0.41	TIMES FOR MAXIMA --	TD = 3.9500	TV = 4.0400	TA = 3.9500
PER = 0.42	TIMES FOR MAXIMA --	TD = 3.9600	TV = 4.0400	TA = 3.9500
PER = 0.43	TIMES FOR MAXIMA --	TD = 3.9700	TV = 4.0500	TA = 3.9600
PER = 0.44	TIMES FOR MAXIMA --	TD = 3.9800	TV = 3.9100	TA = 3.9700
PER = 0.45	TIMES FOR MAXIMA --	TD = 4.6900	TV = 3.9100	TA = 4.6900
PER = 0.46	TIMES FOR MAXIMA --	TD = 4.7000	TV = 3.9100	TA = 4.6900
PER = 0.47	TIMES FOR MAXIMA --	TD = 4.7100	TV = 3.9100	TA = 4.7000
PER = 0.48	TIMES FOR MAXIMA --	TD = 4.7100	TV = 3.9100	TA = 4.7000
PER = 0.49	TIMES FOR MAXIMA --	TD = 5.5200	TV = 5.4100	TA = 5.5100
PER = 0.50	TIMES FOR MAXIMA --	TD = 5.5500	TV = 5.4100	TA = 5.5400
PER = 0.51	TIMES FOR MAXIMA --	TD = 5.5600	TV = 5.4100	TA = 5.5600
PER = 0.52	TIMES FOR MAXIMA --	TD = 2.5100	TV = 5.4400	TA = 2.5000
PER = 0.53	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6100	TA = 2.5000
PER = 0.54	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6300	TA = 2.5000
PER = 0.55	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6400	TA = 2.5000
PER = 0.56	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6400	TA = 2.5000

PER = 0.57	TIMES FOR MAXIMA --	TD = 2.5200	TV = 2.6400	TA = 2.5100
PER = 0.58	TIMES FOR MAXIMA --	TD = 2.5200	TV = 2.6400	TA = 2.5100
PER = 0.60	TIMES FOR MAXIMA --	TD = 2.5400	TV = 2.4800	TA = 2.5300
PER = 0.62	TIMES FOR MAXIMA --	TD = 2.5600	TV = 2.4800	TA = 2.5500
PER = 0.64	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.4800	TA = 2.5800
PER = 0.66	TIMES FOR MAXIMA --	TD = 2.6000	TV = 2.4900	TA = 2.5900
PER = 0.68	TIMES FOR MAXIMA --	TD = 3.4100	TV = 2.4900	TA = 3.4000
PER = 0.70	TIMES FOR MAXIMA --	TD = 3.4200	TV = 2.4900	TA = 3.4100
PER = 0.72	TIMES FOR MAXIMA --	TD = 3.4300	TV = 3.6100	TA = 3.4200
PER = 0.74	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.6100	TA = 3.4300
PER = 0.76	TIMES FOR MAXIMA --	TD = 1.8100	TV = 3.6100	TA = 1.7500
PER = 0.78	TIMES FOR MAXIMA --	TD = 1.4700	TV = 3.6100	TA = 1.8100
PER = 0.80	TIMES FOR MAXIMA --	TD = 1.4700	TV = 3.6100	TA = 1.4600
PER = 0.82	TIMES FOR MAXIMA --	TD = 1.4900	TV = 3.6100	TA = 1.4700
PER = 0.84	TIMES FOR MAXIMA --	TD = 6.4900	TV = 3.6200	TA = 6.4800
PER = 0.86	TIMES FOR MAXIMA --	TD = 3.4700	TV = 4.2200	TA = 3.4700
PER = 0.88	TIMES FOR MAXIMA --	TD = 4.0000	TV = 4.2200	TA = 3.9700
PER = 0.90	TIMES FOR MAXIMA --	TD = 4.0100	TV = 4.2200	TA = 4.0000
PER = 0.92	TIMES FOR MAXIMA --	TD = 4.0100	TV = 4.2900	TA = 4.0000
PER = 0.94	TIMES FOR MAXIMA --	TD = 3.1200	TV = 4.2900	TA = 3.1100
PER = 0.96	TIMES FOR MAXIMA --	TD = 3.1200	TV = 3.9100	TA = 3.1100
PER = 0.98	TIMES FOR MAXIMA --	TD = 3.1300	TV = 3.9100	TA = 3.1200
PER = 1.00	TIMES FOR MAXIMA --	TD = 3.1500	TV = 3.9100	TA = 3.1200
PER = 1.05	TIMES FOR MAXIMA --	TD = 3.2000	TV = 3.9100	TA = 3.1800
PER = 1.10	TIMES FOR MAXIMA --	TD = 3.2300	TV = 2.4900	TA = 3.2200
PER = 1.15	TIMES FOR MAXIMA --	TD = 3.3000	TV = 2.4900	TA = 3.2900
PER = 1.20	TIMES FOR MAXIMA --	TD = 3.3300	TV = 2.4900	TA = 3.3100
PER = 1.25	TIMES FOR MAXIMA --	TD = 3.3500	TV = 2.4900	TA = 3.3300
PER = 1.30	TIMES FOR MAXIMA --	TD = 3.3700	TV = 2.4900	TA = 3.3600
PER = 1.35	TIMES FOR MAXIMA --	TD = 2.8400	TV = 2.4900	TA = 2.8200
PER = 1.40	TIMES FOR MAXIMA --	TD = 2.8700	TV = 2.4900	TA = 2.8300
PER = 1.45	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.4900	TA = 2.8600
PER = 1.50	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.4900	TA = 2.8900
PER = 1.55	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.4900	TA = 2.9100
PER = 1.60	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.4900	TA = 2.9100
PER = 1.65	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.4900	TA = 2.9100
PER = 1.70	TIMES FOR MAXIMA --	TD = 2.9900	TV = 2.4900	TA = 2.3700
PER = 1.75	TIMES FOR MAXIMA --	TD = 2.3900	TV = 2.4900	TA = 2.3700
PER = 1.80	TIMES FOR MAXIMA --	TD = 5.9300	TV = 2.4900	TA = 5.9200
PER = 1.85	TIMES FOR MAXIMA --	TD = 6.0000	TV = 2.4900	TA = 5.9900
PER = 1.90	TIMES FOR MAXIMA --	TD = 6.0500	TV = 5.7600	TA = 6.0400
PER = 1.95	TIMES FOR MAXIMA --	TD = 5.3500	TV = 5.7600	TA = 5.3400
PER = 2.00	TIMES FOR MAXIMA --	TD = 5.3600	TV = 5.7600	TA = 5.3400
PER = 2.05	TIMES FOR MAXIMA --	TD = 5.3600	TV = 5.7600	TA = 5.3400
PER = 2.10	TIMES FOR MAXIMA --	TD = 5.3600	TV = 5.7600	TA = 5.3400
PER = 2.15	TIMES FOR MAXIMA --	TD = 8.7100	TV = 5.7600	TA = 5.3400
PER = 2.20	TIMES FOR MAXIMA --	TD = 8.8100	TV = 5.7600	TA = 7.6700
PER = 2.25	TIMES FOR MAXIMA --	TD = 8.8900	TV = 5.7600	TA = 8.8800
PER = 2.30	TIMES FOR MAXIMA --	TD = 7.8200	TV = 5.7600	TA = 8.8800
PER = 2.35	TIMES FOR MAXIMA --	TD = 7.8800	TV = 5.7600	TA = 7.7900
PER = 2.40	TIMES FOR MAXIMA --	TD = 7.9100	TV = 5.7600	TA = 7.8800
PER = 2.50	TIMES FOR MAXIMA --	TD = 8.0300	TV = 7.3100	TA = 8.0100
PER = 2.60	TIMES FOR MAXIMA --	TD = 8.0600	TV = 7.6400	TA = 8.0200
PER = 2.70	TIMES FOR MAXIMA --	TD = 6.9400	TV = 7.6400	TA = 6.8800
PER = 2.80	TIMES FOR MAXIMA --	TD = 6.9400	TV = 7.6500	TA = 6.8800
PER = 2.90	TIMES FOR MAXIMA --	TD = 7.0600	TV = 7.6500	TA = 6.9300
PER = 3.00	TIMES FOR MAXIMA --	TD = 7.1500	TV = 7.6500	TA = 7.0400
PER = 3.10	TIMES FOR MAXIMA --	TD = 7.1900	TV = 5.3000	TA = 7.1400
PER = 3.20	TIMES FOR MAXIMA --	TD = 7.2000	TV = 5.3000	TA = 7.1400
PER = 3.30	TIMES FOR MAXIMA --	TD = 7.2100	TV = 5.3000	TA = 7.1800
PER = 3.40	TIMES FOR MAXIMA --	TD = 7.2100	TV = 5.3000	TA = 7.1800

PER = 3.50 TIMES FOR MAXIMA -- TD = 7.2200 TV = 5.3000 TA = 7.1900
PER = 3.60 TIMES FOR MAXIMA -- TD = 7.4500 TV = 5.3000 TA = 7.3800
PER = 3.70 TIMES FOR MAXIMA -- TD = 7.4600 TV = 5.3000 TA = 7.3900
PER = 3.80 TIMES FOR MAXIMA -- TD = 7.5000 TV = 5.3000 TA = 7.4400
PER = 3.90 TIMES FOR MAXIMA -- TD = 7.5100 TV = 5.3000 TA = 7.4500
PER = 4.00 TIMES FOR MAXIMA -- TD = 7.6200 TV = 5.3000 TA = 7.4500
PER = 4.10 TIMES FOR MAXIMA -- TD = 6.1600 TV = 5.3000 TA = 6.0900
PER = 4.20 TIMES FOR MAXIMA -- TD = 6.1600 TV = 5.3000 TA = 6.1400
PER = 4.30 TIMES FOR MAXIMA -- TD = 6.1700 TV = 5.3000 TA = 6.1500
PER = 4.40 TIMES FOR MAXIMA -- TD = 6.1900 TV = 5.3000 TA = 6.1500
PER = 4.50 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.60 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.70 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.80 TIMES FOR MAXIMA -- TD = 6.3400 TV = 5.3000 TA = 6.1500
PER = 4.90 TIMES FOR MAXIMA -- TD = 6.3400 TV = 5.3000 TA = 6.1500
PER = 5.00 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.10 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.20 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.40 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.60 TIMES FOR MAXIMA -- TD = 6.5400 TV = 5.3000 TA = 6.3200
PER = 5.80 TIMES FOR MAXIMA -- TD = 6.5500 TV = 5.3000 TA = 6.5000
PER = 6.00 TIMES FOR MAXIMA -- TD = 6.5500 TV = 5.3000 TA = 6.5000
PER = 6.20 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.5200
PER = 6.40 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.7300
PER = 6.60 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.7300
PER = 6.80 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.30 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.60 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 8.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 8.50 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 9.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 9.50 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER =10.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300

SPECTRAL VALUES--

(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00005	0.00136	0.02849	0.55850	0.55584	100.00
2	0.02	0.00018	0.04499	0.05569	0.55907	0.54337	50.00
3	0.03	0.00100	0.17299	0.21036	1.35502	1.36825	33.33
4	0.04	0.00178	0.23944	0.27972	1.41661	1.36454	25.00
5	0.05	0.00238	0.31660	0.29913	1.19625	1.16738	20.00
6	0.06	0.00324	0.37402	0.33931	1.11290	1.10350	16.67
7	0.07	0.00410	0.42586	0.36768	1.00192	1.02494	14.29
8	0.08	0.00662	0.49285	0.51989	1.30592	1.26808	12.50
9	0.09	0.01058	0.74261	0.73891	1.61391	1.60203	11.11
10	0.10	0.00992	0.62974	0.62356	1.19459	1.21675	10.00
11	0.11	0.00945	0.61752	0.53978	0.94469	0.95753	9.09
12	0.12	0.00955	0.45760	0.49991	0.83422	0.81289	8.33
13	0.13	0.00942	0.48076	0.45527	0.67574	0.68335	7.69
14	0.14	0.01238	0.51781	0.55546	0.77129	0.77420	7.14
15	0.15	0.01197	0.53788	0.50127	0.65502	0.65209	6.67
16	0.16	0.01428	0.62039	0.56072	0.68796	0.68383	6.25
17	0.17	0.01619	0.69957	0.59823	0.69353	0.68666	5.88
18	0.18	0.01573	0.57102	0.54919	0.60640	0.59536	5.56
19	0.19	0.01745	0.63990	0.57695	0.59795	0.59253	5.26
20	0.20	0.01613	0.56661	0.50682	0.50024	0.49448	5.00
21	0.21	0.01674	0.60435	0.50091	0.46688	0.46544	4.76
22	0.22	0.01774	0.54424	0.50670	0.46072	0.44942	4.55
23	0.23	0.01530	0.47636	0.41797	0.35437	0.35460	4.35

24	0.24	0.01639	0.46797	0.42917	0.35591	0.34893	4.17
25	0.25	0.01736	0.48167	0.43619	0.34254	0.34046	4.00
26	0.26	0.01916	0.51490	0.46302	0.35118	0.34750	3.85
27	0.27	0.02110	0.53368	0.49104	0.35711	0.35488	3.70
28	0.28	0.02280	0.53679	0.51153	0.35936	0.35648	3.57
29	0.29	0.02363	0.56432	0.51192	0.34832	0.34445	3.45
30	0.30	0.02424	0.55960	0.50764	0.33261	0.33018	3.33
31	0.31	0.02969	0.62717	0.60171	0.38143	0.37875	3.23
32	0.32	0.03087	0.64924	0.60610	0.37197	0.36959	3.13
33	0.33	0.02956	0.62054	0.56290	0.33676	0.33284	3.03
34	0.34	0.02988	0.59171	0.55227	0.32331	0.31695	2.94
35	0.35	0.03145	0.58062	0.56451	0.32000	0.31472	2.86
36	0.36	0.03369	0.56893	0.58806	0.32211	0.31875	2.78
37	0.37	0.03527	0.58074	0.59894	0.31687	0.31587	2.70
38	0.38	0.03518	0.57848	0.58166	0.30335	0.29868	2.63
39	0.39	0.03387	0.62913	0.54565	0.27671	0.27301	2.56
40	0.40	0.03589	0.68918	0.56383	0.27621	0.27505	2.50
41	0.41	0.03816	0.69282	0.58485	0.27999	0.27835	2.44
42	0.42	0.03860	0.65645	0.57750	0.26954	0.26830	2.38
43	0.43	0.03804	0.60516	0.55578	0.25364	0.25221	2.33
44	0.44	0.03681	0.59581	0.52568	0.23464	0.23313	2.27
45	0.45	0.03653	0.60067	0.51004	0.22154	0.22117	2.22
46	0.46	0.03729	0.59047	0.50937	0.21665	0.21607	2.17
47	0.47	0.03606	0.57052	0.48207	0.20332	0.20014	2.13
48	0.48	0.03349	0.54379	0.43835	0.18014	0.17820	2.08
49	0.49	0.03413	0.51793	0.43769	0.17566	0.17430	2.04
50	0.50	0.03500	0.52157	0.43985	0.17218	0.17165	2.00
51	0.51	0.03473	0.49075	0.42793	0.16499	0.16373	1.96
52	0.52	0.03363	0.45429	0.40638	0.15517	0.15249	1.92
53	0.53	0.03853	0.46746	0.45674	0.17096	0.16816	1.89
54	0.54	0.04389	0.51448	0.51070	0.18737	0.18454	1.85
55	0.55	0.04926	0.55886	0.56278	0.20245	0.19966	1.82
56	0.56	0.05415	0.59863	0.60760	0.21441	0.21172	1.79
57	0.57	0.05848	0.62378	0.64468	0.22381	0.22070	1.75
58	0.58	0.06184	0.63106	0.66986	0.22829	0.22536	1.72
59	0.60	0.06544	0.70068	0.68529	0.22393	0.22287	1.67
60	0.62	0.06573	0.79556	0.66617	0.21124	0.20966	1.61
61	0.64	0.06527	0.83826	0.64083	0.19701	0.19538	1.56
62	0.66	0.06037	0.83336	0.57472	0.17238	0.16992	1.52
63	0.68	0.05937	0.78867	0.54857	0.15814	0.15742	1.47
64	0.70	0.06308	0.71314	0.56623	0.15969	0.15784	1.43
65	0.72	0.06124	0.63612	0.53441	0.14674	0.14483	1.39
66	0.74	0.05637	0.58189	0.47867	0.12760	0.12622	1.35
67	0.76	0.05182	0.52189	0.42839	0.11039	0.10999	1.32
68	0.78	0.05224	0.48141	0.42084	0.10620	0.10528	1.28
69	0.80	0.05347	0.46947	0.41997	0.10299	0.10244	1.25
70	0.82	0.05454	0.48106	0.41789	0.09999	0.09944	1.22
71	0.84	0.05857	0.50396	0.43810	0.10258	0.10177	1.19
72	0.86	0.06521	0.56033	0.47640	0.10880	0.10809	1.16
73	0.88	0.07540	0.63272	0.53836	0.11994	0.11938	1.14
74	0.90	0.08642	0.69483	0.60330	0.13206	0.13080	1.11
75	0.92	0.09546	0.73421	0.65194	0.14025	0.13828	1.09
76	0.94	0.10261	0.79469	0.68589	0.14302	0.14238	1.06
77	0.96	0.11124	0.85758	0.72810	0.14917	0.14799	1.04
78	0.98	0.11832	0.92962	0.75859	0.15264	0.15105	1.02
79	1.00	0.12378	0.97242	0.77774	0.15296	0.15176	1.00
80	1.05	0.13543	0.94462	0.81038	0.15223	0.15060	0.95
81	1.10	0.13936	0.91425	0.79602	0.14229	0.14121	0.91
82	1.15	0.13942	0.92776	0.76173	0.12990	0.12925	0.87
83	1.20	0.13742	0.91717	0.71955	0.11796	0.11700	0.83
84	1.25	0.13052	0.89112	0.65605	0.10342	0.10241	0.80

85	1.30	0.12014	0.85653	0.58064	0.08786	0.08715	0.77
86	1.35	0.11483	0.81840	0.53443	0.07843	0.07725	0.74
87	1.40	0.11078	0.78000	0.49719	0.06994	0.06930	0.71
88	1.45	0.10667	0.74332	0.46222	0.06255	0.06220	0.69
89	1.50	0.10247	0.70939	0.42921	0.05627	0.05583	0.67
90	1.55	0.09800	0.67864	0.39727	0.05054	0.05001	0.65
91	1.60	0.09315	0.65110	0.36578	0.04533	0.04461	0.63
92	1.65	0.08827	0.62659	0.33614	0.04056	0.03975	0.61
93	1.70	0.08406	0.60485	0.31070	0.03642	0.03566	0.59
94	1.75	0.08232	0.58554	0.29557	0.03416	0.03296	0.57
95	1.80	0.08511	0.56835	0.29710	0.03252	0.03221	0.56
96	1.85	0.09046	0.55299	0.30724	0.03299	0.03241	0.54
97	1.90	0.09369	0.55264	0.30982	0.03228	0.03182	0.53
98	1.95	0.09719	0.57669	0.31317	0.03199	0.03134	0.51
99	2.00	0.10618	0.59049	0.33357	0.03334	0.03254	0.50
100	2.05	0.11329	0.59503	0.34724	0.03395	0.03305	0.49
101	2.10	0.11848	0.59178	0.35449	0.03395	0.03294	0.48
102	2.15	0.12507	0.58239	0.36551	0.03345	0.03317	0.47
103	2.20	0.13231	0.56849	0.37788	0.03396	0.03352	0.45
104	2.25	0.14127	0.55156	0.39451	0.03461	0.03421	0.44
105	2.30	0.14555	0.53286	0.39762	0.03432	0.03373	0.43
106	2.35	0.15032	0.51341	0.40191	0.03358	0.03337	0.43
107	2.40	0.15378	0.49399	0.40261	0.03307	0.03273	0.42
108	2.50	0.16045	0.47493	0.40326	0.03175	0.03148	0.40
109	2.60	0.16086	0.46775	0.38874	0.02958	0.02918	0.38
110	2.70	0.16244	0.48295	0.37802	0.02799	0.02732	0.37
111	2.80	0.16553	0.48384	0.37144	0.02643	0.02589	0.36
112	2.90	0.16738	0.47446	0.36265	0.02483	0.02440	0.34
113	3.00	0.17264	0.45662	0.36159	0.02380	0.02352	0.33
114	3.10	0.17811	0.44595	0.36099	0.02309	0.02272	0.32
115	3.20	0.18202	0.45345	0.35740	0.02213	0.02179	0.31
116	3.30	0.18346	0.46135	0.34931	0.02109	0.02065	0.30
117	3.40	0.18236	0.46940	0.33701	0.01986	0.01934	0.29
118	3.50	0.17866	0.47735	0.32073	0.01848	0.01788	0.29
119	3.60	0.17795	0.48496	0.31058	0.01717	0.01683	0.28
120	3.70	0.17716	0.49200	0.30084	0.01615	0.01587	0.27
121	3.80	0.17389	0.49830	0.28752	0.01510	0.01476	0.26
122	3.90	0.16892	0.50375	0.27215	0.01394	0.01362	0.26
123	4.00	0.16257	0.50827	0.25536	0.01270	0.01246	0.25
124	4.10	0.16720	0.51183	0.25624	0.01240	0.01220	0.24
125	4.20	0.17130	0.51442	0.25627	0.01215	0.01191	0.24
126	4.30	0.17439	0.51608	0.25482	0.01186	0.01156	0.23
127	4.40	0.17660	0.51685	0.25219	0.01151	0.01118	0.23
128	4.50	0.17784	0.51679	0.24832	0.01111	0.01077	0.22
129	4.60	0.17820	0.51597	0.24340	0.01069	0.01033	0.22
130	4.70	0.17762	0.51446	0.23745	0.01023	0.00986	0.21
131	4.80	0.17619	0.51234	0.23064	0.00976	0.00938	0.21
132	4.90	0.17586	0.50969	0.22550	0.00929	0.00898	0.20
133	5.00	0.17475	0.50658	0.21959	0.00889	0.00857	0.20
134	5.10	0.17300	0.50308	0.21314	0.00850	0.00815	0.20
135	5.20	0.17062	0.49924	0.20616	0.00810	0.00774	0.19
136	5.40	0.16427	0.49084	0.19114	0.00731	0.00691	0.19
137	5.60	0.15767	0.48179	0.17690	0.00653	0.00616	0.18
138	5.80	0.15136	0.47242	0.16397	0.00581	0.00552	0.17
139	6.00	0.14395	0.46299	0.15074	0.00521	0.00490	0.17
140	6.20	0.14150	0.45370	0.14340	0.00485	0.00451	0.16
141	6.40	0.14276	0.44470	0.14015	0.00459	0.00427	0.16
142	6.60	0.14344	0.43607	0.13655	0.00436	0.00404	0.15
143	6.80	0.14364	0.42789	0.13273	0.00413	0.00381	0.15
144	7.00	0.14346	0.42018	0.12877	0.00392	0.00359	0.14
145	7.30	0.14249	0.40956	0.12264	0.00361	0.00328	0.14

146	7.60	0.14087	0.40837	0.11646	0.00332	0.00299	0.13
147	8.00	0.13798	0.41060	0.10837	0.00297	0.00264	0.13
148	8.50	0.13357	0.41312	0.09873	0.00259	0.00227	0.12
149	9.00	0.12865	0.41537	0.08981	0.00226	0.00195	0.11
150	9.50	0.12352	0.41738	0.08169	0.00198	0.00168	0.11
151	10.00	0.11835	0.41917	0.07436	0.00175	0.00145	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.
AREA OF ACC. RESPONSE SPECTRUM = 0.331
AREA OF VEL. RESPONSE SPECTRUM = 1.567
MAX. ACCELERATION RESPONSE VALUE = 1.195
MAX. VELOCITY RESPONSE VALUE = 0.972

*** End of Output File No. 1 ***

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Induced Cyclic Shear Stresses and Strains, and Time Histories PAGE 54 OF 187

of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M

MADE BY BEG DATE 1/7/08 CHECKED BY [illegible] DATE 1/23/09

SUMMARY OF EARTHQUAKE INDUCED CYCLIC SHEAR STRESS AND STRAIN SHAKE2000 ANALYSES OUTPUT FILES FOR M6.8 BACKGROUND MDE AT 13.5 KM SHAKE2000 COLUMN PCSC300M

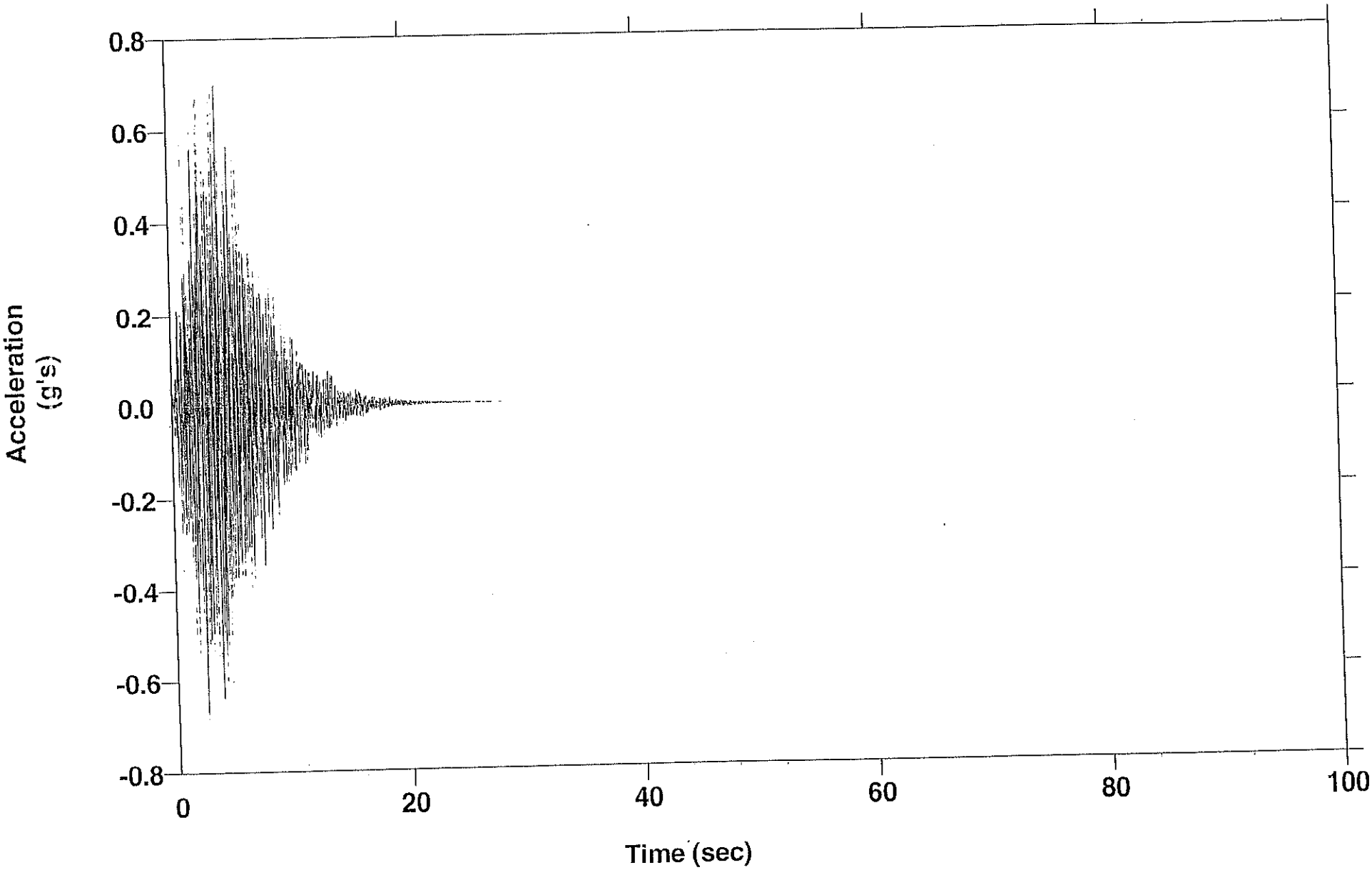
PCSC300M Crest Column
Williamson - Pond Creek South Cell - Surf. El. 502, GWT 32ft., Fines El. 474
M6.8 Background Synthetic @13.5km, PGA=0.54g - Atkinson & Boore (1995)

Layer	Depth to Middle of Layer (ft)	Total Unit Weight (kcf)	Damping Used (%)	Shear Modulus (ksf)	Maximum Shear Strain (%)	Maximum Shear Stress (psf)	Shear Wave Velocity (fps)	Depth to Top of Layer (ft)	Peak Acceleration (g)	G/Gmax Curve	Damping Curve
1	2	.13	2.7	2984.4	.00699	208.65	859.775	0	.82118	Coarse	Coarse
2	5.5	.13	4.3	2790.8	.01829	510.56	831.4203	4	.66221	Coarse	Coarse
3	8.5	.13	4.9	2786.4	.02359	657.19	830.7646	7	.45724	Coarse	Coarse
4	11.5	.13	4.2	4180.1	.01783	745.46	1017.536	10	.4914	Coarse	Coarse
5	14.5	.14	5.1	3242.1	.02661	862.84	863.5294	13	.47695	Coarse	Coarse
6	17.5	.14	6.3	2562.8	.04089	1047.93	767.7526	16	.48874	Coarse	Coarse
7	20.5	.14	6.4	2737.4	.04286	1173.22	793.4746	19	.46491	Coarse	Coarse
8	23.5	.14	7.3	2187.7	.05683	1243.29	709.3455	22	.51703	Coarse	Coarse
9	26.5	.14	6.7	2567.1	.04803	1232.98	768.3964	25	.52919	Coarse	Coarse
10	30	.14	6.4	2734.6	.04236	1158.3	793.0687	28	.52041	Coarse	Coarse
11	33.5	.135	5.9	1680.1	.06726	1130.04	633.0363	32	.76846	Residual	Residual
12	36.5	.135	6.1	1669.8	.07088	1183.52	631.0929	35	.80342	Residual	Residual
13	39.5	.135	5.8	1929.1	.06525	1258.79	678.3259	38	.73631	Residual	Residual
14	42.5	.135	5.2	2549.6	.05468	1394.02	779.8249	41	.6505	Residual	Residual
15	45.5	.135	3.3	5182.9	.0282	1461.76	1111.853	44	.53855	Residual	Residual
16	48.5	.135	3.5	5064.7	.03086	1562.9	1099.102	47	.52173	Residual	Residual
17	Base							50	.49204		
17	Outcrop							50	.55791		

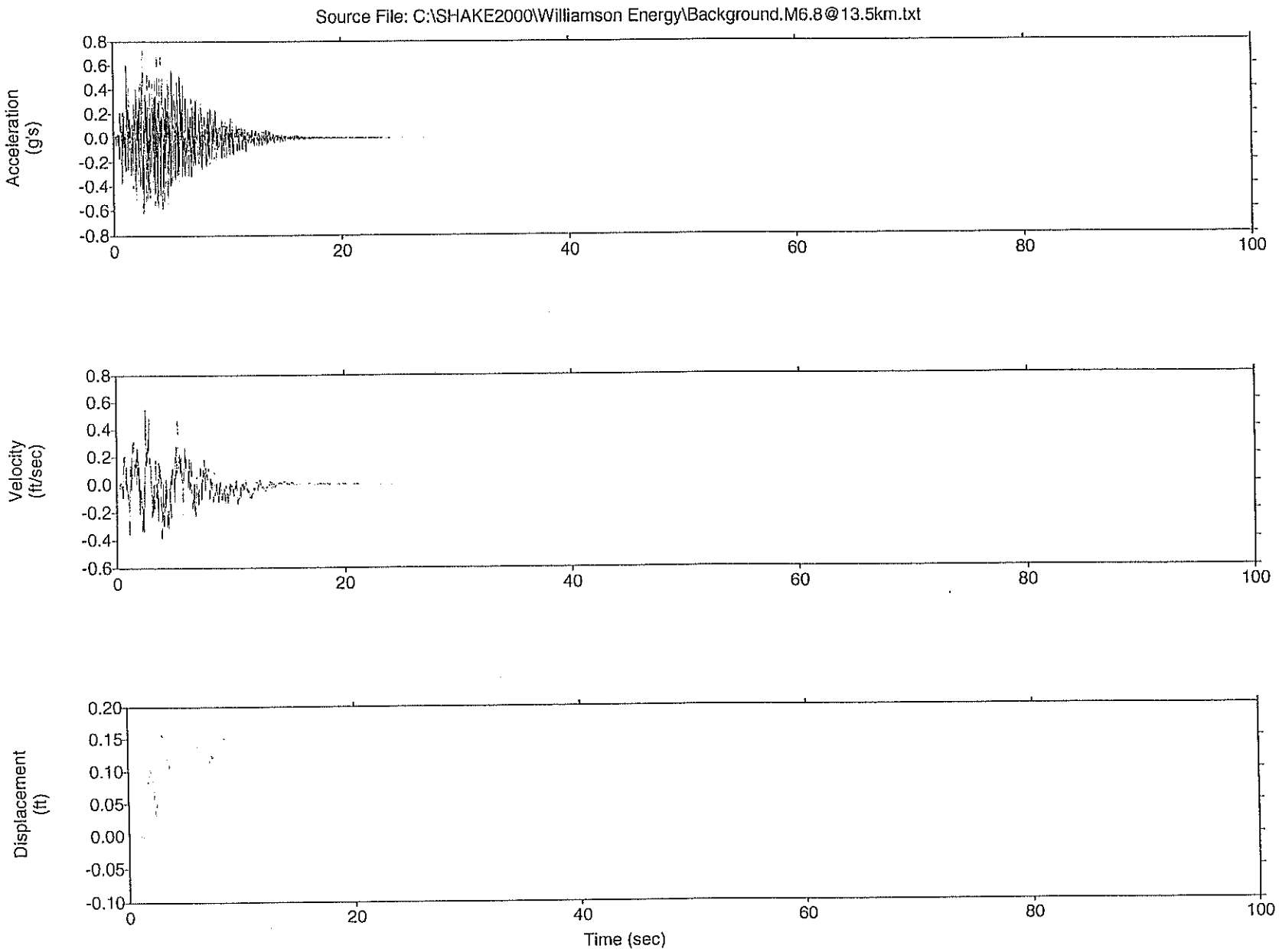
Notes:
Period for Soil Column: .24 sec
Average Shear Wave Velocity for Soil Column: 823 ft/sec

55 / 182
R14196

M6.8 Background Synthetic @13.5km - Atkinson & Boore (1995)

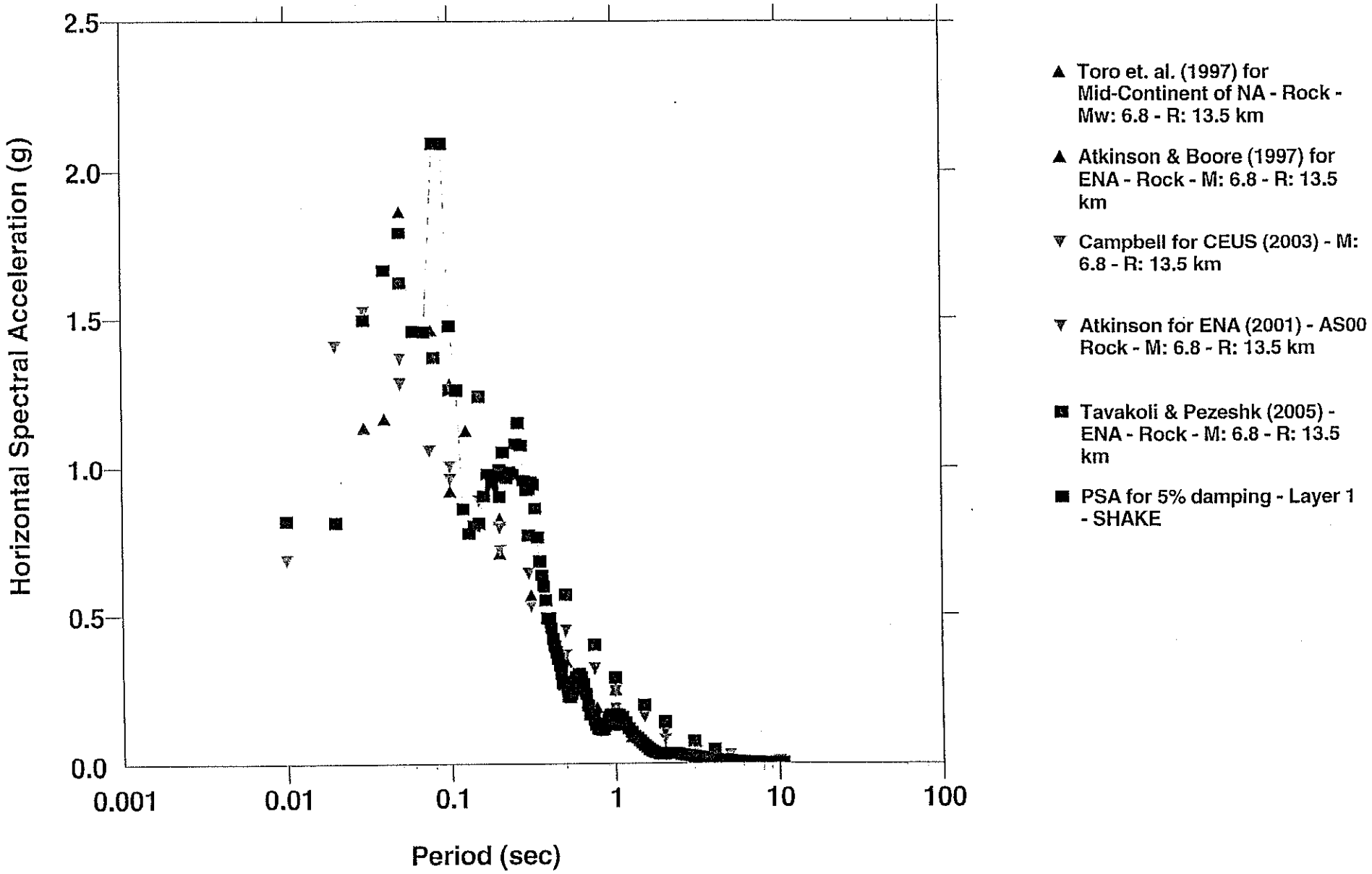


R14197


Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt
Acceleration (g's)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0
20
40
60
80
100
Velocity (ft/sec)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
0
20
40
60
80
100
Displacement (ft)
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
0
20
40
60
80
100
Time (sec)

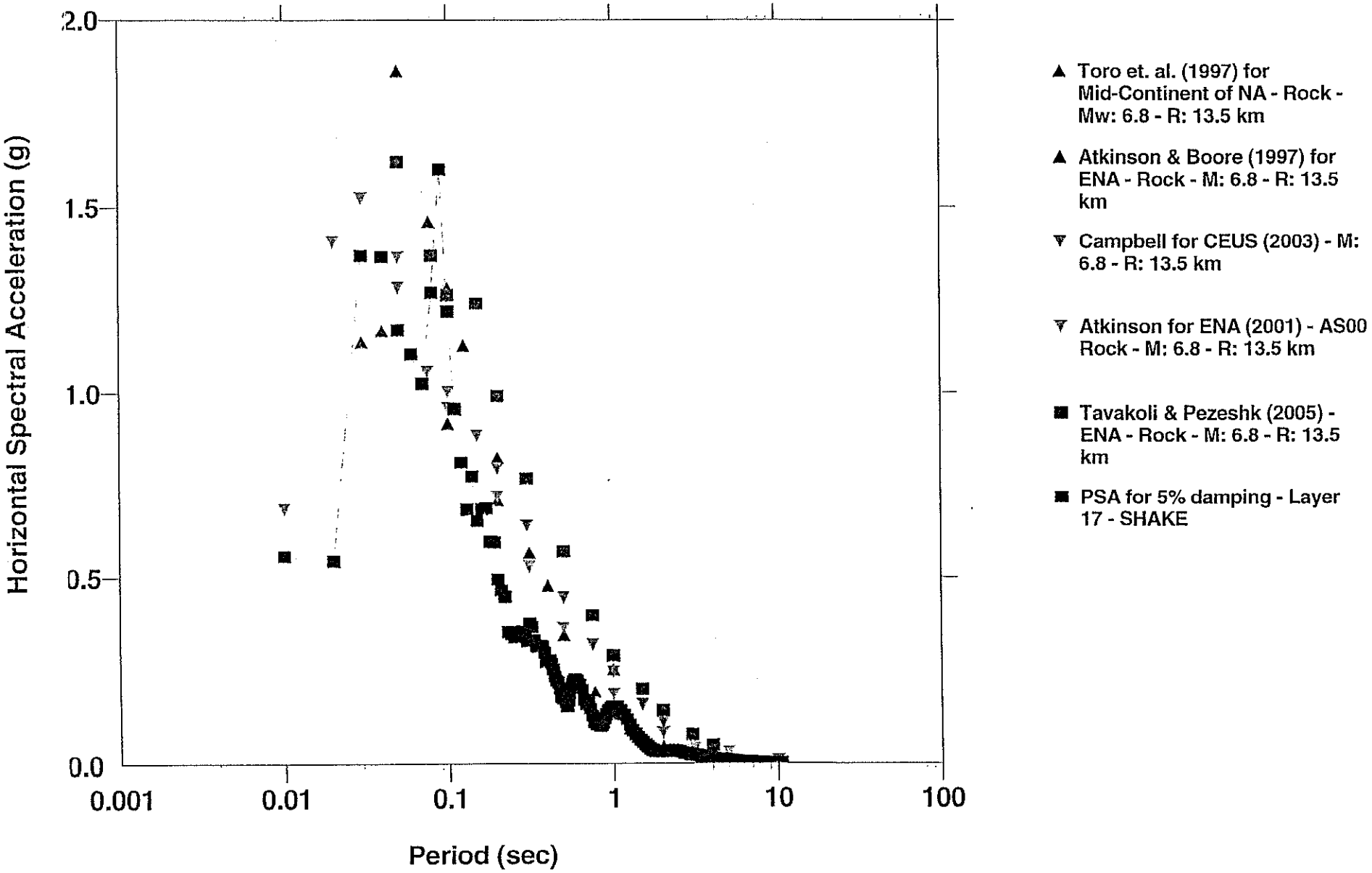
R14198

PSCS300M Crest Column - M6.8 Background Synthetic @13.5km



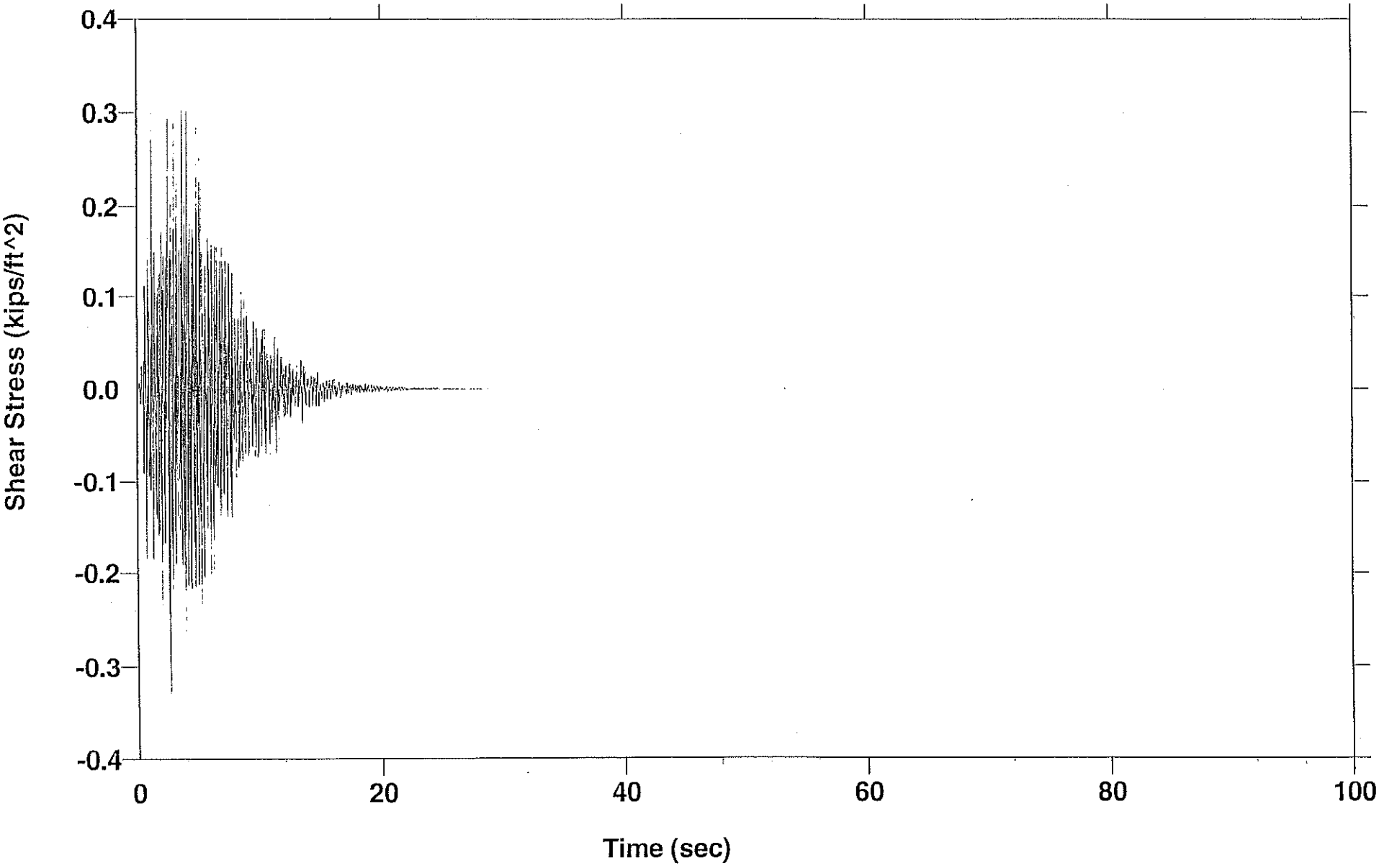
R14199

PSCS300M Crest Column - M6.8 Background Synthetic @13.5km

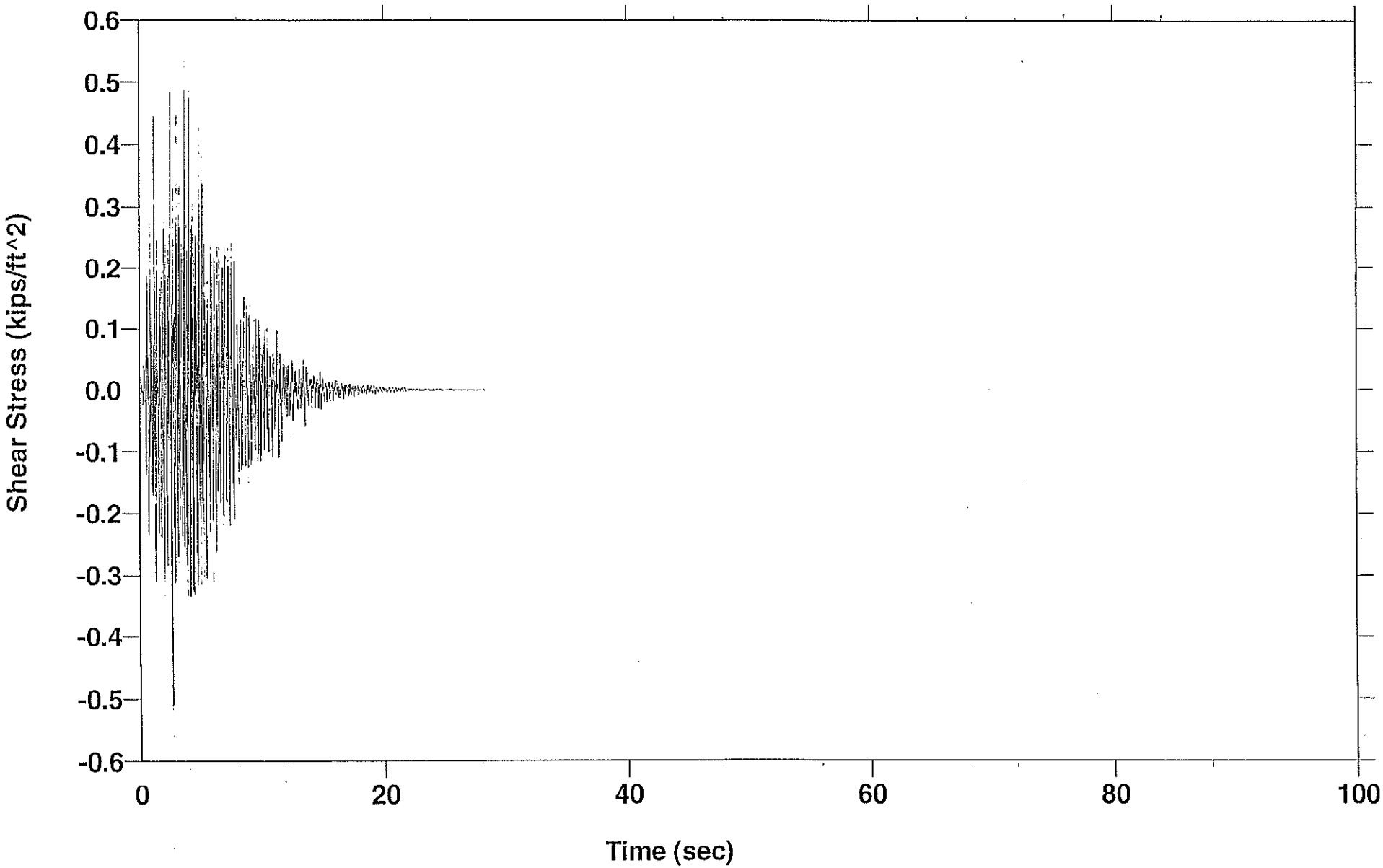


R14200

PCSC300M Layer 2 Stress - M6.8 Background Synthetic

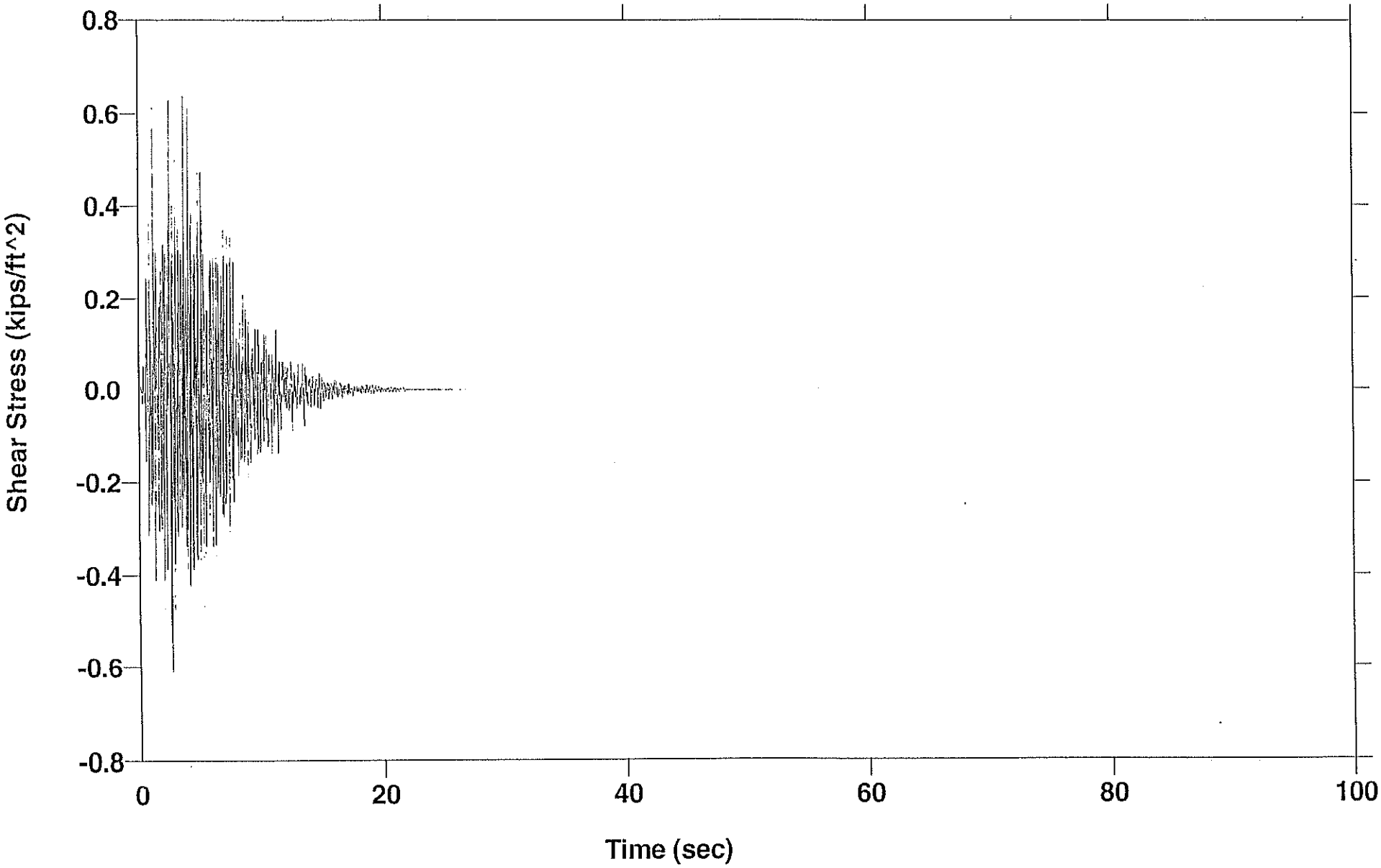


PCSC300M Layer 3 Stress - M6.8 Background Synthetic



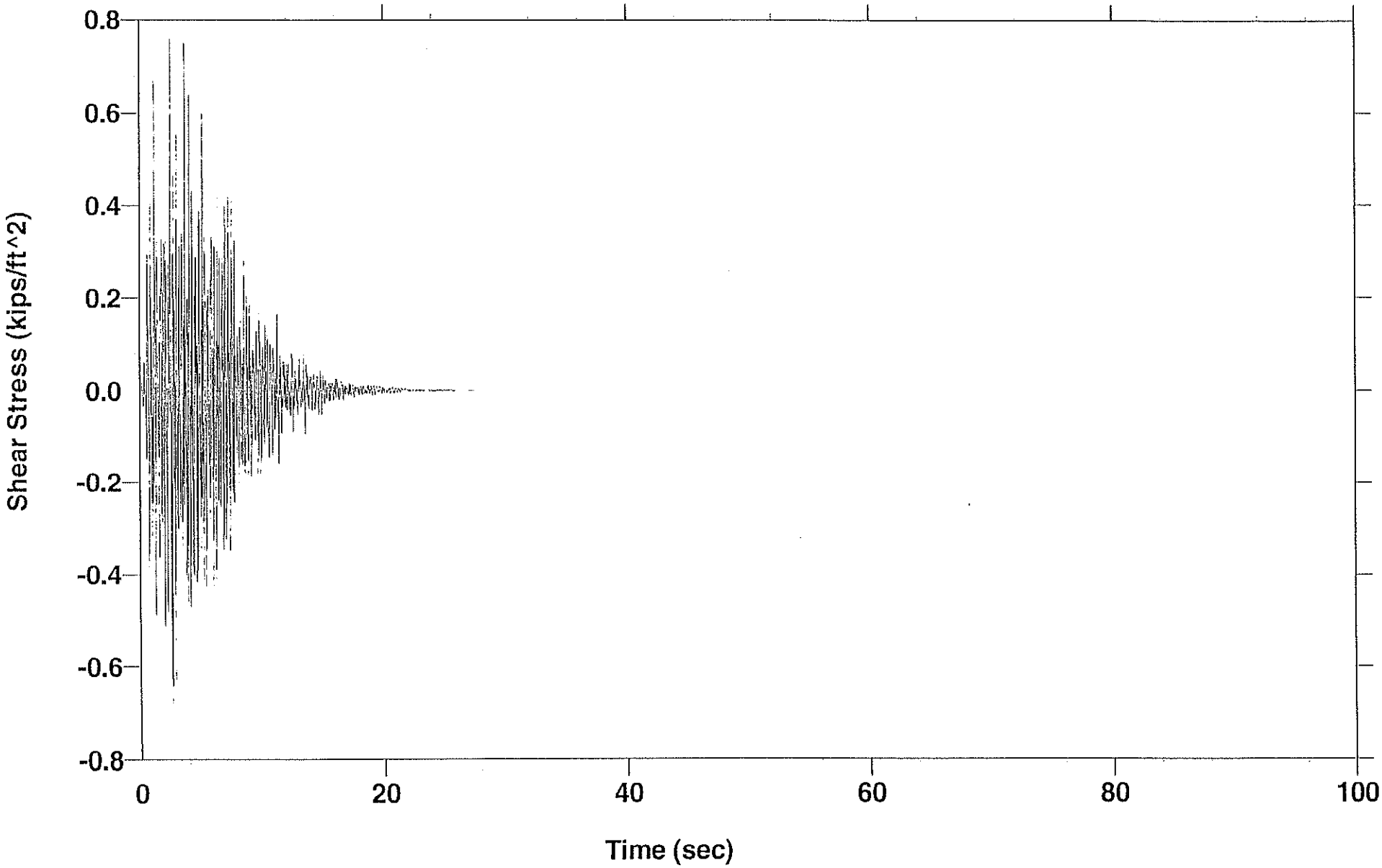
R14202

PCSC300M Layer 4 Stress - M6.8 Background Synthetic



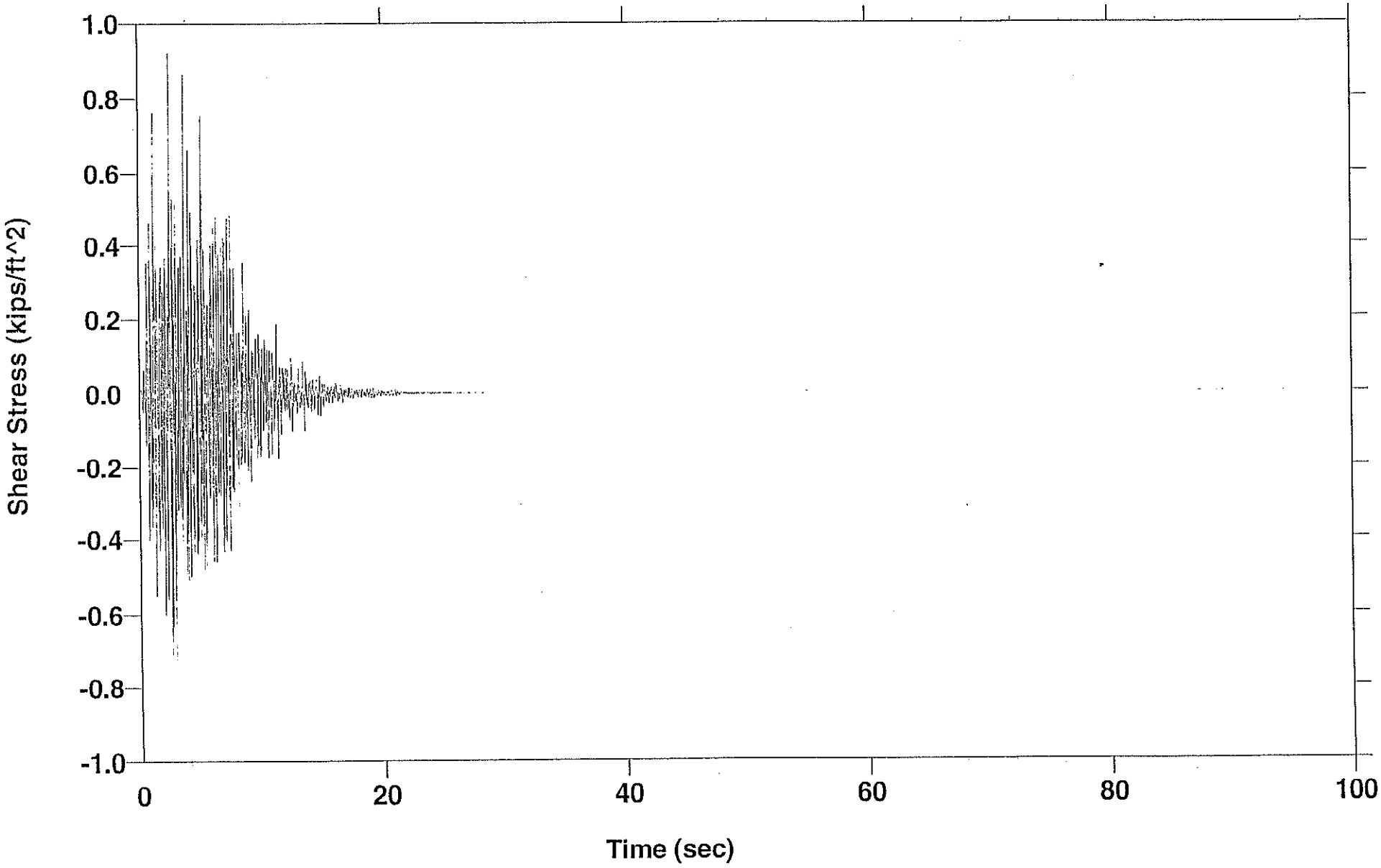
R14203

PCSC300M Layer 5 Stress - M6.8 Background Synthetic



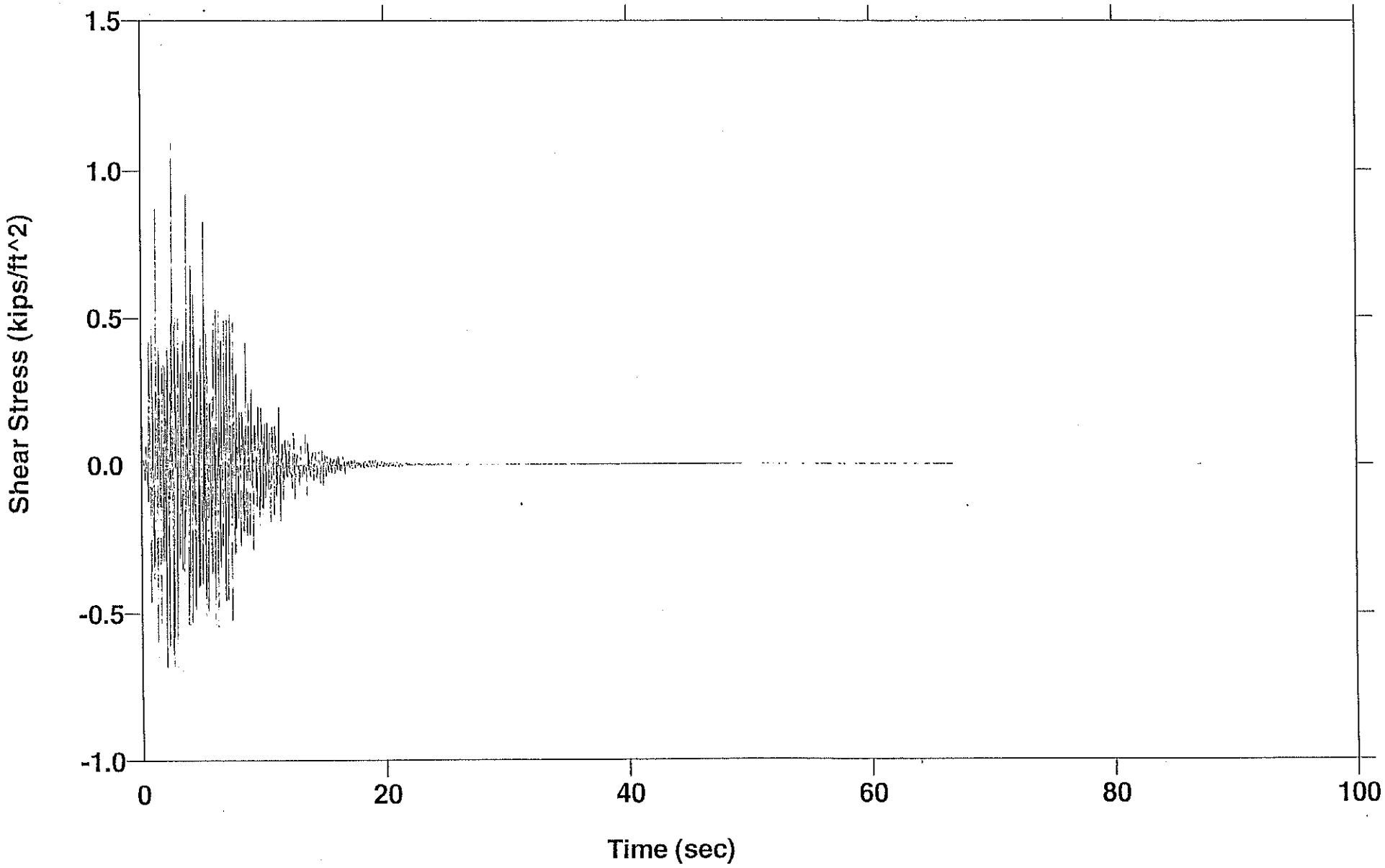
R14204

PCSC330M Layer 6 Stress - M6.8 Background Synthetic



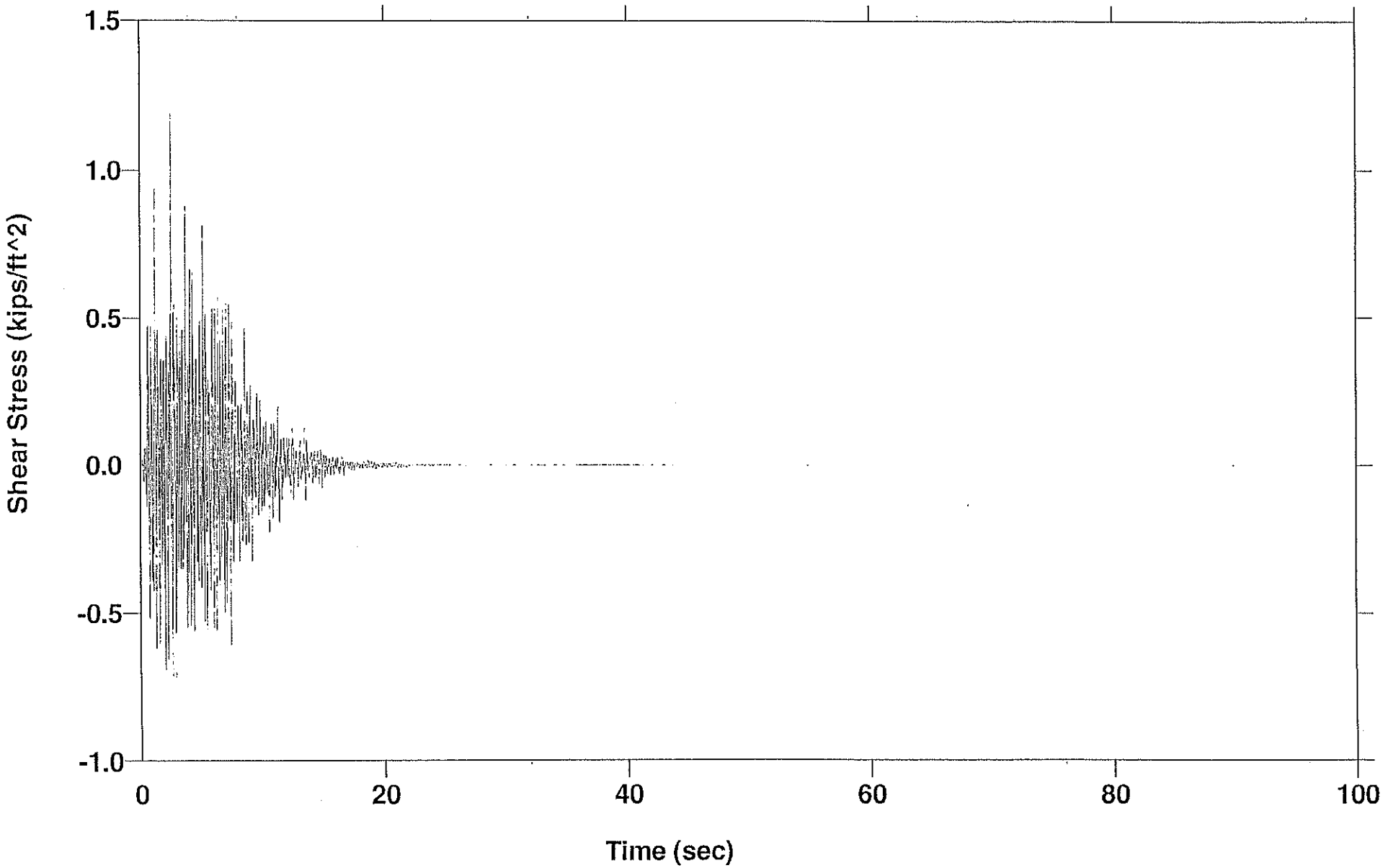
R14205

PCSC300M Layer 7 Stress - M6.8 Background Synthetic



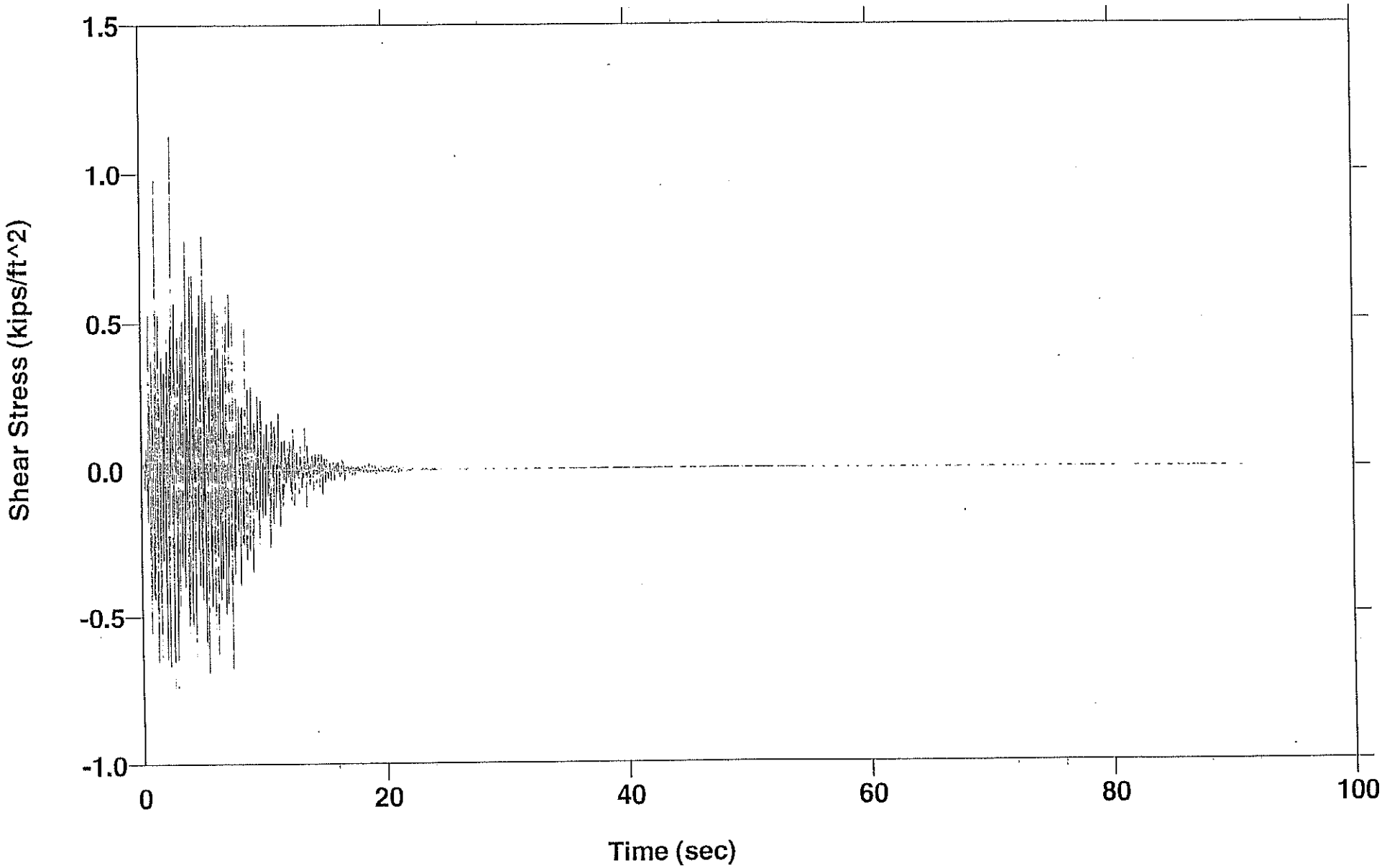
R14206

PCSC300M Layer 8 Stress - M6.8 Background Synthetic



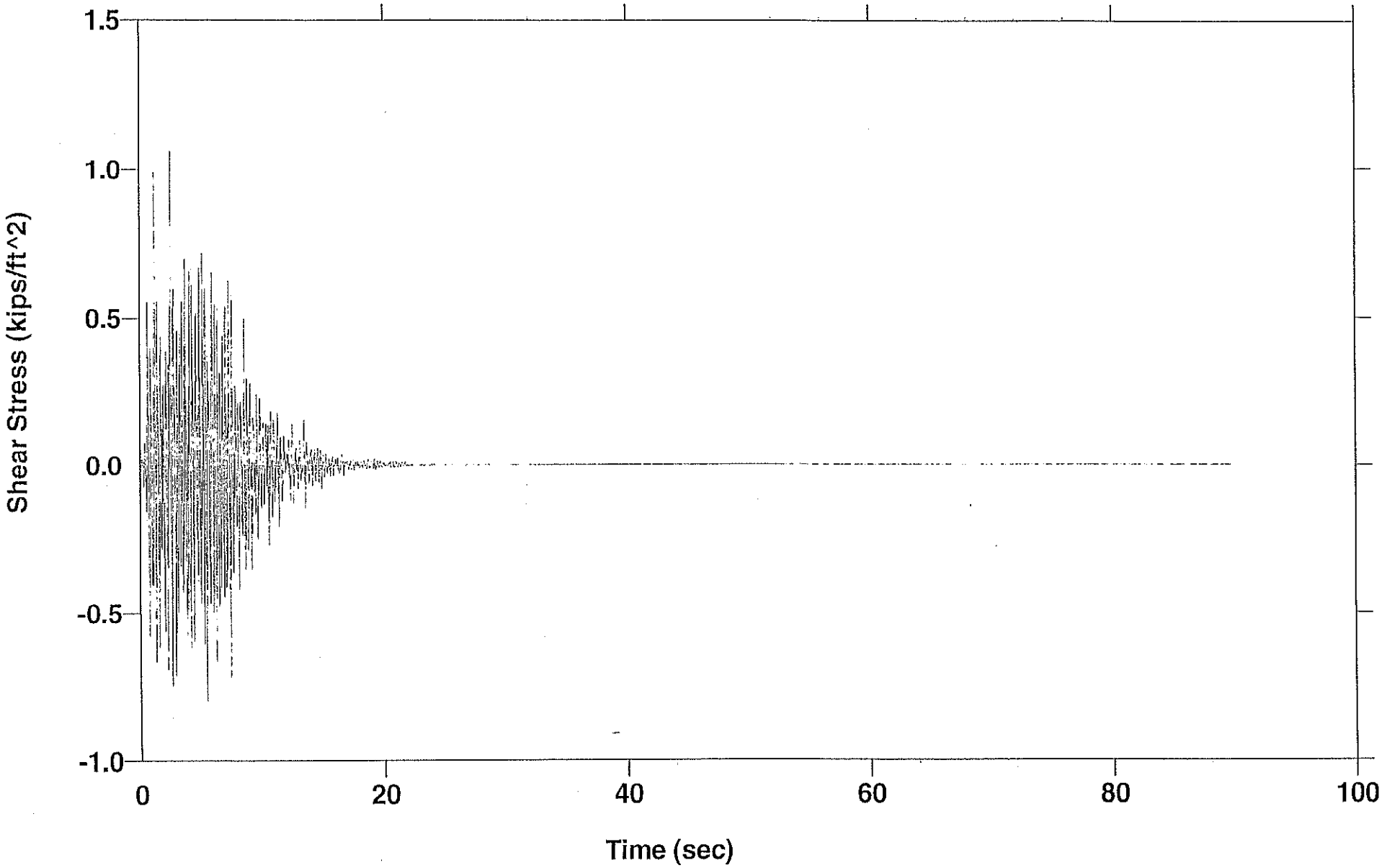
R14207

PCSC300M Layer 9 Stress - M6.8 Background Synthetic



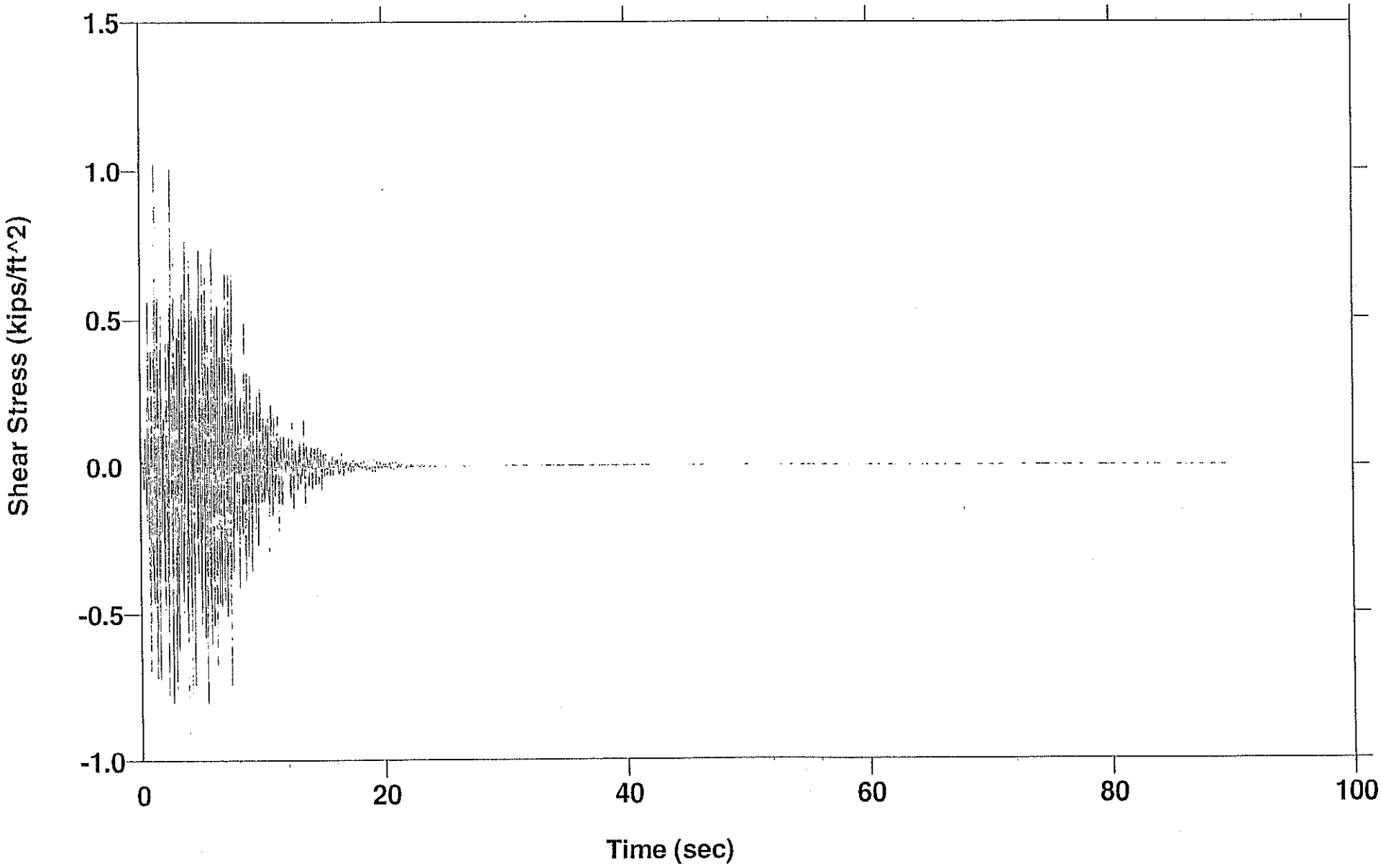
R14208

PCSC300M Layer 10 Stress - M6.8 Background Synthetic

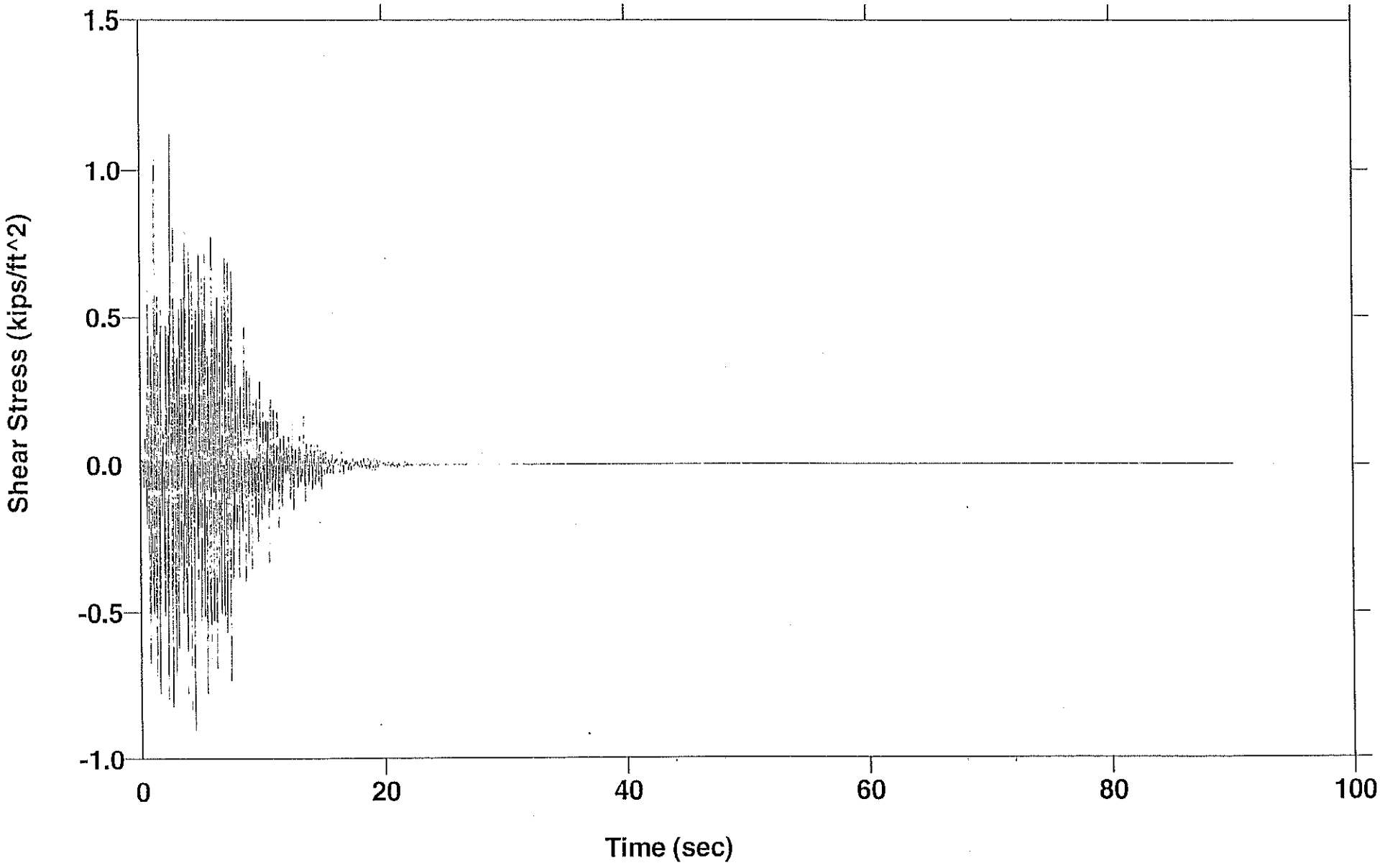


R14209

PCSC300M Layer 11 Stress - M6.8 Background Synthetic

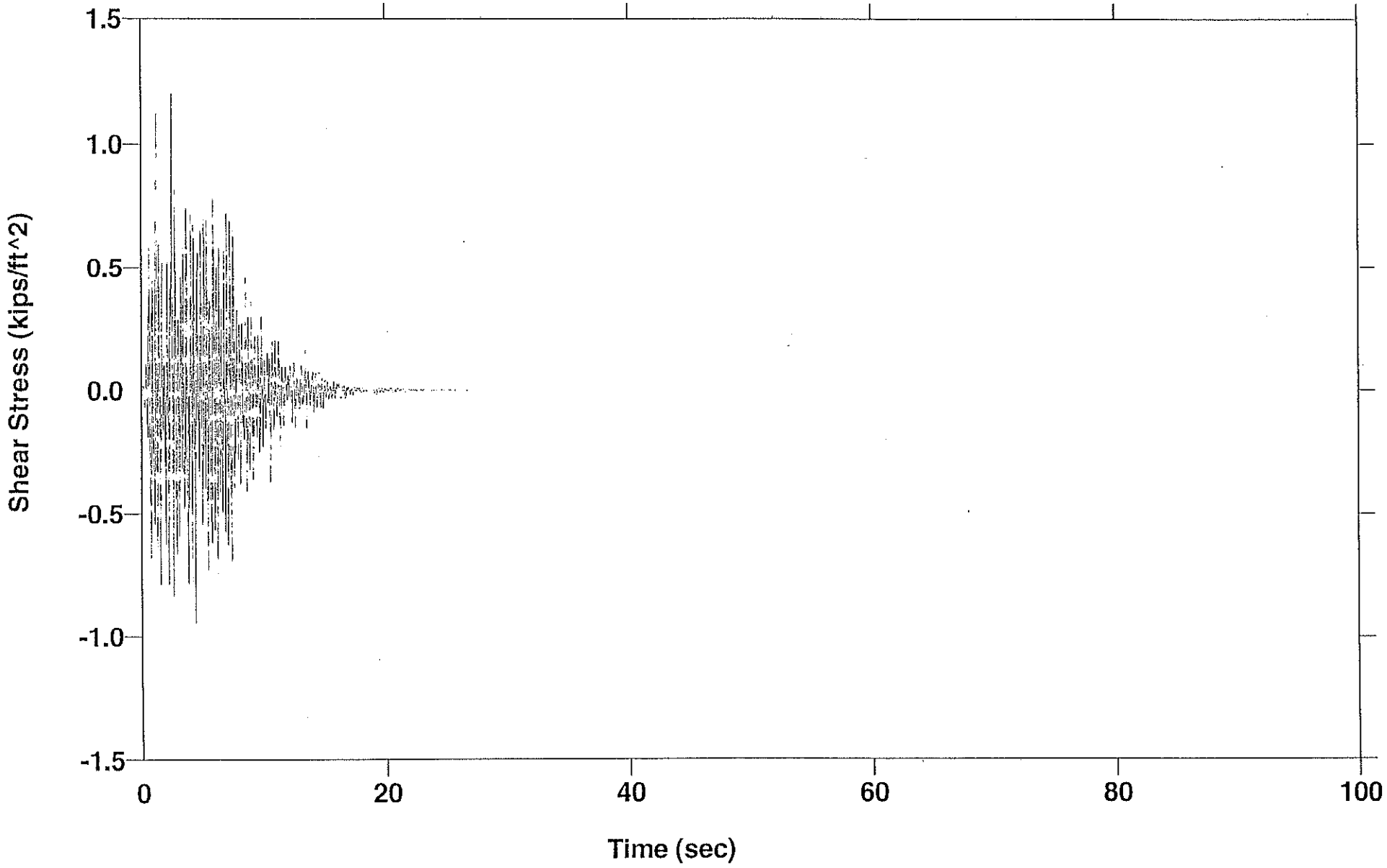


R14210


PCSC300M Layer 12 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
0
20
40
60
80
100
Time (sec)

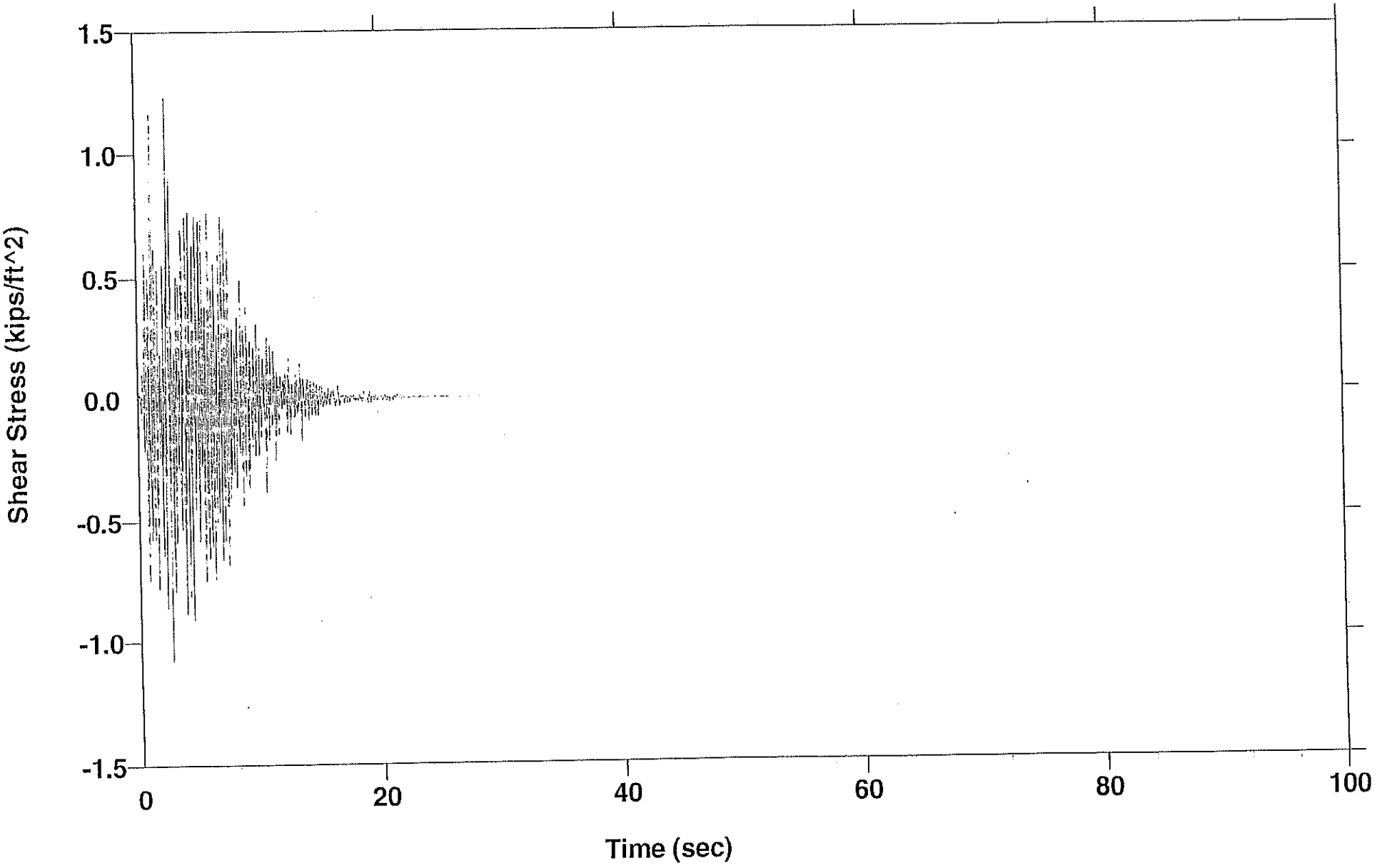
R14211

PCSC300M Layer 13 Stress - M6.8 Background Synthetic



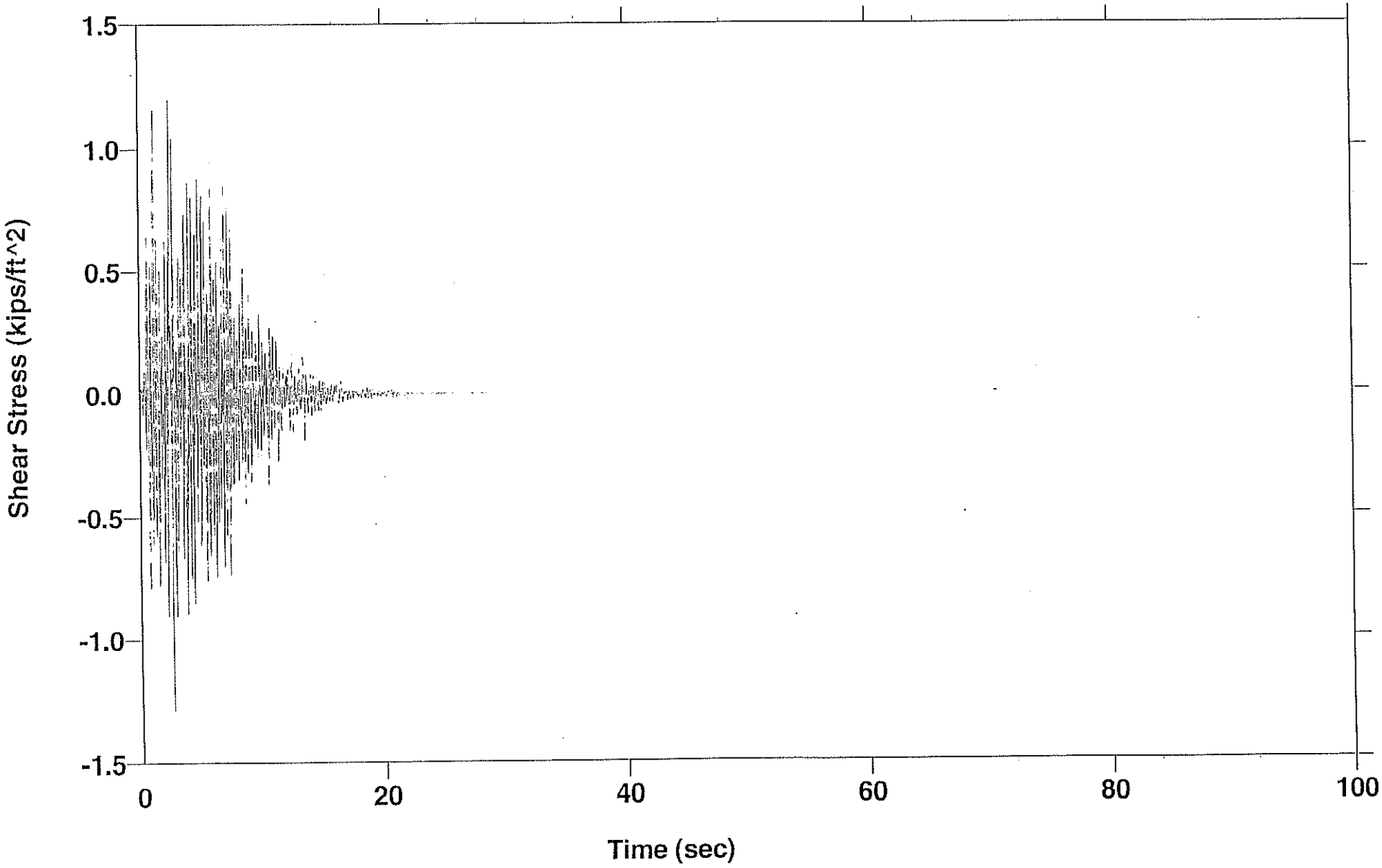
R14212

PCSC300M Layer 14 Stress - M6.8 Background Synthetic



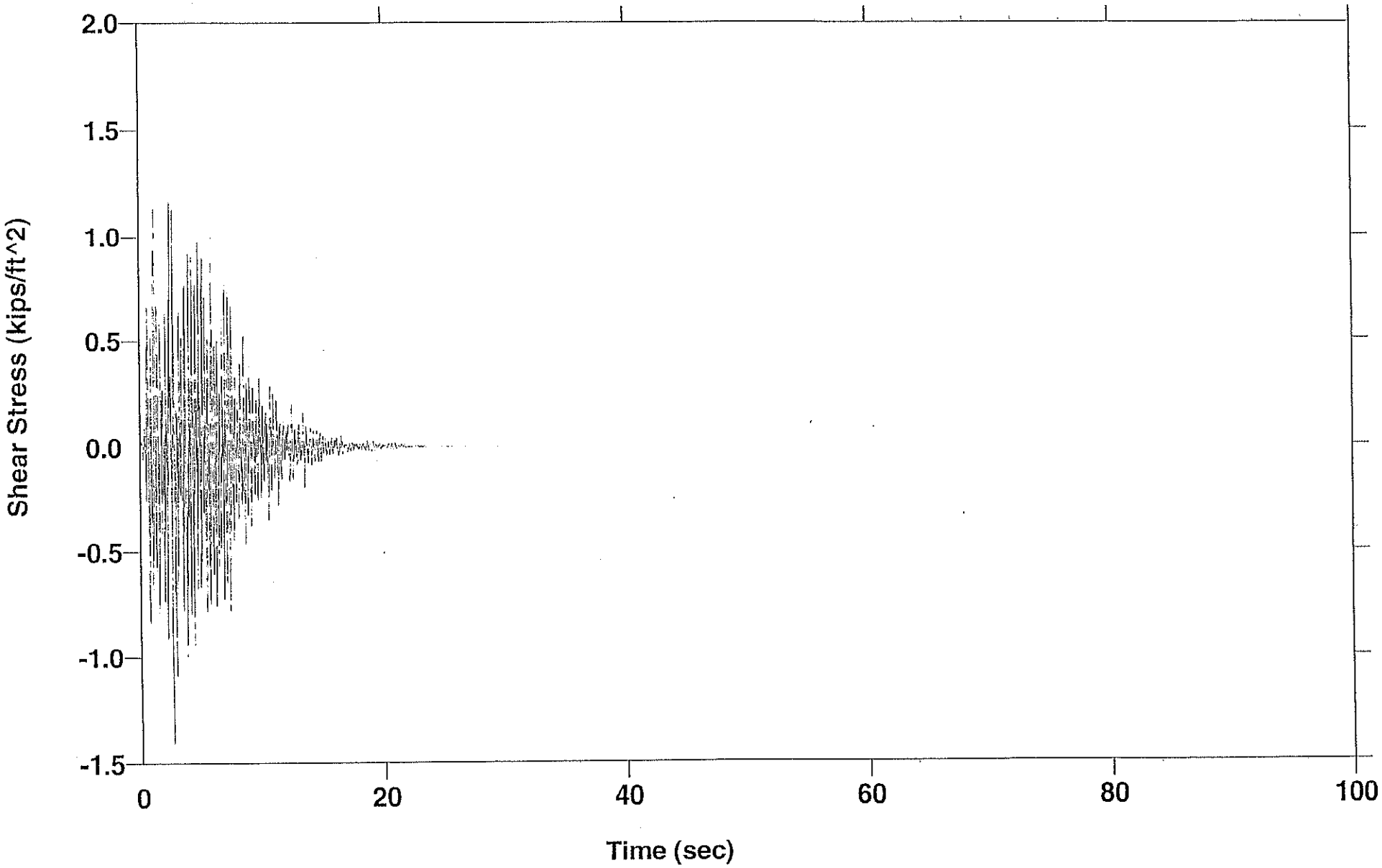
R14213

PCSC300M Layer 15 Stress - M6.8 Background Synthetic



R14214

PCSC300M Layer 16 Stress - M6.8 Background Synthetic



R14215

```
************************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*    LAYERED SITES by Per Schnable & John Lysmer - 1970  *
* ---------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
* ---------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added   *
*     using results from Sun et al (1988) by J. I. Sun   *
*     & Ramin Golesorkhi February 26, 1988            *
* ----------------------------------------------------*
* SHAKE90/91: Adjust last iteration; Input now is either  *
*     Gmax or max Vs; up to 13 materials can be specified*
*     by user; up to 50 Layers can be specified; object  *
*     motion can be read in from a separate file and can *
*     user specified format; Different periods for res-  *
*     ponse spectral calculations;options are renumbered;*
*     and general cleanup by: J. I. Sun, I. M. Idriss &  *
*     P. Dirrim June 1990 - February 1991             *
* ---------------------------------------------------- *
* SHAKE91: General cleanup and finalization of input out- *
*     output format ... etc by: I. M. Idriss Dec. 1991   *
* ---------------------------------------------------- *
* SHAKE2000: Fix the incorrect output of Tot. Stress in   *
* Option 2. Changed path of ground motion file in         *
* SHAKE91.  Control file to input file names.  Modified   *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
*         RUN DATE  1/02/2008                          *
*         RUN TIME 11:01                               *
************************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =    32768
 NECESSARY LENGTH OF BLANK COMMON X       =   204819

1****** OPTION  1  *** READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

**********************
 MATERIAL TYPE NO. 1
**********************

CURVE NO.  1:   Coarse    G/Gmax - Gravel (Mean) - Rollins et al. JGGE
CURVE NO.  2:   Coarse    Damping for Gravel (Mean) - Rollins et al. J
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.90
0.0002	0.995	0.0003	1.11
0.0005	0.980	0.0006	1.30
0.0008	0.970	0.0010	1.50
0.0010	0.960	0.0020	1.91
0.0020	0.930	0.0030	2.24
0.0030	0.905	0.0040	2.54
0.0040	0.880	0.0060	3.05
0.0070	0.810	0.0080	3.50
0.0100	0.755	0.0100	3.89
0.0200	0.630	0.0200	5.45
0.0700	0.390	0.0300	6.61
0.1000	0.325	0.0500	8.28
0.2000	0.205	0.1000	10.79
0.3000	0.150	0.2000	13.23

0.4000	0.115	0.3000	14.47
0.5000	0.095	0.4000	15.24
0.6000	0.080	0.6000	16.14
0.8000	0.070	0.8000	16.66
1.0000	0.050	1.0000	17.01

****
MATERIAL TYPE NO. 2
****

CURVE NO. 3: Fine Refuse Moduli for Fine Refuse (Ellison & Cho, 1976)
CURVE NO. 4: Fine Refuse Damping Values for Fine Refuse (Ellison & Ch

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.75
0.0004	1.000	0.0004	0.65
0.0010	0.995	0.0010	0.70
0.0020	0.992	0.0020	0.80
0.0040	0.989	0.0040	0.90
0.0060	0.981	0.0060	1.10
0.0080	0.965	0.0080	1.30
0.0100	0.955	0.0100	1.40
0.0200	0.905	0.0200	2.00
0.0400	0.828	0.0400	3.10
0.0600	0.750	0.0600	4.00
0.0800	0.670	0.0800	5.20
0.1000	0.610	0.1000	6.00
0.2000	0.610	0.2000	6.00

****
MATERIAL TYPE NO. 3
****

CURVE NO. 5: Residual G/Gmax PI=15% - Effective Confining Pressure
CURVE NO. 6: Residual Damping PI=15% - Effective Confining Pressur

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0000	1.000	0.0000	0.67
0.0000	1.000	0.0000	0.67
0.0000	0.999	0.0000	0.68
0.0001	0.998	0.0001	0.68
0.0002	0.996	0.0002	0.70
0.0005	0.991	0.0005	0.75
0.0010	0.983	0.0010	0.83
0.0022	0.965	0.0022	1.02
0.0048	0.931	0.0048	1.43
0.0100	0.873	0.0100	2.17
0.0220	0.770	0.0220	3.68
0.0484	0.618	0.0484	6.24
0.1000	0.454	0.1000	9.48
0.2200	0.287	0.2200	13.40
0.4840	0.163	0.4840	16.87
1.0000	0.091	1.0000	19.16

****
MATERIAL TYPE NO. 4
****

CURVE NO. 7: Rock G/Gmax - ROCK (Schnabel 1973)
CURVE NO. 8: Rock Damping for ROCK (Schnabel 1973)

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.40
0.0003	1.000	0.0010	0.80
0.0010	0.990	0.0100	1.50
0.0030	0.950	0.1000	3.00
0.0100	0.900	1.0000	4.60
0.0300	0.810	0.0000	0.00
0.1000	0.725	0.0000	0.00
1.0000	0.550	0.0000	0.00

1****** OPTION 2 *** READ SOIL PROFILE
NEW SOIL PROFILE NO. 1 IDENTIFICATION PSCS300E Crest Column
NUMBER OF LAYERS 17 DEPTH TO BEDROCK 50.00

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	1	4.0000	2.0000	0.26	3454.	0.050	0.130	924.9
2	1	3.0000	5.5000	0.71	3856.	0.050	0.130	977.3
3	1	3.0000	8.5000	1.11	4110.	0.050	0.130	1009.0
4	1	3.0000	11.5000	1.50	5739.	0.050	0.130	1192.3
5	1	3.0000	14.5000	1.90	4941.	0.050	0.140	1066.0
6	1	3.0000	17.5000	2.32	4453.	0.050	0.140	1012.0
7	1	3.0000	20.5000	2.74	4832.	0.050	0.140	1054.2
8	1	3.0000	23.5000	3.16	4269.	0.050	0.140	990.9
9	1	3.0000	26.5000	3.58	4713.	0.050	0.140	1041.1
10	1	4.0000	30.0000	4.07	4808.	0.050	0.140	1051.6
11	3	3.0000	33.5000	4.55	2635.	0.050	0.135	792.8
12	3	3.0000	36.5000	4.96	2661.	0.050	0.135	796.7
13	3	3.0000	39.5000	5.36	2998.	0.050	0.135	845.6
14	3	3.0000	42.5000	5.77	3763.	0.050	0.135	947.4
15	3	3.0000	45.5000	6.17	6529.	0.050	0.135	1247.9
16	3	3.0000	48.5000	6.58	6476.	0.050	0.135	1242.8
17	BASE				74534.	0.050	0.150	4000.0

PERIOD = 0.20 FROM AVERAGE SHEAR VEL. = 1011.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 12.34
FOR FREQUENCY = 4.85 C/SEC.
PERIOD = 0.21 SEC.

1****** OPTION 3 *** READ INPUT MOTION

FILE NAME FOR INPUT MOTION = C:\SHAKE2000\Williamson Energy\Background6.8.eq
NO. OF INPUT ACC. POINTS = 8192
NO. OF POINTS USED IN FFT = 16384
NO. OF HEADING LINES = 4
NO. OF POINTS PER LINE = 8

```
 TIME STEP FOR INPUT MOTION = 0.0100
   FORMAT FOR TIME HISTORY =     (8f9.6)


 *****HEADER*****
Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt
SHAKE2000 Conversion:   8192     .01      4       8       9      (8f9.6
Acceleration Units: (g's) - No. Values: 8192 - Time Step: .01 (secs)
Data Format: (8f9.6) - No. Header Lines: 4
 ** FIRST AND LAST 5 LINES OF INPUT MOTION *****

    1  0.000068-0.000484 0.004440-0.000089 0.002476-0.002297-0.001876 0.007725
    2  0.009680 0.020998-0.014349-0.012924 0.018874-0.019831-0.000946 0.024811
    3 -0.016894-0.002461 0.007682-0.006573-0.008604-0.018410 0.024194-0.064656
    4 -0.017516 0.023926-0.061566 0.003326 0.022873 0.052730 0.049159 0.008778
    5 -0.041034 0.029324-0.005991 0.066674-0.051336 0.029966-0.067257 0.001274
  .....INPUT MOTION READ NOT ECHOED.....
 1020 -0.000017 0.000017-0.000018 0.000017-0.000019 0.000019-0.000020 0.000020
 1021 -0.000021 0.000021-0.000022 0.000022-0.000024 0.000023-0.000025 0.000025
 1022 -0.000027 0.000027-0.000028 0.000028-0.000030 0.000030-0.000032 0.000032
 1023 -0.000034 0.000034-0.000035 0.000035-0.000037 0.000037-0.000038 0.000038
 1024 -0.000038 0.000037-0.000036 0.000032-0.000026 0.000014 0.000006-0.000045

 MAXIMUM ACCELERATION =  0.75473
 AT TIME              =  3.64 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  0.715
 TO GIVE NEW MAXIMUM ACCELERATION         =  0.54000
 MEAN SQUARE FREQUENCY =     20.41 C/SEC.
 MAX ACCELERATION =    0.55791 FOR FREQUENCIES REMOVED ABOVE     40.00 C/SEC.
1****** OPTION  4 *** READ WHERE OBJECT MOTION IS GIVEN
 OBJECT MOTION IN LAYER NUMBER  17 OUTCROPPING

1****** OPTION  5 *** OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
 MAXIMUM NUMBER OF ITERATIONS             =  10
 FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN =   0.65

    EARTHQUAKE  - C:\SHAKE2000\Williamson Energy\Background6.8.eq
    SOIL PROFILE - PSCS300E Crest Column

  ITERATION NUMBER  1

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ----> <---- SHEAR MODULUS -----> G/Go
      (FT)  STRAIN NEW   USED  ERROR     NEW    USED   ERROR  RATIO
--- ---- ---- -------- ----- ------ ------- ------ ------ -----
 1  1   2.0 0.00351 0.024  0.050  -108.1   3078.9   3454.0   -12.2  1.000
 2  1   5.5 0.00785 0.035  0.050   -44.1   3055.2   3856.0   -26.2  1.000
 3  1   8.5 0.00986 0.039  0.050   -29.4   3112.0   4110.0   -32.1  1.000
 4  1  11.5 0:00805 0.035  0.050   -42.5   4525.4   5739.0   -26.8  1.000
 5  1  14.5 0.01151 0.042  0.050   -18.9   3605.0   4941.0   -37.1  1.000
 6  1  17.5 0.01524 0.048  0.050    -3.3   3023.5   4453.0   -47.3  1.000
 7  1  20.5 0.01605 0.050  0.050    -0.9   3235.9   4832.0   -49.3  1.000
 8  1  23.5 0.02052 0.055  0.050     9.5   2668.7   4269.0   -60.0  1.000
 9  1  26.5 0.02025 0.055  0.050     8.8   2958.1   4713.0   -59.3  1.000
10  1  30.0 0.02107 0.056  0.050    10.7   2980.8   4808.0   -61.3  1.000
11  3  33.5 0.03946 0.056  0.050    10.3   1732.1   2635.0   -52.1  1.000
12  3  36.5 0.03887 0.055  0.050     9.5   1756.9   2661.0   -51.5  1.000
13  3  39.5 0.03374 0.051  0.050     1.3   2061.4   2998.0   -45.4  1.000
14  3  42.5 0.02773 0.044  0.050   -12.8   2729.6   3763.0   -37.9  1.000
15  3  45.5 0.01672 0.032  0.050   -58.3   5261.4   6529.0   -24.1  1.000
```

16 3 48.5 0.01790 0.033 0.050 -52.0 5160.9 6476.0 -25.5 1.000

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00433	0.026	0.024	8.9	3005.7	3078.9	-2.4	0.891
2	1	5.5	0.01076	0.041	0.035	14.4	2860.4	3055.2	-6.8	0.792
3	1	8.5	0.01356	0.046	0.039	15.5	2877.3	3112.0	-8.2	0.757
4	1	11.5	0.01116	0.041	0.035	15.2	4219.2	4525.4	-7.3	0.789
5	1	14.5	0.01611	0.050	0.042	15.2	3305.5	3605.0	-9.1	0.730
6	1	17.5	0.02293	0.058	0.048	17.2	2688.9	3023.5	-12.4	0.679
7	1	20.5	0.02391	0.060	0.050	16.9	2878.8	3235.9	-12.4	0.670
8	1	23.5	0.03112	0.067	0.055	17.9	2328.0	2668.7	-14.6	0.625
9	1	26.5	0.02861	0.065	0.055	15.3	2646.0	2958.1	-11.8	0.628
10	1	30.0	0.02760	0.064	0.056	12.1	2732.5	2980.8	-9.1	0.620
11	3	33.5	0.04460	0.060	0.056	6.6	1669.9	1732.1	-3.7	0.657
12	3	36.5	0.04332	0.059	0.055	6.0	1701.4	1756.9	-3.3	0.660
13	3	39.5	0.03826	0.055	0.051	7.4	1988.7	2061.4	-3.7	0.688
14	3	42.5	0.03202	0.049	0.044	9.5	2625.2	2729.6	-4.0	0.725
15	3	45.5	0.01907	0.034	0.032	7.4	5149.3	5261.4	-2.2	0.806
16	3	48.5	0.02074	0.036	0.033	7.9	5036.3	5160.9	-2.5	0.797

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00460	0.027	0.026	2.9	2979.0	3005.7	-0.9	0.870
2	1	5.5	0.01185	0.043	0.041	5.1	2793.0	2860.4	-2.4	0.742
3	1	8.5	0.01514	0.048	0.046	5.1	2795.6	2877.3	-2.9	0.700
4	1	11.5	0.01171	0.042	0.041	2.5	4169.5	4219.2	-1.2	0.735
5	1	14.5	0.01732	0.051	0.050	3.2	3241.1	3305.5	-2.0	0.669
6	1	17.5	0.02575	0.062	0.058	5.4	2589.8	2688.9	-3.8	0.604
7	1	20.5	0.02687	0.063	0.060	5.3	2770.8	2878.8	-3.9	0.596
8	1	23.5	0.03516	0.071	0.067	5.6	2228.1	2328.0	-4.5	0.545
9	1	26.5	0.03072	0.067	0.065	3.2	2581.7	2646.0	-2.5	0.561
10	1	30.0	0.02818	0.064	0.064	0.9	2713.3	2732.5	-0.7	0.568
11	3	33.5	0.04444	0.060	0.060	-0.2	1671.8	1669.9	0.1	0.634
12	3	36.5	0.04493	0.060	0.059	2.0	1682.6	1701.4	-1.1	0.639
13	3	39.5	0.04084	0.057	0.055	3.7	1950.9	1988.7	-1.9	0.663
14	3	42.5	0.03430	0.051	0.049	4.3	2575.4	2625.2	-1.9	0.698
15	3	45.5	0.01855	0.034	0.034	-1.6	5173.0	5149.3	0.5	0.789
16	3	48.5	0.02042	0.035	0.036	-0.8	5049.4	5036.3	0.3	0.778

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00456	0.027	0.027	-0.4	2982.5	2979.0	0.1	0.862
2	1	5.5	0.01191	0.043	0.043	0.3	2789.6	2793.0	-0.1	0.724
3	1	8.5	0.01531	0.048	0.048	0.5	2787.6	2795.6	-0.3	0.680
4	1	11.5	0.01166	0.042	0.042	-0.2	4174.2	4169.5	0.1	0.727
5	1	14.5	0.01740	0.051	0.051	0.2	3236.7	3241.1	-0.1	0.656
6	1	17.5	0.02642	0.062	0.062	1.2	2567.9	2589.8	-0.9	0.582
7	1	20.5	0.02762	0.064	0.063	1.2	2745.2	2770.8	-0.9	0.573
8	1	23.5	0.03637	0.072	0.071	1.5	2200.3	2228.1	-1.3	0.522
9	1	26.5	0.03115	0.067	0.067	0.7	2569.2	2581.7	-0.5	0.548
10	1	30.0	0.02787	0.064	0.064	-0.5	2723.4	2713.3	0.4	0.564
11	3	33.5	0.04402	0.059	0.060	-0.5	1676.6	1671.8	0.3	0.634
12	3	36.5	0.04564	0.060	0.060	0.8	1674.6	1682.6	-0.5	0.632
13	3	39.5	0.04189	0.058	0.057	1.4	1936.2	1950.9	-0.8	0.651
14	3	42.5	0.03519	0.052	0.051	1.6	2556.7	2575.4	-0.7	0.684
15	3	45.5	0.01837	0.033	0.034	-0.5	5181.0	5173.0	0.2	0.792
16	3	48.5	0.02016	0.035	0.035	-0.7	5060.6	5049.4	0.2	0.780

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00455	0.027	0.027	-0.2	2984.2	2982.5	0.1	0.863
2	1	5.5	0.01189	0.043	0.043	-0.1	2790.6	2789.6	0.0	0.723
3	1	8.5	0.01532	0.048	0.048	0.0	2787.0	2787.6	0.0	0.678
4	1	11.5	0.01161	0.042	0.042	-0.2	4178.3	4174.2	0.1	0.727
5	1	14.5	0.01735	0.051	0.051	-0.1	3239.3	3236.7	0.1	0.655
6	1	17.5	0.02655	0.063	0.062	0.2	2563.6	2567.9	-0.2	0.577
7	1	20.5	0.02780	0.064	0.064	0.3	2739.2	2745.2	-0.2	0.568
8	1	23.5	0.03675	0.073	0.072	0.5	2191.9	2200.3	-0.4	0.515
9	1	26.5	0.03122	0.067	0.067	0.1	2567.1	2569.2	-0.1	0.545
10	1	30.0	0.02767	0.064	0.064	-0.3	2730.0	2723.4	0.2	0.566
11	3	33.5	0.04382	0.059	0.059	-0.2	1678.9	1676.6	0.1	0.636
12	3	36.5	0.04592	0.061	0.060	0.3	1671.5	1674.6	-0.2	0.629
13	3	39.5	0.04225	0.058	0.058	0.5	1931.3	1936.2	-0.3	0.646
14	3	42.5	0.03545	0.052	0.052	0.5	2551.4	2556.7	-0.2	0.679
15	3	45.5	0.01834	0.033	0.033	-0.1	5182.3	5181.0	0.0	0.794
16	3	48.5	0.02008	0.035	0.035	-0.2	5063.8	5060.6	0.1	0.781

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 6

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.2	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.9	2790.6	0.0	0.724

3	1	8.5	0.01532	0.049	0.048	0.0	2786.7	2787.0	0.0	0.678
4	1	11.5	0.01160	0.042	0.042	-0.1	4179.6	4178.3	0.0	0.728
5	1	14.5	0.01732	0.051	0.051	-0.1	3241.0	3239.3	0.1	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.8	2563.6	0.0	0.576
7	1	20.5	0.02785	0.064	0.064	0.1	2737.8	2739.2	-0.1	0.567
8	1	23.5	0.03687	0.073	0.073	0.2	2189.2	2191.9	-0.1	0.513
9	1	26.5	0.03123	0.067	0.067	0.0	2566.9	2567.1	0.0	0.545
10	1	30.0	0.02758	0.064	0.064	-0.1	2732.9	2730.0	0.1	0.568
11	3	33.5	0.04375	0.059	0.059	-0.1	1679.7	1678.9	0.0	0.637
12	3	36.5	0.04602	0.061	0.061	0.1	1670.4	1671.5	-0.1	0.628
13	3	39.5	0.04237	0.058	0.058	0.2	1929.7	1931.3	-0.1	0.644
14	3	42.5	0.03552	0.052	0.052	0.1	2550.0	2551.4	-0.1	0.678
15	3	45.5	0.01834	0.033	0.033	0.0	5182.7	5182.3	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.5	5063.8	0.0	0.782

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 7

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.4	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.9	2790.9	0.0	0.724
3	1	8.5	0.01533	0.049	0.049	0.0	2786.5	2786.7	0.0	0.678
4	1	11.5	0.01159	0.042	0.042	0.0	4180.0	4179.6	0.0	0.728
5	1	14.5	0.01731	0.051	0.051	0.0	3241.7	3241.0	0.0	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.7	2562.8	0.0	0.576
7	1	20.5	0.02786	0.064	0.064	0.0	2737.5	2737.8	0.0	0.567
8	1	23.5	0.03692	0.073	0.073	0.1	2188.2	2189.2	0.0	0.513
9	1	26.5	0.03122	0.067	0.067	0.0	2567.0	2566.9	0.0	0.545
10	1	30.0	0.02755	0.064	0.064	-0.1	2734.0	2732.9	0.0	0.568
11	3	33.5	0.04373	0.059	0.059	0.0	1680.0	1679.7	0.0	0.637
12	3	36.5	0.04605	0.061	0.061	0.0	1670.0	1670.4	0.0	0.628
13	3	39.5	0.04240	0.058	0.058	0.0	1929.3	1929.7	0.0	0.644
14	3	42.5	0.03554	0.052	0.052	0.0	2549.7	2550.0	0.0	0.678
15	3	45.5	0.01833	0.033	0.033	0.0	5182.8	5182.7	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.7	5064.5	0.0	0.782

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 8

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.4	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.8	2790.9	0.0	0.724
3	1	8.5	0.01533	0.049	0.049	0.0	2786.4	2786.5	0.0	0.678
4	1	11.5	0.01159	0.042	0.042	0.0	4180.1	4180.0	0.0	0.728
5	1	14.5	0.01730	0.051	0.051	0.0	3242.0	3241.7	0.0	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.8	2562.7	0.0	0.576
7	1	20.5	0.02786	0.064	0.064	0.0	2737.4	2737.5	0.0	0.567
8	1	23.5	0.03693	0.073	0.073	0.0	2187.9	2188.2	0.0	0.513
9	1	26.5	0.03122	0.067	0.067	0.0	2567.1	2567.0	0.0	0.545

10	1	30.0	0.02754	0.064	0.064	0.0	2734.4	2734.0	0.0	0.569
11	3	33.5	0.04372	0.059	0.059	0.0	1680.1	1680.0	0.0	0.638
12	3	36.5	0.04606	0.061	0.061	0.0	1669.9	1670.0	0.0	0.628
13	3	39.5	0.04241	0.058	0.058	0.0	1929.1	1929.3	0.0	0.644
14	3	42.5	0.03554	0.052	0.052	0.0	2549.6	2549.7	0.0	0.678
15	3	45.5	0.01833	0.033	0.033	0.0	5182.9	5182.8	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.7	5064.7	0.0	0.782

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 9

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.4	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.8	2790.8	0.0	0.724
3	1	8.5	0.01533	0.049	0.049	0.0	2786.4	2786.4	0.0	0.678
4	1	11.5	0.01159	0.042	0.042	0.0	4180.1	4180.1	0.0	0.728
5	1	14.5	0.01730	0.051	0.051	0.0	3242.1	3242.0	0.0	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.8	2562.8	0.0	0.576
7	1	20.5	0.02786	0.064	0.064	0.0	2737.4	2737.4	0.0	0.567
8	1	23.5	0.03694	0.073	0.073	0.0	2187.7	2187.9	0.0	0.513
9	1	26.5	0.03122	0.067	0.067	0.0	2567.1	2567.1	0.0	0.545
10	1	30.0	0.02753	0.064	0.064	0.0	2734.6	2734.4	0.0	0.569
11	3	33.5	0.04372	0.059	0.059	0.0	1680.1	1680.1	0.0	0.638
12	3	36.5	0.04607	0.061	0.061	0.0	1669.8	1669.9	0.0	0.628
13	3	39.5	0.04241	0.058	0.058	0.0	1929.1	1929.1	0.0	0.643
14	3	42.5	0.03554	0.052	0.052	0.0	2549.6	2549.6	0.0	0.678
15	3	45.5	0.01833	0.033	0.033	0.0	5182.9	5182.9	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.7	5064.7	0.0	0.782

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 10

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.4	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.8	2790.8	0.0	0.724
3	1	8.5	0.01533	0.049	0.049	0.0	2786.4	2786.4	0.0	0.678
4	1	11.5	0.01159	0.042	0.042	0.0	4180.1	4180.1	0.0	0.728
5	1	14.5	0.01730	0.051	0.051	0.0	3242.1	3242.1	0.0	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.8	2562.8	0.0	0.576
7	1	20.5	0.02786	0.064	0.064	0.0	2737.4	2737.4	0.0	0.567
8	1	23.5	0.03694	0.073	0.073	0.0	2187.7	2187.7	0.0	0.512
9	1	26.5	0.03122	0.067	0.067	0.0	2567.1	2567.1	0.0	0.545
10	1	30.0	0.02753	0.064	0.064	0.0	2734.6	2734.6	0.0	0.569
11	3	33.5	0.04372	0.059	0.059	0.0	1680.1	1680.1	0.0	0.638
12	3	36.5	0.04607	0.061	0.061	0.0	1669.8	1669.8	0.0	0.628
13	3	39.5	0.04241	0.058	0.058	0.0	1929.1	1929.1	0.0	0.643
14	3	42.5	0.03554	0.052	0.052	0.0	2549.6	2549.6	0.0	0.678
15	3	45.5	0.01833	0.033	0.033	0.0	5182.9	5182.9	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.7	5064.7	0.0	0.782

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	1	4.0000	2.0000	0.00699	208.65	2.66
2	1	3.0000	5.5000	0.01829	510.56	2.66
3	1	3.0000	8.5000	0.02359	657.19	2.66
4	1	3.0000	11.5000	0.01783	745.46	3.70
5	1	3.0000	14.5000	0.02661	862.84	2.53
6	1	3.0000	17.5000	0.04089	1047.93	2.53
7	1	3.0000	20.5000	0.04286	1173.22	2.53
8	1	3.0000	23.5000	0.05683	1243.29	2.53
9	1	3.0000	26.5000	0.04803	1232.98	2.53
10	1	4.0000	30.0000	0.04236	1158.30	2.52
11	3	3.0000	33.5000	0.06726	1130.04	2.52
12	3	3.0000	36.5000	0.07088	1183.52	2.51
13	3	3.0000	39.5000	0.06525	1258.79	2.50
14	3	3.0000	42.5000	0.05468	1394.02	2.62
15	3	3.0000	45.5000	0.02820	1461.76	2.62
16	3	3.0000	48.5000	0.03086	1562.90	2.49

PERIOD = 0.24 FROM AVERAGE SHEAR VEL. = 823.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 10.74
FOR FREQUENCY = 3.87 C/SEC.
PERIOD = 0.26 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	TIME C/SEC	MEAN SQ. FR. QUIET ZONE	ACC. RATIO ACC. RECORD	TH SAVED
OUTCR.	0.0000	0.82118	2.66	15.92	0.000	2048	
WITHIN	4.0000	0.66221	2.66	12.85	0.000	2048	
WITHIN	7.0000	0.45724	2.53	9.08	0.000	2048	
WITHIN	10.0000	0.49140	2.53	12.60	0.001	2048	
WITHIN	13.0000	0.47695	2.53	15.09	0.001	2048	
WITHIN	16.0000	0.48874	2.64	14.93	0.000	2048	
WITHIN	19.0000	0.46491	2.64	15.27	0.001	2048	
WITHIN	22.0000	0.51703	2.60	16.98	0.001	2048	
WITHIN	25.0000	0.52919	2.63	16.94	0.000	2048	
WITHIN	28.0000	0.52041	2.63	16.49	0.001	2048	
WITHIN	32.0000	0.76846	2.62	17.02	0.000	2048	
WITHIN	35.0000	0.80342	2.62	18.94	0.000	2048	
WITHIN	38.0000	0.73631	2.61	20.52	0.001	2048	
WITHIN	41.0000	0.65050	2.59	20.50	0.001	2048	
WITHIN	44.0000	0.53855	3.91	20.21	0.001	2048	

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	TIME C/SEC	MEAN SQ. FR. QUIET ZONE	ACC. RATIO ACC. RECORD	TH SAVED
WITHIN	47.0000	0.52173	3.91	19.79	0.001	2048	
WITHIN	50.0000	0.49204	2.58	19.33	0.001	2048	

OUTCR.	50.0000	0.55791	2.58	20.41	0.001	2048

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 1 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 1 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 2 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 2 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 3 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 3 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 4 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 4 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 5 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 5 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC330M Layer 6 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PSCS300M Layer 6 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 7 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 7 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 8 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 8 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 9 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PSCS300E Layer 9 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 10 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 10 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 11 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 11 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 12 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 12 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 13
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 13 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 13
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 13 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 14
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 14 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 14
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 14 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 15
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 15 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 15
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 15 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 16
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 16 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 16
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 16 Strain

1****** OPTION 9 *** COMPUTE RESPONSE SPECTRUM
RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER 1
CALCULATED FOR DAMPING 0.050

TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
TD = TIME FOR MAX. RELATIVE DISP.
TV = TIME FOR MAX. RELATIVE VEL.
TA = TIME FOR MAX. ABSOLUTE ACC.
DAMPING RATIO = 0.050

PER = 0.01	TIMES FOR MAXIMA --	TD = 2.6500	TV = 2.6500	TA = 2.6500
PER = 0.02	TIMES FOR MAXIMA --	TD = 2.6500	TV = 2.6400	TA = 2.6500
PER = 0.03	TIMES FOR MAXIMA --	TD = 3.0100	TV = 3.0200	TA = 3.0100
PER = 0.04	TIMES FOR MAXIMA --	TD = 2.6600	TV = 2.6700	TA = 3.6900
PER = 0.05	TIMES FOR MAXIMA --	TD = 4.9300	TV = 4.9400	TA = 4.9000
PER = 0.06	TIMES FOR MAXIMA --	TD = 4.3800	TV = 4.3900	TA = 4.3800
PER = 0.07	TIMES FOR MAXIMA --	TD = 5.2600	TV = 5.2800	TA = 5.2600
PER = 0.08	TIMES FOR MAXIMA --	TD = 5.2700	TV = 5.2900	TA = 5.2700
PER = 0.09	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.7000	TA = 2.7200
PER = 0.10	TIMES FOR MAXIMA --	TD = 2.6000	TV = 2.6600	TA = 2.5900
PER = 0.11	TIMES FOR MAXIMA --	TD = 2.6000	TV = 2.5800	TA = 2.6000
PER = 0.12	TIMES FOR MAXIMA --	TD = 2.6100	TV = 2.5800	TA = 2.6100

PER = 0.13	TIMES FOR MAXIMA --	TD = 3.7200	TV = 5.1900	TA = 3.7200
PER = 0.14	TIMES FOR MAXIMA --	TD = 3.7300	TV = 2.5800	TA = 3.7300
PER = 0.15	TIMES FOR MAXIMA --	TD = 4.1600	TV = 2.5800	TA = 4.1600
PER = 0.16	TIMES FOR MAXIMA --	TD = 2.6200	TV = 2.5800	TA = 2.6100
PER = 0.17	TIMES FOR MAXIMA --	TD = 4.2800	TV = 4.3200	TA = 4.2800
PER = 0.18	TIMES FOR MAXIMA --	TD = 1.4300	TV = 2.5900	TA = 1.4300
PER = 0.19	TIMES FOR MAXIMA --	TD = 2.7500	TV = 2.7100	TA = 2.7500
PER = 0.20	TIMES FOR MAXIMA --	TD = 7.1100	TV = 6.7400	TA = 7.1100
PER = 0.21	TIMES FOR MAXIMA --	TD = 7.1400	TV = 7.0900	TA = 7.1300
PER = 0.22	TIMES FOR MAXIMA --	TD = 7.2700	TV = 7.1000	TA = 7.1500
PER = 0.23	TIMES FOR MAXIMA --	TD = 7.4200	TV = 2.3500	TA = 7.4100
PER = 0.24	TIMES FOR MAXIMA --	TD = 7.5600	TV = 2.3700	TA = 7.5600
PER = 0.25	TIMES FOR MAXIMA --	TD = 1.6100	TV = 6.3700	TA = 1.6100
PER = 0.26	TIMES FOR MAXIMA --	TD = 6.3200	TV = 6.3800	TA = 6.3200
PER = 0.27	TIMES FOR MAXIMA --	TD = 1.6400	TV = 1.7100	TA = 1.6300
PER = 0.28	TIMES FOR MAXIMA --	TD = 1.6500	TV = 1.3200	TA = 1.6500
PER = 0.29	TIMES FOR MAXIMA --	TD = 5.2100	TV = 5.1500	TA = 5.2100
PER = 0.30	TIMES FOR MAXIMA --	TD = 5.2400	TV = 5.1600	TA = 5.2300
PER = 0.31	TIMES FOR MAXIMA --	TD = 2.9800	TV = 2.9000	TA = 2.9700
PER = 0.32	TIMES FOR MAXIMA --	TD = 3.0000	TV = 2.9100	TA = 2.9900
PER = 0.33	TIMES FOR MAXIMA --	TD = 3.0100	TV = 2.9100	TA = 3.0000
PER = 0.34	TIMES FOR MAXIMA --	TD = 3.0100	TV = 2.7900	TA = 3.0100
PER = 0.35	TIMES FOR MAXIMA --	TD = 3.0200	TV = 2.7900	TA = 3.0200
PER = 0.36	TIMES FOR MAXIMA --	TD = 2.8800	TV = 2.7900	TA = 2.8700
PER = 0.37	TIMES FOR MAXIMA --	TD = 2.7200	TV = 2.7900	TA = 2.7100
PER = 0.38	TIMES FOR MAXIMA --	TD = 2.7300	TV = 2.6600	TA = 2.7200
PER = 0.39	TIMES FOR MAXIMA --	TD = 2.7300	TV = 2.6600	TA = 4.1300
PER = 0.40	TIMES FOR MAXIMA --	TD = 4.1500	TV = 2.6600	TA = 4.1400
PER = 0.41	TIMES FOR MAXIMA --	TD = 4.1600	TV = 4.0900	TA = 4.1600
PER = 0.42	TIMES FOR MAXIMA --	TD = 3.9900	TV = 4.0900	TA = 3.9800
PER = 0.43	TIMES FOR MAXIMA --	TD = 4.0000	TV = 4.0900	TA = 3.9900
PER = 0.44	TIMES FOR MAXIMA --	TD = 4.6800	TV = 4.1000	TA = 4.6700
PER = 0.45	TIMES FOR MAXIMA --	TD = 4.6900	TV = 4.1000	TA = 4.6800
PER = 0.46	TIMES FOR MAXIMA --	TD = 4.7100	TV = 4.1000	TA = 4.7100
PER = 0.47	TIMES FOR MAXIMA --	TD = 4.7300	TV = 4.6400	TA = 4.7200
PER = 0.48	TIMES FOR MAXIMA --	TD = 4.7400	TV = 4.6500	TA = 4.7300
PER = 0.49	TIMES FOR MAXIMA --	TD = 5.5500	TV = 4.6500	TA = 5.5400
PER = 0.50	TIMES FOR MAXIMA --	TD = 5.5700	TV = 2.6700	TA = 5.5600
PER = 0.51	TIMES FOR MAXIMA --	TD = 5.5800	TV = 2.6700	TA = 5.5700
PER = 0.52	TIMES FOR MAXIMA --	TD = 5.5800	TV = 2.6700	TA = 5.5700
PER = 0.53	TIMES FOR MAXIMA --	TD = 2.7600	TV = 2.6700	TA = 2.7500
PER = 0.54	TIMES FOR MAXIMA --	TD = 2.7700	TV = 2.6700	TA = 2.7600
PER = 0.55	TIMES FOR MAXIMA --	TD = 2.7700	TV = 2.6700	TA = 2.7600
PER = 0.56	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.6700	TA = 2.5600
PER = 0.57	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.6700	TA = 2.5600
PER = 0.58	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.6700	TA = 2.5600
PER = 0.60	TIMES FOR MAXIMA --	TD = 2.5800	TV = 2.6700	TA = 2.5700
PER = 0.62	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.6700	TA = 2.5800
PER = 0.64	TIMES FOR MAXIMA --	TD = 2.6100	TV = 2.5400	TA = 2.6000
PER = 0.66	TIMES FOR MAXIMA --	TD = 2.6200	TV = 2.5400	TA = 2.6100
PER = 0.68	TIMES FOR MAXIMA --	TD = 2.6400	TV = 2.5400	TA = 2.6200
PER = 0.70	TIMES FOR MAXIMA --	TD = 3.4700	TV = 2.5500	TA = 3.4600
PER = 0.72	TIMES FOR MAXIMA --	TD = 3.4800	TV = 2.5500	TA = 3.4700
PER = 0.74	TIMES FOR MAXIMA --	TD = 3.4900	TV = 2.5500	TA = 3.4800
PER = 0.76	TIMES FOR MAXIMA --	TD = 3.4900	TV = 1.6100	TA = 3.4800
PER = 0.78	TIMES FOR MAXIMA --	TD = 1.8200	TV = 1.6100	TA = 1.8000
PER = 0.80	TIMES FOR MAXIMA --	TD = 1.5200	TV = 1.2700	TA = 1.5100
PER = 0.82	TIMES FOR MAXIMA --	TD = 1.5300	TV = 1.2700	TA = 1.5100
PER = 0.84	TIMES FOR MAXIMA --	TD = 3.5000	TV = 6.3000	TA = 3.4800
PER = 0.86	TIMES FOR MAXIMA --	TD = 3.5000	TV = 5.9400	TA = 3.4800
PER = 0.88	TIMES FOR MAXIMA --	TD = 3.5100	TV = 5.9400	TA = 3.4900

PER = 0.90	TIMES FOR MAXIMA --	TD = 4.0300	TV = 3.3000	TA = 4.0200
PER = 0.92	TIMES FOR MAXIMA --	TD = 4.0600	TV = 4.2900	TA = 4.0500
PER = 0.94	TIMES FOR MAXIMA --	TD = 4.0700	TV = 4.3500	TA = 4.0600
PER = 0.96	TIMES FOR MAXIMA --	TD = 4.0700	TV = 4.3500	TA = 4.0600
PER = 0.98	TIMES FOR MAXIMA --	TD = 3.1800	TV = 4.3500	TA = 3.1700
PER = 1.00	TIMES FOR MAXIMA --	TD = 3.1900	TV = 3.9700	TA = 3.1800
PER = 1.05	TIMES FOR MAXIMA --	TD = 3.2100	TV = 3.9700	TA = 3.1900
PER = 1.10	TIMES FOR MAXIMA --	TD = 3.2500	TV = 2.5500	TA = 3.2400
PER = 1.15	TIMES FOR MAXIMA --	TD = 3.2700	TV = 2.5500	TA = 3.2500
PER = 1.20	TIMES FOR MAXIMA --	TD = 3.3500	TV = 2.5500	TA = 3.2800
PER = 1.25	TIMES FOR MAXIMA --	TD = 3.3900	TV = 2.5500	TA = 3.3800
PER = 1.30	TIMES FOR MAXIMA --	TD = 2.8800	TV = 2.5500	TA = 2.8700
PER = 1.35	TIMES FOR MAXIMA --	TD = 2.8900	TV = 2.5500	TA = 2.8700
PER = 1.40	TIMES FOR MAXIMA --	TD = 2.8900	TV = 2.5500	TA = 2.8700
PER = 1.45	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5500	TA = 2.8700
PER = 1.50	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5500	TA = 2.8700
PER = 1.55	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5500	TA = 2.8700
PER = 1.60	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5500	TA = 2.8700
PER = 1.65	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.5500	TA = 2.8700
PER = 1.70	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.5500	TA = 2.8700
PER = 1.75	TIMES FOR MAXIMA --	TD = 5.9000	TV = 2.5500	TA = 5.8900
PER = 1.80	TIMES FOR MAXIMA --	TD = 5.9100	TV = 2.5500	TA = 5.8900
PER = 1.85	TIMES FOR MAXIMA --	TD = 5.9200	TV = 2.5500	TA = 5.8900
PER = 1.90	TIMES FOR MAXIMA --	TD = 6.1200	TV = 2.5500	TA = 6.1000
PER = 1.95	TIMES FOR MAXIMA --	TD = 6.1200	TV = 2.5500	TA = 6.1100
PER = 2.00	TIMES FOR MAXIMA --	TD = 5.4200	TV = 2.5500	TA = 5.4100
PER = 2.05	TIMES FOR MAXIMA --	TD = 5.4300	TV = 2.5500	TA = 5.4100
PER = 2.10	TIMES FOR MAXIMA --	TD = 5.4300	TV = 2.5500	TA = 5.4100
PER = 2.15	TIMES FOR MAXIMA --	TD = 8.7600	TV = 2.5500	TA = 5.4100
PER = 2.20	TIMES FOR MAXIMA --	TD = 8.7700	TV = 2.5500	TA = 5.4100
PER = 2.25	TIMES FOR MAXIMA --	TD = 8.9500	TV = 2.5500	TA = 8.9400
PER = 2.30	TIMES FOR MAXIMA --	TD = 8.9700	TV = 2.5500	TA = 8.9400
PER = 2.35	TIMES FOR MAXIMA --	TD = 7.9000	TV = 2.5500	TA = 7.8800
PER = 2.40	TIMES FOR MAXIMA --	TD = 7.9400	TV = 2.5500	TA = 7.8800
PER = 2.50	TIMES FOR MAXIMA --	TD = 8.0900	TV = 2.5500	TA = 7.9400
PER = 2.60	TIMES FOR MAXIMA --	TD = 8.1100	TV = 2.5500	TA = 8.0800
PER = 2.70	TIMES FOR MAXIMA --	TD = 6.9700	TV = 2.5500	TA = 6.9400
PER = 2.80	TIMES FOR MAXIMA --	TD = 7.0000	TV = 2.5500	TA = 6.9400
PER = 2.90	TIMES FOR MAXIMA --	TD = 7.0000	TV = 2.5500	TA = 6.9400
PER = 3.00	TIMES FOR MAXIMA --	TD = 7.0100	TV = 2.5500	TA = 6.9400
PER = 3.10	TIMES FOR MAXIMA --	TD = 7.2400	TV = 2.5500	TA = 7.1900
PER = 3.20	TIMES FOR MAXIMA --	TD = 7.2500	TV = 2.5500	TA = 7.2000
PER = 3.30	TIMES FOR MAXIMA --	TD = 7.2500	TV = 2.5500	TA = 7.2000
PER = 3.40	TIMES FOR MAXIMA --	TD = 7.2600	TV = 2.5500	TA = 7.2000
PER = 3.50	TIMES FOR MAXIMA --	TD = 7.2600	TV = 2.5500	TA = 7.2400
PER = 3.60	TIMES FOR MAXIMA --	TD = 7.5200	TV = 2.5500	TA = 7.2400
PER = 3.70	TIMES FOR MAXIMA --	TD = 7.5200	TV = 2.5500	TA = 7.5000
PER = 3.80	TIMES FOR MAXIMA --	TD = 7.5200	TV = 2.5500	TA = 7.5000
PER = 3.90	TIMES FOR MAXIMA --	TD = 7.5300	TV = 2.5500	TA = 7.5000
PER = 4.00	TIMES FOR MAXIMA --	TD = 7.5300	TV = 2.5500	TA = 7.5000
PER = 4.10	TIMES FOR MAXIMA --	TD = 6.2300	TV = 2.5500	TA = 6.0000
PER = 4.20	TIMES FOR MAXIMA --	TD = 6.2400	TV = 2.5500	TA = 6.2100
PER = 4.30	TIMES FOR MAXIMA --	TD = 6.2400	TV = 2.5500	TA = 6.2100
PER = 4.40	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5500	TA = 6.2100
PER = 4.50	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5500	TA = 6.2100
PER = 4.60	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5500	TA = 6.2100
PER = 4.70	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5500	TA = 6.2100
PER = 4.80	TIMES FOR MAXIMA --	TD = 6.2600	TV = 2.5500	TA = 6.2100
PER = 4.90	TIMES FOR MAXIMA --	TD = 6.2600	TV = 2.5500	TA = 6.2100
PER = 5.00	TIMES FOR MAXIMA --	TD = 6.2600	TV = 2.5500	TA = 6.2100
PER = 5.10	TIMES FOR MAXIMA --	TD = 6.2600	TV = 2.5500	TA = 6.2200

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PER = 5.20 TIMES FOR MAXIMA -- TD = 6.2600 TV = 2.5500 TA = 6.2200
PER = 5.40 TIMES FOR MAXIMA -- TD = 6.2600 TV = 2.5500 TA = 6.2200
PER = 5.60 TIMES FOR MAXIMA -- TD = 6.4700 TV = 2.5500 TA = 6.2200
PER = 5.80 TIMES FOR MAXIMA -- TD = 6.4700 TV = 2.5500 TA = 6.2200
PER = 6.00 TIMES FOR MAXIMA -- TD = 6.4800 TV = 2.5500 TA = 6.2200
PER = 6.20 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.5300
PER = 6.40 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 6.60 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 6.80 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 7.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 7.30 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 7.60 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 8.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 8.50 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 9.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 9.50 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER =10.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900

SPECTRAL VALUES--

(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00007	0.00171	0.04195	0.82192	0.81858	100.00
2	0.02	0.00027	0.04335	0.08336	0.82243	0.81328	50.00
3	0.03	0.00110	0.18379	0.22974	1.51822	1.49432	33.33
4	0.04	0.00217	0.31642	0.34155	1.74493	1.66617	25.00
5	0.05	0.00366	0.44677	0.45974	1.82459	1.79417	20.00
6	0.06	0.00428	0.41585	0.44797	1.42638	1.45686	16.67
7	0.07	0.00581	0.47802	0.52194	1.47018	1.45494	14.29
8	0.08	0.01091	0.79906	0.85696	2.13704	2.09023	12.50
9	0.09	0.01380	0.91960	0.96375	2.07701	2.08952	11.11
10	0.10	0.01203	0.70258	0.75557	1.50682	1.47435	10.00
11	0.11	0.01243	0.73464	0.71011	1.28682	1.25967	9.09
12	0.12	0.01009	0.54647	0.52809	0.85116	0.85872	8.33
13	0.13	0.01069	0.46673	0.51688	0.78573	0.77583	7.69
14	0.14	0.01281	0.55624	0.57507	0.81192	0.80152	7.14
15	0.15	0.01487	0.56239	0.62302	0.80252	0.81046	6.67
16	0.16	0.01884	0.75229	0.73986	0.91472	0.90230	6.25
17	0.17	0.02303	0.86039	0.85120	0.97551	0.97703	5.88
18	0.18	0.02485	0.86020	0.86750	0.93942	0.94042	5.56
19	0.19	0.02857	0.87770	0.94490	0.97165	0.97042	5.26
20	0.20	0.02938	0.95448	0.92312	0.90821	0.90064	5.00
21	0.21	0.03784	1.14946	1.13222	1.05638	1.05204	4.76
22	0.22	0.03804	1.12843	1.08630	0.97513	0.96349	4.55
23	0.23	0.04244	1.13944	1.15933	0.98812	0.98357	4.35
24	0.24	0.04588	1.22517	1.20103	0.98291	0.97648	4.17
25	0.25	0.05505	1.45180	1.38356	1.07767	1.07990	4.00
26	0.26	0.06352	1.64419	1.53498	1.15887	1.15200	3.85
27	0.27	0.06397	1.49739	1.48854	1.07894	1.07578	3.70
28	0.28	0.06108	1.44705	1.37074	0.96463	0.95526	3.57
29	0.29	0.06330	1.50041	1.37148	0.92871	0.92282	3.45
30	0.30	0.06799	1.58132	1.42398	0.92831	0.92621	3.33
31	0.31	0.07450	1.56110	1.50998	0.95436	0.95046	3.23
32	0.32	0.07866	1.60487	1.54449	0.94665	0.94180	3.13
33	0.33	0.07637	1.45088	1.45416	0.86887	0.85985	3.03
34	0.34	0.07200	1.33968	1.33047	0.77205	0.76357	2.94
35	0.35	0.06812	1.34283	1.22295	0.68539	0.68181	2.86
36	0.36	0.06715	1.33822	1.17200	0.64080	0.63526	2.78
37	0.37	0.06656	1.28137	1.13028	0.60109	0.59609	2.70
38	0.38	0.06468	1.25981	1.06944	0.55415	0.54916	2.63
39	0.39	0.06068	1.23910	0.97764	0.49358	0.48915	2.56
40	0.40	0.06370	1.17128	1.00062	0.49250	0.48813	2.50

41	0.41	0.06256	1.18616	0.95865	0.45808	0.45625	2.44
42	0.42	0.06037	1.19616	0.90309	0.42280	0.41957	2.38
43	0.43	0.05966	1.15192	0.87180	0.39751	0.39561	2.33
44	0.44	0.05930	1.07742	0.84685	0.37888	0.37556	2.27
45	0.45	0.05866	0.99663	0.81904	0.35661	0.35515	2.22
46	0.46	0.05718	0.90387	0.78104	0.33309	0.33131	2.17
47	0.47	0.05473	0.84874	0.73170	0.30536	0.30378	2.13
48	0.48	0.05130	0.84985	0.67155	0.27399	0.27300	2.08
49	0.49	0.05240	0.81367	0.67192	0.26905	0.26757	2.04
50	0.50	0.05402	0.80880	0.67886	0.26657	0.26493	2.00
51	0.51	0.05288	0.83519	0.65150	0.25161	0.24927	1.96
52	0.52	0.05027	0.87985	0.60736	0.22945	0.22791	1.92
53	0.53	0.05172	0.93855	0.61319	0.22691	0.22576	1.89
54	0.54	0.05617	1.00433	0.65351	0.23851	0.23615	1.85
55	0.55	0.06000	1.06884	0.68548	0.24516	0.24320	1.82
56	0.56	0.06644	1.12386	0.74544	0.26427	0.25974	1.79
57	0.57	0.07374	1.16245	0.81287	0.28269	0.27827	1.75
58	0.58	0.08007	1.17982	0.86741	0.29612	0.29182	1.72
59	0.60	0.08866	1.14420	0.92849	0.30613	0.30196	1.67
60	0.62	0.09140	1.02596	0.92630	0.29378	0.29153	1.61
61	0.64	0.08974	1.03125	0.88106	0.26991	0.26863	1.56
62	0.66	0.08366	1.08019	0.79642	0.23773	0.23546	1.52
63	0.68	0.07428	1.06790	0.68631	0.19773	0.19694	1.47
64	0.70	0.06678	1.00885	0.59944	0.16771	0.16710	1.43
65	0.72	0.06933	0.92792	0.60506	0.16570	0.16398	1.39
66	0.74	0.06680	0.83311	0.56721	0.15157	0.14957	1.35
67	0.76	0.06220	0.75200	0.51422	0.13421	0.13203	1.32
68	0.78	0.05906	0.72919	0.47575	0.12066	0.11902	1.28
69	0.80	0.06091	0.71267	0.47839	0.11739	0.11669	1.25
70	0.82	0.06283	0.70235	0.48142	0.11542	0.11456	1.22
71	0.84	0.06816	0.71704	0.50982	0.12036	0.11843	1.19
72	0.86	0.07687	0.74262	0.56162	0.12907	0.12743	1.16
73	0.88	0.08600	0.77734	0.61406	0.13751	0.13616	1.14
74	0.90	0.09759	0.79993	0.68129	0.14881	0.14771	1.11
75	0.92	0.10954	0.86595	0.74812	0.15920	0.15868	1.09
76	0.94	0.11962	0.95982	0.79954	0.16788	0.16597	1.06
77	0.96	0.12541	1.02877	0.82083	0.16974	0.16684	1.04
78	0.98	0.12810	1.05347	0.82127	0.16447	0.16353	1.02
79	1.00	0.13647	1.06090	0.85746	0.16889	0.16732	1.00
80	1.05	0.14854	1.12673	0.88885	0.16702	0.16518	0.95
81	1.10	0.15387	1.13175	0.87890	0.15746	0.15591	0.91
82	1.15	0.14959	1.17120	0.81732	0.14084	0.13868	0.87
83	1.20	0.14036	1.18130	0.73495	0.12010	0.11951	0.83
84	1.25	0.13601	1.17059	0.68368	0.10739	0.10672	0.80
85	1.30	0.13061	1.14666	0.63128	0.09671	0.09475	0.77
86	1.35	0.12893	1.11542	0.60008	0.08915	0.08674	0.74
87	1.40	0.12537	1.08104	0.56265	0.08085	0.07842	0.71
88	1.45	0.12030	1.04630	0.52129	0.07258	0.07015	0.69
89	1.50	0.11476	1.01286	0.48069	0.06478	0.06253	0.67
90	1.55	0.10878	0.98162	0.44095	0.05766	0.05551	0.65
91	1.60	0.10271	0.95297	0.40335	0.05129	0.04919	0.63
92	1.65	0.09704	0.92697	0.36955	0.04565	0.04370	0.61
93	1.70	0.09180	0.90352	0.33927	0.04070	0.03894	0.59
94	1.75	0.09076	0.88242	0.32585	0.03720	0.03633	0.57
95	1.80	0.09549	0.86342	0.33334	0.03725	0.03614	0.56
96	1.85	0.09582	0.84627	0.32543	0.03556	0.03432	0.54
97	1.90	0.09635	0.83074	0.31862	0.03353	0.03272	0.53
98	1.95	0.09936	0.81662	0.32016	0.03318	0.03204	0.51
99	2.00	0.10823	0.80374	0.34003	0.03435	0.03317	0.50
100	2.05	0.11706	0.79193	0.35877	0.03544	0.03415	0.49
101	2.10	0.12401	0.78107	0.37104	0.03586	0.03448	0.48

102	2.15	0.12967	0.77105	0.37894	0.03573	0.03439	0.47
103	2.20	0.13671	0.76177	0.39044	0.03518	0.03463	0.45
104	2.25	0.14201	0.75315	0.39657	0.03481	0.03439	0.44
105	2.30	0.14953	0.74515	0.40849	0.03535	0.03466	0.43
106	2.35	0.15353	0.73769	0.41049	0.03452	0.03408	0.43
107	2.40	0.15782	0.73074	0.41317	0.03399	0.03359	0.42
108	2.50	0.16052	0.71820	0.40344	0.03180	0.03149	0.40
109	2.60	0.16493	0.70726	0.39857	0.03037	0.02991	0.38
110	2.70	0.16824	0.69772	0.39151	0.02956	0.02829	0.37
111	2.80	0.17313	0.68944	0.38851	0.02827	0.02707	0.36
112	2.90	0.17573	0.68225	0.38075	0.02670	0.02562	0.34
113	3.00	0.17624	0.67604	0.36911	0.02498	0.02401	0.33
114	3.10	0.18240	0.67068	0.36968	0.02391	0.02327	0.32
115	3.20	0.18800	0.66610	0.36914	0.02315	0.02251	0.31
116	3.30	0.19088	0.66221	0.36343	0.02213	0.02149	0.30
117	3.40	0.19114	0.65890	0.35323	0.02089	0.02027	0.29
118	3.50	0.18855	0.65614	0.33849	0.01960	0.01887	0.29
119	3.60	0.18358	0.65386	0.32040	0.01815	0.01737	0.28
120	3.70	0.18463	0.65196	0.31354	0.01716	0.01654	0.27
121	3.80	0.18252	0.65044	0.30178	0.01623	0.01550	0.26
122	3.90	0.17770	0.64924	0.28629	0.01514	0.01432	0.26
123	4.00	0.17042	0.64831	0.26769	0.01393	0.01306	0.25
124	4.10	0.17053	0.64762	0.26134	0.01297	0.01244	0.24
125	4.20	0.17579	0.64713	0.26299	0.01273	0.01222	0.24
126	4.30	0.17994	0.64684	0.26293	0.01248	0.01193	0.23
127	4.40	0.18295	0.64670	0.26125	0.01217	0.01159	0.23
128	4.50	0.18495	0.64668	0.25824	0.01180	0.01120	0.22
129	4.60	0.18589	0.64682	0.25391	0.01140	0.01077	0.22
130	4.70	0.18585	0.64703	0.24845	0.01096	0.01032	0.21
131	4.80	0.18495	0.64733	0.24209	0.01050	0.00984	0.21
132	4.90	0.18336	0.64771	0.23511	0.01004	0.00936	0.20
133	5.00	0.18105	0.64813	0.22752	0.00956	0.00888	0.20
134	5.10	0.17813	0.64865	0.21946	0.00909	0.00840	0.20
135	5.20	0.17468	0.64916	0.21107	0.00862	0.00792	0.19
136	5.40	0.16651	0.65031	0.19375	0.00771	0.00700	0.19
137	5.60	0.16025	0.65159	0.17980	0.00686	0.00627	0.18
138	5.80	0.15264	0.65291	0.16536	0.00607	0.00556	0.17
139	6.00	0.14415	0.65430	0.15096	0.00536	0.00491	0.17
140	6.20	0.14369	0.65562	0.14562	0.00501	0.00458	0.16
141	6.40	0.14541	0.65698	0.14276	0.00478	0.00435	0.16
142	6.60	0.14651	0.65833	0.13947	0.00455	0.00412	0.15
143	6.80	0.14706	0.65959	0.13588	0.00433	0.00390	0.15
144	7.00	0.14716	0.66086	0.13209	0.00411	0.00368	0.14
145	7.30	0.14656	0.66269	0.12615	0.00380	0.00337	0.14
146	7.60	0.14526	0.66446	0.12009	0.00351	0.00308	0.13
147	8.00	0.14272	0.66661	0.11209	0.00316	0.00273	0.13
148	8.50	0.13864	0.66906	0.10248	0.00277	0.00235	0.12
149	9.00	0.13396	0.67127	0.09352	0.00243	0.00203	0.11
150	9.50	0.12900	0.67322	0.08532	0.00214	0.00175	0.11
151	10.00	0.12397	0.67505	0.07789	0.00190	0.00152	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.
AREA OF ACC. RESPONSE SPECTRUM = 0.495
AREA OF VEL. RESPONSE SPECTRUM = 2.289
MAX. ACCELERATION RESPONSE VALUE = 1.507
MAX. VELOCITY RESPONSE VALUE = 1.644

1****** OPTION 9 *** COMPUTE RESPONSE SPECTRUM
RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER 17
CALCULATED FOR DAMPING 0.050

TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
TD = TIME FOR MAX. RELATIVE DISP.
TV = TIME FOR MAX. RELATIVE VEL.
TA = TIME FOR MAX. ABSOLUTE ACC.
DAMPING RATIO = 0.050

PER = 0.01	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5700	TA = 2.5700
PER = 0.02	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5800	TA = 2.5700
PER = 0.03	TIMES FOR MAXIMA --	TD = 2.9500	TV = 2.9400	TA = 2.9500
PER = 0.04	TIMES FOR MAXIMA --	TD = 3.6300	TV = 2.6100	TA = 3.6300
PER = 0.05	TIMES FOR MAXIMA --	TD = 4.8700	TV = 4.8300	TA = 4.8400
PER = 0.06	TIMES FOR MAXIMA --	TD = 4.3200	TV = 4.3300	TA = 1.9700
PER = 0.07	TIMES FOR MAXIMA --	TD = 4.3300	TV = 4.3100	TA = 4.3300
PER = 0.08	TIMES FOR MAXIMA --	TD = 2.5200	TV = 2.5400	TA = 2.5200
PER = 0.09	TIMES FOR MAXIMA --	TD = 2.5300	TV = 2.6000	TA = 2.5300
PER = 0.10	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.6100	TA = 2.5900
PER = 0.11	TIMES FOR MAXIMA --	TD = 2.5500	TV = 2.5800	TA = 2.5500
PER = 0.12	TIMES FOR MAXIMA --	TD = 4.8000	TV = 2.5800	TA = 4.8000
PER = 0.13	TIMES FOR MAXIMA --	TD = 3.6600	TV = 4.7900	TA = 3.6600
PER = 0.14	TIMES FOR MAXIMA --	TD = 3.6700	TV = 3.7100	TA = 3.6700
PER = 0.15	TIMES FOR MAXIMA --	TD = 3.6800	TV = 3.7200	TA = 3.6800
PER = 0.16	TIMES FOR MAXIMA --	TD = 4.1800	TV = 4.1500	TA = 4.1800
PER = 0.17	TIMES FOR MAXIMA --	TD = 4.1100	TV = 4.1500	TA = 4.1100
PER = 0.18	TIMES FOR MAXIMA --	TD = 2.5600	TV = 2.5200	TA = 2.5600
PER = 0.19	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5300	TA = 2.5700
PER = 0.20	TIMES FOR MAXIMA --	TD = 6.6100	TV = 2.5300	TA = 6.6000
PER = 0.21	TIMES FOR MAXIMA --	TD = 2.5800	TV = 2.5300	TA = 7.0500
PER = 0.22	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5500	TA = 2.5000
PER = 0.23	TIMES FOR MAXIMA --	TD = 3.4200	TV = 7.0400	TA = 6.9800
PER = 0.24	TIMES FOR MAXIMA --	TD = 2.2400	TV = 2.2900	TA = 2.2300
PER = 0.25	TIMES FOR MAXIMA --	TD = 6.2400	TV = 6.3100	TA = 6.2400
PER = 0.26	TIMES FOR MAXIMA --	TD = 1.5600	TV = 6.3200	TA = 6.2500
PER = 0.27	TIMES FOR MAXIMA --	TD = 1.1900	TV = 1.2600	TA = 1.1900
PER = 0.28	TIMES FOR MAXIMA --	TD = 1.2100	TV = 1.2600	TA = 1.2000
PER = 0.29	TIMES FOR MAXIMA --	TD = 1.2100	TV = 5.1000	TA = 1.2100
PER = 0.30	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.8400	TA = 2.9100
PER = 0.31	TIMES FOR MAXIMA --	TD = 2.9400	TV = 2.8500	TA = 2.9400
PER = 0.32	TIMES FOR MAXIMA --	TD = 2.9500	TV = 2.5600	TA = 2.9500
PER = 0.33	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5600	TA = 2.5000
PER = 0.34	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5600	TA = 2.5000
PER = 0.35	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.5600	TA = 2.5000
PER = 0.36	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.9300	TA = 2.5000
PER = 0.37	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6000	TA = 2.5000
PER = 0.38	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.8000	TA = 2.5100
PER = 0.39	TIMES FOR MAXIMA --	TD = 2.5200	TV = 4.0300	TA = 2.5100
PER = 0.40	TIMES FOR MAXIMA --	TD = 3.9400	TV = 4.0300	TA = 3.9400
PER = 0.41	TIMES FOR MAXIMA --	TD = 3.9500	TV = 4.0400	TA = 3.9500
PER = 0.42	TIMES FOR MAXIMA --	TD = 3.9600	TV = 4.0400	TA = 3.9500
PER = 0.43	TIMES FOR MAXIMA --	TD = 3.9700	TV = 4.0500	TA = 3.9600
PER = 0.44	TIMES FOR MAXIMA --	TD = 3.9800	TV = 3.9100	TA = 3.9700
PER = 0.45	TIMES FOR MAXIMA --	TD = 4.6900	TV = 3.9100	TA = 4.6900
PER = 0.46	TIMES FOR MAXIMA --	TD = 4.7000	TV = 3.9100	TA = 4.6900
PER = 0.47	TIMES FOR MAXIMA --	TD = 4.7100	TV = 3.9100	TA = 4.7000
PER = 0.48	TIMES FOR MAXIMA --	TD = 4.7100	TV = 3.9100	TA = 4.7000
PER = 0.49	TIMES FOR MAXIMA --	TD = 5.5200	TV = 5.4100	TA = 5.5100
PER = 0.50	TIMES FOR MAXIMA --	TD = 5.5500	TV = 5.4100	TA = 5.5400
PER = 0.51	TIMES FOR MAXIMA --	TD = 5.5600	TV = 5.4100	TA = 5.5600
PER = 0.52	TIMES FOR MAXIMA --	TD = 2.5100	TV = 5.4400	TA = 2.5000
PER = 0.53	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6100	TA = 2.5000
PER = 0.54	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6300	TA = 2.5000
PER = 0.55	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6400	TA = 2.5000
PER = 0.56	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6400	TA = 2.5000

PER = 0.57	TIMES FOR MAXIMA --	TD = 2.5200	TV = 2.6400	TA = 2.5100
PER = 0.58	TIMES FOR MAXIMA --	TD = 2.5200	TV = 2.6400	TA = 2.5100
PER = 0.60	TIMES FOR MAXIMA --	TD = 2.5400	TV = 2.4800	TA = 2.5300
PER = 0.62	TIMES FOR MAXIMA --	TD = 2.5600	TV = 2.4800	TA = 2.5500
PER = 0.64	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.4800	TA = 2.5800
PER = 0.66	TIMES FOR MAXIMA --	TD = 2.6000	TV = 2.4900	TA = 2.5900
PER = 0.68	TIMES FOR MAXIMA --	TD = 3.4100	TV = 2.4900	TA = 3.4000
PER = 0.70	TIMES FOR MAXIMA --	TD = 3.4200	TV = 2.4900	TA = 3.4100
PER = 0.72	TIMES FOR MAXIMA --	TD = 3.4300	TV = 3.6100	TA = 3.4200
PER = 0.74	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.6100	TA = 3.4300
PER = 0.76	TIMES FOR MAXIMA --	TD = 1.8100	TV = 3.6100	TA = 1.7500
PER = 0.78	TIMES FOR MAXIMA --	TD = 1.4700	TV = 3.6100	TA = 1.8100
PER = 0.80	TIMES FOR MAXIMA --	TD = 1.4700	TV = 3.6100	TA = 1.4600
PER = 0.82	TIMES FOR MAXIMA --	TD = 1.4900	TV = 3.6100	TA = 1.4700
PER = 0.84	TIMES FOR MAXIMA --	TD = 6.4900	TV = 3.6200	TA = 6.4800
PER = 0.86	TIMES FOR MAXIMA --	TD = 3.4700	TV = 4.2200	TA = 3.4700
PER = 0.88	TIMES FOR MAXIMA --	TD = 4.0000	TV = 4.2200	TA = 3.9700
PER = 0.90	TIMES FOR MAXIMA --	TD = 4.0100	TV = 4.2200	TA = 4.0000
PER = 0.92	TIMES FOR MAXIMA --	TD = 4.0100	TV = 4.2900	TA = 4.0000
PER = 0.94	TIMES FOR MAXIMA --	TD = 3.1200	TV = 4.2900	TA = 3.1100
PER = 0.96	TIMES FOR MAXIMA --	TD = 3.1200	TV = 3.9100	TA = 3.1100
PER = 0.98	TIMES FOR MAXIMA --	TD = 3.1300	TV = 3.9100	TA = 3.1200
PER = 1.00	TIMES FOR MAXIMA --	TD = 3.1500	TV = 3.9100	TA = 3.1200
PER = 1.05	TIMES FOR MAXIMA --	TD = 3.2000	TV = 3.9100	TA = 3.1800
PER = 1.10	TIMES FOR MAXIMA --	TD = 3.2300	TV = 2.4900	TA = 3.2200
PER = 1.15	TIMES FOR MAXIMA --	TD = 3.3000	TV = 2.4900	TA = 3.2900
PER = 1.20	TIMES FOR MAXIMA --	TD = 3.3300	TV = 2.4900	TA = 3.3100
PER = 1.25	TIMES FOR MAXIMA --	TD = 3.3500	TV = 2.4900	TA = 3.3300
PER = 1.30	TIMES FOR MAXIMA --	TD = 3.3700	TV = 2.4900	TA = 3.3600
PER = 1.35	TIMES FOR MAXIMA --	TD = 2.8400	TV = 2.4900	TA = 2.8200
PER = 1.40	TIMES FOR MAXIMA --	TD = 2.8700	TV = 2.4900	TA = 2.8300
PER = 1.45	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.4900	TA = 2.8600
PER = 1.50	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.4900	TA = 2.8900
PER = 1.55	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.4900	TA = 2.9100
PER = 1.60	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.4900	TA = 2.9100
PER = 1.65	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.4900	TA = 2.9100
PER = 1.70	TIMES FOR MAXIMA --	TD = 2.9900	TV = 2.4900	TA = 2.3700
PER = 1.75	TIMES FOR MAXIMA --	TD = 2.3900	TV = 2.4900	TA = 2.3700
PER = 1.80	TIMES FOR MAXIMA --	TD = 5.9300	TV = 2.4900	TA = 5.9200
PER = 1.85	TIMES FOR MAXIMA --	TD = 6.0000	TV = 2.4900	TA = 5.9900
PER = 1.90	TIMES FOR MAXIMA --	TD = 6.0500	TV = 5.7600	TA = 6.0400
PER = 1.95	TIMES FOR MAXIMA --	TD = 5.3500	TV = 5.7600	TA = 5.3400
PER = 2.00	TIMES FOR MAXIMA --	TD = 5.3600	TV = 5.7600	TA = 5.3400
PER = 2.05	TIMES FOR MAXIMA --	TD = 5.3600	TV = 5.7600	TA = 5.3400
PER = 2.10	TIMES FOR MAXIMA --	TD = 5.3600	TV = 5.7600	TA = 5.3400
PER = 2.15	TIMES FOR MAXIMA --	TD = 8.7100	TV = 5.7600	TA = 5.3400
PER = 2.20	TIMES FOR MAXIMA --	TD = 8.8100	TV = 5.7600	TA = 7.6700
PER = 2.25	TIMES FOR MAXIMA --	TD = 8.8900	TV = 5.7600	TA = 8.8800
PER = 2.30	TIMES FOR MAXIMA --	TD = 7.8200	TV = 5.7600	TA = 8.8800
PER = 2.35	TIMES FOR MAXIMA --	TD = 7.8800	TV = 5.7600	TA = 7.7900
PER = 2.40	TIMES FOR MAXIMA --	TD = 7.9100	TV = 5.7600	TA = 7.8800
PER = 2.50	TIMES FOR MAXIMA --	TD = 8.0300	TV = 7.3100	TA = 8.0100
PER = 2.60	TIMES FOR MAXIMA --	TD = 8.0600	TV = 7.6400	TA = 8.0200
PER = 2.70	TIMES FOR MAXIMA --	TD = 6.9400	TV = 7.6400	TA = 6.8800
PER = 2.80	TIMES FOR MAXIMA --	TD = 6.9400	TV = 7.6500	TA = 6.8800
PER = 2.90	TIMES FOR MAXIMA --	TD = 7.0600	TV = 7.6500	TA = 6.9300
PER = 3.00	TIMES FOR MAXIMA --	TD = 7.1500	TV = 7.6500	TA = 7.0400
PER = 3.10	TIMES FOR MAXIMA --	TD = 7.1900	TV = 5.3000	TA = 7.1400
PER = 3.20	TIMES FOR MAXIMA --	TD = 7.2000	TV = 5.3000	TA = 7.1400
PER = 3.30	TIMES FOR MAXIMA --	TD = 7.2100	TV = 5.3000	TA = 7.1800
PER = 3.40	TIMES FOR MAXIMA --	TD = 7.2100	TV = 5.3000	TA = 7.1800

PER = 3.50 TIMES FOR MAXIMA -- TD = 7.2200 TV = 5.3000 TA = 7.1900
PER = 3.60 TIMES FOR MAXIMA -- TD = 7.4500 TV = 5.3000 TA = 7.3800
PER = 3.70 TIMES FOR MAXIMA -- TD = 7.4600 TV = 5.3000 TA = 7.3900
PER = 3.80 TIMES FOR MAXIMA -- TD = 7.5000 TV = 5.3000 TA = 7.4400
PER = 3.90 TIMES FOR MAXIMA -- TD = 7.5100 TV = 5.3000 TA = 7.4500
PER = 4.00 TIMES FOR MAXIMA -- TD = 7.6200 TV = 5.3000 TA = 7.4500
PER = 4.10 TIMES FOR MAXIMA -- TD = 6.1600 TV = 5.3000 TA = 6.0900
PER = 4.20 TIMES FOR MAXIMA -- TD = 6.1600 TV = 5.3000 TA = 6.1400
PER = 4.30 TIMES FOR MAXIMA -- TD = 6.1700 TV = 5.3000 TA = 6.1500
PER = 4.40 TIMES FOR MAXIMA -- TD = 6.1900 TV = 5.3000 TA = 6.1500
PER = 4.50 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.60 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.70 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.80 TIMES FOR MAXIMA -- TD = 6.3400 TV = 5.3000 TA = 6.1500
PER = 4.90 TIMES FOR MAXIMA -- TD = 6.3400 TV = 5.3000 TA = 6.1500
PER = 5.00 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.10 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.20 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.40 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.60 TIMES FOR MAXIMA -- TD = 6.5400 TV = 5.3000 TA = 6.3200
PER = 5.80 TIMES FOR MAXIMA -- TD = 6.5500 TV = 5.3000 TA = 6.5000
PER = 6.00 TIMES FOR MAXIMA -- TD = 6.5500 TV = 5.3000 TA = 6.5000
PER = 6.20 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.5200
PER = 6.40 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.7300
PER = 6.60 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.7300
PER = 6.80 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.30 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.60 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 8.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 8.50 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 9.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 9.50 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER =10.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300

SPECTRAL VALUES--
(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00005	0.00136	0.02849	0.55850	0.55584	100.00
2	0.02	0.00018	0.04499	0.05569	0.55907	0.54337	50.00
3	0.03	0.00100	0.17299	0.21036	1.35502	1.36825	33.33
4	0.04	0.00178	0.23944	0.27972	1.41661	1.36454	25.00
5	0.05	0.00238	0.31660	0.29913	1.19625	1.16738	20.00
6	0.06	0.00324	0.37402	0.33931	1.11290	1.10350	16.67
7	0.07	0.00410	0.42586	0.36768	1.00192	1.02494	14.29
8	0.08	0.00662	0.49285	0.51989	1.30592	1.26808	12.50
9	0.09	0.01058	0.74261	0.73891	1.61391	1.60203	11.11
10	0.10	0.00992	0.62974	0.62356	1.19459	1.21675	10.00
11	0.11	0.00945	0.61752	0.53978	0.94469	0.95753	9.09
12	0.12	0.00955	0.45760	0.49991	0.83422	0.81289	8.33
13	0.13	0.00942	0.48076	0.45526	0.67574	0.68335	7.69
14	0.14	0.01238	0.51781	0.55546	0.77129	0.77420	7.14
15	0.15	0.01197	0.53788	0.50127	0.65502	0.65209	6.67
16	0.16	0.01428	0.62039	0.56072	0.68796	0.68383	6.25
17	0.17	0.01619	0.69957	0.59823	0.69353	0.68666	5.88
18	0.18	0.01573	0.57102	0.54919	0.60640	0.59536	5.56
19	0.19	0.01745	0.63990	0.57695	0.59795	0.59253	5.26
20	0.20	0.01613	0.56661	0.50682	0.50024	0.49448	5.00
21	0.21	0.01674	0.60435	0.50091	0.46688	0.46544	4.76
22	0.22	0.01774	0.54424	0.50670	0.46072	0.44942	4.55
23	0.23	0.01530	0.47636	0.41797	0.35437	0.35460	4.35

24	0.24	0.01639	0.46797	0.42917	0.35591	0.34893	4.17
25	0.25	0.01736	0.48167	0.43619	0.34254	0.34046	4.00
26	0.26	0.01916	0.51490	0.46302	0.35118	0.34750	3.85
27	0.27	0.02110	0.53368	0.49104	0.35711	0.35488	3.70
28	0.28	0.02280	0.53679	0.51153	0.35936	0.35648	3.57
29	0.29	0.02363	0.56432	0.51192	0.34832	0.34445	3.45
30	0.30	0.02424	0.55960	0.50764	0.33261	0.33018	3.33
31	0.31	0.02969	0.62717	0.60171	0.38143	0.37875	3.23
32	0.32	0.03087	0.64924	0.60610	0.37197	0.36959	3.13
33	0.33	0.02956	0.62054	0.56290	0.33676	0.33284	3.03
34	0.34	0.02988	0.59171	0.55227	0.32331	0.31695	2.94
35	0.35	0.03145	0.58062	0.56451	0.32000	0.31472	2.86
36	0.36	0.03369	0.56893	0.58806	0.32211	0.31875	2.78
37	0.37	0.03527	0.58074	0.59894	0.31687	0.31587	2.70
38	0.38	0.03518	0.57848	0.58166	0.30335	0.29868	2.63
39	0.39	0.03387	0.62913	0.54565	0.27671	0.27301	2.56
40	0.40	0.03589	0.68918	0.56383	0.27621	0.27505	2.50
41	0.41	0.03816	0.69282	0.58485	0.27999	0.27835	2.44
42	0.42	0.03860	0.65645	0.57750	0.26954	0.26830	2.38
43	0.43	0.03804	0.60516	0.55578	0.25364	0.25221	2.33
44	0.44	0.03681	0.59581	0.52568	0.23464	0.23313	2.27
45	0.45	0.03653	0.60067	0.51004	0.22154	0.22117	2.22
46	0.46	0.03729	0.59047	0.50937	0.21665	0.21607	2.17
47	0.47	0.03606	0.57052	0.48207	0.20332	0.20014	2.13
48	0.48	0.03349	0.54379	0.43835	0.18014	0.17820	2.08
49	0.49	0.03413	0.51793	0.43769	0.17566	0.17430	2.04
50	0.50	0.03500	0.52157	0.43985	0.17218	0.17165	2.00
51	0.51	0.03473	0.49075	0.42793	0.16499	0.16373	1.96
52	0.52	0.03363	0.45429	0.40638	0.15517	0.15249	1.92
53	0.53	0.03853	0.46746	0.45674	0.17096	0.16816	1.89
54	0.54	0.04389	0.51448	0.51070	0.18737	0.18454	1.85
55	0.55	0.04926	0.55886	0.56278	0.20245	0.19966	1.82
56	0.56	0.05415	0.59863	0.60760	0.21441	0.21172	1.79
57	0.57	0.05848	0.62378	0.64468	0.22381	0.22070	1.75
58	0.58	0.06184	0.63106	0.66986	0.22829	0.22536	1.72
59	0.60	0.06544	0.70068	0.68529	0.22393	0.22287	1.67
60	0.62	0.06573	0.79556	0.66617	0.21124	0.20966	1.61
61	0.64	0.06527	0.83826	0.64083	0.19701	0.19538	1.56
62	0.66	0.06037	0.83336	0.57472	0.17238	0.16992	1.52
63	0.68	0.05937	0.78867	0.54857	0.15814	0.15742	1.47
64	0.70	0.06308	0.71314	0.56623	0.15969	0.15784	1.43
65	0.72	0.06124	0.63612	0.53441	0.14674	0.14483	1.39
66	0.74	0.05637	0.58189	0.47867	0.12760	0.12622	1.35
67	0.76	0.05182	0.52189	0.42839	0.11039	0.10999	1.32
68	0.78	0.05224	0.48141	0.42084	0.10620	0.10528	1.28
69	0.80	0.05347	0.46947	0.41997	0.10299	0.10244	1.25
70	0.82	0.05454	0.48106	0.41789	0.09999	0.09944	1.22
71	0.84	0.05857	0.50396	0.43810	0.10258	0.10177	1.19
72	0.86	0.06521	0.56033	0.47640	0.10880	0.10809	1.16
73	0.88	0.07540	0.63272	0.53836	0.11994	0.11938	1.14
74	0.90	0.08642	0.69483	0.60330	0.13206	0.13080	1.11
75	0.92	0.09546	0.73421	0.65194	0.14025	0.13828	1.09
76	0.94	0.10261	0.79469	0.68589	0.14302	0.14238	1.06
77	0.96	0.11124	0.85758	0.72810	0.14917	0.14799	1.04
78	0.98	0.11832	0.92962	0.75859	0.15264	0.15105	1.02
79	1.00	0.12378	0.97242	0.77774	0.15296	0.15176	1.00
80	1.05	0.13543	0.94462	0.81038	0.15223	0.15060	0.95
81	1.10	0.13936	0.91425	0.79602	0.14229	0.14121	0.91
82	1.15	0.13942	0.92776	0.76173	0.12990	0.12925	0.87
83	1.20	0.13742	0.91717	0.71955	0.11796	0.11700	0.83
84	1.25	0.13052	0.89112	0.65605	0.10342	0.10241	0.80

85	1.30	0.12014	0.85653	0.58064	0.08786	0.08715	0.77
86	1.35	0.11483	0.81840	0.53443	0.07843	0.07725	0.74
87	1.40	0.11078	0.78000	0.49719	0.06994	0.06930	0.71
88	1.45	0.10667	0.74332	0.46222	0.06255	0.06220	0.69
89	1.50	0.10247	0.70939	0.42921	0.05627	0.05583	0.67
90	1.55	0.09800	0.67864	0.39727	0.05054	0.05001	0.65
91	1.60	0.09315	0.65110	0.36578	0.04533	0.04461	0.63
92	1.65	0.08827	0.62659	0.33614	0.04056	0.03975	0.61
93	1.70	0.08406	0.60485	0.31070	0.03642	0.03566	0.59
94	1.75	0.08232	0.58554	0.29557	0.03416	0.03296	0.57
95	1.80	0.08511	0.56835	0.29710	0.03252	0.03221	0.56
96	1.85	0.09046	0.55299	0.30724	0.03299	0.03241	0.54
97	1.90	0.09369	0.55264	0.30982	0.03228	0.03182	0.53
98	1.95	0.09719	0.57669	0.31317	0.03199	0.03134	0.51
99	2.00	0.10618	0.59049	0.33357	0.03334	0.03254	0.50
100	2.05	0.11329	0.59503	0.34724	0.03395	0.03305	0.49
101	2.10	0.11848	0.59178	0.35449	0.03395	0.03294	0.48
102	2.15	0.12507	0.58239	0.36551	0.03345	0.03317	0.47
103	2.20	0.13231	0.56849	0.37788	0.03396	0.03352	0.45
104	2.25	0.14127	0.55156	0.39451	0.03461	0.03421	0.44
105	2.30	0.14555	0.53286	0.39762	0.03432	0.03373	0.43
106	2.35	0.15032	0.51341	0.40191	0.03358	0.03337	0.43
107	2.40	0.15378	0.49399	0.40260	0.03307	0.03273	0.42
108	2.50	0.16045	0.47493	0.40326	0.03175	0.03148	0.40
109	2.60	0.16086	0.46775	0.38874	0.02958	0.02918	0.38
110	2.70	0.16244	0.48295	0.37802	0.02799	0.02732	0.37
111	2.80	0.16553	0.48384	0.37144	0.02643	0.02589	0.36
112	2.90	0.16738	0.47446	0.36265	0.02483	0.02440	0.34
113	3.00	0.17264	0.45662	0.36159	0.02380	0.02352	0.33
114	3.10	0.17811	0.44595	0.36099	0.02309	0.02272	0.32
115	3.20	0.18202	0.45345	0.35740	0.02213	0.02179	0.31
116	3.30	0.18346	0.46135	0.34931	0.02109	0.02065	0.30
117	3.40	0.18236	0.46940	0.33701	0.01986	0.01934	0.29
118	3.50	0.17866	0.47735	0.32073	0.01848	0.01788	0.29
119	3.60	0.17795	0.48496	0.31058	0.01717	0.01683	0.28
120	3.70	0.17716	0.49200	0.30084	0.01615	0.01587	0.27
121	3.80	0.17389	0.49830	0.28752	0.01510	0.01476	0.26
122	3.90	0.16892	0.50375	0.27215	0.01394	0.01362	0.26
123	4.00	0.16257	0.50827	0.25536	0.01270	0.01246	0.25
124	4.10	0.16720	0.51183	0.25624	0.01240	0.01220	0.24
125	4.20	0.17130	0.51442	0.25627	0.01215	0.01191	0.24
126	4.30	0.17439	0.51608	0.25482	0.01186	0.01156	0.23
127	4.40	0.17660	0.51685	0.25219	0.01151	0.01118	0.23
128	4.50	0.17784	0.51679	0.24832	0.01111	0.01077	0.22
129	4.60	0.17820	0.51597	0.24340	0.01069	0.01033	0.22
130	4.70	0.17762	0.51446	0.23745	0.01023	0.00986	0.21
131	4.80	0.17619	0.51234	0.23064	0.00976	0.00938	0.21
132	4.90	0.17586	0.50969	0.22550	0.00929	0.00898	0.20
133	5.00	0.17475	0.50658	0.21959	0.00889	0.00857	0.20
134	5.10	0.17300	0.50308	0.21314	0.00850	0.00815	0.20
135	5.20	0.17062	0.49924	0.20616	0.00810	0.00774	0.19
136	5.40	0.16427	0.49084	0.19114	0.00731	0.00691	0.19
137	5.60	0.15767	0.48179	0.17690	0.00653	0.00616	0.18
138	5.80	0.15136	0.47242	0.16397	0.00581	0.00552	0.17
139	6.00	0.14395	0.46299	0.15074	0.00521	0.00490	0.17
140	6.20	0.14150	0.45370	0.14340	0.00485	0.00451	0.16
141	6.40	0.14276	0.44470	0.14015	0.00459	0.00427	0.16
142	6.60	0.14344	0.43607	0.13655	0.00436	0.00404	0.15
143	6.80	0.14364	0.42789	0.13273	0.00413	0.00381	0.15
144	7.00	0.14346	0.42018	0.12877	0.00392	0.00359	0.14
145	7.30	0.14249	0.40956	0.12264	0.00361	0.00328	0.14

146	7.60	0.14087	0.40837	0.11646	0.00332	0.00299	0.13
147	8.00	0.13798	0.41060	0.10837	0.00297	0.00264	0.13
148	8.50	0.13357	0.41312	0.09873	0.00259	0.00227	0.12
149	9.00	0.12865	0.41537	0.08981	0.00226	0.00195	0.11
150	9.50	0.12352	0.41738	0.08169	0.00198	0.00168	0.11
151	10.00	0.11835	0.41917	0.07436	0.00175	0.00145	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.

AREA OF ACC. RESPONSE SPECTRUM = 0.331

AREA OF VEL. RESPONSE SPECTRUM = 1.567

MAX. ACCELERATION RESPONSE VALUE = 1.195

MAX. VELOCITY RESPONSE VALUE = 0.972

*** End of Output File No. 1 ***

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Induced Cyclic Shear Stresses and Strains, and Time Histories of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M PAGE 98 OF 187

MADE BY BEG DATE 1/7/08 CHECKED BY [illegible] DATE 1/23/08

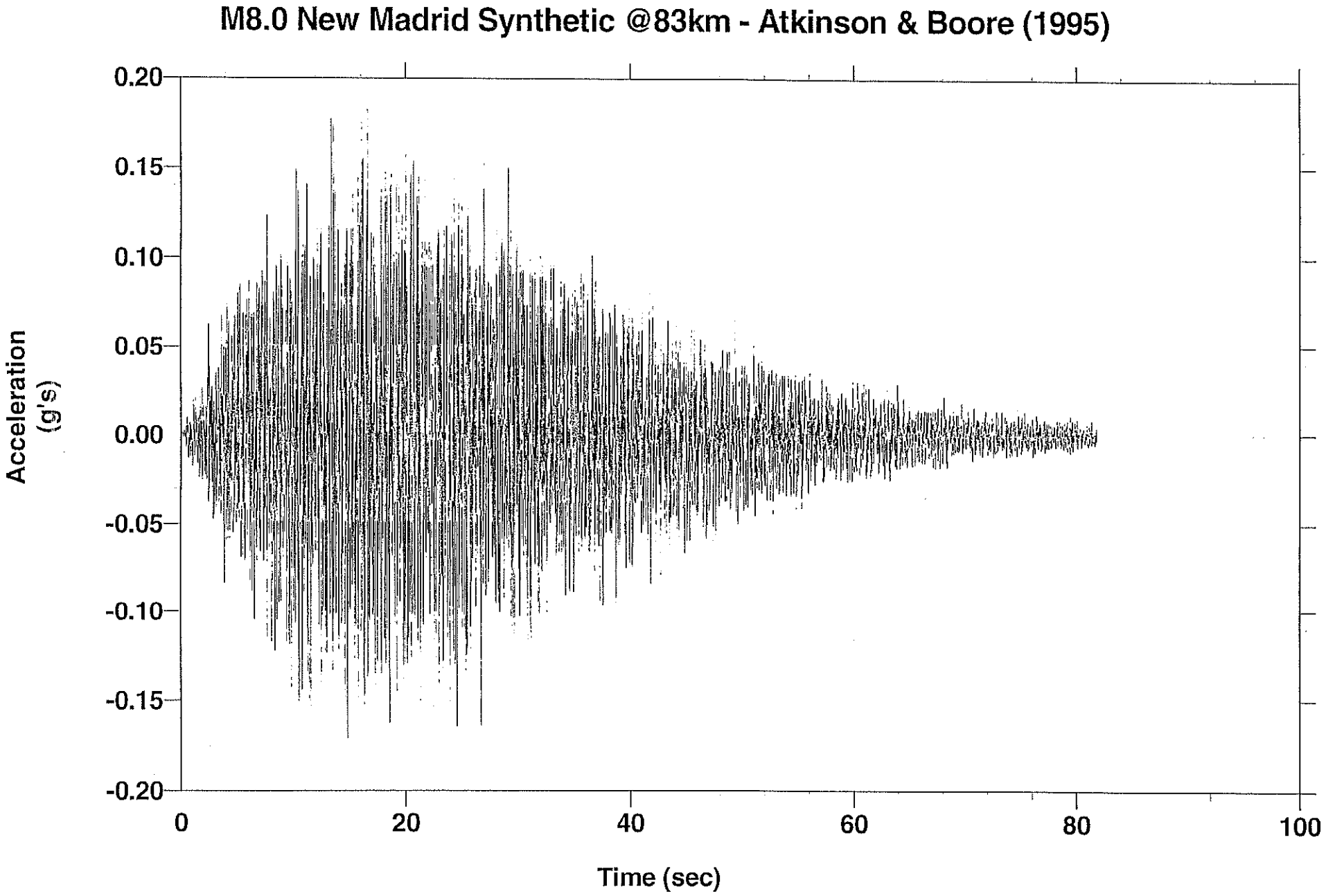
SUMMARY OF EARTHQUAKE INDUCED CYCLIC SHEAR STRESS AND STRAIN SHAKE2000 ANALYSES OUTPUT FILES FOR M8.0 NEW MADRID, MO MDE AT 83 KM SHAKE2000 COLUMN PCSC300E

PSCS300E Crest Column
Williamson - Pond Creek South Cell - Surf. El. 502, GWT 32ft., Fines El. 474
M8.0 New Madrid Synthetic @83km, PGA 0.54g, Atkinson & Boore (1995)

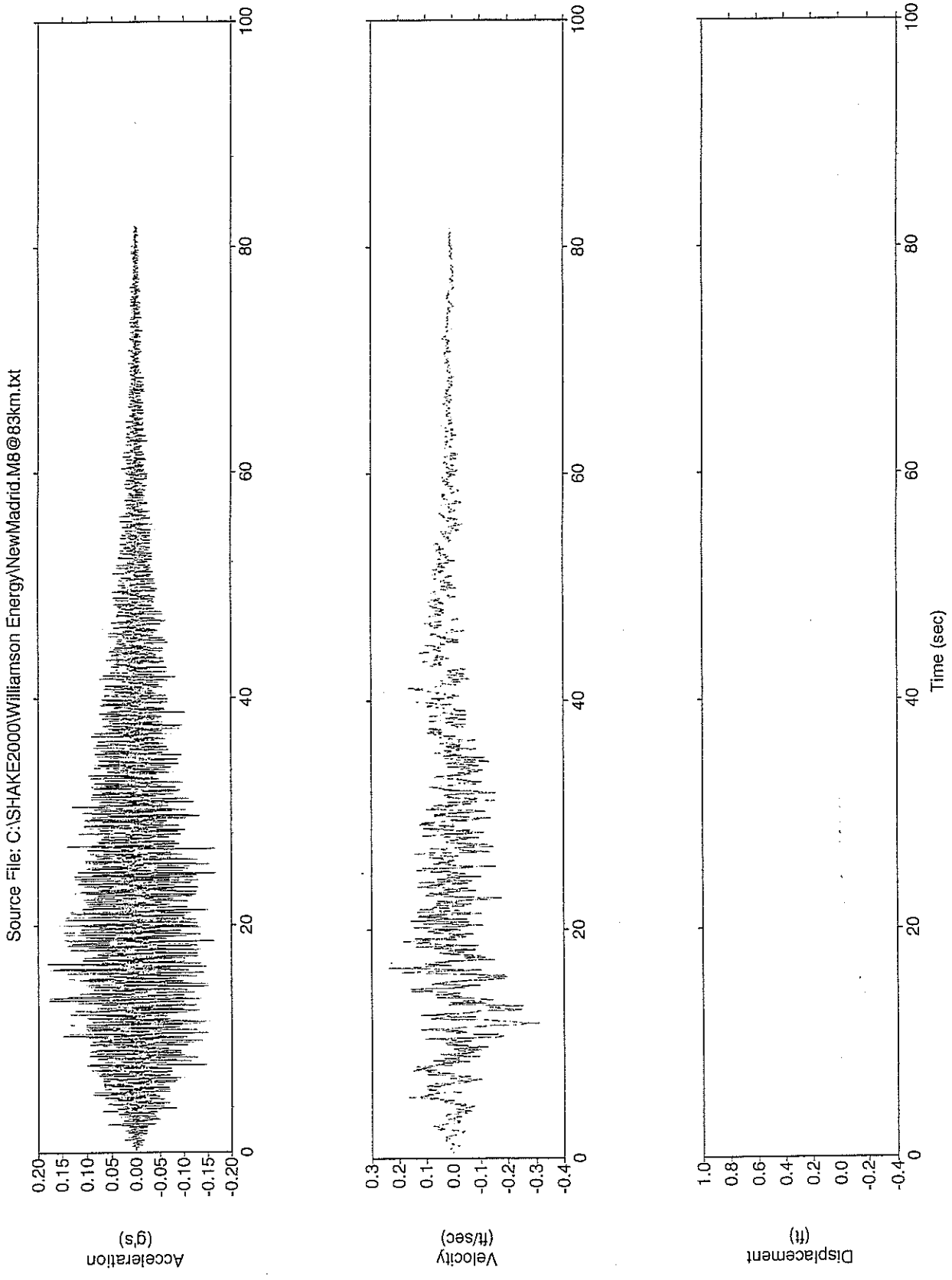
Layer	Depth to Middle of Layer (ft)	Total Unit Weight (kcf)	Damping Used (%)	Shear Modulus (ksf)	Maximum Shear Strain (%)	Maximum Shear Stress (psf)	Shear Wave Velocity (fps)	Depth to Top of Layer (ft)	Peak Acceleration (g)	G/Gmax Curve	Damping Curve
1	2	.13	2.8	2936.6	.00781	229.28	852.8618	0	.88444	Coarse	Coarse
2	5.5	.13	4.8	2625.1	.02321	609.39	806.3604	4	.82933	Coarse	Coarse
3	8.5	.13	5.9	2463.4	.0361	889.22	781.1307	7	.71118	Coarse	Coarse
4	11.5	.13	5.4	3620.9	.03061	1108.37	947.0317	10	.68971	Coarse	Coarse
5	14.5	.13	6.6	2752.4	.04636	1276.05	825.6805	13	.70046	Coarse	Coarse
6	17.5	.13	7.8	2187.7	.06713	1468.56	736.1226	16	.70832	Coarse	Coarse
7	20.5	.13	8.1	2328.9	.072	1676.72	759.5068	19	.72553	Coarse	Coarse
8	23.5	.13	9.6	1701.8	.1116	1899.25	649.2479	22	.64994	Coarse	Coarse
9	26.5	.13	9.5	1928.4	.10693	2062.11	691.1222	25	.59498	Coarse	Coarse
10	30	.13	9.6	1952.4	.11012	2149.98	695.4096	28	.60985	Coarse	Coarse
11	33.5	.135	10	1272.2	.17006	2163.55	550.8568	32	.67343	Residual	Residual
12	36.5	.135	10	1272.9	.17118	2178.85	551.0084	35	.70548	Residual	Residual
13	39.5	.135	8.900001	1596.4	.13549	2162.95	617.0664	38	.71515	Residual	Residual
14	42.5	.135	7.5	2296.9	.0979	2248.68	740.171	41	.56671	Residual	Residual
15	45.5	.135	4.6	5110.6	.04475	2286.77	1104.071	44	.53756	Residual	Residual
16	48.5	.135	4.8	4981.3	.04706	2344.02	1090.015	47	.52869	Residual	Residual
17	Base							50	.52663		
17	Outcrop							50	.57825		

Notes:
Period for Soil Column: .26 sec
Average Shear Wave Velocity for Soil Column: 775 ft/sec

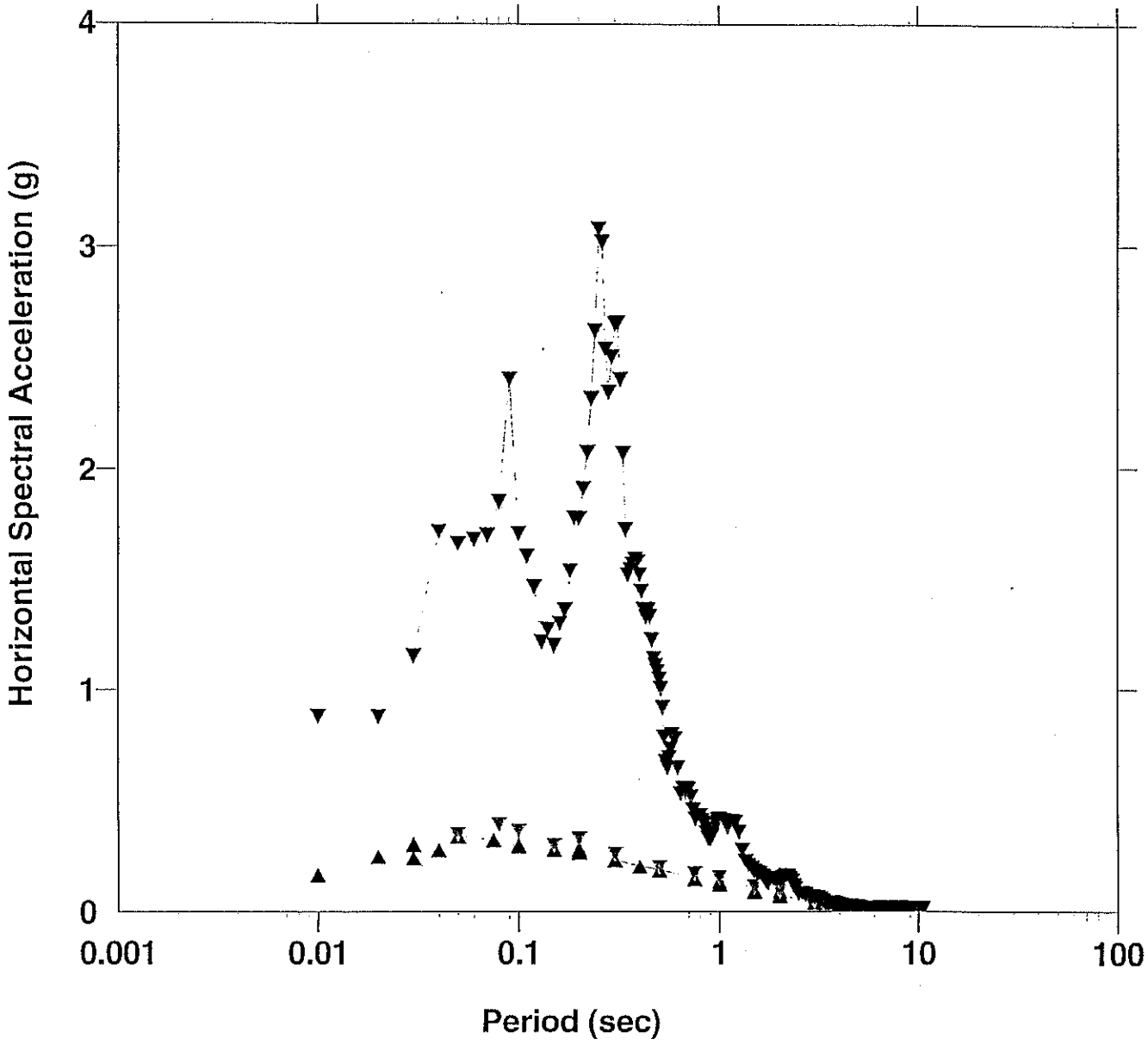
R14240


M8.0 New Madrid Synthetic @83km - Atkinson & Boore (1995)
Acceleration (g's)
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
0
20
40
60
80
100
Time (sec)

R14241


Source File: C:\SHAKE2000\Williamson Energy\NewMadrid.M8@83km.txt
Acceleration (g's)
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
Velocity (ft/sec)
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
Displacement (ft)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
0
20
40
60
80
100
Time (sec)

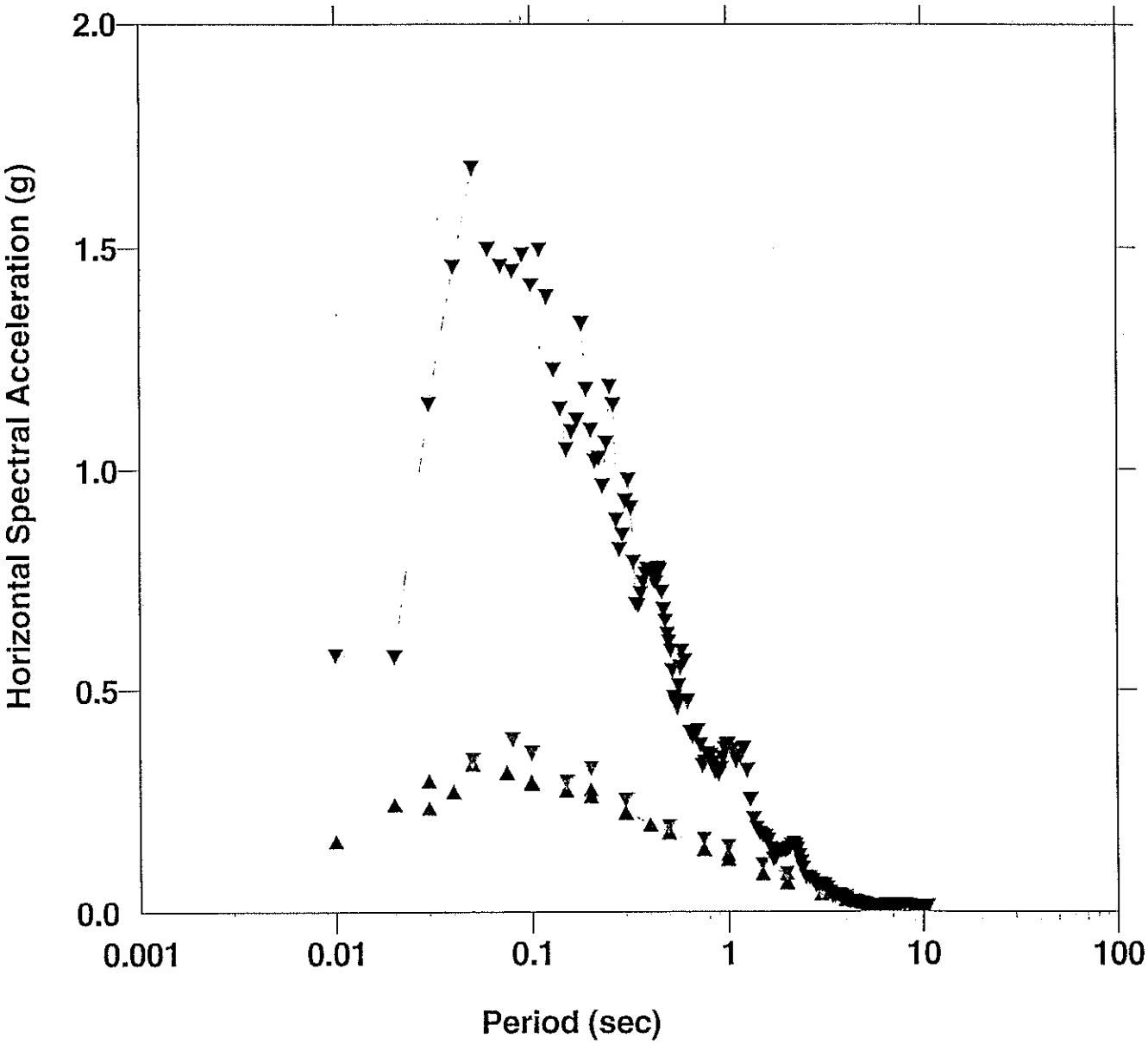
PSCS300E Crest Column - M8.0 New Madrid Synthetic @83km



- ▲ Toro et. al. (1997) for Mid-Continent of NA - Rock - Mw: 8 - R: 83 km
- ▲ Campbell for CEUS (2003) - M: 8 - R: 83 km
- ▼ Tavakoli & Pezeshk (2005) - ENA - Rock - M: 8 - R: 83 km
- ▼ PSA for 5% damping - Layer 1 - SHAKE

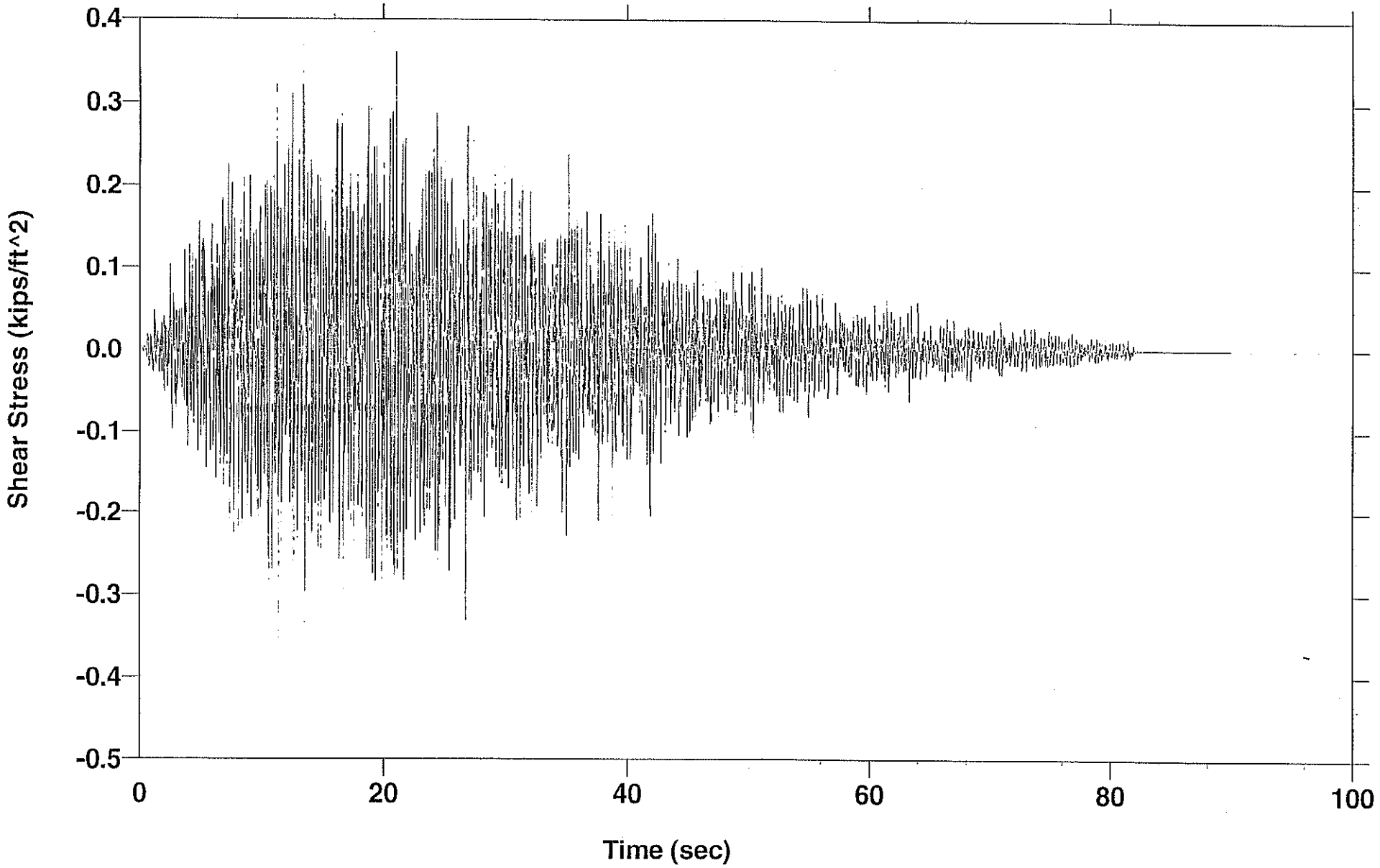
R14243

PSCS300E Crest Column - M8.0 New Madrid Synthetic @83km



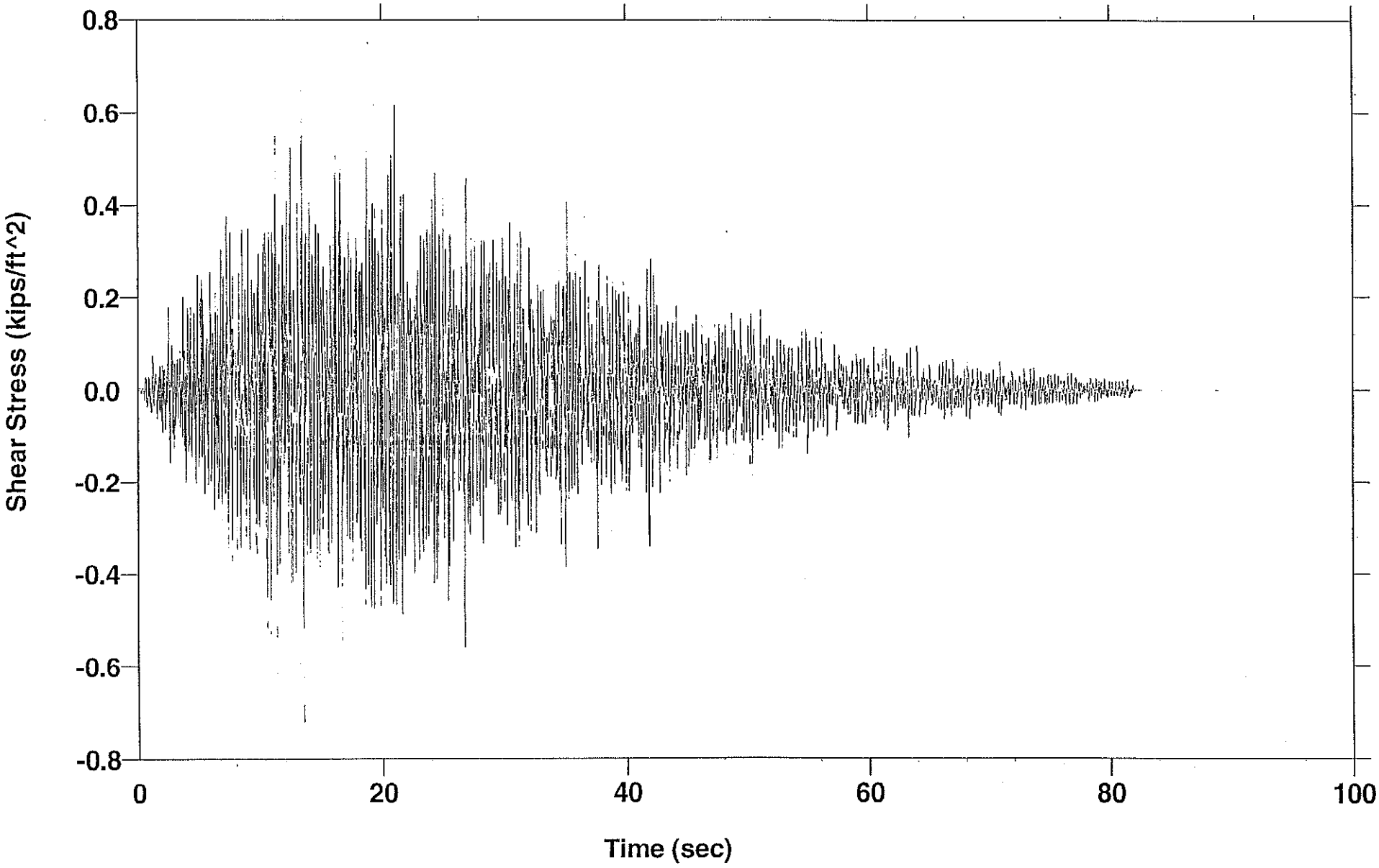
- ▲ Toro et. al. (1997) for Mid-Continent of NA - Rock - Mw: 8 - R: 83 km
- ▲ Campbell for CEUS (2003) - M: 8 - R: 83 km
- ▼ Tavakoli & Pezeshk (2005) - ENA - Rock - M: 8 - R: 83 km
- ▼ PSA for 5% damping - Layer 17 - SHAKE

PCSC300E Layer 2 Stress - M8.0 New Madrid Synthetic



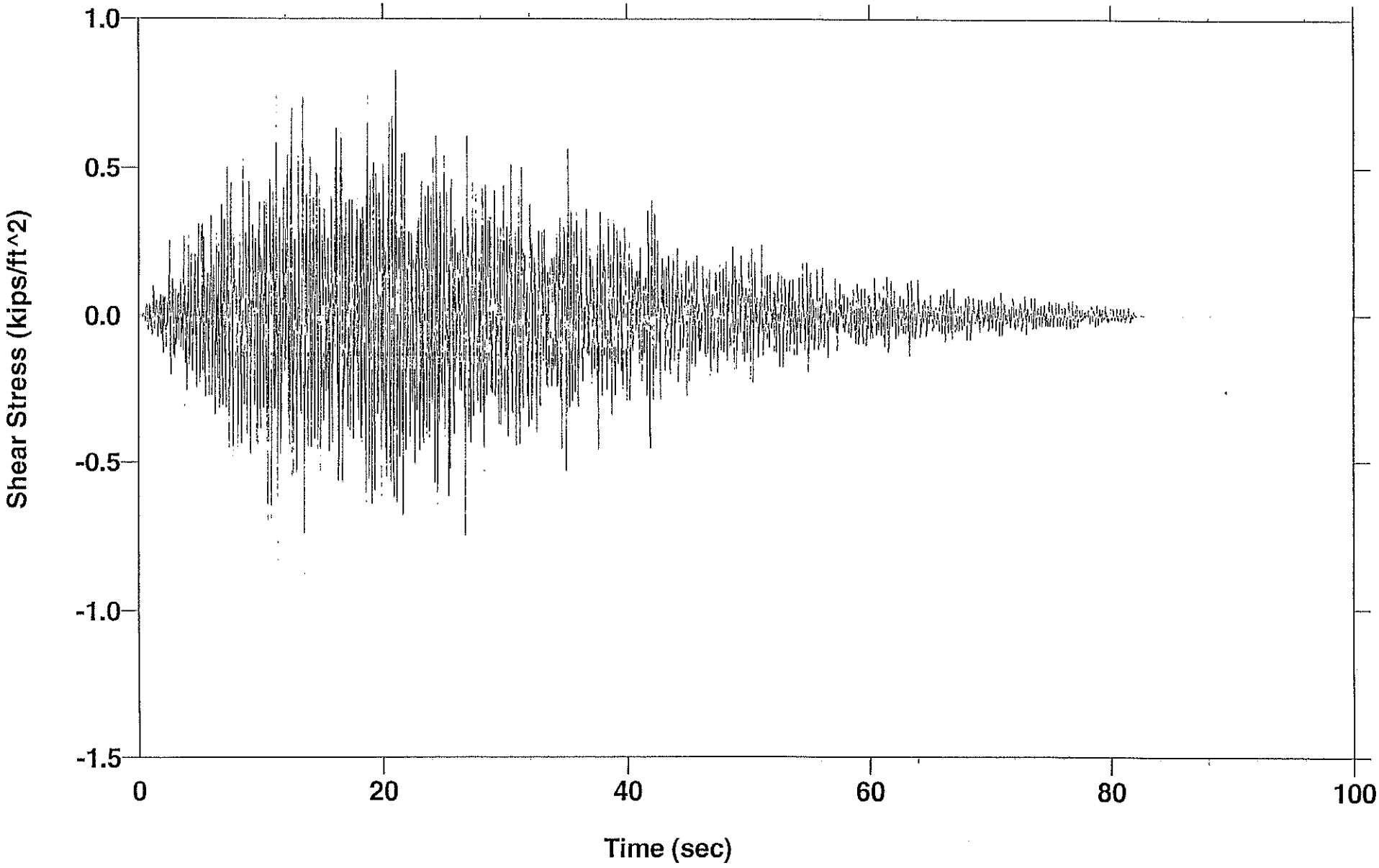
R14245

PCSC300E Layer 3 Stress - M8.0 New Madrid Synthetic

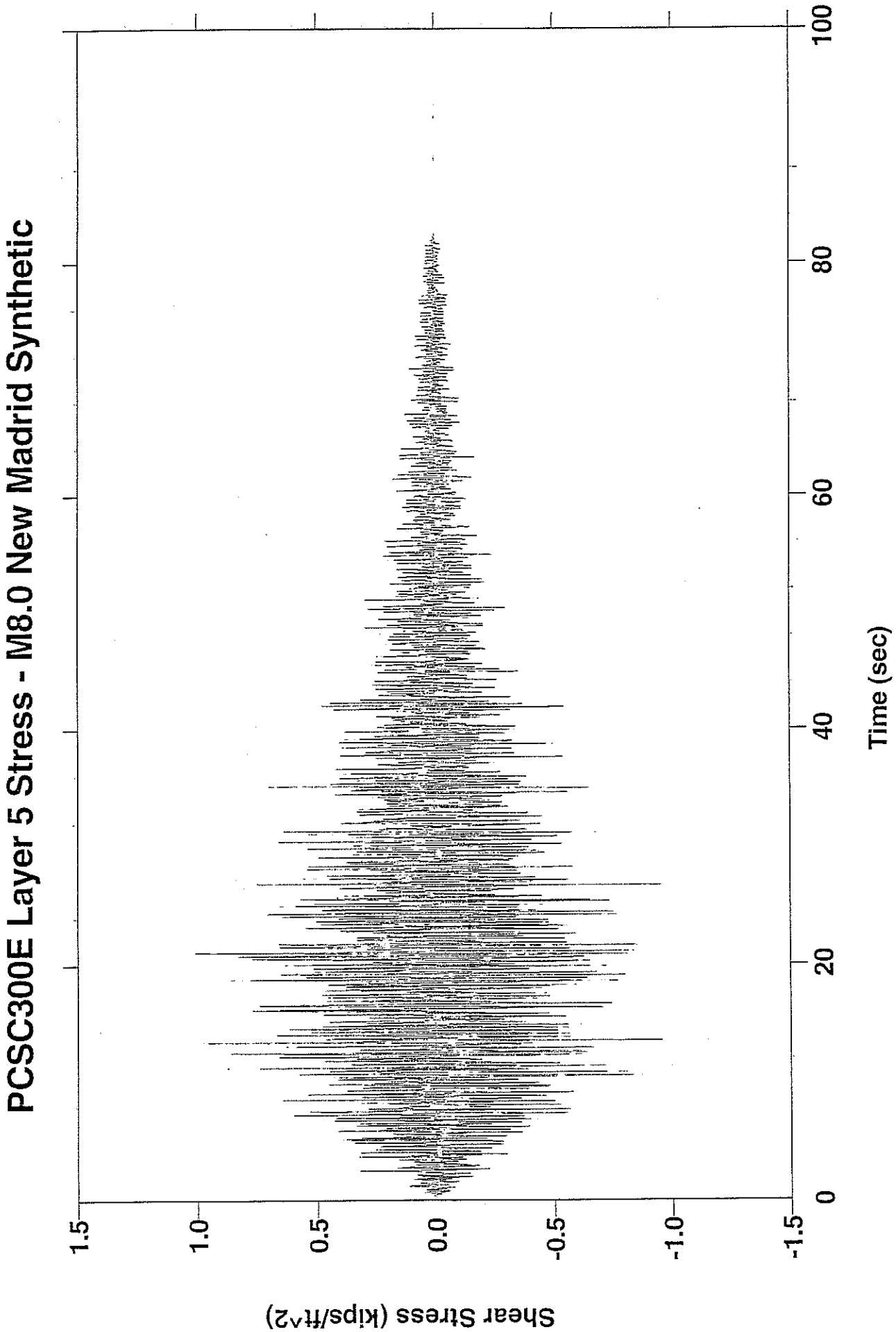


R14246

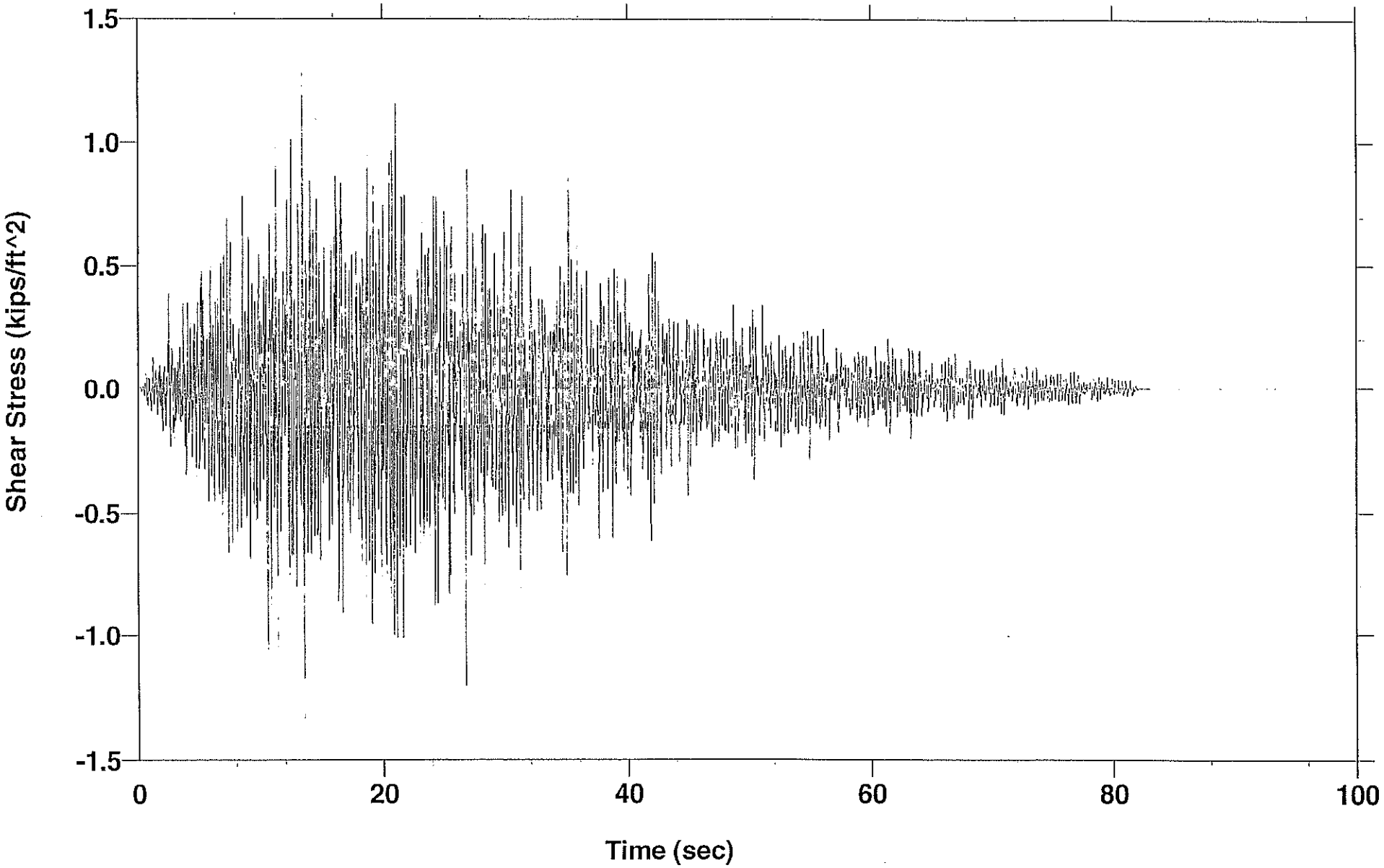
PCSC300E Layer 4 Stress - M8.0 New Madrid Synthetic



R14247

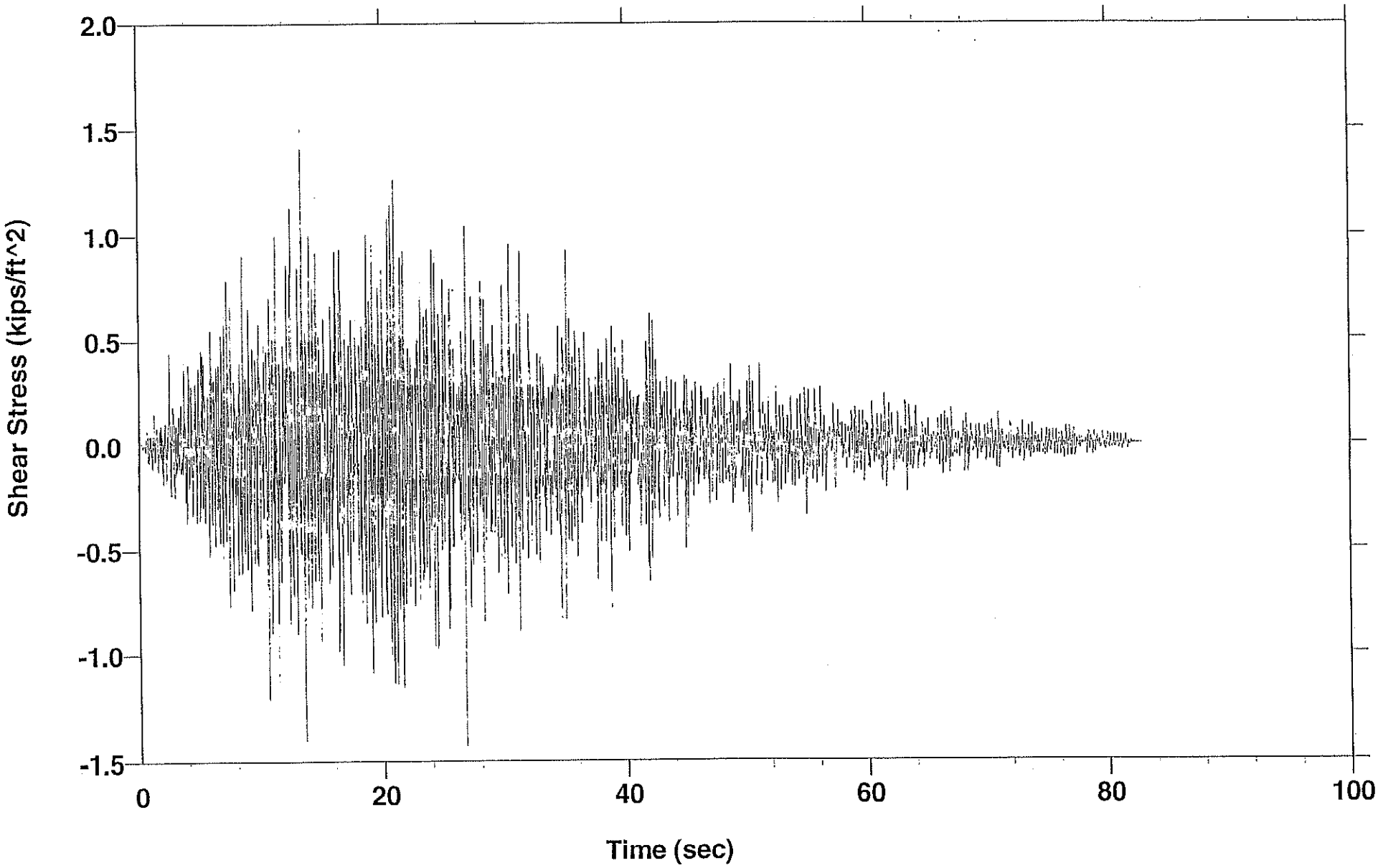

PCSC300E Layer 5 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
Time (sec)
0
20
40
60
80
100

PCSC300E Layer 6 Stress - M8.0 New Madrid Synthetic



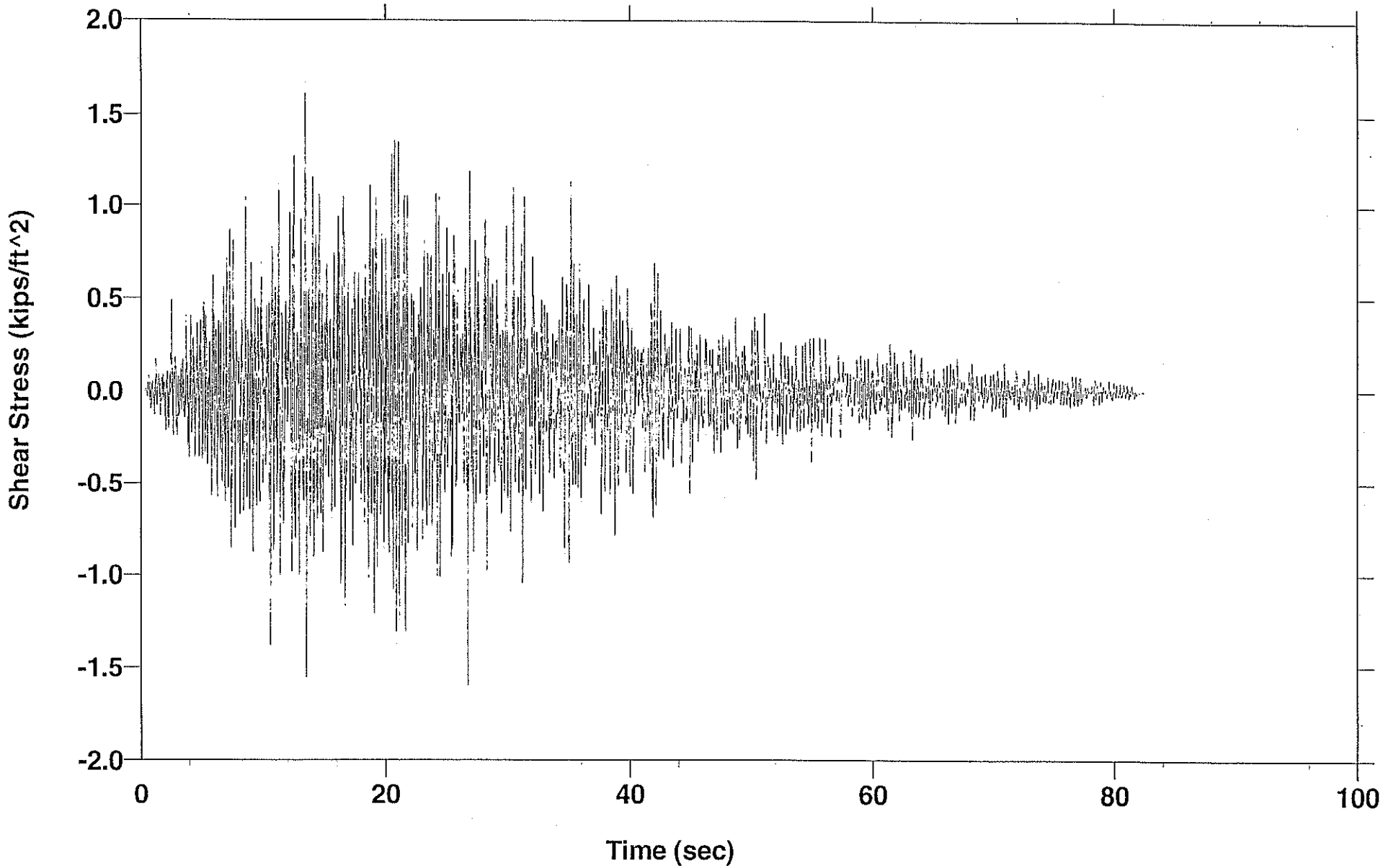
R14249

PCSC300E Layer 7 Stress - M8.0 New Madrid Synthetic



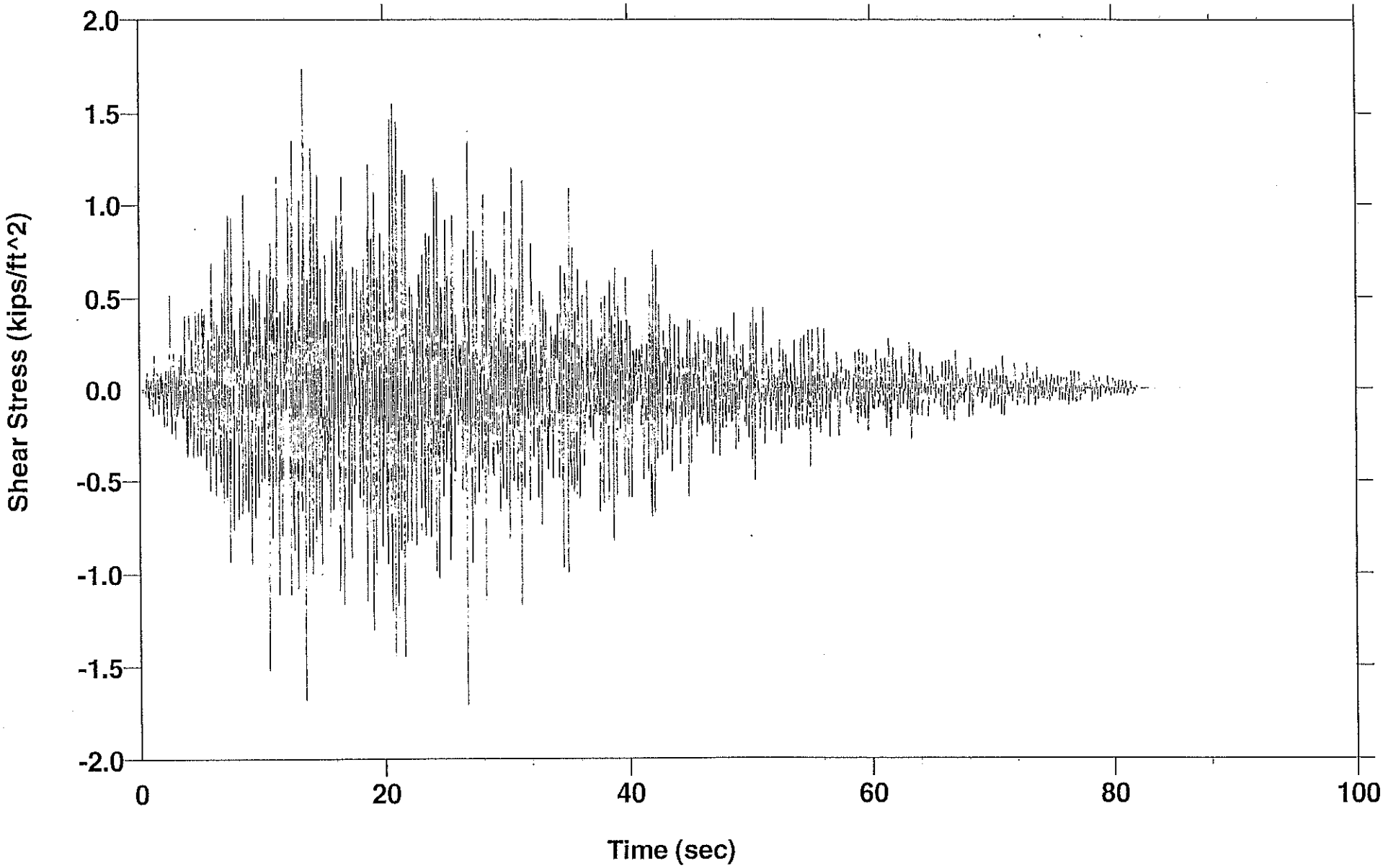
R14250

PCSC300E Layer 8 Stress - M8.0 New Madrid Synthetic



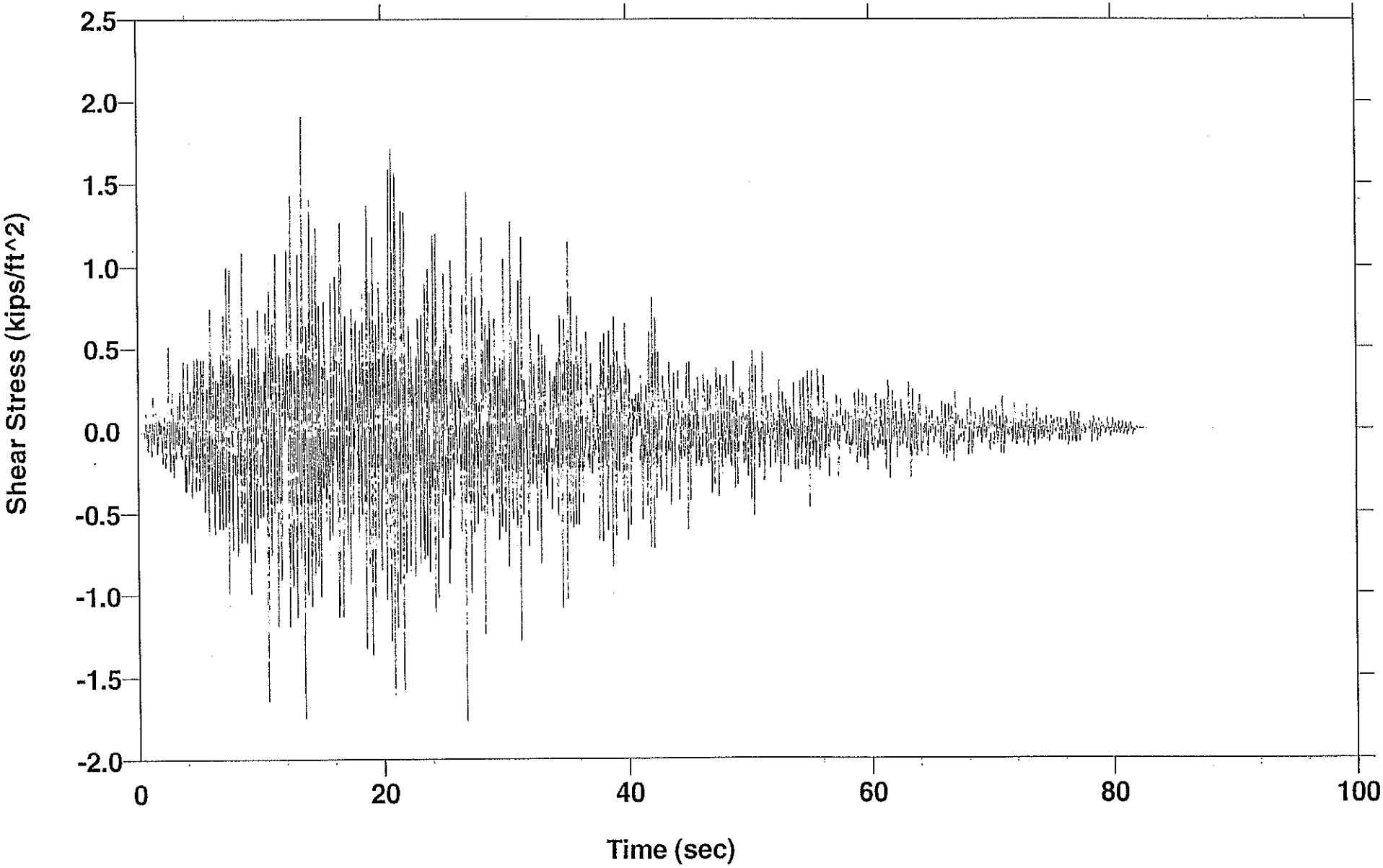
R14251

PCSC300E Layer 9 Stress - M8.0 New Madrid Synthetic



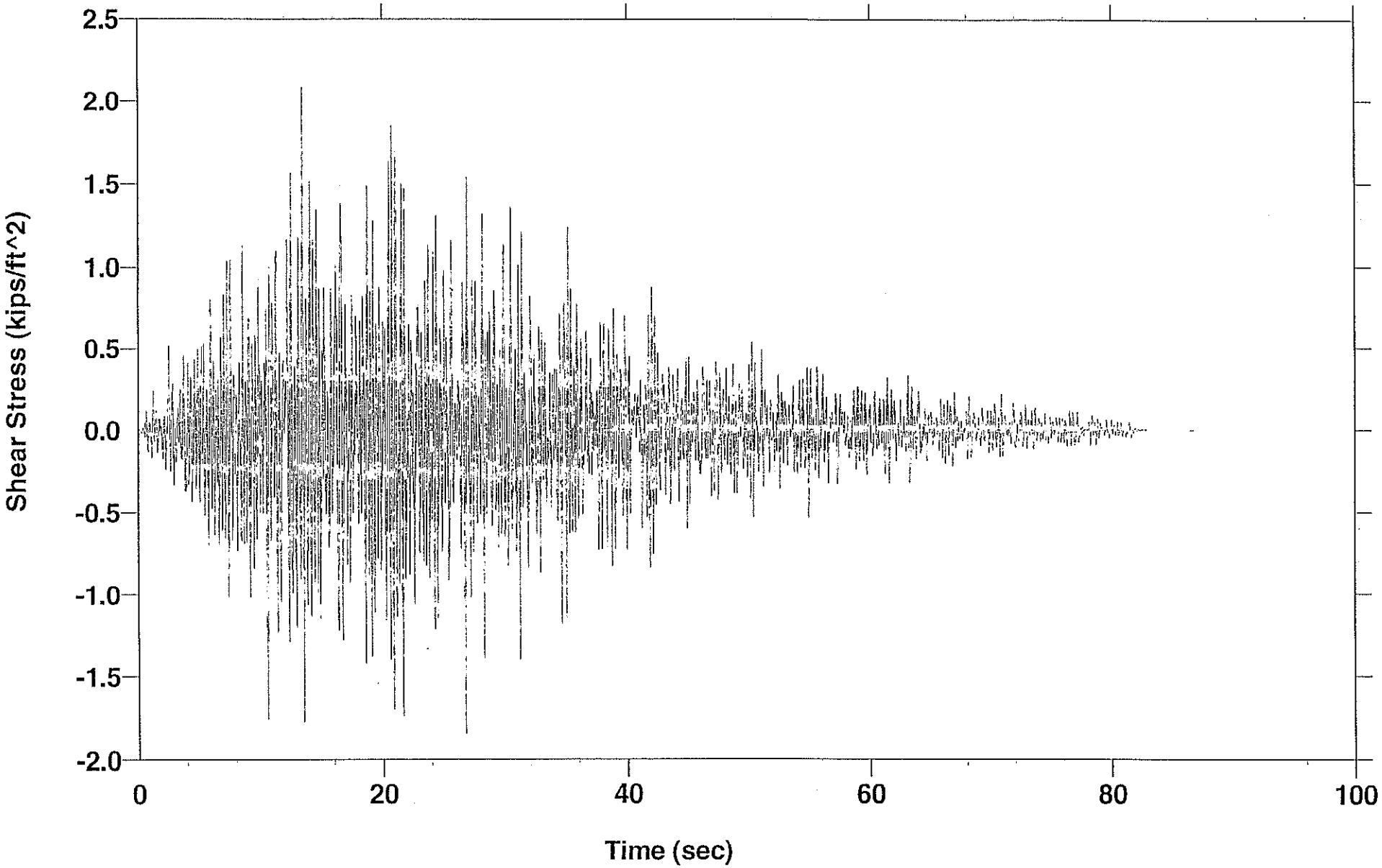
R14252

PCSC300E Layer 10 Stress - M8.0 New Madrid Synthetic

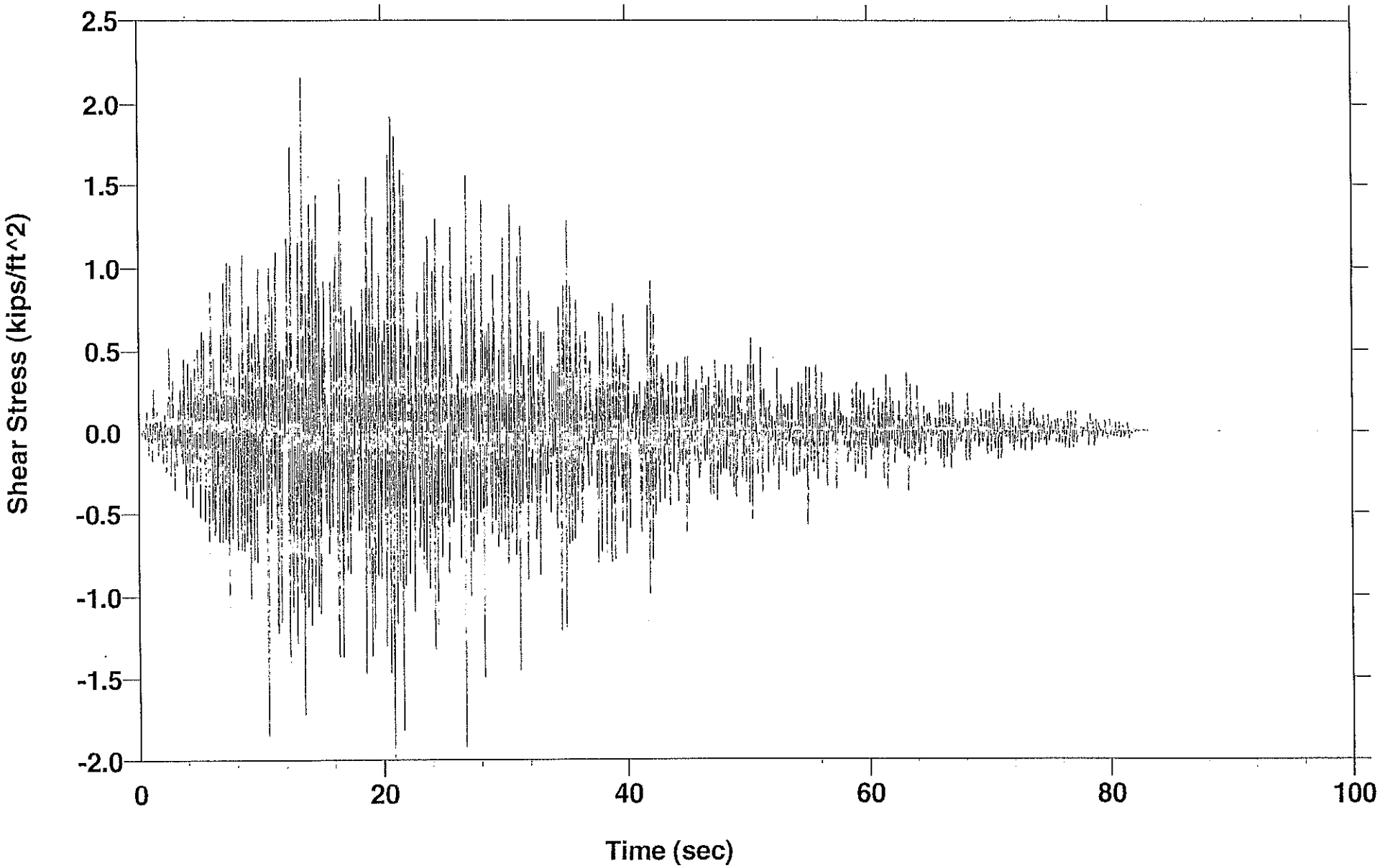


R14253

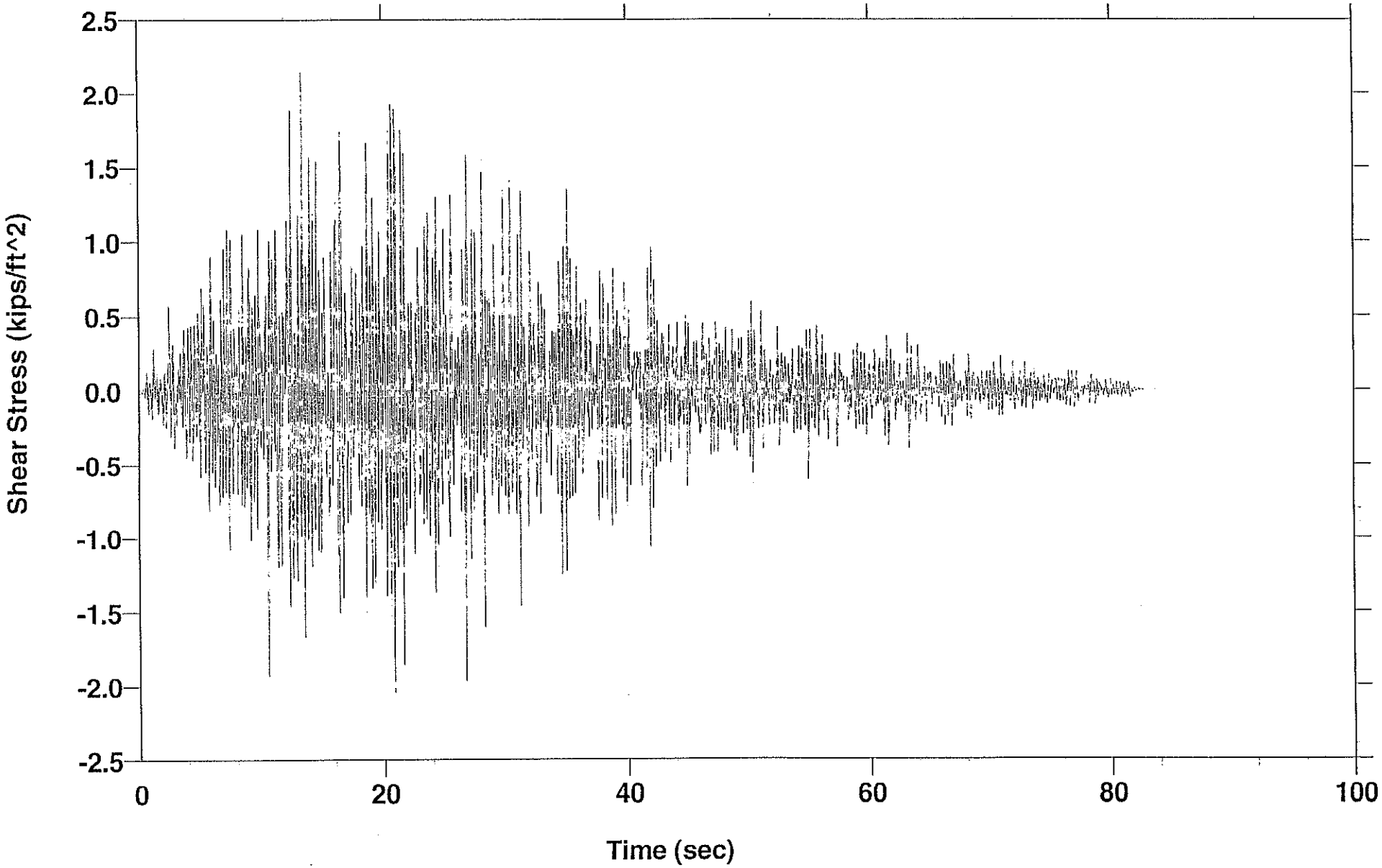
PCSC300E Layer 11 Stress - M8.0 New Madrid Synthetic



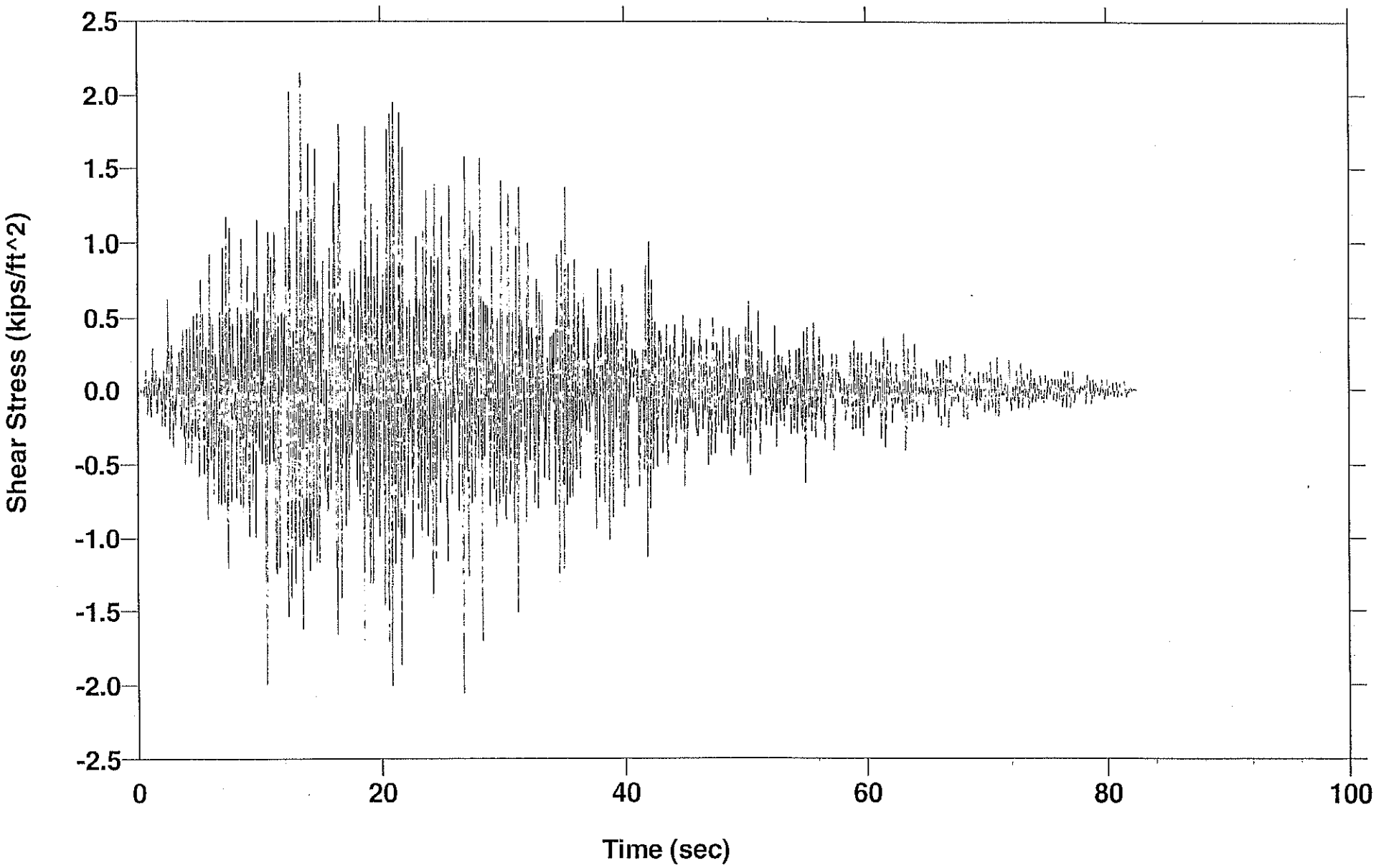
PCSC300E Layer 12 Stress - M8.0 New Madrid Synthetic



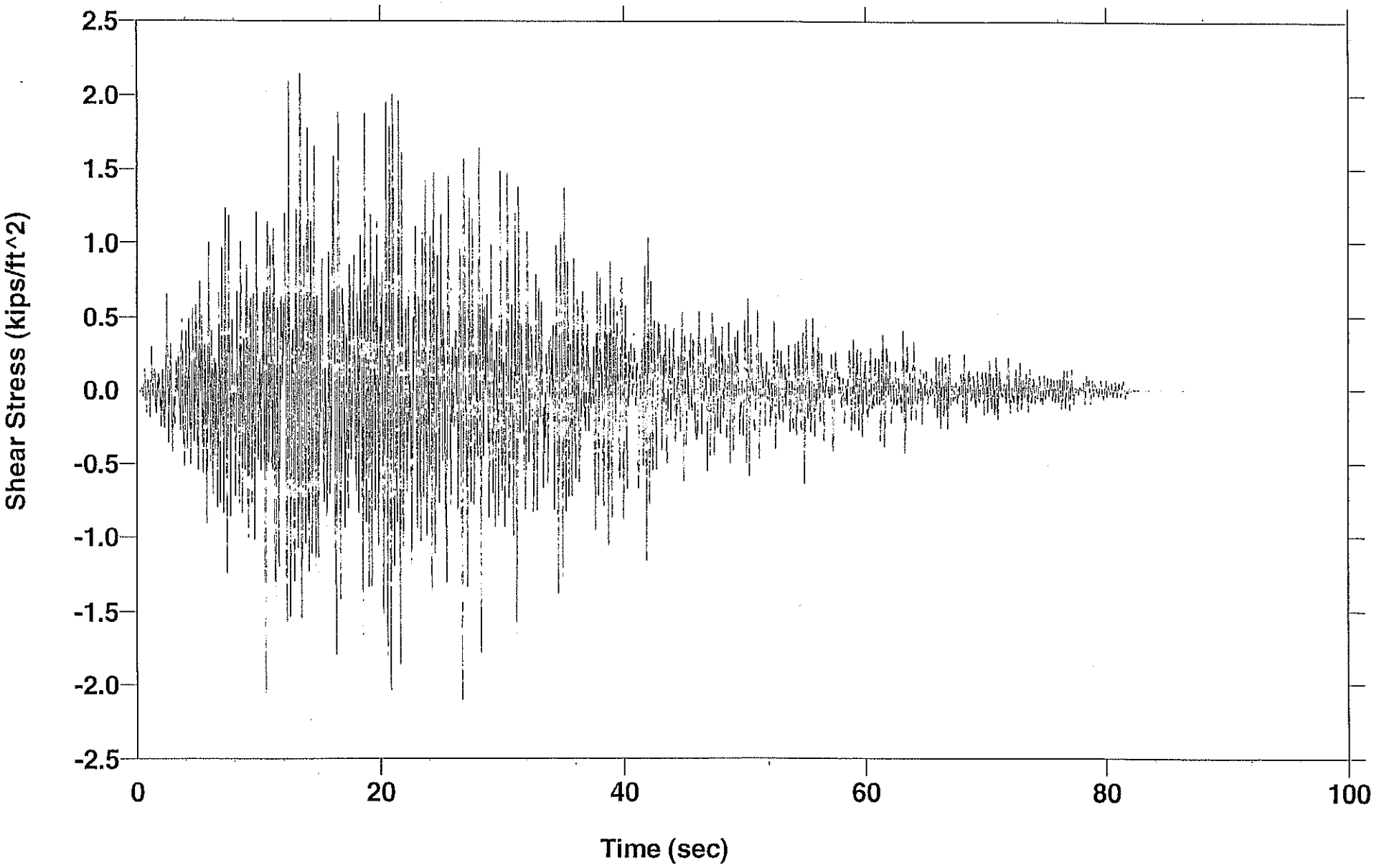
PCSC300E Layer 13 Stress - M8.0 New Madrid Synthetic



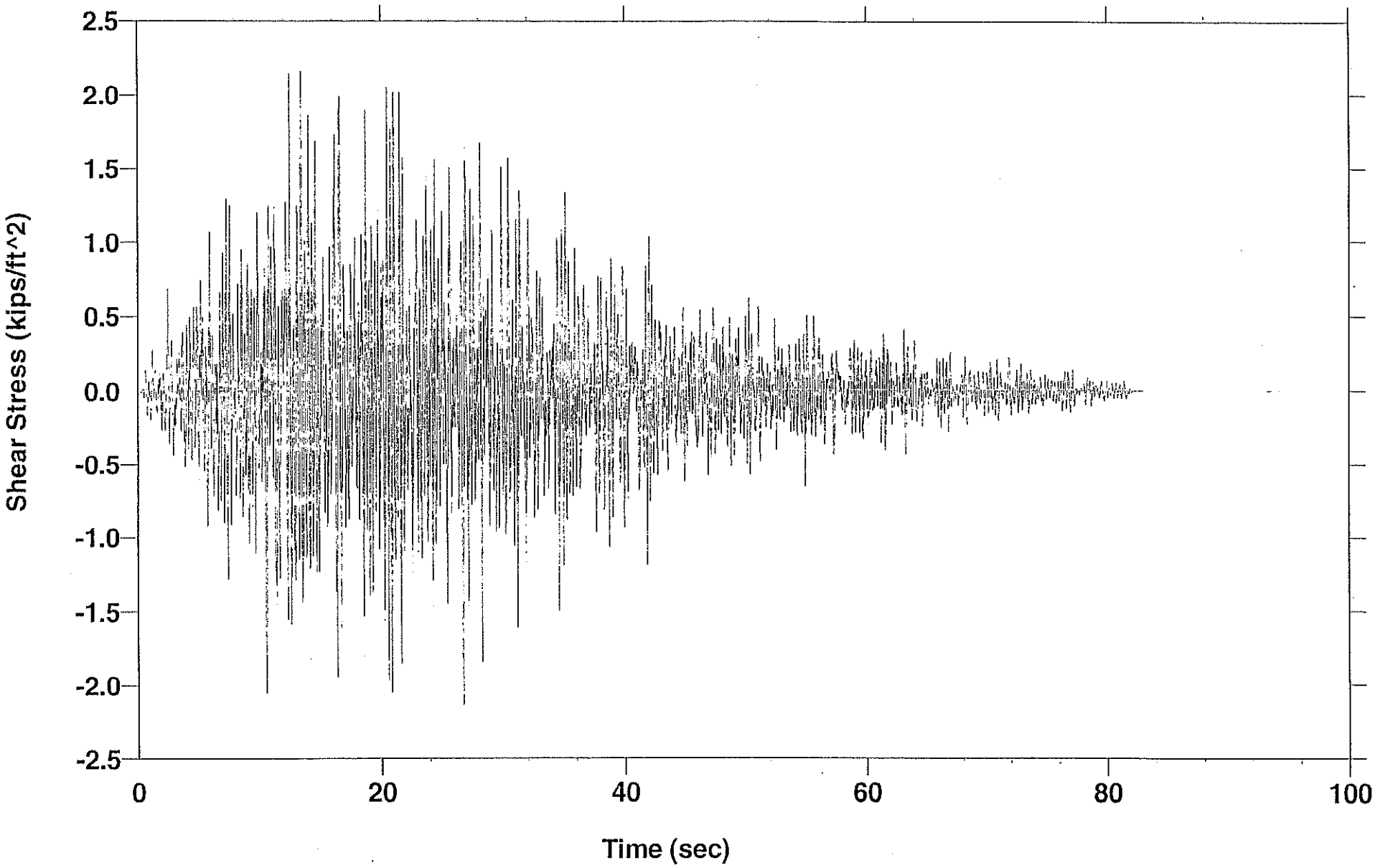
PCSC300E Layer 14 Stress - M8.0 New Madrid Synthetic



PCSC300E Layer 15 Stress - M8.0 New Madrid Synthetic



PCSC300E Layer 16 Stress - M8.0 New Madrid Synthetic



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************************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*   LAYERED SITES by Per Schnable & John Lysmer - 1970  *
* ---------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
* ---------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added  *
*    using results from Sun et al (1988) by J. I. Sun  *
*    & Ramin Golesorkhi February 26, 1988          *
* ----------------------------------------------------*
* SHAKE90/91: Adjust last iteration; Input now is either  *
*    Gmax or max Vs; up to 13 materials can be specified*
*    by user; up to 50 Layers can be specified; object  *
*    motion can be read in from a separate file and can *
*    user specified format; Different periods for res-  *
*    ponse spectral calculations;options are renumbered;*
*    and general cleanup by: J. I. Sun, I. M. Idriss &  *
*    P. Dirrim June 1990 - February 1991          *
* ---------------------------------------------------- *
* SHAKE91: General cleanup and finalization of input out- *
*    output format ... etc by: I. M. Idriss Dec. 1991  *
* ---------------------------------------------------- *
* SHAKE2000: Fix the incorrect output of Tot. Stress in  *
* Option 2. Changed path of ground motion file in       *
* SHAKE91.  Control file to input file names.  Modified  *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
*       RUN DATE  1/02/2008                  *
*       RUN TIME 11:11                     *
************************************************************
MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =    32768
NECESSARY LENGTH OF BLANK COMMON X       =   204819

1******  OPTION  1  *** READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

***********************
 MATERIAL TYPE NO. 1
***********************

CURVE NO.  1:   Coarse    G/Gmax - Gravel (Mean) - Rollins et al. JGGE
CURVE NO.  2:   Coarse    Damping for Gravel (Mean) - Rollins et al. J
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.90
0.0002	0.995	0.0003	1.11
0.0005	0.980	0.0006	1.30
0.0008	0.970	0.0010	1.50
0.0010	0.960	0.0020	1.91
0.0020	0.930	0.0030	2.24
0.0030	0.905	0.0040	2.54
0.0040	0.880	0.0060	3.05
0.0070	0.810	0.0080	3.50
0.0100	0.755	0.0100	3.89
0.0200	0.630	0.0200	5.45
0.0700	0.390	0.0300	6.61
0.1000	0.325	0.0500	8.28
0.2000	0.205	0.1000	10.79
0.3000	0.150	0.2000	13.23

0.4000	0.115	0.3000	14.47
0.5000	0.095	0.4000	15.24
0.6000	0.080	0.6000	16.14
0.8000	0.070	0.8000	16.66
1.0000	0.050	1.0000	17.01

****
MATERIAL TYPE NO. 2
****

CURVE NO. 3: Fine Refuse Moduli for Fine Refuse (Ellison & Cho, 1976)
CURVE NO. 4: Fine Refuse Damping Values for Fine Refuse (Ellison & Ch

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.75
0.0004	1.000	0.0004	0.65
0.0010	0.995	0.0010	0.70
0.0020	0.992	0.0020	0.80
0.0040	0.989	0.0040	0.90
0.0060	0.981	0.0060	1.10
0.0080	0.965	0.0080	1.30
0.0100	0.955	0.0100	1.40
0.0200	0.905	0.0200	2.00
0.0400	0.828	0.0400	3.10
0.0600	0.750	0.0600	4.00
0.0800	0.670	0.0800	5.20
0.1000	0.610	0.1000	6.00
0.2000	0.610	0.2000	6.00

****
MATERIAL TYPE NO. 3
****

CURVE NO. 5: Residual G/Gmax PI=15% - Effective Confining Pressure
CURVE NO. 6: Residual Damping PI=15% - Effective Confining Pressur

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0000	1.000	0.0000	0.67
0.0000	1.000	0.0000	0.67
0.0000	0.999	0.0000	0.68
0.0001	0.998	0.0001	0.68
0.0002	0.996	0.0002	0.70
0.0005	0.991	0.0005	0.75
0.0010	0.983	0.0010	0.83
0.0022	0.965	0.0022	1.02
0.0048	0.931	0.0048	1.43
0.0100	0.873	0.0100	2.17
0.0220	0.770	0.0220	3.68
0.0484	0.618	0.0484	6.24
0.1000	0.454	0.1000	9.48
0.2200	0.287	0.2200	13.40
0.4840	0.163	0.4840	16.87
1.0000	0.091	1.0000	19.16

****
MATERIAL TYPE NO. 4
****

CURVE NO. 7: Rock G/Gmax - ROCK (Schnabel 1973)
CURVE NO. 8: Rock Damping for ROCK (Schnabel 1973)

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.40
0.0003	1.000	0.0010	0.80
0.0010	0.990	0.0100	1.50
0.0030	0.950	0.1000	3.00
0.0100	0.900	1.0000	4.60
0.0300	0.810	0.0000	0.00
0.1000	0.725	0.0000	0.00
1.0000	0.550	0.0000	0.00

1****** OPTION 2 *** READ SOIL PROFILE
NEW SOIL PROFILE NO. 1 IDENTIFICATION PSCS300E Crest Column
NUMBER OF LAYERS 17 DEPTH TO BEDROCK 50.00

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	1	4.0000	2.0000	0.26	3454.	0.050	0.130	924.9
2	1	3.0000	5.5000	0.71	3856.	0.050	0.130	977.3
3	1	3.0000	8.5000	1.11	4110.	0.050	0.130	1009.0
4	1	3.0000	11.5000	1.50	5739.	0.050	0.130	1192.3
5	1	3.0000	14.5000	1.88	4991.	0.050	0.130	1111.9
6	1	3.0000	17.5000	2.28	4552.	0.050	0.130	1061.8
7	1	3.0000	20.5000	2.66	4985.	0.050	0.130	1111.2
8	1	3.0000	23.5000	3.05	4436.	0.050	0.130	1048.2
9	1	3.0000	26.5000	3.44	4926.	0.050	0.130	1104.6
10	1	4.0000	30.0000	3.90	5058.	0.050	0.130	1119.3
11	3	3.0000	33.5000	4.36	2940.	0.050	0.135	837.4
12	3	3.0000	36.5000	4.77	2951.	0.050	0.135	839.0
13	3	3.0000	39.5000	5.17	3307.	0.050	0.135	888.1
14	3	3.0000	42.5000	5.58	4130.	0.050	0.135	992.5
15	3	3.0000	45.5000	5.98	7136.	0.050	0.135	1304.6
16	3	3.0000	48.5000	6.39	7051.	0.050	0.135	1296.8
17	BASE				74534.	0.050	0.150	4000.0

PERIOD = 0.19 FROM AVERAGE SHEAR VEL. = 1050.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 12.49
FOR FREQUENCY = 5.15 C/SEC.
PERIOD = 0.19 SEC.

1****** OPTION 3 *** READ INPUT MOTION

FILE NAME FOR INPUT MOTION = C:\SHAKE2000\Williamson Energy\NewMadrid.eq
NO. OF INPUT ACC. POINTS = 8184
NO. OF POINTS USED IN FFT = 16384
NO. OF HEADING LINES = 4
NO. OF POINTS PER LINE = 8

TIME STEP FOR INPUT MOTION = 0.0100
FORMAT FOR TIME HISTORY = (8f9.6)

*****HEADER*****
Source File: C:\SHAKE2000\Williamson Energy\NewMadrid.M8@83km.txt
SHAKE2000 Conversion: 8184 .01 4 8 9 (8f9.6
Acceleration Units: (g's) - No. Values: 8184 - Time Step: .01 (secs)
Data Format: (8f9.6) - No. Header Lines: 4
** FIRST AND LAST 5 LINES OF INPUT MOTION *****

1 -0.000279 0.000491 0.000916 0.001028 0.001072 0.001012 0.000914 0.001178
2 0.001267 0.001643 0.000738 0.000404 0.001162 0.000325 0.000442 0.001287
3 0.000332 0.000352 0.000667 0.000333 0.000100-0.000289 0.000774-0.001450
4 -0.001068 0.000422-0.001711-0.000650 0.000432 0.001691 0.002168 0.001175
5 -0.000695 0.000756 0.000277 0.002243-0.000523 0.000775-0.001563-0.000602
.....INPUT MOTION READ NOT ECHOED.....
1019 0.002157 0.001240-0.001104 0.000476-0.001755-0.000138 0.000159-0.003048
1020 -0.003913 0.000251 0.002962-0.003793-0.003142-0.004436-0.001657-0.000252
1021 0.001471 0.001823-0.000479-0.000738-0.002774-0.005429-0.002747 0.002040
1022 -0.000940-0.002779-0.004528-0.001675 0.001024-0.002927-0.001433 0.002515
1023 0.000569-0.002711-0.002134-0.001855 0.001529 0.003698 0.004083-0.003032

MAXIMUM ACCELERATION = 0.18389
AT TIME = 16.61 SEC
THE VALUES WILL BE MULTIPLIED BY A FACTOR = 2.937
TO GIVE NEW MAXIMUM ACCELERATION = 0.54000
MEAN SQUARE FREQUENCY = 14.61 C/SEC.
MAX ACCELERATION = 0.57825 FOR FREQUENCIES REMOVED ABOVE 40.00 C/SEC.
1****** OPTION 4 *** READ WHERE OBJECT MOTION IS GIVEN
OBJECT MOTION IN LAYER NUMBER 17 OUTCROPPING

1****** OPTION 5 *** OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
MAXIMUM NUMBER OF ITERATIONS = 10
FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN = 0.65

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 1

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00468	0.027	0.050	-82.7	2971.7	3454.0	-16.2	1.000
2	1	5.5	0.01102	0.041	0.050	-21.7	2843.7	3856.0	-35.6	1.000
3	1	8.5	0.01499	0.048	0.050	-4.1	2802.8	4110.0	-46.6	1.000
4	1	11.5	0.01387	0.046	0.050	-8.1	3994.5	5739.0	-43.7	1.000
5	1	14.5	0.01927	0.054	0.050	6.8	3177.8	4991.0	-57.1	1.000
6	1	17.5	0.02455	0.060	0.050	17.2	2689.0	4552.0	-69.3	1.000
7	1	20.5	0.02579	0.062	0.050	19.1	2897.9	4985.0	-72.0	1.000
8	1	23.5	0.03295	0.069	0.050	27.7	2370.3	4436.0	-87.1	1.000
9	1	26.5	0.03309	0.069	0.050	27.9	2628.2	4926.0	-87.4	1.000
10	1	30.0	0.03577	0.072	0.050	30.4	2623.1	5058.0	-92.8	1.000
11	3	33.5	0.06665	0.077	0.050	34.8	1604.3	2940.0	-83.3	1.000
12	3	36.5	0.06911	0.078	0.050	36.1	1586.2	2951.0	-86.0	1.000
13	3	39.5	0.06240	0.074	0.050	32.2	1853.9	3307.0	-78.4	1.000
14	3	42.5	0.04960	0.063	0.050	21.2	2529.5	4130.0	-63.3	1.000
15	3	45.5	0.02941	0.046	0.050	-8.1	5095.2	7136.0	-40.1	1.000

16 3 48.5 0.03031 0.047 0.050 -5.9 4993.8 7051.0 -41.2 1.000

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00493	0.028	0.027	2.3	2949.2	2971.7	-0.8	0.860
2	1	5.5	0.01365	0.046	0.041	10.5	2694.9	2843.7	-5.5	0.737
3	1	8.5	0.02058	0.055	0.048	13.2	2566.7	2802.8	-9.2	0.682
4	1	11.5	0.01847	0.053	0.046	12.2	3697.7	3994.5	-8.0	0.696
5	1	14.5	0.02740	0.064	0.054	15.5	2843.4	3177.8	-11.8	0.637
6	1	17.5	0.03652	0.073	0.060	16.8	2342.7	2689.0	-14.8	0.591
7	1	20.5	0.03830	0.074	0.062	16.6	2520.0	2897.9	-15.0	0.581
8	1	23.5	0.05277	0.085	0.069	18.4	1970.2	2370.3	-20.3	0.534
9	1	26.5	0.05152	0.084	0.069	17.4	2210.3	2628.2	-18.9	0.534
10	1	30.0	0.05542	0.087	0.072	17.0	2198.9	2623.1	-19.3	0.519
11	3	33.5	0.09518	0.093	0.077	17.2	1367.6	1604.3	-17.3	0.546
12	3	36.5	0.09600	0.093	0.078	15.8	1367.0	1586.2	-16.0	0.538
13	3	39.5	0.08485	0.087	0.074	15.7	1624.2	1853.9	-14.1	0.561
14	3	42.5	0.06425	0.075	0.063	15.4	2288.0	2529.5	-10.6	0.612
15	3	45.5	0.03230	0.049	0.046	6.1	4966.6	5095.2	-2.6	0.714
16	3	48.5	0.03317	0.050	0.047	5.8	4871.3	4993.8	-2.5	0.708

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00518	0.029	0.028	2.1	2928.2	2949.2	-0.7	0.854
2	1	5.5	0.01508	0.048	0.046	4.7	2625.6	2694.9	-2.6	0.699
3	1	8.5	0.02302	0.059	0.055	5.5	2478.4	2566.7	-3.6	0.624
4	1	11.5	0.01973	0.054	0.053	2.7	3629.4	3697.7	-1.9	0.644
5	1	14.5	0.02937	0.065	0.064	3.0	2777.0	2843.4	-2.4	0.570
6	1	17.5	0.04080	0.076	0.073	4.8	2246.0	2342.7	-4.3	0.515
7	1	20.5	0.04313	0.078	0.074	5.0	2406.7	2520.0	-4.7	0.506
8	1	23.5	0.06290	0.091	0.085	7.0	1820.9	1970.2	-8.2	0.444
9	1	26.5	0.06112	0.090	0.084	6.9	2049.1	2210.3	-7.9	0.449
10	1	30.0	0.06434	0.092	0.087	5.9	2054.3	2198.9	-7.0	0.435
11	3	33.5	0.10581	0.098	0.093	5.1	1299.6	1367.6	-5.2	0.465
12	3	36.5	0.10664	0.098	0.093	5.1	1299.6	1367.0	-5.2	0.463
13	3	39.5	0.08772	0.089	0.087	1.7	1599.3	1624.2	-1.6	0.491
14	3	42.5	0.06349	0.074	0.075	-0.7	2299.1	2288.0	0.5	0.554
15	3	45.5	0.02982	0.047	0.049	-5.5	5076.4	4966.6	2.2	0.696
16	3	48.5	0.03122	0.048	0.050	-4.1	4953.5	4871.3	1.7	0.691

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00516	0.029	0.029	-0.1	2929.5	2928.2	0.0	0.848
2	1	5.5	0.01530	0.048	0.048	0.7	2615.4	2625.6	-0.4	0.681
3	1	8.5	0.02361	0.059	0.059	1.2	2458.7	2478.4	-0.8	0.603
4	1	11.5	0.01999	0.054	0.054	0.5	3615.8	3629.4	-0.4	0.632
5	1	14.5	0.02998	0.066	0.065	0.9	2757.1	2777.0	-0.7	0.556
6	1	17.5	0.04246	0.077	0.076	1.7	2211.3	2246.0	-1.6	0.493
7	1	20.5	0.04528	0.080	0.078	2.0	2360.3	2406.7	-2.0	0.483
8	1	23.5	0.06799	0.094	0.091	3.0	1754.8	1820.9	-3.8	0.410
9	1	26.5	0.06569	0.093	0.090	2.8	1981.1	2049.1	-3.4	0.416
10	1	30.0	0.06842	0.094	0.092	2.4	1994.8	2054.3	-3.0	0.406
11	3	33.5	0.10946	0.099	0.098	1.7	1278.5	1299.6	-1.6	0.442
12	3	36.5	0.11027	0.100	0.098	1.7	1278.6	1299.6	-1.6	0.440
13	3	39.5	0.08781	0.089	0.089	0.1	1598.6	1599.3	0.0	0.484
14	3	42.5	0.06348	0.074	0.074	0.0	2299.3	2299.1	0.0	0.557
15	3	45.5	0.02924	0.046	0.047	-1.4	5103.1	5076.4	0.5	0.711
16	3	48.5	0.03074	0.048	0.048	-1.0	4974.4	4953.5	0.4	0.703

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00512	0.028	0.029	-0.4	2933.2	2929.5	0.1	0.848
2	1	5.5	0.01523	0.048	0.048	-0.2	2618.6	2615.4	0.1	0.678
3	1	8.5	0.02362	0.059	0.059	0.0	2458.3	2458.7	0.0	0.598
4	1	11.5	0.01998	0.054	0.054	0.0	3616.7	3615.8	0.0	0.630
5	1	14.5	0.03012	0.066	0.066	0.2	2752.9	2757.1	-0.2	0.552
6	1	17.5	0.04313	0.078	0.077	0.7	2197.6	2211.3	-0.6	0.486
7	1	20.5	0.04618	0.080	0.080	0.8	2341.3	2360.3	-0.8	0.473
8	1	23.5	0.07044	0.095	0.094	1.4	1724.9	1754.8	-1.7	0.396
9	1	26.5	0.06778	0.094	0.093	1.2	1951.6	1981.1	-1.5	0.402
10	1	30.0	0.07022	0.095	0.094	1.0	1969.7	1994.8	-1.3	0.394
11	3	33.5	0.11048	0.100	0.099	0.5	1272.7	1278.5	-0.5	0.435
12	3	36.5	0.11127	0.100	0.100	0.4	1273.0	1278.6	-0.4	0.433
13	3	39.5	0.08787	0.089	0.089	0.0	1598.0	1598.6	0.0	0.483
14	3	42.5	0.06355	0.075	0.074	0.1	2298.2	2299.3	0.0	0.557
15	3	45.5	0.02912	0.046	0.046	-0.3	5109.0	5103.1	0.1	0.715
16	3	48.5	0.03063	0.048	0.048	-0.3	4979.4	4974.4	0.1	0.705

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 6

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00509	0.028	0.028	-0.2	2935.3	2933.2	0.1	0.849
2	1	5.5	0.01516	0.048	0.048	-0.2	2622.0	2618.6	0.1	0.679

3	1	8.5	0.02355	0.059	0.059	-0.1	2460.5	2458.3	0.1	0.598
4	1	11.5	0.01994	0.054	0.054	-0.1	3618.9	3616.7	0.1	0.630
5	1	14.5	0.03013	0.066	0.066	0.0	2752.4	2752.9	0.0	0.552
6	1	17.5	0.04342	0.078	0.078	0.3	2191.8	2197.6	-0.3	0.483
7	1	20.5	0.04655	0.080	0.080	0.3	2333.7	2341.3	-0.3	0.470
8	1	23.5	0.07161	0.096	0.095	0.6	1711.7	1724.9	-0.8	0.389
9	1	26.5	0.06873	0.094	0.094	0.5	1938.4	1951.6	-0.7	0.396
10	1	30.0	0.07102	0.096	0.095	0.4	1959.3	1969.7	-0.5	0.389
11	3	33.5	0.11068	0.100	0.100	0.1	1271.6	1272.7	-0.1	0.433
12	3	36.5	0.11144	0.100	0.100	0.1	1272.0	1273.0	-0.1	0.431
13	3	39.5	0.08796	0.089	0.089	0.1	1597.3	1598.0	0.0	0.483
14	3	42.5	0.06360	0.075	0.075	0.0	2297.4	2298.2	0.0	0.556
15	3	45.5	0.02909	0.046	0.046	-0.1	5110.2	5109.0	0.0	0.716
16	3	48.5	0.03060	0.048	0.048	-0.1	4980.6	4979.4	0.0	0.706

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 7

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00508	0.028	0.028	-0.1	2936.2	2935.3	0.0	0.850
2	1	5.5	0.01512	0.048	0.048	-0.1	2623.9	2622.0	0.1	0.680
3	1	8.5	0.02350	0.059	0.059	-0.1	2462.2	2460.5	0.1	0.599
4	1	11.5	0.01991	0.054	0.054	0.0	3620.1	3618.9	0.0	0.631
5	1	14.5	0.03013	0.066	0.066	0.0	2752.4	2752.4	0.0	0.551
6	1	17.5	0.04354	0.078	0.078	0.1	2189.3	2191.8	-0.1	0.482
7	1	20.5	0.04670	0.081	0.080	0.1	2330.7	2333.7	-0.1	0.468
8	1	23.5	0.07214	0.096	0.096	0.3	1705.7	1711.7	-0.3	0.386
9	1	26.5	0.06916	0.095	0.094	0.2	1932.5	1938.4	-0.3	0.394
10	1	30.0	0.07135	0.096	0.096	0.2	1955.0	1959.3	-0.2	0.387
11	3	33.5	0.11066	0.100	0.100	0.0	1271.7	1271.6	0.0	0.433
12	3	36.5	0.11141	0.100	0.100	0.0	1272.2	1272.0	0.0	0.431
13	3	39.5	0.08802	0.089	0.089	0.0	1596.8	1597.3	0.0	0.483
14	3	42.5	0.06363	0.075	0.075	0.0	2297.0	2297.4	0.0	0.556
15	3	45.5	0.02909	0.046	0.046	0.0	5110.4	5110.2	0.0	0.716
16	3	48.5	0.03060	0.048	0.048	0.0	4981.0	4980.6	0.0	0.706

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 8

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00508	0.028	0.028	0.0	2936.5	2936.2	0.0	0.850
2	1	5.5	0.01510	0.048	0.048	-0.1	2624.7	2623.9	0.0	0.680
3	1	8.5	0.02348	0.059	0.059	-0.1	2463.0	2462.2	0.0	0.599
4	1	11.5	0.01990	0.054	0.054	0.0	3620.7	3620.1	0.0	0.631
5	1	14.5	0.03013	0.066	0.066	0.0	2752.4	2752.4	0.0	0.551
6	1	17.5	0.04360	0.078	0.078	0.1	2188.2	2189.3	-0.1	0.481
7	1	20.5	0.04676	0.081	0.081	0.1	2329.4	2330.7	-0.1	0.468
8	1	23.5	0.07238	0.096	0.096	0.1	1703.0	1705.7	-0.2	0.385
9	1	26.5	0.06937	0.095	0.095	0.1	1929.7	1932.5	-0.1	0.392

10	1	30.0	0.07149	0.096	0.096	0.1	1953.2	1955.0	-0.1	0.387
11	3	33.5	0.11060	0.100	0.100	0.0	1272.0	1271.7	0.0	0.433
12	3	36.5	0.11134	0.100	0.100	0.0	1272.6	1272.2	0.0	0.431
13	3	39.5	0.08805	0.089	0.089	0.0	1596.5	1596.8	0.0	0.483
14	3	42.5	0.06364	0.075	0.075	0.0	2296.9	2297.0	0.0	0.556
15	3	45.5	0.02909	0.046	0.046	0.0	5110.5	5110.4	0.0	0.716
16	3	48.5	0.03059	0.048	0.048	0.0	4981.1	4981.0	0.0	0.706

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 9

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00508	0.028	0.028	0.0	2936.6	2936.5	0.0	0.850
2	1	5.5	0.01509	0.048	0.048	0.0	2625.1	2624.7	0.0	0.681
3	1	8.5	0.02347	0.059	0.059	0.0	2463.4	2463.0	0.0	0.599
4	1	11.5	0.01990	0.054	0.054	0.0	3620.9	3620.7	0.0	0.631
5	1	14.5	0.03013	0.066	0.066	0.0	2752.4	2752.4	0.0	0.551
6	1	17.5	0.04362	0.078	0.078	0.0	2187.7	2188.2	0.0	0.481
7	1	20.5	0.04679	0.081	0.081	0.0	2328.9	2329.4	0.0	0.467
8	1	23.5	0.07249	0.096	0.096	0.1	1701.8	1703.0	-0.1	0.384
9	1	26.5	0.06946	0.095	0.095	0.1	1928.4	1929.7	-0.1	0.392
10	1	30.0	0.07155	0.096	0.096	0.0	1952.4	1953.2	0.0	0.386
11	3	33.5	0.11056	0.100	0.100	0.0	1272.2	1272.0	0.0	0.433
12	3	36.5	0.11129	0.100	0.100	0.0	1272.9	1272.6	0.0	0.431
13	3	39.5	0.08806	0.089	0.089	0.0	1596.4	1596.5	0.0	0.483
14	3	42.5	0.06364	0.075	0.075	0.0	2296.9	2296.9	0.0	0.556
15	3	45.5	0.02909	0.046	0.046	0.0	5110.6	5110.5	0.0	0.716
16	3	48.5	0.03059	0.048	0.048	0.0	4981.3	4981.1	0.0	0.706

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 10

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00507	0.028	0.028	0.0	2936.7	2936.6	0.0	0.850
2	1	5.5	0.01509	0.048	0.048	0.0	2625.2	2625.1	0.0	0.681
3	1	8.5	0.02346	0.059	0.059	0.0	2463.6	2463.4	0.0	0.599
4	1	11.5	0.01990	0.054	0.054	0.0	3620.9	3620.9	0.0	0.631
5	1	14.5	0.03014	0.066	0.066	0.0	2752.3	2752.4	0.0	0.551
6	1	17.5	0.04363	0.078	0.078	0.0	2187.5	2187.7	0.0	0.481
7	1	20.5	0.04680	0.081	0.081	0.0	2328.7	2328.9	0.0	0.467
8	1	23.5	0.07254	0.096	0.096	0.0	1701.2	1701.8	0.0	0.384
9	1	26.5	0.06951	0.095	0.095	0.0	1927.8	1928.4	0.0	0.391
10	1	30.0	0.07158	0.096	0.096	0.0	1952.1	1952.4	0.0	0.386
11	3	33.5	0.11054	0.100	0.100	0.0	1272.4	1272.2	0.0	0.433
12	3	36.5	0.11126	0.100	0.100	0.0	1273.0	1272.9	0.0	0.431
13	3	39.5	0.08807	0.089	0.089	0.0	1596.3	1596.4	0.0	0.483
14	3	42.5	0.06364	0.075	0.075	0.0	2296.9	2296.9	0.0	0.556
15	3	45.5	0.02908	0.046	0.046	0.0	5110.7	5110.6	0.0	0.716
16	3	48.5	0.03059	0.048	0.048	0.0	4981.3	4981.3	0.0	0.706

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	1	4.0000	2.0000	0.00781	229.28	13.59
2	1	3.0000	5.5000	0.02321	609.39	13.59
3	1	3.0000	8.5000	0.03610	889.22	13.59
4	1	3.0000	11.5000	0.03061	1108.37	13.59
5	1	3.0000	14.5000	0.04636	1276.05	13.59
6	1	3.0000	17.5000	0.06713	1468.56	13.46
7	1	3.0000	20.5000	0.07200	1676.72	13.45
8	1	3.0000	23.5000	0.11160	1899.25	13.45
9	1	3.0000	26.5000	0.10693	2062.11	13.45
10	1	4.0000	30.0000	0.11012	2149.98	13.45
11	3	3.0000	33.5000	0.17006	2163.55	13.44
12	3	3.0000	36.5000	0.17118	2178.85	13.44
13	3	3.0000	39.5000	0.13549	2162.95	13.47
14	3	3.0000	42.5000	0.09790	2248.68	13.47
15	3	3.0000	45.5000	0.04475	2286.77	13.47
16	3	3.0000	48.5000	0.04706	2344.02	13.47

PERIOD = 0.26 FROM AVERAGE SHEAR VEL. = 775.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 7.03
FOR FREQUENCY = 3.56 C/SEC.
PERIOD = 0.28 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE	TH SAVED ACC. RECORD
OUTCR.	0.0000	0.88444	13.59	8.87	0.001	2048
WITHIN	4.0000	0.82933	13.59	7.47	0.000	2048
WITHIN	7.0000	0.71118	13.59	5.76	0.000	2048
WITHIN	10.0000	0.68971	13.44	6.00	0.001	2048
WITHIN	13.0000	0.70046	13.44	6.71	0.001	2048
WITHIN	16.0000	0.70832	13.57	7.10	0.000	2048
WITHIN	19.0000	0.72553	13.57	7.99	0.001	2048
WITHIN	22.0000	0.64994	13.57	8.95	0.001	2048
WITHIN	25.0000	0.59498	11.38	9.77	0.001	2048
WITHIN	28.0000	0.60985	12.50	10.67	0.001	2048
WITHIN	32.0000	0.67343	16.20	11.73	0.001	2048
WITHIN	35.0000	0.70548	16.19	13.87	0.002	2048
WITHIN	38.0000	0.71515	16.19	15.38	0.002	2048
WITHIN	41.0000	0.56671	18.60	15.37	0.002	2048
WITHIN	44.0000	0.53756	20.00	15.23	0.002	2048

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE	TH SAVED ACC. RECORD
WITHIN	47.0000	0.52869	20.00	14.54	0.002	2048
WITHIN	50.0000	0.52663	24.57	13.47	0.002	2048

OUTCR.	50.0000	0.57825	24.57	14.61	0.002	2048

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 1 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 1 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 2 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 2 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 3 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 3 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 4 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 4 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 5 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 5 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 6 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC3005 Layer 6 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 7 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 7 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 8 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 8 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 9 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 9 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 10 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 10 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 11 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 11 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 12 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 12 Strain

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1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER  13
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 13 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER  13
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 13 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER  14
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 14 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER  14
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 14 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER  15
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 15 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER  15
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 15 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER  16
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 16 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER  16
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 16 Strain

1******  OPTION  9  ***  COMPUTE RESPONSE SPECTRUM
 RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER       1
CALCULATED FOR DAMPING       0.050

  TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
     TD = TIME FOR MAX. RELATIVE DISP.
     TV = TIME FOR MAX. RELATIVE VEL.
     TA = TIME FOR MAX. ABSOLUTE ACC.
  DAMPING RATIO = 0.050
  PER = 0.01    TIMES FOR MAXIMA --  TD = 13.5800  TV = 18.6700  TA = 13.5800
  PER = 0.02    TIMES FOR MAXIMA --  TD = 13.5800  TV = 18.6600  TA = 13.5800
  PER = 0.03    TIMES FOR MAXIMA --  TD = 13.5800  TV = 20.0700  TA = 13.5800
  PER = 0.04    TIMES FOR MAXIMA --  TD = 18.7600  TV = 27.0100  TA = 18.7600
  PER = 0.05    TIMES FOR MAXIMA --  TD = 20.5800  TV = 13.6100  TA = 20.5800
  PER = 0.06    TIMES FOR MAXIMA --  TD = 18.3000  TV = 18.2800  TA = 18.3000
  PER = 0.07    TIMES FOR MAXIMA --  TD = 24.7500  TV = 24.7700  TA = 24.7500
  PER = 0.08    TIMES FOR MAXIMA --  TD = 16.1600  TV = 16.2600  TA = 16.1600
  PER = 0.09    TIMES FOR MAXIMA --  TD = 11.4300  TV = 11.4100  TA = 11.4300
  PER = 0.10    TIMES FOR MAXIMA --  TD = 20.7500  TV = 20.0900  TA = 20.7500
  PER = 0.11    TIMES FOR MAXIMA --  TD = 20.7600  TV = 25.5700  TA = 25.5900
  PER = 0.12    TIMES FOR MAXIMA --  TD = 21.6700  TV = 21.2200  TA = 21.6700
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PER = 0.13	TIMES FOR MAXIMA --	TD = 16.7500	TV = 15.2200	TA = 16.7500
PER = 0.14	TIMES FOR MAXIMA --	TD = 16.7500	TV = 16.7900	TA = 16.7500
PER = 0.15	TIMES FOR MAXIMA --	TD = 14.1800	TV = 11.3400	TA = 14.1800
PER = 0.16	TIMES FOR MAXIMA --	TD = 20.6300	TV = 20.5900	TA = 20.6300
PER = 0.17	TIMES FOR MAXIMA --	TD = 19.3300	TV = 19.3000	TA = 19.3300
PER = 0.18	TIMES FOR MAXIMA --	TD = 13.5800	TV = 13.6400	TA = 13.5800
PER = 0.19	TIMES FOR MAXIMA --	TD = 13.6000	TV = 13.6500	TA = 13.5900
PER = 0.20	TIMES FOR MAXIMA --	TD = 13.6100	TV = 13.6500	TA = 13.6000
PER = 0.21	TIMES FOR MAXIMA --	TD = 24.5200	TV = 24.5700	TA = 24.5200
PER = 0.22	TIMES FOR MAXIMA --	TD = 24.5300	TV = 19.4400	TA = 24.5300
PER = 0.23	TIMES FOR MAXIMA --	TD = 21.9300	TV = 21.8700	TA = 21.9200
PER = 0.24	TIMES FOR MAXIMA --	TD = 21.9400	TV = 21.8800	TA = 21.9400
PER = 0.25	TIMES FOR MAXIMA --	TD = 21.8400	TV = 21.9000	TA = 21.8300
PER = 0.26	TIMES FOR MAXIMA --	TD = 21.8600	TV = 21.9200	TA = 21.8500
PER = 0.27	TIMES FOR MAXIMA --	TD = 21.2400	TV = 21.1800	TA = 21.2300
PER = 0.28	TIMES FOR MAXIMA --	TD = 21.2500	TV = 21.1800	TA = 21.2400
PER = 0.29	TIMES FOR MAXIMA --	TD = 14.8000	TV = 21.1900	TA = 14.8000
PER = 0.30	TIMES FOR MAXIMA --	TD = 14.2400	TV = 14.3200	TA = 14.2400
PER = 0.31	TIMES FOR MAXIMA --	TD = 14.1200	TV = 13.5900	TA = 13.6500
PER = 0.32	TIMES FOR MAXIMA --	TD = 13.6700	TV = 13.6000	TA = 13.6700
PER = 0.33	TIMES FOR MAXIMA --	TD = 13.6900	TV = 13.6100	TA = 13.5300
PER = 0.34	TIMES FOR MAXIMA --	TD = 13.5500	TV = 20.9500	TA = 13.5400
PER = 0.35	TIMES FOR MAXIMA --	TD = 16.8100	TV = 20.8000	TA = 16.8100
PER = 0.36	TIMES FOR MAXIMA --	TD = 16.8200	TV = 20.8100	TA = 16.8200
PER = 0.37	TIMES FOR MAXIMA --	TD = 16.8300	TV = 16.7400	TA = 16.8300
PER = 0.38	TIMES FOR MAXIMA --	TD = 16.8400	TV = 16.7400	TA = 16.8300
PER = 0.39	TIMES FOR MAXIMA --	TD = 16.8500	TV = 16.7500	TA = 16.8400
PER = 0.40	TIMES FOR MAXIMA --	TD = 16.8600	TV = 16.9700	TA = 16.8500
PER = 0.41	TIMES FOR MAXIMA --	TD = 16.8700	TV = 16.9700	TA = 16.8600
PER = 0.42	TIMES FOR MAXIMA --	TD = 16.8800	TV = 16.9800	TA = 16.8700
PER = 0.43	TIMES FOR MAXIMA --	TD = 16.8800	TV = 16.9800	TA = 16.8800
PER = 0.44	TIMES FOR MAXIMA --	TD = 16.8900	TV = 16.7900	TA = 16.8900
PER = 0.45	TIMES FOR MAXIMA --	TD = 16.9100	TV = 16.7900	TA = 16.9000
PER = 0.46	TIMES FOR MAXIMA --	TD = 16.9200	TV = 16.8100	TA = 16.9100
PER = 0.47	TIMES FOR MAXIMA --	TD = 16.7100	TV = 16.8200	TA = 16.7000
PER = 0.48	TIMES FOR MAXIMA --	TD = 16.7100	TV = 16.8200	TA = 16.7100
PER = 0.49	TIMES FOR MAXIMA --	TD = 16.7200	TV = 16.8300	TA = 16.7100
PER = 0.50	TIMES FOR MAXIMA --	TD = 16.7200	TV = 16.8300	TA = 16.7200
PER = 0.51	TIMES FOR MAXIMA --	TD = 16.7300	TV = 16.6200	TA = 16.7200
PER = 0.52	TIMES FOR MAXIMA --	TD = 16.7400	TV = 16.6400	TA = 16.7300
PER = 0.53	TIMES FOR MAXIMA --	TD = 16.5400	TV = 16.6700	TA = 16.5300
PER = 0.54	TIMES FOR MAXIMA --	TD = 16.5500	TV = 16.6700	TA = 16.5400
PER = 0.55	TIMES FOR MAXIMA --	TD = 29.5500	TV = 21.5900	TA = 29.5400
PER = 0.56	TIMES FOR MAXIMA --	TD = 32.1900	TV = 28.3400	TA = 32.1800
PER = 0.57	TIMES FOR MAXIMA --	TD = 30.5300	TV = 28.3400	TA = 30.5200
PER = 0.58	TIMES FOR MAXIMA --	TD = 30.5400	TV = 30.6800	TA = 30.5300
PER = 0.60	TIMES FOR MAXIMA --	TD = 30.5800	TV = 30.4700	TA = 30.5700
PER = 0.62	TIMES FOR MAXIMA --	TD = 30.6000	TV = 30.4900	TA = 30.5900
PER = 0.64	TIMES FOR MAXIMA --	TD = 16.7400	TV = 28.1800	TA = 16.7300
PER = 0.66	TIMES FOR MAXIMA --	TD = 16.7600	TV = 16.6700	TA = 16.7500
PER = 0.68	TIMES FOR MAXIMA --	TD = 16.5200	TV = 16.6700	TA = 16.5100
PER = 0.70	TIMES FOR MAXIMA --	TD = 16.5400	TV = 16.6800	TA = 16.5200
PER = 0.72	TIMES FOR MAXIMA --	TD = 16.5500	TV = 16.6800	TA = 16.5400
PER = 0.74	TIMES FOR MAXIMA --	TD = 16.5600	TV = 16.6800	TA = 16.5500
PER = 0.76	TIMES FOR MAXIMA --	TD = 16.5700	TV = 16.4700	TA = 16.5500
PER = 0.78	TIMES FOR MAXIMA --	TD = 32.7400	TV = 16.4700	TA = 32.7200
PER = 0.80	TIMES FOR MAXIMA --	TD = 32.7600	TV = 16.4700	TA = 32.7400
PER = 0.82	TIMES FOR MAXIMA --	TD = 33.6400	TV = 16.4700	TA = 33.6300
PER = 0.84	TIMES FOR MAXIMA --	TD = 33.6700	TV = 16.4700	TA = 33.6600
PER = 0.86	TIMES FOR MAXIMA --	TD = 16.3100	TV = 16.4800	TA = 16.2900
PER = 0.88	TIMES FOR MAXIMA --	TD = 12.2300	TV = 12.4200	TA = 12.2200

PER = 0.90	TIMES FOR MAXIMA --	TD = 12.2400	TV = 12.4200	TA = 12.2300
PER = 0.92	TIMES FOR MAXIMA --	TD = 12.2400	TV = 12.4200	TA = 12.2300
PER = 0.94	TIMES FOR MAXIMA --	TD = 12.2500	TV = 12.4200	TA = 12.2400
PER = 0.96	TIMES FOR MAXIMA --	TD = 12.2600	TV = 12.4200	TA = 12.2500
PER = 0.98	TIMES FOR MAXIMA --	TD = 12.2800	TV = 12.4300	TA = 12.2600
PER = 1.00	TIMES FOR MAXIMA --	TD = 12.2900	TV = 12.4300	TA = 12.2700
PER = 1.05	TIMES FOR MAXIMA --	TD = 12.3200	TV = 13.1600	TA = 12.3100
PER = 1.10	TIMES FOR MAXIMA --	TD = 13.5500	TV = 13.1900	TA = 13.5300
PER = 1.15	TIMES FOR MAXIMA --	TD = 13.5700	TV = 13.2000	TA = 13.5600
PER = 1.20	TIMES FOR MAXIMA --	TD = 13.6100	TV = 13.9600	TA = 13.5800
PER = 1.25	TIMES FOR MAXIMA --	TD = 13.1100	TV = 13.4800	TA = 13.0800
PER = 1.30	TIMES FOR MAXIMA --	TD = 13.1300	TV = 13.5200	TA = 13.1100
PER = 1.35	TIMES FOR MAXIMA --	TD = 13.8500	TV = 13.5200	TA = 13.8300
PER = 1.40	TIMES FOR MAXIMA --	TD = 13.8600	TV = 13.5200	TA = 13.8400
PER = 1.45	TIMES FOR MAXIMA --	TD = 13.8800	TV = 13.5200	TA = 13.8600
PER = 1.50	TIMES FOR MAXIMA --	TD = 13.1900	TV = 13.5200	TA = 13.8700
PER = 1.55	TIMES FOR MAXIMA --	TD = 13.3800	TV = 13.5200	TA = 13.3600
PER = 1.60	TIMES FOR MAXIMA --	TD = 13.4100	TV = 13.5200	TA = 13.3900
PER = 1.65	TIMES FOR MAXIMA --	TD = 13.4200	TV = 13.0200	TA = 13.4000
PER = 1.70	TIMES FOR MAXIMA --	TD = 13.4300	TV = 13.0200	TA = 13.4100
PER = 1.75	TIMES FOR MAXIMA --	TD = 16.3700	TV = 18.6600	TA = 16.3500
PER = 1.80	TIMES FOR MAXIMA --	TD = 17.4700	TV = 18.6600	TA = 17.4500
PER = 1.85	TIMES FOR MAXIMA --	TD = 17.4900	TV = 17.9200	TA = 17.4600
PER = 1.90	TIMES FOR MAXIMA --	TD = 18.5500	TV = 17.9200	TA = 18.5200
PER = 1.95	TIMES FOR MAXIMA --	TD = 18.5700	TV = 20.9600	TA = 18.5400
PER = 2.00	TIMES FOR MAXIMA --	TD = 18.5800	TV = 19.1600	TA = 18.5500
PER = 2.05	TIMES FOR MAXIMA --	TD = 19.7100	TV = 19.1600	TA = 19.6800
PER = 2.10	TIMES FOR MAXIMA --	TD = 17.7100	TV = 16.2500	TA = 19.7000
PER = 2.15	TIMES FOR MAXIMA --	TD = 17.7700	TV = 16.2500	TA = 17.7500
PER = 2.20	TIMES FOR MAXIMA --	TD = 17.8200	TV = 16.2500	TA = 17.7900
PER = 2.25	TIMES FOR MAXIMA --	TD = 19.0800	TV = 16.2500	TA = 19.0500
PER = 2.30	TIMES FOR MAXIMA --	TD = 19.1100	TV = 16.2500	TA = 19.0900
PER = 2.35	TIMES FOR MAXIMA --	TD = 17.0700	TV = 16.6800	TA = 17.0600
PER = 2.40	TIMES FOR MAXIMA --	TD = 16.0600	TV = 16.6800	TA = 16.0400
PER = 2.50	TIMES FOR MAXIMA --	TD = 12.9100	TV = 12.5600	TA = 12.8700
PER = 2.60	TIMES FOR MAXIMA --	TD = 12.0200	TV = 12.5600	TA = 12.0000
PER = 2.70	TIMES FOR MAXIMA --	TD = 12.0900	TV = 12.5600	TA = 12.0700
PER = 2.80	TIMES FOR MAXIMA --	TD = 17.1000	TV = 16.6800	TA = 17.0700
PER = 2.90	TIMES FOR MAXIMA --	TD = 17.1300	TV = 16.6800	TA = 17.0900
PER = 3.00	TIMES FOR MAXIMA --	TD = 16.0700	TV = 16.6800	TA = 16.0400
PER = 3.10	TIMES FOR MAXIMA --	TD = 16.1200	TV = 16.6800	TA = 16.0400
PER = 3.20	TIMES FOR MAXIMA --	TD = 16.1300	TV = 16.6800	TA = 16.1100
PER = 3.30	TIMES FOR MAXIMA --	TD = 16.1400	TV = 16.6800	TA = 16.1200
PER = 3.40	TIMES FOR MAXIMA --	TD = 16.1400	TV = 16.6800	TA = 16.1200
PER = 3.50	TIMES FOR MAXIMA --	TD = 45.5600	TV = 16.6800	TA = 45.4800
PER = 3.60	TIMES FOR MAXIMA --	TD = 45.7200	TV = 16.6800	TA = 45.6600
PER = 3.70	TIMES FOR MAXIMA --	TD = 44.2500	TV = 16.6800	TA = 44.2300
PER = 3.80	TIMES FOR MAXIMA --	TD = 44.2900	TV = 16.6800	TA = 44.2300
PER = 3.90	TIMES FOR MAXIMA --	TD = 44.4000	TV = 16.6800	TA = 46.2200
PER = 4.00	TIMES FOR MAXIMA --	TD = 44.6100	TV = 16.6800	TA = 44.3900
PER = 4.10	TIMES FOR MAXIMA --	TD = 16.1500	TV = 16.6800	TA = 16.1200
PER = 4.20	TIMES FOR MAXIMA --	TD = 14.9200	TV = 16.6800	TA = 14.8800
PER = 4.30	TIMES FOR MAXIMA --	TD = 14.9200	TV = 12.5600	TA = 14.8800
PER = 4.40	TIMES FOR MAXIMA --	TD = 14.9200	TV = 15.7200	TA = 14.8900
PER = 4.50	TIMES FOR MAXIMA --	TD = 14.9300	TV = 15.7200	TA = 14.8900
PER = 4.60	TIMES FOR MAXIMA --	TD = 14.9300	TV = 14.6600	TA = 14.8900
PER = 4.70	TIMES FOR MAXIMA --	TD = 32.0400	TV = 14.6600	TA = 14.8900
PER = 4.80	TIMES FOR MAXIMA --	TD = 32.0500	TV = 26.8100	TA = 32.0000
PER = 4.90	TIMES FOR MAXIMA --	TD = 32.0800	TV = 26.8100	TA = 32.0000
PER = 5.00	TIMES FOR MAXIMA --	TD = 32.0900	TV = 26.8100	TA = 32.0000
PER = 5.10	TIMES FOR MAXIMA --	TD = 28.0900	TV = 26.8100	TA = 32.0000

PER = 5.20 TIMES FOR MAXIMA -- TD = 28.0900 TV = 26.8100 TA = 28.0600
PER = 5.40 TIMES FOR MAXIMA -- TD = 9.8500 TV = 26.8100 TA = 9.7800
PER = 5.60 TIMES FOR MAXIMA -- TD = 9.8500 TV = 26.8100 TA = 9.7800
PER = 5.80 TIMES FOR MAXIMA -- TD = 9.8600 TV = 12.5600 TA = 9.7800
PER = 6.00 TIMES FOR MAXIMA -- TD = 14.9200 TV = 12.5600 TA = 14.8800
PER = 6.20 TIMES FOR MAXIMA -- TD = 14.9200 TV = 12.5600 TA = 14.8800
PER = 6.40 TIMES FOR MAXIMA -- TD = 14.9200 TV = 12.5600 TA = 14.8800
PER = 6.60 TIMES FOR MAXIMA -- TD = 14.9200 TV = 12.5600 TA = 14.8800
PER = 6.80 TIMES FOR MAXIMA -- TD = 14.9300 TV = 12.5600 TA = 14.8800
PER = 7.00 TIMES FOR MAXIMA -- TD = 14.9300 TV = 12.5600 TA = 14.8800
PER = 7.30 TIMES FOR MAXIMA -- TD = 15.3900 TV = 12.5600 TA = 14.8800
PER = 7.60 TIMES FOR MAXIMA -- TD = 15.4000 TV = 12.5600 TA = 15.3500
PER = 8.00 TIMES FOR MAXIMA -- TD = 15.4500 TV = 12.5600 TA = 15.3500
PER = 8.50 TIMES FOR MAXIMA -- TD = 15.5600 TV = 14.6600 TA = 15.3500
PER = 9.00 TIMES FOR MAXIMA -- TD = 16.7700 TV = 14.6600 TA = 16.6800
PER = 9.50 TIMES FOR MAXIMA -- TD = 17.1200 TV = 14.6600 TA = 16.6800
PER =10.00 TIMES FOR MAXIMA -- TD = 17.1300 TV = 14.6600 TA = 16.6800

SPECTRAL VALUES--
(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00007	0.00162	0.04521	0.88469	0.88226	100.00
2	0.02	0.00029	0.02448	0.09022	0.88457	0.88018	50.00
3	0.03	0.00084	0.11368	0.17674	1.15665	1.14954	33.33
4	0.04	0.00224	0.26450	0.35226	1.69734	1.71839	25.00
5	0.05	0.00339	0.43475	0.42596	1.69653	1.66236	20.00
6	0.06	0.00493	0.43930	0.51672	1.65029	1.68045	16.67
7	0.07	0.00680	0.53118	0.61010	1.72996	1.70069	14.29
8	0.08	0.00967	0.66552	0.75965	1.85850	1.85289	12.50
9	0.09	0.01588	1.01170	1.10894	2.43771	2.40430	11.11
10	0.10	0.01392	0.75444	0.87471	1.72961	1.70681	10.00
11	0.11	0.01583	0.77282	0.90409	1.61125	1.60378	9.09
12	0.12	0.01718	0.70809	0.89976	1.44876	1.46308	8.33
13	0.13	0.01669	0.64237	0.80683	1.20634	1.21105	7.69
14	0.14	0.02029	0.70091	0.91060	1.28686	1.26918	7.14
15	0.15	0.02194	0.80547	0.91884	1.19663	1.19528	6.67
16	0.16	0.02709	0.98643	1.06368	1.31004	1.29722	6.25
17	0.17	0.03196	1.08053	1.18126	1.37371	1.35588	5.88
18	0.18	0.04061	1.35903	1.41752	1.54569	1.53667	5.56
19	0.19	0.05237	1.72532	1.73194	1.78480	1.77870	5.26
20	0.20	0.05801	1.82442	1.82245	1.77765	1.77807	5.00
21	0.21	0.06878	1.78704	2.05791	1.90841	1.91219	4.76
22	0.22	0.08194	2.20406	2.34007	2.09973	2.07554	4.55
23	0.23	0.09997	2.59270	2.73103	2.31275	2.31698	4.35
24	0.24	0.12316	3.15870	3.22420	2.63270	2.62141	4.17
25	0.25	0.15686	4.02617	3.94226	3.11519	3.07701	4.00
26	0.26	0.16642	4.06351	4.02165	3.03217	3.01825	3.85
27	0.27	0.15099	3.50836	3.51375	2.54003	2.53940	3.70
28	0.28	0.14992	3.44354	3.36413	2.36295	2.34444	3.57
29	0.29	0.17192	3.86748	3.72481	2.51630	2.50628	3.45
30	0.30	0.19488	4.17024	4.08147	2.67455	2.65472	3.33
31	0.31	0.20840	4.37387	4.22392	2.67581	2.65875	3.23
32	0.32	0.20073	4.35173	3.94124	2.42234	2.40330	3.13
33	0.33	0.18382	3.89455	3.49997	2.08016	2.06954	3.03
34	0.34	0.16282	3.28428	3.00890	1.73723	1.72684	2.94
35	0.35	0.15163	3.07962	2.72214	1.52233	1.51763	2.86
36	0.36	0.16310	2.73950	2.84668	1.54817	1.54298	2.78
37	0.37	0.17492	2.90359	2.97047	1.57026	1.56656	2.70
38	0.38	0.18727	3.03641	3.09646	1.59281	1.59003	2.63
39	0.39	0.19573	3.09348	3.15332	1.58249	1.57771	2.56
40	0.40	0.19817	3.12881	3.11283	1.52666	1.51851	2.50

41	0.41	0.19781	3.12847	3.03143	1.45166	1.44274	2.44
42	0.42	0.19553	3.07504	2.92508	1.36688	1.35898	2.38
43	0.43	0.19970	3.05538	2.91797	1.33031	1.32415	2.33
44	0.44	0.21410	3.18111	3.05735	1.36313	1.35586	2.27
45	0.45	0.21944	3.21896	3.06393	1.33751	1.32859	2.22
46	0.46	0.21073	3.07841	2.87837	1.22911	1.22099	2.17
47	0.47	0.20515	2.96726	2.74248	1.14497	1.13860	2.13
48	0.48	0.20805	2.94250	2.72333	1.11632	1.10709	2.08
49	0.49	0.21171	2.90325	2.71478	1.08902	1.08109	2.04
50	0.50	0.21303	2.83354	2.67699	1.05423	1.04472	2.00
51	0.51	0.21291	2.76686	2.62301	1.01089	1.00358	1.96
52	0.52	0.20289	2.71755	2.45151	0.92604	0.91993	1.92
53	0.53	0.18103	2.62710	2.14606	0.79665	0.79012	1.89
54	0.54	0.16196	2.39962	1.88454	0.68697	0.68098	1.85
55	0.55	0.16061	2.12608	1.83486	0.65455	0.65097	1.82
56	0.56	0.17830	2.15307	2.00048	0.70039	0.69706	1.79
57	0.57	0.19490	2.31606	2.14841	0.74001	0.73547	1.75
58	0.58	0.21968	2.46230	2.37977	0.80523	0.80063	1.72
59	0.60	0.22951	2.36487	2.40340	0.78617	0.78163	1.67
60	0.62	0.20419	2.38136	2.06925	0.65586	0.65125	1.61
61	0.64	0.17857	2.02978	1.75312	0.53919	0.53451	1.56
62	0.66	0.19855	2.29758	1.89015	0.56188	0.55883	1.52
63	0.68	0.20384	2.58326	1.88344	0.54544	0.54046	1.47
64	0.70	0.22247	2.60616	1.99687	0.56092	0.55664	1.43
65	0.72	0.21968	2.41282	1.91704	0.52393	0.51954	1.39
66	0.74	0.20576	2.15920	1.74710	0.46443	0.46069	1.35
67	0.76	0.19776	2.01496	1.63495	0.42305	0.41977	1.32
68	0.78	0.21543	2.04485	1.73537	0.43747	0.43413	1.28
69	0.80	0.22642	2.16380	1.77833	0.43709	0.43376	1.25
70	0.82	0.22615	2.36168	1.73282	0.41471	0.41235	1.22
71	0.84	0.22816	2.46266	1.70665	0.39872	0.39645	1.19
72	0.86	0.21523	2.36504	1.57250	0.36010	0.35679	1.16
73	0.88	0.20813	2.25229	1.48606	0.33040	0.32952	1.14
74	0.90	0.21667	2.25370	1.51263	0.32931	0.32795	1.11
75	0.92	0.23529	2.32383	1.60695	0.34247	0.34083	1.09
76	0.94	0.26701	2.44503	1.78476	0.37224	0.37049	1.06
77	0.96	0.30007	2.51276	1.96398	0.40130	0.39920	1.04
78	0.98	0.32552	2.49169	2.08705	0.41788	0.41556	1.02
79	1.00	0.34288	2.39869	2.15440	0.42284	0.42039	1.00
80	1.05	0.37072	2.32275	2.21837	0.41565	0.41226	0.95
81	1.10	0.37626	2.36139	2.14918	0.38524	0.38125	0.91
82	1.15	0.43986	2.36340	2.40322	0.41253	0.40777	0.87
83	1.20	0.47417	2.61047	2.48275	0.40899	0.40372	0.83
84	1.25	0.45663	2.92361	2.29525	0.36178	0.35830	0.80
85	1.30	0.38072	2.69034	1.84009	0.27888	0.27620	0.77
86	1.35	0.33504	2.47567	1.55936	0.22790	0.22539	0.74
87	1.40	0.32858	2.39300	1.47466	0.20790	0.20554	0.71
88	1.45	0.33092	2.36311	1.43393	0.19495	0.19297	0.69
89	1.50	0.32725	2.31073	1.37079	0.17982	0.17832	0.67
90	1.55	0.33777	2.16537	1.36922	0.17327	0.17237	0.65
91	1.60	0.35224	1.91605	1.38324	0.17027	0.16869	0.63
92	1.65	0.34112	1.83969	1.29899	0.15622	0.15362	0.61
93	1.70	0.31002	1.69562	1.14584	0.13464	0.13152	0.59
94	1.75	0.32133	1.77498	1.15370	0.13133	0.12864	0.57
95	1.80	0.37514	1.80200	1.30949	0.14377	0.14196	0.56
96	1.85	0.40807	1.71844	1.38594	0.14840	0.14618	0.54
97	1.90	0.42454	1.68995	1.40392	0.14568	0.14418	0.53
98	1.95	0.44700	1.72463	1.44030	0.14603	0.14413	0.51
99	2.00	0.47167	1.83758	1.48180	0.14637	0.14457	0.50
100	2.05	0.51428	1.94446	1.57626	0.15243	0.15004	0.49
101	2.10	0.55060	2.03638	1.64740	0.15426	0.15308	0.48

102	2.15	0.59783	2.23409	1.74710	0.15939	0.15856	0.47
103	2.20	0.61910	2.35829	1.76815	0.15826	0.15683	0.45
104	2.25	0.59931	2.35412	1.67359	0.14627	0.14514	0.44
105	2.30	0.57243	2.21310	1.56377	0.13475	0.13267	0.43
106	2.35	0.51023	2.06246	1.36419	0.11383	0.11327	0.43
107	2.40	0.47344	2.03374	1.23947	0.10246	0.10077	0.42
108	2.50	0.40221	1.85006	1.01085	0.07932	0.07890	0.40
109	2.60	0.43136	1.89756	1.04244	0.07895	0.07824	0.38
110	2.70	0.42310	1.76273	0.98460	0.07188	0.07116	0.37
111	2.80	0.38647	1.61794	0.86725	0.06139	0.06044	0.36
112	2.90	0.43621	1.81473	0.94511	0.06469	0.06359	0.34
113	3.00	0.45622	1.89744	0.95550	0.06373	0.06215	0.33
114	3.10	0.47128	1.84423	0.95521	0.06172	0.06013	0.32
115	3.20	0.44498	1.70647	0.87371	0.05433	0.05328	0.31
116	3.30	0.39333	1.55338	0.74890	0.04564	0.04428	0.30
117	3.40	0.33998	1.43465	0.62829	0.03748	0.03606	0.29
118	3.50	0.34496	1.36838	0.61927	0.03531	0.03453	0.29
119	3.60	0.38815	1.34667	0.67745	0.03708	0.03672	0.28
120	3.70	0.40047	1.34846	0.68006	0.03652	0.03586	0.27
121	3.80	0.41400	1.35166	0.68454	0.03617	0.03515	0.26
122	3.90	0.38699	1.34063	0.62347	0.03199	0.03119	0.26
123	4.00	0.34307	1.30893	0.53889	0.02645	0.02629	0.25
124	4.10	0.31681	1.25834	0.48551	0.02453	0.02311	0.24
125	4.20	0.33732	1.19591	0.50463	0.02490	0.02344	0.24
126	4.30	0.35545	1.15211	0.51938	0.02508	0.02357	0.23
127	4.40	0.36425	1.11772	0.52015	0.02464	0.02307	0.23
128	4.50	0.36362	1.08790	0.50770	0.02366	0.02202	0.22
129	4.60	0.35463	1.08060	0.48440	0.02223	0.02055	0.22
130	4.70	0.34728	1.09383	0.46426	0.02053	0.01927	0.21
131	4.80	0.35988	1.12501	0.47108	0.02046	0.01915	0.21
132	4.90	0.34542	1.16697	0.44293	0.01900	0.01764	0.20
133	5.00	0.31399	1.18672	0.39458	0.01673	0.01540	0.20
134	5.10	0.28415	1.18983	0.35008	0.01427	0.01339	0.20
135	5.20	0.28355	1.18399	0.34262	0.01363	0.01286	0.19
136	5.40	0.28420	1.16958	0.33068	0.01290	0.01195	0.19
137	5.60	0.30689	1.16205	0.34433	0.01297	0.01200	0.18
138	5.80	0.32224	1.19908	0.34909	0.01272	0.01174	0.17
139	6.00	0.33764	1.24291	0.35357	0.01271	0.01150	0.17
140	6.20	0.39242	1.27869	0.39769	0.01371	0.01252	0.16
141	6.40	0.44751	1.30537	0.43934	0.01459	0.01340	0.16
142	6.60	0.49824	1.32312	0.47432	0.01525	0.01402	0.15
143	6.80	0.54183	1.33279	0.50065	0.01563	0.01437	0.15
144	7.00	0.57653	1.33559	0.51749	0.01573	0.01443	0.14
145	7.30	0.62892	1.32979	0.54132	0.01543	0.01447	0.14
146	7.60	0.67527	1.31560	0.55827	0.01501	0.01433	0.13
147	8.00	0.71082	1.28918	0.55827	0.01436	0.01362	0.13
148	8.50	0.72495	1.30925	0.53588	0.01296	0.01230	0.12
149	9.00	0.74183	1.34853	0.51789	0.01281	0.01123	0.11
150	9.50	0.82449	1.37083	0.54531	0.01261	0.01120	0.11
151	10.00	0.89170	1.38046	0.56027	0.01199	0.01093	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.
AREA OF ACC. RESPONSE SPECTRUM = 1.273
AREA OF VEL. RESPONSE SPECTRUM = 5.457
MAX. ACCELERATION RESPONSE VALUE = 3.115
MAX. VELOCITY RESPONSE VALUE = 4.374

1****** OPTION 9 *** COMPUTE RESPONSE SPECTRUM
RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER 17
CALCULATED FOR DAMPING 0.050

TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
TD = TIME FOR MAX. RELATIVE DISP.
TV = TIME FOR MAX. RELATIVE VEL.
TA = TIME FOR MAX. ABSOLUTE ACC.
DAMPING RATIO = 0.050

PER = 0.01	TIMES FOR MAXIMA --	TD = 24.5600	TV = 18.6000	TA = 24.5600
PER = 0.02	TIMES FOR MAXIMA --	TD = 24.5600	TV = 11.4800	TA = 24.5600
PER = 0.03	TIMES FOR MAXIMA --	TD = 23.3800	TV = 23.3700	TA = 23.3800
PER = 0.04	TIMES FOR MAXIMA --	TD = 24.6700	TV = 24.6800	TA = 24.6700
PER = 0.05	TIMES FOR MAXIMA --	TD = 10.4700	TV = 10.4600	TA = 10.4700
PER = 0.06	TIMES FOR MAXIMA --	TD = 18.2300	TV = 18.2200	TA = 18.2300
PER = 0.07	TIMES FOR MAXIMA --	TD = 18.2800	TV = 24.6700	TA = 18.2800
PER = 0.08	TIMES FOR MAXIMA --	TD = 16.0900	TV = 24.6500	TA = 16.0900
PER = 0.09	TIMES FOR MAXIMA --	TD = 11.3700	TV = 11.3500	TA = 11.3700
PER = 0.10	TIMES FOR MAXIMA --	TD = 13.6400	TV = 20.0800	TA = 13.6400
PER = 0.11	TIMES FOR MAXIMA --	TD = 25.5300	TV = 25.5100	TA = 25.5300
PER = 0.12	TIMES FOR MAXIMA --	TD = 21.3600	TV = 21.3900	TA = 21.3600
PER = 0.13	TIMES FOR MAXIMA --	TD = 15.1900	TV = 15.2900	TA = 15.1900
PER = 0.14	TIMES FOR MAXIMA --	TD = 16.6900	TV = 16.0000	TA = 16.6900
PER = 0.15	TIMES FOR MAXIMA --	TD = 14.1100	TV = 14.1500	TA = 14.1100
PER = 0.16	TIMES FOR MAXIMA --	TD = 20.5600	TV = 20.5200	TA = 20.5600
PER = 0.17	TIMES FOR MAXIMA --	TD = 13.8400	TV = 13.8800	TA = 13.8400
PER = 0.18	TIMES FOR MAXIMA --	TD = 22.8300	TV = 22.7900	TA = 22.8300
PER = 0.19	TIMES FOR MAXIMA --	TD = 22.8500	TV = 22.8100	TA = 22.8500
PER = 0.20	TIMES FOR MAXIMA --	TD = 22.2200	TV = 13.5800	TA = 22.2200
PER = 0.21	TIMES FOR MAXIMA --	TD = 24.3200	TV = 24.5800	TA = 24.3200
PER = 0.22	TIMES FOR MAXIMA --	TD = 24.3400	TV = 19.2400	TA = 24.3300
PER = 0.23	TIMES FOR MAXIMA --	TD = 24.4600	TV = 21.8900	TA = 24.4600
PER = 0.24	TIMES FOR MAXIMA --	TD = 21.8600	TV = 21.8000	TA = 21.8500
PER = 0.25	TIMES FOR MAXIMA --	TD = 21.7500	TV = 21.6900	TA = 21.7500
PER = 0.26	TIMES FOR MAXIMA --	TD = 21.6500	TV = 21.7100	TA = 21.6500
PER = 0.27	TIMES FOR MAXIMA --	TD = 21.0300	TV = 21.6100	TA = 21.6600
PER = 0.28	TIMES FOR MAXIMA --	TD = 21.0400	TV = 21.1100	TA = 21.0300
PER = 0.29	TIMES FOR MAXIMA --	TD = 21.0500	TV = 21.1200	TA = 21.0400
PER = 0.30	TIMES FOR MAXIMA --	TD = 13.4300	TV = 13.5200	TA = 13.4300
PER = 0.31	TIMES FOR MAXIMA --	TD = 13.4500	TV = 13.5300	TA = 13.4500
PER = 0.32	TIMES FOR MAXIMA --	TD = 13.4700	TV = 13.5300	TA = 13.4600
PER = 0.33	TIMES FOR MAXIMA --	TD = 13.4800	TV = 13.4100	TA = 13.4700
PER = 0.34	TIMES FOR MAXIMA --	TD = 21.6700	TV = 13.4100	TA = 21.6700
PER = 0.35	TIMES FOR MAXIMA --	TD = 16.7700	TV = 16.6800	TA = 16.7700
PER = 0.36	TIMES FOR MAXIMA --	TD = 16.7800	TV = 16.6800	TA = 16.7800
PER = 0.37	TIMES FOR MAXIMA --	TD = 16.7900	TV = 16.6800	TA = 16.7900
PER = 0.38	TIMES FOR MAXIMA --	TD = 16.8000	TV = 16.9100	TA = 16.8000
PER = 0.39	TIMES FOR MAXIMA --	TD = 16.8200	TV = 16.9200	TA = 16.8100
PER = 0.40	TIMES FOR MAXIMA --	TD = 16.8300	TV = 16.9200	TA = 16.8300
PER = 0.41	TIMES FOR MAXIMA --	TD = 16.8400	TV = 16.9300	TA = 16.8400
PER = 0.42	TIMES FOR MAXIMA --	TD = 27.2100	TV = 27.3100	TA = 27.2000
PER = 0.43	TIMES FOR MAXIMA --	TD = 16.8600	TV = 27.3100	TA = 16.8500
PER = 0.44	TIMES FOR MAXIMA --	TD = 16.8700	TV = 16.9900	TA = 16.8600
PER = 0.45	TIMES FOR MAXIMA --	TD = 16.8800	TV = 16.9900	TA = 16.8800
PER = 0.46	TIMES FOR MAXIMA --	TD = 16.8900	TV = 16.7800	TA = 16.8900
PER = 0.47	TIMES FOR MAXIMA --	TD = 16.9000	TV = 16.7800	TA = 16.8900
PER = 0.48	TIMES FOR MAXIMA --	TD = 16.9100	TV = 16.8200	TA = 16.9000
PER = 0.49	TIMES FOR MAXIMA --	TD = 16.6900	TV = 16.6100	TA = 16.9100
PER = 0.50	TIMES FOR MAXIMA --	TD = 16.7000	TV = 16.6100	TA = 16.6900
PER = 0.51	TIMES FOR MAXIMA --	TD = 16.7100	TV = 16.6100	TA = 16.7000
PER = 0.52	TIMES FOR MAXIMA --	TD = 16.7300	TV = 16.6100	TA = 16.7200
PER = 0.53	TIMES FOR MAXIMA --	TD = 29.4900	TV = 16.6100	TA = 29.4800
PER = 0.54	TIMES FOR MAXIMA --	TD = 29.5100	TV = 16.6200	TA = 29.5000
PER = 0.55	TIMES FOR MAXIMA --	TD = 29.5300	TV = 29.1200	TA = 29.5200
PER = 0.56	TIMES FOR MAXIMA --	TD = 32.1700	TV = 29.4300	TA = 32.1600

PER = 0.57	TIMES FOR MAXIMA --	TD = 30.4900	TV = 30.6500	TA = 30.4800
PER = 0.58	TIMES FOR MAXIMA --	TD = 30.5200	TV = 30.6600	TA = 30.5100
PER = 0.60	TIMES FOR MAXIMA --	TD = 30.5600	TV = 30.4200	TA = 30.5500
PER = 0.62	TIMES FOR MAXIMA --	TD = 30.5900	TV = 30.4300	TA = 30.5800
PER = 0.64	TIMES FOR MAXIMA --	TD = 15.6700	TV = 16.6100	TA = 15.6600
PER = 0.66	TIMES FOR MAXIMA --	TD = 16.7500	TV = 16.6100	TA = 16.7400
PER = 0.68	TIMES FOR MAXIMA --	TD = 16.4800	TV = 16.6200	TA = 16.4700
PER = 0.70	TIMES FOR MAXIMA --	TD = 16.5100	TV = 16.6200	TA = 16.5000
PER = 0.72	TIMES FOR MAXIMA --	TD = 16.5300	TV = 16.4100	TA = 16.5200
PER = 0.74	TIMES FOR MAXIMA --	TD = 16.5400	TV = 16.4100	TA = 16.5300
PER = 0.76	TIMES FOR MAXIMA --	TD = 32.6800	TV = 16.4100	TA = 32.6700
PER = 0.78	TIMES FOR MAXIMA --	TD = 32.7100	TV = 16.4100	TA = 32.7000
PER = 0.80	TIMES FOR MAXIMA --	TD = 32.7400	TV = 16.4200	TA = 32.7200
PER = 0.82	TIMES FOR MAXIMA --	TD = 33.6100	TV = 16.4200	TA = 33.6000
PER = 0.84	TIMES FOR MAXIMA --	TD = 33.6600	TV = 16.4200	TA = 33.6400
PER = 0.86	TIMES FOR MAXIMA --	TD = 12.1700	TV = 16.4300	TA = 12.1600
PER = 0.88	TIMES FOR MAXIMA --	TD = 12.1900	TV = 12.3600	TA = 12.1800
PER = 0.90	TIMES FOR MAXIMA --	TD = 12.2000	TV = 12.3600	TA = 12.1800
PER = 0.92	TIMES FOR MAXIMA --	TD = 12.2000	TV = 12.3600	TA = 12.1900
PER = 0.94	TIMES FOR MAXIMA --	TD = 12.2100	TV = 12.3600	TA = 12.2000
PER = 0.96	TIMES FOR MAXIMA --	TD = 12.2200	TV = 12.3700	TA = 12.2000
PER = 0.98	TIMES FOR MAXIMA --	TD = 12.2500	TV = 12.4500	TA = 12.2300
PER = 1.00	TIMES FOR MAXIMA --	TD = 12.2600	TV = 16.1800	TA = 12.2500
PER = 1.05	TIMES FOR MAXIMA --	TD = 12.3000	TV = 13.1700	TA = 12.2800
PER = 1.10	TIMES FOR MAXIMA --	TD = 13.5000	TV = 13.2000	TA = 13.4900
PER = 1.15	TIMES FOR MAXIMA --	TD = 13.5400	TV = 13.8400	TA = 13.5100
PER = 1.20	TIMES FOR MAXIMA --	TD = 13.6200	TV = 13.4000	TA = 13.6000
PER = 1.25	TIMES FOR MAXIMA --	TD = 13.0900	TV = 13.4100	TA = 13.0700
PER = 1.30	TIMES FOR MAXIMA --	TD = 13.7800	TV = 13.4100	TA = 13.7600
PER = 1.35	TIMES FOR MAXIMA --	TD = 13.8100	TV = 13.4600	TA = 13.7800
PER = 1.40	TIMES FOR MAXIMA --	TD = 13.8200	TV = 13.4600	TA = 13.8000
PER = 1.45	TIMES FOR MAXIMA --	TD = 13.1900	TV = 13.4600	TA = 13.1500
PER = 1.50	TIMES FOR MAXIMA --	TD = 13.2300	TV = 13.5900	TA = 13.1900
PER = 1.55	TIMES FOR MAXIMA --	TD = 13.3200	TV = 12.9500	TA = 13.3000
PER = 1.60	TIMES FOR MAXIMA --	TD = 13.3500	TV = 12.9500	TA = 13.3400
PER = 1.65	TIMES FOR MAXIMA --	TD = 13.3700	TV = 13.0000	TA = 13.3400
PER = 1.70	TIMES FOR MAXIMA --	TD = 13.3800	TV = 13.0000	TA = 13.3500
PER = 1.75	TIMES FOR MAXIMA --	TD = 18.2300	TV = 18.5900	TA = 18.2100
PER = 1.80	TIMES FOR MAXIMA --	TD = 17.4300	TV = 17.8500	TA = 17.4000
PER = 1.85	TIMES FOR MAXIMA --	TD = 17.4700	TV = 17.9300	TA = 17.4400
PER = 1.90	TIMES FOR MAXIMA --	TD = 18.5100	TV = 17.9400	TA = 18.4800
PER = 1.95	TIMES FOR MAXIMA --	TD = 18.5300	TV = 17.9400	TA = 18.5100
PER = 2.00	TIMES FOR MAXIMA --	TD = 19.6300	TV = 20.1700	TA = 19.6100
PER = 2.05	TIMES FOR MAXIMA --	TD = 19.6600	TV = 20.1700	TA = 19.6200
PER = 2.10	TIMES FOR MAXIMA --	TD = 17.7000	TV = 19.3000	TA = 17.6800
PER = 2.15	TIMES FOR MAXIMA --	TD = 17.7500	TV = 17.3100	TA = 17.7100
PER = 2.20	TIMES FOR MAXIMA --	TD = 17.7800	TV = 17.3100	TA = 17.7500
PER = 2.25	TIMES FOR MAXIMA --	TD = 19.0300	TV = 17.3200	TA = 18.9800
PER = 2.30	TIMES FOR MAXIMA --	TD = 19.0600	TV = 16.2700	TA = 19.0300
PER = 2.35	TIMES FOR MAXIMA --	TD = 17.0200	TV = 16.6100	TA = 17.0000
PER = 2.40	TIMES FOR MAXIMA --	TD = 16.0500	TV = 16.6100	TA = 15.9800
PER = 2.50	TIMES FOR MAXIMA --	TD = 12.8600	TV = 12.4900	TA = 12.8400
PER = 2.60	TIMES FOR MAXIMA --	TD = 12.0000	TV = 12.4900	TA = 11.9500
PER = 2.70	TIMES FOR MAXIMA --	TD = 12.0800	TV = 12.5000	TA = 12.0100
PER = 2.80	TIMES FOR MAXIMA --	TD = 17.0500	TV = 11.7800	TA = 17.0400
PER = 2.90	TIMES FOR MAXIMA --	TD = 17.1000	TV = 16.6100	TA = 17.0500
PER = 3.00	TIMES FOR MAXIMA --	TD = 16.0600	TV = 16.6100	TA = 15.9800
PER = 3.10	TIMES FOR MAXIMA --	TD = 16.0800	TV = 16.6100	TA = 16.0500
PER = 3.20	TIMES FOR MAXIMA --	TD = 16.1000	TV = 16.6200	TA = 16.0600
PER = 3.30	TIMES FOR MAXIMA --	TD = 16.1100	TV = 16.6200	TA = 16.0600
PER = 3.40	TIMES FOR MAXIMA --	TD = 16.1200	TV = 15.7000	TA = 16.0600

PER = 3.50 TIMES FOR MAXIMA -- TD = 45.5300 TV = 16.6200 TA = 45.4900
PER = 3.60 TIMES FOR MAXIMA -- TD = 45.6800 TV = 16.6200 TA = 45.6000
PER = 3.70 TIMES FOR MAXIMA -- TD = 44.1900 TV = 16.6200 TA = 44.1600
PER = 3.80 TIMES FOR MAXIMA -- TD = 44.3200 TV = 16.6200 TA = 44.2900
PER = 3.90 TIMES FOR MAXIMA -- TD = 44.3600 TV = 16.6200 TA = 44.3200
PER = 4.00 TIMES FOR MAXIMA -- TD = 44.5500 TV = 15.8300 TA = 44.4500
PER = 4.10 TIMES FOR MAXIMA -- TD = 44.5800 TV = 15.8300 TA = 14.8100
PER = 4.20 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 4.30 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 4.40 TIMES FOR MAXIMA -- TD = 14.8600 TV = 15.8300 TA = 14.8100
PER = 4.50 TIMES FOR MAXIMA -- TD = 14.8600 TV = 15.8300 TA = 14.8200
PER = 4.60 TIMES FOR MAXIMA -- TD = 14.9400 TV = 15.8300 TA = 14.8200
PER = 4.70 TIMES FOR MAXIMA -- TD = 32.0400 TV = 15.8300 TA = 14.8200
PER = 4.80 TIMES FOR MAXIMA -- TD = 32.0600 TV = 15.8300 TA = 32.0200
PER = 4.90 TIMES FOR MAXIMA -- TD = 32.0700 TV = 15.8300 TA = 32.0200
PER = 5.00 TIMES FOR MAXIMA -- TD = 32.1300 TV = 15.8300 TA = 32.0200
PER = 5.10 TIMES FOR MAXIMA -- TD = 28.0300 TV = 15.8300 TA = 28.0000
PER = 5.20 TIMES FOR MAXIMA -- TD = 28.0300 TV = 15.8300 TA = 28.0000
PER = 5.40 TIMES FOR MAXIMA -- TD = 9.7900 TV = 11.2400 TA = 28.0000
PER = 5.60 TIMES FOR MAXIMA -- TD = 9.7900 TV = 11.2400 TA = 9.7500
PER = 5.80 TIMES FOR MAXIMA -- TD = 9.8200 TV = 15.8300 TA = 9.7500
PER = 6.00 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 6.20 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 6.40 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 6.60 TIMES FOR MAXIMA -- TD = 14.8600 TV = 15.8300 TA = 14.8100
PER = 6.80 TIMES FOR MAXIMA -- TD = 14.8600 TV = 15.8300 TA = 14.8100
PER = 7.00 TIMES FOR MAXIMA -- TD = 14.9800 TV = 12.5000 TA = 14.8100
PER = 7.30 TIMES FOR MAXIMA -- TD = 15.3900 TV = 17.3200 TA = 14.8100
PER = 7.60 TIMES FOR MAXIMA -- TD = 15.4000 TV = 17.3200 TA = 15.3100
PER = 8.00 TIMES FOR MAXIMA -- TD = 15.4900 TV = 17.3200 TA = 15.3700
PER = 8.50 TIMES FOR MAXIMA -- TD = 15.5300 TV = 14.6000 TA = 15.4700
PER = 9.00 TIMES FOR MAXIMA -- TD = 16.8100 TV = 14.6000 TA = 16.6200
PER = 9.50 TIMES FOR MAXIMA -- TD = 17.0600 TV = 14.6000 TA = 16.7400
PER =10.00 TIMES FOR MAXIMA -- TD = 17.1500 TV = 14.6000 TA = 17.0400

SPECTRAL VALUES--
(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00005	0.00137	0.02954	0.57869	0.57636	100.00
2	0.02	0.00019	0.03246	0.05874	0.57851	0.57313	50.00
3	0.03	0.00084	0.16225	0.17610	1.10556	1.14542	33.33
4	0.04	0.00190	0.26915	0.29880	1.48423	1.45761	25.00
5	0.05	0.00342	0.38292	0.43034	1.68897	1.67944	20.00
6	0.06	0.00440	0.46805	0.46042	1.55729	1.49736	16.67
7	0.07	0.00583	0.52196	0.52342	1.45432	1.45906	14.29
8	0.08	0.00756	0.58863	0.59363	1.49438	1.44794	12.50
9	0.09	0.00981	0.68527	0.68468	1.49214	1.48446	11.11
10	0.10	0.01153	0.67832	0.72473	1.39533	1.41416	10.00
11	0.11	0.01476	0.77760	0.84282	1.51649	1.49509	9.09
12	0.12	0.01629	0.83139	0.85295	1.40540	1.38697	8.33
13	0.13	0.01684	0.79261	0.81412	1.22022	1.22200	7.69
14	0.14	0.01815	0.79492	0.81472	1.12382	1.13554	7.14
15	0.15	0.01917	0.78885	0.80311	1.04837	1.04474	6.67
16	0.16	0.02264	0.87808	0.88913	1.08719	1.08435	6.25
17	0.17	0.02615	0.95564	0.96640	1.11464	1.10926	5.88
18	0.18	0.03507	1.12475	1.22425	1.32698	1.32716	5.56
19	0.19	0.03470	1.15550	1.14761	1.17936	1.17860	5.26
20	0.20	0.03549	1.24968	1.11510	1.08628	1.08794	5.00
21	0.21	0.03665	1.13296	1.09655	1.02129	1.01890	4.76
22	0.22	0.04047	1.20959	1.15594	1.03249	1.02527	4.55
23	0.23	0.04161	1.16229	1.13658	0.97652	0.96427	4.35

24	0.24	0.04975	1.29290	1.30247	1.06242	1.05896	4.17
25	0.25	0.06040	1.56475	1.51813	1.19290	1.18493	4.00
26	0.26	0.06309	1.61978	1.52473	1.14568	1.14431	3.85
27	0.27	0.05277	1.29989	1.22801	0.89238	0.88749	3.70
28	0.28	0.05245	1.28803	1.17691	0.82117	0.82018	3.57
29	0.29	0.05858	1.42125	1.26924	0.85688	0.85402	3.45
30	0.30	0.06833	1.51338	1.43100	0.93704	0.93077	3.33
31	0.31	0.07664	1.71775	1.55334	0.97975	0.97775	3.23
32	0.32	0.07644	1.62581	1.50080	0.92328	0.91516	3.13
33	0.33	0.07036	1.46608	1.33963	0.79885	0.79213	3.03
34	0.34	0.06555	1.29567	1.21135	0.69574	0.69521	2.94
35	0.35	0.06914	1.36883	1.24114	0.69509	0.69195	2.86
36	0.36	0.07611	1.43229	1.32829	0.72534	0.71997	2.78
37	0.37	0.08321	1.46923	1.41300	0.74916	0.74518	2.70
38	0.38	0.09015	1.54982	1.49059	0.76953	0.76542	2.63
39	0.39	0.09619	1.64563	1.54976	0.77692	0.77539	2.56
40	0.40	0.10071	1.66299	1.58202	0.77619	0.77175	2.50
41	0.41	0.10438	1.61478	1.59959	0.76625	0.76129	2.44
42	0.42	0.10761	1.63710	1.60983	0.75221	0.74792	2.38
43	0.43	0.11229	1.61004	1.64084	0.74872	0.74460	2.33
44	0.44	0.12294	1.71041	1.75551	0.78269	0.77853	2.27
45	0.45	0.12786	1.77832	1.78529	0.77785	0.77414	2.22
46	0.46	0.12471	1.71825	1.70342	0.72783	0.72258	2.17
47	0.47	0.12287	1.65704	1.64265	0.68560	0.68198	2.13
48	0.48	0.12350	1.63243	1.61656	0.66244	0.65717	2.08
49	0.49	0.12258	1.70238	1.57185	0.63005	0.62595	2.04
50	0.50	0.12409	1.78871	1.55941	0.61130	0.60858	2.00
51	0.51	0.12464	1.86376	1.53559	0.59053	0.58753	1.96
52	0.52	0.11959	1.85372	1.44501	0.54442	0.54224	1.92
53	0.53	0.11048	1.70483	1.30978	0.48598	0.48222	1.89
54	0.54	0.11235	1.47125	1.30726	0.47394	0.47238	1.85
55	0.55	0.11423	1.38020	1.30494	0.46612	0.46297	1.82
56	0.56	0.12991	1.43053	1.45756	0.51070	0.50788	1.79
57	0.57	0.14552	1.58598	1.60414	0.55167	0.54915	1.75
58	0.58	0.16090	1.75597	1.74305	0.58929	0.58642	1.72
59	0.60	0.16552	1.90732	1.73336	0.56612	0.56372	1.67
60	0.62	0.14914	1.71916	1.51142	0.47783	0.47568	1.61
61	0.64	0.13615	1.46806	1.33669	0.40996	0.40754	1.56
62	0.66	0.14161	1.75359	1.34813	0.40145	0.39858	1.52
63	0.68	0.15367	1.85258	1.41993	0.41058	0.40746	1.47
64	0.70	0.16446	1.75202	1.47616	0.41334	0.41149	1.43
65	0.72	0.16040	1.64248	1.39978	0.38212	0.37936	1.39
66	0.74	0.14915	1.61251	1.26642	0.33597	0.33394	1.35
67	0.76	0.16057	1.57224	1.32750	0.34338	0.34084	1.32
68	0.78	0.17913	1.59266	1.44299	0.36327	0.36099	1.28
69	0.80	0.18584	1.69089	1.45956	0.35775	0.35600	1.25
70	0.82	0.19547	1.83473	1.49779	0.35886	0.35642	1.22
71	0.84	0.19510	1.85877	1.45935	0.34022	0.33900	1.19
72	0.86	0.19321	1.71122	1.41159	0.32171	0.32028	1.16
73	0.88	0.20256	1.67547	1.44626	0.32247	0.32069	1.14
74	0.90	0.20867	1.64417	1.45683	0.31757	0.31586	1.11
75	0.92	0.22540	1.68543	1.53941	0.32824	0.32651	1.09
76	0.94	0.25264	1.75116	1.68869	0.35247	0.35055	1.06
77	0.96	0.27876	1.75505	1.82446	0.37302	0.37084	1.04
78	0.98	0.29797	1.72103	1.91040	0.38186	0.38038	1.02
79	1.00	0.31142	1.70665	1.95673	0.38400	0.38182	1.00
80	1.05	0.33056	1.86700	1.97809	0.37049	0.36760	0.95
81	1.10	0.34010	1.98275	1.94264	0.34638	0.34461	0.91
82	1.15	0.38232	2.18670	2.08887	0.35752	0.35444	0.87
83	1.20	0.43710	2.43040	2.28867	0.37540	0.37216	0.83
84	1.25	0.41217	2.48596	2.07178	0.32532	0.32341	0.80

85	1.30	0.35374	2.07796	1.70971	0.25849	0.25663	0.77
86	1.35	0.31529	1.82241	1.46742	0.21360	0.21210	0.74
87	1.40	0.30429	1.71927	1.36566	0.19212	0.19034	0.71
88	1.45	0.30631	1.66137	1.32732	0.18009	0.17862	0.69
89	1.50	0.31859	1.66658	1.33450	0.17445	0.17360	0.67
90	1.55	0.33532	1.63453	1.35927	0.17193	0.17112	0.65
91	1.60	0.33890	1.61066	1.33085	0.16392	0.16231	0.63
92	1.65	0.31778	1.50173	1.21009	0.14561	0.14311	0.61
93	1.70	0.28140	1.35995	1.04004	0.12177	0.11938	0.59
94	1.75	0.30802	1.33546	1.10590	0.12463	0.12331	0.57
95	1.80	0.35605	1.46700	1.24285	0.13603	0.13473	0.56
96	1.85	0.38459	1.54226	1.30617	0.13881	0.13777	0.54
97	1.90	0.41120	1.54079	1.35982	0.14101	0.13965	0.53
98	1.95	0.42776	1.50608	1.37831	0.13955	0.13792	0.51
99	2.00	0.45877	1.58228	1.44128	0.14253	0.14062	0.50
100	2.05	0.49417	1.68678	1.51462	0.14614	0.14417	0.49
101	2.10	0.54015	1.79415	1.61614	0.15074	0.15017	0.48
102	2.15	0.58631	1.97185	1.71343	0.15668	0.15551	0.47
103	2.20	0.59876	2.08291	1.71005	0.15348	0.15167	0.45
104	2.25	0.59010	2.04481	1.64786	0.14423	0.14291	0.44
105	2.30	0.54691	1.88205	1.49406	0.12852	0.12675	0.43
106	2.35	0.50389	1.76316	1.34725	0.11256	0.11187	0.43
107	2.40	0.45720	1.68962	1.19696	0.09891	0.09732	0.42
108	2.50	0.39717	1.45197	0.99821	0.07839	0.07791	0.40
109	2.60	0.42222	1.44539	1.02035	0.07780	0.07658	0.38
110	2.70	0.41356	1.27860	0.96239	0.07028	0.06955	0.37
111	2.80	0.37799	1.27516	0.84821	0.05970	0.05911	0.36
112	2.90	0.42097	1.45197	0.91208	0.06234	0.06137	0.34
113	3.00	0.44342	1.50548	0.92870	0.06150	0.06041	0.33
114	3.10	0.45766	1.42670	0.92760	0.05970	0.05839	0.32
115	3.20	0.42651	1.27704	0.83745	0.05273	0.05107	0.31
116	3.30	0.37342	1.12135	0.71100	0.04371	0.04204	0.30
117	3.40	0.32021	1.01441	0.59175	0.03557	0.03396	0.29
118	3.50	0.33969	0.94441	0.60981	0.03443	0.03400	0.29
119	3.60	0.38484	0.92642	0.67168	0.03683	0.03641	0.28
120	3.70	0.39485	0.92955	0.67051	0.03594	0.03536	0.27
121	3.80	0.40968	0.93190	0.67740	0.03518	0.03478	0.26
122	3.90	0.38228	0.91874	0.61588	0.03143	0.03081	0.26
123	4.00	0.34203	0.92697	0.53726	0.02642	0.02621	0.25
124	4.10	0.30825	0.96203	0.47239	0.02341	0.02248	0.24
125	4.20	0.32556	0.98725	0.48703	0.02406	0.02263	0.24
126	4.30	0.34146	0.99738	0.49894	0.02413	0.02264	0.23
127	4.40	0.34807	0.99104	0.49705	0.02358	0.02204	0.23
128	4.50	0.34534	0.97000	0.48218	0.02249	0.02091	0.22
129	4.60	0.33556	0.93804	0.45834	0.02099	0.01944	0.22
130	4.70	0.33170	0.89990	0.44343	0.01925	0.01841	0.21
131	4.80	0.34522	0.86035	0.45189	0.01886	0.01837	0.21
132	4.90	0.33190	0.82347	0.42559	0.01758	0.01695	0.20
133	5.00	0.30064	0.79241	0.37780	0.01543	0.01474	0.20
134	5.10	0.28033	0.76907	0.34537	0.01383	0.01321	0.20
135	5.20	0.27769	0.75443	0.33554	0.01330	0.01259	0.19
136	5.40	0.27310	0.77836	0.31776	0.01207	0.01148	0.19
137	5.60	0.29401	0.79628	0.32988	0.01202	0.01149	0.18
138	5.80	0.30778	0.80794	0.33342	0.01178	0.01122	0.17
139	6.00	0.32463	0.84580	0.33995	0.01222	0.01106	0.17
140	6.20	0.37930	0.87676	0.38439	0.01325	0.01210	0.16
141	6.40	0.43335	0.89546	0.42544	0.01413	0.01297	0.16
142	6.60	0.48253	0.89989	0.45937	0.01477	0.01358	0.15
143	6.80	0.52393	0.89041	0.48411	0.01512	0.01389	0.15
144	7.00	0.55920	0.87529	0.50194	0.01518	0.01399	0.14
145	7.30	0.62005	0.88042	0.53368	0.01482	0.01427	0.14

146	7.60	0.66716	0.90825	0.55156	0.01449	0.01416	0.13
147	8.00	0.70847	0.90727	0.55643	0.01389	0.01357	0.13
148	8.50	0.72253	0.93252	0.53409	0.01272	0.01226	0.12
149	9.00	0.72748	0.96895	0.50788	0.01163	0.01101	0.11
150	9.50	0.81580	0.98875	0.53956	0.01146	0.01108	0.11
151	10.00	0.88090	0.99633	0.55349	0.01116	0.01080	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.

AREA OF ACC. RESPONSE SPECTRUM = 0.859

AREA OF VEL. RESPONSE SPECTRUM = 4.045

MAX. ACCELERATION RESPONSE VALUE = 1.516

MAX. VELOCITY RESPONSE VALUE = 2.486

*** End of Output File No. 1 ***

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Induced Cyclic Shear Stresses and Strains, and Time Histories PAGE 142 OF 187

of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M

MADE BY BEG DATE 1/7/08 CHECKED BY [signature] DATE 1/23/08

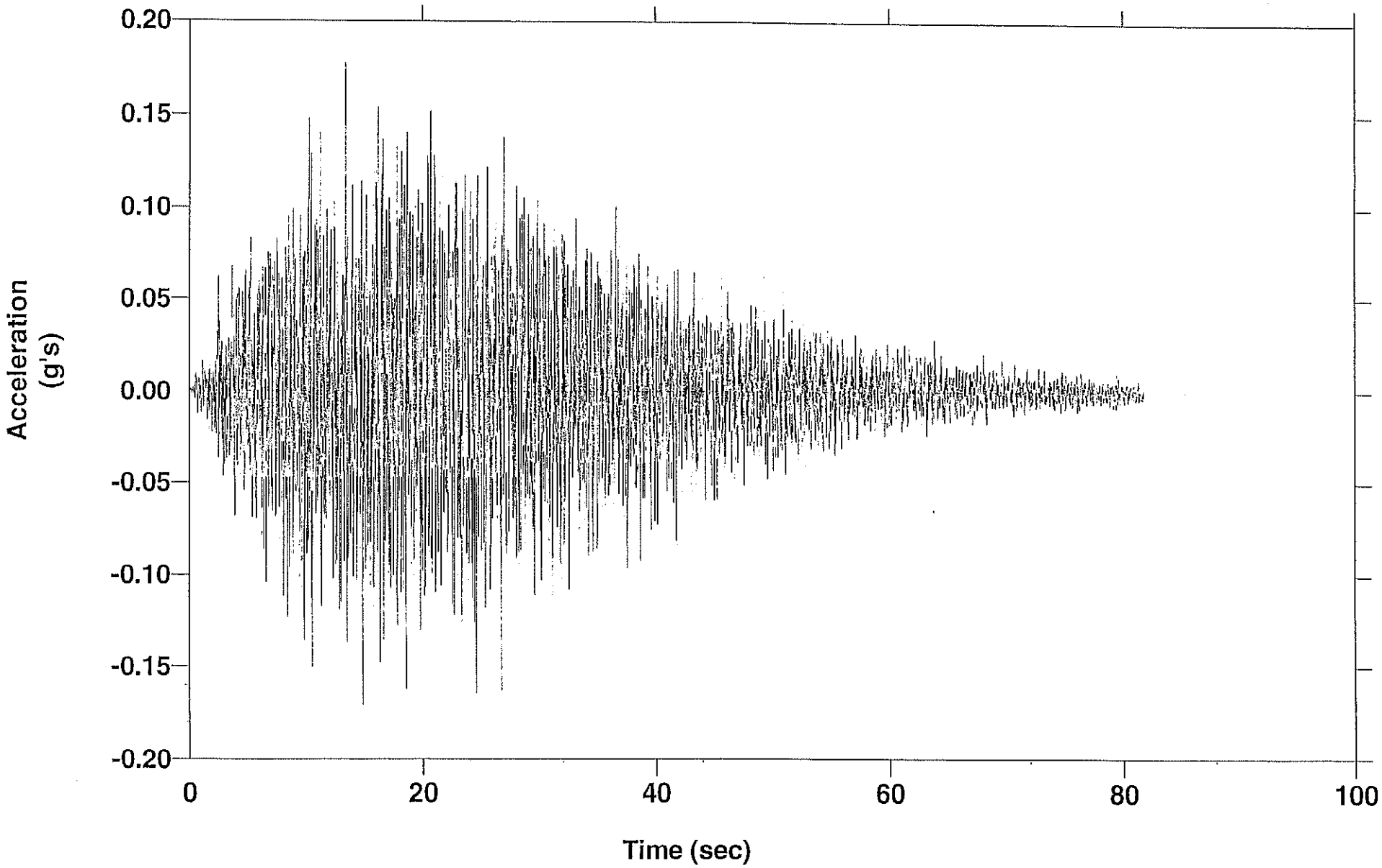
SUMMARY OF EARTHQUAKE INDUCED CYCLIC SHEAR STRESS AND STRAIN SHAKE2000 ANALYSES OUTPUT FILES FOR M8.0 NEW MADRID, MO MDE AT 83 KM SHAKE2000 COLUMN PCSC300M

PCSC300M Crest Column
Williamson - Pond Creek South Cell - Surf. El. 502, GWT 14ft., Fines El. 496
M8.0 New Madrid Synthetic @83km, PGA=0.54g - Atkinson & Boore (1995)

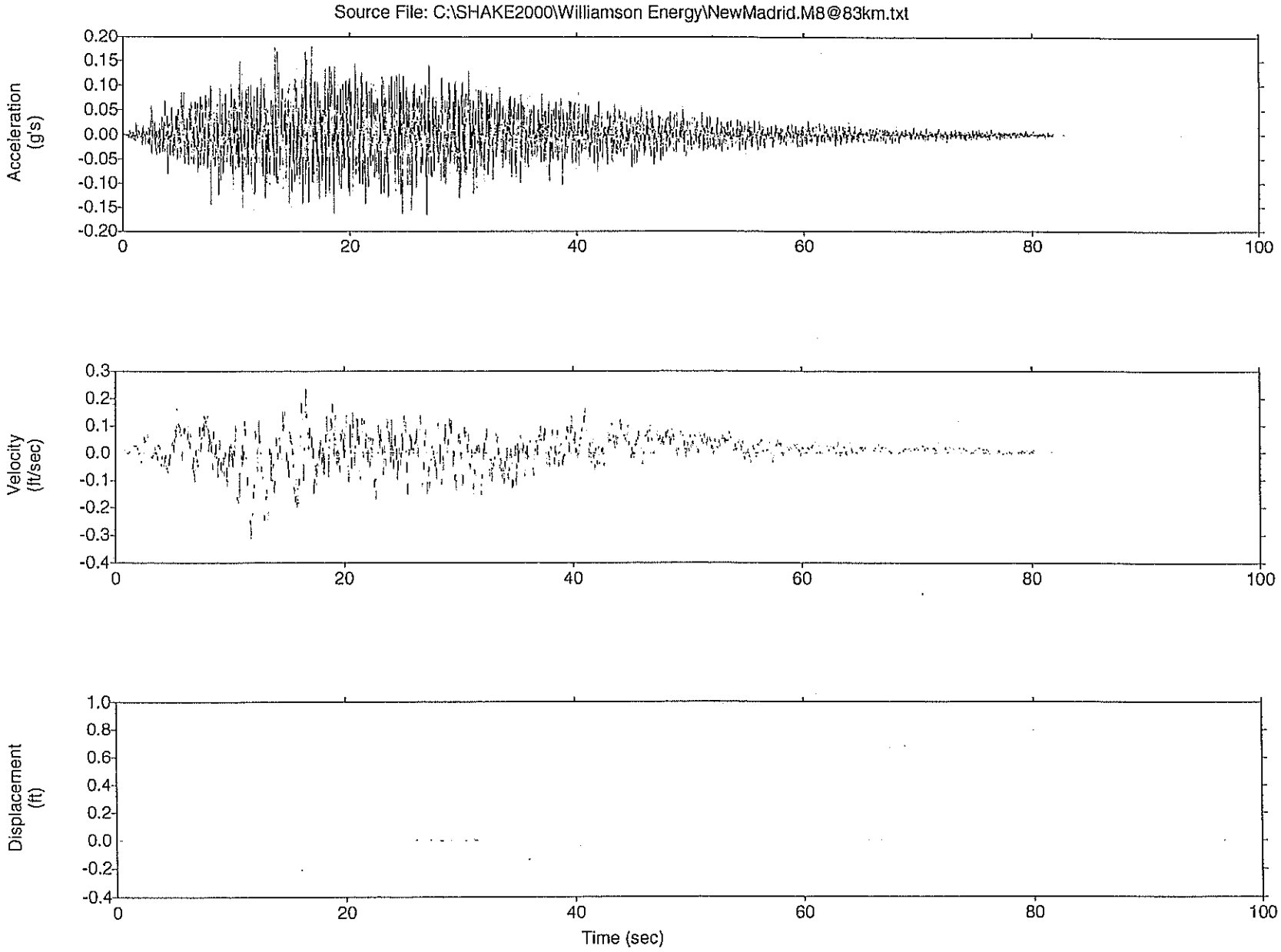
Layer	Depth to Middle of Layer (ft)	Total Unit Weight (kcf)	Damping Used (%)	Shear Modulus (ksf)	Maximum Shear Strain (%)	Maximum Shear Stress (psf)	Shear Wave Velocity (fps)	Depth to Top of Layer (ft)	Peak Acceleration (g)	G/Gmax Curve	Damping Curve
1	2	.13	2.6	3011.9	.00656	197.47	863.7271	0	.75475	Coarse	Coarse
2	5.5	.13	4.4	2764.1	.019	525.07	827.4336	4	.70138	Coarse	Coarse
3	8.5	.13	5.3	2634.9	.02891	761.69	807.8641	7	.65623	Coarse	Coarse
4	11.5	.13	5.1	3768.3	.02654	1000	966.1154	10	.63991	Coarse	Coarse
5	14.5	.14	6.5	2764.2	.04445	1228.7	797.3494	13	.65636	Coarse	Coarse
6	17.5	.14	7.8	2154.6	.06592	1420.3	703.9588	16	.64637	Coarse	Coarse
7	20.5	.14	8.2	2228.9	.07416	1653.05	715.9937	19	.59333	Coarse	Coarse
8	23.5	.14	9.700001	1617.7	.11434	1849.71	609.9762	22	.57039	Coarse	Coarse
9	26.5	.14	9.5	1841.1	.10723	1974.16	650.7327	25	.55506	Coarse	Coarse
10	30	.14	9.6	1848.3	.11091	2050.01	652.0038	28	.59901	Coarse	Coarse
11	33.5	.135	10.7	1056.3	.19765	2087.75	501.9433	32	.6765	Residual	Residual
12	36.5	.135	11.3	998.5	.22343	2230.89	488.0172	35	.64739	Residual	Residual
13	39.5	.135	10.7	1207	.19636	2370.16	536.5555	38	.71677	Residual	Residual
14	42.5	.135	8.7	1853.6	.12973	2404.61	664.9195	41	.59839	Residual	Residual
15	45.5	.135	5.3	4401	.05567	2449.9	1024.558	44	.52211	Residual	Residual
16	48.5	.135	5.4	4313.4	.05803	2503.04	1014.31	47	.51594	Residual	Residual
17	Base							50	.52906		
17	Outcrop							50	.57825		

Notes:
Period for Soil Column: .27 sec
Average Shear Wave Velocity for Soil Column: 740 ft/sec

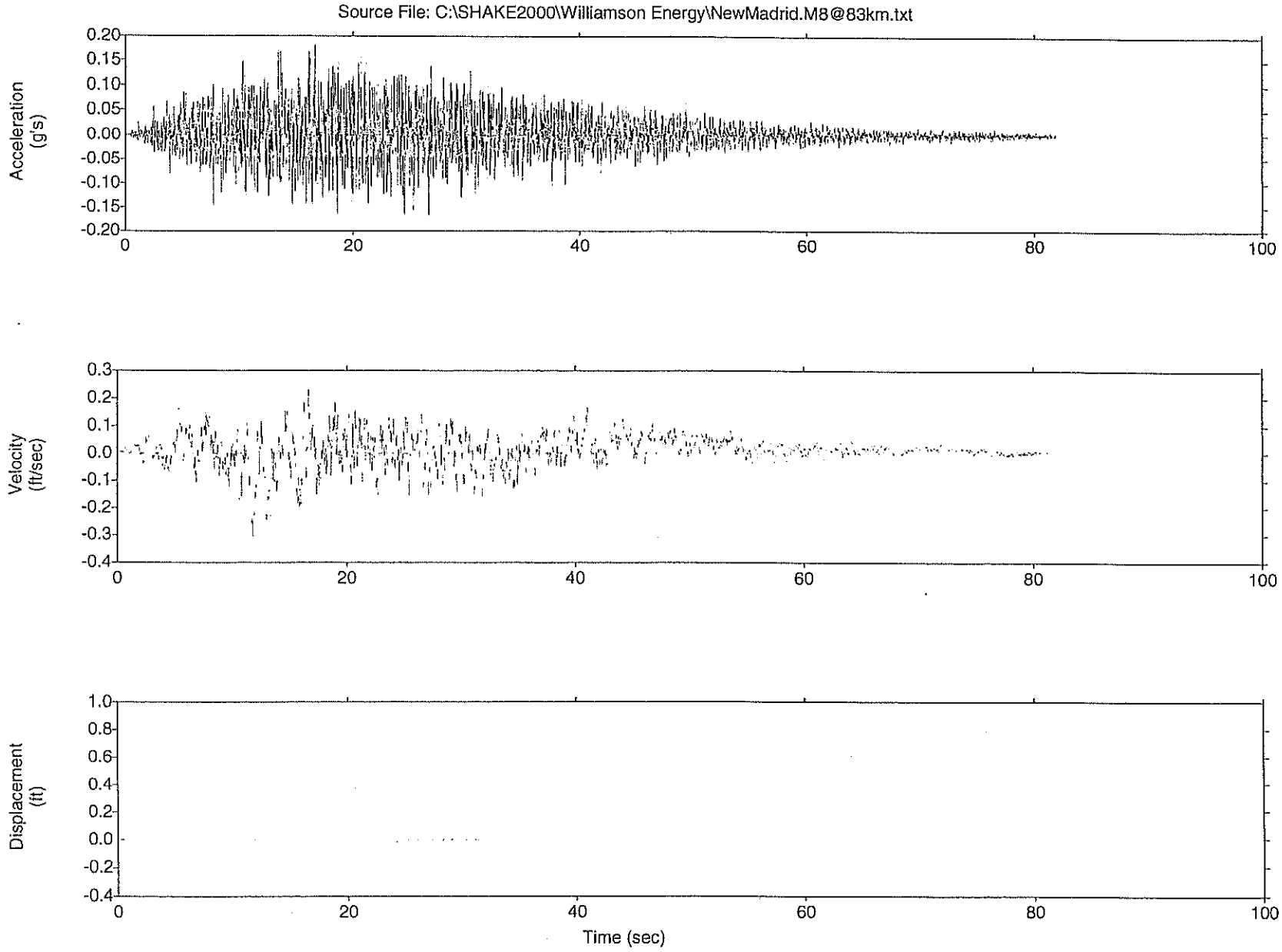
143 / 187
R14284


M8.0 New Madrid Synthetic @83km - Atkinson & Boore (1995)
Acceleration (g's)
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
0
20
40
60
80
100
Time (sec)

R14285

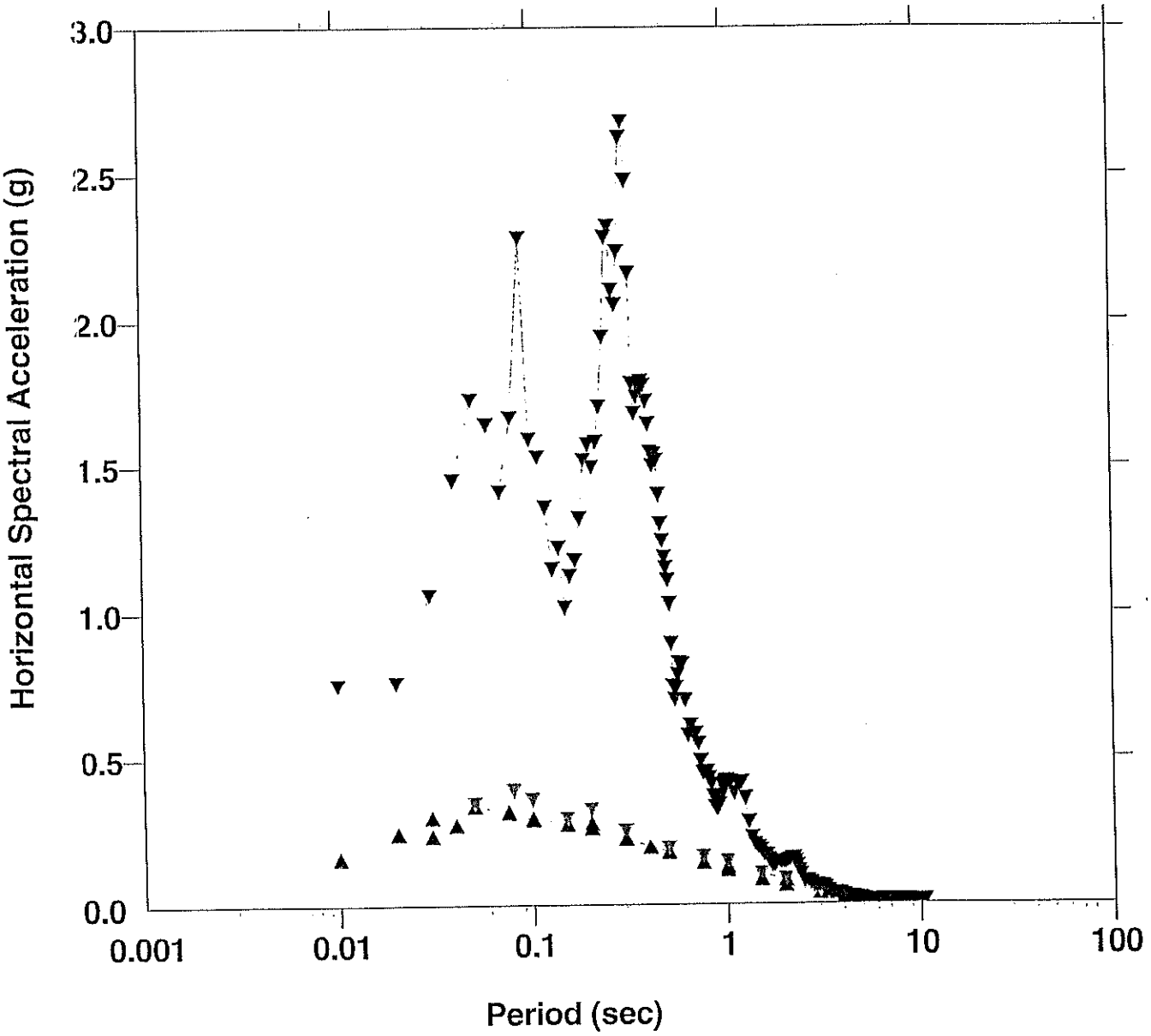

Source File: C:\SHAKE2000\Williamson Energy\NewMadrid.M8@83km.txt
Acceleration (g's)
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
0
20
40
60
80
100
Velocity (ft/sec)
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
Displacement (ft)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
Time (sec)

R14286


Source File: C:\SHAKE2000\Williamson Energy\NewMadrid.M8@83km.txt
Acceleration (g's)
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
0
20
40
60
80
100
Velocity (ft/sec)
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
Displacement (ft)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
Time (sec)

R14287

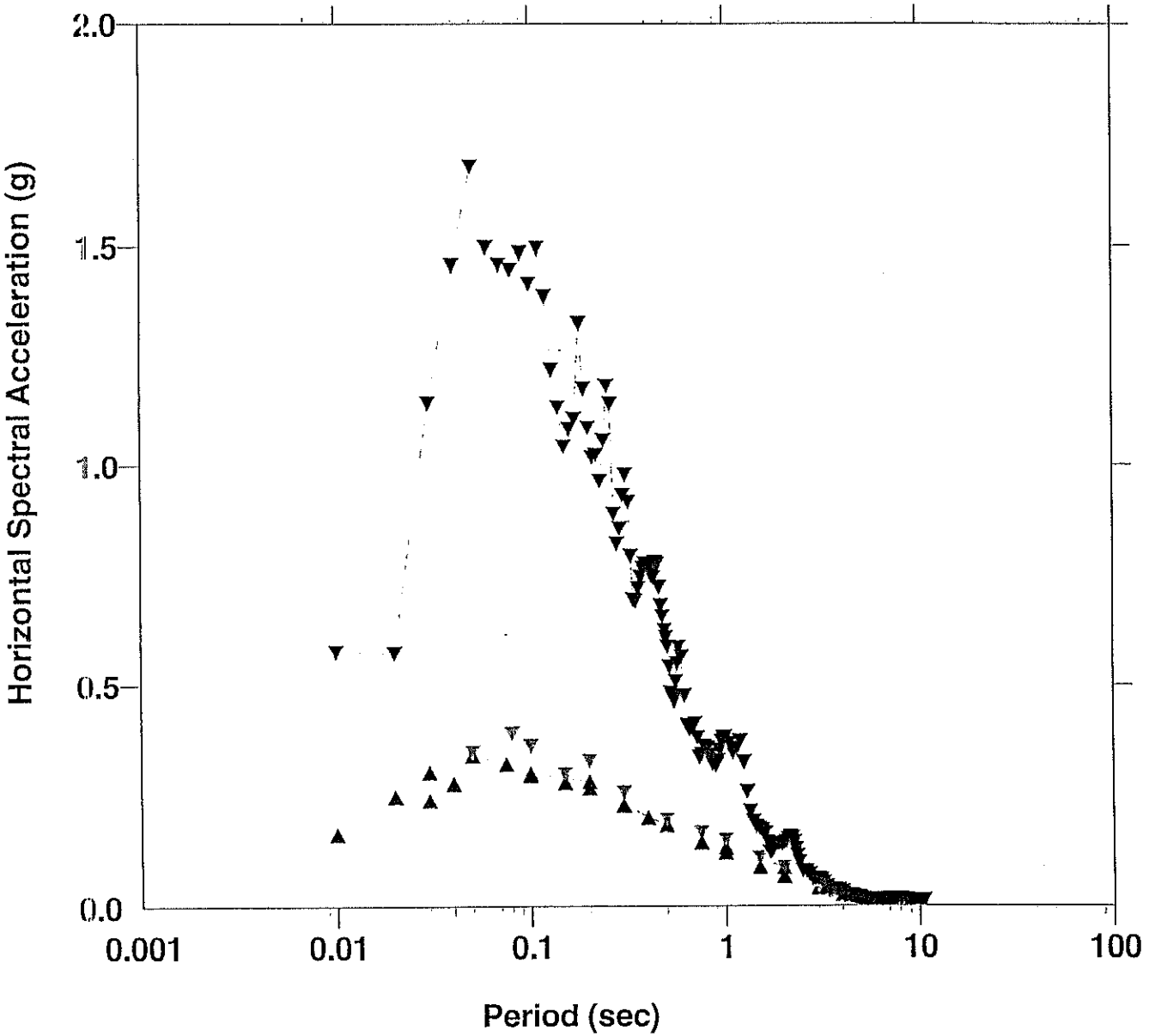
PSCS300M Crest Column - M8.0 New Madrid Synthetic @83km



- ▲ Toro et. al. (1997) for Mid-Continent of NA - Rock - Mw: 8 - R: 83 km
- ▲ Campbell for CEUS (2003) - M: 8 - R: 83 km
- ▼ Tavakoli & Pezeshk (2005) - ENA - Rock - M: 8 - R: 83 km
- ▼ PSA for 5% damping - Layer 1 - SHAKE

R14288

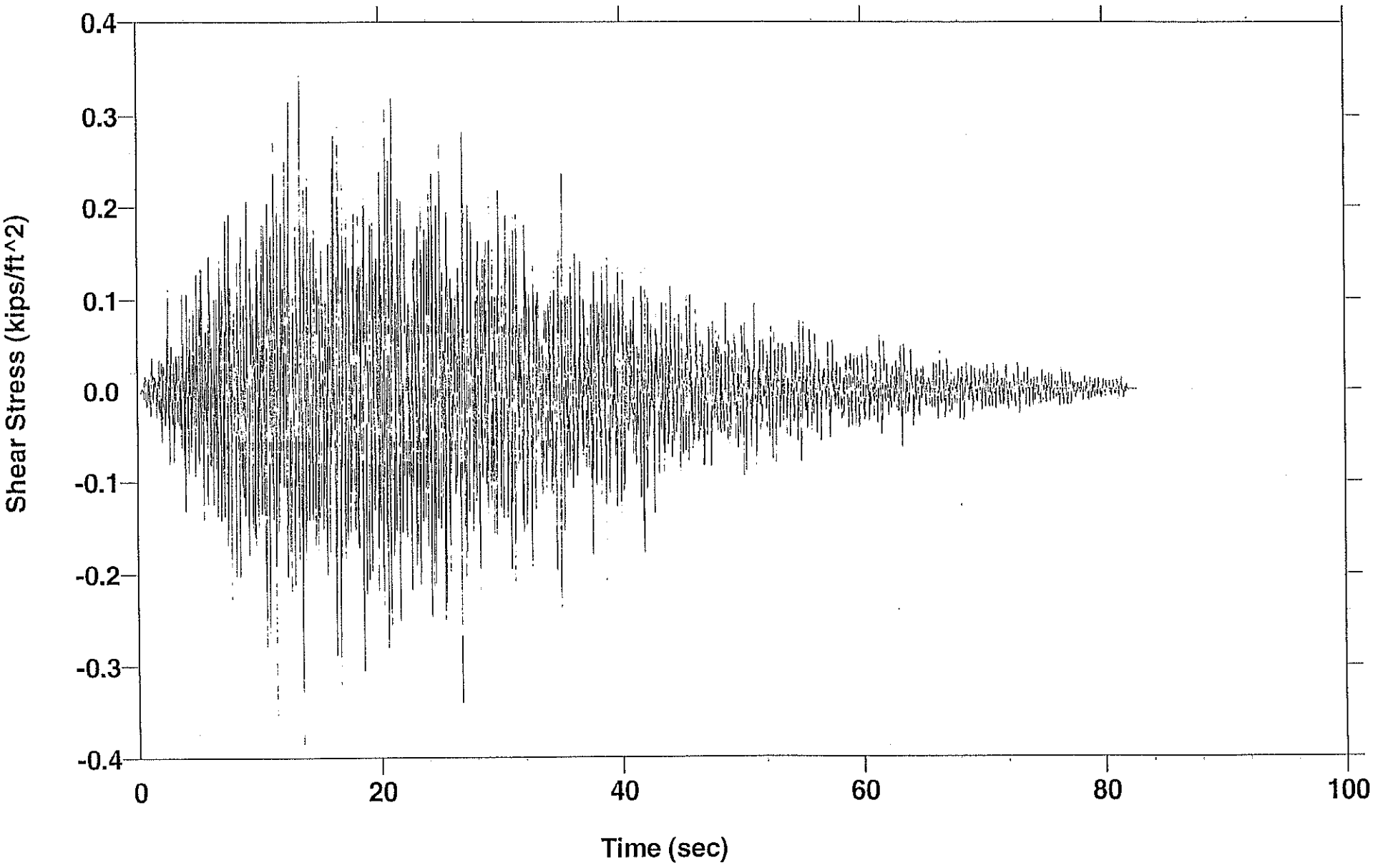
PSCS300M Crest Column - M8.0 New Madrid Synthetic @83km



- ▲ Toro et. al. (1997) for Mid-Continent of NA - Rock - Mw: 8 - R: 83 km
- ▲ Campbell for CEUS (2003) - M: 8 - R: 83 km
- ▼ Tavakoli & Pezeshk (2005) - ENA - Rock - M: 8 - R: 83 km
- ▼ PSA for 5% damping - Layer 17 - SHAKE

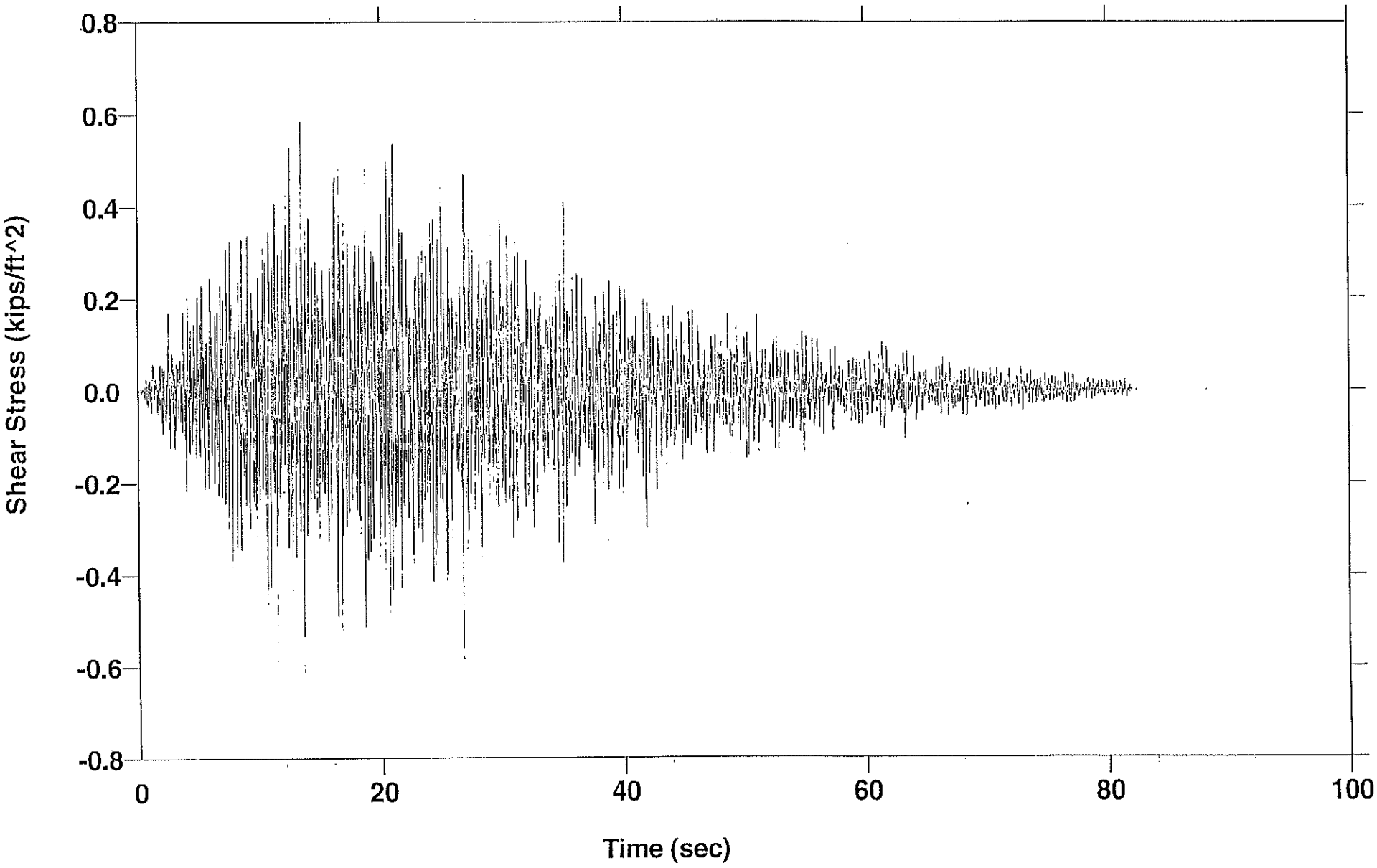
R14289

PCSC300M Layer 2 Stress - M8.0 New Madrid Synthetic



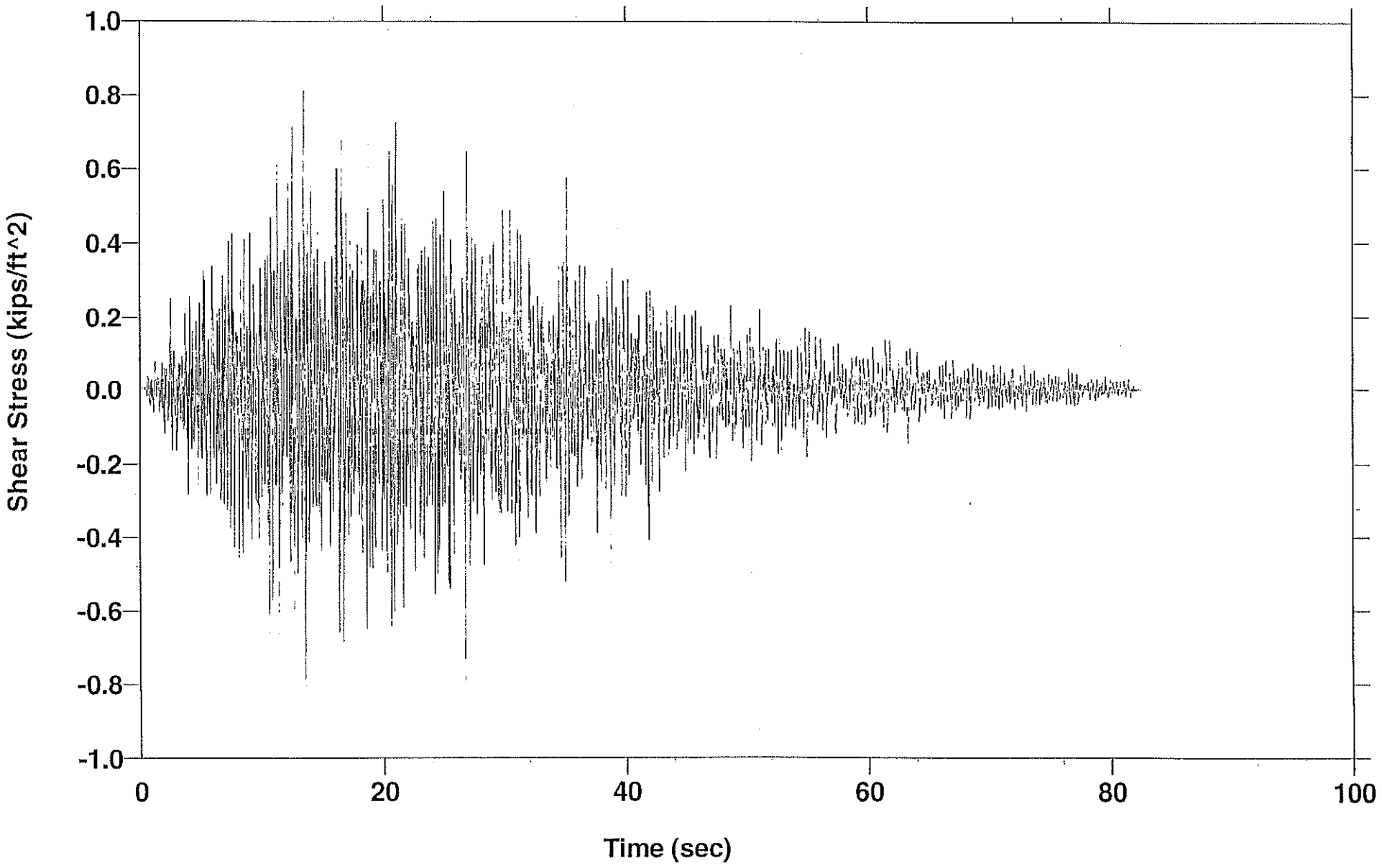
R14290

PCSC300M Layer 3 Stress - M8.0 New Madrid Synthetic



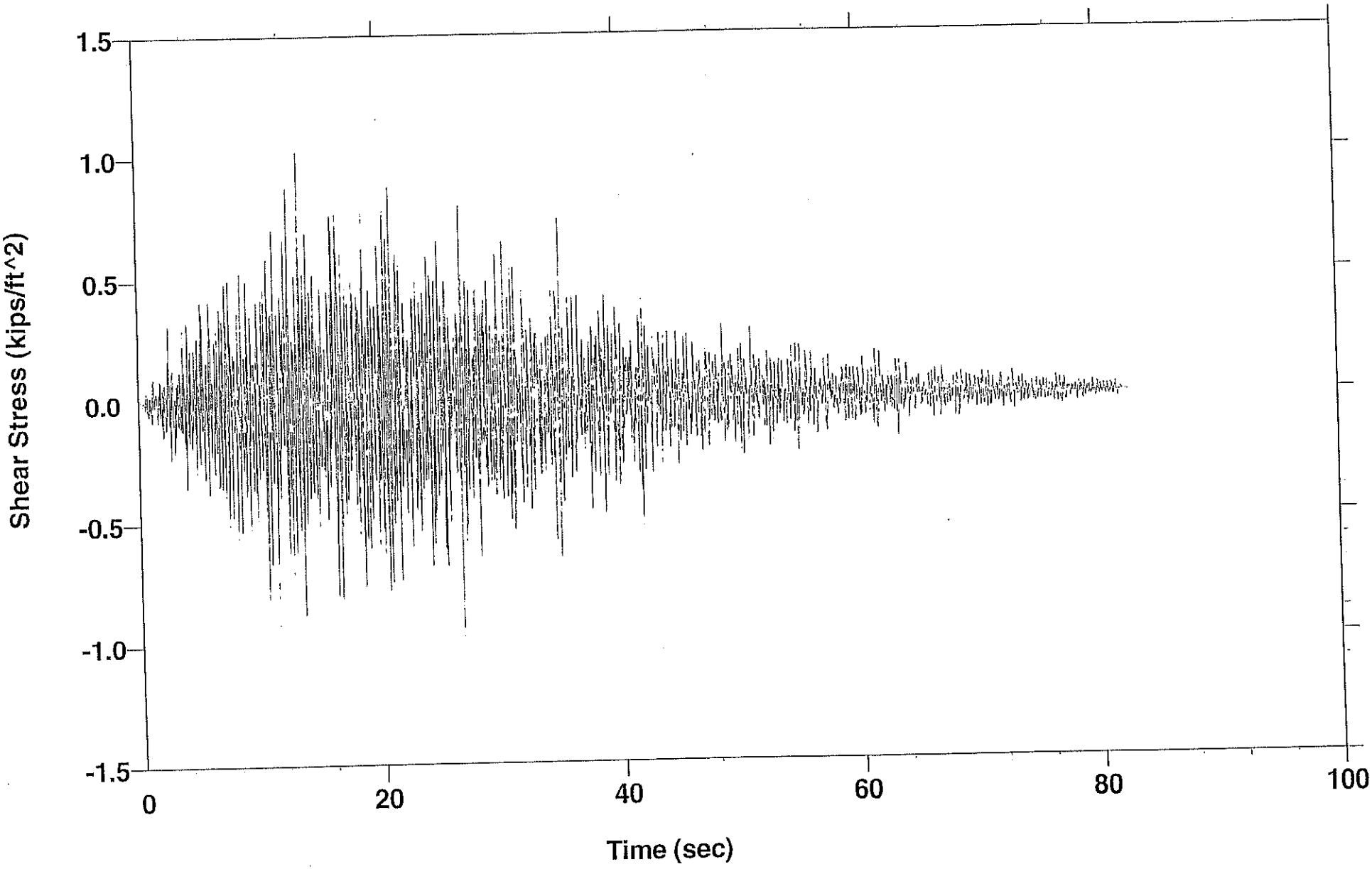
R14291

PCSC300M Layer 4 Stress - M8.0 New Madrid Synthetic



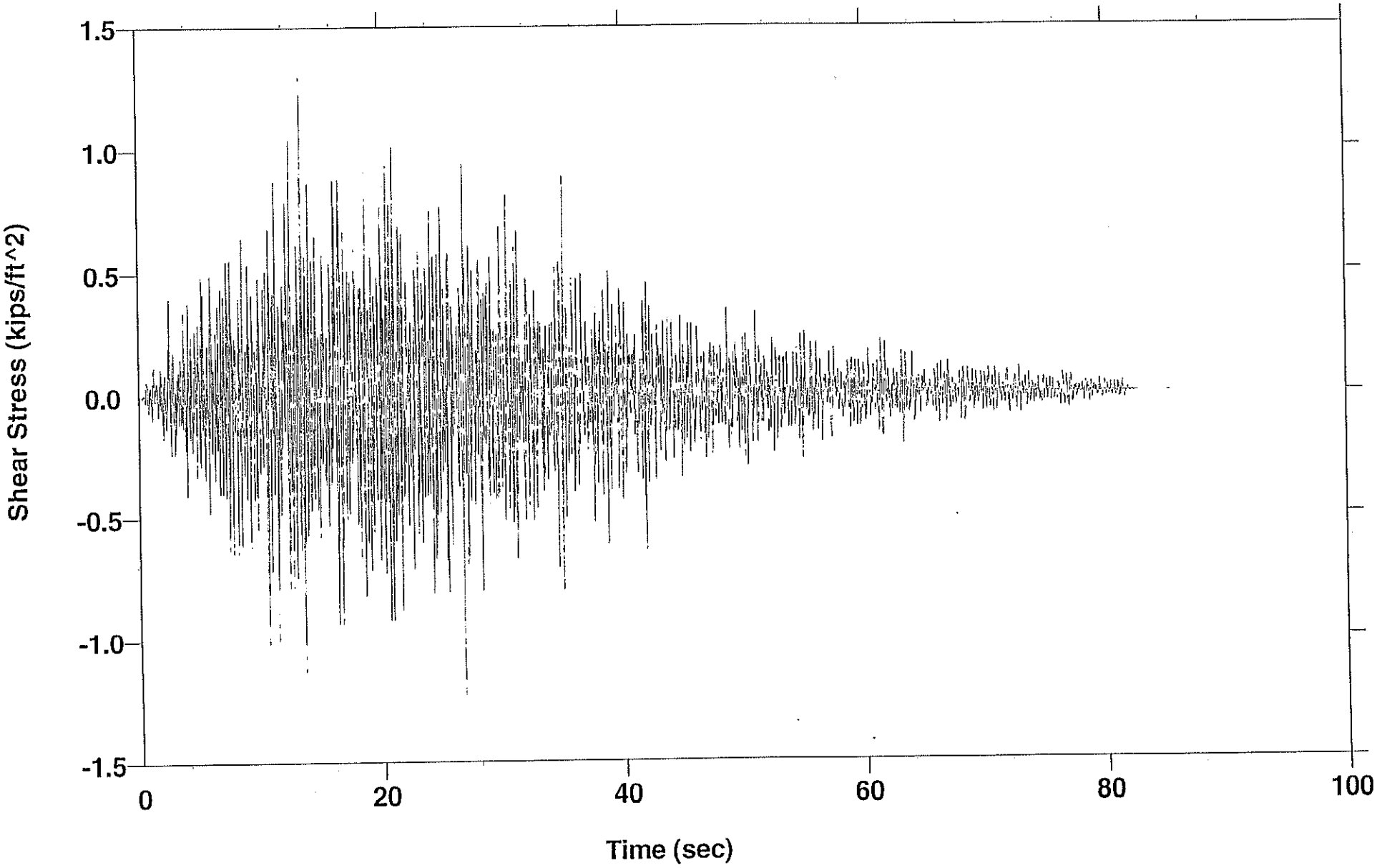
R14292

PCSC300M Layer 5 Stress - M8.0 New Madrid Synthetic

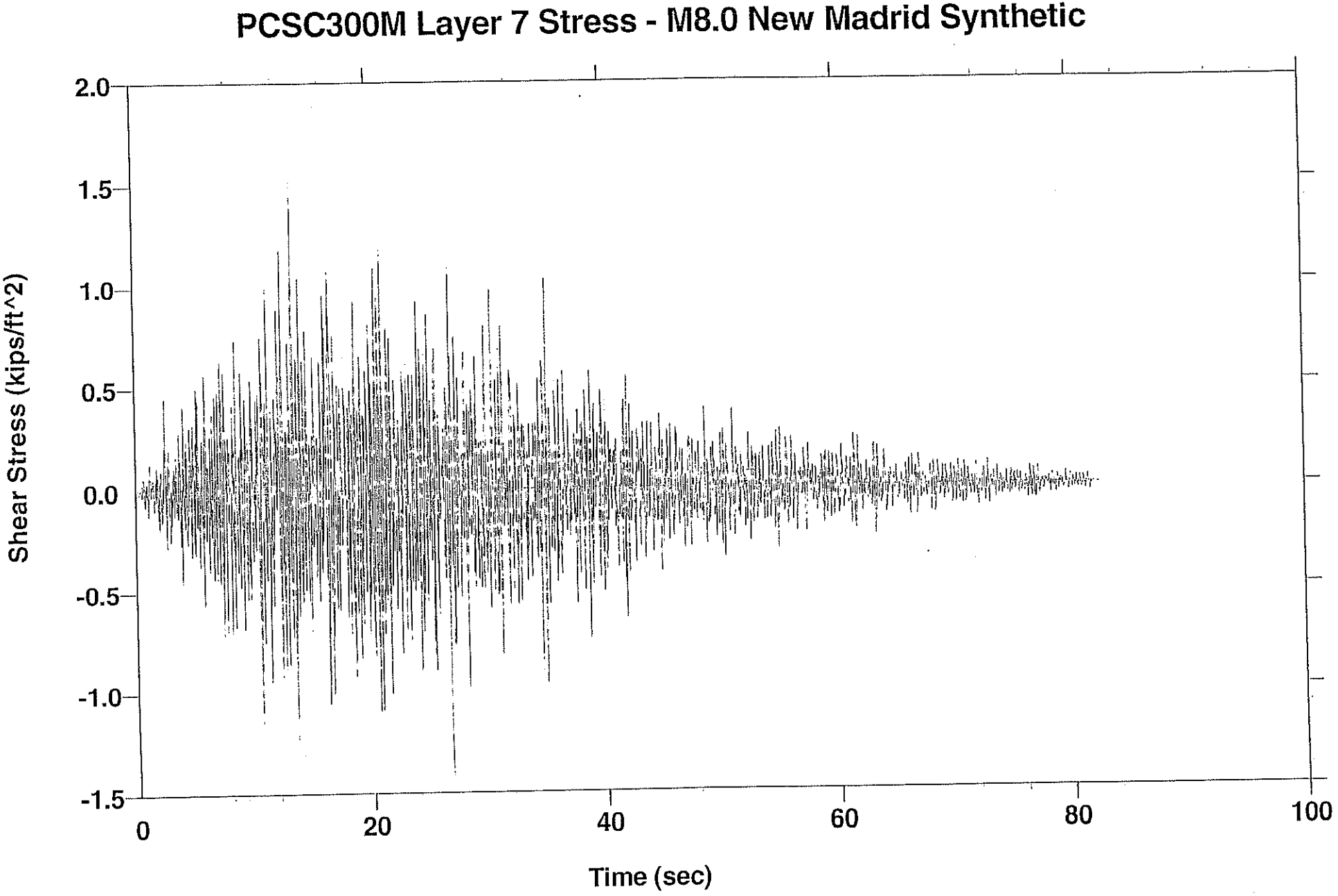


R14293

PCSC330M Layer 6 Stress - M8.0 New Madrid Synthetic

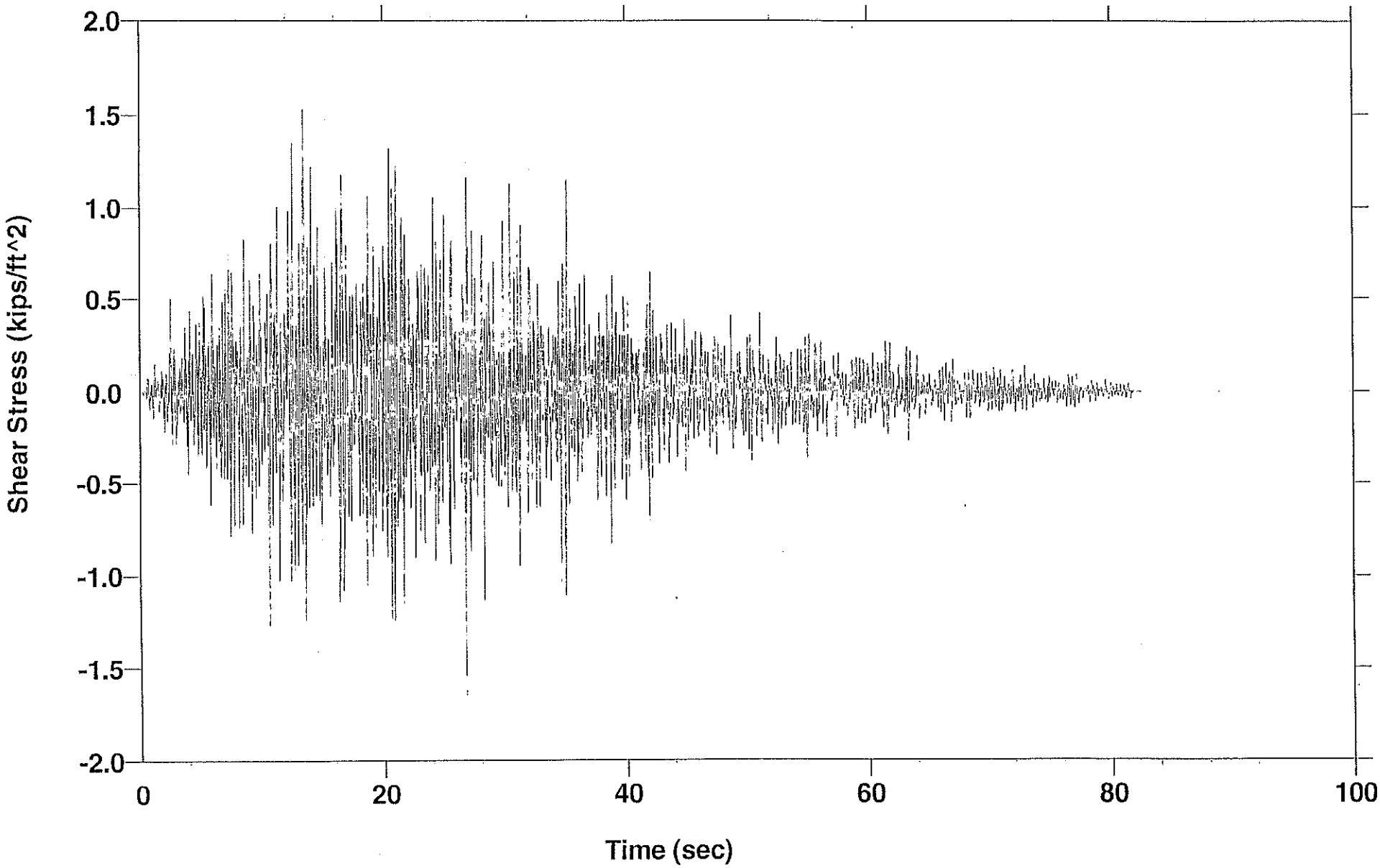


R14294


PCSC300M Layer 7 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0
20
40
60
80
100
Time (sec)

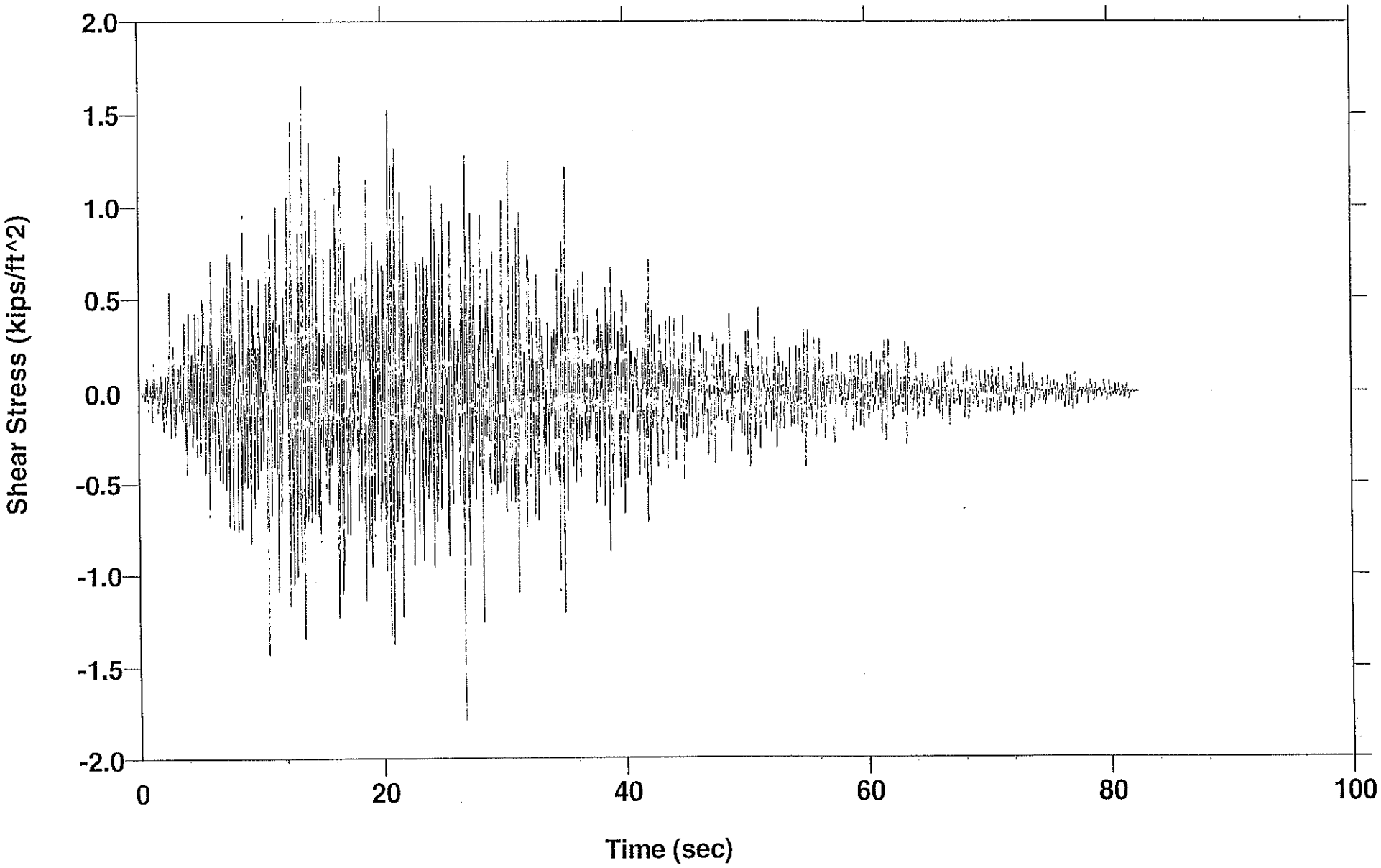
R14295

PCSC300M Layer 8 Stress - M8.0 New Madrid Synthetic



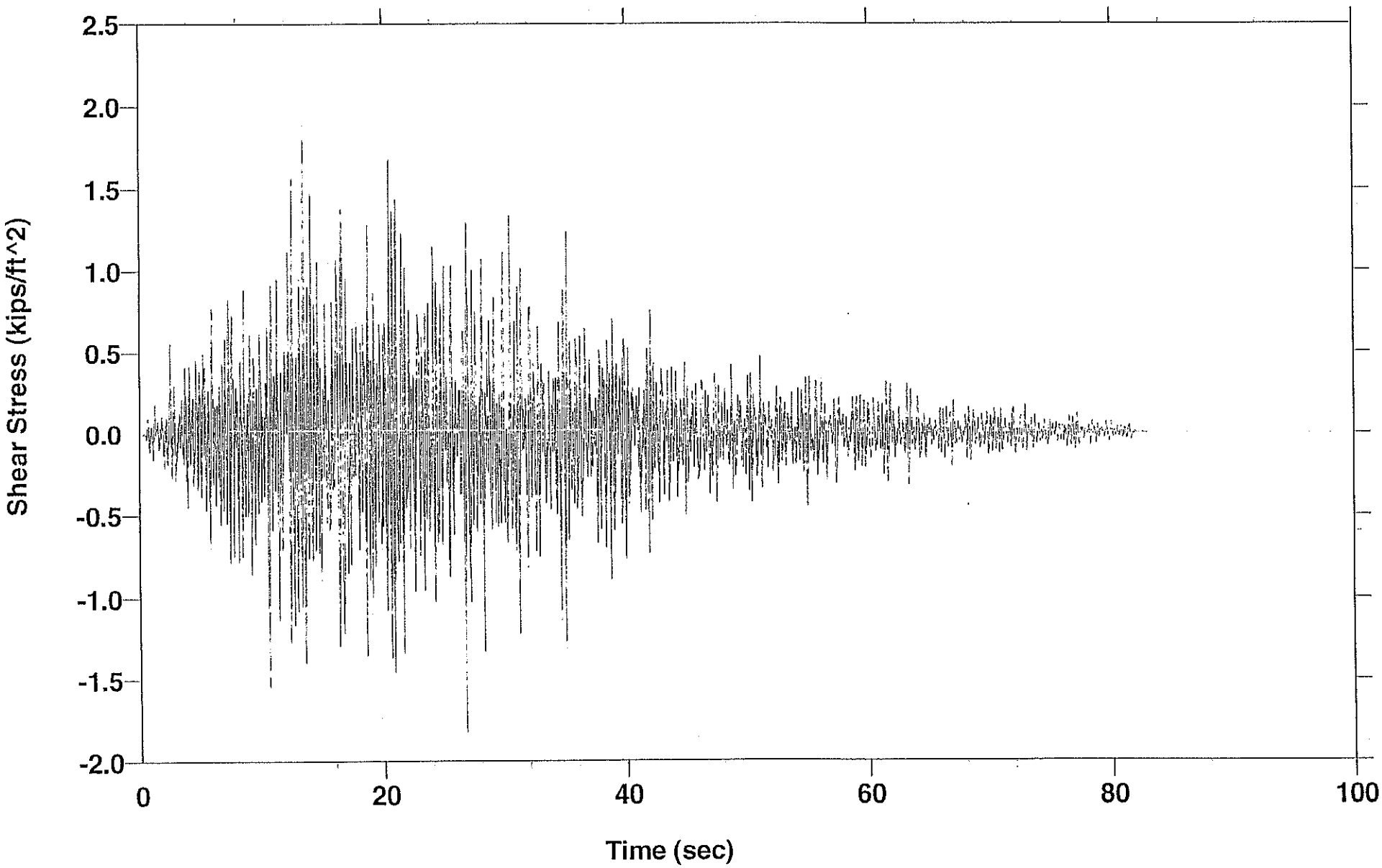
R14296

PCSC300M Layer 9 Stress - M8.0 New Madrid Synthetic

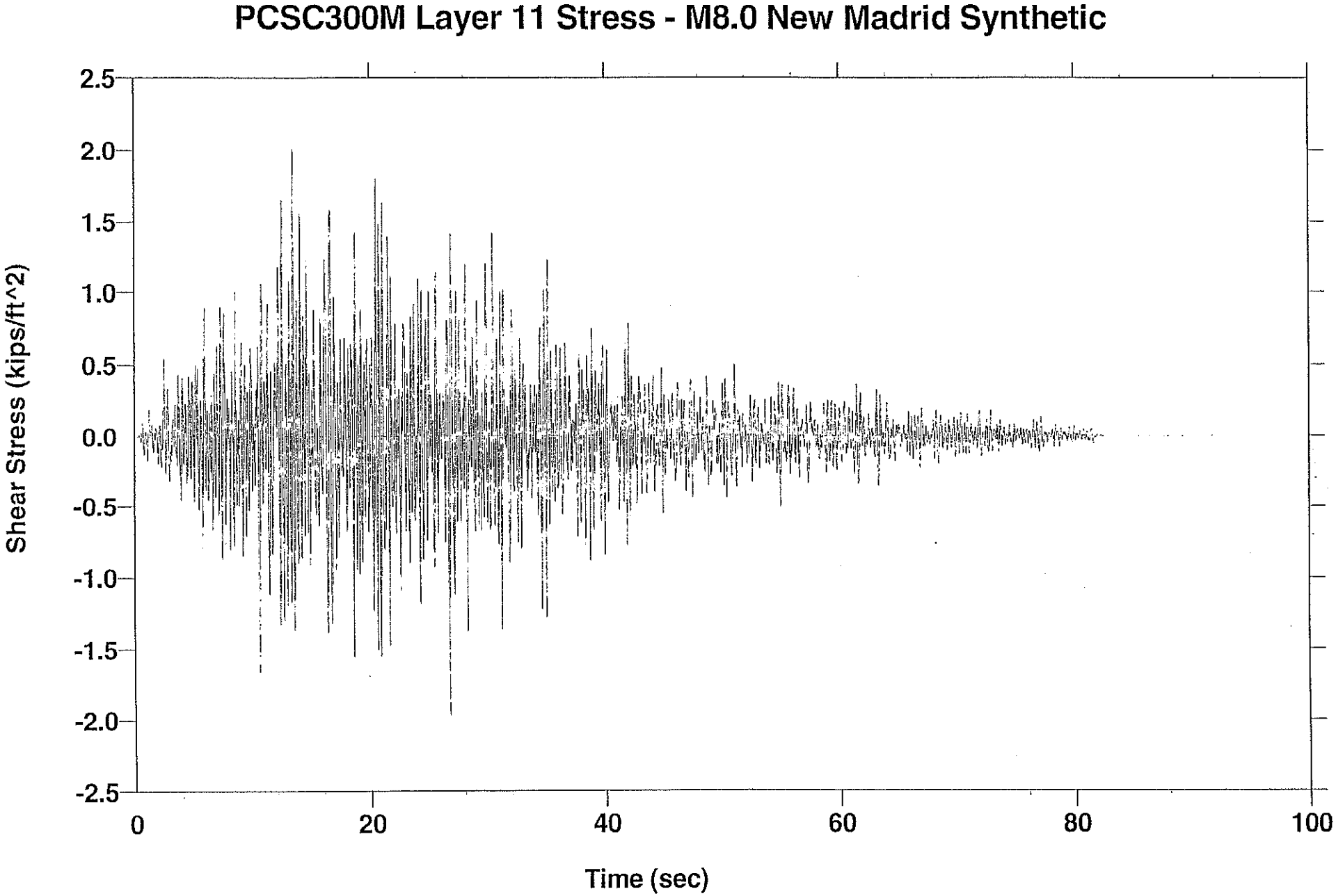


R14297

PCSC300M Layer 10 Stress - M8.0 New Madrid Synthetic

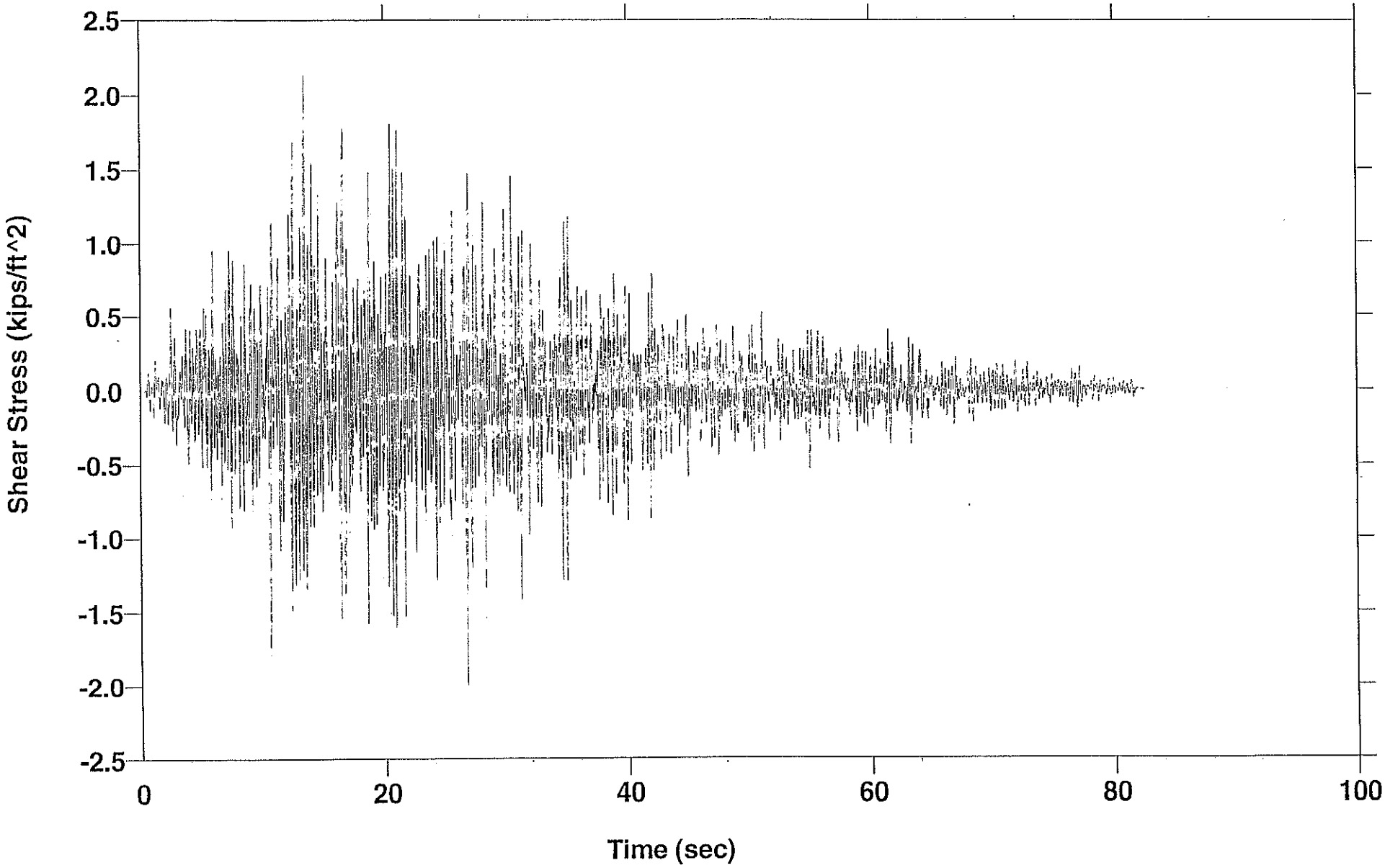


R14298


PCSC300M Layer 11 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
0
20
40
60
80
100
Time (sec)

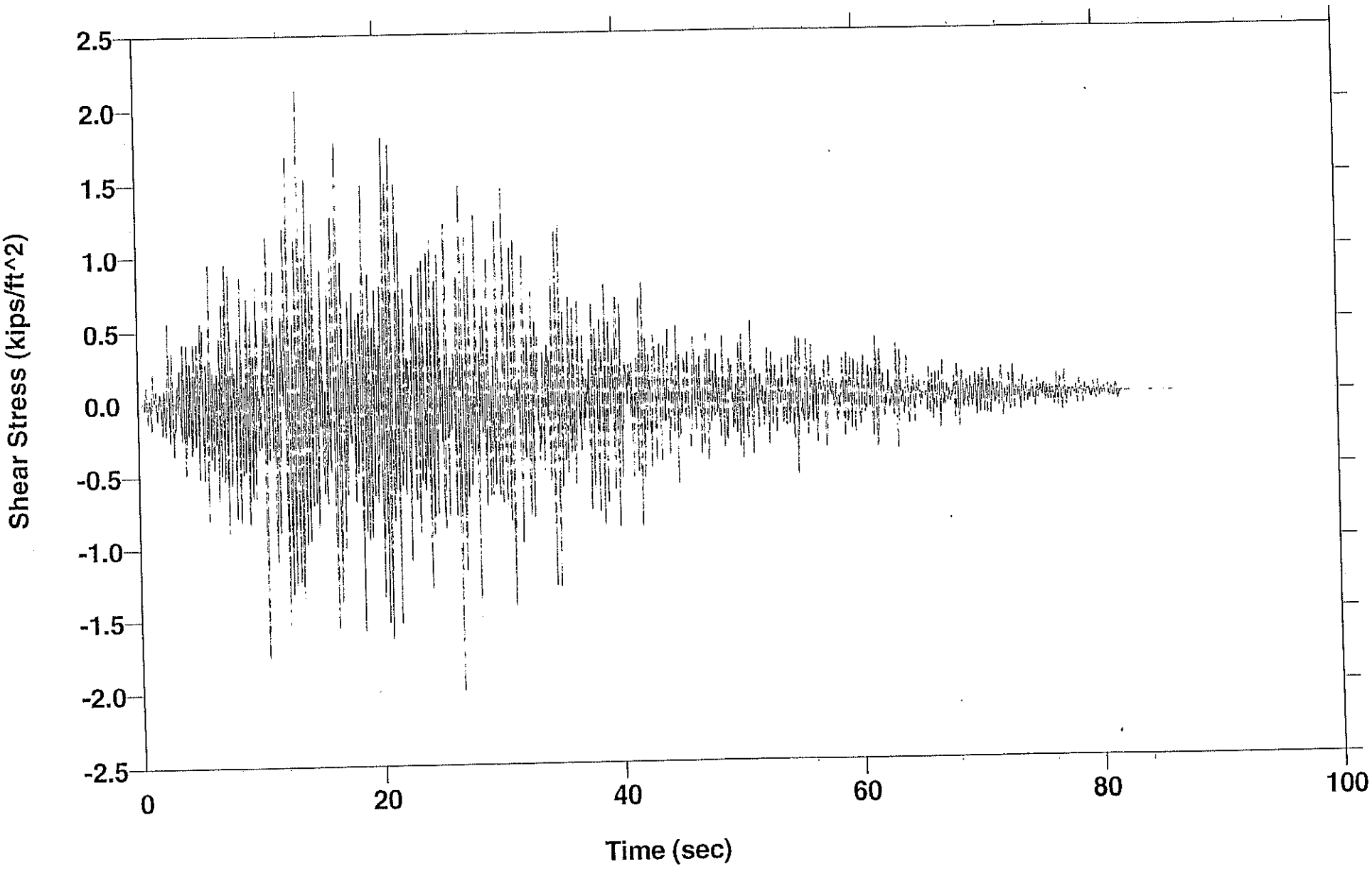
R14299

PCSC300M Layer 12 Stress - M8.0 New Madrid Synthetic



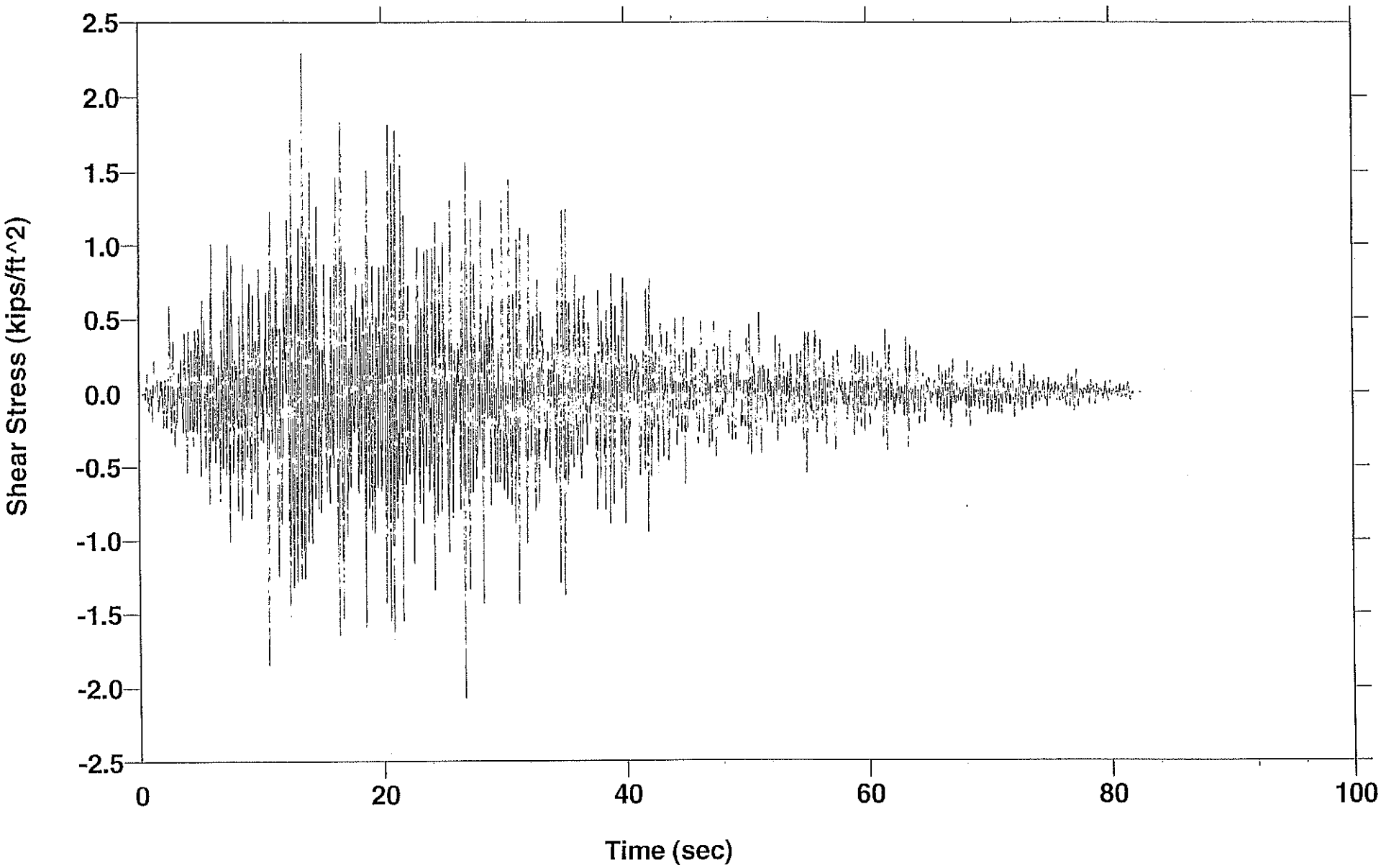
R14300

PCSC300M Layer 12 Stress - M8.0 New Madrid Synthetic

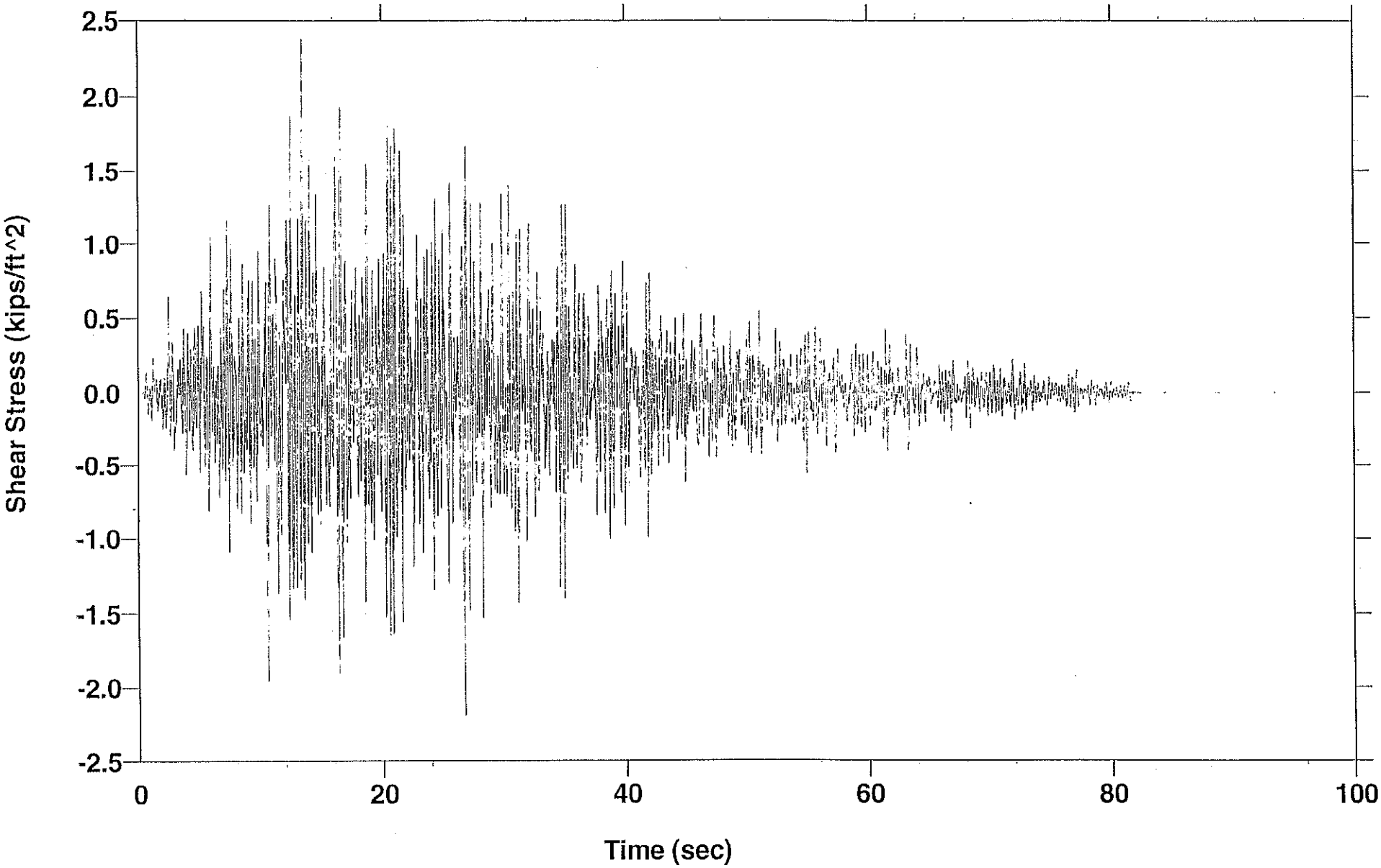


R14301

PCSC300M Layer 13 Stress - M8.0 New Madrid Synthetic

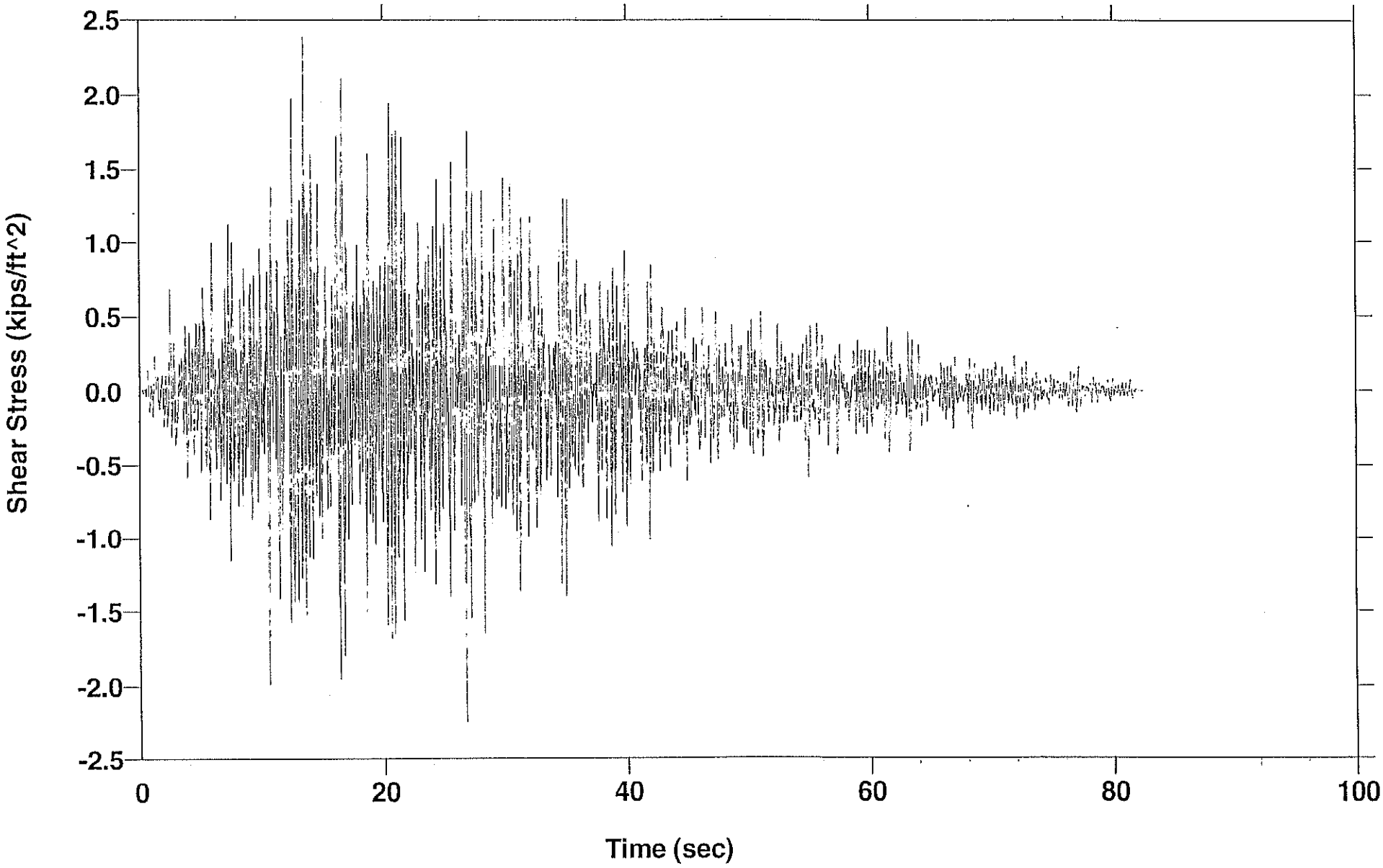


PCSC300M Layer 14 Stress - M8.0 New Madrid Synthetic



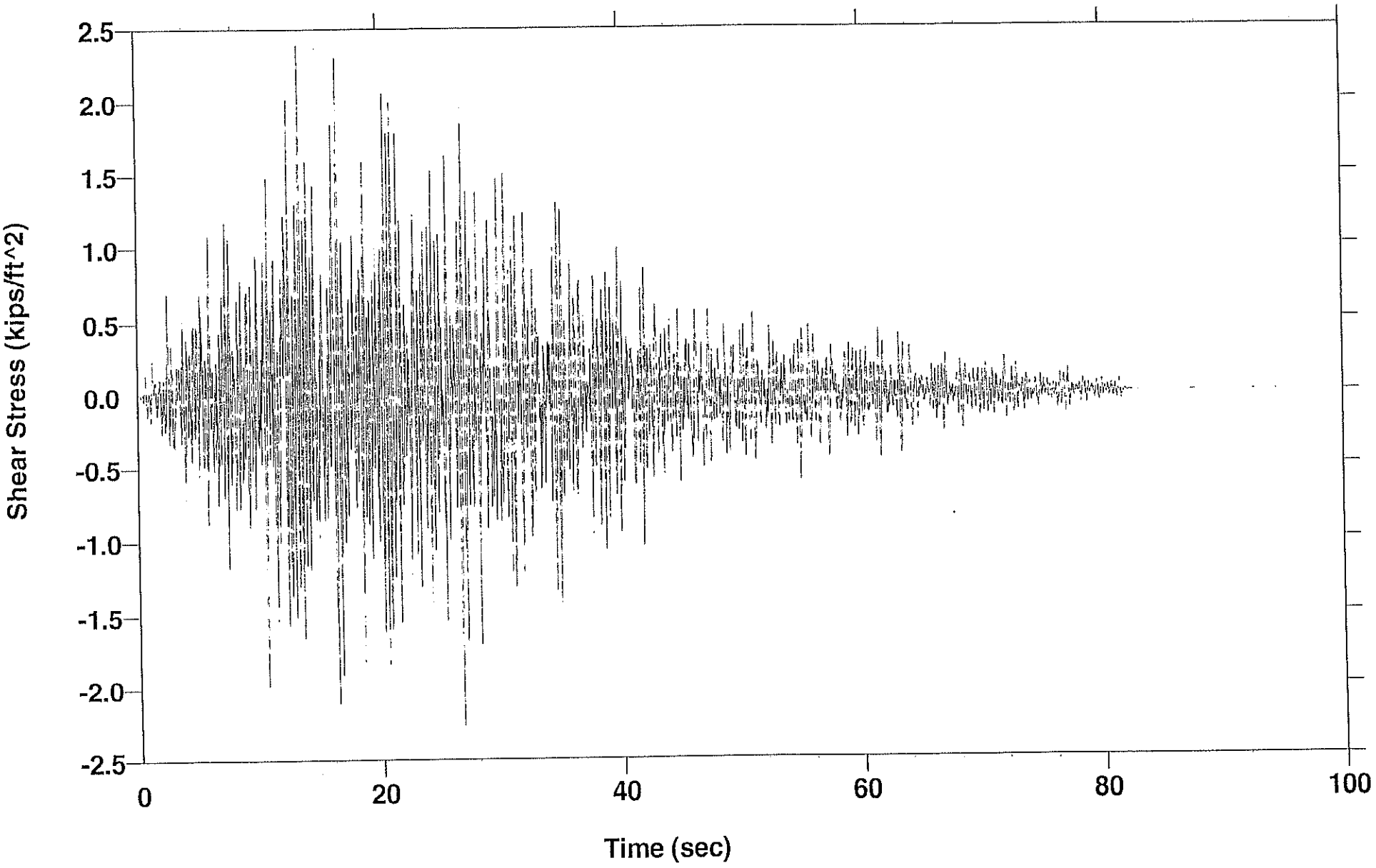
R14303

PCSC300M Layer 15 Stress - M8.0 New Madrid Synthetic



R14304

PCSC300M Layer 16 Stress - M8.0 New Madrid Synthetic



R14305

PCSC300M-1.out

```
************************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*    LAYERED SITES by Per Schnable & John Lysmer - 1970  *
* ---------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai.Jan 1985 *
* ---------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added   *
*     using results from Sun et al (1988) by J. I. Sun   *
*     & Ramin Golesorkhi February 26, 1988            *
* ----------------------------------------------------*
* SHAKE90/91: Adjust last iteration; Input now is either  *
*     Gmax or max Vs; up to 13 materials can be specified*
*     by user; up to 50 Layers can be specified; object  *
*     motion can be read in from a separate file and can *
*     user specified format; Different periods for res-  *
*     ponse spectral calculations;options are renumbered;*
*     and general cleanup by: J. I. Sun, I. M. Idriss &  *
*     P. Dirrim June 1990 - February 1991             *
* ---------------------------------------------------- *
* SHAKE91: General cleanup and finalization of input out- *
*     output format ... etc by: I. M. Idriss Dec. 1991   *
* ---------------------------------------------------- *
* SHAKE2000: Fix the incorrect output of Tot. Stress in   *
* Option 2. Changed path of ground motion file in         *
* SHAKE91.  Control file to input file names.  Modified   *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
*         RUN DATE  1/02/2008                          *
*         RUN TIME 11:03                              *
************************************************************
MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =    32768
NECESSARY LENGTH OF BLANK COMMON X       =   204819

1******  OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

**********************
 MATERIAL TYPE NO. 1
**********************

CURVE NO.  1:   Coarse    G/Gmax - Gravel (Mean) - Rollins et al. JGGE
CURVE NO.  2:   Coarse    Damping for Gravel (Mean) - Rollins et al. J
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.90
0.0002	0.995	0.0003	1.11
0.0005	0.980	0.0006	1.30
0.0008	0.970	0.0010	1.50
0.0010	0.960	0.0020	1.91
0.0020	0.930	0.0030	2.24
0.0030	0.905	0.0040	2.54
0.0040	0.880	0.0060	3.05
0.0070	0.810	0.0080	3.50
0.0100	0.755	0.0100	3.89
0.0200	0.630	0.0200	5.45
0.0700	0.390	0.0300	6.61
0.1000	0.325	0.0500	8.28
0.2000	0.205	0.1000	10.79
0.3000	0.150	0.2000	13.23

0.4000	0.115	0.3000	14.47
0.5000	0.095	0.4000	15.24
0.6000	0.080	0.6000	16.14
0.8000	0.070	0.8000	16.66
1.0000	0.050	1.0000	17.01

****
MATERIAL TYPE NO. 2
****

CURVE NO. 3: Fine Refuse Moduli for Fine Refuse (Ellison & Cho, 1976)
CURVE NO. 4: Fine Refuse Damping Values for Fine Refuse (Ellison & Ch

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.75
0.0004	1.000	0.0004	0.65
0.0010	0.995	0.0010	0.70
0.0020	0.992	0.0020	0.80
0.0040	0.989	0.0040	0.90
0.0060	0.981	0.0060	1.10
0.0080	0.965	0.0080	1.30
0.0100	0.955	0.0100	1.40
0.0200	0.905	0.0200	2.00
0.0400	0.828	0.0400	3.10
0.0600	0.750	0.0600	4.00
0.0800	0.670	0.0800	5.20
0.1000	0.610	0.1000	6.00
0.2000	0.610	0.2000	6.00

****
MATERIAL TYPE NO. 3
****

CURVE NO. 5: Residual G/Gmax PI=15% - Effective Confining Pressure
CURVE NO. 6: Residual Damping PI=15% - Effective Confining Pressur

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0000	1.000	0.0000	0.67
0.0000	1.000	0.0000	0.67
0.0000	0.999	0.0000	0.68
0.0001	0.998	0.0001	0.68
0.0002	0.996	0.0002	0.70
0.0005	0.991	0.0005	0.75
0.0010	0.983	0.0010	0.83
0.0022	0.965	0.0022	1.02
0.0048	0.931	0.0048	1.43
0.0100	0.873	0.0100	2.17
0.0220	0.770	0.0220	3.68
0.0484	0.618	0.0484	6.24
0.1000	0.454	0.1000	9.48
0.2200	0.287	0.2200	13.40
0.4840	0.163	0.4840	16.87
1.0000	0.091	1.0000	19.16

****
MATERIAL TYPE NO. 4
****

CURVE NO. 7: Rock G/Gmax - ROCK (Schnabel 1973)
CURVE NO. 8: Rock Damping for ROCK (Schnabel 1973)

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.40
0.0003	1.000	0.0010	0.80
0.0010	0.990	0.0100	1.50
0.0030	0.950	0.1000	3.00
0.0100	0.900	1.0000	4.60
0.0300	0.810	0.0000	0.00
0.1000	0.725	0.0000	0.00
1.0000	0.550	0.0000	0.00

1****** OPTION 2 *** READ SOIL PROFILE
NEW SOIL PROFILE NO. 1 IDENTIFICATION PSCS300E Crest Column
NUMBER OF LAYERS 17 DEPTH TO BEDROCK 50.00

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	1	4.0000	2.0000	0.26	3454.	0.050	0.130	924.9
2	1	3.0000	5.5000	0.71	3856.	0.050	0.130	977.3
3	1	3.0000	8.5000	1.11	4110.	0.050	0.130	1009.0
4	1	3.0000	11.5000	1.50	5739.	0.050	0.130	1192.3
5	1	3.0000	14.5000	1.90	4941.	0.050	0.140	1066.0
6	1	3.0000	17.5000	2.32	4453.	0.050	0.140	1012.0
7	1	3.0000	20.5000	2.74	4832.	0.050	0.140	1054.2
8	1	3.0000	23.5000	3.16	4269.	0.050	0.140	990.9
9	1	3.0000	26.5000	3.58	4713.	0.050	0.140	1041.1
10	1	4.0000	30.0000	4.07	4808.	0.050	0.140	1051.6
11	3	3.0000	33.5000	4.55	2635.	0.050	0.135	792.8
12	3	3.0000	36.5000	4.96	2661.	0.050	0.135	796.7
13	3	3.0000	39.5000	5.36	2998.	0.050	0.135	845.6
14	3	3.0000	42.5000	5.77	3763.	0.050	0.135	947.4
15	3	3.0000	45.5000	6.17	6529.	0.050	0.135	1247.9
16	3	3.0000	48.5000	6.58	6476.	0.050	0.135	1242.8
17	BASE				74534.	0.050	0.150	4000.0

PERIOD = 0.20 FROM AVERAGE SHEAR VEL. = 1011.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 12.34
FOR FREQUENCY = 4.85 C/SEC.
PERIOD = 0.21 SEC.

1****** OPTION 3 *** READ INPUT MOTION

FILE NAME FOR INPUT MOTION = C:\SHAKE2000\Williamson Energy\NewMadrid.eq
NO. OF INPUT ACC. POINTS = 8184
NO. OF POINTS USED IN FFT = 16384
NO. OF HEADING LINES = 4
NO. OF POINTS PER LINE = 8

TIME STEP FOR INPUT MOTION = 0.0100
FORMAT FOR TIME HISTORY = (8f9.6)

*****HEADER*****
Source File: C:\SHAKE2000\Williamson Energy\NewMadrid.M8@83km.txt
SHAKE2000 Conversion: 8184 .01 4 8 9 (8f9.6
Acceleration Units: (g's) - No. Values: 8184 - Time Step: .01 (secs)
Data Format: (8f9.6) - No. Header Lines: 4
** FIRST AND LAST 5 LINES OF INPUT MOTION *****

1 -0.000279 0.000491 0.000916 0.001028 0.001072 0.001012 0.000914 0.001178
2 0.001267 0.001643 0.000738 0.000404 0.001162 0.000325 0.000442 0.001287
3 0.000332 0.000352 0.000667 0.000333 0.000100-0.000289 0.000774-0.001450
4 -0.001068 0.000422-0.001711-0.000650 0.000432 0.001691 0.002168 0.001175
5 -0.000695 0.000756 0.000277 0.002243-0.000523 0.000775-0.001563-0.000602
.....INPUT MOTION READ NOT ECHOED.....
1019 0.002157 0.001240-0.001104 0.000476-0.001755-0.000138 0.000159-0.003048
1020 -0.003913 0.000251 0.002962-0.003793-0.003142-0.004436-0.001657-0.000252
1021 0.001471 0.001823-0.000479-0.000738-0.002774-0.005429-0.002747 0.002040
1022 -0.000940-0.002779-0.004528-0.001675 0.001024-0.002927-0.001433 0.002515
1023 0.000569-0.002711-0.002134-0.001855 0.001529 0.003698 0.004083-0.003032

MAXIMUM ACCELERATION = 0.18389
AT TIME = 16.61 SEC
THE VALUES WILL BE MULTIPLIED BY A FACTOR = 2.937
TO GIVE NEW MAXIMUM ACCELERATION = 0.54000
MEAN SQUARE FREQUENCY = 14.61 C/SEC.
MAX ACCELERATION = 0.57825 FOR FREQUENCIES REMOVED ABOVE 40.00 C/SEC.
1****** OPTION 4 *** READ WHERE OBJECT MOTION IS GIVEN
OBJECT MOTION IN LAYER NUMBER 17 OUTCROPPING

1****** OPTION 5 *** OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
MAXIMUM NUMBER OF ITERATIONS = 10
FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN = 0.65

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 1

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00461	0.027	0.050	-83.9	2978.1	3454.0	-16.0	1.000
2	1	5.5	0.01094	0.041	0.050	-22.2	2848.9	3856.0	-35.4	1.000
3	1	8.5	0.01510	0.048	0.050	-3.8	2797.7	4110.0	-46.9	1.000
4	1	11.5	0.01386	0.046	0.050	-8.1	3995.3	5739.0	-43.6	1.000
5	1	14.5	0.01946	0.054	0.050	7.2	3137.2	4941.0	-57.5	1.000
6	1	17.5	0.02527	0.061	0.050	18.3	2605.8	4453.0	-70.9	1.000
7	1	20.5	0.02663	0.063	0.050	20.2	2779.1	4832.0	-73.9	1.000
8	1	23.5	0.03437	0.071	0.050	29.1	2246.6	4269.0	-90.0	1.000
9	1	26.5	0.03469	0.071	0.050	29.4	2471.9	4713.0	-90.7	1.000
10	1	30.0	0.03753	0.073	0.050	31.9	2449.2	4808.0	-96.3	1.000
11	3	33.5	0.07359	0.081	0.050	38.3	1378.9	2635.0	-91.1	1.000
12	3	36.5	0.07541	0.082	0.050	39.2	1377.8	2661.0	-93.1	1.000
13	3	39.5	0.06759	0.077	0.050	35.3	1626.5	2998.0	-84.3	1.000
14	3	42.5	0.05330	0.067	0.050	25.0	2243.6	3763.0	-67.7	1.000
15	3	45.5	0.03114	0.048	0.050	-4.0	4589.9	6529.0	-42.2	1.000

16 3 48.5 0.03254 0.050 0.050 -1.0 4497.8 6476.0 -44.0 1.000

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00529	0.029	0.027	6.0	2918.7	2978.1	-2.0	0.862
2	1	5.5	0.01469	0.048	0.041	14.0	2643.7	2848.9	-7.8	0.739
3	1	8.5	0.02173	0.057	0.048	15.3	2523.9	2797.7	-10.8	0.681
4	1	11.5	0.01880	0.053	0.046	12.9	3679.7	3995.3	-8.6	0.696
5	1	14.5	0.02751	0.064	0.054	15.3	2811.1	3137.2	-11.6	0.635
6	1	17.5	0.03794	0.074	0.061	17.1	2259.2	2605.8	-15.3	0.585
7	1	20.5	0.04016	0.076	0.063	17.1	2398.9	2779.1	-15.8	0.575
8	1	23.5	0.05732	0.088	0.071	19.6	1828.3	2246.6	-22.9	0.526
9	1	26.5	0.05743	0.088	0.071	19.3	2016.7	2471.9	-22.6	0.524
10	1	30.0	0.06134	0.090	0.073	18.6	1996.8	2449.2	-22.7	0.509
11	3	33.5	0.11183	0.100	0.081	19.2	1133.9	1378.9	-21.6	0.523
12	3	36.5	0.11292	0.101	0.082	18.5	1139.6	1377.8	-20.9	0.518
13	3	39.5	0.09290	0.092	0.077	15.5	1411.0	1626.5	-15.3	0.543
14	3	42.5	0.06870	0.078	0.067	14.6	2027.7	2243.6	-10.6	0.596
15	3	45.5	0.03450	0.051	0.048	6.5	4460.9	4589.9	-2.9	0.703
16	3	48.5	0.03620	0.053	0.050	6.5	4364.8	4497.8	-3.0	0.695

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00475	0.028	0.029	-4.9	2965.5	2918.7	1.6	0.845
2	1	5.5	0.01390	0.046	0.048	-2.7	2682.1	2643.7	1.4	0.686
3	1	8.5	0.02141	0.056	0.057	-0.8	2535.7	2523.9	0.5	0.614
4	1	11.5	0.01863	0.053	0.053	-0.4	3689.2	3679.7	0.3	0.641
5	1	14.5	0.02895	0.065	0.064	2.2	2762.9	2811.1	-1.7	0.569
6	1	17.5	0.04291	0.078	0.074	5.2	2154.2	2259.2	-4.9	0.507
7	1	20.5	0.04652	0.080	0.076	6.0	2262.8	2398.9	-6.0	0.496
8	1	23.5	0.06862	0.094	0.088	6.9	1681.3	1828.3	-8.7	0.428
9	1	26.5	0.06795	0.094	0.088	6.5	1864.9	2016.7	-8.1	0.428
10	1	30.0	0.07245	0.096	0.090	6.3	1845.0	1996.8	-8.2	0.415
11	3	33.5	0.12841	0.107	0.100	6.4	1056.7	1133.9	-7.3	0.430
12	3	36.5	0.12873	0.107	0.101	6.1	1065.8	1139.6	-6.9	0.428
13	3	39.5	0.10845	0.099	0.092	7.4	1309.6	1411.0	-7.7	0.471
14	3	42.5	0.07848	0.084	0.078	7.1	1914.4	2027.7	-5.9	0.539
15	3	45.5	0.03657	0.053	0.051	3.5	4387.7	4460.9	-1.7	0.683
16	3	48.5	0.03825	0.055	0.053	3.3	4296.1	4364.8	-1.6	0.674

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00444	0.027	0.028	-3.2	2994.8	2965.5	1.0	0.859
2	1	5.5	0.01306	0.045	0.046	-3.1	2725.5	2682.1	1.6	0.696
3	1	8.5	0.02003	0.055	0.056	-3.5	2588.1	2535.7	2.0	0.617
4	1	11.5	0.01781	0.052	0.053	-2.0	3735.7	3689.2	1.2	0.643
5	1	14.5	0.02917	0.065	0.065	0.3	2755.5	2762.9	-0.3	0.559
6	1	17.5	0.04389	0.079	0.078	0.9	2134.9	2154.2	-0.9	0.484
7	1	20.5	0.04854	0.082	0.080	1.7	2223.4	2262.8	-1.8	0.468
8	1	23.5	0.07304	0.097	0.094	2.3	1631.9	1681.3	-3.0	0.394
9	1	26.5	0.07019	0.095	0.094	1.2	1835.8	1864.9	-1.6	0.396
10	1	30.0	0.07452	0.097	0.096	1.1	1820.2	1845.0	-1.4	0.384
11	3	33.5	0.13094	0.108	0.107	0.9	1045.9	1056.7	-1.0	0.401
12	3	36.5	0.13677	0.110	0.107	2.7	1031.6	1065.8	-3.3	0.401
13	3	39.5	0.11811	0.103	0.099	4.1	1255.4	1309.6	-4.3	0.437
14	3	42.5	0.08203	0.086	0.084	2.3	1876.8	1914.4	-2.0	0.509
15	3	45.5	0.03673	0.053	0.053	0.3	4382.2	4387.7	-0.1	0.672
16	3	48.5	0.03835	0.055	0.055	0.2	4292.8	4296.1	-0.1	0.663

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00433	0.026	0.027	-1.1	3004.9	2994.8	0.3	0.867
2	1	5.5	0.01267	0.044	0.045	-1.6	2746.9	2725.5	0.8	0.707
3	1	8.5	0.01935	0.054	0.055	-1.5	2614.0	2588.1	1.0	0.630
4	1	11.5	0.01748	0.051	0.052	-0.8	3754.7	3735.7	0.5	0.651
5	1	14.5	0.02911	0.065	0.065	-0.1	2757.5	2755.5	0.1	0.558
6	1	17.5	0.04365	0.078	0.079	-0.2	2139.7	2134.9	0.2	0.479
7	1	20.5	0.04877	0.082	0.082	0.2	2219.0	2223.4	-0.2	0.460
8	1	23.5	0.07433	0.097	0.097	0.7	1618.2	1631.9	-0.8	0.382
9	1	26.5	0.07045	0.095	0.095	0.1	1832.5	1835.8	-0.2	0.390
10	1	30.0	0.07390	0.097	0.097	-0.3	1827.6	1820.2	0.4	0.379
11	3	33.5	0.13009	0.108	0.108	-0.3	1049.5	1045.9	0.3	0.397
12	3	36.5	0.14090	0.112	0.110	1.3	1014.8	1031.6	-1.7	0.388
13	3	39.5	0.12289	0.105	0.103	1.9	1230.2	1255.4	-2.0	0.419
14	3	42.5	0.08343	0.087	0.086	0.9	1862.4	1876.8	-0.8	0.499
15	3	45.5	0.03646	0.053	0.053	-0.5	4391.5	4382.2	0.2	0.671
16	3	48.5	0.03803	0.055	0.055	-0.5	4303.2	4292.8	0.2	0.663

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 6

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00429	0.026	0.026	-0.4	3009.0	3004.9	0.1	0.870
2	1	5.5	0.01249	0.044	0.044	-0.7	2756.7	2746.9	0.4	0.712

3	1	8.5	0.01904	0.053	0.054	-0.7	2625.8	2614.0	0.5	0.636
4	1	11.5	0.01735	0.051	0.051	-0.3	3762.7	3754.7	0.2	0.654
5	1	14.5	0.02902	0.065	0.065	-0.1	2760.3	2757.5	0.1	0.558
6	1	17.5	0.04331	0.078	0.078	-0.3	2146.2	2139.7	0.3	0.481
7	1	20.5	0.04861	0.082	0.082	-0.1	2222.0	2219.0	0.1	0.459
8	1	23.5	0.07458	0.097	0.097	0.1	1615.6	1618.2	-0.2	0.379
9	1	26.5	0.07025	0.095	0.095	-0.1	1835.0	1832.5	0.1	0.389
10	1	30.0	0.07312	0.097	0.097	-0.4	1836.9	1827.6	0.5	0.380
11	3	33.5	0.12922	0.108	0.108	-0.3	1053.2	1049.5	0.4	0.398
12	3	36.5	0.14301	0.113	0.112	0.7	1006.4	1014.8	-0.8	0.381
13	3	39.5	0.12526	0.106	0.105	0.9	1218.1	1230.2	-1.0	0.410
14	3	42.5	0.08396	0.087	0.087	0.3	1857.0	1862.4	-0.3	0.495
15	3	45.5	0.03629	0.053	0.053	-0.3	4397.5	4391.5	0.1	0.673
16	3	48.5	0.03784	0.054	0.055	-0.3	4309.6	4303.2	0.1	0.664

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 7

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00428	0.026	0.026	-0.2	3010.7	3009.0	0.1	0.871
2	1	5.5	0.01241	0.044	0.044	-0.3	2761.0	2756.7	0.2	0.715
3	1	8.5	0.01890	0.053	0.053	-0.3	2631.1	2625.8	0.2	0.639
4	1	11.5	0.01729	0.051	0.051	-0.1	3766.0	3762.7	0.1	0.656
5	1	14.5	0.02896	0.065	0.065	-0.1	2762.3	2760.3	0.1	0.559
6	1	17.5	0.04309	0.078	0.078	-0.2	2150.6	2146.2	0.2	0.482
7	1	20.5	0.04844	0.082	0.082	-0.1	2225.2	2222.0	0.1	0.460
8	1	23.5	0.07455	0.097	0.097	0.0	1615.9	1615.6	0.0	0.378
9	1	26.5	0.07003	0.095	0.095	-0.1	1837.7	1835.0	0.1	0.389
10	1	30.0	0.07262	0.096	0.097	-0.3	1842.9	1836.9	0.3	0.382
11	3	33.5	0.12880	0.107	0.108	-0.2	1055.0	1053.2	0.2	0.400
12	3	36.5	0.14413	0.113	0.113	0.3	1002.1	1006.4	-0.4	0.378
13	3	39.5	0.12648	0.106	0.106	0.5	1211.9	1218.1	-0.5	0.406
14	3	42.5	0.08418	0.087	0.087	0.1	1854.9	1857.0	-0.1	0.494
15	3	45.5	0.03622	0.053	0.053	-0.1	4399.9	4397.5	0.1	0.674
16	3	48.5	0.03776	0.054	0.054	-0.1	4312.2	4309.6	0.1	0.665

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 8

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00427	0.026	0.026	-0.1	3011.5	3010.7	0.0	0.872
2	1	5.5	0.01238	0.044	0.044	-0.2	2763.1	2761.0	0.1	0.716
3	1	8.5	0.01884	0.053	0.053	-0.1	2633.6	2631.1	0.1	0.640
4	1	11.5	0.01727	0.051	0.051	-0.1	3767.6	3766.0	0.0	0.656
5	1	14.5	0.02893	0.065	0.065	-0.1	2763.5	2762.3	0.0	0.559
6	1	17.5	0.04296	0.078	0.078	-0.1	2153.2	2150.6	0.1	0.483
7	1	20.5	0.04833	0.082	0.082	-0.1	2227.5	2225.2	0.1	0.461
8	1	23.5	0.07446	0.097	0.097	0.0	1616.9	1615.9	0.1	0.379
9	1	26.5	0.06987	0.095	0.095	-0.1	1839.8	1837.7	0.1	0.390

10	1	30.0	0.07233	0.096	0.096	-0.1	1846.4	1842.9	0.2	0.383
11	3	33.5	0.12860	0.107	0.107	-0.1	1055.9	1055.0	0.1	0.400
12	3	36.5	0.14473	0.113	0.113	0.2	999.7	1002.1	-0.2	0.377
13	3	39.5	0.12712	0.107	0.106	0.2	1208.7	1211.9	-0.3	0.404
14	3	42.5	0.08427	0.087	0.087	0.1	1854.0	1854.9	0.0	0.493
15	3	45.5	0.03619	0.053	0.053	0.0	4400.8	4399.9	0.0	0.674
16	3	48.5	0.03773	0.054	0.054	0.0	4313.1	4312.2	0.0	0.666

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 9

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00426	0.026	0.026	0.0	3011.9	3011.5	0.0	0.872
2	1	5.5	0.01236	0.044	0.044	-0.1	2764.1	2763.1	0.0	0.717
3	1	8.5	0.01881	0.053	0.053	-0.1	2634.9	2633.6	0.0	0.641
4	1	11.5	0.01726	0.051	0.051	0.0	3768.3	3767.6	0.0	0.656
5	1	14.5	0.02891	0.065	0.065	0.0	2764.2	2763.5	0.0	0.559
6	1	17.5	0.04289	0.078	0.078	-0.1	2154.6	2153.2	0.1	0.484
7	1	20.5	0.04825	0.082	0.082	-0.1	2228.9	2227.5	0.1	0.461
8	1	23.5	0.07438	0.097	0.097	0.0	1617.7	1616.9	0.1	0.379
9	1	26.5	0.06976	0.095	0.095	-0.1	1841.1	1839.8	0.1	0.390
10	1	30.0	0.07218	0.096	0.096	-0.1	1848.3	1846.4	0.1	0.384
11	3	33.5	0.12851	0.107	0.107	0.0	1056.3	1055.9	0.0	0.401
12	3	36.5	0.14505	0.113	0.113	0.1	998.5	999.7	-0.1	0.376
13	3	39.5	0.12746	0.107	0.107	0.1	1207.0	1208.7	-0.1	0.403
14	3	42.5	0.08430	0.087	0.087	0.0	1853.6	1854.0	0.0	0.493
15	3	45.5	0.03618	0.053	0.053	0.0	4401.0	4400.8	0.0	0.674
16	3	48.5	0.03772	0.054	0.054	0.0	4313.4	4313.1	0.0	0.666

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 10

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00426	0.026	0.026	0.0	3012.1	3011.9	0.0	0.872
2	1	5.5	0.01235	0.044	0.044	0.0	2764.6	2764.1	0.0	0.717
3	1	8.5	0.01879	0.053	0.053	0.0	2635.6	2634.9	0.0	0.641
4	1	11.5	0.01725	0.051	0.051	0.0	3768.7	3768.3	0.0	0.657
5	1	14.5	0.02889	0.065	0.065	0.0	2764.6	2764.2	0.0	0.559
6	1	17.5	0.04285	0.078	0.078	0.0	2155.4	2154.6	0.0	0.484
7	1	20.5	0.04821	0.082	0.082	0.0	2229.8	2228.9	0.0	0.461
8	1	23.5	0.07432	0.097	0.097	0.0	1618.3	1617.7	0.0	0.379
9	1	26.5	0.06970	0.095	0.095	0.0	1842.0	1841.1	0.0	0.391
10	1	30.0	0.07209	0.096	0.096	0.0	1849.3	1848.3	0.1	0.384
11	3	33.5	0.12847	0.107	0.107	0.0	1056.5	1056.3	0.0	0.401
12	3	36.5	0.14523	0.113	0.113	0.1	997.8	998.5	-0.1	0.375
13	3	39.5	0.12763	0.107	0.107	0.1	1206.2	1207.0	-0.1	0.403
14	3	42.5	0.08432	0.087	0.087	0.0	1853.4	1853.6	0.0	0.493
15	3	45.5	0.03618	0.053	0.053	0.0	4401.1	4401.0	0.0	0.674
16	3	48.5	0.03772	0.054	0.054	0.0	4313.4	4313.4	0.0	0.666

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	1	4.0000	2.0000	0.00656	197.47	13.60
2	1	3.0000	5.5000	0.01900	525.07	13.60
3	1	3.0000	8.5000	0.02891	761.69	13.60
4	1	3.0000	11.5000	0.02654	1000.00	13.47
5	1	3.0000	14.5000	0.04445	1228.70	13.47
6	1	3.0000	17.5000	0.06592	1420.30	13.46
7	1	3.0000	20.5000	0.07416	1653.05	13.46
8	1	3.0000	23.5000	0.11434	1849.71	13.46
9	1	3.0000	26.5000	0.10723	1974.16	13.46
10	1	4.0000	30.0000	0.11091	2050.01	13.45
11	3	3.0000	33.5000	0.19765	2087.75	26.78
12	3	3.0000	36.5000	0.22343	2230.89	13.48
13	3	3.0000	39.5000	0.19636	2370.16	13.48
14	3	3.0000	42.5000	0.12973	2404.61	13.48
15	3	3.0000	45.5000	0.05567	2449.90	13.47
16	3	3.0000	48.5000	0.05803	2503.04	13.47

PERIOD = 0.27 FROM AVERAGE SHEAR VEL. = 740.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 6.29
FOR FREQUENCY = 3.22 C/SEC.
PERIOD = 0.31 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE	TH SAVED ACC. RECORD
OUTCR.	0.0000	0.75475	13.60	8.54	0.001	2048
WITHIN	4.0000	0.70138	13.60	7.22	0.000	2048
WITHIN	7.0000	0.65623	13.47	5.56	0.000	2048
WITHIN	10.0000	0.63991	13.45	5.53	0.001	2048
WITHIN	13.0000	0.65636	13.45	6.13	0.001	2048
WITHIN	16.0000	0.64637	13.45	6.55	0.000	2048
WITHIN	19.0000	0.59333	13.45	7.41	0.001	2048
WITHIN	22.0000	0.57039	18.63	8.36	0.001	2048
WITHIN	25.0000	0.55506	16.57	9.15	0.001	2048
WITHIN	28.0000	0.59901	16.56	9.97	0.001	2048
WITHIN	32.0000	0.67650	16.20	10.98	0.001	2048
WITHIN	35.0000	0.64739	16.20	13.92	0.002	2048
WITHIN	38.0000	0.71677	16.19	15.30	0.001	2048
WITHIN	41.0000	0.59839	20.01	15.65	0.002	2048
WITHIN	44.0000	0.52211	24.58	15.50	0.002	2048

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE	TH SAVED ACC. RECORD
WITHIN	47.0000	0.51594	16.61	14.54	0.002	2048
WITHIN	50.0000	0.52906	24.57	13.40	0.002	2048

OUTCR.	50.0000	0.57825	24.57	14.61	0.002	2048

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 1 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 1 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 2 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 2 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 3 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 3 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 4 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 4 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 5 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 5 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC330M Layer 6 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PSCS300M Layer 6 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 7 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 7 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 8 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 8 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 9 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PSCS300E Layer 9 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 10 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 10 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 11 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 11 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 12 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 12 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 13
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 13 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 13
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 13 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 14
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 14 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 14
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 14 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 15
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 15 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 15
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 15 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 16
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 16 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 16
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 16 Strain

1****** OPTION 9 *** COMPUTE RESPONSE SPECTRUM
RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER 1
CALCULATED FOR DAMPING 0.050

TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
TD = TIME FOR MAX. RELATIVE DISP.
TV = TIME FOR MAX. RELATIVE VEL.
TA = TIME FOR MAX. ABSOLUTE ACC.
DAMPING RATIO = 0.050

PER = 0.01	TIMES FOR MAXIMA --	TD = 13.5900	TV = 18.6700 TA = 13.5900
PER = 0.02	TIMES FOR MAXIMA --	TD = 13.5900	TV = 18.6600 TA = 13.5900
PER = 0.03	TIMES FOR MAXIMA --	TD = 16.7300	TV = 23.4400 TA = 16.7300
PER = 0.04	TIMES FOR MAXIMA --	TD = 18.7600	TV = 24.7500 TA = 18.7600
PER = 0.05	TIMES FOR MAXIMA --	TD = 10.5400	TV = 10.5300 TA = 10.5400
PER = 0.06	TIMES FOR MAXIMA --	TD = 18.3000	TV = 18.6800 TA = 18.3000
PER = 0.07	TIMES FOR MAXIMA --	TD = 18.3500	TV = 18.3300 TA = 24.1300
PER = 0.08	TIMES FOR MAXIMA --	TD = 11.4200	TV = 16.2700 TA = 11.4200
PER = 0.09	TIMES FOR MAXIMA --	TD = 11.4400	TV = 11.4200 TA = 11.4400
PER = 0.10	TIMES FOR MAXIMA --	TD = 20.7600	TV = 13.7300 TA = 20.7600
PER = 0.11	TIMES FOR MAXIMA --	TD = 25.6000	TV = 25.5700 TA = 25.5900
PER = 0.12	TIMES FOR MAXIMA --	TD = 20.7800	TV = 20.1100 TA = 20.7800

PER = 0.13	TIMES FOR MAXIMA --	TD = 16.7500	TV = 25.5800	TA = 16.7500
PER = 0.14	TIMES FOR MAXIMA --	TD = 16.7600	TV = 16.7900	TA = 16.7500
PER = 0.15	TIMES FOR MAXIMA --	TD = 14.1800	TV = 14.1500	TA = 14.1800
PER = 0.16	TIMES FOR MAXIMA --	TD = 13.4700	TV = 20.6000	TA = 13.4700
PER = 0.17	TIMES FOR MAXIMA --	TD = 13.4800	TV = 8.6400	TA = 13.4700
PER = 0.18	TIMES FOR MAXIMA --	TD = 13.4800	TV = 13.6400	TA = 13.4800
PER = 0.19	TIMES FOR MAXIMA --	TD = 13.6000	TV = 13.6500	TA = 13.6000
PER = 0.20	TIMES FOR MAXIMA --	TD = 13.6100	TV = 13.6600	TA = 13.6100
PER = 0.21	TIMES FOR MAXIMA --	TD = 24.4100	TV = 24.3600	TA = 24.4100
PER = 0.22	TIMES FOR MAXIMA --	TD = 24.5400	TV = 24.4900	TA = 24.5400
PER = 0.23	TIMES FOR MAXIMA --	TD = 21.8200	TV = 21.8800	TA = 21.8200
PER = 0.24	TIMES FOR MAXIMA --	TD = 21.8300	TV = 21.8900	TA = 21.8300
PER = 0.25	TIMES FOR MAXIMA --	TD = 21.8500	TV = 21.9100	TA = 21.8400
PER = 0.26	TIMES FOR MAXIMA --	TD = 21.1000	TV = 21.1800	TA = 21.1000
PER = 0.27	TIMES FOR MAXIMA --	TD = 21.2600	TV = 21.1900	TA = 21.2500
PER = 0.28	TIMES FOR MAXIMA --	TD = 21.2600	TV = 21.1900	TA = 21.2600
PER = 0.29	TIMES FOR MAXIMA --	TD = 21.2800	TV = 21.2000	TA = 21.2700
PER = 0.30	TIMES FOR MAXIMA --	TD = 13.6600	TV = 14.1900	TA = 13.6500
PER = 0.31	TIMES FOR MAXIMA --	TD = 14.1400	TV = 13.6000	TA = 14.1400
PER = 0.32	TIMES FOR MAXIMA --	TD = 13.7000	TV = 13.6100	TA = 13.6900
PER = 0.33	TIMES FOR MAXIMA --	TD = 13.7100	TV = 13.6300	TA = 13.7100
PER = 0.34	TIMES FOR MAXIMA --	TD = 21.8900	TV = 20.9600	TA = 13.7200
PER = 0.35	TIMES FOR MAXIMA --	TD = 17.0100	TV = 21.8300	TA = 17.0000
PER = 0.36	TIMES FOR MAXIMA --	TD = 17.2000	TV = 17.3000	TA = 17.2000
PER = 0.37	TIMES FOR MAXIMA --	TD = 17.2200	TV = 17.1300	TA = 17.2100
PER = 0.38	TIMES FOR MAXIMA --	TD = 17.2300	TV = 17.1400	TA = 17.2300
PER = 0.39	TIMES FOR MAXIMA --	TD = 17.0600	TV = 17.1600	TA = 17.0500
PER = 0.40	TIMES FOR MAXIMA --	TD = 17.0700	TV = 17.1700	TA = 17.0700
PER = 0.41	TIMES FOR MAXIMA --	TD = 17.0800	TV = 16.9800	TA = 17.0800
PER = 0.42	TIMES FOR MAXIMA --	TD = 17.0900	TV = 16.9900	TA = 17.0900
PER = 0.43	TIMES FOR MAXIMA --	TD = 16.9000	TV = 16.9900	TA = 16.8900
PER = 0.44	TIMES FOR MAXIMA --	TD = 16.9000	TV = 17.0000	TA = 16.9000
PER = 0.45	TIMES FOR MAXIMA --	TD = 16.9200	TV = 16.8200	TA = 16.9100
PER = 0.46	TIMES FOR MAXIMA --	TD = 16.9300	TV = 16.8200	TA = 16.9200
PER = 0.47	TIMES FOR MAXIMA --	TD = 16.9300	TV = 16.8300	TA = 16.9300
PER = 0.48	TIMES FOR MAXIMA --	TD = 16.9400	TV = 16.8300	TA = 16.9300
PER = 0.49	TIMES FOR MAXIMA --	TD = 16.7300	TV = 16.8400	TA = 16.7200
PER = 0.50	TIMES FOR MAXIMA --	TD = 16.7300	TV = 16.8400	TA = 16.7300
PER = 0.51	TIMES FOR MAXIMA --	TD = 16.7400	TV = 16.8500	TA = 16.7300
PER = 0.52	TIMES FOR MAXIMA --	TD = 16.7500	TV = 16.6500	TA = 16.7400
PER = 0.53	TIMES FOR MAXIMA --	TD = 16.7600	TV = 16.6700	TA = 16.7600
PER = 0.54	TIMES FOR MAXIMA --	TD = 16.5500	TV = 16.6800	TA = 16.5400
PER = 0.55	TIMES FOR MAXIMA --	TD = 29.2800	TV = 16.6800	TA = 29.2700
PER = 0.56	TIMES FOR MAXIMA --	TD = 32.2000	TV = 29.1800	TA = 32.1900
PER = 0.57	TIMES FOR MAXIMA --	TD = 32.2200	TV = 30.6800	TA = 32.2200
PER = 0.58	TIMES FOR MAXIMA --	TD = 30.5500	TV = 30.6900	TA = 30.5400
PER = 0.60	TIMES FOR MAXIMA --	TD = 30.5900	TV = 30.7200	TA = 30.5800
PER = 0.62	TIMES FOR MAXIMA --	TD = 30.6100	TV = 30.4900	TA = 30.6000
PER = 0.64	TIMES FOR MAXIMA --	TD = 16.7500	TV = 16.8900	TA = 16.7400
PER = 0.66	TIMES FOR MAXIMA --	TD = 16.7700	TV = 16.6700	TA = 16.7600
PER = 0.68	TIMES FOR MAXIMA --	TD = 16.7900	TV = 16.6800	TA = 16.7800
PER = 0.70	TIMES FOR MAXIMA --	TD = 16.5400	TV = 16.6800	TA = 16.5300
PER = 0.72	TIMES FOR MAXIMA --	TD = 16.5600	TV = 16.6800	TA = 16.5500
PER = 0.74	TIMES FOR MAXIMA --	TD = 16.5700	TV = 16.6800	TA = 16.5600
PER = 0.76	TIMES FOR MAXIMA --	TD = 16.5800	TV = 16.6800	TA = 16.5600
PER = 0.78	TIMES FOR MAXIMA --	TD = 32.7400	TV = 16.4800	TA = 32.7300
PER = 0.80	TIMES FOR MAXIMA --	TD = 32.7600	TV = 16.4800	TA = 32.7500
PER = 0.82	TIMES FOR MAXIMA --	TD = 32.7800	TV = 16.4800	TA = 16.5800
PER = 0.84	TIMES FOR MAXIMA --	TD = 33.6700	TV = 16.4800	TA = 33.6600
PER = 0.86	TIMES FOR MAXIMA --	TD = 16.3200	TV = 16.4800	TA = 16.3000
PER = 0.88	TIMES FOR MAXIMA --	TD = 12.1700	TV = 16.4800	TA = 16.3100

PER = 0.90	TIMES FOR MAXIMA --	TD = 12.2400	TV = 12.4300	TA = 12.2300
PER = 0.92	TIMES FOR MAXIMA --	TD = 12.2400	TV = 12.4300	TA = 12.2300
PER = 0.94	TIMES FOR MAXIMA --	TD = 12.2500	TV = 12.4300	TA = 12.2400
PER = 0.96	TIMES FOR MAXIMA --	TD = 12.2600	TV = 12.4300	TA = 12.2500
PER = 0.98	TIMES FOR MAXIMA --	TD = 12.2800	TV = 12.4400	TA = 12.2700
PER = 1.00	TIMES FOR MAXIMA --	TD = 12.3000	TV = 12.4400	TA = 12.2800
PER = 1.05	TIMES FOR MAXIMA --	TD = 12.3300	TV = 13.7000	TA = 12.3200
PER = 1.10	TIMES FOR MAXIMA --	TD = 12.3500	TV = 13.2000	TA = 12.3300
PER = 1.15	TIMES FOR MAXIMA --	TD = 13.5900	TV = 13.2400	TA = 13.5700
PER = 1.20	TIMES FOR MAXIMA --	TD = 13.6300	TV = 13.9700	TA = 13.5900
PER = 1.25	TIMES FOR MAXIMA --	TD = 13.1200	TV = 13.5200	TA = 13.1000
PER = 1.30	TIMES FOR MAXIMA --	TD = 13.1500	TV = 13.5300	TA = 13.1200
PER = 1.35	TIMES FOR MAXIMA --	TD = 13.1500	TV = 13.5300	TA = 13.1300
PER = 1.40	TIMES FOR MAXIMA --	TD = 13.1600	TV = 13.5300	TA = 13.1400
PER = 1.45	TIMES FOR MAXIMA --	TD = 13.1700	TV = 13.5300	TA = 13.1500
PER = 1.50	TIMES FOR MAXIMA --	TD = 13.1900	TV = 13.5300	TA = 13.1700
PER = 1.55	TIMES FOR MAXIMA --	TD = 13.2300	TV = 13.5300	TA = 13.1900
PER = 1.60	TIMES FOR MAXIMA --	TD = 13.4200	TV = 13.5300	TA = 13.4000
PER = 1.65	TIMES FOR MAXIMA --	TD = 13.4300	TV = 13.0600	TA = 13.4100
PER = 1.70	TIMES FOR MAXIMA --	TD = 13.4400	TV = 13.0600	TA = 13.4100
PER = 1.75	TIMES FOR MAXIMA --	TD = 16.3800	TV = 18.6600	TA = 16.3600
PER = 1.80	TIMES FOR MAXIMA --	TD = 17.4800	TV = 18.6600	TA = 17.4600
PER = 1.85	TIMES FOR MAXIMA --	TD = 17.5000	TV = 17.9200	TA = 17.4700
PER = 1.90	TIMES FOR MAXIMA --	TD = 18.5500	TV = 17.9200	TA = 18.5300
PER = 1.95	TIMES FOR MAXIMA --	TD = 18.5800	TV = 16.2500	TA = 18.5500
PER = 2.00	TIMES FOR MAXIMA --	TD = 18.5900	TV = 16.2500	TA = 18.5600
PER = 2.05	TIMES FOR MAXIMA --	TD = 19.7100	TV = 16.2500	TA = 19.6800
PER = 2.10	TIMES FOR MAXIMA --	TD = 17.7100	TV = 16.2500	TA = 19.7100
PER = 2.15	TIMES FOR MAXIMA --	TD = 17.7800	TV = 16.2500	TA = 17.7600
PER = 2.20	TIMES FOR MAXIMA --	TD = 17.8200	TV = 16.2600	TA = 17.8000
PER = 2.25	TIMES FOR MAXIMA --	TD = 16.8100	TV = 16.2600	TA = 16.7700
PER = 2.30	TIMES FOR MAXIMA --	TD = 19.1100	TV = 16.2600	TA = 19.0900
PER = 2.35	TIMES FOR MAXIMA --	TD = 17.0900	TV = 16.6800	TA = 17.0600
PER = 2.40	TIMES FOR MAXIMA --	TD = 16.0700	TV = 16.6800	TA = 16.0500
PER = 2.50	TIMES FOR MAXIMA --	TD = 11.9300	TV = 16.6800	TA = 11.8600
PER = 2.60	TIMES FOR MAXIMA --	TD = 12.0100	TV = 12.5700	TA = 11.9400
PER = 2.70	TIMES FOR MAXIMA --	TD = 12.0900	TV = 12.5700	TA = 12.0200
PER = 2.80	TIMES FOR MAXIMA --	TD = 17.1100	TV = 16.6800	TA = 17.0700
PER = 2.90	TIMES FOR MAXIMA --	TD = 17.1400	TV = 16.6800	TA = 17.1000
PER = 3.00	TIMES FOR MAXIMA --	TD = 16.0800	TV = 16.6800	TA = 16.0500
PER = 3.10	TIMES FOR MAXIMA --	TD = 16.1300	TV = 16.6800	TA = 16.0500
PER = 3.20	TIMES FOR MAXIMA --	TD = 16.1400	TV = 16.6800	TA = 16.1200
PER = 3.30	TIMES FOR MAXIMA --	TD = 16.1500	TV = 16.6800	TA = 16.1200
PER = 3.40	TIMES FOR MAXIMA --	TD = 16.1500	TV = 16.6800	TA = 16.1200
PER = 3.50	TIMES FOR MAXIMA --	TD = 45.5600	TV = 16.6800	TA = 45.4800
PER = 3.60	TIMES FOR MAXIMA --	TD = 45.7200	TV = 16.6800	TA = 45.6600
PER = 3.70	TIMES FOR MAXIMA --	TD = 44.2600	TV = 16.6800	TA = 44.2300
PER = 3.80	TIMES FOR MAXIMA --	TD = 44.3000	TV = 16.6800	TA = 44.2400
PER = 3.90	TIMES FOR MAXIMA --	TD = 46.2900	TV = 16.6800	TA = 46.2200
PER = 4.00	TIMES FOR MAXIMA --	TD = 44.6200	TV = 16.6800	TA = 16.1200
PER = 4.10	TIMES FOR MAXIMA --	TD = 16.1500	TV = 16.6800	TA = 16.1200
PER = 4.20	TIMES FOR MAXIMA --	TD = 14.9100	TV = 16.6800	TA = 14.8800
PER = 4.30	TIMES FOR MAXIMA --	TD = 14.9200	TV = 16.6800	TA = 14.8800
PER = 4.40	TIMES FOR MAXIMA --	TD = 14.9200	TV = 16.6800	TA = 14.8800
PER = 4.50	TIMES FOR MAXIMA --	TD = 14.9200	TV = 16.6800	TA = 14.8900
PER = 4.60	TIMES FOR MAXIMA --	TD = 14.9300	TV = 16.6800	TA = 14.8900
PER = 4.70	TIMES FOR MAXIMA --	TD = 32.0500	TV = 16.6800	TA = 32.0000
PER = 4.80	TIMES FOR MAXIMA --	TD = 32.0700	TV = 26.8200	TA = 32.0000
PER = 4.90	TIMES FOR MAXIMA --	TD = 32.0900	TV = 26.8200	TA = 32.0000
PER = 5.00	TIMES FOR MAXIMA --	TD = 32.1000	TV = 26.8200	TA = 32.0000
PER = 5.10	TIMES FOR MAXIMA --	TD = 28.0900	TV = 26.8200	TA = 32.0000

PER = 5.20 TIMES FOR MAXIMA -- TD = 28.1000 TV = 26.8200 TA = 28.0700
PER = 5.40 TIMES FOR MAXIMA -- TD = 9.8600 TV = 26.8200 TA = 9.7900
PER = 5.60 TIMES FOR MAXIMA -- TD = 9.8600 TV = 26.8200 TA = 9.7900
PER = 5.80 TIMES FOR MAXIMA -- TD = 9.8700 TV = 26.8200 TA = 9.8100
PER = 6.00 TIMES FOR MAXIMA -- TD = 14.9200 TV = 12.5700 TA = 14.8800
PER = 6.20 TIMES FOR MAXIMA -- TD = 14.9200 TV = 12.5700 TA = 14.8800
PER = 6.40 TIMES FOR MAXIMA -- TD = 14.9200 TV = 12.5700 TA = 14.8800
PER = 6.60 TIMES FOR MAXIMA -- TD = 14.9200 TV = 12.5700 TA = 14.8800
PER = 6.80 TIMES FOR MAXIMA -- TD = 14.9300 TV = 12.5700 TA = 14.8800
PER = 7.00 TIMES FOR MAXIMA -- TD = 14.9300 TV = 12.5700 TA = 14.8800
PER = 7.30 TIMES FOR MAXIMA -- TD = 15.4000 TV = 12.5700 TA = 15.3500
PER = 7.60 TIMES FOR MAXIMA -- TD = 15.4200 TV = 12.5700 TA = 15.3500
PER = 8.00 TIMES FOR MAXIMA -- TD = 15.4500 TV = 12.5700 TA = 15.3500
PER = 8.50 TIMES FOR MAXIMA -- TD = 15.5600 TV = 14.6700 TA = 15.3500
PER = 9.00 TIMES FOR MAXIMA -- TD = 16.7900 TV = 14.6700 TA = 16.6900
PER = 9.50 TIMES FOR MAXIMA -- TD = 17.1300 TV = 14.6700 TA = 16.6900
PER =10.00 TIMES FOR MAXIMA -- TD = 17.1400 TV = 16.6800 TA = 16.6900

SPECTRAL VALUES--
(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00006	0.00148	0.03859	0.75485	0.75291	100.00
2	0.02	0.00025	0.02224	0.07796	0.75500	0.76065	50.00
3	0.03	0.00078	0.11720	0.16261	1.03737	1.05770	33.33
4	0.04	0.00189	0.22142	0.29725	1.49386	1.45006	25.00
5	0.05	0.00353	0.36329	0.44334	1.72141	1.73017	20.00
6	0.06	0.00483	0.44388	0.50543	1.65995	1.64373	16.67
7	0.07	0.00564	0.47782	0.50625	1.41515	1.41122	14.29
8	0.08	0.00871	0.58053	0.68370	1.68512	1.66764	12.50
9	0.09	0.01508	0.96101	1.05299	2.26021	2.28299	11.11
10	0.10	0.01299	0.72198	0.81629	1.56974	1.59283	10.00
11	0.11	0.01511	0.75961	0.86325	1.51221	1.53132	9.09
12	0.12	0.01593	0.71575	0.83428	1.34972	1.35661	8.33
13	0.13	0.01582	0.62295	0.76445	1.16305	1.14744	7.69
14	0.14	0.01950	0.63144	0.87519	1.21278	1.21982	7.14
15	0.15	0.01864	0.67126	0.78082	1.02964	1.01574	6.67
16	0.16	0.02349	0.86132	0.92251	1.13603	1.12506	6.25
17	0.17	0.02777	0.90208	1.02633	1.17499	1.17804	5.88
18	0.18	0.03486	1.06543	1.21697	1.32473	1.31927	5.56
19	0.19	0.04476	1.40113	1.48005	1.53362	1.52001	5.26
20	0.20	0.05135	1.48010	1.61313	1.59068	1.57385	5.00
21	0.21	0.05378	1.40334	1.60911	1.50057	1.49517	4.76
22	0.22	0.06247	1.68568	1.78428	1.58991	1.58257	4.55
23	0.23	0.07357	1.91656	2.00969	1.70152	1.70500	4.35
24	0.24	0.09137	2.33734	2.39194	1.95066	1.94475	4.17
25	0.25	0.11652	2.94881	2.92858	2.30515	2.28582	4.00
26	0.26	0.12800	3.02688	3.09326	2.34448	2.32149	3.85
27	0.27	0.12504	2.99262	2.90987	2.12452	2.10298	3.70
28	0.28	0.13141	3.03524	2.94874	2.07401	2.05496	3.57
29	0.29	0.15347	3.42825	3.32509	2.24634	2.23732	3.45
30	0.30	0.19268	4.03283	4.03556	2.64720	2.62486	3.33
31	0.31	0.20983	4.47487	4.25300	2.68072	2.67706	3.23
32	0.32	0.20696	4.25418	4.06370	2.48767	2.47797	3.13
33	0.33	0.19217	3.75961	3.65883	2.18322	2.16348	3.03
34	0.34	0.16818	3.26236	3.10792	1.79320	1.78367	2.94
35	0.35	0.16793	3.20433	3.01476	1.69344	1.68077	2.86
36	0.36	0.18371	3.12146	3.20641	1.74523	1.73796	2.78
37	0.37	0.19763	3.36541	3.35610	1.77853	1.76994	2.70
38	0.38	0.21096	3.55027	3.48817	1.80305	1.79118	2.63
39	0.39	0.22040	3.63331	3.55073	1.78392	1.77655	2.56
40	0.40	0.22485	3.69214	3.53190	1.72705	1.72295	2.50

41	0.41	0.22536	3.65259	3.45358	1.65110	1.64365	2.44
42	0.42	0.22255	3.54459	3.32938	1.55420	1.54681	2.38
43	0.43	0.22619	3.51520	3.30516	1.50884	1.49985	2.33
44	0.44	0.24333	3.58677	3.47469	1.55138	1.54094	2.27
45	0.45	0.25076	3.58192	3.50127	1.52911	1.51823	2.22
46	0.46	0.24164	3.47798	3.30053	1.40986	1.40007	2.17
47	0.47	0.23406	3.37542	3.12904	1.30713	1.29908	2.13
48	0.48	0.23328	3.35192	3.05362	1.24660	1.24136	2.08
49	0.49	0.23208	3.32575	2.97592	1.19463	1.18509	2.04
50	0.50	0.23446	3.26179	2.94635	1.15763	1.14984	2.00
51	0.51	0.23536	3.14001	2.89964	1.11697	1.10942	1.96
52	0.52	0.22644	3.03081	2.73608	1.03255	1.02671	1.92
53	0.53	0.20464	2.94390	2.42606	0.89792	0.89320	1.89
54	0.54	0.17782	2.68504	2.06905	0.75226	0.74765	1.85
55	0.55	0.17279	2.35637	1.97391	0.70502	0.70031	1.82
56	0.56	0.18963	2.26618	2.12761	0.74412	0.74136	1.79
57	0.57	0.20836	2.39709	2.29681	0.78980	0.78627	1.75
58	0.58	0.22669	2.66539	2.45580	0.83077	0.82621	1.72
59	0.60	0.24149	2.62894	2.52889	0.82756	0.82244	1.67
60	0.62	0.21879	2.42628	2.21730	0.70270	0.69784	1.61
61	0.64	0.19260	2.06369	1.89080	0.58082	0.57649	1.56
62	0.66	0.21707	2.48272	2.06651	0.61478	0.61097	1.52
63	0.68	0.21999	2.78608	2.03270	0.58776	0.58329	1.47
64	0.70	0.23315	2.82933	2.09279	0.58841	0.58338	1.43
65	0.72	0.23178	2.61336	2.02264	0.55220	0.54816	1.39
66	0.74	0.21850	2.34059	1.85522	0.49252	0.48920	1.35
67	0.76	0.21042	2.16903	1.73960	0.45021	0.44664	1.32
68	0.78	0.22309	2.13432	1.79706	0.45295	0.44956	1.28
69	0.80	0.23577	2.25645	1.85170	0.45490	0.45165	1.25
70	0.82	0.23552	2.46660	1.80462	0.43393	0.42943	1.22
71	0.84	0.23594	2.58781	1.76482	0.41263	0.40996	1.19
72	0.86	0.22187	2.48884	1.62096	0.37085	0.36779	1.16
73	0.88	0.21006	2.33420	1.49985	0.33389	0.33257	1.14
74	0.90	0.21609	2.27460	1.50858	0.32804	0.32708	1.11
75	0.92	0.23488	2.35067	1.60410	0.34148	0.34023	1.09
76	0.94	0.26691	2.48294	1.78408	0.37188	0.37035	1.06
77	0.96	0.30028	2.56589	1.96533	0.40160	0.39947	1.04
78	0.98	0.32639	2.54769	2.09262	0.41885	0.41667	1.02
79	1.00	0.34474	2.46579	2.16605	0.42491	0.42266	1.00
80	1.05	0.37607	2.36155	2.25040	0.42136	0.41821	0.95
81	1.10	0.37369	2.42711	2.13453	0.38205	0.37865	0.91
82	1.15	0.44233	2.50484	2.41675	0.41528	0.41007	0.87
83	1.20	0.48888	2.59708	2.55975	0.41871	0.41624	0.83
84	1.25	0.46177	2.85322	2.32110	0.36556	0.36233	0.80
85	1.30	0.38996	2.70824	1.88476	0.28546	0.28290	0.77
86	1.35	0.34167	2.50267	1.59021	0.23213	0.22985	0.74
87	1.40	0.33081	2.42499	1.48467	0.20902	0.20693	0.71
88	1.45	0.33516	2.40128	1.45233	0.19733	0.19544	0.69
89	1.50	0.34051	2.35661	1.42631	0.18699	0.18554	0.67
90	1.55	0.33300	2.21880	1.34989	0.17078	0.16994	0.65
91	1.60	0.34984	1.97367	1.37380	0.16938	0.16754	0.63
92	1.65	0.34094	1.83003	1.29831	0.15644	0.15354	0.61
93	1.70	0.31162	1.71375	1.15175	0.13541	0.13220	0.59
94	1.75	0.32900	1.75582	1.18124	0.13427	0.13171	0.57
95	1.80	0.37390	1.78172	1.30517	0.14309	0.14149	0.56
96	1.85	0.40832	1.76324	1.38679	0.14828	0.14627	0.54
97	1.90	0.42440	1.73356	1.40346	0.14562	0.14414	0.53
98	1.95	0.44906	1.71742	1.44692	0.14647	0.14479	0.51
99	2.00	0.47550	1.77268	1.49383	0.14750	0.14575	0.50
100	2.05	0.51275	1.90190	1.57155	0.15154	0.14959	0.49
101	2.10	0.54946	2.09561	1.64398	0.15386	0.15276	0.48

102	2.15	0.59857	2.29334	1.74927	0.15955	0.15876	0.47
103	2.20	0.62244	2.42372	1.77767	0.15911	0.15767	0.45
104	2.25	0.60487	2.42782	1.68911	0.14863	0.14649	0.44
105	2.30	0.56825	2.29373	1.55237	0.13338	0.13170	0.43
106	2.35	0.51158	2.16262	1.36781	0.11455	0.11357	0.43
107	2.40	0.47300	2.13297	1.23832	0.10226	0.10068	0.42
108	2.50	0.40057	1.82526	1.00674	0.07968	0.07858	0.40
109	2.60	0.43355	1.81593	1.04772	0.07951	0.07863	0.38
110	2.70	0.42170	1.68762	0.98134	0.07168	0.07092	0.37
111	2.80	0.39019	1.71376	0.87559	0.06217	0.06102	0.36
112	2.90	0.44155	1.91046	0.95667	0.06579	0.06437	0.34
113	3.00	0.45601	1.99271	0.95507	0.06361	0.06212	0.33
114	3.10	0.47532	1.93884	0.96340	0.06185	0.06064	0.32
115	3.20	0.45002	1.80040	0.88360	0.05513	0.05388	0.31
116	3.30	0.39849	1.64675	0.75873	0.04644	0.04486	0.30
117	3.40	0.34537	1.52765	0.63824	0.03824	0.03663	0.29
118	3.50	0.34585	1.46112	0.62087	0.03541	0.03461	0.29
119	3.60	0.38778	1.43922	0.67680	0.03705	0.03668	0.28
120	3.70	0.40027	1.44089	0.67971	0.03652	0.03585	0.27
121	3.80	0.41610	1.44393	0.68801	0.03621	0.03533	0.26
122	3.90	0.38890	1.43272	0.62655	0.03211	0.03135	0.26
123	4.00	0.34298	1.40085	0.53876	0.02659	0.02628	0.25
124	4.10	0.32261	1.35007	0.49440	0.02509	0.02353	0.24
125	4.20	0.33552	1.28748	0.50193	0.02433	0.02332	0.24
126	4.30	0.35346	1.22218	0.51648	0.02452	0.02344	0.23
127	4.40	0.36225	1.16271	0.51729	0.02409	0.02294	0.23
128	4.50	0.36139	1.11530	0.50460	0.02310	0.02188	0.22
129	4.60	0.35233	1.08319	0.48125	0.02169	0.02041	0.22
130	4.70	0.34994	1.06690	0.46782	0.02067	0.01942	0.21
131	4.80	0.36366	1.12886	0.47603	0.02067	0.01935	0.21
132	4.90	0.35074	1.17140	0.44974	0.01920	0.01791	0.20
133	5.00	0.31965	1.19172	0.40168	0.01692	0.01568	0.20
134	5.10	0.28175	1.19536	0.34712	0.01445	0.01328	0.20
135	5.20	0.28122	1.18986	0.33981	0.01336	0.01275	0.19
136	5.40	0.28226	1.17590	0.32843	0.01256	0.01187	0.19
137	5.60	0.30531	1.16881	0.34256	0.01265	0.01194	0.18
138	5.80	0.32103	1.15075	0.34777	0.01244	0.01170	0.17
139	6.00	0.33548	1.16305	0.35132	0.01228	0.01143	0.17
140	6.20	0.39029	1.19910	0.39552	0.01329	0.01245	0.16
141	6.40	0.44539	1.22615	0.43726	0.01419	0.01333	0.16
142	6.60	0.49611	1.24427	0.47230	0.01486	0.01396	0.15
143	6.80	0.53946	1.25423	0.49846	0.01525	0.01430	0.15
144	7.00	0.57413	1.25733	0.51534	0.01536	0.01437	0.14
145	7.30	0.63071	1.25193	0.54286	0.01516	0.01451	0.14
146	7.60	0.67786	1.23807	0.56041	0.01512	0.01439	0.13
147	8.00	0.71450	1.21192	0.56116	0.01446	0.01369	0.13
148	8.50	0.72441	1.21511	0.53549	0.01306	0.01229	0.12
149	9.00	0.75099	1.25493	0.52429	0.01297	0.01137	0.11
150	9.50	0.82840	1.27770	0.54789	0.01277	0.01125	0.11
151	10.00	0.89637	1.29458	0.56321	0.01215	0.01099	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.
AREA OF ACC. RESPONSE SPECTRUM = 1.256
AREA OF VEL. RESPONSE SPECTRUM = 5.565
MAX. ACCELERATION RESPONSE VALUE = 2.681
MAX. VELOCITY RESPONSE VALUE = 4.475

1****** OPTION 9 *** COMPUTE RESPONSE SPECTRUM
RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER 17
CALCULATED FOR DAMPING 0.050

TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
TD = TIME FOR MAX. RELATIVE DISP.
TV = TIME FOR MAX. RELATIVE VEL.
TA = TIME FOR MAX. ABSOLUTE ACC.
DAMPING RATIO = 0.050

PER = 0.01	TIMES FOR MAXIMA --	TD = 24.5600	TV = 18.6000	TA = 24.5600
PER = 0.02	TIMES FOR MAXIMA --	TD = 24.5600	TV = 11.4800	TA = 24.5600
PER = 0.03	TIMES FOR MAXIMA --	TD = 23.3800	TV = 23.3700	TA = 23.3800
PER = 0.04	TIMES FOR MAXIMA --	TD = 24.6700	TV = 24.6800	TA = 24.6700
PER = 0.05	TIMES FOR MAXIMA --	TD = 10.4700	TV = 10.4600	TA = 10.4700
PER = 0.06	TIMES FOR MAXIMA --	TD = 18.2300	TV = 18.2200	TA = 18.2300
PER = 0.07	TIMES FOR MAXIMA --	TD = 18.2800	TV = 24.6700	TA = 18.2800
PER = 0.08	TIMES FOR MAXIMA --	TD = 16.0900	TV = 24.6500	TA = 16.0900
PER = 0.09	TIMES FOR MAXIMA --	TD = 11.3700	TV = 11.3500	TA = 11.3700
PER = 0.10	TIMES FOR MAXIMA --	TD = 13.6400	TV = 20.0800	TA = 13.6400
PER = 0.11	TIMES FOR MAXIMA --	TD = 25.5300	TV = 25.5100	TA = 25.5300
PER = 0.12	TIMES FOR MAXIMA --	TD = 21.3600	TV = 21.3900	TA = 21.3600
PER = 0.13	TIMES FOR MAXIMA --	TD = 15.1900	TV = 15.2900	TA = 15.1900
PER = 0.14	TIMES FOR MAXIMA --	TD = 16.6900	TV = 16.0000	TA = 16.6900
PER = 0.15	TIMES FOR MAXIMA --	TD = 14.1100	TV = 14.1500	TA = 14.1100
PER = 0.16	TIMES FOR MAXIMA --	TD = 20.5600	TV = 20.5200	TA = 20.5600
PER = 0.17	TIMES FOR MAXIMA --	TD = 13.8400	TV = 13.8800	TA = 13.8400
PER = 0.18	TIMES FOR MAXIMA --	TD = 22.8300	TV = 22.7900	TA = 22.8300
PER = 0.19	TIMES FOR MAXIMA --	TD = 22.8500	TV = 22.8100	TA = 22.8500
PER = 0.20	TIMES FOR MAXIMA --	TD = 22.2200	TV = 13.5800	TA = 22.2200
PER = 0.21	TIMES FOR MAXIMA --	TD = 24.3200	TV = 24.5800	TA = 24.3200
PER = 0.22	TIMES FOR MAXIMA --	TD = 24.3400	TV = 19.2400	TA = 24.3300
PER = 0.23	TIMES FOR MAXIMA --	TD = 24.4600	TV = 21.8900	TA = 24.4600
PER = 0.24	TIMES FOR MAXIMA --	TD = 21.8600	TV = 21.8000	TA = 21.8500
PER = 0.25	TIMES FOR MAXIMA --	TD = 21.7500	TV = 21.6900	TA = 21.7500
PER = 0.26	TIMES FOR MAXIMA --	TD = 21.6500	TV = 21.7100	TA = 21.6500
PER = 0.27	TIMES FOR MAXIMA --	TD = 21.0300	TV = 21.6100	TA = 21.6600
PER = 0.28	TIMES FOR MAXIMA --	TD = 21.0400	TV = 21.1100	TA = 21.0300
PER = 0.29	TIMES FOR MAXIMA --	TD = 21.0500	TV = 21.1200	TA = 21.0400
PER = 0.30	TIMES FOR MAXIMA --	TD = 13.4300	TV = 13.5200	TA = 13.4300
PER = 0.31	TIMES FOR MAXIMA --	TD = 13.4500	TV = 13.5300	TA = 13.4500
PER = 0.32	TIMES FOR MAXIMA --	TD = 13.4700	TV = 13.5300	TA = 13.4600
PER = 0.33	TIMES FOR MAXIMA --	TD = 13.4800	TV = 13.4100	TA = 13.4700
PER = 0.34	TIMES FOR MAXIMA --	TD = 21.6700	TV = 13.4100	TA = 21.6700
PER = 0.35	TIMES FOR MAXIMA --	TD = 16.7700	TV = 16.6800	TA = 16.7700
PER = 0.36	TIMES FOR MAXIMA --	TD = 16.7800	TV = 16.6800	TA = 16.7800
PER = 0.37	TIMES FOR MAXIMA --	TD = 16.7900	TV = 16.6800	TA = 16.7900
PER = 0.38	TIMES FOR MAXIMA --	TD = 16.8000	TV = 16.9100	TA = 16.8000
PER = 0.39	TIMES FOR MAXIMA --	TD = 16.8200	TV = 16.9200	TA = 16.8100
PER = 0.40	TIMES FOR MAXIMA --	TD = 16.8300	TV = 16.9200	TA = 16.8300
PER = 0.41	TIMES FOR MAXIMA --	TD = 16.8400	TV = 16.9300	TA = 16.8400
PER = 0.42	TIMES FOR MAXIMA --	TD = 27.2100	TV = 27.3100	TA = 27.2000
PER = 0.43	TIMES FOR MAXIMA --	TD = 16.8600	TV = 27.3100	TA = 16.8500
PER = 0.44	TIMES FOR MAXIMA --	TD = 16.8700	TV = 16.9900	TA = 16.8600
PER = 0.45	TIMES FOR MAXIMA --	TD = 16.8800	TV = 16.9900	TA = 16.8800
PER = 0.46	TIMES FOR MAXIMA --	TD = 16.8900	TV = 16.7800	TA = 16.8900
PER = 0.47	TIMES FOR MAXIMA --	TD = 16.9000	TV = 16.7800	TA = 16.8900
PER = 0.48	TIMES FOR MAXIMA --	TD = 16.9100	TV = 16.8200	TA = 16.9000
PER = 0.49	TIMES FOR MAXIMA --	TD = 16.6900	TV = 16.6100	TA = 16.9100
PER = 0.50	TIMES FOR MAXIMA --	TD = 16.7000	TV = 16.6100	TA = 16.6900
PER = 0.51	TIMES FOR MAXIMA --	TD = 16.7100	TV = 16.6100	TA = 16.7000
PER = 0.52	TIMES FOR MAXIMA --	TD = 16.7300	TV = 16.6100	TA = 16.7200
PER = 0.53	TIMES FOR MAXIMA --	TD = 29.4900	TV = 16.6100	TA = 29.4800
PER = 0.54	TIMES FOR MAXIMA --	TD = 29.5100	TV = 16.6200	TA = 29.5000
PER = 0.55	TIMES FOR MAXIMA --	TD = 29.5300	TV = 29.1200	TA = 29.5200
PER = 0.56	TIMES FOR MAXIMA --	TD = 32.1700	TV = 29.4300	TA = 32.1600

PER = 0.57	TIMES FOR MAXIMA --	TD = 30.4900	TV = 30.6500	TA = 30.4800
PER = 0.58	TIMES FOR MAXIMA --	TD = 30.5200	TV = 30.6600	TA = 30.5100
PER = 0.60	TIMES FOR MAXIMA --	TD = 30.5600	TV = 30.4200	TA = 30.5500
PER = 0.62	TIMES FOR MAXIMA --	TD = 30.5900	TV = 30.4300	TA = 30.5800
PER = 0.64	TIMES FOR MAXIMA --	TD = 15.6700	TV = 16.6100	TA = 15.6600
PER = 0.66	TIMES FOR MAXIMA --	TD = 16.7500	TV = 16.6100	TA = 16.7400
PER = 0.68	TIMES FOR MAXIMA --	TD = 16.4800	TV = 16.6200	TA = 16.4700
PER = 0.70	TIMES FOR MAXIMA --	TD = 16.5100	TV = 16.6200	TA = 16.5000
PER = 0.72	TIMES FOR MAXIMA --	TD = 16.5300	TV = 16.4100	TA = 16.5200
PER = 0.74	TIMES FOR MAXIMA --	TD = 16.5400	TV = 16.4100	TA = 16.5300
PER = 0.76	TIMES FOR MAXIMA --	TD = 32.6800	TV = 16.4100	TA = 32.6700
PER = 0.78	TIMES FOR MAXIMA --	TD = 32.7100	TV = 16.4100	TA = 32.7000
PER = 0.80	TIMES FOR MAXIMA --	TD = 32.7400	TV = 16.4200	TA = 32.7200
PER = 0.82	TIMES FOR MAXIMA --	TD = 33.6100	TV = 16.4200	TA = 33.6000
PER = 0.84	TIMES FOR MAXIMA --	TD = 33.6600	TV = 16.4200	TA = 33.6400
PER = 0.86	TIMES FOR MAXIMA --	TD = 12.1700	TV = 16.4300	TA = 12.1600
PER = 0.88	TIMES FOR MAXIMA --	TD = 12.1900	TV = 12.3600	TA = 12.1800
PER = 0.90	TIMES FOR MAXIMA --	TD = 12.2000	TV = 12.3600	TA = 12.1800
PER = 0.92	TIMES FOR MAXIMA --	TD = 12.2000	TV = 12.3600	TA = 12.1900
PER = 0.94	TIMES FOR MAXIMA --	TD = 12.2100	TV = 12.3600	TA = 12.2000
PER = 0.96	TIMES FOR MAXIMA --	TD = 12.2200	TV = 12.3700	TA = 12.2000
PER = 0.98	TIMES FOR MAXIMA --	TD = 12.2500	TV = 12.4500	TA = 12.2300
PER = 1.00	TIMES FOR MAXIMA --	TD = 12.2600	TV = 16.1800	TA = 12.2500
PER = 1.05	TIMES FOR MAXIMA --	TD = 12.3000	TV = 13.1700	TA = 12.2800
PER = 1.10	TIMES FOR MAXIMA --	TD = 13.5000	TV = 13.2000	TA = 13.4900
PER = 1.15	TIMES FOR MAXIMA --	TD = 13.5400	TV = 13.8400	TA = 13.5100
PER = 1.20	TIMES FOR MAXIMA --	TD = 13.6200	TV = 13.4000	TA = 13.6000
PER = 1.25	TIMES FOR MAXIMA --	TD = 13.0900	TV = 13.4100	TA = 13.0700
PER = 1.30	TIMES FOR MAXIMA --	TD = 13.7800	TV = 13.4100	TA = 13.7600
PER = 1.35	TIMES FOR MAXIMA --	TD = 13.8100	TV = 13.4600	TA = 13.7800
PER = 1.40	TIMES FOR MAXIMA --	TD = 13.8200	TV = 13.4600	TA = 13.8000
PER = 1.45	TIMES FOR MAXIMA --	TD = 13.1900	TV = 13.4600	TA = 13.1500
PER = 1.50	TIMES FOR MAXIMA --	TD = 13.2300	TV = 13.5900	TA = 13.1900
PER = 1.55	TIMES FOR MAXIMA --	TD = 13.3200	TV = 12.9500	TA = 13.3000
PER = 1.60	TIMES FOR MAXIMA --	TD = 13.3500	TV = 12.9500	TA = 13.3400
PER = 1.65	TIMES FOR MAXIMA --	TD = 13.3700	TV = 13.0000	TA = 13.3400
PER = 1.70	TIMES FOR MAXIMA --	TD = 13.3800	TV = 13.0000	TA = 13.3500
PER = 1.75	TIMES FOR MAXIMA --	TD = 18.2300	TV = 18.5900	TA = 18.2100
PER = 1.80	TIMES FOR MAXIMA --	TD = 17.4300	TV = 17.8500	TA = 17.4000
PER = 1.85	TIMES FOR MAXIMA --	TD = 17.4700	TV = 17.9300	TA = 17.4400
PER = 1.90	TIMES FOR MAXIMA --	TD = 18.5100	TV = 17.9400	TA = 18.4800
PER = 1.95	TIMES FOR MAXIMA --	TD = 18.5300	TV = 17.9400	TA = 18.5100
PER = 2.00	TIMES FOR MAXIMA --	TD = 19.6300	TV = 20.1700	TA = 19.6100
PER = 2.05	TIMES FOR MAXIMA --	TD = 19.6600	TV = 20.1700	TA = 19.6200
PER = 2.10	TIMES FOR MAXIMA --	TD = 17.7000	TV = 19.3000	TA = 17.6800
PER = 2.15	TIMES FOR MAXIMA --	TD = 17.7500	TV = 17.3100	TA = 17.7100
PER = 2.20	TIMES FOR MAXIMA --	TD = 17.7800	TV = 17.3100	TA = 17.7500
PER = 2.25	TIMES FOR MAXIMA --	TD = 19.0300	TV = 17.3200	TA = 18.9800
PER = 2.30	TIMES FOR MAXIMA --	TD = 19.0600	TV = 16.2700	TA = 19.0300
PER = 2.35	TIMES FOR MAXIMA --	TD = 17.0200	TV = 16.6100	TA = 17.0000
PER = 2.40	TIMES FOR MAXIMA --	TD = 16.0500	TV = 16.6100	TA = 15.9800
PER = 2.50	TIMES FOR MAXIMA --	TD = 12.8600	TV = 12.4900	TA = 12.8400
PER = 2.60	TIMES FOR MAXIMA --	TD = 12.0000	TV = 12.4900	TA = 11.9500
PER = 2.70	TIMES FOR MAXIMA --	TD = 12.0800	TV = 12.5000	TA = 12.0100
PER = 2.80	TIMES FOR MAXIMA --	TD = 17.0500	TV = 11.7800	TA = 17.0400
PER = 2.90	TIMES FOR MAXIMA --	TD = 17.1000	TV = 16.6100	TA = 17.0500
PER = 3.00	TIMES FOR MAXIMA --	TD = 16.0600	TV = 16.6100	TA = 15.9800
PER = 3.10	TIMES FOR MAXIMA --	TD = 16.0800	TV = 16.6100	TA = 16.0500
PER = 3.20	TIMES FOR MAXIMA --	TD = 16.1000	TV = 16.6200	TA = 16.0600
PER = 3.30	TIMES FOR MAXIMA --	TD = 16.1100	TV = 16.6200	TA = 16.0600
PER = 3.40	TIMES FOR MAXIMA --	TD = 16.1200	TV = 15.7000	TA = 16.0600

PER = 3.50 TIMES FOR MAXIMA -- TD = 45.5300 TV = 16.6200 TA = 45.4900
PER = 3.60 TIMES FOR MAXIMA -- TD = 45.6800 TV = 16.6200 TA = 45.6000
PER = 3.70 TIMES FOR MAXIMA -- TD = 44.1900 TV = 16.6200 TA = 44.1600
PER = 3.80 TIMES FOR MAXIMA -- TD = 44.3200 TV = 16.6200 TA = 44.2900
PER = 3.90 TIMES FOR MAXIMA -- TD = 44.3600 TV = 16.6200 TA = 44.3200
PER = 4.00 TIMES FOR MAXIMA -- TD = 44.5500 TV = 15.8300 TA = 44.4500
PER = 4.10 TIMES FOR MAXIMA -- TD = 44.5800 TV = 15.8300 TA = 14.8100
PER = 4.20 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 4.30 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 4.40 TIMES FOR MAXIMA -- TD = 14.8600 TV = 15.8300 TA = 14.8100
PER = 4.50 TIMES FOR MAXIMA -- TD = 14.8600 TV = 15.8300 TA = 14.8200
PER = 4.60 TIMES FOR MAXIMA -- TD = 14.9400 TV = 15.8300 TA = 14.8200
PER = 4.70 TIMES FOR MAXIMA -- TD = 32.0400 TV = 15.8300 TA = 14.8200
PER = 4.80 TIMES FOR MAXIMA -- TD = 32.0600 TV = 15.8300 TA = 32.0200
PER = 4.90 TIMES FOR MAXIMA -- TD = 32.0700 TV = 15.8300 TA = 32.0200
PER = 5.00 TIMES FOR MAXIMA -- TD = 32.1300 TV = 15.8300 TA = 32.0200
PER = 5.10 TIMES FOR MAXIMA -- TD = 28.0300 TV = 15.8300 TA = 28.0000
PER = 5.20 TIMES FOR MAXIMA -- TD = 28.0300 TV = 15.8300 TA = 28.0000
PER = 5.40 TIMES FOR MAXIMA -- TD = 9.7900 TV = 11.2400 TA = 28.0000
PER = 5.60 TIMES FOR MAXIMA -- TD = 9.7900 TV = 11.2400 TA = 9.7500
PER = 5.80 TIMES FOR MAXIMA -- TD = 9.8200 TV = 15.8300 TA = 9.7500
PER = 6.00 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 6.20 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 6.40 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 6.60 TIMES FOR MAXIMA -- TD = 14.8600 TV = 15.8300 TA = 14.8100
PER = 6.80 TIMES FOR MAXIMA -- TD = 14.8600 TV = 15.8300 TA = 14.8100
PER = 7.00 TIMES FOR MAXIMA -- TD = 14.9800 TV = 12.5000 TA = 14.8100
PER = 7.30 TIMES FOR MAXIMA -- TD = 15.3900 TV = 17.3200 TA = 14.8100
PER = 7.60 TIMES FOR MAXIMA -- TD = 15.4000 TV = 17.3200 TA = 15.3100
PER = 8.00 TIMES FOR MAXIMA -- TD = 15.4900 TV = 17.3200 TA = 15.3700
PER = 8.50 TIMES FOR MAXIMA -- TD = 15.5300 TV = 14.6000 TA = 15.4700
PER = 9.00 TIMES FOR MAXIMA -- TD = 16.8100 TV = 14.6000 TA = 16.6200
PER = 9.50 TIMES FOR MAXIMA -- TD = 17.0600 TV = 14.6000 TA = 16.7400
PER =10.00 TIMES FOR MAXIMA -- TD = 17.1500 TV = 14.6000 TA = 17.0400

SPECTRAL VALUES--
(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00005	0.00137	0.02954	0.57869	0.57636	100.00
2	0.02	0.00019	0.03246	0.05874	0.57851	0.57313	50.00
3	0.03	0.00084	0.16225	0.17610	1.10556	1.14542	33.33
4	0.04	0.00190	0.26915	0.29880	1.48423	1.45761	25.00
5	0.05	0.00342	0.38292	0.43034	1.68897	1.67944	20.00
6	0.06	0.00440	0.46805	0.46042	1.55729	1.49736	16.67
7	0.07	0.00583	0.52196	0.52342	1.45432	1.45906	14.29
8	0.08	0.00756	0.58863	0.59363	1.49438	1.44794	12.50
9	0.09	0.00981	0.68527	0.68468	1.49214	1.48446	11.11
10	0.10	0.01153	0.67832	0.72473	1.39533	1.41416	10.00
11	0.11	0.01476	0.77760	0.84282	1.51649	1.49509	9.09
12	0.12	0.01629	0.83139	0.85295	1.40540	1.38697	8.33
13	0.13	0.01684	0.79261	0.81412	1.22022	1.22200	7.69
14	0.14	0.01815	0.79492	0.81472	1.12382	1.13554	7.14
15	0.15	0.01917	0.78885	0.80311	1.04837	1.04474	6.67
16	0.16	0.02264	0.87808	0.88913	1.08719	1.08435	6.25
17	0.17	0.02615	0.95564	0.96640	1.11464	1.10926	5.88
18	0.18	0.03507	1.12475	1.22425	1.32698	1.32716	5.56
19	0.19	0.03470	1.15550	1.14761	1.17936	1.17860	5.26
20	0.20	0.03549	1.24968	1.11510	1.08628	1.08794	5.00
21	0.21	0.03665	1.13296	1.09655	1.02129	1.01890	4.76
22	0.22	0.04047	1.20959	1.15594	1.03249	1.02527	4.55
23	0.23	0.04161	1.16229	1.13658	0.97652	0.96427	4.35

24	0.24	0.04975	1.29290	1.30247	1.06242	1.05896	4.17
25	0.25	0.06040	1.56475	1.51813	1.19290	1.18493	4.00
26	0.26	0.06309	1.61978	1.52473	1.14568	1.14431	3.85
27	0.27	0.05277	1.29989	1.22801	0.89238	0.88749	3.70
28	0.28	0.05245	1.28803	1.17691	0.82117	0.82018	3.57
29	0.29	0.05858	1.42125	1.26924	0.85688	0.85402	3.45
30	0.30	0.06833	1.51338	1.43100	0.93704	0.93077	3.33
31	0.31	0.07664	1.71775	1.55334	0.97975	0.97775	3.23
32	0.32	0.07644	1.62581	1.50080	0.92328	0.91516	3.13
33	0.33	0.07036	1.46608	1.33963	0.79885	0.79213	3.03
34	0.34	0.06555	1.29567	1.21135	0.69574	0.69521	2.94
35	0.35	0.06914	1.36883	1.24114	0.69509	0.69195	2.86
36	0.36	0.07611	1.43229	1.32829	0.72534	0.71997	2.78
37	0.37	0.08321	1.46923	1.41300	0.74916	0.74518	2.70
38	0.38	0.09015	1.54982	1.49059	0.76953	0.76542	2.63
39	0.39	0.09619	1.64563	1.54976	0.77692	0.77539	2.56
40	0.40	0.10071	1.66299	1.58202	0.77619	0.77175	2.50
41	0.41	0.10438	1.61478	1.59959	0.76625	0.76129	2.44
42	0.42	0.10761	1.63710	1.60983	0.75221	0.74792	2.38
43	0.43	0.11229	1.61004	1.64084	0.74872	0.74460	2.33
44	0.44	0.12294	1.71041	1.75551	0.78269	0.77853	2.27
45	0.45	0.12786	1.77832	1.78529	0.77785	0.77414	2.22
46	0.46	0.12471	1.71825	1.70342	0.72783	0.72258	2.17
47	0.47	0.12287	1.65704	1.64265	0.68560	0.68198	2.13
48	0.48	0.12350	1.63243	1.61656	0.66244	0.65717	2.08
49	0.49	0.12258	1.70238	1.57185	0.63005	0.62595	2.04
50	0.50	0.12409	1.78871	1.55941	0.61130	0.60858	2.00
51	0.51	0.12464	1.86376	1.53559	0.59053	0.58753	1.96
52	0.52	0.11959	1.85372	1.44501	0.54442	0.54224	1.92
53	0.53	0.11048	1.70483	1.30978	0.48598	0.48222	1.89
54	0.54	0.11235	1.47125	1.30725	0.47394	0.47238	1.85
55	0.55	0.11423	1.38020	1.30494	0.46612	0.46297	1.82
56	0.56	0.12991	1.43053	1.45756	0.51070	0.50788	1.79
57	0.57	0.14553	1.58598	1.60414	0.55167	0.54915	1.75
58	0.58	0.16090	1.75597	1.74305	0.58929	0.58642	1.72
59	0.60	0.16552	1.90732	1.73336	0.56612	0.56372	1.67
60	0.62	0.14914	1.71916	1.51142	0.47783	0.47568	1.61
61	0.64	0.13615	1.46806	1.33669	0.40996	0.40754	1.56
62	0.66	0.14161	1.75359	1.34813	0.40145	0.39858	1.52
63	0.68	0.15367	1.85258	1.41993	0.41058	0.40746	1.47
64	0.70	0.16446	1.75202	1.47616	0.41334	0.41149	1.43
65	0.72	0.16040	1.64248	1.39978	0.38212	0.37936	1.39
66	0.74	0.14915	1.61251	1.26642	0.33597	0.33394	1.35
67	0.76	0.16057	1.57224	1.32750	0.34338	0.34084	1.32
68	0.78	0.17913	1.59266	1.44299	0.36327	0.36099	1.28
69	0.80	0.18584	1.69089	1.45955	0.35775	0.35600	1.25
70	0.82	0.19547	1.83473	1.49779	0.35886	0.35642	1.22
71	0.84	0.19510	1.85877	1.45935	0.34022	0.33900	1.19
72	0.86	0.19321	1.71122	1.41159	0.32171	0.32028	1.16
73	0.88	0.20256	1.67547	1.44626	0.32247	0.32069	1.14
74	0.90	0.20867	1.64417	1.45683	0.31757	0.31586	1.11
75	0.92	0.22540	1.68543	1.53941	0.32824	0.32651	1.09
76	0.94	0.25264	1.75116	1.68869	0.35247	0.35055	1.06
77	0.96	0.27876	1.75505	1.82446	0.37302	0.37084	1.04
78	0.98	0.29797	1.72103	1.91040	0.38186	0.38038	1.02
79	1.00	0.31142	1.70665	1.95673	0.38400	0.38182	1.00
80	1.05	0.33056	1.86700	1.97809	0.37049	0.36760	0.95
81	1.10	0.34010	1.98275	1.94264	0.34638	0.34461	0.91
82	1.15	0.38232	2.18670	2.08887	0.35752	0.35444	0.87
83	1.20	0.43710	2.43040	2.28867	0.37540	0.37216	0.83
84	1.25	0.41217	2.48596	2.07178	0.32532	0.32341	0.80

85	1.30	0.35374	2.07796	1.70971	0.25849	0.25663	0.77
86	1.35	0.31529	1.82241	1.46742	0.21360	0.21210	0.74
87	1.40	0.30429	1.71927	1.36566	0.19212	0.19034	0.71
88	1.45	0.30631	1.66137	1.32732	0.18009	0.17862	0.69
89	1.50	0.31859	1.66658	1.33450	0.17445	0.17360	0.67
90	1.55	0.33532	1.63453	1.35927	0.17193	0.17112	0.65
91	1.60	0.33890	1.61066	1.33085	0.16392	0.16231	0.63
92	1.65	0.31778	1.50173	1.21009	0.14561	0.14311	0.61
93	1.70	0.28140	1.35995	1.04004	0.12177	0.11938	0.59
94	1.75	0.30802	1.33546	1.10590	0.12463	0.12331	0.57
95	1.80	0.35605	1.46700	1.24286	0.13603	0.13473	0.56
96	1.85	0.38459	1.54226	1.30617	0.13881	0.13777	0.54
97	1.90	0.41120	1.54079	1.35982	0.14101	0.13965	0.53
98	1.95	0.42776	1.50608	1.37831	0.13955	0.13792	0.51
99	2.00	0.45877	1.58228	1.44128	0.14253	0.14062	0.50
100	2.05	0.49417	1.68678	1.51462	0.14614	0.14417	0.49
101	2.10	0.54015	1.79416	1.61614	0.15074	0.15017	0.48
102	2.15	0.58631	1.97185	1.71343	0.15668	0.15551	0.47
103	2.20	0.59876	2.08291	1.71005	0.15348	0.15167	0.45
104	2.25	0.59010	2.04481	1.64786	0.14423	0.14291	0.44
105	2.30	0.54691	1.88205	1.49406	0.12852	0.12675	0.43
106	2.35	0.50389	1.76316	1.34725	0.11256	0.11187	0.43
107	2.40	0.45720	1.68962	1.19696	0.09891	0.09732	0.42
108	2.50	0.39717	1.45197	0.99821	0.07839	0.07791	0.40
109	2.60	0.42222	1.44539	1.02035	0.07780	0.07658	0.38
110	2.70	0.41356	1.27860	0.96239	0.07028	0.06955	0.37
111	2.80	0.37799	1.27516	0.84821	0.05970	0.05911	0.36
112	2.90	0.42097	1.45197	0.91208	0.06234	0.06137	0.34
113	3.00	0.44342	1.50548	0.92870	0.06150	0.06041	0.33
114	3.10	0.45766	1.42670	0.92760	0.05970	0.05839	0.32
115	3.20	0.42651	1.27704	0.83745	0.05273	0.05107	0.31
116	3.30	0.37342	1.12135	0.71100	0.04371	0.04204	0.30
117	3.40	0.32021	1.01441	0.59175	0.03557	0.03396	0.29
118	3.50	0.33969	0.94441	0.60981	0.03443	0.03400	0.29
119	3.60	0.38484	0.92642	0.67168	0.03683	0.03641	0.28
120	3.70	0.39485	0.92955	0.67051	0.03594	0.03536	0.27
121	3.80	0.40968	0.93190	0.67740	0.03518	0.03478	0.26
122	3.90	0.38228	0.91874	0.61588	0.03143	0.03081	0.26
123	4.00	0.34203	0.92697	0.53726	0.02642	0.02621	0.25
124	4.10	0.30825	0.96203	0.47239	0.02341	0.02248	0.24
125	4.20	0.32556	0.98725	0.48703	0.02406	0.02263	0.24
126	4.30	0.34146	0.99738	0.49894	0.02413	0.02264	0.23
127	4.40	0.34807	0.99104	0.49705	0.02358	0.02204	0.23
128	4.50	0.34534	0.97000	0.48218	0.02249	0.02091	0.22
129	4.60	0.33556	0.93804	0.45834	0.02099	0.01944	0.22
130	4.70	0.33170	0.89990	0.44343	0.01925	0.01841	0.21
131	4.80	0.34522	0.86035	0.45189	0.01886	0.01837	0.21
132	4.90	0.33190	0.82347	0.42559	0.01758	0.01695	0.20
133	5.00	0.30064	0.79241	0.37780	0.01543	0.01474	0.20
134	5.10	0.28033	0.76907	0.34537	0.01383	0.01321	0.20
135	5.20	0.27769	0.75443	0.33554	0.01330	0.01259	0.19
136	5.40	0.27310	0.77836	0.31776	0.01207	0.01148	0.19
137	5.60	0.29401	0.79628	0.32988	0.01202	0.01149	0.18
138	5.80	0.30778	0.80794	0.33342	0.01178	0.01122	0.17
139	6.00	0.32463	0.84580	0.33995	0.01222	0.01106	0.17
140	6.20	0.37930	0.87676	0.38439	0.01325	0.01210	0.16
141	6.40	0.43335	0.89546	0.42544	0.01413	0.01297	0.16
142	6.60	0.48253	0.89989	0.45937	0.01477	0.01358	0.15
143	6.80	0.52393	0.89041	0.48411	0.01512	0.01389	0.15
144	7.00	0.55920	0.87529	0.50194	0.01518	0.01399	0.14
145	7.30	0.62005	0.88042	0.53368	0.01482	0.01427	0.14

146	7.60	0.66716	0.90825	0.55156	0.01449	0.01416	0.13
147	8.00	0.70847	0.90727	0.55643	0.01389	0.01357	0.13
148	8.50	0.72253	0.93252	0.53409	0.01272	0.01226	0.12
149	9.00	0.72748	0.96895	0.50788	0.01163	0.01101	0.11
150	9.50	0.81580	0.98875	0.53956	0.01146	0.01108	0.11
151	10.00	0.88090	0.99633	0.55348	0.01116	0.01080	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.

AREA OF ACC. RESPONSE SPECTRUM = 0.859

AREA OF VEL. RESPONSE SPECTRUM = 4.045

MAX. ACCELERATION RESPONSE VALUE = 1.516

MAX. VELOCITY RESPONSE VALUE = 2.486

*** End of Output File No. 1 ***

7225-11
part 23

APPENDIX D-3

ESTIMATES OF POTENTIAL EMBANKMENT SETTLEMENTS (PERMANENT DEFORMATIONS)

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation — PROJECT NO. 072047

Estimate of Potential Embankment Settlements (Permanent Deformations) — PAGE 1 OF 68

MADE BY BEG DATE 1/22/08 CHECKED BY [illegible] DATE 1/23/08

CALCULATION BRIEF FOR

ESTIMATE OF POTENTIAL EMBANKMENT SETTLEMENTS (PERMANENT DEFORMATIONS)

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH CELL

OBJECTIVE: Estimate maximum anticipated settlements for the Pond Creek – South Cell embankment and impoundment geometry.

METHODOLOGY: Use SHAKE2000 (Ordonez, G., 2006) (Reference 1) to determine time history of accelerations from time history of horizontal shear stresses (Reference 7) at the critical layer-to-failure surface interface, and estimate permanent deformations based on (Houston, et al., 1987), for the critical soil mass. Cumulative deformations are estimated from stress-to-acceleration time histories, above the yield accelerations (determined in Reference 8), using the techniques presented by Newmark (1965).

REFERENCES:

1. Ordonez, Gustavo A.(2006) "SHAKE2000: A Computer Program for the 1-D Analysis of Geotechnical Earthquake Engineering Problems," February 2006.

2. Schnabel, P. B., Lysmer, J. and Seed, H. B. (1972) "SHAKE: A Computer Program for Earthquake Response Analysis of Horizontally Layered Sites," Report No. EERC 72-12, University of California, Berkeley.

3. Houston, S. L., Houston, W. N., and Padilla, J. M. (1987) "Microcomputer-Aided Evaluation of Earthquake-Induced Permanent Slope Displacements," Arizona State University, Microcomputers in Civil Engineering 2, Elsevier.

4. Newmark, N. M. (1965) "Effects of Earthquake on Dams and Embankments," Geotechnique, London, Vol. 5, No. 2, June, 1965.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation

PROJECT NO. 072047

Estimate of Potential Embankment Settlements (Permanent Deformations)

PAGE 2 OF 68

MADE BY BEG DATE 1/22/08 CHECKED BY [illegible] DATE 1/23/08

5. Poulos, S. J., Robinsky, E. I., Keller, T. O. (1986) "Liquefaction Resistance of Thickened Tailings," Journal of Geotechnical Engineering, ASCE, Vol. 111, No. 12, Paper No. 20213, pp. 1380-1394.

6. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Shear Modulus Calculations for SHAKE Columns PCSC300E and PCSC300M," Pond Creek Coal Refuse Disposal Site – South Cell" BEG, 12/28/07.

7. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Induced Cyclic Shear Stresses and Strains and Time History of Cyclic Shear Stress, SHAKE Columns PCSC300E and PCSC300M," Pond Creek Coal Refuse Disposal Site – South Cell," BEG, 1/7/07.

8. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Estimation of the Seismic Pseudo-Static Factors of Safety and Yield Accelerations for the Downstream and Upstream Slope Geometries, Pond Creek Coal Refuse Disposal Site, South Cell," BEG, 1/22/08.

Pseudo-Static (Seismic) Factor of Safety and Estimation of Yield Accelerations:

Based on the information presented in Reference 8 and shown in Figure 3 of the permanent deformation report, the minimum pseudo-static (seismic) factors of safety were less than 1.0, thus permanent deformation analyses are required. Also shown in Reference 8, the minimum yield acceleration for the Pond Creek – South Cell embankment in the downstream and upstream directions was estimated at 0.18g. A yield acceleration of 0.18g is assumed for all downstream and upstream slope conditions, which will be used as input for estimating the corresponding permanent deformations.

SHAKE2000 Input Summary

A SHAKE2000 crest column was chosen to analyze the induced acceleration of the coal refuse/subgrade soil materials. SHAKE2000 column PCSC300E and PCSC300M were created based on shear wave velocities from eight (8) piezo-seismic cone penetration test (PSCPT) holes performed throughout the Pond Creek facility, particularly in the vicinity of the South Cell (Reference 6) including CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B. Columns PCSC300E and PCSC300M are utilized for the permanent deformation analyses in the upstream (min. fines) and downstream (max. fines) directions, respectively, and all (16) layers were evaluated to assess maximum permanent deformations in the both the upstream and downstream directions.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation

PROJECT NO. 072047

Estimate of Potential Embankment Settlements (Permanent Deformations)

PAGE 3 OF 68

MADE BY BEG DATE 1/22/08 CHECKED BY [illegible] DATE 1/23/08

Maximum Design Earthquake (MDE)

As discussed in Reference 7, two synthetic acceleration-time histories were created utilizing Eastern North American (ENA) earthquake source and propagation parameters for the site maximum design earthquakes (MDE). The New Madrid earthquake source has a maximum magnitude (M) of 8.0 and an epicenter distance of 83 km from the site. The Background earthquake, which could occur practically anywhere in this region has a magnitude of M6.8 and was placed 13.5 km from the site. Since the two MDE scenarios are markedly different in terms of maximum acceleration, duration, and frequency content, both records were used in SHAKE2000 to investigate the response of the embankment to these earthquakes. The resulting ground motion parameters and the response of the embankment to these MDE's are discussed in the Critical Mass Displacement subsection of this calculation brief.

Analysis to Define Time History of Accelerations:

Analyses were performed to estimate the time history of horizontal shear stress at various layer interfaces (Option 7 of SHAKE2000, See Reference 7). The (stress) time history data is subsequently converted to acceleration time histories in SHAKE2000 and subsequently used in SHAKE2000 to estimate the maximum displacement associated with the center of gravity of the failure mass based on Houston, et al., 1989.

The analysis technique for determining time histories of accelerations corresponds to the techniques used by Castro et al., (1989) and Houston et al., (1989). The time histories of earthquake accelerations on the potential sliding mass were converted in SHAKE2000 by dividing each time step by the effective vertical stress on each layer, based on the equation F = ma and solving for acceleration, a, at each time step.

Critical Mass Displacements:

Horizontal displacements of the proposed South Cell geometry were computed using SHAKE2000 which double integrates the difference between the estimated accelerations and yield accelerations for the duration of the time history. The integration is performed assuming that movements of the sliding block can only occur in the downhill direction for estimated values of acceleration which exceeds the yield acceleration. Movements in the uphill direction are not likely since the value of yield acceleration is notably higher due to the additive static weight resistance against pushing the sliding block uphill.

The anticipated maximum displacements of the soil mass were estimated as a function of earthquake acceleration for the corresponding critical failure surface. A summary of ground motion response

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PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation

PROJECT NO. 072047

Estimate of Potential Embankment Settlements (Permanent Deformations)

PAGE 4 OF 68

MADE BY BEG DATE 1/22/08 CHECKED BY [illegible] DATE 1/23/08

parameters and ground displacements estimated for the critical South Cell geometry is presented in the following tables.

Upstream (E) Downstream (M) Permanent Deformation Analysis, Yield Acceleration (Ay = 0.18 g)

M6.8 @ 13.5 km Epicenter (A_{max} = 0.54 g, f_M = 20.4 Hz) (SHAKE Option 3)

SHAKE2000 Column	(Option 5) Average f_N of Column, Hz	(Option 6) A_{max} in Any Critical Layer, g (Layer No.)	A_{max} Critical Layer / A_{max} Earthquake, %	Maximum Permanent Deformation, in
PCSC300E	4.35	0.81 (14)	144	1.19
PCSC300M	4.17	0.80(12)	148	1.09

f_M = Mean Square Frequency = $\frac{\sum C_i^2 f_i}{\sum C_i^2}$

where C_i = Fourier amplitudes of the entire accelogram, and
f_i = discrete Fourier frequencies.

f_N = Average Fundamental frequency of the SHAKE column = V_S / (4 * H)

Where H = Height of the SHAKE column, and
V_S = Average Shear Velocity of the SHAKE column.

M8.0@ 83 km Epicenter (A_{max} = 0.54 g, f_M = 14.6 Hz) (SHAKE Option 3)

SHAKE2000 Column	(Option 5) Average f_N of Column, Hz	(Option 6) A_{max} in Any Critical Layer, g (Layer No.)	A_{max} Critical Layer / A_{max} Earthquake, %	Maximum Permanent Deformation, in.
PCSC300E	3.85	0.88 (2)	163	16.7
PCSC300M	3.70	0.75 (2)	139	13.7

As shown in the tables above, the mean square frequency of the M6.8 Background earthquake (20.4 Hz) is greater than the M8.0 earthquake (14.6 Hz). The average fundamental frequencies of the SHAKE2000 columns are similar, ranging from about 3.70 to 4.35Hertz. Due to the large variation in frequency content between the low frequency Pond Creek – South Cell SHAKE2000 columns to the high frequency ENA earthquake scenarios, moderate shear stresses and strains are induced into the soil columns. The percentage of acceleration within the critical layer to that of the base acceleration is lower for the M6.8 and higher for the M8.0 earthquake due to their higher mean square frequency. In other words, while the input acceleration is high, particularly for both MDE scenarios (Amax = 0.54 g), most of its energy is in the high frequency range and only a portion of the induced base acceleration affects the critical layer.

Based on the Newmark method, the amount of permanent deformation for the downstream and upstream directions varies from about 1 inches to 17 inches for both columns and both MDE scenarios. The deformation is a maximum value associated with all 16 layers and should envelope any condition within the embankment at any one particular critical failure surface location. Since the maximum accelerations are higher than the 0.18g yield acceleration, there is some displacement accumulated [following performing the double integration of (Ay – A)] of the Newmark method. The Pond Creek – South Pond SHAKE2000 time histories of shear stress are presented in Appendix D, Attachment D-2, and displacement plots and output files for each layer of the permanent deformation analyses are attached.

The crest elevation (El.) for South Cell is about 502 feet, while the maximum fines level is El. 496 ft. Consequently, 6 feet of freeboard exists relative to the 17 inches (or 1.4 feet) of maximum deformation, which is more than enough to prevent overtopping in the event of either MDE scenario.

CONCLUSION

Based on the information presented in this calculation brief, the anticipated maximum permanent deformation of the Pond Creek – South Cell soil mass was estimated to be about 1.4 feet for both the downstream and upstream slope conditions and both M6.8 Background (at 13.5 km) and M8.0 New Madrid (at 83 km) MDE scenarios with maximum accelerations of 0.54g. Limited displacements in the downstream and upstream directions are anticipated since the ground motion response of the embankment only slightly exceeds the 0.18g yield acceleration in both directions. Given the amount of freeboard (about 6 feet), 1.4 feet of permanent deformations would not pose a threat to the integrity of the impoundment or adversely affect the Pond Creek – South Cell impoundment.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation

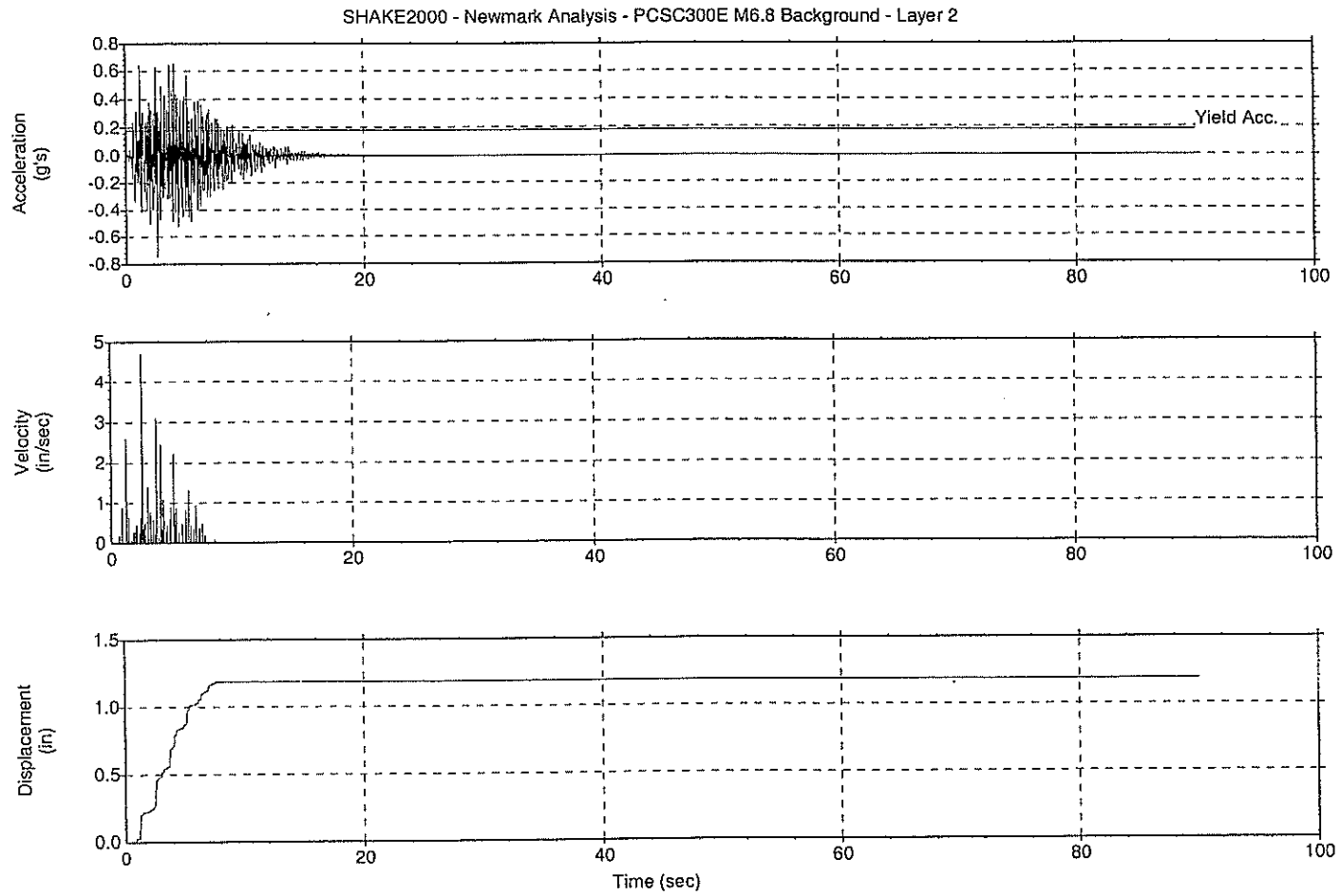
PROJECT NO. 072047

Estimate of Potential Embankment Settlements (Permanent Deformations)

PAGE 6 OF 68

MADE BY BEG DATE 1/22/08 CHECKED BY [illegible] DATE 1/23/08

SHAKE2000 PERMANENT DEFORMATION OUTPUT FILE
PCSC300E – LAYERS 1 THROUGH 16
M6.8 BACKGROUND MDE @ 13.5 KM

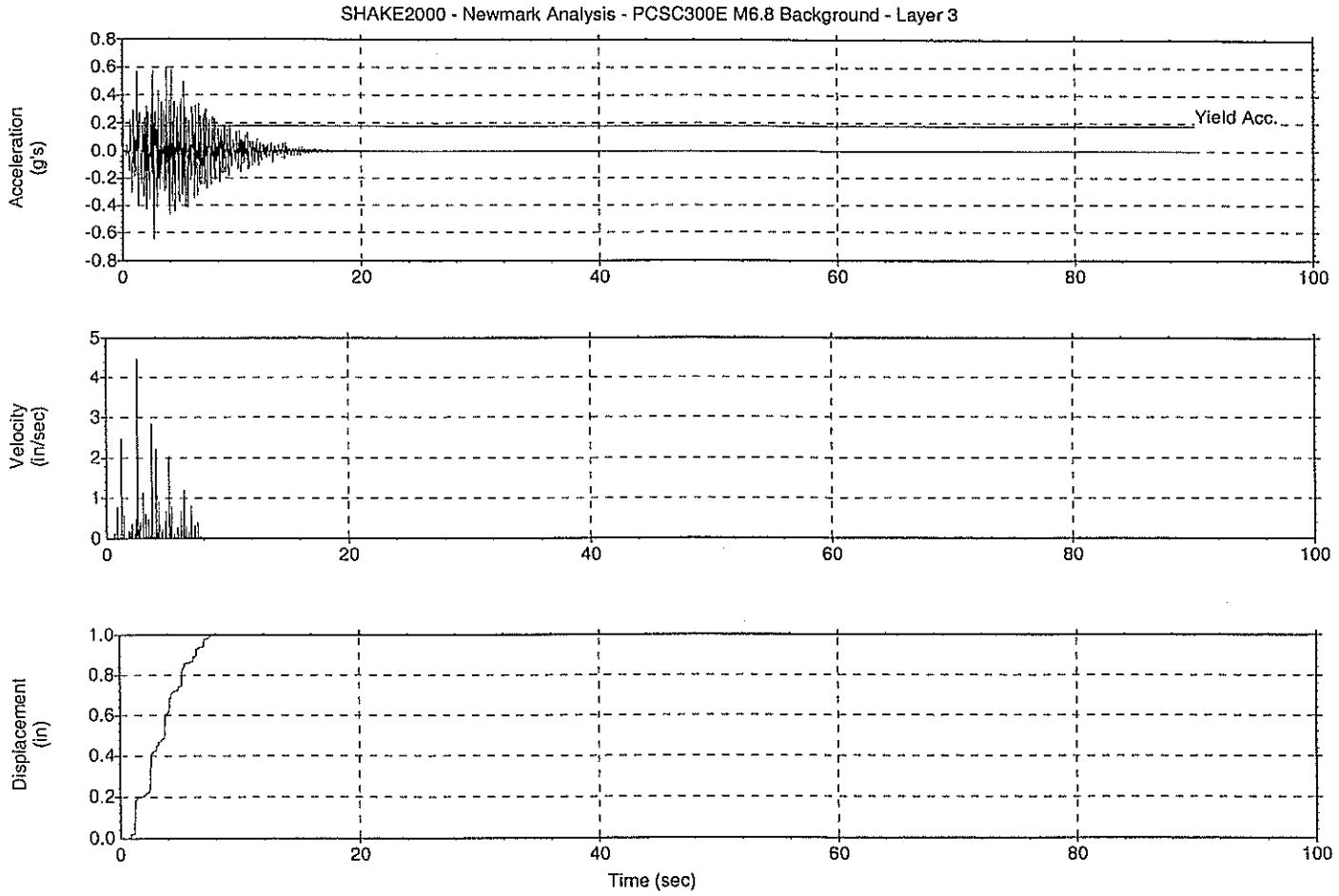


Notes:
Displacement Analysis - Newmark Method
Project: SHAKE2000 - Newmark Analysis - PCSC300E M6.8 Background - Layer 2

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 2 Stress - HEA - Layer: 2 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l2a1d1-21.hea
Peak Acceleration Value: .751025 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 1.188367 in

6 of 68

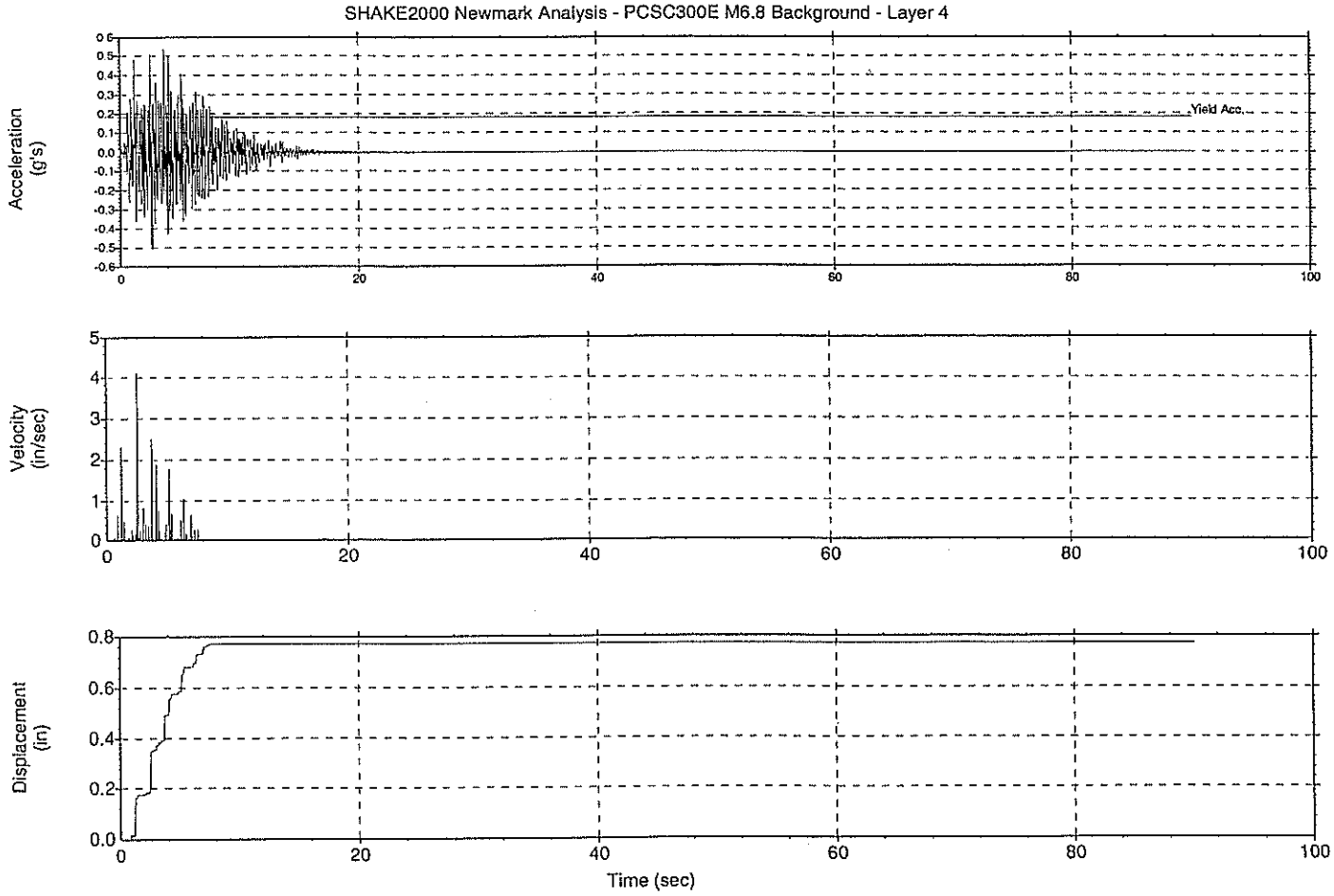


Notes:
Displacement Analysis - Newmark Method
Project: SHAKE2000 - Newmark Analysis - PCSC300E M6.8 Background - Layer 3

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 3 Stress - HEA - Layer: 3 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l3a1d1-23.hea
Peak Acceleration Value: .6469341 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .9947649 in

R14337



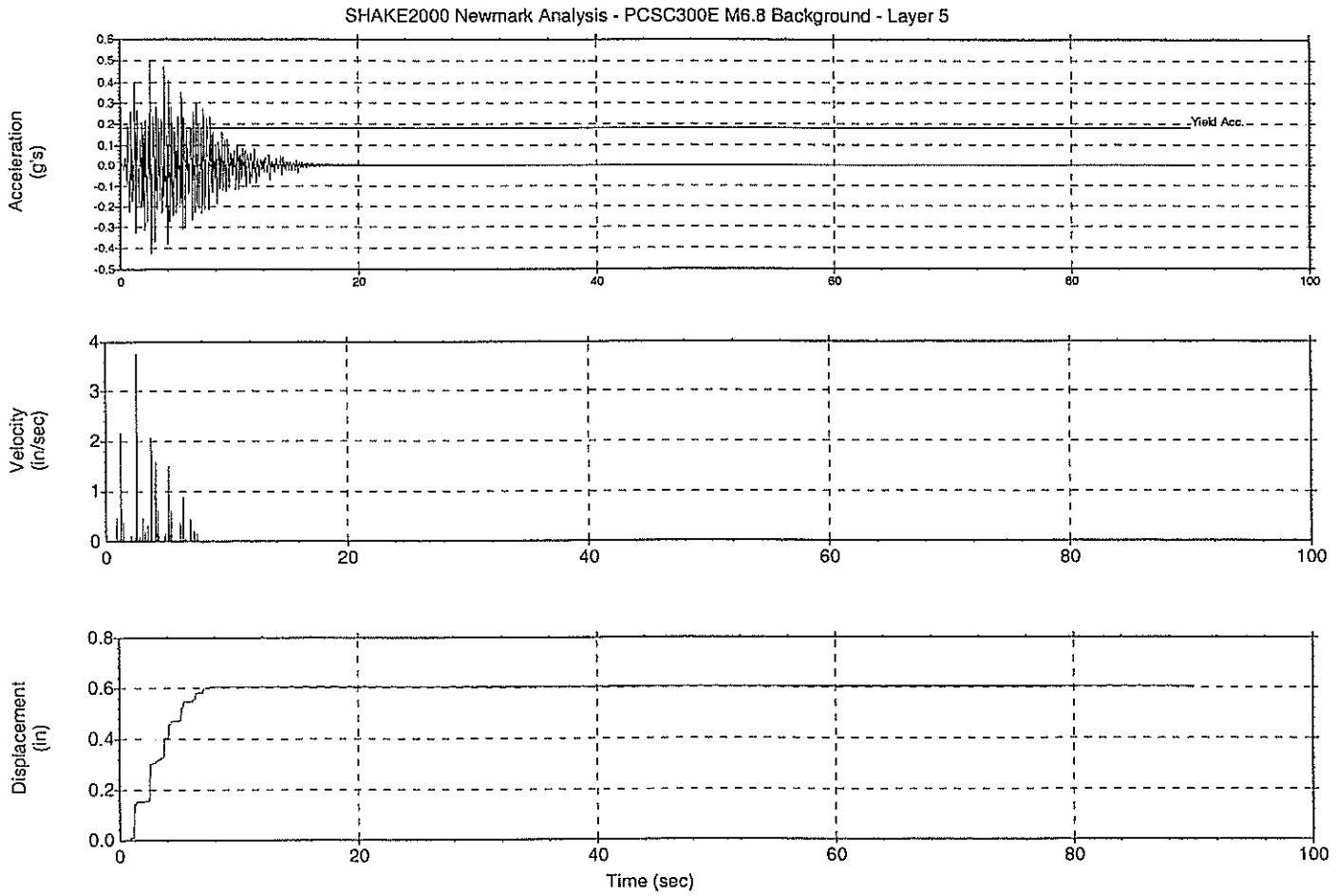
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 4

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 4 Stress - HBA - Layer: 4 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l4a1d1-25.hea
Peak Acceleration Value: .5376392 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .7707678 in

R14338



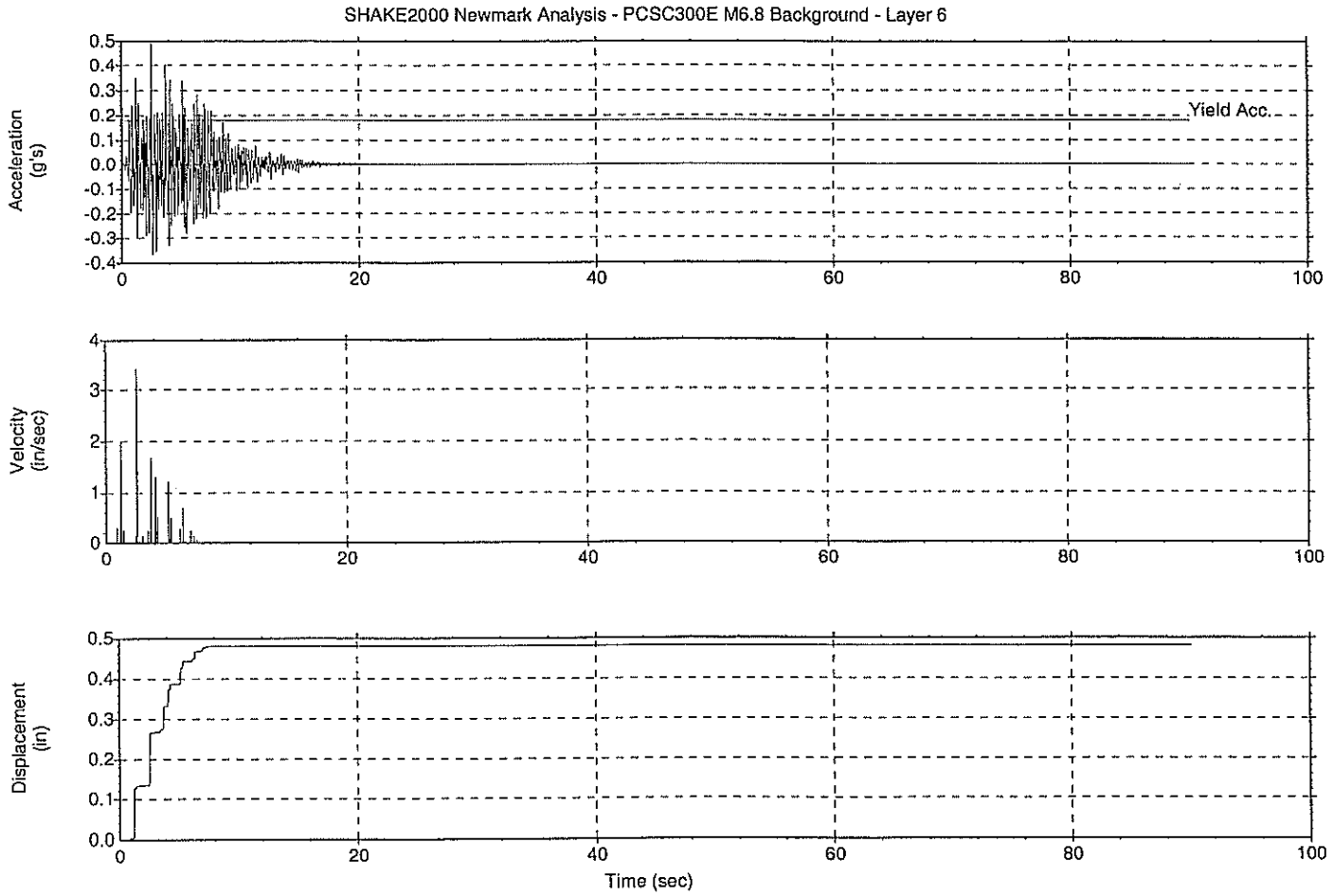
Notes:
Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 5

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 5 Stress - HEA - Layer: 5 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\15a1d1-27.hea
Peak Acceleration Value: .5017272 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .6051853 in

9/9/68

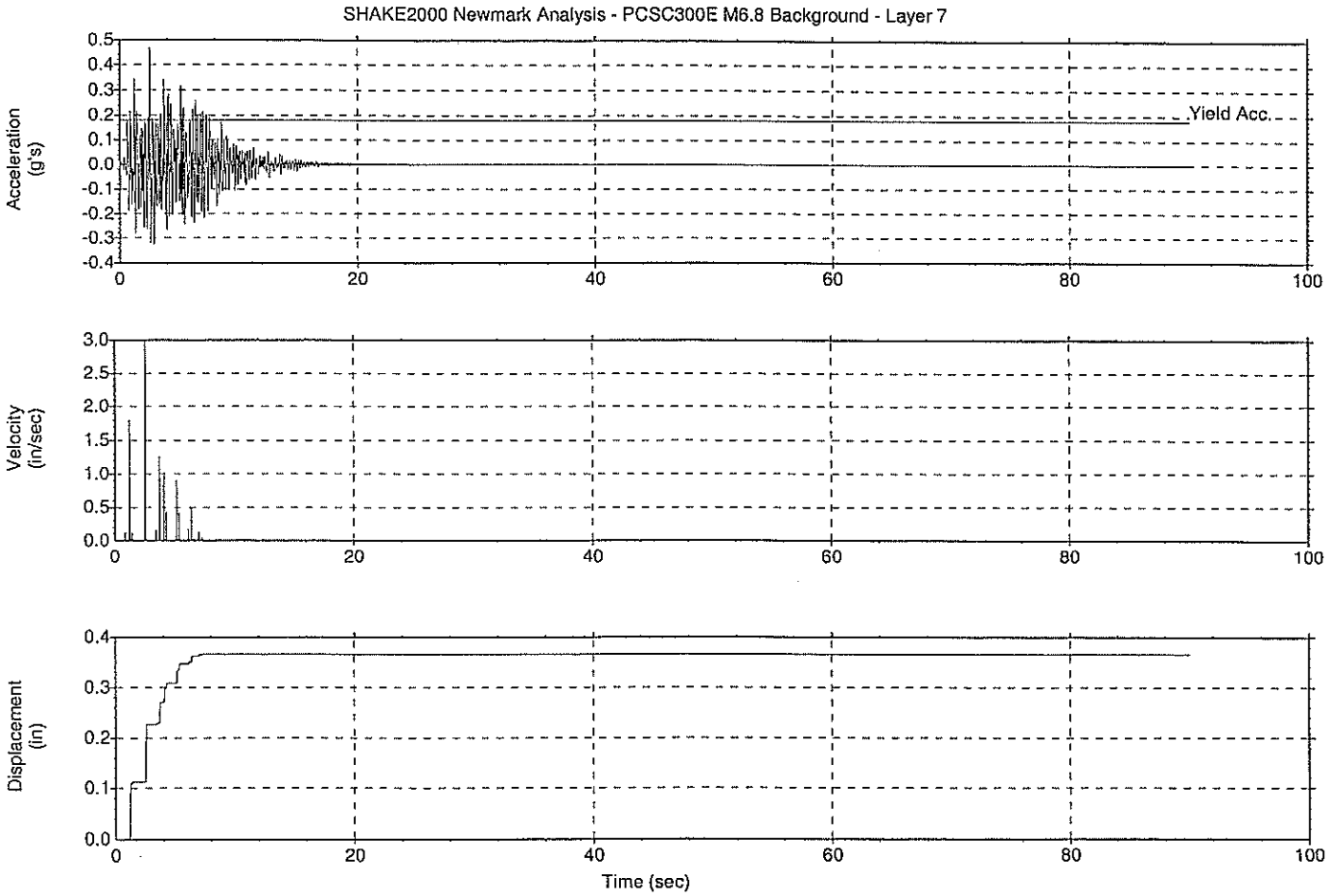
R14339



Notes:
Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 6

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 6 Stress - HEA - Layer: 6 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\16ald1-29.hea
Peak Acceleration Value: .4929173 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .4800507 in



Notes:

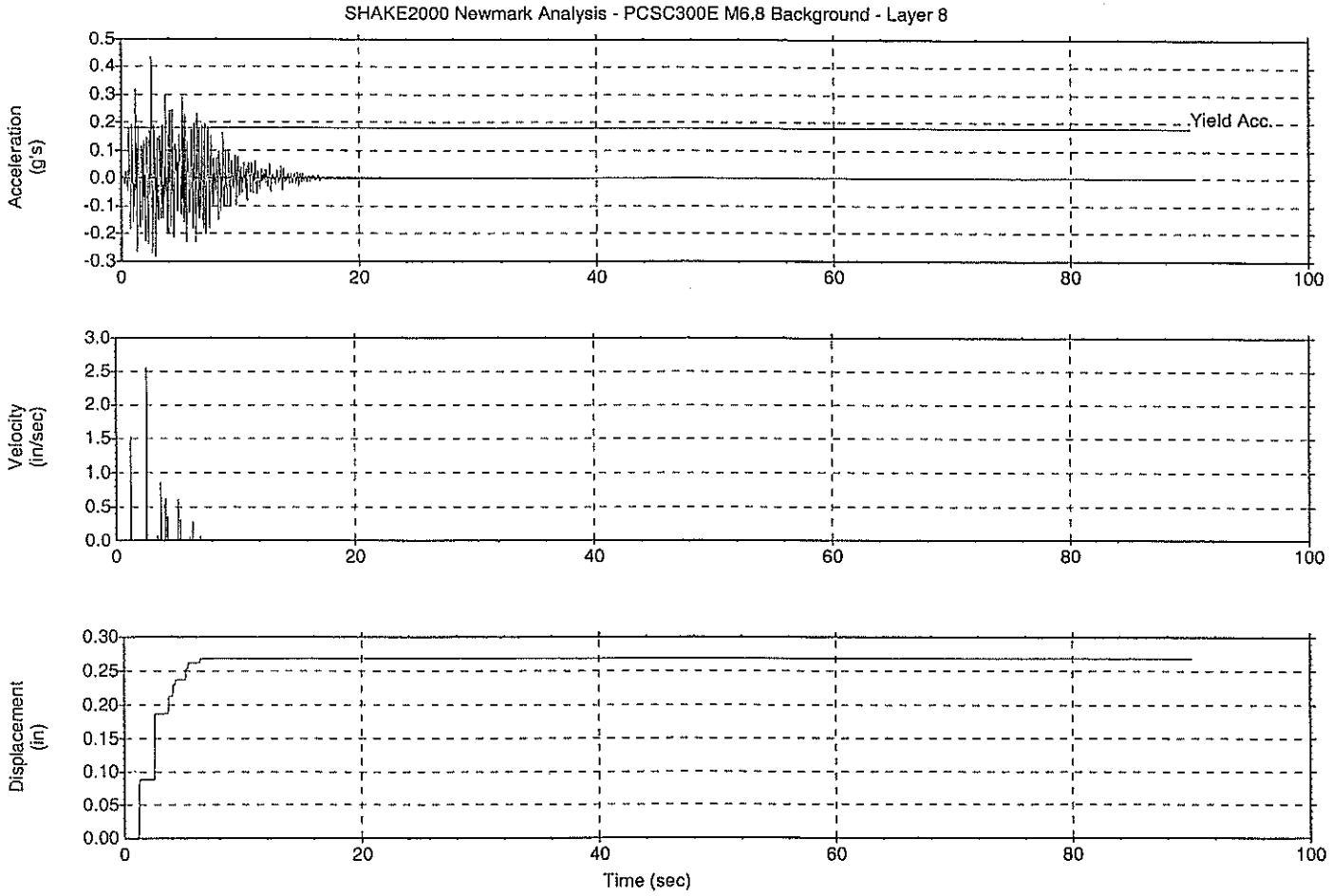
Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 7

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 7 Stress - HEA - Layer: 7 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\17aldl-31.hea
Peak Acceleration Value: .4681036 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .3661694 in

11 / 68

R14341



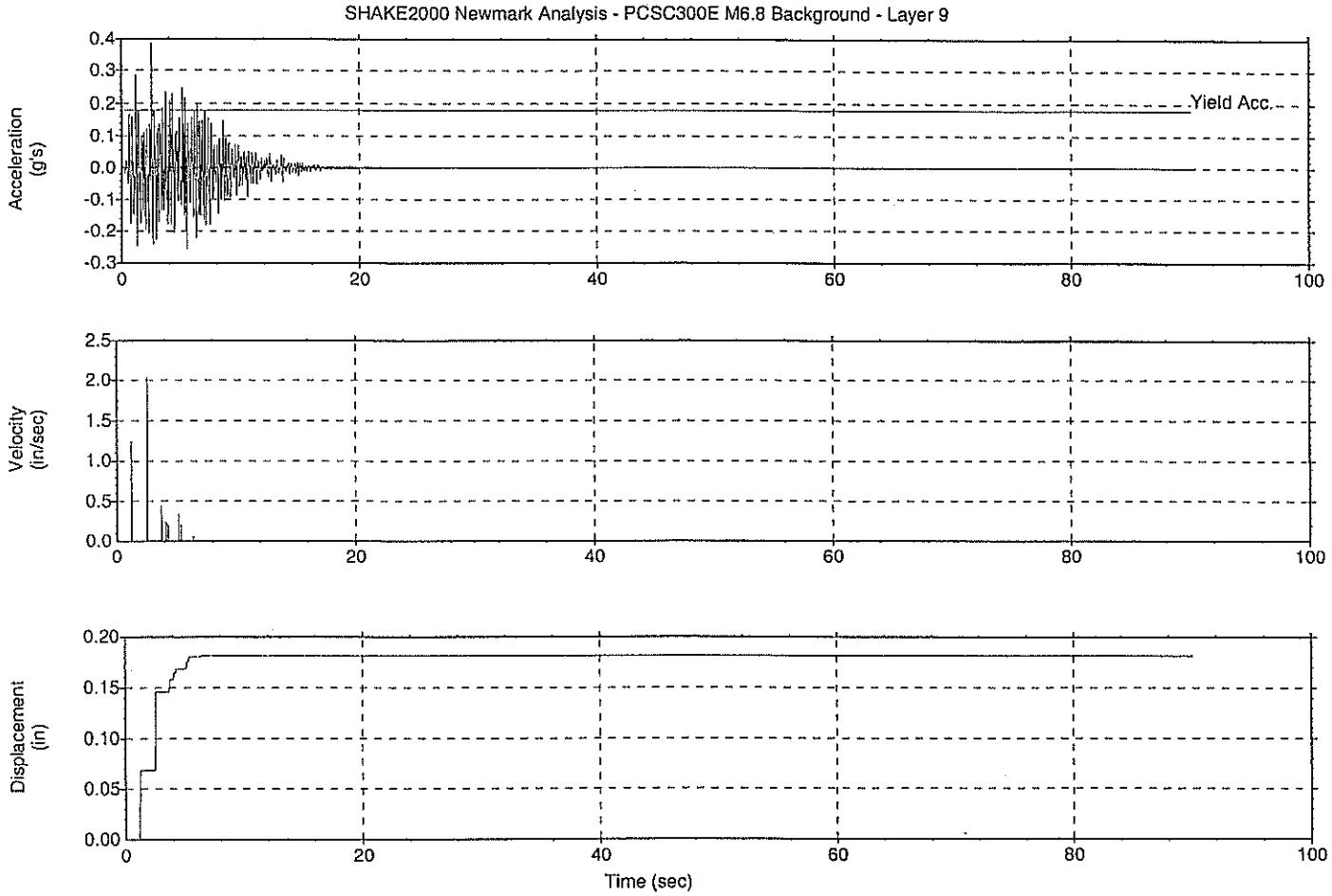
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 8

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 8 Stress - HEA - Layer: 8 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\18a1d1-33.hea
Peak Acceleration Value: .4352388 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .2687874 in

R14342



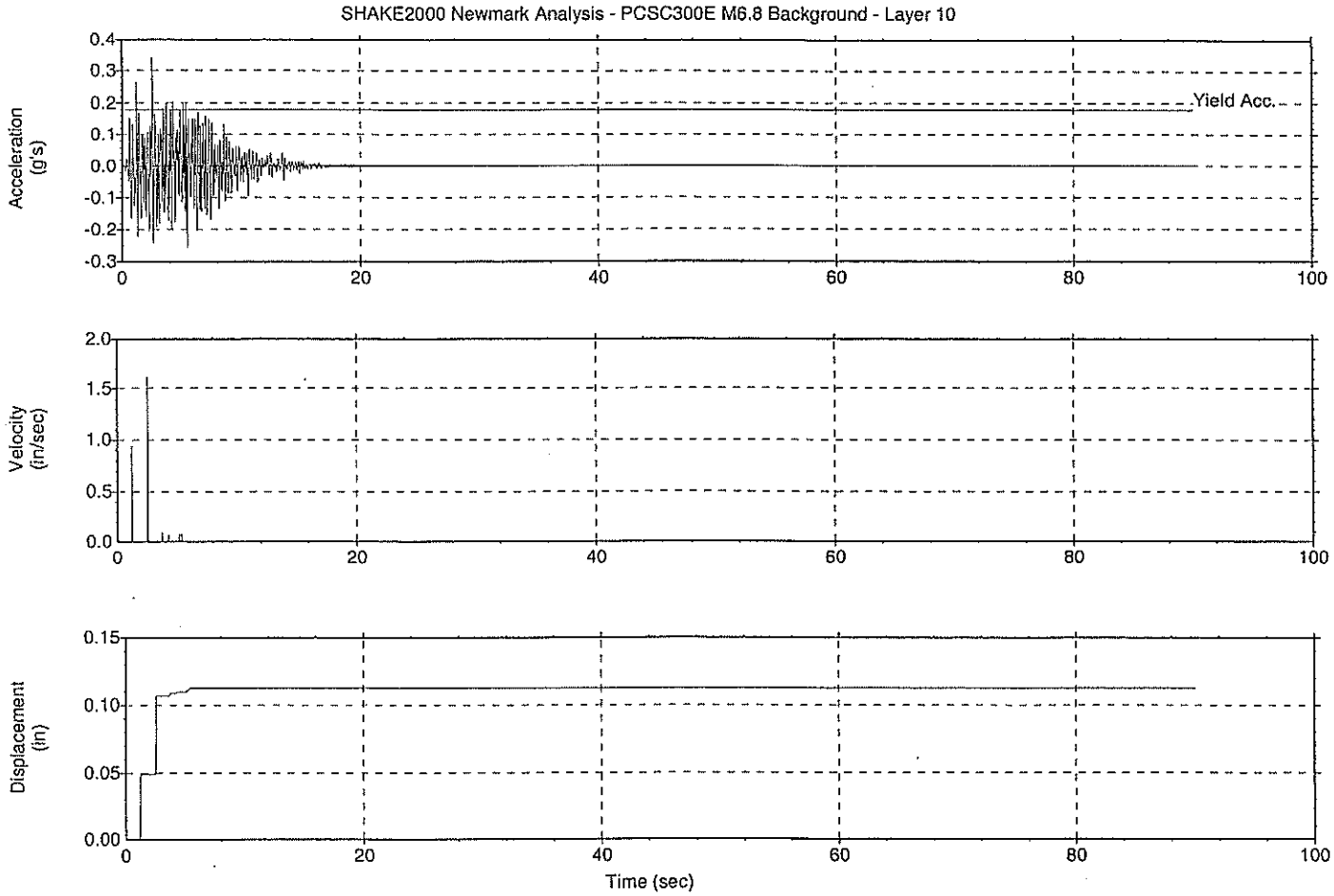
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 9

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 9 Stress - HEA - Layer: 9 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\19a1d1-35.hea
Peak Acceleration Value: .3880689 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .1818185 in

R14343



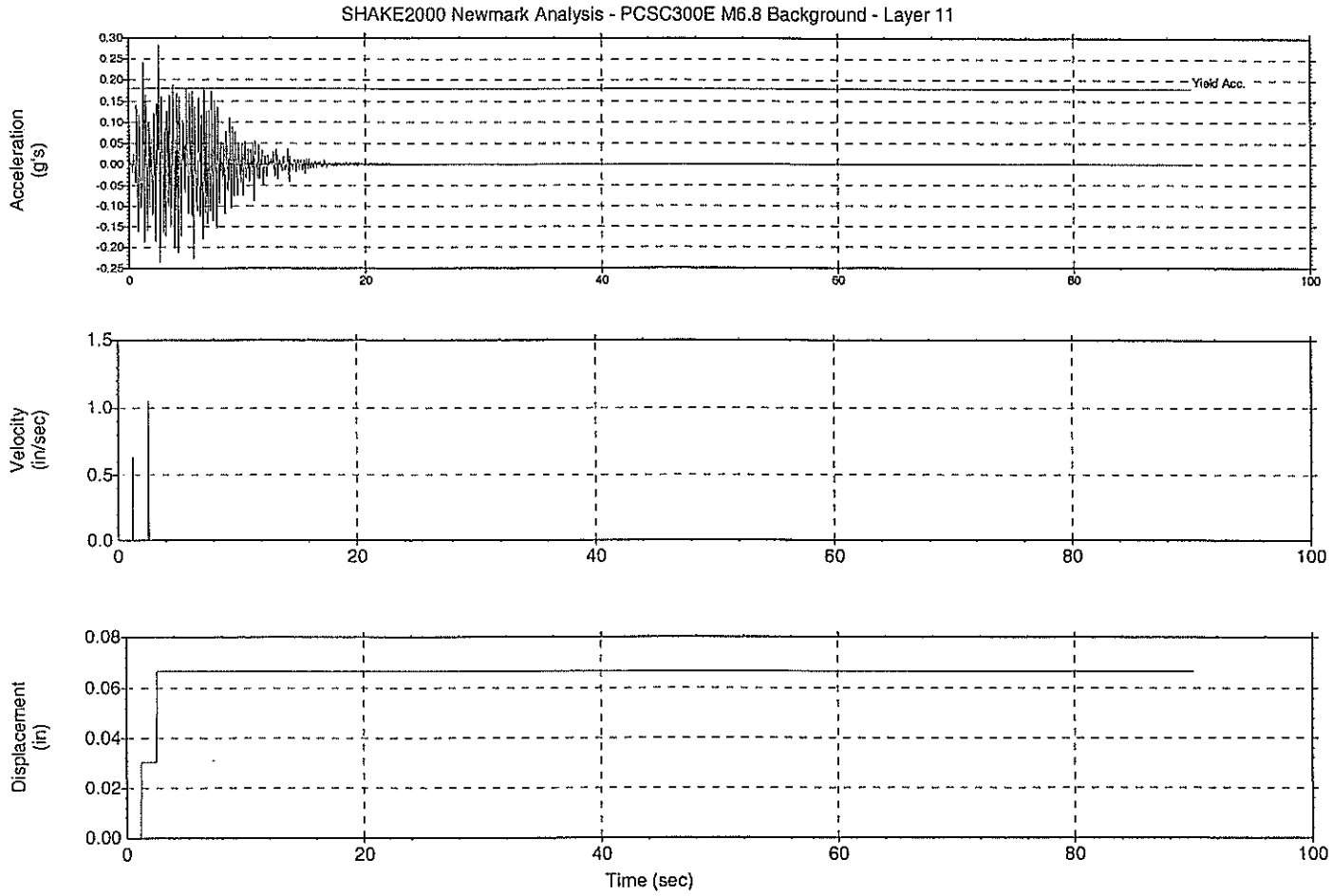
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 10

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 10 Stress - HEA - Layer: 10 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l10ald1-37.hea
Peak Acceleration Value: .3427745 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .1125055 in

R14344



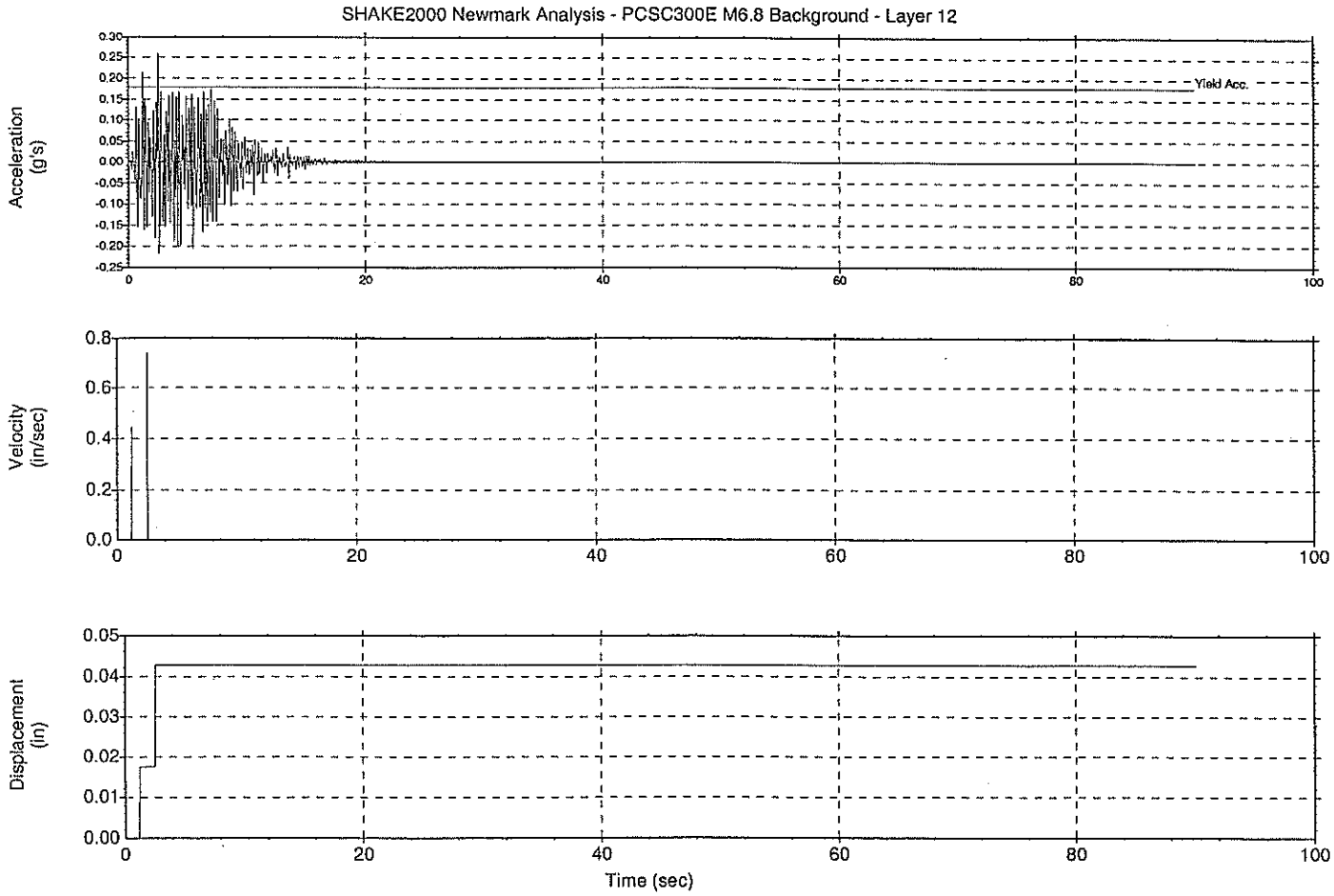
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 11

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 11 Stress - HEA - Layer: 11 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\lllald1-39.hea
Peak Acceleration Value: .2842841 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 6.657416E-02 in

R14345



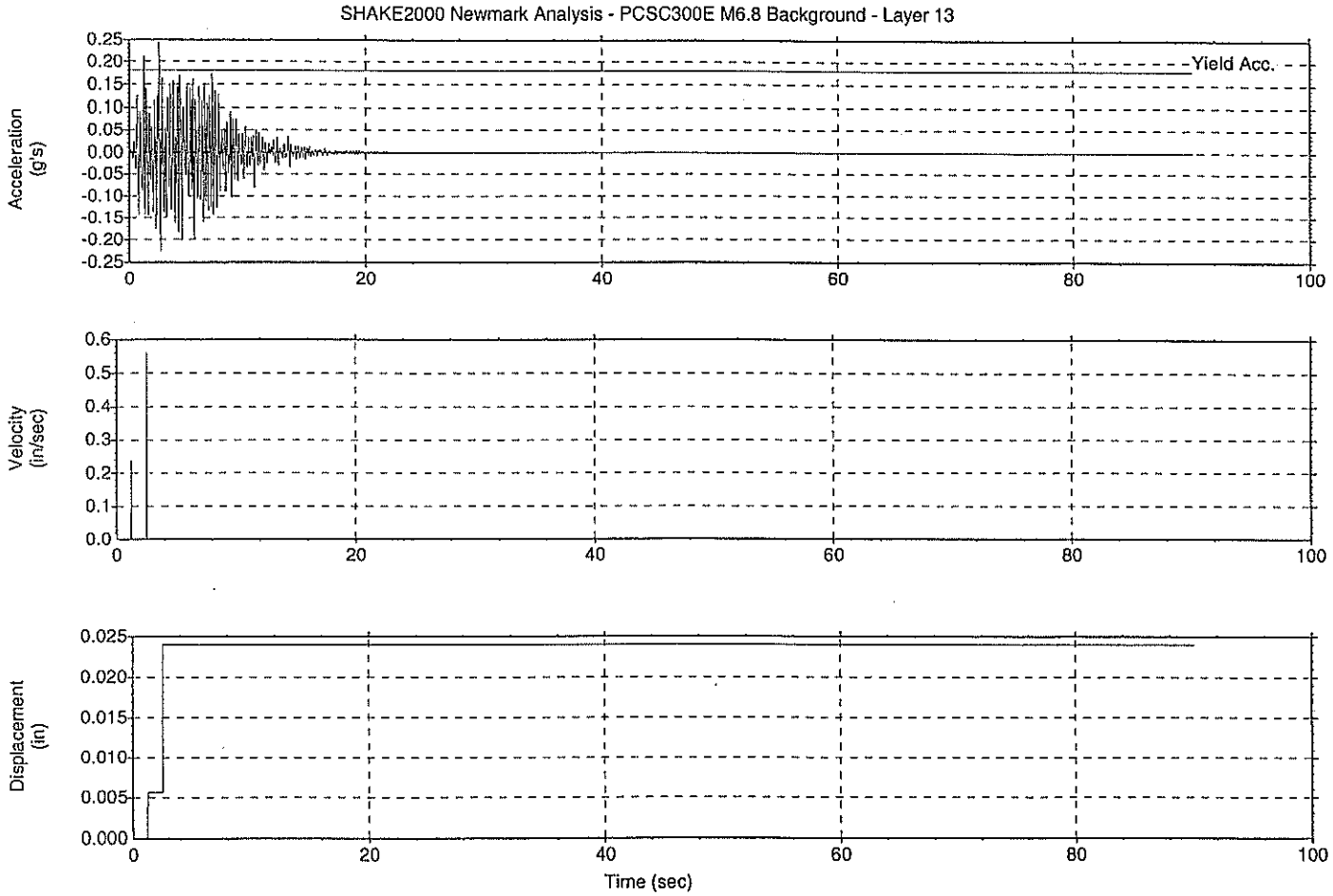
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 12

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 12 Stress - HEA - Layer: 12 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\112a1d1-41.hea
Peak Acceleration Value: .2584438 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 4.273162E-02 in

R14346



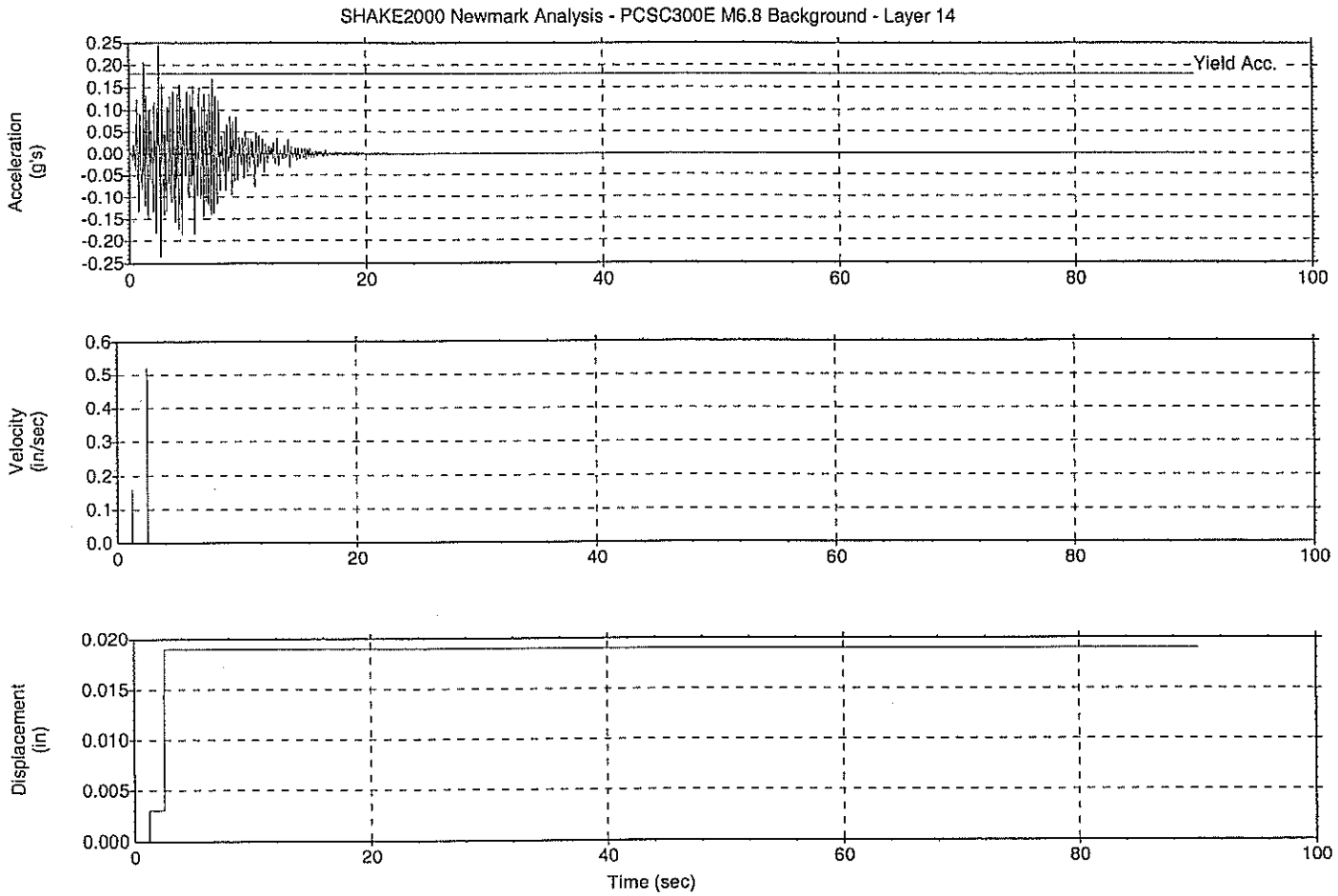
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 13

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 13 Stress - HEA - Layer: 13 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\113aldl-43.hea
Peak Acceleration Value: .2430648 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 2.399014E-02 in

R14347



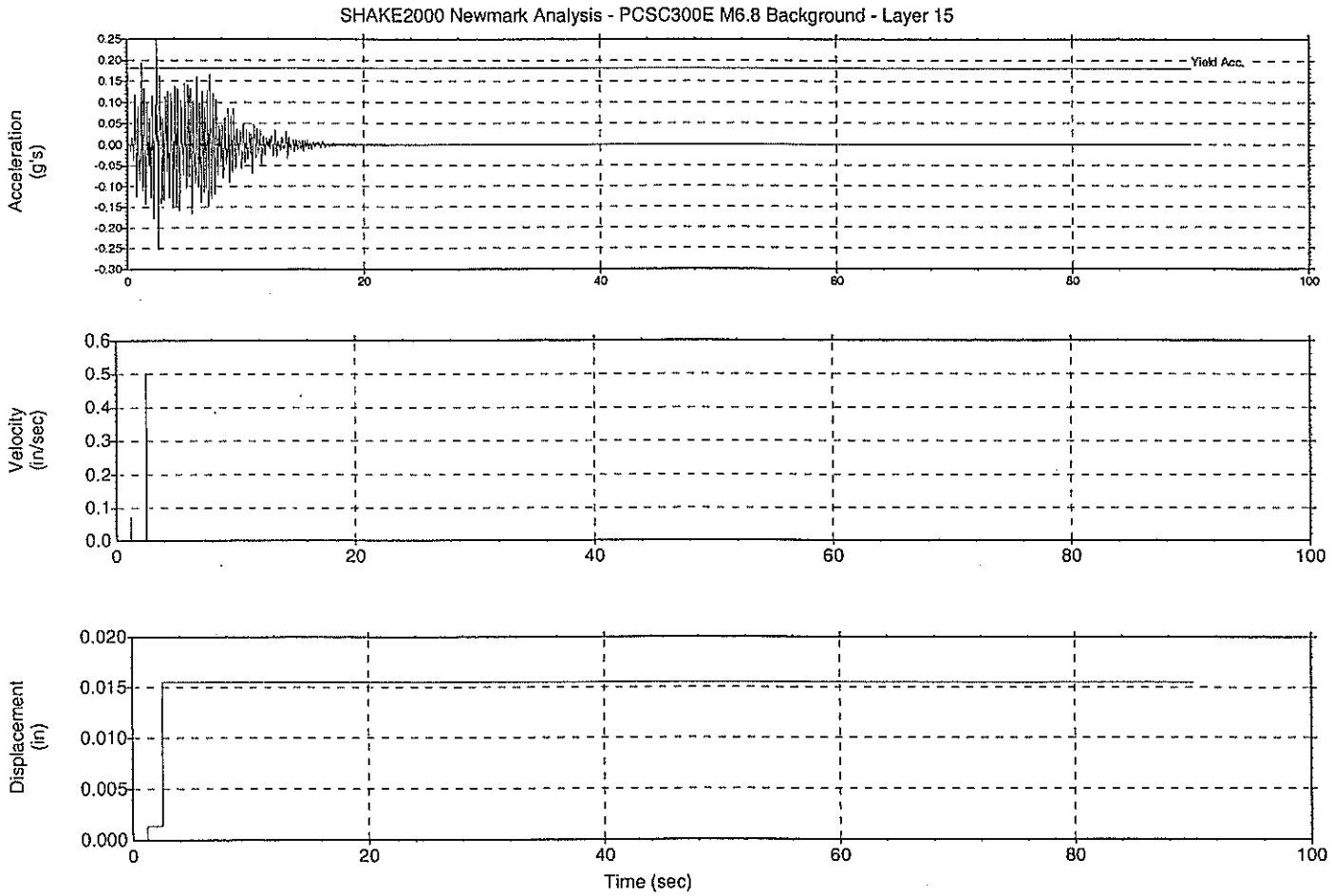
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 14

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 14 Stress - HEA - Layer: 14 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\114ald1-45.hea
Peak Acceleration Value: .2440292 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 1.901044E-02 in

R14348



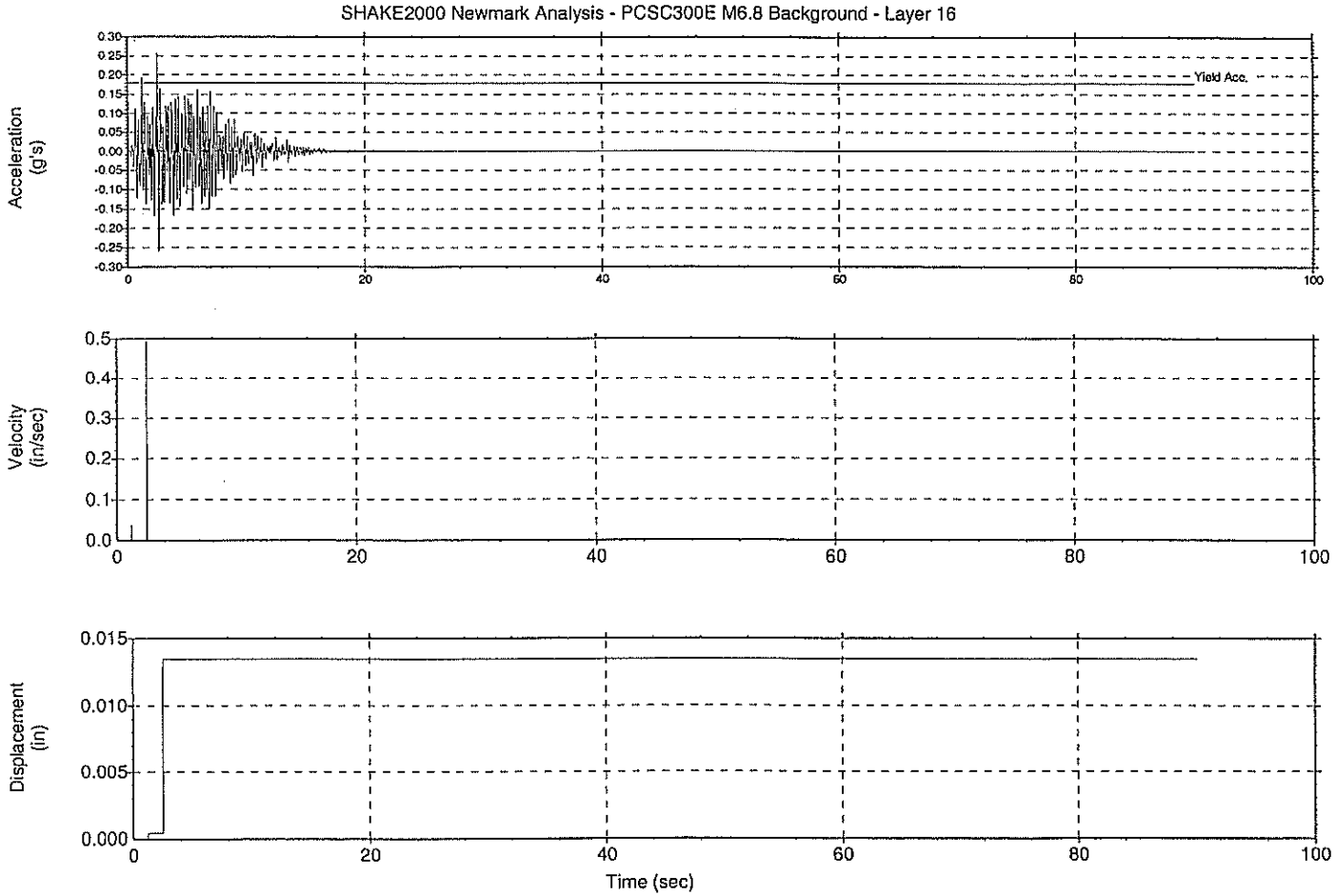
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 15

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 15 Stress - HEA - Layer: 15 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\115ald1-47.hea
Peak Acceleration Value: .2555991 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 1.554617E-02 in

R14349



Notes:
Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 16

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 16 Stress - HEA - Layer: 16 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\116a1d1-49.hea
Peak Acceleration Value: .2608154 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 1.346898E-02 in

R14350

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation

PROJECT NO. 072047

Estimate of Potential Embankment Settlements (Permanent Deformations)

PAGE 21 OF 68

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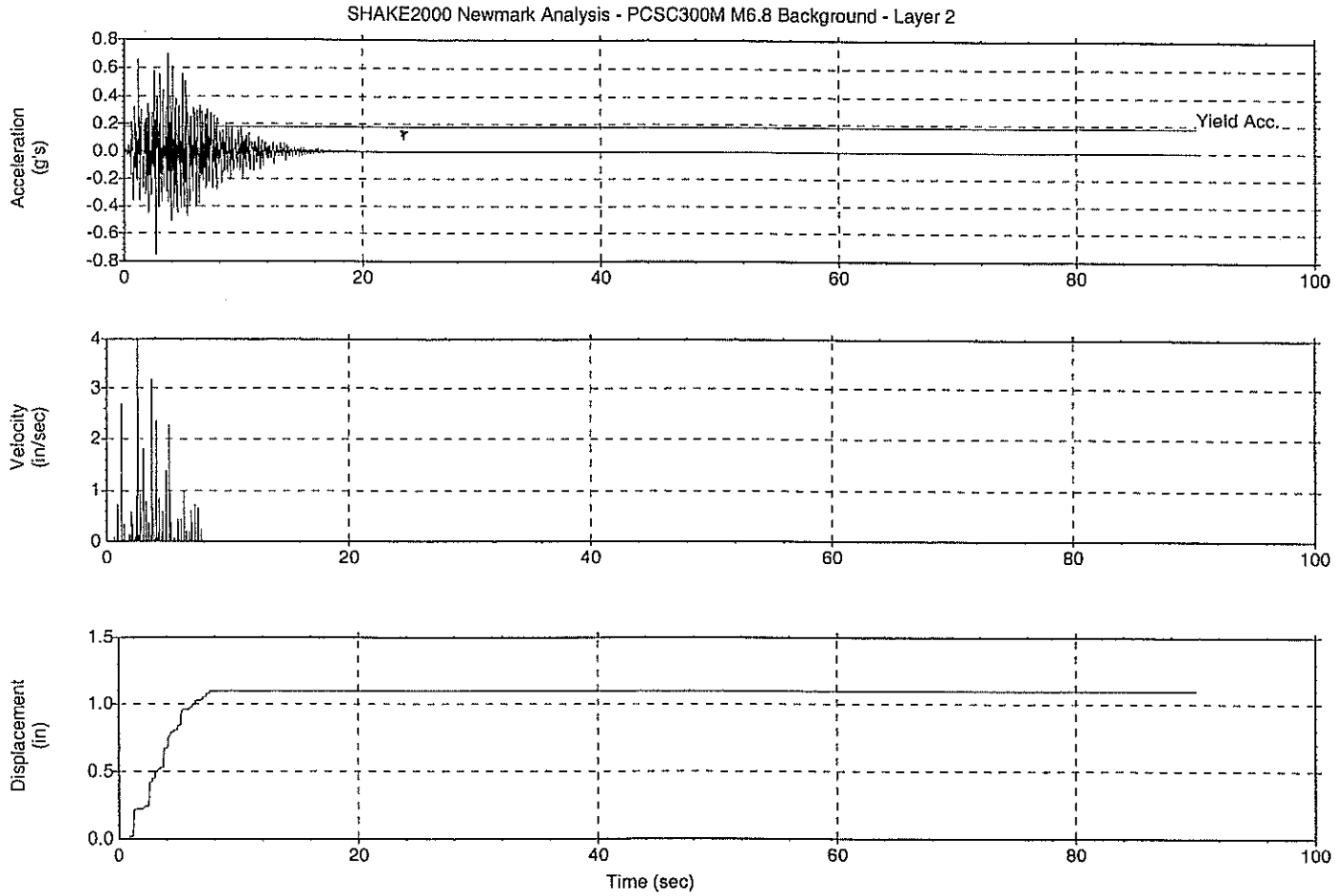
SHAKE2000 PERMANENT DEFORMATION OUTPUT FILE
PCSC300M – LAYERS 1 THROUGH 16
M6.8 BACKGROUND MDE @ 13.5 KM



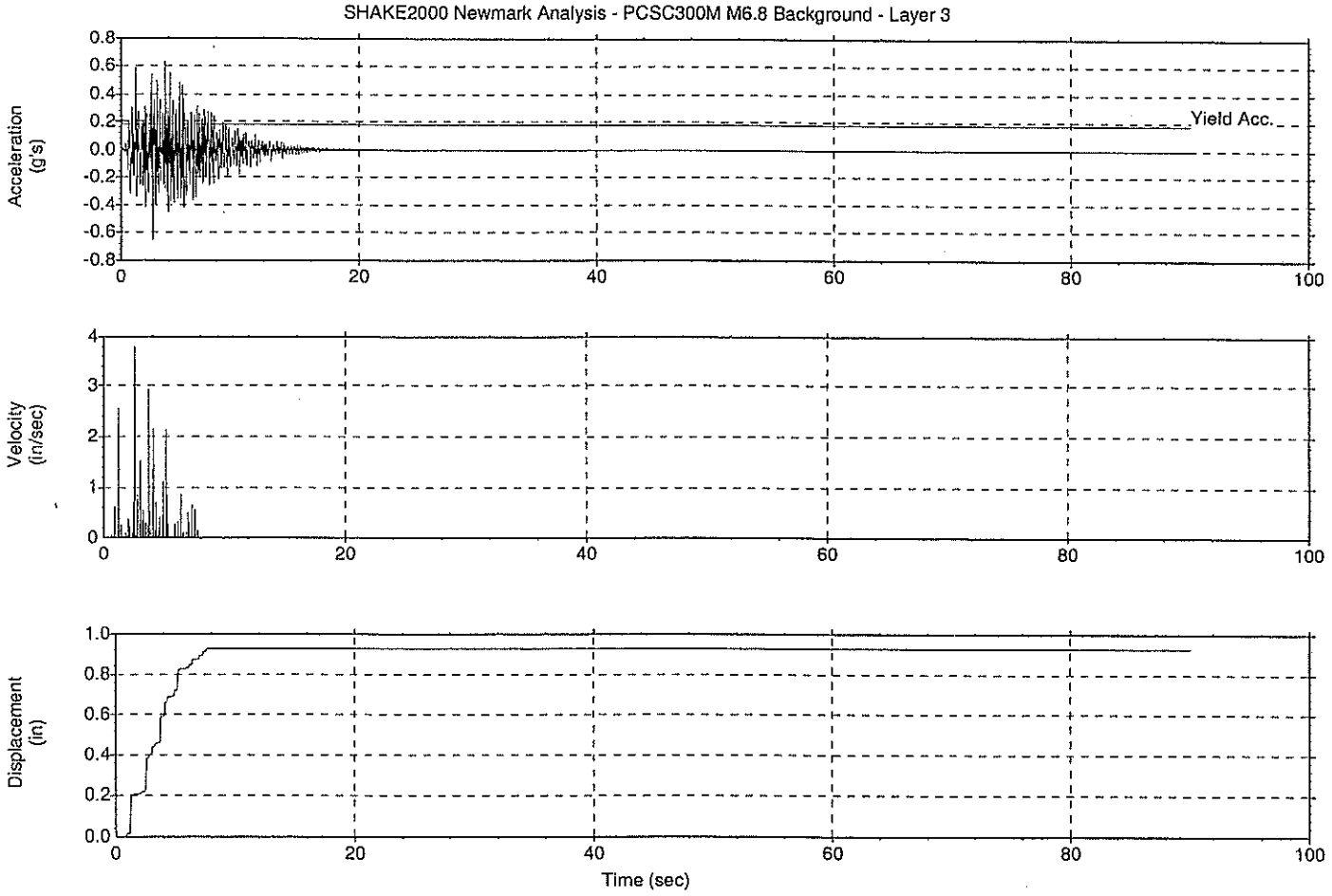
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 2

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 2 Stress - HEA - Layer: 2 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l2ald1-21.hea
Peak Acceleration Value: .7591308 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 1.096441 in

R14352



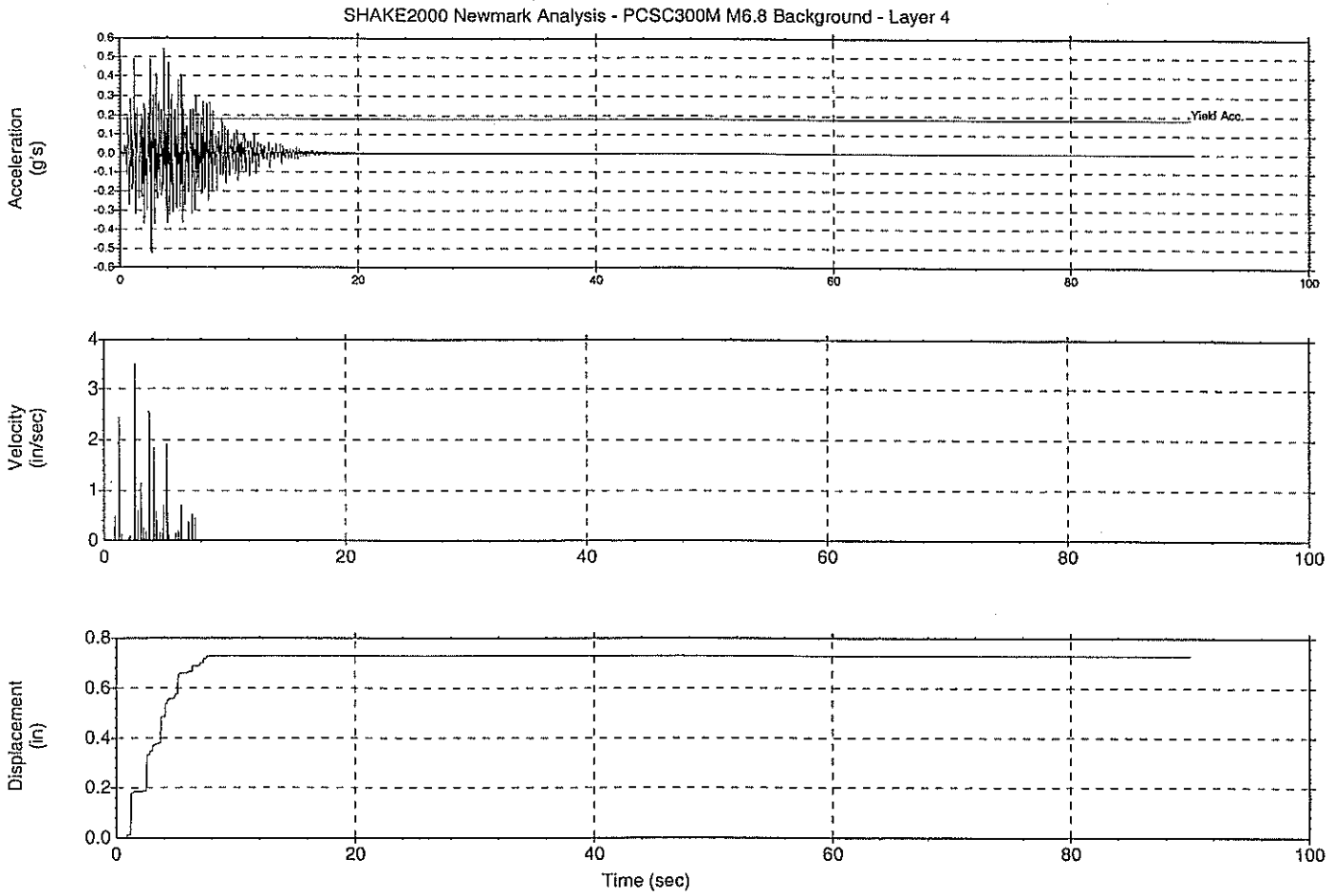
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 3

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 3 Stress - HEA - Layer: 3 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l3a1d1-23.hea
Peak Acceleration Value: .6572132 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .928295 in

R14353



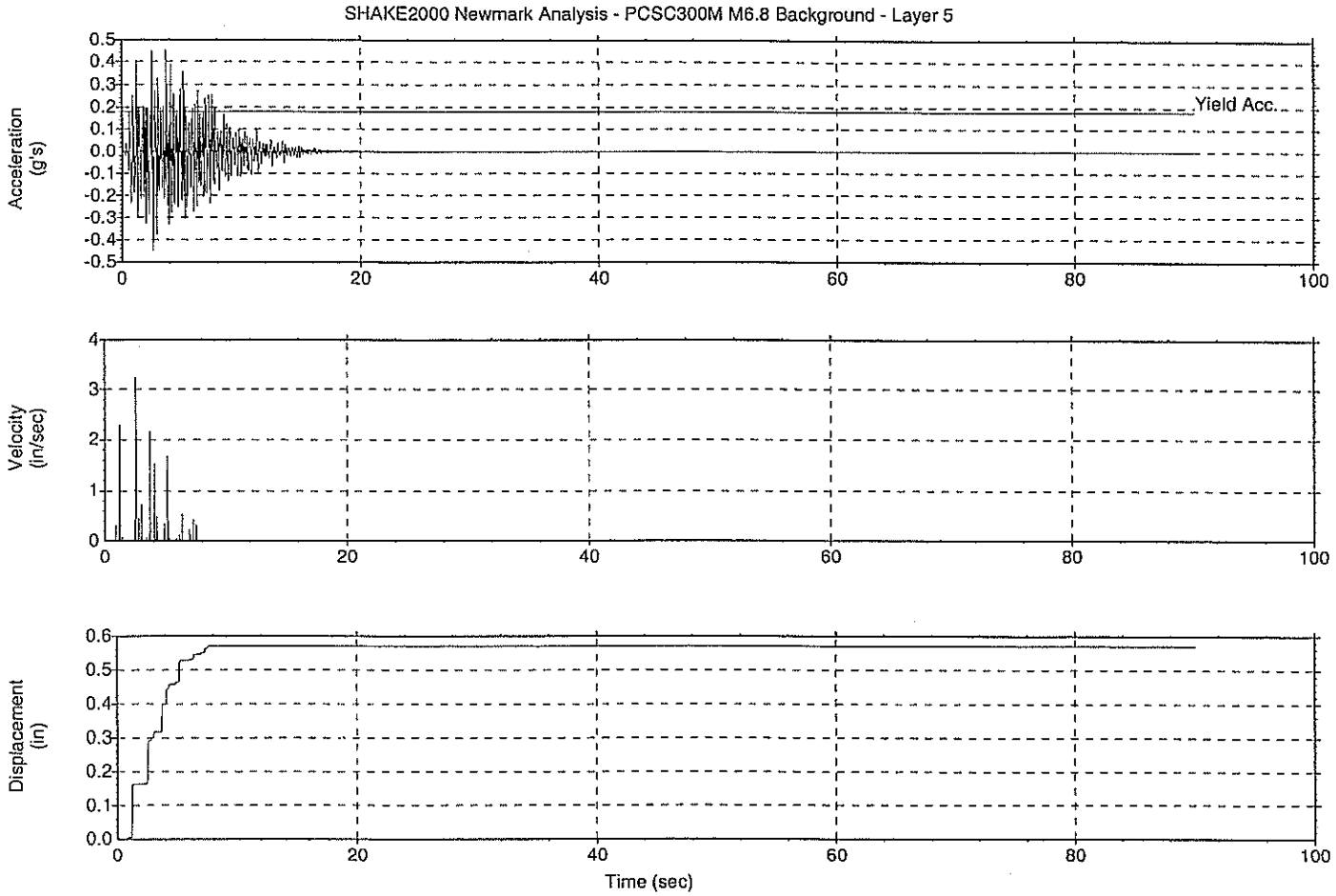
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 4

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 4 Stress - HEA - Layer: 4 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l4ald1-25.hea
Peak Acceleration Value: .5447469 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .7276583 in

R14354



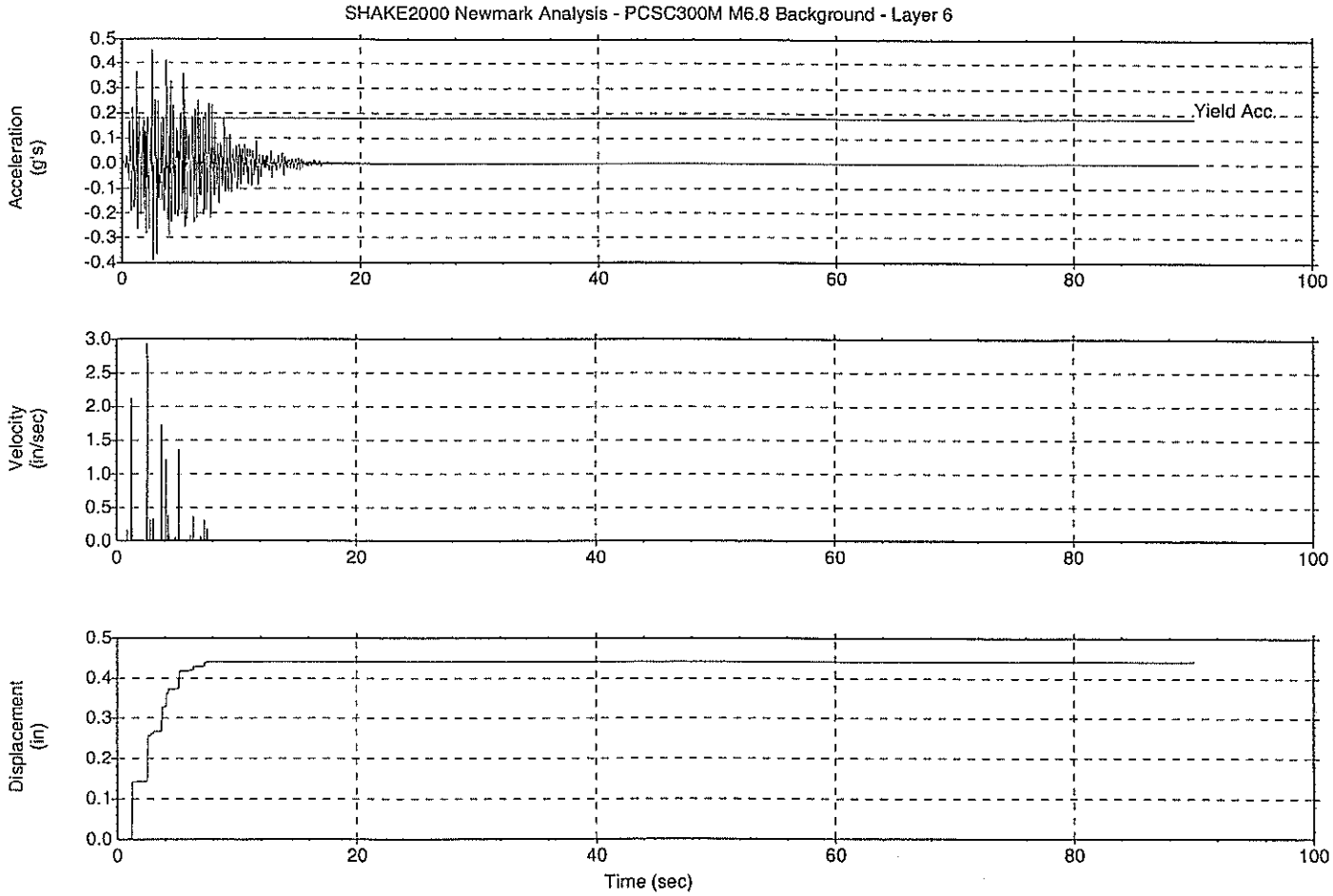
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 5

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 5 Stress - HEA - Layer: 5 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\15a1d1-27.hea
Peak Acceleration Value: .4537432 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .5699688 in

R14355

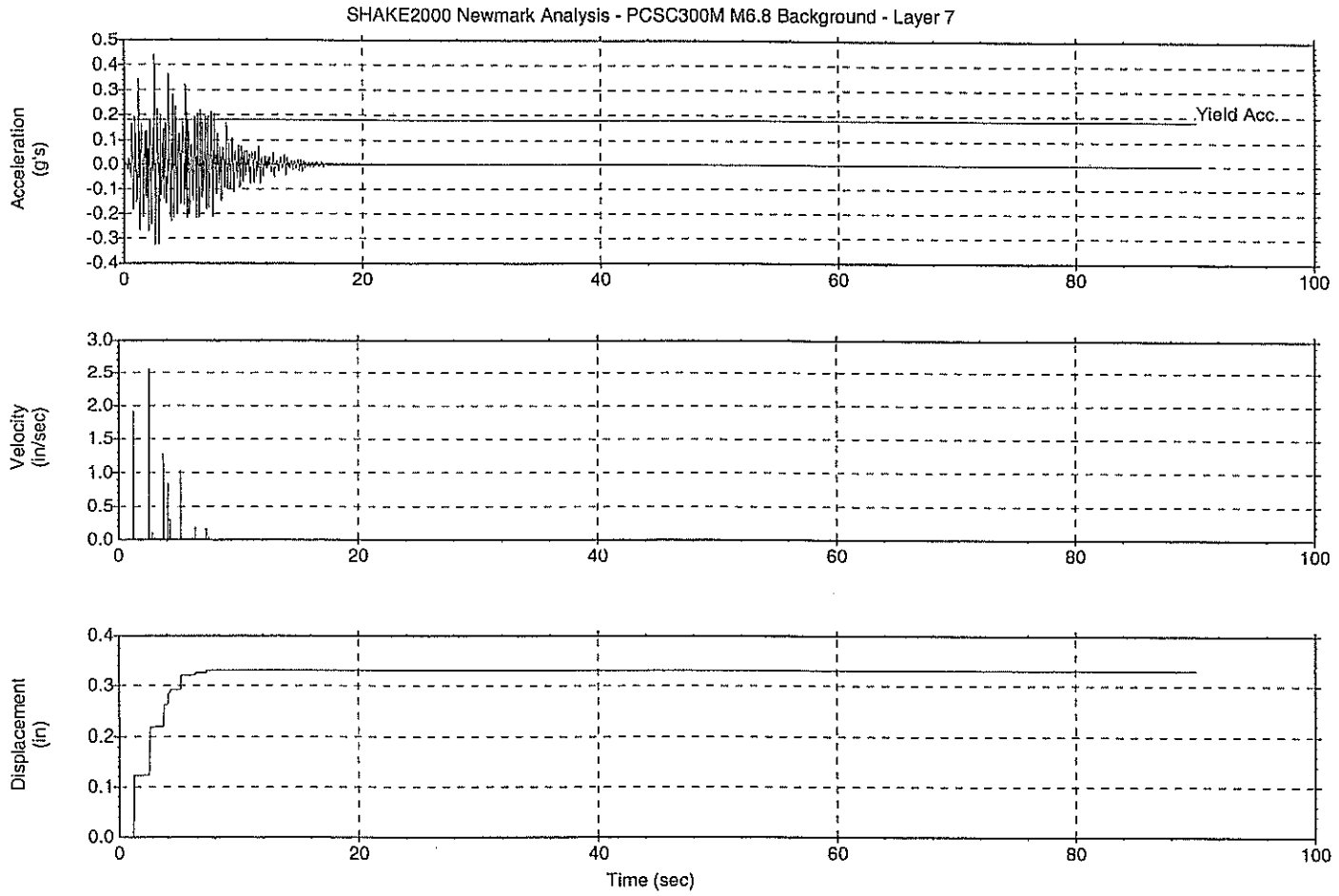


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 6

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC330M Layer 6 Stress - HEA - Layer: 6 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\16a1d1-29.hea
Peak Acceleration Value: .4564626 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .4413362 in



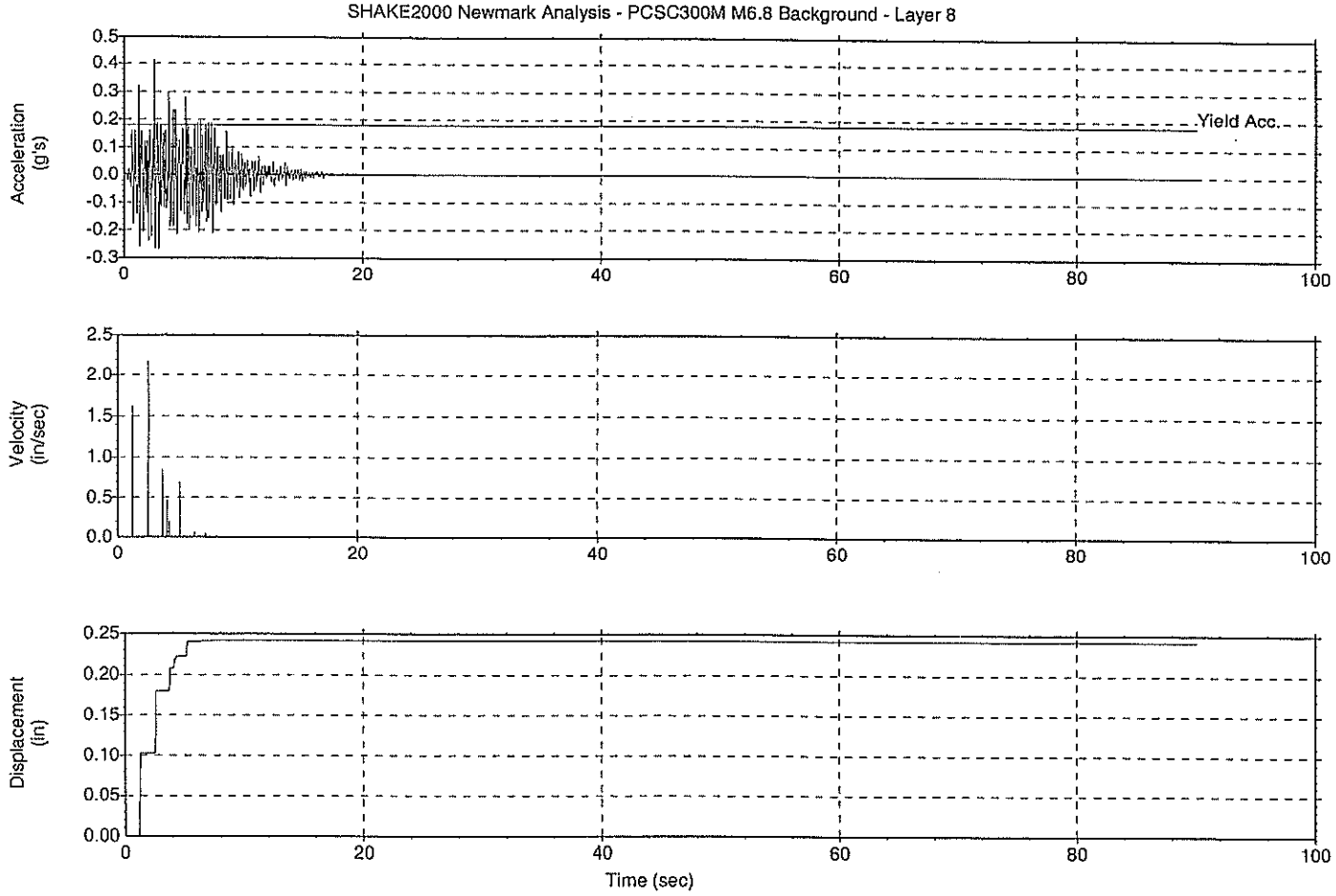
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 7

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 7 Stress - HEA - Layer: 7 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\17a1d1-31.hea
Peak Acceleration Value: .4421774 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .3306053 in

R14357

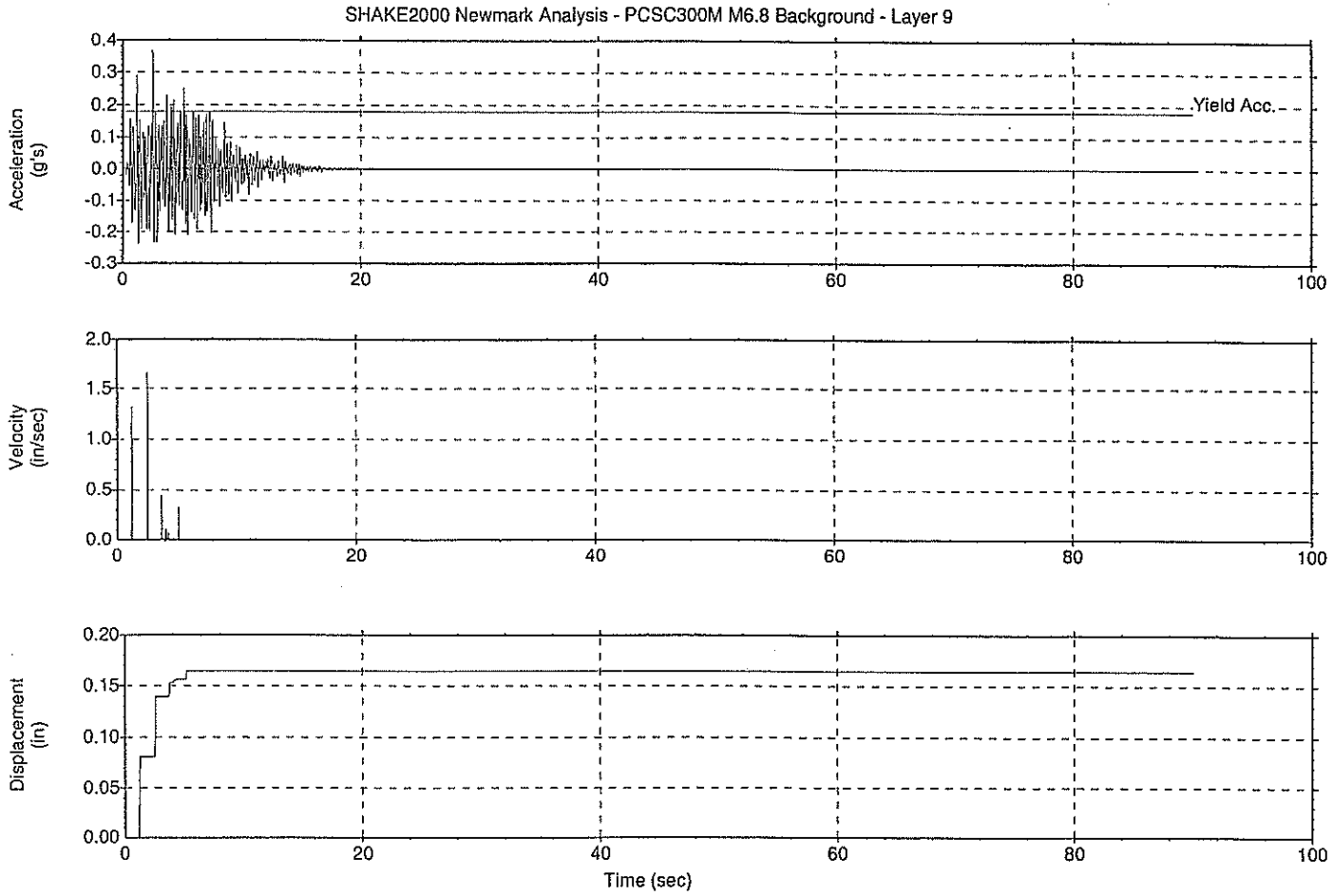


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 8

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 8 Stress - HEA - Layer: 8 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\18ald1-33.hea
Peak Acceleration Value: .4134678 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .2417877 in

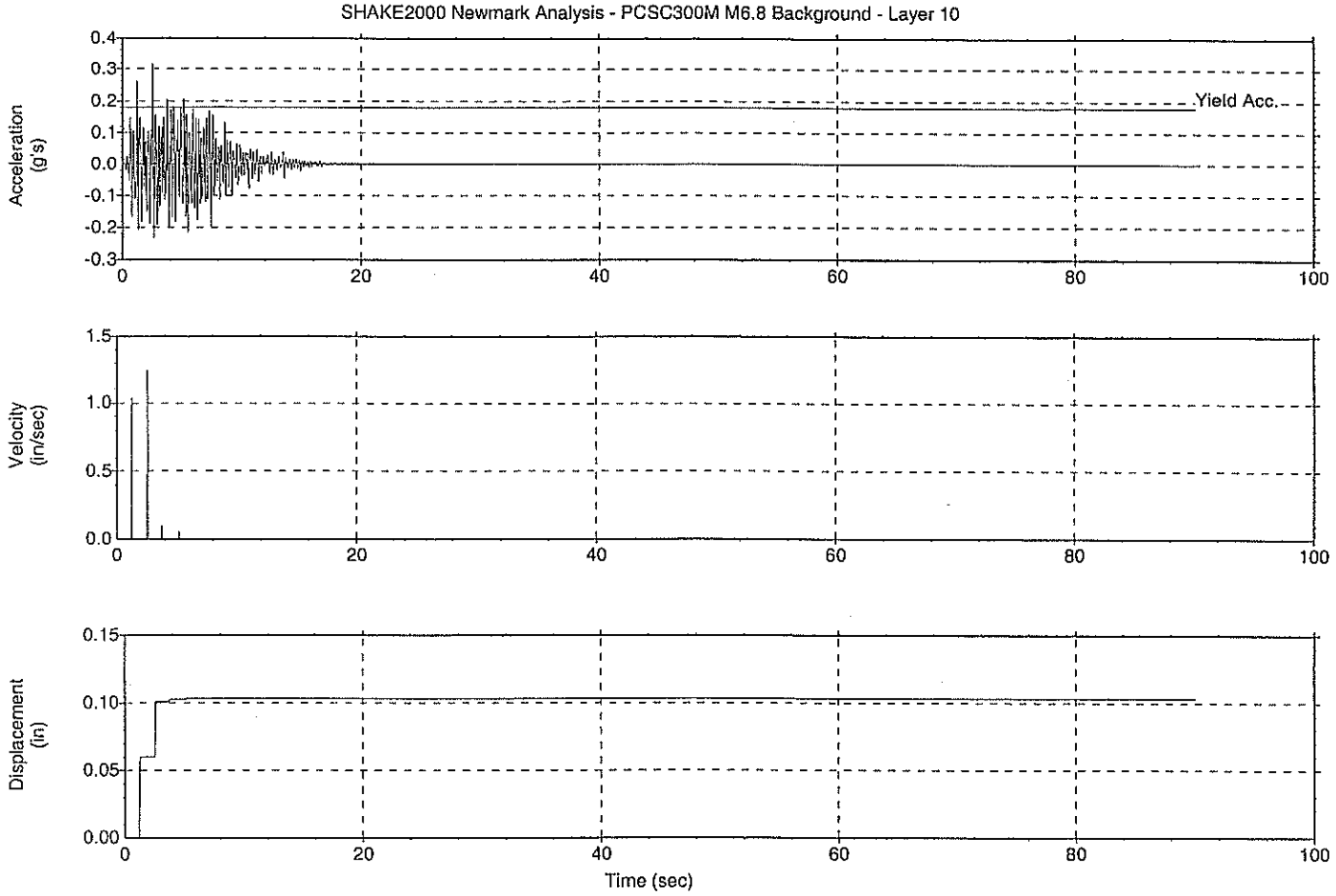


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 9

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 9 Stress - HEA - Layer: 9 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\19ald1-35.hea
Peak Acceleration Value: .3690042 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .1643203 in



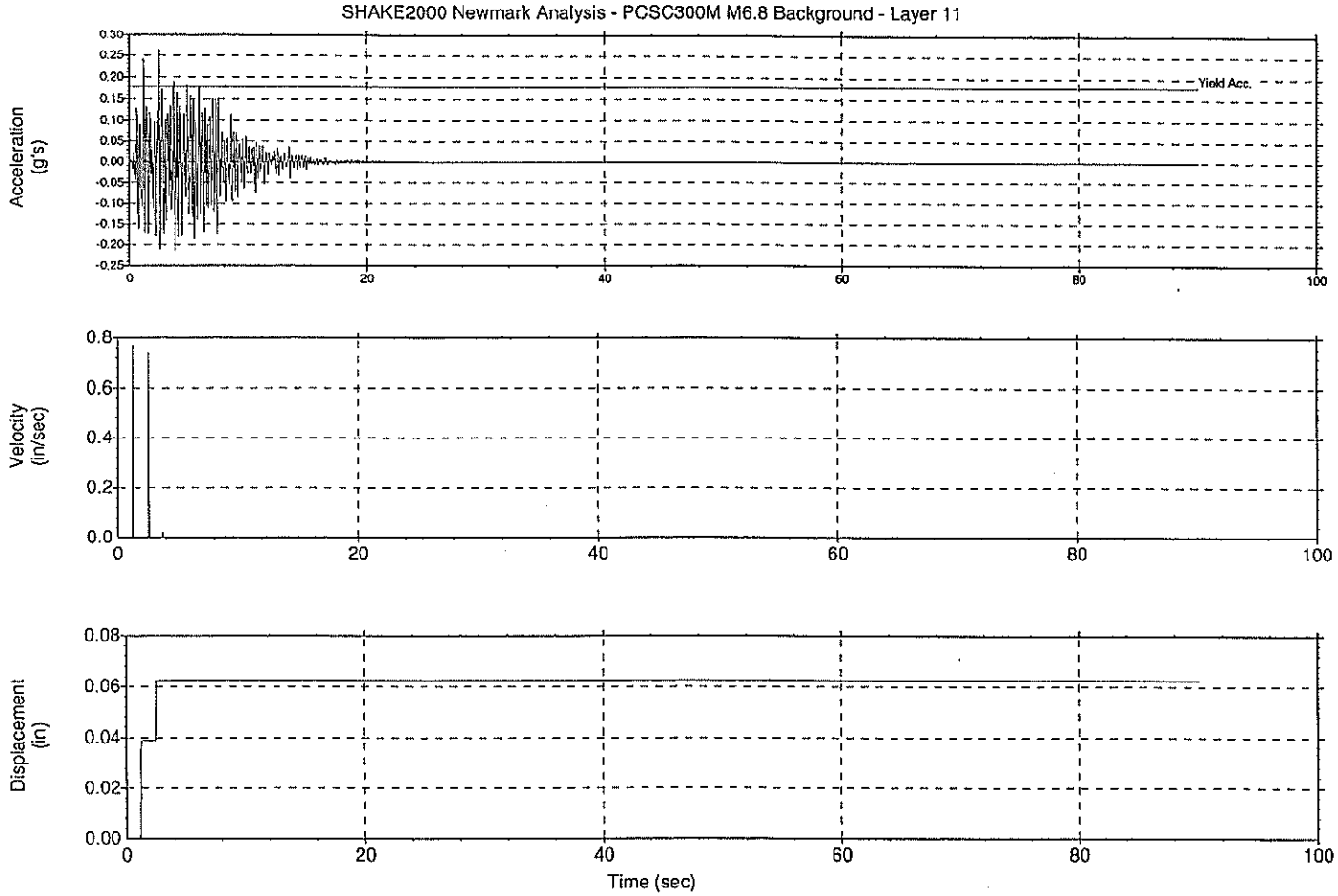
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 10

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 10 Stress - HEA - Layer: 10 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l10aldl-37.hea
Peak Acceleration Value: .3174475 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .1034276 in

R14360



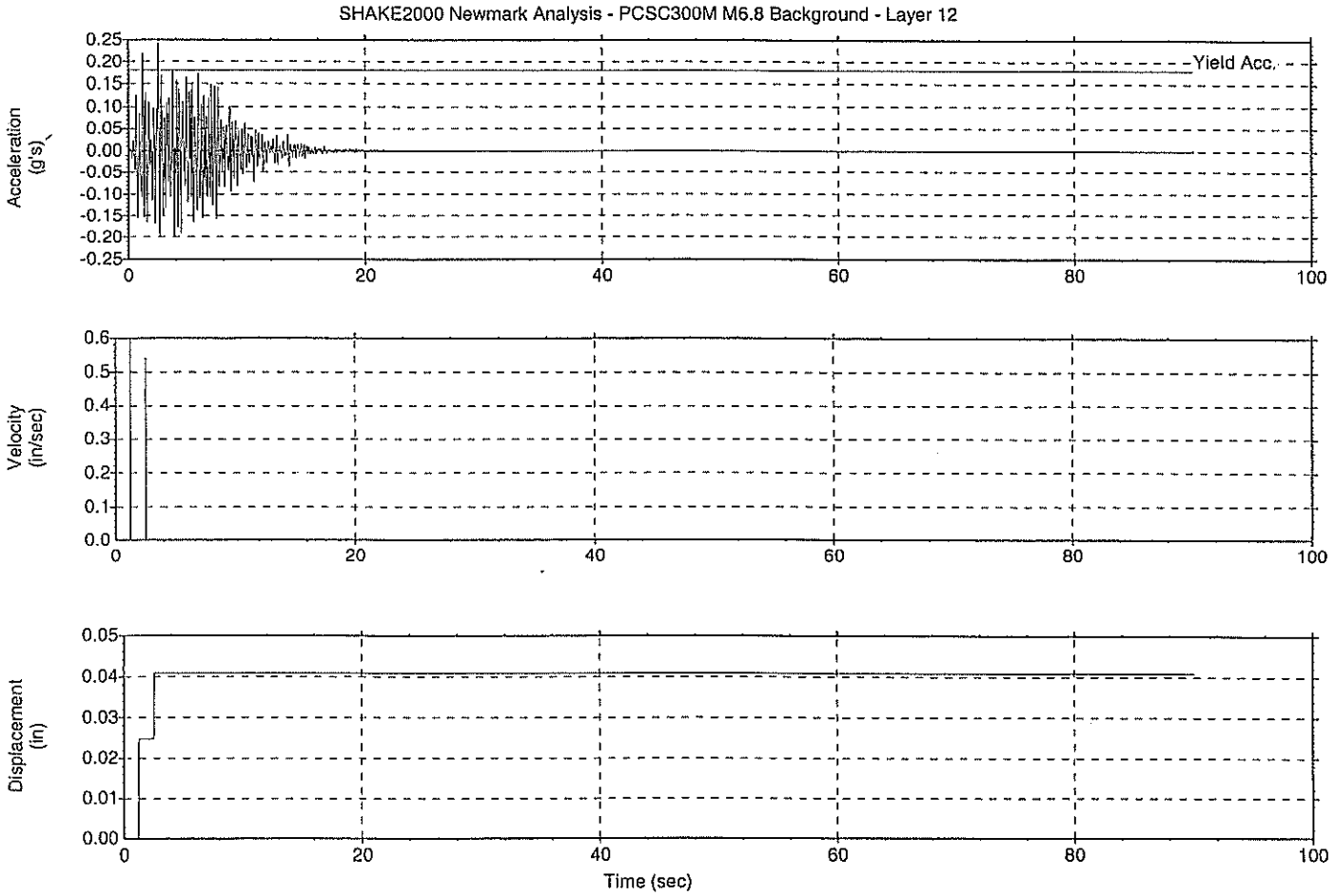
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 11

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 11 Stress - HEA - Layer: 11 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\111aldl-39.hea
Peak Acceleration Value: .2632202 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 6.246461E-02 in

R14361



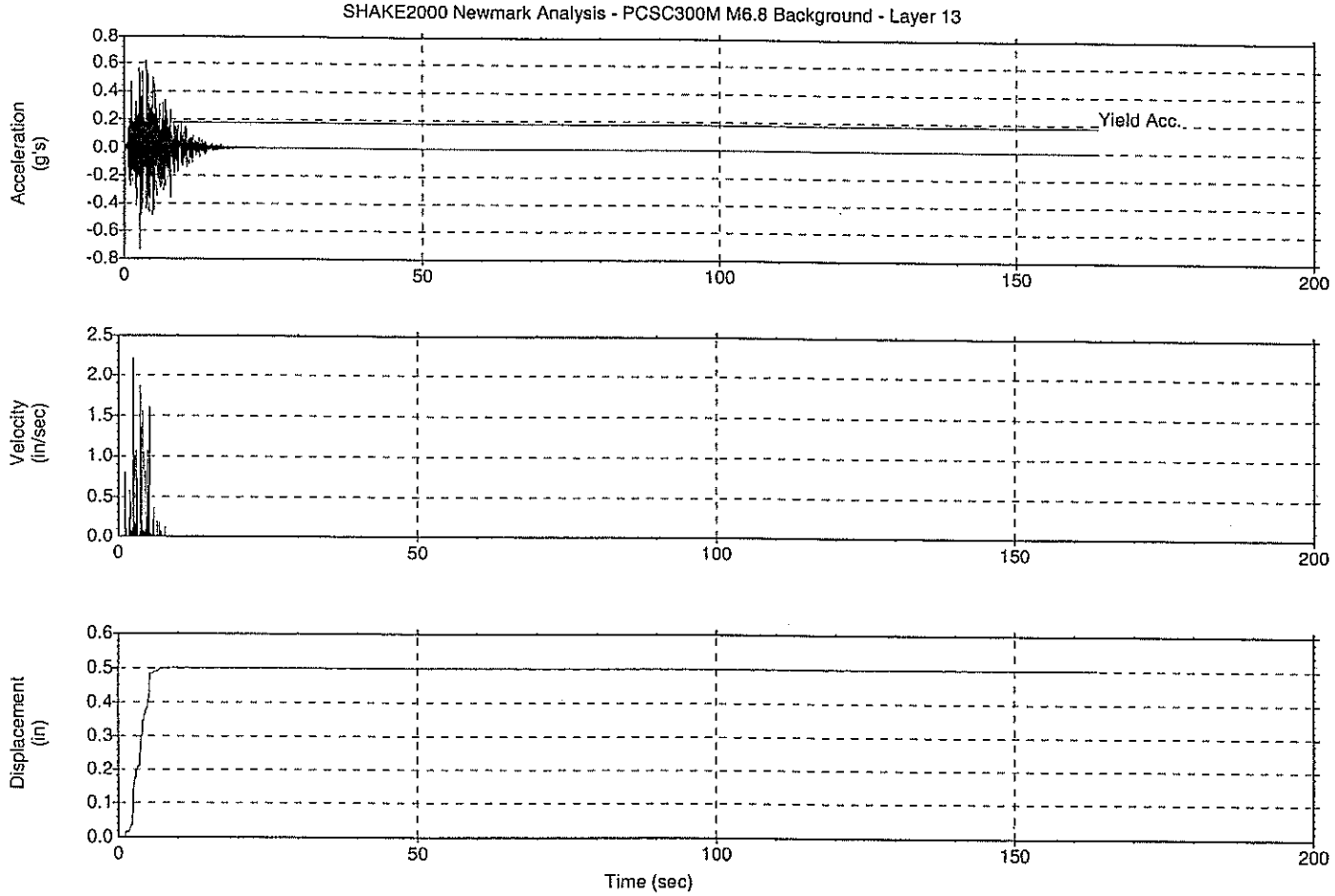
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 12

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 12 Stress - HEA - Layer: 12 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l12a1d1-41.hea
Peak Acceleration Value: .2418566 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 4.078336E-02 in

R14362



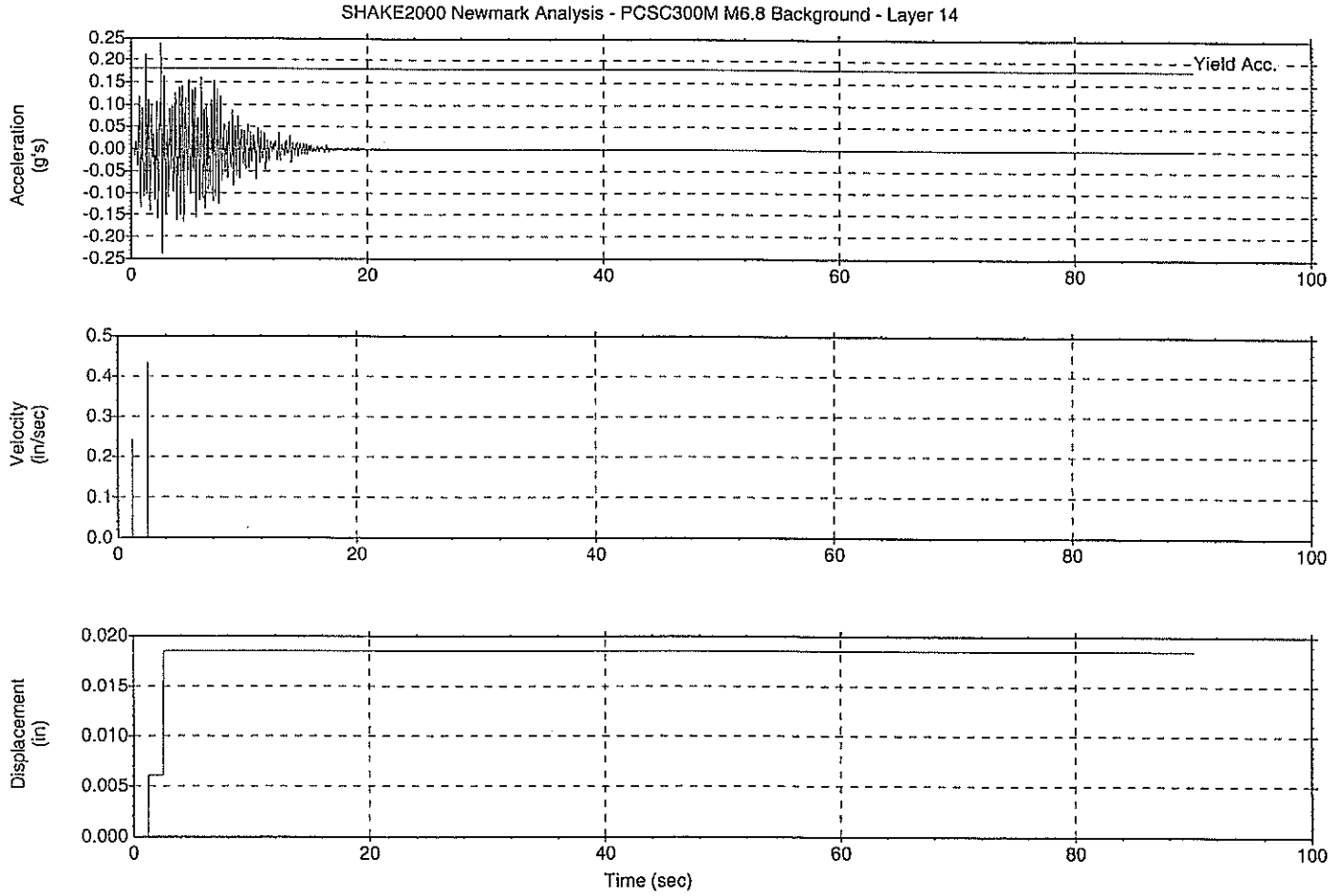
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 13

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: Within - PSCS300E Crest Column - AHL -
Layer: 13 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\113ald1-13.ah1
Peak Acceleration Value: .736312 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .5018111 in

R14363



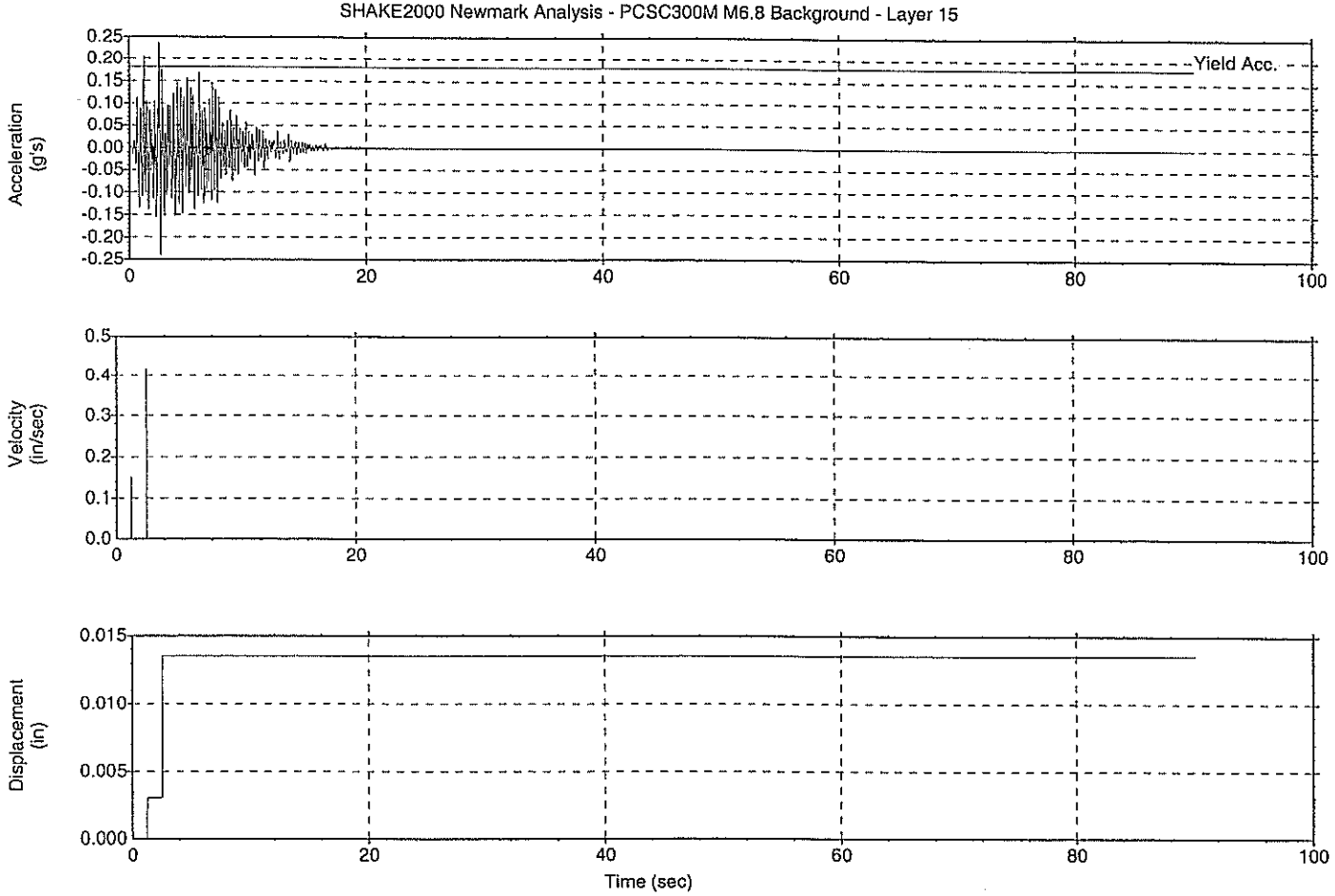
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 14

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 14 Stress - HEA - Layer: 14 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l14a1d1-45.hea
Peak Acceleration Value: .2398237 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 1.851576E-02 in

R14364



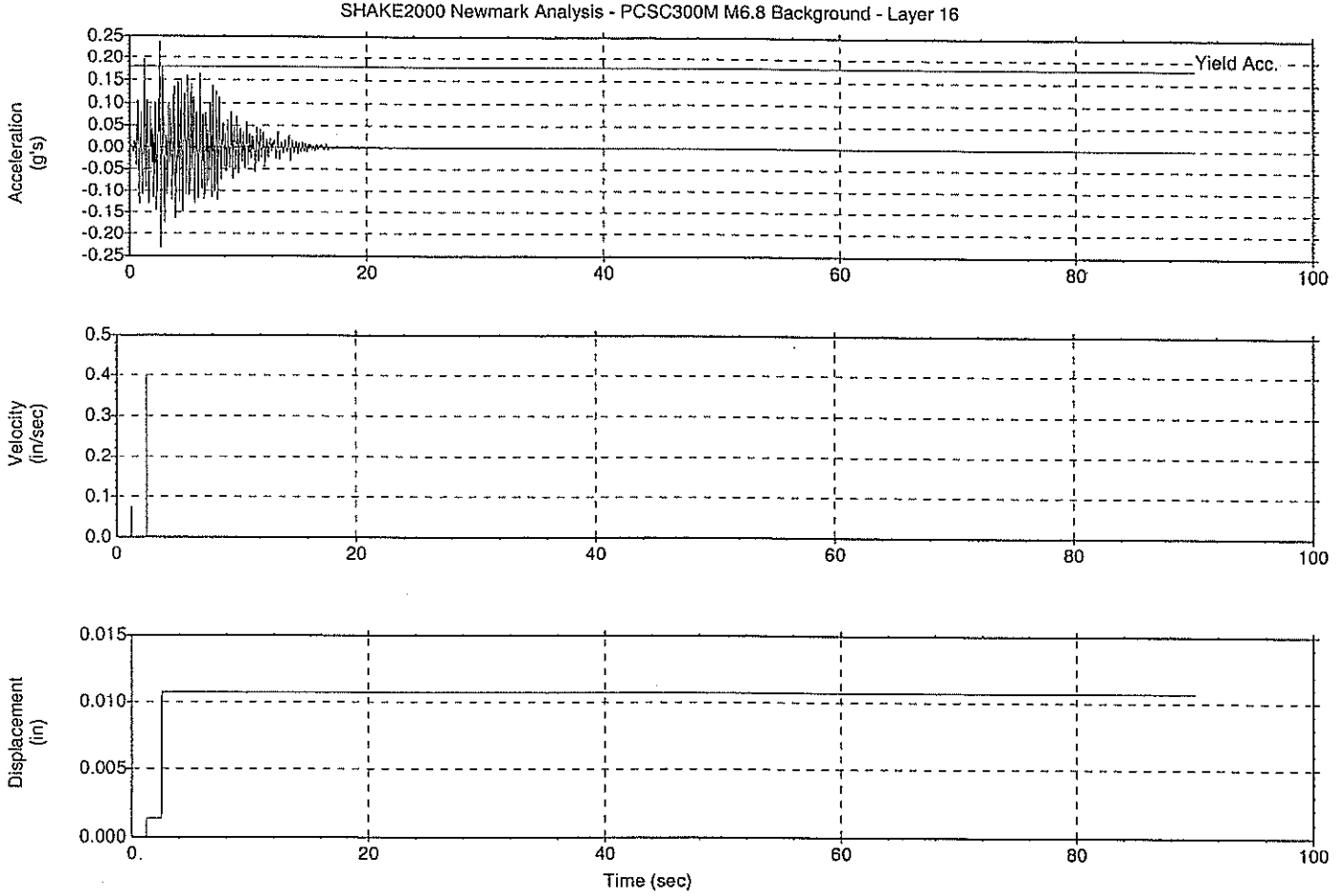
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 15

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 15 Stress - HEA - Layer: 15 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\115a1d1-47.hea
Peak Acceleration Value: .2405543 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 1.355834E-02 in

R14365



Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 16

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 16 Stress - HEA - Layer: 16 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l16ald1-49.hea
Peak Acceleration Value: .2372678 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 1.073878E-02 in

R14366

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation

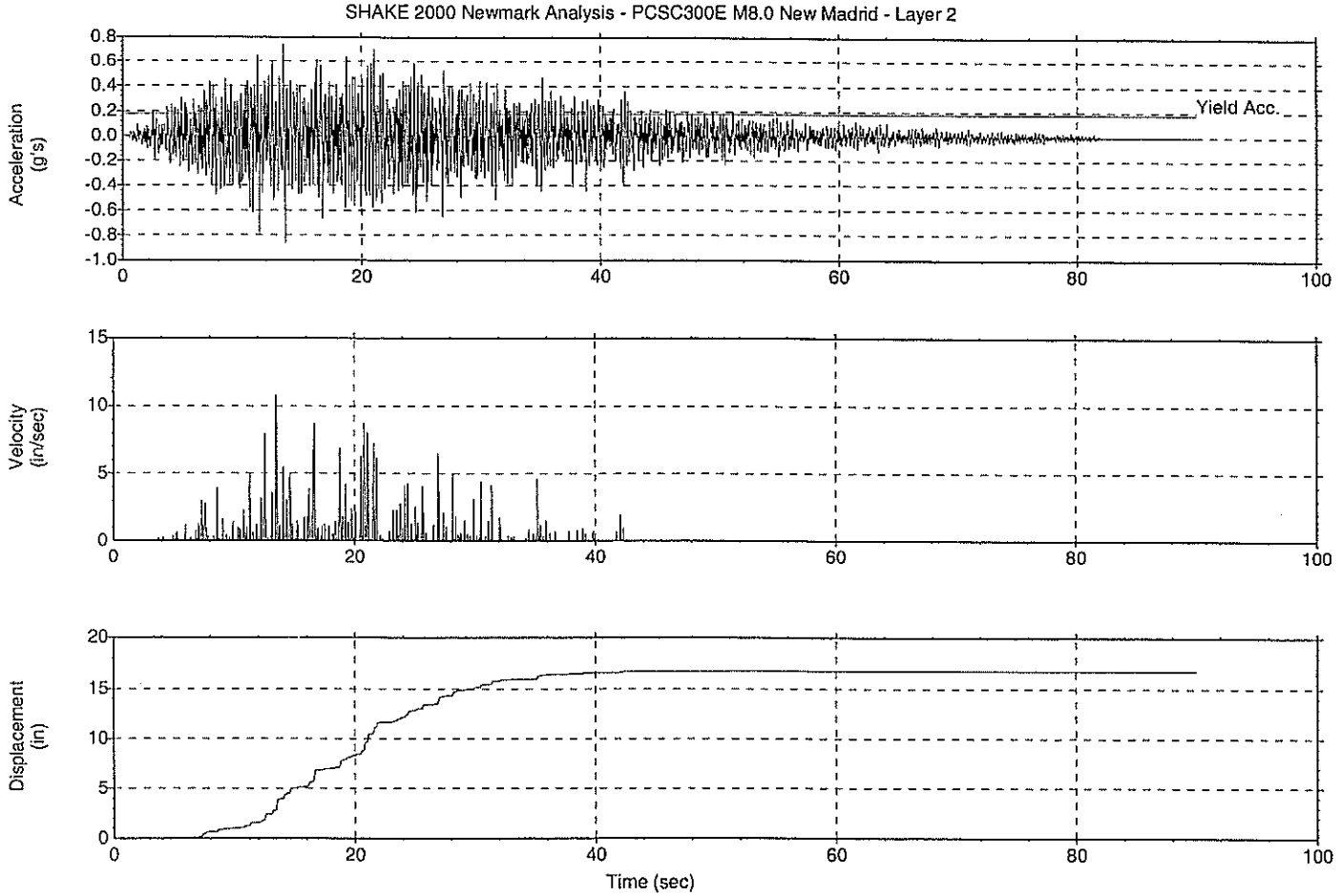
PROJECT NO. 072047

Estimate of Potential Embankment Settlements (Permanent Deformations)

PAGE 37 OF 68

MADE BY BEG DATE 1/22/08 CHECKED BY [signature] DATE 1/23/09

SHAKE2000 PERMANENT DEFORMATION OUTPUT FILE
PCSC300E – LAYERS 1 THROUGH 16
M8.0 NEW MADRID MDE @ 83 KM



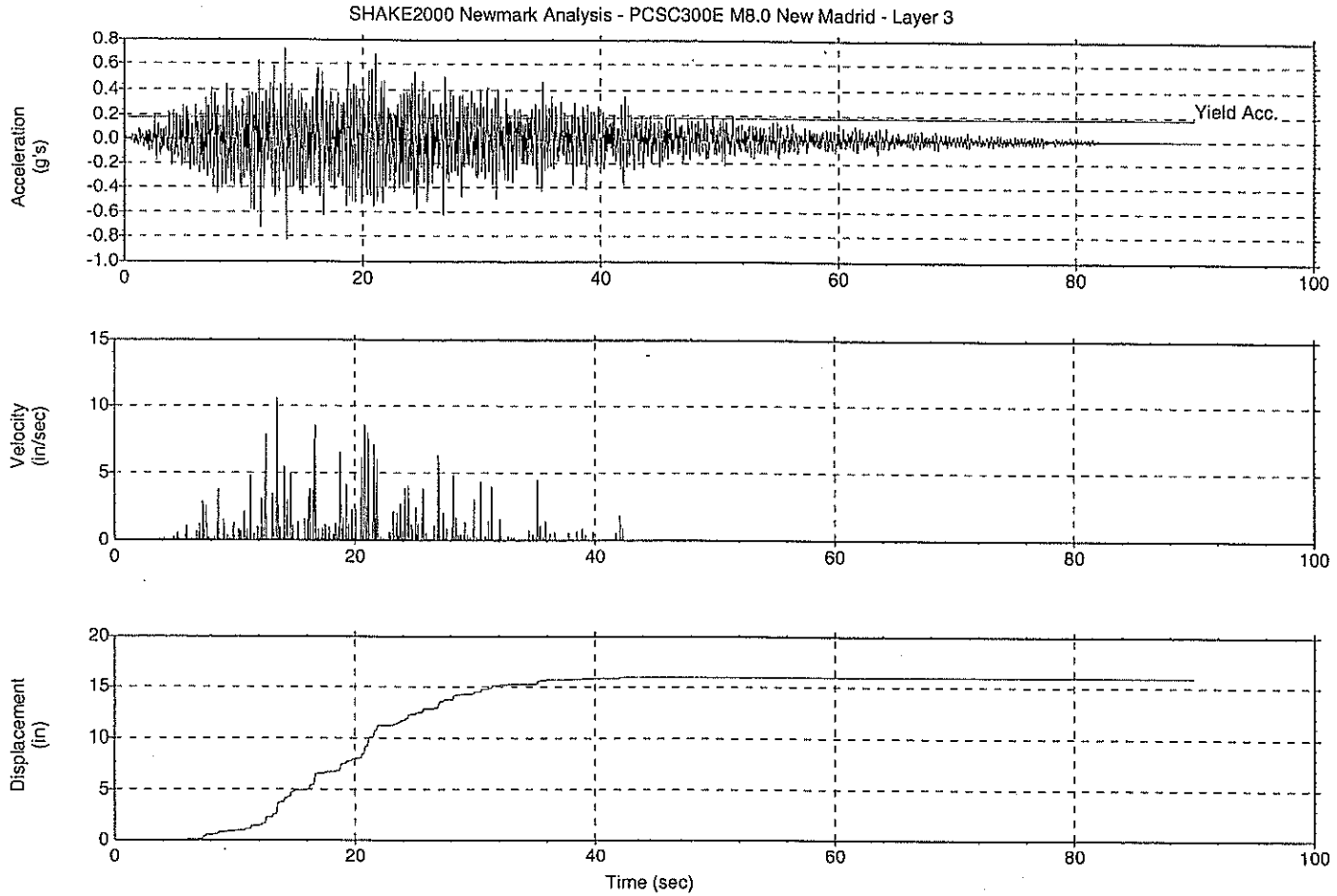
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE 2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 2

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 2 Stress - HEA - Layer: 2 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\12a1d1-21.hea
Peak Acceleration Value: .86835 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 16.73038 in

R14368



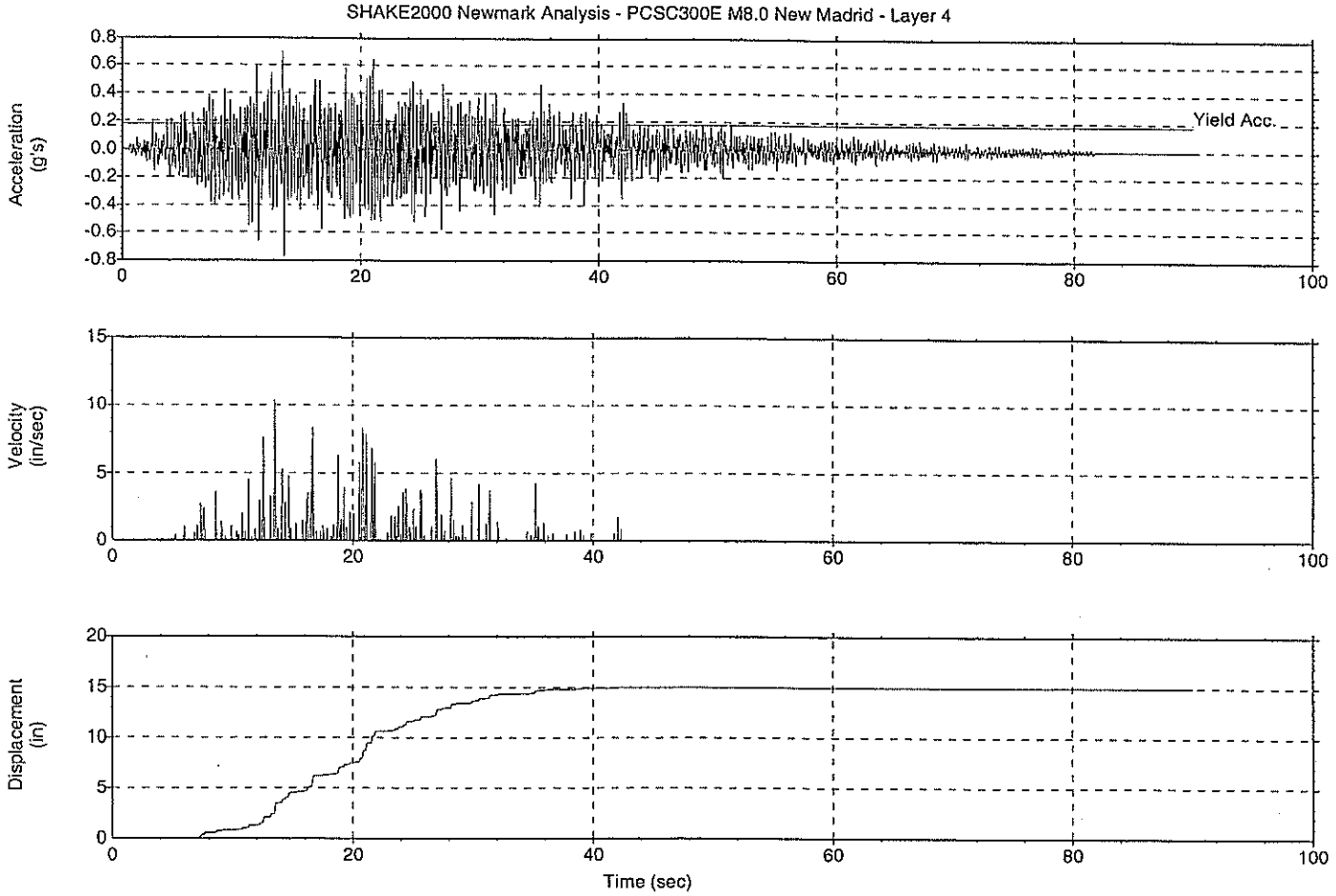
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 3

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 3 Stress - HEA - Layer: 3 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l3ald1-23.hea
Peak Acceleration Value: .8308055 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 15.98448 in

R14369



Notes:

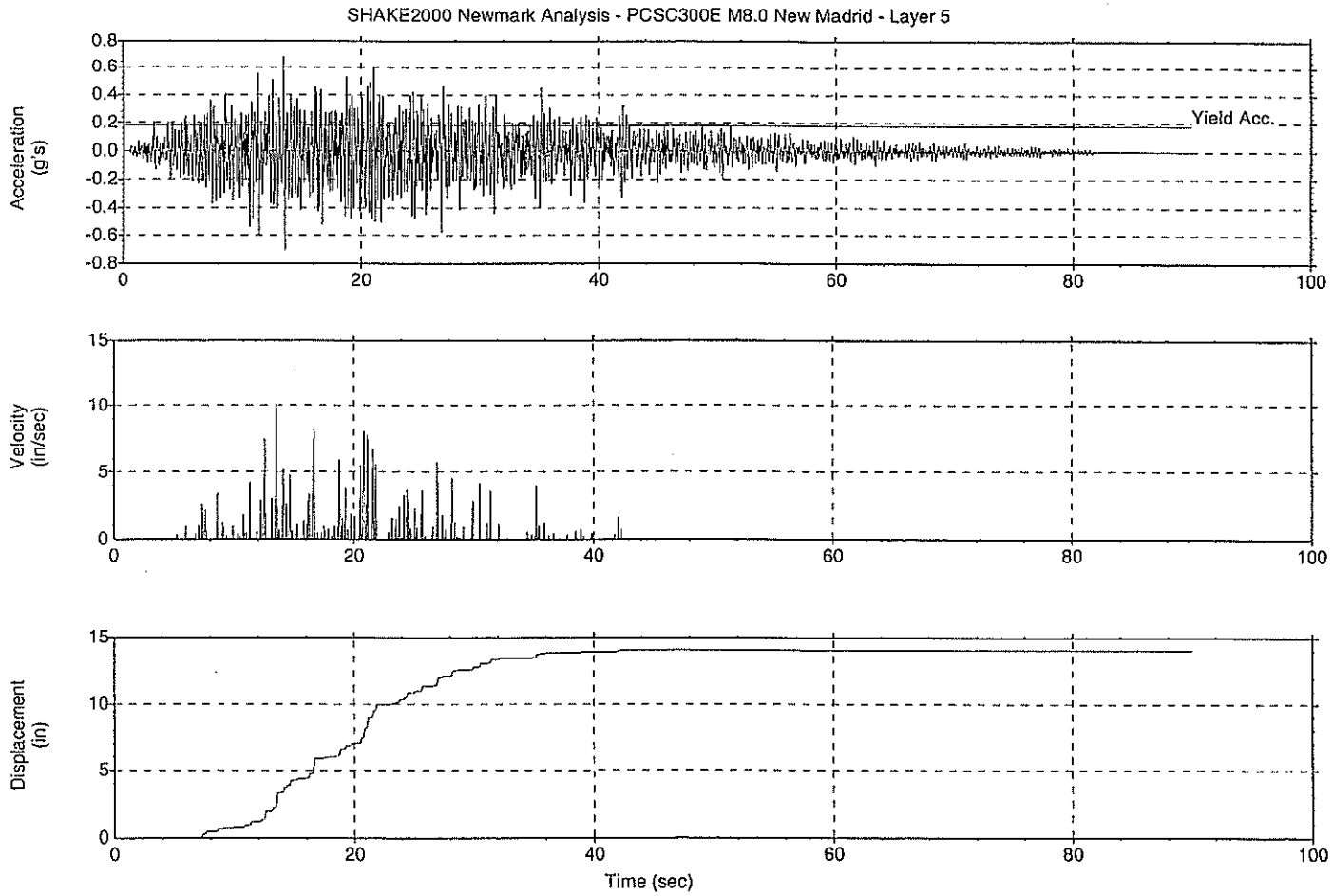
Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 4

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 4 Stress - HEA - Layer: 4 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l4a1d1-25.hea
Peak Acceleration Value: .7739446 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 15.02532 in

40 / 68

R14370



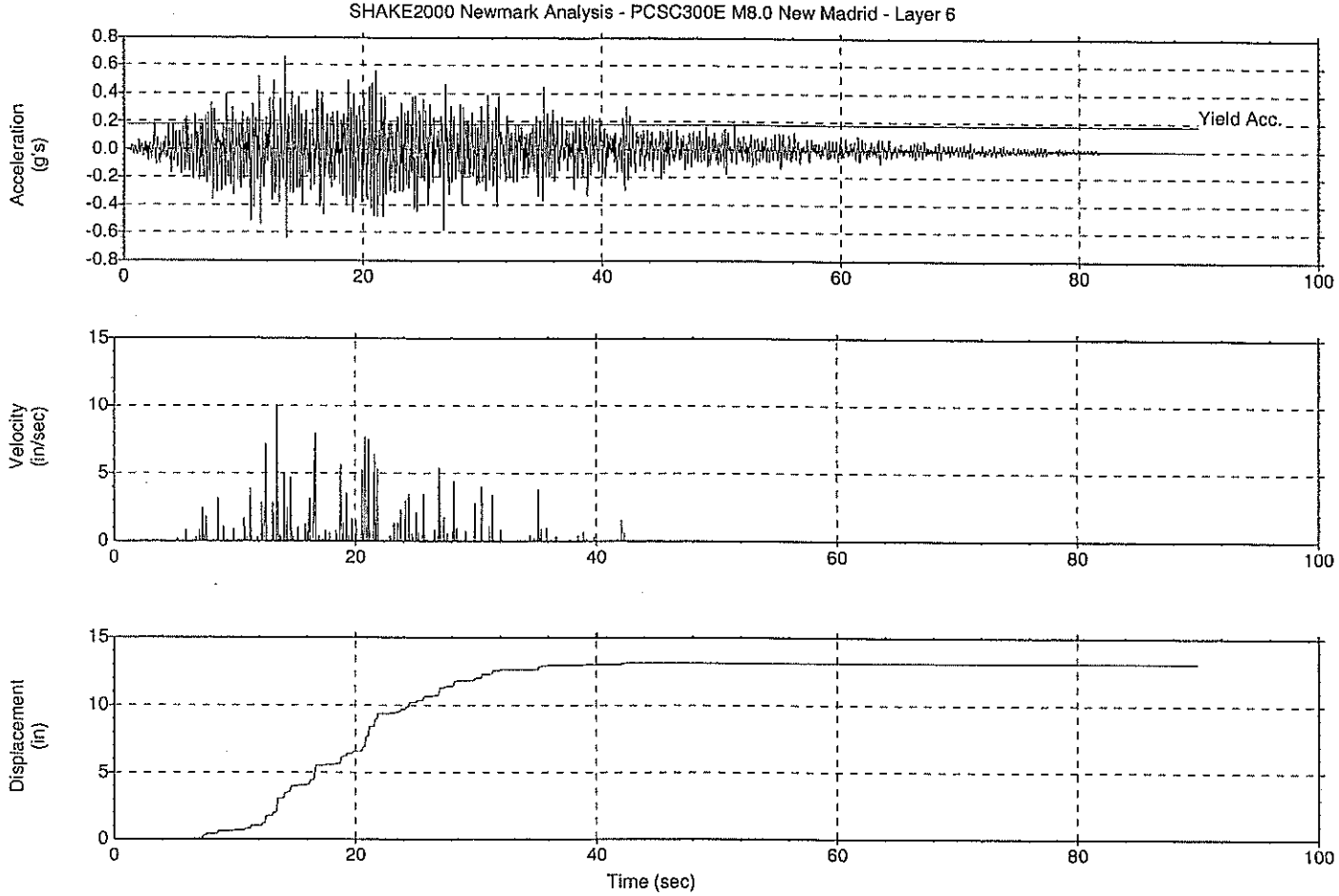
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 5

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 5 Stress - HEA - Layer: 5 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\15a1d1-27.hea
Peak Acceleration Value: .7099189 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 14.04136 in

R14371



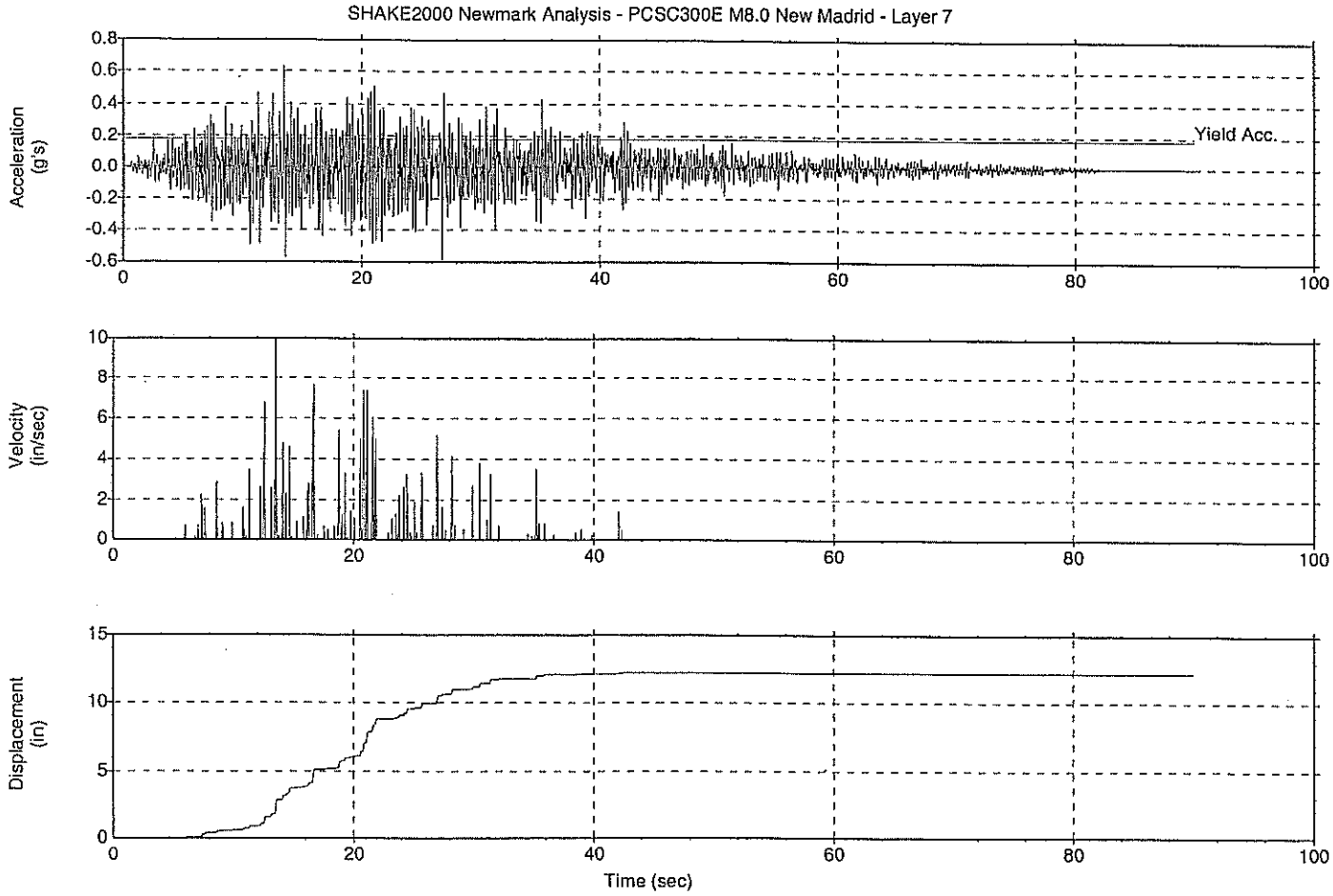
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 6

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 6 Stress - HEA - Layer: 6 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\16ald1-29.hea
Peak Acceleration Value: .6580572 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 13.13006 in

R14372

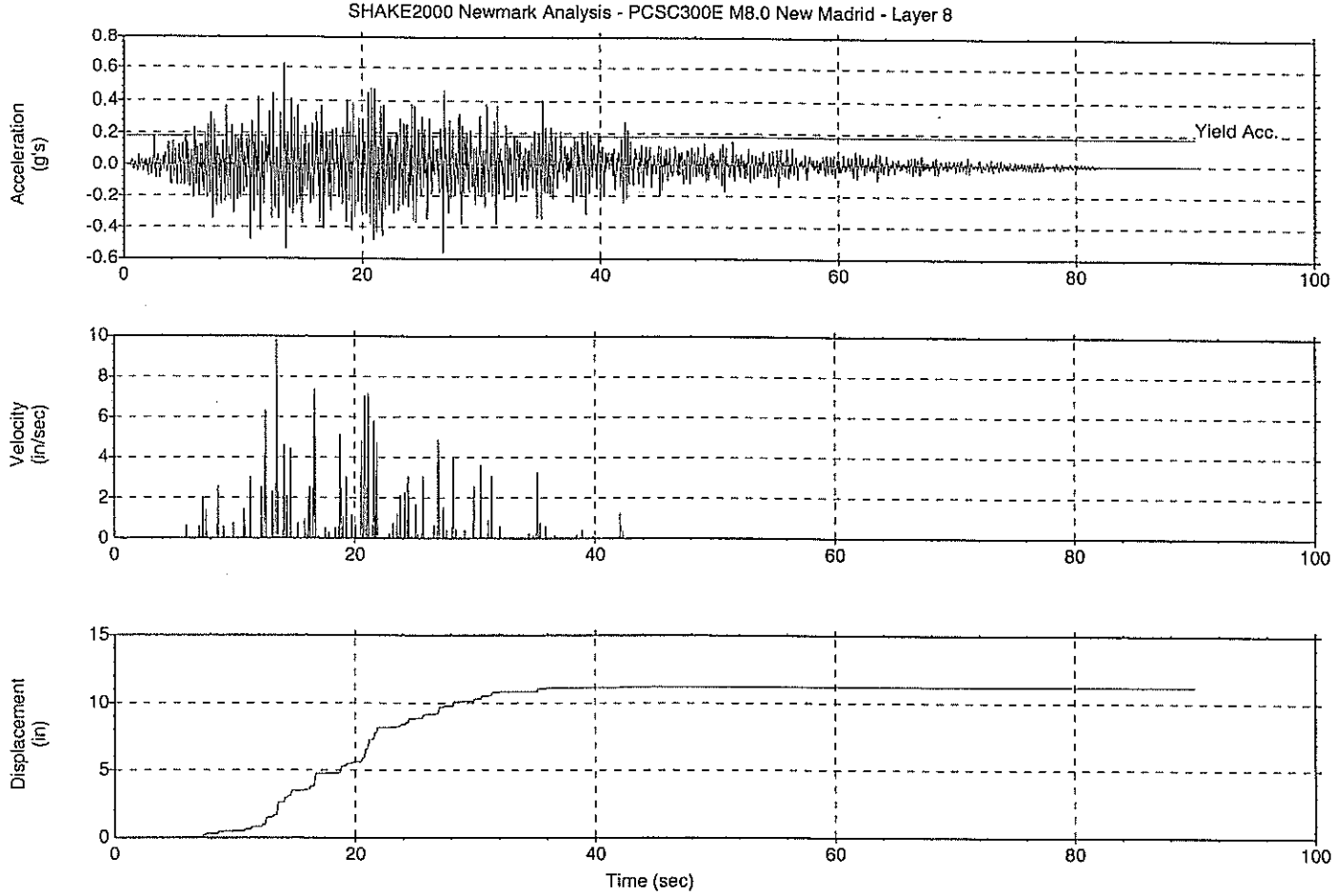


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 7

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 7 Stress - HEA - Layer: 7 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\17ald1-31.hea
Peak Acceleration Value: .6326251 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 12.19506 in

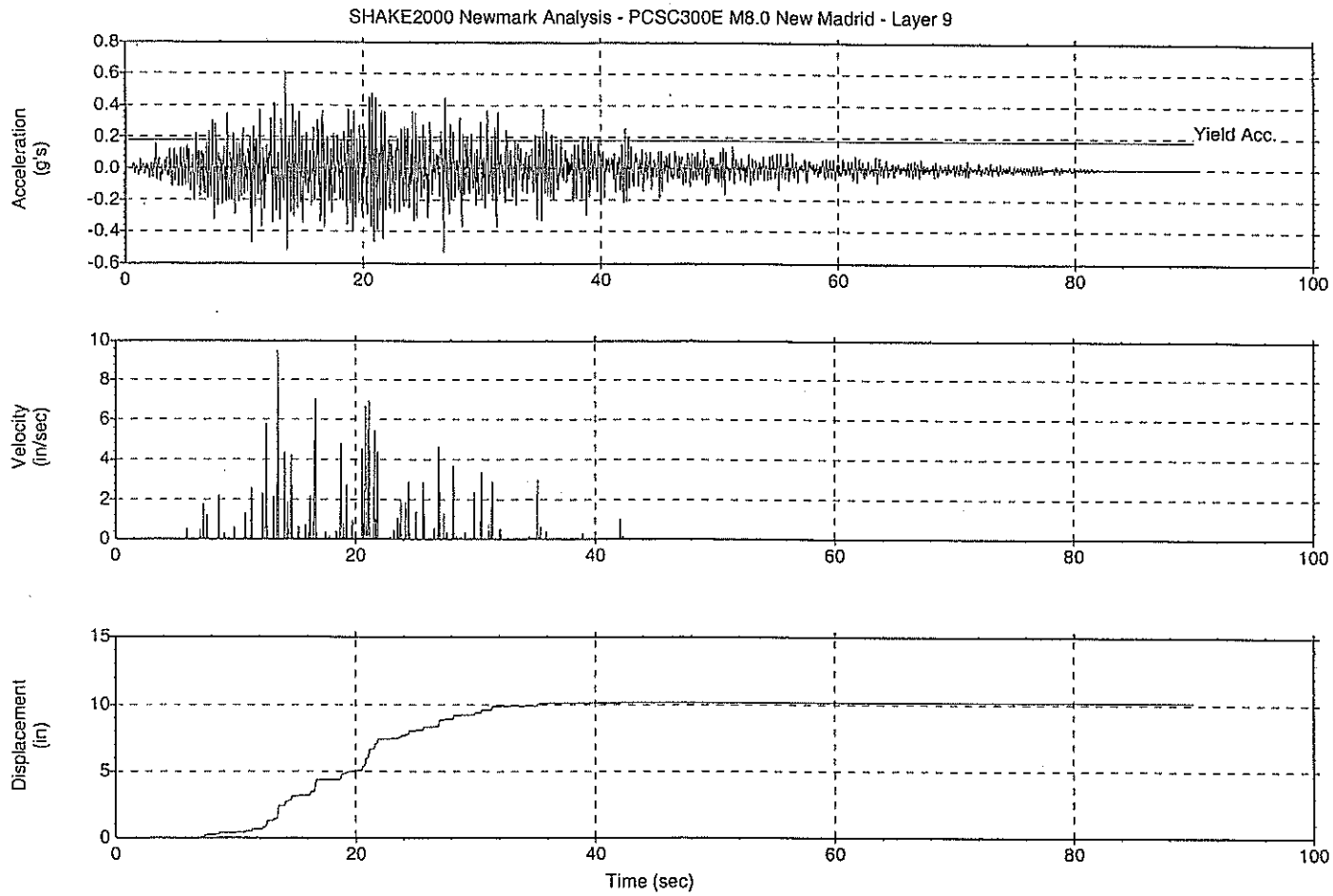


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 8

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 8 Stress - HEA - Layer: 8 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\18ald1-33.hea
Peak Acceleration Value: .6261951 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 11.22001 in

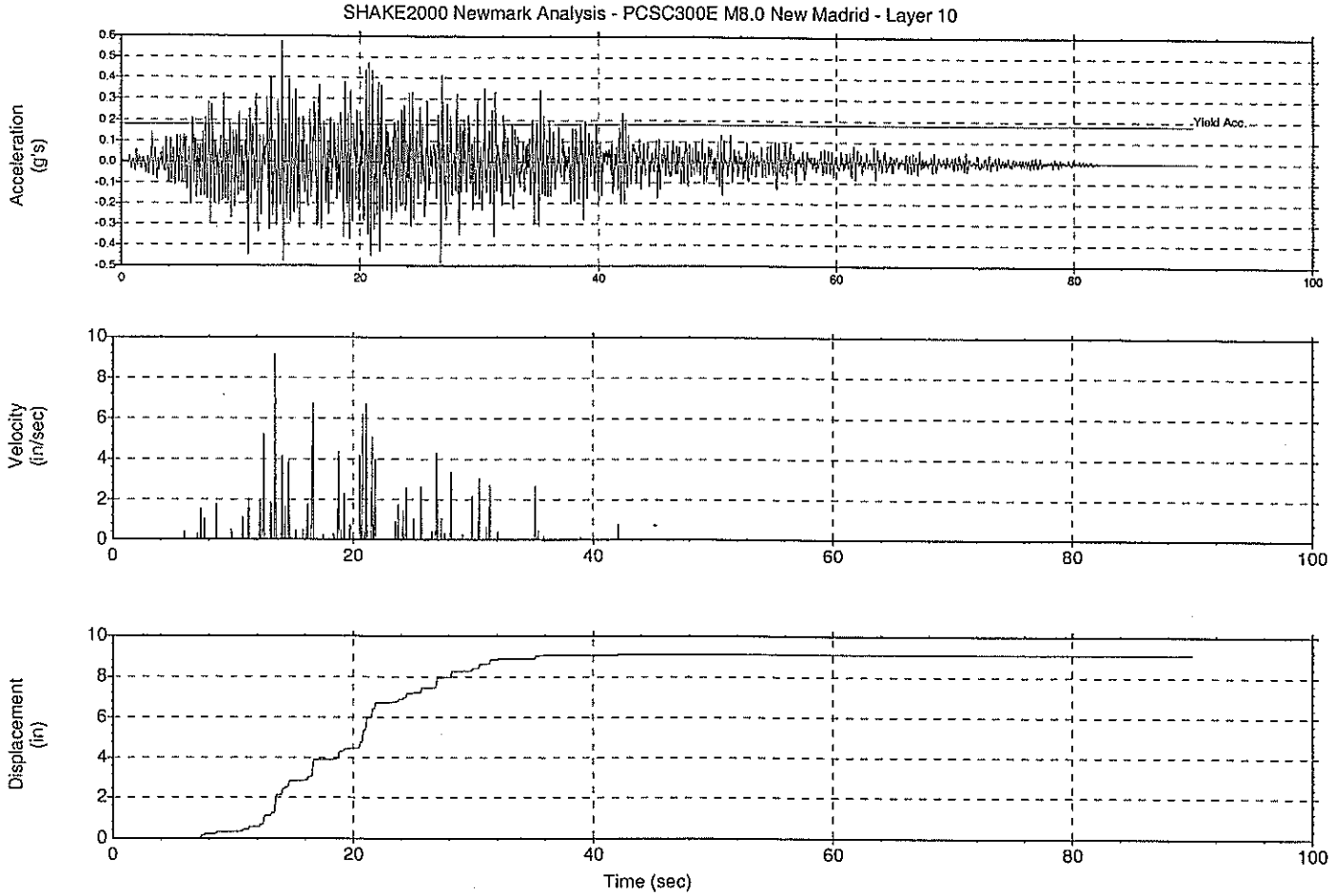


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 9

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 9 Stress - HEA - Layer: 9 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\19ald1-35.hea
Peak Acceleration Value: .6125532 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 10.18864 in



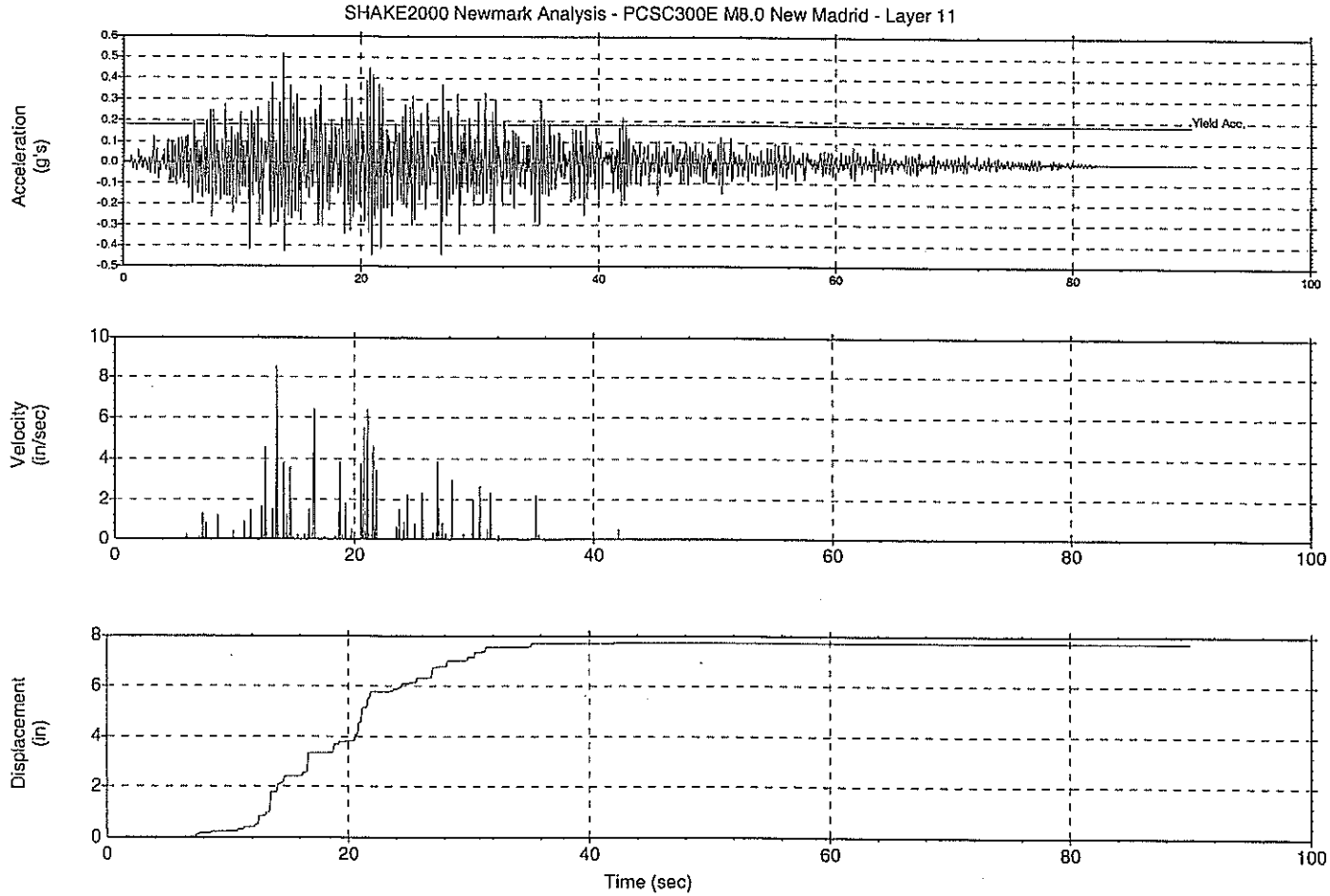
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 10

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 10 Stress - HEA - Layer: 10 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l10a1d1-37.hea
Peak Acceleration Value: .5804698 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 9.100734 in

R14376

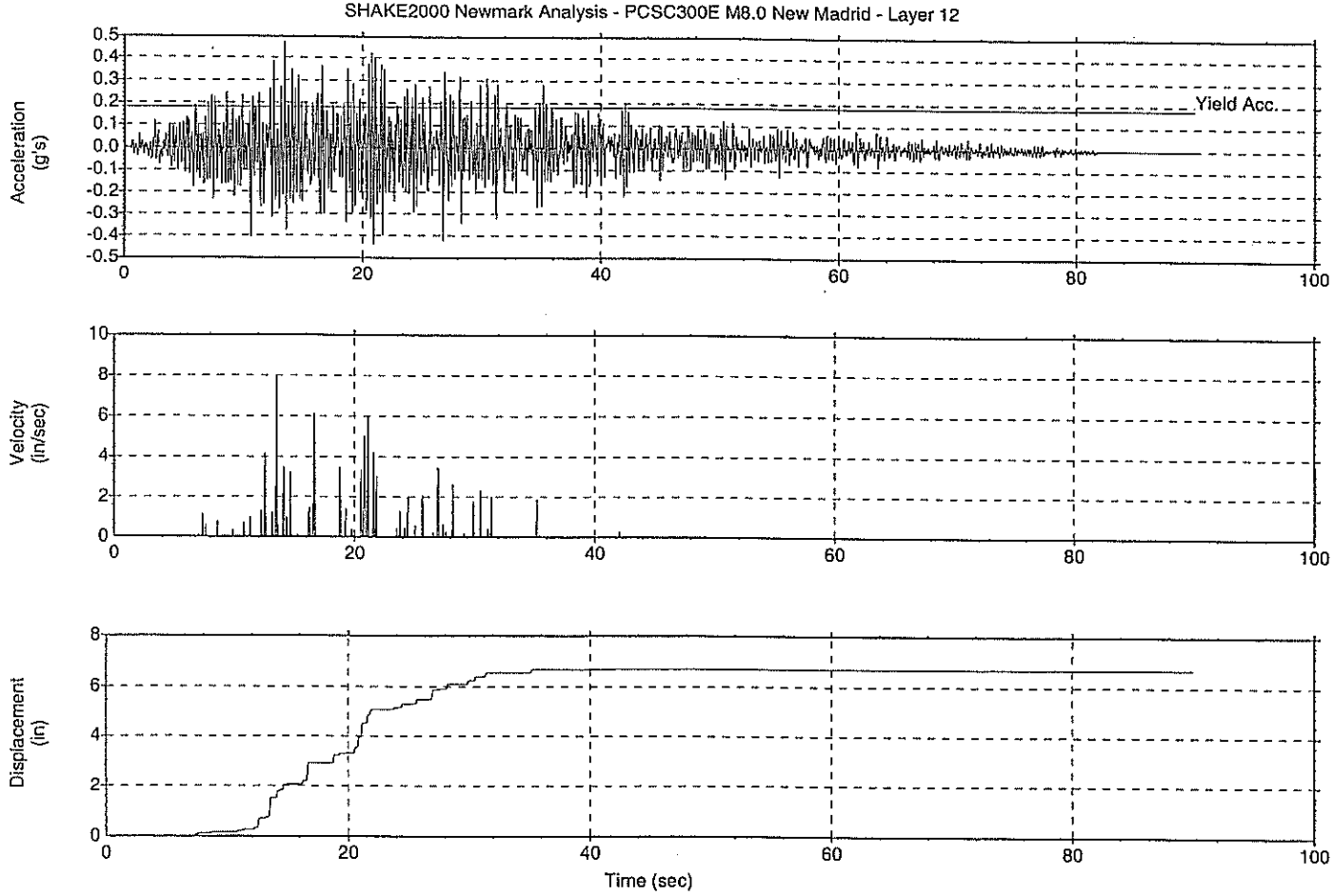


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 11

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 11 Stress - HEA - Layer: 11 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\111a1d1-39.hea
Peak Acceleration Value: .5182784 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 7.725144 in

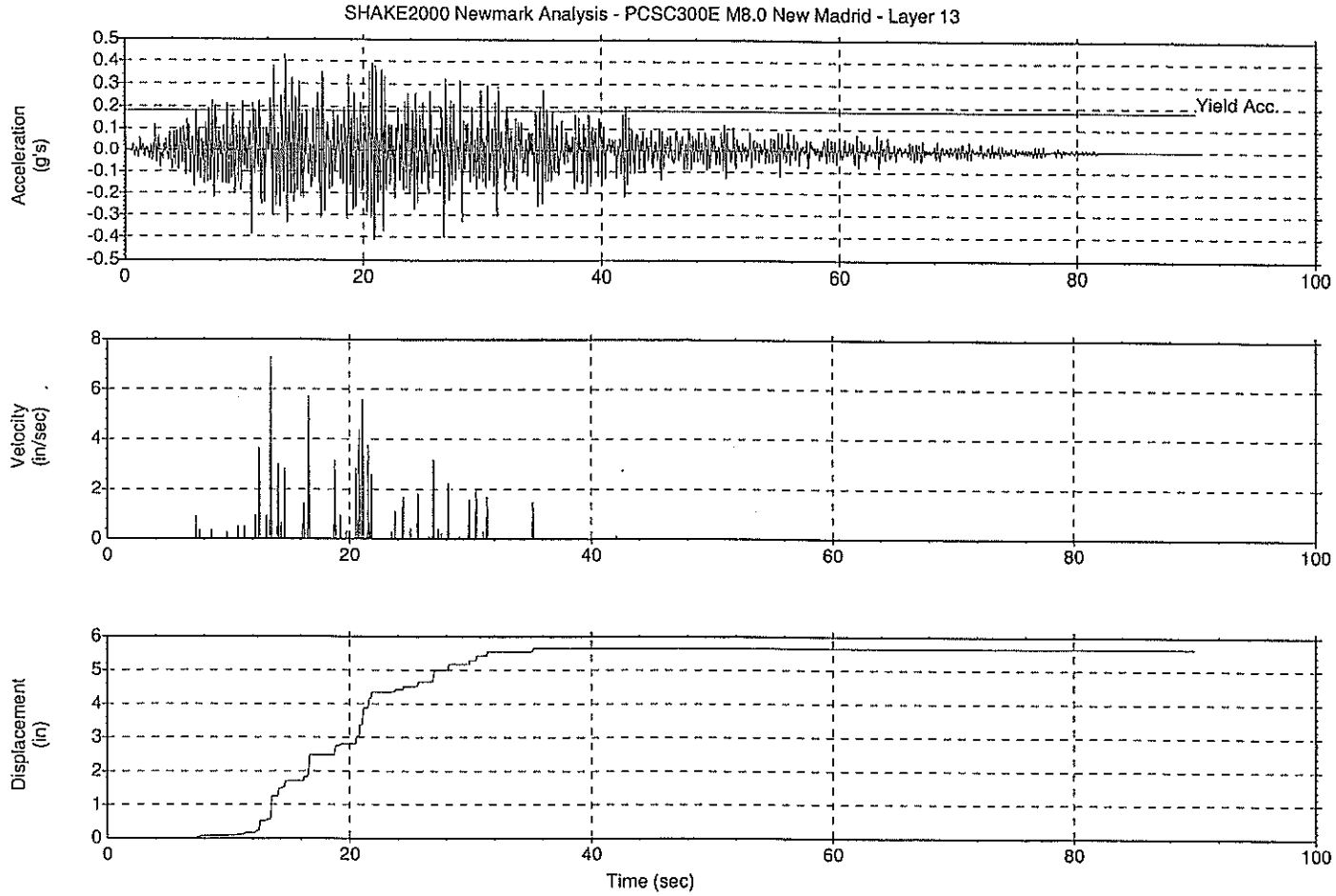


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 12

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 12 Stress - HEA - Layer: 12 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\112aldl-41.hea
Peak Acceleration Value: .4786401 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 6.693882 in



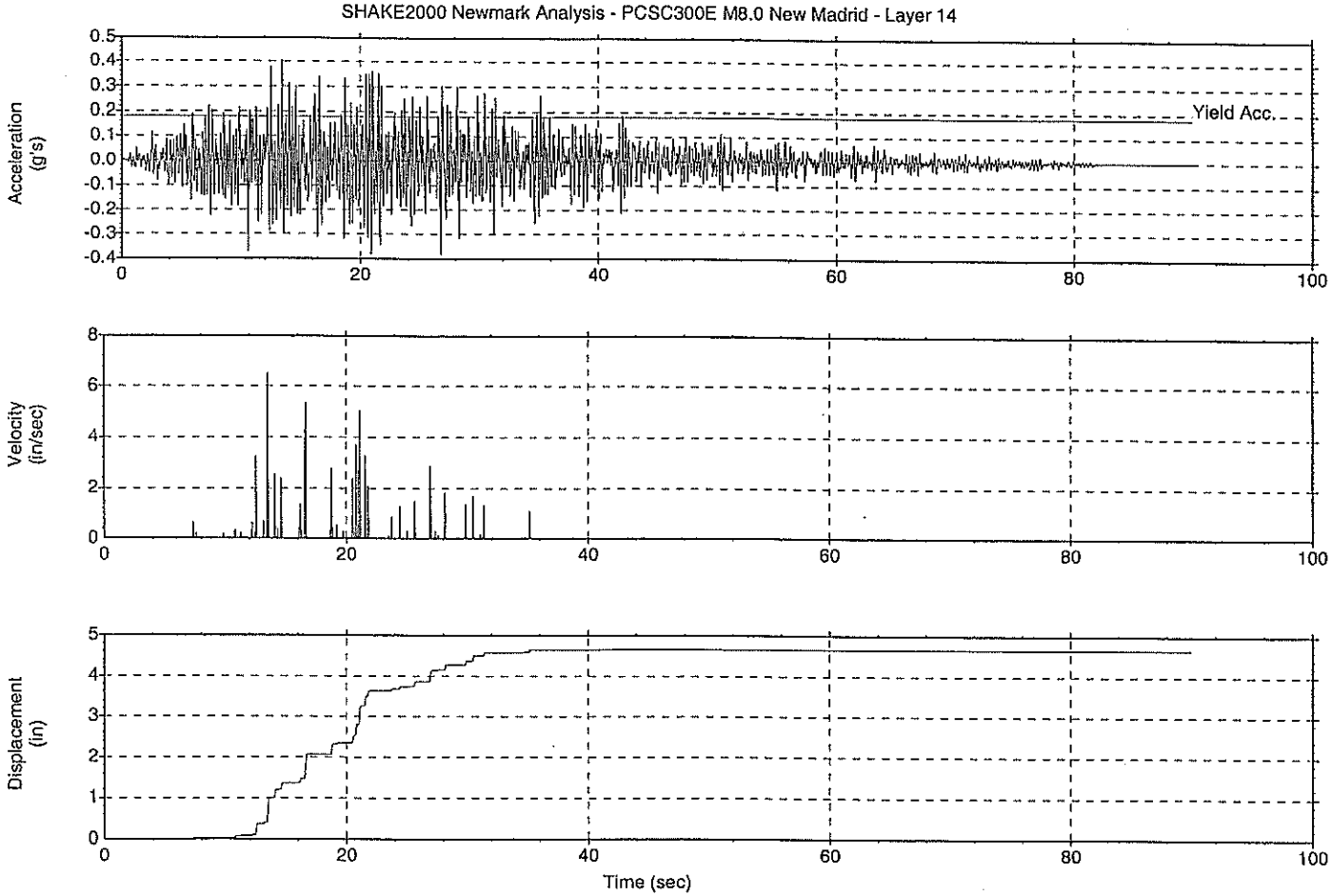
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 13

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 13 Stress - HEA - Layer: 13 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\113a1d1-43.hea
Peak Acceleration Value: .434305 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 5.65029 in

R14379

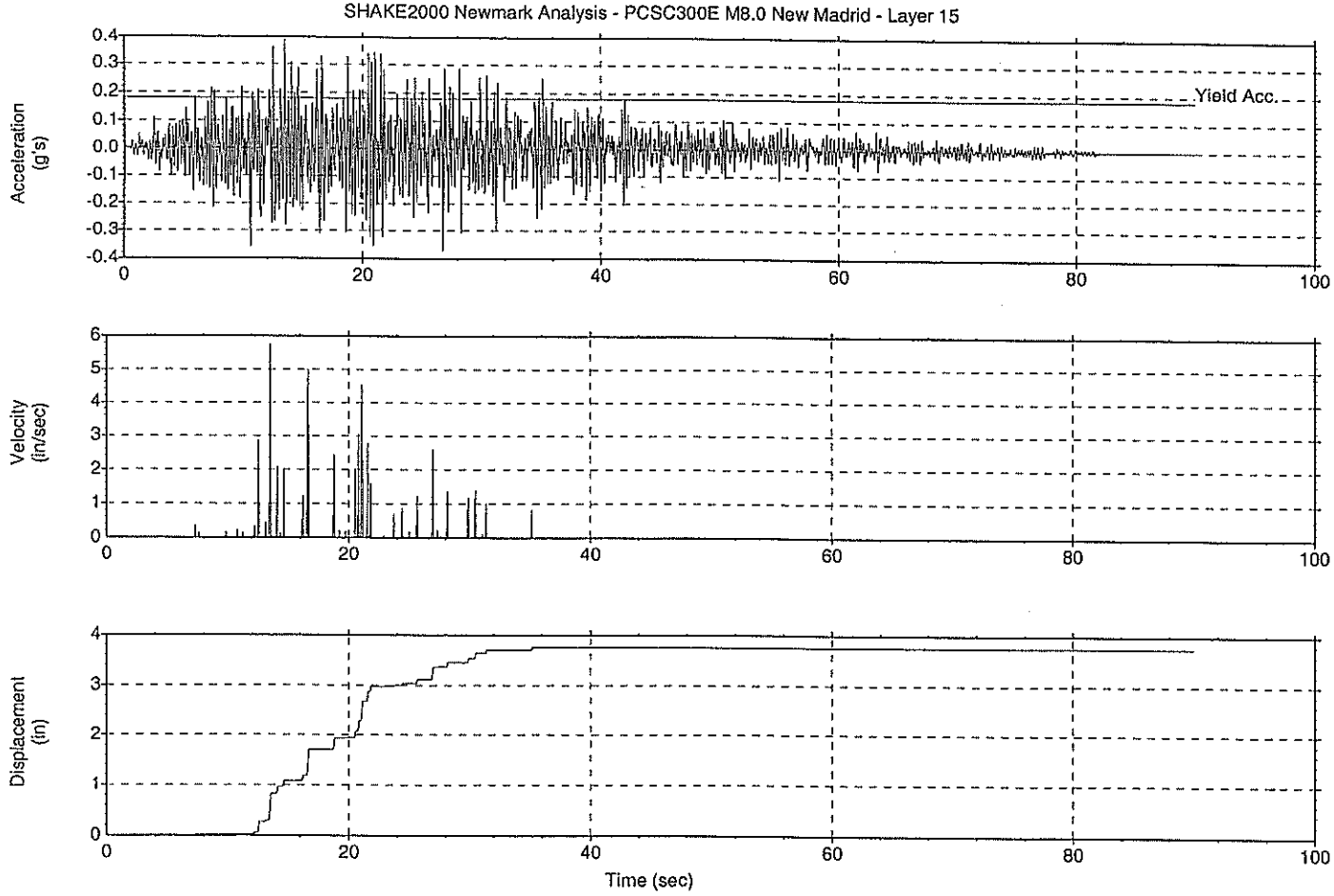


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 14

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 14 Stress - HEA - Layer: 14 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l14a1d1-45.hea
Peak Acceleration Value: .4086577 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

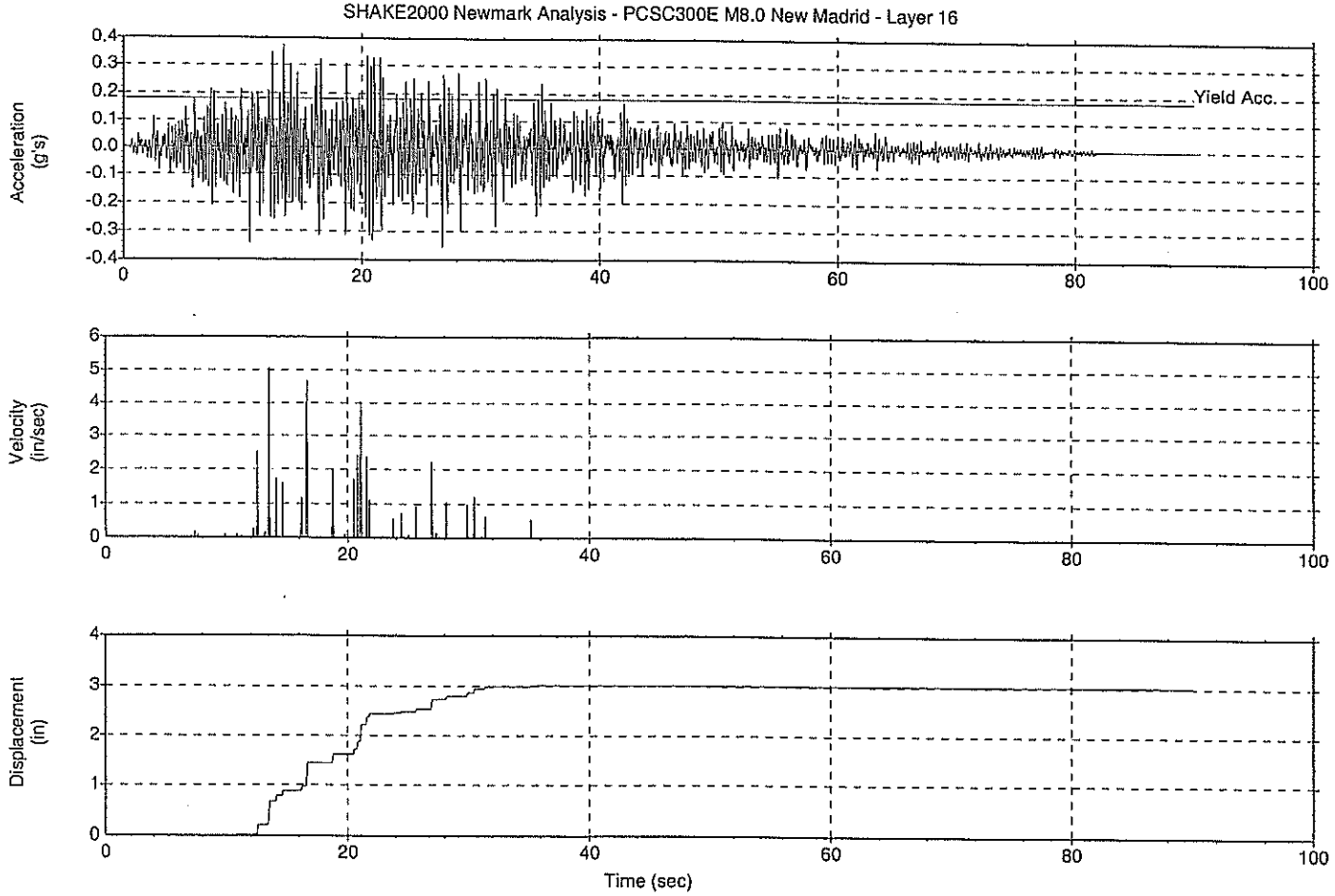
Displacement computed: 4.652216 in



Notes:
Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 15

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 15 Stress - HEA - Layer: 15 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\115a1d1-47.hea
Peak Acceleration Value: .3889318 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 3.752027 in



Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 16

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 16 Stress - HEA - Layer: 16 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\116a1d1-49.hea
Peak Acceleration Value: .3753596 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 3.017025 in

R14382

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation

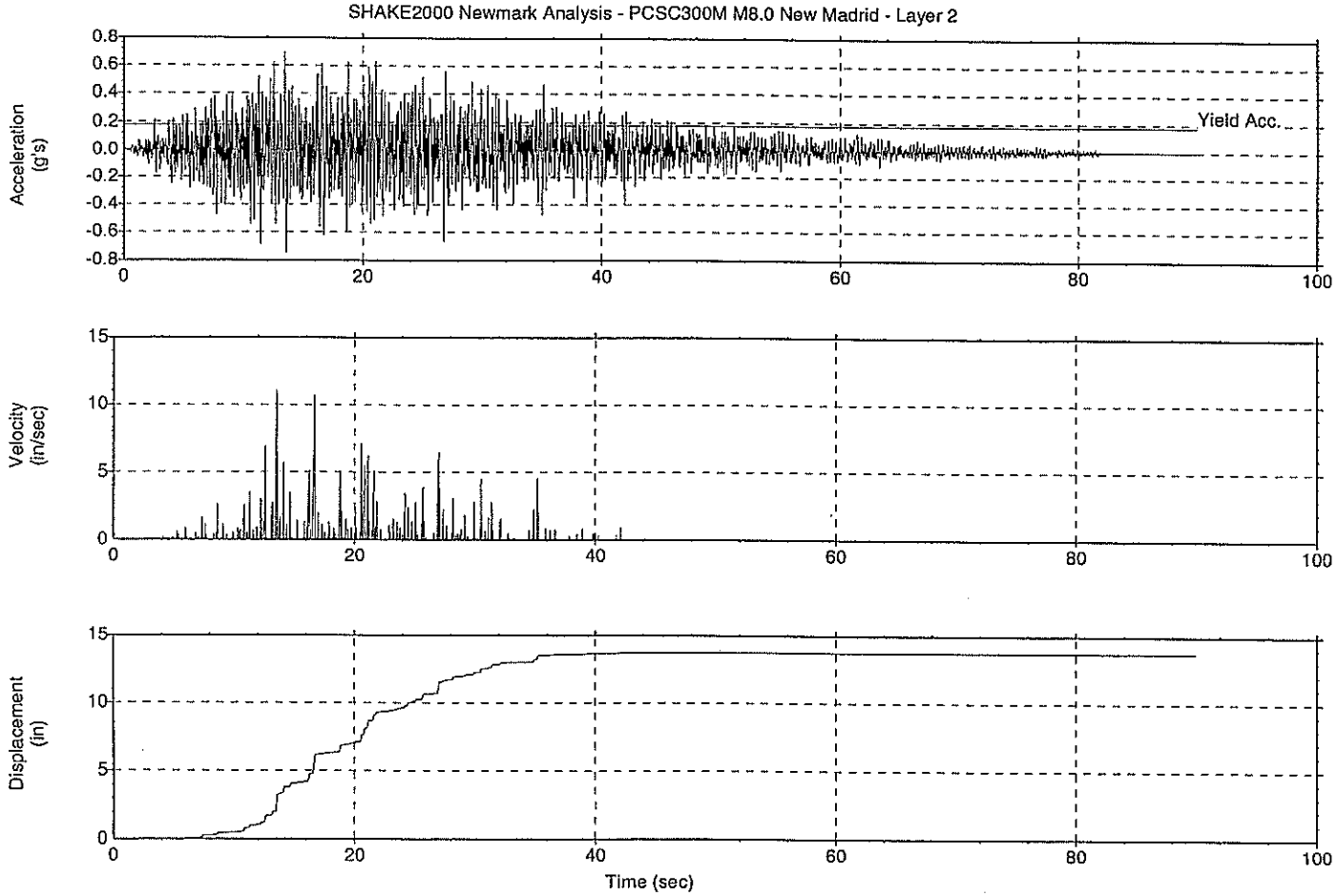
PROJECT NO. 072047

Estimate of Potential Embankment Settlements (Permanent Deformations)

PAGE 53 OF 68

MADE BY BEG DATE 1/22/08 CHECKED BY [signature] DATE 1/23/08

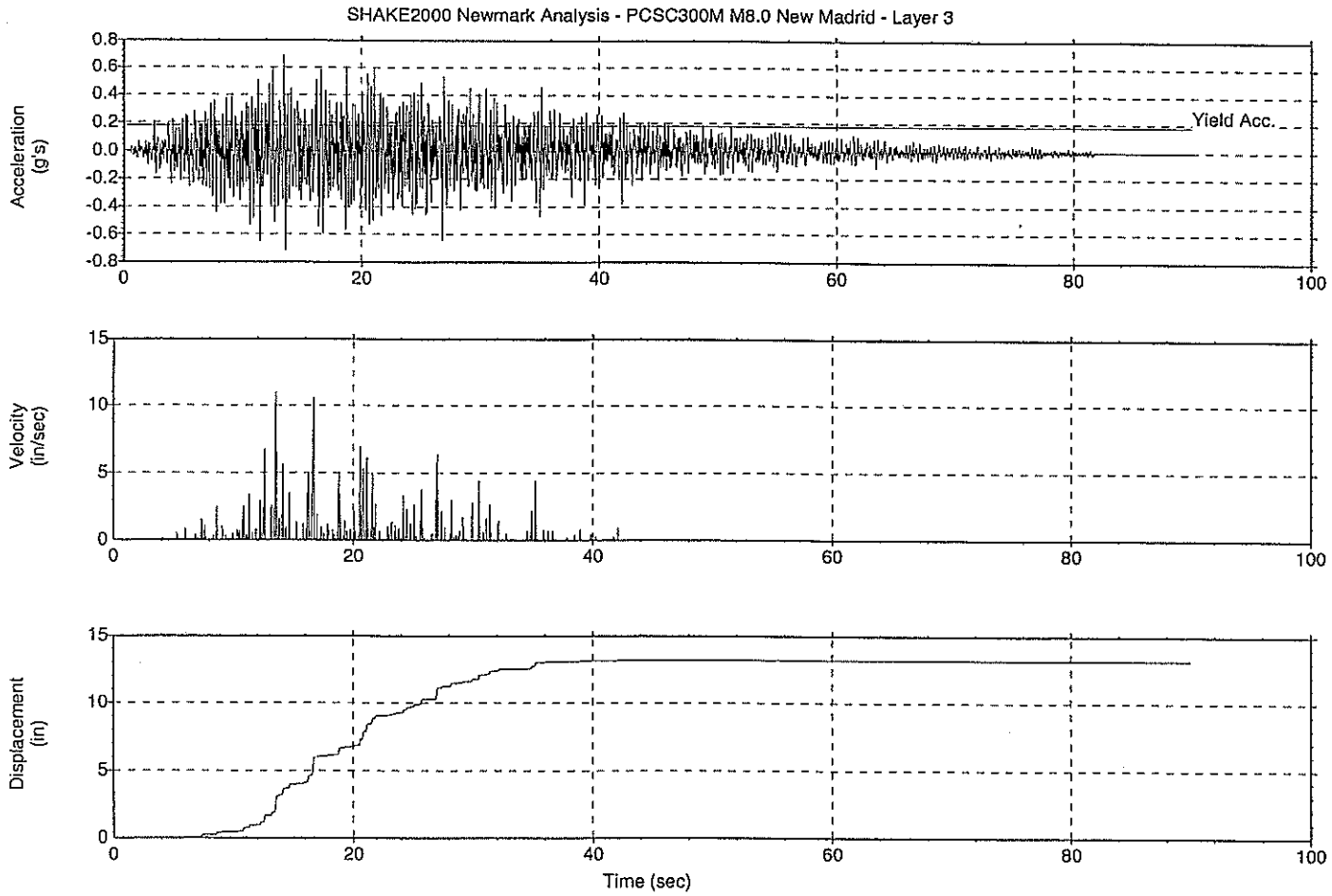
SHAKE2000 PERMANENT DEFORMATION OUTPUT FILE
PCSC300M – LAYERS 1 THROUGH 16
M8.0 NEW MADRID MDE @ 83 KM



Notes:
Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 2

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 2 Stress - HEA - Layer: 2 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l2ald1-21.hea
Peak Acceleration Value: .7507865 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 13.72214 in



Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 3

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
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Analysis: 1 - Soil Deposit: 1
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Displacement computed: 13.18699 in

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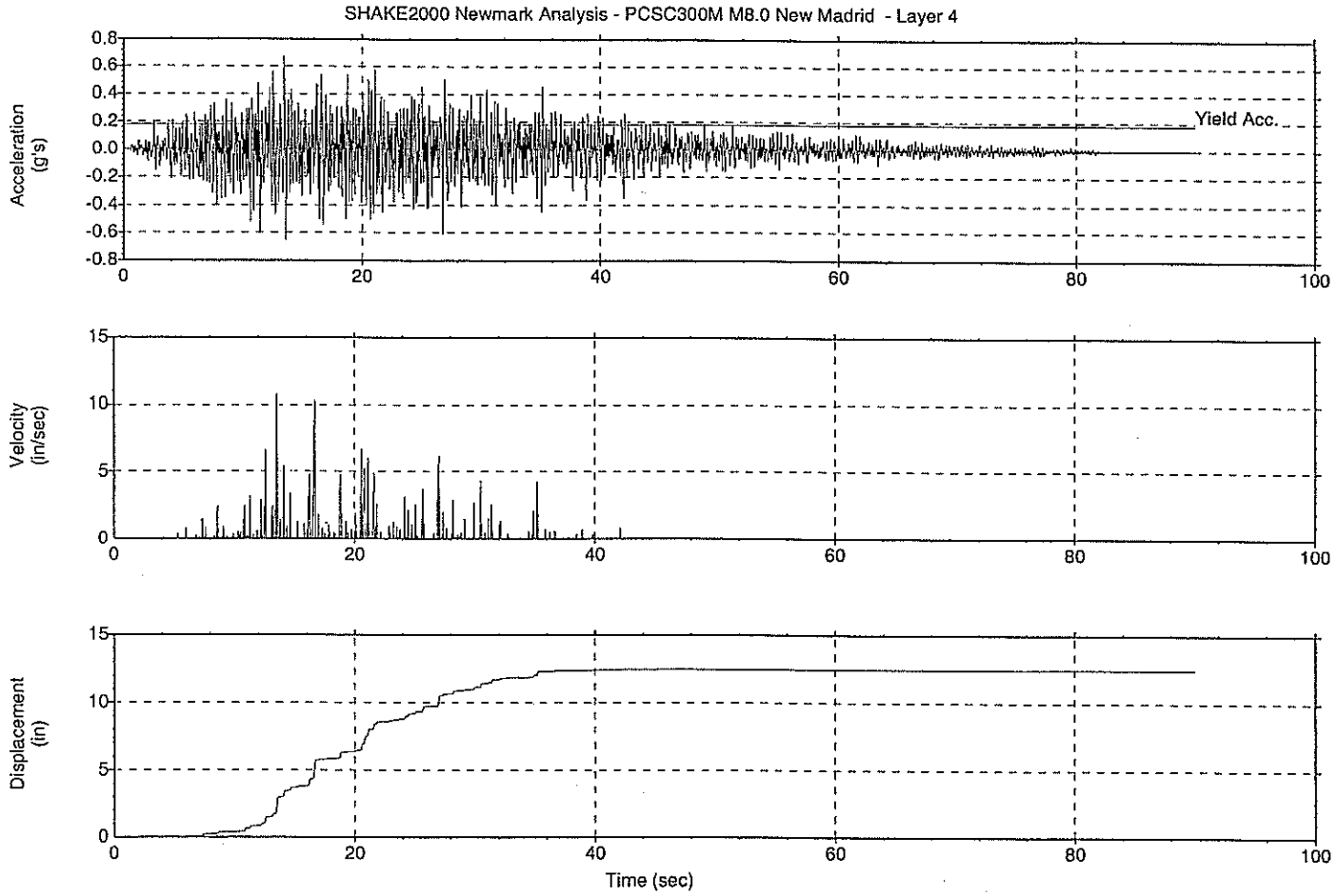

Notes:
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Newmark Method by Houston et.al. (1987)
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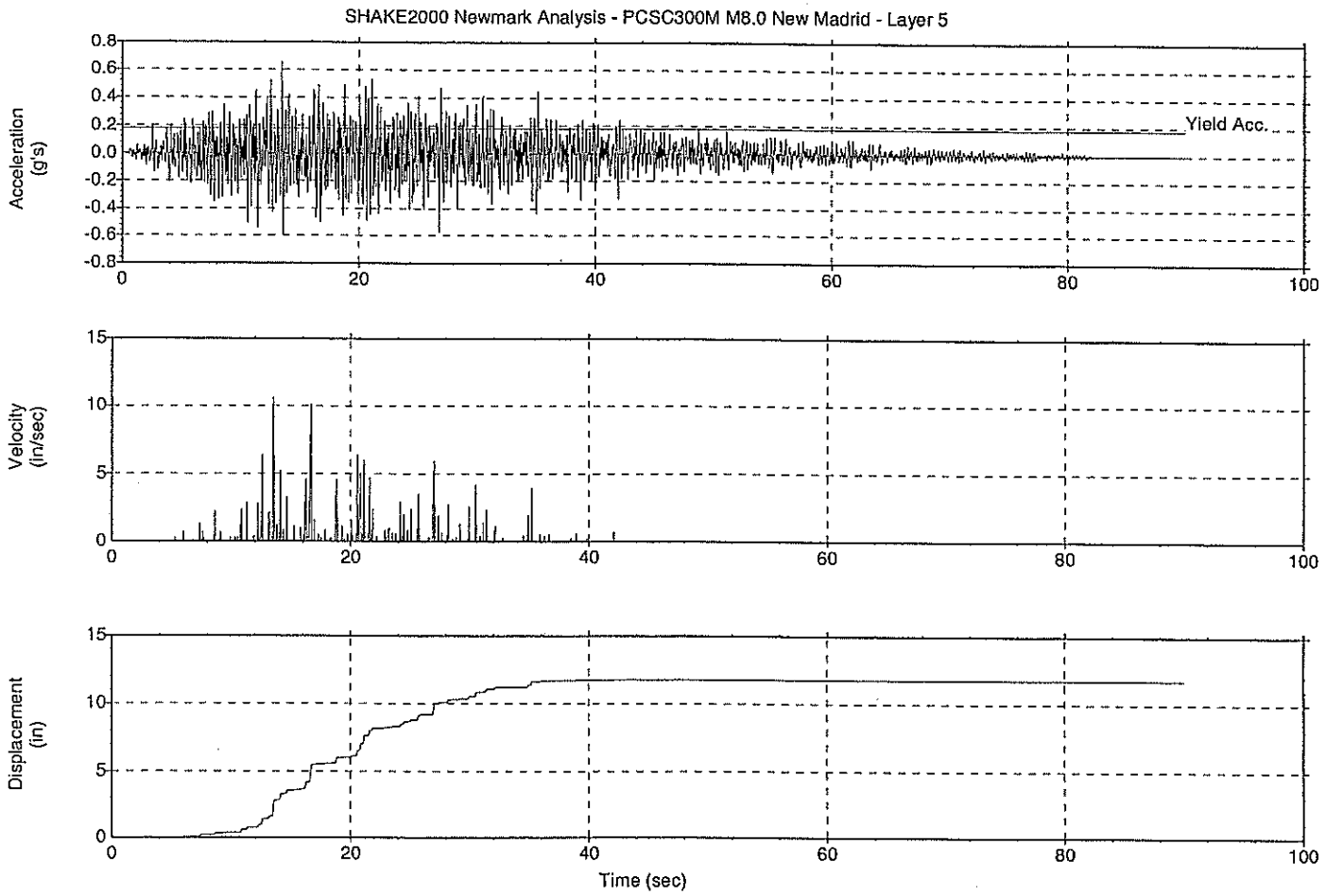

Notes:

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Newmark Method by Houston et.al. (1987)
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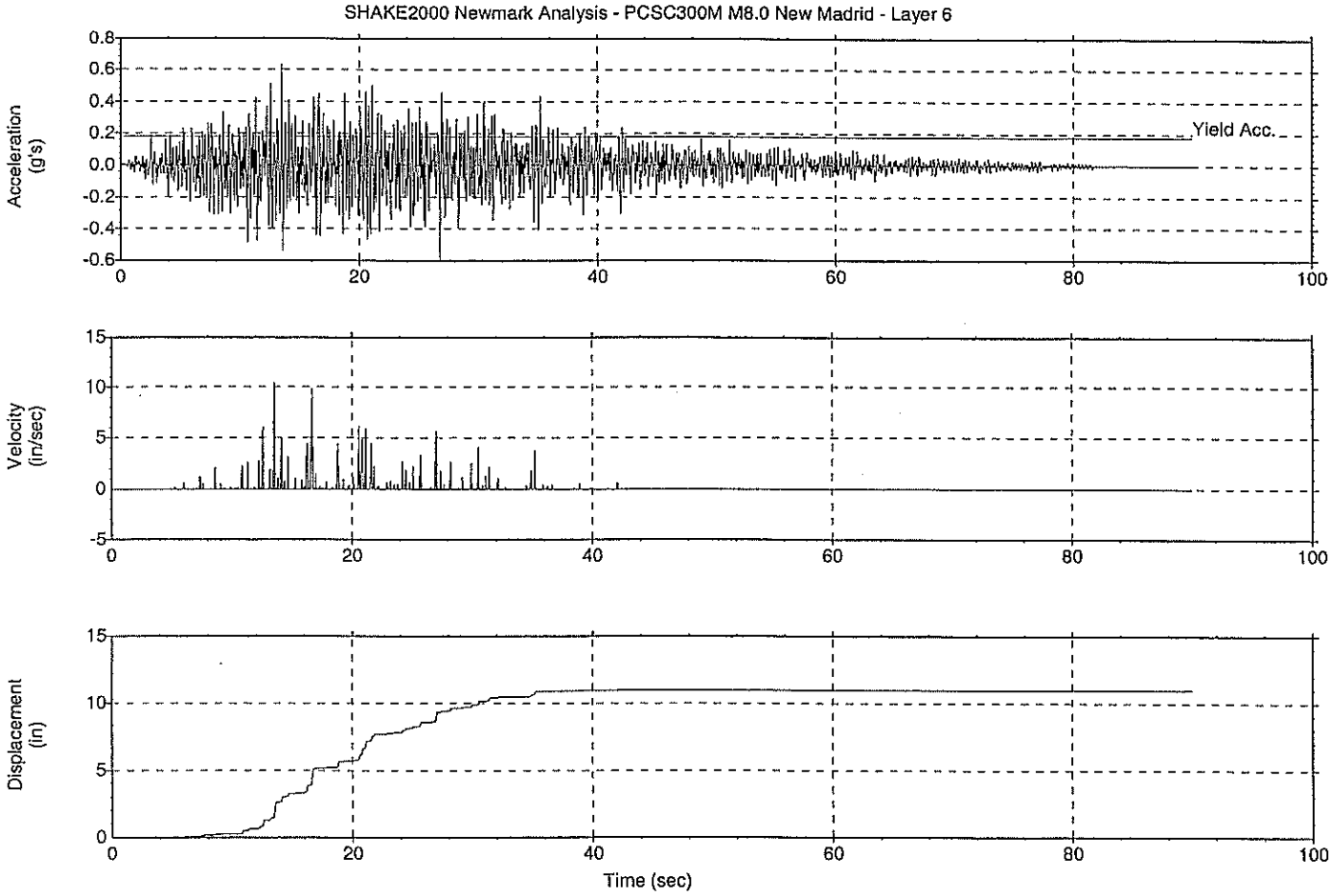

Notes:

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Newmark Method by Houston et.al. (1987)
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Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 10.96653 in

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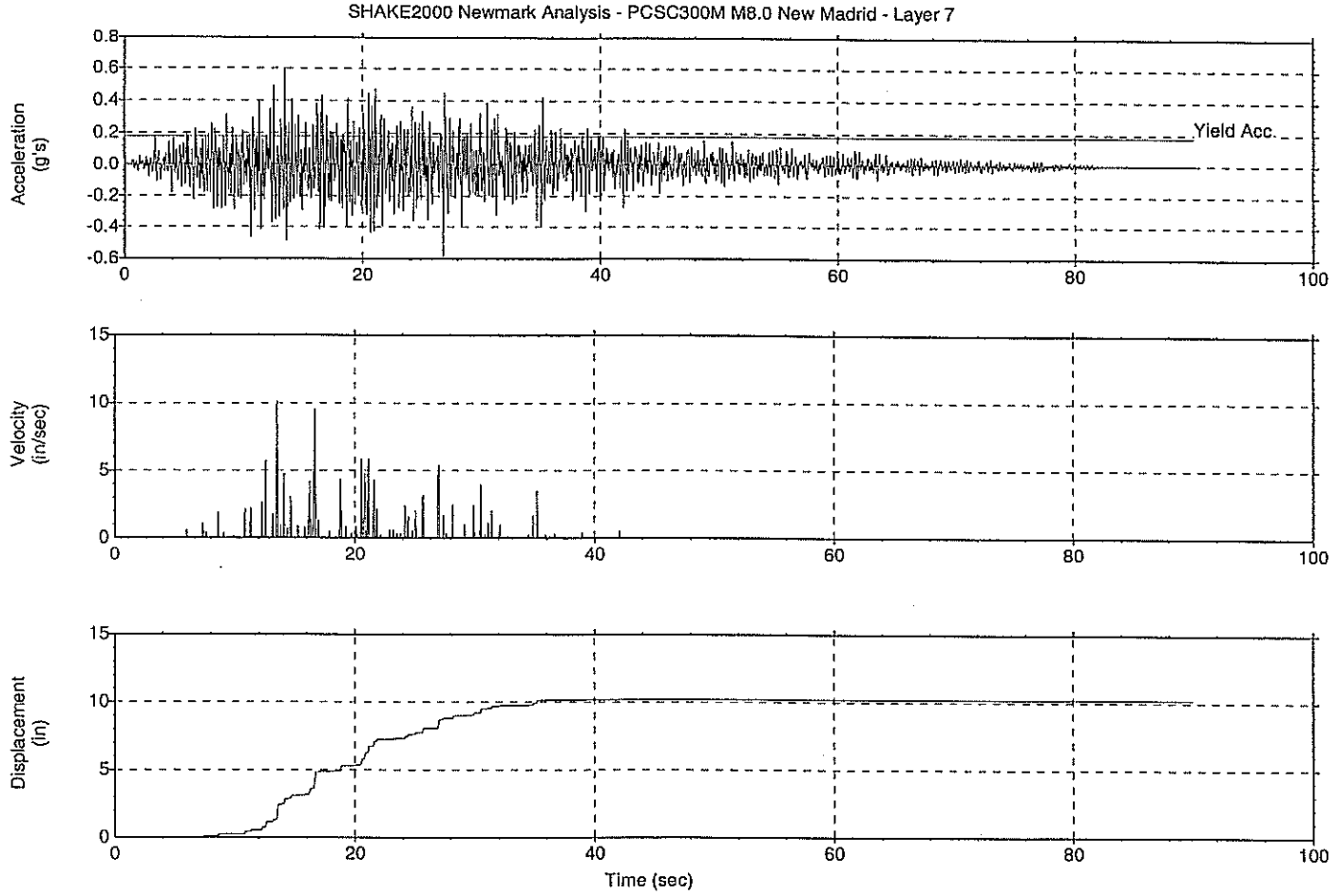

Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 7

Newmark Method by Houston et.al. (1987)
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Acceleration Time History: PCSC300M Layer 7 Stress - HEA - Layer: 7 -
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Displacement computed: 10.20521 in

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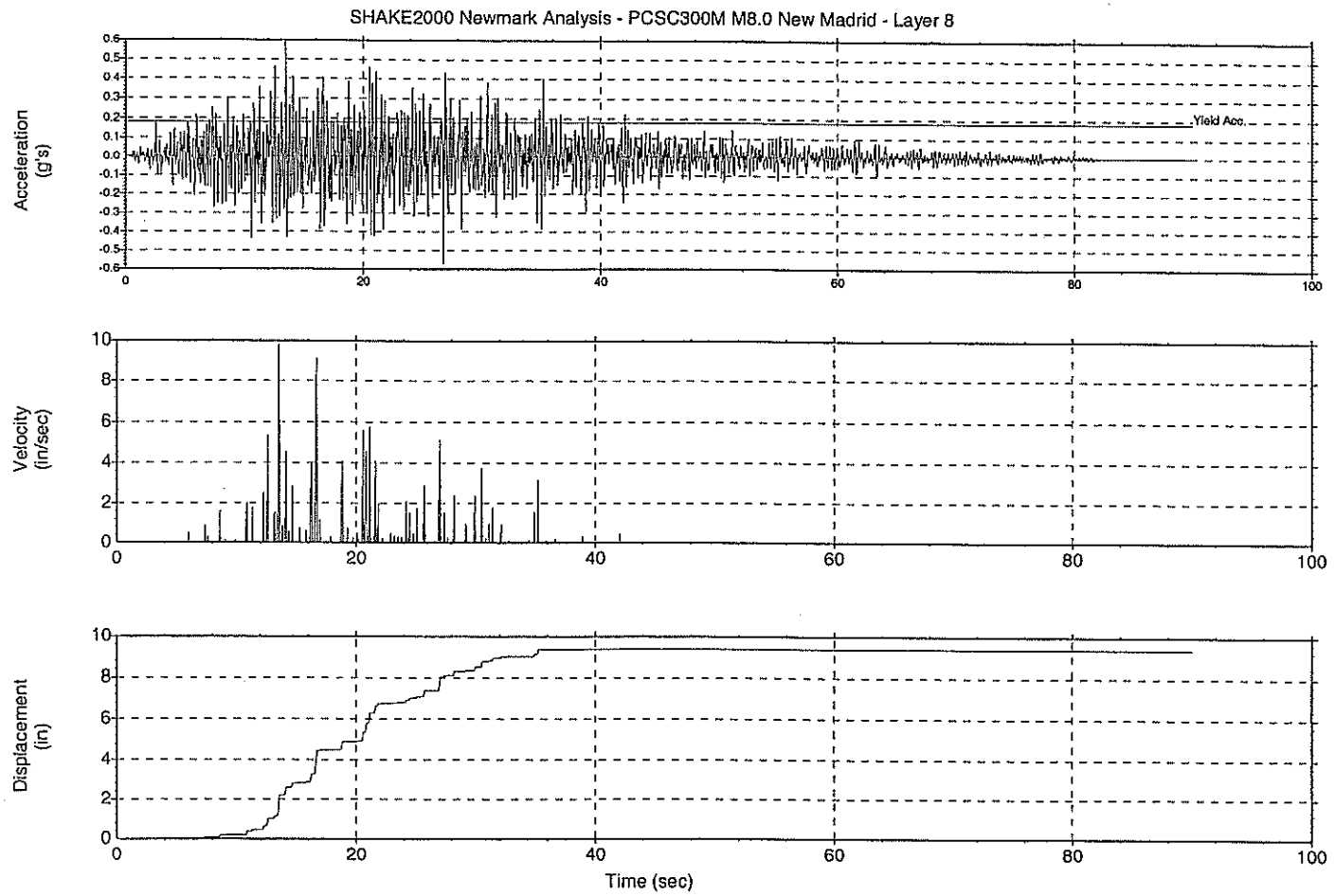

Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 8

Newmark Method by Houston'et.al. (1987)
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Acceleration Time History: PCSC300M Layer 8 Stress - HEA - Layer: 8 -
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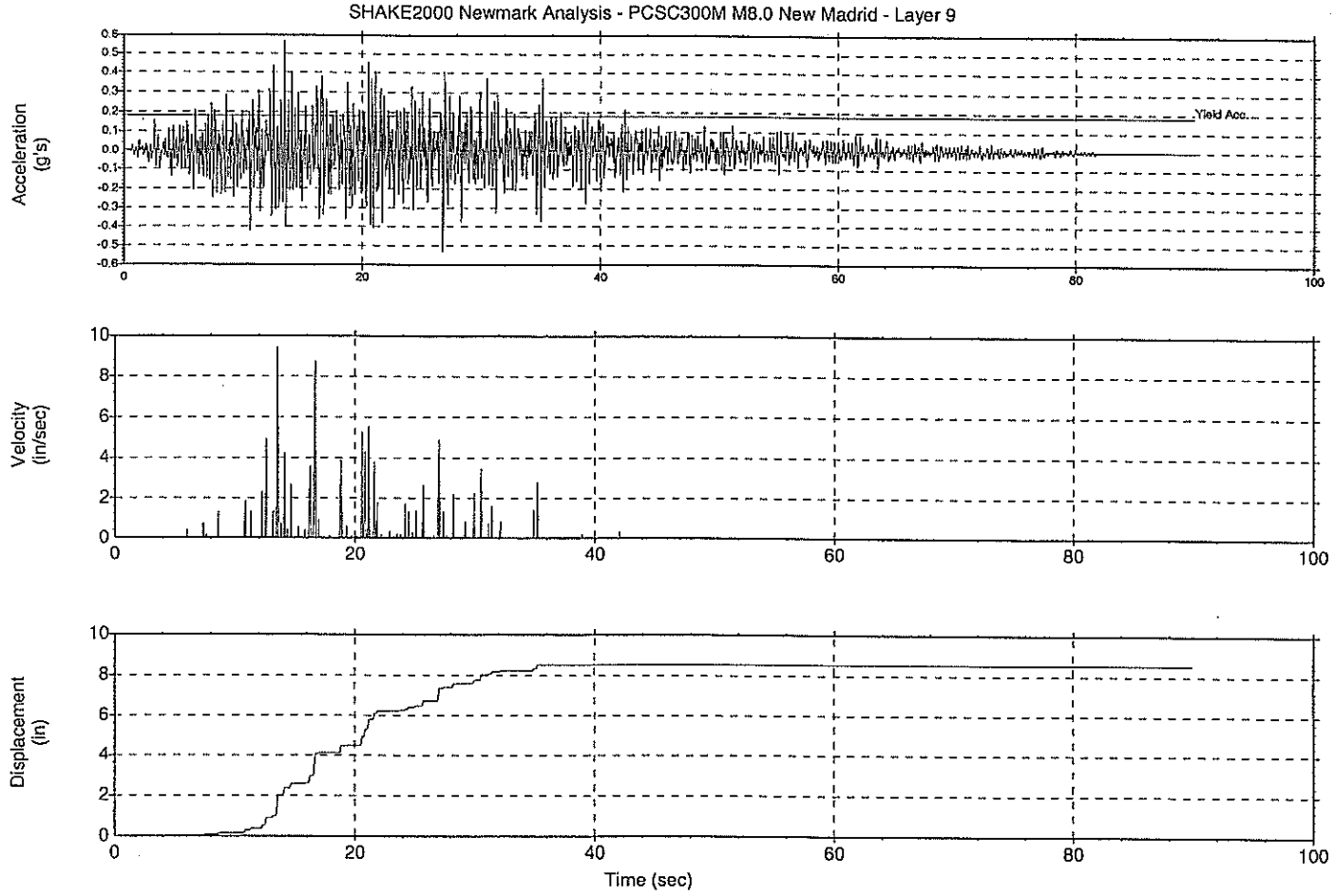

Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 9

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 9 Stress - HEA - Layer: 9 -
Analysis: 1 - Soil Deposit: 1
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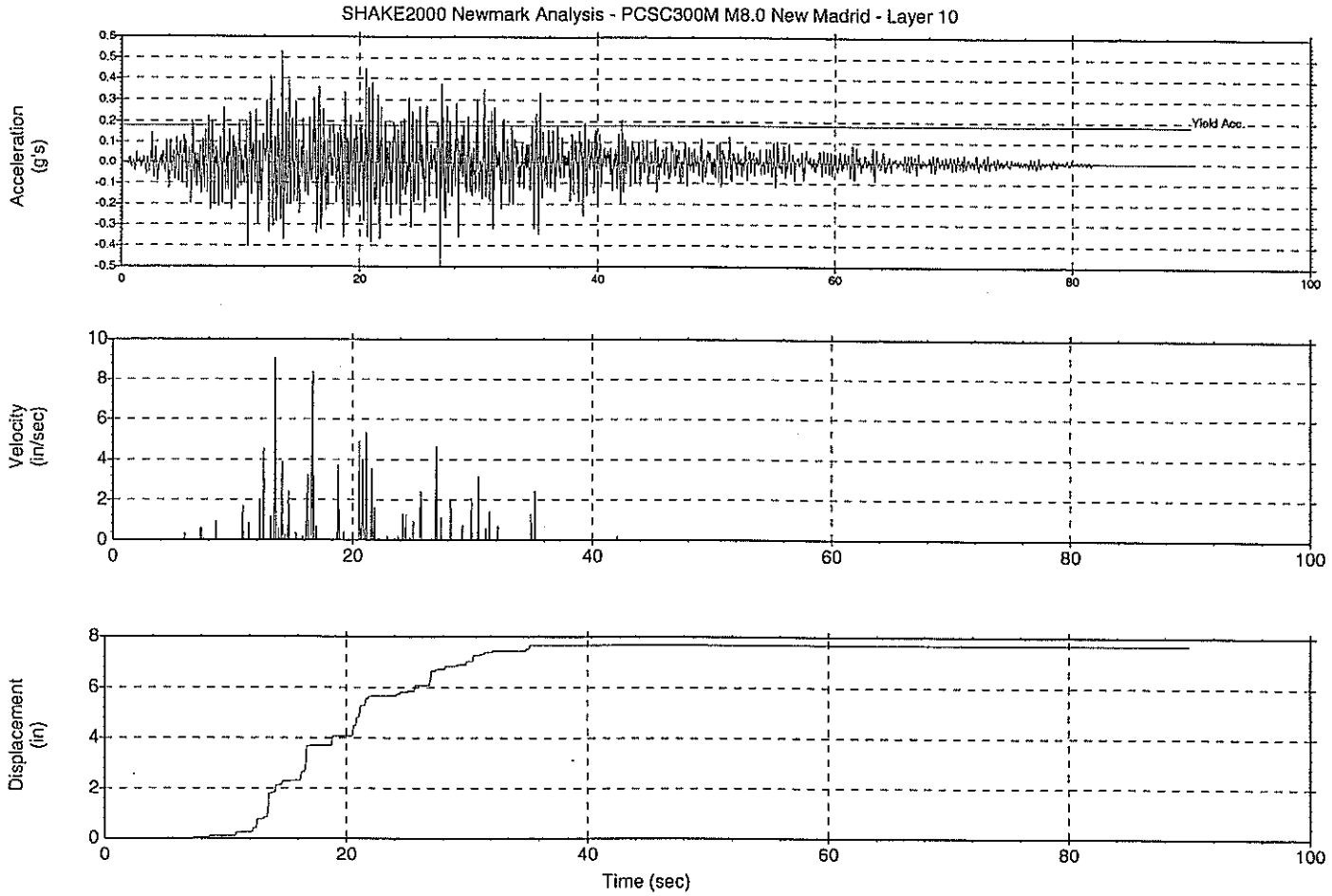
Displacement computed: 8.528267 in

R14391



Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 10

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 10 Stress - HEA - Layer: 10 -
Analysis: 1 - Soil Deposit: 1
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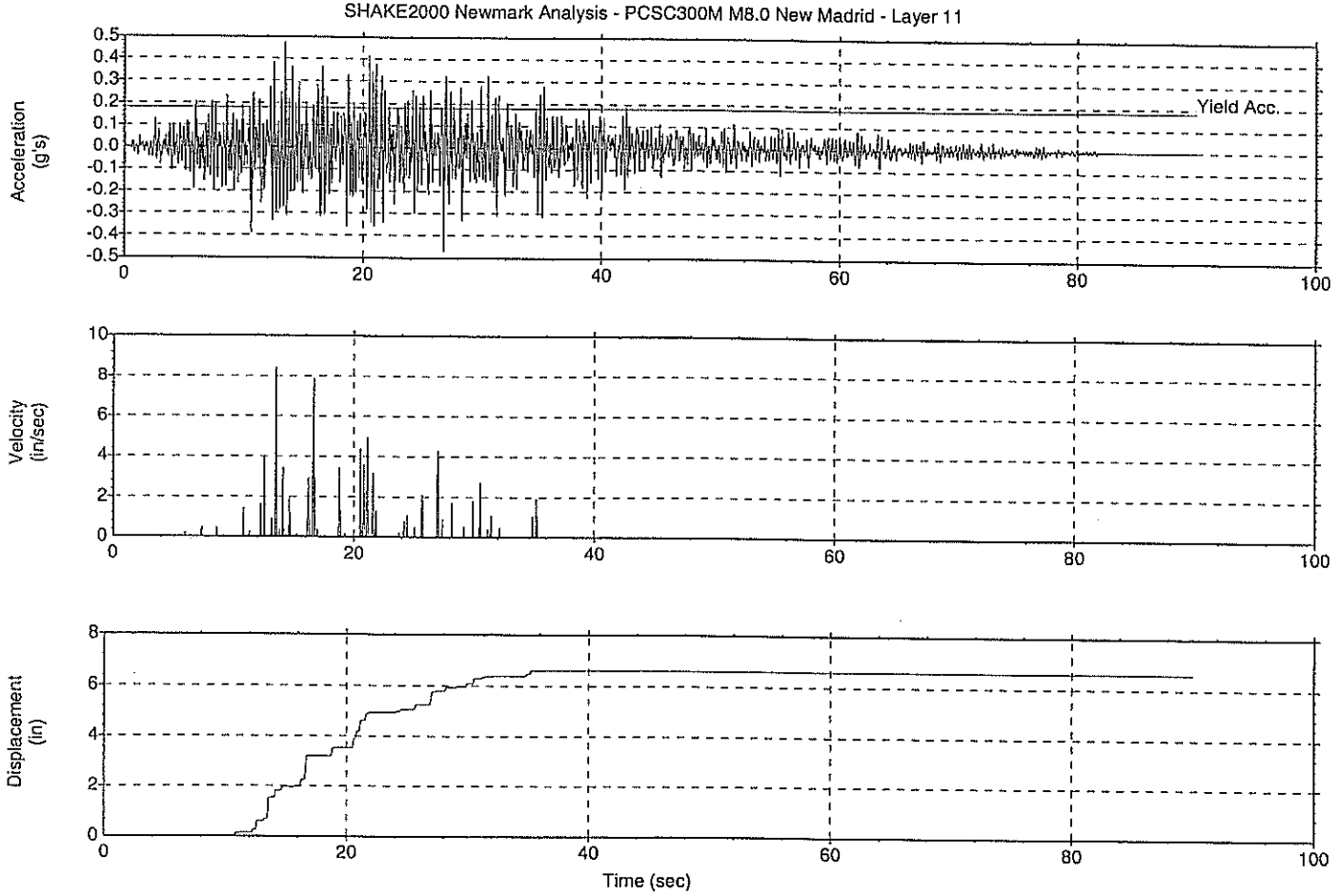
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 7.681901 in

R14392



Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 11

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 11 Stress - HEA - Layer: 11 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\111ald1-39.hea
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Displacement computed: 6.6054 in

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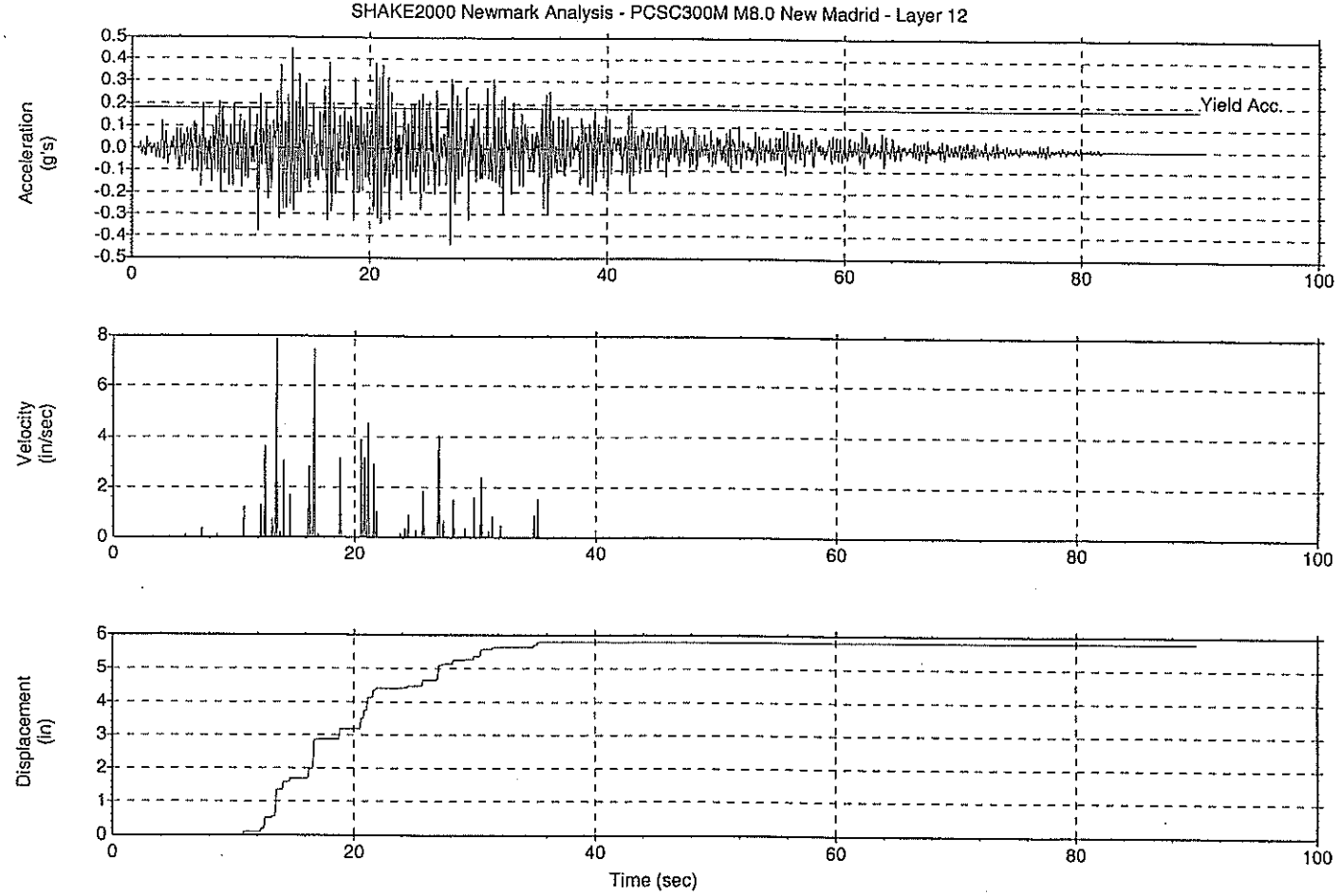

Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 12

Newmark Method by Houston et.al. (1987)
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Acceleration Time History: PCSC300M Layer 12 Stress - HEA - Layer: 12 - Analysis: 1 - Soil Deposit: 1
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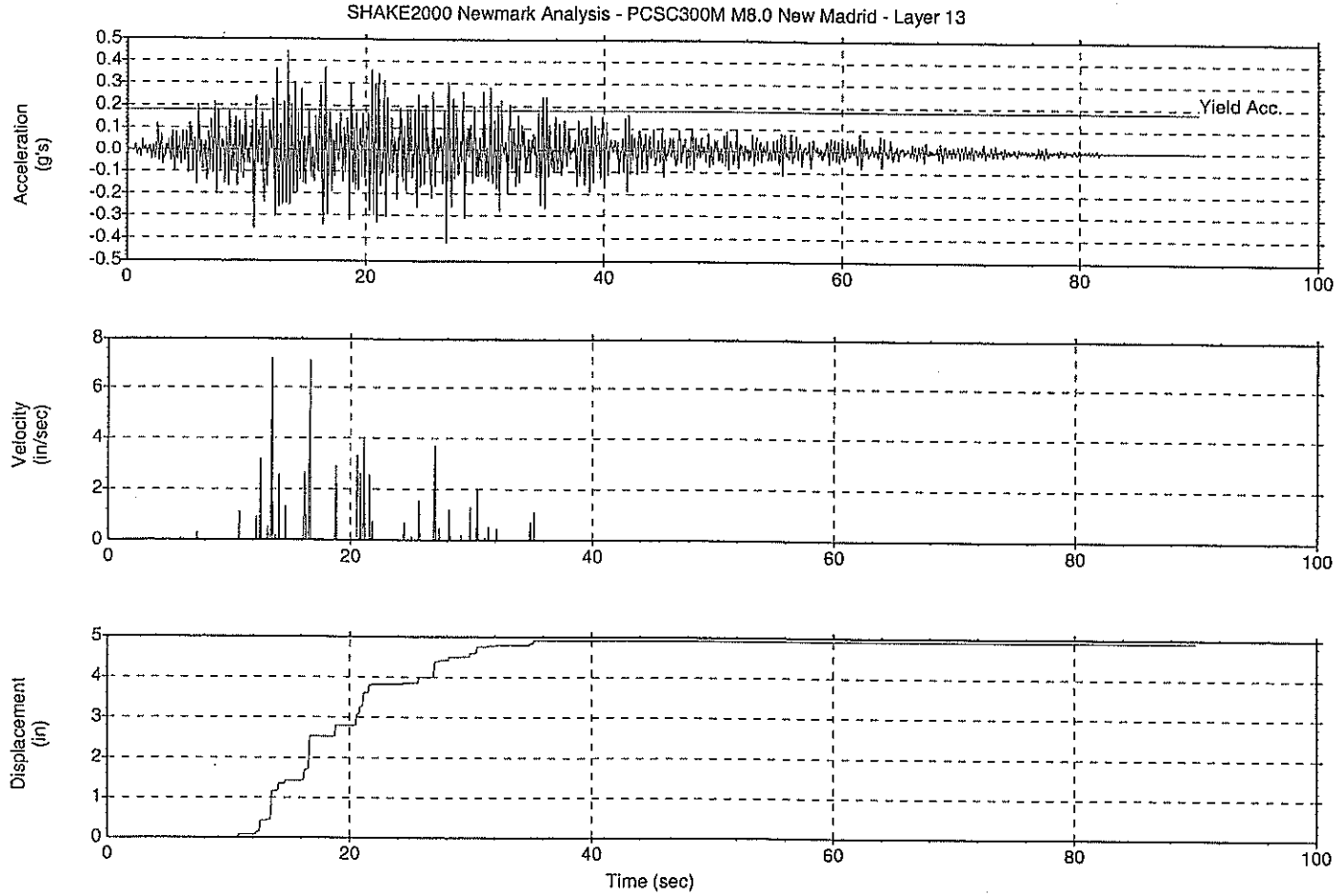
Displacement computed: 5.79074 in

R14394



Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 13

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 13 Stress - HEA - Layer: 13 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\113a1d1-43.hea
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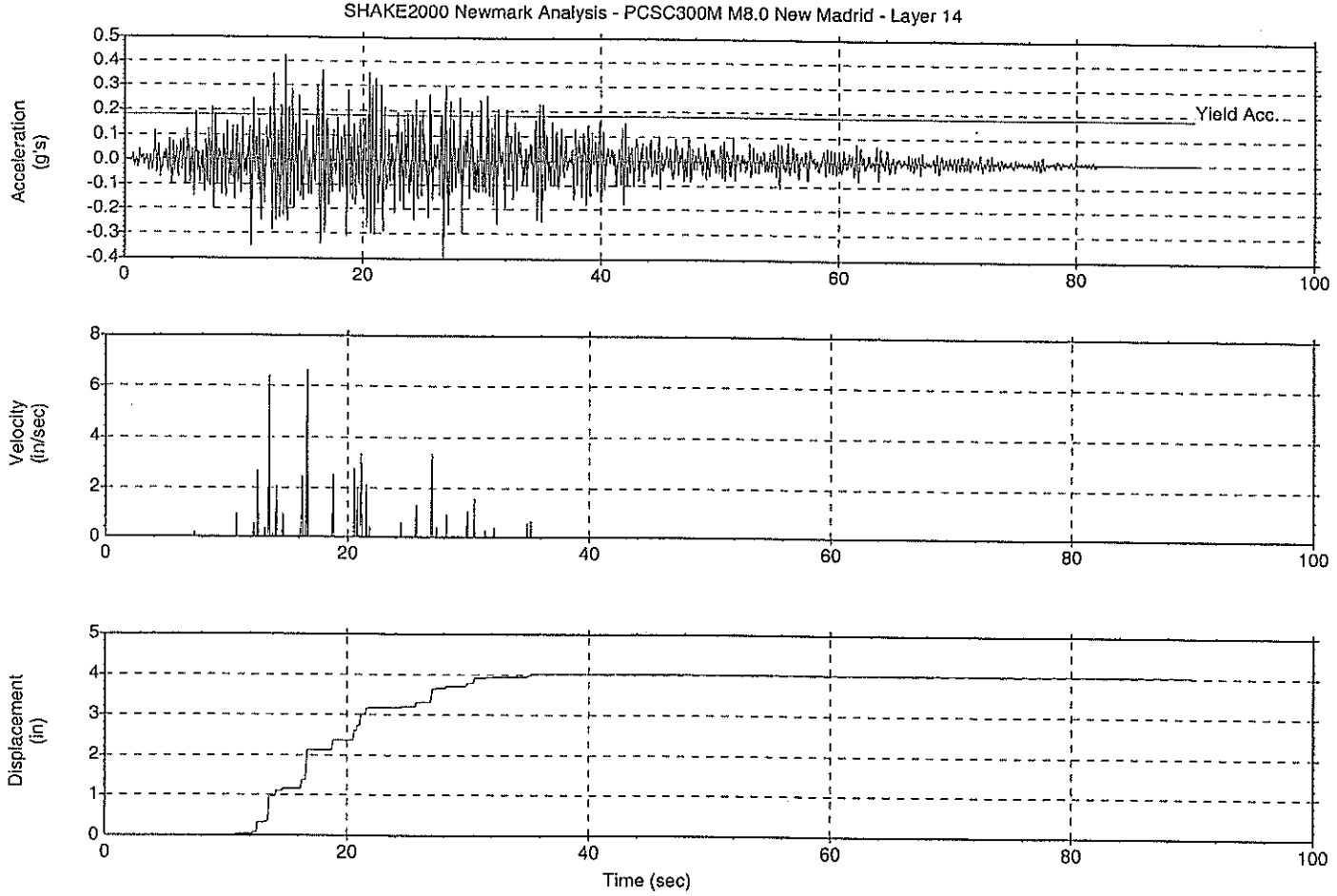
Displacement computed: 4.90984 in

R14395



Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 14

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 14 Stress - HEA - Layer: 14 - Analysis: 1 - Soil Deposit: 1
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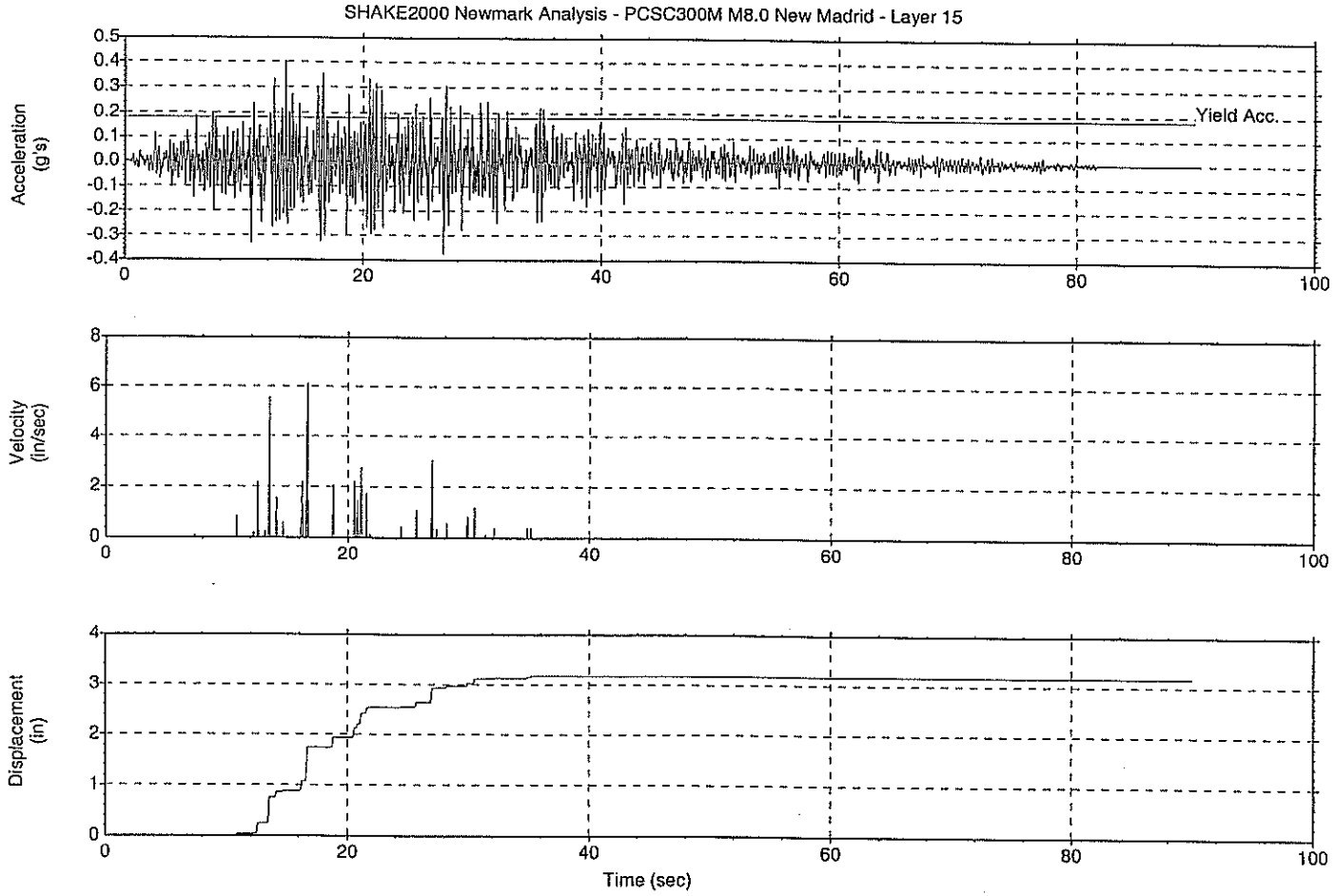
Displacement computed: 4.012906 in



Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 15

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 15 Stress - HEA - Layer: 15 -
Analysis: 1 - Soil Deposit: 1
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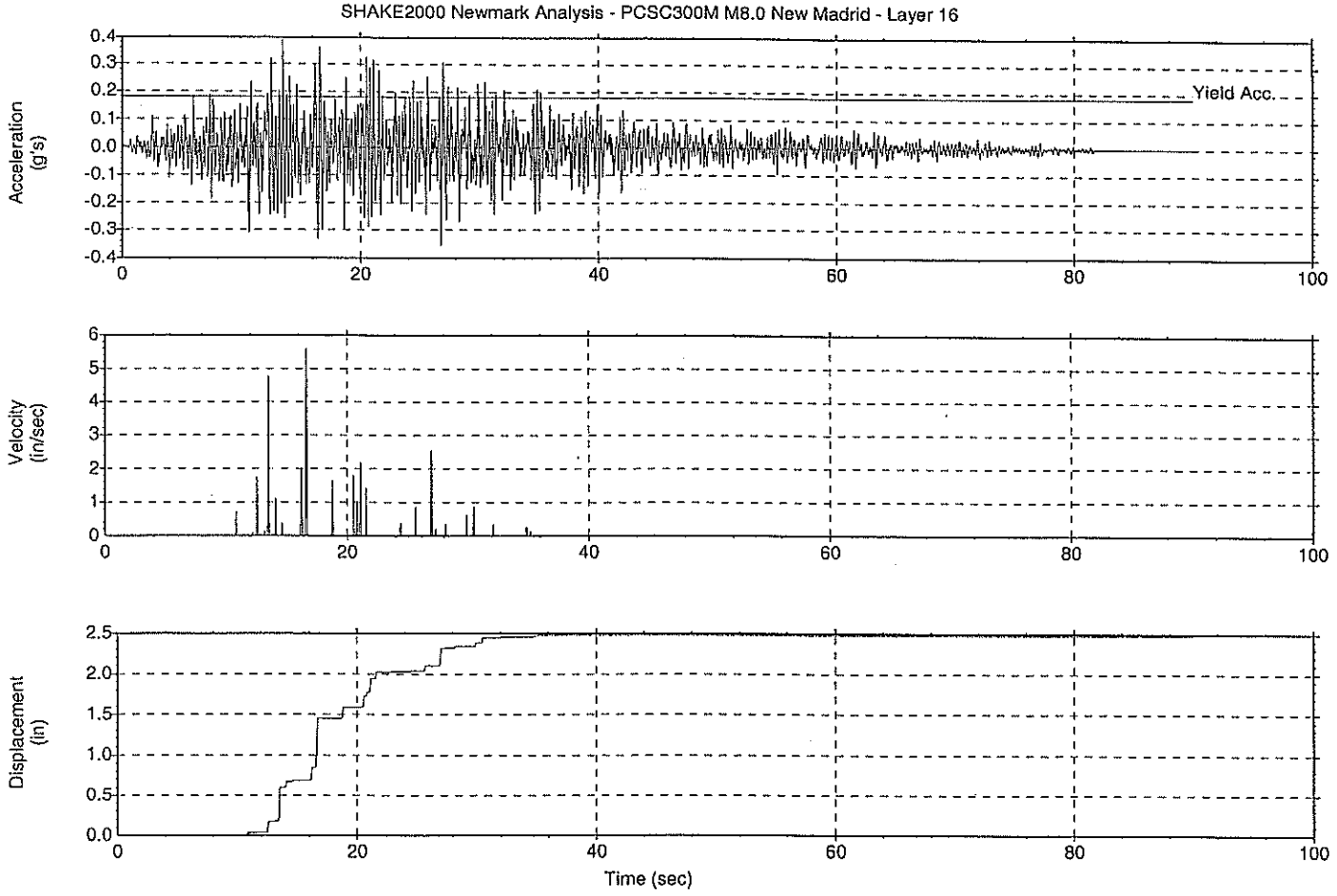
Displacement computed: 3.174503 in

R14397



Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 16

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 16 Stress - HEA - Layer: 16 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\116aldl-49.hea
Peak Acceleration Value: .38933 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 2.475344 in

R14399

7225.111
part 25

Alliance Consulting, Inc.
Engineers • Constructors • Scientists

ILLINOIS DEPARTMENT OF NATURAL RESOURCES
PERMIT NO. 375
REPORT
ABANDONMENT EVALUATION
VOLUME 6 OF 7

POND CREEK NO. 1 COAL REFUSE DISPOSAL SITE
PHASE 2 SOUTH POND SLURRY IMPOUNDMENT
JOHNSTON CITY, WILLIAMSON COUNTY, ILLINOIS

Prepared for

WILLIAMSON ENERGY, LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B10-148-1413
NOVEMBER 2010

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REPORT
ABANDONMENT EVALUATION

POND CREEK NO. 1 COAL REFUSE DISPOSAL SITE
PHASE 2 SOUTH POND SLURRY IMPOUNDMENT
JOHNSTON CITY, WILLIAMSON COUNTY, ILLINOIS

Prepared For:

ALLIANCE CONSULTING, INC.
BECKLEY, WEST VIRGINIA

Prepared By:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
EXPORT, PENNSYLVANIA

CEC Project 080-851

July 23, 2008

TABLE OF CONTENTS

		Page
1.0	Introduction	1
2.0	Analytical Approach	3
3.0	Previous Deformation Analyses	5
4.0	Laboratory Testing and Summary of Results	6
4.1	Estimates of In-Situ Steady-State Undrained Shear Strength	7
4.2	Summary of Engineering Properties	8
5.0	Liquefaction Susceptibility Evaluation	9
5.1	In-Situ Driving Shear Stress	9
5.2	Factor of Safety Against Liquefaction	10
6.0	Conclusions	11
7.0	References	13

FIGURE

Figure 1 – Cross-Section A-A Liquefaction Slope Stability Analyses Results

APPENDICES

Appendix A – Summary of Laboratory Testing Results and Characterization of the Subsurface Materials

Appendix B – Summary of Engineering Properties

Appendix C – Driving Shear Stress and Factor of Safety Against Liquefaction Slope Stability Analyses Results

1.0 INTRODUCTION

Plans have been developed for the construction of a coarse and fine coal refuse disposal facility to be located near Johnston City in Williamson County, Illinois. The proposed Pond Creek facility will provide disposal capacity for both coarse and fine coal refuse produced by the Pond Creek Mine No. 1 coal preparation plant located approximately 0.25-mile to the west. The location of the site is just southwest of the intersection of Dwina Road and Dean Road.

The design plans for the Phase 2 expansion of the Pond Creek facility, submitted under separate cover by Alliance Consulting, Inc. (Alliance) of Beckley, West Virginia, includes raising the embankment crest to Elevation (El.) 502 by constructing a coarse coal refuse embankment cell (South Pond). The corresponding minimum and maximum fine coal refuse slurry impoundment levels for the proposed South Pond are El. 474 and El. 496, respectively. The abandonment geometry includes an additional 4-foot layer of coarse coal refuse up to El. 500 and a 2-foot thick, one (1) percent sloping soil cover.

The Illinois Department of Natural Resources (IDNR) Part 3702 Chapter IX requires that the evaluation of the abandonment condition for the South Pond address the following issues:

1. The classification of the existing condition of the impounded material with respect to its fluid nature;

2. The liquefaction potential of the impounded material and the related stability of the containing dam;

3. The final surface configuration for the impoundment including the potential for resaturation of the impounded material especially from any surface water impounding characteristics; and

4. The establishment of a follow-up inspection schedule to ensure the proposed plans have been effective and the submittal of record drawings.

The following sections of this report include generalized descriptions of the analytical techniques and results of the material characterizations, summaries of previous deformation analyses and laboratory testing, various abandonment analyses associated with IDNR guideline Nos. 1 and 2 noted above, our conclusions and a reference list. Alliance will present under separate cover the final surface configuration and follow-up inspection schedule associated with Nos. 3 and 4 of the IDNR guidelines noted above. Figure 1 presents the Cross-Section A-A, Pond Creek Phase 2 South Pond abandonment geometry and results of the liquefaction susceptibility analysis. Appendices A through C present supporting information, including detailed calculation briefs for the various analytical procedures discussed herein.

2.0 ANALYTICAL APPROACH

In general, the procedure utilized by Civil & Environmental Consultants, Inc. (CEC) for evaluating the Phase 2 South Pond abandonment geometry is presented by Poulos, Castro and France (1985), which includes characterizing the impounded fine coal refuse material and assessing the susceptibility of the impoundment and embankment to a liquefaction (flow slide) failure. Liquefaction susceptibility was determined by performing a stability analysis, which requires the undrained steady-state strength (S_{us}) and the in-situ static driving shear stress be determined.

Poulos, et al (1985) states a soil mass susceptible to liquefaction will only experience a liquefaction failure when a sufficiently large triggering event causes the strength of the soil to decrease to the undrained steady-state strength. Conversely, a soil mass which is not susceptible to liquefaction physically cannot fail by liquefaction since the minimum undrained strength exceeds the in-situ driving shear stress along the critical failure surface. These principles form the basis of the liquefaction-based abandonment analyses described below.

Liquefaction susceptibility of the proposed Phase 2 South Pond abandonment geometry and, in general, the fine coal refuse hydraulically placed behind the coarse refuse embankment involved the determination of:

1. The physical properties and relationship between peak and steady-state undrained shear strength of fine coal refuse with variations in effective stress, based on index and strength tests on remolded, site-specific slurry samples of the fine coal refuse to characterize the material relative to its potential for strength loss and flow failure;

2. Driving shear stresses through the fine coal refuse and coarse refuse embankment/residual soil in the downstream and upstream directions to assess the potential for liquefaction; and

3. The factor of safety against liquefaction (F_L) by comparing the steady-state undrained strength of the fine coal refuse to the in-situ driving shear stress generated by the downstream and upstream abandonment soil mass geometries.

Liquefaction susceptibility depends on the strength of all the soils along the potential failure surface. Zones of loose (contractive) soils are critical to analyzing liquefaction potential since only loose soils can have an undrained strength that is significantly lower than their drained strength. Therefore, the behavior of the fine coal refuse and its potential to lose strength were evaluated when an earthquake, or similar rapid loading, changes the condition from drained to undrained.

3.0 PREVIOUS DEFORMATION ANALYSES

IDNR previously required a revised (seismic) slope stability analysis be performed for the Phase 2 South Pond geometry using equivalent static load methods and the appropriate peak acceleration based on the Peak Ground Acceleration (PGA) for the 2% Probability of Exceedance in 50 Years maps from the United States Geologic Survey (USGS). Since the required factor of safety (i.e., a minimum factor of safety of 1.0 with seismic forces for the steady seepage condition) was not met, a permanent deformation evaluation was required by IDNR. CEC/Alliance submitted a detailed deformation evaluation[1] of the proposed Pond Creek Phase 2 impoundment addressing relevant issues such as material characterizations, seismic hazard, induced cyclic shear stresses and permanent deformations.

Permanent deformation analyses indicated the South Pond was not susceptible to adverse post-earthquake permanent deformations. These conclusions were based on the results of high quality field testing and detailed, seismically-related engineering and deformation analyses in both the upstream and downstream directions.

CEC utilized the results of field testing performed for the permanent deformation analyses, particularly the seismic cone penetration testing (SCPT), and engineering properties developed for the coarse coal refuse and residual soils. Where applicable, the previous results are incorporated, summarized and referenced herein.

[1] Civil & Environmental Consultants, Inc. "Report, Permanent Deformation Evaluation, Pond Creek No. 1 Coal Refuse Disposal Site. South Cell Slurry Impoundment, Johnston City, Williamson County, Illinois," dated January 23, 2008.

4.0 LABORATORY TESTING AND SUMMARY OF RESULTS

In addition to the SCPT results of the existing coarse refuse and sandy clay residual soils underlying the site, Alliance obtained bulk fine coal refuse slurry samples from the South Pond impoundment for subsequent laboratory testing. Surface samples of fine coal refuse slurry were obtained from the existing tailings pond adjacent to the upstream slope of the coarse embankment. The samples were generally fine-grained, very soft and wet. The slurry material was shipped to CEC's Export, Pennsylvania office and subsequently hand-delivered to the laboratory.

CEC retained Geotechnics, Inc. (Geotechnics) of East Pittsburgh, Pennsylvania to perform laboratory tests and characterize the fine coal refuse. Laboratory testing included performing moisture content, Atterberg limit, grain size analysis and specific gravity testing on slurry samples to aid in soil classification and evaluation of the material properties. The fine coal refuse material was composited in the laboratory to form two (2) remolded slurry samples. The sample preparation was designed to simulate the in-situ hydraulic deposition process, and estimate the in-situ steady-state and peak shear strength after consolidation to various effective stresses. Consolidated-undrained (CU) triaxial strength tests on the remolded slurry samples were performed to estimate peak and steady-state strength data of the fine coal refuse and assess liquefaction susceptibility of the Phase 2 abandonment geometry. Effective and total strength parameters were also determined for the slurry samples. Laboratory testing procedures and results are summarized in Appendix A.

In general, the as-received moisture contents of the sampled fine coal refuse ranged from about 86 to 94 percent. Liquid and plastic limits were 36 and 19, respectively, yielding a plasticity index of 17. CU triaxial shear strength testing was performed at confining pressures of about 5, 10 and 20 pounds per square inch (psi). The CU testing produced peak undrained shear strengths (S_{up}) ranging from about 2.6 to 9.3 psi [375 to 1,340 pounds per square foot (psf)]. Peak (axial)

strains ranged from about 8.4 to 18.4 percent. Steady-state (or residual) undrained shear strengths (S_{us}) ranged from about 2.5 to 8.7 psi (360 to 1250 psf) at maximum strains of about 17.3 to 21.7 percent.

The results of the laboratory testing indicated the fine coal refuse is clay-like based on an average 93 percent passing the No. 200 sieve and plasticity index of 17. Peak and steady-state undrained strengths presented in Appendix A were reached at generally high strains (between 8 and 18 percent), and there was very little drop-off from peak to steady-state with increasing strain. The results generally indicated a higher resistance to strength loss (and flow) due to the large strains required to exceed the peak strength and correspondingly small decrease to the steady-state strength at higher strains. Further, previous deformation analyses results indicated induced shear strains from the PGA at less than one-tenth (0.1) percent, which is well below a threshold (peak) triggering strain of the material.

4.1 Estimates of In-Situ Steady-State Undrained Shear Strength

To assess the liquefaction susceptibility of the fine coal refuse, the estimation of S_{us} values for fine refuse layers at in-situ conditions different than the laboratory samples tested is based on laboratory test results correlated with effective vertical stress (σ'_v) of the layers in question. By assuming fine coal refuse S_{us} values vary linearly with σ'_v, the in-situ S_{us} value for the fine coal refuse layer can be estimated based on the S_{us} characteristics of the fine coal refuse samples tested in the laboratory and the in-situ σ'_v of a particular fine coal refuse.

The effective consolidation stresses at which the laboratory tests were performed were converted into equivalent in-situ vertical effective stresses, assuming that the lateral stresses are equal to one-half of the vertical stresses. Therefore, the triaxial test consolidation stresses were multiplied by a factor of 1.5 to develop a relationship between σ'_v and S_{us}. An S_{us}/σ'_v ratio of 0.24 extends from the zero intercept to the point where two-thirds of the data fall above the straight line, which is the lowest datum plus one-third of the distance from the lowest datum to

the second lowest datum, i.e., 2/3 – 1/3 relationship. This relationship of $S_{us} = 0.24\ \sigma'_v$ was based on the results of consolidated-undrained triaxial tests of slurry fine coal refuse samples, and is presented in further detail in Appendix B.

4.2 Summary of Engineering Properties

The following soil properties were estimated based on previous field and laboratory testing as well as current fine coal refuse testing for use in the various post-earthquake liquefaction slope stability analyses:

Summary of Engineering Properties

Material Type	Total Unit Weight γt (pcf)	Saturated Unit Weight γs (pcf)	Effective Friction ϕ' (deg)	Effective Cohesion c' (psf)
Coarse Refuse	130	140	33.7	0
Fine Refuse	80	90	0	200 to 276
Residual Soil	125	130	19	4000
Soil Cap	130	1135	30	0

5.0 LIQUEFACTION SUSCEPTIBILITY EVALUATION

Factors of safety against a liquefaction flow failure (F_L) were calculated using steady-state principles and the Phase 2 South Pond upstream and downstream embankment/impoundment abandonment conditions. Following the estimation of in-situ driving shear stresses for Phase 2, the average vertical effective stress along the critical failure surface and various fine coal refuse layers was calculated. The σ'_V values were determined at various depths within the layer boundaries shown in Figure 1. S_{us} values were then estimated by multiplying the in-situ average σ'_V for each layer by the 0.24 ratio. Figure 1 also presents the S_{us} values estimated for each fine coal refuse layer used in the downstream and upstream liquefaction stability analyses.

5.1 In-Situ Driving Shear Stress

Estimating the in-situ static driving shear stress in the critical soil layer (i.e., fine coal refuse) is one of the steps for evaluating liquefaction susceptibility. The driving shear stress in the critical fine coal refuse layer is equal to the minimum shear resistance the layer must have to simply maintain stability of the slope (i.e., factor of safety of 1.0). The driving stress assumes fully mobilized shear strengths in the other, less critical coarse refuse and residual soil layers comprising the model. The fully mobilized strengths are those that would act while deformation of the slope is occurring and, thus, would be available to resist a massive flow slide. These shear strengths are quantified by performing a stability analysis for the slope in question.

When evaluating slope stability by means of circular failure surface analysis (using the limit equilibrium approach), the driving shear stress (τ_d) acting along the failure surface analyzed is determined by assuming the shearing resistance (i.e., shear strength) of the material through which the failure surface passes is provided solely by cohesion [i.e., angle of internal friction (ϕ) = 0]. The driving stress is determined by varying the cohesion value used in the analysis until a factor of safety of 1.0 is obtained. For this condition, the driving stress acting along the failure surface analyzed is equal to the cohesion value used for the material.

Using the impoundment geometry shown in Figure 1, a series of GSTABL7 analyses were performed to identify the most critical circular failure surface passing through the Phase 2 impoundment for both the downstream and upstream (abandonment) conditions. The range of starting and ending points for failure circle generation were iteratively analyzed to evaluate the critical failure surface and included the entire impoundment surface. The drained strengths of the coarse refuse and total strength of the residual soil described above were used while the cohesion values for the fine coal refuse layers were modeled equal to one another and varied until a factor of safety of 1.0 was obtained.

The results of the driving shear stress slope stability analyses indicated the embankment and impoundment geometry is very favorable, and there is zero (0) driving stress in the fine coal refuse impoundment for both the upstream and downstream abandonment geometry. Hard copies of the input and output files for the driving stress analyses are presented in Appendix C.

5.2 Factor of Safety Against Liquefaction

The minimum F_L in the downstream direction for the abandonment condition is 1.6 and, in the upstream direction, the minimum F_L is about 9. These results are based on a site-specific, steady-state shear strength to effective stress relationship ($S_{us} = 0.24\ \sigma'_v$), which relates the shear strength of slurry fine coal refuse samples with the estimated vertical effective overburden pressure. The following table presents the results of the downstream and upstream post-earthquake stability analyses. GSTABL output files are presented in Appendix C for the South Pond Stage 2 impoundment.

Stage 2 Abandonment (Crest El. 502)	Top of Fines Elevation (ft)	Top of Cap Elevation[1] (ft)	Driving Shear Stress in Fine Coal Refuse (τ_d) (psf)	Factor of Safety Against Liquefaction (F_L) (dim)
Downstream	496	502	0	1.6
Upstream	496	502	0	8.4

[1] Cap includes 4-foot coarse refuse and 2-foot soil cover layer above top of fines elevation. The soil cover is sloped at one percent to maintain positive drainage.

6.0 CONCLUSIONS

CEC has completed an evaluation of the liquefaction susceptibility of the proposed Pond Creek Phase 2 South Pond abandonment geometry. Based on this evaluation, the facility is not susceptible to a liquefaction (flow) failure. This conclusion is based on the following:

- Characterization of the fine coal refuse as clay-like, which typically is more resistant to strength loss (or flow) than sand-like materials;

- Elevated peak and steady-state undrained shear strengths and corresponding elevated shear strains. Previous deformation analyses results indicating induced maximum shear strains from the PGA less than 0.1 percent, further indicating a resistance to strength loss (and flow);

- In-situ driving shear stresses through the fine coal refuse of 0 psf; and

- Factors of safety against liquefaction susceptibility in both the downstream and upstream directions ranging from 1.6 to greater than 9, respectively.

To prevent resaturation, the Phase 2 abandonment geometry will promote long-term positive drainage and permanent drainage controls to minimize surface water infiltration. Plans to prevent future surface water impounding capability, erosion and sedimentation controls and drainage are provided under separate cover by Alliance.

Finally, CEC and Alliance understand a final inspection and report by a professional engineer must be completed and submitted to the IDNR, Office of Water Resources one (1) year after the completion of the abandonment modifications to the dam. This inspection is intended to evaluate and report the effectiveness of the abandonment plans, and record drawings will be submitted with the final inspection report.

In preparing this report, CEC's professional services have been performed, findings obtained and conclusions prepared in accordance with generally accepted engineering principles and practices. No warranty, expressed or implied, is made or intended by rendering of these services or by furnishing oral or written reports of our findings. This report was prepared for the exclusive use of Alliance and/or its affiliates.

7.0 REFERENCES

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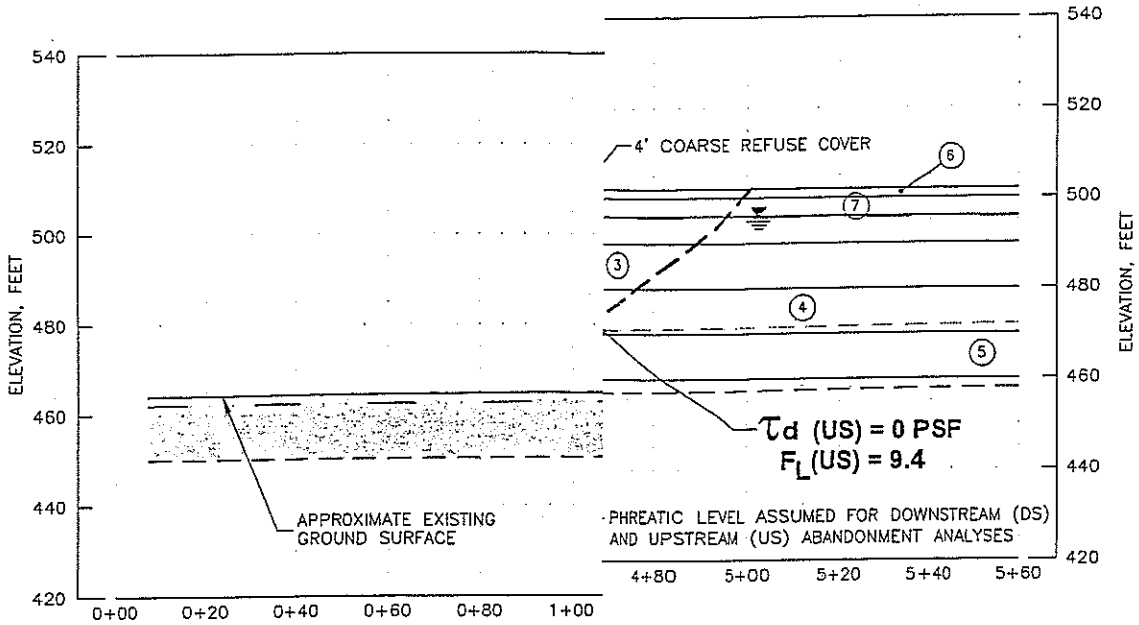
FIGURE

NO	DATE	DESCRIPTION
△		
△		
△		
△		

R14417

SUBMITTAL RECORD

NO	DATE	DESCRIPTION



SOUTH PON
FACTORS OF SAFET

PHASE 2 ANALYSIS	IN-SITU DRIVING S (p
DOWNSTREAM	
UPSTREAM	

NOTES

1. COARSE REFUSE AND RESIDUAL SOIL MATERIAL PROPERTIES USED IN THE SLOPE STABILITY ANALYSES ARE BASED ON LABORATORY TEST DATA AND WERE PROVIDED BY ALLIANCE CONSULTING, INC.
2. STEADY-STATE UNDRAINED STRENGTHS WERE DEVELOPED BASED ON LABORATORY TEST DATA AND PRESENTED IN APPENDIXES A AND B.
3. CROSS-SECTION A-A REPRESENTS THE GENERALIZED CONDITIONS OF THE PHASE 2 SOUTH POND ABANDONMENT CONDITION.
4. τ_d DETERMINED FROM GSTAL7 STATIC STABILITY ANALYSIS USING DRAINED PROPERTIES FOR COARSE REFUSE AND TOTAL STRENGTH FOR RESIDUAL SOIL, AND VARYING UNDRAINED PROPERTIES (COHESION) FOR FINE COAL REFUSE TO OBTAIN A FACTOR OF SAFETY OF 1.00.
5. STEADY-STATE STRENGTHS (Sus) DETERMINED BY CALCULATING THE AVERAGE VERTICAL EFFECTIVE STRESS ($\sigma v'$) OF EACH FINE COAL REFUSE LAYER, AND USING THE RELATIONSHIP $Sus=0.24*\sigma v'$ DEVELOPED FROM CONSOLIDATED-UNDRAINED TRIAXIAL TESTS OF FINE COAL REFUSE SLURRY SAMPLES.
6. F_L DETERMINED FROM GSTABL7 STATIC STABILITY ANALYSIS USING DRAINED PROPERTIES FOR COARSE REFUSE AND TOTAL STRENGTH FOR RESIDUAL SOIL, AND THE UNDRAINED STEADY-STATE STRENGTHS FOR EACH FINE COAL REFUSE LAYER AS DESCRIBED IN NOTE 5.

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333 Baldwin Road - Pittsburgh, PA 15205-9072
Ph: 412.429.2324 - 800.365.2324 - Fax: 412.429.2114
www.cecinc.com

POND CREEK MINE NO. 1
SOUTH POND ABANDONMENT
WILLIAMSON COUNTY, ILLINOIS
ALLIANCE CONSULTING, INC.

DRAWN BY:	DMM	CHECKED BY:	MJS	APPROVED BY:	BEG*
DATE:	JULY 23, 2008	DWG SCALE:	AS SHOWN	PROJECT NO:	080-851

CROSS-SECTION A-A LIQUEFACTION SLOPE STABILITY RESULTS

FIGURE NO.: 1

*HAND SIGNATURE ON FILE

APPENDIX A

SUMMARY OF LABORATORY TESTING RESULTS AND CHARACTERIZATION OF THE SUBSURFACE MATERIALS

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond – Phase 2 Abandonment Evaluation Laboratory Testing Summary – Fine Coal Refuse

PROJECT NO. 080-851

PAGE 1 OF 3

MADE BY BEG DATE 7/10/08 CHECKED BY MJS DATE 7/23/08

CALCULATION BRIEF FOR SUMMARY OF LABORATORY TESTING

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH POND

OBJECTIVE:

Summarize the laboratory testing program and results obtained for fine coal refuse materials at the Pond Creek facility, South Pond impoundment. A laboratory testing summary table is attached, as well as laboratory testing results.

METHODOLOGY:

CEC retained Geotechnics, Inc. (Geotechnics) of East Pittsburgh, Pennsylvania to perform laboratory testing on bulk samples of fine coal refuse materials collected from the South Pond impoundment. The laboratory testing was performed between May 2008 and June 2008 at Geotechnics. The purpose of the testing program was to determine index and strength parameters, and summarize the results for the fine coal refuse materials relative to the eventual abandonment of the South Pond.

The laboratory testing program performed by Geotechnics included:

a. Index tests on bulk/slurried samples:
   - (2) Moisture content;
   - (2) Grain-size distributions;
   - (2) Hydrometers;
   - (2) Atterberg limits; and
   - (2) Specific gravity.

b. Shear strength tests on remolded slurried samples:
   - (6) Consolidated Undrained Triaxial, including (6) additional moisture contents and (6) total and dry density.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond – Phase 2 Abandonment Evaluation Laboratory Testing Summary – Fine Coal Refuse

PROJECT NO. 080-851

PAGE 2 OF 3

MADE BY BEG DATE 7/10/08 CHECKED BY MJS DATE 7/23/08

RESULTS:

The attached table presents a summary of the individual laboratory test data, and a formal copy of the laboratory testing results performed by Geotechnics, Inc. is attached.

R14421

Summary of Laboratory Test Results
Fine Coal Refuse Bulk Samples
Pond Creek Coal Refuse Disposal Facility - South Pond Abandonment
Franklin County, Illinois

BOREHOLE STATISTICS				INDEX						LIMITS			CONSOLIDATION		SHEAR STRENGTH									
															Peak Strength			Steady State			Effective Strength		Total Strength	
Sample Type	Sample No.	Depth (ft)	Materials	Wat Con (w) (%)	Total Den (γ) (pcf)	Dry Den (γd) (pcf)	Spec. Gr. (dim)	Passing No. 200 (%)	Passing No. 40 (%)	LL (%)	PL (%)	PI (%)	Initial Void Ratio (eo) (dim)	After Void Ratio (e) (dim)	ϕ_p (deg)	c_p (%)	q_p (ksf)	ϕ_{ss} (Deg)	c_{ss} (%)	q_{ss} (ksf)	ϕ' (Deg)	c' (ksf)	ϕ (Deg)	c (ksf)
Bucket	1	Remold	FCR	82.60	76.60	42.00	2.24						2.333	0.944	40.40	18.40	0.664	40.40	21.51	0.485				
Test No.	1																							
Bucket	1	Remold	FCR	82.70	84.20	46.10	2.24						2.035	0.955	39.60	13.40	1.086	39.00	21.67	0.817	36.14	0.000	17.30	0.216
Test No.	2																							
Bucket	1	Remold	FCR	79.50	80.50	44.80	2.24						2.119	0.956	37.80	13.50	1.558	36.70	21.74	1.149				
Test No.	3																							
Bucket	1	Bulk	FCR	85.80			2.24	92.83	99.41	36	19	17												
Bucket	2	Remold	FCR	82.90	82.60	45.20	2.24						2.095	1.129	38.30	10.30	0.485	36.30	17.29	0.354				
Test No.	1																							
Bucket	2	Remold	FCR	85.70	85.70	44.30	2.24						2.159	0.931	39.20	14.20	0.825	38.60	21.32	0.616	37.71	0.000	20.30	0.013
Test No.	2																							
Bucket	2	Remold	FCR	83.00	83.00	46.20	2.24						2.029	0.910	37.50	8.40	1.681	35.70	21.49	1.245				
Test No.	3																							
Bucket	2	Bulk	FCR	94.40			2.24	92.62	99.29	36	19	17												

ATTACHMENT A-1

LABORATORY TESTING RESULTS – FINE COAL REFUSE

Geotechnics
.....GEOTECHNICAL AND
GEOSYNTHETIC SERVICES

June 5, 2008

Project No. 2008-210-01

Mr. Blaise Genes
Civil & Environmental Consultants
4 Triangle Dr, Suite 200
Export, PA 15632-9255

Transmittal
Laboratory Test Results
Pond Creek

Please find attached the laboratory test results for the above referenced project. The tests were outlined on the Project Verification Form that was faxed to your firm prior to the testing. The testing was performed in general accordance with the methods listed on the enclosed data sheets. The test results are believed to be representative of the samples that were submitted for testing and are indicative only of the specimens which were evaluated. We have no direct knowledge of the origin of the samples and imply no position with regard to the nature of the test results, i.e. pass/fail and no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization by our Client. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please contact our office.

Respectively submitted,
Geotechnics, Inc.

David R. Backstrom
Laboratory Director

We understand that you have a choice in your laboratory services and we thank you for choosing Geotechnics.

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MOISTURE CONTENT

ASTM D 2216 (SOP-S1)

Client	CEC
Client Reference	POND CREEK 080851
Project No.	2008-210-01

Lab ID	01	02
Boring No.	SOUTH POND	SOUTH POND
Depth (ft)	NA	NA
Sample No.	BUCKET 1	BUCKET 2
Tare Number	877	729
Wt. of Tare & WS (gm)	621.7	578.3
Wt. of Tare & DS (gm)	385.56	339.54
Wt. of Tare (gm)	110.33	86.52
Wt. of Water (gm)	236.14	238.76
Wt. of DS (gm)	275.23	253.02
Water Content (%)	**85.8**	**94.4**

Notes : *NA*

Tested By PC *Date* 5/13/08 *Checked By* KB *Date* 5-14-08

DCN: CT-S1 DATE 6-30-98 REVISION: 2

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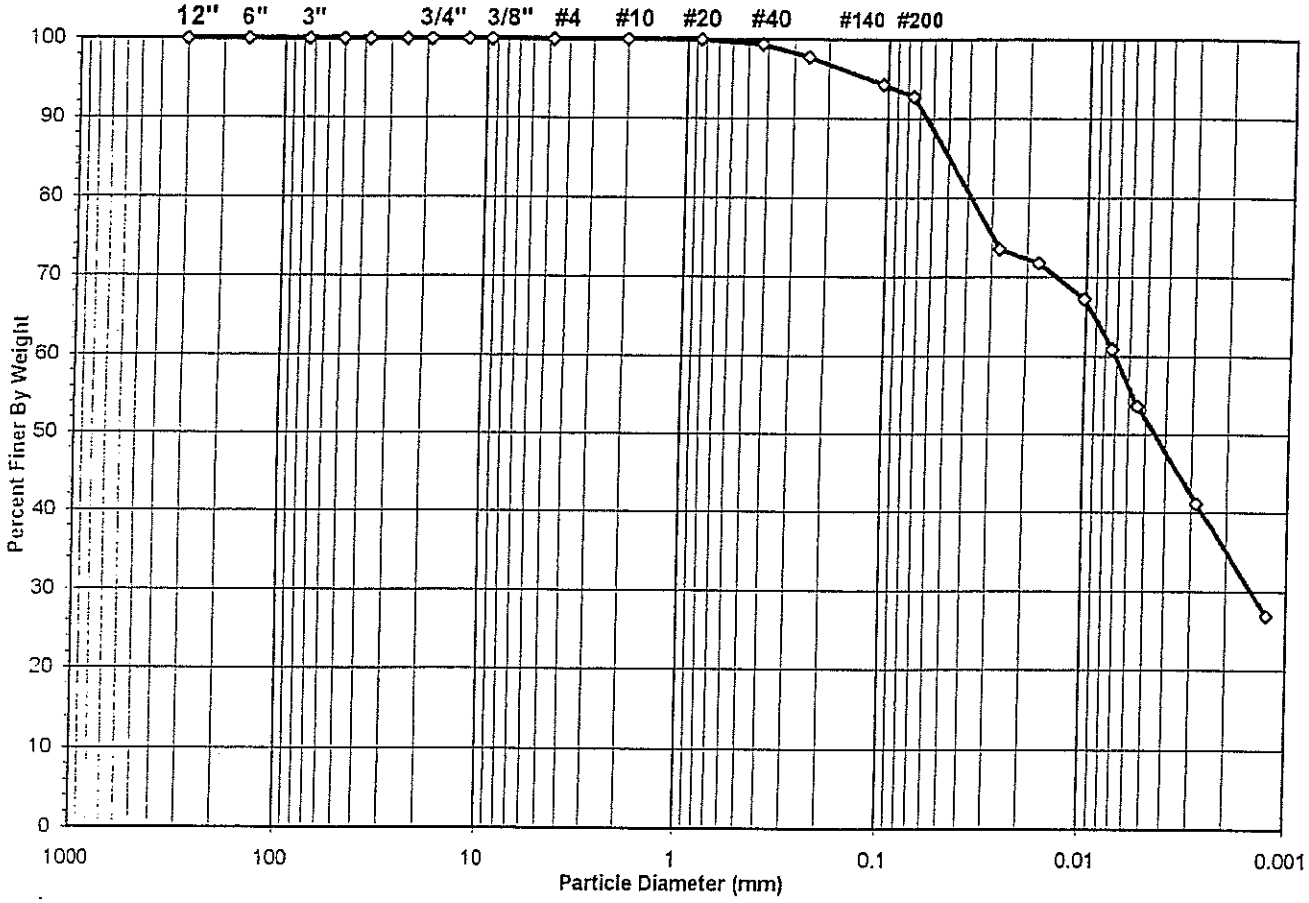
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Color	BLACK

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	7.17
Finer Than #200	*Silt & Clay*	92.83

USCS Symbol	*CL, TESTED*
USCS Classification	*LEAN CLAY*

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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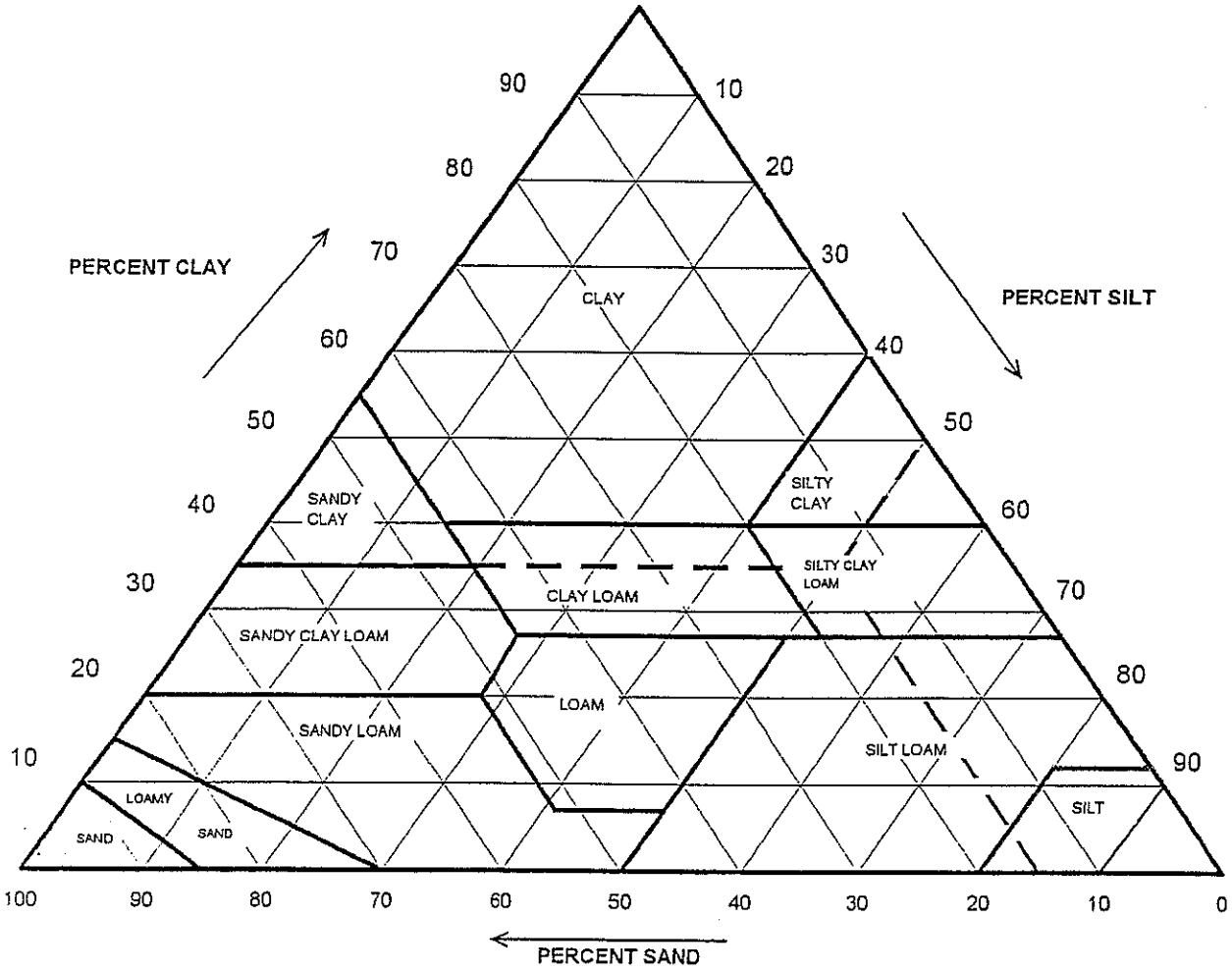
USDA CLASSIFICATION CHART

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Color	BLACK



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.00	**0.00**
2	100.00	*Sand*	14.88	**14.88**
0.05	85.12	*Silt*	50.02	**50.02**
0.002	35.10	*Clay*	35.10	**35.10**

USDA Classification: ***SILTY CLAY LOAM***

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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WASH SIEVE ANALYSIS

ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Color	BLACK

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	703	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	1020.20	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	609.00	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	100.40	Weight of Tare (gm)	NA
Weight of Water (gm)	411.20	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	508.60	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**80.8**	**Moisture Content (%)**	NA

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	508.60
Dry Weight - 3/4" Sample (gm)	36.47	Weight of minus #200 material (gm)	472.13
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	36.47
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	100.00
6"	150	0.00	0.00	0.00	100.00	100.00
3"	75	0.00	0.00	0.00	100.00	100.00
2"	50	0.00	0.00	0.00	100.00	100.00
1 1/2"	37.5	0.00	0.00	0.00	100.00	100.00
1"	25.0	0.00	0.00	0.00	100.00	100.00
3/4"	19.0	0.00	0.00	0.00	100.00	100.00
1/2"	12.5	0.00	0.00	0.00	100.00	100.00
3/8"	9.50	0.00	0.00	0.00	100.00	100.00
#4	4.75	0.00	0.00	0.00	100.00	100.00
#10	2.00	0.00	0.00	0.00	100.00	100.00
#20	0.85	0.12	0.02	0.02	99.98	99.98
#40	0.425	2.90	0.57	0.59	99.41	99.41
#60	0.250	7.89	1.55	2.15	97.85	97.85
#140	0.106	17.74	3.49	5.63	94.37	94.37
#200	0.075	7.82	1.54	7.17	92.83	92.83
Pan	-	472.13	92.83	100.00	-	-

Tested By JP Date 5/21/08 Checked By KR Date 5-23-08

DCN: CT-S3A DATE:2/20/06 REVISION: 8

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HYDROMETER ANALYSIS

ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Color	BLACK

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	47.0	21.9	6.02	41.0	79.2	0.01314	0.0272	**73.6**
5	46.0	21.9	6.02	40.0	77.3	0.01314	0.0174	**71.8**
15	43.5	21.9	6.02	37.5	72.5	0.01314	0.0103	**67.3**
31	40.0	21.9	6.02	34.0	65.7	0.01314	0.0074	**61.0**
60	36.0	21.8	6.07	29.9	57.9	0.01316	0.0055	**53.7**
250	29.0	21.7	6.11	22.9	44.3	0.01317	0.0028	**41.1**
1440	21.0	21.9	6.02	15.0	29.0	0.01314	0.0012	**26.9**

Soil Specimen Data		Other Corrections	
Tare No.	2487		
Tare + Dry Material (gm)	151.2	a - Factor	0.99
Weight of Tare (gm)	95.01		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 200	92.83
Weight of Dry Material (gm)	51.19		
		Specific Gravity	2.7 Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 5/21/08 Checked By KR Date 5-23-08

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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Description	BLACK LEAN CLAY

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

(Minus No. 40 sieve material, Airdried)

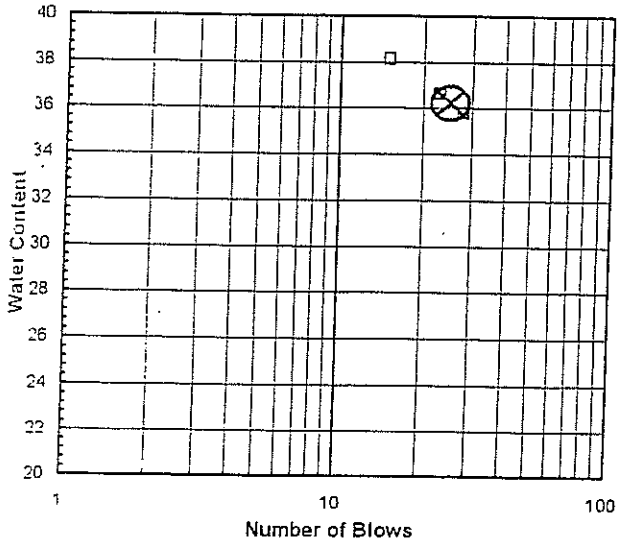
Liquid Limit Test	1	2	3	
Tare Number	110	37	40	MULTIPOINT
Wt. of Tare & WS (gm)	36.10	35.31	37.89	
Wt. of Tare & DS (gm)	30.53	29.82	31.72	
Wt. of Tare (gm)	14.96	14.83	15.54	
Wt. of Water (gm)	5.6	5.5	6.2	
Wt. of DS (gm)	15.6	15.0	16.2	
Moisture Content (%)	**35.8**	**36.6**	**38.1**	
Number of Blows	**28**	**23**	**15**	

Plastic Limit Test	1	2	Range
Tare Number	134	267	
Wt. of Tare & WS (gm)	21.41	20.16	
Wt. of Tare & DS (gm)	20.44	19.10	
Wt. of Tare (gm)	15.29	13.36	
Wt. of Water (gm)	1.0	1.1	
Wt. of DS (gm)	5.2	5.7	
Moisture Content (%)	**18.8**	**18.5**	**0.4**

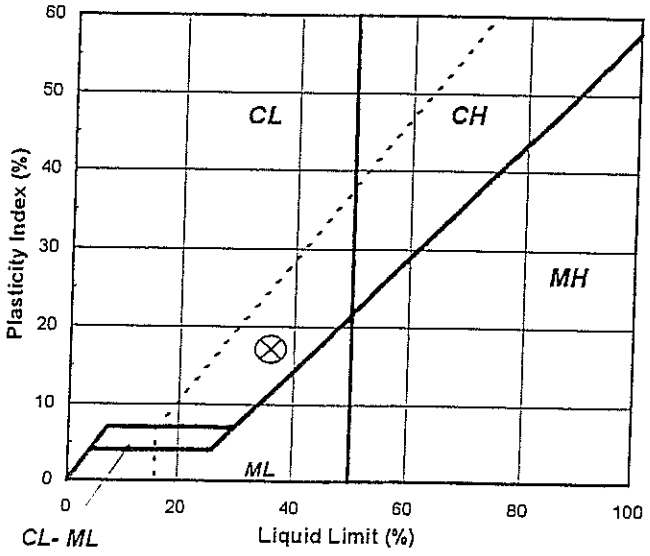
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	36
Plastic Limit (%)	19
Plasticity Index (%)	17
USCS Symbol	CL

Flow Curve



Plasticity Chart



Tested By TO *Date* 5/21/08 *Checked By* HB *Date* 5-23-08

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Geotechnics
INTEGRITY IN TESTING

SPECIFIC GRAVITY

ASTM D 854-02, AASHTO T100-03 (SOP - S5)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Visual Description	BLACK SLUDGE
			(Minus No.4 sieve material, airdried)

Replicate Number	1	2
Pycnometer ID	G 1155	G 1156
Weight of Pycnometer + Soil + Water (gm)	737.55	736.34
Temperature, T (°Celsius)	26.4	25.5
Weight of Pycnometer + Water (gm)	682.36	681.04
Tare Number	674	2487
Weight of Tare + Dry Soil (gm)	199.03	195.46
Weight of Tare (gm)	99.26	95.76
Weight of Dry Soil (gm)	99.77	99.70
Specific Gravity of Soil @ T	2.238	2.246
Specific Gravity of Water @ T	0.9967	0.9969
Conversion Factor for Temperature T	0.9985	0.9987
Specific Gravity @ 20° Celsius	2.241	2.248

Average Specific Gravity @ 20° Celsius	2.24

Tested By TO *Date* 05/20/08 *Checked By* KB *Date* 5-23-08

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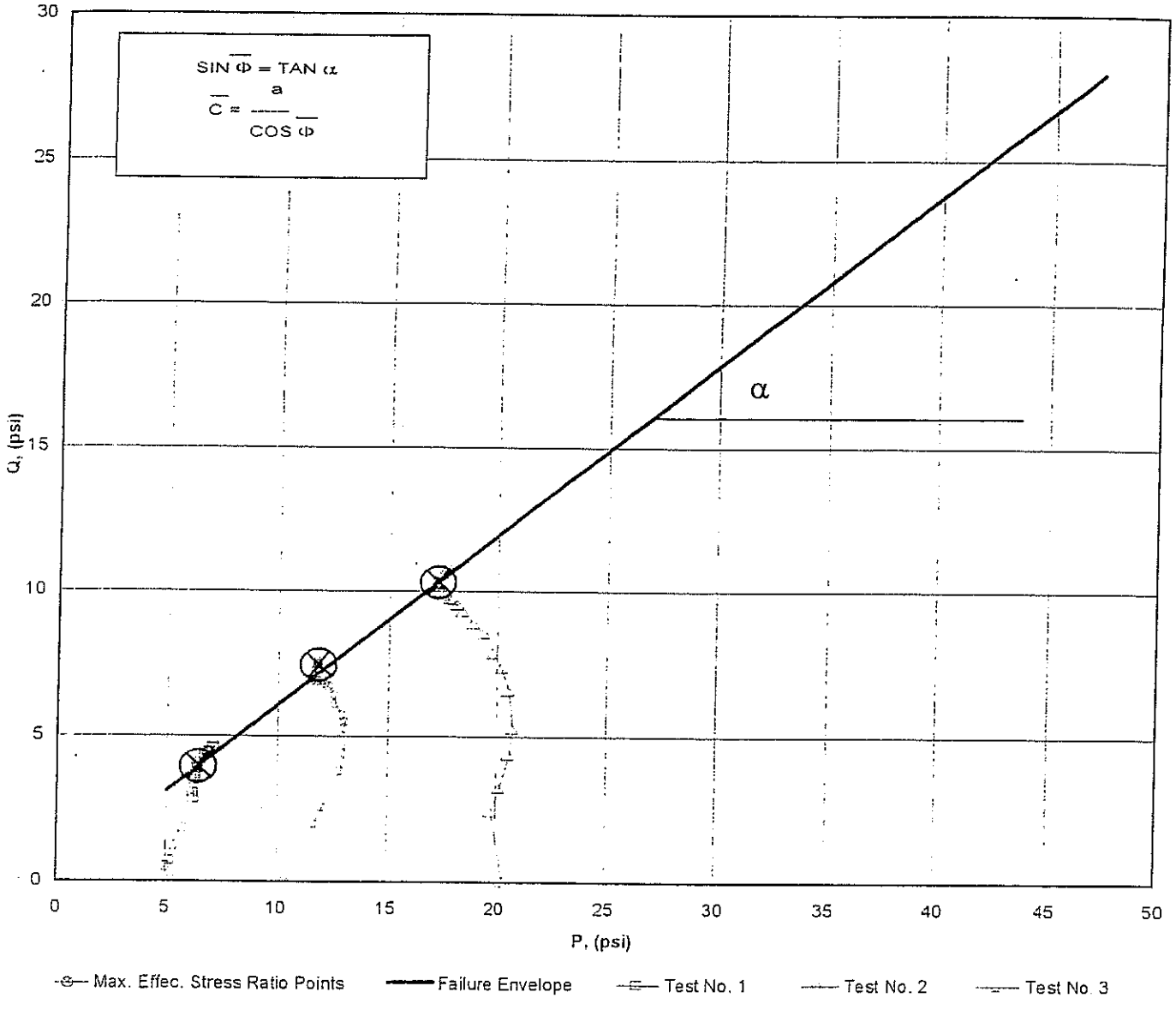
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	30.5	$\bar{\Phi}$	=	36.14

Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

DCN CT-S28 DATE 6-25-98 REVISION 1

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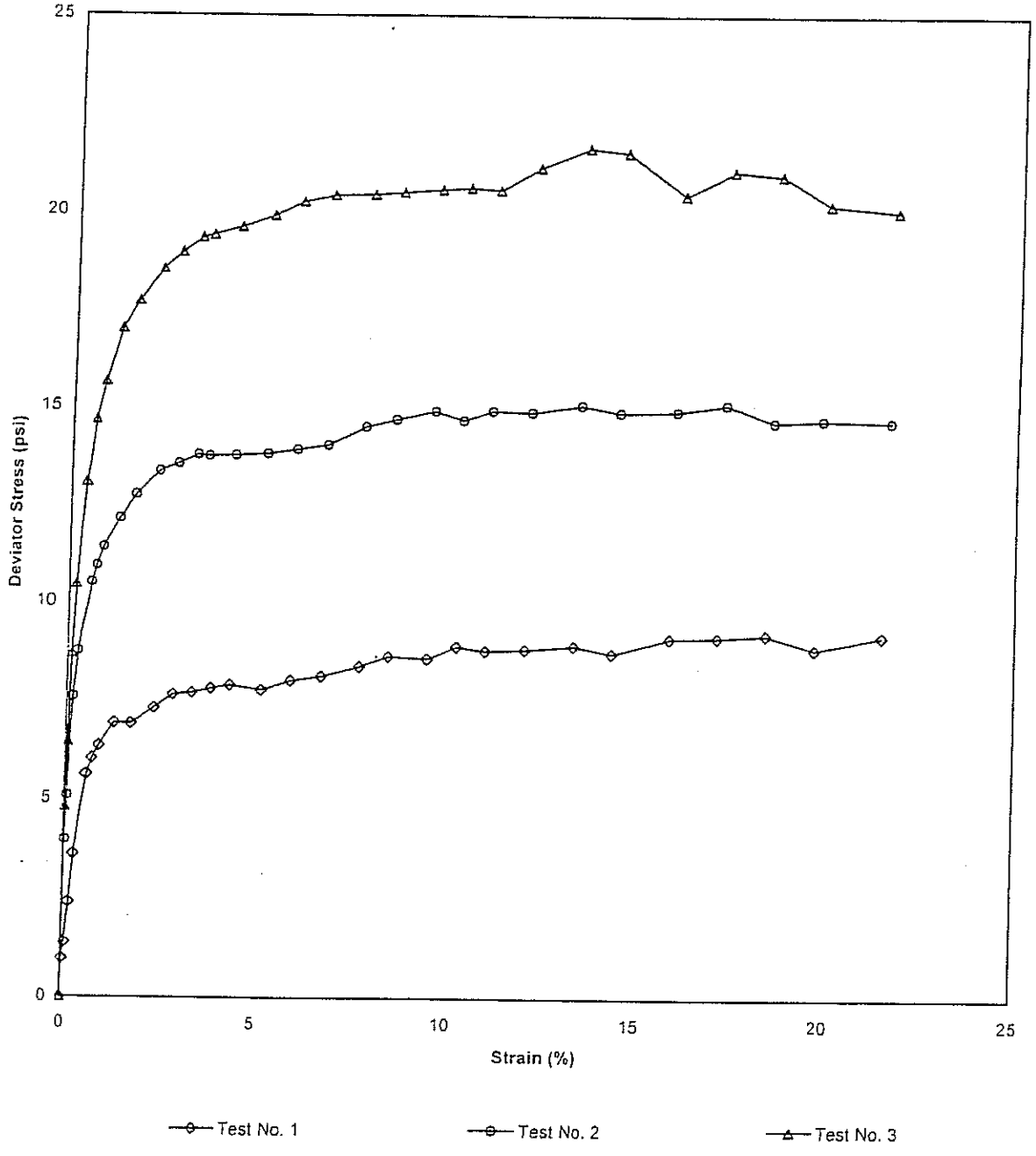
INTEGRITY IN TESTING

CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	1

PRESSURES (psi)

Cell Pressure(psi)	36.6
Back Pressure(psi)	31.4
Eff. Cons. Pressure(psi)	5.2
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	6.41
Q	=	3.95

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.140	Diameter 1	1.375
Length 2	3.148	Diameter 2	1.389
Length 3	3.151	Diameter 3	1.399
Avg Leng.=	3.146	Avg. Diam.=	1.388

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.7
Final Change (ml)	2.3

Initial Dial Reading (D.R.), mils	235
D.R. After Saturation, mils	250
D.R. After Consolidation, mils	294

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.4
8.2	0.001	32.1
8.8	0.002	32.1
10.3	0.005	32.5
12.1	0.008	32.8
15.1	0.016	33.2
15.8	0.020	33.4
16.2	0.026	33.6
17.1	0.038	33.7
17.2	0.051	33.8
17.8	0.069	33.9
18.4	0.085	34.0
18.5	0.101	34.0
18.8	0.116	34.1
19.0	0.132	34.1
18.9	0.158	34.1
19.4	0.182	34.2
19.6	0.205	34.2
20.2	0.236	34.2
20.7	0.260	34.2
20.8	0.292	34.1
21.4	0.316	34.3
21.4	0.340	34.1
21.6	0.371	34.1
22.0	0.411	34.1
21.8	0.443	34.1
22.8	0.490	34.1
23.1	0.530	34.2
23.5	0.569	34.1
23.1	0.610	34.1
24.0	0.664	34.2

Tested By JCM Date 05/21/08 Input Checked By MB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.2	*Stage No.*	1
		Test No	1

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.51
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.55
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.474

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	0.98	0.73	5.45	4.5	1.219	0.76	4.96	0.49
0.07	1.39	0.75	5.84	4.5	1.311	0.55	5.14	0.69
0.15	2.40	1.15	6.46	4.1	1.593	0.49	5.25	1.20
0.25	3.62	1.36	7.46	3.8	1.941	0.38	5.65	1.81
0.52	5.63	1.79	9.04	3.4	2.649	0.32	6.23	2.81
0.66	6.03	2.01	9.22	3.2	2.893	0.34	6.20	3.02
0.84	6.35	2.21	9.34	3.0	3.125	0.36	6.16	3.18
1.22	6.92	2.33	9.79	2.9	3.417	0.34	6.33	3.46
1.64	6.91	2.40	9.71	2.8	3.469	0.35	6.26	3.46
2.25	7.31	2.55	9.96	2.7	3.753	0.36	6.31	3.65
2.75	7.66	2.61	10.25	2.6	3.961	0.35	6.42	3.83
3.27	7.71	2.64	10.26	2.6	4.017	0.35	6.41	3.85
3.77	7.81	2.68	10.34	2.5	4.098	0.35	6.43	3.91
4.28	7.90	2.74	10.37	2.5	4.208	0.35	6.41	3.95
5.11	7.78	2.71	10.27	2.5	4.124	0.36	6.38	3.89
5.89	8.02	2.84	10.38	2.4	4.400	0.36	6.37	4.01
6.65	8.13	2.78	10.56	2.4	4.359	0.35	6.49	4.07
7.66	8.39	2.83	10.76	2.4	4.538	0.34	6.56	4.19
8.42	8.64	2.76	11.09	2.4	4.536	0.33	6.77	4.32
9.45	8.59	2.72	11.07	2.5	4.464	0.32	6.77	4.29
10.23	8.90	2.86	11.25	2.3	4.797	0.33	6.79	4.45
11.00	8.80	2.67	11.33	2.5	4.474	0.31	6.93	4.40
12.03	8.83	2.74	11.29	2.5	4.594	0.32	6.87	4.42
13.30	8.93	2.72	11.41	2.5	4.601	0.31	6.94	4.46
14.34	8.73	2.69	11.25	2.5	4.477	0.31	6.88	4.37
15.88	9.12	2.66	11.66	2.5	4.587	0.30	7.10	4.56
17.15	9.15	2.77	11.59	2.4	4.762	0.31	7.01	4.58
18.44	9.22	2.70	11.72	2.5	4.691	0.30	7.11	4.61
19.74	8.86	2.70	11.36	2.5	4.536	0.31	6.93	4.43
21.51	9.19	2.82	11.56	2.4	4.864	0.31	6.97	4.59

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	2

PRESSURES (psi)

Cell Pressure(psi)	46.5
Back Pressure(psi)	36.1
Eff. Cons. Pressure(ps	10.4
Pore Pressure Response (%)	100

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	11.84
Q	=	7.45

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.120	Diameter 1	1.396
Length 2	3.137	Diameter 2	1.398
Length 3	3.135	Diameter 3	1.344
Avg Leng.=	3.131	Avg. Diam.=	1.379

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	18.4
Final Change (ml)	5.6

Initial Dial Reading (D.R.), mils	77
D.R. After Saturation, mils	112
D.R. After Consolidation, mils	166

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.9	0.000	36.1
13.4	0.001	36.8
14.9	0.002	37.0
18.3	0.005	37.4
20.0	0.008	37.8
22.4	0.017	38.7
23.0	0.020	38.9
23.7	0.026	39.3
24.8	0.038	39.9
25.7	0.051	40.3
26.7	0.069	40.9
27.1	0.085	41.1
27.5	0.100	41.3
27.5	0.110	41.5
27.7	0.131	41.6
27.9	0.157	41.8
28.2	0.181	41.9
28.6	0.204	41.9
29.5	0.235	42.0
30.0	0.259	42.1
30.5	0.290	42.1
30.4	0.313	42.0
31.0	0.337	42.1
31.2	0.368	42.0
31.8	0.408	42.2
31.8	0.439	42.1
32.3	0.486	42.1
33.0	0.526	42.2
32.6	0.565	42.1
33.1	0.604	42.2
33.6	0.659	42.2

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-96 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.4	*Stage No.*	1
		Test No	2

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.49
Initial Sample Volume (in^3)	4.68

VOLUME CHANGE

Volume After Consolidation (in^3)	4.18
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.03	3.98	0.65	13.73	9.7	1.408	0.16	11.74	1.99
0.06	5.09	0.89	14.59	9.5	1.535	0.18	12.05	2.54
0.15	7.59	1.34	16.65	9.1	1.838	0.18	12.85	3.79
0.25	8.76	1.72	17.44	8.7	2.010	0.20	13.06	4.38
0.54	10.51	2.62	18.29	7.8	2.351	0.25	13.04	5.26
0.67	10.94	2.79	18.56	7.6	2.438	0.25	13.08	5.47
0.86	11.42	3.19	18.64	7.2	2.584	0.28	12.92	5.71
1.25	12.16	3.85	18.71	6.6	2.856	0.32	12.63	6.08
1.67	12.77	4.19	18.98	6.2	3.055	0.33	12.60	6.38
2.28	13.37	4.77	19.00	5.6	3.373	0.36	12.32	6.68
2.79	13.56	5.04	18.92	5.4	3.530	0.37	12.14	6.78
3.30	13.79	5.25	18.94	5.2	3.675	0.38	12.05	6.89
3.60	13.76	5.40	18.76	5.0	3.751	0.39	11.88	6.88
4.32	13.77	5.50	18.67	4.9	3.812	0.40	11.79	6.89
5.16	13.82	5.69	18.52	4.7	3.934	0.41	11.62	6.91
5.95	13.93	5.80	18.52	4.6	4.029	0.42	11.56	6.96
6.72	14.04	5.83	18.61	4.6	4.072	0.42	11.59	7.02
7.73	14.51	5.87	19.04	4.5	4.205	0.40	11.78	7.26
8.52	14.69	6.01	19.08	4.4	4.349	0.41	11.73	7.35
9.54	14.91	6.01	19.30	4.4	4.397	0.40	11.84	7.45
10.30	14.68	5.94	19.15	4.5	4.289	0.40	11.80	7.34
11.07	14.93	6.00	19.33	4.4	4.390	0.40	11.87	7.46
12.10	14.89	5.95	19.34	4.5	4.346	0.40	11.90	7.45
13.40	15.08	6.10	19.38	4.3	4.506	0.40	11.84	7.54
14.44	14.89	6.03	19.25	4.4	4.410	0.41	11.81	7.44
15.98	14.92	5.99	19.34	4.4	4.381	0.40	11.88	7.46
17.28	15.10	6.12	19.38	4.3	4.528	0.41	11.83	7.55
18.58	14.65	5.96	19.09	4.4	4.303	0.41	11.76	7.33
19.86	14.71	6.07	19.04	4.3	4.398	0.41	11.68	7.35
21.67	14.66	6.08	18.99	4.3	4.393	0.41	11.65	7.33

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	3

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	20.4
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	17.19
Q	=	10.31

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.130	Diameter 1	1.404
Length 2	3.121	Diameter 2	1.373
Length 3	3.136	Diameter 3	1.371
Avg Leng.=	3.129	Avg. Diam.=	1.383

VOLUME CHANGE

Initial Burette Reading (ml)	48.0
Final Burette Reading (ml)	40.5
Final Change (ml)	7.5

Initial Dial Reading (D.R.), mils	60
D.R. After Saturation, mils	68
D.R. After Consolidation, mils	154

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.0
13.5	0.001	34.0
15.7	0.002	34.5
18.9	0.003	35.2
21.3	0.005	35.9
25.0	0.011	37.4
27.3	0.017	38.5
28.7	0.024	39.4
30.6	0.036	40.5
31.7	0.049	41.4
33.1	0.067	42.3
33.8	0.083	42.8
34.5	0.099	43.2
34.7	0.108	43.4
35.2	0.131	43.7
35.9	0.157	44.0
36.6	0.180	44.2
37.1	0.204	44.3
37.5	0.236	44.4
37.8	0.260	44.4
38.3	0.290	44.5
38.7	0.314	44.5
38.8	0.337	44.5
40.1	0.369	44.6
41.4	0.408	44.6
41.7	0.440	44.6
40.5	0.488	44.6
42.1	0.527	44.6
42.5	0.566	44.6
41.7	0.605	44.6
42.3	0.660	44.7

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.4	*Stage No.*	1
		Test No	3

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.20
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.385

Strain (%)	Deviation Stress	Δ U	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	4.82	3.04	22.17	17.4	1.278	0.64	19.76	2.41
0.05	6.44	3.45	23.39	16.9	1.380	0.54	20.17	3.22
0.10	8.70	4.15	24.95	16.2	1.536	0.48	20.60	4.35
0.17	10.46	4.86	26.01	15.5	1.673	0.47	20.77	5.23
0.37	13.09	6.38	27.10	14.0	1.934	0.49	20.56	6.54
0.58	14.68	7.49	27.59	12.9	2.137	0.52	20.25	7.34
0.80	15.66	8.40	27.66	12.0	2.305	0.54	19.83	7.83
1.18	17.01	9.52	27.89	10.9	2.563	0.57	19.38	8.50
1.61	17.71	10.40	27.71	10.0	2.772	0.59	18.85	8.86
2.22	18.54	11.31	27.63	9.1	3.039	0.62	18.36	9.27
2.74	18.96	11.76	27.60	8.6	3.196	0.63	18.12	9.48
3.26	19.34	12.21	27.53	8.2	3.361	0.64	17.86	9.67
3.57	19.40	12.35	27.45	8.0	3.411	0.64	17.75	9.70
4.31	19.60	12.73	27.27	7.7	3.556	0.66	17.47	9.80
5.17	19.89	12.96	27.33	7.4	3.676	0.66	17.38	9.95
5.94	20.25	13.15	27.50	7.2	3.795	0.66	17.37	10.13
6.73	20.42	13.27	27.54	7.1	3.864	0.66	17.34	10.21
7.78	20.44	13.38	27.46	7.0	3.912	0.66	17.24	10.22
8.55	20.50	13.40	27.50	7.0	3.928	0.66	17.25	10.25
9.57	20.57	13.48	27.49	6.9	3.973	0.66	17.20	10.28
10.34	20.62	13.52	27.50	6.9	3.995	0.66	17.19	10.31
11.11	20.56	13.51	27.45	6.9	3.982	0.66	17.17	10.28
12.15	21.14	13.55	27.99	6.8	4.088	0.65	17.42	10.57
13.45	21.64	13.57	28.47	6.8	4.170	0.63	17.65	10.82
14.49	21.53	13.56	28.36	6.8	4.149	0.64	17.60	10.76
16.07	20.44	13.58	27.26	6.8	3.997	0.67	17.04	10.22
17.35	21.06	13.58	27.88	6.8	4.086	0.65	17.35	10.53
18.64	20.95	13.63	27.72	6.8	4.094	0.66	17.25	10.48
19.92	20.20	13.64	26.96	6.8	3.988	0.68	16.86	10.10
21.74	20.03	13.67	26.77	6.7	3.975	0.69	16.75	10.02

Tested By JCM Date 05/21/08 Input Checked By KP Date 6-19-08

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MOHR TOTAL STRENGTH ENVELOPE

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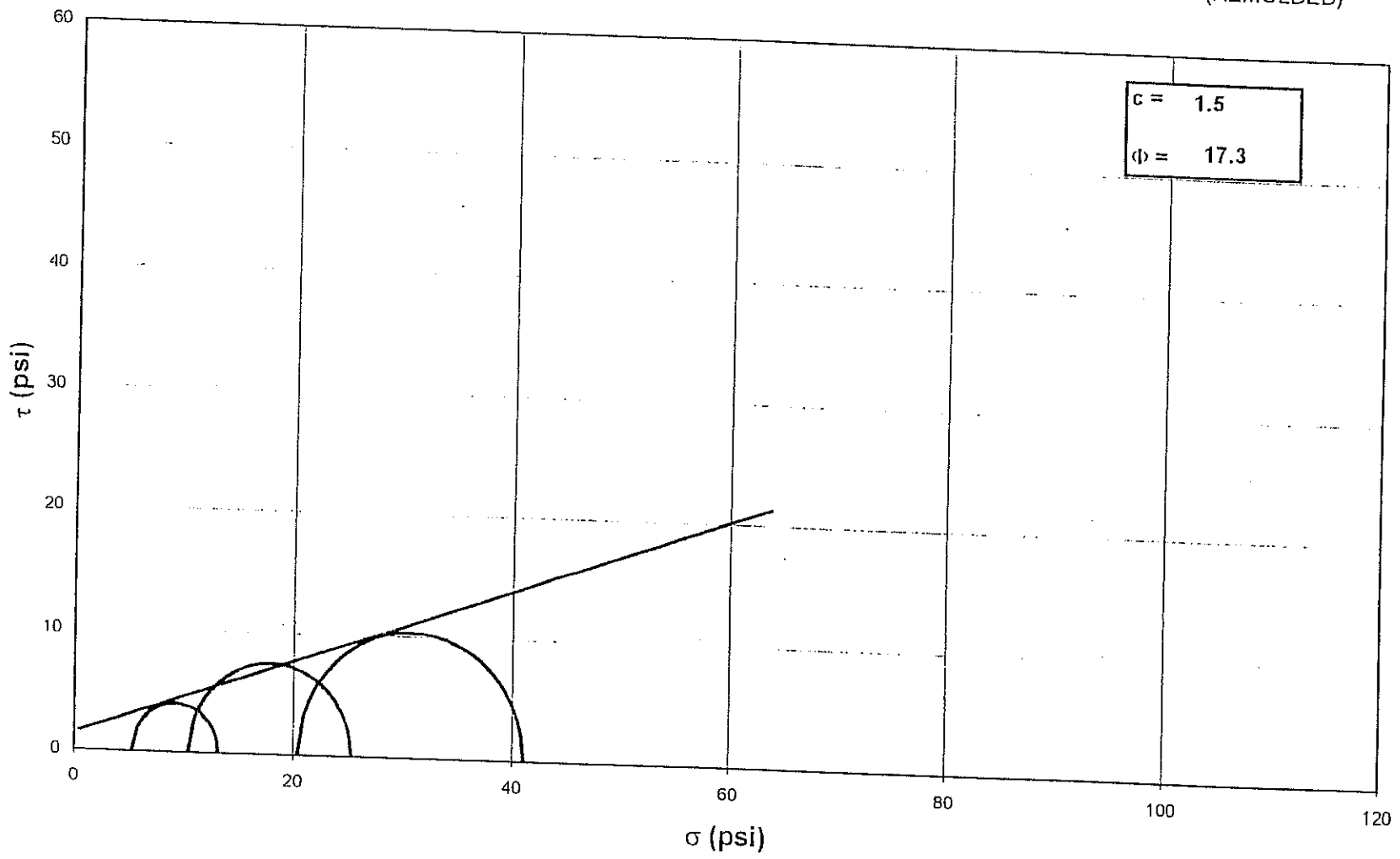
Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/19/08

NOTE: GRAPH NOT TO SCALE

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	82.6	82.7	79.5
Total Unit Weight (pcf)	76.6	84.2	80.5
Dry Unit Weight (pcf)	42.0	46.1	44.8
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	2.333	2.035	2.119

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

DCN CT-S28 DATE 6-25-96 REVISION 1

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	41.7	43.3	42.4
Total Unit Weight (pcf)	102.0	102.5	101.8
Dry Unit Weight (pcf)	71.9	71.5	71.5
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	0.944	0.955	0.956

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

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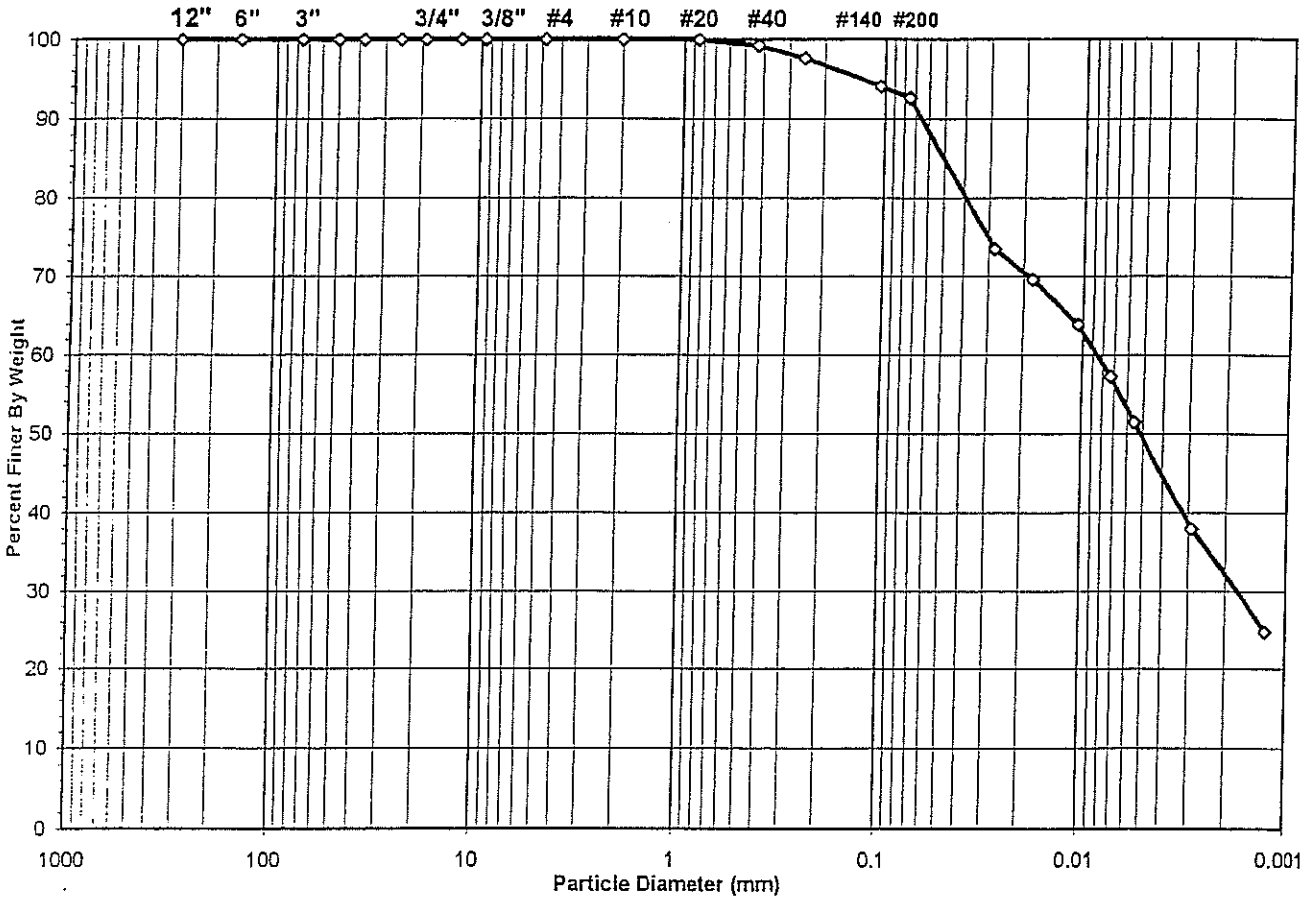
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Color	**BLACK**

	SIEVE ANALYSIS			*HYDROMETER*	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	7.38
Finer Than #200	*Silt & Clay*	92.62

USCS Symbol	*CL, TESTED*
USCS Classification	*LEAN CLAY*

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INTEGRITY IN TESTING

WASH SIEVE ANALYSIS

ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Color	BLACK

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	517	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	1095.30	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	630.20	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	97.36	Weight of Tare (gm)	NA
Weight of Water (gm)	465.10	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	532.84	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**87.3**	**Moisture Content (%)**	NA

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	532.84
Dry Weight - 3/4" Sample (gm)	39.31	Weight of minus #200 material (gm)	493.53
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	39.31
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	100.00
6"	150	0.00	0.00	0.00	100.00	100.00
3"	75	0.00	0.00	0.00	100.00	100.00
2"	50	0.00	0.00	0.00	100.00	100.00
1 1/2"	37.5	0.00	0.00	0.00	100.00	100.00
1"	25.0	0.00	0.00	0.00	100.00	100.00
3/4"	19.0	0.00	0.00	0.00	100.00	100.00
1/2"	12.5	0.00	0.00	0.00	100.00	100.00
3/8"	9.50	0.00	0.00	0.00	100.00	100.00
#4	4.75	0.00	0.00	0.00	100.00	100.00
#10	2.00	0.00	0.00	0.00	100.00	100.00
#20	0.85	0.13	0.02	0.02	99.98	99.98
#40	0.425	3.63	0.68	0.71	99.29	99.29
#60	0.250	8.79	1.65	2.36	97.64	97.64
#140	0.106	19.00	3.57	5.92	94.08	94.08
#200	0.075	7.76	1.46	7.38	92.62	92.62
Pan	-	493.53	92.62	100.00	-	-

Tested By JP Date 5/21/08 Checked By KAB Date 5-23-08

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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HYDROMETER ANALYSIS

ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Color	BLACK

Elapsed Time (min)	R Measured	Temp. (° C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	44.5	21.9	6.02	38.5	79.3	0.01314	0.0279	**73.5**
5	42.5	21.9	6.02	36.5	75.2	0.01314	0.0180	**69.7**
15	39.5	21.9	6.02	33.5	69.0	0.01314	0.0106	**63.9**
34	36.0	21.9	6.02	30.0	61.8	0.01314	0.0073	**57.2**
62	33.0	21.8	6.07	26.9	55.5	0.01316	0.0055	**51.4**
250	26.0	21.7	6.11	19.9	41.0	0.01317	0.0029	**38.0**
1440	19.0	21.9	6.02	13.0	26.8	0.01314	0.0013	**24.8**

Soil Specimen Data		Other Corrections	
Tare No.	2343		
Tare + Dry Material (gm)	151.6	a - Factor	0.99
Weight of Tare (gm)	98.58		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 200	92.62
Weight of Dry Material (gm)	48.02		
		Specific Gravity	2.7 Assumed

Note: Hydrometer test is performed on - # 200 sieve material.

Tested By TO Date 5/21/08 Checked By KB Date 5 23 08

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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Description	**BLACK LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

Liquid Limit Test	1	2	3
Tare Number	250	20	284
Wt. of Tare & WS (gm)	37.67	39.66	39.57
Wt. of Tare & DS (gm)	32.45	34.22	33.70
Wt. of Tare (gm)	17.54	19.33	18.37
Wt. of Water (gm)	5.2	5.4	5.9
Wt. of DS (gm)	14.9	14.9	15.3
Moisture Content (%)	**35.0**	**36.5**	**38.3**
Number of Blows	**31**	**22**	**15**

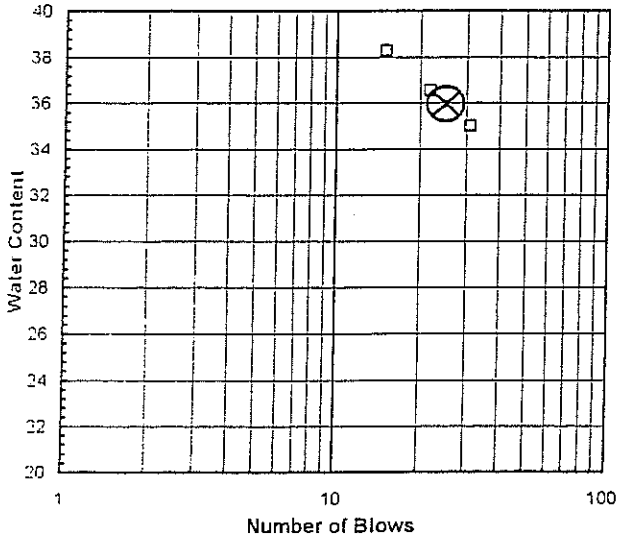
MULTI POINT

Plastic Limit Test	1	2	Range
Tare Number	43	274	
Wt. of Tare & WS (gm)	25.49	26.20	
Wt. of Tare & DS (gm)	24.45	25.21	
Wt. of Tare (gm)	19.03	19.96	
Wt. of Water (gm)	1.0	1.0	
Wt. of DS (gm)	5.4	5.3	
Moisture Content (%)	**19.2**	**18.9**	**0.3**

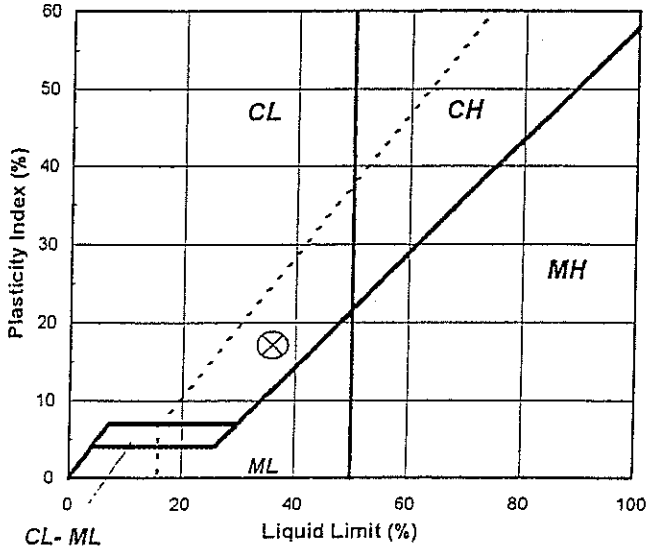
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	36
Plastic Limit (%)	19
Plasticity Index (%)	17
USCS Symbol	CL

Flow Curve



Plasticity Chart



Tested By TO Date 5/21/08 Checked By AR Date 5-23-08

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SPECIFIC GRAVITY

ASTM D 854-02, AASHTO T100-03 (SOP - S5)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Visual Description	**BLACK SLUDGE**
			(Minus No.4 sieve material, airdried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1155	G 1156
Weight of Pycnometer + Soil + Water (gm)	738.67	736.62
Temperature, T (°Celsius)	23.6	22.8
Weight of Pycnometer + Water (gm)	682.72	681.37
Tare Number	932	966
Weight of Tare + Dry Soil (gm)	203.65	202.41
Weight of Tare (gm)	102.67	102.57
Weight of Dry Soil (gm)	100.98	99.84
Specific Gravity of Soil @ T	2.242	2.239
Specific Gravity of Water @ T	0.9974	0.9976
Conversion Factor for Temperature T	0.9992	0.9994
Specific Gravity @ 20° Celsius	2.244	2.240

Average Specific Gravity @ 20° Celsius	2.24

Tested By TO *Date* 05/20/08 *Checked By* KB *Date* 5-23-08

DCN: CT-S5 Date 09/25/06 Revision: 12 *C:\MSOFFICE\EXCEL\PnntQ\[F158.xls]Sheet1*

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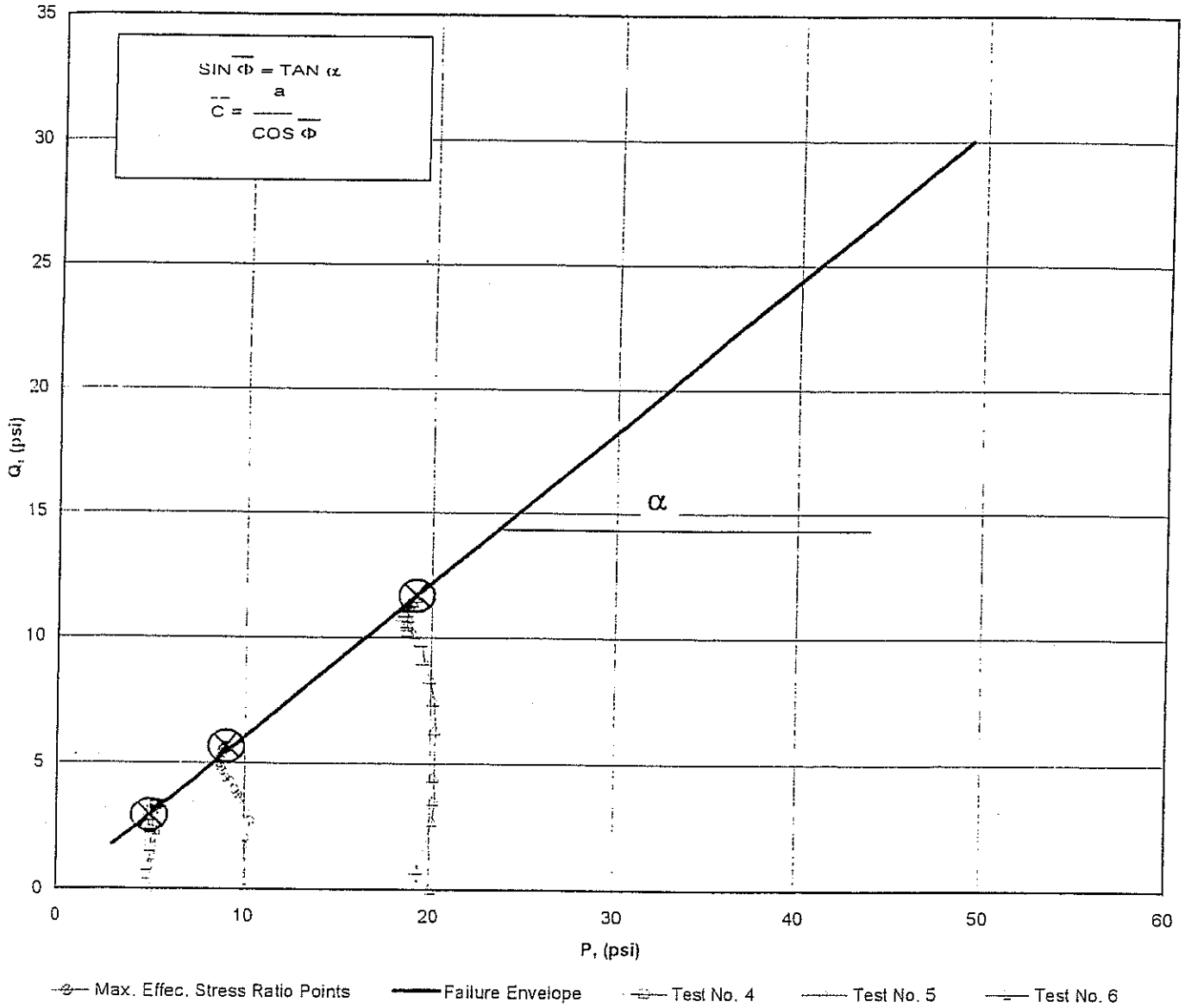
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	31.5	$\bar{\Phi}$	=	37.71

Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

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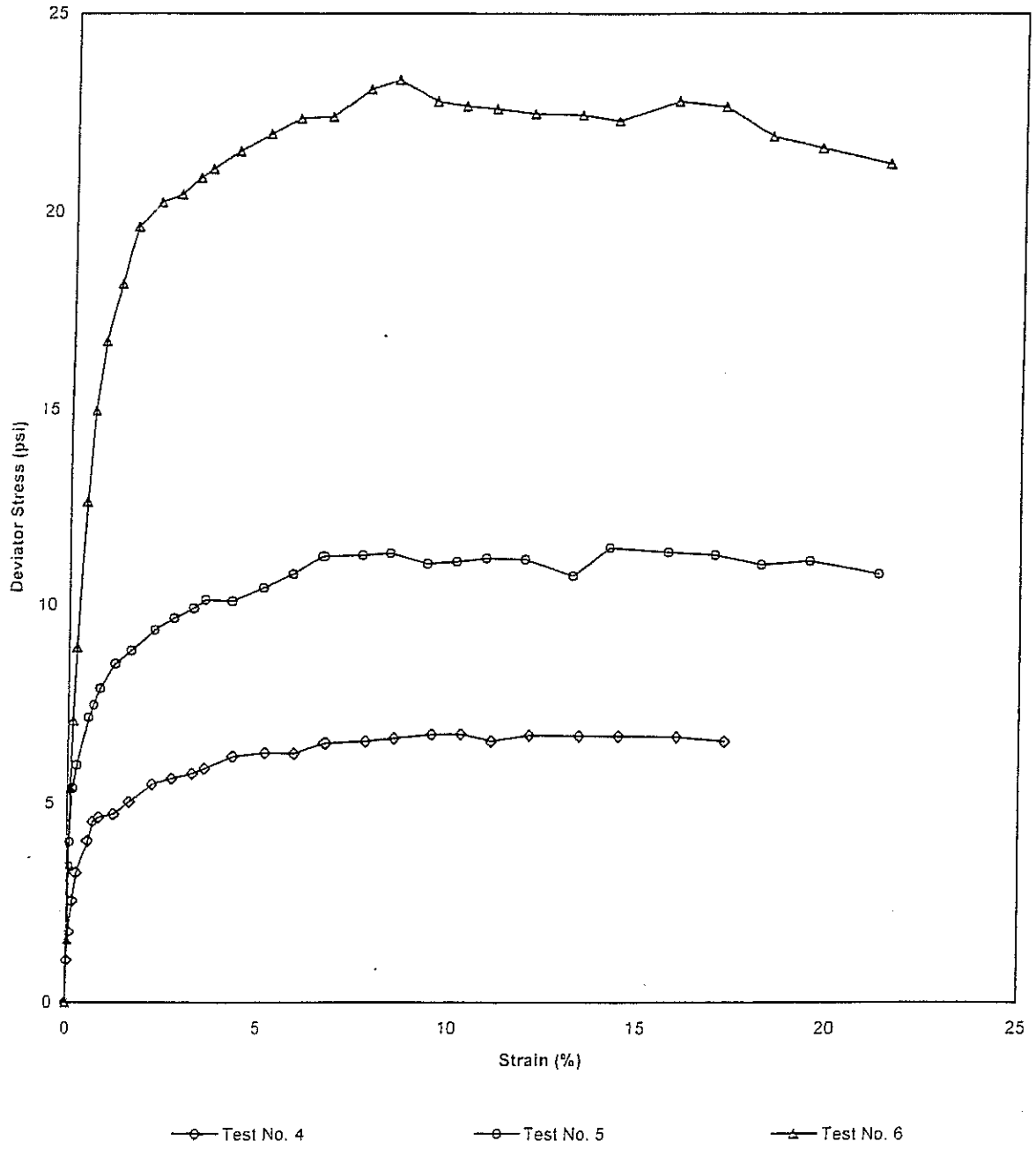
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	4

PRESSURES (psi)

Cell Pressure(psi)	36.3
Back Pressure(psi)	31.2
Eff. Cons. Pressure(psi)	5.1
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	4.92
Q	=	2.94

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.150	Diameter 1	1.453
Length 2	3.142	Diameter 2	1.463
Length 3	3.147	Diameter 3	1.461
Avg Leng.=	3.146	Avg. Diam.=	1.459

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.9
Final Change (ml)	2.1

Initial Dial Reading (D.R.), mils	54
D.R. After Saturation, mils	110
D.R. After Consolidation, mils	130

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.6	0.000	31.2
9.3	0.001	32.1
10.4	0.002	32.3
11.6	0.005	32.6
12.8	0.008	32.9
14.0	0.016	33.3
14.8	0.020	33.3
15.0	0.025	33.6
15.2	0.037	33.8
15.7	0.050	33.9
16.5	0.068	34.2
16.7	0.084	34.2
17.0	0.100	34.2
17.2	0.110	34.3
17.8	0.133	34.2
18.1	0.159	34.3
18.1	0.182	34.3
18.6	0.205	34.2
18.8	0.237	34.2
19.0	0.261	34.3
19.3	0.293	34.3
19.5	0.316	34.2
19.3	0.340	34.3
19.7	0.372	34.2
19.8	0.412	34.3
19.9	0.445	34.3
20.1	0.491	34.2
20.1	0.531	34.2

Tested By JCM Date 05/27/08 Input Checked By IKB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.1	*Stage No.*	1
		Test No	4

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.46
Initial Sample Area (in^2)	1.67
Initial Sample Volume (in^3)	5.26

VOLUME CHANGE

Volume After Consolidation (in^3)	4.85
Length After Consolidation (in)	3.07
Area After Consolidation (in^2)	1.580

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	1.06	0.90	5.26	4.2	1.253	0.86	4.73	0.53
0.07	1.77	1.15	5.72	4.0	1.449	0.66	4.84	0.89
0.15	2.55	1.44	6.21	3.7	1.698	0.58	4.94	1.28
0.25	3.26	1.71	6.65	3.4	1.959	0.53	5.02	1.63
0.53	4.05	2.11	7.04	3.0	2.358	0.53	5.01	2.03
0.65	4.54	2.14	7.50	3.0	2.531	0.48	5.23	2.27
0.82	4.65	2.39	7.36	2.7	2.712	0.52	5.04	2.32
1.21	4.72	2.58	7.25	2.5	2.873	0.56	4.89	2.36
1.62	5.03	2.72	7.42	2.4	3.112	0.55	4.90	2.52
2.22	5.48	2.95	7.63	2.1	3.550	0.55	4.89	2.74
2.74	5.62	3.02	7.70	2.1	3.705	0.55	4.89	2.81
3.27	5.75	3.04	7.81	2.1	3.790	0.54	4.93	2.87
3.59	5.88	3.12	7.86	2.0	3.968	0.54	4.92	2.94
4.33	6.18	3.02	8.27	2.1	3.967	0.50	5.17	3.09
5.17	6.27	3.08	8.30	2.0	4.101	0.50	5.16	3.14
5.93	6.25	3.13	8.22	2.0	4.176	0.51	5.10	3.13
6.69	6.51	3.03	8.58	2.1	4.152	0.48	5.32	3.26
7.73	6.56	3.04	8.62	2.1	4.176	0.47	5.34	3.28
8.50	6.63	3.14	8.59	2.0	4.380	0.48	5.27	3.31
9.53	6.72	3.14	8.68	2.0	4.436	0.48	5.32	3.36
10.30	6.74	3.03	8.81	2.1	4.256	0.46	5.44	3.37
11.09	6.56	3.07	8.59	2.0	4.235	0.48	5.31	3.28
12.10	6.71	3.03	8.78	2.1	4.233	0.46	5.43	3.35
13.42	6.69	3.06	8.74	2.0	4.281	0.47	5.39	3.35
14.49	6.68	3.10	8.68	2.0	4.342	0.47	5.34	3.34
16.00	6.66	3.02	8.74	2.1	4.204	0.46	5.41	3.33
17.29	6.55	3.03	8.62	2.1	4.171	0.47	5.34	3.28

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	5

PRESSURES (psi)

Cell Pressure(psi)	41.1
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	10.1
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	9.00
Q	=	5.66

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.138	Diameter 1	1.407
Length 2	3.138	Diameter 2	1.383
Length 3	3.137	Diameter 3	1.378
Avg Leng.=	3.138	Avg. Diam.=	1.389

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	20.2
Final Change (ml)	3.8
Initial Dial Reading (D.R.), mils	88
D.R. After Saturation, mils	94
D.R. After Consolidation, mils	124

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
8.5	0.000	31.0
13.5	0.001	32.8
14.3	0.002	33.0
16.3	0.004	33.4
17.2	0.007	33.9
18.9	0.016	34.9
19.4	0.020	35.2
20.0	0.025	35.6
21.0	0.038	36.1
21.5	0.051	36.6
22.4	0.070	37.0
22.9	0.085	37.2
23.4	0.101	37.4
23.7	0.110	37.4
23.8	0.132	37.5
24.5	0.158	37.6
25.1	0.181	37.7
26.0	0.205	37.7
26.2	0.236	37.7
26.4	0.259	37.8
26.2	0.290	37.7
26.4	0.314	37.8
26.7	0.338	37.8
26.9	0.370	37.8
26.5	0.410	37.8
27.9	0.441	37.8
28.0	0.488	37.8
28.2	0.527	37.8
28.1	0.566	37.8
28.5	0.605	37.8
28.4	0.661	37.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.1	*Stage No.*	1
		Test No	5

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.52
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.50
Length After Consolidation (in)	3.10
Area After Consolidation (in^2)	1.450

Strain (%)	Deviation Stress	Δ U	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	3.42	1.75	11.77	8.3	1.410	0.52	10.06	1.71
0.06	4.03	2.01	12.12	8.1	1.497	0.50	10.11	2.01
0.13	5.39	2.43	13.05	7.7	1.703	0.46	10.36	2.69
0.23	5.96	2.92	13.13	7.2	1.830	0.50	10.16	2.98
0.51	7.15	3.87	13.37	6.2	2.148	0.55	9.80	3.57
0.64	7.46	4.19	13.37	5.9	2.262	0.57	9.64	3.73
0.82	7.88	4.57	13.41	5.5	2.427	0.59	9.47	3.94
1.21	8.51	5.13	13.48	5.0	2.714	0.61	9.22	4.26
1.63	8.84	5.57	13.38	4.5	2.950	0.64	8.96	4.42
2.24	9.37	5.97	13.50	4.1	3.271	0.64	8.81	4.69
2.75	9.67	6.18	13.59	3.9	3.468	0.65	8.75	4.84
3.25	9.92	6.35	13.66	3.7	3.648	0.65	8.70	4.96
3.56	10.14	6.40	13.83	3.7	3.741	0.64	8.76	5.07
4.26	10.10	6.55	13.65	3.6	3.843	0.66	8.60	5.05
5.08	10.44	6.59	13.95	3.5	3.978	0.64	8.73	5.22
5.85	10.80	6.68	14.21	3.4	4.161	0.63	8.81	5.40
6.60	11.25	6.70	14.65	3.4	4.304	0.60	9.03	5.62
7.60	11.27	6.75	14.63	3.4	4.363	0.60	8.99	5.64
8.34	11.32	6.76	14.66	3.3	4.395	0.60	9.00	5.66
9.36	11.06	6.74	14.42	3.4	4.292	0.62	8.89	5.53
10.13	11.11	6.76	14.46	3.3	4.323	0.61	8.90	5.56
10.91	11.20	6.81	14.49	3.3	4.401	0.61	8.89	5.60
11.94	11.17	6.80	14.47	3.3	4.383	0.62	8.88	5.58
13.21	10.75	6.76	14.09	3.3	4.214	0.64	8.72	5.37
14.21	11.47	6.77	14.80	3.3	4.445	0.60	9.06	5.73
15.72	11.35	6.78	14.67	3.3	4.418	0.60	9.00	5.68
16.98	11.28	6.79	14.59	3.3	4.411	0.61	8.95	5.64
18.25	11.04	6.80	14.33	3.3	4.350	0.62	8.81	5.52
19.51	11.13	6.82	14.40	3.3	4.397	0.62	8.84	5.56
21.32	10.80	6.85	14.05	3.3	4.318	0.64	8.65	5.40

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	6

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.3
Eff. Cons. Pressure(ps	20.1
Pore Pressure Response (%)	97

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	19.19
Q	=	11.67

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.142	Diameter 1	1.379
Length 2	3.130	Diameter 2	1.377
Length 3	3.141	Diameter 3	1.386
Avg Leng.=	3.138	Avg. Diam.=	1.381

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	17.7
Final Change (ml)	6.3

Initial Dial Reading (D.R.), mils	40
D.R. After Saturation, mils	56
D.R. After Consolidation, mils	91

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
4.3	0.000	31.3
6.5	0.001	32.8
11.7	0.002	33.9
14.0	0.004	34.7
16.6	0.006	35.6
21.7	0.012	37.4
25.0	0.019	38.7
27.5	0.026	39.8
29.6	0.038	40.9
31.7	0.051	41.7
32.8	0.070	42.4
33.2	0.085	42.8
33.9	0.101	43.1
34.3	0.110	43.2
35.2	0.132	43.4
36.1	0.157	43.7
37.0	0.181	43.7
37.3	0.205	43.8
38.7	0.236	43.8
39.3	0.259	43.9
38.9	0.291	43.8
39.0	0.316	43.9
39.2	0.340	43.9
39.4	0.371	43.8
39.9	0.410	43.8
40.1	0.441	43.9
41.5	0.489	43.8
41.9	0.528	43.7
41.2	0.568	43.8
41.3	0.608	43.8
41.4	0.663	43.8

Tested By JCM Date 05/27/08 Input Checked By KR Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.1	*Stage No.*	1
		Test No	6

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.24
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	1.58	1.52	20.16	18.6	1.085	0.99	19.37	0.79
0.07	5.38	2.62	22.86	17.5	1.308	0.50	20.17	2.69
0.12	7.06	3.36	23.80	16.7	1.422	0.49	20.27	3.53
0.19	8.92	4.30	24.73	15.8	1.565	0.50	20.26	4.46
0.40	12.65	6.12	26.62	14.0	1.905	0.50	20.30	6.32
0.61	14.97	7.35	27.72	12.7	2.174	0.51	20.23	7.48
0.85	16.72	8.47	28.36	11.6	2.438	0.52	19.99	8.36
1.24	18.18	9.56	28.72	10.5	2.724	0.54	19.63	9.09
1.64	19.63	10.41	29.32	9.7	3.025	0.55	19.51	9.81
2.26	20.24	11.15	29.19	9.0	3.262	0.57	19.07	10.12
2.77	20.44	11.54	29.00	8.6	3.388	0.58	18.78	10.22
3.26	20.87	11.82	29.15	8.3	3.521	0.58	18.71	10.43
3.58	21.09	11.94	29.25	8.2	3.584	0.58	18.70	10.54
4.27	21.54	12.14	29.50	8.0	3.705	0.58	18.73	10.77
5.09	21.97	12.38	29.69	7.7	3.846	0.58	18.71	10.99
5.86	22.37	12.43	30.04	7.7	3.918	0.57	18.85	11.19
6.64	22.41	12.54	29.98	7.6	3.962	0.58	18.77	11.21
7.63	23.10	12.49	30.71	7.6	4.034	0.56	19.16	11.55
8.39	23.33	12.58	30.85	7.5	4.102	0.56	19.19	11.67
9.43	22.79	12.55	30.34	7.6	4.018	0.57	18.95	11.39
10.22	22.67	12.59	30.18	7.5	4.021	0.57	18.84	11.34
11.00	22.61	12.56	30.14	7.5	4.001	0.57	18.84	11.30
12.01	22.49	12.53	30.05	7.6	3.973	0.57	18.81	11.24
13.28	22.46	12.52	30.04	7.6	3.961	0.57	18.81	11.23
14.28	22.30	12.63	29.77	7.5	3.986	0.58	18.62	11.15
15.84	22.80	12.50	30.40	7.6	4.001	0.57	19.00	11.40
17.12	22.66	12.41	30.35	7.7	3.948	0.56	19.02	11.33
18.40	21.92	12.46	29.57	7.6	3.868	0.59	18.61	10.96
19.69	21.62	12.51	29.21	7.6	3.846	0.60	18.40	10.81
21.49	21.21	12.54	28.77	7.6	3.805	0.61	18.17	10.61

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

MOHR TOTAL STRENGTH ENVELOPE

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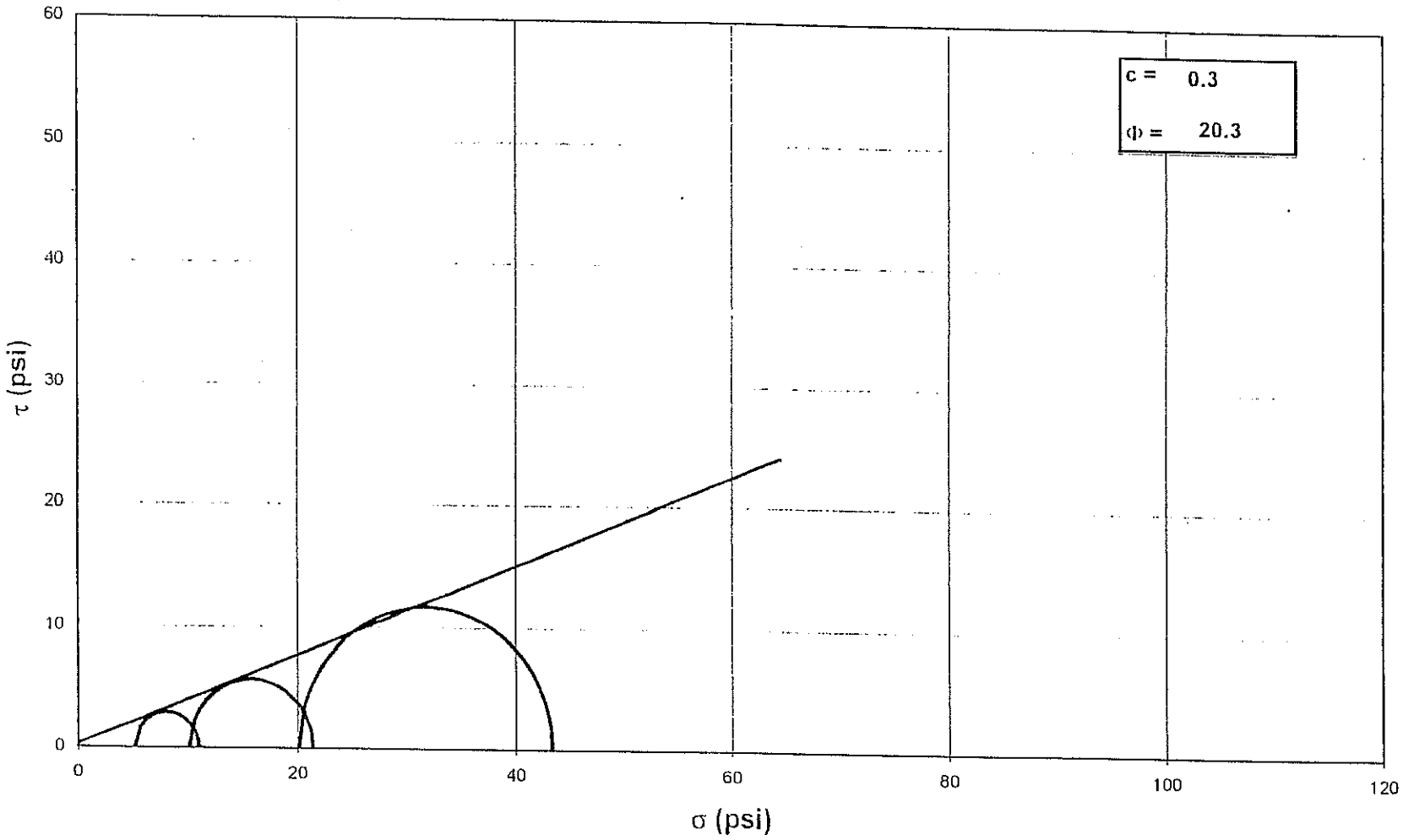
Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/14/08

#N/A

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R14455

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	82.9	85.7	83.0
Total Unit Weight (pcf)	82.6	82.2	84.5
Dry Unit Weight (pcf)	45.2	44.3	46.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	2.095	2.159	2.029

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-5-08

Geotechnics
INTEGRITY IN TESTING

UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	41.5	41.5	40.9
Total Unit Weight (pcf)	92.9	102.5	103.2
Dry Unit Weight (pcf)	65.7	72.4	73.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	1.129	0.931	0.910

Tested By JCM Date 05/27/08 Input Checked By Date

ATTACHMENT A-2

LABORATORY TESTING RESULTS – COARSE REFUSE AND RESIDUAL SOILS PROVIDED BY ALLIANCE CONSULTING, INC.

APPENDIX C

LABORATORY TESTING
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY, LLC
BECKLEY, WEST VIRGINIA

TABLE OF CONTENTS

	PAGE
SOIL TESTING	
Summary	1
Strength Test	3
Grain Size	10
Atterberg Limits Test Results	12
COARSE COAL REFUSE TESTING	
Summary	13
Grain Size	15
Proctor Test	17
Permeability Test	18
Strength Test	20

R14460

(1)

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800-333-1740
FAX 618-457-8991

February 10, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Soil Boring and Laboratory Tests
Boring #8874
Mach Mine #1
Johnston City, Illinois
HFE File H-05278
Mach Mining Purchase Order No. _____

Dear Sir:

In accordance with your instructions, on February 1, 2006, we drilled one soil boring and sampled the subsoils with Shelby tubes. The soil sample taken from 10 to 12 feet in depth was subjected to laboratory tests. Results of the tests are as follows:

Boring No.:	8874
Depth:	8.0-10.0'
Visual Classification:	Silty CLAY (CL)
Atterberg Limits:	LL = 41.8% PL = 17.7% PI = 24.1
Unit Weight:	105.3 PCF
Moisture Content:	21.5%
Effective Cohesion:	0 PSF
Effective Phi Angle:	26.8 Degrees

All Tubes From Boring 8874

The Boring Log and test results are enclosed. If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

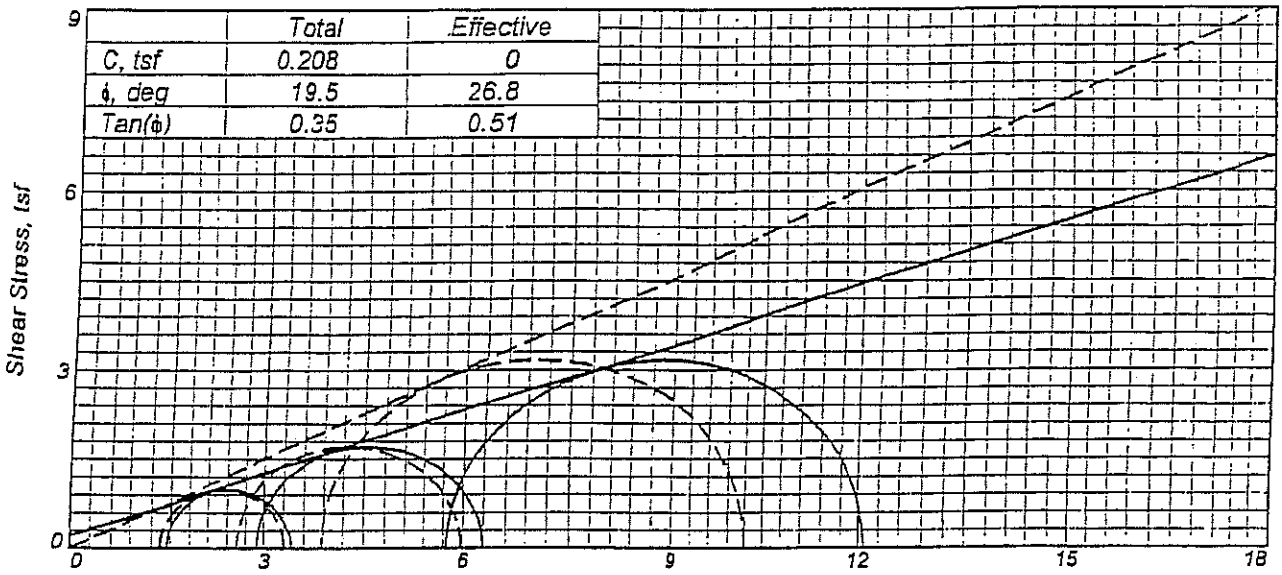
REGISTERED PROFESSIONAL ENGINEER
TIMOTHY J.
HOLCOMB
062-042149
2-10-06
ILLINOIS

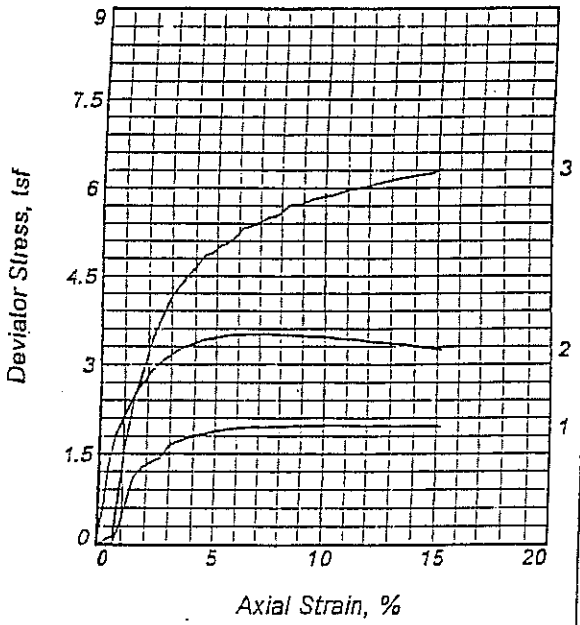
1 copy: Fred Vass - Alliance Consulting

R14462

3

	Total	Effective
C, tsf	0.208	0
ϕ, deg	19.5	26.8
Tan(ϕ)	0.35	0.51





Sample No.		1	2	3
Initial	Water Content,	21.5	20.8	17.6
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	99.7	98.9
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
At Test	Water Content,	21.5	20.9	17.8
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.6	3.6	2.2
Cell Pressure, tsf		5.0	6.5	7.9
Fail. Stress, tsf		2.0	3.4	6.3
Total Pore Pr., tsf		3.7	3.9	4.1
Ult. Stress, tsf		2.0	3.2	6.3
Total Pore Pr., tsf		3.6	3.8	4.1
$\bar{\sigma}_1$ Failure, tsf		3.3	6.0	10.2
$\bar{\sigma}_3$ Failure, tsf		1.3	2.6	3.9

Type of Test: CU with Pore Pressures

Sample Type: Shelby Tube - Undisturbed

Description: Gray Mottled Brown Silty CLAY

LL= 41.8 PL= 17.7 PI= 24.1

Assumed Specific Gravity= 2.65

Remarks:

Client: Alliance Consulting

Project: Triaxial Test
Mach Mine #1

Location: Boring #8874

Sample Number: 3 **Depth:** 10.0-12.0'

Proj. No.: H-05278 **Date:** 2-1-05

TRIAXIAL SHEAR TEST REPORT

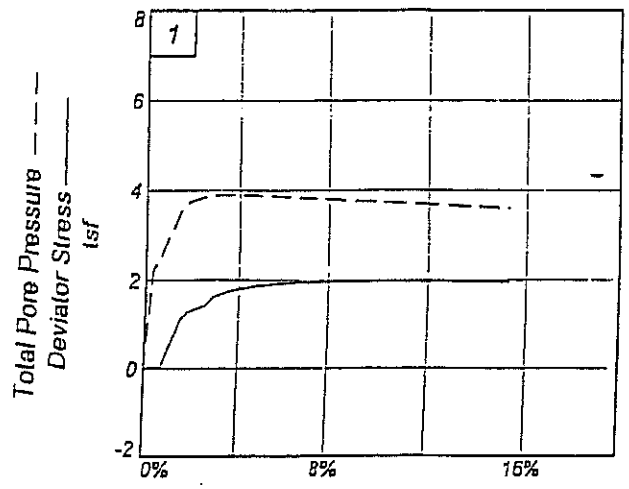
HOLCOMB FOUNDATION ENGINEERING CO.

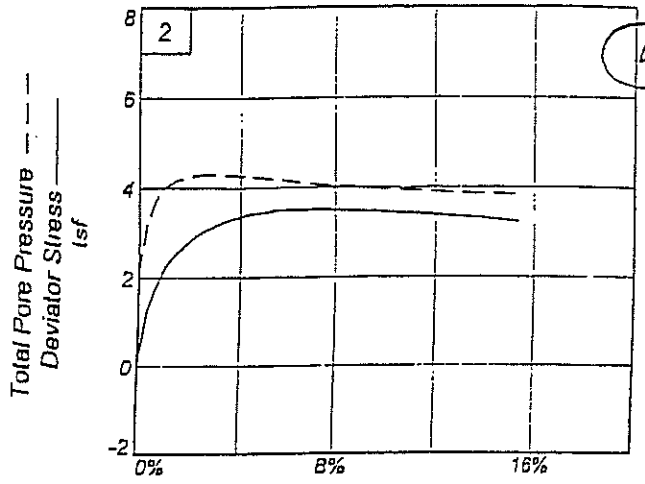
Plate

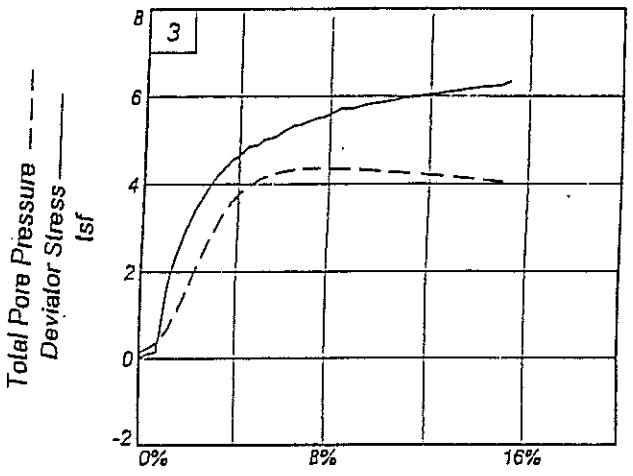
Tested By: LC Checked By: TH

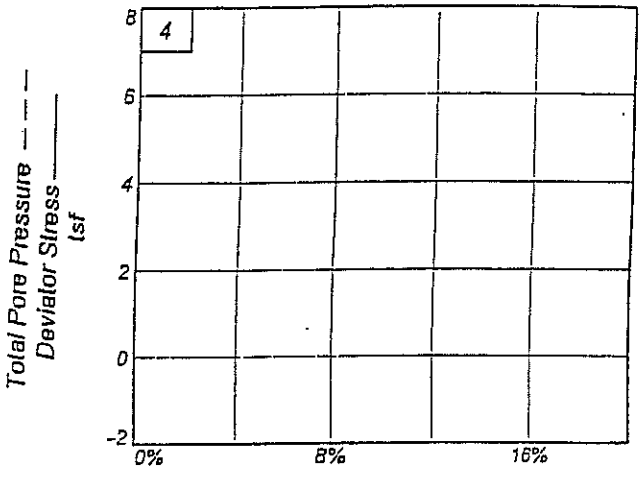
10 4 21 R14463

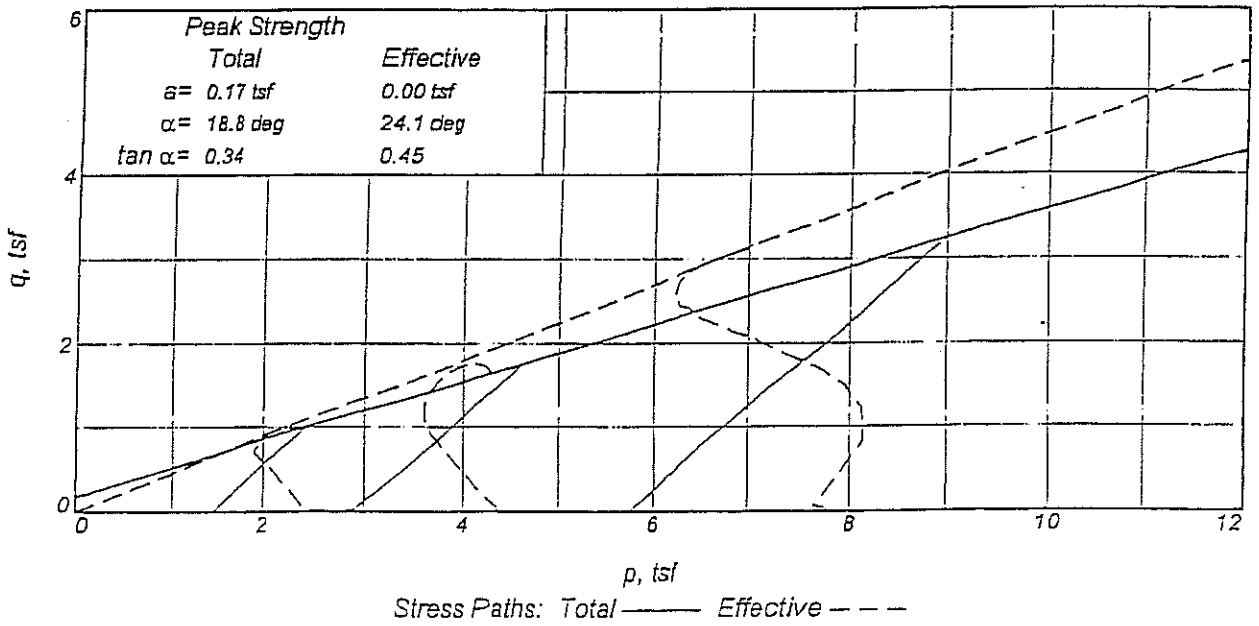
4











Stress Paths: Total ——— Effective — — —

Client: Alliance Consulting
Project: Triaxial Test
Location: Boring #8874
Project No.: H-05278

Depth: 10.0-12.0'
Plate _____

Sample Number: 3

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC

Checked By: TH

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

2/9/2006 5
8:50 PM

Date:	2-1-05
Client:	Alliance Consulting
Project:	Triaxial Test Mach Mine #1 Johnston City, Illinois
Location:	Boring #8874
Depth:	10.0-12.0'
Sample Number:	3
Description:	Gray Mottled Brown Silty CLAY
Remarks:	
Type of Sample:	Shelby Tube - Undisturbed
Assumed Specific Gravity=2.65	LL=41.8 PL=17.7 PI=24.1
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	189.100			1279.000
Moisture content: Dry soil+tare, gms.	176.100			1072.200
Moisture content: Tare, gms.	115.700			103.200
Moisture, %	21.5	21.5	21.5	21.3
Moist specimen weight, gms.	1140.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.51	5.51	5.51	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.0	128.0	128.0	
Dry density, pcf	105.3	105.3	105.3	
Void ratio	0.5706	0.5706	0.5706	
Saturation, %	100.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.981 tsf at reading no. 24
Ult. Stress = 1.955 tsf at reading no. 30

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(6)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	18.30	0.0	0.0	0.000	5.112	5.112	1.00	-1.00	5.112	0.000
1	0.0190	20.00	1.7	0.3	0.014	2.830	2.844	1.00	30.70	2.837	0.007
2	0.0400	21.60	3.3	0.7	0.026	2.426	2.452	1.01	36.30	2.439	0.013
3	0.0810	113.20	94.9	1.5	1.093	1.505	2.598	1.73	49.10	2.051	0.547
4	0.1010	129.80	111.5	1.8	1.280	1.318	2.597	1.97	51.70	1.958	0.640
5	0.1420	143.10	124.8	2.6	1.422	1.181	2.602	2.20	53.60	1.892	0.711
6	0.1620	161.50	143.2	2.9	1.625	1.159	2.784	2.40	53.90	1.972	0.813
7	0.1830	168.90	150.6	3.3	1.702	1.145	2.847	2.49	54.10	1.996	0.851
8	0.2030	174.80	156.5	3.7	1.763	1.138	2.900	2.55	54.20	2.019	0.881
9	0.2240	178.90	160.6	4.1	1.802	1.145	2.946	2.57	54.10	2.046	0.901
10	0.2440	182.30	164.0	4.4	1.833	1.145	2.978	2.60	54.10	2.061	0.916
11	0.2650	186.40	168.1	4.8	1.871	1.152	3.023	2.62	54.00	2.088	0.936
12	0.2850	188.10	169.8	5.2	1.883	1.166	3.049	2.61	53.80	2.108	0.941
13	0.3060	191.40	173.1	5.6	1.912	1.166	3.078	2.64	53.80	2.122	0.956
14	0.3260	193.10	174.8	5.9	1.923	1.181	3.104	2.63	53.60	2.142	0.962
15	0.3460	194.70	176.4	6.3	1.933	1.188	3.121	2.63	53.50	2.155	0.967
16	0.3670	196.40	178.1	6.7	1.944	1.202	3.146	2.62	53.30	2.174	0.972
17	0.3870	198.10	179.8	7.0	1.955	1.210	3.164	2.62	53.20	2.187	0.977
18	0.4080	198.10	179.8	7.4	1.947	1.224	3.171	2.59	53.00	2.197	0.973
19	0.4280	200.60	182.3	7.8	1.966	1.231	3.197	2.60	52.90	2.214	0.983
20	0.4490	200.60	182.3	8.1	1.958	1.238	3.196	2.58	52.80	2.217	0.979
21	0.4890	203.10	184.8	8.9	1.969	1.267	3.236	2.55	52.40	2.252	0.985
22	0.5300	204.70	186.4	9.6	1.970	1.289	3.259	2.53	52.10	2.274	0.985
23	0.5710	207.20	188.9	10.4	1.980	1.310	3.290	2.51	51.80	2.300	0.990
24	0.6120	208.90	190.6	11.1	1.981	1.332	3.313	2.49	51.50	2.323	0.991
25	0.6530	209.10	190.8	11.8	1.967	1.346	3.313	2.46	51.30	2.330	0.983
26	0.6940	211.40	193.1	12.6	1.974	1.361	3.334	2.45	51.10	2.348	0.987
27	0.7350	212.20	193.9	13.3	1.965	1.390	3.354	2.41	50.70	2.372	0.982
28	0.7790	213.90	195.6	14.1	1.964	1.404	3.368	2.40	50.50	2.386	0.982
29	0.8170	215.50	197.2	14.8	1.964	1.426	3.390	2.38	50.20	2.408	0.982
30	0.8380	215.50	197.2	15.2	1.955	1.433	3.388	2.36	50.10	2.410	0.978

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	154.800			1347.900
Moisture content: Dry soil+tare, gms.	145.800			1154.100
Moisture content: Tare, gms.	102.600			135.100
Moisture, %	20.8	20.9	20.9	19.0
Moist specimen weight, gms.	1142.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.49	5.49	5.49	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.7	128.7	128.7	
Dry density, pcf	106.5	106.5	106.5	
Void ratio	0.5536	0.5536	0.5536	
Saturation, %	99.7	100.0	100.0	

7

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 3.418 tsf at reading no. 24
Ult. Stress = 3.250 tsf at reading no. 29

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	27.50	0.0	0.0	0.000	4.385	4.385	1.00	29.10	4.385	0.000
1	0.0190	134.00	106.5	0.3	1.241	3.254	4.495	1.38	44.80	3.875	0.620
2	0.0400	183.10	155.6	0.7	1.806	2.750	4.557	1.66	51.80	3.653	0.903
3	0.0600	218.90	191.4	1.1	2.214	2.484	4.698	1.89	55.50	3.591	1.107
4	0.0810	243.80	216.3	1.5	2.492	2.340	4.832	2.06	57.50	3.586	1.246
5	0.1010	264.60	237.1	1.8	2.721	2.254	4.975	2.21	58.70	3.614	1.361
6	0.1220	282.10	254.6	2.2	2.911	2.210	5.121	2.32	59.30	3.666	1.455
7	0.1420	295.40	267.9	2.6	3.052	2.182	5.233	2.40	59.70	3.707	1.526
8	0.1620	305.40	277.9	2.9	3.154	2.182	5.335	2.45	59.70	3.758	1.577
9	0.1830	314.60	287.1	3.3	3.245	2.189	5.434	2.48	59.60	3.811	1.623
10	0.2030	322.10	294.6	3.7	3.317	2.196	5.513	2.51	59.50	3.855	1.659
11	0.2240	327.10	299.6	4.1	3.360	2.218	5.578	2.52	59.20	3.898	1.680
12	0.2440	332.90	305.4	4.4	3.412	2.232	5.644	2.53	59.00	3.938	1.706
13	0.2650	336.20	308.7	4.8	3.435	2.254	5.689	2.52	58.70	3.971	1.718
14	0.2850	339.50	312.0	5.2	3.459	2.275	5.734	2.52	58.40	4.005	1.729
15	0.3060	343.70	316.2	5.6	3.491	2.297	5.788	2.52	58.10	4.042	1.746
16	0.3260	345.40	317.9	5.9	3.497	2.318	5.815	2.51	57.80	4.067	1.748
17	0.3670	348.70	321.2	6.7	3.505	2.369	5.874	2.48	57.10	4.121	1.752
18	0.4080	352.00	324.5	7.4	3.512	2.412	5.924	2.46	56.50	4.168	1.756
19	0.4490	353.70	326.2	8.2	3.502	2.441	5.943	2.43	56.10	4.192	1.751
20	0.4890	354.50	327.0	8.9	3.483	2.470	5.953	2.41	55.70	4.211	1.742
21	0.5300	355.40	327.9	9.7	3.464	2.498	5.963	2.39	55.30	4.230	1.732

(8)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.5510	357.00	329.5	10.0	3.466	2.513	5.979	2.38	55.10	4.246	1.733
23	0.5920	356.20	328.7	10.8	3.429	2.534	5.964	2.35	54.80	4.249	1.715
24	0.6330	357.90	330.4	11.5	3.418	2.556	5.974	2.34	54.50	4.265	1.709
25	0.6730	357.00	329.5	12.3	3.381	2.585	5.966	2.31	54.10	4.275	1.690
26	0.7140	357.90	330.4	13.0	3.361	2.599	5.960	2.29	53.90	4.280	1.681
27	0.7550	357.90	330.4	13.7	3.332	2.614	5.946	2.27	53.70	4.280	1.666
28	0.7960	356.20	328.7	14.5	3.286	2.628	5.914	2.25	53.50	4.271	1.643
29	0.8370	355.40	327.9	15.2	3.250	2.635	5.885	2.23	53.40	4.260	1.625

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	248.400			1374.500
Moisture content: Dry soil+tare, gms.	226.700			1195.400
Moisture content: Tare, gms.	103.200			127.700
Moisture, %	17.6	17.8	17.8	16.8
Moist specimen weight, gms.	1184.7			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.54	5.54	5.54	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	132.3	132.5	132.5	
Dry density, pcf	112.5	112.5	112.5	
Void ratio	0.4707	0.4707	0.4707	
Saturation, %	98.9	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 6.334 tsf at reading no. 33
Ult. Stress = 6.334 tsf at reading no. 33

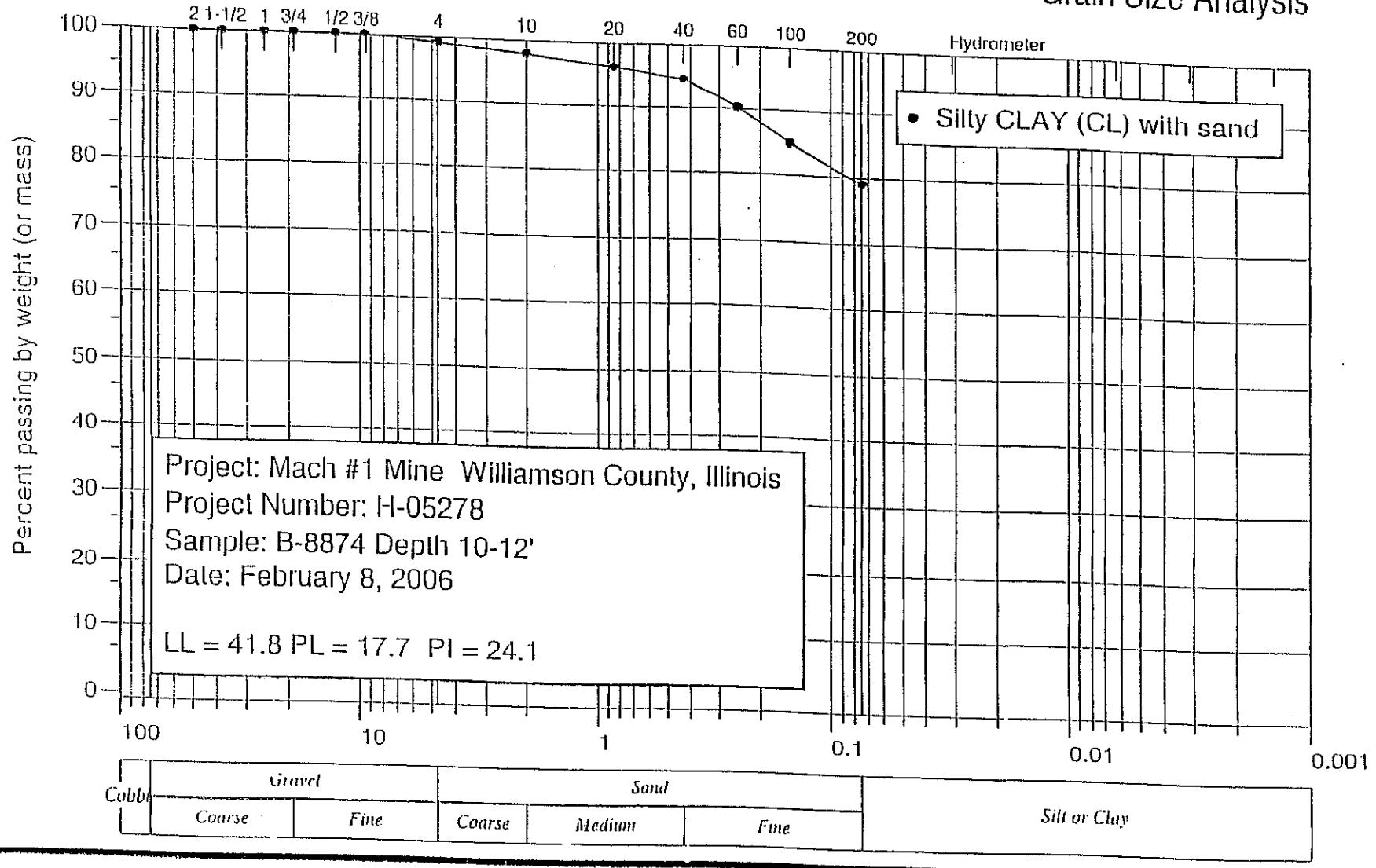
No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	31.60	0.0	0.0	0.000	7.812	7.812	1.00	1.50	7.812	0.000
1	0.0190	39.90	8.3	0.3	0.091	7.690	7.781	1.01	3.20	7.735	0.045
2	0.0400	44.10	12.5	0.7	0.133	7.574	7.707	1.02	4.80	7.641	0.066
3	0.0600	175.60	144.0	1.1	1.666	7.308	8.974	1.23	8.50	8.141	0.833
4	0.0810	240.50	208.9	1.5	2.407	6.926	9.333	1.35	13.80	8.130	1.203
5	0.1010	291.30	259.7	1.8	2.981	6.466	9.447	1.46	20.20	7.956	1.491
6	0.1220	329.60	298.0	2.2	3.408	5.983	9.391	1.57	26.90	7.687	1.704
7	0.1420	362.00	330.4	2.6	3.764	5.479	9.244	1.69	33.90	7.361	1.882
8	0.1620	392.00	360.4	2.9	4.091	5.040	9.131	1.81	40.00	7.085	2.045
9	0.1830	412.80	381.2	3.3	4.310	4.666	8.976	1.92	45.20	6.821	2.155

(9)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
10	0.2030	432.80	401.2	3.7	4.519	4.363	8.883	2.04	49.40	6.623	2.260
11	0.2240	446.90	415.3	4.0	4.660	4.140	8.800	2.13	52.50	6.470	2.330
12	0.2440	465.20	433.6	4.4	4.847	3.982	8.828	2.22	54.70	6.405	2.423
13	0.2650	471.00	439.4	4.8	4.892	3.852	8.744	2.27	56.50	6.298	2.446
14	0.2850	483.50	451.9	5.1	5.012	3.766	8.778	2.33	57.70	6.272	2.506
15	0.3060	490.20	458.6	5.5	5.066	3.694	8.760	2.37	58.70	6.227	2.533
16	0.3260	503.50	471.9	5.9	5.193	3.643	8.837	2.43	59.40	6.240	2.597
17	0.3460	516.80	485.2	6.2	5.319	3.607	8.926	2.47	59.90	6.267	2.660
18	0.3670	521.80	490.2	6.6	5.352	3.586	8.938	2.49	60.20	6.262	2.676
19	0.3870	530.10	498.5	7.0	5.422	3.571	8.993	2.52	60.40	6.282	2.711
20	0.4080	538.40	506.8	7.4	5.490	3.564	9.054	2.54	60.50	6.309	2.745
21	0.4280	543.40	511.8	7.7	5.522	3.564	9.086	2.55	60.50	6.325	2.761
22	0.4490	554.30	522.7	8.1	5.617	3.571	9.188	2.57	60.40	6.380	2.808
23	0.4690	565.90	534.3	8.5	5.719	3.578	9.297	2.60	60.30	6.438	2.859
24	0.4890	567.60	536.0	8.8	5.714	3.578	9.293	2.60	60.30	6.436	2.857
25	0.5300	581.70	550.1	9.6	5.817	3.600	9.417	2.62	60.00	6.509	2.909
26	0.5710	591.70	560.1	10.3	5.874	3.636	9.510	2.62	59.50	6.573	2.937
27	0.6120	605.00	573.4	11.0	5.964	3.665	9.629	2.63	59.10	6.647	2.982
28	0.6530	615.00	583.4	11.8	6.018	3.701	9.719	2.63	58.60	6.710	3.009
29	0.6940	626.70	595.1	12.5	6.087	3.737	9.824	2.63	58.10	6.780	3.044
30	0.7350	638.30	606.7	13.3	6.153	3.773	9.926	2.63	57.60	6.849	3.077
31	0.7760	649.10	617.5	14.0	6.209	3.816	10.025	2.63	57.00	6.921	3.105
32	0.8170	657.50	625.9	14.7	6.240	3.852	10.092	2.62	56.50	6.972	3.120
33	0.8390	669.90	638.3	15.1	6.334	3.866	10.200	2.64	56.30	7.033	3.167

Holcomb Foundation Engineering

Grain Size Analysis



14 / 57 (10)

17 of 57

(11)

Holcomb Foundation Engineering Company

Laboratory Testing Results

2/8/2006

Project: Mach #1 Mine

Project No: H-05278

Sieve Analysis - ASTM C136-96a

Sample: Silty CLAY (CL)

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
1.5000	38.1000	1 -1/2"	0.0	0.0	100.0
1.0000	25.4000	1"	0.0	0.0	100.0
0.7500	19.1000	3/4"	0.0	0.0	100.0
0.5000	12.7000	1/2"	0.0	0.0	100.0
3.7500	9.5200	3/8"	0.0	0.0	100.0
0.1870	4.7600	No. 4	2.1	0.9	99.1
0.0790	2.0000	No. 10	4.6	2.0	98.0
0.0469	1.1800	No. 16	4.6	2.0	98.0
0.0331	0.8500	No. 20	8.6	3.8	96.2
0.0165	0.4200	No. 40	12.6	5.5	94.5
0.0117	0.2980	No. 50	12.6	5.5	94.5
0.0083	0.2500	No. 60	22.2	9.8	90.2
0.0059	0.1490	No. 100	34.6	15.2	84.8
0.0029	0.0740	No. 200	47.7	21.0	79.0

Total Weight in Grams 227.20

Holcomb Foundation Engineering Company

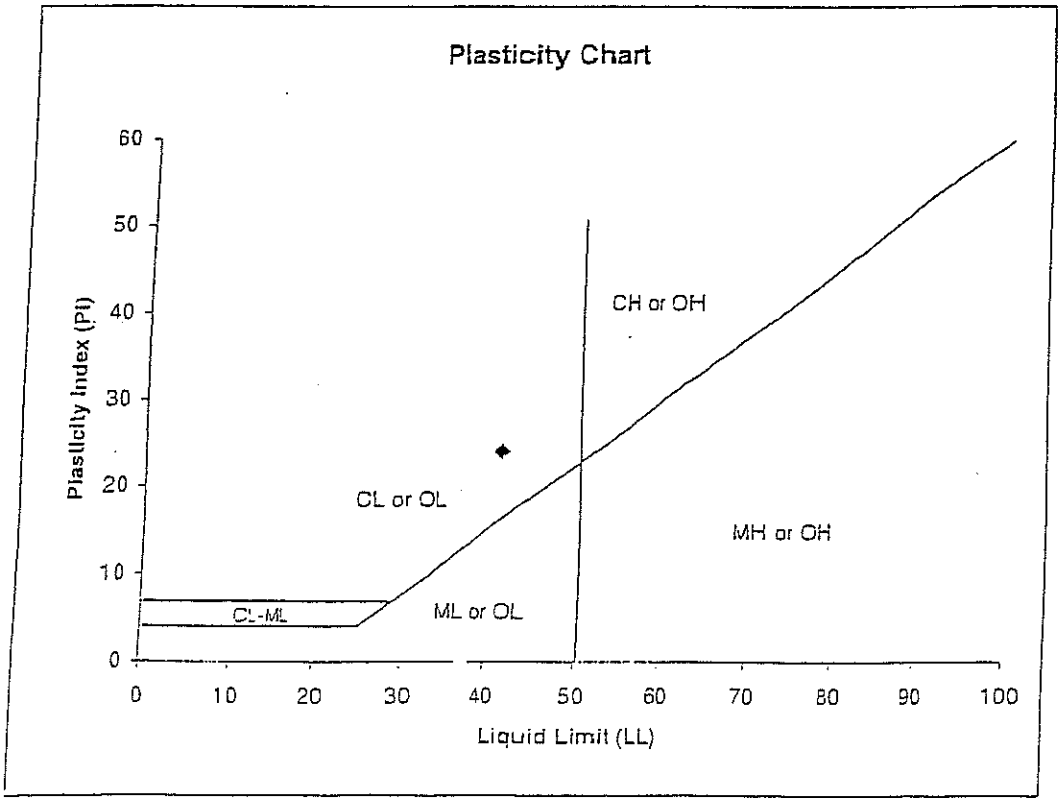
Laboratory Testing Results

Project: Mach #1 Mine
Project No: H-05278

Sample	1	2	3
Dish Number	LL_1	LL_2	LL_3
Mass of can, W_1 (g)	34.70		
Mass of can + moist soil, W_2 (g)	62.84		
Mass of can + dry soil, W_3 (g)	54.52		
Moisture content, w (%)	41.98		
Number of blows, N	24		
Liquid Limit, LL	41.8		

Dish Number	PL_1
Mass of can, W_1 (g)	39.76
Mass of can + moist soil, W_2 (g)	54.79
Mass of can + dry soil, W_3 (g)	52.53
Plastic Limit, PL	17.7

PI = 24.1



19 of 57 R14472 (13)

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

SHIPPING ADDRESS
Box 393 Wood Road
Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

November 30, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Pond Creek Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on November 17, 2006, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification: Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)

Proctor Test Results:
Maximum Dry Unit Weight: 124.6 PCF
Optimum Moisture Content: 9.3 %

Specific Gravity: 2.37

Triaxial Test Results:
Effective Cohesion: 0 PSF
Effective Phi Angle: 33.7 Degrees

Permeability: 2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

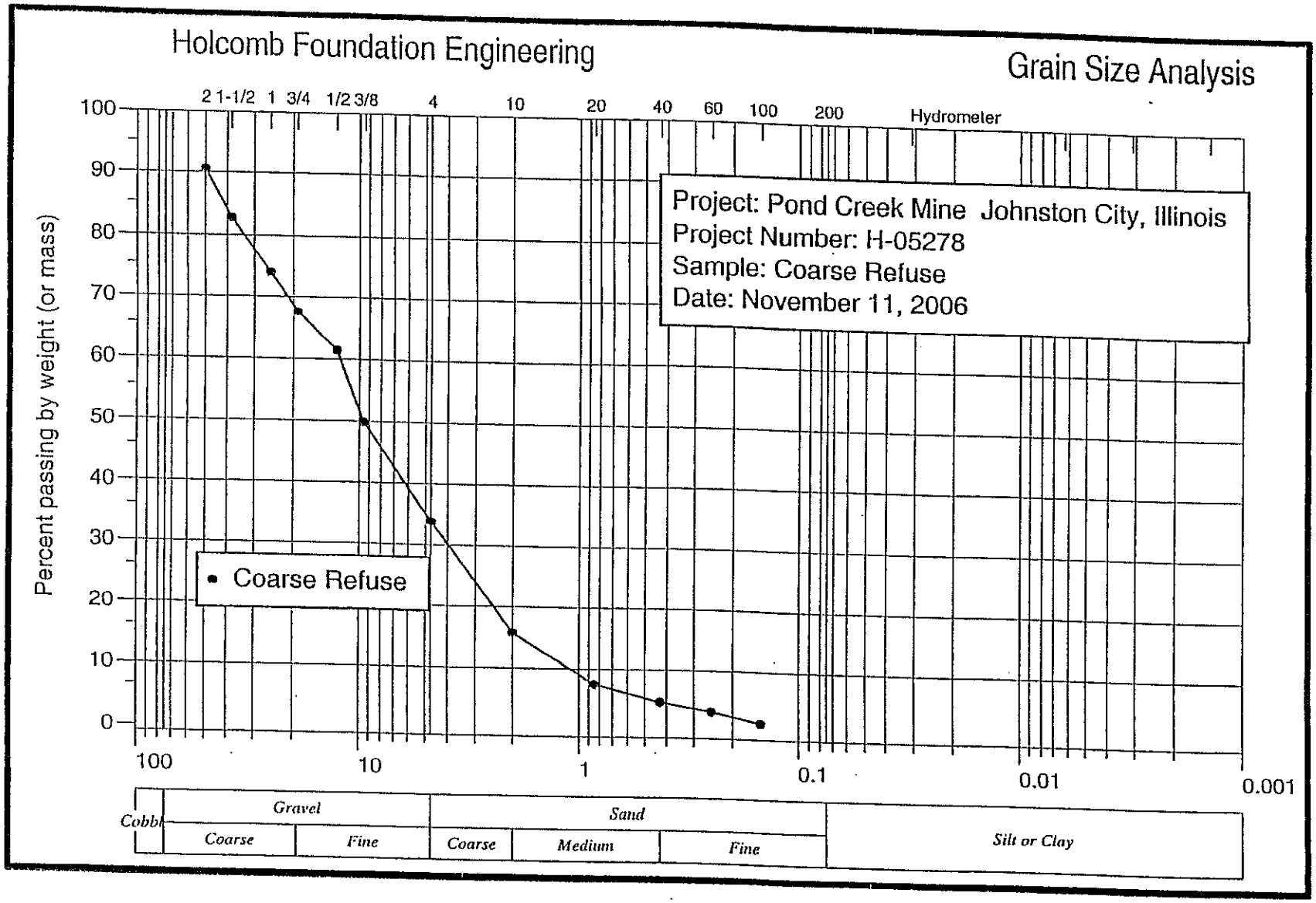
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting


Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
Project: Pond Creek Mine Johnston City, Illinois
Project Number: H-05278
Sample: Coarse Refuse
Date: November 11, 2006
Coarse Refuse
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

Holcomb Foundation Engineering Company

Laboratory Testing Results 11/30/2006

Project: Coarse Refuse Disposal Area
Pond Creek Mine Johnston City, Illinois
Project No: H-05317

Sieve Analysis - ASTM C136-96a

Sample: Coarse Refuse

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
3	76.2	3"	0.0	0.0	100.0
2.0000	50.8100	2"	619.6	9.5	90.5
1.5000	38.1000	1 -1/2"	1124.0	17.2	82.8
1.0000	25.4000	1"	1696.2	25.9	74.1
0.7500	19.1000	3/4"	2110.9	32.3	67.7
0.5000	12.7000	1/2"	2513.0	38.4	61.6
3.7500	9.5200	3/8"	3263.7	49.9	50.1
0.1870	4.7600	No. 4	4310.7	65.9	34.1
0.0790	2.0000	No. 10	5470.5	83.6	16.4
0.0469	1.1800	No. 16			
0.0331	0.8500	No. 20	6004.4	91.8	8.2
0.0165	0.4200	No. 40	6178.9	94.4	5.6
0.0117	0.2980	No. 50			
0.0083	0.2500	No. 60	6267.8	95.8	4.2
0.0059	0.1490	No. 100			
0.0029	0.0740	No. 200	6372.4	97.4	2.6

Total Weight in Grams **6542.80**

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

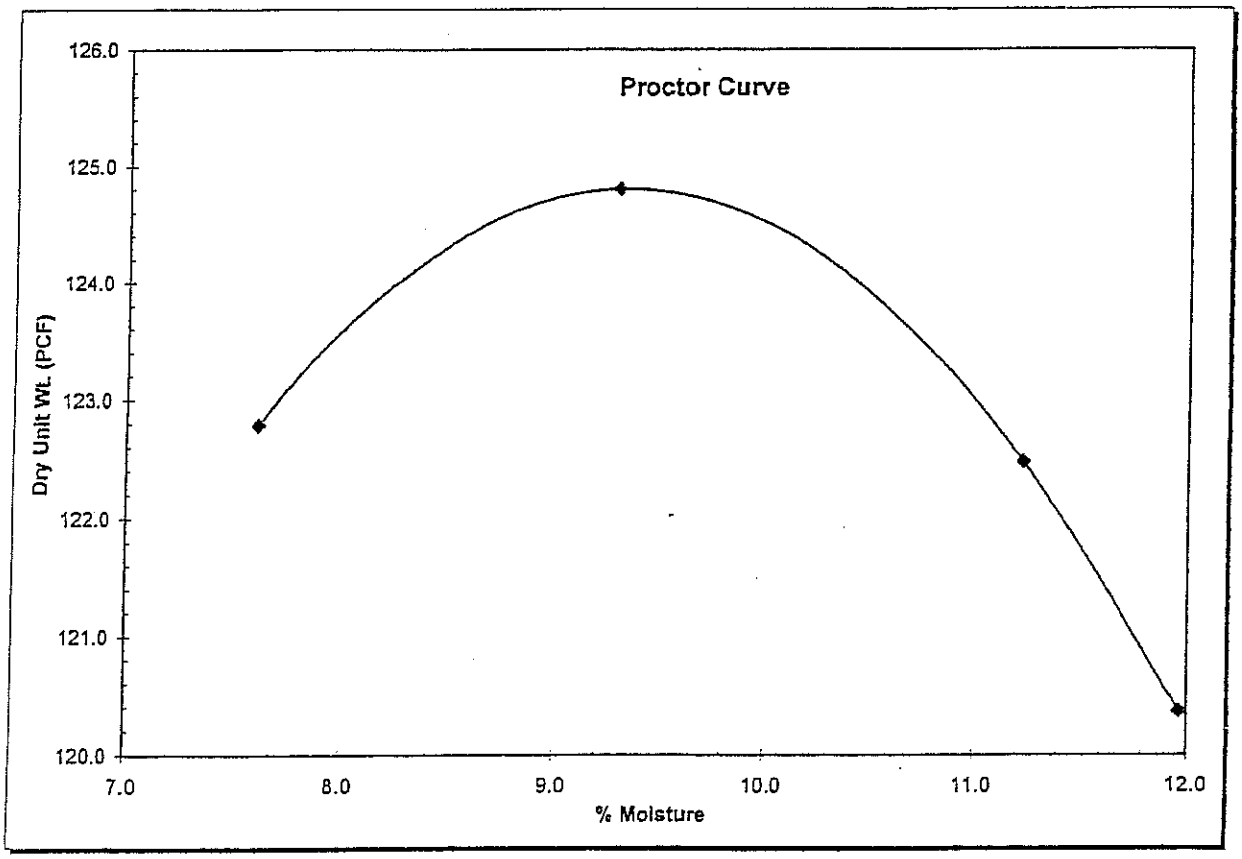
Date: 11/30/2006

Proctor Test Results

Soil Classification:	**Gray Coarse Refuse**
Maximum Dry Density (PCF)	**124.8**
Optimum Moisture Content (%)	**9.3**

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
7.6	122.8
11.2	122.5
12.0	120.4
9.3	124.8



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Permeability Tests Results

Laboratory Tests
Coarse Refuse
Pond Creek Mine - Johnston City, Illinois

Date: 11/30/2006

Client: Pond Creek Mine
Johnston City, Illinois

Project No.: H-05278

Sample	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse		7.7	11.8	119.3	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

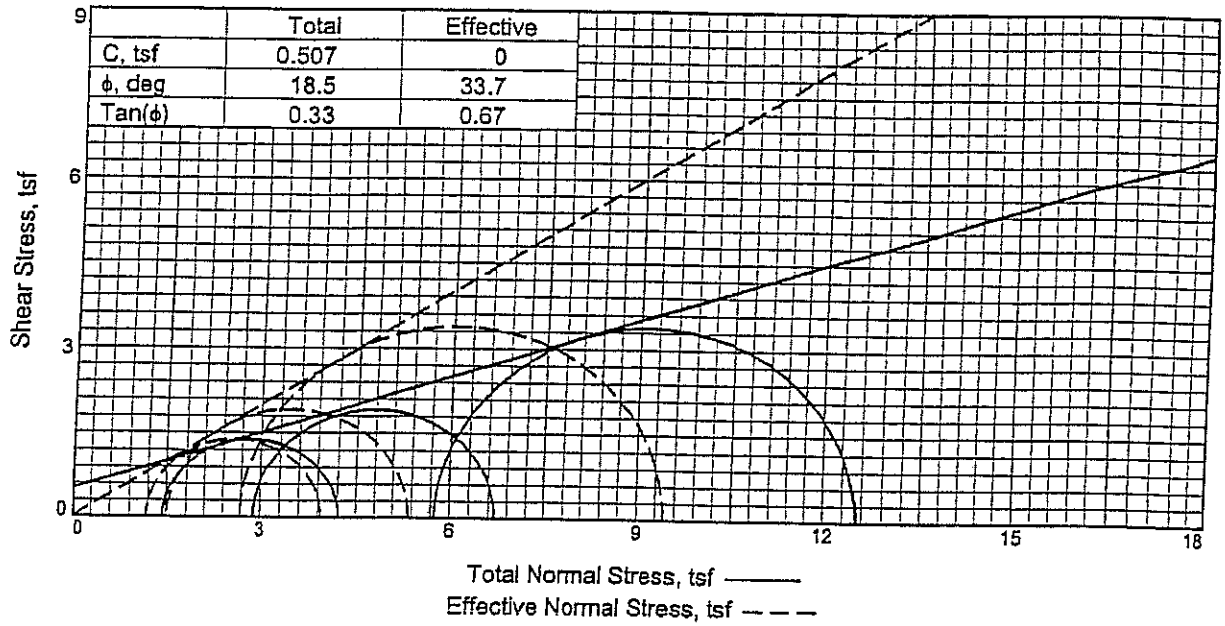
PERMEABILITY TEST RESULTS

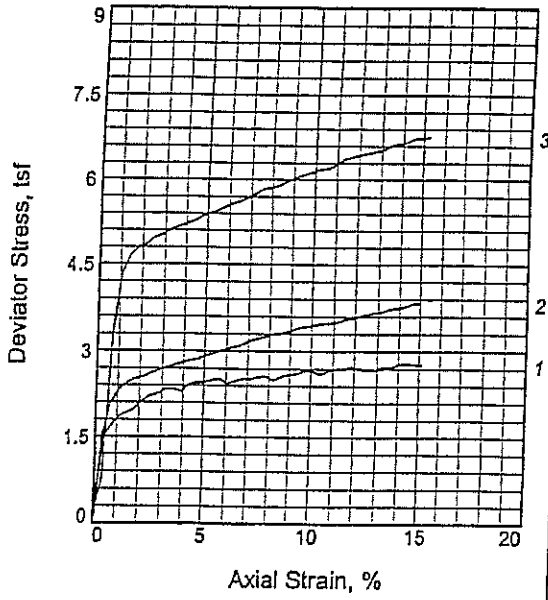
Project	Pond Creek Mine	Boring/Sample Depth	Coarse Refuse
Project #	H-05278	Classification	
Date	11/30/2006	Diameter	2.8 Inch
		Length	5.6 Inch

In Place Mc		After Test Mc		Unit Weight (PCF)	
Wet Wt.	195.3	Wet Wt.	1300.4	Sample Wt.	1161.8
Pan	94.2	Pan	103.1		
Dry Wt.	188.1	Dry Wt.	1173.6	Wet UW=	128.5
Mc (%)	7.7	Mc (%)	11.8	Dry UW=	119.3

Time(hrs)	Time(min)	Quantity (cc)	Head (psi)	Permeability (cm/sec)
7	26	24.7		
7	34	8.2	1	1.75E-04
7	33	24.5		
7	45	2.7	1	1.54E-04
7	47	0.8	1	1.44E-04
9	16	24.4		
9	23	9.6	1	1.79E-04
9	30	0.9	1	1.43E-04
		Average Permeability		1.63E-04

	Total	Effective
C, tsf	0.507	0
ϕ, deg	18.5	33.7
Tan(ϕ)	0.33	0.67





Sample No.		1	2	3
Initial	Water Content,	10.1	10.8	10.3
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	97.0	99.8	99.3
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
At Test	Water Content,	10.4	10.8	10.4
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
Strain rate, in./min.		0.01	0.01	0.01
Back Pressure, tsf		3.60	3.60	2.16
Cell Pressure, tsf		5.04	6.48	7.92
Fail. Stress, tsf		2.78	3.83	6.76
Total Pore Pr., tsf		3.86	4.96	5.23
Ult. Stress, tsf		2.77	3.83	6.76
Total Pore Pr., tsf		3.85	4.95	5.23
$\bar{\sigma}_1$ Failure, tsf		3.96	5.35	9.44
$\bar{\sigma}_3$ Failure, tsf		1.18	1.52	2.69

Type of Test:
CU with Pore Pressures
Sample Type: Remolded
Description: Coarse Coal Refuse

Assumed Specific Gravity= 2.37
Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

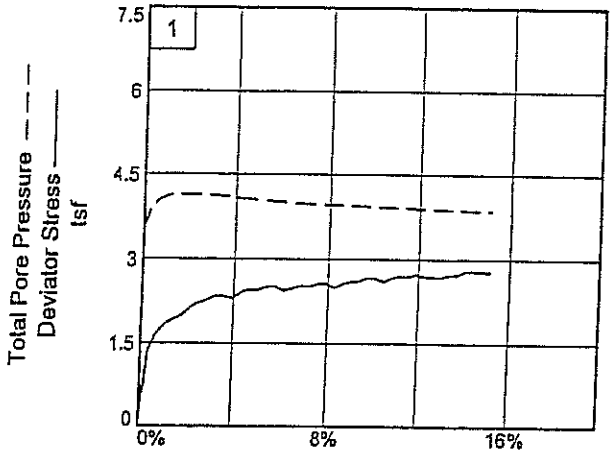
Location: Coarse Refuse Stockpile
Sample Number: Coarse Refuse
Proj. No.: H-05278 **Date:** 11/17/06

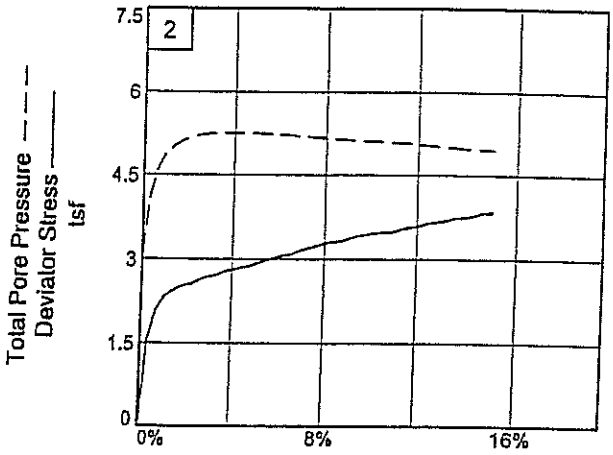
TRIAXIAL SHEAR TEST REPORT

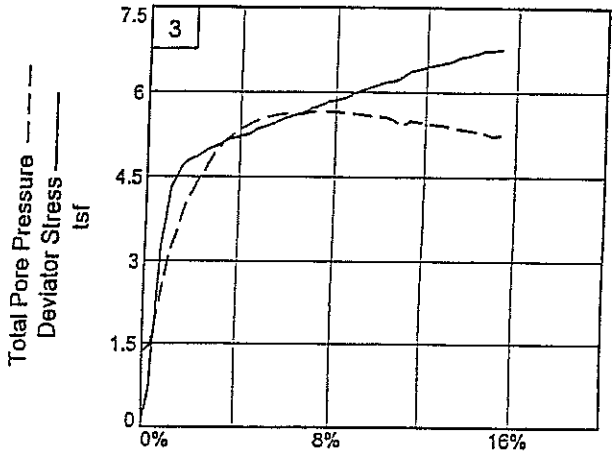
HOLCOMB FOUNDATION ENGINEERING CO.

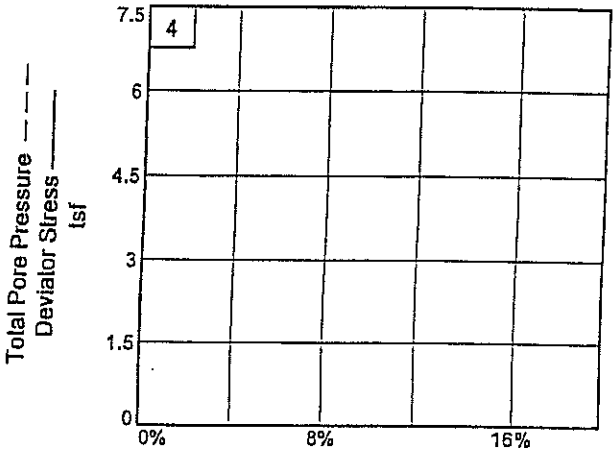
Plate _____

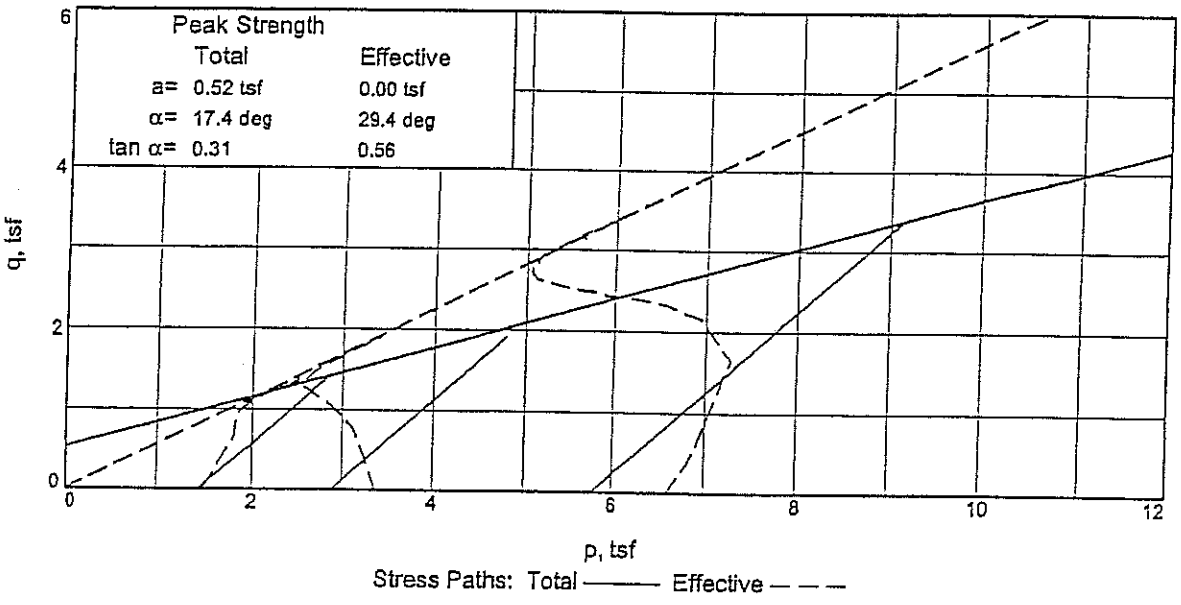
Tested By: LC Checked By: TH











Stress Paths: Total ——— Effective — — —

Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Coarse Refuse Stockpile
Project No.: H-05278
Sample Number: Coarse Refuse
Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

11/30/2006
10:19 AM

Date:	11/17/06
Client:	Pond Creek Mine
Project:	Coarse Refuse Laboratory Tests
Location:	Coarse Refuse Stockpile
Sample Number:	Coarse Refuse
Description:	Coarse Coal Refuse
Remarks:	
Type of Sample:	Remolded
Assumed Specific Gravity=2.37	**LL=** **PL=** **PI=**
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	226.800			1320.700
Moisture content: Dry soil+tare, gms.	218.600			1195.800
Moisture content: Tare, gms.	137.500			107.600
Moisture, %	10.1	10.4	10.4	11.5
Moist specimen weight, gms.	1193.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.65	5.65	5.65	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.6	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2470	0.2470	0.2470	
Saturation, %	97.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 2.778 tsf at reading no. 41
Ult. Stress = 2.767 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0010	46.60	0.0	0.0	0.000	1.498	1.498	1.00	49.20	1.498	0.000
1	0.0180	160.60	114.0	0.3	1.329	1.152	2.481	2.15	54.00	1.816	0.664
2	0.0390	189.70	143.1	0.7	1.662	1.001	2.663	2.66	56.10	1.832	0.831
3	0.0590	205.60	159.0	1.0	1.840	0.929	2.769	2.98	57.10	1.849	0.920
4	0.0800	212.20	165.6	1.4	1.909	0.907	2.816	3.10	57.40	1.862	0.955
5	0.1000	218.90	172.3	1.8	1.979	0.900	2.879	3.20	57.50	1.890	0.990
6	0.1200	232.20	185.6	2.1	2.125	0.900	3.025	3.36	57.50	1.962	1.062
7	0.1410	240.50	193.9	2.5	2.211	0.907	3.118	3.44	57.40	2.013	1.106
8	0.1610	245.50	198.9	2.8	2.260	0.914	3.174	3.47	57.30	2.044	1.130
9	0.1820	252.20	205.6	3.2	2.327	0.922	3.249	3.53	57.20	2.085	1.164
10	0.2020	253.80	207.2	3.6	2.337	0.936	3.273	3.50	57.00	2.104	1.168
11	0.2230	250.50	203.9	3.9	2.291	0.958	3.248	3.39	56.70	2.103	1.145
12	0.2430	261.30	214.7	4.3	2.403	0.972	3.375	3.47	56.50	2.173	1.201
13	0.2630	266.30	219.7	4.6	2.450	0.979	3.429	3.50	56.40	2.204	1.225
14	0.2840	266.30	219.7	5.0	2.440	0.994	3.434	3.46	56.20	2.214	1.220
15	0.3040	272.10	225.5	5.4	2.495	1.008	3.503	3.48	56.00	2.256	1.248
16	0.3250	274.60	228.0	5.7	2.513	1.022	3.536	3.46	55.80	2.279	1.257
17	0.3450	268.00	221.4	6.1	2.431	1.037	3.468	3.34	55.60	2.252	1.216
18	0.3660	273.00	226.4	6.5	2.476	1.051	3.527	3.36	55.40	2.289	1.238
19	0.3860	278.00	231.4	6.8	2.521	1.058	3.580	3.38	55.30	2.319	1.261
20	0.4070	278.00	231.4	7.2	2.511	1.066	3.577	3.36	55.20	2.321	1.256
21	0.4270	283.00	236.4	7.5	2.556	1.073	3.629	3.38	55.10	2.351	1.278
22	0.4470	284.60	238.0	7.9	2.563	1.080	3.643	3.37	55.00	2.362	1.282
23	0.4680	278.80	232.2	8.3	2.491	1.087	3.578	3.29	54.90	2.333	1.245
24	0.4880	286.30	239.7	8.6	2.561	1.087	3.648	3.36	54.90	2.368	1.281
25	0.5090	290.40	243.8	9.0	2.594	1.094	3.689	3.37	54.80	2.392	1.297
26	0.5290	292.10	245.5	9.3	2.602	1.102	3.704	3.36	54.70	2.403	1.301
27	0.5500	298.80	252.2	9.7	2.662	1.109	3.771	3.40	54.60	2.440	1.331
28	0.5700	299.60	253.0	10.1	2.660	1.116	3.776	3.38	54.50	2.446	1.330
29	0.5910	294.60	248.0	10.4	2.597	1.116	3.713	3.33	54.50	2.415	1.299
30	0.6110	302.10	255.5	10.8	2.665	1.123	3.788	3.37	54.40	2.456	1.333
31	0.6310	306.30	259.7	11.2	2.698	1.130	3.828	3.39	54.30	2.479	1.349
32	0.6520	306.30	259.7	11.5	2.687	1.130	3.817	3.38	54.30	2.474	1.343
33	0.6720	312.10	265.5	11.9	2.736	1.145	3.881	3.39	54.10	2.513	1.368
34	0.6930	309.60	263.0	12.2	2.699	1.145	3.843	3.36	54.10	2.494	1.349
35	0.7130	308.80	262.2	12.6	2.680	1.152	3.832	3.33	54.00	2.492	1.340
36	0.7340	309.60	263.0	13.0	2.676	1.159	3.835	3.31	53.90	2.497	1.338
37	0.7540	315.40	268.8	13.3	2.724	1.166	3.891	3.34	53.80	2.528	1.362
38	0.7750	316.20	269.6	13.7	2.721	1.166	3.887	3.33	53.80	2.527	1.360
39	0.7950	323.70	277.1	14.1	2.785	1.181	3.966	3.36	53.60	2.573	1.392
40	0.8150	325.40	278.8	14.4	2.790	1.181	3.971	3.36	53.60	2.576	1.395
41	0.8360	325.40	278.8	14.8	2.778	1.181	3.959	3.35	53.60	2.570	1.389
42	0.8560	325.40	278.8	15.1	2.767	1.188	3.955	3.33	53.50	2.571	1.383

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	211.600			1335.900
Moisture content: Dry soil+tare, gms.	203.200			1222.200
Moisture content: Tare, gms.	125.200			134.800
Moisture, %	10.8	10.8	10.8	10.5
Moist specimen weight, gms.	1175.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.57	5.57	5.57	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.5	130.5	130.5	
Dry density, pcf	117.8	117.8	117.8	
Void ratio	0.2558	0.2558	0.2558	
Saturation, %	99.8	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 3.829 tsf at reading no. 40
Ult. Stress = 3.828 tsf at reading no. 41

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	51.60	0.0	0.0	0.000	3.377	3.377	1.00	43.10	3.377	0.000
1	0.0190	185.60	134.0	0.3	1.562	2.340	3.902	1.67	57.50	3.121	0.781
2	0.0400	233.00	181.4	0.7	2.106	1.814	3.920	2.16	64.80	2.867	1.053
3	0.0600	253.00	201.4	1.1	2.330	1.562	3.892	2.49	68.30	2.727	1.165
4	0.0810	263.80	212.2	1.5	2.445	1.433	3.878	2.71	70.10	2.655	1.223
5	0.1010	270.50	218.9	1.8	2.513	1.346	3.860	2.87	71.30	2.603	1.257
6	0.1220	274.60	223.0	2.2	2.550	1.289	3.839	2.98	72.10	2.564	1.275
7	0.1420	281.30	229.7	2.5	2.617	1.260	3.877	3.08	72.50	2.569	1.309
8	0.1620	287.10	235.5	2.9	2.674	1.238	3.912	3.16	72.80	2.575	1.337
9	0.1830	291.30	239.7	3.3	2.711	1.231	3.942	3.20	72.90	2.587	1.355
10	0.2030	297.10	245.5	3.6	2.766	1.224	3.990	3.26	73.00	2.607	1.383
11	0.2240	301.30	249.7	4.0	2.802	1.224	4.026	3.29	73.00	2.625	1.401
12	0.2440	305.40	253.8	4.4	2.838	1.224	4.062	3.32	73.00	2.643	1.419
13	0.2650	309.60	258.0	4.8	2.873	1.224	4.097	3.35	73.00	2.661	1.437
14	0.2850	315.40	263.8	5.1	2.927	1.231	4.158	3.38	72.90	2.695	1.463
15	0.3060	320.40	268.8	5.5	2.970	1.238	4.209	3.40	72.80	2.724	1.485
16	0.3260	326.20	274.6	5.9	3.023	1.246	4.269	3.43	72.70	2.757	1.512
17	0.3460	330.40	278.8	6.2	3.058	1.253	4.310	3.44	72.60	2.782	1.529
18	0.3670	334.60	283.0	6.6	3.091	1.267	4.358	3.44	72.40	2.813	1.546
19	0.3870	341.20	289.6	6.9	3.151	1.282	4.433	3.46	72.20	2.857	1.576
20	0.4080	346.20	294.6	7.3	3.192	1.296	4.488	3.46	72.00	2.892	1.596
21	0.4280	351.20	299.6	7.7	3.234	1.310	4.544	3.47	71.80	2.927	1.617

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	357.00	305.4	8.1	3.283	1.318	4.601	3.49	71.70	2.959	1.642
23	0.4690	359.50	307.9	8.4	3.297	1.332	4.629	3.48	71.50	2.981	1.649
24	0.4890	362.80	311.2	8.8	3.319	1.339	4.659	3.48	71.40	2.999	1.660
25	0.5100	368.70	317.1	9.2	3.368	1.346	4.715	3.50	71.30	3.031	1.684
26	0.5300	374.50	322.9	9.5	3.416	1.361	4.777	3.51	71.10	3.069	1.708
27	0.5510	377.00	325.4	9.9	3.429	1.368	4.797	3.51	71.00	3.082	1.714
28	0.5710	381.20	329.6	10.2	3.459	1.368	4.827	3.53	71.00	3.098	1.730
29	0.5920	384.50	332.9	10.6	3.479	1.382	4.861	3.52	70.80	3.122	1.739
30	0.6120	386.20	334.6	11.0	3.483	1.390	4.872	3.51	70.70	3.131	1.741
31	0.6330	392.00	340.4	11.4	3.528	1.397	4.925	3.53	70.60	3.161	1.764
32	0.6530	397.00	345.4	11.7	3.565	1.411	4.977	3.53	70.40	3.194	1.783
33	0.6730	400.30	348.7	12.1	3.585	1.426	5.010	3.51	70.20	3.218	1.792
34	0.6940	406.10	354.5	12.5	3.629	1.440	5.069	3.52	70.00	3.254	1.814
35	0.7140	410.30	358.7	12.8	3.657	1.454	5.111	3.51	69.80	3.283	1.828
36	0.7350	413.60	362.0	13.2	3.674	1.469	5.143	3.50	69.60	3.306	1.837
37	0.7550	420.30	368.7	13.6	3.727	1.483	5.210	3.51	69.40	3.347	1.863
38	0.7760	423.60	372.0	13.9	3.744	1.498	5.242	3.50	69.20	3.370	1.872
39	0.7960	427.80	376.2	14.3	3.770	1.505	5.275	3.51	69.10	3.390	1.885
40	0.8170	435.30	383.7	14.7	3.829	1.519	5.348	3.52	68.90	3.434	1.914
41	0.8370	436.90	385.3	15.0	3.828	1.526	5.355	3.51	68.80	3.441	1.914

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	184.300			1333.800
Moisture content: Dry soil+tare, gms.	177.100			1230.400
Moisture content: Tare, gms.	107.500			135.300
Moisture, %	10.3	10.4	10.4	9.4
Moist specimen weight, gms.	1185.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.60	5.60	5.60	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.9	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2468	0.2468	0.2468	
Saturation, %	99.3	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 6.758 tsf at reading no. 42
Ult. Stress = 6.758 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	25.00	0.0	0.0	0.000	6.588	6.588	1.00	18.50	6.588	0.000
1	0.0190	88.20	63.2	0.3	0.736	6.458	7.195	1.11	20.30	6.827	0.368
2	0.0400	309.60	284.6	0.7	3.304	5.623	8.927	1.59	31.90	7.275	1.652
3	0.0600	397.00	372.0	1.1	4.303	4.795	9.098	1.90	43.40	6.947	2.152
4	0.0810	428.60	403.6	1.4	4.651	4.234	8.885	2.10	51.20	6.559	2.326
5	0.1010	441.90	416.9	1.8	4.787	3.830	8.617	2.25	56.80	6.224	2.393
6	0.1220	449.40	424.4	2.2	4.854	3.521	8.375	2.38	61.10	5.948	2.427
7	0.1420	460.20	435.2	2.5	4.960	3.283	8.243	2.51	64.40	5.763	2.480
8	0.1620	467.70	442.7	2.9	5.027	3.017	8.044	2.67	68.10	5.530	2.513
9	0.1830	476.00	451.0	3.3	5.101	2.837	7.938	2.80	70.60	5.387	2.551
10	0.2030	483.50	458.5	3.6	5.167	2.693	7.860	2.92	72.60	5.276	2.583
11	0.2240	489.30	464.3	4.0	5.212	2.585	7.797	3.02	74.10	5.191	2.606
12	0.2440	495.20	470.2	4.4	5.258	2.491	7.750	3.11	75.40	5.120	2.629
13	0.2650	505.20	480.2	4.7	5.349	2.419	7.768	3.21	76.40	5.094	2.675
14	0.2850	511.00	486.0	5.1	5.394	2.369	7.762	3.28	77.10	5.066	2.697
15	0.3060	518.50	493.5	5.5	5.455	2.333	7.788	3.34	77.60	5.060	2.728
16	0.3260	526.80	501.8	5.8	5.526	2.304	7.830	3.40	78.00	5.067	2.763
17	0.3460	533.50	508.5	6.2	5.579	2.297	7.875	3.43	78.10	5.086	2.789
18	0.3670	539.30	514.3	6.6	5.620	2.326	7.945	3.42	77.70	5.135	2.810
19	0.3870	548.40	523.4	6.9	5.697	2.275	7.972	3.50	78.40	5.124	2.849
20	0.4080	555.90	530.9	7.3	5.756	2.261	8.016	3.55	78.60	5.139	2.878
21	0.4280	565.90	540.9	7.6	5.841	2.261	8.102	3.58	78.60	5.181	2.921

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	569.20	544.2	8.0	5.853	2.268	8.121	3.58	78.50	5.195	2.927
23	0.4690	575.10	550.1	8.4	5.894	2.282	8.176	3.58	78.30	5.229	2.947
24	0.4890	584.20	559.2	8.7	5.968	2.297	8.265	3.60	78.10	5.281	2.984
25	0.5100	592.50	567.5	9.1	6.031	2.311	8.343	3.61	77.90	5.327	3.016
26	0.5300	599.20	574.2	9.5	6.079	2.333	8.411	3.61	77.60	5.372	3.039
27	0.5510	605.90	580.9	9.8	6.124	2.354	8.479	3.60	77.30	5.416	3.062
28	0.5710	613.30	588.3	10.2	6.178	2.362	8.539	3.62	77.20	5.450	3.089
29	0.5920	617.50	592.5	10.6	6.196	2.405	8.601	3.58	76.60	5.503	3.098
30	0.6120	626.70	601.7	10.9	6.267	2.527	8.794	3.48	74.90	5.661	3.133
31	0.6330	638.30	613.3	11.3	6.361	2.426	8.787	3.62	76.30	5.607	3.180
32	0.6530	644.10	619.1	11.7	6.395	2.448	8.843	3.61	76.00	5.646	3.198
33	0.6730	650.80	625.8	12.0	6.438	2.477	8.915	3.60	75.60	5.696	3.219
34	0.6940	656.60	631.6	12.4	6.470	2.498	8.968	3.59	75.30	5.733	3.235
35	0.7140	662.50	637.5	12.8	6.504	2.506	9.009	3.60	75.20	5.758	3.252
36	0.7350	669.10	644.1	13.1	6.543	2.542	9.085	3.57	74.70	5.813	3.271
37	0.7550	678.30	653.3	13.5	6.609	2.563	9.172	3.58	74.40	5.868	3.305
38	0.7760	684.10	659.1	13.9	6.639	2.585	9.224	3.57	74.10	5.904	3.319
39	0.7960	690.70	665.7	14.2	6.678	2.614	9.291	3.55	73.70	5.952	3.339
40	0.8170	699.10	674.1	14.6	6.732	2.635	9.367	3.55	73.40	6.001	3.366
41	0.8370	701.60	676.6	14.9	6.729	2.700	9.429	3.49	72.50	6.065	3.365
42	0.8570	707.40	682.4	15.3	6.758	2.686	9.444	3.52	72.70	6.065	3.379

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

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Carbondale, IL 62901

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P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

April 9, 2007

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Mach Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on March 29, 2007, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification:	Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)
Proctor Test Results:	
Maximum Dry Unit Weight:	120.3 PCF
Optimum Moisture Content:	10.7 %
Specific Gravity:	2.50
Triaxial Test Results:	
Effective Cohesion:	152 PSF
Effective Phi Angle:	29.3 Degrees
Permeability (2 tests):	3 x 10-4 cm./sec.
	2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

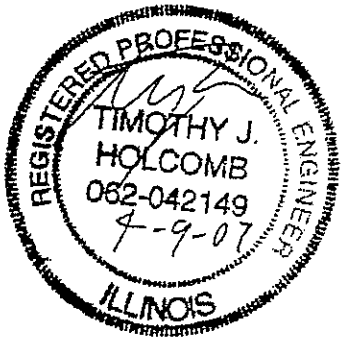
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting



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Permeability Tests Results

Mach Mine
Johnston City, Illinois

Date: 4/9/2007 Client: Williamson Energy

Project No.: H-05278

Boring No.	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse Sample #1		10.9	14.6	115.7	3 x 10-4
Coarse Refuse Sample #2		10.1	14.3	114.7	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

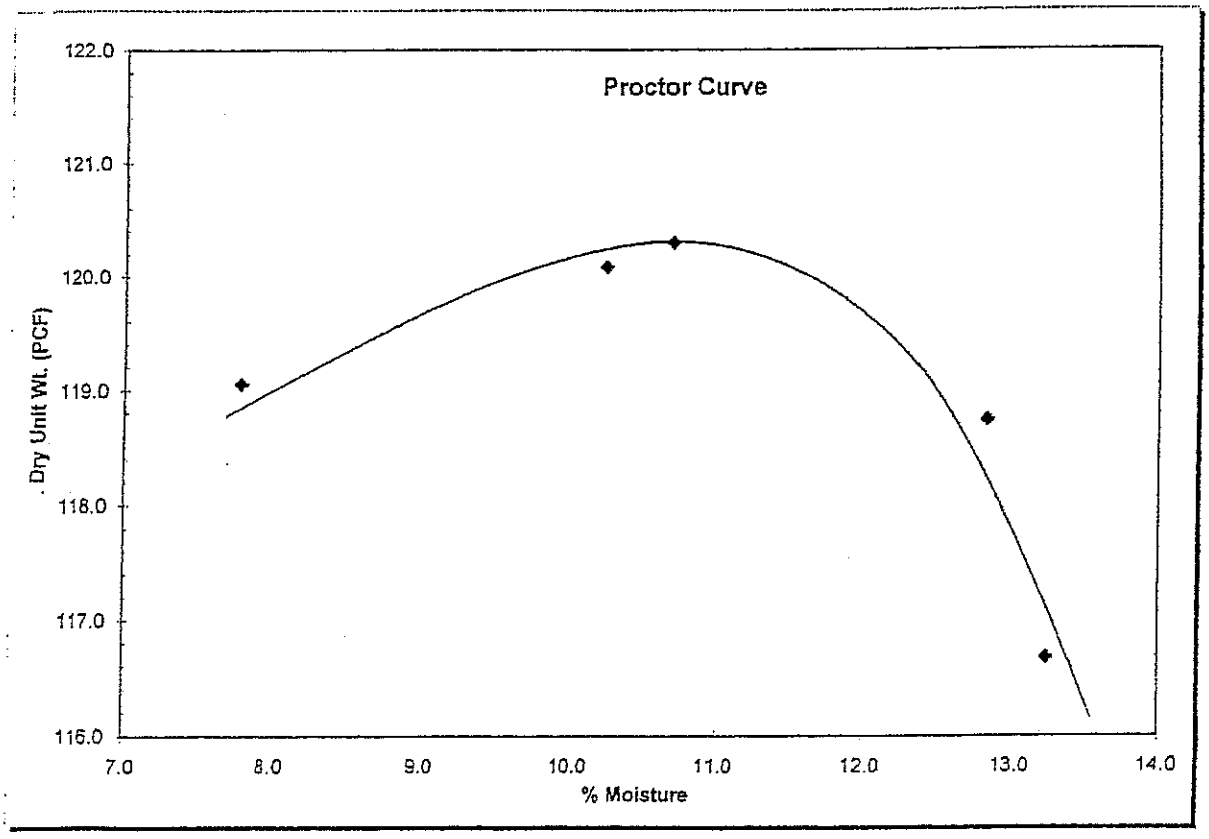
Date: 4/9/2007

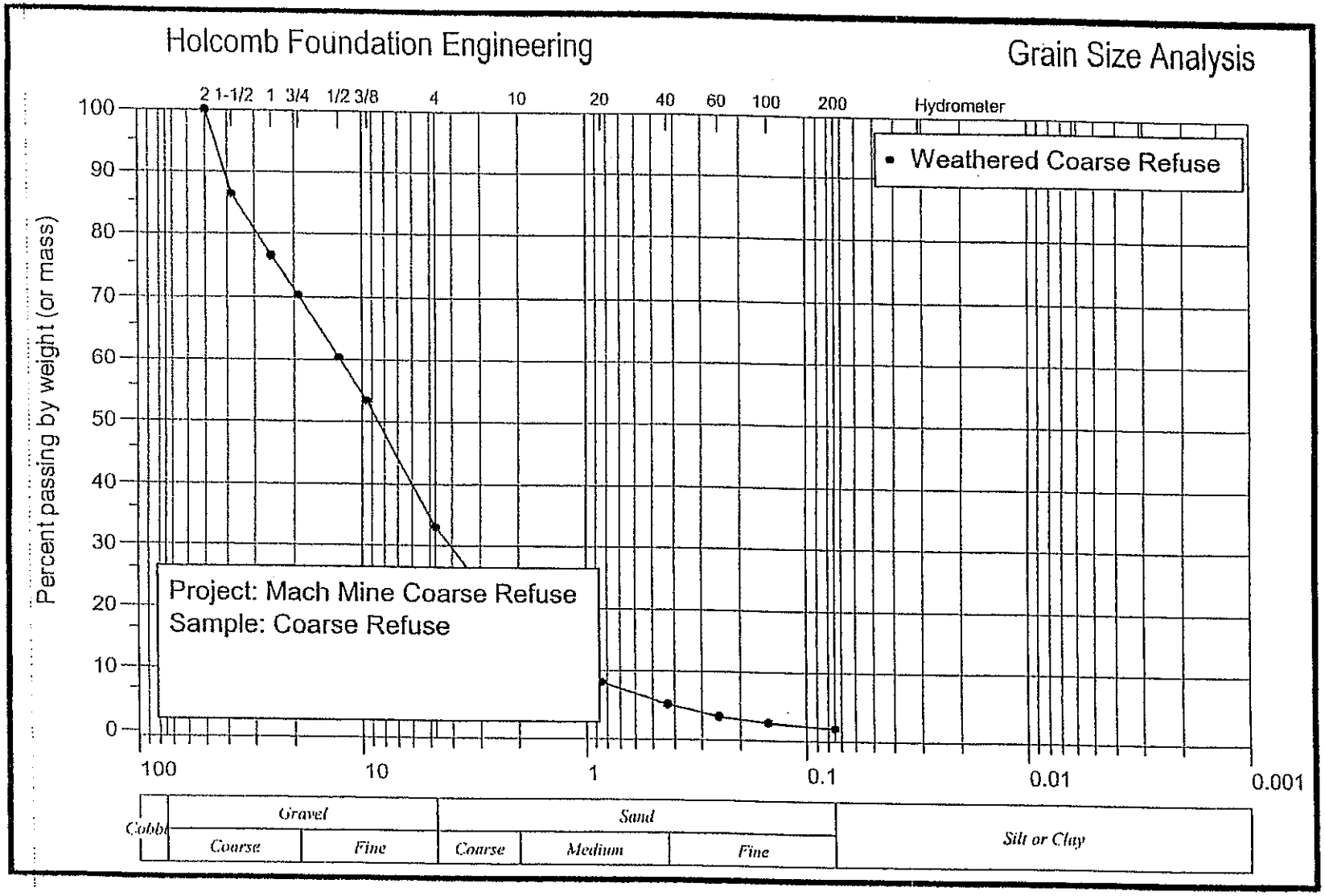
Proctor Test Results

Soil Classification:	**Weathered Coarse Refuse**
Maximum Dry Density (PCF)	**120.3**
Optimum Moisture Content (%)	**10.7**

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
12.8	118.7
13.2	116.7
10.2	120.1
7.8	119.1
10.7	120.3




Holcomb Foundation Engineering
Grain Size Analysis
Percent passing by weight (or mass)
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
100 90 80 70 60 50 40 30 20 10 0
• Weathered Coarse Refuse
Project: Mach Mine Coarse Refuse
Sample: Coarse Refuse
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

R14491

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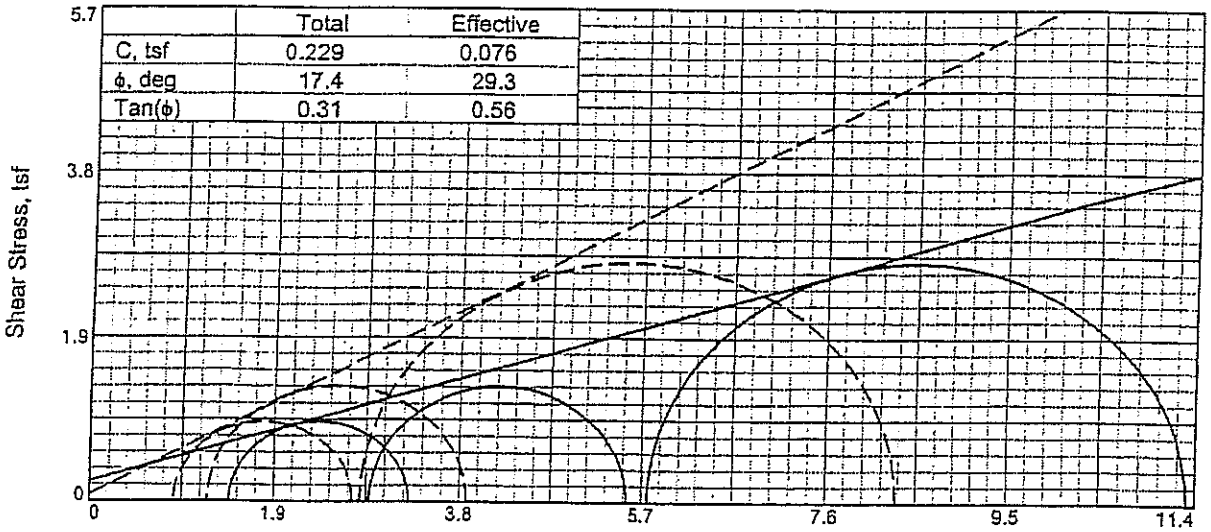
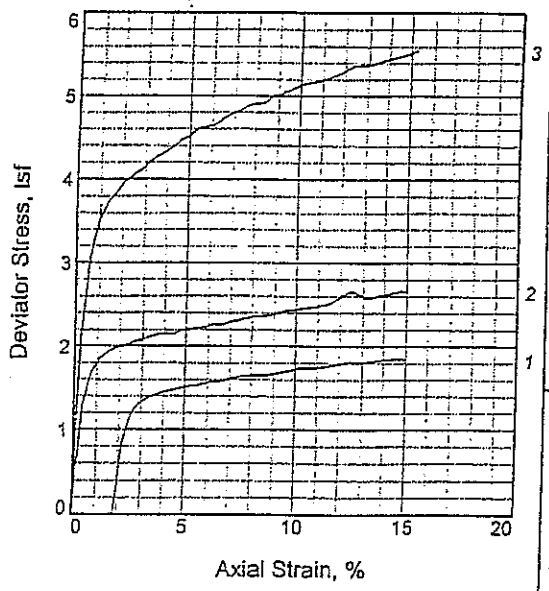
Grain Size Analysis

Project:	Mach Mine	Client:	Mach Mine
Project No.:	H-05278	Date:	4/9/2007
Sample No.	Coarse Refuse	Total Weight:	2290.30

Sieve	Wt. Retained	% Ret.	% Passing
2"	0.0	0.0	100.0
1.5"	314.4	13.7	86.3
1"	536.7	23.4	76.6
3/4"	674.8	29.5	70.5
1/2"	901.6	39.4	60.6
3/8"	1061.2	46.3	53.7
#4	1522.1	66.5	33.5
#10	1911.6	83.5	16.5
#20	2091.9	91.3	8.7
#40	2166.2	94.6	5.4
#60	2202.2	96.2	3.8
#100	2223.7	97.1	2.9
#200	2245.2	98.0	2.0

	Total	Effective
C, tsf	0.229	0.076
ϕ, deg	17.4	29.3
Tan(ϕ)	0.31	0.56





Sample No.		1	2	3
Initial	Water Content,	14.4	12.7	13.1
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	95.1	89.0	90.4
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
At Test	Water Content,	15.2	14.2	14.5
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.60	3.60	1.80
Cell Pressure, tsf		5.04	6.48	7.56
Fail. Stress, tsf		1.85	2.67	5.55
Total Pore Pr., tsf		4.18	5.27	4.77
Ult. Stress, tsf		1.85	2.66	5.55
Total Pore Pr., tsf		4.18	5.22	4.77
$\bar{\sigma}_1$ Failure, tsf		2.71	3.88	8.34
$\bar{\sigma}_3$ Failure, tsf		0.86	1.21	2.79

Type of Test: CU with Pore Pressures

Sample Type: Coarse Refuse

Description:

Assumed Specific Gravity= 2.50

Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

Location: Weathered Coarse Refuse

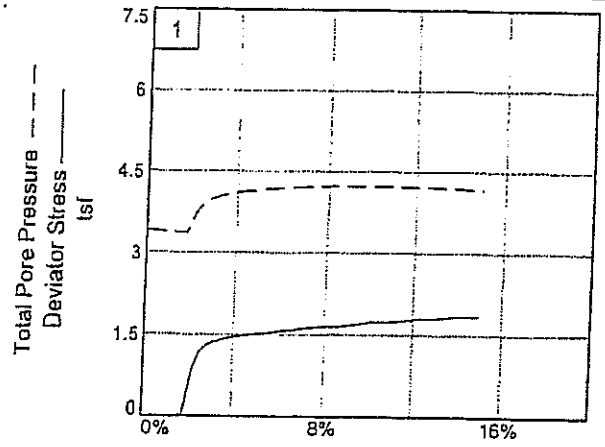
Proj. No.: H-05278 **Date:** 4/2/07

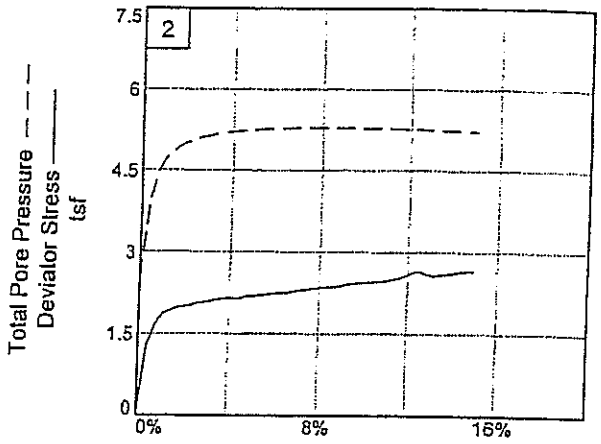
TRIAXIAL SHEAR TEST REPORT

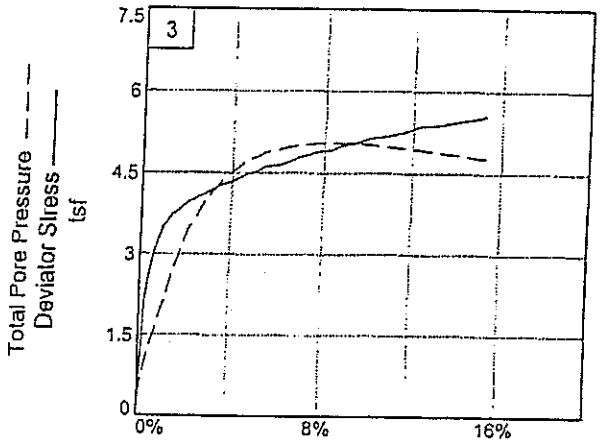
HOLCOMB FOUNDATION ENGINEERING CO.

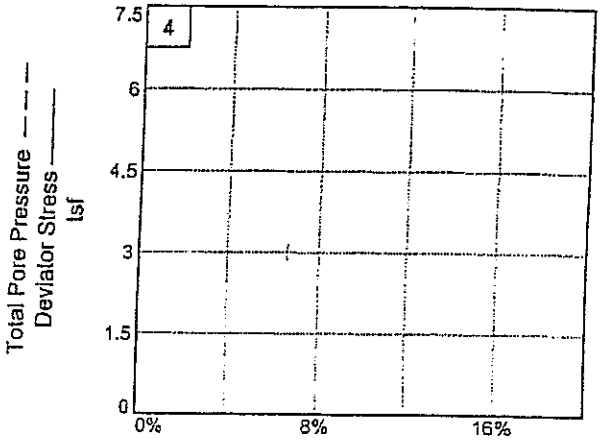
Plate _____

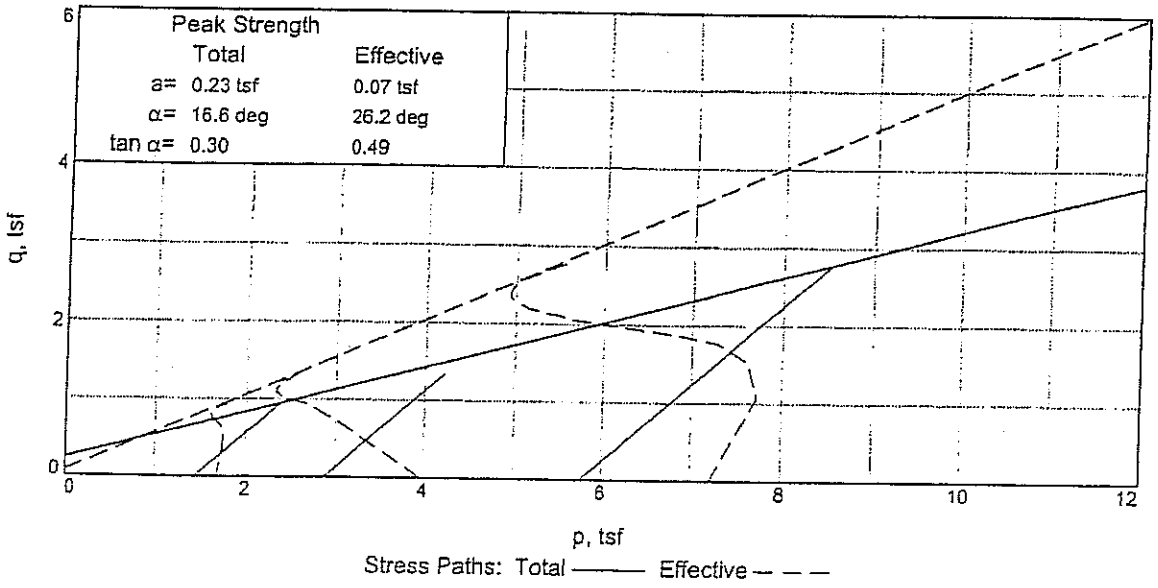
Tested By: LC Checked By: TH











Stress Paths: Total ——— Effective - - -

Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Weathered Coarse Refuse
Project No.: H-05278 **Plate** _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

4/9/2007
11:10 AM

Date: 4/2/07
Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Weathered Coarse Refuse
Description:
Remarks:
Type of Sample: Coarse Refuse
Assumed Specific Gravity=2.50 LL= PL= PI=
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	179.300			1255.500
Moisture content: Dry soil+tare, gms.	165.700			1117.500
Moisture content: Tare, gms.	71.400			79.600
Moisture, %	14.4	15.2	15.2	13.3
Moist specimen weight, gms.	1170.0			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.59	5.59	5.59	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.5	130.3	130.3	
Dry density, pcf	113.2	113.2	113.2	
Void ratio	0.3793	0.3793	0.3793	
Saturation, %	95.1	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.845 tsf at reading no. 31
Ult. Stress = 1.845 tsf at reading no. 31

Triaxial Test Results for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	19.10	0.0	0.0	0.000	1.627	1.627	1.00	47.40	1.627	0.000
1	0.0190	20.00	0.9	0.3	0.001	1.642	1.642	1.00	47.20	1.642	0.000
2	0.0400	20.00	0.9	0.7	0.000	1.656	1.656	1.00	47.00	1.656	0.000
3	0.0600	20.00	0.9	1.1	0.000	1.663	1.663	1.00	46.90	1.663	0.000
4	0.0810	20.00	0.9	1.4	0.000	1.678	1.678	1.00	46.70	1.678	0.000
5	0.1010	25.00	5.9	1.8	0.017	1.678	1.694	1.01	46.70	1.686	0.008
6	0.1220	99.00	79.9	2.2	0.857	1.318	2.175	1.65	51.70	1.746	0.429
7	0.1420	124.00	104.9	2.5	1.195	1.152	2.347	2.04	54.00	1.750	0.598
8	0.1620	134.80	115.7	2.9	1.314	1.058	2.372	2.24	55.30	1.715	0.657
9	0.1830	140.60	121.5	3.3	1.374	1.001	2.375	2.37	56.10	1.688	0.687
10	0.2030	144.80	125.7	3.6	1.416	0.965	2.381	2.47	56.60	1.673	0.708
11	0.2240	148.10	129.0	4.0	1.448	0.936	2.384	2.55	57.00	1.660	0.724
12	0.2440	150.60	131.5	4.4	1.471	0.914	2.385	2.61	57.30	1.650	0.735
13	0.2650	153.10	134.0	4.7	1.493	0.900	2.393	2.66	57.50	1.646	0.746
14	0.2850	155.60	136.5	5.1	1.515	0.878	2.393	2.72	57.80	1.636	0.757
15	0.3060	157.30	138.2	5.5	1.528	0.864	2.392	2.77	58.00	1.628	0.764
16	0.3260	159.80	140.7	5.8	1.549	0.857	2.406	2.81	58.10	1.631	0.775
17	0.3460	162.30	143.2	6.2	1.571	0.850	2.420	2.85	58.20	1.635	0.785
18	0.3670	163.10	144.0	6.6	1.573	0.835	2.408	2.88	58.40	1.622	0.787
19	0.3870	166.40	147.3	6.9	1.603	0.828	2.431	2.94	58.50	1.630	0.802
20	0.4080	168.90	149.8	7.3	1.624	0.821	2.445	2.98	58.60	1.633	0.812
21	0.4490	172.30	153.2	8.0	1.648	0.814	2.461	3.02	58.70	1.637	0.824
22	0.4890	173.90	154.8	8.7	1.652	0.806	2.458	3.05	58.80	1.632	0.826
23	0.5300	178.90	159.8	9.5	1.691	0.806	2.498	3.10	58.80	1.652	0.846
24	0.5710	184.80	165.7	10.2	1.740	0.814	2.553	3.14	58.70	1.683	0.870
25	0.6120	186.40	167.3	10.9	1.742	0.806	2.549	3.16	58.80	1.677	0.871
26	0.6530	190.60	171.5	11.7	1.771	0.821	2.592	3.16	58.60	1.706	0.886
27	0.6940	195.60	176.5	12.4	1.808	0.821	2.628	3.20	58.60	1.725	0.904
28	0.7350	197.20	178.1	13.1	1.809	0.835	2.644	3.17	58.40	1.740	0.904
29	0.7760	201.40	182.3	13.9	1.836	0.842	2.678	3.18	58.30	1.760	0.918
30	0.8170	204.70	185.6	14.6	1.853	0.857	2.710	3.16	58.10	1.783	0.927
31	0.8370	204.70	185.6	15.0	1.845	0.864	2.709	3.14	58.00	1.787	0.923

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	169.900			1238.700
Moisture content: Dry soil+tare, gms.	158.800			1117.200
Moisture content: Tare, gms.	71.200			73.100
Moisture, %	12.7	14.2	14.2	11.6
Moist specimen weight, gms.	1169.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.7	131.5	131.5	
Dry density, pcf	115.1	115.1	115.1	
Void ratio	0.3560	0.3560	0.3560	
Saturation, %	89.0	100.0	100.0	

Test Results for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 2.666 tsf at reading no. 27
Ult. Stress = 2.663 tsf at reading no. 31

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	62.40	0.0	0.0	0.000	3.967	3.967	1.00	34.90	3.967	0.000
1	0.0220	173.10	110.7	0.4	1.289	2.484	3.773	1.52	55.50	3.129	0.645
2	0.0420	206.40	144.0	0.8	1.671	2.016	3.687	1.83	62.00	2.852	0.836
3	0.0620	223.00	160.6	1.1	1.857	1.764	3.621	2.05	65.50	2.693	0.929
4	0.0830	230.50	168.1	1.5	1.936	1.613	3.549	2.20	67.60	2.581	0.968
5	0.1030	235.50	173.1	1.8	1.987	1.512	3.499	2.31	69.00	2.505	0.993
6	0.1240	238.00	175.6	2.2	2.008	1.447	3.455	2.39	69.90	2.451	1.004
7	0.1440	242.20	179.8	2.6	2.048	1.390	3.438	2.47	70.70	2.414	1.024
8	0.1650	245.50	183.1	3.0	2.078	1.346	3.424	2.54	71.30	2.385	1.039
9	0.1850	248.80	186.4	3.3	2.107	1.310	3.418	2.61	71.80	2.364	1.054
10	0.2060	252.20	189.8	3.7	2.137	1.289	3.426	2.66	72.10	2.358	1.069
11	0.2260	254.70	192.3	4.0	2.158	1.267	3.425	2.70	72.40	2.346	1.079
12	0.2460	253.80	191.4	4.4	2.139	1.253	3.392	2.71	72.60	2.322	1.070
13	0.2670	258.80	196.4	4.8	2.187	1.238	3.425	2.77	72.80	2.332	1.093
14	0.2870	260.50	198.1	5.1	2.197	1.231	3.428	2.78	72.90	2.330	1.099
15	0.3080	263.00	200.6	5.5	2.216	1.217	3.433	2.82	73.10	2.325	1.108
16	0.3280	265.50	203.1	5.9	2.235	1.210	3.445	2.85	73.20	2.327	1.118
17	0.3490	268.80	206.4	6.3	2.263	1.210	3.472	2.87	73.20	2.341	1.131
18	0.3690	268.80	206.4	6.6	2.254	1.202	3.456	2.87	73.30	2.329	1.127
19	0.3900	273.00	210.6	7.0	2.290	1.195	3.486	2.92	73.40	2.340	1.145
20	0.4100	275.50	213.1	7.3	2.309	1.195	3.504	2.93	73.40	2.350	1.154
21	0.4510	281.30	218.9	8.1	2.353	1.188	3.541	2.98	73.50	2.364	1.176

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4920	284.60	222.2	8.8	2.369	1.195	3.564	2.98	73.40	2.380	1.185
23	0.5330	292.10	229.7	9.6	2.429	1.195	3.625	3.03	73.40	2.410	1.215
24	0.5740	296.30	233.9	10.3	2.454	1.202	3.656	3.04	73.30	2.429	1.227
25	0.6140	300.40	238.0	11.0	2.477	1.202	3.679	3.06	73.30	2.441	1.238
26	0.6440	305.40	243.0	11.5	2.514	1.217	3.730	3.07	73.10	2.474	1.257
27	0.6960	322.90	260.5	12.5	2.666	1.210	3.876	3.20	73.20	2.543	1.333
28	0.7370	316.20	253.8	13.2	2.576	1.238	3.814	3.08	72.80	2.526	1.288
29	0.7780	322.10	259.7	13.9	2.613	1.238	3.852	3.11	72.80	2.545	1.307
30	0.8190	328.70	266.3	14.7	2.657	1.253	3.910	3.12	72.60	2.581	1.328
31	0.8390	330.40	268.0	15.0	2.663	1.260	3.923	3.11	72.50	2.591	1.331

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	171.400			1284.500
Moisture content: Dry soil+tare, gms.	160.000			1180.500
Moisture content: Tare, gms.	72.800			134.900
Moisture, %	13.1	14.5	14.5	9.9
Moist specimen weight, gms.	1168.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.6	131.2	131.2	
Dry density, pcf	114.6	114.6	114.6	
Void ratio	0.3615	0.3615	0.3615	
Saturation, %	90.4	100.0	100.0	

Test Readings for Specimen No. 3

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 105.00 psi (7.560 tsf)
Consolidation back pressure = 25.00 psi (1.800 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 5.549 tsf at reading no. 35
Ult. Stress = 5.549 tsf at reading no. 35

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0020	102.40	0.0	0.0	0.000	7.207	7.207	1.00	4.90	7.207	0.000
1	0.0170	286.30	183.9	0.3	2.145	6.674	8.819	1.32	12.30	7.747	1.072
2	0.0370	364.50	262.1	0.6	3.046	6.113	9.158	1.50	20.10	7.636	1.523
3	0.0580	407.00	304.6	1.0	3.526	5.537	9.063	1.64	28.10	7.300	1.763
4	0.0780	426.10	323.7	1.4	3.733	4.997	8.730	1.75	35.60	6.864	1.867
5	0.0990	437.70	335.3	1.7	3.853	4.536	8.389	1.85	42.00	6.462	1.926
6	0.1190	449.40	347.0	2.1	3.972	4.133	8.105	1.96	47.60	6.119	1.986
7	0.1400	457.70	355.3	2.5	4.052	3.838	7.889	2.06	51.70	5.863	2.026

Test Readings for Specimen No. 1

No.	Def. Dial In.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
8	0.1600	464.40	362.0	2.8	4.113	3.593	7.706	2.14	55.10	5.649	2.056
9	0.1810	474.40	372.0	3.2	4.210	3.384	7.594	2.24	58.00	5.489	2.105
10	0.2010	481.90	379.5	3.6	4.279	3.211	7.490	2.33	60.40	5.351	2.140
11	0.2210	487.70	385.3	3.9	4.328	3.074	7.403	2.41	62.30	5.239	2.164
12	0.2420	495.20	392.8	4.3	4.395	2.959	7.355	2.49	63.90	5.157	2.198
13	0.2620	503.50	401.1	4.7	4.471	2.851	7.323	2.57	65.40	5.087	2.236
14	0.2830	509.30	406.9	5.0	4.518	2.772	7.290	2.63	66.50	5.031	2.259
15	0.3030	519.30	416.9	5.4	4.612	2.693	7.305	2.71	67.60	4.999	2.306
16	0.3240	522.60	420.2	5.8	4.630	2.650	7.279	2.75	68.20	4.965	2.315
17	0.3440	526.00	423.6	6.1	4.650	2.621	7.270	2.77	68.60	4.946	2.325
18	0.3650	534.30	431.9	6.5	4.722	2.578	7.299	2.83	69.20	4.938	2.361
19	0.3850	541.80	439.4	6.9	4.785	2.549	7.334	2.88	69.60	4.941	2.393
20	0.4050	546.80	444.4	7.2	4.821	2.534	7.355	2.90	69.80	4.945	2.411
21	0.4260	553.40	451.0	7.6	4.873	2.520	7.393	2.93	70.00	4.956	2.436
22	0.4460	558.40	456.0	8.0	4.908	2.506	7.413	2.96	70.20	4.959	2.454
23	0.4670	560.90	458.5	8.3	4.914	2.506	7.420	2.96	70.20	4.963	2.457
24	0.4870	569.20	466.8	8.7	4.984	2.506	7.489	2.99	70.20	4.997	2.492
25	0.5080	574.20	471.8	9.1	5.016	2.513	7.529	3.00	70.10	5.021	2.508
26	0.5280	580.10	477.7	9.4	5.059	2.520	7.579	3.01	70.00	5.050	2.530
27	0.5690	592.50	490.1	10.2	5.148	2.534	7.683	3.03	69.80	5.109	2.574
28	0.6100	600.00	497.6	10.9	5.184	2.570	7.755	3.02	69.30	5.163	2.592
29	0.6510	610.90	508.5	11.6	5.254	2.599	7.853	3.02	68.90	5.226	2.627
30	0.6920	625.80	523.4	12.4	5.363	2.628	7.991	3.04	68.50	5.310	2.682
31	0.7330	631.70	529.3	13.1	5.378	2.671	8.049	3.01	67.90	5.360	2.689
32	0.7730	641.60	539.2	13.8	5.434	2.707	8.141	3.01	67.40	5.424	2.717
33	0.8140	651.60	549.2	14.6	5.487	2.750	8.238	3.00	66.80	5.494	2.744
34	0.8350	656.60	554.2	14.9	5.513	2.772	8.285	2.99	66.50	5.528	2.756
35	0.8540	662.50	560.1	15.3	5.549	2.786	8.335	2.99	66.30	5.561	2.775

APPENDIX D

Boring Logs

TD 5/14/07

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 8874

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N. Penetration, Blows/Ft.
10 20 30 40 50 60

Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Brown Silty CLAY (CL) with sand and pebbles
5	1	st		
	2	st		
10	3	st		Gray Mottled Brown Silty CLAY (CL)
15	4	st		
	5	st		
20				End of Boring @ -20.0'
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling and None Upon Completion.

Mach #1 Mine Soils Investigation
Mach #1 Mine Williamson County Illinois

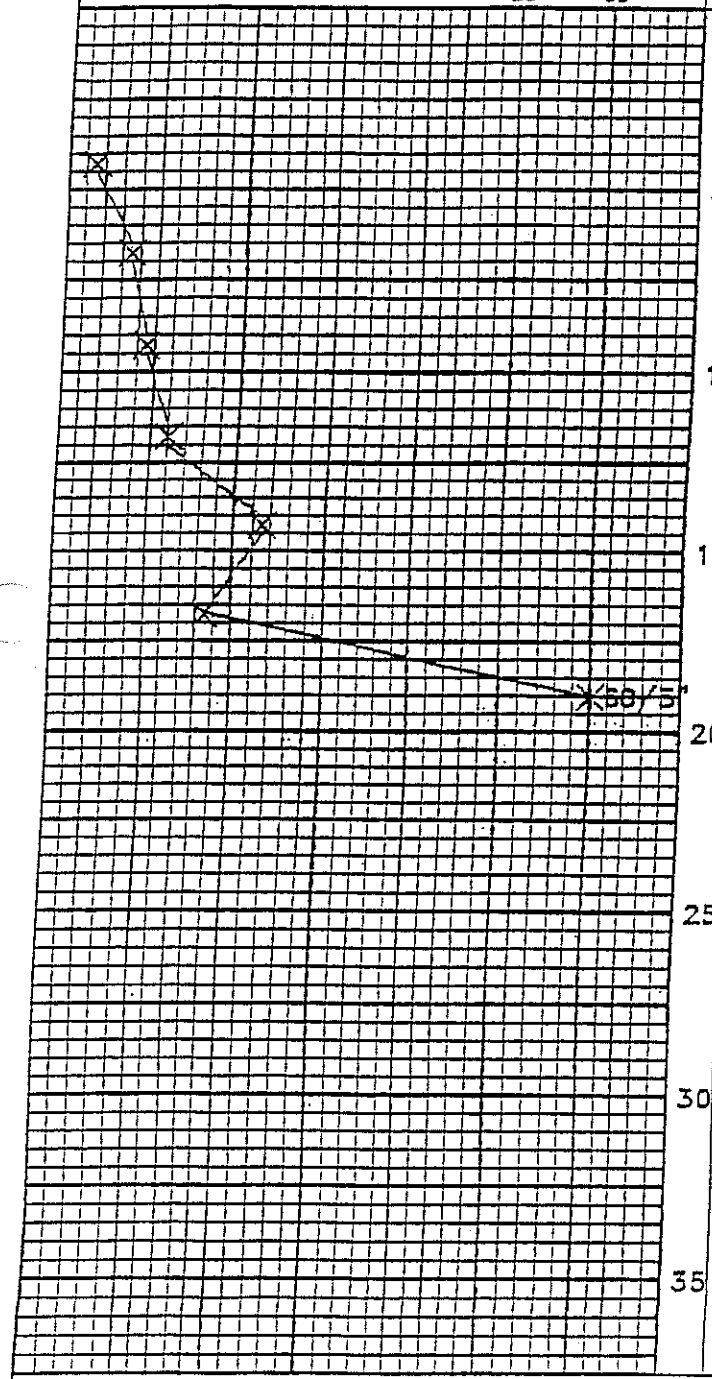
Date of Boring
February 1, 2006

Client:
Alliance Consulting, Inc.
Beaver, West Virginia

Project No.
H-05278

LOG of BORING B293

Holcomb Foundation Engineering Co.



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				7" Topsoil
				Gray Mottled Brown Silty CLAY (CL) with trace of sand
5	1	SS		
	2	SS		
10	3	SS		Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
	4	SS		
15	5	SS		
	6	SS		
	7	SS		Gray SHALE
20				End of Boring ▽ −19.0'

Ground Water Data

Ground Water Encountered ▽ −12.0' During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring: December 5, 2005

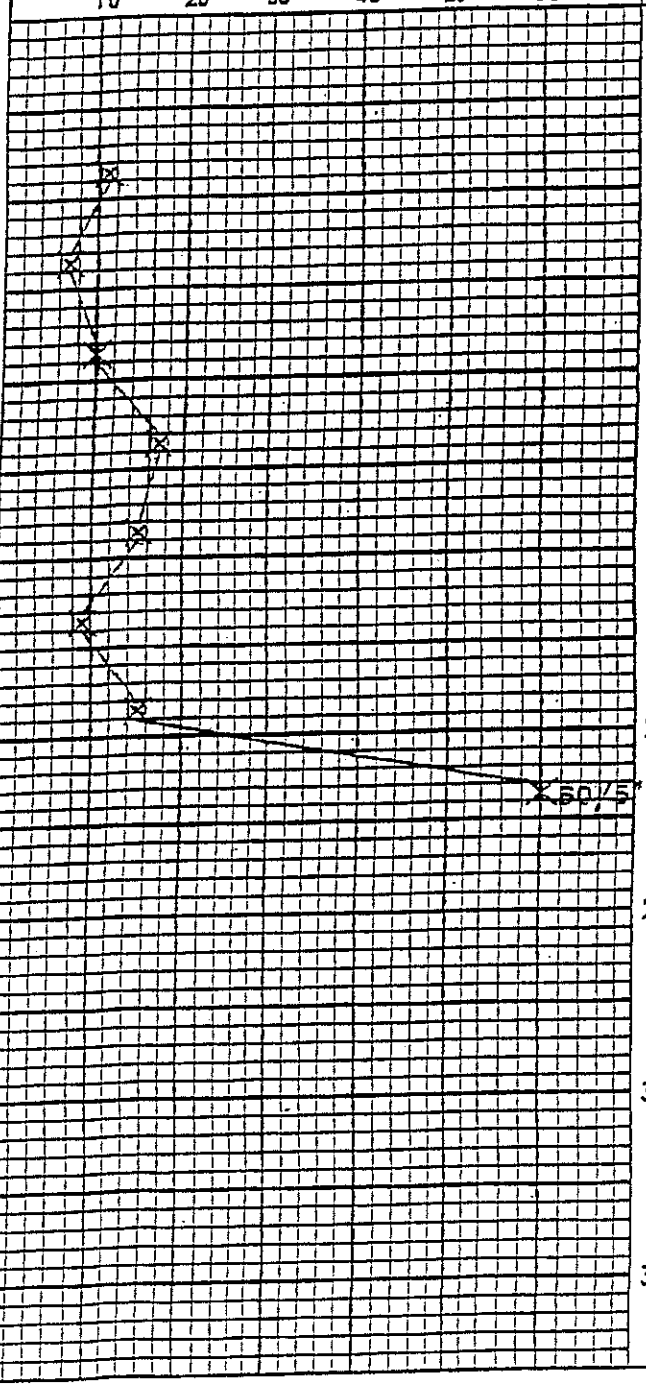
Client: Williamson County Energy
Marion, Illinois

Project No.: H-05278

R14503

LOG of BORING B294

Holcomb Foundation Engineering Co.



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				7" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
10	3	ss		
	4	ss		
15	5	ss		
	6	ss		
20	7	ss		
	8	ss		Brown SHALE
25				End of Boring @ -22.5'
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

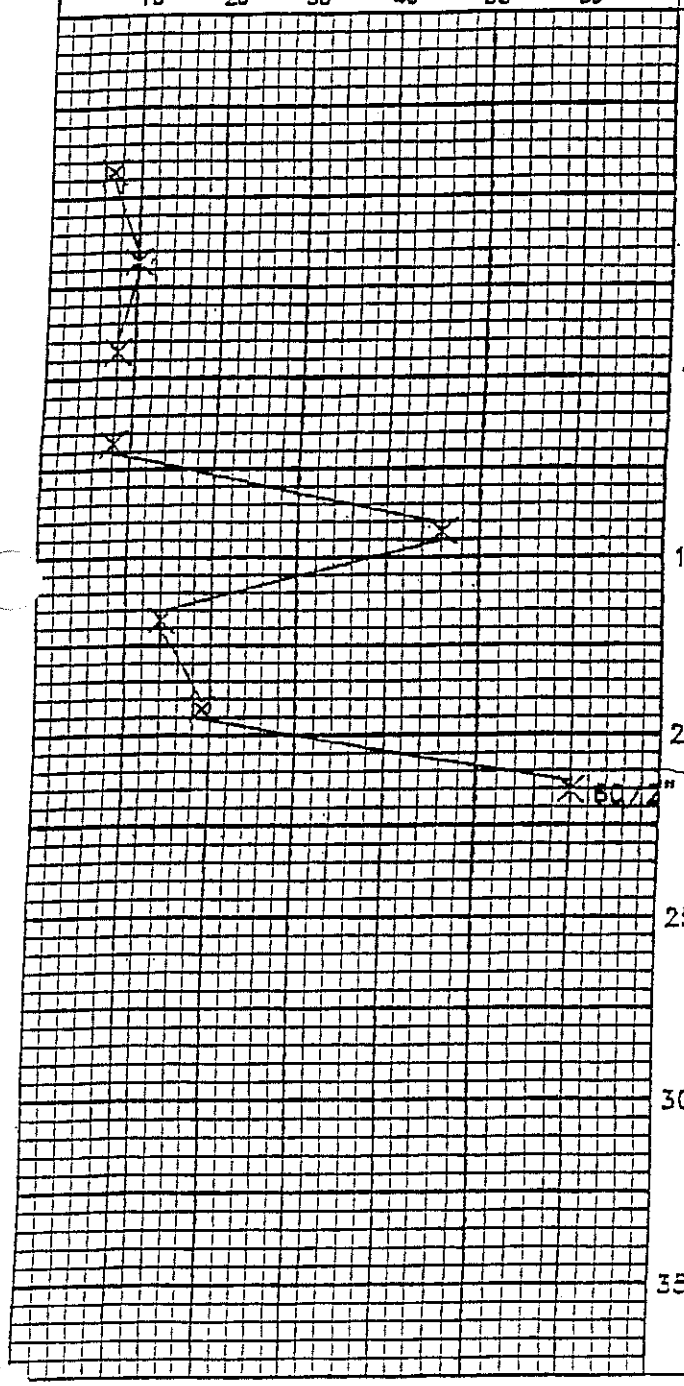
Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

R14504

LOG of BORING B295

Holcomb Foundation Engineering Co.



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				9" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
10	3	ss		
	4	ss		
15	5	ss		Brown SILT (ML)
	6	ss		Brown Medium to Coarse SAND (SC-SP)
20	7	ss		
	8	ss		Gray Mottled Brown SHALE
				End of Boring @ -22.0'

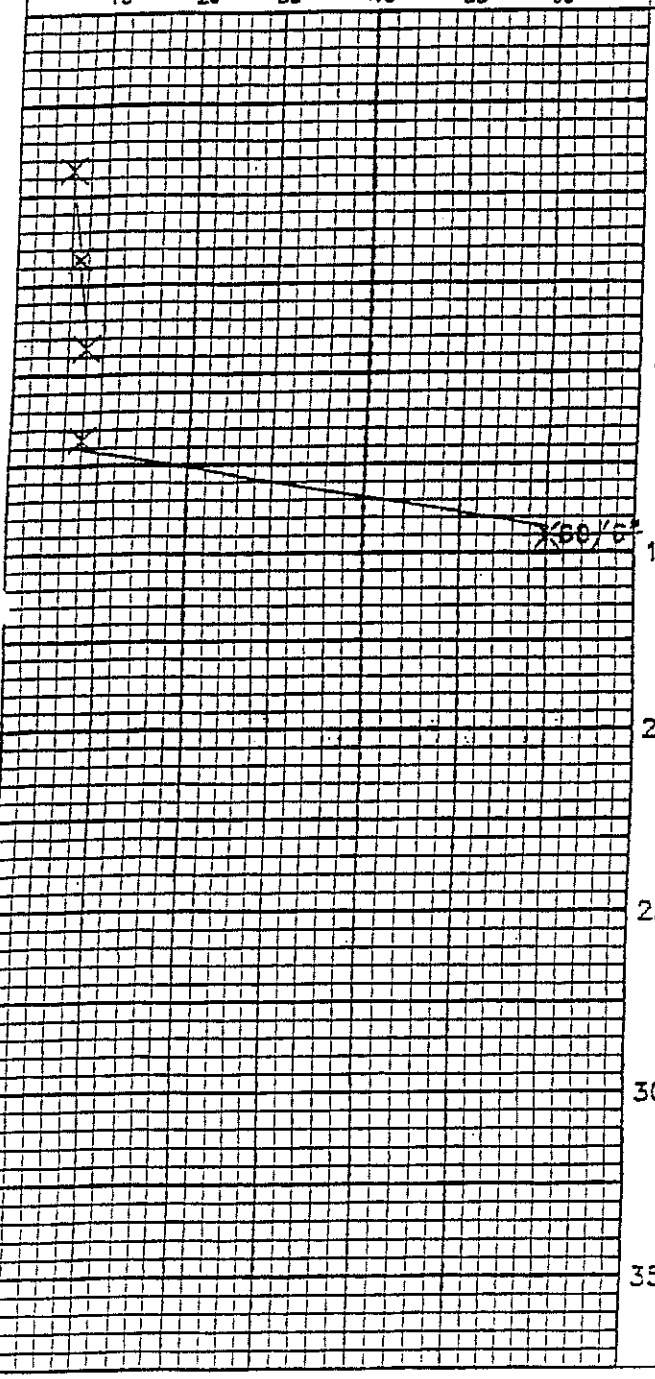
round Water Data
Ground Water Encountered @ -16.0' During Drilling/ @ -10.0' Upon Completion.

Project: Rock Probes for Mach Mine Johnston City, Illinois	Date of Boring December 5, 2005
Client: Williamson County Energy Marion, Illinois	Project No. H-05278

R14505

LOG of BORING 8297

Holcomb Foundation Engineering Co.



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				9" Topsoil
				Gray Mottled Brown Silty CLAY (CL) with sand and pebbles
	1	SS		
	2	SS		
	3	SS		
10				Brown Mottled Gray Silty CLAY (CL) with trace of sand
	4	SS		
				Gray Mottled Brown Silty CLAY (CL) with trace of sand
	5	SS		
15				Brown SHALE
				End of Boring @ -15.5'

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

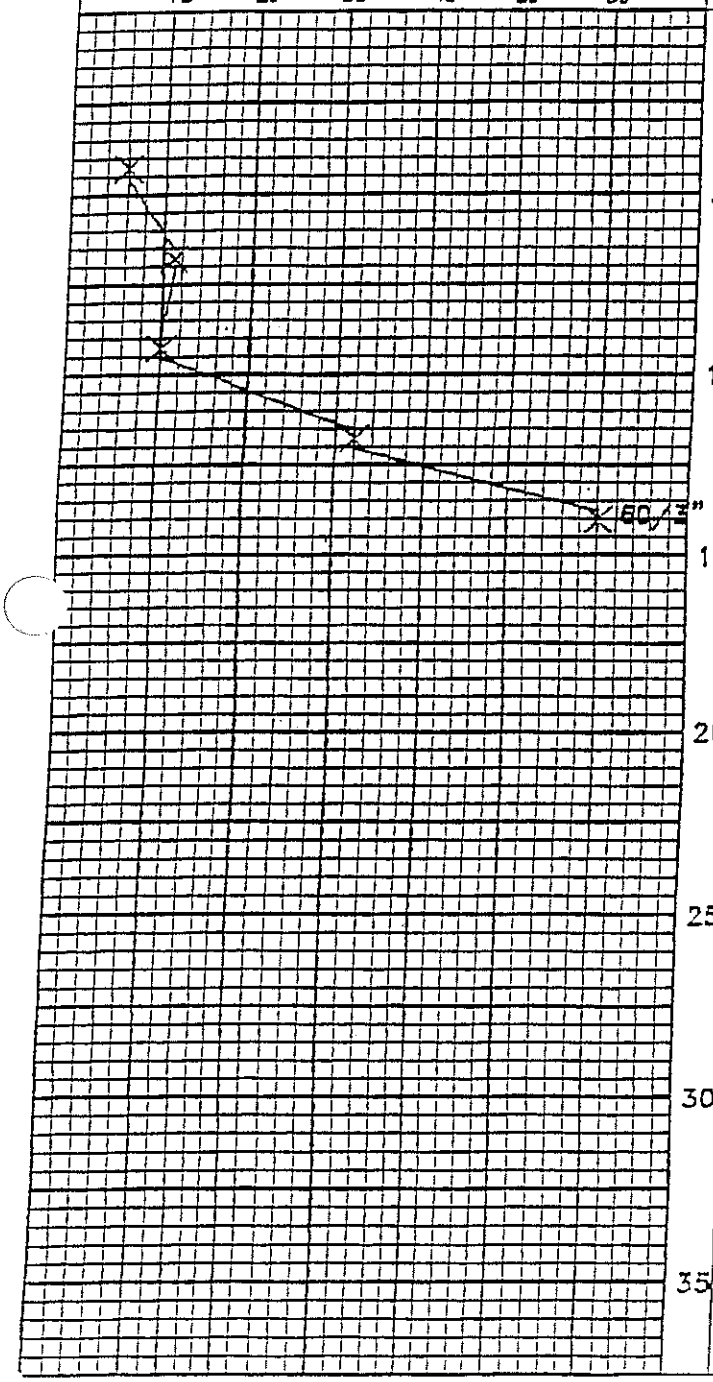
Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

LOG of BORING 8298

Holcomb Foundation Engineering Co.



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				6" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
	3	ss		Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
10	4	ss		Brown Mottled Gray SHALE
	5	ss		Gray SHALE
15				End of Boring @ −14.5'
20				
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine Johnston City, Illinois	Date of Boring December 5, 2005
Client: Williamson County Energy Marion, Illinois	Project No. H-05278

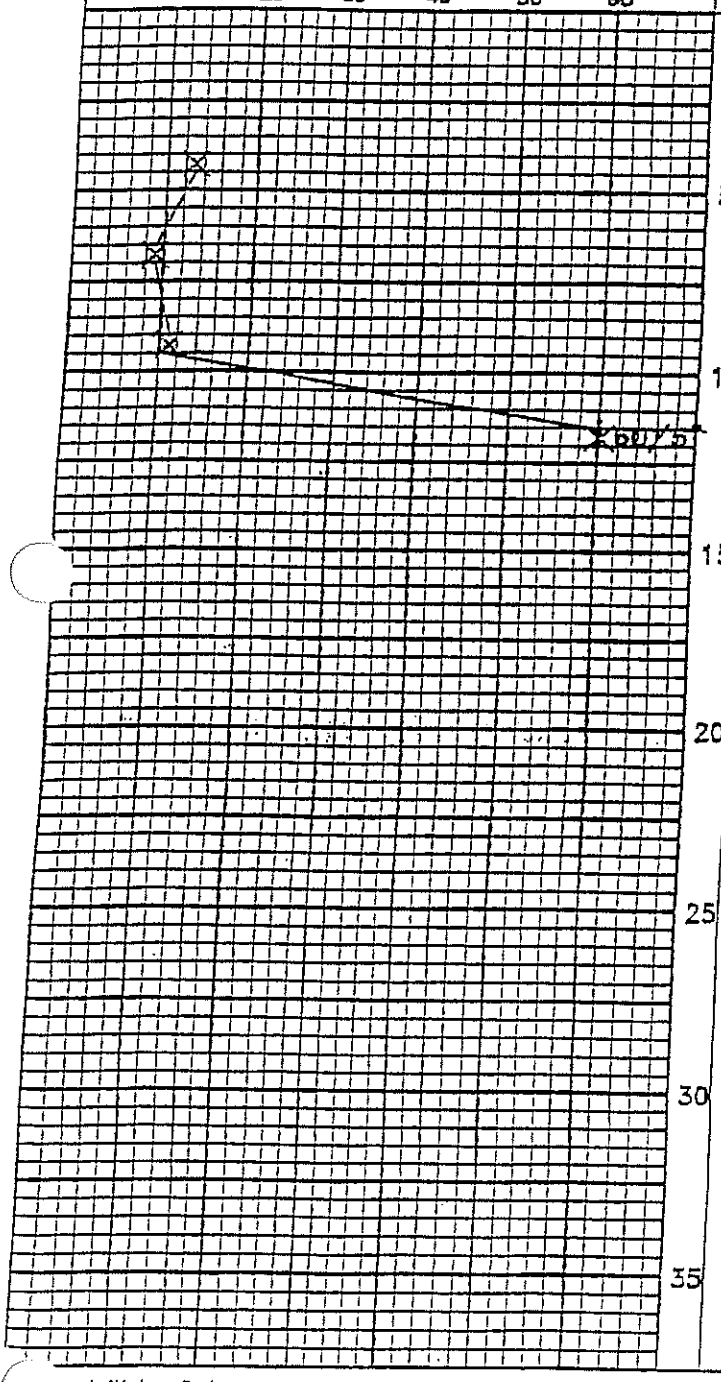
LOG of BORING B299

Holcomb Foundation Engineering Co.

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (X)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	SS		
	2	SS		
10	3	SS		
	4	SS		Brown SHALE
				End of Boring @ -12.5'
15				
20				
25				
30				
35				

nd Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

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part 26

R14508

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

PAGE 1 OF 12

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/25/08

CALCULATION BRIEF
FOR
CHARACTERIZATION OF SAND-LIKE AND CLAY-LIKE SUBSURFACE MATERIALS

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH CELL

OBJECTIVE: To characterize subsurface materials including coarse coal refuse, fine coal refuse and residual soils encountered at the Pond Creek South Cell refuse disposal facility. Materials are characterized as either sand-like or clay-like in accordance with various pertinent references shown below and included within the "Draft" Mine Health and Safety Administration (MSHA) Engineering and Design Manual, specifically Chapter 7: Seismic Design: Stability and Deformation Analyses, March 2007.

REFERENCES:

1. Illinois Department of Natural Resources, Office of Water Resources, Construction and Maintenance of Dams, Part 3702, Chapter IX.

2. Mine Safety and Health Administration, "Draft - Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 – Seismic Design: Stability and Deformation Analyses," dated, March 13, 2007.

3. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Piezo-Cone Penetration Testing," Pond Creed Coal Refuse Disposal Site, BEG, dated 12/21/07.

4. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Normalized PS-CPT Data and Parameter Correlations," Pond Creek Coal Refuse Disposal Site, BEG, dated 12/28/07.

5. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Laboratory Testing," Pond Coal Refuse Disposal Site – South Pond, BEG, dated 7/8/08.

6. Boulanger, R.W. and Idriss, I.M. (2004). "Evaluating the Potential for Liquefaction or Cyclic Failure of Silts and Clays," Report No. UCD/CGM-04/01, Center for Geotechnical Modeling, Department of Civil and Environmental Engineering, University of California, Davis, California.

7. Robertson, P.K., (Fear) Wride, C.E., List, B.R., Atukorala, U., Biggar, K.W., Byrne, P.M., Campanella, R.G., Cathro, D.C., Chan, D.H., Czajewski, K., Finn, W.D.L., Gu, W.H., Hammamji, Y., Hofmann, B.A., Howie, J.A., Hughes, J., Imrie, A.S., Konrad, J.-M., Küpper, A., Law, T., Lord, E.R.F., Monahan, P.A., Morgenstern, N.R., Phillips, R., Piché, Plewes, H.D., Scott, D., Sego, D.C., Sobkowicz, J., Stewart, R.A., Tan, S., Vaid, Y.P., Watts, B.D., Woeller, D.J., Youd, T.L., and Zavodni, Z., The CANLEX Project: Summary and Conclusions. Canadian Geotechnical Journal, 2000, Vol. 37, No. 3, June, pp. 499-504

8. Youd, T. L. et al. (2001). "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 127, No. 10, pp. 817-833.

9. Blight, G. E. and Bentel, G. M., (1983) "The Behaviour of Mine Tailings During Hydraulic Deposition," Journal of the South African Institute of Mining and Metallurgy, April 1983.

GENERAL:

Reference (Ref.) Number (No.) 1 presents the following guidelines regarding the methods of testing, analyses and computations which must be completed and submitted with an application to support an owner's request for abandonment of a disposal impoundment dam:

1. The classification of the existing condition of the impounded material with respect to its fluid nature;
2. The liquefaction potential of the impounded material and the related stability of the containing dam;
3. The final surface configuration for the impounded materials, especially from any surface water impounding characteristics and the erosion potential of the surface material; and
4. The establishment of a follow-up inspection schedule to ensure the proposed plans have been effective and the submittal of record drawings.

This, and subsequent calculation briefs prepared by Civil & Environmental Consultants, Inc. (CEC), address the characterization of the impounded fine coal refuse and the liquefaction potential of the fine coal refuse and related stability (i.e., Requirements 1 and 2 above). Alliance Consulting, Inc. (Alliance) will provide the final surface configuration and the follow-up inspection schedule.

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 3 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

From Ref. No. 2, the basic elements for seismic design and analysis are:

1. Characterize the subsurface materials;
2. Evaluate if design earthquake will trigger strength loss;
3. Evaluate seismic stability using post-earthquake strength parameters; and
4. Evaluate deformations.

Therefore, the first step for both abandonment and seismic design and analysis is to characterize the subsurface conditions to evaluate the fluid nature and whether any zones have the potential for strength loss due to earthquake shaking (i.e., liquefaction potential). Previously, the materials making up the coarse refuse dike and underlying residual soils were evaluated using piezo-seismic cone penetration testing (PSCPT) (Ref. Nos. 3 and 4) as part of the deformation analyses of the South Pond. Subsequently, and as part of the abandonment evaluation, laboratory testing (Ref. No. 5) and characterization of the fine coal refuse retained behind the embankment was performed as described below.

For many aspects of seismic stability analyses described in Ref. No. 2, coal refuse and natural soils are referred to as sand-like or clay-like depending on whether they exhibit monotonic and cyclic undrained shear loading behavior that is fundamentally more similar to that of either sand or clay. This differentiation is significant primarily if the material is loose enough (sands) or soft enough (clays) that it is potentially susceptible to strength loss.

SUMMARY OF POND CREEK FIELD AND LABORATORY TESTING/RESULTS:

CEC developed, implemented and oversaw a detailed and thorough field testing program consisting of performing PS-CPT at several sounding locations throughout the Pond Creek site, including the ongoing South Pond impoundment. PS-CPT was executed at Pond Creek by ConeTec, Inc. (ConeTec) of West Berlin, New Jersey. Also, Alliance provided bulk (bucket) samples of fine coal refuse, which were obtained for subsequent laboratory testing. Geotechnics, Inc. (Geotechnics) of Pittsburgh, Pennsylvania performed consolidated undrained triaxial shear strength laboratory testing of the fine coal refuse materials. Ref. Nos. 3 -5 present summaries of the field and laboratory testing programs and Appendixes A - C of the Pond Creek abandonment report present the results of the field and laboratory testing.

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 4 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

PIEZO-SEISMIC CONE PENETRATION TEST RESULTS SUMMARY:

Generalized South Cell CPT Profiles from the October 2007 field testing presented in Ref. Nos. 3 and 4 indicated the following:

CPT-1	CPT-2
El. 482.19 – Surface Elevation	El. 494.21 – Surface Elevation
15.3 feet – Depth to Static Ground Water	38.8 feet – Depth to Static Ground Water
0 – 18.4 feet – Residual Soil	0 – 32 feet – Coarse Refuse
Refusal at 18.4 feet - Bedrock	32 – 45.3 feet – Residual Soil
	Refusal at 45.3 feet - Bedrock

CPT-2A	CPT-3
El. 492.40 – Surface Elevation	El. 466.98 – Surface Elevation
37.0 feet – Depth to Static Ground Water	11.1 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 22.2 feet – Residual Soil
29 – 41.7 feet – Residual Soil	Refusal at 22.2 feet – Bedrock
Refusal at 41.7 feet - Bedrock	

CPT-4	CPT-5
El. 482.55 – Surface Elevation	El. 482.55 – Surface Elevation
21.7 feet – Depth to Static Ground Water	34.4 feet – Depth to Static Ground Water
0 – 18.9 feet – Residual Soil	0 – 29 feet – Coarse Refuse
Refusal at 18.9 feet – Bedrock	29 – 49.2feet – Residual Soil
	Refusal at 49.2 feet - Bedrock

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 5 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-5A	CPT-5B
El. 483.00 – Surface Elevation	El. 479.90 – Surface Elevation
35.9 feet – Depth to Static Ground Water	28.0 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 19 feet – Coarse Refuse
29 – 53.2 feet – Residual Soil	19 – 39.7 feet – Residual Soil
Refusal at 53.2 feet - Bedrock	Refusal at 39.7 feet - Bedrock

Cone penetration testing results for CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A AND CPT-5B presented in Ref. Nos. 3 and 4 indicated the following:

CPT-1	CPT-3
Residual Soil (Layer Thickness = 18.4)	**Residual Soil (Layer Thickness = 22.2)**
Avg. Tip Stress, Qc avg. = 79 tsf	Avg. Tip Stress, Qc avg. = 43 tsf
Avg. Fines Content, FC avg. = 27%	Avg. Fines Content, FC avg. = 32%
Avg. SBT Index, Ic = 2.38	Avg. SBT Index, Ic = 2.49

CPT-4
Residual Soil (Layer Thickness = 18.9)
Avg. Tip Stress, Qc avg. = 64 tsf
Avg. Fines Content, FC avg. = 28%
Avg. SBT Index, Ic = 2.41

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PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

PAGE 6 OF 12

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-2	CPT-2A
Coarse Coal Refuse (Layer Thickness = 32')	**Coarse Coal Refuse (Layer Thickness = 29')**
Avg. Tip Stress, Qc avg. = 54 tsf	Avg. Tip Stress, Qc avg. = 45 tsf
Avg. Fines Content, FC avg. = 24%	Avg. Fines Content, FC avg. = 22%
Avg. SBT Index, Ic = 2.30	Avg. SBT Index, Ic = 2.23

Residual Soil (Layer Thickness = 13.3')	**Residual Soil (Layer Thickness = 12.7')**
Avg. Tip Stress, Qc avg. = 47 tsf	Avg. Tip Stress, Qc avg. = 86 tsf
Avg. Fines Content, FC avg. = 60%	Avg. Fines Content, FC avg. = 48%
Avg. SBT Index, Ic = 2.99	Avg. SBT Index, Ic = 2.80

CPT-5	CPT-5A
Coarse Coal Refuse (Layer Thickness = 29')	**Coarse Coal Refuse (Layer Thickness = 29')**
Avg. Tip Stress, Qc avg. = 50 tsf	Avg. Tip Stress, Qc avg. = 37 tsf
Avg. Fines Content, FC avg. = 23%	Avg. Fines Content, FC avg. = 24%
Avg. SBT Index, Ic = 2.24	Avg. SBT Index, Ic = 2.29

Residual Soil (Layer Thickness = 20.2')	**Residual Soil (Layer Thickness = 24.2')**
Avg. Tip Stress, Qc avg. = 66 tsf	Avg. Tip Stress, Qc avg. = 49 tsf
Avg. Fines Content, FC avg. = 64%	Avg. Fines Content, FC avg. = 56%
Avg. SBT Index, Ic = 3.04	Avg. SBT Index, Ic = 2.94

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 7 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-5B
Coarse Coal Refuse
(Layer Thickness = 19')
Avg. Tip Stress, Qc avg. = 41 tsf
Avg. Fines Content, FC avg. = 19%
Avg. SBT Index, Ic = 2.15

Residual Soil
(Layer Thickness = 20.7')
Avg. Tip Stress, Qc avg. = 63 tsf
Avg. Fines Content, FC avg. = 51%
Avg. SBT Index, Ic = 2.84

Cone Penetration Testing Results – Shear Wave Velocities

CPT No.	Shear Wave Velocity Coarse Coal Refuse (ft/sec)			Shear Wave Velocity Residual Soil (ft/sec)		
	Max.	Min.	Avg.	Max.	Min.	Avg.
CPT-1	NA			1402	645	905
CPT-2	1284	1029	1120	1173	795	957
CPT-2A	1169	895	1042	1256	780	918
CPT-3	NA			1058	569	765
CPT-4	NA			1242	476	817
CPT-5	1190	936	1063	1599	780	947
CPT-5A	1396	779	1064	1580	728	1005
CPT-5B	1517	818	1080	1649	686	978

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PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

LABORATORY TESTING RESULTS SUMMARY:

Ref. No. 4 and Appendix A present the details and results of the June 2008 laboratory testing program performed by Geotechnics. The following summarizes laboratory testing results of each of 2 buckets of fine coal refuse sampled from the South Pond impoundment.

Bucket 1	Bucket 2
Fine Coal Refuse	Fine Coal Refuse
Moisture = 85.8 %	Moisture = 94.4 %
Passing No. 200 = 92.8 %	Passing No. 200 = 92.6 %
Passing No. 40 = 99.4 %	Passing No. 40 = 99.3%
Plasticity Index = 17 %	Plasticity Index = 17 %
Avg. Strain to Peak = 15.1 %	Avg. Strain to Peak = 11.0 %

Normalized tip stress and fines content with depth for CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B including a summary of pertinent average field and laboratory test results for each material layer are attached.

CRITERIA AND METHODOLOGY:

From Ref. No. 2, the first step common to all approaches is to review the subsurface conditions at the embankment to evaluate whether any zones have the potential for strength loss. For this initial screening step, saturated to nearly saturated sand-like materials with $N_{1,60}$ values less than 15 blows per foot (bpf), or q_{c1} (or Qc) values less than 75 tons per square foot (tsf), should be considered potentially susceptible to strength loss. Ref. No. 2 noted these values are likely too conservative and apply only to clean sands. Their application to silty sands and sands with high fines content, which are more representative of fine coal refuse, will likely be overly conservative.

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 9 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MCS DATE 7/23/08

Generalized field-related CPT-derived criteria noted in various references within Reference 2 include:

Sand-like:	Fines content < 50% or PI < 12%
Loose:	SPT $N_{1,60}$ < 15 or CPT q_{c1} > 75 tsf, & SBT Ic < 2.6 or F_r < 2%).
Clay-like:	Fines content > 50% and PI >12%
Soft:	OCR < 5, S_u/σ'_v < 1.0, CPT Q_t < 20 tsf & SBT Ic > 2.6, SPT $N_{1,60}$ < 8

CPT data may be used in conjunction with Atterberg limit data (criteria shown below) to differentiate sand-like from clay-like material. CPT Soil Behavior Type Index (I_c), as described in Robertson and Wride 1998 and reproduced in Youd et al. 2001, values below 2.6 should be considered sand-like. I_c values above 2.6 may be considered clay-like.

Generalized laboratory results criteria noted in various references within and in Ref. No. 1 include the following Atterberg Limit and sieve criteria:

Atterberg Limits.

- Material should be considered sand-like if any of the following three (3) criteria apply:

  1. The material has less than 35% particles by dry weight passing the No. 40 sieve and less than 20% by dry weight passing the No. 200 sieve; or

  2. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 12%; or

  3. The material has 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 20%.

The material may be considered clay-like if any of the following two (2) criteria apply:

1. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 12% or higher; or

2. The material has 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 20% or higher.

Atterberg limit criteria include as sand-like some materials that are considered clay-like by some investigators (e.g. Boulanger and Idriss, 2004, who suggested a break between sand-like and clay-like behavior at a PI of 7%). The intent is to classify borderline materials as sand-like to be conservative.

Another key factor in differentiating loose sand-like material from soft or medium clay-like material, for the purposes of seismic stability and deformation analyses, are the strain at peak undrained strength and the abruptness of the drop-off in shearing resistance as strains increase beyond the strain at peak. Loose sands and highly sensitive clays can reach S_{up} at small strains, and experience abrupt drop-off in resistance at higher strains. Most clays tend to reach S_{up} at higher strains, and tend to experience more gradual and limited drop-off in shearing resistance at higher strains. Fine coal refuse deposits often include materials falling within both classifications, and near the boundary of these two types of behavior.

Loose materials with shear strain at peak strength of less than 2% in an undrained monotonic (non-cyclic) test, and a rapid drop-off in resistance after reaching peak strength, are considered sand-like. Loose or soft materials with shear strain at peak strength of more than about 5%, and a gradual drop-off in resistance after reaching peak strength are considered clay-like. Materials with strain behavior between these descriptions are considered borderline and, to be conservative, should generally be analyzed as sand-like. (Note that shear strain in an undrained triaxial test is 1.5 times axial strain.)

Soil, rock, and mixtures of soil and rock that are not coal refuse such as the underlying starter embankment will be referred to as natural soils. Natural soils may be described as sand-like, or clay-like, using the same general criteria as refuse.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 11 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A AND CPT-5B AVG. WEIGHTED AVERAGE FIELD AND LAB RESULTS SUMMARY
Coarse Coal Refuse (138')
Avg. Tip Stress, Qc avg. = 46 tsf
Avg. Fines Content, FC avg. = 23%
Avg. SBT Index, Ic = 2.25

Fine Coal Refuse
Avg. % Passing No. 200 = 92.7%
Avg. % Passing No. 40 = 99.4 %
Avg. Plasticity Index = 17%
Avg. Strain to Peak = 13.1 %

Residual Soil (150.6')
Avg. Tip Stress, Qc avg. = 61 tsf
Avg. Fines Content, FC avg. = 46%
Avg. SBT Index, Ic = 2.73

Plots of individual and average normalized tip stress with depth are included with an attached complete copy of Ref. No. 4.

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PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

PAGE 12 OF 12

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CONCLUSION

Based on the information presented in this calculation brief, the following material characteristic designations were determined for the coarse coal refuse, fine coal refuse and residual soil:

Coarse Coal Refuse: Medium Dense Sand-Like;

Fine Coal Refuse: Medium Stiff Clay-Like;

Residual Soil: Medium Dense Sand-Like and Medium Stiff Clay-Like.

Further, the results of the laboratory testing indicate that the fine coal refuse is clay-like based on an average 93% passing the No. 200 sieve and plasticity index of 17%. Peak and steady-state undrained strengths presented in Appendix A were reached at generally high strains (between 8 and 18%), and there was very little drop off from peak to steady-state with increasing strain. The results generally indicated a higher resistance to strength loss (and flow) due to the large strains required to exceed the peak strength and correspondingly small decrease to the steady-state strength at higher strains. Further, previous deformation analyses results indicated induced shear strains from the PGA at less than 0.1%, which is well below a threshold (peak) triggering strain of the material.

The susceptibility of the embankment and impoundment to a liquefaction flow failure is a function of both the undrained strength (worst case steady-state strength) and the in-situ driving shear stress on a critical failure plane passing through the critical layer fine coal refuse material, which is further addressed in subsequent calculation briefs.

REFERENCE 4
NORMALIZED TIP STRESS WITH FIELD/LAB SUMMARY AND
SOIL CLASSIFICATION VS DEPTH;
FINES CONTENT AND FIELD/LAB SUMMARY VS DEPTH AND
NORMALIZED TIP STRESS AND FINES CONTENT VS DEPTH SPREADSHEET

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 1 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY TJS DATE 1/23/08

CALCULATION BRIEF
FOR
NORMALIZED PS-CPT DATA AND PARAMETER CORRELATIONS

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE:

Use data recorded during the piezo-seismic cone penetration testing (PS-CPT) at the Williamson Energy, Pond Creek Coal Refuse Disposal facility located in Williamson County, Illinois to correlate various index and strength properties. Also, nearly continuous profiles with depth of various applicable engineering properties of the refuse and subgrade soil materials in the fifteen (15) soundings tested at the Pond Creek facility are tabulated and attached.

REFERENCES:

1. Bowles, Joseph E. (1984) "Physical and Geotechnical Properties of Soils," Mc-Graw Hill. New York: 367-369 and 393-396.

2. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Piezo-Cone Penetration Testing," Pond Creek Coal Refuse Disposal Site, BEG, dated 12/21/07.

3. ConeTec, Inc. (2007), Field Report Entitled "Presentation of CPTU Test Results for: Pond Creek Mine – Williamson County, Illinois, December 10, 2007.

4. Robertson, P.K (1998), "Applications Guide – CPT" **Fax**

5. Robertson, P.K., et.al. (1992) "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE 109 (11): 1449-1459.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 7 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

6. Robertson, P.K and Campanella, R.G, (1989), "Guidelines for Geotechnical Design Using CPT and CPTU", UBC Soil Mechanics Series No. 120, Civil Eng. Dept., Vancouver, B.C., Canada

7. Robertson, P.K and Campanella, R.G, (1983), "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE Vol. 109 No. 11, pp. 1449-1459.

8. Civil and Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak Undrained Shear Strength for Refuse and Subgrade Materials," Pond Creek Coal Refusal Site, BEG 12/28/07.

METHODOLOGY:

Using laboratory-derived unit weights for the coarse coal refuse and residual soil layers, provided by Alliance Consulting, Inc. (Alliance), the following parameters are correlated based on established CPT correlations (References 2, 3, 4, 5, 6 and 7) and the data collected during the Pond Creek Piezo-Seismic Cone Penetration Testing subsurface investigation (Ref. 2):

- Total stress (σ_v)
- Effective stress (σ_{vo}')
- Pore pressure (U_{eq})
- SPT N_{60} correction factor (C_n)
- SPT blow counts at 60% energy (N_{60})
- N_{60} corrected for overburden ($(N_1)_{60}$)
- Corrected tip resistance (q_c)
- Fines content (F_c)
- Effective friction angle (ϕ)
- Soil Behavior Index (I_c)

Undrained shear strength (S_u) was also correlated, and is discussed separately in the calculation brief entitled Estimation and Summary of Engineering Properties Including Peak Undrained Shear Strength for Refuse and Subgrade Materials," (Reference 8).

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PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 3 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY KJ DATE 1/23/08

ANALYSIS:

ConeTec, Inc. (ConeTec) performed the PS-CPT and correlated the above noted parameters based on various unit weights that were correlated directly from the Soil Behavior Type (SBT) (Robertson and Campanella, 1989). The unit weights used by ConeTec were based on data interpolation and thus require modification to reflect the laboratory derived unit weights of the coarse refuse and residual soil, which were provided by Alliance. Therefore, laboratory-derived unit weight for each of the layers was used to correlate the applicable parameters, particularly total and effective stresses, which are used throughout the calculations.

PSCPT correlations were based on much of the work described by Robertson and Campanella (1998, 1992, 1989, 1988, 1983). During field testing, ConeTec measured four parameters insitu, which were not correlated. They include the recorded tip resistance (AvgQt), the recorded side friction (AvgFs), the recorded friction ratio (AvgRf) and the pore pressure generated by the CPT probe (AvgUd), all of which were used in subsequent correlations. The soil behavior type (SBT) was also determined by the ConeTec, and was based on observations and readings of the four parameters just listed.

The following paragraphs briefly describe the parameters as well as providing a definition of the parameter and any additional calculations needed: Total stress and effective stress are both used in many of the correlations, and are related to each other by the presence of water in the form of pore water pressure. Total stress was defined as:

$$\sigma_v = (\gamma * H) / 2000 \text{ (lb/ton)}$$

where: σ_v = total stress (tsf)
γ = unit weight (pcf)
H = depth of the sample (ft)

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PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 4 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

Pore pressure is defined as:

$$U_{eq} = (\gamma_w * H) / 2000 \text{ (lb/ton)}$$

where: U_{eq} = pore pressure (tsf)
γ_w = unit weight of water (pcf)
= 62.5 pcf
H = depth of the sample (ft)

The difference between the two determines the effective stress:

$$\sigma_{vo}' = \sigma_v - U_{eq}$$

where: U_{eq} = pore pressure (tsf)
σ_v = total stress (tsf)

The PS-CPT sampler correlated the number of blows per foot, without the overburden correction, to the tip resistance measured as the probe was advanced. This gave measurements of N_{60} every 0.2 meters. Corrected for overburden, the measured tip resistance was then calculated:

$$q_c = AvgQt - (1 - 0.85) * U$$

where: AvgQt = measured tip resistance (tsf)
0.85 = area ratio of the PS-CPT probe
U = measured pore pressure (tsf)

This corrected tip resistance (q_c) was used along with the soil behavior type index (Ic) and atmospheric pressure to give the recorded N_{60} value by the equation:

$$N_{60} = (q_c / Pa) / 8.5 * (1 - (Ic / 4.6))$$

where: q_c = corrected tip resistance (tsf)
Pa = atmospheric pressure (tsf)
= 1.058 tsf
Ic = soil behavior type index (dim)

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PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 5 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

and: $Ic = ((3.47 - \text{Log}_{10}(Q))^2 + (\text{Log}_{10}(F) + 1.22)^2)^{0.5}$

where: Q = normalized cone penetration resistance (dim)
F = normalized friction ratio (pct)

and: $Q = (q_c - \sigma_v) / \sigma_{vo}'$

where: q_c = corrected tip resistance (tsf)
σ_v = total stress = (γ * H) / 2000(lb/ton) (tsf)
σ_{vo}' = vertical effective overburden (tsf)

and: $F = 100\% * \text{AvgFs} / (q_c - \sigma_{vo}')$

where: AvgFs= recorded side friction (tsf)
q_c = corrected tip resistance (tsf)
σ_{vo}' = vertical effective overburden (tsf)

Once N_{60} and σ_{vo}' had been calculated, a correction factor (Cn) was applied to N_{60} to give $(N_1)_{60}$:

$(N_1)_{60} = N_{60} * Cn$

where N_{60} = Number of blows/foot to advance 1.5 feet
Cn = $(\sigma_{vo}')^{-0.5}$ (dim)

Using tip resistance, corrected for overburden, and effective overburden the effective friction of the material in the Pond Creek facility could be calculated (Robertson, 1989). This was done using the following calculation:

$$\phi' = \tan^{-1}[(1/2.68) * (\text{Log}_{10}(q_c / \sigma_{vo}') + 0.29)]$$

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PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 6 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

where: q_c = corrected tip resistance (tsf)
σ_{vo}' = effective vertical stress (tsf)

Similarly, the fines content was correlated from PS-CPT data but was not used in any further analysis. The fines content was correlated using the soil behavior type index, I_c, as defined above. To determine the fines content of the material, the following relationship was used:

$$F_c = (1.75 * I_c^{3.25} - 3.7)$$

where: F_c = fines content (%)
I_c = soil behavior type index (dim)

RESULTS:

The results of the correlations between PS-CPT data recorded during field testing yield a profile of geotechnical parameters at the 15 sounding locations tested at the Pond Creek facility. Effective and total stresses provide an indication of the stresses being experienced insitu, and generally will increase as material is placed on top of the existing materials to the lines and grades of the proposed final geometry.

In-situ effective friction values were correlated using in-situ corrected tip resistance and effective overburden pressures for the 15 soundings tested at the Pond Creek facility.

CONCLUSIONS:

Summarizing, data recorded during PS-CPT field testing was used to correlate index and strength parameters for comparison to limited laboratory testing at discrete sample locations and to develop nearly continuous profile(s) of engineering properties with depth to model the variability of the insitu conditions at the Pond Creek facility.

Based on modified results, the correlated parameters from PS-CPT are generally consistent with each other and similar parameters determined from similar materials at other refuse facilities, and from laboratory testing of discrete samples. Therefore, in general, a reasonably high confidence level exists applying/using the results of the PS-CPT correlations to the 15 profiles shown in the attached tables.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 7 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-1

ConeTec Inc. Interpretation
Interpretation C lease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4622
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-1
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 13:23
CPT File: 804CP01.COR
Northing (m): 0.000000
Easting (m): 0.000000
Elevation (m): 482.2

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	41.95	2.42	78.91	26.81	2.36

User Inputs:
Assumed: Water Table Depth (ft): 15.3
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
Ground Surface Elev. 482.2
CPT area ratio: 0.85 See Below
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.026	16.61	0.44	2.66	0.11	1619.49	2.651	1.66	1619.49	2.65	5	125.00	0.010	0.010	0.000	2.000	2.89	5.79	0.514	16.61	5.45572	52.56
0.492	481.698	45.67	1.03	2.25	4.37	1484.2	2.257	1.60	1483.55	2.25	5	125.00	0.031	0.031	0.000	2.000	7.79	15.57	1.413	45.65	4.991	52.25
0.82	481.370	44.31	1.6	3.61	-3.26	863.585	3.615	1.86	863.98	3.61	5	125.00	0.051	0.051	0.000	2.000	8.26	16.52	1.370	44.33	9.36475	50.29
1.148	481.042	49.34	1.93	3.91	-6.42	686.666	3.917	1.92	687.22	3.91	5	125.00	0.072	0.072	0.000	2.000	9.42	18.84	1.626	49.38	10.8792	49.41
1.476	480.714	50.64	2.12	4.19	-7.64	547.943	4.194	1.98	548.49	4.19	5	125.00	0.092	0.092	0.000	2.000	9.80	19.60	1.565	50.69	12.4636	48.51
1.804	480.386	45.45	2.14	4.71	-0.65	402.104	4.720	2.06	402.10	4.72	4	125.00	0.113	0.113	0.000	2.000	9.23	18.46	1.404	45.45	15.2837	47.21
2.133	480.057	40.4	1.81	4.48	3.68	302.047	4.495	2.12	301.82	4.50	4	125.00	0.133	0.133	0.000	2.000	8.32	16.64	1.247	40.37	16.3803	45.86
2.461	479.729	34.96	1.32	3.78	8.22	226.29	3.792	2.12	225.96	3.80	5	125.00	0.154	0.154	0.000	2.000	7.19	14.38	1.078	34.91	16.3426	44.63
2.789	479.401	31.16	1.1	3.52	11.85	177.974	3.548	2.15	177.47	3.56	5	125.00	0.174	0.174	0.000	2.000	6.50	12.99	0.960	31.11	17.7915	43.48
3.117	479.073	29.29	1.15	3.92	14.97	149.35	3.953	2.23	148.89	3.96	5	125.00	0.195	0.195	0.000	2.000	6.31	12.62	0.901	29.2	20.1364	42.62
3.445	478.745	29.06	1.09	3.74	29.44	133.967	3.779	2.25	133.13	3.80	5	125.00	0.215	0.215	0.000	2.000	6.26	12.55	0.893	28.98	20.6255	42.05
3.773	478.417	32.91	1.15	3.49	32.84	138.56	3.520	2.21	137.67	3.54	5	125.00	0.236	0.236	0.000	2.000	7.01	14.02	1.012	32.7	19.4713	42.22
4.101	478.089	34.84	1.39	4	29.66	134.928	4.018	2.27	134.19	4.04	5	125.00	0.256	0.255	0.000	1.975	7.58	15.00	1.071	34.65	21.3078	42.09
4.429	477.761	35.36	1.49	4.22	29.72	126.812	4.245	2.30	126.16	4.27	4	125.00	0.277	0.277	0.000	1.901	7.83	14.88	1.087	35.2	22.5787	41.78
4.757	477.433	34.51	1.53	4.44	31.68	115.073	4.472	2.35	114.40	4.50	4	125.00	0.297	0.297	0.000	1.834	7.76	14.27	1.059	34.31	24.2407	41.27
5.085	477.105	32.05	1.52	4.75	32.73	99.8466	4.790	2.41	99.16	4.82	4	125.00	0.318	0.318	0.000	1.774	7.42	13.17	0.982	31.84	26.6972	40.52
5.413	476.777	33.07	1.53	4.62	33.55	86.7499	4.674	2.41	86.13	4.70	4	125.00	0.338	0.338	0.000	1.719	7.66	13.17	1.013	32.86	26.6937	40.36
5.741	476.449	28.11	1.63	5.81	25.35	77.3418	5.874	2.54	76.90	5.91	3	125.00	0.359	0.359	0.000	1.569	6.95	11.61	0.859	27.95	32.7178	39.15
6.069	476.121	23.82	1.72	7.24	9.62	61.7978	7.338	2.82	61.67	7.35	3	125.00	0.379	0.379	0.000	1.624	6.43	10.27	0.726	23.77	39.3343	37.91
6.398	475.792	23.35	1.75	7.49	4.73	57.3932	7.625	2.71	57.32	7.64	3	125.00	0.400	0.400	0.000	1.581	6.31	9.96	0.711	23.32	41.0639	37.49
6.726	475.464	25.01	1.76	7.04	6.71	58.4945	7.157	2.66	58.42	7.17	3	125.00	0.420	0.420	0.000	1.542	6.67	10.29	0.761	24.98	39.6542	37.80
7.054	475.136	26.32	1.96	7.47	4.23	58.6995	7.574	2.70	58.63	7.58	3	125.00	0.441	0.441	0.000	1.506	7.09	10.67	0.801	26.29	40.6073	37.62
7.382	474.808	26.5	1.77	6.7	3.32	56.437	6.798	2.68	56.39	6.80	3	125.00	0.461	0.461	0.000	1.472	7.04	10.37	0.806	26.48	39.2566	37.40
7.71	474.480	22.44	1.48	6.61	3	45.5681	6.740	2.74	45.53	6.75	3	125.00	0.482	0.482	0.000	1.441	6.15	8.86	0.680	22.42	42.3496	36.15
8.038	474.152	24.71	1.6	6.49	3.7	48.1864	6.609	2.71	48.15	6.61	3	125.00	0.502	0.502	0.000	1.411	6.62	9.44	0.749	24.69	41.1319	36.48
8.365	473.824	35.83	2.03	5.68	4.8	67.525	5.750	2.57	67.47	5.75	3	125.00	0.523	0.523	0.000	1.383	9.02	12.48	1.093	35.8	33.9863	36.42
8.694	473.496	39.18	2.59	6.61	3.46	71.1049	6.703	2.61	71.07	6.71	3	125.00	0.543	0.543	0.000	1.357	10.06	13.64	1.196	39.16	35.8018	36.71
9.022	473.168	64.62	3.1	4.8	6.26	113.6	4.840	2.37	113.53	4.84	11	125.00	0.564	0.564	0.000	1.332	14.83	19.75	1.983	64.58	25.3247	41.23
9.35	472.840	86.35	5.07	5.87	3.14	146.765	5.911	2.36	146.70	5.91	11	125.00	0.584	0.584	0.000	1.308	19.89	26.02	2.655	86.33	25.6191	42.54
9.678	472.512	73.23	5.54	7.56	-2.24	120.066	7.628	2.52	120.08	7.63	11	125.00	0.605	0.605	0.000	1.285	18.01	23.16	2.246	73.24	31.6127	41.52
10.006	472.184	46.41	4.03	8.68	-9.82	73.2115	8.802	2.69	73.31	8.79	8	125.00	0.625	0.625	0.000	1.265	12.47	15.77	1.417	46.47	40.1446	38.86
10.335	471.855	39.89	2.66	6.66	-11.16	60.7552	6.778	2.65	60.86	6.77	3	125.00	0.646	0.646	0.000	1.244	10.50	13.07	1.215	39.96	36.0706	37.83
10.663	471.527	54.17	2.97	5.48	-11.19	80.2829	5.551	2.51	80.39	5.54	3	125.00	0.666	0.666	0.000	1.225	13.28	16.26	1.656	54.24	31.1774	38.39
10.991	471.199	62.34	4.01	6.44	-10.85	89.7506	6.504	2.54	89.85	6.50	11	125.00	0.687	0.687	0.000	1.207	15.46	18.65	1.909	62.41	32.3205	39.02
11.319	470.871	75.65	4.56	6.06	-9.15	105.935	6.111	2.47	106.01	6.11	11	125.00	0.707	0.707	0.000	1.189	18.19	21.60	2.320	75.7	29.4448	40.87
11.647	470.543	96	6.72	7	-6.93	130.879	7.053	2.47	130.93	7.05	11	125.00	0.728	0.728	0.000	1.172	23.07	27.04	2.950	96.04	28.4226	41.97
11.975	470.215	83.38	6.59	7.9	-7.87	110.405	7.975	2.56	110.47	7.97	11	125.00	0.748	0.748	0.000	1.156	20.88	24.13	2.558	83.43	33.2785	41.09
12.303	469.887	57.02	4.42	7.74	-9.36	75.1543	7.856	2.66	75.22	7.85	5	125.00	0.769	0.769	0.000	1.140	15.01	17.11	1.742	57.08	36.1113	38.86
12.631	469.559	67.48	3.97	5.89	-6.63	84.4786	5.953	2.52	84.57	5.95	11	125.00	0.789	0.789	0.000	1.125	16.61	18.70	2.065	67.52	31.6801	39.66
12.959	469.231	79.63	5.29	6.64	-4.3	97.3162	6.711	2.53	97.36	6.71	11	125.00	0.810	0.810	0.000	1.111	19.65	21.93	2.440	79.68	31.9895	40.42
13.287	468.903	74.37	5.39	7.24	-3.35	88.5552	7.329	2.58	88.58	7.33	11	125.00	0.830	0.830	0.000	1.097	18.85	20.68	2.277	74.39	34.4742	39.92
13.615	468.575	71.75	5.08	7.08	-2.33	83.3186	7.165	2.59	83.34	7.16	11	125.00	0.851	0.851	0.000	1.084	18.25	19.79	2.195	71.77	34.8502	39.59
13.943	468.247	102.33	5.18	5.06	-0.78	116.427	5.106	2.38	116.44	5.11	11	125.00	0.871	0.871	0.000	1.071	22.62	25.31	2.141	102.34	25.8028	41.36
14.271	467.919	114.91	6.8	5.91	2.36	127.832	5.964	2.42	127.81	5.97	11	125.00	0.892	0.892	0.000	1.059	26.91	28.49	3.530	114.89	27.1057	41.84
14.6	467.590	134.53	9.49	7.06	8.8	146.43	7.102	2.45	146.36	7.11	11	125.00	0.913	0.913	0.000	1.047	31.95	33.45	4.137	134.47	28.4187	42.53
14.928	467.262	140.8	8.87	6.3	10.72	149.911	6.342	2.40	149.84	6.34	11	125.00	0.933	0.935	0.000	1.035	32.73	33.86	4.330	140.73	26.4589	42.65
15.256	466.934	130.38	7.43	5.7	7.1	135.749	5.740	2.39	135.73	5.74	11	125.00	0.954	0.954	0.000	1.024	30.14	30.8	4.007	130.38	25.9423	42.15

R14528

Depth (ft)	Sam (s	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)		EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.606	108.8	7.14	6.56	-4.18	111.721	6.622	2.49	111.71	6.62	11	135.00	0.974	0.965	0.009	1.015	26.54	26.81	3.938	109.82	30.1191	41.15
15.912	466.278	78.99	5.55	7.03	-5.77	79.9262	7.116	2.60	79.86	7.11	11	135.00	0.996	0.977	0.019	1.012	20.18	20.42	2.415	79.02	35.2737	39.35
16.24	465.950	119.1	5.81	4.88	0.48	119.401	4.920	2.37	119.40	4.92	11	135.00	1.018	0.989	0.029	1.006	27.25	27.41	3.656	119.1	25.0315	41.50
16.568	465.622	148.8	8.34	5.6	1.5	147.633	5.644	2.36	147.64	5.64	11	135.00	1.040	1.021	0.040	1.000	34.00	33.98	4.575	148.81	24.89	42.58
16.896	465.294	186.21	10.35	5.59	7.64	181.826	5.620	2.31	181.78	5.62	11	135.00	1.063	1.013	0.050	0.994	41.38	41.12	5.701	185.16	22.9713	43.60
17.224	464.966	333.69	12.91	3.87	16.83	324.597	3.881	2.05	324.50	3.88	12	135.00	1.085	1.025	0.060	0.988	66.92	66.01	10.297	333.59	14.2684	46.26
17.552	464.638	421.41	14.07	3.34	22.43	405.472	3.346	1.95	405.46	3.35	12	135.00	1.107	1.037	0.070	0.982	81.17	79.72	13.012	421.27	11.5386	47.26
17.88	464.310	395.49	15.59	3.94	0.37	376.125	3.953	2.03	376.12	3.95	12	135.00	1.129	1.046	0.080	0.977	78.54	76.70	12.209	395.49	13.6425	46.93

R14529

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 10 OF 48

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NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-2

ConeTec Inc.
Interpretation C ase 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4589
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-2
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 13:46
CPT File: 804CP02.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 494.21

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.31	1.63	53.64	24.15	2.30
125	Residual Soil	27.01	1.39	47.19	58.75	2.99

User Inputs:

Assumed:
Water Table Depth (ft): 38.8
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
Ground Surface Elev. 494.2
CPT area ratio: 0.85 See Below
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	494.046	4.44	0.09	1.92	-0.14	415.51	2.032	1.75	415.61	2.03	4	130.00	0.011	0.011	0.000	2.000	0.80	1.59	0.137	4.44	7.08955	47.35
0.492	493.718	15.27	0.31	2	0	476.486	2.034	1.72	476.49	2.03	5	130.00	0.032	0.032	0.000	2.000	2.71	5.42	0.472	15.27	6.5252	47.93
0.82	493.390	32.2	0.81	2.51	0.41	603.128	2.520	1.76	603.13	2.52	6	130.00	0.053	0.053	0.000	2.000	5.60	11.60	0.995	32.2	7.32759	48.89
1.148	493.062	74.45	2.09	2.81	0.28	996.722	2.810	1.73	996.86	2.81	6	130.00	0.075	0.075	0.000	2.000	13.28	26.57	2.303	74.46	6.76919	50.63
1.476	492.734	107.36	2.18	2.03	0.29	1118.03	2.032	1.59	1118.03	2.03	7	130.00	0.096	0.096	0.000	2.000	18.21	36.42	3.321	107.36	4.12002	51.25
1.804	492.406	114.67	2.19	1.91	0.11	976.912	1.912	1.58	976.91	1.91	7	130.00	0.117	0.117	0.000	2.000	19.39	38.78	3.547	114.67	3.98073	50.75
2.133	492.077	93.71	1.85	1.98	-0.3	674.899	1.977	1.65	674.90	1.98	7	130.00	0.139	0.139	0.000	2.000	16.22	32.44	2.897	93.71	5.13754	49.34
2.461	491.749	78.06	1.5	1.92	-0.23	486.982	1.926	1.70	486.98	1.93	7	130.00	0.160	0.160	0.000	2.000	13.74	27.49	2.412	78.06	6.04007	48.02
2.789	491.421	58.8	1.47	2.51	0.67	323.351	2.508	1.88	323.35	2.51	6	130.00	0.181	0.181	0.000	2.000	11.06	22.13	1.815	58.8	9.97805	46.26
3.117	491.093	40.59	0.92	2.26	0.62	199.341	2.278	1.96	199.39	2.28	6	130.00	0.203	0.203	0.000	2.000	7.66	15.75	1.250	40.6	11.9985	44.04
3.445	490.765	26.44	0.57	2.16	0.21	117.075	2.174	2.10	117.08	2.17	6	130.00	0.224	0.224	0.000	2.000	5.40	10.79	0.812	26.44	15.6629	41.39
3.773	490.437	29.6	0.5	1.68	0.56	119.696	1.703	2.01	119.74	1.70	6	130.00	0.245	0.245	0.000	2.000	5.85	11.69	0.909	29.61	13.2397	41.51
4.101	490.109	25.33	0.62	2.43	0.39	94.0237	2.474	2.20	94.02	2.47	6	130.00	0.267	0.267	0.000	1.937	5.40	10.46	0.778	25.33	19.0184	40.24
4.429	489.781	28.49	0.71	2.5	0.44	97.9631	2.518	2.19	97.96	2.52	6	130.00	0.288	0.288	0.000	1.864	6.08	11.29	0.873	28.49	18.8025	40.46
4.757	489.453	31.04	0.87	2.79	0.58	99.3865	2.831	2.23	99.42	2.83	6	130.00	0.309	0.309	0.000	1.798	6.69	12.04	0.951	31.05	19.9408	40.64
5.085	489.125	58.32	1.1	1.88	0.53	176.447	1.897	1.94	176.45	1.90	7	130.00	0.331	0.331	0.000	1.739	11.19	19.47	1.795	58.32	11.2709	43.43
5.413	488.797	64.77	1.14	1.76	0.39	183.087	1.770	1.90	183.12	1.77	7	130.00	0.352	0.352	0.000	1.686	12.27	20.69	1.994	64.78	10.4054	43.63
5.741	488.469	49.99	1.55	3.1	0.19	132.962	3.124	2.18	132.96	3.12	6	130.00	0.373	0.373	0.000	1.637	10.56	17.29	1.536	49.99	18.3323	42.05
6.069	488.141	98.88	2.6	2.63	1.89	249.656	2.636	1.95	249.68	2.64	7	130.00	0.394	0.394	0.000	1.592	19.06	30.34	3.049	98.89	11.5492	45.10
6.398	487.812	86.03	2.55	2.97	3.23	205.869	2.978	2.05	205.92	2.98	6	130.00	0.416	0.416	0.000	1.551	17.26	26.77	2.651	86.05	14.3668	44.20
6.726	487.484	74.12	2.09	2.82	2.7	168.537	2.836	2.08	168.56	2.84	6	130.00	0.437	0.437	0.000	1.512	15.07	22.79	2.281	74.13	15.335	43.23
7.054	487.156	57.9	1.75	3.03	0.39	125.279	3.047	2.19	125.30	3.05	6	130.00	0.459	0.459	0.000	1.477	12.27	18.13	1.778	57.91	18.5782	41.74
7.382	486.828	73.94	1.79	2.42	0.32	153.096	2.437	2.06	153.10	2.44	6	130.00	0.480	0.480	0.000	1.444	14.87	21.47	2.274	73.94	14.5542	42.75
7.71	486.500	100.23	1.95	1.95	0.48	199	1.955	1.91	199.00	1.96	7	130.00	0.501	0.501	0.000	1.413	19.07	26.93	3.088	100.23	10.6813	44.03
8.038	486.172	96.56	2.95	3.06	0.34	183.814	3.072	2.09	183.81	3.07	6	130.00	0.522	0.522	0.000	1.383	19.67	27.21	2.973	96.56	15.5135	43.65
8.366	485.844	180.73	3.63	2.78	5.11	239.405	2.788	1.99	239.46	2.79	7	130.00	0.544	0.544	0.000	1.356	25.62	34.75	4.031	130.76	12.698	44.90
8.694	485.516	98.21	2.49	2.54	0.94	172.789	2.550	2.04	172.81	2.55	7	130.00	0.565	0.565	0.000	1.330	19.62	26.10	3.023	98.22	14.0752	43.35
9.022	485.189	72.31	1.82	2.52	0.92	122.305	2.539	2.10	122.32	2.54	6	130.00	0.586	0.586	0.000	1.306	14.99	19.57	2.221	72.32	16.8246	41.62
9.35	484.860	80.46	1.62	2.02	0.93	131.374	2.029	2.04	131.39	2.03	7	130.00	0.608	0.608	0.000	1.283	16.07	20.61	2.472	80.46	14.0363	41.99
9.678	484.532	69.84	1.16	1.66	0.09	110.18	1.674	2.03	110.20	1.67	7	130.00	0.629	0.629	0.000	1.261	13.92	17.55	2.146	69.85	13.7865	41.06
10.006	484.204	61.74	0.9	1.45	-0.39	93.9277	1.473	2.04	93.93	1.47	7	130.00	0.650	0.650	0.000	1.240	12.34	15.30	1.891	61.74	14.1065	40.23
10.335	483.876	66.65	1.35	2.02	0.53	98.2148	2.046	2.13	98.23	2.05	7	130.00	0.672	0.672	0.000	1.220	13.79	16.82	2.043	66.66	16.6601	40.47
10.663	483.547	83.84	2.23	2.65	0.46	119.965	2.682	2.18	119.96	2.68	6	130.00	0.693	0.693	0.000	1.201	17.55	21.06	2.574	83.84	17.6802	41.52
10.991	483.219	117.25	2.55	2.17	0.83	163.12	2.188	2.00	163.12	2.19	7	130.00	0.714	0.714	0.000	1.183	23.09	27.32	3.608	117.25	13.0514	43.07
11.319	482.891	126.97	2.65	2.08	0.44	171.576	2.099	1.98	171.59	2.10	7	130.00	0.736	0.736	0.000	1.166	24.74	28.84	3.908	126.97	12.3081	43.32
11.647	482.563	100.73	2.81	2.79	1.16	132.055	2.811	2.15	132.07	2.81	6	130.00	0.757	0.757	0.000	1.149	20.99	24.12	3.095	100.74	17.2321	42.01
11.975	482.235	110.03	2.03	1.85	0.79	140.359	1.856	1.99	140.37	1.86	7	130.00	0.778	0.778	0.000	1.133	21.57	24.45	3.382	110.04	12.7249	42.32
12.303	481.907	89.84	1.64	1.83	0.58	111.343	1.842	2.05	111.36	1.84	7	130.00	0.800	0.800	0.000	1.118	18.07	20.20	2.757	89.85	14.5435	41.13
12.631	481.579	64.26	1.13	1.75	1.04	77.269	1.781	2.16	77.28	1.78	7	130.00	0.821	0.821	0.000	1.104	13.47	14.85	1.964	64.27	17.6781	39.17
12.959	481.251	53.66	0.81	1.5	0.76	62.7039	1.534	2.18	62.70	1.53	7	130.00	0.842	0.842	0.000	1.090	11.36	12.38	1.635	53.66	18.4929	38.00
13.287	480.923	47.49	0.8	1.68	-0.14	53.9872	1.716	2.27	54.00	1.72	7	130.00	0.864	0.864	0.000	1.076	10.41	11.20	1.444	47.5	21.2802	37.16
13.615	480.595	49.6	0.9	1.82	-0.26	55.0468	1.847	2.28	55.05	1.85	7	130.00	0.885	0.885	0.000	1.063	10.93	11.62	1.508	49.6	21.8025	37.26
13.943	480.267	33.73	0.59	1.74	-0.11	36.2175	1.797	2.41	36.22	1.80	6	130.00	0.906	0.906	0.000	1.050	7.89	8.29	1.016	33.73	26.9811	34.77
14.271	479.939	30.54	0.56	1.82	-0.3	31.9231	1.891	2.47	31.92	1.89	6	130.00	0.928	0.928	0.000	1.038	7.33	7.61	0.917	30.54	28.3952	34.00
14.6	479.610	31.88	0.48	1.49	0.09	32.5933	1.552	2.41	32.59	1.55	6	130.00	0.949	0.949	0.000	1.027	7.45	7.65	0.958	31.88	26.9209	34.13
14.928	479.282	41.36	0.41	0.98	-0.28	41.6251	1.015	2.22	41.63	1.02	7	130.00	0.970	0.970	0.000	1.015	8.89	9.02	1.250	41.36	19.6777	35.61
15.256	478.954	37.15	0.45	1.21	-0.14	36.4632	1.245	2.32	36.46	1.24	7	130.00	0.992	0.992	0.000	1.004	8.32	8.36	1.119	37.15	23.1707	34.81

R14531

Depth (ft)	San (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...sf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	476.626	35.51	0.42	1.19	0.23	34.0557	1.217	2.34	34.07	1.22	7	130.00	1.013	1.013	0.000	0.994	8.02	7.97	1.068	35.52	23.8923	34.40
15.912	476.298	35.52	0.45	1.26	0.07	33.3427	1.305	2.36	33.34	1.30	7	130.00	1.034	1.034	0.000	0.983	8.11	7.98	1.068	35.52	24.6516	34.27
16.24	477.970	39.22	0.5	1.28	0.18	36.1542	1.3101	2.33	36.16	1.31	7	130.00	1.056	1.056	0.000	0.973	8.85	8.61	1.182	39.23	23.7631	34.76
16.568	477.642	38.39	0.42	1.08	0	34.648	1.126	2.31	34.65	1.13	7	130.00	1.077	1.077	0.000	0.964	8.68	8.27	1.155	38.39	22.946	34.50
16.896	477.314	40.69	0.25	0.6	0.04	36.0502	0.631	2.17	36.05	0.63	7	130.00	1.098	1.098	0.000	0.954	8.56	8.16	1.226	40.69	17.9445	34.74
17.224	476.986	26.93	0.46	1.71	0.18	23.0541	1.782	2.57	23.05	1.78	6	130.00	1.120	1.120	0.000	0.945	6.78	6.41	0.799	26.93	33.9054	31.95
17.552	476.658	23.41	0.62	2.63	0.25	19.5192	2.784	2.74	19.52	2.78	5	130.00	1.141	1.141	0.000	0.936	6.44	6.03	0.689	23.41	42.7657	30.87
17.88	476.330	65.32	1.62	2.49	0.04	55.2036	2.525	2.37	55.20	2.53	6	130.00	1.162	1.162	0.000	0.928	14.98	13.89	1.986	65.32	25.2127	37.27
18.208	476.002	75.66	2.12	2.8	0.99	62.9279	2.84654	2.36561	62.9279	2.84654	6	130.00	1.18352	1.18352	0	0.9192	17.31394	15.91506	2.30577	75.66	25.0311	38.024
18.537	475.673	74.29	1.97	2.66	0.05	60.6563	2.69549	2.36029	60.6563	2.69549	6	130.00	1.20491	1.204905	0	0.911	16.96011	15.45084	2.2527	74.29	24.8219	37.815
18.865	475.345	66.95	1.6	2.4	0.05	53.5985	2.43443	2.36877	53.5985	2.43443	6	130.00	1.22623	1.226225	0	0.9031	15.34246	13.85511	2.03479	66.95	25.186	37.104
19.193	475.017	63.66	1.37	2.16	0.04	49.9481	2.1986	2.36187	49.9481	2.1986	7	130.00	1.24755	1.247545	0	0.8953	14.52072	13.0005	1.92918	63.66	24.8839	36.693
19.521	474.689	54.9	1.01	1.84	0.12	42.267	1.88323	2.37383	42.267	1.88323	7	130.00	1.26887	1.268865	0	0.8878	12.60965	11.19426	1.66041	54.9	25.3569	35.705
19.849	474.361	41.75	0.84	2.02	0.51	31.3597	2.07613	2.50167	31.3597	2.07613	6	130.00	1.29019	1.290185	0	0.8804	10.17354	8.956661	1.25263	41.75	30.7577	33.687
20.177	474.033	45.14	0.57	1.25	0.28	33.4185	1.30052	2.35955	33.4108	1.30082	7	130.00	1.31151	1.311505	0	0.8732	10.29958	8.993624	1.35692	45.13	24.7928	34.278
20.505	473.705	50.75	0.66	1.29	0.28	37.077	1.33557	2.329	37.077	1.33557	7	130.00	1.33293	1.332825	0	0.8662	11.42634	9.897887	1.52994	50.75	23.6109	34.915
20.833	473.377	43.95	0.93	2.11	0.21	31.4559	2.18331	2.51412	31.4559	2.18331	6	130.00	1.35415	1.354145	0	0.8593	10.77355	9.25819	1.31876	43.95	31.3181	33.906
21.161	473.049	37.82	0.76	2	0.16	26.4962	2.08536	2.56098	26.4962	2.08536	6	130.00	1.37547	1.375465	0	0.8527	9.483875	8.086508	1.12031	37.82	33.4834	32.832
21.489	472.721	31.66	0.63	1.99	0.12	21.6663	2.08174	2.6309	21.6663	2.08174	6	130.00	1.39679	1.396785	0	0.8461	8.221135	6.956119	0.93694	31.66	36.886	31.548
21.817	472.393	29.26	0.61	1.75	0.11	19.6332	1.83177	2.63406	19.6332	1.83177	6	130.00	1.41811	1.418105	0	0.8397	7.610153	6.390564	0.86198	29.26	37.0448	30.91
22.145	472.065	27.79	0.57	2.04	0.16	18.3063	2.16314	2.70017	18.3063	2.16314	6	130.00	1.43943	1.439425	0	0.8335	7.479319	6.234011	0.81581	27.79	40.4629	30.453
22.473	471.737	29.87	0.47	1.58	0.21	19.4485	1.65439	2.61284	19.4485	1.65439	6	130.00	1.46075	1.460745	0	0.8274	7.685847	6.35923	0.87954	29.87	35.9877	30.848
22.802	471.408	28.42	0.58	2.03	0.16	18.1751	2.1531	2.70156	18.1751	2.1531	6	130.00	1.48213	1.48213	0	0.8214	7.654487	6.287427	0.83399	28.42	40.5369	30.406
23.13	471.080	31.05	0.62	1.99	0.28	19.6525	2.09838	2.66738	19.6525	2.09838	6	130.00	1.50345	1.50345	0	0.8156	8.214939	6.699769	0.91475	31.05	38.7436	30.916
23.458	470.752	46.22	1.11	2.4	0.37	29.3128	2.48349	2.57298	29.3128	2.48349	6	130.00	1.52477	1.52477	0	0.8098	11.65897	9.441869	1.38375	46.22	34.0532	33.467
23.786	470.424	39.92	0.83	2.08	0.37	24.82	2.16293	2.59318	24.82	2.16293	6	130.00	1.54609	1.54609	0	0.8042	10.1712	8.180027	1.18805	39.92	35.0255	32.418
24.114	470.096	27.53	0.53	1.93	0.37	16.564	2.0414	2.72157	16.564	2.0414	6	130.00	1.56741	1.56741	0	0.7987	7.493763	5.985618	0.8038	27.53	41.6107	29.796
24.442	469.768	29.77	0.51	1.72	0.37	17.7382	1.80971	2.66769	17.7382	1.80971	6	130.00	1.58873	1.58873	0	0.7934	7.677548	6.249799	0.87249	29.77	38.7598	30.247
24.77	469.440	42.36	0.65	1.53	0.82	25.8097	1.59509	2.50911	25.8097	1.59509	7	130.00	1.61005	1.61005	0	0.7881	10.35889	8.163824	1.26161	42.36	31.0917	32.542
25.099	469.112	53.82	1.3	2.41	0.39	31.9907	2.49096	2.54436	31.9907	2.49096	6	130.00	1.63137	1.63137	0	0.7829	13.08709	10.48117	1.61575	53.82	32.7057	34.01
25.426	468.784	51.09	0.9	1.77	0.53	29.9072	1.82086	2.4837	29.9011	1.82122	7	130.00	1.65269	1.65269	0	0.7779	12.33893	9.59802	1.53026	51.07	29.9596	33.591
25.754	468.456	40.34	0.96	2.39	0.39	23.0978	2.48828	2.65426	23.0978	2.48828	6	130.00	1.67401	1.67401	0	0.7729	10.60082	8.193331	1.19709	40.34	38.0689	31.959
26.082	468.128	38.33	0.62	1.36	0.09	21.6092	1.41942	2.5382	21.6092	1.41942	7	130.00	1.69533	1.69533	0	0.768	9.50564	7.300528	1.11342	38.33	32.4199	31.531
26.41	467.800	33.19	0.47	1.42	0.42	18.3342	1.49333	2.61024	18.3342	1.49333	7	130.00	1.71665	1.71665	0	0.7632	8.52896	6.509614	0.97441	33.19	35.8595	30.463
26.739	467.471	35.49	0.61	1.72	0.44	19.4196	1.8073	2.63471	19.4196	1.8073	6	130.00	1.73804	1.738035	0	0.7585	9.233542	7.003886	1.04495	35.49	37.0774	30.839
27.067	467.143	42.19	0.58	1.38	0.21	22.9804	1.43456	2.51828	22.9804	1.43456	7	130.00	1.75936	1.759355	0	0.7539	10.36277	7.812664	1.25172	42.19	31.5067	31.926
27.395	466.815	45.32	0.59	1.3	0.28	24.4566	1.35479	2.4822	24.451	1.3551	7	130.00	1.78068	1.780675	0	0.7494	10.94193	8.199766	1.34828	45.32	29.8936	32.323
27.723	466.487	34.11	0.71	2.09	0.25	17.929	2.1976	2.71151	17.929	2.1976	6	130.00	1.802	1.801995	0	0.7449	9.235424	6.879887	1.00025	34.11	41.0689	30.317
28.051	466.159	38.11	0.64	1.67	0.16	19.9015	1.76373	2.61995	19.9015	1.76373	7	130.00	1.82332	1.823315	0	0.7406	9.84131	7.28823	1.12343	38.11	36.3399	30.998
28.379	465.831	54.69	0.64	1.17	0.14	28.6427	1.21131	2.39804	28.6427	1.21131	7	130.00	1.84464	1.844635	0	0.7363	12.69719	9.346728	1.63577	54.68	26.331	33.329
28.707	465.503	38.3	0.69	1.78	0.12	19.5257	1.86639	2.64061	19.5257	1.86639	6	130.00	1.86598	1.865955	0	0.7321	9.994656	7.316734	1.12799	38.3	37.3751	30.874
29.035	465.176	39.55	0.71	1.8	0.09	19.9561	1.88515	2.63527	19.9561	1.88515	6	130.00	1.88728	1.887275	0	0.7279	10.29276	7.492265	1.16603	39.55	37.1054	31.016
29.363	464.847	36.83	0.63	1.71	0.04	18.2969	1.80405	2.65573	18.2969	1.80405	6	130.00	1.9086	1.908695	0	0.7238	9.685775	7.01099	1.08116	36.83	38.1443	30.45
29.691	464.519	45.2	0.73	1.62	0.32	22.4207	1.68708	2.56643	22.4155	1.68747	7	130.00	1.92992	1.929915	0	0.7198	11.36246	8.179058	1.33963	45.19	33.742	31.767
30.019	464.191	50.69	0.58	1.15	0.3	24.9784	1.19002	2.44406	24.9784	1.19002	7	130.00	1.95124	1.951235	0	0.7159	12.62198	8.605381	1.50894	50.69	28.246	32.458
30.347	463.863	39.45	0.49	1.23	0.32	18.9994	1.30745	2.56664	18.9994	1.30745	7	130.00	1.97256	1.972555	0	0.712	9.920241	7.0633	1.16029	39.45	33.752	30.698
30.6755	463.535	51.05	0.69	1.36	0.21	24.6034	1.40655	2.48892	24.6984	1.40684	7	130.00	1.99389	1.993875	0	0.7082	12.36218	8.754796	1.51877	51.04	30.1901	32.361
31.004	463.206	35.96	0.8	2.22	0.25	16.8439	2.35677	2.75119	16.8439	2.35677	6	130.00	2.01526	2.01526	0	0.7044	9.945252	7.005679	1.05092	35.96	43.233	29.907
31.332	462.878	34.69	0.81	2.33	0.23	16.0336	2.4806	2.78153	16.0335	2.4808	6	130.00	2.03658	2.03658	0	0.7007	9.764086	6.894958	1.01094	34.69	44.9361	29.581
31.66	462.550	32.8	0.69	2.11	0.04	14.9366	2.24448	2.78183	14.9366	2.24448	6	130.00	2.0579	2.0579	0	0.6971	9.224214	6.430093	0.95177	32.8	44.9595	29.119
31.988	462.222	41.84	0.77	1.83	0.11	19.1229	1.93656	2.65715	19.1229	1.93658	6	130.00	2.07922	2.07922	0	0.6935	11.01138	7.636449	1.23098	41.84	38.2171	30.736
32.316	461.894	37.05	1.05	2.83	0.04	16.6383	3.00434	2.81773	16.6383	3.00434	6	125.00	2.10054	2.10054	0	0.69	10.62955	7.334144	1.08203	37.05	47.0264	29.826
32.644	461.566	67.03	0.55	0.82	-5.6	30.6024	0.84734	2.29207	30.6213	0.84682	8	125.00	2.12104	2.12104	0	0.6866	14.85816	10.20282	2.00957	67.07	22.2286	33.739
32.972	461.238	54.68	1.11	2.03	0.21	24.533	2.11274	2.59114	24.533	2.11274	7	125.00	2.14154	2.14154	0	0.6833	13.91768	9.510511	1.62658	54.68	34.9261	32.344
33.3	460.910	49.23	1.53	3.11	2.91	21.7702	3.25062	2.74669	21.7754	3.24924	6	125.00	2.16204	2.15208	0	0.6801	13.58773	9.240813	1.45721	49.25	42.084	31.581
33.628	460.582	42.89	1.67	3.9	0.53	18.6514	4.10244	2.86303	18.6514	4.10244	5	125.00	2.18254	2.18254	0	0.6769	12.62559	8.54815	1.26028	42.89	49.722	30.575
33.956	460.254	42.8	1.32	3.09	0.12	19.4277	3.25147	2.80356	19.4277	3.25147	6	125.00	2.20304	2.20304	0	0.6737	12.18217	8.207546	1.25627	42.8	46.2006	30.497
34.284	459.926	30.89	1.35	4.37	0.37	12.8923	4.70934	3.02532	12.8878	4.71098	4	125.00	2.22354	2.22354	0	0.6706	10.02714	6.72442	0.86751	30.88	60.2073	28.127
34.612	459.598	24.22	1.28	5.28	0.81	9.79303	5.82455	3.1763	9.78858	5.8277	3	125.00	2.24404	2.24404	0	0.6675	8.694916	5.804303	0.68037	24.21	71.1657	26.272
34.941	459.269	21.73	0.96	4.43	1.31	8.5955	4.93183	3.17671	8.59109	4.93046	4	125.00	2.26456	2.264603	0	0.6645	7.802906	5.185139	0.60264	21.72	71.1974	25.386
35.269	458.941	23.04	0.79	3.42	1.72	9.0807	3.60633	3.09075	9.07832	3.60617	5	125.00	2.2851	2.285175	0	0.6615	7.80225	5.161394	0.64257	23.03	64.9092	25.762
35.597	458.613	22.63	0.74	3.26	2.47	8.81522	3.64094	3.09045	8.80655	3.64452	5	125.00	2.3056	2.305603	0	0.6585	7.858449	5.043693	0.62924	22.61	64.7858	25.556
35.925	458.285	23.37	0.6	2.57	3.4	9.04686	2.85118	3.02107	9.04825	2.9539	5	125.00	2.3261	2.326103	0	0.6557	7.58159	4.95791	0.65151	23.35	59.9152	25.732
36.253	457.957	29.16	0.73	2.49	9.07	11.4765	2.72252	2.9268	11.4009	2.72763	6	125.00	2.3466	2.346803	0	0.6528	8.891671	5.804484	0.83014	29.1	53.6748	27.302
36.581	457.629	30.74	0.64	2.07	12.21	11.9963	2.25567	2.86414	11.9525	2.26205	6	125.00	2.3671	2.367103	0	0.65	9.021822	5.870002	0.87642	30.66	49.7897	27.622
36.909	457.301	30.69	0.47	1.52	13.92	11.8539	1.66064	2.79759	11.8162	1.66593	6	125.00	2.3876	2.387503	0	0.6472	8.860726	5.617913	0.87624	30.6	45.9547	27.544
37.237	456.973	31.75	0.55	1.72	16.67	12.1888	1.87381	2.81505	12.1431	1.88086	6	125.00	2.4081	2.408103	0	0.6444	9.066453	5.842516	0.90873	31.65	46.8672	27.728
37.565	456.645	33.62	0.61	1.8	17.96	12.8434	1.95567	2.80566	12.7981	1.96259	6	125.00	2.4286	2.428703	0	0.6417	9.549631	6.127468	0.96565	33.61	46.3211	28.051

R14532

Depth (ft)	Sar	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt (pcf)	ss (.)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	456.317	32.15	0.63	1.95	15.64	12.1273	2.12115	2.84602	12.0783	2.12975	6	125.00	2.4481	2.464103	0	0.639	9.337217	5.965486	0.91950	32.03	46.6975	27.692
38.221	455.989	25.87	0.50	2.26	19.84	9.47587	2.47859	2.97339	9.42678	2.49137	6	125.00	2.4696	2.489503	0	0.6363	8.094387	5.15075	0.72447	25.75	56.71	26.018
38.549	455.661	21.3	0.57	3.13	19.56	7.55386	3.56195	3.14336	7.50567	3.58482	5	125.00	2.4901	2.4901103	0	0.6337	7.134711	4.711459	0.58235	21.18	68.672	24.471
38.877	455.333	19.83	0.72	3.64	19.54	6.90511	4.15719	3.21395	6.85727	4.18619	4	125.00	2.5106	2.5082	0.0024	0.6314	7.271031	4.591981	0.5362	19.71	74.0883	23.859
39.206	455.004	19.78	0.91	4.59	17.32	6.84374	5.27622	3.27716	6.80009	5.31409	3	125.00	2.53281	2.520143	0.0127	0.6292	7.602996	4.788302	0.53397	19.67	79.1712	23.806
39.534	454.676	20.68	0.93	4.49	18.01	7.15825	5.13102	3.25407	7.11481	5.16235	3	125.00	2.55495	2.539049	0.0229	0.6284	7.814492	4.91094	0.56115	20.57	77.2888	24.117
39.862	454.348	20.78	0.84	4.03	18.73	7.15536	4.61465	3.22705	7.11212	4.6427	4	125.00	2.57708	2.5643956	0.0331	0.627	7.69793	4.826354	0.56366	20.67	75.1234	24.118
40.19	454.020	19.42	0.88	4.52	19.38	6.58126	5.23163	3.28913	6.5343	5.26922	3	125.00	2.59923	2.5556862	0.0434	0.6255	7.528098	4.708868	0.52077	19.5	80.159	23.549
40.518	453.692	16.99	0.73	4.36	19.84	5.59577	5.08051	3.33962	5.54903	5.1213	3	125.00	2.62137	2.567768	0.0536	0.6241	6.843678	4.279948	0.44485	16.87	84.4156	22.454
40.846	453.364	16.52	0.38	2.28	21.46	5.37916	2.73644	3.20777	5.32489	2.76635	5	125.00	2.64351	2.5736675	0.0638	0.6226	6.015767	3.745489	0.42961	16.38	73.6091	22.183
41.174	453.036	17.43	0.39	1.99	23.46	5.69704	2.30284	3.14792	5.63916	2.32648	5	125.00	2.66565	2.5915491	0.0741	0.6215	6.064749	3.779725	0.4571	17.28	69.0136	22.571
41.502	452.708	22.29	0.68	3.06	24.25	7.52921	3.469	3.13915	7.46776	3.49754	5	125.00	2.68779	2.603488	0.0843	0.6196	7.745791	4.800517	0.60688	22.12	68.3574	24.466
41.83	452.380	19.56	0.73	3.74	20.72	6.4603	4.32719	3.24865	6.40059	4.36079	4	125.00	2.70993	2.6153994	0.0945	0.6183	7.359357	4.550626	0.52229	19.45	76.8511	23.43
42.158	452.052	20.78	0.6	2.87	23.56	6.86938	3.32448	3.1617	6.8161	3.35647	5	125.00	2.73207	2.6273	0.1048	0.6169	7.337513	4.526828	0.55876	20.64	70.053	23.857
42.486	451.724	27.89	0.85	3.06	26.14	9.52399	3.36163	3.04802	9.45966	3.40466	5	125.00	2.75421	2.6392207	0.115	0.6155	9.132647	5.6216	0.7782	27.72	61.7782	26.072
42.814	451.396	26.69	1.21	4.53	37.12	9.77463	4.86935	3.12299	9.69787	4.91117	4	125.00	2.77638	2.651113	0.1252	0.6142	9.952366	6.050983	0.80228	28.46	67.1585	26.236
43.143	451.067	21.75	0.81	3.73	40.41	7.11643	4.27408	3.214	7.02255	4.33122	4	125.00	2.79856	2.6630056	0.1355	0.6128	7.931649	4.860415	0.58673	21.5	74.0922	24.089
43.471	450.739	22.78	0.68	3.01	41.96	7.46153	3.45703	3.14483	7.38059	3.50444	5	125.00	2.8207	2.6749962	0.1457	0.6114	7.909522	4.836057	0.61794	22.51	68.7816	24.388
43.799	450.411	20.59	0.61	2.97	43.95	6.80515	3.43717	3.18878	6.50094	3.48227	5	125.00	2.84284	2.686869	0.156	0.6101	7.35876	4.489329	0.54945	20.31	72.126	23.567
44.127	450.083	23.42	1.1	4.71	47.39	7.61643	5.35149	3.24833	7.50897	5.42807	3	125.00	2.85496	2.6987775	0.1662	0.6087	8.749722	5.32612	0.63838	23.13	76.8256	24.529
44.455	449.755	253.58	4.96	1.96	20.09	92.4833	1.98649	2.13724	92.6354	1.98758	8	125.00	2.87712	2.710882	0.1764	0.6074	52.82093	31.98092	7.76139	253.45	16.9566	40.151
44.783	449.427	555.99	13.9	2.5	21.27	203.145	2.5132	1.99391	203.193	2.5126	12	125.00	2.89929	2.7225888	0.1867	0.6061	109.1065	66.12409	17.1232	556.12	12.7819	44.134

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek
Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 14 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-2A

ConeTec Inc. Interpretation
Interpretation r lease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4556
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-2A
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 14:50
CPT File: 804CP02A.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 492.4

Material Types and Unit Weight (pcf)

		Phi Avg.	Su Avg.	Qc Avg.	Fc Avg.	Ic Avg.
		deg	tsf	tsf	%	%
130	Coarse Refuse	37.34	1.98	45.43	22.11	2.23
125	Residual Soil	30.69	2.60	96.31	45.18	2.80

User Inputs:

Assumed: Water Table Depth (ft): 37
Nk: 32.3
Slate Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 492.4
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	492.236	8.72	0.08	0.86	0.23	817.011	0.919	1.31	817.01	0.92	5	130.00	0.011	0.011	0.000	2.000	1.35	8.71	0.270	8.72	0.46799	50.08
0.492	491.908	16.38	0.2	1.22	0.05	511.195	1.223	1.51	511.20	1.22	6	130.00	0.032	0.032	0.000	2.000	2.71	5.43	0.506	16.38	3.08371	48.22
0.82	491.580	25.84	0.5	1.94	0.39	483.803	1.938	1.70	483.80	1.94	6	130.00	0.053	0.053	0.000	2.000	4.56	9.11	0.798	25.84	6.11479	47.99
1.148	491.252	28.06	0.51	1.82	0.21	375.307	1.821	1.73	375.31	1.82	6	130.00	0.075	0.075	0.000	2.000	5.00	10.01	0.867	28.06	6.6951	46.92
1.476	490.924	44.3	0.61	1.37	0.26	460.747	1.380	1.58	460.75	1.38	7	130.00	0.096	0.096	0.000	2.000	7.50	15.01	1.369	44.3	4.05565	47.79
1.804	490.596	29.61	0.72	2.43	0.14	250.663	2.460	1.93	250.66	2.45	6	130.00	0.117	0.117	0.000	2.000	5.66	11.31	0.910	29.51	11.2006	45.12
2.133	490.267	24.15	0.47	1.95	0.02	173.166	1.957	1.95	173.19	1.96	6	130.00	0.139	0.139	0.000	2.000	4.66	9.32	0.743	24.15	11.6289	43.36
2.461	489.939	20.69	0.35	1.67	0.39	128.341	1.705	1.99	128.40	1.70	6	130.00	0.160	0.160	0.000	2.000	4.06	8.11	0.636	20.7	12.6808	41.87
2.789	489.611	29.8	0.44	1.46	0.02	163.382	1.486	1.88	163.38	1.49	6	130.00	0.181	0.181	0.000	2.000	5.59	11.18	0.917	29.8	9.80656	43.08
3.117	489.283	30.73	0.22	0.72	0.05	150.674	0.721	1.68	150.67	0.72	7	130.00	0.203	0.203	0.000	2.000	5.39	10.77	0.945	30.73	5.79201	42.68
3.445	488.955	21.3	0.33	1.55	0.07	94.1211	1.566	2.06	94.12	1.57	6	130.00	0.224	0.224	0.000	2.000	4.25	8.57	0.653	21.3	14.6082	40.24
3.773	488.627	26.99	0.22	0.82	0.09	108.645	0.826	1.83	108.69	0.83	7	130.00	0.245	0.245	0.000	2.000	4.96	9.93	0.825	26.9	8.76744	41.01
4.101	488.299	18.81	0.35	1.84	0.07	69.5644	1.887	2.21	69.56	1.89	6	130.00	0.267	0.267	0.000	1.937	4.03	7.80	0.574	18.81	19.3515	38.59
4.429	487.971	43.41	0.31	0.72	0.16	149.799	0.719	1.68	149.79	0.72	7	130.00	0.288	0.288	0.000	1.884	7.61	14.19	1.335	43.41	5.0155	42.65
4.757	487.643	28.48	0.59	2.06	0.16	90.9455	2.098	2.16	90.95	2.10	6	130.00	0.309	0.309	0.000	1.798	5.96	10.71	0.871	28.43	17.646	40.06
5.085	487.315	16	0.39	2.44	0.49	47.4078	2.489	2.41	47.41	2.49	5	130.00	0.331	0.331	0.000	1.739	3.74	6.51	0.485	16	27.0118	36.39
5.413	486.987	29.13	0.49	1.69	0.72	81.7921	1.703	2.15	81.79	1.70	6	130.00	0.352	0.352	0.000	1.686	6.03	10.16	0.891	29.13	16.6865	39.48
5.741	486.659	49.67	0.79	1.59	0.67	132.105	1.603	1.96	132.10	1.60	7	130.00	0.373	0.373	0.000	1.637	9.63	15.76	1.526	49.67	11.947	42.01
6.069	486.331	53.37	0.83	1.55	0.05	134.29	1.567	1.95	134.29	1.57	7	130.00	0.394	0.394	0.000	1.592	10.30	16.40	1.640	53.37	11.6376	42.10
6.398	486.002	49.99	0.63	1.26	1.39	119.182	1.271	1.92	119.21	1.27	7	130.00	0.416	0.416	0.000	1.551	9.55	14.80	1.534	49.99	10.9396	41.49
6.726	485.674	36.17	0.52	1.35	0.56	86.3076	1.378	2.05	86.31	1.38	7	130.00	0.437	0.437	0.000	1.512	7.65	11.57	1.169	36.17	14.3272	39.78
7.054	485.346	40.75	0.64	1.32	0.74	87.8746	1.340	2.04	87.87	1.34	7	130.00	0.459	0.459	0.000	1.477	8.13	12.00	1.247	40.75	13.9337	39.87
7.382	485.018	37.01	0.6	1.62	0.79	76.1315	1.642	2.14	76.15	1.64	7	130.00	0.480	0.480	0.000	1.444	7.70	11.11	1.131	37.02	17.0891	39.09
7.71	484.690	59.19	0.77	1.3	0.23	117.108	1.312	1.94	117.11	1.31	7	130.00	0.501	0.501	0.000	1.413	11.37	16.06	1.817	59.19	11.3174	41.38
8.038	484.362	57.04	1.08	1.85	0.25	108.174	1.878	2.07	108.17	1.88	7	130.00	0.522	0.522	0.000	1.383	11.63	15.96	1.760	57.04	14.9626	40.66
8.366	484.034	57.87	0.86	1.48	0.53	105.42	1.500	2.01	105.44	1.50	7	130.00	0.544	0.544	0.000	1.356	11.43	15.50	1.775	57.86	13.2395	40.85
8.694	483.706	75.02	0.89	1.16	0.74	133.169	1.169	1.86	133.19	1.17	8	130.00	0.565	0.565	0.000	1.330	14.16	18.84	2.330	75.83	9.50907	42.05
9.022	483.378	63.21	1.11	1.75	0.44	106.788	1.772	2.06	106.79	1.77	7	130.00	0.586	0.586	0.000	1.306	12.71	16.60	1.939	63.21	14.5645	40.91
9.35	483.050	80.49	0.91	1.51	0.93	98.531	1.520	2.04	98.55	1.52	7	130.00	0.608	0.608	0.000	1.283	13.06	15.47	1.864	80.5	13.9359	40.49
9.678	482.722	64.51	0.83	1.28	1.11	101.548	1.299	1.98	101.56	1.30	7	130.00	0.629	0.629	0.000	1.261	10.59	15.87	1.978	64.52	12.4093	40.65
10.006	482.394	80.65	1.03	1.28	0.65	122.849	1.289	1.92	122.86	1.29	8	130.00	0.650	0.650	0.000	1.240	15.85	19.04	2.474	80.58	10.8105	41.64
10.335	482.065	67.71	1.39	2.04	0.64	99.7927	2.059	2.12	99.79	2.06	7	130.00	0.672	0.672	0.000	1.220	13.99	17.07	2.075	67.71	16.5727	40.56
10.663	481.737	66.47	1.17	1.76	0.6	94.9032	1.779	2.10	94.90	1.78	7	130.00	0.693	0.693	0.000	1.201	13.57	16.30	2.036	66.47	15.6621	40.29
10.991	481.409	56.44	0.72	1.28	0.88	78.0017	1.292	2.06	78.00	1.29	7	130.00	0.714	0.714	0.000	1.183	11.38	13.47	1.725	56.44	14.7573	39.22
11.319	481.081	53.65	0.56	1.06	0.95	71.9203	1.096	2.05	71.93	1.10	7	130.00	0.736	0.736	0.000	1.166	10.75	12.53	1.638	53.65	14.2461	38.78
11.647	480.753	39.63	0.46	1.15	1.11	51.3476	1.193	2.18	51.36	1.18	7	130.00	0.757	0.757	0.000	1.149	8.39	9.64	1.203	39.64	18.4421	36.66
11.975	480.425	34.17	0.51	1.46	1.16	42.8991	1.527	2.31	42.91	1.53	7	130.00	0.778	0.778	0.000	1.133	7.64	8.66	1.094	34.18	22.9801	36.00
12.303	480.097	26.38	0.35	1.33	1.02	31.9876	1.368	2.39	31.99	1.37	6	130.00	0.800	0.800	0.000	1.118	6.10	6.82	0.792	26.38	25.9069	34.01
12.631	479.769	31.58	0.43	1.35	1.16	37.4646	1.398	2.34	37.48	1.40	7	130.00	0.821	0.821	0.000	1.104	7.14	7.88	0.952	31.59	23.9035	34.98
12.959	479.441	33.88	0.34	0.99	1.04	39.2215	1.029	2.24	39.23	1.03	7	130.00	0.842	0.842	0.000	1.090	7.36	8.02	1.023	33.89	20.5322	35.26
13.287	479.113	40.62	0.47	1.14	0.55	46.2642	1.176	2.22	46.26	1.18	7	130.00	0.864	0.864	0.000	1.076	8.76	9.43	1.237	40.62	19.6264	35.24
13.615	478.785	40.68	0.48	1.18	0.62	45.1934	1.200	2.23	45.19	1.20	7	130.00	0.885	0.885	0.000	1.063	8.83	9.38	1.238	40.68	20.0856	35.10
13.943	478.457	67.39	0.84	1.25	0.51	73.3577	1.263	2.08	73.36	1.26	7	130.00	0.906	0.906	0.000	1.050	13.67	14.36	2.056	67.39	15.1748	38.88
14.271	478.129	83.33	1.06	1.27	0.49	88.8325	1.286	2.02	88.83	1.29	8	130.00	0.928	0.928	0.000	1.038	16.52	17.15	2.551	83.33	13.5058	39.93
14.6	477.800	84.96	0.88	1.03	0.44	88.5268	1.047	1.96	88.53	1.05	8	130.00	0.949	0.949	0.000	1.027	16.48	16.92	2.601	84.96	11.9944	39.91
14.928	477.472	62.57	1.08	1.72	0.55	63.4839	1.753	2.22	63.48	1.75	7	130.00	0.970	0.970	0.000	1.015	13.44	13.64	1.907	62.57	19.6287	38.07
15.256	477.144	54.17	0.79	1.46	0.62	53.6267	1.486	2.23	53.64	1.49	7	130.00	0.992	0.992	0.000	1.004	11.68	11.73	1.646	54.18	19.9666	37.11

R14535

Depth (ft)	Sampl (ft)	Qt	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)		EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	476.816	44.07	0.61	1.38	-0.69	42.5052	1.417	2.30	42.52	1.42	7	130.00	1.013	1.013	0.000	0.994	9.78	9.72	1.333	44.06	22.569	35.74
15.912	476.488	48.65	0.7	1.45	-0.58	46.9409	1.473	2.26	46.94	1.47	7	130.00	1.034	1.034	0.000	0.983	10.70	10.62	1.471	48.55	21.7636	36.20
16.24	476.160	44.39	0.49	1.11	-0.51	41.0519	1.131	2.25	41.06	1.13	7	130.00	1.056	1.056	0.000	0.973	9.67	9.41	1.342	44.4	20.757	35.63
16.568	475.832	49.03	0.87	0.75	-0.55	44.528	0.772	2.13	44.53	0.77	8	130.00	1.077	1.077	0.000	0.964	10.16	9.79	1.485	49.03	16.7798	36.02
16.896	475.504	41.84	0.47	1.13	-0.34	37.0973	1.154	2.29	37.10	1.15	7	130.00	1.098	1.098	0.000	0.954	9.27	8.85	1.281	41.84	22.2493	34.92
17.224	475.176	36.67	0.81	2.21	-0.18	31.7539	2.278	2.52	31.75	2.28	6	130.00	1.120	1.120	0.000	0.945	9.03	8.53	1.101	36.67	31.6967	33.96
17.552	474.848	53.97	0.73	1.35	-0.44	46.3056	1.382	2.26	46.31	1.38	7	130.00	1.141	1.141	0.000	0.936	11.79	11.04	1.636	53.98	21.0557	36.25
17.88	474.520	91.09	1.69	1.85	-0.88	77.3772	1.868	2.17	77.38	1.87	7	130.00	1.162	1.162	0.000	0.928	19.20	17.81	2.764	91.09	18.1251	39.18
18.208	474.192	100.89	2.65	2.62	-1.27	84.2457	2.85839	2.27913	84.2542	2.8581	6	130.00	1.18352	1.18352	0	0.9192	22.22949	20.43345	3.06689	100.9	21.7659	39.646
18.537	473.863	79.53	2.26	2.84	-0.71	65.0052	2.88541	2.35906	65.0052	2.88541	6	130.00	1.20491	1.204905	0	0.911	18.15282	16.53742	2.42493	79.53	24.8046	38.209
18.865	473.535	60.94	1.2	1.97	-0.49	48.6972	2.00959	2.9446	48.6972	2.00959	7	130.00	1.22523	1.226225	0	0.9031	13.81554	12.47621	1.84872	60.94	24.2101	36.545
19.193	473.207	41.14	0.68	1.66	-0.56	31.9768	1.70458	2.44317	31.9768	1.70458	7	130.00	1.24755	1.247545	0	0.8953	9.752974	8.791904	1.28506	41.14	28.207	34.009
19.521	472.879	43.98	0.41	0.92	0.65	33.6609	0.95994	2.28476	33.6609	0.95994	7	130.00	1.26887	1.268865	0	0.8878	9.712904	8.622663	1.32233	43.98	21.9609	34.324
19.849	472.551	44.49	0.5	1.13	0.23	33.4834	1.15741	2.33046	33.4834	1.15741	7	130.00	1.29019	1.290185	0	0.8804	10.02335	8.824437	1.33748	44.49	23.6666	34.292
20.177	472.223	60.56	0.75	1.23	0.23	45.176	1.26585	2.24572	45.176	1.26585	7	130.00	1.31151	1.311505	0	0.8732	13.15276	11.48602	1.83432	60.56	20.563	36.102
20.505	471.895	62.15	0.84	1.35	-0.37	45.6303	1.38119	2.26465	45.6378	1.38096	7	130.00	1.33289	1.332825	0	0.8662	13.60669	11.78858	1.88289	62.16	21.234	36.162
20.833	471.567	59.15	0.81	1.4	-0.14	41.9496	1.42591	2.30229	41.9496	1.42591	7	130.00	1.35415	1.354145	0	0.8593	12.94251	11.12207	1.7587	59.16	22.6062	35.66
21.161	471.239	61.14	0.88	1.6	0.23	43.4504	1.63977	2.32698	43.4504	1.63977	7	130.00	1.37547	1.375465	0	0.8527	13.75345	11.727	1.8503	61.14	23.8343	35.87
21.489	470.911	58.39	1.21	2.08	-0.09	40.6031	2.12306	2.4187	40.6031	2.12306	7	130.00	1.39679	1.396785	0	0.8461	13.68713	11.58104	1.7645	58.39	27.1802	35.494
21.817	470.583	68.68	1.4	2.05	-0.21	47.3603	2.08452	2.36412	47.3603	2.08452	7	130.00	1.41811	1.418105	0	0.8397	15.66334	13.16995	2.07932	68.68	24.9725	36.361
22.145	470.255	62.38	1.27	2.03	-0.14	42.3367	2.084	2.40123	42.3367	2.084	7	130.00	1.43943	1.439425	0	0.8335	14.50622	12.09093	1.88671	62.38	26.4611	35.715
22.473	469.927	56.41	1.04	1.85	-0.23	37.6173	1.89266	2.4147	37.6173	1.89266	7	130.00	1.46075	1.460745	0	0.8274	13.19879	10.92061	1.70122	56.41	27.0145	35.003
22.802	469.598	43.25	0.55	1.27	-0.21	28.181	1.3168	2.42382	28.181	1.3168	7	130.00	1.48213	1.48213	0	0.8214	10.16202	8.347122	1.29312	43.25	27.393	33.22
23.13	469.270	47.18	0.49	1.04	-0.09	30.3812	1.07276	2.34808	30.3812	1.07276	7	130.00	1.50345	1.50345	0	0.8156	10.7126	8.736759	1.41418	47.18	24.3451	33.69
23.458	468.942	41.56	0.66	1.58	-0.04	26.2566	1.64855	2.60417	26.2566	1.64855	7	130.00	1.52477	1.52477	0	0.8098	10.13933	8.21121	1.23946	41.56	30.8699	32.775
23.786	468.614	33	0.65	1.96	-0.16	20.3442	2.06652	2.65128	20.3442	2.06652	6	130.00	1.54609	1.54609	0	0.8042	8.65873	6.983648	0.97381	33	37.9169	31.141
24.114	468.286	31.46	0.73	2.33	0.09	19.0713	2.44208	2.71649	19.0713	2.44208	6	130.00	1.56741	1.56741	0	0.7987	8.540436	6.821639	0.92547	31.46	41.3365	30.721
24.442	467.958	28.46	0.84	2.94	-0.07	16.9137	3.12602	2.82253	16.9137	3.12602	5	130.00	1.58873	1.58873	0	0.7934	8.186954	6.495271	0.83193	28.46	47.3052	29.934
24.77	467.630	36.73	0.76	2.06	0.19	21.813	2.16401	2.63841	21.813	2.16401	6	130.00	1.61005	1.61005	0	0.7881	9.574187	7.545899	1.0873	36.73	37.2639	31.591
25.098	467.302	53.09	0.84	1.58	-0.04	31.5432	1.63238	2.43664	31.5432	1.63238	7	130.00	1.63137	1.63137	0	0.7829	12.54912	9.825098	1.59315	53.09	27.9392	33.923
25.426	466.974	37.37	0.93	2.48	0.02	21.6116	2.60378	2.68975	21.6116	2.60378	6	130.00	1.65269	1.65269	0	0.7779	10.00281	7.780841	1.1058	37.37	39.9116	31.531
25.754	466.646	29.67	0.83	2.8	0.05	16.7239	2.96471	2.81252	16.7239	2.96471	5	130.00	1.67401	1.67401	0	0.7729	8.487242	6.559754	0.86675	29.67	46.7198	29.86
26.082	466.318	29.89	0.72	2.4	0.04	16.6308	2.55367	2.77598	16.6308	2.55367	6	130.00	1.69533	1.69533	0	0.768	8.378865	6.435141	0.8729	29.89	44.8215	29.823
26.41	465.990	40.76	0.67	1.65	0.51	22.7439	1.71604	2.56534	22.7439	1.71604	7	130.00	1.71665	1.71665	0	0.7632	10.24312	7.817922	1.20877	40.76	33.6905	31.86
26.739	465.661	31.14	0.85	2.72	0.6	16.9169	2.89098	2.80187	16.9168	2.89096	6	130.00	1.73804	1.738035	0	0.7585	8.855459	6.7171	0.91028	31.14	46.1075	29.935
27.067	465.333	27.6	0.95	3.45	0.11	14.6876	3.67638	2.91406	14.6876	3.67638	5	130.00	1.75936	1.759355	0	0.7539	8.370606	6.310738	0.80002	27.6	52.8798	29
27.395	465.005	20.8	0.75	3.59	0.09	10.681	3.94336	3.04266	10.681	3.94336	5	130.00	1.78066	1.780675	0	0.7494	6.829167	5.117707	0.59883	20.8	61.4043	26.863
27.723	464.677	32.97	0.92	2.78	0.41	17.2964	2.95174	2.79991	17.2908	2.95269	6	130.00	1.802	1.801995	0	0.7449	9.362277	6.974365	0.98495	32.96	45.9884	30.079
28.051	464.349	34.02	0.75	2.2	0.56	17.6563	2.32943	2.73173	17.6528	2.33016	6	130.00	1.82332	1.823315	0	0.7406	9.30799	6.893266	0.9968	34.01	42.1628	30.215
28.379	464.021	30.25	0.56	1.86	0.39	15.3989	1.97146	2.73942	15.3988	1.97146	6	130.00	1.84464	1.844635	0	0.7369	8.313169	6.120845	0.87942	30.25	42.5839	29.314
28.707	463.693	26.45	0.54	2.03	0.44	13.175	2.19655	2.82207	13.1697	2.19744	6	130.00	1.86596	1.865955	0	0.7321	7.603892	5.56664	0.76112	26.44	47.2761	28.272
29.035	463.365	35.65	0.64	1.79	0.42	17.8997	1.89558	2.67593	17.8997	1.89558	6	125.00	1.88728	1.887275	0	0.7279	9.473402	6.895859	1.04529	35.65	39.1826	30.303
29.363	463.037	31.91	0.6	2.81	0.03	15.7283	2.99878	2.83696	15.7283	2.99878	6	125.00	1.90778	1.907775	0	0.724	9.284513	6.760236	0.92896	31.91	48.1574	29.463
29.691	462.709	78.81	1.79	2.27	-13.37	39.8707	2.32825	2.45145	39.9174	2.32552	7	125.00	1.92828	1.928275	0	0.7201	18.77876	13.52185	2.38024	78.9	28.6599	35.362
30.019	462.381	75.42	2.46	3.26	19.88	37.7012	3.34825	2.57393	37.7628	3.34275	6	125.00	1.94878	1.948775	0	0.7165	19.06391	13.65624	2.27465	75.54	34.0886	35.027
30.347	462.053	73.52	2.36	3.23	-21.24	36.3335	3.32531	2.59372	36.3996	3.32028	6	125.00	1.96928	1.969275	0	0.7126	18.57716	13.30937	2.21519	73.65	34.5679	34.803
30.675	461.725	61.35	2.05	3.35	-21.62	29.8026	3.45349	2.65802	29.803	3.44537	6	125.00	1.98978	1.989775	0	0.7089	16.19004	11.47746	1.83778	61.49	38.2814	33.691
31.004	461.396	28.32	1.36	4.8	-15.93	13.0872	5.1692	3.04424	13.1369	5.14963	3	125.00	2.01034	2.010345	0	0.7053	9.3345539	6.5803523	0.61464	28.42	61.4455	28.256
31.332	461.068	40.8	1.24	3.05	-12.77	19.0902	3.19842	2.78585	19.1296	3.19184	6	125.00	2.03084	2.030835	0	0.7017	11.62195	8.0851165	1.20028	40.86	45.182	30.741
31.66	460.740	44.64	1.36	3.05	-16.6	20.7614	3.19334	2.75656	20.815	3.18611	6	125.00	2.05134	2.051335	0	0.6982	12.31234	8.66833	1.31853	44.75	43.5317	31.289
31.988	460.412	35.89	0.92	2.56	-16.6	16.3228	2.72043	2.79674	16.3759	2.71161	6	125.00	2.07184	2.071835	0	0.6947	10.20754	7.091796	1.047	36	45.8061	29.721
32.316	460.084	41.49	0.76	1.84	-15.52	18.8296	1.92905	2.6602	18.8773	1.92416	6	125.00	2.09234	2.092345	0	0.6913	10.95277	7.579869	1.21974	41.59	38.3734	30.654
32.644	459.756	44.62	0.87	1.94	-15.36	20.1165	2.04671	2.6514	20.1658	2.04191	6	125.00	2.11284	2.112855	0	0.688	11.73457	8.072984	1.31601	44.72	37.9227	31.084
32.972	459.428	46.81	0.97	2.07	-12.88	20.9421	2.17116	2.65248	20.9795	2.16728	6	125.00	2.13334	2.133335	0	0.6847	12.31092	8.426633	1.38318	46.89	37.978	31.34
33.3	459.100	34.78	0.63	1.82	-11.57	15.1479	1.93097	2.73912	15.1804	1.92883	6	125.00	2.15384	2.153835	0	0.6814	9.575753	6.624796	1.0101	34.85	42.9673	29.219
33.628	458.772	27.97	0.53	1.88	-11.11	11.8837	2.05461	2.84249	11.8959	2.04905	6	125.00	2.17434	2.174335	0	0.6782	8.157752	5.532317	0.78862	28.04	48.487	27.59
33.956	458.444	25.2	0.51	2.03	-10.93	10.4815	2.21689	2.90541	10.5134	2.21017	6	125.00	2.19484	2.194835	0	0.675	7.62481	5.146688	0.71223	25.27	52.2052	26.756
34.284	458.116	23.12	0.44	1.91	-10.81	9.43633	2.10479	2.93186	9.46794	2.09777	6	125.00	2.21534	2.215435	0	0.6719	7.108146	4.776693	0.6472	23.19	54.0101	26.047
34.612	457.788	24.88	0.56	2.24	-10.49	10.1278	2.47304	2.94368	10.1591	2.46542	6	125.00	2.23584	2.235635	0	0.6688	7.702224	5.151053	0.70106	24.95	54.7701	25.525
34.941	457.459	27.6	0.74	2.67	-10.42	11.2319	2.91987	2.94724	11.2585	2.91297	6	125.00	2.25634	2.25634	0	0.6657	8.557203	5.696705	0.78462	27.65	55.0001	27.219
35.269	457.131	22.71	0.58	2.56	-10.21	8.97409	2.83853	3.02029	9.00483	2.82884	5	125.00	2.27683	2.27683	0	0.6627	7.273349	4.886443	0.6326	22.78	59.8616	25.707
35.597	456.803	20.39	0.6	2.46	9.49	7.87525	2.76356	3.06177	7.89701	2.75554	5	125.00	2.29734	2.29734	0	0.6598	6.794369	4.462639	0.56014	20.44	62.7431	24.816
35.925	456.475	20.1	0.58	2.89	8.89	7.67164	3.26171	3.1108	7.69321	3.25268	5	125.00	2.31784	2.31784	0	0.6569	6.818507	4.54428	0.56053	20.15	66.264	24.639
36.253	456.147	21.46	0.65	3.04	-5.91	8.17722	3.3993	3.09836	8.19412	3.3923	5	125.00	2.33834	2.33834	0	0.6539	7.208135	4.787417	0.592	21.5	65.3582	25.067
36.581	456.819	18.81	0.64	3.38	5.48	6.97406	3.89332	3.18867	6.96577	3.88324	5	125.00	2.35884	2.35884	0	0.6511	6.8256	4.444123	0.50932	18.84	72.1173	23.985
36.909	455.491	18.56	0.68	3.67	-4.82	6.90029	4.20256	3.21677	6.91289	4.19479	5	125.00	2.37934	2.37934	0	0.6482	6.871849	4.45492	0.50095	18.59	74.3104	23.814
37.237	455.163	16.85	0.84	5.06	4.85	5.96614	5.8947	3.34912	5.96886	5.88231	3	125.00	2.39984	2.399835	0	0.6454	6.618186	4.309098	0.44116	16.88	85.2026	22.923
37.565	454.835	18.46	0.76	4.11	5.01	6.67022	4.73876	3.25373	6.6807	4.72981	4	125.00	2.42034	2.420335	0.0174	0.6426	7.020524	4.548858	0.49652	18.49	77.2612	23.491

Depth (ft)	Sam (ft,	qCt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	454.507	17.57	0.66	3.71	4.48	8.25986	4.3634	3.25585	6.27328	4.35478	4	135.00	2.44416	2.416318	0.0279	0.6433	5.693405	4.30599	0.46829	17.6	77.4062	23.257
38.221	454.179	23.26	0.72	3.08	3.6	8.56333	3.46259	3.08679	6.57568	3.4578	5	135.00	2.46632	2.428225	0.0381	0.6417	7.869741	5.050286	0.64377	23.29	64.5241	25.388
38.549	453.851	35.17	1.71	4.86	-4.65	13.3934	5.23231	3.04061	13.4056	5.22751	3	135.00	2.48946	2.440131	0.0483	0.6402	11.54187	7.388724	1.01181	35.2	61.2618	26.401
38.877	453.523	74.79	4.27	5.7	12.75	29.4773	5.90763	2.82205	29.5099	5.9011	11	135.00	2.5106	2.452038	0.0586	0.6386	21.5316	13.75032	2.23775	74.87	47.2766	33.514
39.206	453.194	104.68	6.22	5.94	-19.79	41.4562	6.08925	2.72869	41.5049	6.08211	11	135.00	2.53281	2.463398	0.0688	0.6371	28.63555	18.24261	3.16245	104.8	41.9974	35.6
39.534	452.866	152.53	8.46	5.55	-19.17	60.5743	5.64094	2.59482	60.6227	5.63643	11	135.00	2.55495	2.475887	0.0791	0.6365	38.92148	24.73568	4.64319	152.65	35.0952	37.615
39.862	452.538	232.67	10.79	4.64	-19.12	92.4888	4.68941	2.41592	92.543	4.68717	11	135.00	2.57709	2.487793	0.0893	0.634	54.49618	34.55087	7.12062	232.78	27.0649	40.155
40.19	452.210	391.32	13.96	3.57	-18.27	155.507	3.59127	2.18739	155.551	3.59025	12	135.00	2.59923	2.4997	0.0995	0.6325	82.95758	52.47014	12.0347	391.43	18.574	42.836
40.518	451.882	504.54	14.95	2.96	-19.14	199.84	2.97857	2.05825	199.886	2.97786	12	135.00	2.62137	2.511606	0.1098	0.631	101.5206	64.05876	15.5393	504.66	14.5769	44.055
40.846	451.554	352.83	14.47	4.1	7.69	138.769	4.13208	2.26597	138.754	4.13256	12	135.00	2.64351	2.523612	0.12	0.6295	77.28576	48.65156	10.8417	352.79	21.2614	42.264
41.174	451.226	428.29	14.1	3.29	55.96	167.871	3.31279	2.14021	167.713	3.31561	12	135.00	2.66565	2.535419	0.1302	0.6278	88.95583	55.86613	13.1772	427.94	17.0501	43.207

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 18 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-3

ConeTec Inc. 'pretation
Interpretation O lease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4528
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-3
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 07:09
CPT File: 804CP03.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 466.98

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	36.95	1.32	47.13	32.39	2.48

User Inputs

Assumed: Water Table Depth (ft): 11.1
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 467.0
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	466.816	22.8	0.36	1.56	-0.74	2223.39	1.580	1.42	2224.31	1.58	6	125.00	0.010	0.010	0.000	2.000	3.67	7.34	0.706	22.81	1.61802	53.62
0.492	466.488	42.46	0.67	1.58	-5.17	1379.49	1.579	1.46	1380.46	1.58	7	125.00	0.031	0.031	0.000	2.000	6.91	13.82	1.313	42.48	2.23467	52.00
0.82	466.160	28.94	0.66	2.29	-5.45	563.603	2.285	1.73	564.37	2.28	6	125.00	0.051	0.051	0.000	2.000	5.17	10.34	0.894	28.97	6.77422	48.62
1.148	465.832	23.43	0.46	1.97	-7.27	325.551	1.969	1.79	326.25	1.97	6	125.00	0.072	0.072	0.000	2.000	4.27	8.55	0.720	23.46	7.91559	46.30
1.476	465.504	32.54	0.58	1.77	-11.34	361.737	1.787	1.74	362.50	1.78	6	125.00	0.092	0.092	0.000	2.000	5.82	11.65	1.005	32.61	6.82459	46.64
1.804	465.176	38.02	0.94	2.47	-4.06	336.206	2.480	1.87	336.89	2.46	6	125.00	0.113	0.113	0.000	2.000	7.12	14.25	1.174	38.04	9.67104	46.44
2.133	464.847	36.81	1.27	3.46	-2.93	275.118	3.463	2.04	275.27	3.46	5	125.00	0.133	0.133	0.000	2.000	7.35	14.70	1.136	36.83	14.0176	45.54
2.461	464.519	32.44	1.98	5.81	-1.76	208.906	5.823	2.29	208.97	5.82	3	125.00	0.154	0.154	0.000	2.000	7.19	14.38	1.000	32.46	22.2623	44.29
2.789	464.191	33.21	1.93	5.82	-0.93	189.52	5.842	2.32	189.58	5.84	3	125.00	0.174	0.174	0.000	2.000	7.44	14.88	1.023	33.22	23.1469	43.80
3.117	463.863	41.96	2.26	5.38	1.78	214.489	5.409	2.26	214.44	5.41	3	125.00	0.195	0.195	0.000	2.000	9.17	18.35	1.294	41.97	21.0994	44.39
3.445	463.535	51.02	2.5	4.89	1.36	235.958	4.921	2.20	235.91	4.92	4	125.00	0.215	0.215	0.000	2.000	10.89	21.79	1.573	51.01	19.1479	44.83
3.773	463.207	61.43	2.63	4.28	0.26	259.504	4.298	2.13	259.46	4.30	5	125.00	0.236	0.236	0.000	2.000	12.73	25.46	1.895	61.42	16.8244	45.27
4.101	462.879	66.35	2.47	3.72	5.77	257.864	3.737	2.08	257.71	3.74	5	125.00	0.256	0.256	0.000	1.975	13.47	26.60	2.046	66.31	15.2758	45.24
4.429	462.551	70.01	2.46	3.51	-1.2	251.915	3.528	2.07	251.91	3.53	6	125.00	0.277	0.277	0.000	1.901	14.12	28.84	2.159	70.01	14.7869	45.14
4.757	462.223	47.34	1.98	4.19	4.97	158.226	4.209	2.24	158.09	4.21	5	125.00	0.297	0.297	0.000	1.854	10.25	18.80	1.456	47.3	20.3659	42.91
5.085	461.895	35.26	1.25	3.54	14.76	109.946	3.577	2.26	109.66	3.59	5	125.00	0.318	0.318	0.000	1.771	7.75	13.74	1.092	35.17	21.7542	41.06
5.413	461.567	29.45	1.07	3.63	14.25	86.0497	3.675	2.36	85.78	3.69	5	125.00	0.338	0.338	0.000	1.719	6.69	11.60	0.901	29.36	24.6747	39.74
5.741	461.239	22.73	0.72	3.15	18.2	62.3478	3.218	2.41	62.01	3.24	5	125.00	0.359	0.359	0.000	1.668	5.28	8.81	0.693	22.61	26.8102	37.84
6.069	460.911	20.62	0.5	2.43	23.72	53.3615	2.470	2.38	52.97	2.49	5	125.00	0.379	0.379	0.000	1.624	4.71	7.85	0.627	20.47	25.8859	37.04
6.398	460.582	23.44	0.52	2.22	51.64	57.6183	2.257	2.33	56.82	2.29	6	125.00	0.400	0.400	0.000	1.581	5.21	8.24	0.713	23.12	23.7246	37.44
6.726	460.254	16.44	0.47	2.84	44.02	38.1079	2.934	2.54	37.44	2.99	5	125.00	0.420	0.420	0.000	1.542	4.02	6.20	0.496	16.16	32.6769	34.87
7.054	459.926	14.75	0.41	2.79	46.61	32.4662	2.865	2.59	31.82	2.92	5	125.00	0.441	0.441	0.000	1.506	3.66	5.56	0.443	14.47	34.9073	33.96
7.382	459.598	17.36	0.43	2.45	47.02	36.67	2.542	2.52	36.04	2.59	5	125.00	0.461	0.461	0.000	1.472	4.19	6.17	0.524	17.09	31.3627	34.74
7.71	459.270	18.54	0.47	2.51	37.83	37.4747	2.603	2.51	36.99	2.64	5	125.00	0.482	0.482	0.000	1.441	4.48	6.46	0.559	18.3	31.2547	34.90
8.038	458.942	19.4	0.5	2.58	37.94	37.6166	2.646	2.52	37.16	2.68	5	125.00	0.502	0.502	0.000	1.411	4.70	6.63	0.995	19.17	31.3584	34.93
8.366	458.614	17.21	0.55	3.2	34.73	31.9142	3.296	2.63	31.49	3.34	5	125.00	0.523	0.523	0.000	1.382	4.41	6.11	0.517	16.99	36.9521	33.91
8.694	458.286	17.95	0.56	3.1	31.31	32.0343	3.217	2.62	31.88	3.25	5	125.00	0.543	0.543	0.000	1.357	4.59	6.23	0.639	17.76	36.4732	33.95
9.022	457.958	19.33	0.57	2.93	27.69	33.2806	3.037	2.59	32.98	3.07	5	125.00	0.564	0.564	0.000	1.332	4.88	6.50	0.581	19.16	34.995	34.20
9.35	457.630	16.87	0.64	3.4	23.97	31.2909	3.500	2.65	31.03	3.53	5	125.00	0.584	0.584	0.000	1.308	4.32	6.43	0.568	16.72	37.0977	33.82
9.678	457.302	20.7	0.61	2.95	26.23	33.2219	3.036	2.59	32.94	3.06	5	125.00	0.605	0.605	0.000	1.286	5.23	6.72	0.622	20.53	34.9967	34.19
10.006	456.974	20.8	0.74	3.57	10.97	32.26	3.668	2.65	32.15	3.66	5	125.00	0.625	0.625	0.000	1.265	5.45	6.99	0.625	20.73	36.0423	34.04
10.335	456.645	22.06	0.78	3.52	6.13	33.1519	3.642	2.64	33.07	3.65	5	125.00	0.646	0.646	0.000	1.244	5.75	7.15	0.663	22.01	37.4577	34.22
10.663	456.317	22.26	0.84	3.76	9.06	32.4015	3.890	2.67	32.31	3.90	4	125.00	0.666	0.666	0.000	1.225	5.68	7.20	0.669	22.2	38.8361	34.07
10.991	455.989	22.23	0.86	3.88	10.07	31.361	3.992	2.69	31.27	4.00	4	125.00	0.687	0.687	0.020	1.207	5.93	7.15	0.667	22.17	39.7778	33.87
11.319	455.661	19.23	0.81	4.2	10.53	26.3739	4.373	2.77	26.27	4.39	4	125.00	0.709	0.709	0.007	1.193	5.35	6.39	0.573	19.16	44.2873	32.78
11.647	455.333	18	0.62	3.43	12.28	24.1809	3.590	2.74	24.07	3.61	5	125.00	0.731	0.714	0.017	1.183	4.93	5.84	0.535	17.92	42.7427	32.23
11.975	455.005	21.25	0.62	2.92	16.42	28.2301	3.025	2.64	28.09	3.04	5	125.00	0.753	0.726	0.027	1.174	5.53	6.49	0.615	21.15	37.4988	33.21
12.303	454.677	21.1	0.8	3.8	12.7	27.5413	3.936	2.73	27.42	3.95	4	125.00	0.775	0.736	0.038	1.164	5.73	6.67	0.629	21.02	41.8264	33.06
12.631	454.349	17.94	0.7	3.88	13.37	22.8604	4.053	2.80	22.74	4.11	4	125.00	0.798	0.750	0.048	1.155	5.06	5.85	0.531	17.85	45.8564	31.89
12.959	454.021	16.67	0.53	3.19	25.01	20.8069	3.344	2.78	20.60	3.36	5	125.00	0.820	0.762	0.058	1.146	4.63	5.30	0.491	16.51	44.6307	31.24
13.287	453.693	17.05	0.47	2.76	26.87	20.98	2.894	2.73	20.76	2.93	5	125.00	0.842	0.774	0.068	1.137	4.64	5.27	0.503	16.9	42.3273	31.30
13.615	453.365	15.98	0.45	2.79	32.33	19.2415	2.977	2.77	18.99	3.02	5	125.00	0.864	0.786	0.078	1.128	4.42	4.98	0.468	15.78	44.472	30.73
13.943	453.037	17	0.42	2.48	36.98	20.2055	2.606	2.72	19.92	2.64	5	125.00	0.886	0.797	0.089	1.120	4.57	5.11	0.499	16.77	41.6351	31.04
14.271	452.709	20.35	0.53	2.61	41.32	24.0139	2.726	2.67	23.70	2.78	5	125.00	0.908	0.809	0.099	1.112	5.33	5.93	0.602	20.09	39.0883	32.16
14.6	452.380	24.99	0.7	2.79	53.19	29.2928	2.909	2.63	28.89	2.85	5	125.00	0.931	0.821	0.109	1.107	6.39	7.05	0.745	24.66	36.6088	33.40
14.928	452.052	25.64	0.92	3.55	51.01	29.8677	3.697	2.69	29.48	3.74	5	125.00	0.953	0.833	0.119	1.098	6.82	7.47	0.771	25.52	39.7482	33.53
15.256	451.724	26.35	0.86	3.26	58.45	28.841	3.528	2.69	28.45	3.56	5	125.00	0.975	0.845	0.130	1.088	6.87	7.26	0.758	24.98	39.714	33.30

RR4539

Depth (ft)	Samp (ft)	qCt (sf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	[illegible]	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	451.396	25.2	0.94	3.72	60.14	28.2095	3.884	2.72	27.80	3.95	5	135.00	0.997	0.857	0.140	1.080	6.75	7.29	0.749	24.82	41.5723	33.17
15.912	451.068	23.53	0.87	3.69	58.12	25.9052	3.865	2.75	25.46	3.93	5	135.00	1.019	0.866	0.150	1.073	6.39	6.86	0.697	23.16	43.0523	32.83
16.24	450.740	24.42	0.79	3.22	95.41	26.5403	3.378	2.71	25.87	3.47	5	135.00	1.041	0.881	0.160	1.065	6.44	6.86	0.724	23.83	43.6417	32.73
16.568	450.412	23.13	0.79	3.4	93.16	24.7167	3.580	2.75	24.07	3.68	5	135.00	1.064	0.893	0.171	1.058	6.22	6.59	0.683	22.55	43.0416	32.27
16.896	450.084	25.8	0.86	3.32	86.21	27.3182	3.480	2.70	26.73	3.56	5	135.00	1.086	0.905	0.181	1.051	6.81	7.16	0.765	25.27	40.6511	32.84
17.224	449.756	27.36	1.09	3.99	68.75	28.6411	4.152	2.74	28.17	4.22	4	135.00	1.106	0.917	0.191	1.045	7.39	7.72	0.813	26.93	42.4068	33.28
17.552	449.428	23.92	1.23	5.16	49.52	24.5451	5.397	2.86	24.21	5.47	3	135.00	1.130	0.929	0.201	1.038	6.94	7.20	0.706	23.61	49.6011	32.32
17.88	449.100	22.38	1.09	4.86	39.24	22.5732	5.135	2.87	22.31	5.20	3	135.00	1.152	0.940	0.212	1.031	6.55	6.75	0.657	22.13	50.2616	31.80
18.208	448.772	17.75	0.82	4.63	24.36	17.4059	4.947	2.94	17.25	4.99	3	135.00	1.174	0.952	0.222	1.025	5.43	5.57	0.513	17.6	54.7916	30.15
18.537	448.443	16.18	0.53	3.25	29.47	15.5391	3.537	2.99	15.35	3.58	5	135.00	1.196	0.964	0.232	1.018	4.79	4.88	0.464	16	51.4876	29.40
18.865	448.115	16.38	0.38	2.32	30.44	15.5318	2.506	2.80	15.34	2.54	5	135.00	1.218	0.976	0.242	1.012	4.61	4.66	0.469	16.19	46.1677	29.39
19.193	447.787	17.22	0.42	2.44	41.84	16.1723	2.626	2.80	16.91	2.67	5	135.00	1.241	0.988	0.253	1.006	4.83	4.86	0.495	16.96	46.1732	29.64
19.521	447.459	27.26	0.55	2.02	43.37	25.9979	2.116	2.58	25.73	2.14	6	135.00	1.263	1.000	0.263	1.000	6.82	6.82	0.805	26.99	34.2771	32.71
19.849	447.131	15.42	0.71	4.62	19.56	13.9691	5.023	3.02	13.85	5.07	3	135.00	1.285	1.012	0.273	0.994	4.95	4.93	0.438	15.3	59.9097	28.74
20.177	446.803	42.76	1.36	3.19	-1.64	40.4898	3.281	2.55	40.50	3.28	5	135.00	1.307	1.024	0.283	0.988	10.65	10.52	1.283	42.77	32.7842	35.49
20.505	446.475	21.33	1.36	6.39	-21.13	19.3115	6.800	2.99	19.44	6.76	3	135.00	1.329	1.036	0.293	0.983	6.83	6.71	0.619	21.46	58.031	30.94
20.833	446.147	94.63	4.34	4.59	-16.03	89.0402	4.653	2.42	89.14	4.65	11	135.00	1.351	1.048	0.304	0.977	22.25	21.74	2.888	94.73	27.3675	39.97
21.161	445.819	325.72	14.52	4.46	12.24	306.129	4.477	2.11	306.20	4.48	11	135.00	1.373	1.060	0.314	0.972	67.01	66.10	10.042	325.8	16.2306	46.03
21.489	445.491	395.71	17.73	4.48	-7.11	368.031	4.496	2.08	368.07	4.50	12	135.00	1.395	1.071	0.324	0.966	80.29	77.56	12.208	395.75	15.201	46.84
21.817	445.163	424.33	18.21	4.29	-15.47	390.385	4.305	2.05	390.48	4.30	12	135.00	1.415	1.083	0.334	0.961	85.16	81.82	13.093	424.43	14.3837	47.09

R14540

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 21 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY ZJA DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-4

ConeTec Inc. pretation
Interpretation Of ase 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4501
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-4
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 12:51
CPT File: 804CP04.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 482.55

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	40.98	1.95	63.49	28.02	2.41

User Inputs:

Assumed: Water Table Depth (ft): 21.7
Nk: 32.3
Slate Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 482.6
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	ESIress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.386	16.72	0.55	2.92	0.12	1825.34	2.940	1.70	1825.36	2.94	5	125.00	0.010	0.010	0.000	2.000	5.30	8.80	0.579	16.72	6.13882	52.96
0.492	482.058	32.37	1.04	3.2	7.35	1061.68	3.216	1.79	1050.38	3.22	5	125.00	0.031	0.031	0.000	2.000	5.87	11.75	1.001	32.33	7.80728	51.02
0.82	481.730	59.25	1.53	2.59	5.02	1165.1	2.586	1.68	1164.51	2.59	6	125.00	0.051	0.051	0.000	2.000	10.38	20.76	1.853	59.22	5.79663	51.36
1.148	481.402	69.32	1.89	2.73	-7.9	985.132	2.729	1.73	965.83	2.73	6	125.00	0.072	0.072	0.000	2.000	12.34	24.68	2.144	69.37	6.60102	50.71
1.476	481.074	55.93	1.68	3.01	-4.6	605.287	3.009	1.82	605.51	3.01	6	125.00	0.092	0.092	0.000	2.000	10.34	20.68	1.729	55.96	6.8717	48.91
1.804	480.746	47.44	1.34	2.82	-9.26	419.754	2.831	1.87	420.29	2.83	6	125.00	0.113	0.113	0.000	2.000	8.91	17.82	1.465	47.5	6.76433	47.40
2.133	480.417	31.92	1.13	3.53	8.69	236.437	3.555	2.01	236.81	3.56	5	125.00	0.133	0.133	0.000	2.000	6.49	12.97	0.984	31.97	15.2078	44.89
2.461	480.089	34.91	0.98	2.81	-9.96	225.965	2.820	2.01	226.35	2.81	6	125.00	0.154	0.154	0.000	2.000	6.90	13.80	1.076	34.97	13.1573	44.64
2.789	479.761	22.26	0.83	3.71	-10	126.702	3.758	2.25	127.05	3.75	4	125.00	0.174	0.174	0.000	2.000	4.87	9.73	0.684	22.32	20.8602	41.81
3.117	479.433	18.96	0.9	4.76	-6.79	96.3244	4.796	2.41	96.58	4.78	3	125.00	0.195	0.195	0.000	2.000	4.44	8.88	0.581	19.01	26.8756	40.38
3.446	479.105	26.28	1.23	4.69	6.97	121.055	4.719	2.36	121.24	4.71	3	125.00	0.215	0.215	0.000	2.000	5.97	11.94	0.807	26.32	24.2642	41.57
3.773	478.777	29.78	1.59	5.34	-8.66	125.287	5.382	2.38	125.50	5.37	3	125.00	0.236	0.236	0.000	2.000	6.88	13.77	0.915	29.83	25.7669	41.75
4.101	478.449	30.45	1.78	5.86	-8.64	117.8	5.895	2.43	118.00	5.89	3	125.00	0.256	0.256	0.000	1.978	7.19	14.21	0.935	30.5	27.7303	41.43
4.429	478.121	31.27	1.79	5.72	-10.05	111.966	5.776	2.44	112.22	5.76	3	125.00	0.277	0.277	0.000	1.901	7.41	14.08	0.960	31.34	27.9465	41.17
4.757	477.793	29.3	1.55	5.3	9.47	97.5495	5.344	2.45	97.75	5.33	3	125.00	0.297	0.297	0.000	1.834	6.97	12.78	0.898	29.36	29.3092	40.45
5.085	477.466	29.53	1.58	5.36	-6.95	91.9164	5.409	2.47	92.07	5.40	3	125.00	0.318	0.318	0.000	1.774	7.09	12.57	0.904	29.58	29.17	40.13
5.413	477.137	29.07	1.51	5.21	-5.15	84.9265	5.256	2.48	85.02	5.25	3	125.00	0.338	0.338	0.000	1.719	7.01	12.05	0.890	29.1	29.6819	39.89
5.741	476.809	26.51	1.35	5.1	-4.32	72.8826	5.162	2.51	72.97	5.16	3	125.00	0.359	0.359	0.000	1.669	6.80	10.86	0.810	26.54	31.275	38.86
6.069	476.481	27.29	1.35	4.94	-2.56	70.946	5.017	2.51	71.00	5.01	3	125.00	0.379	0.379	0.000	1.624	6.69	10.86	0.833	27.31	31.1947	38.70
6.398	476.152	32.7	1.45	4.43	-4.16	80.7756	4.489	2.44	80.79	4.49	3	125.00	0.400	0.400	0.000	1.581	7.73	12.23	1.000	32.67	28.0404	39.41
6.726	475.824	32.33	1.57	4.85	6.33	75.9075	4.920	2.49	75.81	4.93	3	125.00	0.420	0.420	0.000	1.542	7.61	12.05	0.986	32.29	30.1186	39.07
7.054	475.496	27.79	1.42	5.1	5.99	62.0337	5.192	2.56	61.97	5.20	3	125.00	0.441	0.441	0.000	1.505	6.96	10.49	0.847	27.76	33.5207	37.94
7.382	475.168	27.8	1.26	4.54	6.3	59.2547	4.609	2.54	59.17	4.62	4	125.00	0.461	0.461	0.000	1.472	6.88	10.13	0.846	27.76	32.3359	37.67
7.71	474.840	26.97	1.13	4.2	7.16	54.9689	4.266	2.53	54.89	4.27	4	125.00	0.482	0.482	0.000	1.441	6.66	9.60	0.820	26.93	32.2137	37.24
8.038	474.512	23.35	0.77	3.28	9.98	45.4792	3.370	2.52	45.36	3.38	5	125.00	0.502	0.502	0.000	1.411	5.72	8.07	0.707	23.29	31.5492	36.13
8.366	474.184	23.34	0.89	3.8	13.65	43.6378	3.901	2.58	43.47	3.92	4	125.00	0.523	0.523	0.000	1.382	5.86	8.13	0.706	23.25	34.2563	35.87
8.694	473.856	23.05	1.41	6.13	7.81	41.4201	6.265	2.74	41.32	6.28	3	125.00	0.543	0.543	0.000	1.357	5.32	8.58	0.697	23	42.6219	35.57
9.022	473.528	21.04	1.1	5.22	9.84	36.3132	5.372	2.73	36.21	5.39	3	125.00	0.564	0.564	0.000	1.332	5.74	7.65	0.634	20.98	42.147	34.77
9.35	473.200	24.56	1.13	4.61	14	41.0276	4.713	2.65	40.87	4.73	3	125.00	0.584	0.584	0.000	1.308	6.43	8.41	0.742	24.47	36.0584	35.50
9.678	472.872	29.72	1.6	5.4	18.45	48.1341	5.495	2.66	47.95	5.52	3	125.00	0.605	0.605	0.000	1.286	7.78	10.01	0.901	29.61	36.1091	36.45
10.006	472.544	27.78	1.68	6.06	20.23	43.4213	6.187	2.72	43.23	6.21	3	125.00	0.625	0.625	0.000	1.265	7.54	9.58	0.841	27.66	41.7217	35.84
10.335	472.215	35.02	2.44	6.95	1.71	53.2158	7.098	2.71	53.20	7.10	3	125.00	0.646	0.646	0.000	1.244	9.46	11.77	1.064	35.01	40.8697	37.06
10.663	471.887	39.84	2.72	6.82	-8.71	58.7805	6.943	2.67	58.86	6.93	3	125.00	0.666	0.666	0.000	1.225	10.58	12.96	1.213	39.89	36.9729	37.64
10.991	471.559	51.44	3.01	5.85	-13.44	73.8831	5.931	2.56	74.00	5.92	3	125.00	0.687	0.687	0.000	1.207	12.39	15.55	1.571	51.52	33.2411	38.93
11.319	471.231	49.73	3.35	6.74	15.60	69.296	6.834	2.62	69.44	6.82	3	125.00	0.707	0.707	0.000	1.189	12.67	15.31	1.518	49.83	36.392	38.59
11.647	470.903	59.48	3.27	5.5	-19.93	80.7105	5.665	2.51	80.88	5.65	11	125.00	0.728	0.728	0.000	1.172	14.52	17.09	1.819	59.6	31.1331	39.42
11.975	470.575	59.84	3.39	5.67	-19.21	76.9532	5.737	2.54	79.11	5.73	11	125.00	0.748	0.748	0.000	1.156	14.78	17.09	1.829	59.96	31.8715	39.30
12.303	470.247	46.27	3.26	7.05	21.45	59.1739	7.165	2.66	59.36	7.14	3	125.00	0.769	0.769	0.000	1.140	12.36	14.09	1.409	46.41	39.3661	37.69
12.631	469.919	60.74	3.55	5.84	-21.71	75.9409	5.922	2.55	76.12	5.91	11	125.00	0.789	0.789	0.000	1.125	15.17	17.07	1.856	60.86	32.6461	39.09
12.959	469.591	85.44	5.35	6.27	-21.04	104.49	6.322	2.49	104.65	6.31	11	125.00	0.810	0.810	0.000	1.111	20.71	22.01	2.620	85.57	30.0976	40.81
13.287	469.263	93.83	6.4	6.82	-21.32	111.969	6.882	2.50	112.16	6.87	11	125.00	0.830	0.830	0.000	1.097	22.88	25.10	2.879	93.97	30.688	41.17
13.615	468.935	102.07	7.14	6.64	21.2	127.176	6.598	2.45	127.38	6.59	11	125.00	0.851	0.851	0.000	1.084	26.01	28.20	3.350	109.2	28.6643	41.93
13.943	468.607	131.31	8.27	6.3	-20.49	149.682	6.340	2.40	149.83	6.33	11	125.00	0.871	0.871	0.000	1.071	30.56	32.73	4.095	131.44	26.4331	42.65
14.271	468.279	130.51	8.58	6.57	-20.11	145.322	6.619	2.42	145.47	6.61	11	125.00	0.892	0.892	0.000	1.058	30.69	32.49	4.013	130.64	27.3685	42.50
14.6	467.950	121.15	8.14	6.72	-19.98	131.767	6.770	2.45	131.91	6.76	11	125.00	0.913	0.913	0.000	1.047	28.90	30.26	3.723	121.28	28.6919	42.01
14.928	467.622	117.27	7.69	6.56	-18.71	124.691	6.610	2.46	124.81	6.60	11	125.00	0.933	0.933	0.000	1.036	28.04	29.03	3.600	117.36	28.8952	41.72
15.256	467.294	114.14	9.49	8.32	-17.94	116.706	7.501	2.56	116.82	7.49	11	125.00	0.954	0.954	0.000	1.026	28.04	28.72	3.504	114.25	31.4374	41.17

R14542

Depth (ft)	San (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	s (-)	ESIress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.966	104.36	7.93	7.6	18.2	106.146	7.670	2.55	106.27	7.06	11	125.00	0.974	0.974	0.000	1.013	36.08	36.43	3.201	104.48	33.0563	40.89
15.912	466.638	108.46	7.37	6.8	18.02	108.06	6.858	2.51	108.17	6.85	11	125.00	0.995	0.995	0.000	1.003	28.53	28.60	3.327	108.57	31.0225	40.06
16.24	466.310	113.79	7.6	6.86	-17.9	111.108	6.916	2.50	111.22	6.91	11	125.00	1.015	1.015	0.000	0.993	27.78	27.58	3.491	113.8	30.8499	41.13
16.568	465.982	153.77	8.7	5.66	-14.55	147.498	5.696	2.37	147.59	5.69	11	125.00	1.036	1.036	0.000	0.983	35.20	34.59	4.729	153.86	25.0169	42.57
16.896	465.654	147.94	9.72	6.57	-6	139.095	6.617	2.45	139.13	6.62	11	125.00	1.056	1.056	0.000	0.973	34.93	33.99	4.547	147.98	27.8141	42.28
17.224	465.326	138.28	8.74	6.32	-8.2	127.453	6.370	2.44	127.51	6.37	11	125.00	1.077	1.077	0.000	0.964	32.76	31.58	4.248	138.34	28.1122	41.83
17.552	464.998	221.55	7.13	3.22	-7.74	200.96	3.234	2.09	201.01	3.23	12	125.00	1.097	1.097	0.000	0.955	45.08	43.04	6.825	221.6	15.4929	44.08
17.88	464.670	100.12	6.85	6.84	-12.15	88.5928	6.919	2.56	88.66	6.91	11	125.00	1.116	1.116	0.000	0.946	25.13	23.77	3.065	100.2	33.4871	39.92
18.208	464.342	76.59	4.86	6.34	-10.09	66.3023	6.441	2.61	66.36	6.44	11	125.00	1.136	1.136	0.000	0.937	19.22	17.50	2.336	76.66	36.0279	38.32
18.537	464.013	175.62	5.94	3.38	-2.06	150.584	3.405	2.16	150.58	3.40	12	125.00	1.156	1.156	0.000	0.929	37.06	34.49	5.401	175.61	16.2358	42.67

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 24 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5

ConeTec Inc. pretation
Interpretation Of ease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4462
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 12:34
CPT File: 804CP05.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 482.55

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.49	1.51	49.57	22.51	2.24
125	Soil Embankment	27.27	1.95	65.50	63.68	3.04

User Inputs:

Water Table Depth (ft): 34.4
Assumed: Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 482.6
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.386	8.66	0.05	0.59	-0.16	802.002	0.585	1.14	802.00	0.58	1	130.00	0.011	0.011	0.000	2.000	1.26	2.53	0.265	8.56	-1.0384	50.01
0.492	482.058	13.06	0.18	1.38	-0.41	407.38	1.382	1.61	407.69	1.38	6	130.00	0.032	0.032	0.000	2.000	2.23	4.47	0.403	13.07	4.50958	47.27
0.82	481.730	39.92	0.69	1.73	-0.58	747.968	1.731	1.59	746.16	1.73	7	130.00	0.053	0.053	0.000	2.000	6.75	13.50	1.234	39.93	3.96322	49.74
1.148	481.402	81.09	1.4	1.72	-0.71	1085.71	1.728	1.52	1085.84	1.73	7	130.00	0.075	0.075	0.000	2.000	13.47	26.93	2.508	81.1	3.13579	51.14
1.476	481.074	98.28	2.17	2.21	-0.39	1023.39	2.210	1.63	1023.39	2.21	7	130.00	0.096	0.095	0.000	2.000	16.92	33.85	3.040	98.28	4.87426	50.92
1.804	480.746	102.52	1.75	1.71	-0.72	873.296	1.709	1.55	873.38	1.71	7	130.00	0.117	0.117	0.000	2.000	17.17	34.33	3.170	102.53	3.50958	50.93
2.133	480.417	76.33	1.69	2.22	-0.49	549.543	2.218	1.73	549.61	2.22	7	130.00	0.139	0.139	0.000	2.000	13.59	27.18	2.359	76.34	6.64681	48.52
2.461	480.089	77.28	1.31	1.7	-0.51	481.981	1.699	1.65	481.98	1.70	7	130.00	0.160	0.160	0.000	2.000	13.39	26.78	2.387	77.26	5.20939	47.98
2.789	479.761	73.62	1.23	1.67	-0.64	405.101	1.675	1.68	405.10	1.67	7	130.00	0.181	0.181	0.000	2.000	12.90	25.80	2.274	73.62	5.76223	47.24
3.117	479.433	51.07	0.77	1.5	-1.11	251.067	1.514	1.76	251.07	1.51	7	130.00	0.203	0.203	0.000	2.000	9.20	18.40	1.575	51.07	7.33445	45.12
3.445	479.105	45.47	0.65	1.49	-0.99	193.127	1.503	1.83	193.17	1.50	7	130.00	0.224	0.224	0.000	2.000	8.03	16.06	1.339	43.46	8.80013	43.89
3.773	478.777	37.71	0.53	1.4	-1.27	152.765	1.415	1.88	152.81	1.41	7	130.00	0.245	0.245	0.000	2.000	7.09	14.18	1.160	37.72	9.89985	42.76
4.101	478.449	27.27	0.39	1.43	-1.04	101.302	1.444	2.01	101.34	1.44	6	130.00	0.267	0.267	0.000	1.937	5.39	10.44	0.836	27.28	13.2675	40.64
4.429	478.121	26.38	0.42	1.6	-1.23	90.5338	1.610	2.08	90.63	1.61	6	130.00	0.288	0.288	0.000	1.864	5.35	9.97	0.808	26.38	15.1944	40.04
4.757	477.793	16.86	0.58	3.17	-1.09	58.3781	3.219	2.43	58.38	3.21	5	130.00	0.309	0.309	0.000	1.798	4.32	7.77	0.559	16.86	27.4805	37.60
5.085	477.465	64.13	1.14	1.77	-1.43	193.025	1.787	1.89	193.05	1.79	7	130.00	0.331	0.331	0.000	1.739	12.10	21.04	1.975	64.14	10.1362	43.89
5.413	477.137	80.68	2.1	2.6	-1.02	228.306	2.614	1.98	228.33	2.61	6	130.00	0.352	0.352	0.000	1.686	15.74	26.54	2.487	80.69	12.3846	44.68
5.741	476.809	82.5	2.19	2.65	-0.19	220.082	2.667	2.00	220.08	2.67	6	130.00	0.373	0.373	0.000	1.637	16.19	26.51	2.543	82.5	12.8155	44.51
6.069	476.481	62.21	1.32	1.6	-0.88	207.398	1.613	1.84	207.40	1.61	7	130.00	0.394	0.394	0.000	1.592	15.20	24.21	2.533	62.21	6.89156	44.23
6.398	476.152	69.65	0.67	0.96	-0.92	166.48	0.968	1.74	166.50	0.97	6	130.00	0.416	0.416	0.000	1.551	12.44	18.28	2.143	69.66	6.80329	43.17
6.726	475.824	67.23	1.03	1.54	-0.51	152.776	1.542	1.91	152.78	1.54	7	130.00	0.437	0.437	0.000	1.512	12.76	19.31	2.068	67.23	10.5604	42.74
7.054	475.496	62.5	1.02	1.64	-0.74	135.311	1.644	1.96	135.33	1.64	7	130.00	0.459	0.459	0.000	1.477	12.12	17.90	1.921	62.51	11.9604	42.14
7.382	475.168	50.83	0.75	1.27	-0.83	121.606	1.285	1.92	121.61	1.29	7	130.00	0.480	0.480	0.000	1.444	11.22	16.20	1.807	50.83	10.869	41.59
7.71	474.840	46.66	0.49	1.05	-1.29	92.1059	1.062	1.95	92.11	1.06	7	130.00	0.501	0.501	0.000	1.413	9.02	12.74	1.429	46.66	11.7456	40.13
8.038	474.512	87.02	0.37	0.99	-0.74	69.8557	1.014	2.04	69.86	1.01	7	130.00	0.522	0.522	0.000	1.383	7.36	10.21	1.130	87.02	13.9466	38.61
8.366	474.184	26.15	0.38	1.46	-1.04	47.0884	1.464	2.27	47.11	1.48	6	130.00	0.544	0.544	0.000	1.356	5.75	7.79	0.793	26.15	21.5182	36.35
8.694	473.856	15.2	0.12	0.79	-0.81	25.8974	0.820	2.35	25.90	0.82	6	130.00	0.565	0.565	0.000	1.330	3.45	4.59	0.463	15.2	24.3631	32.69
9.022	473.528	13.51	0.23	1.67	-1.09	22.0377	1.780	2.59	22.04	1.78	5	130.00	0.588	0.588	0.000	1.306	3.43	4.48	0.400	13.51	34.6587	31.66
9.35	473.200	16.76	0.4	2.39	-2.31	26.5771	2.476	2.01	26.59	2.47	5	130.00	0.606	0.608	0.000	1.283	4.30	5.51	0.500	16.77	35.6064	32.86
9.678	472.872	59.24	0.76	1.29	-1.66	93.1708	1.297	2.01	93.19	1.30	7	130.00	0.629	0.629	0.000	1.261	11.68	14.73	1.815	59.25	13.14	40.19
10.006	472.544	72.22	0.96	1.33	-0.79	110.041	1.341	1.96	110.04	1.34	7	130.00	0.650	0.650	0.000	1.240	14.01	17.37	2.216	72.22	11.9981	41.07
10.335	472.215	64.71	1.11	1.72	-0.51	95.3269	1.733	2.09	95.33	1.73	7	130.00	0.672	0.672	0.000	1.220	13.16	16.06	1.983	64.71	15.3858	40.31
10.663	471.887	67.23	1.33	1.98	-0.56	95.9997	1.999	2.13	96.00	2.00	7	130.00	0.693	0.693	0.000	1.201	13.90	16.70	2.060	67.23	16.6515	40.35
10.991	471.559	52.10	1.10	2.22	-1.01	72.0108	2.255	2.28	72.01	2.25	6	130.00	0.714	0.714	0.000	1.183	11.36	13.44	1.593	52.10	20.8129	38.78
11.319	471.231	55.94	1.24	2.17	-1.5	76.392	2.206	2.23	76.41	2.21	6	130.00	0.736	0.736	0.000	1.166	12.28	14.31	1.740	55.95	19.9382	39.11
11.647	470.903	52.44	1.04	1.99	-1.08	69.2684	2.012	2.24	69.28	2.01	7	130.00	0.757	0.757	0.000	1.149	11.34	13.03	1.600	52.45	20.2013	38.48
11.975	470.575	33.75	0.91	2.69	-0.92	42.3596	2.760	2.46	42.37	2.76	6	130.00	0.778	0.778	0.000	1.133	8.15	9.23	1.021	33.76	29.8338	35.72
12.303	470.247	35.95	0.93	2.59	-2.38	43.9546	2.646	2.46	43.98	2.64	6	130.00	0.800	0.800	0.000	1.118	8.58	9.59	1.088	35.97	28.7745	35.94
12.631	469.919	39.86	0.73	1.84	-1.87	47.5375	1.870	2.33	47.55	1.87	6	130.00	0.821	0.821	0.000	1.104	8.99	9.92	1.209	39.86	23.739	36.40
12.959	469.591	38.57	0.32	0.82	-1.48	44.7694	0.848	2.15	44.80	0.85	7	130.00	0.842	0.842	0.000	1.090	8.05	8.78	1.168	38.58	17.3896	36.05
13.287	469.263	53.21	0.49	0.91	-0.83	60.6102	0.936	2.07	60.61	0.94	7	130.00	0.864	0.864	0.000	1.076	10.74	11.55	1.621	53.21	14.7902	37.81
13.615	468.935	34.3	0.61	1.77	-0.69	37.7582	1.826	2.40	37.77	1.82	6	130.00	0.885	0.885	0.000	1.063	7.99	8.49	1.035	34.31	28.5558	35.03
13.943	468.607	28.16	0.33	1.17	-0.69	30.0716	1.211	2.58	30.08	1.21	7	130.00	0.906	0.906	0.000	1.050	6.49	6.82	0.844	28.17	25.6033	33.63
14.271	468.279	26.64	0.48	1.79	-0.69	27.7188	1.667	2.62	27.72	1.67	6	130.00	0.928	0.928	0.000	1.038	6.54	6.79	0.796	26.64	31.4282	33.12
14.6	467.950	28.1	0.34	1.19	-0.97	28.6101	1.252	2.41	28.62	1.25	7	130.00	0.949	0.949	0.000	1.027	6.55	6.73	0.841	28.11	26.6607	33.32
14.928	467.622	26.73	0.36	1.33	-0.67	26.5476	1.398	2.46	26.55	1.40	6	130.00	0.970	0.970	0.000	1.015	6.39	6.48	0.798	26.73	28.915	32.84
15.256	467.294	39.54	0.32	0.81	-0.79	38.8733	0.830	2.20	38.89	0.83	7	130.00	0.992	0.992	0.000	1.004	8.42	8.46	1.193	39.55	18.9383	35.20

Depth (ft)	Sar	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...ss (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.966	38.96	0.32	0.81	-0.78	37.4615	0.843	2.22	37.46	0.84	7	130.00	1.013	1.013	0.000	0.994	8.36	8.30	1.175	38.96	19.527	34.96
15.912	466.638	27.47	0.35	1.28	-0.74	25.5595	1.324	2.46	25.56	1.32	6	130.00	1.034	1.034	0.000	0.983	6.57	6.46	0.818	27.47	28.9508	32.60
16.24	466.310	23.16	0.23	0.99	-0.74	20.9591	1.040	2.46	20.97	1.04	6	130.00	1.056	1.056	0.000	0.973	5.59	5.44	0.685	23.19	29.75	31.34
16.568	465.982	22.71	0.18	0.77	-0.45	20.0879	0.832	2.45	20.09	0.83	7	130.00	1.077	1.077	0.000	0.964	5.40	5.20	0.670	22.71	26.4423	31.08
16.896	465.654	24.05	0.41	1.71	-0.53	20.8987	1.786	2.61	20.90	1.79	6	130.00	1.098	1.098	0.000	0.954	6.17	5.88	0.711	24.05	35.6268	31.31
17.224	465.326	23.09	0.43	1.87	-0.51	19.6242	1.957	2.65	19.63	1.96	6	130.00	1.120	1.120	0.000	0.945	6.06	5.73	0.680	23.1	37.8641	30.91
17.552	464.998	22.68	0.23	1.02	-0.74	18.8794	1.068	2.52	18.88	1.07	6	130.00	1.141	1.141	0.000	0.936	5.59	5.23	0.657	22.68	31.7842	30.65
17.88	464.670	21.11	0.44	2.07	-0.46	17.1638	2.206	2.73	17.16	2.21	6	130.00	1.162	1.162	0.000	0.928	5.77	5.35	0.618	21.11	41.9584	30.03
18.208	464.342	25.83	0.62	2.41	-1.27	20.8247	2.61557	2.69328	20.8332	2.61456	6	130.00	1.18352	1.18352	0	0.9192	6.929377	6.369516	0.76305	25.84	40.0978	31.295
18.537	464.013	26.98	0.58	2.14	-1.5	21.9918	2.25023	2.65503	21.4001	2.24936	6	130.00	1.20491	1.204905	0	0.911	7.09544	6.464023	0.79799	26.99	38.1085	31.468
18.865	463.685	32.84	0.54	1.65	-0.37	25.7814	1.70812	2.51953	25.7814	1.70812	6	130.00	1.22623	1.226225	0	0.9031	8.07106	7.288623	0.97875	32.84	31.5636	32.659
19.193	463.357	28.01	0.56	2	-0.64	21.4521	2.09248	2.63571	21.4521	2.09248	6	130.00	1.24755	1.247545	0	0.8953	7.291148	6.527814	0.82856	28.01	37.1276	31.484
19.521	463.029	42.88	0.77	1.81	-1.09	32.8998	1.87297	2.463	32.4078	1.87252	7	130.00	1.26887	1.268865	0	0.8878	10.14259	9.084115	1.27279	42.39	29.0567	34.09
19.849	462.701	48.16	0.77	1.59	-0.46	36.3047	1.6439	2.38956	36.3047	1.6439	7	130.00	1.29019	1.290185	0	0.8804	11.13334	9.801657	1.45015	48.19	25.9872	34.787
20.177	462.373	40.56	1.01	2.5	-0.3	29.9263	2.57335	2.57572	29.9263	2.57335	6	130.00	1.31161	1.311505	0	0.8732	10.24612	8.946066	1.21512	40.56	34.1844	33.596
20.505	462.045	53.08	1.3	2.45	-0.41	38.8252	2.51221	2.4824	38.8252	2.51221	6	130.00	1.33283	1.332825	0	0.8662	12.81671	11.10171	1.60206	53.08	29.9025	35.195
20.833	461.717	72.85	1.66	2.28	-0.37	52.7976	2.32181	2.35952	52.8052	2.32149	7	130.00	1.35415	1.354145	0	0.8593	16.62862	14.28971	2.21349	72.86	24.7953	37.018
21.161	461.389	66.65	1.76	2.62	-0.53	61.9969	2.0522	2.27196	62.0041	2.05196	7	130.00	1.37547	1.375465	0	0.8527	19.03346	16.22904	2.64008	66.66	21.4966	37.941
21.489	461.061	99.74	1.53	1.53	-0.42	70.4068	1.55578	2.15059	70.414	1.55562	8	130.00	1.39679	1.396785	0	0.8461	20.8237	17.61048	3.04468	99.75	17.3821	38.657
21.817	460.733	86.19	1.62	1.88	-0.48	59.7712	1.91124	2.26316	59.7712	1.91124	7	130.00	1.41811	1.418105	0	0.8397	18.85677	15.83482	2.62421	86.18	21.1809	37.732
22.145	460.405	86.56	1.53	1.77	-0.55	59.1351	1.79745	2.24908	59.1351	1.79745	7	130.00	1.43943	1.439425	0	0.8336	18.82842	15.69181	2.63531	86.56	20.681	37.67
22.473	460.077	83.42	1.73	2.08	-0.6	56.1078	2.1108	2.3123	56.1147	2.11055	7	130.00	1.46075	1.460745	0	0.8274	18.64714	15.42855	2.53744	83.43	22.9798	37.369
22.802	459.748	74.32	1.6	2.15	-0.97	49.144	2.19666	2.36683	49.1508	2.19636	7	130.00	1.48213	1.48213	0	0.8214	17.01887	13.97937	2.26504	74.33	25.0792	36.599
23.13	459.420	71.25	1.63	2.28	-0.64	46.4176	2.33669	2.40313	46.4176	2.33569	7	130.00	1.50345	1.50345	0	0.8156	16.59253	13.53219	2.16057	71.29	26.5386	36.262
23.458	459.092	64.8	1.34	2.07	-0.51	41.4982	2.11773	2.41227	41.5048	2.1174	7	130.00	1.52477	1.52477	0	0.8098	15.14737	12.26691	1.95899	64.81	26.9142	35.596
23.786	458.764	57.97	0.97	1.6	-0.49	36.4946	1.5419	2.37112	36.4946	1.5419	7	130.00	1.54609	1.54609	0	0.8042	13.2986	10.69519	1.74687	57.97	25.2493	34.819
24.114	458.436	57.68	0.89	1.55	-0.56	35.7996	1.5661	2.38513	35.7996	1.5661	7	130.00	1.56741	1.56741	0	0.7987	13.91578	10.63593	1.73723	57.68	25.809	34.702
24.442	458.108	51.01	0.65	1.27	-0.53	31.1074	1.31522	2.38788	31.1074	1.31522	7	130.00	1.58873	1.58873	0	0.7934	11.79061	9.354301	1.53007	51.01	25.9197	33.837
24.77	457.780	45.04	0.65	1.45	-0.56	26.9743	1.49666	2.47065	26.9743	1.49666	7	130.00	1.61005	1.61005	0	0.7891	10.81503	8.523542	1.34458	45.04	29.3982	32.945
25.098	457.452	51.99	0.93	1.79	-0.67	30.8689	1.84675	2.47611	30.875	1.84539	7	130.00	1.63137	1.63137	0	0.7829	12.51872	9.8013	1.55909	52	29.6264	33.79
25.426	457.124	48.03	1.05	2.18	-0.67	28.0617	2.26404	2.56273	28.0678	2.26355	6	130.00	1.65269	1.65269	0	0.7779	12.05714	9.378831	1.43563	48.04	33.567	33.195
25.754	456.796	45.32	0.59	1.29	-0.49	26.0727	1.35179	2.45827	26.0727	1.35179	7	130.00	1.67401	1.67401	0	0.7729	10.81969	8.362491	1.35127	45.32	29.8526	32.73
26.082	456.468	65.38	0.34	0.62	-0.74	37.6662	0.63333	2.21862	37.6662	0.63333	8	130.00	1.69533	1.69533	0	0.766	11.89086	9.132489	1.66206	55.38	19.6243	33.947
26.41	456.140	73.15	0.73	0.99	-0.26	41.6121	1.02193	2.22191	41.6121	1.02193	8	130.00	1.71665	1.71665	0	0.7632	13.72803	12.00421	2.21156	73.15	19.7367	35.612
26.739	455.811	74.59	0.95	1.27	-0.07	41.9163	1.30401	2.27962	41.9163	1.30401	8	130.00	1.73804	1.738035	0	0.7585	16.43665	12.46756	2.25548	74.59	21.7737	35.656
27.067	455.483	59.6	1.28	2.11	-0.54	32.8761	2.1784	2.49849	32.8761	2.1784	7	130.00	1.75936	1.759365	0	0.7539	14.50122	10.93271	1.79073	59.6	30.6157	34.179
27.395	455.155	62.45	1.36	2.18	-0.02	34.071	2.24166	2.4942	34.071	2.24166	7	130.00	1.78068	1.780675	0	0.7494	15.16369	11.36351	1.87831	62.45	30.4245	34.399
27.723	454.827	50.82	1.25	2.47	-0.46	27.2021	2.55008	2.60548	27.2021	2.55008	6	130.00	1.802	1.801995	0	0.7449	13.02823	9.705289	1.51759	50.82	35.6254	32.998
28.051	454.499	35	1.08	3.08	-1.09	18.1958	3.2553	2.80804	18.2013	3.25432	5	130.00	1.82332	1.823315	0	0.7406	9.969687	7.398114	1.02714	35.01	46.4587	30.416
28.379	454.171	33.92	1.21	3.58	-0.14	17.3885	3.77237	2.86349	17.3985	3.77237	5	130.00	1.84464	1.844635	0	0.7363	9.98773	7.353796	0.99305	33.92	49.75	30.116
28.707	453.843	24.82	1.39	5.59	-20.74	12.3015	6.05556	3.10673	12.3712	6.02148	3	130.00	1.86596	1.865955	0	0.7321	8.543187	6.254165	0.71065	24.95	65.8662	27.853
29.035	453.515	30.38	1.32	4.36	-20.28	15.0973	4.63276	2.96444	15.1609	4.61333	4	125.00	1.88728	1.887275	0	0.7279	9.53739	6.942437	0.88213	30.5	56.1472	29.211
29.363	453.187	26.39	1.19	4.5	-19.63	12.8029	4.86067	3.03231	12.8958	4.83686	4	125.00	1.90778	1.907775	0	0.724	8.646449	6.259998	0.75796	26.51	60.6874	28.132
29.691	452.859	32.99	1.13	3.43	-16.73	16.1086	3.63792	2.87768	16.1604	3.62624	5	125.00	1.92828	1.928275	0	0.7201	9.823652	7.074381	0.95166	33.09	50.616	29.634
30.019	452.531	38.04	1.29	3.39	-14.99	18.52	3.57426	2.82578	18.5713	3.5644	5	125.00	1.94878	1.948775	0	0.7163	10.99164	7.873748	1.11738	38.14	47.4962	30.547
30.347	452.203	35.48	1.02	2.88	-14.16	17.0219	3.04289	2.8116	17.0676	3.03475	5	125.00	1.96928	1.969275	0	0.7126	10.17256	7.248986	1.03779	35.58	46.666	29.994
30.675	451.875	36.01	0.81	2.24	-13.42	17.0975	2.38094	2.74704	17.1377	2.37536	5	125.00	1.98978	1.989775	0	0.7089	9.956889	7.060068	1.05326	36.09	43.0037	30.021
31.004	451.546	30.49	0.67	2.19	-12.69	14.1666	2.35256	2.81069	14.2064	2.34697	6	125.00	2.01034	2.010338	0	0.7053	8.735745	6.161203	0.98172	30.57	46.6132	28.778
31.332	451.218	20.88	0.57	2.71	-12.47	9.28147	3.02401	3.02299	9.32087	3.01129	5	125.00	2.03084	2.030838	0	0.7017	6.795868	4.788781	0.58367	20.96	60.0464	25.941
31.66	450.890	16.5	0.4	2.43	-12.06	7.04353	2.76842	3.10136	7.08253	2.75318	5	125.00	2.05134	2.051338	0	0.6982	5.656688	3.949654	0.44733	16.58	65.5763	24.077
31.988	450.562	15.2	0.37	2.41	-11.71	6.33648	2.81837	3.1445	6.37027	2.80342	5	125.00	2.07184	2.071838	0	0.6947	5.364346	3.726824	0.40644	15.27	68.7573	23.359
32.316	450.234	13.42	0.31	2.32	-10.81	5.41388	2.73686	3.19603	5.44256	2.72224	5	125.00	2.09234	2.092338	0	0.6913	4.908323	3.393952	0.3507	13.48	72.6878	22.298
32.644	449.906	13.41	0.39	2.86	-10.09	5.34691	3.45219	3.25342	5.38005	3.43094	5	125.00	2.11284	2.112838	0	0.688	5.118563	3.521397	0.36076	13.48	77.2066	22.221
32.972	449.578	13.24	0.28	2.12	-7.72	5.20824	2.52101	3.19262	5.22988	2.50971	5	125.00	2.13334	2.133338	0	0.6847	4.829085	3.306202	0.34386	13.29	72.4383	22.031
33.3	449.250	15.29	0.27	1.74	-7.34	6.09096	2.05539	3.08974	6.11753	2.04916	6	125.00	2.15384	2.153838	0	0.6814	5.190141	3.536492	0.40669	15.33	64.7359	23.086
33.628	448.922	12.74	0.24	1.85	-6.3	4.86926	2.27151	3.19655	4.87765	2.26294	5	125.00	2.17434	2.174338	0	0.6782	4.656115	3.157623	0.32711	12.78	72.7283	21.565
33.956	448.594	15.46	0.33	2.14	-5.57	6.0438	2.48772	3.13551	6.05747	2.48211	5	125.00	2.19484	2.194838	0	0.675	5.408217	3.660504	0.41069	15.49	68.086	23.019
34.284	448.266	19.07	0.47	2.44	-5.31	7.60817	2.78955	3.07707	7.62171	2.78359	5	125.00	2.21534	2.215338	0	0.6719	6.41274	4.306476	0.52182	19.1	63.8284	24.575
34.612	447.938	20.99	0.5	2.36	-4.73	8.41287	2.66607	3.02892	8.42633	2.66182	5	125.00	2.23584	2.229223	0.0066	0.6698	6.845398	4.584817	0.58062	21.02	60.5225	25.259
34.941	447.609	25.65	0.82	3.16	-4.43	10.4074	3.50548	3.01977	10.4508	3.50099	5	125.00	2.25805	2.241166	0.0169	0.668	8.308312	5.550648	0.72421	25.66	59.8266	26.721
35.269	447.281	24.21	1.06	4.37	-9.01	9.73329	4.8336	3.12648	9.75092	4.82041	4	125.00	2.28019	2.253072	0.0271	0.6662	8.421758	5.610676	0.67894	24.27	67.4162	26.261
35.597	446.953	22.27	0.91	4.1	-14.16	8.81583	4.55737	3.14431	8.96557	4.53692	4	125.00	2.30233	2.264979	0.0373	0.6646	7.854004	5.218661	0.61619	22.36	68.7426	25.606
35.925	446.625	19.46	0.98	5.05	-13.21	7.52587	5.71911	3.25807	7.5654	5.68923	3	125.00	2.32447	2.276905	0.0478	0.6627	7.448111	4.935668	0.53051	19.55	77.6125	24.544
36.253	446.297	24.68	1.3	5.26	-11.24	9.75772	5.82088	3.17489	9.79288	5.8001	3	125.00	2.34661	2.288791	0.0579	0.661	9.883868	6.872043	0.69144	24.76	71.058	25.293
36.581	445.969	26.57	1.26	4.75	-10.88	10.5191	5.20634	3.11986	10.5452	5.19347	3	125.00	2.36875	2.300698	0.068	0.6593	9.199371	6.064966	0.74926	25.63	66.9282	26.799
36.909	445.641	22.11	0.92	4.17	-10.16	8.5268	4.66552	3.16289	8.55275	4.65137	4	125.00	2.39089	2.312604	0.0783	0.6576	7.957958	5.186978	0.6105	22.17	70.1423	25.384
37.237	445.313	21.91	0.71	3.22	-9.52	8.38756	3.64159	3.10571	8.41337	3.63042	5	125.00	2.41303	2.324511	0.0885	0.6559	7.517677	4.930806	0.60362	21.97	65.8921	25.277
37.565	444.985	23	0.88	3.81	-9.38	8.80187	4.27915	3.12957	8.82755	4.27667	4	125.00	2.43517	2.336417	0.0987	0.6542	8.018715	5.246016	0.64668	23.06	67.6451	25.885

Depth (ft)	Samp (ft,	qCl (sf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	444.657	19.45	0.95	4.9	10	7.2361	5.59064	3.20678	7.26186	5.57067	5	135.00	2.45731	2.448424	0.169	3.6526	7.482228	4.88261	0.52609	19.51	78.3181	24.29
38.221	444.329	18.24	0.79	4.34	9.37	6.67755	5.01251	3.26944	6.70297	4.9938	5	135.00	2.47545	2.46023	0.1192	3.6509	7.016581	4.567189	0.48794	18.3	75.2934	23.755
38.549	444.001	21.57	0.78	3.6	9.87	8.0385	4.08053	3.14988	8.08379	4.9777	5	135.00	2.50159	2.472146	0.1294	3.6493	7.626764	4.951904	0.59035	21.63	69.1608	26.004
38.877	443.673	18.25	0.67	3.65	-8.11	6.59647	4.26039	3.2302	6.61746	4.24686	6	135.00	2.52373	2.494043	0.1397	3.6477	6.83099	4.424117	0.46688	18.3	75.3741	23.677
39.206	443.344	20.75	0.81	3.91	-7.44	7.59774	4.44956	3.19132	7.61861	4.43737	6	135.00	2.54583	2.515985	0.1499	3.646	7.549899	4.87752	0.56359	20.8	72.3227	24.628
39.534	443.016	21.68	1.16	5.34	-5.68	7.9372	6.06951	2.85744	7.95382	6.05683	3	135.00	2.56807	2.537892	0.1602	3.6444	8.272102	5.330862	0.5917	21.72	77.562	24.921
39.862	442.688	22.71	1.16	5.1	-5.2	8.31466	5.76547	3.22705	8.33119	5.75403	3	135.00	2.59021	2.419796	0.1704	3.6429	8.477683	5.449889	0.6229	22.75	75.1893	25.237
40.19	442.360	28.63	1.19	4.17	-3.31	10.6993	4.57382	3.08047	10.7076	4.57031	4	135.00	2.61236	2.431706	0.1805	3.6413	9.640815	6.18279	0.8055	28.65	64.071	26.927
40.518	442.032	28.19	1.27	4.52	-2.28	10.4581	4.96957	3.11052	10.4622	4.96763	4	135.00	2.63439	2.443611	0.1909	3.6397	9.6813	6.193237	0.79119	28.2	66.2507	26.774
40.846	441.704	26.69	1.27	4.77	1.6	9.7875	5.28432	3.14971	9.79157	5.28212	3	135.00	2.65663	2.455617	0.2011	3.6382	9.413385	6.007229	0.74407	26.7	69.148	26.331
41.174	441.376	24.58	1.31	5.34	-1.94	8.87615	5.9814	3.21533	8.88802	5.97067	3	135.00	2.67877	2.467424	0.2112	3.6366	9.086888	5.784866	0.67806	24.59	74.2759	25.678
41.502	441.048	24.83	1.39	5.59	-2.79	8.92543	6.28133	3.22741	8.9535	6.27566	3	135.00	2.70091	2.47933	0.2216	3.6351	9.257119	5.879071	0.68511	24.85	75.1525	25.721
41.83	440.720	23.62	1.17	4.96	2.81	8.38818	5.5989	3.21797	8.3922	5.59623	3	135.00	2.72305	2.491237	0.2318	3.6336	8.742523	5.538974	0.64696	23.63	74.4055	25.304
42.158	440.392	24.48	0.98	4.01	-1.99	8.68301	4.5088	3.14929	8.687	4.50892	4	135.00	2.74514	2.503143	0.242	3.6321	8.631702	5.455739	0.6729	24.48	69.1162	25.538
42.486	440.064	22.76	1.11	5	-2.06	7.94921	5.70209	3.24129	7.95319	5.69924	3	135.00	2.76733	2.515049	0.2523	3.6306	8.568914	5.403219	0.61897	22.77	76.2598	24.949
42.814	439.736	20.25	0.99	4.9	-0.12	6.90971	5.68993	3.28858	6.90971	5.68993	3	135.00	2.79947	2.528956	0.2625	3.6291	7.89536	4.96676	0.54057	20.25	80.1137	24.011
43.143	439.407	14.05	0.79	5.63	0.05	4.42646	7.02952	3.49955	4.42646	7.02952	3	135.00	2.81168	2.540898	0.2728	3.6276	6.528217	4.097056	0.34794	14.06	98.8834	21.08
43.471	439.079	11.7	0.65	5.57	1.64	3.47584	7.33123	3.59605	3.47192	7.33961	3	135.00	2.83382	2.550805	0.283	3.6261	5.953759	3.7278	0.27449	11.69	100	19.54
43.799	438.751	14.29	0.66	4.63	1.87	4.4617	5.77224	3.4474	4.46779	5.77729	3	135.00	2.85596	2.562711	0.2932	3.6247	6.334606	3.957221	0.354	14.28	93.9984	21.135
44.127	438.423	16.74	0.83	4.94	0.9	5.38406	5.98764	3.38977	5.38406	5.98764	3	135.00	2.8781	2.574619	0.3035	3.6232	7.072566	4.407787	0.42916	16.74	88.7893	22.371
44.455	438.095	16.83	0.84	5	0.58	5.38551	6.03025	3.39149	5.38551	6.03025	3	135.00	2.90024	2.586524	0.3137	3.6218	7.120717	4.427571	0.43126	16.83	88.9421	22.377
44.783	437.767	14.82	0.61	4.12	1.29	4.57877	5.12708	3.40827	4.57877	5.12708	3	135.00	2.92238	2.59843	0.3239	3.6204	6.356557	3.9446	0.36035	14.82	90.4396	21.323
45.111	437.439	17.14	0.44	2.57	3.14	5.43818	3.09958	3.22672	5.43052	3.10385	5	135.00	2.94462	2.610327	0.3342	3.6189	6.374336	3.94536	0.43949	17.12	75.0978	22.44
45.439	437.111	33.51	1.27	3.8	6.51	11.6478	4.15803	3.02727	11.8325	4.16348	5	135.00	2.96668	2.622243	0.3444	0.8175	10.88157	6.719778	0.94561	33.47	60.3408	27.515
45.767	436.783	58.12	2.69	4.62	3.76	20.9294	4.87927	2.87443	20.9218	4.88104	4	135.00	2.9888	2.63415	0.3547	0.8161	17.21601	10.60748	1.70685	58.1	50.4166	31.362
46.095	436.455	82.78	3.66	5.89	-7.46	22.688	6.15703	2.91763	22.6089	6.15189	11	135.00	3.01094	2.646056	0.3649	0.8148	19.09563	11.73909	1.85044	62.83	53.1048	31.85
46.423	436.127	83.6	4.9	5.86	-7.76	30.3115	6.0819	2.82272	30.3303	6.07813	11	135.00	3.03306	2.657962	0.3751	0.8134	24.06568	14.76127	2.49433	83.65	47.316	33.709
46.751	435.799	294.51	7.43	2.52	-2.96	109.164	2.54928	2.16692	109.168	2.54019	7	135.00	3.05522	2.669869	0.3854	0.812	61.8938	37.87932	9.02337	294.52	17.9036	41.036
47.079	435.471	443.15	13.54	3.06	-9.68	164.098	3.07678	2.11943	164.12	3.07635	12	135.00	3.07736	2.681775	0.3956	0.8106	91.3583	55.78749	13.6245	443.21	16.4026	43.103
47.408	435.142	441.36	16.48	3.73	-14.99	162.697	3.76032	2.19234	162.734	3.75946	12	135.00	3.09957	2.693718	0.4058	0.8093	93.75299	57.12275	13.5684	441.46	16.7382	43.062
47.736	434.814	430.27	19.31	4.49	-16.14	157.874	4.52068	2.2656	157.911	4.51962	12	135.00	3.12171	2.705624	0.4161	0.8079	94.26613	57.30888	13.2244	430.37	21.268	42.913
48.064	434.486	389.54	18.26	4.94	-18.24	134.827	4.98095	2.33911	134.867	4.97945	11	135.00	3.14385	2.717531	0.4263	0.8066	83.59886	50.71228	11.3435	389.65	23.9983	42.124
48.392	434.158	373.72	19.14	5.12	-23.12	135.762	5.16524	2.36029	135.817	5.16315	11	135.00	3.16599	2.729437	0.4366	0.8053	64.97333	51.4335	11.4723	373.87	24.4307	42.16
48.72	433.830	313.66	15.82	5.04	-20.02	113.255	5.09547	2.39117	113.303	5.09334	11	135.00	3.18813	2.741344	0.4466	0.804	72.63847	43.87175	9.61213	313.79	26.0526	41.23

CR14547

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 28 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5A

ConeTec Inc. - Interpretation
Interpretation Ou ease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4429
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5A
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 10:44
CPT File: 804CP05A.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 483

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	35.73	1.11	36.82	24.15	2.29
125	Soil Embankment	38.29	1.43	48.95	56.29	2.94

User Inputs

Assumed:
Water Table Depth (ft): 35.9
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 483.0
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.836	28.42	0.16	0.61	0.04	2383.62	0.630	1.02	2383.62	0.63	7	130.00	0.011	0.011	0.000	2.000	3.63	7.27	0.787	25.42	1.6137	53.84
0.492	482.508	30.63	0.26	0.83	0.09	956.786	0.850	1.25	956.79	0.85	7	130.00	0.032	0.032	0.000	2.000	4.67	9.35	0.947	30.63	0.0948	50.67
0.82	482.180	34.85	0.47	1.34	0.02	652.846	1.351	1.50	652.85	1.35	7	130.00	0.053	0.053	0.000	2.000	5.75	11.50	1.077	34.85	2.85165	49.21
1.148	481.852	45.55	0.61	1.33	0.55	609.426	1.341	1.51	609.43	1.34	7	130.00	0.075	0.075	0.000	2.000	7.54	15.08	1.408	45.55	3.00348	48.93
1.476	481.524	30.66	0.46	1.49	0.18	318.576	1.505	1.70	316.57	1.51	6	130.00	0.096	0.096	0.000	2.000	5.40	10.81	0.946	30.66	6.10537	46.20
1.804	481.196	25.49	0.36	1.4	0.21	216.38	1.419	1.78	216.36	1.42	6	130.00	0.117	0.117	0.000	2.000	4.62	9.24	0.786	25.49	7.70894	44.43
2.133	480.867	24.98	0.31	1.22	0.07	179.172	1.248	1.79	179.17	1.25	6	130.00	0.139	0.139	0.000	2.000	4.55	9.10	0.769	24.98	7.96054	43.53
2.461	480.539	22	0.24	1.07	0.37	136.53	1.099	1.84	136.53	1.10	6	130.00	0.160	0.160	0.000	2.000	4.07	8.14	0.676	22	8.91183	42.16
2.789	480.211	19.96	0.2	1	0.25	109.103	1.011	1.88	109.10	1.01	6	130.00	0.181	0.181	0.000	2.000	3.76	7.52	0.612	19.96	10.022	41.03
3.117	479.883	16.87	0.21	1.22	0.14	82.2655	1.260	2.04	82.27	1.26	6	130.00	0.203	0.203	0.000	2.000	3.37	6.74	0.516	16.87	14.0492	39.52
3.445	479.555	27.63	0.29	1.05	0.81	122.39	1.058	1.86	122.39	1.06	7	130.00	0.224	0.224	0.000	2.000	5.16	10.31	0.848	27.63	9.45051	41.62
3.773	479.227	28.29	0.55	1.95	0.9	114.354	1.961	2.07	114.39	1.96	6	130.00	0.245	0.245	0.000	2.000	5.72	11.43	0.868	28.3	14.8825	41.27
4.101	478.899	31.49	0.42	1.32	0.58	117.433	1.345	1.94	117.17	1.34	7	130.00	0.267	0.267	0.000	1.937	6.07	11.75	0.957	31.5	11.5005	41.40
4.429	478.571	21.53	0.34	1.58	0.26	73.7868	1.601	2.14	73.79	1.60	6	130.00	0.288	0.288	0.000	1.864	4.48	8.35	0.658	21.53	17.1574	39.92
4.757	478.243	20.69	0.25	1.19	1.01	65.9135	1.227	2.11	65.95	1.23	6	130.00	0.309	0.309	0.000	1.798	4.24	7.63	0.631	20.7	16.0068	39.29
5.085	477.915	15.26	0.33	2.14	1.38	45.169	2.210	2.40	45.20	2.21	5	130.00	0.331	0.331	0.000	1.739	3.64	6.16	0.462	15.27	26.2447	36.10
5.413	477.587	14.21	0.29	2.05	1.25	39.3871	2.093	2.43	39.39	2.09	5	130.00	0.352	0.352	0.000	1.686	3.34	5.64	0.429	14.21	27.5061	35.26
5.741	477.259	24.82	0.37	1.47	0.26	65.5121	1.513	2.17	65.51	1.51	6	130.00	0.373	0.373	0.000	1.637	5.22	8.54	0.757	24.82	17.8966	38.25
6.069	476.931	37.04	0.39	1.02	1.27	95.176	1.039	1.94	95.20	1.04	7	130.00	0.394	0.394	0.000	1.592	7.29	11.60	1.162	37.05	11.3095	40.30
6.398	476.602	38.71	0.49	1.26	0.18	92.082	1.280	2.01	92.08	1.28	7	130.00	0.416	0.416	0.000	1.551	7.63	11.84	1.180	38.71	13.1428	40.13
6.726	476.274	62.69	0.91	1.45	0.74	142.393	1.463	1.91	142.42	1.46	7	130.00	0.437	0.437	0.000	1.512	11.92	18.03	1.927	62.7	10.6517	42.39
7.054	475.946	61.98	1.01	1.63	0.67	134.133	1.642	1.97	134.16	1.64	7	130.00	0.459	0.459	0.000	1.477	11.79	17.76	1.904	61.97	12.0276	42.09
7.382	475.618	77.1	0.92	1.19	1.34	159.682	1.201	1.81	159.70	1.20	6	130.00	0.480	0.480	0.000	1.444	14.16	20.13	2.372	77.11	8.4368	42.96
7.71	475.290	60.49	0.84	1.39	0.67	119.702	1.400	1.95	119.72	1.40	7	130.00	0.501	0.501	0.000	1.413	11.67	16.49	1.857	60.5	11.6404	41.51
8.038	474.962	43.56	0.42	0.95	0.41	82.3732	0.976	1.97	82.39	0.98	7	130.00	0.522	0.522	0.000	1.383	8.47	11.72	1.332	43.57	12.1295	39.58
8.366	474.634	31.78	0.35	1.09	0.72	57.4417	1.120	2.13	57.44	1.12	7	130.00	0.544	0.544	0.000	1.356	6.58	8.92	0.967	31.78	16.7393	37.50
8.694	474.306	23.44	0.25	1.07	0.83	40.4767	1.093	2.25	40.50	1.09	6	130.00	0.565	0.565	0.000	1.330	5.10	6.78	0.709	23.45	20.6378	36.45
9.022	473.978	14.75	0.2	1.39	1.86	24.1522	1.412	2.60	24.17	1.41	6	130.00	0.586	0.586	0.000	1.305	3.59	4.68	0.439	14.76	30.5056	32.25
9.35	473.650	18.93	0.1	0.53	1.34	30.1477	0.546	2.21	30.16	0.55	7	130.00	0.608	0.608	0.000	1.283	4.05	5.19	0.557	18.94	19.2809	33.65
9.678	473.322	14.31	0.1	0.7	0.99	21.7479	0.731	2.39	21.75	0.73	6	130.00	0.629	0.629	0.000	1.261	3.31	4.18	0.424	14.31	26.0949	31.57
10.006	472.994	13.41	0.1	0.75	0.53	19.6184	0.784	2.45	19.63	0.78	6	130.00	0.650	0.650	0.000	1.240	3.18	3.95	0.395	13.42	28.3013	30.91
10.335	472.665	9.07	0.17	1.82	0.74	12.5016	2.024	2.82	12.50	2.02	5	130.00	0.672	0.672	0.000	1.220	2.61	3.18	0.260	9.07	47.2437	27.92
10.663	472.337	9.3	0.05	0.54	0.39	12.4181	0.561	2.57	12.42	0.56	1	130.00	0.693	0.693	0.000	1.201	2.34	2.82	0.268	9.3	33.9922	27.88
10.991	472.009	8.69	0.07	0.81	0.46	11.1638	0.878	2.69	11.16	0.88	5	130.00	0.714	0.714	0.000	1.183	2.32	2.76	0.247	8.69	39.7705	27.16
11.319	471.681	8.9	0.07	0.94	0.74	6.97838	1.196	2.85	8.38	1.14	1	130.00	0.736	0.736	0.000	1.166	2.01	2.95	0.191	8.9	48.0316	25.22
11.647	471.353	8.91	0.09	1.01	0.44	10.7693	1.104	2.75	10.77	1.10	5	130.00	0.757	0.757	0.000	1.149	2.46	2.82	0.252	8.91	42.9199	26.92
11.975	471.025	18.87	0.21	1.09	0.26	23.2428	1.161	2.46	23.26	1.16	6	130.00	0.778	0.778	0.000	1.133	4.62	5.12	0.560	18.88	29.1282	32.00
12.303	470.697	19.57	0.24	1.23	0.51	23.4716	1.279	2.48	23.48	1.28	6	130.00	0.800	0.800	0.000	1.118	4.79	5.29	0.581	19.58	29.9383	32.07
12.631	470.369	17.34	0.28	1.62	0.61	20.1202	1.695	2.81	20.13	1.69	6	130.00	0.821	0.821	0.000	1.104	4.45	4.91	0.511	17.35	36.652	31.07
12.959	470.041	19.9	0.26	1.28	0.3	22.6248	1.364	2.51	22.62	1.36	6	130.00	0.842	0.842	0.000	1.090	4.97	5.31	0.690	19.9	31.2276	31.83
13.287	469.713	30.28	0.23	0.76	0.3	34.0603	0.782	2.23	34.06	0.78	7	130.00	0.864	0.864	0.000	1.076	6.55	7.04	0.911	30.28	20.1787	34.40
13.615	469.385	38.96	0.31	0.78	0.41	43.0238	0.814	2.16	43.02	0.81	7	130.00	0.885	0.885	0.000	1.063	8.15	8.67	1.179	38.96	17.5679	35.81
13.943	469.057	33.22	0.36	1.07	0.44	35.6547	1.114	2.30	35.65	1.11	7	130.00	0.906	0.906	0.000	1.050	7.38	7.75	1.000	33.22	22.4677	34.68
14.271	468.729	32.32	0.37	1.16	0.62	33.642	1.179	2.33	33.64	1.18	7	130.00	0.926	0.926	0.000	1.038	7.28	7.56	0.972	32.32	23.6858	34.36
14.6	468.400	25.81	0.32	1.24	0.3	26.197	1.287	2.44	26.20	1.29	6	130.00	0.949	0.949	0.000	1.027	6.12	6.29	0.770	25.81	28.2811	32.76
14.928	468.072	26.82	0.29	1.08	0.97	26.6404	1.122	2.41	26.65	1.12	7	130.00	0.970	0.970	0.000	1.015	6.25	6.35	0.800	26.83	26.6766	32.87
15.256	467.744	27.87	0.29	1.06	0.53	26.6007	1.099	2.40	26.61	1.10	7	130.00	0.992	0.992	0.000	1.004	6.37	6.40	0.817	27.88	26.5119	32.86

Depth (ft)	Sam (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgFf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	s	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	467.416	27.05	0.21	0.76	-0.81	25.7039	0.807	2.35	25.71	0.81	7	130.00	1.013	1.013	0.000	0.994	6.14	6.10	0.806	27.06	24.3313	32.64
15.912	467.088	23.69	0.19	0.78	-0.58	21.9048	0.839	2.42	21.91	0.84	7	130.00	1.034	1.034	0.000	0.993	5.55	5.46	0.701	23.7	27.103	31.62
16.24	466.760	39.57	0.35	0.87	-0.52	36.4858	0.909	2.24	36.50	0.91	7	130.00	1.056	1.056	0.000	0.973	8.58	8.35	1.192	39.58	20.444	34.82
16.568	466.432	74.07	1.13	1.52	0	67.7795	1.648	2.16	67.78	1.55	7	130.00	1.077	1.077	0.000	0.964	15.53	14.97	2.260	74.07	17.7393	36.44
16.896	466.104	66.69	1.62	2.43	-0.62	59.7244	2.470	2.34	59.72	2.47	6	130.00	1.098	1.098	0.000	0.954	15.08	14.35	2.031	66.69	23.9849	37.79
17.224	465.776	65.22	1.33	2.04	-0.58	57.255	2.075	2.30	57.26	2.07	7	130.00	1.120	1.120	0.000	0.945	14.50	13.71	1.986	65.22	22.6529	37.48
17.552	465.448	57.66	1.09	1.89	-0.39	49.5575	1.928	2.33	49.56	1.93	7	130.00	1.141	1.141	0.000	0.936	12.98	12.15	1.750	57.66	23.6395	38.65
17.88	465.120	32	1.01	3.16	-0.39	26.584	3.275	2.68	26.53	3.28	5	130.00	1.162	1.162	0.000	0.928	8.53	7.82	0.955	32	39.6519	32.04
18.208	464.792	51.85	0.91	1.76	-3.51	42.81	1.79806	2.35635	42.8269	1.79535	7	130.00	1.18352	1.18352	0	0.9192	11.82091	10.86583	1.56862	51.87	24.8574	35.784
18.537	464.463	43.9	1.02	2.33	-7.82	35.4344	2.38903	2.49787	35.4759	2.38624	6	130.00	1.20491	1.204905	0	0.911	10.69025	9.738938	1.32183	43.95	30.5877	34.646
18.865	464.135	23.27	0.79	3.4	-2.63	17.9769	3.58378	2.83772	17.9933	3.58053	5	130.00	1.22628	1.226225	0	0.9031	6.757485	6.102354	0.69247	23.29	48.2029	30.34
19.193	463.807	39.72	0.64	1.62	-1.94	30.8385	1.66353	2.44929	30.8546	1.66268	7	130.00	1.24765	1.247545	0	0.8953	9.447868	8.468769	1.1911	39.74	20.4675	33.786
19.521	463.479	50.01	1.09	2.17	-2.24	38.4368	2.23483	2.45276	38.4447	2.23447	6	130.00	1.26887	1.268865	0	0.8878	11.91839	10.58059	1.50094	50.05	28.617	35.135
19.849	463.151	60.08	1.06	1.76	-0.18	45.667	1.80303	2.33657	45.567	1.80303	7	130.00	1.29019	1.290185	0	0.8804	13.57227	11.94886	1.82012	60.08	23.9008	36.153
20.177	462.823	52.92	0.68	1.24	0.07	39.3506	1.27888	2.29701	39.3506	1.27886	7	130.00	1.31151	1.311505	0	0.8732	11.74944	10.25965	1.59779	52.92	22.4107	35.276
20.505	462.495	36.79	0.47	1.27	-0.14	26.603	1.32554	2.44629	26.603	1.32554	7	130.00	1.33283	1.332825	0	0.8662	8.734366	7.585625	1.09775	36.79	28.3397	32.859
20.833	462.167	44.24	0.4	0.91	-0.16	31.6701	0.93271	2.30083	31.6701	0.93271	7	130.00	1.35415	1.354145	0	0.8593	9.838615	8.454762	1.32774	44.24	22.6522	33.948
21.161	461.839	38.42	0.52	1.36	-0.21	26.9324	1.40372	2.45559	26.9324	1.40372	7	130.00	1.37547	1.375465	0	0.8527	9.160916	7.811137	1.14689	38.42	28.7374	32.936
21.489	461.511	36.09	0.66	1.83	-0.49	24.8379	1.90239	2.55989	24.8379	1.90239	6	130.00	1.39679	1.396765	0	0.8461	9.045296	7.653463	1.07409	36.09	33.4329	32.423
21.817	461.183	32.39	0.51	1.56	-0.46	21.8403	1.64665	2.5698	21.8403	1.64655	6	130.00	1.41811	1.418105	0	0.8397	8.157585	6.850266	0.95888	32.39	33.9021	31.599
22.145	460.855	35.52	0.56	1.58	-0.65	23.6765	1.64316	2.54029	23.6765	1.64315	7	130.00	1.43943	1.439425	0	0.8335	8.817705	7.349555	1.05513	35.52	32.5166	32.117
22.473	460.527	48.51	0.94	1.93	-0.44	32.2091	1.99791	2.48214	32.2159	1.99748	7	130.00	1.46075	1.460745	0	0.8274	11.71422	9.692283	1.45663	48.52	29.8912	34.054
22.802	460.198	40.72	0.8	1.97	-0.09	26.474	2.03885	2.55539	26.474	2.03885	6	130.00	1.48213	1.48213	0	0.8214	10.1832	8.364521	1.21479	40.72	33.2206	32.827
23.13	459.870	34.78	0.69	1.97	-0.11	22.1335	2.07353	2.62238	22.1335	2.07353	6	130.00	1.50345	1.50345	0	0.8156	8.99242	7.333851	1.03023	34.78	36.4607	31.685
23.458	459.542	27.98	0.71	2.53	-0.02	17.3503	2.68378	2.77387	17.3503	2.68378	6	130.00	1.52477	1.52477	0	0.8098	7.63439	6.344582	0.81905	27.98	44.5023	30.102
23.786	459.214	34.88	0.64	1.83	-0.21	21.5601	1.91997	2.61226	21.5601	1.91997	6	130.00	1.54609	1.54609	0	0.8042	8.972323	7.215851	1.03201	34.88	35.0587	31.516
24.114	458.886	34.14	0.66	1.92	-0.04	20.7812	2.02624	2.63881	20.7812	2.02624	6	130.00	1.56741	1.56741	0	0.7987	8.900875	7.109538	1.00844	34.14	37.284	31.278
24.442	458.558	46.63	0.8	1.71	-0.12	28.3505	1.77615	2.49586	28.3505	1.77615	7	130.00	1.58873	1.58873	0	0.7934	11.33143	8.989997	1.39447	46.63	30.4993	33.258
24.77	458.230	37.3	0.79	2.12	-0.44	22.167	2.21851	2.63841	22.1732	2.21289	6	130.00	1.61005	1.61005	0	0.7881	9.725366	7.664543	1.10495	37.31	37.2636	31.697
25.098	457.902	39.41	0.89	2.45	-0.32	23.3187	2.55904	2.6899	23.3187	2.55904	6	130.00	1.63137	1.63137	0	0.7829	9.746595	7.630917	1.07674	39.41	39.9193	31.443
25.426	457.574	48.8	0.86	1.76	-0.18	28.5276	1.82407	2.50053	28.5276	1.82407	7	130.00	1.65269	1.65269	0	0.7779	11.89499	9.244918	1.45957	48.8	30.7065	33.297
25.754	457.246	74.39	0.71	0.96	-0.07	43.4382	0.9764	2.19543	43.4382	0.9764	8	130.00	1.67401	1.67401	0	0.7729	15.61851	12.22605	2.25127	74.39	18.941	35.869
26.082	456.918	60.47	1.1	1.82	-0.18	34.6686	1.87155	2.43963	34.6686	1.87155	7	130.00	1.69533	1.69533	0	0.768	14.31205	10.99195	1.81965	60.47	28.0573	34.505
26.41	456.590	80.94	0.74	0.91	-0.04	46.15	0.93407	2.16287	46.15	0.93407	8	130.00	1.71665	1.71665	0	0.7632	16.98142	12.96084	2.45274	80.94	17.7728	36.228
26.739	456.261	80.42	0.62	0.77	-0.07	45.2706	0.78709	2.13015	45.2764	0.78789	8	130.00	1.73804	1.738035	0	0.7585	16.85087	12.63012	2.43597	80.43	16.7349	36.115
27.067	455.933	55.83	0.67	1.2	-0.09	30.7332	1.23912	2.37784	30.7332	1.23912	7	130.00	1.75936	1.759355	0	0.7539	12.64642	9.885131	1.67401	55.83	25.5169	33.762
27.395	455.605	46.5	0.82	1.77	-0.14	25.1137	1.83366	2.54667	25.1137	1.83366	7	130.00	1.78068	1.780675	0	0.7494	11.5793	8.677407	1.3845	46.5	32.8129	32.493
27.723	455.277	57.97	0.96	1.65	0.23	31.1699	1.70916	2.45279	31.1699	1.70916	7	130.00	1.802	1.801995	0	0.7449	13.80444	10.28352	1.73895	57.97	26.6174	33.849
28.051	454.949	68	0.97	1.43	-0.32	36.2947	1.46577	2.36006	36.2947	1.46577	7	130.00	1.82332	1.823315	0	0.7406	15.52249	11.49557	2.04881	68	24.8128	34.786
28.379	454.621	53.43	1.26	2.35	-0.41	27.9651	2.44255	2.58142	27.9651	2.44255	6	130.00	1.84464	1.844635	0	0.7363	13.55423	9.976782	1.59707	53.43	34.6019	33.172
28.707	454.293	48.16	0.78	1.62	-0.58	24.8098	1.68488	2.52977	24.8098	1.68488	7	130.00	1.86596	1.865955	0	0.7324	11.89481	8.707769	1.43325	48.16	32.0316	32.415
29.035	453.965	64.33	0.45	0.69	-0.6	33.0862	0.72066	2.22831	33.0862	0.72066	8	125.00	1.88728	1.887275	0	0.7279	13.86901	10.0955	1.93321	64.33	19.9571	34.218
29.363	453.637	56.15	0.73	1.3	-0.09	28.4322	1.34581	2.42586	28.4322	1.34581	7	125.00	1.90778	1.907775	0	0.724	13.20537	9.560644	1.67933	56.15	27.4781	33.276
29.691	453.309	58.81	0.91	1.54	0.09	29.4988	1.59981	2.45535	29.4988	1.59981	7	125.00	1.92828	1.928275	0	0.7201	14.02117	10.09717	1.76104	58.81	28.7271	33.506
30.019	452.981	67.14	1.23	1.84	0.11	33.4524	1.88676	2.45406	33.4524	1.88676	7	125.00	1.94878	1.948775	0	0.7163	15.99764	11.45968	2.0183	67.14	28.6717	34.286
30.347	452.653	112.05	2.2	1.96	-0.41	55.8991	1.99853	2.2978	56.8991	1.99853	7	125.00	1.96928	1.968275	0	0.7126	24.88619	17.73394	3.40907	112.05	22.4399	37.347
30.675	452.325	73.06	2.44	3.34	-6.34	35.7177	3.43322	2.59915	35.7428	3.43081	6	125.00	1.98978	1.989775	0	0.7088	18.6832	13.24492	2.20032	73.11	35.3158	34.692
31.004	451.996	39.96	1.78	4.47	10.67	18.8773	4.69042	2.89568	18.9071	4.68302	4	126.00	2.01034	2.010338	0	0.7052	12.00648	8.468011	1.17491	40.02	51.728	30.664
31.332	451.668	36.72	1.19	3.25	-12.47	17.0812	3.43047	2.84264	17.1157	3.42356	5	126.00	2.03084	2.030848	0	0.7017	10.70429	7.511391	1.07397	36.79	48.4956	30.012
31.66	451.340	32.6	0.98	3	11.92	14.8921	3.208	2.87199	14.9262	3.20066	5	126.00	2.05134	2.051338	0	0.6982	9.566982	6.749511	0.94578	32.67	50.2673	29.107
31.988	451.012	30.21	0.84	2.79	-11.04	13.5813	2.98527	2.8855	13.615	2.97786	6	126.00	2.07184	2.071838	0	0.6947	9.030418	6.27379	0.87715	30.28	51.0971	28.495
32.316	450.684	30.02	0.75	2.5	-10.81	13.3476	2.68561	2.86492	13.361	2.6798	6	126.00	2.09234	2.092336	0	0.6913	8.967267	6.130203	0.86463	30.09	49.8367	28.379
32.644	450.356	32.58	0.7	2.16	-8.52	14.4106	2.29906	2.79963	14.4342	2.2953	6	126.00	2.11284	2.112834	0	0.688	9.261456	6.371566	0.94264	32.61	45.9727	28.684
32.972	450.028	32.67	0.61	1.86	-7.05	14.2672	2.00416	2.77023	14.2859	2.00153	6	126.00	2.13334	2.133338	0	0.6847	9.112641	6.238993	0.94231	32.61	44.2973	28.816
33.3	449.700	31.3	0.63	2.02	-5.48	13.5322	2.16152	2.80746	13.5508	2.15856	6	126.00	2.15384	2.153838	0	0.6814	8.939627	6.091342	0.90236	31.34	46.4254	28.463
33.628	449.372	31.82	0.66	2.08	-3.97	13.6343	2.2263	2.81229	13.6435	2.22479	6	126.00	2.17434	2.174338	0	0.6782	9.106774	6.175912	0.91782	31.84	46.706	28.509
33.956	449.044	28.86	0.57	1.98	-2.68	12.149	2.13762	2.84432	12.1581	2.13602	6	126.00	2.19484	2.194838	0	0.675	8.41085	5.677259	0.82555	28.88	48.5967	27.736
34.284	448.716	23.21	0.5	2.14	-1.27	9.47698	2.38156	2.96057	9.48147	2.38042	6	126.00	2.21534	2.215338	0	0.6719	7.241997	4.865622	0.64999	23.22	55.8673	26.057
34.612	448.388	20.41	0.42	2.06	0.02	8.12857	2.31097	3.0103	8.12857	2.31097	6	126.00	2.23564	2.235638	0	0.6688	6.564749	4.390339	0.56267	20.41	59.1814	25.012
34.941	448.059	23.17	0.41	1.77	0.71	9.26857	1.96045	2.92469	9.26414	1.96138	6	125.00	2.2564	2.2564	0	0.6657	7.068599	4.705711	0.64748	23.16	53.5531	25.9
35.269	447.731	24.74	0.45	1.82	2.5	9.86565	2.00329	2.90667	9.85667	2.00507	6	125.00	2.2769	2.2769	0	0.6627	7.464431	4.946804	0.69545	24.72	52.4146	26.32
35.597	447.403	23.56	0.62	2.64	4.16	9.25507	2.91592	3.01828	9.24637	2.91969	5	125.00	2.2974	2.2974	0	0.6598	7.609665	5.020503	0.65826	23.54	59.7243	25.987
35.925	447.075	26.46	0.63	2.39	12.8	10.419	2.60955	2.95013	10.3845	2.61823	6	135.00	2.3179	2.317712	0.0008	0.6569	8.175519	5.370826	0.74743	26.38	55.1875	26.673
36.253	446.747	24.52	0.58	2.37	14.27	9.52328	2.61497	2.98363	9.48463	2.62563	6	135.00	2.34004	2.339026	0.011	0.6553	7.72807	5.080086	0.68669	24.43	57.3883	26.063
36.581	446.419	23.35	0.59	2.53	14.8	8.96558	2.81115	3.02296	8.92713	2.82326	5	135.00	2.36218	2.360933	0.0212	0.6536	7.541419	4.929997	0.64978	23.26	60.0438	25.655
36.909	446.091	20.73	0.59	2.83	15.59	7.79725	3.21602	3.10619	7.758	3.23167	5	135.00	2.38432	2.382839	0.0315	0.6519	7.064655	4.6015822	0.56798	20.64	65.9272	24.708
37.237	445.763	23.32	0.68	2.92	16.49	8.86389	3.25148	3.06352	8.8016	3.2671	5	135.00	2.40646	2.404746	0.0417	0.6503	7.727244	5.024958	0.64748	23.22	62.9665	25.566
37.565	445.435	24.74	0.81	3.26	16.36	9.38774	3.63045	3.08619	9.36671	3.63856	5	135.00	2.42888	2.426652	0.0519	0.6487	8.24148	5.34582	0.69076	24.69	63.1968	25.99

R14550

Depth (ft)	Samp (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	446.107	23.87	0.87	3.63	-3.35	8.95744	4.06176	3.11089	8.97582	4.05798	5	135.00	2.45074	2.388558	0.0822	0.647	8.203105	5.307748	0.66319	23.89	66.2702	25.705
38.221	444.779	22.91	0.77	3.37	3.42	8.51382	3.76765	3.10987	8.53632	3.76213	5	135.00	2.47288	2.409465	0.0724	0.6454	7.871536	5.080503	0.63273	22.94	66.196	25.351
38.549	444.451	25.19	0.68	2.69	-2.47	9.40775	2.99626	3.01817	9.41189	2.99494	5	135.00	2.49502	2.429571	0.0826	0.6436	8.145735	5.24455	0.70263	25.2	59.717	26.032
38.877	444.123	22.12	0.7	3.15	-2.17	8.08605	3.57091	3.11545	8.09018	3.56909	5	135.00	2.51716	2.449278	0.0922	0.6423	7.62211	4.895353	0.6069	22.13	66.604	25.012
39.206	443.794	19.76	0.61	3.07	3.07	7.06859	3.54226	3.1627	7.08038	3.54638	5	135.00	2.53937	2.469622	0.1031	0.6407	7.022462	4.499157	0.53315	19.74	70.1291	24.097
39.534	443.466	24.4	0.75	3.06	4.32	8.92049	3.4343	3.07189	8.90824	3.43903	5	135.00	2.56151	2.488127	0.1134	0.6391	8.154388	5.211628	0.67611	24.37	63.4594	25.669
39.862	443.138	26.59	0.74	2.9	5.43	9.35205	3.2165	3.03903	9.33579	3.22211	5	135.00	2.58365	2.507033	0.1236	0.6376	8.384236	5.335994	0.71227	25.55	61.1526	25.988
40.19	442.810	25.05	0.72	2.86	6.14	9.0796	3.20795	3.04897	9.06341	3.21368	5	135.00	2.60579	2.47194	0.1338	0.636	8.244856	5.244024	0.69487	25.01	61.8447	25.792
40.515	442.482	23.27	0.76	3.25	7.14	8.31053	3.6818	3.11505	8.2904	3.69074	5	135.00	2.62793	2.488646	0.1441	0.6345	7.905391	5.073146	0.63907	23.22	66.5748	25.193
40.846	442.154	25.96	0.88	3.4	8.43	9.33984	3.77521	3.08008	9.3158	3.78496	5	135.00	2.65027	2.508752	0.1543	0.633	9.713036	5.515295	0.72167	25.9	64.0434	25.982
41.174	441.826	25.09	1.01	4.03	8.59	8.93973	4.50535	3.14056	8.91979	4.51542	4	135.00	2.67221	2.507669	0.1645	0.6315	8.772766	5.539906	0.69405	25.04	68.4623	25.693
41.502	441.498	23.31	0.9	3.85	10.14	8.18223	4.36561	3.16394	8.16841	4.37836	4	135.00	2.69436	2.519585	0.1748	0.63	8.27787	5.214892	0.63826	23.25	70.2152	25.098
41.83	441.170	22.11	0.83	3.76	10.72	7.66096	4.27978	3.18239	7.63331	4.28529	4	135.00	2.71649	2.531472	0.185	0.6285	7.949599	4.998417	0.60042	22.04	71.6336	24.66
42.158	440.842	22.65	0.97	4.29	10.46	7.92871	4.87159	3.20765	7.80119	4.88877	4	135.00	2.73863	2.543478	0.1952	0.627	8.293291	5.200217	0.61845	22.58	73.8096	24.8
42.486	440.514	21.66	0.88	4.07	10.99	7.39814	4.66627	3.21626	7.36874	4.67358	4	135.00	2.76077	2.555264	0.2055	0.6256	7.977854	4.990776	0.58612	21.59	74.2704	24.42
42.814	440.186	22.04	0.74	3.34	10.67	7.50123	3.64274	3.16291	7.47396	3.65676	5	135.00	2.78291	2.567191	0.2157	0.6241	7.8169	4.878716	0.59619	21.97	70.1447	24.519
43.143	439.857	19.95	0.77	3.87	8.24	6.64754	4.49114	3.24432	6.62815	4.50427	4	135.00	2.80512	2.579103	0.226	0.6227	7.505574	4.673651	0.5308	19.9	76.5028	23.717
43.471	439.529	17	0.74	4.34	6.35	5.46991	5.22129	3.35118	5.45447	5.23607	3	135.00	2.82726	2.59104	0.2362	0.6212	6.944066	4.313867	0.43878	16.96	85.4106	22.424
43.799	439.201	19.37	0.84	4.35	6.47	6.34689	5.09456	3.29171	6.33152	5.0989	3	135.00	2.8494	2.602948	0.2464	0.6198	7.554698	4.682573	0.51147	19.33	80.3734	23.418
44.127	438.873	21.4	1.06	4.94	0.86	7.08685	5.72093	3.28219	7.08585	5.72083	3	135.00	2.87154	2.614853	0.2567	0.6184	8.303236	5.134803	0.57364	21.4	79.585	24.174
44.455	438.545	19.64	0.74	3.78	-0.78	6.37528	4.41888	3.25299	6.37909	4.41624	4	135.00	2.89366	2.626759	0.2669	0.617	7.458995	4.60225	0.51846	19.65	77.2014	23.475
44.783	438.217	15.29	0.69	5.83	-1.04	4.68956	7.19239	3.48477	4.69335	7.18659	3	135.00	2.91582	2.638565	0.2771	0.6156	7.014631	4.318422	0.3831	15.3	97.4824	21.456
45.111	437.889	18.24	0.81	4.42	1.23	5.77311	5.29341	3.33426	5.76934	5.29687	3	135.00	2.93796	2.650572	0.2874	0.6142	7.364226	4.52332	0.47375	18.23	93.9568	22.816
45.439	437.561	23.11	0.9	3.9	2.4	7.5681	4.46652	3.19593	7.56059	4.47096	4	135.00	2.9601	2.662478	0.2976	0.6129	8.408624	5.153258	0.62384	23.09	72.6801	24.62
45.767	437.233	23.58	1.04	4.42	10.81	7.70187	5.04902	3.22274	7.6757	5.06631	4	135.00	2.98224	2.674385	0.3079	0.6115	8.726223	5.337205	0.6377	23.51	74.782	24.724
46.095	436.905	23.42	0.95	4.05	11.02	7.59993	4.6583	3.20639	7.57387	4.66931	4	135.00	3.00438	2.686291	0.3181	0.6101	8.56709	5.227052	0.63206	23.35	73.495	24.638
46.423	436.577	19.66	0.81	4.12	11.46	6.17208	4.86385	3.29142	6.14613	4.88438	4	135.00	3.02652	2.698197	0.3283	0.6086	7.562429	4.664765	0.51559	19.81	80.3493	23.25
46.751	436.249	18.67	0.6	3.22	13.05	5.76411	3.8109	3.25926	5.73459	3.86067	5	135.00	3.04866	2.710104	0.3386	0.6074	7.064343	4.303349	0.48363	18.59	77.6282	22.795
47.079	435.921	19.1	0.56	2.91	15.36	5.88874	3.49362	3.22851	5.852	3.51556	5	135.00	3.0708	2.72201	0.3488	0.6061	7.083562	4.293448	0.49626	19	75.2399	22.932
47.408	435.592	21.41	0.69	3.23	16.88	6.69982	3.76699	3.19955	6.66324	3.78767	5	135.00	3.093	2.733953	0.359	0.6048	7.780455	4.70554	0.56709	21.31	72.9515	23.796
47.736	435.264	49.22	1.77	3.6	20.42	16.7907	3.63907	2.89182	16.7433	3.64993	5	135.00	3.11514	2.745859	0.3693	0.6035	14.60875	8.816064	1.42739	49.09	50.8702	29.92
48.064	434.936	108.31	4.31	3.98	24.9	38.1069	4.09802	2.63254	38.0789	4.10426	5	135.00	3.13728	2.757766	0.3795	0.6022	28.10668	16.92509	3.25612	108.15	36.9683	35.099
48.392	434.608	174.89	6.35	3.63	23.46	61.9931	3.6983	2.45237	61.9389	3.70153	12	135.00	3.15942	2.769672	0.3898	0.6009	41.59568	24.99384	5.31581	174.71	28.5992	37.947
48.72	434.280	126.51	6.37	5.04	9.38	44.3376	5.16507	2.65754	44.316	5.16756	11	135.00	3.18156	2.781579	0.4	0.5996	33.2856	19.95771	3.81822	126.45	38.2371	36.007
49.048	433.952	166.9	6.34	3.8	22.06	58.5993	3.87303	2.49371	58.5492	3.87634	12	135.00	3.2037	2.793485	0.4102	0.5983	40.29083	24.10544	5.068	166.76	29.9602	37.628
49.375	433.624	185.28	8	4.32	29.84	64.8944	4.3943	2.494436	64.8267	4.39889	11	135.00	3.22584	2.805391	0.4205	0.597	44.94566	26.83435	5.63635	185.09	30.4315	38.206
49.704	433.296	146.4	7.86	5.37	33.05	50.8118	5.49087	2.63756	50.7373	5.49873	11	135.00	3.24798	2.817296	0.4307	0.5956	36.08986	22.69306	4.43195	146.19	37.2207	36.803
50.032	432.968	154.76	6.18	3.99	62.54	53.5451	4.07948	2.52808	53.4072	4.09001	12	135.00	3.27012	2.829204	0.4409	0.5945	38.09591	22.64865	4.69009	154.37	31.9538	37.1
50.36	432.640	137.82	5.3	3.84	25.31	47.3504	3.93971	2.55353	47.2941	3.9444	12	135.00	3.29226	2.841111	0.4512	0.5933	34.39466	20.40549	4.16495	137.66	33.1337	36.392
50.686	432.312	83.36	3.81	4.57	22.91	28.0635	4.7586	2.77386	28.0144	4.78693	11	135.00	3.3144	2.853017	0.4614	0.592	23.30703	13.79869	2.47881	83.24	44.5017	33.219
51.016	431.984	58.49	2.41	4.12	21.11	19.2513	4.36953	2.87161	19.2059	4.37995	5	135.00	3.33654	2.864923	0.4716	0.5908	17.26483	10.20013	1.70764	58.36	50.2442	30.822
51.345	431.655	40.89	1.24	3.03	26.95	13.0459	3.30391	2.92987	12.9868	3.31896	6	135.00	3.35875	2.876666	0.4819	0.5896	12.46659	7.350011	1.18196	40.72	53.8854	28.264
51.673	431.327	51.35	1.29	2.52	29.37	16.6054	2.68923	2.79202	16.5431	2.69936	6	135.00	3.38089	2.888772	0.4921	0.5884	14.47144	8.514418	1.48511	51.17	45.5361	29.856
52.001	430.999	79.13	2.66	3.36	27.12	26.1066	3.51262	2.70938	26.048	3.52052	6	135.00	3.40303	2.900679	0.5024	0.5872	21.35463	12.5084	2.34449	78.96	40.9545	32.768
52.329	430.671	74.91	5.41	7.23	2.71	24.5434	7.56804	2.96489	24.5503	7.56592	11	135.00	3.42517	2.912585	0.5126	0.586	23.28987	13.64418	2.21315	74.93	55.4968	32.394
52.657	430.343	267.69	12.98	4.85	1.85	90.3551	4.91215	2.43829	90.3595	4.91197	11	135.00	3.44731	2.924492	0.5228	0.5848	69.31944	37.02643	8.18089	267.7	27.9998	40.035

51 of 64
14551

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 24 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5B

ConeTec Inc.
Interpretation O ase 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4397
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5B
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 15:44
CPT File: 804CP05B.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 479.9

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	38.10	1.25	40.93	19.30	2.15
125	Soil Embankment	31.26	1.88	62.63	50.48	2.64

User Inputs:
Assumed: Water Table Depth (ft): 28
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 479.9
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	479.736	18.44	0.14	0.76	0.34	1728.83	0.760	1.13	1727.89	0.76	6	130.00	0.011	0.011	0.000	2.000	2.71	5.42	0.671	18.43	1.1326	52.78
0.492	479.408	23.22	0.26	1.12	0.21	725.079	1.121	1.41	725.08	1.12	6	130.00	0.032	0.032	0.000	2.000	3.72	7.44	0.718	23.22	1.626B4	49.62
0.82	479.080	13.32	0.2	1.51	0.32	248.906	1.508	1.76	248.91	1.51	6	130.00	0.053	0.053	0.000	2.000	2.40	4.80	0.411	13.32	7.35209	45.08
1.148	478.752	12.84	0.15	1.17	0.16	171.072	1.175	1.79	171.07	1.18	6	130.00	0.075	0.075	0.000	2.000	2.33	4.67	0.395	12.84	7.84987	43.30
1.476	478.424	39.97	0.24	0.62	0.39	405.191	0.617	1.33	405.09	0.62	7	130.00	0.096	0.096	0.000	2.000	6.09	12.18	1.204	39.96	0.7066	47.24
1.804	478.096	74.14	0.58	0.78	0.09	631.27	0.784	1.30	631.18	0.78	8	130.00	0.117	0.117	0.000	2.000	11.49	22.97	2.292	74.13	0.40522	49.07
2.133	477.767	60.91	0.73	1.2	0.14	436.329	1.201	1.54	436.32	1.20	7	130.00	0.139	0.139	0.000	2.000	10.18	20.36	1.881	60.91	3.43634	47.68
2.461	477.439	48.52	0.69	1.42	0.23	302.316	1.427	1.69	302.32	1.43	7	130.00	0.160	0.160	0.000	2.000	8.54	17.07	1.497	48.52	5.99658	45.97
2.789	477.111	43.89	0.75	1.7	0.09	241.105	1.716	1.82	241.10	1.72	7	130.00	0.181	0.181	0.000	2.000	8.06	16.12	1.353	43.89	8.4724	44.94
3.117	476.783	44.62	0.57	1.28	0.05	219.231	1.283	1.74	219.23	1.28	7	130.00	0.203	0.203	0.000	2.000	7.99	15.97	1.375	44.62	6.95479	44.49
3.445	476.455	38.58	0.44	1.13	0.02	171.29	1.147	1.78	171.29	1.15	7	130.00	0.224	0.224	0.000	2.000	6.99	13.99	1.187	38.58	7.68466	43.31
3.773	476.127	23.25	0.37	1.67	-0.51	93.6032	1.608	2.07	93.80	1.61	6	130.00	0.245	0.245	0.000	2.000	4.70	9.39	0.712	23.25	14.8691	40.23
4.101	475.799	18.59	0.19	1.02	0.32	68.7301	1.037	2.05	68.74	1.04	6	130.00	0.267	0.267	0.000	1.937	3.72	7.21	0.567	18.59	14.2745	38.62
4.429	475.471	17.34	0.16	0.92	0.21	59.2324	0.939	2.07	59.23	0.94	5	130.00	0.288	0.288	0.000	1.864	3.51	6.54	0.528	17.34	15.0462	37.66
4.757	475.143	25.81	0.28	1.09	0.09	82.4721	1.098	2.00	82.47	1.10	7	130.00	0.309	0.309	0.000	1.798	5.08	9.13	0.789	25.81	12.9698	39.53
5.085	474.815	24.43	0.46	1.87	-0.41	72.9127	1.909	2.20	72.91	1.91	6	130.00	0.331	0.331	0.000	1.739	5.20	9.05	0.746	24.43	18.9585	38.85
5.413	474.487	10.46	0.38	2.06	-0.64	51.4663	2.099	2.34	51.47	2.10	6	130.00	0.352	0.352	0.000	1.686	4.17	7.04	0.561	18.46	23.9842	36.87
5.741	474.159	16.54	0.27	1.61	-0.67	43.3238	1.670	2.33	43.35	1.67	6	130.00	0.373	0.373	0.000	1.637	3.73	6.11	0.501	16.55	23.7454	35.86
6.069	473.831	15.2	0.19	1.22	0.62	37.5312	1.265	2.31	37.53	1.28	6	130.00	0.394	0.394	0.000	1.592	3.40	5.41	0.458	15.2	23.0694	34.99
6.398	473.502	15.29	0.17	1.08	0.48	35.7663	1.143	2.30	35.79	1.14	6	130.00	0.416	0.416	0.000	1.551	3.41	5.28	0.460	15.3	22.6384	34.70
6.726	473.174	18.36	0.25	1.34	0.09	40.9955	1.395	2.30	41.00	1.39	6	130.00	0.437	0.437	0.000	1.512	4.09	6.19	0.555	18.36	22.6937	35.52
7.054	472.846	20.73	0.37	1.77	0.23	44.2117	1.825	2.35	44.21	1.83	6	130.00	0.459	0.459	0.000	1.477	4.71	6.85	0.628	20.73	24.4234	35.97
7.382	472.518	11.94	0.22	1.8	0.14	23.8838	1.920	2.59	23.88	1.92	5	130.00	0.480	0.480	0.000	1.444	3.02	4.35	0.355	11.94	34.1973	32.17
7.71	472.190	11.14	0.1	0.85	0.35	21.2269	0.940	2.45	21.25	0.94	6	130.00	0.501	0.501	0.000	1.413	2.65	3.75	0.329	11.15	28.5942	31.42
8.038	471.862	15.59	0.13	0.8	0.44	28.639	0.863	2.32	28.64	0.86	6	130.00	0.522	0.522	0.000	1.383	3.49	4.83	0.466	15.59	23.2198	33.36
8.366	471.534	15.96	0.17	1.04	0.67	28.3495	1.103	2.38	28.37	1.10	6	130.00	0.544	0.544	0.000	1.356	3.68	4.99	0.477	15.97	25.5838	33.26
8.694	471.206	13.31	0.18	1.32	0.46	22.5529	1.412	2.52	22.57	1.41	6	130.00	0.565	0.565	0.000	1.330	3.28	4.38	0.395	13.32	31.6281	31.81
9.022	470.878	16.16	0.14	0.84	0.64	26.5566	0.999	2.36	26.56	0.90	6	130.00	0.586	0.586	0.000	1.306	3.69	4.81	0.482	16.16	24.7561	32.85
9.35	470.550	17.95	0.14	0.79	0.8	28.6352	0.807	2.31	28.64	0.81	6	130.00	0.608	0.608	0.000	1.283	4.01	5.14	0.537	17.95	22.8851	33.30
9.678	470.222	14.69	0.11	0.72	0.51	22.3519	0.782	2.39	22.37	0.78	6	130.00	0.629	0.629	0.000	1.261	3.41	4.30	0.435	14.7	26.1982	31.75
10.006	469.894	15.13	0.13	0.83	0.32	22.263	0.898	2.42	22.28	0.90	6	130.00	0.650	0.650	0.000	1.240	3.56	4.41	0.448	15.14	27.4267	31.73
10.335	469.565	19.67	0.48	2.45	-0.05	28.2805	2.527	2.69	28.28	2.53	5	130.00	0.672	0.672	0.000	1.220	5.00	6.10	0.586	19.67	34.8607	33.24
10.663	469.237	22.81	0.74	3.23	0.67	31.9104	3.346	2.63	31.91	3.35	5	130.00	0.693	0.693	0.000	1.201	5.92	7.11	0.685	22.81	36.7632	33.99
10.991	468.909	13.41	0.42	3.14	0.42	17.7706	3.308	2.82	17.77	3.31	4	130.00	0.714	0.714	0.000	1.183	3.85	4.59	0.393	13.41	47.1932	30.26
11.319	468.581	19.13	0.26	1.36	0.67	25.0012	1.413	2.48	25.00	1.41	6	130.00	0.736	0.736	0.000	1.166	4.62	5.39	0.569	19.13	29.9799	32.46
11.647	468.253	17.75	0.22	1.21	0.62	22.4481	1.295	2.50	22.46	1.29	6	130.00	0.757	0.757	0.000	1.149	4.83	4.98	0.526	17.76	30.7942	31.78
11.975	467.925	18.33	0.28	1.53	0.82	22.8491	1.595	2.55	22.55	1.60	6	130.00	0.778	0.778	0.000	1.133	4.57	5.18	0.543	18.33	32.9971	31.80
12.303	467.597	33.79	0.45	1.32	0.58	41.2536	1.364	2.30	41.25	1.36	7	130.00	0.800	0.800	0.000	1.118	7.50	8.39	1.021	33.79	22.8995	35.56
12.631	467.269	97.39	1.27	1.31	0.35	117.621	1.316	1.94	117.62	1.32	6	130.00	0.821	0.821	0.000	1.104	18.70	20.64	2.990	97.39	11.3008	41.42
12.959	466.941	115.69	1.69	1.46	0.39	136.344	1.472	1.93	136.34	1.47	6	130.00	0.842	0.842	0.000	1.090	22.12	24.10	3.556	115.69	11.0264	42.17
13.287	466.613	126.13	2.46	1.95	0.69	145.042	1.964	2.00	145.04	1.96	7	130.00	0.864	0.864	0.000	1.076	24.81	26.70	3.878	126.13	12.9601	42.49
13.615	466.285	126.8	2.52	1.98	0.67	142.281	2.001	2.01	142.28	2.00	7	130.00	0.885	0.885	0.000	1.063	25.05	26.63	3.898	126.8	13.2784	42.39
13.943	465.957	96.74	2.09	2.16	0.09	105.742	2.181	2.13	106.74	2.18	7	130.00	0.906	0.906	0.000	1.050	19.99	21.00	2.967	96.74	16.6031	40.86
14.271	465.629	74.23	1.62	2.18	1.2	79.0224	2.210	2.22	79.03	2.21	7	130.00	0.928	0.928	0.000	1.038	15.94	16.55	2.269	74.24	19.5985	39.80
14.6	465.300	62.31	1	1.61	0.99	64.6586	1.630	2.19	64.67	1.63	7	130.00	0.949	0.949	0.000	1.027	13.23	13.56	1.900	62.32	18.7205	38.18
14.928	464.972	62.88	1	1.59	0.92	63.8034	1.615	2.19	63.81	1.61	7	130.00	0.970	0.970	0.000	1.015	13.36	13.57	1.917	62.89	18.7825	38.10
15.255	464.644	49.08	0.73	1.48	1.5	48.4938	1.518	2.27	48.50	1.52	7	130.00	0.992	0.992	0.000	1.004	10.77	10.81	1.489	49.09	21.3776	36.52

RI4553

Depth (ft)	Sam (ft,	qOt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	464.316	46.97	0.47	1	-1.55	45.3691	1.023	2.19	45.36	1.02	7	130.00	1.013	1.013	0.000	0.994	9.97	9.91	1.423	46.98	18.6666	36.13
15.912	463.988	56.61	0.64	1.12	-1.5	53.9271	1.147	2.16	53.94	1.15	7	130.00	1.034	1.034	0.000	0.983	11.90	11.70	1.727	56.82	17.6279	37.14
16.24	463.660	70.21	1	1.28	-1.71	73.0906	1.296	2.09	73.10	1.30	8	130.00	1.056	1.056	0.000	0.973	15.91	15.49	2.389	70.22	15.4178	38.87
16.568	463.332	70.07	1.01	1.44	-0.58	64.0652	1.464	2.18	64.07	1.46	7	130.00	1.077	1.077	0.000	0.964	14.74	14.16	2.136	70.08	17.8331	38.13
16.896	463.004	58.9	0.8	1.36	-0.58	52.6313	1.384	2.22	52.63	1.38	7	130.00	1.098	1.098	0.000	0.954	12.63	12.05	1.790	58.9	19.5365	37.60
17.224	462.676	49.64	0.81	1.64	-0.21	43.3398	1.869	2.33	43.34	1.87	7	130.00	1.120	1.120	0.000	0.945	11.09	10.58	1.502	49.64	23.7509	35.85
17.552	462.348	41.77	0.69	1.64	0.86	35.6121	1.698	2.40	35.62	1.70	7	130.00	1.141	1.141	0.000	0.936	9.73	9.11	1.258	41.78	26.5998	34.67
17.88	462.020	56.82	0.68	1.19	0.42	47.89	1.222	2.22	47.89	1.22	7	130.00	1.162	1.162	0.000	0.928	12.19	11.31	1.723	56.82	19.5408	36.45
18.208	461.692	67.55	1.17	1.74	0.42	56.0755	1.78294	2.26108	56.0755	1.76294	7	130.00	1.18352	1.18352	0	0.9192	14.76722	13.57409	2.05469	67.55	21.1084	37.365
18.537	461.363	65.8	1.63	2.48	0.64	53.6101	2.52341	2.3793	53.6101	2.52341	6	130.00	1.20491	1.204905	0	0.911	15.15043	13.80221	1.99985	65.8	25.5751	37.106
18.865	461.035	61.65	1.3	2.11	-0.67	49.2763	2.15147	2.36009	49.2763	2.15147	7	130.00	1.22823	1.226225	0	0.9031	14.07313	12.70883	1.87071	61.65	24.8137	36.614
19.193	460.707	47.05	0.79	1.67	-0.53	36.7141	1.7248	2.39828	36.7141	1.7248	7	125.00	1.24755	1.247545	0	0.8953	10.92664	9.782697	1.41803	47.05	26.3409	34.856
19.521	460.379	44.52	0.68	1.53	-0.9	34.1092	1.57218	2.39864	34.1171	1.57182	7	125.00	1.26805	1.268045	0	0.888	10.3478	9.189267	1.33907	44.53	25.3963	34.407
19.849	460.051	40.76	0.63	1.55	-0.25	30.6326	1.59609	2.44144	30.6326	1.59609	7	125.00	1.28855	1.288545	0	0.8808	9.655144	8.505678	1.22203	40.76	28.1337	33.741
20.177	459.723	38.62	0.63	1.64	-0.16	28.5024	1.68851	2.46119	28.5024	1.68851	7	125.00	1.30905	1.309046	0	0.874	9.319563	8.145509	1.15514	38.62	29.8463	33.291
20.505	459.395	44.39	0.75	1.69	-0.51	32.3874	1.74174	2.44416	32.3949	1.74133	7	125.00	1.32955	1.329545	0	0.8673	10.53065	9.132793	1.33314	44.4	28.2491	34.088
20.833	459.067	57.91	1.33	2.3	-0.41	41.8949	2.35149	2.43962	41.8949	2.35149	6	125.00	1.35005	1.350045	0	0.8606	13.59973	11.79066	1.75108	57.91	28.0146	35.652
21.161	458.739	25.08	1.34	5.36	-0.07	17.2993	5.65175	2.97846	17.2993	5.65175	3	125.00	1.37055	1.370545	0	0.8542	7.90839	6.75525	0.73404	25.08	57.0449	30.082
21.489	458.411	21.57	0.8	3.69	2.73	14.5063	3.96453	2.93879	14.4991	3.96849	4	125.00	1.39105	1.391045	0	0.8479	6.636117	5.626566	0.62474	21.56	54.455	28.914
21.817	458.083	29.59	0.95	3.2	6.9	19.9628	3.37137	2.78704	19.9345	3.37616	5	125.00	1.41155	1.411545	0	0.8417	8.334097	7.014733	0.8724	29.58	45.2501	31.009
22.145	457.755	33.08	1.22	3.68	8.57	22.0998	3.85491	2.79022	22.0649	3.86101	5	125.00	1.43205	1.432045	0	0.8356	9.321922	7.798171	0.97981	33.03	45.4317	31.665
22.473	457.427	38.31	1.19	3.29	9.54	23.9975	3.4139	2.72893	23.9562	3.41979	5	125.00	1.45255	1.452545	0	0.8297	9.806188	8.219431	1.07918	38.25	42.0101	32.192
22.802	457.098	35.83	1.22	3.4	9.26	23.3227	3.55096	2.74943	23.282	3.55717	5	125.00	1.47311	1.473108	0	0.8239	9.883284	8.142993	1.06368	35.77	43.1354	32.01
23.13	456.770	36.3	1.11	3.07	13.62	23.3036	3.18907	2.7202	23.25	3.19642	5	125.00	1.49361	1.493608	0	0.8182	9.852044	8.061356	1.0776	36.22	41.5368	32.091
23.458	456.442	34.31	1.06	3.08	15.82	21.6602	3.23211	2.74896	21.5942	3.242	5	125.00	1.51411	1.514108	0	0.8127	9.449872	7.679759	1.01635	34.21	43.1096	31.526
23.786	456.114	34.28	1.04	3.03	17.95	21.338	3.17602	2.74944	21.2663	3.18672	5	125.00	1.53461	1.534608	0	0.8072	9.441263	7.621342	1.01379	34.17	43.136	31.428
24.114	455.786	34.12	1.05	3.07	21.36	20.9406	3.22433	2.7603	20.857	3.23725	5	125.00	1.55511	1.555108	0	0.7967	9.463703	7.539406	0.97568	32.96	47.1098	31.004
24.442	455.458	33.09	1.19	3.59	20.71	20.0014	3.77606	2.8192	19.9189	3.79169	5	125.00	1.57561	1.575608	0	0.7915	9.937404	7.865781	1.04068	35.07	45.7356	31.336
24.77	455.130	35.21	1.24	3.53	21.94	21.0599	3.68895	2.79552	20.9722	3.70438	5	125.00	1.59611	1.596108	0	0.7865	9.93126	7.810917	1.04345	35.17	45.3767	31.27
25.098	454.802	35.32	1.2	3.39	24.9	20.8482	3.56047	2.78926	20.7554	3.57639	5	125.00	1.61661	1.616608	0	0.7815	9.93126	7.810917	1.04345	35.17	45.3767	31.27
25.426	454.474	33.07	1.09	3.29	27.37	19.2003	3.46771	2.81093	19.0964	3.48656	5	125.00	1.63711	1.637108	0	0.7766	9.399677	7.346396	0.97315	32.9	46.5923	30.729
25.754	454.146	30.14	0.89	2.96	28.13	17.1828	3.12474	2.82084	17.0742	3.14461	5	125.00	1.65761	1.657608	0	0.7767	8.610264	6.687692	0.88181	29.96	47.206	29.996
26.082	453.818	26.04	0.96	3.41	30.18	15.7093	3.64162	2.8929	15.5961	3.66806	5	125.00	1.67811	1.678108	0	0.772	8.341715	6.439401	0.81816	27.85	51.555	29.398
26.41	453.490	27.22	1.12	4.12	32.24	15.0249	4.09848	2.95894	14.9071	4.12314	4	125.00	1.69861	1.698608	0	0.7673	8.418813	6.459581	0.79014	27.02	55.761	29.099
26.739	453.161	25.07	1.08	4.3	31.06	13.5826	4.6251	3.00754	13.4721	4.66305	4	125.00	1.71917	1.71917	0	0.7627	7.988621	6.092736	0.72294	24.88	58.9941	28.424
27.067	452.833	22.52	0.88	3.89	31.69	11.945	4.23477	3.02853	11.83	4.27593	4	125.00	1.73967	1.73967	0	0.7582	7.262348	5.506094	0.64335	22.32	60.4271	27.552
27.395	452.505	23.13	1	4.33	31.09	12.1408	4.67949	3.04924	12.0328	4.72147	4	125.00	1.76017	1.76017	0	0.7537	7.563756	5.70113	0.6616	22.94	61.8634	27.667
27.723	452.177	24.42	1.29	5.28	27.74	12.7139	5.69805	3.08711	12.6139	5.74377	3	125.00	1.78067	1.78067	0	0.7494	8.192462	6.139354	0.70091	24.24	64.5468	27.983
28.051	451.849	25.99	1.44	5.53	25.13	13.4414	5.85316	3.07963	13.356	5.99031	3	135.00	1.80117	1.799579	0.0016	0.7454	8.691388	6.478936	0.74888	25.84	64.0251	28.368
28.379	451.521	24.42	1.32	5.42	22.7	12.4741	5.84156	3.09958	12.3913	5.8806	3	135.00	1.82331	1.811485	0.0118	0.743	8.270747	6.145077	0.69959	24.27	65.4465	27.867
28.707	451.193	24.47	1.16	4.75	25.24	12.4079	5.12717	3.08558	12.3202	5.16369	3	135.00	1.84546	1.823392	0.0221	0.7406	8.100847	5.99816	0.70045	24.31	63.0122	27.632
29.035	450.865	24.85	1.17	4.72	24.97	12.5224	5.09086	3.06047	12.4253	5.12654	3	135.00	1.86759	1.835298	0.0323	0.7382	8.200162	6.052979	0.71153	24.69	62.6514	27.897
29.363	450.537	25.04	1.24	4.96	25.89	12.5326	5.35631	3.07414	12.446	5.39359	3	135.00	1.88973	1.847204	0.0425	0.7358	8.337266	6.151317	0.71673	24.86	63.6191	27.906
29.691	450.209	24.64	1.36	5.51	22.33	12.2253	5.98377	3.1127	12.15	6.02086	3	135.00	1.91187	1.859111	0.0528	0.7334	8.422789	6.177365	0.70366	24.5	66.4024	27.747
30.019	449.881	19.78	1.13	5.7	16.6	9.53812	5.33195	3.21114	9.48467	5.36764	3	135.00	1.93401	1.871017	0.063	0.7311	7.245293	5.296842	0.58251	19.68	73.8677	26.083
30.347	449.553	16.42	0.86	5.37	15.59	7.68159	6.08413	3.27481	7.62648	6.12649	3	135.00	1.95615	1.882924	0.0732	0.7288	6.296958	4.588952	0.4478	16.32	75.9795	24.616
30.675	449.225	20.02	0.87	4.36	20.02	9.52155	4.82218	3.13916	9.45822	4.85445	4	135.00	1.97829	1.894483	0.0835	0.7265	6.965318	5.060062	0.55857	19.9	68.3583	26.072
31.004	448.896	23.04	1.19	5.16	16.63	11.0341	5.65603	3.1306	10.9816	5.68304	3	135.00	2.0005	1.906773	0.0937	0.7242	7.902536	5.780646	0.65138	22.94	67.7209	27.081
31.332	448.568	21.44	1.16	5.4	11.94	10.1202	5.97403	3.17402	10.0837	5.99565	3	135.00	2.02264	1.918679	0.104	0.7219	7.662654	5.531947	0.60116	21.37	70.991	26.51
31.66	448.240	16.53	1.16	6.88	4.5	7.55841	7.84567	3.34165	7.64287	7.86162	3	135.00	2.04478	1.930586	0.1142	0.7197	6.826499	4.913068	0.45775	16.8	84.59	24.646
31.988	447.912	14.1	1.08	7.64	2.65	6.19466	8.97526	3.44974	6.18437	8.9902	3	135.00	2.06692	1.942492	0.1244	0.7175	6.256887	4.490736	0.37254	14.08	94.2141	23.229
32.316	447.584	36.86	1.64	4.99	8.52	17.786	5.2933	2.95167	17.7553	5.30245	3	135.00	2.08906	1.954396	0.1347	0.7153	11.41236	8.163359	1.07619	36.79	55.2875	30.278
32.644	447.256	53.58	2.7	5.03	7.3	26.1754	5.2459	2.82443	26.15	5.251	4	135.00	2.1112	1.966305	0.1449	0.7131	15.41519	10.99318	1.59346	53.53	47.4168	32.767
32.972	446.928	41.09	2.46	5.99	2.4	19.6625	6.32445	2.97095	19.6524	6.3277	3	135.00	2.13334	1.978211	0.1551	0.711	12.86718	9.148439	1.20423	41.01	56.5089	30.942
33.3	446.600	30.73	1.67	5.43	5.52	14.3582	5.84437	3.04966	14.3431	5.85051	3	135.00	2.15546	1.990118	0.1654	0.7089	10.12526	7.177398	0.98466	30.7	61.8941	28.881
33.628	446.272	25.44	1.21	4.77	7.23	11.8194	5.20153	3.0684	11.5995	5.21049	3	135.00	2.17782	2.002024	0.1756	0.7067	8.591848	6.072283	0.7202	25.4	64.6397	27.47
33.956	445.944	24.46	1.07	4.38	8.06	11.0631	4.80246	3.03838	11.0382	4.81326	4	135.00	2.19976	2.013933	0.1858	0.7047	8.238087	5.80559	0.68979	24.49	64.3124	27.142
34.284	445.616	24.3	1.08	4.43	9.26	10.8903	4.89172	3.0942	10.8886	4.90505	4	135.00	2.2219	2.025837	0.1961	0.7026	8.231024	5.782979	0.68353	24.24	65.0574	27.041
34.612	445.288	25.03	1.22	4.87	9.17	11.182	5.35417	3.10955	11.1574	5.36595	3	135.00	2.24404	2.037743	0.2063	0.7005	8.569686	6.003302	0.70545	24.98	66.1725	27.219
34.941	444.959	21.34	0.88	4.11	11.34	9.3057	4.61367	3.13367	9.27155	4.63066	4	135.00	2.26625	2.049586	0.2166	0.6985	7.41695	5.180619	0.59052	21.27	67.9493	25.986
35.269	444.631	22.16	0.83	3.76	13.05	9.63896	4.17681	3.0961	9.59531	4.19582	4	135.00	2.28839	2.061592	0.2268	0.6965	7.503638	5.226013	0.61522	22.07	65.1947	26.215
35.597	444.303	27.65	1.08	3.92	12.93	12.2206	4.26212	3.01844	12.1821	4.27562	4	135.00	2.31053	2.073499	0.237	0.6945	8.913341	6.189971	0.7845	27.57	59.7354	27.812
35.925	443.975	41.71	1.36	3.26	15.45	18.8823	3.45376	2.81298	18.8392	3.46189	5	135.00	2.33267	2.085405	0.2473	0.6925	11.90861	8.246427	1.21911	41.62	46.7462	30.682
36.253	443.647	119.94	5.26	4.39	10.53	56.0647	4.47336	2.54245	56.0314	4.47602	11	135.00	2.35481	2.097211	0.2575	0.6905	29.70849	20.56918	3.64041	119.87	32.6187	37.379
36.581	443.319	232.84	9.81	4.21	-2.08	109.265	4.25665	2.33641	109.269	4.25646	12	135.00	2.37695	2.109018	0.2677	0.6886	52.64439	36.24861	7.12508	232.85	23.9715	41.04
36.909	442.991	245.39	11.65	4.75	-7.92	114.558	4.79442	2.36708	114.581	4.79343	11	135.00	2.39909	2.121124	0.278	0.6866	56.20518	38.59027	7.52294	245.44	25.0892	41.287
37.237	442.663	185.81	11.73	6.31	-9.21	86.9757	6.39625	2.54196	86.9038	6.39416	11	135.00	2.42123	2.133031	0.2882	0.6847	46.17875	31.61867	5.67787	185.87	32.5936	39.766
37.565	442.335	190.28	10.73	5.64	-3.88	87.5721	5.71241	2.49822	87.5614	5.7118	11	135.00	2.44337	2.144937	0.2984	0.6828	46.29597	31.61081	5.81539	190.3	31.6039	39.865

CR14554

Depth (ft)	Sam	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt (pcf)	ss	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.093	442.007	280.56	11.76	4.19	-0.79	128.936	4.22878	2.29281	126.941	4.22862	12	135.00	2.46551	2.156843	0.3087	0.6809	62.17955	42.33877	8.60974	280.57	22.2559	41.995
38.221	441.679	230.05	12.58	5.47	8.43	104.928	5.52815	2.40946	104.951	5.52694	11	135.00	2.48765	2.16975	0.3189	0.679	54.45582	36.97767	7.04527	230.1	28.0501	40.929
38.549	441.361	214.58	12.79	5.96	3.42	97.2506	6.03102	2.48953	97.2644	6.03017	11	135.00	2.50979	2.180656	0.3291	0.6772	51.99489	35.21008	6.56564	214.61	30.2173	40.427
38.877	441.023	252.97	15.89	6.28	5.22	114.222	6.34488	2.48678	114.206	6.34564	11	135.00	2.53193	2.192663	0.3394	0.6753	60.62771	40.84446	7.7535	252.94	29.2202	41.271
39.206	440.694	369.1	14.5	3.93	49.56	166.271	3.95585	2.20669	166.131	3.9682	12	135.00	2.55413	2.204506	0.3486	0.6735	78.75678	53.04353	11.3482	368.79	19.1854	43.169

R14555

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 20 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-6

ConeTec Inc. Interpretation
Interpretation Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4364
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-6
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 12:00
CPT File: 804CP06.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 457.8

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	37.16	1.98	45.31	35.45	2.55

User Inputs:
Assumed: Water Table Depth (ft): 9.2
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 457.8
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	457.636	8.56	0.1	1.11	-0.53	834.122	1.170	1.40	834.12	1.17	5	125.00	0.010	0.010	0.000	2.000	1.37	2.74	0.265	8.56	1.52433	50.15
0.492	457.308	9.31	0.29	3.12	-2.93	301.764	3.125	1.98	302.41	3.12	4	125.00	0.031	0.031	0.000	2.000	1.86	3.64	0.287	9.33	12.388	45.97
0.82	456.980	10.89	0.47	4.33	-10.58	211.488	4.336	2.18	212.85	4.31	3	125.00	0.051	0.051	0.000	2.000	2.31	4.63	0.336	10.96	18.2558	44.36
1.148	456.652	15.32	0.83	5.4	-7.37	212.519	5.443	2.26	213.08	5.43	3	125.00	0.072	0.072	0.000	2.000	3.36	6.72	0.472	15.36	21.1963	44.36
1.476	456.324	38.89	1.49	3.84	3.12	420.572	3.840	1.99	420.36	3.84	5	125.00	0.092	0.092	0.000	2.000	7.62	15.25	1.201	38.87	12.7664	47.40
1.804	455.996	64.95	2.12	3.26	8.39	575.053	3.270	1.87	574.61	3.27	6	125.00	0.113	0.113	0.000	2.000	12.18	24.35	2.007	64.9	9.79283	48.70
2.133	455.667	91.43	3.22	3.53	-3.19	684.832	3.527	1.86	684.96	3.53	6	125.00	0.133	0.133	0.000	2.000	17.18	34.35	2.827	91.45	9.86183	49.40
2.461	455.339	106.27	4.78	4.5	0.53	689.906	4.504	1.98	689.84	4.50	11	125.00	0.154	0.154	0.000	2.000	20.72	41.43	3.285	106.26	12.339	49.42
2.789	455.011	97.06	5.09	5.25	3.16	555.816	5.254	2.07	555.70	5.25	11	125.00	0.174	0.174	0.000	2.000	19.62	39.25	3.000	97.04	14.9656	48.56
3.117	454.683	83.61	4.4	5.26	13.6	428.182	5.275	2.12	427.72	5.28	11	125.00	0.195	0.195	0.000	2.000	17.19	34.38	2.583	83.62	16.2983	47.48
3.445	454.355	75.27	3.59	4.77	18.34	348.586	4.783	2.11	348.07	4.79	11	125.00	0.215	0.215	0.000	2.000	15.46	30.93	2.324	75.16	16.2656	46.59
3.773	454.027	65.07	3.24	4.98	11.57	274.94	4.997	2.18	274.64	5.00	11	125.00	0.236	0.236	0.000	2.000	13.73	27.45	2.007	65	18.2882	45.53
4.101	453.699	64.94	3.2	4.93	6.12	252.363	4.947	2.19	252.21	4.95	11	125.00	0.256	0.256	0.000	1.975	13.78	27.23	2.003	64.9	18.7426	45.14
4.429	453.371	68.37	3.12	4.93	5.33	227.928	4.946	2.21	227.82	4.95	11	125.00	0.277	0.277	0.000	1.901	13.57	25.80	1.953	68.34	19.4706	44.67
4.757	453.043	55.6	2.82	5.07	3.75	186.009	5.099	2.27	185.91	5.10	4	125.00	0.297	0.297	0.000	1.854	12.20	22.38	1.712	55.57	21.4653	43.71
5.085	452.715	46.31	2.63	5.68	-1.89	144.715	5.718	2.37	144.75	5.72	3	125.00	0.318	0.318	0.000	1.774	10.63	18.85	1.424	46.32	25.262	42.47
5.413	452.387	49.15	2.45	4.98	-2.28	144.28	5.019	2.33	144.31	5.02	4	125.00	0.338	0.338	0.000	1.719	11.05	19.00	1.511	49.16	23.4659	42.46
5.741	452.059	41.44	2.45	5.91	-3.06	114.492	5.964	2.44	114.55	5.96	3	125.00	0.359	0.359	0.000	1.669	9.63	16.41	1.272	41.46	28.2345	41.28
6.069	451.731	40.26	2.34	5.81	-3.23	105.139	5.868	2.46	105.19	5.86	3	125.00	0.379	0.379	0.000	1.624	9.62	15.62	1.235	40.28	28.9115	40.83
6.398	451.402	35.34	1.94	5.49	-2.68	87.3776	5.552	2.48	87.43	5.55	3	125.00	0.400	0.400	0.000	1.581	8.56	13.54	1.082	35.36	30.1842	39.85
6.726	451.074	29.43	1.47	4.99	-1.85	69.0089	5.057	2.52	69.06	5.06	3	125.00	0.420	0.420	0.000	1.542	7.25	11.18	0.898	29.45	31.6997	38.55
7.054	450.746	22.96	1.12	4.89	-1.15	51.0783	4.974	2.60	51.10	4.97	3	125.00	0.441	0.441	0.000	1.506	5.88	8.86	0.697	22.97	35.5076	36.83
7.382	450.418	22.39	1.27	5.66	-4.08	47.5289	5.792	2.67	47.59	5.78	3	125.00	0.461	0.461	0.000	1.472	5.95	8.78	0.679	22.42	39.0065	36.41
7.71	450.090	24.72	1.47	5.94	-6.27	50.2996	6.065	2.67	50.38	6.05	3	125.00	0.482	0.482	0.000	1.441	6.50	9.45	0.750	24.76	38.9216	36.74
8.038	449.762	25.96	1.6	6.16	-6.42	50.6745	6.285	2.68	50.75	6.26	3	125.00	0.502	0.502	0.000	1.411	6.93	9.77	0.788	26	39.4189	36.79
8.366	449.434	23.65	1.49	6.3	-8.13	44.2307	6.443	2.73	44.33	6.43	3	125.00	0.523	0.523	0.000	1.383	6.47	8.95	0.716	23.7	41.9185	35.99
8.694	449.106	24.35	1.37	5.64	-8.36	43.8126	5.755	2.69	43.90	5.74	3	125.00	0.543	0.543	0.000	1.357	6.55	8.88	0.737	24.4	40.1268	35.93
9.022	448.778	28.29	1.49	5.28	-7.83	49.153	5.376	2.64	49.24	5.37	3	125.00	0.564	0.564	0.000	1.332	7.38	9.83	0.858	28.33	37.2649	36.61
9.35	448.450	28.51	1.65	5.78	-7.81	48.173	5.909	2.67	48.24	5.90	3	135.00	0.584	0.580	0.005	1.313	7.68	9.96	0.865	28.55	39.1366	36.49
9.678	448.122	28.8	1.69	5.86	-6.77	47.6562	5.994	2.66	47.72	5.99	3	135.00	0.607	0.592	0.015	1.300	7.69	10.00	0.873	28.84	39.5436	36.43
10.006	447.794	30.5	1.75	5.68	-4.18	49.9933	5.800	2.66	50.03	5.80	3	136.00	0.629	0.604	0.025	1.287	8.12	10.45	0.934	30.52	38.2961	36.71
10.335	447.465	27.19	1.42	5.23	-3.86	43.1215	5.351	2.68	43.17	5.34	3	135.00	0.651	0.615	0.036	1.275	7.20	9.22	0.822	27.22	39.1905	35.94
10.663	447.137	24.41	1.15	4.72	-3.58	37.8366	4.845	2.68	37.87	4.84	3	135.00	0.673	0.627	0.046	1.263	6.52	8.23	0.735	24.42	39.6428	35.06
10.991	446.809	22.72	0.94	4.13	-3.23	34.4635	4.268	2.68	34.48	4.26	4	135.00	0.695	0.639	0.056	1.251	6.04	7.55	0.682	22.74	39.1418	34.49
11.319	446.481	22.41	0.62	3.65	-2.63	33.3135	3.780	2.65	33.33	3.78	5	135.00	0.717	0.651	0.066	1.239	5.88	7.28	0.672	22.42	37.8448	34.28
11.647	446.153	22.09	0.86	3.9	-2.01	32.1993	4.028	2.68	32.21	4.03	4	135.00	0.739	0.663	0.076	1.228	5.88	7.23	0.661	22.1	39.3712	34.08
11.975	445.825	19.57	0.82	4.2	-1.41	27.8651	4.360	2.75	27.88	4.36	4	135.00	0.762	0.675	0.087	1.217	5.41	6.58	0.582	19.58	43.1038	33.18
12.303	445.497	18.59	0.79	4.26	-0.78	25.9231	4.437	2.78	25.92	4.44	4	135.00	0.784	0.687	0.097	1.207	5.22	6.29	0.551	18.59	44.7056	32.73
12.631	445.169	16.32	0.61	4.95	-0.6	22.2013	5.221	2.87	22.20	5.22	3	135.00	0.806	0.699	0.107	1.196	4.84	5.79	0.480	16.32	50.4414	31.75
12.959	444.841	19.07	0.83	4.36	0.74	25.6676	4.550	2.79	25.67	4.55	3	135.00	0.828	0.711	0.117	1.186	5.38	6.38	0.565	19.07	45.3058	32.67
13.287	444.513	21.2	1	4.73	8.36	28.1617	4.914	2.78	28.09	4.93	3	135.00	0.850	0.725	0.128	1.176	5.95	7.00	0.630	21.15	45.0064	33.24
13.615	444.185	20.7	0.95	4.58	10.95	26.9943	4.791	2.79	26.91	4.81	3	135.00	0.872	0.736	0.138	1.167	5.83	6.80	0.614	20.64	45.3618	32.97
13.943	443.857	23.12	1.2	5.2	13.55	29.7762	5.399	2.79	29.66	5.42	3	136.00	0.894	0.746	0.148	1.157	6.52	7.55	0.688	23.03	45.6855	33.58
14.271	443.529	29.53	1.34	4.53	13.72	37.7323	4.683	2.68	37.52	4.70	4	135.00	0.917	0.758	0.158	1.148	7.83	8.99	0.806	29.45	39.2582	35.04
14.6	443.200	26.74	0.91	3.39	16.67	33.4964	3.527	2.63	33.37	3.54	5	135.00	0.939	0.770	0.168	1.139	6.92	7.88	0.799	26.64	36.8635	34.31
14.928	442.872	20.25	0.7	3.44	21.11	24.6608	3.629	2.74	24.49	3.65	5	135.00	0.961	0.782	0.179	1.131	5.53	6.25	0.697	20.12	42.6233	32.39
15.256	442.544	17.79	0.62	3.49	24.51	21.1653	3.689	2.80	20.96	3.72	4	135.00	0.983	0.794	0.189	1.125	5.00	5.61	0.520	17.62	46.8287	31.47

R14557

Depth (ft)	Sam (.	AvgQt sf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)		EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	442.216	15.28	0.55	3.61	26.19	17.7109	3.853	2.87	17.50	3.90	4	135.00	1.005	0.806	0.199	1.114	4.47	4.98	0.442	15.11	50.169	30.25
15.912	441.888	12.73	0.44	3.46	28.8	14.3085	3.760	2.94	14.09	3.82	4	135.00	1.027	0.818	0.209	1.106	3.86	4.27	0.362	12.55	54.4336	28.84
16.24	441.560	10.89	0.43	3.91	30.79	11.8589	4.370	3.05	11.63	4.46	3	135.00	1.049	0.830	0.220	1.098	3.52	3.86	0.305	10.7	61.5912	27.59
16.568	441.232	10.9	0.3	2.76	46.79	11.6767	3.052	2.96	11.33	3.15	4	135.00	1.072	0.842	0.230	1.090	3.32	3.61	0.304	10.61	56.0979	27.42
16.896	440.904	10.8	0.23	2.13	52.75	11.3708	2.370	2.91	11.00	2.45	5	135.00	1.094	0.854	0.240	1.082	3.18	3.44	0.301	10.48	52.8448	27.23
17.224	440.576	11.97	0.28	2.35	59.86	12.5406	2.580	2.90	12.10	2.67	5	135.00	1.116	0.865	0.250	1.075	3.49	3.75	0.335	11.59	52.0107	27.86
17.552	440.248	10.88	0.31	2.86	64.85	11.1029	3.182	3.00	10.65	3.32	4	135.00	1.138	0.877	0.261	1.068	3.35	3.57	0.302	10.48	58.4614	27.03
17.88	439.920	8.13	0.21	2.58	64.13	7.83716	3.013	3.12	7.39	3.20	4	135.00	1.160	0.889	0.271	1.060	2.67	2.83	0.216	7.73	67.0317	24.64
18.208	439.592	9.83	0.21	2.14	70.88	9.59534	2.428	2.99	9.11	2.56	5	135.00	1.182	0.901	0.281	1.053	2.99	3.15	0.268	9.39	57.9642	26.01
18.537	439.263	14.59	0.35	2.37	85.33	14.6681	2.615	2.86	14.07	2.72	5	135.00	1.204	0.913	0.291	1.046	4.11	4.30	0.414	14.05	49.0242	28.86
18.865	438.935	17.47	0.43	2.47	91.82	17.5587	2.647	2.79	16.94	2.74	5	135.00	1.227	0.925	0.302	1.040	4.77	4.96	0.503	16.9	45.2966	30.07
19.193	438.607	23.8	0.66	2.76	108.66	24.0676	2.927	2.70	23.34	3.02	5	135.00	1.249	0.937	0.312	1.033	6.23	6.44	0.698	23.12	40.6187	32.12
19.521	438.279	26.5	1.31	4.94	95.15	26.5877	5.192	2.83	25.97	5.32	5	135.00	1.271	0.949	0.322	1.027	7.49	7.69	0.781	25.91	47.7872	32.79
19.849	437.951	23.66	0.83	3.52	20.44	23.2793	3.711	2.76	22.15	3.73	5	135.00	1.293	0.961	0.332	1.020	6.56	6.69	0.692	23.54	43.9821	32.07
20.177	437.623	18.99	0.49	2.56	28.01	18.1706	2.772	2.77	18.00	2.80	5	135.00	1.315	0.973	0.342	1.014	5.26	5.34	0.547	18.82	44.4019	30.47
20.505	437.295	18.95	0.78	4.1	37.55	17.8877	4.429	2.91	17.65	4.49	4	135.00	1.337	0.985	0.353	1.008	5.65	5.70	0.545	18.72	52.3926	30.35
20.833	436.967	49.87	2.16	4.32	27.3	48.6795	4.453	2.58	48.51	4.47	6	135.00	1.359	0.997	0.363	1.002	12.61	12.63	1.502	49.7	34.6157	36.57
21.161	436.639	83.66	5.29	6.33	-14.43	81.5902	6.429	2.56	81.68	6.42	11	135.00	1.382	1.008	0.373	0.996	20.96	20.87	2.547	83.75	33.2996	39.50
21.489	436.311	243.98	10.44	4.28	-17.83	237.74	4.304	2.15	237.85	4.30	11	135.00	1.404	1.020	0.383	0.990	50.99	50.46	7.510	244.09	17.4322	44.88
21.817	435.983	336.34	16.44	4.89	-19.03	324.461	4.909	2.14	324.57	4.91	11	135.00	1.426	1.032	0.394	0.984	69.87	68.77	10.369	336.46	16.9751	46.29
22.145	435.655	423.23	17.94	4.24	-18.69	403.946	4.253	2.04	404.05	4.25	12	135.00	1.448	1.044	0.404	0.979	84.57	82.76	13.058	423.34	14.0663	47.24

SRK4558

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 31 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY JLS DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-7

ConeTec Inc. Interpretation
Interpretation C lease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4331
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-7
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 07:58
CPT File: 804CP07.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 457.8

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.96	1.90	98.51	25.19	2.31

User Inputs

Assumed: Water Table Depth (ft): 9.2
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 457.8
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	457.636	9.8	0.17	1.69	-0.53	955.098	1.737	1.54	955.10	1.74	5	125.00	0.010	0.010	0.000	2.000	1.64	3.27	0.303	9.8	3.41667	50.67
0.492	457.308	30.91	0.44	1.41	-5.98	1004.2	1.425	1.45	1005.50	1.42	6	125.00	0.031	0.031	0.000	2.000	5.02	10.05	0.956	30.95	2.16306	50.86
0.82	456.980	42	0.69	1.65	-14.97	818.512	1.645	1.54	820.46	1.64	7	125.00	0.051	0.051	0.000	2.000	7.03	14.07	1.299	42.1	3.40523	50.09
1.148	456.652	38.42	0.68	1.76	-15.08	534.47	1.773	1.64	535.86	1.77	6	125.00	0.072	0.072	0.000	2.000	6.66	13.33	1.187	38.52	5.10589	48.41
1.476	456.324	35.13	0.57	1.61	-15.89	379.813	1.627	1.68	380.90	1.62	6	125.00	0.092	0.092	0.000	2.000	6.18	12.36	1.085	35.23	5.82026	46.96
1.804	455.996	33.61	0.6	1.77	-9.86	297.093	1.791	1.78	297.63	1.79	6	125.00	0.113	0.113	0.000	2.000	6.10	12.20	1.037	33.67	7.65399	45.90
2.133	455.667	35.29	0.79	2.24	-0.3	263.716	2.247	1.89	263.79	2.25	6	125.00	0.133	0.133	0.000	2.000	6.66	13.32	1.088	35.3	10.1362	45.35
2.461	455.339	39.86	1	2.5	-0.42	258.147	2.518	1.94	258.15	2.52	6	125.00	0.154	0.154	0.000	2.000	7.65	15.30	1.229	39.86	11.2767	45.25
2.789	455.011	41.14	1.05	2.55	-0.46	235.013	2.563	1.96	235.01	2.56	6	125.00	0.174	0.174	0.000	2.000	7.98	15.97	1.268	41.14	12.0156	44.82
3.117	454.683	36.47	0.82	2.25	-0.6	186.206	2.260	1.98	186.26	2.25	6	125.00	0.195	0.195	0.000	2.000	7.12	14.23	1.123	36.48	12.3943	43.72
3.445	454.355	34.59	0.81	2.35	-0.76	159.65	2.356	2.03	159.65	2.36	6	125.00	0.215	0.215	0.000	2.000	6.89	13.79	1.064	34.59	13.9069	42.96
3.773	454.027	45.16	1.24	2.75	-0.76	190.508	2.760	2.04	190.51	2.76	6	125.00	0.236	0.236	0.000	2.000	9.03	18.06	1.391	45.16	14.1489	43.82
4.101	453.699	52.95	1.71	3.23	-0.23	205.584	3.245	2.06	205.58	3.25	6	125.00	0.256	0.256	0.000	1.975	10.75	21.24	1.631	52.96	15.2795	44.19
4.429	453.371	39.45	1.59	4.04	4.97	141.515	4.059	2.26	141.41	4.06	5	125.00	0.277	0.277	0.000	1.901	8.60	16.34	1.213	39.42	20.8937	42.36
4.757	453.043	25.66	0.97	3.77	17.39	85.3065	3.825	2.37	84.94	3.84	5	125.00	0.297	0.297	0.000	1.834	5.87	10.76	0.785	25.65	25.3185	39.69
5.085	452.715	16.21	0.6	3.68	17.83	50.0049	3.775	2.53	49.83	3.80	4	125.00	0.318	0.318	0.000	1.774	3.97	7.04	0.492	16.09	31.9342	38.66
5.413	452.387	12.96	0.42	3.21	19.31	37.3078	3.328	2.56	36.95	3.36	4	125.00	0.338	0.338	0.000	1.719	3.26	5.59	0.391	12.84	34.5011	34.90
5.741	452.059	11.86	0.37	3.13	19.93	32.0256	3.220	2.62	31.86	3.26	4	125.00	0.359	0.359	0.000	1.669	3.02	5.06	0.355	11.72	36.5016	33.95
6.069	451.731	10.67	0.33	3.1	21.39	27.1299	3.207	2.66	26.79	3.25	4	125.00	0.379	0.379	0.000	1.624	2.80	4.55	0.319	10.54	39.2642	32.90
6.398	451.402	9.96	0.31	3.07	23.76	23.9078	3.243	2.72	23.53	3.29	4	125.00	0.400	0.400	0.000	1.581	2.67	4.23	0.296	9.81	41.7887	32.08
6.726	451.074	9.7	0.29	2.95	38.8	22.0746	3.125	2.75	21.50	3.21	4	125.00	0.420	0.420	0.000	1.542	2.61	4.03	0.287	9.46	43.0291	31.50
7.054	450.746	14.29	0.34	2.35	47.48	31.4128	2.455	2.56	30.73	2.51	5	125.00	0.441	0.441	0.000	1.506	3.51	5.28	0.429	13.99	33.4317	33.76
7.382	450.418	16.68	0.5	3	56.9	35.1528	3.083	2.59	34.37	3.15	5	125.00	0.461	0.461	0.000	1.472	4.15	6.10	0.502	16.32	34.7346	34.45
7.71	450.090	21.63	0.78	3.61	62.19	43.8872	3.688	2.57	43.08	3.76	5	125.00	0.482	0.482	0.000	1.441	5.34	7.70	0.655	21.24	33.789	35.82
8.038	449.762	21.3	0.89	4.19	65.69	41.3986	4.279	2.63	40.58	4.37	4	125.00	0.502	0.502	0.000	1.411	5.43	7.66	0.844	20.89	36.9226	35.46
8.366	449.434	20.62	0.75	3.62	74.41	38.4356	3.732	2.62	37.54	3.82	4	125.00	0.523	0.523	0.000	1.383	5.19	7.18	0.622	20.15	36.1207	34.99
8.694	449.106	21.71	0.73	3.35	81.34	38.954	3.449	2.59	38.03	3.53	5	125.00	0.543	0.543	0.000	1.357	5.39	7.31	0.655	21.21	34.7719	35.07
9.022	448.778	22.26	0.62	2.79	96.35	36.4768	2.858	2.54	37.41	2.94	5	125.00	0.564	0.564	0.000	1.332	5.37	7.16	0.672	21.66	32.4751	34.97
9.35	448.450	20.7	0.61	2.93	91.74	34.7004	3.032	2.59	33.70	3.12	5	135.00	0.584	0.580	0.005	1.313	5.12	6.73	0.623	20.12	34.9106	34.33
9.678	448.122	20.96	0.7	3.35	82.7	34.4041	3.419	2.68	33.53	3.53	5	135.00	0.607	0.592	0.015	1.300	5.30	6.89	0.630	20.44	36.7405	34.30
10.006	447.794	23.37	0.86	3.67	95.38	37.6819	3.782	2.63	36.70	3.86	5	135.00	0.629	0.604	0.025	1.287	5.90	7.60	0.704	22.78	36.7081	34.86
10.335	447.465	23.21	0.93	4.02	86.47	36.6547	4.122	2.66	35.79	4.22	4	135.00	0.651	0.615	0.035	1.275	5.98	7.62	0.698	22.68	38.3828	34.71
10.663	447.137	22.31	0.82	3.68	48.55	34.4891	3.790	2.65	34.01	3.84	4	135.00	0.673	0.627	0.046	1.263	5.77	7.28	0.670	22.01	37.7717	34.40
10.991	446.809	21.94	0.83	3.79	50.34	33.2333	3.907	2.67	32.73	3.97	4	135.00	0.695	0.639	0.056	1.251	5.73	7.16	0.658	21.62	38.8777	34.17
11.319	446.481	23.94	0.89	3.73	69.05	35.6631	3.832	2.64	35.00	3.90	5	135.00	0.717	0.651	0.066	1.239	6.15	7.62	0.719	23.51	37.5487	34.58
11.647	446.153	31.58	1.47	4.66	33.07	46.451	4.773	2.62	46.13	4.81	4	135.00	0.739	0.663	0.076	1.228	8.10	9.96	0.954	31.33	36.4723	36.24
11.975	445.825	52.03	1.94	3.73	5.47	75.9652	3.784	2.40	75.91	3.79	5	135.00	0.762	0.675	0.087	1.217	12.09	14.71	1.587	52	26.4167	39.05
12.303	445.497	68.4	2.67	3.91	-22.86	98.4385	3.949	2.34	98.66	3.94	5	135.00	0.784	0.687	0.097	1.207	15.51	18.71	2.093	68.56	24.0213	40.50
12.631	445.169	53.25	3.19	6	-25.04	75.0494	6.083	2.56	75.26	6.07	3	135.00	0.806	0.699	0.107	1.196	13.38	16.01	1.624	53.4	33.4083	39.04
12.959	444.841	50.44	2.84	5.63	-25.2	69.8071	5.724	2.56	70.05	5.71	3	135.00	0.828	0.711	0.117	1.186	12.67	15.03	1.536	50.6	33.3638	38.64
13.287	444.513	31.23	2.43	7.77	-27.34	42.042	7.999	2.81	42.26	7.96	3	135.00	0.850	0.723	0.128	1.176	8.97	10.55	0.941	31.4	46.5809	35.73
13.615	444.185	36.66	2.18	5.95	-26.55	48.723	6.091	2.68	48.94	6.06	3	135.00	0.872	0.735	0.138	1.167	9.60	11.44	1.108	36.82	39.3635	36.60
13.943	443.857	56.53	3.08	5.44	-25.93	74.5965	5.536	2.53	74.75	5.52	3	135.00	0.894	0.746	0.148	1.157	14.00	16.20	1.722	56.69	32.013	39.00
14.271	443.529	129.14	5.32	4.12	-25.68	169.087	4.149	2.22	169.30	4.14	11	135.00	0.917	0.758	0.158	1.148	27.75	31.86	3.970	129.3	19.5836	43.26
14.6	443.200	241.69	8.13	3.37	-25.73	312.654	3.377	2.00	312.78	3.37	12	135.00	0.939	0.770	0.168	1.139	47.59	54.23	7.454	241.85	12.9931	46.12
14.928	442.872	231.67	8.83	3.81	-25.66	294.958	3.827	2.06	296.16	3.82	12	135.00	0.961	0.782	0.179	1.131	46.69	52.80	7.143	231.83	14.6671	45.86
15.256	442.544	258.79	8.96	3.46	-26.07	324.647	3.472	2.05	324.86	3.47	12	135.00	0.983	0.794	0.189	1.122	51.01	57.24	7.981	258.94	13.0637	46.29

R14560

Depth (ft)	Sa	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.W (pcf)	...ss ...f)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	442.216	285.8	8.43	2.95	-26.3	363.348	2.950	1.93	353.55	2.95	12	135.00	1.005	0.806	0.199	1.114	54.68	60.90	9.817	285.98	11.0253	46.66
15.912	441.888	277.04	7.22	2.61	-28.01	337.467	2.616	1.89	337.67	2.61	7	135.00	1.007	0.816	0.209	1.105	52.28	57.81	8.545	277.21	10.1227	46.46
16.24	441.560	219.73	6.99	3.18	-28.89	263.533	3.196	2.02	263.75	3.19	12	135.00	1.049	0.830	0.220	1.098	43.55	47.81	6.770	219.91	13.4471	45.36

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 34 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY TJS DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-8

ConeTec Inc. Interpretation
Interpretation Ou ase 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4303
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-8
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 09:53
CPT File: 804CP08.COR
Northing (ft): 0.000000
Easting (ft) 0.000000
Elevation (ft): 445

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.90	1.70	55.34	26.74	2.35

User Inputs:

Assumed: Water Table Depth (ft): 6.6
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 445.0
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	444.836	17.37	0.13	0.75	0.35	1693.63	0.749	1.12	1693.65	0.75	6	125.00	0.010	0.010	0.000	2.000	2.85	5.11	0.537	17.37	-1.1659	52.71
0.492	444.508	21.17	0.35	1.66	-1.57	687.455	1.656	1.57	687.78	1.65	6	125.00	0.031	0.031	0.000	2.000	3.58	7.15	0.654	21.18	3.90719	49.41
0.82	444.180	31.35	0.66	2.09	-3.09	610.707	2.109	1.69	611.10	2.11	6	125.00	0.051	0.051	0.000	2.000	5.61	11.02	0.969	31.37	5.90214	48.94
1.148	443.852	43.85	0.95	2.17	-1.25	610.15	2.170	1.70	610.29	2.17	6	125.00	0.072	0.072	0.000	2.000	7.73	15.47	1.356	43.86	6.12164	48.94
1.476	443.524	44.4	1.46	3.29	-0.37	480.301	3.295	1.91	480.30	3.30	5	125.00	0.092	0.092	0.000	2.000	8.43	16.87	1.372	44.4	10.5956	47.96
1.804	443.196	47.24	1.66	3.51	0.21	417.98	3.522	1.96	417.98	3.52	5	125.00	0.113	0.113	0.000	2.000	9.15	18.30	1.459	47.24	11.8951	47.36
2.133	442.867	63.62	1.74	2.74	-0.23	476.225	2.741	1.84	476.22	2.74	6	125.00	0.133	0.133	0.000	2.000	11.78	23.55	1.966	63.62	6.93891	47.93
2.461	442.539	81.01	2.67	3.29	1.8	525.68	3.302	1.89	525.62	3.30	6	125.00	0.154	0.154	0.000	2.000	15.30	30.60	2.503	81	10.2349	48.39
2.789	442.211	87.64	3.13	3.57	-0.02	501.775	3.579	1.93	501.78	3.58	6	125.00	0.174	0.174	0.000	2.000	16.80	33.61	2.706	87.64	11.2144	48.14
3.117	441.883	72.36	2.94	4.06	0.61	370.434	4.074	2.04	370.38	4.07	5	125.00	0.195	0.195	0.000	2.000	14.45	28.90	2.234	72.35	14.0568	46.86
3.445	441.555	54.96	2.44	4.43	7.57	254.257	4.457	2.15	254.02	4.46	5	125.00	0.215	0.215	0.000	2.000	11.47	22.93	1.695	54.91	17.4107	45.18
3.773	441.227	45.6	1.94	4.26	13.4	192.374	4.277	2.20	192.03	4.28	5	125.00	0.236	0.236	0.000	2.000	9.70	19.39	1.404	45.52	18.9745	43.86
4.101	440.899	47.91	1.89	3.94	10.16	185.92	3.966	2.16	185.69	3.97	5	125.00	0.256	0.256	0.000	1.975	10.11	19.97	1.475	47.85	18.3226	43.70
4.429	440.571	55.66	1.91	3.43	18.45	200.075	3.449	2.11	199.64	3.46	5	125.00	0.277	0.277	0.000	1.901	11.41	21.70	1.715	55.54	16.1775	44.05
4.757	440.243	51.39	1.71	3.33	24.18	171.848	3.347	2.14	171.31	3.36	6	125.00	0.297	0.297	0.000	1.834	10.65	19.52	1.592	51.23	17.0225	43.31
5.085	439.915	45.68	1.53	3.36	21.34	142.733	3.373	2.19	142.32	3.38	5	125.00	0.318	0.318	0.000	1.774	9.66	17.14	1.404	45.65	18.6417	42.39
5.413	439.587	37.97	1.4	3.7	20.18	111.234	3.720	2.29	110.88	3.73	5	125.00	0.338	0.338	0.000	1.719	8.38	14.40	1.165	37.95	22.1372	41.11
5.741	439.259	32.73	1.25	3.83	18.96	90.2176	3.861	2.36	89.86	3.88	5	125.00	0.359	0.359	0.000	1.669	7.44	12.43	1.002	32.61	24.8088	40.00
6.069	438.931	32.51	1.3	3.99	14.67	84.7077	4.046	2.39	84.47	4.06	5	125.00	0.379	0.379	0.000	1.624	7.51	12.19	0.995	32.42	26.1077	39.66
6.398	438.602	30.81	1.37	4.44	8.27	76.0491	4.505	2.46	75.92	4.51	4	125.00	0.400	0.400	0.000	1.581	7.54	11.61	0.941	30.78	28.8283	39.08
6.726	438.274	30.16	1.35	4.47	11.29	71.4133	4.539	2.48	71.25	4.55	4	135.00	0.420	0.416	0.004	1.550	7.25	11.24	0.921	30.09	29.7266	38.72
7.054	437.946	30.78	1.3	4.22	12.22	70.820	4.285	2.46	70.64	4.30	4	135.00	0.443	0.428	0.014	1.528	7.39	11.22	0.939	30.7	29.0142	38.68
7.382	437.618	28.58	1.25	4.38	14.3	63.8613	4.446	2.50	63.66	4.46	4	135.00	0.465	0.440	0.024	1.507	6.95	10.48	0.870	28.49	30.8671	38.09
7.71	437.290	25.37	1.1	4.35	16	56.0315	4.421	2.55	54.81	4.44	4	135.00	0.487	0.452	0.035	1.487	6.29	9.36	0.770	25.27	32.7937	37.24
8.038	436.962	23.17	1.04	4.48	16.81	49.8312	4.569	2.59	48.59	4.61	4	135.00	0.509	0.464	0.045	1.468	5.86	8.63	0.702	23.06	35.0715	36.54
8.366	436.634	21.72	0.99	4.55	15.7	44.5168	4.672	2.63	44.31	4.69	3	135.00	0.531	0.476	0.055	1.449	5.60	8.12	0.656	21.62	36.7119	36.00
8.694	436.306	22.5	0.76	3.39	17	44.9838	3.463	2.53	44.76	3.48	5	135.00	0.553	0.488	0.065	1.432	5.54	7.93	0.672	22.38	32.1478	36.06
9.022	435.978	20.87	0.66	3.17	17.39	40.6065	3.252	2.55	40.41	3.27	5	135.00	0.575	0.500	0.076	1.415	5.17	7.31	0.628	20.77	32.7885	35.46
9.35	435.650	20.28	0.77	3.78	19.44	38.4659	3.912	2.62	38.23	3.94	4	135.00	0.597	0.512	0.086	1.398	5.20	7.27	0.609	20.16	35.2763	35.13
9.678	435.322	22.23	1.07	4.83	14.64	41.2726	4.951	2.67	41.08	4.97	3	135.00	0.620	0.524	0.096	1.382	5.85	8.10	0.669	22.13	38.7923	35.56
10.006	434.994	27.84	1.15	4.14	14.22	50.7896	4.226	2.56	50.62	4.24	4	135.00	0.642	0.536	0.106	1.367	6.94	9.48	0.842	27.75	33.2318	36.79
10.335	434.665	30.49	1.3	4.26	-2.51	54.4817	4.359	2.54	54.50	4.36	4	135.00	0.664	0.547	0.117	1.352	7.58	10.24	0.923	30.5	32.5983	37.22
10.663	434.337	20.58	1.04	5.04	-8.43	35.5656	5.228	2.73	35.67	5.21	3	135.00	0.686	0.559	0.127	1.337	5.63	7.53	0.616	20.64	41.8344	34.72
10.991	434.009	21.84	0.79	3.66	-8.2	36.6411	3.774	2.62	36.73	3.77	4	135.00	0.708	0.571	0.137	1.323	5.60	7.40	0.648	21.69	36.2422	34.90
11.319	433.681	18.91	0.92	4.85	-4.76	31.1738	5.061	2.76	31.25	5.05	3	135.00	0.730	0.583	0.147	1.309	5.26	6.88	0.563	18.94	43.5695	33.91
11.647	433.353	17	0.91	5.34	-3.97	27.3032	5.601	2.83	27.35	5.59	3	135.00	0.753	0.595	0.157	1.296	4.92	6.37	0.503	17.03	47.693	33.09
11.975	433.025	20.2	1.09	5.41	-3.4	32.0031	5.611	2.78	32.04	5.61	3	135.00	0.775	0.607	0.168	1.284	5.58	7.30	0.601	20.22	44.908	34.07
12.303	432.697	23.77	1.16	4.87	-3.74	37.12	5.049	2.70	37.15	5.04	3	135.00	0.797	0.619	0.178	1.271	6.41	8.15	0.711	23.79	40.6258	34.97
12.631	432.369	23.53	1.14	4.86	-2.66	36.0038	5.020	2.71	36.02	5.02	3	135.00	0.819	0.631	0.188	1.259	6.37	8.02	0.703	23.54	41.0417	34.79
12.959	432.041	26.86	1.03	3.99	-1.59	38.9277	4.117	2.63	38.94	4.12	4	135.00	0.841	0.643	0.198	1.247	6.70	8.36	0.775	25.87	36.859	35.26
13.287	431.713	28.74	1.22	4.25	4.68	42.5954	4.376	2.62	42.54	4.38	4	135.00	0.863	0.655	0.209	1.236	7.41	9.15	0.863	28.71	35.2562	35.79
13.615	431.385	23.7	0.95	4.02	4.89	34.2297	4.164	2.67	34.16	4.17	4	135.00	0.885	0.667	0.219	1.225	6.27	7.69	0.706	23.67	38.9352	34.48
13.943	431.057	21.82	0.56	2.56	10.93	30.8252	2.678	2.58	30.72	2.69	5	135.00	0.908	0.678	0.229	1.214	5.50	6.68	0.647	21.75	34.3343	33.85
14.271	430.729	17.59	0.45	2.54	19.05	24.134	2.701	2.67	23.98	2.72	5	135.00	0.930	0.690	0.239	1.204	4.62	5.56	0.516	17.47	38.6783	32.28
14.6	430.400	15.35	0.32	2.09	24.25	20.5023	2.223	2.67	20.29	2.25	5	135.00	0.952	0.702	0.250	1.193	4.03	4.81	0.446	15.2	39.0527	31.24
14.928	430.072	13.48	0.21	1.52	31.31	17.5111	1.679	2.66	17.25	1.71	6	135.00	0.974	0.714	0.260	1.183	3.51	4.15	0.387	13.29	38.5544	30.20
15.256	429.744	13.47	0.25	1.82	40.37	17.1797	2.004	2.72	16.84	2.05	6	135.00	0.996	0.726	0.270	1.174	3.50	4.21	0.386	13.22	41.3202	30.05

Depth (ft)	San	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.WL. (pcf)	ss)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
16.584	429.416	16.28	0.5	2.74	47	23.3932	2.897	2.70	22.96	2.95	5	135.00	1.018	0.735	0.280	1.164	4.84	5.64	0.534	17.96	40.5576	32.03
15.912	429.088	44.7	2.02	4.53	28.04	58.2209	4.527	2.54	57.98	4.65	4	135.00	1.040	0.750	0.291	1.156	11.07	12.79	1.352	44.62	32.7068	37.60
16.24	428.760	126.44	5.34	4.22	-16.4	164.56	4.259	2.23	164.72	4.26	11	135.00	1.063	0.762	0.301	1.146	27.34	31.33	3.982	126.55	20.1417	43.13
16.568	428.432	213.9	10.81	5.05	-15.7	275.059	5.080	2.18	275.19	5.08	11	136.00	1.085	0.774	0.311	1.137	45.29	51.49	6.589	214	18.4606	45.55
16.896	428.104	378.55	14.03	3.71	-15.73	480.355	3.717	1.96	480.48	3.72	12	137.00	1.107	0.786	0.321	1.128	73.23	82.61	11.686	378.66	11.787	47.97
17.224	427.776	341.19	15.02	4.4	-15.91	426.134	4.417	2.06	426.26	4.42	12	138.00	1.129	0.799	0.331	1.119	66.32	76.47	10.528	341.29	14.213d	47.46
17.552	427.448	312.91	15.43	4.93	-12.1	384.691	4.949	2.11	384.79	4.95	11	139.00	1.152	0.810	0.342	1.111	64.25	71.37	9.652	312.99	16.0829	47.05

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 37 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-9

ConeTec Inc. Interpretation
Interpretation C lease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4276
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-9
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 09:17
CPT File: 804CP09.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 445.7

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	39.25	1.38	45.19	28.05	2.40

User Inputs:

Assumed:
Water Table Depth (ft): 7.8
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 445.7
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	445.536	15.38	0.2	1.27	-2.59	1499.49	1.301	1.37	1501.43	1.30	6	125.00	0.010	0.010	0.000	2.000	2.43	4.87	0.476	15.4	1.11893	52.29
0.492	445.208	19.82	0.38	1.92	-12.81	643.553	1.920	1.64	646.15	1.91	6	125.00	0.031	0.031	0.000	2.000	3.44	6.98	0.613	19.9	5.03728	49.17
0.82	444.880	30.1	0.63	2.1	-9.01	588.317	2.097	1.69	587.29	2.09	6	125.00	0.051	0.051	0.000	2.000	5.30	10.61	0.930	30.15	5.98332	46.78
1.148	444.552	43.87	0.91	2.07	-3.21	810.429	2.078	1.65	810.71	2.08	6	125.00	0.072	0.072	0.000	2.000	7.69	15.39	1.356	43.89	5.7973	46.84
1.476	444.224	47.66	1.19	2.49	0.07	515.64	2.502	1.79	515.64	2.50	6	125.00	0.092	0.092	0.000	2.000	8.66	17.33	1.473	47.66	7.8425	48.25
1.804	443.896	45.87	1.66	3.62	0.07	405.629	3.628	1.96	405.83	3.63	5	125.00	0.113	0.113	0.000	2.000	9.94	17.89	1.417	45.87	12.3418	47.25
2.133	443.567	41.72	1.66	3.98	0.25	311.949	3.992	2.07	311.95	3.99	5	125.00	0.133	0.133	0.000	2.000	8.42	16.84	1.288	41.72	14.8063	46.11
2.461	443.239	37.44	1.52	4.06	0.39	242.413	4.077	2.13	242.41	4.08	5	125.00	0.154	0.154	0.000	2.000	7.74	15.49	1.154	37.44	16.6663	44.96
2.789	442.911	44.47	1.87	4.2	0.86	254.117	4.222	2.13	254.06	4.22	5	125.00	0.174	0.174	0.000	2.000	9.21	18.41	1.371	44.46	16.7567	45.18
3.117	442.583	59.57	2.65	4.44	0.23	304.781	4.463	2.11	304.78	4.46	5	125.00	0.195	0.195	0.000	2.000	12.25	24.50	1.838	59.57	16.2268	46.00
3.446	442.255	70.47	2.79	3.95	1.85	326.292	3.971	2.06	326.25	3.97	5	125.00	0.215	0.215	0.000	2.000	14.16	28.31	2.175	70.46	14.467	46.30
3.773	441.927	74.67	2.46	3.29	-0.62	315.65	3.305	1.99	315.69	3.30	6	125.00	0.236	0.236	0.000	2.000	14.64	29.28	2.304	74.68	12.725	46.16
4.101	441.599	84.53	2.85	3.37	1.85	328.793	3.382	1.99	328.75	3.38	6	125.00	0.256	0.256	0.000	1.975	16.57	32.73	2.609	84.52	12.7342	46.34
4.429	441.271	104.33	3.86	3.72	1.8	375.898	3.729	2.00	375.86	3.73	6	125.00	0.277	0.277	0.000	1.901	20.54	39.03	3.221	104.32	13.0225	46.92
4.757	440.943	96.44	3.96	4.11	2.45	323.373	4.119	2.07	323.34	4.12	5	125.00	0.297	0.297	0.000	1.834	19.50	35.76	2.977	96.43	14.9462	46.26
5.085	440.615	102.25	4.19	4.1	0.62	320.731	4.111	2.07	320.70	4.11	5	125.00	0.318	0.318	0.000	1.774	20.68	36.68	3.156	102.24	14.9718	46.23
5.413	440.287	98.2	4.51	4.59	1.13	289.264	4.609	2.14	289.23	4.61	11	125.00	0.338	0.338	0.000	1.719	20.38	35.04	3.030	98.19	16.9403	45.77
5.741	439.959	94.73	4.11	4.34	4.32	263.01	4.355	2.14	262.93	4.36	11	125.00	0.359	0.359	0.000	1.669	19.66	32.80	2.922	94.7	16.894	45.33
6.069	439.631	84.93	3.46	4.08	5.01	222.905	4.092	2.15	222.83	4.09	5	125.00	0.379	0.379	0.000	1.624	17.71	28.75	2.618	84.9	17.3092	44.57
6.398	439.302	87.66	3.56	4.07	-2.24	218.219	4.080	2.15	218.24	4.08	5	125.00	0.400	0.400	0.000	1.581	18.31	28.96	2.702	87.67	17.4182	44.47
6.726	438.974	69.12	3.37	4.87	4.89	163.425	4.905	2.29	163.35	4.91	11	125.00	0.420	0.420	0.000	1.542	15.27	23.56	2.127	69.09	22.0488	43.08
7.054	438.646	63.77	3.03	4.76	3.08	143.644	4.785	2.31	143.60	4.79	3	125.00	0.441	0.441	0.000	1.506	14.22	21.43	1.961	63.75	22.8724	42.43
7.382	438.318	53.39	2.77	5.19	7.53	114.719	5.233	2.40	114.61	5.24	3	125.00	0.461	0.461	0.000	1.472	12.39	18.24	1.639	53.34	26.3327	41.28
7.71	437.990	48.17	2.41	4.99	4.9	98.9637	5.054	2.42	98.90	5.06	3	125.00	0.482	0.482	0.000	1.441	11.31	16.30	1.476	48.14	27.4055	40.51
8.038	437.662	38.46	1.96	5.15	10.26	76.6899	5.216	2.50	76.55	5.23	3	135.00	0.502	0.495	0.007	1.421	9.37	13.31	1.175	38.39	30.8807	39.12
8.366	437.334	30.22	1.55	5.12	11.57	58.5876	5.220	2.58	58.45	5.23	3	135.00	0.526	0.507	0.018	1.405	7.69	10.72	0.919	30.15	34.4169	37.61
8.694	437.006	28.4	1.39	4.89	12.03	53.6919	4.990	2.59	53.56	5.00	3	135.00	0.547	0.519	0.028	1.388	7.21	10.01	0.862	28.33	34.9372	37.11
9.022	436.678	29.4	1.32	4.5	11.46	54.33	4.578	2.56	54.20	4.59	4	135.00	0.569	0.531	0.038	1.373	7.36	10.09	0.893	29.33	33.449	37.18
9.35	436.350	28.31	1.17	4.14	11.87	51.066	4.221	2.55	50.94	4.23	4	135.00	0.591	0.543	0.048	1.358	7.05	9.57	0.868	28.23	33.1117	36.82
9.678	436.022	26.35	1.19	4.53	15.1	46.4162	4.624	2.61	46.24	4.64	4	135.00	0.613	0.554	0.059	1.343	6.75	9.06	0.797	26.25	35.9001	36.25
10.006	436.694	25.07	1.15	4.6	14.56	43.1414	4.706	2.64	42.98	4.72	3	135.00	0.635	0.566	0.069	1.329	6.51	8.85	0.756	24.98	37.2699	35.82
10.335	435.365	25.89	1.24	4.78	13.4	43.63	4.914	2.65	43.49	4.93	3	135.00	0.657	0.578	0.079	1.315	6.76	8.89	0.781	25.81	37.7669	35.89
10.663	435.037	22.8	1.2	5.28	9.91	37.4772	5.425	2.72	37.38	5.44	3	135.00	0.680	0.590	0.089	1.302	6.20	8.07	0.685	22.74	41.7646	34.99
10.991	434.709	27.92	1.16	4.22	10.86	45.2028	4.335	2.60	45.09	4.35	4	135.00	0.702	0.602	0.100	1.289	7.11	9.17	0.843	27.85	35.267	36.11
11.319	434.381	29.42	1.45	4.92	10.88	46.7326	5.053	2.64	46.62	5.07	3	135.00	0.724	0.614	0.110	1.276	7.64	9.75	0.988	29.35	37.1499	36.31
11.647	434.053	26.23	1.41	5.39	11.38	40.7121	5.533	2.71	40.60	5.55	3	135.00	0.746	0.626	0.120	1.264	7.06	8.93	0.789	26.16	40.7787	35.49
11.975	433.725	23.16	0.99	4.29	10.95	35.1046	4.421	2.68	34.99	4.44	4	135.00	0.768	0.638	0.130	1.252	6.16	7.71	0.693	23.09	39.5208	34.60
12.303	433.397	20.42	0.52	2.55	11.83	30.2103	2.649	2.68	30.10	2.66	5	135.00	0.790	0.650	0.140	1.241	5.16	6.40	0.608	20.35	34.5204	33.68
12.631	433.069	16.58	0.49	2.64	14.43	26.8524	2.758	2.63	26.72	2.77	5	135.00	0.812	0.662	0.151	1.229	4.81	5.91	0.560	18.49	37.0571	32.94
12.959	432.741	22.2	0.51	2.28	45.47	31.7192	2.387	2.54	31.29	2.42	6	135.00	0.835	0.674	0.161	1.218	5.46	6.64	0.661	21.91	32.6826	33.92
13.287	432.413	18.14	0.35	1.91	50.26	25.2132	2.025	2.56	24.78	2.06	6	135.00	0.857	0.686	0.171	1.208	4.52	5.45	0.535	17.82	34.4848	32.46
13.615	432.085	15.81	0.26	1.65	56.56	21.4099	1.741	2.60	20.91	1.78	6	135.00	0.879	0.697	0.181	1.197	3.96	4.74	0.462	15.46	36.5971	31.40
13.943	431.757	12.95	0.21	1.59	52.01	16.9872	1.743	2.69	16.52	1.79	5	135.00	0.901	0.709	0.192	1.187	3.38	4.01	0.373	12.62	39.9818	29.89
14.271	431.429	11.94	0.19	1.55	59.86	15.2756	1.725	2.73	14.75	1.79	5	135.00	0.923	0.721	0.202	1.178	3.16	3.73	0.341	11.56	42.1627	29.15
14.6	431.100	12.25	0.19	1.51	66.28	15.433	1.679	2.72	14.87	1.74	5	135.00	0.945	0.733	0.212	1.168	3.23	3.77	0.350	11.85	41.679	29.21
14.928	430.772	11.19	0.19	1.7	73.44	13.7205	1.859	2.80	13.10	1.95	5	135.00	0.967	0.745	0.222	1.159	3.04	3.52	0.316	10.73	45.7108	28.39
15.256	430.444	15.59	0.3	1.9	87.39	19.2881	2.055	2.69	18.56	2.11	5	135.00	0.989	0.757	0.231	1.149	4.03	4.62	0.452	15.04	40.05	30.65

R14566

Depth (ft)	Sar	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt (pcf)	...ss ...sf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	430.116	23.74	0.44	1.84	87.72	29.5606	1.936	2.52	28.85	1.98	6	135.00	1.012	0.788	0.243	1.130	5.70	6.50	0.704	23.19	31.6153	35.43
15.912	429.788	29.33	0.86	2.69	108.61	36.2411	3.004	2.57	35.37	3.06	5	135.00	1.034	0.761	0.253	1.102	7.22	8.17	0.876	28.65	33.9566	34.68
16.568	429.132	56.19	2.18	3.88	102.93	68.4989	3.956	2.45	67.69	4.00	5	136.00	1.078	0.805	0.274	1.115	9.55	10.73	1.166	38.08	33.507	36.34
16.896	428.804	60.78	3.03	4.98	65.61	73.0777	5.077	2.51	72.58	5.11	11	137.00	1.100	0.817	0.284	1.107	14.78	16.36	1.548	60.37	31.2128	36.85
17.224	428.476	50.94	2.78	5.46	60.44	60.1007	5.580	2.60	59.64	5.62	3	138.00	1.123	0.829	0.294	1.098	12.92	14.19	1.542	50.56	35.2823	37.75
17.88	427.820	39.51	1.86	4.71	-0.56	44.9042	4.851	2.63	44.90	4.85	4	140.00	1.168	0.854	0.314	1.082	10.27	11.12	1.187	39.51	37.026	36.11
18.208	427.492	41.11	1.74	4.23	0.62	46.0646	4.359	2.58	46.06	4.36	4	141.00	1.191	0.867	0.325	1.074	10.47	11.25	1.236	41.11	34.9935	36.27
18.865	426.835	45.7	1.83	4	4.37	49.814	4.116	2.55	49.79	4.12	5	143.00	1.236	0.893	0.345	1.058	11.40	12.07	1.377	45.68	33.0275	36.72
19.193	426.507	43.86	2.11	4.81	4.87	47.0298	4.953	2.63	47.00	4.96	4	144.00	1.261	0.906	0.355	1.051	11.36	11.93	1.319	43.83	36.6851	36.38
19.849	425.851	49.37	2.52	5.1	12.88	51.5286	5.243	2.62	51.43	5.25	3	146.00	1.309	0.933	0.376	1.035	12.72	13.17	1.488	49.28	36.286	36.91
20.177	425.523	60.48	3.37	5.58	-1.34	62.5064	5.697	2.59	62.52	5.70	11	147.00	1.333	0.946	0.386	1.028	15.39	15.82	1.831	60.5	34.8428	38.02
20.833	424.867	74.98	3.23	4.31	-7.5	75.5377	4.289	2.46	75.59	4.30	5	149.00	1.381	0.974	0.407	1.013	17.84	18.07	2.279	75.03	28.4777	39.08
21.161	424.539	51.59	2	3.88	4.69	50.7665	3.965	2.53	50.80	3.98	5	150.00	1.405	0.989	0.417	1.006	12.78	12.85	1.554	51.62	32.2646	36.84
21.489	424.211	88.98	4.5	5.06	-4.98	87.2965	5.140	2.46	87.34	5.14	11	151.00	1.429	1.003	0.427	0.999	21.30	21.27	2.711	99.02	29.0451	39.87

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 40 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-10

ConeTec Inc. erpretation
Interpretation (elease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4243
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-10
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 08:35
CPT File: 804CP10.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 442.1

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.49	1.77	67.98	26.87	2.36

User Inputs:

Assumed: Water Table Depth (ft): 3.4
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 442.1
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	441.936	22.84	0.17	0.76	0.53	2227.29	0.745	1.10	2227.29	0.74	7	125.00	0.010	0.010	0.000	2.000	3.34	6.67	0.707	22.84	1.3253	53.62
0.492	441.608	28.68	0.4	1.4	-1.45	931.683	1.396	1.45	931.66	1.40	6	125.00	0.031	0.031	0.000	2.000	4.66	9.32	0.887	28.68	2.20669	50.57
0.82	441.280	30.14	0.52	1.73	-6.33	587.098	1.728	1.62	587.86	1.73	6	125.00	0.051	0.051	0.000	2.000	5.17	10.35	0.932	30.18	4.63942	48.79
1.148	440.952	41.06	0.62	1.5	-7.39	571.265	1.513	1.57	571.96	1.51	7	125.00	0.072	0.072	0.000	2.000	6.94	13.88	1.269	41.11	3.86432	48.98
1.476	440.624	62.23	0.9	1.44	-3.79	673.58	1.448	1.52	673.91	1.45	7	125.00	0.092	0.092	0.000	2.000	10.34	20.68	1.924	62.26	3.15878	49.33
1.804	440.296	70.49	1.29	1.83	-0.76	624.188	1.833	1.63	624.28	1.83	7	125.00	0.113	0.113	0.000	2.000	12.13	24.27	2.179	70.5	4.85185	49.03
2.461	439.639	64.76	1.42	2.19	-1.66	420.032	2.198	1.78	420.10	2.20	7	125.00	0.154	0.154	0.000	2.000	11.73	23.46	2.000	64.77	7.63043	47.40
2.789	439.311	67.64	1.58	2.34	-1.64	387.039	2.342	1.82	387.10	2.34	6	125.00	0.174	0.174	0.000	2.000	12.43	24.87	2.089	67.65	8.50804	47.05
3.117	438.983	62.08	1.55	2.49	-2.26	317.665	2.505	1.89	317.77	2.50	6	125.00	0.195	0.195	0.000	2.000	11.70	23.40	1.916	62.1	10.0559	46.19
3.445	438.655	61.6	1.76	2.86	-2.61	286.967	2.867	1.96	287.01	2.87	6	125.00	0.215	0.214	0.001	2.000	11.93	23.86	1.900	61.61	11.8665	45.73
3.773	438.327	49.6	1.64	3.29	-3.46	221.096	3.309	2.07	221.23	3.31	6	125.00	0.236	0.224	0.012	2.000	10.06	20.15	1.534	49.83	14.9852	44.54
4.101	437.999	35.16	1.26	3.59	-0.53	148.88	3.610	2.20	148.92	3.61	5	125.00	0.256	0.234	0.022	2.000	7.49	14.99	1.081	35.17	19.0045	42.62
4.429	437.671	23.8	0.94	3.96	5.47	96.1277	3.996	2.35	95.96	4.00	4	125.00	0.277	0.245	0.032	2.000	5.41	10.81	0.728	23.76	24.5219	40.35
4.757	437.343	20.99	0.83	3.94	15.36	81.156	4.011	2.40	80.76	4.03	4	125.00	0.297	0.255	0.042	1.980	4.86	9.63	0.641	20.89	26.5321	39.43
5.085	437.015	23.58	0.9	3.8	17.32	87.7022	3.869	2.37	87.29	3.89	4	125.00	0.318	0.265	0.053	1.942	5.38	10.45	0.720	23.47	25.1707	39.85
5.413	436.687	26.07	1.08	4.15	16.35	93.3976	4.197	2.38	93.03	4.21	4	125.00	0.338	0.276	0.063	1.905	5.98	11.39	0.797	25.97	25.5391	40.19
5.741	436.359	28	1.26	4.46	13.72	96.7242	4.522	2.39	96.44	4.54	4	125.00	0.359	0.286	0.073	1.871	6.47	12.10	0.856	27.92	26.1485	40.39
6.069	436.031	27.78	1.26	4.55	13.97	92.5575	4.598	2.41	92.25	4.61	4	125.00	0.379	0.296	0.083	1.838	6.47	11.89	0.848	27.69	26.8768	40.15
6.398	435.702	23.67	0.97	4.09	20.98	75.9624	4.166	2.43	75.84	4.19	4	125.00	0.400	0.306	0.094	1.807	5.56	10.04	0.720	23.54	27.8545	39.07
6.726	435.374	22.65	0.83	3.65	20.09	70.2128	3.734	2.42	69.80	3.76	5	125.00	0.420	0.317	0.104	1.777	5.29	9.40	0.688	22.52	27.3099	38.63
7.054	435.046	23.86	0.78	3.26	20.76	71.6466	3.331	2.38	71.25	3.35	5	125.00	0.441	0.327	0.114	1.749	5.46	9.56	0.725	23.73	25.568	38.75
7.382	434.718	19.8	0.64	3.24	24.65	57.3614	3.309	2.45	56.89	3.34	5	125.00	0.461	0.337	0.124	1.722	4.66	8.03	0.599	19.64	28.3064	37.49
7.71	434.390	17.31	0.59	3.42	30.58	48.4398	3.506	2.52	47.89	3.55	4	125.00	0.482	0.347	0.134	1.697	4.20	7.13	0.521	17.12	31.4473	36.49
8.038	434.062	18.65	0.73	3.9	29.81	50.7385	4.023	2.54	50.21	4.07	4	125.00	0.502	0.358	0.145	1.672	4.59	7.66	0.562	18.46	32.7232	36.77
8.366	433.734	15.11	0.63	4.15	30.69	39.4655	4.319	2.65	38.95	4.38	3	125.00	0.525	0.370	0.156	1.645	3.90	6.42	0.462	14.92	37.5988	35.28
8.694	433.406	14.94	0.58	3.89	35.5	37.7301	4.030	2.64	37.15	4.09	4	125.00	0.547	0.381	0.165	1.619	3.84	6.22	0.446	14.72	37.3103	35.00
9.022	433.078	15.71	0.65	4.15	39.67	38.4992	4.293	2.65	37.85	4.36	3	125.00	0.569	0.393	0.175	1.594	4.06	6.47	0.469	15.46	38.0083	35.11
9.35	432.750	20.24	0.82	4.06	39.19	48.4809	4.173	2.57	47.86	4.23	4	125.00	0.591	0.406	0.186	1.571	5.04	7.91	0.608	19.89	33.9763	36.50
9.678	432.422	21.26	1.1	5.19	18.66	49.4891	5.328	2.64	49.23	5.36	3	125.00	0.613	0.417	0.198	1.548	5.51	8.53	0.639	21.15	37.2394	35.66
10.006	432.094	21.52	1.14	5.29	14.2	48.6703	5.459	2.65	48.46	5.48	3	125.00	0.635	0.429	0.206	1.527	5.62	8.58	0.647	21.43	37.6499	35.57
10.335	431.765	22.36	1.16	5.2	0.19	49.2066	5.345	2.64	49.21	5.34	3	125.00	0.657	0.441	0.216	1.506	5.83	8.77	0.672	22.38	37.2112	35.66
10.663	431.437	18.99	1.06	5.57	-6.84	40.4242	5.789	2.72	40.53	5.77	3	125.00	0.680	0.453	0.227	1.486	5.18	7.69	0.567	19.04	41.4795	35.53
10.991	431.109	14.81	0.82	5.55	-7.21	30.3493	5.812	2.81	30.44	5.80	3	125.00	0.702	0.465	0.237	1.467	4.23	6.21	0.437	14.85	46.4001	33.80
11.319	430.781	15.17	0.79	5.19	-6.65	30.3001	5.469	2.79	30.38	5.45	3	125.00	0.724	0.477	0.247	1.448	4.29	6.22	0.447	15.21	45.3583	33.80
11.647	430.453	13.83	0.74	5.37	-6.98	26.7744	5.656	2.84	26.84	5.64	3	125.00	0.746	0.489	0.257	1.431	4.02	5.75	0.405	13.86	48.2129	33.04
11.975	430.125	11.53	0.58	4.82	-4.81	21.4987	5.204	2.88	21.56	5.19	3	125.00	0.769	0.501	0.268	1.413	3.44	4.88	0.333	11.56	50.9108	31.67
12.303	429.797	12.82	0.45	3.52	-3.23	23.4732	3.741	2.76	23.51	3.73	4	125.00	0.790	0.512	0.278	1.397	3.57	4.98	0.372	12.84	43.714	32.22
12.631	429.469	13.05	0.43	3.3	-2.06	23.3366	3.514	2.74	23.37	3.51	4	125.00	0.812	0.524	0.288	1.381	3.60	4.97	0.379	13.07	42.8475	32.18
12.959	429.141	13.03	0.41	3.16	-0.78	22.7399	3.362	2.74	22.74	3.36	4	125.00	0.835	0.535	0.298	1.366	3.58	4.90	0.378	13.03	42.7021	32.01
13.287	428.813	14.48	0.43	2.98	12.21	24.8506	3.156	2.70	24.70	3.17	5	125.00	0.857	0.546	0.308	1.351	3.87	5.23	0.422	14.4	40.3482	32.53
13.615	428.485	14.54	0.43	2.97	15.45	24.39	3.148	2.70	24.21	3.17	5	125.00	0.879	0.560	0.319	1.336	3.90	5.20	0.423	14.44	40.6879	32.41
13.943	428.157	13.29	0.47	3.56	20.09	21.6584	3.794	2.80	21.43	3.83	4	125.00	0.901	0.572	0.329	1.322	3.73	4.94	0.384	13.16	45.8728	31.65
14.271	427.829	16.42	0.51	3.08	25.66	26.5391	3.291	2.69	26.27	3.33	5	125.00	0.923	0.584	0.339	1.309	4.35	5.70	0.460	16.26	39.9534	32.91
14.6	427.500	19.35	0.75	3.86	19.79	30.8871	4.075	2.70	30.69	4.10	4	125.00	0.945	0.596	0.349	1.295	5.18	6.71	0.570	19.23	40.477	33.87
14.928	427.172	23.7	1.01	4.25	-5.33	37.4026	4.443	2.86	37.45	4.44	4	125.00	0.967	0.608	0.360	1.283	6.26	8.03	0.704	23.73	38.4335	35.07
15.256	426.844	26.27	0.82	3.11	-8.01	40.7957	3.244	2.54	40.88	3.24	5	125.00	0.988	0.620	0.370	1.270	6.53	8.30	0.783	26.32	32.4669	36.59

R14569

Depth (ft)	Sai	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	s	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	426.516	28.43	0.71	2.5	1.06	43.4116	2.590	2.45	43.40	2.59	6	145.00	1.013	0.632	0.380	1.258	6.77	8.52	0.849	28.42	28.7046	35.94
15.912	426.188	34.11	0.83	2.42	14.23	51.4007	2.509	2.39	51.26	2.52	6	135.00	1.034	0.643	0.390	1.247	7.88	9.82	1.024	34.02	28.1157	36.91
16.24	425.860	36.87	1.15	3.11	26.79	54.6443	3.211	2.45	54.38	3.23	5	135.00	1.056	0.656	0.401	1.236	8.72	10.78	1.109	36.7	28.4601	37.25
16.896	425.204	42.17	1.45	3.45	136.77	60.4516	3.531	2.46	59.17	3.61	5	137.00	1.100	0.679	0.421	1.213	9.86	11.86	1.272	41.3	28.8349	37.73
17.224	424.876	49.75	1.96	3.95	80.34	70.3096	4.031	2.45	69.59	4.07	5	136.00	1.123	0.692	0.431	1.202	11.71	14.08	1.505	49.25	28.4507	38.84
17.88	424.220	51.6	1.85	3.59	140.27	70.3788	3.668	2.42	69.15	3.73	5	139.00	1.146	0.704	0.442	1.192	11.00	13.11	1.437	46.89	27.2425	38.26
18.208	423.892	65.03	2.32	3.57	168.7	87.5341	3.634	2.36	86.09	3.69	5	141.00	1.191	0.729	0.462	1.171	14.58	17.07	1.976	63.98	27.3444	38.61
18.537	423.563	70.02	2.53	3.61	155.08	92.701	3.677	2.34	91.39	3.73	5	142.00	1.215	0.742	0.472	1.161	15.64	18.15	2.130	69.05	24.1286	40.12
18.865	423.235	65.59	2.53	3.86	43.83	85.2026	3.931	2.38	84.85	3.95	5	143.00	1.238	0.755	0.483	1.151	15.06	17.33	1.992	65.32	25.6929	39.72
19.193	422.907	55.6	2.73	4.9	4.71	70.7073	5.024	2.61	70.67	5.03	4	144.00	1.261	0.769	0.493	1.141	13.62	15.54	1.682	55.57	31.2954	39.73
19.521	422.579	110.1	2.81	2.56	-0.87	139.17	2.582	2.10	139.17	2.58	7	145.00	1.285	0.782	0.503	1.131	22.55	25.50	3.369	110.1	15.903	42.30
19.849	422.251	160.51	4.84	3.02	-18.41	200.145	3.040	2.06	200.30	3.04	7	146.00	1.309	0.795	0.513	1.121	32.40	36.33	4.929	160.63	14.7692	44.08
20.177	421.923	111.07	5.1	4.59	-23.58	135.622	4.647	2.31	136.79	4.64	11	147.00	1.333	0.809	0.523	1.112	24.86	27.63	3.397	111.21	22.9849	42.18
20.505	421.595	66.81	3.39	5.76	-23.83	69.8082	5.900	2.57	69.99	5.89	11	148.00	1.357	0.823	0.534	1.102	14.84	16.36	1.779	58.96	33.8626	38.67
20.833	421.267	53.52	2.16	4.03	-22.7	62.2987	4.143	2.48	62.46	4.13	5	148.00	1.381	0.837	0.544	1.093	12.97	14.18	1.614	53.66	30.0156	38.04
21.161	420.939	65.22	2.52	4.56	-21.43	63.2178	4.683	2.52	63.37	4.67	4	150.00	1.405	0.851	0.554	1.084	13.61	14.75	1.666	55.35	31.6051	38.12
21.489	420.611	99.33	2.92	2.94	-20.71	113.098	2.983	2.21	113.25	2.98	6	151.00	1.430	0.868	0.564	1.075	21.26	22.85	3.031	99.46	19.2589	41.25
21.817	420.283	112.37	3.22	2.86	-15.47	126.018	2.903	2.17	126.13	2.90	6	152.00	1.455	0.880	0.575	1.066	23.66	25.22	3.434	112.47	17.9771	41.80
22.145	419.955	57.05	2.85	4.99	-4.13	62.1002	5.129	2.56	62.13	5.13	4	153.00	1.480	0.895	0.586	1.057	14.28	15.10	1.720	57.08	33.269	38.01
22.473	419.627	49.22	2.02	4.1	-0.06	52.4512	4.233	2.54	52.45	4.23	5	154.00	1.505	0.910	0.595	1.048	12.24	12.84	1.477	49.22	32.7044	37.06
22.802	419.298	45.2	1.76	3.89	26.33	47.2222	4.030	2.56	47.04	4.05	5	155.00	1.530	0.925	0.605	1.040	11.30	11.75	1.352	45.03	33.5817	36.42
23.13	418.970	86.55	1.09	2.18	44.16	90.4233	2.224	2.18	90.13	2.23	7	155.00	1.556	0.940	0.616	1.031	18.23	18.81	2.631	86.27	18.3567	40.05
23.458	418.642	135.75	2.31	1.7	0.11	140.445	1.722	1.97	140.43	1.72	8	157.00	1.581	0.955	0.626	1.023	26.36	25.97	4.154	135.74	12.0719	42.35
23.786	418.314	80.31	2.82	3.51	-7.76	81.0692	3.583	2.36	81.12	3.58	6	158.00	1.607	0.971	0.636	1.015	18.37	18.64	2.437	80.36	24.9247	39.48
24.114	417.986	60.5	2.64	4.36	-3.63	59.6725	4.485	2.52	59.70	4.48	5	159.00	1.633	0.987	0.646	1.007	14.91	15.01	1.823	60.53	31.782	37.79
24.442	417.658	127.06	4.56	3.59	-4.92	125.108	3.636	2.25	125.14	3.64	6	160.00	1.658	1.002	0.657	0.999	27.63	27.60	3.862	127.09	20.6606	41.76
24.77	417.330	149.98	9.93	6.62	-11.87	145.622	6.696	2.43	145.70	6.69	11	161.00	1.685	1.018	0.667	0.991	35.31	34.99	4.591	150.06	27.5358	42.59
25.098	417.002	328.34	15.26	4.65	23.26	315.728	4.672	2.19	315.56	4.67	11	162.00	1.712	1.035	0.677	0.980	67.79	66.65	10.112	328.19	16.5598	46.17
25.426	416.674	419.75	19.4	4.62	18.11	397.781	4.641	2.08	397.68	4.64	11	163.00	1.738	1.051	0.687	0.976	85.07	82.99	12.942	419.64	15.1488	47.17
25.754	416.346	389.73	16.71	4.8	436.91	363.462	4.823	2.11	360.92	4.86	11	164.00	1.765	1.067	0.697	0.968	79.55	77.03	12.011	386.99	16.2214	46.75

RR4570

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 43 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-11

ConeTec Inc. Interpretation
Interpretation O ease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4215
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-11
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 10:31
CPT File: 804CP11.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 440.6

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.85	2.75	88.72	26.76	2.35

User Inputs:
Assumed: Water Table Depth (ft): 11.4
Nkc: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 440.6
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	440.436	28.5	0.22	0.76	0.16	2779.49	0.772	1.11	2778.51	0.77	7	125.00	0.010	0.010	0.000	2.000	4.17	8.34	0.882	28.49	1.2563	54.33
0.492	440.108	28.29	0.44	1.56	0.67	919	1.557	1.50	919.33	1.56	6	125.00	0.031	0.031	0.000	2.000	4.67	9.34	0.875	28.3	2.83968	50.52
0.82	439.780	20.17	0.54	2.66	-2.66	392.561	2.664	1.87	392.75	2.69	5	125.00	0.051	0.051	0.000	2.000	3.78	7.55	0.629	20.18	9.60794	47.11
1.148	439.452	19.6	0.52	2.63	-12.35	272.171	2.663	1.94	273.29	2.65	5	125.00	0.072	0.072	0.000	2.000	3.78	7.57	0.605	19.68	11.4161	45.61
1.476	439.124	28.99	0.42	1.43	-1.13	313.255	1.453	1.69	313.36	1.45	6	125.00	0.092	0.092	0.000	2.000	5.10	10.19	0.895	29	5.94772	46.13
1.804	438.796	38.06	0.46	1.25	-0.07	318.823	1.252	1.63	318.82	1.25	7	125.00	0.113	0.113	0.000	2.000	6.22	12.43	1.113	38.06	4.93192	45.20
2.133	438.467	38.17	0.54	1.52	-0.16	262.816	1.541	1.76	262.82	1.54	7	125.00	0.133	0.133	0.000	2.000	6.32	12.65	1.085	38.17	7.21926	45.33
2.461	438.139	37.91	0.55	1.44	-0.05	245.469	1.457	1.76	245.47	1.46	7	125.00	0.154	0.154	0.000	2.000	6.81	13.63	1.169	37.91	7.18838	45.02
2.789	437.811	36.47	0.68	1.87	-0.34	208.222	1.874	1.99	208.22	1.87	6	125.00	0.174	0.174	0.000	2.000	6.87	13.74	1.124	36.47	10.0384	44.25
3.117	437.483	27.44	0.59	2.16	-0.37	139.853	2.166	2.04	139.85	2.17	6	125.00	0.195	0.195	0.000	2.000	5.49	10.97	0.844	27.44	14.139	42.30
3.445	437.155	20.54	0.68	3.22	-0.44	94.3962	3.247	2.29	94.40	3.25	5	125.00	0.215	0.215	0.000	2.000	4.54	9.08	0.629	20.54	22.0663	40.26
3.773	436.827	22.61	0.6	3.52	-1.01	94.8813	3.576	2.32	94.88	3.58	5	125.00	0.236	0.236	0.000	2.000	5.07	10.13	0.693	22.61	23.1961	40.29
4.101	436.499	26.22	0.98	3.73	-1.36	101.297	3.775	2.32	101.30	3.77	5	125.00	0.256	0.256	0.000	1.975	5.88	11.60	0.804	26.22	23.1946	40.63
4.429	436.171	31.36	1.08	3.46	-1.09	112.29	3.475	2.26	112.33	3.47	6	125.00	0.277	0.277	0.000	1.901	6.86	13.04	0.962	31.37	21.1287	41.18
4.757	435.843	38.92	1.07	2.74	1.76	129.906	2.770	2.15	129.84	2.77	6	125.00	0.297	0.297	0.000	1.834	8.11	14.86	1.198	38.9	17.2319	41.92
5.085	435.515	38.04	1.11	2.93	4.37	118.693	2.943	2.19	118.60	2.94	6	125.00	0.318	0.318	0.000	1.774	8.07	14.31	1.168	38.01	18.7018	41.46
5.413	435.187	30.78	1.06	3.45	13.37	89.981	3.482	2.33	89.71	3.49	5	125.00	0.338	0.339	0.000	1.719	6.90	11.86	0.942	30.69	23.4971	39.99
5.741	434.859	25.89	0.85	3.29	18.5	71.1547	3.329	2.39	70.85	3.34	5	125.00	0.359	0.359	0.000	1.669	5.94	9.91	0.790	25.78	26.6136	38.69
6.069	434.531	23.4	0.79	3.36	23.9	60.6906	3.432	2.44	60.30	3.46	5	125.00	0.379	0.379	0.000	1.624	5.50	9.03	0.713	23.25	28.015	37.78
6.398	434.202	25.75	1.15	4.46	22.01	63.3951	4.536	2.51	63.07	4.56	4	125.00	0.400	0.400	0.000	1.581	6.28	9.93	0.785	25.62	31.3104	38.04
6.726	433.874	29.09	1.27	4.36	14.11	68.2001	4.430	2.48	68.01	4.44	4	125.00	0.420	0.420	0.000	1.542	7.01	10.81	0.888	29.01	29.9625	38.46
7.054	433.546	24	1	4.16	11.96	53.4372	4.245	2.54	53.28	4.26	4	125.00	0.441	0.441	0.000	1.506	5.94	8.95	0.729	23.93	32.5699	37.07
7.382	433.218	21.53	0.94	4.36	14.92	45.6649	4.462	2.61	45.45	4.48	4	125.00	0.461	0.461	0.000	1.472	5.49	8.09	0.652	21.43	35.6188	36.14
7.71	432.890	22.03	1.05	4.75	14.57	44.7173	4.873	2.64	44.53	4.89	3	125.00	0.482	0.482	0.000	1.441	5.72	8.24	0.667	21.94	37.2891	36.02
8.038	432.562	22.77	0.99	4.34	10.23	44.3247	4.446	2.61	44.21	4.46	4	125.00	0.502	0.502	0.000	1.411	5.84	8.24	0.689	22.71	35.9462	35.97
8.366	432.234	32.54	1.27	3.9	8.77	61.2328	3.967	2.46	61.12	3.97	5	125.00	0.523	0.523	0.000	1.383	7.83	10.83	0.991	32.48	29.7484	37.86
8.694	431.906	28.72	1.47	5.13	1.57	51.8548	5.217	2.61	51.84	5.22	3	125.00	0.543	0.543	0.000	1.357	7.39	10.03	0.872	28.71	36.0688	36.91
9.022	431.578	25.38	1.28	5.04	3.58	44.01	5.158	2.66	43.97	5.16	3	125.00	0.564	0.564	0.000	1.332	6.66	8.90	0.768	25.36	38.3363	35.94
9.35	431.250	21.81	1.12	5.12	4.5	36.3219	5.277	2.72	36.27	5.28	3	125.00	0.584	0.584	0.000	1.308	5.94	7.77	0.657	21.78	41.7898	34.78
9.678	430.922	19.77	1.16	5.88	0.32	31.6644	6.053	2.81	31.68	6.05	3	125.00	0.605	0.605	0.000	1.286	5.64	7.25	0.593	19.77	46.4618	33.96
10.006	430.594	16.91	1.13	6.7	7.09	26.0398	6.939	2.91	25.98	6.96	3	125.00	0.625	0.625	0.000	1.266	5.11	6.46	0.504	16.87	52.7324	32.71
10.335	430.265	12.18	0.84	6.91	7.27	17.8563	7.283	3.05	17.78	7.31	3	125.00	0.646	0.646	0.000	1.246	3.99	4.96	0.357	12.13	61.5745	30.26
10.663	429.937	13.61	0.58	4.27	11.11	19.422	4.461	2.88	19.32	4.51	3	125.00	0.666	0.666	0.000	1.225	4.02	4.92	0.401	13.54	50.6152	30.80
10.991	429.609	16.16	0.58	3.6	16.15	22.5247	3.748	2.78	22.38	3.77	4	125.00	0.687	0.687	0.000	1.207	4.51	5.44	0.479	16.06	44.7951	31.76
11.319	429.281	20.35	0.95	4.66	10.23	27.7656	4.836	2.78	27.67	4.86	3	125.00	0.707	0.707	0.000	1.189	5.71	6.79	0.608	20.28	45.0299	33.10
11.647	428.953	15.41	0.83	5.37	7.37	20.3852	5.653	2.93	20.33	5.67	3	135.00	0.728	0.720	0.008	1.178	4.70	5.64	0.455	15.37	53.7104	31.14
11.975	428.625	15.03	0.51	3.4	12.31	19.5044	3.571	2.81	19.40	3.59	4	135.00	0.750	0.732	0.018	1.169	4.28	5.00	0.442	14.95	46.7592	30.84
12.303	428.297	13.48	0.39	2.86	16.05	17.0793	3.069	2.82	16.94	3.09	5	135.00	0.772	0.744	0.028	1.159	3.84	4.45	0.393	13.38	47.1053	29.96
12.631	427.969	14.27	0.45	3.13	24.68	17.8261	3.339	2.83	17.61	3.38	5	135.00	0.794	0.756	0.038	1.150	4.07	4.69	0.417	14.11	47.7069	30.22
12.959	427.641	16.62	0.59	3.53	32.75	20.5813	3.733	2.81	20.21	3.78	4	135.00	0.816	0.768	0.049	1.141	4.69	5.36	0.489	16.41	46.6978	31.16
13.287	427.313	15.45	0.53	3.41	85.75	18.7382	3.627	2.85	18.06	3.76	4	135.00	0.839	0.780	0.059	1.132	4.36	4.94	0.452	14.92	48.9421	30.39
13.615	426.985	14.31	0.4	2.77	92.79	16.9984	2.974	2.83	16.26	3.11	5	135.00	0.861	0.792	0.068	1.124	3.98	4.47	0.416	13.73	48.0254	29.71
13.943	426.657	16.27	0.56	3.45	78.04	19.1483	3.639	2.84	18.54	3.76	4	135.00	0.883	0.804	0.079	1.116	4.59	5.12	0.476	15.76	48.3929	30.57
14.271	426.329	75.29	0.83	1.1	37.25	91.2159	1.116	1.97	90.93	1.12	8	135.00	0.905	0.815	0.090	1.107	14.61	16.18	2.303	75.06	12.2389	40.07
14.6	426.000	92.32	1.92	2.08	-13.9	110.454	2.101	2.10	110.55	2.10	7	135.00	0.927	0.827	0.100	1.098	18.00	20.78	2.829	92.4	15.8278	41.16
14.928	425.672	64.03	2.18	3.4	6.64	75.1558	3.456	2.37	75.22	3.45	5	135.00	0.949	0.839	0.110	1.092	14.71	16.06	1.963	64.08	25.3244	39.03
15.256	425.344	42.81	1.59	3.92	110.63	49.1901	4.015	2.56	48.27	4.09	5	135.00	0.972	0.851	0.120	1.084	10.53	11.42	1.295	42.06	29.3652	36.51

R14572

Depth (ft)	Samp (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	s	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	426.016	31.18	1.38	4.44	88.96	34.9725	4.572	2.70	34.34	4.68	5	135.00	0.999	0.863	0.131	1.076	8.26	8.89	0.935	30.83	40.6127	34.47
15.912	424.688	74.08	1.85	2.5	119.6	83.4971	2.532	2.25	82.64	2.56	6	135.00	1.016	0.875	0.141	1.069	15.95	17.05	2.262	73.33	20.7052	39.55
16.24	424.360	168.1	3.39	2.02	-0.74	168.354	2.029	1.94	168.35	2.03	7	135.00	1.038	0.887	0.151	1.062	32.30	34.30	5.172	168.1	11.3615	43.77
16.558	424.032	179.25	4.43	2.47	-10.55	198.239	2.486	2.00	198.32	2.49	7	136.00	1.060	0.899	0.161	1.055	35.21	37.14	5.517	179.32	12.8438	44.02
16.896	423.704	134.23	3.06	2.28	-18.82	148.166	2.298	2.05	146.30	2.30	7	137.00	1.082	0.911	0.171	1.048	26.94	28.22	4.122	134.35	14.3363	42.53
17.224	423.376	78.48	1.39	1.78	-20.86	83.8148	1.796	2.14	83.96	1.79	7	138.00	1.105	0.923	0.182	1.041	16.31	16.98	2.396	78.61	16.912	39.64
17.552	423.048	61.76	2.91	4.71	-21.8	64.8083	4.799	2.62	64.96	4.79	4	139.00	1.128	0.936	0.192	1.034	15.23	15.74	1.877	61.9	31.6498	38.22
17.88	422.720	131.97	4.46	3.38	-22.01	137.977	3.409	2.20	138.12	3.41	6	140.00	1.150	0.948	0.202	1.027	28.14	28.90	4.050	132.11	18.9817	42.25
18.208	422.392	229.79	6.98	3.04	1.89	237.93	3.053	2.03	237.92	3.05	12	141.00	1.173	0.961	0.212	1.020	45.63	46.55	7.078	229.78	13.6451	44.68
18.537	422.063	178.23	4.87	2.73	5.9	181.799	2.751	2.05	181.77	2.75	7	142.00	1.196	0.974	0.223	1.013	35.79	36.27	5.481	178.2	14.4578	43.60
18.865	421.735	158.32	3.85	1.93	-5.91	159.195	1.941	1.97	159.24	1.94	8	143.00	1.220	0.987	0.233	1.007	30.79	31.00	4.864	158.36	12.157	42.96
19.193	421.407	129.65	3.89	3	-15.68	128.399	3.029	2.16	129.49	3.03	6	144.00	1.243	1.000	0.243	1.000	27.40	27.40	3.975	129.74	18.2843	41.86
19.521	421.079	173.42	5.09	2.94	-12.86	169.87	2.957	2.10	169.95	2.96	7	145.00	1.267	1.013	0.253	0.993	35.43	35.20	5.330	173.5	15.7016	43.29
19.849	420.751	263.85	6.2	2.35	-1.66	255.66	2.361	1.91	255.67	2.36	7	146.00	1.291	1.027	0.264	0.987	50.25	49.58	8.129	263.86	10.7536	45.21
20.177	420.423	128.37	5.69	4.43	4.11	122.087	4.478	2.33	122.06	4.48	11	147.00	1.315	1.041	0.274	0.980	28.87	28.30	3.934	128.34	23.5384	41.62
20.505	420.095	79.4	4.72	5.95	5.06	74.0219	6.047	2.56	73.99	6.05	11	148.00	1.338	1.055	0.284	0.974	18.92	18.40	2.417	79.37	33.5824	38.95
20.833	419.767	78.64	4.44	5.65	4.76	72.3155	5.746	2.55	72.29	5.75	11	149.00	1.362	1.069	0.294	0.967	19.63	18.99	2.392	78.61	33.0698	38.82
21.161	419.439	89.37	5.02	5.61	5.8	81.2538	5.706	2.52	81.23	5.71	11	150.00	1.387	1.083	0.305	0.961	21.94	21.09	2.724	89.34	31.4994	39.47
21.489	419.111	108.25	5.71	5.27	5.22	97.3752	5.345	2.45	97.35	5.35	11	151.00	1.412	1.097	0.315	0.955	25.71	24.54	3.308	108.22	28.3906	40.44
21.817	418.783	132	7.15	5.41	2.48	117.444	5.476	2.41	117.43	5.48	11	152.00	1.437	1.112	0.325	0.948	30.78	29.19	4.042	131.98	26.7224	41.42
22.145	418.455	152.55	8.54	5.6	-0.62	134.133	5.652	2.39	134.13	5.65	11	153.00	1.462	1.126	0.335	0.942	35.23	33.19	4.678	152.55	25.8345	42.10
22.473	418.127	166.92	10.03	6.01	-0.81	144.956	6.063	2.39	144.96	6.06	11	154.00	1.487	1.141	0.345	0.936	38.65	36.19	5.122	166.92	26.1022	42.49
22.802	417.798	175.61	10.85	6.18	-0.16	150.561	6.232	2.39	150.56	6.23	11	155.00	1.512	1.156	0.356	0.930	40.69	37.84	5.390	175.61	26.1461	42.68
23.13	417.470	186.83	11.72	6.27	0.3	158.165	6.325	2.39	158.16	6.33	11	156.00	1.537	1.172	0.366	0.924	43.17	39.89	5.737	186.82	25.9033	42.93
23.458	417.142	212.47	12.86	6.05	-0.81	177.701	6.097	2.35	177.70	6.10	11	157.00	1.563	1.187	0.376	0.918	46.23	44.27	6.530	212.47	24.3144	43.50
23.786	416.814	206.47	13.26	6.42	-3.42	170.396	6.472	2.38	170.42	6.47	11	158.00	1.589	1.202	0.386	0.912	47.54	43.35	6.343	206.5	25.5551	43.29
24.114	416.486	224.17	13.65	6.04	-3.65	182.713	6.088	2.34	182.73	6.09	11	159.00	1.615	1.218	0.397	0.906	50.73	45.97	6.890	224.19	24.049	43.63
24.442	416.158	237.64	15.41	6.48	-5.54	191.262	6.530	2.36	191.29	6.53	11	160.00	1.641	1.234	0.407	0.900	54.17	48.76	7.308	237.67	24.6695	43.85
24.77	415.830	244.94	15.19	6.2	-7.81	194.633	6.244	2.34	194.66	6.24	11	161.00	1.667	1.250	0.417	0.894	55.32	49.48	7.532	244.98	23.8705	43.94
25.098	415.502	239.96	14.94	6.23	-11.67	188.192	6.270	2.34	188.25	6.27	11	162.00	1.693	1.266	0.427	0.888	54.42	48.36	7.377	240.03	24.2139	43.78
25.426	415.174	217.85	14.42	6.62	-17.67	168.534	6.672	2.39	168.62	6.67	11	163.00	1.720	1.282	0.438	0.883	50.48	44.58	6.691	217.96	26.1001	43.24
25.754	414.846	219.37	13.74	6.26	-20.97	167.543	6.314	2.37	167.64	6.31	11	164.00	1.747	1.299	0.448	0.877	50.40	44.22	6.736	219.5	25.3316	43.21
26.082	414.518	214.66	13.21	6.15	-22.49	161.82	6.205	2.37	161.93	6.20	11	165.00	1.774	1.316	0.458	0.872	49.36	43.03	6.591	214.8	25.3928	43.04
26.41	414.190	225.44	13.56	6.01	-24.85	167.647	6.063	2.36	167.97	6.06	11	166.00	1.801	1.332	0.468	0.866	51.45	44.57	6.924	225.6	24.7228	43.22
26.739	413.861	266.44	15.56	5.6	-24.92	197.572	5.836	2.31	197.68	5.83	11	167.00	1.828	1.349	0.479	0.861	61.56	53.89	8.254	266.59	22.7802	44.01
27.067	413.533	344.83	16.55	4.8	-25.2	250.97	4.825	2.18	251.09	4.82	11	168.00	1.855	1.367	0.489	0.855	73.00	62.45	10.618	344.98	18.4477	45.13

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Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 46 OF 48

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POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-12

ConeTec Inc. 'erpretation
Interpretation (Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4182
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-12
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date 07/31/10
CPT Time: 11:15
CPT File: 804CP12.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 442.1

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.01	2.80	91.11	27.59	2.37

User Inputs:

Assumed: Water Table Depth (ft): 11.7
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 442.1
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	441.936	11.62	0.14	1.16	-0.32	1132.66	1.206	1.37	1132.66	1.21	6	125.00	0.010	0.010	0.000	2.000	1.84	3.67	0.359	11.62	1.12402	51.29
0.492	441.608	7.94	0.16	2.02	-1.8	257.211	2.023	1.86	257.54	2.02	5	125.00	0.031	0.031	0.000	2.000	1.48	2.96	0.245	7.95	3.3841	45.24
0.82	441.280	9.78	0.15	1.54	-4.83	189.829	1.542	1.84	190.41	1.54	5	125.00	0.051	0.051	0.000	2.000	1.82	3.64	0.301	9.81	9.05791	43.82
1.148	440.952	14.93	0.28	1.85	-7.94	207.084	1.864	1.89	207.78	1.88	5	125.00	0.072	0.072	0.000	2.000	2.82	5.65	0.460	14.98	10.0719	44.24
1.804	440.296	10.42	0.21	2.02	-9.49	91.4169	2.037	2.14	91.95	2.03	5	125.00	0.113	0.113	0.000	2.000	2.18	4.36	0.319	10.48	17.1922	40.12
2.461	439.639	11.4	0.39	3.39	-0.6	73.1162	3.468	2.38	73.12	3.47	4	125.00	0.154	0.154	0.000	2.000	2.63	5.26	0.348	11.4	25.7091	38.87
2.789	439.311	19.33	0.58	3.01	0.23	109.893	3.028	2.22	109.89	3.03	5	125.00	0.174	0.174	0.000	2.000	4.16	8.31	0.593	19.33	19.7298	41.06
3.117	438.983	28.96	0.84	2.89	2.91	147.604	2.921	2.13	147.55	2.92	5	125.00	0.195	0.195	0.000	2.000	5.99	11.98	0.890	28.94	16.7116	42.57
3.446	438.655	31.92	1.09	3.41	12.38	147.25	3.438	2.19	146.92	3.46	5	125.00	0.215	0.215	0.000	2.000	6.75	13.50	0.982	31.85	18.5805	42.55
3.773	438.327	29.03	1.2	4.13	24.36	122.106	4.168	2.31	121.47	4.19	4	125.00	0.236	0.236	0.000	2.000	6.43	12.87	0.891	28.88	22.7083	41.58
4.101	437.999	26.16	1.06	4.04	36.19	101.063	4.092	2.36	100.20	4.13	4	125.00	0.256	0.256	0.000	1.975	5.90	11.65	0.802	26.94	24.4642	40.58
4.429	437.671	24.24	0.91	3.76	45.54	86.5683	3.797	2.37	85.56	3.84	4	125.00	0.277	0.277	0.000	1.901	5.50	10.46	0.742	23.96	25.2412	39.73
4.757	437.343	19.02	0.82	4.29	43.98	62.9731	4.360	2.51	62.05	4.44	4	125.00	0.297	0.297	0.000	1.834	4.59	8.41	0.580	18.75	31.1432	37.95
5.085	437.015	21.3	0.75	3.53	49.65	66.0206	3.574	2.47	65.05	3.63	5	125.00	0.318	0.318	0.000	1.774	4.95	8.78	0.650	20.99	27.7143	38.21
5.413	436.687	23.02	0.78	3.4	49.79	67.0436	3.439	2.41	66.13	3.49	5	125.00	0.338	0.338	0.000	1.719	5.31	9.13	0.702	22.71	26.9846	38.30
5.741	436.359	19.94	0.81	4.05	42.61	54.5722	4.137	2.53	53.82	4.19	4	125.00	0.359	0.359	0.000	1.669	4.87	8.13	0.606	19.67	32.2135	37.13
6.069	436.031	19.3	0.6	3.12	42.66	49.9815	3.171	2.46	49.20	3.22	5	125.00	0.379	0.379	0.000	1.624	4.59	7.45	0.596	19.04	29.7477	36.60
6.398	435.702	19.44	0.61	3.15	38.64	47.6152	3.204	2.50	47.02	3.24	5	125.00	0.400	0.400	0.000	1.581	4.67	7.38	0.589	19.2	30.4845	36.34
6.726	435.374	19.51	0.69	3.55	28.89	45.4109	3.615	2.55	44.98	3.65	4	125.00	0.420	0.420	0.000	1.542	4.81	7.42	0.591	19.33	32.7392	36.08
7.054	435.046	19.87	0.87	4.39	16.93	44.0695	4.478	2.62	43.84	4.50	3	125.00	0.441	0.441	0.000	1.506	5.10	7.68	0.602	19.77	36.2175	35.92
7.382	434.718	19.53	0.85	4.34	16.8	41.33	4.458	2.64	41.08	4.48	3	125.00	0.461	0.461	0.000	1.472	5.06	7.44	0.590	19.42	37.1432	35.54
7.71	434.390	17.5	0.83	4.73	14.09	35.3165	4.877	2.71	35.13	4.90	3	125.00	0.482	0.482	0.000	1.441	4.71	6.79	0.527	17.41	41.076	34.69
8.038	434.062	16.42	0.64	4.16	15.08	29.6942	4.290	2.73	29.52	4.32	3	125.00	0.502	0.502	0.000	1.411	4.19	5.91	0.462	15.33	41.9523	33.61
8.366	433.734	15.44	0.6	3.86	17.32	28.529	4.022	2.72	28.32	4.05	4	125.00	0.523	0.523	0.000	1.383	4.18	5.77	0.462	15.33	41.6655	33.26
8.694	433.406	19.79	0.74	3.75	18.08	35.4205	3.845	2.64	35.22	3.87	4	125.00	0.543	0.543	0.000	1.357	5.13	6.96	0.596	19.68	37.304	34.60
9.022	433.078	19.84	0.86	4.34	16.61	34.1851	4.461	2.69	34.01	4.48	4	125.00	0.564	0.564	0.000	1.332	5.30	7.05	0.597	19.74	40.1678	34.39
9.35	432.750	17.62	0.88	4.98	13.99	29.1519	5.166	2.79	29.01	5.19	3	125.00	0.584	0.584	0.000	1.308	4.95	6.48	0.527	17.54	45.3203	33.40
9.678	432.422	16.33	0.72	4.42	21.5	25.9973	4.579	2.79	25.77	4.62	3	125.00	0.605	0.605	0.000	1.286	4.58	5.88	0.487	16.19	45.491	32.88
10.006	432.094	13.67	0.59	4.33	11.13	20.8582	4.523	2.86	20.75	4.55	3	125.00	0.625	0.625	0.000	1.265	3.99	5.04	0.404	13.6	48.3482	31.27
10.335	431.765	12.63	0.44	3.48	13.16	18.553	3.672	2.94	18.43	3.70	4	125.00	0.646	0.646	0.000	1.244	3.64	4.53	0.371	12.55	48.2363	30.50
10.663	431.437	12.67	0.5	3.92	14.21	18.0115	4.166	2.98	17.89	4.19	3	125.00	0.666	0.666	0.000	1.225	3.75	4.59	0.372	12.59	50.9429	30.30
10.991	431.109	12.7	0.63	4.97	13.9	17.4879	5.244	2.96	17.37	5.28	3	125.00	0.687	0.687	0.000	1.207	3.93	4.74	0.372	12.62	55.6721	30.11
11.319	430.781	10.22	0.46	4.51	14.5	13.4465	4.836	3.02	13.31	4.89	3	125.00	0.707	0.707	0.000	1.189	3.28	3.91	0.295	10.12	60.1556	28.34
11.647	430.453	8.57	0.2	2.34	16.35	10.773	2.550	2.94	10.64	2.58	4	125.00	0.728	0.728	0.000	1.172	2.61	3.06	0.243	8.47	54.4211	26.83
11.975	430.125	9.06	0.17	1.83	18.91	11.234	2.045	2.87	11.07	2.08	5	135.00	0.748	0.740	0.009	1.163	2.64	3.08	0.257	8.94	50.2638	27.11
12.303	429.797	10.52	0.15	1.38	22.7	12.9687	1.539	2.75	12.78	1.56	5	135.00	0.771	0.752	0.019	1.153	2.87	3.32	0.302	10.38	43.3768	28.09
12.631	429.469	13.05	0.29	2.23	28.38	16.0505	2.366	2.79	15.81	2.40	5	135.00	0.793	0.764	0.029	1.144	3.61	4.13	0.379	12.87	44.7486	28.51
12.959	429.141	13.23	0.43	3.26	16.7	16.0076	3.464	2.87	15.88	3.49	4	135.00	0.815	0.776	0.039	1.136	3.99	4.42	0.384	13.13	50.3648	29.54
13.287	428.813	13.91	0.36	2.56	7.57	16.601	2.754	2.80	16.54	2.76	5	135.00	0.837	0.787	0.050	1.127	3.93	4.43	0.405	13.86	45.8936	29.81
13.615	428.485	17.32	0.69	3.96	6.49	20.5918	4.192	2.84	20.54	4.20	4	135.00	0.858	0.799	0.060	1.118	5.01	5.61	0.510	17.28	48.2013	31.23
13.943	428.157	28.86	1.37	4.74	1.25	34.4741	4.898	2.72	34.46	4.90	3	135.00	0.881	0.811	0.070	1.110	7.03	8.70	0.866	28.84	41.3835	34.48
14.271	427.829	35.76	1.81	5.06	8.08	42.3427	5.193	2.67	42.28	5.20	3	135.00	0.903	0.823	0.080	1.102	9.48	10.45	1.079	35.71	39.0642	35.72
14.6	427.500	93.11	1.97	2.12	5.47	110.381	2.137	2.11	110.35	2.14	7	135.00	0.926	0.835	0.090	1.094	19.09	20.89	2.854	93.08	16.0213	41.09
14.928	427.172	198.6	4.08	2.06	-1.59	233.341	2.064	1.89	233.36	2.06	8	135.00	0.946	0.847	0.101	1.087	37.46	40.71	6.119	198.61	10.1383	44.79
15.256	426.844	186.18	5.12	2.75	-9.91	215.622	2.764	2.01	215.70	2.76	7	135.00	0.970	0.859	0.111	1.079	36.81	39.72	5.734	186.25	13.2986	44.42

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Depth (ft)	Sar	vgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)		EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	426.516	190.04	5.38	2.83	-11.83	217.081	2.846	2.02	217.16	2.64	7	135.00	0.992	0.671	0.121	1.072	37.70	40.40	5.853	190.11	13.5387	44.45
15.912	426.188	263.65	6.16	2.34	-13.14	297.513	2.345	1.98	297.80	2.34	7	135.00	1.011	0.683	0.131	1.064	49.51	52.70	8.131	263.73	9.83312	45.90
16.24	425.860	284.27	6.89	2.42	-9.63	316.576	2.433	1.88	316.64	2.43	7	135.00	1.036	0.695	0.142	1.057	53.37	56.42	8.769	284.33	9.8196	46.17
16.568	425.532	255.09	5.78	2.27	-12.84	280.208	2.275	1.88	280.30	2.27	7	136.00	1.058	0.707	0.152	1.050	47.96	50.37	7.865	255.17	9.90035	45.63
16.896	425.204	262.69	5.83	2.22	-14.73	284.775	2.229	1.87	284.87	2.23	8	137.00	1.081	0.719	0.162	1.043	48.18	51.31	8.099	262.78	9.63384	45.70
17.224	424.876	262.49	6.06	2.31	-15.84	280.793	2.318	1.89	280.90	2.32	7	138.00	1.103	0.931	0.172	1.036	49.47	51.27	8.092	262.59	10.0493	45.64
17.552	424.548	275.92	6.07	2.2	-16.9	291.316	2.209	1.86	291.43	2.21	8	139.00	1.126	0.943	0.183	1.030	51.50	53.02	8.508	276.03	9.43529	45.80
17.88	424.220	282.44	5.86	2.07	-17.67	294.284	2.083	1.84	294.40	2.08	8	140.00	1.149	0.956	0.193	1.023	52.26	53.45	8.709	282.55	8.89784	45.85
18.208	423.892	257.04	5.91	2.3	-18.27	264.17	2.310	1.90	264.28	2.31	7	141.00	1.172	0.969	0.203	1.016	46.88	48.46	7.922	257.15	10.3624	45.36
18.537	423.563	242.82	4.68	1.93	-18.43	246.176	1.937	1.85	246.30	1.94	8	142.00	1.195	0.982	0.213	1.009	45.22	45.65	7.481	242.94	9.29281	45.04
18.865	423.235	257.45	4.85	1.88	-18.64	257.634	1.893	1.83	257.75	1.89	8	143.00	1.218	0.995	0.224	1.003	47.61	47.74	7.933	257.57	8.85195	45.25
19.193	422.907	260.77	6.02	2.31	-18.77	257.525	2.320	1.91	257.64	2.32	7	144.00	1.242	1.008	0.234	0.996	49.52	49.33	8.035	260.89	10.5471	45.25
19.521	422.579	170.7	6.5	3.81	-14.05	165.924	3.836	2.19	166.01	3.83	12	145.00	1.265	1.021	0.244	0.990	36.30	35.92	5.246	170.79	18.807	43.16
19.849	422.251	99.48	6.6	6.53	-16.39	94.8975	6.620	2.53	95.00	6.61	11	146.00	1.289	1.035	0.254	0.983	24.57	24.16	3.040	99.59	31.9422	40.31
20.177	421.923	121.55	7.95	6.54	-17.74	114.684	6.612	2.48	114.80	6.61	11	147.00	1.313	1.048	0.264	0.977	29.34	28.86	3.723	121.67	29.7866	41.30
20.505	421.595	160.73	12.29	7.65	-14.95	150.046	7.711	2.47	150.13	7.71	11	148.00	1.337	1.062	0.275	0.970	38.65	37.50	4.936	160.82	29.4577	42.67
20.833	421.267	215.14	14.59	6.78	-12.33	196.618	6.825	2.36	196.68	6.82	11	149.00	1.361	1.076	0.285	0.964	49.23	47.46	6.619	215.22	24.995	44.03
21.161	420.939	213.16	15.63	7.33	2.1	194.194	7.380	2.40	194.18	7.38	11	150.00	1.386	1.091	0.295	0.958	49.52	47.42	6.556	213.14	26.385	43.92
21.489	420.611	245.28	17.26	7.04	16.49	220.717	7.078	2.36	220.62	7.08	11	151.00	1.410	1.105	0.305	0.951	56.88	53.16	7.550	245.17	24.68	44.53
21.817	420.283	304.39	19.87	6.53	34.98	270.633	6.559	2.29	270.64	6.56	11	152.00	1.436	1.119	0.316	0.945	67.22	63.53	9.379	304.17	22.0175	45.47
22.145	419.955	331.65	17.77	5.36	221.32	291.141	5.382	2.20	289.92	5.40	11	153.00	1.460	1.134	0.326	0.939	70.29	66.00	10.223	330.27	18.9079	45.78

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part 27

APPENDIX B

SUMMARY OF ENGINEERING PROPERTIES

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation
Estimation and Summary of Engineering Properties for Fine Coal Refuse

PROJECT NO. 080851

PAGE 1 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

CALCULATION BRIEF FOR

ESTIMATION AND SUMMARY OF ENGINEERING PROPERTIES INCLUDING PEAK AND STEADY-STATE UNDRAINED SHEAR STRENGTH FOR REFUSE AND SUBGRADE MATERIALS

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH POND STAGE 2

OBJECTIVE: To estimate and summarize engineering properties for fine coal refuse materials samples obtained at the Pond Creek Coal Refuse Disposal site including unit weight (γ), specific gravity (G_s), effective strength, i.e., angle of internal friction (ϕ') and cohesion (c'), total strength, peak undrained shear strength (S_{up}), and steady-state undrained shear strength (S_{us}). The various strengths will be used in the South Pond abandonment analyses model(s).

REFERENCES:

1. Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Summary of Piezo-Seismic Cone Penetration Testing," Pond Creek Coal Refuse Disposal Site," BEG, 12/21/07.

2. Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Summary of Laboratory Testing – Fine Coal Refuse," Pond Creek Coal Refuse Disposal Site – South Pond," BEG, 7/10/08.

3. Alliance Consulting, Inc., "Appendix C Laboratory Testing, Proposed Coal Refuse Disposal Facility No. 2, Pond Creek Mine No. 1, Williamson County, Illinois."

4. Poulos, S.J., Castro, G., France, J.W. (1985), "Liquefaction Evaluation Procedure," Journal of Geotechnical Engineering, ASCE, 111(6), pp. 772-791.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation
Estimation and Summary of Engineering Properties for Fine Coal Refuse

PROJECT NO. 080851

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

5. Genes, B.E., Keller, T.O., and Laird, J.P. (2000) "Steady State Liquefaction Susceptibility of High Hazard Upstream-Constructed Coal Refuse Disposal Facilities," Proceedings of Tailings Dams 2000, ASDSO/USCOLD, Las Vegas, NV, March 28-30, pp. 47-58.

6. Almes, R. A. and Butail, A. (1976) "Coal Refuse: Its Behavior Related to the Design and Operation of Coal Refuse Disposal Facilities," Proceedings of the Ohio River Valley Soils Seminar, Lexington, Kentucky, October, 1976.

7. Bowles, Joseph E. (1984) "Physical and Geotechnical Properties of Soils," Mc-Graw Hill. New York: 367-369 and 393-396.

SOIL PROPERTIES:

The following soil properties were estimated based on laboratory testing [Reference Numbers (Ref. Nos.) 2 and 3] performed for abandonment analyses and/or provided by Alliance Consulting, Inc. for previous deformation analyses, which are used in the various slope stability analyses and attached for information:

Refuse/Soil Properties

Description	Unit Weight (γ) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion [1] (c) (psf)	Comment
Coarse Refuse	130	36	0	Frictional
Fine Coal Refuse	85	36.9	0	Effective Strength (Drained)
		18.8	0	Total Strength (Undrained)
		0	Varies (See Below)	Steady-State (Undrained)
Residual Soil	125	19.5	400	Total Strength (Undrained)
		0	3000	80% Peak Undrained

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation — PROJECT NO. 080851

Estimation and Summary of Engineering Properties for Fine Coal Refuse — PAGE 3 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

LABORATORY-DERIVED S_{up} and S_{us}:

Two (2) consolidated – undrained (CU) triaxial series tests (3 points each) were performed on reconstituted bulk fine coal refuse slurry to determine effective and total strength parameters as well as peak (S_{up}) and steady-state (S_{us}) undrained shear strengths. Samples were prepared in the laboratory to simulate in-situ placement and consolidation. Samples were consolidated to a range of vertical effective stresses of about 5, 10 and 20 pounds per square inch (psi) [or 720 to 2880 pounds per square foot (psf)]. All specimens exhibited contractive behavior when sheared under undrained conditions. In general, all specimens reached, or nearly reached, a steady-state of deformation within the strain limits of the test equipment.

A total of 6 CU points comprise the (2) series from which peak and steady-state shear strength state. S_{us} represents the liquefied shear strength [i.e., the minimum (residual) strength available following a rapid loading event, such as an earthquake].

The following equations (Ref. No. 4) were used to calculate peak (S_{up}) and steady-state (S_{us}) shear strengths from laboratory test specimens:

Peak:

$$S_{up} = q_{up} \cos \phi_p$$

Or

$$S_{up} = \sigma'_{3p} [\cos \phi_p \sin \phi_p] / (1 - \sin \phi_p)$$

Steady-State:

$$S_{us} = q_{us} \cos \phi_{us}$$

Or

$$S_{us} = \sigma'_{3s} [\cos \phi_{us} \sin \phi_{us}] / (1 - \sin \phi_{us})$$

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Estimation and Summary of Engineering Properties
for Fine Coal Refuse

PROJECT NO. 080851

PAGE 4 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

Where,

q_{up} = shear stress on 45-degree plane at peak strain

ϕ_p = friction angle at peak = arcsin (q/p) at peak strain

σ'_{3p} = lateral effective stress at peak strain

q_{us} = shear stress on 45-degree plane at steady-state (max) strain

ϕ_{us} = friction angle at steady-state = arcsin (q/p) at max strain

σ'_{3us} = lateral effective stress at steady-state (max) strain

The following peak and steady-state data is presented from CU testing on bulk fine coal refuse samples Bucket 1 and Bucket 2 and applying the equations above. CU laboratory test results are attached.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Estimation and Summary of Engineering Properties
for Fine Coal Refuse

PROJECT NO. 080851

PAGE 5 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

Sample No.	Bucket 1 – Fine Coal Refuse			Bucket 2 – Fine Coal Refuse		
CU Test No. (Confining Pressure)	1 (5.2 psi)	2 (10.2 psi)	3 (20.4 psi)	1 (5.2 psi)	2 (10.4 psi)	3 (20.4 psi)
Parameter						
q_{up} (psi) @	4.61	7.54	10.82	3.37	5.73	11.67
Peak Strain (%)	18.4	13.4	13.5	10.3	14.2	8.4
ϕ_p (deg)	40.4	39.6	37.8	38.3	39.2	37.5
σ'_{3p} (psi)	2.5	4.3	6.8	2.1	3.3	7.5
S_{up} (psi)	3.51	5.81	8.55	2.64	4.44	9.26
q_{us} (psi) @	4.59	7.33	10.02	3.28	5.4	10.61
Max. Strain (%)	21.5	21.67	21.74	17.29	21.32	21.42
ϕ_{us} (deg)	40.4	39.0	36.7	36.3	38.6	35.7
σ'_{3us} (psi)	2.4	4.3	6.7	2.1	3.3	7.6
S_{us} (psi)	3.37	5.67	7.98	2.46	4.28	8.65

A plot of the S_{us} of the reconstituted coal refuse slurry samples versus vertical effective stress ($\sigma'v$) is presented in the attached Figure 1. The equivalent effective vertical stress was assumed to be 1.5 times the isotropic effective consolidation stress (i.e., $1.5*\sigma'3$). A 2/3 – 1/3 relationship of the data was employed to yield an S_{us} to $\sigma'v$ relationship of $S_{us} = 0.28\ \sigma'v$. Ref. No. 5 and recent undisturbed/remolded fine coal refuse testing on other projects yielded a range of $S_{us} = 0.06$ to $0.28\ \sigma'v$, with an average of about $S_{us} = 0.22\ \sigma'v$. Since site specific testing was performed, a reasonable S_{us} to $\sigma'v$ relationship of $S_{us} = 0.24\ \sigma'v$ is considered realistic with some conservatism. The impounded/abandoned fine coal refuse in the South Pond will be modeled utilizing this relationship.

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PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation

Estimation and Summary of Engineering Properties for Fine Coal Refuse

PROJECT NO. 080851

PAGE 6 OF 6

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Subsequent slope stability analyses determine the magnitude of driving shear stress on a failure plane through the fine coal refuse impoundment to assess the required S_{us} to maintain equilibrium and assess the likelihood of a (liquefaction) flow failure. Post-earthquake slope stability of the embankment/impoundment is evaluated as well to assess the failure potential of the South Pond embankment using the abandonment geometry.

CONCLUSIONS

Laboratory undrained shear strength data from consolidated undrained triaxial tests of fine coal refuse were determined. Procedures were performed to estimate S_{up}, S_{us}, and a reasonable S_{us} to $\sigma'v$ relationship of $S_{us} = 0.24\ \sigma'v$ for the material. The results of the laboratory testing indicated Sup and Sus reach their peak and steady-state strength at high strains, and there is very little drop off with increasing strain. Further, Sup and Sus values generally indicated resistance to flow. Thus, the results suggest undrained strengths of the fine coal refuse will be maintained at or near peak levels during an undrained event such as an earthquake, and the susceptibility of the impounded fine coal refuse to a liquefaction flow failure is a function of both the undrained strength (worst case steady-state strength) and the in-situ driving shear stress on a critical failure plane through the fine refuse material.

Based on this information, the properties evaluated/developed in Ref. No. 2 for fine coal refuse, as well as coarse refuse and residual soil, indicated the South Pond fine coal refuse has sufficient steady-state shear strength to limit the flowability of the material. The likelihood of a flow failure associated with the abandonment scenario will be assessed in a subsequent calculation brief by evaluating the driving shear stress and factor of safety against liquefaction in the fine coal refuse.

POND CREEK PHASE 2 SOUTH POND
STEADY-STATE UNDRAINED SHEAR STRENGTH-TO-EFFECTIVE STRESS RELATIONSHIP

Pond Creek Phase 2 South Pond
Steady-State Undrained Strength vs. Vertical Effective Stress

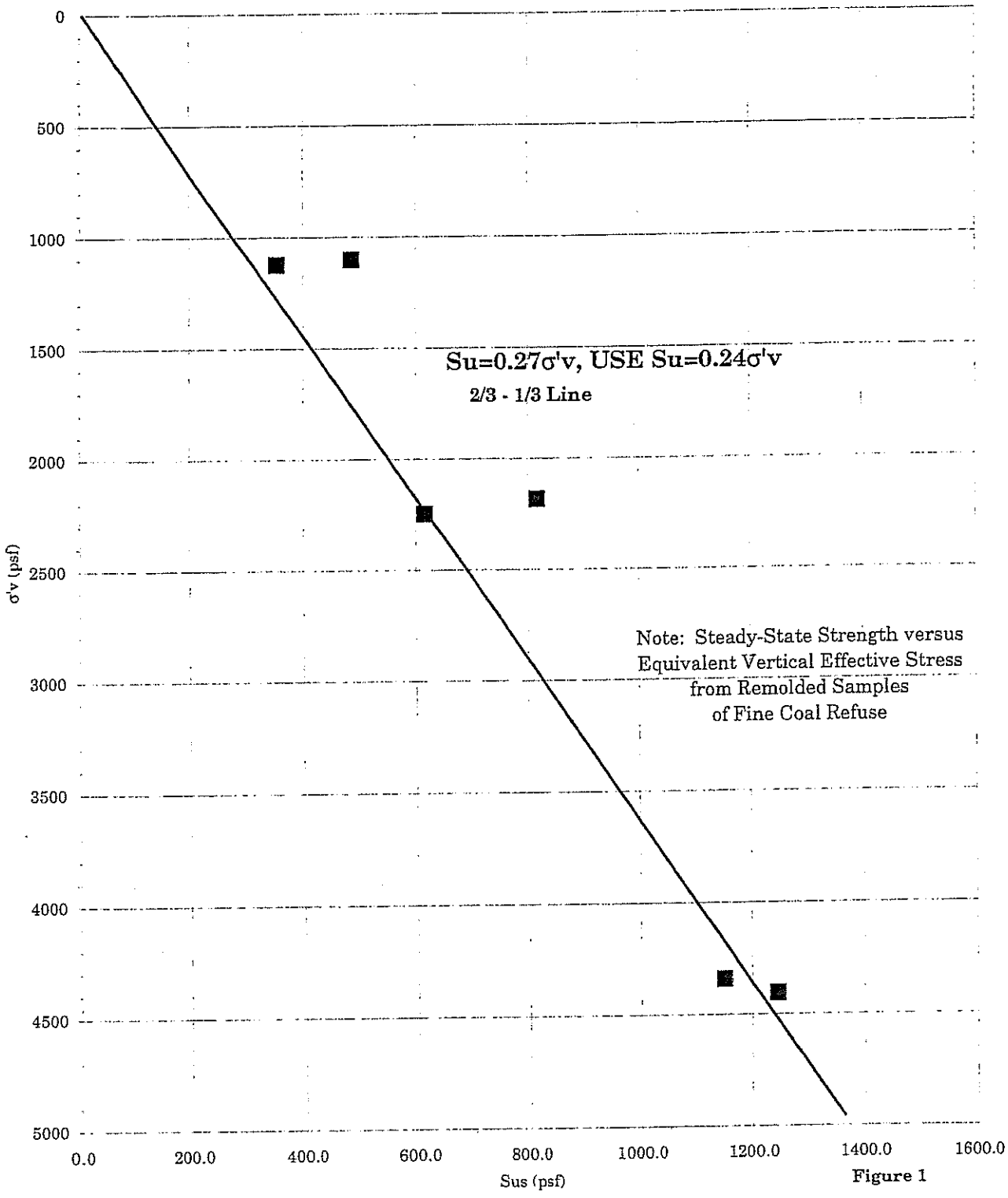

Figure 1

POND CREEK – SOUTH POND
CONSOLIDATED – UNDRAINED TRIAXIAL LABORATORY TESTING RESULTS FOR FINE COAL REFUSE

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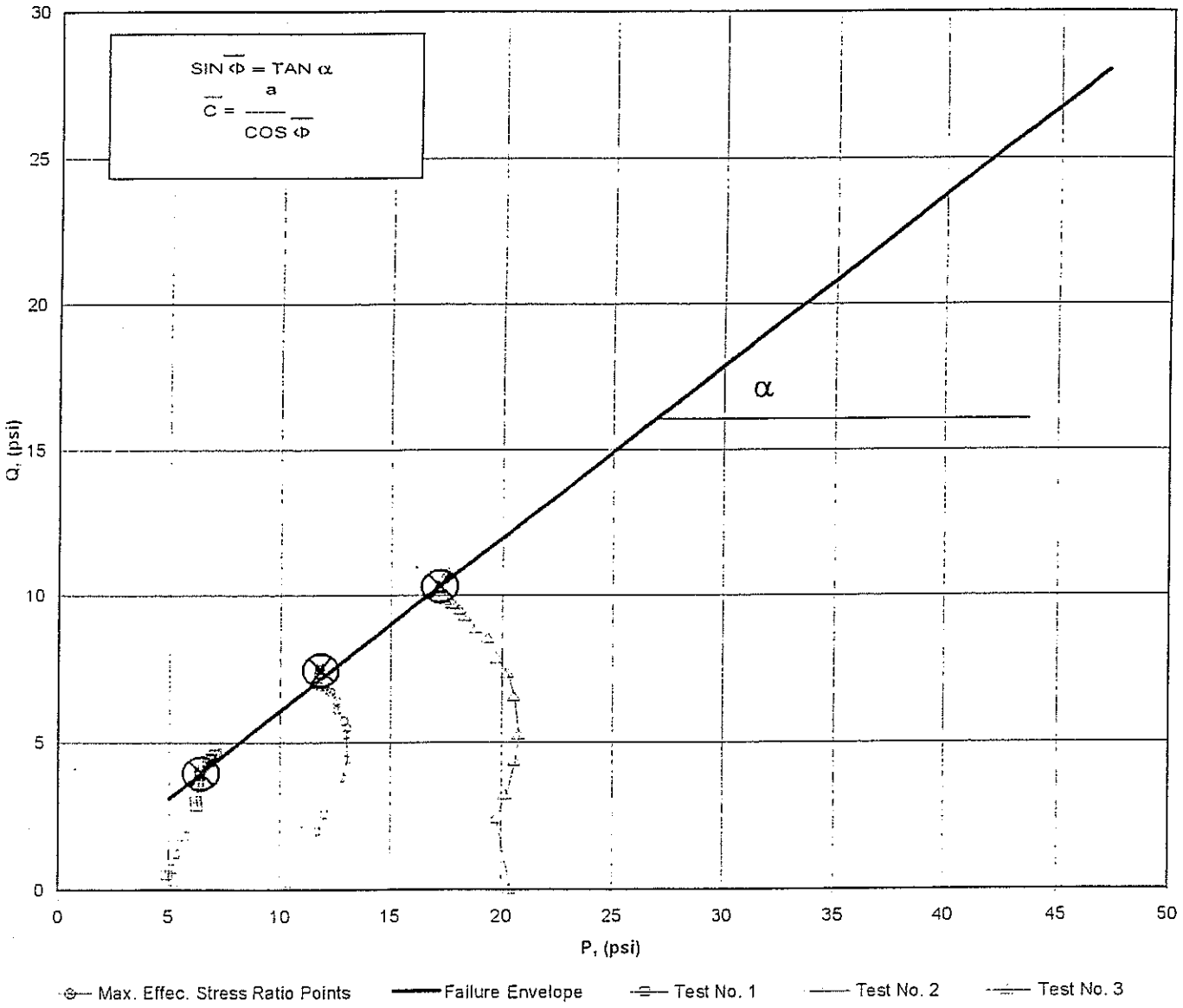
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	30.5	$\bar{\Phi}$	=	36.14

Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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R14588

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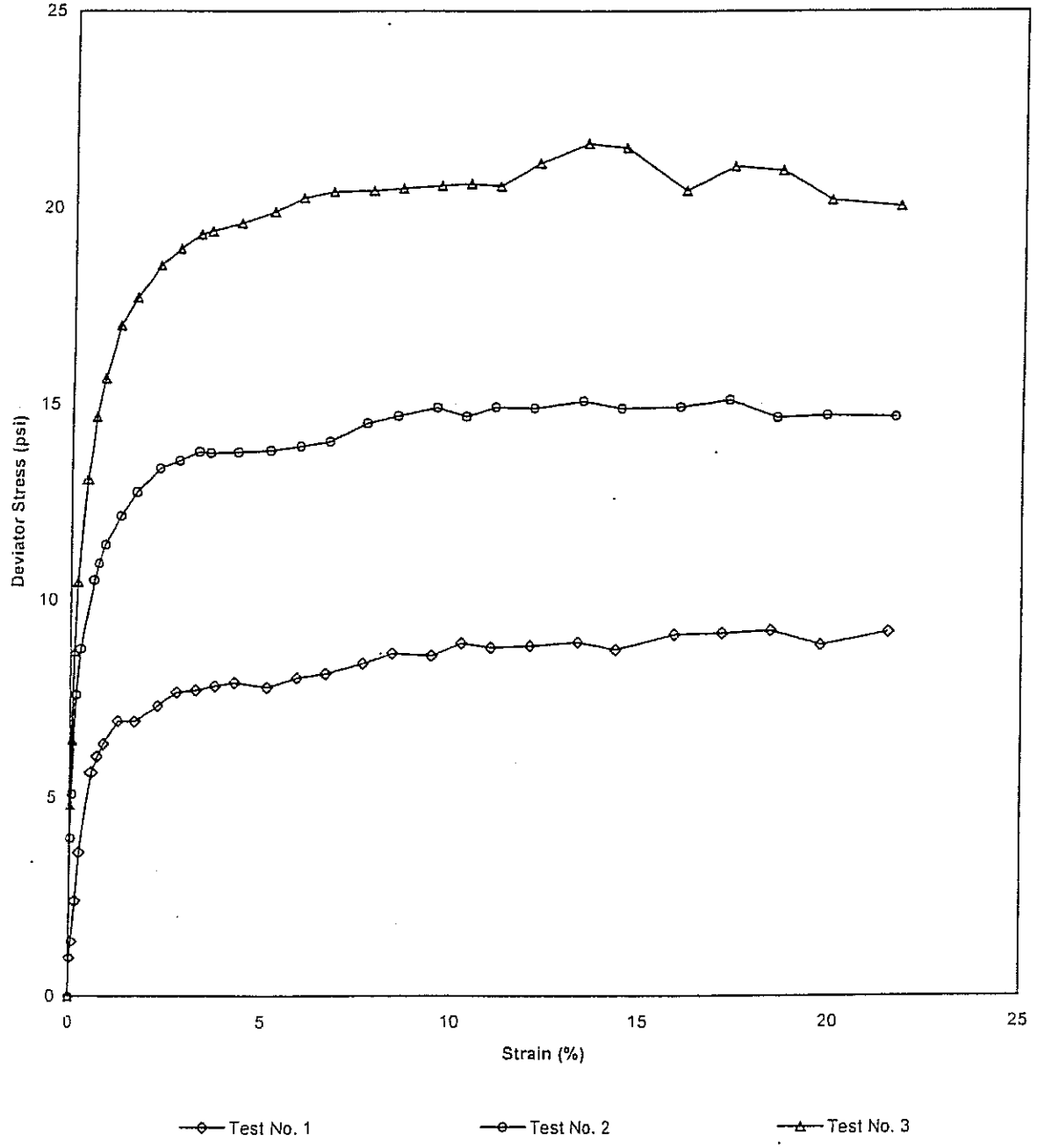
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	1

PRESSURES (psi)

Cell Pressure(psi)	36.6
Back Pressure(psi)	31.4
Eff. Cons. Pressure(psi)	5.2
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	6.41
Q	=	3.95

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.140	Diameter 1	1.375
Length 2	3.148	Diameter 2	1.389
Length 3	3.151	Diameter 3	1.399
Avg Leng.=	3.146	Avg. Diam.=	1.388

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.7
Final Change (ml)	2.3

Initial Dial Reading (D.R.), mils	235
D.R. After Saturation, mils	250
D.R. After Consolidation, mils	294

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.4
8.2	0.001	32.1
8.8	0.002	32.1
10.3	0.005	32.5
12.1	0.008	32.8
15.1	0.016	33.2
15.8	0.020	33.4
16.2	0.026	33.6
17.1	0.038	33.7
17.2	0.051	33.8
17.8	0.069	33.9
18.4	0.085	34.0
18.5	0.101	34.0
18.8	0.116	34.1
19.0	0.132	34.1
18.9	0.158	34.1
19.4	0.182	34.2
19.6	0.205	34.2
20.2	0.236	34.2
20.7	0.260	34.2
20.8	0.292	34.1
21.4	0.316	34.3
21.4	0.340	34.1
21.6	0.371	34.1
22.0	0.411	34.1
21.8	0.443	34.1
22.8	0.490	34.1
23.1	0.530	34.2
23.5	0.569	34.1
23.1	0.610	34.1
24.0	0.664	34.2

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics INTEGRITY IN TESTING R14590

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.2	*Stage No.*	1
		Test No	1

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.51
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.55
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.474

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	0.98	0.73	5.45	4.5	1.219	0.76	4.96	0.49
0.07	1.39	0.75	5.84	4.5	1.311	0.55	5.14	0.69
0.15	2.40	1.15	6.46	4.1	1.593	0.49	5.25	1.20
0.25	3.62	1.36	7.46	3.8	1.941	0.38	5.65	1.81
0.52	5.63	1.79	9.04	3.4	2.649	0.32	6.23	2.81
0.66	6.03	2.01	9.22	3.2	2.893	0.34	6.20	3.02
0.84	6.35	2.21	9.34	3.0	3.125	0.36	6.16	3.18
1.22	6.92	2.33	9.79	2.9	3.417	0.34	6.33	3.46
1.64	6.91	2.40	9.71	2.8	3.469	0.35	6.26	3.46
2.25	7.31	2.55	9.96	2.7	3.753	0.36	6.31	3.65
2.75	7.66	2.61	10.25	2.6	3.961	0.35	6.42	3.83
3.27	7.71	2.64	10.26	2.6	4.017	0.35	6.41	3.85
3.77	7.81	2.68	10.34	2.5	4.098	0.35	6.43	3.91
4.28	7.90	2.74	10.37	2.5	4.208	0.35	6.41	3.95
5.11	7.78	2.71	10.27	2.5	4.124	0.36	6.38	3.89
5.89	8.02	2.84	10.38	2.4	4.400	0.36	6.37	4.01
6.65	8.13	2.78	10.56	2.4	4.359	0.35	6.49	4.07
7.66	8.39	2.83	10.76	2.4	4.538	0.34	6.56	4.19
8.42	8.64	2.76	11.09	2.4	4.536	0.33	6.77	4.32
9.45	8.59	2.72	11.07	2.5	4.464	0.32	6.77	4.29
10.23	8.90	2.86	11.25	2.3	4.797	0.33	6.79	4.45
11.00	8.80	2.67	11.33	2.5	4.474	0.31	6.93	4.40
12.03	8.83	2.74	11.29	2.5	4.594	0.32	6.87	4.42
13.30	8.93	2.72	11.41	2.5	4.601	0.31	6.94	4.46
14.34	8.73	2.69	11.25	2.5	4.477	0.31	6.88	4.37
15.88	9.12	2.66	11.66	2.5	4.587	0.30	7.10	4.56
17.15	9.15	2.77	11.59	2.4	4.762	0.31	7.01	4.58
18.44	9.22	2.70	11.72	2.5	4.691	0.30	7.11	4.61
19.74	8.86	2.70	11.36	2.5	4.536	0.31	6.93	4.43
21.51	9.19	2.82	11.56	2.4	4.864	0.31	6.97	4.59

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

R14591

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ient	CEC	Boring No.	SOUTH POND
ent Reference	POND CREEK 080851	Depth(ft.)	NA
roject No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	2

PRESSURES (psi)

Cell Pressure(psi)	46.5
Back Pressure(psi)	36.1
Eff. Cons. Pressure(ps	10.4
Pore Pressure Response (%)	100

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	11.84
Q	=	7.45

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.120	Diameter 1	1.396
Length 2	3.137	Diameter 2	1.398
Length 3	3.135	Diameter 3	1.344
Avg Leng.=	3.131	Avg. Diam.=	1.379

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	18.4
Final Change (ml)	5.6

Initial Dial Reading (D.R.), mils	77
D.R. After Saturation, mils	112
D.R. After Consolidation, mils	166

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.9	0.000	36.1
13.4	0.001	36.8
14.9	0.002	37.0
18.3	0.005	37.4
20.0	0.008	37.8
22.4	0.017	38.7
23.0	0.020	38.9
23.7	0.026	39.3
24.8	0.038	39.9
25.7	0.051	40.3
26.7	0.069	40.9
27.1	0.085	41.1
27.5	0.100	41.3
27.5	0.110	41.5
27.7	0.131	41.6
27.9	0.157	41.8
28.2	0.181	41.9
28.6	0.204	41.9
29.5	0.235	42.0
30.0	0.259	42.1
30.5	0.290	42.1
30.4	0.313	42.0
31.0	0.337	42.1
31.2	0.368	42.0
31.8	0.408	42.2
31.8	0.439	42.1
32.3	0.486	42.1
33.0	0.526	42.2
32.6	0.565	42.1
33.1	0.604	42.2
33.6	0.659	42.2

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

R14592
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INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.4	*Stage No.*	1
		Test No	2

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.49
Initial Sample Volume (in^3)	4.68

VOLUME CHANGE

Volume After Consolidation (in^3)	4.18
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma}_1$	$\overline{\sigma}_3$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.03	3.98	0.65	13.73	9.7	1.408	0.16	11.74	1.99
0.06	5.09	0.89	14.59	9.5	1.535	0.18	12.05	2.54
0.15	7.59	1.34	16.65	9.1	1.838	0.18	12.85	3.79
0.25	8.76	1.72	17.44	8.7	2.010	0.20	13.06	4.38
0.54	10.51	2.62	18.29	7.8	2.351	0.25	13.04	5.26
0.67	10.94	2.79	18.56	7.6	2.438	0.25	13.08	5.47
0.86	11.42	3.19	18.64	7.2	2.584	0.28	12.92	5.71
1.25	12.16	3.85	18.71	6.6	2.856	0.32	12.63	6.08
1.67	12.77	4.19	18.98	6.2	3.055	0.33	12.60	6.38
2.28	13.37	4.77	19.00	5.6	3.373	0.36	12.32	6.68
2.79	13.56	5.04	18.92	5.4	3.530	0.37	12.14	6.78
3.30	13.79	5.25	18.94	5.2	3.675	0.38	12.05	6.89
3.60	13.76	5.40	18.76	5.0	3.751	0.39	11.88	6.88
4.32	13.77	5.50	18.67	4.9	3.812	0.40	11.79	6.89
5.16	13.82	5.69	18.52	4.7	3.934	0.41	11.62	6.91
5.95	13.93	5.80	18.52	4.6	4.029	0.42	11.56	6.96
6.72	14.04	5.83	18.61	4.6	4.072	0.42	11.59	7.02
7.73	14.51	5.87	19.04	4.5	4.205	0.40	11.78	7.26
8.52	14.69	6.01	19.08	4.4	4.349	0.41	11.73	7.35
9.54	14.91	6.01	19.30	4.4	4.397	0.40	11.84	7.45
10.30	14.68	5.94	19.15	4.5	4.289	0.40	11.80	7.34
11.07	14.93	6.00	19.33	4.4	4.390	0.40	11.87	7.46
12.10	14.89	5.95	19.34	4.5	4.346	0.40	11.90	7.45
13.40	15.08	6.10	19.38	4.3	4.506	0.40	11.84	7.54
14.44	14.89	6.03	19.25	4.4	4.410	0.41	11.81	7.44
15.98	14.92	5.99	19.34	4.4	4.381	0.40	11.88	7.46
17.28	15.10	6.12	19.38	4.3	4.528	0.41	11.83	7.55
18.58	14.65	5.96	19.09	4.4	4.303	0.41	11.76	7.33
19.86	14.71	6.07	19.04	4.3	4.398	0.41	11.68	7.35
21.67	14.66	6.08	18.99	4.3	4.393	0.41	11.65	7.33

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	3

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	20.4
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	17.19
Q	=	10.31

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.130	Diameter 1	1.404
Length 2	3.121	Diameter 2	1.373
Length 3	3.136	Diameter 3	1.371
Avg Leng.=	3.129	Avg. Diam.=	1.383

VOLUME CHANGE

Initial Burette Reading (ml)	48.0
Final Burette Reading (ml)	40.5
Final Change (ml)	7.5

Initial Dial Reading (D.R.), mils	60
D.R. After Saturation, mils	68
D.R. After Consolidation, mils	154

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.0
13.5	0.001	34.0
15.7	0.002	34.5
18.9	0.003	35.2
21.3	0.005	35.9
25.0	0.011	37.4
27.3	0.017	38.5
28.7	0.024	39.4
30.6	0.036	40.5
31.7	0.049	41.4
33.1	0.067	42.3
33.8	0.083	42.8
34.5	0.099	43.2
34.7	0.108	43.4
35.2	0.131	43.7
35.9	0.157	44.0
36.6	0.180	44.2
37.1	0.204	44.3
37.5	0.236	44.4
37.8	0.260	44.4
38.3	0.290	44.5
38.7	0.314	44.5
38.8	0.337	44.5
40.1	0.369	44.6
41.4	0.408	44.6
41.7	0.440	44.6
40.5	0.488	44.6
42.1	0.527	44.6
42.5	0.566	44.6
41.7	0.605	44.6
42.3	0.660	44.7

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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R14594

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INTEGRITY IN TESTING

CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.4	*Stage No.*	1
		Test No	3

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.20
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.385

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma}_1$	$\overline{\sigma}_3$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	4.82	3.04	22.17	17.4	1.278	0.64	19.76	2.41
0.05	6.44	3.45	23.39	16.9	1.380	0.54	20.17	3.22
0.10	8.70	4.15	24.95	16.2	1.536	0.48	20.60	4.35
0.17	10.46	4.86	26.01	15.5	1.673	0.47	20.77	5.23
0.37	13.09	6.38	27.10	14.0	1.934	0.49	20.56	6.54
0.58	14.68	7.49	27.59	12.9	2.137	0.52	20.25	7.34
0.80	15.66	8.40	27.66	12.0	2.305	0.54	19.83	7.83
1.18	17.01	9.52	27.89	10.9	2.563	0.57	19.38	8.50
1.61	17.71	10.40	27.71	10.0	2.772	0.59	18.85	8.86
2.22	18.54	11.31	27.63	9.1	3.039	0.62	18.36	9.27
2.74	18.96	11.76	27.60	8.6	3.196	0.63	18.12	9.48
3.26	19.34	12.21	27.53	8.2	3.361	0.64	17.86	9.67
3.57	19.40	12.35	27.45	8.0	3.411	0.64	17.75	9.70
4.31	19.60	12.73	27.27	7.7	3.556	0.66	17.47	9.80
5.17	19.89	12.96	27.33	7.4	3.676	0.66	17.38	9.95
5.94	20.25	13.15	27.50	7.2	3.795	0.66	17.37	10.13
6.73	20.42	13.27	27.54	7.1	3.864	0.66	17.34	10.21
7.78	20.44	13.38	27.46	7.0	3.912	0.66	17.24	10.22
8.55	20.50	13.40	27.50	7.0	3.928	0.66	17.25	10.25
9.57	20.57	13.48	27.49	6.9	3.973	0.66	17.20	10.28
10.34	20.62	13.52	27.50	6.9	3.995	0.66	17.19	10.31
11.11	20.56	13.51	27.45	6.9	3.982	0.66	17.17	10.28
12.15	21.14	13.55	27.99	6.8	4.088	0.65	17.42	10.57
13.45	21.64	13.57	28.47	6.8	4.170	0.63	17.65	10.82
14.49	21.53	13.56	28.36	6.8	4.149	0.64	17.60	10.76
16.07	20.44	13.58	27.26	6.8	3.997	0.67	17.04	10.22
17.35	21.06	13.58	27.88	6.8	4.086	0.65	17.35	10.53
18.64	20.95	13.63	27.72	6.8	4.094	0.66	17.25	10.48
19.92	20.20	13.64	26.96	6.8	3.988	0.68	16.86	10.10
21.74	20.03	13.67	26.77	6.7	3.975	0.69	16.75	10.02

Tested By JCM Date 05/21/08 Input Checked By KR Date 6-19-08

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MOHR TOTAL STRENGTH ENVELOPE

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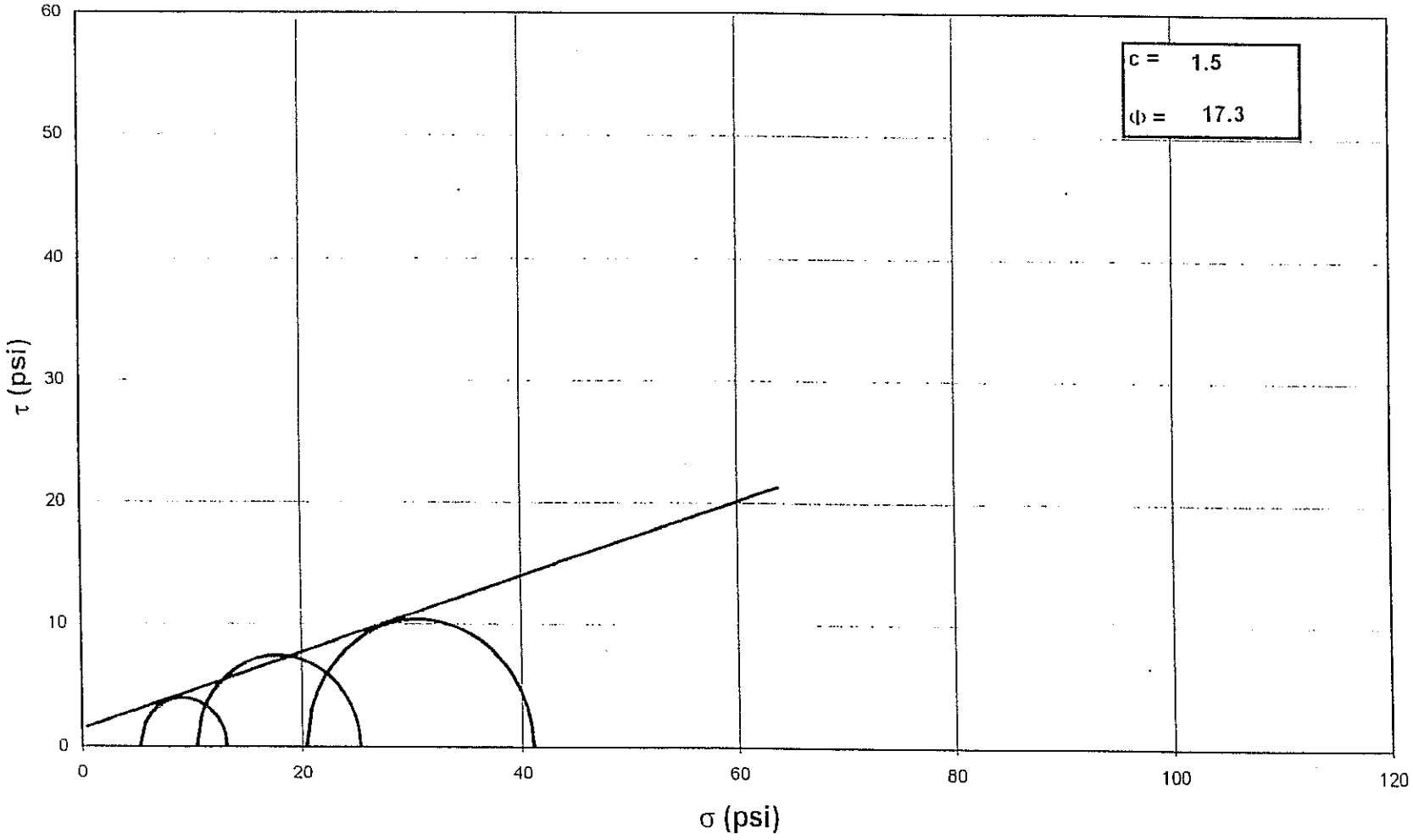
Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/19/08

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R14595

R14596

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	82.6	82.7	79.5
Total Unit Weight (pcf)	76.6	84.2	80.5
Dry Unit Weight (pcf)	42.0	46.1	44.8
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	2.333	2.035	2.119

Tested By JCM Date 05/21/08 Input Checked By KB Date 10-3-08

DCN CT-S28 DATE 6-25-98 REVISION 1

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	41.7	43.3	42.4
Total Unit Weight (pcf)	102.0	102.5	101.8
Dry Unit Weight (pcf)	71.9	71.5	71.5
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	0.944	0.955	0.956

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

DCN CT-S28 DATE 6-25-98 REVISION 1

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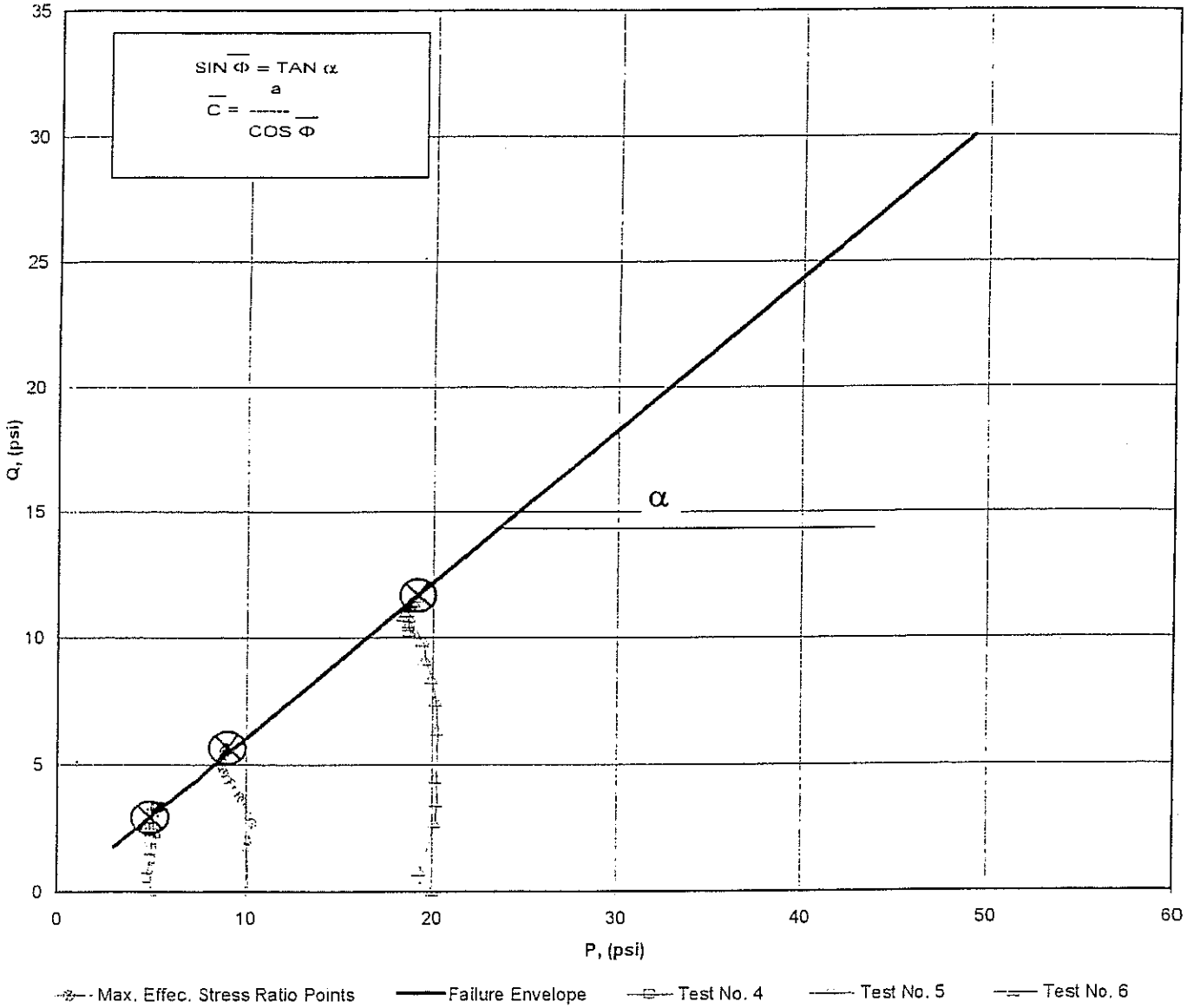
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	31.5	$\bar{\Phi}$	=	37.71

Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

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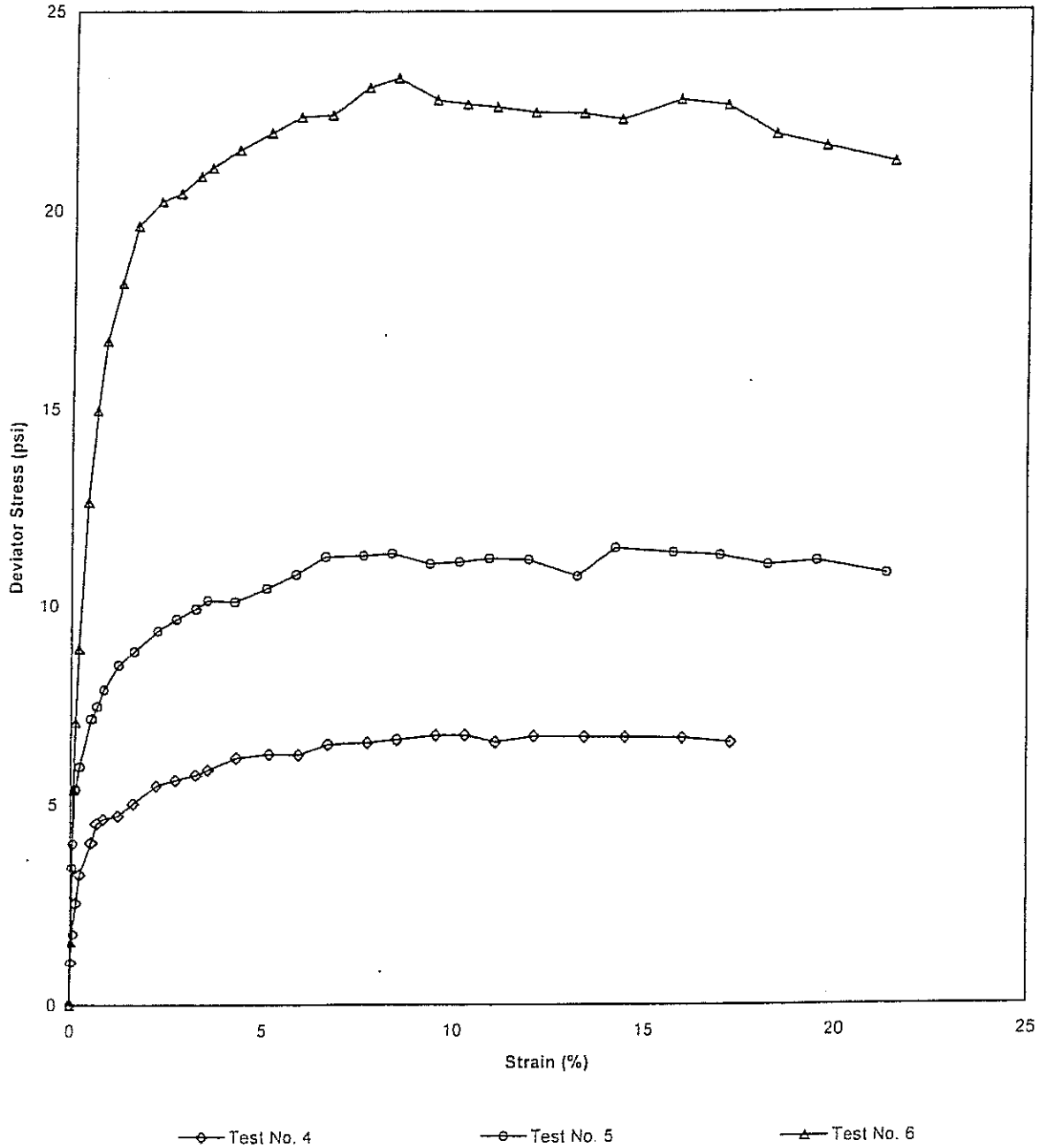
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	4

PRESSURES (psi)

Cell Pressure(psi)	36.3
Back Pressure(psi)	31.2
Eff. Cons. Pressure(psi)	5.1
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	4.92
Q	=	2.94

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.150	Diameter 1	1.453
Length 2	3.142	Diameter 2	1.463
Length 3	3.147	Diameter 3	1.461
Avg Leng.=	3.146	Avg. Diam.=	1.459

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.9
Final Change (ml)	2.1

Initial Dial Reading (D.R.), mils	54
D.R. After Saturation, mils	110
D.R. After Consolidation, mils	130

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.6	0.000	31.2
9.3	0.001	32.1
10.4	0.002	32.3
11.6	0.005	32.6
12.8	0.008	32.9
14.0	0.016	33.3
14.8	0.020	33.3
15.0	0.025	33.6
15.2	0.037	33.8
15.7	0.050	33.9
16.5	0.068	34.2
16.7	0.084	34.2
17.0	0.100	34.2
17.2	0.110	34.3
17.8	0.133	34.2
18.1	0.159	34.3
18.1	0.182	34.3
18.6	0.205	34.2
18.8	0.237	34.2
19.0	0.261	34.3
19.3	0.293	34.3
19.5	0.316	34.2
19.3	0.340	34.3
19.7	0.372	34.2
19.8	0.412	34.3
19.9	0.445	34.3
20.1	0.491	34.2
20.1	0.531	34.2

Tested By JCM Date 05/27/08 Input Checked By HKB Date 6-19-08

DCN: CT-526 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.1	*Stage No.*	1
		Test No	4

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.46
Initial Sample Area (in^2)	1.67
Initial Sample Volume (in^3)	5.26

VOLUME CHANGE

Volume After Consolidation (in^3)	4.85
Length After Consolidation (in)	3.07
Area After Consolidation (in^2)	1.580

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	1.06	0.90	5.26	4.2	1.253	0.86	4.73	0.53
0.07	1.77	1.15	5.72	4.0	1.449	0.66	4.84	0.89
0.15	2.55	1.44	6.21	3.7	1.698	0.58	4.94	1.28
0.25	3.26	1.71	6.65	3.4	1.959	0.53	5.02	1.63
0.53	4.05	2.11	7.04	3.0	2.358	0.53	5.01	2.03
0.65	4.54	2.14	7.50	3.0	2.531	0.48	5.23	2.27
0.82	4.65	2.39	7.36	2.7	2.712	0.52	5.04	2.32
1.21	4.72	2.58	7.25	2.5	2.873	0.56	4.89	2.36
1.62	5.03	2.72	7.42	2.4	3.112	0.55	4.90	2.52
2.22	5.48	2.95	7.63	2.1	3.550	0.55	4.89	2.74
2.74	5.62	3.02	7.70	2.1	3.705	0.55	4.89	2.81
3.27	5.75	3.04	7.81	2.1	3.790	0.54	4.93	2.87
3.59	5.88	3.12	7.86	2.0	3.968	0.54	4.92	2.94
4.33	6.18	3.02	8.27	2.1	3.967	0.50	5.17	3.09
5.17	6.27	3.08	8.30	2.0	4.101	0.50	5.16	3.14
5.93	6.25	3.13	8.22	2.0	4.176	0.51	5.10	3.13
6.69	6.51	3.03	8.58	2.1	4.152	0.48	5.32	3.26
7.73	6.56	3.04	8.62	2.1	4.176	0.47	5.34	3.28
8.50	6.63	3.14	8.59	2.0	4.380	0.48	5.27	3.31
9.53	6.72	3.14	8.68	2.0	4.436	0.48	5.32	3.36
10.30	6.74	3.03	8.81	2.1	4.256	0.46	5.44	3.37
11.09	6.56	3.07	8.59	2.0	4.235	0.48	5.31	3.28
12.10	6.71	3.03	8.78	2.1	4.233	0.46	5.43	3.35
13.42	6.69	3.06	8.74	2.0	4.281	0.47	5.39	3.35
14.49	6.68	3.10	8.68	2.0	4.342	0.47	5.34	3.34
16.00	6.66	3.02	8.74	2.1	4.204	0.46	5.41	3.33
17.29	6.55	3.03	8.62	2.1	4.171	0.47	5.34	3.28

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

ent	CEC	Boring No.	SOUTH POND
ilent Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	5

PRESSURES (psi)

Cell Pressure(psi)	41.1
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	10.1
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	9.00
Q	=	5.66

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.138	Diameter 1	1.407
Length 2	3.138	Diameter 2	1.383
Length 3	3.137	Diameter 3	1.378
Avg Leng.=	3.138	Avg. Diam.=	1.389

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	20.2
Final Change (ml)	3.8

Initial Dial Reading (D.R.), mils	88
D.R. After Saturation, mils	94
D.R. After Consolidation, mils	124

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
8.5	0.000	31.0
13.5	0.001	32.8
14.3	0.002	33.0
16.3	0.004	33.4
17.2	0.007	33.9
18.9	0.016	34.9
19.4	0.020	35.2
20.0	0.025	35.6
21.0	0.038	36.1
21.5	0.051	36.6
22.4	0.070	37.0
22.9	0.085	37.2
23.4	0.101	37.4
23.7	0.110	37.4
23.8	0.132	37.5
24.5	0.158	37.6
25.1	0.181	37.7
26.0	0.205	37.7
26.2	0.236	37.7
26.4	0.259	37.8
26.2	0.290	37.7
26.4	0.314	37.8
26.7	0.338	37.8
26.9	0.370	37.8
26.5	0.410	37.8
27.9	0.441	37.8
28.0	0.488	37.8
28.2	0.527	37.8
28.1	0.566	37.8
28.5	0.605	37.8
28.4	0.661	37.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

DCN CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics INTEGRITY IN TESTING

ent	CEC	Boring No.	SOUTH POND
ient Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.1	*Stage No.*	1
		Test No	5

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.52
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.50
Length After Consolidation (in)	3.10
Area After Consolidation (in^2)	1.450

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma}_1$	$\overline{\sigma}_3$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	3.42	1.75	11.77	8.3	1.410	0.52	10.06	1.71
0.06	4.03	2.01	12.12	8.1	1.497	0.50	10.11	2.01
0.13	5.39	2.43	13.05	7.7	1.703	0.46	10.36	2.69
0.23	5.96	2.92	13.13	7.2	1.830	0.50	10.16	2.98
0.51	7.15	3.87	13.37	6.2	2.148	0.55	9.80	3.57
0.64	7.46	4.19	13.37	5.9	2.262	0.57	9.64	3.73
0.82	7.88	4.57	13.41	5.5	2.427	0.59	9.47	3.94
1.21	8.51	5.13	13.48	5.0	2.714	0.61	9.22	4.26
1.63	8.84	5.57	13.38	4.5	2.950	0.64	8.96	4.42
2.24	9.37	5.97	13.50	4.1	3.271	0.64	8.81	4.69
2.75	9.67	6.18	13.59	3.9	3.468	0.65	8.75	4.84
3.25	9.92	6.35	13.66	3.7	3.648	0.65	8.70	4.96
3.56	10.14	6.40	13.83	3.7	3.741	0.64	8.76	5.07
4.26	10.10	6.55	13.65	3.6	3.843	0.66	8.60	5.05
5.08	10.44	6.59	13.95	3.5	3.978	0.64	8.73	5.22
5.85	10.80	6.68	14.21	3.4	4.161	0.63	8.81	5.40
6.60	11.25	6.70	14.65	3.4	4.304	0.60	9.03	5.62
7.60	11.27	6.75	14.63	3.4	4.363	0.60	8.99	5.64
8.34	11.32	6.76	14.66	3.3	4.395	0.60	9.00	5.66
9.36	11.06	6.74	14.42	3.4	4.292	0.62	8.89	5.53
10.13	11.11	6.76	14.46	3.3	4.323	0.61	8.90	5.56
10.91	11.20	6.81	14.49	3.3	4.401	0.61	8.89	5.60
11.94	11.17	6.80	14.47	3.3	4.383	0.62	8.88	5.58
13.21	10.75	6.76	14.09	3.3	4.214	0.64	8.72	5.37
14.21	11.47	6.77	14.80	3.3	4.445	0.60	9.06	5.73
15.72	11.35	6.78	14.67	3.3	4.418	0.60	9.00	5.68
16.98	11.28	6.79	14.59	3.3	4.411	0.61	8.95	5.64
18.25	11.04	6.80	14.33	3.3	4.350	0.62	8.81	5.52
19.51	11.13	6.82	14.40	3.3	4.397	0.62	8.84	5.56
21.32	10.80	6.85	14.05	3.3	4.318	0.64	8.65	5.40

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	6

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.3
Eff. Cons. Pressure(ps	20.1
Pore Pressure Response (%)	97

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	19.19
Q	=	11.67

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.142	Diameter 1	1.379
Length 2	3.130	Diameter 2	1.377
Length 3	3.141	Diameter 3	1.386
Avg Leng.=	3.138	Avg. Diam.=	1.381

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	17.7
Final Change (ml)	6.3
Initial Dial Reading (D.R.), mils	40
D.R. After Saturation, mils	56
D.R. After Consolidation, mils	91

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
4.3	0.000	31.3
6.5	0.001	32.8
11.7	0.002	33.9
14.0	0.004	34.7
16.6	0.006	35.6
21.7	0.012	37.4
25.0	0.019	38.7
27.5	0.026	39.8
29.6	0.038	40.9
31.7	0.051	41.7
32.8	0.070	42.4
33.2	0.085	42.8
33.9	0.101	43.1
34.3	0.110	43.2
35.2	0.132	43.4
36.1	0.157	43.7
37.0	0.181	43.7
37.3	0.205	43.8
38.7	0.236	43.8
39.3	0.259	43.9
38.9	0.291	43.8
39.0	0.316	43.9
39.2	0.340	43.9
39.4	0.371	43.8
39.9	0.410	43.8
40.1	0.441	43.9
41.5	0.489	43.8
41.9	0.528	43.7
41.2	0.568	43.8
41.3	0.608	43.8
41.4	0.663	43.8

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DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.1	*Stage No.*	1
		Test No	6

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.24
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	Δ U	$\overline{\sigma}_1$	$\overline{\sigma}_3$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	1.58	1.52	20.16	18.6	1.085	0.99	19.37	0.79
0.07	5.38	2.62	22.86	17.5	1.308	0.50	20.17	2.69
0.12	7.06	3.36	23.80	16.7	1.422	0.49	20.27	3.53
0.19	8.92	4.30	24.73	15.8	1.565	0.50	20.26	4.46
0.40	12.65	6.12	26.62	14.0	1.905	0.50	20.30	6.32
0.61	14.97	7.35	27.72	12.7	2.174	0.51	20.23	7.48
0.85	16.72	8.47	28.36	11.6	2.438	0.52	19.99	8.36
1.24	18.18	9.56	28.72	10.5	2.724	0.54	19.63	9.09
1.64	19.63	10.41	29.32	9.7	3.025	0.55	19.51	9.81
2.26	20.24	11.15	29.19	9.0	3.262	0.57	19.07	10.12
2.77	20.44	11.54	29.00	8.6	3.388	0.58	18.78	10.22
3.26	20.87	11.82	29.15	8.3	3.521	0.58	18.71	10.43
3.58	21.09	11.94	29.25	8.2	3.584	0.58	18.70	10.54
4:27	21.54	12.14	29.50	8.0	3.705	0.58	18.73	10.77
5.09	21.97	12.38	29.69	7.7	3.846	0.58	18.71	10.99
5.86	22.37	12.43	30.04	7.7	3.918	0.57	18.85	11.19
6.64	22.41	12.54	29.98	7.6	3.962	0.58	18.77	11.21
7.63	23.10	12.49	30.71	7.6	4.034	0.56	19.16	11.55
8.39	23.33	12.58	30.85	7.5	4.102	0.56	19.19	11.67
9.43	22.79	12.55	30.34	7.6	4.018	0.57	18.95	11.39
10.22	22.67	12.59	30.18	7.5	4.021	0.57	18.84	11.34
11.00	22.61	12.56	30.14	7.5	4.001	0.57	18.84	11.30
12.01	22.49	12.53	30.05	7.6	3.973	0.57	18.81	11.24
13.28	22.46	12.52	30.04	7.6	3.961	0.57	18.81	11.23
14.28	22.30	12.63	29.77	7.5	3.986	0.58	18.62	11.15
15.84	22.80	12.50	30.40	7.6	4.001	0.57	19.00	11.40
17.12	22.66	12.41	30.35	7.7	3.948	0.56	19.02	11.33
18.40	21.92	12.46	29.57	7.6	3.868	0.59	18.61	10.96
19.69	21.62	12.51	29.21	7.6	3.846	0.60	18.40	10.81
21.49	21.21	12.54	28.77	7.6	3.805	0.61	18.17	10.61

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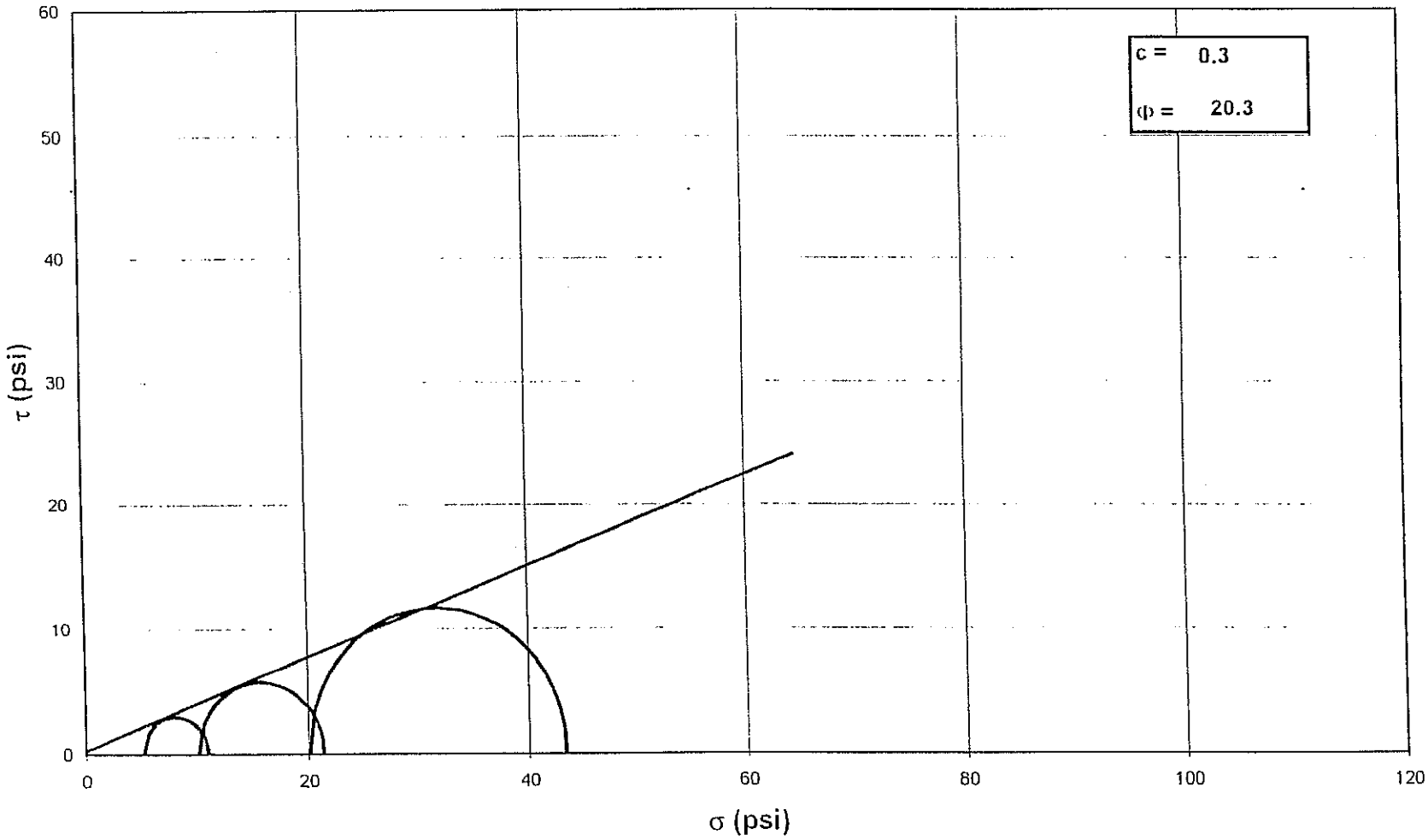
Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/14/08

#N/A

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	82.9	85.7	83.0
Total Unit Weight (pcf)	82.6	82.2	84.5
Dry Unit Weight (pcf)	45.2	44.3	46.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	2.095	2.159	2.029

Tested By JCM Date 05/27/08 Input Checked By KB Date 10-5-08

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	41.5	41.5	40.9
Total Unit Weight (pcf)	92.9	102.5	103.2
Dry Unit Weight (pcf)	65.7	72.4	73.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	1.129	0.931	0.910

Tested By JCM Date 05/27/08 Input Checked By Date

DCN: CT-S28 DATE 6-25-98 REVISION: 1

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REFERENCE 5 AND OTHER PERTINENT FINE COAL REFUSE DATA EFFECTIVE STRESS – TO – STEADY STATE STRENGTH RELATIONSHIPS

R14610

Tailing Dams 2000

PROCEEDINGS

Association of State Dam Safety Officials • U.S. Committee on Large Dams

March 28-30, 2000 • Las Vegas, Nevada

STEADY STATE LIQUEFACTION SUSCEPTIBILITY OF HIGH HAZARD UPSTREAM-CONSTRUCTED COAL REFUSE DISPOSAL FACILITIES

Blaise E. Genes[1], Thomas O. Keller, P.E.[2] and Joseph P. Laird, P.E.[3]

1.0 Introduction

Coal refuse disposal facilities are manifestations of deep mining and surface mining activities and the resulting need for the disposal of waste materials. Due to the massive volumes of materials produced annually by mining operations, these "tailings dams" are among the largest earth structures in the world and consequently, receive intense regulatory and public scrutiny. Coal refuse disposal facilities, their design, construction and operation are regulated by the U.S. Department of Labor, Mine Safety and Health Administration (MSHA). The concern for refuse disposal safety and environmental control by MSHA, the coal industry, engineering consultants and the public has led to the development of design procedures that address these concerns, particularly siting, material handling and placement techniques.

For the most part, tailings dams evaluations are similar to those of water retention dams and address geotechnical issues such as foundation materials, hydrology, hydraulics, seepage control, slope stability (static and seismic), construction practices and long-term monitoring. In the past, pseudo-static analyses were performed to address seismic stability using regional, historic seismic acceleration values and a slightly lowered factor of safety limit to assess adequacy. Empirical evaluations are sometimes performed to address seismic stability with adequacy based on comparison of limited field and laboratory test data with historical performance data of liquefaction and non-liquefaction sites from around the world. During the initial to intermediate stages of a refuse facility design, simplified analytical methods may be appropriate, such as those based on pseudo-static and cone penetration testing (CPT) or standard penetration testing (SPT). However, given the uniqueness and complexity of moderate to high hazard tailings dams, which are significantly influenced by factors such as the number and geometry of upstream stages, deposition history and cross-valley topography, simplified analyses are often inadequate to effectively address safety and cost issues. They often do not account for critical site-specific conditions and may either over-predict strengths leading to a potentially unconservative analysis or under-predict strengths leading to costly remediation efforts.

The focus of this paper is on the application of established steady-state liquefaction evaluation procedures to high hazard tailings dams, assessing liquefaction susceptibility using site-specific data to estimate the factor of safety against a liquefaction flow slide failure. A significant emphasis is placed on obtaining in-situ samples and developing

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properties of the hydraulically placed, fine coal refuse consolidated beneath multiple, upstream-constructed stages of coarse coal refuse. Detailed evaluations have been performed at five Appalachian coal refuse disposal facilities in southern West Virginia as part of the permitting process for the various facilities.

2.0 Analytical Approach

Coal refuse disposal facilities are generally constructed by three methods, either separately or in combination, and include upstream, downstream, and centerline construction. Downstream and centerline constructed facilities typically pose only minor liquefaction concerns since critical failure surfaces pass mainly through the compacted coarse refuse embankments. A typical high hazard, upstream constructed coal refuse facility, such as the one shown in Figure 1, is constructed over long periods of time (up to 25 to 30 years) to heights of 400-plus feet and includes multiple upstream stages "pushed out" into the previous stage's tailings pond. Fine coal refuse consolidated under upstream stages typically is loose to very loose, silty sand to sandy silt- and clay-sized particles, saturated and usually highly contractive. Thus, the potential exists for excess pore pressure generation and significant loss of strength during and following a rapid (undrained) loading event, such as an earthquake.

All five facilities evaluated and discussed in the context of this paper were all moderate to high hazard structures with downstream toe to crest heights varying from 300 to 440 feet. Detailed studies of liquefaction susceptibility were performed using the methodology presented by Poulos, Castro, and France (1985) to estimate in-situ void ratio and undrained steady-state strength of the critical layer, fine coal refuse. Presented below are the generalized results of field and laboratory testing at the various sites. Field testing included performing fixed-piston undisturbed sampling to measure in-situ void ratio and piezo-seismic cone penetration testing (PS-CPT) to evaluate stratigraphy and estimate shear wave velocity with depth. Laboratory strength testing of undisturbed, remolded and slurry fine coal refuse samples was performed to estimate in-situ, undrained steady-state shear strength (S_{us}) and develop a site-specific S_{us}-to-effective stress relationship.

Liquefaction susceptibility was assessed based on the results of limit-equilibrium slope stability analyses. Post-earthquake deformations were estimated using one-dimensional wave propagation and sliding block analysis techniques and the results compared to the available freeboard to assess the likelihood of overtopping. Based on the regional database of information related to S_{us}, various trends regarding the general behavior of fine coal refuse during undrained loading and the practical implications affecting liquefaction susceptibility of upstream-constructed coal refuse impoundments are discussed. Detailed discussions regarding post-earthquake deformation analyses and the seismic response of coal refuse facilities to acceleration time-histories from stochastic simulations of eastern North America earthquakes are reserved for another paper.

3.0 Field Investigations

Fixed Piston Sampling

The main purpose of the subsurface exploration program at the various sites was to obtain high quality "undisturbed" fine coal refuse samples of a character suitable for

laboratory steady-state strength testing. Multiple undisturbed samples were obtained at each site at various depths using a hydraulically actuated Gregory Undisturbed Sampler (GUS) fixed piston sampler. The GUS fixed piston sampler was used to advance a thin-wall galvanized steel sampling tube by delivering drilling fluid pressure to the top of the sampler, which subsequently advanced the tube around a fixed piston. Penetration of the tube into the soil was accurately measured to within ½ to 1 millimeter when "full penetration" of the sampler was achieved. Full penetration of the sampling tube was confirmed by observation of the fluid level in the borehole casing which would dramatically rise when fluid pressure applied to the top of the sampler vented through ports in the sampler. The technique used for undisturbed fixed piston sampling allowed samples to be obtained to depths as great as 344 feet below the ground surface.

Detailed measurements of the tube inside, outside and cutting edge diameters and length were made and volume changes that occurred during sampling calculated in the field from tube penetration and sample recovery measurements. Samples were selected for subsequent laboratory testing based on the quality of the "undisturbed" sample using a criteria for the change in soil volume ($\Delta V/V$). For the fine coal refuse, minimizing the tube clearance ratio [(ID-CE)/CE] minimized sample volume changes, which typically ranged from zero to 2.5 percent. All undisturbed samples were stored in specially designed padded wooden boxes and changes in volume routinely monitored during storage and prior to and following shipment. Prior to laboratory testing, the tube samples were x-rayed and reviewed to select portions of the sample that had a minimum amount of stratification.

Piezo-Seismic/Cone Penetrometer Testing

PS-CPT soundings were performed prior to or concurrently with undisturbed sampling to help delineate the depth to the top and bottom of fine coal refuse. As shown in Figure 2, fine coal refuse layers are characterized by significantly lower tip stresses and elevated pore pressure generation, while the coarse and coarse-fine mix typically yield much higher tip stresses and lower pore pressure generation. Using seismic downhole techniques, estimates of shear wave velocity were obtained at each site to correlate small strain shear modulus (G) with depth. These tests were generally conducted at 5-foot intervals throughout the soil profile to depths of 365 feet at one site. Shear wave velocities for coarse, coarse-fines mix and fine coal refuse ranged from about 1,000 to 2,300 feet per second (fps), 800 to 2,000 fps and 800 to 1,200 fps, respectively. These velocities were based on data from 14 PS-CPT soundings. Velocities varied dramatically with depth, consistent with variations in placement techniques and the micro-layering associated with the deposition history of the facility.

Stratification

Much of the coarse refuse embankment drilled and sampled was dense to very dense as expected due to the structural placement of the material. Loose deposits of fine coal refuse were typically encountered below a dense mixed zone of coarse and fine coal refuse. The fines were characterized by corrected cone tip resistance values between 300 to 1,000 pounds per square inch (psi). The CPT soundings (and visually verified in SPT samples) have shown that there are significantly thick zones of mixed coarse and fine coal refuse. Mixing apparently occurred during the various push-out phases of upstream embankment construction into the tailings pond and possibly from the "pumping" of fines

up into the coarse refuse during subsequent stage construction. Due to the infusion of coarse refuse into the fines, the mix zones typically exhibited significantly higher average cone tip resistance, as well as lower pore pressure generation during cone advancement.

In-Situ Void Ratio

A total of 34 undisturbed fine coal refuse samples were obtained from the various sites. In-situ void ratio was calculated for each based on the field measurements described previously combined with laboratory measurements of the volume of solids in the tube. Table 1 presents a summary of sample depth and calculated in-situ void ratio at each site. Samples were obtained from beneath about 65 to 344 feet of overlying refuse and in-situ void ratios varied from about 0.39 to 0.79, with most (82 percent) of the values between 0.43 and 0.59. While in-situ void ratio is influenced by mean effective stress and time rate of consolidation, the range of values is relatively narrow. Direct correlation between estimated mean effective stress and in-situ void ratio can not be inferred due to the unique and complex nature of each site's geometric constraints and deposition history.

4.0 Laboratory Testing

Steady-state liquefaction-related laboratory test programs of the coal refuse materials sampled from the five sites included performing index tests such as grain size distributions, Atterberg limits, and specific gravity, as well as triaxial shear strength tests on undisturbed, remolded and slurry samples of fine coal refuse. Table 1 presents a summary of laboratory test results from Sites 1 through 5.

Index Tests

Fine coal refuse particles vary in size from about 2 mm (No. 10 sieve) to 0.0005 mm (finer than clay fraction). It is analogous to silty sand to silty clay-sized material. Fines content (passing a No. 200 sieve) for fine coal refuse from the five sites varied from 35 to 76 percent. Fine refuse generally has a low plasticity, ranging from nonplastic to Plasticity Indices of 12 percent or less. Values are affected by the parent rock formation from which the coal was extracted and from clay layers near the coal seam that get mixed within the coal. The specific gravity of fine coal refuse is low and generally varied from about 1.4 to 2.4 for the sites tested. As a result, densities are also relatively low, with in-place total unit weight ranging from about 75 to 90 pounds per cubic foot (pcf).

Steady-State Strength Of Undisturbed Samples

Isotropically consolidated, undrained triaxial compression ($\overline{CU}$) tests were performed on undisturbed, remolded and slurry samples of fine coal refuse. The main purpose of the triaxial tests was to measure the undrained steady-state shear strength of the samples in the laboratory to allow in-situ steady-state shear strengths to be estimated based on void ratio corrections (from laboratory to field). A total of 34 $\overline{CU}$ tests were performed on undisturbed samples of fine coal refuse from the five sites. Specimens were typically consolidated to an isotropic, effective consolidation stress ($\overline{\sigma}_{3c}$) ranging from 8 to 16 kilograms per square centimeter (kg/cm^2) [16.3 to 32.7 kips per square foot (ksf)]. These relatively high confining pressures were used to ensure contractive behavior,

particularly since most samples were obtained from 200 to 344 feet below the ground surface. The samples exhibited contractive behavior and reached or approximately reached a steady-state of deformation within the strain limits of the test. Laboratory values of S_{us} were corrected to represent steady-state strengths at in-situ void ratios.

Steady-State Line and In-Situ Steady-State Strength

Triaxial tests were performed on compacted specimens to determine the steady-state line (SSL) of the fine coal refuse representative for each site. Samples of each batch mix were formed using two methods: 1) by placing layers of fine coal refuse in a split mold and compacting each layer to a target void ratio; and 2) by placing the material in a mold as a slurry subject to one-dimensional consolidation to simulate in-situ placement conditions. The various SSL's for each batch mix are shown in Figure 3 where the slope ($\Delta e/\Delta \log S_{us}$) varies from 0.11 to 0.13 for moist tamped batch samples with additional slurry prepared samples of the batch mix shown for comparison. As discussed by Poulos et. al (1985), the slope of the steady state line is dependent on the shape of the grains and the vertical position is affected by slight differences in grain-size distribution. In general, the variation of the fine refuse coal particle shape from site to site would not be expected to vary significantly since the coal was mined from the same region using generally similar cleaning techniques. However, the fines content of the coal refuse sampled from the region varies widely. Thus, the SSL's in Figure 3 are consistent with the above observations.

In-situ S_{us} for each site was estimated by "correcting" the steady-state strengths at laboratory void ratios to their respective in-situ void ratio along the slope of the SSL as defined by Poulos et. al (1985). In-situ S_{us} values ranged from 0.06 to 4.62 kg/cm^2 (0.122 ksf to 9.42 ksf) with 74 percent of the data falling between 0.25 and 2.1 kg/cm^2 (0.51 ksf to 4.28 ksf). Figure 4 presents correlated S_{us} versus in-situ void ratio for 34 tested samples at the 5 sites. Note that S_{us} values can vary by more than a factor of 10 for a given void ratio.

S_{us} Versus Effective Stress Relationship

The estimation of S_{us} values for fine coal refuse layers that are at in-situ conditions different from the samples obtained and tested were estimated using a correlation between S_{us} and effective vertical stress (σ'_v) determined for each site. This includes proposed upstream stages where sampling is not yet feasible or existing portions of the embankment not sampled due to budgetary constraints. By generally assuming that S_{us} values vary linearly with σ'_v, and estimating the in-situ effective stress conditions for proposed layers of fine coal refuse, the in-situ S_{us} values for the proposed additional zones of fine coal refuse can be approximated. Site-specific S_{us} /σ'_v relationships are presented in Figure 5 and varied from 0.06 to 0.27. The various relationships were approximated by conservatively drawing a line from zero through the location at which two-thirds of the data points at a particular site lie above the line.

The lowest strength relationship was achieved at a narrow valley fill with over 200 feet of coarse and mixed refuse placed above the fine coal refuse. It is deduced that significant arching may be occurring within the coarse refuse preventing the full height of

overburden from consolidating the critical fine coal refuse layer. Therefore, factors such as cross-valley topography and deposition history are significantly relevant to the S_{us}/σ'_v relationship. Similarly, the database of S_{us}/σ'_v relationships obtained from bulk fine coal refuse samples prepared as slurried samples may be used to investigate what kind of relationship with depth (or effective stress) may be expected in the slurry pond prior to any encroachment of coarse embankments. The effective consolidation stresses at which the laboratory tests were performed were converted into equivalent vertical effective stresses in the field, assuming that the lateral stresses are equal to one-half of the vertical stresses. As shown in Figure 6, an S_{us}/σ'_v ratio of 0.18 extends from the zero intercept to the point where two-thirds of the data falls above the straight line.

5.0 Liquefaction Susceptibility Evaluations

Liquefaction susceptibility depends on the S_{us} of all the soils along the potential failure surface compared to the driving stress along that failure surface. Zones of loose (contractive) cohesionless soils are critical to analyzing liquefaction potential because they can have an undrained strength that is significantly lower than their drained strength. Therefore, the embankment geometry was evaluated to assess the liquefaction potential of each stage of construction estimating the average driving shear stresses along the critical failure surface at each of the high hazard sites. Generally, as the construction of future upstream staging progresses, there is a corresponding increase in driving stress. For layers in which fixed-piston samples were obtained and tested, or layers where similar effective stresses are present, a weighted average of steady-state strength, such as the Two-Thirds Strength Method, was utilized. This method, utilized by Castro et. al. (1989) and recommended by the U.S. Army Corps of Engineers (1970) in their manual for analyzing the stability of earth dams, involves using a design shear strength value that is lower than two-thirds of the total test values selected. S_{us} values for fine coal refuse layers at in-situ σ'_v values that significantly differ from the σ'_v values at sample locations were estimated using the site specific S_{us}/σ'_v relationship as previously discussed. Limit equilibrium slope stability analyses were performed at each site with S_{us} values applied to fine coal refuse layers and frictional (drained) strengths applied to coarse and mixed refuse layers. Factors of safety against liquefaction (F_L) along the critical failure surfaces for the various sites ranged from 1.02 to 1.32.

6.0 Notable Trends From Completed Studies

Liquefaction evaluations have been performed at five different sites using steady-state techniques as well as other complementary analyses. Since most of the sites are in the same geographical region, it is useful to compare the results of the fine coal refuse tested to identify trends in its engineering properties. A discussion of notable trends for the presented data is discussed below.

1. Consistent with the sensitivity of S_{us} to void ratio, S_{us} values can vary over 10 times at the same void ratio illustrating the need for site specific testing. In-situ void ratios varied between 0.39 and 0.79, however, most ranged from 0.43 to 0.59.

2. In-situ S_{us} values for unsampled fine coal refuse layers can be estimated based on S_{us} versus σ'_v correlations developed for a particular site. S_{us}/σ'_v relationships used for the coal refuse impoundment sites have ranged from 0.06 to 0.27 also illustrating the need for site specific testing, particularly at facilities with proposed multiple upstream stages.
3. S_{us} and S_{us}/σ'_v are significantly influenced by factors such as cross-valley topography, deposition history, upstream embankment geometry and construction sequencing.

7.0 Conclusions

Steady-state methodology can be effectively applied for the detailed evaluation of the liquefaction susceptibility of high hazard coal refuse disposal facilities. The evaluation needs to be based on site specific geometry and subsurface conditions, and properties developed accounting for the uniqueness and complexity of each site. While it is often useful to express the steady-state strength with respect to an estimated vertical stress, proper caution should be exercised during its development. The database of slurried samples has shown that the behavior of newly deposited fine coal refuse can be reasonably predicted. The S_{us}/σ'_v ratio of fine coal refuse consolidated beneath multiple upstream embankment stages can vary significantly with age, loading history, arching, and geometric constraints. For initial or preliminary liquefaction assessments, it is recommended that a range of S_{us}/σ'_v ratios be used to investigate the sensitivity of the critical layer to liquefaction susceptibility. For detailed evaluations where significant driving stresses are present for multiple upstream stages, site-specific shear strength testing of high quality undisturbed samples is recommended to develop the site's S_{us}/σ'_v relationship and each individual stage evaluated to estimate the factor of safety against liquefaction susceptibility. In general, factors of safety against liquefaction susceptibility were above 1.0 for the existing and proposed staging at the various high hazard sites. Factors of safety below 1.0 indicated the need for remedial design of existing embankments or redesign of the staging for proposed expansions to lower driving stresses.

References

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Table 1: Summary of Strength and Index [illegible] erformed on Fine Coal Refuse Samples

					Field Data			Laboratory Data												
												(CU) Triaxial Results at Peak			Consolidated-Undrained (CU) Triaxial Results at Steady-State (SS)					
Site No.	Sample Type	Percent Passing No. 200 Sieve	PI %	Specific Gravity	Depth to Top of Sample, Feet	Estimated In-Situ Vert. Effective Stress, kg/cm²	Void Ratio In-Situ (Sampled)	Void Ratio In Tube/Mold	Void Ratio During Shear	Lab Effective Consol Stress, kg/cm²	Estimated Equiv. Vert. Effect. Stress In Field [1], kg/cm²	Shear Stress at Peak, q, kg/cm²	Axial Strain, %	Peak Friction Angle	Shear Stress at SS, q, kg/cm²	Minor Principal Stress, kg/cm²	Axial Strain, %	Undrained SS Strength Sus, kg/cm²	SS Friction Friction Angle	Sus at In-Situ Void Ratio, kg/cm²
1	FP	29.4	NA	2.28	90.7	3.45	0.484	0.487	0.402	8.00	12.00	2.70	12.5	34.6	2.68	2.15	17.8	2.23	33.7	0.44
	FP	40.4	NA	2.02	70.3	3.19	0.511	0.515	0.397	8.00	12.00	2.81	12.2	34.7	2.71	2.22	22.6	2.26	33.4	0.19
	FP	44.7	NA	2.37	80.8	3.30	0.488	0.489	0.390	8.00	12.00	2.78	13.2	35.3	2.59	2.17	25.9	2.17	32.9	0.42
	FP	43.6	NA	1.84	75.8	3.25	0.496	0.502	0.384	8.00	12.00	3.38	16.0	33.7	3.29	2.93	22.6	2.78	32.0	0.53
2	FP	47.2	NP	1.76	100.3	4.61	0.665	0.667	0.443	8.00	12.00	3.60	17.9	35.3	3.36	2.75	24.5	2.81	33.4	0.36
	FP	38.8	7	2.01	105.8	4.68	0.460	0.462	0.414	8.00	12.00	3.20	15.1	34.2	3.00	2.65	24.4	2.54	32.1	1.30
	FP	63.9	11	1.63	65.0	4.10	0.553	0.543	0.454	8.00	12.00	2.85	14.2	32.7	2.68	2.58	22.9	2.45	31.9	0.53
	FP	87.0	4	1.84	75.6	4.27	0.541	0.628	0.421	8.00	12.00	3.41	16.7	34.1	3.29	2.78	23.3	2.77	32.8	0.38
1 & 2	BM	34.7	NP	1.98	NA	NA	NA	0.732	0.300	4.00	6.00	0.99	1.6	24.7	0.90	0.81	20.6	0.80	32.8	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.746	0.331	10.00	15.00	2.39	1.8	25.2	2.42	2.03	25.2	2.03	32.9	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.975	0.465	1.00	1.50	0.23	1.2	23.6	0.18	0.14	26.3	0.15	34.1	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.973	0.433	2.00	3.00	0.46	1.3	23.2	0.41	0.35	23.0	0.34	32.9	NA
3	FP	97.7	NA	1.88	310.5	11.02	0.514	0.562	0.510	16.10	24.15	5.07	6.3	30.1	5.87	5.64	6.3	4.91	30.1	4.65
	FP	70.5	NA	1.89	209.5	10.07	0.444	0.460	0.424	16.20	24.30	5.40	7.3	28.1	5.21	5.13	16.5	4.82	27.4	3.15
	FP	78.7	NA	1.85	329.4	11.17	0.443	0.482	0.439	16.10	24.15	5.87	9.4	29.8	5.69	5.12	18.1	4.99	28.8	4.62
	FP	91.7	11	1.88	343.3	11.62	0.541	0.605	0.545	12.00	18.00	4.87	10.2	30.9	4.81	4.68	18.0	4.14	30.5	4.47
	FP	66.6	NA	1.61	290.8	10.65	0.582	0.568	0.485	12.00	18.00	6.57	16.7	33.7	6.57	6.27	16.7	5.47	33.7	0.85
	FP	21.3	NA	1.49	275.8	10.37	0.789	0.790	0.681	8.00	12.00	3.77	19.8	35.0	3.77	2.61	19.8	3.09	35.0	0.06
3	BM	70.1	8	1.80	NA	NA	NA	0.513	0.363	16.20	24.30	5.44	19.3	29.7	5.44	5.56	19.7	4.72	29.7	NA
	BM	70.1	8	1.80	NA	NA	NA	0.483	0.300	8.00	12.00	3.08	20.3	31.2	3.08	2.94	20.3	2.61	31.2	NA
	BM	70.1	8	1.80	NA	NA	NA	0.633	0.479	2.00	3.00	0.65	16.6	33.4	0.65	0.53	16.8	0.54	33.4	NA
	BM	70.1	8	1.80	NA	NA	NA	0.616	0.456	3.00	4.50	1.00	10.6	33.0	1.00	0.83	16.5	0.84	33.0	NA
	BM/S	70.1	8	1.80	NA	NA	NA	1.270	0.407	7.00	10.50	2.31	12.8	32.2	2.31	2.02	12.8	1.95	32.2	NA
	BM/S	37.0	4	2.29	NA	NA	NA	1.070	0.362	7.00	10.50	2.52	17.9	33.4	2.52	2.06	17.9	2.10	33.4	NA
	BM/S	23.6	NA	1.48	NA	NA	NA	0.840	0.504	7.00	10.50	3.71	19.7	35.2	3.71	2.72	19.7	3.03	35.2	NA
4	FP	24.9	NA	1.45	210.0	7.47	0.557	0.595	0.517	12.00	18.00	4.74	19.9	36.1	4.74	3.30	19.9	3.83	36.1	1.78
	FP	15.7	NA	1.48	222.2	7.68	0.540	0.571	0.466	12.00	18.00	4.85	16.7	36.2	4.85	3.45	16.7	3.91	36.2	0.85
	FP	72.0	NA	1.75	135.5	5.49	0.486	0.520	0.456	8.00	12.00	3.41	13.9	33.3	3.37	2.89	18.2	2.84	32.6	1.60
	FP	39.1	NA	1.58	150.2	5.75	0.389	0.400	0.360	8.00	12.00	3.92	14.1	35.2	3.90	3.09	17.8	3.24	33.9	1.86
	FP	71.3	NA	1.70	170.2	6.08	0.467	0.466	0.446	8.00	12.00	3.85	17.3	33.6	3.84	3.30	18.9	3.24	32.5	2.16
	FP	61.0	NA	1.65	218.3	7.74	0.491	0.519	0.453	12.00	18.00	4.94	14.2	33.6	4.89	4.17	17.7	4.11	32.7	1.98
	FP	72.7	NA	1.71	223.3	7.83	0.485	0.482	0.415	12.00	18.00	4.75	13.1	32.4	4.60	4.23	18.3	3.93	31.4	1.60
	FP	75.0	NA	1.73	213.2	7.65	0.484	0.507	0.428	12.00	18.00	6.06	12.8	35.2	4.68	3.77	19.7	3.90	33.6	1.33
4	BM	75.1	12	1.72	NA	NA	NA	0.575	0.410	8.00	12.00	2.99	20.8	32.4	2.92	2.58	18.0	2.47	32.3	NA
	BM	75.1	12	1.72	NA	NA	NA	0.795	0.450	4.00	6.00	1.41	17.3	33.2	1.42	1.18	18.0	1.19	33.0	NA
	BM	75.1	12	1.72	NA	NA	NA	0.804	0.387	11.90	17.85	4.31	19.3	31.8	4.26	3.88	18.0	3.63	31.6	NA
	BM	75.1	12	1.72	NA	NA	NA	0.805	0.491	2.00	3.00	0.66	21.4	32.8	0.62	0.53	18.0	0.52	32.8	NA
	BM/S	75.1	12	1.72	NA	NA	NA	NA	0.465	5.00	7.50	1.68	19.0	34.3	1.85	3.48	18.0	1.55	33.3	NA
	BM/S	52.2	4	1.56	NA	NA	NA	NA	0.380	6.00	7.50	2.48	23.4	37.2	2.48	1.81	23.4	2.02	35.3	NA
5	FP	81.0	NA	1.77	219.9	9.54	0.562	0.580	0.460	12.00	18.00	4.43	10.9	32.9	4.14	3.76	22.2	3.63	31.6	0.63
	FP	48.8	NA	1.64	234.3	9.72	0.546	0.661	0.448	12.00	18.00	5.34	16.7	35.6	5.33	3.86	17.3	4.34	35.4	0.53
	FP	90.6	NA	1.95	260.0	9.93	0.550	0.688	0.505	12.00	18.00	4.33	8.7	28.9	4.22	4.62	13.9	3.71	28.5	1.16
	FP	67.6	NA	1.79	188.3	8.63	0.622	0.515	0.440	12.00	18.00	4.68	8.5	32.8	4.23	3.98	20.7	3.62	31.0	0.64
	FP	88.9	NA	1.96	194.0	8.61	0.658	0.665	0.547	12.00	18.00	4.00	3.5	26.7	3.87	4.70	4.0	3.53	27.1	0.33
	FP	35.5	NA	1.55	233.3	11.02	0.509	0.525	0.421	12.00	18.00	4.63	20.3	35.6	4.63	3.35	20.3	3.77	35.5	0.69
	FP	22.5	NA	1.41	241.0	11.12	0.547	0.551	0.483	12.00	18.00	4.56	20.5	33.7	4.58	3.67	20.8	3.79	33.7	0.98
	FP	34.4	NA	1.64	160.4	8.67	0.626	0.608	0.444	12.00	18.00	4.37	19.6	35.6	4.36	3.21	21.6	3.57	35.1	0.08
	FP	79.5	NA	1.87	166.0	8.05	0.612	0.600	0.448	12.00	18.00	4.37	9.0	32.0	4.01	3.86	21.3	3.46	30.5	0.11
	FP	74.0	NA	1.88	183.3	8.46	0.618	0.588	0.450	12.00	18.00	5.12	8.8	33.7	4.78	4.20	19.4	4.05	32.1	0.12
	FP	80.7	NA	1.88	200.4	10.13	0.562	0.575	0.466	12.00	18.00	4.04	11.0	33.8	3.85	3.21	21.7	3.23	33.0	0.43
	FP	25.5	NA	1.57	210.3	10.53	0.588	0.599	0.480	12.00	18.00	4.88	17.9	36.3	4.75	3.65	24.4	3.90	34.9	0.26
5	BM	62.0	9	1.70	NA	NA	NA	0.546	0.401	8.00	12.00	2.58	19.2	32.9	2.58	2.17	19.2	2.15	32.7	NA
	BM	62.0	9	1.70	NA	NA	NA	0.544	0.473	2.00	3.00	0.58	20.2	34.6	0.58	0.46	20.3	0.48	33.9	NA
	BM	62.0	9	1.70	NA	NA	NA	0.548	0.512	1.00	1.50	0.28	1.7	35.2	0.27	0.21	19.8	0.22	33.7	NA
	BM/S	62.0	9	1.70	NA	NA	NA	0.753	0.358	6.50	9.75	2.32	19.6	32.0	2.32	2.10	19.6	1.98	31.6	NA
	BM/S	85.1	NP	1.88	NA	NA	NA	NA	0.533	6.50	9.75	3.08	18.3	34.8	3.08	2.32	18.3	2.53	34.8	NA

NOTES: FP - Fixed Piston, Undisturbed Sample
BM - Reconstituted Batch Mix Sample Prepared by Moist Tamping
[1] K_o = 0.5 (Ratio of Horizontal to Vertical Effective Stress)
BM/S - Reconstituted Batch Mix Sample Prepared as Slurry
NA - Not Applicable
NP - Non-Plastic
PI - Plasticity Index
$q = (\sigma_1 - \sigma_3) / 2$

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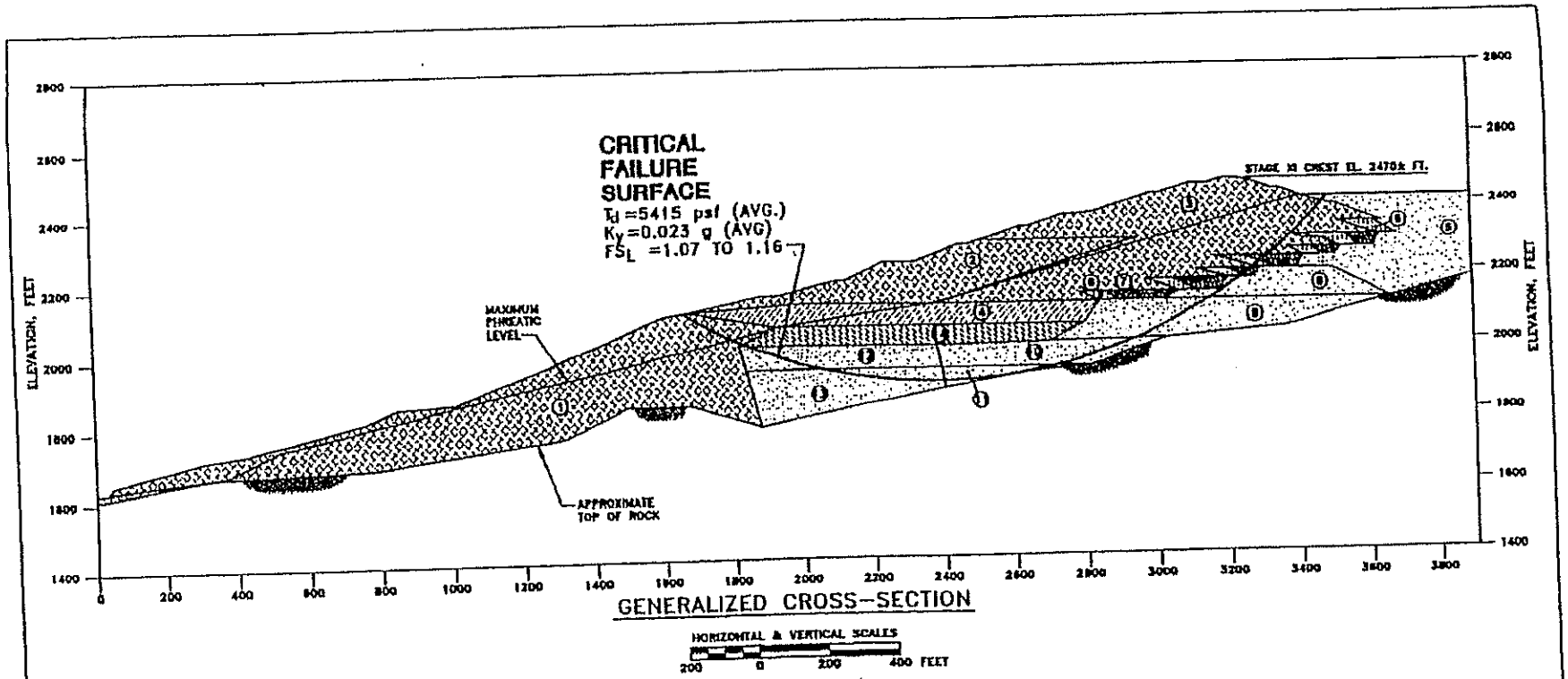

LEGEND:

T_d (AVG.)	AVERAGE IN-SITU STATIC DRIVING SHEAR STRESS
K_y (AVG.)	AVERAGE YIELD ACCELERATION
FS_L (AVG.)&(MAX.)	AVERAGE AND MAXIMUM FACTORS OF SAFETY AGAINST LIQUEFACTION
①	MATERIAL LAYER NO.

- FINE COAL REFUSE
- FINE COAL REFUSE (BEACHED ZONES)
- MIXED COARSE AND FINE COAL REFUSE
- COARSE COAL REFUSE
- COMBINED COAL REFUSE
- MIXED COMBINED AND FINE COAL REFUSE

ALMES & ASSOCIATES, INC.
CONSULTING ENGINEERS
BECKLEY, WV
PITTSBURGH, PA

FIGURE 1
GENERALIZED CROSS-SECTION AND LIQUEFACTION SUSCEPTIBILITY EVALUATION SUMMARY

R14619

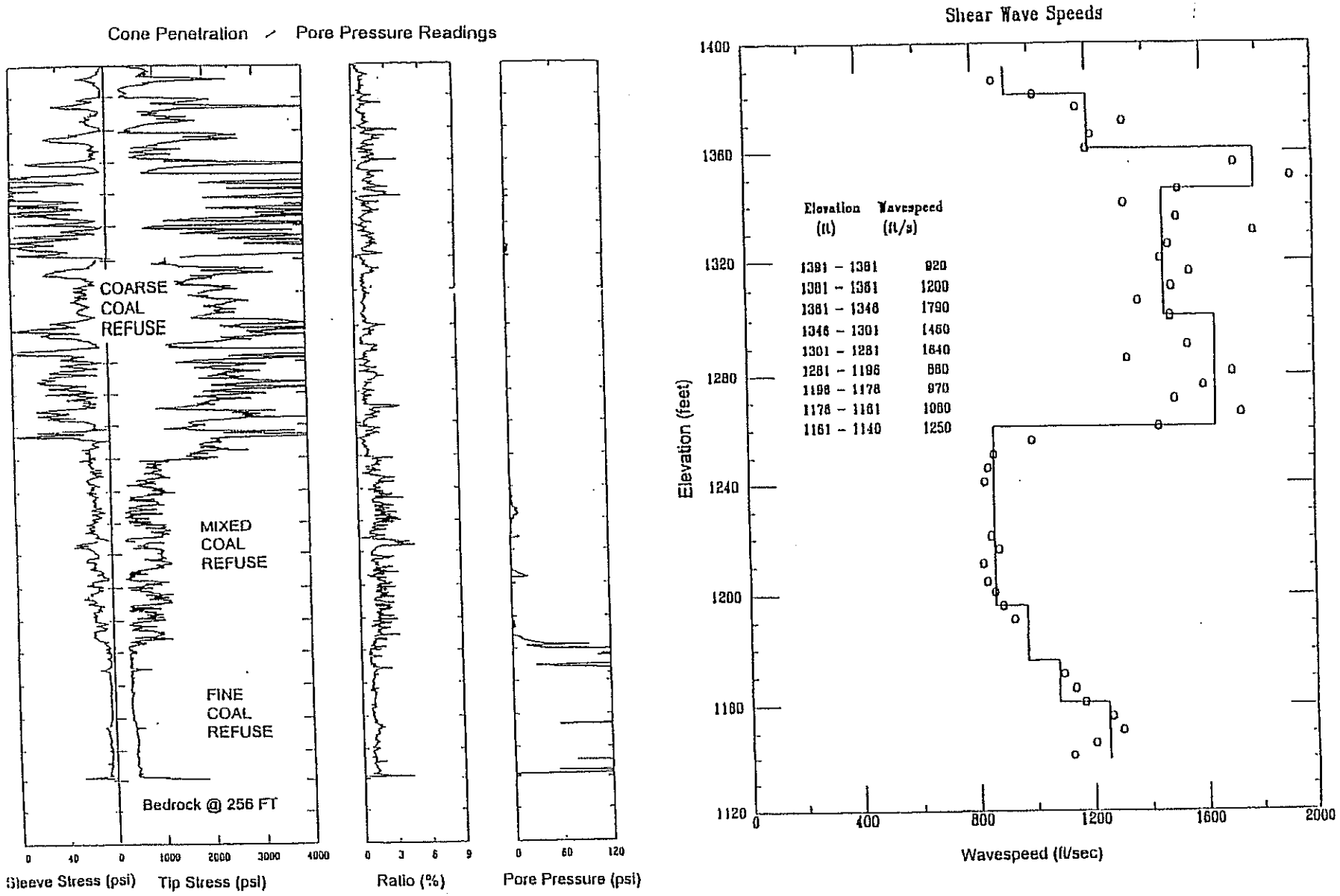

Figure 2 – CPT Log and Shear Wave Velocity Profile

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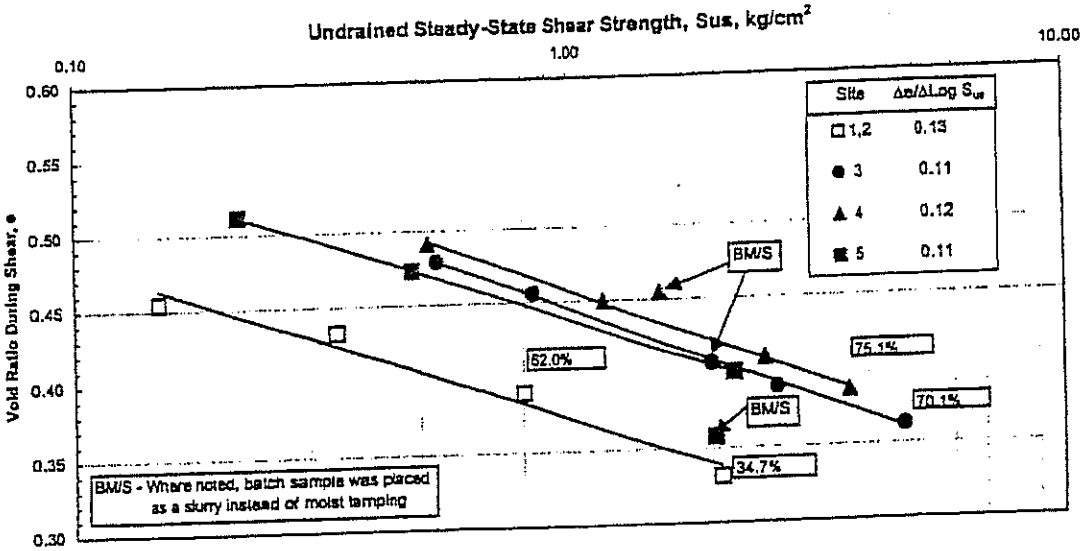


FIGURE 3 - Steady State Lines of Fine Coal Refuse Batch Samples

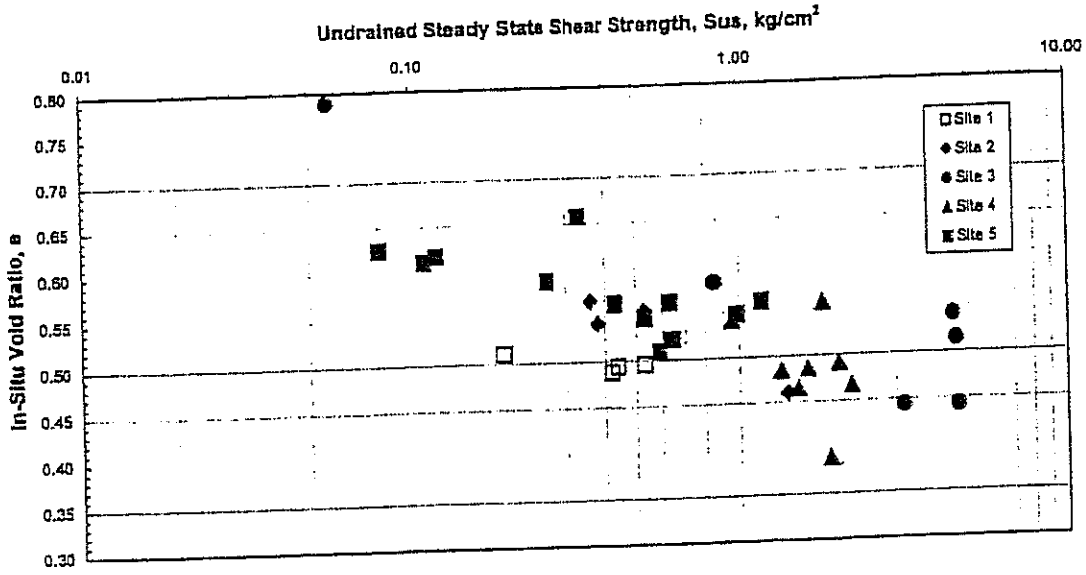


FIGURE 4 - S_{us} of Fixed Piston Samples at In-Situ Void Ratio, After Correction of Lab Void Ratio

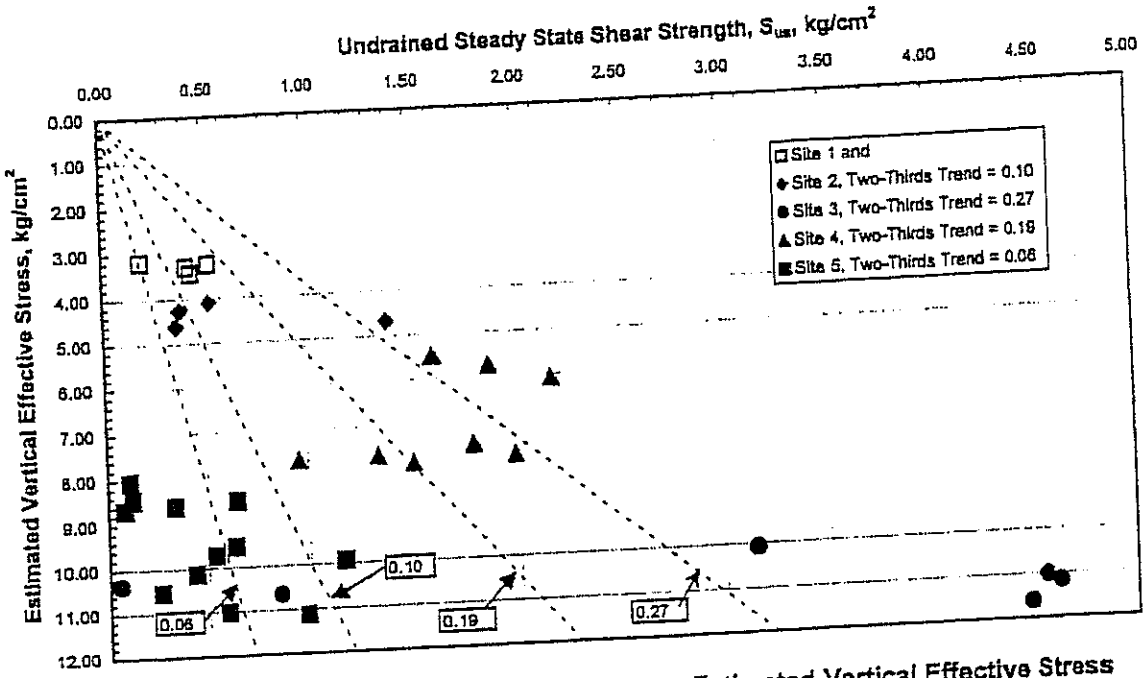


FIGURE 5 - S_{us} of Fixed Piston Samples Versus Estimated Vertical Effective Stress

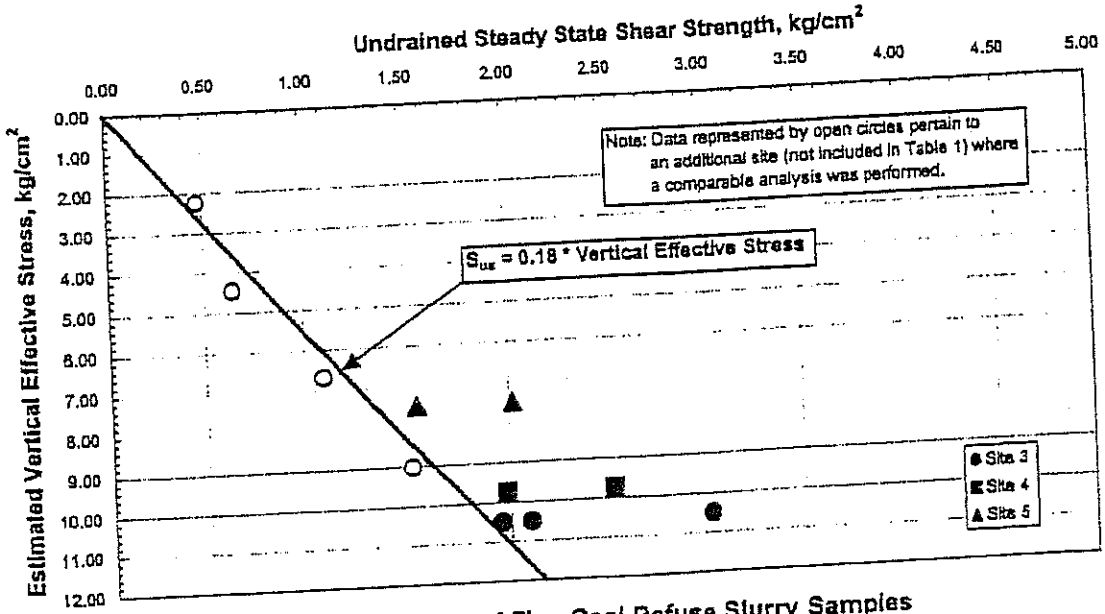
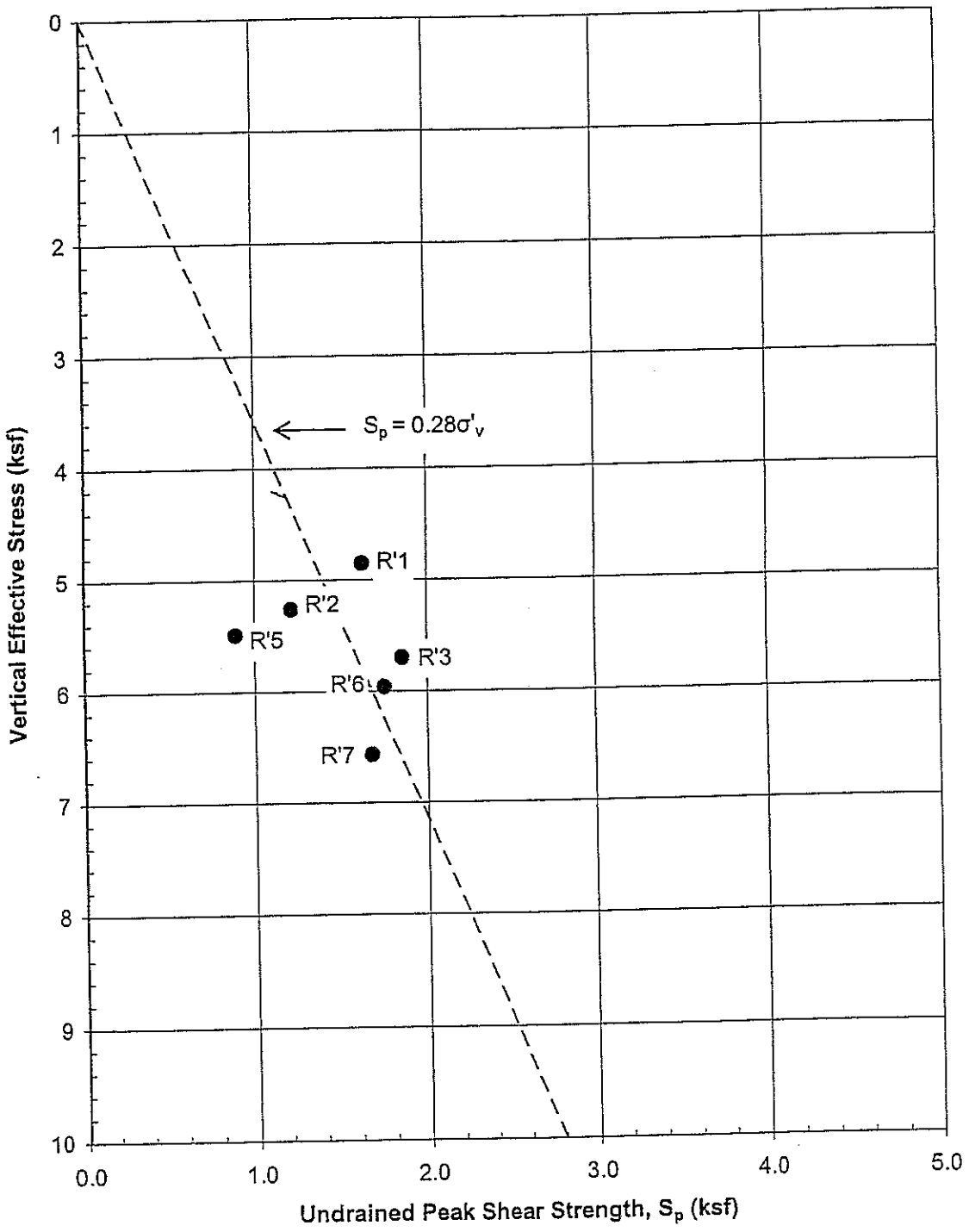
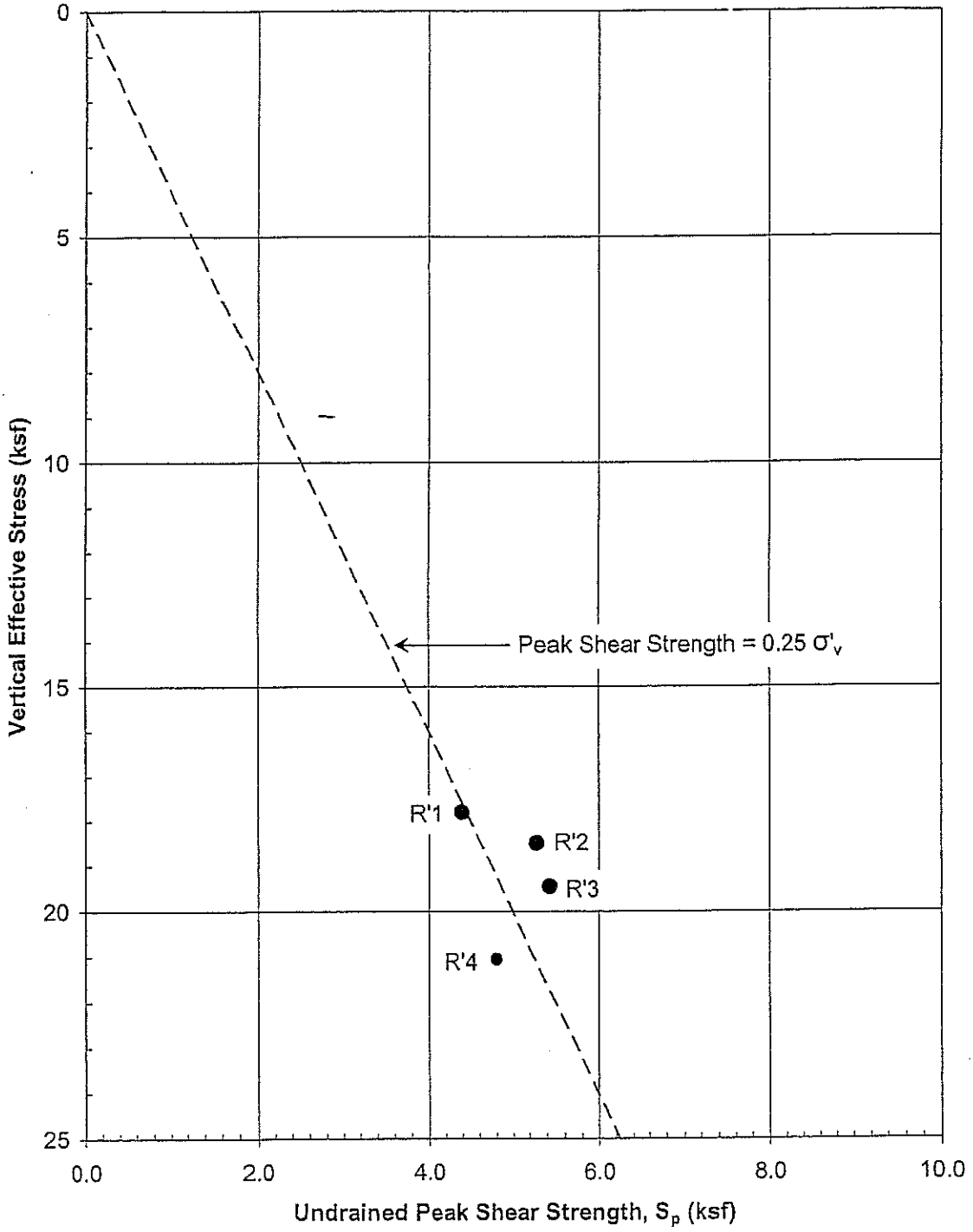


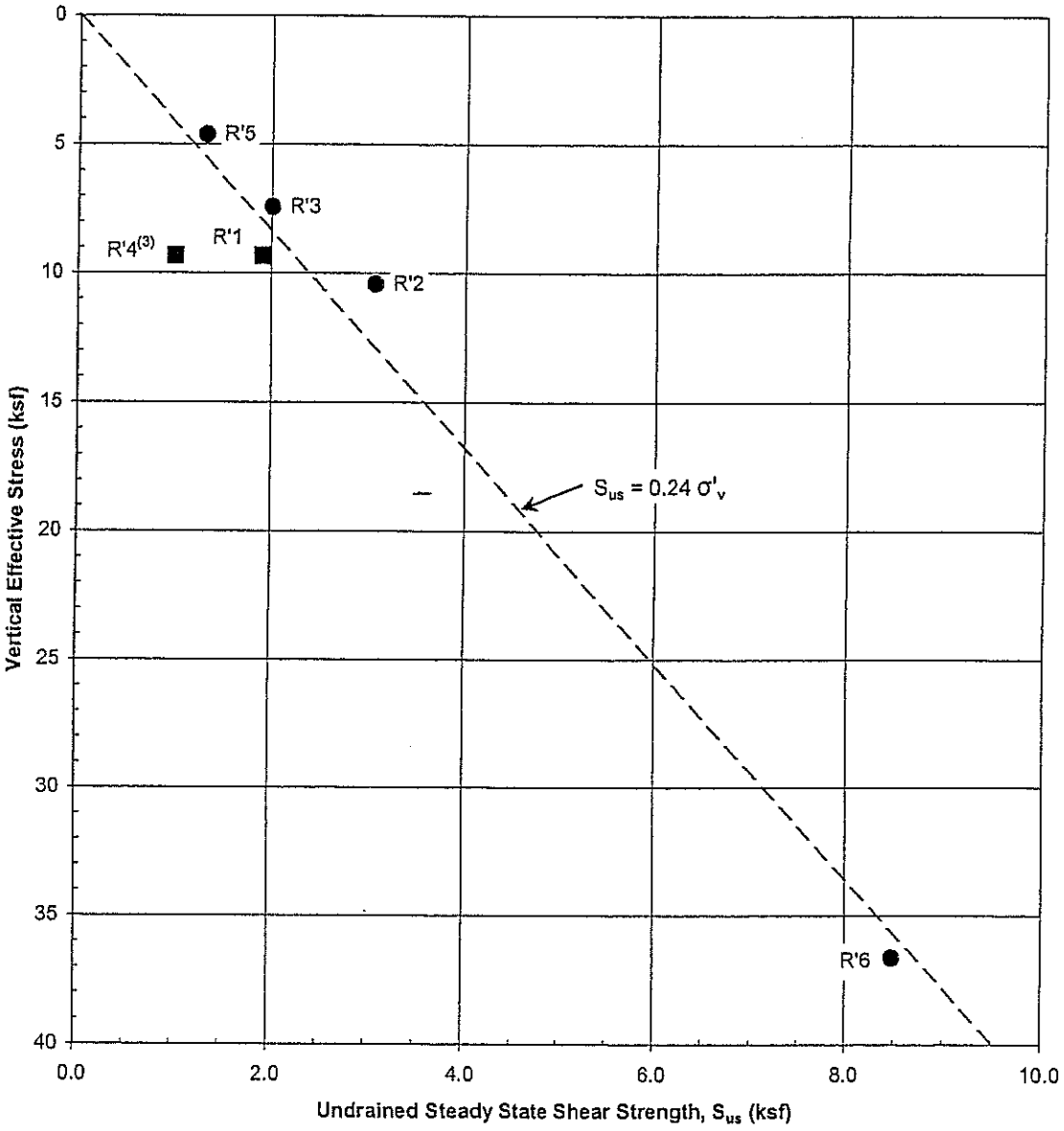
FIGURE 6 - S_{us} of Fine Coal Refuse Slurry Samples Versus Estimated In-Situ Vertical Effective Stress



Harvey Run No. 1 Slurry Impoundment Monongalia County, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_p VERSUS VERTICAL EFFECTIVE STRESS
Consolidation Coal Company Pittsburgh, Pennsylvania	Project 070810	June 2007 Figure 6



Wallace Cabin Branch Slurry Impoundment Wyoming County, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_p VERSUS VERTICAL EFFECTIVE STRESS
Kepler Processing Company Pineville, West Virginia	Project 063560	April 2007 Figure 4



LEGEND
- ● Reconstituted Coal Refuse Slurry Sample
- ■ Undisturbed Tube Sample

NOTES
1. Vertical effective stress for reconstituted coal refuse samples assumed to be 1.5 times the isotropic effective consolidation stress.
2. Vertical effective stress of undisturbed tube samples estimated by CEC, Inc.
3. R'4 composed of two different soil types. S_{us} shown is uncertain.

Hughes Hollow Slurry Impoundment Wana, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_{us} VERSUS VERTICAL EFFECTIVE STRESS
Consolidation Coal Company Pittsburgh, Pennsylvania	Project 063570	February 2007 Figure 3

APPENDIX C

DRIVING SHEAR STRESS AND FACTOR OF SAFETY AGAINST LIQUEFACTION SLOPE STABILITY ANALYSES RESULTS

APPENDIX C

DRIVING SHEAR STRESS AND FACTOR OF SAFETY AGAINST LIQUEFACTION SLOPE STABILITY ANALYSES RESULTS

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Pond Phase 2 Abandonment Evaluation

PROJECT NO. 080-851

Determination of Downstream and Upstream In-Situ Driving Shear Stress by Elastic (GStabl) Solution

PAGE 1 OF 3

MADE BY BEG DATE 7/17/08 CHECKED BY MJS DATE 7/23/08

CALCULATION BRIEF FOR DETERMINATION OF DOWNSTREAM AND UPSTREAM IN-SITU DRIVING SHEAR STRESS BY ELASTIC (GSTABL) SOLUTION

POND CREEK COAL REFUSE DISPOSAL SITE - SOUTH POND

OBJECTIVE: To determine the initial state of static stress (a.k.a., "driving stress") for the fine coal refuse layers in the downstream and upstream directions of the Pond Creek South Pond Phase 2 abandonment geometry. This driving stress will be used to evaluate liquefaction susceptibility of the impoundment by steady-state analysis

METHODOLOGY: Use limit equilibrium analyses to estimate the driving shear stress acting on the most critical circular failure surface passing through the Phase 2 impoundment and embankment geometry shown in Figure 1. Failure planes in both the upstream and downstream directions will be evaluated.

REFERENCES:

1. Gregory, P.E., Garry H., "GSTABL7 with STEDwin Slope Stability Analysis System, Version 2.0," dated September 2001.

2. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak and Steady-State Undrained Shear Strengths For Refuse and Subgrade Materials, Pond Creek Coal Refuse Disposal Site – South Pond", BEG, 7/12/08.

3. Poulos, S.J., Castro, G., and France, J.W. (1985a) "Liquefaction Evaluation Procedure," Journal of the Geotechnical Engineering Division, ASCE, Vol. 111, No. GT6, pp. 772-792.

ANALYSIS:

The Illinois Department of Natural Resources (IDNR) has required that the evaluation of the abandonment condition for the South Pond address the following issues:

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Pond Phase 2 Abandonment Evaluation

PROJECT NO. 080-851

Determination of Downstream and Upstream In-Situ Driving Shear Stress by Elastic (GStabl) Solution

PAGE 2 OF 3

MADE BY BEG DATE 7/17/08 CHECKED BY MJS DATE 7/23/08

1. The classification of the existing condition of the impounded material with respect to its fluid nature; and

2. The liquefaction potential of the impounded material and the related stability of the containing dam.

Determining the in-situ static driving shear stress in a critical (relative to slope stability) soil layer (i.e., fine coal refuse) is one of the steps for evaluating liquefaction susceptibility (No. 2 above). The driving shear stress in a critical soil layer is equal to the minimum shear resistance the layer must have to just maintain stability of the slope. This assumes fully mobilized shear strengths in the other soil layers comprising the slope. The fully mobilized strengths are those that would act while deformation of the slope is occurring and, thus, would be available to resist a massive flow slide. These shear strengths can be quantified by performing a stability analysis for the slope in question.

When evaluating slope stability by means of circular failure surface analysis (using the limit equilibrium approach), the driving shear stress (τ_d) acting along the failure surface analyzed can be determined by assuming that the shearing resistance (i.e., shear strength) of the material through which the failure surface passes is provided solely by cohesion [i.e., angle of internal friction (ϕ) = 0]. The driving stress is determined by varying the cohesion value used in the analysis until a factor of safety (F.S.) of 1.0 is obtained. For this condition (F.S. = 1.0), the driving stress acting along the failure surface analyzed is equal to the cohesion value used for the material.

The following soil properties were estimated based on previous field and laboratory testing as well as current fine coal refuse testing for use in the various post-earthquake liquefaction slope stability analyses:

Material Type	Total Unit Weight (γt) (pcf)	Saturated Unit Weight (γs) (pcf)	Effective Friction (ϕ') (deg)	Effective Cohesion (c') (psf)
Coarse Refuse	130	140	33.7	0
Fine Refuse	80	90	0	Varies
Residual Soil	125	130	19	4000
Soil Cap	130	1135	30	0

Civil & Environmental Consultants, Inc.

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PAGE 3 OF 3

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Note: Refuse properties provided by Alliance Consulting, Inc. based on laboratory testing and/or literature values noted in the Alliance static/seismic slope stability analyses.

Results of Driving Shear Stress Slope Stability Analyses:

Phase 2 Abandonment (Crest El. 502 ft)	Top of Fines Elevation (ft)	Top of Cap Elevation[1] (ft)	Driving Shear Stress in Fine Coal Refuse (τ_d) (psf)
Downstream	496	502	0
Upstream	496	502	0

[1] Cap includes 4-foot coarse refuse and 2-foot soil cover layer above top of fines elevation. Soil cover sloped at one percent to maintain positive drainage.

CONCLUSION:

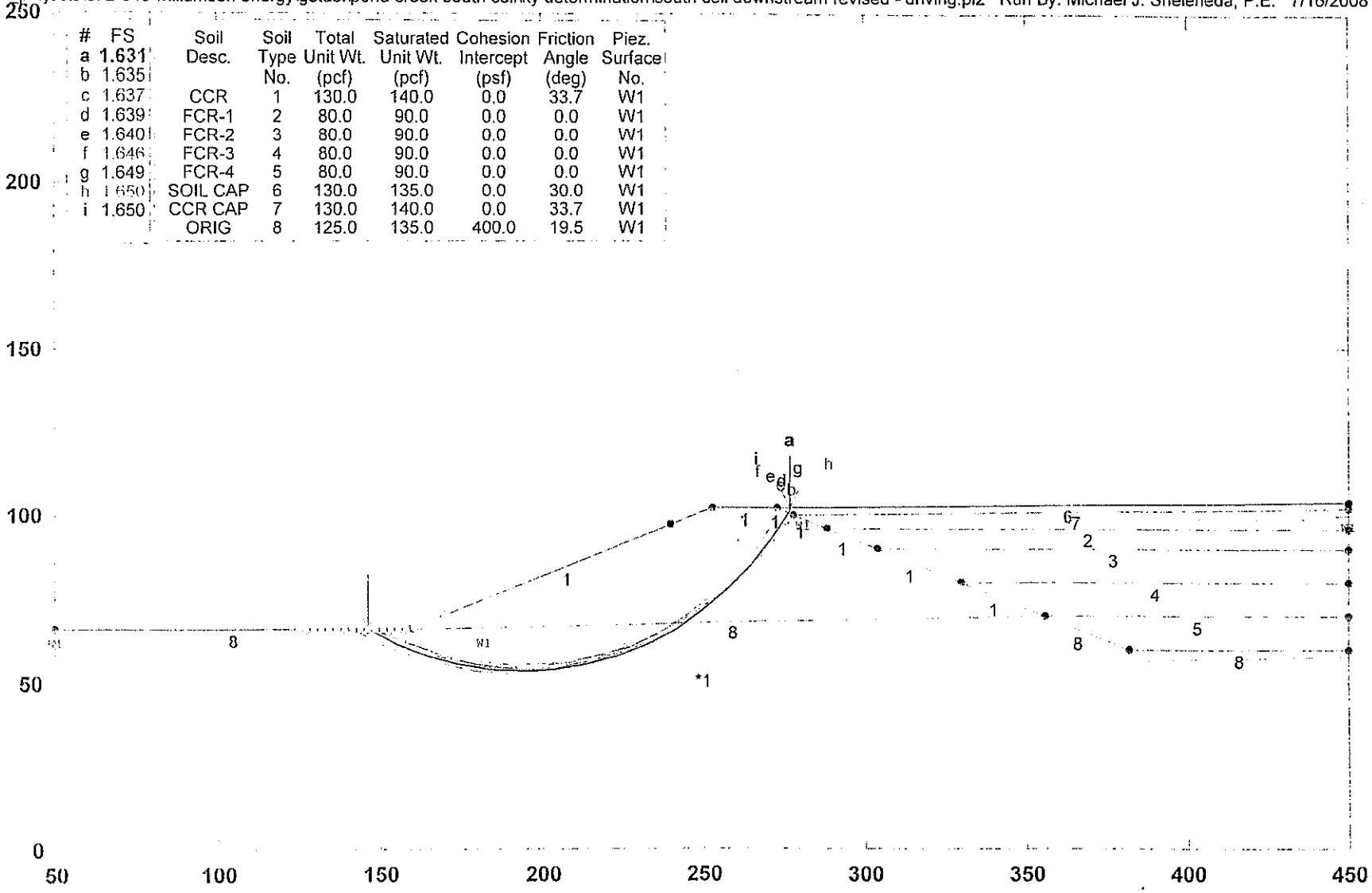
Based on the information presented in this calculation brief, CEC determined that the Pond Creek – Phase 2 abandonment geometry has 0 psf driving shear stress through the fine coal refuse for both the upstream and downstream conditions.

POND CREEK – SOUTH POND ABANDONMENT
GSTABL OUTPUT – DRIVING SHEAR STRESS
STABILITY ANALYSIS OUTPUT FILES
DOWNSTREAM AND UPSTREAM CONDITIONS

Pond Creek, South Cell, Abandonment Post-Eq Downstream Driving Analysis

p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\ky determination\south cell downstream revised - driving.pl2 Run By: Michael J. Sheleheda, P.E. 7/16/2008 11:36AM

#	FS	Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
a	1.631							
b	1.635							
c	1.637	CCR	1	130.0	140.0	0.0	33.7	W1
d	1.639	FCR-1	2	80.0	90.0	0.0	0.0	W1
e	1.640	FCR-2	3	80.0	90.0	0.0	0.0	W1
f	1.646	FCR-3	4	80.0	90.0	0.0	0.0	W1
g	1.649	FCR-4	5	80.0	90.0	0.0	0.0	W1
h	1.650	SOIL CAP	6	130.0	135.0	0.0	30.0	W1
i	1.650	CCR CAP	7	130.0	140.0	0.0	33.7	W1
		ORIG	8	125.0	135.0	400.0	19.5	W1



GSTABL7 v.2 FSmin=1.631

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R14632

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                                  *** GSTABL7 ***
                        ** GSTABL7 by Garry H. Gregory, P.E. **
          ** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
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    ************************************************************************
                        SLOPE STABILITY ANALYSIS SYSTEM
              Modified Bishop, Simplified Janbu, or GLE Method of Slices.
              (Includes Spencer & Morgenstern-Price Type Analysis)
              Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
              Nonlinear Undrained Shear Strength, Curved Phi Envelope,
              Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
              Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
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uth Cell\Ky Determination\south cell downstream revised - driving.PLT
    PROBLEM DESCRIPTION:  Pond Creek, South Cell, Abandonment
                          Post-Eq Downstream Driving Analysis

    BOUNDARY COORDINATES
        4 Top   Boundaries
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17 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	50.00	66.00	159.40	66.00	8
2	159.40	66.00	253.00	102.00	1
3	253.00	102.00	273.00	102.00	1
4	273.00	102.00	450.00	103.75	6
5	273.00	102.00	278.20	100.00	1
6	278.20	100.00	450.00	101.75	7
7	278.20	100.00	288.60	96.00	1
8	288.60	96.00	450.00	96.00	2
9	288.60	96.00	304.20	90.00	1
10	304.20	90.00	450.00	90.00	3
11	304.20	90.00	330.20	80.00	1
12	330.20	80.00	450.00	80.00	4
13	330.20	80.00	356.20	70.00	1
14	356.20	70.00	450.00	70.00	5
15	159.40	66.00	356.20	70.00	8
16	356.20	70.00	382.20	60.00	8
17	382.20	60.00	450.00	60.00	8

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS

8 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	0.0	0.0	0.00	0.0	1
3	80.0	90.0	0.0	0.0	0.00	0.0	1
4	80.0	90.0	0.0	0.0	0.00	0.0	1
5	80.0	90.0	0.0	0.0	0.00	0.0	1
6	130.0	135.0	0.0	30.0	0.00	0.0	1
7	130.0	140.0	0.0	33.7	0.00	0.0	1
8	125.0	135.0	400.0	19.5	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 4 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	50.00	64.00
2	182.00	64.00
3	280.80	99.00
4	450.00	99.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	50.00	50.00	450.00	58.00

EARTHQUAKE DATA HAS BEEN SUPPRESSED
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 125.00(ft)
and X = 170.00(ft)
Each Surface Terminates Between X = 240.00(ft)
and X = 450.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400

Statistical Data On All Valid FS Values:
FS Max = 3.085 FS Min = 1.631 FS Ave = 1.951
Standard Deviation = 0.269 Coefficient of Variation = 13.78 %

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	146.32	66.00
2	155.23	61.48
3	164.58	57.91
4	174.24	55.34
5	184.12	53.79
6	194.11	53.29
7	204.09	53.83
8	213.97	55.41
9	223.62	58.01
10	232.95	61.61
11	241.86	66.16
12	250.23	71.62
13	258.00	77.93
14	265.06	85.01
15	271.34	92.79
16	276.78	101.18
17	277.21	102.04

Circle Center At X = 193.95 ; Y = 148.86 ; and Radius = 95.57

Factor of Safety
*** 1.631 ***

Individual data on the 25 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.9	492.9	0.0	0.0	0.	0.	0.0	0.0	0.0
2	5.0	2091.1	0.0	439.1	0.	0.	0.0	0.0	0.0
3	4.2	2907.5	0.0	923.3	0.	0.	0.0	0.0	0.0
4	5.2	5528.1	0.0	1764.0	0.	0.	0.0	0.0	0.0
5	9.7	16864.1	0.0	4602.1	0.	0.	0.0	0.0	0.0
6	7.8	18896.4	0.0	4542.1	0.	0.	0.0	0.0	0.0
7	2.1	5903.1	0.0	1317.2	0.	0.	0.0	0.0	0.0
8	5.2	15841.2	0.0	3719.4	0.	0.	0.0	0.0	0.0
9	4.7	15746.5	0.0	3929.0	0.	0.	0.0	0.0	0.0
10	10.0	36868.6	0.0	9722.8	0.	0.	0.0	0.0	0.0
11	9.9	40271.4	0.0	11170.8	0.	0.	0.0	0.0	0.0
12	9.7	41681.5	0.0	11976.2	0.	0.	0.0	0.0	0.0
13	9.3	41104.8	0.0	12130.5	0.	0.	0.0	0.0	0.0
14	8.9	38666.4	0.0	11631.9	0.	0.	0.0	0.0	0.0
15	2.4	10150.9	0.0	3151.2	0.	0.	0.0	0.0	0.0
16	6.0	24396.6	0.0	7334.6	0.	0.	0.0	0.0	0.0
17	2.8	10743.4	0.0	3341.8	0.	0.	0.0	0.0	0.0
18	5.0	17622.9	0.0	5363.1	0.	0.	0.0	0.0	0.0
19	7.1	19563.0	0.0	6308.5	0.	0.	0.0	0.0	0.0
20	6.3	11036.7	0.0	3322.9	0.	0.	0.0	0.0	0.0
21	1.7	1740.8	0.0	337.3	0.	0.	0.0	0.0	0.0
22	0.7	592.2	0.0	35.9	0.	0.	0.0	0.0	0.0
23	2.7	1206.0	0.0	0.0	0.	0.	0.0	0.0	0.0
24	0.3	47.3	0.0	0.0	0.	0.	0.0	0.0	0.0
25	0.4	24.4	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.68	66.00
2	157.67	61.62
3	167.07	58.21
4	176.78	55.79
5	186.68	54.41
6	196.68	54.08
7	206.65	54.79
8	216.50	56.54
9	226.10	59.31

10	235.37	63.08
11	244.19	67.80
12	252.46	73.41
13	260.11	79.86
14	267.03	87.07
15	273.16	94.97
16	277.55	102.04

Circle Center At X = 194.87 ; Y = 149.27 ; and Radius = 95.22

Factor of Safety

*** 1.635 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	146.32	66.00
2	155.28	61.56
3	164.66	58.10
4	174.36	55.67
5	184.26	54.28
6	194.26	53.95
7	204.23	54.70
8	214.07	56.50
9	223.65	59.34
10	232.88	63.19
11	241.65	67.99
12	249.86	73.71
13	257.41	80.27
14	264.21	87.59
15	270.20	95.60
16	274.00	102.01

Circle Center At X = 192.27 ; Y = 147.41 ; and Radius = 93.48

Factor of Safety

*** 1.637 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.58	66.00
2	150.50	61.49
3	159.84	57.91
4	169.50	55.31
5	179.37	53.71
6	189.35	53.12
7	199.34	53.56
8	209.24	55.02
9	218.93	57.48
10	228.32	60.91
11	237.31	65.29
12	245.81	70.56
13	253.72	76.68
14	260.97	83.57
15	267.47	91.16
16	273.17	99.38
17	274.62	102.02

Circle Center At X = 190.08 ; Y = 150.88 ; and Radius = 97.76

Factor of Safety

*** 1.639 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.05	66.00
2	159.86	61.27
3	169.18	57.62
4	178.85	55.11
5	188.76	53.77
6	198.76	53.61
7	208.71	54.65
8	218.46	56.86
9	227.88	60.22
10	236.83	64.67

11	245.19	70.16
12	252.84	76.60
13	259.67	83.91
14	265.58	91.97
15	270.49	100.69
16	271.03	102.00

Circle Center At X = 195.05 ; Y = 137.31 ; and Radius = 83.79

Factor of Safety

*** 1.640 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.68	66.00
2	157.44	61.17
3	166.72	57.45
4	176.39	54.89
5	186.30	53.54
6	196.30	53.41
7	206.24	54.51
8	215.96	56.82
9	225.34	60.31
10	234.21	64.91
11	242.46	70.58
12	249.94	77.20
13	256.56	84.70
14	262.21	92.95
15	266.80	101.84
16	266.86	102.00

Circle Center At X = 192.33 ; Y = 134.71 ; and Radius = 81.40

Factor of Safety

*** 1.646 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.68	66.00
2	157.85	61.99
3	167.36	58.90
4	177.13	56.77
5	187.06	55.60
6	197.06	55.41
7	207.02	56.21
8	216.87	57.98
9	226.49	60.71
10	235.79	64.37
11	244.69	68.93
12	253.10	74.34
13	260.94	80.55
14	268.13	87.50
15	274.60	95.13
16	279.40	102.06

Circle Center At X = 193.94 ; Y = 156.89 ; and Radius = 101.54

Factor of Safety

*** 1.649 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	139.21	66.00
2	148.34	61.92
3	157.78	58.61
4	167.46	56.10
5	177.31	54.41
6	187.28	53.55
7	197.28	53.53
8	207.24	54.34
9	217.11	55.98
10	226.80	58.44
11	236.25	61.70
12	245.40	65.73

13	254.18	70.52
14	262.53	76.03
15	270.39	82.21
16	277.71	89.03
17	284.43	96.43
18	288.81	102.16

Circle Center At X = 192.55 ; Y = 172.86 ; and Radius = 119.43

Factor of Safety

*** 1.650 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.05	66.00
2	159.94	61.41
3	169.32	57.95
4	179.05	55.66
5	189.00	54.59
6	198.99	54.75
7	208.90	56.14
8	218.56	58.73
9	227.82	62.50
10	236.55	67.37
11	244.62	73.28
12	251.90	80.13
13	258.28	87.83
14	263.67	96.26
15	266.41	102.00

Circle Center At X = 192.70 ; Y = 135.70 ; and Radius = 81.20

Factor of Safety

*** 1.650 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.58	66.00
2	150.68	61.85
3	160.14	58.60
4	169.86	56.27
5	179.76	54.89
6	189.76	54.47
7	199.74	55.01
8	209.63	56.50
9	219.33	58.94
10	228.75	62.30
11	237.80	66.55
12	246.40	71.65
13	254.47	77.56
14	261.94	84.21
15	268.73	91.55
16	274.78	99.51
17	276.34	102.03

Circle Center At X = 189.16 ; Y = 158.37 ; and Radius = 103.91

Factor of Safety

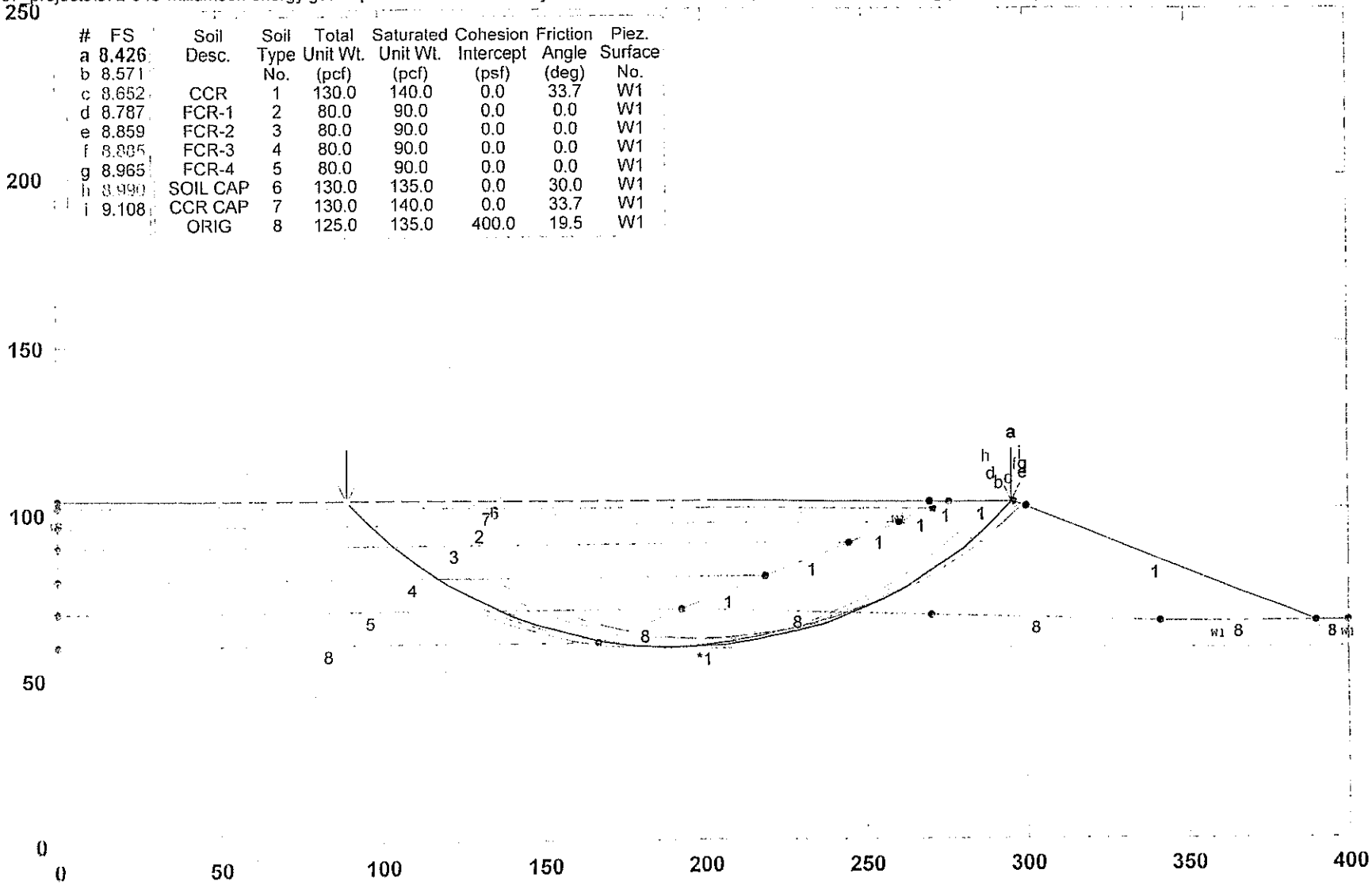
*** 1.653 ***

**** END OF GSTABL7 OUTPUT ****

Pond Creek, South Cell, Abandonment Post-Eq Upstream Analysis - Driving

p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\ky determination\south cell upstream revised - driving.pl2 Run By: Michael J. Sheleheda, P.E. 7/16/2008 11:44AM

#	FS	Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
a	8.426							
b	8.571							
c	8.652	CCR	1	130.0	140.0	0.0	33.7	W1
d	8.787	FCR-1	2	80.0	90.0	0.0	0.0	W1
e	8.859	FCR-2	3	80.0	90.0	0.0	0.0	W1
f	8.885	FCR-3	4	80.0	90.0	0.0	0.0	W1
g	8.965	FCR-4	5	80.0	90.0	0.0	0.0	W1
h	8.990	SOIL CAP	6	130.0	135.0	0.0	30.0	W1
i	9.108	CCR CAP	7	130.0	140.0	0.0	33.7	W1
		ORIG	8	125.0	135.0	400.0	19.5	W1



GSTABL7 v.2 FSmin=8.426

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R14639

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **

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SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

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Time of Run: 11:44AM
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k South Cell\Ky Determination\south cell upstream revised - driving.OUT
Unit System: English
Plotted Output Filename: P:_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek So
uth Cell\Ky Determination\south cell upstream revised - driving.PLT
PROBLEM DESCRIPTION: Pond Creek, South Cell, Abandonment
Post-Eq Upstream Analysis - Driving

BOUNDARY COORDINATES
4 Top Boundaries
19 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	103.75	276.24	102.00	6
2	276.24	102.00	296.24	102.00	1
3	296.24	102.00	389.84	66.00	1
4	389.84	66.00	400.00	66.00	8
5	0.00	101.75	271.04	100.00	7
6	271.04	100.00	276.24	102.00	1
7	0.00	96.00	260.64	96.00	2
8	260.64	96.00	271.04	100.00	1
9	0.00	90.00	245.04	90.00	3
10	245.04	90.00	260.64	96.00	1
11	0.00	80.00	219.04	80.00	4
12	219.04	80.00	245.04	90.00	1
13	0.00	70.00	193.04	70.00	5
14	193.04	70.00	219.04	80.00	1
15	0.00	60.00	167.04	60.00	8
16	167.04	60.00	193.04	70.00	8
17	193.46	70.16	270.39	68.00	8
18	270.39	68.00	341.70	66.00	8
19	341.70	66.00	389.84	66.00	8

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
8 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	0.0	0.0	0.00	0.0	1
3	80.0	90.0	0.0	0.0	0.00	0.0	1
4	80.0	90.0	0.0	0.0	0.00	0.0	1
5	80.0	90.0	0.0	0.0	0.00	0.0	1
6	130.0	135.0	0.0	30.0	0.00	0.0	1
7	130.0	140.0	0.0	33.7	0.00	0.0	1
8	125.0	135.0	400.0	19.5	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 4 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	99.00
2	260.64	99.00
3	359.44	64.00
4	400.00	64.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	0.00	58.00	400.00	58.00

EARTHQUAKE DATA HAS BEEN SUPPRESSED
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00(ft)
and X = 200.00(ft)
Each Surface Terminates Between X = 270.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.85	101.73
3	69.73	100.17
4	79.63	98.75
5	89.55	97.48
6	99.49	96.36
7	109.44	95.39
8	119.40	94.56
9	129.38	93.87
10	139.37	93.34
11	149.36	92.95
12	159.36	92.71
13	169.36	92.62
14	179.36	92.67
15	189.35	92.87
16	199.35	93.22
17	209.34	93.71
18	219.31	94.36
19	229.28	95.15
20	239.24	96.08
21	249.18	97.17
22	259.10	98.39
23	269.01	99.77
24	278.89	101.29
25	283.09	102.00

Factor Of Safety For The Preceding Specified Surface =-22.205
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.58	100.56
3	69.23	97.93
4	78.93	95.53
5	88.70	93.36
6	98.51	91.44
7	108.37	89.76
8	118.26	88.32
9	128.19	87.12

10	138.15	86.17
11	148.12	85.45
12	158.11	84.99
13	168.11	84.76
14	178.11	84.78
15	188.10	85.05
16	198.09	85.56
17	208.06	86.31
18	218.01	87.31
19	227.93	88.55
20	237.82	90.03
21	247.67	91.76
22	257.48	93.72
23	267.23	95.93
24	276.93	98.37
25	286.57	101.04
26	289.71	102.00

Factor Of Safety For The Preceding Specified Surface =-10.349
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.81	101.50
3	69.66	99.75
4	79.53	98.16
5	89.43	96.74
6	99.35	95.49
7	109.29	94.42
8	119.25	93.52
9	129.23	92.79
10	139.21	92.23
11	149.20	91.85
12	159.20	91.63
13	169.20	91.60
14	179.20	91.73
15	189.19	92.04
16	199.18	92.52
17	209.16	93.17
18	219.13	94.00
19	229.08	94.99
20	239.01	96.16
21	248.92	97.51
22	258.80	99.02
23	268.66	100.70
24	275.56	102.00

Factor Of Safety For The Preceding Specified Surface =-17.555
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.78	101.36
3	69.60	99.44
4	79.44	97.69
5	89.31	96.09
6	99.21	94.66
7	109.13	93.39
8	119.07	92.28
9	129.02	91.34
10	138.99	90.56
11	148.97	89.94
12	158.96	89.49
13	168.96	89.20
14	178.96	89.07
15	188.96	89.10

16	198.96	89.30
17	208.95	89.67
18	218.94	90.20
19	228.91	90.89
20	238.88	91.74
21	248.82	92.76
22	258.75	93.94
23	268.66	95.28
24	278.55	96.78
25	288.41	98.45
26	298.24	100.27
27	299.87	100.60

Factor Of Safety For The Preceding Specified Surface =-16.036
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	58.92	98.92
3	68.02	94.77
4	77.28	90.99
5	86.68	87.58
6	96.21	84.55
7	105.85	81.90
8	115.59	79.64
9	125.42	77.77
10	135.31	76.29
11	145.25	75.21
12	155.23	74.53
13	165.22	74.25
14	175.22	74.37
15	185.21	74.89
16	195.17	75.80
17	205.08	77.12
18	214.93	78.83
19	224.71	80.93
20	234.39	83.42
21	243.97	86.30
22	253.42	89.55
23	262.74	93.19
24	271.91	97.19
25	280.90	101.55
26	281.74	102.00

Factor Of Safety For The Preceding Specified Surface =-31.135
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	58.94	98.95
3	68.05	94.82
4	77.32	91.07
5	86.73	87.68
6	96.26	84.68
7	105.91	82.06
8	115.66	79.83
9	125.49	77.99
10	135.39	76.55
11	145.33	75.50
12	155.31	74.85
13	165.31	74.60
14	175.31	74.75
15	185.29	75.30
16	195.25	76.25
17	205.16	77.60
18	215.00	79.34

19	224.77	81.47
20	234.45	84.00
21	244.02	86.90
22	253.46	90.19
23	262.76	93.86
24	271.91	97.89
25	280.31	102.00

Factor Of Safety For The Preceding Specified Surface =-22.593
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.65	100.81
3	69.35	98.39
4	79.10	96.18
5	88.90	94.17
6	98.74	92.37
7	108.61	90.78
8	118.51	89.39
9	128.44	88.22
10	138.40	87.25
11	148.37	86.50
12	158.35	85.95
13	168.35	85.62
14	178.35	85.50
15	188.35	85.59
16	198.34	85.89
17	208.33	86.40
18	218.30	87.12
19	228.26	88.06
20	238.20	89.20
21	248.10	90.55
22	257.98	92.11
23	267.82	93.88
24	277.63	95.86
25	287.38	98.04
26	297.10	100.43
27	299.00	100.94

Factor Of Safety For The Preceding Specified Surface =-17.636
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	67.21	99.76
3	76.65	96.45
4	86.19	93.45
5	95.83	90.77
6	105.54	88.42
7	115.34	86.39
8	125.19	84.68
9	135.09	83.31
10	145.04	82.26
11	155.01	81.55
12	165.01	81.17
13	175.01	81.12
14	185.00	81.40
15	194.98	82.02
16	204.94	82.97
17	214.86	84.25
18	224.73	85.86
19	234.54	87.79
20	244.28	90.05
21	253.94	92.64
22	263.51	95.54

23	272.98	98.76
24	281.55	102.00

Factor Of Safety For The Preceding Specified Surface = -8.537
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	67.52	100.68
3	77.21	98.21
4	86.95	95.95
5	96.75	93.92
6	106.58	92.11
7	116.45	90.52
8	126.36	89.16
9	136.30	88.03
10	146.26	87.13
11	156.23	86.45
12	166.22	86.00
13	176.22	85.78
14	186.22	85.78
15	196.22	86.02
16	206.21	86.48
17	216.18	87.17
18	226.14	88.09
19	236.07	89.23
20	245.98	90.60
21	255.85	92.20
22	265.68	94.02
23	275.47	96.07
24	285.21	98.34
25	294.90	100.83
26	297.43	101.54

Factor Of Safety For The Preceding Specified Surface =-16.382
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	66.76	98.76
3	75.81	94.51
4	85.04	90.64
5	94.41	87.16
6	103.92	84.08
7	113.56	81.39
8	123.29	79.11
9	133.11	77.23
10	143.01	75.77
11	152.95	74.71
12	162.93	74.08
13	172.93	73.86
14	182.93	74.06
15	192.91	74.67
16	202.85	75.70
17	212.75	77.14
18	222.58	79.00
19	232.32	81.26
20	241.95	83.92
21	251.47	86.99
22	260.86	90.45
23	270.09	94.29
24	279.15	98.52
25	285.86	102.00

Factor Of Safety For The Preceding Specified Surface =*******
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.

Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	67.17	99.64
3	76.55	96.19
4	86.04	93.04
5	95.63	90.18
6	105.29	87.62
7	115.04	85.37
8	124.85	83.43
9	134.71	81.79
10	144.62	80.46
11	154.57	79.44
12	164.55	78.73
13	174.54	78.34
14	184.54	78.26
15	194.54	78.49
16	204.52	79.03
17	214.48	79.88
18	224.42	81.05
19	234.31	82.53
20	244.15	84.31
21	253.92	86.40
22	263.63	88.80
23	273.26	91.50
24	282.80	94.50
25	292.24	97.79
26	299.71	100.66

Factor Of Safety For The Preceding Specified Surface =*******
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	67.14	99.58
3	76.51	96.08
4	85.98	92.87
5	95.55	89.97
6	105.21	87.38
7	114.95	85.10
8	124.75	83.13
9	134.61	81.47
10	144.52	80.13
11	154.47	79.10
12	164.44	78.40
13	174.44	78.01
14	184.44	77.94
15	194.43	78.20
16	204.42	78.77
17	214.38	79.66
18	224.30	80.86
19	234.19	82.39
20	244.02	84.22
21	253.78	86.37
22	263.48	88.84
23	273.08	91.61
24	282.60	94.68
25	292.01	98.06
26	299.15	100.88

Factor Of Safety For The Preceding Specified Surface =*******
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38

2	67.77	101.80
3	77.66	100.34
4	87.57	99.01
5	97.50	97.80
6	107.44	96.72
7	117.40	95.77
8	127.36	94.94
9	137.34	94.24
10	147.32	93.67
11	157.31	93.23
12	167.31	92.91
13	177.30	92.71
14	187.30	92.65
15	197.30	92.71
16	207.30	92.90
17	217.30	93.22
18	227.29	93.66
19	237.27	94.23
20	247.25	94.93
21	257.21	95.75
22	267.17	96.70
23	277.11	97.78
24	287.04	98.98
25	296.95	100.31
26	299.62	100.70

Factor Of Safety For The Preceding Specified Surface =-20.548
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	66.88	99.00
3	76.04	94.97
4	85.34	91.32

###################### SOME LINES SKIPPED ######################
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Number of Trial Surfaces with Misleading FS = 144
Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Evaluated = 36.0 %
Statistical Data On All Valid FS Values:
FS Max = 390.835 FS Min = 8.426 FS Ave = 29.886
Standard Deviation = 46.769 Coefficient of Variation = 156.49 %
Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.47	103.18
2	96.57	96.14
3	104.14	89.61
4	112.15	83.62
5	120.57	78.22
6	129.34	73.42
7	138.43	69.25
8	147.79	65.72
9	157.37	62.87
10	167.13	60.69
11	177.02	59.21
12	186.99	58.42
13	196.99	58.34
14	206.97	58.96
15	216.88	60.28
16	226.68	62.29
17	236.31	64.98
18	245.72	68.35

19	254.88	72.37
20	263.73	77.02
21	272.24	82.29
22	280.35	88.13
23	288.03	94.54
24	295.24	101.46
25	295.73	102.00

Circle Center At X = 193.18 ; Y = 200.50 ; and Radius = 142.22

Factor of Safety

*** 8.426 ***

Individual data on the 41 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.0	266.4	0.0	0.0	0.	0.	0.0	0.0	0.0
2	2.2	871.5	0.0	0.0	0.	0.	0.0	0.0	0.0
3	2.9	2132.6	0.0	363.1	0.	0.	0.0	0.0	0.0
4	0.2	149.9	0.0	38.2	0.	0.	0.0	0.0	0.0
5	7.0	8522.5	0.0	3439.7	0.	0.	0.0	0.0	0.0
6	0.5	690.7	0.0	346.7	0.	0.	0.0	0.0	0.0
7	8.0	14368.7	0.0	7728.8	0.	0.	0.0	0.0	0.0
8	5.6	12519.1	0.0	7189.6	0.	0.	0.0	0.0	0.0
9	2.8	6822.4	0.0	4092.0	0.	0.	0.0	0.0	0.0
10	8.8	24133.2	0.0	14465.5	0.	0.	0.0	0.0	0.0
11	7.4	23188.6	0.0	13952.9	0.	0.	0.0	0.0	0.0
12	1.6	5415.3	0.0	3311.8	0.	0.	0.0	0.0	0.0
13	9.4	32625.3	0.0	19665.4	0.	0.	0.0	0.0	0.0
14	9.6	36083.9	0.0	21655.7	0.	0.	0.0	0.0	0.0
15	9.8	38883.1	0.0	23225.8	0.	0.	0.0	0.0	0.0
16	1.2	5010.3	0.0	2971.6	0.	0.	0.0	0.0	0.0
17	8.7	36837.6	0.0	21396.3	0.	0.	0.0	0.0	0.0
18	10.0	45327.4	0.0	25076.4	0.	0.	0.0	0.0	0.0
19	6.0	28647.7	0.0	15329.2	0.	0.	0.0	0.0	0.0
20	0.4	2037.3	0.0	1064.9	0.	0.	0.0	0.0	0.0
21	3.5	17051.7	0.0	8953.6	0.	0.	0.0	0.0	0.0
22	10.0	49067.6	0.0	25180.6	0.	0.	0.0	0.0	0.0
23	9.9	49264.0	0.0	24575.7	0.	0.	0.0	0.0	0.0
24	2.2	10703.5	0.0	5290.0	0.	0.	0.0	0.0	0.0
25	7.6	37565.5	0.0	18246.3	0.	0.	0.0	0.0	0.0
26	9.6	46127.0	0.0	22067.3	0.	0.	0.0	0.0	0.0
27	8.7	39883.1	0.0	18779.2	0.	0.	0.0	0.0	0.0
28	0.7	3032.8	0.0	1396.8	0.	0.	0.0	0.0	0.0
29	0.7	3232.8	0.0	1525.7	0.	0.	0.0	0.0	0.0
30	8.4	35428.8	0.0	16346.2	0.	0.	0.0	0.0	0.0
31	5.8	22263.7	0.0	10196.2	0.	0.	0.0	0.0	0.0
32	3.1	11056.8	0.0	4580.0	0.	0.	0.0	0.0	0.0
33	1.0	3298.4	0.0	1367.8	0.	0.	0.0	0.0	0.0
34	6.3	19528.5	0.0	7405.3	0.	0.	0.0	0.0	0.0
35	1.2	3276.4	0.0	1093.1	0.	0.	0.0	0.0	0.0
36	4.0	9912.6	0.0	3040.5	0.	0.	0.0	0.0	0.0
37	4.1	8432.6	0.0	1818.3	0.	0.	0.0	0.0	0.0
38	3.3	5376.9	0.0	487.5	0.	0.	0.0	0.0	0.0
39	4.4	5332.8	0.0	0.0	0.	0.	0.0	0.0	0.0
40	7.2	3750.3	0.0	0.0	0.	0.	0.0	0.0	0.0
41	0.5	16.9	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.47	103.18
2	96.55	96.11
3	104.11	89.57
4	112.12	83.59
5	120.55	78.20
6	129.34	73.43
7	138.44	69.30
8	147.83	65.85
9	157.43	63.07

10	167.22	60.99
11	177.12	59.62
12	187.10	58.97
13	197.10	59.04
14	207.07	59.83
15	216.96	61.33
16	226.71	63.54
17	236.28	66.44
18	245.61	70.03
19	254.67	74.27
20	263.39	79.16
21	271.74	84.67
22	279.67	90.75
23	287.15	97.40
24	291.63	102.00

Circle Center At X = 191.11 ; Y = 197.72 ; and Radius = 138.80

Factor of Safety

*** 8.571 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.37	103.13
2	104.44	96.06
3	112.02	89.54
4	120.06	83.59
5	128.51	78.25
6	137.34	73.55
7	146.49	69.51
8	155.91	66.16
9	165.55	63.51
10	175.36	61.59
11	185.29	60.39
12	195.28	59.93
13	205.28	60.20
14	215.23	61.22
15	225.07	62.96
16	234.76	65.43
17	244.24	68.61
18	253.47	72.48
19	262.38	77.01
20	270.93	82.20
21	279.07	88.00
22	286.77	94.38
23	293.97	101.32
24	294.58	102.00

Circle Center At X = 196.51 ; Y = 195.25 ; and Radius = 135.33

Factor of Safety

*** 8.652 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	103.23
2	88.68	96.19
3	96.25	89.66
4	104.27	83.68
5	112.68	78.27
6	121.45	73.46
7	130.53	69.28
8	139.88	65.74
9	149.46	62.86
10	159.21	60.66
11	169.10	59.14
12	179.06	58.32
13	189.06	58.20
14	199.04	58.77
15	208.96	60.04
16	218.77	62.00
17	228.41	64.64

18	237.85	67.95
19	247.03	71.91
20	255.92	76.50
21	264.46	81.70
22	272.62	87.48
23	280.35	93.82
24	287.62	100.69
25	288.83	102.00

Circle Center At X = 185.83 ; Y = 201.25 ; and Radius = 143.09

Factor of Safety

*** 8.787 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.26	103.08
2	112.34	96.02
3	119.93	89.51
4	127.99	83.59
5	136.46	78.28
6	145.31	73.62
7	154.48	69.63
8	163.93	66.35
9	173.59	63.77
10	183.42	61.93
11	193.36	60.83
12	203.35	60.47
13	213.35	60.86
14	223.28	61.99
15	233.10	63.87
16	242.76	66.47
17	252.19	69.79
18	261.35	73.81
19	270.18	78.49
20	278.64	83.83
21	286.68	89.78
22	294.25	96.32
23	298.89	100.98

Circle Center At X = 203.14 ; Y = 194.17 ; and Radius = 133.70

Factor of Safety

*** 8.859 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.26	103.08
2	112.35	96.02
3	119.95	89.53
4	128.02	83.63
5	136.52	78.36
6	145.40	73.75
7	154.60	69.83
8	164.07	66.63
9	173.76	64.16
10	183.61	62.43
11	193.56	61.46
12	203.56	61.25
13	213.54	61.80
14	223.46	63.11
15	233.24	65.17
16	242.84	67.97
17	252.20	71.49
18	261.27	75.72
19	269.98	80.62
20	278.30	86.18
21	286.16	92.35
22	293.54	99.10
23	296.25	102.00

Circle Center At X = 201.33 ; Y = 192.41 ; and Radius = 131.18

Factor of Safety

*** 8.885 ***
Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	103.23
2	88.99	96.52
3	96.80	90.28
4	105.00	84.55
5	113.54	79.35
6	122.39	74.69
7	131.52	70.61
8	140.89	67.11
9	150.46	64.21
10	160.19	61.92
11	170.05	60.24
12	179.99	59.20
13	189.99	58.78
14	199.98	59.00
15	209.95	59.84
16	219.84	61.31
17	229.62	63.41
18	239.24	66.12
19	248.68	69.43
20	257.89	73.33
21	266.83	77.80
22	275.47	82.83
23	283.78	88.39
24	291.72	94.47
25	299.11	100.90

Circle Center At X = 191.58 ; Y = 217.09 ; and Radius = 158.31

Factor of Safety
*** 8.965 ***
Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.47	103.18
2	96.59	96.15
3	104.19	89.66
4	112.25	83.75
5	120.73	78.43
6	129.56	73.75
7	138.72	69.73
8	148.14	66.39
9	157.79	63.74
10	167.60	61.81
11	177.53	60.60
12	187.51	60.12
13	197.51	60.37
14	207.46	61.34
15	217.32	63.05
16	227.02	65.46
17	236.52	68.58
18	245.77	72.39
19	254.71	76.86
20	263.31	81.98
21	271.50	87.70
22	279.26	94.01
23	286.54	100.87
24	287.57	102.00

Circle Center At X = 189.08 ; Y = 196.82 ; and Radius = 136.71

Factor of Safety
*** 8.990 ***
Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.37	103.13
2	104.65	96.28
3	112.40	89.95

4	120.57	84.19
5	129.12	79.01
6	138.02	74.45
7	147.21	70.52
8	156.66	67.24
9	166.32	64.64
10	176.13	62.72
11	186.06	61.50
12	196.04	60.97
13	206.04	61.15
14	216.00	62.03
15	225.88	63.61
16	235.62	65.87
17	245.18	68.81
18	254.50	72.42
19	263.55	76.67
20	272.28	81.55
21	280.65	87.03
22	288.61	93.08
23	296.12	99.68
24	297.82	101.39

Circle Center At X = 198.47 ; Y = 203.21 ; and Radius = 142.26

Factor of Safety

*** 9.108 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	103.23
2	88.66	96.17
3	96.23	89.64
4	104.25	83.66
5	112.67	78.28
6	121.47	73.52
7	130.58	69.40
8	139.97	65.95
9	149.58	63.18
10	159.36	61.11
11	169.27	59.75
12	179.25	59.11
13	189.25	59.18
14	199.21	59.98
15	209.10	61.48
16	218.85	63.70
17	228.42	66.61
18	237.75	70.20
19	246.80	74.45
20	255.52	79.35
21	263.87	84.85
22	271.80	90.95
23	279.27	97.60
24	283.55	102.00

Circle Center At X = 183.15 ; Y = 197.89 ; and Radius = 138.84

Factor of Safety

*** 9.115 ***

**** END OF GSTABL7 OUTPUT ****

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Pond Phase 2 Abandonment Evaluation
Post-Earthquake Stability Analyses and Factor of Safety Against Liquefaction – South Pond Stage 2
Downstream and Upstream Slope Geometries

PROJECT NO. 080-851

PAGE 1 OF 4

MADE BY BEG DATE 7/17/08 CHECKED BY NJS DATE 7/23/08

CALCULATION BRIEF FOR AND FACTOR OF SAFETY AGAINST LIQUEFACTION FOR THE DOWNSTREAM AND UPSTREAM SLOPE GEOMETRIES

POND CREEK COAL REFUSE DISPOSAL SITE - SOUTH POND

OBJECTIVE: To determine the factor of safety against liquefaction (F_L) for the Pond Creek – South Pond Phase 2 abandonment embankment and impoundment using the undrained steady-state shear strengths (S_{us}) determined for the impounded fine coal refuse.

METHODOLOGY: Use GSTABL limit equilibrium analyses and fine coal refuse S_{us} values to determine F_L for the Pond Creek – South Pond Phase 2 abandonment embankment for both downstream and upstream critical failure surfaces.

REFERENCES:

1. Gregory, P.E., Garry H., "GSTABL7 with STEDwin Slope Stability Analysis System, Version 2.0," dated September 2001.

2. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Determination of Downstream and Upstream In-Situ Driving Shear Stress by Elastic (GStabl) Solution," Pond Creek Coal Refuse Disposal Site – South Pond," BEG, 7/12/08.

3. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak and Steady-State Undrained Shear Strengths For Refuse and Subgrade Materials, Pond Creek Coal Refuse Disposal Site – South Pond," BEG, 7/12/08.

4. Poulos, S.J., Castro, G., and France, J.W. (1985a) "Liquefaction Evaluation Procedure," Journal of the Geotechnical Engineering Division, ASCE, Vol. 111, No. GT6, pp. 772-792.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Pond Phase 2 Abandonment Evaluation
Post-Earthquake Stability Analyses and Factor of Safety Against Liquefaction – South Pond Stage 2
Downstream and Upstream Slope Geometries

PROJECT NO. 080-851

MADE BY BEG DATE 7/17/08 CHECKED BY MGS DATE 7/23/08

ANALYSIS:

The Illinois Department of Natural Resources (IDNR) has required that the evaluation of the abandonment condition for the South Pond address the following issues:

1. The classification of the existing condition of the impounded material with respect to its fluid nature; and

2. The liquefaction potential of the impounded material and the related stability of the containing dam.

Post-earthquake factors of safety against a liquefaction flow failure (F_L) were calculated using steady-state principles and the Phase 2 upstream and downstream embankment/impoundment conditions. Following the estimation of in-situ driving shear stresses for Phase 2, the average vertical effective stress along the critical failure surface and various fine coal refuse "micro" layers was calculated. The σ'_V values were determined at various stations at layer boundary locations shown in Figure 1. S_{us} values were then estimated by multiplying the in-situ average σ'_V for each layer by the 0.24 ratio. Figure 1 presents the S_{us} values estimated for each fine coal refuse layer used in the downstream post-earthquake stability analyses.

The following soil properties were estimated based on previous field and laboratory testing as well as current fine coal refuse testing for use in the various post-earthquake liquefaction slope stability analyses:

Summary of Engineering Properties

Material Type	Total Unit Weight (γt) (pcf)	Saturated Unit Weight (γs) (pcf)	Effective Friction, (ϕ') (deg)	Effective Cohesion (c') (psf)
Coarse Refuse	130	140	33.7	0
Fine Refuse	80	90	0	200 to 276
Residual Soil	125	130	19	4000
Soil Cap	130	1135	30	0

Note: Refuse properties provided by Alliance Consulting, Inc. based on laboratory testing and/or literature values noted in the Alliance static/seismic slope stability analyses.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Pond Phase 2 Abandonment Evaluation
Post-Earthquake Stability Analyses and Factor of Safety Against Liquefaction – South Pond Stage 2
Downstream and Upstream Slope Geometries

PROJECT NO. 080-851

PAGE 3 OF 4

MADE BY BEG DATE 7/17/08 CHECKED BY MJS DATE 7/23/08

Using the impoundment geometry shown in Figure 1, a series of GSTABL7 analyses were performed to identify the most critical circular failure surface passing through the Stage 2 impoundment for both the downstream and upstream (abandonment) conditions. The range of starting and ending points for failure circle generation were iteratively analyzed to evaluate the critical failure surface and included the entire impoundment surface. The drained strengths of the coarse and total strength of the residual soil described above were used while the cohesion values for the fine coal refuse layers were modeled using the steady-state to effective stress relationship determined in Ref. 2 to estimate a factor of safety of against liquefaction.

The minimum safety factor against liquefaction in the downstream direction for this critical stage is 1.6, and in the upstream direction, the minimum F_L is 8. These results are based on a site-specific steady-state shear strength to effective stress relationship ($S_{us} = 0.24\ \sigma'_v$), which relates the shear strength of slurry fine coal refuse samples with the estimated vertical effective overburden pressure above the fine coal refuse layers. The following table presents the results of the downstream and upstream post-earthquake stability analyses. GSTABL output files are presented in Appendix C for the South Pond Phase 2 impoundment.

Phase 2 Abandonment (Crest El. 502 ft)	Top of Fines Elevation (ft)	Top of Cap Elevation[1] (ft)	Driving Shear Stress in Fine Coal Refuse (τ_d) (psf)	Factor of Safety Against Liquefaction (dim)
Downstream	496	502	0	1.6
Upstream	496	502	0	8.4

[1] Cap includes 4-foot coarse refuse and 2-foot soil cover layer above top of fines elevation. Soil cover sloped at one percent to maintain positive drainage.

Poulos, et al (1985) states a soil mass susceptible to liquefaction will only experience a liquefaction failure when a sufficiently large triggering event, such as an earthquake, causes the strength of the soil to decrease to the undrained steady-state strength. Conversely, a soil mass unsusceptible to liquefaction physically cannot fail by liquefaction since the minimum undrained strength exceeds the in-situ driving shear stress along the critical failure surface.

Civil & Environmental Consultants, Inc.

ROJECT Williamson Energy – Pond Creek South Pond
Phase 2 Abandonment Evaluation
Post-Earthquake Stability Analyses and Factor of Safety
Against Liquefaction – South Pond Stage 2
Downstream and Upstream Slope Geometries

PROJECT NO. 080-851

PAGE 4 OF 4

MADE BY BEG DATE 7/17/08 CHECKED BY MJS DATE 7/23/08

CONCLUSION:

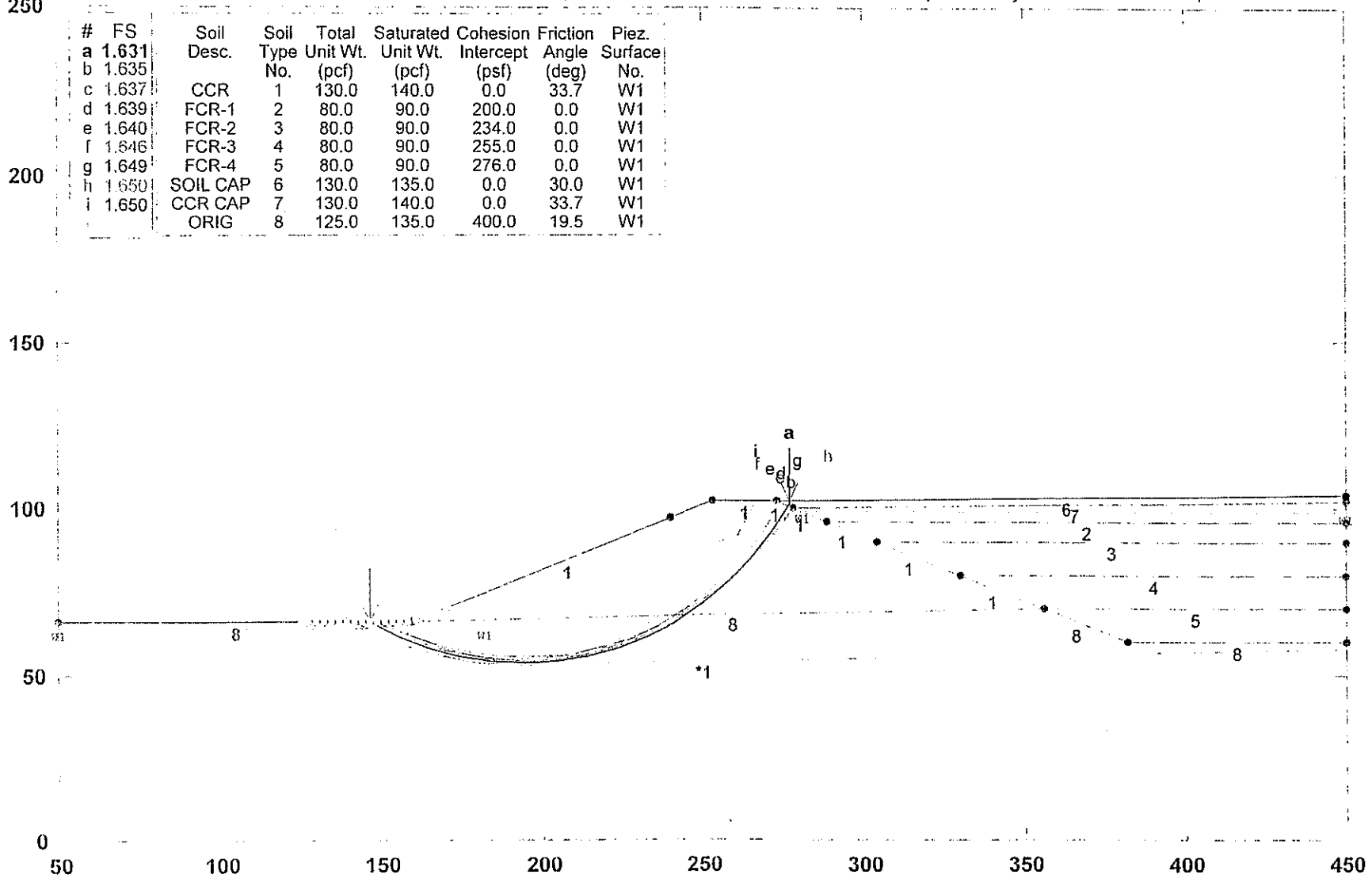
CEC has completed an evaluation of the liquefaction susceptibility of the proposed Pond Creek South Pond (Phase 2) abandonment geometry. Based on the information presented in this calculation brief, CEC determined that the Pond Creek – Phase 2 abandonment geometry is not susceptible to a liquefaction (flow) failure. This conclusion is based on the characterization of the fine coal refuse, peak and steady-state undrained shear strength, shear strains, in-situ driving shear stresses through the fine coal refuse and adequate factor of safety against post-earthquake liquefaction susceptibility in both the upstream and downstream directions.

POND CREEK – PHASE 2 SOUTH POND ABANDONMENT
GSTABL OUTPUT – FACTOR OF SAFETY AGAINST LIQUEFACTION
STABILITY ANALYSIS OUTPUT FILES
DOWNSTREAM AND UPSTREAM CONDITIONS

Pond Creek, South Cell, Abandonment Post-Eq Downstream Analysis

p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\ky determination\south cell downstream revised.pl2 Run By: Michael J. Sheleheda, P.E. 7/16/2008 11:38AM

#	FS	Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
a	1.631							
b	1.635							
c	1.637	CCR	1	130.0	140.0	0.0	33.7	W1
d	1.639	FCR-1	2	80.0	90.0	200.0	0.0	W1
e	1.640	FCR-2	3	80.0	90.0	234.0	0.0	W1
f	1.646	FCR-3	4	80.0	90.0	255.0	0.0	W1
g	1.649	FCR-4	5	80.0	90.0	276.0	0.0	W1
h	1.650	SOIL CAP	6	130.0	135.0	0.0	30.0	W1
i	1.650	CCR CAP	7	130.0	140.0	0.0	33.7	W1
		ORIG	8	125.0	135.0	400.0	19.5	W1



GSTABL7 v.2 FSmin=1.631

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R14659

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
(All Rights Reserved-Unauthorized Use Prohibited)

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

Analysis Run Date: 7/16/2008
Time of Run: 11:38AM
Run By: Michael J. Sheleheda, P.E.
Input Data Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Cree
k South Cell\Ky Determination\south cell downstream revised.in
Output Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Cree
k South Cell\Ky Determination\south cell downstream revised.OUT
Unit System: English
Plotted Output Filename: P:_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek So
uth Cell\Ky Determination\south cell downstream revised.PLT
PROBLEM DESCRIPTION: Pond Creek, South Cell, Abandonment
Post-Eq Downstream Analysis

BOUNDARY COORDINATES
4 Top Boundaries
17 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	50.00	66.00	159.40	66.00	8
2	159.40	66.00	253.00	102.00	1
3	253.00	102.00	273.00	102.00	1
4	273.00	102.00	450.00	103.75	6
5	273.00	102.00	278.20	100.00	1
6	278.20	100.00	450.00	101.75	7
7	278.20	100.00	288.60	96.00	1
8	288.60	96.00	450.00	96.00	2
9	288.60	96.00	304.20	90.00	1
10	304.20	90.00	450.00	90.00	3
11	304.20	90.00	330.20	80.00	1
12	330.20	80.00	450.00	80.00	4
13	330.20	80.00	356.20	70.00	1
14	356.20	70.00	450.00	70.00	5
15	159.40	66.00	356.20	70.00	8
16	356.20	70.00	382.20	60.00	8
17	382.20	60.00	450.00	60.00	8

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
8 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	200.0	0.0	0.00	0.0	1
3	80.0	90.0	234.0	0.0	0.00	0.0	1
4	80.0	90.0	255.0	0.0	0.00	0.0	1
5	80.0	90.0	276.0	0.0	0.00	0.0	1
6	130.0	135.0	0.0	30.0	0.00	0.0	1
7	130.0	140.0	0.0	33.7	0.00	0.0	1
8	125.0	135.0	400.0	19.5	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 4 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)

1	50.00	64.00
2	182.00	64.00
3	280.80	99.00
4	450.00	99.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	50.00	50.00	450.00	58.00

EARTHQUAKE DATA HAS BEEN SUPPRESSED
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 125.00(ft)
and X = 170.00(ft)
Each Surface Terminates Between X = 240.00(ft)
and X = 450.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Statistical Data On All Valid FS Values:
FS Max = 3.307 FS Min = 1.631 FS Ave = 1.968
Standard Deviation = 0.303 Coefficient of Variation = 15.41 %
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	146.32	66.00
2	155.23	61.48
3	164.58	57.91
4	174.24	55.34
5	184.12	53.79
6	194.11	53.29
7	204.09	53.83
8	213.97	55.41
9	223.62	58.01
10	232.95	61.61
11	241.86	66.16
12	250.23	71.62
13	258.00	77.93
14	265.06	85.01
15	271.34	92.79
16	276.78	101.18
17	277.21	102.04

Circle Center At X = 193.95 ; Y = 148.86 ; and Radius = 95.57
Factor of Safety
*** 1.631 ***
Individual data on the 25 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.9	492.9	0.0	0.0	0.	0.	0.0	0.0	0.0
2	5.0	2091.1	0.0	439.1	0.	0.	0.0	0.0	0.0
3	4.2	2907.5	0.0	923.3	0.	0.	0.0	0.0	0.0
4	5.2	5528.1	0.0	1764.0	0.	0.	0.0	0.0	0.0
5	9.7	16864.1	0.0	4602.1	0.	0.	0.0	0.0	0.0
6	7.8	18896.4	0.0	4542.1	0.	0.	0.0	0.0	0.0
7	2.1	5903.1	0.0	1317.2	0.	0.	0.0	0.0	0.0
8	5.2	15841.2	0.0	3719.4	0.	0.	0.0	0.0	0.0
9	4.7	15746.5	0.0	3929.0	0.	0.	0.0	0.0	0.0
10	10.0	36868.6	0.0	9722.8	0.	0.	0.0	0.0	0.0
11	9.9	40271.4	0.0	11170.9	0.	0.	0.0	0.0	0.0

12	9.7	41681.5	0.0	11976.2	0.	0.	0.0	0.0	0.0
13	9.3	41104.8	0.0	12130.5	0.	0.	0.0	0.0	0.0
14	8.9	38666.4	0.0	11631.9	0.	0.	0.0	0.0	0.0
15	2.4	10150.9	0.0	3151.2	0.	0.	0.0	0.0	0.0
16	6.0	24396.6	0.0	7334.6	0.	0.	0.0	0.0	0.0
17	2.8	10743.4	0.0	3341.8	0.	0.	0.0	0.0	0.0
18	5.0	17622.9	0.0	5363.1	0.	0.	0.0	0.0	0.0
19	7.1	19563.0	0.0	6308.5	0.	0.	0.0	0.0	0.0
20	6.3	11036.7	0.0	3322.9	0.	0.	0.0	0.0	0.0
21	1.7	1740.8	0.0	337.3	0.	0.	0.0	0.0	0.0
22	0.7	592.2	0.0	35.9	0.	0.	0.0	0.0	0.0
23	2.7	1206.0	0.0	0.0	0.	0.	0.0	0.0	0.0
24	0.3	47.3	0.0	0.0	0.	0.	0.0	0.0	0.0
25	0.4	24.4	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.68	66.00
2	157.67	61.62
3	167.07	58.21
4	176.78	55.79
5	186.68	54.41
6	196.68	54.08
7	206.65	54.79
8	216.50	56.54
9	226.10	59.31
10	235.37	63.08
11	244.19	67.80
12	252.46	73.41
13	260.11	79.86
14	267.03	87.07
15	273.16	94.97
16	277.55	102.04

Circle Center At X = 194.87 ; Y = 149.27 ; and Radius = 95.22

Factor of Safety

*** 1.635 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	146.32	66.00
2	155.28	61.56
3	164.66	58.10
4	174.36	55.67
5	184.26	54.28
6	194.26	53.95
7	204.23	54.70
8	214.07	56.50
9	223.65	59.34
10	232.88	63.19
11	241.65	67.99
12	249.86	73.71
13	257.41	80.27
14	264.21	87.59
15	270.20	95.60
16	274.00	102.01

Circle Center At X = 192.27 ; Y = 147.41 ; and Radius = 93.48

Factor of Safety

*** 1.637 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.58	66.00
2	150.50	61.49
3	159.84	57.91
4	169.50	55.31
5	179.37	53.71
6	189.35	53.12
7	199.34	53.56

8	209.24	55.02
9	218.93	57.48
10	228.32	60.91
11	237.31	65.29
12	245.81	70.56
13	253.72	76.68
14	260.97	83.57
15	267.47	91.16
16	273.17	99.38
17	274.62	102.02

Circle Center At X = 190.08 ; Y = 150.88 ; and Radius = 97.76

Factor of Safety

*** 1.639 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.05	66.00
2	159.86	61.27
3	169.18	57.62
4	178.85	55.11
5	188.76	53.77
6	198.76	53.61
7	208.71	54.65
8	218.46	56.86
9	227.88	60.22
10	236.83	64.67
11	245.19	70.16
12	252.84	76.60
13	259.67	83.91
14	265.58	91.97
15	270.49	100.69
16	271.03	102.00

Circle Center At X = 195.05 ; Y = 137.31 ; and Radius = 83.79

Factor of Safety

*** 1.640 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.68	66.00
2	157.44	61.17
3	166.72	57.45
4	176.39	54.89
5	186.30	53.54
6	196.30	53.41
7	206.24	54.51
8	215.96	56.82
9	225.34	60.31
10	234.21	64.91
11	242.46	70.58
12	249.94	77.20
13	256.56	84.70
14	262.21	92.95
15	266.80	101.84
16	266.86	102.00

Circle Center At X = 192.33 ; Y = 134.71 ; and Radius = 81.40

Factor of Safety

*** 1.646 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.68	66.00
2	157.85	61.99
3	167.36	58.90
4	177.13	56.77
5	187.06	55.60
6	197.06	55.41
7	207.02	56.21
8	216.87	57.98

9	226.49	60.71
10	235.79	64.37
11	244.69	68.93
12	253.10	74.34
13	260.94	80.55
14	268.13	87.50
15	274.60	95.13
16	279.40	102.06

Circle Center At X = 193.94 ; Y = 156.89 ; and Radius = 101.54

Factor of Safety

*** 1.649 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	139.21	66.00
2	148.34	61.92
3	157.78	58.61
4	167.46	56.10
5	177.31	54.41
6	187.28	53.55
7	197.28	53.53
8	207.24	54.34
9	217.11	55.98
10	226.80	58.44
11	236.25	61.70
12	245.40	65.73
13	254.18	70.52
14	262.53	76.03
15	270.39	82.21
16	277.71	89.03
17	284.43	96.43
18	288.81	102.16

Circle Center At X = 192.55 ; Y = 172.86 ; and Radius = 119.43

Factor of Safety

*** 1.650 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.05	66.00
2	159.94	61.41
3	169.32	57.95
4	179.05	55.66
5	189.00	54.59
6	198.99	54.75
7	208.90	56.14
8	218.56	58.73
9	227.82	62.50
10	236.55	67.37
11	244.62	73.28
12	251.90	80.13
13	258.28	87.83
14	263.67	96.26
15	266.41	102.00

Circle Center At X = 192.70 ; Y = 135.70 ; and Radius = 81.20

Factor of Safety

*** 1.650 ***

Failure Surface Specified By 17 Coordinate Points

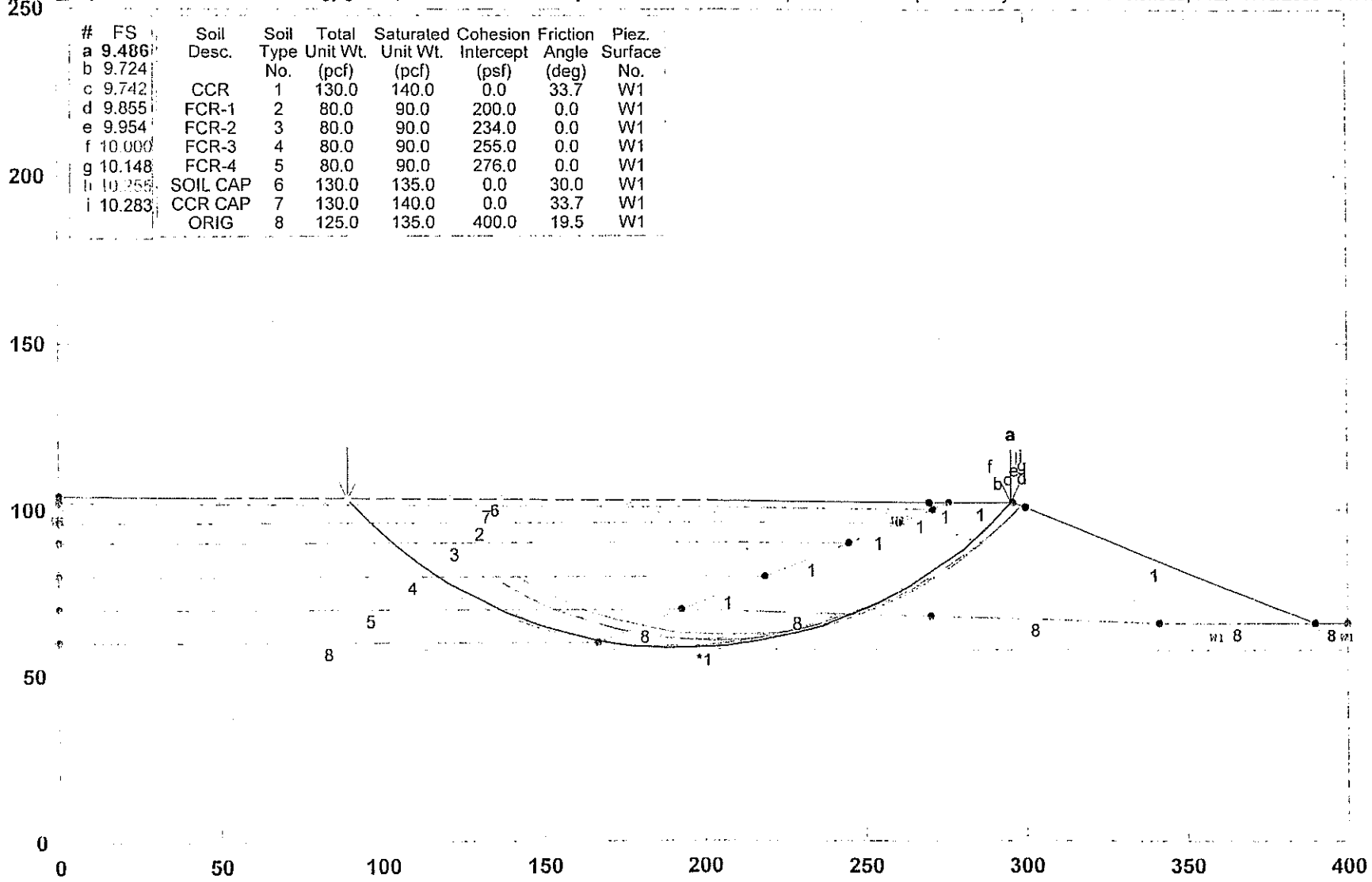
Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.58	66.00
2	150.68	61.85
3	160.14	58.60
4	169.86	56.27
5	179.76	54.89
6	189.76	54.47
7	199.74	55.01
8	209.63	56.50
9	219.33	58.94

```
    10         228.75        62.30
    11         237.80        66.55
    12         246.40        71.65
    13         254.47        77.56
    14         261.94        84.21
    15         268.73        91.55
    16         274.78        99.51
    17         276.34       102.03
Circle Center At X =   189.16 ; Y =   158.37 ; and Radius =   103.91
      Factor of Safety
     ***    1.653   ***
         **** END OF GSTABL7 OUTPUT ****
```

Pond Creek, South Cell, Abandonment Post-Eq Upstream Analysis

p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\ky determination\south cell upstream revised.pl2 Run By: Michael J. Sheleheda, P.E. 7/16/2008 11:43AM

#	FS	Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
a	9.486							
b	9.724							
c	9.742	CCR	1	130.0	140.0	0.0	33.7	W1
d	9.855	FCR-1	2	80.0	90.0	200.0	0.0	W1
e	9.954	FCR-2	3	80.0	90.0	234.0	0.0	W1
f	10.000	FCR-3	4	80.0	90.0	255.0	0.0	W1
g	10.148	FCR-4	5	80.0	90.0	276.0	0.0	W1
h	10.256	SOIL CAP	6	130.0	135.0	0.0	30.0	W1
i	10.283	CCR CAP	7	130.0	140.0	0.0	33.7	W1
		ORIG	8	125.0	135.0	400.0	19.5	W1



GSTABL7 v.2 FSmin=9.486

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R14666

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **

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SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 7/16/2008
Time of Run: 11:43AM
Run By: Michael J. Sheleheda, P.E.
Input Data Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Cree
k South Cell\Ky Determination\south cell upstream revised.in
Output Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Cree
k South Cell\Ky Determination\south cell upstream revised.OUT
Unit System: English
Plotted Output Filename: P:_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek So
uth Cell\Ky Determination\south cell upstream revised.PLT
PROBLEM DESCRIPTION: Pond Creek, South Cell, Abandonment
Post-Eq Upstream Analysis

BOUNDARY COORDINATES

4 Top Boundaries
19 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	103.75	276.24	102.00	6
2	276.24	102.00	296.24	102.00	1
3	296.24	102.00	389.84	66.00	1
4	389.84	66.00	400.00	66.00	8
5	0.00	101.75	271.04	100.00	7
6	271.04	100.00	276.24	102.00	1
7	0.00	96.00	260.64	96.00	2
8	260.64	96.00	271.04	100.00	1
9	0.00	90.00	245.04	90.00	3
10	245.04	90.00	260.64	96.00	1
11	0.00	80.00	219.04	80.00	4
12	219.04	80.00	245.04	90.00	1
13	0.00	70.00	193.04	70.00	5
14	193.04	70.00	219.04	80.00	1
15	0.00	60.00	167.04	60.00	8
16	167.04	60.00	193.04	70.00	8
17	193.46	70.16	270.39	68.00	8
18	270.39	68.00	341.70	66.00	8
19	341.70	66.00	389.84	66.00	8

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS

8 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	200.0	0.0	0.00	0.0	1
3	80.0	90.0	234.0	0.0	0.00	0.0	1
4	80.0	90.0	255.0	0.0	0.00	0.0	1
5	80.0	90.0	276.0	0.0	0.00	0.0	1
6	130.0	135.0	0.0	30.0	0.00	0.0	1
7	130.0	140.0	0.0	33.7	0.00	0.0	1
8	125.0	135.0	400.0	19.5	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 4 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	99.00
2	260.64	99.00
3	359.44	64.00
4	400.00	64.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	0.00	58.00	400.00	58.00

EARTHQUAKE DATA HAS BEEN SUPPRESSED
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00(ft)
and X = 200.00(ft)
Each Surface Terminates Between X = 270.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.85	101.73
3	69.73	100.17
4	79.63	98.75
5	89.55	97.48
6	99.49	96.36
7	109.44	95.39
8	119.40	94.56
9	129.38	93.87
10	139.37	93.34
11	149.36	92.95
12	159.36	92.71
13	169.36	92.62
14	179.36	92.67
15	189.35	92.87
16	199.35	93.22
17	209.34	93.71
18	219.31	94.36
19	229.28	95.15
20	239.24	96.08
21	249.18	97.17
22	259.10	98.39
23	269.01	99.77
24	278.89	101.29
25	283.09	102.00

Factor Of Safety For The Preceding Specified Surface =-43.485
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.58	100.56
3	69.23	97.93
4	78.93	95.53
5	88.70	93.36
6	98.51	91.44
7	108.37	89.76
8	118.26	88.32
9	128.19	87.12

10	138.15	86.17
11	148.12	85.45
12	158.11	84.99
13	168.11	84.76
14	178.11	84.78
15	188.10	85.05
16	198.09	85.56
17	208.06	86.31
18	218.01	87.31
19	227.93	88.55
20	237.82	90.03
21	247.67	91.76
22	257.48	93.72
23	267.23	95.93
24	276.93	98.37
25	286.57	101.04
26	289.71	102.00

Factor Of Safety For The Preceding Specified Surface =-28.283
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.81	101.50
3	69.66	99.75
4	79.53	98.16
5	89.43	96.74
6	99.35	95.49
7	109.29	94.42
8	119.25	93.52
9	129.23	92.79
10	139.21	92.23
11	149.20	91.85
12	159.20	91.63
13	169.20	91.60
14	179.20	91.73
15	189.19	92.04
16	199.18	92.52
17	209.16	93.17
18	219.13	94.00
19	229.08	94.99
20	239.01	96.16
21	248.92	97.51
22	258.80	99.02
23	268.66	100.70
24	275.56	102.00

Factor Of Safety For The Preceding Specified Surface =-38.522
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.78	101.36
3	69.60	99.44
4	79.44	97.69
5	89.31	96.09
6	99.21	94.66
7	109.13	93.39
8	119.07	92.28
9	129.02	91.34
10	138.99	90.56
11	148.97	89.94
12	158.96	89.49
13	168.96	89.20
14	178.96	89.07
15	188.96	89.10

16	198.96	89.30
17	208.95	89.67
18	218.94	90.20
19	228.91	90.89
20	238.88	91.74
21	248.82	92.76
22	258.75	93.94
23	268.66	95.28
24	278.55	96.78
25	288.41	98.45
26	298.24	100.27
27	299.87	100.60

Factor Of Safety For The Preceding Specified Surface =-33.944
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	58.92	98.92
3	68.02	94.77
4	77.28	90.99
5	86.68	87.58
6	96.21	84.55
7	105.85	81.90
8	115.59	79.64
9	125.42	77.77
10	135.31	76.29
11	145.25	75.21
12	155.23	74.53
13	165.22	74.25
14	175.22	74.37
15	185.21	74.89
16	195.17	75.80
17	205.08	77.12
18	214.93	78.83
19	224.71	80.93
20	234.39	83.42
21	243.97	86.30
22	253.42	89.55
23	262.74	93.19
24	271.91	97.19
25	280.90	101.55
26	281.74	102.00

Factor Of Safety For The Preceding Specified Surface =-56.250
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	58.94	98.95
3	68.05	94.82
4	77.32	91.07
5	86.73	87.68
6	96.26	84.68
7	105.91	82.06
8	115.66	79.83
9	125.49	77.99
10	135.39	76.55
11	145.33	75.50
12	155.31	74.85
13	165.31	74.60
14	175.31	74.75
15	185.29	75.30
16	195.25	76.25
17	205.16	77.60
18	215.00	79.34

19	224.77	81.47
20	234.45	84.00
21	244.02	86.90
22	253.46	90.19
23	262.76	93.86
24	271.91	97.89
25	280.31	102.00

Factor Of Safety For The Preceding Specified Surface =-43.156
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.65	100.81
3	69.35	98.39
4	79.10	96.18
5	88.90	94.17
6	98.74	92.37
7	108.61	90.78
8	118.51	89.39
9	128.44	88.22
10	138.40	87.25
11	148.37	86.50
12	158.35	85.95
13	168.35	85.62
14	178.35	85.50
15	188.35	85.59
16	198.34	85.89
17	208.33	86.40
18	218.30	87.12
19	228.26	88.06
20	238.20	89.20
21	248.10	90.55
22	257.98	92.11
23	267.82	93.88
24	277.63	95.86
25	287.38	98.04
26	297.10	100.43
27	299.00	100.94

Factor Of Safety For The Preceding Specified Surface =-36.351
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	67.21	99.76
3	76.65	96.45
4	86.19	93.45
5	95.83	90.77
6	105.54	88.42
7	115.34	86.39
8	125.19	84.68
9	135.09	83.31
10	145.04	82.26
11	155.01	81.55
12	165.01	81.17
13	175.01	81.12
14	185.00	81.40
15	194.98	82.02
16	204.94	82.97
17	214.86	84.25
18	224.73	85.86
19	234.54	87.79
20	244.28	90.05
21	253.94	92.64
22	263.51	95.54

23	272.98	98.76
24	281.55	102.00

Factor Of Safety For The Preceding Specified Surface =-24.764
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	67.52	100.68
3	77.21	98.21
4	86.95	95.95
5	96.75	93.92
6	106.58	92.11
7	116.45	90.52
8	126.36	89.16
9	136.30	88.03
10	146.26	87.13
11	156.23	86.45
12	166.22	86.00
13	176.22	85.78
14	186.22	85.78
15	196.22	86.02
16	206.21	86.48
17	216.18	87.17
18	226.14	88.09
19	236.07	89.23
20	245.98	90.60
21	255.85	92.20
22	265.68	94.02
23	275.47	96.07
24	285.21	98.34
25	294.90	100.83
26	297.43	101.54

Factor Of Safety For The Preceding Specified Surface =-36.183
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	66.76	98.76
3	75.81	94.51
4	85.04	90.64
5	94.41	87.16
6	103.92	84.08
7	113.56	81.39
8	123.29	79.11
9	133.11	77.23
10	143.01	75.77
11	152.95	74.71
12	162.93	74.08
13	172.93	73.86
14	182.93	74.06
15	192.91	74.67
16	202.85	75.70
17	212.75	77.14
18	222.58	79.00
19	232.32	81.26
20	241.95	83.92
21	251.47	86.99
22	260.86	90.45
23	270.09	94.29
24	279.15	98.52
25	285.86	102.00

Factor Of Safety For The Preceding Specified Surface =*******
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.

Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	67.17	99.64
3	76.55	96.19
4	86.04	93.04
5	95.63	90.18
6	105.29	87.62
7	115.04	85.37
8	124.85	83.43
9	134.71	81.79
10	144.62	80.46
11	154.57	79.44
12	164.55	78.73
13	174.54	78.34
14	184.54	78.26
15	194.54	78.49
16	204.52	79.03
17	214.48	79.88
18	224.42	81.05
19	234.31	82.53
20	244.15	84.31
21	253.92	86.40
22	263.63	88.80
23	273.26	91.50
24	282.80	94.50
25	292.24	97.79
26	299.71	100.66

Factor Of Safety For The Preceding Specified Surface =*******
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.

Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	67.14	99.58
3	76.51	96.08
4	85.98	92.87
5	95.55	89.97
6	105.21	87.38
7	114.95	85.10
8	124.75	83.13
9	134.61	81.47
10	144.52	80.13
11	154.47	79.10
12	164.44	78.40
13	174.44	78.01
14	184.44	77.94
15	194.43	78.20
16	204.42	78.77
17	214.38	79.66
18	224.30	80.86
19	234.19	82.39
20	244.02	84.22
21	253.78	86.37
22	263.48	88.84
23	273.08	91.61
24	282.60	94.68
25	292.01	98.06
26	299.15	100.88

Factor Of Safety For The Preceding Specified Surface =*******
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.

Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38

2	67.77	101.80
3	77.66	100.34
4	87.57	99.01
5	97.50	97.80
6	107.44	96.72
7	117.40	95.77
8	127.36	94.94
9	137.34	94.24
10	147.32	93.67
11	157.31	93.23
12	167.31	92.91
13	177.30	92.71
14	187.30	92.65
15	197.30	92.71
16	207.30	92.90
17	217.30	93.22
18	227.29	93.66
19	237.27	94.23
20	247.25	94.93
21	257.21	95.75
22	267.17	96.70
23	277.11	97.78
24	287.04	98.98
25	296.95	100.31
26	299.62	100.70

Factor Of Safety For The Preceding Specified Surface =-40.221
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	66.88	99.00
3	76.04	94.97
4	85.34	91.32

###################### SOME LINES SKIPPED ######################
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Number of Trial Surfaces with Misleading FS = 144
Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Evaluated = 36.0 %
Statistical Data On All Valid FS Values:
FS Max = 477.564 FS Min = 9.486 FS Ave = 34.448
Standard Deviation = 51.756 Coefficient of Variation = 150.24 %
Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.47	103.18
2	96.57	96.14
3	104.14	89.61
4	112.15	83.62
5	120.57	78.22
6	129.34	73.42
7	138.43	69.25
8	147.79	65.72
9	157.37	62.87
10	167.13	60.69
11	177.02	59.21
12	186.99	58.42
13	196.99	58.34
14	206.97	58.96
15	216.88	60.28
16	226.68	62.29
17	236.31	64.98
18	245.72	68.35

19	254.88	72.37
20	263.73	77.02
21	272.24	82.29
22	280.35	88.13
23	288.03	94.54
24	295.24	101.46
25	295.73	102.00

Circle Center At X = 193.18 ; Y = 200.50 ; and Radius = 142.22

Factor of Safety

*** 9.486 ***

Individual data on the 41 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.0	266.4	0.0	0.0	0.	0.	0.0	0.0	0.0
2	2.2	871.5	0.0	0.0	0.	0.	0.0	0.0	0.0
3	2.9	2132.6	0.0	363.1	0.	0.	0.0	0.0	0.0
4	0.2	149.9	0.0	38.2	0.	0.	0.0	0.0	0.0
5	7.0	8522.5	0.0	3439.7	0.	0.	0.0	0.0	0.0
6	0.5	690.7	0.0	346.7	0.	0.	0.0	0.0	0.0
7	8.0	14368,7	0.0	7728.8	0.	0.	0.0	0.0	0.0
8	5.6	12519.1	0.0	7189.6	0.	0.	0.0	0.0	0.0
9	2.8	6822.4	0.0	4092.0	0.	0.	0.0	0.0	0.0
10	8.8	24133.2	0.0	14465.5	0.	0.	0.0	0.0	0.0
11	7.4	23188.6	0.0	13952.9	0.	0.	0.0	0.0	0.0
12	1.6	5415.3	0.0	3311.8	0.	0.	0.0	0.0	0.0
13	9.4	32625.3	0.0	19665.4	0.	0.	0.0	0.0	0.0
14	9.6	36083.9	0.0	21655.7	0.	0.	0.0	0.0	0.0
15	9.8	38883.1	0.0	23225.8	0.	0.	0.0	0.0	0.0
16	1.2	5010.3	0.0	2971.6	0.	0.	0.0	0.0	0.0
17	8.7	36837.6	0.0	21396.3	0.	0.	0.0	0.0	0.0
18	10.0	45327.4	0.0	25076.4	0.	0.	0.0	0.0	0.0
19	6.0	28647.7	0.0	15329.2	0.	0.	0.0	0.0	0.0
20	0.4	2037.3	0.0	1064.9	0.	0.	0.0	0.0	0.0
21	3.5	17051.7	0.0	8953.6	0.	0.	0.0	0.0	0.0
22	10.0	49067.6	0.0	25180.6	0.	0.	0.0	0.0	0.0
23	9.9	49264.0	0.0	24575.7	0.	0.	0.0	0.0	0.0
24	2.2	10703.5	0.0	5290.0	0.	0.	0.0	0.0	0.0
25	7.6	37565.5	0.0	18246.3	0.	0.	0.0	0.0	0.0
26	9.6	46127.0	0.0	22067.3	0.	0.	0.0	0.0	0.0
27	8.7	39883.1	0.0	18779.2	0.	0.	0.0	0.0	0.0
28	0.7	3032.8	0.0	1396.8	0.	0.	0.0	0.0	0.0
29	0.7	3232.8	0.0	1525.7	0.	0.	0.0	0.0	0.0
30	8.4	35428.8	0.0	16346.2	0.	0.	0.0	0.0	0.0
31	5.8	22263.7	0.0	10196.2	0.	0.	0.0	0.0	0.0
32	3.1	11056.8	0.0	4580.0	0.	0.	0.0	0.0	0.0
33	1.0	3298.4	0.0	1367.8	0.	0.	0.0	0.0	0.0
34	6.3	19528.5	0.0	7405.3	0.	0.	0.0	0.0	0.0
35	1.2	3276.4	0.0	1093.1	0.	0.	0.0	0.0	0.0
36	4.0	9912.6	0.0	3040.5	0.	0.	0.0	0.0	0.0
37	4.1	8432.6	0.0	1818.3	0.	0.	0.0	0.0	0.0
38	3.3	5376.9	0.0	487.5	0.	0.	0.0	0.0	0.0
39	4.4	5332.8	0.0	0.0	0.	0.	0.0	0.0	0.0
40	7.2	3750.3	0.0	0.0	0.	0.	0.0	0.0	0.0
41	0.5	16.9	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.47	103.18
2	96.55	96.11
3	104.11	89.57
4	112.12	83.59
5	120.55	78.20
6	129.34	73.43
7	138.44	69.30
8	147.83	65.85
9	157.43	63.07

10	167.22	60.99
11	177.12	59.62
12	187.10	58.97
13	197.10	59.04
14	207.07	59.83
15	216.96	61.33
16	226.71	63.54
17	236.28	66.44
18	245.61	70.03
19	254.67	74.27
20	263.39	79.16
21	271.74	84.67
22	279.67	90.75
23	287.15	97.40
24	291.63	102.00

Circle Center At X = 191.11 ; Y = 197.72 ; and Radius = 138.80

Factor of Safety

*** 9.724 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.37	103.13
2	104.44	96.06
3	112.02	89.54
4	120.06	83.59
5	128.51	78.25
6	137.34	73.55
7	146.49	69.51
8	155.91	66.16
9	165.55	63.51
10	175.36	61.59
11	185.29	60.39
12	195.28	59.93
13	205.28	60.20
14	215.23	61.22
15	225.07	62.96
16	234.76	65.43
17	244.24	68.61
18	253.47	72.48
19	262.38	77.01
20	270.93	82.20
21	279.07	88.00
22	286.77	94.38
23	293.97	101.32
24	294.58	102.00

Circle Center At X = 196.51 ; Y = 195.25 ; and Radius = 135.33

Factor of Safety

*** 9.742 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.26	103.08
2	112.34	96.02
3	119.93	89.51
4	127.99	83.59
5	136.46	78.28
6	145.31	73.62
7	154.48	69.63
8	163.93	66.35
9	173.59	63.77
10	183.42	61.93
11	193.36	60.83
12	203.35	60.47
13	213.35	60.86
14	223.28	61.99
15	233.10	63.87
16	242.76	66.47
17	252.19	69.79

18	261.35	73.81
19	270.18	78.49
20	278.64	83.83
21	286.68	89.78
22	294.25	96.32
23	298.89	100.98

Circle Center At X = 203.14 ; Y = 194.17 ; and Radius = 133.70

Factor of Safety

*** 9.855 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.26	103.08
2	112.35	96.02
3	119.95	89.53
4	128.02	83.63
5	136.52	78.36
6	145.40	73.75
7	154.60	69.83
8	164.07	66.63
9	173.76	64.16
10	183.61	62.43
11	193.56	61.46
12	203.56	61.25
13	213.54	61.80
14	223.46	63.11
15	233.24	65.17
16	242.84	67.97
17	252.20	71.49
18	261.27	75.72
19	269.98	80.62
20	278.30	86.18
21	286.16	92.35
22	293.54	99.10
23	296.25	102.00

Circle Center At X = 201.33 ; Y = 192.41 ; and Radius = 131.18

Factor of Safety

*** 9.954 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	103.23
2	88.68	96.19
3	96.25	89.66
4	104.27	83.68
5	112.68	78.27
6	121.45	73.46
7	130.53	69.28
8	139.88	65.74
9	149.46	62.86
10	159.21	60.66
11	169.10	59.14
12	179.06	58.32
13	189.06	58.20
14	199.04	58.77
15	208.96	60.04
16	218.77	62.00
17	228.41	64.64
18	237.85	67.95
19	247.03	71.91
20	255.92	76.50
21	264.46	81.70
22	272.62	87.48
23	280.35	93.82
24	287.62	100.69
25	288.83	102.00

Circle Center At X = 185.83 ; Y = 201.25 ; and Radius = 143.09

Factor of Safety

*** 10.000 ***
Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	103.23
2	88.99	96.52
3	96.80	90.28
4	105.00	84.55
5	113.54	79.35
6	122.39	74.69
7	131.52	70.61
8	140.89	67.11
9	150.46	64.21
10	160.19	61.92
11	170.05	60.24
12	179.99	59.20
13	189.99	58.78
14	199.98	59.00
15	209.95	59.84
16	219.84	61.31
17	229.62	63.41
18	239.24	66.12
19	248.68	69.43
20	257.89	73.33
21	266.83	77.80
22	275.47	82.83
23	283.78	88.39
24	291.72	94.47
25	299.11	100.90

Circle Center At X = 191.58 ; Y = 217.09 ; and Radius = 158.31

Factor of Safety
*** 10.148 ***
Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.37	103.13
2	104.65	96.28
3	112.40	89.95
4	120.57	84.19
5	129.12	79.01
6	138.02	74.45
7	147.21	70.52
8	156.66	67.24
9	166.32	64.64
10	176.13	62.72
11	186.06	61.50
12	196.04	60.97
13	206.04	61.15
14	216.00	62.03
15	225.88	63.61
16	235.62	65.87
17	245.18	68.81
18	254.50	72.42
19	263.55	76.67
20	272.28	81.55
21	280.65	87.03
22	288.61	93.08
23	296.12	99.68
24	297.82	101.39

Circle Center At X = 198.47 ; Y = 203.21 ; and Radius = 142.26

Factor of Safety
*** 10.255 ***
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.16	103.03
2	120.26	96.00
3	127.69	89.53

4	136.01	83.69
5	144.55	78.49
6	153.47	73.97
7	162.72	70.16
8	172.23	67.09
9	181.96	64.76
10	191.84	63.20
11	201.81	62.42
12	211.81	62.41
13	221.78	63.19
14	231.65	64.73
15	241.38	67.05
16	250.90	70.11
17	260.15	73.91
18	269.08	78.41
19	277.63	83.60
20	285.75	89.44
21	293.39	95.89
22	298.64	101.08

Circle Center At X = 206.83 ; Y = 190.43 ; and Radius = 128.11

Factor of Safety

*** 10.283 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.47	103.18
2	96.59	96.15
3	104.19	89.66
4	112.25	83.75
5	120.73	78.43
6	129.56	73.75
7	138.72	69.73
8	148.14	66.39
9	157.79	63.74
10	167.60	61.81
11	177.53	60.60
12	187.51	60.12
13	197.51	60.37
14	207.46	61.34
15	217.32	63.05
16	227.02	65.46
17	236.52	68.58
18	245.77	72.39
19	254.71	76.86
20	263.31	81.98
21	271.50	87.70
22	279.26	94.01
23	286.54	100.87
24	287.57	102.00

Circle Center At X = 189.08 ; Y = 196.82 ; and Radius = 136.71

Factor of Safety

*** 10.327 ***

**** END OF GSTABL7 OUTPUT ****

Alliance Consulting, Inc.
Engineers • Constructors • Scientists

7225-711 R14680
part 28

ILLINOIS DEPARTMENT OF NATURAL RESOURCES
PERMIT NO. 375
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
VOLUME 7 OF 7

POND CREEK MINE NO. 1
COAL REFUSE DISPOSAL FACILITY NO. 2
PHASES 3 – 7 DAM

Prepared for

WILLIAMSON ENERGY, LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B10-148-1413
NOVEMBER 2010

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Alliance Consulting, Inc.
Engineers · Constructors · Scientists

January 12, 2010

Project No. B09-095-1413

Mr. Jerry Bishoff
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
One Natural Resources Way
Springfield, IL 62702-1271

Response to Comments
Additional Information
Williamson Energy, LLC
Pond Creek No. 1 Mine, Coal Refuse Disposal Facility No. 2
Application No. 20093068

Dear Mr. Bishoff:

On behalf of our client, Williamson Energy, LLC, this letter and document is being submitted as additional information to Mr. Michael Diedrichsen's comments regarding the Engineering Design Plan dated October 8, 2009 (copy attached).

2. The seismic acceleration used in the slope stability analysis does not meet the required values. The Peak Ground Acceleration should be obtained from the USGS National Seismic Hazard Mapping Project map for 2% probability of exceedance in 50 years. If this analysis does not produce satisfactory results, a deformation analysis may be necessary.

A letter report prepared by GAI Consultants dated January 7, 2010 and entitled "Letter Report, Response to IDNR Comment No. 2, Pond Creek Mine No. 1 Coal Refuse Disposal Facility No. 2, Phases 3 – 7 Dam, Application No. 20093068, Williamson Energy LLC, Mach Mining Company, Williamson County, Illinois" is enclosed herein.

Should you need any additional information, please do not hesitate to contact us.

Sincerely,

ALLIANCE CONSULTING, INC.

Claudio E. Yon, P. E.
Senior Project Manager

CEY:wmb
Enclosures

FILE: 09095-06

cc: Jim Slapak w/attachments

Illinois Department of
Natural Resources
One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

Pat Quinn, Governor
Marc Miller, Director

October 8, 2009

SUBJECT: Application No. 20093068
Pond Creek Mine No. 1,
Coal Refuse Disposal Facility No. 2, Phases 3 – 7 Dam
Williamson Energy, LLC, Williamson County

Mr. Claudio E. Yon
Alliance Consulting, Inc.
124 Philpott Lane
Beaver, West Virginia 25813

Dear Mr. Yon:

We have completed our review of your June 11, 2009 application and supporting materials and are in the process of issuing a public notice (copy enclosed) for the referenced dam. Per the guidelines set forth in our Part 3702 Dam Safety Rules, this office is provisionally classifying this impoundment as an intermediate-size, Class 1 (high hazard potential) dam. In order to continue our review of this application, the following comments should be addressed:

1) For construction phases after stage 4, there is no indication of the subsidence monitoring method or minimum subsidence required prior to initiation of construction.

2) The seismic acceleration used in the slope stability analyses does not meet the required values. The Peak Ground Acceleration should be obtained from the USGS National Seismic Hazard Mapping Project map for 2% probability of exceedance in 50 years. If this analysis does not produce satisfactory results, a deformation analysis may be necessary.

3) The dewatering calculations were performed for a 30 day time interval. Due to the Class I hazard classification, the required drawdown time for 50% of the impounded water is 7 days.

4) The plans indicate that the decant system will outlet to grouted riprap ditches which run down the embankment. Due to problems with erosion of embankment materials beneath grouted riprap, this office does not allow its use in spillway construction. Revised plans and calculations should be submitted to this office demonstrating that there will be no erosion of embankment materials from spillway discharge.

5) The following items should be addressed specific to the Emergency Action Plan (EAP):

a. The term "evacuation" should be revised to use the term "notify to evacuate" where it appears in the document. Mandatory evacuation is only available in Illinois after the declaration of martial law.

b. The EAP should contain a detailed description of the method by which individuals will be notified to evacuate and specify the agency responsible for these notifications.

c. The Notification Flow Chart should appear at the front of the EAP.

d. The Inundation Maps should be placed in Section 5 of the EAP. The engineering data from the dam breach analysis should be included in an appendix.

e. The materials labeled Appendix 1 and Appendix 2 are the forms from our General Permit 02-01. The engineer's certification (Appendix 1) should not be part of the EAP. The Appendix 2 information should be incorporated into Section 1.

Upon receipt of materials addressing these items, as well as an Operation & Maintenance (O&M) Plan, we will continue to process your application. Additionally, after revising the EAP to address the comments in Item 5, an EAP orientation meeting should be arranged with local emergency services personnel and a representative of our office to determine if any other revisions will be necessary to ensure the plan's effectiveness. If you have any questions or comments, please feel free to contact Jerry Bishoff of my staff at 217/558-6617.

Sincerely,

Michael L. Diedrichsen

Michael L. Diedrichsen, P.E.
Acting Manager, Downstate Regulatory Programs

MLD:JMB:crw
Enclosure
cc: Williamson Energy, LLC

gai consultants
transforming ideas into reality

January 7, 2010

Project C090403.01.001

Mr. Claudio Yon, P.E.
Alliance Consulting, Inc.
124 Philpott Lane
Raleigh County Airport Industrial Park
Beaver, West Virginia 25813-9502

Letter Report
Response to IDNR Comment No. 2
Pond Creek Mine No. 1 Coal Refuse Disposal Facility No.2 – Phases 3 – 7 Dam
Application No. 20093068
Williamson Energy, LLC
Williamson County, Illinois
GAI Project C090403.01.001

Dear Mr. Yon:

In accordance with our Work Order Memorandum No. 001, dated March 25, 2009, and your October 29, 2009 email request and authorization, GAI Consultants, Inc. (GAI) has prepared a response to the October 8, 2009 Illinois Department of Natural Resources (IDNR) review comments, specifically Comment No. 2. In general, this comment response addresses a pseudo-static slope stability analysis using a Peak Ground Acceleration (PGA) obtained from the USGS National Seismic Hazard Mapping Project Map for a 2% Probability of Exceedance in 50 years, and the resulting permanent deformation analysis for the Phase 7C Dam maximum condition at the Williamson Energy, LLC (Williamson), Pond Creek Coal Refuse Disposal Facility No. 2 (Pond Creek).

GAI performed engineering analyses and prepared a comment response for IDNR Comment No. 2 based on our discussions, understanding of the site conditions, and our experience performing similar analyses. GAI notes only Comment No. 2 is addressed herein.

INTRODUCTION

Plans have been developed by Alliance Consulting, Inc. (Alliance), Beaver, West Virginia for the construction of a coal refuse disposal facility located near Johnston City in Williamson County, Illinois. The proposed Pond Creek facility will provide disposal capacity for both coarse and fine coal refuse, and will be constructed in five (5) phases designated Phases 3 through 7.

The proposed Phases 3 through 6 impoundments will be constructed by downstream or centerline methods, and Phase 7 is partially constructed by upstream methods. The upstream and downstream slopes will be about three horizontal to one vertical (3H:1V) except for Phase 3, which will have 2.6H:1V upstream slopes. Maximum slope heights will range from 49 feet for Phase 3 to 100 feet for Phase 7. All of the embankments, with the exception of a portion of Phase 7 will be founded on 15 to 22 feet of medium stiff to stiff, sandy clay overlying shale

bedrock. The south facing slope of Phase 7 (designated 7A and 7C) will be founded on impounded fine coal refuse (FCR) of Phase 3.

A previous permanent deformation analysis was submitted by Civil & Environmental Consultants, Inc, (CEC) to IDNR in January 2008 for Phase 2, which is similar to the incised and/or dike geometry of Phases 3 – 6 founded on residual soil. Therefore, the combined upstream-constructed Phases 7A and 7C is considered the most critical geometry. GAI further notes that Phase 7A will be constructed in approximately 200 days, and thus is considered a temporary condition relative to the occurrence of a maximum design earthquake (MDE).

IDNR COMMENT NO. 2

IDNR noted in their October 2008 review that "The seismic acceleration used in the slope stability analyses does not meet the required values. The Peak Ground Acceleration should be obtained from the USGS National Seismic Hazard Mapping Project map for 2% probability of exceedance in 50 years. If this analysis does not produce satisfactory results, a deformation analysis may be necessary."

GAI RESPONSE TO COMMENT NO. 2

Determination of Seismic Factor of Safety (Fs) and Yield Acceleration (Ky)

In accordance with the IDNR guidelines Part 3702 Dam and Safety Rules, GAI performed pseudo-static slope stability analyses of the Phase 7 Dam to determine the seismic factor of safety (Fs) and yield acceleration (Ky). A site PGA = 0.54 g obtained from the USGS National Seismic Hazard Mapping Project map for 2% Probability of Exceedance in 50 years was used in the Fs slope stability analyses. Appendix A presents the seismic hazard assessment performed for the Pond Creek facility located in Williamson County, Illinois

Drained and undrained strengths were developed for the various coal refuse materials including coarse and fine coal refuse, and residual soil, and input in PCSTABL slope stability analyses to obtain Fs and Ky. In accordance with the guidelines presented in the Mine Safety and Health Administration (MSHA) Engineering Design Manual, Coal Refuse Disposal Facilities, 2nd Edition (Reference 10), 80 percent of the peak undrained shear strength (Sup) was used for the FCR based on an average effective stress ($\sigma'v$) of approximately 6,450 pounds per square foot (psf) and $Sup/\sigma'v$ relationship of 0.27. Engineering properties presented in Table 1 were provided by Alliance and/or derived from field and laboratory testing results of site-specific materials presented in Appendix B.

Table 1 – Refuse/Soil Properties Used in Pseudo-Static and Yield Acceleration Slope Stability Analyses

Description	Unit Weights (γ_t,γ_s) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion (c) (psf)	Shear Strength
Coarse Coal Refuse (CCR)	130, 140	33.7	0	Effective (Drained)
Fine Coal Refuse (FCR)	80, 90	0	1,393	80% of Peak (Undrained)
Residual Soil	125, 135	19.5	416	Total (Undrained)

The slope stability analyses resulted in a minimum factor of safety of 0.51 using a horizontal acceleration corresponding to the PGA value of 0.54g. Consequently, the results of the Phase 7 pseudo-static (seismic) slope stability analyses are not satisfactory, and thus a permanent deformation analysis is required per the IDNR guidelines.

GAI subsequently performed yield acceleration slope stability analyses, which varied the input horizontal acceleration in PCSTABL until a Factor of Safety equal to 1.0 was achieved. Based on these analyses, a yield acceleration of 0.18g was iteratively determined for the Phase 7 Dam soil mass and the downstream critical failure surface.

The yield acceleration is the acceleration level:

- Below which yielding of the embankment (soil mass) does not occur and the soil mass deforms elastic-plastic; and/or
- Above which yielding occurs causing permanent deformation.

The yield acceleration is used as input to subsequent permanent deformation analyses.

Hard copies of the PCSTABL output and plot files for the Fs and Ky pseudo-static slope stability analyses are presented in Appendix C.

Permanent Deformation Analyses

As previously noted, IDNR has required that a seismic slope stability analysis be performed for the Phase 7 Dam using equivalent static load methods and the appropriate PGA based on the USGS 2% Probability of Exceedance in 50 Years hazard maps. Since the required factor of safety was not met, i.e., Factor of Safety = 0.51, a permanent deformation evaluation must be completed.

Therefore, GAI performed permanent deformation analyses of the Phase 7 Dam constructed over the Phase 3 fine coal refuse to estimate the magnitude of Phase 7 crest settlements. Permanent deformations and the resulting crest settlements accumulate depending upon the acceleration levels above the defined yield acceleration during an earthquake event.

(Newmark, 1965). If the estimated crest settlements do not exceed the available Phase 7 freeboard, overtopping of the dam will not occur.

GAI utilized two (2) empirically-based methods including the Makdisi-Seed (Makdisi, ,F.I. and Seed, H.B., 1978) and the Hynes-Griffin Franklin (Hynes-Griffin, M.E., Franklin, A.G., 1984) procedures to estimate the magnitude of earthquake-induced permanent deformations. The results of these empirically-based analyses are compared to the results of the Phase 2 permanent deformation analyses previously submitted to IDNR in January 2008, which used the Newmark double-integration, sliding block method of calculating soil mass displacements from one-dimensional, dynamic site response analyses. Finally, GAI notes that the failure surface impacts only a portion of the approximate 400-foot wide Phase 7 crest width, as shown in the Appendix C slope stability results, which adds significantly to the downstream safety of the dam.

Makdisi-Seed Method

In order to use the Makdisi-Seed method, the minimum and maximum design spectral acceleration was estimated at 0.36g and 0.73g, respectively, using the procedures outlined in the International Building Code (IBC) 2006, specifically Section 1613 Earthquake Loads. Additionally, an IBC 2006 Site Class D was chosen based on shear wave velocity testing performed at the Pond Creek facility. Site Class D is a 'Stiff Soil Profile' with a shear wave velocity (V_s) between 600 and 1,200 feet per second (fps). The site class was based on the average properties within the upper 100 feet of the site that supports the Phase 7 embankment.

The fundamental period (T_0) of the Phase 7 dam was approximated from the permanent deformation site response analysis of Phase 2, which was 0.23 seconds. This value is compared to IBC 2000, $T_S = S_{D1}/S_{DS}$, which was estimated at 0.49 seconds, and it is conservatively assumed that $T_0 = T_S = 0.49$ seconds.

Based on the various data described above, the design charts in IBC 2006 and Makdisi-Seed (1984), permanent deformations due to a PGA with 2% probability of exceedance in 50 years were estimated to be 1.7 feet or about 20 inches.

Hynes-Griffin and Franklin Method

Alternatively, the Hynes-Griffin and Franklin (1984) method was also used to estimate permanent deformations of the Phase 7 dam. Hynes-Griffin and Franklin developed upper bound, mean plus one standard deviation and mean curves estimated for earthquake-induced slope displacements based on the results of Newmark analyses of 348 earthquake motions and six (6) synthetic acceleration time histories.

Slope displacements are estimated using the most conservative upper bound curve and the ratio of horizontal acceleration that reduces the factor of safety to 1.0, i.e., the yield acceleration (Ky) and the peak horizontal acceleration (PGA). Based on the various data for the Phase 7 Dam and Pond Creek facility, slope displacements were estimated at 16 inches.

Appendix D presents the calculations and results of the Makdisi-Seed and Hynes-Griffin Franklin permanent deformation analyses methods.

Conclusions and Recommendations

Permanent deformations of the Phase 7 Dam from the empirically-based Makdisi-Seed and Hynes-Griffin Franklin methods yielded crest settlements of 20 and 16 inches, respectively. Further, Phase 2 deformations were previously estimated at 17 inches based on dynamic site response analyses and Newmark sliding block methods, which is consistent with the empirically-based analyses and estimates of Phase 7 Dam crest settlement. Therefore, the maximum Phase 7 Dam crest settlement of 20 inches compares favorably to an available freeboard of the Phase 7 Dam of 96 inches above the maximum fines level.

Although permanent deformations are acceptable relative to the available freeboard, GAI recommends that the dam be thoroughly inspected following a seismic event to make observations and note any ground movement, scarps, sloughing, toe bulges, etc. on the exposed downstream and upstream slopes, increased piezometric groundwater levels, and any other issues that may suggest slope instability.

In preparing this letter report, GAI's professional services have been performed, findings obtained and conclusions prepared in accordance with generally accepted engineering principles and practices. No warranty, expressed or implied is made or intended by rendering of these services or by furnishing oral or written reports of our findings. This report was prepared for the exclusive use of Alliance.

GAI appreciates this opportunity to provide to Alliance geotechnical earthquake engineering services. Please do not hesitate to contact us if you have any questions concerning any of the information presented.

Respectfully submitted,
GAI CONSULTANTS, INC.

Blaise E. Genes
Manager of Geotechnical and Structural

BEG/tlg
09040301001-ltr rpt-ac-rtc-beg/tlg D1

Attachments

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APPENDIX A

SEISMIC HAZARD ASSESSMENT
POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS

gai consultants
transforming ideas into reality

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Probabilistic Seismic Hazard Assessment – Source, Maximum Magnitude and Peak Ground Acceleration

PAGE 1 OF 11

MADE BY BEG DATE 1/3/08 CHECKED BY TJS DATE 1/23/08

CALCULATION BRIEF FOR PROBABILISTIC SEISMIC HAZARD ASSESSMENT – SOURCE, MAXIMUM MAGNITUDE, DISTANCE AND PEAK GROUND ACCELERATION

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE: Utilizing the 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps (Frankel, 2002), particularly the 2% Probability of Exceedance in 50 years recurrence interval, define the local and regional seismic events, maximum earthquake magnitudes, focal depths, epicentral distances and peak ground accelerations potentially impacting the Williamson Energy, Pond Creek coal refuse disposal site, Williamson County, Illinois.

METHODOLOGY: A probabilistic seismic hazard assessment (PSHA) is performed for the Pond Creek site located near Johnston City, Williamson County, Illinois. PSHA involves utilizing the 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps (Frankel, 2002), particularly the 2% Probability of Exceedance in 50 years maps for the site coordinates and the development of a particular seismic scenario upon which a ground motion hazard evaluation is based. The scenario consists of the postulated occurrence of an earthquake (i.e., 2% Probability of Exceedance in 50 years) of a specified size based on the latest USGS hazard mapping for the Pond Creek site. In general, PSHA involves four basic elements:

1. Evaluate earthquake sources;
2. Determine controlling earthquake(s): the maximum magnitude, maximum credible, or maximum considered earthquake;
3. Determination of ground motion attenuation relationships or distance from the site; and
4. Determination the peak ground acceleration (PGA).

PSHA determines the earthquakes that have the most significant impacts, and for engineering design and analyses of tailing dams, a design earthquake is desired.

Stochastic modeling, based on the published predictive relations of Atkinson and Boore (1995) is subsequently used to create synthetic acceleration-time histories

for the critical earthquake scenarios. The required input parameters for the critical earthquake source spectra, including moment magnitude, epicentral distance, and focal depth are developed from the published information discussed above, and summarized below.

Subsequently discussed in a separate calculation brief, a comparison of input parameters and site response will be made using both eastern US synthetic earthquake time histories and actual western US earthquake time histories. Available records are scaled in SHAKE (Schnabel, 1971) to the Pond Creek site PGA and the site response compared to published eastern US ground motion attenuation (GMA) response spectra to assess the reasonableness of the various time histories.

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SEISMIC HAZARD ASSESSMENT

General

Nuttli and Herrmann (1978) outline the input necessary for performing either a deterministic or probabilistic method of assessing seismic hazard, which requires that the seismic source zones be identified, that the maximum-magnitude earthquake for each source zone be estimated, that the magnitude-frequency recurrence rate for each source zone be determined, and that the attenuation of seismic wave energy with distance be known.

Based on the current ability to generate synthetic earthquake acceleration-time histories for eastern North American (ENA) earthquakes using the stochastic modeling techniques developed by Boore (1983) and Atkinson and Boore (1995), a PSHA approach was chosen to generate a design earthquake(s). Using this approach, the Maximum Design Earthquake (MDE) for the 2% Probability of Exceedance in 50 years was chosen, which for the Pond Creek site has a PGA of 0.54g. As discussed in Atkinson and Boore (1995 and 1998), the utilized ground motion relationships compared well to the limited database of recorded Eastern North America (ENA) earthquakes and large earthquakes from analogous intra-plate, hard rock sites. In a separate calculation brief, a comparison is made of the PGA from the various

ground motion attenuation relationships and the synthetic time-histories, as well as a comparison of the site response and response spectra of both the synthetic earthquake acceleration time histories and a scaled western U.S. acceleration-time history record to evaluate the consistency and results of the eastern and western time histories relative to the embankment response, i.e., frequency content, spectral acceleration, etc.

The PSHA methodology chosen for this evaluation represents a more refined approach to previous methods which used empirical, pseudostatic embankment analyses. Similarly, the PSHA developed specifically for the Pond Creek site also attempts to eliminate the potential for over-conservative, unrealistic strong ground motion associated with the "floating earthquake" concept. This approach is generally applied in regions where active earthquake-generating surface faults exist and the intensity-based peak acceleration relationships are from only long-period western U.S. and Japanese seismic activity and more importantly, the peak acceleration does not account for distance.

Selection of Maximum Credible Earthquake Scenarios and Peak Ground Acceleration

Based on the most critical regional and local seismic sources to the Pond Creek site as identified in the USGS Interactive Deaggregation Maps, two MDE scenarios have been selected for analysis including a magnitude (M) 8.0, which has boundary limits of about 83 km from the site and the potential to generate a high intensity earthquake. The Pond Creek site also has the potential to be impacted by a smaller magnitude earthquake or a comparable local "background" earthquake at a closer epicentral distance to the site, which based on the USGS seismic hazard program is an M6.8 at 13.5 km. The PGA associated with this hazard was defined at 0.54g. The 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps (Frankel, 2002), particularly the 2% Probability of Exceedance in 50 years maps are attached.

The rate at which the strength of earthquake ground motion attenuates and the amount of geometric spreading with distance from the epicenter are required for seismic hazard analyses. The focal depth of the earthquake and the near surface geological conditions have a significant influence on the intensity attenuation relationship. Information on earthquakes occurring in the eastern United States suggests that surface faulting does not occur and the center of energy release is deeper than the average of California earthquakes. The earthquake energy is therefore radiated over a larger area than is experienced in California, and California data cannot be extrapolated directly to this region. Several ENA and CEUS ground motion attenuation relationships including Toro, et.al. (1997), Atkinson & Boore (1997), Campbell (2003), Atkinson (2001) and Tavakoli & Pezeshk (2005) are used to compare the USGS PGA for the Pond Creek site to that of other ENA and CEUS ground motion relationships.

Therefore, these two MDE scenarios will be evaluated for their impact on the Pond Creek impoundment since the maximum ground accelerations, frequency contents, and durations of effective cycles will be notably different.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation — PROJECT NO. 072046

Probabilistic Seismic Hazard Assessment – Source, Maximum Magnitude and Peak Ground Acceleration — PAGE 5 OF 11

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As previously discussed, utilizing the Atkinson and Boore (1995) empirically-derived earthquake source spectra model for eastern North American hard rock sites, quality synthetic acceleration-time histories have been created for the bedrock motions. Subsequently, the various input parameters from these synthetic earthquake records are compared to the Pond Creek site input and the time histories scaled accordingly to the PGA anticipated at the Pond Creek site. Also, selection of an earthquake time history record from the PEER Strong Motion Database for western U.S. and Japanese earthquake records, scaled to the PGA is performed. Finally (in another calculation brief), the corresponding response spectra curves of the site response due to the ENA/CEUS synthetic and PEER earthquake time histories are compared to the ENA and CEUS ground motion attenuation response spectra to assess the reasonableness of the time history.

CONCLUSION

A Probabilistic Seismic Hazard Assessment (PSHA) which utilized the 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps indicated local and regional seismic scenarios of potential impact to the Pond Creek coal refuse disposal site located in Williamson County, Illinois. Two MDE scenarios were chosen for analysis including M8.0 earthquake located at a epicentral distance of 83 km from the site was chosen for potential for a large intensity earthquake with a corresponding PGA of 0.54g. Additionally, an M6.8 earthquake at an epicentral distance of 13.5 km from the site was identified and will be used to model an earthquake that could "occur anywhere" with a PGA of 0.54g. These scenarios will be used to scale existing eastern U.S. synthetic acceleration-time histories, based on the source spectra models defined by Atkinson and Boore (1995) and a western U.S., PEER earthquake record. A comparison of the various input time histories, site response (spectra) and published eastern U.S. ground motion attenuation relationships spectra performed in a separate calculation brief.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation — PROJECT NO. 072046

Probabilistic Seismic Hazard Assessment – Source, Maximum Magnitude and Peak Ground Acceleration — PAGE 6 OF 11

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FIGURES
2002 USGS EARTHQUAKE HAZARDS PROGRAM – PEAK GROUND ACCELERATION AND INTERACTIVE DEAGGRAGATION MAPS FOR 2% PROBABILITY OF EXCEEDANCE IN 50 YEARS RECURRENCE INTERVAL

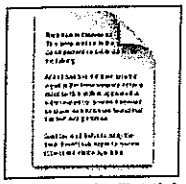
POND CREEK SITE
WILLIAMSON COUNTY, ILLINOIS

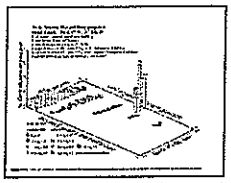
USGS science for a changing world

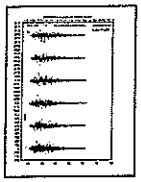
Earthquake Hazards Program

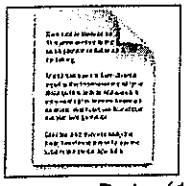
2 Interactive Deaggragations

Generated Output:
Click a link below to view the output file.


Report (15 Kb)


Deagregation (59 Kb)


Seismograms (62 Kb)


Seismogram Data (1 Mb)

On this page you may select a return time, SA frequency, specify a latitude and longitude and request seismograms. Links to the following information will be returned:

- A plot of deaggregated distance, magnitude and ground-motion uncertainty for the specified parameters.
- An ascii text file of the hazard matrices, containing, but not limited to, the frequency selected.
- A geographic deaggregation plot may also be specified (for designated frequencies only - see below). This is in addition to the plot mentioned above.
- An ascii text file and graph of the seismograms for the modal or mean event (if requested).

Please read the README file before trying to use this site. The README explains about the input parameters and also describes how the deaggregation is done. Stochastic Seismograms and What is Epsilon? are articles which discuss the theory behind the seismograms.

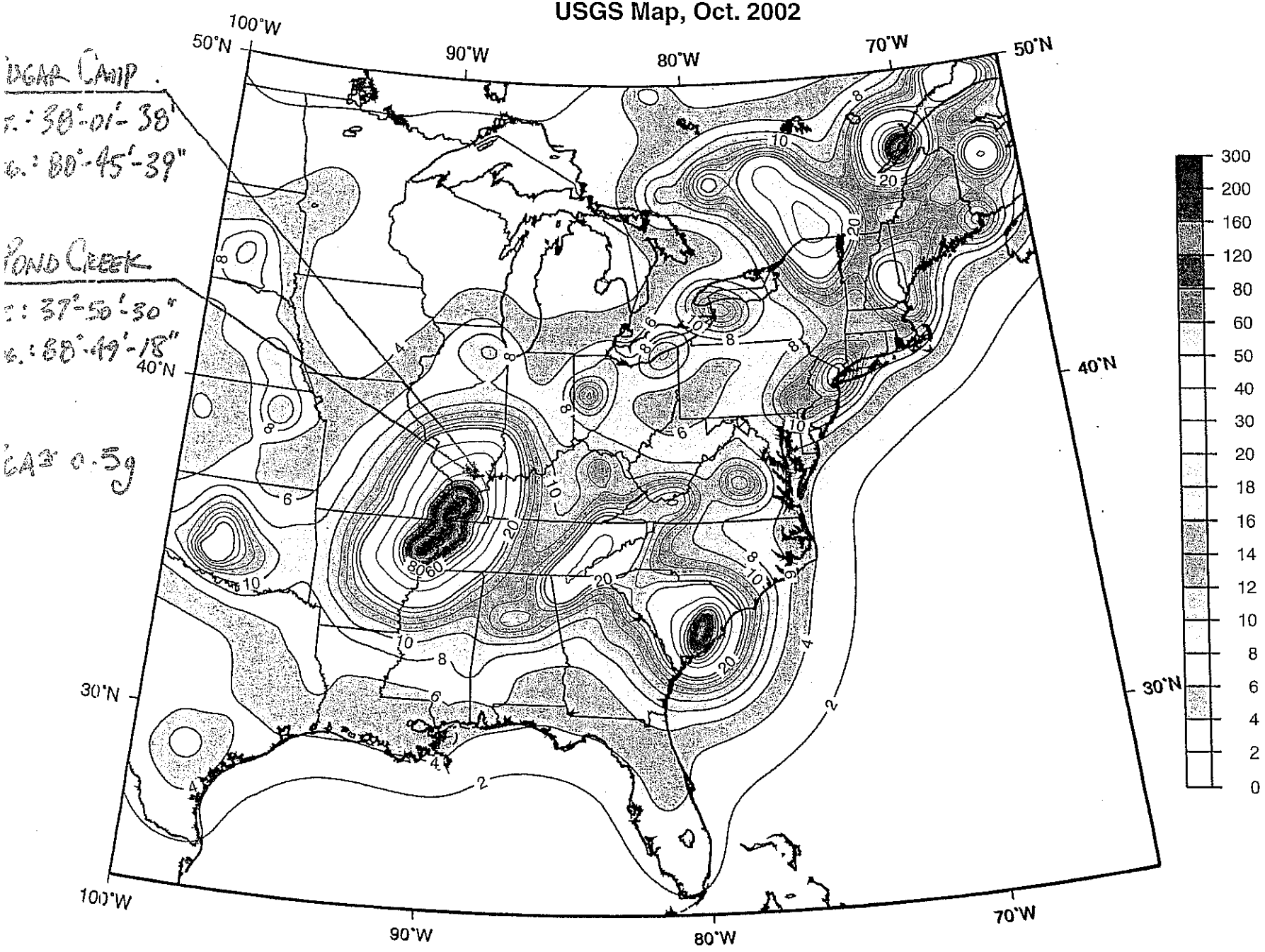
Choose parameters and click "Generate Output"

Site Name: (Help)	Pond_Creek
Latitude: (Help)	37.84
Longitude: (Help)	-88.82
Return Period: (Help)	2475 years (2% in 50 years)
Frequency: (Help)	PGA
Geographic Deaggs: (Help)	None
Stochastic Seismograms: (Help)	Modal, One-Corner Source

Start Over | Generate Output

U.S. Department of the Interior | U.S. Geological Survey
URL: http://earthquake.usgs.gov/research/hazmaps/interactive/wrapper.php
Page Contact Information: Web Team
Page Last Modified: June 28, 2007 1:14:52 PM.

Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002



8 of 11

R14698

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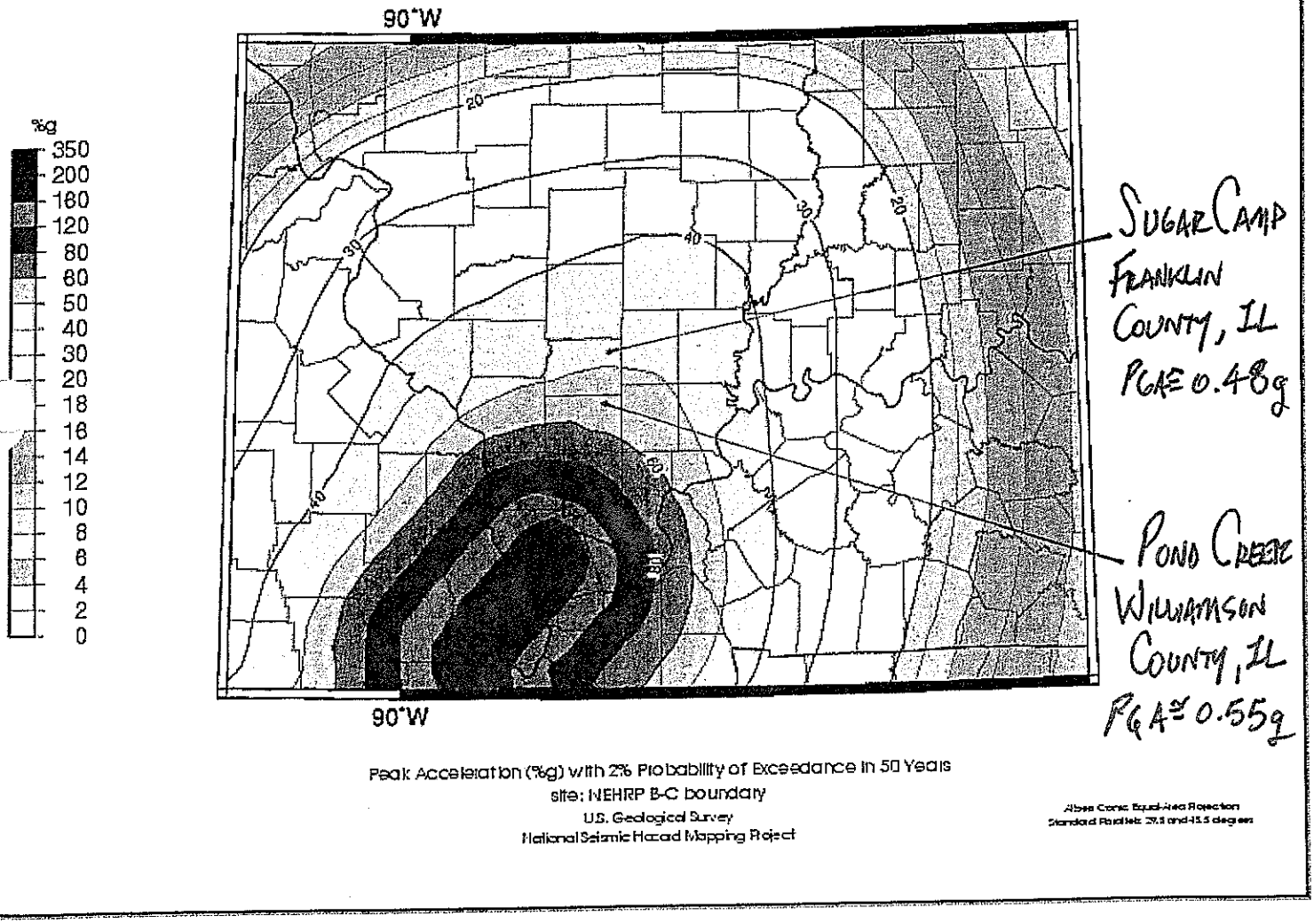
Earthquake Hazards Program

2002 NSHMP Hazard Mapping

Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years



DF Version
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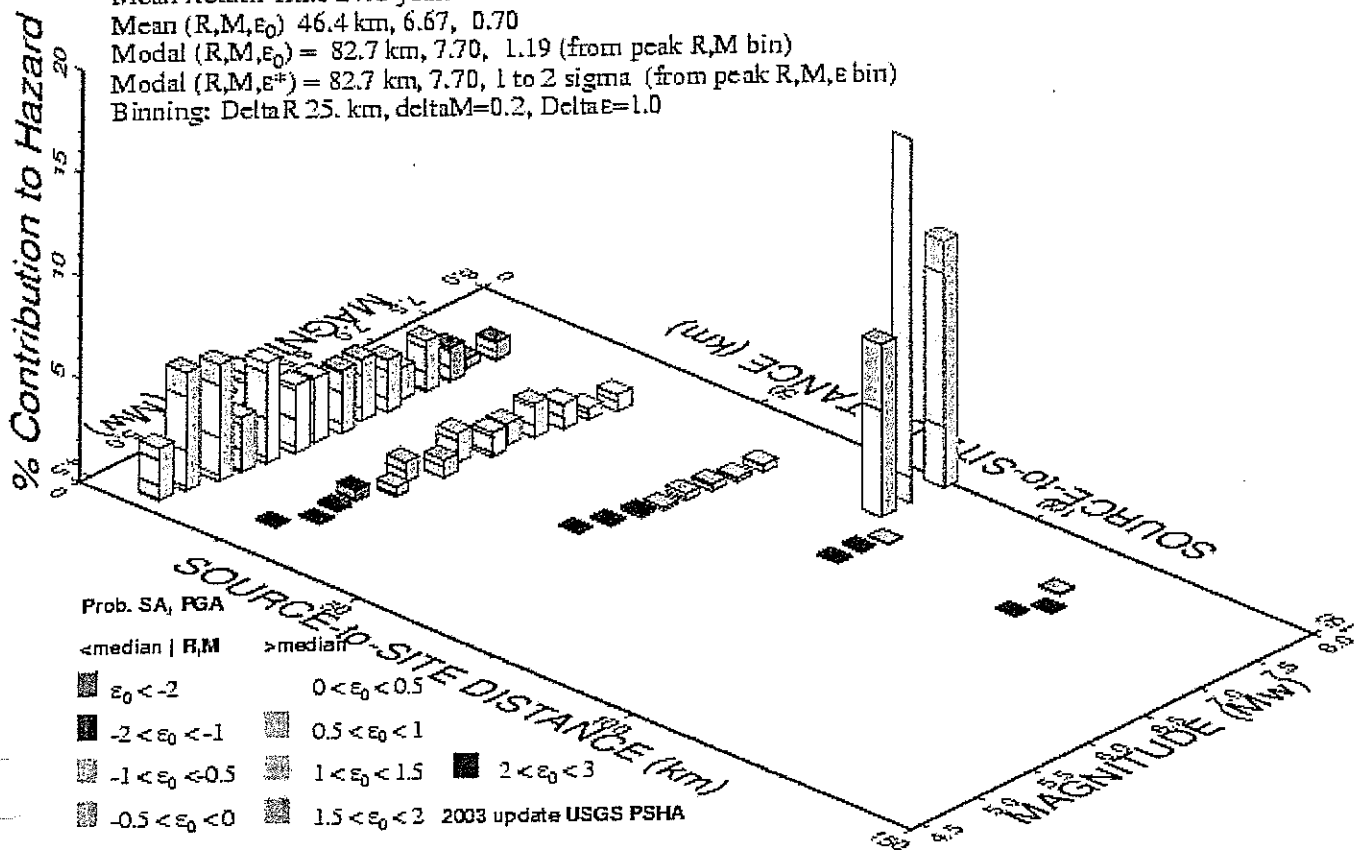
e above files will be deleted every hour on the hour.

S. Department of the Interior | U.S. Geological Survey
RL: http://earthquake.usgs.gov/research/hazmaps/interactive/cmaps/custom2002_2006.php
ige Contact Information: Web Team
ge Last Modified: December 27, 2006 3:26:50 PM

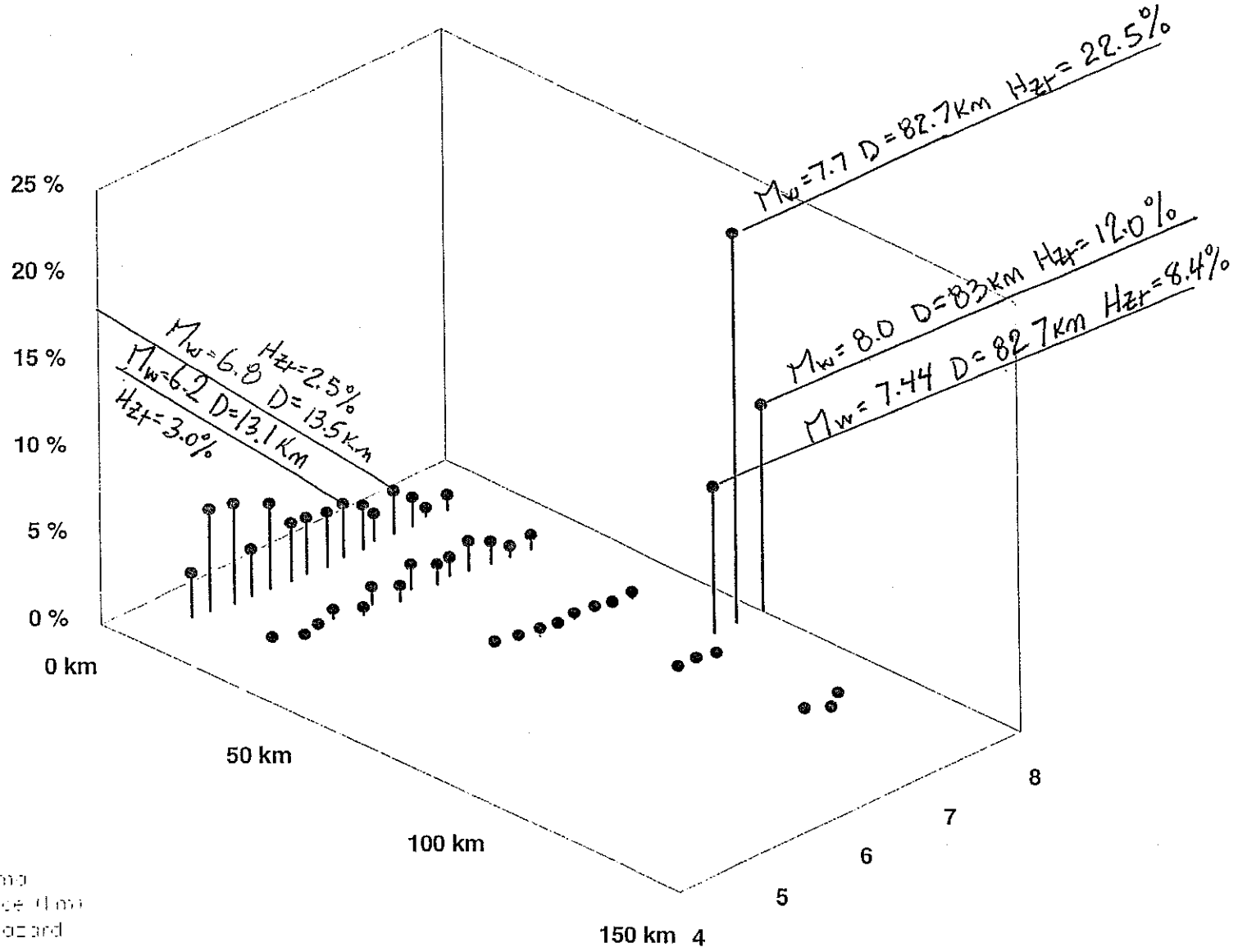
Prob. Seismic Hazard Deaggregation
Pond_Creek 88.820° W, 37.840 N.

Peak Horiz. Ground Accel.>=0.5401 g
Mean Return Time 2475 years
Mean (R,M,ε_0) 46.4 km, 6.67, 0.70
Modal (R,M,ε_0) = 82.7 km, 7.70, 1.19 (from peak R,M bin)
Modal (R,M,ε^*) = 82.7 km, 7.70, 1 to 2 sigma (from peak R,M,ε bin)
Binning: DeltaR 25. km, deltaM=0.2, Deltaε=1.0



GMT 2007 Dec 5 09:20:52 Distance (R), magnitude (M), epsilon (ε0,ε) deaggregation for a site on ROCK avg Vs=760 m/s top 30 m USGS CGHT PSHA2002v3 UPDATE Bins with ll 0.05% contrib. omitted

Probabilistic Seismic Hazard Deaggregation - Pond Creek (88.820° W , 37.840° N)



ISE, M8.0 @ 83Km
AND M6.2 @ 13Km
OR
M6.8 @ 13.5Km

Epsilon Interval: All Sigma
Source to Site Distance (km)
% Contribution to Hazard
Magnitude (Mw)

Deaggregation of the PGA >= .5401 g for a 2475 year return period

11/1 R14401

APPENDIX B

CHARACTERIZATION OF THE SAND-LIKE AND CLAY-LIKE SUBSURFACE MATERIALS PREPARED BY CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

ESTIMATION AND SUMMARY OF ENGINEERING PROPERTIES INCLUDING PEAK AND STEADY-STATE UNDRAINED SHEAR STRENGTH FOR REFUSE AND SUBGRADE MATERIALS PREPARED BY CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

LABORATORY TESTING RESULTS PROVIDED BY ALLIANCE CONSULTING, INC.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

PAGE 1 OF 12

MADE BY BEG DATE 7/11/08 CHECKED BY MTS DATE 7/25/08

CALCULATION BRIEF
FOR
CHARACTERIZATION OF SAND-LIKE AND CLAY-LIKE SUBSURFACE MATERIALS

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH CELL

OBJECTIVE: To characterize subsurface materials including coarse coal refuse, fine coal refuse and residual soils encountered at the Pond Creek South Cell refuse disposal facility. Materials are characterized as either sand-like or clay-like in accordance with various pertinent references shown below and included within the "Draft" Mine Health and Safety Administration (MSHA) Engineering and Design Manual, specifically Chapter 7: Seismic Design: Stability and Deformation Analyses, March 2007.

REFERENCES:

1. Illinois Department of Natural Resources, Office of Water Resources, Construction and Maintenance of Dams, Part 3702, Chapter IX.

2. Mine Safety and Health Administration, "Draft - Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 – Seismic Design: Stability and Deformation Analyses," dated, March 13, 2007.

3. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Piezo-Cone Penetration Testing," Pond Creed Coal Refuse Disposal Site, BEG, dated 12/21/07.

4. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Normalized PS-CPT Data and Parameter Correlations," Pond Creek Coal Refuse Disposal Site, BEG, dated 12/28/07.

5. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Laboratory Testing," Pond Coal Refuse Disposal Site – South Pond, BEG, dated 7/8/08.

6. Boulanger, R.W. and Idriss, I.M. (2004). "Evaluating the Potential for Liquefaction or Cyclic Failure of Silts and Clays," Report No. UCD/CGM-04/01, Center for Geotechnical Modeling, Department of Civil and Environmental Engineering, University of California, Davis, California.

7. Robertson, P.K., (Fear) Wride, C.E., List, B.R., Atukorala, U., Biggar, K.W., Byrne, P.M., Campanella, R.G., Cathro, D.C., Chan, D.H., Czajewski, K., Finn, W.D.L., Gu, W.H., Hammamji, Y., Hofmann, B.A., Howie, J.A., Hughes, J., Imrie, A.S., Konrad, J.-M., Küpper, A., Law, T., Lord, E.R.F., Monahan, P.A., Morgenstern, N.R., Phillips, R., Piché, Plewes, H.D., Scott, D., Sego, D.C., Sobkowicz, J., Stewart, R.A., Tan, S., Vaid, Y.P., Watts, B.D., Woeller, D.J., Youd, T.L., and Zavodni, Z., The CANLEX Project: Summary and Conclusions. Canadian Geotechnical Journal, 2000, Vol. 37, No. 3, June, pp. 499-504

8. Youd, T. L. et al. (2001). "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 127, No. 10, pp. 817-833.

9. Blight, G. E. and Bentel, G. M., (1983) "The Behaviour of Mine Tailings During Hydraulic Deposition," Journal of the South African Institute of Mining and Metallurgy, April 1983.

GENERAL:

Reference (Ref.) Number (No.) 1 presents the following guidelines regarding the methods of testing, analyses and computations which must be completed and submitted with an application to support an owner's request for abandonment of a disposal impoundment dam:

1. The classification of the existing condition of the impounded material with respect to its fluid nature;
2. The liquefaction potential of the impounded material and the related stability of the containing dam;
3. The final surface configuration for the impounded materials, especially from any surface water impounding characteristics and the erosion potential of the surface material; and
4. The establishment of a follow-up inspection schedule to ensure the proposed plans have been effective and the submittal of record drawings.

This, and subsequent calculation briefs prepared by Civil & Environmental Consultants, Inc. (CEC), address the characterization of the impounded fine coal refuse and the liquefaction potential of the fine coal refuse and related stability (i.e., Requirements 1 and 2 above). Alliance Consulting, Inc. (Alliance) will provide the final surface configuration and the follow-up inspection schedule.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 3 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

From Ref. No. 2, the basic elements for seismic design and analysis are:

1. Characterize the subsurface materials;
2. Evaluate if design earthquake will trigger strength loss;
3. Evaluate seismic stability using post-earthquake strength parameters; and
4. Evaluate deformations.

Therefore, the first step for both abandonment and seismic design and analysis is to characterize the subsurface conditions to evaluate the fluid nature and whether any zones have the potential for strength loss due to earthquake shaking (i.e., liquefaction potential). Previously, the materials making up the coarse refuse dike and underlying residual soils were evaluated using piezo-seismic cone penetration testing (PSCPT) (Ref. Nos. 3 and 4) as part of the deformation analyses of the South Pond. Subsequently, and as part of the abandonment evaluation, laboratory testing (Ref. No. 5) and characterization of the fine coal refuse retained behind the embankment was performed as described below.

For many aspects of seismic stability analyses described in Ref. No. 2, coal refuse and natural soils are referred to as sand-like or clay-like depending on whether they exhibit monotonic and cyclic undrained shear loading behavior that is fundamentally more similar to that of either sand or clay. This differentiation is significant primarily if the material is loose enough (sands) or soft enough (clays) that it is potentially susceptible to strength loss.

SUMMARY OF POND CREEK FIELD AND LABORATORY TESTING/RESULTS:

CEC developed, implemented and oversaw a detailed and thorough field testing program consisting of performing PS-CPT at several sounding locations throughout the Pond Creek site, including the ongoing South Pond impoundment. PS-CPT was executed at Pond Creek by ConeTec, Inc. (ConeTec) of West Berlin, New Jersey. Also, Alliance provided bulk (bucket) samples of fine coal refuse, which were obtained for subsequent laboratory testing. Geotechnics, Inc. (Geotechnics) of Pittsburgh, Pennsylvania performed consolidated undrained triaxial shear strength laboratory testing of the fine coal refuse materials. Ref. Nos. 3 -5 present summaries of the field and laboratory testing programs and Appendixes A - C of the Pond Creek abandonment report present the results of the field and laboratory testing.

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PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 4 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

PIEZO-SEISMIC CONE PENETRATION TEST RESULTS SUMMARY:

Generalized South Cell CPT Profiles from the October 2007 field testing presented in Ref. Nos. 3 and 4 indicated the following:

CPT-1	CPT-2
El. 482.19 – Surface Elevation	El. 494.21 – Surface Elevation
15.3 feet – Depth to Static Ground Water	38.8 feet – Depth to Static Ground Water
0 – 18.4 feet – Residual Soil	0 – 32 feet – Coarse Refuse
Refusal at 18.4 feet - Bedrock	32 – 45.3 feet – Residual Soil
	Refusal at 45.3 feet - Bedrock

CPT-2A	CPT-3
El. 492.40 – Surface Elevation	El. 466.98 – Surface Elevation
37.0 feet – Depth to Static Ground Water	11.1 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 22.2 feet – Residual Soil
29 – 41.7 feet – Residual Soil	Refusal at 22.2 feet – Bedrock
Refusal at 41.7 feet - Bedrock	

CPT-4	CPT-5
El. 482.55 – Surface Elevation	El. 482.55 – Surface Elevation
21.7 feet – Depth to Static Ground Water	34.4 feet – Depth to Static Ground Water
0 – 18.9 feet – Residual Soil	0 – 29 feet – Coarse Refuse
Refusal at 18.9 feet – Bedrock	29 – 49.2feet – Residual Soil
	Refusal at 49.2 feet - Bedrock

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

PAGE 5 OF 12

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-5A	CPT-5B
El. 483.00 – Surface Elevation	El. 479.90 – Surface Elevation
35.9 feet – Depth to Static Ground Water	28.0 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 19 feet – Coarse Refuse
29 – 53.2 feet – Residual Soil	19 – 39.7 feet – Residual Soil
Refusal at 53.2 feet - Bedrock	Refusal at 39.7 feet - Bedrock

Cone penetration testing results for CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A AND CPT-5B presented in Ref. Nos. 3 and 4 indicated the following:

CPT-1	CPT-3
Residual Soil (Layer Thickness = 18.4)	**Residual Soil (Layer Thickness = 22.2)**
Avg. Tip Stress, Qc avg. = 79 tsf	Avg. Tip Stress, Qc avg. = 43 tsf
Avg. Fines Content, FC avg. = 27%	Avg. Fines Content, FC avg. = 32%
Avg. SBT Index, Ic = 2.38	Avg. SBT Index, Ic = 2.49

CPT-4
Residual Soil (Layer Thickness = 18.9)
Avg. Tip Stress, Qc avg. = 64 tsf
Avg. Fines Content, FC avg. = 28%
Avg. SBT Index, Ic = 2.41

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PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

MADE BY BEG DATE 7/11/08 CHECKED BY MRS DATE 7/23/08

CPT-2	CPT-2A
Coarse Coal Refuse (Layer Thickness = 32')	**Coarse Coal Refuse (Layer Thickness = 29')**
Avg. Tip Stress, Qc avg. = 54 tsf	Avg. Tip Stress, Qc avg. = 45 tsf
Avg. Fines Content, FC avg. = 24%	Avg. Fines Content, FC avg. = 22%
Avg. SBT Index, Ic = 2.30	Avg. SBT Index, Ic = 2.23

Residual Soil (Layer Thickness = 13.3')	**Residual Soil (Layer Thickness = 12.7')**
Avg. Tip Stress, Qc avg. = 47 tsf	Avg. Tip Stress, Qc avg. = 86 tsf
Avg. Fines Content, FC avg. = 60%	Avg. Fines Content, FC avg. = 48%
Avg. SBT Index, Ic = 2.99	Avg. SBT Index, Ic = 2.80

CPT-5	CPT-5A
Coarse Coal Refuse (Layer Thickness = 29')	**Coarse Coal Refuse (Layer Thickness = 29')**
Avg. Tip Stress, Qc avg. = 50 tsf	Avg. Tip Stress, Qc avg. = 37 tsf
Avg. Fines Content, FC avg. = 23%	Avg. Fines Content, FC avg. = 24%
Avg. SBT Index, Ic = 2.24	Avg. SBT Index, Ic = 2.29

Residual Soil (Layer Thickness = 20.2')	**Residual Soil (Layer Thickness = 24.2')**
Avg. Tip Stress, Qc avg. = 66 tsf	Avg. Tip Stress, Qc avg. = 49 tsf
Avg. Fines Content, FC avg. = 64%	Avg. Fines Content, FC avg. = 56%
Avg. SBT Index, Ic = 3.04	Avg. SBT Index, Ic = 2.94

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 7 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-5B
Coarse Coal Refuse (Layer Thickness = 19')
Avg. Tip Stress, Qc avg. = 41 tsf
Avg. Fines Content, FC avg. = 19%
Avg. SBT Index, Ic = 2.15

Residual Soil (Layer Thickness = 20.7')
Avg. Tip Stress, Qc avg. = 63 tsf
Avg. Fines Content, FC avg. = 51%
Avg. SBT Index, Ic = 2.84

Cone Penetration Testing Results – Shear Wave Velocities

CPT No.	Shear Wave Velocity Coarse Coal Refuse (ft/sec)			Shear Wave Velocity Residual Soil (ft/sec)		
	Max.	Min.	Avg.	Max.	Min.	Avg.
CPT-1	NA			1402	645	905
CPT-2	1284	1029	1120	1173	795	957
CPT-2A	1169	895	1042	1256	780	918
CPT-3	NA			1058	569	765
CPT-4	NA			1242	476	817
CPT-5	1190	936	1063	1599	780	947
CPT-5A	1396	779	1064	1580	728	1005
CPT-5B	1517	818	1080	1649	686	978

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

PAGE 8 OF 12

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

LABORATORY TESTING RESULTS SUMMARY:

Ref. No. 4 and Appendix A present the details and results of the June 2008 laboratory testing program performed by Geotechnics. The following summarizes laboratory testing results of each of 2 buckets of fine coal refuse sampled from the South Pond impoundment.

Bucket 1	Bucket 2
Fine Coal Refuse	**Fine Coal Refuse**
Moisture = 85.8 %	Moisture = 94.4 %
Passing No. 200 = 92.8 %	Passing No. 200 = 92.6 %
Passing No. 40 = 99.4 %	Passing No. 40 = 99.3%
Plasticity Index = 17 %	Plasticity Index = 17 %
Avg. Strain to Peak = 15.1 %	Avg. Strain to Peak = 11.0 %

Normalized tip stress and fines content with depth for CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B including a summary of pertinent average field and laboratory test results for each material layer are attached.

CRITERIA AND METHODOLOGY:

From Ref. No. 2, the first step common to all approaches is to review the subsurface conditions at the embankment to evaluate whether any zones have the potential for strength loss. For this initial screening step, saturated to nearly saturated sand-like materials with $N_{1,60}$ values less than 15 blows per foot (bpf), or q_{c1} (or Qc) values less than 75 tons per square foot (tsf), should be considered potentially susceptible to strength loss. Ref. No. 2 noted these values are likely too conservative and apply only to clean sands. Their application to silty sands and sands with high fines content, which are more representative of fine coal refuse, will likely be overly conservative.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 9 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MCS DATE 7/23/08

Generalized field-related CPT-derived criteria noted in various references within Reference 2 include:

Sand-like:	Fines content < 50% or PI < 12%
Loose:	SPT $N_{1,60}$ < 15 or CPT q_{c1} > 75 tsf, & SBT Ic < 2.6 or F_r < 2%).
Clay-like:	Fines content > 50% and PI >12%
Soft:	OCR < 5, S_u/σ'_v < 1.0, CPT Q_t < 20 tsf & SBT Ic > 2.6, SPT $N_{1,60}$ < 8

CPT data may be used in conjunction with Atterberg limit data (criteria shown below) to differentiate sand-like from clay-like material. CPT Soil Behavior Type Index (I_c), as described in Robertson and Wride 1998 and reproduced in Youd et al. 2001, values below 2.6 should be considered sand-like. I_c values above 2.6 may be considered clay-like.

Generalized laboratory results criteria noted in various references within and in Ref. No. 1 include the following Atterberg Limit and sieve criteria:

Atterberg Limits.

- Material should be considered sand-like if any of the following three (3) criteria apply:

  1. The material has less than 35% particles by dry weight passing the No. 40 sieve and less than 20% by dry weight passing the No. 200 sieve; or

  2. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 12%; or

  3. The material has 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 20%.

The material may be considered clay-like if any of the following two (2) criteria apply:

1. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 12% or higher; or

2. The material has 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 20% or higher.

Atterberg limit criteria include as sand-like some materials that are considered clay-like by some investigators (e.g. Boulanger and Idriss, 2004, who suggested a break between sand-like and clay-like behavior at a PI of 7%). The intent is to classify borderline materials as sand-like to be conservative.

Another key factor in differentiating loose sand-like material from soft or medium clay-like material, for the purposes of seismic stability and deformation analyses, are the strain at peak undrained strength and the abruptness of the drop-off in shearing resistance as strains increase beyond the strain at peak. Loose sands and highly sensitive clays can reach S_{up} at small strains, and experience abrupt drop-off in resistance at higher strains. Most clays tend to reach S_{up} at higher strains, and tend to experience more gradual and limited drop-off in shearing resistance at higher strains. Fine coal refuse deposits often include materials falling within both classifications, and near the boundary of these two types of behavior.

Loose materials with shear strain at peak strength of less than 2% in an undrained monotonic (non-cyclic) test, and a rapid drop-off in resistance after reaching peak strength, are considered sand-like. Loose or soft materials with shear strain at peak strength of more than about 5%, and a gradual drop-off in resistance after reaching peak strength are considered clay-like. Materials with strain behavior between these descriptions are considered borderline and, to be conservative, should generally be analyzed as sand-like. (Note that shear strain in an undrained triaxial test is 1.5 times axial strain.)

Soil, rock, and mixtures of soil and rock that are not coal refuse such as the underlying starter embankment will be referred to as natural soils. Natural soils may be described as sand-like, or clay-like, using the same general criteria as refuse.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 11 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A AND CPT-5B AVG. WEIGHTED AVERAGE FIELD AND LAB RESULTS SUMMARY
Coarse Coal Refuse (138')
Avg. Tip Stress, Qc avg. = 46 tsf
Avg. Fines Content, FC avg. = 23%
Avg. SBT Index, Ic = 2.25

Fine Coal Refuse
Avg. % Passing No. 200 = 92.7%
Avg. % Passing No. 40 = 99.4 %
Avg. Plasticity Index = 17%
Avg. Strain to Peak = 13.1 %

Residual Soil (150.6')
Avg. Tip Stress, Qc avg. = 61 tsf
Avg. Fines Content, FC avg. = 46%
Avg. SBT Index, Ic = 2.73

Plots of individual and average normalized tip stress with depth are included with an attached complete copy of Ref. No. 4.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

PAGE 12 OF 12

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CONCLUSION

Based on the information presented in this calculation brief, the following material characteristic designations were determined for the coarse coal refuse, fine coal refuse and residual soil:

Coarse Coal Refuse: Medium Dense Sand-Like;

Fine Coal Refuse: Medium Stiff Clay-Like;

Residual Soil: Medium Dense Sand-Like and Medium Stiff Clay-Like.

Further, the results of the laboratory testing indicate that the fine coal refuse is clay-like based on an average 93% passing the No. 200 sieve and plasticity index of 17%. Peak and steady-state undrained strengths presented in Appendix A were reached at generally high strains (between 8 and 18%), and there was very little drop off from peak to steady-state with increasing strain. The results generally indicated a higher resistance to strength loss (and flow) due to the large strains required to exceed the peak strength and correspondingly small decrease to the steady-state strength at higher strains. Further, previous deformation analyses results indicated induced shear strains from the PGA at less than 0.1%, which is well below a threshold (peak) triggering strain of the material.

The susceptibility of the embankment and impoundment to a liquefaction flow failure is a function of both the undrained strength (worst case steady-state strength) and the in-situ driving shear stress on a critical failure plane passing through the critical layer fine coal refuse material, which is further addressed in subsequent calculation briefs.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Estimation and Summary of Engineering Properties
for Fine Coal Refuse

PROJECT NO. 080851

PAGE 1 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

CALCULATION BRIEF
FOR

ESTIMATION AND SUMMARY OF ENGINEERING PROPERTIES INCLUDING PEAK AND STEADY-STATE UNDRAINED SHEAR STRENGTH FOR REFUSE AND SUBGRADE MATERIALS

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH POND STAGE 2

OBJECTIVE: To estimate and summarize engineering properties for fine coal refuse materials samples obtained at the Pond Creek Coal Refuse Disposal site including unit weight (γ), specific gravity (G_s), effective strength, i.e., angle of internal friction (ϕ') and cohesion (c'), total strength, peak undrained shear strength (S_{up}), and steady-state undrained shear strength (S_{us}). The various strengths will be used in the South Pond abandonment analyses model(s).

REFERENCES:

1. Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Summary of Piezo-Seismic Cone Penetration Testing," Pond Creek Coal Refuse Disposal Site," BEG, 12/21/07.

2. Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Summary of Laboratory Testing – Fine Coal Refuse," Pond Creek Coal Refuse Disposal Site – South Pond," BEG, 7/10/08.

3. Alliance Consulting, Inc., "Appendix C Laboratory Testing, Proposed Coal Refuse Disposal Facility No. 2, Pond Creek Mine No. 1, Williamson County, Illinois."

4. Poulos, S.J., Castro, G., France, J.W. (1985), "Liquefaction Evaluation Procedure," Journal of Geotechnical Engineering, ASCE, 111(6), pp. 772-791.

5. Genes, B.E., Keller, T.O., and Laird, J.P. (2000) "Steady State Liquefaction Susceptibility of High Hazard Upstream-Constructed Coal Refuse Disposal Facilities," Proceedings of Tailings Dams 2000, ASDSO/USCOLD, Las Vegas, NV, March 28-30, pp. 47-58.

6. Almes, R. A. and Butail, A. (1976) "Coal Refuse: Its Behavior Related to the Design and Operation of Coal Refuse Disposal Facilities," Proceedings of the Ohio River Valley Soils Seminar, Lexington, Kentucky, October, 1976.

7. Bowles, Joseph E. (1984) "Physical and Geotechnical Properties of Soils," Mc-Graw Hill. New York: 367-369 and 393-396.

SOIL PROPERTIES:

The following soil properties were estimated based on laboratory testing [Reference Numbers (Ref. Nos.) 2 and 3] performed for abandonment analyses and/or provided by Alliance Consulting, Inc. for previous deformation analyses, which are used in the various slope stability analyses and attached for information:

Refuse/Soil Properties

Description	Unit Weight (γ) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion [1] (c) (psf)	Comment
Coarse Refuse	130	36	0	Frictional
Fine Coal Refuse	85	36.9	0	Effective Strength (Drained)
		18.8	0	Total Strength (Undrained)
		0	Varies (See Below)	Steady-State (Undrained)
Residual Soil	125	19.5	400	Total Strength (Undrained)
		0	3000	80% Peak Undrained

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PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation

Estimation and Summary of Engineering Properties for Fine Coal Refuse

PROJECT NO. 080851

PAGE 3 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MTS DATE 7/23/08

LABORATORY-DERIVED S_{up} and S_{us}:

Two (2) consolidated – undrained (CU) triaxial series tests (3 points each) were performed on reconstituted bulk fine coal refuse slurry to determine effective and total strength parameters as well as peak (S_{up}) and steady-state (S_{us}) undrained shear strengths. Samples were prepared in the laboratory to simulate in-situ placement and consolidation. Samples were consolidated to a range of vertical effective stresses of about 5, 10 and 20 pounds per square inch (psi) [or 720 to 2880 pounds per square foot (psf)]. All specimens exhibited contractive behavior when sheared under undrained conditions. In general, all specimens reached, or nearly reached, a steady-state of deformation within the strain limits of the test equipment.

A total of 6 CU points comprise the (2) series from which peak and steady-state shear strength state. S_{us} represents the liquefied shear strength [i.e., the minimum (residual) strength available following a rapid loading event, such as an earthquake].

The following equations (Ref. No. 4) were used to calculate peak (S_{up}) and steady-state (S_{us}) shear strengths from laboratory test specimens:

Peak:

$S_{up} = q_{up} \cos \phi_p$

Or

$S_{up} = \sigma'_{3p} [\cos \phi_p \sin \phi_p] / (1 - \sin \phi_p)$

Steady-State:

$S_{us} = q_{us} \cos \phi_{us}$

Or

$S_{us} = \sigma'_{3s} [\cos \phi_{us} \sin \phi_{us}] / (1 - \sin \phi_{us})$

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PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Estimation and Summary of Engineering Properties
for Fine Coal Refuse

PROJECT NO. 080851

PAGE 4 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

Where,

q_{up} = shear stress on 45-degree plane at peak strain

ϕ_p = friction angle at peak = arcsin (q/p) at peak strain

σ'_{3p} = lateral effective stress at peak strain

q_{us} = shear stress on 45-degree plane at steady-state (max) strain

ϕ_{us} = friction angle at steady-state = arcsin (q/p) at max strain

σ'_{3us} = lateral effective stress at steady-state (max) strain

The following peak and steady-state data is presented from CU testing on bulk fine coal refuse samples Bucket 1 and Bucket 2 and applying the equations above. CU laboratory test results are attached.

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PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation

PROJECT NO. 080851

Estimation and Summary of Engineering Properties for Fine Coal Refuse

PAGE 5 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

Sample No.	Bucket 1 – Fine Coal Refuse			Bucket 2 – Fine Coal Refuse		
CU Test No. (Confining Pressure)	1 (5.2 psi)	2 (10.2 psi)	3 (20.4 psi)	1 (5.2 psi)	2 (10.4 psi)	3 (20.4 psi)
Parameter						
q_{up} (psi) @	4.61	7.54	10.82	3.37	5.73	11.67
Peak Strain (%)	18.4	13.4	13.5	10.3	14.2	8.4
ϕ_p (deg)	40.4	39.6	37.8	38.3	39.2	37.5
σ'_{3p} (psi)	2.5	4.3	6.8	2.1	3.3	7.5
S_{up} (psi)	3.51	5.81	8.55	2.64	4.44	9.26
q_{us} (psi) @	4.59	7.33	10.02	3.28	5.4	10.61
Max. Strain (%)	21.5	21.67	21.74	17.29	21.32	21.42
ϕ_{us} (deg)	40.4	39.0	36.7	36.3	38.6	35.7
σ'_{3us} (psi)	2.4	4.3	6.7	2.1	3.3	7.6
S_{us} (psi)	3.37	5.67	7.98	2.46	4.28	8.65

A plot of the S_{us} of the reconstituted coal refuse slurry samples versus vertical effective stress ($\sigma'v$) is presented in the attached Figure 1. The equivalent effective vertical stress was assumed to be 1.5 times the isotropic effective consolidation stress (i.e., $1.5*\sigma'3$). A 2/3 – 1/3 relationship of the data was employed to yield an S_{us} to $\sigma'v$ relationship of $S_{us} = 0.28\ \sigma'v$. Ref. No. 5 and recent undisturbed/remolded fine coal refuse testing on other projects yielded a range of $S_{us} = 0.06$ to $0.28\ \sigma'v$, with an average of about $S_{us} = 0.22\ \sigma'v$. Since site specific testing was performed, a reasonable S_{us} to $\sigma'v$ relationship of $S_{us} = 0.24\ \sigma'v$ is considered realistic with some conservatism. The impounded/abandoned fine coal refuse in the South Pond will be modeled utilizing this relationship.

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PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation

PROJECT NO. 080851

Estimation and Summary of Engineering Properties for Fine Coal Refuse

PAGE 6 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

Subsequent slope stability analyses determine the magnitude of driving shear stress on a failure plane through the fine coal refuse impoundment to assess the required S_{us} to maintain equilibrium and assess the likelihood of a (liquefaction) flow failure. Post-earthquake slope stability of the embankment/impoundment is evaluated as well to assess the failure potential of the South Pond embankment using the abandonment geometry.

CONCLUSIONS

Laboratory undrained shear strength data from consolidated undrained triaxial tests of fine coal refuse were determined. Procedures were performed to estimate S_{up}, S_{us}, and a reasonable S_{us} to $\sigma'v$ relationship of $S_{us} = 0.24\ \sigma'v$ for the material. The results of the laboratory testing indicated Sup and Sus reach their peak and steady-state strength at high strains, and there is very little drop off with increasing strain. Further, Sup and Sus values generally indicated resistance to flow. Thus, the results suggest undrained strengths of the fine coal refuse will be maintained at or near peak levels during an undrained event such as an earthquake, and the susceptibility of the impounded fine coal refuse to a liquefaction flow failure is a function of both the undrained strength (worst case steady-state strength) and the in-situ driving shear stress on a critical failure plane through the fine refuse material.

Based on this information, the properties evaluated/developed in Ref. No. 2 for fine coal refuse, as well as coarse refuse and residual soil, indicated the South Pond fine coal refuse has sufficient steady-state shear strength to limit the flowability of the material. The likelihood of a flow failure associated with the abandonment scenario will be assessed in a subsequent calculation brief by evaluating the driving shear stress and factor of safety against liquefaction in the fine coal refuse.

POND CREEK PHASE 2 SOUTH POND
STEADY-STATE UNDRAINED SHEAR STRENGTH-TO-EFFECTIVE STRESS RELATIONSHIP

Pond Creek Phase 2 South Pond
Steady-State Undrained Strength vs. Vertical Effective Stress

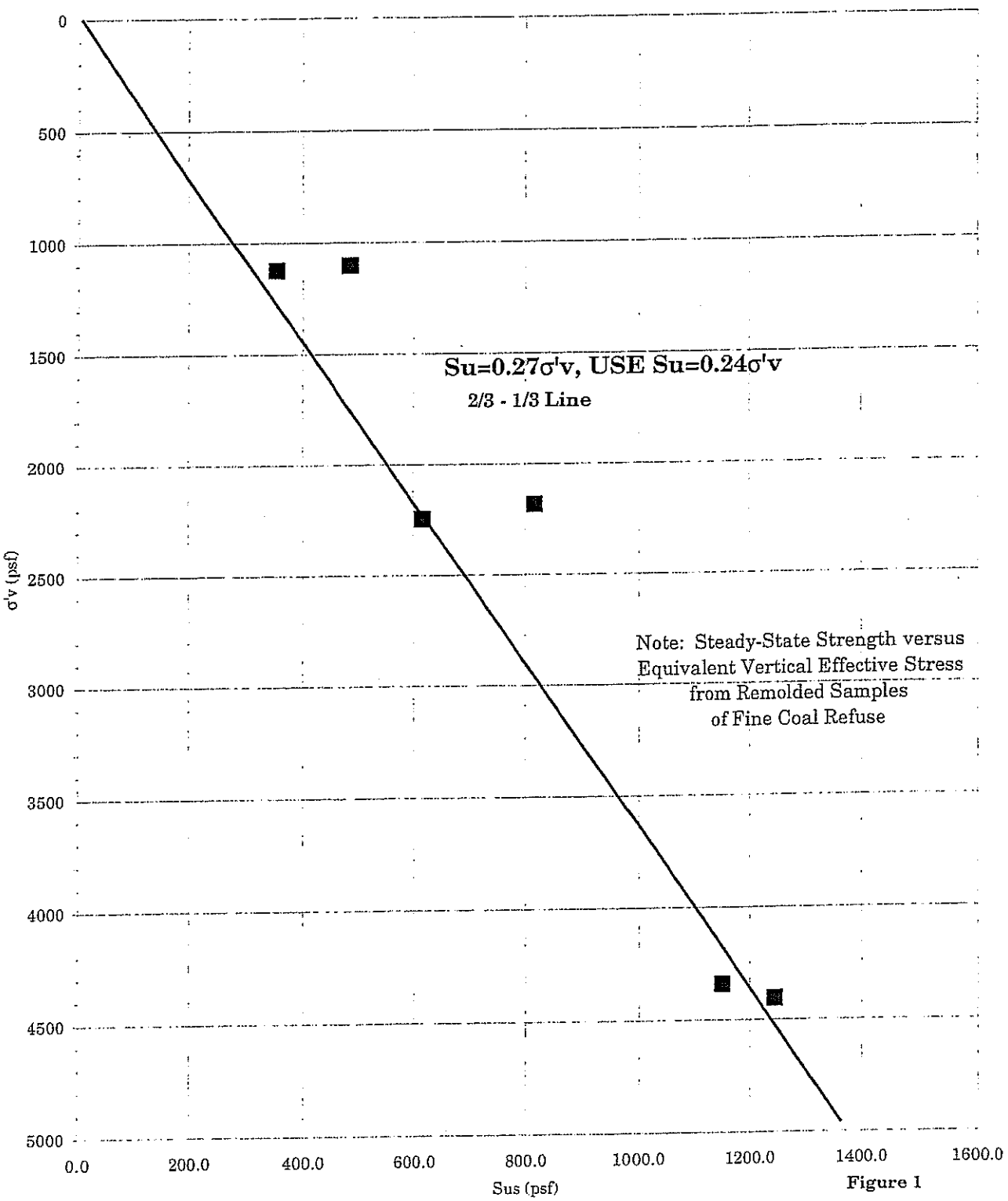

Figure 1

POND CREEK – SOUTH POND
CONSOLIDATED – UNDRAINED TRIAXIAL LABORATORY TESTING RESULTS FOR FINE COAL REFUSE

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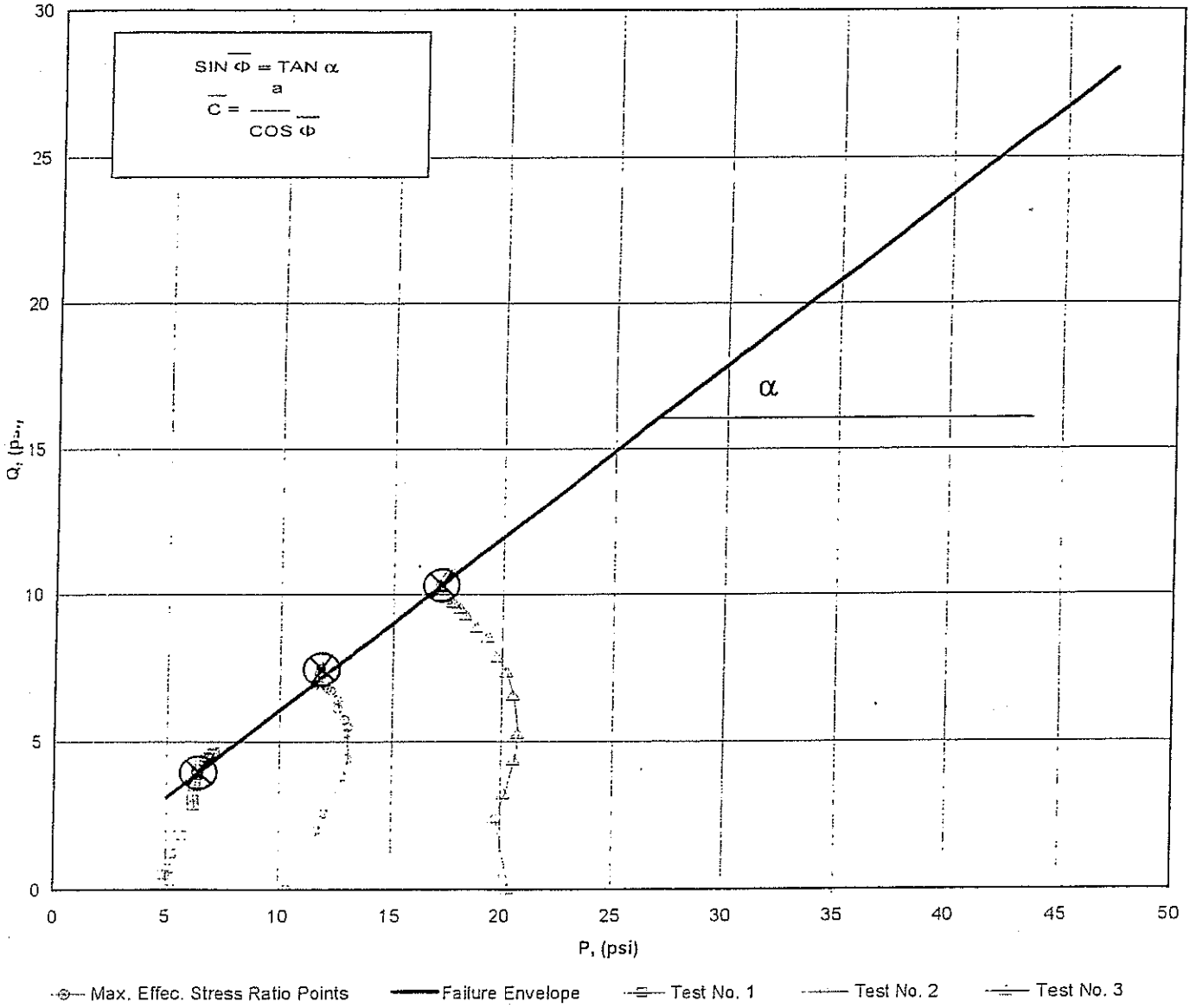
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	30.5	$\bar{\Phi}$	=	36.14

Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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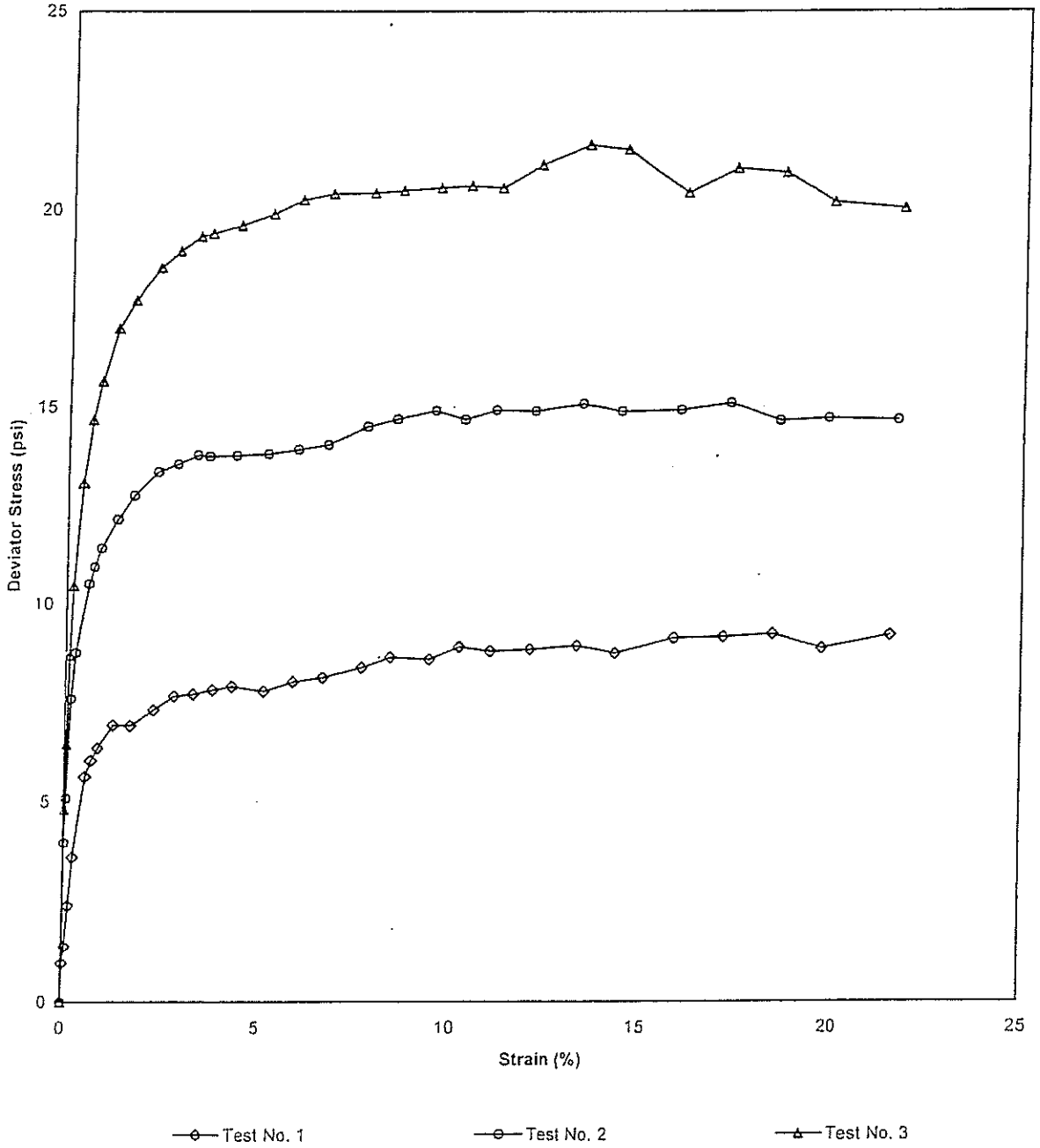
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	1

PRESSURES (psi)

Cell Pressure(psi)	36.6
Back Pressure(psi)	31.4
Eff. Cons. Pressure(psi)	5.2
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	6.41
Q	=	3.95

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.140	Diameter 1	1.375
Length 2	3.148	Diameter 2	1.389
Length 3	3.151	Diameter 3	1.399
Avg Leng.=	3.146	Avg. Diam.=	1.388

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.7
Final Change (ml)	2.3

Initial Dial Reading (D.R.), mils	235
D.R. After Saturation, mils	250
D.R. After Consolidation, mils	294

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.4
8.2	0.001	32.1
8.8	0.002	32.1
10.3	0.005	32.5
12.1	0.008	32.8
15.1	0.016	33.2
15.8	0.020	33.4
16.2	0.026	33.6
17.1	0.038	33.7
17.2	0.051	33.8
17.8	0.069	33.9
18.4	0.085	34.0
18.5	0.101	34.0
18.8	0.116	34.1
19.0	0.132	34.1
18.9	0.158	34.1
19.4	0.182	34.2
19.6	0.205	34.2
20.2	0.236	34.2
20.7	0.260	34.2
20.8	0.292	34.1
21.4	0.316	34.3
21.4	0.340	34.1
21.6	0.371	34.1
22.0	0.411	34.1
21.8	0.443	34.1
22.8	0.490	34.1
23.1	0.530	34.2
23.5	0.569	34.1
23.1	0.610	34.1
24.0	0.664	34.2

Tested By JCM Date 05/21/08 Input Checked By MB Date 6-19-08

DCN. CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.2	*Stage No.*	1
		Test No	1

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.51
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.55
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.474

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	0.98	0.73	5.45	4.5	1.219	0.76	4.96	0.49
0.07	1.39	0.75	5.84	4.5	1.311	0.55	5.14	0.69
0.15	2.40	1.15	6.46	4.1	1.593	0.49	5.25	1.20
0.25	3.62	1.36	7.46	3.8	1.941	0.38	5.65	1.81
0.52	5.63	1.79	9.04	3.4	2.649	0.32	6.23	2.81
0.66	6.03	2.01	9.22	3.2	2.893	0.34	6.20	3.02
0.84	6.35	2.21	9.34	3.0	3.125	0.36	6.16	3.18
1.22	6.92	2.33	9.79	2.9	3.417	0.34	6.33	3.46
1.64	6.91	2.40	9.71	2.8	3.469	0.35	6.26	3.46
2.25	7.31	2.55	9.96	2.7	3.753	0.36	6.31	3.65
2.75	7.66	2.61	10.25	2.6	3.961	0.35	6.42	3.83
3.27	7.71	2.64	10.26	2.6	4.017	0.35	6.41	3.85
3.77	7.81	2.68	10.34	2.5	4.098	0.35	6.43	3.91
4.28	7.90	2.74	10.37	2.5	4.208	0.35	6.41	3.95
5.11	7.78	2.71	10.27	2.5	4.124	0.36	6.38	3.89
5.89	8.02	2.84	10.38	2.4	4.400	0.36	6.37	4.01
6.65	8.13	2.78	10.56	2.4	4.359	0.35	6.49	4.07
7.66	8.39	2.83	10.76	2.4	4.538	0.34	6.56	4.19
8.42	8.64	2.76	11.09	2.4	4.536	0.33	6.77	4.32
9.45	8.59	2.72	11.07	2.5	4.464	0.32	6.77	4.29
10.23	8.90	2.86	11.25	2.3	4.797	0.33	6.79	4.45
11.00	8.80	2.67	11.33	2.5	4.474	0.31	6.93	4.40
12.03	8.83	2.74	11.29	2.5	4.594	0.32	6.87	4.42
13.30	8.93	2.72	11.41	2.5	4.601	0.31	6.94	4.46
14.34	8.73	2.69	11.25	2.5	4.477	0.31	6.88	4.37
15.88	9.12	2.66	11.66	2.5	4.587	0.30	7.10	4.56
17.15	9.15	2.77	11.59	2.4	4.762	0.31	7.01	4.58
18.44	9.22	2.70	11.72	2.5	4.691	0.30	7.11	4.61
19.74	8.86	2.70	11.36	2.5	4.536	0.31	6.93	4.43
21.51	9.19	2.62	11.56	2.4	4.664	0.31	6.97	4.59

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	2

PRESSURES (psi)

Cell Pressure(psi)	46.5
Back Pressure(psi)	36.1
Eff. Cons. Pressure(ps	10.4
Pore Pressure Response (%)	100

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	11.84
Q	=	7.45

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.120	Diameter 1	1.396
Length 2	3.137	Diameter 2	1.398
Length 3	3.135	Diameter 3	1.344
Avg Leng.=	3.131	Avg. Diam.=	1.379

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	18.4
Final Change (ml)	5.6

Initial Dial Reading (D.R.), mils	77
D.R. After Saturation, mils	112
D.R. After Consolidation, mils	166

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.9	0.000	36.1
13.4	0.001	36.8
14.9	0.002	37.0
18.3	0.005	37.4
20.0	0.008	37.8
22.4	0.017	38.7
23.0	0.020	38.9
23.7	0.026	39.3
24.8	0.038	39.9
25.7	0.051	40.3
26.7	0.069	40.9
27.1	0.085	41.1
27.5	0.100	41.3
27.5	0.110	41.5
27.7	0.131	41.6
27.9	0.157	41.8
28.2	0.181	41.9
28.6	0.204	41.9
29.5	0.235	42.0
30.0	0.259	42.1
30.5	0.290	42.1
30.4	0.313	42.0
31.0	0.337	42.1
31.2	0.368	42.0
31.8	0.408	42.2
31.8	0.439	42.1
32.3	0.486	42.1
33.0	0.526	42.2
32.6	0.565	42.1
33.1	0.604	42.2
33.6	0.659	42.2

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-96 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics — INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.4	*Stage No.*	1
		Test No	2

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.49
Initial Sample Volume (in^3)	4.68

VOLUME CHANGE

Volume After Consolidation (in^3)	4.18
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.03	3.98	0.65	13.73	9.7	1.408	0.16	11.74	1.99
0.06	5.09	0.89	14.59	9.5	1.535	0.18	12.05	2.54
0.15	7.59	1.34	16.65	9.1	1.838	0.18	12.85	3.79
.25	8.76	1.72	17.44	8.7	2.010	0.20	13.06	4.38
0.54	10.51	2.62	18.29	7.8	2.351	0.25	13.04	5.26
0.67	10.94	2.79	18.56	7.6	2.438	0.25	13.08	5.47
0.86	11.42	3.19	18.64	7.2	2.584	0.28	12.92	5.71
1.25	12.16	3.85	18.71	6.6	2.856	0.32	12.63	6.08
1.67	12.77	4.19	18.98	6.2	3.055	0.33	12.60	6.38
2.28	13.37	4.77	19.00	5.6	3.373	0.36	12.32	6.68
2.79	13.56	5.04	18.92	5.4	3.530	0.37	12.14	6.78
3.30	13.79	5.25	18.94	5.2	3.675	0.38	12.05	6.89
3.60	13.76	5.40	18.76	5.0	3.751	0.39	11.88	6.88
4.32	13.77	5.50	18.67	4.9	3.812	0.40	11.79	6.89
5.16	13.82	5.69	18.52	4.7	3.934	0.41	11.62	6.91
5.95	13.93	5.80	18.52	4.6	4.029	0.42	11.56	6.96
6.72	14.04	5.83	18.61	4.6	4.072	0.42	11.59	7.02
7.73	14.51	5.87	19.04	4.5	4.205	0.40	11.78	7.26
8.52	14.69	6.01	19.08	4.4	4.349	0.41	11.73	7.35
9.54	14.91	6.01	19.30	4.4	4.397	0.40	11.84	7.45
10.30	14.68	5.94	19.15	4.5	4.289	0.40	11.80	7.34
11.07	14.93	6.00	19.33	4.4	4.390	0.40	11.87	7.46
12.10	14.89	5.95	19.34	4.5	4.346	0.40	11.90	7.45
13.40	15.08	6.10	19.38	4.3	4.506	0.40	11.84	7.54
14.44	14.89	6.03	19.25	4.4	4.410	0.41	11.81	7.44
15.98	14.92	5.99	19.34	4.4	4.381	0.40	11.88	7.46
17.28	15.10	6.12	19.38	4.3	4.528	0.41	11.83	7.55
18.58	14.65	5.96	19.09	4.4	4.303	0.41	11.76	7.33
19.86	14.71	6.07	19.04	4.3	4.398	0.41	11.68	7.35
21.67	14.66	6.08	18.99	4.3	4.393	0.41	11.65	7.33

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	3

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	20.4
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	17.19
Q	=	10.31

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.130	Diameter 1	1.404
Length 2	3.121	Diameter 2	1.373
Length 3	3.136	Diameter 3	1.371
Avg Leng.=	3.129	Avg. Diam.=	1.383

VOLUME CHANGE

Initial Burette Reading (ml)	48.0
Final Burette Reading (ml)	40.5
Final Change (ml)	7.5
Initial Dial Reading (D.R.), mils	60
D.R. After Saturation, mils	68
D.R. After Consolidation, mils	154

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.0
13.5	0.001	34.0
15.7	0.002	34.5
18.9	0.003	35.2
21.3	0.005	35.9
25.0	0.011	37.4
27.3	0.017	38.5
28.7	0.024	39.4
30.6	0.036	40.5
31.7	0.049	41.4
33.1	0.067	42.3
33.8	0.083	42.8
34.5	0.099	43.2
34.7	0.108	43.4
35.2	0.131	43.7
35.9	0.157	44.0
36.6	0.180	44.2
37.1	0.204	44.3
37.5	0.236	44.4
37.8	0.260	44.4
38.3	0.290	44.5
38.7	0.314	44.5
38.8	0.337	44.5
40.1	0.369	44.6
41.4	0.408	44.6
41.7	0.440	44.6
40.5	0.488	44.6
42.1	0.527	44.6
42.5	0.566	44.6
41.7	0.605	44.6
42.3	0.660	44.7

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-96 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.4	*Stage No.*	1
		Test No	3

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.20
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.385

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	4.82	3.04	22.17	17.4	1.278	0.64	19.76	2.41
0.05	6.44	3.45	23.39	16.9	1.380	0.54	20.17	3.22
0.10	8.70	4.15	24.95	16.2	1.536	0.48	20.60	4.35
0.17	10.46	4.86	26.01	15.5	1.673	0.47	20.77	5.23
0.37	13.09	6.38	27.10	14.0	1.934	0.49	20.56	6.54
0.58	14.68	7.49	27.59	12.9	2.137	0.52	20.25	7.34
0.80	15.66	8.40	27.66	12.0	2.305	0.54	19.83	7.83
1.18	17.01	9.52	27.89	10.9	2.563	0.57	19.38	8.50
1.61	17.71	10.40	27.71	10.0	2.772	0.59	18.85	8.86
2.22	18.54	11.31	27.63	9.1	3.039	0.62	18.36	9.27
2.74	18.96	11.76	27.60	8.6	3.196	0.63	18.12	9.48
3.26	19.34	12.21	27.53	8.2	3.361	0.64	17.86	9.67
3.57	19.40	12.35	27.45	8.0	3.411	0.64	17.75	9.70
4.31	19.60	12.73	27.27	7.7	3.556	0.66	17.47	9.80
5.17	19.89	12.96	27.33	7.4	3.676	0.66	17.38	9.95
5.94	20.25	13.15	27.50	7.2	3.795	0.66	17.37	10.13
6.73	20.42	13.27	27.54	7.1	3.864	0.66	17.34	10.21
7.78	20.44	13.38	27.46	7.0	3.912	0.66	17.24	10.22
8.55	20.50	13.40	27.50	7.0	3.928	0.66	17.25	10.25
9.57	20.57	13.48	27.49	6.9	3.973	0.66	17.20	10.28
10.34	20.62	13.52	27.50	6.9	3.995	0.66	17.19	10.31
11.11	20.56	13.51	27.45	6.9	3.982	0.66	17.17	10.28
12.15	21.14	13.55	27.99	6.8	4.088	0.65	17.42	10.57
13.45	21.64	13.57	28.47	6.8	4.170	0.63	17.65	10.82
14.49	21.53	13.56	28.36	6.8	4.149	0.64	17.60	10.76
16.07	20.44	13.58	27.26	6.8	3.997	0.67	17.04	10.22
17.35	21.06	13.58	27.88	6.8	4.086	0.65	17.35	10.53
18.64	20.95	13.63	27.72	6.8	4.094	0.66	17.25	10.48
19.92	20.20	13.64	26.96	6.8	3.988	0.68	16.86	10.10
21.74	20.03	13.67	26.77	6.7	3.975	0.69	16.75	10.02

Tested By JCM Date 05/21/08 Input Checked By KP Date 6-19-08

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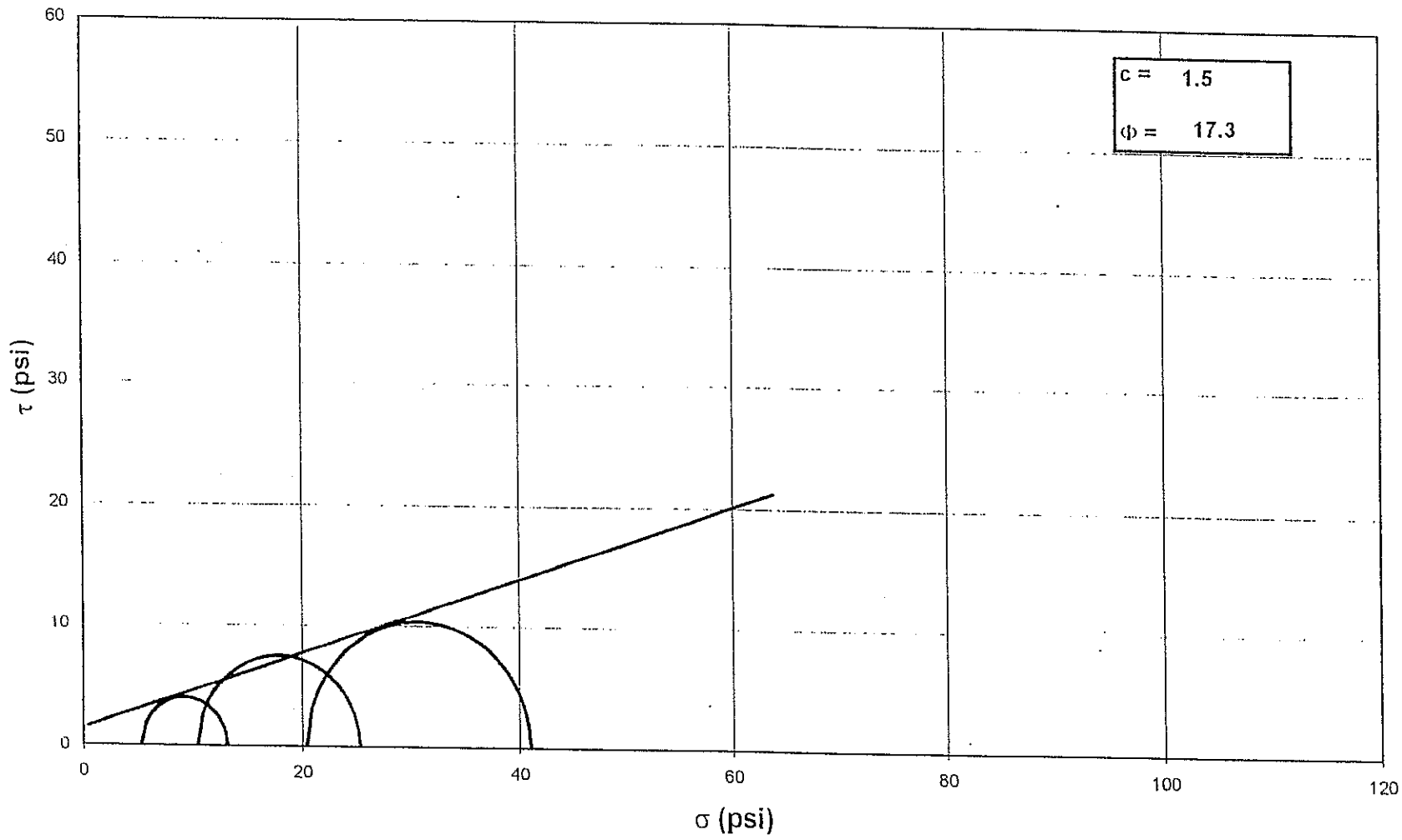
MOHR TOTAL STRENGTH ENVELOPE

Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/19/08

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	82.6	82.7	79.5
Total Unit Weight (pcf)	76.6	84.2	80.5
Dry Unit Weight (pcf)	42.0	46.1	44.8
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	2.333	2.035	2.119

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

DCN CT-S28 DATE 6-25-98 REVISION: 1

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	41.7	43.3	42.4
Total Unit Weight (pcf)	102.0	102.5	101.8
Dry Unit Weight (pcf)	71.9	71.5	71.5
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	0.944	0.955	0.956

Tested By JCM Date 05/21/08 Input Checked By WB Date 6-3-08

DCN: CT-S28 DATE 6-25-96 REVISION: 1

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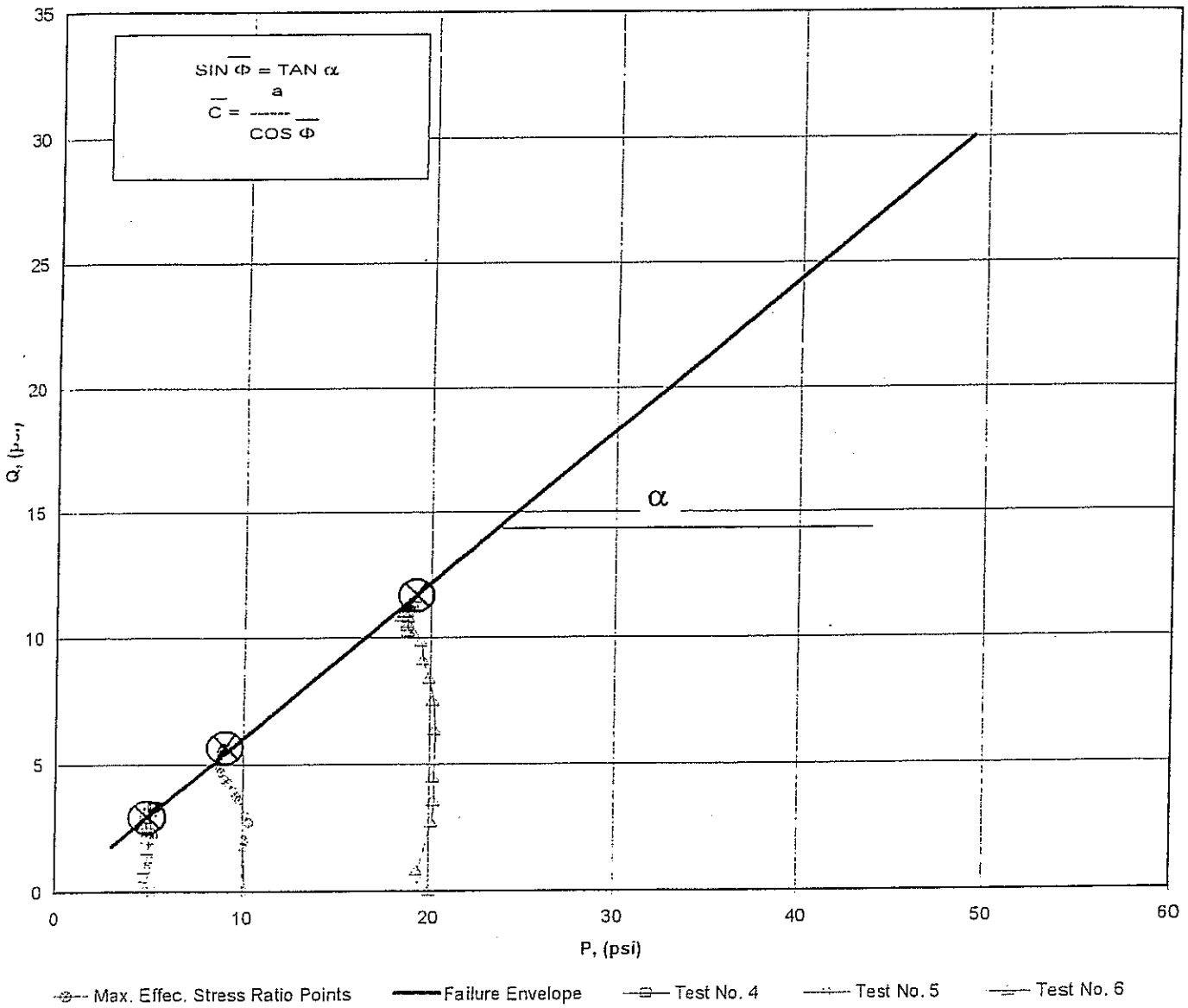
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	31.5	$\bar{\Phi}$	=	37.71

Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

DCN: CT-S26 DATE 6-25-98 REVISION 1

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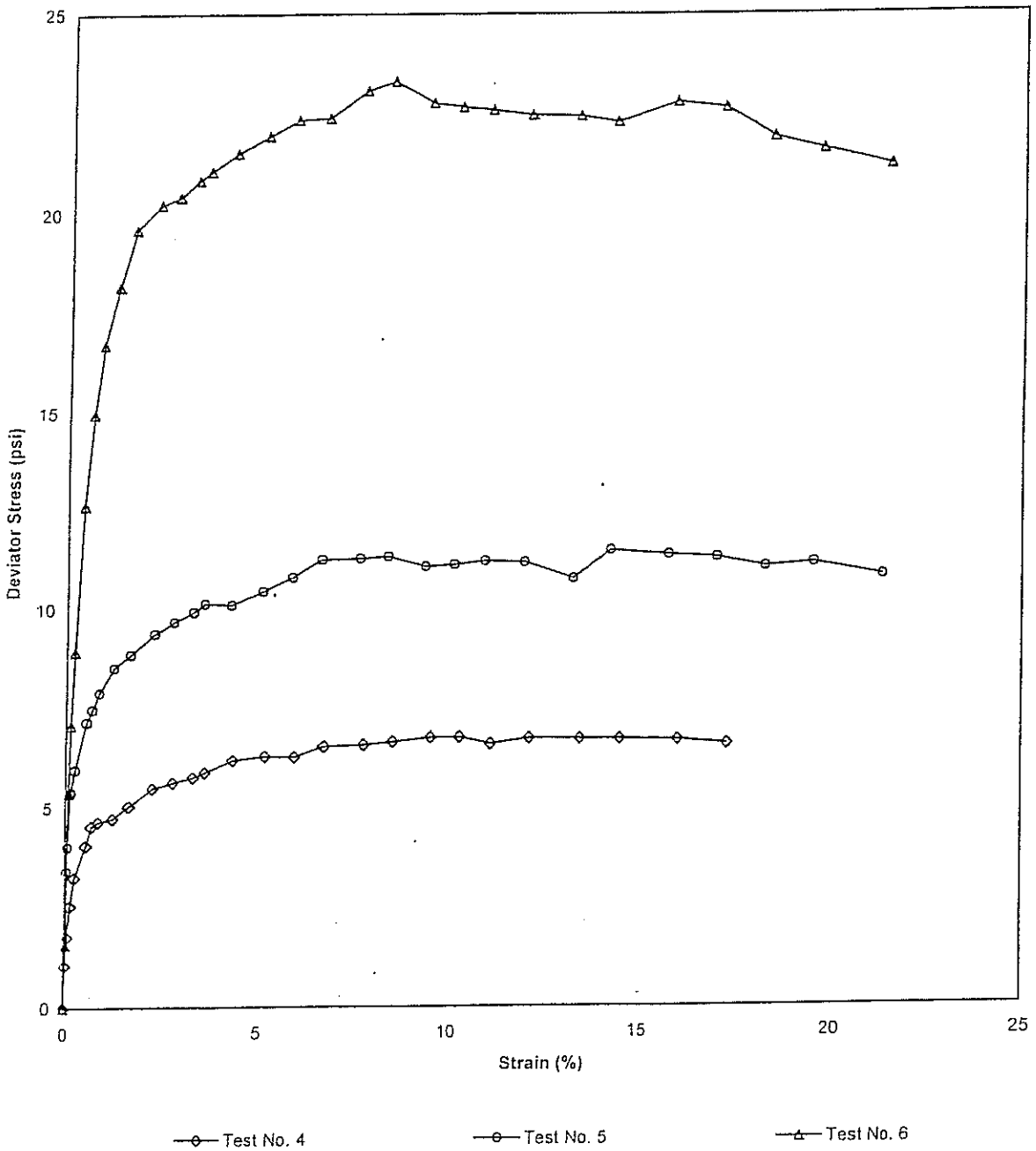
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	4

PRESSURES (psi)

Cell Pressure(psi)	36.3
Back Pressure(psi)	31.2
Eff. Cons. Pressure(psi)	5.1
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	4.92
Q	=	2.94

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.150	Diameter 1	1.453
Length 2	3.142	Diameter 2	1.463
Length 3	3.147	Diameter 3	1.461
Avg Leng.=	3.146	Avg. Diam.=	1.459

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.9
Final Change (ml)	2.1

Initial Dial Reading (D.R.), mils	54
D.R. After Saturation, mils	110
D.R. After Consolidation, mils	130

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.6	0.000	31.2
9.3	0.001	32.1
10.4	0.002	32.3
11.6	0.005	32.6
12.8	0.008	32.9
14.0	0.016	33.3
14.8	0.020	33.3
15.0	0.025	33.6
15.2	0.037	33.8
15.7	0.050	33.9
16.5	0.068	34.2
16.7	0.084	34.2
17.0	0.100	34.2
17.2	0.110	34.3
17.8	0.133	34.2
18.1	0.159	34.3
18.1	0.182	34.3
18.6	0.205	34.2
18.8	0.237	34.2
19.0	0.261	34.3
19.3	0.293	34.3
19.5	0.316	34.2
19.3	0.340	34.3
19.7	0.372	34.2
19.8	0.412	34.3
19.9	0.445	34.3
20.1	0.491	34.2
20.1	0.531	34.2

Tested By JCM Date 05/27/08 Input Checked By MB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.1	*Stage No.*	1
		Test No	4

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.46
Initial Sample Area (in^2)	1.67
Initial Sample Volume (in^3)	5.26

VOLUME CHANGE

Volume After Consolidation (in^3)	4.85
Length After Consolidation (in)	3.07
Area After Consolidation (in^2)	1.580

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	1.06	0.90	5.26	4.2	1.253	0.86	4.73	0.53
0.07	1.77	1.15	5.72	4.0	1.449	0.66	4.84	0.89
0.15	2.55	1.44	6.21	3.7	1.698	0.58	4.94	1.28
0.25	3.26	1.71	6.65	3.4	1.959	0.53	5.02	1.63
0.53	4.05	2.11	7.04	3.0	2.358	0.53	5.01	2.03
0.65	4.54	2.14	7.50	3.0	2.531	0.48	5.23	2.27
0.82	4.65	2.39	7.36	2.7	2.712	0.52	5.04	2.32
1.21	4.72	2.58	7.25	2.5	2.873	0.56	4.89	2.36
1.62	5.03	2.72	7.42	2.4	3.112	0.55	4.90	2.52
2.22	5.48	2.95	7.63	2.1	3.550	0.55	4.89	2.74
2.74	5.62	3.02	7.70	2.1	3.705	0.55	4.89	2.81
3.27	5.75	3.04	7.81	2.1	3.790	0.54	4.93	2.87
3.59	5.88	3.12	7.86	2.0	3.968	0.54	4.92	2.94
4.33	6.18	3.02	8.27	2.1	3.967	0.50	5.17	3.09
5.17	6.27	3.08	8.30	2.0	4.101	0.50	5.16	3.14
5.93	6.25	3.13	8.22	2.0	4.176	0.51	5.10	3.13
6.69	6.51	3.03	8.58	2.1	4.152	0.48	5.32	3.26
7.73	6.56	3.04	8.62	2.1	4.176	0.47	5.34	3.28
8.50	6.63	3.14	8.59	2.0	4.380	0.48	5.27	3.31
9.53	6.72	3.14	8.68	2.0	4.436	0.48	5.32	3.36
10.30	6.74	3.03	8.81	2.1	4.256	0.46	5.44	3.37
11.09	6.56	3.07	8.59	2.0	4.235	0.48	5.31	3.28
12.10	6.71	3.03	8.78	2.1	4.233	0.46	5.43	3.35
13.42	6.69	3.06	8.74	2.0	4.281	0.47	5.39	3.35
14.49	6.68	3.10	8.68	2.0	4.342	0.47	5.34	3.34
16.00	6.66	3.02	8.74	2.1	4.204	0.46	5.41	3.33
17.29	6.55	3.03	8.62	2.1	4.171	0.47	5.34	3.28

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	5

PRESSURES (psi)

Cell Pressure(psi)	41.1
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	10.1
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	9.00
Q	=	5.66

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.138	Diameter 1	1.407
Length 2	3.138	Diameter 2	1.383
Length 3	3.137	Diameter 3	1.378
Avg Leng.=	3.138	Avg. Diam.=	1.389

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	20.2
Final Change (ml)	3.8

Initial Dial Reading (D.R.), mils	88
D.R. After Saturation, mils	94
D.R. After Consolidation, mils	124

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
8.5	0.000	31.0
13.5	0.001	32.8
14.3	0.002	33.0
16.3	0.004	33.4
17.2	0.007	33.9
18.9	0.016	34.9
19.4	0.020	35.2
20.0	0.025	35.6
21.0	0.038	36.1
21.5	0.051	36.6
22.4	0.070	37.0
22.9	0.085	37.2
23.4	0.101	37.4
23.7	0.110	37.4
23.8	0.132	37.5
24.5	0.158	37.6
25.1	0.181	37.7
26.0	0.205	37.7
26.2	0.236	37.7
26.4	0.259	37.8
26.2	0.290	37.7
26.4	0.314	37.8
26.7	0.338	37.8
26.9	0.370	37.8
26.5	0.410	37.8
27.9	0.441	37.8
28.0	0.488	37.8
28.2	0.527	37.8
28.1	0.566	37.8
28.5	0.605	37.8
28.4	0.661	37.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.1	*Stage No.*	1
		Test No	5

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.52
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.50
Length After Consolidation (in)	3.10
Area After Consolidation (in^2)	1.450

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	3.42	1.75	11.77	8.3	1.410	0.52	10.06	1.71
0.06	4.03	2.01	12.12	8.1	1.497	0.50	10.11	2.01
0.13	5.39	2.43	13.05	7.7	1.703	0.46	10.36	2.69
0.23	5.96	2.92	13.13	7.2	1.830	0.50	10.16	2.98
0.51	7.15	3.87	13.37	6.2	2.148	0.55	9.80	3.57
0.64	7.46	4.19	13.37	5.9	2.262	0.57	9.64	3.73
0.82	7.88	4.57	13.41	5.5	2.427	0.59	9.47	3.94
1.21	8.51	5.13	13.48	5.0	2.714	0.61	9.22	4.26
1.63	8.84	5.57	13.38	4.5	2.950	0.64	8.96	4.42
2.24	9.37	5.97	13.50	4.1	3.271	0.64	8.81	4.69
2.75	9.67	6.18	13.59	3.9	3.468	0.65	8.75	4.84
3.25	9.92	6.35	13.66	3.7	3.648	0.65	8.70	4.96
3.56	10.14	6.40	13.83	3.7	3.741	0.64	8.76	5.07
4.26	10.10	6.55	13.65	3.6	3.843	0.66	8.60	5.05
5.08	10.44	6.59	13.95	3.5	3.978	0.64	8.73	5.22
5.85	10.80	6.68	14.21	3.4	4.161	0.63	8.81	5.40
6.60	11.25	6.70	14.65	3.4	4.304	0.60	9.03	5.62
7.60	11.27	6.75	14.63	3.4	4.363	0.60	8.99	5.64
8.34	11.32	6.76	14.66	3.3	4.395	0.60	9.00	5.66
9.36	11.06	6.74	14.42	3.4	4.292	0.62	8.89	5.53
10.13	11.11	6.76	14.46	3.3	4.323	0.61	8.90	5.56
10.91	11.20	6.81	14.49	3.3	4.401	0.61	8.89	5.60
11.94	11.17	6.80	14.47	3.3	4.383	0.62	8.88	5.58
13.21	10.75	6.76	14.09	3.3	4.214	0.64	8.72	5.37
14.21	11.47	6.77	14.80	3.3	4.445	0.60	9.06	5.73
15.72	11.35	6.78	14.67	3.3	4.418	0.60	9.00	5.68
16.98	11.28	6.79	14.59	3.3	4.411	0.61	8.95	5.64
18.25	11.04	6.80	14.33	3.3	4.350	0.62	8.81	5.52
19.51	11.13	6.82	14.40	3.3	4.397	0.62	8.84	5.56
21.32	10.80	6.85	14.05	3.3	4.318	0.64	8.65	5.40

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	6

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.3
Eff. Cons. Pressure(ps	20.1
Pore Pressure Response (%)	97

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	19.19
Q	=	11.67

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.142	Diameter 1	1.379
Length 2	3.130	Diameter 2	1.377
Length 3	3.141	Diameter 3	1.386
Avg Leng.=	3.138	Avg. Diam.=	1.381

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	17.7
Final Change (ml)	6.3

Initial Dial Reading (D.R.), mils	40
D.R. After Saturation, mils	56
D.R. After Consolidation, mils	91

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
4.3	0.000	31.3
6.5	0.001	32.8
11.7	0.002	33.9
14.0	0.004	34.7
16.6	0.006	35.6
21.7	0.012	37.4
25.0	0.019	38.7
27.5	0.026	39.8
29.6	0.038	40.9
31.7	0.051	41.7
32.8	0.070	42.4
33.2	0.085	42.8
33.9	0.101	43.1
34.3	0.110	43.2
35.2	0.132	43.4
36.1	0.157	43.7
37.0	0.181	43.7
37.3	0.205	43.8
38.7	0.236	43.8
39.3	0.259	43.9
38.9	0.291	43.8
39.0	0.316	43.9
39.2	0.340	43.9
39.4	0.371	43.8
39.9	0.410	43.8
40.1	0.441	43.9
41.5	0.489	43.8
41.9	0.528	43.7
41.2	0.568	43.8
41.3	0.608	43.8
41.4	0.663	43.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.1	*Stage No.*	1
		Test No	6

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.24
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	1.58	1.52	20.16	18.6	1.085	0.99	19.37	0.79
0.07	5.38	2.62	22.86	17.5	1.308	0.50	20.17	2.69
0.12	7.06	3.36	23.80	16.7	1.422	0.49	20.27	3.53
0.19	8.92	4.30	24.73	15.8	1.565	0.50	20.26	4.46
0.40	12.65	6.12	26.62	14.0	1.905	0.50	20.30	6.32
0.61	14.97	7.35	27.72	12.7	2.174	0.51	20.23	7.48
0.85	16.72	8.47	28.36	11.6	2.438	0.52	19.99	8.36
1.24	18.18	9.56	28.72	10.5	2.724	0.54	19.63	9.09
1.64	19.63	10.41	29.32	9.7	3.025	0.55	19.51	9.81
2.26	20.24	11.15	29.19	9.0	3.262	0.57	19.07	10.12
2.77	20.44	11.54	29.00	8.6	3.388	0.58	18.78	10.22
3.26	20.87	11.82	29.15	8.3	3.521	0.58	18.71	10.43
3.58	21.09	11.94	29.25	8.2	3.584	0.58	18.70	10.54
4.27	21.54	12.14	29.50	8.0	3.705	0.58	18.73	10.77
5.09	21.97	12.38	29.69	7.7	3.846	0.58	18.71	10.99
5.86	22.37	12.43	30.04	7.7	3.918	0.57	18.85	11.19
6.64	22.41	12.54	29.98	7.6	3.962	0.58	18.77	11.21
7.63	23.10	12.49	30.71	7.6	4.034	0.56	19.16	11.55
8.39	23.33	12.58	30.85	7.5	4.102	0.56	19.19	11.67
9.43	22.79	12.55	30.34	7.6	4.018	0.57	18.95	11.39
10.22	22.67	12.59	30.18	7.5	4.021	0.57	18.84	11.34
11.00	22.61	12.56	30.14	7.5	4.001	0.57	18.84	11.30
12.01	22.49	12.53	30.05	7.6	3.973	0.57	18.81	11.24
13.28	22.46	12.52	30.04	7.6	3.961	0.57	18.81	11.23
14.28	22.30	12.63	29.77	7.5	3.986	0.58	18.62	11.15
15.84	22.80	12.50	30.40	7.6	4.001	0.57	19.00	11.40
17.12	22.66	12.41	30.35	7.7	3.948	0.56	19.02	11.33
18.40	21.92	12.46	29.57	7.6	3.868	0.59	18.61	10.96
19.69	21.62	12.51	29.21	7.6	3.846	0.60	18.40	10.81
21.49	21.21	12.54	28.77	7.6	3.805	0.61	18.17	10.61

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MOHR TOTAL STRENGTH ENVELOPE

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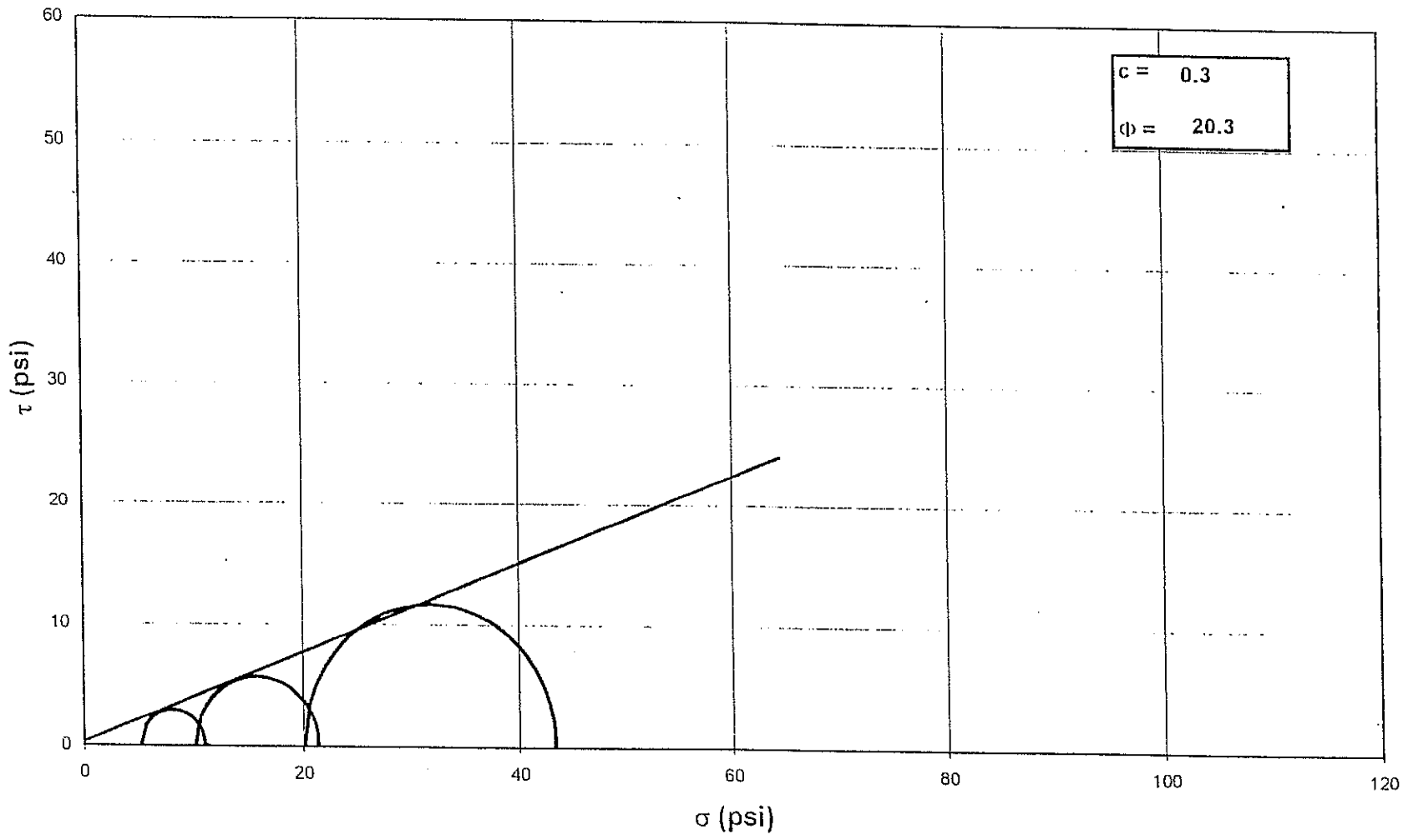
Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/14/08

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R14743

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	82.9	85.7	83.0
Total Unit Weight (pcf)	82.6	82.2	84.5
Dry Unit Weight (pcf)	45.2	44.3	46.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	2.095	2.159	2.029

Tested By JCM Date 05/27/08 Input Checked By [illegible] Date 10-5-08

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	41.5	41.5	40.9
Total Unit Weight (pcf)	92.9	102.5	103.2
Dry Unit Weight (pcf)	65.7	72.4	73.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	1.129	0.931	0.910

Tested By JCM Date 05/27/08 Input Checked By Date

DCN: CT-S28 DATE 6-25-98 REVISION: 1

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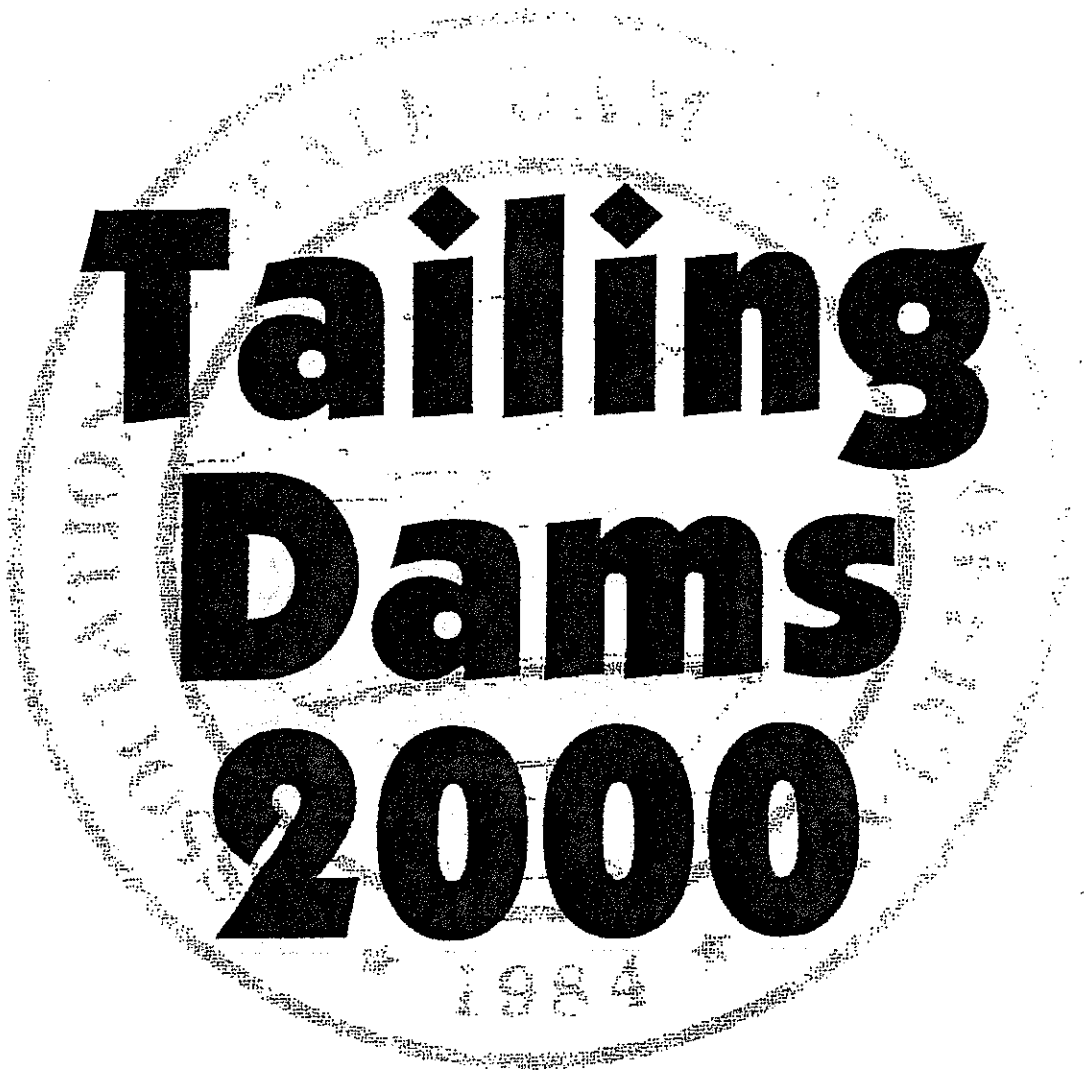
REFERENCE 5 AND OTHER PERTINENT FINE COAL REFUSE DATA EFFECTIVE STRESS – TO – STEADY STATE STRENGTH RELATIONSHIPS

R14747



PROCEEDINGS

Association of State Dam Safety Officials • U.S. Committee on Large Dams

March 28-30, 2000 • Las Vegas, Nevada

STEADY STATE LIQUEFACTION SUSCEPTIBILITY OF HIGH HAZARD UPSTREAM-CONSTRUCTED COAL REFUSE DISPOSAL FACILITIES

Blaise E. Genes[1], Thomas O. Keller, P.E.[2] and Joseph P. Laird, P.E.[3]

1.0 Introduction

Coal refuse disposal facilities are manifestations of deep mining and surface mining activities and the resulting need for the disposal of waste materials. Due to the massive volumes of materials produced annually by mining operations, these "tailings dams" are among the largest earth structures in the world and consequently, receive intense regulatory and public scrutiny. Coal refuse disposal facilities, their design, construction and operation are regulated by the U.S. Department of Labor, Mine Safety and Health Administration (MSHA). The concern for refuse disposal safety and environmental control by MSHA, the coal industry, engineering consultants and the public has led to the development of design procedures that address these concerns, particularly siting, material handling and placement techniques.

For the most part, tailings dams evaluations are similar to those of water retention dams and address geotechnical issues such as foundation materials, hydrology, hydraulics, seepage control, slope stability (static and seismic), construction practices and long-term monitoring. In the past, pseudo-static analyses were performed to address seismic stability using regional, historic seismic acceleration values and a slightly lowered factor of safety limit to assess adequacy. Empirical evaluations are sometimes performed to address seismic stability with adequacy based on comparison of limited field and laboratory test data with historical performance data of liquefaction and non-liquefaction sites from around the world. During the initial to intermediate stages of a refuse facility design, simplified analytical methods may be appropriate, such as those based on pseudo-static and cone penetration testing (CPT) or standard penetration testing (SPT). However, given the uniqueness and complexity of moderate to high hazard tailings dams, which are significantly influenced by factors such as the number and geometry of upstream stages, deposition history and cross-valley topography, simplified analyses are often inadequate to effectively address safety and cost issues. They often do not account for critical site-specific conditions and may either over-predict strengths leading to a potentially unconservative analysis or under-predict strengths leading to costly remediation efforts.

The focus of this paper is on the application of established steady-state liquefaction evaluation procedures to high hazard tailings dams, assessing liquefaction susceptibility using site-specific data to estimate the factor of safety against a liquefaction flow slide failure. A significant emphasis is placed on obtaining in-situ samples and developing

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properties of the hydraulically placed, fine coal refuse consolidated beneath multiple, upstream-constructed stages of coarse coal refuse. Detailed evaluations have been performed at five Appalachian coal refuse disposal facilities in southern West Virginia as part of the permitting process for the various facilities.

2.0 Analytical Approach

Coal refuse disposal facilities are generally constructed by three methods, either separately or in combination, and include upstream, downstream, and centerline construction. Downstream and centerline constructed facilities typically pose only minor liquefaction concerns since critical failure surfaces pass mainly through the compacted coarse refuse embankments. A typical high hazard, upstream constructed coal refuse facility, such as the one shown in Figure 1, is constructed over long periods of time (up to 25 to 30 years) to heights of 400-plus feet and includes multiple upstream stages "pushed out" into the previous stage's tailings pond. Fine coal refuse consolidated under upstream stages typically is loose to very loose, silty sand to sandy silt- and clay-sized particles, saturated and usually highly contractive. Thus, the potential exists for excess pore pressure generation and significant loss of strength during and following a rapid (undrained) loading event, such as an earthquake.

All five facilities evaluated and discussed in the context of this paper were all moderate to high hazard structures with downstream toe to crest heights varying from 300 to 440 feet. Detailed studies of liquefaction susceptibility were performed using the methodology presented by Poulos, Castro, and France (1985) to estimate in-situ void ratio and undrained steady-state strength of the critical layer, fine coal refuse. Presented below are the generalized results of field and laboratory testing at the various sites. Field testing included performing fixed-piston undisturbed sampling to measure in-situ void ratio and piezo-seismic cone penetration testing (PS-CPT) to evaluate stratigraphy and estimate shear wave velocity with depth. Laboratory strength testing of undisturbed, remolded and slurry fine coal refuse samples was performed to estimate in-situ, undrained steady-state shear strength (S_{us}) and develop a site-specific S_{us}-to-effective stress relationship.

Liquefaction susceptibility was assessed based on the results of limit-equilibrium slope stability analyses. Post-earthquake deformations were estimated using one-dimensional wave propagation and sliding block analysis techniques and the results compared to the available freeboard to assess the likelihood of overtopping. Based on the regional database of information related to S_{us}, various trends regarding the general behavior of fine coal refuse during undrained loading and the practical implications affecting liquefaction susceptibility of upstream-constructed coal refuse impoundments are discussed. Detailed discussions regarding post-earthquake deformation analyses and the seismic response of coal refuse facilities to acceleration time-histories from stochastic simulations of eastern North America earthquakes are reserved for another paper.

3.0 Field Investigations

Fixed Piston Sampling

The main purpose of the subsurface exploration program at the various sites was to obtain high quality "undisturbed" fine coal refuse samples of a character suitable for

laboratory steady-state strength testing. Multiple undisturbed samples were obtained at each site at various depths using a hydraulically actuated Gregory Undisturbed Sampler (GUS) fixed piston sampler. The GUS fixed piston sampler was used to advance a thin-wall galvanized steel sampling tube by delivering drilling fluid pressure to the top of the sampler, which subsequently advanced the tube around a fixed piston. Penetration of the tube into the soil was accurately measured to within ½ to 1 millimeter when "full penetration" of the sampler was achieved. Full penetration of the sampling tube was confirmed by observation of the fluid level in the borehole casing which would dramatically rise when fluid pressure applied to the top of the sampler vented through ports in the sampler. The technique used for undisturbed fixed piston sampling allowed samples to be obtained to depths as great as 344 feet below the ground surface.

Detailed measurements of the tube inside, outside and cutting edge diameters and length were made and volume changes that occurred during sampling calculated in the field from tube penetration and sample recovery measurements. Samples were selected for subsequent laboratory testing based on the quality of the "undisturbed" sample using a criteria for the change in soil volume ($\Delta V/V$). For the fine coal refuse, minimizing the tube clearance ratio [(ID-CE)/CE] minimized sample volume changes, which typically ranged from zero to 2.5 percent. All undisturbed samples were stored in specially designed padded wooden boxes and changes in volume routinely monitored during storage and prior to and following shipment. Prior to laboratory testing, the tube samples were x-rayed and reviewed to select portions of the sample that had a minimum amount of stratification.

Piezo-Seismic/Cone Penetrometer Testing

PS-CPT soundings were performed prior to or concurrently with undisturbed sampling to help delineate the depth to the top and bottom of fine coal refuse. As shown in Figure 2, fine coal refuse layers are characterized by significantly lower tip stresses and elevated pore pressure generation, while the coarse and coarse-fine mix typically yield much higher tip stresses and lower pore pressure generation. Using seismic downhole techniques, estimates of shear wave velocity were obtained at each site to correlate small strain shear modulus (G) with depth. These tests were generally conducted at 5-foot intervals throughout the soil profile to depths of 365 feet at one site. Shear wave velocities for coarse, coarse-fines mix and fine coal refuse ranged from about 1,000 to 2,300 feet per second (fps), 800 to 2,000 fps and 800 to 1,200 fps, respectively. These velocities were based on data from 14 PS-CPT soundings. Velocities varied dramatically with depth, consistent with variations in placement techniques and the micro-layering associated with the deposition history of the facility.

Stratification

Much of the coarse refuse embankment drilled and sampled was dense to very dense as expected due to the structural placement of the material. Loose deposits of fine coal refuse were typically encountered below a dense mixed zone of coarse and fine coal refuse. The fines were characterized by corrected cone tip resistance values between 300 to 1,000 pounds per square inch (psi). The CPT soundings (and visually verified in SPT samples) have shown that there are significantly thick zones of mixed coarse and fine coal refuse. Mixing apparently occurred during the various push-out phases of upstream embankment construction into the tailings pond and possibly from the "pumping" of fines

up into the coarse refuse during subsequent stage construction. Due to the infusion of coarse refuse into the fines, the mix zones typically exhibited significantly higher average cone tip resistance, as well as lower pore pressure generation during cone advancement.

In-Situ Void Ratio

A total of 34 undisturbed fine coal refuse samples were obtained from the various sites. In-situ void ratio was calculated for each based on the field measurements described previously combined with laboratory measurements of the volume of solids in the tube. Table 1 presents a summary of sample depth and calculated in-situ void ratio at each site. Samples were obtained from beneath about 65 to 344 feet of overlying refuse and in-situ void ratios varied from about 0.39 to 0.79, with most (82 percent) of the values between 0.43 and 0.59. While in-situ void ratio is influenced by mean effective stress and time rate of consolidation, the range of values is relatively narrow. Direct correlation between estimated mean effective stress and in-situ void ratio can not be inferred due to the unique and complex nature of each site's geometric constraints and deposition history.

4.0 Laboratory Testing

Steady-state liquefaction-related laboratory test programs of the coal refuse materials sampled from the five sites included performing index tests such as grain size distributions, Atterberg limits, and specific gravity, as well as triaxial shear strength tests on undisturbed, remolded and slurry samples of fine coal refuse. Table 1 presents a summary of laboratory test results from Sites 1 through 5.

Index Tests

Fine coal refuse particles vary in size from about 2 mm (No. 10 sieve) to 0.0005 mm (finer than clay fraction). It is analogous to silty sand to silty clay-sized material. Fines content (passing a No. 200 sieve) for fine coal refuse from the five sites varied from 35 to 76 percent. Fine refuse generally has a low plasticity, ranging from nonplastic to Plasticity Indices of 12 percent or less. Values are affected by the parent rock formation from which the coal was extracted and from clay layers near the coal seam that get mixed within the coal. The specific gravity of fine coal refuse is low and generally varied from about 1.4 to 2.4 for the sites tested. As a result, densities are also relatively low, with in-place total unit weight ranging from about 75 to 90 pounds per cubic foot (pcf).

Steady-State Strength Of Undisturbed Samples

Isotropically consolidated, undrained triaxial compression ($\overline{CU}$) tests were performed on undisturbed, remolded and slurry samples of fine coal refuse. The main purpose of the triaxial tests was to measure the undrained steady-state shear strength of the samples in the laboratory to allow in-situ steady-state shear strengths to be estimated based on void ratio corrections (from laboratory to field). A total of 34 $\overline{CU}$ tests were performed on undisturbed samples of fine coal refuse from the five sites. Specimens were typically consolidated to an isotropic, effective consolidation stress ($\overline{\sigma}_{3c}$) ranging from 8 to 16 kilograms per square centimeter (kg/cm^2) [16.3 to 32.7 kips per square foot (ksf)]. These relatively high confining pressures were used to ensure contractive behavior,

particularly since most samples were obtained from 200 to 344 feet below the ground surface. The samples exhibited contractive behavior and reached or approximately reached a steady-state of deformation within the strain limits of the test. Laboratory values of S_{us} were corrected to represent steady-state strengths at in-situ void ratios.

Steady-State Line and In-Situ Steady-State Strength

Triaxial tests were performed on compacted specimens to determine the steady-state line (SSL) of the fine coal refuse representative for each site. Samples of each batch mix were formed using two methods: 1) by placing layers of fine coal refuse in a split mold and compacting each layer to a target void ratio; and 2) by placing the material in a mold as a slurry subject to one-dimensional consolidation to simulate in-situ placement conditions. The various SSL's for each batch mix are shown in Figure 3 where the slope ($\Delta e/\Delta \log S_{us}$) varies from 0.11 to 0.13 for moist tamped batch samples with additional slurry prepared samples of the batch mix shown for comparison. As discussed by Poulos et. al (1985), the slope of the steady state line is dependent on the shape of the grains and the vertical position is affected by slight differences in grain-size distribution. In general, the variation of the fine refuse coal particle shape from site to site would not be expected to vary significantly since the coal was mined from the same region using generally similar cleaning techniques. However, the fines content of the coal refuse sampled from the region varies widely. Thus, the SSL's in Figure 3 are consistent with the above observations.

In-situ S_{us} for each site was estimated by "correcting" the steady-state strengths at laboratory void ratios to their respective in-situ void ratio along the slope of the SSL as defined by Poulos et. al (1985). In-situ S_{us} values ranged from 0.06 to 4.62 kg/cm^2 (0.122 ksf to 9.42 ksf) with 74 percent of the data falling between 0.25 and 2.1 kg/cm^2 (0.51 ksf to 4.28 ksf). Figure 4 presents correlated S_{us} versus in-situ void ratio for 34 tested samples at the 5 sites. Note that S_{us} values can vary by more than a factor of 10 for a given void ratio.

S_{us} Versus Effective Stress Relationship

The estimation of S_{us} values for fine coal refuse layers that are at in-situ conditions different from the samples obtained and tested were estimated using a correlation between S_{us} and effective vertical stress (σ'_v) determined for each site. This includes proposed upstream stages where sampling is not yet feasible or existing portions of the embankment not sampled due to budgetary constraints. By generally assuming that S_{us} values vary linearly with σ'_v, and estimating the in-situ effective stress conditions for proposed layers of fine coal refuse, the in-situ S_{us} values for the proposed additional zones of fine coal refuse can be approximated. Site-specific S_{us}/σ'_v relationships are presented in Figure 5 and varied from 0.06 to 0.27. The various relationships were approximated by conservatively drawing a line from zero through the location at which two-thirds of the data points at a particular site lie above the line.

The lowest strength relationship was achieved at a narrow valley fill with over 200 feet of coarse and mixed refuse placed above the fine coal refuse. It is deduced that significant arching may be occurring within the coarse refuse preventing the full height of

verburden from consolidating the critical fine coal refuse layer. Therefore, factors such as cross-valley topography and deposition history are significantly relevant to the S_{us}/σ'_v relationship. Similarly, the database of S_{us}/σ'_v relationships obtained from bulk fine coal refuse samples prepared as slurried samples may be used to investigate what kind of relationship with depth (or effective stress) may be expected in the slurry pond prior to any encroachment of coarse embankments. The effective consolidation stresses at which the laboratory tests were performed were converted into equivalent vertical effective stresses in the field, assuming that the lateral stresses are equal to one-half of the vertical stresses. As shown in Figure 6, an S_{us}/σ'_v ratio of 0.18 extends from the zero intercept to the point where two-thirds of the data falls above the straight line.

5.0 Liquefaction Susceptibility Evaluations

Liquefaction susceptibility depends on the S_{us} of all the soils along the potential failure surface compared to the driving stress along that failure surface. Zones of loose (contractive) cohesionless soils are critical to analyzing liquefaction potential because they can have an undrained strength that is significantly lower than their drained strength. Therefore, the embankment geometry was evaluated to assess the liquefaction potential of each stage of construction estimating the average driving shear stresses along the critical failure surface at each of the high hazard sites. Generally, as the construction of future upstream staging progresses, there is a corresponding increase in driving stress. or layers in which fixed-piston samples were obtained and tested, or layers where similar effective stresses are present, a weighted average of steady-state strength, such as the Two-Thirds Strength Method, was utilized. This method, utilized by Castro et. al. (1989) and recommended by the U.S. Army Corps of Engineers (1970) in their manual for analyzing the stability of earth dams, involves using a design shear strength value that is lower than two-thirds of the total test values selected. S_{us} values for fine coal refuse layers at in-situ σ'_v values that significantly differ from the σ'_v values at sample locations were estimated using the site specific S_{us}/σ'_v relationship as previously discussed. Limit equilibrium slope stability analyses were performed at each site with S_{us} values applied to fine coal refuse layers and frictional (drained) strengths applied to coarse and mixed refuse layers. Factors of safety against liquefaction (F_L) along the critical failure surfaces for the various sites ranged from 1.02 to 1.32.

6.0 Notable Trends From Completed Studies

Liquefaction evaluations have been performed at five different sites using steady-state techniques as well as other complementary analyses. Since most of the sites are in the same geographical region, it is useful to compare the results of the fine coal refuse tested to identify trends in its engineering properties. A discussion of notable trends for the presented data is discussed below.

1. Consistent with the sensitivity of S_{us} to void ratio, S_{us} values can vary over 10 times at the same void ratio illustrating the need for site specific testing. In-situ void ratios varied between 0.39 and 0.79, however, most ranged from 0.43 to 0.59.

2. In-situ S_{us} values for unsampled fine coal refuse layers can be estimated based on S_{us} versus σ'_v correlations developed for a particular site. S_{us}/σ'_v relationships used for the coal refuse impoundment sites have ranged from 0.06 to 0.27 also illustrating the need for site specific testing, particularly at facilities with proposed multiple upstream stages.
3. S_{us} and S_{us}/σ'_v are significantly influenced by factors such as cross-valley topography, deposition history, upstream embankment geometry and construction sequencing.

7.0 Conclusions

Steady-state methodology can be effectively applied for the detailed evaluation of the liquefaction susceptibility of high hazard coal refuse disposal facilities. The evaluation needs to be based on site specific geometry and subsurface conditions, and properties developed accounting for the uniqueness and complexity of each site. While it is often useful to express the steady-state strength with respect to an estimated vertical stress, proper caution should be exercised during its development. The database of slurried samples has shown that the behavior of newly deposited fine coal refuse can be reasonably predicted. The S_{us}/σ'_v ratio of fine coal refuse consolidated beneath multiple upstream embankment stages can vary significantly with age, loading history, arching, and geometric constraints. For initial or preliminary liquefaction assessments, it is recommended that a range of S_{us}/σ'_v ratios be used to investigate the sensitivity of the critical layer to liquefaction susceptibility. For detailed evaluations where significant driving stresses are present for multiple upstream stages, site-specific shear strength testing of high quality undisturbed samples is recommended to develop the site's S_{us}/σ'_v relationship and each individual stage evaluated to estimate the factor of safety against liquefaction susceptibility. In general, factors of safety against liquefaction susceptibility were above 1.0 for the existing and proposed staging at the various high hazard sites. Factors of safety below 1.0 indicated the need for remedial design of existing embankments or redesign of the staging for proposed expansions to lower driving stresses.

References

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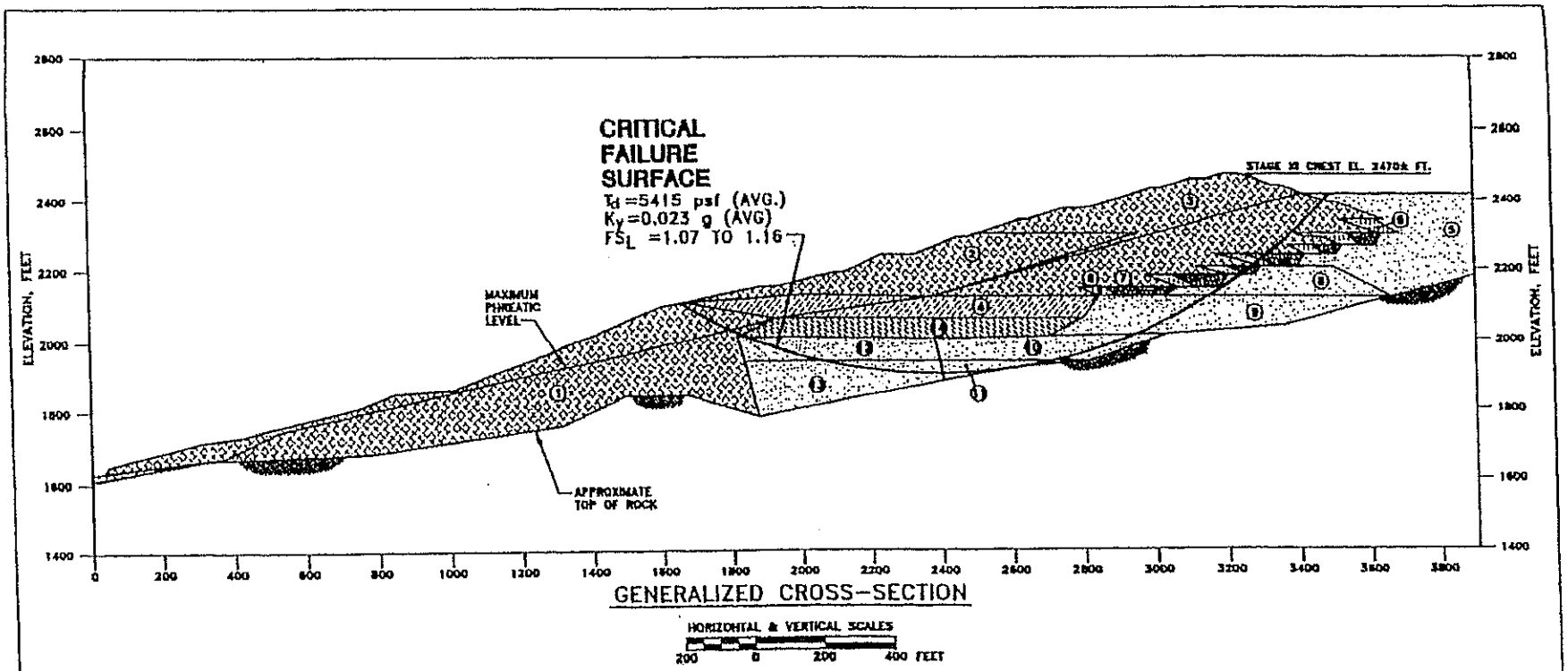
Table 1: Summary of Strength and Index Performed on Fine Coal Refuse Samples

					Field Data			Laboratory Data												
												(CU) Triaxial Results at Peak			Consolidated-Undrained (CU) Triaxial Results at Steady-State (SS)					
Site No.	Sample Type	Percent Passing No. 200 Sieve	PI %	Specific Gravity	Depth to Top of Sample, Feet	Estimated In-Situ Vert. Effective Stress, kg/cm²	Void Ratio In-Situ (Sampled)	Void Ratio in Tube/Mold	Void Ratio During Shear	Lab Effective Consol Stress, kg/cm²	Estimated Equiv. Vert. Effect. Stress In Field [1], kg/cm²	Shear Stress at Peak, q, kg/cm²	Axial Strain, %	Peak Friction Angle	Shear Stress at SS, q, kg/cm²	Minor Principal Stress, kg/cm²	Axial Strain, %	Undrained SS Strength Sus, kg/cm²	SS Friction Friction Angle	Sus at In-Situ Void Ratio, kg/cm²
1	FP	29.4	NA	2.28	90.7	3.45	0.494	0.497	0.402	8.00	12.00	2.70	12.6	34.6	2.68	2.15	17.6	2.23	33.7	0.44
	FP	40.4	NA	2.02	70.3	3.19	0.511	0.515	0.397	8.00	12.00	2.81	12.2	34.7	2.71	2.22	22.6	2.26	33.4	0.19
	FP	44.7	NA	2.37	80.6	3.30	0.488	0.489	0.390	8.00	12.00	2.79	13.2	35.3	2.59	2.17	25.9	2.17	32.9	0.42
	FP	43.6	NA	1.94	75.8	3.25	0.496	0.502	0.384	8.00	12.00	3.38	16.0	33.7	3.29	2.93	22.6	2.79	32.0	0.63
2	FP	47.2	NP	1.76	100.3	4.61	0.565	0.567	0.443	8.00	12.00	3.60	17.9	35.3	3.36	2.76	24.5	2.81	33.4	0.36
	FP	38.8	7	2.01	105.8	4.68	0.460	0.462	0.414	8.00	12.00	3.20	15.1	34.2	3.00	2.65	24.4	2.64	32.1	1.30
	FP	83.9	11	1.63	65.0	4.10	0.553	0.543	0.454	8.00	12.00	2.85	14.2	32.7	2.69	2.58	22.9	2.45	31.9	0.53
	FP	87.0	4	1.64	75.6	4.27	0.541	0.529	0.421	8.00	12.00	3.41	16.7	34.1	3.29	2.78	23.3	2.77	32.8	0.38
1 & 2	BM	34.7	NP	1.98	NA	NA	NA	0.732	0.390	4.00	6.00	0.99	1.8	24.7	0.96	0.81	26.6	0.80	32.8	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.745	0.331	10.00	15.00	2.39	1.8	25.2	2.42	2.03	25.2	2.03	32.9	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.975	0.465	1.00	1.50	0.23	1.2	23.6	0.18	0.14	26.3	0.15	34.1	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.973	0.433	2.00	3.00	0.46	1.3	23.2	0.41	0.35	23.0	0.34	32.9	NA
3	FP	97.7	NA	1.88	310.5	11.02	0.514	0.562	0.510	16.10	24.15	5.07	9.3	30.1	5.67	5.84	9.3	4.91	30.1	4.65
	FP	70.5	NA	1.89	269.5	10.07	0.444	0.468	0.424	16.20	24.30	5.40	7.3	28.1	5.21	5.13	16.5	4.62	27.4	3.15
	FP	78.7	NA	1.85	329.4	11.17	0.443	0.482	0.439	16.10	24.15	5.87	9.4	29.8	5.69	5.12	18.1	4.09	29.8	4.62
	FP	91.7	11	1.88	343.3	11.62	0.541	0.605	0.545	12.00	18.00	4.87	10.2	30.9	4.81	4.68	18.0	4.14	30.5	4.47
	FP	66.6	NA	1.61	290.8	10.65	0.582	0.568	0.485	12.00	18.00	5.67	16.7	33.7	5.57	5.27	16.7	5.47	33.7	0.85
	FP	21.3	NA	1.49	275.8	10.37	0.789	0.790	0.681	8.00	12.00	3.77	19.8	35.0	3.77	2.81	19.8	3.09	35.0	0.06
3	BM	70.1	8	1.80	NA	NA	NA	0.513	0.363	16.20	24.30	5.44	19.3	29.7	5.44	5.56	19.7	4.72	29.7	NA
	BM	70.1	8	1.80	NA	NA	NA	0.483	0.390	8.00	12.00	3.06	20.3	31.2	3.06	2.84	20.3	2.81	31.2	NA
	BM	70.1	8	1.80	NA	NA	NA	0.633	0.479	2.00	3.00	0.65	16.8	33.4	0.65	0.53	16.8	0.54	33.4	NA
	BM	70.1	8	1.80	NA	NA	NA	0.616	0.456	3.00	4.50	1.00	18.5	33.0	1.00	0.83	18.5	0.84	33.0	NA
	BM/S	70.1	8	1.80	NA	NA	NA	1.270	0.487	7.00	10.50	2.31	12.8	32.2	2.31	2.02	12.8	1.85	32.2	NA
	BM/S	37.0	4	2.29	NA	NA	NA	1.070	0.362	7.00	10.50	2.52	17.9	33.4	2.52	2.05	17.9	2.10	33.4	NA
	BM/S	23.8	NA	1.48	NA	NA	NA	0.840	0.504	7.00	10.50	3.71	19.7	35.2	3.71	2.72	19.7	3.03	35.2	NA
4	FP	24.9	NA	1.45	210.0	7.47	0.557	0.695	0.517	12.00	18.00	4.74	19.9	36.1	4.74	3.30	19.9	3.83	36.1	1.78
	FP	15.7	NA	1.46	222.2	7.68	0.640	0.671	0.466	12.00	18.00	4.85	18.7	36.2	4.85	3.45	18.7	3.91	36.2	0.95
	FP	72.0	NA	1.76	135.5	5.49	0.486	0.520	0.456	8.00	12.00	3.41	13.9	33.3	3.37	2.89	18.2	2.84	32.6	1.60
	FP	39.1	NA	1.58	150.2	5.75	0.389	0.400	0.360	8.00	12.00	3.02	14.1	35.2	3.00	3.09	17.6	3.24	33.9	1.88
	FP	71.3	NA	1.70	170.2	6.08	0.467	0.488	0.446	8.00	12.00	3.85	17.3	33.6	3.84	3.30	18.9	3.24	32.5	2.18
	FP	81.0	NA	1.65	218.3	7.74	0.491	0.519	0.453	12.00	18.00	4.94	14.2	33.6	4.89	4.17	17.7	4.11	32.7	1.98
	FP	72.7	NA	1.71	223.3	7.83	0.485	0.462	0.415	12.00	18.00	4.75	13.1	32.4	4.60	4.23	18.3	3.93	31.4	1.50
	FP	75.6	NA	1.73	213.2	7.65	0.484	0.507	0.428	12.00	18.00	6.00	12.8	35.2	4.80	3.77	19.7	3.90	33.6	1.33
4	BM	75.1	12	1.72	NA	NA	NA	0.575	0.410	8.00	12.00	2.99	20.8	32.4	2.92	2.66	18.0	2.47	32.3	NA
	BM	76.1	12	1.72	NA	NA	NA	0.796	0.450	4.00	6.00	1.41	17.3	33.2	1.42	1.18	18.0	1.18	33.0	NA
	BM	76.1	12	1.72	NA	NA	NA	0.804	0.387	11.90	17.85	4.31	19.3	31.6	4.28	3.86	18.0	3.63	31.6	NA
	BM	76.1	12	1.72	NA	NA	NA	0.805	0.481	2.00	3.00	0.66	21.4	32.6	0.62	0.53	18.0	0.52	32.8	NA
	BM/S	75.1	12	1.72	NA	NA	NA	NA	0.455	5.00	7.50	1.88	19.0	34.3	1.85	3.48	18.0	1.55	33.3	NA
	BM/S	52.2	4	1.56	NA	NA	NA	NA	0.380	5.00	7.50	2.48	23.4	37.2	2.48	1.81	23.4	2.02	35.3	NA
5	FP	81.0	NA	1.77	219.9	9.54	0.562	0.580	0.480	12.00	18.00	4.43	10.9	32.9	4.14	3.76	22.2	3.53	31.6	0.63
	FP	48.8	NA	1.64	234.3	9.72	0.546	0.661	0.448	12.00	18.00	5.34	16.7	35.6	5.33	3.66	17.3	4.34	35.4	0.53
	FP	90.5	NA	1.95	260.0	9.93	0.660	0.588	0.505	12.00	18.00	4.33	8.7	28.9	4.22	4.62	13.9	3.71	28.5	1.16
	FP	67.6	NA	1.79	188.3	8.53	0.522	0.515	0.440	12.00	18.00	4.68	8.5	32.8	4.23	3.98	20.7	3.62	31.0	0.64
	FP	88.9	NA	1.96	194.0	8.61	0.558	0.605	0.547	12.00	18.00	4.00	3.5	26.7	3.97	4.78	4.0	3.53	27.1	0.33
	FP	35.5	NA	1.55	233.3	11.02	0.609	0.525	0.421	12.00	18.00	4.63	20.3	35.6	4.63	3.35	20.3	3.77	35.5	0.59
	FP	22.5	NA	1.41	241.9	11.12	0.547	0.551	0.483	12.00	18.00	4.56	20.5	33.7	4.56	3.67	20.8	3.79	33.7	0.98
	FP	34.4	NA	1.64	180.4	8.67	0.626	0.608	0.444	12.00	18.00	4.37	19.6	35.5	4.30	3.21	21.6	3.57	35.1	0.08
	FP	79.5	NA	1.87	166.0	8.05	0.612	0.600	0.448	12.00	18.00	4.37	9.0	32.0	4.01	3.88	21.3	3.46	30.5	0.11
	FP	74.0	NA	1.88	183.3	8.46	0.618	0.598	0.450	12.00	18.00	5.12	8.8	33.7	4.78	4.20	19.4	4.05	32.1	0.12
	FP	80.7	NA	1.88	200.4	10.13	0.562	0.576	0.466	12.00	18.00	4.84	17.9	36.3	4.75	3.65	24.4	3.90	34.9	0.26
	FP	25.5	NA	1.57	210.3	10.53	0.598	0.599	0.460	12.00	18.00	2.58	19.2	32.9	2.56	2.17	19.2	2.15	32.7	NA
5	BM	62.0	9	1.70	NA	NA	NA	0.545	0.401	8.00	12.00	0.58	20.2	34.8	0.58	0.46	20.3	0.46	33.9	NA
	BM	62.0	9	1.70	NA	NA	NA	0.544	0.473	2.00	3.00	0.28	1.7	35.2	0.27	0.21	19.8	0.22	33.7	NA
	BM	62.0	9	1.70	NA	NA	NA	0.546	0.512	1.00	1.50	2.32	18.6	32.0	2.32	2.10	19.6	1.98	31.6	NA
	BM/S	62.0	9	1.70	NA	NA	NA	0.753	0.358	6.50	9.75	3.08	18.3	34.8	3.08	2.32	18.3	2.53	34.8	NA
	BM/S	85.1	NP	1.88	NA	NA	NA	NA	0.533	6.50	9.75									

NOTES:
FP - Fixed Piston, Undisturbed Sample
BM - Reconstituted Batch Mix Sample Prepared by Moist Tamping
[1] K_o = 0.6 (Ratio of Horizontal to Vertical Effective Stress)
BM/S - Reconstituted Batch Mix Sample Prepared as Slurry
NA - Not Applicable
NP - Non-Plastic
PI - Plasticity Index
$q = (\sigma_1 - \sigma_3)/2$

R14755



GENERALIZED CROSS-SECTION

HORIZONTAL & VERTICAL SCALES

200 0 200 400 FEET

LEGEND:

T_d (AVG.)	AVERAGE IN-SITU STATIC DRIVING SHEAR STRESS
K_y (AVG.)	AVERAGE YIELD ACCELERATION
FS_L (AVG.)&(MAX.)	AVERAGE AND MAXIMUM FACTORS OF SAFETY AGAINST LIQUEFACTION
①	MATERIAL LAYER NO.

- FINE COAL REFUSE
- FINE COAL REFUSE (BEACHED ZONES)
- MIXED COARSE AND FINE COAL REFUSE
- COARSE COAL REFUSE
- COMBINED COAL REFUSE
- MIXED COMBINED AND FINE COAL REFUSE

ALMES & ASSOCIATES, INC.
CONSULTING ENGINEERS
BECKLEY, WV
PITTSBURGH, PA

FIGURE 1
GENERALIZED CROSS-SECTION AND LIQUEFACTION SUSCEPTIBILITY EVALUATION SUMMARY

R14756

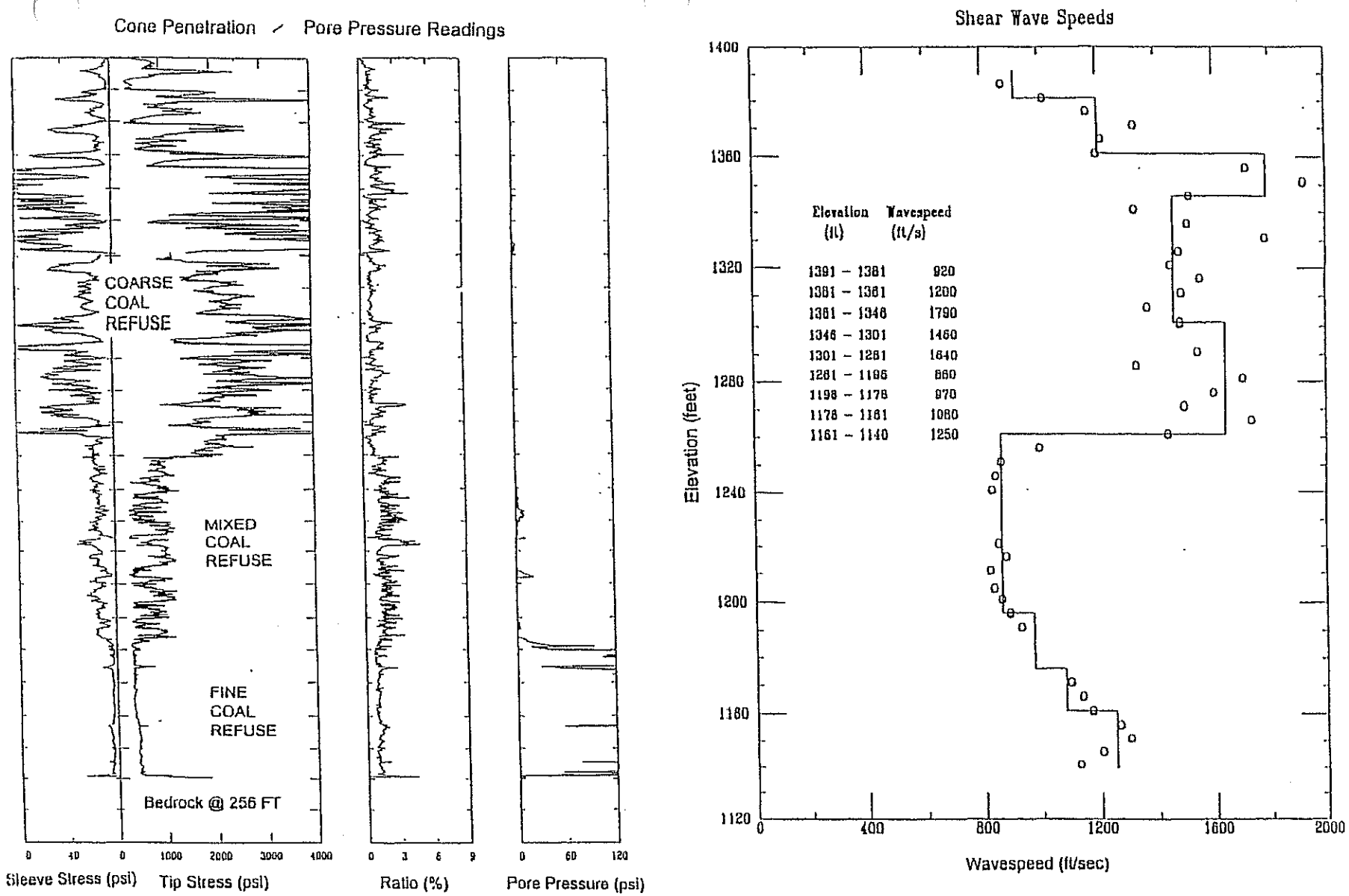


Figure 2 – CPT Log and Shear Wave Velocity Profile

R14757

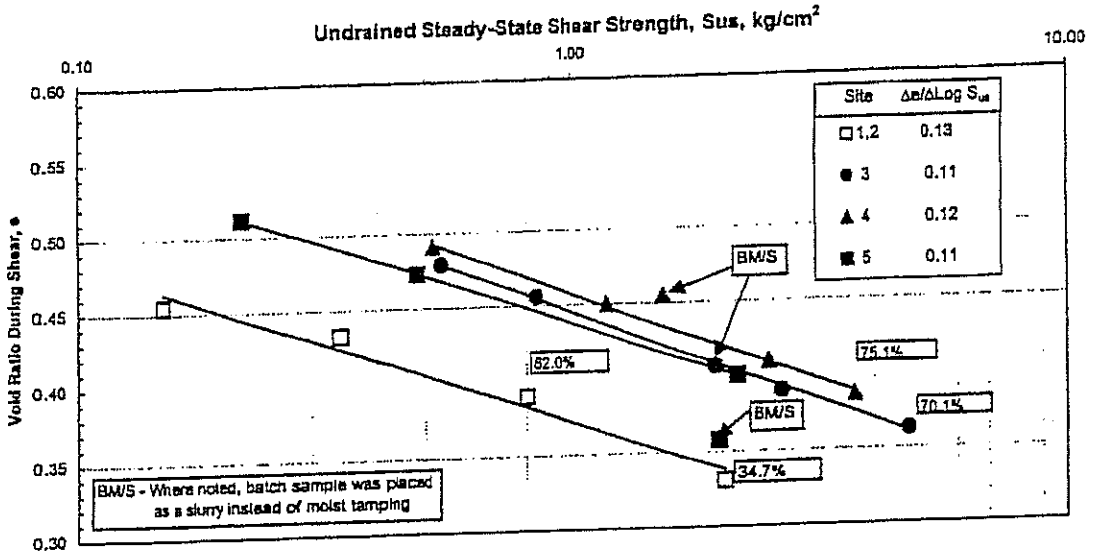


FIGURE 3 - Steady State Lines of Fine Coal Refuse Batch Samples

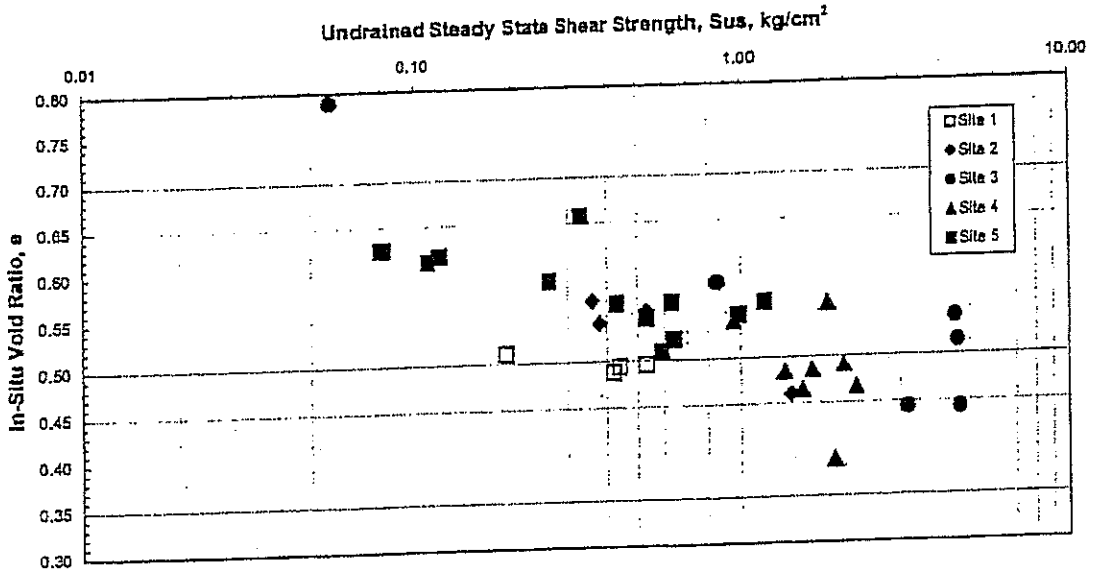


FIGURE 4 - S_{us} of Fixed Piston Samples at In-Situ Void Ratio, After Correction of Lab Void Ratio

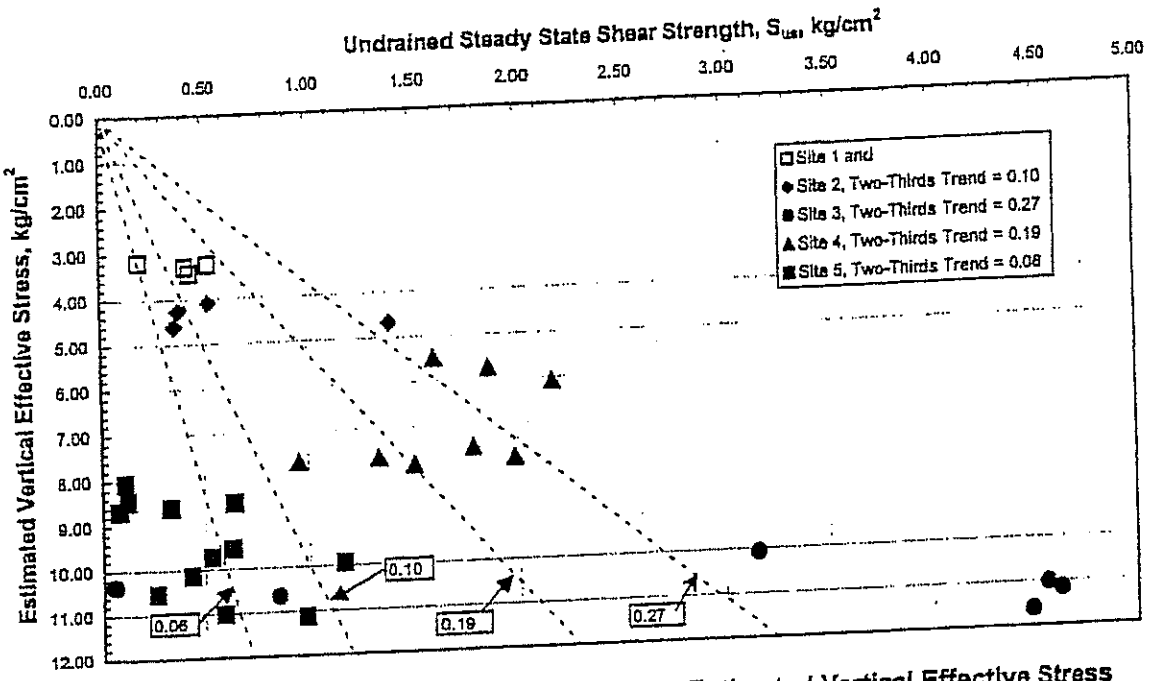


FIGURE 5 - S_{us} of Fixed Piston Samples Versus Estimated Vertical Effective Stress

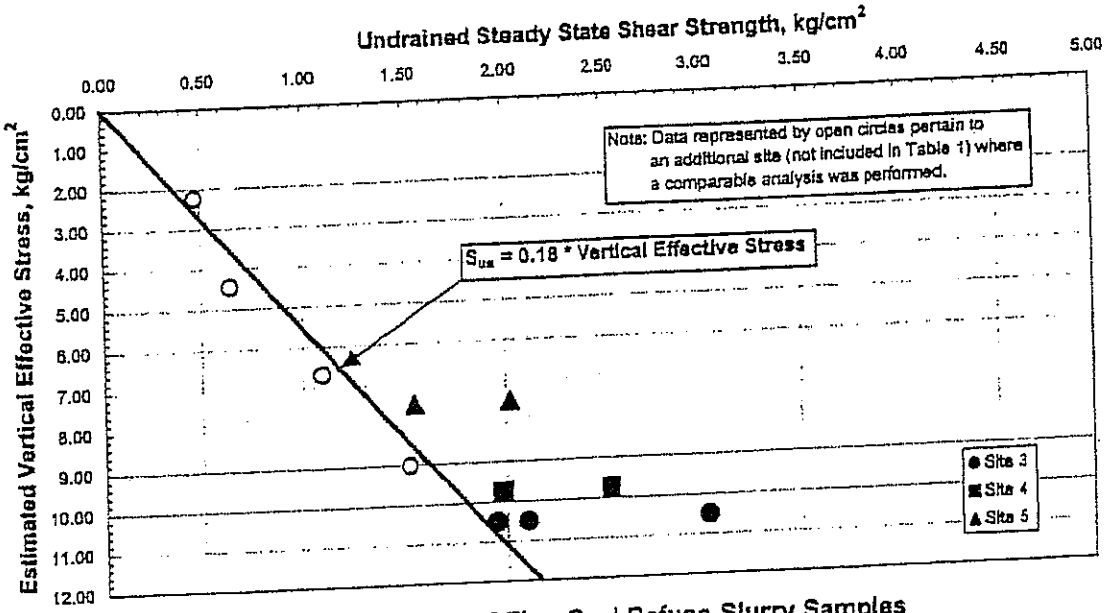
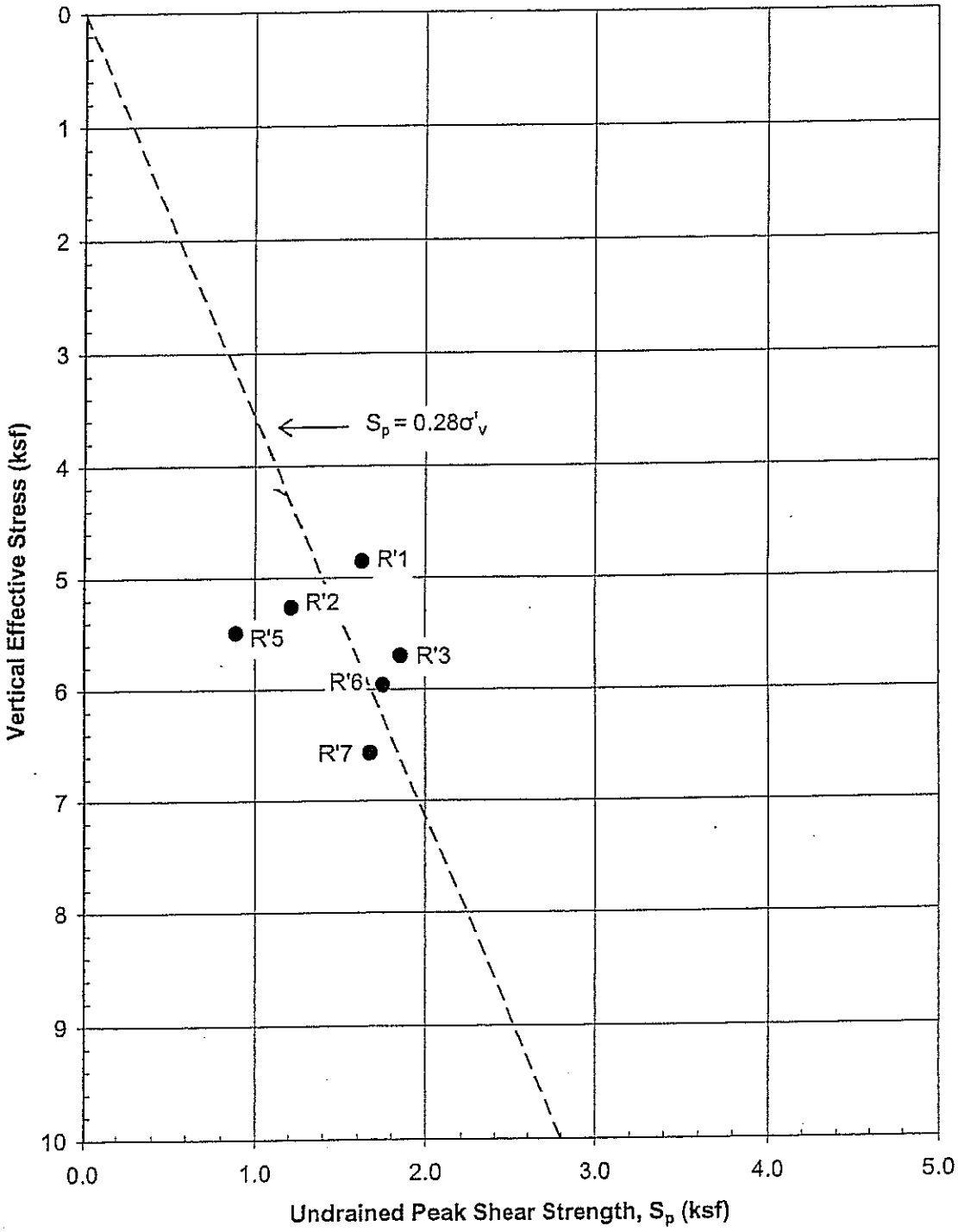
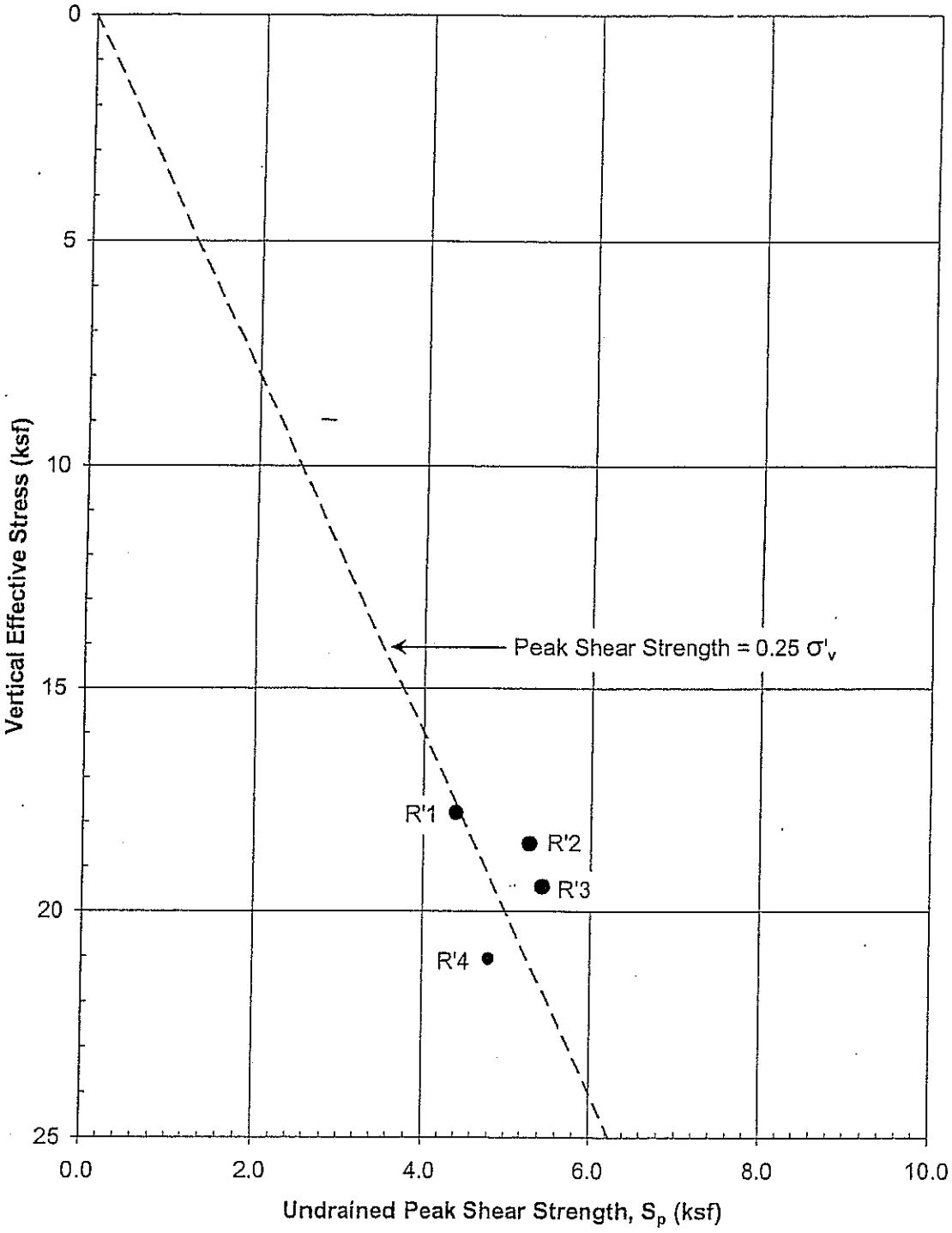


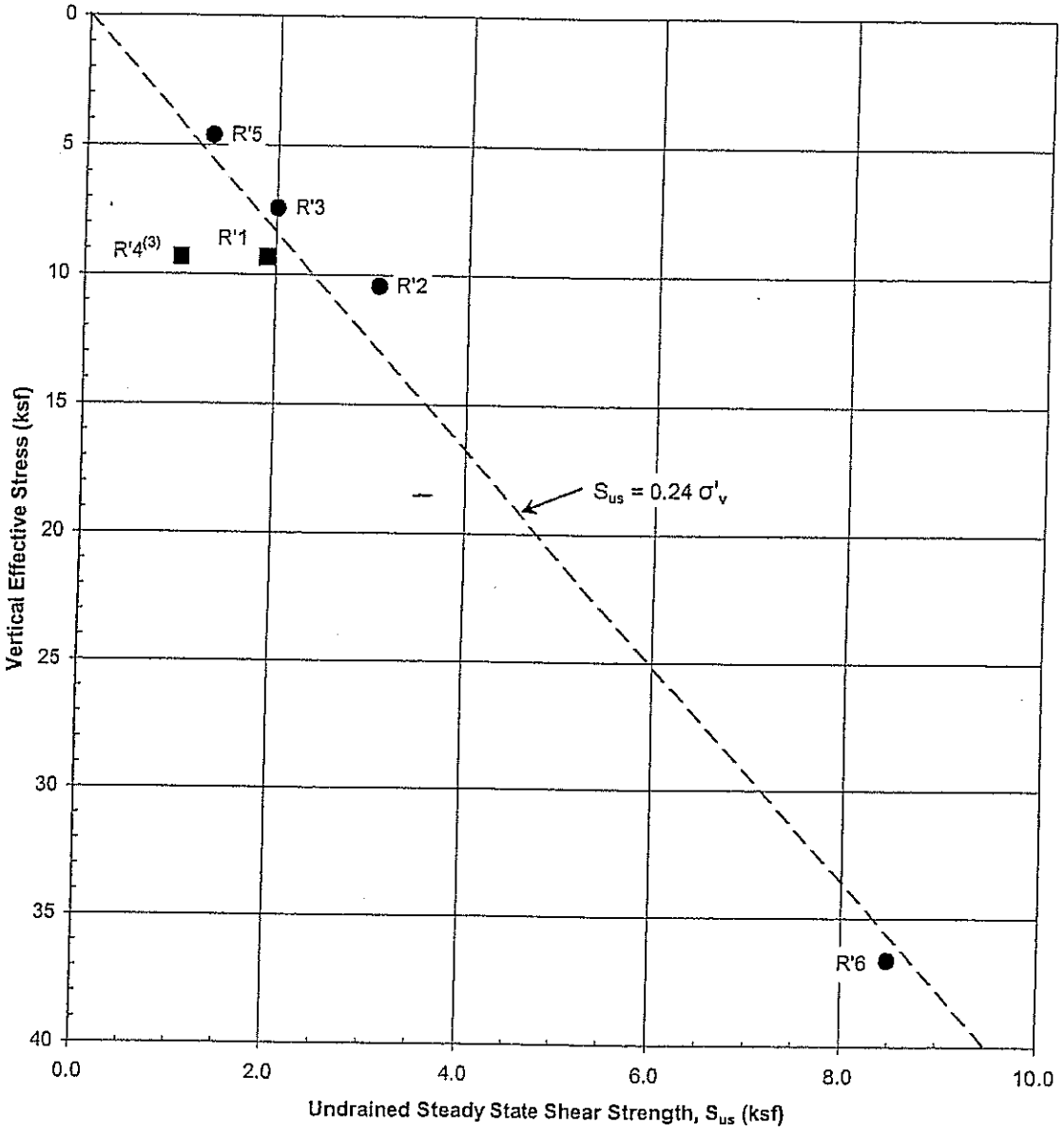
FIGURE 6 - S_{us} of Fine Coal Refuse Slurry Samples Versus Estimated In-Situ Vertical Effective Stress



Harvey Run No. 1 Slurry Impoundment Monongalia County, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_p VERSUS VERTICAL EFFECTIVE STRESS
Consolidation Coal Company Pittsburgh, Pennsylvania	Project 070810	June 2007 Figure 6



Wallace Cabin Branch Slurry Impoundment Wyoming County, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_p VERSUS VERTICAL EFFECTIVE STRESS
Kepler Processing Company Pineville, West Virginia	Project 063560	April 2007 Figure 4



LEGEND
- Reconstituted Coal Refuse Slurry Sample
- Undisturbed Tube Sample

NOTES
1. Vertical effective stress for reconstituted coal refuse samples assumed to be 1.5 times the isotropic effective consolidation stress.
2. Vertical effective stress of undisturbed tube samples estimated by CEC, Inc.
3. R'4 composed of two different soil types. S_{us} shown is uncertain.

Hughes Hollow Slurry Impoundment Wana, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_{us} VERSUS VERTICAL EFFECTIVE STRESS
Consolidation Coal Company Pittsburgh, Pennsylvania	Project 063570	February 2007 Figure 3

7225-11
part 23

LABORATORY TESTING RESULTS – COARSE REFUSE AND RESIDUAL SOILS PROVIDED BY ALLIANCE CONSULTING, INC.

APPENDIX C

LABORATORY TESTING
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY, LLC
BECKLEY, WEST VIRGINIA

TABLE OF CONTENTS

	PAGE
SOIL TESTING	
Summary	1
Strength Test	3
Grain Size	10
Atterberg Limits Test Results	12
COARSE COAL REFUSE TESTING	
Summary	13
Grain Size	15
Proctor Test	17
Permeability Test	18
Strength Test	20

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SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

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February 10, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Soil Boring and Laboratory Tests
Boring #8874
Mach Mine #1
Johnston City, Illinois
HFE File H-05278
Mach Mining Purchase Order No. _____

Dear Sir:

In accordance with your instructions, on February 1, 2006, we drilled one soil boring and sampled the subsoils with Shelby tubes. The soil sample taken from 10 to 12 feet in depth was subjected to laboratory tests. Results of the tests are as follows:

Boring No.:	8874
Depth:	8.0-10.0'
Visual Classification:	Silty CLAY (CL)
Atterberg Limits:	LL = 41.8% PL = 17.7% PI = 24.1
Unit Weight:	105.3 PCF
Moisture Content:	21.5%
Effective Cohesion:	0 PSF
Effective Phi Angle:	26.8 Degrees

All Tubes From Boring 8874

The Boring Log and test results are enclosed. If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

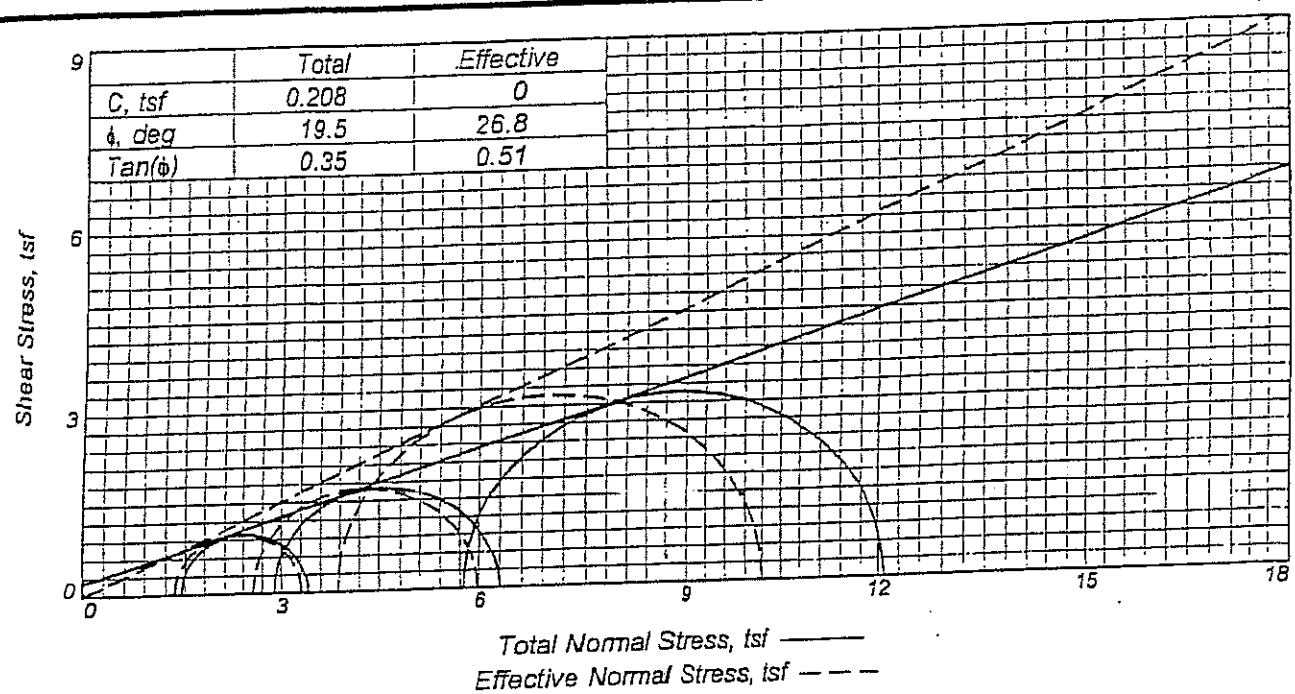
HOLCOMB FOUNDATION ENGINEERING CO.

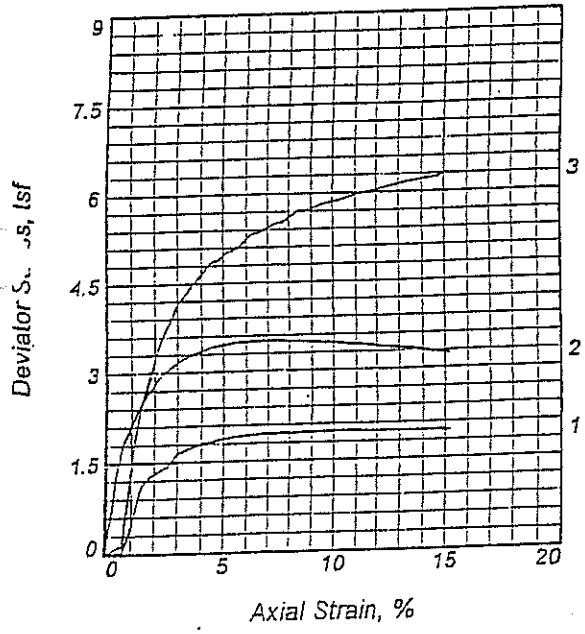
Timothy J. Holcomb, P.E.

REGISTERED PROFESSIONAL ENGINEER
TIMOTHY J.
HOLCOMB
062-042149
2-10-06
ILLINOIS

1 copy: Fred Vass - Alliance Consulting

3 R14767





Sample No.		1	2	3
Initial	Water Content,	21.5	20.8	17.6
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	99.7	98.9
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
At Test	Water Content,	21.5	20.9	17.8
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.6	3.6	2.2
Cell Pressure, tsf		5.0	6.5	7.9
Fail. Stress, tsf		2.0	3.4	6.3
Total Pore Pr., tsf		3.7	3.9	4.1
Ult. Stress, tsf		2.0	3.2	6.3
Total Pore Pr., tsf		3.6	3.8	4.1
$\bar{\sigma}_1$ Failure, tsf		3.3	6.0	10.2
$\bar{\sigma}_3$ Failure, tsf		1.3	2.6	3.9

Type of Test:
CU with Pore Pressures
Sample Type: Shelby Tube - Undisturbed
Description: Gray Mottled Brown Silty CLAY

LL= 41.8 PL= 17.7 PI= 24.1
Assumed Specific Gravity= 2.65
Remarks:

Client: Alliance Consulting

Project: Triaxial Test
Mach Mine #1
Location: Boring #8874
Sample Number: 3 Depth: 10.0-12.0'
Proj. No.: H-05278 Date: 2-1-05

TRIAXIAL SHEAR TEST REPORT

HOLCOMB FOUNDATION ENGINEERING CO.

Plate _____

Tested By: LC Checked By: TH

10 of 21

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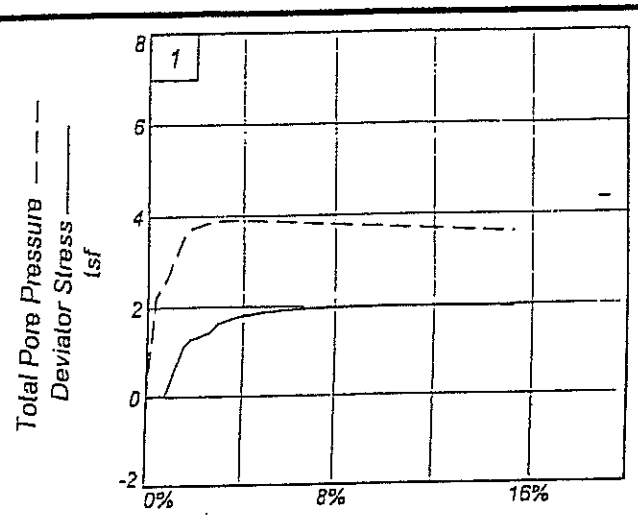
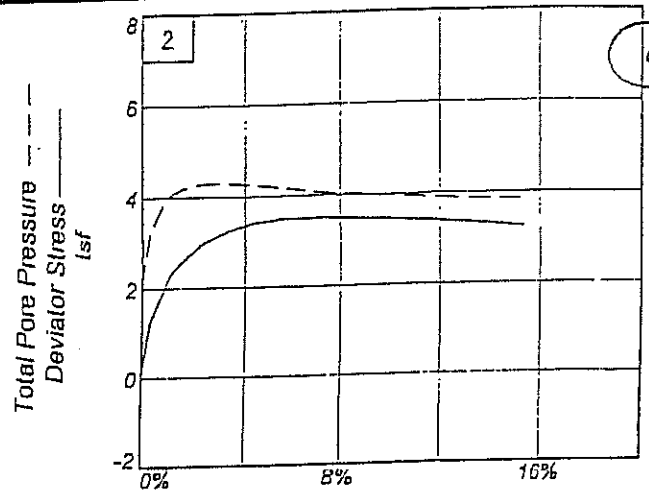
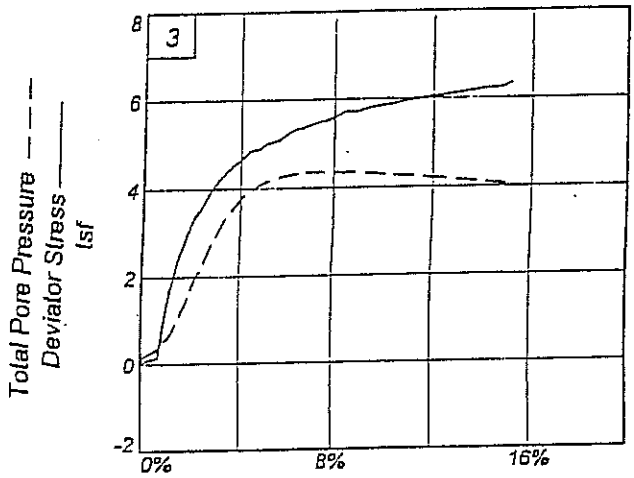
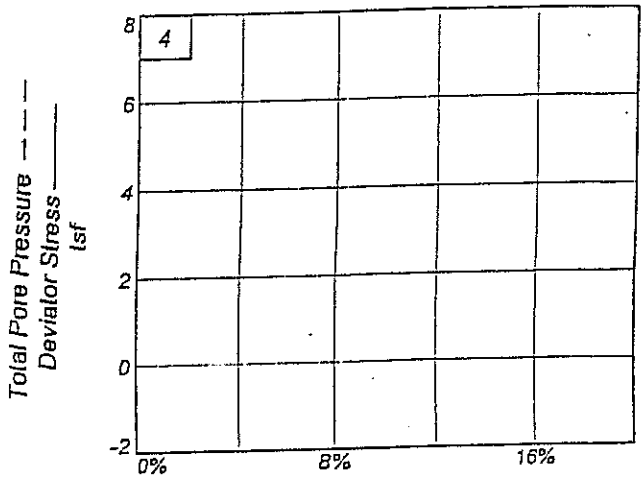
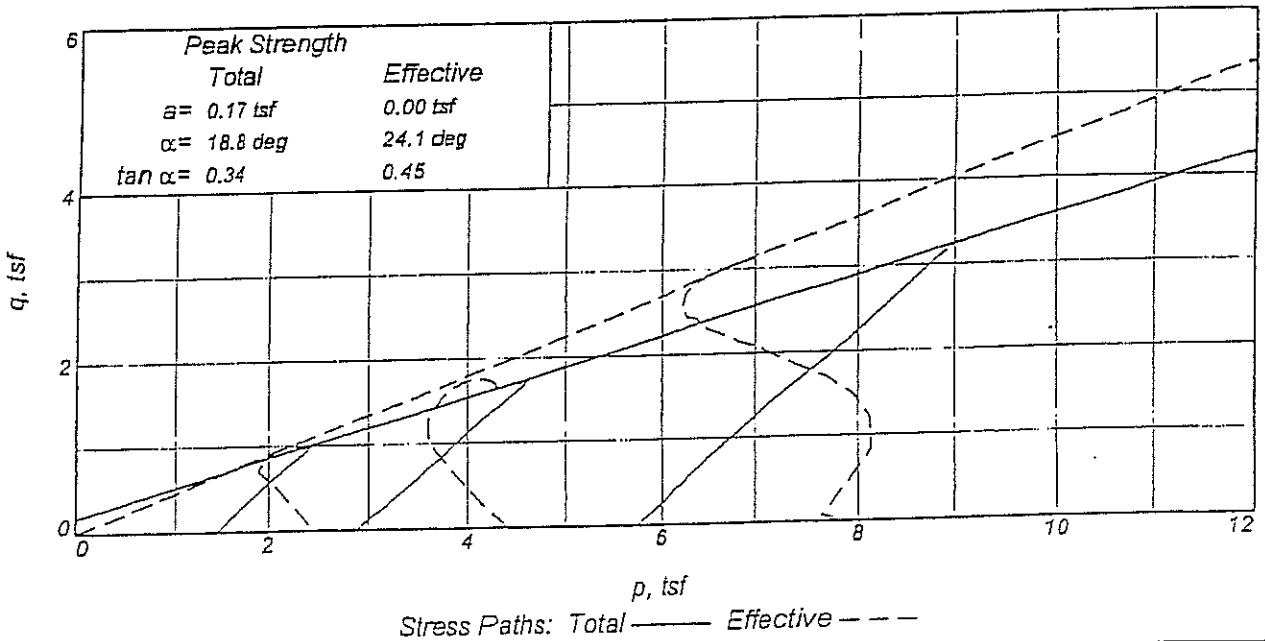
4











Stress Paths: Total ——— Effective - - -

Client: Alliance Consulting

Project: Triaxial Test

Location: Boring #8874

Project No.: H-05278

Depth: 10.0-12.0'

Plate _____

Sample Number: 3

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC

Checked By: TH

R14769

5

2/9/2006
8:50 PM

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

Date:	2-1-05
Client:	Alliance Consulting
Project:	Triaxial Test Mach Mine #1 Johnston City, Illinois
Location:	Boring #8874
Depth:	10.0-12.0'
Sample Number:	3
Description:	Gray Mottled Brown Silty CLAY
Remarks:	
Type of Sample:	Shelby Tube - Undisturbed
Assumed Specific Gravity=2.65	LL=41.8 PL=17.7 PI=24.1
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	189.100			1279.000
Moisture content: Dry soil+tare, gms.	176.100			1072.200
Moisture content: Tare, gms.	115.700			103.200
Moisture, %	21.5	21.5	21.5	21.3
Moist specimen weight, gms.	1140.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.51	5.51	5.51	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.0	128.0	128.0	
Dry density, pcf	105.3	105.3	105.3	
Void ratio	0.5706	0.5706	0.5706	
Saturation, %	100.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.981 tsf at reading no. 24
Ult. Stress = 1.955 tsf at reading no. 30

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(6)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	18.30	0.0	0.0	0.000	5.112	5.112	1.00	-1.00	5.112	0.000
1	0.0190	20.00	1.7	0.3	0.014	2.830	2.844	1.00	30.70	2.837	0.007
2	0.0400	21.60	3.3	0.7	0.026	2.426	2.452	1.01	36.30	2.439	0.013
3	0.0810	113.20	94.9	1.5	1.093	1.505	2.598	1.73	49.10	2.051	0.547
4	0.1010	129.80	111.5	1.8	1.280	1.318	2.597	1.97	51.70	1.958	0.640
5	0.1420	143.10	124.8	2.6	1.422	1.181	2.602	2.20	53.60	1.892	0.711
6	0.1620	161.50	143.2	2.9	1.625	1.159	2.784	2.40	53.90	1.972	0.813
7	0.1830	168.90	150.6	3.3	1.702	1.145	2.847	2.49	54.10	1.996	0.851
8	0.2030	174.80	156.5	3.7	1.763	1.138	2.900	2.55	54.20	2.019	0.881
9	0.2240	178.90	160.6	4.1	1.802	1.145	2.946	2.57	54.10	2.046	0.901
10	0.2440	182.30	164.0	4.4	1.833	1.145	2.978	2.60	54.10	2.061	0.916
11	0.2650	186.40	168.1	4.8	1.871	1.152	3.023	2.62	54.00	2.088	0.936
12	0.2850	188.10	169.8	5.2	1.883	1.166	3.049	2.61	53.80	2.108	0.941
13	0.3060	191.40	173.1	5.6	1.912	1.166	3.078	2.64	53.80	2.122	0.956
14	0.3260	193.10	174.8	5.9	1.923	1.181	3.104	2.63	53.60	2.142	0.962
15	0.3460	194.70	176.4	6.3	1.933	1.188	3.121	2.63	53.50	2.155	0.967
16	0.3670	196.40	178.1	6.7	1.944	1.202	3.146	2.62	53.30	2.174	0.972
17	0.3870	198.10	179.8	7.0	1.955	1.210	3.164	2.62	53.20	2.187	0.977
18	0.4080	198.10	179.8	7.4	1.947	1.224	3.171	2.59	53.00	2.197	0.973
19	0.4280	200.60	182.3	7.8	1.966	1.231	3.197	2.60	52.90	2.214	0.983
20	0.4490	200.60	182.3	8.1	1.958	1.238	3.196	2.58	52.80	2.217	0.979
21	0.4890	203.10	184.8	8.9	1.969	1.267	3.236	2.55	52.40	2.252	0.985
22	0.5300	204.70	186.4	9.6	1.970	1.289	3.259	2.53	52.10	2.274	0.985
23	0.5710	207.20	188.9	10.4	1.980	1.310	3.290	2.51	51.80	2.300	0.990
24	0.6120	208.90	190.6	11.1	1.981	1.332	3.313	2.49	51.50	2.323	0.991
25	0.6530	209.10	190.8	11.8	1.967	1.346	3.313	2.46	51.30	2.330	0.983
26	0.6940	211.40	193.1	12.6	1.974	1.361	3.334	2.45	51.10	2.348	0.987
27	0.7350	212.20	193.9	13.3	1.965	1.390	3.354	2.41	50.70	2.372	0.982
28	0.7790	213.90	195.6	14.1	1.964	1.404	3.368	2.40	50.50	2.386	0.982
29	0.8170	215.50	197.2	14.8	1.964	1.426	3.390	2.38	50.20	2.408	0.982
30	0.8380	215.50	197.2	15.2	1.955	1.433	3.388	2.36	50.10	2.410	0.978

7

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	154.800			1347.900
Moisture content: Dry soil+tare, gms.	145.800			1154.100
Moisture content: Tare, gms.	102.600			135.100
Moisture, %	20.8	20.9	20.9	19.0
Moist specimen weight, gms.	1142.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.49	5.49	5.49	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.7	128.7	128.7	
Dry density, pcf	106.5	106.5	106.5	
Void ratio	0.5536	0.5536	0.5536	
Saturation, %	99.7	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 3.418 tsf at reading no. 24
Ult. Stress = 3.250 tsf at reading no. 29

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	27.50	0.0	0.0	0.000	4.385	4.385	1.00	29.10	4.385	0.000
1	0.0190	134.00	106.5	0.3	1.241	3.254	4.495	1.38	44.80	3.875	0.620
2	0.0400	183.10	155.6	0.7	1.806	2.750	4.557	1.66	51.80	3.653	0.903
3	0.0600	218.90	191.4	1.1	2.214	2.484	4.698	1.89	55.50	3.591	1.107
4	0.0810	243.80	216.3	1.5	2.492	2.340	4.832	2.06	57.50	3.586	1.246
5	0.1010	264.60	237.1	1.8	2.721	2.254	4.975	2.21	58.70	3.614	1.361
6	0.1220	282.10	254.6	2.2	2.911	2.210	5.121	2.32	59.30	3.666	1.455
7	0.1420	295.40	267.9	2.6	3.052	2.182	5.233	2.40	59.70	3.707	1.526
8	0.1620	305.40	277.9	2.9	3.154	2.182	5.335	2.45	59.70	3.758	1.577
9	0.1830	314.60	287.1	3.3	3.245	2.189	5.434	2.48	59.60	3.811	1.623
10	0.2030	322.10	294.6	3.7	3.317	2.196	5.513	2.51	59.50	3.855	1.659
11	0.2240	327.10	299.6	4.1	3.360	2.218	5.578	2.52	59.20	3.898	1.680
12	0.2440	332.90	305.4	4.4	3.412	2.232	5.644	2.53	59.00	3.938	1.706
13	0.2650	336.20	308.7	4.8	3.435	2.254	5.689	2.52	58.70	3.971	1.718
14	0.2850	339.50	312.0	5.2	3.459	2.275	5.734	2.52	58.40	4.005	1.729
15	0.3060	343.70	316.2	5.6	3.491	2.297	5.788	2.52	58.10	4.042	1.746
16	0.3260	345.40	317.9	5.9	3.497	2.318	5.815	2.51	57.80	4.067	1.748
17	0.3670	348.70	321.2	6.7	3.505	2.369	5.874	2.48	57.10	4.121	1.752
18	0.4080	352.00	324.5	7.4	3.512	2.412	5.924	2.46	56.50	4.168	1.756
19	0.4490	353.70	326.2	8.2	3.502	2.441	5.943	2.43	56.10	4.192	1.751
20	0.4890	354.50	327.0	8.9	3.483	2.470	5.953	2.41	55.70	4.211	1.742
21	0.5300	355.40	327.9	9.7	3.464	2.498	5.963	2.39	55.30	4.230	1.732

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.5510	357.00	329.5	10.0	3.466	2.513	5.979	2.38	55.10	4.246	1.733
23	0.5920	356.20	328.7	10.8	3.429	2.534	5.964	2.35	54.80	4.249	1.715
24	0.6330	357.90	330.4	11.5	3.418	2.556	5.974	2.34	54.50	4.265	1.709
25	0.6730	357.00	329.5	12.3	3.381	2.585	5.966	2.31	54.10	4.275	1.690
26	0.7140	357.90	330.4	13.0	3.361	2.599	5.960	2.29	53.90	4.280	1.681
27	0.7550	357.90	330.4	13.7	3.332	2.614	5.946	2.27	53.70	4.280	1.666
28	0.7960	356.20	328.7	14.5	3.286	2.628	5.914	2.25	53.50	4.271	1.643
29	0.8370	355.40	327.9	15.2	3.250	2.635	5.885	2.23	53.40	4.260	1.625

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	248.400			1374.500
Moisture content: Dry soil+tare, gms.	226.700			1195.400
Moisture content: Tare, gms.	103.200			127.700
Moisture, %	17.6	17.8	17.8	16.8
Moist specimen weight, gms.	1184.7			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.54	5.54	5.54	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	132.3	132.5	132.5	
Dry density, pcf	112.5	112.5	112.5	
Void ratio	0.4707	0.4707	0.4707	
Saturation, %	98.9	100.0	100.0	

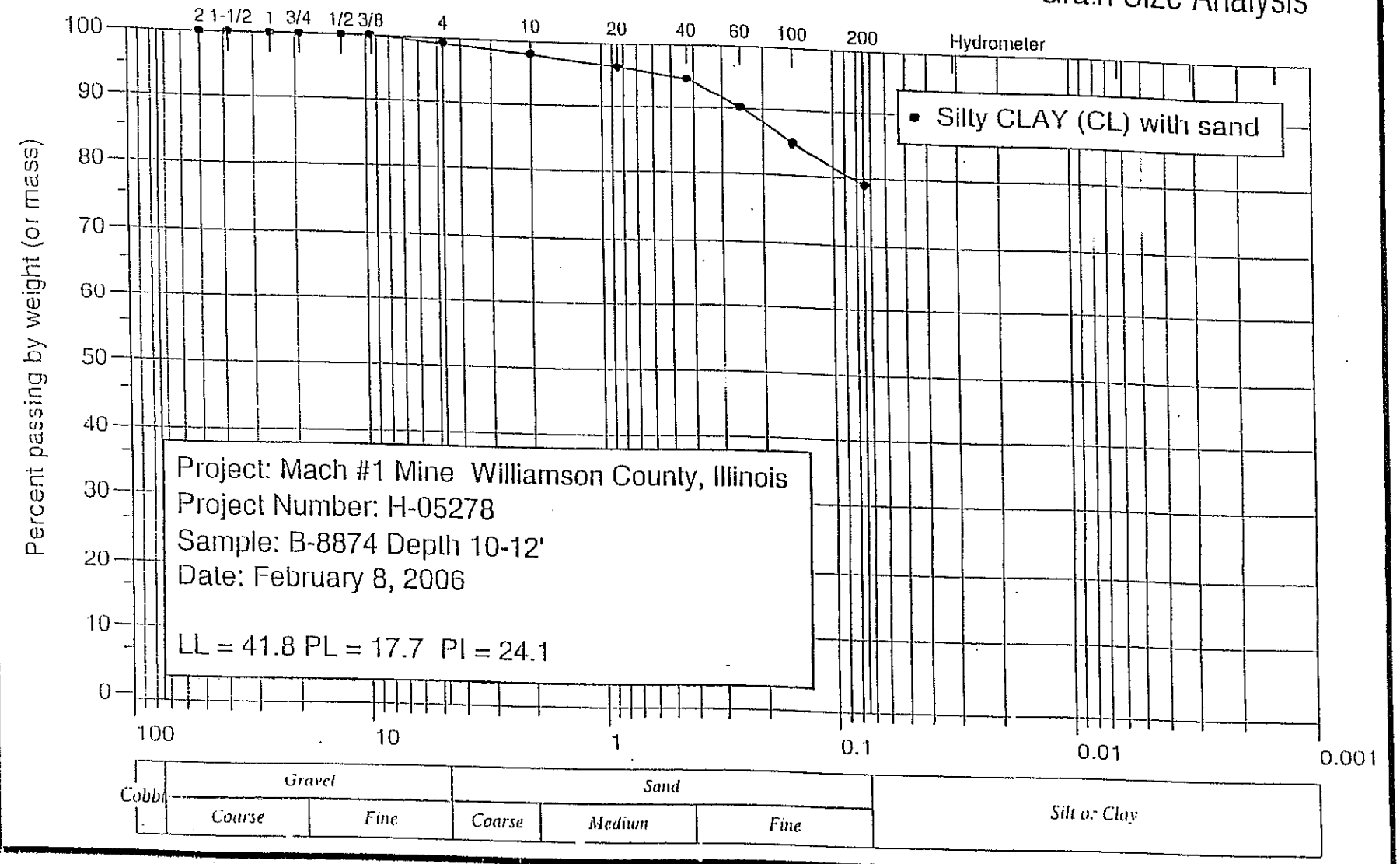
Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 6.334 tsf at reading no. 33
Ult. Stress = 6.334 tsf at reading no. 33

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	31.60	0.0	0.0	0.000	7.812	7.812	1.00	1.50	7.812	0.000
1	0.0190	39.90	8.3	0.3	0.091	7.690	7.781	1.01	3.20	7.735	0.045
2	0.0400	44.10	12.5	0.7	0.133	7.574	7.707	1.02	4.80	7.641	0.066
3	0.0600	175.60	144.0	1.1	1.666	7.308	8.974	1.23	8.50	8.141	0.833
4	0.0810	240.50	208.9	1.5	2.407	6.926	9.333	1.35	13.80	8.130	1.203
5	0.1010	291.30	259.7	1.8	2.981	6.466	9.447	1.46	20.20	7.956	1.491
6	0.1220	329.60	298.0	2.2	3.408	5.983	9.391	1.57	26.90	7.687	1.704
7	0.1420	362.00	330.4	2.6	3.764	5.479	9.244	1.69	33.90	7.361	1.882
8	0.1620	392.00	360.4	2.9	4.091	5.040	9.131	1.81	40.00	7.085	2.045
9	0.1830	412.80	381.2	3.3	4.310	4.666	8.976	1.92	45.20	6.821	2.155

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
10	0.2030	432.80	401.2	3.7	4.519	4.363	8.883	2.04	49.40	6.623	2.260
11	0.2240	446.90	415.3	4.0	4.660	4.140	8.800	2.13	52.50	6.470	2.330
12	0.2440	465.20	433.6	4.4	4.847	3.982	8.828	2.22	54.70	6.405	2.423
13	0.2650	471.00	439.4	4.8	4.892	3.852	8.744	2.27	56.50	6.298	2.446
14	0.2850	483.50	451.9	5.1	5.012	3.766	8.778	2.33	57.70	6.272	2.506
15	0.3060	490.20	458.6	5.5	5.066	3.694	8.760	2.37	58.70	6.227	2.533
16	0.3260	503.50	471.9	5.9	5.193	3.643	8.837	2.43	59.40	6.240	2.597
17	0.3460	516.80	485.2	6.2	5.319	3.607	8.926	2.47	59.90	6.267	2.660
18	0.3670	521.80	490.2	6.6	5.352	3.586	8.938	2.49	60.20	6.262	2.676
19	0.3870	530.10	498.5	7.0	5.422	3.571	8.993	2.52	60.40	6.282	2.711
20	0.4080	538.40	506.8	7.4	5.490	3.564	9.054	2.54	60.50	6.309	2.745
21	0.4280	543.40	511.8	7.7	5.522	3.564	9.086	2.55	60.50	6.325	2.761
22	0.4490	554.30	522.7	8.1	5.617	3.571	9.188	2.57	60.40	6.380	2.808
23	0.4690	565.90	534.3	8.5	5.719	3.578	9.297	2.60	60.30	6.438	2.859
24	0.4890	567.60	536.0	8.8	5.714	3.578	9.293	2.60	60.30	6.436	2.857
25	0.5300	581.70	550.1	9.6	5.817	3.600	9.417	2.62	60.00	6.509	2.909
26	0.5710	591.70	560.1	10.3	5.874	3.636	9.510	2.62	59.50	6.573	2.937
27	0.6120	605.00	573.4	11.0	5.964	3.665	9.629	2.63	59.10	6.647	2.982
28	0.6530	615.00	583.4	11.8	6.018	3.701	9.719	2.63	58.60	6.710	3.009
29	0.6940	626.70	595.1	12.5	6.087	3.737	9.824	2.63	58.10	6.780	3.044
30	0.7350	638.30	606.7	13.3	6.153	3.773	9.926	2.63	57.60	6.849	3.077
31	0.7760	649.10	617.5	14.0	6.209	3.816	10.025	2.63	57.00	6.921	3.105
32	0.8170	657.50	625.9	14.7	6.240	3.852	10.092	2.62	56.50	6.972	3.120
33	0.8390	669.90	638.3	15.1	6.334	3.866	10.200	2.64	56.30	7.033	3.167

Holcomb Foundation Engineering

Grain Size Analysis



14 / 57

17 of 57

R14775

Holcomb Foundation Engineering Company

Laboratory Testing Results

2/8/2006

Project: Mach #1 Mine

Project No: H-05278

Sieve Analysis - ASTM C136-96a

Sample: Silty CLAY (CL)

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
1.5000	38.1000	1 -1/2"	0.0	0.0	100.0
1.0000	25.4000	1"	0.0	0.0	100.0
0.7500	19.1000	3/4"	0.0	0.0	100.0
0.5000	12.7000	1/2"	0.0	0.0	100.0
3.7500	9.5200	3/8"	0.0	0.0	100.0
0.1870	4.7600	No. 4	2.1	0.9	99.1
0.0790	2.0000	No. 10	4.6	2.0	98.0
0.0469	1.1800	No. 16	4.6	2.0	98.0
0.0331	0.8500	No. 20	8.6	3.8	96.2
0.0165	0.4200	No. 40	12.6	5.5	94.5
0.0117	0.2980	No. 50	12.6	5.5	94.5
0.0083	0.2500	No. 60	22.2	9.8	90.2
0.0059	0.1490	No. 100	34.6	15.2	84.8
0.0029	0.0740	No. 200	47.7	21.0	79.0

Total Weight in Grams 227.20

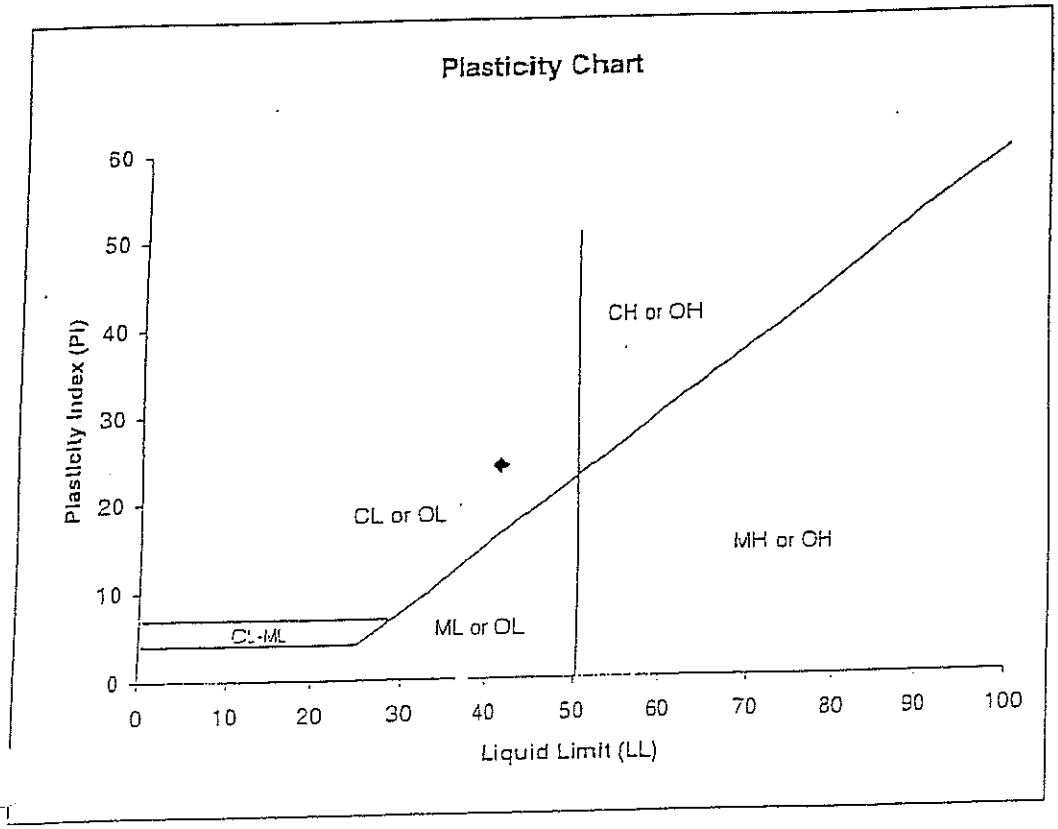
Holcomb Foundation Engineering Company

Laboratory Testing Results

Project: Mach #1 Mine
Project No: H-05278

Sample	1	2	3
Dish Number	LL_1	LL_2	LL_3
Mass of can, W_1 (g)	34.70		
Mass of can + moist soil, W_2 (g)	62.84		
Mass of can + dry soil, W_3 (g)	54.52		
Moisture content, w (%)	41.98		
Number of blows, N	24		
Liquid Limit, LL	41.8		

Dish Number	PL_1
Mass of can, W_1 (g)	39.76
Mass of can + moist soil, W_2 (g)	54.79
Mass of can + dry soil, W_3 (g)	52.53
Plastic Limit, PL	17.7
PI =	24.1



19 of 57

R14377

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

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Box 393 Wood Road
Carbondale, IL 62901

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P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

November 30, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Pond Creek Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on November 17, 2006, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification: Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)

Proctor Test Results:
Maximum Dry Unit Weight: 124.6 PCF
Optimum Moisture Content: 9.3 %

Specific Gravity: 2.37

Triaxial Test Results:
Effective Cohesion: 0 PSF
Effective Phi Angle: 33.7 Degrees

Permeability: 2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

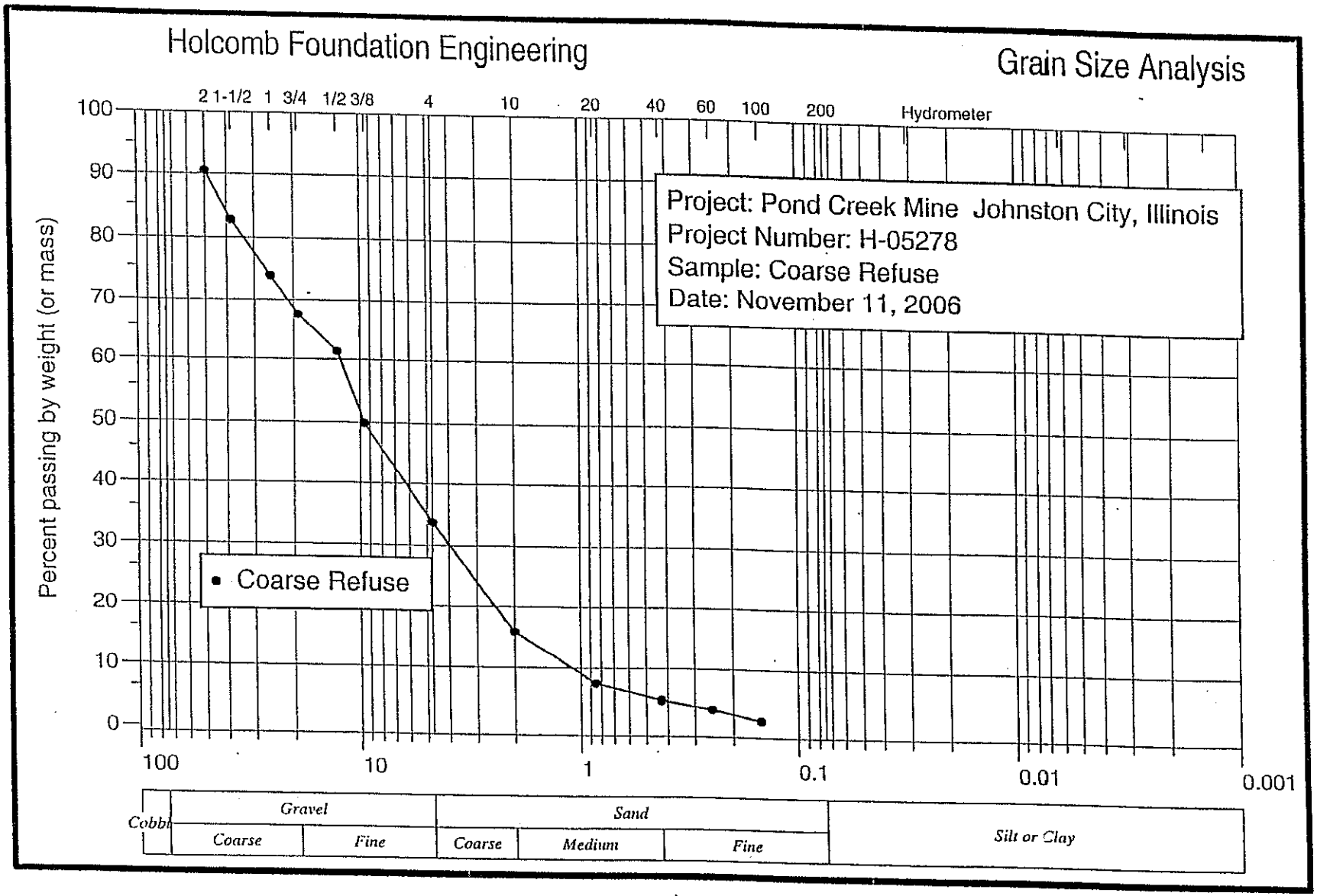
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting


Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
Project: Pond Creek Mine Johnston City, Illinois
Project Number: H-05278
Sample: Coarse Refuse
Date: November 11, 2006
Coarse Refuse
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

21 / 57

R14759

Holcomb Foundation Engineering Company

Laboratory Testing Results

11/30/2006

Project: Coarse Refuse Disposal Area
Pond Creek Mine Johnston City, Illinois

Project No: H-05317

Sieve Analysis - ASTM C136-96a

Sample: Coarse Refuse

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
3	76.2	3"	0.0	0.0	100.0
2.0000	50.8100	2"	619.6	9.5	90.5
1.5000	38.1000	1 -1/2"	1124.0	17.2	82.8
1.0000	25.4000	1"	1696.2	25.9	74.1
0.7500	19.1000	3/4"	2110.9	32.3	67.7
0.5000	12.7000	1/2"	2513.0	38.4	61.6
3.7500	9.5200	3/8"	3263.7	49.9	50.1
0.1870	4.7600	No. 4	4310.7	65.9	34.1
0.0790	2.0000	No. 10	5470.5	83.6	16.4
0.0469	1.1800	No. 16			
0.0331	0.8500	No. 20	6004.4	91.8	8.2
0.0165	0.4200	No. 40	6178.9	94.4	5.6
0.0117	0.2980	No. 50			
0.0083	0.2500	No. 60	6267.8	95.8	4.2
0.0059	0.1490	No. 100			
0.0029	0.0740	No. 200	6372.4	97.4	2.6

Total Weight in Grams **6542.80**

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

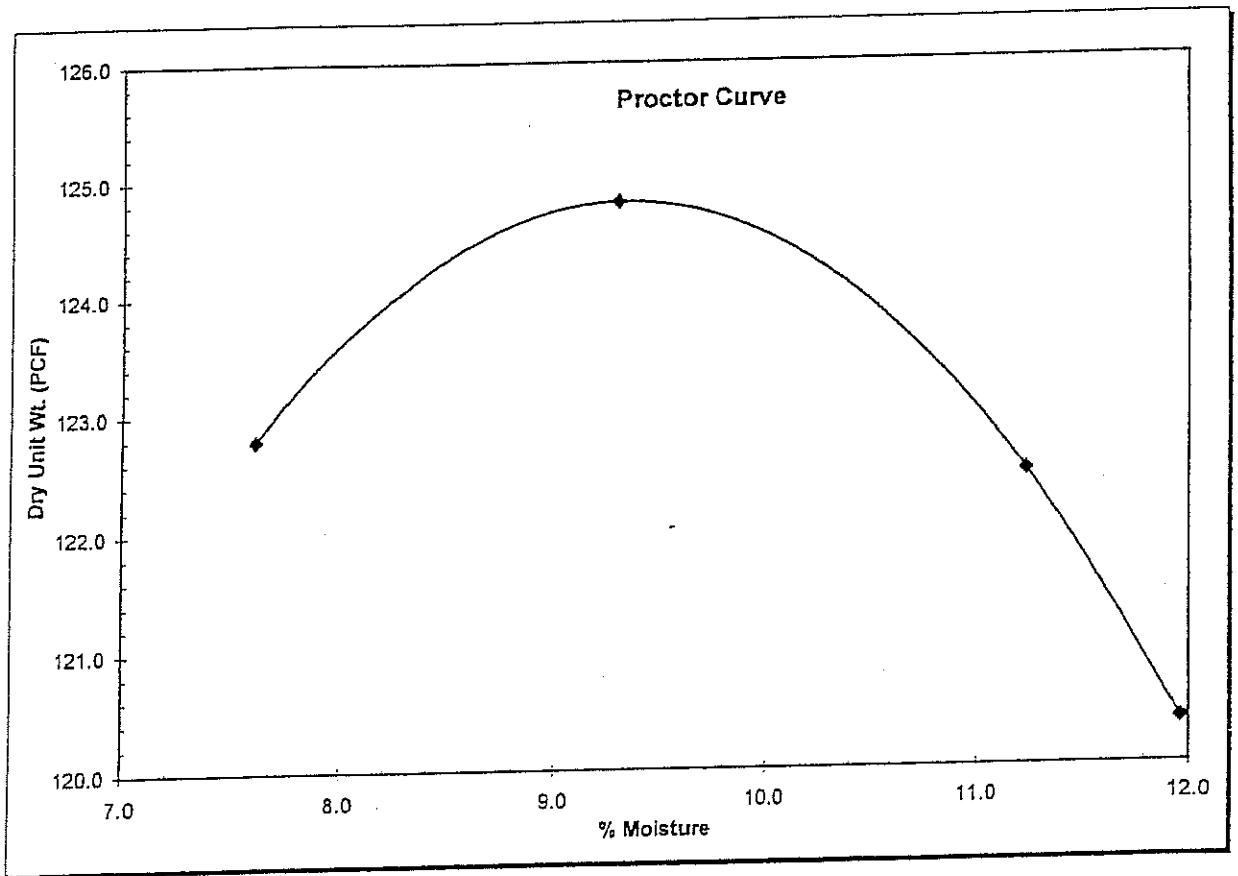
Date: 11/30/2006

Proctor Test Results

Soil Classification:	Gray Coarse Refuse
Maximum Dry Density (PCF)	124.8
Optimum Moisture Content (%)	9.3

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
7.6	122.8
11.2	122.5
12.0	120.4
9.3	124.8



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Permeability Tests Results

Laboratory Tests
Coarse Refuse
Pond Creek Mine - Johnston City, Illinois

Date: 11/30/2006

Client: Pond Creek Mine
Johnston City, Illinois

Project No.: H-05278

Sample	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse		7.7	11.8	119.3	2 x 10-4

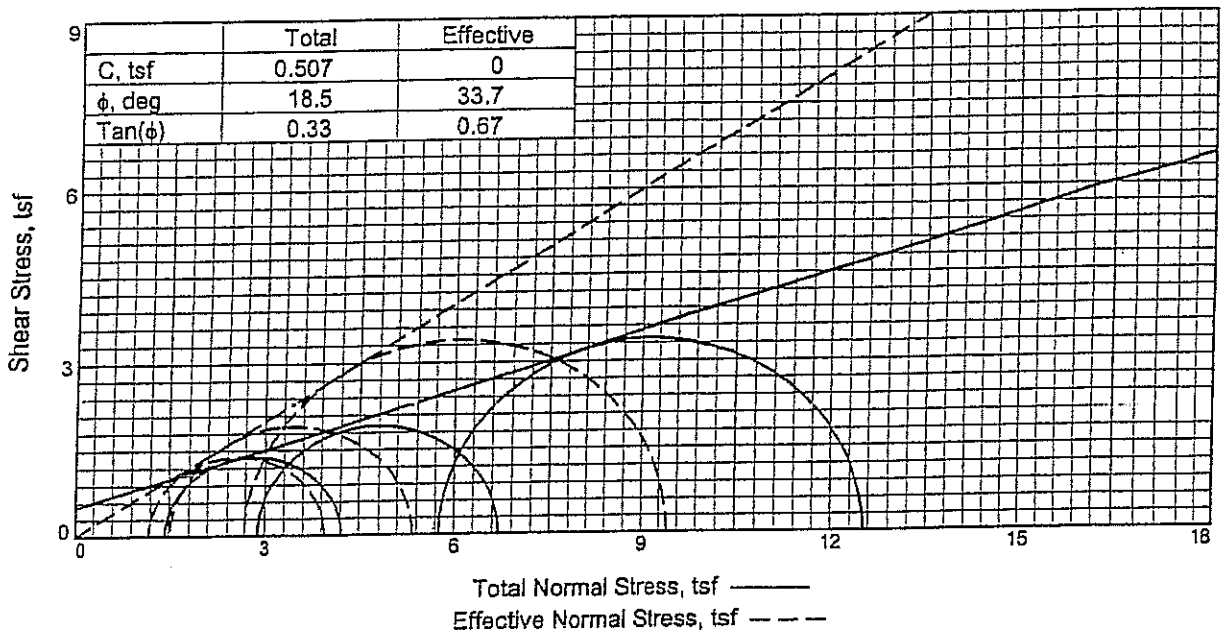
Permeability Tests performed in accordance with ASTM D-5084

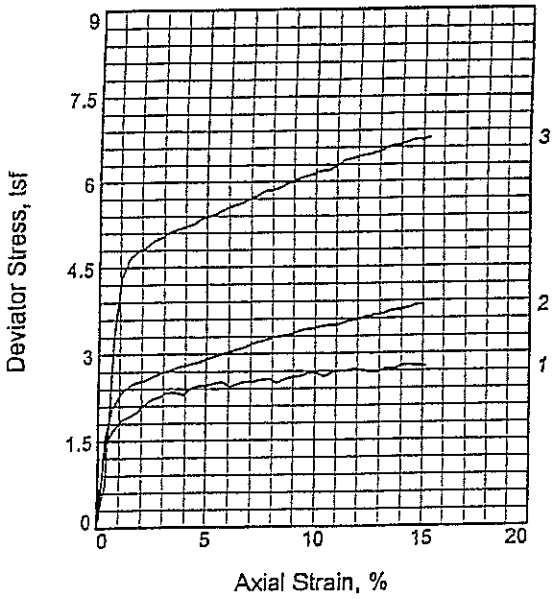
PERMEABILITY TEST RESULTS

Project	Pond Creek Mine	Boring/Sample Depth	Coarse Refuse
#	H-05278	Classification	
Date	11/30/2006	Diameter	2.8 Inch
		Length	5.6 Inch

In Place Mc		After Test Mc		Unit Weight (PCF)	
Wet Wt.	195.3	Wet Wt.	1300.4	Sample Wt.	1161.8
Pan	94.2	Pan	103.1		
Dry Wt.	188.1	Dry Wt.	1173.6	Wet UW=	128.5
Mc (%)	7.7	Mc (%)	11.8	Dry UW=	119.3

Time(hrs)	Time(min)	Quantity (cc)	Head (psi)		Permeability (cm/sec)
7	26	24.7			
7	34	8.2	1		1.75E-04
7	33	24.5			
7	45	2.7	1		1.54E-04
7	47	0.8	1		1.44E-04
9	16	24.4			
9	23	9.6	1		1.79E-04
9	30	0.9	1		1.43E-04
=					
			Average Permeability		1.63E-04





Sample No.		1	2	3
Initial	Water Content,	10.1	10.8	10.3
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	97.0	99.8	99.3
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
At Test	Water Content,	10.4	10.8	10.4
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
Strain rate, in./min.		0.01	0.01	0.01
Back Pressure, tsf		3.60	3.60	2.16
Cell Pressure, tsf		5.04	6.48	7.92
Fail. Stress, tsf		2.78	3.83	6.76
Total Pore Pr., tsf		3.86	4.96	5.23
Ult. Stress, tsf		2.77	3.83	6.76
Total Pore Pr., tsf		3.85	4.95	5.23
$\bar{\sigma}_1$ Failure, tsf		3.96	5.35	9.44
$\bar{\sigma}_3$ Failure, tsf		1.18	1.52	2.69

Type of Test:
CU with Pore Pressures
Sample Type: Remolded
Description: Coarse Coal Refuse

Assumed Specific Gravity= 2.37
Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

Location: Coarse Refuse Stockpile
Sample Number: Coarse Refuse
Proj. No.: H-05278 **Date:** 11/17/06

TRIAXIAL SHEAR TEST REPORT

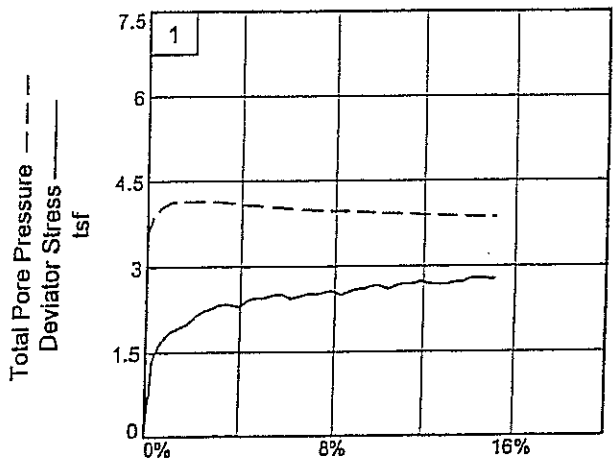
HOLCOMB FOUNDATION ENGINEERING CO.

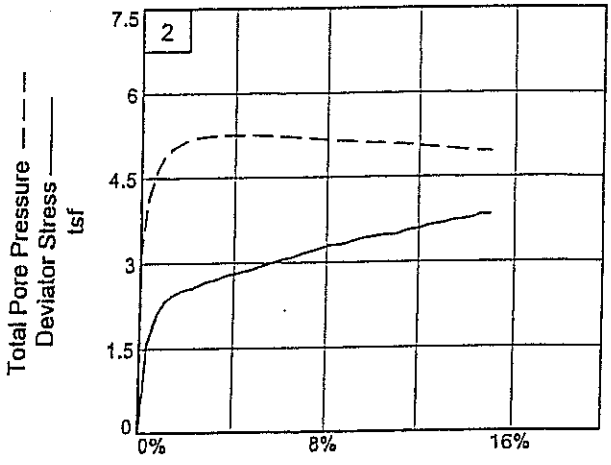
Plate _____

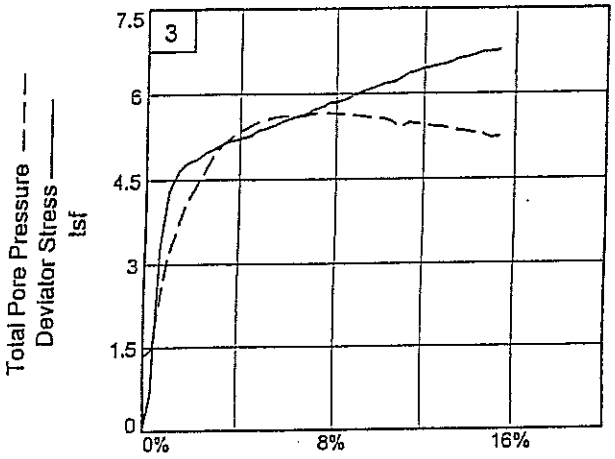
Tested By: LC Checked By: TH

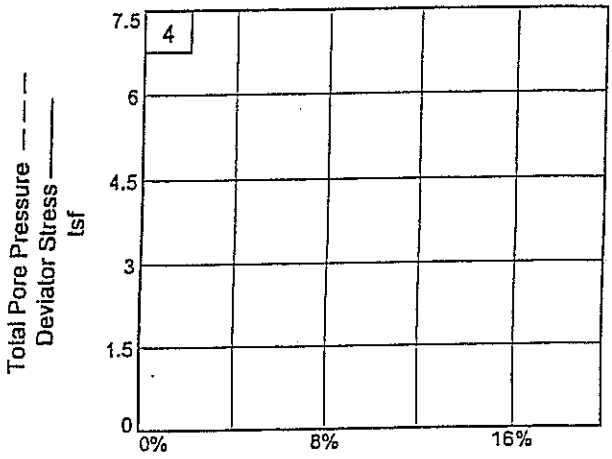
27 of 57 (21)

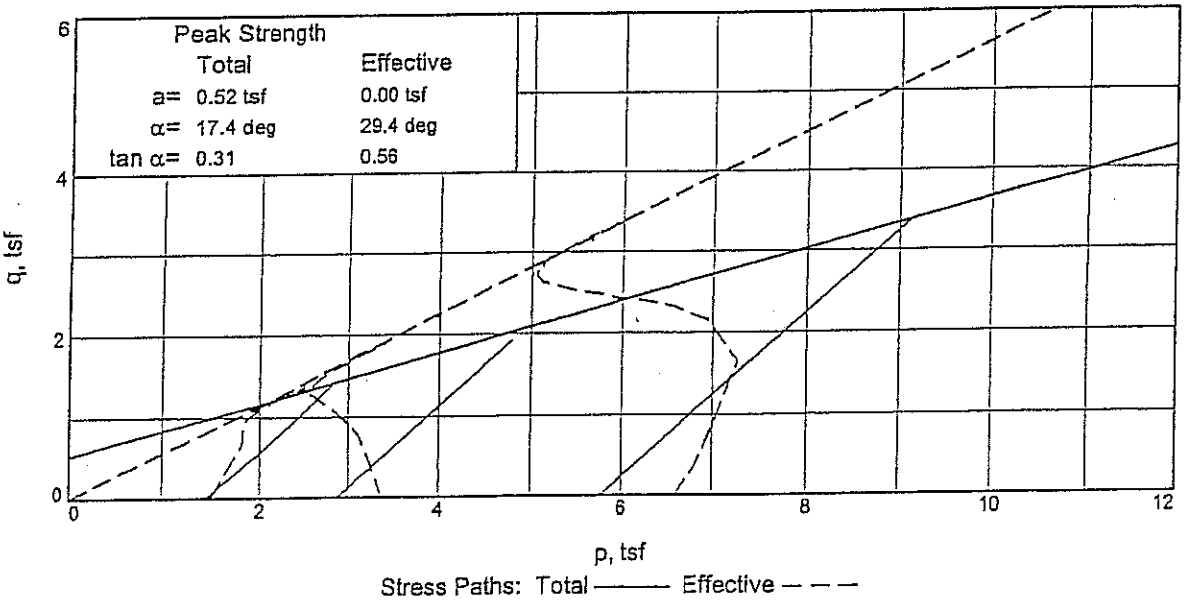
R14785











Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Coarse Refuse Stockpile
Project No.: H-05278

Sample Number: Coarse Refuse
Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC **Checked By:** TH

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

11/30/2006
10:19 AM

Date:	11/17/06
Client:	Pond Creek Mine
Project:	Coarse Refuse Laboratory Tests
Location:	Coarse Refuse Stockpile
Sample Number:	Coarse Refuse
Description:	Coarse Coal Refuse
Remarks:	
Type of Sample:	Remolded
Assumed Specific Gravity=2.37	**LL=** **PL=** **PI=**
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	226.800			1320.700
Moisture content: Dry soil+tare, gms.	218.600			1195.800
Moisture content: Tare, gms.	137.500			107.600
Moisture, %	10.1	10.4	10.4	11.5
Moist specimen weight, gms.	1193.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.65	5.65	5.65	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.6	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2470	0.2470	0.2470	
Saturation, %	97.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 2.778 tsf at reading no. 41
Ult. Stress = 2.767 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0010	46.60	0.0	0.0	0.000	1.498	1.498	1.00	49.20	1.498	0.000
1	0.0180	160.60	114.0	0.3	1.329	1.152	2.481	2.15	54.00	1.816	0.664
2	0.0390	189.70	143.1	0.7	1.662	1.001	2.663	2.66	56.10	1.832	0.831
3	0.0590	205.60	159.0	1.0	1.840	0.929	2.769	2.98	57.10	1.849	0.920
4	0.0800	212.20	165.6	1.4	1.909	0.907	2.816	3.10	57.40	1.862	0.955
5	0.1000	218.90	172.3	1.8	1.979	0.900	2.879	3.20	57.50	1.890	0.990
6	0.1200	232.20	185.6	2.1	2.125	0.900	3.025	3.36	57.50	1.962	1.062
7	0.1410	240.50	193.9	2.5	2.211	0.907	3.118	3.44	57.40	2.013	1.106
8	0.1610	245.50	198.9	2.8	2.260	0.914	3.174	3.47	57.30	2.044	1.130
9	0.1820	252.20	205.6	3.2	2.327	0.922	3.249	3.53	57.20	2.085	1.164
10	0.2020	253.80	207.2	3.6	2.337	0.936	3.273	3.50	57.00	2.104	1.168
11	0.2230	250.50	203.9	3.9	2.291	0.958	3.248	3.39	56.70	2.103	1.145
12	0.2430	261.30	214.7	4.3	2.403	0.972	3.375	3.47	56.50	2.173	1.201
13	0.2630	266.30	219.7	4.6	2.450	0.979	3.429	3.50	56.40	2.204	1.225
14	0.2840	266.30	219.7	5.0	2.440	0.994	3.434	3.46	56.20	2.214	1.220
15	0.3040	272.10	225.5	5.4	2.495	1.008	3.503	3.48	56.00	2.256	1.248
16	0.3250	274.60	228.0	5.7	2.513	1.022	3.536	3.46	55.80	2.279	1.257
17	0.3450	268.00	221.4	6.1	2.431	1.037	3.468	3.34	55.60	2.252	1.216
18	0.3660	273.00	226.4	6.5	2.476	1.051	3.527	3.36	55.40	2.289	1.238
19	0.3860	278.00	231.4	6.8	2.521	1.058	3.580	3.38	55.30	2.319	1.261
20	0.4070	278.00	231.4	7.2	2.511	1.066	3.577	3.36	55.20	2.321	1.256
21	0.4270	283.00	236.4	7.5	2.556	1.073	3.629	3.38	55.10	2.351	1.278
22	0.4470	284.60	238.0	7.9	2.563	1.080	3.643	3.37	55.00	2.362	1.282
23	0.4680	278.80	232.2	8.3	2.491	1.087	3.578	3.29	54.90	2.333	1.245
24	0.4880	286.30	239.7	8.6	2.561	1.087	3.648	3.36	54.90	2.368	1.281
25	0.5090	290.40	243.8	9.0	2.594	1.094	3.689	3.37	54.80	2.392	1.297
26	0.5290	292.10	245.5	9.3	2.602	1.102	3.704	3.36	54.70	2.403	1.301
27	0.5500	298.80	252.2	9.7	2.662	1.109	3.771	3.40	54.60	2.440	1.331
28	0.5700	299.60	253.0	10.1	2.660	1.116	3.776	3.38	54.50	2.446	1.330
29	0.5910	294.60	248.0	10.4	2.597	1.116	3.713	3.33	54.50	2.415	1.299
30	0.6110	302.10	255.5	10.8	2.665	1.123	3.788	3.37	54.40	2.456	1.333
31	0.6310	306.30	259.7	11.2	2.698	1.130	3.828	3.39	54.30	2.479	1.349
32	0.6520	306.30	259.7	11.5	2.687	1.130	3.817	3.38	54.30	2.474	1.343
33	0.6720	312.10	265.5	11.9	2.736	1.145	3.881	3.39	54.10	2.513	1.368
34	0.6930	309.60	263.0	12.2	2.699	1.145	3.843	3.36	54.10	2.494	1.349
35	0.7130	308.80	262.2	12.6	2.680	1.152	3.832	3.33	54.00	2.492	1.340
36	0.7340	309.60	263.0	13.0	2.676	1.159	3.835	3.31	53.90	2.497	1.338
37	0.7540	315.40	268.8	13.3	2.724	1.166	3.891	3.34	53.80	2.528	1.362
38	0.7750	316.20	269.6	13.7	2.721	1.166	3.887	3.33	53.80	2.527	1.360
39	0.7950	323.70	277.1	14.1	2.785	1.181	3.966	3.36	53.60	2.573	1.392
40	0.8150	325.40	278.8	14.4	2.790	1.181	3.971	3.36	53.60	2.576	1.395
41	0.8360	325.40	278.8	14.8	2.778	1.181	3.959	3.35	53.60	2.570	1.389
42	0.8560	325.40	278.8	15.1	2.767	1.188	3.955	3.33	53.50	2.571	1.383

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	211.600			1335.900
Moisture content: Dry soil+tare, gms.	203.200			1222.200
Moisture content: Tare, gms.	125.200			134.800
Moisture, %	10.8	10.8	10.8	10.5
Moist specimen weight, gms.	1175.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.57	5.57	5.57	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.5	130.5	130.5	
Dry density, pcf	117.8	117.8	117.8	
Void ratio	0.2558	0.2558	0.2558	
Saturation, %	99.8	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 3.829 tsf at reading no. 40
Ult. Stress = 3.828 tsf at reading no. 41

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	51.60	0.0	0.0	0.000	3.377	3.377	1.00	43.10	3.377	0.000
1	0.0190	185.60	134.0	0.3	1.562	2.340	3.902	1.67	57.50	3.121	0.781
2	0.0400	233.00	181.4	0.7	2.106	1.814	3.920	2.16	64.80	2.867	1.053
3	0.0600	253.00	201.4	1.1	2.330	1.562	3.892	2.49	68.30	2.727	1.165
4	0.0810	263.80	212.2	1.5	2.445	1.433	3.878	2.71	70.10	2.655	1.223
5	0.1010	270.50	218.9	1.8	2.513	1.346	3.860	2.87	71.30	2.603	1.257
6	0.1220	274.60	223.0	2.2	2.550	1.289	3.839	2.98	72.10	2.564	1.275
7	0.1420	281.30	229.7	2.5	2.617	1.260	3.877	3.08	72.50	2.569	1.309
8	0.1620	287.10	235.5	2.9	2.674	1.238	3.912	3.16	72.80	2.575	1.337
9	0.1830	291.30	239.7	3.3	2.711	1.231	3.942	3.20	72.90	2.587	1.355
10	0.2030	297.10	245.5	3.6	2.766	1.224	3.990	3.26	73.00	2.607	1.383
11	0.2240	301.30	249.7	4.0	2.802	1.224	4.026	3.29	73.00	2.625	1.401
12	0.2440	305.40	253.8	4.4	2.838	1.224	4.062	3.32	73.00	2.643	1.419
13	0.2650	309.60	258.0	4.8	2.873	1.224	4.097	3.35	73.00	2.661	1.437
14	0.2850	315.40	263.8	5.1	2.927	1.231	4.158	3.38	72.90	2.695	1.463
15	0.3060	320.40	268.8	5.5	2.970	1.238	4.209	3.40	72.80	2.724	1.485
16	0.3260	326.20	274.6	5.9	3.023	1.246	4.269	3.43	72.70	2.757	1.512
17	0.3460	330.40	278.8	6.2	3.058	1.253	4.310	3.44	72.60	2.782	1.529
18	0.3670	334.60	283.0	6.6	3.091	1.267	4.358	3.44	72.40	2.813	1.546
19	0.3870	341.20	289.6	6.9	3.151	1.282	4.433	3.46	72.20	2.857	1.576
20	0.4080	346.20	294.6	7.3	3.192	1.296	4.488	3.46	72.00	2.892	1.596
21	0.4280	351.20	299.6	7.7	3.234	1.310	4.544	3.47	71.80	2.927	1.617

No.	Def. Dial In.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	357.00	305.4	8.1	3.283	1.318	4.601	3.49	71.70	2.959	1.642
23	0.4690	359.50	307.9	8.4	3.297	1.332	4.629	3.48	71.50	2.981	1.649
24	0.4890	362.80	311.2	8.8	3.319	1.339	4.659	3.48	71.40	2.999	1.660
25	0.5100	368.70	317.1	9.2	3.368	1.346	4.715	3.50	71.30	3.031	1.684
26	0.5300	374.50	322.9	9.5	3.416	1.361	4.777	3.51	71.10	3.069	1.708
27	0.5510	377.00	325.4	9.9	3.429	1.368	4.797	3.51	71.00	3.082	1.714
28	0.5710	381.20	329.6	10.2	3.459	1.368	4.827	3.53	71.00	3.098	1.730
29	0.5920	384.50	332.9	10.6	3.479	1.382	4.861	3.52	70.80	3.122	1.739
30	0.6120	386.20	334.6	11.0	3.483	1.390	4.872	3.51	70.70	3.131	1.741
31	0.6330	392.00	340.4	11.4	3.528	1.397	4.925	3.53	70.60	3.161	1.764
32	0.6530	397.00	345.4	11.7	3.565	1.411	4.977	3.53	70.40	3.194	1.783
33	0.6730	400.30	348.7	12.1	3.585	1.426	5.010	3.51	70.20	3.218	1.792
34	0.6940	406.10	354.5	12.5	3.629	1.440	5.069	3.52	70.00	3.254	1.814
35	0.7140	410.30	358.7	12.8	3.657	1.454	5.111	3.51	69.80	3.283	1.828
36	0.7350	413.60	362.0	13.2	3.674	1.469	5.143	3.50	69.60	3.306	1.837
37	0.7550	420.30	368.7	13.6	3.727	1.483	5.210	3.51	69.40	3.347	1.863
38	0.7760	423.60	372.0	13.9	3.744	1.498	5.242	3.50	69.20	3.370	1.872
39	0.7960	427.80	376.2	14.3	3.770	1.505	5.275	3.51	69.10	3.390	1.885
40	0.8170	435.30	383.7	14.7	3.829	1.519	5.348	3.52	68.90	3.434	1.914
41	0.8370	436.90	385.3	15.0	3.828	1.526	5.355	3.51	68.80	3.441	1.914

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	184.300			1333.800
Moisture content: Dry soil+tare, gms.	177.100			1230.400
Moisture content: Tare, gms.	107.500			135.300
Moisture, %	10.3	10.4	10.4	9.4
Moist specimen weight, gms.	1185.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.60	5.60	5.60	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.9	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2468	0.2468	0.2468	
Saturation, %	99.3	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 6.758 tsf at reading no. 42
Ult. Stress = 6.758 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	25.00	0.0	0.0	0.000	6.588	6.588	1.00	18.50	6.588	0.000
1	0.0190	88.20	63.2	0.3	0.736	6.458	7.195	1.11	20.30	6.827	0.368
2	0.0400	309.60	284.6	0.7	3.304	5.623	8.927	1.59	31.90	7.275	1.652
3	0.0600	397.00	372.0	1.1	4.303	4.795	9.098	1.90	43.40	6.947	2.152
4	0.0810	428.60	403.6	1.4	4.651	4.234	8.885	2.10	51.20	6.559	2.326
5	0.1010	441.90	416.9	1.8	4.787	3.830	8.617	2.25	56.80	6.224	2.393
6	0.1220	449.40	424.4	2.2	4.854	3.521	8.375	2.38	61.10	5.948	2.427
7	0.1420	460.20	435.2	2.5	4.960	3.283	8.243	2.51	64.40	5.763	2.480
8	0.1620	467.70	442.7	2.9	5.027	3.017	8.044	2.67	68.10	5.530	2.513
9	0.1830	476.00	451.0	3.3	5.101	2.837	7.938	2.80	70.60	5.387	2.551
10	0.2030	483.50	458.5	3.6	5.167	2.693	7.860	2.92	72.60	5.276	2.583
11	0.2240	489.30	464.3	4.0	5.212	2.585	7.797	3.02	74.10	5.191	2.606
12	0.2440	495.20	470.2	4.4	5.258	2.491	7.750	3.11	75.40	5.120	2.629
13	0.2650	505.20	480.2	4.7	5.349	2.419	7.768	3.21	76.40	5.094	2.675
14	0.2850	511.00	486.0	5.1	5.394	2.369	7.762	3.28	77.10	5.066	2.697
15	0.3060	518.50	493.5	5.5	5.455	2.333	7.788	3.34	77.60	5.060	2.728
16	0.3260	526.80	501.8	5.8	5.526	2.304	7.830	3.40	78.00	5.067	2.763
17	0.3460	533.50	508.5	6.2	5.579	2.297	7.875	3.43	78.10	5.086	2.789
18	0.3670	539.30	514.3	6.6	5.620	2.326	7.945	3.42	77.70	5.135	2.810
19	0.3870	548.40	523.4	6.9	5.697	2.275	7.972	3.50	78.40	5.124	2.849
20	0.4080	555.90	530.9	7.3	5.756	2.261	8.016	3.55	78.60	5.139	2.878
21	0.4280	565.90	540.9	7.6	5.841	2.261	8.102	3.58	78.60	5.181	2.921

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	569.20	544.2	8.0	5.853	2.268	8.121	3.58	78.50	5.195	2.927
23	0.4690	575.10	550.1	8.4	5.894	2.282	8.176	3.58	78.30	5.229	2.947
24	0.4890	584.20	559.2	8.7	5.968	2.297	8.265	3.60	78.10	5.281	2.984
25	0.5100	592.50	567.5	9.1	6.031	2.311	8.343	3.61	77.90	5.327	3.016
26	0.5300	599.20	574.2	9.5	6.079	2.333	8.411	3.61	77.60	5.372	3.039
27	0.5510	605.90	580.9	9.8	6.124	2.354	8.479	3.60	77.30	5.416	3.062
28	0.5710	613.30	588.3	10.2	6.178	2.362	8.539	3.62	77.20	5.450	3.089
29	0.5920	617.50	592.5	10.6	6.196	2.405	8.601	3.58	76.60	5.503	3.098
30	0.6120	626.70	601.7	10.9	6.267	2.527	8.794	3.48	74.90	5.661	3.133
31	0.6330	638.30	613.3	11.3	6.361	2.426	8.787	3.62	76.30	5.607	3.180
32	0.6530	644.10	619.1	11.7	6.395	2.448	8.843	3.61	76.00	5.646	3.198
33	0.6730	650.80	625.8	12.0	6.438	2.477	8.915	3.60	75.60	5.696	3.219
34	0.6940	656.60	631.6	12.4	6.470	2.498	8.968	3.59	75.30	5.733	3.235
35	0.7140	662.50	637.5	12.8	6.504	2.506	9.009	3.60	75.20	5.758	3.252
36	0.7350	669.10	644.1	13.1	6.543	2.542	9.085	3.57	74.70	5.813	3.271
37	0.7550	678.30	653.3	13.5	6.609	2.563	9.172	3.58	74.40	5.868	3.305
38	0.7760	684.10	659.1	13.9	6.639	2.585	9.224	3.57	74.10	5.904	3.319
39	0.7960	690.70	665.7	14.2	6.678	2.614	9.291	3.55	73.70	5.952	3.339
40	0.8170	699.10	674.1	14.6	6.732	2.635	9.367	3.55	73.40	6.001	3.366
41	0.8370	701.60	676.6	14.9	6.729	2.700	9.429	3.49	72.50	6.065	3.365
42	0.8570	707.40	682.4	15.3	6.758	2.686	9.444	3.52	72.70	6.065	3.379

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

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Carbondale, IL 62901

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P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

April 9, 2007

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Mach Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on March 29, 2007, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification:	Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)
Proctor Test Results:	
Maximum Dry Unit Weight:	120.3 PCF
Optimum Moisture Content:	10.7 %
Specific Gravity:	2.50
Triaxial Test Results:	
Effective Cohesion:	152 PSF
Effective Phi Angle:	29.3 Degrees
Permeability (2 tests):	3 x 10-4 cm./sec.
	2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting



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Permeability Tests Results

Mach Mine
Johnston City, Illinois

Date: 4/9/2007 Client: Williamson Energy

Project No.: H-05278

Boring No.	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse Sample #1		10.9	14.6	115.7	3 x 10-4
Coarse Refuse Sample #2		10.1	14.3	114.7	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

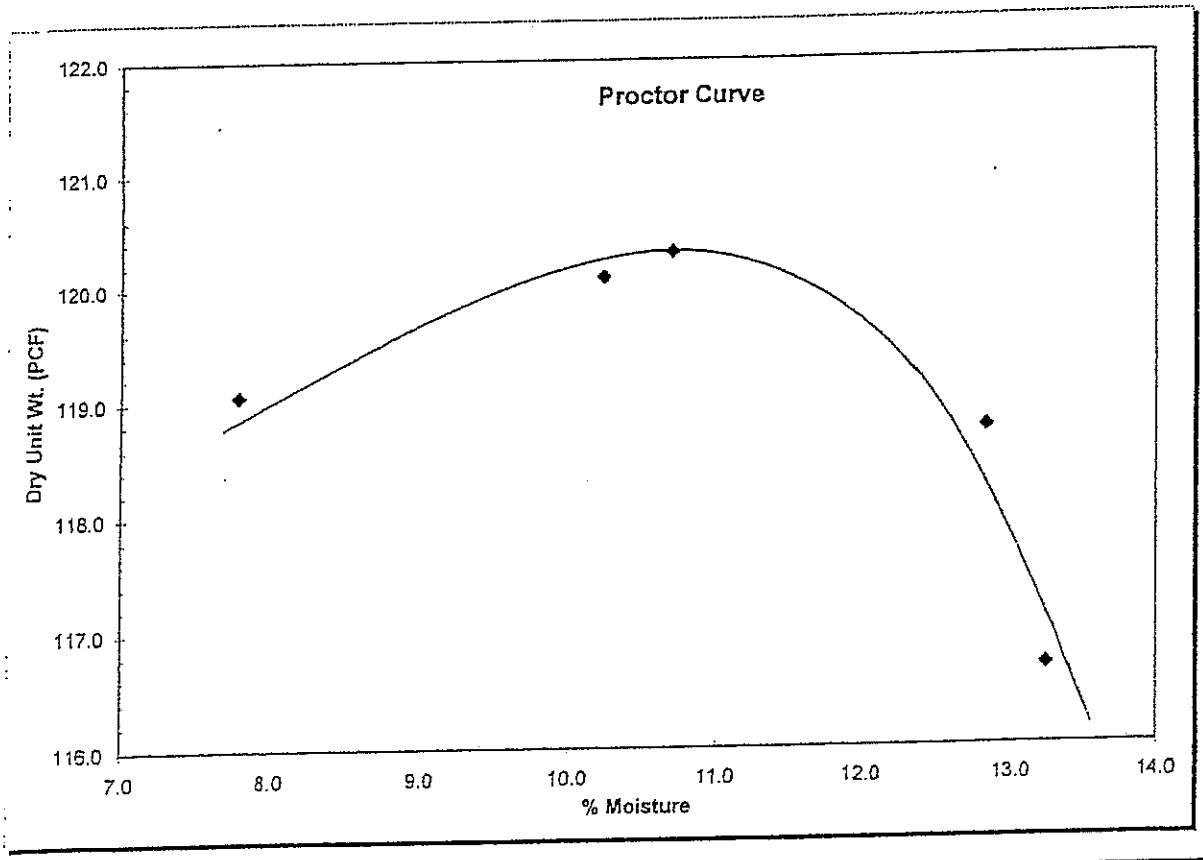
Date: 4/9/2007

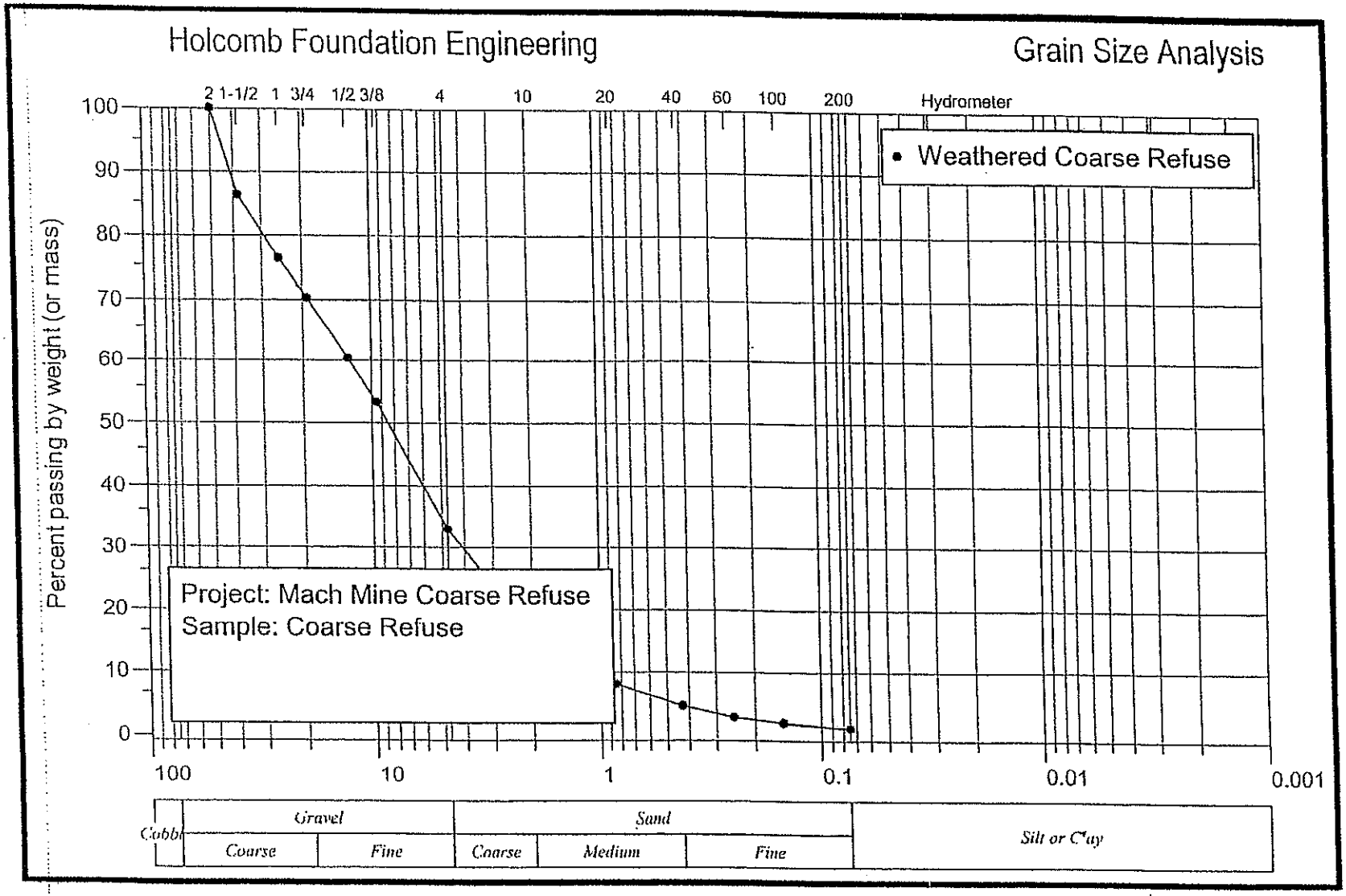
Proctor Test Results

Soil Classification:	**Weathered Coarse Refuse**
Maximum Dry Density (PCF)	**120.3**
Optimum Moisture Content (%)	**10.7**

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
12.8	118.7
13.2	116.7
10.2	120.1
7.8	119.1
10.7	120.3




Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Weathered Coarse Refuse
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
Project: Mach Mine Coarse Refuse
Sample: Coarse Refuse
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

R14796

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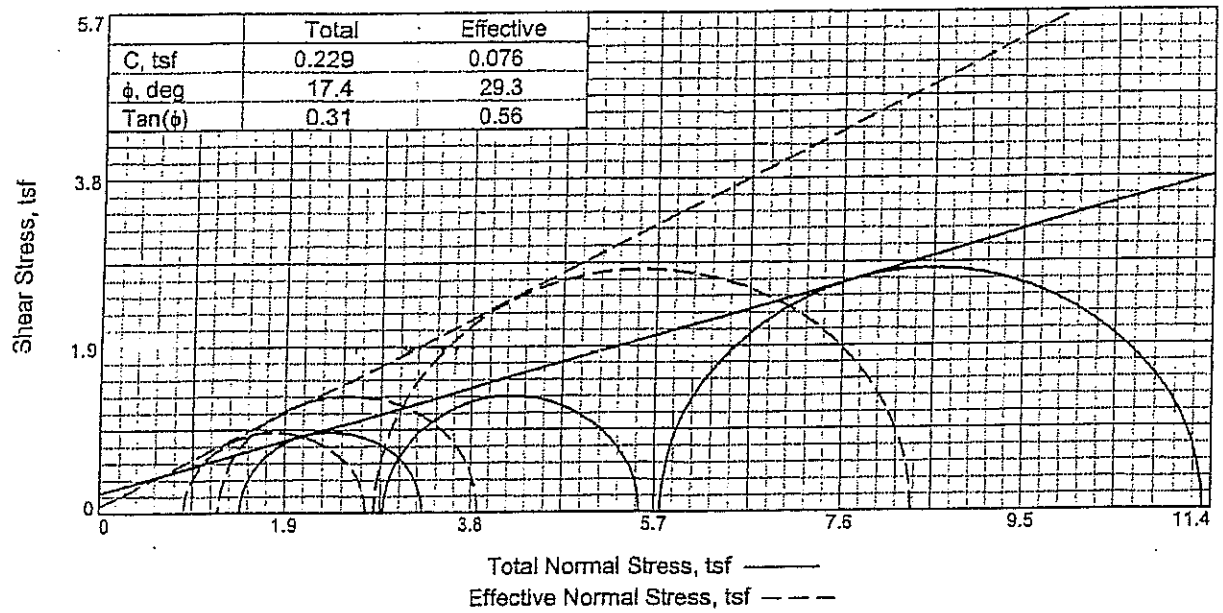
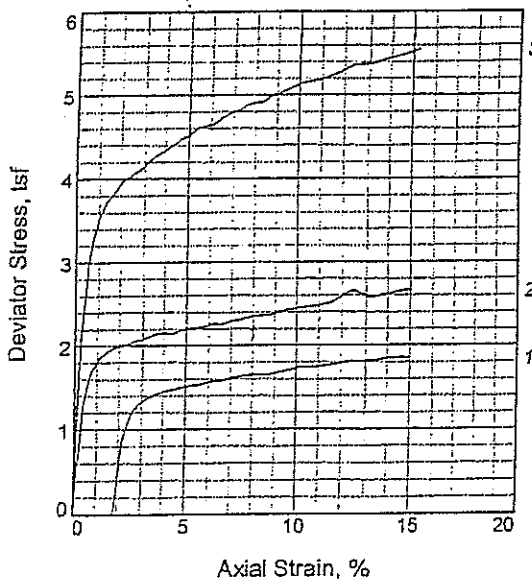
Grain Size Analysis

Project:	Mach Mine	Client:	Mach Mine
Project No.:	H-05278	Date:	4/9/2007
Sample No.	Coarse Refuse	Total Weight:	2290.30

Sieve	Wt. Retained	% Ret.	% Passing
2"	0.0	0.0	100.0
1.5"	314.4	13.7	86.3
1"	536.7	23.4	76.6
3/4"	674.8	29.5	70.5
1/2"	901.6	39.4	60.6
3/8"	1061.2	46.3	53.7
#4	1522.1	66.5	33.5
#10	1911.6	83.5	16.5
#20	2091.9	91.3	8.7
#40	2166.2	94.6	5.4
#60	2202.2	96.2	3.8
#100	2223.7	97.1	2.9
#200	2245.2	98.0	2.0

R14798





Sample No.		1	2	3
Initial	Water Content,	14.4	12.7	13.1
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	95.1	89.0	90.4
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
At Test	Water Content,	15.2	14.2	14.5
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.60	3.60	1.80
Cell Pressure, tsf		5.04	6.48	7.56
Fail. Stress, tsf		1.85	2.67	5.55
Total Pore Pr., tsf		4.18	5.27	4.77
Ult. Stress, tsf		1.85	2.66	5.55
Total Pore Pr., tsf		4.18	5.22	4.77
$\bar{\sigma}_1$ Failure, tsf		2.71	3.88	8.34
$\bar{\sigma}_3$ Failure, tsf		0.86	1.21	2.79

Type of Test:
CU with Pore Pressures
Sample Type: Coarse Refuse
Description:

Assumed Specific Gravity= 2.50
Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

Location: Weathered Coarse Refuse

Proj. No.: H-05278 **Date:** 4/2/07

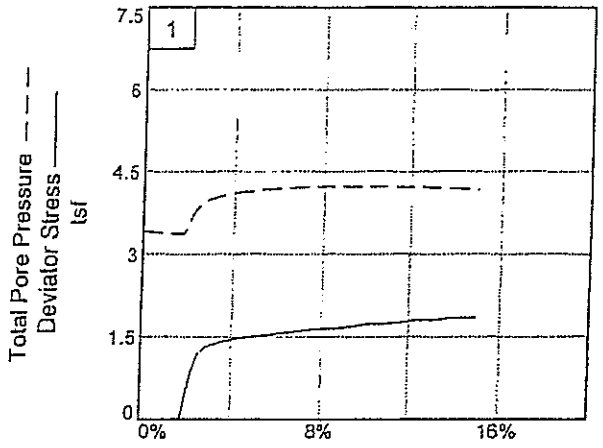
TRIAXIAL SHEAR TEST REPORT

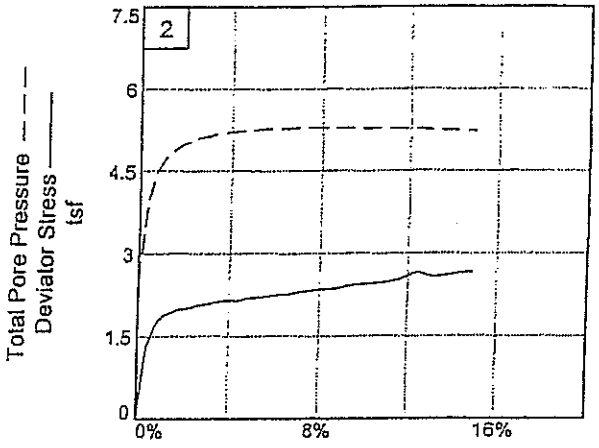
HOLCOMB FOUNDATION ENGINEERING CO.

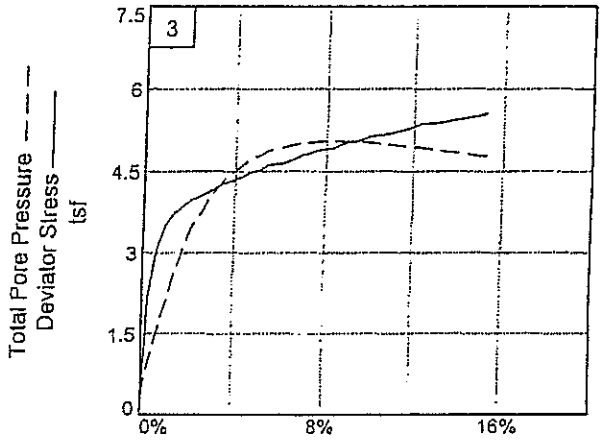
Plate _____

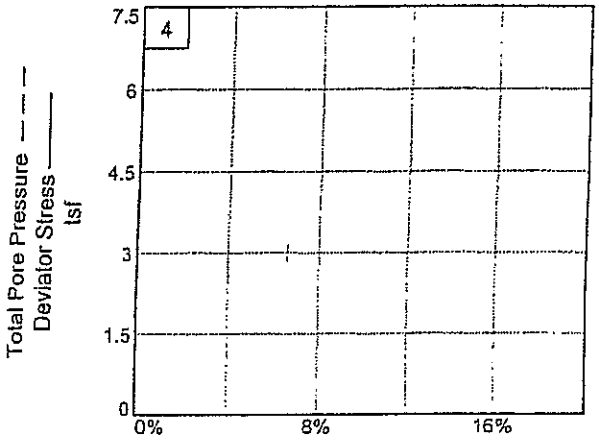
Tested By: LC Checked By: TH

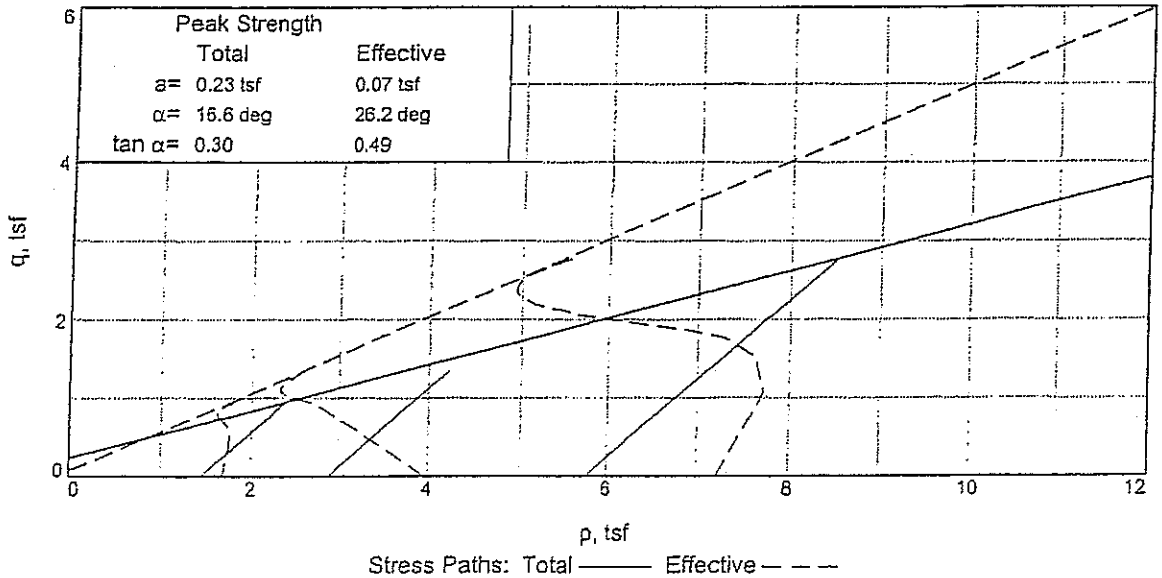
R14799











Stress Paths: Total ——— Effective — – —

Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Weathered Coarse Refuse
Project No.: H-05278

Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

4/9/2007
11:10 AM

Date: 4/2/07
Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Weathered Coarse Refuse
Description:
Remarks:
Type of Sample: Coarse Refuse
Assumed Specific Gravity=2.50 LL= PL= PI=
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	179.300			1255.500
Moisture content: Dry soil+tare, gms.	165.700			1117.500
Moisture content: Tare, gms.	71.400			79.600
Moisture, %	14.4	15.2	15.2	13.3
Moist specimen weight, gms.	1170.0			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.59	5.59	5.59	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.5	130.3	130.3	
Dry density, pcf	113.2	113.2	113.2	
Void ratio	0.3793	0.3793	0.3793	
Saturation, %	95.1	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.845 tsf at reading no. 31
Ult. Stress = 1.845 tsf at reading no. 31

Test Results for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	19.10	0.0	0.0	0.000	1.627	1.627	1.00	47.40	1.627	0.000
1	0.0190	20.00	0.9	0.3	0.001	1.642	1.642	1.00	47.20	1.642	0.000
2	0.0400	20.00	0.9	0.7	0.000	1.656	1.656	1.00	47.00	1.656	0.000
3	0.0600	20.00	0.9	1.1	0.000	1.663	1.663	1.00	46.90	1.663	0.000
4	0.0810	20.00	0.9	1.4	0.000	1.678	1.678	1.00	46.70	1.678	0.000
5	0.1010	25.00	5.9	1.8	0.017	1.678	1.694	1.01	46.70	1.686	0.008
6	0.1220	99.00	79.9	2.2	0.857	1.318	2.175	1.65	51.70	1.746	0.429
7	0.1420	124.00	104.9	2.5	1.195	1.152	2.347	2.04	54.00	1.750	0.598
8	0.1620	134.80	115.7	2.9	1.314	1.058	2.372	2.24	55.30	1.715	0.657
9	0.1830	140.60	121.5	3.3	1.374	1.001	2.375	2.37	56.10	1.688	0.687
10	0.2030	144.80	125.7	3.6	1.416	0.965	2.381	2.47	56.60	1.673	0.708
11	0.2240	148.10	129.0	4.0	1.448	0.936	2.384	2.55	57.00	1.660	0.724
12	0.2440	150.60	131.5	4.4	1.471	0.914	2.385	2.61	57.30	1.650	0.735
13	0.2650	153.10	134.0	4.7	1.493	0.900	2.393	2.66	57.50	1.646	0.746
14	0.2850	155.60	136.5	5.1	1.515	0.878	2.393	2.72	57.80	1.636	0.757
15	0.3060	157.30	138.2	5.5	1.528	0.864	2.392	2.77	58.00	1.628	0.764
16	0.3260	159.80	140.7	5.8	1.549	0.857	2.406	2.81	58.10	1.631	0.775
17	0.3460	162.30	143.2	6.2	1.571	0.850	2.420	2.85	58.20	1.635	0.785
18	0.3670	163.10	144.0	6.6	1.573	0.835	2.408	2.88	58.40	1.622	0.787
19	0.3870	166.40	147.3	6.9	1.603	0.828	2.431	2.94	58.50	1.630	0.802
20	0.4080	168.90	149.8	7.3	1.624	0.821	2.445	2.98	58.60	1.633	0.812
21	0.4490	172.30	153.2	8.0	1.648	0.814	2.461	3.02	58.70	1.637	0.824
22	0.4890	173.90	154.8	8.7	1.652	0.806	2.458	3.05	58.80	1.632	0.826
23	0.5300	178.90	159.8	9.5	1.691	0.806	2.498	3.10	58.80	1.652	0.846
24	0.5710	184.80	165.7	10.2	1.740	0.814	2.553	3.14	58.70	1.683	0.870
25	0.6120	186.40	167.3	10.9	1.742	0.806	2.549	3.16	58.80	1.677	0.871
26	0.6530	190.60	171.5	11.7	1.771	0.821	2.592	3.16	58.60	1.706	0.886
27	0.6940	195.60	176.5	12.4	1.808	0.821	2.628	3.20	58.60	1.725	0.904
28	0.7350	197.20	178.1	13.1	1.809	0.835	2.644	3.17	58.40	1.740	0.904
29	0.7760	201.40	182.3	13.9	1.836	0.842	2.678	3.18	58.30	1.760	0.918
30	0.8170	204.70	185.6	14.6	1.853	0.857	2.710	3.16	58.10	1.783	0.927
31	0.8370	204.70	185.6	15.0	1.845	0.864	2.709	3.14	58.00	1.787	0.923

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	169.900			1238.700
Moisture content: Dry soil+tare, gms.	158.800			1117.200
Moisture content: Tare, gms.	71.200			73.100
Moisture, %	12.7	14.2	14.2	11.6
Moist specimen weight, gms.	1169.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.7	131.5	131.5	
Dry density, pcf	115.1	115.1	115.1	
Void ratio	0.3560	0.3560	0.3560	
Saturation, %	89.0	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 2.666 tsf at reading no. 27
Ult. Stress = 2.663 tsf at reading no. 31

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	62.40	0.0	0.0	0.000	3.967	3.967	1.00	34.90	3.967	0.000
1	0.0220	173.10	110.7	0.4	1.289	2.484	3.773	1.52	55.50	3.129	0.645
2	0.0420	206.40	144.0	0.8	1.671	2.016	3.687	1.83	62.00	2.852	0.836
3	0.0620	223.00	160.6	1.1	1.857	1.764	3.621	2.05	65.50	2.693	0.929
4	0.0830	230.50	168.1	1.5	1.936	1.613	3.549	2.20	67.60	2.581	0.968
5	0.1030	235.50	173.1	1.8	1.987	1.512	3.499	2.31	69.00	2.505	0.993
6	0.1240	238.00	175.6	2.2	2.008	1.447	3.455	2.39	69.90	2.451	1.004
7	0.1440	242.20	179.8	2.6	2.048	1.390	3.438	2.47	70.70	2.414	1.024
8	0.1650	245.50	183.1	3.0	2.078	1.346	3.424	2.54	71.30	2.385	1.039
9	0.1850	248.80	186.4	3.3	2.107	1.310	3.418	2.61	71.80	2.364	1.054
10	0.2060	252.20	189.8	3.7	2.137	1.289	3.426	2.66	72.10	2.358	1.069
11	0.2260	254.70	192.3	4.0	2.158	1.267	3.425	2.70	72.40	2.346	1.079
12	0.2460	253.80	191.4	4.4	2.139	1.253	3.392	2.71	72.60	2.322	1.070
13	0.2670	258.80	196.4	4.8	2.187	1.238	3.425	2.77	72.80	2.332	1.093
14	0.2870	260.50	198.1	5.1	2.197	1.231	3.428	2.78	72.90	2.330	1.099
15	0.3080	263.00	200.6	5.5	2.216	1.217	3.433	2.82	73.10	2.325	1.108
16	0.3280	265.50	203.1	5.9	2.235	1.210	3.445	2.85	73.20	2.327	1.118
17	0.3490	268.80	206.4	6.3	2.263	1.210	3.472	2.87	73.20	2.341	1.131
18	0.3690	268.80	206.4	6.6	2.254	1.202	3.456	2.87	73.30	2.329	1.127
19	0.3900	273.00	210.6	7.0	2.290	1.195	3.486	2.92	73.40	2.340	1.145
20	0.4100	275.50	213.1	7.3	2.309	1.195	3.504	2.93	73.40	2.350	1.154
21	0.4510	281.30	218.9	8.1	2.353	1.188	3.541	2.98	73.50	2.364	1.176

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4920	284.60	222.2	8.8	2.369	1.195	3.564	2.98	73.40	2.380	1.185
23	0.5330	292.10	229.7	9.6	2.429	1.195	3.625	3.03	73.40	2.410	1.215
24	0.5740	296.30	233.9	10.3	2.454	1.202	3.656	3.04	73.30	2.429	1.227
25	0.6140	300.40	238.0	11.0	2.477	1.202	3.679	3.06	73.30	2.441	1.238
26	0.6440	305.40	243.0	11.5	2.514	1.217	3.730	3.07	73.10	2.474	1.257
27	0.6960	322.90	260.5	12.5	2.666	1.210	3.876	3.20	73.20	2.543	1.333
28	0.7370	316.20	253.8	13.2	2.576	1.238	3.814	3.08	72.80	2.526	1.288
29	0.7780	322.10	259.7	13.9	2.613	1.238	3.852	3.11	72.80	2.545	1.307
30	0.8190	328.70	266.3	14.7	2.657	1.253	3.910	3.12	72.60	2.581	1.328
31	0.8390	330.40	268.0	15.0	2.663	1.260	3.923	3.11	72.50	2.591	1.331

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	171.400			1284.500
Moisture content: Dry soil+tare, gms.	160.000			1180.500
Moisture content: Tare, gms.	72.800			134.900
Moisture, %	13.1	14.5	14.5	9.9
Moist specimen weight, gms.	1168.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.6	131.2	131.2	
Dry density, pcf	114.6	114.6	114.6	
Void ratio	0.3615	0.3615	0.3615	
Saturation, %	90.4	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 105.00 psi (7.560 tsf)
Consolidation back pressure = 25.00 psi (1.800 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 5.549 tsf at reading no. 35
Ult. Stress = 5.549 tsf at reading no. 35

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0020	102.40	0.0	0.0	0.000	7.207	7.207	1.00	4.90	7.207	0.000
1	0.0170	286.30	183.9	0.3	2.145	6.674	8.819	1.32	12.30	7.747	1.072
2	0.0370	364.50	262.1	0.6	3.046	6.113	9.158	1.50	20.10	7.636	1.523
3	0.0580	407.00	304.6	1.0	3.526	5.537	9.063	1.64	28.10	7.300	1.763
4	0.0780	426.10	323.7	1.4	3.733	4.997	8.730	1.75	35.60	6.864	1.867
5	0.0990	437.70	335.3	1.7	3.853	4.536	8.389	1.85	42.00	6.462	1.926
6	0.1190	449.40	347.0	2.1	3.972	4.133	8.105	1.96	47.60	6.119	1.986
7	0.1400	457.70	355.3	2.5	4.052	3.838	7.889	2.06	51.70	5.863	2.026

16 of 31

R14804

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
8	0.1600	464.40	362.0	2.8	4.113	3.593	7.706	2.14	55.10	5.649	2.056
9	0.1810	474.40	372.0	3.2	4.210	3.384	7.594	2.24	58.00	5.489	2.105
10	0.2010	481.90	379.5	3.6	4.279	3.211	7.490	2.33	60.40	5.351	2.140
11	0.2210	487.70	385.3	3.9	4.328	3.074	7.403	2.41	62.30	5.239	2.164
12	0.2420	495.20	392.8	4.3	4.395	2.959	7.355	2.49	63.90	5.157	2.198
13	0.2620	503.50	401.1	4 7	4 471	2.851	7.323	2.57	65.40	5.087	2.236
14	0.2830	509.30	406.9	5.0	4.518	2.772	7.290	2.63	66.50	5.031	2.259
15	0.3030	519.30	416.9	5.4	4.612	2.693	7.305	2.71	67.60	4.999	2.306
16	0.3240	522.60	420.2	5.8	4.630	2.650	7.279	2.75	68.20	4.965	2.315
17	0.3440	526.00	423.6	6.1	4.650	2.621	7.270	2.77	68.60	4.946	2.325
18	0.3650	534.30	431.9	6.5	4.722	2.578	7.299	2.83	69.20	4.938	2.361
19	0.3850	541.80	439.4	6.9	4.785	2.549	7.334	2.88	69.60	4.941	2.393
20	0.4050	546.80	444.4	7.2	4.821	2.534	7.355	2.90	69.80	4.945	2.411
21	0.4260	553.40	451.0	7.6	4.873	2.520	7.393	2.93	70.00	4.956	2.436
22	0.4460	558.40	456.0	8.0	4.908	2.506	7.413	2.96	70.20	4.959	2.454
23	0.4670	560.90	458.5	8.3	4.914	2.506	7.420	2.96	70.20	4.963	2.457
24	0.4870	569.20	466.8	8.7	4.984	2.506	7.489	2.99	70.20	4.997	2.492
25	0.5080	574.20	471.8	9.1	5.016	2.513	7.529	3.00	70.10	5.021	2.508
26	0.5280	580.10	477.7	9.4	5.059	2.520	7.579	3.01	70.00	5.050	2.530
27	0.5690	592.50	490.1	10.2	5.148	2.534	7.683	3.03	69.80	5.109	2.574
28	0.6100	600.00	497.6	10.9	5.184	2.570	7.755	3.02	69.30	5.163	2.592
29	0.6510	610.90	508.5	11.6	5.254	2.599	7.853	3.02	68.90	5.226	2.627
30	0.6920	625.80	523.4	12.4	5.363	2.628	7.991	3.04	68.50	5.310	2.682
31	0.7330	631.70	529.3	13.1	5.378	2.671	8.049	3.01	67.90	5.360	2.689
32	0.7730	641.60	539.2	13.8	5.434	2.707	8.141	3.01	67.40	5.424	2.717
33	0.8140	651.60	549.2	14.6	5.487	2.750	8.238	3.00	66.80	5.494	2.744
34	0.8350	656.60	554.2	14.9	5.513	2.772	8.285	2.99	66.50	5.528	2.756
35	0.8540	662.50	560.1	15.3	5.549	2.786	8.335	2.99	66.30	5.561	2.775

APPENDIX D

Boring Logs

TD 757
R14806

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 8874

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6
Water Content (%)
Standard N Penetration, Blows/Ft.
10 20 30 40 50 60

Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Brown Silty CLAY (CL) with sand and pebbles
5	1	st		
	2	st		
10	3	st		Gray Mottled Brown Silty CLAY (CL)
15	4	st		
	5	st		
20				End of Boring @ -20.0'
25				
30				
35				

ound Water Data
No Ground Water Encountered During Drilling and None Upon Completion.

Mach #1 Mine Soils Investigation
Mach #1 Mine Williamson County Illinois

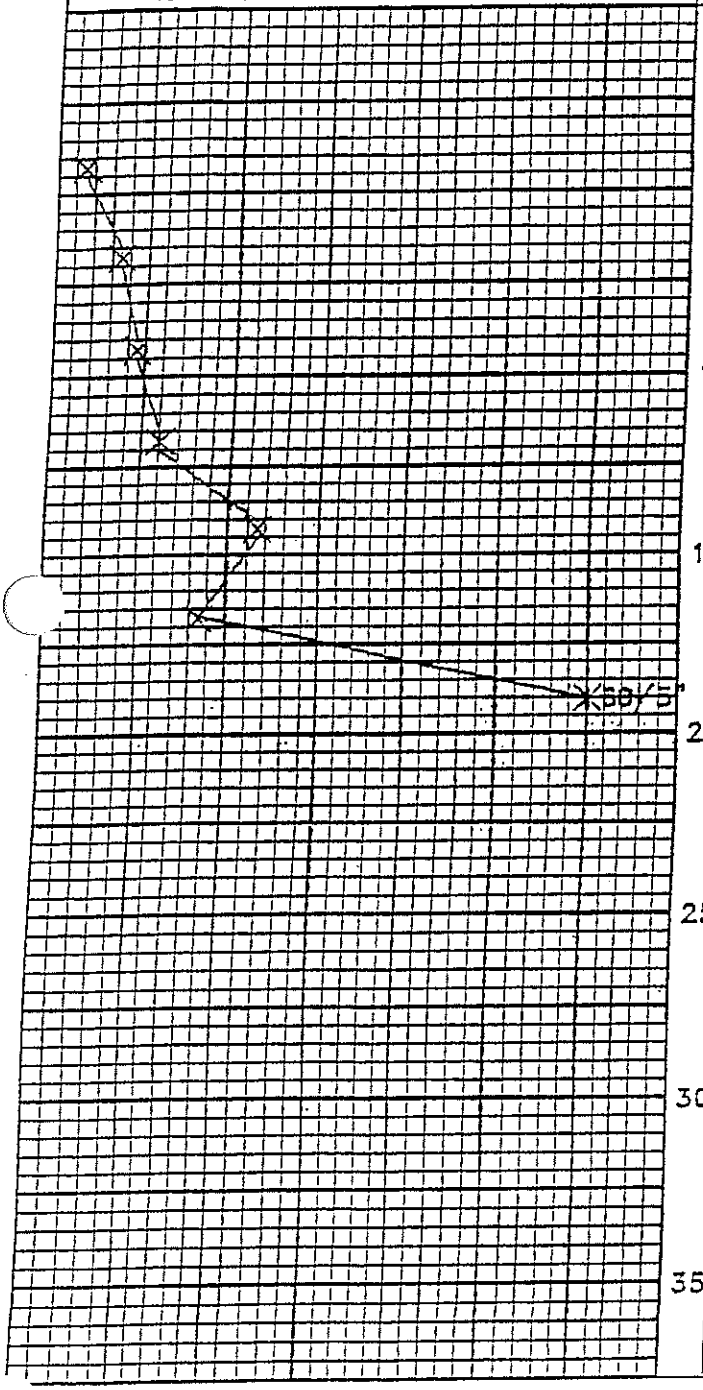
Date of Boring
February 1, 2006

ent:
Alliance Consulting, Inc.
Beaver, West Virginia

Project No.
H-05278

LOG of BORING B293

Holcomb Foundation Engineering Co.



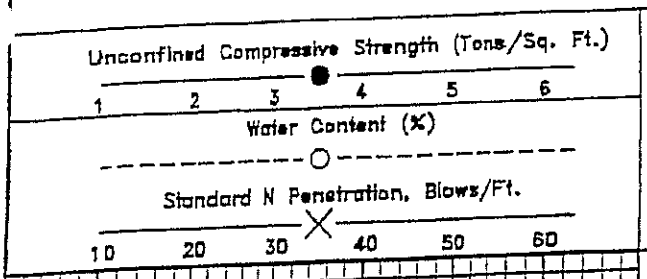
Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				7" Topsoil
				Gray Mottled Brown Silty CLAY (CL) with trace of sand
	1	ss		
5	2	ss		
	3	ss		Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
10	4	ss		
	5	ss		
15	6	ss		
	7	ss		Gray SHALE
20				End of Boring ⊜ −19.0'

nd Water Data
Ground Water Encountered ⊜ −12.0' During Drilling.

Project: Rock Probes for Mach Mine Johnston City, Illinois	Date of Boring December 5, 2005
Client: Williamson County Energy Marion, Illinois	Project No. H-05278

LOG of BORING 8294

Holcomb Foundation Engineering Co.



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				7" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	SS		
	2	SS		
10	3	SS		
	4	SS		
15	5	SS		
	6	SS		
20	7	SS		
	8	SS		Brown SHALE
				End of Boring @ -22.5'
25				
30				
35				

50/5"

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

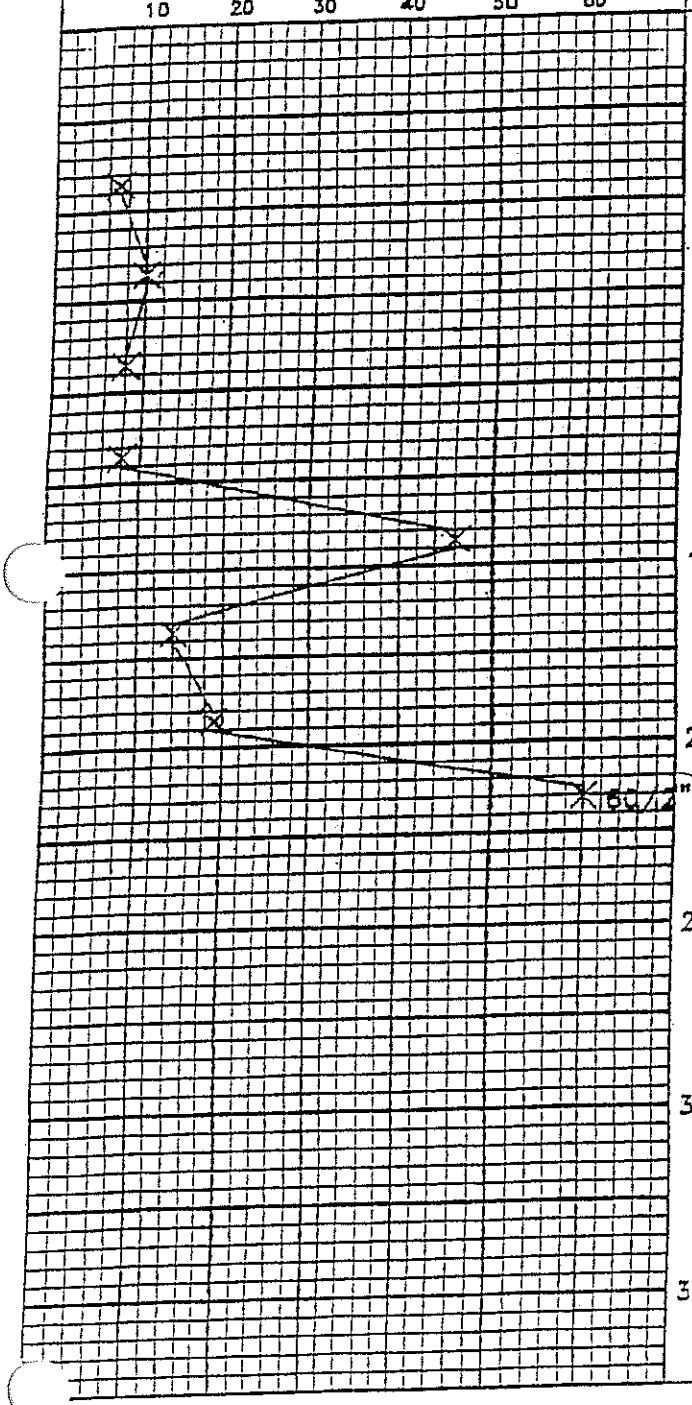
Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

LOG of BORING B295

Holcomb Foundation Engineering Co.

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6
Water Content (%)
Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				9" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
10	3	ss		
	4	ss		
15	5	ss		Brown SILT (ML)
	6	ss		Brown Medium to Coarse SAND (SC-SP)
20	7	ss		
	8	ss		Gray Mottled Brown SHALE
				End of Boring @ -22.0'
25				
30				
35				

Ground Water Data
Ground Water Encountered @ -16.0' During Drilling/ @ -10.0' Upon Completion.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring: December 5, 2005

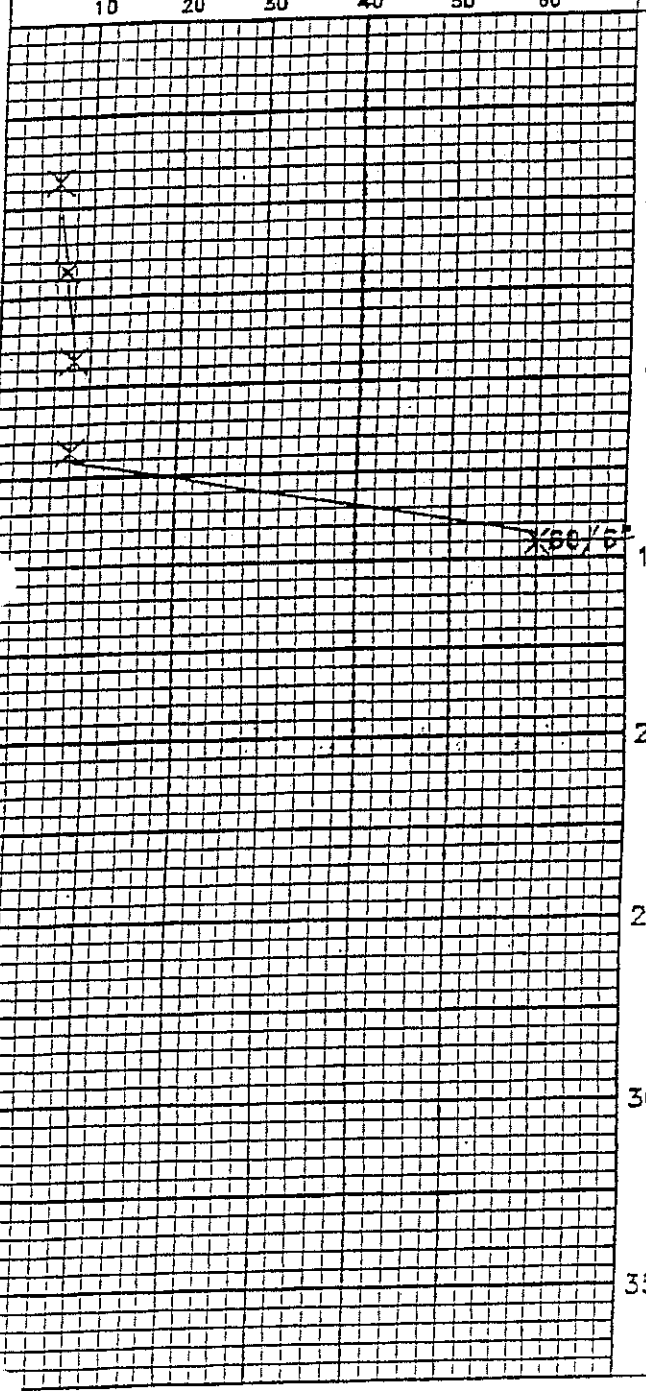
Client: Williamson County Energy

Project No.: H-05278

R14810

LOG of BORING 8297

Holcomb Foundation Engineering Co.



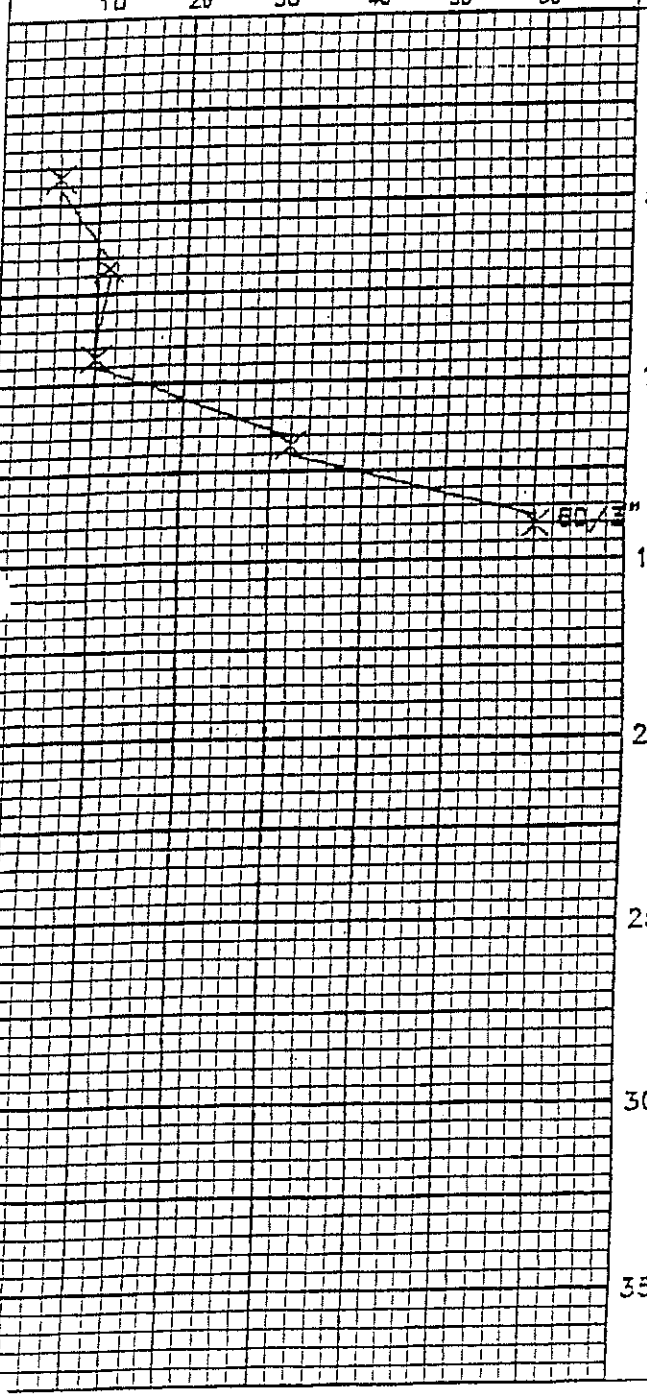
Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				9" Topsoil
				Gray Mottled Brown Silty CLAY (CL) with sand and pebbles
5	1	SS		
	2	SS		
	3	SS		
10				Brown Mottled Gray Silty CLAY (CL) with trace of sand
	4	SS		
				Gray Mottled Brown Silty CLAY (CL) with trace of sand
15	5	SS		
				Brown SHALE
				End of Boring @ -15.5'
20				
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine Johnston City, Illinois	Date of Boring December 5, 2005
Client: Williamson County Energy Marion, Illinois	Project No. H-05278

LOG of BORING 8298

Holcomb Foundation Engineering Co.



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				6" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
	1	ss		
5				
	2	ss		
	3	ss		Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
10				
	4	ss		Brown Mottled Gray SHALE
	5	ss		Gray SHALE
15				End of Boring @ −14.5'
20				
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

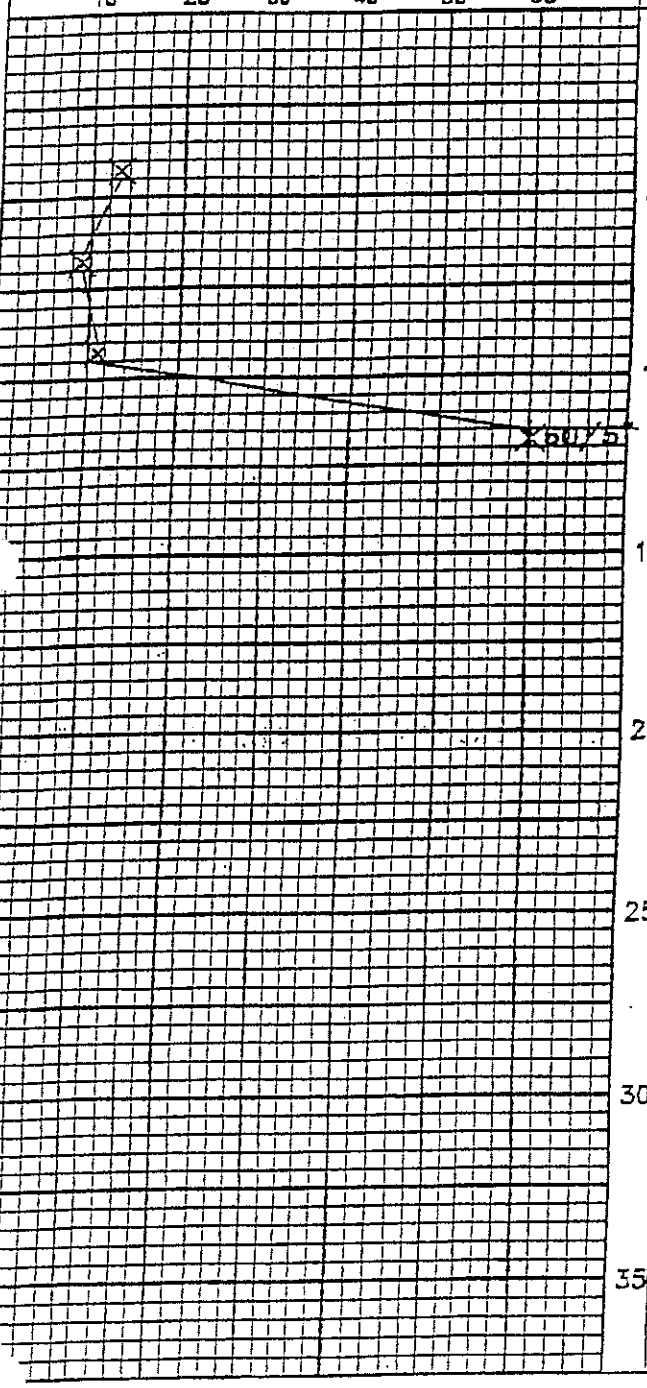
Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

LOG of BORING B299

Holcomb Foundation Engineering Co.



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	SS		
	2	SS		
10	3	SS		
	4	SS		Brown SHALE
				End of Boring @ -12.5'
15				
20				
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

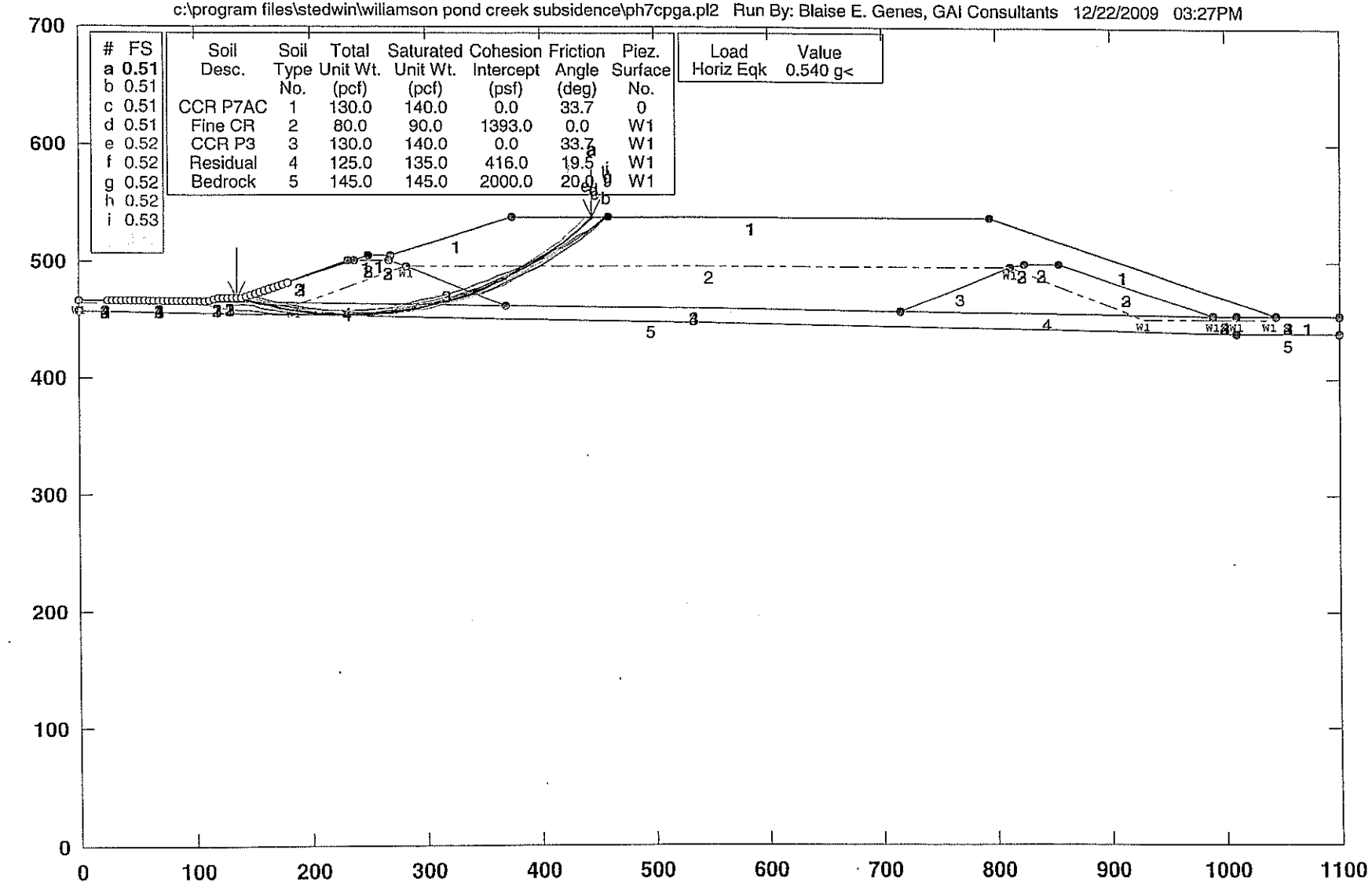
Project No.
H-05278

APPENDIX C

PSEUDO-STATIC SLOPE STABILITY ANALYSES RESULTS
SEISMIC FACTOR OF SAFETY AND YIELD ACCELERATION

Pond Creek, Phase 7C South - 80% Sup FCR- PGA=.54g Pseudo-Static

c:\program files\stedwin\wiliamson pond creek subsidence\ph7cpga.pl2 Run By: Blaise E. Genes, GAI Consultants 12/22/2009 03:27PM



#	FS
a	0.51
b	0.51
c	0.51
d	0.51
e	0.52
f	0.52
g	0.52
h	0.52
i	0.53

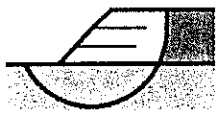
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR P7AC	1	130.0	140.0	0.0	33.7	0
Fine CR	2	80.0	90.0	1393.0	0.0	W1
CCR P3	3	130.0	140.0	0.0	33.7	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1

Load	Value
Horiz Eqk	0.540 g<

PCSTABL5M/si FSmin=0.51

Safety Factors Are Calculated By The Modified Bishop Method

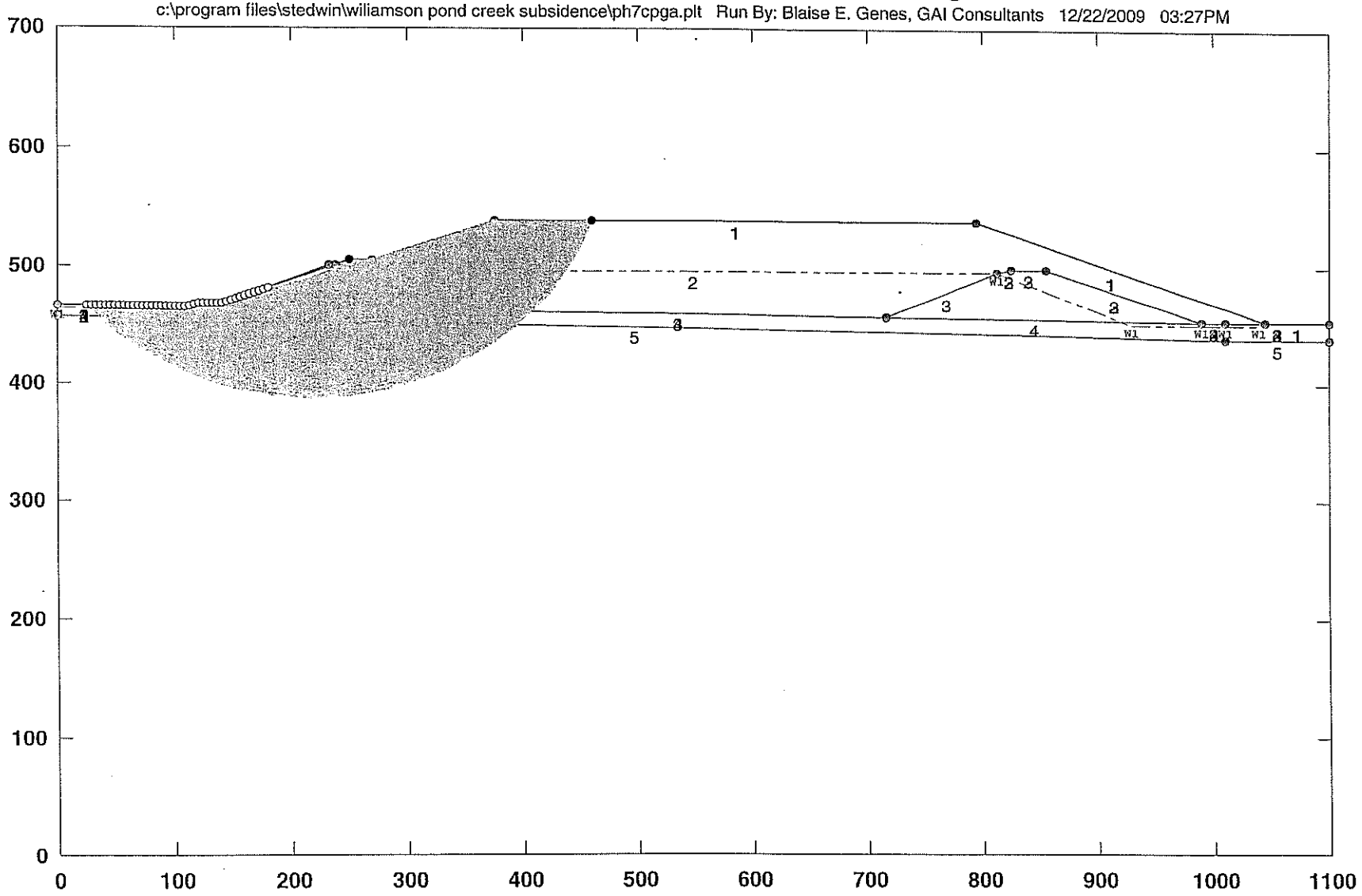
STED



R14814

Pond Creek, Phase 7C South - 80% Sup FCR- PGA=.54g Pseudo-Static

c:\program files\stedwin\wiliamson pond creek subsidence\ph7cpga.plt Run By: Blaise E. Genes, GAI Consultants 12/22/2009 03:27PM



STED



R14815

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 12/22/2009
Time of Run: 03:27PM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph7cPGA.in
Output Filename: C:ph7cPGA.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph7cPGA.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 7C South - 80% Sup FCR
- PGA=.54g Pseudo-Static
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

11 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1
5	140.00	468.00	238.00	500.00	1
6	238.00	500.00	250.00	505.00	1
7	250.00	505.00	270.00	505.00	1
8	270.00	505.00	375.00	538.00	1
9	375.00	538.00	795.00	538.00	1
10	795.00	538.00	1045.00	454.00	1
11	1045.00	454.00	1100.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1100.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1100.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4

45	990.00	454.00	1010.00	454.00	4
46	1010.00	454.00	1100.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1100.00	439.00	5

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	0
2	80.0	90.0	1393.0	.0	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Horizontal Earthquake Loading Coefficient
Of .540 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
1600 Trial Surfaces Have Been Generated.
40 Surfaces Initiate From Each Of 40 Points Equally Spaced
Along The Ground Surface Between X = 25.00 ft.
and X = 180.00 ft.
Each Surface Terminates Between X = 250.00 ft.
and X = 460.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.28	468.00
2	145.82	465.01
3	155.46	462.32
4	165.17	459.95
5	174.96	457.90
6	184.81	456.17
7	194.71	454.76
8	204.65	453.67
9	214.62	452.90
10	224.61	452.46
11	234.61	452.34
12	244.61	452.55
13	254.59	453.09
14	264.56	453.94
15	274.49	455.12
16	284.37	456.63
17	294.20	458.45

18	303.97	460.59
19	313.67	463.05
20	323.27	465.82
21	332.79	468.91
22	342.19	472.30
23	351.49	475.99
24	360.65	479.98
25	369.69	484.27
26	378.58	488.86
27	387.31	493.72
28	395.88	498.87
29	404.29	504.30
30	412.51	509.99
31	420.54	515.95
32	428.37	522.17
33	436.00	528.64
34	443.41	535.35
35	446.15	538.00

Circle Center At X = 233.2 ; Y = 760.0 and Radius, 307.7

*** .506 ***

Individual data on the 49 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.7	282.0	.0	.0	.0	.0	152.3	.0	.0
2	5.8	2295.1	.0	.0	.0	.0	1239.4	.0	.0
3	2.7	1985.6	.0	.0	.0	.0	1072.2	.0	.0
4	7.0	7764.7	.0	.0	.0	.0	4193.0	.0	.0
5	4.3	6636.2	.0	.0	.0	.0	3583.5	.0	.0
6	5.4	10302.5	.0	219.2	.0	.0	5563.4	.0	.0
7	9.8	24012.8	.0	1394.1	.0	.0	12966.9	.0	.0
8	9.8	30782.9	.0	2508.5	.0	.0	16622.8	.0	.0
9	.2	663.1	.0	58.6	.0	.0	358.1	.0	.0
10	7.0	25759.1	.0	2736.6	.0	.0	13909.9	.0	.0
11	2.7	10901.0	.0	1452.8	.0	.0	5886.6	.0	.0
12	9.9	43666.5	.0	7015.0	.0	.0	23579.9	.0	.0
13	10.0	49591.5	.0	9602.2	.0	.0	26779.4	.0	.0
14	10.0	55069.2	.0	12003.2	.0	.0	29737.3	.0	.0
15	8.4	50089.1	.0	11785.3	.0	.0	27048.1	.0	.0
16	1.6	9985.1	.0	2430.0	.0	.0	5392.0	.0	.0
17	3.4	21424.8	.0	5291.6	.0	.0	11569.4	.0	.0
18	6.6	43415.3	.0	10944.8	.0	.0	23444.2	.0	.0
19	5.4	37150.5	.0	9541.7	.0	.0	20061.3	.0	.0
20	4.6	32216.4	.0	8522.6	.0	.0	17396.9	.0	.0
21	10.0	69400.0	.0	19697.0	.0	.0	37476.0	.0	.0
22	3.4	23777.8	.0	7179.0	.0	.0	12840.0	.0	.0
23	2.0	13737.6	.0	4242.2	.0	.0	7418.3	.0	.0
24	4.5	31037.8	.0	9711.6	.0	.0	16760.4	.0	.0
25	8.5	60318.3	.0	19198.0	.0	.0	32571.9	.0	.0
26	1.4	9886.6	.0	3331.7	.0	.0	5338.8	.0	.0
27	9.8	70655.5	.0	23375.5	.0	.0	38154.0	.0	.0
28	9.8	69572.7	.0	22138.4	.0	.0	37569.3	.0	.0
29	2.5	17523.6	.0	5445.1	.0	.0	9462.7	.0	.0
30	7.2	50436.8	.0	15258.0	.0	.0	27235.9	.0	.0
31	9.6	65774.3	.0	19071.3	.0	.0	35518.1	.0	.0
32	9.5	63110.8	.0	17244.7	.0	.0	34079.8	.0	.0
33	8.0	50889.5	.0	13008.8	.0	.0	27480.4	.0	.0
34	1.5	9147.2	.0	2216.3	.0	.0	4939.5	.0	.0
35	9.3	58698.3	.0	13014.8	.0	.0	31697.1	.0	.0
36	9.2	58194.7	.0	10616.1	.0	.0	31425.1	.0	.0
37	9.0	57331.3	.0	8031.5	.0	.0	30958.9	.0	.0
38	5.3	33592.3	.0	3489.4	.0	.0	18139.9	.0	.0
39	3.6	22268.6	.0	1774.3	.0	.0	12025.1	.0	.0
40	8.7	51748.2	.0	2315.7	.0	.0	27944.0	.0	.0
41	2.1	12010.0	.0	98.9	.0	.0	6485.4	.0	.0
42	6.4	34410.7	.0	.0	.0	.0	18581.8	.0	.0

43	8.4	39769.7	.0	.0	.0	.0	21475.6	.0	.0
44	8.2	32972.9	.0	.0	.0	.0	17805.4	.0	.0
45	8.0	26130.1	.0	.0	.0	.0	14110.2	.0	.0
46	7.8	19287.2	.0	.0	.0	.0	10415.1	.0	.0
47	7.6	12491.4	.0	.0	.0	.0	6745.3	.0	.0
48	7.4	5790.1	.0	.0	.0	.0	3126.7	.0	.0
49	2.7	473.2	.0	.0	.0	.0	255.5	.0	.0

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.23	469.38
2	153.75	466.32
3	163.36	463.56
4	173.06	461.12
5	182.83	458.99
6	192.66	457.17
7	202.55	455.68
8	212.48	454.50
9	222.45	453.65
10	232.43	453.12
11	242.43	452.91
12	252.43	453.02
13	262.42	453.45
14	272.39	454.21
15	282.33	455.29
16	292.23	456.69
17	302.09	458.40
18	311.88	460.44
19	321.60	462.78
20	331.24	465.45
21	340.79	468.42
22	350.23	471.69
23	359.57	475.27
24	368.79	479.15
25	377.87	483.33
26	386.82	487.79
27	395.62	492.54
28	404.26	497.58
29	412.74	502.89
30	421.03	508.47
31	429.15	514.31
32	437.07	520.41
33	444.79	526.77
34	452.30	533.37
35	457.24	538.00

Circle Center At X = 244.0 ; Y = 762.9 and Radius, 310.0

*** .507 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.39	468.00
2	129.98	465.19
3	139.66	462.66
4	149.40	460.42
5	159.21	458.46
6	169.07	456.78
7	178.97	455.40
8	188.91	454.30
9	198.88	453.49
10	208.86	452.97
11	218.86	452.75
12	228.86	452.81
13	238.85	453.17
14	248.83	453.81
15	258.79	454.75
16	268.71	455.98
17	278.60	457.49

18	288.44	459.30
19	298.21	461.38
20	307.93	463.76
21	317.57	466.41
22	327.13	469.34
23	336.60	472.55
24	345.97	476.04
25	355.24	479.79
26	364.40	483.82
27	373.43	488.11
28	382.34	492.66
29	391.10	497.47
30	399.73	502.53
31	408.20	507.84
32	416.52	513.39
33	424.67	519.19
34	432.65	525.22
35	440.44	531.47
36	448.06	537.96
37	448.11	538.00

Circle Center At X = 221.6 ; Y = 796.1 and Radius, 343.4

*** .507 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.26	468.08
2	149.82	465.16
3	159.47	462.54
4	169.20	460.24
5	179.01	458.26
6	188.87	456.60
7	198.78	455.27
8	208.73	454.25
9	218.70	453.56
10	228.69	453.20
11	238.69	453.16
12	248.69	453.45
13	258.67	454.06
14	268.63	455.00
15	278.55	456.26
16	288.42	457.85
17	298.24	459.76
18	307.99	461.98
19	317.66	464.52
20	327.24	467.38
21	336.73	470.54
22	346.11	474.01
23	355.37	477.79
24	364.50	481.87
25	373.49	486.24
26	382.34	490.90
27	391.03	495.85
28	399.55	501.08
29	407.90	506.58
30	416.06	512.36
31	424.04	518.39
32	431.81	524.69
33	439.37	531.23
34	446.70	538.00

Circle Center At X = 234.9 ; Y = 760.0 and Radius, 306.9

*** .509 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.23	469.38
2	153.74	466.28
3	163.35	463.51

4	173.05	461.08
5	182.83	458.99
6	192.67	457.24
7	202.57	455.84
8	212.52	454.78
9	222.49	454.08
10	232.49	453.72
11	242.49	453.71
12	252.48	454.05
13	262.46	454.74
14	272.40	455.78
15	282.31	457.17
16	292.16	458.90
17	301.94	460.97
18	311.64	463.39
19	321.26	466.14
20	330.77	469.22
21	340.17	472.64
22	349.44	476.39
23	358.57	480.45
24	367.56	484.83
25	376.39	489.53
26	385.05	494.53
27	393.53	499.83
28	401.82	505.42
29	409.91	511.30
30	417.79	517.45
31	425.45	523.88
32	432.88	530.58
33	440.07	537.53
34	440.53	538.00

Circle Center At X = 237.7 ; Y = 739.7 and Radius, 286.0

*** .519 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.28	468.00
2	146.00	465.65
3	155.78	463.57
4	165.62	461.76
5	175.50	460.21
6	185.42	458.94
7	195.37	457.93
8	205.34	457.20
9	215.33	456.74
10	225.33	456.55
11	235.33	456.63
12	245.32	456.98
13	255.30	457.61
14	265.26	458.51
15	275.19	459.68
16	285.09	461.12
17	294.94	462.83
18	304.74	464.80
19	314.49	467.04
20	324.17	469.55
21	333.78	472.32
22	343.31	475.35
23	352.75	478.64
24	362.10	482.18
25	371.35	485.98
26	380.50	490.03
27	389.53	494.32
28	398.44	498.86
29	407.22	503.64
30	415.87	508.66
31	424.38	513.91

32	432.74	519.40
33	440.96	525.10
34	449.01	531.03
35	456.90	537.18
36	457.89	538.00

Circle Center At X = 227.3 ; Y = 823.7 and Radius, 367.1

*** .519 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.21	470.68
2	157.78	467.79
3	167.44	465.20
4	177.18	462.92
5	186.98	460.95
6	196.84	459.28
7	206.74	457.92
8	216.69	456.87
9	226.66	456.13
10	236.65	455.71
11	246.65	455.60
12	256.65	455.80
13	266.64	456.32
14	276.60	457.15
15	286.54	458.29
16	296.43	459.74
17	306.28	461.50
18	316.06	463.57
19	325.77	465.94
20	335.41	468.62
21	344.96	471.59
22	354.40	474.87
23	363.75	478.44
24	372.97	482.30
25	382.07	486.44
26	391.04	490.87
27	399.86	495.58
28	408.53	500.56
29	417.04	505.81
30	425.38	511.33
31	433.55	517.10
32	441.53	523.13
33	449.31	529.40
34	456.90	535.92
35	459.18	538.00

Circle Center At X = 245.2 ; Y = 774.8 and Radius, 319.2

*** .521 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.23	469.38
2	153.88	466.77
3	163.61	464.44
4	173.40	462.41
5	183.25	460.66
6	193.14	459.21
7	203.07	458.05
8	213.04	457.18
9	223.02	456.61
10	233.01	456.33
11	243.01	456.35
12	253.01	456.66
13	262.99	457.27
14	272.95	458.18
15	282.88	459.38
16	292.77	460.87
17	302.61	462.66

18	312.39	464.73
19	322.10	467.09
20	331.75	469.74
21	341.31	472.68
22	350.78	475.89
23	360.15	479.39
24	369.41	483.15
25	378.56	487.20
26	387.58	491.51
27	396.47	496.08
28	405.22	500.92
29	413.83	506.01
30	422.28	511.35
31	430.57	516.95
32	438.69	522.78
33	446.64	528.86
34	454.40	535.16
35	457.69	538.00

Circle Center At X = 237.4 ; Y = 794.4 and Radius, 338.1

*** .521 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	88.59	465.33
2	98.37	463.22
3	108.18	461.33
4	118.04	459.64
5	127.93	458.16
6	137.85	456.90
7	147.80	455.85
8	157.76	455.01
9	167.74	454.38
10	177.73	453.97
11	187.73	453.77
12	197.73	453.79
13	207.73	454.02
14	217.72	454.46
15	227.70	455.12
16	237.66	455.99
17	247.60	457.07
18	257.52	458.37
19	267.40	459.88
20	277.25	461.59
21	287.06	463.52
22	296.83	465.66
23	306.55	468.01
24	316.22	470.56
25	325.83	473.32
26	335.38	476.29
27	344.87	479.46
28	354.28	482.83
29	363.62	486.40
30	372.89	490.17
31	382.07	494.14
32	391.16	498.30
33	400.16	502.65
34	409.07	507.20
35	417.87	511.94
36	426.58	516.86
37	435.17	521.97
38	443.66	527.27
39	452.03	532.74
40	459.71	538.00

Circle Center At X = 192.0 ; Y = 921.3 and Radius, 467.5

*** .526 ***

Failure Surface Specified By 33 Coordinate Points

Point	X-Surf	Y-Surf

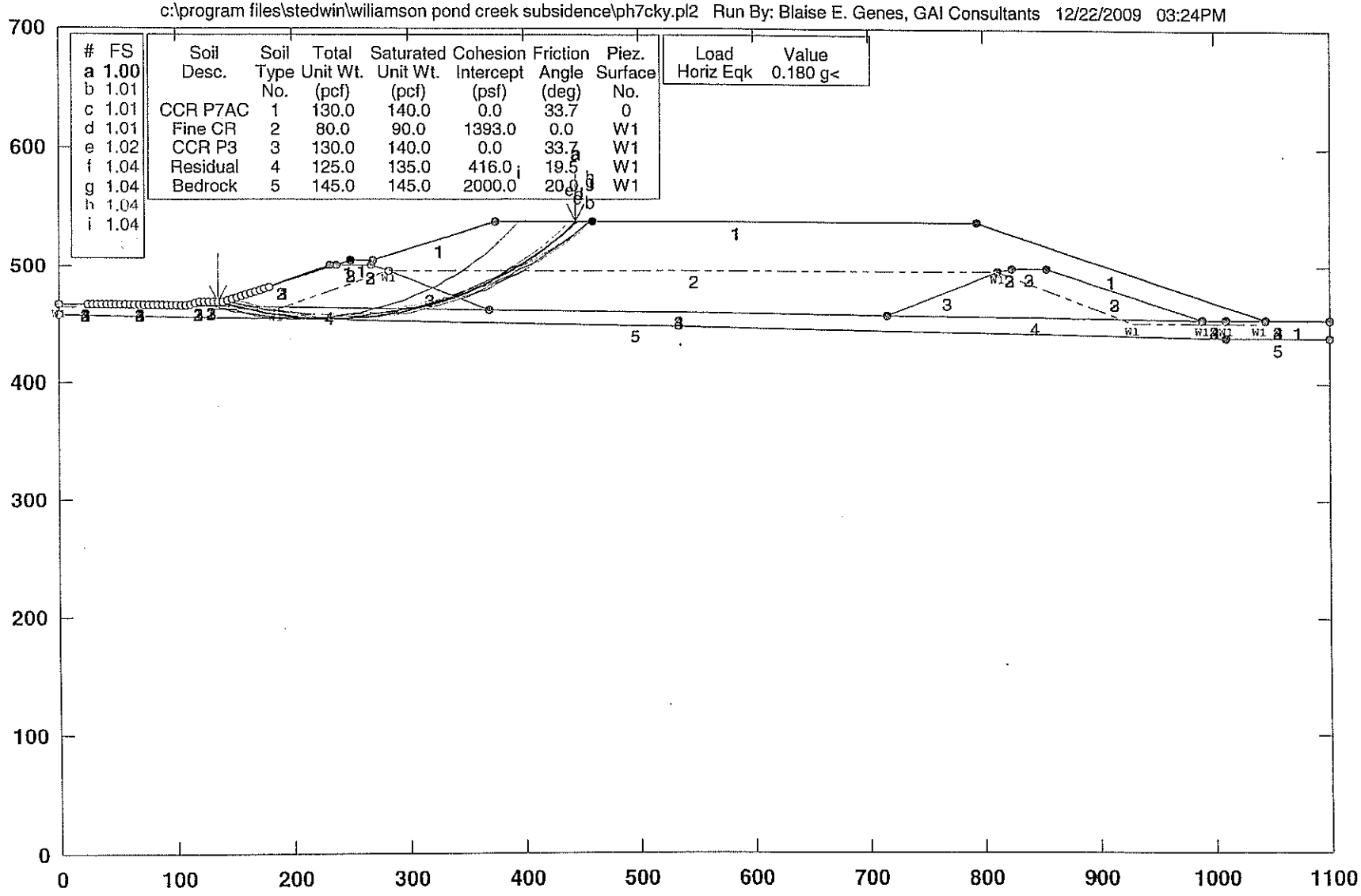
No.	(ft)	(ft)
1	128.33	468.00
2	137.98	465.35
3	147.70	463.01
4	157.49	460.99
5	167.35	459.28
6	177.25	457.89
7	187.19	456.83
8	197.16	456.09
9	207.16	455.67
10	217.15	455.57
11	227.15	455.80
12	237.14	456.35
13	247.10	457.22
14	257.03	458.42
15	266.91	459.93
16	276.74	461.77
17	286.51	463.92
18	296.20	466.38
19	305.81	469.16
20	315.32	472.25
21	324.72	475.64
22	334.02	479.34
23	343.18	483.33
24	352.22	487.62
25	361.11	492.20
26	369.85	497.06
27	378.42	502.21
28	386.83	507.62
29	395.05	513.31
30	403.09	519.26
31	410.93	525.47
32	418.56	531.93
33	425.29	538.00

Circle Center At X = 215.1 ; Y = 764.7 and Radius, 309.2

*** .532 ***

Pond Creek, Phase 7C South - 80% Sup FCR- Ky Yield Acceleration

c:\program files\stedwin\wiliamson pond creek subsidence\ph7cky.pl2 Run By: Blaise E. Genes, GAI Consultants 12/22/2009 03:24PM



#	FS
a	1.00
b	1.01
c	1.01
d	1.01
e	1.02
f	1.04
g	1.04
h	1.04
i	1.04

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR P7AC	1	130.0	140.0	0.0	33.7	0
Fine CR	2	80.0	90.0	1393.0	0.0	W1
CCR P3	3	130.0	140.0	0.0	33.7	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1

Load	Value
Horiz Eqk	0.180 g<

PCSTABL5M/si FSmin=1.00

Safety Factors Are Calculated By The Modified Bishop Method

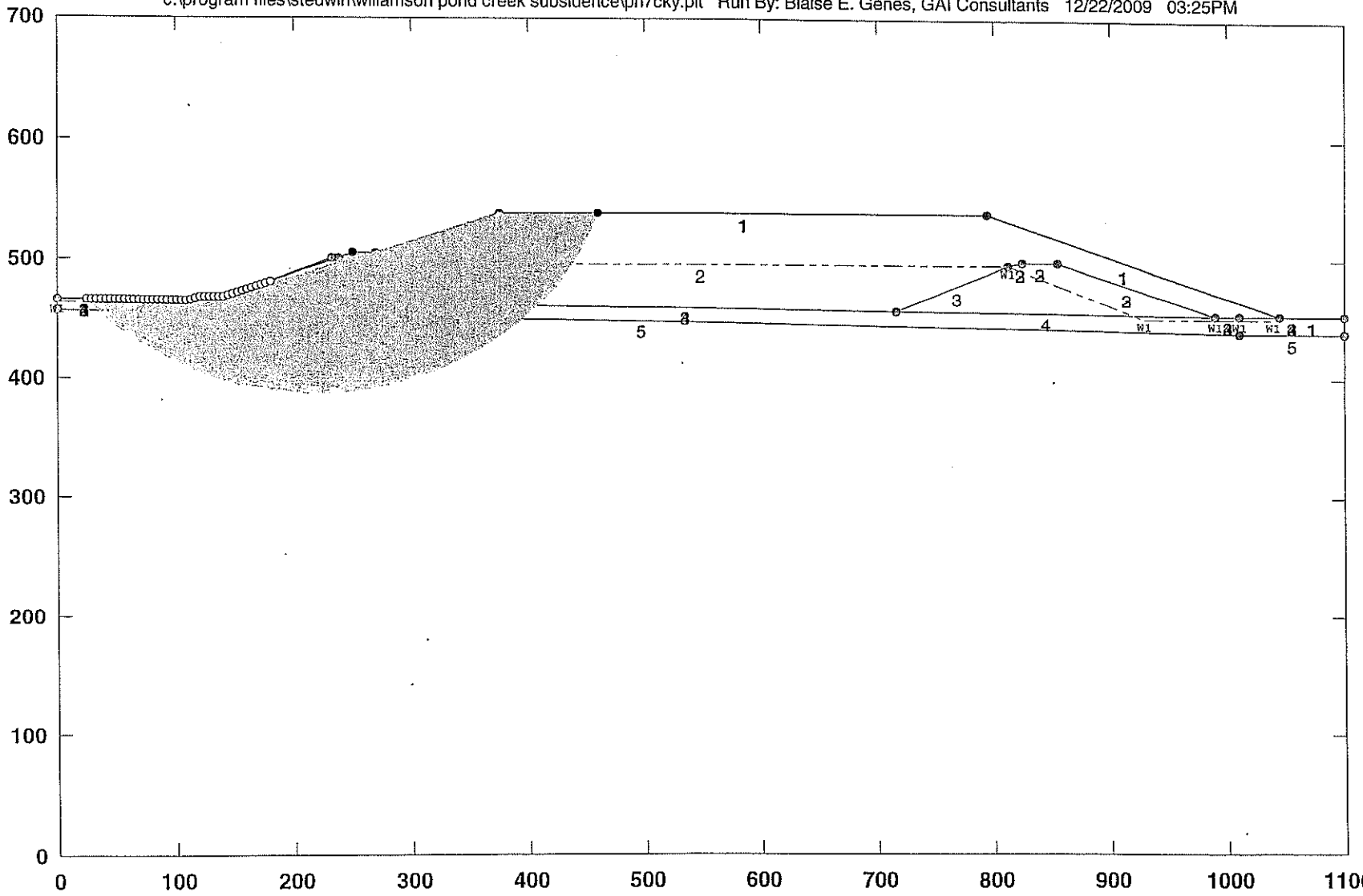
STED



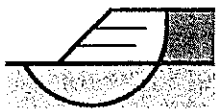
R14825

Pond Creek, Phase 7C South - 80% Sup FCR- Ky Yield Acceleration

c:\program files\stedwin\williamson pond creek subsidence\ph7cky.plt Run By: Blaise E. Genes, GAI Consultants 12/22/2009 03:25PM



STED



R14826

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 12/22/2009
Time of Run: 03:25PM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph7cky.in
Output Filename: C:ph7cky.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph7cky.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 7C South - 80% Sup FCR
- Ky Yield Acceleration

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

11 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1

5	140.00	468.00	238.00	500.00	1
6	238.00	500.00	250.00	505.00	1
7	250.00	505.00	270.00	505.00	1
8	270.00	505.00	375.00	538.00	1
9	375.00	538.00	795.00	538.00	1
10	795.00	538.00	1045.00	454.00	1
11	1045.00	454.00	1100.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1100.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1100.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4
46	1010.00	454.00	1100.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1100.00	439.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	0
2	80.0	90.0	1393.0	.0	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Horizontal Earthquake Loading Coefficient
Of .180 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
1600 Trial Surfaces Have Been Generated.
40 Surfaces Initiate From Each Of 40 Points Equally Spaced
Along The Ground Surface Between X = 25.00 ft.
and X = 180.00 ft.
Each Surface Terminates Between X = 250.00 ft.
and X = 460.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.28	468.00
2	145.82	465.01
3	155.46	462.32
4	165.17	459.95
5	174.96	457.90
6	184.81	456.17
7	194.71	454.76
8	204.65	453.67
9	214.62	452.90
10	224.61	452.46
11	234.61	452.34
12	244.61	452.55
13	254.59	453.09
14	264.56	453.94
15	274.49	455.12
16	284.37	456.63
17	294.20	458.45
18	303.97	460.59
19	313.67	463.05
20	323.27	465.82
21	332.79	468.91
22	342.19	472.30
23	351.49	475.99
24	360.65	479.98
25	369.69	484.27
26	378.58	488.86
27	387.31	493.72
28	395.88	498.87
29	404.29	504.30
30	412.51	509.99
31	420.54	515.95
32	428.37	522.17
33	436.00	528.64
34	443.41	535.35
35	446.15	538.00

Circle Center At X = 233.2 ; Y = 760.0 and Radius, 307.7
*** .998 ***
Individual data on the 49 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.7	282.0	.0	.0	.0	.0	50.8	.0	.0
2	5.8	2295.1	.0	.0	.0	.0	413.1	.0	.0

3	2.7	1985.6	.0	.0	.0	.0	357.4	.0	.0
4	7.0	7764.7	.0	.0	.0	.0	1397.7	.0	.0
5	4.3	6636.2	.0	.0	.0	.0	1194.5	.0	.0
6	5.4	10302.5	.0	219.2	.0	.0	1854.5	.0	.0
7	9.8	24012.8	.0	1394.1	.0	.0	4322.3	.0	.0
8	9.8	30782.9	.0	2508.5	.0	.0	5540.9	.0	.0
9	.2	663.1	.0	58.6	.0	.0	119.4	.0	.0
10	7.0	25759.1	.0	2736.6	.0	.0	4636.6	.0	.0
11	2.7	10901.0	.0	1452.8	.0	.0	1962.2	.0	.0
12	9.9	43666.5	.0	7015.0	.0	.0	7860.0	.0	.0
13	10.0	49591.5	.0	9602.2	.0	.0	8926.5	.0	.0
14	10.0	55069.2	.0	12003.2	.0	.0	9912.4	.0	.0
15	8.4	50089.1	.0	11785.3	.0	.0	9016.0	.0	.0
16	1.6	9985.1	.0	2430.0	.0	.0	1797.3	.0	.0
17	3.4	21424.8	.0	5291.6	.0	.0	3856.5	.0	.0
18	6.6	43415.3	.0	10944.8	.0	.0	7814.7	.0	.0
19	5.4	37150.5	.0	9541.7	.0	.0	6687.1	.0	.0
20	4.6	32216.4	.0	8522.6	.0	.0	5799.0	.0	.0
21	10.0	69400.0	.0	19697.0	.0	.0	12492.0	.0	.0
22	3.4	23777.8	.0	7179.0	.0	.0	4280.0	.0	.0
23	2.0	13737.6	.0	4242.2	.0	.0	2472.8	.0	.0
24	4.5	31037.8	.0	9711.6	.0	.0	5586.8	.0	.0
25	8.5	60318.3	.0	19198.0	.0	.0	10857.3	.0	.0
26	1.4	9886.6	.0	3331.7	.0	.0	1779.6	.0	.0
27	9.8	70655.5	.0	23375.5	.0	.0	12718.0	.0	.0
28	9.8	69572.7	.0	22138.4	.0	.0	12523.1	.0	.0
29	2.5	17523.6	.0	5445.1	.0	.0	3154.2	.0	.0
30	7.2	50436.8	.0	15258.0	.0	.0	9078.6	.0	.0
31	9.6	65774.3	.0	19071.3	.0	.0	11839.4	.0	.0
32	9.5	63110.8	.0	17244.7	.0	.0	11359.9	.0	.0
33	8.0	50889.5	.0	13008.8	.0	.0	9160.1	.0	.0
34	1.5	9147.2	.0	2216.3	.0	.0	1646.5	.0	.0
35	9.3	58698.3	.0	13014.8	.0	.0	10565.7	.0	.0
36	9.2	58194.7	.0	10616.1	.0	.0	10475.0	.0	.0
37	9.0	57331.3	.0	8031.5	.0	.0	10319.6	.0	.0
38	5.3	33592.3	.0	3489.4	.0	.0	6046.6	.0	.0
39	3.6	22268.6	.0	1774.3	.0	.0	4008.4	.0	.0
40	8.7	51748.2	.0	2315.7	.0	.0	9314.7	.0	.0
41	2.1	12010.0	.0	98.9	.0	.0	2161.8	.0	.0
42	6.4	34410.7	.0	.0	.0	.0	6193.9	.0	.0
43	8.4	39769.7	.0	.0	.0	.0	7158.5	.0	.0
44	8.2	32972.9	.0	.0	.0	.0	5935.1	.0	.0
45	8.0	26130.1	.0	.0	.0	.0	4703.4	.0	.0
46	7.8	19287.2	.0	.0	.0	.0	3471.7	.0	.0
47	7.6	12491.4	.0	.0	.0	.0	2248.4	.0	.0
48	7.4	5790.1	.0	.0	.0	.0	1042.2	.0	.0
49	2.7	473.2	.0	.0	.0	.0	85.2	.0	.0

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.23	469.38
2	153.75	466.32
3	163.36	463.56
4	173.06	461.12
5	182.83	458.99
6	192.66	457.17
7	202.55	455.68
8	212.48	454.50
9	222.45	453.65
10	232.43	453.12
11	242.43	452.91
12	252.43	453.02
13	262.42	453.45
14	272.39	454.21
15	282.33	455.29
16	292.23	456.69
17	302.09	458.40

18	311.88	460.44
19	321.60	462.78
20	331.24	465.45
21	340.79	468.42
22	350.23	471.69
23	359.57	475.27
24	368.79	479.15
25	377.87	483.33
26	386.82	487.79
27	395.62	492.54
28	404.26	497.58
29	412.74	502.89
30	421.03	508.47
31	429.15	514.31
32	437.07	520.41
33	444.79	526.77
34	452.30	533.37
35	457.24	538.00

Circle Center At X = 244.0 ; Y = 762.9 and Radius, 310.0

*** 1.005 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.26	468.08
2	149.82	465.16
3	159.47	462.54
4	169.20	460.24
5	179.01	458.26
6	188.87	456.60
7	198.78	455.27
8	208.73	454.25
9	218.70	453.56
10	228.69	453.20
11	238.69	453.16
12	248.69	453.45
13	258.67	454.06
14	268.63	455.00
15	278.55	456.26
16	288.42	457.85
17	298.24	459.76
18	307.99	461.98
19	317.66	464.52
20	327.24	467.38
21	336.73	470.54
22	346.11	474.01
23	355.37	477.79
24	364.50	481.87
25	373.49	486.24
26	382.34	490.90
27	391.03	495.85
28	399.55	501.08
29	407.90	506.58
30	416.06	512.36
31	424.04	518.39
32	431.81	524.69
33	439.37	531.23
34	446.70	538.00

Circle Center At X = 234.9 ; Y = 760.0 and Radius, 306.9

*** 1.006 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.39	468.00
2	129.98	465.19
3	139.66	462.66
4	149.40	460.42
5	159.21	458.46

6	169.07	456.78
7	178.97	455.40
8	188.91	454.30
9	198.88	453.49
10	208.86	452.97
11	218.86	452.75
12	228.86	452.81
13	238.85	453.17
14	248.83	453.81
15	258.79	454.75
16	268.71	455.98
17	278.60	457.49
18	288.44	459.30
19	298.21	461.38
20	307.93	463.76
21	317.57	466.41
22	327.13	469.34
23	336.60	472.55
24	345.97	476.04
25	355.24	479.79
26	364.40	483.82
27	373.43	488.11
28	382.34	492.66
29	391.10	497.47
30	399.73	502.53
31	408.20	507.84
32	416.52	513.39
33	424.67	519.19
34	432.65	525.22
35	440.44	531.47
36	448.06	537.96
37	448.11	538.00

Circle Center At X = 221.6 ; Y = 796.1 and Radius, 343.4

*** 1.007 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.23	469.38
2	153.74	466.28
3	163.35	463.51
4	173.05	461.08
5	182.83	458.99
6	192.67	457.24
7	202.57	455.84
8	212.52	454.78
9	222.49	454.08
10	232.49	453.72
11	242.49	453.71
12	252.48	454.05
13	262.46	454.74
14	272.40	455.78
15	282.31	457.17
16	292.16	458.90
17	301.94	460.97
18	311.64	463.39
19	321.26	466.14
20	330.77	469.22
21	340.17	472.64
22	349.44	476.39
23	358.57	480.45
24	367.56	484.83
25	376.39	489.53
26	385.05	494.53
27	393.53	499.83
28	401.82	505.42
29	409.91	511.30
30	417.79	517.45

31	425.45	523.88
32	432.88	530.58
33	440.07	537.53
34	440.53	538.00

Circle Center At X = 237.7 ; Y = 739.7 and Radius, 286.0

*** 1.018 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.21	470.68
2	157.78	467.79
3	167.44	465.20
4	177.18	462.92
5	186.98	460.95
6	196.84	459.28
7	206.74	457.92
8	216.69	456.87
9	226.66	456.13
10	236.65	455.71
11	246.65	455.60
12	256.65	455.80
13	266.64	456.32
14	276.60	457.15
15	286.54	458.29
16	296.43	459.74
17	306.28	461.50
18	316.06	463.57
19	325.77	465.94
20	335.41	468.62
21	344.96	471.59
22	354.40	474.87
23	363.75	478.44
24	372.97	482.30
25	382.07	486.44
26	391.04	490.87
27	399.86	495.58
28	408.53	500.56
29	417.04	505.81
30	425.38	511.33
31	433.55	517.10
32	441.53	523.13
33	449.31	529.40
34	456.90	535.92
35	459.18	538.00

Circle Center At X = 245.2 ; Y = 774.8 and Radius, 319.2

*** 1.036 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.23	469.38
2	153.88	466.77
3	163.61	464.44
4	173.40	462.41
5	183.25	460.66
6	193.14	459.21
7	203.07	458.05
8	213.04	457.18
9	223.02	456.61
10	233.01	456.33
11	243.01	456.35
12	253.01	456.66
13	262.99	457.27
14	272.95	458.18
15	282.88	459.38
16	292.77	460.87
17	302.61	462.66
18	312.39	464.73

19	322.10	467.09
20	331.75	469.74
21	341.31	472.68
22	350.78	475.89
23	360.15	479.39
24	369.41	483.15
25	378.56	487.20
26	387.58	491.51
27	396.47	496.08
28	405.22	500.92
29	413.83	506.01
30	422.28	511.35
31	430.57	516.95
32	438.69	522.78
33	446.64	528.86
34	454.40	535.16
35	457.69	538.00

Circle Center At X = 237.4 ; Y = 794.4 and Radius, 338.1

*** 1.040 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.28	468.00
2	146.00	465.65
3	155.78	463.57
4	165.62	461.76
5	175.50	460.21
6	185.42	458.94
7	195.37	457.93
8	205.34	457.20
9	215.33	456.74
10	225.33	456.55
11	235.33	456.63
12	245.32	456.98
13	255.30	457.61
14	265.26	458.51
15	275.19	459.68
16	285.09	461.12
17	294.94	462.83
18	304.74	464.80
19	314.49	467.04
20	324.17	469.55
21	333.78	472.32
22	343.31	475.35
23	352.75	478.64
24	362.10	482.18
25	371.35	485.98
26	380.50	490.03
27	389.53	494.32
28	398.44	498.86
29	407.22	503.64
30	415.87	508.66
31	424.38	513.91
32	432.74	519.40
33	440.96	525.10
34	449.01	531.03
35	456.90	537.18
36	457.89	538.00

Circle Center At X = 227.3 ; Y = 823.7 and Radius, 367.1

*** 1.042 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.39	468.00
2	129.85	464.76
3	139.43	461.90
4	149.12	459.42

5	158.89	457.32
6	168.75	455.62
7	178.66	454.30
8	188.62	453.38
9	198.60	452.85
10	208.60	452.72
11	218.60	452.98
12	228.58	453.64
13	238.52	454.69
14	248.42	456.14
15	258.25	457.97
16	268.00	460.20
17	277.65	462.80
18	287.19	465.79
19	296.61	469.15
20	305.89	472.89
21	315.01	476.98
22	323.96	481.44
23	332.73	486.24
24	341.31	491.39
25	349.67	496.87
26	357.81	502.68
27	365.71	508.81
28	373.36	515.25
29	380.76	521.98
30	387.88	529.00
31	394.72	536.30
32	396.19	538.00

Circle Center At X = 206.9 ; Y = 705.3 and Radius, 252.6

*** 1.042 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	152.18	471.98
2	161.52	468.41
3	171.01	465.24
4	180.61	462.45
5	190.32	460.06
6	200.12	458.06
7	209.99	456.47
8	219.92	455.29
9	229.89	454.51
10	239.88	454.14
11	249.88	454.18
12	259.87	454.63
13	269.84	455.49
14	279.76	456.76
15	289.62	458.43
16	299.40	460.50
17	309.09	462.97
18	318.67	465.84
19	328.12	469.09
20	337.44	472.73
21	346.60	476.75
22	355.58	481.14
23	364.38	485.89
24	372.98	491.00
25	381.36	496.46
26	389.51	502.25
27	397.41	508.38
28	405.06	514.82
29	412.44	521.57
30	419.53	528.61
31	426.34	535.94
32	428.09	538.00

Circle Center At X = 243.9 ; Y = 698.3 and Radius, 244.2

*** 1.046 ***

APPENDIX D

PERMANENT DEFORMATION ANALYSIS

MAKDISI-SEED PROCEDURE

AND

HYNES-GRIFFEN AND FRANKLIN PROCEDURE

SUBJECT WILLIAMSON ENERGY – POND CREEK

R14837

Phase 7 Permanent Deformation Analyses – Makdisi-Seed and Hynes-Griffin Franklin Methods

BEG DATE 2009-DEC-028 PROJ. NO. C090403.01.001

SHEET 1 OF 5

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CALCULATION BRIEF
FOR
ESTIMATING PERMANENT DEFORMATIONS – MAKDISI-SEED AND HYNES-GRIFFIN AND FRANKLIN METHODS

POND CREEK COAL REFUSE DISPOSAL SITE – PHASE 7 DAM

OBJECTIVE: To estimate the permanent deformations of the Phase 7 Dam using the empirically-based Makdisi-Seed and Hynes-Griffin Franklin methods.

METHODOLOGY: In accordance with the IDNR guidelines Part 3702 Dam and Safety Rules, GAI performed permanent deformation analyses of the Phase 7 Dam to estimate crest settlement using the empirically-based Makdisi-Seed and Hynes-Griffin Franklin methods. The analyses were required since the Phase 7 seismic factor of safety (Fs), pseudo-static slope stability analyses using a peak ground acceleration (PGA) = 0.54 g yielded a Fs of 0.51. The site PGA was obtained from the USGS National Seismic Hazard Mapping Project map for 2% Probability of Exceedance in 50 years.

The Makdisi-Seed method (Reference 8) uses the yield acceleration (Ky) of 0.18 determined from pseudo-static slope stability analyses for a factor of safety of 1.0, the maximum spectral acceleration, and the fundamental period of the dam (To). The procedures outlined in the International Building Code (IBC) 2006, specifically Section 1613 Earthquake Loads are used to determine the maximum spectral acceleration. Based on the various data, design charts in Reference 8 provide estimates of permanent deformation.

Alternatively, the Hynes-Griffin and Franklin (1984) method was also used to estimate permanent deformations of the Phase 7 dam. Hynes-Griffin and Franklin developed upper bound, mean plus one standard deviation and mean curves estimated for earthquake-induced slope displacements based on the results of Newmark analyses of 348 earthquake motions and six (6) synthetic acceleration time histories.

Slope displacements are estimated using the conservative upper bound curve and the ratio of horizontal acceleration that reduces the factor of safety to 1.0, i.e., the yield acceleration (Ky) and the peak horizontal acceleration (PGA).

REFERENCES:

1. Civil & Environmental Consultants, Inc. Report, "Permanent Deformation Evaluation, Pond Creek No. 1 Coal Refuse Disposal Site, South Cell Slurry Impoundment, Johnston City, Williamson County, Illinois," January 23, 2008.
2. Civil & Environmental Consultants, Inc. Report, "Abandonment Evaluation, Pond Creek No. 1 Coal Refuse Disposal Site, South Cell Slurry Impoundment, Johnston City, Williamson County, Illinois," July 23, 2008.

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3. Hynes-Griffin, M.E., Franklin, A.G. 1984, "Rationalizing the Seismic Coefficient Method," Miscellaneous Paper GL-84-3, US Army Corp of Engineers Waterways Experiment Station, Vicksburg, Mississippi.

4. Illinois Department of Natural Resources, Office of Water Resources, Construction and Maintenance of Dams, Part 3702, Chapter IX.

5. International Building Code 2006 and 2000.

6. Kramer, S.L., 1996, "Geotechnical Earthquake Engineering," Prentice Hall Publishers.

7. Hynes-Griffin, M.E., Franklin, A.G. 1984, "Rationalizing the Seismic Coefficient Method," Miscellaneous Paper GL-84-3, US Army Corp of Engineers Waterways Experiment Station, Vicksburg, Mississippi.

8. Makdisi, F.I. and Seed, H.B., 1978, "Simplified Procedure for Estimating Dam and Embankment Earthquake Induced Deformations," Journal of the Geotechnical Engineering Division, ASCE, Vol. 104, No. GT7, pp 849-867.

9. Newmark, N.M., 1965, "Effects of Earthquakes on Dams and Embankments," Geotechnique 15, pp. 139-160.

10. U.S. Department of Labor, Mine Safety and Health Administration, "Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 Seismic Design: Stability and Deformation Analyses," May 2009.

ANALYSIS:

In accordance with the IDNR guidelines Part 3702 Dam and Safety Rules, GAI performed pseudo-static slope stability analyses of the Phase 7 Dam to determine the seismic factor of safety (Fs) and yield acceleration (Ky). A site PGA = 0.54 g obtained from the USGS National Seismic Hazard Mapping Project map for 2% Probability of Exceedance in 50 years was used in the Fs slope stability analyses.

Table 1 – Refuse/Soil Properties Used in Pseudo-Static and Yield Acceleration Slope Stability Analyses

Description	Unit Weights (γ_t,γ_s) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion (c) (psf)	Shear Strength
Coarse Coal Refuse (CCR)	130, 140	33.7	0	Effective (Drained)
Fine Coal Refuse (FCR)	80, 90	0	1,393	80% of Peak (Undrained)
Residual Soil	125, 135	19.5	416	Total (Undrained)

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The slope stability analyses resulted in a minimum factor of safety of 0.51 using a horizontal acceleration corresponding to the PGA value of 0.54g. Consequently, the results of the Phase 7 pseudo-static (seismic) slope stability analyses are not satisfactory, and thus a permanent deformation analysis is required per the IDNR guidelines.

GAI subsequently performed yield acceleration slope stability analyses, which varied the input horizontal acceleration in PCSTABL until a Factor of Safety equal to 1.0 was achieved. Based on these analyses, a yield acceleration of 0.18g was iteratively determined for the Phase 7 Dam soil mass and the downstream critical failure surface.

Hard copies of the input and output files for the Phase 7 pseudo-static slope stability analyses are attached.

MAKDISI-SEED DEFORMATION ANALYSES

Spectral Accelerations: (for use in calculating fundamental period)

Using the IBC 2006 the maximum spectral acceleration for Williamson County, IL is as follows:

0.2 second spectral response acceleration: Ss = 1.0 See IBC 2006 page 318 (attached)

1.0 second spectral response acceleration: S1 = 0.28 See IBC 2006 page 319 (attached)

Site Class:

Site Class D from IBC 2006 Table 1613.5.2 was assumed based on a stiff residual soil profile and shear wave velocity between 600 and 1,200 feet per second (fps) determined from field testing at the Pond Creek site within the top 100 feet beneath the proposed Phase 7 Dam.

Site Coefficients Fa and Fv: (for use in calculating fundamental period)

From IBC 2006 Table 1613.5.3(1): Fa = 1.1 (Site Class D)

From IBC 2006 Table 1613.5.3(2): Fv = 1.9 (Site Class D)

Design Spectral Response Acceleration Parameters: (for use in calculating fundamental period)

IBC 2006 Equation 16-37: $S_{MS} = F_a * S_S = 1.1*1.0 = 1.1g$

IBC 2006 Equation 16-38: $S_{M1} = F_v * S_1 = 1.9*0.28 = 0.53g$

IBC 2006 Equation 16-39: $S_{DS} = 2/3 * S_{MS} = 2/3*1.1 = 0.73g$

IBC 2006 Equation 16-40: $S_{D1} = 2/3 * S_{M1} = 2/3*0.53 = 0.36g$

Note: Although S_{DS} is larger than PGA (0.73g > 0.54g),

USE PGA = 0.54g = amax (as required by IDNR)

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Fundamental Period of the Dam:

From IBC 2000, and for the Phase 7 dam, it is assumed that the fundamental (predominant) period

To = Ts = S_{D1}/S_{DS} = 0.36/0.73 = 0.49 seconds

Note: From the Phase 2 dynamic site response deformation analyses, the fundamental frequency of the Phase 2 soil column was about 4.4 hertz (Hz) or 1 / 4.4 = 0.23 seconds.

USE To = Ts = 0.49 seconds (conservative)

Deformation Estimate: From Makdisi-Seed (1978) Figure 16 and:

Maximum Design Earthquake = M 8.0 (Reference 1); Assumed between M 7-1/2 and M 8-1/4 in Fig. 16

Yield/Maximum Acceleration = ay/amax = 0.18g/0.54g = 0.33;

ay=Ky = 0.18g and amax=PGA = 0.54g

To = 0.49 seconds:

From Figure 16 (attached), U/amax* To = 0.2 (approx.)

Therefore, U = amax* To*0.2*32.2 = 0.54g*0.49sec.*0.2*32.2ft/sec2 = 1.7 feet

U = 1.7 feet = 20 inches

HYNES-GRIFFEN FRANKLIN DEFORMATION ANALYSES

Based on the various data for the Phase 7 Dam and Pond Creek facility including:

N = Ky = 0.18g;

A = PGA = 0.54g; and,

Figure 7 of Reference 3:

Therefore,

U = slope displacements = about 40 centimeters = 16 inches.

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CONCLUSIONS

GAI has completed permanent deformation analyses of the Phase 7 Dam using empirically-based Makdisi-Seed and Hynes-Griffin Franklin methods, which yielded crest settlements of 20 and 16 inches, respectively. Further, Phase 2 deformations were previously estimated at 17 inches based on dynamic site response analyses and Newmark sliding block methods, which is consistent with the empirically-based analyses and estimates of Phase 7 Dam crest settlement. Therefore, the maximum Phase 7 Dam crest settlement of 20 inches compares favorably to an available freeboard of the Phase 7 Dam of 96 inches above the Phase 7 maximum fines level. GAI notes that the failure surface impacts only a portion of the approximate 400-foot wide Phase 7 crest width, as shown in the slope stability results, which adds significantly to the downstream safety of the dam.

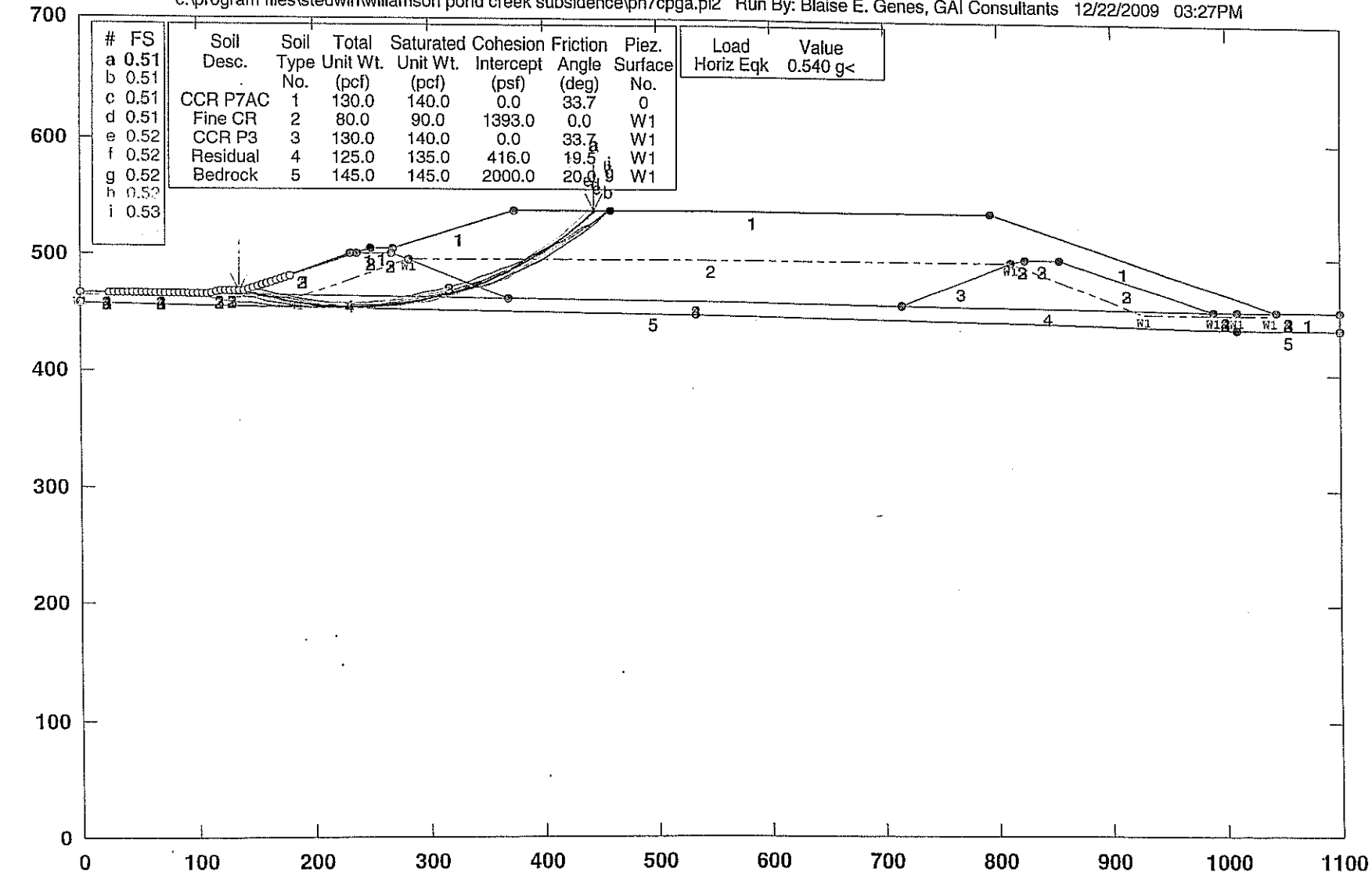
Although permanent deformations are acceptable relative to the available freeboard, GAI recommends that the dam be thoroughly inspected following a seismic event to make observations and note any ground movement, scarps, sloughing, toe bulges, etc. on the exposed downstream and upstream slopes, increased piezometric groundwater levels, and any other issues that may suggest slope instability.

ATTACHMENT 1

SEISMIC FACTOR OF SAFET AND YIELD ACCELERATION PSEUDO-STATIC SLOPE STABILITY ANALYSES RESULTS

Pond Creek, Phase 7C South - 80% Sup FCR- PGA=.54g Pseudo-Static

c:\program files\stedwin\williamson pond creek subsidence\ph7cpga.pl2 Run By: Blaise E. Genes, GAI Consultants 12/22/2009 03:27PM



#	FS
a	0.51
b	0.51
c	0.51
d	0.51
e	0.52
f	0.52
g	0.52
h	0.52
i	0.53

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR P7AC	1	130.0	140.0	0.0	33.7	0
Fine CR	2	80.0	90.0	1393.0	0.0	W1
CCR P3	3	130.0	140.0	0.0	33.7	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1

Load	Value
Horiz Eqk	0.540 g<

PCSTABL5M/si FSmin=0.51

Safety Factors Are Calculated By The Modified Bishop Method

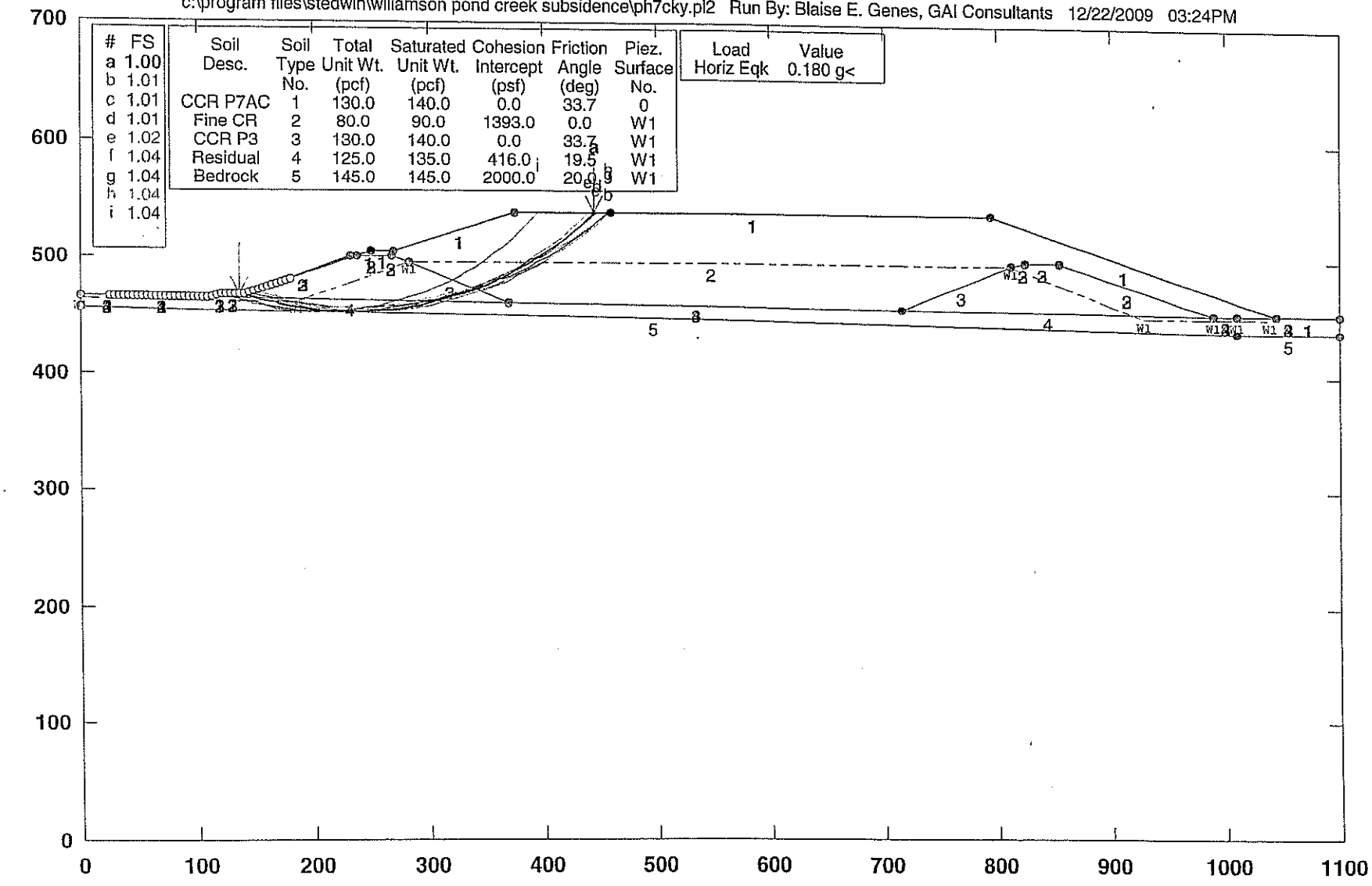
STED



R14843

Pond Creek, Phase 7C South - 80% Sup FCR- Ky Yield Acceleration

c:\program files\stedwin\williamson pond creek subsidence\ph7cky.pl2 Run By: Blaise E. Genes, GAI Consultants 12/22/2009 03:24PM



#	FS
a	1.00
b	1.01
c	1.01
d	1.01
e	1.02
f	1.04
g	1.04
h	1.04
i	1.04

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR P7AC	1	130.0	140.0	0.0	33.7	0
Fine CR	2	80.0	90.0	1393.0	0.0	W1
CCR P3	3	130.0	140.0	0.0	33.7	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1

Load	Value
Horiz Eqk	0.180 g<

PCSTABL5M/si FSmin=1.00

Safety Factors Are Calculated By The Modified Bishop Method

STED



R14844

ATTACHMENT 2

IBC 2006 AND MAKDISI-SEED DESIGN CHART/CURVES

IBC (2006)

identified by the building official and that are the minimum necessary to assure safe living conditions.

2. Any alteration of a historic structure provided that the alteration will not preclude the structure's continued designation as a historic structure.

1612.3 Establishment of flood hazard areas. To establish flood hazard areas, the governing body shall adopt a flood hazard map and supporting data. The flood hazard map shall include, at a minimum, areas of special flood hazard as identified by the Federal Emergency Management Agency in an engineering report entitled "The Flood Insurance Study for [INSERT NAME OF JURISDICTION]," dated [INSERT DATE OF ISSUANCE], as amended or revised with the accompanying Flood Insurance Rate Map (FIRM) and Flood Boundary and Floodway Map (FBFM) and related supporting data along with any revisions thereto. The adopted flood hazard map and supporting data are hereby adopted by reference and declared to be part of this section.

1612.4 Design and construction. The design and construction of buildings and structures located in flood hazard areas, including flood hazard areas subject to high velocity wave action, shall be in accordance with ASCE 24.

1612.5 Flood hazard documentation. The following documentation shall be prepared and sealed by a registered design professional and submitted to the building official:

1. For construction in flood hazard areas not subject to high-velocity wave action:
   - 1.1. The elevation of the lowest floor, including the basement, as required by the lowest floor elevation inspection in Section 109.3.3.
   - 1.2. For fully enclosed areas below the design flood elevation where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.6.2.1 of ASCE 24, construction documents shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.6.2.2 of ASCE 24.
   - 1.3. For dry floodproofed nonresidential buildings, construction documents shall include a statement that the dry floodproofing is designed in accordance with ASCE 24.
2. For construction in flood hazard areas subject to high-velocity wave action:
   - 2.1. The elevation of the bottom of the lowest horizontal structural member as required by the lowest floor elevation inspection in Section 109.3.3.
   - 2.2. Construction documents shall include a statement that the building is designed in accordance with ASCE 24, including that the pile or column foundation and building or structure to be attached thereto is designed to be anchored to resist flotation, collapse and lateral movement due to the effects of wind and flood loads acting simultaneously on all building components, and other load requirements of Chapter 16.
   - 2.3. For breakaway walls designed to resist a nominal load of less than 10 psf (0.48 kN/m²) or more than 20 psf (0.96 kN/m²), construction documents shall include a statement that the breakaway wall is designed in accordance with ASCE 24.

SECTION 1613
EARTHQUAKE LOADS

1613.1 Scope. Every structure, and portion thereof, including nonstructural components that are permanently attached to structures and their supports and attachments, shall be designed and constructed to resist the effects of earthquake motions in accordance with ASCE 7, excluding Chapter 14 and Appendix 11A. The seismic design category for a structure is permitted to be determined in accordance with Section 1613 or ASCE 7.

Exceptions:

1. Detached one- and two-family dwellings, assigned to Seismic Design Category A, B or C, or located where the mapped short-period spectral response acceleration, S_S, is less than 0.4 g.
2. The seismic-force-resisting system of wood-frame buildings that conform to the provisions of Section 2308 are not required to be analyzed as specified in this section.
3. Agricultural storage structures intended only for incidental human occupancy.
4. Structures that require special consideration of their response characteristics and environment that are not addressed by this code or ASCE 7 and for which other regulations provide seismic criteria, such as vehicular bridges, electrical transmission towers, hydraulic structures, buried utility lines and their appurtenances and nuclear reactors.

1613.2 Definitions. The following words and terms shall, for the purposes of this section, have the meanings shown herein.

DESIGN EARTHQUAKE GROUND MOTION. The earthquake ground motion that buildings and structures are specifically proportioned to resist in Section 1613.

MAXIMUM CONSIDERED EARTHQUAKE GROUND MOTION. The most severe earthquake effects considered by this code.

MECHANICAL SYSTEMS. For the purposes of determining seismic loads in ASCE 7, mechanical systems shall include plumbing systems as specified therein.

ORTHOGONAL. To be in two horizontal directions, at 90 degrees (1.57 rad) to each other.

SEISMIC DESIGN CATEGORY. A classification assigned to a structure based on its occupancy category and the severity of the design earthquake ground motion at the site.

SEISMIC-FORCE-RESISTING SYSTEM. That part of the structural system that has been considered in the design to provide the required resistance to the prescribed seismic forces.

SITE CLASS. A classification assigned to a site based on the types of soils present and their engineering properties as defined in Section 1613.5.2.

SITE COEFFICIENTS. The values of F_a and F_v indicated in Tables 1613.5.3(1) and 1613.5.3(2), respectively.

1613.3 Existing buildings. Additions, alterations, modification, or change of occupancy of existing buildings shall be in accordance with Sections 3403.2.3 and 3406.4.

1613.4 Special inspections. Where required by Section 1705.3, the statement of special inspections shall include the special inspections required by Section 1705.3.1.

1613.5 Seismic ground motion values. Seismic ground motion values shall be determined in accordance with this section.

1613.5.1 Mapped acceleration parameters. The parameters S_s and S_1 shall be determined from the 0.2 and 1-second spectral response accelerations shown on Figures 1613.5(1) through 1613.5(14). Where S_1 is less than or equal to 0.04 and S_s is less than or equal to 0.15, the structure is permitted to be assigned to Seismic Design Category A.

1613.5.2 Site class definitions. Based on the site soil properties, the site shall be classified as either Site Class A, B, C, D, E or F in accordance with Table 1613.5.2. When the soil properties are not known in sufficient detail to determine the site class, Site Class D shall be used unless the building official or geotechnical data determines that Site Class E or F soil is likely to be present at the site.

1613.5.3 Site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters. The maximum considered earthquake spectral response acceleration for short periods, S_{MS}, and at 1-second period, S_{M1}, adjusted for site class effects shall be determined by Equations 16-37 and 16-38, respectively:

$$S_{MS} = F_a S_s \quad \textbf{(Equation 16-37)}$$

$$S_{M1} = F_v S_1 \quad \textbf{(Equation 16-38)}$$

where:

F_a = Site coefficient defined in Table 1613.5.3(1).

F_v = Site coefficient defined in Table 1613.5.3(2).

S_S = The mapped spectral accelerations for short periods as determined in Section 1613.5.1.

S_1 = The mapped spectral accelerations for a 1-second period as determined in Section 1613.5.1.

TABLE 1613.5.2
SITE CLASS DEFINITIONS

SITE CLASS	SOIL PROFILE NAME	AVERAGE PROPERTIES IN TOP 100 feet, SEE SECTION 1613.5.5		
		Soil shear wave velocity, $\bar{v}_s$, (ft/s)	Standard penetration resistance, $\bar{N}$	Soil undrained shear strength, $\bar{s}_u$, (psf)
A	Hard rock	$\bar{v}_s > 5{,}000$	N/A	N/A
B	Rock	$2{,}500 < \bar{v}_s \le 5{,}000$	N/A	N/A
C	Very dense soil and soft rock	$1{,}200 < \bar{v}_s \le 2{,}500$	$\bar{N} > 50$	$\bar{s}_u \ge 2{,}000$
D	Stiff soil profile	$600 \le \bar{v}_s \le 1{,}200$	$15 \le \bar{N} \le 50$	$1{,}000 \le \bar{s}_u \le 2{,}000$
E	Soft soil profile	$\bar{v}_s < 600$	$\bar{N} < 15$	$\bar{s}_u < 1{,}000$
E	—	Any profile with more than 10 feet of soil having the following characteristics: 1. Plasticity index $PI > 20$, 2. Moisture content $w \ge 40\%$, and 3. Undrained shear strength $\bar{s}_u < 500$ psf		
F	—	Any profile containing soils having one or more of the following characteristics: 1. Soils vulnerable to potential failure or collapse under seismic loading such as liquefiable soils, quick and highly sensitive clays, collapsible weakly cemented soils. 2. Peats and/or highly organic clays (H > 10 feet of peat and/or highly organic clay where H = thickness of soil) 3. Very high plasticity clays (H > 25 feet with plasticity index PI > 75) 4. Very thick soft/medium stiff clays (H > 120 feet)		

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m², 1 pound per square foot = 0.0479 kPa. N/A = Not applicable

TABLE 1613.5.3(1)
VALUES OF SITE COEFFICIENT F_a [a]

SITE CLASS	MAPPED SPECTRAL RESPONSE ACCELERATION AT SHORT PERIOD				
	$S_s \le 0.25$	$S_s = 0.50$	$S_s = 0.75$	$S_s = 1.00$	$S_s \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	Note b	Note b	Note b	Note b	Note b

a. Use straight-line interpolation for intermediate values of mapped spectral response acceleration at short period, S_s.
b. Values shall be determined in accordance with Section 11.4.7 of ASCE 7.

TABLE 1613.5.3(2)
VALUES OF SITE COEFFICIENT F_v [a]

SITE CLASS	MAPPED SPECTRAL RESPONSE ACCELERATION AT 1-SECOND PERIOD				
	$S_1 \le 0.1$	$S_1 = 0.2$	$S_1 = 0.3$	$S_1 = 0.4$	$S_1 \ge 0.5$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	Note b	Note b	Note b	Note b	Note b

a. Use straight-line interpolation for intermediate values of mapped spectral response acceleration at 1-second period, S_1.
b. Values shall be determined in accordance with Section 11.4.7 of ASCE 7.

1613.5.4 Design spectral response acceleration parameters. Five-percent damped design spectral response acceleration at short periods, S_{DS}, and at 1-second period, S_{D1}, shall be determined from Equations 16-39 and 16-40, respectively:

$$S_{DS} = \frac{2}{3} S_{MS} \qquad \text{(Equation 16-39)}$$

$$S_{D1} = \frac{2}{3} S_{M1} \qquad \text{(Equation 16-40)}$$

where:

S_{MS} = The maximum considered earthquake spectral response accelerations for short period as determined in Section 1613.5.3.

S_{M1} = The maximum considered earthquake spectral response accelerations for 1-second period as determined in Section 1613.5.3.

1613.5.5 Site classification for seismic design. Site classification for Site Class C, D or E shall be determined from Table 1613.5.5.

The notations presented below apply to the upper 100 feet (30 480 mm) of the site profile. Profiles containing distinctly different soil and/or rock layers shall be subdivided into those layers designated by a number that ranges from 1 to n at the bottom where there is a total of n distinct layers in the upper 100 feet (30 480 mm). The symbol i then refers to any one of the layers between 1 and n.

where:

v_{si} = The shear wave velocity in feet per second (m/s).

d_i = The thickness of any layer between 0 and 100 feet (30 480 mm).

where:

$$\bar{v}_s = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{v_{si}}} \qquad \text{(Equation 16-41)}$$

$$\sum_{i=1}^{n} d_i = 100 \text{ feet (30 480 mm)}$$

N_i is the Standard Penetration Resistance (ASTM D 1586) not to exceed 100 blows/foot (305 mm) as directly measured in the field without corrections. When refusal is met for a rock layer, N_i shall be taken as 100 blows/foot (305 mm).

$$\overline{N} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{N_i}} \qquad \textbf{(Equation 16-42)}$$

where N_i and d_i in Equation 16-42 are for cohesionless soil, cohesive soil and rock layers.

$$\overline{N}_{ch} = \frac{d_s}{\sum_{i=1}^{m} \frac{d_i}{N_i}} \qquad \textbf{(Equation 16-43)}$$

where:

$$\sum_{i=1}^{m} d_i = d_s$$

Use d_i and N_i for cohesionless soil layers only in Equation 16-43.

d_s = The total thickness of cohesionless soil layers in the top 100 feet (30 480 mm).

m = The number of cohesionless soil layers in the top 100 feet (30 480 mm).

s_{ui} = The undrained shear strength in psf (kPa), not to exceed 5,000 psf (240 kPa), ASTM D 2166 or D 2850.

$$\overline{s}_u = \frac{d_c}{\sum_{i=1}^{k} \frac{d_i}{s_{ui}}} \qquad \textbf{(Equation 16-44)}$$

where:

$$\sum_{i=1}^{k} d_i = d_c$$

d_c = The total thickness of cohesive soil layers in the top 100 feet (30 480 mm).

k = The number of cohesive soil layers in the top 100 feet (30 480 mm).

PI = The plasticity index, ASTM D 4318.

w = The moisture content in percent, ASTM D 2216.

Where a site does not qualify under the criteria for Site Class F and there is a total thickness of soft clay greater than 10 feet (3048 mm) where a soft clay layer is defined by: $s_u <$ 500 psf (24 kPa), $w \geq 40$ percent, and PI > 20, it shall be classified as Site Class E.

The shear wave velocity for rock, Site Class B, shall be either measured on site or estimated by a geotechnical engineer or engineering geologist/seismologist for competent rock with moderate fracturing and weathering. Softer and more highly fractured and weathered rock shall either be measured on site for shear wave velocity or classified as Site Class C.

The hard rock category, Site Class A, shall be supported by shear wave velocity measurements either on site or on profiles of the same rock type in the same formation with an equal or greater degree of weathering and fracturing. Where hard rock conditions are known to be continuous to a depth of 100 feet (30 480 mm), surficial shear wave velocity measurements are permitted to be extrapolated to assess $\overline{v}_s$.

The rock categories, Site Classes A and B, shall not be used if there is more than 10 feet (3048 mm) of soil between the rock surface and the bottom of the spread footing or mat foundation.

1613.5.5.1 Steps for classifying a site.

1. Check for the four categories of Site Class F requiring site-specific evaluation. If the site corresponds to any of these categories, classify the site as Site Class F and conduct a site-specific evaluation.
2. Check for the existence of a total thickness of soft clay > 10 feet (3048 mm) where a soft clay layer is defined by: $\overline{s}_u <$ 500 psf (24 kPa), $w \geq 40$ percent and $PI > 20$. If these criteria are satisfied, classify the site as Site Class E.
3. Categorize the site using one of the following three methods with $\overline{v}_s$, $\overline{N}$, and $\overline{s}_u$ and computed in all cases as specified.

TABLE 1613.5.5
SITE CLASSIFICATION[a]

SITE CLASS	$\overline{v}_s$	$\overline{N}$ or $\overline{N}_{ch}$	$\overline{s}_u$
E	< 600 ft/s	< 15	< 1,000 psf
D	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
C	1,200 to 2,500 ft/s	> 50	> 2,000

For SI: 1 foot per second = 304.8 mm per second, 1 pound per square foot = 0.0479 kN/m².

a. If the $\overline{s}_u$ method is used and the $\overline{N}_{ch}$ and $\overline{s}_u$ criteria differ, select the category with the softer soils (for example, use Site Class E instead of D).

3.1. $\overline{v_s}$ for the top 100 feet (30 480 mm) ($\overline{v_s}$ method).

3.2. $\overline{N_{ch}}$ for the top 100 feet (30 480 mm) ($\overline{N}$ method).

3.3. $\overline{N}$ for cohesionless soil layers ($PI < 20$) in the top 100 feet (30 480 mm) and average, s_u for cohesive soil layers ($PI > 20$) in the top 100 feet (30 480 mm) ($\overline{s_u}$ method).

1613.5.6 Determination of seismic design category. Occupancy Category I, II or III structures located where the mapped spectral response acceleration parameter at 1-second period, S_1, is greater than or equal to 0.75 shall be assigned to Seismic Design Category E. Occupancy Category IV structures located where the mapped spectral response acceleration parameter at 1-second period, S_1, is greater than or equal to 0.75 shall be assigned to Seismic Design Category F. All other structures shall be assigned to a seismic design category based on their occupancy category and the design spectral response acceleration coefficients, S_{DS} and S_{D1}, determined in accordance with Section 1613.5.4 or the site-specific procedures of ASCE 7. Each building and structure shall be assigned to the more severe seismic design category in accordance with Table 1613.5.6(1) or 1613.5.6(2), irrespective of the fundamental period of vibration of the structure, T.

TABLE 1613.5.6(1)
SEISMIC DESIGN CATEGORY BASED ON SHORT-PERIOD RESPONSE ACCELERATIONS

VALUE OF S_{DS}	OCCUPANCY CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

TABLE 1613.5.6(2)
SEISMIC DESIGN CATEGORY BASED ON 1-SECOND PERIOD RESPONSE ACCELERATION

VALUE OF S_{D1}	OCCUPANCY CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

1613.5.6.1 Alternative seismic design category determination. Where S_1 is less than 0.75, the seismic design category is permitted to be determined from Table 1613.5.6(1) alone when all of the following apply:

1. In each of the two orthogonal directions, the approximate fundamental period of the structure, T_a, in each of the two orthogonal directions determined in accordance with Section 12.8.2.1 of ASCE 7, is less than 0.8 T_s determined in accordance with Section 11.4.5 of ASCE 7.
2. In each of the two orthogonal directions, the fundamental period of the structure used to calculate the story drift is less than T_s.
3. Equation 12.8-2 of ASCE 7 is used to determine the seismic response coefficient, C_s.
4. The diaphragms are rigid as defined in Section 12.3.1 in ASCE 7 or for diaphragms that are flexible, the distance between vertical elements of the seismic-force-resisting system does not exceed 40 feet (12 192 mm).

1613.5.6.2 Simplified design procedure. Where the alternate simplified design procedure of ASCE 7 is used, the seismic design category shall be determined in accordance with ASCE 7.

1613.6 Alternatives to ASCE 7. The provisions of Section 1613.6 shall be permitted as alternatives to the relevant provisions of ASCE 7.

1613.6.1 Assumption of flexible diaphragm. Add the following text at the end of Section 12.3.1.1 of ASCE 7:

Diaphragms constructed of wood structural panels or untopped steel decking shall also be permitted to be idealized as flexible, provided all of the following conditions are met:

1. Toppings of concrete or similar materials are not placed over wood structural panel diaphragms except for nonstructural toppings no greater than $1\frac{1}{2}$ inches (38 mm) thick.
2. Each line of vertical elements of the lateral-force-resisting system complies with the allowable story drift of Table 12.12-1.
3. Vertical elements of the lateral-force-resisting system are light-framed walls sheathed with wood structural panels rated for shear resistance or steel sheets.
4. Portions of wood structural panel diaphragms that cantilever beyond the vertical elements of the lateral-force-resisting system are designed in accordance with Section 2305.2.5 of the *International Building Code*.

1613.6.2 Additional seismic-force-resisting systems for seismically isolated structures. Add the following exception to the end of Section 17.5.4.2 of ASCE 7:

Exception: For isolated structures designed in accordance with this standard, the Structural System Limitations and the Building Height Limitations in Table 12.2-1 for ordinary steel concentrically braced frames (OCBFs) as defined in Chapter 11 and ordinary moment frames (OMFs) as defined in Chapter 11 are permitted to be taken as 160 feet (48 768 mm) for structures assigned to Seismic Design Category D, E or F, provided that the following conditions are satisfied:

1. The value of R_I as defined in Chapter 17 is taken as 1.
2. For OMFs and OCBFs, design is in accordance with AISC 341.

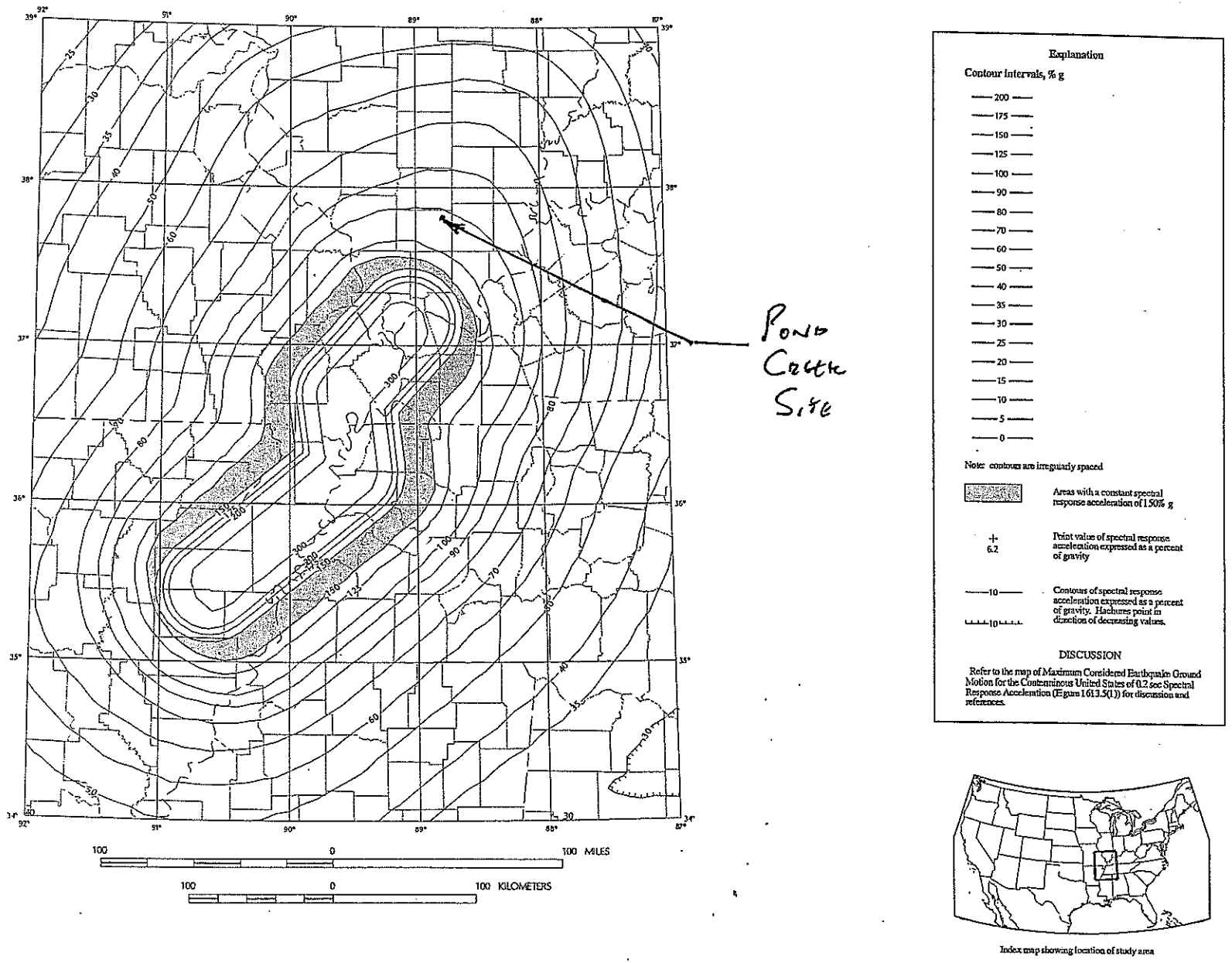
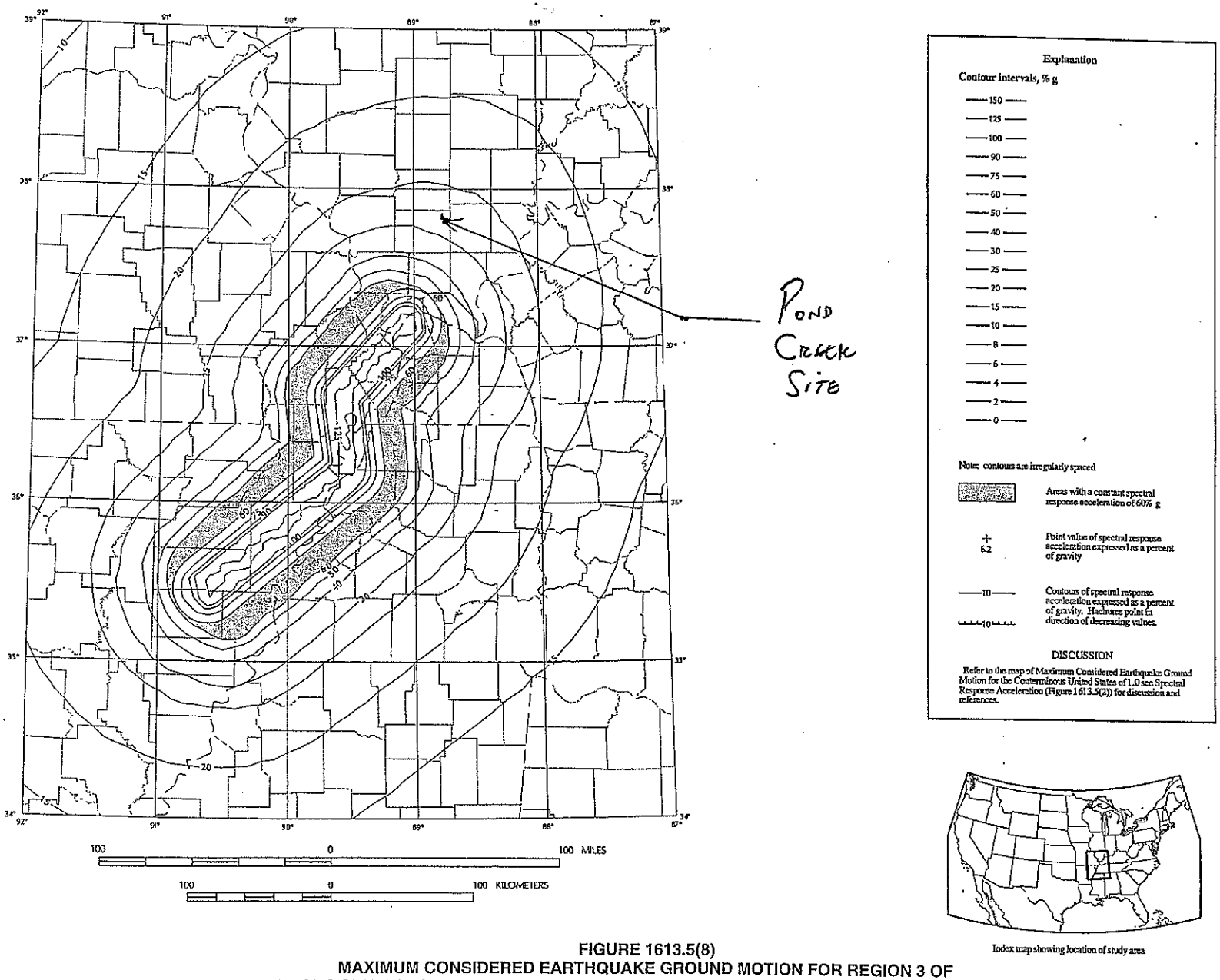


FIGURE 1613.5(7)
MAXIMUM CONSIDERED EARTHQUAKE GROUND MOTION FOR REGION 3 OF
0.2 SEC SPECTRAL RESPONSE ACCELERATION (5% PERCENT OF CRITICAL DAMPING), SITE CLASS B



Index map showing location of study area

FIGURE 1613.5(8)
MAXIMUM CONSIDERED EARTHQUAKE GROUND MOTION FOR REGION 3 OF 1.0 SEC SPECTRAL RESPONSE ACCELERATION (5% OF CRITICAL DAMPING), SITE CLASS B

R14853

TABLE 1615.1.2(1)
VALUES OF SITE COEFFICIENT F_a AS A FUNCTION OF SITE CLASS AND MAPPED SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS (S_S)[a]

SITE CLASS	MAPPED SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS				
	$S_s \le 0.25$	$S_s = 0.50$	$S_s = 0.75$	$S_s = 1.00$	$S_s \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	Note b
F	Note b	Note b	Note b	Note b	Note b

a. Use straight line interpolation for intermediate values of mapped spectral acceleration at short period, S_s.
b. Site-specific geotechnical investigation and dynamic site response analyses shall be performed to determine appropriate values.

TABLE 1615.1.2(2)
VALUES OF SITE COEFFICIENT F_v AS A FUNCTION OF SITE CLASS AND MAPPED SPECTRAL RESPONSE ACCELERATION AT 1-SECOND PERIOD (S_1)[a]

SITE CLASS	MAPPED SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS				
	$S_s \le 0.1$	$S_1 = 0.2$	$S_1 = 0.3$	$S_1 = 0.4$	$S_1 \ge 0.5$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	Note b
F	Note b	Note b	Note b	Note b	Note b

a. Use straight line interpolation for intermediate values of mapped spectral acceleration at 1-second period, S_1.
b. Site-specific geotechnical investigation and dynamic site response analyses shall be performed to determine appropriate values.

3. For periods greater than T_S, the design spectral response acceleration, S_a, shall be given by Equation 16-21.

$$S_a = 0.6\frac{S_{DS}}{T_O}T + 0.4S_{DS} \qquad \text{(Equation 16-20)}$$

$$S_a = \frac{S_{D1}}{T} \qquad \text{(Equation 16-21)}$$

where:

S_{DS} = The design spectral response acceleration at short periods as determined in Section 1615.1.3.

S_{D1} = The design spectral response acceleration at 1 second period as determined in Section 1615.1.3.

T = Fundamental period (in seconds) of the structure (Section 1617.4.2).

$T_O = 0.2\,S_{D1}/S_{DS}$

$T_S = S_{D1}/S_{DS}$

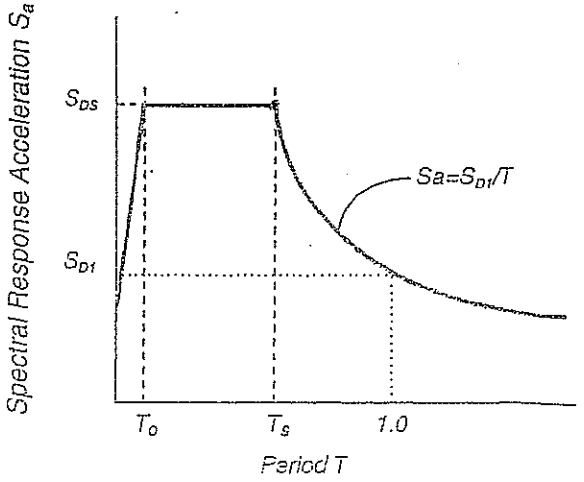


FIGURE 1615.1.4
DESIGN RESPONSE SPECTRUM

R14855

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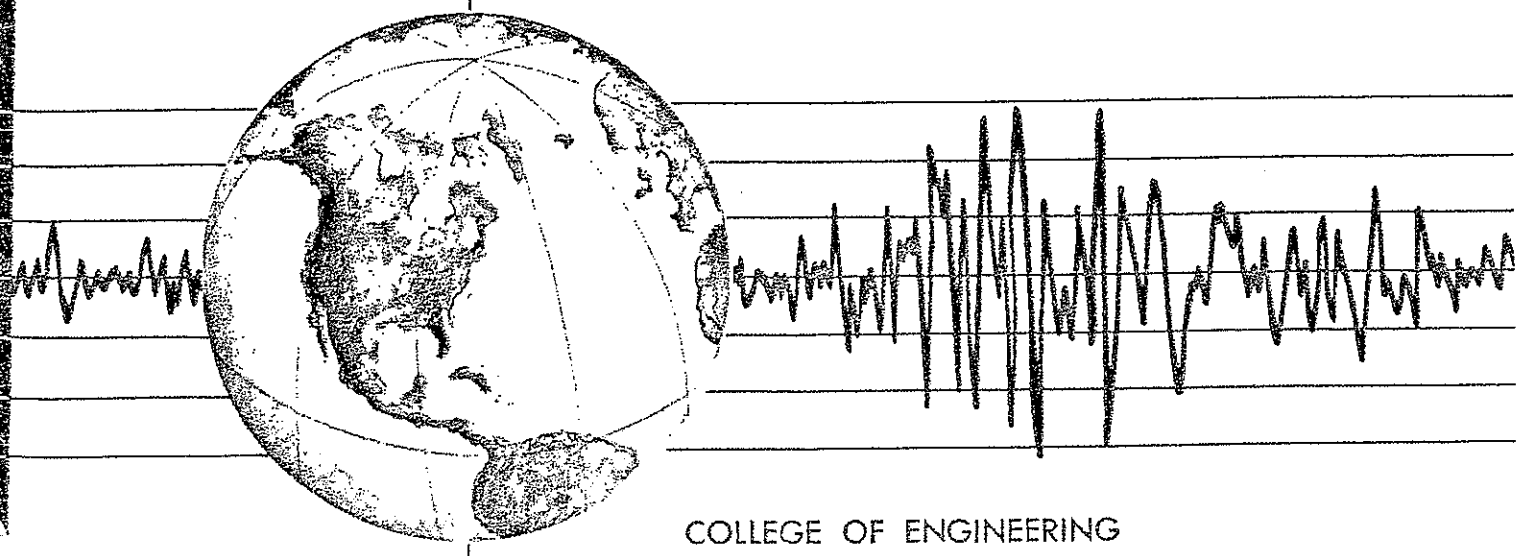
AUGUST 1977

EARTHQUAKE ENGINEERING RESEARCH CENTER

A SIMPLIFIED PROCEDURE FOR ESTIMATING EARTHQUAKE-INDUCED DEFORMATIONS IN DAMS AND EMBANKMENTS

by
F. I. MAKDISI
H. BOLTON SEED

A report on research sponsored by
the National Science Foundation



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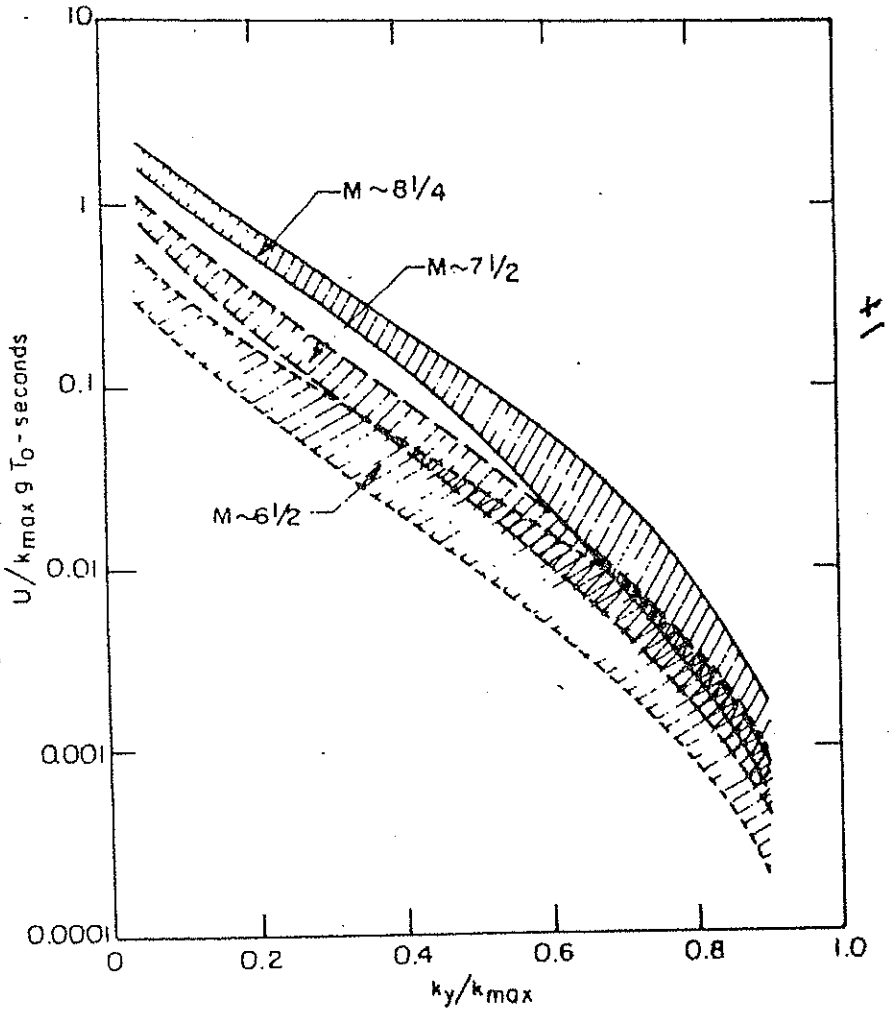

FIG. 15 VARIATION OF NORMALIZED PERMANENT DISPLACEMENT WITH YIELD ACCELERATION - SUMMARY OF ALL DATA

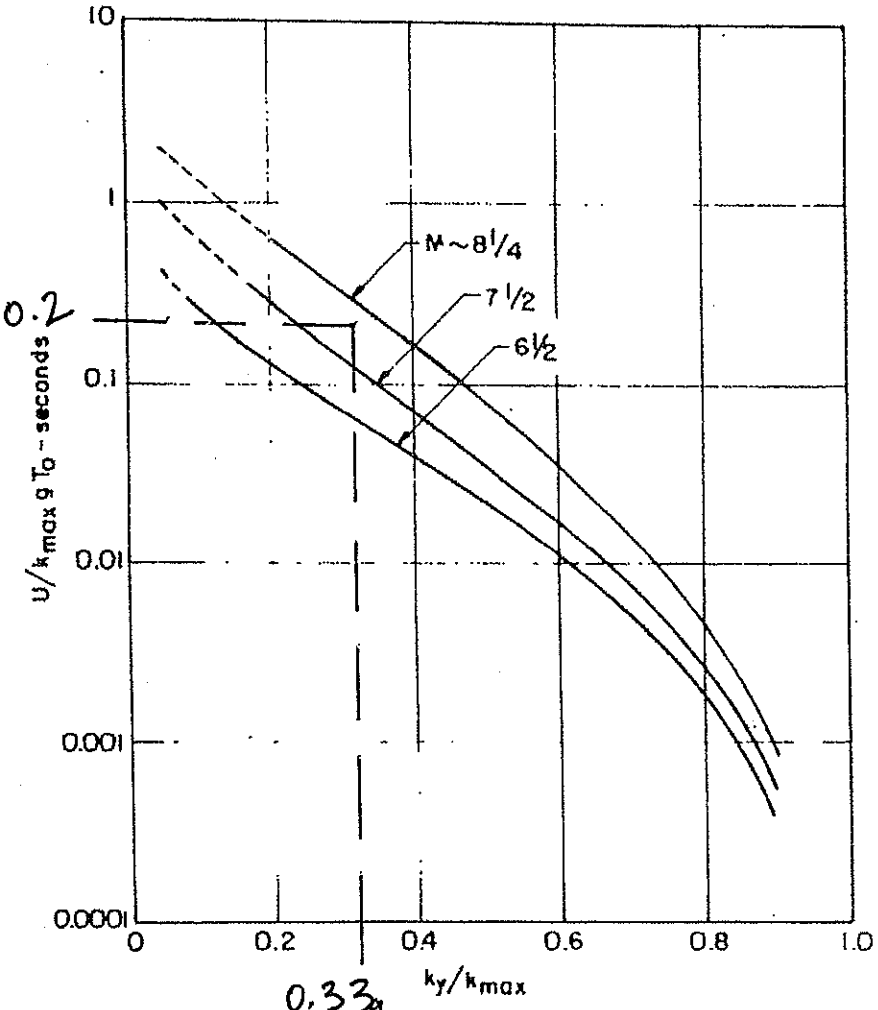

FIG. 16 VARIATION OF AVERAGE NORMALIZED DISPLACEMENT WITH YIELD ACCELERATION

R14856

ATTACHMENT 3

HYNES-GRIFFIN AND FRANKLIN DESIGN CURVE

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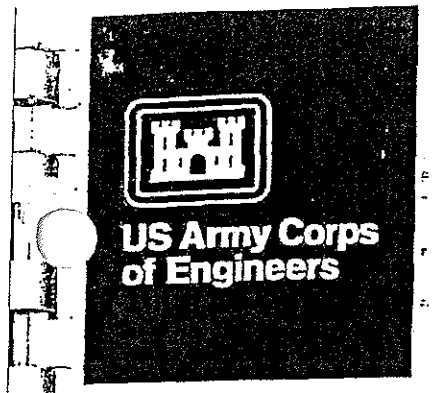



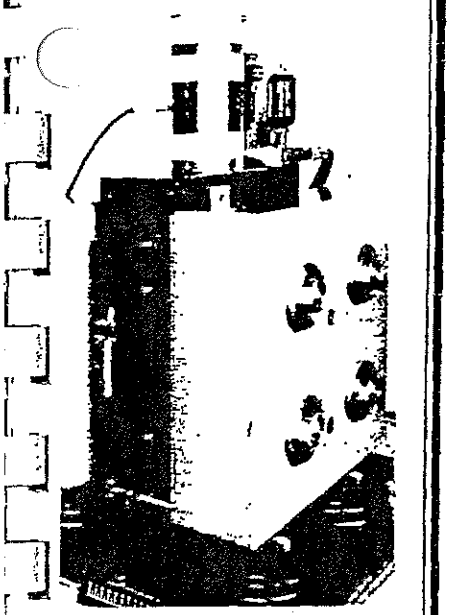

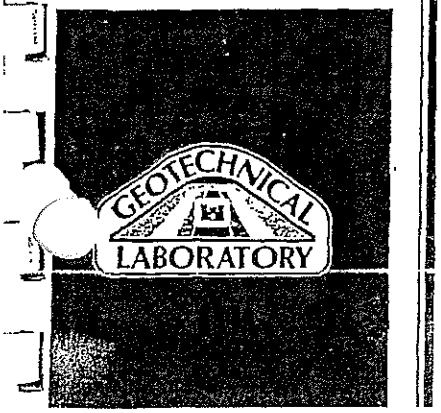

MISCELLANEOUS PAPER GL-84-13

RATIONALIZING THE SEISMIC COEFFICIENT METHOD

by

Mary E. Hynes-Griffin, Arley G. Franklin

Geotechnical Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
PO Box 631
Vicksburg, Mississippi 39180



July 1984
Final Report

Approved For Public Release; Distribution Unlimited

UNIVERSITY OF CALIFORNIA
Earthquake Engineering
Research Center

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Prepared for DEPARTMENT OF THE ARMY
US Army Corps of Engineers
Washington, DC 20314
Under CWIS Work Unit 31145

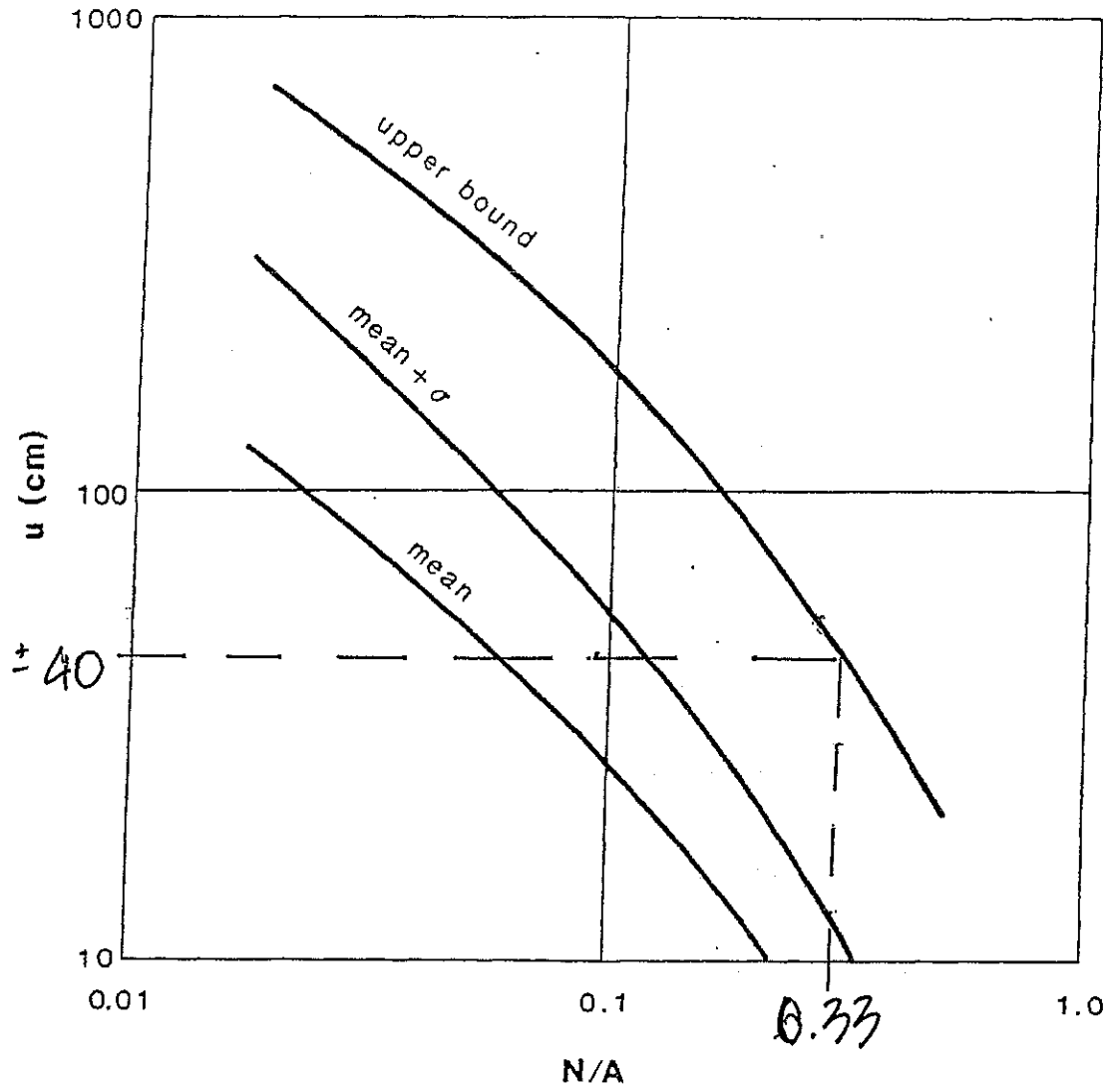

Figure 7. Permanent displacement u versus N/A , based on 348 horizontal components and 6 synthetic accelerograms

Embankment Response Analysis

21. Amplification of ground motions in the embankments may be examined by analysis of a shear-beam model of the embankment-foundation system. A closed-form solution has been obtained by Sarma (1979) for the problem illustrated by Figure 8. The model considered is an untruncated triangular wedge of height h_1 with a shear-wave velocity S_1 and density ρ_1, underlain by a foundation layer with thickness h_2, shear-wave velocity S_2, and density ρ_2. Both the wedge and foundation are linearly visco-elastic and have the same damping ratio D. The earthquake motions are considered to be rigid-body

DOCUMENT

72

Alliance Consulting, Inc.
Engineers • Constructors • Scientists

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ILLINOIS DEPARTMENT OF NATURAL RESOURCES
OFFICE OF LANDS AND MINERALS

INCIDENTAL PERMIT REVISION
POND CREEK MINE NO. 1

COAL REFUSE DISPOSAL FACILITY NO. 2
PHASES 4 THROUGH 7
PERMIT NO. 375

Prepared for

WILLIAMSON ENERGY, LLC
JOHNSTON CITY, ILLINOIS

ALLIANCE PROJECT NO. B11-179-1413
APRIL 2011

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PLAN MODIFICATION
MACH #1 MINE

COAL REFUSE DISPOSAL FACILITY NO. 2
PHASES 4 THROUGH 7
IMPOUNDMENT ID NO. IL 08-03141-02

Prepared for

WILLIAMSON ENERGY, LLC
JOHNSON CITY, ILLINOIS

ALLIANCE PROJECT NO. B11-179-1413
APRIL 2011

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Office: 618-983-3020 Fax: 618-983-3017

April 15, 2011

Mr. Scott Fowler
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
Land Reclamation Division
503 E. Main, FL 001
Benton, IL 62812

Re: Permit No. 375, Coal Refuse Disposal Facility No. 2, Phases 4 Through 7

Dear Mr. Fowler:

Please accept this letter as authorization for Alliance Consulting, Inc. (Alliance) to perform work on the above-referenced Plan Modification and make corrections as necessary. Please send copies of any comments to Alliance as well as Williamson Energy, LLC.

Should you have any questions or require additional information, please do not hesitate to contact me.

Respectfully submitted,

WILLIAMSON ENERGY, LLC

Anthony Webb

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IL Environmental Protection Agency
MARION REGIONAL OFFICE

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

April 18, 2011

Project No. B11-179-1413

Mr. Larry Crislip
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
2309 West Main Street, Suite 116
Marion, IL 62959

Transmittal
Permit No. 375
Coal Refuse Disposal Facility No. 2
Phases 4 Through 7
Mach #1 Mine

Dear Mr. Crisp:

On behalf of our client, Williamson Energy, LLC, please find attached two copies of a Incidental Permit Revision report for your review. The impoundment plan has been modified to provide for pumping into Phase 4 of the impoundment and elimination of Phase 7B from the plan.

The current approved plan requires that slurry pumping into the Phase 4/6/7 impoundment area will not begin until the Phase 7 embankment crest reaches elevation 500. This modification will provide Mach Mining, LLC with more slurry storage capacity and additional flexibility in the timing of disposal of coarse and fine coal refuse at the impoundment complex.

After the totally incised into natural ground portion of the Phase 4 impounding area is filled with fine coal refuse, it is proposed to keep the Phase 6 embankment at least a design storm volume (one 72-hour duration probable maximum rainfall) in elevation above the fine coal refuse/water level in Phase 4. Storm water drawdown of the runoff from the design rainfall storm in 10 days or less will be accomplished by the use of diesel pumps. After the principal spillway/decant pipe is installed in Phase 7, Stage 6, the runoff from one 72-hour duration probable maximum rainfall can be drawn down in less than 10 days by the pipe.

The revised staging provides for 2.3 years of coarse coal refuse disposal and 2.8 years of fine coal refuse disposal beyond February 1, 2011. The staging computations were revised to account for Phase 4 and Phase 6 impoundment and embankment volume changes due to ground subsidence caused by longwall mining in Panel No. 2 and the incised portion of Phase 4.

Design Considerations and Analysis

1. Pumping Into Phases 4 and 6

   The bottom portion of the Phase 4 impoundment area has been incised into natural ground to provide an additional slurry storage volume of 251,000 cubic yards. It is proposed to pump into the totally incised area, in combination with finishing pumping into Phase 5, while the Phase 6

embankment is built. The Phase 6 embankment will be kept one design rainfall runoff volume above the fine coal refuse level in Phase 4 to provide for a buttressing embankment around the east and west sides of the Phase 4 embankment.

Stability analysis performed for the most critical times during pumping into Phase 4 are enclosed. Slope stability safety factors of greater that 1.5 and 1.2 for the static and seismic conditions, respectively, were obtained

The design rainfall for Phases 4, 6, and 7 has been changed from two times the 72-hour duration probable maximum precipitation (PMP), with drawdown by pumps of one storm in 30 days or less, to one 72-hour duration PMP, 90 percent of which is to be pumped out in 10 days or less. A maximum pumping capacity of 6,039 gallons per minute is required. Sufficient diesel pumps and piping are present and will be kept at the mine site to meet the 10-day drawdown criteria.

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Phase 7B was previously proposed to be placed in the Phase 4 impoundment area on the north side of the Phase 3 embankment. Elimination of Phase 7B provides additional fine coal refuse slurry storage capacity and additional coarse coal refuse for impoundment capping and embankment construction. One of its initial purposes was to provide a lining/buttress between the Phase 7 pool and the potentially cracked Phase 3 embankment after the Phase 3 embankment is undermined. Subsequent analyses and undermining experience at the refuse disposal area have determined that cracking of the north side of the Phase 3 embankment should not present a problem regarding the Phase 4/6/7 impoundment pool. Any cracking of the Phase 3 north embankment will be sealed in accordance with the specifications prior to pumping slurry in the Phase 4/6/7 pool above the incise volume. We performed slope stability analyses and determined that adequate factors of safety exist with Phase 7B removed.

Stability analyses were performed for the most critical times during the construction of Phase 7 to evaluate the effect of eliminating Phase 7B. Slope stability safety factors of greater that 1.5 and 1.2 for the static and seismic conditions, respectively, were obtained with Phase 7B removed.

Flood storage requirements and flood routings were performed to determine various maximum allowable slurry levels versus embankment crest elevations for Phases 4, 6, and 7. Previously submitted Phases 4, 6, and 7 impoundment storage values have been revised to account for the incised portion of the pool and the removal of Phase 7B. Revised flood storage computations were done to account for additional flood storage capability due to the removal of Phase 7B.

A flood routing was done to take into account the discharge capacity of the Phase 7, Step 6 spillway/decant pipe. As a result, we were able to raise the Phase 7, Step 6 principal spillway pipe riser inlet elevation and maximum allowable slurry elevation from 530.0 to 531.1 and still maintain the required amount of embankment freeboard.

Computations for the above mentioned analysis are enclosed.

Revised Documents

The following enclosed plan documents have been revised and should be used in conjunction with our July 2009 and March 2010 plan submittal reports:

1. Report narrative and table of contents.

2. Revised computations concerning impoundment and embankment volumes, drainage areas, available and required storm water removal pumping capacity, embankment construction times, storm storage requirements, fine coal refuse pumping time provided, storm drawdown pumping requirements and capacity, flood routing for the Phase 7 principal spillway/decant pipe, and slope stability analysis for the removal of Phase 7B and pumping into Phases 4 and 6.

3. Revisions to Drawing Nos. B05-330-M31, B05-330-M34, B05-330-M33, B05-330-E13, and B05-330-E22. These drawings have been revised to show: (1) the elimination of Phase 7B, (2) the topographic data for the incised portion of Phase 4, (3) maximum allowable slurry levels, (4) revised embankment volumes, (5) a revised allowable fine coal refuse elevation graph, and (6) a revised stage-storage volume graph for Phase 7.

If you have any questions, or require additional information, please contact us.

Respectively submitted,

ALLIANCE CONSULTING, INC.

Claudio E. Yon, P.E.
Principal Engineer

CEY:knb
Enclosures

File: 11179-02

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Office: 618-983-3020 Fax: 618-983-3017

April 15, 2011

Mr. Scott Fowler
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
Land Reclamation Division
503 E. Main, FL 001
Benton, IL 62812

Re: Permit No. 375, Coal Refuse Disposal Facility No. 2, Phases 4 Through 7

Dear Mr. Fowler:

Please accept this letter as authorization for Alliance Consulting, Inc. (Alliance) to perform work on the above-referenced Plan Modification and make corrections as necessary. Please send copies of any comments to Alliance as well as Williamson Energy, LLC.

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Respectfully submitted,

WILLIAMSON ENERGY, LLC

Anthony Webb

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

April 18, 2011

Project No. B11-179-1413

Mr. Scott Fowler
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
Land Reclamation Division
One Natural Resources Way
Springfield, IL 62702-1271

Transmittal
Permit No. 375
Pond Creek No. 1 Mine
Coal Refuse Disposal Facility No. 2
Phases 4 Through 7

Dear Mr. Fowler:

On behalf of our client, Williamson Energy, LLC, please find attached three copies of Incidental Permit Revision for your approval. Two copies of the application have been submitted to Larry Crislip. The impoundment plan has been modified to provide for pumping into Phase 4 of the impoundment and elimination of Phase 7B from the plan.

The current approved plan requires that slurry pumping into the Phase 4/6/7 impoundment area will not begin until the Phase 7 embankment crest reaches elevation 500. This modification will provide Mach Mining, LLC with more slurry storage capacity and additional flexibility in the timing of disposal of coarse and fine coal refuse at the impoundment complex.

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Respectively submitted,

ALLIANCE CONSULTING, INC.

Claudio E. Yon, P.E.
Principal Engineer

CEY:knb
Enclosures

File: 11179-01

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

April 19, 2011

Project No. B11-180-1413

Mr. Michael L. Diedrichsen, P. E.
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
One Natural Resources Way
Springfield, IL 62702-1271

Transmittal
Plan Modification
Coal Refuse Disposal Facility No. 2
Phases 4 Through 7
ID No. 20061019

Dear Mr. Diedrichsen:

On behalf of our client, Williamson Energy, LLC, please find attached a copy of a plan modification report for your approval. We have sent copies of applications to the Office of Mines & Minerals and Illinois Environmental Protection Agency. The impoundment plan has been modified to provide for pumping into Phase 4 of the impoundment prior to completion of Phase 6 and elimination of Phase 7B from the plan.

The current approved plan requires that slurry pumping into the Phase 4/6/7 impoundment area will not begin until the Phase 7 embankment crest reaches elevation 500. This modification will provide Mach Mining, LLC with more slurry storage capacity and additional flexibility in the timing of disposal of coarse and fine coal refuse at the impoundment complex.

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Respectively submitted,

ALLIANCE CONSULTING, INC.

Claudio E. Yon, P.E.
Principal Engineer

CEY:knb
Enclosures

File: 11180-01

ENGINEERING DESIGN PLAN

REPORT
ENGINEERING DESIGN PLAN
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
MACH #1 MINE
WILLIAMSON ENERGY, LLC
WILLIAMSON COUNTY, ILLINOIS
JOHNSON CITY, ILLINOIS

TABLE OF CONTENTS

		PAGE
1.0 INTRODUCTION		1
2.0 EXISTING SITE CONDITIONS		2
2.1	Site Characteristics	2
2.2	Geology	2
3.0 MINING OPERATIONS AND COAL REFUSE PRODUCTION		2
3.1	Mining Operations	2
3.2	Coal Refuse Production	4
4.0 SUBSURFACE EXPLORATION		4
4.1	Subsurface Exploration	4
5.0 FIELD AND LABORATORY TESTING		5
5.1	Soil	5
5.2	Coarse Coal Refuse	5
6.0 COAL REFUSE DISPOSAL PLAN		6
6.1	Phase 3	7
6.2	Phase 4	8
6.3	Phase 5	9
6.4	Phase 6	11
6.5	Phase 7	12
6.6	Abandonment Plan	13
7.0 ENGINEERING ANALYSES		13
7.1	Hydrologic and Hydraulic Analyses	13
7.2	Slope Stability Analyses	14
8.0 SUMMARY		15

TABLE OF CONTENTS (continued)

CERTIFICATION OF PLAN

APPENDIX A – GUIDELINE TECHNICAL SPECIFICATIONS

APPENDIX B – CALCULATION BRIEF

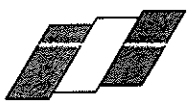
APPENDIX C – LABORATORY TESTING

APPENDIX D – BORING AND TEST PIT LOGS

FIGURES

LIST OF FIGURES

FIGURE NO.	DRAWING NO.	TITLE
1	B05-330-T1	Title Sheet
2	B05-330-M15	Plan – Existing Conditions
3	B05-330-M2	Plan – Phase 1
4	B05-330-M3	Plan – Phase 2
5	B05-330-E9	Section A-A
6	B05-330-E10	Slope Stability
7	B05-330-E11	Details
8	B05-330-M16	Abandonment
9	B05-330-E23	Decant Installation Details
10	B05-330-E14	Details
11	B05-330-E24	Decant Installation and Uniform Section Map Details
12	B05-330-E49	Ditch "F" Profile and Details
13	B05-330-E47	Instrumentation and Contingency Buttress Details
14	B05-330-E12	Slope Stability Analysis – Section C-C and D-D
15	B05-330-E39	Slope Stability Analysis – Sections F-F and G-G
16	B05-330-E48	Slope Stability Analysis – Sections F-F (Phase 7C)
17	B05-330-M36	Mining/Impoundment Construction Timing Map
18	B05-330-E46	Subsidence Effects Predictions Maps
19	B05-330-M50	Mine Vertical Subsidence Predictions
20	B05-330-M51	Mine Subsidence Horizontal Strain Predictions
21	B05-330-M44	Subsidence Survey Panel No. 1 Section
22	B05-330-M20	Abandonment Plan



REPORT
ENGINEERING DESIGN PLAN
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
MACH #1 MINE
WILLIAMSON ENERGY, LLC
WILLIAMSON COUNTY, ILLINOIS
JOHNSON CITY, ILLINOIS

1.0 INTRODUCTION

Plans have been developed for the construction of a coarse and fine coal refuse disposal facility to be located near Johnston City in Williamson County, Illinois. The proposed coal refuse disposal facility will provide disposal capacity for both coarse and fine coal refuse produced by the Mach #1 mine coal preparation plant located approximately 0.25 mile west of the proposed facility. The location of the site is just southwest of the intersection of Dwina Road and Dean Road and is shown on Figure No. 1.

The plan, as presented herein, provides for the disposal of approximately 4 years of coarse coal refuse and 7 years of fine coal refuse based on production rates provided by Williamson Energy operations for Williamson Energy LLC (Williamson Energy). The facility shall be constructed in five phases of coarse coal refuse embankment construction (Phases 3 through 7). During the initial construction of the Disposal Facility No. 2, fine coal refuse shall be disposed in the Disposal Facility No. 1 impoundment[1] MSHA ID No. 1211-IL08-03141-02 (Phases 1 and 2).

The proposed facility has been designed as a high hazard impoundment using the Probable Maximum Flood (PMF) storm event. Based on the design production rates, at the 1-year anniversary of initial impounding capability and thereafter, the facility will be capable of storing the runoff associated with the design storm event. The stored runoff volume, as well as operational water, shall be evacuated using a pump for Phases 4 and 6 and decant pipes for Phases 3, 5 and 7.

Combination sedimentation and perimeter ditches, access road gutters and bench gutters have been specified to convey storm runoff away from the embankment in a controlled manner. The ditches have been designed for routing the runoff associated with the 100-year, 6-hour recurrence interval storm event.

This report presents the design drawings, guideline technical specifications (Appendix A), and calculations (Appendix B) necessary for the design and construction of the embankment. The laboratory data and boring logs are contained in Appendices C and D, respectively.

---

[1] Alliance Consulting, Inc. report entitled "Report, Engineering Design Plan, Proposed Coal Refuse Disposal Facility, Pond Creek Mine No. 1, Williamson County, Illinois" prepared for Williamson Energy, LLC, Beckley, West Virginia, dated April 2006.

2.0 EXISTING SITE CONDITIONS

2.1 Site Characteristics

The general area of the proposed impoundment has previously been used for agricultural purposes and has relatively flat to mild slopes to the ridgeline at approximate Elevation 572. The surrounding landscape is characterized by extensive agricultural and rural residential land use. Regionally, the proposed permit area is located on the southern shelf of the Illinois Basin in the Mt. Vernon Hill Country physiographic division. Surrounding landforms are the results of both Wisconsinian glaciations and normal degradation processes such as weathering, mass wasting, and stream erosion. Surrounding topography is characterized by generally flat ridge tops, moderately steep hill slopes and broad flat valley floors associated with major streams. The local drainage pattern is dendritic reflecting the regional generally horizontal bedrock stratigraphy. The total relief of the Facility No. 2 footprint is approximately 32 feet ranging from approximately 436' to 468' above mean seal level (based on aerial photography).

Glacial deposits of the Carmi Member of the Equality Formation, consisting of quiet water lake silt and clay, constituted the original surface materials within the proposed permit area.

2.2 Geology

The proposed permit area is underlain by lower Pennsylvanian age rocks consisting of shale, sandstone, and siltstone with minor underclay, coal and limestone. These sequences reflect fluctuating shorelines, deltas, and shallow seas indicating deltaic, fluvial, and coal swamp depositional environments. These bedrock units can be highly variable in thickness and continuity. Mississippian rocks unconformably underlie the Pennsylvanian, however, they do not outcrop in the subject area and were not penetrated during exploration drilling.

The major stratigraphic marker is the Herrin No. 6 coal which is generally uniform and continuous in the subject area and occurs at approximate Elevation 10 beneath the proposed refuse disposal facility. Shale and sandstone units in the subject area exhibit a high degree of lateral facies changes and interbedding. The Herrin No. 6 seam is described as a normal bright-banded coal with a lower portion that contains a prominent claystone parting. The base of the Herrin No. 6 exhibits an undulating surface with a general structural trend toward the north-northeast dipping approximately 60 feet per mile. No major faults or other structural anomalies are known to be present within the proposed permit.

3.0 MINING OPERATIONS AND COAL REFUSE PRODUCTION

3.1 Mining Operations

The Herrin No. 6 coal seam (average Elevation 10 feet above mean sea level) is proposed to be mined by both longwall and conventional mining techniques beneath the footprint area of the proposed facility. The disposal plan has been staged to minimize the impacts of the mining on the integrity of the embankments. Due to the timing of the proposed mining, it will be necessary to initiate Phases 3 and 4 embankment construction above unmined areas.

Based on a report prepared by Syd S. Peng, etal[2], it is anticipated that substantially all of the significant surface subsidence resulting from the longwall mining activities should occur within approximately 14 to 21 days following longwall mining. Phase 3 shall be filled to capacity with fine coal refuse and the impounding capability eliminated before being mined under. Prior to the deposition of the fines, but following the subsidence period, a downstream stage (Phase 6) will be constructed around the Phase 4 impoundment area. This phase essentially "rings" the initial embankment and should serve to mitigate any cracks that may have developed in the initial embankment as a result of the subsidence. Internal drains have been specified for the Phase 3, 5, and 6 embankments to collect and convey potential seepage. Based on the predicted subsidence, the drains have been designed so that positive drainage will occur post subsidence. Also, as discussed in Section 6 of this report, observed cracks in the pool area of Phase 4, on the upstream and downstream slopes of Phase 4, the pool area and foundation area of Phase 5, and the foundation area of Phase 6 shall be over excavated to a depth of at least 4 feet and backfilled with compacted coarse coal refuse.

Subsidence monitoring baselines will be used to calibrate the subsidence prediction model and compare predicted to actual subsidence due to mining. The location of the baselines are shown on Figure No. 17 and the monitoring plan is discussed in Appendix F.

Concerning breakthrough potential, the Bureau of Mines Information Circular 8741 recommends an overburden thickness equal to 60 times the extraction height for total extraction mining. The lowest level of the proposed pool area is Elevation 426, and the bottom of coal seam is at average Elevation 10 feet with an extraction height of 6.5 feet. Therefore, the existing overburden thickness is greater than the recommended thickness and there is no significant potential for a catastrophic breakthrough of fine coal refuse slurry into the mine to occur.

Chapter 8, Section 25 of the MSHA Coal Mine Inspection and Plan Review Handbook, October, 2007, recommends a pillar factor of safety should be greater than 2.0 for the long-term support of critical areas. The maximum crest elevation of the proposed embankment is 538 which create an overburden height of 528 feet. Based on these dimensions, the ALPS factor of safety is 2.30, which is greater than the recommended minimum of 2.0.

Based on these conditions and recommended guidelines, it is expected that no adverse effects shall impact the stability or breakthrough potential of the impoundments.

No significant depth of impoundment water will be allowed prior to any of the required remediation of subsidence disturbance prior to the raising of the post-subsidence stages to a suitable elevation.

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[2]Report entitled "Prediction of Ground Movement Parameters due to Longwall Mining During different Phases of Impoundments", prepared by Syd S. Peng and Thomas Du, Department of Mining Engineering, West Virginia University, May 2009.

3.2 Coal Refuse Production

Based on information provided by Williamson Energy, the following annual production quantities, beginning with the first year of plant operation, were used in the design (see Calculations in Appendix B).

• Coarse Coal Refuse	Prior to longwall startup	34,330 cubic yards/year
	After longwall startup	2.53 million cubic yards/year
	For Phases 6 and 7	2.20 million cubic yards/year
• Fine Coal Refuse	Prior to longwall startup	17,945 cubic yards/year
	After longwall startup	1.32 million cubic yards/year
	For Phases 4, 5, 6 and 7	1.77 million cubic yards/year

4.0 SUBSURFACE EXPLORATION

4.1 Subsurface Exploration

During the month of February 2006, a subsurface exploration program consisting of drilling one soil boring (No. 8874) was conducted within the footprint of the proposed embankment. The intent of the program was to obtain soil samples to define the conditions and engineering characteristics relative to the construction and operation of the fine coal refuse slurry disposal impoundment. In addition to this soil boring, the results of a previous subsurface exploration program performed by Holcomb Foundation Engineering Co. (Holcomb) are presented in Appendix C and indicate the following:

- Sample number, type, standard penetration test blow counts, and depth;
- An overall description of the consistency, color and character of the soil; and,
- Indication of the observed groundwater level in the boreholes at the time of drilling.

The locations of the borings are depicted on Figure No. 2.

Generally, the soils encountered beneath the dam footprint consist of brown and gray silty clay with sand and pebbles. The thickness of the soil varied from 12.5' to 22.5' while the surface elevation for the borings varied from Elevation 438.5± to Elevation 473.0±. Each of the borings was terminated at the top of the bedrock.

Groundwater was encountered in two (2) of the seven (7) borings (i.e. Nos. 8293 and 8295). Following drilling, the depth from the ground surface to groundwater level varied from 10 to 13.5 feet or from Elevation 432.4± to Elevation 438.5± in the borings.

5.0 FIELD AND LABORATORY TESTING

5.1 Soil

Samples of the soils obtained during the subsurface exploration program from Boring No. 8874 were used for laboratory testing. The scope of the testing is discussed below and the results are presented in Appendix D.

Visual classification tests were performed by Holcomb on the split spoon samples obtained during drilling. Samples from the borings represent the foundation conditions for the proposed embankment. Additional testing performed on the borings included the following:

- Grain Size Analysis – Grain size analysis were performed on a sample from Boring No. 8874;
- Atterberg Limits Test – Atterberg Limits tests were performed on a sample from Boring No. 8874;
- Unit Weight Determination – Performed on a Shelby tube sample from Boring No. 8874; and,
- Shear Strength Test – A consolidated, undrained triaxial shear strength test with pore pressure measurements was performed on a Shelby tube sample from Boring No. 8874.

5.2 Coarse Coal Refuse

The proposed embankment shall be constructed with coarse coal refuse. The coarse coal refuse used to construct the embankment has been sampled from the Mach #1 Mine coal processing plant and has undergone laboratory testing. The scope of the testing is discussed below and results are presented in Appendix C.

- Grain Size Analysis – A grain size analysis was performed on the coarse coal refuse sample.
- Shear Strength Test – A consolidated, undrained triaxial shear strength test with pore pressure measurements was performed on re-molded samples of the coarse coal refuse. Material from the sample was re-molded to a density equivalent to approximately 95 percent of Standard Proctor maximum dry density.
- Permeability – A constant head permeability test was performed on a re-molded sample to determine the permeability characteristics of the coarse coal refuse for the embankment construction. The sample was compacted to approximately 95 percent of the Standard Proctor maximum dry density.
- Compaction Test – A Standard Proctor compaction test was performed on the coarse coal refuse sample.



5.3 Fine Coal Refuse

Two fine coal refuse bulk samples were obtained from the South Pond (Phase 2) for laboratory testing. The scope of the testing is discussed below and the results are presented in Appendix I [1(3)] (under separate cover).

- Moisture Content – Moisture contents were performed on the two fine coal refuse samples.
- Grain-size Analysis – Grain size distribution analysis was performed on the two fine coal refuse samples (sieve and hydrometer).
- Atterburg Limits – Atterberg Limit tests were performed on the two fine coal refuse samples.
- Specific Gravity – Specific gravity tests were performed on the two fine coal refuse samples.
- Shear Strength – Six consolidated – undrained triaxial tests were run on remolded fine coal refuse samples. These six tests included moisture content and total and dry density determinations.

5.4 Piezo-Seismic Cone Penetration Testing

- Fifteen piezo-seismic cone penetration soundings were performed at the Pond Creek site to measure tip stress, sleeve stress, pore water pressure, and shear wave velocities. The testing g was used to correlate index and strength parameters for the coarse coal refuse and foundation soil and for use in a deformation analysis.

- The testing data and results are presented in Appendix I (under separate cover).

6.0 COAL REFUSE DISPOSAL PLAN

The proposed plan provides disposal capacity for approximately 4 years of coarse and 7 years of fine coal refuse production. The plan has been developed in accordance with prudent engineering principles and practices and current Mine Safety and Health Administration (MSHA) design criteria for coal refuse disposal facilities. It is intended that the construction of the facility be monitored by experienced persons knowledgeable of the design, specifications and regulatory requirements.

A brief description of the disposal plan is as follows:

1. Sedimentation control for the construction of the embankment shall be provided by sedimentation ditches. Bench gutters and conveyance ditches shall be constructed to route the runoff from the embankment area to the sedimentation ditches.

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[3] GAI Consulting, Inc. report entitled "Response to MSHA Comment Nos. 1, 3, 7, and 8, Pond Creek mine No. 1, Coal Refuse Disposal Facility No. 2, Phases 3 and 7, Impoundment ID No. 1211-IL08-03141-02, Williamson Energy, LLC, Williamson Energy Company, Williamson County, Illinois," prepared for Alliance Consulting, Inc. Project C090403.01, May 2009.

2. Following topsoil removal, the Phase 3 embankment footprint shall be proofrolled and the Phase 3 embankment shall be constructed. Subsequently, the Phase 4 embankment footprint shall be proofrolled and Phase 4 embankment constructed followed by Phases 5, 6 and 7. Phase 6 shall be constructed using downstream construction techniques and Phase 7 shall raise the Phase 6 crest.

3. Fine coal refuse slurry may be pumped into the Phase 3 impoundment upon commencement of the construction of the Phase 4 embankment. The discharge line(s) shall be moved to result in a relatively uniform surface of fines throughout the impoundment and to minimize the depth of any water impounded directly against the embankment slope. Generally, a delta of fine coal refuse shall be maintained along the embankment slope.

4. Operational pump(s) and discharge line(s) shall be maintained to remove clarified water and normal rainfall from the impoundment. The facility has been designed to store the runoff associated with a PMF design storm event. Decant pipes have been specified to evacuate the design storm runoff for Phases 5 and for Phase 7 after its dam crest elevation reaches 538. Additional pumps with independent power supplies (diesel motors or generators) will be kept on site and used to evacuate storm water for Phases 3, 4, and 6; and for Phase 7 until its dam crest elevation reaches 538.

5. An internal drainage system located within the Phases 3, 5 and 6 embankments shall be installed to aid in controlling the phreatic level within the embankments.

6. Bench and road gutters shall be installed to control surface runoff and minimize erosion. All final surfaces shall be revegetated upon completion.

6.1 Phase 3

Prior to Phase 3 embankment construction, it will be necessary to initiate general site preparation activities to include topsoil removal and proof rolling. Soft areas encountered during the proof rolling shall be compacted or the material shall be removed and replaced with the same material as used in the Phase 3 embankment. Following proof rolling, the Phase 3 embankment shall be constructed using coarse coal refuse from the Mach #1 Mine coal preparation plant. The approximate location of the Phase 3 embankment is shown in plan and cross section on Figure Nos. 3 and 8, respectively, requires approximately 0.5 years of coarse coal refuse production to construct. Pertinent construction items include:

1. Coarse Coal Refuse Disposal – Phase 3 involves constructing an embankment 50 feet high to Elevation 500 using coarse coal refuse. As shown on Figure No. 8, the upstream slope of the embankment shall be constructed on a grade of 2.6H:1V and the downstream slope shall be on a grade of 3H:1V.

2. Fine Coal Refuse Disposal – Fine coal refuse slurry may be pumped into the impoundment upon the end of Phase 3 construction. Periodic relocation of the slurry discharge line shall be performed to promote a more uniform distribution of the fine



coal refuse and to minimize the depth of clarified water impounded directly against the embankment slope.

3. Pump Installation – An operational pump, of sufficient capacity to remove clarified water and normal precipitation, and associated discharge lines shall be installed during construction of Phase 4. The pump shall discharge into Sediment Pond No. 6 and/or the Freshwater Pond. Additional pumps will be kept available on site to evacuate 90 percent of the design storm in 10 days or less.

4. Internal Drain - An internal drainage system consisting of a perforated pipe and gravel, both wrapped with filter fabric, shall be installed during the construction of Phase 3 to aid in controlling the phreatic level within the embankment. The location and invert elevations for the internal drain are presented on Figure No. 3. Details pertaining to the drain construction are provided in the guideline technical specifications and on Figure No. 10.

5. Surface Drainage – Sedimentation/perimeter ditches shall be constructed as shown on Figure No. 3, to collect surface water and clarify the runoff before it is discharged into an existing channel. Ditch details are included on Figure Nos. 10, 11 and 12.

6. Instrumentation – Piezometer Nos. P-6, P-7, and P-8 shall be installed during Phase 3 construction at the locations shown on Figure No. 3. The proposed piezometer tip elevations are presented on Figure No. 15 and the piezometer installation detail is presented on Figure No. 13. Pressure transducers PN-1 and PN-2 (pneumatic piezometers or vibrating wire piezometers) and inclinometers I-1 and I-2 shall be installed in the Phase 3 embankment prior to undermining the phase. Their locations are shown on Figure No. 3. The proposed pressure transducer elevations are shown on Figure No. 16 and the installations details for the transducers and inclinometers are shown on Figure No. 13.

7. The impounding embankment of Phase 3 will be completed and slurry pumping into the impoundment will be completed before mining beneath the phase occurs. The Phase 3 impoundment will be capped before undermining occurs. Based on subsidence predictions, the internal drainage system for the embankment has been redesigned to continue to function post-subsidence. Any disruption of surface drainage features due to subsidence will be repaired. In the unlikely event embankment cracking and potential loss of slurry occurs during undermining of Phase 3, a contingency buttress and blanket drain have been designed as shown on Figure No. 13.

6.2 Phase 4

Phase 4, which is shown in plan and cross section on Figure Nos. 4 and 8, respectively, requires approximately 0.5 years of coarse coal refuse production to construct. Pertinent construction items include:

1. Embankment Construction – The Phase 4 embankment shall be situated approximately as shown on Figure No. 4 with an upstream toe at Elevation 446± and a final crest at

Elevation 492. The embankment will require the placement of approximately 1.33 million cubic yards of coarse coal refuse. The material used for the embankment construction shall be compacted to 95 percent of Standard Proctor maximum dry density. The moisture content of the material shall be within -2 to +3 percent of the optimum moisture content. As indicted on Figure No. 8 the upstream and downstream slopes of the Phase 4 embankment shall be constructed on a grade of 3 (horizontal) to 1 (vertical).

2. Fine Coal Refuse Disposal – During construction of the Phase 4 embankment, the fine coal refuse slurry shall continue to be pumped into the Phase 2 and 3 impoundments. Near the end of Phase 5's fine coal refuse storage capacity, slurry will be pumped into the incised into natural ground part of the Phase 4 pool. It is anticipated that when slurry pumping begins in Phase 4 any undetected subsidence cracks in the Phase 4 embankment and foundation will be sealed by the slurry. Phase 4 will be buttressed to the south by Phase 3, which will be already completed and full of slurry; by Phase 6 to the east and west, which will be built post-subsidence; and by Phase 5 to the north, which will be also built post-subsidence. After the slurry level in Phase 4 exceeds the incised portion of the pool, Phase 6 will be kept constructed to one 72-hour PMF flood storage volume above the Phase 4 slurry level.

3. Pump Installation – An operational pump, of sufficient capacity to remove clarified water and normal precipitation, and associated discharge lines shall be installed during construction of Phase 4. The pump shall discharge into Sediment Pond No. 6 and/or the Freshwater Pond. Additional pumps will be kept available on site to excavate 90 percent of the design storm in 10 days or less.

Phase 4 is an intermediate phase in preparation for the construction of Phases 5, 6, and 7. No slurry will be pumped into Phase 4 until after it has been undermined and no internal drainage features are included in this phase. Undermining of the Phase 4 embankment will occur shortly after its construction. The embankment and pool area of this phase will be examined for subsidence cracks and repairs will be made as needed.

6.3 Phase 5

Phase 5 will be built post-undermining. Prior to Phase 5 embankment construction, the Phase 5 cell shall be excavated and general site preparation activities including topsoil removal, subsidence crack sealing, and proof rolling. Soft areas encountered during the proof rolling shall be compacted or the material shall be removed and replaced with the same material as used in the Phase 5 embankment. Following subsidence crack sealing and proof rolling, the Phase 5 embankment shall be constructed using coarse coal refuse from the Mach #1 Mine preparation plant. The approximate location of the Phase 5 embankment is shown in plan and cross section on Figure Nos. 5 and 8, respectively, requires approximately 0.6 years of coarse coal refuse production to construct. Pertinent construction items include:

1. Coarse Coal Refuse Disposal – Phase 5 involves constructing an embankment 50 feet high to Elevation 488 using coarse coal refuse. The upstream slope of the embankment



shall be constructed on a grade of 3H:1V and the downstream slope shall be on a grade of 3H:1V.

2. Fine Coal Refuse Disposal – Fine coal refuse slurry may be pumped into the impoundment throughout Phase 5 construction. The average settled fine coal refuse level is expected to rise to Elevation 432± by the completion of the phase. Periodic relocation of the slurry discharge line shall be performed to promote a more uniform distribution of the fine coal refuse and to minimize the depth of clarified water impounded directly against the embankment slope.

3. Internal drain – An internal drainage system consisting of either a geocomposite and perforated pipe or non-calcareous gravel wrapped with a geotextile and perforated pipe, shall be installed during the construction of Phase 5 to aid in controlling the phreatic level within the embankment. The location and invert elevations for the internal drain are presented on Figure No. 5. Details pertaining to the drain construction are provided in the guideline technical specifications and on Figure No. 10.

4. Surface Drainage – Bench gutters shall be constructed as shown on Figure No. 5, to collect and convey surface water runoff to the sediment ditches. Ditch details are presented on Figure No. 10, 11 and 12.

5. Instrumentation – Piezometer Nos. P-9, P-10 and P-11 shall be installed during Phase 5 construction at the locations shown on Figure No. 5. The proposed piezometer tip elevations are presented on Figure No. 14 and the piezometer installation detail is presented on Figure No. 13.

6. Decant Pipe – Construction of the decant pipe shall be performed concurrent with the construction of the Phase 5 embankment. The installation includes excavating a trench into the embankment and placing approximately 94 feet of HDPE pipe and appurtenant structures (drop inlet, ditch, filter and drainage diaphragm and outlet drain). The drop inlet shall be extended vertically to Elevation 480 by adding the appropriate length of 18-inch diameter SDR 26 HPDE pipe to the HDPE elbow attached to the transport section of the decant pipe. The decant pipe shall be installed in accordance with the details presented on Figure No. 11.

7. Subsidence Crack Repair – The Phase 5 pool area will be examined for cracking and any areas containing cracks will be excavated to a depth of at least four feet, proof rolled, and backfilled and sealed with compacted coarse coal refuse placed to the compaction standard in the Guideline Technical Specifications. In the event that extensive, deep cracking is discovered, a slurry trench or cutoff trench will be extended to bedrock through the affected areas. The trench will be located beneath the underdrain alignment for Stage 5. If it is discovered that a slurry or cutoff trench is needed, a specific design will be submitted for approval prior to its construction. Any additional cracks discovered after slurry pumping begins during Phase 5 will be sealed by directing the slurry into the pool over to the cracks.



Phase 5 will be buttressed to the south by Phase 4.

6.4 Phase 6

Phase 6 will be built post-mining and no slurry will be pumped into this phase. Phase 6, which is shown in plan and cross section on Figure Nos. 6 and 8, respectively, requires approximately 0.9 years of coarse coal refuse production to construct. Phase 6 buttresses Phase 4 to the east and west to a final crest elevation of 492.0. Pertinent construction items include:

1. Coarse Coal Refuse Disposal – Phase 6 involves widening the Phase 4 embankment crest using downstream construction techniques. The upstream and downstream slopes of the embankment shall be constructed on a grade of 3H:1V.

2. Fine Coal Refuse Disposal – Fine coal refuse slurry will continue to be pumped into the Phase 5 impoundment during the first part of the Phase 6 construction. Fine coal refuse pumping into Phase 5 is expected to be fininshed before the completition of Phase 6. The Phase 6 embankment crest will be kept to at least one 72-hour flood storage volume above the fine coal refuse level in the Phase 4/6 pool until the pool elevation reaches 481.3, after which the crest elevation must be 492.0. Periodic relocation of the slurry discharge line shall be performed to promote a more uniform distribution of the fine coal refuse and to minimize the depth of clarified water impounded directly against the Phase 4/6 embankment slope.

3. Pump Installation – An operational pump, of sufficient capacity to remove clarified water and normal precipitation, and associated discharge lines shall be kept installed during construction of Phase 6. The pump shall discharge into Sediment Pond No. 6 and/or the Fresh Water Pond. Additional pumps will be kept available on site to excavate 90 percent of the design storm in 10 days or less.

4. Internal drain – An internal drainage system consisting of either a geocomposite and perforated pipe or non-calcareous gravel wrapped with a geotextile and perforated pipe, shall be installed during the construction of Phase 6 to aid in controlling the phreatic level within the embankment. The location and invert elevations for the internal drain are presented on Figure No. 6. Details pertaining to the drain construction are provided in the guideline technical specifications and on Figure No. 10.

5. Surface Drainage – Sedimentation/perimeter ditches shall be constructed as shown on Figure No. 6, to collect surface water and clarify the runoff before it is discharged into an existing channel. Ditch details are included on Figure Nos. 10, 11 and 12.

6. Instrumentation – Piezometer Nos. P-12, P-13, P-15 and P-16 shall be installed during Phase 6 construction at the locations shown on Figure No. 6. The proposed piezometer tip elevations are presented on Figure Nos. 14 and 15 and the piezometer installation detail is presented on Figure No. 13.



7. Subsidence Crack Repair – Prior to construction of the Phase 6 embankment, the Phase 4 pool area, Phase 4 embankment, and Phase 6 foundation area will be examined for cracking and any areas containing cracks will be excavated to a depth of at least four feet, proof rolled, and backfilled and sealed with a compacted coarse coal refuse placed to the compaction standard in the Guideline Technical Specifications. In the event that extensive, deep cracking is discovered, a slurry trench or cutoff trench will be extended to bedrock through the affected areas. The trench will be located beneath the underdrain alignment for Stage 6. If it is discovered that a slurry or cutoff trench is needed, a specific design will be submitted for approval prior to its construction. The Phase 4 embankment is the only embankment subject to subsidence cracking prior to slurry pumping. Any additional cracks discovered after slurry pumping begins during Phase 6 will be sealed by directing the slurry into the pool over to the cracks.

6.5 Phase 7

Phase 7, which is shown in plan and cross section on Figures No. 7 and on Figure 8, respectively, requires approximately 1.4 years of coarse coal refuse production to construct. Pertinent construction items include:

1. Coarse Coal Refuse Disposal – Phase 7 involves raising the Phase 6 embankment crest 46 feet to Elevation 538 using coarse coal refuse. Phase 7 will be constructed in six stages to maintain the required storm runoff storage capacity. The upstream and downstream embankment slopes shall be constructed to 3H:1V. The final embankment slopes shall be soil covered and vegetated in accordance with the Illinois reclamation permit.

2. Fine Coal Refuse Disposal – Fine coal refuse will continue to be pumped into the Phases 4/6/7 impoundment area as the Phase 7 embankment is being built. The Phase 7 embankment crest will be kept to at least one 72-hour flood storage volume, plus 3 feet of freeboard, above the fine coal refuse level in the Phase 4/6/7 pool until the principal swillway/decant pipe is installed and the crest elevation reaches 538.0, its final elevation. Periodic relocation of the slurry discharge line shall be performed to promote a more uniform distribution of the fine coal refuse and to minimize the depth of clarified water impounded directly against the embankment slope.

3. Surface Drainage – Bench and access road gutters shall be constructed as shown on Figure No. 7, to control and convey surface water runoff. Ditch details are presented on Figure Nos. 10, 11 and 12.

4. Instrumentation – Piezometer Nos. P-14 and P-17 shall be installed, during Phase 7 construction at the locations shown on Figure No. 7. Piezometer extension and installation details are presented on Figure No. 13. The piezometer tip elevations are specified on Figure Nos. 14 and 15. Pressure transducers PN-3 and PN-4 will be installed after Phase 3 is capped but before Phase 7 is started at the locations shown on Figure No. 3. The proposed pressure transducer elevations are shown on Figure 16 and the installation details are shown on Figure No. 13.



5. Decant Pipe – Construction of the decant pipe shall be performed concurrent with the construction of the Phase 7 embankment. The installation includes excavating a trench into the embankment and placing approximately 190 feet of HDPE pipe and appurtenant structures (drop inlet, ditch, filter and drainage diaphragm and outlet drain). The drop inlet shall be extended vertically to Elevation 531.1 by adding the appropriate length of 18-inch diameter SDR 26 HPDE pipe to the HDPE elbow attached to the transport section of the decant pipe. The decant pipe shall be installed in accordance with the details presented on Figure No. 11. The principal spillway/decant pipe is capable of routing the runoff from a 72-hour duration PMP rainfall with 3 feet of freeboard and evacuating it in less than 10 days.

Phase 7 will be built post-mining. Previously proposed Phase 7B has been eliminated and previously proposed Phases 7A and 7C have been replaced by Stages 1 through 6 as shown on Figure Nos. 7 and 9. As previously stated, it is anticipated that the slurry will seal any undetected cracks not detected and repaired during Phases 4 and 6.

6.6 Abandonment Plan

An abandonment grading plan has been provided on Figure No. 22. Briefly, the impounding capability shall be eliminated by filling the impoundment with coarse coal refuse. The final embankment configuration shall be constructed to drain as per the lines and grades shown on Figure No. 22 and the entire site shall be soil covered and seeded in accordance with the Illinois reclamation permit. The plan shall be reevaluated prior to abandonment based on actual coal refuse production rates, existing site conditions and embankment configuration, and revised if necessary.

7.0 ENGINEERING ANALYSES

In support of the plan, engineering analyses included slope stability analyses and the hydrologic and hydraulic studies for the impoundment and surface drainage facilities. The calculations describing the design assumptions, methodology and results are included in Appendix B.

7.1 Hydrologic and Hydraulic Analyses

The proposed facility has been evaluated using storm criteria for high hazard dams. Upon the one-year anniversary and thereafter, the impoundment shall be capable of storing the runoff associated with a PMF design storm event plus three feet of freeboard.

Evacuation of the stored water shall be accomplished by pumping for Phases 4 and 6. The required pumping capacity (6,039 gallons per minute for Phases 4, 6, and Phase 7 through the end of Stage 6) is based on storing the runoff associated with one design storm event and evacuating the runoff associated with one design storm event within 10 days. Pumps with an independent power source (diesel motor or generator) and associated discharge lines and connections will be kept on site to evacuate the stored storm runoff.



Evacuation of the stored runoff shall be accomplished by means of a decant pipe for the Phases 5 and 7 impoundments after they reach their final embankment crest elevation. The required pipe size, 18-inch HDPE SDR 26, is based on evacuating 90% of the runoff associated with one design storm event within 10 days. The surface drainage facilities, including road and bench gutters, and Ditches C through M have been sized to convey runoff associated with the 100-year, 6-hour recurrence interval storm event. The computed peak discharges were estimated using the computer program SedCad developed by the University of Kentucky. All permanent facilities have been designed with appropriate protection to minimize the potential for channel erosion. Details for the surface drainage facilities are presented on Figure Nos. 10, 11 and 12.

7.2 Slope Stability Analyses

Slope stability analyses have been performed for the upstream and downstream slopes of the Phases 3, 5 and 7 embankments using PCSTABL5, a computerized version of the modified Bishop Method of Slices, developed by Purdue University and the Indiana State Highway Commission. The critical potential failure surfaces, minimum factors of safety, and material properties used in the slope stability analyses are presented on Figure Nos. 14, 15 and 16 and in the calculation brief.

Slope stability was analyzed for both static and seismic (pseudo static) loading conditions for the downstream and upstream embankment slopes. For the static analysis, effective properties for the coal refuse and existing soil were used. For the pseudo-static analysis, total stress properties were used for the existing soils. The use of effective stress properties for the coal refuse and total stress properties for the existing cohesive soils is appropriate, giving the effects of the sudden loading in an earthquake event and the relatively slow drainage characteristics of the soils. Also, for the pseudo-static analysis, a horizontal acceleration of 0.15g[4] was used. The phreatic level used in the stability analyses was conservatively based on top flow line calculations performed on a transformed section. The transformed section was based on the horizontal permeability of the embankment material being nine times greater than the vertical permeability. The engineering properties of the embankment material were based on laboratory test results and our experience with similar materials.

The most critical potential long-term failure surfaces, as shown on Figure Nos. 14, 15 and 16, are summarized below:

[4] National Earthquake Hazards Reduction Program, Part I, Provisions for the Development of Seismic Regulations for New Buildings, Map 1, 1991 Edition.

Stage	Case	Minimum Static F.S.	Minimum Seismic F.S.
Phase 3	Downstream	1.51	1.23
	Upstream	1.89	1.20
Phase 5	Downstream	1.58	1.21
	Upstream	1.76	1.32
Phase 7	Downstream	1.52	1.20
	Upstream	1.82	1.26
Phase 7C South Slope	Downstream	1.50	*

As indicated in the above table, the computed factors of safety meet the minimum requirements (1.5 and 1.2 for the static and seismic cases, respectively).

* A liquefaction susceptibility analysis for Phase 7C was performed using zero-strength to very low strength for the fine coal refuse to evaluate the post-earthquake factors of safety. Factors of safety range from 1.2 to 1.6 for shallow and deep failure circles, respectively. The possibility of liquefaction of the fine coal refuse in Phase 3 during mining subsidence related disturbance was evaluated using a driving shear stress slope stability analysis with zero strength for the fine coal refuse. Factors of safety for the Phase 3 embankment, in the upstream and downstream directions, were 2.2 and 1.3 respectively. The factor of safety against embankment cracking during mine subsidence was evaluated and estimated to be 1.1. These analyses are contained in Appendix I (under separate cover).

Additional slope stability analyses were run to evaluate the effects of eliminating Stage 7B. The most critical static case failure surface had a safety factor of 1.90 and the most critical seismic failure surface had a safety factor of 1.25.

8.0 SUMMARY

The design plans for the proposed Mach #1 Mine Coal Refuse Disposal Facility No. 2 (Phases 3 through 7) are based on the subsurface exploration program, field and laboratory testing, and the engineering analyses described herein.

The plan should provide for disposal for approximately 3.3 years of coarse coal refuse and 5.8 years of fine coal refuse. The coarse coal refuse disposal life under this plan remaining after January 2011, plus the coarse coal refuse that will be used to cover the Phases 5 and 7 pool areas, is about 2.3 years. About 2.8 years of fine coal refuse storage will remain.

We trust that the plans, design calculations and guideline technical specifications described herein are acceptable to Williamson Energy and the appropriate regulatory authorities. In preparing this document, our professional services have been performed with care and skill ordinarily exercised by reputable members of the profession practicing under similar conditions at the same time and the same or similar locality. No warranty, expressed or implied, is made by rendition of these consulting services or by furnishing oral or written reports of the findings made.



If there are any questions, or if further clarification is required, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Claudio E. Yon, P. E.
Principal Engineer

CEY:knb

File: State/Report

CALCULATION BRIEF

CALCULATION BRIEF
PLAN MODIFICATION TO ELIMINATE PHASE 7B AND TO PUMP INTO PHASES 4 AND 6
COAL REFUSE DISPOSAL FACILITY NO. 2
MACH #1 MINE
MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS

TABLE OF CONTENTS

TOPIC	PAGE
Production Rates	1
Revised Impoundment Volumes	2 - 6
Revised Phase 6 and Phase 7 Embankment Volumes	7 - 12
Revised Drainage Areas	13 - 15
Hydrologic Design Parameters	16
Pump Capacity Calculations	17 - 23
Summary – Pumping and Embankment Construction Times	24
Impoundment Pumping Times and Storm Storage Requirements	25 - 34
Embankment Construction Times	35 - 38
Phase 7 Principal Spillway Pipe Discharge Table	39
Phase 7 HEC-1 Floodrouting and Drawdown	40 - 51
Slope Stability Analysis and Results	52 - 92

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BY: HLO DATE: 12/31/10 CHKD BY: TLG DATE: 4/11/2011 (1)

PROJECT NAME: **Refuse Disposal Area No. 2, Mach Mining, LLC**

PROJECT NO. **B05-330-1413** SHEET 1 OF 1

DESCRIPTION **Worksheet - Eliminate Phase 7B, Pump Into Phase 4**

FCR & CCR Production Rates and Volumes

Production Rates (based on June 2010 mine data)

6,000,000 tons clean coal per year
Recovery ratio (clean coal/raw coal) = 55%
CCR weighs 117 PCF, FCR weighs 58 PCF
CCR to FCR ratio by weight = 3.11:1
CCR to FCR ratio by volume = 1.54:1, conservatively use 1.24:1
Conservatively assume CCR weighs 125 PCF, FCR weighs 50 PCF

Total Refuse Production = 6,000,000 TPY(0.45)/(0.55) =	4,909,091	TPY	(say	4,909,000	TPY)
FCR Production = 4,909,091 TPY/(3.11 + 1) =	1,194,426	TPY	(say	1,194,000	TPY)
CCR Production = 4,909,091 - 1,194,424 TPY =	3,714,665	TPY	(say	3,715,000	TPY)

FCR Production = 1,194,426 TPY(2,000 LB/Ton)/50 PCF =	47,777,040	CF/Year
CCR Production = 3,714,665 TPY(2,000 LB/Ton)/125 PCF =	59,434,638	CF/Year

Check CCR/FCR Ratio: 59,434,638/47,777,040 = 1.24 OK

For Timing and Staging Volume Computations Use: (rounded to nearest 1,000 CF & 100 CY)

CCR =	59,435,000	CF/Year =	2,201,300	CY/Year
FCR =	47,777,000	CF/Year =	1,769,500	CY/Year
			3,970,800	CY/Year

File: Mach 7B-4Timing1.xls, hlo, rev. 04/07/11

R14895

(2)

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BY: HLO DATE: 12/13/10 CHKD BY: ____ DATE: ____

PROJECT NAME: Refuse Disposal Area No. 2, Mach Mining, LLC

PROJECT NO. B09-341-1413 SHEET ____ OF ____

DESCRIPTION Eliminate Phase 7B, Pump Into Phase 4 Impoundment Volumes - Stages 4, 6, and 7

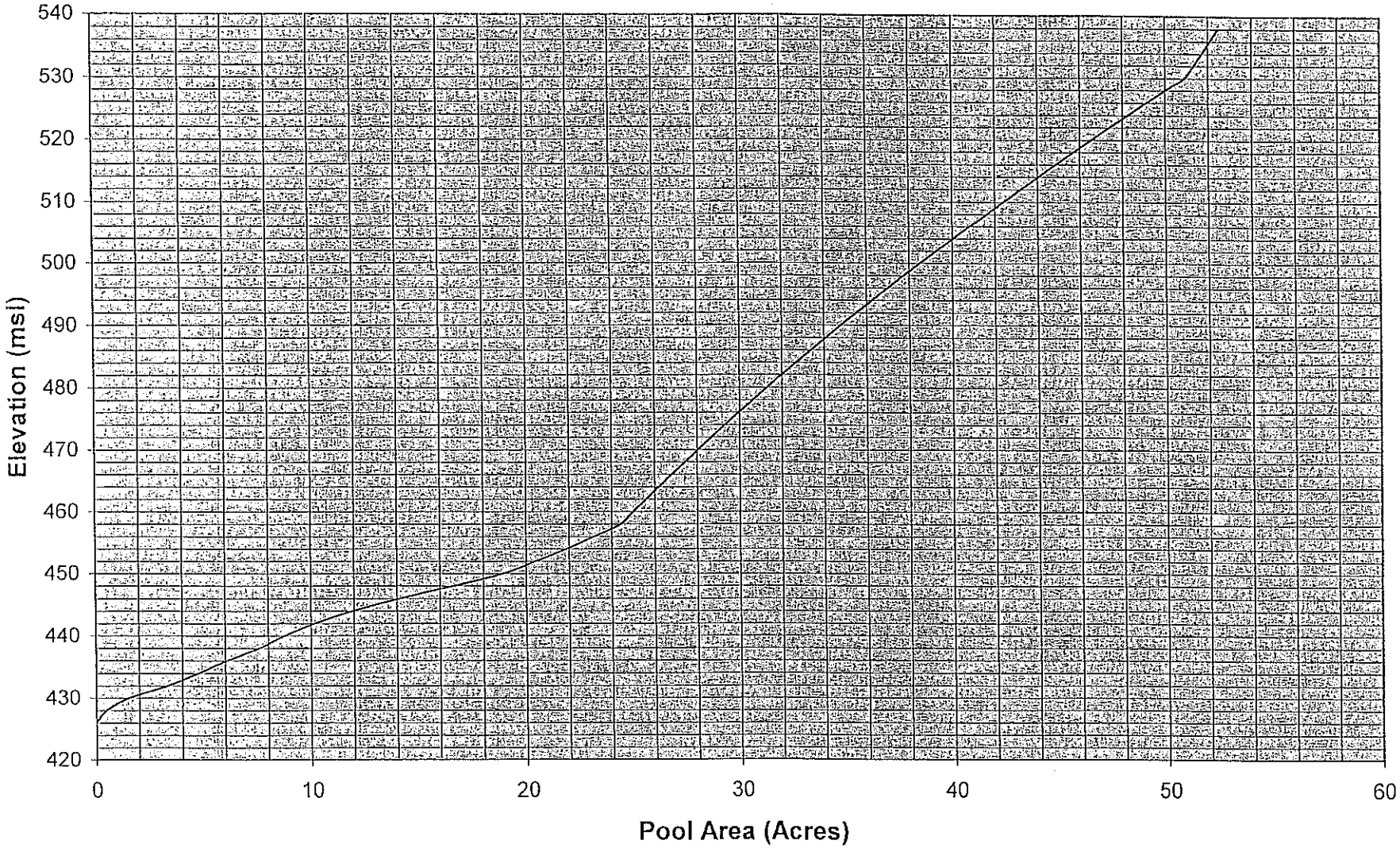
Phase 4/6/7 Impoundment Volumes - Stage 7B Eliminated

Elev.	Area (Acres)	Σ Vol. (Ac-Ft)	Σ Vol. CF	Σ Vol. CY	
426	0	0.000	0	0	Bottom of incised portion of pool
428	0.485	0.394	17,163	636	
430	1.514	2.278	99,242	3,676	
432	3.308	7.669	334,072	12,373	
434	4.760	15.958	695,116	25,745	
436	6.110	26.888	1,171,232	43,379	
438	7.601	40.721	1,773,806	65,697	
440	8.800	57.180	2,490,744	92,250	
442	10.193	76.184	3,318,588	122,911	
444	11.983	98.366	4,284,820	158,697	
446	14.140	124.474	5,422,084	200,818	
448	16.678	155.304	6,765,037	250,557	Top of incised portion of pool (low point)
450	18.946	190.994	8,319,717	308,138	
452	20.442	230.401	10,036,265	371,714	
454	21.903	272.836	11,884,754	440,176	
456	23.174	318.064	13,854,870	513,143	
458	24.423	366.326	15,957,161	591,006	
460	25.007	415.757	18,440,371	670,754	
470	28.057	680.903	29,660,115	1,098,523	
480	31.323	977.629	42,585,509	1,577,241	
490	34.806	1308.099	56,980,798	2,110,400	
492	35.528	1378.432	60,044,513	2,223,871	Phase 4 and Phase 6 Dam Crest Elevation
500	38.505	1674.475	72,940,133	2,701,486	
510	42.419	2078.920	90,557,755	3,353,991	
520	46.550	2523.599	109,927,957	4,071,406	
528	50.013	2909.767	126,749,431	4,694,423	Phase 7 Principal Spillway Pipe Invert Elevation
530	50.901	3010.690	131,145,676	4,857,247	
538	52.487	3424.469	149,169,885	5,524,811	Phase 7 Dam Crest Elevation

Notes: Incised portion of Phase 4 pool is from Elev. 426 to Elev 448.
Refer to accompanying Volume Report, Dec. 23 09:24:18 2010 for areas and volumes.

File: Mach7B-4Stage-Storage1.xls, hlo, rev. 03/03/2011

Phases 4, 6, & 7 - Stage Area Curve - Phase 7b Eliminated



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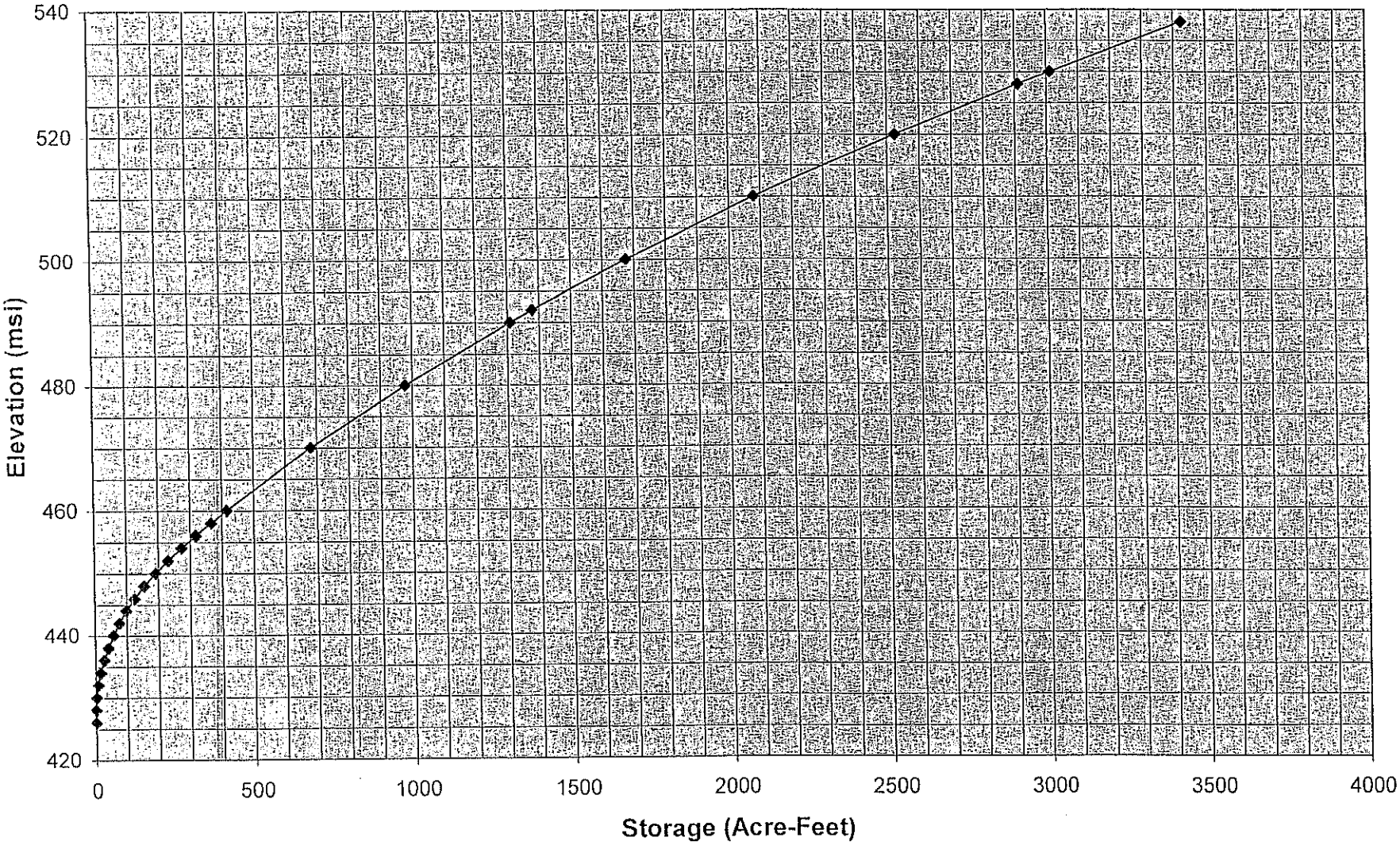
R14897

Phases 4, 6, & 7 - Stage Storage Curve - Phase 7B Eliminated



R14898

5

B05-330-1413
Volume Report Thu Dec 23 09:24:18 2010

Lower left grid corner : 358138.74,427500.81
Upper right grid corner: 359798.74,428950.81
X grid resolution: 1660, Y grid resolution: 1450
X grid cell size : 1.00, Y grid cell size: 1.00

Pond/Pit volume : 149,169,884.9 C.F., 5,524,810.55 C.Y., 3,424.47 Acre-Ft
Area: 2,286,344.2 S.F., 52.487 Acres
Elevation Range: 426.10 to 538.00

Storage Volumes

Elevation	Storage(AcreFt)	(C.Y.)	(C.F.)	Area(Acre)
426.00	0.00001	0.0	0.4	0.000
428.00	0.39402	635.7	17,163.3	0.485
430.00	2.27828	3,675.6	99,241.7	1.514
432.00	7.66925	12,373.1	334,072.4	3.308
434.00	15.95768	25,745.0	695,116.3	4.760
436.00	26.88778	43,379.0	1,171,231.9	6.110
438.00	40.72098	65,696.5	1,773,805.9	7.601
440.00	57.17962	92,249.8	2,490,744.2	8.800
442.00	76.18430	122,910.7	3,318,588.3	10.193
444.00	98.36594	158,697.1	4,284,820.5	11.983
446.00	124.47392	200,817.9	5,422,084.0	14.140
448.00	155.30389	250,556.9	6,765,037.3	16.678
450.00	190.99443	308,137.7	8,319,717.4	18.946
452.00	230.40094	371,713.5	10,036,265.0	20.442
454.00	272.83641	440,176.1	11,884,753.9	21.903
456.00	318.06404	513,143.3	13,854,869.7	23.174
458.00	366.32601	591,006.0	15,957,161.1	24.423
460.00	415.75692	670,754.5	18,110,371.4	25.007
462.00	466.36344	752,399.7	20,314,791.7	25.600
464.00	518.16372	835,970.8	22,571,211.8	26.201
466.00	571.17562	921,496.7	24,880,410.1	26.811
468.00	625.41604	1,009,004.6	27,243,122.9	27.430
470.00	680.90255	1,098,522.8	29,660,115.2	28.057
472.00	737.65225	1,190,079.0	32,132,131.9	28.693
474.00	795.68235	1,283,700.9	34,659,923.3	29.337
476.00	855.01034	1,379,416.7	37,244,250.6	29.991
478.00	915.65317	1,477,253.8	39,885,852.2	30.653
480.00	977.62877	1,577,241.1	42,585,509.2	31.323
482.00	1,040.95401	1,679,405.8	45,343,956.7	32.002
484.00	1,105.64664	1,783,776.6	48,161,967.8	32.690
486.00	1,171.72360	1,890,380.7	51,040,280.2	33.387
488.00	1,239.20185	1,999,245.7	53,979,632.6	34.091
490.00	1,308.09912	2,110,399.9	56,980,797.7	34.806
492.00	1,378.43234	2,223,870.8	60,044,512.7	35.528
494.00	1,450.21937	2,339,687.2	63,171,555.7	36.259
496.00	1,523.47720	2,457,876.5	66,362,666.8	36.999
498.00	1,598.22333	2,578,467.0	69,618,608.1	37.748
500.00	1,674.47505	2,701,486.4	72,940,133.3	38.505
502.00	1,752.24927	2,826,962.1	76,327,978.0	39.270
504.00	1,831.56367	2,954,922.7	79,782,913.4	40.044
506.00	1,912.43516	3,085,395.4	83,305,675.6	40.828
508.00	1,994.88159	3,218,409.0	86,897,042.1	41.619

510.00	2,078.91999	3,353,990.9	90,557,754.6	42.419
512.00	2,164.56762	3,492,169.1	94,288,565.4	43.228
514.00	2,251.84202	3,632,971.8	98,090,238.4	44.047
516.00	2,340.76034	3,776,426.7	101,963,520.4	44.873
518.00	2,431.34029	3,922,562.3	105,909,182.9	45.707
520.00	2,523.59864	4,071,405.8	109,927,956.8	46.550
522.00	2,617.55316	4,222,985.8	114,020,615.6	47.404
524.00	2,713.22095	4,377,329.8	118,187,904.8	48.265
526.00	2,810.61935	4,534,465.9	122,430,578.9	49.134
528.00	2,909.76654	4,694,423.4	126,749,430.6	50.013
530.00	3,010.69044	4,857,247.2	131,145,675.7	50.901
532.00	3,112.92439	5,022,184.7	135,598,986.5	51.329
534.00	3,215.99339	5,188,469.3	140,088,671.9	51.736
536.00	3,319.85521	5,356,033.1	144,612,893.0	52.122
538.00	3,424.46935	5,524,810.6	149,169,884.9	52.487

(4)

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BY: HLO DATE: 01/01/11 CHKD BY: TLG DATE: (7) 4/11/2011

PROJECT NAME: **Refuse Disposal Area No. 2, Mach Mining, LLC**

PROJECT NO. **B05-330-1413** SHEET 1 OF 1

DESCRIPTION **Worksheet - Eliminate Phase 7B, Pump Into Phase 4 Phase 6 and Revised Phase 7 Embankment Volumes**

Adjust embankment volumes for elimination of Phase 7B & Phases 4 & 6 for subsidence

Elev. (MSL)	Original Phase 6 Volume (CY)	Δ Phase 4 & Phase 6 Volume (CY)	Revised Phase 6 Volume (CY)	Phase 7 Volume (CY)	Phase 7C Volume (CY)	Phase 7B Volume (CY)	Revised Phase 7 Volume (CY)	Embankment Crest Elevation Remarks
440	0	0						
450	146,000	219,600	365,600					
453	---	---	---			0		
460	470,000	219,600	689,600			12,890		
470	840,000	219,600	1,059,600			40,321		
480	1,220,000	219,600	1,439,600			68,319		
488	1,520,000	219,600	1,739,600			---		
490	1,620,000	219,600	1,839,600			95,691		
492	1,720,000	219,600	1,939,600	0		101,013	0	Phases 4 & 6
500				566,000	0	122,300	443,700	Phase 7, Stage 1
510				1,280,000	253,744	149,100	1,384,644	
520				1,850,000	486,810	177,073	2,159,737	
530				2,280,000	705,293	206,220	2,779,073	
538				2,520,000	874,854	230,355	3,164,499	Phase 7, Stage 6

Revised Phase 7 Volume = Phase 7 + Phase 7C - Phase 7B Volumes
Original Phase 4, 6, & 7 embankment volumes from 10/22/2007 computations by JLH.
Phase 7B & 7C embankment volumes from 02/21/2008 Volume Reports.
Phase 7C is now incorporated into Phase 7, Stages 1 through 6

Δ Phase 4 & 6 Volume from attached worksheets
Δ Phase 4 volume included in Revised Phase 6 Volume (Phase 4 subsidence corrections will be fixed during Phase 6)

File: Mach7B-4Computations3.xls, hlo, rev. 04/07/11

R14901

R14902

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Engineers
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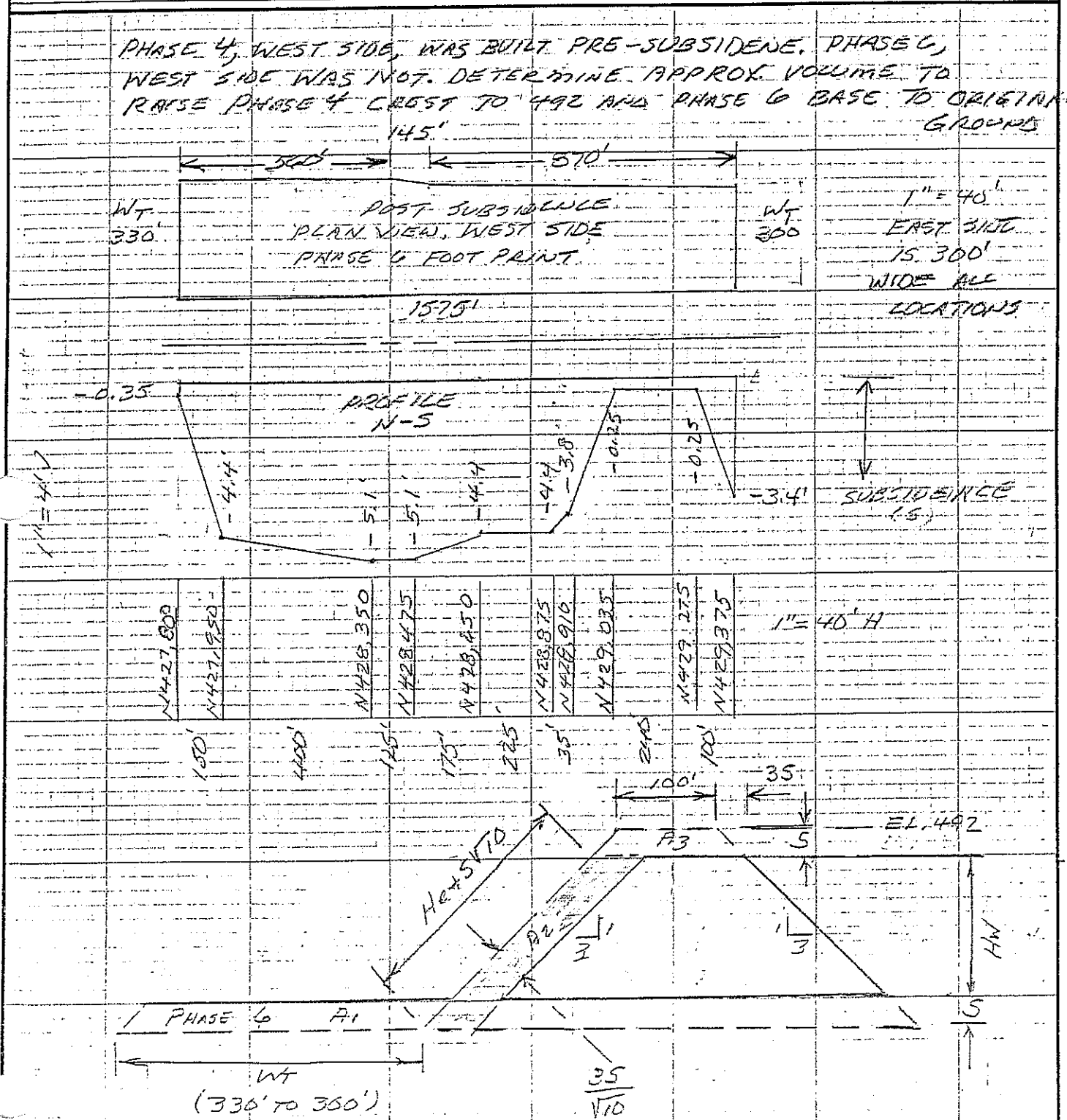
BECKLEY, WV
(304) 255-0491

BY: H2O DATE: 2/4/11 CHKD BY: TLG DATE: 3/27/2011 (8)
PROJECT NAME: REFUSE DISPOSAL AREA NO. 2
PROJECT NO. 805-330-1413 SHEET 1 OF 5
DESCRIPTION PHASE 4 AND PHASE 6 SUBSIDENCE VOLUME ADJUSTMENT - WEST SIDE

PHASE 4, WEST SIDE, WAS BUILT PRE-SUBSIDENCE. PHASE 6, WEST SIDE WAS NOT. DETERMINE APPROX. VOLUME TO RAISE PHASE 4 CREST TO 492 AND PHASE 6 BASE TO ORIGINAL GROUND



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BECKLEY, WV (304) 255-0491

BY: HAO DATE: 02/08/11 CHKD BY: TLG DATE: 3/30/2011 (9)
PROJECT NAME: REFUSE DISPOSAL AREA NO. 2
PROJECT NO. B05-330-1413 SHEET 2 OF 5
DESCRIPTION PHASE 4 AND PHASE 6 SUBSIDENCE VOLUME ADJUSTMENT – WEST SIDE

ADDITIONAL X-SECTIONAL AREA - SUBSIDED WEST SIDE OF PHASE 6 SECTIONS

$A_1 = W_T S$

$A_2 = (H_W + S\sqrt{10})\, 3S/\sqrt{10} = 3SH_E + 3S^2$

$A_3 = (100 + 100 + 3S)\, S/2 = 100S + 1.5S^2$

$\Sigma A = S(W_T + 100 + 3H_W) + 4.5(S)^2$

HW VALUES – PHASE 4 WEST SIDE

STATION	ORIG. GROUND ELEV.	HW (FT)	SUBSIDED GROUND ELEV.
N 427,800	450.0	42	449.65
427,950	450.0	42	445.6
428,350	450.0	42	444.9
428,360	450.0	42	
428,475	449.5	42.5	444.4
428,505	448.8	43.2	
428,650	447.5	44.5	443.1
428,875	446.2	45.8	441.8
428,910	446.0	46.0	442.2
429,035	445.0	47.0	444.75
429,275	442.8	49.2	442.55
429,375	440.0	52.0	436.6

HW = (492 – ORIG. GROUND ELEV)

Δ PHASE 4 & PHASE 6 VOLUME = (212,407 + 107,256) CY = 319663 CY
(SEE SHEETS 3 OF 5 & 5 OF 5)

(USE 319,700)
(MOSTLY BELOW ELEV. 450)

(10)

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BY: HLO DATE: 02/04/11 CHKD BY: TLG DATE: 4/11/2011

PROJECT NAME: **Refuse Disposal Area No. 2, Mach Mining, LLC**

PROJECT NO. **B05-330-1413** SHEET 3 OF

DESCRIPTION **Worksheet - Phase 4 and Phase 6 West Side Embankment**
Volumes Adjusted for Longwall Panel No. 2 Subsidence

Adjust Phases 4 and 6 West Side Embankment Volumes for Panel No. 2 Subsidence

(Volumes by the Average End Area Method) S = Phase 6 West Side Subsidence at Northing Coordinate

Northing (Feet)	Top Width W_T (Feet)	S (Feet)	Phase 4 Height (H_W) (Feet)	Area (SF)	Ave. Area (SF)	Δ Length (Feet)	Δ Volume (CY)	Σ Volume (CY)
427,800	330	0.35	42.0	195	-	0	-	0
427,950	330	4.40	42.0	2,534	1364	150	7,580	7,580
428,350	330	5.10	42.0	2,953	2743	400	40,638	48,218
428,360	330	5.10	42.0	2,953	2953	10	1,094	49,311
428,475	306	5.10	42.5	2,838	2895	115	12,332	61,643
428,505	300	5.00	43.2	2,761	2799	30	3,110	64,753
428,650	300	4.40	44.5	2,435	2598	145	13,950	78,703
428,875	300	4.40	45.8	2,452	2443	225	20,359	99,062
428,910	300	3.80	46.0	2,109	2281	35	2,956	102,018
429,035	300	0.25	47.0	136	1122	125	5,197	107,215
429,275	300	0.25	49.2	137	136	240	1,212	108,427
429,375	300	3.40	52.0	1,942	1040	100	3,851	**112,278**
						1575	112,278	

$Area = S(W_T + 3H_W + 100) + 4.5(S)^2$

W_T = Phase 6 Width; S = Subsidence at Northing Station (Feet); H_W = Original West Side Phase 4 Embankment Height

Volumes are CCR needed to bring west side subsided Phase 4 crest up to elev. 492 & west side Phase 6 base up to original ground elevation

Note: Σ Volume numbers rounded to include tenths of CY File: Mach7B-4Computations8.xls, hlo, rev. 04/07/2011

R14904

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Scientists
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(304) 255-0491

BY: HJD DATE: 2/28/11 CHKD BY: _____ DATE: _____ (11)

PROJECT NAME: REFUSE DISPSAL AREA No. 2, MACH MINING

PROJECT NO. 805-330-1413 SHEET 4 OF 5

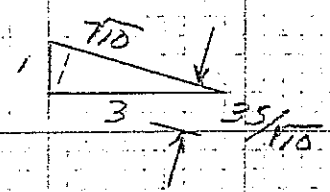
DESCRIPTION PHASE 4 AND PHASE 6 SUBSIDENCE
EMBANKMENT VOLUME ADJUSTMENT - EAST SIDE

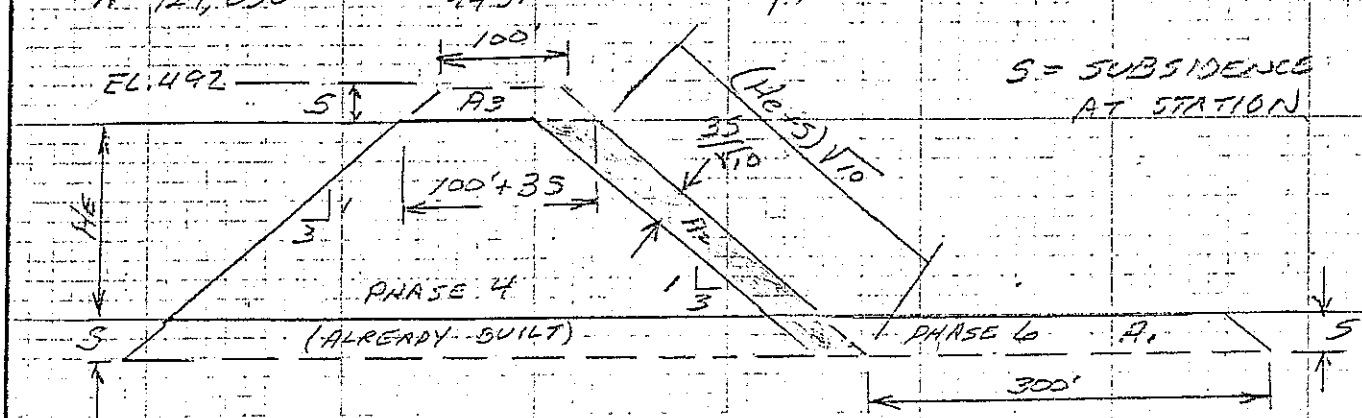
AS OF 01/28/2011, PHASE 4 EAST SIDE IS COMPLETED EXCEPT FOR CREST RAISING TO ACCOUNT FOR SUBSIDENCE. AS OF THAT DATE, ABOUT 300,000 TONS OF CCR HAD BEEN PLACED IN PHASE 6, EAST SIDE.

DETERMINE THE CCR NEEDED TO RAISE THE PHASE 4 CREST TO REQ'D ELEV. 492 AND TO FILL IN THE SUBSIDED BASE FOR PHASE 6 EAST.

HE VALUES - PHASE 4 EAST SIDE

STATION	ORIG. GROUND ELEV.	HE (FEET) = HE - ORIG. GROUND ELEV
N 427,800	454.8	37.2
427,890	454.0	38.0
427,950	453.4	38.6
428,080	452.0	40.0
428,360	450.0	42.0
428,475	449.1	42.9
428,610	448.0	44.0
428,650	447.3	44.7
428,740	446.0	46.0
428,875	444.4	47.6
428,900	444.0	48.0
N 429,050	443.0	49.0





S = SUBSIDENCE AT STATION

$A_1 = 300\ S$

$A_2 = (He+S)\sqrt{10}\ 3S/\sqrt{10} = 3S(He+S) = 3SHe + 3S^2$

$A_3 = (100+100+3S)\ S/2 = 100S + 1.5S^2$

$\Sigma A = S(400 + 3He) + 4.5\ S^2$

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

BY: HLO DATE: 02/26/11 CHKD BY: TLG DATE: 4/11/2011 (12)

PROJECT NAME: Refuse Disposal Area No. 2, Mach Mining, LLC

PROJECT NO. B05-330-1413 SHEET 5 OF

DESCRIPTION Worksheet - Phase 4 and Phase 6 East Side Embankment
Volumes Adjusted for Longwall Panel No. 2 Subsidence

Adjust Phases 4 and 6 East Side Embankment Volumes for Panel No. 2 Subsidence

(Volumes by the Average End Area Method) S = Phase 6 Eest Side Subsidence at Northing Coordinate

Northing (Feet)	S (Feet)	Phase 4 Height (H_E) (Feet)	Area (SF)	Ave. Area (SF)	Δ Length (Feet)	Δ Volume (CY)	Σ Volume (CY)
427,800	0.35	37.2	180	-	0	-	0
427,890	2.90	38.0	1,528	854	90	2,847	2,847
427,950	4.40	38.6	2,357	1943	60	4,317	7,164
428,080	5.10	40.0	2,769	2563	130	12,340	19,503
428,360	5.10	42.0	2,800	2784	280	28,875	48,378
428,475	5.10	42.9	2,813	2807	115	11,954	60,332
428,610	5.10	44.0	2,830	2822	135	14,109	74,441
428,650	4.40	44.7	2,437	2634	40	3,902	78,342
428,740	4.40	46.0	2,454	2446	90	8,152	86,495
428,875	4.40	47.6	2,475	2465	135	12,324	98,819
428,900	3.80	48.0	2,132	2304	25	2,133	100,953
429,050	0.25	49.0	137	1135	150	6,303	**107,256**
					1,250	107,256	

Note: Σ Volume numbers rounded to include tenths of CY

Area = $S(3H_E + 400) + 4.5(S)^2$

W_T = Phase 6 Width; S = Subsidence at Northing Station (Feet); H_W = Original East Side Phase 4 Embankment Height

Volumes are CCR needed to bring east side subsided Phase 4 crest up to elev. 492 & east side Phase 6 base up to original ground elevation

File: Mach7B-4Computations9.xls, hlo, rev. 03/02/2011

R14906

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Beckley, WV

BY: HLO DATE: 12/21/10 CHKD BY: TLG DATE: 3/30/2011 (13)

PROJECT NAME: **Refuse Disposal Area No. 2, Mach Mining, LLC**

PROJECT NO. **B05-330-1413** SHEET 1 OF 3

DESCRIPTION **Worksheet - Eliminate Phase 7B, Pump Into Phase 4**

Drainage Areas

Phase No.	Elevation	Planimeter Readings (sq.-in.) 1st	2nd	3rd	Ave.	Drainage Area (sq-ft)	(Ac.)	
4	492	48.59	48.60	48.59	48.59	1,943,600	44.62	
6	492	81.79	81.75	81.82	81.79	3,271,467	75.10	
7	500						86.8	*
	504						84.7	*
	509						81.9	*
	517						77.8	*
	528						72.4	(interpolated)
	531						70.7	*
	538						67	**

*From TLG's timing computations, ACI's March 22, 2010 report "Response to MSHA Comments Phase 7".
** From JLH's staging calculations, 1-31/08, Appendix B, ACI's July 2009 report.

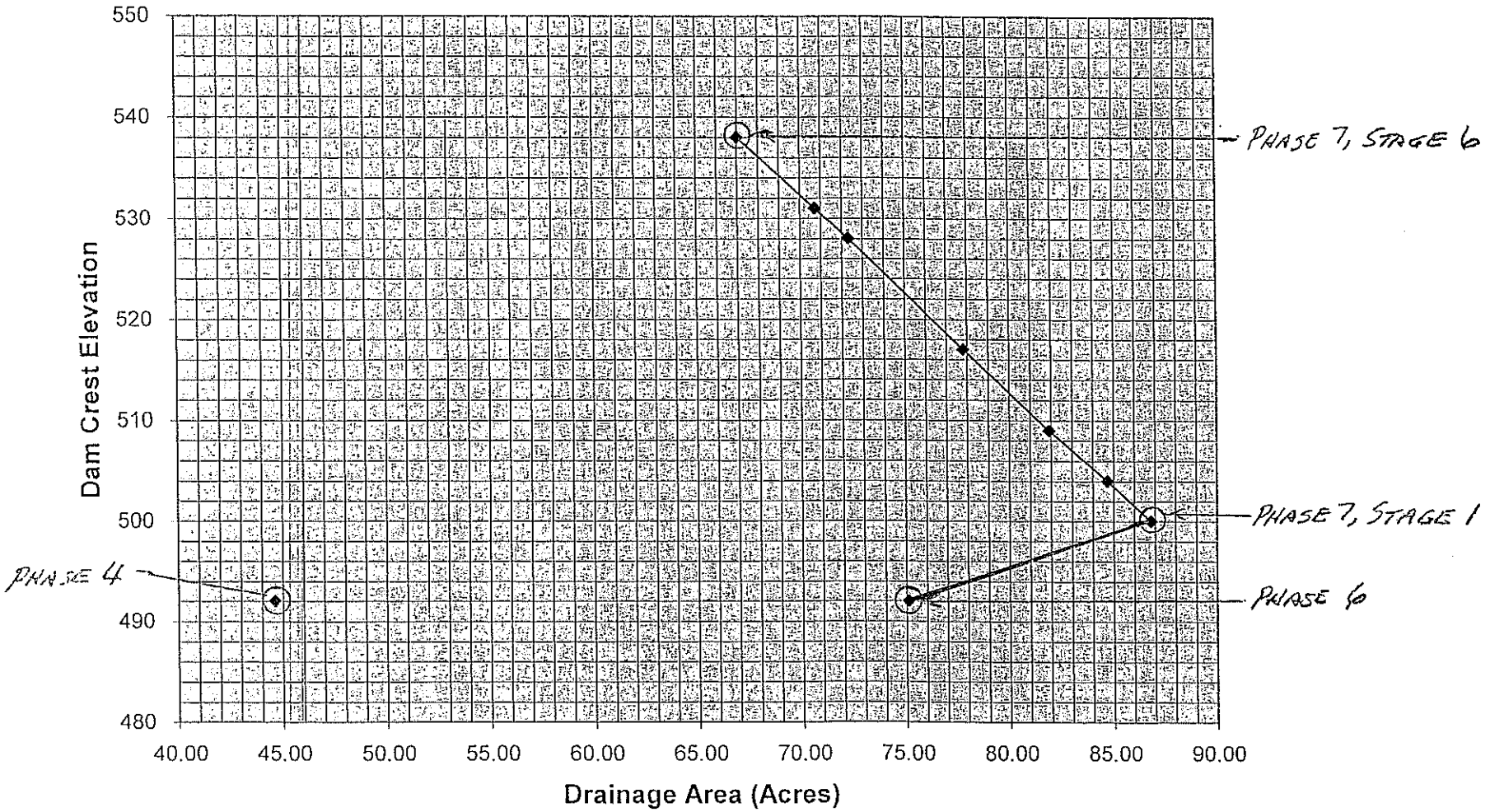
Drainage Areas based on pool + crest area for each stage, assuming Phase 3 cap and Phase 7, Steps 1 through 6, fill over Phase 3 drains away from the pool.

File: Mach 7B-4Computations6.xls, hlo, rev. 12/22/10

R14907

SHEET 2 OF 3

Drainage Areas - Phases 4, 6 & 7



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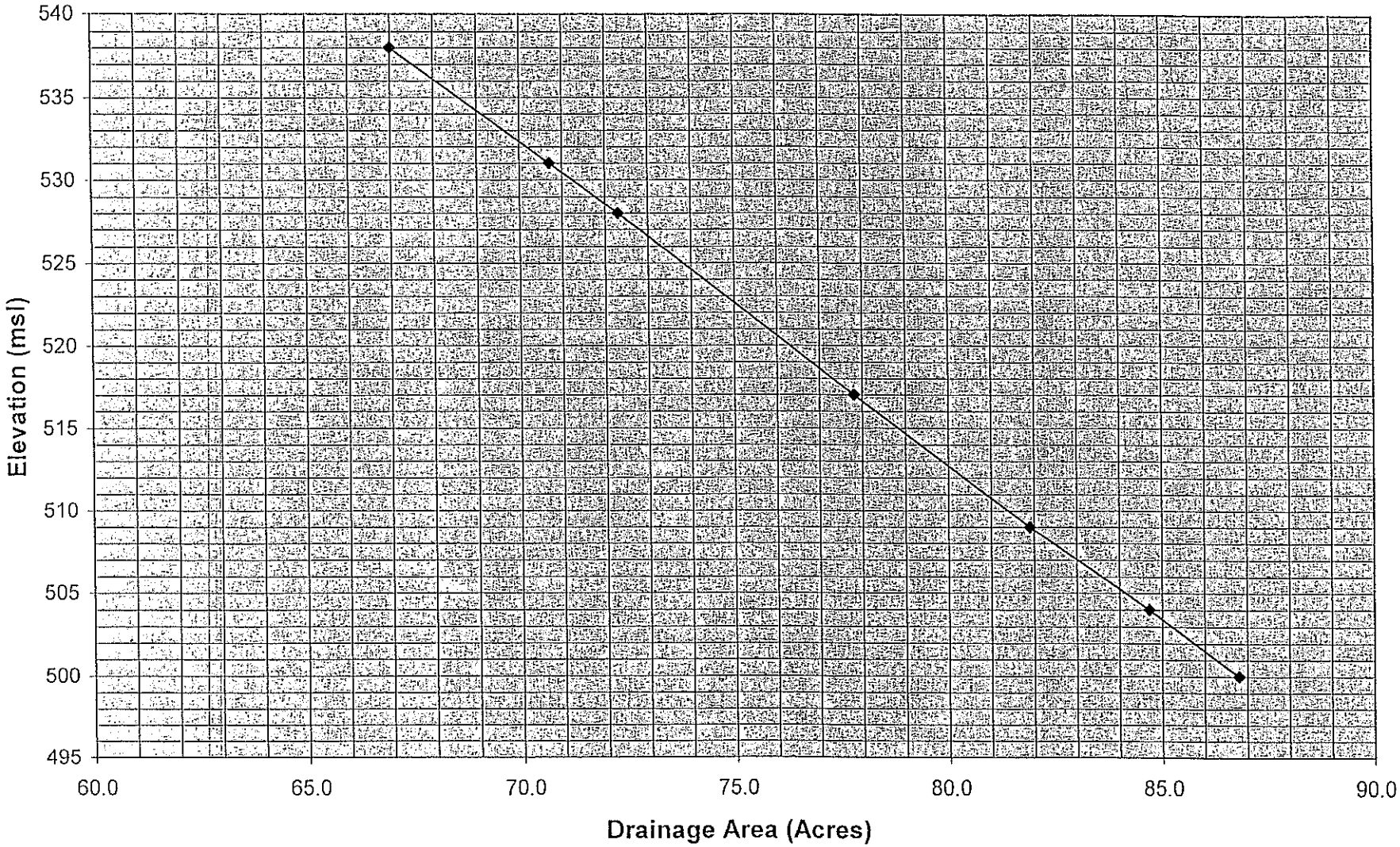
R14908

Drainage Area - Phase 7

SHEET 3 OF 3



15

R14909

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Beckley, WV

BY: HLO DATE: 12/21/10 CHKD BY: TLG DATE: 3/30/2011 (16)
PROJECT NAME: Refuse Disposal Area No. 2, Mach Mining, LLC
PROJECT NO. B05-330-1413 SHEET 1 OF
DESCRIPTION Worksheet - Eliminate Phase 7B, Pump Into Phase 4
Hydrologic Design Parameters

Runoff Curve Number

Conservatively assume the Runoff Curve Number = 100

Design Rainfall

72-hour PMP = 41" Hazard Classification = High (Class C)

The design rainfall is one PMF's, to be stored and 90% pumped out within 10 days or less until the decant/principal spillway pipe is installed at elev. 531.1, after which the design storm is routed and drawn down by the pipe. Diesel motor powered pumps are kept on site.

The pumping capacity and decant pipe provided will be more than adequate to evacuate the antecedent 100-year rainfall before the PMP rainfall occurs 5 days later.

Drainage Areas

Phase	Crest Elev.	DA (ac.)	1 PMF Runoff Volume (AF)	1 PMF Runoff Volume (CY)	Phase 7 Stage
Phase 4	492	44.62	152.45	245,955	
Phase 6	492	75.10	256.59	413,968	
Phase 7	500	86.80	296.57	478,461	1
	504	84.70	289.39	466,885	2
	509	81.90	279.83	451,451	3
	517	77.80	265.82	428,851	4
	531	70.70	241.56	389,714	5
	538	67.00	228.92	369,319	6

Data for HEC-1 Flood Routing

The pipe is installed at the beginning of Phase 7, Stage 6
Flow path is overland flow, bare ground, slope = 1%
Velocity = 1 fps, longest length = 700'
Tc = 700 ft/(1 fps x 3600 sec/hr) = 0.19 hr. Watershed Lag = L = 0.6 Tc = 0.11 hr.
Drainage Area = 67.0 Acres = 0.1047 sq-mi

(17)

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BY: HLO DATE: 01/11/11 CHKD BY: TLG DATE: 3/30/2011
PROJECT NAME: Refuse Disposal Area No. 2, Mach Mining, LLC
PROJECT NO. B05-330-1413 SHEET 2 OF
DESCRIPTION Worksheet - Eliminate Phase 7B, Pump Into Phase 4
Hydrologic Design Parameters & Flood Routing Results

Notes: The Phase 4 & Phase 6 drainage areas include the pool and north, west, & east entire crest areas plus the north side of the Phase 3 embankment below elev. 500.

The Phase 7 drainage areas include the north, west, and east crest areas. The portion of Phase 7, except for a 100' crest width, which lies over Phase 3 is assumed to be kept graded to drain away from the Phase 7 pool area.

Phase 4 will be completed to its final crest elevation of 492 shortly after slurry pumping begins. into Phase 4 begins

The Phase 6 embankment will not be able to drain into the pool area until it reaches its final crest elev. 492.

Floodrouting Results (see HEC-1 printouts)

Rainfall: 72-hour PMF (41")
Maximum Stage = Elev 534.93
90 % Drawdown in 9.75 days

PSW: 18" OD DR-26 HDPE pipe with inlet elev. 531.1
Freeboard = 3.07' (more than 3' required, OK)
(less than 10 days, OK)

Pumping Capacity

Worst head drawdown case: Pumping into Phase 4, slurry elev. = 448
Dam crest elev. = 492, total static head = 44'
Use delivery head = 40', suction head = 10'

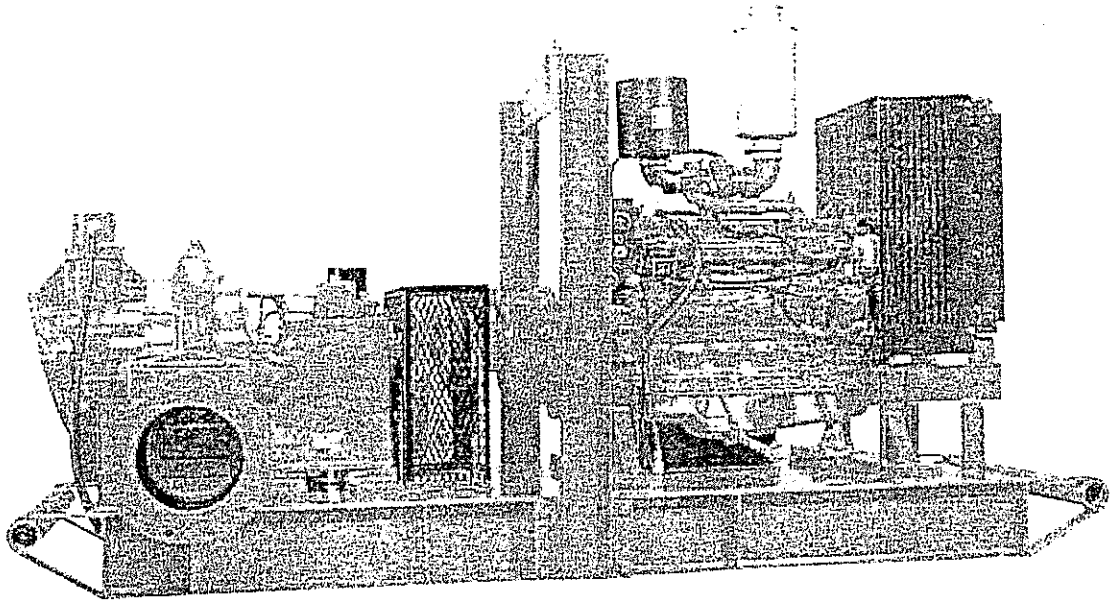
Pumps Available on Property. See the attached pump specifications, all of the pumps are Godwin Diesel Dri-Prime Pumps as follows:

Model No.	No. Present	Size (Inches)	Pumping Capacity Each (gpm)	Total Pumping Capacity (gpm)	
DPC300	1	12	4,490	4,490	(at above heads)
CD150M	2	6	1,700	3,400	
CD100M	2	4	695	1,390	
Sum	5			9,280	

Since the maximum drawdown pumping requirement is 6,039 gpm, the pumps maintained on site are more than adequate to meet the drawdown requirement.

(12)

DPC300 Dri-Prime® Pumps



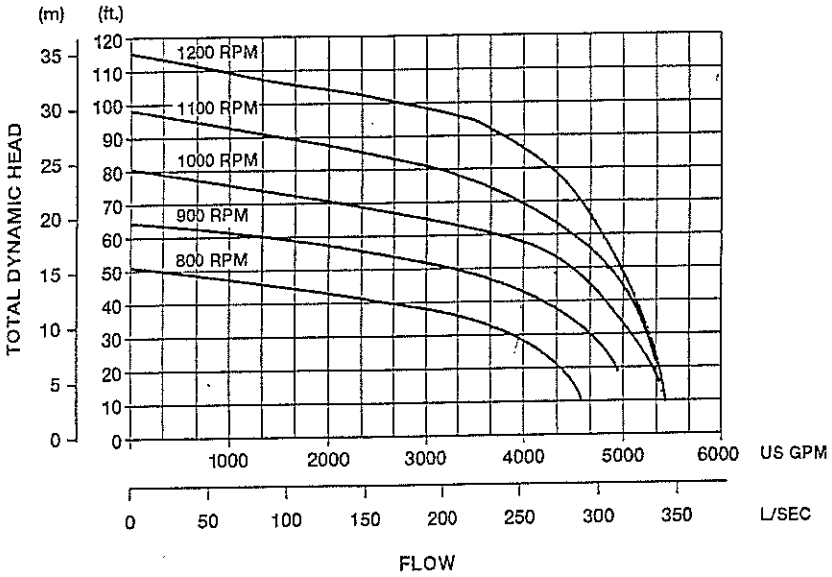
The Godwin DPC300 automatic Dri-Prime 12" (300mm) centrifugal pump has gained recognition as the industry leader in high volume bypass pumping over the last fifteen years. With flows to 5,000 gallons per minute (315.5 l/sec.) and solids handling to 3-1/2" (89mm) in diameter, the DPC300 moves large volumes of water while providing the ease of automatic priming to 28 feet (8.5M). The convenience of a low profile discharge flange makes pipe connections easy and efficient. When the job calls for high volume, the Godwin DPC300 is the benchmark by which all others are judged.

Features

- Direct drive automatic priming 12" (300mm) high volume centrifugal pump with vacuum priming compressor mounted to a diesel engine. Available in electric drive or as bare shaft pumpend.
- All cast iron construction with 4 vane cast iron impeller.
- Extensive application flexibility — will handle raw sewage, sludges and liquids with solids up to 3-1/2" (89mm) in diameter.
- Continuously operated "Godwin" air ejector priming device requiring no form of periodic adjustment or control.
- Dry running, oil lubricated, mechanical seal with abrasion resistant solid silicon carbide interfaces.
- Solids handling swing check Non Return valve at pump discharge.
- Skid base incorporating integral overnight running fuel tank.
- Simple maintenance — normally limited to checking engine oil, compressor oil, and seal lubrication.
- Standard engine — John Deere 6068T. Available with a variety of engines including Cummins, Caterpillar and Deutz.
- Low profile side discharge for easy pipe connection.
- Balanced unit with centralized lifting bracket for easy handling.
- A variety of silenced units are available.

godwin pumps

DPC300 Performance Curve



Performance Table

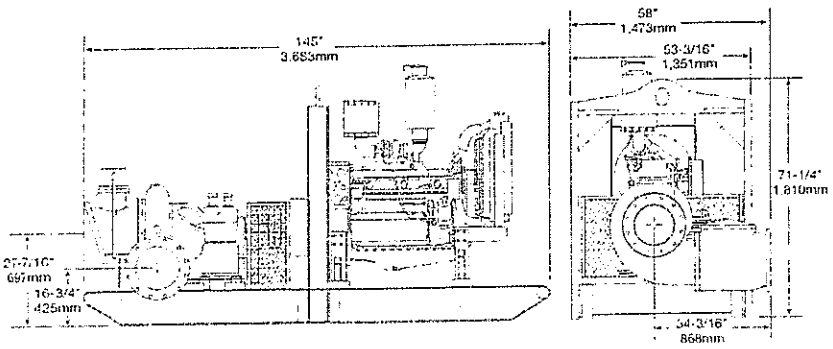
Diesel Set: John Deere 6068T, 151 hp (113kw) @ 2400 rpm, Skid Base
Impeller Diameter: 17 inches (430 mm)

	Total Delivery Head — Feet				
Total Suction Head — Feet	10	20	30	40	50
	Output — GPM				
10	5810	5620	5000	4490	3115
15	5500	5140	4710	4250	2900
20	4600	4500	4230	3130	1415
25	3875	3730	3250	2105	960

Performance data listed in table and curves are based on water tests at sea level and 68° F (20° C). Larger diameter pipes may be required for maximum flows.

Dimensions

DPC300 — John Deere 6068T, Skid Base
Weight: 7,265 lbs. (3,295 kg.)



Specifications

Maximum Operating Speed:
Engine: 2450 rpm/Pump: 1200 rpm
Maximum Operating Temperature:
+212° F (100° C)
Maximum Working Pressure:
52.0 psi (3.6 BAR)
Maximum Suction Pressure:
30 psi (2.1 BAR)
Maximum Casing Pressure:
75 psi (5.2 BAR)
Fuel Tank Capacity:
105 and 150 gal. sizes available
(397 and 548 liters)
Fuel Consumption:
7.8 gph (29.52 lph) @ 2400 rpm
(full load & max. speed)
Pipe Connections:
12 inch (300mm) ASA 150#
Solids Handling:
3-1/2" (89mm) diameter

Materials

Pump Casing, Suction Cover, Separation Tank and Wearplates:
Close Grained Cast Iron
Pump Shaft:
1-1/2% Nickel/Chromium Steel
Non Return Valve Body Ejector Housing:
Close Grained Cast Iron
Non Return Valve Flapper:
High Nitrile Rubber
Mechanical Seal Faces:
Solid Silicon Carbide

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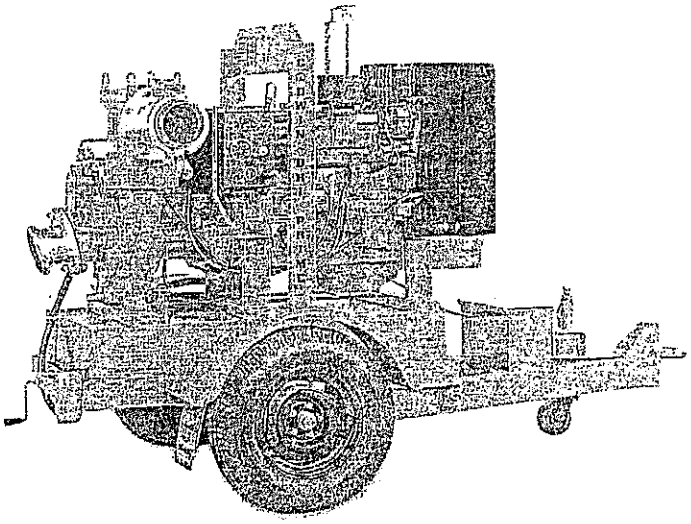
CD150M Dri-Prime® Pumps

The Godwin Dri-Prime six-inch(150mm) CD150M automatic priming centrifugal pump is clearly the backbone of the temporary portable pumping industry. With solids-handling to 3" (75 mm) in diameter, maximum flows of 1700 GPM (385.9 m³/h) and 160' (48.8 m) of total dynamic head, and indefinite dry-running capabilities, the CD150M can be found in a wide variety of applications from dewatering to sewage bypassing. Mounted on a highway trailer, the CD150M is the most maneuverable and versatile portable pumping system available, making it a favorite of contractors, municipalities, industry and environmental companies across the country.



Features

- Fully automatic priming from dry to 28' (8.5 m) of suction lift.
- Close coupled centrifugal pump with vacuum priming compressor mounted to a diesel engine. Also available in electric drive.
- Extensive application flexibility — will handle raw sewage, slurries and liquids with solids up to 3" (75 mm) in diameter.
- Dry running, oil bath mechanical seal with abrasion-resistant solid silicon carbide faces.
- Continuously operated Godwin venturi air ejector priming device featuring belt-driven air compressor requiring no form of periodic adjustment or control.
- All cast iron construction with cast chromium steel impelier.
- Standard John Deere 4045D-T2, John Deere 4045T-T3, or Caterpillar 3054C-NA engine. Also available with a variety of other engines including Hatz, Perkins and Deutz.

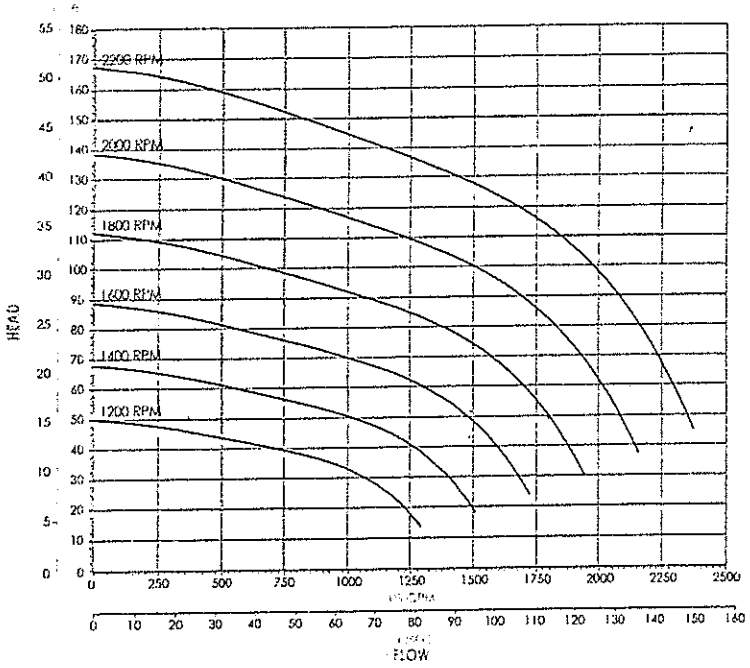
Specifications

Pipe Connections	6" (150 mm) ASA150#
Max. Capacity	1700 GPM (385.9 m³/h)
Max. Head	160' (48.8 m)
Solids Handling	3" (75 mm)
Impeller Diameter	11" (279 mm)
Max. Op. Temp.	+212°F (100°C)
Max. Working Press.	58.5 psi (4 BAR)
Max. Suction Press.	40 psi (2.8 BAR)
Max. Test Press.	88 psi (6.1 BAR)
Max. Op. Speed	2200 RPM
Fuel Tank Capacity	30* - 100 gal (113.5 - 378.5 l)
Fuel Consumption @ 2200 RPM (Full Load)	JD4045D-T2 - 3.74 GPH (0.014 m³/h) JD4045T-T3 - 4.07 GPH (0.015 m³/h) CAT3054C-NA - 4.3 GPH (0.016 m³/h)

* 60 gal. (227 l) standard equipment

godwin pumps

Pump Curves



Materials

Pump Casing, Suction Cover, Separation Tank, Weaplates, Non-Return Valve Body, Ejector Housing	Close-grained cast iron
Impeller	Cast chromium steel, hardened to minimum Brinell 341 HB
Non-Return Valve - Ball & Seat	High nitrile rubber
Mechanical Seal Faces	Solid silicon carbide
Pump Shaft	1½ Nickel/chromium steel

Performance Table

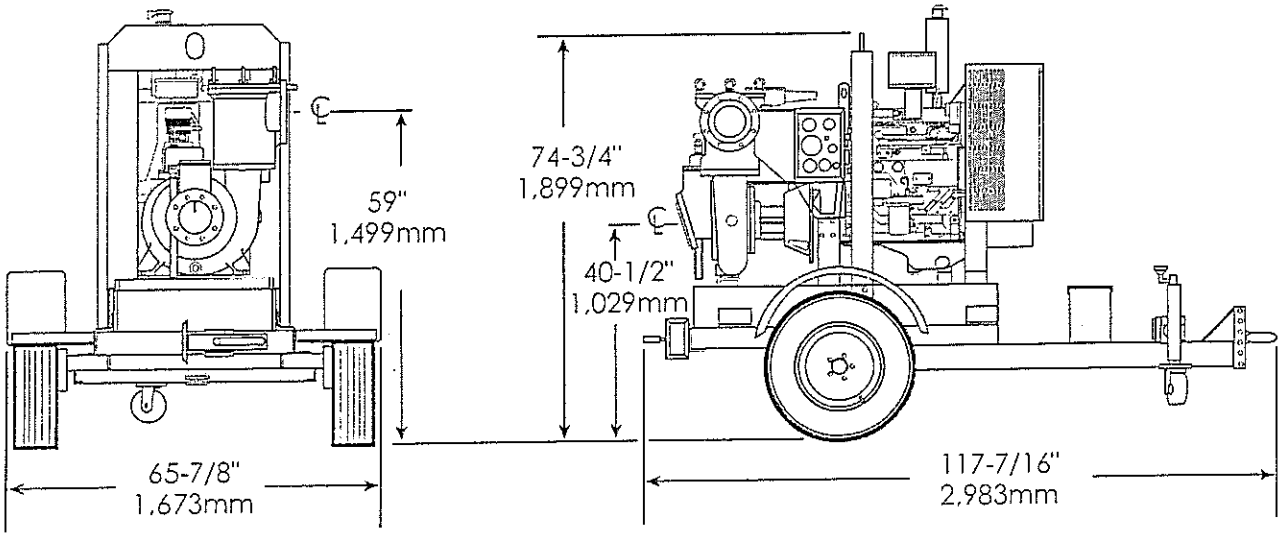
Diesel Set: JD4045D-T2, 68 HP (51 kW) @ 2200 RPM
JD4045T-T3, 71 HP (53 kW) @ 2200 RPM
CAT3054C-NA, 74 HP (55 kW) @ 2200 RPM
Impeller Diameter: 11" (279 mm)

Total Suction Head - Feet	Total Delivery Head - Feet: 10	20	30	40	50
	Output - GPM				
10	1800	1780	1750	1700	1680
15	1700	1650	1600	1520	1400
20	1670	1590	1500	1380	1240
25	1500	1400	1340	1240	1100

Performance data listed in table and curves based on water tests at sea level and 68°F (20°C). Maximum flows may require larger diameter pipes.

Drawings

CD150M - John Deere 4045D, GP60 Highway Trailer
Dry weight - 3250 lbs. (1474 kg)



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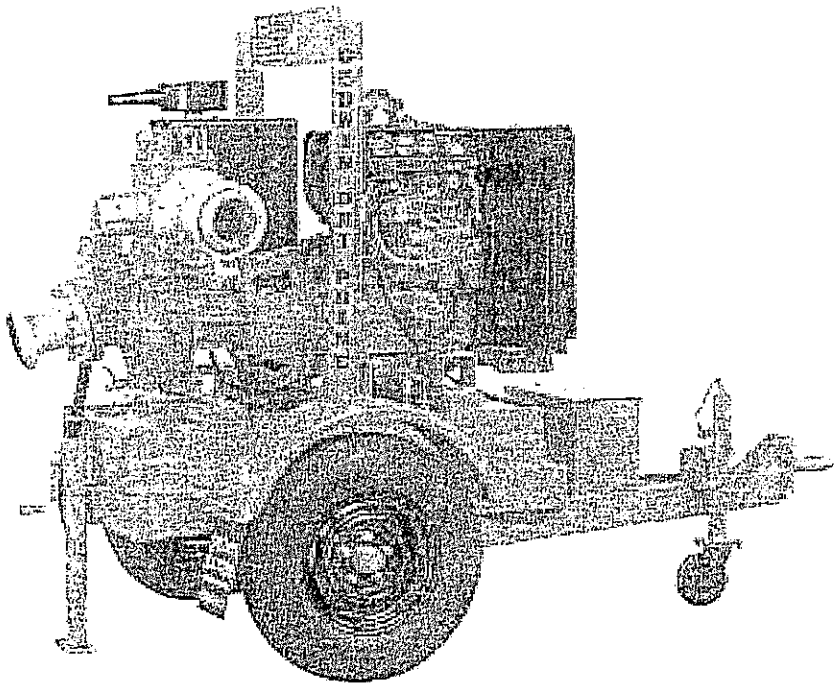
CD100M Dri-Prime® Pumps



The Godwin Dri-Prime 4 inch (100mm) CD100M automatic priming centrifugal pump is a highly maneuverable portable trash pump with flow capabilities to 750 gallons per minute (47 liters per second), total dynamic heads to 115 feet (35 meters) and solids handling to 2 inch (50mm) in diameter. The unique Godwin venturi air evacuation system allows the CD100M to prime from dry conditions with suction lifts up to 28 feet (8.5 meters). Perfect in intermittent flow situations, the CD100M can run dry indefinitely without damage due to the oil bath mechanical seal design. For sewer bypass, general dewatering, and many other applications, the Godwin CD100M with 4 inch (100mm) hoses is a powerful, yet versatile and portable pumping system.

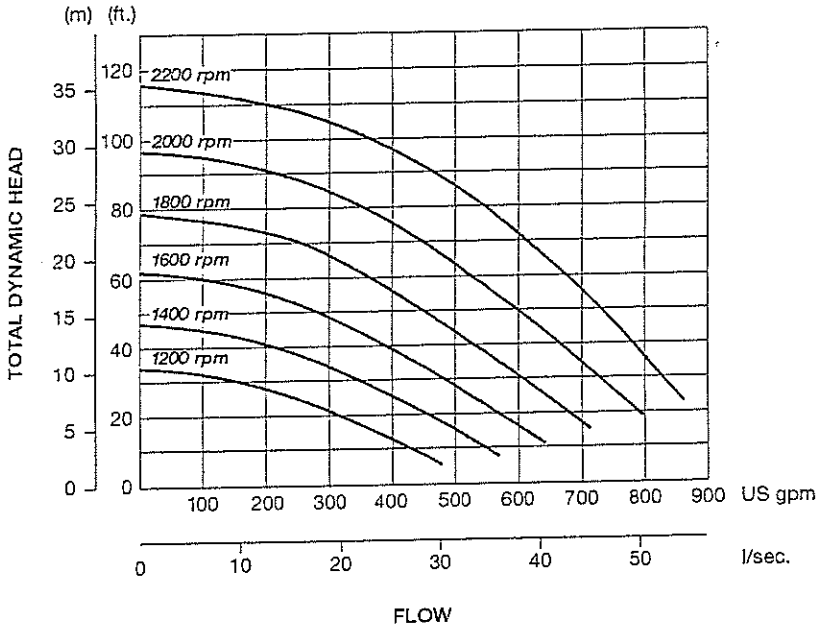
Features

- Close coupled centrifugal pump with vacuum priming compressor mounted to a diesel engine. Also available in electric drive or as bare shaft pumpend.
- All cast iron construction with cast chromium steel impeller.
- Extensive application flexibility — will handle raw sewage, slurries and liquids with solids up to 2 inch (50mm) in diameter.

  Recessed impeller version available handling solids in excess of 2-3/16 inch (56mm) in diameter.
- Continuously operated "Godwin" air ejector priming device requiring no form of periodic adjustment or control.
- Dry running, high pressure oil bath mechanical seal with abrasion resistant solid Silicon Carbide interfaces.
- Solids handling ball type Non Return Valve with renewable flexible rubber seat and quick release access feature.
- Compact unit mounted on skid base or two wheeled highway trailer both incorporating integral overnight running fuel tank.
- Simple maintenance — normally limited to checking engine and seal cavity oil levels.
- Standard engine — Yanmar 3TNV88 or Caterpillar 3013C. Available with a variety of engines including Hatz, Perkins and Deutz.
- A variety of silenced sets are available.

godwin pumps

CD100M Performance Curve



CD100M Performance Table

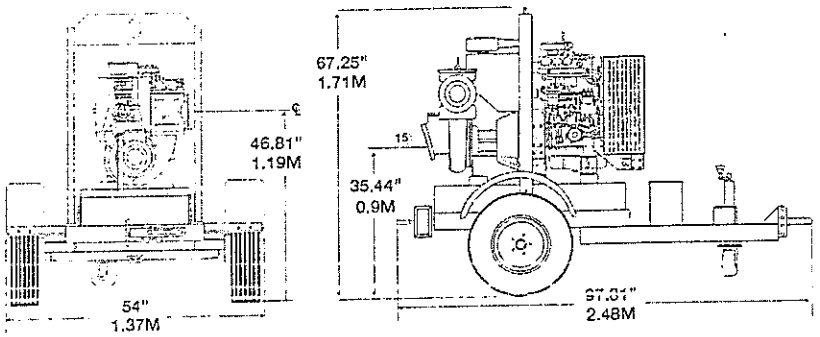
Diesel Set — Yanmar 3TNV88, 24 hp @ 2200 rpm
Caterpillar 3013C, 28 hp @ 2200 rpm
Impeller Diameter — 8-5/8 in. (220 mm)

	Total Delivery Head — Feet				
Total Suction Head - Feet	10	20	30	40	50
	Output — GPM				
10	720	710	700	695	690
15	615	580	530	500	450
20	510	490	475	430	375
25	450	440	400	390	350

Performance data listed in table and curves are based on water tests at sea level and 68° F (20° C). Larger diameter pipes may be required for maximum flows.

Dimensions

CD100M — Yanmar 3TNV88, GP30 Highway Trailer
Weight: 1734 lbs. (788 kg.)



Specifications

Maximum Operating Speed:
2200 rpm
Maximum Operating Temperature:
+212° F (100° C)
Maximum Working Pressure:
50.0 psi (3.4 BAR)
Maximum Suction Pressure:
40 psi (2.8 BAR)
Maximum Casing Pressure:
75.0 psi (5.2 BAR)
Fuel Tank Capacity:
30 to 100 gallons (30 gallon standard)
(113.5 to 378.5 liters)
Fuel Consumption (full load, max. speed):
Yanmar: 1.21 gph (4.58 lph) @ 2200 rpm
CAT: 1.67 gph (6.32 lph) @ 2200 rpm
Pipe Connections:
4" (100mm) ASA 150#
Solids Handling:
2" (50mm) dia. standard impeller
2-3/16" (56mm) dia. recessed impeller

Materials

Pump Casing, Suction Cover, Separation Tank and Wearplates:
Close grained cast iron
Impeller:
Cast chromium steel hardened to minimum Brinell 341 HB
Shaft Sleeve and Shaft:
1-1/2% nickel/chromium steel
Non Return Valve Body:
Close grained cast iron
Non Return Valve Ball and Seat:
High nitrile rubber
Mechanical Seal Faces:
Solid Silicon Carbide

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BY: HLO DATE: 2/2/2011 CHKD BY: TLG DATE: 4/11/2011

PROJECT NAME: **Refuse Disposal Area No. 2, Mach Mining LLC**

PROJECT NO.: **B05-330-1413** SHEET 1 OF 1

DESCRIPTION: **Embankment Construction and Slurry Pumping Time Schedule - Pumping Into Phase 4, Phase 7B Eliminated**

Summary - Pumping and Embankment Construction Time Schedule - Phases 4, 5, 6 & 7

Pumping End Date	Σ Pump Time (Days)	Phase 4/6/7 FCR Elev.	Const. End Date	Σ Const. Time (Days)	Min. Req'd Embank. Elev.	Remarks
02/01/11	-	-	-	0		Start schedule, still pumping into Phase 5
02/13/11	11	-	-	-	-	Finish Pumping Into Phase 5
02/14/11	-	-	-	-	-	Start pumping into Phase 4
04/17/11	63	448.0	04/13/11	71	455.7	Slurry at top of Phase 4 incised pool, build Phase 6 W. embank. to 455.7
07/01/11	150	460.0	06/05/11	124	466.0	Build Phase 6 W embankment to 466.0
09/27/11	238	470.0	08/02/11	182	475.3	Phase 6 embank. construction should now be ahead of required min. elev.
01/17/12	350	481.3	11/23/11	295	492.0	Phase 6 is finished to final crest elev. 492
04/08/12	432	488.7	02/05/12	369	500.0	Phase 7, Stage 1, is completed
06/01/12	486	493.3	04/07/12	431	504.0	Phase 7, Stage 2, is completed
08/08/12	554	498.9	06/24/12	509	509.0	Phase 7, Stage 3, is completed
12/04/12	672	507.8	10/08/12	615	517.0	Phase 7, Stage 4, is completed
03/26/13	784	515.6	12/27/12	695	524.0	Intermediate stage to check timing
07/19/13	899	523.1	03/07/13	765	531.0	Phase 7, Stage 5, is completed
11/29/13	1032	531.1	05/02/13	821	538.0	Phase 7, Stage 6, is completed to final crest elev. 528.0

Notes: The Phase 6 embankment is to be kept above the slurry level in the Phase 4/6/7 pool level to the elevations shown above until Phase 6 is completed at crest 492.0. This is to buttress and seal the west and east sides of the Phase 4 embankment, which were cracked during the longwall undermining by Panel No. 3 in March 2009.

Due to slope stability requirements (surcharge load on capped Phase 3) the 6 stages of Phase 7 will be built in continuous horizontal lifts Should problems be encountered in meeting the required Phase 7 embankment crest elevation, priority should be given to maintaining a minimum crest width of 100' around the pool area.

File: Mach 4-5-6-7 Times.xls, hlo, rev. 04/07/2011

R14918

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

(25)

BY: HLO DATE: 1/31/2011 CHKD BY: TLG DATE: 4/11/2011

PROJECT NAME: **Refuse Disposal Area No. 2, Mach Mining LLC**

PROJECT NO.: **B05-330-1413** SHEET 1 OF 8

DESCRIPTION: **Impoundment Pumping & Storm Storage Requirements**
Phase 4 - With Phase 6 Buttress East & West Sides

Drawdown Pumping Requirements

File: Mack7B-4Pumping1rev.xls, hlo, rev 04/07/2011

Phase 7, Stage 1, drainage area (largest) = 86.8 acres

PMF Runoff = (86.8 Ac.)(41 Inches/12 Inches/Ft.) = 296.57 AF = 12,918,444 CF = 478,461 CY

Pumping Requirements for 10-day Drawdown - 90% of full PMF

(Store one 72 -hour duration PMF rainfall and pump 90% of it out of the impoundment in 10 days)

0.9(12,918444 CF)(7.48 Gal/CF)/(10 Days x 24 Hours/Day x 60 Min./Hour) = **6,039** gpm ***(Worst Case)***

Diesel motor powered mobile pumps, piping, fittings, fuel, etc. are kept available on the mine site to meet this pumping requirement.

Storm Storage & Freeboard Requirements

Required wave action freeboard = 3 Ft. Design High Water Elev. = Dam Crest Elev. - 3.0 Feet

Determine: Required elevation of Phase 6 to buttress Phase 4 to a height equal to the one PMF storage above the FCR elevation in the Phase 4 pool area. The Phase 5 embankment to the north is completed. The Phase 3 embankment and pool (constructed and capped) buttresses Phase 4 to the south. Since the Phase 4 embankment cracked due to longwall undermining during the winter of 2009-2010, the Phase 6 embankment will be kept a height equal to one design storm storage above the Phase 4 FCR (slurry) level. The Phase 4 embankment has been completed except for some needed increase in embankment height to account for subsidence which occurred during mining by LW Panel No. 2. Determine the time to fill Phase 4/6/7 pool to various elevations with FCR. The existing Phase 4 embankment has sufficient base width to safely permit the start of FCR pumping into the Phase 4 incised pool.

1 **FCR Pumping Time to Fill the Incised Portion of the Phase 4 Pool (to Elev. 426 to Elev 448)**

Storage volume elevations 426 to 448 = 6,765,037 CF = 250,557 CY

FCR pumping rate = 1,769,500 CY/Year

Time = **0.1416** Year = **52** Days

R14919

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BY: HLO DATE: 1/31/2011 CHKD BY: TLG DATE: 3/30/2011 (26)

PROJECT NAME: **Refuse Disposal Area No. 2, Mach Mining LLC**

PROJECT NO.: **B05-330-1413** SHEET 2 OF 8

DESCRIPTION: **Impoundment Pumping & Storm Storage Requirements**
Phase 4 - With Phase 6 Buttress East & West Sides

Storm Storage Requirements for the Incised Portion of the Phase 4 Pool

File: Mach7B-4Pumping2rev.xls, hlo, rev. 01/31/2011

See Stage 4/6/7 Impoundment Volumes Table & Volume Report for storage volume -vs- elevation
One PMF Runoff Volume = 152.45 AF = 245,955 CY

			Elev.	Storage (CY)
Storage at Elev. 448 =	250,557	CY		
1 PMF Runoff Volume =	245,955	CY	460	670,754
Total Required Storage =	496,512	CY	*455.73*	*496,512*
Req'd Phase 6 Crest Elev. =	**455.7**		462	752,400

2 FCC Pumping Time to Fill the Phase 4/6/7 Pool From Elev. 448 to Elev. 460

Storage at Elev 460 =	670,754	CY		
Storage at Elev 448 =	250,557	CY		
Δ Storage =	420,197	CY		
Δ Time =	0.2375	Year =	87	Days

Storm Storage Requirements for FCR at Elev. 460.0 in Phase 4/6/7

			Elev.	Storage (CY)
Storage at Elev. 460 =	670,754	CY		
1 PMF Runoff Volume =	245,955	CY	470	1,098,523
Total Required Storage =	916,709	CY	*466.03*	*916,709*
Req'd Phase 6 Crest Elev. =	**466.0**		472	1,190,079

3 FCC Pumping Time to Fill the Phase 4/6/7 Pool From Elev. 460 to Elev. 470

Storage at Elev 470 =	1,098,523	CY		
Storage at Elev 460 =	670,754	CY		
Δ Storage =	427,769	CY		
Δ Time =	0.2417	Year =	88	Days

R14920

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BY: HLO DATE: 2/1/2011 CHKD BY: TLG DATE: 3/30/2011 (27)

PROJECT NAME: Refuse Disposal Area No. 2, Mach Mining LLC

PROJECT NO.: B05-330-1413 SHEET 3 OF 8

DESCRIPTION: Impoundment Pumping & Storm Storage Requirements
Phase 4 - With Phase 6 Buttress East & West Sides

Storm Storage Requirements for FCR at Elev. 470 in Phase 4/6/7

File: Mach7B-4Pumping3rev.xls, hlo, rev. 03/03/2011

See Stage 4/6/7 Impoundment Volumes Table & Volume Report for storage volume -vs- elevation

One PMF Runoff Volume = 152.45 AF = 245,955 CY

Storage at Elev. 470 =	1,098,523	CY
1 PMF Runoff Volume =	245,955	CY
Total Required Storage =	1,344,478	CY
Req'd Phase 6 Crest Elev. =	**475.3**	

Elev.	Storage (CY)
474	1,283,701
475.27	*1,344,478*
476	1,379,412

4 ## FCC Pumping Time to Fill the Phase 4/6/7 Pool From Elev. 470 to Elev. 481.3

Storage at Elev 481.3 =			1,641,125	CY
Storage at Elev 470.0 =			1,098,523	CY
Δ Storage =			542,602	CY
Δ Time =	0.3066	Year =	**112**	Days

Elev.	Storage (CY)
480	1,577,241
481.25	*1,641,125*
482	1,679,406

Max. Allowable FCR Elev. For Phases 4 & 6 Final Dam Crest Elev. 492

(For FCR Elevations Below 481.3, the 3' Freeboard has Been Provided by Phase 4 Being Already Constructed to Elev. 492)

Elev. 492 - 3' Freeboard = Elev. 489

Storage at Elev. 489 =	2,054,823	CY
1 PMF Runoff Volume =	413,698	CY
Max FCR Storage Crest Elev 492 =	1,641,125	CY
Max FCR Elev Phase 4/6 =	**481.3**	

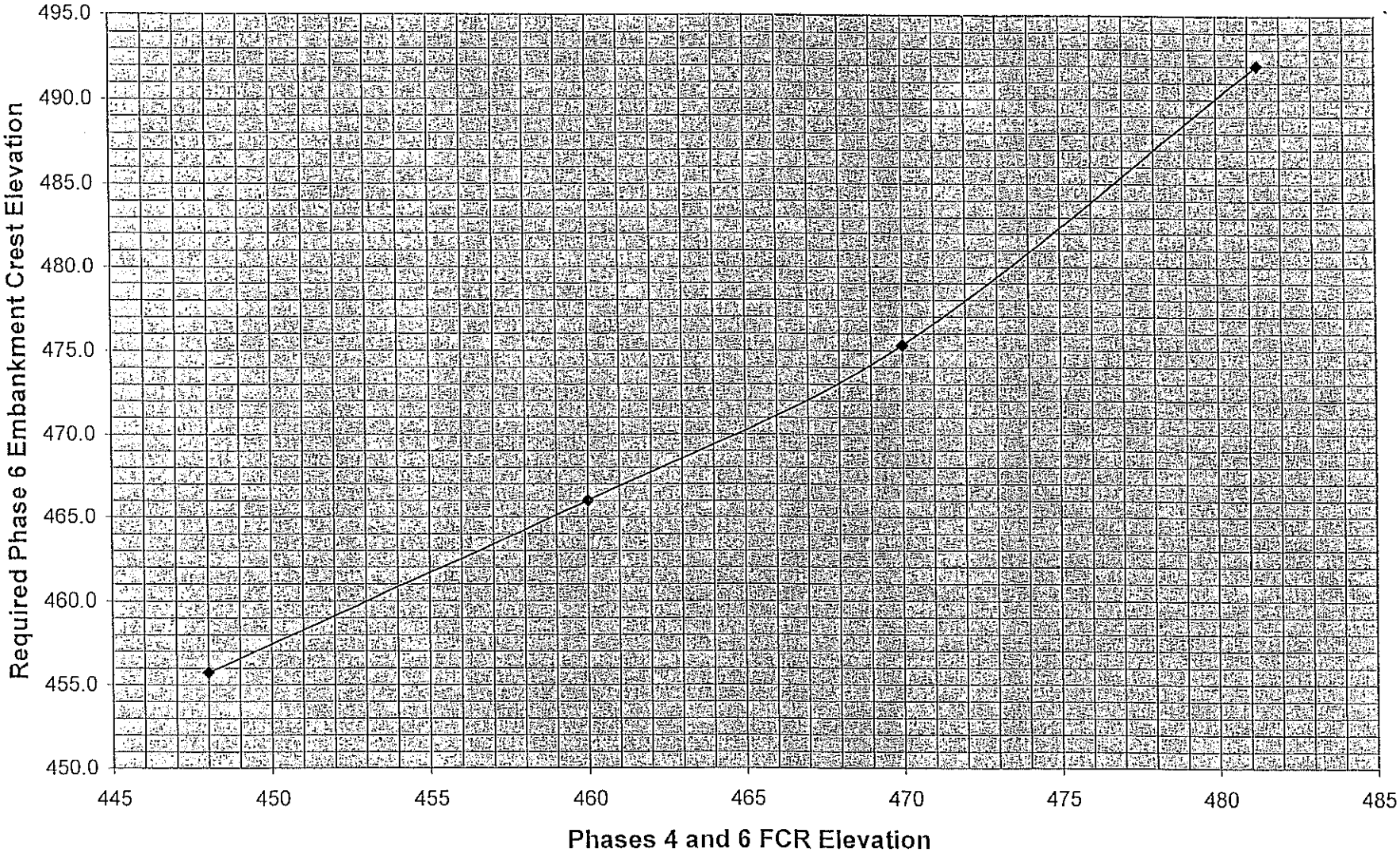
Elev.	Storage (CY)
488	1,999,246
489.00	*2,054,823*
490	2,110,400

Summary - Pumping Into Phases 4 and 6 With Maximum Dam Crest Elev. 492

FCR Elev.	Req'd Phase 6 Elev.	Δ FCR Pumping Time		Σ FCR Pumping Time		Remarks
448	455.7	52	days	52	days	Top of incised portion of Phase 4
460	466.0	87	days	139	days	Phase 4 with Phase 6 Buttress
470	475.3	88	days	227	days	Phase 4 with Phase 6 Buttress
481.3	492.0	112	days	339	days	Max Allowable FCR Elev. For Phase 4/6

R14921

Allowable FCR Elevations for Phases 4 and 6



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BY: HLO DATE: 2/1/2011 CHKD BY: TLG DATE: 3/30/2011 (29)

PROJECT NAME: **Refuse Disposal Area No. 2, Mach Mining LLC**

PROJECT NO.: **B05-330-1413** SHEET 4 OF 8

DESCRIPTION: **Impoundment Pumping & Storm Storage Requirements**
Phase 7

5 Storm Storage Requirements for Phase 7 Dam Crest Elevation 500 **(Phase 7 Stage 1)**

Elev. 500 - 3' Freeboard = Elev. 497
See Stage 4/6/7 Impoundment Volumes Table & Volume Report for storage volume -vs- elevation
See Drainage Areas Worksheet for Stage 7 at Various Dam Crest Elevations.
One PMF Runoff Volume = (86.8 Acres)41Inches/(12 Inches/Ft.) = 296.567 AF = 478,461 CY

			Elev.	Storage (CY)
Storage at Elev. 497 =	2,518,172	CY	488	1,999,246
1 PMF Runoff Volume =	478,461	CY	*488.73*	*2,039,711*
Max. Allow. FCR Storage =	2,039,711	CY	490	2,110,400
Max Allow. FCR Elev. =	**488.7**			

FCC Pumping Time to Fill the Phase 4/6/7 Pool From Elev. 481.3 to Elev. 488.7

Storage at Elev 488.7 =	2,039,711	CY		
Storage at Elev 481.3 =	1,641,125	CY		
Δ Storage =	398,586	CY		
Δ Time =	0.2253	Year =	**82**	Days

6 Storm Storage Requirements for Phase 7 Dam Crest Elevation 504 **(Phase 7 Stage 2)**

One PMF Runoff Volume = (84.7 Acres)41Inches/(12 Inches/Ft.) = 289.392 AF = 466,885 CY
Elev. 504 - 3' Freeboard = Elev. 501

			Elev.	Storage (CY)
Storage at Elev. 501 =	2,764,224	CY	492	2,223,871
One PMF Runoff Volume =	466,885	CY	*493.27*	*2,297,339*
Max Allow. FCR Storage =	2,297,339	CY	494	2,339,687
Max. Allow. FCR Elev. =	**493.3**			

File: Mach7B-4Pumping4rev.xls, hlo, rev. 03/03/2011

R14923

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BY: HLO DATE: 2/1/2011 CHKD BY: TLA DATE: 3/30/2011

PROJECT NAME: **Refuse Disposal Area No. 2, Mach Mining LLC**

PROJECT NO.: B05-330-1413 SHEET 5 OF 8

DESCRIPTION: **Impoundment Pumping & Storm Storage Requirements**
Phase 7

6 FCC Pumping Time to Fill the Phase 4/6/7 Pool From Elev. 488.7 to Elev. 493.3 (continued)

Storage at Elev 493.3 =	2,297,339	CY		
Storage at Elev 488.7 =	2,039,711	CY		
Δ Storage =	257,628	CY		
Δ Time =	0.1456	Year =	**53**	Days

7 Storm Storage Requirements for Phase 7 Dam Crest Elevation 509 (Phase 7 Stage 3)

Elev. 509 - 3' Freeboard = Elev. 506
One PMF Runoff Volume = (81.9 Acres)41Inches/(12 Inches/Ft.) = 279.825 AF = 451,451 CY

			Elev.	Storage (CY)
Storage at Elev. 506 =	3,085,395	CY		
One PMF Runoff Volume =	451,451	CY	498	2,578,467
Max. Allow. FCR Storage =	2,633,944	CY	*498.90*	*2,633,944*
Max Allow. FCR Elev. =	**498.9**		500	2,701,486

FCC Pumping Time to Fill the Phase 4/6/7 Pool From Elev. 493.3 to Elev. 498.9

Storage at Elev 498.9 =	2,633,944	CY		
Storage at Elev 493.3 =	2,297,339	CY		
Δ Storage =	336,605	CY		
Δ Time =	0.1902	Year =	**69**	Days

File: Mach7B-4Pumping5rev.xls, hlo, rev. 02/04/2011

R14924

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BY: HLO DATE: 2/1/2011 CHKD BY: TLG DATE: 3/30/2011

PROJECT NAME: **Refuse Disposal Area No. 2, Mach Mining LLC**

PROJECT NO.: **B05-330-1413** SHEET 6 OF 8

DESCRIPTION: **Impoundment Pumping & Storm Storage Requirements**
Phase 7

8 Storm Storage Requirements for Phase 7 Dam Crest Elevation 517 (Phase 7 Stage 4)

Elev. 517 - 3' Freeboard = Elev. 514
One PMF Runoff Volume = (77.8 Acres)41Inches/(12 Inches/Ft.) = 265.817 AF = 428,851 CY

			Elev.	Storage (CY)
Storage at Elev. 514 =	3,632,972	CY	506	3,085,395
One PMF Runoff Volume =	428,851	CY	*507.79*	*3,204,121*
Max. Allow. FCR Storage =	3,204,121	CY	508	3,218,409
Max Allow. FCR Elev. =	**507.8**			

FCC Pumping Time to Fill the Phase 4/6/7 Pool From Elev. 498.9 to Elev. 507.8

Storage at Elev 507.8 =	3,204,121	CY		
Storage at Elev 498.9 =	2,633,944	CY		
Δ Storage =	570,177	CY		
Δ Time =	0.3222	Year =	118	Days

9 Storm Storage Requirements for Phase 7 Dam Crest Elevation 524 (Intermediate Stage for Timing Computations)

One PMF Runoff Volume = (72.4 Acres)41Inches/(12 Inches/Ft.) = 247.367 AF = 399,085 CY
Elev. 524 - 3' Freeboard = Elev. 521

			Elev.	Storage (CY)
Storage at Elev. 521 =	4,147,196	CY	514	3,632,972
One PMF Runoff Volume =	399,085	CY	*515.61*	*3,748,111*
Max Allow. FCR Storage =	3,748,111	CY	516	3,776,427
Max Allow FCR Elev. =	**515.6**			

File: Mach7B-4Pumping6rev.xls, hlo, rev. 02/01/2011

R14925

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BY: HLO DATE: 2/1/2011 CHKD BY: TLG DATE: 3/30/2011 (32)

PROJECT NAME: **Refuse Disposal Area No. 2, Mach Mining LLC**

PROJECT NO.: **B05-330-1413** SHEET 7 OF 8

DESCRIPTION: **Impoundment Pumping & Storm Storage Requirements**
Phase 7

9 FCC Pumping Time to Fill the Phase 4/6/7 Pool From Elev. 507.8 to Elev. 515.6 (continued)

Storage at Elev 515.6 =	3,748,111	CY		
Storage at Elev 507.8 =	3,204,121	CY		
Δ Storage =	543,990	CY		
Δ Time =	0.3074	Year =	**112**	Days

10 Storm Storage Requirements for Phase 7 Dam Crest Elevation 531 (Phase 7 Stage 5)

One PMF Runoff Volume = (70.7 Acres)41Inches/(12 Inches/Ft.) = 241.558 AF = 389,714 CY

Elev. 531 - 3' Freeboard = Elev. 528

			Elev.	Storage (CY)
Storage at Elev. 528 =	4,694,423	CY		
One PMF Runoff Volume =	389,714	CY	522	4,222,986
Max Allow. FCR Storage =	4,304,709	CY	*523.06*	*4,304,709*
Max Allow FCR Elev. =	**523.1**		524	4,377,330

FCC Pumping Time to Fill the Phase 4/6/7 Pool From Elev. 515.6 to Elev. 523.1

Storage at Elev 523.1 =	4,304,709	CY		
Storage at Elev 515.6 =	3,748,111	CY		
Δ Storage =	556,598	CY		
Δ Time =	0.3146	Year =	**115**	Days

File: Mach7B-4Pumping7rev.xls, hlo, rev. ~~02/01/2~~011

R14926

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BY: HLO DATE: 2/1/2011 CHKD BY: TLG DATE: 3/30/2011

PROJECT NAME: Refuse Disposal Area No. 2, Mach Mining LLC

PROJECT NO.: B05-330-1413 SHEET 8 OF 8

DESCRIPTION: Impoundment Pumping & Storm Storage Requirements
Phase 7

11 Storm Storage Requirements for Phase 7 Dam Crest Elevation 538 (Phase 7 Stage 6)

(The principal spillway pipe will be operational, the design storm goes is one PMF, the max allow. FCR elev. = 531.1)
Elev. 538 - 3' Freeboard = Elev. 535
Storage at Elev. 531.1 = 4,947,963 CY (decant riser inlet elev.)
Design Storm Elev. = **534.9** (see HEC1)
Freeboard =Elev. 538 - Elev . 534.9 = 3.1' > 3.0', OK

FCC Pumping Time to Fill the Phase 4/6/7 Pool From Elev. 523.1 to Elev. 531.1

Storage at Elev 531.1 =	4,947,963	CY			
Storage at Elev 523.1=	4,304,709	CY			
Δ Storage =	643,254	CY			
Δ Time =	0.3635	Year =	**133**	Days	

Elev.	Storage (CY)
530	4,857,247
531.10	*4,947,963*
532	5,022,185

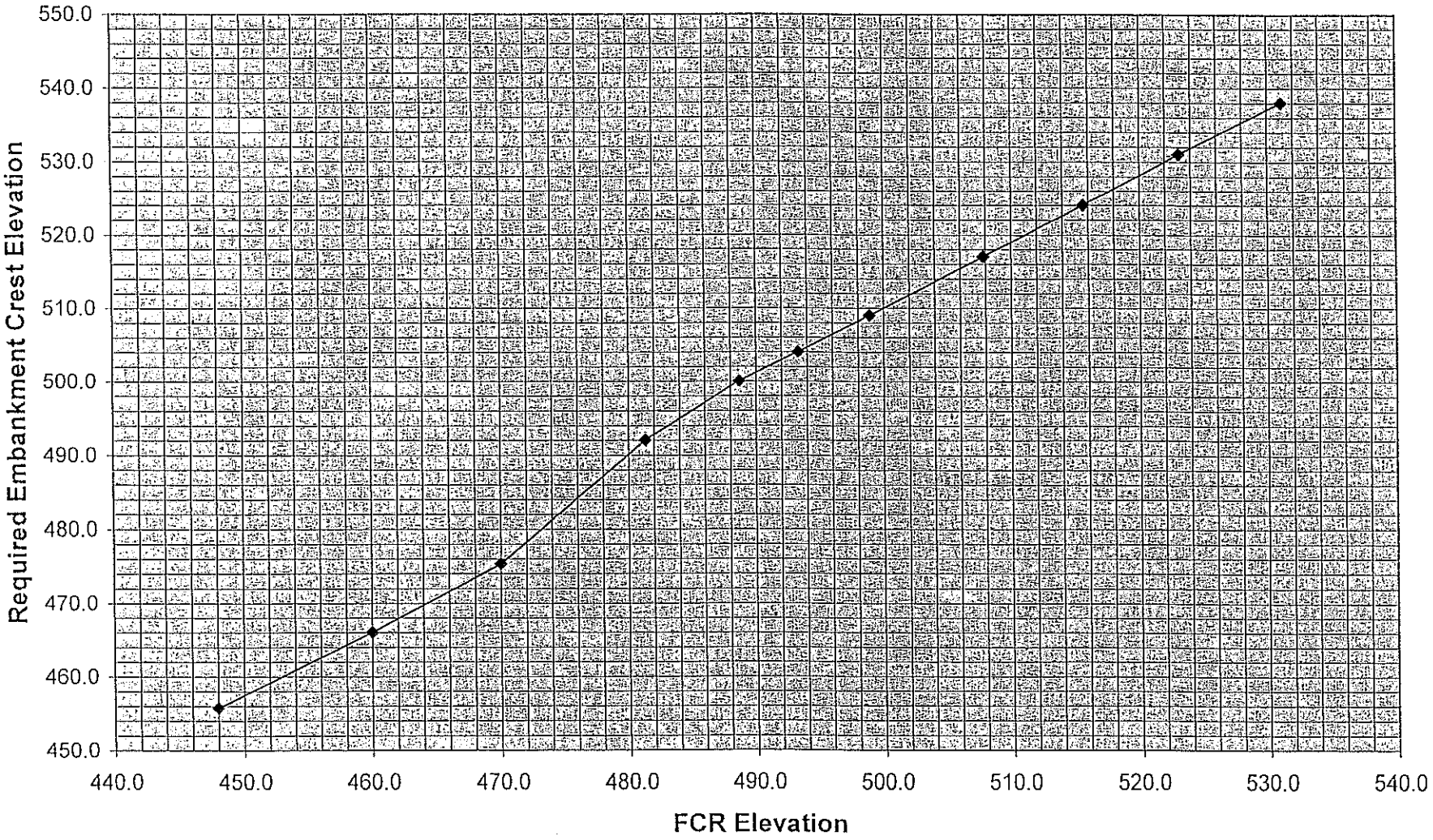
Summary - Pumping Times & Allowable Elevations - Phases 4, 6, & 7 - With Maximum Embankment Dam Crest Elevation 538

FCR Elev.	Req'd Embank. Elev.	Δ FCR Pumping Time		Σ FCR Pumping Time		Remarks
-	-	11	days	11	days	Finish pumping into Phase 5 (Conservative)
448.0	455.7 [1]	52	days	63	days	Top of incised portion of Phase 4
460.0	466.0 [1]	87	days	150	days	[1] Top of Phase 6 Embankment (E & W sides)
470.0	475.3 [1]	88	days	238	days	
481.3	492.0 [1]	112	days	350	days	Max Allowable FCR Elev. For Phases 6
488.7	500.0	82	days	432	days	Phase 7 Stage 1
493.3	504.0	53	days	485	days	Phase 7 Stage 2
498.9	509.0	69	days	554	days	Phase 7 Stage 3
507.8	517.0	118	days	672	days	Phase 7 Stage 4
515.6	524.0	112	days	784	days	Intermediate Phase
523.1	531.0	115	days	899	days	Phase 7 Stage 5
531.1	538.0	133	days	1,032	days	Phase 7 Stage 6
				(2.83 years)		

File: Mach7B-4Pumping8rev.xls, hlo, rev. 03/03/2011

R14927

Required Dam Crest Elevations for Phases 4, 6, and 7 - One PMF Storm Storage Criteria With 10-day Drawdown



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BY: HLO DATE: 2/1/2011 CHKD BY: TLG DATE: 4/11/2011 (35)

PROJECT NAME: Refuse Disposal Area No. 2, Mach Mining LLC

PROJECT NO.: B05-330-1413 SHEET 1 OF 4

DESCRIPTION: Embankment Construction Times - Phases 4, 6, & 7
Pumping Into Phase 4, Phase 7B Eliminated

See accompanying embankment & pool volume tables
Start embankment timing computations on February 1, 2011
CCR Production Rate = 2,201,300 CY/Year

File: Mach7B-4EmbankTimes1rev.xls, hlo, rev. 04/07/2011
The Phase 5 embankment is completed
FCR Production Rate = 1,769,500 CY/Year

Determine: The time to finish pumping FCR into Phase 5; the times to complete the Phase 4, Phase 6, and Phase 7 embankments; and if the Phase 6 and Phase 7 embankments can kept the required elevation above the FCR level in the Phase 4/6/7 pool. See the accompanying Impoundment Pumping & Storm Storage Computations for the required Phase 6 and Phase 7 crest elev.'s.

(Below Phase 6 volumes include bringing Phase 4 to design configuration post subsidence)

A Time to Finish Stage 5 FCR Pumping

Max. Allowable FCR Elev. = 480.0
FCR elevation on 02/01/2011 = 479.0

			Elev.	Volume (CY)	Elev.	Volume (CY)
(2,428,698 - 2,480,754) CY =	58,336	CY	475	2,247,400	475	2,247,400
52,047 CY/(1,769,500 CY/Year) =	0.0330	Year	*479.00*	*2,480,745*	*480.00*	*2,539,081*
=	**12**	Days	482	2,655,754	482	2,655,754

B Phase 6 Embankment in Place 02/01/2011

275,000 Tons CCR = 275,000 Tons(2000 Lb/T)/(125 PCF x 27 CF/CY) = 162,963 CY (already placed in east side)

1 Time to Build the Phase 6 Embankment from 02/01/2011 to Elev. 455.7

				Elev.	Volume (CY)
Δ Embank. Vol. to Elev. 455.7 =	430,360	CY	(593,323 -162,963) CY	450	465,700
Δ Time = 0.1955 Year =	**71**	Days		*455.7*	*593,323*
				460	689,600

2 Time to Build the Phase 6 Embankment from Elev. 455.7 to Elev. 466.0

				Elev.	Volume (CY)
Volume at Elev 455.7 =	430,360	CY		460	689,600
Volume at Elev 466.0 =	748,637	CY	(911,600 -162,963) CY	*466.0*	*911,600*
Δ Volume =	318,277	CY		470	1,059,600
Δ Time = 0.1446 Year =	**53**	Days			

R14929

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BY: HLO DATE: 2/1/2011 CHKD BY: TLG DATE: 4/11/2011

PROJECT NAME: **Refuse Disposal Area No. 2, Mach Mining LLC**

PROJECT NO.: **B05-330-1413** SHEET 2 OF 4

DESCRIPTION: **Embankment Construction Times - Phases 4, 6, & 7**
Pumping Into Phase 4, Phase 7B Eliminated

CCR Production Rate = 2,201,300 CY/Year FCR Production Rate: 1,769,500 CY/Year

3 Time to Build the Phase 6 Embankment from Elev. 466.0 to Elev. 475.3

					Elev.	Volume (CY)
Volume at Elev 466.0 =	748,637	CY				
Volume at Elev 475.3 =	1,098,037	CY	(1,361,700 - 162,963) CY		470	1,059,600
Δ Volume =	349,400	CY			*475.3*	*1,261,000*
Δ Time = 0.1587 Year =	**58**	Days			480	1,439,600

4 Time to Build the Phase 6 Embankment from Elev. 475.3 to Elev. 492.0 **(End of Phase 6)**

					Elev.	Volume (CY)
Volume at Elev 475.3 =	1,098,037	CY				
Volume at Elev 492.0 =	1,776,637	CY	(1,939,600 - 162,963) CY		492	1,939,600
Δ Volume =	678,600	CY				
Δ Time = 0.3083 Year =	**113**	Days				

5 Time to Build the Phase 7 Embankment from Elev. 492.0 to Elev. 500.0 **Phase 7 (Stage 1)**

Volume at Elev 492.0 =	0	CY	
Volume at Elev 500.0 =	443,700	CY	(See Phase 6 & Revised Phase 7 Embankment Volumes Table)
Δ Volume =	443,700	CY	
Δ Time = 0.2016 Year =	**74**	Days	

6 Time to Build the Phase 7 Embankment from Elev. 500.0 to Elev. 504.0 **Phase 7 (Stage 2)**

					Elev.	Volume (CY)
Volume at Elev. 500 =	443,700	CY				
Volume at Elev. 504 =	820,078	CY			500	443,700
Δ Volume =	376,378	CY			*504*	*820,078*
Δ Time = 0.1710 Year =	**62**	Days			510	1,384,644

File: Mach7B-4EmbankTimes2rev.xls, hlo, rev. 04/07/2011

R14930

Alliance Consulting, Inc.
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BY: HLO DATE: 2/1/2011 CHKD BY: TLG DATE: 3/31/2011 (37)

PROJECT NAME: **Refuse Disposal Area No. 2, Mach Mining LLC**

PROJECT NO.: B05-330-1413 SHEET 3 OF 4

DESCRIPTION: **Embankment Construction Times - Phases 4, 6 & 7**
Pumping Into Phase 4, Phase 7B Eliminated

CCR Production Rate = 2,201,300 CY/Year FCR Production Rate: 1,769,500 CY/Year

7 Time to Build the Phase 7 Embankment from Elev. 504.0 to Elev. 509.0 **Phase 7 (Stage 3)**

Volume at Elev 504 =	820,078	CY	
Volume at Elev 509 =	1,290,550	CY	
Δ Volume =	470,472	CY	
Δ Time = 0.2137 Year =	78	Days	

Elev.	Volume (CY)
500	443,700
509.0	*1,290,550*
510	1,384,644

8 Time to Build the Phase 7 Embankment from Elev. 509.0 to Elev. 517.0 **Phase 7 (Stage 4)**

Volume at Elev 509 =	1,290,550	CY	
Volume at Elev 517 =	1,927,209	CY	
Δ Volume =	636,660	CY	
Δ Time = 0.2892 Year =	106	Days	

Elev.	Volume (CY)
510	1,384,644
517.0	*1,927,209*
520	2,159,737

9 Time to Build the Phase 7 Embankment from Elev. 517.0 to Elev. 524.0 **(Intermediate Stage for Timing Computations)**

Volume at Elev 517 =	1,927,209	CY	
Volume at Elev 524 =	2,407,471	CY	
Δ Volume =	480,262	CY	
Δ Time = 0.2182 Year =	80	Days	

Elev.	Volume (CY)
520	2,159,737
524.0	*2,407,471*
530	2,779,073

10 Time to Build the Phase 7 Embankment from Elev. 524.0 to Elev. 531.0 **Phase 7 (Stage 5)**

Volume at Elev. 504 =	2,407,471	CY	
Volume at Elev. 531 =	2,827,251	CY	
Δ Volume =	419,780	CY	
Δ Time = 0.1907 Year =	70	Days	

Elev.	Volume (CY)
530	2,779,073
531	*2,827,251*
538	3,164,499

File: Mach7B-4EmbankTimes3rev.xls, hlo, rev. 02/01/2011

R14931

Alliance Consulting, Inc.
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BY: HLO DATE: 2/1/2011 CHKD BY: TLG DATE: 4/11/2011

PROJECT NAME: Refuse Disposal Area No. 2, Mach Mining LLC

PROJECT NO.: B05-330-1413 SHEET 4 OF 4

DESCRIPTION: Embankment Construction Times - Phases 4, 6 & 7
Pumping Into Phase 4, Phase 7B Eliminated

CCR Production Rate = 2,201,300 CY/Year FCR Production Rate: 1,769,500 CY/Year

11 Time to Build the Phase 7 Embankment from Elev. 531.0 to Elev. 538.0 (Stage 6)

Volume at Elev. 531 =		2,827,251	CY
Volume at Elev. 538 =		3,164,499	CY
Δ Volume =		337,248	CY
Δ Time =	0.1532 Year =	56	Days

Summary - Pumping and Embankment Construction Times - Phases 4, 6 & 7

FCR. Elev.	Δ Pump Time (Days)	Σ Pump Time (Days)	Σ Pump Time (Years)	Req'd Embank. Elev.	Δ Const. Time (Days)	Σ Const. Time (Days)	Σ Const. Time (Years)	Remarks (Start date is 02/01/2011)
-	11	11	0.030	-	-	-	-	Finish Pumping Into Phase 5
448.0	52	63	0.173	455.7	71	71	0.195	Slurry at top of Phase 4 incised pool
460.0	87	150	0.411	466.0	53	124	0.340	
470.0	88	238	0.652	475.3	58	182	0.499	
481.3	112	350	0.959	492.0	113	295	0.808	Phase 4 & Phase 6 Crest Elev. 492
488.7	82	432	1.184	500.0	74	369	1.011	Phase 7, Stage 1, complete
493.3	53	485	1.329	504.0	62	431	1.181	Phase 7, Stage 2, complete
498.9	69	554	1.518	509.0	78	509	1.395	Phase 7, Stage 3, complete
507.8	118	672	1.841	517.0	106	615	1.685	Phase 7, Stage 4, complete
515.6	112	784	2.148	524.0	80	695	1.904	Intermediate Stage to check timing
523.1	115	899	2.463	531.0	70	765	2.096	Phase 7, Stage 5, complete
531.1	133	1032	2.827	538.0	56	821	2.249	Phase 7, Stage 6, Crest Elev. 528 finished

Checks: Total Phase 4/5/6/7 FCR pumping time = 4,947,963 CY/(1,769,500 CY/Year) + 0.030 Year = 2.826 Year = 1,031 Days, OK
Total Phases (4+ 6+7) CCR construction time = (1,939,600 - 162,963 + 3,164,499) CY/(2,201,300 CY/Year) = 2.245 Year = 819 days, OK

File: Mach7B-4EmbankTimes4rev.xls, hlo, rev. 04/07/2011

(39)

Alliance Consulting, Inc.
Engineers · Constructors · Scientists
Beckley, WV

BY: HLO DATE: 01/14/11 CHKD BY: TLB DATE: 4/11/2011

PROJECT NAME: Refuse Disposal Area No. 2, Mach Mining, LLC

PROJECT NO.: B05-330-1413 SHEET _____ OF _____

DESCRIPTION: Phase 7 Principal Spillway Pipe Stage-Discharge Table
Riser Invert Elev. 531.1

USE: Riser and outlet pipe of consistant diameter and Manning's "n".

Weir Flow: $Q_w = C_w L_w H_w 3/2 = C(H_w)^{3/2}$

Pipe I.D. (in.)	Lw (ft.)	Cw	C	Weir Elev.
16.62	4.35	3.1	13.49	531.1

Orfice Flow: $Q_o = C_o A_o (2gH_o) 1/2 = C(H_o)^{1/2}$

Pipe I.D. (in.)	Ao (sf)	Co	C	Orfice Elev.
16.62	1.51	0.6	7.2541	531.1

Pipe Pressure Flow: $Qp = (A_p (2gH_p)^{1/2}) / (1 + K_e + \sum K_m + K_p L_p)^{1/2} = C(H_p)^{1/2}$

Pipe I.D. (in.)	Ap (sf)	Ke	∑Kmisc.	Kp	Lp (ft.)	C	$^C/_L$ Pipe Outlet Elev.
16.62	1.51	0.9	1.1	0.0173	175	4.927	524.5

Pipe Rating Table

W.S. Elev.	Hw (ft)	Qw (cfs)	Ho (cfs)	Qo (cfs)	Hp (ft)	Qp (cfs)	remarks
531.10	0	0.00	0	0.00	6.60	12.66	invert inlet riser
531.30	0.2	1.21	0.2	3.24	6.80	12.85	
531.50	0.4	3.41	0.4	4.59	7.00	13.03	
531.64	0.54	5.35	0.54	5.33	7.14	13.16	orfice flow controls
532.00	0.90	11.52	0.90	6.88	7.50	13.49	
533.00			1.90	10.00	8.50	14.36	
534.00			2.90	12.35	9.50	15.18	
535.00			3.90	14.33	10.50	15.96	
536.00			4.9	16.06	11.50	16.71	
536.75			5.65	17.24	12.25	17.24	full pipe flow starts
537.00					12.50	17.42	
538.00					13.5	18.10	top of dam

K_e (Projecting entrance) = 0.8 (use 0.9)

K_b (90° miter bend) = 1.1

See Dwg. No. B05-330-E13 for pipe grade & elevations.

File: Phase7DecantRev.xls, hlo, rev. 01/14/201

Mach Mining, LLC
Refuse Disposal Area No. 2
MSHA ID No. IL08-03141-02
Modification to Eliminate Phase 7B, Pump into Phases 4 and 6
HEC-1 Flood Routing Files and Results

File No.	Description	Results
MACH7B2	72-hour PMF rainfall, 18" OD DR-26 HDPE PSW with Riser invert elev. 531.1. Top of dam elev. 538.0.	DHW Elev. 534.93 FB = 3.07'
MACH7BD2	10-day drawdown for PSW pipe riser inlet elevation 531.1 (drawdown for DHW routing above).	90% drawdown in 9.75 days

PMF - Probable maximum flood
PSW – Principal spillway pipe
DHW – Design high water for 72-Hr. PMF
OD – Outside diameter
DR – Dimensionless ratio
HDPE – High density polyethylene pipe

File: Mach7Bhec-1.doc, hlo, 01/14/2011

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*                                       *
*             JUN   1998                *
*                                       *
*          VERSION 4.1                  *
*                                       *
*                                       *
*  RUN DATE   14JAN11  TIME  14:43:14   *
*                                       *
*  BY:  HLO   CHECKED BY: _____         *
*                                       *
*****************************************
```

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************************************
*                                  *
*    U.S. ARMY CORPS OF ENGINEERS  *
*                                  *
*    HYDROLOGIC ENGINEERING CENTER *
*                                  *
*         609 SECOND STREET        *
*                                  *
*       DAVIS, CALIFORNIA 95616    *
*                                  *
*           (916) 756-1104         *
*                                  *
************************************
```

REFUSE DISPOSAL AREA NO. 2
PHASE 7 - STAGE 6, PHASE 7B ELIMINATED
72-HOUR PMF FLOODROUTING
18" OD DR-26 HDPE PSW PIPE AT INLET ELEVATION 531.1

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X       XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

R14935

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

    1     ID   FILE: MACH7B2DAT
    2     ID  REFUSE DISPOSAL AREA NO. 2, MACH MINING, LLC
    3     ID   PHASE 7, STAGE 6 FLOODROUTING - PHASE 7B ELIMINATED
    4     ID   72-HOUR PMP RAINFALL, 18" DR 26 PSW PIPE AT INLET ELEV. 531.1
    5     IT       5 10JAN14     0000      865
    6     IO       5        0

    7     KK  PHASE7
    8     BA  0.1047
    9     IN      30
   10     PB    41.0
   11     PC   .0008   .0015   .0023   .0031   .0038   .0046   .0054   .0061   .0069   .0077
   12     PC   .0084   .0092   .0101   .0111   .0120   .0129   .0139   .0148   .0157   .0167
   13     PC   .0176   .0185   .0194   .0204   .0216   .0228   .0240   .0252   .0264   .0276
   14     PC   .0288   .0300   .0311   .0323   .0335   .0347   .0364   .0381   .0398   .0414
   15     PC   .0431   .0448   .0465   .0481   .0498   .0515   .0532   .0548   .0573   .0598
   16     PC   .0623   .0649   .0676   .0703   .0732   .0761   .0791   .0822   .0855   .0888
   17     PC   .0951   .1020   .1094   .1175   .1261   .1354   .1454   .1559   .1672   .1791
   18     PC   .1917   .2050   .2207   .2433   .2703   .3047   .3451   .4833   .7146   .7693
   19     PC   .8106   .8388   .8639   .8834   .8892   .8946   .8997   .9045   .9090   .9133
   20     PC   .9173   .9212   .9249   .9285   .9320   .9354   .9375   .9396   .9417   .9438
   21     PC   .9459   .9480   .9501   .9522   .9544   .9565   .9586   .9607   .9621   .9634
   22     PC   .9648   .9662   .9676   .9690   .9704   .9718   .9732   .9745   .9759   .9773
   23     PC   .9784   .9794   .9805   .9815   .9826   .9836   .9847   .9857   .9868   .9878
   24     PC   .9889   .9900   .9908   .9916   .9925   .9933   .9941   .9950   .9958   .9967
   25     PC   .9975   .9983   .9992       1
   26     LS             100                             100
   27     UD    0.11

   28     KK     PSW
   29     RS       1    ELEV   531.1
   30     SV  3010.7 3112.92 3215.99 3319.85 3424.47
   31     SE     530     532     534     536     538
   32     SQ       0    1.21    3.41    5.33    6.88    10.0   12.35   14.33   16.06   17.24
   33     SQ   17.42    18.1
   34     SE   531.1   531.3   531.5  531.64     532     533     534     535     536  536.75
   35     SE     537     538
   36     ZZ
```

4/2

R14936

```
*****************************************                                    ***********************************
*                                       *                                   *
*                                       *                                   *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                   *    U.S. ARMY CORPS OF ENGINEERS
*                                       *                                   *
*              JUN   1998               *                                   *    HYDROLOGIC ENGINEERING CENTER
*                                       *                                   *
*           VERSION 4.1                 *                                   *          609 SECOND STREET
*                                       *                                   *
*                                       *                                   *       DAVIS, CALIFORNIA 95616
*                                       *                                   *
*  RUN DATE   14JAN11  TIME  14:43:14   *                                   *           (916) 756-1104
*                                       *                                   *
*****************************************                                    ***********************************
```

FILE: MACH7B1.DAT
REFUSE DISPOSAL AREA NO. 2, MACH MINING, LLC
PHASE 7, STAGE 6 FLOODROUTING - PHASE 7B ELIMINATED
72-HOUR PMP RAINFALL, 18" DR 26 PSW PIPE AT INLET ELEV. 531.1

```
 6 IO          OUTPUT CONTROL VARIABLES
                    IPRNT           5  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT          HYDROGRAPH TIME DATA
                     NMIN           5  MINUTES IN COMPUTATION INTERVAL
                    IDATE     10JAN14  STARTING DATE
                    ITIME        0000  STARTING TIME
                       NQ         865  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE     13JAN14  ENDING DATE
                   NDTIME        0000  ENDING TIME
                   ICENT          19  CENTURY MARK

                COMPUTATION INTERVAL     .08 HOURS
                     TOTAL TIME BASE   72.00 HOURS
```

43

R14937

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	PHASE7	1278.	39.00	313.	102.	38.	.10		
ROUTED TO	PSW	14.	47.58	14.	14.	8.	.10	534.93	47.67

*** NORMAL END OF HEC-1 ***

FB = 538.0 − 534.93 = 3.07' OK

FOR 10-DAY DRAWDOWN:

47.67 HOURS = 11 JAN 2340

STORAGE AT ELEV. 530.0 = 3010.690 AF
STORAGE AT " 532.0 = 3112.924 "
102.234 "
(1.1/2.0) 102.234 = 56.229 "
+3010.690
STORAGE AT ELEV. 531.1 = 3066.919 AF

STORAGE AT 534.0 = 3215.994 AF
" " 536.0 = 3319.855 "
103.861 "
(0.93/200) 103.861 = 48.295 AF
3215.994 "
STORAGE @ 534.93 = 3,264.289 AF
" " 531.1 = 3,066.919 "
STORM STORAGE = 197.370 "

90% DRAWDOWN STORAGE = 3066.919 + 0.10(197.37) = 3086.656 AF

14938

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*                                       *
*             JUN   1998                *
*                                       *
*           VERSION 4.1                 *
*                                       *
*                                       *
*  RUN DATE   14JAN11  TIME  15:26:04   *
*                                       *
*  by:  hlo   checked by: _____         *
*                                       *
*****************************************
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***********************************
*                                 *
*    U.S. ARMY CORPS OF ENGINEERS *
*                                 *
*    HYDROLOGIC ENGINEERING CENTER*
*                                 *
*         609 SECOND STREET       *
*                                 *
*       DAVIS, CALIFORNIA 95616   *
*                                 *
*         (916) 756-1104          *
*                                 *
***********************************
```

REFUSE DISPOSAL AREA NO. 2
PHASE 7 - STAGE 6, PHASE 7B ELIMINATED
72-HOUR PMF FLOODROUTING - 10 DAY DRAWDOWN
18" OD DR-26 HDPE PSW PIPE AT INLET ELEVATION 531.1

```
X     X  XXXXXXX   XXXXX           X
X     X  X         X     X         XX
X     X  X         X               X
XXXXXXX  XXXX      X         XXXXX X
X     X  X         X               X
X     X  X         X     X         X
X     X  XXXXXXX   XXXXX           XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

R14939

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID   FILE: MACH7BD2
  2           ID  REFUSE DISPOSAL AREA NO. 2, MACH MINING, LLC
  3           ID   PHASE 7, STAGE 6 FLOODROUTING - PHASE 7B ELIMINATED
  4           ID   72-HOUR PMP RAINFALL, 18" DR 26 PSW PIPE AT INLET ELEV. 531.1
  5           ID   10-DAY DRAWDOWN
  6           IT      60 11JAN11    2340         22JAN11    2340
  7           IO       0       0
  8           RS       1    ELEV  534.93
  9           SV  3010.7 3112.92 3215.99 3319.85 3424.47
 10           SE     530     532     534     536     538
 11           SQ       0    1.21    3.41    5.33    6.88    10.0   12.35   14.33   16.06   17.24
 12           SQ   17.42    18.1
 13           SE   531.1   531.3   531.5  531.64     532     533     534     535     536  537.65
 14           SE     537     538
 15           ZZ
```

```
*****************************************                                  ********************************
*                                       *                                  *
*                                       *                                  *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                  *    U.S. ARMY CORPS OF ENGINEERS
*                                       *                                  *
*              JUN   1998               *                                  *    HYDROLOGIC ENGINEERING CENTER
*                                       *                                  *
*           VERSION 4.1                 *                                  *          609 SECOND STREET
*                                       *                                  *
*                                       *                                  *       DAVIS, CALIFORNIA 95616
*                                       *                                  *
*  RUN DATE   14JAN11  TIME  15:26:04   *                                  *           (916) 756-1104
*                                       *                                  *
*                                       *                                  *
*****************************************                                  ***********************************
```

FILE: MACH7BD2
REFUSE DISPOSAL AREA NO. 2, MACH MINING, LLC
PHASE 7, STAGE 6 FLOODROUTING - PHASE 7B ELIMINATED
72-HOUR PMP RAINFALL, 18" DR 26 PSW PIPE AT INLET ELEV. 531.1
10-DAY DRAWDOWN

7 IO OUTPUT CONTROL VARIABLES

IPRNT	0	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	60	MINUTES IN COMPUTATION INTERVAL
IDATE	11JAN11	STARTING DATE
ITIME	2340	STARTING TIME
NQ	265	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	22JAN11	ENDING DATE
NDTIME	2340	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL 1.00 HOURS
TOTAL TIME BASE 264.00 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

HYDROGRAPH ROUTING DATA

8 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	ELEV	TYPE OF INITIAL CONDITION
RSVRIC	534.93	INITIAL CONDITION
X	.00	WORKING R AND D COEFFICIENT

9 SV	STORAGE	3010.7	3112.9	3216.0	3319.9	3424.5					
10 SE	ELEVATION	530.00	532.00	534.00	536.00	538.00					
11 SQ	DISCHARGE	0.	1.	3.	5.	7.	10.	12.	14.	16.	17.
		17.	18.								
13 SE	ELEVATION	531.10	531.30	531.50	531.64	532.00	533.00	534.00	535.00	536.00	537.65
		537.00	538.00								

47

R14941

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	3010.70	3066.92	3077.14	3087.36	3094.52	3112.92	3164.46	3215.99	3267.92	3319.85
OUTFLOW	.00	.00	1.21	3.41	5.33	6.88	10.00	12.35	14.33	16.06
ELEVATION	530.00	531.10	531.30	531.50	531.64	532.00	533.00	534.00	535.00	536.00
STORAGE	3406.16	3424.47								
OUTFLOW	17.24	18.10								
ELEVATION	537.65	538.00								

****

HYDROGRAPH AT STATION [redacted]

****

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
11	JAN	2340	1	14.	3264.3	534.9	*	15	JAN	1640	90	10.	3173.8	533.2	*	19	JAN	0940	179	7.	3111.2	532.0
12	JAN	0040	2	14.	3263.1	534.9	*	15	JAN	1740	91	10.	3173.0	533.2	*	19	JAN	1040	180	7.	3110.6	532.0
12	JAN	0140	3	14.	3261.9	534.9	*	15	JAN	1840	92	10.	3172.1	533.1	*	19	JAN	1140	181	7.	3110.0	531.9
12	JAN	0240	4	14.	3260.8	534.9	*	15	JAN	1940	93	10.	3171.3	533.1	*	19	JAN	1240	182	7.	3109.5	531.9
12	JAN	0340	5	14.	3259.6	534.8	*	15	JAN	2040	94	10.	3170.4	533.1	*	19	JAN	1340	183	7.	3109.0	531.9
12	JAN	0440	6	14.	3258.5	534.8	*	15	JAN	2140	95	10.	3169.6	533.1	*	19	JAN	1440	184	7.	3108.4	531.9
12	JAN	0540	7	14.	3257.3	534.8	*	15	JAN	2240	96	10.	3168.7	533.1	*	19	JAN	1540	185	6.	3107.9	531.9
12	JAN	0640	8	14.	3256.2	534.8	*	15	JAN	2340	97	10.	3167.9	533.1	*	19	JAN	1640	186	6.	3107.3	531.9
12	JAN	0740	9	14.	3255.0	534.8	*	16	JAN	0040	98	10.	3167.0	533.1	*	19	JAN	1740	187	6.	3106.8	531.9
12	JAN	0840	10	14.	3253.9	534.7	*	16	JAN	0140	99	10.	3166.2	533.0	*	19	JAN	1840	188	6.	3106.3	531.9
12	JAN	0940	11	14.	3252.7	534.7	*	16	JAN	0240	100	10.	3165.4	533.0	*	19	JAN	1940	189	6.	3105.8	531.9
12	JAN	1040	12	14.	3251.6	534.7	*	16	JAN	0340	101	10.	3164.5	533.0	*	19	JAN	2040	190	6.	3105.3	531.9
12	JAN	1140	13	14.	3250.5	534.7	*	16	JAN	0440	102	10.	3163.7	533.0	*	19	JAN	2140	191	6.	3104.7	531.8
12	JAN	1240	14	14.	3249.3	534.6	*	16	JAN	0540	103	10.	3162.9	533.0	*	19	JAN	2240	192	6.	3104.2	531.8
12	JAN	1340	15	14.	3248.2	534.6	*	16	JAN	0640	104	10.	3162.1	533.0	*	19	JAN	2340	193	6.	3103.7	531.8
12	JAN	1440	16	14.	3247.1	534.6	*	16	JAN	0740	105	10.	3161.3	532.9	*	20	JAN	0040	194	6.	3103.2	531.8
12	JAN	1540	17	13.	3246.0	534.6	*	16	JAN	0840	106	10.	3160.5	532.9	*	20	JAN	0140	195	6.	3102.7	531.8
12	JAN	1640	18	13.	3244.9	534.6	*	16	JAN	0940	107	10.	3159.7	532.9	*	20	JAN	0240	196	6.	3102.2	531.8
12	JAN	1740	19	13.	3243.8	534.5	*	16	JAN	1040	108	10.	3158.9	532.9	*	20	JAN	0340	197	6.	3101.7	531.8
12	JAN	1840	20	13.	3242.7	534.5	*	16	JAN	1140	109	10.	3158.1	532.9	*	20	JAN	0440	198	6.	3101.3	531.8
12	JAN	1940	21	13.	3241.6	534.5	*	16	JAN	1240	110	10.	3157.3	532.9	*	20	JAN	0540	199	6.	3100.8	531.8
12	JAN	2040	22	13.	3240.5	534.5	*	16	JAN	1340	111	10.	3156.5	532.8	*	20	JAN	0640	200	6.	3100.3	531.8
12	JAN	2140	23	13.	3239.4	534.4	*	16	JAN	1440	112	9.	3155.7	532.8	*	20	JAN	0740	201	6.	3099.8	531.7

12 JAN 2240	24	13.	3238.3	534.4	*	16 JAN 1540	113	9.	3154.9	532.8	*	20 JAN 0840	202	6.	3099.3	531.7
12 JAN 2340	25	13.	3237.2	534.4	*	16 JAN 1640	114	9.	3154.1	532.8	*	20 JAN 0940	203	6.	3098.9	531.7
13 JAN 0040	26	13.	3236.1	534.4	*	16 JAN 1740	115	9.	3153.4	532.8	*	20 JAN 1040	204	6.	3098.4	531.7
13 JAN 0140	27	13.	3235.0	534.4	*	16 JAN 1840	116	9.	3152.6	532.8	*	20 JAN 1140	205	6.	3097.9	531.7
13 JAN 0240	28	13.	3233.9	534.3	*	16 JAN 1940	117	9.	3151.8	532.8	*	20 JAN 1240	206	6.	3097.5	531.7
13 JAN 0340	29	13.	3232.9	534.3	*	16 JAN 2040	118	9.	3151.1	532.7	*	20 JAN 1340	207	6.	3097.0	531.7
13 JAN 0440	30	13.	3231.8	534.3	*	16 JAN 2140	119	9.	3150.3	532.7	*	20 JAN 1440	208	6.	3096.5	531.7
13 JAN 0540	31	13.	3230.7	534.3	*	16 JAN 2240	120	9.	3149.6	532.7	*	20 JAN 1540	209	5.	3096.1	531.7
13 JAN 0640	32	13.	3229.6	534.3	*	16 JAN 2340	121	9.	3148.8	532.7	*	20 JAN 1640	210	5.	3095.6	531.7
13 JAN 0740	33	13.	3228.6	534.2	*	17 JAN 0040	122	9.	3148.1	532.7	*	20 JAN 1740	211	5.	3095.2	531.7
13 JAN 0840	34	13.	3227.5	534.2	*	17 JAN 0140	123	9.	3147.3	532.7	*	20 JAN 1840	212	5.	3094.7	531.6
13 JAN 0940	35	13.	3226.5	534.2	*	17 JAN 0240	124	9.	3146.6	532.7	*	20 JAN 1940	213	5.	3094.3	531.6
13 JAN 1040	36	13.	3225.4	534.2	*	17 JAN 0340	125	9.	3145.8	532.6	*	20 JAN 2040	214	5.	3093.9	531.6
13 JAN 1140	37	13.	3224.4	534.2	*	17 JAN 0440	126	9.	3145.1	532.6	*	20 JAN 2140	215	5.	3093.5	531.6
13 JAN 1240	38	13.	3223.3	534.1	*	17 JAN 0540	127	9.	3144.4	532.6	*	20 JAN 2240	216	5.	3093.0	531.6
13 JAN 1340	39	13.	3222.3	534.1	*	17 JAN 0640	128	9.	3143.7	532.6	*	20 JAN 2340	217	5.	3092.6	531.6
13 JAN 1440	40	13.	3221.2	534.1	*	17 JAN 0740	129	9.	3142.9	532.6	*	21 JAN 0040	218	5.	3092.2	531.6
13 JAN 1540	41	13.	3220.2	534.1	*	17 JAN 0840	130	9.	3142.2	532.6	*	21 JAN 0140	219	5.	3091.9	531.6
13 JAN 1640	42	12.	3219.2	534.1	*	17 JAN 0940	131	9.	3141.5	532.6	*	21 JAN 0240	220	5.	3091.5	531.6
13 JAN 1740	43	12.	3218.1	534.0	*	17 JAN 1040	132	9.	3140.8	532.5	*	21 JAN 0340	221	4.	3091.1	531.6
13 JAN 1840	44	12.	3217.1	534.0	*	17 JAN 1140	133	9.	3140.1	532.5	*	21 JAN 0440	222	4.	3090.8	531.6
13 JAN 1940	45	12.	3216.1	534.0	*	17 JAN 1240	134	8.	3139.4	532.5	*	21 JAN 0540	223	4.	3090.4	531.6
13 JAN 2040	46	12.	3215.1	534.0	*	17 JAN 1340	135	8.	3138.7	532.5	*	21 JAN 0640	224	4.	3090.1	531.6
13 JAN 2140	47	12.	3214.1	534.0	*	17 JAN 1440	136	8.	3138.0	532.5	*	21 JAN 0740	225	4.	3089.7	531.5
13 JAN 2240	48	12.	3213.1	533.9	*	17 JAN 1540	137	8.	3137.3	532.5	*	21 JAN 0840	226	4.	3089.4	531.5
13 JAN 2340	49	12.	3212.0	533.9	*	17 JAN 1640	138	8.	3136.6	532.5	*	21 JAN 0940	227	4.	3089.1	531.5
14 JAN 0040	50	12.	3211.0	533.9	*	17 JAN 1740	139	8.	3135.9	532.4	*	21 JAN 1040	228	4.	3088.7	531.5
14 JAN 0140	51	12.	3210.0	533.9	*	17 JAN 1840	140	8.	3135.3	532.4	*	21 JAN 1140	229	4.	3088.4	531.5
14 JAN 0240	52	12.	3209.0	533.9	*	17 JAN 1940	141	8.	3134.6	532.4	*	21 JAN 1240	230	4.	3088.1	531.5
14 JAN 0340	53	12.	3208.1	533.8	*	17 JAN 2040	142	8.	3133.9	532.4	*	21 JAN 1340	231	4.	3087.8	531.5
14 JAN 0440	54	12.	3207.1	533.8	*	17 JAN 2140	143	8.	3133.2	532.4	*	21 JAN 1440	232	3.	3087.6	531.5
14 JAN 0540	55	12.	3206.1	533.8	*	17 JAN 2240	144	8.	3132.6	532.4	*	21 JAN 1540	233	3.	3087.3	531.5
14 JAN 0640	56	12.	3205.1	533.8	*	17 JAN 2340	145	8.	3131.9	532.4	*	21 JAN 1640	234	3.	3087.0	531.5
14 JAN 0740	57	12.	3204.1	533.8	*	18 JAN 0040	146	8.	3131.2	532.4	*	21 JAN 1740	235	3.	3086.7	531.5
14 JAN 0840	58	12.	3203.1	533.8	*	18 JAN 0140	147	8.	3130.6	532.3	*	21 JAN 1840	236	3.	3086.5	531.5
14 JAN 0940	59	12.	3202.2	533.7	*	18 JAN 0240	148	8.	3129.9	532.3	*	21 JAN 1940	237	3.	3086.2	531.5
14 JAN 1040	60	12.	3201.2	533.7	*	18 JAN 0340	149	8.	3129.3	532.3	*	21 JAN 2040	238	3.	3085.9	531.5
14 JAN 1140	61	12.	3200.2	533.7	*	18 JAN 0440	150	8.	3128.6	532.3	*	21 JAN 2140	239	3.	3085.7	531.5
14 JAN 1240	62	12.	3199.3	533.7	*	18 JAN 0540	151	8.	3128.0	532.3	*	21 JAN 2240	240	3.	3085.4	531.5
14 JAN 1340	63	12.	3198.3	533.7	*	18 JAN 0640	152	8.	3127.3	532.3	*	21 JAN 2340	241	3.	3085.2	531.5
14 JAN 1440	64	12.	3197.4	533.6	*	18 JAN 0740	153	8.	3126.7	532.3	*	22 JAN 0040	242	3.	3084.9	531.5
14 JAN 1540	65	11.	3196.4	533.6	*	18 JAN 0840	154	8.	3126.1	532.3	*	22 JAN 0140	243	3.	3084.7	531.4
14 JAN 1640	66	11.	3195.5	533.6	*	18 JAN 0940	155	8.	3125.4	532.2	*	22 JAN 0240	244	3.	3084.5	531.4
14 JAN 1740	67	11.	3194.5	533.6	*	18 JAN 1040	156	8.	3124.8	532.2	*	22 JAN 0340	245	3.	3084.2	531.4
14 JAN 1840	68	11.	3193.6	533.6	*	18 JAN 1140	157	8.	3124.2	532.2	*	22 JAN 0440	246	3.	3084.0	531.4
14 JAN 1940	69	11.	3192.7	533.5	*	18 JAN 1240	158	8.	3123.5	532.2	*	22 JAN 0540	247	3.	3083.8	531.4
14 JAN 2040	70	11.	3191.7	533.5	*	18 JAN 1340	159	7.	3122.9	532.2	*	22 JAN 0640	248	3.	3083.6	531.4

90%
DD

14 JAN 2140	71	11.	3190.8	533.5 *	18 JAN 1440	160	7.	3122.3	532.2 *	22 JAN 0740	249	3.	3083.4	531.4
14 JAN 2240	72	11.	3189.9	533.5 *	18 JAN 1540	161	7.	3121.7	532.2 *	22 JAN 0840	250	3.	3083.2	531.4
14 JAN 2340	73	11.	3189.0	533.5 *	18 JAN 1640	162	7.	3121.1	532.2 *	22 JAN 0940	251	2.	3083.0	531.4
15 JAN 0040	74	11.	3188.0	533.5 *	18 JAN 1740	163	7.	3120.5	532.1 *	22 JAN 1040	252	2.	3082.8	531.4
15 JAN 0140	75	11.	3187.1	533.4 *	18 JAN 1840	164	7.	3119.9	532.1 *	22 JAN 1140	253	2.	3082.6	531.4
15 JAN 0240	76	11.	3186.2	533.4 *	18 JAN 1940	165	7.	3119.3	532.1 *	22 JAN 1240	254	2.	3082.4	531.4
15 JAN 0340	77	11.	3185.3	533.4 *	18 JAN 2040	166	7.	3118.7	532.1 *	22 JAN 1340	255	2.	3082.2	531.4
15 JAN 0440	78	11.	3184.4	533.4 *	18 JAN 2140	167	7.	3118.1	532.1 *	22 JAN 1440	256	2.	3082.0	531.4
15 JAN 0540	79	11.	3183.5	533.4 *	18 JAN 2240	168	7.	3117.5	532.1 *	22 JAN 1540	257	2.	3081.8	531.4
15 JAN 0640	80	11.	3182.6	533.4 *	18 JAN 2340	169	7.	3116.9	532.1 *	22 JAN 1640	258	2.	3081.6	531.4
15 JAN 0740	81	11.	3181.7	533.3 *	19 JAN 0040	170	7.	3116.3	532.1 *	22 JAN 1740	259	2.	3081.4	531.4
15 JAN 0840	82	11.	3180.8	533.3 *	19 JAN 0140	171	7.	3115.7	532.1 *	22 JAN 1840	260	2.	3081.3	531.4
15 JAN 0940	83	11.	3179.9	533.3 *	19 JAN 0240	172	7.	3115.1	532.0 *	22 JAN 1940	261	2.	3081.1	531.4
15 JAN 1040	84	11.	3179.1	533.3 *	19 JAN 0340	173	7.	3114.6	532.0 *	22 JAN 2040	262	2.	3080.9	531.4
15 JAN 1140	85	11.	3178.2	533.3 *	19 JAN 0440	174	7.	3114.0	532.0 *	22 JAN 2140	263	2.	3080.8	531.4
15 JAN 1240	86	11.	3177.3	533.2 *	19 JAN 0540	175	7.	3113.4	532.0 *	22 JAN 2240	264	2.	3080.6	531.4
15 JAN 1340	87	11.	3176.4	533.2 *	19 JAN 0640	176	7.	3112.8	532.0 *	22 JAN 2340	265	2.	3080.4	531.4
15 JAN 1440	88	11.	3175.6	533.2 *	19 JAN 0740	177	7.	3112.3	532.0 *					
15 JAN 1540	89	10.	3174.7	533.2 *	19 JAN 0840	178	7.	3111.7	532.0 *					
				*					*					

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	264.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 14.	.00		14.	14.	13.	8.
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	7.	27.	75.	184.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	264.00-HR
+ (AC-FT)	(HR)				
3264.	.00	3261.	3251.	3225.	3151.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	264.00-HR
+ (FEET)	(HR)				
534.93	.00	534.86	534.67	534.17	532.73

CUMULATIVE AREA = .00 SQ MI

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
ROUTED TO	[redacted]	14.	.00	14.	14.	13.	.00	534.93	.00

*** NORMAL END OF HEC-1 ***

90% DRAWDOWN TARGET STORAGE = 3,086.656 AF (SEE 72-HR ANF ROUTING)

OCCURS AT 21 JAN 1740
STARTS AT 11 JAN 2340 (PEAK STORAGE)
9 DAYS 1800 = 9.75 DAYS < 10 DAY, OK

57

7186-11
Part 2

52 R14946

Mach Mining, LLC
Refuse Disposal Area No. 2
MSHA ID No. IL08-03141-02
Modification to Eliminate Phase 7B; Pump into Phases 4 and 6
Stability Analysis Files and Results

File No.	Description	SF
7BEMPTY1	Static stability analysis. Phase 4 incised portion full of water, analysis is on north side of Phase 3 on Cross Section E-E. Phase 3 capped to elev. 500. Effective strengths for FCR & CCR, total strength for foundation soil. Theoretical phreatic line from top of capped FCR for Phase 3 underdrain then straight line to standing water in incised Phase 4 pool.	1.90
7BSTEP1	Static stability analysis. Same section and strength parameters as above. FCR in Phases 4/6/7 pool is at max. allowable level for Phase 7, Step 1, Elev. 479.7. Phreatic line at Elev. 479.7 in Phase 4/6/7 pool and level into Phase 3 embankment and Phase 3 capped FCR.	2.11
7BSTEP6	Static stability analysis. Same section and strength parameters as above. Phase 7 completed to Step 6 elevation, FCR is at max. level for end of Step 5. Phreatic line assumed level from FCR elevation 517.9 in Phase 7 pool into Phase 3 cap.	2.15
7BEMPTY2	Seismic stability analysis on cross-section used in 7BEMPTY1, above. Horizontal acceleration = 0.15g, effective strength properties for FCR & CCR, total strength parameters for the foundation soil. Same phreatic line.	1.25
7BSTEP1S	Seismic stability analysis. Same section, strength parameters, and phreatic level as for 7BSTEP1 above. Horizontal acceleration = 0.15g, effective strength properties for FCR & CCR, total strength parameters for the foundation soil. The phreatic level is conservative, as the capped Phase 3 FCR is draining and consolidating. The piezometer readings as of 01/05/2011 indicate that the phreatic level in the Phase 3 embankment is at Elev. 477.5.	1.29
7BSTEP6S	Seismic stability analysis. Same section, strength parameters, and phreatic line as for 7BSTEP6 above. Horizontal acceleration = 0.15g, effective strength properties for FCR & CCR, total strength parameters for the foundation soil.	1.29

File: Mach7B-4stability.doc, hlo, rev. 03/048/2011

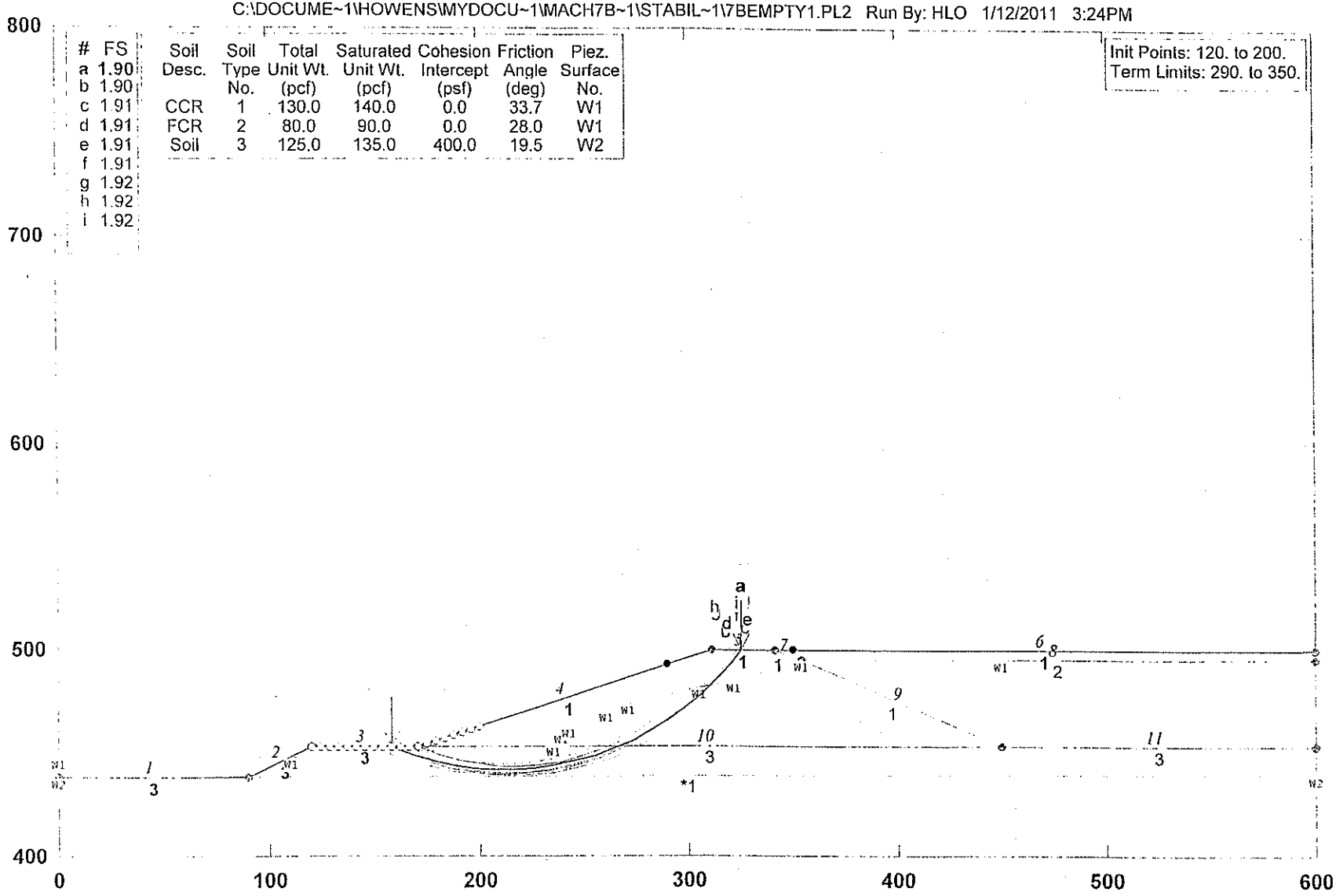
Mach Mining, LLC, Static Analysis Phase 7B Elimination, End of Phase 3

C:\DOCUME~1\HOWENS\MYDOCU~1\MACH7B~1\STABIL~1\7BEMPTY1.PL2 Run By: HLO 1/12/2011 3:24PM

#	FS
a	1.90
b	1.90
c	1.91
d	1.91
e	1.91
f	1.91
g	1.92
h	1.92
i	1.92

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	28.0	W1
Soil	3	125.0	135.0	400.0	19.5	W2

Init Points: 120. to 200.
Term Limits: 290. to 350.



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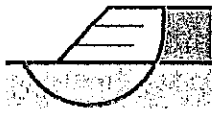
Safety Factors Are Calculated By The Modified Bishop Method

STED



R44947

Mach Mining, LLC, Static Analysis Phase 7B Elimination, End of Phase 3

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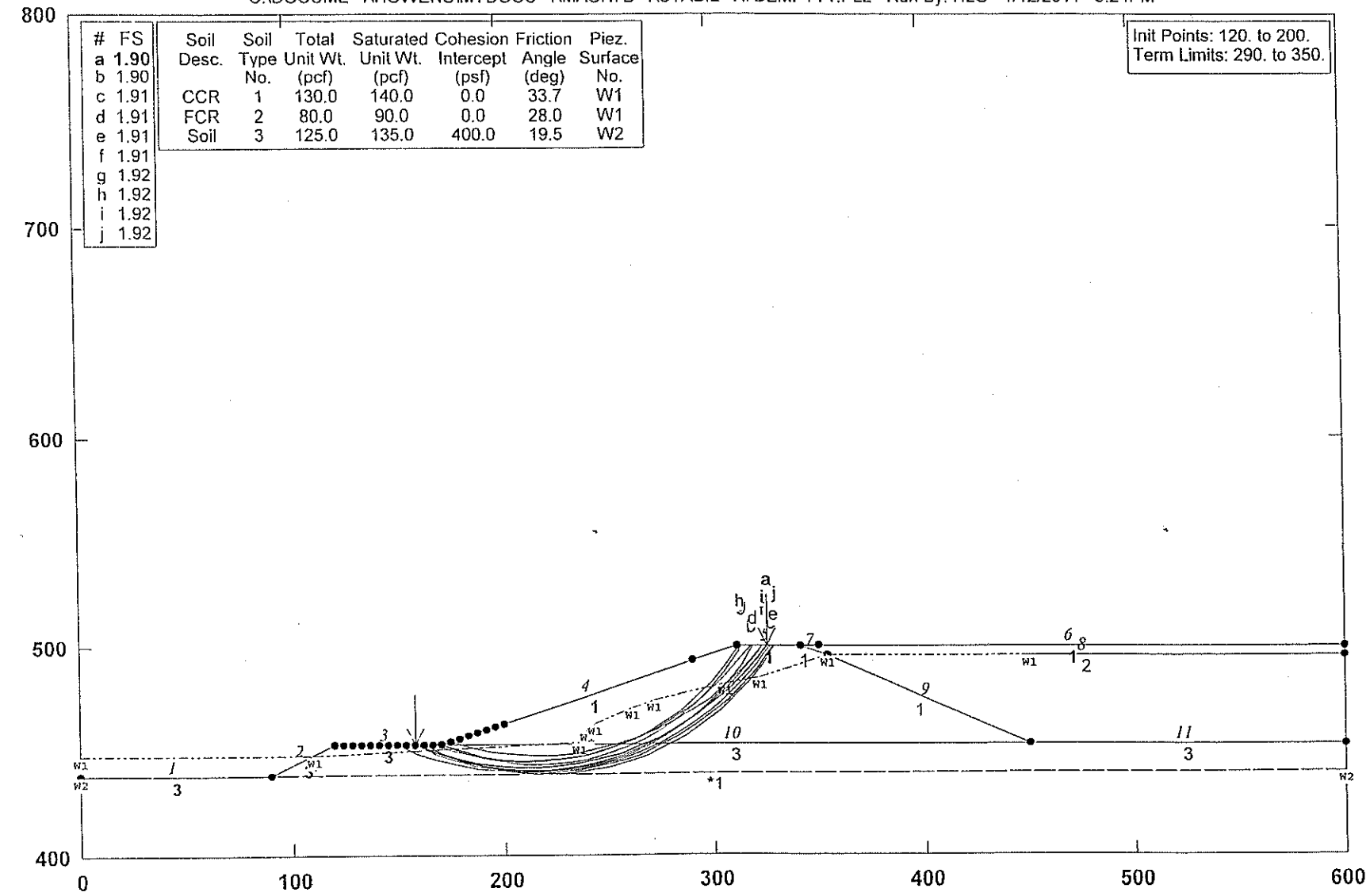


PCSTABL5M/si FSmin=1.90

Safety Factors Are Calculated By The Modified Bishop Method

STED



54R14948

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 1/12/2011
Time of Run: 3:24PM
Run By: HLO
Input Data Filename: C:7bempty1.
Output Filename: C:7bempty1.OUT
Unit: ENGLISH
Plotted Output Filename: C:7bempty1.PLT
PROBLEM DESCRIPTION Mach Mining, LLC, Static Analysis
Phase 7B Elimination, End of Phase 3

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 400.00 to Y-values listed.

6 Top Boundaries
11 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	38.00	90.00	38.00	3
2	90.00	38.00	120.00	53.00	3
3	120.00	53.00	170.00	53.00	3
4	170.00	53.00	311.00	100.00	1
5	311.00	100.00	341.00	100.00	1
6	341.00	100.00	600.00	100.00	1
7	341.00	100.00	354.00	95.00	1
8	354.00	95.00	600.00	95.00	2
9	354.00	95.00	450.20	53.00	1
10	170.00	53.00	450.20	53.00	3
11	450.20	53.00	600.00	53.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 11 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	48.00
2	110.00	48.00
3	235.80	54.00
4	239.00	60.00
5	243.00	63.00
6	261.00	70.80
7	271.50	74.00
8	305.00	82.00
9	321.70	85.00
10	354.00	95.00
11	450.00	95.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	38.00
2	600.00	40.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)

1 .00 38.00 600.00 40.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

400 Trial Surfaces Have Been Generated.

20 Surfaces Initiate From Each Of 20 Points Equally Spaced Along The Ground Surface Between X = 120.00 ft.
and X = 200.00 ft.

Each Surface Terminates Between X = 290.00 ft.
and X = 350.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 38.00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	157.90	53.00
2	167.24	49.45
3	176.82	46.57
4	186.58	44.38
5	196.47	42.89
6	206.44	42.12
7	216.44	42.06
8	226.41	42.71
9	236.32	44.07
10	246.10	46.14
11	255.72	48.90
12	265.11	52.34
13	274.23	56.45
14	283.03	61.19
15	291.47	66.55
16	299.51	72.49
17	307.10	79.00
18	314.21	86.03
19	320.80	93.56
20	325.68	100.00

Circle Center At X = 212.3 ; Y = 181.8 and Radius, 139.8

*** 1.901 ***

Individual data on the 31 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	6.3	956.8	.0	.0	.0	.0	.0	.0	.0
2	3.0	1119.9	.0	.0	.0	.0	.0	.0	.0
3	2.8	1368.5	.0	.0	.0	.0	.0	.0	.0
4	6.8	5617.5	.0	.0	.0	.0	.0	.0	.0
5	9.8	14127.3	.0	.0	.0	.0	.0	.0	.0
6	9.9	20796.8	.0	.0	.0	.0	.0	.0	.0
7	10.0	26664.8	.0	.0	.0	.0	.0	.0	.0
8	8.4	26235.7	.0	.0	.0	.0	.0	.0	.0
9	1.6	5359.0	.0	.0	.0	.0	.0	.0	.0
10	10.0	35508.0	.0	.0	.0	.0	.0	.0	.0
11	9.4	36239.1	.0	.0	.0	.0	.0	.0	.0
12	.5	2073.8	.0	.0	.0	.0	.0	.0	.0
13	2.7	10750.0	.0	.0	.0	.0	.0	.0	.0
14	4.0	16496.6	.0	.0	.0	.0	.0	.0	.0
15	3.1	13105.9	.0	.0	.0	.0	.0	.0	.0
16	9.6	41425.9	.0	.0	.0	.0	.0	.0	.0
17	5.3	23096.2	.0	.0	.0	.0	.0	.0	.0
18	4.1	17999.5	.0	.0	.0	.0	.0	.0	.0
19	1.5	6393.4	.0	.0	.0	.0	.0	.0	.0
20	4.9	21367.3	.0	6186.7	.0	.0	.0	.0	.0
21	2.7	11635.8	.0	3355.7	.0	.0	.0	.0	.0

22	8.8	36231.1	.0	10252.4	.0	.0	.0	.0	.0
23	8.4	32110.5	.0	8436.1	.0	.0	.0	.0	.0
24	8.0	27247.4	.0	6198.2	.0	.0	.0	.0	.0
25	5.5	16216.3	.0	2852.0	.0	.0	.0	.0	.0
26	2.1	5623.7	.0	695.9	.0	.0	.0	.0	.0
27	3.9	9399.1	.0	605.6	.0	.0	.0	.0	.0
28	.3	606.5	.0	2.6	.0	.0	.0	.0	.0
29	2.9	5891.7	.0	.0	.0	.0	.0	.0	.0
30	6.6	8740.7	.0	.0	.0	.0	.0	.0	.0
31	4.9	2042.4	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	166.32	53.00
2	175.84	49.95
3	185.57	47.64
4	195.45	46.07
5	205.41	45.26
6	215.41	45.21
7	225.39	45.92
8	235.28	47.39
9	245.03	49.61
10	254.58	52.56
11	263.88	56.23
12	272.88	60.60
13	281.51	65.65
14	289.74	71.33
15	297.51	77.63
16	304.78	84.49
17	311.50	91.90
18	317.65	99.79
19	317.79	100.00

Circle Center At X = 211.1 ; Y = 176.4 and Radius, 131.3

*** 1.902 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	157.90	53.00
2	167.08	49.04
3	176.53	45.77
4	186.20	43.22
5	196.03	41.40
6	205.97	40.32
7	215.97	39.99
8	225.96	40.41
9	235.89	41.58
10	245.71	43.48
11	255.35	46.12
12	264.77	49.47
13	273.92	53.51
14	282.74	58.23
15	291.17	63.60
16	299.19	69.58
17	306.73	76.15
18	313.76	83.26
19	320.24	90.88
20	326.13	98.96
21	326.77	100.00

Circle Center At X = 215.4 ; Y = 173.5 and Radius, 133.5

*** 1.906 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	162.11	53.00
2	171.20	48.85
3	180.62	45.48
4	190.29	42.92

5	200.13	41.18
6	210.09	40.27
7	220.09	40.21
8	230.06	40.98
9	239.93	42.60
10	249.63	45.03
11	259.09	48.28
12	268.24	52.31
13	277.02	57.10
14	285.36	62.61
15	293.22	68.80
16	300.52	75.63
17	307.22	83.05
18	313.28	91.01
19	318.64	99.45
20	318.93	100.00

Circle Center At X = 215.9 ; Y = 158.8 and Radius, 118.7

*** 1.910 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	157.90	53.00
2	167.03	48.93
3	176.44	45.55
4	186.08	42.89
5	195.89	40.95
6	205.82	39.76
7	215.81	39.32
8	225.81	39.62
9	235.75	40.67
10	245.59	42.47
11	255.26	44.99
12	264.72	48.23
13	273.91	52.18
14	282.78	56.80
15	291.28	62.07
16	299.36	67.96
17	306.97	74.44
18	314.08	81.48
19	320.64	89.02
20	326.62	97.04
21	328.50	100.00

Circle Center At X = 216.8 ; Y = 172.7 and Radius, 133.4

*** 1.911 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	174.74	54.58
2	184.35	51.84
3	194.15	49.81
4	204.06	48.51
5	214.05	47.95
6	224.04	48.12
7	234.00	49.04
8	243.87	50.68
9	253.58	53.04
10	263.10	56.12
11	272.36	59.89
12	281.32	64.33
13	289.93	69.42
14	298.14	75.13
15	305.90	81.43
16	313.18	88.29
17	319.94	95.66
18	323.36	100.00

Circle Center At X = 216.7 ; Y = 183.2 and Radius, 135.3

*** 1.913 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	170.53	53.18
2	179.84	49.53
3	189.44	46.74
4	199.25	44.80
5	209.20	43.75
6	219.19	43.58
7	229.17	44.30
8	239.04	45.91
9	248.73	48.38
10	258.16	51.71
11	267.26	55.86
12	275.95	60.80
13	284.17	66.50
14	291.85	72.90
15	298.93	79.97
16	305.35	87.63
17	311.07	95.83
18	313.46	100.00

Circle Center At X = 216.1 ; Y = 155.7 and Radius, 112.2

*** 1.917 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	170.53	53.18
2	180.00	49.97
3	189.71	47.58
4	199.59	46.02
5	209.56	45.31
6	219.56	45.44
7	229.51	46.42
8	239.34	48.24
9	248.99	50.89
10	258.37	54.35
11	267.43	58.59
12	276.09	63.58
13	284.30	69.30
14	291.99	75.68
15	299.12	82.70
16	305.62	90.29
17	311.46	98.41
18	312.41	100.00

Circle Center At X = 213.0 ; Y = 162.9 and Radius, 117.6

*** 1.917 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	149.47	53.00
2	158.68	49.09
3	168.14	45.84
4	177.80	43.28
5	187.63	41.42
6	197.56	40.27
7	207.55	39.84
8	217.55	40.12
9	227.50	41.11
10	237.35	42.82
11	247.06	45.22
12	256.57	48.32
13	265.83	52.08
14	274.80	56.51
15	283.43	61.56
16	291.67	67.22
17	299.49	73.45
18	306.85	80.23

19	313.69	87.52
20	320.00	95.28
21	323.31	100.00

Circle Center At X = 208.6 ; Y = 179.4 and Radius, 139.5

*** 1.918 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	162.11	53.00
2	171.17	48.77
3	180.53	45.27
4	190.15	42.51
5	199.95	40.51
6	209.87	39.29
7	219.86	38.86
8	229.85	39.20
9	239.79	40.33
10	249.61	42.24
11	259.24	44.91
12	268.64	48.32
13	277.74	52.47
14	286.49	57.31
15	294.83	62.83
16	302.71	68.98
17	310.09	75.74
18	316.91	83.05
19	323.14	90.87
20	328.74	99.16
21	329.21	100.00

Circle Center At X = 220.4 ; Y = 166.2 and Radius, 127.4

*** 1.918 ***

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

BY: HLO DATE: 1/12/2011 CHKD BY: TLG DATE: 4/11/2011 (61)

PROJECT NAME: Refuse Disposal Area No. 2, Mach Mining, LLC

PROJECT NO.: B05-330-1413 SHEET 1 OF 1

DESCRIPTION: Phreatic Line - Pool to Underdrain, Capped Phase 3
Section E-E, North Side of Phase 3, Phase 7B Removed

SCS SM Note No. 7, Case V

k_x = 0.0018 cm/sec
k_y = 0.0002 cm/sec
z_u = 2.60
z_d = 3.00

k_y/k_x = 0.1111

$y_o = (h^2 + d^2)^{1/2} - d$
$a = a_o = y_o/2$

$x_T = (y^2 - y_o^2)/(2y_o)$

$x_T = (f_T)(x_A)$
x_A = x distance on actual section
x_T = x distance on transformed section
y = y distance on both sections

Transformation Factor = $f_T = (k_y/k_x)^{1/2}$ = 0.3333

h (ft.)	d (ft.)	m (ft.)	0.3 m (ft.)	y_o (ft.)	a_o (ft.)
41.0	41.66	35.53	10.66	16.79	8.40

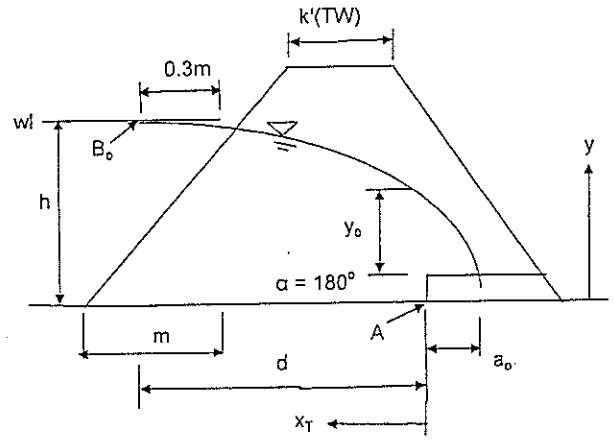
Phreatic Line Coordinates

y (ft.)	x_T (ft.)	x_A (ft.)	Elev. (ft)	Stability X-Sect "x" Distance
0.00	-8.40	-25.19	454.00	235.8
3.00	-8.13	-24.38	457.00	236.6
6.00	-7.32	-21.97	460.00	239.0
9.00	-5.98	-17.95	463.00	243.0
12.00	-4.11	-12.32	466.00	248.7
16.80	0.01	0.03	470.80	261.0
20.00	3.52	10.55	474.00	271.5
24.00	8.76	26.27	478.00	287.3
28.00	14.95	44.85	482.00	305.8
31.00	20.22	60.66	485.00	321.7
36.00	30.20	90.59	490.00	351.6
41.00	41.66	124.98	495.00	*354.0*

U.S. face dam

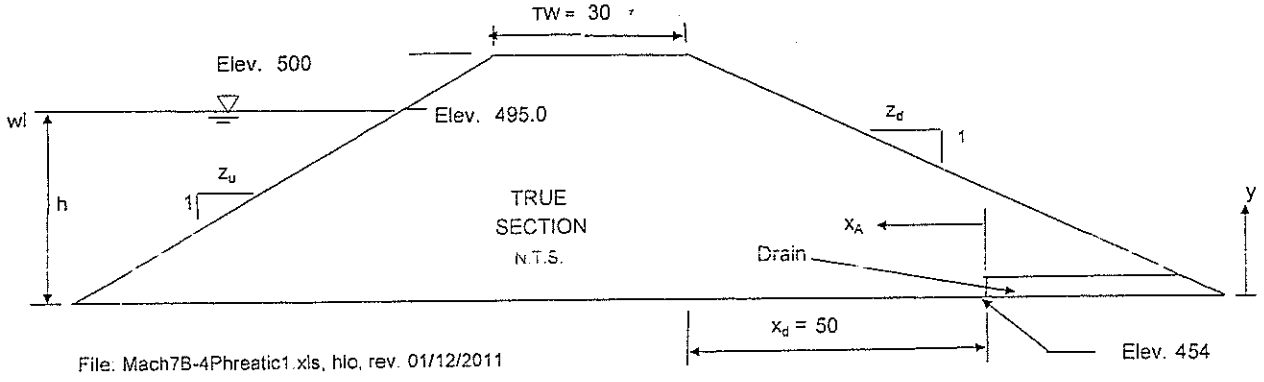
$k' = (k_v k_h)^{1/2}$ = 0.00060 cm/sec = 1.7008 ft/day
$q = k'y_o$ = 28.5584 ft^3/day/ft = **0.1483** *gpm/ft*

Note: $q = k'y_o$ when d > h and α > 60°, othersize, see SM Note No. 7



TRANSFORMED SECTON
N.T.S.

Phase 3 Capped, Incised Part of Phase 4
Full of Water, UD Sta. 33+00



R14956

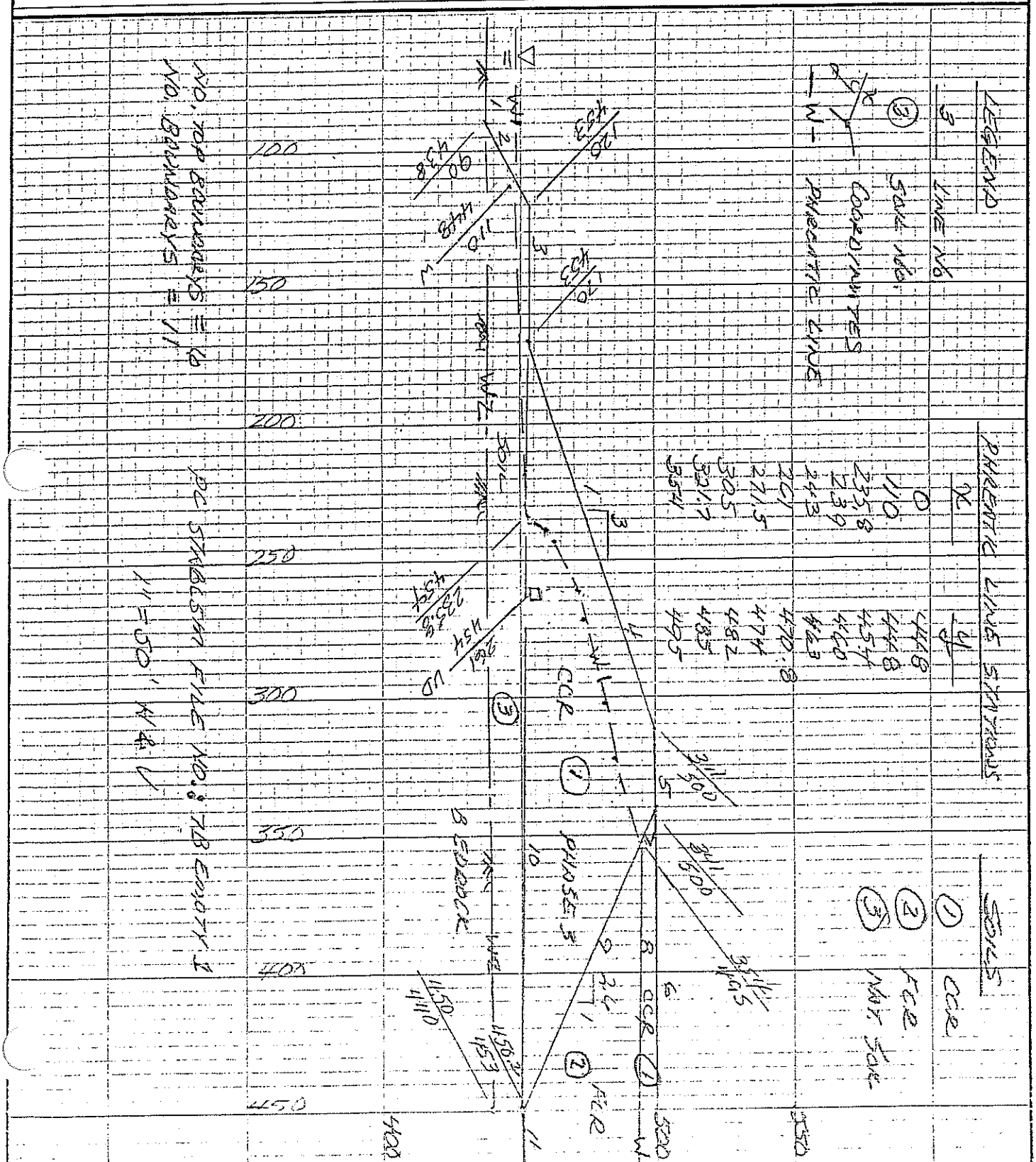
Alliance Consulting, Inc.
Engineers
Constructors
Scientists
BECKLEY, WV
(304) 255-0491

BY: HJO DATE: 01/12/11 CHKD BY: TLK DATE: 4/11/2011 (62)

PROJECT NAME: REFUSE DISPOSAL AREA NO. 2

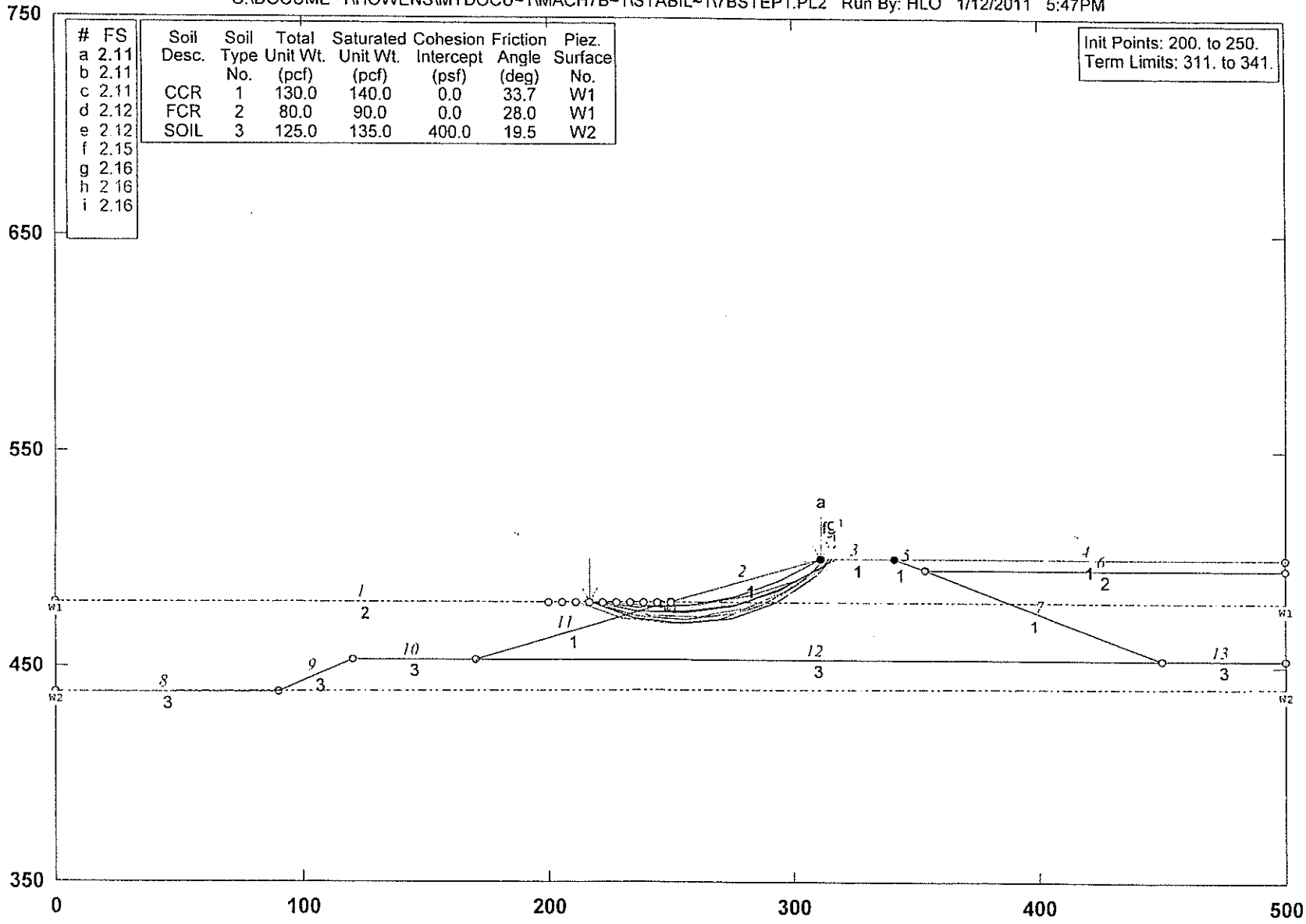
PROJECT NO. 805-330-1413 SHEET ____ OF ____

DESCRIPTION STABILITY ANALYSIS CROSS-SECTION
E-E' PHASE 2B REMOVED


LEGEND
LINE NO.
STA. NO.
CODED VALUES
PHREATIC LINE
PHREATIC LINES STRATIGRAPHY
SCALES
HOR.
VERT.
PHASE 3
PHASE 2
PHASE 1
NO. 1 & 2 BOUNDARYS
NO. 3 BOUNDARY
NO. 4 BOUNDARY
TOE STABILITY FILTER NO. 2
TOE STABILITY FILTER NO. 1
TOE BERM
TOE DRAIN
TOE DRAIN
TOE DRAIN

Mach Mining, LLC, Static Analysis - Phase 7B Elimination, Phase 7 Step 1

C:\DOCUME~1\HOWENS\MYDOCU~1\MACH7B~1\STABIL~1\7BSTEP1.PL2 Run By: HLO 1/12/2011 5:47PM



PCSTABL5M/si FSmin=2.11

Safety Factors Are Calculated By The Modified Bishop Method

STED



63

R14957

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 1/12/2011
Time of Run: 5:47PM
Run By: HLO
Input Data Filename: C:7bstep1.
Output Filename: C:7bstep1.OUT
Unit: ENGLISH
Plotted Output Filename: C:7bstep1.PLT
PROBLEM DESCRIPTION Mach Mining, LLC, Static Analysis - Phase 7B Elimination, Phase 7 Step 1

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 350.00 to Y-values listed.

4 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	129.70	250.10	129.70	2
2	250.10	129.70	311.00	150.00	1
3	311.00	150.00	341.00	150.00	1
4	341.00	150.00	500.00	150.00	1
5	341.00	150.00	354.00	145.00	1
6	354.00	145.00	500.00	145.00	2
7	354.00	145.00	450.20	103.00	1
8	.00	88.00	90.00	88.00	3
9	90.00	88.00	120.00	103.00	3
10	120.00	103.00	170.00	103.00	3
11	170.00	103.00	246.50	128.50	1
12	170.00	103.00	450.20	103.00	3
13	450.20	103.00	500.00	103.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 3 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	129.70
2	250.10	129.70
3	500.00	129.70

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	88.00
2	500.00	90.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
200 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 200.00 ft.
and X = 250.00 ft.
Each Surface Terminates Between X = 311.00 ft.
and X = 341.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 88.00 ft.

20.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	216.67	129.70
2	236.53	127.38
3	256.51	128.34
4	276.06	132.55
5	294.67	139.89
6	311.55	150.00

Circle Center At X = 240.7 ; Y = 249.3 and Radius, 122.0
*** 2.111 ***
Individual data on the 10 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	19.9	2069.8	.0	1444.8	.0	.0	.0	.0	.0
2	7.7	1482.5	.0	1029.0	.0	.0	.0	.0	.0
3	2.2	415.8	.0	263.9	.0	.0	.0	.0	.0
4	3.6	567.4	.0	393.9	.0	.0	.0	.0	.0
5	6.4	2246.5	.0	605.2	.0	.0	.0	.0	.0
6	6.3	3217.8	.0	273.6	.0	.0	.0	.0	.0
7	13.2	8647.2	.0	.0	.0	.0	.0	.0	.0
8	18.6	12670.6	.0	.0	.0	.0	.0	.0	.0
9	16.3	5310.2	.0	.0	.0	.0	.0	.0	.0
10	.6	12.0	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	216.67	129.70
2	236.18	125.32
3	256.17	124.83
4	275.88	128.27
5	294.53	135.49
6	311.40	146.22
7	315.35	150.00

Circle Center At X = 248.6 ; Y = 226.3 and Radius, 101.8
*** 2.113 ***
Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	222.22	129.70
2	241.35	123.84
3	261.33	122.99
4	280.88	127.21
5	298.73	136.22
6	313.74	149.44
7	314.12	150.00

Circle Center At X = 254.6 ; Y = 201.4 and Radius, 78.7
*** 2.114 ***
Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	216.67	129.70
2	236.27	125.73
3	256.27	125.48
4	275.96	128.97
5	294.66	136.08
6	311.70	146.54
7	315.49	150.00

Circle Center At X = 247.6 ; Y = 231.8 and Radius, 106.7
*** 2.117 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	216.67	129.70
2	235.65	123.40
3	255.58	121.76
4	275.34	124.87
5	293.80	132.56
6	309.93	144.39
7	314.65	150.00

Circle Center At X = 252.5 ; Y = 205.8 and Radius, 84.1

*** 2.122 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	211.11	129.70
2	229.69	122.30
3	249.52	119.69
4	269.39	122.03
5	288.07	129.18
6	304.42	140.69
7	312.42	150.00

Circle Center At X = 250.1 ; Y = 200.5 and Radius, 80.8

*** 2.151 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	216.67	129.70
2	235.25	122.30
3	255.10	119.86
4	274.92	122.53
5	293.41	130.16
6	309.36	142.22
7	315.47	150.00

Circle Center At X = 254.6 ; Y = 198.0 and Radius, 78.1

*** 2.157 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	216.67	129.70
2	235.69	123.54
3	255.61	121.74
4	275.44	124.38
5	294.19	131.34
6	310.93	142.27
7	318.42	150.00

Circle Center At X = 253.7 ; Y = 211.6 and Radius, 89.9

*** 2.157 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	222.22	129.70
2	242.13	127.83
3	262.10	128.99
4	281.66	133.17
5	300.36	140.25
6	317.61	150.00

Circle Center At X = 244.5 ; Y = 259.4 and Radius, 131.6

*** 2.161 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	233.33	129.70
2	253.15	127.01
3	273.10	128.44
4	292.33	133.93
5	310.03	143.25

```
     6        318.19       150.00
Circle Center At X =   256.2 ; Y =   221.8   and Radius,    94.9
      ***      2.178    ***
```

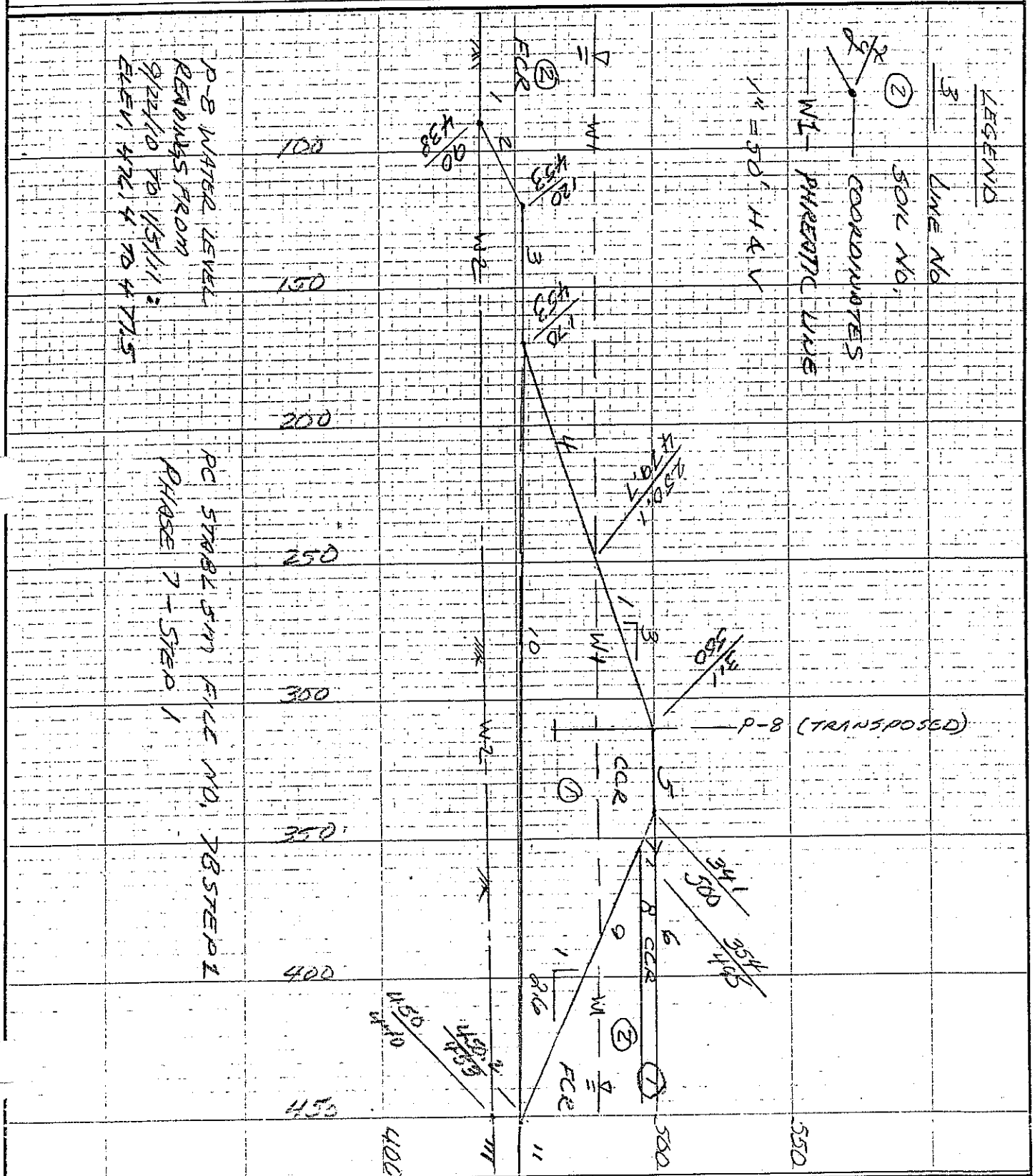
Alliance Consulting, Inc.
Engineers
Constructors
Scientists
BECKLEY, WV
(304) 255-0491

BY: WJO DATE: 01/12/11 CHKD BY: _____ DATE: _____ (68)

PROJECT NAME: REFUSE DISPOSAL AREA No. 2

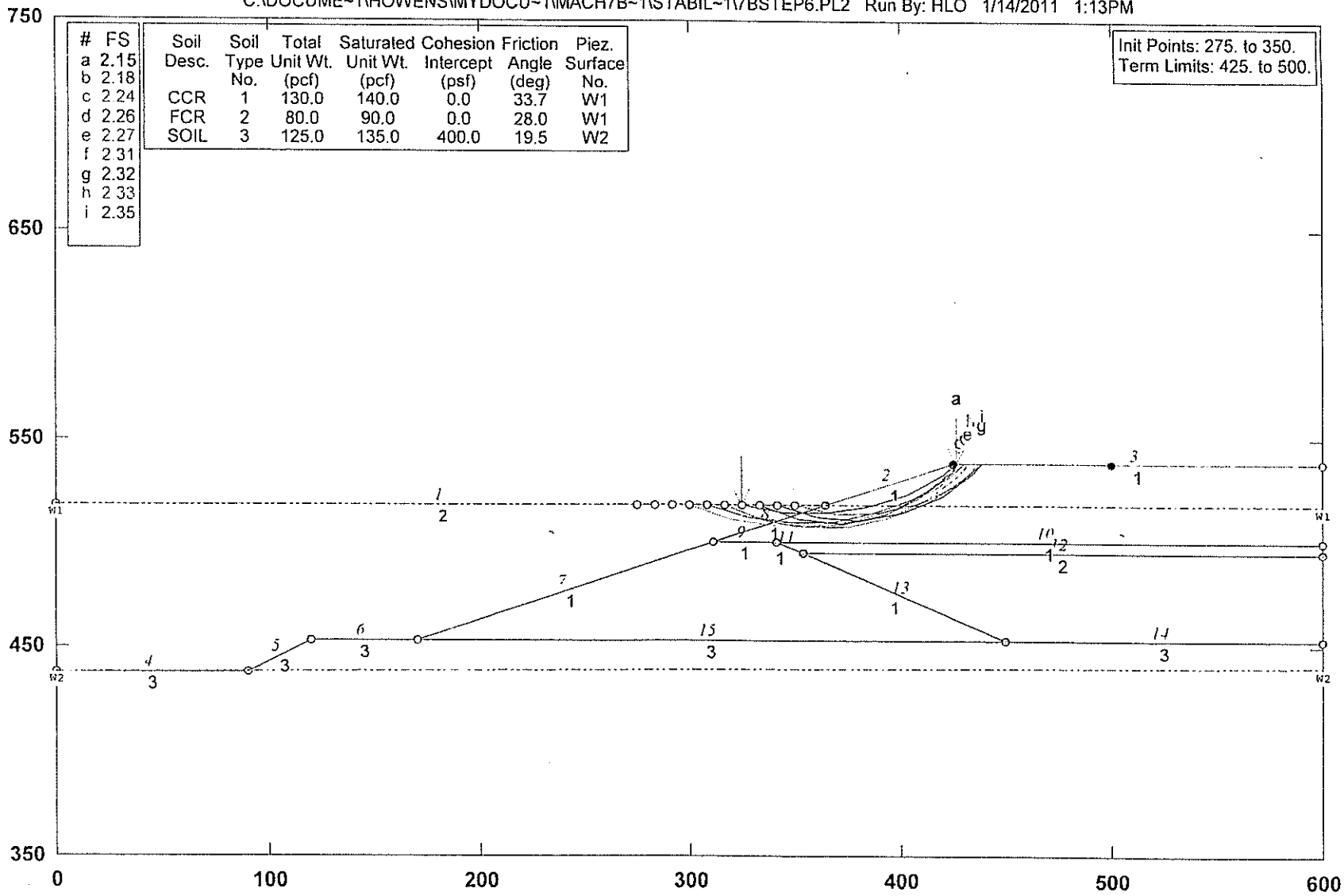
PROJECT NO. 805-330-1413 SHEET _____ OF _____

DESCRIPTION STABILITY ANALYSIS CROSS-SECTION E-E, PHASE 7B REMOVED



Mach Mining, LLC, Static Analysis - Phase 7B Elimination, Phase 7 Step 6

C:\DOCUME~1\HOWENS\MYDOCU~1\MACH7B~1\STABIL~1\7BSTEP6.PL2 Run By: HLO 1/14/2011 1:13PM



PCSTABL5M/si FSmin=2.15

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 1/14/2011
Time of Run: 1:13PM
Run By: HLO
Input Data Filename: C:7bstep6.
Output Filename: C:7bstep6.OUT
Unit: ENGLISH
Plotted Output Filename: C:7bstep6.PLT
PROBLEM DESCRIPTION Mach Mining, LLC, Static Analysis - Phase 7B Elimination, Phase 7 Step 6

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 350.00 to Y-values listed.

3 Top Boundaries
15 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	167.90	364.70	167.90	2
2	364.70	167.90	425.00	188.00	1
3	425.00	188.00	600.00	188.00	1
4	.00	88.00	90.00	88.00	3
5	90.00	88.00	120.00	103.00	3
6	120.00	103.00	170.00	103.00	3
7	170.00	103.00	311.00	150.00	1
8	311.00	150.00	364.70	167.90	1
9	311.00	150.00	341.00	150.00	1
10	341.00	150.00	600.00	150.00	1
11	341.00	150.00	354.00	145.00	1
12	354.00	145.00	600.00	145.00	2
13	354.00	145.00	450.20	103.00	1
14	450.20	103.00	600.00	103.00	3
15	170.00	103.00	450.20	103.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	167.90
2	600.00	167.90

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	88.00
2	600.00	90.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
200 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 275.00 ft.
and X = 350.00 ft.
Each Surface Terminates Between X = 425.00 ft.
and X = 500.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y = 88.00 ft.
20.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	325.00	167.90
2	344.65	164.19
3	364.65	163.90
4	384.40	167.05
5	403.32	173.54
6	420.84	183.18
7	426.85	188.00

Circle Center At X = 356.3 ; Y = 279.7 and Radius, 116.1
*** 2.155 ***
Individual data on the 10 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	19.7	3284.9	.0	2317.9	.0	.0	.0	.0	.0
2	8.5	2900.9	.0	2011.5	.0	.0	.0	.0	.0
3	11.5	5184.5	.0	2803.3	.0	.0	.0	.0	.0
4	.0	27.7	.0	12.5	.0	.0	.0	.0	.0
5	19.7	15091.4	.0	3015.9	.0	.0	.0	.0	.0
6	2.5	2400.3	.0	69.7	.0	.0	.0	.0	.0
7	16.4	15625.0	.0	.0	.0	.0	.0	.0	.0
8	17.5	12143.6	.0	.0	.0	.0	.0	.0	.0
9	4.2	1328.6	.0	.0	.0	.0	.0	.0	.0
10	1.9	178.4	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	333.33	167.90
2	352.12	161.04
3	372.05	159.34
4	391.73	162.90
5	409.79	171.49
6	424.98	184.50
7	427.36	188.00

Circle Center At X = 368.5 ; Y = 235.1 and Radius, 75.8
*** 2.184 ***
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	316.67	167.90
2	335.33	160.70
3	355.10	157.67
4	375.06	158.94
5	394.28	164.45
6	411.88	173.95
7	427.04	187.00
8	427.79	188.00

Circle Center At X = 359.2 ; Y = 250.1 and Radius, 92.6
*** 2.243 ***
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	308.33	167.90
2	327.46	162.04
3	347.28	159.41
4	367.27	160.09
5	386.87	164.06
6	405.56	171.20

7	422.80	181.33
8	430.78	188.00

Circle Center At X = 353.0 ; Y = 278.8 and Radius, 119.5

*** 2.264 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	316.67	167.90
2	335.14	160.24
3	354.81	156.64
4	374.81	157.25
5	394.22	162.05
6	412.19	170.83
7	427.92	183.18
8	431.91	188.00

Circle Center At X = 361.7 ; Y = 249.9 and Radius, 93.6

*** 2.272 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	316.67	167.90
2	335.35	160.76
3	355.05	157.29
4	375.04	157.61
5	394.62	161.71
6	413.06	169.45
7	429.71	180.53
8	437.29	188.00

Circle Center At X = 363.2 ; Y = 260.9 and Radius, 104.0

*** 2.307 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	341.67	167.90
2	360.81	162.11
3	380.77	160.84
4	400.49	164.17
5	418.93	171.91
6	435.11	183.67
7	438.85	188.00

Circle Center At X = 376.3 ; Y = 247.7 and Radius, 86.9

*** 2.318 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.00	167.90
2	318.98	161.60
3	338.70	158.28
4	358.70	158.01
5	378.51	160.80
6	397.65	166.59
7	415.68	175.24
8	432.18	186.55
9	433.73	188.00

Circle Center At X = 350.4 ; Y = 288.1 and Radius, 130.4

*** 2.332 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	350.00	167.90
2	369.55	163.67
3	389.55	163.98
4	408.95	168.81
5	426.76	177.91
6	438.72	188.00

Circle Center At X = 378.1 ; Y = 249.8 and Radius, 86.6

*** 2.346 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.00	167.90
2	319.51	163.52
3	339.42	161.54
4	359.41	162.01
5	379.20	164.91
6	398.49	170.19
7	416.99	177.79
8	434.42	187.59
9	434.98	188.00

Circle Center At X = 345.6 ; Y = 325.2 and Radius, 163.8

*** 2.350 ***

R14968

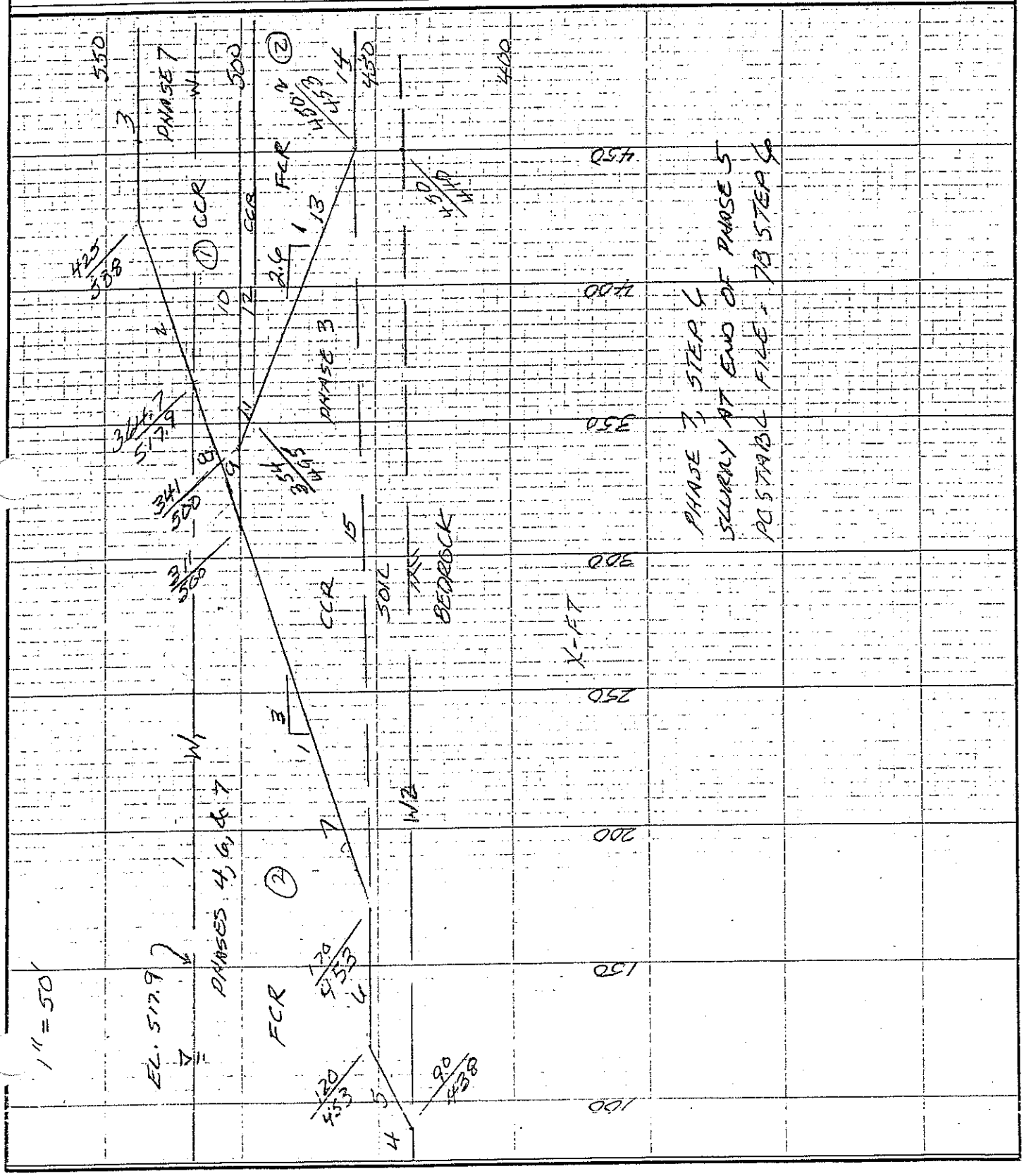
Alliance Consulting, Inc.
Engineers
Constructors
Scientists
BECKLEY, WV
(304) 255-0491

BY: HJO DATE: 12/16/10 CHKD BY: TLG DATE: 4/11/2011 (74)

PROJECT NAME: REFUSE DISPOSAL AREA NO. 2

PROJECT NO. 805-330-1413 SHEET ____ OF ____

DESCRIPTION TRIAL STABILITY ANALYSIS CROSS SECTION, PHASE 7B REMOVED



Mach Mining, LLC, Seismic Analysis Phase 7B Elimination, End of Phase 3

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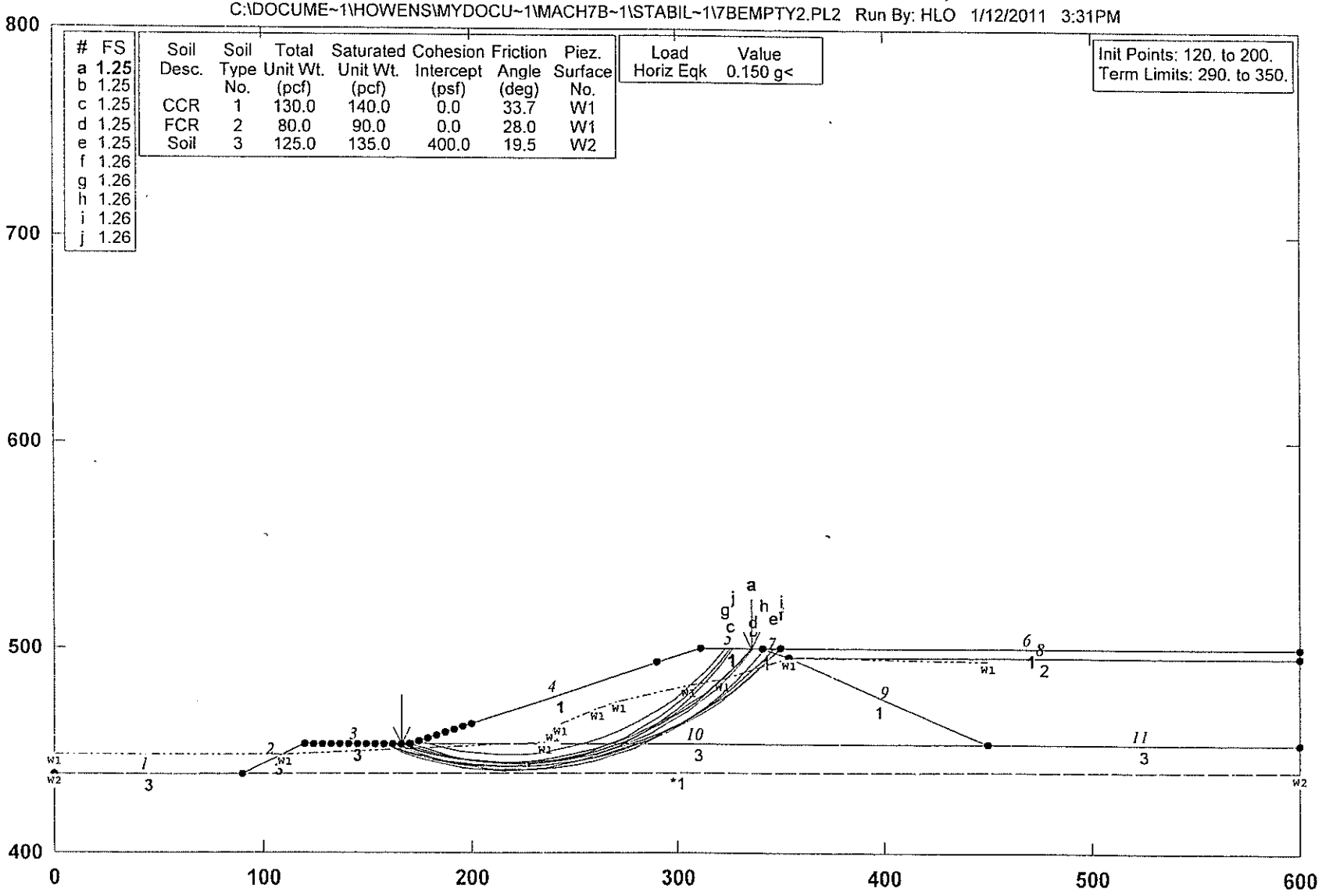


PCSTABL5M/si FSmin=1.25

Safety Factors Are Calculated By The Modified Bishop Method

STED



Mach Mining, LLC, Seismic Analysis Phase 7B Elimination, End of Phase 3

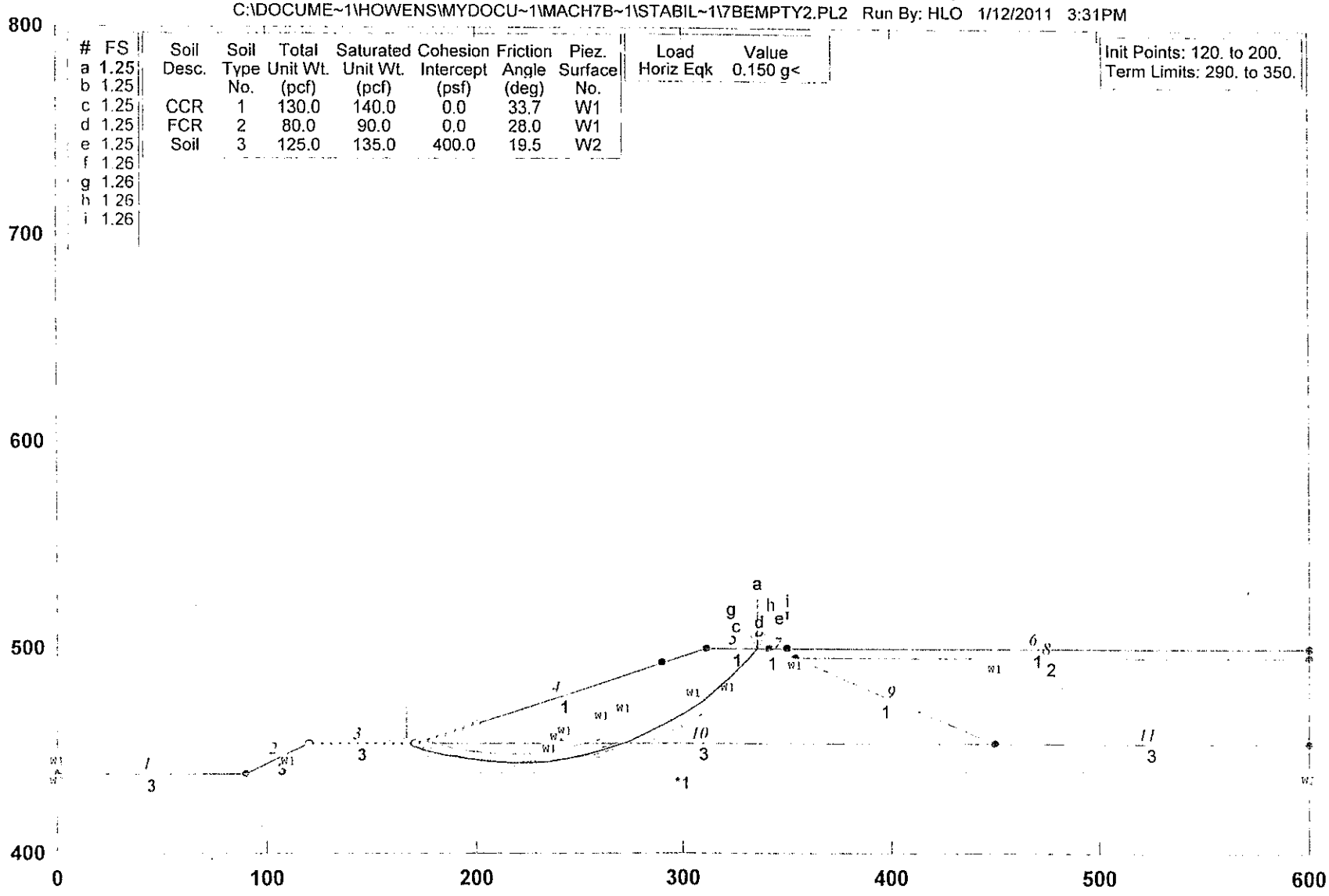
C:\DOCUME~1\HOWENS\MYDOCU~1\MACH7B~1\STABIL~1\7BEMPTY2.PL2 Run By: HLO 1/12/2011 3:31PM

#	FS
a	1.25
b	1.25
c	1.25
d	1.25
e	1.25
f	1.26
g	1.26
h	1.26
i	1.26

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	28.0	W1
Soil	3	125.0	135.0	400.0	19.5	W2

Load	Value
Horiz Eqk	0.150 g<

Init Points: 120. to 200.
Term Limits: 290. to 350.



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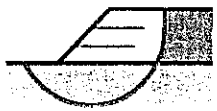
Safety Factors Are Calculated By The Modified Bishop Method

STED



76R14970

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 1/12/2011
Time of Run: 3:31PM
Run By: HLO
Input Data Filename: C:7bempty2.
Output Filename: C:7bempty2.OUT
Unit: ENGLISH
Plotted Output Filename: C:7bempty2.PLT
PROBLEM DESCRIPTION Mach Mining, LLC, Seismic Analysis
Phase 7B Elimination, End of Phase 3

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 400.00 to Y-values listed.

6 Top Boundaries
11 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	38.00	90.00	38.00	3
2	90.00	38.00	120.00	53.00	3
3	120.00	53.00	170.00	53.00	3
4	170.00	53.00	311.00	100.00	1
5	311.00	100.00	341.00	100.00	1
6	341.00	100.00	600.00	100.00	1
7	341.00	100.00	354.00	95.00	1
8	354.00	95.00	600.00	95.00	2
9	354.00	95.00	450.20	53.00	1
10	170.00	53.00	450.20	53.00	3
11	450.20	53.00	600.00	53.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 11 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	48.00
2	110.00	48.00
3	235.80	54.00
4	239.00	60.00
5	243.00	63.00
6	261.00	70.80
7	271.50	74.00
8	305.00	82.00
9	321.70	85.00
10	354.00	95.00
11	450.00	94.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	38.00
2	600.00	40.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)

1 .00 38.00 600.00 40.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 120.00 ft.
and X = 200.00 ft.
Each Surface Terminates Between X = 290.00 ft.
and X = 350.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 38.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	166.32	53.00
2	175.81	49.84
3	185.48	47.33
4	195.31	45.46
5	205.23	44.24
6	215.22	43.69
7	225.22	43.80
8	235.19	44.58
9	245.08	46.02
10	254.86	48.11
11	264.48	50.84
12	273.90	54.21
13	283.07	58.20
14	291.95	62.78
15	300.52	67.95
16	308.72	73.67
17	316.52	79.93
18	323.89	86.69
19	330.79	93.92
20	335.87	100.00

Circle Center At X = 218.5 ; Y = 194.0 and Radius, 150.4
*** 1.250 ***
Individual data on the 32 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.7	282.0	.0	.0	.0	.0	42.3	.0	.0
2	2.4	612.9	.0	.0	.0	.0	91.9	.0	.0
3	3.4	1706.6	.0	.0	.0	.0	256.0	.0	.0
4	9.7	9803.9	.0	.0	.0	.0	1470.6	.0	.0
5	9.8	16796.5	.0	.0	.0	.0	2519.5	.0	.0
6	9.9	23132.1	.0	.0	.0	.0	3469.8	.0	.0
7	9.6	27480.9	.0	.0	.0	.0	4122.1	.0	.0
8	.4	1196.8	.0	.0	.0	.0	179.5	.0	.0
9	10.0	33348.2	.0	.0	.0	.0	5002.2	.0	.0
10	10.0	37056.9	.0	.0	.0	.0	5558.5	.0	.0
11	.6	2387.7	.0	.0	.0	.0	358.2	.0	.0
12	3.2	12585.3	.0	.0	.0	.0	1887.8	.0	.0
13	4.0	16318.6	.0	.0	.0	.0	2447.8	.0	.0
14	2.1	8730.2	.0	.0	.0	.0	1309.5	.0	.0
15	9.8	42273.4	.0	.0	.0	.0	6341.0	.0	.0
16	6.1	27382.3	.0	.0	.0	.0	4107.3	.0	.0

17	3.5	15749.2	.0	.0	.0	.0	2362.4	.0	.0
18	6.0	27422.2	.0	.0	.0	.0	4113.3	.0	.0
19	1.0	4507.9	.0	1299.1	.0	.0	676.2	.0	.0
20	2.4	10899.5	.0	3168.6	.0	.0	1634.9	.0	.0
21	9.2	41029.6	.0	11817.2	.0	.0	6154.4	.0	.0
22	8.9	38096.3	.0	10524.1	.0	.0	5714.4	.0	.0
23	8.6	34283.6	.0	8828.5	.0	.0	5142.5	.0	.0
24	4.5	16689.0	.0	3967.2	.0	.0	2503.4	.0	.0
25	3.7	13044.9	.0	2772.4	.0	.0	1956.7	.0	.0
26	2.3	7616.0	.0	1489.2	.0	.0	1142.4	.0	.0
27	5.5	16306.6	.0	2545.3	.0	.0	2446.0	.0	.0
28	5.2	12032.8	.0	963.3	.0	.0	1804.9	.0	.0
29	.5	1033.5	.0	6.8	.0	.0	155.0	.0	.0
30	1.7	3040.4	.0	.0	.0	.0	456.1	.0	.0
31	6.9	8702.9	.0	.0	.0	.0	1305.4	.0	.0
32	5.1	2005.4	.0	.0	.0	.0	300.8	.0	.0

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	162.11	53.00
2	171.66	50.05
3	181.38	47.70
4	191.23	45.96
5	201.16	44.83
6	211.15	44.32
7	221.15	44.42
8	231.12	45.14
9	241.03	46.48
10	250.84	48.43
11	260.51	50.99
12	270.00	54.14
13	279.28	57.86
14	288.31	62.16
15	297.06	67.01
16	305.49	72.38
17	313.57	78.27
18	321.27	84.65
19	328.57	91.49
20	335.42	98.78
21	336.44	100.00

Circle Center At X = 214.5 ; Y = 205.8 and Radius, 161.5

*** 1.251 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	157.90	53.00
2	167.24	49.45
3	176.82	46.57
4	186.58	44.38
5	196.47	42.89
6	206.44	42.12
7	216.44	42.06
8	226.41	42.71
9	236.32	44.07
10	246.10	46.14
11	255.72	48.90
12	265.11	52.34
13	274.23	56.45
14	283.03	61.19
15	291.47	66.55
16	299.51	72.49
17	307.10	79.00
18	314.21	86.03
19	320.80	93.56
20	325.68	100.00

Circle Center At X = 212.3 ; Y = 181.8 and Radius, 139.8

*** 1.254 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	170.53	53.18
2	179.98	49.91
3	189.63	47.30
4	199.44	45.37
5	209.37	44.12
6	219.35	43.56
7	229.35	43.69
8	239.31	44.51
9	249.20	46.02
10	258.96	48.21
11	268.54	51.06
12	277.90	54.58
13	287.00	58.73
14	295.79	63.50
15	304.23	68.87
16	312.27	74.80
17	319.89	81.28
18	327.04	88.27
19	333.69	95.74
20	336.98	100.00

Circle Center At X = 222.5 ; Y = 187.9 and Radius, 144.4

*** 1.255 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	157.90	53.00
2	167.33	49.69
3	176.95	46.95
4	186.71	44.77
5	196.58	43.18
6	206.53	42.16
7	216.52	41.74
8	226.52	41.90
9	236.49	42.65
10	246.40	43.98
11	256.22	45.90
12	265.90	48.38
13	275.42	51.44
14	284.75	55.05
15	293.85	59.20
16	302.69	63.87
17	311.23	69.06
18	319.46	74.75
19	327.34	80.91
20	334.85	87.52
21	341.95	94.56
22	346.83	100.00

Circle Center At X = 218.8 ; Y = 211.5 and Radius, 169.8

*** 1.255 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	157.90	53.00
2	167.36	49.78
3	177.00	47.10
4	186.77	44.98
5	196.65	43.41
6	206.59	42.40
7	216.58	41.96
8	226.58	42.09
9	236.56	42.79
10	246.48	44.05
11	256.31	45.88
12	266.03	48.25

13	275.59	51.18
14	284.97	54.64
15	294.14	58.64
16	303.07	63.14
17	311.72	68.15
18	320.08	73.63
19	328.12	79.59
20	335.80	85.99
21	343.11	92.81
22	349.98	100.00

Circle Center At X = 219.3 ; Y = 218.0 and Radius, 176.1

*** 1.256 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	174.74	54.58
2	184.35	51.84
3	194.15	49.81
4	204.06	48.51
5	214.05	47.95
6	224.04	48.12
7	234.00	49.04
8	243.87	50.68
9	253.58	53.04
10	263.10	56.12
11	272.36	59.89
12	281.32	64.33
13	289.93	69.42
14	298.14	75.13
15	305.90	81.43
16	313.18	88.29
17	319.94	95.66
18	323.36	100.00

Circle Center At X = 216.7 ; Y = 183.2 and Radius, 135.3

*** 1.257 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	162.11	53.00
2	171.39	49.28
3	180.90	46.19
4	190.59	43.74
5	200.43	41.94
6	210.36	40.80
7	220.35	40.32
8	230.35	40.51
9	240.32	41.36
10	250.20	42.88
11	259.96	45.05
12	269.56	47.87
13	278.94	51.32
14	288.08	55.39
15	296.92	60.05
16	305.44	65.30
17	313.58	71.10
18	321.32	77.43
19	328.62	84.26
20	335.46	91.57
21	341.79	99.31
22	342.28	100.00

Circle Center At X = 222.5 ; Y = 190.3 and Radius, 150.0

*** 1.258 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	166.32	53.00
2	175.89	50.13

3	185.62	47.80
4	195.46	46.04
5	205.39	44.84
6	215.37	44.20
7	225.37	44.14
8	235.36	44.65
9	245.30	45.72
10	255.17	47.36
11	264.92	49.56
12	274.53	52.31
13	283.98	55.61
14	293.21	59.43
15	302.22	63.78
16	310.96	68.63
17	319.42	73.98
18	327.55	79.80
19	335.34	86.07
20	342.76	92.77
21	349.78	99.89
22	349.88	100.00

Circle Center At X = 221.5 ; Y = 219.5 and Radius, 175.4

*** 1.258 ***

Failure Surface Specified By 21 Coordinate Points

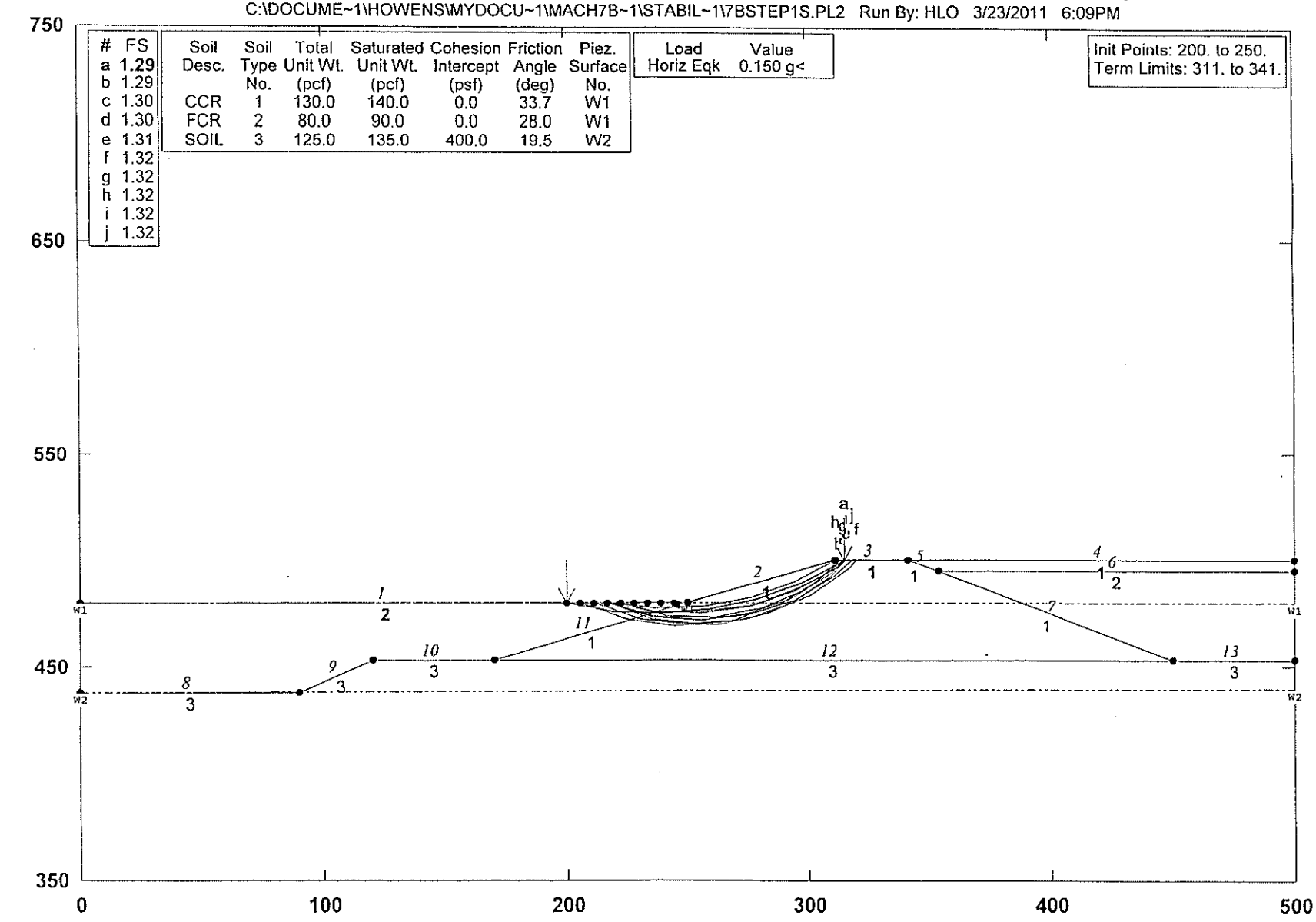
Point No.	X-Surf (ft)	Y-Surf (ft)
1	157.90	53.00
2	167.08	49.04
3	176.53	45.77
4	186.20	43.22
5	196.03	41.40
6	205.97	40.32
7	215.97	39.99
8	225.96	40.41
9	235.89	41.58
10	245.71	43.48
11	255.35	46.12
12	264.77	49.47
13	273.92	53.51
14	282.74	58.23
15	291.17	63.60
16	299.19	69.58
17	306.73	76.15
18	313.76	83.26
19	320.24	90.88
20	326.13	98.96
21	326.77	100.00

Circle Center At X = 215.4 ; Y = 173.5 and Radius, 133.5

*** 1.259 ***

Mach Mining, LLC, Seismic Analysis - Phase 7B Elimination, Phase 7 Step 1

C:\DOCUME~1\HOWENS\MYDOCU~1\MACH7B~1\STABIL~1\7BSTEP1S.PL2 Run By: HLO 3/23/2011 6:09PM



PCSTABL5M/si FSmin=1.29

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 3/23/2011
Time of Run: 6:09PM
Run By: HLO
Input Data Filename: C:7bstep1s.
Output Filename: C:7bstep1s.OUT
Unit: ENGLISH
Plotted Output Filename: C:7bstep1s.PLT
PROBLEM DESCRIPTION Mach Mining, LLC, Seismic Analysis - Phase 7B Elimination, Phase 7 Step 1

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 350.00 to Y-values listed.

4 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	129.70	250.10	129.70	2
2	250.10	129.70	311.00	150.00	1
3	311.00	150.00	341.00	150.00	1
4	341.00	150.00	500.00	150.00	1
5	341.00	150.00	354.00	145.00	1
6	354.00	145.00	500.00	145.00	2
7	354.00	145.00	450.20	103.00	1
8	.00	88.00	90.00	88.00	3
9	90.00	88.00	120.00	103.00	3
10	120.00	103.00	170.00	103.00	3
11	170.00	103.00	246.50	128.50	1
12	170.00	103.00	450.20	103.00	3
13	450.20	103.00	500.00	103.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 3 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	129.70
2	250.10	129.70
3	500.00	129.70

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	88.00
2	500.00	90.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
200 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 200.00 ft.

and X = 250.00 ft.
Each Surface Terminates Between X = 311.00 ft.
and X = 341.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 88.00 ft.
20.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	200.00	129.70
2	219.62	125.81
3	239.60	124.85
4	259.50	126.82
5	278.90	131.69
6	297.37	139.35
7	314.52	149.65
8	314.95	150.00

Circle Center At X = 236.2 ; Y = 260.6 and Radius, 135.8
*** 1.286 ***
Individual data on the 12 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	19.6	3432.0	.0	2425.8	.0	.0	514.8	.0	.0
2	16.4	6337.2	.0	4398.9	.0	.0	950.6	.0	.0
3	3.5	1641.7	.0	1056.3	.0	.0	246.3	.0	.0
4	6.9	3550.5	.0	1953.7	.0	.0	532.6	.0	.0
5	3.6	1293.4	.0	901.1	.0	.0	194.0	.0	.0
6	9.4	6318.0	.0	1972.7	.0	.0	947.7	.0	.0
7	11.5	9839.2	.0	1063.6	.0	.0	1475.9	.0	.0
8	7.9	7502.2	.0	.0	.0	.0	1125.3	.0	.0
9	18.5	16462.6	.0	.0	.0	.0	2469.4	.0	.0
10	13.6	7590.5	.0	.0	.0	.0	1138.6	.0	.0
11	3.5	644.6	.0	.0	.0	.0	96.7	.0	.0
12	.4	9.9	.0	.0	.0	.0	1.5	.0	.0

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	211.11	129.70
2	229.69	122.30
3	249.52	119.69
4	269.39	122.03
5	288.07	129.18
6	304.42	140.69
7	312.42	150.00

Circle Center At X = 250.1 ; Y = 200.5 and Radius, 80.8
*** 1.290 ***
Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	216.67	129.70
2	235.65	123.40
3	255.58	121.76
4	275.34	124.87
5	293.80	132.56
6	309.93	144.39
7	314.65	150.00

Circle Center At X = 252.5 ; Y = 205.8 and Radius, 84.1
*** 1.302 ***
Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	216.67	129.70
2	236.18	125.32
3	256.17	124.83
4	275.88	128.27
5	294.53	135.49
6	311.40	146.22
7	315.35	150.00

Circle Center At X = 248.6 ; Y = 226.3 and Radius, 101.8

*** 1.305 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	216.67	129.70
2	236.27	125.73
3	256.27	125.48
4	275.96	128.97
5	294.66	136.08
6	311.70	146.54
7	315.49	150.00

Circle Center At X = 247.6 ; Y = 231.8 and Radius, 106.7

*** 1.311 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	205.56	129.70
2	224.19	122.42
3	243.92	119.17
4	263.90	120.06
5	283.26	125.08
6	301.16	134.00
7	316.83	146.43
8	319.78	150.00

Circle Center At X = 249.5 ; Y = 214.1 and Radius, 95.2

*** 1.316 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	222.22	129.70
2	241.35	123.84
3	261.33	122.99
4	280.88	127.21
5	298.73	136.22
6	313.74	149.44
7	314.12	150.00

Circle Center At X = 254.6 ; Y = 201.4 and Radius, 78.7

*** 1.317 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	216.67	129.70
2	236.53	127.38
3	256.51	128.34
4	276.06	132.55
5	294.67	139.89
6	311.55	150.00

Circle Center At X = 240.7 ; Y = 249.3 and Radius, 122.0

*** 1.318 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	216.67	129.70
2	235.25	122.30
3	255.10	119.86
4	274.92	122.53
5	293.41	130.16
6	309.36	142.22
7	315.47	150.00

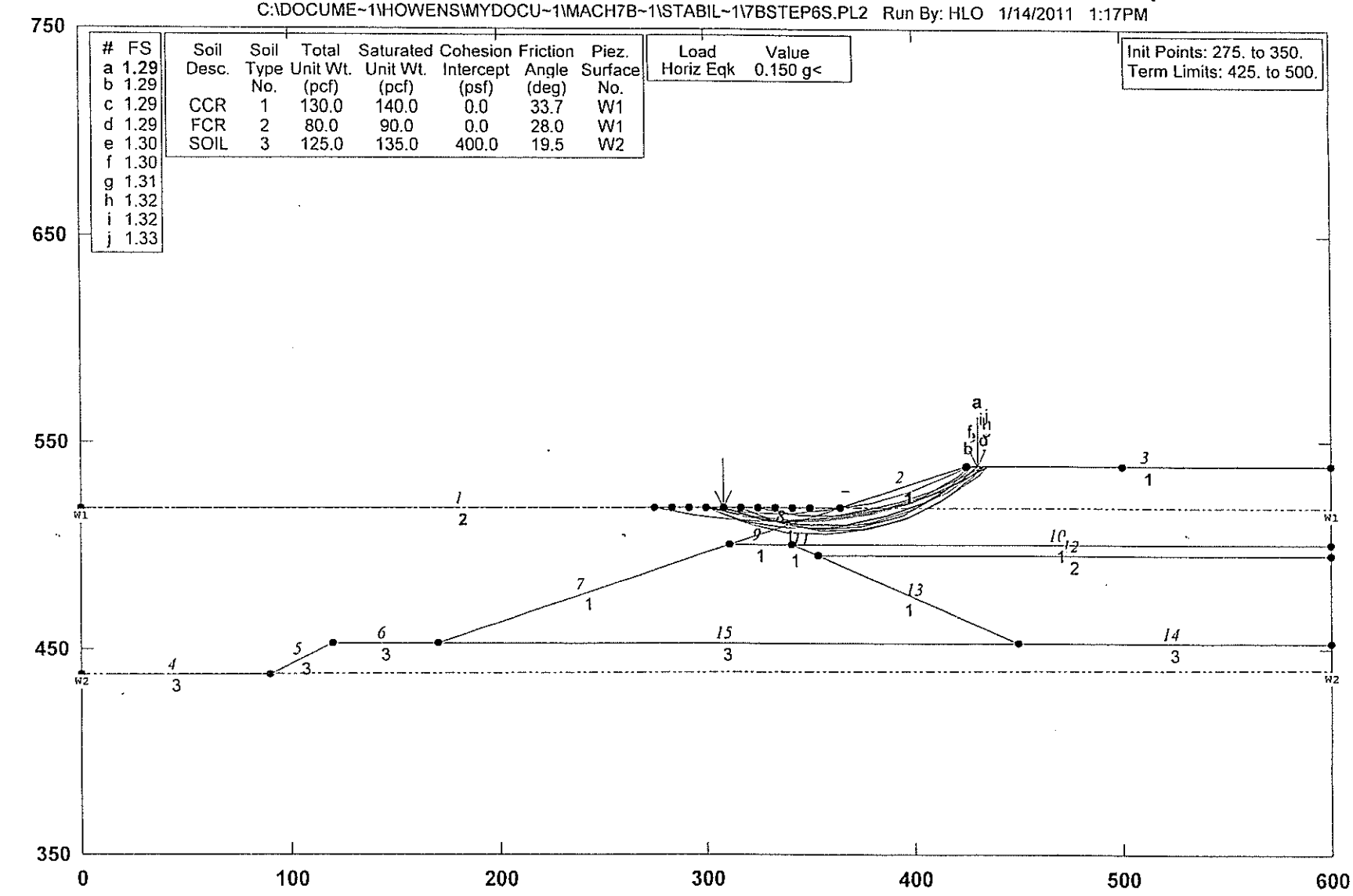
Circle Center At X = 254.6 ; Y = 198.0 and Radius, 78.1
*** 1.322 ***
Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	216.67	129.70
2	235.69	123.54
3	255.61	121.74
4	275.44	124.38
5	294.19	131.34
6	310.93	142.27
7	318.42	150.00

Circle Center At X = 253.7 ; Y = 211.6 and Radius, 89.9
*** 1.324 ***

Mach Mining, LLC, Seismic Analysis - Phase 7B Elimination, Phase 7 Step 6

C:\DOCUME~1\HOWENS\MYDOCU~1\MACH7B~1\STABIL~1\7BSTEP6S.PL2 Run By: HLO 1/14/2011 1:17PM



PCSTABL5M/si FSmin=1.29

Safety Factors Are Calculated By The Modified Bishop Method

STED



RT4982

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 1/14/2011
Time of Run: 1:17PM
Run By: HLO
Input Data Filename: C:7BSTEP6S.
Output Filename: C:7BSTEP6S.OUT
Unit: ENGLISH
Plotted Output Filename: C:7BSTEP6S.PLT
PROBLEM DESCRIPTION Mach Mining, LLC, Seismic Analysis - Phase 7B Elimination, Phase 7 Step 6

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 350.00 to Y-values listed.

3 Top Boundaries
15 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	167.90	364.70	167.90	2
2	364.70	167.90	425.00	188.00	1
3	425.00	188.00	600.00	188.00	1
4	.00	88.00	90.00	88.00	3
5	90.00	88.00	120.00	103.00	3
6	120.00	103.00	170.00	103.00	3
7	170.00	103.00	311.00	150.00	1
8	311.00	150.00	364.70	167.90	1
9	311.00	150.00	341.00	150.00	1
10	341.00	150.00	600.00	150.00	1
11	341.00	150.00	354.00	145.00	1
12	354.00	145.00	600.00	145.00	2
13	354.00	145.00	450.20	103.00	1
14	450.20	103.00	600.00	103.00	3
15	170.00	103.00	450.20	103.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	167.90
2	600.00	167.90

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	88.00
2	600.00	90.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
200 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 10 Points Equally Spaced

Along The Ground Surface Between X = 275.00 ft.
and X = 350.00 ft.
Each Surface Terminates Between X = 425.00 ft.
and X = 500.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 88.00 ft.
20.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	308.33	167.90
2	327.46	162.04
3	347.28	159.41
4	367.27	160.09
5	386.87	164.06
6	405.56	171.20
7	422.80	181.33
8	430.78	188.00

Circle Center At X = 353.0 ; Y = 278.8 and Radius, 119.5
*** 1.287 ***
Individual data on the 11 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	19.1	5042.2	.0	3656.3	.0	.0	756.3	.0	.0
2	14.1	8602.0	.0	6016.1	.0	.0	1290.3	.0	.0
3	5.8	4582.4	.0	2935.3	.0	.0	687.4	.0	.0
4	17.4	17442.1	.0	8906.0	.0	.0	2616.3	.0	.0
5	2.6	2969.5	.0	1260.4	.0	.0	445.4	.0	.0
6	19.6	26493.6	.0	7268.3	.0	.0	3974.0	.0	.0
7	10.0	14538.9	.0	1288.8	.0	.0	2180.8	.0	.0
8	8.6	11819.3	.0	.0	.0	.0	1772.9	.0	.0
9	17.2	18222.8	.0	.0	.0	.0	2733.4	.0	.0
10	2.2	1538.8	.0	.0	.0	.0	230.8	.0	.0
11	5.8	1815.5	.0	.0	.0	.0	272.3	.0	.0

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.00	167.90
2	319.87	165.58
3	339.86	165.26
4	359.79	166.92
5	379.46	170.56
6	398.67	176.14
7	417.22	183.60
8	425.63	188.00

Circle Center At X = 333.1 ; Y = 363.6 and Radius, 198.5
*** 1.287 ***
Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.00	167.90
2	318.98	161.60
3	338.70	158.28
4	358.70	158.01
5	378.51	160.80
6	397.65	166.59
7	415.68	175.24
8	432.18	186.55
9	433.73	188.00

Circle Center At X = 350.4 ; Y = 288.1 and Radius, 130.4
*** 1.292 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	275.00	167.90
2	294.62	164.01
3	314.51	161.90
4	334.50	161.58
5	354.45	163.06
6	374.18	166.33
7	393.54	171.35
8	412.37	178.09
9	430.52	186.49
10	433.14	188.00

Circle Center At X = 328.0 ; Y = 383.2 and Radius, 221.7

*** 1.295 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	316.67	167.90
2	335.33	160.70
3	355.10	157.67
4	375.06	158.94
5	394.28	164.45
6	411.88	173.95
7	427.04	187.00
8	427.79	188.00

Circle Center At X = 359.2 ; Y = 250.1 and Radius, 92.6

*** 1.298 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	325.00	167.90
2	344.65	164.19
3	364.65	163.90
4	384.40	167.05
5	403.32	173.54
6	420.84	183.18
7	426.85	188.00

Circle Center At X = 356.3 ; Y = 279.7 and Radius, 116.1

*** 1.303 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.00	167.90
2	318.58	160.50
3	338.13	156.29
4	358.11	155.38
5	377.96	157.81
6	397.14	163.49
7	415.10	172.29
8	431.35	183.95
9	435.37	188.00

Circle Center At X = 353.5 ; Y = 275.3 and Radius, 120.0

*** 1.310 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.00	167.90
2	319.51	163.52
3	339.42	161.54
4	359.41	162.01
5	379.20	164.91
6	398.49	170.19
7	416.99	177.79
8	434.42	187.59
9	434.98	188.00

Circle Center At X = 345.6 ; Y = 325.2 and Radius, 163.8

*** 1.315 ***
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	316.67	167.90
2	335.14	160.24
3	354.81	156.64
4	374.81	157.25
5	394.22	162.05
6	412.19	170.83
7	427.92	183.18
8	431.91	188.00

Circle Center At X = 361.7 ; Y = 249.9 and Radius, 93.6

*** 1.324 ***
Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.00	167.90
2	319.60	163.93
3	339.53	162.24
4	359.52	162.85
5	379.31	165.76
6	398.63	170.94
7	417.22	178.30
8	434.85	187.75
9	435.21	188.00

Circle Center At X = 344.2 ; Y = 335.6 and Radius, 173.4

*** 1.325 ***

DOCUMENT

73

STATE OF ILLINOIS
ENVIRONMENTAL PROTECTION AGENCY

Subject: Williamson Energy, LLC – Pond Creek Mine

Data: Log No. 8554-10

Reviewed by: D. Maschhoff **Date:** 2/20/15

Log No. 8554-10 ⇒ IPR No. 37 to OMM Permit No. 375

Log No. 8554-10

- IPR is for the removal of Sedimentation Basin Nos. 007 and 008 and the re-designation of Sediment ditches 1, 2, 3 and 4.
- This is necessary for the construction of Coal Refuse Disposal Facility No. 2.
- Sediment Ditches 1 and 2 were re-designated as Sediment Pond Nos. 008 and 008A and discharges using the existing Outfall 008.
- Sediment Ditch 3 was re-designated as Pond 006A and discharges under the railroad loop to Sediment Pond 006.
- Sediment Ditch 4 was re-designated as Pond 007A and discharges into Sediment Ditch 2 before discharging out Outfall 007.
- The Operations Map has been updated with this submittal.
- Ponds 007 and 008 have been removed and the new linear ponds have been constructed around the Coal Refuse Disposal Facility No. 2 as depicted on Map 6 S.F of this submittal.

* Action: Reference IEPA Log No. 8554-10 in renewed and modified NPDES permit for the incorporation of the removal of Sedimentation Basin Nos. 007 and 008 and the re-designation of Sediment ditches 1, 2, 3 and 4. Outfall Nos. 007 and 008 will still remain.

8554 - / 10
R14989
Due date 1-19-11

Illinois Department of **Natural Resources**

One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

Pat Quinn, Governor
Marc Miller, Director

December 6, 2010

Steve Sutphin
Alliance Consulting, Inc.
c/o Williamson Energy, LLC
124 Philpott Lane
Raleigh County Airport Industrial Park
Beaver, WV 25813

Re: Permit No. 375
Insignificant Revision No. 37

Dear Mr. Sutphin:

The appropriate Department technical staff has reviewed the proposed change dated September 17, 2010, submitted by Williamson Energy for the Pond Creek Mine. The permittee has requested approval to remove basin's 007 and 008 and the re-designation of sediment ditches 1, 2, 3, and 4. Since this operation is not currently approved, it will constitute a change to the approved plan. Insignificant permit revisions are allowed under 62 Ill. Adm. Code 1774.13(b)(2).

The Department has determined the proposed alteration will have no significant potential adverse impact on the achievement of final reclamation plans or upon the surrounding area, is in compliance with 62 Ill. Adm. Code 1700 – 1850 and is insignificant, and hereby exempts the permittee from submitting a significant permit revision application in accordance with Section 1774.13(b)(2). The Department grants permission to remove basin's 007 and 008 and re-designate sediment ditches 1, 2, 3, and 4.

No additional bond is required because of this change.

All conditions and provisions contained in the approved permit also apply to this revision. Approval from this agency does not relieve the permittee from obtaining approval from other agencies requiring such.

RECEIVED
DEC 08 2010
IL Environmental Protection Agency
MARION REGIONAL OFFICE

Please submit two additional copies of your request letter and maps to Ronald Morse, Illinois Environmental Protection Agency, 2309 West Main Street, Marion, Illinois 62959.

Should you have any questions, please contact Brad Murphy at our Benton Office.

Sincerely,

Scott K. Fowler, Supervisor
Land Reclamation Division

SKF:CBM:gr

cc: B. Murphy
J. Slapak
R. Morse

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

September 17, 2010

Project No. B10-192-1413

Mr. Scott K. Fowler, Supervisor
Land Reclamation Division
ILLINOIS DEPARTMENT
OF NATURAL RESOURCES
One Natural Resources Way
Springfield, IL 62702-1271

Transmittal
IPR For Permit No. 375
Williamson Energy, LLC
Pond Creek No. 1 Mine
Williamson County, Illinois

Dear Mr. Fowler:

Williamson Energy, LLC and it operator, Mach Mining, LLC,, Inc. are submitting an original and one copy of an insignificant permit revision. This IPR is addressing the removal of Sediment Ponds 007 and 008, the re-design and re-designation of Sediment Ditches 1, 2, 3 and 4, and to address the current drainage patterns for the permitted refuse disposal area.

The existing Sediment Ponds 007 and 008 were designed for the refused disposal plan submitted in the original Permit 375 application. With the approval of Significant Revision No. 2 on April 1, 2009, a series of sediment ditches (Pond 011) were constructed to provide additional sediment control. A condition of the approval for Revision No. 2 was that Sediment Ponds 007 and 008 could not be removed until IEPA approved the proposed Outlet 011. To this date, IEPA has not responded to the request to add a new NPDES outlet. Therefore, this IPR is requesting to remove of the existing Pond 7 and 8 and to re-design and re-designate of the sediment ditches as Ponds 006A, 007, 007A, 008 and 008A. No new NPDES outlets are being proposed. Pond 006A will discharge into Pond 006, Ponds 007 and 007A will discharge through Outlet 007 and Ponds 008 and 008A will discharge through Outlet 008. This request is necessary to continue the construction of the Coal Refuse Disposal Facility No. 2 (North Refuse Area).

In Revision No. 2, Sediment Ditches 1 and 2 were designed with a series of barriers to be constructed through-out the entire length of the ditches. However, due to the flatness of the terrain at the site, only four barriers have been constructed. Sediment Ditches 1 and 2 are being re-designated as Sediment Ponds 008 and 008A and will discharge using the existing Outlet 008. Pond 008A will be partitioned into four

cells. In order to complete the construction of proposed Pond 008, the existing pond must be removed and replaced by the linear configuration presented within this IPR.

In Revision No. 2, Sediment Ditch 3 was designed with a series of barriers. Ditch 3 will be re-designated as Pond 006A and will have only one barrier. As per the previously approved drainage plan, the ditch discharges into twin 48 inch culverts and the culverts discharge into a drainage ditch. However, instead of the drainage ditch discharging into proposed Pond 007 and 007A(Sediment Ditch 4), the ditch is discharging into a 36 inch culvert under the railroad loop and into Sediment Pond 006.

In Revision No. 2, Sediment Ditch 4 was designed as a two cell ditch and would discharge into Sediment Ditch 2 before discharging through an outlet. In order to construct this structure, the existing Pond 007 must be removed and new linear Pond 007 and 007A will be constructed in its place. Pond 007 and 007A will discharge through existing Outlet 007.

Attached to this IPR, are new sediment volume calculations sheets, sediment structure design calculations sheets, and Map 6 S.F. (Supplemental). It is the intention of this IPR to clarify the drainage patterns and drainage structures associated with the current refuse disposal area. The location of NPDES Outlets 007 and 008 will be re-constructed in the location of the existing outlets.

Refer to the following drawing, Map 6 S.F. (Drawing No. B10-192-M1) for additional information.

One copy of this IPR has been sent to Mr. Charles (Brad) Murphy in the Benton Office.

If you have any questions, or require additional information regarding this application, please contact us.

Respectfully submitted for,

WILLIAMSON ENERGY LLC

Stephen M. Sutphin
Alliance Consulting, Inc.
Project Manager

SMS:sms
Enclosures

FILE: 10192-01

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

September 17, 2010

Project No. B10-192-1413

Mr. Brad Murphy
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
Office of Mines and Minerals
Land Reclamation Division
503 E. Main; FL001
Benton, IL 62812

Transmittal
IPR For Permit No. 375
Williamson Energy, LLC
Pond Creek No. 1 Mine
Williamson County, Illinois

Dear Mr. Murphy:

Williamson Energy, LLC and it operator, Mach Mining, LLC,, Inc. are submitting an original and one copy of an insignificant permit revision. This IPR is addressing the removal of Sediment Ponds 007 and 008, the re-design and re-designation of Sediment Ditches 1, 2, 3 and 4, and to address the current drainage patterns for the permitted refuse disposal area.

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In Revision No. 2, Sediment Ditch 4 was designed as a two cell ditch and would discharge into Sediment Ditch 2 before discharging through an outlet. In order to construct this structure, the existing Pond 007 must be removed and new linear Pond 007 and 007A will be constructed in its place. Pond 007 and 007A will discharge through existing Outlet 007.

Attached to this IPR, are new sediment volume calculations sheets, sediment structure design calculations sheets, and Map 6 S.F. (Supplemental). It is the intention of this IPR to clarify the drainage patterns and drainage structures associated with the current refuse disposal area. The location of NPDES Outlets 007 and 008 will be re-constructed in the location of the existing outlets.

Refer to the following drawing, Map 6 S.F. (Drawing No. B10-192-M1) for additional information.

An original and one copy have been sent to Mr. Scott Fowler in the Springfield Office.

If you have any questions, or require additional information regarding this application, please contact us.

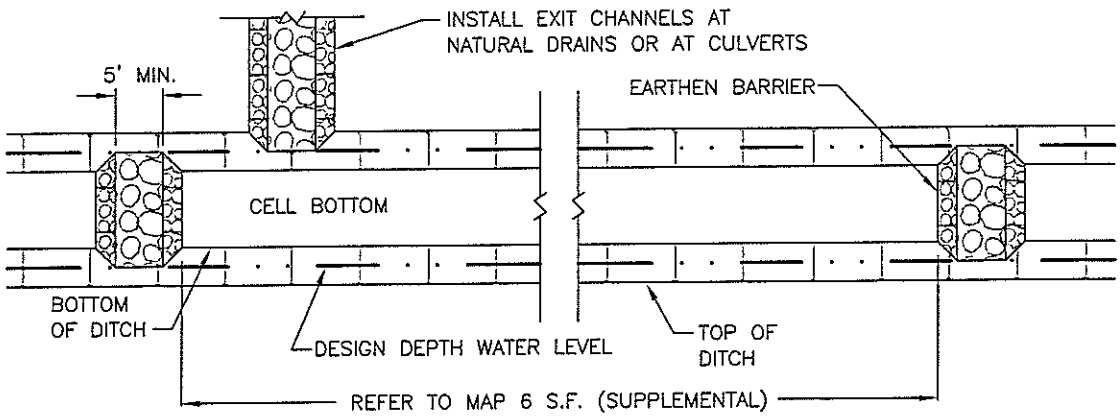
Respectfully submitted for,

WILLIAMSON ENERGY LLC

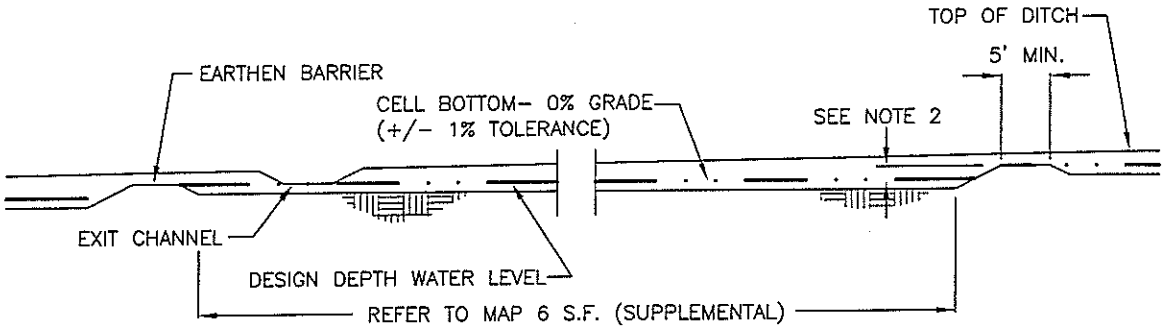
Stephen M. Sutphin
Alliance Consulting, Inc.
Project Manager

SMS:sms
Enclosures

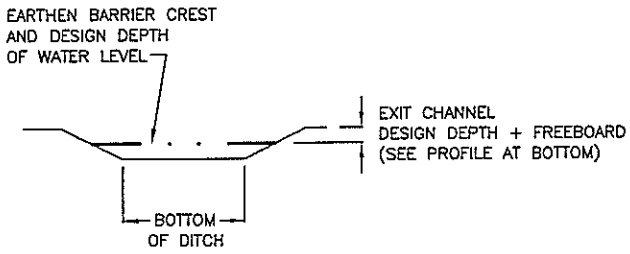
FILE: 10192-02



PLAN VIEW
NOT TO SCALE



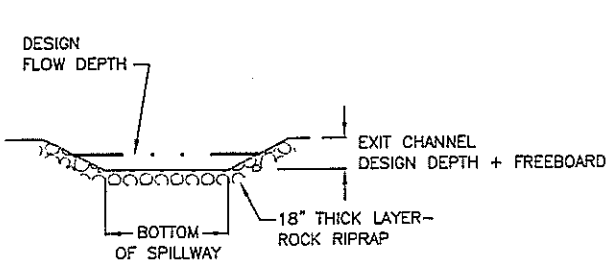
PROFILE
NOT TO SCALE



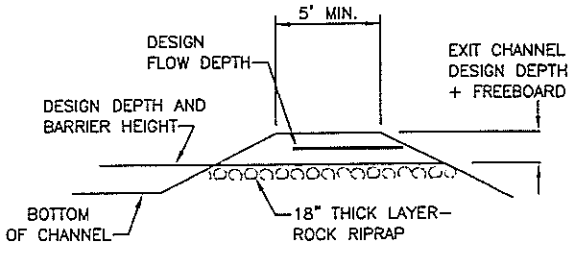
TYPICAL SECTION- SEDIMENT DITCH
NOT TO SCALE

NOTES:

1. SEE DESIGN SHEETS FOR SIDE SLOPES AND DIMENSIONS OF PROPOSED STRUCTURES.
2. THIS DIMENSION MUST BE EQUAL TO OR GREATER THAN THE MINIMUM HEAD DIMENSIONS (BARRIER/SPILLWAY) ON THE SEDIMENT DITCH DESIGN SHEETS. A CHART WHICH SHOWS THIS MINIMUM DIMENSION FOR EACH DITCH IS CONTAINED IN THIS APPLICATION.



TYPICAL SECTION- EXIT CHANNEL
NOT TO SCALE



TYPICAL PROFILE- EXIT CHANNEL
NOT TO SCALE

Alliance Consulting, Inc.
Engineers
Constructors
Scientists
BECKLEY, WV (304) 255-0491
CANONSBURG, PA (724) 745-3630
SUMMERSVILLE, WV (304) 883-2360

TYPICAL DETAILS
PONDS 006A, 007, 007A, 008 & 008A
POND CREEK MINE NO. 1
COAL REFUSE DISPOSAL FACILITY NO. 2
PREPARED FOR
WILLIAMSON ENERGY, LLC.
P.O. BOX 99, JOHNSTON CITY, IL

DRAWN BY	SMS	09/15/10
CHECKED BY	SMS	09/15/10
APPROVED BY	CEY	09/15/10
DRAWING NUMBER		FIGURE NUMBER
B10-192-A1		--

Pond 006 & 006A

Required Capacity = 20.42 ac. ft.

Designed/Provided Capacity = 44.06 ac. ft.
(Pond 006A design capacity is 9.51 ac. ft. and
Pond 006 as-built capacity is 34.55 ac. ft.)

GENERAL INFORMATION
Permit No. 375
Structure ID: **Pond 006**
Type: **Combination** (Dam, Incised, or Combination)

DESIGN DETAILS

A.	Design Storm: 100yr/6hr	**6.21**	in
B.	Estimated Runoff Area:	**21.02**	acres
C.	Estimated Distrubed Area:	**21.02**	acres
D.	Runoff Coefficient:	**100.00**	percent
E.	Quanitity of Runoff (10 hrs of a 10yr/24hr stori	**2.75**	ac/ft
F.	Sediment Volume (Dist. Area X 0.1):	**2.10**	ac/ft
G.	Pit Pumpage:	**2000.00**	gpm
H.	Pit Pumpage Treatment:	**None**	
I.	Basin Volume (Required at Normal Pool*):	**9.27**	ac/ft
	Basin Volume (Provided at Normal Pool):		ac/ft
J.	Basin Freeboard (Designed Storm 100yr/6hr):	**2.00**	feet (Reference SCS-IL, June, 1992)
K.	Surface Area at Design Storm (25yr/6hr):	-	acres
L.	Diversion Ditching:	**None**	
M.	Inlet Elevation**:	**N/A**	feet
	Outlet Elevation	**N/A**	feet
	Outfall Elevation	**N/A**	feet
N.	Emergency Spillway System**: (Design Storm 25yr/6hr)	**None**	

Notes:

* Basin Volume Required = (0.33 X Runoff Volume) + Sediment Volume + (pit Pumpage X 0.00442 X 0.5)

** Detailed drawings are submitted with the basin plan view and sections.

GENERAL INFORMATION
Permit No. 375
Structure ID: **Pond 006A**
Type: **Combination** (Dam, Incised, or Combination)

DESIGN DETAILS

A.	Design Storm: 100yr/6hr	**6.21**	in	
B.	Estimated Runoff Area:	**32.92**	acres	
C.	Estimated Distrubed Area:	**32.92**	acres	
D.	Runoff Coefficient:	**100.00**	percent	
E.	Quanitity of Runoff (10 hrs of a 10yr/24hr storı	**3.44**	ac/ft	
F.	Sediment Volume (Dist. Area X 0.1):	**3.29**	ac/ft	
G.	Pit Pumpage:	**2000.00**	gpm	
H.	Pit Pumpage Treatment:	**None**		
I.	Basin Volume (Required at Normal Pool*):	**11.15**	ac/ft	
	Basin Volume (Provided at Normal Pool):		ac/ft	
J.	Basin Freeboard (Designed Storm 100yr/6hr):	**2.00**	feet	(Reference SCS-IL, June, 1992)
K.	Surface Area at Design Storm (25yr/6hr):	-	acres	
L.	Diversion Ditching:	**None**		
M.	Inlet Elevation**:	**N/A**	feet	
	Outlet Elevation	**N/A**	feet	
	Outfall Elevation	**N/A**	feet	
N.	Emergency Spillway System**: (Design Storm 25yr/6hr)	**None**		

Notes:

* Basin Volume Required = (0.33 X Runoff Volume) + Sediment Volume + (pit Pumpage X 0.00442 X 0.5)

** Detailed drawings are submitted with the basin plan view and sections.

EXCAVATED SEDIMENT DITCH
STRUCTURE PROPORTIONING SHEET

PROJECT NAME: POND CREEK MINE NO.1
PROJECT NUMBER: B10-192-1413
DESCRIPTION: *POND 6A*

SEDIMENT STORAGE REQUIREMENTS:

DRAINAGE AREA NO. :	6A				
TOTAL AREA =	32.92	ACRES	DISTURBED AREA =	32.92	ACRES
SED STORAGE FACTOR =	0.1	AC.FT./AC	REQUIRED SED VOL =	3.29	AC. FT.
10YR. 24HR. RUNOFF VOL	8.25	AC.FT	REQUIRED RUNOFF VO (10HR) L=	3.44	AC. FT.
PUMPAGE	2000	GPM	PUMPAGE VOLUME =	4.42	AC. FT.
LINEAR FEET OF DITCHLINE AVAILABLE =			2199 FEET	11.15	TOTAL REQ.

PROPOSED DITCH DIMENSIONS:

SIDE SLOPE (L) =	2.00:1		SIDE SLOPE (R) =	2.00:1	
BOTTOM WIDTH =	20.0	FEET	BARRIER DAM HEIGHT (MIN) =	6.00	FEET
NUMBER OF CELLS =	2		BARRIER SPACING =	1099.50	FEET
NUMBER OF BARRIERS =	1		TOP WIDTH (TOTAL) =	55.87	FEET
POOL AREA=	1.10	AC.			

SEDIMENT DITCH CAPACITY:

TOTAL VOLUME OF DITCH (NO BARRIERS) =	9.55	ACRE FEET
TOTAL VOLUME OF BARRIERS =	0.04	ACRE FEET
TOTAL AVAILABLE STORAGE VOLUME =	9.51	ACRE FEET
60% CLEANOUT DEPTH = 4.22 FEET		

BARRIER/SPILLWAY DIMENSIONS:

SPILLWAY LENGTH = 12.0 FEET REQD SPILLWAY FLOW = 121.20 CFS

SPILLWAY CHECK BASED ON WEIR EQUATION

Q = CLH^1.5 OR
Q = CH^1.5(L+0.4(Z1+Z2)H)
REF. (MESA MANUAL, Pg. 6.136)

REF. (OPEN CHANNEL HYDRAULICS, CHOW, Pg. 53)

WHERE:

COEFFICIENT C =	2.8	
BOTTOM WIDTH L =	44.0	FEET
SIDE SLOPE Z1 =	2	
SIDE SLOPE Z2 =	2	

SPILLWAY FLOW DEPTH =	0.97	FEET
AREA OF FLOW =	44.41	SQ.FT.
VELOCITY =	2.73	FPS
FREEBOARD =	2.00	FEET
TOP WIDTH =	55.87	FEET

Q ACTUAL = 121.23 CFS

TOTAL SPILLWAY DEPTH (DEPTH ABOVE BARRIER DAM) =	2.97	FEET
TOTAL (MINIMUM) DITCH DEPTH =	8.97	FEET

NOTES:
1. BARRIERS SHALL BE SPACED TO MAINTAIN A BOTTOM GRADE ON THE SEDIMENT DITCH OF 0%, BUT IN NO CASE MORE THAN 500 FT APART.
2. ALL BARRIER DAM UPSTREAM AND DOWNSTREAM SIDE SLOPES WILL BE 3:1.

Pond 006 and 006A

10yr 24hr Storm Event

BLA

Alliance Consulting, inc.
124 Philpott Lane
Beaver, WV 25813

Phone: (304)-255-0491

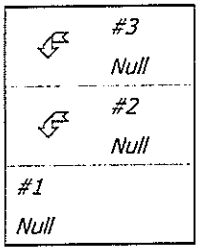
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	5.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Pond 006
Null	#2	==>	#1	0.088	0.319	Pond 006A
Null	#3	==>	#1	0.088	0.319	P/O Pond 006



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	8. Large gullies, diversions, and low flowing streams	1.00	9.59	960.00	3.00	0.088
#2	**Muskingum K:**					**0.088**
#3	8. Large gullies, diversions, and low flowing streams	1.00	9.59	960.00	3.00	0.088
#3	**Muskingum K:**					**0.088**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#3	32.700	32.700	70.21	8.18
#2	32.920	32.920	76.00	8.25
#1	21.020	86.640	184.99	23.03

Structure Detail:

Structure #3 (Null)

P/O Pond 006

Structure #2 (Null)

Pond 006A

Structure #1 (Null)

Pond 006

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#3	1	32.700	0.388	0.000	0.000	87.000	M	70.21	8.180
	Σ	**32.700**						**70.21**	**8.180**
#2	1	32.920	0.288	0.000	0.000	87.000	M	76.00	8.255
	Σ	**32.920**						**76.00**	**8.255**
#1	1	21.020	0.000	0.000	0.000	87.000	M	74.84	6.591
	Σ	**86.640**						**184.99**	**23.025**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	8. Large gullies, diversions, and low flowing streams	0.50	11.00	2,200.00	2.120	0.288
#2	**1**	**Time of Concentration:**					**0.288**
#3	1	8. Large gullies, diversions, and low flowing streams	1.00	42.00	4,200.00	3.000	0.388
#3	**1**	**Time of Concentration:**					**0.388**

Pond 006 and 006A

25yr 6hr Storm Event

BLA

Alliance Consulting, inc.
124 Philpott Lane
Beaver, WV 25813

Phone: (304)-255-0491

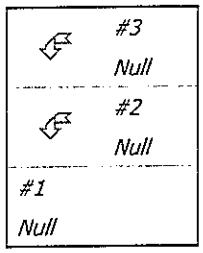
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 6 hr
Rainfall Depth:	4.680 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Pond 006
Null	#2	==>	#1	0.088	0.319	Pond 006A
Null	#3	==>	#1	0.088	0.319	P/O Pond 006



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#2	**Muskingum K:**					**0.088**
#3	8. Large gullies, diversions, and low flowing streams	1.00	9.59	960.00	3.00	0.088
#3	**Muskingum K:**					**0.088**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#3	32.700	32.700	84.42	7.10
#2	32.920	32.920	92.49	7.16
#1	21.020	86.640	219.10	19.96

Structure Detail:

Structure #3 (Null)

P/O Pond 006

Structure #2 (Null)

Pond 006A

Structure #1 (Null)

Pond 006

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#3	1	32.700	0.388	0.000	0.000	87.000	M	84.42	7.097
	Σ	**32.700**						**84.42**	**7.097**
#2	1	32.920	0.288	0.000	0.000	87.000	M	92.49	7.162
	Σ	**32.920**						**92.49**	**7.162**
#1	1	21.020	0.000	0.000	0.000	87.000	M	94.77	5.705
	Σ	**86.640**						**219.10**	**19.964**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	8. Large gullies, diversions, and low flowing streams	0.50	11.00	2,200.00	2.120	0.288
#2	**1**	**Time of Concentration:**					**0.288**
#3	1	8. Large gullies, diversions, and low flowing streams	1.00	42.00	4,200.00	3.000	0.388
#3	**1**	**Time of Concentration:**					**0.388**

Pond 006 Spillway

Spillway Design Flow = 385.80 cfs (based on 10 yr./ 24 hr. storm)

Spillway Capacity = 151.91cfs (based on 25 yr. / 6 hr. storm
for Ponds 006, 006A, and Fresh Water Pond)

Pond 006, 006A and Fresh Water Pond

25yr 6hr Storm Event

BLA

Alliance Consulting, inc.
124 Philpott Lane
Beaver, WV 25813

Phone: (304)-255-0491

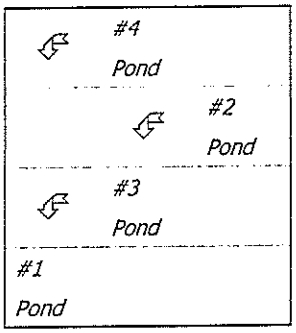
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 6 hr
Rainfall Depth:	4.680 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Pond 006
Pond	#2	==>	#3	0.088	0.319	Pond 006A
Pond	#3	==>	#1	0.088	0.319	P/O Pond 006
Pond	#4	==>	#1	0.000	0.000	Fresh Water Pond



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	8. Large gullies, diversions, and low flowing streams	1.00	9.59	960.00	3.00	0.088
#2	**Muskingum K:**					**0.088**
#3	8. Large gullies, diversions, and low flowing streams	1.00	9.59	960.00	3.00	0.088
#3	**Muskingum K:**					**0.088**

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#4	In	31.030	31.030	104.54	7.46
	Out			1.43	4.03
#2	In	32.920	32.920	92.49	7.16
	Out			13.01	7.16
#3	In	32.700	65.620	90.59	14.26
	Out			90.56	14.26
#1	In	21.020	117.670	151.91	24.53
	Out			2.93	9.63

Structure Detail:

Structure #4 (Pond)

Fresh Water Pond

Pond Inputs:

Initial Pool Elev:	449.21 ft
Initial Pool:	0.22 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
36.00	60.00	2.50	0.0240	449.21	0.90	0.00

Pond Results:

Peak Elevation:	449.54 ft
Dewater Time:	4.31 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
449.20	21.600	0.000	0.000		
449.21	21.606	0.216	0.000		Spillway #1
449.54	21.809	7.304	1.434	43.65	Peak Stage
449.70	21.912	10.878	2.156		
450.00	22.100	17.479	4.413		
450.20	22.287	21.918	6.194		
450.70	22.757	33.179	11.427		
451.20	23.231	44.676	17.643		
451.70	23.711	56.411	24.682		
452.00	24.000	63.567	29.278		
452.20	24.160	68.384	32.478		
452.50	24.400	75.667	37.489		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Straight Pipe (cfs)	Combined Total Discharge (cfs)
449.20	0.000	0.000
449.21	0.000	0.000
449.70	(3)>2.156	2.156
450.00	(3)>4.413	4.413
450.20	(3)>6.194	6.194
450.70	(3)>11.427	11.427
451.20	(3)>17.643	17.643
451.70	(3)>24.682	24.682
452.00	(3)>29.278	29.278
452.20	(3)>32.478	32.478
452.50	(3)>37.489	37.489

Structure #2 (Pond)

Pond 006A

Pond Inputs:

Initial Pool Elev:	462.61 ft
Initial Pool:	0.21 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
48.00	241.00	0.50	0.0240	462.61	0.90	0.00

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
48.00	241.00	0.50	0.0240	462.61	0.90	0.00

Pond Results:

Peak Elevation:	462.82 ft
Dewater Time:	1.48 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
462.60	21.400	0.000	0.000		
462.61	21.444	0.214	0.000		Spillway #1 Spillway #2
462.82	22.373	4.903	13.012	35.55	Peak Stage
463.10	23.630	11.253	30.633		
463.60	25.959	23.646	39.126		
464.00	27.900	34.415	45.235		
464.10	29.201	37.270	46.648		
464.60	35.841	53.502	53.452		
465.10	43.162	73.224	59.651		
465.60	51.163	96.777	72.212		
466.00	58.000	118.595	88.528		

Detailed Discharge Table

Elevation (ft)	Straight Pipe (cfs)	Straight Pipe (cfs)	Combined Total Discharge (cfs)
462.60	0.000	0.000	0.000
462.61	0.000	0.000	0.000
463.10	(1)>15.316	(1)>15.316	30.633
463.60	(1)>19.563	(1)>19.563	39.126
464.00	(1)>22.618	(1)>22.618	45.235
464.10	(1)>23.324	(1)>23.324	46.648
464.60	(1)>26.726	(1)>26.726	53.452
465.10	(1)>29.826	(1)>29.826	59.651
465.60	(1)>36.106	(1)>36.106	72.212
466.00	(1)>44.264	(1)>44.264	88.528

Structure #3 (Pond)

P/O Pond 006

Pond Inputs:

Initial Pool Elev:	452.10 ft
Initial Pool:	0.00 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
72.00	200.00	2.50	0.0240	452.10	0.90	0.00

Pond Results:

Peak Elevation:	455.83 ft
Dewater Time:	1.53 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
452.00	0.001	0.000	0.000		
452.10	0.001	0.000	0.000		Spillway #1
452.50	0.001	0.001	3.180	28.15	
453.00	0.001	0.001	10.728	5.00	
453.50	0.002	0.002	20.813	1.80	
454.00	0.002	0.003	32.904	0.85	
454.50	0.002	0.004	46.710	0.50	
455.00	0.002	0.005	62.044	0.15	
455.50	0.002	0.006	78.768	0.10	
455.83	0.003	0.007	90.563	0.10	Peak Stage
456.00	0.003	0.007	96.768		
456.50	0.003	0.008	115.956		
457.00	0.003	0.010	136.271		
457.50	0.003	0.012	157.651		
458.00	0.004	0.013	180.041		
458.50	0.004	0.015	203.407		
459.00	0.004	0.017	227.704		
459.50	0.005	0.020	246.877		
460.00	0.005	0.022	266.165		

Detailed Discharge Table

Elevation (ft)	Straight Pipe (cfs)	Combined Total Discharge (cfs)
452.00	0.000	0.000
452.10	0.000	0.000
452.50	(3)>3.180	3.180
453.00	(3)>10.728	10.728
453.50	(3)>20.813	20.813
454.00	(3)>32.904	32.904
454.50	(3)>46.710	46.710
455.00	(3)>62.044	62.044
455.50	(3)>78.768	78.768
456.00	(3)>96.768	96.768
456.50	(3)>115.956	115.956
457.00	(3)>136.271	136.271
457.50	(3)>157.651	157.651
458.00	(3)>180.041	180.041
458.50	(3)>203.407	203.407
459.00	(3)>227.704	227.704
459.50	(5)>246.877	246.877
460.00	(5)>266.165	266.165

Structure #1 (Pond)

Pond 006

Pond Inputs:

Initial Pool Elev:	444.61 ft
Initial Pool:	0.32 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
36.00	80.00	3.25	0.0240	444.61	0.90	0.00

Pond Results:

Peak Elevation:	445.20 ft
Dewater Time:	4.84 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
444.60	31.800	0.000	0.000		
444.61	31.808	0.317	0.000		Spillway #1
445.10	32.191	15.998	2.156	87.98*	
445.20	32.267	19.084	2.926	28.25	Peak Stage
445.60	32.584	32.191	6.194		
446.00	32.900	45.288	10.298		
446.10	33.057	48.586	11.427		
446.60	33.845	65.311	17.643		
447.10	34.642	82.433	24.682		
447.60	35.449	99.955	32.478		
448.00	36.100	114.264	39.210		
448.10	37.475	117.943	40.856		
448.60	44.472	138.405	47.566		
449.10	52.067	162.515	53.675		
449.60	60.261	190.572	59.158		
450.00	67.200	216.051	63.201		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Straight Pipe (cfs)	Combined Total Discharge (cfs)
444.60	0.000	0.000
444.61	0.000	0.000
445.10	(3)>2.156	2.156
445.60	(3)>6.194	6.194
446.00	(3)>10.298	10.298
446.10	(3)>11.427	11.427
446.60	(3)>17.643	17.643
447.10	(3)>24.682	24.682
447.60	(3)>32.478	32.478
448.00	(3)>39.210	39.210
448.10	(3)>40.856	40.856
448.60	(5)>47.566	47.566
449.10	(5)>53.675	53.675
449.60	(5)>59.158	59.158
450.00	(5)>63.201	63.201

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#4	1	31.030	0.181	0.000	0.000	90.000	M	104.54	7.463
	Σ	**31.030**						**104.54**	**7.463**
#2	1	32.920	0.288	0.000	0.000	87.000	M	92.49	7.162
	Σ	**32.920**						**92.49**	**7.162**
#3	1	32.700	0.388	0.000	0.000	87.000	M	84.42	7.097
	Σ	**65.620**						**90.59**	**14.258**
#1	1	21.020	0.000	0.000	0.000	90.000	M	99.07	6.233
	Σ	**117.670**						**151.91**	**24.526**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	8. Large gullies, diversions, and low flowing streams	0.50	11.00	2,200.00	2.120	0.288
#2	**1**	**Time of Concentration:**					**0.288**
#3	1	8. Large gullies, diversions, and low flowing streams	1.00	42.00	4,200.00	3.000	0.388
#3	**1**	**Time of Concentration:**					**0.388**
#4	1	8. Large gullies, diversions, and low flowing streams	0.55	8.00	1,450.00	2.220	0.181
#4	**1**	**Time of Concentration:**					**0.181**

Pond 007 & 007A

Required Capacity = 5.50 ac. ft.

Designed Capacity = 5.52 ac. ft.
(Pond 007A design capacity is 2.76 ac. ft. and
Pond 007 design capacity is 2.76 ac. ft.)

GENERAL INFORMATION
Permit No. 375
Structure ID: **Pond 007**
Type: **Combination** (Dam, Incised, or Combination)

DESIGN DETAILS

A.	Design Storm: 100yr/6hr	**6.21**	in
B.	Estimated Runoff Area:	**4.68**	acres
C.	Estimated Distrubed Area:	**4.68**	acres
D.	Runoff Coefficient:	**100.00**	percent
E.	Quanitity of Runoff (10 hrs of a 10yr/24hr stor	**0.61**	ac/ft
F.	Sediment Volume (Dist. Area X 0.1):	**0.47**	ac/ft
G.	Pit Pumpage:	**2000.00**	gpm
H.	Pit Pumpage Treatment:	**None**	
I.	Basin Volume (Required at Normal Pool*):	**5.50**	ac/ft
	Basin Volume (Provided at Normal Pool):		ac/ft
J.	Basin Freeboard (Designed Storm 100yr/6hr):	**2.00**	feet (Reference SCS-IL, June, 1992)
K.	Surface Area at Design Storm (25yr/6hr):	-	acres
L.	Diversion Ditching:	**None**	
M.	Inlet Elevation**:	**N/A**	feet
	Outlet Elevation	**N/A**	feet
	Outfall Elevation	**N/A**	feet
N.	Emergency Spillway System**: (Design Storm 25yr/6hr)	**None**	

Notes:

* Basin Volume Required = (0.33 X Runoff Volume) + Sediment Volume + (pit Pumpage X 0.00442 X 0.5)

** Detailed drawings are submitted with the basin plan view and sections.

EXCAVATED SEDIMENT DITCH
STRUCTURE PROPORTIONING SHEET

PROJECT NAME: POND CREEK MINE NO.1
PROJECT NUMBER: B10-192-1413
DESCRIPTION: *POND 7*

SEDIMENT STORAGE REQUIREMENTS:

DRAINAGE AREA NO. :	7				
TOTAL AREA =	4.68	ACRES	DISTURBED AREA =	4.68	ACRES
SED STORAGE FACTOR =	0.1	AC.FT./AC	REQUIRED SED VOL =	0.47	AC. FT.
10YR. 24HR. RUNOFF VOL	1.47	AC.FT	REQUIRED RUNOFF VO (10HR) L=	0.61	AC. FT.
PUMPAGE	2000	GPM	PUMPAGE VOLUME =	4.42	AC. FT.
LINEAR FEET OF DITCHLINE AVAILABLE =	835	FEET		5.50	TOTAL REQ.

PROPOSED DITCH DIMENSIONS:

SIDE SLOPE (L) =	2.00:1		SIDE SLOPE (R) =	2.00:1	
BOTTOM WIDTH =	20.0	FEET	BARRIER DAM HEIGHT (MIN) =	8.18	FEET
NUMBER OF CELLS =	2		BARRIER SPACING =	417.50	FEET
NUMBER OF BARRIERS =	1		TOP WIDTH (TOTAL) =	62.07	FEET
POOL AREA=	1.24	AC.			

SEDIMENT DITCH CAPACITY:

TOTAL VOLUME OF DITCH (NO BARRIERS) =	5.57	ACRE FEET
TOTAL VOLUME OF BARRIERS =	0.05	ACRE FEET
TOTAL AVAILABLE STORAGE VOLUME =	5.52	ACRE FEET
60% CLEANOUT DEPTH = 4.89 FEET		

BARRIER/SPILLWAY DIMENSIONS:

SPILLWAY LENGTH = 5.0 FEET REQD SPILLWAY FLOW = 29.22 CFS

SPILLWAY CHECK BASED ON WEIR EQUATION

Q = CLH^1.5 OR
Q = CH^1.5(L+0.4(Z1+Z2)H)
REF. (MESA MANUAL, Pg. 6.136)

REF. (OPEN CHANNEL HYDRAULICS, CHOW, Pg. 53)

WHERE:

COEFFICIENT C =	2.8	
BOTTOM WIDTH L =	52.7	FEET
SIDE SLOPE Z1 =	2	
SIDE SLOPE Z2 =	2	

SPILLWAY FLOW DEPTH =	0.34	FEET
AREA OF FLOW =	18.04	SQ.FT.
VELOCITY =	1.62	FPS
FREEBOARD =	2.00	FEET
TOP WIDTH =	62.07	FEET

Q ACTUAL = 29.29 CFS

TOTAL SPILLWAY DEPTH (DEPTH ABOVE BARRIER DAM) = 2.34 FEET
TOTAL (MINIMUM) DITCH DEPTH = 10.52 FEET

NOTES:
1. BARRIERS SHALL BE SPACED TO MAINTAIN A BOTTOM GRADE ON THE SEDIMENT DITCH OF 0%, BUT IN NO CASE MORE THAN 500 FT APART.
2. ALL BARRIER DAM UPSTREAM AND DOWNSTREAM SIDE SLOPES WILL BE 3:1.

Pond 007 and 007A

10yr 24hr Storm Event

BLA

Alliance Consulting, inc.
124 Philpott Lane
Beaver, WV 25813

Phone: (304)-255-0491

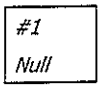
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	5.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Pond 007



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	4.680	4.680	16.66	1.47

Structure Detail:

Structure #1 (Null)

Pond 007

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	4.680	0.000	0.000	0.000	87.000	M	16.66	1.467
	Σ	**4.680**						**16.66**	**1.467**

Pond 007 Spillway

Spillway Design Flow = 385.80 cfs (based on 10 yr./ 24 hr. storm)

Spillway Capacity = 29.22 cfs (based on 100 yr. / 6 hr. storm
for Ponds 007 and 007A

Pond 007 and 007A

100yr 6hr Storm Event

BLA

Alliance Consulting, inc.
124 Philpott Lane
Beaver, WV 25813

Phone: (304)-255-0491

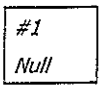
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Pond 007



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	4.680	4.680	29.22	1.83

Structure Detail:

Structure #1 (Null)

Pond 007

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	4.680	0.000	0.000	0.000	87.000	M	29.22	1.835
	Σ	**4.680**						**29.22**	**1.835**

Pond 008 & 008A

Required Capacity = 29.58 ac. ft.

Designed Capacity = 31.40 ac. ft.
(Pond 008A design capacity is 7.56 ac. ft. and
Pond 008 design capacity is 24.47 ac. ft.)

GENERAL INFORMATION

Permit No. 375

Structure ID: **Pond 008**

Type: **Combination** (Dam, Incised, or Combination)

DESIGN DETAILS

A.	Design Storm: 100yr/6hr	**6.21** in	
B.	Estimated Runoff Area:	**59.45** acres	
C.	Estimated Distrubed Area:	**59.45** acres	
D.	Runoff Coefficient:	**100.00** percent	
E.	Quanitity of Runoff (10 hrs of a 10yr/24hr storı	**0.37** ac/ft	
F.	Sediment Volume (Dist. Area X 0.1):	**5.95** ac/ft	
G.	Pit Pumpage:	**2000.00** gpm	
H.	Pit Pumpage Treatment:	**None**	
I.	Basin Volume (Required at Normal Pool*):	**10.73** ac/ft	
	Basin Volume (Provided at Normal Pool):	ac/ft	
J.	Basin Freeboard (Designed Storm 100yr/6hr):	**2.00** feet	(Reference SCS-IL, June, 1992)
K.	Surface Area at Design Storm (25yr/6hr):	- acres	
L.	Diversion Ditching:	**None**	
M.	Inlet Elevation**:	**N/A** feet	
	Outlet Elevation	**N/A** feet	
	Outfall Elevation	**N/A** feet	
N.	Emergency Spillway System**: (Design Storm 25yr/6hr)	**None**	

Notes:

* Basin Volume Required = (0.33 X Runoff Volume) + Sediment Volume + (pit Pumpage X 0.00442 X 0.5)

** Detailed drawings are submitted with the basin plan view and sections.

GENERAL INFORMATION
Permit No. 375
Structure ID: **Pond 008A**
Type: **Combination** (Dam, Incised, or Combination)

DESIGN DETAILS

A.	Design Storm:	100yr/6hr	**6.21** in	
B.	Estimated Runoff Area:		**135.84** acres	
C.	Estimated Distrubed Area:		**135.84** acres	
D.	Runoff Coefficient:		**100.00** percent	
E.	Quanitity of Runoff (10 hrs of a 10yr/24hr stor		**0.84** ac/ft	
F.	Sediment Volume (Dist. Area X 0.1):		**13.58** ac/ft	
G.	Pit Pumpage:		**2000.00** gpm	
H.	Pit Pumpage Treatment:		**None**	
I.	Basin Volume (Required at Normal Pool*):		**18.85** ac/ft	
	Basin Volume (Provided at Normal Pool):		ac/ft	
J.	Basin Freeboard (Designed Storm 100yr/6hr):		**2.00** feet	(Reference SCS-IL, June, 1992)
K.	Surface Area at Design Storm (25yr/6hr):		- acres	
L.	Diversion Ditching:		**None**	
M.	Inlet Elevation**:		**N/A** feet	
		Outlet Elevation	**N/A** feet	
		Outfall Elevation	**N/A** feet	
N.	Emergency Spillway System**:		**None**	
		(Design Storm 25yr/6hr)		

Notes:

* Basin Volume Required = (0.33 X Runoff Volume) + Sediment Volume + (pit Pumpage X 0.00442 X 0.5)

** Detailed drawings are submitted with the basin plan view and sections.

EXCAVATED SEDIMENT DITCH
STRUCTURE PROPORTIONING SHEET

PROJECT NAME: POND CREEK MINE NO.1
PROJECT NUMBER: B10-192-1413
DESCRIPTION: *POND 8*

SEDIMENT STORAGE REQUIREMENTS:

DRAINAGE AREA NO. :	DA 8				
TOTAL AREA =	59.45	ACRES	DISTURBED AREA =	59.45	ACRES
SED STORAGE FACTOR =	0.1	AC.FT./AC	REQUIRED SED VOL =	5.95	AC. FT.
10YR. 24HR. RUNOFF VOL	0.883	AC.FT	REQUIRED RUNOFF VO (10HR) L=	0.37	AC. FT.
PUMPAGE	2000	GPM	PUMPAGE VOLUME =	4.42	AC. FT.
LINEAR FEET OF DITCHLINE AVAILABLE =			6108 FEET	10.73	TOTAL REQ.

PROPOSED DITCH DIMENSIONS:

SIDE SLOPE (L) =	2.00:1		SIDE SLOPE (R) =	2.00:1	
BOTTOM WIDTH =	20.0	FEET	BARRIER DAM HEIGHT (MIN) =	5.60	FEET
NUMBER OF CELLS =	1		BARRIER SPACING =	6108.00	FEET
NUMBER OF BARRIERS =	0		TOP WIDTH (TOTAL) =	59.86	FEET
POOL AREA=	0.60	AC.			

SEDIMENT DITCH CAPACITY:

TOTAL VOLUME OF DITCH (NO BARRIERS) =	24.47	ACRE FEET
TOTAL VOLUME OF BARRIERS =	0.00	ACRE FEET
TOTAL AVAILABLE STORAGE VOLUME =	24.47	ACRE FEET
60% CLEANOUT DEPTH = 1.47 FEET		

BARRIER/SPILLWAY DIMENSIONS:

SPILLWAY LENGTH = 0.0 FEET

REQD SPILLWAY FLOW = 470.32 CFS
(100 yr. 6 hr. peak flow for Drainage Areas 8 and 8A)

SPILLWAY CHECK BASED ON WEIR EQUATION

Q = CLH^1.5 OR
Q = CH^1.5(L+0.4(Z1+Z2)H)
REF. (MESA MANUAL, Pg. 6.136)

REF. (OPEN CHANNEL HYDRAULICS, CHOW, Pg. 53)

WHERE:

COEFFICIENT C =	2.8	
BOTTOM WIDTH L =	42.4	FEET
SIDE SLOPE Z1 =	2	
SIDE SLOPE Z2 =	2	

SPILLWAY FLOW DEPTH =	2.37	FEET
AREA OF FLOW =	111.47	SQ.FT.
VELOCITY =	4.22	FPS
FREEBOARD =	2.00	FEET
TOP WIDTH =	59.86	FEET

Q ACTUAL = 470.40 CFS

TOTAL SPILLWAY DEPTH (DEPTH ABOVE BARRIER DAM) =	4.37	FEET
TOTAL (MINIMUM) DITCH DEPTH =	9.97	FEET

NOTES:

1. BARRIERS SHALL BE SPACED TO MAINTAIN A BOTTOM GRADE ON THE SEDIMENT DITCH OF 0%, BUT IN NO CASE MORE THAN 500 FT APART.
2. ALL BARRIER DAM UPSTREAM AND DOWNSTREAM SIDE SLOPES WILL BE 3:1.

Pond 8A

Volume = At + Ab + (√ At * Ab) * D/3

At = Area of the top (at pool elevation)
Ab= Area of the bottom
D = Depth (at pool elevation)

Assume side slopes are 2:1.

Cell #	Pool Length	Pool width	Pool Depth	Bottom Length	Bottom width
1	764.8	43.7	6	740.8	19.7
2	531.4	34.4	6	507.4	10.4
3	243.3	32.9	6	219.3	8.9
4	441.3	49.2	6	417.3	25.2

Cell #	Area top	Area bottom	Depth/3	Volume of cell	
1	33421.76	14593.76	2	140201.1269	cu. Ft.
2	18280.16	5276.96	2	66757.42438	cu. Ft.
3	8004.57	1951.77	2	27817.88831	cu. Ft.
4	21711.96	10515.96	2	94676.502	cu. Ft.

TOTAL VOLUME FOR POND 8A =	329452.9416	cu. Ft.
	7.563198843	ac. Ft.

Pond 008 and 008A

10yr 24hr Storm Event

Alliance Consulting, inc.
124 Philpott Lane
Beaver, WV 25813

Phone: (304)-255-0491

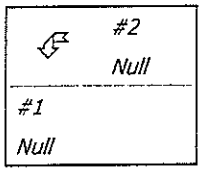
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.000 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Pond 008
Null	#2	==>	#1	0.792	0.277	Pond 008A



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	8. Large gullies, diversions, and low flowing streams	0.50	30.25	6,050.00	2.12	0.792
#2	**Muskingum K:**					**0.792**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#2	135.840	135.840	12.60	2.02
#1	59.450	195.290	13.62	2.90

Copyright 1998 -2002 Pamela J. Schwab

Structure Detail:

Structure #2 (Null)

Pond 008A

Structure #1 (Null)

Pond 008

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	135.840	0.539	0.000	0.000	87.000	M	12.60	2.020
	Σ	**135.840**						**12.60**	**2.020**
#1	1	59.450	0.792	0.000	0.000	87.000	M	4.38	0.883
	Σ	**195.290**						**13.62**	**2.903**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	0.50	30.25	6,050.00	2.120	0.792
#1	**1**	**Time of Concentration:**					**0.792**
#2	1	8. Large gullies, diversions, and low flowing streams	1.00	30.09	3,010.00	3.000	0.278
		8. Large gullies, diversions, and low flowing streams	50.00	125.00	250.00	21.210	0.003
		8. Large gullies, diversions, and low flowing streams	0.50	9.87	1,975.00	2.120	0.258
#2	**1**	**Time of Concentration:**					**0.539**

Pond 008 Spillway

Spillway Design Flow = 385.80 cfs (based on 10 yr./ 24 hr. storm)

Spillway Capacity = 470.32 cfs (based on 100 yr. / 6 hr. storm
for Ponds 008 and 008A

Pond 008 and 008A

100yr 6hr Storm Event

Alliance Consulting, inc.
124 Philpott Lane
Beaver, WV 25813

Phone: (304)-255-0491

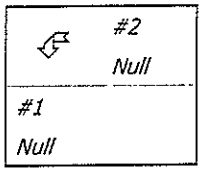
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Pond 008
Null	#2	==>	#1	0.792	0.277	Pond 008A



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	8. Large gullies, diversions, and low flowing streams	0.50	30.25	6,050.00	2.12	0.792
#2	**Muskingum K:**					**0.792**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#2	135.840	135.840	437.38	42.56
#1	59.450	195.290	470.32	61.16

Structure Detail:

Structure #2 (Null)

Pond 008A

Structure #1 (Null)

Pond 008

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	135.840	0.539	0.000	0.000	87.000	M	437.38	42.558
	Σ	**135.840**						**437.38**	**42.558**
#1	1	59.450	0.792	0.000	0.000	87.000	M	154.50	18.607
	Σ	**195.290**						**470.32**	**61.164**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	0.50	30.25	6,050.00	2.120	0.792
#1	**1**	**Time of Concentration:**					**0.792**
#2	1	8. Large gullies, diversions, and low flowing streams	1.00	30.09	3,010.00	3.000	0.278
		8. Large gullies, diversions, and low flowing streams	50.00	125.00	250.00	21.210	0.003
		8. Large gullies, diversions, and low flowing streams	0.50	9.87	1,975.00	2.120	0.258
#2	**1**	**Time of Concentration:**					**0.539**

ENGINEERING CERTIFICATION

I hereby certify the engineering design used in preparation of this application, attachments, and supplements was done by me or under my direct supervision.

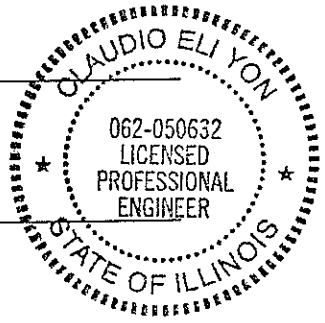
I further certify to the best of my knowledge all such design is in accordance with all applicable local, state and federal laws, rules and regulations. I have placed an "X" in the box below if that item is relevant.

☐ Whereas the Reclamation Plan calls for an alternative land use, I also certify the plans to conform to applicable accepted standards for adequate land stability, drainage, vegetative cover, and aesthetic design appropriate for the post-mining use of the site.

☐ Whereas the operation proposes disposal of spoil or waste materials in areas other than mining workings or excavations, I also certify such fills are designed in accordance with recognized professional standards and all applicable laws.

☒ Certification of Illinois Environmental Protection Agency-35 Ill. Adm. Code 405.104(a) Permit. In my professional judgment, the plans and specifications submitted as part of this application describe an operation which will meet all applicable effluent and water quality standards. I certify that I am familiar with all of the plans, specifications, reports, and maps submitted as part of this application and that said plans, etc. are accurate insofar as they represent existing conditions.

Claudio E. Yon
Name



062-050632
Illinois Registration Number (Seal)

Alliance Consulting, Inc.
Firm

(304) 255-0491
Phone Number

124 Philpott Lane. Beaver, West Virginia 25801
Address

Claudio E. Yon
Signature

9/17/10
Date

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

Steve Sutphin <ssutphin@aci-wv.com>

Project No. B10-192-1413

2 messages

Devardo, Tim <Tim.Devardo@illinois.gov> Tue, Nov 23, 2010 at 3:12 PM
To: Steve Sutphin <ssutphin@aci-wv.com>
Cc: "Murphy, Brad" <Brad.Murphy@illinois.gov>

Steve:

This IPR is requesting to remove existing Sediment Ponds 007 and 008 and revise/redesign the existing sediment ditches to become Ponds 006A, 007, 007A, 008 and 008A.

I have the following questions:

1. The single sheet titled, "Pond 006 Spillway" lists a Spillway Design Flow of 386 cfs for the 10 yr/24 hr event. It then lists the Spillway Capacity at 152 cfs for the 25 yr/6 hr event. I don't understand the disparity in the numbers since there is only ½ inch difference in rainfall amounts? For a given rainfall amount we would expect to see the peak to increase as the duration gets shorter. The 006 and 006A numbers seem to support this, with a 10 yr/24 hr of 185 cfs and a 25 yr/6 hr of 219 cfs.

2. I read the narrative to say the discharge structures be reconstructed in the currently approved location and to the currently approved dimensions. Is this correct.

3. In the future, please revise the general design sheet under the note section [item *] to read 0.42 × Runoff Volume.

Thanks,

Tim DeVardo

618-439-9111 [X259]

Steve Sutphin <ssutphin@aci-wv.com> Tue, Nov 30, 2010 at 9:46 AM
To: "Devardo, Tim" <Tim.Devardo@illinois.gov>

Tim:

In reference to your email, please review my responses below.

Question 1
I may have incorrectly stated the storm event for the Pond 006 spillway, but not the peak discharge listed for the spillway.

In the original permit application for P375, Pond 006 had an open channel spillway proposed. Two Reservoir Routing calculations were submitted, one for a 10 year / 24 hour storm event and a second one for a 25 year / 6 hour storm event. The 10yr./ 24 hr. calculations showed a "outflow rate at peak elevation" of 35.35cfs and the 25 yr. / 6 hr. calculation showed 25.18 cfs. However, both printouts showed under the heading Reservoir Parameters a "storage volume & discharge rate at embankment crest elevation = 385.8cfs", which is the cfs used to size the open channel spillway.

For the purpose of the submitted IPR, we calculated the runoff by routing the flow from Pond 006A and the Fresh Water Pond into Pond 006 and used a 25 yr./ 6 hour storm event. So if you compare the cfs from the 25 yr./6 hr. storm event submitted in the original permit application to the 25 yr./6 hr. storm event in the IPR application, the peak discharge has increased from 25.18 cfs to 152 cfs.

Question 2
The proposed spillway for Pond 007 is within 38 feet of the existing spillway and the proposed spillway for Pond 008 is within 27 feet of the existing spillway. Both spillways will discharge into the same drainage channel as before and the placement of these spillways will not affect the NPDES latitude and longitude location.

Question 3
Your comment is noted. As you have probably concluded, the calculation is correct and only the note at the bottom of the page is incorrect.

If you have any more questions, please feel free to email me or call me at the number listed below.

Thanks

Steve Sutphin
Alliance Consulting, Inc.
124 Philpott Lane
Beaver, WV 25813
Phone: (304) 255-0491 ext. 313
Fax: (304) 255-4232

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Thank you

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DOCUMENT

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8114 / 10
Due date: 5-19-10

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Engineers • Constructors • Scientists

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
MODIFICATION TO PERMIT NO. IL0078565
REPORT
ABANDONMENT EVALUATION
VOLUME 1 OF 6

POND CREEK NO. 1 COAL REFUSE DISPOSAL SITE
PHASE 2 SOUTH POND SLURRY IMPOUNDMENT
JOHNSTON CITY, WILLIAMSON COUNTY, ILLINOIS

Prepared for

MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B10-148-1413
MARCH 2010

Summersville, WV
848 Northside Drive
Summersville, WV 26651
Telephone: (304) 883-2360
Fax: (304) 883-2361

Beckley, WV
Raleigh County Airport Industrial Park
124 Philpott Lane
Beaver, WV 25813-9502
Telephone: (304) 255-0491
Fax: (304) 255-4232

Canonsburg, PA
151 East Pike Street
Canonsburg, PA 15317
Telephone: (724) 745-3630
Fax: (724) 745-3631

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

April 5, 2010

Project No. B10-148-1413

Mr. Larry Crislip
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
2309 West Main Street, Suite 116
Marion, IL 62959

Transmittal
Modification to Abandon
Permit No. IL0078565
Williamson Energy, LLC
Williamson County, Illinois

Dear Mr. Crislip:

Please find enclosed two copies of a joint application form for the referenced facility. The purpose of this application is to request permission to abandon and mine beneath capped slurry cells (Phase No. 2 and Phase No. 3). This application was also submitted to the Illinois Department of Natural Resources, Office of Water Resources and Land Reclamation division.

The following documents are part of this application:

1. Report, Abandonment Evaluation, Volume 1 Of 6, Pond Creek No. 1 Coal Refuse Disposal Site, Phase 2 South Pond Slurry Impoundment
2. Pseudo-Static Slope Stability Analysis, Volume 2 Of 6, Pond Creek Mine No. 1, Coal Refuse Disposal Facility No. 2, Phases 3 – 7 Dam
3. Report, Permanent Deformation Evaluation, Volume 3 Of 6, Pond Creek No. 1 Coal Refuse Disposal Site, South Cell Slurry Impoundment
4. Additional MSHA Information, Comments 1, 3, 7, And 8, Volume 4 Of 6, Coal Refuse Disposal Facility No. 2, Phase 3 Through 7, Impoundment I.D. No. 1211-IL08-0341-02, MSHA I.D. No. 11-03141
5. Additional MSHA Information, Comments 2, 4, 5, 6, 9, 10 And 11, Volume 5 Of 6, Coal Refuse Disposal Facility No. 2, Phase 3 Through 7, Impoundment I.D. No. 1211-IL08-0341-02, MSHA I.D. No. 11-03141
6. Additional MSHA Information, Maps, Volume 6 Of 6, Coal Refuse Disposal Facility No. 2, Phase 3 Through 7, Impoundment I.D. No. 1211-IL08-0341-02, MSHA I.D. No. 11-03141

If you have any questions, or require additional information, please contact us.

RECEIVED
APR 07 2010
IL Environmental Protection Agency
MARION REGIONAL OFFICE

124 Philpott Lane • Raleigh County Airport Industrial Park • Beaver, WV 25813-9502 • TELE: (304) 255-0491 • FAX: (304) 255-4232

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Claudio E. Yon, P. E.
Senior Project Manager

CEY:wmb
Enclosures

FILE: 10148-01

JOINT APPLICATION FORM

1. Application Number (to be assigned by Agency)	2. Date	3. For agency use only (Date Received)
2009 3068	12 January 2010 (Day Month Year)	

4. Name and address of applicant

Williamson Energy, LLC
P.O. Box 99
Johnston City, Illinois 62951

Telephone no. during business hours include area code: (618) 983-3020

5. Name, address, and title of authorized agent

Claudio E. Yon, Senior Project Manager
Alliance Consulting, Inc.
124 Philpott Lane
Beaver, WV 25813

Telephone no. during business hours include area code: (304) 255-0491 ext. 314
(304) 255-4232 (fax)

6. Project Description and Remarks: Describe in detail the proposed activity, its purpose, and intended use. Also indicate the drainage area at the watershed to the downstream limit. Use attachments if needed.

See Attachment 6 for project description and remarks. Abandonment plan for Coal Refuse Disposal Facility No. 1 (Phase 2) and Facility No. 2 (Phase 3 through 7).

7. Names, addresses, and telephone numbers of all adjoining and potentially affected property owners, including the owner of the subject property if different from applicant.

Owner of the property is Williamson Development Company, LLC, P.O. Box 99, Johnston City, IL 62951. Adjoining property owners: Paul Hillman, 16632 Dwina Road, Marion, IL 62959, (618) 983-6300; Phillip Anderson, 16661 Liberty School Road, Marion, IL 62959 (618) 983-5209; Peggy Trout, 302 Indian Drive, Johnston City, IL 62951 (618) 983-8360; Carl and Merilee Anderson TR, 302 Circle Drive, Salem, IL 62881 (618) 548-4054; Scottie Harris, 18924 Dean Road, Thompsonville, IL 62890 (618) 983-6656; Ward and Eva McKown, 800 W. Perrine St., Johnston City, IL 62951, (618) 983-8680.

8. Location of activity

Unnamed Tributary of Pond Creek of the Big Muddy River and Unnamed Tributaries of the Middle Fork of the Saline River
Name of waterway at location of the activity

Address: Liberty School Road
Street, road, or other descriptive location

Johnston City
In or near city or town

Williamson
County

Legal Description: SW (1/4) 12 (Sec) 8S (Twp.) 3E (Rge) 3rd (P.M.)

UTM (Universal Transverse Mercator): If available: -- (Zone) -- (North) -- (East)

N/A
Name of Local Governing Community

Illinois
State

62951
Zip Code

9. Date activity is proposed to commence: March 2010 Estimated Time of Construction: 6 months

10. Is any portion of the activity for which authorization is sought now complete? Yes ☐ No X If answer is "Yes" give reasons in item 6.

Month and Year the activity was completed. Indicate the existing work on drawings.

11. List all approvals or certifications required by other federal, interstate, state, or local agencies for any structures, construction, discharges, deposits, or other activities described in this application. If this form is being used for concurrent application to the Corps of Engineers, Illinois Department of Natural Resources, and Illinois Environmental Protection Agency, these agencies need not be listed.

Issuing Agency	Type of Approval	Identification No.	Date of Application	Date of Approval
Illinois Dept. of Natural Resources	SCMRO	Application No. 375	12/17/04	7/7/05
Illinois Environmental Protection Agency	NPDES	IEPA Log No. 007666	12/17/04	6/28/05

12. Has any agency denied approval for the activity described herein or for any activity directly related to the activity described herein? Yes ☐ No X (If "Yes", explain in item 6.)

13. Application is hereby made for authorizations of the activities described herein. I certify that I am familiar with information contained in the application, and that to the best of my knowledge and belief, such information is true, complete, and accurate. I further certify that I possess the authority to undertake the proposed activities.

Signature of Applicant or Authorized Agent

Michael J. Beyer
Typed or Printed Name of Applicant or Authorized Agent

NCR FORM 426
08 AUG 02

☐ CORPS OF ENGINEERS COPY ☐ IDNR/OWR COPY ☐ IEPA COPY ☐ APPLICANT'S COPY

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
MODIFICATION TO PERMIT NO. IL0078565
REPORT
ABANDONMENT EVALUATION
VOLUME 1 OF 6

POND CREEK NO. 1 COAL REFUSE DISPOSAL SITE
PHASE 2 SOUTH POND SLURRY IMPOUNDMENT
JOHNSTON CITY, WILLIAMSON COUNTY, ILLINOIS

Prepared for

MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B10-148-1413
MARCH 2010

REPORT
ABANDONMENT EVALUATION

POND CREEK NO. 1 COAL REFUSE DISPOSAL SITE
PHASE 2 SOUTH POND SLURRY IMPOUNDMENT
JOHNSTON CITY, WILLIAMSON COUNTY, ILLINOIS

Prepared For:

ALLIANCE CONSULTING, INC.
BECKLEY, WEST VIRGINIA

Prepared By:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
EXPORT, PENNSYLVANIA

CEC Project 080-851

July 23, 2008

TABLE OF CONTENTS

Page

1.0 Introduction 1

2.0 Analytical Approach 3

3.0 Previous Deformation Analyses 5

4.0 Laboratory Testing and Summary of Results 6
4.1 Estimates of In-Situ Steady-State Undrained Shear Strength 7
4.2 Summary of Engineering Properties 8

5.0 Liquefaction Susceptibility Evaluation 9
5.1 In-Situ Driving Shear Stress 9
5.2 Factor of Safety Against Liquefaction 10

6.0 Conclusions 11

7.0 References 13

FIGURE

Figure 1 – Cross-Section A-A Liquefaction Slope Stability Analyses Results

APPENDICES

Appendix A – Summary of Laboratory Testing Results and Characterization of the Subsurface Materials
Appendix B – Summary of Engineering Properties
Appendix C – Driving Shear Stress and Factor of Safety Against Liquefaction Slope Stability Analyses Results

1.0 INTRODUCTION

Plans have been developed for the construction of a coarse and fine coal refuse disposal facility to be located near Johnston City in Williamson County, Illinois. The proposed Pond Creek facility will provide disposal capacity for both coarse and fine coal refuse produced by the Pond Creek Mine No. 1 coal preparation plant located approximately 0.25-mile to the west. The location of the site is just southwest of the intersection of Dwina Road and Dean Road.

The design plans for the Phase 2 expansion of the Pond Creek facility, submitted under separate cover by Alliance Consulting, Inc. (Alliance) of Beckley, West Virginia, includes raising the embankment crest to Elevation (El.) 502 by constructing a coarse coal refuse embankment cell (South Pond). The corresponding minimum and maximum fine coal refuse slurry impoundment levels for the proposed South Pond are El. 474 and El. 496, respectively. The abandonment geometry includes an additional 4-foot layer of coarse coal refuse up to El. 500 and a 2-foot thick, one (1) percent sloping soil cover.

The Illinois Department of Natural Resources (IDNR) Part 3702 Chapter IX requires that the evaluation of the abandonment condition for the South Pond address the following issues:

1. The classification of the existing condition of the impounded material with respect to its fluid nature;

2. The liquefaction potential of the impounded material and the related stability of the containing dam;

3. The final surface configuration for the impoundment including the potential for resaturation of the impounded material especially from any surface water impounding characteristics; and

4. The establishment of a follow-up inspection schedule to ensure the proposed plans have been effective and the submittal of record drawings.

The following sections of this report include generalized descriptions of the analytical techniques and results of the material characterizations, summaries of previous deformation analyses and laboratory testing, various abandonment analyses associated with IDNR guideline Nos. 1 and 2 noted above, our conclusions and a reference list. Alliance will present under separate cover the final surface configuration and follow-up inspection schedule associated with Nos. 3 and 4 of the IDNR guidelines noted above. Figure 1 presents the Cross-Section A-A, Pond Creek Phase 2 South Pond abandonment geometry and results of the liquefaction susceptibility analysis. Appendices A through C present supporting information, including detailed calculation briefs for the various analytical procedures discussed herein.

2.0 ANALYTICAL APPROACH

In general, the procedure utilized by Civil & Environmental Consultants, Inc. (CEC) for evaluating the Phase 2 South Pond abandonment geometry is presented by Poulos, Castro and France (1985), which includes characterizing the impounded fine coal refuse material and assessing the susceptibility of the impoundment and embankment to a liquefaction (flow slide) failure. Liquefaction susceptibility was determined by performing a stability analysis, which requires the undrained steady-state strength (S_{us}) and the in-situ static driving shear stress be determined.

Poulos, et al (1985) states a soil mass susceptible to liquefaction will only experience a liquefaction failure when a sufficiently large triggering event causes the strength of the soil to decrease to the undrained steady-state strength. Conversely, a soil mass which is not susceptible to liquefaction physically cannot fail by liquefaction since the minimum undrained strength exceeds the in-situ driving shear stress along the critical failure surface. These principles form the basis of the liquefaction-based abandonment analyses described below.

Liquefaction susceptibility of the proposed Phase 2 South Pond abandonment geometry and, in general, the fine coal refuse hydraulically placed behind the coarse refuse embankment involved the determination of:

1. The physical properties and relationship between peak and steady-state undrained shear strength of fine coal refuse with variations in effective stress, based on index and strength tests on remolded, site-specific slurry samples of the fine coal refuse to characterize the material relative to its potential for strength loss and flow failure;

2. Driving shear stresses through the fine coal refuse and coarse refuse embankment/residual soil in the downstream and upstream directions to assess the potential for liquefaction; and

3. The factor of safety against liquefaction (F_L) by comparing the steady-state undrained strength of the fine coal refuse to the in-situ driving shear stress generated by the downstream and upstream abandonment soil mass geometries.

Liquefaction susceptibility depends on the strength of all the soils along the potential failure surface. Zones of loose (contractive) soils are critical to analyzing liquefaction potential since only loose soils can have an undrained strength that is significantly lower than their drained strength. Therefore, the behavior of the fine coal refuse and its potential to lose strength were evaluated when an earthquake, or similar rapid loading, changes the condition from drained to undrained.

3.0 PREVIOUS DEFORMATION ANALYSES

IDNR previously required a revised (seismic) slope stability analysis be performed for the Phase 2 South Pond geometry using equivalent static load methods and the appropriate peak acceleration based on the Peak Ground Acceleration (PGA) for the 2% Probability of Exceedance in 50 Years maps from the United States Geologic Survey (USGS). Since the required factor of safety (i.e., a minimum factor of safety of 1.0 with seismic forces for the steady seepage condition) was not met, a permanent deformation evaluation was required by IDNR. CEC/Alliance submitted a detailed deformation evaluation[1] of the proposed Pond Creek Phase 2 impoundment addressing relevant issues such as material characterizations, seismic hazard, induced cyclic shear stresses and permanent deformations.

Permanent deformation analyses indicated the South Pond was not susceptible to adverse post-earthquake permanent deformations. These conclusions were based on the results of high quality field testing and detailed, seismically-related engineering and deformation analyses in both the upstream and downstream directions.

CEC utilized the results of field testing performed for the permanent deformation analyses, particularly the seismic cone penetration testing (SCPT), and engineering properties developed for the coarse coal refuse and residual soils. Where applicable, the previous results are incorporated, summarized and referenced herein.

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[1] Civil & Environmental Consultants, Inc. "Report, Permanent Deformation Evaluation, Pond Creek No. 1 Coal Refuse Disposal Site, South Cell Slurry Impoundment, Johnston City, Williamson County, Illinois," dated January 23, 2008.

4.0 LABORATORY TESTING AND SUMMARY OF RESULTS

In addition to the SCPT results of the existing coarse refuse and sandy clay residual soils underlying the site, Alliance obtained bulk fine coal refuse slurry samples from the South Pond impoundment for subsequent laboratory testing. Surface samples of fine coal refuse slurry were obtained from the existing tailings pond adjacent to the upstream slope of the coarse embankment. The samples were generally fine-grained, very soft and wet. The slurry material was shipped to CEC's Export, Pennsylvania office and subsequently hand-delivered to the laboratory.

CEC retained Geotechnics, Inc. (Geotechnics) of East Pittsburgh, Pennsylvania to perform laboratory tests and characterize the fine coal refuse. Laboratory testing included performing moisture content, Atterberg limit, grain size analysis and specific gravity testing on slurry samples to aid in soil classification and evaluation of the material properties. The fine coal refuse material was composited in the laboratory to form two (2) remolded slurry samples. The sample preparation was designed to simulate the in-situ hydraulic deposition process, and estimate the in-situ steady-state and peak shear strength after consolidation to various effective stresses. Consolidated-undrained (CU) triaxial strength tests on the remolded slurry samples were performed to estimate peak and steady-state strength data of the fine coal refuse and assess liquefaction susceptibility of the Phase 2 abandonment geometry. Effective and total strength parameters were also determined for the slurry samples. Laboratory testing procedures and results are summarized in Appendix A.

In general, the as-received moisture contents of the sampled fine coal refuse ranged from about 86 to 94 percent. Liquid and plastic limits were 36 and 19, respectively, yielding a plasticity index of 17. CU triaxial shear strength testing was performed at confining pressures of about 5, 10 and 20 pounds per square inch (psi). The CU testing produced peak undrained shear strengths (S_{up}) ranging from about 2.6 to 9.3 psi [375 to 1,340 pounds per square foot (psf)]. Peak (axial)

strains ranged from about 8.4 to 18.4 percent. Steady-state (or residual) undrained shear strengths (S_{us}) ranged from about 2.5 to 8.7 psi (360 to 1250 psf) at maximum strains of about 17.3 to 21.7 percent.

The results of the laboratory testing indicated the fine coal refuse is clay-like based on an average 93 percent passing the No. 200 sieve and plasticity index of 17. Peak and steady-state undrained strengths presented in Appendix A were reached at generally high strains (between 8 and 18 percent), and there was very little drop-off from peak to steady-state with increasing strain. The results generally indicated a higher resistance to strength loss (and flow) due to the large strains required to exceed the peak strength and correspondingly small decrease to the steady-state strength at higher strains. Further, previous deformation analyses results indicated induced shear strains from the PGA at less than one-tenth (0.1) percent, which is well below a threshold (peak) triggering strain of the material.

4.1 Estimates of In-Situ Steady-State Undrained Shear Strength

To assess the liquefaction susceptibility of the fine coal refuse, the estimation of S_{us} values for fine refuse layers at in-situ conditions different than the laboratory samples tested is based on laboratory test results correlated with effective vertical stress (σ'_v) of the layers in question. By assuming fine coal refuse S_{us} values vary linearly with σ'_v, the in-situ S_{us} value for the fine coal refuse layer can be estimated based on the S_{us} characteristics of the fine coal refuse samples tested in the laboratory and the in-situ σ'_v of a particular fine coal refuse.

The effective consolidation stresses at which the laboratory tests were performed were converted into equivalent in-situ vertical effective stresses, assuming that the lateral stresses are equal to one-half of the vertical stresses. Therefore, the triaxial test consolidation stresses were multiplied by a factor of 1.5 to develop a relationship between σ'_v and S_{us}. An S_{us}/σ'_v ratio of 0.24 extends from the zero intercept to the point where two-thirds of the data fall above the straight line, which is the lowest datum plus one-third of the distance from the lowest datum to

the second lowest datum, i.e., 2/3 – 1/3 relationship. This relationship of $S_{us} = 0.24\ \sigma'_v$ was based on the results of consolidated-undrained triaxial tests of slurry fine coal refuse samples, and is presented in further detail in Appendix B.

4.2 Summary of Engineering Properties

The following soil properties were estimated based on previous field and laboratory testing as well as current fine coal refuse testing for use in the various post-earthquake liquefaction slope stability analyses:

Summary of Engineering Properties

Material Type	Total Unit Weight γt (pcf)	Saturated Unit Weight γs (pcf)	Effective Friction ϕ' (deg)	Effective Cohesion c' (psf)
Coarse Refuse	130	140	33.7	0
Fine Refuse	80	90	0	200 to 276
Residual Soil	125	130	19	4000
Soil Cap	130	1135	30	0

5.0 LIQUEFACTION SUSCEPTIBILITY EVALUATION

Factors of safety against a liquefaction flow failure (F_L) were calculated using steady-state principles and the Phase 2 South Pond upstream and downstream embankment/impoundment abandonment conditions. Following the estimation of in-situ driving shear stresses for Phase 2, the average vertical effective stress along the critical failure surface and various fine coal refuse layers was calculated. The σ'_V values were determined at various depths within the layer boundaries shown in Figure 1. S_{us} values were then estimated by multiplying the in-situ average σ'_V for each layer by the 0.24 ratio. Figure 1 also presents the S_{us} values estimated for each fine coal refuse layer used in the downstream and upstream liquefaction stability analyses.

5.1 In-Situ Driving Shear Stress

Estimating the in-situ static driving shear stress in the critical soil layer (i.e., fine coal refuse) is one of the steps for evaluating liquefaction susceptibility. The driving shear stress in the critical fine coal refuse layer is equal to the minimum shear resistance the layer must have to simply maintain stability of the slope (i.e., factor of safety of 1.0). The driving stress assumes fully mobilized shear strengths in the other, less critical coarse refuse and residual soil layers comprising the model. The fully mobilized strengths are those that would act while deformation of the slope is occurring and, thus, would be available to resist a massive flow slide. These shear strengths are quantified by performing a stability analysis for the slope in question.

When evaluating slope stability by means of circular failure surface analysis (using the limit equilibrium approach), the driving shear stress (τ_d) acting along the failure surface analyzed is determined by assuming the shearing resistance (i.e., shear strength) of the material through which the failure surface passes is provided solely by cohesion [i.e., angle of internal friction (ϕ) = 0]. The driving stress is determined by varying the cohesion value used in the analysis until a factor of safety of 1.0 is obtained. For this condition, the driving stress acting along the failure surface analyzed is equal to the cohesion value used for the material.

Using the impoundment geometry shown in Figure 1, a series of GSTABL7 analyses were performed to identify the most critical circular failure surface passing through the Phase 2 impoundment for both the downstream and upstream (abandonment) conditions. The range of starting and ending points for failure circle generation were iteratively analyzed to evaluate the critical failure surface and included the entire impoundment surface. The drained strengths of the coarse refuse and total strength of the residual soil described above were used while the cohesion values for the fine coal refuse layers were modeled equal to one another and varied until a factor of safety of 1.0 was obtained.

The results of the driving shear stress slope stability analyses indicated the embankment and impoundment geometry is very favorable, and there is zero (0) driving stress in the fine coal refuse impoundment for both the upstream and downstream abandonment geometry. Hard copies of the input and output files for the driving stress analyses are presented in Appendix C.

5.2 Factor of Safety Against Liquefaction

The minimum F_L in the downstream direction for the abandonment condition is 1.6 and, in the upstream direction, the minimum F_L is about 9. These results are based on a site-specific, steady-state shear strength to effective stress relationship ($S_{us} = 0.24\ \sigma'_v$), which relates the shear strength of slurry fine coal refuse samples with the estimated vertical effective overburden pressure. The following table presents the results of the downstream and upstream post-earthquake stability analyses. GSTABL output files are presented in Appendix C for the South Pond Stage 2 impoundment.

Stage 2 Abandonment (Crest El. 502)	Top of Fines Elevation (ft)	Top of Cap Elevation[1] (ft)	Driving Shear Stress in Fine Coal Refuse (τ_d) (psf)	Factor of Safety Against Liquefaction (F_L) (dim)
Downstream	496	502	0	1.6
Upstream	496	502	0	8.4

[1] Cap includes 4-foot coarse refuse and 2-foot soil cover layer above top of fines elevation. The soil cover is sloped at one percent to maintain positive drainage.

6.0 CONCLUSIONS

CEC has completed an evaluation of the liquefaction susceptibility of the proposed Pond Creek Phase 2 South Pond abandonment geometry. Based on this evaluation, the facility is not susceptible to a liquefaction (flow) failure. This conclusion is based on the following:

- Characterization of the fine coal refuse as clay-like, which typically is more resistant to strength loss (or flow) than sand-like materials;

- Elevated peak and steady-state undrained shear strengths and corresponding elevated shear strains. Previous deformation analyses results indicating induced maximum shear strains from the PGA less than 0.1 percent, further indicating a resistance to strength loss (and flow);

- In-situ driving shear stresses through the fine coal refuse of 0 psf; and

- Factors of safety against liquefaction susceptibility in both the downstream and upstream directions ranging from 1.6 to greater than 9, respectively.

To prevent resaturation, the Phase 2 abandonment geometry will promote long-term positive drainage and permanent drainage controls to minimize surface water infiltration. Plans to prevent future surface water impounding capability, erosion and sedimentation controls and drainage are provided under separate cover by Alliance.

Finally, CEC and Alliance understand a final inspection and report by a professional engineer must be completed and submitted to the IDNR, Office of Water Resources one (1) year after the completion of the abandonment modifications to the dam. This inspection is intended to evaluate and report the effectiveness of the abandonment plans, and record drawings will be submitted with the final inspection report.

In preparing this report, CEC's professional services have been performed, findings obtained and conclusions prepared in accordance with generally accepted engineering principles and practices. No warranty, expressed or implied, is made or intended by rendering of these services or by furnishing oral or written reports of our findings. This report was prepared for the exclusive use of Alliance and/or its affiliates.

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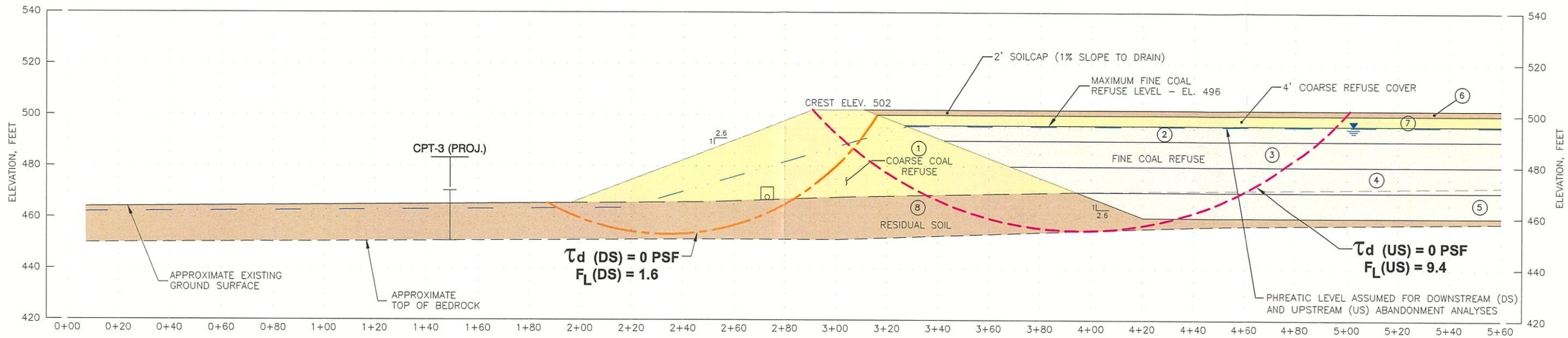
FIGURE

R15084

REVISION RECORD		
NO	DATE	DESCRIPTION
△		
△		
△		
△		

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION



CROSS-SECTION A-A (SOUTH POND)

SCALE IN FEET
0 20 40

SOUTH POND ABANDONMENT
FACTORS OF SAFETY AGAINST LIQUEFACTION

PHASE 2 ANALYSIS	IN-SITU STATIC DRIVING STRESS, τ_d (psf)	FACTOR OF SAFETY AGAINST LIQUEFACTION, F_L
DOWNSTREAM	0	1.6
UPSTREAM	0	9.4

MATERIAL PROPERTIES USED IN DRIVING SHEAR STRESS (τ_d) AND FACTOR OF SAFETY AGAINST LIQUEFACTION (F_L) SLOPE STABILITY ANALYSIS

SOIL TYPE NO.	MATERIAL	TOTAL UNIT WEIGHT, (PCF)	EFFECTIVE SHEAR STRENGTH PARAMETERS	
			FRICTION ANGLE, (DEGREES)	COHESION, (PSF)
1 & 7	COARSE COAL REFUSE	130	33.7	0
2 3 4 5	FINE COAL REFUSE	80	0	200 234 255 276
6 & 8	RESIDUAL SOIL	135	19.5 (TOTAL STRENGTH)	400 (TOTAL STRENGTH)

NOTES

1. COARSE REFUSE AND RESIDUAL SOIL MATERIAL PROPERTIES USED IN THE SLOPE STABILITY ANALYSES ARE BASED ON LABORATORY TEST DATA AND WERE PROVIDED BY ALLIANCE CONSULTING, INC.
2. STEADY-STATE UNDRAINED STRENGTHS WERE DEVELOPED BASED ON LABORATORY TEST DATA AND PRESENTED IN APPENDIXES A AND B.
3. CROSS-SECTION A-A REPRESENTS THE GENERALIZED CONDITIONS OF THE PHASE 2 SOUTH POND ABANDONMENT CONDITION.
4. τ_d DETERMINED FROM GSTAL7 STATIC STABILITY ANALYSIS USING DRAINED PROPERTIES FOR COARSE REFUSE AND TOTAL STRENGTH FOR RESIDUAL SOIL, AND VARYING UNDRAINED PROPERTIES (COHESION) FOR FINE COAL REFUSE TO OBTAIN A FACTOR OF SAFETY OF 1.00.
5. STEADY-STATE STRENGTHS (Sus) DETERMINED BY CALCULATING THE AVERAGE VERTICAL EFFECTIVE STRESS ($\sigma v'$) OF EACH FINE COAL REFUSE LAYER, AND USING THE RELATIONSHIP Sus=0.24*$\sigma v'$ DEVELOPED FROM CONSOLIDATED-UNDRAINED TRIAXIAL TESTS OF FINE COAL REFUSE SLURRY SAMPLES.
6. F_L DETERMINED FROM GSTABL7 STATIC STABILITY ANALYSIS USING DRAINED PROPERTIES FOR COARSE REFUSE AND TOTAL STRENGTH FOR RESIDUAL SOIL, AND THE UNDRAINED STEADY-STATE STRENGTHS FOR EACH FINE COAL REFUSE LAYER AS DESCRIBED IN NOTE 5.

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POND CREEK MINE NO. 1
SOUTH POND ABANDONMENT
WILLIAMSON COUNTY, ILLINOIS
ALLIANCE CONSULTING, INC.

DRAWN BY: DMM	CHECKED BY: MJS	APPROVED BY: BEG*
DATE: JULY 23, 2008	DWG SCALE: AS SHOWN	PROJECT NO: 080-851

CROSS-SECTION A-A LIQUEFACTION SLOPE STABILITY RESULTS

FIGURE NO.: 1

*HAND SIGNATURE ON FILE

APPENDIX A

SUMMARY OF LABORATORY TESTING RESULTS AND CHARACTERIZATION OF THE SUBSURFACE MATERIALS

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond – Phase 2 Abandonment Evaluation Laboratory Testing Summary – Fine Coal Refuse

PROJECT NO. 080-851

PAGE 1 OF 3

MADE BY BEG DATE 7/10/08 CHECKED BY MJS DATE 7/23/08

CALCULATION BRIEF FOR SUMMARY OF LABORATORY TESTING

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH POND

OBJECTIVE:

Summarize the laboratory testing program and results obtained for fine coal refuse materials at the Pond Creek facility, South Pond impoundment. A laboratory testing summary table is attached, as well as laboratory testing results.

METHODOLOGY:

CEC retained Geotechnics, Inc. (Geotechnics) of East Pittsburgh, Pennsylvania to perform laboratory testing on bulk samples of fine coal refuse materials collected from the South Pond impoundment. The laboratory testing was performed between May 2008 and June 2008 at Geotechnics. The purpose of the testing program was to determine index and strength parameters, and summarize the results for the fine coal refuse materials relative to the eventual abandonment of the South Pond.

The laboratory testing program performed by Geotechnics included:

a. Index tests on bulk/slurried samples:
   - (2) Moisture content;
   - (2) Grain-size distributions;
   - (2) Hydrometers;
   - (2) Atterberg limits; and
   - (2) Specific gravity.

b. Shear strength tests on remolded slurried samples:
   - (6) Consolidated Undrained Triaxial, including (6) additional moisture contents and (6) total and dry density.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond – Phase 2 Abandonment Evaluation Laboratory Testing Summary – Fine Coal Refuse

PROJECT NO. 080-851

PAGE 2 OF 3

MADE BY BEG DATE 7/10/08 CHECKED BY MAS DATE 7/23/08

RESULTS:

The attached table presents a summary of the individual laboratory test data, and a formal copy of the laboratory testing results performed by Geotechnics, Inc. is attached.

R15088

Summary of Laboratory Test Results
Fine Coal Refuse Bulk Samples
Pond Creek Coal Refuse Disposal Facility - South Pond Abandonment
Franklin County, Illinois

BOREHOLE STATISTICS				INDEX						LIMITS			CONSOLIDATION		SHEAR STRENGTH									
															Peak Strength			Steady-State			Effective Strength		Total Strength	
Sample Type	Sample No.	Depth (ft)	Material	Wat. Con. (w) (%)	Total Den. (γ) (pcf)	Dry Den. (γ_D) (pcf)	Spec. Gr. (dim)	Passing No. 200 (%)	Passing No. 40 (%)	LL (%)	PL (%)	PI (%)	Initial Void Ratio (eo) (dim)	After Void Ratio (e) (dim)	f_p (deg)	ε_p (%)	q_p (ksf)	ϕ_{us} (Deg)	ε_{us} (%)	q_s (ksf)	ϕ (Deg)	c (ksf)	ϕ (Deg)	c (ksf)
Bucket	1	Remold	FCR	82.60	76.60	42.00	2.24						2.333	0.944	40.40	18.40	0.664	40.40	21.51	0.485				
Test No.	1																							
Bucket	1	Remold	FCR	82.70	84.20	46.10	2.24						2.035	0.955	39.60	13.40	1.086	39.00	21.67	0.817	36.14	0.000	17.30	0.216
Test No.	2																							
Bucket	1	Remold	FCR	79.50	80.50	44.80	2.24						2.119	0.956	37.80	13.50	1.558	36.70	21.74	1.149				
Test No.	3																							
Bucket	1	Bulk	FCR	85.80			2.24	92.83	99.41	36	19	17												
Bucket	2	Remold	FCR	82.90	82.60	45.20	2.24						2.095	1.129	38.30	10.30	0.485	36.30	17.29	0.354				
Test No.	1																							
Bucket	2	Remold	FCR	85.70	85.70	44.30	2.24						2.159	0.931	39.20	14.20	0.825	38.60	21.32	0.616	37.71	0.000	20.30	0.013
Test No.	2																							
Bucket	2	Remold	FCR	83.00	83.00	46.20	2.24						2.029	0.910	37.50	8.40	1.681	35.70	21.49	1.245				
Test No.	3																							
Bucket	2	Bulk	FCR	94.40			2.24	92.62	99.29	36	19	17												

ATTACHMENT A-1

LABORATORY TESTING RESULTS – FINE COAL REFUSE

Geotechnics
.....GEOTECHNICAL AND
GEOSYNTHETIC SERVICES

June 5, 2008

Project No. 2008-210-01

Mr. Blaise Genes
Civil & Environmental Consultants
4 Triangle Dr, Suite 200
Export, PA 15632-9255

Transmittal
Laboratory Test Results
Pond Creek

Please find attached the laboratory test results for the above referenced project. The tests were outlined on the Project Verification Form that was faxed to your firm prior to the testing. The testing was performed in general accordance with the methods listed on the enclosed data sheets. The test results are believed to be representative of the samples that were submitted for testing and are indicative only of the specimens which were evaluated. We have no direct knowledge of the origin of the samples and imply no position with regard to the nature of the test results, i.e. pass/fail and no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization by our Client. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please contact our office.

Respectively submitted,
Geotechnics, Inc.

David R. Backstrom
Laboratory Director

We understand that you have a choice in your laboratory services and we thank you for choosing Geotechnics.

544 Braddock Avenue • East Pittsburgh, PA 15112 • 412-823-7600 • FAX 412-823-8999 • www.geotechnics.net

Geotechnics
INTEGRITY IN TESTING

MOISTURE CONTENT

ASTM D 2216 (SOP-S1)

Client	CEC
Client Reference	POND CREEK 080851
Project No.	2008-210-01

Lab ID	01	02
Boring No.	SOUTH POND	SOUTH POND
Depth (ft)	NA	NA
Sample No.	BUCKET 1	BUCKET 2
Tare Number	877	729
Wt. of Tare & WS (gm)	621.7	578.3
Wt. of Tare & DS (gm)	385.56	339.54
Wt. of Tare (gm)	110.33	86.52
Wt. of Water (gm)	236.14	238.76
Wt. of DS (gm)	275.23	253.02
Water Content (%)	**85.8**	**94.4**

Notes : *NA*

Tested By PC *Date* 5/13/08 *Checked By* KB *Date* 5-14-08

DCN: CT-S1 DATE 6-30-98 REVISION: 2

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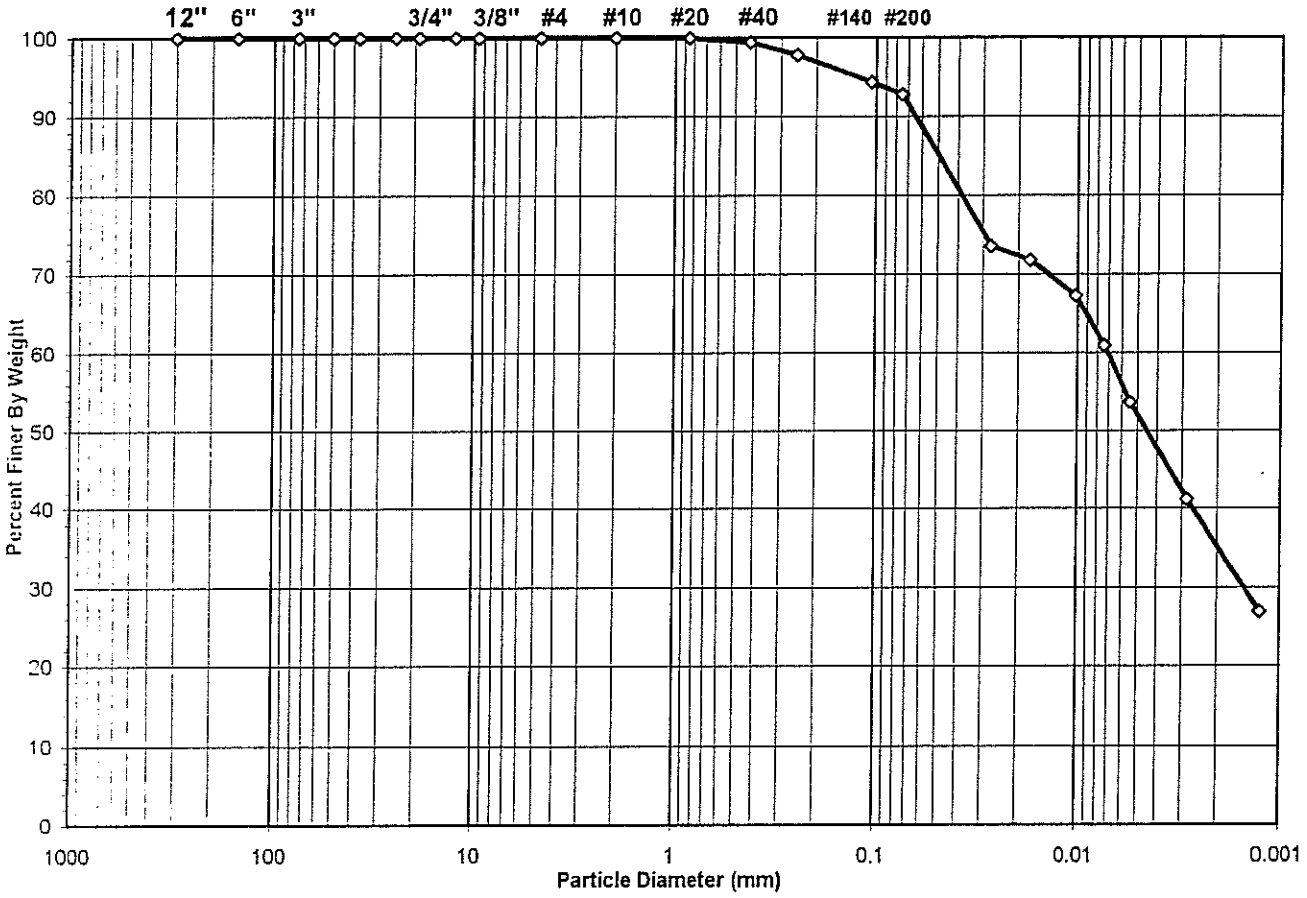
geotechnics
INTEGRITY IN TESTING

SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Color	**BLACK**

	SIEVE ANALYSIS			*HYDROMETER*	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	7.17
Finer Than #200	*Silt & Clay*	92.83

USCS Symbol	*CL, TESTED*
USCS Classification	*LEAN CLAY*

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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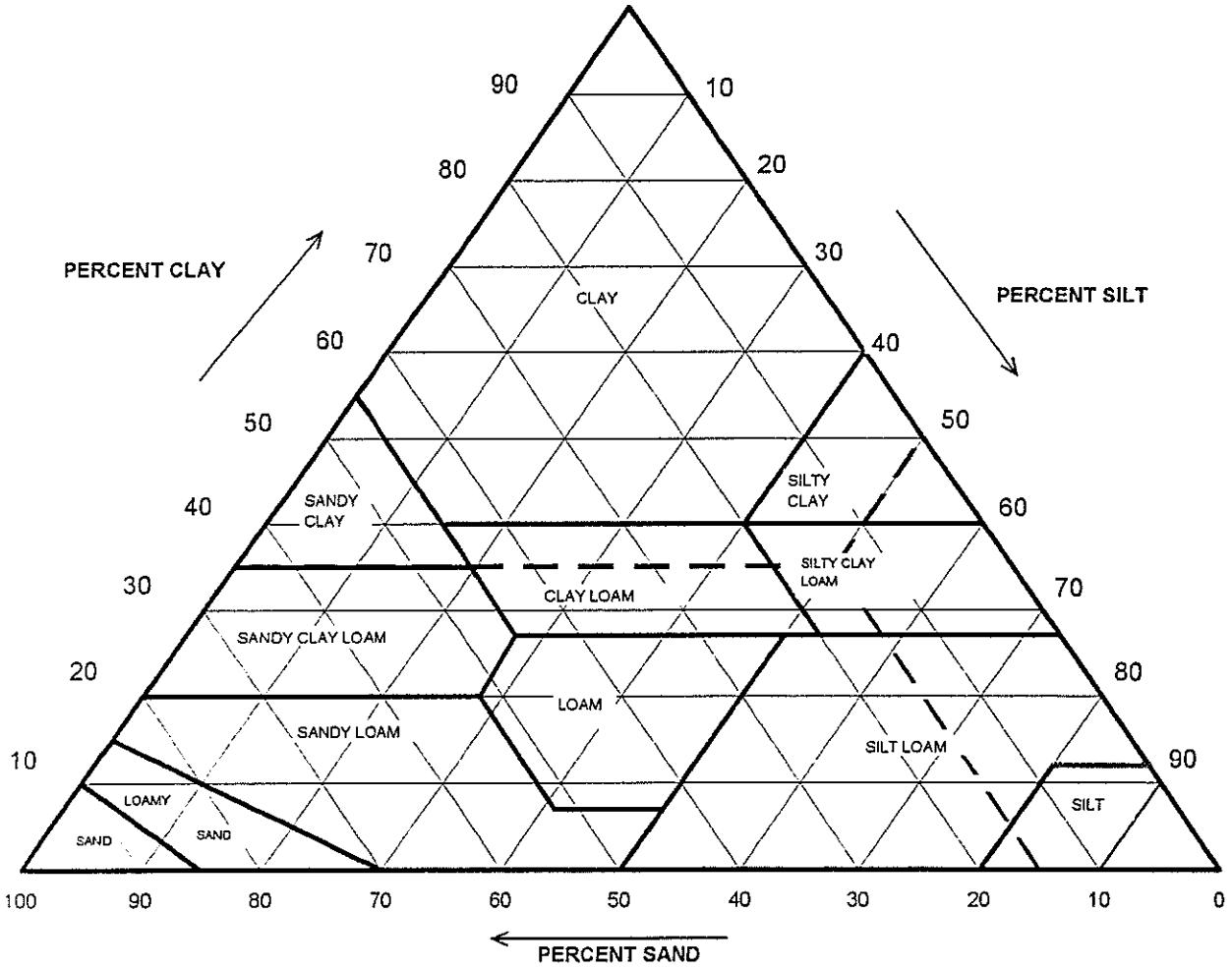
USDA CLASSIFICATION CHART

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Color	BLACK



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.00	**0.00**
2	100.00	*Sand*	14.88	**14.88**
0.05	85.12	*Silt*	50.02	**50.02**
0.002	35.10	*Clay*	35.10	**35.10**

USDA Classification: ***SILTY CLAY LOAM***

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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WASH SIEVE ANALYSIS

ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Color	**BLACK**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	703	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	1020.20	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	609.00	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	100.40	Weight of Tare (gm)	NA
Weight of Water (gm)	411.20	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	508.60	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**80.8**	**Moisture Content (%)**	NA

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	508.60
Dry Weight - 3/4" Sample (gm)	36.47	Weight of minus #200 material (gm)	472.13
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	36.47
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.00	0.00	0.00	100.00	**100.00**
#20	0.85	0.12	0.02	0.02	99.98	**99.98**
#40	0.425	2.90	0.57	0.59	99.41	**99.41**
#60	0.250	7.89	1.55	2.15	97.85	**97.85**
#140	0.106	17.74	3.49	5.63	94.37	**94.37**
#200	0.075	7.82	1.54	7.17	92.83	**92.83**
Pan	-	472.13	92.83	100.00	-	-

Tested By JP Date 5/21/08 Checked By KB Date 5-23-08

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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HYDROMETER ANALYSIS

ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Color	**BLACK**

Elapsed Time (min)	R Measured	Temp. (° C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	47.0	21.9	6.02	41.0	79.2	0.01314	0.0272	**73.6**
5	46.0	21.9	6.02	40.0	77.3	0.01314	0.0174	**71.8**
15	43.5	21.9	6.02	37.5	72.5	0.01314	0.0103	**67.3**
31	40.0	21.9	6.02	34.0	65.7	0.01314	0.0074	**61.0**
60	36.0	21.8	6.07	29.9	57.9	0.01316	0.0055	**53.7**
250	29.0	21.7	6.11	22.9	44.3	0.01317	0.0028	**41.1**
1440	21.0	21.9	6.02	15.0	29.0	0.01314	0.0012	**26.9**

Soil Specimen Data		Other Corrections	
Tare No.	2487		
Tare + Dry Material (gm)	151.2	a - Factor	0.99
Weight of Tare (gm)	95.01		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 200	92.83
Weight of Dry Material (gm)	51.19		
		Specific Gravity	2.7 Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 5/21/08 Checked By KB Date 5-23-08

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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R15096

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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Description	**BLACK LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

(Minus No. 40 sieve material, Airdried)

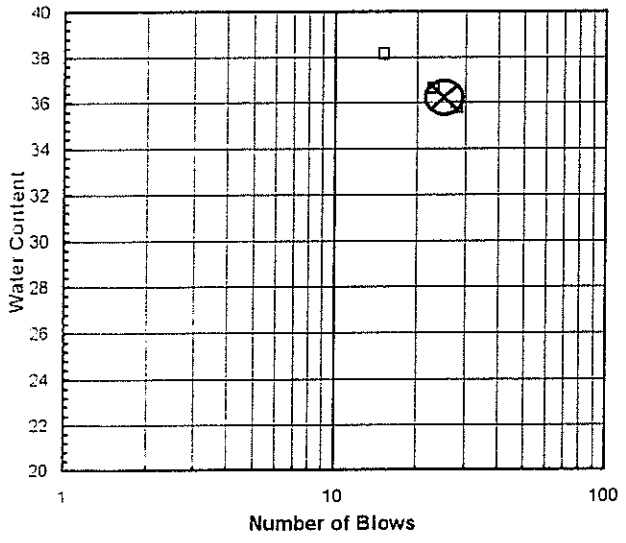
Liquid Limit Test	**1**	**2**	**3**	MULTIPOINT
Tare Number	110	37	40	
Wt. of Tare & WS (gm)	36.10	35.31	37.89	
Wt. of Tare & DS (gm)	30.53	29.82	31.72	
Wt. of Tare (gm)	14.96	14.83	15.54	
Wt. of Water (gm)	5.6	5.5	6.2	
Wt. of DS (gm)	15.6	15.0	16.2	
Moisture Content (%)	**35.8**	**36.6**	**38.1**	
Number of Blows	**28**	**23**	**15**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	134	267	
Wt. of Tare & WS (gm)	21.41	20.16	
Wt. of Tare & DS (gm)	20.44	19.10	
Wt. of Tare (gm)	15.29	13.36	
Wt. of Water (gm)	1.0	1.1	
Wt. of DS (gm)	5.2	5.7	
Moisture Content (%)	**18.8**	**18.5**	**0.4**

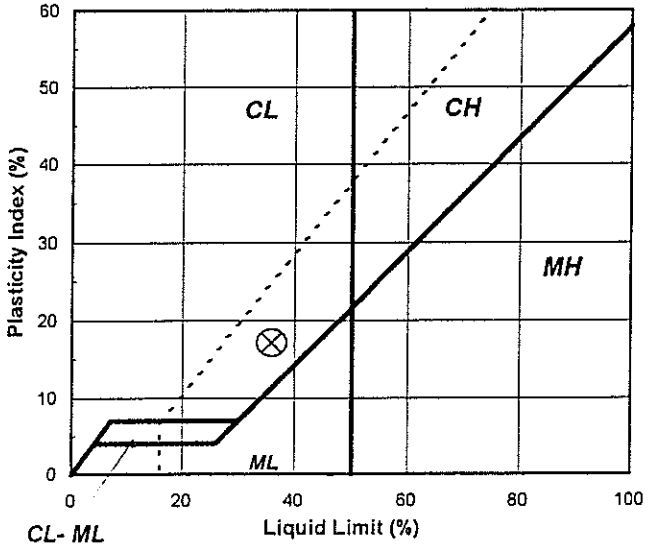
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**36**
Plastic Limit (%)	**19**
Plasticity Index (%)	**17**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart



Tested By TO *Date* 5/21/08 *Checked By* KB *Date* 5-23-08

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R15097

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SPECIFIC GRAVITY

ASTM D 854-02, AASHTO T100-03 (SOP - S5)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Visual Description	**BLACK SLUDGE** (Minus No.4 sieve material, airdried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1155	G 1156
Weight of Pycnometer + Soil + Water (gm)	737.55	736.34
Temperature, T (°Celsius)	26.4	25.5
Weight of Pycnometer + Water (gm)	682.36	681.04
Tare Number	674	2487
Weight of Tare + Dry Soil (gm)	199.03	195.46
Weight of Tare (gm)	99.26	95.76
Weight of Dry Soil (gm)	99.77	99.70
Specific Gravity of Soil @ T	2.238	2.246
Specific Gravity of Water @ T	0.9967	0.9969
Conversion Factor for Temperature T	0.9985	0.9987
Specific Gravity @ 20° Celsius	2.241	2.248

Average Specific Gravity @ 20° Celsius	2.24

Tested By TO *Date* 05/20/08 *Checked By* KB *Date* 5-23-08

DCN: CT-S5 Date 09/25/06 Revision: 12 *C:\MSOFFICE\EXCEL\PrintO\F157.xls]Sheet1*

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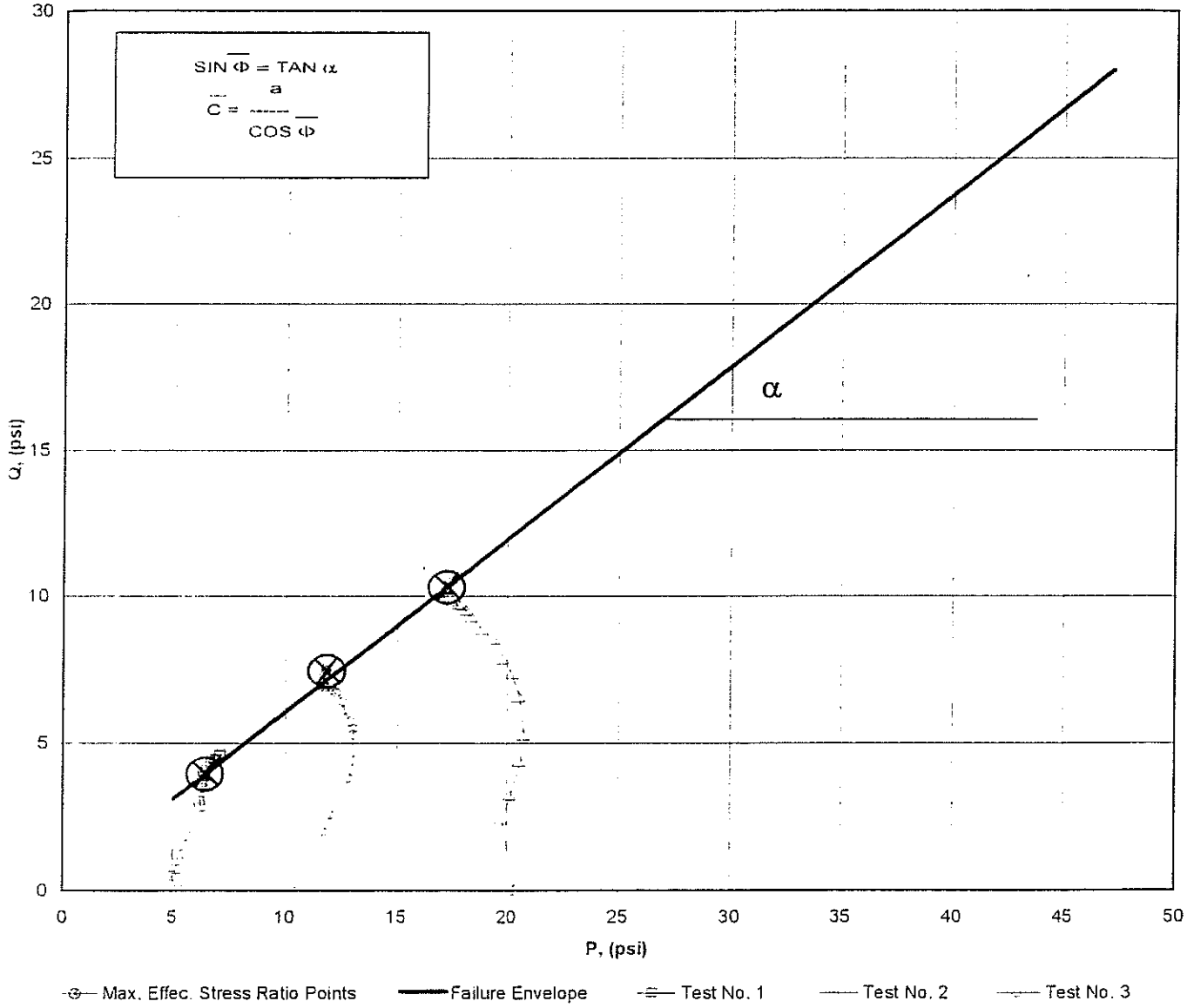
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\overline{C}$	=	0.00
α	=	30.5	$\overline{\Phi}$	=	36.14

Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

DCN CT-S28 DATE 6-25-98 REVISION 1

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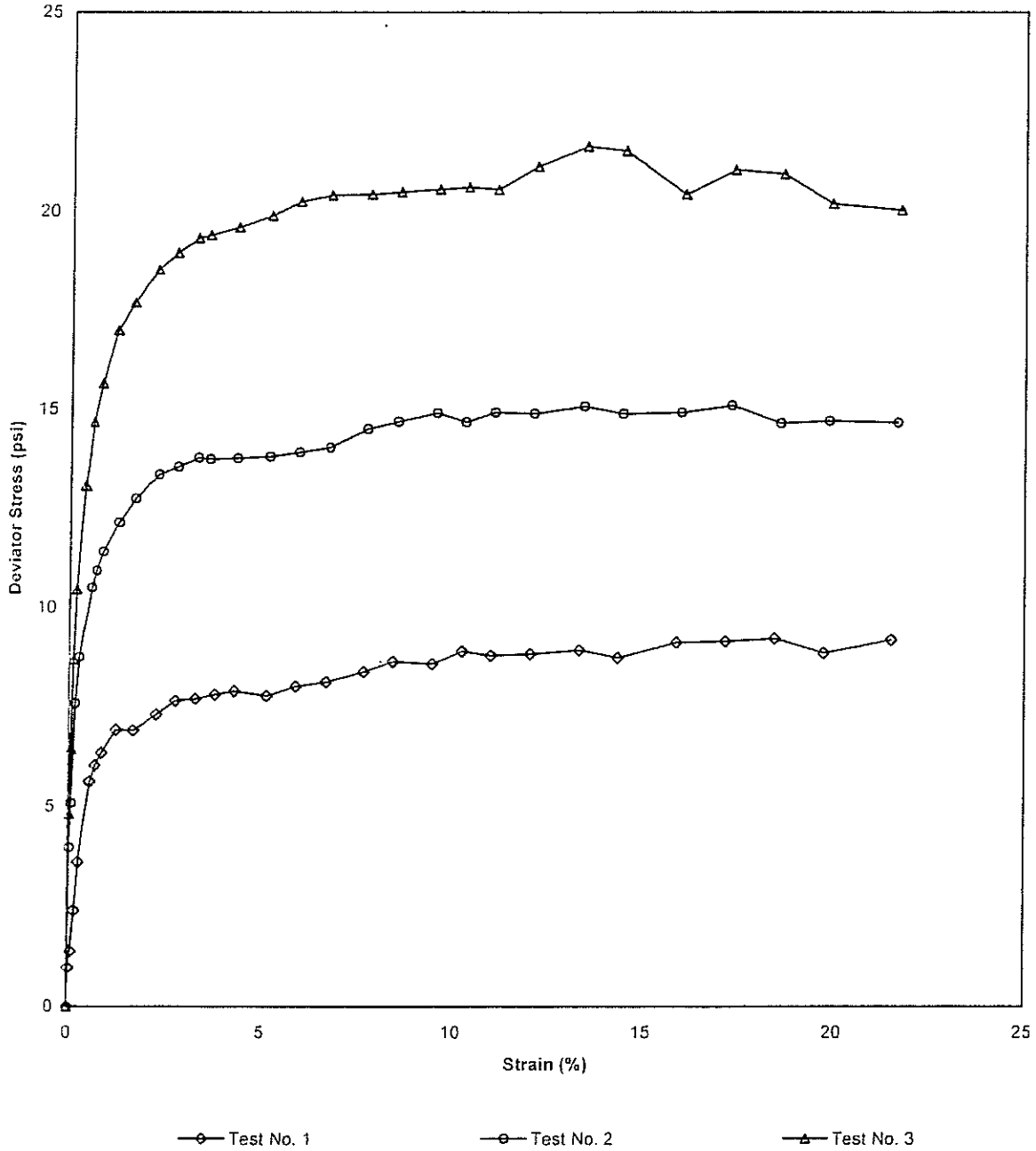
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		
Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	1

PRESSURES (psi)

Cell Pressure(psi)	36.6
Back Pressure(psi)	31.4
Eff. Cons. Pressure(psi)	5.2
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	6.41
Q	=	3.95

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.140	Diameter 1	1.375
Length 2	3.148	Diameter 2	1.389
Length 3	3.151	Diameter 3	1.399
Avg Leng.=	3.146	Avg. Diam.=	1.388

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.7
Final Change (ml)	2.3

Initial Dial Reading (D.R.), mils	235
D.R. After Saturation, mils	250
D.R. After Consolidation, mils	294

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.4
8.2	0.001	32.1
8.8	0.002	32.1
10.3	0.005	32.5
12.1	0.008	32.8
15.1	0.016	33.2
15.8	0.020	33.4
16.2	0.026	33.6
17.1	0.038	33.7
17.2	0.051	33.8
17.8	0.069	33.9
18.4	0.085	34.0
18.5	0.101	34.0
18.8	0.116	34.1
19.0	0.132	34.1
18.9	0.158	34.1
19.4	0.182	34.2
19.6	0.205	34.2
20.2	0.236	34.2
20.7	0.260	34.2
20.8	0.292	34.1
21.4	0.316	34.3
21.4	0.340	34.1
21.6	0.371	34.1
22.0	0.411	34.1
21.8	0.443	34.1
22.8	0.490	34.1
23.1	0.530	34.2
23.5	0.569	34.1
23.1	0.610	34.1
24.0	0.664	34.2

Tested By JCM Date 05/21/08 Input Checked By MB Date 6-19-08

DCN CT-328 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.2	*Stage No.*	1
		Test No	1

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.51
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.55
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.474

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	0.98	0.73	5.45	4.5	1.219	0.76	4.96	0.49
0.07	1.39	0.75	5.84	4.5	1.311	0.55	5.14	0.69
0.15	2.40	1.15	6.46	4.1	1.593	0.49	5.25	1.20
0.25	3.62	1.36	7.46	3.8	1.941	0.38	5.65	1.81
0.52	5.63	1.79	9.04	3.4	2.649	0.32	6.23	2.81
0.66	6.03	2.01	9.22	3.2	2.893	0.34	6.20	3.02
0.84	6.35	2.21	9.34	3.0	3.125	0.36	6.16	3.18
1.22	6.92	2.33	9.79	2.9	3.417	0.34	6.33	3.46
1.64	6.91	2.40	9.71	2.8	3.469	0.35	6.26	3.46
2.25	7.31	2.55	9.96	2.7	3.753	0.36	6.31	3.65
2.75	7.66	2.61	10.25	2.6	3.961	0.35	6.42	3.83
3.27	7.71	2.64	10.26	2.6	4.017	0.35	6.41	3.85
3.77	7.81	2.68	10.34	2.5	4.098	0.35	6.43	3.91
4.28	7.90	2.74	10.37	2.5	4.208	0.35	6.41	3.95
5.11	7.78	2.71	10.27	2.5	4.124	0.36	6.38	3.89
5.89	8.02	2.84	10.38	2.4	4.400	0.36	6.37	4.01
6.65	8.13	2.78	10.56	2.4	4.359	0.35	6.49	4.07
7.66	8.39	2.83	10.76	2.4	4.538	0.34	6.56	4.19
8.42	8.64	2.76	11.09	2.4	4.536	0.33	6.77	4.32
9.45	8.59	2.72	11.07	2.5	4.464	0.32	6.77	4.29
10.23	8.90	2.86	11.25	2.3	4.797	0.33	6.79	4.45
11.00	8.80	2.67	11.33	2.5	4.474	0.31	6.93	4.40
12.03	8.83	2.74	11.29	2.5	4.594	0.32	6.87	4.42
13.30	8.93	2.72	11.41	2.5	4.601	0.31	6.94	4.46
14.34	8.73	2.69	11.25	2.5	4.477	0.31	6.88	4.37
15.88	9.12	2.66	11.66	2.5	4.587	0.30	7.10	4.56
17.15	9.15	2.77	11.59	2.4	4.762	0.31	7.01	4.58
18.44	9.22	2.70	11.72	2.5	4.691	0.30	7.11	4.61
19.74	8.86	2.70	11.36	2.5	4.536	0.31	6.93	4.43
21.51	9.19	2.82	11.56	2.4	4.864	0.31	6.97	4.59

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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R15102

CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	2

PRESSURES (psi)

Cell Pressure(psi)	46.5
Back Pressure(psi)	36.1
Eff. Cons. Pressure(ps	10.4
Pore Pressure Response (%)	100

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	11.84
Q	=	7.45

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.120	Diameter 1	1.396
Length 2	3.137	Diameter 2	1.398
Length 3	3.135	Diameter 3	1.344
Avg Leng.=	3.131	Avg. Diam.=	1.379

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	18.4
Final Change (ml)	5.6

Initial Dial Reading (D.R.), mils	77
D.R. After Saturation, mils	112
D.R. After Consolidation, mils	166

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.9	0.000	36.1
13.4	0.001	36.8
14.9	0.002	37.0
18.3	0.005	37.4
20.0	0.008	37.8
22.4	0.017	38.7
23.0	0.020	38.9
23.7	0.026	39.3
24.8	0.038	39.9
25.7	0.051	40.3
26.7	0.069	40.9
27.1	0.085	41.1
27.5	0.100	41.3
27.5	0.110	41.5
27.7	0.131	41.6
27.9	0.157	41.8
28.2	0.181	41.9
28.6	0.204	41.9
29.5	0.235	42.0
30.0	0.259	42.1
30.5	0.290	42.1
30.4	0.313	42.0
31.0	0.337	42.1
31.2	0.368	42.0
31.8	0.408	42.2
31.8	0.439	42.1
32.3	0.486	42.1
33.0	0.526	42.2
32.6	0.565	42.1
33.1	0.604	42.2
33.6	0.659	42.2

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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R15103

CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.4	*Stage No.*	1
		Test No	2

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.49
Initial Sample Volume (in^3)	4.68

VOLUME CHANGE

Volume After Consolidation (in^3)	4.18
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma}_1$	$\overline{\sigma}_3$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.03	3.98	0.65	13.73	9.7	1.408	0.16	11.74	1.99
0.06	5.09	0.89	14.59	9.5	1.535	0.18	12.05	2.54
0.15	7.59	1.34	16.65	9.1	1.838	0.18	12.85	3.79
0.25	8.76	1.72	17.44	8.7	2.010	0.20	13.06	4.38
0.54	10.51	2.62	18.29	7.8	2.351	0.25	13.04	5.26
0.67	10.94	2.79	18.56	7.6	2.438	0.25	13.08	5.47
0.86	11.42	3.19	18.64	7.2	2.584	0.28	12.92	5.71
1.25	12.16	3.85	18.71	6.6	2.856	0.32	12.63	6.08
1.67	12.77	4.19	18.98	6.2	3.055	0.33	12.60	6.38
2.28	13.37	4.77	19.00	5.6	3.373	0.36	12.32	6.68
2.79	13.56	5.04	18.92	5.4	3.530	0.37	12.14	6.78
3.30	13.79	5.25	18.94	5.2	3.675	0.38	12.05	6.89
3.60	13.76	5.40	18.76	5.0	3.751	0.39	11.88	6.88
4.32	13.77	5.50	18.67	4.9	3.812	0.40	11.79	6.89
5.16	13.82	5.69	18.52	4.7	3.934	0.41	11.62	6.91
5.95	13.93	5.80	18.52	4.6	4.029	0.42	11.56	6.96
6.72	14.04	5.83	18.61	4.6	4.072	0.42	11.59	7.02
7.73	14.51	5.87	19.04	4.5	4.205	0.40	11.78	7.26
8.52	14.69	6.01	19.08	4.4	4.349	0.41	11.73	7.35
9.54	14.91	6.01	19.30	4.4	4.397	0.40	11.84	7.45
10.30	14.68	5.94	19.15	4.5	4.289	0.40	11.80	7.34
11.07	14.93	6.00	19.33	4.4	4.390	0.40	11.87	7.46
12.10	14.89	5.95	19.34	4.5	4.346	0.40	11.90	7.45
13.40	15.08	6.10	19.38	4.3	4.506	0.40	11.84	7.54
14.44	14.89	6.03	19.25	4.4	4.410	0.41	11.81	7.44
15.98	14.92	5.99	19.34	4.4	4.381	0.40	11.88	7.46
17.28	15.10	6.12	19.38	4.3	4.528	0.41	11.83	7.55
18.58	14.65	5.96	19.09	4.4	4.303	0.41	11.76	7.33
19.86	14.71	6.07	19.04	4.3	4.398	0.41	11.68	7.35
21.67	14.66	6.08	18.99	4.3	4.393	0.41	11.65	7.33

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No	1
Test No	3

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	20.4
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	17.19
Q	=	10.31

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.130	Diameter 1	1.404
Length 2	3.121	Diameter 2	1.373
Length 3	3.136	Diameter 3	1.371
Avg Leng.=	3.129	Avg. Diam.=	1.383

VOLUME CHANGE

Initial Burette Reading (ml)	48.0
Final Burette Reading (ml)	40.5
Final Change (ml)	7.5
Initial Dial Reading (D.R.), mils	60
D.R. After Saturation, mils	68
D.R. After Consolidation, mils	154

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.0
13.5	0.001	34.0
15.7	0.002	34.5
18.9	0.003	35.2
21.3	0.005	35.9
25.0	0.011	37.4
27.3	0.017	38.5
28.7	0.024	39.4
30.6	0.036	40.5
31.7	0.049	41.4
33.1	0.067	42.3
33.8	0.083	42.8
34.5	0.099	43.2
34.7	0.108	43.4
35.2	0.131	43.7
35.9	0.157	44.0
36.6	0.180	44.2
37.1	0.204	44.3
37.5	0.236	44.4
37.8	0.260	44.4
38.3	0.290	44.5
38.7	0.314	44.5
38.8	0.337	44.5
40.1	0.369	44.6
41.4	0.408	44.6
41.7	0.440	44.6
40.5	0.488	44.6
42.1	0.527	44.6
42.5	0.566	44.6
41.7	0.605	44.6
42.3	0.660	44.7

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.4	*Stage No.*	1
		Test No	3

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.20
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.385

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	4.82	3.04	22.17	17.4	1.278	0.64	19.76	2.41
0.05	6.44	3.45	23.39	16.9	1.380	0.54	20.17	3.22
0.10	8.70	4.15	24.95	16.2	1.536	0.48	20.60	4.35
0.17	10.46	4.86	26.01	15.5	1.673	0.47	20.77	5.23
0.37	13.09	6.38	27.10	14.0	1.934	0.49	20.56	6.54
0.58	14.68	7.49	27.59	12.9	2.137	0.52	20.25	7.34
0.80	15.66	8.40	27.66	12.0	2.305	0.54	19.83	7.83
1.18	17.01	9.52	27.89	10.9	2.563	0.57	19.38	8.50
1.61	17.71	10.40	27.71	10.0	2.772	0.59	18.85	8.86
2.22	18.54	11.31	27.63	9.1	3.039	0.62	18.36	9.27
2.74	18.96	11.76	27.60	8.6	3.196	0.63	18.12	9.48
3.26	19.34	12.21	27.53	8.2	3.361	0.64	17.86	9.67
3.57	19.40	12.35	27.45	8.0	3.411	0.64	17.75	9.70
4.31	19.60	12.73	27.27	7.7	3.556	0.66	17.47	9.80
5.17	19.89	12.96	27.33	7.4	3.676	0.66	17.38	9.95
5.94	20.25	13.15	27.50	7.2	3.795	0.66	17.37	10.13
6.73	20.42	13.27	27.54	7.1	3.864	0.66	17.34	10.21
7.78	20.44	13.38	27.46	7.0	3.912	0.66	17.24	10.22
8.55	20.50	13.40	27.50	7.0	3.928	0.66	17.25	10.25
9.57	20.57	13.48	27.49	6.9	3.973	0.66	17.20	10.28
10.34	20.62	13.52	27.50	6.9	3.995	0.66	17.19	10.31
11.11	20.56	13.51	27.45	6.9	3.982	0.66	17.17	10.28
12.15	21.14	13.55	27.99	6.8	4.088	0.65	17.42	10.57
13.45	21.64	13.57	28.47	6.8	4.170	0.63	17.65	10.82
14.49	21.53	13.56	28.36	6.8	4.149	0.64	17.60	10.76
16.07	20.44	13.58	27.26	6.8	3.997	0.67	17.04	10.22
17.35	21.06	13.58	27.88	6.8	4.086	0.65	17.35	10.53
18.64	20.95	13.63	27.72	6.8	4.094	0.66	17.25	10.48
19.92	20.20	13.64	26.96	6.8	3.988	0.68	16.86	10.10
21.74	20.03	13.67	26.77	6.7	3.975	0.69	16.75	10.02

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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MOHR TOTAL STRENGTH ENVELOPE

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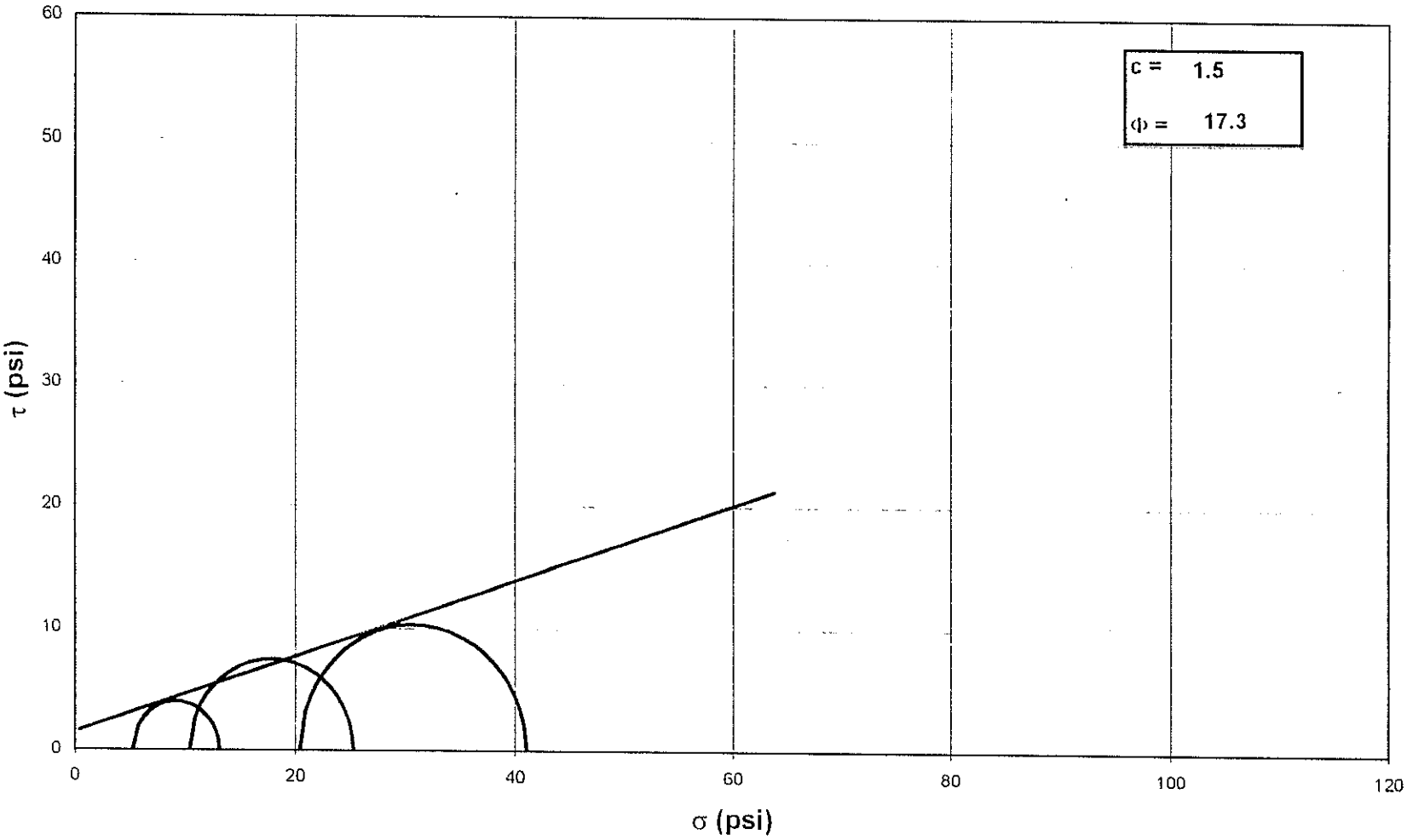
Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-0*	Sample No.	BUCKET 1
Lab ID	2008-210-0*-01	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/19/08

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R15106

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	82.6	82.7	79.5
Total Unit Weight (pcf)	76.6	84.2	80.5
Dry Unit Weight (pcf)	42.0	46.1	44.8
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	2.333	2.035	2.119

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	41.7	43.3	42.4
Total Unit Weight (pcf)	102.0	102.5	101.8
Dry Unit Weight (pcf)	71.9	71.5	71.5
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	0.944	0.955	0.956

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

DCN CT-S28 DATE 6-25-96 REVISION 1

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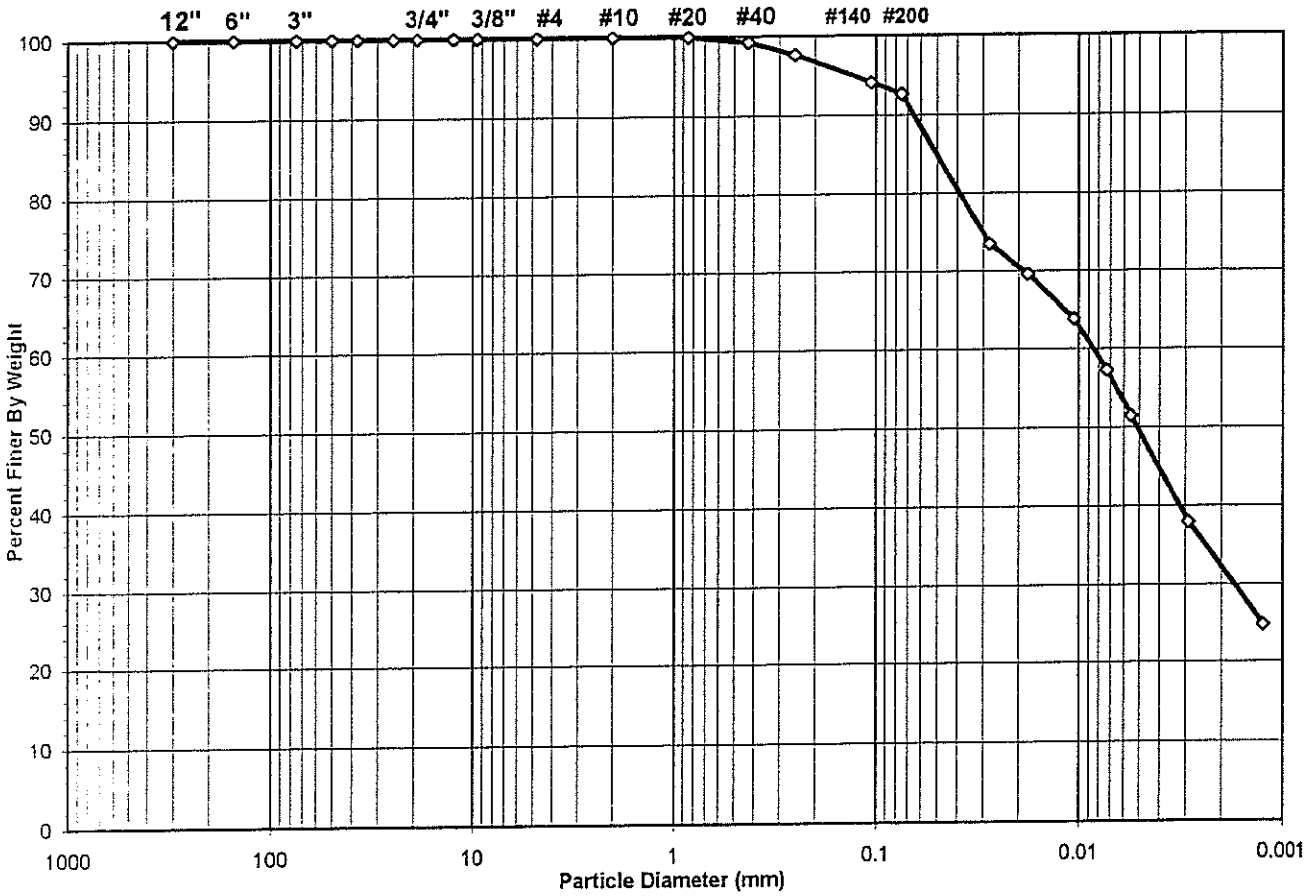
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Color	BLACK

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	7.38
Finer Than #200	*Silt & Clay*	92.62

USCS Symbol *CL, TESTED*

USCS Classification *LEAN CLAY*

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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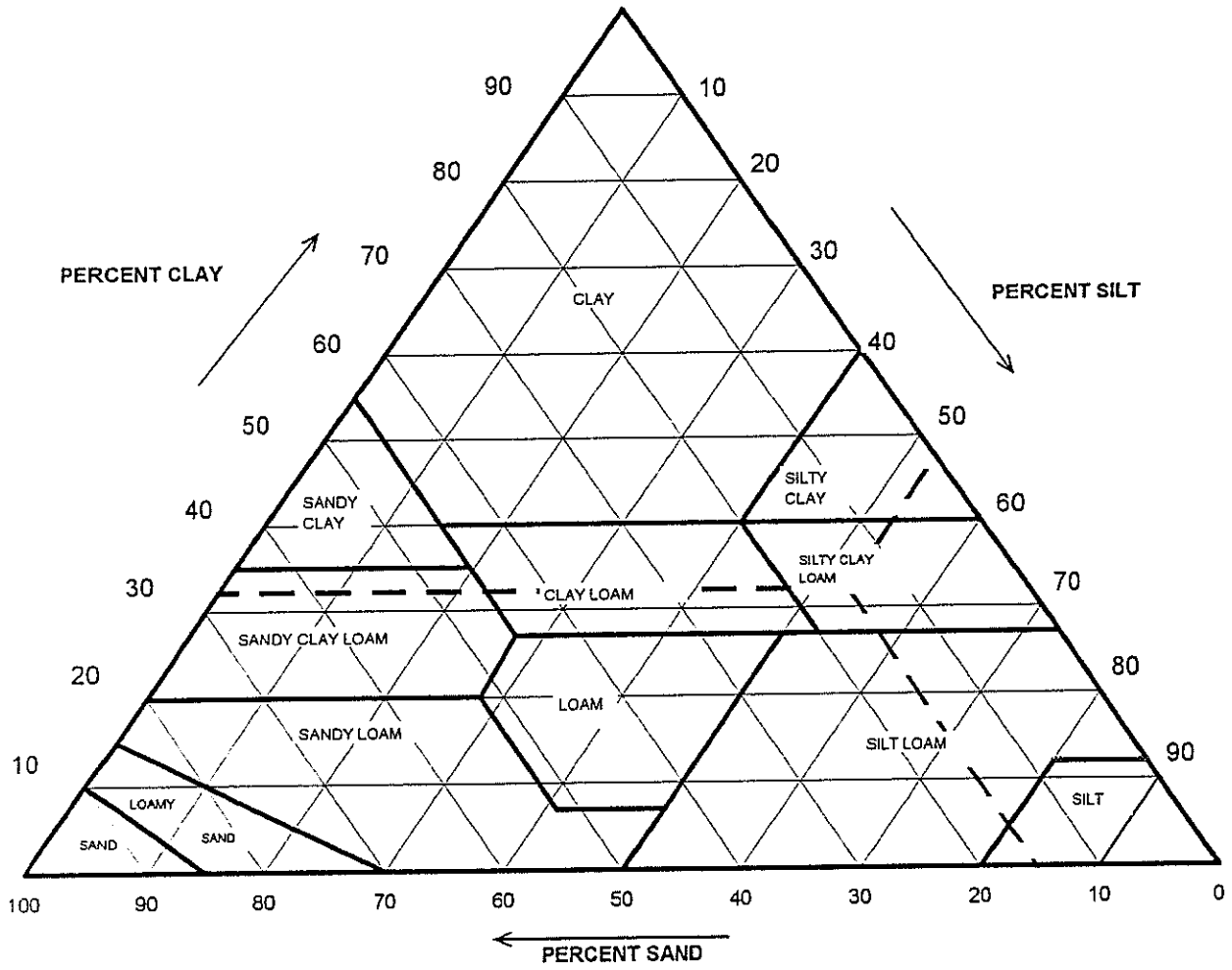
USDA CLASSIFICATION CHART

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Color	BLACK



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.00	**0.00**
2	100.00	*Sand*	15.22	**15.22**
0.05	84.78	*Silt*	52.64	**52.64**
0.002	32.14	*Clay*	32.14	**32.14**

USDA Classification: ***SILTY CLAY LOAM***

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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WASH SIEVE ANALYSIS

ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Color	**BLACK**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	517	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	1095.30	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	630.20	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	97.36	Weight of Tare (gm)	NA
Weight of Water (gm)	465.10	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	532.84	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**87.3**	**Moisture Content (%)**	NA

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	532.84
Dry Weight - 3/4" Sample (gm)	39.31	Weight of minus #200 material (gm)	493.53
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	39.31
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated **Percent Finer** (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.00	0.00	0.00	100.00	**100.00**
#20	0.85	0.13	0.02	0.02	99.98	**99.98**
#40	0.425	3.63	0.68	0.71	99.29	**99.29**
#60	0.250	8.79	1.65	2.36	97.64	**97.64**
#140	0.106	19.00	3.57	5.92	94.08	**94.08**
#200	0.075	7.76	1.46	7.38	92.62	**92.62**
Pan	-	493.53	92.62	100.00	-	-

Tested By JP Date 5/21/08 Checked By KB Date 5-23-08

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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INTEGRITY IN TESTING

HYDROMETER ANALYSIS

ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Color	**BLACK**

Elapsed Time (min)	R Measured	Temp. (° C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	44.5	21.9	6.02	38.5	79.3	0.01314	0.0279	**73.5**
5	42.5	21.9	6.02	36.5	75.2	0.01314	0.0180	**69.7**
15	39.5	21.9	6.02	33.5	69.0	0.01314	0.0106	**63.9**
34	36.0	21.9	6.02	30.0	61.8	0.01314	0.0073	**57.2**
62	33.0	21.8	6.07	26.9	55.5	0.01316	0.0055	**51.4**
250	26.0	21.7	6.11	19.9	41.0	0.01317	0.0029	**38.0**
1440	19.0	21.9	6.02	13.0	26.8	0.01314	0.0013	**24.8**

Soil Specimen Data		Other Corrections	
Tare No.	2343		
Tare + Dry Material (gm)	151.6	a - Factor	0.99
Weight of Tare (gm)	98.58		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 200	92.62
Weight of Dry Material (gm)	48.02		
		Specific Gravity	2.7 Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 5/21/08 Checked By KB Date 5-23-08

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Description	**BLACK LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

(Minus No. 40 sieve material, Airdried)

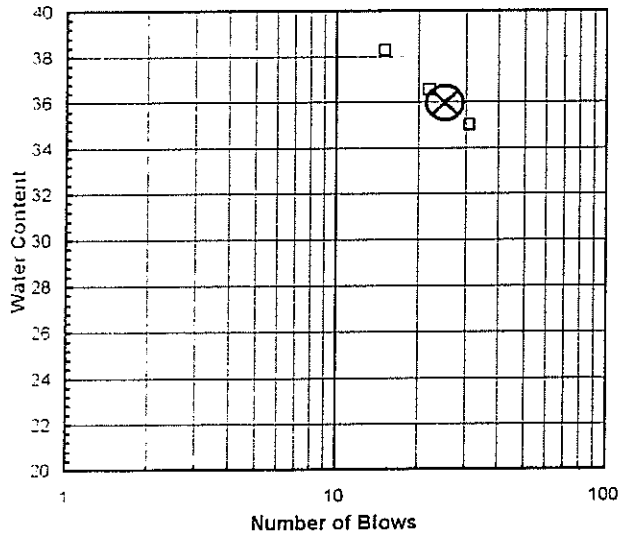
Liquid Limit Test	**1**	**2**	**3**	MULTIPOINT
Tare Number	250	20	284	
Wt. of Tare & WS (gm)	37.67	39.66	39.57	
Wt. of Tare & DS (gm)	32.45	34.22	33.70	
Wt. of Tare (gm)	17.54	19.33	18.37	
Wt. of Water (gm)	5.2	5.4	5.9	
Wt. of DS (gm)	14.9	14.9	15.3	
Moisture Content (%)	**35.0**	**36.5**	**38.3**	
Number of Blows	**31**	**22**	**15**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	43	274	
Wt. of Tare & WS (gm)	25.49	26.20	
Wt. of Tare & DS (gm)	24.45	25.21	
Wt. of Tare (gm)	19.03	19.96	
Wt. of Water (gm)	1.0	1.0	
Wt. of DS (gm)	5.4	5.3	
Moisture Content (%)	**19.2**	**18.9**	**0.3**

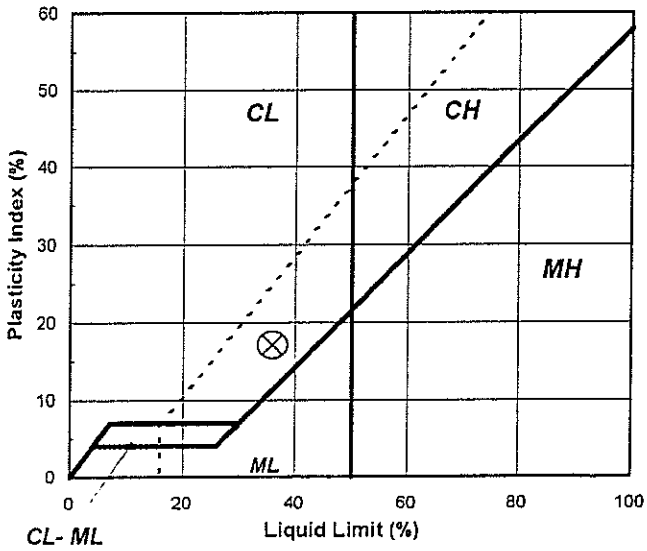
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**36**
Plastic Limit (%)	**19**
Plasticity Index (%)	**17**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart



CL- ML

Tested By TO *Date* 5/21/08 *Checked By* AR *Date* 5-23-08

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SPECIFIC GRAVITY

ASTM D 854-02, AASHTO T100-03 (SOP - S5)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Visual Description	**BLACK SLUDGE** (Minus No.4 sieve material, airdried)

Replicate Number	1	2
Pycnometer ID	G 1155	G 1156
Weight of Pycnometer + Soil + Water (gm)	738.67	736.62
Temperature, T (°Celsius)	23.6	22.8
Weight of Pycnometer + Water (gm)	682.72	681.37
Tare Number	932	966
Weight of Tare + Dry Soil (gm)	203.65	202.41
Weight of Tare (gm)	102.67	102.57
Weight of Dry Soil (gm)	100.98	99.84
Specific Gravity of Soil @ T	2.242	2.239
Specific Gravity of Water @ T	0.9974	0.9976
Conversion Factor for Temperature T	0.9992	0.9994
Specific Gravity @ 20° Celsius	2.244	2.240

Average Specific Gravity @ 20° Celsius	2.24

Tested By TO *Date* 05/20/08 *Checked By* KB *Date* 5-23-08

DCN: CT-S5 Date 09/25/06 Revision: 12

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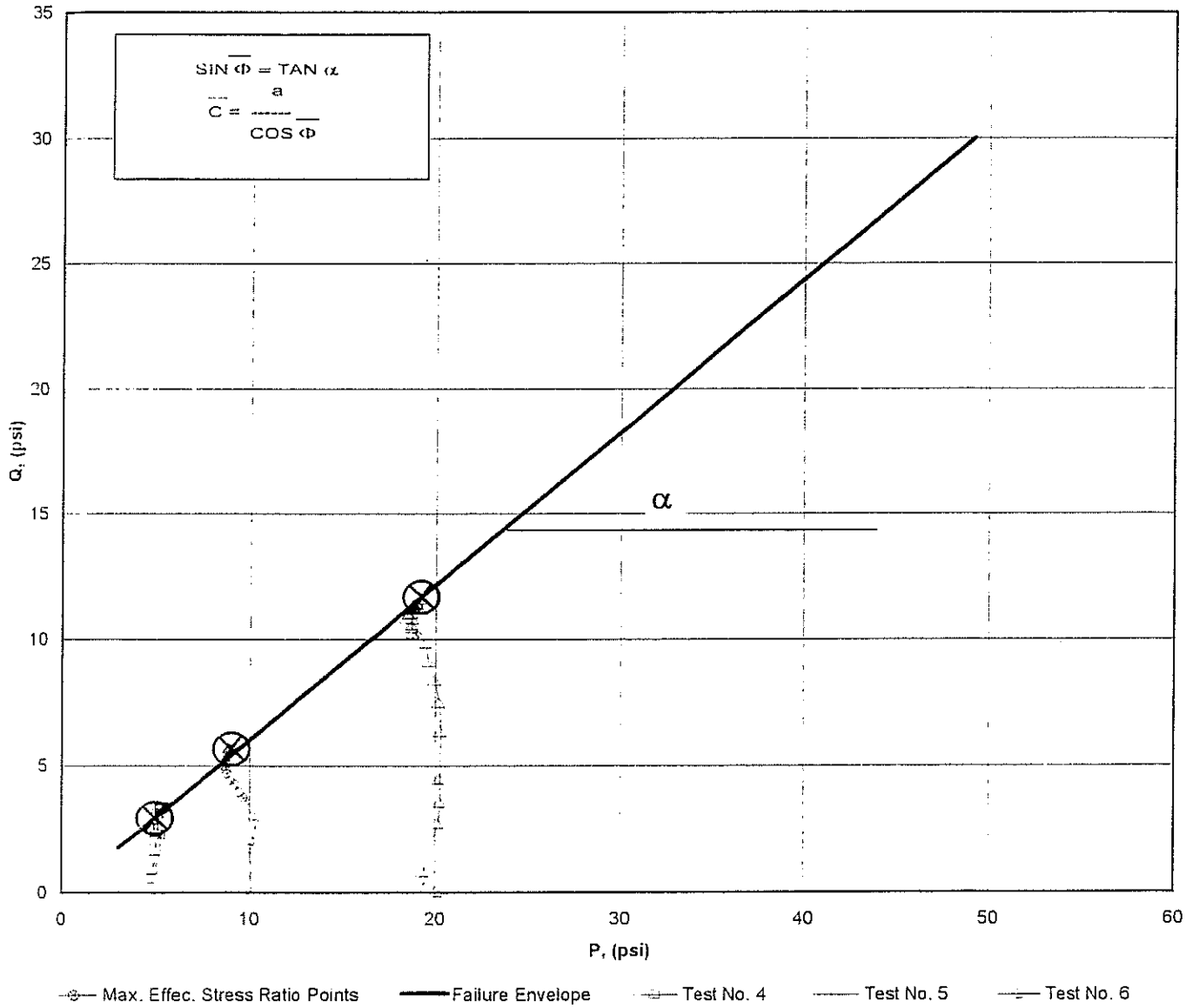
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\overline{C}$	=	0.00
α	=	31.5	$\overline{\Phi}$	=	37.71

Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

DCN CT-S28 DATE 6-25-98 REVISION 1

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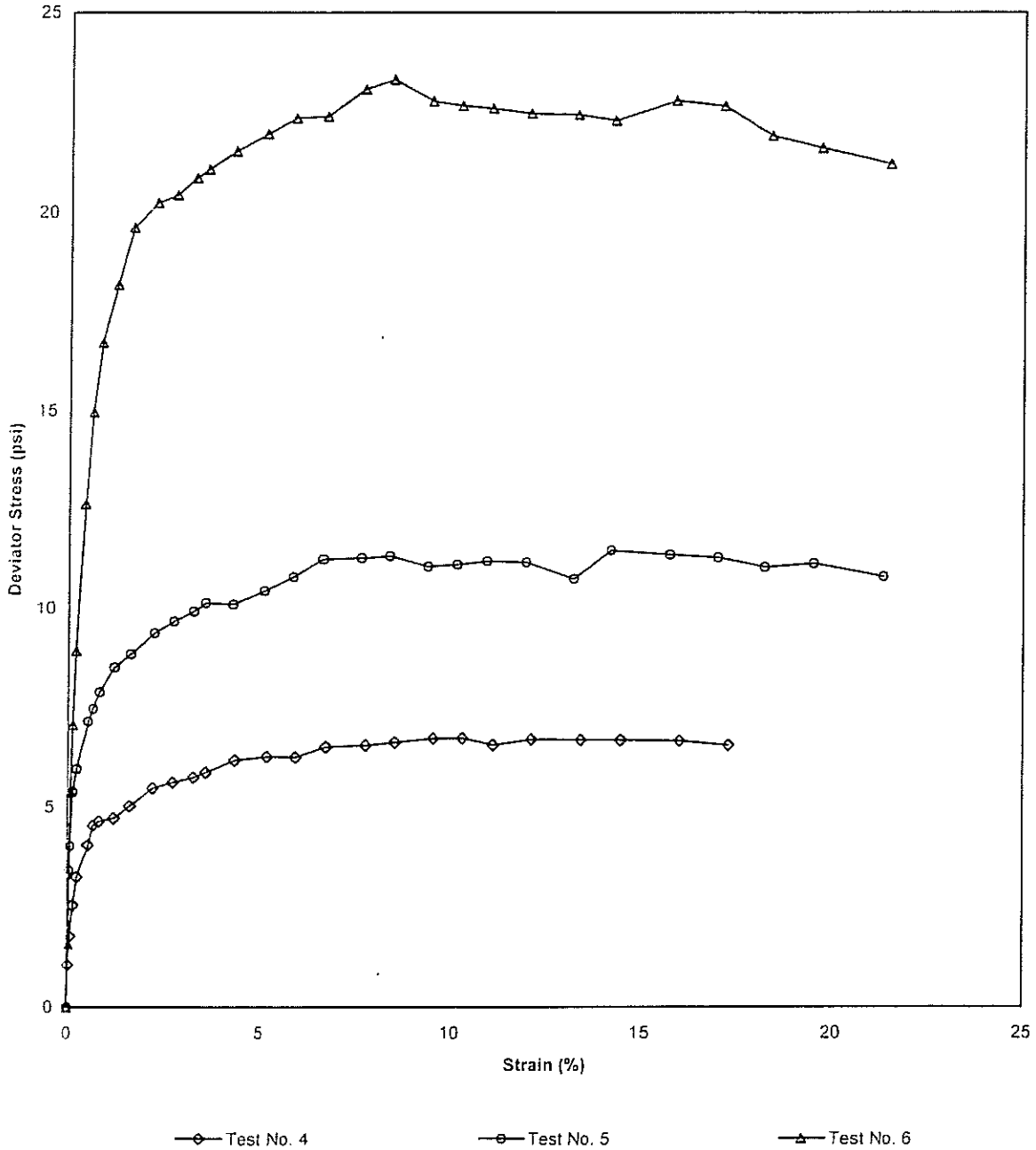
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	4

PRESSURES (psi)

Cell Pressure(psi)	36.3
Back Pressure(psi)	31.2
Eff. Cons. Pressure(psi)	5.1
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	4.92
Q	=	2.94

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.150	Diameter 1	1.453
Length 2	3.142	Diameter 2	1.463
Length 3	3.147	Diameter 3	1.461
Avg Leng.=	3.146	Avg. Diam.=	1.459

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.9
Final Change (ml)	2.1

Initial Dial Reading (D.R.), mils	54
D.R. After Saturation, mils	110
D.R. After Consolidation, mils	130

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.6	0.000	31.2
9.3	0.001	32.1
10.4	0.002	32.3
11.6	0.005	32.6
12.8	0.008	32.9
14.0	0.016	33.3
14.8	0.020	33.3
15.0	0.025	33.6
15.2	0.037	33.8
15.7	0.050	33.9
16.5	0.068	34.2
16.7	0.084	34.2
17.0	0.100	34.2
17.2	0.110	34.3
17.8	0.133	34.2
18.1	0.159	34.3
18.1	0.182	34.3
18.6	0.205	34.2
18.8	0.237	34.2
19.0	0.261	34.3
19.3	0.293	34.3
19.5	0.316	34.2
19.3	0.340	34.3
19.7	0.372	34.2
19.8	0.412	34.3
19.9	0.445	34.3
20.1	0.491	34.2
20.1	0.531	34.2

Tested By JCM Date 05/27/08 Input Checked By MB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.1	*Stage No.*	1
		Test No	4

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.46
Initial Sample Area (in^2)	1.67
Initial Sample Volume (in^3)	5.26

VOLUME CHANGE

Volume After Consolidation (in^3)	4.85
Length After Consolidation (in)	3.07
Area After Consolidation (in^2)	1.580

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	1.06	0.90	5.26	4.2	1.253	0.86	4.73	0.53
0.07	1.77	1.15	5.72	4.0	1.449	0.66	4.84	0.89
0.15	2.55	1.44	6.21	3.7	1.698	0.58	4.94	1.28
0.25	3.26	1.71	6.65	3.4	1.959	0.53	5.02	1.63
0.53	4.05	2.11	7.04	3.0	2.358	0.53	5.01	2.03
0.65	4.54	2.14	7.50	3.0	2.531	0.48	5.23	2.27
0.82	4.65	2.39	7.36	2.7	2.712	0.52	5.04	2.32
1.21	4.72	2.58	7.25	2.5	2.873	0.56	4.89	2.36
1.62	5.03	2.72	7.42	2.4	3.112	0.55	4.90	2.52
2.22	5.48	2.95	7.63	2.1	3.550	0.55	4.89	2.74
2.74	5.62	3.02	7.70	2.1	3.705	0.55	4.89	2.81
3.27	5.75	3.04	7.81	2.1	3.790	0.54	4.93	2.87
3.59	5.88	3.12	7.86	2.0	3.968	0.54	4.92	2.94
4.33	6.18	3.02	8.27	2.1	3.967	0.50	5.17	3.09
5.17	6.27	3.08	8.30	2.0	4.101	0.50	5.16	3.14
5.93	6.25	3.13	8.22	2.0	4.176	0.51	5.10	3.13
6.69	6.51	3.03	8.58	2.1	4.152	0.48	5.32	3.26
7.73	6.56	3.04	8.62	2.1	4.176	0.47	5.34	3.28
8.50	6.63	3.14	8.59	2.0	4.380	0.48	5.27	3.31
9.53	6.72	3.14	8.68	2.0	4.436	0.48	5.32	3.36
10.30	6.74	3.03	8.81	2.1	4.256	0.46	5.44	3.37
11.09	6.56	3.07	8.59	2.0	4.235	0.48	5.31	3.28
12.10	6.71	3.03	8.78	2.1	4.233	0.46	5.43	3.35
13.42	6.69	3.06	8.74	2.0	4.281	0.47	5.39	3.35
14.49	6.68	3.10	8.68	2.0	4.342	0.47	5.34	3.34
16.00	6.66	3.02	8.74	2.1	4.204	0.46	5.41	3.33
17.29	6.55	3.03	8.62	2.1	4.171	0.47	5.34	3.28

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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R15119

CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	5

PRESSURES (psi)

Cell Pressure(psi)	41.1
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	10.1
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	9.00
Q	=	5.66

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.138	Diameter 1	1.407
Length 2	3.138	Diameter 2	1.383
Length 3	3.137	Diameter 3	1.378
Avg Leng.=	3.138	Avg. Diam.=	1.389

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	20.2
Final Change (ml)	3.8

Initial Dial Reading (D.R.), mils	88
D.R. After Saturation, mils	94
D.R. After Consolidation, mils	124

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
8.5	0.000	31.0
13.5	0.001	32.8
14.3	0.002	33.0
16.3	0.004	33.4
17.2	0.007	33.9
18.9	0.016	34.9
19.4	0.020	35.2
20.0	0.025	35.6
21.0	0.038	36.1
21.5	0.051	36.6
22.4	0.070	37.0
22.9	0.085	37.2
23.4	0.101	37.4
23.7	0.110	37.4
23.8	0.132	37.5
24.5	0.158	37.6
25.1	0.181	37.7
26.0	0.205	37.7
26.2	0.236	37.7
26.4	0.259	37.8
26.2	0.290	37.7
26.4	0.314	37.8
26.7	0.338	37.8
26.9	0.370	37.8
26.5	0.410	37.8
27.9	0.441	37.8
28.0	0.488	37.8
28.2	0.527	37.8
28.1	0.566	37.8
28.5	0.605	37.8
28.4	0.661	37.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.1	*Stage No.*	1
		Test No	5

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.52
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.50
Length After Consolidation (in)	3.10
Area After Consolidation (in^2)	1.450

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	3.42	1.75	11.77	8.3	1.410	0.52	10.06	1.71
0.06	4.03	2.01	12.12	8.1	1.497	0.50	10.11	2.01
0.13	5.39	2.43	13.05	7.7	1.703	0.46	10.36	2.69
0.23	5.96	2.92	13.13	7.2	1.830	0.50	10.16	2.98
0.51	7.15	3.87	13.37	6.2	2.148	0.55	9.80	3.57
0.64	7.46	4.19	13.37	5.9	2.262	0.57	9.64	3.73
0.82	7.88	4.57	13.41	5.5	2.427	0.59	9.47	3.94
1.21	8.51	5.13	13.48	5.0	2.714	0.61	9.22	4.26
1.63	8.84	5.57	13.38	4.5	2.950	0.64	8.96	4.42
2.24	9.37	5.97	13.50	4.1	3.271	0.64	8.81	4.69
2.75	9.67	6.18	13.59	3.9	3.468	0.65	8.75	4.84
3.25	9.92	6.35	13.66	3.7	3.648	0.65	8.70	4.96
3.56	10.14	6.40	13.83	3.7	3.741	0.64	8.76	5.07
4.26	10.10	6.55	13.65	3.6	3.843	0.66	8.60	5.05
5.08	10.44	6.59	13.95	3.5	3.978	0.64	8.73	5.22
5.85	10.80	6.68	14.21	3.4	4.161	0.63	8.81	5.40
6.60	11.25	6.70	14.65	3.4	4.304	0.60	9.03	5.62
7.60	11.27	6.75	14.63	3.4	4.363	0.60	8.99	5.64
8.34	11.32	6.76	14.66	3.3	4.395	0.60	9.00	5.66
9.36	11.06	6.74	14.42	3.4	4.292	0.62	8.89	5.53
10.13	11.11	6.76	14.46	3.3	4.323	0.61	8.90	5.56
10.91	11.20	6.81	14.49	3.3	4.401	0.61	8.89	5.60
11.94	11.17	6.80	14.47	3.3	4.383	0.62	8.88	5.58
13.21	10.75	6.76	14.09	3.3	4.214	0.64	8.72	5.37
14.21	11.47	6.77	14.80	3.3	4.445	0.60	9.06	5.73
15.72	11.35	6.78	14.67	3.3	4.418	0.60	9.00	5.68
16.98	11.28	6.79	14.59	3.3	4.411	0.61	8.95	5.64
18.25	11.04	6.80	14.33	3.3	4.350	0.62	8.81	5.52
19.51	11.13	6.82	14.40	3.3	4.397	0.62	8.84	5.56
21.32	10.80	6.85	14.05	3.3	4.318	0.64	8.65	5.40

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	6

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.3
Eff. Cons. Pressure(ps	20.1
Pore Pressure Response (%)	97

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	19.19
Q	=	11.67

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.142	Diameter 1	1.379
Length 2	3.130	Diameter 2	1.377
Length 3	3.141	Diameter 3	1.386
Avg Leng.=	3.138	Avg. Diam.=	1.381

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	17.7
Final Change (ml)	6.3

Initial Dial Reading (D.R.), mils	40
D.R. After Saturation, mils	56
D.R. After Consolidation, mils	91

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
4.3	0.000	31.3
6.5	0.001	32.8
11.7	0.002	33.9
14.0	0.004	34.7
16.6	0.006	35.6
21.7	0.012	37.4
25.0	0.019	38.7
27.5	0.026	39.8
29.6	0.038	40.9
31.7	0.051	41.7
32.8	0.070	42.4
33.2	0.085	42.8
33.9	0.101	43.1
34.3	0.110	43.2
35.2	0.132	43.4
36.1	0.157	43.7
37.0	0.181	43.7
37.3	0.205	43.8
38.7	0.236	43.8
39.3	0.259	43.9
38.9	0.291	43.8
39.0	0.316	43.9
39.2	0.340	43.9
39.4	0.371	43.8
39.9	0.410	43.8
40.1	0.441	43.9
41.5	0.489	43.8
41.9	0.528	43.7
41.2	0.568	43.8
41.3	0.608	43.8
41.4	0.663	43.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.1	*Stage No.*	1
		Test No	6

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.24
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma}_1$	$\overline{\sigma}_3$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	1.58	1.52	20.16	18.6	1.085	0.99	19.37	0.79
0.07	5.38	2.62	22.86	17.5	1.308	0.50	20.17	2.69
0.12	7.06	3.36	23.80	16.7	1.422	0.49	20.27	3.53
0.19	8.92	4.30	24.73	15.8	1.565	0.50	20.26	4.46
0.40	12.65	6.12	26.62	14.0	1.905	0.50	20.30	6.32
0.61	14.97	7.35	27.72	12.7	2.174	0.51	20.23	7.48
0.85	16.72	8.47	28.36	11.6	2.438	0.52	19.99	8.36
1.24	18.18	9.56	28.72	10.5	2.724	0.54	19.63	9.09
1.64	19.63	10.41	29.32	9.7	3.025	0.55	19.51	9.81
2.26	20.24	11.15	29.19	9.0	3.262	0.57	19.07	10.12
2.77	20.44	11.54	29.00	8.6	3.388	0.58	18.78	10.22
3.26	20.87	11.82	29.15	8.3	3.521	0.58	18.71	10.43
3.58	21.09	11.94	29.25	8.2	3.584	0.58	18.70	10.54
4.27	21.54	12.14	29.50	8.0	3.705	0.58	18.73	10.77
5.09	21.97	12.38	29.69	7.7	3.846	0.58	18.71	10.99
5.86	22.37	12.43	30.04	7.7	3.918	0.57	18.85	11.19
6.64	22.41	12.54	29.98	7.6	3.962	0.58	18.77	11.21
7.63	23.10	12.49	30.71	7.6	4.034	0.56	19.16	11.55
8.39	23.33	12.58	30.85	7.5	4.102	0.56	19.19	11.67
9.43	22.79	12.55	30.34	7.6	4.018	0.57	18.95	11.39
10.22	22.67	12.59	30.18	7.5	4.021	0.57	18.84	11.34
11.00	22.61	12.56	30.14	7.5	4.001	0.57	18.84	11.30
12.01	22.49	12.53	30.05	7.6	3.973	0.57	18.81	11.24
13.28	22.46	12.52	30.04	7.6	3.961	0.57	18.81	11.23
14.28	22.30	12.63	29.77	7.5	3.986	0.58	18.62	11.15
15.84	22.80	12.50	30.40	7.6	4.001	0.57	19.00	11.40
17.12	22.66	12.41	30.35	7.7	3.948	0.56	19.02	11.33
18.40	21.92	12.46	29.57	7.6	3.868	0.59	18.61	10.96
19.69	21.62	12.51	29.21	7.6	3.846	0.60	18.40	10.81
21.49	21.21	12.54	28.77	7.6	3.805	0.61	18.17	10.61

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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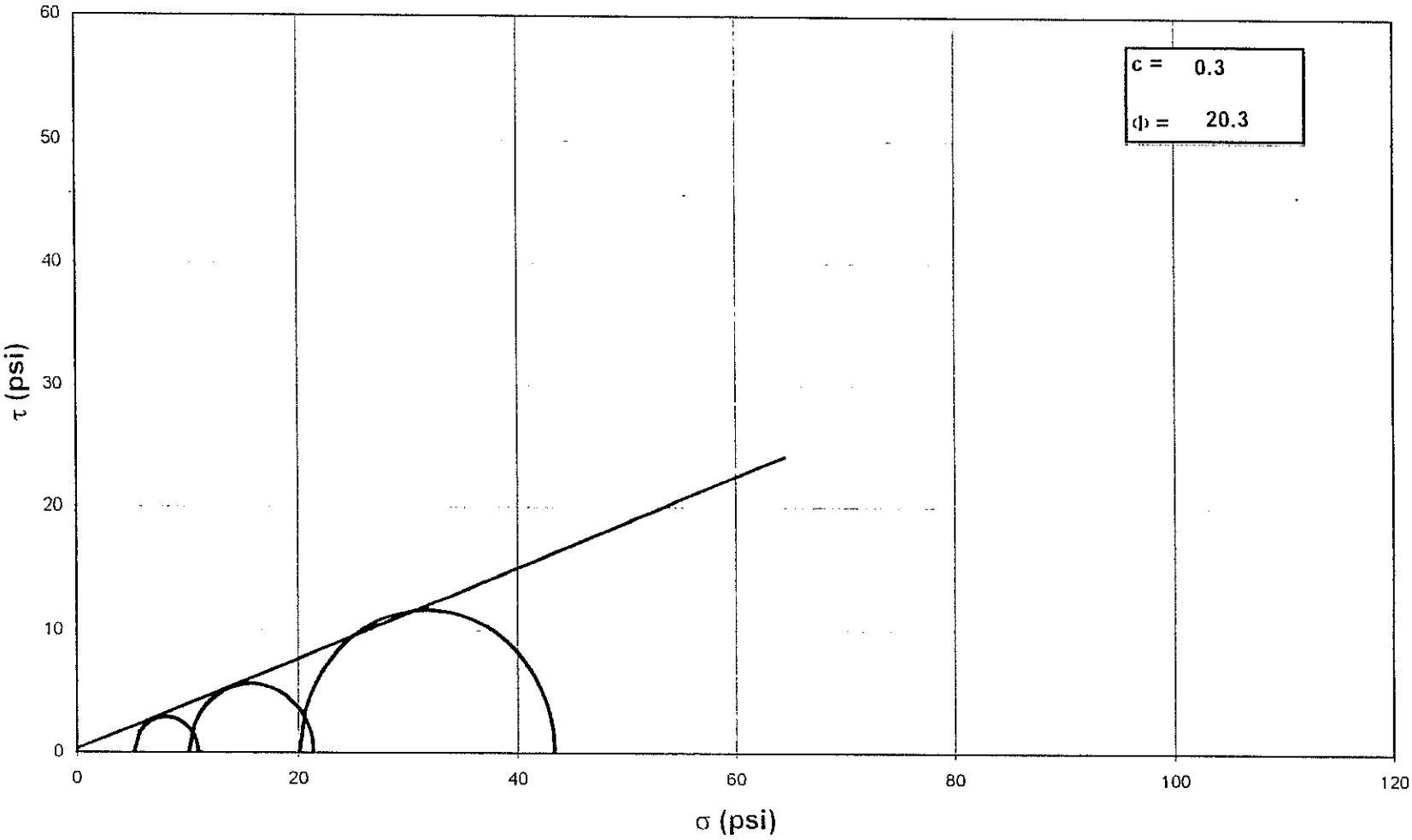
MOHR TOTAL STRENGTH ENVELOPE

Geotechnics

Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/19/08

#N/A

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R15123

geotechnics
INTEGRITY IN TESTING

REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	82.9	85.7	83.0
Total Unit Weight (pcf)	82.6	82.2	84.5
Dry Unit Weight (pcf)	45.2	44.3	46.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	2.095	2.159	2.029

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-5-08

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Geotechnics
INTEGRITY IN TESTING

UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	41.5	41.5	40.9
Total Unit Weight (pcf)	92.9	102.5	103.2
Dry Unit Weight (pcf)	65.7	72.4	73.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	1.129	0.931	0.910

Tested By JCM Date 05/27/08 Input Checked By Date

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ATTACHMENT A-2

LABORATORY TESTING RESULTS – COARSE REFUSE AND RESIDUAL SOILS PROVIDED BY ALLIANCE CONSULTING, INC.

APPENDIX C

LABORATORY TESTING
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY, LLC
BECKLEY, WEST VIRGINIA

TABLE OF CONTENTS

	PAGE
SOIL TESTING	
Summary	1
Strength Test	3
Grain Size	10
Atterberg Limits Test Results	12
COARSE COAL REFUSE TESTING	
Summary	13
Grain Size	15
Proctor Test	17
Permeability Test	18
Strength Test	20

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

SHIPPING ADDRESS
Box 393 Wood Road
Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

February 10, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Soil Boring and Laboratory Tests
Boring #8874
Mach Mine #1
Johnston City, Illinois
HFE File H-05278
Mach Mining Purchase Order No. _____

Dear Sir:

In accordance with your instructions, on February 1, 2006, we drilled one soil boring and sampled the subsoils with Shelby tubes. The soil sample taken from 10 to 12 feet in depth was subjected to laboratory tests. Results of the tests are as follows:

Boring No.:	8874
Depth:	8.0-10.0'
Visual Classification:	Silty CLAY (CL)
Atterberg Limits:	LL = 41.8% PL = 17.7% PI = 24.1
Unit Weight:	105.3 PCF
Moisture Content:	21.5%
Effective Cohesion:	0 PSF
Effective Phi Angle:	26.8 Degrees

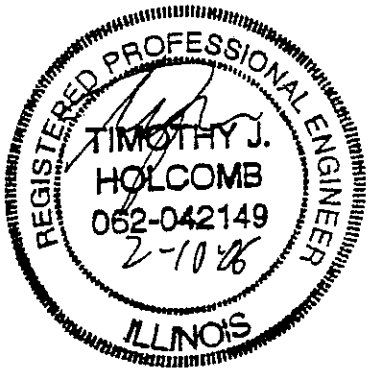
All Tubes From Boring 8874

The Boring Log and test results are enclosed. If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

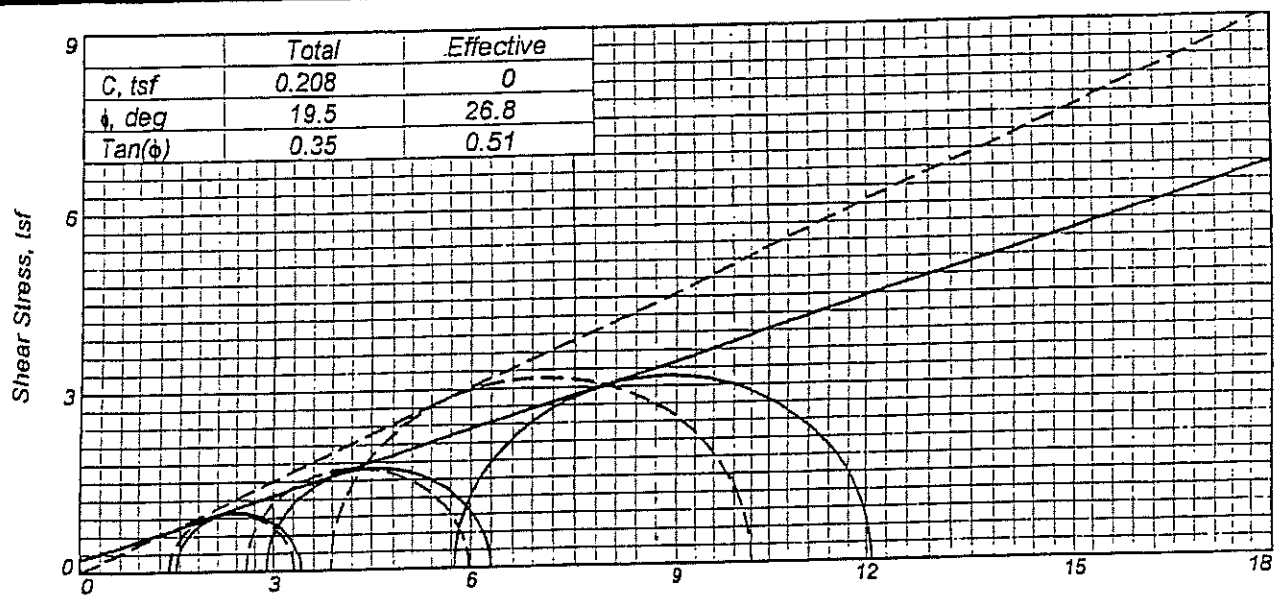
Sincerely,

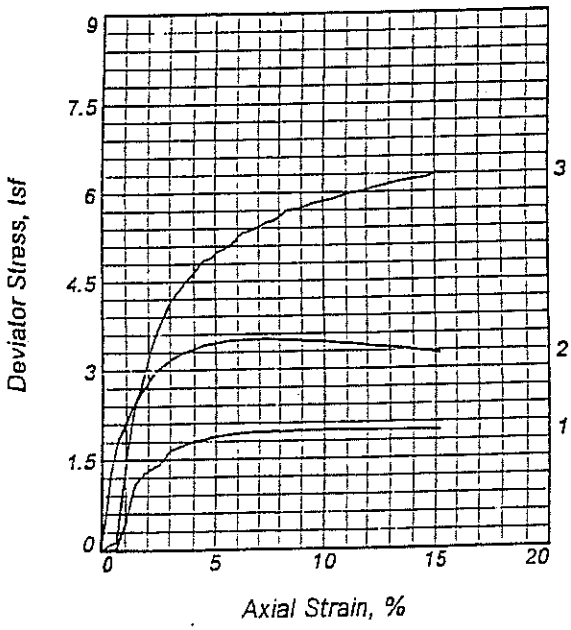
HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.



1 copy: Fred Vass - Alliance Consulting





Sample No.		1	2	3
Initial	Water Content,	21.5	20.8	17.6
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	99.7	98.9
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
At Test	Water Content,	21.5	20.9	17.8
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.6	3.6	2.2
Cell Pressure, tsf		5.0	6.5	7.9
Fail. Stress, tsf		2.0	3.4	6.3
Total Pore Pr., tsf		3.7	3.9	4.1
Ult. Stress, tsf		2.0	3.2	6.3
Total Pore Pr., tsf		3.6	3.8	4.1
$\bar{\sigma}_1$ Failure, tsf		3.3	6.0	10.2
$\bar{\sigma}_3$ Failure, tsf		1.3	2.6	3.9

Type of Test:
CU with Pore Pressures
Sample Type: Shelby Tube - Undisturbed
Description: Gray Mottled Brown Silty CLAY

LL= 41.8 PL= 17.7 PI= 24.1
Assumed Specific Gravity= 2.65
Remarks:

Client: Alliance Consulting

Project: Triaxial Test
Mach Mine #1
Location: Boring #8874
Sample Number: 3 **Depth:** 10.0-12.0'
Proj. No.: H-05278 **Date:** 2-1-05

TRIAXIAL SHEAR TEST REPORT

HOLCOMB FOUNDATION ENGINEERING CO.

Plate _____

Tested By: LC Checked By: TH

R15131

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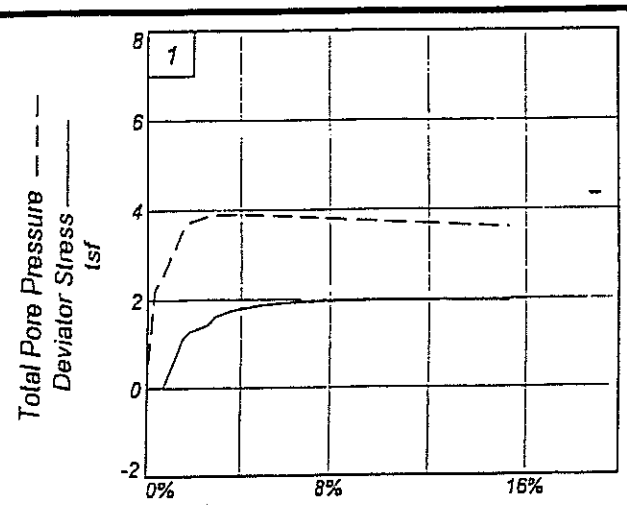
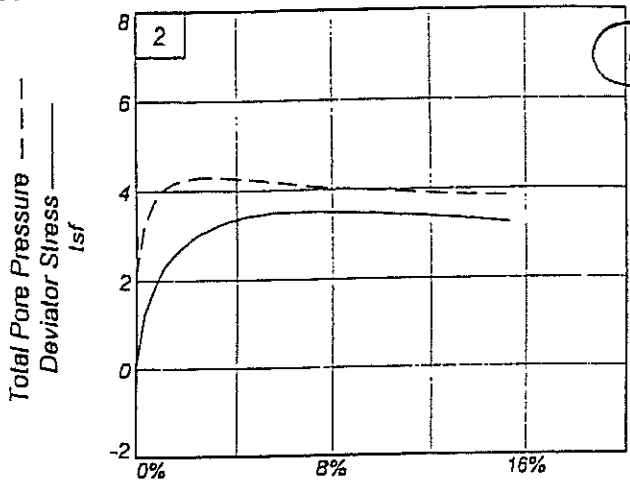
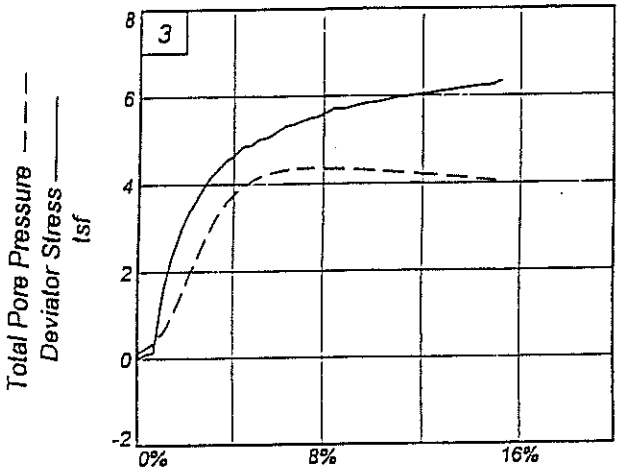
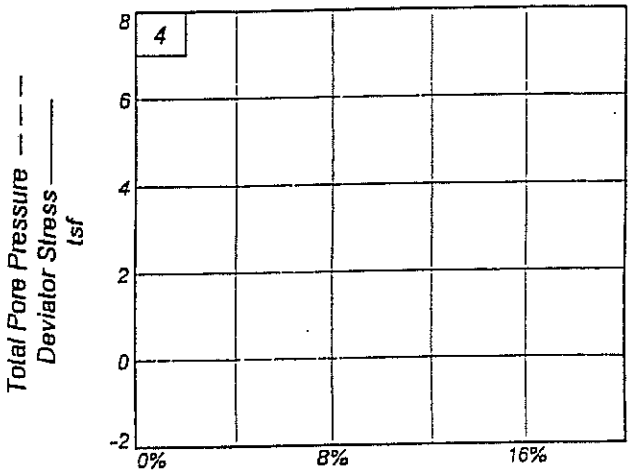
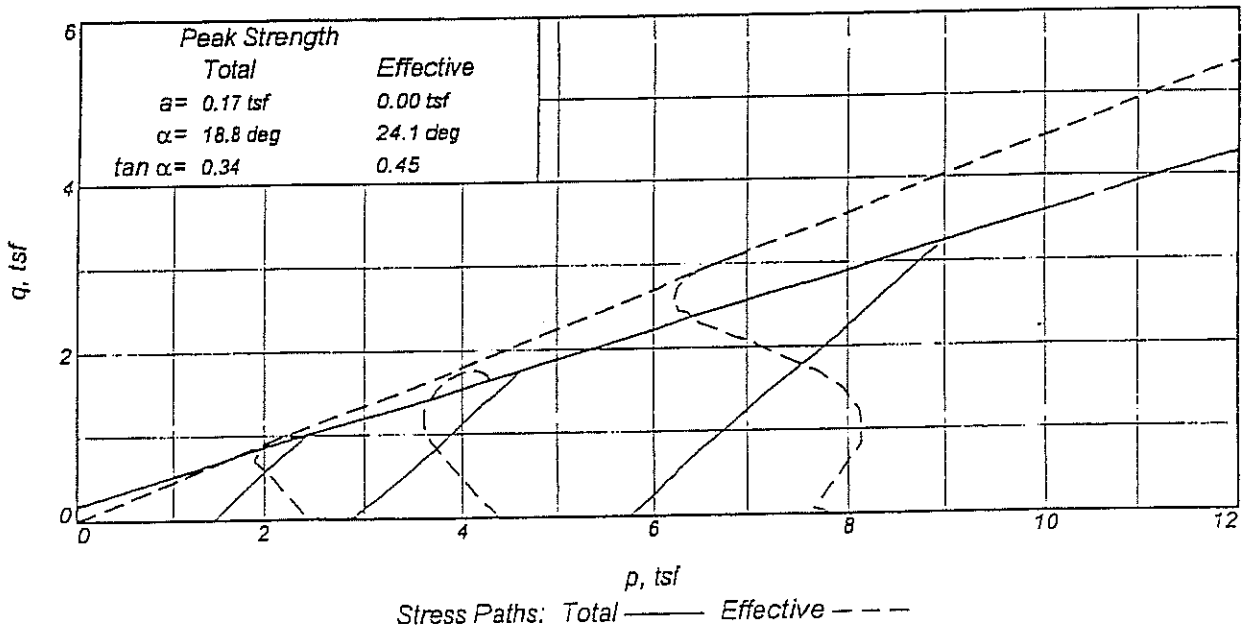










Client: Alliance Consulting
Project: Triaxial Test
Location: Boring #8874
Project No.: H-05278

Depth: 10.0-12.0'
Plate _____

Sample Number: 3

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC

Checked By: TH

5

2/9/2006
8:50 PM

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

Date:	2-1-05
Client:	Alliance Consulting
Project:	Triaxial Test Mach Mine #1 Johnston City, Illinois
Location:	Boring #8874
Depth:	10.0-12.0'
Sample Number:	3
Description:	Gray Mottled Brown Silty CLAY
Remarks:	
Type of Sample:	Shelby Tube - Undisturbed
Assumed Specific Gravity=2.65	LL=41.8 PL=17.7 PI=24.1
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	189.100			1279.000
Moisture content: Dry soil+tare, gms.	176.100			1072.200
Moisture content: Tare, gms.	115.700			103.200
Moisture, %	21.5	21.5	21.5	21.3
Moist specimen weight, gms.	1140.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.51	5.51	5.51	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.0	128.0	128.0	
Dry density, pcf	105.3	105.3	105.3	
Void ratio	0.5706	0.5706	0.5706	
Saturation, %	100.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.981 tsf at reading no. 24
Ult. Stress = 1.955 tsf at reading no. 30

(6)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	18.30	0.0	0.0	0.000	5.112	5.112	1.00	-1.00	5.112	0.000
1	0.0190	20.00	1.7	0.3	0.014	2.830	2.844	1.00	30.70	2.837	0.007
2	0.0400	21.60	3.3	0.7	0.026	2.426	2.452	1.01	36.30	2.439	0.013
3	0.0810	113.20	94.9	1.5	1.093	1.505	2.598	1.73	49.10	2.051	0.547
4	0.1010	129.80	111.5	1.8	1.280	1.318	2.597	1.97	51.70	1.958	0.640
5	0.1420	143.10	124.8	2.6	1.422	1.181	2.602	2.20	53.60	1.892	0.711
6	0.1620	161.50	143.2	2.9	1.625	1.159	2.784	2.40	53.90	1.972	0.813
7	0.1830	168.90	150.6	3.3	1.702	1.145	2.847	2.49	54.10	1.996	0.851
8	0.2030	174.80	156.5	3.7	1.763	1.138	2.900	2.55	54.20	2.019	0.881
9	0.2240	178.90	160.6	4.1	1.802	1.145	2.946	2.57	54.10	2.046	0.901
10	0.2440	182.30	164.0	4.4	1.833	1.145	2.978	2.60	54.10	2.061	0.916
11	0.2650	186.40	168.1	4.8	1.871	1.152	3.023	2.62	54.00	2.088	0.936
12	0.2850	188.10	169.8	5.2	1.883	1.166	3.049	2.61	53.80	2.108	0.941
13	0.3060	191.40	173.1	5.6	1.912	1.166	3.078	2.64	53.80	2.122	0.956
14	0.3260	193.10	174.8	5.9	1.923	1.181	3.104	2.63	53.60	2.142	0.962
15	0.3460	194.70	176.4	6.3	1.933	1.188	3.121	2.63	53.50	2.155	0.967
16	0.3670	196.40	178.1	6.7	1.944	1.202	3.146	2.62	53.30	2.174	0.972
17	0.3870	198.10	179.8	7.0	1.955	1.210	3.164	2.62	53.20	2.187	0.977
18	0.4080	198.10	179.8	7.4	1.947	1.224	3.171	2.59	53.00	2.197	0.973
19	0.4280	200.60	182.3	7.8	1.966	1.231	3.197	2.60	52.90	2.214	0.983
20	0.4490	200.60	182.3	8.1	1.958	1.238	3.196	2.58	52.80	2.217	0.979
21	0.4890	203.10	184.8	8.9	1.969	1.267	3.236	2.55	52.40	2.252	0.985
22	0.5300	204.70	186.4	9.6	1.970	1.289	3.259	2.53	52.10	2.274	0.985
23	0.5710	207.20	188.9	10.4	1.980	1.310	3.290	2.51	51.80	2.300	0.990
24	0.6120	208.90	190.6	11.1	1.981	1.332	3.313	2.49	51.50	2.323	0.991
25	0.6530	209.10	190.8	11.8	1.967	1.346	3.313	2.46	51.30	2.330	0.983
26	0.6940	211.40	193.1	12.6	1.974	1.361	3.334	2.45	51.10	2.348	0.987
27	0.7350	212.20	193.9	13.3	1.965	1.390	3.354	2.41	50.70	2.372	0.982
28	0.7790	213.90	195.6	14.1	1.964	1.404	3.368	2.40	50.50	2.386	0.982
29	0.8170	215.50	197.2	14.8	1.964	1.426	3.390	2.38	50.20	2.408	0.982
30	0.8380	215.50	197.2	15.2	1.955	1.433	3.388	2.36	50.10	2.410	0.978

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	154.800			1347.900
Moisture content: Dry soil+tare, gms.	145.800			1154.100
Moisture content: Tare, gms.	102.600			135.100
Moisture, %	20.8	20.9	20.9	19.0
Moist specimen weight, gms.	1142.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.49	5.49	5.49	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.7	128.7	128.7	
Dry density, pcf	106.5	106.5	106.5	
Void ratio	0.5536	0.5536	0.5536	
Saturation, %	99.7	100.0	100.0	

7

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 3.418 tsf **at reading no.** 24
Ult. Stress = 3.250 tsf **at reading no.** 29

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	27.50	0.0	0.0	0.000	4.385	4.385	1.00	29.10	4.385	0.000
1	0.0190	134.00	106.5	0.3	1.241	3.254	4.495	1.38	44.80	3.875	0.620
2	0.0400	183.10	155.6	0.7	1.806	2.750	4.557	1.66	51.80	3.653	0.903
3	0.0600	218.90	191.4	1.1	2.214	2.484	4.698	1.89	55.50	3.591	1.107
4	0.0810	243.80	216.3	1.5	2.492	2.340	4.832	2.06	57.50	3.586	1.246
5	0.1010	264.60	237.1	1.8	2.721	2.254	4.975	2.21	58.70	3.614	1.361
6	0.1220	282.10	254.6	2.2	2.911	2.210	5.121	2.32	59.30	3.666	1.455
7	0.1420	295.40	267.9	2.6	3.052	2.182	5.233	2.40	59.70	3.707	1.526
8	0.1620	305.40	277.9	2.9	3.154	2.182	5.335	2.45	59.70	3.758	1.577
9	0.1830	314.60	287.1	3.3	3.245	2.189	5.434	2.48	59.60	3.811	1.623
10	0.2030	322.10	294.6	3.7	3.317	2.196	5.513	2.51	59.50	3.855	1.659
11	0.2240	327.10	299.6	4.1	3.360	2.218	5.578	2.52	59.20	3.898	1.680
12	0.2440	332.90	305.4	4.4	3.412	2.232	5.644	2.53	59.00	3.938	1.706
13	0.2650	336.20	308.7	4.8	3.435	2.254	5.689	2.52	58.70	3.971	1.718
14	0.2850	339.50	312.0	5.2	3.459	2.275	5.734	2.52	58.40	4.005	1.729
15	0.3060	343.70	316.2	5.6	3.491	2.297	5.788	2.52	58.10	4.042	1.746
16	0.3260	345.40	317.9	5.9	3.497	2.318	5.815	2.51	57.80	4.067	1.748
17	0.3670	348.70	321.2	6.7	3.505	2.369	5.874	2.48	57.10	4.121	1.752
18	0.4080	352.00	324.5	7.4	3.512	2.412	5.924	2.46	56.50	4.168	1.756
19	0.4490	353.70	326.2	8.2	3.502	2.441	5.943	2.43	56.10	4.192	1.751
20	0.4890	354.50	327.0	8.9	3.483	2.470	5.953	2.41	55.70	4.211	1.742
21	0.5300	355.40	327.9	9.7	3.464	2.498	5.963	2.39	55.30	4.230	1.732

8

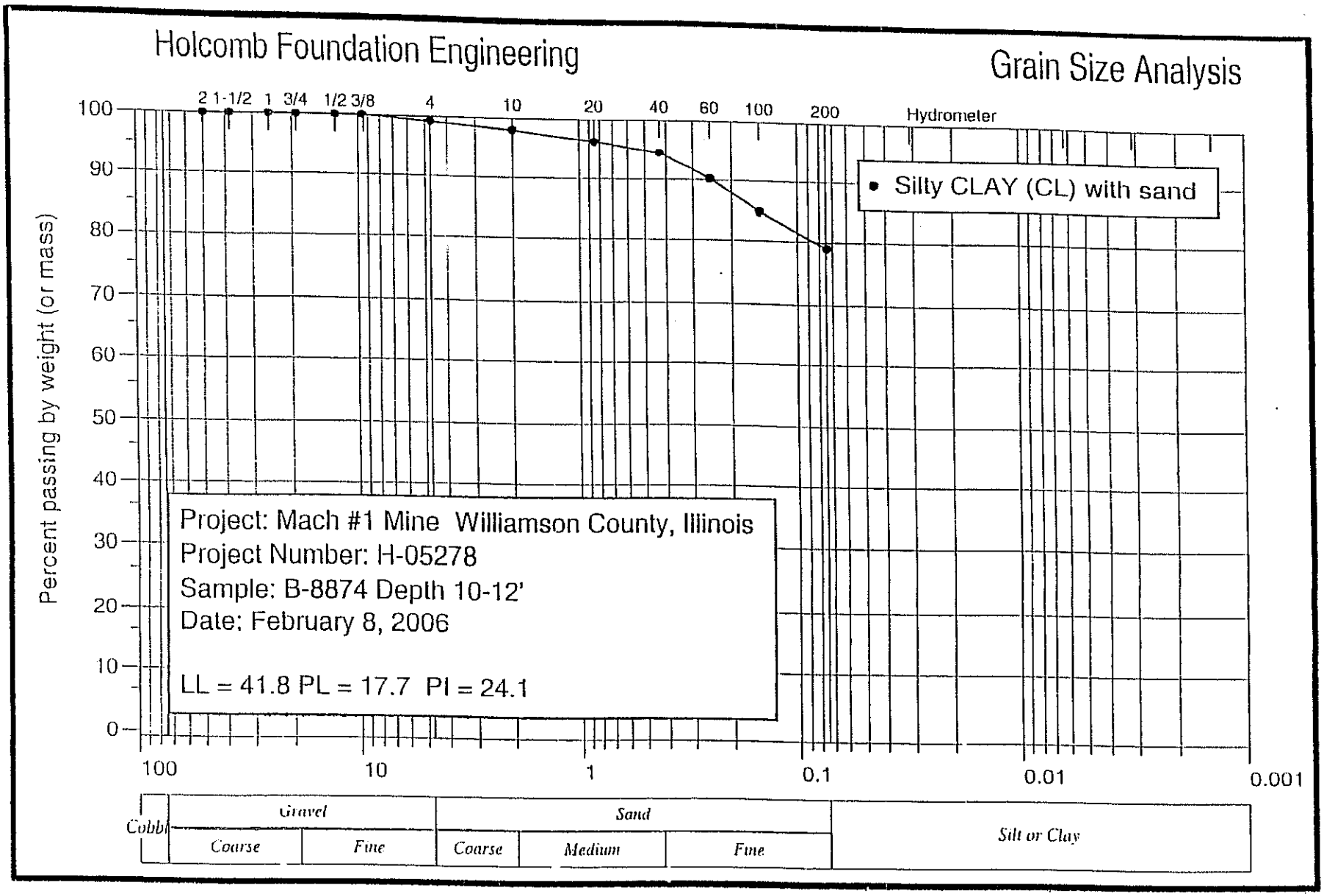
No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.5510	357.00	329.5	10.0	3.466	2.513	5.979	2.38	55.10	4.246	1.733
23	0.5920	356.20	328.7	10.8	3.429	2.534	5.964	2.35	54.80	4.249	1.715
24	0.6330	357.90	330.4	11.5	3.418	2.556	5.974	2.34	54.50	4.265	1.709
25	0.6730	357.00	329.5	12.3	3.381	2.585	5.966	2.31	54.10	4.275	1.690
26	0.7140	357.90	330.4	13.0	3.361	2.599	5.960	2.29	53.90	4.280	1.681
27	0.7550	357.90	330.4	13.7	3.332	2.614	5.946	2.27	53.70	4.280	1.666
28	0.7960	356.20	328.7	14.5	3.286	2.628	5.914	2.25	53.50	4.271	1.643
29	0.8370	355.40	327.9	15.2	3.250	2.635	5.885	2.23	53.40	4.260	1.625

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	248.400			1374.500
Moisture content: Dry soil+tare, gms.	226.700			1195.400
Moisture content: Tare, gms.	103.200			127.700
Moisture, %	17.6	17.8	17.8	16.8
Moist specimen weight, gms.	1184.7			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.54	5.54	5.54	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	132.3	132.5	132.5	
Dry density, pcf	112.5	112.5	112.5	
Void ratio	0.4707	0.4707	0.4707	
Saturation, %	98.9	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 6.334 tsf at reading no. 33
Ult. Stress = 6.334 tsf at reading no. 33

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	31.60	0.0	0.0	0.000	7.812	7.812	1.00	1.50	7.812	0.000
1	0.0190	39.90	8.3	0.3	0.091	7.690	7.781	1.01	3.20	7.735	0.045
2	0.0400	44.10	12.5	0.7	0.133	7.574	7.707	1.02	4.80	7.641	0.066
3	0.0600	175.60	144.0	1.1	1.666	7.308	8.974	1.23	8.50	8.141	0.833
4	0.0810	240.50	208.9	1.5	2.407	6.926	9.333	1.35	13.80	8.130	1.203
5	0.1010	291.30	259.7	1.8	2.981	6.466	9.447	1.46	20.20	7.956	1.491
6	0.1220	329.60	298.0	2.2	3.408	5.983	9.391	1.57	26.90	7.687	1.704
7	0.1420	362.00	330.4	2.6	3.764	5.479	9.244	1.69	33.90	7.361	1.882
8	0.1620	392.00	360.4	2.9	4.091	5.040	9.131	1.81	40.00	7.085	2.045
9	0.1830	412.80	381.2	3.3	4.310	4.666	8.976	1.92	45.20	6.821	2.155

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
10	0.2030	432.80	401.2	3.7	4.519	4.363	8.883	2.04	49.40	6.623	2.260
11	0.2240	446.90	415.3	4.0	4.660	4.140	8.800	2.13	52.50	6.470	2.330
12	0.2440	465.20	433.6	4.4	4.847	3.982	8.828	2.22	54.70	6.405	2.423
13	0.2650	471.00	439.4	4.8	4.892	3.852	8.744	2.27	56.50	6.298	2.446
14	0.2850	483.50	451.9	5.1	5.012	3.766	8.778	2.33	57.70	6.272	2.506
15	0.3060	490.20	458.6	5.5	5.066	3.694	8.760	2.37	58.70	6.227	2.533
16	0.3260	503.50	471.9	5.9	5.193	3.643	8.837	2.43	59.40	6.240	2.597
17	0.3460	516.80	485.2	6.2	5.319	3.607	8.926	2.47	59.90	6.267	2.660
18	0.3670	521.80	490.2	6.6	5.352	3.586	8.938	2.49	60.20	6.262	2.676
19	0.3870	530.10	498.5	7.0	5.422	3.571	8.993	2.52	60.40	6.282	2.711
20	0.4080	538.40	506.8	7.4	5.490	3.564	9.054	2.54	60.50	6.309	2.745
21	0.4280	543.40	511.8	7.7	5.522	3.564	9.086	2.55	60.50	6.325	2.761
22	0.4490	554.30	522.7	8.1	5.617	3.571	9.188	2.57	60.40	6.380	2.808
23	0.4690	565.90	534.3	8.5	5.719	3.578	9.297	2.60	60.30	6.438	2.859
24	0.4890	567.60	536.0	8.8	5.714	3.578	9.293	2.60	60.30	6.436	2.857
25	0.5300	581.70	550.1	9.6	5.817	3.600	9.417	2.62	60.00	6.509	2.909
26	0.5710	591.70	560.1	10.3	5.874	3.636	9.510	2.62	59.50	6.573	2.937
27	0.6120	605.00	573.4	11.0	5.964	3.665	9.629	2.63	59.10	6.647	2.982
28	0.6530	615.00	583.4	11.8	6.018	3.701	9.719	2.63	58.60	6.710	3.009
29	0.6940	626.70	595.1	12.5	6.087	3.737	9.824	2.63	58.10	6.780	3.044
30	0.7350	638.30	606.7	13.3	6.153	3.773	9.926	2.63	57.60	6.849	3.077
31	0.7760	649.10	617.5	14.0	6.209	3.816	10.025	2.63	57.00	6.921	3.105
32	0.8170	657.50	625.9	14.7	6.240	3.852	10.092	2.62	56.50	6.972	3.120
33	0.8390	669.90	638.3	15.1	6.334	3.866	10.200	2.64	56.30	7.033	3.167


Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
• Silty CLAY (CL) with sand
Project: Mach #1 Mine Williamson County, Illinois
Project Number: H-05278
Sample: B-8874 Depth 10-12'
Date: February 8, 2006
LL = 41.8 PL = 17.7 PI = 24.1
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

14 of 57

17 of 57

R15138

Holcomb Foundation Engineering Company

Laboratory Testing Results

2/8/2006

Project: Mach #1 Mine

Project No: H-05278

Sieve Analysis - ASTM C136-96a

Sample: Silty CLAY (CL)

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
1.5000	38.1000	1 -1/2"	0.0	0.0	100.0
1.0000	25.4000	1"	0.0	0.0	100.0
0.7500	19.1000	3/4"	0.0	0.0	100.0
0.5000	12.7000	1/2"	0.0	0.0	100.0
3.7500	9.5200	3/8"	0.0	0.0	100.0
0.1870	4.7600	No. 4	2.1	0.9	99.1
0.0790	2.0000	No. 10	4.6	2.0	98.0
0.0469	1.1800	No 16	4.6	2.0	98.0
0.0331	0.8500	No. 20	8.6	3.8	96.2
0.0165	0.4200	No. 40	12.6	5.5	94.5
0.0117	0.2980	No. 50	12.6	5.5	94.5
0.0083	0.2500	No. 60	22.2	9.8	90.2
0.0059	0.1490	No. 100	34.6	15.2	84.8
0.0029	0.0740	No. 200	47.7	21.0	79.0

Total Weight in Grams 227.20

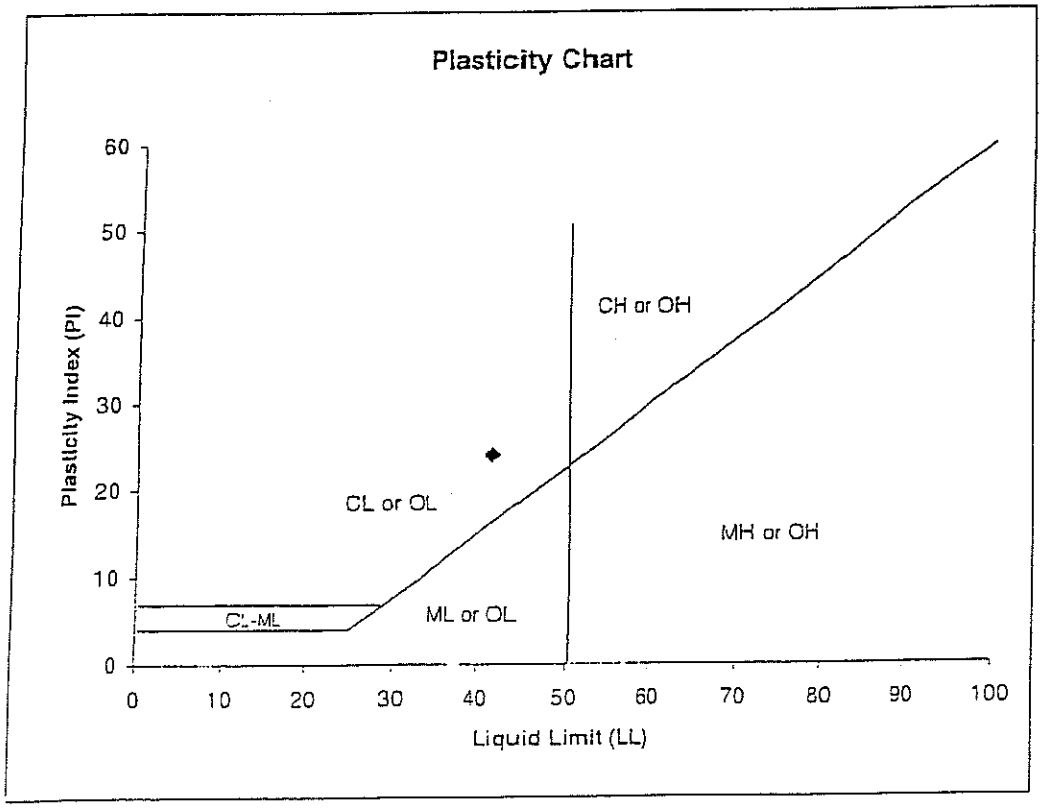
Holcomb Foundation Engineering Company

Laboratory Testing Results

Project: Mach #1 Mine
Project No: H-05278

Sample	1	2	3
Dish Number	LL_1	LL_2	LL_3
Mass of can, W_1 (g)	34.70		
Mass of can + moist soil, W_2 (g)	62.84		
Mass of can + dry soil, W_3 (g)	54.52		
Moisture content, w (%)	41.98		
Number of blows, N	24		
Liquid Limit, LL	41.8		

Dish Number	PL_1
Mass of can, W_1 (g)	39.76
Mass of can + moist soil, W_2 (g)	54.79
Mass of can + dry soil, W_3 (g)	52.53
Plastic Limit, PL	17.7
PI =	24.1



19 of 57

R16.140

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

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P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

November 30, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Pond Creek Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on November 17, 2006, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification: Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)

Proctor Test Results:
Maximum Dry Unit Weight: 124.6 PCF
Optimum Moisture Content: 9.3 %

Specific Gravity: 2.37

Triaxial Test Results:
Effective Cohesion: 0 PSF
Effective Phi Angle: 33.7 Degrees

Permeability: 2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

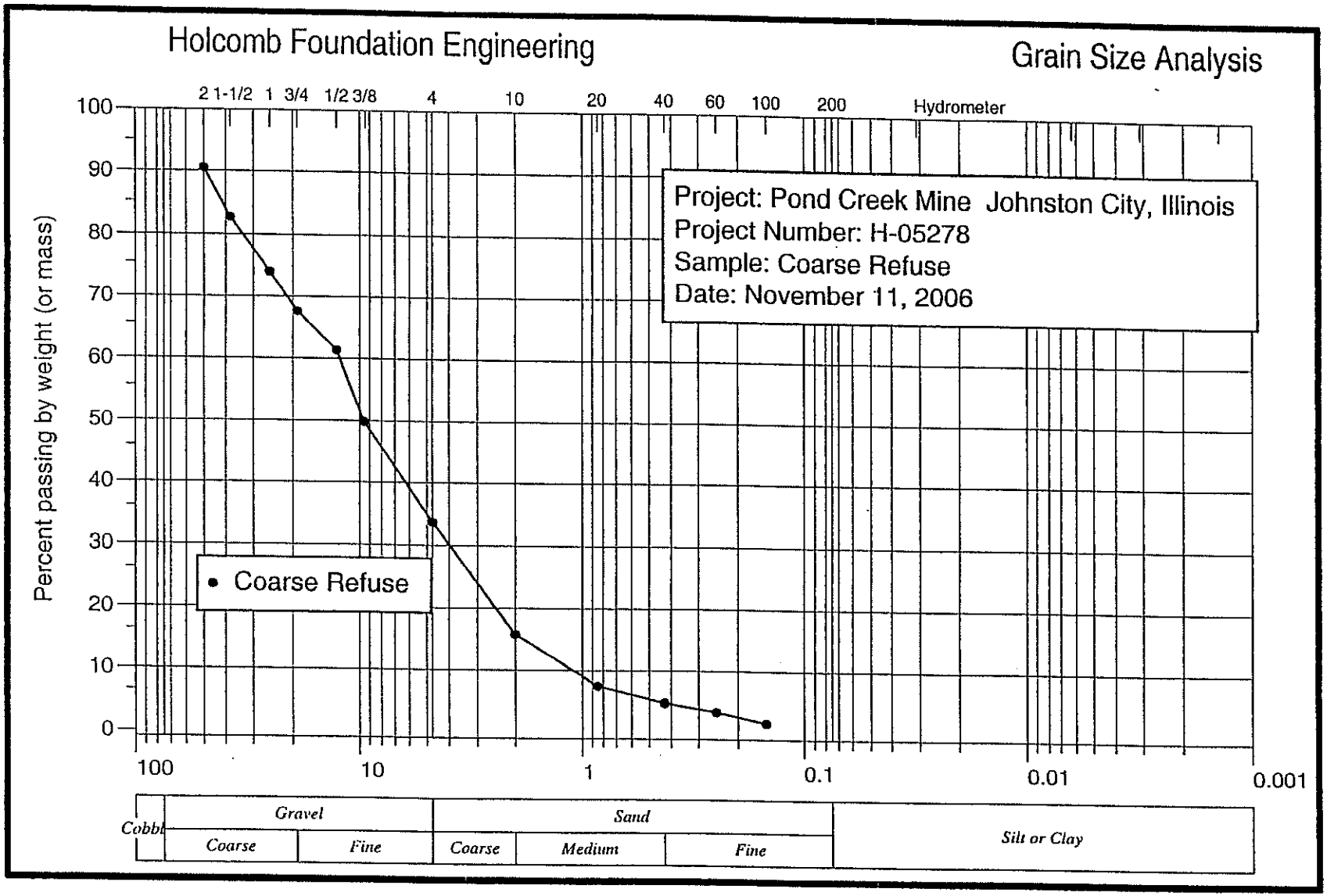
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting


Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
Project: Pond Creek Mine Johnston City, Illinois
Project Number: H-05278
Sample: Coarse Refuse
Date: November 11, 2006
• Coarse Refuse
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

21 / 57

R15/52

Holcomb Foundation Engineering Company

Laboratory Testing Results

11/30/2006

Project: Coarse Refuse Disposal Area
Pond Creek Mine Johnston City, Illinois

Project No: H-05317

Sieve Analysis - ASTM C136-96a

Sample: Coarse Refuse

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
3	76.2	3"	0.0	0.0	100.0
2.0000	50.8100	2"	619.6	9.5	90.5
1.5000	38.1000	1 -1/2"	1124.0	17.2	82.8
1.0000	25.4000	1"	1696.2	25.9	74.1
0.7500	19.1000	3/4"	2110.9	32.3	67.7
0.5000	12.7000	1/2"	2513.0	38.4	61.6
3.7500	9.5200	3/8"	3263.7	49.9	50.1
0.1870	4.7600	No. 4	4310.7	65.9	34.1
0.0790	2.0000	No. 10	5470.5	83.6	16.4
0.0469	1.1800	No. 16			
0.0331	0.8500	No. 20	6004.4	91.8	8.2
0.0165	0.4200	No. 40	6178.9	94.4	5.6
0.0117	0.2980	No. 50			
0.0083	0.2500	No. 60	6267.8	95.8	4.2
0.0059	0.1490	No. 100			
0.0029	0.0740	No. 200	6372.4	97.4	2.6

Total Weight in Grams **6542.80**

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

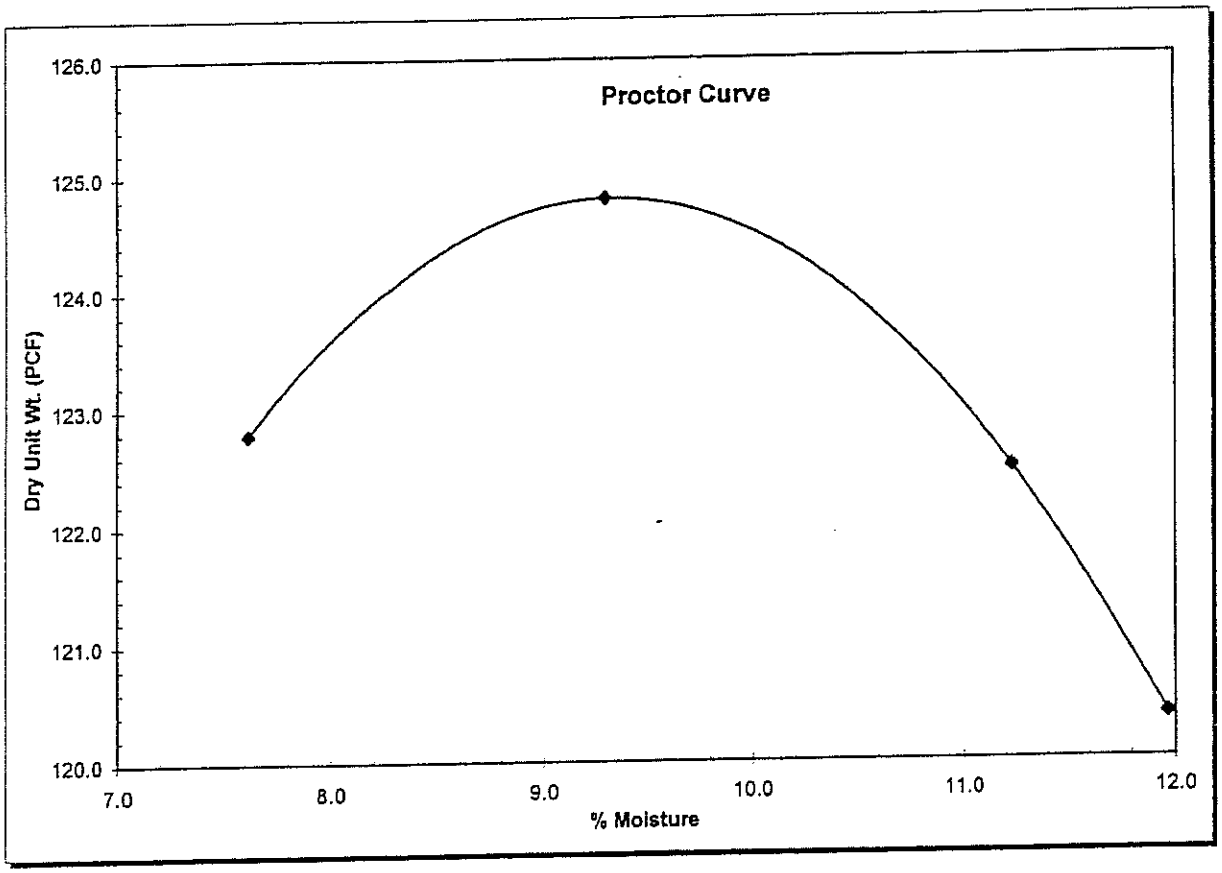
Date: 11/30/2006

Proctor Test Results

Soil Classification:	**Gray Coarse Refuse**
Maximum Dry Density (PCF)	**124.8**
Optimum Moisture Content (%)	**9.3**

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
7.6	122.8
11.2	122.5
12.0	120.4
9.3	124.8



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Permeability Tests Results

Laboratory Tests
Coarse Refuse
Pond Creek Mine - Johnston City, Illinois

Date: 11/30/2006

Client: Pond Creek Mine
Johnston City, Illinois

Project No.: H-05278

Sample	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse		7.7	11.8	119.3	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

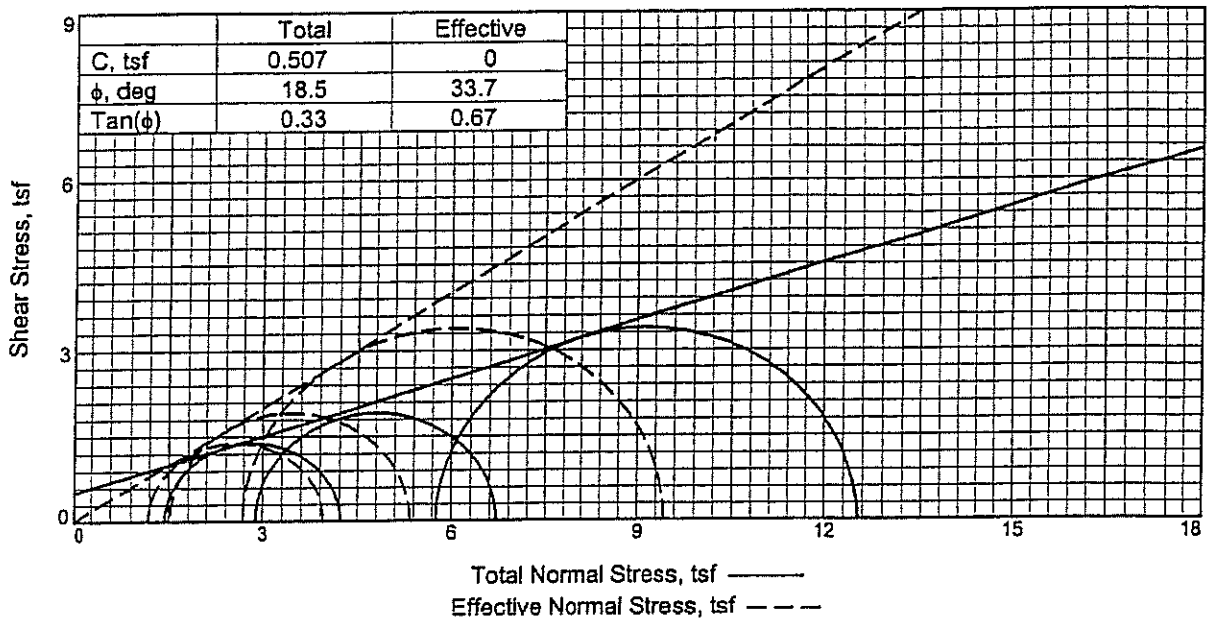
(19)
R15146

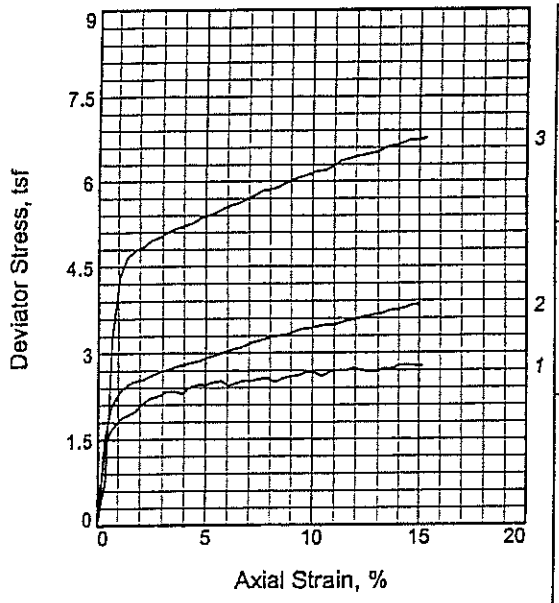
PERMEABILITY TEST RESULTS

Project	Pond Creek Mine		Boring/Sample Depth		Coarse Refuse
Project #	H-05278		Classification		
Date	11/30/2006		Diameter	2.8	Inch
			Length	5.6	Inch

In Place Mc		After Test Mc		Unit Weight (PCF)	
Wet Wt.	195.3	Wet Wt.	1300.4	Sample Wt.	1161.8
Pan	94.2	Pan	103.1		
Dry Wt.	188.1	Dry Wt.	1173.6	Wet UW=	128.5
Mc (%)	7.7	Mc (%)	11.8	Dry UW=	119.3

Time(hrs)	Time(min)	Quantity (cc)	Head (psi)	Permeability (cm/sec)
7	26	24.7		
7	34	8.2	1	1.75E-04
7	33	24.5		
7	45	2.7	1	1.54E-04
7	47	0.8	1	1.44E-04
9	16	24.4		
9	23	9.6	1	1.79E-04
9	30	0.9	1	1.43E-04
		Average Permeability		1.63E-04





Sample No.		1	2	3
Initial	Water Content,	10.1	10.8	10.3
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	97.0	99.8	99.3
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
At Test	Water Content,	10.4	10.8	10.4
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
Strain rate, in./min.		0.01	0.01	0.01
Back Pressure, tsf		3.60	3.60	2.16
Cell Pressure, tsf		5.04	6.48	7.92
Fail. Stress, tsf		2.78	3.83	6.76
Total Pore Pr., tsf		3.86	4.96	5.23
Ult. Stress, tsf		2.77	3.83	6.76
Total Pore Pr., tsf		3.85	4.95	5.23
$\bar{\sigma}_1$ Failure, tsf		3.96	5.35	9.44
$\bar{\sigma}_3$ Failure, tsf		1.18	1.52	2.69

Type of Test:
CU with Pore Pressures
Sample Type: Remolded
Description: Coarse Coal Refuse

Assumed Specific Gravity= 2.37
Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

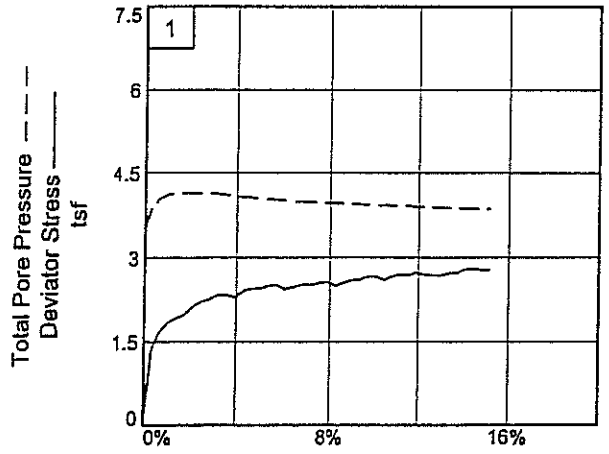
Location: Coarse Refuse Stockpile
Sample Number: Coarse Refuse
Proj. No.: H-05278 **Date:** 11/17/06

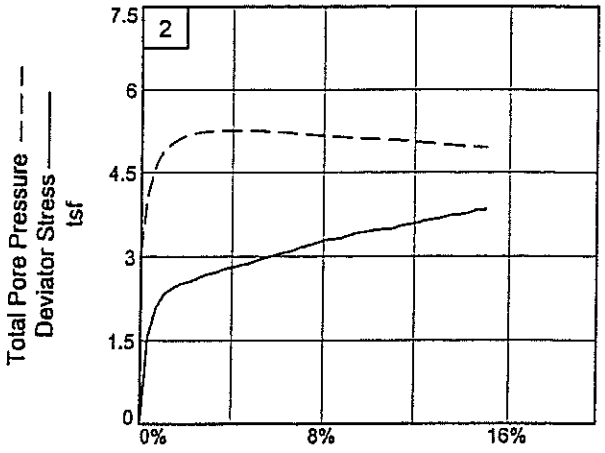
TRIAXIAL SHEAR TEST REPORT

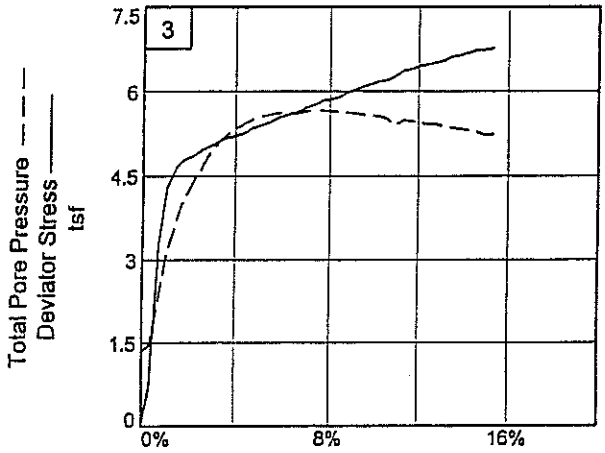
HOLCOMB FOUNDATION ENGINEERING CO.

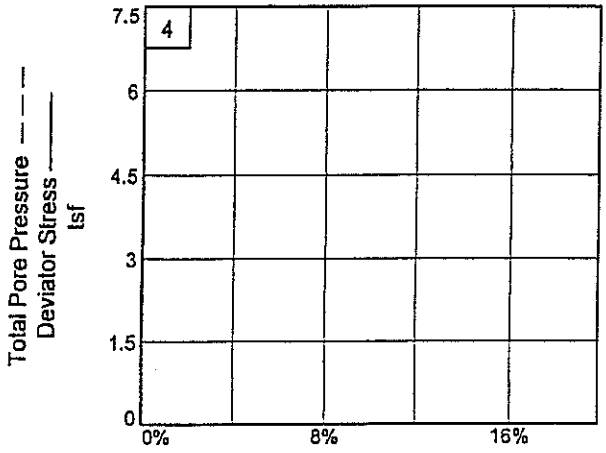
Plate _____

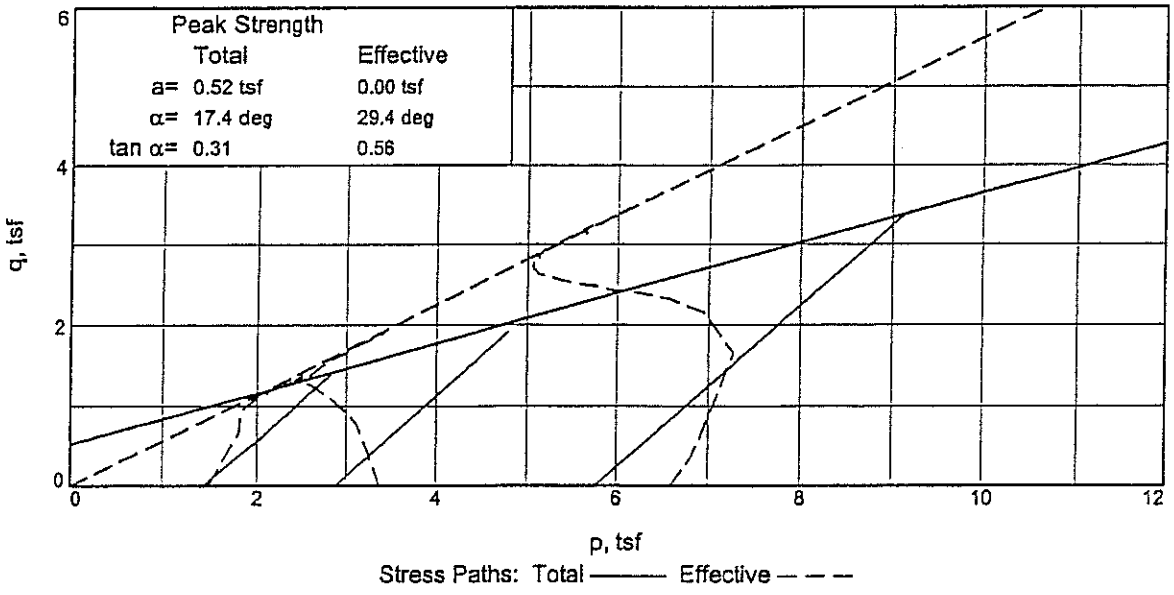
Tested By: LC **Checked By:** TH











Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Coarse Refuse Stockpile
Project No.: H-05278
Sample Number: Coarse Refuse
Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC **Checked By:** TH

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

11/30/2006
10:19 AM

Date: 11/17/06
Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Coarse Refuse Stockpile
Sample Number: Coarse Refuse
Description: Coarse Coal Refuse
Remarks:
Type of Sample: Remolded
Assumed Specific Gravity=2.37 **LL=** **PL=** **PI=**
Test Method: COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	226.800			1320.700
Moisture content: Dry soil+tare, gms.	218.600			1195.800
Moisture content: Tare, gms.	137.500			107.600
Moisture, %	10.1	10.4	10.4	11.5
Moist specimen weight, gms.	1193.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.65	5.65	5.65	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.6	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2470	0.2470	0.2470	
Saturation, %	97.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 2.778 tsf **at reading no.** 41
Ult. Stress = 2.767 tsf **at reading no.** 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0010	46.60	0.0	0.0	0.000	1.498	1.498	1.00	49.20	1.498	0.000
1	0.0180	160.60	114.0	0.3	1.329	1.152	2.481	2.15	54.00	1.816	0.664
2	0.0390	189.70	143.1	0.7	1.662	1.001	2.663	2.66	56.10	1.832	0.831
3	0.0590	205.60	159.0	1.0	1.840	0.929	2.769	2.98	57.10	1.849	0.920
4	0.0800	212.20	165.6	1.4	1.909	0.907	2.816	3.10	57.40	1.862	0.955
5	0.1000	218.90	172.3	1.8	1.979	0.900	2.879	3.20	57.50	1.890	0.990
6	0.1200	232.20	185.6	2.1	2.125	0.900	3.025	3.36	57.50	1.962	1.062
7	0.1410	240.50	193.9	2.5	2.211	0.907	3.118	3.44	57.40	2.013	1.106
8	0.1610	245.50	198.9	2.8	2.260	0.914	3.174	3.47	57.30	2.044	1.130
9	0.1820	252.20	205.6	3.2	2.327	0.922	3.249	3.53	57.20	2.085	1.164
10	0.2020	253.80	207.2	3.6	2.337	0.936	3.273	3.50	57.00	2.104	1.168
11	0.2230	250.50	203.9	3.9	2.291	0.958	3.248	3.39	56.70	2.103	1.145
12	0.2430	261.30	214.7	4.3	2.403	0.972	3.375	3.47	56.50	2.173	1.201
13	0.2630	266.30	219.7	4.6	2.450	0.979	3.429	3.50	56.40	2.204	1.225
14	0.2840	266.30	219.7	5.0	2.440	0.994	3.434	3.46	56.20	2.214	1.220
15	0.3040	272.10	225.5	5.4	2.495	1.008	3.503	3.48	56.00	2.256	1.248
16	0.3250	274.60	228.0	5.7	2.513	1.022	3.536	3.46	55.80	2.279	1.257
17	0.3450	268.00	221.4	6.1	2.431	1.037	3.468	3.34	55.60	2.252	1.216
18	0.3660	273.00	226.4	6.5	2.476	1.051	3.527	3.36	55.40	2.289	1.238
19	0.3860	278.00	231.4	6.8	2.521	1.058	3.580	3.38	55.30	2.319	1.261
20	0.4070	278.00	231.4	7.2	2.511	1.066	3.577	3.36	55.20	2.321	1.256
21	0.4270	283.00	236.4	7.5	2.556	1.073	3.629	3.38	55.10	2.351	1.278
22	0.4470	284.60	238.0	7.9	2.563	1.080	3.643	3.37	55.00	2.362	1.282
23	0.4680	278.80	232.2	8.3	2.491	1.087	3.578	3.29	54.90	2.333	1.245
24	0.4880	286.30	239.7	8.6	2.561	1.087	3.648	3.36	54.90	2.368	1.281
25	0.5090	290.40	243.8	9.0	2.594	1.094	3.689	3.37	54.80	2.392	1.297
26	0.5290	292.10	245.5	9.3	2.602	1.102	3.704	3.36	54.70	2.403	1.301
27	0.5500	298.80	252.2	9.7	2.662	1.109	3.771	3.40	54.60	2.440	1.331
28	0.5700	299.60	253.0	10.1	2.660	1.116	3.776	3.38	54.50	2.446	1.330
29	0.5910	294.60	248.0	10.4	2.597	1.116	3.713	3.33	54.50	2.415	1.299
30	0.6110	302.10	255.5	10.8	2.665	1.123	3.788	3.37	54.40	2.456	1.333
31	0.6310	306.30	259.7	11.2	2.698	1.130	3.828	3.39	54.30	2.479	1.349
32	0.6520	306.30	259.7	11.5	2.687	1.130	3.817	3.38	54.30	2.474	1.343
33	0.6720	312.10	265.5	11.9	2.736	1.145	3.881	3.39	54.10	2.513	1.368
34	0.6930	309.60	263.0	12.2	2.699	1.145	3.843	3.36	54.10	2.494	1.349
35	0.7130	308.80	262.2	12.6	2.680	1.152	3.832	3.33	54.00	2.492	1.340
36	0.7340	309.60	263.0	13.0	2.676	1.159	3.835	3.31	53.90	2.497	1.338
37	0.7540	315.40	268.8	13.3	2.724	1.166	3.891	3.34	53.80	2.528	1.362
38	0.7750	316.20	269.6	13.7	2.721	1.166	3.887	3.33	53.80	2.527	1.360
39	0.7950	323.70	277.1	14.1	2.785	1.181	3.966	3.36	53.60	2.573	1.392
40	0.8150	325.40	278.8	14.4	2.790	1.181	3.971	3.36	53.60	2.576	1.395
41	0.8360	325.40	278.8	14.8	2.778	1.181	3.959	3.35	53.60	2.570	1.389
42	0.8560	325.40	278.8	15.1	2.767	1.188	3.955	3.33	53.50	2.571	1.383

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	211.600			1335.900
Moisture content: Dry soil+tare, gms.	203.200			1222.200
Moisture content: Tare, gms.	125.200			134.800
Moisture, %	10.8	10.8	10.8	10.5
Moist specimen weight, gms.	1175.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.57	5.57	5.57	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.5	130.5	130.5	
Dry density, pcf	117.8	117.8	117.8	
Void ratio	0.2558	0.2558	0.2558	
Saturation, %	99.8	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 3.829 tsf **at reading no.** 40
Ult. Stress = 3.828 tsf **at reading no.** 41

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	51.60	0.0	0.0	0.000	3.377	3.377	1.00	43.10	3.377	0.000
1	0.0190	185.60	134.0	0.3	1.562	2.340	3.902	1.67	57.50	3.121	0.781
2	0.0400	233.00	181.4	0.7	2.106	1.814	3.920	2.16	64.80	2.867	1.053
3	0.0600	253.00	201.4	1.1	2.330	1.562	3.892	2.49	68.30	2.727	1.165
4	0.0810	263.80	212.2	1.5	2.445	1.433	3.878	2.71	70.10	2.655	1.223
5	0.1010	270.50	218.9	1.8	2.513	1.346	3.860	2.87	71.30	2.603	1.257
6	0.1220	274.60	223.0	2.2	2.550	1.289	3.839	2.98	72.10	2.564	1.275
7	0.1420	281.30	229.7	2.5	2.617	1.260	3.877	3.08	72.50	2.569	1.309
8	0.1620	287.10	235.5	2.9	2.674	1.238	3.912	3.16	72.80	2.575	1.337
9	0.1830	291.30	239.7	3.3	2.711	1.231	3.942	3.20	72.90	2.587	1.355
10	0.2030	297.10	245.5	3.6	2.766	1.224	3.990	3.26	73.00	2.607	1.383
11	0.2240	301.30	249.7	4.0	2.802	1.224	4.026	3.29	73.00	2.625	1.401
12	0.2440	305.40	253.8	4.4	2.838	1.224	4.062	3.32	73.00	2.643	1.419
13	0.2650	309.60	258.0	4.8	2.873	1.224	4.097	3.35	73.00	2.661	1.437
14	0.2850	315.40	263.8	5.1	2.927	1.231	4.158	3.38	72.90	2.695	1.463
15	0.3060	320.40	268.8	5.5	2.970	1.238	4.209	3.40	72.80	2.724	1.485
16	0.3260	326.20	274.6	5.9	3.023	1.246	4.269	3.43	72.70	2.757	1.512
17	0.3460	330.40	278.8	6.2	3.058	1.253	4.310	3.44	72.60	2.782	1.529
18	0.3670	334.60	283.0	6.6	3.091	1.267	4.358	3.44	72.40	2.813	1.546
19	0.3870	341.20	289.6	6.9	3.151	1.282	4.433	3.46	72.20	2.857	1.576
20	0.4080	346.20	294.6	7.3	3.192	1.296	4.488	3.46	72.00	2.892	1.596
21	0.4280	351.20	299.6	7.7	3.234	1.310	4.544	3.47	71.80	2.927	1.617

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	357.00	305.4	8.1	3.283	1.318	4.601	3.49	71.70	2.959	1.642
23	0.4690	359.50	307.9	8.4	3.297	1.332	4.629	3.48	71.50	2.981	1.649
24	0.4890	362.80	311.2	8.8	3.319	1.339	4.659	3.48	71.40	2.999	1.660
25	0.5100	368.70	317.1	9.2	3.368	1.346	4.715	3.50	71.30	3.031	1.684
26	0.5300	374.50	322.9	9.5	3.416	1.361	4.777	3.51	71.10	3.069	1.708
27	0.5510	377.00	325.4	9.9	3.429	1.368	4.797	3.51	71.00	3.082	1.714
28	0.5710	381.20	329.6	10.2	3.459	1.368	4.827	3.53	71.00	3.098	1.730
29	0.5920	384.50	332.9	10.6	3.479	1.382	4.861	3.52	70.80	3.122	1.739
30	0.6120	386.20	334.6	11.0	3.483	1.390	4.872	3.51	70.70	3.131	1.741
31	0.6330	392.00	340.4	11.4	3.528	1.397	4.925	3.53	70.60	3.161	1.764
32	0.6530	397.00	345.4	11.7	3.565	1.411	4.977	3.53	70.40	3.194	1.783
33	0.6730	400.30	348.7	12.1	3.585	1.426	5.010	3.51	70.20	3.218	1.792
34	0.6940	406.10	354.5	12.5	3.629	1.440	5.069	3.52	70.00	3.254	1.814
35	0.7140	410.30	358.7	12.8	3.657	1.454	5.111	3.51	69.80	3.283	1.828
36	0.7350	413.60	362.0	13.2	3.674	1.469	5.143	3.50	69.60	3.306	1.837
37	0.7550	420.30	368.7	13.6	3.727	1.483	5.210	3.51	69.40	3.347	1.863
38	0.7760	423.60	372.0	13.9	3.744	1.498	5.242	3.50	69.20	3.370	1.872
39	0.7960	427.80	376.2	14.3	3.770	1.505	5.275	3.51	69.10	3.390	1.885
40	0.8170	435.30	383.7	14.7	3.829	1.519	5.348	3.52	68.90	3.434	1.914
41	0.8370	436.90	385.3	15.0	3.828	1.526	5.355	3.51	68.80	3.441	1.914

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	184.300			1333.800
Moisture content: Dry soil+tare, gms.	177.100			1230.400
Moisture content: Tare, gms.	107.500			135.300
Moisture, %	10.3	10.4	10.4	9.4
Moist specimen weight, gms.	1185.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.60	5.60	5.60	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.9	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2468	0.2468	0.2468	
Saturation, %	99.3	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 6.758 tsf at reading no. 42
Ult. Stress = 6.758 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	25.00	0.0	0.0	0.000	6.588	6.588	1.00	18.50	6.588	0.000
1	0.0190	88.20	63.2	0.3	0.736	6.458	7.195	1.11	20.30	6.827	0.368
2	0.0400	309.60	284.6	0.7	3.304	5.623	8.927	1.59	31.90	7.275	1.652
3	0.0600	397.00	372.0	1.1	4.303	4.795	9.098	1.90	43.40	6.947	2.152
4	0.0810	428.60	403.6	1.4	4.651	4.234	8.885	2.10	51.20	6.559	2.326
5	0.1010	441.90	416.9	1.8	4.787	3.830	8.617	2.25	56.80	6.224	2.393
6	0.1220	449.40	424.4	2.2	4.854	3.521	8.375	2.38	61.10	5.948	2.427
7	0.1420	460.20	435.2	2.5	4.960	3.283	8.243	2.51	64.40	5.763	2.480
8	0.1620	467.70	442.7	2.9	5.027	3.017	8.044	2.67	68.10	5.530	2.513
9	0.1830	476.00	451.0	3.3	5.101	2.837	7.938	2.80	70.60	5.387	2.551
10	0.2030	483.50	458.5	3.6	5.167	2.693	7.860	2.92	72.60	5.276	2.583
11	0.2240	489.30	464.3	4.0	5.212	2.585	7.797	3.02	74.10	5.191	2.606
12	0.2440	495.20	470.2	4.4	5.258	2.491	7.750	3.11	75.40	5.120	2.629
13	0.2650	505.20	480.2	4.7	5.349	2.419	7.768	3.21	76.40	5.094	2.675
14	0.2850	511.00	486.0	5.1	5.394	2.369	7.762	3.28	77.10	5.066	2.697
15	0.3060	518.50	493.5	5.5	5.455	2.333	7.788	3.34	77.60	5.060	2.728
16	0.3260	526.80	501.8	5.8	5.526	2.304	7.830	3.40	78.00	5.067	2.763
17	0.3460	533.50	508.5	6.2	5.579	2.297	7.875	3.43	78.10	5.086	2.789
18	0.3670	539.30	514.3	6.6	5.620	2.326	7.945	3.42	77.70	5.135	2.810
19	0.3870	548.40	523.4	6.9	5.697	2.275	7.972	3.50	78.40	5.124	2.849
20	0.4080	555.90	530.9	7.3	5.756	2.261	8.016	3.55	78.60	5.139	2.878
21	0.4280	565.90	540.9	7.6	5.841	2.261	8.102	3.58	78.60	5.181	2.921

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	569.20	544.2	8.0	5.853	2.268	8.121	3.58	78.50	5.195	2.927
23	0.4690	575.10	550.1	8.4	5.894	2.282	8.176	3.58	78.30	5.229	2.947
24	0.4890	584.20	559.2	8.7	5.968	2.297	8.265	3.60	78.10	5.281	2.984
25	0.5100	592.50	567.5	9.1	6.031	2.311	8.343	3.61	77.90	5.327	3.016
26	0.5300	599.20	574.2	9.5	6.079	2.333	8.411	3.61	77.60	5.372	3.039
27	0.5510	605.90	580.9	9.8	6.124	2.354	8.479	3.60	77.30	5.416	3.062
28	0.5710	613.30	588.3	10.2	6.178	2.362	8.539	3.62	77.20	5.450	3.089
29	0.5920	617.50	592.5	10.6	6.196	2.405	8.601	3.58	76.60	5.503	3.098
30	0.6120	626.70	601.7	10.9	6.267	2.527	8.794	3.48	74.90	5.661	3.133
31	0.6330	638.30	613.3	11.3	6.361	2.426	8.787	3.62	76.30	5.607	3.180
32	0.6530	644.10	619.1	11.7	6.395	2.448	8.843	3.61	76.00	5.646	3.198
33	0.6730	650.80	625.8	12.0	6.438	2.477	8.915	3.60	75.60	5.696	3.219
34	0.6940	656.60	631.6	12.4	6.470	2.498	8.968	3.59	75.30	5.733	3.235
35	0.7140	662.50	637.5	12.8	6.504	2.506	9.009	3.60	75.20	5.758	3.252
36	0.7350	669.10	644.1	13.1	6.543	2.542	9.085	3.57	74.70	5.813	3.271
37	0.7550	678.30	653.3	13.5	6.609	2.563	9.172	3.58	74.40	5.868	3.305
38	0.7760	684.10	659.1	13.9	6.639	2.585	9.224	3.57	74.10	5.904	3.319
39	0.7960	690.70	665.7	14.2	6.678	2.614	9.291	3.55	73.70	5.952	3.339
40	0.8170	699.10	674.1	14.6	6.732	2.635	9.367	3.55	73.40	6.001	3.366
41	0.8370	701.60	676.6	14.9	6.729	2.700	9.429	3.49	72.50	6.065	3.365
42	0.8570	707.40	682.4	15.3	6.758	2.686	9.444	3.52	72.70	6.065	3.379

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

SHIPPING ADDRESS
Box 393 Wood Road
Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

April 9, 2007

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Mach Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on March 29, 2007, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification:	Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)
Proctor Test Results:	
Maximum Dry Unit Weight:	120.3 PCF
Optimum Moisture Content:	10.7 %
Specific Gravity:	2.50
Triaxial Test Results:	
Effective Cohesion:	152 PSF
Effective Phi Angle:	29.3 Degrees
Permeability (2 tests):	3 x 10-4 cm./sec.
	2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting



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Permeability Tests Results

Mach Mine
Johnston City, Illinois

Date: 4/9/2007 Client: Williamson Energy

Project No.: H-05278

Boring No.	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse Sample #1		10.9	14.6	115.7	3 x 10-4
Coarse Refuse Sample #2		10.1	14.3	114.7	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

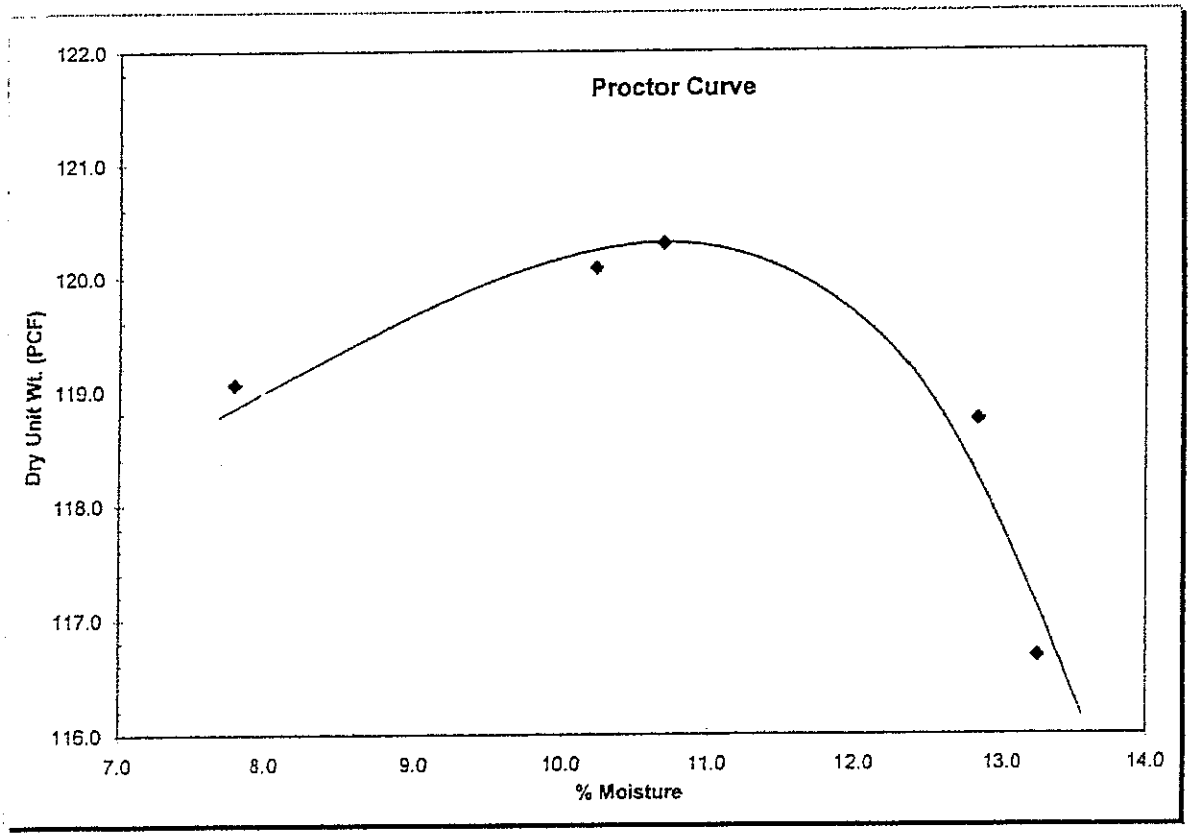
Date: 4/9/2007

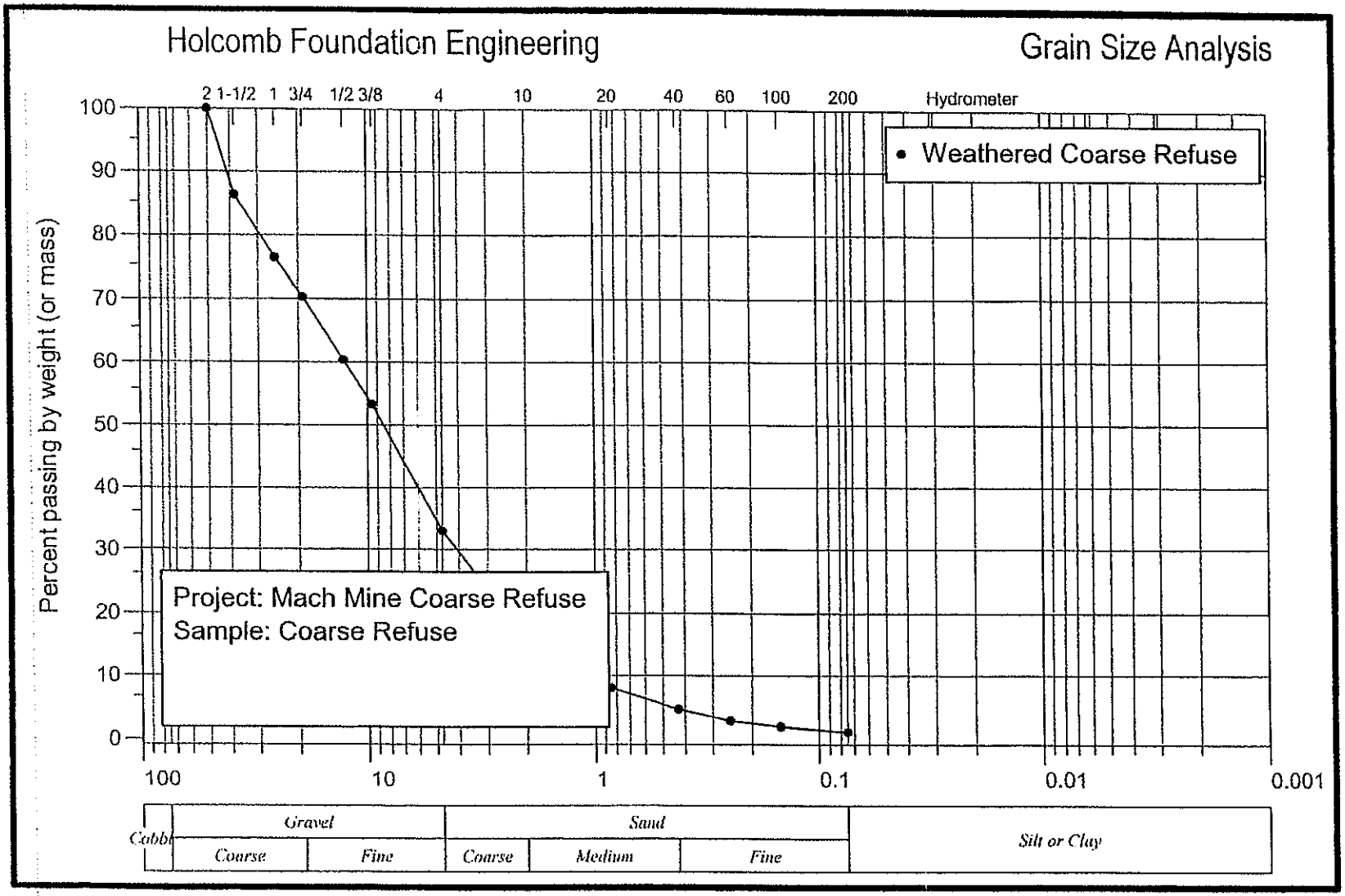
Proctor Test Results

Soil Classification:	**Weathered Coarse Refuse**
Maximum Dry Density (PCF)	**120.3**
Optimum Moisture Content (%)	**10.7**

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
12.8	118.7
13.2	116.7
10.2	120.1
7.8	119.1
10.7	120.3




Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
• Weathered Coarse Refuse
Project: Mach Mine Coarse Refuse
Sample: Coarse Refuse
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

R15159

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SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

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618-529-5262
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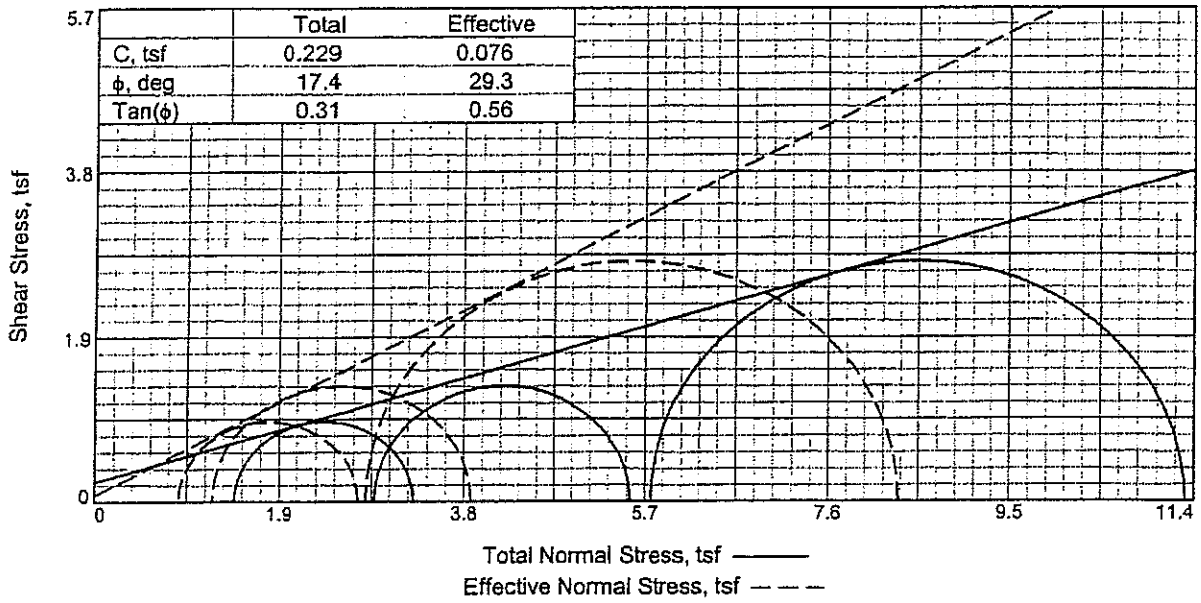
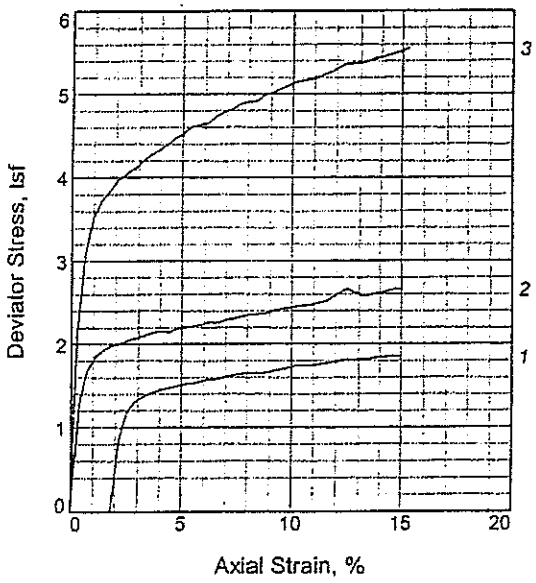
Grain Size Analysis

Project:	Mach Mine	Client:	Mach Mine
Project No.:	H-05278	Date:	4/9/2007
Sample No.	Coarse Refuse	Total Weight:	2290.30

Sieve	Wt. Retained	% Ret.	% Passing
2"	0.0	0.0	100.0
1.5"	314.4	13.7	86.3
1"	536.7	23.4	76.6
3/4"	674.8	29.5	70.5
1/2"	901.6	39.4	60.6
3/8"	1061.2	46.3	53.7
#4	1522.1	66.5	33.5
#10	1911.6	83.5	16.5
#20	2091.9	91.3	8.7
#40	2166.2	94.6	5.4
#60	2202.2	96.2	3.8
#100	2223.7	97.1	2.9
#200	2245.2	98.0	2.0





Sample No.		1	2	3
Initial	Water Content,	14.4	12.7	13.1
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	95.1	89.0	90.4
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
At Test	Water Content,	15.2	14.2	14.5
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.60	3.60	1.80
Cell Pressure, tsf		5.04	6.48	7.56
Fail. Stress, tsf		1.85	2.67	5.55
Total Pore Pr., tsf		4.18	5.27	4.77
Ult. Stress, tsf		1.85	2.66	5.55
Total Pore Pr., tsf		4.18	5.22	4.77
$\bar{\sigma}_1$ Failure, tsf		2.71	3.88	8.34
$\bar{\sigma}_3$ Failure, tsf		0.86	1.21	2.79

Type of Test:
CU with Pore Pressures
Sample Type: Coarse Refuse
Description:

Assumed Specific Gravity= 2.50
Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

Location: Weathered Coarse Refuse

Proj. No.: H-05278 **Date:** 4/2/07

TRIAXIAL SHEAR TEST REPORT

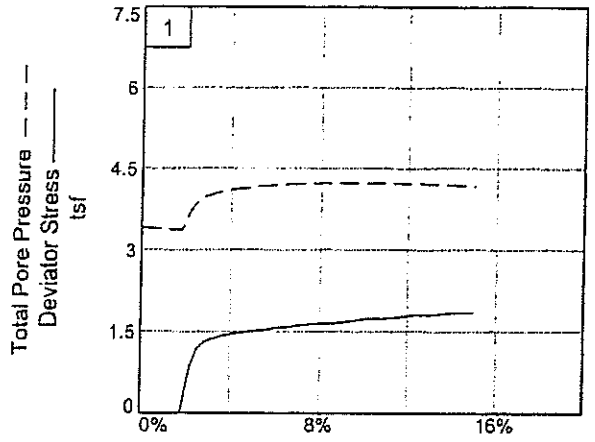
HOLCOMB FOUNDATION ENGINEERING CO.

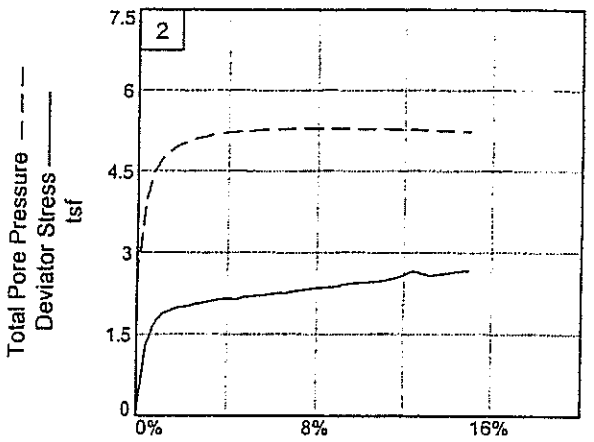
Plate _____

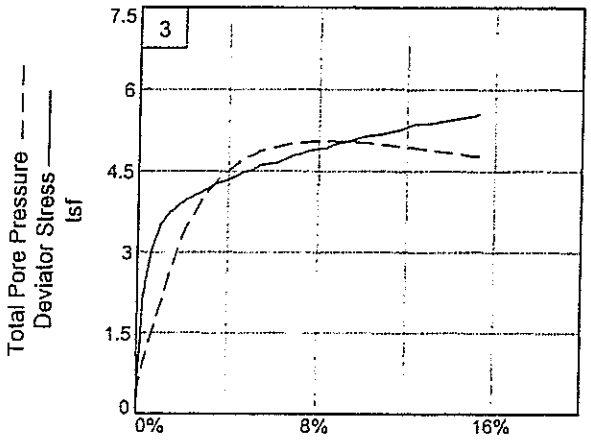
Tested By: LC Checked By: TH

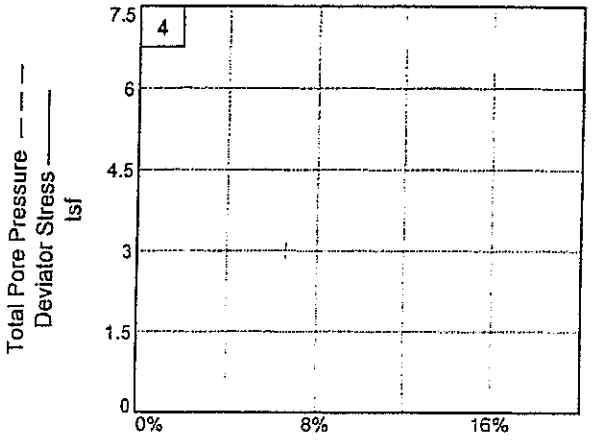
41 of 51

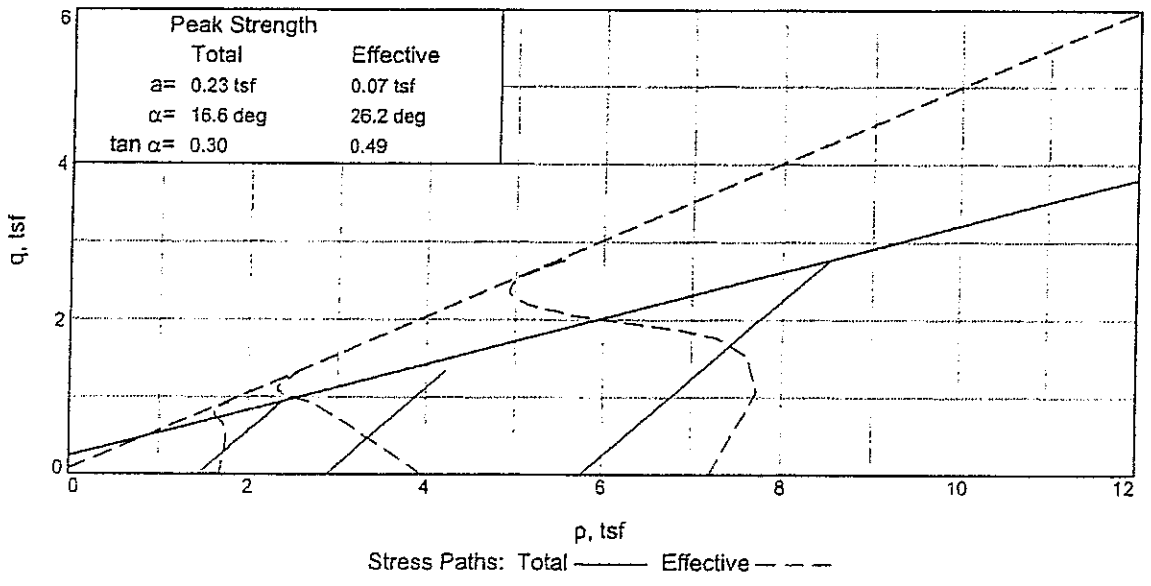
R15162











Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Weathered Coarse Refuse
Project No.: H-05278

Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC **Checked By:** TH

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

4/9/2007
11:10 AM

Date: 4/2/07
Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Weathered Coarse Refuse
Description:
Remarks:
Type of Sample: Coarse Refuse
Assumed Specific Gravity=2.50 **LL=** **PL=** **PI=**
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	179.300			1255.500
Moisture content: Dry soil+tare, gms.	165.700			1117.500
Moisture content: Tare, gms.	71.400			79.600
Moisture, %	14.4	15.2	15.2	13.3
Moist specimen weight, gms.	1170.0			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.59	5.59	5.59	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.5	130.3	130.3	
Dry density, pcf	113.2	113.2	113.2	
Void ratio	0.3793	0.3793	0.3793	
Saturation, %	95.1	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.845 tsf at reading no. 31
Ult. Stress = 1.845 tsf at reading no. 31

Test Results for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	19.10	0.0	0.0	0.000	1.627	1.627	1.00	47.40	1.627	0.000
1	0.0190	20.00	0.9	0.3	0.001	1.642	1.642	1.00	47.20	1.642	0.000
2	0.0400	20.00	0.9	0.7	0.000	1.656	1.656	1.00	47.00	1.656	0.000
3	0.0600	20.00	0.9	1.1	0.000	1.663	1.663	1.00	46.90	1.663	0.000
4	0.0810	20.00	0.9	1.4	0.000	1.678	1.678	1.00	46.70	1.678	0.000
5	0.1010	25.00	5.9	1.8	0.017	1.678	1.694	1.01	46.70	1.686	0.008
6	0.1220	99.00	79.9	2.2	0.857	1.318	2.175	1.65	51.70	1.746	0.429
7	0.1420	124.00	104.9	2.5	1.195	1.152	2.347	2.04	54.00	1.750	0.598
8	0.1620	134.80	115.7	2.9	1.314	1.058	2.372	2.24	55.30	1.715	0.657
9	0.1830	140.60	121.5	3.3	1.374	1.001	2.375	2.37	56.10	1.688	0.687
10	0.2030	144.80	125.7	3.6	1.416	0.965	2.381	2.47	56.60	1.673	0.708
11	0.2240	148.10	129.0	4.0	1.448	0.936	2.384	2.55	57.00	1.660	0.724
12	0.2440	150.60	131.5	4.4	1.471	0.914	2.385	2.61	57.30	1.650	0.735
13	0.2650	153.10	134.0	4.7	1.493	0.900	2.393	2.66	57.50	1.646	0.746
14	0.2850	155.60	136.5	5.1	1.515	0.878	2.393	2.72	57.80	1.636	0.757
15	0.3060	157.30	138.2	5.5	1.528	0.864	2.392	2.77	58.00	1.628	0.764
16	0.3260	159.80	140.7	5.8	1.549	0.857	2.406	2.81	58.10	1.631	0.775
17	0.3460	162.30	143.2	6.2	1.571	0.850	2.420	2.85	58.20	1.635	0.785
18	0.3670	163.10	144.0	6.6	1.573	0.835	2.408	2.88	58.40	1.622	0.787
19	0.3870	166.40	147.3	6.9	1.603	0.828	2.431	2.94	58.50	1.630	0.802
20	0.4080	168.90	149.8	7.3	1.624	0.821	2.445	2.98	58.60	1.633	0.812
21	0.4490	172.30	153.2	8.0	1.648	0.814	2.461	3.02	58.70	1.637	0.824
22	0.4890	173.90	154.8	8.7	1.652	0.806	2.458	3.05	58.80	1.632	0.826
23	0.5300	178.90	159.8	9.5	1.691	0.806	2.498	3.10	58.80	1.652	0.846
24	0.5710	184.80	165.7	10.2	1.740	0.814	2.553	3.14	58.70	1.683	0.870
25	0.6120	186.40	167.3	10.9	1.742	0.806	2.549	3.16	58.80	1.677	0.871
26	0.6530	190.60	171.5	11.7	1.771	0.821	2.592	3.16	58.60	1.706	0.886
27	0.6940	195.60	176.5	12.4	1.808	0.821	2.628	3.20	58.60	1.725	0.904
28	0.7350	197.20	178.1	13.1	1.809	0.835	2.644	3.17	58.40	1.740	0.904
29	0.7760	201.40	182.3	13.9	1.836	0.842	2.678	3.18	58.30	1.760	0.918
30	0.8170	204.70	185.6	14.6	1.853	0.857	2.710	3.16	58.10	1.783	0.927
31	0.8370	204.70	185.6	15.0	1.845	0.864	2.709	3.14	58.00	1.787	0.923

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	169.900			1238.700
Moisture content: Dry soil+tare, gms.	158.800			1117.200
Moisture content: Tare, gms.	71.200			73.100
Moisture, %	12.7	14.2	14.2	11.6
Moist specimen weight, gms.	1169.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.7	131.5	131.5	
Dry density, pcf	115.1	115.1	115.1	
Void ratio	0.3560	0.3560	0.3560	
Saturation, %	89.0	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 2.666 tsf **at reading no.** 27
Ult. Stress = 2.663 tsf **at reading no.** 31

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	62.40	0.0	0.0	0.000	3.967	3.967	1.00	34.90	3.967	0.000
1	0.0220	173.10	110.7	0.4	1.289	2.484	3.773	1.52	55.50	3.129	0.645
2	0.0420	206.40	144.0	0.8	1.671	2.016	3.687	1.83	62.00	2.852	0.836
3	0.0620	223.00	160.6	1.1	1.857	1.764	3.621	2.05	65.50	2.693	0.929
4	0.0830	230.50	168.1	1.5	1.936	1.613	3.549	2.20	67.60	2.581	0.968
5	0.1030	235.50	173.1	1.8	1.987	1.512	3.499	2.31	69.00	2.505	0.993
6	0.1240	238.00	175.6	2.2	2.008	1.447	3.455	2.39	69.90	2.451	1.004
7	0.1440	242.20	179.8	2.6	2.048	1.390	3.438	2.47	70.70	2.414	1.024
8	0.1650	245.50	183.1	3.0	2.078	1.346	3.424	2.54	71.30	2.385	1.039
9	0.1850	248.80	186.4	3.3	2.107	1.310	3.418	2.61	71.80	2.364	1.054
10	0.2060	252.20	189.8	3.7	2.137	1.289	3.426	2.66	72.10	2.358	1.069
11	0.2260	254.70	192.3	4.0	2.158	1.267	3.425	2.70	72.40	2.346	1.079
12	0.2460	253.80	191.4	4.4	2.139	1.253	3.392	2.71	72.60	2.322	1.070
13	0.2670	258.80	196.4	4.8	2.187	1.238	3.425	2.77	72.80	2.332	1.093
14	0.2870	260.50	198.1	5.1	2.197	1.231	3.428	2.78	72.90	2.330	1.099
15	0.3080	263.00	200.6	5.5	2.216	1.217	3.433	2.82	73.10	2.325	1.108
16	0.3280	265.50	203.1	5.9	2.235	1.210	3.445	2.85	73.20	2.327	1.118
17	0.3490	268.80	206.4	6.3	2.263	1.210	3.472	2.87	73.20	2.341	1.131
18	0.3690	268.80	206.4	6.6	2.254	1.202	3.456	2.87	73.30	2.329	1.127
19	0.3900	273.00	210.6	7.0	2.290	1.195	3.486	2.92	73.40	2.340	1.145
20	0.4100	275.50	213.1	7.3	2.309	1.195	3.504	2.93	73.40	2.350	1.154
21	0.4510	281.30	218.9	8.1	2.353	1.188	3.541	2.98	73.50	2.364	1.176

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4920	284.60	222.2	8.8	2.369	1.195	3.564	2.98	73.40	2.380	1.185
23	0.5330	292.10	229.7	9.6	2.429	1.195	3.625	3.03	73.40	2.410	1.215
24	0.5740	296.30	233.9	10.3	2.454	1.202	3.656	3.04	73.30	2.429	1.227
25	0.6140	300.40	238.0	11.0	2.477	1.202	3.679	3.06	73.30	2.441	1.238
26	0.6440	305.40	243.0	11.5	2.514	1.217	3.730	3.07	73.10	2.474	1.257
27	0.6960	322.90	260.5	12.5	2.666	1.210	3.876	3.20	73.20	2.543	1.333
28	0.7370	316.20	253.8	13.2	2.576	1.238	3.814	3.08	72.80	2.526	1.288
29	0.7780	322.10	259.7	13.9	2.613	1.238	3.852	3.11	72.80	2.545	1.307
30	0.8190	328.70	266.3	14.7	2.657	1.253	3.910	3.12	72.60	2.581	1.328
31	0.8390	330.40	268.0	15.0	2.663	1.260	3.923	3.11	72.50	2.591	1.331

Test Moisture for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	171.400			1284.500
Moisture content: Dry soil+tare, gms.	160.000			1180.500
Moisture content: Tare, gms.	72.800			134.900
Moisture, %	13.1	14.5	14.5	9.9
Moist specimen weight, gms.	1168.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.6	131.2	131.2	
Dry density, pcf	114.6	114.6	114.6	
Void ratio	0.3615	0.3615	0.3615	
Saturation, %	90.4	100.0	100.0	

Test Readings for Specimen No. 3

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 105.00 psi (7.560 tsf)
Consolidation back pressure = 25.00 psi (1.800 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 5.549 tsf at reading no. 35
Ult. Stress = 5.549 tsf at reading no. 35

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0020	102.40	0.0	0.0	0.000	7.207	7.207	1.00	4.90	7.207	0.000
1	0.0170	286.30	183.9	0.3	2.145	6.674	8.819	1.32	12.30	7.747	1.072
2	0.0370	364.50	262.1	0.6	3.046	6.113	9.158	1.50	20.10	7.636	1.523
3	0.0580	407.00	304.6	1.0	3.526	5.537	9.063	1.64	28.10	7.300	1.763
4	0.0780	426.10	323.7	1.4	3.733	4.997	8.730	1.75	35.60	6.864	1.867
5	0.0990	437.70	335.3	1.7	3.853	4.536	8.389	1.85	42.00	6.462	1.926
6	0.1190	449.40	347.0	2.1	3.972	4.133	8.105	1.96	47.60	6.119	1.986
7	0.1400	457.70	355.3	2.5	4.052	3.838	7.889	2.06	51.70	5.863	2.026

Test Readings for Specimen No. 1

No.	Def. Dial In.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
8	0.1600	464.40	362.0	2.8	4.113	3.593	7.706	2.14	55.10	5.649	2.056
9	0.1810	474.40	372.0	3.2	4.210	3.384	7.594	2.24	58.00	5.489	2.105
10	0.2010	481.90	379.5	3.6	4.279	3.211	7.490	2.33	60.40	5.351	2.140
11	0.2210	487.70	385.3	3.9	4.328	3.074	7.403	2.41	62.30	5.239	2.164
12	0.2420	495.20	392.8	4.3	4.395	2.959	7.355	2.49	63.90	5.157	2.198
13	0.2620	503.50	401.1	4.7	4.471	2.851	7.323	2.57	65.40	5.087	2.236
14	0.2830	509.30	406.9	5.0	4.518	2.772	7.290	2.63	66.50	5.031	2.259
15	0.3030	519.30	416.9	5.4	4.612	2.693	7.305	2.71	67.60	4.999	2.306
16	0.3240	522.60	420.2	5.8	4.630	2.650	7.279	2.75	68.20	4.965	2.315
17	0.3440	526.00	423.6	6.1	4.650	2.621	7.270	2.77	68.60	4.946	2.325
18	0.3650	534.30	431.9	6.5	4.722	2.578	7.299	2.83	69.20	4.938	2.361
19	0.3850	541.80	439.4	6.9	4.785	2.549	7.334	2.88	69.60	4.941	2.393
20	0.4050	546.80	444.4	7.2	4.821	2.534	7.355	2.90	69.80	4.945	2.411
21	0.4260	553.40	451.0	7.6	4.873	2.520	7.393	2.93	70.00	4.956	2.436
22	0.4460	558.40	456.0	8.0	4.908	2.506	7.413	2.96	70.20	4.959	2.454
23	0.4670	560.90	458.5	8.3	4.914	2.506	7.420	2.96	70.20	4.963	2.457
24	0.4870	569.20	466.8	8.7	4.984	2.506	7.489	2.99	70.20	4.997	2.492
25	0.5080	574.20	471.8	9.1	5.016	2.513	7.529	3.00	70.10	5.021	2.508
26	0.5280	580.10	477.7	9.4	5.059	2.520	7.579	3.01	70.00	5.050	2.530
27	0.5690	592.50	490.1	10.2	5.148	2.534	7.683	3.03	69.80	5.109	2.574
28	0.6100	600.00	497.6	10.9	5.184	2.570	7.755	3.02	69.30	5.163	2.592
29	0.6510	610.90	508.5	11.6	5.254	2.599	7.853	3.02	68.90	5.226	2.627
30	0.6920	625.80	523.4	12.4	5.363	2.628	7.991	3.04	68.50	5.310	2.682
31	0.7330	631.70	529.3	13.1	5.378	2.671	8.049	3.01	67.90	5.360	2.689
32	0.7730	641.60	539.2	13.8	5.434	2.707	8.141	3.01	67.40	5.424	2.717
33	0.8140	651.60	549.2	14.6	5.487	2.750	8.238	3.00	66.80	5.494	2.744
34	0.8350	656.60	554.2	14.9	5.513	2.772	8.285	2.99	66.50	5.528	2.756
35	0.8540	662.50	560.1	15.3	5.549	2.786	8.335	2.99	66.30	5.561	2.775

APPENDIX D

Boring Logs

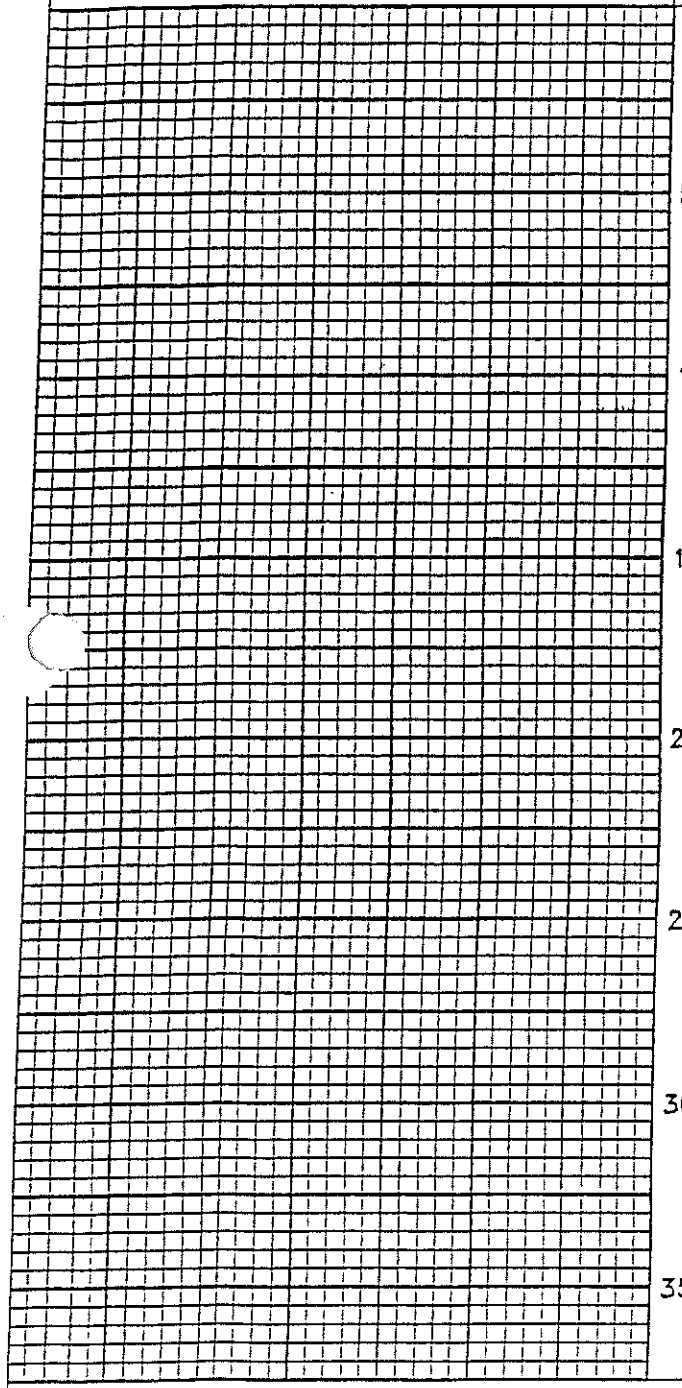
Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 8874

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Brown Silty CLAY (CL) with sand and pebbles
5	1	st		
	2	st		
10				Gray Mottled Brown Silty CLAY (CL)
	3	st		
15				
	4	st		
	5	st		
20				End of Boring @ -20.0'
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling and None Upon Completion.

Project: Mach #1 Mine Soils Investigation
Mach #1 Mine Williamson County Illinois

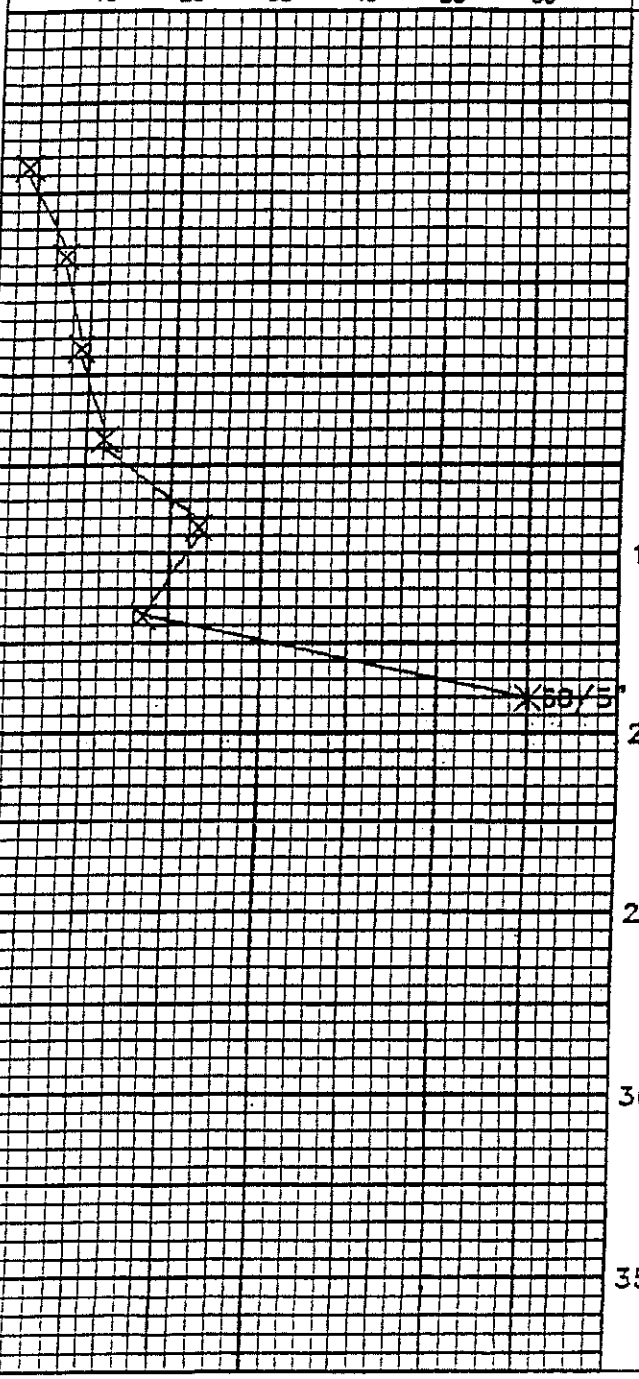
Date of Boring
February 1, 2006

Client: Alliance Consulting, Inc.
Beaver, West Virginia

Project No.
H-05278

LOG of BORING 8293

Holcomb Foundation Engineering Co.



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				7" Topsoil
				Gray Mottled Brown Silty CLAY (CL) with trace of sand
5	1	SS		
	2	SS		
	3	SS		
10				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
	4	SS		
	5	SS		
15				
	6	SS		
	7	SS		Gray SHALE
20				End of Boring ⊖ −19.0'
25				
30				
35				

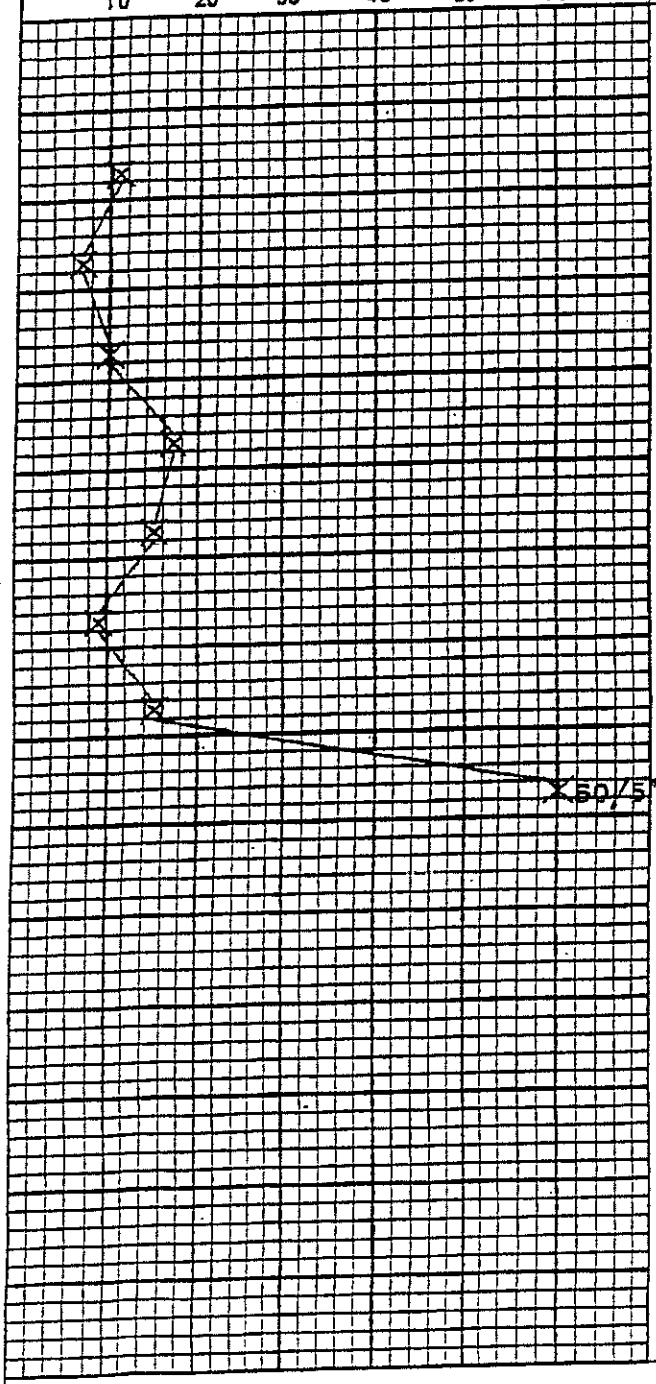
Ground Water Data
Ground Water Encountered ⊖ −12.0' During Drilling.

Project: Rock Probes for Mach Mine Johnston City, Illinois	Date of Boring December 5, 2005
Client: Williamson County Energy Marion, Illinois	Project No. H-05278

LOG of BORING B294

Holcomb Foundation Engineering Co.

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6
Water Content (%)
Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				7" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
10	3	ss		
	4	ss		
15	5	ss		
	6	ss		
20	7	ss		
	8	ss		Brown SHALE
				End of Boring ● -22.5'
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

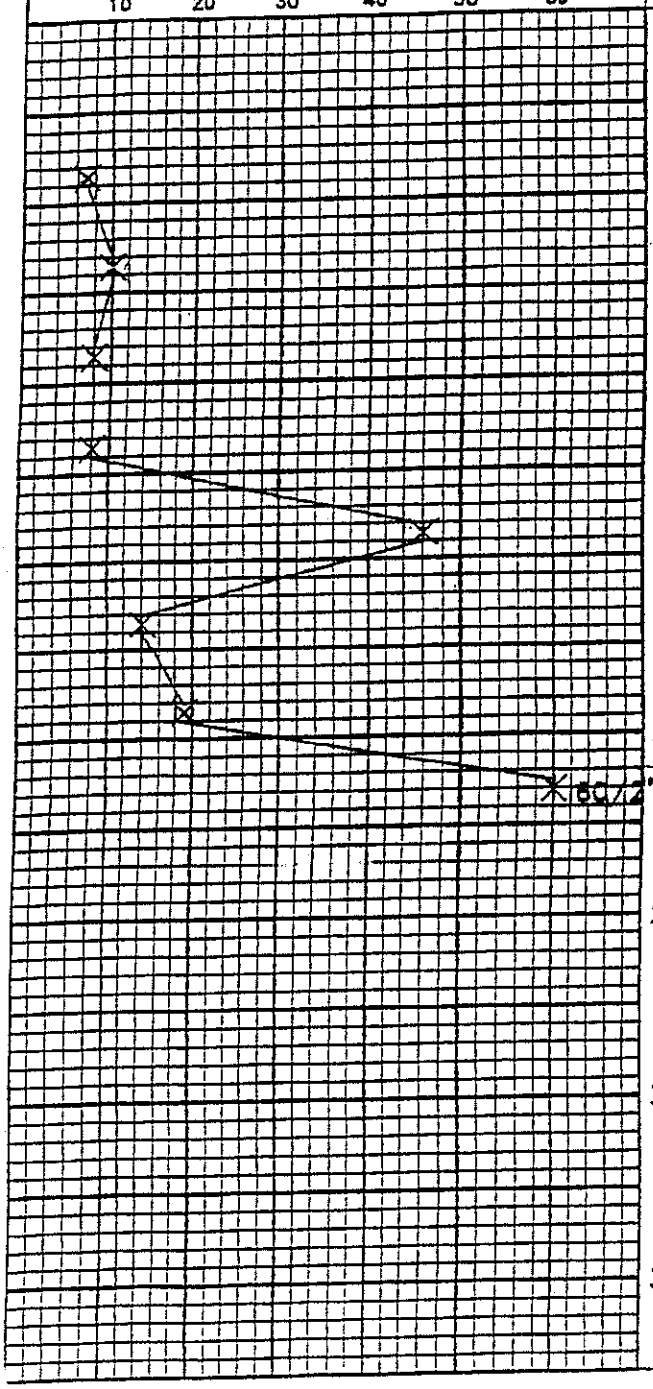
Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

LOG of BORING B295

Holcomb Foundation Engineering Co.



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				9" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
10	3	ss		
	4	ss		
15	5	ss		Brown SILT (ML)
	6	ss		Brown Medium to Coarse SAND (SC-SP)
20	7	ss		
	8	ss		Gray Mottled Brown SHALE
25				End of Boring @ -22.0'
30				
35				

Ground Water Data
Ground Water Encountered @ -16.0' During Drilling/ @ -10.0' Upon Completion.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

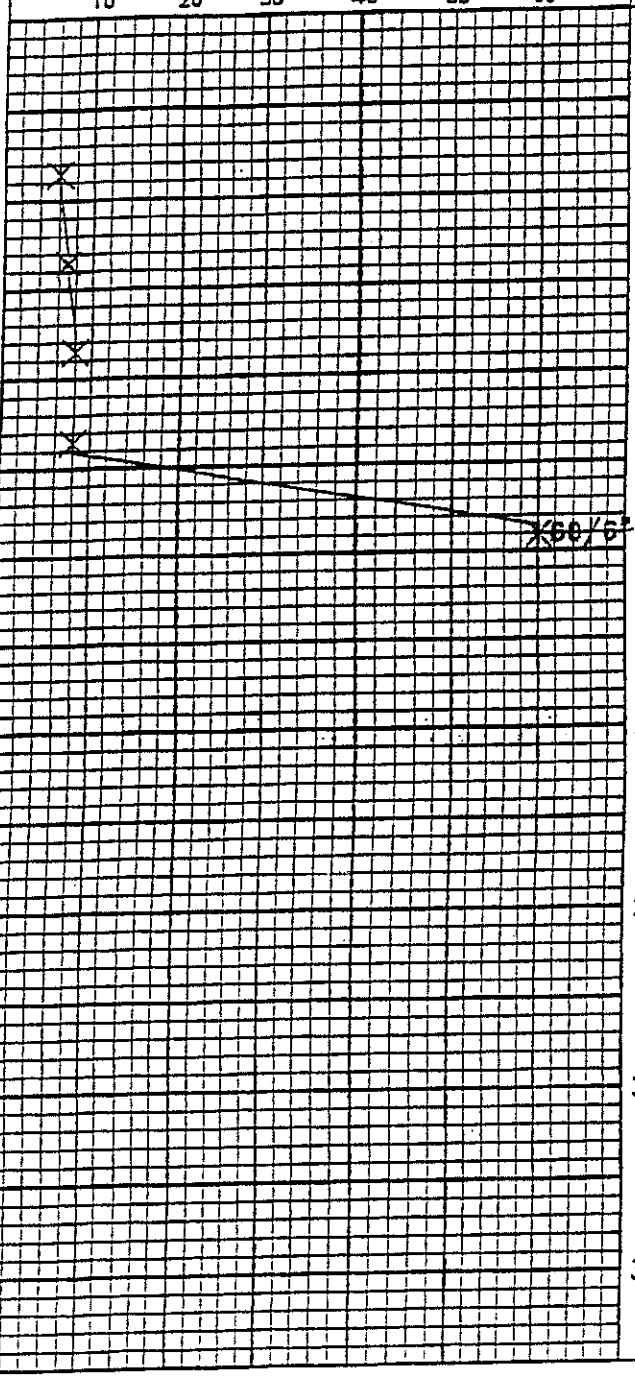
Date of Boring: December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.: H-05278

LOG of BORING 8297

Holcomb Foundation Engineering Co.



Sample No.	Type Sample	Sample Distance	Description of Material
			Surface Elevation
			9" Topsoil
			Gray Mottled Brown Silty CLAY (CL) with sand and pebbles
1	ss		
2	ss		
3	ss		Brown Mottled Gray Silty CLAY (CL) with trace of sand
4	ss		Gray Mottled Brown Silty CLAY (CL) with trace of sand
5	ss		Brown SHALE
			End of Boring @ -15.5'

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

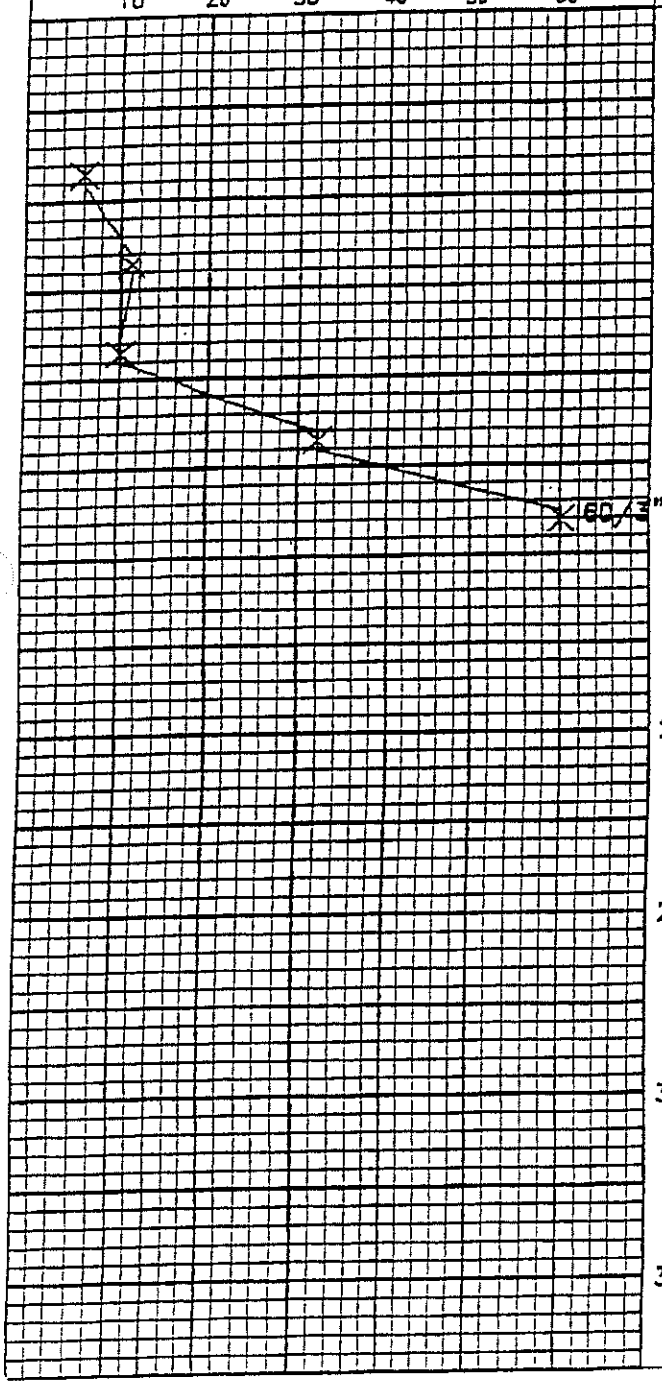
Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

LOG of BORING 8298

Holcomb Foundation Engineering Co.



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				6" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	SS		
	2	SS		
	3	SS		Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
10	4	SS		Brown Mottled Gray SHALE
	5	SS		Gray SHALE
15				End of Boring @ −14.5'
20				
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

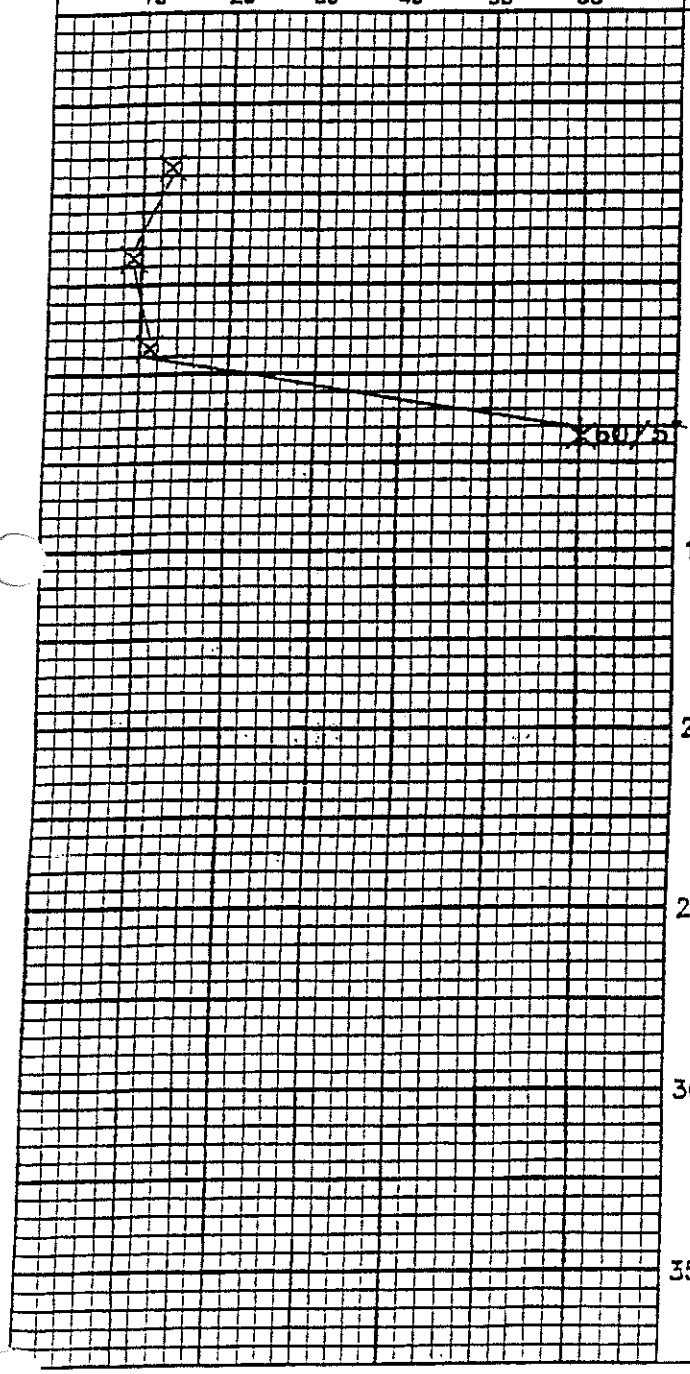
LOG of BORING B299

Holcomb Foundation Engineering Co.

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
	1	SS		
	2	SS		
	3	SS		
	4	SS		Brown SHALE
				End of Boring @ -12.5'

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

8114-10
Part 2

R15176

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

PAGE 1 OF 12

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CALCULATION BRIEF
FOR
CHARACTERIZATION OF SAND-LIKE AND CLAY-LIKE SUBSURFACE MATERIALS

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH CELL

OBJECTIVE: To characterize subsurface materials including coarse coal refuse, fine coal refuse and residual soils encountered at the Pond Creek South Cell refuse disposal facility. Materials are characterized as either sand-like or clay-like in accordance with various pertinent references shown below and included within the "Draft" Mine Health and Safety Administration (MSHA) Engineering and Design Manual, specifically Chapter 7: Seismic Design: Stability and Deformation Analyses, March 2007.

REFERENCES:

1. Illinois Department of Natural Resources, Office of Water Resources, Construction and Maintenance of Dams, Part 3702, Chapter IX.

2. Mine Safety and Health Administration, "Draft - Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 – Seismic Design: Stability and Deformation Analyses," dated, March 13, 2007.

3. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Piezo-Cone Penetration Testing," Pond Creed Coal Refuse Disposal Site, BEG, dated 12/21/07.

4. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Normalized PS-CPT Data and Parameter Correlations," Pond Creek Coal Refuse Disposal Site, BEG, dated 12/28/07.

5. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Laboratory Testing," Pond Coal Refuse Disposal Site – South Pond, BEG, dated 7/8/08.

6. Boulanger, R.W. and Idriss, I.M. (2004). "Evaluating the Potential for Liquefaction or Cyclic Failure of Silts and Clays," Report No. UCD/CGM-04/01, Center for Geotechnical Modeling, Department of Civil and Environmental Engineering, University of California, Davis, California.

7. Robertson, P.K., (Fear) Wride, C.E., List, B.R., Atukorala, U., Biggar, K.W., Byrne, P.M., Campanella, R.G., Cathro, D.C., Chan, D.H., Czajewski, K., Finn, W.D.L., Gu, W.H., Hammamji, Y., Hofmann, B.A., Howie, J.A., Hughes, J., Imrie, A.S., Konrad, J.-M., Küpper, A., Law, T., Lord, E.R.F., Monahan, P.A., Morgenstern, N.R., Phillips, R., Piché, Plewes, H.D., Scott, D., Sego, D.C., Sobkowicz, J., Stewart, R.A., Tan, S., Vaid, Y.P., Watts, B.D., Woeller, D.J., Youd, T.L., and Zavodni, Z., The CANLEX Project: Summary and Conclusions. Canadian Geotechnical Journal, 2000, Vol. 37, No. 3, June, pp. 499-504

8. Youd, T. L. et al. (2001). "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 127, No. 10, pp. 817-833.

9. Blight, G. E. and Bentel, G. M., (1983) "The Behaviour of Mine Tailings During Hydraulic Deposition," Journal of the South African Institute of Mining and Metallurgy, April 1983.

GENERAL:

Reference (Ref.) Number (No.) 1 presents the following guidelines regarding the methods of testing, analyses and computations which must be completed and submitted with an application to support an owner's request for abandonment of a disposal impoundment dam:

1. The classification of the existing condition of the impounded material with respect to its fluid nature;
2. The liquefaction potential of the impounded material and the related stability of the containing dam;
3. The final surface configuration for the impounded materials, especially from any surface water impounding characteristics and the erosion potential of the surface material; and
4. The establishment of a follow-up inspection schedule to ensure the proposed plans have been effective and the submittal of record drawings.

This, and subsequent calculation briefs prepared by Civil & Environmental Consultants, Inc. (CEC), address the characterization of the impounded fine coal refuse and the liquefaction potential of the fine coal refuse and related stability (i.e., Requirements 1 and 2 above). Alliance Consulting, Inc. (Alliance) will provide the final surface configuration and the follow-up inspection schedule.

From Ref. No. 2, the basic elements for seismic design and analysis are:

1. Characterize the subsurface materials;
2. Evaluate if design earthquake will trigger strength loss;
3. Evaluate seismic stability using post-earthquake strength parameters; and
4. Evaluate deformations.

Therefore, the first step for both abandonment and seismic design and analysis is to characterize the subsurface conditions to evaluate the fluid nature and whether any zones have the potential for strength loss due to earthquake shaking (i.e., liquefaction potential). Previously, the materials making up the coarse refuse dike and underlying residual soils were evaluated using piezo-seismic cone penetration testing (PSCPT) (Ref. Nos. 3 and 4) as part of the deformation analyses of the South Pond. Subsequently, and as part of the abandonment evaluation, laboratory testing (Ref. No. 5) and characterization of the fine coal refuse retained behind the embankment was performed as described below.

For many aspects of seismic stability analyses described in Ref. No. 2, coal refuse and natural soils are referred to as sand-like or clay-like depending on whether they exhibit monotonic and cyclic undrained shear loading behavior that is fundamentally more similar to that of either sand or clay. This differentiation is significant primarily if the material is loose enough (sands) or soft enough (clays) that it is potentially susceptible to strength loss.

SUMMARY OF POND CREEK FIELD AND LABORATORY TESTING/RESULTS:

CEC developed, implemented and oversaw a detailed and thorough field testing program consisting of performing PS-CPT at several sounding locations throughout the Pond Creek site, including the ongoing South Pond impoundment. PS-CPT was executed at Pond Creek by ConeTec, Inc. (ConeTec) of West Berlin, New Jersey. Also, Alliance provided bulk (bucket) samples of fine coal refuse, which were obtained for subsequent laboratory testing. Geotechnics, Inc. (Geotechnics) of Pittsburgh, Pennsylvania performed consolidated undrained triaxial shear strength laboratory testing of the fine coal refuse materials. Ref. Nos. 3 -5 present summaries of the field and laboratory testing programs and Appendixes A - C of the Pond Creek abandonment report present the results of the field and laboratory testing.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 4 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

PIEZO-SEISMIC CONE PENETRATION TEST RESULTS SUMMARY:

Generalized South Cell CPT Profiles from the October 2007 field testing presented in Ref. Nos. 3 and 4 indicated the following:

CPT-1	CPT-2
El. 482.19 – Surface Elevation	El. 494.21 – Surface Elevation
15.3 feet – Depth to Static Ground Water	38.8 feet – Depth to Static Ground Water
0 – 18.4 feet – Residual Soil	0 – 32 feet – Coarse Refuse
Refusal at 18.4 feet - Bedrock	32 – 45.3 feet – Residual Soil
	Refusal at 45.3 feet - Bedrock

CPT-2A	CPT-3
El. 492.40 – Surface Elevation	El. 466.98 – Surface Elevation
37.0 feet – Depth to Static Ground Water	11.1 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 22.2 feet – Residual Soil
29 – 41.7 feet – Residual Soil	Refusal at 22.2 feet – Bedrock
Refusal at 41.7 feet - Bedrock	

CPT-4	CPT-5
El. 482.55 – Surface Elevation	El. 482.55 – Surface Elevation
21.7 feet – Depth to Static Ground Water	34.4 feet – Depth to Static Ground Water
0 – 18.9 feet – Residual Soil	0 – 29 feet – Coarse Refuse
Refusal at 18.9 feet – Bedrock	29 – 49.2feet – Residual Soil
	Refusal at 49.2 feet - Bedrock

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 5 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-5A	CPT-5B
El. 483.00 – Surface Elevation	El. 479.90 – Surface Elevation
35.9 feet – Depth to Static Ground Water	28.0 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 19 feet – Coarse Refuse
29 – 53.2 feet – Residual Soil	19 – 39.7 feet – Residual Soil
Refusal at 53.2 feet - Bedrock	Refusal at 39.7 feet - Bedrock

Cone penetration testing results for CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A AND CPT-5B presented in Ref. Nos. 3 and 4 indicated the following:

CPT-1	CPT-3
Residual Soil (Layer Thickness = 18.4)	**Residual Soil (Layer Thickness = 22.2)**
Avg. Tip Stress, Qc avg. = 79 tsf	Avg. Tip Stress, Qc avg. = 43 tsf
Avg. Fines Content, FC avg. = 27%	Avg. Fines Content, FC avg. = 32%
Avg. SBT Index, Ic = 2.38	Avg. SBT Index, Ic = 2.49

CPT-4
Residual Soil (Layer Thickness = 18.9)
Avg. Tip Stress, Qc avg. = 64 tsf
Avg. Fines Content, FC avg. = 28%
Avg. SBT Index, Ic = 2.41

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

MADE BY BEG DATE 7/11/08 CHECKED BY [illegible] DATE 7/23/08

CPT-2	CPT-2A
Coarse Coal Refuse (Layer Thickness = 32')	**Coarse Coal Refuse (Layer Thickness = 29')**
Avg. Tip Stress, Qc avg. = 54 tsf	Avg. Tip Stress, Qc avg. = 45 tsf
Avg. Fines Content, FC avg. = 24%	Avg. Fines Content, FC avg. = 22%
Avg. SBT Index, Ic = 2.30	Avg. SBT Index, Ic = 2.23

Residual Soil (Layer Thickness = 13.3')	**Residual Soil (Layer Thickness = 12.7')**
Avg. Tip Stress, Qc avg. = 47 tsf	Avg. Tip Stress, Qc avg. = 86 tsf
Avg. Fines Content, FC avg. = 60%	Avg. Fines Content, FC avg. = 48%
Avg. SBT Index, Ic = 2.99	Avg. SBT Index, Ic = 2.80

CPT-5	CPT-5A
Coarse Coal Refuse (Layer Thickness = 29')	**Coarse Coal Refuse (Layer Thickness = 29')**
Avg. Tip Stress, Qc avg. = 50 tsf	Avg. Tip Stress, Qc avg. = 37 tsf
Avg. Fines Content, FC avg. = 23%	Avg. Fines Content, FC avg. = 24%
Avg. SBT Index, Ic = 2.24	Avg. SBT Index, Ic = 2.29

Residual Soil (Layer Thickness = 20.2')	**Residual Soil (Layer Thickness = 24.2')**
Avg. Tip Stress, Qc avg. = 66 tsf	Avg. Tip Stress, Qc avg. = 49 tsf
Avg. Fines Content, FC avg. = 64%	Avg. Fines Content, FC avg. = 56%
Avg. SBT Index, Ic = 3.04	Avg. SBT Index, Ic = 2.94

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PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 7 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-5B
Coarse Coal Refuse (Layer Thickness = 19')
Avg. Tip Stress, Qc avg. = 41 tsf
Avg. Fines Content, FC avg. = 19%
Avg. SBT Index, Ic = 2.15

Residual Soil (Layer Thickness = 20.7')
Avg. Tip Stress, Qc avg. = 63 tsf
Avg. Fines Content, FC avg. = 51%
Avg. SBT Index, Ic = 2.84

Cone Penetration Testing Results – Shear Wave Velocities

CPT No.	Shear Wave Velocity Coarse Coal Refuse (ft/sec)			Shear Wave Velocity Residual Soil (ft/sec)		
	Max.	Min.	Avg.	Max.	Min.	Avg.
CPT-1	NA			1402	645	905
CPT-2	1284	1029	1120	1173	795	957
CPT-2A	1169	895	1042	1256	780	918
CPT-3	NA			1058	569	765
CPT-4	NA			1242	476	817
CPT-5	1190	936	1063	1599	780	947
CPT-5A	1396	779	1064	1580	728	1005
CPT-5B	1517	818	1080	1649	686	978

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PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 8 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

LABORATORY TESTING RESULTS SUMMARY:

Ref. No. 4 and Appendix A present the details and results of the June 2008 laboratory testing program performed by Geotechnics. The following summarizes laboratory testing results of each of 2 buckets of fine coal refuse sampled from the South Pond impoundment.

Bucket 1	Bucket 2
Fine Coal Refuse	**Fine Coal Refuse**
Moisture = 85.8 %	Moisture = 94.4 %
Passing No. 200 = 92.8 %	Passing No. 200 = 92.6 %
Passing No. 40 = 99.4 %	Passing No. 40 = 99.3%
Plasticity Index = 17 %	Plasticity Index = 17 %
Avg. Strain to Peak = 15.1 %	Avg. Strain to Peak = 11.0 %

Normalized tip stress and fines content with depth for CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B including a summary of pertinent average field and laboratory test results for each material layer are attached.

CRITERIA AND METHODOLOGY:

From Ref. No. 2, the first step common to all approaches is to review the subsurface conditions at the embankment to evaluate whether any zones have the potential for strength loss. For this initial screening step, saturated to nearly saturated sand-like materials with $N_{1,60}$ values less than 15 blows per foot (bpf), or q_{c1} (or Qc) values less than 75 tons per square foot (tsf), should be considered potentially susceptible to strength loss. Ref. No. 2 noted these values are likely too conservative and apply only to clean sands. Their application to silty sands and sands with high fines content, which are more representative of fine coal refuse, will likely be overly conservative.

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 9 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

Generalized field-related CPT-derived criteria noted in various references within Reference 2 include:

Sand-like:	Fines content < 50% or PI < 12%
Loose:	SPT $N_{1,60}$ < 15 or CPT q_{c1} > 75 tsf, & SBT Ic < 2.6 or F_r < 2%).
Clay-like:	Fines content > 50% and PI >12%
Soft:	OCR < 5, S_u/σ'_v < 1.0, CPT Q_t < 20 tsf & SBT Ic > 2.6, SPT $N_{1,60}$ < 8

CPT data may be used in conjunction with Atterberg limit data (criteria shown below) to differentiate sand-like from clay-like material. CPT Soil Behavior Type Index (I_c), as described in Robertson and Wride 1998 and reproduced in Youd et al. 2001, values below 2.6 should be considered sand-like. I_c values above 2.6 may be considered clay-like.

Generalized laboratory results criteria noted in various references within and in Ref. No. 1 include the following Atterberg Limit and sieve criteria:

Atterberg Limits.

- Material should be considered sand-like if any of the following three (3) criteria apply:

  1. The material has less than 35% particles by dry weight passing the No. 40 sieve and less than 20% by dry weight passing the No. 200 sieve; or

  2. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 12%; or

  3. The material has 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 20%.

The material may be considered clay-like if any of the following two (2) criteria apply:

1. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 12% or higher; or

2. The material has 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 20% or higher.

Atterberg limit criteria include as sand-like some materials that are considered clay-like by some investigators (e.g. Boulanger and Idriss, 2004, who suggested a break between sand-like and clay-like behavior at a PI of 7%). The intent is to classify borderline materials as sand-like to be conservative.

Another key factor in differentiating loose sand-like material from soft or medium clay-like material, for the purposes of seismic stability and deformation analyses, are the strain at peak undrained strength and the abruptness of the drop-off in shearing resistance as strains increase beyond the strain at peak. Loose sands and highly sensitive clays can reach S_{up} at small strains, and experience abrupt drop-off in resistance at higher strains. Most clays tend to reach S_{up} at higher strains, and tend to experience more gradual and limited drop-off in shearing resistance at higher strains. Fine coal refuse deposits often include materials falling within both classifications, and near the boundary of these two types of behavior.

Loose materials with shear strain at peak strength of less than 2% in an undrained monotonic (non-cyclic) test, and a rapid drop-off in resistance after reaching peak strength, are considered sand-like. Loose or soft materials with shear strain at peak strength of more than about 5%, and a gradual drop-off in resistance after reaching peak strength are considered clay-like. Materials with strain behavior between these descriptions are considered borderline and, to be conservative, should generally be analyzed as sand-like. (Note that shear strain in an undrained triaxial test is 1.5 times axial strain.)

Soil, rock, and mixtures of soil and rock that are not coal refuse such as the underlying starter embankment will be referred to as natural soils. Natural soils may be described as sand-like, or clay-like, using the same general criteria as refuse.

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PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

PAGE 11 OF 12

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A AND CPT-5B AVG. WEIGHTED AVERAGE FIELD AND LAB RESULTS SUMMARY
Coarse Coal Refuse (138')
Avg. Tip Stress, Qc avg. = 46 tsf
Avg. Fines Content, FC avg. = 23%
Avg. SBT Index, Ic = 2.25

Fine Coal Refuse
Avg. % Passing No. 200 = 92.7%
Avg. % Passing No. 40 = 99.4 %
Avg. Plasticity Index = 17%
Avg. Strain to Peak = 13.1 %

Residual Soil (150.6')
Avg. Tip Stress, Qc avg. = 61 tsf
Avg. Fines Content, FC avg. = 46%
Avg. SBT Index, Ic = 2.73

Plots of individual and average normalized tip stress with depth are included with an attached complete copy of Ref. No. 4.

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 12 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MSS DATE 7/23/08

CONCLUSION

Based on the information presented in this calculation brief, the following material characteristic designations were determined for the coarse coal refuse, fine coal refuse and residual soil:

Coarse Coal Refuse: Medium Dense Sand-Like;

Fine Coal Refuse: Medium Stiff Clay-Like;

Residual Soil: Medium Dense Sand-Like and Medium Stiff Clay-Like.

Further, the results of the laboratory testing indicate that the fine coal refuse is clay-like based on an average 93% passing the No. 200 sieve and plasticity index of 17%. Peak and steady-state undrained strengths presented in Appendix A were reached at generally high strains (between 8 and 18%), and there was very little drop off from peak to steady-state with increasing strain. The results generally indicated a higher resistance to strength loss (and flow) due to the large strains required to exceed the peak strength and correspondingly small decrease to the steady-state strength at higher strains. Further, previous deformation analyses results indicated induced shear strains from the PGA at less than 0.1%, which is well below a threshold (peak) triggering strain of the material.

The susceptibility of the embankment and impoundment to a liquefaction flow failure is a function of both the undrained strength (worst case steady-state strength) and the in-situ driving shear stress on a critical failure plane passing through the critical layer fine coal refuse material, which is further addressed in subsequent calculation briefs.

REFERENCE 4
NORMALIZED TIP STRESS WITH FIELD/LAB SUMMARY AND SOIL CLASSIFICATION VS DEPTH;
FINES CONTENT AND FIELD/LAB SUMMARY VS DEPTH AND
NORMALIZED TIP STRESS AND FINES CONTENT VS DEPTH SPREADSHEET

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PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 1 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

CALCULATION BRIEF
FOR
NORMALIZED PS-CPT DATA AND PARAMETER CORRELATIONS

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE:

Use data recorded during the piezo-seismic cone penetration testing (PS-CPT) at the Williamson Energy, Pond Creek Coal Refuse Disposal facility located in Williamson County, Illinois to correlate various index and strength properties. Also, nearly continuous profiles with depth of various applicable engineering properties of the refuse and subgrade soil materials in the fifteen (15) soundings tested at the Pond Creek facility are tabulated and attached.

REFERENCES:

1. Bowles, Joseph E. (1984) "Physical and Geotechnical Properties of Soils," Mc-Graw Hill. New York: 367-369 and 393-396.

2. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Piezo-Cone Penetration Testing," Pond Creek Coal Refuse Disposal Site, BEG, dated 12/21/07.

3. ConeTec, Inc. (2007), Field Report Entitled "Presentation of CPTU Test Results for: Pond Creek Mine – Williamson County, Illinois, December 10, 2007.

4. Robertson, P.K (1998), "Applications Guide – CPT" **Fax**

5. Robertson, P.K., et.al. (1992) "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE 109 (11): 1449-1459.

6. Robertson, P.K and Campanella, R.G, (1989), "Guidelines for Geotechnical Design Using CPT and CPTU", UBC Soil Mechanics Series No. 120, Civil Eng. Dept., Vancouver, B.C., Canada

7. Robertson, P.K and Campanella, R.G, (1983), "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE Vol. 109 No. 11, pp. 1449-1459.

8. Civil and Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak Undrained Shear Strength for Refuse and Subgrade Materials," Pond Creek Coal Refusal Site, BEG 12/28/07.

METHODOLOGY:

Using laboratory-derived unit weights for the coarse coal refuse and residual soil layers, provided by Alliance Consulting, Inc. (Alliance), the following parameters are correlated based on established CPT correlations (References 2, 3, 4, 5, 6 and 7) and the data collected during the Pond Creek Piezo-Seismic Cone Penetration Testing subsurface investigation (Ref. 2):

- Total stress (σ_v)
- Effective stress (σ_{vo}')
- Pore pressure (U_{eq})
- SPT N_{60} correction factor (C_n)
- SPT blow counts at 60% energy (N_{60})
- N_{60} corrected for overburden ($(N_1)_{60}$)
- Corrected tip resistance (q_c)
- Fines content (F_c)
- Effective friction angle (ϕ)
- Soil Behavior Index (I_c)

Undrained shear strength (S_u) was also correlated, and is discussed separately in the calculation brief entitled Estimation and Summary of Engineering Properties Including Peak Undrained Shear Strength for Refuse and Subgrade Materials," (Reference 8).

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PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 3 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

ANALYSIS:

ConeTec, Inc. (ConeTec) performed the PS-CPT and correlated the above noted parameters based on various unit weights that were correlated directly from the Soil Behavior Type (SBT) (Robertson and Campanella, 1989). The unit weights used by ConeTec were based on data interpolation and thus require modification to reflect the laboratory derived unit weights of the coarse refuse and residual soil, which were provided by Alliance. Therefore, laboratory-derived unit weight for each of the layers was used to correlate the applicable parameters, particularly total and effective stresses, which are used throughout the calculations.

PSCPT correlations were based on much of the work described by Robertson and Campanella (1998, 1992, 1989, 1988, 1983). During field testing, ConeTec measured four parameters insitu, which were not correlated. They include the recorded tip resistance (AvgQt), the recorded side friction (AvgFs), the recorded friction ratio (AvgRf) and the pore pressure generated by the CPT probe (AvgUd), all of which were used in subsequent correlations. The soil behavior type (SBT) was also determined by the ConeTec, and was based on observations and readings of the four parameters just listed.

The following paragraphs briefly describe the parameters as well as providing a definition of the parameter and any additional calculations needed: Total stress and effective stress are both used in many of the correlations, and are related to each other by the presence of water in the form of pore water pressure. Total stress was defined as:

$$\sigma_v = (\gamma * H) / 2000 \text{ (lb/ton)}$$

where: σ_v = total stress (tsf)
γ = unit weight (pcf)
H = depth of the sample (ft)

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PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 4 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

Pore pressure is defined as:

$$U_{eq} = (\gamma_w * H) / 2000 \text{ (lb/ton)}$$

where: U_{eq} = pore pressure (tsf)
γ_w = unit weight of water (pcf)
= 62.5 pcf
H = depth of the sample (ft)

The difference between the two determines the effective stress:

$$\sigma_{vo}' = \sigma_v - U_{eq}$$

where: U_{eq} = pore pressure (tsf)
σ_v = total stress (tsf)

The PS-CPT sampler correlated the number of blows per foot, without the overburden correction, to the tip resistance measured as the probe was advanced. This gave measurements of N_{60} every 0.2 meters. Corrected for overburden, the measured tip resistance was then calculated:

$$q_c = AvgQt - (1 - 0.85) * U$$

where: AvgQt = measured tip resistance (tsf)
0.85 = area ratio of the PS-CPT probe
U = measured pore pressure (tsf)

This corrected tip resistance (q_c) was used along with the soil behavior type index (Ic) and atmospheric pressure to give the recorded N_{60} value by the equation:

$$N_{60} = (q_c / Pa) / 8.5 * (1 - (Ic / 4.6))$$

where: q_c = corrected tip resistance (tsf)
Pa = atmospheric pressure (tsf)
= 1.058 tsf
Ic = soil behavior type index (dim)

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PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 5 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

and: $Ic = ((3.47 - Log_{10}(Q))^2 + (Log_{10}(F) + 1.22)^2)^{0.5}$

where: Q = normalized cone penetration resistance (dim)
F = normalized friction ratio (pct)

and: $Q = (q_c - \sigma_v) / \sigma_{vo}'$

where: q_c = corrected tip resistance (tsf)
σ_v = total stress = (γ * H) / 2000(lb/ton) (tsf)
σ_{vo}' = vertical effective overburden (tsf)

and: $F = 100\% * AvgFs / (q_c - \sigma_{vo}')$

where: AvgFs= recorded side friction (tsf)
q_c = corrected tip resistance (tsf)
σ_{vo}' = vertical effective overburden (tsf)

Once N_{60} and σ_{vo}' had been calculated, a correction factor (Cn) was applied to N_{60} to give $(N_1)_{60}$:

$(N_1)_{60} = N_{60} * Cn$

where N_{60} = Number of blows/foot to advance 1.5 feet
Cn = $(\sigma_{vo}')^{-0.5}$ (dim)

Using tip resistance, corrected for overburden, and effective overburden the effective friction of the material in the Pond Creek facility could be calculated (Robertson, 1989). This was done using the following calculation:

$$\phi' = \tan^{-1}[(1/2.68) * (Log_{10}(q_c / \sigma_{vo}') + 0.29)]$$

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PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 6 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

where: q_c = corrected tip resistance (tsf)
σ_{vo}' = effective vertical stress (tsf)

Similarly, the fines content was correlated from PS-CPT data but was not used in any further analysis. The fines content was correlated using the soil behavior type index, I_c, as defined above. To determine the fines content of the material, the following relationship was used:

$$F_c = (1.75 * I_c^{3.25} - 3.7)$$

where: F_c = fines content (%)
I_c = soil behavior type index (dim)

RESULTS:

The results of the correlations between PS-CPT data recorded during field testing yield a profile of geotechnical parameters at the 15 sounding locations tested at the Pond Creek facility. Effective and total stresses provide an indication of the stresses being experienced insitu, and generally will increase as material is placed on top of the existing materials to the lines and grades of the proposed final geometry.

In-situ effective friction values were correlated using in-situ corrected tip resistance and effective overburden pressures for the 15 soundings tested at the Pond Creek facility.

CONCLUSIONS:

Summarizing, data recorded during PS-CPT field testing was used to correlate index and strength parameters for comparison to limited laboratory testing at discrete sample locations and to develop nearly continuous profile(s) of engineering properties with depth to model the variability of the insitu conditions at the Pond Creek facility.

Based on modified results, the correlated parameters from PS-CPT are generally consistent with each other and similar parameters determined from similar materials at other refuse facilities, and from laboratory testing of discrete samples. Therefore, in general, a reasonably high confidence level exists applying/using the results of the PS-CPT correlations to the 15 profiles shown in the attached tables.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 7 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-1

ConeTec Inc. Interpretation
Interpretation Out... Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4622
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-1
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 13:23
CPT File: 804CP01.COR
Northing (m): 0.000000
Easting (m): 0.000000
Elevation (m): 482.2

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	41.95	2.43	78.91	26.51	2.38

User Inputs:

Assumed: Water Table Depth (ft): 15.3
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 482.2

Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.026	16.61	0.44	2.66	0.11	1619.49	2.651	1.66	1619.49	2.65	5	125.00	0.010	0.010	0.000	2.000	2.89	5.79	0.514	16.61	5.45572	52.56
0.492	481.698	45.67	1.03	2.25	4.37	1484.2	2.257	1.60	1483.55	2.26	6	125.00	0.031	0.031	0.000	2.000	7.79	15.57	1.413	45.65	4.391	52.25
0.82	481.370	44.31	1.6	3.61	-3.26	863.585	3.615	1.86	863.98	3.61	5	125.00	0.051	0.051	0.000	2.000	8.26	16.52	1.370	44.33	9.36475	50.29
1.148	481.042	49.34	1.93	3.91	-6.42	686.666	3.917	1.92	687.22	3.91	5	125.00	0.072	0.072	0.000	2.000	9.42	18.84	1.525	49.38	10.8792	49.41
1.476	480.714	50.64	2.12	4.19	-7.64	547.943	4.194	1.98	548.49	4.19	5	125.00	0.092	0.092	0.000	2.000	9.90	19.80	1.585	50.69	12.4636	48.51
1.804	480.386	45.45	2.14	4.71	-0.65	402.104	4.720	2.08	402.10	4.72	4	125.00	0.113	0.113	0.000	2.000	8.23	18.46	1.404	45.45	15.2837	47.21
2.133	480.057	40.4	1.81	4.48	3.83	302.047	4.495	2.12	301.82	4.50	4	125.00	0.133	0.133	0.000	2.000	8.32	16.64	1.247	40.37	16.3803	45.96
2.461	479.729	34.96	1.32	3.78	8.22	226.29	3.792	2.12	225.96	3.80	5	125.00	0.154	0.154	0.000	2.000	7.19	14.38	1.078	34.91	16.3424	44.63
2.789	479.401	31.18	1.1	3.52	11.85	177.874	3.548	2.15	177.47	3.56	5	125.00	0.174	0.174	0.000	2.000	6.50	12.99	0.960	31.11	17.3915	43.48
3.117	479.073	29.29	1.15	3.92	14.97	149.35	3.953	2.23	148.89	3.96	5	125.00	0.195	0.195	0.000	2.000	6.31	12.62	0.901	29.2	20.1364	42.62
3.445	478.745	29.06	1.09	3.74	29.44	133.967	3.779	2.25	133.13	3.80	5	125.00	0.215	0.215	0.000	2.000	6.28	12.55	0.893	28.88	20.6255	42.05
3.773	478.417	32.91	1.15	3.49	32.84	138.56	3.520	2.21	137.67	3.54	5	125.00	0.236	0.236	0.000	2.000	7.01	14.02	1.012	32.7	19.4713	42.22
4.101	478.089	34.84	1.39	4	29.66	134.928	4.019	2.27	134.19	4.04	5	125.00	0.256	0.256	0.000	1.975	7.59	15.00	1.071	34.65	21.3078	42.09
4.429	477.761	35.38	1.49	4.22	29.72	126.812	4.245	2.30	126.16	4.27	4	125.00	0.277	0.277	0.000	1.901	7.83	14.88	1.087	35.2	22.5787	41.78
4.757	477.433	34.51	1.53	4.44	31.68	115.073	4.472	2.35	114.40	4.50	4	125.00	0.297	0.297	0.000	1.834	7.78	14.27	1.059	34.31	24.2407	41.27
5.085	477.105	32.05	1.52	4.75	32.73	99.6456	4.790	2.41	99.18	4.82	4	125.00	0.318	0.318	0.000	1.774	7.42	13.17	0.982	31.84	26.6972	40.52
5.413	476.777	33.07	1.53	4.62	33.55	96.7499	4.674	2.41	96.13	4.70	4	125.00	0.338	0.338	0.000	1.719	7.66	13.17	1.013	32.86	26.6837	40.36
5.741	476.449	28.11	1.63	5.81	25.35	77.3418	5.874	2.54	76.90	5.91	3	125.00	0.359	0.359	0.000	1.669	6.95	11.61	0.859	27.95	32.7178	39.15
6.069	476.121	23.82	1.72	7.24	9.62	61.7978	7.338	2.68	61.67	7.35	3	125.00	0.379	0.379	0.000	1.624	6.33	10.27	0.726	23.77	39.3343	37.91
6.398	475.792	23.35	1.75	7.49	4.73	57.3932	7.625	2.71	57.32	7.64	3	125.00	0.400	0.400	0.000	1.581	6.31	9.96	0.711	23.32	41.0639	37.49
6.726	475.464	25.01	1.76	7.04	4.71	58.4945	7.157	2.68	58.42	7.17	3	125.00	0.420	0.420	0.000	1.542	6.67	10.29	0.761	24.98	39.6542	37.80
7.054	475.136	26.32	1.96	7.47	4.23	58.6995	7.574	2.70	58.63	7.58	3	125.00	0.441	0.441	0.000	1.506	7.09	10.67	0.801	26.29	40.6073	37.62
7.382	474.808	26.5	1.77	6.7	3.32	56.437	6.798	2.68	56.39	6.80	3	125.00	0.461	0.461	0.000	1.472	7.04	10.37	0.806	26.48	39.2566	37.40
7.71	474.480	22.44	1.48	6.61	3	45.5681	6.740	2.74	45.53	6.75	3	125.00	0.482	0.482	0.000	1.441	6.15	8.86	0.680	22.42	42.3496	36.15
8.038	474.152	24.71	1.6	6.49	3.7	48.1864	6.609	2.71	48.15	6.61	3	125.00	0.502	0.502	0.000	1.411	6.69	9.44	0.749	24.69	41.1319	36.48
8.366	473.824	35.63	2.03	5.68	4.8	67.525	5.750	2.57	67.47	5.75	3	125.00	0.523	0.523	0.000	1.383	9.02	12.48	1.093	35.8	33.9863	38.42
8.694	473.496	39.18	2.59	6.61	3.46	71.1049	6.703	2.61	71.07	6.71	3	125.00	0.543	0.543	0.000	1.357	10.06	13.64	1.196	39.16	35.8018	38.71
9.022	473.168	64.62	3.1	4.8	6.26	113.6	4.840	2.37	113.53	4.84	11	125.00	0.564	0.564	0.000	1.332	14.83	19.75	1.963	64.58	25.3247	41.23
9.35	472.840	86.35	5.07	5.87	3.14	146.765	5.911	2.38	146.73	5.91	11	125.00	0.584	0.584	0.000	1.308	19.89	26.02	2.655	86.33	25.6191	42.54
9.678	472.512	73.23	5.54	7.56	-2.24	120.066	7.628	2.52	120.08	7.63	11	125.00	0.605	0.605	0.000	1.286	18.01	23.16	2.248	73.24	31.6127	41.52
10.006	472.184	46.41	4.03	8.68	-9.82	73.2115	8.802	2.69	73.31	8.79	0	125.00	0.625	0.625	0.000	1.265	12.47	15.77	1.417	46.47	40.1446	38.88
10.335	471.855	39.89	2.66	6.66	-11.18	60.7552	6.778	2.65	60.86	6.77	3	125.00	0.646	0.646	0.000	1.244	10.50	13.07	1.215	39.96	38.0706	37.83
10.663	471.527	54.17	2.97	5.48	-11.19	80.2829	5.551	2.51	80.39	5.54	3	125.00	0.666	0.666	0.000	1.225	13.28	16.26	1.556	54.24	31.1774	39.39
10.991	471.199	62.34	4.01	6.44	-10.85	89.7506	6.504	2.54	89.85	6.50	11	125.00	0.687	0.687	0.000	1.207	15.46	18.65	1.909	62.41	32.3205	39.99
11.319	470.871	75.65	4.56	6.06	-9.15	105.935	6.111	2.47	106.01	6.11	11	125.00	0.707	0.707	0.000	1.189	18.19	21.63	2.320	75.7	29.4445	40.87
11.647	470.543	96	6.72	7	-6.93	130.879	7.053	2.47	130.93	7.05	11	125.00	0.728	0.728	0.000	1.172	23.07	27.04	2.950	96.04	29.4226	41.97
11.975	470.215	83.38	6.59	7.9	-7.67	110.405	7.975	2.56	110.47	7.97	11	125.00	0.748	0.748	0.000	1.156	20.88	24.13	2.558	83.43	33.2785	41.09
12.303	469.887	57.02	4.42	7.74	-9.36	73.1543	7.858	2.66	73.23	7.85	3	125.00	0.769	0.769	0.000	1.140	15.01	17.11	1.742	57.08	38.1113	38.88
12.631	469.559	67.48	3.97	5.89	-6.63	84.4756	5.953	2.52	84.53	5.95	11	125.00	0.789	0.789	0.000	1.125	16.61	18.70	2.065	67.52	31.6601	39.66
12.959	469.231	79.63	5.29	6.64	-4.3	97.3162	6.711	2.53	97.35	6.71	11	125.00	0.810	0.810	0.000	1.111	19.65	21.93	2.440	79.66	31.9895	40.42
13.287	468.903	74.37	5.39	7.24	-3.35	88.5552	7.329	2.58	88.58	7.33	11	125.00	0.830	0.830	0.000	1.097	18.85	20.68	2.277	74.39	34.4742	39.92
13.615	468.575	71.75	5.08	7.08	-2.33	83.3188	7.165	2.59	83.34	7.18	11	125.00	0.851	0.851	0.000	1.084	18.25	19.79	2.195	71.77	34.8502	39.59
13.943	468.247	102.33	5.18	5.06	-0.78	116.427	5.106	2.38	116.44	5.11	11	125.00	0.871	0.871	0.000	1.071	23.62	25.31	3.141	102.34	25.8028	41.36
14.271	467.919	114.91	6.8	5.91	2.36	127.832	5.964	2.42	127.81	5.97	11	125.00	0.892	0.892	0.000	1.059	26.91	28.49	3.530	114.89	27.1057	41.84
14.6	467.590	134.53	9.49	7.06	8.8	146.43	7.102	2.45	146.36	7.11	11	125.00	0.913	0.913	0.000	1.047	31.95	33.45	4.137	134.47	28.4187	42.53
14.928	467.262	140.8	8.87	6.3	10.72	149.911	6.342	2.40	149.84	6.34	11	125.00	0.933	0.933	0.000	1.035	32.73	33.88	4.330	140.73	26.4588	42.65
15.256	466.934	130.39	7.43	5.7	2.1	135.749	5.740	2.39	135.74	5.74	11	125.00	0.954	0.954	0.000	1.024	30.14	30.87	4.007	130.38	25.9423	42.15

R15196

Depth (ft)	Sam (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...ss (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.606	108.8	7.14	6.56	-4.16	111.721	6.622	2.49	111.78	6.62	11	135.00	0.974	0.965	0.009	1.018	26.34	26.81	3.938	108.82	30.1191	41.15
15.912	466.278	78.99	5.55	7.03	-5.77	79.9262	7.116	2.60	79.86	7.11	11	135.00	0.996	0.977	0.019	1.012	20.18	20.42	2.415	79.02	35.2737	39.35
16.24	465.950	119.1	5.81	4.88	-0.48	119.401	4.920	2.37	119.40	4.92	11	135.00	1.018	0.989	0.029	1.006	27.25	27.41	3.656	119.1	25.0315	41.50
16.568	465.622	148.6	8.34	5.6	-1.5	147.633	5.644	2.36	147.64	5.64	11	135.00	1.040	1.001	0.040	1.000	34.00	33.96	4.575	148.81	24.89	42.58
16.896	465.294	185.21	10.35	5.59	7.64	181.826	5.620	2.31	181.78	5.62	11	135.00	1.063	1.013	0.050	0.994	41.38	41.12	5.701	185.16	22.9713	43.60
17.224	464.966	333.69	12.91	3.87	16.63	324.597	3.861	2.05	324.50	3.98	12	135.00	1.085	1.025	0.060	0.986	66.92	66.01	10.297	333.59	14.2684	46.26
17.552	464.638	421.41	14.07	3.34	22.43	405.472	3.348	1.95	405.34	3.35	12	135.00	1.107	1.037	0.070	0.982	81.17	79.72	13.012	421.27	11.5386	47.26
17.88	464.310	395.49	16.59	3.94	0.37	376.125	3.953	2.03	376.12	3.95	12	135.00	1.129	1.048	0.080	0.977	28.54	76.70	12.209	395.49	13.6425	46.93

R15197

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 10 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/09

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-2

ConeTec Inc. Interpretation
Interpretation Ou elease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4589
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-2
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 13:46
CPT File: 804CP02.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 494.21

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.31	1.63	53.64	24.15	2.30
125	Residual Soil	27.01	1.39	47.18	59.75	2.99

User Inputs:

Assumed:
Water Table Depth (ft): 38.8
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratic: 0.85 See Below
Ground Surface Elev. 494.2
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	494.046	4.44	0.09	1.92	-0.14	415.51	2.032	1.75	415.51	2.03	4	130.00	0.011	0.011	0.000	2.000	0.80	1.59	0.137	4.44	7.06955	47.35
0.492	493.718	15.27	0.31	2	0	476.486	2.034	1.72	476.49	2.03	5	130.00	0.032	0.032	0.000	2.000	2.71	5.42	0.472	15.27	6.5252	47.93
0.82	493.390	32.2	0.81	2.51	0.41	603.128	2.520	1.76	603.13	2.52	6	130.00	0.053	0.053	0.000	2.000	5.60	11.60	0.995	32.2	7.32759	48.89
1.148	493.062	74.45	2.09	2.81	-0.28	996.722	2.810	1.73	996.66	2.81	6	130.00	0.075	0.075	0.000	2.000	13.28	26.57	2.303	74.46	6.76919	50.83
1.476	492.734	107.36	2.18	2.03	0.28	1118.03	2.032	1.59	1118.03	2.03	7	130.00	0.096	0.096	0.000	2.000	18.21	36.42	3.321	107.36	4.12002	51.25
1.804	492.406	114.67	2.19	1.91	-0.11	976.912	1.912	1.58	976.91	1.91	7	130.00	0.117	0.117	0.000	2.000	19.39	38.78	3.547	114.67	3.98073	50.75
2.133	492.077	93.71	1.85	1.98	-0.3	674.899	1.977	1.65	674.90	1.98	7	130.00	0.139	0.139	0.000	2.000	16.22	32.44	2.897	93.71	5.13754	49.34
2.461	491.749	78.06	1.5	1.92	-0.23	486.982	1.926	1.70	486.98	1.93	7	130.00	0.160	0.160	0.000	2.000	13.74	27.49	2.412	78.06	6.04007	48.02
2.789	491.421	58.8	1.47	2.51	-0.67	323.351	2.508	1.88	323.35	2.51	6	130.00	0.181	0.181	0.000	2.000	11.06	22.13	1.815	58.8	9.97805	46.26
3.117	491.093	40.59	0.92	2.26	-0.62	199.341	2.278	1.96	199.39	2.28	6	130.00	0.203	0.203	0.000	2.000	7.88	15.75	1.250	40.6	11.9985	44.04
3.445	490.765	26.44	0.57	2.16	-0.21	117.075	2.174	2.10	117.08	2.17	6	130.00	0.224	0.224	0.000	2.000	5.40	10.79	0.812	26.44	15.6626	41.39
3.773	490.437	29.6	0.5	1.68	-0.56	119.696	1.703	2.01	119.74	1.70	6	130.00	0.245	0.245	0.000	2.000	5.85	11.69	0.909	29.61	13.2397	41.51
4.101	490.109	25.33	0.62	2.43	-0.39	94.0237	2.474	2.20	94.02	2.47	6	130.00	0.267	0.267	0.000	1.937	5.40	10.46	0.776	25.33	19.0184	40.24
4.429	489.781	28.49	0.71	2.5	-0.44	97.9631	2.518	2.19	97.96	2.52	6	130.00	0.288	0.288	0.000	1.864	6.06	11.29	0.873	28.49	18.8025	40.46
4.757	489.453	31.04	0.87	2.79	-0.58	99.3865	2.831	2.23	99.42	2.83	6	130.00	0.309	0.309	0.000	1.798	6.69	12.04	0.951	31.05	19.9408	40.64
5.085	489.125	58.32	1.1	1.88	-0.53	175.447	1.897	1.94	175.45	1.90	7	130.00	0.331	0.331	0.000	1.739	11.19	19.47	1.795	58.32	11.2709	43.43
5.413	488.797	64.77	1.14	1.76	-0.39	183.087	1.770	1.90	183.12	1.77	7	130.00	0.352	0.352	0.000	1.686	12.27	20.69	1.994	64.78	10.4054	43.63
5.741	488.469	49.99	1.55	3.1	-0.19	132.962	3.124	2.18	132.96	3.12	6	130.00	0.373	0.373	0.000	1.637	10.56	17.29	1.536	49.99	18.3323	42.05
6.069	488.141	98.88	2.5	2.53	-1.89	249.656	2.538	1.95	249.68	2.54	7	130.00	0.394	0.394	0.000	1.592	19.06	30.34	3.049	98.89	11.5492	45.10
6.398	487.812	86.03	2.55	2.97	-3.23	205.868	2.978	2.05	205.92	2.98	6	130.00	0.416	0.416	0.000	1.551	17.26	26.77	2.651	86.05	14.3668	44.20
6.726	487.484	74.12	2.09	2.82	-2.7	168.537	2.836	2.08	168.56	2.84	6	130.00	0.437	0.437	0.000	1.512	15.07	22.79	2.281	74.13	15.335	43.23
7.054	487.156	57.9	1.75	3.03	-0.39	125.279	3.047	2.19	125.30	3.05	6	130.00	0.459	0.459	0.000	1.477	12.27	18.13	1.778	57.91	18.5782	41.74
7.382	486.828	73.94	1.79	2.42	-0.32	153.096	2.437	2.06	153.10	2.44	6	130.00	0.480	0.480	0.000	1.444	14.87	21.47	2.274	73.94	14.5542	42.75
7.71	486.500	100.23	1.95	1.95	-0.48	199	1.955	1.91	199.00	1.96	7	130.00	0.501	0.501	0.000	1.413	19.07	26.93	3.088	100.23	10.6813	44.03
8.038	486.172	96.56	2.95	3.06	-0.34	183.814	3.072	2.09	183.81	3.07	6	130.00	0.522	0.522	0.000	1.383	19.67	27.21	2.973	96.56	15.5135	43.65
8.366	485.844	130.73	3.63	2.78	-5.11	239.405	2.788	1.99	239.46	2.79	7	130.00	0.544	0.544	0.000	1.356	25.62	34.75	4.031	130.76	12.698	44.90
8.694	485.516	98.21	2.49	2.54	-0.94	172.789	2.550	2.04	172.81	2.55	7	130.00	0.565	0.565	0.000	1.330	19.62	26.10	3.023	98.22	14.0752	43.35
9.022	485.188	72.31	1.82	2.52	-0.92	122.305	2.538	2.13	122.32	2.54	6	130.00	0.586	0.586	0.000	1.306	14.99	19.57	2.221	72.32	16.8246	41.62
9.35	484.860	80.45	1.62	2.02	-0.93	131.374	2.029	2.04	131.39	2.03	7	130.00	0.608	0.608	0.000	1.283	16.07	20.61	2.472	80.46	14.0363	41.99
9.678	484.532	69.94	1.16	1.66	-0.99	110.18	1.674	2.03	110.20	1.67	7	130.00	0.629	0.629	0.000	1.261	13.92	17.55	2.146	69.95	13.7865	41.08
10.006	484.204	61.74	0.9	1.45	-0.39	93.9277	1.473	2.04	93.93	1.47	7	130.00	0.650	0.650	0.000	1.240	12.34	15.30	1.891	61.74	14.1065	40.23
10.335	483.875	66.65	1.35	2.02	-0.53	98.2148	2.046	2.13	98.23	2.05	7	130.00	0.672	0.672	0.000	1.220	13.79	16.82	2.043	66.66	16.6601	40.47
10.663	483.547	83.84	2.23	2.65	-0.46	119.965	2.682	2.16	119.96	2.68	6	130.00	0.693	0.693	0.000	1.201	17.55	21.08	2.574	83.84	17.5802	41.52
10.991	483.219	117.25	2.55	2.17	-0.83	163.12	2.188	2.00	163.12	2.19	7	130.00	0.714	0.714	0.000	1.183	23.09	27.32	3.608	117.25	13.0514	43.07
11.319	482.891	126.97	2.65	2.08	-0.44	171.576	2.099	1.98	171.58	2.10	7	130.00	0.736	0.736	0.000	1.166	24.74	28.84	3.908	126.97	12.3081	43.32
11.647	482.563	100.73	2.81	2.79	-1.16	132.055	2.811	2.15	132.07	2.81	6	130.00	0.757	0.757	0.000	1.149	20.99	24.12	3.095	100.74	17.2321	42.01
11.975	482.235	110.03	2.03	1.85	-0.79	140.359	1.858	1.99	140.37	1.86	7	130.00	0.778	0.778	0.000	1.133	21.57	24.45	3.382	110.04	12.7249	42.32
12.303	481.907	89.84	1.64	1.83	-0.58	111.343	1.842	2.06	111.36	1.84	7	130.00	0.800	0.800	0.000	1.118	18.07	20.20	2.757	89.85	14.5435	41.13
12.631	481.579	64.26	1.13	1.75	-1.04	77.269	1.781	2.16	77.28	1.78	7	130.00	0.821	0.821	0.000	1.104	13.47	14.86	1.964	64.27	17.6781	39.17
12.959	481.251	53.66	0.81	1.5	-0.76	62.7039	1.534	2.18	62.70	1.53	7	130.00	0.842	0.842	0.000	1.090	11.36	12.38	1.635	53.66	18.4929	38.00
13.287	480.923	47.49	0.8	1.68	-0.14	53.9872	1.716	2.27	54.00	1.72	7	130.00	0.864	0.864	0.000	1.076	10.41	11.20	1.444	47.5	21.2802	37.15
13.615	480.595	49.6	0.9	1.82	-0.26	55.0468	1.847	2.28	55.05	1.85	7	130.00	0.885	0.885	0.000	1.063	10.93	11.62	1.508	49.6	21.8025	37.26
13.943	480.267	33.73	0.59	1.74	-0.11	36.2175	1.797	2.41	36.22	1.80	6	130.00	0.906	0.906	0.000	1.050	7.89	8.29	1.016	33.73	26.9811	34.77
14.271	479.939	30.54	0.56	1.82	-0.3	31.9231	1.891	2.47	31.92	1.89	6	130.00	0.928	0.928	0.000	1.038	7.33	7.61	0.917	30.54	29.3952	34.00
14.6	479.610	31.88	0.48	1.49	0.09	32.5933	1.552	2.41	32.59	1.55	6	130.00	0.949	0.949	0.000	1.027	7.45	7.65	0.958	31.88	26.9209	34.13
14.928	479.282	41.36	0.41	0.98	-0.28	41.6251	1.015	2.22	41.63	1.02	7	130.00	0.970	0.970	0.000	1.015	8.89	9.02	1.250	41.36	19.6777	35.61
15.256	478.954	37.15	0.45	1.21	-0.14	36.4632	1.245	2.32	36.46	1.24	7	130.00	0.992	0.992	0.000	1.004	8.32	8.36	1.119	37.15	23.1707	34.81

R15199

Depth (ft)	Sam (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	ss (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	478.626	35.51	0.42	1.19	-0.23	34.0557	1.217	2.34	34.07	1.22	7	130.00	1.013	1.013	0.000	0.994	8.02	7.97	1.068	35.52	23.8923	34.40
15.912	478.298	35.52	0.45	1.26	0.07	33.3427	1.305	2.36	33.34	1.30	7	130.00	1.034	1.034	0.000	0.983	8.11	7.98	1.069	35.52	24.8516	34.27
16.24	477.970	39.22	0.5	1.28	-0.18	36.1542	1.310	2.33	36.16	1.31	7	130.00	1.056	1.056	0.000	0.973	8.85	8.61	1.182	39.23	23.7631	34.76
16.568	477.642	38.39	0.42	1.08	0	34.648	1.126	2.31	34.65	1.13	7	130.00	1.077	1.077	0.000	0.964	8.56	8.27	1.155	38.39	22.946	34.50
16.896	477.314	40.69	0.25	0.6	0.04	36.0502	0.631	2.17	36.05	0.63	7	130.00	1.098	1.098	0.000	0.954	8.56	8.16	1.226	40.69	17.9445	34.74
17.224	476.986	26.93	0.46	1.71	0.18	23.0541	1.782	2.57	23.05	1.78	6	130.00	1.120	1.120	0.000	0.945	6.78	6.41	0.799	26.93	33.9054	31.95
17.552	476.658	23.41	0.62	2.63	0.25	19.5192	2.784	2.74	19.52	2.78	5	130.00	1.141	1.141	0.000	0.936	6.44	6.03	0.689	23.41	42.7557	30.87
17.88	476.330	65.32	1.62	2.49	0.04	55.2038	2.525	2.37	55.20	2.53	6	130.00	1.162	1.162	0.000	0.928	14.98	13.89	1.986	65.32	25.2127	37.27
18.208	476.002	75.66	2.12	2.8	-0.99	62.9279	2.84654	2.36561	62.9279	2.84654	6	130.00	1.18352	1.18352	0	0.9192	17.31394	15.91506	2.30577	75.66	25.0311	38.024
18.537	475.673	74.29	1.97	2.66	0.05	60.6563	2.69549	2.36029	60.5563	2.69549	6	130.00	1.20491	1.204905	0	0.911	16.96011	15.45084	2.2627	74.29	24.8219	37.815
18.865	475.345	66.95	1.6	2.4	-0.05	53.5985	2.43443	2.36877	53.5985	2.43443	6	130.00	1.22623	1.226225	0	0.9031	15.34246	13.85511	2.03479	66.95	25.156	37.104
19.193	475.017	63.56	1.37	2.16	0.04	49.9481	2.1986	2.36187	49.9481	2.1986	7	130.00	1.24755	1.247545	0	0.8953	14.52072	13.0005	1.92918	63.56	24.8839	36.693
19.521	474.689	54.9	1.01	1.84	0.12	42.267	1.88323	2.37383	42.267	1.88323	7	130.00	1.26887	1.268865	0	0.8878	12.60965	11.19426	1.66041	54.9	25.3569	35.705
19.849	474.361	41.75	0.84	2.02	0.51	31.3597	2.07613	2.50167	31.3597	2.07613	6	130.00	1.29019	1.290185	0	0.8804	10.17354	8.956661	1.25263	41.75	30.7577	33.887
20.177	474.033	45.14	0.57	1.25	0.28	33.4185	1.30052	2.35955	33.4108	1.30082	7	130.00	1.31151	1.311505	0	0.8732	10.29958	8.993624	1.35692	45.13	24.7928	34.278
20.505	473.705	50.75	0.66	1.29	0.28	37.077	1.33557	2.329	37.077	1.33557	7	130.00	1.33283	1.332825	0	0.8662	11.42634	9.897387	1.52994	50.75	23.6109	34.915
20.833	473.377	43.95	0.93	2.11	0.21	31.4559	2.18331	2.51412	31.4559	2.18331	6	130.00	1.35415	1.354145	0	0.8593	10.77355	9.25819	1.31876	43.95	31.3181	33.906
21.161	473.049	37.82	0.76	2	0.18	26.4962	2.08536	2.56096	26.4962	2.08536	6	130.00	1.37547	1.375465	0	0.8527	9.483875	8.086508	1.12831	37.82	33.4834	32.832
21.489	472.721	31.66	0.63	1.99	0.12	21.6663	2.08174	2.6309	21.6663	2.08174	6	130.00	1.39679	1.396785	0	0.8461	8.221135	6.956119	0.93694	31.66	36.896	31.548
21.817	472.393	29.26	0.51	1.75	0.11	19.6332	1.83177	2.63406	19.6332	1.83177	6	130.00	1.41811	1.418105	0	0.8397	7.610153	6.390564	0.86198	29.26	37.0448	30.91
22.145	472.065	27.79	0.57	2.04	0.16	18.3063	2.16314	2.70017	18.3063	2.16314	6	130.00	1.43943	1.439425	0	0.8335	7.479319	6.234011	0.81581	27.79	40.4629	30.453
22.473	471.737	29.87	0.47	1.58	0.21	19.4485	1.65439	2.61284	19.4485	1.65439	6	130.00	1.46075	1.460745	0	0.8274	7.685847	6.35923	0.87954	29.87	35.9877	30.848
22.802	471.408	28.42	0.58	2.03	0.16	18.1751	2.1531	2.70156	18.1751	2.1531	6	130.00	1.48213	1.48213	0	0.8214	7.654487	6.287427	0.83399	28.42	40.5369	30.406
23.13	471.080	31.05	0.62	1.99	0.28	19.6525	2.09838	2.66738	19.6525	2.09838	6	130.00	1.50345	1.50345	0	0.8156	8.214939	6.699769	0.91475	31.05	38.7438	30.916
23.458	470.752	46.22	1.11	2.4	0.37	29.3128	2.48349	2.57298	29.3128	2.48349	6	130.00	1.52477	1.52477	0	0.8098	11.65897	9.441869	1.38375	46.22	34.0532	33.467
23.786	470.424	39.92	0.83	2.08	0.37	24.82	2.16293	2.59318	24.82	2.16293	6	130.00	1.54609	1.54609	0	0.8042	10.1712	8.180027	1.18805	39.92	35.0255	32.418
24.114	470.096	27.53	0.53	1.93	0.37	16.564	2.0414	2.72157	16.564	2.0414	6	130.00	1.56741	1.56741	0	0.7987	7.493763	5.985613	0.8038	27.53	41.6107	29.796
24.442	469.768	29.77	0.51	1.72	0.37	17.7382	1.80971	2.66769	17.7382	1.80971	6	130.00	1.58873	1.58873	0	0.7934	7.877548	6.249799	0.87249	29.77	38.7598	30.247
24.77	469.440	42.36	0.65	1.53	0.32	25.3097	1.59509	2.50911	25.3097	1.59509	7	130.00	1.61005	1.61005	0	0.7881	10.35889	8.163824	1.26161	42.36	31.0917	32.542
25.098	469.112	53.82	1.3	2.41	0.39	31.9907	2.49096	2.54436	31.9907	2.49096	6	130.00	1.63137	1.63137	0	0.7829	13.38709	10.48117	1.61575	53.82	32.7057	34.01
25.426	468.784	51.08	0.9	1.77	0.53	29.9072	1.82086	2.4837	29.9011	1.82122	7	130.00	1.65269	1.65269	0	0.7779	12.33893	9.59802	1.53026	51.07	29.9596	33.591
25.754	468.456	40.34	0.96	2.39	0.39	23.0978	2.4828	2.65426	23.0978	2.4828	6	130.00	1.67401	1.67401	0	0.7729	10.60082	8.193331	1.19709	40.34	38.0689	31.959
26.082	468.128	38.33	0.52	1.36	0.09	21.6092	1.41942	2.5382	21.6092	1.41942	7	130.00	1.69533	1.69533	0	0.768	9.50564	7.300528	1.1342	38.33	32.4199	31.531
26.41	467.800	33.19	0.47	1.42	0.42	18.3342	1.49333	2.61024	18.3342	1.49333	7	130.00	1.71665	1.71665	0	0.7632	8.52896	6.509614	0.97441	33.19	35.8595	30.463
26.739	467.471	35.49	0.61	1.72	0.44	19.4196	1.8073	2.63471	19.4196	1.8073	6	130.00	1.73804	1.738035	0	0.7585	9.233542	7.003886	1.04495	35.49	37.0774	30.839
27.067	467.143	42.19	0.58	1.38	0.21	22.9804	1.43456	2.51828	22.9804	1.43456	7	130.00	1.75936	1.759355	0	0.7539	10.36277	7.812664	1.25172	42.19	31.5067	31.926
27.395	466.815	45.33	0.59	1.3	0.28	24.4566	1.35479	2.4822	24.451	1.3551	7	130.00	1.78068	1.780675	0	0.7494	10.94193	8.199766	1.34828	45.32	29.8936	32.323
27.723	466.487	34.11	0.71	2.09	0.25	17.929	2.1976	2.71151	17.929	2.1976	6	130.00	1.802	1.801995	0	0.7449	9.235424	6.879867	1.00025	34.11	41.0689	30.317
28.051	466.159	38.11	0.64	1.67	0.16	19.9015	1.76373	2.61995	19.9015	1.76373	7	130.00	1.82332	1.823315	0	0.7406	9.84131	7.28823	1.12343	38.11	36.3399	30.998
28.379	465.831	54.68	0.64	1.17	0.14	28.6427	1.21131	2.39804	28.6427	1.21131	7	130.00	1.84464	1.844635	0	0.7363	12.69719	9.348728	1.63577	54.68	26.331	33.322
28.707	465.503	38.3	0.68	1.78	0.12	19.5257	1.86639	2.64061	19.5257	1.86639	6	130.00	1.86596	1.865955	0	0.7321	9.994656	7.316734	1.12799	38.3	37.3751	30.874
29.035	465.175	39.55	0.71	1.8	0.09	19.9561	1.88515	2.63527	19.9561	1.88515	6	130.00	1.88728	1.887275	0	0.7279	10.29276	7.492285	1.16603	39.55	37.1054	31.016
29.363	464.847	36.83	0.63	1.71	-0.04	18.2969	1.80405	2.65573	18.2969	1.80405	6	130.00	1.9086	1.908595	0	0.7238	9.685775	7.01096	1.08116	36.83	38.1443	30.45
29.691	464.519	45.2	0.73	1.62	0.32	22.4207	1.68708	2.56643	22.4155	1.68747	7	130.00	1.92992	1.929915	0	0.7198	11.36246	8.179056	1.33963	45.19	33.742	31.767
30.019	464.191	50.69	0.58	1.15	0.3	24.9784	1.19002	2.44406	24.9784	1.19002	7	130.00	1.95124	1.951235	0	0.7159	12.02196	8.606381	1.50894	50.69	28.245	32.458
30.347	463.863	39.45	0.49	1.23	0.32	18.9994	1.30745	2.56664	18.9994	1.30745	7	130.00	1.97256	1.972555	0	0.712	9.920241	7.0633	1.16029	39.45	33.752	30.696
30.675	463.535	51.05	0.69	1.36	0.21	24.6034	1.40655	2.48892	24.5984	1.40684	7	130.00	1.99388	1.993875	0	0.7082	12.36218	8.754796	1.51877	51.04	30.1901	32.361
31.004	463.206	35.96	0.8	2.22	0.25	16.8439	2.35677	2.75119	16.8439	2.35677	6	130.00	2.01526	2.01526	0	0.7044	9.945252	7.005679	1.05092	35.96	43.233	29.907
31.332	462.878	34.69	0.81	2.33	0.23	16.0335	2.4806	2.78153	16.0335	2.4806	6	130.00	2.03658	2.03658	0	0.7007	9.754086	6.834958	1.01094	34.69	44.9361	29.581
31.66	462.550	32.8	0.69	2.11	0.04	14.9386	2.24448	2.78183	14.9386	2.24448	6	130.00	2.0579	2.0579	0	0.6971	9.224214	6.430093	0.95177	32.8	44.9535	29.113
31.988	462.222	41.84	0.77	1.83	0.11	19.1229	1.93658	2.65715	19.1229	1.93658	6	130.00	2.07922	2.07922	0	0.6935	11.01138	7.636449	1.23098	41.84	38.2171	30.738
32.316	461.894	37.05	1.05	2.83	0.04	16.6383	3.00434	2.81778	16.6383	3.00434	6	125.00	2.10054	2.10054	0	0.69	10.62955	7.334144	1.08203	37.05	47.0264	29.626
32.644	461.566	67.03	0.55	0.82	-6.6	30.6024	0.84734	2.29207	30.6213	0.84682	8	125.00	2.12104	2.12104	0	0.6866	14.85918	10.20282	2.00957	67.07	22.2286	33.739
32.972	461.238	54.68	1.11	2.03	0.21	24.533	2.11274	2.59114	24.533	2.11274	7	125.00	2.14154	2.14154	0	0.6833	13.91768	9.510511	1.62858	54.68	34.9261	32.344
33.3	460.910	49.23	1.53	3.11	-2.91	21.7702	3.25062	2.74669	21.7794	3.24924	6	125.00	2.16204	2.16204	0	0.6801	13.58773	9.240913	1.45721	49.25	42.084	31.581
33.628	460.582	42.89	1.67	3.9	-0.53	18.6514	4.10244	2.86303	18.6514	4.10244	5	125.00	2.18254	2.18254	0	0.6769	12.62559	8.54615	1.26029	42.89	49.722	30.575
33.956	460.254	42.8	1.32	3.09	0.12	18.4277	3.25147	2.80358	18.4277	3.25147	6	125.00	2.20304	2.20304	0	0.6737	12.18217	8.207546	1.25687	42.8	46.2004	30.497
34.284	459.926	30.89	1.35	4.37	0.37	12.8923	4.70934	3.02533	12.8878	4.71098	4	125.00	2.22354	2.22354	0	0.6706	10.02714	6.72442	0.88751	30.88	60.2073	28.127
34.612	459.598	24.22	1.28	5.28	0.81	9.79303	5.82455	3.1763	9.78858	5.8272	3	125.00	2.24404	2.24404	0	0.6676	8.694916	5.804303	0.68037	24.21	71.1657	26.273
34.941	459.269	21.73	0.96	4.43	1.31	8.5955	4.93183	3.17671	8.59109	4.93436	4	125.00	2.2646	2.264603	0	0.6645	7.802906	5.185139	0.60264	21.72	71.1974	25.388
35.269	458.941	23.04	0.79	3.42	1.73	9.0827	3.80633	3.09074	9.07832	3.80817	5	125.00	2.2851	2.285103	0	0.6615	7.80225	5.161394	0.64257	23.03	64.8082	25.762
35.597	458.613	22.63	0.74	3.26	2.47	8.81522	3.64094	3.09045	8.80855	3.64453	5	125.00	2.3056	2.305603	0	0.6586	7.658449	5.043693	0.62924	22.61	64.7868	25.556
35.925	458.285	23.37	0.6	2.57	3.4	9.04685	2.85118	3.02107	9.03825	2.8539	5	125.00	2.3261	2.326103	0	0.6557	7.56159	4.95791	0.65151	23.35	59.9152	25.732
36.253	457.957	29.16	0.73	2.49	9.07	11.4265	2.72252	2.9266	11.4009	2.72863	6	125.00	2.3466	2.346603	0	0.6528	8.891671	5.804484	0.83014	29.1	53.6748	27.303
36.581	457.629	30.74	0.64	2.07	12.21	11.9863	2.25567	2.86414	11.9525	2.26205	6	125.00	2.3671	2.367103	0	0.65	9.031228	5.870002	0.87842	30.66	49.7897	27.622
36.909	457.301	30.69	0.47	1.52	13.92	11.8539	1.66064	2.79759	11.8162	1.66593	6	125.00	2.3876	2.387603	0	0.6472	8.880726	5.617913	0.87624	30.6	45.8547	27.544
37.237	456.973	31.76	0.55	1.72	16.67	12.1888	1.87381	2.81505	12.1431	1.88086	6	125.00	2.4081	2.408103	0	0.6444	9.066453	5.842516	0.90873	31.65	46.8672	27.728
37.565	456.645	33.62	0.61	1.8	17.92	12.8434	1.95667	2.80566	12.7981	1.96259	6	125.00	2.4286	2.428603	0	0.6417	9.549031	6.127468	0.96568	33.61	46.3211	28.061

R15200

Depth (ft)	Samp (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	ss (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	456.317	32.15	0.63	1.95	15.64	12.1273	2.12115	2.84602	12.0783	2.12975	6	125.00	2.4481	2.448103	0	0.639	9.337317	5.966486	0.91953	32.03	46.6978	27.692
38.221	455.989	25.87	0.58	2.25	19.84	9.47537	2.47859	2.97339	9.42678	2.49137	6	125.00	2.4696	2.469603	0	0.6363	8.094387	5.15075	0.72447	25.75	56.71	26.018
38.549	455.661	21.3	0.67	3.13	19.56	7.55386	3.56195	3.14336	7.50567	3.58482	5	125.00	2.4901	2.490103	0	0.6337	7.434711	4.711459	0.58235	21.18	68.672	24.471
39.206	455.004	19.78	0.91	4.59	17.32	6.84374	5.27622	3.27716	6.80009	5.31009	3	135.00	2.5106	2.5082	0.0024	0.6314	7.271031	4.591081	0.5362	19.71	74.0883	23.859
39.534	454.676	20.68	0.93	4.48	18.01	7.15825	5.13102	3.25407	7.11481	5.16235	3	135.00	2.53281	2.520143	0.0127	0.6299	7.602996	4.789302	0.53397	19.67	79.1712	23.806
39.862	454.348	20.78	0.84	4.03	18.73	7.15536	4.61465	3.22705	7.11212	4.6427	4	135.00	2.55495	2.532049	0.0229	0.6284	7.814492	4.91094	0.56115	20.57	77.2888	24.117
40.19	454.020	19.42	0.88	4.52	19.38	6.58125	5.23163	3.28913	6.5343	5.26922	3	135.00	2.58923	2.555862	0.0434	0.6255	7.528098	4.708868	0.52077	19.3	80.159	23.549
40.518	453.692	16.99	0.73	4.28	19.84	5.59577	5.08051	3.33962	5.54903	5.1233	3	135.00	2.62137	2.567768	0.0536	0.6241	6.843678	4.270948	0.44485	16.87	84.4156	22.454
40.846	453.364	16.52	0.38	2.28	21.46	5.37916	2.73644	3.20777	5.32489	2.75635	5	135.00	2.64351	2.579675	0.0638	0.6226	6.015767	3.745489	0.42961	16.38	73.6031	22.183
41.174	453.036	17.43	0.34	1.93	23.46	5.69704	2.30284	3.14792	5.63916	2.32648	6	135.00	2.66565	2.591581	0.0741	0.6212	6.064749	3.779725	0.4571	17.28	69.0136	22.571
41.502	452.708	22.29	0.68	3.06	24.25	7.52921	3.469	3.13915	7.46776	3.49754	5	135.00	2.68779	2.603488	0.0843	0.6198	7.745791	4.800517	0.60688	22.13	68.3574	24.466
41.83	452.380	19.58	0.73	3.74	20.72	6.4503	4.32719	3.24865	6.40059	4.36079	4	135.00	2.70993	2.615394	0.0945	0.6183	7.359357	4.550628	0.52229	19.45	76.8511	23.43
42.158	452.052	20.78	0.6	2.87	23.56	6.86938	3.32448	3.1617	6.8161	3.35047	5	135.00	2.73207	2.6273	0.1048	0.6169	7.337513	4.526828	0.55876	20.64	70.053	23.857
42.486	451.724	27.89	0.85	3.06	26.14	9.52399	3.36163	3.04802	9.45958	3.40466	5	135.00	2.75421	2.639207	0.115	0.6155	9.132647	5.6216	0.7782	27.72	61.7782	26.072
42.814	451.396	28.69	1.21	4.23	37.12	9.77463	4.86935	3.12299	9.68787	4.71117	4	135.00	2.77635	2.651113	0.1252	0.6142	9.852356	6.060983	0.80228	28.46	67.1585	26.236
43.143	451.067	21.75	0.81	3.73	40.41	7.11643	4.27408	3.214	7.02255	4.33122	4	135.00	2.79856	2.663056	0.1355	0.6128	7.931649	4.860415	0.58673	21.5	74.0922	24.069
43.471	450.739	22.78	0.69	3.01	41.96	7.46153	3.45703	3.14483	7.36059	3.50444	5	135.00	2.8207	2.674962	0.1457	0.6114	7.909522	4.836057	0.61794	22.51	68.7816	24.389
43.799	450.411	20.59	0.61	2.97	43.95	6.60515	3.43717	3.18878	6.50094	3.48227	5	135.00	2.84264	2.686869	0.156	0.6101	7.35878	4.489329	0.54945	20.31	72.126	23.557
44.127	450.083	23.42	1.1	4.71	47.39	7.61643	5.35149	3.24833	7.50897	5.42807	3	135.00	2.86498	2.698775	0.1662	0.6087	8.749722	5.32612	0.63638	23.13	76.8256	24.529
44.455	449.755	253.58	4.98	1.96	20.09	92.4833	1.98649	2.13724	92.4354	1.98753	8	135.00	2.88712	2.710682	0.1764	0.6074	52.62093	31.96092	7.76139	253.45	16.9566	40.151
44.783	449.427	555.99	13.9	2.5	-21.27	203.145	2.5132	1.99381	203.193	2.5126	12	135.00	2.90926	2.722588	0.1867	0.6061	109.1065	66.12409	17.1232	556.12	12.7819	44.134

13 of 48

R15201

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 14 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-2A

ConeTec Inc. nterpretation
Interpretation Of elease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4556
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-2A
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 14:50
CPT File: 804CP02A.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 492.4

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.34	1.38	45.43	22.11	2.23
125	Residual Soil	30.89	2.60	86.31	46.14	2.80

User Inputs:

Assumed: Water Table Depth (ft): 37
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 492.4

Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	492.236	8.72	0.08	0.86	0.23	817.011	0.919	1.31	817.01	0.92	5	130.00	0.011	0.011	0.000	2.000	1.35	2.71	0.270	8.72	0.48799	50.08
0.492	491.908	16.38	0.2	1.22	-0.05	511.195	1.223	1.51	511.20	1.22	6	130.00	0.032	0.032	0.000	2.000	2.71	5.43	0.506	16.38	3.02371	48.22
0.82	491.580	25.84	0.5	1.94	-0.39	483.803	1.939	1.70	483.80	1.94	6	130.00	0.053	0.053	0.000	2.000	4.56	9.11	0.798	25.84	6.11479	47.99
1.148	491.252	28.08	0.51	1.82	-0.21	375.307	1.821	1.73	375.31	1.82	6	130.00	0.075	0.075	0.000	2.000	5.00	10.01	0.867	28.08	6.6951	46.92
1.476	490.924	44.3	0.61	1.37	-0.26	460.747	1.380	1.58	460.75	1.38	7	130.00	0.096	0.096	0.000	2.000	7.50	15.01	1.369	44.3	4.05565	47.79
1.804	490.596	29.51	0.72	2.43	-0.14	250.663	2.450	1.93	250.66	2.45	6	130.00	0.117	0.117	0.000	2.000	5.66	11.31	0.910	29.51	11.2006	45.12
2.133	490.267	24.15	0.47	1.95	0.02	173.186	1.957	1.95	173.19	1.96	6	130.00	0.139	0.139	0.000	2.000	4.66	9.32	0.743	24.15	11.6289	43.36
2.461	489.939	20.69	0.35	1.67	-0.39	128.341	1.705	1.99	128.40	1.70	6	130.00	0.160	0.160	0.000	2.000	4.06	8.11	0.636	20.7	12.6808	41.87
2.789	489.611	29.8	0.44	1.46	-0.02	163.382	1.486	1.88	163.38	1.49	6	130.00	0.181	0.181	0.000	2.000	5.59	11.18	0.917	29.8	9.80656	43.08
3.117	489.283	30.73	0.22	0.72	0.05	150.674	0.721	1.68	150.67	0.72	7	130.00	0.203	0.203	0.000	2.000	5.39	10.77	0.945	30.73	5.79201	42.68
3.445	488.955	21.3	0.33	1.55	-0.07	94.1211	1.566	2.06	94.12	1.57	6	130.00	0.224	0.224	0.000	2.000	4.29	8.57	0.653	21.3	14.6052	40.24
3.773	488.627	26.89	0.22	0.82	-0.09	108.645	0.826	1.83	108.69	0.83	7	130.00	0.245	0.245	0.000	2.000	4.96	9.93	0.825	26.9	8.76744	41.01
4.101	488.299	18.81	0.35	1.84	0.07	69.5644	1.887	2.21	69.56	1.89	6	130.00	0.267	0.267	0.000	1.937	4.03	7.80	0.574	18.81	19.3515	38.59
4.429	487.971	43.41	0.31	0.72	0.16	149.789	0.719	1.68	149.79	0.72	7	130.00	0.288	0.288	0.000	1.864	7.61	14.19	1.335	43.41	5.8155	42.65
4.757	487.643	28.43	0.59	2.06	0.16	90.9455	2.098	2.16	90.95	2.10	6	130.00	0.309	0.309	0.000	1.798	5.96	10.71	0.871	28.43	17.646	40.06
5.085	487.315	16	0.39	2.44	-0.49	47.4078	2.489	2.41	47.41	2.49	5	130.00	0.331	0.331	0.000	1.739	3.74	6.51	0.485	16	27.0118	36.39
5.413	486.987	29.13	0.49	1.69	-0.72	81.7921	1.703	2.13	81.79	1.70	6	130.00	0.352	0.352	0.000	1.686	6.03	10.16	0.891	29.13	16.6865	39.48
5.741	486.659	49.67	0.79	1.59	-0.67	132.105	1.603	1.96	132.10	1.60	7	130.00	0.373	0.373	0.000	1.637	9.63	15.76	1.526	49.67	11.947	42.01
6.069	486.331	53.37	0.83	1.55	0.05	134.29	1.567	1.95	134.29	1.57	7	130.00	0.394	0.394	0.000	1.592	10.30	16.40	1.640	53.37	11.6376	42.10
6.398	486.002	49.98	0.63	1.26	-1.39	119.182	1.271	1.92	119.21	1.27	7	130.00	0.416	0.416	0.000	1.551	9.55	14.80	1.534	49.99	10.9396	41.49
6.726	485.674	38.17	0.52	1.35	-0.56	86.3076	1.378	2.05	86.31	1.38	7	130.00	0.437	0.437	0.000	1.512	7.65	11.57	1.168	38.17	14.3272	39.78
7.054	485.346	40.75	0.54	1.32	-0.74	87.8748	1.340	2.04	87.87	1.34	7	130.00	0.459	0.459	0.000	1.477	8.13	12.00	1.247	40.75	13.9337	39.87
7.382	485.018	37.01	0.6	1.62	-0.79	76.1315	1.642	2.14	76.15	1.64	7	130.00	0.480	0.480	0.000	1.444	7.70	11.11	1.131	37.02	17.0691	39.09
7.71	484.690	59.19	0.77	1.3	-0.23	117.108	1.312	1.94	117.11	1.31	7	130.00	0.501	0.501	0.000	1.413	11.37	16.06	1.817	59.19	11.3174	41.39
8.038	484.362	57.04	1.06	1.85	-0.25	108.174	1.876	2.07	108.17	1.88	7	130.00	0.522	0.522	0.000	1.383	11.53	15.96	1.750	57.04	14.9626	40.98
8.366	484.034	57.87	0.86	1.48	-0.53	105.42	1.500	2.01	105.44	1.50	7	130.00	0.544	0.544	0.000	1.356	11.43	15.50	1.775	57.88	13.2395	40.85
8.694	483.706	75.82	0.88	1.16	-0.74	133.169	1.169	1.86	133.19	1.17	8	130.00	0.565	0.565	0.000	1.330	14.16	18.84	2.330	75.83	9.50987	42.05
9.022	483.378	63.21	1.11	1.75	-0.44	106.788	1.772	2.06	106.79	1.77	7	130.00	0.586	0.586	0.000	1.306	12.71	16.60	1.939	63.21	14.5645	40.91
9.35	483.050	60.49	0.91	1.51	-0.93	98.5311	1.520	2.04	98.55	1.52	7	130.00	0.608	0.608	0.000	1.283	12.06	15.47	1.854	60.5	13.9359	40.49
9.678	482.722	64.51	0.83	1.28	-1.11	101.548	1.299	1.98	101.56	1.30	7	130.00	0.629	0.629	0.000	1.261	12.59	15.87	1.978	64.52	12.4093	40.65
10.006	482.394	80.55	1.03	1.28	-0.85	122.849	1.289	1.92	122.86	1.29	8	130.00	0.650	0.650	0.000	1.240	15.35	19.04	2.474	80.56	10.8105	41.64
10.335	482.065	67.71	1.38	2.04	-0.64	99.7927	2.059	2.12	99.79	2.06	7	130.00	0.672	0.672	0.000	1.220	13.99	17.07	2.075	67.71	16.5727	40.56
10.663	481.737	66.47	1.17	1.76	-0.6	94.9032	1.779	2.10	94.90	1.78	7	130.00	0.693	0.693	0.000	1.201	13.57	16.30	2.036	66.47	15.6621	40.29
10.991	481.409	56.44	0.72	1.28	-0.88	78.0017	1.292	2.06	78.00	1.29	7	130.00	0.714	0.714	0.000	1.183	11.38	13.47	1.725	56.44	14.7573	39.22
11.319	481.081	53.65	0.58	1.08	-0.95	71.9203	1.096	2.05	71.93	1.10	7	130.00	0.736	0.736	0.000	1.166	10.75	12.53	1.638	53.66	14.2461	38.78
11.647	480.753	39.63	0.46	1.15	-1.11	51.3476	1.183	2.18	51.36	1.18	7	130.00	0.757	0.757	0.000	1.149	8.39	9.64	1.203	39.64	18.4421	36.86
11.975	480.425	34.17	0.51	1.48	-1.16	42.8991	1.527	2.31	42.91	1.53	7	130.00	0.778	0.778	0.000	1.133	7.64	8.66	1.034	34.18	22.9801	35.80
12.303	480.097	26.38	0.35	1.33	-1.02	31.9876	1.368	2.39	31.99	1.37	6	130.00	0.800	0.800	0.000	1.118	6.10	6.82	0.792	26.38	25.9069	34.01
12.631	479.769	31.58	0.43	1.35	-1.16	37.4646	1.398	2.34	37.48	1.40	7	130.00	0.821	0.821	0.000	1.104	7.14	7.88	0.952	31.59	23.9035	34.98
12.959	479.441	33.88	0.34	0.99	-1.04	39.2215	1.029	2.24	39.23	1.03	7	130.00	0.842	0.842	0.000	1.090	7.36	8.02	1.023	33.89	20.5322	35.26
13.287	479.113	40.82	0.47	1.14	-0.55	46.2642	1.176	2.22	46.26	1.18	7	130.00	0.864	0.864	0.000	1.076	8.76	9.43	1.237	40.82	19.6264	36.24
13.615	478.785	40.88	0.48	1.18	-0.62	45.1934	1.200	2.23	45.19	1.20	7	130.00	0.885	0.885	0.000	1.063	8.83	9.38	1.238	40.88	20.0856	36.10
13.943	478.457	67.39	0.84	1.25	-0.51	73.3577	1.263	2.08	73.36	1.26	7	130.00	0.906	0.906	0.000	1.050	13.67	14.36	2.058	67.39	15.1748	38.88
14.271	478.129	83.33	1.06	1.27	-0.49	88.8325	1.286	2.02	88.83	1.29	8	130.00	0.928	0.928	0.000	1.038	16.52	17.15	2.551	83.33	13.5068	39.93
14.6	477.800	84.96	0.88	1.03	-0.44	88.5258	1.047	1.96	88.53	1.05	8	130.00	0.949	0.949	0.000	1.027	16.48	16.92	2.601	84.96	11.9944	39.91
14.928	477.472	62.57	1.08	1.72	-0.55	63.4839	1.753	2.22	63.48	1.75	7	130.00	0.970	0.970	0.000	1.015	13.44	13.64	1.907	62.57	19.6287	38.07
15.256	477.144	54.17	0.79	1.46	-0.62	53.6267	1.486	2.23	53.64	1.49	7	130.00	0.992	0.992	0.000	1.004	11.68	11.73	1.646	54.18	19.9666	37.11

R15203

Depth (ft)	Sampl (ft)	vgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	s (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	476.816	44.07	0.61	1.38	-0.69	42.5062	1.417	2.30	42.52	1.42	7	130.00	1.013	1.013	0.000	0.994	9.78	9.72	1.333	44.08	22.369	35.74
15.912	476.488	48.55	0.7	1.45	-0.58	45.9409	1.473	2.28	45.94	1.47	7	130.00	1.034	1.034	0.000	0.983	10.70	10.52	1.471	48.55	21.7636	36.20
16.24	476.160	44.39	0.49	1.11	-0.51	41.0519	1.131	2.25	41.06	1.13	7	130.00	1.056	1.056	0.000	0.973	9.67	9.41	1.342	44.4	20.757	35.53
16.568	475.832	49.03	0.37	0.75	-0.55	44.528	0.772	2.13	44.53	0.77	8	130.00	1.077	1.077	0.000	0.964	10.16	9.79	1.485	49.03	16.7798	36.02
16.896	475.504	41.84	0.47	1.13	-0.34	37.0973	1.154	2.29	37.10	1.15	7	130.00	1.098	1.098	0.000	0.954	9.27	8.85	1.261	41.84	22.2493	34.92
17.224	475.176	36.67	0.81	2.21	-0.18	31.7539	2.278	2.52	31.75	2.28	6	130.00	1.120	1.120	0.000	0.945	9.03	8.53	1.101	36.67	31.6967	33.96
17.552	474.848	53.97	0.73	1.35	-0.44	46.3056	1.382	2.26	46.31	1.38	7	130.00	1.141	1.141	0.000	0.936	11.79	11.04	1.636	53.98	21.0557	36.25
17.88	474.520	91.09	1.68	1.85	-0.88	77.3772	1.868	2.17	77.38	1.87	7	130.00	1.162	1.162	0.000	0.928	19.20	17.81	2.784	91.09	18.1251	39.18
18.208	474.192	100.89	2.85	2.82	-1.27	84.2457	2.85839	2.27913	84.2542	2.8581	6	130.00	1.18352	1.18352	0	0.9192	22.22949	20.43345	3.08689	100.9	21.7559	39.646
18.537	473.863	79.53	2.26	2.84	-0.71	65.0052	2.88541	2.35986	65.0052	2.88541	6	130.00	1.20491	1.204905	0	0.911	18.15282	16.53742	2.42493	79.53	24.8046	38.208
18.865	473.535	60.94	1.2	1.97	-0.49	48.6972	2.00959	2.3446	48.6972	2.00959	7	130.00	1.22623	1.226225	0	0.9031	13.81554	12.47621	1.84872	60.94	24.2101	36.545
19.193	473.207	41.14	0.68	1.66	-0.56	31.9768	1.70458	2.44317	31.9768	1.70458	7	130.00	1.24755	1.247545	0	0.8953	9.752974	8.731904	1.23506	41.14	28.207	34.008
19.521	472.879	43.98	0.41	0.92	-0.65	33.6609	0.95994	2.28476	33.6609	0.95994	7	130.00	1.26887	1.268865	0	0.8878	9.712904	8.622663	1.32233	43.98	21.9609	34.324
19.849	472.551	44.49	0.5	1.13	-0.23	33.4834	1.15741	2.33046	33.4834	1.15741	7	130.00	1.29019	1.290185	0	0.8804	10.02335	8.824437	1.33746	44.49	23.6666	34.292
20.177	472.223	60.56	0.75	1.23	-0.23	45.176	1.26585	2.24572	45.176	1.26585	7	130.00	1.31151	1.311505	0	0.8732	13.15276	11.48502	1.83432	60.56	20.563	36.102
20.505	471.895	62.15	0.84	1.35	-0.37	45.6303	1.38119	2.26465	45.6378	1.38096	7	130.00	1.33283	1.332825	0	0.8662	13.60969	11.78858	1.88288	62.16	21.234	36.162
20.833	471.567	58.16	0.81	1.4	-0.14	41.9496	1.42591	2.30229	41.9496	1.42591	7	130.00	1.35415	1.354145	0	0.8593	12.94251	11.12207	1.7587	58.16	22.6062	35.66
21.161	471.239	61.14	0.98	1.6	-0.23	43.4504	1.63977	2.32698	43.4504	1.63977	7	130.00	1.37547	1.375465	0	0.8527	13.75345	11.727	1.8503	61.14	23.5343	35.87
21.489	470.911	58.39	1.21	2.08	-0.09	40.8031	2.12306	2.4187	40.8031	2.12306	7	130.00	1.39679	1.396785	0	0.8461	13.68713	11.58104	1.7645	58.39	27.1802	35.494
21.817	470.583	68.58	1.4	2.05	-0.21	47.3603	2.08452	2.36412	47.3603	2.08452	7	130.00	1.41811	1.418105	0	0.8397	15.68334	13.16995	2.07932	68.58	24.9725	36.381
22.145	470.255	62.38	1.27	2.03	-0.14	42.3367	2.084	2.40123	42.3367	2.084	7	130.00	1.43943	1.439425	0	0.8335	14.50622	12.09093	1.88671	62.38	26.4611	35.715
22.473	469.927	56.41	1.04	1.85	-0.23	37.6173	1.89266	2.4147	37.6173	1.89266	7	130.00	1.46075	1.460745	0	0.8274	13.19879	10.92061	1.70122	56.41	27.0145	35.003
22.802	469.598	43.25	0.55	1.27	-0.21	28.181	1.3168	2.42382	28.181	1.3168	7	130.00	1.48213	1.48213	0	0.8214	10.16202	8.347122	1.29312	43.25	27.393	33.22
23.13	469.270	47.18	0.49	1.04	-0.09	30.3812	1.07276	2.34808	30.3812	1.07276	7	130.00	1.50345	1.50345	0	0.8156	10.7126	8.736759	1.41413	47.18	24.3451	33.69
23.458	468.942	41.56	0.66	1.58	-0.04	26.2566	1.64855	2.50417	26.2566	1.64855	7	130.00	1.52477	1.52477	0	0.8098	10.13933	8.21121	1.23948	41.56	30.8699	32.775
23.786	468.614	33	0.65	1.96	0.16	20.3442	2.06652	2.65128	20.3442	2.06652	6	130.00	1.54609	1.54609	0	0.8042	8.65873	6.963648	0.97381	33	37.9169	31.141
24.114	468.286	31.46	0.73	2.33	0.09	19.0713	2.44208	2.71649	19.0713	2.44208	6	130.00	1.56741	1.56741	0	0.7987	8.540436	6.821639	0.92547	31.46	41.3365	30.721
24.442	467.958	28.46	0.84	2.94	-0.07	16.9137	3.12602	2.82253	16.9137	3.12602	5	130.00	1.58873	1.58873	0	0.7934	8.186954	6.495271	0.83193	28.46	47.3052	29.934
24.77	467.630	36.73	0.76	2.06	0.19	21.813	2.16401	2.63841	21.813	2.16401	6	130.00	1.61005	1.61005	0	0.7881	9.574187	7.545399	1.0873	36.73	37.2639	31.591
25.098	467.302	53.09	0.84	1.58	-0.04	31.5432	1.63238	2.43684	31.5432	1.63238	7	130.00	1.63137	1.63137	0	0.7829	12.54912	9.825098	1.59315	53.09	27.9392	33.923
25.426	466.974	37.37	0.93	2.48	0.02	21.6116	2.60378	2.68975	21.6116	2.60378	6	130.00	1.65269	1.65269	0	0.7779	10.00281	7.780841	1.1058	37.37	39.9116	31.531
25.754	466.646	29.67	0.83	2.8	0.05	16.7239	2.96471	2.81252	16.7239	2.96471	5	130.00	1.67401	1.67401	0	0.7729	8.487242	6.559754	0.86675	29.67	46.7198	29.86
26.082	466.318	29.89	0.72	2.4	0.04	16.6308	2.55367	2.77598	16.6308	2.55367	6	130.00	1.69533	1.69533	0	0.768	8.378865	6.435141	0.8729	29.89	44.6215	29.823
26.41	465.990	40.76	0.67	1.65	0.51	22.7439	1.71604	2.56534	22.7439	1.71604	7	130.00	1.71665	1.71665	0	0.7632	10.24312	7.817922	1.20877	40.76	33.6905	31.86
26.739	465.661	31.14	0.85	2.72	0.6	16.9168	2.89096	2.80197	16.9168	2.89096	6	130.00	1.73804	1.738035	0	0.7585	8.855459	6.7171	0.91028	31.14	46.1075	29.935
27.067	465.333	27.6	0.95	3.45	0.11	14.6876	3.67638	2.91406	14.6876	3.67638	5	130.00	1.75936	1.759355	0	0.7539	8.370606	6.310738	0.80002	27.6	52.8796	29
27.395	465.005	20.8	0.75	3.59	0.09	10.681	3.94336	3.04266	10.681	3.94336	5	130.00	1.78068	1.780675	0	0.7494	6.829167	5.117707	0.58883	20.8	61.4043	26.863
27.723	464.677	32.97	0.92	2.78	0.41	17.2964	2.95174	2.79991	17.2908	2.95269	6	130.00	1.802	1.801995	0	0.7449	9.362277	6.974365	0.96495	32.96	45.9884	30.079
28.051	464.349	34.02	0.75	2.2	0.56	17.6583	2.32943	2.73173	17.6528	2.33016	6	130.00	1.82332	1.823315	0	0.7406	9.30799	6.893266	0.9968	34.01	42.1628	30.215
28.379	464.021	30.25	0.56	1.86	0.39	15.3989	1.97146	2.73942	15.3989	1.97146	6	130.00	1.84464	1.844635	0	0.7363	8.313169	6.120845	0.87942	30.25	42.5839	29.314
28.707	463.693	26.45	0.54	2.03	0.44	13.175	2.19655	2.82207	13.1697	2.19744	6	130.00	1.86596	1.865955	0	0.7321	7.603892	5.56654	0.76112	26.44	47.2781	28.272
29.035	463.365	35.65	0.64	1.79	0.42	17.8897	1.89558	2.67583	17.8897	1.89558	6	125.00	1.88728	1.887275	0	0.7279	9.473402	6.895859	1.04529	35.65	39.1825	30.303
29.363	463.037	31.91	0.9	2.81	0.93	15.7263	2.99978	2.83696	15.7263	2.99978	6	125.00	1.90778	1.907775	0	0.724	9.254513	6.700235	0.92886	31.91	48.1574	29.453
29.691	462.709	78.81	1.79	2.27	-13.37	39.8707	2.32825	2.45145	39.9174	2.32553	7	125.00	1.92828	1.928275	0	0.7201	18.77876	13.52185	2.38024	78.9	28.5599	35.362
30.019	462.381	75.42	2.46	3.26	-19.88	37.7012	3.34825	2.57393	37.7628	3.34279	6	125.00	1.94878	1.948775	0	0.7163	19.08391	13.65624	2.27465	75.54	34.0988	35.027
30.347	462.053	73.52	2.38	3.23	-21.24	36.3335	3.32631	2.58372	36.3996	3.32028	6	125.00	1.96928	1.969275	0	0.7126	18.67716	13.30937	2.21519	73.65	34.5679	34.803
30.675	461.725	61.35	2.05	3.35	-21.62	29.8326	3.45349	2.66802	29.903	3.44537	6	125.00	1.98978	1.989775	0	0.7089	16.19004	11.47746	1.83778	61.49	38.2614	33.591
31.004	461.396	28.32	1.36	4.8	-15.93	13.0872	5.1692	3.04324	13.1369	5.14963	3	125.00	2.01034	2.010338	0	0.7053	9.334539	6.583523	0.81454	28.42	61.4453	28.256
31.332	461.068	40.8	1.24	3.05	-12.77	19.0902	3.19842	2.78585	19.1296	3.19183	6	125.00	2.03084	2.030838	0	0.7017	11.52195	8.085156	1.20028	40.88	45.182	30.741
31.66	460.740	44.64	1.36	3.05	-16.6	20.7614	3.19334	2.75656	20.815	3.18511	6	125.00	2.05134	2.051338	0	0.6982	12.41234	8.66633	1.31853	44.75	43.5317	31.289
31.988	460.412	35.89	0.92	2.56	-16.6	16.3228	2.72043	2.79674	16.3759	2.71161	6	125.00	2.07184	2.071838	0	0.6947	10.20784	7.091796	1.047	36	45.8061	29.721
32.316	460.084	41.49	0.76	1.84	-15.52	18.8295	1.92905	2.6602	18.8773	1.92416	6	125.00	2.09234	2.092338	0	0.6913	10.98277	7.578869	1.21974	41.59	38.3734	30.654
32.644	459.756	44.62	0.87	1.94	-15.36	20.1185	2.04671	2.6514	20.1658	2.04191	6	125.00	2.11284	2.112838	0	0.688	11.73457	8.072984	1.31601	44.72	37.9227	31.084
32.972	459.428	46.81	0.97	2.07	-12.68	20.9421	2.17116	2.65248	20.9796	2.16728	6	125.00	2.13334	2.133338	0	0.6847	12.31082	8.428633	1.38318	46.89	37.978	31.34
33.3	459.100	34.78	0.63	1.82	-11.57	15.1479	1.93097	2.73912	15.1804	1.92683	6	125.00	2.15384	2.153838	0	0.6814	9.575763	6.524796	1.0101	34.85	42.5673	29.219
33.628	458.772	27.97	0.53	1.88	-11.11	11.8687	2.05461	2.84249	11.8959	2.04905	6	125.00	2.17434	2.174338	0	0.6782	8.157752	5.532317	0.79863	28.04	48.487	27.59
33.956	458.444	25.2	0.51	2.03	-10.93	10.4815	2.21688	2.90541	10.5134	2.21017	6	125.00	2.19484	2.194838	0	0.675	7.62481	5.146688	0.71223	25.27	52.3352	26.756
34.284	458.116	23.12	0.44	1.91	-10.81	9.43633	2.10479	2.93186	9.46793	2.09777	6	125.00	2.21534	2.215338	0	0.6719	7.108146	4.775693	0.6472	23.19	54.0101	26.047
34.612	457.788	24.88	0.56	2.24	-10.49	10.1278	2.47304	2.94368	10.1591	2.46542	6	125.00	2.23584	2.235838	0	0.6688	7.702224	5.151053	0.70106	24.95	54.7701	26.525
34.941	457.459	27.6	0.74	2.67	-10.42	11.2319	2.91987	2.94724	11.2585	2.91297	6	125.00	2.2564	2.2564	0	0.6657	8.557203	5.696706	0.78463	27.66	55.0001	27.219
35.269	457.131	22.71	0.58	2.56	-10.21	8.97409	2.83853	3.02029	9.00483	2.82884	5	125.00	2.2769	2.2769	0	0.6627	7.373349	4.886443	0.6326	22.78	59.8616	25.707
35.597	456.803	20.39	0.5	2.46	-9.49	7.87525	2.78356	3.06177	7.89701	2.75594	5	125.00	2.2974	2.2974	0	0.6598	6.794369	4.482609	0.56014	20.44	62.7431	24.816
35.925	456.475	20.1	0.58	2.89	-8.89	7.67164	3.26171	3.1108	7.69321	3.25256	5	125.00	2.3179	2.3179	0	0.6568	6.918507	4.54428	0.55053	20.15	66.264	24.639
36.253	456.147	21.46	0.65	3.04	-5.91	8.17722	3.3993	3.09836	8.19432	3.3922	5	125.00	2.3384	2.3384	0	0.6539	7.320835	4.787417	0.592	21.5	65.3582	25.067
36.581	455.819	18.81	0.64	3.38	-5.48	6.97406	3.89032	3.18867	6.96677	3.89324	5	125.00	2.3589	2.3589	0	0.6511	6.8256	4.444123	0.50932	18.84	72.1173	23.985
36.909	455.491	18.56	0.68	3.67	-4.62	6.80029	4.20256	3.21677	6.81289	4.19479	4	125.00	2.3794	2.3794	0	0.6483	6.871849	4.45492	0.50095	18.59	74.3104	23.814
37.237	455.163	16.65	0.84	5.06	-4.85	5.95614	5.8947	3.34912	5.96868	5.88231	3	135.00	2.3999	2.392506	0.0074	0.6465	6.818186	4.408008	0.44118	16.68	85.2328	22.923
37.565	454.835	18.46	0.76	4.13	-5.01	6.67022	4.73676	3.25373	6.6827	4.72991	4	135.00	2.42204	2.404412	0.0178	0.6449	7.022524	4.528859	0.49653	18.49	77.2612	23.691

16 7 17

R15204

Depth (ft)	Samp (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	ss (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	454.507	17.57	0.66	3.77	-4.46	6.25986	4.3634	3.25552	6.27228	4.35476	4	135.00	2.44418	2.416318	0.0279	0.6433	6.693405	4.30596	0.46829	17.6	77.4062	23.267
38.221	454.179	23.26	0.72	3.06	-3.6	8.56333	3.46259	3.08679	8.57568	3.4576	5	135.00	2.46632	2.428225	0.0381	0.6417	7.869741	5.050286	0.64377	23.29	64.524	25.388
38.549	453.851	35.17	1.71	4.86	-4.65	13.3934	5.23231	3.04061	13.4056	5.22751	3	135.00	2.48846	2.440131	0.0483	0.6402	11.54187	7.388724	1.01181	35.2	61.2619	28.401
38.877	453.523	74.79	4.27	5.7	-12.75	29.4773	5.90763	2.82205	29.5099	5.9011	11	135.00	2.5106	2.452038	0.0586	0.6386	21.5316	13.75032	2.23775	74.87	47.2766	33.514
39.206	453.194	104.68	6.22	5.94	-19.79	41.4562	6.08926	2.72869	41.5049	6.08211	11	135.00	2.53281	2.46398	0.0688	0.6371	28.63555	18.24261	3.16245	104.8	41.9974	35.6
39.534	452.866	152.53	8.46	5.55	-19.17	60.5743	5.64094	2.59462	60.6227	5.63643	11	135.00	2.55495	2.475887	0.0791	0.6355	38.02148	24.73568	4.64319	152.65	35.0952	37.815
39.862	452.538	232.67	10.79	4.64	-19.12	92.4888	4.68941	2.41592	92.533	4.68717	11	135.00	2.57709	2.487793	0.0893	0.634	54.49618	34.55087	7.12362	232.78	27.0649	40.155
40.19	452.210	391.32	13.96	3.57	-18.27	155.507	3.59127	2.18739	155.551	3.59025	12	135.00	2.59923	2.4997	0.0995	0.6325	82.95759	52.47014	12.0347	391.43	18.574	42.835
40.518	451.882	504.54	14.95	2.96	-19.14	199.84	2.97857	2.05825	199.888	2.97786	12	135.00	2.62137	2.511806	0.1098	0.631	101.5206	64.05876	15.5393	504.66	14.5769	44.055
40.846	451.554	352.83	14.47	4.1	7.69	138.769	4.13208	2.26597	138.754	4.13256	12	135.00	2.64351	2.523512	0.12	0.6295	77.28576	48.65156	10.8417	352.79	21.2614	42.264
41.174	451.226	428.29	14.1	3.29	55.96	167.871	3.31278	2.14021	167.733	3.31561	12	135.00	2.66565	2.535419	0.1302	0.628	88.95568	55.86613	13.1772	427.94	17.0501	43.207

17 of 70

R15205

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 18 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY TJS DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-3

ConeTec Inc. rpretation
Interpretation Ou: elease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4528
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-3
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 07:09
CPT File: 804CP03.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 466.98

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	36.95	1.32	43.13	32.39	2.49

User Inputs:

Assumed:
Water Table Depth (ft): 11.1
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 467.0
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	466.816	22.8	0.36	1.56	-0.74	2223.39	1.580	1.42	2224.37	1.58	6	125.00	0.010	0.010	0.000	2.000	3.67	7.34	0.706	22.81	1.81602	53.62
0.492	466.488	42.45	0.67	1.58	-5.17	1379.49	1.579	1.46	1380.46	1.58	7	125.00	0.031	0.031	0.000	2.000	6.91	13.82	1.313	42.48	2.23467	52.00
0.82	466.160	28.94	0.66	2.29	-5.45	563.683	2.285	1.73	564.27	2.28	6	125.00	0.051	0.051	0.000	2.000	5.17	10.34	0.894	28.97	6.77422	48.62
1.148	465.832	23.43	0.46	1.97	-7.27	325.551	1.969	1.79	326.25	1.97	6	125.00	0.072	0.072	0.000	2.000	4.27	8.55	0.723	23.48	7.91559	46.30
1.476	465.504	32.54	0.58	1.77	-11.34	351.737	1.787	1.74	352.50	1.78	6	125.00	0.092	0.092	0.000	2.000	5.82	11.65	1.005	32.61	6.82459	46.64
1.804	465.176	38.02	0.94	2.47	-4.06	336.206	2.480	1.87	336.38	2.48	6	125.00	0.113	0.113	0.000	2.000	7.12	14.25	1.174	38.04	9.67104	46.44
2.133	464.847	36.81	1.27	3.46	-2.93	275.118	3.463	2.04	275.27	3.46	5	125.00	0.133	0.133	0.000	2.000	7.35	14.70	1.136	36.83	14.0176	45.54
2.461	464.519	32.44	1.88	5.81	-1.76	209.906	5.823	2.29	209.97	5.82	3	125.00	0.154	0.154	0.000	2.000	7.19	14.38	1.000	32.45	22.2623	44.29
2.789	464.191	33.21	1.93	5.82	-0.93	189.52	5.842	2.32	189.58	5.84	3	125.00	0.174	0.174	0.000	2.000	7.44	14.88	1.023	33.22	23.1469	43.80
3.117	463.863	41.98	2.26	5.38	1.78	214.489	5.409	2.26	214.44	5.41	3	125.00	0.195	0.195	0.000	2.000	9.17	18.35	1.294	41.97	21.0994	44.39
3.445	463.535	51.02	2.5	4.89	1.36	235.958	4.921	2.20	235.91	4.92	4	125.00	0.215	0.215	0.000	2.000	10.89	21.78	1.573	51.01	19.1479	44.83
3.773	463.207	61.43	2.63	4.28	0.26	259.504	4.296	2.13	259.46	4.30	5	125.00	0.236	0.236	0.000	2.000	12.73	25.46	1.895	61.42	16.8244	45.27
4.101	462.879	66.35	2.47	3.72	5.77	257.864	3.737	2.08	257.71	3.74	5	125.00	0.256	0.256	0.000	1.975	13.47	26.60	2.046	66.31	15.2758	45.24
4.429	462.551	70.01	2.46	3.51	-1.2	251.915	3.528	2.07	251.91	3.53	6	125.00	0.277	0.277	0.000	1.901	14.12	26.84	2.159	70.01	14.7869	45.14
4.757	462.223	47.34	1.98	4.19	4.97	158.226	4.209	2.24	158.09	4.21	5	125.00	0.297	0.297	0.000	1.834	10.25	18.80	1.456	47.3	20.3659	42.91
5.085	461.895	35.26	1.25	3.54	14.76	109.946	3.577	2.28	109.66	3.59	5	125.00	0.318	0.318	0.000	1.774	7.75	13.74	1.082	35.17	21.7542	41.06
5.413	461.567	29.45	1.07	3.63	14.25	86.0497	3.675	2.36	85.78	3.69	5	125.00	0.338	0.338	0.000	1.719	6.69	11.50	0.901	29.36	24.6747	39.74
5.741	461.239	22.73	0.72	3.15	18.2	62.3478	3.218	2.41	62.01	3.24	5	125.00	0.359	0.359	0.000	1.669	5.28	8.81	0.693	22.61	26.8102	37.94
6.069	460.911	20.62	0.5	2.43	23.72	53.3615	2.470	2.38	52.97	2.49	5	125.00	0.379	0.379	0.000	1.624	4.71	7.65	0.627	20.47	25.5653	37.04
6.398	460.582	23.44	0.52	2.22	51.64	57.6183	2.257	2.33	56.82	2.29	6	125.00	0.400	0.400	0.000	1.581	5.21	8.24	0.713	23.12	23.7246	37.44
6.726	460.254	16.44	0.47	2.84	44.02	36.1079	2.934	2.54	37.44	2.99	5	125.00	0.420	0.420	0.000	1.542	4.02	6.20	0.496	16.16	32.6769	34.97
7.054	459.926	14.75	0.41	2.79	45.61	32.4562	2.865	2.59	31.82	2.92	5	125.00	0.441	0.441	0.000	1.506	3.68	5.58	0.443	14.47	34.9073	33.98
7.382	459.598	17.38	0.43	2.45	47.02	36.67	2.542	2.52	36.04	2.59	5	125.00	0.461	0.461	0.000	1.472	4.19	6.17	0.524	17.09	31.3627	34.74
7.71	459.270	18.54	0.47	2.51	37.83	37.4747	2.603	2.51	36.98	2.64	5	125.00	0.482	0.482	0.000	1.441	4.46	6.46	0.559	18.3	31.2347	34.90
8.038	458.942	19.4	0.5	2.58	37.94	37.6166	2.646	2.52	37.16	2.68	5	125.00	0.502	0.502	0.000	1.411	4.70	6.63	0.585	19.17	31.3584	34.93
8.366	458.614	17.21	0.55	3.2	34.73	31.9142	3.296	2.63	31.49	3.34	5	125.00	0.523	0.523	0.000	1.385	4.41	6.11	0.517	16.99	36.9521	33.91
8.694	458.286	17.95	0.56	3.1	31.31	32.0343	3.217	2.62	31.68	3.25	5	125.00	0.543	0.543	0.000	1.357	4.59	6.23	0.539	17.76	36.4732	33.95
9.022	457.958	19.33	0.57	2.93	27.69	33.2806	3.037	2.59	32.98	3.07	5	125.00	0.564	0.564	0.000	1.332	4.88	6.50	0.581	19.16	34.995	34.20
9.35	457.630	18.87	0.64	3.4	23.97	31.2909	3.500	2.65	31.03	3.53	5	125.00	0.584	0.584	0.000	1.308	4.92	6.43	0.566	18.72	37.5977	33.82
9.678	457.302	20.7	0.61	2.95	26.23	33.2219	3.036	2.59	32.94	3.06	5	125.00	0.605	0.605	0.000	1.286	5.23	6.72	0.622	20.53	34.9967	34.19
10.006	456.974	20.8	0.74	3.57	10.97	32.26	3.668	2.65	32.15	3.68	5	125.00	0.625	0.625	0.000	1.265	5.45	6.89	0.625	20.73	38.0423	34.04
10.335	456.645	22.06	0.78	3.52	8.13	33.1519	3.642	2.64	33.07	3.65	5	125.00	0.646	0.646	0.000	1.244	5.75	7.15	0.663	22.01	37.4577	34.22
10.663	456.317	22.26	0.84	3.76	9.06	32.4015	3.890	2.67	32.31	3.90	4	125.00	0.666	0.666	0.000	1.225	5.88	7.20	0.669	22.2	38.8361	34.07
10.991	455.989	22.23	0.86	3.88	10.07	31.361	3.992	2.69	31.27	4.00	4	135.00	0.687	0.687	0.000	1.207	5.93	7.15	0.667	22.17	39.7778	33.87
11.319	455.661	19.23	0.81	4.2	10.53	26.3739	4.373	2.77	26.27	4.39	4	135.00	0.709	0.702	0.007	1.193	5.35	6.39	0.573	19.16	44.2873	32.78
11.647	455.333	18	0.62	3.43	12.26	24.1809	3.590	2.74	24.07	3.61	5	135.00	0.731	0.714	0.017	1.183	4.93	5.84	0.535	17.92	42.7427	32.23
11.975	455.005	21.25	0.62	2.92	16.42	28.2301	3.025	2.64	28.09	3.04	5	135.00	0.753	0.726	0.027	1.174	5.53	6.49	0.635	21.15	37.4988	33.21
12.303	454.677	21.1	0.8	3.8	12.7	27.5413	3.936	2.73	27.43	3.95	4	135.00	0.775	0.736	0.038	1.164	5.73	6.67	0.629	21.02	41.8264	33.06
12.631	454.349	17.94	0.7	3.88	13.37	22.8604	4.083	2.80	22.74	4.11	4	135.00	0.798	0.750	0.048	1.155	5.06	5.85	0.531	17.85	45.8564	31.88
12.959	454.021	16.67	0.53	3.19	25.01	20.8069	3.344	2.78	20.60	3.36	5	135.00	0.820	0.762	0.058	1.146	4.63	5.30	0.491	16.61	44.6307	31.24
13.287	453.693	17.06	0.47	2.76	28.87	20.988	2.894	2.73	20.76	2.93	5	135.00	0.842	0.774	0.068	1.137	4.63	5.27	0.503	16.9	42.3273	31.30
13.615	453.365	15.98	0.45	2.79	32.33	19.2415	2.977	2.77	18.99	3.02	5	135.00	0.864	0.786	0.078	1.128	4.42	4.98	0.468	15.78	44.472	30.73
13.943	453.037	17	0.42	2.45	36.95	20.2055	2.606	2.72	19.92	2.64	5	135.00	0.886	0.797	0.089	1.120	4.57	5.11	0.499	16.77	41.6351	31.04
14.271	452.709	20.35	0.53	2.61	41.32	24.0198	2.726	2.67	23.70	2.76	5	135.00	0.908	0.809	0.099	1.112	5.33	5.93	0.602	20.09	39.0883	32.16
14.6	452.380	24.99	0.7	2.79	53.19	29.2928	2.909	2.63	28.89	2.95	5	135.00	0.931	0.821	0.109	1.103	6.39	7.05	0.745	24.66	36.6088	33.40
14.928	452.052	25.84	0.92	3.55	51.01	29.8677	3.697	2.69	29.48	3.74	5	135.00	0.953	0.833	0.119	1.095	6.82	7.47	0.771	25.52	39.7482	33.53
15.256	451.724	25.35	0.86	3.36	59.49	28.841	3.528	2.69	28.46	3.58	5	135.00	0.975	0.845	0.130	1.088	6.67	7.26	0.755	24.98	39.714	33.30

Depth (ft)	Sampl (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt (pcf)	ss (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	451.396	25.2	0.94	3.72	60.14	28.2395	3.884	2.72	27.80	3.95	5	135.00	0.997	0.857	0.140	1.080	6.75	7.29	0.749	24.82	41.5723	33.17
15.912	451.068	23.53	0.87	3.69	59.12	25.9052	3.865	2.75	25.48	3.93	5	135.00	1.019	0.869	0.150	1.073	6.39	6.86	0.697	23.16	43.0523	32.63
16.24	450.740	24.42	0.79	3.22	95.41	26.5403	3.379	2.71	25.87	3.47	5	135.00	1.041	0.881	0.160	1.065	6.44	6.86	0.724	23.83	40.8417	32.73
16.896	450.084	25.8	0.86	3.32	86.21	27.3182	3.480	2.70	26.73	3.56	5	135.00	1.086	0.905	0.181	1.051	6.81	7.16	0.765	25.27	40.6511	32.94
17.224	449.756	27.36	1.09	3.99	68.75	28.6411	4.152	2.74	28.17	4.22	4	135.00	1.108	0.917	0.191	1.045	7.39	7.72	0.813	26.93	42.4068	33.26
17.88	449.100	22.38	1.09	4.86	39.24	22.5732	5.135	2.87	22.31	5.20	3	135.00	1.130	0.929	0.201	1.038	6.94	7.20	0.706	23.61	49.6011	32.32
18.208	448.772	17.75	0.82	4.63	24.36	17.4059	4.947	2.94	17.25	4.99	3	135.00	1.174	0.952	0.222	1.025	5.43	5.57	0.513	17.6	54.7916	30.15
18.537	448.443	16.18	0.53	3.25	29.47	15.5391	3.537	2.89	15.35	3.58	5	135.00	1.196	0.964	0.232	1.018	4.79	4.88	0.464	16	51.4876	29.40
18.865	448.115	16.38	0.38	2.32	30.44	15.5318	2.506	2.80	15.34	2.54	5	135.00	1.218	0.976	0.242	1.012	4.61	4.66	0.469	16.19	46.1677	29.39
19.193	447.787	17.22	0.42	2.44	41.64	16.1723	2.628	2.80	15.91	2.67	5	135.00	1.241	0.988	0.253	1.006	4.83	4.86	0.495	16.96	46.1732	29.64
19.521	447.459	27.26	0.55	2.02	43.37	25.9979	2.116	2.58	25.73	2.14	6	135.00	1.263	1.000	0.263	1.000	6.82	6.82	0.805	26.99	34.2771	32.71
19.849	447.131	15.42	0.71	4.62	19.56	13.9691	5.023	3.02	13.85	5.07	3	135.00	1.285	1.012	0.273	0.994	4.95	4.93	0.438	15.3	59.9097	28.74
20.177	446.803	42.76	1.36	3.19	-1.64	40.4898	3.281	2.55	40.50	3.28	5	135.00	1.307	1.024	0.283	0.988	10.65	10.52	1.263	42.77	32.7842	35.49
20.505	446.475	21.33	1.36	6.39	-21.13	19.3115	6.800	2.99	19.44	6.76	3	135.00	1.329	1.036	0.293	0.983	6.83	6.71	0.619	21.46	58.031	30.94
20.833	446.147	94.63	4.34	4.59	-16.03	89.0402	4.653	2.42	89.14	4.65	11	135.00	1.351	1.048	0.304	0.977	22.25	21.74	2.888	94.73	27.3675	39.97
21.161	445.819	325.72	14.52	4.46	-12.24	306.129	4.477	2.11	306.20	4.48	11	135.00	1.373	1.060	0.314	0.972	67.01	65.10	10.042	325.8	16.2306	46.03
21.489	445.491	395.71	17.73	4.48	-7.11	368.031	4.496	2.08	368.07	4.50	12	135.00	1.396	1.071	0.324	0.966	80.29	77.56	12.208	395.75	15.201	46.84
21.817	445.163	424.33	18.21	4.29	-16.47	390.385	4.306	2.05	390.48	4.30	12	135.00	1.418	1.083	0.334	0.961	85.16	81.82	13.093	424.43	14.3837	47.09

R15208

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 21 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-4

ConeTec Inc. pretation
Interpretation Out lease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4501
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-4
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 12:51
CPT File: 804CP04.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 482.55

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	40.98	1.95	63.49	28.02	2.41

User Inputs:

Assumed:
Water Table Depth (ft): 21.7
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 482.6

Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.386	18.72	0.55	2.92	-0.12	1825.34	2.940	1.70	1825.36	2.94	5	125.00	0.010	0.010	0.000	2.000	3.30	6.60	0.579	18.72	6.13882	52.96
0.492	482.058	32.37	1.04	3.2	7.35	1051.68	3.216	1.79	1050.38	3.22	5	125.00	0.031	0.031	0.000	2.000	5.87	11.75	1.001	32.33	7.80728	51.02
0.82	481.730	59.25	1.53	2.59	5.03	1155.1	2.585	1.68	1154.51	2.59	6	125.00	0.051	0.051	0.000	2.000	10.38	20.76	1.833	59.22	5.79663	51.36
1.148	481.402	69.32	1.89	2.73	-7.9	965.132	2.729	1.73	965.83	2.73	6	125.00	0.072	0.072	0.000	2.000	12.34	24.68	2.144	69.37	6.60102	50.71
1.476	481.074	55.93	1.68	3.01	-4.6	605.267	3.009	1.83	605.61	3.01	6	125.00	0.092	0.092	0.000	2.000	10.34	20.68	1.729	55.96	6.8217	48.91
1.804	480.746	47.44	1.34	2.82	-9.26	419.754	2.831	1.87	420.29	2.83	6	125.00	0.113	0.113	0.000	2.000	8.91	17.82	1.465	47.5	9.76493	47.40
2.133	480.417	31.92	1.13	3.53	-8.69	236.437	3.555	2.08	236.81	3.55	5	125.00	0.133	0.133	0.000	2.000	6.49	12.97	0.984	31.97	15.2078	44.89
2.461	480.089	34.91	0.98	2.81	-9.96	225.965	2.820	2.01	226.35	2.81	6	125.00	0.154	0.154	0.000	2.000	6.90	13.80	1.076	34.97	13.1573	44.64
2.789	479.761	22.26	0.83	3.71	-10	126.702	3.758	2.25	127.05	3.75	4	125.00	0.174	0.174	0.000	2.000	4.87	9.73	0.684	22.32	20.8802	41.81
3.117	479.433	18.96	0.9	4.76	-6.79	96.3244	4.796	2.41	96.58	4.78	3	125.00	0.195	0.195	0.000	2.000	4.44	8.88	0.581	19.01	26.8756	40.38
3.445	479.105	26.28	1.23	4.69	-6.97	121.055	4.719	2.35	121.24	4.71	3	125.00	0.215	0.215	0.000	2.000	5.97	11.94	0.807	26.32	24.2642	41.57
3.773	478.777	29.78	1.59	5.34	-8.66	125.267	5.382	2.38	125.50	5.37	3	125.00	0.236	0.236	0.000	2.000	6.88	13.77	0.915	29.83	25.7669	41.75
4.101	478.449	30.45	1.78	5.86	-8.64	117.8	5.895	2.43	118.00	5.89	3	125.00	0.256	0.256	0.000	1.975	7.19	14.21	0.935	30.5	27.7303	41.43
4.429	478.121	31.27	1.79	5.72	-10.05	111.965	5.775	2.44	112.22	5.76	3	125.00	0.277	0.277	0.000	1.901	7.41	14.08	0.960	31.34	27.9465	41.17
4.757	477.793	29.3	1.55	5.3	-9.47	97.5495	5.344	2.45	97.75	5.33	3	125.00	0.297	0.297	0.000	1.834	6.97	12.78	0.898	29.36	28.3092	40.45
5.085	477.465	29.53	1.58	5.36	-6.95	91.9164	5.409	2.47	92.07	5.40	3	125.00	0.318	0.318	0.000	1.774	7.09	12.57	0.904	29.58	29.17	40.13
5.413	477.137	29.07	1.51	5.21	-5.13	84.9265	5.256	2.48	85.02	5.25	3	125.00	0.338	0.338	0.000	1.719	7.01	12.05	0.890	29.1	29.6819	39.69
5.741	476.809	26.51	1.35	5.1	-4.32	72.8826	5.162	2.51	72.97	5.16	3	125.00	0.359	0.359	0.000	1.669	6.50	10.86	0.810	26.54	31.275	38.86
6.069	476.481	27.29	1.35	4.94	-2.56	70.946	5.017	2.51	71.00	5.01	3	125.00	0.379	0.379	0.000	1.624	6.69	10.86	0.833	27.31	31.1947	38.70
6.398	476.152	32.7	1.45	4.43	4.16	80.7756	4.489	2.44	80.70	4.49	4	125.00	0.400	0.400	0.000	1.581	7.73	12.23	1.000	32.67	28.0404	39.41
6.726	475.824	32.33	1.57	4.85	6.33	75.9075	4.920	2.49	75.81	4.93	3	125.00	0.420	0.420	0.000	1.542	7.81	12.05	0.988	32.29	30.1186	39.07
7.054	475.496	27.79	1.42	5.1	5.89	62.0337	5.192	2.56	61.97	5.20	3	125.00	0.441	0.441	0.000	1.506	6.96	10.49	0.847	27.78	33.5207	37.94
7.382	475.168	27.8	1.26	4.54	6.3	59.2547	4.609	2.54	59.17	4.62	4	125.00	0.461	0.461	0.000	1.472	6.88	10.13	0.846	27.76	32.3359	37.67
7.71	474.840	26.97	1.13	4.2	7.16	54.9689	4.266	2.53	54.89	4.27	4	125.00	0.482	0.482	0.000	1.441	6.66	9.60	0.820	26.93	32.2137	37.24
8.038	474.512	23.36	0.77	3.28	9.98	45.4792	3.370	2.52	45.36	3.38	5	125.00	0.502	0.502	0.000	1.411	5.72	8.07	0.707	23.29	31.5492	36.13
8.366	474.184	23.34	0.89	3.8	13.65	43.6378	3.901	2.58	43.47	3.92	4	125.00	0.523	0.523	0.000	1.383	5.88	8.13	0.706	23.25	34.2563	35.87
8.694	473.856	23.05	1.41	6.13	7.81	41.4201	6.265	2.74	41.33	6.28	3	125.00	0.543	0.543	0.000	1.357	6.32	8.58	0.697	23	42.6219	35.57
9.022	473.528	21.04	1.1	5.22	9.84	36.3132	5.372	2.73	36.2*	5.39	3	125.00	0.564	0.564	0.000	1.332	5.74	7.65	0.634	20.98	42.147	34.77
9.35	473.200	24.56	1.13	4.61	14	41.0278	4.713	2.65	40.87	4.73	3	125.00	0.584	0.584	0.000	1.308	6.43	8.41	0.742	24.47	38.0684	35.50
9.678	472.872	29.72	1.6	5.4	18.45	48.1341	5.495	2.66	47.95	5.52	3	125.00	0.605	0.605	0.000	1.286	7.78	10.01	0.901	29.61	38.1091	36.45
10.006	472.544	27.78	1.68	6.06	20.23	43.4213	6.187	2.72	43.23	6.21	3	125.00	0.625	0.625	0.000	1.265	7.54	9.53	0.841	27.66	41.7217	35.84
10.335	472.215	35.02	2.44	6.96	1.71	53.2158	7.098	2.71	53.20	7.10	3	125.00	0.646	0.646	0.000	1.244	9.46	11.77	1.064	35.01	40.8687	37.06
10.663	471.887	39.84	2.72	6.82	-8.71	58.7805	6.943	2.67	58.86	6.93	3	125.00	0.666	0.666	0.000	1.225	10.58	12.96	1.213	39.89	38.9729	37.64
10.991	471.559	51.44	3.01	5.85	-13.44	73.8831	5.931	2.56	74.00	5.92	3	125.00	0.687	0.687	0.000	1.207	12.89	15.55	1.571	51.52	33.2411	38.93
11.319	471.231	49.73	3.35	6.74	-15.66	69.296	6.834	2.62	69.44	6.82	3	125.00	0.707	0.707	0.000	1.189	12.87	15.31	1.518	49.83	36.392	38.58
11.647	470.903	59.48	3.27	5.5	-19.93	80.7103	5.566	2.51	80.88	5.55	11	125.00	0.728	0.728	0.000	1.172	14.58	17.09	1.819	59.6	31.1331	39.42
11.975	470.575	59.84	3.39	5.67	-19.21	78.9532	5.737	2.53	79.11	5.73	11	125.00	0.748	0.748	0.000	1.156	14.78	17.09	1.829	59.96	31.8715	39.30
12.303	470.247	46.27	3.26	7.05	-21.45	59.1739	7.165	2.68	59.36	7.14	3	125.00	0.769	0.769	0.000	1.140	12.36	14.09	1.409	46.41	39.3681	37.69
12.631	469.919	60.74	3.55	5.84	-21.71	75.9409	5.922	2.55	76.12	5.91	11	125.00	0.789	0.789	0.000	1.125	15.17	17.07	1.856	60.88	32.8461	39.09
12.959	469.591	85.44	5.35	6.27	-21.04	104.49	6.322	2.49	104.65	6.31	11	125.00	0.810	0.810	0.000	1.111	20.71	23.01	2.620	85.57	30.0976	40.81
13.287	469.263	93.83	6.4	6.82	-21.32	111.969	6.882	2.50	112.15	6.87	11	125.00	0.830	0.830	0.000	1.097	22.88	25.10	2.879	93.97	30.668	41.17
13.615	468.935	109.07	7.14	6.54	-21.2	127.176	6.598	2.45	127.38	6.59	11	125.00	0.851	0.851	0.000	1.084	26.01	28.20	3.350	109.2	28.6543	41.83
13.943	468.607	131.31	8.27	6.3	-20.49	149.682	6.340	2.40	149.83	6.33	11	125.00	0.871	0.871	0.000	1.071	30.56	32.73	4.038	131.44	26.4331	42.65
14.271	468.279	130.51	8.58	6.57	-20.11	145.322	6.619	2.42	145.47	6.61	11	125.00	0.892	0.892	0.000	1.059	30.69	32.49	4.013	130.64	27.3685	42.50
14.6	467.950	121.15	8.14	6.72	-19.98	131.767	6.770	2.45	131.91	6.76	11	125.00	0.913	0.913	0.000	1.047	28.90	30.26	3.723	121.28	28.6919	42.01
14.928	467.622	117.27	7.69	6.56	-18.71	124.691	6.610	2.46	124.81	6.60	11	125.00	0.933	0.933	0.000	1.035	28.04	29.03	3.602	117.38	28.8952	41.72
15.256	467.294	114.14	8.49	7.43	-17.94	118.706	7.501	2.52	118.82	7.49	11	125.00	0.954	0.954	0.000	1.024	28.04	28.72	3.604	114.26	31.4374	41.47

R15210

Depth (ft)	Sampl (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	ss (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.966	104.36	7.93	7.6	-18.2	106.146	7.670	2.55	106.27	7.66	11	125.00	0.974	0.974	0.000	1.013	26.08	26.43	3.201	104.48	33.0563	40.89
15.912	466.638	108.46	7.37	6.8	-18.02	108.06	6.858	2.51	108.17	6.85	11	125.00	0.995	0.995	0.000	1.003	26.53	26.60	3.327	108.67	31.0225	40.98
16.24	466.310	113.79	7.8	6.86	-17.9	111.108	6.916	2.50	111.22	6.91	11	125.00	1.015	1.015	0.000	0.993	27.78	27.58	3.491	113.9	30.8499	41.13
16.568	465.982	153.77	8.7	5.66	-14.55	147.498	5.696	2.37	147.59	5.69	11	125.00	1.036	1.036	0.000	0.983	35.20	34.59	4.729	153.86	25.0169	42.57
16.896	465.654	147.94	9.72	6.57	-6	139.095	6.617	2.43	139.13	6.62	11	125.00	1.056	1.056	0.000	0.973	34.93	33.99	4.547	147.98	27.8141	42.28
17.224	465.326	138.28	8.74	6.32	-8.2	127.453	6.370	2.44	127.51	6.37	11	125.00	1.077	1.077	0.000	0.964	32.76	31.58	4.248	138.34	28.1122	41.83
17.552	464.998	221.55	7.13	3.22	-7.74	200.96	3.234	2.09	201.01	3.23	12	125.00	1.097	1.097	0.000	0.955	45.08	43.04	6.825	221.6	15.4929	44.08
17.88	464.670	100.12	6.85	6.84	-12.15	88.5928	6.919	2.56	88.66	6.91	11	125.00	1.118	1.118	0.000	0.946	25.13	23.77	3.065	100.2	33.4931	39.92
18.208	464.342	76.59	4.86	6.34	-10.09	66.3023	6.441	2.61	66.36	6.44	11	125.00	1.138	1.138	0.000	0.937	19.73	18.50	2.336	76.66	36.0279	38.32
18.537	464.013	175.62	5.94	3.38	2.08	150.584	3.405	2.18	150.58	3.40	6	125.00	1.159	1.159	0.000	0.929	37.06	34.43	5.401	175.61	18.2355	42.67

23 of 48
R15211

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 24 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5

ConeTec Inc. Interpretation
Interpretation Output Release 1.22 Rev. Format: NLI Imperial

Run No: 07-1210-1008-4462
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 12:34
CPT File: 804CP05.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 482.55

Material Types and Unit Weight (pcf)

		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.49	1.51	49.57	22.51	2.24
125	Soil Embankment	27.37	1.95	65.50	63.68	3.04

User Inputs:

Assumed: Water Table Depth (ft): 34.4
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 482.6

Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.386	8.56	0.05	0.59	-0.16	802.002	0.585	1.14	802.00	0.58	1	130.00	0.011	0.011	0.000	2.000	1.26	2.53	0.265	8.56	-1.0384	50.01
0.492	482.058	13.06	0.18	1.38	-0.41	407.38	1.382	1.61	407.69	1.38	6	130.00	0.032	0.032	0.000	2.000	2.23	4.47	0.403	13.07	4.50958	47.27
0.82	481.730	39.92	0.69	1.73	-0.58	747.968	1.731	1.58	748.16	1.73	7	130.00	0.053	0.053	0.000	2.000	6.75	13.50	1.234	39.93	3.96322	49.74
1.148	481.402	81.09	1.4	1.72	-0.71	1085.71	1.728	1.52	1085.84	1.73	7	130.00	0.075	0.075	0.000	2.000	13.47	26.93	2.508	81.1	3.13579	51.14
1.476	481.074	98.28	2.17	2.21	-0.39	1023.39	2.210	1.63	1023.39	2.21	7	130.00	0.096	0.096	0.000	2.000	16.92	33.85	3.040	98.28	4.87426	50.92
1.804	480.746	102.52	1.75	1.71	-0.72	873.296	1.709	1.55	873.38	1.71	7	130.00	0.117	0.117	0.000	2.000	17.17	34.33	3.170	102.53	3.50958	50.33
2.133	480.417	76.33	1.69	2.22	-0.49	549.543	2.218	1.73	549.61	2.22	7	130.00	0.139	0.139	0.000	2.000	13.59	27.18	2.359	76.34	6.64681	48.52
2.461	480.089	77.26	1.31	1.7	-0.51	481.981	1.699	1.65	481.98	1.70	7	130.00	0.160	0.160	0.000	2.000	13.39	26.78	2.387	77.26	5.20939	47.98
2.789	479.761	73.62	1.23	1.67	-0.64	405.101	1.675	1.68	405.10	1.67	7	130.00	0.181	0.181	0.000	2.000	12.90	25.80	2.274	73.62	5.78223	47.24
3.117	479.433	51.07	0.77	1.5	-1.11	251.067	1.514	1.76	251.07	1.51	7	130.00	0.203	0.203	0.000	2.000	9.20	18.40	1.575	51.07	7.33445	45.12
3.445	479.105	43.47	0.65	1.49	-0.99	193.127	1.503	1.83	193.17	1.50	7	130.00	0.224	0.224	0.000	2.000	8.03	16.06	1.339	43.48	8.80013	43.89
3.773	478.777	37.71	0.53	1.4	-1.27	152.765	1.415	1.88	152.81	1.41	7	130.00	0.245	0.245	0.000	2.000	7.09	14.18	1.160	37.72	9.89985	42.75
4.101	478.449	27.27	0.39	1.43	-1.04	101.302	1.444	2.01	101.34	1.44	6	130.00	0.267	0.267	0.000	1.937	5.39	10.44	0.836	27.28	13.2675	40.64
4.429	478.121	26.38	0.42	1.6	-1.23	90.6338	1.610	2.08	90.63	1.61	6	130.00	0.288	0.288	0.000	1.864	5.35	9.97	0.808	26.38	15.1944	40.04
4.757	477.793	18.36	0.58	3.17	-1.09	58.3781	3.213	2.43	58.38	3.21	5	130.00	0.309	0.309	0.000	1.798	4.32	7.77	0.559	18.36	27.4805	37.60
5.085	477.465	64.13	1.14	1.77	-1.43	193.025	1.787	1.89	193.05	1.79	7	130.00	0.331	0.331	0.000	1.739	12.10	21.04	1.975	64.14	10.1362	43.89
5.413	477.137	80.68	2.1	2.6	-1.02	228.306	2.614	1.98	228.33	2.61	6	130.00	0.352	0.352	0.000	1.686	15.74	26.54	2.487	80.69	12.3846	44.68
5.741	476.809	82.5	2.19	2.65	-0.19	220.082	2.667	2.00	220.08	2.67	6	130.00	0.373	0.373	0.000	1.637	16.19	26.51	2.543	82.5	12.8155	44.51
6.069	476.481	82.21	1.32	1.6	-0.88	207.398	1.613	1.84	207.40	1.61	7	130.00	0.394	0.394	0.000	1.592	15.20	24.21	2.533	82.21	8.89156	44.23
6.398	476.152	69.65	0.67	0.96	-0.92	166.48	0.968	1.74	166.50	0.97	8	130.00	0.416	0.416	0.000	1.551	12.44	19.28	2.143	69.66	6.80329	43.17
6.726	475.824	67.23	1.03	1.54	-0.51	152.778	1.542	1.91	152.78	1.54	7	130.00	0.437	0.437	0.000	1.512	12.76	19.31	2.068	67.23	10.5604	42.74
7.054	475.496	62.5	1.02	1.64	-0.74	135.311	1.644	1.96	135.33	1.64	7	130.00	0.459	0.459	0.000	1.477	12.12	17.90	1.921	62.51	11.9694	42.14
7.382	475.168	58.83	0.75	1.27	-0.83	121.606	1.285	1.92	121.61	1.29	7	130.00	0.480	0.480	0.000	1.444	11.22	16.20	1.807	58.83	10.869	41.59
7.71	474.840	46.66	0.49	1.05	-1.29	92.1059	1.062	1.95	92.11	1.06	7	130.00	0.501	0.501	0.000	1.413	9.02	12.74	1.429	46.66	11.7456	40.13
8.038	474.512	37.02	0.37	0.99	-0.74	69.8557	1.014	2.04	69.86	1.01	7	130.00	0.522	0.522	0.000	1.383	7.38	10.21	1.130	37.02	13.9486	38.61
8.366	474.184	26.15	0.38	1.46	-1.04	47.0884	1.484	2.27	47.11	1.48	6	130.00	0.544	0.544	0.000	1.356	5.75	7.79	0.793	26.16	21.5182	36.35
8.694	473.856	15.2	0.12	0.79	-0.81	25.8974	0.820	2.35	25.90	0.82	6	130.00	0.565	0.565	0.000	1.330	3.45	4.59	0.453	15.2	24.3631	32.69
9.022	473.528	13.51	0.23	1.67	-1.09	22.0377	1.780	2.59	22.04	1.78	5	130.00	0.586	0.586	0.000	1.306	3.43	4.48	0.400	13.51	34.6597	31.66
9.35	473.200	16.76	0.4	2.39	-2.31	26.5771	2.476	2.61	26.59	2.47	5	130.00	0.608	0.608	0.000	1.283	4.30	5.51	0.500	16.77	35.6064	32.86
9.678	472.872	59.24	0.76	1.29	-1.66	93.1708	1.297	2.01	93.19	1.30	7	130.00	0.629	0.629	0.000	1.261	11.68	14.73	1.815	59.25	13.14	40.19
10.006	472.544	72.22	0.96	1.33	-0.79	110.041	1.341	1.96	110.04	1.34	7	130.00	0.650	0.650	0.000	1.240	14.01	17.37	2.216	72.22	11.9881	41.07
10.335	472.215	64.71	1.11	1.72	-0.51	95.3269	1.733	2.09	95.33	1.73	7	130.00	0.672	0.672	0.000	1.220	13.16	16.06	1.983	64.71	15.3858	40.31
10.663	471.887	67.23	1.33	1.98	-0.56	95.9997	1.999	2.13	96.00	2.00	7	130.00	0.693	0.693	0.000	1.201	13.90	16.70	2.060	67.23	16.6515	40.35
10.991	471.559	52.16	1.16	2.22	-1.01	72.0108	2.255	2.25	72.01	2.25	6	130.00	0.714	0.714	0.000	1.183	11.36	13.44	1.593	52.16	20.8129	38.78
11.319	471.231	56.94	1.24	2.17	-1.8	76.392	2.206	2.23	76.41	2.21	6	130.00	0.736	0.736	0.000	1.166	12.28	14.31	1.740	56.95	19.9382	39.11
11.647	470.903	52.44	1.04	1.99	-1.08	68.2684	2.012	2.24	68.28	2.01	7	130.00	0.757	0.757	0.000	1.149	11.34	13.03	1.600	52.45	20.2013	38.48
11.975	470.575	33.75	0.91	2.69	-0.92	42.3596	2.760	2.48	42.37	2.76	6	130.00	0.778	0.778	0.000	1.133	8.15	9.23	1.021	33.76	29.8333	35.72
12.303	470.247	35.95	0.93	2.58	-2.38	43.9546	2.646	2.46	43.98	2.64	6	130.00	0.800	0.800	0.000	1.118	8.58	9.59	1.088	35.97	28.7745	35.94
12.631	469.919	39.85	0.73	1.84	-1.87	47.5375	1.870	2.33	47.55	1.87	6	130.00	0.821	0.821	0.000	1.104	8.99	9.92	1.208	39.86	23.739	36.40
12.959	469.591	38.57	0.32	0.82	-1.48	44.7894	0.848	2.15	44.80	0.85	7	130.00	0.842	0.842	0.000	1.090	8.05	8.78	1.168	38.58	17.3896	36.05
13.287	469.263	53.21	0.49	0.91	-0.83	60.6102	0.936	2.07	60.61	0.94	7	130.00	0.864	0.864	0.000	1.076	10.74	11.55	1.621	53.21	14.7902	37.81
13.615	468.935	34.3	0.61	1.77	-0.69	37.7582	1.826	2.40	37.77	1.82	6	130.00	0.885	0.885	0.000	1.063	7.99	8.49	1.035	34.31	26.5559	35.03
13.943	468.607	28.16	0.33	1.17	-0.69	30.0716	1.211	2.38	30.08	1.21	7	130.00	0.906	0.906	0.000	1.050	6.49	6.82	0.844	28.17	25.6033	33.63
14.271	468.279	26.64	0.48	1.79	-0.69	27.7188	1.867	2.52	27.72	1.87	6	130.00	0.928	0.928	0.000	1.038	6.54	6.79	0.796	26.64	31.4282	33.12
14.6	467.950	28.1	0.34	1.19	-0.97	28.6101	1.252	2.41	28.62	1.25	7	130.00	0.949	0.949	0.000	1.027	6.55	6.73	0.841	28.11	26.6607	33.32
14.928	467.622	26.73	0.36	1.33	-0.67	26.5476	1.398	2.46	26.55	1.40	6	130.00	0.970	0.970	0.000	1.015	6.39	6.48	0.798	26.73	28.915	32.84
15.256	467.294	39.54	0.32	0.81	-0.79	38.8733	0.830	2.20	38.88	0.83	7	130.00	0.992	0.992	0.000	1.004	8.42	8.46	1.193	39.55	18.9383	35.20

R15213

Depth (ft)	Sam (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	ss (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.966	38.96	0.32	0.81	-0.78	37.4615	0.843	2.22	37.46	0.84	7	130.00	1.013	1.013	0.000	0.994	8.36	8.30	1.175	38.96	19.527	34.98
15.912	466.638	27.47	0.35	1.28	-0.74	25.5595	1.324	2.46	25.56	1.32	6	130.00	1.034	1.034	0.000	0.983	6.57	6.46	0.818	27.47	28.9508	32.60
16.24	466.310	23.18	0.23	0.99	-0.74	20.9591	1.040	2.48	20.97	1.04	6	130.00	1.056	1.056	0.000	0.973	5.59	5.44	0.685	23.19	29.75	31.34
16.568	465.982	22.71	0.18	0.77	-0.46	20.0879	0.832	2.45	20.09	0.83	7	130.00	1.077	1.077	0.000	0.964	5.40	5.20	0.670	22.71	28.4423	31.06
16.896	465.654	24.05	0.41	1.71	-0.53	20.8987	1.786	2.61	20.90	1.79	6	130.00	1.098	1.098	0.000	0.954	6.17	5.88	0.711	24.05	35.6268	31.31
17.552	464.998	22.68	0.23	1.02	-0.74	18.8794	1.068	2.52	18.88	1.07	6	130.00	1.120	1.120	0.000	0.945	6.06	5.73	0.680	23.1	37.8641	30.91
17.88	464.670	21.11	0.44	2.07	-0.46	17.1638	2.206	2.73	17.16	2.21	6	130.00	1.141	1.141	0.000	0.936	5.59	5.23	0.667	22.68	31.7842	30.65
18.208	464.342	25.83	0.62	2.41	-1.27	20.8247	2.51557	2.69328	20.8332	2.51455	6	130.00	1.162	1.162	0.000	0.928	5.77	5.35	0.618	21.11	41.9564	30.03
18.537	464.013	26.98	0.58	2.14	-1.5	21.3918	2.25023	2.65503	21.4001	2.24936	6	130.00	1.18352	1.18352	0	0.9192	6.929377	6.369515	0.76305	25.84	40.0978	31.295
18.865	463.685	32.84	0.54	1.65	-0.37	25.7814	1.70812	2.51953	25.7814	1.70812	6	130.00	1.20491	1.204905	0	0.911	7.09544	6.464023	0.79799	26.99	38.1085	31.468
19.193	463.357	28.01	0.56	2	-0.64	21.4521	2.09248	2.63571	21.4521	2.09248	6	130.00	1.22623	1.226225	0	0.9031	8.07106	7.288623	0.97875	32.84	31.5636	32.659
19.521	463.029	42.38	0.77	1.81	-1.09	32.3999	1.87297	2.463	32.4078	1.87252	7	130.00	1.24755	1.247545	0	0.8953	7.291148	6.527814	0.82856	28.01	37.1276	31.484
19.849	462.701	48.13	0.77	1.59	-0.46	36.3047	1.6439	2.38956	36.3047	1.6439	7	130.00	1.26887	1.268865	0	0.8878	10.14259	9.004115	1.27279	42.39	29.0567	34.09
20.177	462.373	40.56	1.01	2.5	-0.3	29.9263	2.57335	2.57572	29.9263	2.57335	6	130.00	1.29019	1.290185	0	0.8804	11.13334	9.801657	1.45015	48.13	25.9872	34.787
20.505	462.045	53.08	1.3	2.45	-0.41	38.8252	2.51221	2.4824	38.8252	2.51221	6	130.00	1.33283	1.332825	0	0.8662	12.81671	11.10171	1.60208	53.08	29.9025	35.195
21.161	461.389	86.65	1.75	2.02	-0.53	61.9969	2.0522	2.27196	62.0041	2.05195	7	130.00	1.35415	1.354145	0	0.8593	16.62862	14.28971	2.21349	72.86	24.7953	37.018
21.489	461.061	99.74	1.53	1.53	-0.42	70.4068	1.55578	2.15069	70.414	1.55562	8	130.00	1.37547	1.375465	0	0.8527	19.03346	16.22904	2.64008	86.66	21.4966	37.941
21.817	460.733	86.18	1.62	1.88	-0.48	59.7712	1.91124	2.26316	59.7712	1.91124	7	130.00	1.39679	1.396785	0	0.8461	20.8237	17.61948	3.04468	99.75	17.3821	38.657
22.145	460.405	86.56	1.53	1.77	-0.55	59.1351	1.79745	2.24908	59.1351	1.79745	7	130.00	1.41811	1.418105	0	0.8397	18.85677	15.83482	2.62421	86.18	21.1809	37.732
22.473	460.077	83.42	1.73	2.08	-0.6	56.1078	2.1108	2.3123	56.1147	2.11055	7	130.00	1.43943	1.439425	0	0.8335	18.82642	15.69181	2.63531	86.56	20.681	37.67
22.802	459.748	74.32	1.6	2.15	-0.97	49.144	2.19666	2.36683	49.1508	2.19636	7	130.00	1.46075	1.460745	0	0.8274	18.64714	15.42855	2.53744	83.43	22.9798	37.369
23.13	459.420	71.29	1.63	2.28	-0.64	46.4176	2.33569	2.40313	46.4176	2.33569	7	130.00	1.48213	1.48213	0	0.8214	17.01887	13.97937	2.25504	74.33	25.0792	36.599
23.458	459.092	64.8	1.34	2.07	-0.51	41.4982	2.11773	2.41227	41.5048	2.1174	7	130.00	1.50345	1.50345	0	0.8156	16.59253	13.53219	2.16057	71.29	26.5386	36.262
23.786	458.764	57.97	0.87	1.5	-0.49	36.4946	1.5419	2.37112	36.4946	1.5419	7	130.00	1.52477	1.52477	0	0.8098	15.14737	12.26691	1.95899	64.81	26.9142	35.596
24.114	458.436	57.68	0.89	1.55	-0.58	35.7996	1.5861	2.38513	35.7996	1.5861	7	130.00	1.54609	1.54609	0	0.8042	13.2986	10.69519	1.74687	57.97	25.2493	34.819
24.442	458.108	51.01	0.65	1.27	-0.53	31.1074	1.31522	2.38788	31.1074	1.31522	7	130.00	1.56741	1.56741	0	0.7987	13.31578	10.63593	1.73723	57.68	25.809	34.702
24.77	457.780	45.04	0.65	1.45	-0.56	26.9743	1.49666	2.47065	26.9743	1.49666	7	130.00	1.58873	1.58873	0	0.7934	11.79061	9.354301	1.53007	51.01	25.9197	33.837
25.098	457.452	51.99	0.93	1.79	-0.67	30.8689	1.84675	2.47611	30.875	1.84639	7	130.00	1.61005	1.61005	0	0.7881	10.81533	8.523542	1.34458	45.04	29.3882	32.945
25.426	457.124	48.03	1.05	2.18	-0.67	28.0617	2.26404	2.56273	28.0678	2.26355	6	130.00	1.63137	1.63137	0	0.7829	12.51872	9.8013	1.55909	52	29.6264	33.79
25.754	456.796	45.32	0.59	1.29	-0.49	26.0727	1.35179	2.45827	26.0727	1.35179	7	130.00	1.65269	1.65269	0	0.7779	12.05714	9.378831	1.43583	48.04	33.567	33.195
26.082	456.468	55.38	0.34	0.62	-0.74	31.6662	0.63333	2.21662	31.6662	0.63333	8	130.00	1.67401	1.67401	0	0.7729	10.81969	8.362491	1.35127	45.32	28.8526	32.73
26.41	456.140	73.15	0.73	0.99	-0.26	41.6121	1.02193	2.22191	41.6121	1.02193	8	130.00	1.69533	1.69533	0	0.768	11.89086	9.132429	1.66206	55.38	19.6243	33.947
26.739	455.811	74.59	0.95	1.27	-0.07	41.9163	1.30401	2.27962	41.9 63	1.30401	8	130.00	1.71665	1.71665	0	0.7632	15.72803	12.00421	2.21156	73.15	19.7367	35.612
27.067	455.483	59.6	1.26	2.11	-0.34	32.8761	2.1784	2.49849	32.8761	2.1784	7	130.00	1.73804	1.738035	0	0.7585	16.43655	12.46756	2.25548	74.59	21.7737	35.656
27.395	455.155	62.45	1.36	2.18	-0.02	34.071	2.24166	2.4942	34.071	2.24166	7	130.00	1.75936	1.759355	0	0.7539	14.50122	10.93271	1.79073	59.6	30.6157	34.179
27.723	454.827	50.82	1.25	2.47	-0.46	27.2021	2.55008	2.60548	27.2021	2.55008	6	130.00	1.78068	1.780675	0	0.7494	15.16369	11.36351	1.87831	62.45	30.4245	34.399
28.051	454.499	35	1.08	3.08	-1.09	18.1958	3.2553	2.80804	18.2013	3.25432	5	130.00	1.802	1.801995	0	0.7449	13.02823	9.705289	1.51759	50.82	35.6254	32.998
28.379	454.171	33.92	1.21	3.56	0.14	17.3885	3.77237	2.86349	17.3885	3.77237	5	130.00	1.82332	1.823315	0	0.7406	9.989687	7.398114	1.02714	35.01	46.4587	30.416
28.707	453.843	24.82	1.39	5.59	-20.74	12.3015	6.05558	3.10673	12.3712	6.02148	3	130.00	1.84464	1.844635	0	0.7363	9.99773	7.353796	0.99305	33.92	49.75	30.116
29.035	453.515	30.38	1.32	4.36	-20.28	15.0973	4.63276	2.96464	15.1609	4.61333	4	125.00	1.86596	1.865955	0	0.7321	8.543187	6.254165	0.71065	24.95	65.9662	27.853
29.363	453.187	26.39	1.19	4.5	-19.63	12.8329	4.86067	3.03231	12.8858	4.83696	4	125.00	1.88728	1.887275	0	0.7279	9.53739	6.942437	0.88213	30.5	56.1472	29.211
29.691	452.859	32.99	1.13	3.43	-15.73	16.1086	3.63792	2.87768	16.1604	3.62624	5	125.00	1.90778	1.907775	0	0.724	8.646449	6.269998	0.75796	26.51	60.6874	28.132
30.019	452.531	38.04	1.29	3.39	-14.99	18.52	3.57426	2.82578	18.5713	3.5644	5	125.00	1.92828	1.928275	0	0.7201	9.823652	7.074381	0.96166	33.09	50.616	29.634
30.347	452.203	35.49	1.02	2.88	-14.16	17.0219	3.04289	2.8116	17.0676	3.03475	6	125.00	1.94878	1.948775	0	0.7163	10.99164	7.873748	1.11738	38.14	47.4962	30.547
30.675	451.875	36.01	0.81	2.24	-13.42	17.0975	2.38094	2.74704	17.1377	2.37535	6	125.00	1.96928	1.969275	0	0.7126	10.17256	7.248986	1.03779	35.58	46.666	29.994
31.004	451.546	30.49	0.67	2.19	-12.68	14.1666	2.35256	2.81069	14.2064	2.34597	6	125.00	1.98978	1.989775	0	0.7089	9.958889	7.060069	1.05326	36.09	43.0037	30.021
31.332	451.218	20.88	0.57	2.71	-12.47	9.28147	3.02401	3.02299	9.32087	3.01123	5	125.00	2.01034	2.010338	0	0.7053	8.735746	6.161203	0.88172	30.57	46.6132	28.778
31.66	450.890	16.5	0.4	2.43	-12.06	7.04353	2.76842	3.10136	7.08253	2.75318	5	125.00	2.03084	2.030838	0	0.7017	6.795869	4.788781	0.68357	20.96	60.0464	25.941
31.988	450.562	15.2	0.37	2.41	-11.71	6.33648	2.81837	3.1445	6.37027	2.80342	5	125.00	2.05134	2.051338	0	0.6982	5.656688	3.949654	0.44733	16.58	65.5763	24.077
32.316	450.234	13.42	0.31	2.32	-10.81	5.41388	2.73666	3.19603	5.44256	2.72224	5	125.00	2.07184	2.071838	0	0.6947	5.364346	3.726824	0.40644	15.27	68.7573	23.359
32.644	449.906	13.41	0.39	2.88	-10.09	5.34691	3.45219	3.25342	5.38005	3.43094	5	125.00	2.09234	2.092338	0	0.6913	4.909323	3.393952	0.3507	13.48	72.8878	22.298
32.972	449.578	13.24	0.28	2.12	-7.72	5.20624	2.52101	3.19262	5.22968	2.50971	5	125.00	2.11284	2.112838	0	0.688	5.118563	3.521397	0.34976	13.48	77.2366	22.221
33.3	449.250	15.29	0.27	1.74	-7.34	6.09896	2.05539	3.08974	6.11753	2.04916	6	125.00	2.13334	2.133338	0	0.6847	4.829065	3.306232	0.34386	13.29	72.4383	22.031
33.628	448.922	12.74	0.24	1.85	-6.3	4.86926	2.27151	3.19655	4.87765	2.26294	5	125.00	2.15384	2.153838	0	0.6814	5.190141	3.536492	0.40669	15.33	64.7359	23.086
33.956	448.594	15.46	0.33	2.14	-5.57	6.0438	2.48772	3.13551	6.05747	2.48211	5	125.00	2.17434	2.174338	0	0.6782	4.656115	3.157623	0.32711	12.78	72.7283	21.565
34.284	448.266	19.07	0.47	2.44	-5.31	7.60817	2.78855	3.07707	7.62171	2.78359	5	125.00	2.19484	2.194838	0	0.675	5.408217	3.650504	0.41069	15.49	68.086	23.019
34.612	447.938	20.99	0.5	2.36	-4.73	8.41287	2.66607	3.02992	8.42633	2.66182	5	125.00	2.21534	2.215338	0	0.6719	6.41274	4.308478	0.52182	19.1	63.8284	24.575
34.941	447.609	25.65	0.82	3.18	-4.43	10.4374	3.50548	3.01977	10.4508	3.50099	5	135.00	2.23584	2.229223	0.0066	0.6698	6.645399	4.564817	0.58062	21.02	60.5225	25.259
35.269	447.281	24.21	1.06	4.37	-9.81	9.73329	4.8336	3.12648	9.75992	4.82041	4	135.00	2.25805	2.241186	0.0169	0.668	8.309312	5.550448	0.72421	25.68	59.8266	26.721
35.597	446.953	22.27	0.91	4.1	-14.16	8.81583	4.55737	3.14431	8.85557	4.53692	4	135.00	2.28019	2.253072	0.0271	0.6662	8.421758	5.610676	0.67894	24.27	67.4162	26.261
35.925	446.625	19.46	0.98	5.05	-13.21	7.52587	5.71911	3.25807	7.5654	5.68923	3	135.00	2.30233	2.264979	0.0373	0.6645	7.854004	5.218661	0.61819	22.36	68.7426	25.606
36.253	446.297	24.68	1.3	5.26	-11.24	9.75772	5.82088	3.17489	9.79288	5.8001	3	135.00	2.32447	2.276885	0.0476	0.6627	7.449111	4.936668	0.53051	19.55	77.6125	24.544
36.581	445.969	26.57	1.26	4.75	-10.88	10.5191	5.20634	3.11986	10.5452	5.19347	3	135.00	2.34661	2.288791	0.0579	0.661	8.883668	5.872043	0.69144	24.76	71.058	25.293
36.909	445.641	22.11	0.92	4.17	-10.16	8.5268	4.66552	3.16289	8.55275	4.65137	4	135.00	2.36875	2.300698	0.068	0.6593	9.199371	6.064966	0.74926	26.63	66.9282	26.796
37.237	445.313	21.91	0.71	3.22	-9.52	8.38756	3.64159	3.10571	8.41337	3.63042	5	135.00	2.39089	2.312604	0.0783	0.6576	7.887958	5.186973	0.6105	22.17	70.1433	25.384
37.565	444.985	23	0.88	3.81	-9.38	8.80187	4.27915	3.12957	8.82755	4.2667	4	135.00	2.41303	2.324511	0.0885	0.6559	7.517677	4.930806	0.60362	21.97	65.8921	25.277
												135.00	2.43517	2.336417	0.0987	0.6542	8.018715	5.246016	0.63668	23.06	67.6451	25.605

Depth (ft)	Samp (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	ss (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	444.657	19.45	0.95	4.9	-10	7.2361	5.59064	3.26674	7.26169	5.57097	3	135.00	2.45731	2.348323	0.109	0.6526	7.482228	4.88261	0.52609	19.51	78.3181	24.29
38.221	444.329	18.24	0.79	4.34	-9.37	6.67755	5.01251	3.26644	6.70297	4.9935	3	135.00	2.47945	2.36023	0.1192	0.6509	7.016591	4.567189	0.48794	18.3	78.2934	23.755
38.549	444.001	21.57	0.78	3.6	-8.87	8.0385	4.09053	3.14988	8.05379	4.0777	5	135.00	2.50159	2.372136	0.1294	0.6493	7.626794	4.951904	0.59035	21.63	69.1608	25.004
38.877	443.673	18.25	0.67	3.65	-8.11	6.59647	4.26039	3.2302	6.61745	4.24688	4	135.00	2.52373	2.384043	0.1397	0.6477	6.83099	4.424117	0.48688	18.3	75.3741	23.677
39.206	443.344	20.75	0.81	3.91	-7.44	7.59774	4.44956	3.19132	7.61861	4.43737	4	135.00	2.54593	2.395985	0.1499	0.646	7.549899	4.87752	0.56359	20.8	72.3227	24.628
39.534	443.016	21.68	1.16	5.34	-5.68	7.9372	6.06951	3.25744	7.95382	6.05683	3	135.00	2.56807	2.407892	0.1602	0.6444	8.272102	5.339862	0.5917	21.72	77.562	24.921
39.862	442.688	22.71	1.16	5.1	-5.2	8.31466	5.76547	3.22788	8.33119	5.75403	3	135.00	2.59021	2.419798	0.1704	0.6429	8.477683	5.449889	0.6229	22.75	75.1893	25.237
40.19	442.360	28.63	1.19	4.17	-3.31	10.6993	4.57382	3.08047	10.7076	4.57031	4	135.00	2.61235	2.431705	0.1806	0.6413	9.640615	6.18229	0.8055	28.65	64.071	26.927
40.518	442.032	28.19	1.27	4.52	-2.28	10.4581	4.96957	3.11062	10.4622	4.96763	4	135.00	2.63449	2.443611	0.1909	0.6397	9.6813	6.193237	0.79119	28.2	66.2507	26.774
40.846	441.704	26.69	1.27	4.77	-1.8	9.7875	5.28432	3.14971	9.79157	5.28212	3	135.00	2.65663	2.455517	0.2011	0.6382	9.413383	6.007229	0.74407	26.7	69.148	26.331
41.174	441.376	24.58	1.31	5.34	-1.94	8.87615	5.9814	3.21633	8.8802	5.97867	3	135.00	2.67877	2.467424	0.2113	0.6368	9.086888	5.794866	0.67806	24.59	74.2759	25.678
41.502	441.048	24.83	1.39	5.59	-2.79	8.92543	6.28133	3.22741	8.9335	6.27565	3	135.00	2.70091	2.47933	0.2216	0.6351	9.257119	5.879071	0.68511	24.85	75.1525	25.721
41.83	440.720	23.62	1.17	4.95	-2.61	8.38818	5.5989	3.21797	8.3922	5.59623	3	135.00	2.72305	2.491237	0.2318	0.6336	8.742523	5.538974	0.64696	23.63	74.4055	25.304
42.158	440.392	24.48	0.98	4.01	-1.99	8.68301	4.5089	3.14929	8.687	4.50682	4	135.00	2.74519	2.503143	0.242	0.6321	8.631702	5.455739	0.6729	24.49	69.1162	25.538
42.486	440.064	22.76	1.14	5	-2.06	7.94921	5.70209	3.24129	7.95319	5.69924	3	135.00	2.76733	2.515049	0.2523	0.6306	8.568914	5.403219	0.61897	22.77	76.2596	24.949
42.814	439.736	20.25	0.99	4.9	-0.12	6.90971	5.86993	3.28858	6.90971	5.86993	3	135.00	2.78947	2.526956	0.2625	0.6291	7.89536	4.96676	0.54057	20.25	80.1137	24.011
43.143	439.407	14.05	0.79	5.63	-0.05	4.42646	7.02952	3.49955	4.42646	7.02952	3	135.00	2.81168	2.538898	0.2728	0.6276	6.528217	4.097056	0.34794	14.05	98.8834	21.08
43.471	439.079	11.7	0.65	5.57	1.64	3.47584	7.33123	3.59605	3.47192	7.33951	3	135.00	2.83382	2.550805	0.283	0.6261	5.953759	3.7278	0.27449	11.69	100	19.54
43.799	438.751	14.29	0.66	4.63	1.87	4.4617	5.77224	3.4474	4.45779	5.77729	3	135.00	2.85596	2.562711	0.2932	0.6247	6.334906	3.957221	0.354	14.28	93.9984	21.135
44.127	438.423	16.74	0.83	4.94	0.9	5.38406	5.98764	3.38977	5.38406	5.98764	3	135.00	2.8781	2.574618	0.3035	0.6232	7.072565	4.407787	0.42916	16.74	88.7893	22.371
44.455	438.095	16.83	0.84	5	0.58	5.38551	6.03025	3.39149	5.38551	6.03025	3	135.00	2.90024	2.586524	0.3137	0.6218	7.120717	4.427571	0.43126	16.83	88.9421	22.377
44.783	437.767	14.82	0.61	4.12	1.29	4.57877	5.12708	3.40827	4.57877	5.12708	3	135.00	2.92238	2.598443	0.3239	0.6204	6.358557	3.9446	0.36835	14.82	90.4396	21.323
45.111	437.439	17.14	0.44	2.57	3.14	5.43818	3.09958	3.22672	5.43052	3.10395	5	135.00	2.94452	2.610337	0.3342	0.6189	6.374336	3.94536	0.43949	17.12	75.0978	22.44
45.439	437.111	33.51	1.27	3.8	6.51	11.6478	4.15803	3.02727	11.6325	4.16348	5	135.00	2.96666	2.622243	0.3444	0.6175	10.88157	6.719778	0.94561	33.47	60.3406	27.515
45.767	436.783	58.12	2.69	4.62	3.76	20.9294	4.87927	2.87443	20.9218	4.88104	4	135.00	2.9888	2.63415	0.3547	0.6161	17.21601	10.60746	1.70685	58.1	50.4166	31.363
46.095	436.455	82.78	3.68	5.86	-7.46	22.588	6.15703	2.91763	22.6069	6.15189	11	135.00	3.01094	2.646056	0.3649	0.6146	19.09583	11.73909	1.85044	62.83	53.1048	31.86
46.423	436.127	83.6	4.9	5.86	-7.76	30.3115	6.0819	2.82272	30.3303	6.07813	11	135.00	3.03308	2.657962	0.3751	0.6134	24.05568	14.76127	2.49433	83.65	47.316	33.709
46.751	435.799	294.51	7.43	2.52	-2.96	109.164	2.54928	2.16892	109.168	2.54919	7	135.00	3.05522	2.669869	0.3854	0.612	61.8938	37.87932	9.02337	294.52	17.9036	41.036
47.079	435.471	443.15	13.54	3.06	-9.68	164.098	3.07676	2.11943	164.12	3.07635	12	135.00	3.07736	2.681775	0.3956	0.6106	91.3583	55.78749	13.6245	443.21	16.4026	43.103
47.408	435.142	441.36	16.48	3.73	-14.99	162.697	3.76032	2.19234	162.734	3.75946	12	135.00	3.09957	2.693718	0.4058	0.6093	93.75299	57.12275	13.5684	441.46	18.7382	43.062
47.736	434.814	430.27	19.31	4.49	-16.14	157.874	4.52069	2.2656	157.911	4.51962	12	135.00	3.12171	2.705624	0.4161	0.6079	94.26613	57.30888	13.2244	430.37	21.268	42.913
48.064	434.486	389.54	18.25	4.94	-18.24	134.827	4.98095	2.33911	134.867	4.97945	11	135.00	3.14385	2.717531	0.4263	0.6066	83.59886	50.71228	11.3435	369.65	23.9983	42.124
48.392	434.158	373.72	19.14	5.12	-23.12	135.762	5.16524	2.35029	135.817	5.16315	11	135.00	3.16599	2.729437	0.4366	0.6053	84.97333	51.4335	11.4723	373.87	24.4307	42.16
48.72	433.830	313.66	15.82	5.04	-20.02	113.255	5.09547	2.39117	113.303	5.09334	11	135.00	3.18813	2.741344	0.4468	0.604	72.63947	43.87175	9.61213	313.79	26.0526	41.23

R15215

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 78 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5A

ConeTec Inc. - rpretation
Interpretation Ou elease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4429
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5A
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 10:44
CPT File: 804CP05A.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 483

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	35.73	1.11	36.82	24.15	2.29
125	Soil Embankment	28.29	1.43	48.95	56.29	2.94

User Inputs:

Assumed:
Water Table Depth (ft): 35.9
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 483.0
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.836	25.42	0.16	0.61	-0.04	2383.62	0.630	1.02	2383.62	0.63	7	130.00	0.011	0.011	0.000	2.000	3.63	7.27	0.787	25.42	-1.8137	53.84
0.492	482.508	30.63	0.26	0.83	0.09	956.786	0.850	1.25	956.79	0.85	7	130.00	0.032	0.032	0.000	2.000	4.67	9.35	0.947	30.63	-0.0948	50.67
0.82	482.180	34.85	0.47	1.34	0.02	652.846	1.351	1.50	652.85	1.35	7	130.00	0.053	0.053	0.000	2.000	5.75	11.50	1.077	34.85	2.85185	49.21
1.148	481.852	45.55	0.61	1.33	0.55	609.426	1.341	1.51	609.43	1.34	7	130.00	0.075	0.075	0.000	2.000	7.54	15.08	1.408	45.55	3.00348	48.93
1.476	481.524	30.66	0.46	1.49	-0.16	318.575	1.505	1.70	318.57	1.51	6	130.00	0.096	0.096	0.000	2.000	5.40	10.81	0.946	30.66	6.10537	46.20
1.804	481.196	25.49	0.36	1.4	-0.21	216.38	1.419	1.78	216.38	1.42	6	130.00	0.117	0.117	0.000	2.000	4.62	9.24	0.786	25.49	7.70894	44.43
2.133	480.867	24.98	0.31	1.22	0.07	179.172	1.248	1.79	179.17	1.25	6	130.00	0.139	0.139	0.000	2.000	4.55	9.10	0.769	24.98	7.96054	43.53
2.461	480.539	22	0.24	1.07	-0.37	136.53	1.099	1.84	136.53	1.10	6	130.00	0.160	0.160	0.000	2.000	4.07	8.14	0.676	22	8.91183	42.18
2.789	480.211	19.96	0.2	1	-0.25	109.103	1.011	1.88	109.10	1.01	6	130.00	0.181	0.181	0.000	2.000	3.76	7.52	0.612	19.96	10.022	41.03
3.117	479.883	16.87	0.21	1.22	-0.14	82.2655	1.260	2.04	82.27	1.26	6	130.00	0.203	0.203	0.000	2.000	3.37	6.74	0.516	16.87	14.0492	39.52
3.445	479.555	27.63	0.29	1.05	-0.81	122.39	1.058	1.86	122.39	1.06	7	130.00	0.224	0.224	0.000	2.000	5.16	10.31	0.848	27.63	9.45051	41.62
3.773	479.227	28.29	0.55	1.95	-0.9	114.354	1.961	2.07	114.39	1.96	6	130.00	0.245	0.245	0.000	2.000	5.72	11.43	0.868	28.3	14.8825	41.27
4.101	478.899	31.49	0.42	1.32	-0.58	117.133	1.345	1.94	117.17	1.34	7	130.00	0.267	0.267	0.000	1.937	6.07	11.75	0.967	31.5	11.5005	41.40
4.429	478.571	21.53	0.34	1.58	-0.26	73.7868	1.601	2.14	73.79	1.60	6	130.00	0.288	0.288	0.000	1.864	4.48	8.35	0.658	21.53	17.1574	38.92
4.757	478.243	20.69	0.25	1.19	-1.01	65.9135	1.227	2.11	65.95	1.23	6	130.00	0.309	0.309	0.000	1.798	4.24	7.63	0.631	20.7	16.0068	38.29
5.085	477.915	15.26	0.33	2.14	-1.38	45.169	2.210	2.40	45.20	2.21	5	130.00	0.331	0.331	0.000	1.739	3.54	6.16	0.462	15.27	26.2447	36.10
5.413	477.587	14.21	0.29	2.05	-1.25	39.3871	2.093	2.43	39.39	2.09	5	130.00	0.352	0.352	0.000	1.686	3.34	5.64	0.429	14.21	27.5061	35.28
5.741	477.259	24.82	0.37	1.47	-0.26	65.5121	1.513	2.17	65.51	1.51	6	130.00	0.373	0.373	0.000	1.637	5.22	8.54	0.757	24.82	17.8966	38.25
6.069	476.931	37.94	0.39	1.02	-1.27	95.176	1.039	1.94	95.20	1.04	7	130.00	0.394	0.394	0.000	1.592	7.29	11.60	1.162	37.95	11.3095	40.30
6.398	476.602	38.71	0.49	1.26	-0.12	92.082	1.280	2.01	92.08	1.28	7	130.00	0.416	0.416	0.000	1.551	7.63	11.84	1.186	38.71	13.1428	40.13
6.726	476.274	62.69	0.91	1.45	-0.74	142.393	1.462	1.91	142.42	1.46	7	130.00	0.437	0.437	0.000	1.512	11.92	18.03	1.927	62.7	10.6517	42.39
7.054	475.946	61.96	1.01	1.63	-0.67	134.133	1.642	1.97	134.16	1.64	7	130.00	0.459	0.459	0.000	1.477	12.03	17.76	1.904	61.97	12.0276	42.09
7.382	475.618	77.1	0.92	1.19	-1.34	159.682	1.201	1.81	159.70	1.20	8	130.00	0.480	0.480	0.000	1.444	14.16	20.43	2.372	77.11	8.43681	42.96
7.71	475.290	60.49	0.84	1.38	-0.67	119.702	1.400	1.95	119.72	1.40	7	130.00	0.501	0.501	0.000	1.413	11.67	16.49	1.857	60.5	11.6404	41.51
8.038	474.962	43.56	0.42	0.95	-0.41	82.3732	0.976	1.97	82.39	0.98	7	130.00	0.522	0.522	0.000	1.383	8.47	11.72	1.332	43.57	12.1295	39.52
8.366	474.634	31.78	0.35	1.09	-0.72	57.4417	1.120	2.13	57.44	1.12	7	130.00	0.544	0.544	0.000	1.356	6.58	8.92	0.967	31.78	16.7393	37.50
8.694	474.306	23.44	0.25	1.07	-0.83	40.4787	1.093	2.25	40.50	1.09	6	130.00	0.565	0.565	0.000	1.330	5.10	6.78	0.708	23.45	20.6373	35.45
9.022	473.978	14.75	0.2	1.33	-1.36	24.1522	1.412	2.50	24.17	1.41	6	130.00	0.586	0.586	0.000	1.306	3.59	4.68	0.439	14.76	30.5056	32.25
9.35	473.650	18.93	0.1	0.53	-1.34	30.1477	0.546	2.21	30.16	0.55	7	130.00	0.608	0.608	0.000	1.283	4.05	5.19	0.567	18.94	19.2809	33.65
9.678	473.322	14.31	0.1	0.7	-0.39	21.7479	0.731	2.39	21.75	0.73	6	130.00	0.629	0.629	0.000	1.261	3.31	4.18	0.424	14.31	26.0949	31.57
10.006	472.994	13.41	0.1	0.75	-0.53	19.6184	0.784	2.45	19.63	0.78	6	130.00	0.650	0.650	0.000	1.240	3.18	3.95	0.395	13.42	28.3013	30.91
10.335	472.665	9.07	0.17	1.82	-0.74	12.5015	2.024	2.82	12.50	2.02	5	130.00	0.672	0.672	0.000	1.220	2.61	3.18	0.260	9.07	47.2437	27.92
10.663	472.337	9.3	0.05	0.54	-0.39	12.4181	0.581	2.57	12.42	0.58	1	130.00	0.693	0.693	0.000	1.201	2.34	2.82	0.266	9.3	33.9922	27.88
10.991	472.009	8.69	0.07	0.81	-0.46	11.1638	0.878	2.69	11.16	0.88	5	130.00	0.714	0.714	0.000	1.183	2.32	2.75	0.247	8.69	39.7705	27.16
11.319	471.681	6.9	0.07	0.94	-0.74	8.37838	1.136	2.85	8.38	1.14	1	130.00	0.736	0.736	0.000	1.166	2.01	2.35	0.191	6.9	48.8316	25.22
11.647	471.353	8.91	0.09	1.01	-0.44	10.7693	1.104	2.75	10.77	1.10	5	130.00	0.757	0.757	0.000	1.149	2.46	2.82	0.252	8.91	42.9199	26.92
11.975	471.025	18.87	0.21	1.09	-0.26	23.2428	1.161	2.46	23.26	1.16	6	130.00	0.778	0.778	0.000	1.133	4.52	5.12	0.560	18.88	29.1282	32.00
12.303	470.697	19.57	0.24	1.23	-0.51	23.4718	1.279	2.48	23.48	1.28	6	130.00	0.800	0.800	0.000	1.118	4.73	5.29	0.581	19.58	29.9383	32.07
12.631	470.369	17.34	0.28	1.62	-0.51	20.1202	1.695	2.81	20.13	1.69	6	130.00	0.821	0.821	0.000	1.104	4.45	4.91	0.511	17.35	35.652	31.07
12.959	470.041	19.9	0.26	1.28	-0.3	22.6248	1.364	2.51	22.62	1.36	6	130.00	0.842	0.842	0.000	1.090	4.87	5.31	0.590	19.9	31.2276	31.83
13.287	469.713	30.28	0.23	0.76	-0.3	34.0603	0.782	2.23	34.06	0.78	7	130.00	0.864	0.864	0.000	1.076	6.55	7.04	0.911	30.28	20.1787	34.40
13.615	469.385	38.96	0.31	0.78	-0.41	43.0238	0.814	2.16	43.02	0.81	7	130.00	0.885	0.885	0.000	1.063	8.15	8.67	1.179	38.96	17.5679	35.81
13.943	469.057	33.22	0.36	1.07	-0.44	35.6547	1.114	2.30	35.65	1.11	7	130.00	0.906	0.906	0.000	1.050	7.38	7.75	1.000	33.22	22.4677	34.68
14.271	468.729	32.32	0.37	1.13	-0.62	33.842	1.179	2.33	33.84	1.18	7	130.00	0.928	0.928	0.000	1.038	7.28	7.56	0.972	32.32	23.6858	34.36
14.6	468.400	25.81	0.32	1.24	-0.3	26.197	1.287	2.44	26.20	1.29	6	130.00	0.949	0.949	0.000	1.027	6.12	6.29	0.770	25.81	28.2811	32.76
14.928	468.072	26.82	0.29	1.08	-0.97	26.6404	1.122	2.41	26.65	1.12	7	130.00	0.970	0.970	0.000	1.015	6.25	6.35	0.800	26.83	26.6786	32.87
15.256	467.744	27.37	0.29	1.06	-0.53	26.6007	1.099	2.40	26.6	1.10	7	130.00	0.992	0.992	0.000	1.004	6.37	6.40	0.817	27.38	26.5119	32.86

Depth (ft)	Samp (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	ss (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	467.416	27.05	0.21	0.76	-0.81	25.7039	0.807	2.35	25.71	0.81	7	130.00	1.013	1.013	0.000	0.994	6.14	6.10	0.806	27.06	24.3313	32.64
15.912	467.088	23.69	0.19	0.78	-0.58	21.9048	0.839	2.42	21.91	0.84	7	130.00	1.034	1.034	0.000	0.983	5.55	5.46	0.701	23.7	27.103	31.62
16.24	466.760	39.57	0.35	0.87	-0.32	36.4858	0.909	2.24	36.50	0.91	7	130.00	1.056	1.056	0.000	0.973	8.58	8.35	1.192	39.58	20.444	34.82
16.568	466.432	74.07	1.13	1.52	0	67.7795	1.548	2.16	67.78	1.55	7	130.00	1.077	1.077	0.000	0.964	15.53	14.97	2.260	74.07	17.7393	38.44
16.896	466.104	66.69	1.62	2.43	-0.62	59.7244	2.470	2.34	59.72	2.47	6	130.00	1.098	1.098	0.000	0.954	15.08	14.39	2.031	66.69	23.9849	37.73
17.224	465.776	65.22	1.33	2.04	-0.58	57.255	2.075	2.30	57.26	2.07	7	130.00	1.120	1.120	0.000	0.945	14.50	13.71	1.985	65.22	22.5529	37.49
17.552	465.448	57.68	1.09	1.89	-0.39	49.5575	1.928	2.33	49.56	1.93	7	130.00	1.141	1.141	0.000	0.936	12.98	12.15	1.750	57.68	23.5396	36.65
17.88	465.120	32	1.01	3.16	-0.39	26.534	3.275	2.68	26.53	3.28	5	130.00	1.162	1.162	0.000	0.928	8.53	7.92	0.955	32	39.5519	32.84
18.208	464.792	51.85	0.91	1.76	-3.51	42.81	1.79606	2.35635	42.8269	1.79535	7	130.00	1.18352	1.18352	0	0.9192	11.82091	10.86583	1.56862	51.87	24.6674	35.784
18.537	464.463	43.9	1.02	2.33	-7.82	35.4344	2.38903	2.49787	35.4759	2.38624	6	130.00	1.20491	1.204905	0	0.911	10.69025	9.738938	1.32183	43.95	30.5877	34.646
18.865	464.135	23.27	0.79	3.4	-2.63	17.9769	3.58378	2.83772	17.9933	3.58053	5	130.00	1.22623	1.226225	0	0.9031	6.757445	6.102354	0.68247	23.29	48.2023	30.34
19.193	463.807	39.72	0.64	1.62	-1.94	30.8385	1.66353	2.44929	30.8546	1.66266	7	130.00	1.24755	1.247545	0	0.8953	9.447888	8.458758	1.1911	39.74	28.4675	33.786
19.521	463.479	50.04	1.09	2.17	-2.24	38.4368	2.23493	2.45278	38.4447	2.23447	6	130.00	1.26887	1.268865	0	0.8878	11.91839	10.58059	1.50994	50.05	28.617	35.135
19.849	463.151	60.08	1.06	1.76	-0.18	45.567	1.80303	2.33657	45.567	1.80303	7	130.00	1.29019	1.290185	0	0.8804	13.57227	11.94886	1.82012	60.08	23.9008	36.153
20.177	462.823	52.92	0.66	1.24	0.07	39.3506	1.27886	2.29701	39.3506	1.27886	7	130.00	1.31151	1.311505	0	0.8732	11.74944	10.25965	1.59779	52.92	22.4107	35.276
20.505	462.495	36.79	0.47	1.27	-0.14	26.603	1.32554	2.44629	26.603	1.32554	7	130.00	1.33283	1.332825	0	0.8662	8.734366	7.565625	1.09775	36.79	28.3397	32.858
20.833	462.167	44.24	0.4	0.91	-0.16	31.6701	0.93271	2.30083	31.6701	0.93271	7	130.00	1.35415	1.354145	0	0.8593	9.838615	8.454762	1.32774	44.24	22.5522	33.948
21.161	461.839	38.42	0.52	1.36	-0.21	26.9324	1.40372	2.45559	26.9324	1.40372	7	130.00	1.37547	1.375465	0	0.8527	9.160918	7.811137	1.14689	38.42	28.7374	32.935
21.489	461.511	36.09	0.66	1.83	-0.49	24.8379	1.90239	2.55989	24.8379	1.90239	6	130.00	1.39679	1.396785	0	0.8461	9.045296	7.653463	1.07409	36.09	33.4329	32.423
21.817	461.183	32.39	0.51	1.56	-0.46	21.8403	1.64665	2.5698	21.8403	1.64655	6	130.00	1.41811	1.418105	0	0.8397	8.157585	6.850266	0.95888	32.39	33.9021	31.599
22.145	460.855	35.52	0.56	1.58	-0.65	23.6765	1.64316	2.54029	23.6765	1.64316	7	130.00	1.43943	1.439425	0	0.8335	8.817705	7.349555	1.05513	35.52	32.5166	32.117
22.473	460.527	48.51	0.94	1.93	-0.44	32.2091	1.99791	2.48214	32.2159	1.99748	7	130.00	1.46075	1.460745	0	0.8274	11.71422	9.692283	1.45663	48.52	29.8912	34.054
22.802	460.198	40.72	0.8	1.97	-0.09	26.474	2.03885	2.55538	26.474	2.03885	6	130.00	1.48213	1.48213	0	0.8214	10.1832	8.364521	1.21479	40.72	33.2206	32.827
23.13	459.870	34.78	0.69	1.97	-0.11	22.1335	2.07353	2.62236	22.1335	2.07353	6	130.00	1.50345	1.50345	0	0.8156	8.99242	7.333851	1.03023	34.78	36.4607	31.685
23.458	459.542	27.98	0.71	2.53	-0.02	17.3503	2.68378	2.77387	17.3503	2.68378	6	130.00	1.52477	1.52477	0	0.8098	7.83439	6.344582	0.81905	27.98	44.5023	30.102
23.786	459.214	34.88	0.64	1.83	-0.21	21.5601	1.91997	2.61226	21.5601	1.91997	6	130.00	1.54609	1.54609	0	0.8042	8.972323	7.215851	1.03201	34.88	35.9587	31.516
24.114	458.886	34.14	0.66	1.92	-0.04	20.7812	2.02624	2.63881	20.7812	2.02624	6	130.00	1.56741	1.56741	0	0.7987	8.900875	7.109538	1.00844	34.14	37.284	31.278
24.442	458.558	46.63	0.8	1.71	-0.12	28.3505	1.77615	2.49588	28.3505	1.77615	7	130.00	1.58873	1.58873	0	0.7934	11.33143	8.989997	1.39447	46.63	30.4993	33.258
24.77	458.230	37.3	0.79	2.12	-0.44	22.167	2.21351	2.63841	22.1732	2.21289	6	130.00	1.61005	1.61005	0	0.7881	9.725366	7.664543	1.10495	37.31	37.2638	31.697
25.098	457.902	36.41	0.89	2.45	-0.32	21.3187	2.55904	2.6899	21.3187	2.55904	6	130.00	1.63137	1.63137	0	0.7829	9.746595	7.630917	1.07674	36.41	39.9193	31.443
25.426	457.574	48.8	0.86	1.76	-0.18	28.5276	1.82407	2.50053	28.5276	1.82407	7	130.00	1.65269	1.65269	0	0.7779	11.88499	9.244918	1.45967	48.8	30.7065	33.297
25.754	457.246	74.39	0.71	0.96	-0.07	43.4382	0.9764	2.19543	43.4382	0.9764	8	130.00	1.67401	1.67401	0	0.7729	15.81851	12.22606	2.25127	74.39	18.841	35.869
26.082	456.918	60.47	1.1	1.82	-0.18	34.6686	1.87155	2.43963	34.6686	1.87155	7	130.00	1.69533	1.69533	0	0.768	14.31205	10.99195	1.81965	60.47	28.0573	34.505
26.41	456.590	80.94	0.74	0.91	-0.04	46.15	0.93407	2.16287	46.15	0.93407	8	130.00	1.71665	1.71665	0	0.7632	16.98142	12.96084	2.45274	80.94	17.7728	36.228
26.739	456.261	80.42	0.62	0.77	-0.07	45.2706	0.78798	2.13015	45.2764	0.78788	8	130.00	1.73804	1.738035	0	0.7585	16.65087	12.63012	2.43597	80.43	16.7349	36.115
27.067	455.933	55.83	0.67	1.2	-0.09	30.7332	1.23912	2.37784	30.7332	1.23912	7	130.00	1.75936	1.759355	0	0.7539	12.84642	9.685131	1.67401	55.83	25.5169	33.762
27.395	455.605	46.5	0.82	1.77	-0.14	25.1137	1.83366	2.54667	25.1137	1.83366	7	130.00	1.78068	1.780675	0	0.7494	11.5793	8.677407	1.3845	46.5	32.8129	32.493
27.723	455.277	57.97	0.96	1.65	0.23	31.1699	1.70916	2.45279	31.1699	1.70916	7	130.00	1.802	1.801995	0	0.7449	13.80444	10.28352	1.73895	57.97	28.6174	33.849
28.051	454.949	68	0.97	1.43	-0.32	36.2947	1.46577	2.36006	36.2947	1.46577	7	130.00	1.82332	1.823315	0	0.7406	15.52249	11.49557	2.04881	68	24.8126	34.786
28.379	454.621	53.43	1.26	2.35	-0.41	27.9651	2.44255	2.58442	27.9651	2.44255	6	130.00	1.84464	1.844635	0	0.7363	13.55423	9.979752	1.59707	53.43	34.6019	33.172
28.707	454.293	48.16	0.78	1.62	-0.58	24.8098	1.68488	2.52977	24.8098	1.68488	7	130.00	1.86596	1.865955	0	0.7321	11.89481	8.707769	1.43325	48.16	32.0316	32.415
29.035	453.965	64.33	0.45	0.69	-0.6	33.0862	0.72066	2.22831	33.0462	0.72066	8	125.00	1.88728	1.887275	0	0.7279	13.86901	10.0955	1.93321	64.33	19.9571	34.218
29.363	453.637	56.15	0.73	1.3	-0.09	28.4322	1.34581	2.42586	28.4322	1.34581	7	125.00	1.90778	1.907775	0	0.724	13.20537	9.560644	1.67933	56.15	27.4781	33.276
29.691	453.309	58.81	0.91	1.54	0.09	29.4988	1.59981	2.45535	29.4388	1.59981	7	125.00	1.92828	1.928275	0	0.7201	14.02117	10.09717	1.76104	58.81	28.7271	33.506
30.019	452.981	67.14	1.23	1.84	-0.11	33.4524	1.88676	2.45406	33.4524	1.88676	7	125.00	1.94878	1.948775	0	0.7163	15.99754	11.45968	2.0183	67.14	28.6717	34.286
30.347	452.653	112.05	2.2	1.96	-0.41	55.8991	1.99858	2.2978	55.8991	1.99853	7	125.00	1.96928	1.969275	0	0.7126	24.88619	17.73394	3.40807	112.05	22.4399	37.347
30.675	452.325	73.06	2.44	3.34	-8.34	35.7177	3.43322	2.59915	35.7428	3.43081	6	125.00	1.98978	1.989775	0	0.7089	18.6832	13.24492	2.20032	73.11	35.3158	34.692
31.004	451.996	39.96	1.78	4.47	-10.67	18.8773	4.69042	2.89568	18.9071	4.68302	4	125.00	2.01038	2.010338	0	0.7053	12.00648	8.468011	1.17491	40.02	51.728	30.664
31.332	451.668	36.72	1.19	3.25	-12.47	17.0812	3.43047	2.84264	17.1157	3.42356	5	125.00	2.03084	2.030838	0	0.7017	10.70429	7.511391	1.07397	36.79	48.4956	30.012
31.66	451.340	32.6	0.98	3	-11.92	14.8921	3.208	2.87199	14.9262	3.20066	5	125.00	2.05134	2.051338	0	0.6982	9.666982	6.749511	0.94578	32.67	50.2673	29.107
31.988	451.012	30.21	0.84	2.79	-11.04	13.5813	2.98527	2.8855	13.615	2.97786	6	125.00	2.07184	2.071838	0	0.6947	9.030418	6.27379	0.87115	30.28	51.0971	28.495
32.316	450.684	30.02	0.75	2.5	-10.81	13.3476	2.68551	2.86492	13.381	2.6788	6	125.00	2.09234	2.092338	0	0.6913	8.867287	6.130203	0.86463	30.09	49.8367	28.379
32.644	450.356	32.56	0.7	2.16	-8.52	14.4106	2.29906	2.79963	14.4342	2.2953	6	125.00	2.11284	2.112838	0	0.688	9.261455	6.371566	0.94264	32.61	45.9727	28.884
32.972	450.028	32.57	0.61	1.86	-7.05	14.2672	2.00416	2.77023	14.2859	2.00153	6	125.00	2.13334	2.133338	0	0.6847	9.112641	6.238993	0.94231	32.61	44.2973	28.816
33.3	449.700	31.3	0.63	2.02	-5.48	13.5322	2.16152	2.80746	13.5508	2.15856	6	125.00	2.15384	2.153838	0	0.6814	8.939627	6.091342	0.90236	31.34	46.4254	28.463
33.628	449.372	31.82	0.66	2.08	-3.97	13.6343	2.2263	2.81229	13.6435	2.22479	6	125.00	2.17434	2.174338	0	0.6782	9.106774	6.175812	0.91782	31.84	46.706	28.509
33.956	449.044	28.86	0.57	1.98	-2.68	12.149	2.13762	2.84432	12.1561	2.13602	6	125.00	2.19484	2.194838	0	0.675	8.41085	5.677259	0.82555	28.88	48.5957	27.736
34.284	448.716	23.21	0.5	2.14	-1.27	9.47696	2.38156	2.96057	9.46147	2.38042	6	125.00	2.21534	2.215338	0	0.6719	7.241997	4.865622	0.64999	23.22	55.8673	26.057
34.612	448.388	20.41	0.42	2.06	0.02	8.12857	2.31097	3.0103	8.12857	2.31097	6	125.00	2.23584	2.235838	0	0.6688	6.564749	4.390339	0.56267	20.41	59.1814	25.012
34.941	448.059	23.17	0.41	1.77	0.71	9.26857	1.96045	2.92469	9.26414	1.96138	6	125.00	2.2564	2.2564	0	0.6657	7.068599	4.705711	0.64748	23.16	53.5531	25.9
35.269	447.731	24.74	0.45	1.82	2.5	9.86565	2.00329	2.90667	9.85687	2.00507	6	125.00	2.2769	2.2769	0	0.6627	7.464431	4.946804	0.69545	24.72	52.4146	26.32
35.597	447.403	23.56	0.62	2.64	4.16	9.25507	2.91592	3.01828	9.24537	2.91866	5	125.00	2.2974	2.2974	0	0.6598	7.609665	5.020503	0.65828	23.54	59.7243	25.887
35.925	447.075	26.46	0.63	2.39	12.8	10.419	2.60955	2.95013	10.3845	2.61823	6	135.00	2.3179	2.31712	0.0008	0.6569	8.175519	5.370826	0.74743	26.38	55.1876	26.673
36.253	446.747	24.52	0.58	2.37	14.27	9.52328	2.61497	2.98363	9.48463	2.62563	6	135.00	2.34004	2.329026	0.011	0.6553	7.72807	5.063885	0.68669	24.43	57.3883	26.063
36.581	446.419	23.35	0.59	2.53	14.8	8.96558	2.81115	3.02295	8.92713	2.82326	5	135.00	2.36218	2.349933	0.0212	0.6536	7.541419	4.928997	0.64978	23.26	60.0438	25.695
36.909	446.091	20.73	0.59	2.83	15.59	7.79725	3.21602	3.10619	7.759	3.23187	5	135.00	2.38432	2.352839	0.0315	0.6519	7.064455	4.605822	0.56798	20.64	65.9272	24.708
37.237	445.763	23.32	0.68	2.92	16.49	8.86389	3.25148	3.06352	8.8816	3.2671	5	135.00	2.40646	2.364746	0.0417	0.6503	7.727244	5.024958	0.64748	23.22	62.8665	25.566
37.565	445.435	24.74	0.81	3.26	8.36	9.38774	3.63043	3.06819	9.36671	3.63859	5	135.00	2.4286	2.376652	0.0519	0.6487	8.24148	5.34592	0.69076	24.69	63.1968	25.99

R15218

Depth (ft)	Samp (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	s (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	445.107	23.87	0.87	3.63	-3.35	8.96744	4.06176	3.11089	8.97582	4.05798	5	135.00	2.45074	2.388558	0.0622	0.647	8.203105	5.307748	0.66313	23.89	66.2702	25.705
38.221	444.779	22.91	0.77	3.37	-3.42	8.51382	3.76765	3.10987	8.52632	3.76213	5	135.00	2.47288	2.400465	0.0724	0.6454	7.871536	5.080563	0.63273	22.94	66.196	25.361
38.549	444.451	25.19	0.68	2.69	-2.47	9.40775	2.99626	3.01817	9.41189	2.99494	5	135.00	2.49502	2.412371	0.0826	0.6438	8.145735	5.24456	0.70263	25.2	59.717	26.032
38.877	444.123	22.12	0.7	3.15	-2.17	8.06605	3.57091	3.11545	8.09018	3.56909	5	135.00	2.51716	2.424278	0.0929	0.6423	7.62211	4.895353	0.6069	22.13	66.604	25.012
39.206	443.794	19.76	0.61	3.07	3.07	7.06859	3.54226	3.1627	7.06038	3.54638	5	135.00	2.53937	2.43622	0.1031	0.6407	7.022462	4.499157	0.53315	19.74	70.1291	24.097
39.534	443.466	24.4	0.75	3.06	4.32	8.92049	3.4343	3.07189	8.99824	3.43903	5	135.00	2.56151	2.448127	0.1134	0.6391	8.154368	5.211628	0.67611	24.37	63.4594	25.669
39.862	443.138	25.59	0.74	2.9	5.43	9.35205	3.2165	3.03903	9.33579	3.22211	5	135.00	2.58365	2.460033	0.1236	0.6376	8.369236	5.335994	0.71227	25.55	61.1526	25.988
40.19	442.810	25.05	0.72	2.86	6.14	9.0796	3.20795	3.04897	9.06341	3.21368	5	135.00	2.60579	2.47194	0.1338	0.636	8.244866	5.244024	0.69487	25.01	61.8447	25.792
40.518	442.482	23.27	0.76	3.25	7.14	8.31053	3.6818	3.11505	8.2904	3.69074	5	135.00	2.62793	2.483646	0.1441	0.6345	7.905391	5.073146	0.63907	23.22	66.5748	25.193
40.846	442.154	25.96	0.88	3.4	8.43	9.33984	3.77521	3.08008	9.3158	3.78496	5	135.00	2.65007	2.495752	0.1543	0.633	8.713036	5.515295	0.72167	25.9	64.0434	25.982
41.174	441.826	25.09	1.01	4.03	8.59	8.93973	4.50535	3.14056	8.91979	4.51542	4	135.00	2.67221	2.507659	0.1645	0.6315	8.772768	5.539906	0.69405	25.04	68.4623	25.693
41.502	441.498	23.31	0.9	3.85	10.14	8.18223	4.36561	3.16384	8.15841	4.37836	4	135.00	2.69435	2.519565	0.1748	0.63	8.27787	5.214892	0.63826	23.25	70.2152	25.095
41.83	441.170	22.11	0.83	3.76	10.72	7.66096	4.27978	3.18239	7.63331	4.29529	4	135.00	2.71649	2.531472	0.185	0.6285	7.949599	4.998417	0.60042	22.04	71.6336	24.65
42.158	440.842	22.65	0.97	4.29	10.46	7.82871	4.87159	3.20755	7.80119	4.88877	4	135.00	2.73863	2.543378	0.1952	0.627	8.293291	5.200217	0.61645	22.58	73.6096	24.8
42.486	440.514	21.66	0.88	4.07	10.99	7.39614	4.66627	3.21626	7.36874	4.67358	4	135.00	2.76077	2.555284	0.2055	0.6256	7.977864	4.990776	0.58512	21.59	74.2704	24.42
42.814	440.186	22.04	0.74	3.34	10.67	7.50123	3.84274	3.16291	7.47396	3.85676	5	135.00	2.78291	2.567191	0.2157	0.6241	7.8169	4.878716	0.59619	21.97	70.1447	24.518
43.143	439.857	19.95	0.77	3.87	8.24	6.64754	4.49114	3.24432	6.62815	4.50427	4	135.00	2.80612	2.579133	0.226	0.6227	7.505574	4.673551	0.5308	19.9	76.5026	23.717
43.471	439.529	17	0.74	4.34	6.35	5.46991	5.22129	3.35118	5.45447	5.23607	3	135.00	2.82726	2.59104	0.2362	0.6212	6.944066	4.313967	0.43878	16.96	85.4106	22.424
43.799	439.201	19.37	0.84	4.35	6.47	6.34689	5.08456	3.29171	6.33152	5.0969	3	135.00	2.8494	2.602948	0.2464	0.6198	7.554698	4.682573	0.51147	19.33	80.3734	23.418
44.127	438.873	21.4	1.06	4.94	0.86	7.08585	5.72093	3.28218	7.08585	5.72093	3	135.00	2.87154	2.614853	0.2567	0.6184	8.303236	5.134803	0.57364	21.4	79.585	24.174
44.455	438.545	19.64	0.74	3.78	-0.78	6.37528	4.41888	3.25299	6.37909	4.41624	4	135.00	2.89368	2.626759	0.2669	0.617	7.458995	4.60225	0.51846	19.65	77.2014	23.476
44.783	438.217	15.29	0.89	5.83	-1.04	4.68956	7.19239	3.48477	4.68335	7.18659	3	135.00	2.91582	2.638665	0.2771	0.6156	7.014631	4.318422	0.3831	15.3	97.4824	21.466
45.111	437.889	18.24	0.81	4.42	1.23	5.77311	5.29341	3.33426	5.76834	5.29587	3	135.00	2.93796	2.650572	0.2874	0.6142	7.364226	4.52332	0.47375	18.23	83.9559	22.816
45.439	437.561	23.11	0.9	3.9	2.4	7.5681	4.46652	3.19593	7.56059	4.47096	4	135.00	2.9601	2.662478	0.2976	0.6129	8.408624	5.153258	0.62384	23.09	72.6801	24.62
45.767	437.233	23.58	1.04	4.42	10.81	7.70187	5.04909	3.22274	7.6757	5.06631	4	135.00	2.98224	2.674385	0.3079	0.6115	8.728223	5.337205	0.6377	23.51	74.782	24.724
46.095	436.905	23.42	0.95	4.05	11.02	7.59993	4.6533	3.20639	7.57387	4.66931	4	135.00	3.00438	2.686291	0.3181	0.6101	8.56709	5.227052	0.63206	23.35	73.495	24.638
46.423	436.577	19.66	0.81	4.12	11.46	6.17208	4.86385	3.29142	6.14613	4.88438	4	135.00	3.02652	2.698197	0.3283	0.6088	7.662429	4.664783	0.51559	19.61	80.3493	23.25
46.751	436.249	18.67	0.6	3.22	13.05	5.76411	3.8409	3.25826	5.73459	3.86067	5	135.00	3.04866	2.710104	0.3386	0.6074	7.084343	4.303349	0.48363	18.59	77.6282	22.795
47.079	435.921	19.1	0.56	2.91	15.36	5.88874	3.49362	3.22851	5.852	3.51556	5	135.00	3.0708	2.72201	0.3488	0.6061	7.083552	4.293448	0.49626	19	75.2399	22.932
47.408	435.592	21.41	0.69	3.23	16.68	6.69982	3.76699	3.19955	6.66324	3.78767	5	135.00	3.093	2.733953	0.359	0.6048	7.780455	4.70554	0.56709	21.31	72.9615	23.796
47.736	435.264	49.22	1.77	3.6	20.42	16.7907	3.63907	2.88182	16.7433	3.84993	5	135.00	3.11514	2.745859	0.3693	0.6035	14.60876	8.816054	1.42739	49.09	50.8702	29.92
48.064	434.936	108.31	4.31	3.98	24.9	38.1369	4.09802	2.63254	38.0789	4.10426	5	135.00	3.13728	2.757766	0.3795	0.6022	28.10668	16.92509	3.25612	108.15	36.9683	35.099
48.392	434.608	174.86	6.35	3.63	23.46	61.9931	3.6983	2.45237	61.9389	3.70153	12	135.00	3.15942	2.769672	0.3898	0.6009	41.59558	24.99384	5.31581	174.71	28.5992	37.947
48.72	434.280	126.51	6.37	5.04	9.38	44.3376	5.16507	2.65754	44.316	5.16758	11	135.00	3.18156	2.781579	0.4	0.5996	33.2856	19.95771	3.81822	126.45	38.2371	36.007
49.048	433.952	166.9	6.34	3.8	22.06	58.5993	3.87303	2.48371	58.5492	3.87634	12	135.00	3.2037	2.793485	0.4102	0.5983	40.29083	24.10644	5.068	166.76	29.9602	37.628
49.376	433.624	185.28	8	4.32	29.84	64.8944	4.3943	2.49436	64.8267	4.39689	11	135.00	3.22584	2.805391	0.4205	0.597	44.94566	26.83435	5.63635	185.09	30.4315	38.206
49.704	433.296	146.4	7.86	5.37	33.05	50.8118	5.49067	2.63756	50.7373	5.49873	11	135.00	3.24798	2.817298	0.4307	0.5958	38.08986	22.69306	4.43195	146.19	37.2207	36.803
50.032	432.968	154.76	6.18	3.99	62.54	53.5451	4.07948	2.52808	53.4072	4.09001	12	135.00	3.27012	2.829204	0.4409	0.5945	38.09591	22.64885	4.69009	154.37	31.9538	37.1
50.36	432.640	137.82	5.3	3.84	25.31	47.3504	3.99971	2.55353	47.2941	3.9444	12	135.00	3.29226	2.841111	0.4512	0.5933	34.39466	20.40549	4.16495	137.66	33.1337	36.392
50.688	432.312	83.38	3.81	4.57	22.91	28.0635	4.7586	2.77386	28.0144	4.78693	11	135.00	3.3144	2.853017	0.4614	0.592	23.30703	13.79859	2.47881	83.24	44.5017	33.219
51.016	431.984	58.49	2.41	4.12	21.11	19.2513	4.36963	2.87161	19.2059	4.37995	5	135.00	3.33654	2.864923	0.4716	0.5908	17.26483	10.20013	1.70754	58.36	50.2442	30.822
51.345	431.655	40.89	1.24	3.03	26.95	13.0459	3.30391	2.92987	12.9868	3.31895	6	135.00	3.35875	2.876866	0.4819	0.5896	12.46659	7.350011	1.16196	40.72	53.8834	28.264
51.673	431.327	51.35	1.29	2.52	29.37	16.6054	2.68923	2.79202	16.5431	2.69936	6	135.00	3.38089	2.888772	0.4921	0.5884	14.47144	8.514418	1.48511	51.17	45.5351	29.856
52.001	430.999	79.13	2.66	3.36	27.12	26.1066	3.51262	2.70938	26.048	3.52052	6	135.00	3.40303	2.900679	0.5024	0.5872	21.35463	12.5364	2.34449	78.96	40.9545	32.766
52.329	430.671	74.91	5.41	7.23	-2.71	24.5434	7.56804	2.95489	24.5503	7.56592	11	135.00	3.42517	2.912585	0.5126	0.586	23.28897	13.64618	2.21315	74.93	55.4968	32.394
52.657	430.343	267.69	12.98	4.85	-1.85	90.3551	4.91215	2.43829	90.3585	4.91197	11	135.00	3.44731	2.924492	0.5228	0.5848	63.31944	37.02643	8.18089	267.7	27.9998	40.035

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R15219

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 24 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5B

ConeTec Inc. Interpretation
Interpretation Ou elease 1.22 Rev. Format: NLI Imperial

Run No: 07-1210-1008-4397
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5B
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 15:44
CPT File: 804CP05B.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 479.9

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	38.10	1.25	40.93	19.30	2.15
125	Soil Embankment	31.26	1.88	62.63	50.48	2.84

User Inputs:

Assumed:
Water Table Depth (ft): 28
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 479.9
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	479.736	18.44	0.14	0.76	0.34	1728.83	0.760	1.13	1727.89	0.76	6	130.00	0.011	0.011	0.000	2.000	2.71	5.42	0.571	18.43	-1.1328	52.78
0.492	479.408	23.22	0.26	1.12	0.21	725.079	1.121	1.41	725.08	1.12	6	130.00	0.032	0.032	0.000	2.000	3.72	7.44	0.718	23.22	1.62684	49.62
0.82	479.080	13.32	0.2	1.51	-0.32	248.906	1.508	1.76	248.91	1.51	6	130.00	0.053	0.053	0.000	2.000	2.40	4.80	0.411	13.32	7.35209	45.08
1.148	478.752	12.84	0.15	1.17	0.16	171.072	1.175	1.79	171.07	1.18	6	130.00	0.075	0.075	0.000	2.000	2.33	4.67	0.395	12.84	7.84987	43.30
1.476	478.424	38.97	0.24	0.62	0.39	405.191	0.617	1.33	405.09	0.62	7	130.00	0.096	0.096	0.000	2.000	6.09	12.18	1.204	38.96	0.7066	47.24
1.804	478.096	74.14	0.58	0.78	0.09	631.27	0.784	1.30	631.18	0.78	8	130.00	0.117	0.117	0.000	2.000	11.49	22.97	2.292	74.13	0.40522	49.07
2.133	477.767	60.91	0.73	1.2	0.14	438.323	1.201	1.54	438.32	1.20	7	130.00	0.139	0.139	0.000	2.000	10.18	20.36	1.881	60.91	3.43634	47.58
2.461	477.439	48.52	0.69	1.42	0.23	302.316	1.427	1.69	302.32	1.43	7	130.00	0.160	0.160	0.000	2.000	8.54	17.07	1.497	48.52	5.99658	45.97
2.789	477.111	43.89	0.75	1.7	0.09	241.105	1.716	1.82	241.10	1.72	7	130.00	0.181	0.181	0.000	2.000	8.06	16.12	1.353	43.89	8.4724	44.94
3.117	476.783	44.62	0.57	1.28	-0.05	219.231	1.283	1.74	219.23	1.28	7	130.00	0.203	0.203	0.000	2.000	7.99	15.97	1.375	44.62	6.95479	44.49
3.445	476.455	38.58	0.44	1.13	0.02	171.29	1.147	1.78	171.29	1.15	7	130.00	0.224	0.224	0.000	2.000	6.99	13.99	1.187	38.58	7.68466	43.31
3.773	476.127	23.25	0.37	1.57	-0.51	93.8032	1.608	2.07	93.80	1.61	6	130.00	0.245	0.245	0.000	2.000	4.70	9.39	0.712	23.25	14.8691	40.23
4.101	475.799	18.59	0.19	1.02	-0.32	68.7391	1.037	2.05	68.74	1.04	6	130.00	0.267	0.267	0.000	1.937	3.72	7.21	0.567	18.59	14.2745	38.52
4.429	475.471	17.34	0.16	0.92	-0.21	59.2324	0.938	2.07	59.23	0.94	6	130.00	0.288	0.288	0.000	1.864	3.51	6.54	0.528	17.34	15.0462	37.68
4.757	475.143	25.81	0.28	1.09	-0.09	82.4721	1.098	2.00	82.47	1.10	7	130.00	0.309	0.309	0.000	1.798	5.08	9.13	0.789	25.81	12.9698	39.53
5.085	474.815	24.43	0.46	1.87	-0.41	72.9127	1.909	2.20	72.91	1.91	6	130.00	0.331	0.331	0.000	1.739	5.20	9.05	0.746	24.43	18.9585	38.85
5.413	474.487	18.46	0.38	2.06	-0.64	51.4663	2.099	2.34	51.47	2.10	6	130.00	0.352	0.352	0.000	1.686	4.17	7.04	0.561	18.46	23.9842	36.87
5.741	474.159	16.54	0.27	1.61	-0.67	43.3236	1.670	2.33	43.35	1.67	6	130.00	0.373	0.373	0.000	1.637	3.73	6.11	0.501	16.55	23.7454	35.86
6.069	473.831	15.2	0.19	1.22	-0.62	37.5312	1.283	2.31	37.53	1.28	6	130.00	0.394	0.394	0.000	1.592	3.40	5.41	0.458	15.2	23.0694	34.99
6.398	473.502	15.29	0.17	1.08	-0.48	35.7663	1.143	2.30	35.79	1.14	6	130.00	0.416	0.416	0.000	1.551	3.41	5.28	0.460	15.3	22.6384	34.70
6.726	473.174	18.36	0.25	1.34	-0.09	40.9955	1.395	2.30	41.00	1.39	6	130.00	0.437	0.437	0.000	1.512	4.09	6.19	0.555	18.36	22.6937	35.52
7.054	472.846	20.73	0.37	1.77	-0.23	44.2117	1.825	2.35	44.21	1.83	6	130.00	0.459	0.459	0.000	1.477	4.71	6.96	0.628	20.73	24.4234	35.97
7.382	472.518	11.94	0.22	1.8	-0.14	23.8838	1.920	2.58	23.88	1.92	5	130.00	0.480	0.480	0.000	1.444	3.02	4.35	0.355	11.94	34.1973	32.17
7.71	472.190	11.14	0.1	0.85	-0.35	21.2289	0.940	2.45	21.25	0.94	6	130.00	0.501	0.501	0.000	1.413	2.65	3.75	0.329	11.15	28.5942	31.42
8.038	471.862	15.59	0.13	0.8	-0.44	28.839	0.863	2.32	28.84	0.86	6	130.00	0.522	0.522	0.000	1.383	3.49	4.83	0.466	15.59	23.2198	33.36
8.366	471.534	15.96	0.17	1.04	-0.67	28.3496	1.103	2.38	28.37	1.10	6	130.00	0.544	0.544	0.000	1.356	3.68	4.99	0.477	15.97	25.5838	33.26
8.694	471.206	13.31	0.18	1.32	-0.46	22.5529	1.412	2.52	22.57	1.41	6	130.00	0.565	0.565	0.000	1.330	3.28	4.36	0.395	13.32	31.6281	31.81
9.022	470.878	16.16	0.14	0.84	-0.64	26.5566	0.899	2.36	26.56	0.90	6	130.00	0.586	0.586	0.000	1.306	3.69	4.81	0.482	16.16	24.7561	32.85
9.35	470.550	17.95	0.14	0.78	-0.6	28.5352	0.807	2.31	28.54	0.81	6	130.00	0.608	0.608	0.000	1.283	4.01	5.14	0.537	17.95	22.8351	33.30
9.678	470.222	14.69	0.11	0.72	-0.51	22.3519	0.782	2.39	22.37	0.78	6	130.00	0.629	0.629	0.000	1.261	3.41	4.30	0.435	14.7	26.1982	31.75
10.006	469.894	15.13	0.13	0.83	-0.32	22.263	0.898	2.42	22.28	0.90	6	130.00	0.650	0.650	0.000	1.240	3.56	4.41	0.448	15.14	27.4287	31.73
10.335	469.565	19.67	0.48	2.45	-0.05	28.2806	2.527	2.59	28.28	2.53	5	130.00	0.672	0.672	0.000	1.220	5.00	6.10	0.588	19.67	34.8607	33.24
10.663	469.237	22.81	0.74	3.23	-0.67	31.9104	3.346	2.63	31.91	3.35	5	130.00	0.693	0.693	0.000	1.201	5.92	7.11	0.685	22.81	36.7632	33.99
10.991	468.909	13.41	0.42	3.14	-0.42	17.7706	3.308	2.82	17.77	3.31	4	130.00	0.714	0.714	0.000	1.183	3.85	4.56	0.393	13.41	47.1932	30.26
11.319	468.581	19.13	0.26	1.36	-0.67	25.0012	1.413	2.48	25.00	1.41	6	130.00	0.736	0.736	0.000	1.166	4.62	5.39	0.569	19.13	29.9799	32.46
11.647	468.253	17.75	0.22	1.21	-0.62	22.4461	1.295	2.50	22.46	1.29	6	130.00	0.757	0.757	0.000	1.149	4.33	4.98	0.526	17.76	30.7942	31.78
11.975	467.925	18.33	0.28	1.53	-0.32	22.5491	1.595	2.55	22.55	1.60	6	130.00	0.778	0.778	0.000	1.133	4.57	5.18	0.543	18.33	32.9971	31.80
12.303	467.597	33.79	0.45	1.32	-0.58	41.2536	1.364	2.30	41.25	1.36	7	130.00	0.800	0.800	0.000	1.118	7.50	8.39	1.021	33.79	22.3995	35.56
12.631	467.269	97.39	1.27	1.31	0.35	117.621	1.315	1.94	117.62	1.32	8	130.00	0.821	0.821	0.000	1.104	18.70	20.64	2.990	97.39	11.3008	41.42
12.959	466.941	115.69	1.69	1.46	0.39	136.344	1.472	1.93	136.34	1.47	8	130.00	0.842	0.842	0.000	1.090	22.12	24.10	3.556	115.69	11.0264	42.17
13.287	466.613	126.13	2.46	1.95	-0.69	145.042	1.964	2.00	145.04	1.96	7	130.00	0.864	0.864	0.000	1.076	24.81	26.70	3.878	126.13	12.9601	42.49
13.615	466.285	126.8	2.52	1.98	-0.67	142.281	2.001	2.01	142.28	2.00	7	130.00	0.885	0.885	0.000	1.063	25.05	26.63	3.898	126.8	13.2784	42.39
13.943	465.957	96.74	2.09	2.16	-0.09	105.742	2.181	2.13	105.74	2.18	7	130.00	0.906	0.906	0.000	1.050	19.99	21.00	2.967	96.74	16.6031	40.86
14.271	465.629	74.23	1.62	2.18	-1.2	79.0224	2.210	2.22	79.03	2.21	7	130.00	0.928	0.928	0.000	1.038	15.94	16.55	2.269	74.24	19.5985	39.30
14.6	465.300	62.31	1	1.61	-0.99	64.6586	1.630	2.19	64.67	1.63	7	130.00	0.949	0.949	0.000	1.027	13.23	13.58	1.900	62.32	18.7205	38.18
14.928	464.972	62.88	1	1.59	-0.92	63.8034	1.615	2.19	63.81	1.61	7	130.00	0.970	0.970	0.000	1.015	13.36	13.57	1.917	62.89	18.7825	38.10
15.256	464.644	49.08	0.73	1.48	-1.5	48.4938	1.518	2.27	48.50	1.52	7	130.00	0.992	0.992	0.000	1.004	10.77	10.81	1.489	49.09	21.3776	36.52

Depth (ft)	Sampl (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	s (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	464.316	46.97	0.47	1	-1.55	45.3691	1.023	2.19	45.38	1.02	7	130.00	1.013	1.013	0.000	0.994	9.97	9.91	1.423	46.98	18.6866	36.13
15.912	463.988	56.81	0.64	1.12	-1.5	53.9271	1.147	2.16	53.94	1.15	7	130.00	1.034	1.034	0.000	0.983	11.90	11.70	1.727	56.82	17.6279	37.14
16.24	463.660	78.21	1	1.28	-1.71	73.0906	1.296	2.09	73.10	1.30	8	130.00	1.056	1.056	0.000	0.973	15.91	15.49	2.389	78.22	15.4178	38.87
16.568	463.332	70.07	1.01	1.44	-0.58	64.0652	1.464	2.16	64.07	1.46	7	130.00	1.077	1.077	0.000	0.964	14.71	14.18	2.136	70.08	17.8331	38.13
16.896	463.004	58.9	0.8	1.36	-0.58	52.6313	1.384	2.22	52.63	1.38	7	130.00	1.098	1.098	0.000	0.954	12.63	12.05	1.790	58.9	19.5365	37.00
17.224	462.676	49.64	0.81	1.64	-0.21	43.3388	1.669	2.33	43.34	1.67	7	130.00	1.120	1.120	0.000	0.945	11.19	10.58	1.502	49.64	23.7509	35.85
17.552	462.348	41.77	0.69	1.64	-0.86	35.6121	1.698	2.40	35.62	1.70	7	130.00	1.141	1.141	0.000	0.936	9.73	9.11	1.258	41.78	26.5988	34.67
17.88	462.020	56.82	0.68	1.19	-0.42	47.89	1.222	2.22	47.89	1.22	7	130.00	1.162	1.162	0.000	0.928	12.19	11.31	1.723	56.82	19.5408	36.45
18.208	461.692	67.55	1.17	1.74	-0.42	56.0755	1.76294	2.26108	56.0755	1.76294	7	130.00	1.18352	1.18352	0	0.9192	14.76722	13.57409	2.05469	67.55	21.1064	37.365
18.537	461.363	65.8	1.63	2.48	-0.64	53.6101	2.52341	2.3793	53.6101	2.52341	6	130.00	1.20491	1.204905	0	0.911	15.15043	13.80221	1.99985	65.8	25.5751	37.106
18.865	461.035	61.65	1.3	2.11	-0.67	49.2763	2.15147	2.36009	49.2763	2.15147	7	130.00	1.22623	1.226225	0	0.9031	14.07313	12.70883	1.87071	61.65	24.8137	36.614
19.193	460.707	47.05	0.79	1.67	-0.53	36.7141	1.7248	2.39828	36.7141	1.7248	7	125.00	1.24755	1.247545	0	0.8953	10.92664	9.782697	1.41803	47.05	26.3409	34.856
19.521	460.379	44.52	0.68	1.53	-0.9	34.1092	1.57218	2.39964	34.1171	1.57182	7	125.00	1.26805	1.268045	0	0.888	10.3478	9.189267	1.33907	44.53	26.3963	34.407
19.849	460.051	40.76	0.63	1.55	-0.25	30.6326	1.59609	2.44144	30.6326	1.59609	7	125.00	1.28855	1.288545	0	0.8809	9.655144	8.505678	1.22203	40.76	26.1337	33.741
20.177	459.723	38.62	0.63	1.64	-0.16	28.5024	1.68851	2.48112	28.5024	1.68851	7	125.00	1.30905	1.309045	0	0.874	9.319563	8.145509	1.15514	38.62	29.8463	33.291
20.505	459.395	44.39	0.75	1.69	-0.51	32.3874	1.74174	2.44416	32.3949	1.74133	7	125.00	1.32955	1.329545	0	0.8673	10.53055	9.132793	1.33314	44.4	28.2491	34.088
20.833	459.067	57.91	1.33	2.3	-0.41	41.8949	2.35149	2.43862	41.8949	2.35149	6	125.00	1.35005	1.350045	0	0.8606	13.69973	11.79066	1.75108	57.91	28.0145	35.652
21.161	458.739	25.08	1.34	5.36	-0.07	17.2993	5.65175	2.97546	17.2993	5.65175	3	125.00	1.37055	1.370545	0	0.8542	7.90839	6.75525	0.73404	25.08	57.0449	30.082
21.489	458.411	21.57	0.8	3.69	2.73	14.5063	3.96453	2.93879	14.4991	3.96649	4	125.00	1.39105	1.391045	0	0.8479	6.636117	5.626566	0.62474	21.56	54.455	28.914
21.817	458.083	29.59	0.95	3.2	6.9	19.9628	3.37137	2.78704	19.9345	3.37616	5	125.00	1.41155	1.411545	0	0.8417	8.334097	7.014733	0.8724	29.55	45.2501	31.009
22.145	457.755	33.08	1.22	3.68	8.57	22.0998	3.85491	2.79022	22.0649	3.86101	5	125.00	1.43205	1.432045	0	0.8356	9.331922	7.798171	0.97981	33.03	45.4317	31.665
22.473	457.427	38.31	1.19	3.29	9.54	23.9975	3.4139	2.72893	23.9562	3.41979	5	125.00	1.45255	1.452545	0	0.8297	9.906188	8.219431	1.07918	36.25	42.0101	32.192
22.802	457.098	35.83	1.22	3.4	9.26	23.3227	3.55096	2.74942	23.282	3.55717	5	125.00	1.47311	1.473108	0	0.8239	9.863284	8.142993	1.06368	35.77	43.1354	32.01
23.13	456.770	36.3	1.11	3.07	13.63	23.3036	3.18907	2.7202	23.25	3.19642	5	125.00	1.49361	1.493608	0	0.8182	9.852044	8.061356	1.0776	36.22	41.5368	32.001
23.458	456.442	34.31	1.06	3.08	15.82	21.6602	3.23211	2.74896	21.5942	3.242	5	125.00	1.51411	1.514108	0	0.8127	9.449872	7.679759	1.01535	34.21	43.1096	31.526
23.786	456.114	34.28	1.04	3.03	17.95	21.338	3.17602	2.74944	21.2663	3.18672	5	125.00	1.53461	1.534608	0	0.8072	9.441263	7.621342	1.01379	34.17	43.136	31.428
24.114	455.786	34.12	1.05	3.07	21.34	20.9406	3.22433	2.7603	20.857	3.23725	5	125.00	1.55511	1.555108	0	0.8019	9.44696	7.57551	1.0082	33.99	43.7399	31.302
24.442	455.458	33.09	1.19	3.59	20.71	20.0014	3.77605	2.8192	19.9189	3.79169	5	125.00	1.57561	1.575608	0	0.7967	9.463703	7.539406	0.97568	32.96	47.1098	31.004
24.77	455.130	35.21	1.24	3.53	21.94	21.0599	3.68895	2.79552	20.9722	3.70438	5	125.00	1.59611	1.596108	0	0.7915	9.937404	7.865781	1.04068	35.07	45.7358	31.338
25.098	454.802	35.32	1.2	3.39	24.9	20.8482	3.56047	2.78926	20.7564	3.57639	5	125.00	1.61661	1.616608	0	0.7865	9.93126	7.810917	1.04345	35.17	45.3767	31.27
25.426	454.474	33.07	1.09	3.29	27.37	19.2003	3.46771	2.81033	19.0964	3.48656	5	125.00	1.63711	1.637108	0	0.7816	9.399677	7.346396	0.97315	32.9	46.5923	30.729
25.754	454.146	30.14	0.89	2.96	28.13	17.1828	3.12474	2.82084	17.0742	3.14461	5	125.00	1.65761	1.657608	0	0.7767	8.610264	6.687682	0.88181	29.96	47.206	29.996
26.082	453.818	28.04	0.96	3.41	30.18	15.7093	3.64162	2.8929	15.5961	3.66806	5	125.00	1.67811	1.678108	0	0.772	8.341715	6.439401	0.81616	27.85	51.565	29.398
26.41	453.490	27.22	1.12	4.12	32.24	15.0249	4.38848	2.95894	14.9071	4.42314	4	125.00	1.69861	1.698608	0	0.7673	8.418813	6.459581	0.79014	27.02	55.761	29.099
26.739	453.161	25.07	1.08	4.3	31.06	13.5826	4.6251	3.00754	13.4721	4.66305	4	125.00	1.71917	1.71917	0	0.7627	7.988621	6.092736	0.72294	24.88	58.9941	28.424
27.067	452.833	22.52	0.88	3.89	31.69	11.945	4.23477	3.02853	11.883	4.27593	4	125.00	1.73967	1.73967	0	0.7582	7.262348	5.506094	0.64335	22.32	60.4271	27.552
27.395	452.505	23.13	1	4.33	31.09	12.1408	4.67949	3.04924	12.0328	4.72147	4	125.00	1.76017	1.76017	0	0.7537	7.563768	5.70113	0.6616	22.94	61.8634	27.667
27.723	452.177	24.42	1.29	5.28	27.74	12.7139	5.69805	3.08711	12.6129	5.74372	3	125.00	1.78067	1.78067	0	0.7494	8.192462	6.139354	0.70091	24.24	64.5468	27.983
28.051	451.849	25.99	1.44	5.53	25.13	13.4414	5.95316	3.07983	13.358	5.99031	3	135.00	1.80117	1.799579	0.0016	0.7454	8.691388	6.478936	0.74888	25.84	64.0251	28.368
28.379	451.521	24.42	1.32	5.42	22.7	12.4741	5.84156	3.09958	12.3913	5.8806	3	135.00	1.82331	1.811485	0.0118	0.743	8.270747	6.145077	0.69959	24.27	65.4465	27.867
28.707	451.193	24.47	1.16	4.75	25.24	12.4079	5.12717	3.06558	12.3202	5.16369	3	135.00	1.84545	1.823392	0.0221	0.7406	8.100847	5.99916	0.70045	24.31	63.0122	27.632
29.035	450.865	24.85	1.17	4.72	24.97	12.5224	5.09085	3.06047	12.4353	5.12654	3	135.00	1.86759	1.835298	0.0323	0.7382	8.200162	6.052979	0.71153	24.69	62.6514	27.897
29.363	450.537	25.04	1.24	4.96	25.89	12.5326	5.35631	3.07414	12.446	5.39369	3	135.00	1.88973	1.847204	0.0425	0.7358	8.337266	6.134317	0.71673	24.88	63.6191	27.906
29.691	450.209	24.64	1.36	5.51	22.33	12.2253	5.98377	3.1127	12.15	6.02086	3	135.00	1.91187	1.859111	0.0528	0.7334	8.422789	6.177365	0.70366	24.5	66.4024	27.747
30.019	449.881	19.78	1.13	5.7	16.6	9.53812	6.33195	3.21114	9.48467	6.36764	3	135.00	1.93401	1.871017	0.063	0.7311	7.245293	5.296842	0.55251	19.68	73.8677	26.083
30.347	449.553	16.42	0.88	5.37	15.59	7.68159	6.08413	3.27481	7.62548	6.12649	3	135.00	1.95615	1.882924	0.0732	0.7288	6.296958	4.588962	0.4478	16.32	78.9785	24.616
30.675	449.225	20.02	0.87	4.36	20.02	9.52155	4.82216	3.13916	9.45822	4.85445	4	135.00	1.97829	1.89483	0.0835	0.7265	6.965318	5.060062	0.55857	19.9	68.3583	26.072
31.004	448.896	23.04	1.19	5.16	16.63	11.0341	5.65603	3.1306	10.9816	5.68304	3	135.00	2.0005	1.906773	0.0937	0.7242	7.982536	5.780648	0.65138	22.94	67.7209	27.081
31.332	448.568	21.44	1.16	5.4	11.94	10.1202	5.97403	3.17402	10.0837	5.99565	3	135.00	2.02264	1.918679	0.104	0.7219	7.662654	5.531947	0.60116	21.37	70.991	26.51
31.66	448.240	16.83	1.16	6.88	4.5	7.65841	7.84567	3.34165	7.64287	7.86162	3	135.00	2.04478	1.930586	0.1142	0.7197	6.826488	4.913068	0.45775	16.8	84.59	24.646
31.988	447.912	14.1	1.08	7.64	2.65	6.19466	8.97526	3.44974	6.18437	8.9902	3	135.00	2.06692	1.942492	0.1244	0.7175	6.258887	4.490736	0.37264	14.08	94.2141	23.229
32.316	447.584	36.85	1.84	4.99	8.52	17.786	5.2933	2.95167	17.7553	5.30245	3	135.00	2.08906	1.954398	0.1347	0.7153	11.41236	8.163359	1.07619	36.79	55.2875	30.278
32.644	447.256	53.58	2.7	5.03	7.3	26.1754	5.2459	2.82443	26.15	5.251	4	135.00	2.1112	1.966305	0.1449	0.7131	15.41519	10.99318	1.59346	53.53	47.4168	32.767
32.972	446.928	41.03	2.46	5.99	2.4	19.6625	6.32445	2.97035	19.6524	6.3277	3	135.00	2.13334	1.978211	0.1551	0.711	12.86718	9.148439	1.20423	41.01	56.5089	30.942
33.3	446.600	30.73	1.67	5.43	5.52	14.3582	5.84437	3.04968	14.3431	5.85051	3	135.00	2.15548	1.990118	0.1654	0.7089	10.12526	7.177398	0.88466	30.7	61.8941	28.881
33.628	446.272	25.44	1.21	4.77	7.23	11.6194	5.20153	3.0684	11.5995	5.21049	3	135.00	2.17762	2.002024	0.1756	0.7067	8.581848	6.072283	0.7202	25.4	64.6397	27.47
33.956	445.944	24.48	1.07	4.38	8.06	11.0631	4.80246	3.08384	11.0382	4.81326	4	135.00	2.19976	2.01393	0.1858	0.7047	8.238887	5.80559	0.68979	24.43	64.3124	27.142
34.284	445.616	24.3	1.08	4.43	9.26	10.8983	4.89172	3.0942	10.8686	4.90505	4	135.00	2.2219	2.025837	0.1961	0.7026	8.231024	5.782979	0.68353	24.24	65.0574	27.041
34.612	445.288	25.03	1.22	4.87	9.17	11.182	5.35417	3.10955	11.1574	5.36595	3	135.00	2.24404	2.037743	0.2063	0.7005	8.569686	6.003302	0.70545	24.98	66.1725	27.219
34.941	444.959	21.34	0.88	4.11	11.34	9.3057	4.61367	3.13367	9.27755	4.63066	4	135.00	2.25625	2.049686	0.2166	0.6985	7.41695	5.180619	0.59052	21.27	67.9493	25.982
35.269	444.631	22.16	0.83	3.76	13.05	9.63896	4.17681	3.0961	9.59531	4.19582	4	135.00	2.28839	2.061592	0.2268	0.6965	7.503638	5.226013	0.61522	22.07	65.1947	26.215
35.597	444.303	27.65	1.08	3.92	12.93	12.2206	4.26212	3.01844	12.1821	4.27562	4	135.00	2.31053	2.073499	0.237	0.6945	8.913341	6.189971	0.7845	27.57	59.7354	27.812
35.925	443.975	41.71	1.36	3.26	15.45	18.8823	3.45376	2.81298	18.8392	3.46168	5	135.00	2.33267	2.085405	0.2473	0.6925	11.90861	8.246427	1.21911	41.62	46.7462	30.682
36.253	443.647	119.94	5.26	4.39	10.53	56.0647	4.47335	2.54245	56.0314	4.47602	11	135.00	2.35481	2.097311	0.2575	0.6905	29.78849	20.56918	3.64041	119.67	32.6167	37.373
36.581	443.319	232.84	9.81	4.21	-2.08	109.265	4.25665	2.33841	109.269	4.25646	12	135.00	2.37695	2.109218	0.2677	0.6886	52.64439	36.24861	7.13508	232.85	23.9715	41.04
36.909	442.991	245.39	11.65	4.75	-7.92	114.558	4.79442	2.36708	114.581	4.79343	11	135.00	2.39909	2.121124	0.278	0.6866	56.20318	38.59027	7.52294	245.44	25.0892	41.287
37.237	442.663	185.81	11.73	6.31	-9.21	85.9757	6.39625	2.54195	86.0038	6.39416	11	135.00	2.42123	2.133031	0.2882	0.6847	46.17875	31.61867	5.67767	185.87	32.5936	39.766
37.565	442.335	190.28	10.73	5.64	-3.88	87.5721	5.71241	2.49823	87.5814	5.7118	11	135.00	2.44337	2.144937	0.2984	0.6828	46.29593	31.61081	5.81538	190.3	30.6039	39.865

Depth (ft)	Sam (f	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	ss (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	442.007	280.56	11.76	4.19	-0.79	128.936	4.22878	2.29281	128.941	4.22863	12	135.00	2.46551	2.156843	0.3087	0.6809	62.17955	42.33877	8.60974	280.57	22.2559	41.895
38.221	441.679	230.05	12.58	5.47	-8.43	104.928	5.52816	2.43946	104.951	5.52694	11	135.00	2.48765	2.16875	0.3189	0.679	54.45582	36.97767	7.04527	230.1	28.0501	40.829
38.549	441.351	214.58	12.79	5.96	-3.42	97.2506	6.03102	2.48953	97.2644	6.03017	11	135.00	2.50979	2.180656	0.3291	0.6772	51.99489	35.21008	6.56564	214.61	30.2173	40.427
38.877	441.023	252.97	15.89	6.28	5.22	114.222	6.34488	2.46678	114.208	6.34564	11	135.00	2.53193	2.192563	0.3394	0.6753	60.62771	40.94446	7.7535	252.94	29.2202	41.271
39.206	440.694	369.1	14.5	3.93	49.56	166.271	3.95585	2.20569	166.131	3.9592	12	135.00	2.55413	2.204505	0.3496	0.6735	78.75678	53.04353	11.3482	368.79	19.1854	43.163

R15223

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 26 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-6

ConeTec Inc. Interpretation
Interpretation O Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4364
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-6
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 12:00
CPT File: 804CP06.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 457.8

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	37.16	1.38	45.31	35.45	2.55

User Inputs:

Assumed:
Water Table Depth (ft): 9.2
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 457.8

Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	457.636	8.56	0.1	1.11	-0.53	834.122	1.170	1.40	834.12	1.17	5	125.00	0.010	0.010	0.000	2.000	1.37	2.74	0.265	8.56	1.52433	50.16
0.492	457.308	9.31	0.29	3.12	-2.93	301.764	3.125	1.98	302.41	3.12	4	125.00	0.031	0.031	0.000	2.000	1.82	3.64	0.287	9.33	12.388	45.97
0.82	456.980	10.89	0.47	4.33	-10.58	211.488	4.336	2.18	212.85	4.31	3	125.00	0.051	0.051	0.000	2.000	2.31	4.63	0.336	10.96	18.2558	44.35
1.148	456.652	15.32	0.83	5.4	-7.37	212.519	5.443	2.26	213.08	5.43	3	125.00	0.072	0.072	0.000	2.000	3.36	6.72	0.472	15.36	21.1963	44.36
1.476	456.324	38.89	1.49	3.84	3.12	420.572	3.840	1.99	420.36	3.84	5	125.00	0.092	0.092	0.000	2.000	7.62	15.25	1.201	38.87	12.7664	47.40
1.804	455.996	64.95	2.12	3.26	8.39	575.053	3.270	1.87	574.61	3.27	6	125.00	0.113	0.113	0.000	2.000	12.18	24.35	2.007	64.9	9.79283	48.70
2.133	455.667	91.43	3.22	3.53	-3.19	684.832	3.527	1.88	684.96	3.53	6	125.00	0.133	0.133	0.000	2.000	17.18	34.35	2.827	91.45	9.86183	49.40
2.461	455.339	106.27	4.78	4.5	0.53	689.906	4.504	1.98	689.84	4.50	11	125.00	0.154	0.154	0.000	2.000	20.72	41.43	3.285	106.26	12.339	49.42
2.789	455.011	97.06	5.09	5.25	3.16	555.816	5.254	2.07	555.70	5.25	11	125.00	0.174	0.174	0.000	2.000	19.82	39.25	3.000	97.04	14.9656	48.56
3.117	454.683	83.61	4.4	5.26	13.6	428.182	5.275	2.12	427.72	5.28	11	125.00	0.195	0.195	0.000	2.000	17.19	34.38	2.583	83.52	16.2983	47.48
3.445	454.355	75.27	3.59	4.77	18.34	348.585	4.783	2.11	348.07	4.79	11	125.00	0.215	0.215	0.000	2.000	15.46	30.93	2.324	75.16	16.2656	46.59
3.773	454.027	65.07	3.24	4.98	11.57	274.94	4.997	2.18	274.64	5.00	11	125.00	0.236	0.236	0.000	2.000	13.73	27.45	2.007	65	18.2882	45.53
4.101	453.699	64.94	3.2	4.93	6.12	252.363	4.947	2.19	252.21	4.95	11	125.00	0.256	0.256	0.000	1.975	13.78	27.23	2.003	64.9	18.7426	45.14
4.429	453.371	63.37	3.12	4.93	5.33	227.928	4.945	2.21	227.82	4.95	11	125.00	0.277	0.277	0.000	1.901	13.57	25.80	1.953	63.34	19.4706	44.67
4.757	453.043	55.6	2.82	5.07	3.75	186.009	5.099	2.27	185.91	5.10	4	125.00	0.297	0.297	0.000	1.834	12.20	22.38	1.712	55.57	21.4653	43.71
5.085	452.715	46.31	2.63	5.68	-1.89	144.715	5.718	2.37	144.75	5.72	3	125.00	0.318	0.318	0.000	1.774	10.63	18.85	1.424	46.32	25.262	42.47
5.413	452.387	49.15	2.45	4.98	-2.28	144.28	5.019	2.33	144.31	5.02	4	125.00	0.338	0.338	0.000	1.719	11.05	19.00	1.511	49.16	23.4659	42.46
5.741	452.059	41.44	2.45	5.91	-3.05	114.492	5.964	2.44	114.55	5.96	3	125.00	0.359	0.359	0.000	1.669	9.83	16.41	1.272	41.46	28.2345	41.28
6.069	451.731	40.26	2.34	5.81	-3.23	105.139	5.868	2.46	105.19	5.86	3	125.00	0.379	0.379	0.000	1.624	9.62	15.62	1.235	40.28	28.9115	40.83
6.398	451.402	35.34	1.94	5.49	-2.68	87.3776	5.552	2.49	87.43	5.55	3	125.00	0.400	0.400	0.000	1.581	8.56	13.54	1.082	35.36	30.1642	39.85
6.726	451.074	29.43	1.47	4.99	-1.85	69.0089	5.067	2.52	69.06	5.06	3	125.00	0.420	0.420	0.000	1.542	7.25	11.18	0.898	29.45	31.6997	38.55
7.054	450.746	22.96	1.12	4.89	-1.15	51.0783	4.974	2.60	51.10	4.97	3	125.00	0.441	0.441	0.000	1.506	5.88	8.86	0.697	22.97	35.5076	36.83
7.382	450.418	22.39	1.27	5.66	-4.08	47.5289	5.792	2.67	47.59	5.78	3	125.00	0.461	0.461	0.000	1.472	5.95	8.76	0.679	22.42	39.0065	36.41
7.71	450.090	24.72	1.47	5.94	-5.27	50.2996	6.065	2.67	50.38	6.05	3	125.00	0.482	0.482	0.000	1.441	6.56	9.45	0.750	24.76	38.9216	36.74
8.038	449.762	25.96	1.6	6.18	-6.42	50.6745	6.285	2.68	50.75	6.28	3	125.00	0.502	0.502	0.000	1.411	6.93	9.77	0.788	26	39.4189	36.79
8.366	449.434	23.65	1.49	6.3	-8.13	44.2307	6.443	2.73	44.33	6.43	3	125.00	0.523	0.523	0.000	1.383	6.47	8.95	0.716	23.7	41.9185	35.99
8.694	449.106	24.35	1.37	5.64	-8.36	43.8125	5.755	2.69	43.90	5.74	3	125.00	0.543	0.543	0.000	1.357	6.55	8.88	0.737	24.4	40.1258	35.93
9.022	448.778	28.28	1.49	5.28	-7.83	49.153	5.376	2.64	49.24	5.37	3	125.00	0.564	0.564	0.000	1.332	7.38	9.83	0.858	28.33	37.2649	36.61
9.35	448.450	28.51	1.65	5.78	-7.81	48.173	5.909	2.67	48.24	5.90	3	135.00	0.584	0.580	0.005	1.313	7.58	9.96	0.865	28.55	39.1366	36.49
9.678	448.122	28.8	1.69	5.86	-6.77	47.6562	5.994	2.68	47.72	5.99	3	135.00	0.607	0.592	0.015	1.300	7.69	10.00	0.873	28.84	39.5436	36.43
10.006	447.794	30.8	1.75	5.68	-4.18	49.9933	5.800	2.66	50.03	5.80	3	135.00	0.629	0.604	0.025	1.287	8.12	10.45	0.934	30.82	38.2961	36.71
10.335	447.465	27.19	1.42	5.23	-3.86	43.1215	5.351	2.68	43.17	5.34	3	135.00	0.651	0.615	0.035	1.275	7.23	9.22	0.822	27.22	39.1905	35.84
10.663	447.137	24.41	1.15	4.72	-3.58	37.8365	4.845	2.68	37.87	4.84	3	135.00	0.673	0.627	0.046	1.263	6.52	8.23	0.735	24.43	39.6428	35.06
10.991	446.809	22.72	0.94	4.13	-3.23	34.4535	4.268	2.68	34.48	4.26	4	135.00	0.695	0.639	0.056	1.251	6.04	7.55	0.682	22.74	39.1418	34.49
11.319	446.481	22.41	0.82	3.65	-2.63	33.3135	3.780	2.65	33.33	3.78	5	135.00	0.717	0.651	0.066	1.239	5.88	7.28	0.672	22.42	37.8448	34.28
11.647	446.153	22.09	0.86	3.9	-2.01	32.1993	4.028	2.68	32.21	4.03	4	135.00	0.739	0.663	0.076	1.228	5.88	7.23	0.661	22.1	39.3712	34.08
11.975	445.825	19.57	0.82	4.2	-1.41	27.8651	4.360	2.75	27.88	4.36	4	135.00	0.762	0.675	0.087	1.217	5.41	6.58	0.582	19.58	43.1036	33.18
12.303	445.497	18.59	0.79	4.26	-0.78	25.9231	4.437	2.78	25.92	4.44	4	135.00	0.784	0.687	0.097	1.207	5.22	6.29	0.551	18.59	44.7056	32.73
12.631	445.169	16.32	0.81	4.95	-0.6	22.2013	5.221	2.87	22.20	5.22	3	135.00	0.806	0.699	0.107	1.196	4.84	5.79	0.480	16.32	50.4414	31.75
12.959	444.841	19.07	0.83	4.36	0.74	25.8676	4.550	2.79	25.87	4.55	3	135.00	0.828	0.711	0.117	1.186	5.38	6.38	0.565	19.07	45.3058	32.67
13.287	444.513	21.2	1	4.73	8.36	28.1617	4.914	2.78	28.09	4.93	3	135.00	0.850	0.723	0.128	1.176	5.95	7.00	0.630	21.15	45.0064	33.24
13.615	444.185	20.7	0.95	4.58	10.95	26.9943	4.791	2.79	26.91	4.81	3	135.00	0.872	0.735	0.138	1.167	5.83	6.80	0.614	20.64	45.3618	32.97
13.943	443.857	23.12	1.2	5.2	13.55	29.7762	5.399	2.79	29.66	5.42	3	135.00	0.894	0.746	0.148	1.157	6.52	7.55	0.688	23.03	45.5855	33.58
14.271	443.529	29.53	1.34	4.53	13.72	37.7323	4.683	2.68	37.63	4.70	4	135.00	0.917	0.758	0.158	1.148	7.83	8.99	0.886	29.45	39.2582	35.04
14.6	443.200	26.74	0.91	3.39	16.67	33.4964	3.527	2.63	33.37	3.54	5	135.00	0.939	0.770	0.168	1.139	6.92	7.88	0.799	26.64	36.8635	34.31
14.928	442.872	20.25	0.7	3.44	21.11	24.6608	3.629	2.74	24.49	3.65	5	135.00	0.961	0.782	0.179	1.131	5.53	6.25	0.597	20.12	42.6233	32.39
15.256	442.544	17.79	0.62	3.49	24.51	21.1653	3.689	2.80	20.96	3.72	4	135.00	0.983	0.794	0.189	1.122	5.00	5.61	0.520	17.63	45.8297	31.41

R15225

Depth (ft)	Sam (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	ss (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.564	442.216	15.28	0.55	3.61	26.19	17.7109	3.853	2.87	17.50	3.90	4	135.00	1.005	0.806	0.199	1.114	4.47	4.98	0.442	15.11	50.169	30.25
15.912	441.888	12.73	0.44	3.46	28.8	14.3083	3.760	2.94	14.09	3.82	4	135.00	1.027	0.818	0.209	1.106	3.86	4.27	0.362	12.55	54.4336	28.84
16.24	441.560	10.89	0.43	3.91	30.79	11.8589	4.370	3.05	11.63	4.46	3	135.00	1.049	0.830	0.220	1.098	3.52	3.86	0.305	10.7	61.5912	27.59
16.568	441.232	10.9	0.3	2.76	46.79	11.6767	3.052	2.96	11.33	3.15	4	135.00	1.072	0.842	0.230	1.090	3.32	3.61	0.304	10.61	56.0979	27.42
17.224	440.576	11.97	0.28	2.35	59.86	12.5406	2.580	2.90	12.10	2.67	5	135.00	1.094	0.854	0.240	1.082	3.18	3.44	0.301	10.48	52.8448	27.23
17.552	440.248	10.88	0.31	2.86	64.85	11.1029	3.182	3.00	10.65	3.32	4	135.00	1.116	0.866	0.250	1.075	3.49	3.75	0.336	11.59	52.0107	27.86
17.88	439.920	8.13	0.21	2.59	64.13	7.83716	3.013	3.12	7.39	3.20	4	135.00	1.138	0.877	0.261	1.068	3.35	3.57	0.302	10.48	58.4614	27.03
18.208	439.592	9.83	0.21	2.14	70.88	9.59534	2.428	2.99	9.11	2.56	5	135.00	1.160	0.889	0.271	1.060	2.67	2.83	0.216	7.73	67.0317	24.64
18.537	439.263	14.59	0.35	2.37	85.33	14.6581	2.615	2.85	14.07	2.72	5	135.00	1.182	0.901	0.281	1.053	2.99	3.15	0.268	9.39	57.9642	26.01
18.865	438.935	17.47	0.43	2.47	91.82	17.5587	2.647	2.79	16.94	2.74	5	135.00	1.204	0.913	0.291	1.046	4.11	4.30	0.414	14.05	49.0242	28.86
19.193	438.607	23.8	0.66	2.76	108.66	24.0676	2.927	2.70	23.34	3.02	5	135.00	1.227	0.925	0.302	1.040	4.77	4.96	0.503	16.9	45.2968	30.07
19.521	438.279	26.5	1.31	4.94	95.15	26.5877	5.192	2.83	25.97	5.32	3	135.00	1.271	0.949	0.322	1.027	7.49	7.69	0.781	25.91	47.7672	32.79
19.849	437.951	23.66	0.83	3.52	20.44	23.2793	3.711	2.76	23.15	3.73	5	135.00	1.293	0.961	0.332	1.020	6.56	6.69	0.692	23.54	43.9821	32.07
20.177	437.623	18.99	0.49	2.56	28.01	18.1706	2.772	2.77	18.00	2.80	5	135.00	1.315	0.973	0.342	1.014	5.26	5.34	0.547	18.82	44.4019	30.47
20.505	437.295	18.95	0.78	4.1	37.55	17.8877	4.429	2.91	17.65	4.49	4	135.00	1.337	0.985	0.353	1.008	5.65	5.70	0.545	18.72	52.3926	30.35
20.833	436.967	49.87	2.16	4.32	27.3	48.6795	4.453	2.58	48.51	4.47	5	135.00	1.359	0.997	0.363	1.002	12.61	12.63	1.502	49.7	34.6157	36.57
21.161	436.639	83.66	5.29	6.33	-14.43	81.5902	6.429	2.56	81.68	6.42	11	135.00	1.382	1.008	0.373	0.996	20.96	20.87	2.547	83.75	33.2996	39.50
21.489	436.311	243.98	10.44	4.28	-17.83	237.74	4.304	2.15	237.85	4.30	11	135.00	1.404	1.020	0.383	0.990	50.99	50.48	7.510	244.09	17.4322	44.88
21.817	435.983	336.34	16.44	4.89	-19.33	324.451	4.909	2.14	325.57	4.91	11	135.00	1.426	1.032	0.394	0.984	69.87	68.77	10.369	336.46	16.9751	46.29
22.145	435.656	423.23	17.94	4.24	-18.68	403.946	4.253	2.04	404.05	4.25	12	135.00	1.448	1.044	0.404	0.979	84.57	82.76	13.058	423.34	14.0663	47.24

R15226

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 31 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-7

ConeTec Inc. Interpretation
Interpretation Ou... elease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4331
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-7
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 07:58
CPT File: 804CP07.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 457.8

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.96	1.80	58.51	25.19	2.31

User Inputs:

Assumed:
Water Table Depth (ft): 9.2
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 457.8
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	457.636	9.8	0.17	1.69	-0.53	955.098	1.737	1.54	955.10	1.74	5	125.00	0.010	0.010	0.000	2.000	1.64	3.27	0.303	9.8	3.41567	50.67
0.492	457.308	30.91	0.44	1.41	-5.98	1004.2	1.425	1.45	1005.50	1.42	6	125.00	0.031	0.031	0.000	2.000	5.02	10.05	0.956	30.95	2.16306	50.86
0.82	456.980	42	0.69	1.65	-14.97	818.512	1.645	1.54	820.46	1.64	7	125.00	0.051	0.051	0.000	2.000	7.03	14.07	1.299	42.1	3.40523	50.09
1.148	456.652	38.42	0.68	1.76	-15.08	534.47	1.773	1.64	535.86	1.77	6	125.00	0.072	0.072	0.000	2.000	6.66	13.33	1.187	38.52	5.10589	48.41
1.476	456.324	35.13	0.57	1.61	-15.89	379.813	1.627	1.68	380.90	1.62	6	125.00	0.092	0.092	0.000	2.000	6.18	12.36	1.085	35.23	5.82026	46.98
1.804	455.996	33.61	0.6	1.77	-9.56	297.093	1.791	1.78	297.63	1.79	6	125.00	0.113	0.113	0.000	2.000	6.10	12.20	1.037	33.67	7.65399	45.90
2.133	455.667	35.29	0.79	2.24	-0.3	263.716	2.247	1.89	263.79	2.25	6	125.00	0.133	0.133	0.000	2.000	6.66	13.32	1.088	35.3	10.1362	45.35
2.461	455.339	39.86	1	2.5	-0.42	258.147	2.518	1.94	258.15	2.52	6	125.00	0.154	0.154	0.000	2.000	7.65	15.30	1.229	39.86	11.2767	45.25
2.789	455.011	41.14	1.05	2.55	-0.46	235.013	2.563	1.96	235.01	2.56	6	125.00	0.174	0.174	0.000	2.000	7.98	15.97	1.268	41.14	12.0156	44.82
3.117	454.683	36.47	0.82	2.25	-0.6	186.206	2.260	1.98	186.26	2.26	6	125.00	0.195	0.195	0.000	2.000	7.12	14.23	1.123	36.48	12.3943	43.72
3.445	454.355	34.59	0.81	2.35	-0.76	159.65	2.356	2.03	159.65	2.36	6	125.00	0.215	0.215	0.000	2.000	6.89	13.79	1.064	34.59	13.9069	42.96
3.773	454.027	45.16	1.24	2.75	-0.76	190.508	2.760	2.04	190.51	2.76	6	125.00	0.236	0.236	0.000	2.000	9.03	18.06	1.391	45.16	14.1489	43.82
4.101	453.699	52.95	1.71	3.23	-0.23	205.584	3.245	2.08	205.58	3.25	6	125.00	0.256	0.256	0.000	1.975	10.75	21.24	1.631	52.95	15.2795	44.19
4.429	453.371	39.45	1.59	4.04	4.97	141.515	4.059	2.26	141.41	4.06	5	125.00	0.277	0.277	0.000	1.901	8.60	16.34	1.213	39.42	20.8937	42.36
4.757	453.043	25.66	0.97	3.77	17.39	85.3065	3.825	2.37	84.94	3.84	5	125.00	0.297	0.297	0.000	1.834	5.87	10.76	0.785	25.55	25.3185	39.69
5.085	452.715	16.21	0.6	3.68	17.83	50.0049	3.775	2.53	49.63	3.80	4	125.00	0.318	0.318	0.000	1.774	3.97	7.04	0.492	16.09	31.9342	36.66
5.413	452.387	12.96	0.42	3.21	19.31	37.3078	3.328	2.58	36.95	3.36	4	125.00	0.338	0.338	0.000	1.719	3.25	5.59	0.391	12.84	34.5011	34.90
5.741	452.059	11.85	0.37	3.13	19.93	32.0256	3.220	2.62	31.66	3.26	4	125.00	0.359	0.359	0.000	1.669	3.03	5.06	0.356	11.72	36.5018	33.95
6.069	451.731	10.67	0.33	3.1	21.39	27.1298	3.207	2.68	26.79	3.25	4	125.00	0.379	0.379	0.000	1.624	2.80	4.55	0.319	10.54	39.2642	32.90
6.398	451.402	9.96	0.31	3.07	23.76	23.9078	3.243	2.72	23.53	3.29	4	125.00	0.400	0.400	0.000	1.581	2.67	4.23	0.296	9.81	41.7887	32.08
6.726	451.074	9.7	0.29	2.95	38.8	22.0746	3.125	2.75	21.50	3.21	4	125.00	0.420	0.420	0.000	1.542	2.61	4.03	0.287	9.46	43.0291	31.50
7.054	450.746	14.29	0.34	2.35	47.48	31.4128	2.455	2.56	30.73	2.51	5	125.00	0.441	0.441	0.000	1.506	3.51	5.26	0.429	13.99	33.4317	33.76
7.382	450.418	16.68	0.5	3	56.9	35.1528	3.083	2.59	34.37	3.15	5	125.00	0.461	0.461	0.000	1.472	4.15	6.10	0.502	16.32	34.7346	34.45
7.71	450.090	21.63	0.78	3.61	62.19	43.8872	3.688	2.57	43.08	3.76	5	125.00	0.482	0.482	0.000	1.441	5.34	7.70	0.655	21.24	33.789	35.82
8.038	449.762	21.3	0.89	4.19	65.68	41.3986	4.279	2.63	40.58	4.37	4	125.00	0.502	0.502	0.000	1.411	5.43	7.66	0.644	20.89	36.9226	35.46
8.366	449.434	20.62	0.75	3.62	74.41	38.4358	3.732	2.62	37.54	3.62	4	125.00	0.523	0.523	0.000	1.383	5.19	7.18	0.622	20.15	36.1207	34.99
8.694	449.106	21.71	0.73	3.35	81.34	38.954	3.449	2.59	38.03	3.53	5	125.00	0.543	0.543	0.000	1.357	5.39	7.31	0.655	21.21	34.7719	35.07
9.022	448.778	22.26	0.62	2.79	96.35	38.4768	2.858	2.54	37.41	2.94	5	125.00	0.564	0.564	0.000	1.332	5.37	7.16	0.672	21.66	32.4751	34.97
9.35	448.450	20.7	0.61	2.93	91.74	34.7004	3.032	2.59	33.70	3.12	5	135.00	0.584	0.580	0.005	1.313	5.12	6.73	0.623	20.12	34.9106	34.33
9.678	448.122	20.96	0.7	3.35	82.7	34.4041	3.439	2.63	33.53	3.53	5	135.00	0.607	0.592	0.015	1.300	5.30	6.89	0.630	20.44	36.7405	34.30
10.006	447.794	23.37	0.86	3.67	95.38	37.6819	3.782	2.63	36.70	3.88	5	135.00	0.629	0.604	0.025	1.287	5.90	7.60	0.704	22.78	36.7081	34.86
10.335	447.465	23.21	0.93	4.02	86.47	36.6547	4.122	2.66	35.79	4.22	4	135.00	0.651	0.615	0.035	1.275	5.98	7.62	0.698	22.68	38.3828	34.71
10.663	447.137	22.31	0.82	3.66	48.55	34.4891	3.790	2.65	34.01	3.84	4	135.00	0.673	0.627	0.046	1.263	5.77	7.28	0.670	22.01	37.7717	34.40
10.991	446.809	21.94	0.83	3.79	50.34	33.2333	3.907	2.67	32.73	3.97	4	135.00	0.695	0.639	0.056	1.251	5.73	7.16	0.658	21.62	38.8777	34.17
11.319	446.481	23.94	0.99	3.73	69.05	35.6631	3.832	2.64	35.00	3.90	5	135.00	0.717	0.651	0.066	1.239	6.15	7.62	0.719	23.51	37.5487	34.58
11.647	446.153	31.54	1.47	4.66	33.07	46.451	4.773	2.62	46.13	4.81	4	135.00	0.739	0.663	0.076	1.228	8.10	9.95	0.954	31.33	36.4723	36.24
11.975	445.825	52.03	1.94	3.73	5.47	75.9552	3.784	2.40	75.91	3.79	5	135.00	0.762	0.675	0.087	1.217	12.09	14.71	1.587	52	26.4167	39.08
12.303	445.497	68.4	2.67	3.91	-22.86	98.4385	3.949	2.34	98.66	3.94	5	135.00	0.784	0.687	0.097	1.207	15.51	18.71	2.093	68.55	24.0213	40.50
12.631	445.169	53.25	3.19	6	-25.04	75.0494	6.083	2.56	75.26	6.07	3	135.00	0.806	0.699	0.107	1.196	13.38	16.01	1.624	53.4	33.4083	39.04
12.959	444.841	50.44	2.84	5.63	-25.2	69.8071	5.724	2.55	70.03	5.71	3	135.00	0.828	0.711	0.117	1.186	12.67	15.03	1.536	50.6	33.3638	38.64
13.287	444.513	31.23	2.43	7.77	-27.34	42.042	7.999	2.81	42.26	7.95	3	135.00	0.850	0.723	0.128	1.176	8.97	10.55	0.941	31.4	46.5809	35.73
13.615	444.185	36.66	2.18	5.95	-26.55	48.723	6.091	2.68	48.94	6.06	3	135.00	0.872	0.735	0.138	1.167	9.80	11.44	1.108	36.82	39.3835	36.60
13.943	443.857	56.53	3.08	5.44	-25.93	74.5365	5.536	2.53	74.75	5.52	3	135.00	0.894	0.746	0.148	1.157	14.00	16.20	1.722	56.69	32.013	39.00
14.271	443.529	129.14	5.32	4.12	-25.68	169.087	4.149	2.22	169.30	4.14	11	135.00	0.917	0.758	0.158	1.148	27.75	31.86	3.970	129.3	19.5836	43.26
14.6	443.200	241.69	8.13	3.37	-25.73	312.554	3.377	2.00	312.78	3.37	12	135.00	0.939	0.770	0.168	1.139	47.59	54.23	7.454	241.85	12.9931	46.12
14.928	442.872	231.67	8.83	3.81	-25.66	294.958	3.827	2.06	295.16	3.82	12	135.00	0.961	0.782	0.179	1.131	46.69	52.80	7.143	231.83	14.6671	45.86
15.256	442.544	258.78	8.95	3.46	-26.07	324.647	3.472	2.00	324.85	3.47	12	135.00	0.983	0.794	0.189	1.122	51.01	57.24	7.981	258.94	13.0637	46.29

R15228

Depth (ft)	Sam (..	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...ess (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	442.216	285.8	8.43	2.95	-26.9	353.348	2.960	1.93	353.55	2.96	12	135.00	1.005	0.806	0.199	1.111	54.68	60.90	8.817	285.96	11.0253	46.66
15.912	441.888	277.04	7.22	2.61	-28.01	337.467	2.616	1.89	337.67	2.61	7	135.00	1.027	0.818	0.209	1.106	52.28	57.81	8.545	277.21	10.1227	46.46
16.24	441.560	219.73	6.99	3.18	-28.89	262.533	3.196	2.02	263.25	3.19	12	135.00	1.049	0.830	0.220	1.098	43.55	47.81	6.770	219.91	13.4471	45.36

R15229

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 34 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-8

ConeTec Inc. Interpretation
Interpretation Output Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4303
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-8
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 09:53
CPT File: 804CP08.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 445

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.90	1.70	55.34	26.74	2.35

User Inputs:

Assumed: Water Table Depth (ft): 6.6
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 445.0
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	444.836	17.37	0.13	0.75	0.35	1693.63	0.749	1.12	1693.63	0.75	6	125.00	0.010	0.010	0.000	2.000	2.55	5.11	0.537	17.37	-1.1659	52.71
0.492	444.508	21.17	0.35	1.66	-1.57	687.455	1.656	1.57	687.78	1.65	6	125.00	0.031	0.031	0.000	2.000	3.58	7.15	0.654	21.18	3.90719	49.41
0.82	444.180	31.35	0.66	2.09	-3.09	610.707	2.109	1.69	611.10	2.11	6	125.00	0.051	0.051	0.000	2.000	5.51	11.02	0.969	31.37	5.90214	48.94
1.148	443.852	43.85	0.95	2.17	-1.25	610.15	2.170	1.70	610.29	2.17	6	125.00	0.072	0.072	0.000	2.000	7.73	15.47	1.355	43.86	6.12164	48.94
1.476	443.524	44.4	1.46	3.29	-0.37	480.301	3.295	1.91	480.30	3.30	5	125.00	0.092	0.092	0.000	2.000	8.43	16.87	1.372	44.4	10.5855	47.96
1.804	443.196	47.24	1.66	3.51	0.21	417.98	3.522	1.96	417.98	3.52	5	125.00	0.113	0.113	0.000	2.000	9.15	18.30	1.459	47.24	11.8951	47.36
2.133	442.867	63.62	1.74	2.74	-0.23	476.225	2.741	1.64	476.22	2.74	6	125.00	0.133	0.133	0.000	2.000	11.78	23.55	1.966	63.62	8.93891	47.93
2.461	442.539	81.01	2.67	3.29	1.6	525.68	3.302	1.89	525.62	3.30	6	125.00	0.154	0.154	0.000	2.000	15.30	30.60	2.503	81	10.2349	48.33
2.789	442.211	87.64	3.13	3.57	-0.02	501.775	3.579	1.93	501.78	3.58	6	125.00	0.174	0.174	0.000	2.000	16.80	33.61	2.708	87.64	11.2144	48.14
3.117	441.883	72.36	2.94	4.06	0.81	370.434	4.074	2.04	370.38	4.07	5	125.00	0.195	0.195	0.000	2.000	14.45	28.90	2.234	72.35	14.0558	46.86
3.445	441.555	54.96	2.44	4.43	7.57	254.257	4.457	2.15	254.02	4.46	5	125.00	0.215	0.215	0.000	2.000	11.47	22.93	1.695	54.91	17.4107	45.18
3.773	441.227	45.6	1.94	4.26	13.4	192.374	4.277	2.20	192.03	4.28	5	125.00	0.236	0.236	0.000	2.000	9.70	19.39	1.404	45.52	18.9745	43.86
4.101	440.899	47.91	1.89	3.94	10.16	185.92	3.966	2.18	185.69	3.97	5	125.00	0.256	0.256	0.000	1.975	10.11	19.97	1.475	47.85	18.3226	43.70
4.429	440.571	55.66	1.91	3.43	18.45	200.075	3.449	2.11	199.64	3.46	5	125.00	0.277	0.277	0.000	1.901	11.41	21.70	1.715	55.54	16.1775	44.05
4.757	440.243	51.39	1.71	3.33	24.18	171.848	3.347	2.14	171.31	3.36	6	125.00	0.297	0.297	0.000	1.834	10.65	19.52	1.582	51.23	17.0225	43.31
5.085	439.915	45.68	1.53	3.36	21.34	142.733	3.373	2.19	142.32	3.38	5	125.00	0.318	0.318	0.000	1.774	9.66	17.14	1.404	45.55	18.6417	42.39
5.413	439.587	37.97	1.4	3.7	20.18	111.234	3.720	2.29	110.88	3.73	5	125.00	0.338	0.338	0.000	1.719	8.38	14.40	1.165	37.85	22.1372	41.11
5.741	439.259	32.73	1.25	3.83	18.96	90.2176	3.861	2.36	89.88	3.88	5	125.00	0.359	0.359	0.000	1.669	7.44	12.43	1.002	32.61	24.8088	40.00
6.069	438.931	32.51	1.3	3.99	14.67	84.7077	4.046	2.39	84.47	4.06	5	125.00	0.379	0.379	0.000	1.624	7.51	12.19	0.995	32.42	26.1077	39.66
6.398	438.602	30.81	1.37	4.44	8.27	76.0491	4.505	2.46	75.92	4.51	4	125.00	0.400	0.400	0.000	1.581	7.34	11.61	0.941	30.78	28.8283	39.08
6.726	438.274	30.16	1.35	4.47	11.29	71.4133	4.539	2.48	71.25	4.55	4	135.00	0.420	0.416	0.004	1.550	7.25	11.24	0.921	30.09	29.7266	38.72
7.054	437.946	30.78	1.3	4.22	12.22	70.824	4.285	2.46	70.64	4.30	4	135.00	0.443	0.428	0.014	1.528	7.34	11.22	0.939	30.7	29.0142	38.68
7.382	437.618	28.58	1.25	4.36	14.3	63.8613	4.446	2.50	63.66	4.46	4	135.00	0.465	0.440	0.024	1.507	6.95	10.48	0.870	28.49	30.8671	38.09
7.71	437.290	25.37	1.1	4.35	16	55.0315	4.421	2.55	54.81	4.44	4	135.00	0.487	0.452	0.035	1.487	6.29	9.36	0.770	25.27	32.7937	37.24
8.038	436.962	23.17	1.04	4.48	16.81	48.8312	4.589	2.59	48.59	4.61	4	135.00	0.509	0.464	0.045	1.468	5.88	8.63	0.702	23.06	35.0715	36.54
8.366	436.634	21.72	0.99	4.55	15.7	44.5168	4.672	2.63	44.31	4.69	3	135.00	0.531	0.476	0.055	1.449	5.60	8.12	0.656	21.62	36.7119	36.00
8.694	436.306	22.5	0.76	3.39	17	44.9838	3.463	2.53	44.76	3.48	5	135.00	0.553	0.488	0.065	1.432	5.54	7.93	0.679	22.39	32.1478	36.06
9.022	435.978	20.87	0.66	3.17	17.39	40.6065	3.252	2.55	40.41	3.27	5	135.00	0.575	0.500	0.076	1.415	5.17	7.31	0.628	20.77	32.7685	35.46
9.35	435.650	20.28	0.77	3.78	19.44	38.4653	3.912	2.62	38.23	3.94	4	135.00	0.597	0.512	0.086	1.398	5.20	7.27	0.609	20.16	36.2763	35.13
9.678	435.322	22.23	1.07	4.83	14.64	41.2726	4.951	2.67	41.08	4.97	3	135.00	0.620	0.524	0.096	1.382	5.86	8.10	0.869	22.13	38.7923	35.56
10.006	434.994	27.84	1.15	4.14	14.22	50.7896	4.228	2.56	50.62	4.24	4	135.00	0.642	0.536	0.106	1.367	6.94	9.48	0.842	27.75	33.2318	36.79
10.335	434.665	30.49	1.3	4.26	-2.51	54.4817	4.359	2.54	54.50	4.36	4	135.00	0.664	0.547	0.117	1.352	7.58	10.24	0.923	30.5	32.5983	37.22
10.663	434.337	20.58	1.04	5.04	-8.43	35.5656	5.228	2.73	35.67	5.21	3	135.00	0.686	0.559	0.127	1.337	5.63	7.53	0.616	20.64	41.8344	34.72
10.991	434.009	21.64	0.79	3.66	-8.2	36.6411	3.774	2.62	36.73	3.77	4	135.00	0.708	0.571	0.137	1.323	5.60	7.40	0.648	21.69	36.2422	34.90
11.319	433.681	18.91	0.92	4.86	-4.78	31.1738	5.061	2.76	31.23	5.05	3	135.00	0.730	0.583	0.147	1.309	5.26	6.88	0.563	18.94	43.5695	33.91
11.647	433.353	17	0.91	5.34	-3.97	27.3032	5.601	2.83	27.35	5.59	3	135.00	0.753	0.595	0.157	1.296	4.92	6.37	0.503	17.03	47.693	33.09
11.975	433.025	20.2	1.09	5.41	-3.4	32.0031	5.611	2.78	32.04	5.61	3	135.00	0.775	0.607	0.168	1.284	5.68	7.30	0.601	20.22	44.906	34.07
12.303	432.697	23.77	1.16	4.87	-3.74	37.12	5.049	2.70	37.15	5.04	3	135.00	0.797	0.619	0.178	1.271	6.41	8.15	0.711	23.79	40.6258	34.97
12.631	432.369	23.53	1.14	4.86	-2.66	36.0038	5.020	2.71	36.02	5.02	3	135.00	0.819	0.631	0.188	1.259	6.37	8.02	0.703	23.54	41.0417	34.79
12.959	432.041	25.86	1.03	3.99	-1.59	38.9277	4.117	2.63	38.94	4.12	4	135.00	0.841	0.643	0.198	1.247	6.70	8.36	0.775	25.87	36.659	35.26
13.287	431.713	28.74	1.22	4.25	4.68	42.5854	4.376	2.62	42.54	4.38	4	135.00	0.863	0.655	0.209	1.236	7.41	9.16	0.863	28.71	36.2582	35.79
13.615	431.385	23.7	0.95	4.02	4.89	34.2297	4.164	2.67	34.18	4.17	4	135.00	0.885	0.667	0.219	1.225	6.27	7.69	0.706	23.67	38.9352	34.48
13.943	431.057	21.82	0.56	2.55	10.93	30.8252	2.678	2.58	30.72	2.69	5	135.00	0.908	0.678	0.229	1.214	5.50	6.68	0.647	21.75	34.3343	33.83
14.271	430.729	17.59	0.45	2.54	19.05	24.134	2.701	2.67	23.96	2.72	5	135.00	0.930	0.690	0.239	1.204	4.62	5.56	0.516	17.47	38.6783	32.28
14.6	430.400	15.35	0.32	2.09	24.25	20.5023	2.223	2.67	20.29	2.25	5	135.00	0.952	0.702	0.250	1.193	4.03	4.81	0.446	15.2	39.0527	31.24
14.928	430.072	13.48	0.21	1.52	31.31	17.5111	1.679	2.66	17.25	1.71	6	135.00	0.974	0.714	0.260	1.183	3.51	4.15	0.387	13.29	38.5544	30.20
15.256	429.744	13.47	0.25	1.82	40.37	17.1797	2.004	2.72	16.84	2.05	5	135.00	0.996	0.726	0.270	1.174	3.59	4.21	0.386	13.22	41.3202	30.05

R15231

Depth (ft)	Sam (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	ess (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	429.416	18.28	0.5	2.74	47	23.3902	2.897	2.70	22.98	2.95	5	135.00	1.018	0.738	0.280	1.164	4.84	5.64	0.534	17.98	40.5576	32.03
15.912	429.088	44.7	2.02	4.53	28.04	58.2209	4.627	2.54	57.98	4.65	4	135.00	1.040	0.750	0.291	1.155	11.07	12.79	1.352	44.52	32.7068	37.60
16.24	428.760	126.44	5.34	4.22	-16.4	164.58	4.259	2.23	164.72	4.26	11	135.00	1.063	0.762	0.301	1.146	27.34	31.33	3.882	126.55	20.1417	43.13
16.568	428.432	213.9	10.81	5.05	-15.7	275.059	5.080	2.18	275.19	5.08	11	136.00	1.085	0.774	0.311	1.137	45.29	51.49	6.589	214	18.4606	45.55
16.896	428.104	378.56	14.03	3.71	-15.73	480.355	3.717	1.96	480.48	3.72	12	137.00	1.107	0.786	0.321	1.128	73.23	82.61	11.686	378.66	11.787	47.97
17.224	427.776	341.19	15.02	4.4	-15.91	426.134	4.417	2.06	426.26	4.42	12	136.00	1.129	0.798	0.331	1.119	68.32	76.47	10.528	341.29	14.2134	47.46
17.552	427.448	312.91	15.43	4.93	-12.1	384.691	4.949	2.11	384.79	4.95	11	139.00	1.152	0.810	0.342	1.111	64.25	71.37	9.652	312.99	16.0829	47.03

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 37 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY TJS DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-9

ConeTec Inc. erpretation
Interpretation Of lelease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4276
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-9
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 09:17
CPT File: 804CP09.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 445.7

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	39.25	1.38	45.19	28.02	2.40

User Inputs:

Assumed:
Water Table Depth (ft): 7.8
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area rabo: 0.85 See Below
Ground Surface Elev. 445.7
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	445.536	15.38	0.2	1.27	-2.59	1499.49	1.301	1.37	1501.44	1.30	6	125.00	0.010	0.010	0.000	2.000	2.43	4.87	0.476	15.4	1.11893	52.29
0.492	445.208	19.82	0.38	1.92	-12.01	643.553	1.920	1.64	645.15	1.91	6	125.00	0.031	0.031	0.000	2.000	3.44	6.88	0.613	19.9	5.03728	49.17
0.82	444.880	30.1	0.63	2.1	-9.01	586.317	2.097	1.69	587.29	2.09	6	125.00	0.051	0.051	0.000	2.000	5.30	10.61	0.930	30.15	5.98332	48.78
1.148	444.552	43.87	0.91	2.07	-3.21	610.429	2.078	1.68	610.71	2.08	6	125.00	0.072	0.072	0.000	2.000	7.69	15.39	1.356	43.89	5.7973	48.94
1.476	444.224	47.66	1.19	2.49	0.07	515.64	2.502	1.79	515.64	2.50	6	125.00	0.092	0.092	0.000	2.000	8.66	17.33	1.473	47.66	7.8425	48.25
1.804	443.896	45.87	1.66	3.62	0.07	405.829	3.628	1.98	405.83	3.63	5	125.00	0.113	0.113	0.000	2.000	9.94	17.89	1.417	45.87	12.3418	47.25
2.133	443.567	41.72	1.66	3.98	0.25	311.949	3.992	2.07	311.95	3.99	5	125.00	0.133	0.133	0.000	2.000	8.42	16.84	1.288	41.72	14.8063	46.11
2.461	443.239	37.44	1.52	4.06	0.39	242.413	4.077	2.13	242.41	4.08	5	125.00	0.154	0.154	0.000	2.000	7.74	15.49	1.154	37.44	16.6663	44.96
2.789	442.911	44.47	1.87	4.2	0.86	254.117	4.222	2.13	254.06	4.22	5	125.00	0.174	0.174	0.000	2.000	9.21	18.41	1.371	44.46	16.7567	45.18
3.117	442.583	59.57	2.65	4.44	0.23	304.781	4.463	2.11	304.78	4.46	5	125.00	0.195	0.195	0.000	2.000	12.25	24.50	1.836	59.57	16.2268	46.00
3.445	442.255	70.47	2.79	3.95	1.85	326.292	3.971	2.06	326.25	3.97	5	125.00	0.215	0.215	0.000	2.000	14.16	28.31	2.175	70.46	14.467	46.30
3.773	441.927	74.67	2.46	3.29	-0.62	315.65	3.305	1.99	315.69	3.30	6	125.00	0.236	0.236	0.000	2.000	14.64	29.28	2.304	74.68	12.725	46.16
4.101	441.599	84.53	2.85	3.37	1.85	328.793	3.382	1.99	328.75	3.38	6	125.00	0.256	0.256	0.000	1.975	16.57	32.73	2.609	84.52	12.7342	46.34
4.429	441.271	104.33	3.88	3.72	1.8	375.898	3.729	2.00	375.86	3.73	6	125.00	0.277	0.277	0.000	1.901	20.54	39.03	3.221	104.32	13.0225	46.92
4.757	440.943	96.44	3.96	4.11	2.45	323.373	4.119	2.07	323.34	4.12	5	125.00	0.297	0.297	0.000	1.834	19.50	35.76	2.977	96.43	14.9462	46.26
5.085	440.615	102.25	4.19	4.1	0.62	320.731	4.111	2.07	320.70	4.11	5	125.00	0.318	0.318	0.000	1.774	20.68	36.68	3.156	102.24	14.9718	46.23
5.413	440.287	98.2	4.51	4.59	1.13	289.264	4.609	2.14	289.23	4.61	11	125.00	0.338	0.338	0.000	1.719	20.38	35.04	3.030	98.19	16.9403	45.77
5.741	439.959	94.73	4.11	4.34	4.32	263.01	4.355	2.14	262.93	4.36	11	125.00	0.359	0.359	0.000	1.669	19.65	32.80	2.922	94.7	16.894	45.33
6.069	439.631	84.93	3.46	4.08	5.01	222.905	4.092	2.15	222.83	4.09	5	125.00	0.379	0.379	0.000	1.624	17.71	28.75	2.618	84.9	17.3092	44.57
6.398	439.302	87.66	3.56	4.07	-2.24	218.219	4.080	2.15	218.24	4.08	5	125.00	0.400	0.400	0.000	1.581	18.31	28.96	2.702	87.67	17.4182	44.47
6.726	438.974	69.12	3.37	4.87	4.69	163.425	4.905	2.29	163.35	4.91	11	125.00	0.420	0.420	0.000	1.542	15.27	23.56	2.127	69.09	22.0488	43.08
7.054	438.646	63.77	3.03	4.76	3.08	143.644	4.785	2.31	143.60	4.79	4	125.00	0.441	0.441	0.000	1.506	14.23	21.43	1.961	63.75	22.8724	42.43
7.382	438.318	53.39	2.77	5.19	7.53	114.719	5.233	2.40	114.61	5.24	3	125.00	0.461	0.461	0.000	1.472	12.39	18.24	1.639	53.34	26.3327	41.28
7.71	437.990	48.17	2.41	4.99	4.9	98.9637	5.054	2.42	98.90	5.06	4	125.00	0.482	0.482	0.000	1.441	11.31	16.30	1.476	48.14	27.4055	40.51
8.038	437.662	38.46	1.98	5.15	10.26	76.6899	5.216	2.50	76.55	5.23	3	135.00	0.502	0.495	0.007	1.421	9.37	13.31	1.175	38.39	30.8807	39.12
8.366	437.334	30.22	1.55	5.12	11.57	58.5876	5.220	2.58	58.45	5.23	3	135.00	0.526	0.507	0.018	1.405	7.63	10.72	0.919	30.15	34.4169	37.61
8.694	437.006	28.4	1.39	4.89	12.03	53.6919	4.990	2.59	53.66	5.00	3	135.00	0.547	0.519	0.028	1.388	7.21	10.01	0.862	28.33	34.9372	37.11
9.022	436.678	29.4	1.32	4.5	11.46	54.33	4.578	2.56	54.20	4.59	4	135.00	0.569	0.531	0.038	1.373	7.35	10.09	0.893	29.33	33.449	37.18
9.35	436.350	28.31	1.17	4.14	11.87	51.068	4.221	2.55	50.94	4.23	4	135.00	0.591	0.543	0.048	1.358	7.05	9.57	0.858	28.23	33.1117	36.82
9.678	436.022	26.35	1.19	4.53	15.1	46.4162	4.624	2.61	46.24	4.64	4	135.00	0.613	0.554	0.059	1.343	6.75	9.06	0.797	26.25	35.9001	36.25
10.006	435.694	25.07	1.15	4.6	14.55	43.1414	4.706	2.64	42.98	4.72	3	135.00	0.635	0.566	0.069	1.329	6.51	8.65	0.756	24.98	37.2699	35.82
10.335	435.365	25.89	1.24	4.78	13.4	43.63	4.914	2.65	43.49	4.93	3	135.00	0.657	0.578	0.079	1.315	6.76	8.89	0.781	25.81	37.7669	35.89
10.663	435.037	22.8	1.2	5.28	9.91	37.4772	5.425	2.72	37.38	5.44	3	135.00	0.680	0.590	0.089	1.302	6.20	8.07	0.685	22.74	41.7846	34.99
10.991	434.709	27.92	1.18	4.22	10.86	45.2024	4.335	2.60	45.09	4.35	4	135.00	0.702	0.602	0.100	1.289	7.11	9.17	0.843	27.85	35.267	36.11
11.319	434.381	29.42	1.45	4.92	10.88	46.7326	5.053	2.64	46.62	5.07	3	135.00	0.724	0.614	0.110	1.276	7.64	9.75	0.888	29.35	37.1499	36.31
11.647	434.053	26.23	1.41	5.39	11.38	40.7121	5.533	2.71	40.60	5.55	3	135.00	0.746	0.626	0.120	1.264	7.06	8.93	0.789	26.16	40.7787	35.49
11.975	433.725	23.16	0.99	4.29	10.95	35.1046	4.421	2.68	34.99	4.44	4	135.00	0.768	0.638	0.130	1.252	6.16	7.71	0.693	23.09	39.5208	34.60
12.303	433.397	20.42	0.52	2.55	11.83	30.2103	2.649	2.58	30.10	2.66	5	135.00	0.790	0.650	0.140	1.241	5.16	6.40	0.608	20.35	34.5204	33.68
12.631	433.069	18.58	0.49	2.64	14.43	26.8524	2.758	2.63	26.72	2.77	5	135.00	0.812	0.662	0.151	1.229	4.81	5.91	0.550	18.49	37.0571	32.94
12.959	432.741	22.2	0.51	2.28	45.47	31.7192	2.387	2.54	31.29	2.42	6	135.00	0.836	0.674	0.161	1.218	5.45	6.64	0.661	21.91	32.6826	33.92
13.287	432.413	18.14	0.35	1.91	50.26	25.2132	2.025	2.58	24.75	2.06	6	135.00	0.857	0.685	0.171	1.208	4.52	5.45	0.535	17.82	34.4848	32.46
13.615	432.085	15.81	0.26	1.65	56.56	21.4099	1.741	2.60	20.91	1.78	6	135.00	0.879	0.697	0.181	1.197	3.96	4.74	0.462	15.46	35.5971	31.40
13.943	431.757	12.95	0.21	1.59	52.01	16.9872	1.743	2.69	16.52	1.79	5	135.00	0.901	0.709	0.192	1.187	3.38	4.01	0.373	12.62	39.9818	29.89
14.271	431.429	11.94	0.19	1.55	59.86	15.2756	1.725	2.73	14.75	1.79	5	135.00	0.923	0.721	0.202	1.178	3.16	3.73	0.341	11.56	42.1627	29.15
14.6	431.100	12.26	0.19	1.51	66.28	15.438	1.679	2.72	14.87	1.74	5	135.00	0.945	0.733	0.212	1.168	3.23	3.77	0.350	11.85	41.679	29.21
14.928	430.772	11.19	0.19	1.7	73.44	13.7206	1.859	2.80	13.10	1.95	5	135.00	0.967	0.745	0.222	1.159	3.04	3.52	0.316	10.73	45.7108	28.39
15.256	430.444	15.59	0.3	1.9	87.39	19.2881	2.055	2.69	18.56	2.14	5	135.00	0.990	0.757	0.233	1.149	4.03	4.63	0.452	15.04	40.03	30.65

R15234

Depth (ft)	San (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	ess (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	430.116	23.74	0.44	1.84	87.72	29.5606	1.936	2.52	28.85	1.98	6	135.00	1.012	0.769	0.243	1.140	5.70	6.50	0.704	23.19	31.5153	33.43
15.912	429.788	29.33	0.85	2.89	108.61	36.2411	3.004	2.57	35.37	3.08	5	135.00	1.034	0.781	0.253	1.132	7.22	8.17	0.676	28.65	33.9666	34.68
16.24	429.460	38.72	1.48	3.83	103.37	47.5146	3.929	2.56	46.71	4.00	5	135.00	1.056	0.793	0.263	1.123	9.55	10.73	1.166	38.08	33.507	36.34
16.568	429.132	56.19	2.18	3.88	102.93	68.4969	3.956	2.45	67.69	4.00	5	136.00	1.078	0.805	0.274	1.115	13.22	14.73	1.706	55.54	28.5538	38.46
16.896	428.804	60.78	3.03	4.98	65.61	73.0777	5.077	2.51	72.58	5.11	11	137.00	1.100	0.817	0.284	1.107	14.78	16.36	1.848	60.37	31.2128	36.85
17.224	428.476	50.94	2.78	5.46	60.44	60.1007	5.580	2.60	59.64	5.62	3	138.00	1.123	0.829	0.294	1.098	12.92	14.19	1.542	50.56	35.2823	37.75
17.552	428.148	43.07	2.33	5.4	23.93	49.8334	5.558	2.65	49.66	5.58	3	139.00	1.146	0.841	0.304	1.090	11.25	12.26	1.298	42.92	37.7709	36.70
17.88	427.820	39.51	1.86	4.71	-0.56	44.9042	4.851	2.63	44.90	4.85	4	140.00	1.168	0.854	0.314	1.082	10.27	11.12	1.187	39.51	37.026	36.11
18.208	427.492	41.11	1.74	4.23	0.62	46.0646	4.359	2.59	46.06	4.36	4	141.00	1.191	0.867	0.325	1.074	10.47	11.25	1.236	41.11	34.9935	36.27
18.537	427.163	41.12	1.68	4.1	2.12	45.3724	4.210	2.59	45.35	4.21	5	142.00	1.215	0.880	0.335	1.066	10.44	11.13	1.236	41.1	34.7084	36.17
18.865	426.835	45.7	1.83	4	4.37	49.814	4.116	2.55	49.79	4.12	5	143.00	1.238	0.893	0.345	1.058	11.40	12.07	1.377	45.68	33.0275	36.72
19.193	426.507	43.86	2.11	4.81	4.87	47.0298	4.953	2.63	47.00	4.96	4	144.00	1.261	0.906	0.355	1.051	11.36	11.93	1.319	43.83	36.6851	36.38
19.521	426.179	36.52	1.92	5.26	11.85	38.3338	5.449	2.72	38.25	5.46	3	145.00	1.285	0.919	0.366	1.043	9.91	10.33	1.091	36.44	41.4759	35.17
19.849	425.851	49.37	2.52	5.1	12.88	51.5286	5.243	2.62	51.43	5.25	3	146.00	1.309	0.933	0.376	1.035	12.72	13.17	1.488	49.28	36.286	36.91
20.177	425.523	60.49	3.37	5.58	-1.34	62.5064	5.697	2.59	62.52	5.70	11	147.00	1.333	0.946	0.386	1.028	15.39	15.82	1.831	60.5	34.8428	38.02
20.505	425.195	75.15	3.54	4.72	-5.82	76.8443	4.797	2.47	76.89	4.79	11	148.00	1.357	0.960	0.396	1.020	18.09	18.46	2.285	75.19	29.5495	39.17
20.833	424.867	74.98	3.23	4.31	-7.5	75.5377	4.389	2.45	75.59	4.39	5	149.00	1.381	0.974	0.407	1.013	17.84	18.07	2.279	75.03	28.4777	39.08
21.161	424.539	51.59	2	3.88	-4.69	50.7665	3.985	2.53	50.80	3.98	5	150.00	1.405	0.989	0.417	1.006	12.78	12.85	1.554	51.62	32.2646	36.84
21.489	424.211	88.98	4.5	5.06	-4.99	87.2965	5.140	2.46	87.34	5.14	11	151.00	1.430	1.003	0.427	0.999	21.30	21.27	2.711	89.02	29.0451	39.87

R15235

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 40 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-10

ConeTec Inc. terpretation
Interpretation O Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4243
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-10
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 08:35
CPT File: 804CP10.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 442.1

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	39.49	1.77	57.88	26.87	2.36

User Inputs:

Assumed: Water Table Depth (ft): 3.4
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 442.1

Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	441.936	22.84	0.17	0.75	0.53	2227.29	0.745	1.10	2227.29	0.74	7	125.00	0.010	0.010	0.000	2.000	3.34	6.67	0.707	22.84	-1.3233	53.62
0.492	441.606	28.68	0.4	1.4	-1.45	931.683	1.396	1.45	931.68	1.40	6	125.00	0.031	0.031	0.000	2.000	4.66	9.32	0.887	28.68	2.20569	50.57
0.82	441.280	30.14	0.52	1.73	-6.33	587.098	1.728	1.62	587.86	1.73	6	125.00	0.051	0.051	0.000	2.000	5.17	10.35	0.932	30.18	4.63942	48.79
1.148	440.952	41.06	0.62	1.5	-7.39	571.265	1.513	1.57	571.96	1.51	7	125.00	0.072	0.072	0.000	2.000	6.94	13.88	1.269	41.11	3.86432	48.68
1.476	440.624	62.23	0.9	1.44	-3.79	673.58	1.448	1.52	673.91	1.45	7	125.00	0.092	0.092	0.000	2.000	10.34	20.69	1.924	62.26	3.15876	49.33
1.804	440.296	70.49	1.29	1.83	-0.76	624.188	1.833	1.63	624.29	1.83	7	125.00	0.113	0.113	0.000	2.000	12.13	24.27	2.179	70.5	4.85185	49.03
2.461	439.639	64.76	1.42	2.19	-1.86	420.032	2.198	1.78	420.10	2.20	7	125.00	0.154	0.154	0.000	2.000	11.73	23.46	2.000	64.77	7.63043	47.40
2.789	439.311	67.64	1.58	2.34	-1.64	387.039	2.342	1.82	387.10	2.34	6	125.00	0.174	0.174	0.000	2.000	12.43	24.87	2.089	67.65	8.50804	47.05
3.117	438.983	62.08	1.55	2.49	-2.26	317.665	2.505	1.89	317.77	2.50	6	125.00	0.195	0.195	0.000	2.000	11.70	23.40	1.916	62.1	10.0559	46.19
3.445	438.655	61.6	1.76	2.86	-2.61	286.967	2.867	1.96	287.01	2.87	6	125.00	0.215	0.214	0.001	2.000	11.93	23.86	1.900	61.61	11.8668	45.73
3.773	438.327	49.8	1.64	3.29	-3.46	221.096	3.309	2.07	221.23	3.31	6	125.00	0.236	0.224	0.012	2.000	10.08	20.15	1.534	49.83	14.9652	44.54
4.101	437.999	35.16	1.26	3.59	-0.53	148.88	3.610	2.20	148.92	3.61	5	125.00	0.256	0.234	0.022	2.000	7.49	14.99	1.081	35.17	19.0045	42.62
4.429	437.671	23.8	0.94	3.96	5.47	96.1277	3.996	2.35	95.96	4.00	4	125.00	0.277	0.245	0.032	2.000	5.41	10.81	0.728	23.76	24.5219	40.35
4.757	437.343	20.99	0.83	3.94	15.36	81.156	4.011	2.40	80.76	4.03	4	125.00	0.297	0.255	0.042	1.980	4.86	9.63	0.641	20.89	26.5321	39.43
5.085	437.015	23.58	0.9	3.8	17.32	87.7022	3.869	2.37	87.29	3.89	4	125.00	0.318	0.265	0.053	1.942	5.38	10.45	0.720	23.47	25.1707	39.85
5.413	436.687	26.07	1.08	4.15	16.35	93.3976	4.197	2.38	93.03	4.21	4	125.00	0.338	0.276	0.063	1.905	5.98	11.39	0.797	25.97	25.5391	40.19
5.741	436.359	28	1.25	4.46	13.72	96.7242	4.522	2.39	96.44	4.54	4	125.00	0.359	0.286	0.073	1.871	6.47	12.10	0.866	27.92	26.1485	40.39
6.069	436.031	27.78	1.26	4.55	13.97	92.5575	4.598	2.41	92.25	4.61	4	125.00	0.379	0.296	0.083	1.838	6.47	11.89	0.848	27.69	26.8768	40.15
6.398	435.702	23.67	0.97	4.09	20.99	75.9624	4.166	2.43	75.54	4.19	4	125.00	0.400	0.306	0.094	1.807	5.56	10.04	0.720	23.54	27.8545	39.07
6.726	435.374	22.65	0.83	3.65	20.09	70.2128	3.734	2.42	69.80	3.76	5	125.00	0.420	0.317	0.104	1.777	5.29	9.40	0.688	22.52	27.3099	38.63
7.054	435.046	23.86	0.78	3.26	20.76	71.6466	3.331	2.38	71.25	3.35	5	125.00	0.441	0.327	0.114	1.749	5.46	9.56	0.725	23.73	25.568	38.75
7.382	434.718	19.8	0.64	3.24	24.65	57.3614	3.309	2.45	56.89	3.34	5	125.00	0.461	0.337	0.124	1.722	4.66	8.03	0.599	19.64	28.3064	37.49
7.71	434.390	17.31	0.59	3.42	30.58	48.4398	3.506	2.52	47.89	3.55	4	125.00	0.482	0.347	0.134	1.697	4.20	7.13	0.521	17.12	31.4473	36.49
8.038	434.062	18.65	0.73	3.9	29.81	50.7385	4.023	2.54	50.21	4.07	4	135.00	0.502	0.358	0.145	1.672	4.59	7.68	0.562	18.46	32.7232	36.77
8.366	433.734	15.11	0.63	4.15	30.69	39.4655	4.319	2.65	38.95	4.38	3	135.00	0.525	0.370	0.156	1.645	3.90	6.42	0.452	14.92	37.5988	35.28
8.694	433.406	14.94	0.58	3.89	35.5	37.7301	4.030	2.64	37.15	4.09	4	135.00	0.547	0.381	0.165	1.619	3.84	6.22	0.446	14.72	37.3103	35.00
9.022	433.078	15.71	0.65	4.15	39.87	38.4892	4.293	2.65	37.85	4.36	3	135.00	0.569	0.393	0.175	1.594	4.06	6.47	0.469	15.48	38.0083	35.11
9.35	432.750	20.24	0.82	4.06	39.19	48.4809	4.173	2.57	47.86	4.23	4	135.00	0.591	0.405	0.186	1.571	5.04	7.91	0.608	19.99	33.9763	36.50
9.678	432.422	21.26	1.1	5.19	18.66	49.4891	5.328	2.64	49.23	5.36	3	135.00	0.613	0.417	0.196	1.548	5.51	8.53	0.639	21.15	37.2394	36.66
10.006	432.094	21.52	1.14	5.29	14.2	48.6703	5.459	2.65	48.46	5.48	3	135.00	0.635	0.429	0.206	1.527	5.62	8.56	0.647	21.43	37.8499	36.57
10.335	431.765	22.36	1.16	5.2	0.19	49.2066	5.345	2.64	49.21	5.34	3	135.00	0.657	0.441	0.216	1.506	5.83	8.77	0.672	22.36	37.2112	36.66
10.663	431.437	18.99	1.06	5.57	-6.84	40.4242	5.789	2.72	40.53	5.77	3	135.00	0.680	0.453	0.227	1.486	5.18	7.69	0.567	19.04	41.4795	35.53
10.991	431.109	14.81	0.82	5.55	-7.21	30.3493	5.612	2.81	30.44	5.80	3	135.00	0.702	0.465	0.237	1.467	4.23	6.21	0.437	14.85	46.4001	33.80
11.319	430.781	15.17	0.79	5.19	-6.65	30.3001	5.469	2.79	30.38	5.45	3	135.00	0.724	0.477	0.247	1.448	4.29	6.22	0.447	15.21	45.3683	33.80
11.647	430.453	13.83	0.74	5.37	-5.98	26.7744	5.656	2.84	26.84	5.64	3	135.00	0.746	0.489	0.257	1.431	4.02	5.75	0.405	13.86	48.2129	33.04
11.975	430.125	11.53	0.56	4.82	-4.81	21.4987	5.204	2.88	21.56	5.19	3	135.00	0.768	0.501	0.268	1.413	3.44	4.86	0.333	11.56	50.9108	31.67
12.303	429.797	12.82	0.45	3.52	-3.23	23.4732	3.741	2.76	23.51	3.73	4	135.00	0.790	0.512	0.278	1.397	3.57	4.98	0.372	12.84	43.714	32.22
12.631	429.469	13.05	0.43	3.3	-2.06	23.3366	3.514	2.74	23.37	3.51	4	135.00	0.812	0.524	0.288	1.381	3.60	4.97	0.379	13.07	42.8475	32.18
12.959	429.141	13.03	0.41	3.16	-0.78	22.7399	3.362	2.74	22.74	3.36	4	135.00	0.835	0.535	0.298	1.366	3.58	4.90	0.378	13.03	42.7021	32.01
13.287	428.813	14.48	0.43	2.98	12.21	24.8506	3.156	2.70	24.70	3.17	5	135.00	0.857	0.548	0.308	1.351	3.87	5.23	0.422	14.4	40.3482	32.53
13.615	428.485	14.54	0.43	2.97	15.45	24.39	3.148	2.70	24.21	3.17	5	135.00	0.879	0.560	0.319	1.336	3.90	5.20	0.423	14.44	40.6879	32.41
13.943	428.157	13.29	0.47	3.56	20.09	21.6584	3.794	2.80	21.43	3.83	4	135.00	0.901	0.572	0.329	1.322	3.73	4.94	0.384	13.16	45.8728	31.65
14.271	427.829	16.42	0.51	3.08	25.66	26.5391	3.291	2.69	26.27	3.33	5	135.00	0.923	0.584	0.339	1.309	4.35	5.70	0.480	16.26	39.9534	32.91
14.6	427.500	19.35	0.75	3.86	19.79	30.8871	4.075	2.70	30.59	4.10	4	135.00	0.945	0.596	0.349	1.295	5.18	6.71	0.570	19.23	40.477	33.87
14.928	427.172	23.7	1.01	4.25	-5.33	37.4028	4.443	2.66	37.45	4.44	4	135.00	0.967	0.608	0.360	1.283	6.26	8.03	0.704	23.73	38.4335	35.07
15.256	426.844	26.27	0.82	3.11	-8.01	40.7957	3.244	2.54	40.86	3.24	5	135.00	0.990	0.620	0.370	1.270	6.53	8.30	0.783	26.32	32.4669	35.59

R15237

Depth (ft)	Sam (...)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...ess (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	426.516	28.43	0.71	2.5	1.06	43.4116	2.590	2.45	43.40	2.59	6	135.00	1.012	0.632	0.380	1.258	6.77	8.52	0.849	28.42	28.7045	35.94
15.912	426.188	34.11	0.83	2.42	14.23	51.4007	2.509	2.39	51.26	2.52	6	135.00	1.034	0.643	0.390	1.247	7.88	9.82	1.024	34.02	26.1157	36.91
16.24	425.860	36.87	1.15	3.11	26.79	54.6443	3.211	2.45	54.38	3.23	5	135.00	1.056	0.655	0.401	1.236	8.72	10.78	1.109	36.7	28.4501	37.25
16.568	425.532	38.02	1.21	3.18	114.11	55.3595	3.275	2.46	54.30	3.34	5	136.00	1.078	0.667	0.411	1.224	8.91	10.91	1.144	37.31	28.9263	37.24
16.896	425.204	42.17	1.45	3.45	136.77	60.4516	3.531	2.46	59.17	3.61	5	137.00	1.100	0.679	0.421	1.213	9.86	11.96	1.272	41.3	28.8349	37.73
17.224	424.876	49.75	1.96	3.95	80.34	70.3096	4.031	2.45	69.59	4.07	5	138.00	1.123	0.692	0.431	1.202	11.71	14.08	1.505	49.25	28.4507	38.64
17.552	424.548	47.56	1.6	3.37	107.39	65.9285	3.447	2.42	64.98	3.50	5	139.00	1.146	0.704	0.442	1.192	11.00	13.11	1.437	46.89	27.2425	38.26
17.88	424.220	51.6	1.85	3.59	140.27	70.3788	3.668	2.42	69.15	3.73	5	140.00	1.168	0.717	0.452	1.181	11.91	14.07	1.561	50.72	27.3444	38.61
18.208	423.892	65.03	2.32	3.57	168.7	87.5341	3.634	2.36	86.09	3.69	5	141.00	1.191	0.729	0.462	1.171	14.58	17.07	1.976	63.98	24.6627	39.80
18.537	423.563	70.02	2.53	3.61	155.08	92.701	3.677	2.34	91.39	3.73	5	142.00	1.215	0.742	0.472	1.161	15.64	18.15	2.130	69.05	24.1296	40.12
18.865	423.235	65.59	2.53	3.86	43.83	85.2026	3.931	2.38	84.85	3.95	5	143.00	1.238	0.755	0.483	1.151	15.06	17.33	1.992	65.32	25.6929	39.72
19.193	422.907	55.6	2.73	4.9	4.71	70.7073	5.024	2.51	70.67	5.03	4	144.00	1.261	0.769	0.493	1.141	13.62	15.54	1.682	55.57	31.2954	38.73
19.521	422.579	110.1	2.81	2.55	-0.67	139.17	2.582	2.10	139.17	2.58	7	145.00	1.285	0.782	0.503	1.131	22.55	25.50	3.369	110.1	15.903	42.30
19.849	422.251	160.51	4.84	3.02	-18.41	200.145	3.040	2.06	200.30	3.04	7	146.00	1.309	0.795	0.513	1.121	32.40	36.33	4.929	160.63	14.7692	44.08
20.177	421.923	111.07	5.1	4.59	-23.58	135.622	4.647	2.31	135.79	4.64	11	147.00	1.333	0.809	0.523	1.112	24.86	27.63	3.397	111.21	22.9849	42.18
20.505	421.595	58.81	3.39	5.76	-23.83	69.8082	5.900	2.57	69.99	5.89	11	148.00	1.357	0.823	0.534	1.102	14.84	16.36	1.779	58.96	33.8626	38.67
20.833	421.267	53.52	2.16	4.03	-22.7	62.2887	4.143	2.48	62.46	4.13	5	149.00	1.381	0.837	0.544	1.093	12.97	14.18	1.614	53.66	30.0156	38.04
21.161	420.939	95.22	2.52	4.56	-21.43	83.2178	4.683	2.52	83.37	4.67	4	150.00	1.405	0.851	0.554	1.084	13.61	14.75	1.666	55.35	31.6051	38.12
21.489	420.611	99.33	2.92	2.94	-20.71	113.098	2.983	2.21	113.25	2.98	6	151.00	1.430	0.866	0.564	1.075	21.26	22.85	3.031	99.46	19.2589	41.25
21.817	420.283	112.37	3.22	2.86	-15.47	126.018	2.903	2.17	126.13	2.90	6	152.00	1.455	0.880	0.575	1.066	23.66	25.22	3.434	112.47	17.9771	41.80
22.145	419.955	57.05	2.85	4.99	-4.13	62.1002	5.129	2.56	62.13	5.13	4	153.00	1.480	0.895	0.585	1.057	14.28	15.10	1.720	57.08	33.269	38.01
22.473	419.627	49.22	2.02	4.1	-0.05	52.4512	4.233	2.54	52.45	4.23	5	154.00	1.505	0.910	0.595	1.048	12.24	12.84	1.477	49.22	32.7044	37.05
22.802	419.298	45.2	1.76	3.89	26.33	47.2222	4.030	2.56	47.04	4.05	5	155.00	1.530	0.925	0.605	1.040	11.30	11.75	1.352	45.03	33.5817	36.42
23.13	418.970	86.55	1.89	2.18	44.16	90.4233	2.224	2.18	90.13	2.23	7	156.00	1.556	0.940	0.616	1.031	18.23	18.81	2.631	86.27	18.3567	40.05
23.458	418.642	135.75	2.31	1.7	0.11	140.445	1.722	1.97	140.43	1.72	8	157.00	1.581	0.955	0.626	1.023	26.36	26.97	4.154	135.74	12.0719	42.35
23.786	418.314	80.31	2.82	3.51	-7.76	81.0682	3.583	2.36	81.12	3.58	6	158.00	1.607	0.971	0.636	1.015	18.37	18.64	2.437	80.36	24.9247	39.48
24.114	417.986	60.5	2.64	4.36	-3.63	59.6725	4.485	2.52	59.70	4.48	5	159.00	1.633	0.987	0.646	1.007	14.91	15.01	1.823	60.53	31.782	37.79
24.442	417.658	127.06	4.56	3.59	-4.92	125.108	3.636	2.25	125.14	3.64	6	160.00	1.659	1.002	0.657	0.999	27.63	27.60	3.862	127.09	20.6606	41.76
24.77	417.330	149.98	9.93	6.62	-11.87	145.622	6.696	2.43	145.70	6.69	11	161.00	1.685	1.018	0.667	0.991	35.31	34.99	4.591	150.06	27.5358	42.53
25.098	417.002	328.34	15.26	4.65	23.26	315.728	4.672	2.12	315.58	4.67	11	162.00	1.712	1.035	0.677	0.983	67.79	66.65	10.112	328.19	16.5598	46.17
25.426	416.674	419.75	19.4	4.62	18.11	397.781	4.641	2.08	397.68	4.64	11	163.00	1.738	1.051	0.687	0.976	85.07	82.99	12.942	419.64	15.1488	47.17
25.754	416.346	389.73	18.71	4.8	438.91	363.462	4.823	2.11	360.92	4.86	11	164.00	1.765	1.067	0.697	0.968	79.58	77.03	12.011	386.99	16.2214	46.75

TD R15238

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 43 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-11

ConeTec Inc. Interpretation
Interpretation Ou elease 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4215
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-11
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 10:31
CPT File: 804CP11.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 440.6

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	39.88	2.75	89.72	26.76	2.35

User Inputs:

Assumed: Water Table Depth (ft): 11.4
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 440.6
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	440.436	28.5	0.22	0.76	0.16	2779.49	0.772	1.11	2778.51	0.77	7	125.00	0.010	0.010	0.000	2.000	4.17	8.34	0.882	28.49	-1.2563	54.33
0.492	440.108	28.29	0.44	1.56	-0.67	919	1.557	1.50	919.33	1.56	6	125.00	0.031	0.031	0.000	2.000	4.67	9.34	0.875	28.3	2.83968	50.52
0.82	439.780	20.17	0.54	2.66	-2.66	392.561	2.684	1.87	392.76	2.68	5	125.00	0.051	0.051	0.000	2.000	3.78	7.55	0.623	20.18	9.60794	47.11
1.148	439.452	19.6	0.52	2.63	-12.35	272.171	2.663	1.94	273.29	2.65	5	125.00	0.072	0.072	0.000	2.000	3.79	7.57	0.605	19.68	11.4161	45.51
1.476	439.124	28.99	0.42	1.43	-1.13	313.255	1.453	1.69	313.36	1.45	6	125.00	0.092	0.092	0.000	2.000	5.10	10.19	0.895	29	5.94772	46.13
1.804	438.796	36.06	0.46	1.25	-0.07	318.823	1.252	1.63	318.82	1.25	7	125.00	0.113	0.113	0.000	2.000	6.22	12.43	1.113	36.06	4.93192	46.20
2.133	438.467	35.17	0.54	1.52	-0.16	262.816	1.541	1.76	262.82	1.54	7	125.00	0.133	0.133	0.000	2.000	6.32	12.65	1.085	35.17	7.21826	45.33
2.461	438.139	37.91	0.55	1.44	-0.05	245.469	1.457	1.76	245.47	1.46	7	125.00	0.154	0.154	0.000	2.000	6.81	13.63	1.169	37.91	7.18838	45.02
2.789	437.811	36.47	0.68	1.87	-0.34	208.222	1.874	1.89	208.22	1.87	6	125.00	0.174	0.174	0.000	2.000	6.87	13.74	1.124	36.47	10.0384	44.25
3.117	437.483	27.44	0.59	2.16	-0.37	139.853	2.168	2.04	139.85	2.17	6	125.00	0.195	0.195	0.000	2.000	5.49	10.97	0.844	27.44	14.139	42.30
3.445	437.155	20.54	0.66	3.22	-0.44	94.3962	3.247	2.29	94.40	3.25	5	125.00	0.215	0.215	0.000	2.000	4.54	9.08	0.629	20.54	22.0663	40.26
3.773	436.827	22.61	0.8	3.52	-1.01	94.8813	3.576	2.32	94.88	3.58	5	125.00	0.236	0.236	0.000	2.000	5.07	10.13	0.693	22.61	23.1951	40.29
4.101	436.499	26.22	0.98	3.73	-1.36	101.297	3.775	2.32	101.30	3.77	5	125.00	0.256	0.256	0.000	1.975	5.88	11.60	0.804	26.22	23.1946	40.63
4.429	436.171	31.36	1.08	3.45	-1.09	112.29	3.475	2.26	112.33	3.47	5	125.00	0.277	0.277	0.000	1.901	6.86	13.04	0.962	31.37	21.1287	41.18
4.757	435.843	38.92	1.07	2.74	1.76	129.906	2.770	2.15	129.84	2.77	6	125.00	0.297	0.297	0.000	1.834	8.11	14.86	1.196	38.9	17.2319	41.92
5.085	435.515	38.04	1.11	2.93	4.37	118.693	2.943	2.19	118.60	2.94	6	125.00	0.318	0.318	0.000	1.774	8.07	14.31	1.168	38.01	18.7018	41.46
5.413	435.187	30.78	1.06	3.45	13.37	89.981	3.482	2.33	89.71	3.49	5	125.00	0.338	0.338	0.000	1.719	6.90	11.86	0.942	30.69	23.4971	39.99
5.741	434.859	25.89	0.85	3.29	18.5	71.1547	3.329	2.38	70.85	3.34	5	125.00	0.359	0.359	0.000	1.669	5.94	9.91	0.790	25.78	25.6136	38.69
6.069	434.531	23.4	0.79	3.36	23.9	60.6906	3.432	2.44	60.30	3.45	5	125.00	0.379	0.379	0.000	1.624	5.50	8.93	0.713	23.25	28.015	37.78
6.398	434.202	25.75	1.15	4.46	22.01	63.3951	4.536	2.51	63.07	4.56	4	125.00	0.400	0.400	0.000	1.581	6.28	9.93	0.785	25.62	31.3104	38.04
6.726	433.874	29.09	1.27	4.36	14.11	68.2001	4.430	2.48	68.01	4.44	4	125.00	0.420	0.420	0.000	1.542	7.01	10.81	0.868	29.01	29.9625	38.46
7.054	433.546	24	1	4.16	11.96	53.4372	4.245	2.54	53.28	4.26	4	125.00	0.441	0.441	0.000	1.506	5.94	8.95	0.729	23.93	32.5699	37.07
7.382	433.218	21.53	0.94	4.35	14.92	45.6649	4.462	2.61	45.45	4.46	4	125.00	0.461	0.461	0.000	1.472	5.49	8.09	0.652	21.43	35.6188	36.14
7.71	432.890	22.03	1.05	4.75	14.57	44.7173	4.873	2.64	44.53	4.89	3	125.00	0.482	0.482	0.000	1.441	5.72	8.24	0.667	21.94	37.2891	36.02
8.038	432.562	22.77	0.99	4.34	10.23	44.3247	4.446	2.61	44.21	4.46	4	125.00	0.502	0.502	0.000	1.411	5.84	8.24	0.689	22.71	35.9462	35.97
8.366	432.234	32.54	1.27	3.9	8.77	61.2328	3.967	2.48	61.12	3.97	5	125.00	0.523	0.523	0.000	1.383	7.83	10.83	0.991	32.48	29.7484	37.86
8.694	431.906	28.72	1.47	5.13	1.57	51.8548	5.217	2.61	51.84	5.22	3	125.00	0.543	0.543	0.000	1.357	7.39	10.03	0.872	28.71	36.0689	36.91
9.022	431.578	25.38	1.28	5.04	3.58	44.01	5.158	2.66	43.97	5.16	3	125.00	0.564	0.564	0.000	1.332	6.68	8.90	0.768	25.36	38.3383	35.94
9.35	431.250	21.81	1.12	5.12	4.5	36.3219	5.277	2.72	36.27	5.28	3	125.00	0.584	0.584	0.000	1.308	5.94	7.77	0.657	21.78	41.7898	34.78
9.678	430.922	19.77	1.16	5.88	0.32	31.6644	6.053	2.81	31.68	6.05	3	125.00	0.605	0.605	0.000	1.286	5.64	7.25	0.593	19.77	46.4618	33.95
10.006	430.594	16.91	1.13	6.7	7.09	26.0398	6.939	2.91	25.98	6.96	3	125.00	0.625	0.625	0.000	1.265	5.11	6.46	0.504	16.87	52.7324	32.71
10.335	430.265	12.18	0.84	6.91	7.27	17.8563	7.283	3.05	17.78	7.31	3	125.00	0.646	0.646	0.000	1.244	3.99	4.96	0.357	12.13	61.5745	30.26
10.663	429.937	13.61	0.58	4.27	11.11	19.422	4.461	2.88	19.32	4.51	3	125.00	0.666	0.666	0.000	1.225	4.02	4.92	0.401	13.54	50.6152	30.80
10.991	429.609	16.16	0.58	3.6	16.15	22.5247	3.748	2.78	22.38	3.77	4	125.00	0.687	0.687	0.000	1.207	4.51	5.44	0.479	16.06	44.7951	31.76
11.319	429.281	20.35	0.95	4.66	10.23	27.7658	4.836	2.78	27.67	4.85	3	125.00	0.707	0.707	0.000	1.189	5.71	6.79	0.608	20.25	45.0299	33.10
11.647	428.953	15.41	0.83	5.37	7.37	20.3852	5.653	2.93	20.33	5.67	3	135.00	0.728	0.720	0.008	1.178	4.70	5.54	0.455	15.37	53.7104	31.14
11.975	428.625	15.03	0.51	3.4	12.31	19.5044	3.571	2.81	19.40	3.59	4	135.00	0.750	0.732	0.018	1.169	4.26	5.00	0.442	14.95	46.7592	30.84
12.303	428.297	13.48	0.39	2.86	16.05	17.0793	3.059	2.82	16.94	3.09	5	135.00	0.772	0.744	0.028	1.159	3.84	4.45	0.393	13.38	47.1053	29.96
12.631	427.969	14.27	0.45	3.13	24.68	17.8261	3.339	2.83	17.61	3.38	5	135.00	0.794	0.756	0.038	1.150	4.07	4.69	0.417	14.11	47.7069	30.22
12.959	427.641	16.62	0.59	3.53	32.75	20.5813	3.733	2.81	20.31	3.78	4	135.00	0.816	0.768	0.049	1.141	4.69	5.36	0.489	16.41	46.6978	31.15
13.287	427.313	15.45	0.53	3.41	85.75	18.7382	3.627	2.85	18.06	3.76	4	135.00	0.839	0.780	0.059	1.132	4.36	4.94	0.452	14.92	48.9421	30.39
13.615	426.985	14.31	0.4	2.77	92.79	16.9884	2.974	2.83	16.26	3.11	5	135.00	0.861	0.792	0.069	1.124	3.98	4.47	0.416	13.73	48.0254	29.71
13.943	426.657	16.27	0.56	3.45	78.04	19.1483	3.639	2.84	18.54	3.76	4	135.00	0.883	0.804	0.079	1.116	4.59	5.12	0.476	15.78	48.3929	30.57
14.271	426.329	75.29	0.83	1.1	37.25	91.2159	1.116	1.97	90.93	1.12	8	135.00	0.905	0.815	0.090	1.107	14.61	16.18	2.303	75.06	12.2389	40.07
14.6	426.000	92.32	1.92	2.08	-13.9	110.454	2.101	2.10	110.55	2.10	7	135.00	0.927	0.827	0.100	1.099	18.90	20.78	2.829	92.4	15.8278	41.10
14.928	425.672	64.03	2.18	3.4	-6.84	75.1558	3.456	2.37	75.22	3.45	6	135.00	0.949	0.839	0.110	1.092	14.71	16.06	1.953	64.08	25.3244	39.03
15.256	425.344	42.81	1.68	3.92	119.63	49.1501	4.015	2.56	48.27	4.09	5	135.00	0.972	0.851	0.120	1.084	10.53	11.42	1.295	42.06	33.3652	36.51

R15240

Depth (ft)	Samp (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	ss (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	425.016	31.18	1.36	4.44	88.96	34.9725	4.572	2.70	34.34	4.66	4	135.00	0.994	0.863	0.131	1.076	8.26	8.89	0.935	30.63	40.6127	34.47
15.912	424.688	74.08	1.85	2.5	119.6	83.4971	2.532	2.25	82.64	2.56	6	135.00	1.016	0.875	0.141	1.069	15.95	17.05	2.262	73.33	20.7052	39.55
16.24	424.360	168.1	3.39	2.02	-0.74	168.354	2.029	1.94	188.35	2.03	7	135.00	1.038	0.887	0.151	1.062	32.30	34.30	5.172	168.1	11.3615	43.77
16.568	424.032	179.25	4.43	2.47	-10.55	198.239	2.486	2.00	198.32	2.49	7	136.00	1.060	0.899	0.161	1.055	35.21	37.14	5.517	179.32	12.8438	44.02
16.896	423.704	134.23	3.06	2.28	-18.82	146.166	2.298	2.05	146.30	2.30	7	137.00	1.082	0.911	0.171	1.048	26.94	28.22	4.122	134.35	14.3363	42.53
17.224	423.376	78.48	1.39	1.78	-20.86	83.8148	1.796	2.14	83.96	1.79	7	138.00	1.105	0.923	0.182	1.041	16.31	16.98	2.396	78.61	16.912	39.64
17.552	423.048	61.76	2.91	4.71	-21.8	64.8083	4.799	2.52	64.96	4.79	4	139.00	1.128	0.936	0.192	1.034	15.23	15.74	1.877	61.9	31.6498	38.22
17.88	422.720	131.97	4.46	3.38	-22.01	137.977	3.409	2.20	138.12	3.41	6	140.00	1.150	0.948	0.202	1.027	28.14	28.90	4.050	132.11	18.9817	42.25
18.208	422.392	229.79	6.98	3.04	1.89	237.93	3.053	2.03	237.92	3.05	12	141.00	1.173	0.961	0.212	1.020	45.63	46.55	7.078	229.78	13.6451	44.68
18.537	422.063	178.23	4.87	2.73	5.5	181.799	2.751	2.05	181.77	2.75	7	142.00	1.196	0.974	0.223	1.013	35.79	36.27	5.481	178.2	14.4578	43.60
18.865	421.735	158.32	3.05	1.93	-5.91	159.195	1.941	1.97	159.24	1.94	8	143.00	1.220	0.987	0.233	1.007	30.79	31.00	4.864	158.36	12.157	42.96
19.193	421.407	129.65	3.89	3	-15.68	128.399	3.029	2.18	128.49	3.03	6	144.00	1.243	1.000	0.243	1.000	27.40	27.40	3.975	129.74	18.2843	41.88
19.521	421.079	173.42	5.09	2.94	-12.86	169.87	2.957	2.10	169.95	2.96	7	145.00	1.267	1.013	0.253	0.993	35.43	35.20	5.330	173.5	15.7016	43.28
19.849	420.751	263.85	6.2	2.35	-1.66	255.66	2.361	1.91	255.67	2.36	7	146.00	1.291	1.027	0.264	0.987	50.25	49.58	8.129	263.86	10.7536	45.21
20.177	420.423	128.37	5.69	4.43	4.11	122.087	4.478	2.33	122.06	4.48	11	147.00	1.315	1.041	0.274	0.980	28.87	28.30	3.934	128.34	23.5384	41.62
20.505	420.095	79.4	4.72	5.95	5.06	74.0219	6.047	2.56	73.99	6.05	11	148.00	1.339	1.055	0.284	0.974	19.92	19.40	2.417	79.37	33.5824	38.95
20.833	419.767	78.64	4.44	5.65	4.76	72.3155	5.746	2.55	72.29	5.75	11	149.00	1.363	1.069	0.294	0.967	19.63	18.99	2.392	78.61	33.0698	38.82
21.161	419.439	89.37	5.02	5.61	5.8	81.2538	5.706	2.52	81.23	5.71	11	150.00	1.387	1.083	0.305	0.961	21.94	21.09	2.724	89.34	31.4994	39.47
21.489	419.111	108.25	5.71	5.27	5.22	97.3752	5.345	2.45	97.35	5.35	11	151.00	1.412	1.097	0.315	0.955	25.71	24.54	3.308	108.22	28.3906	40.44
21.817	418.783	132	7.15	5.41	2.48	117.444	5.476	2.41	117.43	5.48	11	152.00	1.437	1.112	0.326	0.948	30.78	29.19	4.042	131.98	26.7224	41.42
22.145	418.455	152.55	8.54	5.6	-0.62	134.133	5.652	2.39	134.13	5.65	11	153.00	1.462	1.126	0.335	0.942	35.23	33.19	4.678	152.55	25.8345	42.10
22.473	418.127	166.92	10.03	6.01	-0.81	144.956	6.063	2.39	144.96	6.06	11	154.00	1.487	1.141	0.345	0.936	38.66	36.19	5.122	166.92	26.1022	42.49
22.802	417.798	175.61	10.85	6.18	-0.16	150.561	6.232	2.39	150.56	6.23	11	155.00	1.512	1.156	0.356	0.930	40.69	37.84	5.390	175.61	26.1461	42.68
23.13	417.470	186.83	11.72	6.27	0.3	158.165	6.325	2.39	158.16	6.33	11	156.00	1.537	1.172	0.366	0.924	43.17	39.89	5.737	186.82	25.9033	42.93
23.458	417.142	212.47	12.86	6.05	-0.81	177.701	6.097	2.35	177.70	6.10	11	157.00	1.563	1.187	0.376	0.918	48.23	44.27	6.530	212.47	24.3144	43.50
23.786	416.814	206.47	13.26	6.42	-3.42	170.396	6.472	2.38	170.42	6.47	11	158.00	1.589	1.202	0.386	0.912	47.54	43.35	6.343	206.5	25.5551	43.29
24.114	416.486	224.17	13.55	6.04	-3.65	182.713	6.088	2.34	182.73	6.09	11	159.00	1.615	1.218	0.397	0.906	50.73	45.97	6.890	224.19	24.049	43.63
24.442	416.158	237.64	15.41	6.48	-5.54	191.262	6.530	2.36	191.29	6.53	11	160.00	1.641	1.234	0.407	0.900	54.17	48.76	7.306	237.67	24.6695	43.85
24.77	415.830	244.94	15.19	6.2	-7.81	194.633	6.244	2.34	194.66	6.24	11	161.00	1.667	1.250	0.417	0.894	55.32	49.48	7.532	244.98	23.8705	43.94
25.098	415.502	239.96	14.94	6.23	-11.57	188.192	6.270	2.34	188.25	6.27	11	162.00	1.693	1.266	0.427	0.889	54.42	48.36	7.377	240.03	24.2139	43.78
25.426	415.174	217.85	14.42	6.62	-17.67	168.534	6.672	2.39	168.62	6.67	11	163.00	1.720	1.282	0.438	0.883	50.48	44.58	6.691	217.96	26.1001	43.24
25.754	414.846	219.37	13.74	6.26	-20.97	167.543	6.314	2.37	167.64	6.31	11	164.00	1.747	1.299	0.448	0.877	50.40	44.22	6.738	219.5	25.3316	43.21
26.082	414.518	214.66	13.21	6.15	-22.49	161.82	6.205	2.37	161.93	6.20	11	165.00	1.774	1.316	0.458	0.872	49.36	43.03	6.591	214.8	25.3928	43.04
26.41	414.190	225.44	13.56	6.01	-24.85	167.847	6.063	2.36	167.97	6.06	11	166.00	1.801	1.332	0.468	0.866	51.45	44.57	6.924	225.6	24.7228	43.22
26.739	413.861	268.44	15.56	5.8	-24.92	197.572	5.836	2.31	197.68	5.83	11	167.00	1.828	1.349	0.479	0.861	59.89	51.56	8.254	268.59	22.7802	44.01
27.067	413.533	344.83	16.55	4.8	-25.2	250.97	4.825	2.18	251.09	4.82	11	168.00	1.855	1.367	0.489	0.855	73.00	62.45	10.618	344.99	18.4477	45.13

R15241

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek
Deformation Evaluation
Normalized PS-CPT Data and Parameter
Correlations

PROJECT NO. 072046

PAGE 46 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-12

ConeTec Inc. Interpretation
Interpretation O Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4182
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-12
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 11:15
CPT File: 804CP12.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 442.1

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.01	2.80	91.11	27.69	2.37

User Inputs:

Assumed: Water Table Depth (ft): 11.7
Nk: 32.3
State Parameter:
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 442.1

Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	441.936	11.62	0.14	1.16	-0.32	1132.66	1.206	1.37	1132.66	1.21	6	125.00	0.010	0.010	0.000	2.000	1.84	3.67	0.359	11.62	1.12402	51.29
0.492	441.608	7.94	0.16	2.02	-1.8	257.211	2.023	1.86	257.54	2.02	5	125.00	0.031	0.031	0.000	2.000	1.48	2.96	0.245	7.95	9.3841	45.24
0.82	441.280	9.78	0.15	1.54	-4.83	189.829	1.542	1.84	190.41	1.54	5	125.00	0.051	0.051	0.000	2.000	1.82	3.64	0.301	9.81	9.05791	43.82
1.148	440.952	14.93	0.28	1.85	-7.94	207.084	1.864	1.89	207.78	1.88	5	125.00	0.072	0.072	0.000	2.000	2.82	5.65	0.460	14.98	10.0719	44.24
1.804	440.296	10.42	0.21	2.02	-9.49	91.4169	2.037	2.14	91.95	2.03	5	125.00	0.092	0.092	0.000	2.000	2.74	5.49	0.410	13.42	15.7665	42.47
2.133	439.967	11.15	0.3	2.65	-4.09	82.6381	2.723	2.27	82.86	2.72	5	125.00	0.113	0.113	0.000	2.000	2.18	4.36	0.319	10.48	17.1922	40.12
2.461	439.639	11.4	0.39	3.39	-0.6	73.1162	3.468	2.38	73.12	3.47	4	125.00	0.133	0.133	0.000	2.000	2.45	4.90	0.341	11.18	21.347	39.56
2.789	439.311	19.33	0.58	3.01	0.23	109.893	3.028	2.22	109.89	3.03	5	125.00	0.154	0.154	0.000	2.000	2.63	5.26	0.348	11.4	25.7091	38.87
3.117	438.983	28.95	0.84	2.89	2.91	147.604	2.921	2.13	147.55	2.92	5	125.00	0.174	0.174	0.000	2.000	4.16	8.31	0.593	19.33	19.7298	41.06
3.445	438.655	31.92	1.09	3.41	12.38	147.25	3.438	2.19	146.92	3.45	5	125.00	0.195	0.195	0.000	2.000	5.99	11.98	0.890	28.94	16.7116	42.57
3.773	438.327	29.03	1.2	4.13	24.36	122.106	4.168	2.31	121.47	4.19	4	125.00	0.215	0.215	0.000	2.000	6.75	13.50	0.982	31.85	18.5805	42.56
4.101	437.999	26.16	1.06	4.04	36.19	101.063	4.092	2.35	100.20	4.13	4	125.00	0.236	0.236	0.000	2.000	6.43	12.87	0.891	28.88	22.7083	41.58
4.429	437.671	24.24	0.91	3.76	45.54	86.5683	3.797	2.37	85.56	3.84	4	125.00	0.256	0.256	0.000	1.975	5.90	11.65	0.802	25.94	24.4642	40.58
4.757	437.343	19.02	0.82	4.29	43.88	62.9731	4.360	2.51	62.06	4.44	4	125.00	0.277	0.277	0.000	1.901	5.50	10.45	0.742	23.96	25.2412	39.73
5.085	437.015	21.3	0.75	3.53	49.65	66.0206	3.574	2.43	65.05	3.63	5	125.00	0.297	0.297	0.000	1.834	4.59	8.41	0.580	18.75	31.1432	37.95
5.413	436.687	23.02	0.78	3.4	49.79	67.0436	3.439	2.41	66.13	3.49	5	125.00	0.318	0.318	0.000	1.774	4.95	8.78	0.650	20.99	27.7143	38.21
5.741	436.359	19.94	0.81	4.05	42.61	54.5722	4.137	2.53	53.82	4.19	4	125.00	0.338	0.338	0.000	1.719	5.31	9.13	0.702	22.71	26.9846	38.30
6.069	436.031	19.3	0.6	3.12	42.66	49.8815	3.171	2.48	49.20	3.22	5	125.00	0.359	0.359	0.000	1.669	4.87	8.13	0.606	19.67	32.2135	37.13
6.398	435.702	19.44	0.61	3.15	38.64	47.6152	3.204	2.50	47.02	3.24	5	125.00	0.379	0.379	0.000	1.624	4.59	7.45	0.586	19.04	29.7477	36.60
6.726	435.374	19.51	0.69	3.55	28.89	45.4109	3.615	2.55	44.98	3.65	4	125.00	0.400	0.400	0.000	1.581	4.67	7.38	0.589	19.2	30.4945	36.34
7.054	435.046	19.87	0.87	4.39	16.93	44.0695	4.478	2.62	43.84	4.50	3	125.00	0.420	0.420	0.000	1.542	4.81	7.42	0.591	19.33	32.7392	36.09
7.382	434.718	19.53	0.85	4.34	16.6	41.33	4.456	2.64	41.09	4.48	3	125.00	0.441	0.441	0.000	1.506	5.10	7.68	0.602	19.77	36.2175	35.92
7.71	434.390	17.5	0.83	4.73	14.09	35.3165	4.877	2.71	35.13	4.90	3	125.00	0.461	0.461	0.000	1.472	5.06	7.44	0.590	19.42	37.1432	35.54
8.038	434.062	15.42	0.64	4.16	15.08	29.6942	4.290	2.73	29.52	4.32	3	125.00	0.482	0.482	0.000	1.441	4.71	6.79	0.527	17.41	41.075	34.59
8.366	433.734	15.44	0.6	3.86	17.32	28.529	4.022	2.72	28.32	4.05	4	125.00	0.502	0.502	0.000	1.411	4.19	5.91	0.462	15.33	41.9523	33.51
8.694	433.406	19.79	0.74	3.75	18.06	35.4205	3.845	2.64	35.22	3.87	4	125.00	0.523	0.523	0.000	1.383	4.18	5.77	0.462	15.33	41.6655	33.25
9.022	433.078	19.84	0.86	4.34	16.61	34.1851	4.461	2.69	34.01	4.48	4	125.00	0.543	0.543	0.000	1.357	5.13	6.98	0.596	19.68	37.304	34.60
9.35	432.750	17.62	0.88	4.98	13.99	29.1519	5.166	2.79	29.01	5.19	3	125.00	0.564	0.564	0.000	1.332	5.30	7.05	0.597	19.74	40.1678	34.39
9.678	432.422	16.33	0.72	4.42	21.5	25.9973	4.579	2.79	25.77	4.62	3	125.00	0.584	0.584	0.000	1.308	4.95	6.48	0.527	17.54	45.3203	33.40
10.006	432.094	13.67	0.59	4.33	11.13	20.8589	4.523	2.86	20.75	4.56	3	125.00	0.605	0.605	0.000	1.286	4.58	5.88	0.487	16.19	45.491	32.66
10.335	431.765	12.63	0.44	3.49	13.16	18.553	3.672	2.84	18.43	3.70	4	125.00	0.625	0.625	0.000	1.265	3.99	5.04	0.404	13.6	49.3482	31.27
10.663	431.437	12.67	0.5	3.92	14.21	18.0115	4.165	2.88	17.89	4.19	3	125.00	0.646	0.646	0.000	1.244	3.64	4.53	0.371	12.55	48.2363	30.50
10.991	431.109	12.7	0.63	4.97	13.9	17.4879	5.244	2.96	17.37	5.28	3	125.00	0.667	0.667	0.000	1.225	3.75	4.59	0.372	12.59	50.9429	30.30
11.319	430.781	10.22	0.46	4.51	14.5	13.4465	4.836	3.02	13.31	4.89	3	125.00	0.707	0.707	0.000	1.189	3.28	3.91	0.295	10.12	60.1558	28.34
11.647	430.453	8.57	0.2	2.34	16.35	10.773	2.550	2.94	10.64	2.56	4	125.00	0.728	0.728	0.000	1.172	2.61	3.05	0.243	8.47	54.4211	26.83
11.976	430.125	9.06	0.17	1.83	18.91	11.234	2.045	2.87	11.07	2.08	5	135.00	0.748	0.740	0.009	1.163	2.64	3.08	0.257	8.94	50.2538	27.11
12.303	429.797	10.52	0.15	1.38	22.7	12.9687	1.539	2.75	12.78	1.56	5	135.00	0.771	0.752	0.019	1.153	2.87	3.32	0.302	10.38	43.3766	28.09
12.631	429.469	13.05	0.29	2.23	28.38	16.0505	2.366	2.78	15.81	2.40	5	135.00	0.793	0.764	0.029	1.144	3.61	4.13	0.379	12.87	44.7486	29.51
12.959	429.141	13.23	0.43	3.26	16.7	16.0076	3.464	2.87	15.88	3.49	4	135.00	0.815	0.776	0.039	1.136	3.89	4.42	0.384	13.13	50.3648	29.54
13.287	428.813	13.91	0.36	2.56	7.57	16.601	2.754	2.80	16.54	2.76	5	135.00	0.837	0.787	0.050	1.127	3.93	4.43	0.405	13.86	45.8936	29.81
13.615	428.485	17.32	0.69	3.96	6.49	20.5918	4.192	2.84	20.54	4.20	4	135.00	0.859	0.799	0.060	1.118	5.01	5.61	0.510	17.28	48.2013	31.23
13.943	428.157	28.85	1.37	4.74	1.25	34.4741	4.898	2.72	34.46	4.90	3	135.00	0.881	0.811	0.070	1.110	7.83	8.70	0.866	28.84	41.3835	34.48
14.271	427.829	35.76	1.81	5.06	8.08	42.3427	5.193	2.67	42.28	5.20	3	135.00	0.903	0.823	0.080	1.102	9.48	10.45	1.079	35.71	39.0642	35.72
14.6	427.500	93.11	1.97	2.12	5.47	110.381	2.137	2.11	110.35	2.14	7	135.00	0.926	0.835	0.090	1.094	19.09	20.89	2.884	93.08	16.0213	41.09
14.928	427.172	198.6	4.08	2.06	-1.59	233.341	2.064	1.89	233.35	2.06	8	135.00	0.948	0.847	0.101	1.087	37.46	40.71	6.119	198.61	10.1383	44.79
15.256	426.844	186.18	5.12	2.75	-9.91	215.622	2.764	2.01	215.70	2.76	7	135.00	0.970	0.859	0.111	1.079	36.81	39.72	5.734	186.25	13.2966	44.42

R15243

Depth (ft)	Sam (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	ss (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	426.516	190.04	5.38	2.83	-11.83	217.081	2.846	2.02	217.16	2.84	7	135.00	0.992	0.871	0.121	1.072	37.70	40.40	5.853	190.11	13.5387	44.45
15.912	426.188	263.65	6.16	2.34	-13.14	297.513	2.345	1.88	297.60	2.34	7	135.00	1.014	0.883	0.131	1.064	49.51	52.70	8.131	263.73	9.83312	45.90
16.24	425.860	284.27	6.89	2.42	-9.63	316.576	2.433	1.88	316.64	2.43	7	135.00	1.036	0.895	0.142	1.057	53.37	56.42	8.769	284.33	9.8196	46.17
16.568	425.532	255.09	5.78	2.27	-12.84	280.208	2.275	1.88	280.30	2.27	7	136.00	1.058	0.907	0.152	1.050	47.96	50.37	7.865	255.17	9.90035	45.63
16.896	425.204	262.69	5.83	2.22	-14.73	284.775	2.229	1.87	284.87	2.23	8	137.00	1.081	0.919	0.162	1.043	49.18	51.31	8.099	262.78	9.63384	45.70
17.224	424.876	262.49	6.06	2.31	-15.84	280.793	2.318	1.89	280.90	2.32	7	138.00	1.103	0.931	0.172	1.036	49.47	51.27	8.092	262.59	10.0493	45.64
17.88	424.220	282.44	5.86	2.07	-17.67	294.284	2.083	1.84	294.40	2.08	8	139.00	1.126	0.943	0.183	1.030	51.50	53.02	8.508	276.03	9.43529	45.80
18.208	423.892	257.04	5.91	2.3	-18.27	264.17	2.310	1.90	264.28	2.31	7	141.00	1.172	0.969	0.203	1.016	48.68	49.46	7.922	257.15	10.3624	45.36
18.537	423.563	242.82	4.68	1.93	-18.43	246.178	1.937	1.85	246.30	1.94	8	142.00	1.195	0.982	0.213	1.009	45.22	45.65	7.481	242.94	9.29281	45.04
18.865	423.235	257.45	4.85	1.88	-18.64	257.634	1.893	1.83	257.75	1.89	8	143.00	1.218	0.995	0.224	1.003	47.61	47.74	7.933	257.57	8.85195	45.25
19.193	422.907	260.77	6.02	2.31	-18.77	257.525	2.320	1.91	257.64	2.32	7	144.00	1.242	1.008	0.234	0.996	48.52	48.33	8.035	260.89	10.5471	45.25
19.521	422.579	170.7	6.5	3.81	-14.05	165.924	3.836	2.19	166.01	3.83	12	145.00	1.265	1.021	0.244	0.990	36.30	35.92	5.246	170.79	18.807	43.16
19.849	422.251	99.48	6.5	6.53	-18.39	94.8975	6.620	2.53	95.00	6.61	11	146.00	1.289	1.035	0.254	0.983	24.57	24.16	3.040	99.59	31.9422	40.31
20.177	421.923	121.55	7.95	6.54	-17.74	114.664	6.612	2.48	114.80	6.61	11	147.00	1.313	1.048	0.264	0.977	29.34	28.66	3.723	121.67	29.7886	41.30
20.505	421.595	160.73	12.29	7.65	-14.95	150.046	7.711	2.47	150.13	7.71	11	148.00	1.337	1.062	0.275	0.970	38.65	37.50	4.939	160.82	29.4577	42.67
20.833	421.267	215.14	14.59	6.78	-12.33	198.618	6.825	2.36	198.69	6.82	11	149.00	1.361	1.078	0.285	0.964	49.23	47.45	6.619	215.22	24.995	44.03
21.161	420.939	213.16	15.63	7.33	2.1	194.194	7.380	2.40	194.18	7.38	11	150.00	1.386	1.091	0.295	0.958	49.52	47.42	6.556	213.14	26.385	43.92
21.489	420.611	245.28	17.26	7.04	16.49	220.717	7.078	2.36	220.62	7.08	11	151.00	1.410	1.105	0.305	0.951	55.88	53.16	7.550	245.17	24.68	44.53
21.817	420.283	304.39	19.87	6.53	34.99	270.633	6.559	2.29	270.44	6.56	11	152.00	1.435	1.119	0.316	0.945	67.22	63.53	9.379	304.17	22.0175	45.47
22.145	419.955	331.65	17.77	5.36	221.32	291.141	5.382	2.20	289.92	5.40	11	153.00	1.460	1.134	0.326	0.939	70.29	66.00	10.223	330.27	18.9079	45.78

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Part 3

APPENDIX B

SUMMARY OF ENGINEERING PROPERTIES

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation — PROJECT NO. 080851

Estimation and Summary of Engineering Properties for Fine Coal Refuse — PAGE 1 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

CALCULATION BRIEF
FOR

ESTIMATION AND SUMMARY OF ENGINEERING PROPERTIES INCLUDING PEAK AND STEADY-STATE UNDRAINED SHEAR STRENGTH FOR REFUSE AND SUBGRADE MATERIALS

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH POND STAGE 2

OBJECTIVE: To estimate and summarize engineering properties for fine coal refuse materials samples obtained at the Pond Creek Coal Refuse Disposal site including unit weight (γ), specific gravity (G_s), effective strength, i.e., angle of internal friction (ϕ') and cohesion (c'), total strength, peak undrained shear strength (S_{up}), and steady-state undrained shear strength (S_{us}). The various strengths will be used in the South Pond abandonment analyses model(s).

REFERENCES:

1. Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Summary of Piezo-Seismic Cone Penetration Testing," Pond Creek Coal Refuse Disposal Site," BEG, 12/21/07.

2. Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Summary of Laboratory Testing – Fine Coal Refuse," Pond Creek Coal Refuse Disposal Site – South Pond," BEG, 7/10/08.

3. Alliance Consulting, Inc., "Appendix C Laboratory Testing, Proposed Coal Refuse Disposal Facility No. 2, Pond Creek Mine No. 1, Williamson County, Illinois."

4. Poulos, S.J., Castro, G., France, J.W. (1985), "Liquefaction Evaluation Procedure," Journal of Geotechnical Engineering, ASCE, 111(6), pp. 772-791.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation — PROJECT NO. 080851

Estimation and Summary of Engineering Properties for Fine Coal Refuse — PAGE 2 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MTS DATE 7/23/08

5. Genes, B.E., Keller, T.O., and Laird, J.P. (2000) "Steady State Liquefaction Susceptibility of High Hazard Upstream-Constructed Coal Refuse Disposal Facilities," Proceedings of Tailings Dams 2000, ASDSO/USCOLD, Las Vegas, NV, March 28-30, pp. 47-58.

6. Almes, R. A. and Butail, A. (1976) "Coal Refuse: Its Behavior Related to the Design and Operation of Coal Refuse Disposal Facilities," Proceedings of the Ohio River Valley Soils Seminar, Lexington, Kentucky, October, 1976.

7. Bowles, Joseph E. (1984) "Physical and Geotechnical Properties of Soils," Mc-Graw Hill. New York: 367-369 and 393-396.

SOIL PROPERTIES:

The following soil properties were estimated based on laboratory testing [Reference Numbers (Ref. Nos.) 2 and 3] performed for abandonment analyses and/or provided by Alliance Consulting, Inc. for previous deformation analyses, which are used in the various slope stability analyses and attached for information:

Refuse/Soil Properties

Description	Unit Weight (γ) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion [1] (c) (psf)	Comment
Coarse Refuse	130	36	0	Frictional
Fine Coal Refuse	85	36.9	0	Effective Strength (Drained)
		18.8	0	Total Strength (Undrained)
		0	Varies (See Below)	Steady-State (Undrained)
Residual Soil	125	19.5	400	Total Strength (Undrained)
		0	3000	80% Peak Undrained

Civil & Environmental Consultants, Inc.

PROJECT: Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Estimation and Summary of Engineering Properties
for Fine Coal Refuse

PROJECT NO. 080851

PAGE 3 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

LABORATORY-DERIVED S_{up} and S_{us}:

Two (2) consolidated – undrained (CU) triaxial series tests (3 points each) were performed on reconstituted bulk fine coal refuse slurry to determine effective and total strength parameters as well as peak (S_{up}) and steady-state (S_{us}) undrained shear strengths. Samples were prepared in the laboratory to simulate in-situ placement and consolidation. Samples were consolidated to a range of vertical effective stresses of about 5, 10 and 20 pounds per square inch (psi) [or 720 to 2880 pounds per square foot (psf)]. All specimens exhibited contractive behavior when sheared under undrained conditions. In general, all specimens reached, or nearly reached, a steady-state of deformation within the strain limits of the test equipment.

A total of 6 CU points comprise the (2) series from which peak and steady-state shear strength state. S_{us} represents the liquefied shear strength [i.e., the minimum (residual) strength available following a rapid loading event, such as an earthquake].

The following equations (Ref. No. 4) were used to calculate peak (S_{up}) and steady-state (S_{us}) shear strengths from laboratory test specimens:

Peak:

$S_{up} = q_{up} \cos \phi_p$

Or

$S_{up} = \sigma'_{3p} [\cos \phi_p \sin \phi_p] / (1 - \sin \phi_p)$

Steady-State:

$S_{us} = q_{us} \cos \phi_{us}$

Or

$S_{us} = \sigma'_{3s} [\cos \phi_{us} \sin \phi_{us}] / (1 - \sin \phi_{us})$

Civil & Environmental Consultants, Inc.

PROJECT **Williamson Energy Pond Creek – South Pond**
Phase 2 Abandonment Evaluation PROJECT NO. **080851**

Estimation and Summary of Engineering Properties PAGE 4 OF 6

for Fine Coal Refuse

MADE BY **BEG** DATE **7/12/08** CHECKED BY MJS DATE 7/23/08

Where,

q_{up} = shear stress on 45-degree plane at peak strain

ϕ_p = friction angle at peak = arcsin (q/p) at peak strain

σ'_{3p} = lateral effective stress at peak strain

q_{us} = shear stress on 45-degree plane at steady-state (max) strain

ϕ_{us} = friction angle at steady-state = arcsin (q/p) at max strain

σ'_{3us} = lateral effective stress at steady-state (max) strain

The following peak and steady-state data is presented from CU testing on bulk fine coal refuse samples Bucket 1 and Bucket 2 and applying the equations above. CU laboratory test results are attached.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Estimation and Summary of Engineering Properties
for Fine Coal Refuse

PROJECT NO. 080851

PAGE 5 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

Sample No.	Bucket 1 – Fine Coal Refuse			Bucket 2 – Fine Coal Refuse		
CU Test No. (Confining Pressure)	1 (5.2 psi)	2 (10.2 psi)	3 (20.4 psi)	1 (5.2 psi)	2 (10.4 psi)	3 (20.4 psi)
Parameter						
q_{up} (psi) @	4.61	7.54	10.82	3.37	5.73	11.67
Peak Strain (%)	18.4	13.4	13.5	10.3	14.2	8.4
ϕ_p (deg)	40.4	39.6	37.8	38.3	39.2	37.5
σ'_{3p} (psi)	2.5	4.3	6.8	2.1	3.3	7.5
S_{up} (psi)	3.51	5.81	8.55	2.64	4.44	9.26
q_{us} (psi) @	4.59	7.33	10.02	3.28	5.4	10.61
Max. Strain (%)	21.5	21.67	21.74	17.29	21.32	21.42
ϕ_{us} (deg)	40.4	39.0	36.7	36.3	38.6	35.7
σ'_{3us} (psi)	2.4	4.3	6.7	2.1	3.3	7.6
S_{us} (psi)	3.37	5.67	7.98	2.46	4.28	8.65

A plot of the S_{us} of the reconstituted coal refuse slurry samples versus vertical effective stress ($\sigma'v$) is presented in the attached Figure 1. The equivalent effective vertical stress was assumed to be 1.5 times the isotropic effective consolidation stress (i.e., 1.5*$\sigma'3$). A 2/3 – 1/3 relationship of the data was employed to yield an S_{us} to $\sigma'v$ relationship of $S_{us} = 0.28\ \sigma'v$. Ref. No. 5 and recent undisturbed/remolded fine coal refuse testing on other projects yielded a range of $S_{us} = 0.06$ to $0.28\ \sigma'v$, with an average of about $S_{us} = 0.22\ \sigma'v$. Since site specific testing was performed, a reasonable S_{us} to $\sigma'v$ relationship of $S_{us} = 0.24\ \sigma'v$ is considered realistic with some conservatism. The impounded/abandoned fine coal refuse in the South Pond will be modeled utilizing this relationship.

Civil & Environmental Consultants, Inc.

PROJECT **Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation** PROJECT NO. **080851**

Estimation and Summary of Engineering Properties for Fine Coal Refuse PAGE 6 OF 6

MADE BY **BEG** DATE **7/12/08** CHECKED BY MJS DATE 7/23/08

Subsequent slope stability analyses determine the magnitude of driving shear stress on a failure plane through the fine coal refuse impoundment to assess the required S_{us} to maintain equilibrium and assess the likelihood of a (liquefaction) flow failure. Post-earthquake slope stability of the embankment/impoundment is evaluated as well to assess the failure potential of the South Pond embankment using the abandonment geometry.

CONCLUSIONS

Laboratory undrained shear strength data from consolidated undrained triaxial tests of fine coal refuse were determined. Procedures were performed to estimate S_{up}, S_{us}, and a reasonable S_{us} to $\sigma'v$ relationship of $S_{us} = 0.24\ \sigma'v$ for the material. The results of the laboratory testing indicated Sup and Sus reach their peak and steady-state strength at high strains, and there is very little drop off with increasing strain. Further, Sup and Sus values generally indicated resistance to flow. Thus, the results suggest undrained strengths of the fine coal refuse will be maintained at or near peak levels during an undrained event such as an earthquake, and the susceptibility of the impounded fine coal refuse to a liquefaction flow failure is a function of both the undrained strength (worst case steady-state strength) and the in-situ driving shear stress on a critical failure plane through the fine refuse material.

Based on this information, the properties evaluated/developed in Ref. No. 2 for fine coal refuse, as well as coarse refuse and residual soil, indicated the South Pond fine coal refuse has sufficient steady-state shear strength to limit the flowability of the material. The likelihood of a flow failure associated with the abandonment scenario will be assessed in a subsequent calculation brief by evaluating the driving shear stress and factor of safety against liquefaction in the fine coal refuse.

POND CREEK PHASE 2 SOUTH POND
STEADY-STATE UNDRAINED SHEAR STRENGTH-TO-EFFECTIVE STRESS RELATIONSHIP

Pond Creek Phase 2 South Pond
Steady-State Undrained Strength vs. Vertical Effective Stress

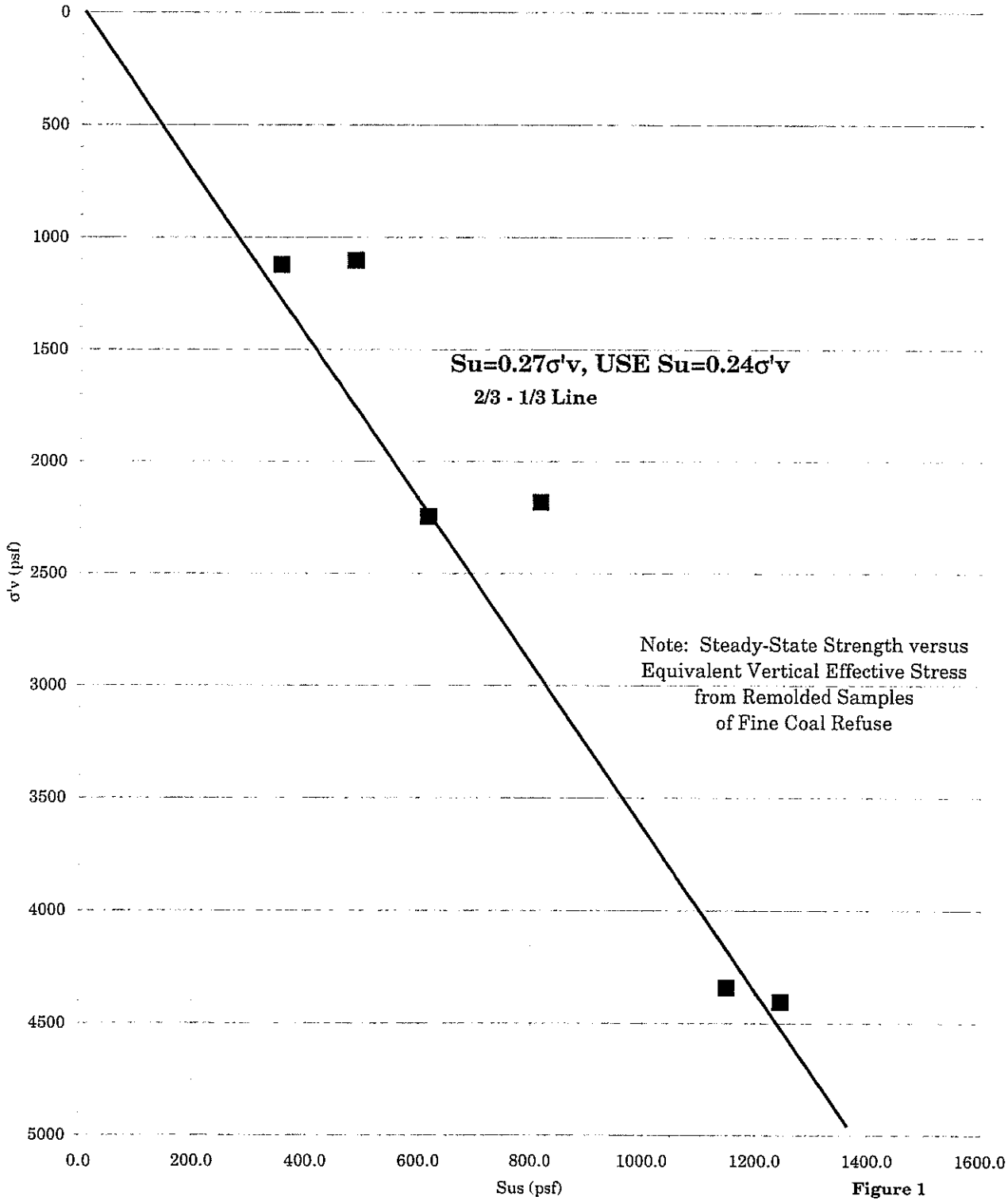

Figure 1

POND CREEK – SOUTH POND
CONSOLIDATED – UNDRAINED TRIAXIAL LABORATORY TESTING RESULTS FOR FINE COAL REFUSE

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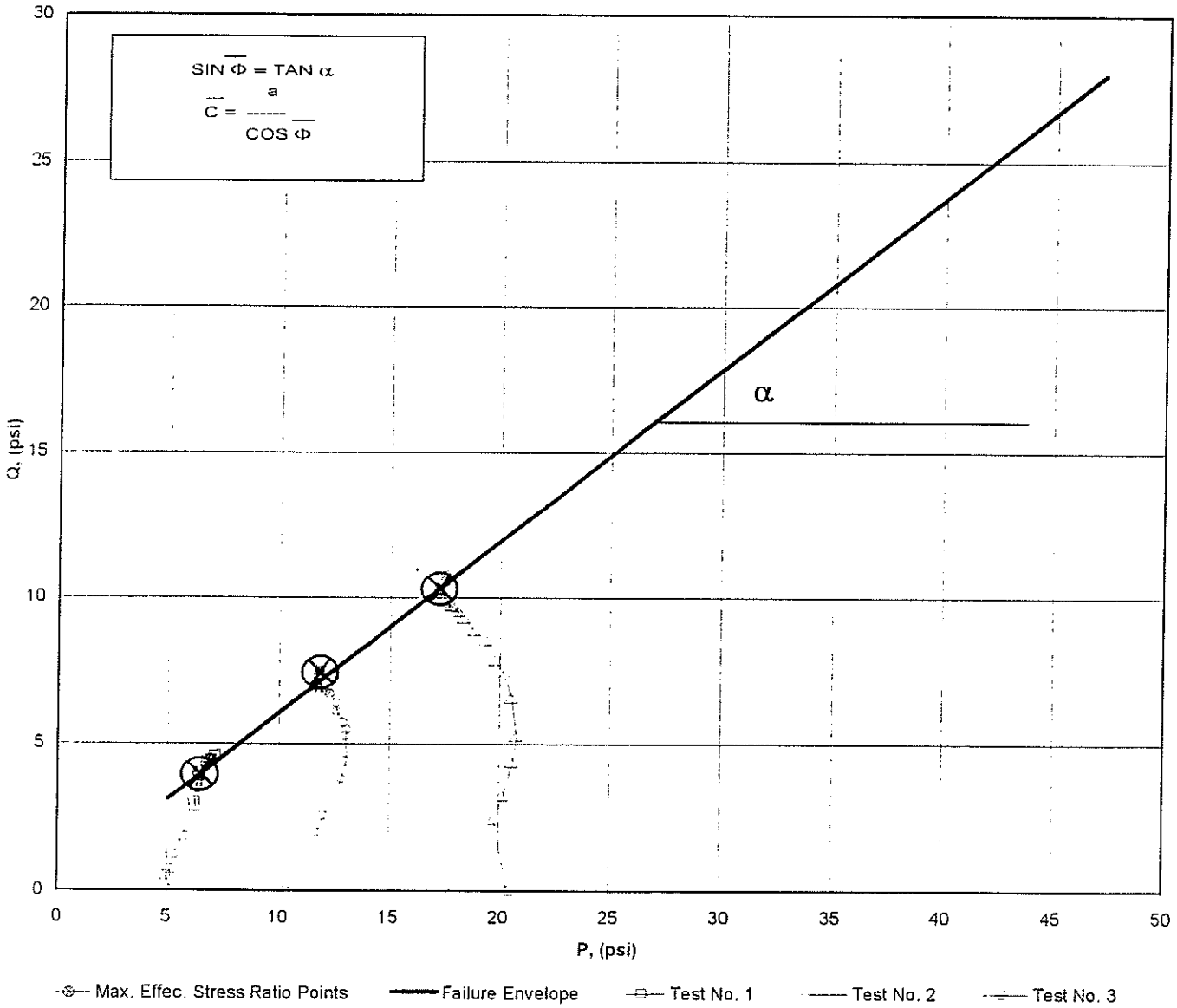
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	30.5	$\bar{\Phi}$	=	36.14

Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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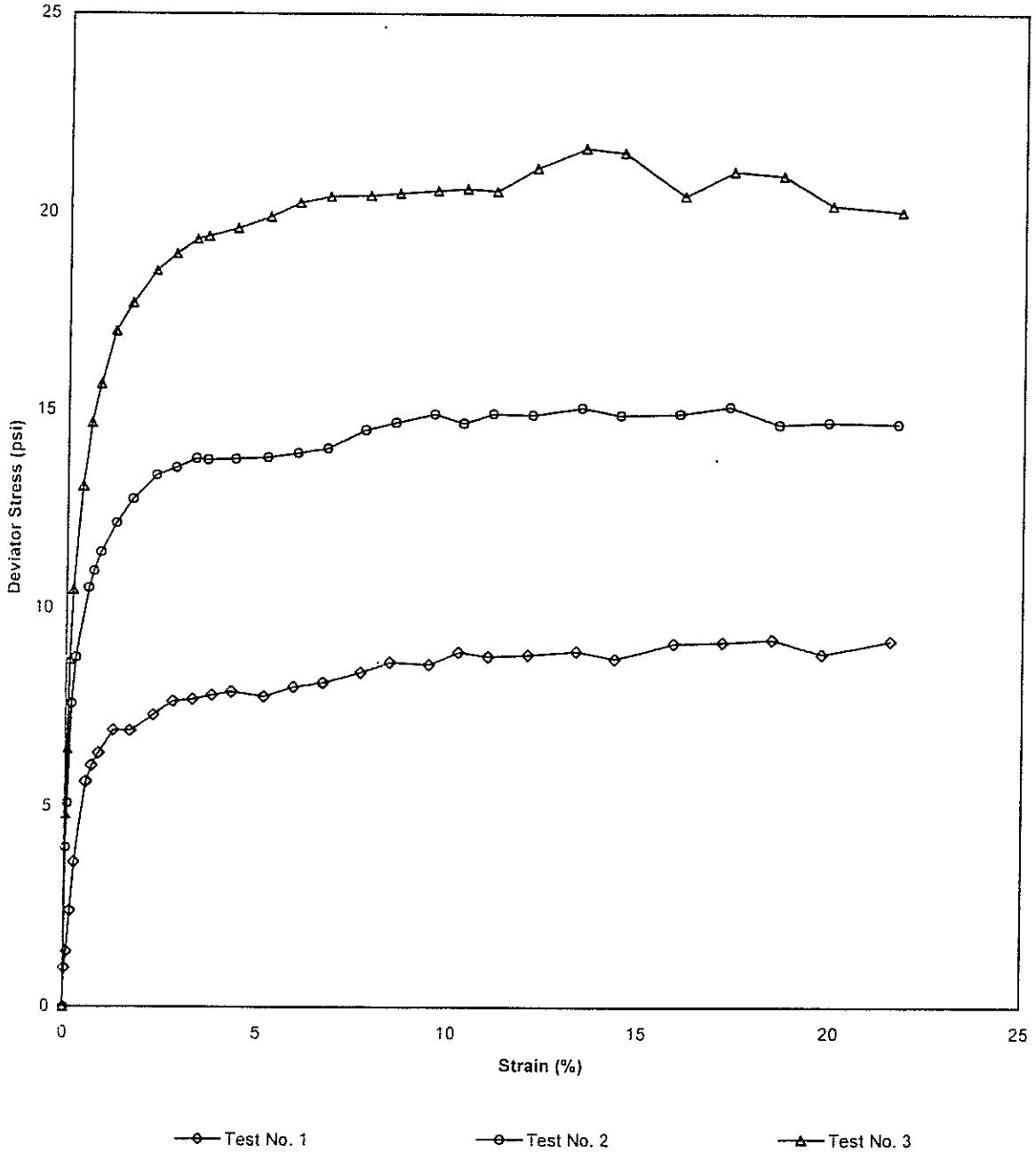
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	1

PRESSURES (psi)

Cell Pressure(psi)	36.6
Back Pressure(psi)	31.4
Eff. Cons. Pressure(psi)	5.2
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\bar{P}$	=	6.41
Q	=	3.95

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.140	Diameter 1	1.375
Length 2	3.148	Diameter 2	1.389
Length 3	3.151	Diameter 3	1.399
Avg Leng.=	3.146	Avg. Diam.=	1.388

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.7
Final Change (ml)	2.3

Initial Dial Reading (D.R.), mils	235
D.R. After Saturation, mils	250
D.R. After Consolidation, mils	294

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.4
8.2	0.001	32.1
8.8	0.002	32.1
10.3	0.005	32.5
12.1	0.008	32.8
15.1	0.016	33.2
15.8	0.020	33.4
16.2	0.026	33.6
17 1	0.038	33.7
17.2	0.051	33.8
17.8	0.069	33.9
18.4	0.085	34.0
18.5	0.101	34.0
18.8	0.116	34.1
19.0	0.132	34.1
18.9	0.158	34.1
19.4	0.182	34.2
19.6	0.205	34.2
20.2	0.236	34.2
20.7	0.260	34.2
20.8	0.292	34.1
21.4	0.316	34.3
21.4	0.340	34.1
21.6	0.371	34.1
22.0	0.411	34.1
21.8	0.443	34.1
22.8	0.490	34.1
23.1	0.530	34.2
23.5	0.569	34.1
23.1	0.610	34.1
24.0	0.664	34.2

Tested By JCM Date 05/21/08 Input Checked By MB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.2	*Stage No.*	1
		Test No	1

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.51
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.55
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.474

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	0.98	0.73	5.45	4.5	1.219	0.76	4.96	0.49
0.07	1.39	0.75	5.84	4.5	1.311	0.55	5.14	0.69
0.15	2.40	1.15	6.46	4.1	1.593	0.49	5.25	1.20
0.25	3.62	1.36	7.46	3.8	1.941	0.38	5.65	1.81
0.52	5.63	1.79	9.04	3.4	2.649	0.32	6.23	2.81
0.66	6.03	2.01	9.22	3.2	2.893	0.34	6.20	3.02
0.84	6.35	2.21	9.34	3.0	3.125	0.36	6.16	3.18
1.22	6.92	2.33	9.79	2.9	3.417	0.34	6.33	3.46
1.64	6.91	2.40	9.71	2.8	3.469	0.35	6.26	3.46
2.25	7.31	2.55	9.96	2.7	3.753	0.36	6.31	3.65
2.75	7.66	2.61	10.25	2.6	3.961	0.35	6.42	3.83
3.27	7.71	2.64	10.26	2.6	4.017	0.35	6.41	3.85
3.77	7.81	2.68	10.34	2.5	4.098	0.35	6.43	3.91
4.28	7.90	2.74	10.37	2.5	4.208	0.35	6.41	3.95
5.11	7.78	2.71	10.27	2.5	4.124	0.36	6.38	3.89
5.89	8.02	2.84	10.38	2.4	4.400	0.36	6.37	4.01
6.65	8.13	2.78	10.56	2.4	4.359	0.35	6.49	4.07
7.66	8.39	2.83	10.76	2.4	4.538	0.34	6.56	4.19
8.42	8.64	2.76	11.09	2.4	4.536	0.33	6.77	4.32
9.45	8.59	2.72	11.07	2.5	4.464	0.32	6.77	4.29
10.23	8.90	2.86	11.25	2.3	4.797	0.33	6.79	4.45
11.00	8.80	2.67	11.33	2.5	4.474	0.31	6.93	4.40
12.03	8.83	2.74	11.29	2.5	4.594	0.32	6.87	4.42
13.30	8.93	2.72	11.41	2.5	4.601	0.31	6.94	4.46
14.34	8.73	2.69	11.25	2.5	4.477	0.31	6.88	4.37
15.88	9.12	2.66	11.66	2.5	4.587	0.30	7.10	4.56
17.15	9.15	2.77	11.59	2.4	4.762	0.31	7.01	4.58
18.44	9.22	2.70	11.72	2.5	4.691	0.30	7.11	4.61
19.74	8.86	2.70	11.36	2.5	4.536	0.31	6.93	4.43
21.51	9.19	2.82	11.56	2.4	4.864	0.31	6.97	4.59

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R15259

CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	2

PRESSURES (psi)

Cell Pressure(psi)	46.5
Back Pressure(psi)	36.1
Eff. Cons. Pressure(ps	10.4
Pore Pressure Response (%)	100

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	11.84
Q	=	7.45

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.120	Diameter 1	1.396
Length 2	3.137	Diameter 2	1.398
Length 3	3.135	Diameter 3	1.344
Avg Leng.=	3.131	Avg. Diam.=	1.379

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	18.4
Final Change (ml)	5.6

Initial Dial Reading (D.R.), mils	77
D.R. After Saturation, mils	112
D.R. After Consolidation, mils	166

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.9	0.000	36.1
13.4	0.001	36.8
14.9	0.002	37.0
18.3	0.005	37.4
20.0	0.008	37.8
22.4	0.017	38.7
23.0	0.020	38.9
23.7	0.026	39.3
24.8	0.038	39.9
25.7	0.051	40.3
26.7	0.069	40.9
27.1	0.085	41.1
27.5	0.100	41.3
27.5	0.110	41.5
27.7	0.131	41.6
27.9	0.157	41.8
28.2	0.181	41.9
28.6	0.204	41.9
29.5	0.235	42.0
30.0	0.259	42.1
30.5	0.290	42.1
30.4	0.313	42.0
31.0	0.337	42.1
31.2	0.368	42.0
31.8	0.408	42.2
31.8	0.439	42.1
32.3	0.486	42.1
33.0	0.526	42.2
32.6	0.565	42.1
33.1	0.604	42.2
33.6	0.659	42.2

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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R15260

CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.4	*Stage No.*	1
		Test No	2

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.49
Initial Sample Volume (in^3)	4.68

VOLUME CHANGE

Volume After Consolidation (in^3)	4.18
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.03	3.98	0.65	13.73	9.7	1.408	0.16	11.74	1.99
0.06	5.09	0.89	14.59	9.5	1.535	0.18	12.05	2.54
0.15	7.59	1.34	16.65	9.1	1.838	0.18	12.85	3.79
0.25	8.76	1.72	17.44	8.7	2.010	0.20	13.06	4.38
0.54	10.51	2.62	18.29	7.8	2.351	0.25	13.04	5.26
0.67	10.94	2.79	18.56	7.6	2.438	0.25	13.08	5.47
0.86	11.42	3.19	18.64	7.2	2.584	0.28	12.92	5.71
1.25	12.16	3.85	18.71	6.6	2.856	0.32	12.63	6.08
1.67	12.77	4.19	18.98	6.2	3.055	0.33	12.60	6.38
2.28	13.37	4.77	19.00	5.6	3.373	0.36	12.32	6.68
2.79	13.56	5.04	18.92	5.4	3.530	0.37	12.14	6.78
3.30	13.79	5.25	18.94	5.2	3.675	0.38	12.05	6.89
3.60	13.76	5.40	18.76	5.0	3.751	0.39	11.88	6.88
4.32	13.77	5.50	18.67	4.9	3.812	0.40	11.79	6.89
5.16	13.82	5.69	18.52	4.7	3.934	0.41	11.62	6.91
5.95	13.93	5.80	18.52	4.6	4.029	0.42	11.56	6.96
6.72	14.04	5.83	18.61	4.6	4.072	0.42	11.59	7.02
7.73	14.51	5.87	19.04	4.5	4.205	0.40	11.78	7.26
8.52	14.69	6.01	19.08	4.4	4.349	0.41	11.73	7.35
9.54	14.91	6.01	19.30	4.4	4.397	0.40	11.84	7.45
10.30	14.68	5.94	19.15	4.5	4.289	0.40	11.80	7.34
11.07	14.93	6.00	19.33	4.4	4.390	0.40	11.87	7.46
12.10	14.89	5.95	19.34	4.5	4.346	0.40	11.90	7.45
13.40	15.08	6.10	19.38	4.3	4.506	0.40	11.84	7.54
14.44	14.89	6.03	19.25	4.4	4.410	0.41	11.81	7.44
15.98	14.92	5.99	19.34	4.4	4.381	0.40	11.88	7.46
17.28	15.10	6.12	19.38	4.3	4.528	0.41	11.83	7.55
18.58	14.65	5.96	19.09	4.4	4.303	0.41	11.76	7.33
19.86	14.71	6.07	19.04	4.3	4.398	0.41	11.68	7.35
21.67	14.66	6.08	18.99	4.3	4.393	0.41	11.65	7.33

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	3

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	20.4
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\bar{P}$	=	17.19
Q	=	10.31

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.130	Diameter 1	1.404
Length 2	3.121	Diameter 2	1.373
Length 3	3.136	Diameter 3	1.371
Avg Leng.=	3.129	Avg. Diam.=	1.383

VOLUME CHANGE

Initial Burette Reading (ml)	48.0
Final Burette Reading (ml)	40.5
Final Change (ml)	7.5

Initial Dial Reading (D.R.), mils	60
D.R. After Saturation, mils	68
D.R. After Consolidation, mils	154

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.0
13.5	0.001	34.0
15.7	0.002	34.5
18.9	0.003	35.2
21.3	0.005	35.9
25.0	0.011	37.4
27.3	0.017	38.5
28.7	0.024	39.4
30.6	0.036	40.5
31.7	0.049	41.4
33.1	0.067	42.3
33.8	0.083	42.8
34.5	0.099	43.2
34.7	0.108	43.4
35.2	0.131	43.7
35.9	0.157	44.0
36.6	0.180	44.2
37.1	0.204	44.3
37.5	0.236	44.4
37.8	0.260	44.4
38.3	0.290	44.5
38.7	0.314	44.5
38.8	0.337	44.5
40.1	0.369	44.6
41.4	0.408	44.6
41.7	0.440	44.6
40.5	0.488	44.6
42.1	0.527	44.6
42.5	0.566	44.6
41.7	0.605	44.6
42.3	0.660	44.7

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.4	*Stage No.*	1
		Test No	3

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.20
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.385

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma}_1$	$\overline{\sigma}_3$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	4.82	3.04	22.17	17.4	1.278	0.64	19.76	2.41
0.05	6.44	3.45	23.39	16.9	1.380	0.54	20.17	3.22
0.10	8.70	4.15	24.95	16.2	1.536	0.48	20.60	4.35
0.17	10.46	4.86	26.01	15.5	1.673	0.47	20.77	5.23
0.37	13.09	6.38	27.10	14.0	1.934	0.49	20.56	6.54
0.58	14.68	7.49	27.59	12.9	2.137	0.52	20.25	7.34
0.80	15.66	8.40	27.66	12.0	2.305	0.54	19.83	7.83
1.18	17.01	9.52	27.89	10.9	2.563	0.57	19.38	8.50
1.61	17.71	10.40	27.71	10.0	2.772	0.59	18.85	8.86
2.22	18.54	11.31	27.63	9.1	3.039	0.62	18.36	9.27
2.74	18.96	11.76	27.60	8.6	3.196	0.63	18.12	9.48
3.26	19.34	12.21	27.53	8.2	3.361	0.64	17.86	9.67
3.57	19.40	12.35	27.45	8.0	3.411	0.64	17.75	9.70
4.31	19.60	12.73	27.27	7.7	3.556	0.66	17.47	9.80
5.17	19.89	12.96	27.33	7.4	3.676	0.66	17.38	9.95
5.94	20.25	13.15	27.50	7.2	3.795	0.66	17.37	10.13
6.73	20.42	13.27	27.54	7.1	3.864	0.66	17.34	10.21
7.78	20.44	13.38	27.46	7.0	3.912	0.66	17.24	10.22
8.55	20.50	13.40	27.50	7.0	3.928	0.66	17.25	10.25
9.57	20.57	13.48	27.49	6.9	3.973	0.66	17.20	10.28
10.34	20.62	13.52	27.50	6.9	3.995	0.66	17.19	10.31
11.11	20.56	13.51	27.45	6.9	3.982	0.66	17.17	10.28
12.15	21.14	13.55	27.99	6.8	4.088	0.65	17.42	10.57
13.45	21.64	13.57	28.47	6.8	4.170	0.63	17.65	10.82
14.49	21.53	13.56	28.36	6.8	4.149	0.64	17.60	10.76
16.07	20.44	13.58	27.26	6.8	3.997	0.67	17.04	10.22
17.35	21.06	13.58	27.88	6.8	4.086	0.65	17.35	10.53
18.64	20.95	13.63	27.72	6.8	4.094	0.66	17.25	10.48
19.92	20.20	13.64	26.96	6.8	3.988	0.68	16.86	10.10
21.74	20.03	13.67	26.77	6.7	3.975	0.69	16.75	10.02

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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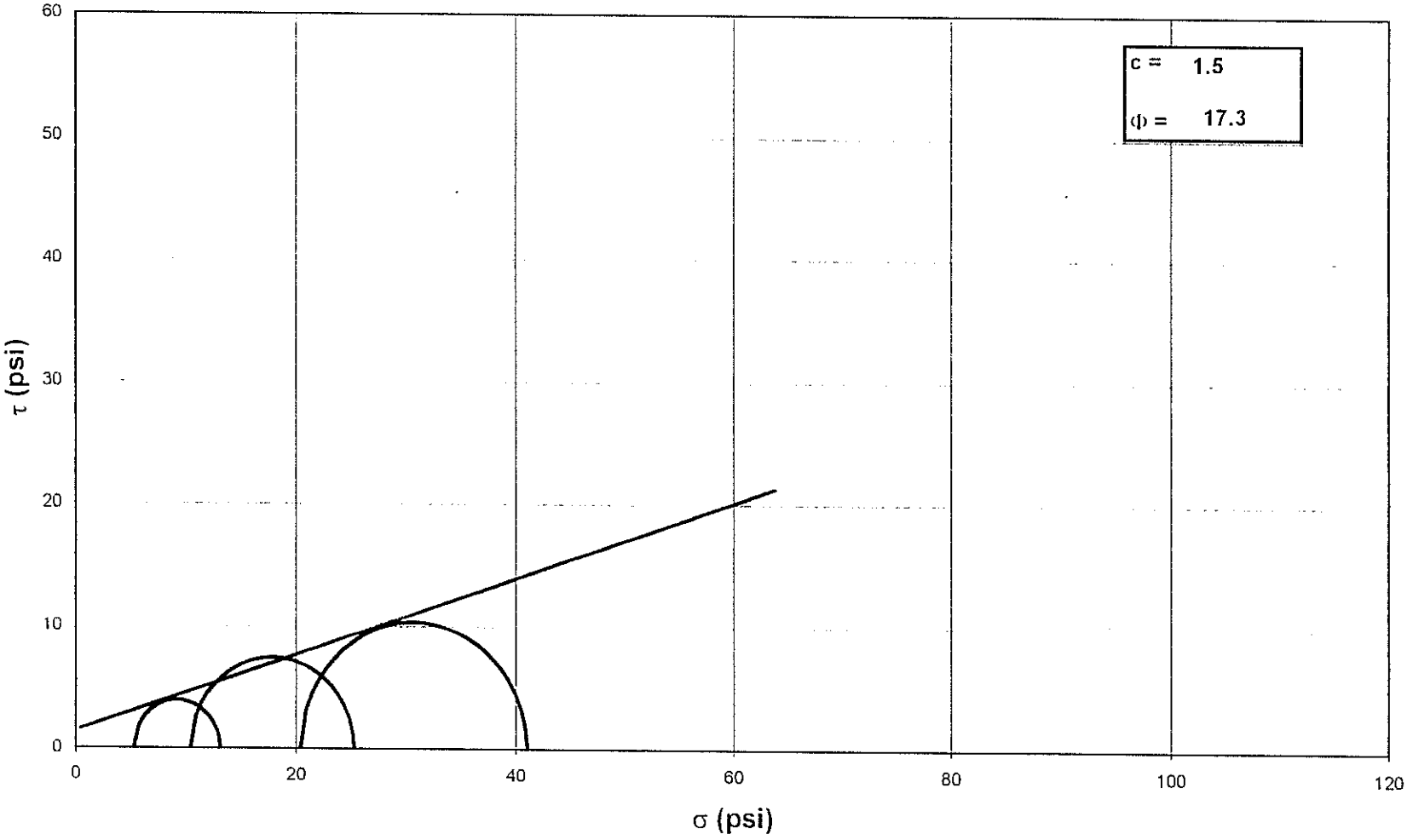
MOHR TOTAL STRENGTH ENVELOPE

Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/19/08

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R15263

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	82.6	82.7	79.5
Total Unit Weight (pcf)	76.6	84.2	80.5
Dry Unit Weight (pcf)	42.0	46.1	44.8
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	2.333	2.035	2.119

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	41.7	43.3	42.4
Total Unit Weight (pcf)	102.0	102.5	101.8
Dry Unit Weight (pcf)	71.9	71.5	71.5
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	0.944	0.955	0.956

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

DCN: GT-S28 DATE 6-25-98 REVISION 1

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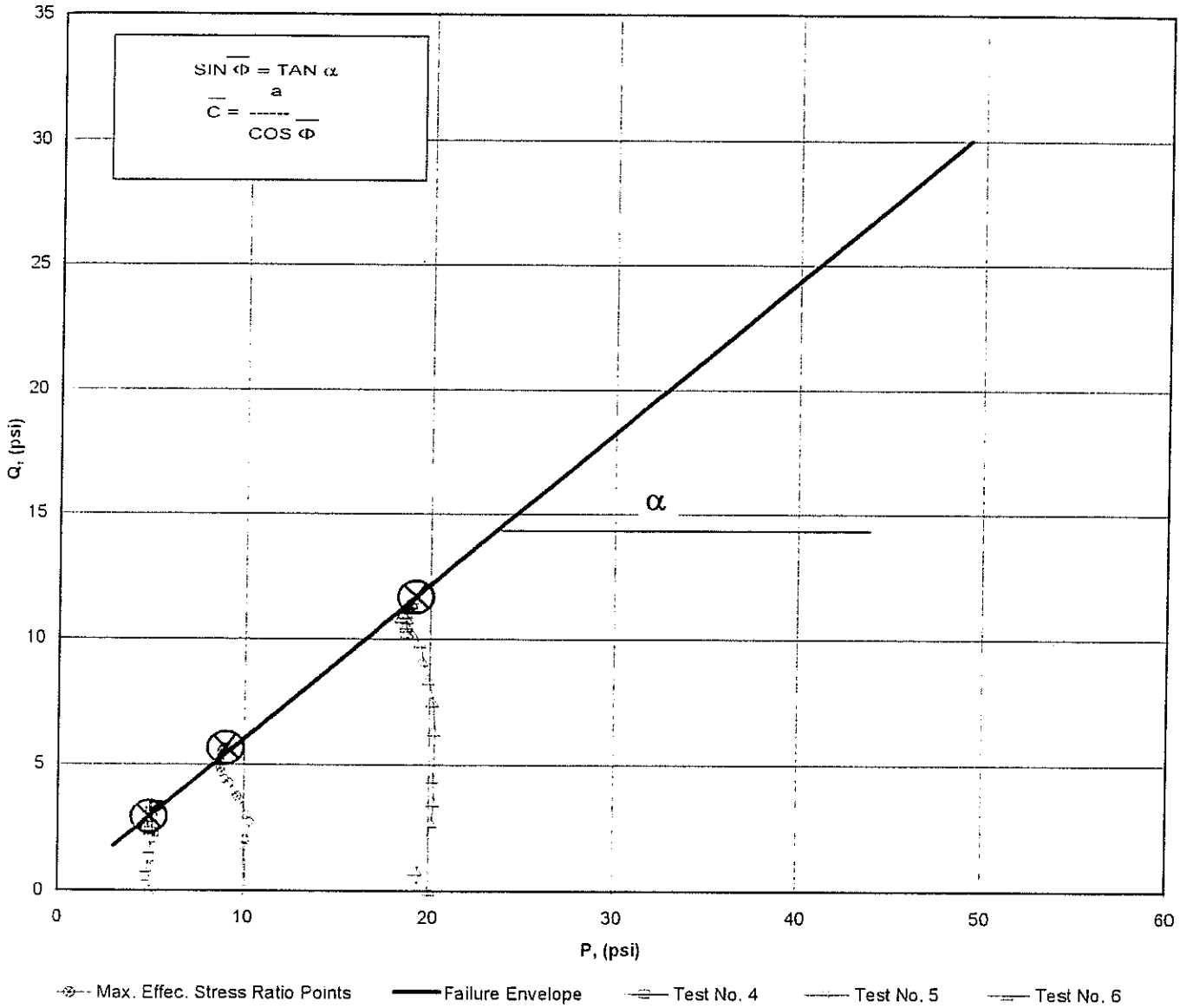
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	31.5	$\bar{\Phi}$	=	37.71

Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

DCN CT-S28 DATE 6-25-98 REVISION 1

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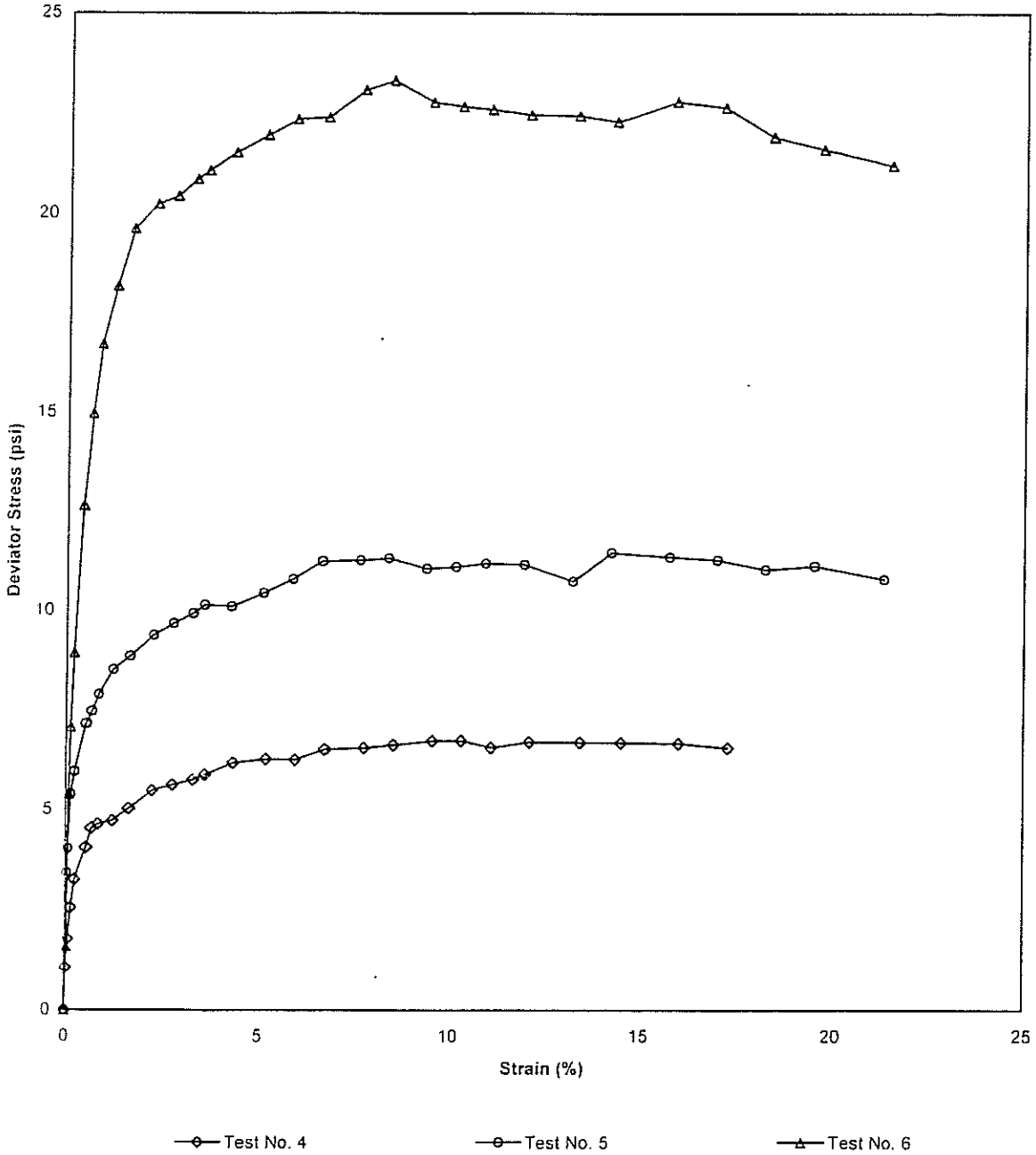
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	4

PRESSURES (psi)

Cell Pressure(psi)	36.3
Back Pressure(psi)	31.2
Eff. Cons. Pressure(psi)	5.1
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\bar{P}$	=	4.92
Q	=	2.94

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.150	Diameter 1	1.453
Length 2	3.142	Diameter 2	1.463
Length 3	3.147	Diameter 3	1.461
Avg Leng.=	3.146	Avg. Diam.=	1.459

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.9
Final Change (ml)	2.1

Initial Dial Reading (D.R.), mils	54
D.R. After Saturation, mils	110
D.R. After Consolidation, mils	130

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.6	0.000	31.2
9.3	0.001	32.1
10.4	0.002	32.3
11.6	0.005	32.6
12.8	0.008	32.9
14.0	0.016	33.3
14.8	0.020	33.3
15.0	0.025	33.6
15.2	0.037	33.8
15.7	0.050	33.9
16.5	0.068	34.2
16.7	0.084	34.2
17.0	0.100	34.2
17.2	0.110	34.3
17.8	0.133	34.2
18.1	0.159	34.3
18.1	0.182	34.3
18.6	0.205	34.2
18.8	0.237	34.2
19.0	0.261	34.3
19.3	0.293	34.3
19.5	0.316	34.2
19.3	0.340	34.3
19.7	0.372	34.2
19.8	0.412	34.3
19.9	0.445	34.3
20.1	0.491	34.2
20.1	0.531	34.2

Tested By JCM Date 05/27/08 Input Checked By HB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.1	*Stage No.*	1
		Test No	4

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.46
Initial Sample Area (in^2)	1.67
Initial Sample Volume (in^3)	5.26

VOLUME CHANGE

Volume After Consolidation (in^3)	4.85
Length After Consolidation (in)	3.07
Area After Consolidation (in^2)	1.580

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	1.06	0.90	5.26	4.2	1.253	0.86	4.73	0.53
0.07	1.77	1.15	5.72	4.0	1.449	0.66	4.84	0.89
0.15	2.55	1.44	6.21	3.7	1.698	0.58	4.94	1.28
0.25	3.26	1.71	6.65	3.4	1.959	0.53	5.02	1.63
0.53	4.05	2.11	7.04	3.0	2.358	0.53	5.01	2.03
0.65	4.54	2.14	7.50	3.0	2.531	0.48	5.23	2.27
0.82	4.65	2.39	7.36	2.7	2.712	0.52	5.04	2.32
1.21	4.72	2.58	7.25	2.5	2.873	0.56	4.89	2.36
1.62	5.03	2.72	7.42	2.4	3.112	0.55	4.90	2.52
2.22	5.48	2.95	7.63	2.1	3.550	0.55	4.89	2.74
2.74	5.62	3.02	7.70	2.1	3.705	0.55	4.89	2.81
3.27	5.75	3.04	7.81	2.1	3.790	0.54	4.93	2.87
3.59	5.88	3.12	7.86	2.0	3.968	0.54	4.92	2.94
4.33	6.18	3.02	8.27	2.1	3.967	0.50	5.17	3.09
5.17	6.27	3.08	8.30	2.0	4.101	0.50	5.16	3.14
5.93	6.25	3.13	8.22	2.0	4.176	0.51	5.10	3.13
6.69	6.51	3.03	8.58	2.1	4.152	0.48	5.32	3.26
7.73	6.56	3.04	8.62	2.1	4.176	0.47	5.34	3.28
8.50	6.63	3.14	8.59	2.0	4.380	0.48	5.27	3.31
9.53	6.72	3.14	8.68	2.0	4.436	0.48	5.32	3.36
10.30	6.74	3.03	8.81	2.1	4.256	0.46	5.44	3.37
11.09	6.56	3.07	8.59	2.0	4.235	0.48	5.31	3.28
12.10	6.71	3.03	8.78	2.1	4.233	0.46	5.43	3.35
13.42	6.69	3.06	8.74	2.0	4.281	0.47	5.39	3.35
14.49	6.68	3.10	8.68	2.0	4.342	0.47	5.34	3.34
16.00	6.66	3.02	8.74	2.1	4.204	0.46	5.41	3.33
17.29	6.55	3.03	8.62	2.1	4.171	0.47	5.34	3.28

Tested By JCM Date 05/27/08 Input Checked By KR Date 6-19-08

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R15270

CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	5

PRESSURES (psi)

Cell Pressure(psi)	41.1
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	10.1
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	9.00
Q	=	5.66

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.138	Diameter 1	1.407
Length 2	3.138	Diameter 2	1.383
Length 3	3.137	Diameter 3	1.378
Avg Leng.=	3.138	Avg. Diam.=	1.389

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	20.2
Final Change (ml)	3.8

Initial Dial Reading (D.R.), mils	88
D.R. After Saturation, mils	94
D.R. After Consolidation, mils	124

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
8.5	0.000	31.0
13.5	0.001	32.8
14.3	0.002	33.0
16.3	0.004	33.4
17.2	0.007	33.9
18.9	0.016	34.9
19.4	0.020	35.2
20.0	0.025	35.6
21.0	0.038	36.1
21.5	0.051	36.6
22.4	0.070	37.0
22.9	0.085	37.2
23.4	0.101	37.4
23.7	0.110	37.4
23.8	0.132	37.5
24.5	0.158	37.6
25.1	0.181	37.7
26.0	0.205	37.7
26.2	0.236	37.7
26.4	0.259	37.8
26.2	0.290	37.7
26.4	0.314	37.8
26.7	0.338	37.8
26.9	0.370	37.8
26.5	0.410	37.8
27.9	0.441	37.8
28.0	0.488	37.8
28.2	0.527	37.8
28.1	0.566	37.8
28.5	0.605	37.8
28.4	0.661	37.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

DCN CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.1	*Stage No.*	1
		Test No	5

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.52
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.50
Length After Consolidation (in)	3.10
Area After Consolidation (in^2)	1.450

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	3.42	1.75	11.77	8.3	1.410	0.52	10.06	1.71
0.06	4.03	2.01	12.12	8.1	1.497	0.50	10.11	2.01
0.13	5.39	2.43	13.05	7.7	1.703	0.46	10.36	2.69
0.23	5.96	2.92	13.13	7.2	1.830	0.50	10.16	2.98
0.51	7.15	3.87	13.37	6.2	2.148	0.55	9.80	3.57
0.64	7.46	4.19	13.37	5.9	2.262	0.57	9.64	3.73
0.82	7.88	4.57	13.41	5.5	2.427	0.59	9.47	3.94
1.21	8.51	5.13	13.48	5.0	2.714	0.61	9.22	4.26
1.63	8.84	5.57	13.38	4.5	2.950	0.64	8.96	4.42
2.24	9.37	5.97	13.50	4.1	3.271	0.64	8.81	4.69
2.75	9.67	6.18	13.59	3.9	3.468	0.65	8.75	4.84
3.25	9.92	6.35	13.66	3.7	3.648	0.65	8.70	4.96
3.56	10.14	6.40	13.83	3.7	3.741	0.64	8.76	5.07
4.26	10.10	6.55	13.65	3.6	3.843	0.66	8.60	5.05
5.08	10.44	6.59	13.95	3.5	3.978	0.64	8.73	5.22
5.85	10.80	6.68	14.21	3.4	4.161	0.63	8.81	5.40
6.60	11.25	6.70	14.65	3.4	4.304	0.60	9.03	5.62
7.60	11.27	6.75	14.63	3.4	4.363	0.60	8.99	5.64
8.34	11.32	6.76	14.66	3.3	4.395	0.60	9.00	5.66
9.36	11.06	6.74	14.42	3.4	4.292	0.62	8.89	5.53
10.13	11.11	6.76	14.46	3.3	4.323	0.61	8.90	5.56
10.91	11.20	6.81	14.49	3.3	4.401	0.61	8.89	5.60
11.94	11.17	6.80	14.47	3.3	4.383	0.62	8.88	5.58
13.21	10.75	6.76	14.09	3.3	4.214	0.64	8.72	5.37
14.21	11.47	6.77	14.80	3.3	4.445	0.60	9.06	5.73
15.72	11.35	6.78	14.67	3.3	4.418	0.60	9.00	5.68
16.98	11.28	6.79	14.59	3.3	4.411	0.61	8.95	5.64
18.25	11.04	6.80	14.33	3.3	4.350	0.62	8.81	5.52
19.51	11.13	6.82	14.40	3.3	4.397	0.62	8.84	5.56
21.32	10.80	6.85	14.05	3.3	4.318	0.64	8.65	5.40

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	6

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.3
Eff. Cons. Pressure(ps	20.1
Pore Pressure Response (%)	97

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	19.19
Q	=	11.67

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.142	Diameter 1	1.379
Length 2	3.130	Diameter 2	1.377
Length 3	3.141	Diameter 3	1.386
Avg Leng.=	3.138	Avg. Diam.=	1.381

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	17.7
Final Change (ml)	6.3

Initial Dial Reading (D.R.), mils	40
D.R. After Saturation, mils	56
D.R. After Consolidation, mils	91

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
4.3	0.000	31.3
6.5	0.001	32.8
11.7	0.002	33.9
14.0	0.004	34.7
16.6	0.006	35.6
21.7	0.012	37.4
25.0	0.019	38.7
27.5	0.026	39.8
29.6	0.038	40.9
31.7	0.051	41.7
32.8	0.070	42.4
33.2	0.085	42.8
33.9	0.101	43.1
34.3	0.110	43.2
35.2	0.132	43.4
36.1	0.157	43.7
37.0	0.181	43.7
37.3	0.205	43.8
38.7	0.236	43.8
39.3	0.259	43.9
38.9	0.291	43.8
39.0	0.316	43.9
39.2	0.340	43.9
39.4	0.371	43.8
39.9	0.410	43.8
40.1	0.441	43.9
41.5	0.489	43.8
41.9	0.528	43.7
41.2	0.568	43.8
41.3	0.608	43.8
41.4	0.663	43.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.1	*Stage No.*	1
		Test No	6

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.24
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma}_1$	$\overline{\sigma}_3$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	1.58	1.52	20.16	18.6	1.085	0.99	19.37	0.79
0.07	5.38	2.62	22.86	17.5	1.308	0.50	20.17	2.69
0.12	7.06	3.36	23.80	16.7	1.422	0.49	20.27	3.53
0.19	8.92	4.30	24.73	15.8	1.565	0.50	20.26	4.46
0.40	12.65	6.12	26.62	14.0	1.905	0.50	20.30	6.32
0.61	14.97	7.35	27.72	12.7	2.174	0.51	20.23	7.48
0.85	16.72	8.47	28.36	11.6	2.438	0.52	19.99	8.36
1.24	18.18	9.56	28.72	10.5	2.724	0.54	19.63	9.09
1.64	19.63	10.41	29.32	9.7	3.025	0.55	19.51	9.81
2.26	20.24	11.15	29.19	9.0	3.262	0.57	19.07	10.12
2.77	20.44	11.54	29.00	8.6	3.388	0.58	18.78	10.22
3.26	20.87	11.82	29.15	8.3	3.521	0.58	18.71	10.43
3.58	21.09	11.94	29.25	8.2	3.584	0.58	18.70	10.54
4.27	21.54	12.14	29.50	8.0	3.705	0.58	18.73	10.77
5.09	21.97	12.38	29.69	7.7	3.846	0.58	18.71	10.99
5.86	22.37	12.43	30.04	7.7	3.918	0.57	18.85	11.19
6.64	22.41	12.54	29.98	7.6	3.962	0.58	18.77	11.21
7.63	23.10	12.49	30.71	7.6	4.034	0.56	19.16	11.55
8.39	23.33	12.58	30.85	7.5	4.102	0.56	19.19	11.67
9.43	22.79	12.55	30.34	7.6	4.018	0.57	18.95	11.39
10.22	22.67	12.59	30.18	7.5	4.021	0.57	18.84	11.34
11.00	22.61	12.56	30.14	7.5	4.001	0.57	18.84	11.30
12.01	22.49	12.53	30.05	7.6	3.973	0.57	18.81	11.24
13.28	22.46	12.52	30.04	7.6	3.961	0.57	18.81	11.23
14.28	22.30	12.63	29.77	7.5	3.986	0.58	18.62	11.15
15.84	22.80	12.50	30.40	7.6	4.001	0.57	19.00	11.40
17.12	22.66	12.41	30.35	7.7	3.948	0.56	19.02	11.33
18.40	21.92	12.46	29.57	7.6	3.868	0.59	18.61	10.96
19.69	21.62	12.51	29.21	7.6	3.846	0.60	18.40	10.81
21.49	21.21	12.54	28.77	7.6	3.805	0.61	18.17	10.61

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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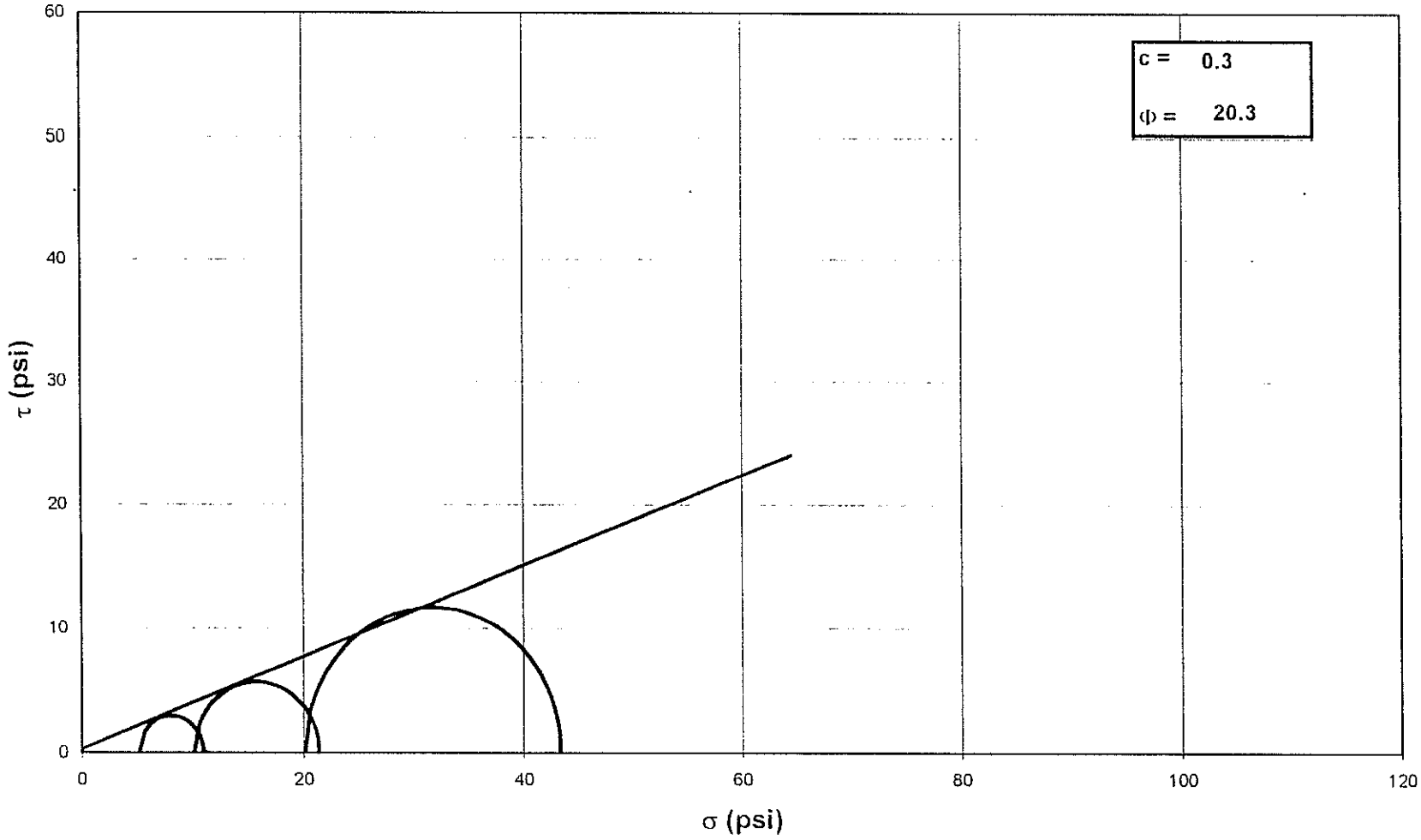
MOHR TOTAL STRENGTH ENVELOPE

Geotechnics

Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/14/08

#N/A

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R15274

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	82.9	85.7	83.0
Total Unit Weight (pcf)	82.6	82.2	84.5
Dry Unit Weight (pcf)	45.2	44.3	46.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	2.095	2.159	2.029

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-5-08

DGN: CT-S28 DATE 6-25-98 REVISION: 1

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	41.5	41.5	40.9
Total Unit Weight (pcf)	92.9	102.5	103.2
Dry Unit Weight (pcf)	65.7	72.4	73.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	1.129	0.931	0.910

Tested By JCM Date 05/27/08 Input Checked By Date

DCN: CT-S28 DATE 6-25-98 REVISION: 1 C:\MSOFFICE\Excel\Printq\[F187.xls]Sheet1

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REFERENCE 5 AND OTHER PERTINENT FINE COAL REFUSE DATA EFFECTIVE STRESS – TO – STEADY STATE STRENGTH RELATIONSHIPS

Tailing Dams 2000

PROCEEDINGS

Association of State Dam Safety Officials • U.S. Committee on Large Dams

March 28-30, 2000 • Las Vegas, Nevada

STEADY STATE LIQUEFACTION SUSCEPTIBILITY OF HIGH HAZARD UPSTREAM-CONSTRUCTED COAL REFUSE DISPOSAL FACILITIES

Blaise E. Genes[1], Thomas O. Keller, P.E.[2] and Joseph P. Laird, P.E.[3]

1.0 Introduction

Coal refuse disposal facilities are manifestations of deep mining and surface mining activities and the resulting need for the disposal of waste materials. Due to the massive volumes of materials produced annually by mining operations, these "tailings dams" are among the largest earth structures in the world and consequently, receive intense regulatory and public scrutiny. Coal refuse disposal facilities, their design, construction and operation are regulated by the U.S. Department of Labor, Mine Safety and Health Administration (MSHA). The concern for refuse disposal safety and environmental control by MSHA, the coal industry, engineering consultants and the public has led to the development of design procedures that address these concerns, particularly siting, material handling and placement techniques.

For the most part, tailings dams evaluations are similar to those of water retention dams and address geotechnical issues such as foundation materials, hydrology, hydraulics, seepage control, slope stability (static and seismic), construction practices and long-term monitoring. In the past, pseudo-static analyses were performed to address seismic stability using regional, historic seismic acceleration values and a slightly lowered factor of safety limit to assess adequacy. Empirical evaluations are sometimes performed to address seismic stability with adequacy based on comparison of limited field and laboratory test data with historical performance data of liquefaction and non-liquefaction sites from around the world. During the initial to intermediate stages of a refuse facility design, simplified analytical methods may be appropriate, such as those based on pseudo-static and cone penetration testing (CPT) or standard penetration testing (SPT). However, given the uniqueness and complexity of moderate to high hazard tailings dams, which are significantly influenced by factors such as the number and geometry of upstream stages, deposition history and cross-valley topography, simplified analyses are often inadequate to effectively address safety and cost issues. They often do not account for critical site-specific conditions and may either over-predict strengths leading to a potentially unconservative analysis or under-predict strengths leading to costly remediation efforts.

The focus of this paper is on the application of established steady-state liquefaction evaluation procedures to high hazard tailings dams, assessing liquefaction susceptibility using site-specific data to estimate the factor of safety against a liquefaction flow slide failure. A significant emphasis is placed on obtaining in-situ samples and developing

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properties of the hydraulically placed, fine coal refuse consolidated beneath multiple, upstream-constructed stages of coarse coal refuse. Detailed evaluations have been performed at five Appalachian coal refuse disposal facilities in southern West Virginia as part of the permitting process for the various facilities.

2.0 Analytical Approach

Coal refuse disposal facilities are generally constructed by three methods, either separately or in combination, and include upstream, downstream, and centerline construction. Downstream and centerline constructed facilities typically pose only minor liquefaction concerns since critical failure surfaces pass mainly through the compacted coarse refuse embankments. A typical high hazard, upstream constructed coal refuse facility, such as the one shown in Figure 1, is constructed over long periods of time (up to 25 to 30 years) to heights of 400-plus feet and includes multiple upstream stages "pushed out" into the previous stage's tailings pond. Fine coal refuse consolidated under upstream stages typically is loose to very loose, silty sand to sandy silt- and clay-sized particles, saturated and usually highly contractive. Thus, the potential exists for excess pore pressure generation and significant loss of strength during and following a rapid (undrained) loading event, such as an earthquake.

All five facilities evaluated and discussed in the context of this paper were all moderate to high hazard structures with downstream toe to crest heights varying from 300 to 440 feet. Detailed studies of liquefaction susceptibility were performed using the methodology presented by Poulos, Castro, and France (1985) to estimate in-situ void ratio and undrained steady-state strength of the critical layer, fine coal refuse. Presented below are the generalized results of field and laboratory testing at the various sites. Field testing included performing fixed-piston undisturbed sampling to measure in-situ void ratio and piezo-seismic cone penetration testing (PS-CPT) to evaluate stratigraphy and estimate shear wave velocity with depth. Laboratory strength testing of undisturbed, remolded and slurry fine coal refuse samples was performed to estimate in-situ, undrained steady-state shear strength (S_{us}) and develop a site-specific S_{us}-to-effective stress relationship.

Liquefaction susceptibility was assessed based on the results of limit-equilibrium slope stability analyses. Post-earthquake deformations were estimated using one-dimensional wave propagation and sliding block analysis techniques and the results compared to the available freeboard to assess the likelihood of overtopping. Based on the regional database of information related to S_{us}, various trends regarding the general behavior of fine coal refuse during undrained loading and the practical implications affecting liquefaction susceptibility of upstream-constructed coal refuse impoundments are discussed. Detailed discussions regarding post-earthquake deformation analyses and the seismic response of coal refuse facilities to acceleration time-histories from stochastic simulations of eastern North America earthquakes are reserved for another paper.

3.0 Field Investigations

Fixed Piston Sampling

The main purpose of the subsurface exploration program at the various sites was to obtain high quality "undisturbed" fine coal refuse samples of a character suitable for

laboratory steady-state strength testing. Multiple undisturbed samples were obtained at each site at various depths using a hydraulically actuated Gregory Undisturbed Sampler (GUS) fixed piston sampler. The GUS fixed piston sampler was used to advance a thin-wall galvanized steel sampling tube by delivering drilling fluid pressure to the top of the sampler, which subsequently advanced the tube around a fixed piston. Penetration of the tube into the soil was accurately measured to within ½ to 1 millimeter when "full penetration" of the sampler was achieved. Full penetration of the sampling tube was confirmed by observation of the fluid level in the borehole casing which would dramatically rise when fluid pressure applied to the top of the sampler vented through ports in the sampler. The technique used for undisturbed fixed piston sampling allowed samples to be obtained to depths as great as 344 feet below the ground surface.

Detailed measurements of the tube inside, outside and cutting edge diameters and length were made and volume changes that occurred during sampling calculated in the field from tube penetration and sample recovery measurements. Samples were selected for subsequent laboratory testing based on the quality of the "undisturbed" sample using a criteria for the change in soil volume ($\Delta V/V$). For the fine coal refuse, minimizing the tube clearance ratio [(ID-CE)/CE] minimized sample volume changes, which typically ranged from zero to 2.5 percent. All undisturbed samples were stored in specially designed padded wooden boxes and changes in volume routinely monitored during storage and prior to and following shipment. Prior to laboratory testing, the tube samples were x-rayed and reviewed to select portions of the sample that had a minimum amount of stratification.

Piezo-Seismic/Cone Penetrometer Testing

PS-CPT soundings were performed prior to or concurrently with undisturbed sampling to help delineate the depth to the top and bottom of fine coal refuse. As shown in Figure 2, fine coal refuse layers are characterized by significantly lower tip stresses and elevated pore pressure generation, while the coarse and coarse-fine mix typically yield much higher tip stresses and lower pore pressure generation. Using seismic downhole techniques, estimates of shear wave velocity were obtained at each site to correlate small strain shear modulus (G) with depth. These tests were generally conducted at 5-foot intervals throughout the soil profile to depths of 365 feet at one site. Shear wave velocities for coarse, coarse-fines mix and fine coal refuse ranged from about 1,000 to 2,300 feet per second (fps), 800 to 2,000 fps and 800 to 1,200 fps, respectively. These velocities were based on data from 14 PS-CPT soundings. Velocities varied dramatically with depth, consistent with variations in placement techniques and the micro-layering associated with the deposition history of the facility.

Stratification

Much of the coarse refuse embankment drilled and sampled was dense to very dense as expected due to the structural placement of the material. Loose deposits of fine coal refuse were typically encountered below a dense mixed zone of coarse and fine coal refuse. The fines were characterized by corrected cone tip resistance values between 300 to 1,000 pounds per square inch (psi). The CPT soundings (and visually verified in SPT samples) have shown that there are significantly thick zones of mixed coarse and fine coal refuse. Mixing apparently occurred during the various push-out phases of upstream embankment construction into the tailings pond and possibly from the "pumping" of fines

up into the coarse refuse during subsequent stage construction. Due to the infusion of coarse refuse into the fines, the mix zones typically exhibited significantly higher average cone tip resistance, as well as lower pore pressure generation during cone advancement.

In-Situ Void Ratio

A total of 34 undisturbed fine coal refuse samples were obtained from the various sites. In-situ void ratio was calculated for each based on the field measurements described previously combined with laboratory measurements of the volume of solids in the tube. Table 1 presents a summary of sample depth and calculated in-situ void ratio at each site. Samples were obtained from beneath about 65 to 344 feet of overlying refuse and in-situ void ratios varied from about 0.39 to 0.79, with most (82 percent) of the values between 0.43 and 0.59. While in-situ void ratio is influenced by mean effective stress and time rate of consolidation, the range of values is relatively narrow. Direct correlation between estimated mean effective stress and in-situ void ratio can not be inferred due to the unique and complex nature of each site's geometric constraints and deposition history.

4.0 Laboratory Testing

Steady-state liquefaction-related laboratory test programs of the coal refuse materials sampled from the five sites included performing index tests such as grain size distributions, Atterberg limits, and specific gravity, as well as triaxial shear strength tests on undisturbed, remolded and slurry samples of fine coal refuse. Table 1 presents a summary of laboratory test results from Sites 1 through 5.

Index Tests

Fine coal refuse particles vary in size from about 2 mm (No. 10 sieve) to 0.0005 mm (finer than clay fraction). It is analogous to silty sand to silty clay-sized material. Fines content (passing a No. 200 sieve) for fine coal refuse from the five sites varied from 35 to 76 percent. Fine refuse generally has a low plasticity, ranging from nonplastic to Plasticity Indices of 12 percent or less. Values are affected by the parent rock formation from which the coal was extracted and from clay layers near the coal seam that get mixed within the coal. The specific gravity of fine coal refuse is low and generally varied from about 1.4 to 2.4 for the sites tested. As a result, densities are also relatively low, with in-place total unit weight ranging from about 75 to 90 pounds per cubic foot (pcf).

Steady-State Strength Of Undisturbed Samples

Isotropically consolidated, undrained triaxial compression ($\overline{CU}$) tests were performed on undisturbed, remolded and slurry samples of fine coal refuse. The main purpose of the triaxial tests was to measure the undrained steady-state shear strength of the samples in the laboratory to allow in-situ steady-state shear strengths to be estimated based on void ratio corrections (from laboratory to field). A total of 34 $\overline{CU}$ tests were performed on undisturbed samples of fine coal refuse from the five sites. Specimens were typically consolidated to an isotropic, effective consolidation stress ($\overline{\sigma}_{3c}$) ranging from 8 to 16 kilograms per square centimeter (kg/cm^2) [16.3 to 32.7 kips per square foot (ksf)]. These relatively high confining pressures were used to ensure contractive behavior,

particularly since most samples were obtained from 200 to 344 feet below the ground surface. The samples exhibited contractive behavior and reached or approximately reached a steady-state of deformation within the strain limits of the test. Laboratory values of S_{us} were corrected to represent steady-state strengths at in-situ void ratios.

Steady-State Line and In-Situ Steady-State Strength

Triaxial tests were performed on compacted specimens to determine the steady-state line (SSL) of the fine coal refuse representative for each site. Samples of each batch mix were formed using two methods: 1) by placing layers of fine coal refuse in a split mold and compacting each layer to a target void ratio; and 2) by placing the material in a mold as a slurry subject to one-dimensional consolidation to simulate in-situ placement conditions. The various SSL's for each batch mix are shown in Figure 3 where the slope ($\Delta e/\Delta \log S_{us}$) varies from 0.11 to 0.13 for moist tamped batch samples with additional slurry prepared samples of the batch mix shown for comparison. As discussed by Poulos et. al (1985), the slope of the steady state line is dependent on the shape of the grains and the vertical position is affected by slight differences in grain-size distribution. In general, the variation of the fine refuse coal particle shape from site to site would not be expected to vary significantly since the coal was mined from the same region using generally similar cleaning techniques. However, the fines content of the coal refuse sampled from the region varies widely. Thus, the SSL's in Figure 3 are consistent with the above observations.

In-situ S_{us} for each site was estimated by "correcting" the steady-state strengths at laboratory void ratios to their respective in-situ void ratio along the slope of the SSL as defined by Poulos et. al (1985). In-situ S_{us} values ranged from 0.06 to 4.62 kg/cm^2 (0.122 ksf to 9.42 ksf) with 74 percent of the data falling between 0.25 and 2.1 kg/cm^2 (0.51 ksf to 4.28 ksf). Figure 4 presents correlated S_{us} versus in-situ void ratio for 34 tested samples at the 5 sites. Note that S_{us} values can vary by more than a factor of 10 for a given void ratio.

S_{us} Versus Effective Stress Relationship

The estimation of S_{us} values for fine coal refuse layers that are at in-situ conditions different from the samples obtained and tested were estimated using a correlation between S_{us} and effective vertical stress (σ'_v) determined for each site. This includes proposed upstream stages where sampling is not yet feasible or existing portions of the embankment not sampled due to budgetary constraints. By generally assuming that S_{us} values vary linearly with σ'_v, and estimating the in-situ effective stress conditions for proposed layers of fine coal refuse, the in-situ S_{us} values for the proposed additional zones of fine coal refuse can be approximated. Site-specific S_{us} /σ'_v relationships are presented in Figure 5 and varied from 0.06 to 0.27. The various relationships were approximated by conservatively drawing a line from zero through the location at which two-thirds of the data points at a particular site lie above the line.

The lowest strength relationship was achieved at a narrow valley fill with over 200 feet of coarse and mixed refuse placed above the fine coal refuse. It is deduced that significant arching may be occurring within the coarse refuse preventing the full height of

overburden from consolidating the critical fine coal refuse layer. Therefore, factors such as cross-valley topography and deposition history are significantly relevant to the S_{us}/σ'_v relationship. Similarly, the database of S_{us}/σ'_v relationships obtained from bulk fine coal refuse samples prepared as slurried samples may be used to investigate what kind of relationship with depth (or effective stress) may be expected in the slurry pond prior to any encroachment of coarse embankments. The effective consolidation stresses at which the laboratory tests were performed were converted into equivalent vertical effective stresses in the field, assuming that the lateral stresses are equal to one-half of the vertical stresses. As shown in Figure 6, an S_{us}/σ'_v ratio of 0.18 extends from the zero intercept to the point where two-thirds of the data falls above the straight line.

5.0 Liquefaction Susceptibility Evaluations

Liquefaction susceptibility depends on the S_{us} of all the soils along the potential failure surface compared to the driving stress along that failure surface. Zones of loose (contractive) cohesionless soils are critical to analyzing liquefaction potential because they can have an undrained strength that is significantly lower than their drained strength. Therefore, the embankment geometry was evaluated to assess the liquefaction potential of each stage of construction estimating the average driving shear stresses along the critical failure surface at each of the high hazard sites. Generally, as the construction of future upstream staging progresses, there is a corresponding increase in driving stress. For layers in which fixed-piston samples were obtained and tested, or layers where similar effective stresses are present, a weighted average of steady-state strength, such as the Two-Thirds Strength Method, was utilized. This method, utilized by Castro et. al. (1989) and recommended by the U.S. Army Corps of Engineers (1970) in their manual for analyzing the stability of earth dams, involves using a design shear strength value that is lower than two-thirds of the total test values selected. S_{us} values for fine coal refuse layers at in-situ σ'_v values that significantly differ from the σ'_v values at sample locations were estimated using the site specific S_{us}/σ'_v relationship as previously discussed. Limit equilibrium slope stability analyses were performed at each site with S_{us} values applied to fine coal refuse layers and frictional (drained) strengths applied to coarse and mixed refuse layers. Factors of safety against liquefaction (F_L) along the critical failure surfaces for the various sites ranged from 1.02 to 1.32.

6.0 Notable Trends From Completed Studies

Liquefaction evaluations have been performed at five different sites using steady-state techniques as well as other complementary analyses. Since most of the sites are in the same geographical region, it is useful to compare the results of the fine coal refuse tested to identify trends in its engineering properties. A discussion of notable trends for the presented data is discussed below.

1. Consistent with the sensitivity of S_{us} to void ratio, S_{us} values can vary over 10 times at the same void ratio illustrating the need for site specific testing. In-situ void ratios varied between 0.39 and 0.79, however, most ranged from 0.43 to 0.59.

2. In-situ S_{us} values for unsampled fine coal refuse layers can be estimated based on S_{us} versus σ'_v correlations developed for a particular site. S_{us}/σ'_v relationships used for the coal refuse impoundment sites have ranged from 0.06 to 0.27 also illustrating the need for site specific testing, particularly at facilities with proposed multiple upstream stages.
3. S_{us} and S_{us}/σ'_v are significantly influenced by factors such as cross-valley topography, deposition history, upstream embankment geometry and construction sequencing.

7.0 Conclusions

Steady-state methodology can be effectively applied for the detailed evaluation of the liquefaction susceptibility of high hazard coal refuse disposal facilities. The evaluation needs to be based on site specific geometry and subsurface conditions, and properties developed accounting for the uniqueness and complexity of each site. While it is often useful to express the steady-state strength with respect to an estimated vertical stress, proper caution should be exercised during its development. The database of slurried samples has shown that the behavior of newly deposited fine coal refuse can be reasonably predicted. The S_{us}/σ'_v ratio of fine coal refuse consolidated beneath multiple upstream embankment stages can vary significantly with age, loading history, arching, and geometric constraints. For initial or preliminary liquefaction assessments, it is recommended that a range of S_{us}/σ'_v ratios be used to investigate the sensitivity of the critical layer to liquefaction susceptibility. For detailed evaluations where significant driving stresses are present for multiple upstream stages, site-specific shear strength testing of high quality undisturbed samples is recommended to develop the site's S_{us}/σ'_v relationship and each individual stage evaluated to estimate the factor of safety against liquefaction susceptibility. In general, factors of safety against liquefaction susceptibility were above 1.0 for the existing and proposed staging at the various high hazard sites. Factors of safety below 1.0 indicated the need for remedial design of existing embankments or redesign of the staging for proposed expansions to lower driving stresses.

References

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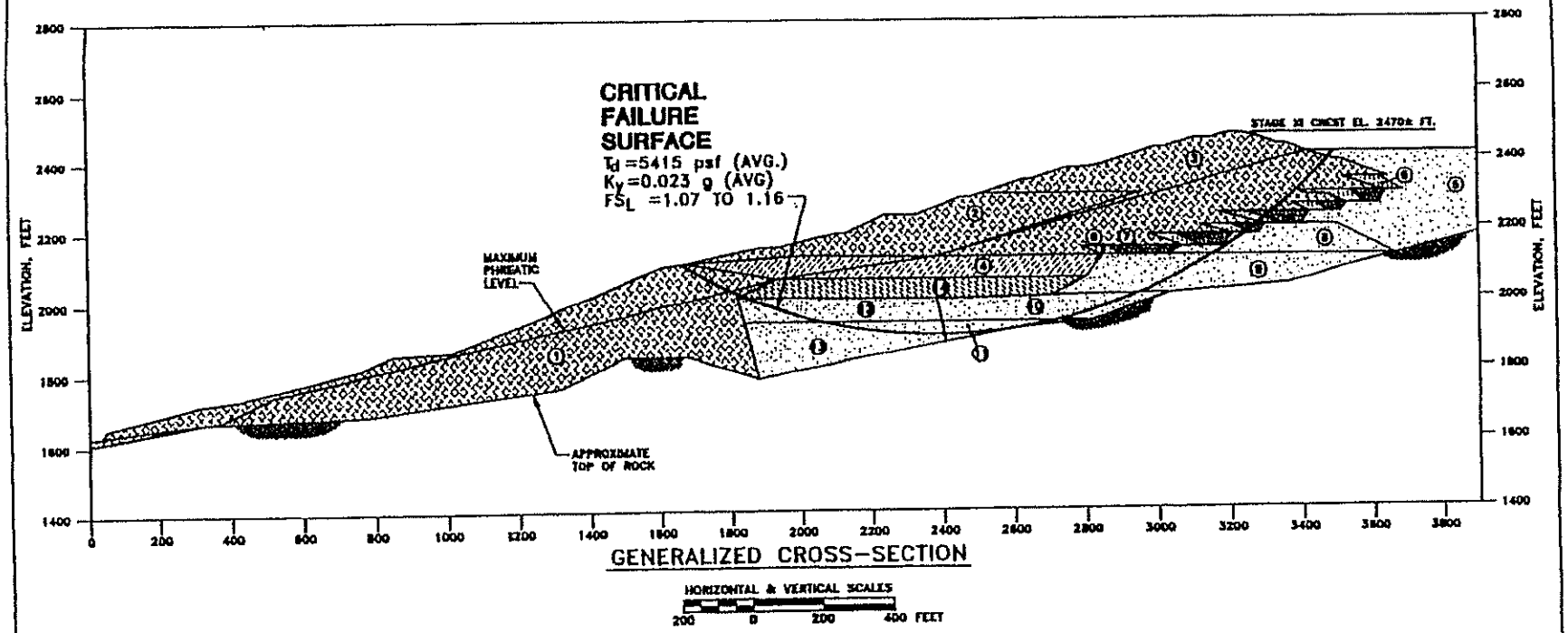
Table 1: Summary of Strength and Index Tests Performed on Fine Coal Refuse Samples

					Field Data			Laboratory Data												
												(CU) Triaxial Results at Peak			Consolidated-Undrained (CU) Triaxial Results at Steady-State (SS)				
Site No	Sample Type	Percent Passing No. 200 Sieve	PI %	Specific Gravity	Depth to Top of Sample, Feet	Estimated In-Situ Vert Effective Stress, kg/cm²	Void Ratio In-Situ (Sampled)	Void Ratio in Tube/Mold	Void Ratio During Shear	Lab Effective Consol Stress, kg/cm²	Estimated Equiv Vert Effect Stress In Field [1], kg/cm²	Shear Stress at Peak, q, kg/cm²	Axial Strain, %	Peak Friction Angle	Shear Stress at SS, q, kg/cm²	Minor Principal Stress, kg/cm²	Axial Strain, %	Undrained SS Strength Sus, kg/cm²	SS Friction Friction Angle	Sus at In-Situ Void Ratio, kg/cm²
1	FP	29.4	NA	2.28	90.7	3.45	0.494	0.497	0.402	6.00	12.00	2.70	12.5	34.6	2.68	2.15	17.6	2.23	33.7	0.44
	FP	40.4	NA	2.02	70.3	3.19	0.511	0.515	0.397	8.00	12.00	2.81	12.2	34.7	2.71	2.22	22.8	2.26	33.4	0.19
	FP	44.7	NA	2.37	80.6	3.30	0.488	0.489	0.390	8.00	12.00	2.79	13.2	35.3	2.59	2.17	25.9	2.17	32.9	0.42
	FP	43.6	NA	1.94	75.8	3.25	0.496	0.502	0.384	8.00	12.00	3.38	16.0	33.7	3.20	2.93	22.6	2.79	32.0	0.63
2	FP	47.2	NP	1.78	100.3	4.81	0.565	0.567	0.443	8.00	12.00	3.60	17.9	35.3	3.38	2.75	24.5	2.81	33.4	0.36
	FP	38.8	7	2.01	105.8	4.68	0.460	0.462	0.414	8.00	12.00	3.20	15.1	34.2	3.00	2.65	24.4	2.64	32.1	1.39
	FP	63.9	11	1.63	65.0	4.10	0.553	0.543	0.454	8.00	12.00	2.95	14.2	32.7	2.88	2.58	22.9	2.45	31.9	0.53
	FP	67.0	4	1.64	75.5	4.27	0.541	0.528	0.421	8.00	12.00	3.41	16.7	34.1	3.29	2.78	23.3	2.77	32.8	0.38
1 & 2	BM	34.7	NP	1.98	NA	NA	NA	0.732	0.390	4.00	6.00	0.99	1.6	24.7	0.90	0.81	28.6	0.80	32.8	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.745	0.331	10.00	15.00	2.39	1.8	25.2	2.42	2.03	25.2	2.03	32.9	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.975	0.455	1.00	1.50	0.23	1.2	23.6	0.18	0.14	28.3	0.15	34.1	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.973	0.433	2.00	3.00	0.46	1.3	23.2	0.41	0.35	23.0	0.34	32.9	NA
3	FP	97.7	NA	1.88	310.5	11.02	0.514	0.562	0.610	16.10	24.15	5.67	6.3	30.1	5.87	5.64	6.3	4.91	30.1	4.65
	FP	70.5	NA	1.89	209.5	10.07	0.444	0.480	0.424	16.20	24.30	5.40	7.3	28.1	5.21	5.13	16.5	4.82	27.4	3.15
	FP	78.7	NA	1.85	329.4	11.17	0.443	0.482	0.439	16.10	24.15	5.87	9.4	29.8	5.69	5.12	18.1	4.99	28.8	4.82
	FP	81.7	11	1.88	343.3	11.62	0.541	0.605	0.545	12.00	18.00	4.87	10.2	30.9	4.81	4.68	18.0	4.14	30.5	4.47
	FP	66.6	NA	1.61	290.8	10.65	0.582	0.568	0.495	12.00	18.00	6.57	16.7	33.7	6.57	6.27	16.7	5.47	33.7	0.85
	FP	21.3	NA	1.49	275.8	10.37	0.789	0.790	0.581	8.00	12.00	3.77	19.8	35.0	3.77	2.81	19.8	3.09	35.0	0.06
3	BM	70.1	8	1.80	NA	NA	NA	0.513	0.363	16.20	24.30	5.44	19.3	29.7	5.44	5.56	19.7	4.72	29.7	NA
	BM	70.1	8	1.80	NA	NA	NA	0.483	0.390	8.00	12.00	3.08	20.3	31.2	3.06	2.84	20.3	2.81	31.2	NA
	BM	70.1	8	1.80	NA	NA	NA	0.633	0.479	2.00	3.00	0.65	18.6	33.4	0.65	0.53	16.8	0.54	33.4	NA
	BM	70.1	8	1.80	NA	NA	NA	0.616	0.456	3.00	4.50	1.00	18.5	33.0	1.00	0.83	16.5	0.84	33.0	NA
	BM/S	70.1	8	1.80	NA	NA	NA	1.270	0.407	7.00	10.50	2.31	12.8	32.2	2.31	2.02	12.8	1.95	32.2	NA
	BM/S	37.0	4	2.29	NA	NA	NA	1.070	0.362	7.00	10.50	2.52	17.9	33.4	2.52	2.05	17.9	2.10	33.4	NA
	BM/S	23.6	NA	1.48	NA	NA	NA	0.840	0.504	7.00	10.50	3.71	19.7	35.2	3.71	2.72	19.7	3.03	35.2	NA
4	FP	24.9	NA	1.45	210.0	7.47	0.557	0.595	0.517	12.00	18.00	4.74	19.9	36.1	4.74	3.30	19.9	3.83	36.1	1.78
	FP	15.7	NA	1.48	222.2	7.68	0.540	0.571	0.468	12.00	18.00	4.85	18.7	36.2	4.85	3.45	18.7	3.91	36.2	0.95
	FP	72.0	NA	1.75	135.5	5.49	0.486	0.520	0.456	8.00	12.00	3.41	13.9	33.3	3.37	2.89	18.2	2.84	32.6	1.60
	FP	39.1	NA	1.58	150.2	5.75	0.389	0.400	0.360	8.00	12.00	3.92	14.1	35.2	3.90	3.09	17.8	3.24	33.9	1.88
	FP	71.3	NA	1.70	170.2	6.08	0.467	0.498	0.446	8.00	12.00	3.85	17.3	33.6	3.84	3.30	18.9	3.24	32.5	2.16
	FP	81.0	NA	1.65	218.3	7.74	0.491	0.519	0.453	12.00	18.00	4.94	14.2	33.6	4.89	4.17	17.7	4.11	32.7	1.98
	FP	72.7	NA	1.71	223.3	7.83	0.485	0.482	0.415	12.00	18.00	4.75	13.1	32.4	4.60	4.23	18.3	3.93	31.4	1.58
	FP	75.6	NA	1.73	213.2	7.65	0.484	0.507	0.428	12.00	18.00	6.06	12.8	35.2	4.68	3.77	19.7	3.90	33.6	1.33
4	BM	75.1	12	1.72	NA	NA	NA	0.575	0.410	8.00	12.00	2.09	20.8	32.4	2.92	2.56	18.0	2.47	32.3	NA
	BM	75.1	12	1.72	NA	NA	NA	0.796	0.450	4.00	6.00	1.41	17.3	33.2	1.42	1.18	18.0	1.19	33.0	NA
	BM	75.1	12	1.72	NA	NA	NA	0.804	0.387	11.90	17.85	4.31	19.3	31.8	4.28	3.86	18.0	3.63	31.6	NA
	BM	75.1	12	1.72	NA	NA	NA	0.805	0.491	2.00	3.00	0.68	21.4	32.8	0.62	0.53	18.0	0.52	32.8	NA
	BM/S	75.1	12	1.72	NA	NA	NA	NA	0.455	5.00	7.50	1.88	19.0	34.3	1.85	3.48	18.0	1.55	33.3	NA
	BM/S	52.2	4	1.58	NA	NA	NA	NA	0.380	6.00	7.50	2.48	23.4	37.2	2.48	1.81	23.4	2.02	35.3	NA
5	FP	81.0	NA	1.77	219.9	9.54	0.582	0.580	0.480	12.00	18.00	4.43	10.9	32.9	4.14	3.76	22.2	3.53	31.6	0.63
	FP	48.8	NA	1.64	234.3	9.72	0.546	0.661	0.446	12.00	18.00	5.34	16.7	35.8	5.33	3.86	17.3	4.34	35.4	0.53
	FP	90.6	NA	1.95	250.0	9.93	0.560	0.588	0.505	12.00	18.00	4.33	8.7	28.9	4.22	4.62	13.9	3.71	28.5	1.16
	FP	67.6	NA	1.79	188.3	8.63	0.522	0.515	0.448	12.00	18.00	4.68	8.5	32.8	4.23	3.98	20.7	3.62	31.0	0.64
	FP	88.9	NA	1.96	194.0	8.81	0.658	0.665	0.547	12.00	18.00	4.00	3.5	28.7	3.97	4.70	4.8	3.53	27.1	0.33
	FP	35.5	NA	1.55	233.3	11.02	0.609	0.525	0.421	12.00	18.00	4.63	20.3	35.6	4.63	3.35	20.3	3.77	35.5	0.69
	FP	22.5	NA	1.41	241.0	11.12	0.547	0.551	0.483	12.00	18.00	4.56	20.5	33.7	4.56	3.67	20.8	3.79	33.7	0.98
	FP	34.4	NA	1.54	180.4	8.67	0.626	0.608	0.444	12.00	18.00	4.37	19.6	35.6	4.30	3.21	21.6	3.57	35.1	0.08
	FP	79.5	NA	1.87	185.0	8.05	0.612	0.600	0.448	12.00	18.00	4.37	9.0	32.0	4.01	3.88	21.3	3.46	30.5	0.11
	FP	74.0	NA	1.88	183.3	8.48	0.618	0.598	0.450	12.00	18.00	5.12	8.8	33.7	4.78	4.20	19.4	4.05	32.1	0.12
	FP	80.7	NA	1.68	200.4	10.13	0.562	0.575	0.466	12.00	18.00	4.04	11.0	33.8	3.85	3.21	21.7	3.23	33.0	0.43
	FP	25.6	NA	1.67	210.3	10.63	0.588	0.599	0.460	12.00	18.00	4.88	17.9	36.3	4.75	3.55	24.4	3.90	34.9	0.26
5	BM	62.0	9	1.70	NA	NA	NA	0.546	0.401	8.00	12.00	2.58	19.2	32.9	2.58	2.17	19.2	2.15	32.7	NA
	BM	62.0	9	1.70	NA	NA	NA	0.544	0.473	2.00	3.00	0.58	20.2	34.6	0.58	0.46	20.3	0.48	33.9	NA
	BM	62.0	9	1.70	NA	NA	NA	0.546	0.512	1.00	1.50	0.28	1.7	35.2	0.27	0.21	19.8	0.22	33.7	NA
	BM/S	62.0	9	1.70	NA	NA	NA	0.753	0.358	6.50	9.75	2.32	19.6	32.0	2.32	2.10	19.6	1.98	31.6	NA
	BM/S	85.1	NP	1.88	NA	NA	NA	NA	0.533	6.50	9.75	3.08	18.3	34.8	3.08	2.32	18.3	2.53	34.8	NA

NOTES:
FP - Fixed Piston, Undisturbed Sample
BM - Reconstituted Batch Mix Sample Prepared by Moist Tamping
BM/S - Reconstituted Batch Mix Sample Prepared as Slurry
NA - Not Applicable
NP - Non-Plastic
PI - Plasticity Index
[1] $K_o = 0.5$ (Ratio of Horizontal to Vertical Effective Stress)
$q = (\sigma_1 - \sigma_3) / 2$

R15286



GENERALIZED CROSS-SECTION

HORIZONTAL & VERTICAL SCALES

200 0 200 400 FEET

LEGEND:

T_d (AVG.)	AVERAGE IN-SITU STATIC DRIVING SHEAR STRESS		FINE COAL REFUSE
K_y (AVG.)	AVERAGE YIELD ACCELERATION		FINE COAL REFUSE (BEACHED ZONES)
FS_L (AVG.)&(MAX.)	AVERAGE AND MAXIMUM FACTORS OF SAFETY AGAINST LIQUEFACTION		MIXED COARSE AND FINE COAL REFUSE
①	MATERIAL LAYER NO.		COARSE COAL REFUSE
			COMBINED COAL REFUSE
			MIXED COMBINED AND FINE COAL REFUSE

ALMES & ASSOCIATES, INC.
CONSULTING ENGINEERS
BECKLEY, WV
PITTSBURGH, PA

FIGURE 1
GENERALIZED CROSS-SECTION AND LIQUEFACTION SUSCEPTIBILITY EVALUATION SUMMARY

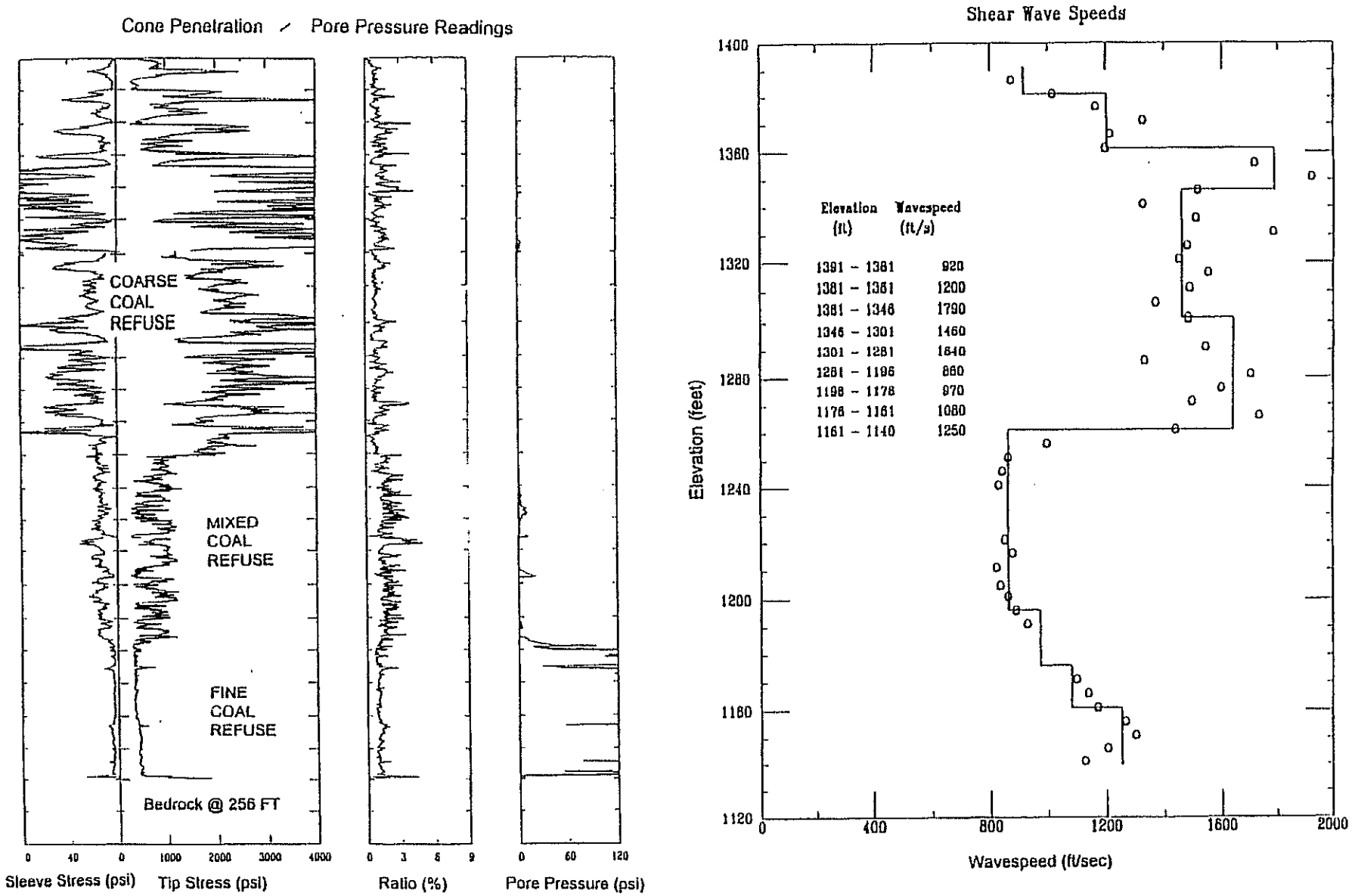


Figure 2 – CPT Log and Shear Wave Velocity Profile

R15288

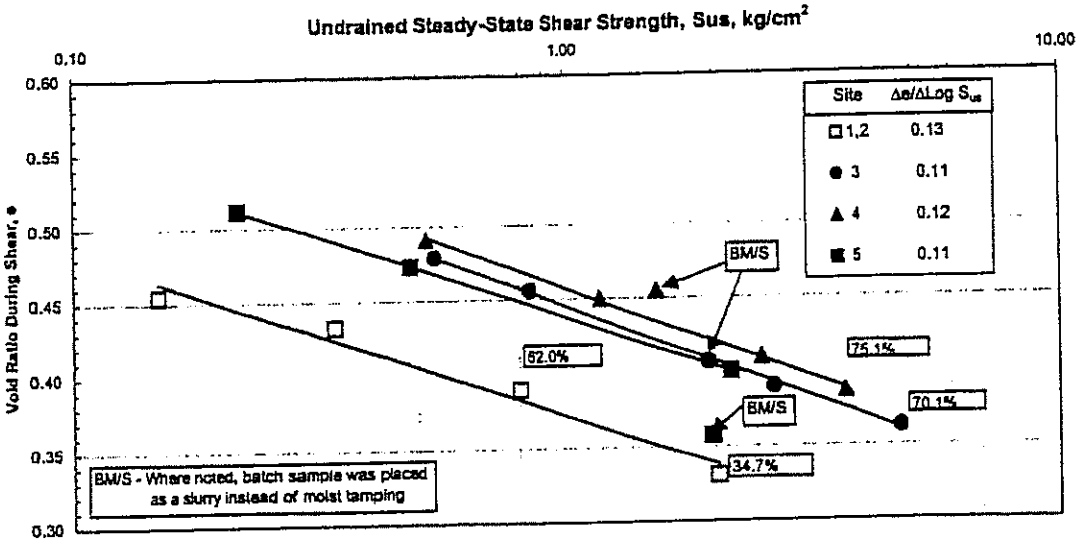


FIGURE 3 - Steady State Lines of Fine Coal Refuse Batch Samples

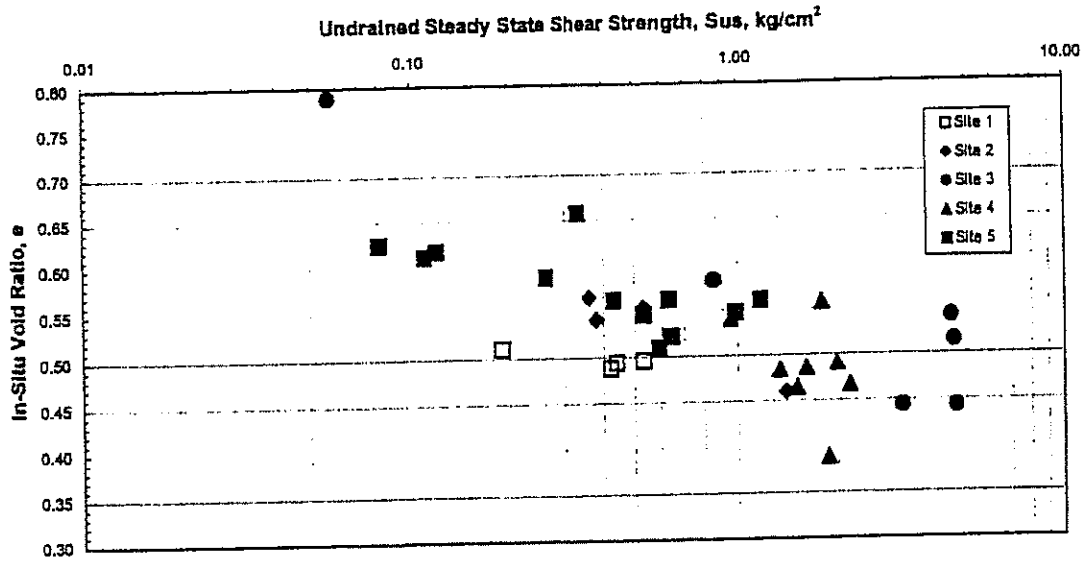


FIGURE 4 - S_{us} of Fixed Piston Samples at In-Situ Void Ratio, After Correction of Lab Void Ratio

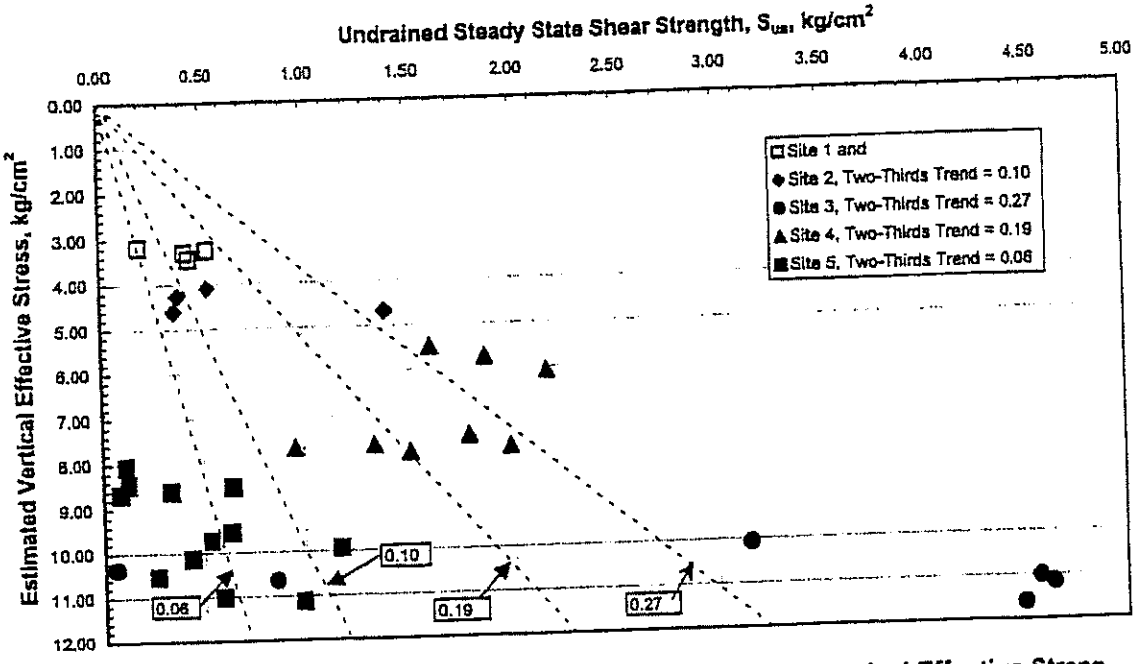


FIGURE 5 - S_{us} of Fixed Piston Samples Versus Estimated Vertical Effective Stress

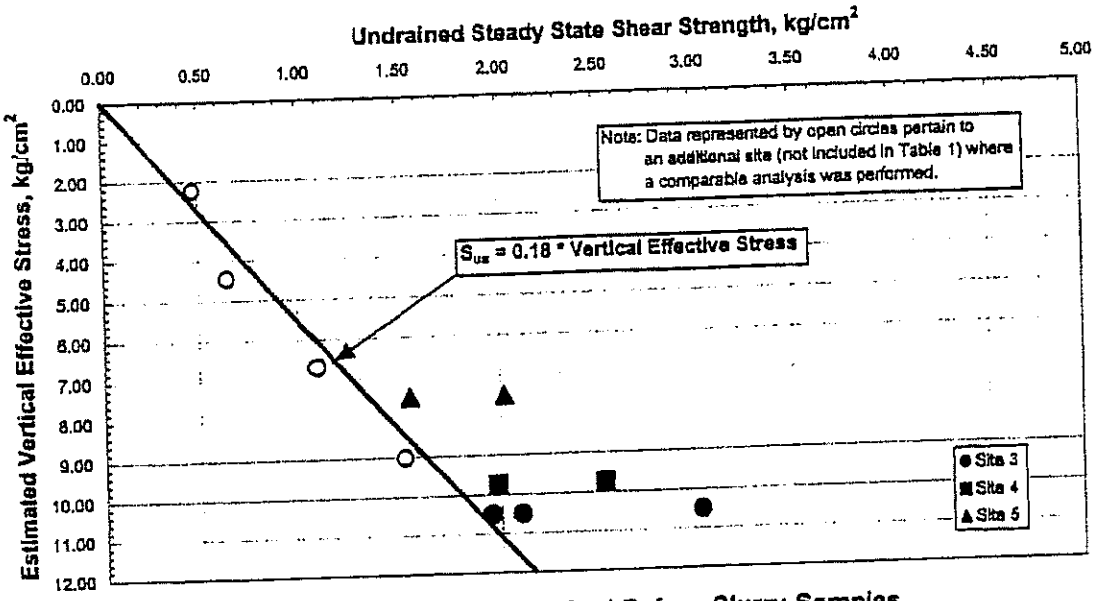
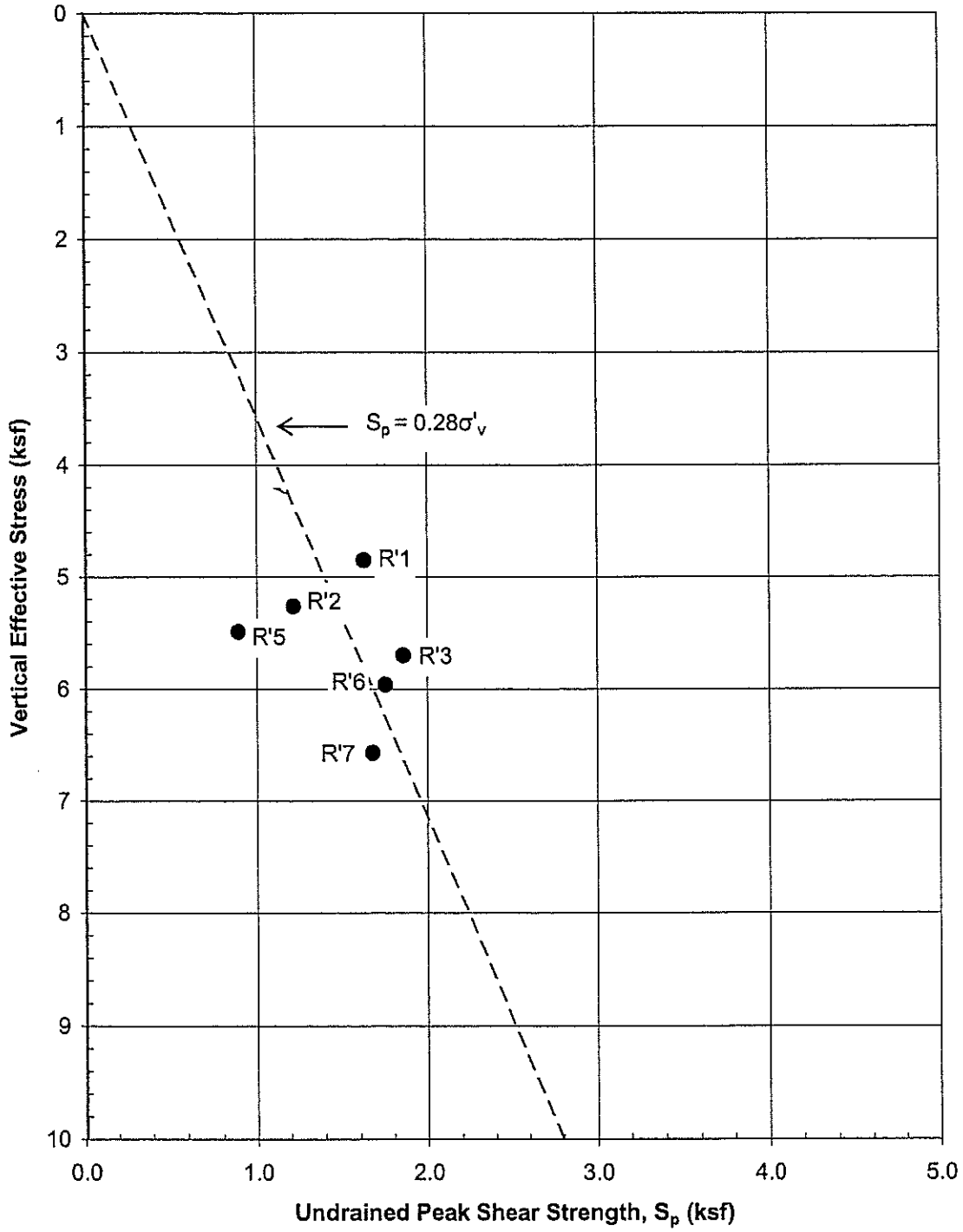
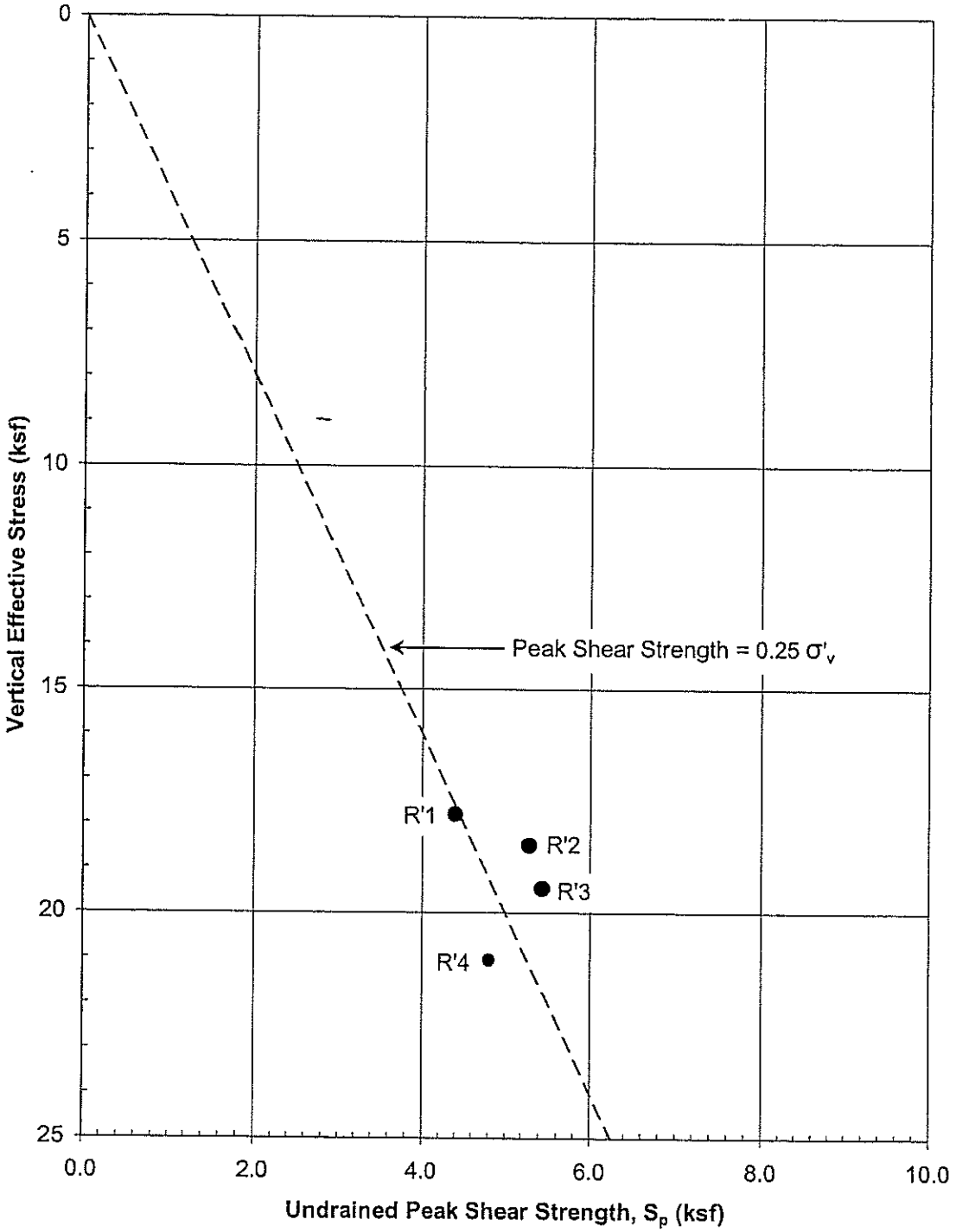


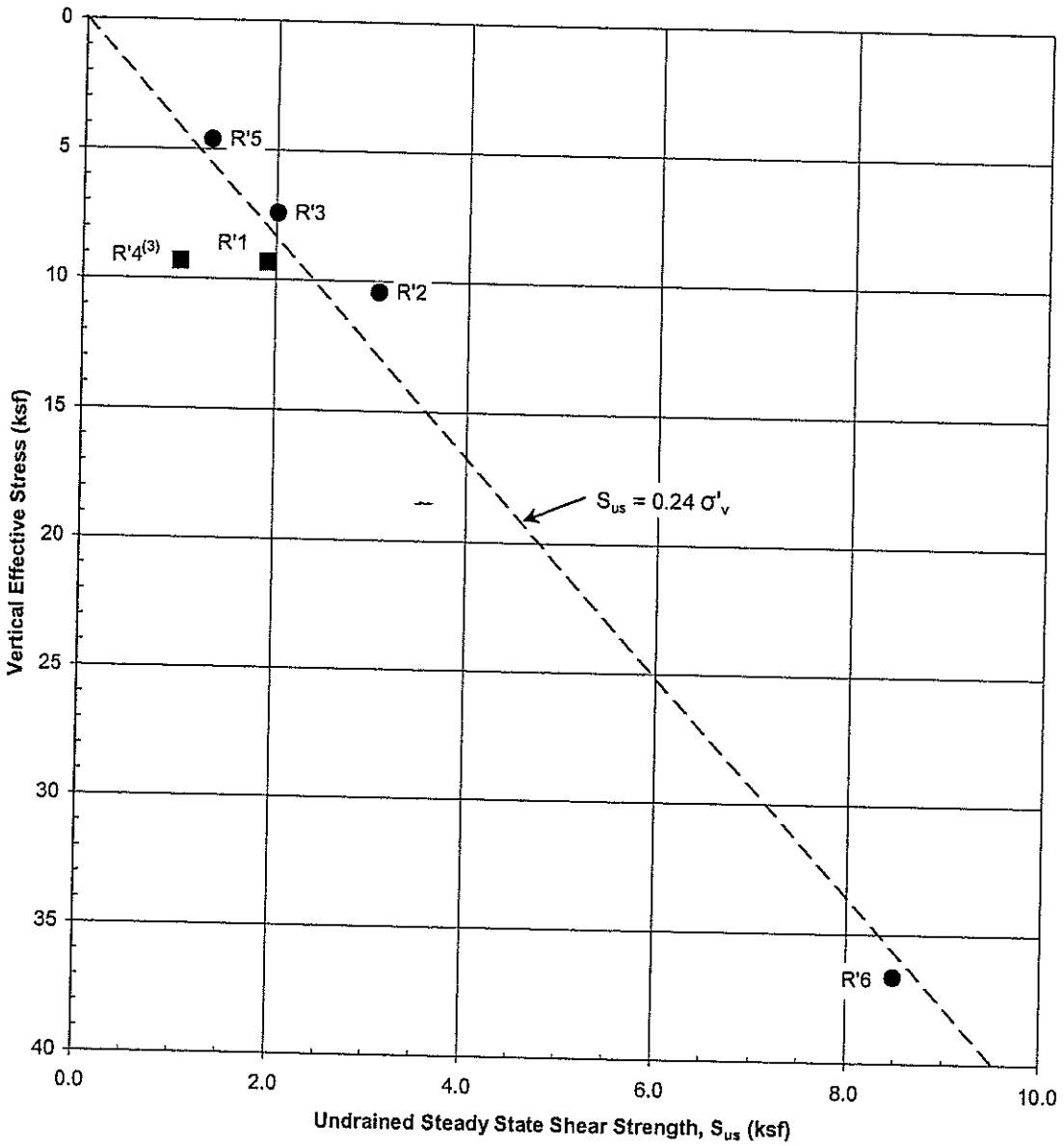
FIGURE 6 - S_{us} of Fine Coal Refuse Slurry Samples Versus Estimated In-Situ Vertical Effective Stress



Harvey Run No. 1 Slurry Impoundment Monongalia County, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_p VERSUS VERTICAL EFFECTIVE STRESS
Consolidation Coal Company Pittsburgh, Pennsylvania	Project 070810	June 2007 Figure 6



Wallace Cabin Branch Slurry Impoundment Wyoming County, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_p VERSUS VERTICAL EFFECTIVE STRESS
Kepler Processing Company Pineville, West Virginia	Project 063560	April 2007 Figure 4



LEGEND
- ● Reconstituted Coal Refuse Slurry Sample
- ■ Undisturbed Tube Sample

NOTES
1. Vertical effective stress for reconstituted coal refuse samples assumed to be 1.5 times the isotropic effective consolidation stress.
2. Vertical effective stress of undisturbed tube samples estimated by CEC, Inc.
3. R'4 composed of two different soil types. S_{us} shown is uncertain.

Hughes Hollow Slurry Impoundment Wana, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_{us} VERSUS VERTICAL EFFECTIVE STRESS
Consolidation Coal Company Pittsburgh, Pennsylvania	Project 063570	February 2007 Figure 3

APPENDIX C

DRIVING SHEAR STRESS AND FACTOR OF SAFETY AGAINST LIQUEFACTION SLOPE STABILITY ANALYSES RESULTS

APPENDIX C

DRIVING SHEAR STRESS AND FACTOR OF SAFETY AGAINST LIQUEFACTION SLOPE STABILITY ANALYSES RESULTS

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Pond Phase 2 Abandonment Evaluation

PROJECT NO. 080-851

Determination of Downstream and Upstream In-Situ Driving Shear Stress by Elastic (GStabl) Solution

PAGE 1 OF 3

MADE BY BEG DATE 7/17/08 CHECKED BY NJS DATE 7/23/08

CALCULATION BRIEF FOR DETERMINATION OF DOWNSTREAM AND UPSTREAM IN-SITU DRIVING SHEAR STRESS BY ELASTIC (GSTABL) SOLUTION

POND CREEK COAL REFUSE DISPOSAL SITE - SOUTH POND

OBJECTIVE: To determine the initial state of static stress (a.k.a., "driving stress") for the fine coal refuse layers in the downstream and upstream directions of the Pond Creek South Pond Phase 2 abandonment geometry. This driving stress will be used to evaluate liquefaction susceptibility of the impoundment by steady-state analysis

METHODOLOGY: Use limit equilibrium analyses to estimate the driving shear stress acting on the most critical circular failure surface passing through the Phase 2 impoundment and embankment geometry shown in Figure 1. Failure planes in both the upstream and downstream directions will be evaluated.

REFERENCES:

1. Gregory, P.E., Garry H., "GSTABL7 with STEDwin Slope Stability Analysis System, Version 2.0," dated September 2001.

2. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak and Steady-State Undrained Shear Strengths For Refuse and Subgrade Materials, Pond Creek Coal Refuse Disposal Site – South Pond", BEG, 7/12/08.

3. Poulos, S.J., Castro, G., and France, J.W. (1985a) "Liquefaction Evaluation Procedure," Journal of the Geotechnical Engineering Division, ASCE, Vol. 111, No. GT6, pp. 772-792.

ANALYSIS:

The Illinois Department of Natural Resources (IDNR) has required that the evaluation of the abandonment condition for the South Pond address the following issues:

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Pond Phase 2 Abandonment Evaluation PROJECT NO. 080-851

Determination of Downstream and Upstream In-Situ Driving Shear Stress by Elastic (GStabl) Solution PAGE 2 OF 3

MADE BY BEG DATE 7/17/08 CHECKED BY MJS DATE 7/23/08

1. The classification of the existing condition of the impounded material with respect to its fluid nature; and

2. The liquefaction potential of the impounded material and the related stability of the containing dam.

Determining the in-situ static driving shear stress in a critical (relative to slope stability) soil layer (i.e., fine coal refuse) is one of the steps for evaluating liquefaction susceptibility (No. 2 above). The driving shear stress in a critical soil layer is equal to the minimum shear resistance the layer must have to just maintain stability of the slope. This assumes fully mobilized shear strengths in the other soil layers comprising the slope. The fully mobilized strengths are those that would act while deformation of the slope is occurring and, thus, would be available to resist a massive flow slide. These shear strengths can be quantified by performing a stability analysis for the slope in question.

When evaluating slope stability by means of circular failure surface analysis (using the limit equilibrium approach), the driving shear stress (τ_d) acting along the failure surface analyzed can be determined by assuming that the shearing resistance (i.e., shear strength) of the material through which the failure surface passes is provided solely by cohesion [i.e., angle of internal friction (ϕ) = 0]. The driving stress is determined by varying the cohesion value used in the analysis until a factor of safety (F.S.) of 1.0 is obtained. For this condition (F.S. = 1.0), the driving stress acting along the failure surface analyzed is equal to the cohesion value used for the material.

The following soil properties were estimated based on previous field and laboratory testing as well as current fine coal refuse testing for use in the various post-earthquake liquefaction slope stability analyses:

Material Type	Total Unit Weight (γt) (pcf)	Saturated Unit Weight (γs) (pcf)	Effective Friction (ϕ') (deg)	Effective Cohesion (c') (psf)
Coarse Refuse	130	140	33.7	0
Fine Refuse	80	90	0	Varies
Residual Soil	125	130	19	4000
Soil Cap	130	1135	30	0

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Pond
Phase 2 Abandonment Evaluation
Determination of Downstream and Upstream In-Situ
Driving Shear Stress by Elastic (GStabl) Solution

PROJECT NO. 080-851

PAGE 3 OF 3

MADE BY BEG DATE 7/17/08 CHECKED BY MJS DATE 7/23/08

Note: Refuse properties provided by Alliance Consulting, Inc. based on laboratory testing and/or literature values noted in the Alliance static/seismic slope stability analyses.

Results of Driving Shear Stress Slope Stability Analyses:

Phase 2 Abandonment (Crest El. 502 ft)	Top of Fines Elevation (ft)	Top of Cap Elevation[(1)] (ft)	Driving Shear Stress in Fine Coal Refuse (τ_d) (psf)
Downstream	496	502	0
Upstream	496	502	0

[(1)] Cap includes 4-foot coarse refuse and 2-foot soil cover layer above top of fines elevation. Soil cover sloped at one percent to maintain positive drainage.

CONCLUSION:

Based on the information presented in this calculation brief, CEC determined that the Pond Creek – Phase 2 abandonment geometry has 0 psf driving shear stress through the fine coal refuse for both the upstream and downstream conditions.

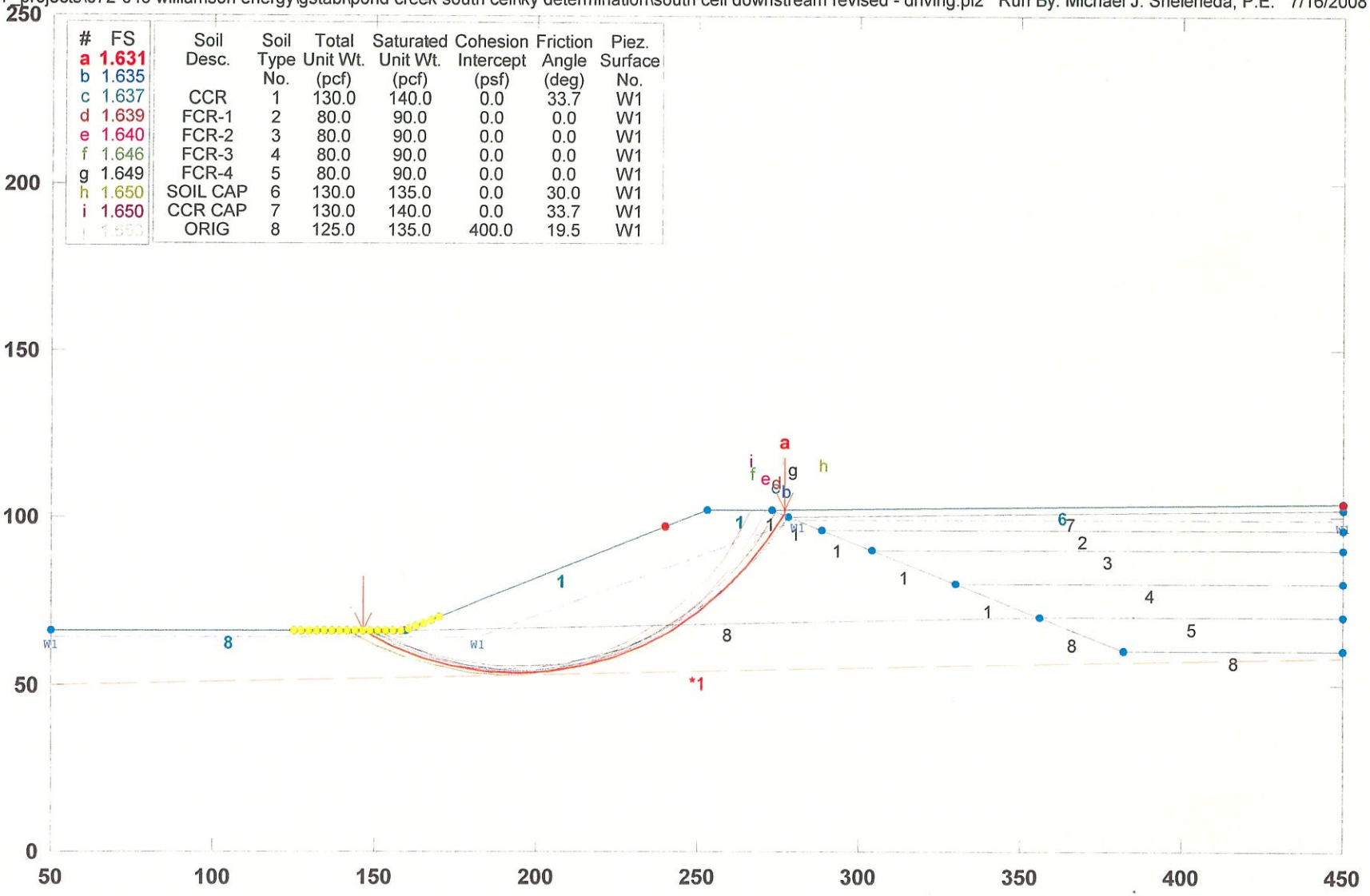
POND CREEK – SOUTH POND ABANDONMENT
GSTABL OUTPUT – DRIVING SHEAR STRESS
STABILITY ANALYSIS OUTPUT FILES
DOWNSTREAM AND UPSTREAM CONDITIONS

Pond Creek, South Cell, Abandonment Post-Eq Downstream Driving Analysis

p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\ky determination\south cell downstream revised - driving.pl2 Run By: Michael J. Sheleheda, P.E. 7/16/2008 11:36AM

#	FS
a	1.631
b	1.635
c	1.637
d	1.639
e	1.640
f	1.646
g	1.649
h	1.650
i	1.650

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR-1	2	80.0	90.0	0.0	0.0	W1
FCR-2	3	80.0	90.0	0.0	0.0	W1
FCR-3	4	80.0	90.0	0.0	0.0	W1
FCR-4	5	80.0	90.0	0.0	0.0	W1
SOIL CAP	6	130.0	135.0	0.0	30.0	W1
CCR CAP	7	130.0	140.0	0.0	33.7	W1
ORIG	8	125.0	135.0	400.0	19.5	W1



GSTABL7 v.2 FSmin=1.631

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R15300

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                              ***  GSTABL7  ***
                        ** GSTABL7 by Garry H. Gregory, P.E. **
      ** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
                  (All Rights Reserved-Unauthorized Use Prohibited)
    ******************************************************************************
                        SLOPE STABILITY ANALYSIS SYSTEM
           Modified Bishop, Simplified Janbu, or GLE Method of Slices.
           (Includes Spencer & Morgenstern-Price Type Analysis)
           Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
           Nonlinear Undrained Shear Strength, Curved Phi Envelope,
           Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
           Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
    ******************************************************************************
    Analysis Run Date:        7/16/2008
    Time of Run:              11:36AM
    Run By:                   Michael J. Sheleheda, P.E.
    Input Data Filename:      P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Cree
k South Cell\Ky Determination\south cell downstream revised - driving.in
    Output Filename:          P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Cree
k South Cell\Ky Determination\south cell downstream revised - driving.OUT
    Unit System:              English
    Plotted Output Filename:  P:\_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek So
uth Cell\Ky Determination\south cell downstream revised - driving.PLT
    PROBLEM DESCRIPTION:  Pond Creek, South Cell, Abandonment
                          Post-Eq Downstream Driving Analysis
    BOUNDARY COORDINATES
        4 Top   Boundaries
```

17 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	50.00	66.00	159.40	66.00	8
2	159.40	66.00	253.00	102.00	1
3	253.00	102.00	273.00	102.00	1
4	273.00	102.00	450.00	103.75	6
5	273.00	102.00	278.20	100.00	1
6	278.20	100.00	450.00	101.75	7
7	278.20	100.00	288.60	96.00	1
8	288.60	96.00	450.00	96.00	2
9	288.60	96.00	304.20	90.00	1
10	304.20	90.00	450.00	90.00	3
11	304.20	90.00	330.20	80.00	1
12	330.20	80.00	450.00	80.00	4
13	330.20	80.00	356.20	70.00	1
14	356.20	70.00	450.00	70.00	5
15	159.40	66.00	356.20	70.00	8
16	356.20	70.00	382.20	60.00	8
17	382.20	60.00	450.00	60.00	8

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS

8 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	0.0	0.0	0.00	0.0	1
3	80.0	90.0	0.0	0.0	0.00	0.0	1
4	80.0	90.0	0.0	0.0	0.00	0.0	1
5	80.0	90.0	0.0	0.0	0.00	0.0	1
6	130.0	135.0	0.0	30.0	0.00	0.0	1
7	130.0	140.0	0.0	33.7	0.00	0.0	1
8	125.0	135.0	400.0	19.5	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 4 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	50.00	64.00
2	182.00	64.00
3	280.80	99.00
4	450.00	99.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	50.00	50.00	450.00	58.00

EARTHQUAKE DATA HAS BEEN SUPPRESSED
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 125.00(ft)
and X = 170.00(ft)
Each Surface Terminates Between X = 240.00(ft)
and X = 450.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400

Statistical Data On All Valid FS Values:
FS Max = 3.085 FS Min = 1.631 FS Ave = 1.951
Standard Deviation = 0.269 Coefficient of Variation = 13.78 %

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	146.32	66.00
2	155.23	61.48
3	164.58	57.91
4	174.24	55.34
5	184.12	53.79
6	194.11	53.29
7	204.09	53.83
8	213.97	55.41
9	223.62	58.01
10	232.95	61.61
11	241.86	66.16
12	250.23	71.62
13	258.00	77.93
14	265.06	85.01
15	271.34	92.79
16	276.78	101.18
17	277.21	102.04

Circle Center At X = 193.95 ; Y = 148.86 ; and Radius = 95.57

Factor of Safety
*** 1.631 ***

Individual data on the 25 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.9	492.9	0.0	0.0	0.	0.	0.0	0.0	0.0
2	5.0	2091.1	0.0	439.1	0.	0.	0.0	0.0	0.0
3	4.2	2907.5	0.0	923.3	0.	0.	0.0	0.0	0.0
4	5.2	5528.1	0.0	1764.0	0.	0.	0.0	0.0	0.0
5	9.7	16864.1	0.0	4602.1	0.	0.	0.0	0.0	0.0
6	7.8	18896.4	0.0	4542.1	0.	0.	0.0	0.0	0.0
7	2.1	5903.1	0.0	1317.2	0.	0.	0.0	0.0	0.0
8	5.2	15841.2	0.0	3719.4	0.	0.	0.0	0.0	0.0
9	4.7	15746.5	0.0	3929.0	0.	0.	0.0	0.0	0.0
10	10.0	36868.6	0.0	9722.8	0.	0.	0.0	0.0	0.0
11	9.9	40271.4	0.0	11170.8	0.	0.	0.0	0.0	0.0
12	9.7	41681.5	0.0	11976.2	0.	0.	0.0	0.0	0.0
13	9.3	41104.8	0.0	12130.5	0.	0.	0.0	0.0	0.0
14	8.9	38666.4	0.0	11631.9	0.	0.	0.0	0.0	0.0
15	2.4	10150.9	0.0	3151.2	0.	0.	0.0	0.0	0.0
16	6.0	24396.6	0.0	7334.6	0.	0.	0.0	0.0	0.0
17	2.8	10743.4	0.0	3341.8	0.	0.	0.0	0.0	0.0
18	5.0	17622.9	0.0	5363.1	0.	0.	0.0	0.0	0.0
19	7.1	19563.0	0.0	6308.5	0.	0.	0.0	0.0	0.0
20	6.3	11036.7	0.0	3322.9	0.	0.	0.0	0.0	0.0
21	1.7	1740.8	0.0	337.3	0.	0.	0.0	0.0	0.0
22	0.7	592.2	0.0	35.9	0.	0.	0.0	0.0	0.0
23	2.7	1206.0	0.0	0.0	0.	0.	0.0	0.0	0.0
24	0.3	47.3	0.0	0.0	0.	0.	0.0	0.0	0.0
25	0.4	24.4	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.68	66.00
2	157.67	61.62
3	167.07	58.21
4	176.78	55.79
5	186.68	54.41
6	196.68	54.08
7	206.65	54.79
8	216.50	56.54
9	226.10	59.31

10	235.37	63.08
11	244.19	67.80
12	252.46	73.41
13	260.11	79.86
14	267.03	87.07
15	273.16	94.97
16	277.55	102.04

Circle Center At X = 194.87 ; Y = 149.27 ; and Radius = 95.22

Factor of Safety

*** 1.635 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	146.32	66.00
2	155.28	61.56
3	164.66	58.10
4	174.36	55.67
5	184.26	54.28
6	194.26	53.95
7	204.23	54.70
8	214.07	56.50
9	223.65	59.34
10	232.88	63.19
11	241.65	67.99
12	249.86	73.71
13	257.41	80.27
14	264.21	87.59
15	270.20	95.60
16	274.00	102.01

Circle Center At X = 192.27 ; Y = 147.41 ; and Radius = 93.48

Factor of Safety

*** 1.637 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.58	66.00
2	150.50	61.49
3	159.84	57.91
4	169.50	55.31
5	179.37	53.71
6	189.35	53.12
7	199.34	53.56
8	209.24	55.02
9	218.93	57.48
10	228.32	60.91
11	237.31	65.29
12	245.81	70.56
13	253.72	76.68
14	260.97	83.57
15	267.47	91.16
16	273.17	99.38
17	274.62	102.02

Circle Center At X = 190.08 ; Y = 150.88 ; and Radius = 97.76

Factor of Safety

*** 1.639 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.05	66.00
2	159.86	61.27
3	169.18	57.62
4	178.85	55.11
5	188.76	53.77
6	198.76	53.61
7	208.71	54.65
8	218.46	56.86
9	227.88	60.22
10	236.83	64.67

11	245.19	70.16
12	252.84	76.60
13	259.67	83.91
14	265.58	91.97
15	270.49	100.69
16	271.03	102.00

Circle Center At X = 195.05 ; Y = 137.31 ; and Radius = 83.79

Factor of Safety

*** 1.640 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.68	66.00
2	157.44	61.17
3	166.72	57.45
4	176.39	54.89
5	186.30	53.54
6	196.30	53.41
7	206.24	54.51
8	215.96	56.82
9	225.34	60.31
10	234.21	64.91
11	242.46	70.58
12	249.94	77.20
13	256.56	84.70
14	262.21	92.95
15	266.80	101.84
16	266.86	102.00

Circle Center At X = 192.33 ; Y = 134.71 ; and Radius = 81.40

Factor of Safety

*** 1.646 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.68	66.00
2	157.85	61.99
3	167.36	58.90
4	177.13	56.77
5	187.06	55.60
6	197.06	55.41
7	207.02	56.21
8	216.87	57.98
9	226.49	60.71
10	235.79	64.37
11	244.69	68.93
12	253.10	74.34
13	260.94	80.55
14	268.13	87.50
15	274.60	95.13
16	279.40	102.06

Circle Center At X = 193.94 ; Y = 156.89 ; and Radius = 101.54

Factor of Safety

*** 1.649 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	139.21	66.00
2	148.34	61.92
3	157.78	58.61
4	167.46	56.10
5	177.31	54.41
6	187.28	53.55
7	197.28	53.53
8	207.24	54.34
9	217.11	55.98
10	226.80	58.44
11	236.25	61.70
12	245.40	65.73

13	254.18	70.52
14	262.53	76.03
15	270.39	82.21
16	277.71	89.03
17	284.43	96.43
18	288.81	102.16

Circle Center At X = 192.55 ; Y = 172.86 ; and Radius = 119.43

Factor of Safety

*** 1.650 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.05	66.00
2	159.94	61.41
3	169.32	57.95
4	179.05	55.66
5	189.00	54.59
6	198.99	54.75
7	208.90	56.14
8	218.56	58.73
9	227.82	62.50
10	236.55	67.37
11	244.62	73.28
12	251.90	80.13
13	258.28	87.83
14	263.67	96.26
15	266.41	102.00

Circle Center At X = 192.70 ; Y = 135.70 ; and Radius = 81.20

Factor of Safety

*** 1.650 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.58	66.00
2	150.68	61.85
3	160.14	58.60
4	169.86	56.27
5	179.76	54.89
6	189.76	54.47
7	199.74	55.01
8	209.63	56.50
9	219.33	58.94
10	228.75	62.30
11	237.80	66.55
12	246.40	71.65
13	254.47	77.56
14	261.94	84.21
15	268.73	91.55
16	274.78	99.51
17	276.34	102.03

Circle Center At X = 189.16 ; Y = 158.37 ; and Radius = 103.91

Factor of Safety

*** 1.653 ***

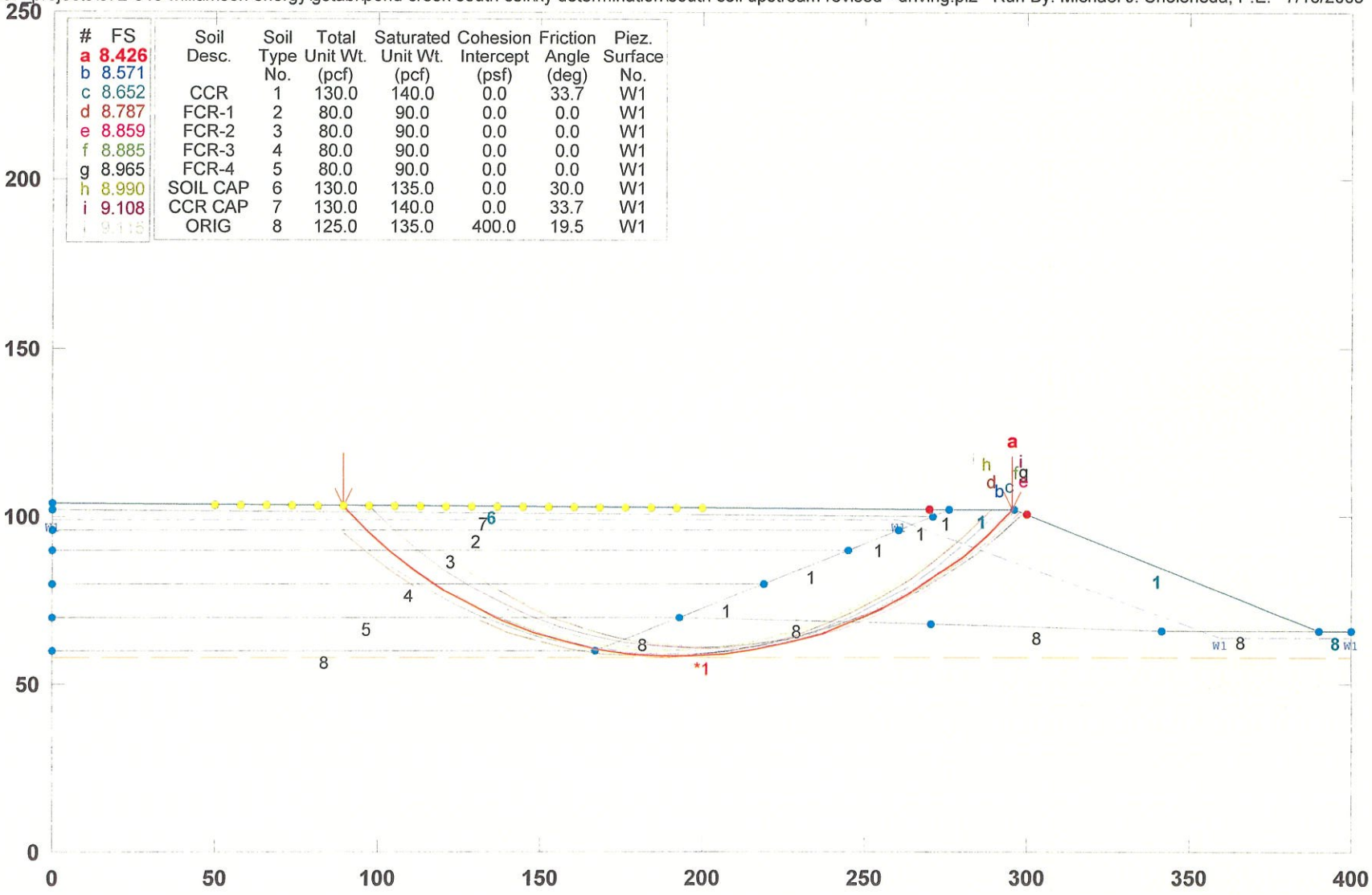
**** END OF GSTABL7 OUTPUT ****

Pond Creek, South Cell, Abandonment Post-Eq Upstream Analysis - Driving

p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\ky determination\south cell upstream revised - driving.pl2 Run By: Michael J. Sheleheda, P.E. 7/16/2008 11:44AM

#	FS
a	8.426
b	8.571
c	8.652
d	8.787
e	8.859
f	8.885
g	8.965
h	8.990
i	9.108

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR-1	2	80.0	90.0	0.0	0.0	W1
FCR-2	3	80.0	90.0	0.0	0.0	W1
FCR-3	4	80.0	90.0	0.0	0.0	W1
FCR-4	5	80.0	90.0	0.0	0.0	W1
SOIL CAP	6	130.0	135.0	0.0	30.0	W1
CCR CAP	7	130.0	140.0	0.0	33.7	W1
ORIG	8	125.0	135.0	400.0	19.5	W1



GSTABL7 v.2 FSmin=8.426

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R15307

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **

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****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 7/16/2008
Time of Run: 11:44AM
Run By: Michael J. Sheleheda, P.E.
Input Data Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Cree
k South Cell\Ky Determination\south cell upstream revised - driving.in
Output Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Cree
k South Cell\Ky Determination\south cell upstream revised - driving.OUT
Unit System: English
Plotted Output Filename: P:_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek So
uth Cell\Ky Determination\south cell upstream revised - driving.PLT
PROBLEM DESCRIPTION: Pond Creek, South Cell, Abandonment
Post-Eq Upstream Analysis - Driving

BOUNDARY COORDINATES
4 Top Boundaries
19 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	103.75	276.24	102.00	6
2	276.24	102.00	296.24	102.00	1
3	296.24	102.00	389.84	66.00	1
4	389.84	66.00	400.00	66.00	8
5	0.00	101.75	271.04	100.00	7
6	271.04	100.00	276.24	102.00	1
7	0.00	96.00	260.64	96.00	2
8	260.64	96.00	271.04	100.00	1
9	0.00	90.00	245.04	90.00	3
10	245.04	90.00	260.64	96.00	1
11	0.00	80.00	219.04	80.00	4
12	219.04	80.00	245.04	90.00	1
13	0.00	70.00	193.04	70.00	5
14	193.04	70.00	219.04	80.00	1
15	0.00	60.00	167.04	60.00	8
16	167.04	60.00	193.04	70.00	8
17	193.46	70.16	270.39	68.00	8
18	270.39	68.00	341.70	66.00	8
19	341.70	66.00	389.84	66.00	8

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
8 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	0.0	0.0	0.00	0.0	1
3	80.0	90.0	0.0	0.0	0.00	0.0	1
4	80.0	90.0	0.0	0.0	0.00	0.0	1
5	80.0	90.0	0.0	0.0	0.00	0.0	1
6	130.0	135.0	0.0	30.0	0.00	0.0	1
7	130.0	140.0	0.0	33.7	0.00	0.0	1
8	125.0	135.0	400.0	19.5	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 4 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	99.00
2	260.64	99.00
3	359.44	64.00
4	400.00	64.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	0.00	58.00	400.00	58.00

EARTHQUAKE DATA HAS BEEN SUPPRESSED
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00(ft)
and X = 200.00(ft)
Each Surface Terminates Between X = 270.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.85	101.73
3	69.73	100.17
4	79.63	98.75
5	89.55	97.48
6	99.49	96.36
7	109.44	95.39
8	119.40	94.56
9	129.38	93.87
10	139.37	93.34
11	149.36	92.95
12	159.36	92.71
13	169.36	92.62
14	179.36	92.67
15	189.35	92.87
16	199.35	93.22
17	209.34	93.71
18	219.31	94.36
19	229.28	95.15
20	239.24	96.08
21	249.18	97.17
22	259.10	98.39
23	269.01	99.77
24	278.89	101.29
25	283.09	102.00

Factor Of Safety For The Preceding Specified Surface =-22.205
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.58	100.56
3	69.23	97.93
4	78.93	95.53
5	88.70	93.36
6	98.51	91.44
7	108.37	89.76
8	118.26	88.32
9	128.19	87.12

10	138.15	86.17
11	148.12	85.45
12	158.11	84.99
13	168.11	84.76
14	178.11	84.78
15	188.10	85.05
16	198.09	85.56
17	208.06	86.31
18	218.01	87.31
19	227.93	88.55
20	237.82	90.03
21	247.67	91.76
22	257.48	93.72
23	267.23	95.93
24	276.93	98.37
25	286.57	101.04
26	289.71	102.00

Factor Of Safety For The Preceding Specified Surface =-10.349
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.81	101.50
3	69.66	99.75
4	79.53	98.16
5	89.43	96.74
6	99.35	95.49
7	109.29	94.42
8	119.25	93.52
9	129.23	92.79
10	139.21	92.23
11	149.20	91.85
12	159.20	91.63
13	169.20	91.60
14	179.20	91.73
15	189.19	92.04
16	199.18	92.52
17	209.16	93.17
18	219.13	94.00
19	229.08	94.99
20	239.01	96.16
21	248.92	97.51
22	258.80	99.02
23	268.66	100.70
24	275.56	102.00

Factor Of Safety For The Preceding Specified Surface =-17.555
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.78	101.36
3	69.60	99.44
4	79.44	97.69
5	89.31	96.09
6	99.21	94.66
7	109.13	93.39
8	119.07	92.28
9	129.02	91.34
10	138.99	90.56
11	148.97	89.94
12	158.96	89.49
13	168.96	89.20
14	178.96	89.07
15	188.96	89.10

16	198.96	89.30
17	208.95	89.67
18	218.94	90.20
19	228.91	90.89
20	238.88	91.74
21	248.82	92.76
22	258.75	93.94
23	268.66	95.28
24	278.55	96.78
25	288.41	98.45
26	298.24	100.27
27	299.87	100.60

Factor Of Safety For The Preceding Specified Surface =-16.036
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	58.92	98.92
3	68.02	94.77
4	77.28	90.99
5	86.68	87.58
6	96.21	84.55
7	105.85	81.90
8	115.59	79.64
9	125.42	77.77
10	135.31	76.29
11	145.25	75.21
12	155.23	74.53
13	165.22	74.25
14	175.22	74.37
15	185.21	74.89
16	195.17	75.80
17	205.08	77.12
18	214.93	78.83
19	224.71	80.93
20	234.39	83.42
21	243.97	86.30
22	253.42	89.55
23	262.74	93.19
24	271.91	97.19
25	280.90	101.55
26	281.74	102.00

Factor Of Safety For The Preceding Specified Surface =-31.135
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	58.94	98.95
3	68.05	94.82
4	77.32	91.07
5	86.73	87.68
6	96.26	84.68
7	105.91	82.06
8	115.66	79.83
9	125.49	77.99
10	135.39	76.55
11	145.33	75.50
12	155.31	74.85
13	165.31	74.60
14	175.31	74.75
15	185.29	75.30
16	195.25	76.25
17	205.16	77.60
18	215.00	79.34

19	224.77	81.47
20	234.45	84.00
21	244.02	86.90
22	253.46	90.19
23	262.76	93.86
24	271.91	97.89
25	280.31	102.00

Factor Of Safety For The Preceding Specified Surface =-22.593
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.65	100.81
3	69.35	98.39
4	79.10	96.18
5	88.90	94.17
6	98.74	92.37
7	108.61	90.78
8	118.51	89.39
9	128.44	88.22
10	138.40	87.25
11	148.37	86.50
12	158.35	85.95
13	168.35	85.62
14	178.35	85.50
15	188.35	85.59
16	198.34	85.89
17	208.33	86.40
18	218.30	87.12
19	228.26	88.06
20	238.20	89.20
21	248.10	90.55
22	257.98	92.11
23	267.82	93.88
24	277.63	95.86
25	287.38	98.04
26	297.10	100.43
27	299.00	100.94

Factor Of Safety For The Preceding Specified Surface =-17.636
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	67.21	99.76
3	76.65	96.45
4	86.19	93.45
5	95.83	90.77
6	105.54	88.42
7	115.34	86.39
8	125.19	84.68
9	135.09	83.31
10	145.04	82.26
11	155.01	81.55
12	165.01	81.17
13	175.01	81.12
14	185.00	81.40
15	194.98	82.02
16	204.94	82.97
17	214.86	84.25
18	224.73	85.86
19	234.54	87.79
20	244.28	90.05
21	253.94	92.64
22	263.51	95.54

23	272.98	98.76
24	281.55	102.00

Factor Of Safety For The Preceding Specified Surface = -8.537
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	67.52	100.68
3	77.21	98.21
4	86.95	95.95
5	96.75	93.92
6	106.58	92.11
7	116.45	90.52
8	126.36	89.16
9	136.30	88.03
10	146.26	87.13
11	156.23	86.45
12	166.22	86.00
13	176.22	85.78
14	186.22	85.78
15	196.22	86.02
16	206.21	86.48
17	216.18	87.17
18	226.14	88.09
19	236.07	89.23
20	245.98	90.60
21	255.85	92.20
22	265.68	94.02
23	275.47	96.07
24	285.21	98.34
25	294.90	100.83
26	297.43	101.54

Factor Of Safety For The Preceding Specified Surface =-16.882
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	66.76	98.76
3	75.81	94.51
4	85.04	90.64
5	94.41	87.16
6	103.92	84.08
7	113.56	81.39
8	123.29	79.11
9	133.11	77.23
10	143.01	75.77
11	152.95	74.71
12	162.93	74.08
13	172.93	73.86
14	182.93	74.06
15	192.91	74.67
16	202.85	75.70
17	212.75	77.14
18	222.58	79.00
19	232.32	81.26
20	241.95	83.92
21	251.47	86.99
22	260.86	90.45
23	270.09	94.29
24	279.15	98.52
25	285.86	102.00

Factor Of Safety For The Preceding Specified Surface =*******
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.

Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	67.17	99.64
3	76.55	96.19
4	86.04	93.04
5	95.63	90.18
6	105.29	87.62
7	115.04	85.37
8	124.85	83.43
9	134.71	81.79
10	144.62	80.46
11	154.57	79.44
12	164.55	78.73
13	174.54	78.34
14	184.54	78.26
15	194.54	78.49
16	204.52	79.03
17	214.48	79.88
18	224.42	81.05
19	234.31	82.53
20	244.15	84.31
21	253.92	86.40
22	263.63	88.80
23	273.26	91.50
24	282.80	94.50
25	292.24	97.79
26	299.71	100.66

Factor Of Safety For The Preceding Specified Surface =*******
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	67.14	99.58
3	76.51	96.08
4	85.98	92.87
5	95.55	89.97
6	105.21	87.38
7	114.95	85.10
8	124.75	83.13
9	134.61	81.47
10	144.52	80.13
11	154.47	79.10
12	164.44	78.40
13	174.44	78.01
14	184.44	77.94
15	194.43	78.20
16	204.42	78.77
17	214.38	79.66
18	224.30	80.86
19	234.19	82.39
20	244.02	84.22
21	253.78	86.37
22	263.48	88.84
23	273.08	91.61
24	282.60	94.68
25	292.01	98.06
26	299.15	100.88

Factor Of Safety For The Preceding Specified Surface =*******
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38

2	67.77	101.80
3	77.66	100.34
4	87.57	99.01
5	97.50	97.80
6	107.44	96.72
7	117.40	95.77
8	127.36	94.94
9	137.34	94.24
10	147.32	93.67
11	157.31	93.23
12	167.31	92.91
13	177.30	92.71
14	187.30	92.65
15	197.30	92.71
16	207.30	92.90
17	217.30	93.22
18	227.29	93.66
19	237.27	94.23
20	247.25	94.93
21	257.21	95.75
22	267.17	96.70
23	277.11	97.78
24	287.04	98.98
25	296.95	100.31
26	299.62	100.70

Factor Of Safety For The Preceding Specified Surface =-20.548
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	66.88	99.00
3	76.04	94.97
4	85.34	91.32

###################### SOME LINES SKIPPED ######################
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Number of Trial Surfaces with Misleading FS = 144
Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Evaluated = 36.0 %
Statistical Data On All Valid FS Values:
FS Max = 390.835 FS Min = 8.426 FS Ave = 29.886
Standard Deviation = 46.769 Coefficient of Variation = 156.49 %
Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.47	103.18
2	96.57	96.14
3	104.14	89.61
4	112.15	83.62
5	120.57	78.22
6	129.34	73.42
7	138.43	69.25
8	147.79	65.72
9	157.37	62.87
10	167.13	60.69
11	177.02	59.21
12	186.99	58.42
13	196.99	58.34
14	206.97	58.96
15	216.88	60.28
16	226.68	62.29
17	236.31	64.98
18	245.72	68.35

19	254.88	72.37
20	263.73	77.02
21	272.24	82.29
22	280.35	88.13
23	288.03	94.54
24	295.24	101.46
25	295.73	102.00

Circle Center At X = 193.18 ; Y = 200.50 ; and Radius = 142.22

Factor of Safety

*** 8.426 ***

Individual data on the 41 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.0	266.4	0.0	0.0	0.	0.	0.0	0.0	0.0
2	2.2	871.5	0.0	0.0	0.	0.	0.0	0.0	0.0
3	2.9	2132.6	0.0	363.1	0.	0.	0.0	0.0	0.0
4	0.2	149.9	0.0	38.2	0.	0.	0.0	0.0	0.0
5	7.0	8522.5	0.0	3439.7	0.	0.	0.0	0.0	0.0
6	0.5	690.7	0.0	346.7	0.	0.	0.0	0.0	0.0
7	8.0	14368.7	0.0	7728.8	0.	0.	0.0	0.0	0.0
8	5.6	12519.1	0.0	7189.6	0.	0.	0.0	0.0	0.0
9	2.8	6822.4	0.0	4092.0	0.	0.	0.0	0.0	0.0
10	8.8	24133.2	0.0	14465.5	0.	0.	0.0	0.0	0.0
11	7.4	23188.6	0.0	13952.9	0.	0.	0.0	0.0	0.0
12	1.6	5415.3	0.0	3311.8	0.	0.	0.0	0.0	0.0
13	9.4	32625.3	0.0	19665.4	0.	0.	0.0	0.0	0.0
14	9.6	36083.9	0.0	21655.7	0.	0.	0.0	0.0	0.0
15	9.8	38883.1	0.0	23225.8	0.	0.	0.0	0.0	0.0
16	1.2	5010.3	0.0	2971.6	0.	0.	0.0	0.0	0.0
17	8.7	36837.6	0.0	21396.3	0.	0.	0.0	0.0	0.0
18	10.0	45327.4	0.0	25076.4	0.	0.	0.0	0.0	0.0
19	6.0	28647.7	0.0	15329.2	0.	0.	0.0	0.0	0.0
20	0.4	2037.3	0.0	1064.9	0.	0.	0.0	0.0	0.0
21	3.5	17051.7	0.0	8953.6	0.	0.	0.0	0.0	0.0
22	10.0	49067.6	0.0	25180.6	0.	0.	0.0	0.0	0.0
23	9.9	49264.0	0.0	24575.7	0.	0.	0.0	0.0	0.0
24	2.2	10703.5	0.0	5290.0	0.	0.	0.0	0.0	0.0
25	7.6	37565.5	0.0	18246.3	0.	0.	0.0	0.0	0.0
26	9.6	46127.0	0.0	22067.3	0.	0.	0.0	0.0	0.0
27	8.7	39883.1	0.0	18779.2	0.	0.	0.0	0.0	0.0
28	0.7	3032.8	0.0	1396.8	0.	0.	0.0	0.0	0.0
29	0.7	3232.8	0.0	1525.7	0.	0.	0.0	0.0	0.0
30	8.4	35428.8	0.0	16346.2	0.	0.	0.0	0.0	0.0
31	5.8	22263.7	0.0	10196.2	0.	0.	0.0	0.0	0.0
32	3.1	11056.8	0.0	4580.0	0.	0.	0.0	0.0	0.0
33	1.0	3298.4	0.0	1367.8	0.	0.	0.0	0.0	0.0
34	6.3	19528.5	0.0	7405.3	0.	0.	0.0	0.0	0.0
35	1.2	3276.4	0.0	1093.1	0.	0.	0.0	0.0	0.0
36	4.0	9912.6	0.0	3040.5	0.	0.	0.0	0.0	0.0
37	4.1	8432.6	0.0	1818.3	0.	0.	0.0	0.0	0.0
38	3.3	5376.9	0.0	487.5	0.	0.	0.0	0.0	0.0
39	4.4	5332.8	0.0	0.0	0.	0.	0.0	0.0	0.0
40	7.2	3750.3	0.0	0.0	0.	0.	0.0	0.0	0.0
41	0.5	16.9	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.47	103.18
2	96.55	96.11
3	104.11	89.57
4	112.12	83.59
5	120.55	78.20
6	129.34	73.43
7	138.44	69.30
8	147.83	65.85
9	157.43	63.07

10	167.22	60.99
11	177.12	59.62
12	187.10	58.97
13	197.10	59.04
14	207.07	59.83
15	216.96	61.33
16	226.71	63.54
17	236.28	66.44
18	245.61	70.03
19	254.67	74.27
20	263.39	79.16
21	271.74	84.67
22	279.67	90.75
23	287.15	97.40
24	291.63	102.00

Circle Center At X = 191.11 ; Y = 197.72 ; and Radius = 138.80

Factor of Safety

*** 8.571 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.37	103.13
2	104.44	96.06
3	112.02	89.54
4	120.06	83.59
5	128.51	78.25
6	137.34	73.55
7	146.49	69.51
8	155.91	66.16
9	165.55	63.51
10	175.36	61.59
11	185.29	60.39
12	195.28	59.93
13	205.28	60.20
14	215.23	61.22
15	225.07	62.96
16	234.76	65.43
17	244.24	68.61
18	253.47	72.48
19	262.38	77.01
20	270.93	82.20
21	279.07	88.00
22	286.77	94.38
23	293.97	101.32
24	294.58	102.00

Circle Center At X = 196.51 ; Y = 195.25 ; and Radius = 135.33

Factor of Safety

*** 8.652 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	103.23
2	88.68	96.19
3	96.25	89.66
4	104.27	83.68
5	112.68	78.27
6	121.45	73.46
7	130.53	69.28
8	139.88	65.74
9	149.46	62.86
10	159.21	60.66
11	169.10	59.14
12	179.06	58.32
13	189.06	58.20
14	199.04	58.77
15	208.96	60.04
16	218.77	62.00
17	228.41	64.64

18	237.85	67.95
19	247.03	71.91
20	255.92	76.50
21	264.46	81.70
22	272.62	87.48
23	280.35	93.82
24	287.62	100.69
25	288.83	102.00

Circle Center At X = 185.83 ; Y = 201.25 ; and Radius = 143.09

Factor of Safety

*** 8.787 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.26	103.08
2	112.34	96.02
3	119.93	89.51
4	127.99	83.59
5	136.46	78.28
6	145.31	73.62
7	154.48	69.63
8	163.93	66.35
9	173.59	63.77
10	183.42	61.93
11	193.36	60.83
12	203.35	60.47
13	213.35	60.86
14	223.28	61.99
15	233.10	63.87
16	242.76	66.47
17	252.19	69.79
18	261.35	73.81
19	270.18	78.49
20	278.64	83.83
21	286.68	89.78
22	294.25	96.32
23	298.89	100.98

Circle Center At X = 203.14 ; Y = 194.17 ; and Radius = 133.70

Factor of Safety

*** 8.859 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.26	103.08
2	112.35	96.02
3	119.95	89.53
4	128.02	83.63
5	136.52	78.36
6	145.40	73.75
7	154.60	69.83
8	164.07	66.63
9	173.76	64.16
10	183.61	62.43
11	193.56	61.46
12	203.56	61.25
13	213.54	61.80
14	223.46	63.11
15	233.24	65.17
16	242.84	67.97
17	252.20	71.49
18	261.27	75.72
19	269.98	80.62
20	278.30	86.18
21	286.16	92.35
22	293.54	99.10
23	296.25	102.00

Circle Center At X = 201.33 ; Y = 192.41 ; and Radius = 131.18

Factor of Safety

*** 8.885 ***
Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	103.23
2	88.99	96.52
3	96.80	90.28
4	105.00	84.55
5	113.54	79.35
6	122.39	74.69
7	131.52	70.61
8	140.89	67.11
9	150.46	64.21
10	160.19	61.92
11	170.05	60.24
12	179.99	59.20
13	189.99	58.78
14	199.98	59.00
15	209.95	59.84
16	219.84	61.31
17	229.62	63.41
18	239.24	66.12
19	248.68	69.43
20	257.89	73.33
21	266.83	77.80
22	275.47	82.83
23	283.78	88.39
24	291.72	94.47
25	299.11	100.90

Circle Center At X = 191.58 ; Y = 217.09 ; and Radius = 158.31

Factor of Safety
*** 8.965 ***
Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.47	103.18
2	96.59	96.15
3	104.19	89.66
4	112.25	83.75
5	120.73	78.43
6	129.56	73.75
7	138.72	69.73
8	148.14	66.39
9	157.79	63.74
10	167.60	61.81
11	177.53	60.60
12	187.51	60.12
13	197.51	60.37
14	207.46	61.34
15	217.32	63.05
16	227.02	65.46
17	236.52	68.58
18	245.77	72.39
19	254.71	76.86
20	263.31	81.98
21	271.50	87.70
22	279.26	94.01
23	286.54	100.87
24	287.57	102.00

Circle Center At X = 189.08 ; Y = 196.82 ; and Radius = 136.71

Factor of Safety
*** 8.990 ***
Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.37	103.13
2	104.65	96.28
3	112.40	89.95

4	120.57	84.19
5	129.12	79.01
6	138.02	74.45
7	147.21	70.52
8	156.66	67.24
9	166.32	64.64
10	176.13	62.72
11	186.06	61.50
12	196.04	60.97
13	206.04	61.15
14	216.00	62.03
15	225.88	63.61
16	235.62	65.87
17	245.18	68.81
18	254.50	72.42
19	263.55	76.67
20	272.28	81.55
21	280.65	87.03
22	288.61	93.08
23	296.12	99.68
24	297.82	101.39

Circle Center At X = 198.47 ; Y = 203.21 ; and Radius = 142.26

Factor of Safety

*** 9.108 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	103.23
2	88.66	96.17
3	96.23	89.64
4	104.25	83.66
5	112.67	78.28
6	121.47	73.52
7	130.58	69.40
8	139.97	65.95
9	149.58	63.18
10	159.36	61.11
11	169.27	59.75
12	179.25	59.11
13	189.25	59.18
14	199.21	59.98
15	209.10	61.48
16	218.85	63.70
17	228.42	66.61
18	237.75	70.20
19	246.80	74.45
20	255.52	79.35
21	263.87	84.85
22	271.80	90.95
23	279.27	97.60
24	283.55	102.00

Circle Center At X = 183.15 ; Y = 197.89 ; and Radius = 138.84

Factor of Safety

*** 9.115 ***

**** END OF GSTABL7 OUTPUT ****

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Pond Phase 2 Abandonment Evaluation
Post-Earthquake Stability Analyses and Factor of Safety Against Liquefaction – South Pond Stage 2
Downstream and Upstream Slope Geometries

PROJECT NO. 080-851

PAGE 1 OF 4

MADE BY BEG DATE 7/17/08 CHECKED BY NJS DATE 7/23/08

CALCULATION BRIEF FOR AND FACTOR OF SAFETY AGAINST LIQUEFACTION FOR THE DOWNSTREAM AND UPSTREAM SLOPE GEOMETRIES

POND CREEK COAL REFUSE DISPOSAL SITE - SOUTH POND

OBJECTIVE: To determine the factor of safety against liquefaction (F_L) for the Pond Creek – South Pond Phase 2 abandonment embankment and impoundment using the undrained steady-state shear strengths (S_{us}) determined for the impounded fine coal refuse.

METHODOLOGY: Use GSTABL limit equilibrium analyses and fine coal refuse S_{us} values to determine F_L for the Pond Creek – South Pond Phase 2 abandonment embankment for both downstream and upstream critical failure surfaces.

REFERENCES:

1. Gregory, P.E., Garry H., "GSTABL7 with STEDwin Slope Stability Analysis System, Version 2.0," dated September 2001.

2. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Determination of Downstream and Upstream In-Situ Driving Shear Stress by Elastic (GStabl) Solution," Pond Creek Coal Refuse Disposal Site – South Pond," BEG, 7/12/08.

3. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak and Steady-State Undrained Shear Strengths For Refuse and Subgrade Materials, Pond Creek Coal Refuse Disposal Site – South Pond," BEG, 7/12/08.

4. Poulos, S.J., Castro, G., and France, J.W. (1985a) "Liquefaction Evaluation Procedure," Journal of the Geotechnical Engineering Division, ASCE, Vol. 111, No. GT6, pp. 772-792.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Pond Phase 2 Abandonment Evaluation
Post-Earthquake Stability Analyses and Factor of Safety Against Liquefaction – South Pond Stage 2
Downstream and Upstream Slope Geometries

PROJECT NO. 080-851

MADE BY BEG DATE 7/17/08 CHECKED BY MGS DATE 7/23/08

ANALYSIS:

The Illinois Department of Natural Resources (IDNR) has required that the evaluation of the abandonment condition for the South Pond address the following issues:

1. The classification of the existing condition of the impounded material with respect to its fluid nature; and

2. The liquefaction potential of the impounded material and the related stability of the containing dam.

Post-earthquake factors of safety against a liquefaction flow failure (F_L) were calculated using steady-state principles and the Phase 2 upstream and downstream embankment/impoundment conditions. Following the estimation of in-situ driving shear stresses for Phase 2, the average vertical effective stress along the critical failure surface and various fine coal refuse "micro" layers was calculated. The σ'_V values were determined at various stations at layer boundary locations shown in Figure 1. S_{us} values were then estimated by multiplying the in-situ average σ'_V for each layer by the 0.24 ratio. Figure 1 presents the S_{us} values estimated for each fine coal refuse layer used in the downstream post-earthquake stability analyses.

The following soil properties were estimated based on previous field and laboratory testing as well as current fine coal refuse testing for use in the various post-earthquake liquefaction slope stability analyses:

Summary of Engineering Properties

Material Type	Total Unit Weight (γt) (pcf)	Saturated Unit Weight (γs) (pcf)	Effective Friction, (ϕ') (deg)	Effective Cohesion (c') (psf)
Coarse Refuse	130	140	33.7	0
Fine Refuse	80	90	0	200 to 276
Residual Soil	125	130	19	4000
Soil Cap	130	1135	30	0

Note: Refuse properties provided by Alliance Consulting, Inc. based on laboratory testing and/or literature values noted in the Alliance static/seismic slope stability analyses.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Pond Phase 2 Abandonment Evaluation
Post-Earthquake Stability Analyses and Factor of Safety Against Liquefaction – South Pond Stage 2
Downstream and Upstream Slope Geometries

PROJECT NO. 080-851

MADE BY BEG DATE 7/17/08 CHECKED BY MJS DATE 7/23/08

Using the impoundment geometry shown in Figure 1, a series of GSTABL7 analyses were performed to identify the most critical circular failure surface passing through the Stage 2 impoundment for both the downstream and upstream (abandonment) conditions. The range of starting and ending points for failure circle generation were iteratively analyzed to evaluate the critical failure surface and included the entire impoundment surface. The drained strengths of the coarse and total strength of the residual soil described above were used while the cohesion values for the fine coal refuse layers were modeled using the steady-state to effective stress relationship determined in Ref. 2 to estimate a factor of safety of against liquefaction.

The minimum safety factor against liquefaction in the downstream direction for this critical stage is 1.6, and in the upstream direction, the minimum F_L is 8. These results are based on a site-specific steady-state shear strength to effective stress relationship ($S_{us} = 0.24\ \sigma'_v$), which relates the shear strength of slurry fine coal refuse samples with the estimated vertical effective overburden pressure above the fine coal refuse layers. The following table presents the results of the downstream and upstream post-earthquake stability analyses. GSTABL output files are presented in Appendix C for the South Pond Phase 2 impoundment.

Phase 2 Abandonment (Crest El. 502 ft)	Top of Fines Elevation (ft)	Top of Cap Elevation[1] (ft)	Driving Shear Stress in Fine Coal Refuse (τ_d) (psf)	Factor of Safety Against Liquefaction (dim)
Downstream	496	502	0	1.6
Upstream	496	502	0	8.4

[1] Cap includes 4-foot coarse refuse and 2-foot soil cover layer above top of fines elevation. Soil cover sloped at one percent to maintain positive drainage.

Poulos, et al (1985) states a soil mass susceptible to liquefaction will only experience a liquefaction failure when a sufficiently large triggering event, such as an earthquake, causes the strength of the soil to decrease to the undrained steady-state strength. Conversely, a soil mass unsusceptible to liquefaction physically cannot fail by liquefaction since the minimum undrained strength exceeds the in-situ driving shear stress along the critical failure surface.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Pond Phase 2 Abandonment Evaluation

PROJECT NO. 080-851

Post-Earthquake Stability Analyses and Factor of Safety Against Liquefaction – South Pond Stage 2

Downstream and Upstream Slope Geometries

MADE BY BEG DATE 7/17/08 CHECKED BY MJS DATE 7/23/08

CONCLUSION:

CEC has completed an evaluation of the liquefaction susceptibility of the proposed Pond Creek South Pond (Phase 2) abandonment geometry. Based on the information presented in this calculation brief, CEC determined that the Pond Creek – Phase 2 abandonment geometry is not susceptible to a liquefaction (flow) failure. This conclusion is based on the characterization of the fine coal refuse, peak and steady-state undrained shear strength, shear strains, in-situ driving shear stresses through the fine coal refuse and adequate factor of safety against post-earthquake liquefaction susceptibility in both the upstream and downstream directions.

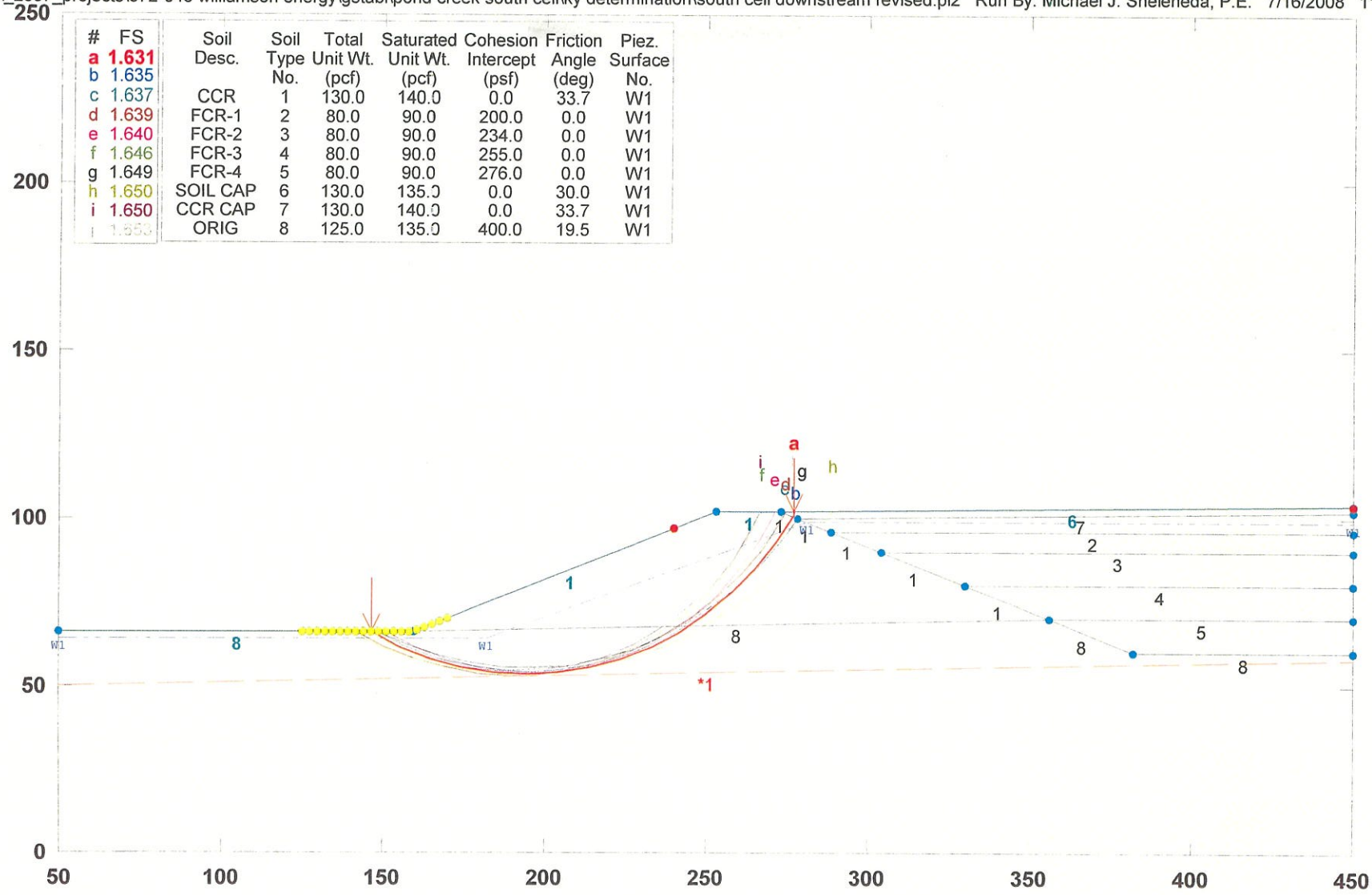
POND CREEK – PHASE 2 SOUTH POND ABANDONMENT
GSTABL OUTPUT – FACTOR OF SAFETY AGAINST LIQUEFACTION
STABILITY ANALYSIS OUTPUT FILES
DOWNSTREAM AND UPSTREAM CONDITIONS

Pond Creek, South Cell, Abandonment Post-Eq Downstream Analysis

p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\ky determination\south cell downstream revised.pl2 Run By: Michael J. Sheleheda, P.E. 7/16/2008 11:38AM

#	FS
a	1.631
b	1.635
c	1.637
d	1.639
e	1.640
f	1.646
g	1.649
h	1.650
i	1.650
j	1.653

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR-1	2	80.0	90.0	200.0	0.0	W1
FCR-2	3	80.0	90.0	234.0	0.0	W1
FCR-3	4	80.0	90.0	255.0	0.0	W1
FCR-4	5	80.0	90.0	276.0	0.0	W1
SOIL CAP	6	130.0	135.0	0.0	30.0	W1
CCR CAP	7	130.0	140.0	0.0	33.7	W1
ORIG	8	125.0	135.0	400.0	19.5	W1



GSTABL7 v.2 FSmin=1.631

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R15327

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
(All Rights Reserved-Unauthorized Use Prohibited)

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

Analysis Run Date: 7/16/2008
Time of Run: 11:38AM
Run By: Michael J. Sheleheda, P.E.
Input Data Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Cree
k South Cell\Ky Determination\south cell downstream revised.in
Output Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Cree
k South Cell\Ky Determination\south cell downstream revised.OUT
Unit System: English
Plotted Output Filename: P:_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek So
uth Cell\Ky Determination\south cell downstream revised.PLT
PROBLEM DESCRIPTION: Pond Creek, South Cell, Abandonment
Post-Eq Downstream Analysis

BOUNDARY COORDINATES
4 Top Boundaries
17 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	50.00	66.00	159.40	66.00	8
2	159.40	66.00	253.00	102.00	1
3	253.00	102.00	273.00	102.00	1
4	273.00	102.00	450.00	103.75	6
5	273.00	102.00	278.20	100.00	1
6	278.20	100.00	450.00	101.75	7
7	278.20	100.00	288.60	96.00	1
8	288.60	96.00	450.00	96.00	2
9	288.60	96.00	304.20	90.00	1
10	304.20	90.00	450.00	90.00	3
11	304.20	90.00	330.20	80.00	1
12	330.20	80.00	450.00	80.00	4
13	330.20	80.00	356.20	70.00	1
14	356.20	70.00	450.00	70.00	5
15	159.40	66.00	356.20	70.00	8
16	356.20	70.00	382.20	60.00	8
17	382.20	60.00	450.00	60.00	8

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
8 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	200.0	0.0	0.00	0.0	1
3	80.0	90.0	234.0	0.0	0.00	0.0	1
4	80.0	90.0	255.0	0.0	0.00	0.0	1
5	80.0	90.0	276.0	0.0	0.00	0.0	1
6	130.0	135.0	0.0	30.0	0.00	0.0	1
7	130.0	140.0	0.0	33.7	0.00	0.0	1
8	125.0	135.0	400.0	19.5	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 4 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)

1	50.00	64.00
2	182.00	64.00
3	280.80	99.00
4	450.00	99.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	50.00	50.00	450.00	58.00

EARTHQUAKE DATA HAS BEEN SUPPRESSED
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 125.00(ft)
and X = 170.00(ft)
Each Surface Terminates Between X = 240.00(ft)
and X = 450.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Statistical Data On All Valid FS Values:
FS Max = 3.307 FS Min = 1.631 FS Ave = 1.968
Standard Deviation = 0.303 Coefficient of Variation = 15.41 %
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	146.32	66.00
2	155.23	61.48
3	164.58	57.91
4	174.24	55.34
5	184.12	53.79
6	194.11	53.29
7	204.09	53.83
8	213.97	55.41
9	223.62	58.01
10	232.95	61.61
11	241.86	66.16
12	250.23	71.62
13	258.00	77.93
14	265.06	85.01
15	271.34	92.79
16	276.78	101.18
17	277.21	102.04

Circle Center At X = 193.95 ; Y = 148.86 ; and Radius = 95.57
Factor of Safety
*** 1.631 ***
Individual data on the 25 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.9	492.9	0.0	0.0	0.	0.	0.0	0.0	0.0
2	5.0	2091.1	0.0	439.1	0.	0.	0.0	0.0	0.0
3	4.2	2907.5	0.0	923.3	0.	0.	0.0	0.0	0.0
4	5.2	5528.1	0.0	1764.0	0.	0.	0.0	0.0	0.0
5	9.7	16864.1	0.0	4602.1	0.	0.	0.0	0.0	0.0
6	7.8	18896.4	0.0	4542.1	0.	0.	0.0	0.0	0.0
7	2.1	5903.1	0.0	1317.2	0.	0.	0.0	0.0	0.0
8	5.2	15841.2	0.0	3719.4	0.	0.	0.0	0.0	0.0
9	4.7	15746.5	0.0	3929.0	0.	0.	0.0	0.0	0.0
10	10.0	36868.6	0.0	9722.8	0.	0.	0.0	0.0	0.0
11	9.9	40271.4	0.0	11170.8	0.	0.	0.0	0.0	0.0

12	9.7	41681.5	0.0	11976.2	0.	0.	0.0	0.0	0.0
13	9.3	41104.8	0.0	12130.5	0.	0.	0.0	0.0	0.0
14	8.9	38666.4	0.0	11631.9	0.	0.	0.0	0.0	0.0
15	2.4	10150.9	0.0	3151.2	0.	0.	0.0	0.0	0.0
16	6.0	24396.6	0.0	7334.6	0.	0.	0.0	0.0	0.0
17	2.8	10743.4	0.0	3341.8	0.	0.	0.0	0.0	0.0
18	5.0	17622.9	0.0	5363.1	0.	0.	0.0	0.0	0.0
19	7.1	19563.0	0.0	6308.5	0.	0.	0.0	0.0	0.0
20	6.3	11036.7	0.0	3322.9	0.	0.	0.0	0.0	0.0
21	1.7	1740.8	0.0	337.3	0.	0.	0.0	0.0	0.0
22	0.7	592.2	0.0	35.9	0.	0.	0.0	0.0	0.0
23	2.7	1206.0	0.0	0.0	0.	0.	0.0	0.0	0.0
24	0.3	47.3	0.0	0.0	0.	0.	0.0	0.0	0.0
25	0.4	24.4	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.68	66.00
2	157.67	61.62
3	167.07	58.21
4	176.78	55.79
5	186.68	54.41
6	196.68	54.08
7	206.65	54.79
8	216.50	56.54
9	226.10	59.31
10	235.37	63.08
11	244.19	67.80
12	252.46	73.41
13	260.11	79.86
14	267.03	87.07
15	273.16	94.97
16	277.55	102.04

Circle Center At X = 194.87 ; Y = 149.27 ; and Radius = 95.22

Factor of Safety

*** 1.635 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	146.32	66.00
2	155.28	61.56
3	164.66	58.10
4	174.36	55.67
5	184.26	54.28
6	194.26	53.95
7	204.23	54.70
8	214.07	56.50
9	223.65	59.34
10	232.88	63.19
11	241.65	67.99
12	249.86	73.71
13	257.41	80.27
14	264.21	87.59
15	270.20	95.60
16	274.00	102.01

Circle Center At X = 192.27 ; Y = 147.41 ; and Radius = 93.48

Factor of Safety

*** 1.637 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.58	66.00
2	150.50	61.49
3	159.84	57.91
4	169.50	55.31
5	179.37	53.71
6	189.35	53.12
7	199.34	53.56

8	209.24	55.02
9	218.93	57.48
10	228.32	60.91
11	237.31	65.29
12	245.81	70.56
13	253.72	76.68
14	260.97	83.57
15	267.47	91.16
16	273.17	99.38
17	274.62	102.02

Circle Center At X = 190.08 ; Y = 150.88 ; and Radius = 97.76

Factor of Safety

*** 1.639 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.05	66.00
2	159.86	61.27
3	169.18	57.62
4	178.85	55.11
5	188.76	53.77
6	198.76	53.61
7	208.71	54.65
8	218.46	56.86
9	227.88	60.22
10	236.83	64.67
11	245.19	70.16
12	252.84	76.60
13	259.67	83.91
14	265.58	91.97
15	270.49	100.69
16	271.03	102.00

Circle Center At X = 195.05 ; Y = 137.31 ; and Radius = 83.79

Factor of Safety

*** 1.640 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.68	66.00
2	157.44	61.17
3	166.72	57.45
4	176.39	54.89
5	186.30	53.54
6	196.30	53.41
7	206.24	54.51
8	215.96	56.82
9	225.34	60.31
10	234.21	64.91
11	242.46	70.58
12	249.94	77.20
13	256.56	84.70
14	262.21	92.95
15	266.80	101.84
16	266.86	102.00

Circle Center At X = 192.33 ; Y = 134.71 ; and Radius = 81.40

Factor of Safety

*** 1.646 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.68	66.00
2	157.85	61.99
3	167.36	58.90
4	177.13	56.77
5	187.06	55.60
6	197.06	55.41
7	207.02	56.21
8	216.87	57.98

9	226.49	60.71
10	235.79	64.37
11	244.69	68.93
12	253.10	74.34
13	260.94	80.55
14	268.13	87.50
15	274.60	95.13
16	279.40	102.06

Circle Center At X = 193.94 ; Y = 156.89 ; and Radius = 101.54

Factor of Safety

*** 1.649 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	139.21	66.00
2	148.34	61.92
3	157.78	58.61
4	167.46	56.10
5	177.31	54.41
6	187.28	53.55
7	197.28	53.53
8	207.24	54.34
9	217.11	55.98
10	226.80	58.44
11	236.25	61.70
12	245.40	65.73
13	254.18	70.52
14	262.53	76.03
15	270.39	82.21
16	277.71	89.03
17	284.43	96.43
18	288.81	102.16

Circle Center At X = 192.55 ; Y = 172.86 ; and Radius = 119.43

Factor of Safety

*** 1.650 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.05	66.00
2	159.94	61.41
3	169.32	57.95
4	179.05	55.66
5	189.00	54.59
6	198.99	54.75
7	208.90	56.14
8	218.56	58.73
9	227.82	62.50
10	236.55	67.37
11	244.62	73.28
12	251.90	80.13
13	258.28	87.83
14	263.67	96.26
15	266.41	102.00

Circle Center At X = 192.70 ; Y = 135.70 ; and Radius = 81.20

Factor of Safety

*** 1.650 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.58	66.00
2	150.68	61.85
3	160.14	58.60
4	169.86	56.27
5	179.76	54.89
6	189.76	54.47
7	199.74	55.01
8	209.63	56.50
9	219.33	58.94

10	228.75	62.30
11	237.80	66.55
12	246.40	71.65
13	254.47	77.56
14	261.94	84.21
15	268.73	91.55
16	274.78	99.51
17	276.34	102.03

Circle Center At X = 189.16 ; Y = 158.37 ; and Radius = 103.91

Factor of Safety

*** 1.653 ***

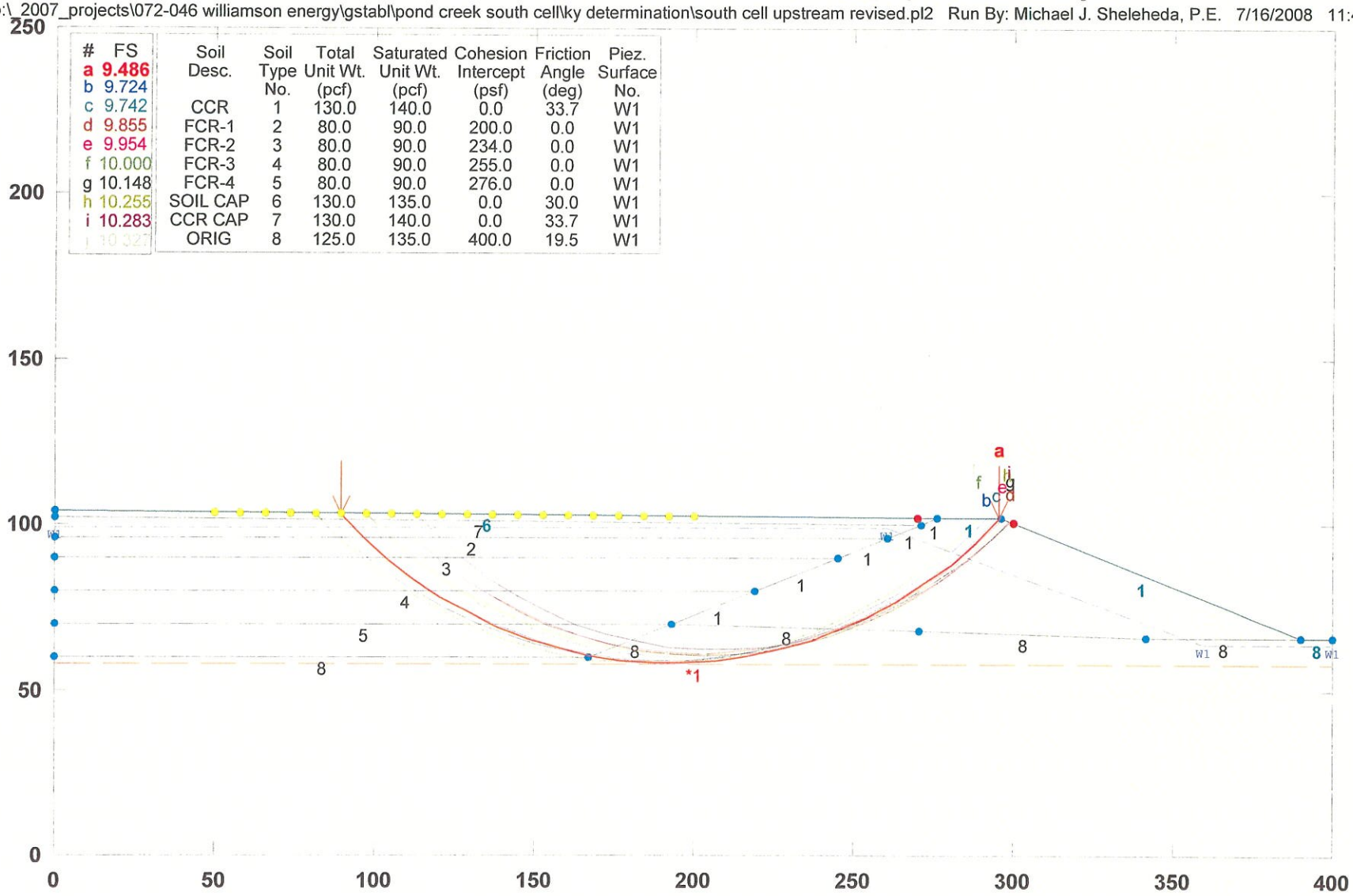
**** END OF GSTABL7 OUTPUT ****

Pond Creek, South Cell, Abandonment Post-Eq Upstream Analysis

p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\ky determination\south cell upstream revised.pl2 Run By: Michael J. Sheleheda, P.E. 7/16/2008 11:43AM

#	FS
a	9.486
b	9.724
c	9.742
d	9.855
e	9.954
f	10.000
g	10.148
h	10.255
i	10.283
j	10.327

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR-1	2	80.0	90.0	200.0	0.0	W1
FCR-2	3	80.0	90.0	234.0	0.0	W1
FCR-3	4	80.0	90.0	255.0	0.0	W1
FCR-4	5	80.0	90.0	276.0	0.0	W1
SOIL CAP	6	130.0	135.0	0.0	30.0	W1
CCR CAP	7	130.0	140.0	0.0	33.7	W1
ORIG	8	125.0	135.0	400.0	19.5	W1



GSTABL7 v.2 FSmin=9.486

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R15334

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
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SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

Analysis Run Date: 7/16/2008
Time of Run: 11:43AM
Run By: Michael J. Sheleheda, P.E.
Input Data Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Cree
k South Cell\Ky Determination\south cell upstream revised.in
Output Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Cree
k South Cell\Ky Determination\south cell upstream revised.OUT
Unit System: English
Plotted Output Filename: P:_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek So
uth Cell\Ky Determination\south cell upstream revised.PLT
PROBLEM DESCRIPTION: Pond Creek, South Cell, Abandonment
Post-Eq Upstream Analysis

BOUNDARY COORDINATES
4 Top Boundaries
19 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	103.75	276.24	102.00	6
2	276.24	102.00	296.24	102.00	1
3	296.24	102.00	389.84	66.00	1
4	389.84	66.00	400.00	66.00	8
5	0.00	101.75	271.04	100.00	7
6	271.04	100.00	276.24	102.00	1
7	0.00	96.00	260.64	96.00	2
8	260.64	96.00	271.04	100.00	1
9	0.00	90.00	245.04	90.00	3
10	245.04	90.00	260.64	96.00	1
11	0.00	80.00	219.04	80.00	4
12	219.04	80.00	245.04	90.00	1
13	0.00	70.00	193.04	70.00	5
14	193.04	70.00	219.04	80.00	1
15	0.00	60.00	167.04	60.00	8
16	167.04	60.00	193.04	70.00	8
17	193.46	70.16	270.39	68.00	8
18	270.39	68.00	341.70	66.00	8
19	341.70	66.00	389.84	66.00	8

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
8 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	200.0	0.0	0.00	0.0	1
3	80.0	90.0	234.0	0.0	0.00	0.0	1
4	80.0	90.0	255.0	0.0	0.00	0.0	1
5	80.0	90.0	276.0	0.0	0.00	0.0	1
6	130.0	135.0	0.0	30.0	0.00	0.0	1
7	130.0	140.0	0.0	33.7	0.00	0.0	1
8	125.0	135.0	400.0	19.5	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 4 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	99.00
2	260.64	99.00
3	359.44	64.00
4	400.00	64.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	0.00	58.00	400.00	58.00

EARTHQUAKE DATA HAS BEEN SUPPRESSED
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00(ft)
and X = 200.00(ft)
Each Surface Terminates Between X = 270.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.85	101.73
3	69.73	100.17
4	79.63	98.75
5	89.55	97.48
6	99.49	96.36
7	109.44	95.39
8	119.40	94.56
9	129.38	93.87
10	139.37	93.34
11	149.36	92.95
12	159.36	92.71
13	169.36	92.62
14	179.36	92.67
15	189.35	92.87
16	199.35	93.22
17	209.34	93.71
18	219.31	94.36
19	229.28	95.15
20	239.24	96.08
21	249.18	97.17
22	259.10	98.39
23	269.01	99.77
24	278.89	101.29
25	283.09	102.00

Factor Of Safety For The Preceding Specified Surface =-43.485
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.58	100.56
3	69.23	97.93
4	78.93	95.53
5	88.70	93.36
6	98.51	91.44
7	108.37	89.76
8	118.26	88.32
9	128.19	87.12

10	138.15	86.17
11	148.12	85.45
12	158.11	84.99
13	168.11	84.76
14	178.11	84.78
15	188.10	85.05
16	198.09	85.56
17	208.06	86.31
18	218.01	87.31
19	227.93	88.55
20	237.82	90.03
21	247.67	91.76
22	257.48	93.72
23	267.23	95.93
24	276.93	98.37
25	286.57	101.04
26	289.71	102.00

Factor Of Safety For The Preceding Specified Surface =-28.283
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.81	101.50
3	69.66	99.75
4	79.53	98.16
5	89.43	96.74
6	99.35	95.49
7	109.29	94.42
8	119.25	93.52
9	129.23	92.79
10	139.21	92.23
11	149.20	91.85
12	159.20	91.63
13	169.20	91.60
14	179.20	91.73
15	189.19	92.04
16	199.18	92.52
17	209.16	93.17
18	219.13	94.00
19	229.08	94.99
20	239.01	96.16
21	248.92	97.51
22	258.80	99.02
23	268.66	100.70
24	275.56	102.00

Factor Of Safety For The Preceding Specified Surface =-38.522
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.78	101.36
3	69.60	99.44
4	79.44	97.69
5	89.31	96.09
6	99.21	94.66
7	109.13	93.39
8	119.07	92.28
9	129.02	91.34
10	138.99	90.56
11	148.97	89.94
12	158.96	89.49
13	168.96	89.20
14	178.96	89.07
15	188.96	89.10

16	198.96	89.30
17	208.95	89.67
18	218.94	90.20
19	228.91	90.89
20	238.88	91.74
21	248.82	92.76
22	258.75	93.94
23	268.66	95.28
24	278.55	96.78
25	288.41	98.45
26	298.24	100.27
27	299.87	100.60

Factor Of Safety For The Preceding Specified Surface =-33.944
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	58.92	98.92
3	68.02	94.77
4	77.28	90.99
5	86.68	87.58
6	96.21	84.55
7	105.85	81.90
8	115.59	79.64
9	125.42	77.77
10	135.31	76.29
11	145.25	75.21
12	155.23	74.53
13	165.22	74.25
14	175.22	74.37
15	185.21	74.89
16	195.17	75.80
17	205.08	77.12
18	214.93	78.83
19	224.71	80.93
20	234.39	83.42
21	243.97	86.30
22	253.42	89.55
23	262.74	93.19
24	271.91	97.19
25	280.90	101.55
26	281.74	102.00

Factor Of Safety For The Preceding Specified Surface =-56.250
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	58.94	98.95
3	68.05	94.82
4	77.32	91.07
5	86.73	87.68
6	96.26	84.68
7	105.91	82.06
8	115.66	79.83
9	125.49	77.99
10	135.39	76.55
11	145.33	75.50
12	155.31	74.85
13	165.31	74.60
14	175.31	74.75
15	185.29	75.30
16	195.25	76.25
17	205.16	77.60
18	215.00	79.34

19	224.77	81.47
20	234.45	84.00
21	244.02	86.90
22	253.46	90.19
23	262.76	93.86
24	271.91	97.89
25	280.31	102.00

Factor Of Safety For The Preceding Specified Surface =-43.156
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	103.43
2	59.65	100.81
3	69.35	98.39
4	79.10	96.18
5	88.90	94.17
6	98.74	92.37
7	108.61	90.78
8	118.51	89.39
9	128.44	88.22
10	138.40	87.25
11	148.37	86.50
12	158.35	85.95
13	168.35	85.62
14	178.35	85.50
15	188.35	85.59
16	198.34	85.89
17	208.33	86.40
18	218.30	87.12
19	228.26	88.06
20	238.20	89.20
21	248.10	90.55
22	257.98	92.11
23	267.82	93.88
24	277.63	95.86
25	287.38	98.04
26	297.10	100.43
27	299.00	100.94

Factor Of Safety For The Preceding Specified Surface =-36.351
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	67.21	99.76
3	76.65	96.45
4	86.19	93.45
5	95.83	90.77
6	105.54	88.42
7	115.34	86.39
8	125.19	84.68
9	135.09	83.31
10	145.04	82.26
11	155.01	81.55
12	165.01	81.17
13	175.01	81.12
14	185.00	81.40
15	194.98	82.02
16	204.94	82.97
17	214.86	84.25
18	224.73	85.86
19	234.54	87.79
20	244.28	90.05
21	253.94	92.64
22	263.51	95.54

23	272.98	98.76
24	281.55	102.00

Factor Of Safety For The Preceding Specified Surface =-24.764
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	67.52	100.68
3	77.21	98.21
4	86.95	95.95
5	96.75	93.92
6	106.58	92.11
7	116.45	90.52
8	126.36	89.16
9	136.30	88.03
10	146.26	87.13
11	156.23	86.45
12	166.22	86.00
13	176.22	85.78
14	186.22	85.78
15	196.22	86.02
16	206.21	86.48
17	216.18	87.17
18	226.14	88.09
19	236.07	89.23
20	245.98	90.60
21	255.85	92.20
22	265.68	94.02
23	275.47	96.07
24	285.21	98.34
25	294.90	100.83
26	297.43	101.54

Factor Of Safety For The Preceding Specified Surface =-36.183
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	66.76	98.76
3	75.81	94.51
4	85.04	90.64
5	94.41	87.16
6	103.92	84.08
7	113.56	81.39
8	123.29	79.11
9	133.11	77.23
10	143.01	75.77
11	152.95	74.71
12	162.93	74.08
13	172.93	73.86
14	182.93	74.06
15	192.91	74.67
16	202.85	75.70
17	212.75	77.14
18	222.58	79.00
19	232.32	81.26
20	241.95	83.92
21	251.47	86.99
22	260.86	90.45
23	270.09	94.29
24	279.15	98.52
25	285.86	102.00

Factor Of Safety For The Preceding Specified Surface =*******
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.

Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	67.17	99.64
3	76.55	96.19
4	86.04	93.04
5	95.63	90.18
6	105.29	87.62
7	115.04	85.37
8	124.85	83.43
9	134.71	81.79
10	144.62	80.46
11	154.57	79.44
12	164.55	78.73
13	174.54	78.34
14	184.54	78.26
15	194.54	78.49
16	204.52	79.03
17	214.48	79.88
18	224.42	81.05
19	234.31	82.53
20	244.15	84.31
21	253.92	86.40
22	263.63	88.80
23	273.26	91.50
24	282.80	94.50
25	292.24	97.79
26	299.71	100.66

Factor Of Safety For The Preceding Specified Surface =*******
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	67.14	99.58
3	76.51	96.08
4	85.98	92.87
5	95.55	89.97
6	105.21	87.38
7	114.95	85.10
8	124.75	83.13
9	134.61	81.47
10	144.52	80.13
11	154.47	79.10
12	164.44	78.40
13	174.44	78.01
14	184.44	77.94
15	194.43	78.20
16	204.42	78.77
17	214.38	79.66
18	224.30	80.86
19	234.19	82.39
20	244.02	84.22
21	253.78	86.37
22	263.48	88.84
23	273.08	91.61
24	282.60	94.68
25	292.01	98.06
26	299.15	100.88

Factor Of Safety For The Preceding Specified Surface =*******
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38

2	67.77	101.80
3	77.66	100.34
4	87.57	99.01
5	97.50	97.80
6	107.44	96.72
7	117.40	95.77
8	127.36	94.94
9	137.34	94.24
10	147.32	93.67
11	157.31	93.23
12	167.31	92.91
13	177.30	92.71
14	187.30	92.65
15	197.30	92.71
16	207.30	92.90
17	217.30	93.22
18	227.29	93.66
19	237.27	94.23
20	247.25	94.93
21	257.21	95.75
22	267.17	96.70
23	277.11	97.78
24	287.04	98.98
25	296.95	100.31
26	299.62	100.70

Factor Of Safety For The Preceding Specified Surface =-40.221
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.89	103.38
2	66.88	99.00
3	76.04	94.97
4	85.34	91.32

##################### SOME LINES SKIPPED ####################

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Number of Trial Surfaces with Misleading FS = 144
Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Evaluated = 36.0 %
Statistical Data On All Valid FS Values:
FS Max = 477.564 FS Min = 9.486 FS Ave = 34.448
Standard Deviation = 51.756 Coefficient of Variation = 150.24 %
Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.47	103.18
2	96.57	96.14
3	104.14	89.61
4	112.15	83.62
5	120.57	78.22
6	129.34	73.42
7	138.43	69.25
8	147.79	65.72
9	157.37	62.87
10	167.13	60.69
11	177.02	59.21
12	186.99	58.42
13	196.99	58.34
14	206.97	58.96
15	216.88	60.28
16	226.68	62.29
17	236.31	64.98
18	245.72	68.35

19	254.88	72.37
20	263.73	77.02
21	272.24	82.29
22	280.35	88.13
23	288.03	94.54
24	295.24	101.46
25	295.73	102.00

Circle Center At X = 193.18 ; Y = 200.50 ; and Radius = 142.22

Factor of Safety

*** 9.486 ***

Individual data on the 41 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.0	266.4	0.0	0.0	0.	0.	0.0	0.0	0.0
2	2.2	871.5	0.0	0.0	0.	0.	0.0	0.0	0.0
3	2.9	2132.6	0.0	363.1	0.	0.	0.0	0.0	0.0
4	0.2	149.9	0.0	38.2	0.	0.	0.0	0.0	0.0
5	7.0	8522.5	0.0	3439.7	0.	0.	0.0	0.0	0.0
6	0.5	690.7	0.0	346.7	0.	0.	0.0	0.0	0.0
7	8.0	14368.7	0.0	7728.8	0.	0.	0.0	0.0	0.0
8	5.6	12519.1	0.0	7189.6	0.	0.	0.0	0.0	0.0
9	2.8	6822.4	0.0	4092.0	0.	0.	0.0	0.0	0.0
10	8.8	24133.2	0.0	14465.5	0.	0.	0.0	0.0	0.0
11	7.4	23188.6	0.0	13952.9	0.	0.	0.0	0.0	0.0
12	1.6	5415.3	0.0	3311.8	0.	0.	0.0	0.0	0.0
13	9.4	32625.3	0.0	19665.4	0.	0.	0.0	0.0	0.0
14	9.6	36083.9	0.0	21655.7	0.	0.	0.0	0.0	0.0
15	9.8	38883.1	0.0	23225.8	0.	0.	0.0	0.0	0.0
16	1.2	5010.3	0.0	2971.6	0.	0.	0.0	0.0	0.0
17	8.7	36837.6	0.0	21396.3	0.	0.	0.0	0.0	0.0
18	10.0	45327.4	0.0	25076.4	0.	0.	0.0	0.0	0.0
19	6.0	28647.7	0.0	15329.2	0.	0.	0.0	0.0	0.0
20	0.4	2037.3	0.0	1064.9	0.	0.	0.0	0.0	0.0
21	3.5	17051.7	0.0	8953.6	0.	0.	0.0	0.0	0.0
22	10.0	49067.6	0.0	25180.6	0.	0.	0.0	0.0	0.0
23	9.9	49264.0	0.0	24575.7	0.	0.	0.0	0.0	0.0
24	2.2	10703.5	0.0	5290.0	0.	0.	0.0	0.0	0.0
25	7.6	37565.5	0.0	18246.3	0.	0.	0.0	0.0	0.0
26	9.6	46127.0	0.0	22067.3	0.	0.	0.0	0.0	0.0
27	8.7	39883.1	0.0	18779.2	0.	0.	0.0	0.0	0.0
28	0.7	3032.8	0.0	1396.8	0.	0.	0.0	0.0	0.0
29	0.7	3232.8	0.0	1525.7	0.	0.	0.0	0.0	0.0
30	8.4	35428.8	0.0	16346.2	0.	0.	0.0	0.0	0.0
31	5.8	22263.7	0.0	10196.2	0.	0.	0.0	0.0	0.0
32	3.1	11056.8	0.0	4580.0	0.	0.	0.0	0.0	0.0
33	1.0	3298.4	0.0	1367.8	0.	0.	0.0	0.0	0.0
34	6.3	19528.5	0.0	7405.3	0.	0.	0.0	0.0	0.0
35	1.2	3276.4	0.0	1093.1	0.	0.	0.0	0.0	0.0
36	4.0	9912.6	0.0	3040.5	0.	0.	0.0	0.0	0.0
37	4.1	8432.6	0.0	1818.3	0.	0.	0.0	0.0	0.0
38	3.3	5376.9	0.0	487.5	0.	0.	0.0	0.0	0.0
39	4.4	5332.8	0.0	0.0	0.	0.	0.0	0.0	0.0
40	7.2	3750.3	0.0	0.0	0.	0.	0.0	0.0	0.0
41	0.5	16.9	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.47	103.18
2	96.55	96.11
3	104.11	89.57
4	112.12	83.59
5	120.55	78.20
6	129.34	73.43
7	138.44	69.30
8	147.83	65.85
9	157.43	63.07

10	167.22	60.99
11	177.12	59.62
12	187.10	58.97
13	197.10	59.04
14	207.07	59.83
15	216.96	61.33
16	226.71	63.54
17	236.28	66.44
18	245.61	70.03
19	254.67	74.27
20	263.39	79.16
21	271.74	84.67
22	279.67	90.75
23	287.15	97.40
24	291.63	102.00

Circle Center At X = 191.11 ; Y = 197.72 ; and Radius = 138.80

Factor of Safety

*** 9.724 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.37	103.13
2	104.44	96.06
3	112.02	89.54
4	120.06	83.59
5	128.51	78.25
6	137.34	73.55
7	146.49	69.51
8	155.91	66.16
9	165.55	63.51
10	175.36	61.59
11	185.29	60.39
12	195.28	59.93
13	205.28	60.20
14	215.23	61.22
15	225.07	62.96
16	234.76	65.43
17	244.24	68.61
18	253.47	72.48
19	262.38	77.01
20	270.93	82.20
21	279.07	88.00
22	286.77	94.38
23	293.97	101.32
24	294.58	102.00

Circle Center At X = 196.51 ; Y = 195.25 ; and Radius = 135.33

Factor of Safety

*** 9.742 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.26	103.08
2	112.34	96.02
3	119.93	89.51
4	127.99	83.59
5	136.46	78.28
6	145.31	73.62
7	154.48	69.63
8	163.93	66.35
9	173.59	63.77
10	183.42	61.93
11	193.36	60.83
12	203.35	60.47
13	213.35	60.86
14	223.28	61.99
15	233.10	63.87
16	242.76	66.47
17	252.19	69.79

18	261.35	73.81
19	270.18	78.49
20	278.64	83.83
21	286.68	89.78
22	294.25	96.32
23	298.89	100.98

Circle Center At X = 203.14 ; Y = 194.17 ; and Radius = 133.70

Factor of Safety

*** 9.855 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	105.26	103.08
2	112.35	96.02
3	119.95	89.53
4	128.02	83.63
5	136.52	78.36
6	145.40	73.75
7	154.60	69.83
8	164.07	66.63
9	173.76	64.16
10	183.61	62.43
11	193.56	61.46
12	203.56	61.25
13	213.54	61.80
14	223.46	63.11
15	233.24	65.17
16	242.84	67.97
17	252.20	71.49
18	261.27	75.72
19	269.98	80.62
20	278.30	86.18
21	286.16	92.35
22	293.54	99.10
23	296.25	102.00

Circle Center At X = 201.33 ; Y = 192.41 ; and Radius = 131.18

Factor of Safety

*** 9.954 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	103.23
2	88.68	96.19
3	96.25	89.66
4	104.27	83.68
5	112.68	78.27
6	121.45	73.46
7	130.53	69.28
8	139.88	65.74
9	149.46	62.86
10	159.21	60.66
11	169.10	59.14
12	179.06	58.32
13	189.06	58.20
14	199.04	58.77
15	208.96	60.04
16	218.77	62.00
17	228.41	64.64
18	237.85	67.95
19	247.03	71.91
20	255.92	76.50
21	264.46	81.70
22	272.62	87.48
23	280.35	93.82
24	287.62	100.69
25	288.83	102.00

Circle Center At X = 185.83 ; Y = 201.25 ; and Radius = 143.09

Factor of Safety

*** 10.000 ***
Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	103.23
2	88.99	96.52
3	96.80	90.28
4	105.00	84.55
5	113.54	79.35
6	122.39	74.69
7	131.52	70.61
8	140.89	67.11
9	150.46	64.21
10	160.19	61.92
11	170.05	60.24
12	179.99	59.20
13	189.99	58.78
14	199.98	59.00
15	209.95	59.84
16	219.84	61.31
17	229.62	63.41
18	239.24	66.12
19	248.68	69.43
20	257.89	73.33
21	266.83	77.80
22	275.47	82.83
23	283.78	88.39
24	291.72	94.47
25	299.11	100.90

Circle Center At X = 191.58 ; Y = 217.09 ; and Radius = 158.31

Factor of Safety
*** 10.148 ***
Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.37	103.13
2	104.65	96.28
3	112.40	89.95
4	120.57	84.19
5	129.12	79.01
6	138.02	74.45
7	147.21	70.52
8	156.66	67.24
9	166.32	64.64
10	176.13	62.72
11	186.06	61.50
12	196.04	60.97
13	206.04	61.15
14	216.00	62.03
15	225.88	63.61
16	235.62	65.87
17	245.18	68.81
18	254.50	72.42
19	263.55	76.67
20	272.28	81.55
21	280.65	87.03
22	288.61	93.08
23	296.12	99.68
24	297.82	101.39

Circle Center At X = 198.47 ; Y = 203.21 ; and Radius = 142.26

Factor of Safety
*** 10.255 ***
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.16	103.03
2	120.26	96.00
3	127.89	89.53

4	136.01	83.69
5	144.55	78.49
6	153.47	73.97
7	162.72	70.16
8	172.23	67.09
9	181.96	64.76
10	191.84	63.20
11	201.81	62.42
12	211.81	62.41
13	221.78	63.19
14	231.65	64.73
15	241.38	67.05
16	250.90	70.11
17	260.15	73.91
18	269.08	78.41
19	277.63	83.60
20	285.75	89.44
21	293.39	95.89
22	298.64	101.08

Circle Center At X = 206.83 ; Y = 190.43 ; and Radius = 128.11

Factor of Safety

*** 10.283 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.47	103.18
2	96.59	96.15
3	104.19	89.66
4	112.25	83.75
5	120.73	78.43
6	129.56	73.75
7	138.72	69.73
8	148.14	66.39
9	157.79	63.74
10	167.60	61.81
11	177.53	60.60
12	187.51	60.12
13	197.51	60.37
14	207.46	61.34
15	217.32	63.05
16	227.02	65.46
17	236.52	68.58
18	245.77	72.39
19	254.71	76.86
20	263.31	81.98
21	271.50	87.70
22	279.26	94.01
23	286.54	100.87
24	287.57	102.00

Circle Center At X = 189.08 ; Y = 196.82 ; and Radius = 136.71

Factor of Safety

*** 10.327 ***

**** END OF GSTABL7 OUTPUT ****

8114-/10
Part 4

Alliance Consulting, Inc.
Engineers • Constructors • Scientists

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
MODIFICATION TO PERMIT NO. IL0078565
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
VOLUME 2 OF 6

POND CREEK MINE NO. 1
COAL REFUSE DISPOSAL FACILITY NO. 2
PHASES 3 – 7 DAM

Prepared for

MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B10-148-1413
MARCH 2010

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
MODIFICATION TO PERMIT NO. IL0078565
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
VOLUME 2 OF 6

POND CREEK MINE NO. 1
COAL REFUSE DISPOSAL FACILITY NO. 2
PHASES 3 – 7 DAM

Prepared for

MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B10-148-1413
MARCH 2010

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

January 12, 2010

Project No. B09-095-1413

Mr. Jerry Bishoff
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
One Natural Resources Way
Springfield, IL 62702-1271

Response to Comments
Additional Information
Williamson Energy, LLC
Pond Creek No. 1 Mine, Coal Refuse Disposal Facility No. 2
Application No. 20093068

Dear Mr. Bishoff:

On behalf of our client, Williamson Energy, LLC, this letter and document is being submitted as additional information to Mr. Michael Diedrichsen's comments regarding the Engineering Design Plan dated October 8, 2009 (copy attached).

2. The seismic acceleration used in the slope stability analysis does not meet the required values. The Peak Ground Acceleration should be obtained from the USGS National Seismic Hazard Mapping Project map for 2% probability of exceedance in 50 years. If this analysis does not produce satisfactory results, a deformation analysis may be necessary.

A letter report prepared by GAI Consultants dated January 7, 2010 and entitled "Letter Report, Response to IDNR Comment No. 2, Pond Creek Mine No. 1 Coal Refuse Disposal Facility No. 2, Phases 3 – 7 Dam, Application No. 20093068, Williamson Energy LLC, Mach Mining Company, Williamson County, Illinois" is enclosed herein.

Should you need any additional information, please do not hesitate to contact us.

Sincerely,

ALLIANCE CONSULTING, INC.

Claudio E. Yon, P. E.
Senior Project Manager

CEY:wmb
Enclosures

FILE: 09095-06

cc: Jim Slapak w/attachments

Illinois Department of
Natural Resources

One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

Pat Quinn, Governor
Marc Miller, Director

October 8, 2009

SUBJECT: Application No. 20093068
Pond Creek Mine No. 1,
Coal Refuse Disposal Facility No. 2, Phases 3 – 7 Dam
Williamson Energy, LLC, Williamson County

Mr. Claudio E. Yon
Alliance Consulting, Inc.
124 Philpott Lane
Beaver, West Virginia 25813

Dear Mr. Yon:

We have completed our review of your June 11, 2009 application and supporting materials and are in the process of issuing a public notice (copy enclosed) for the referenced dam. Per the guidelines set forth in our Part 3702 Dam Safety Rules, this office is provisionally classifying this impoundment as an intermediate-size, Class 1 (high hazard potential) dam. In order to continue our review of this application, the following comments should be addressed:

1) For construction phases after stage 4, there is no indication of the subsidence monitoring method or minimum subsidence required prior to initiation of construction.

2) The seismic acceleration used in the slope stability analyses does not meet the required values. The Peak Ground Acceleration should be obtained from the USGS National Seismic Hazard Mapping Project map for 2% probability of exceedance in 50 years. If this analysis does not produce satisfactory results, a deformation analysis may be necessary.

3) The dewatering calculations were performed for a 30 day time interval. Due to the Class I hazard classification, the required drawdown time for 50% of the impounded water is 7 days.

4) The plans indicate that the decant system will outlet to grouted riprap ditches which run down the embankment. Due to problems with erosion of embankment materials beneath grouted riprap, this office does not allow its use in spillway construction. Revised plans and calculations should be submitted to this office demonstrating that there will be no erosion of embankment materials from spillway discharge.

5) The following items should be addressed specific to the Emergency Action Plan (EAP):

a. The term "evacuation" should be revised to use the term "notify to evacuate" where it appears in the document. Mandatory evacuation is only available in Illinois after the declaration of martial law.

b. The EAP should contain a detailed description of the method by which individuals will be notified to evacuate and specify the agency responsible for these notifications.

c. The Notification Flow Chart should appear at the front of the EAP.

d. The Inundation Maps should be placed in Section 5 of the EAP. The engineering data from the dam breach analysis should be included in an appendix.

e. The materials labeled Appendix 1 and Appendix 2 are the forms from our General Permit 02-01. The engineer's certification (Appendix 1) should not be part of the EAP. The Appendix 2 information should be incorporated into Section 1.

Upon receipt of materials addressing these items, as well as an Operation & Maintenance (O&M) Plan, we will continue to process your application. Additionally, after revising the EAP to address the comments in Item 5, an EAP orientation meeting should be arranged with local emergency services personnel and a representative of our office to determine if any other revisions will be necessary to ensure the plan's effectiveness. If you have any questions or comments, please feel free to contact Jerry Bishoff of my staff at 217/558-6617.

Sincerely,

Michael L. Diedrichsen

Michael L. Diedrichsen, P.E.
Acting Manager, Downstate Regulatory Programs

MLD:JMB:crw
Enclosure
cc: Williamson Energy, LLC

gai consultants
transforming ideas into reality®

January 7, 2010

Project C090403.01.001

Mr. Claudio Yon, P.E.
Alliance Consulting, Inc.
124 Philpott Lane
Raleigh County Airport Industrial Park
Beaver, West Virginia 25813-9502

Letter Report
Response to IDNR Comment No. 2
Pond Creek Mine No. 1 Coal Refuse Disposal Facility No.2 – Phases 3 – 7 Dam
Application No. 20093068
Williamson Energy, LLC
Williamson County, Illinois
GAI Project C090403.01.001

Dear Mr. Yon:

In accordance with our Work Order Memorandum No. 001, dated March 25, 2009, and your October 29, 2009 email request and authorization, GAI Consultants, Inc. (GAI) has prepared a response to the October 8, 2009 Illinois Department of Natural Resources (IDNR) review comments, specifically Comment No. 2. In general, this comment response addresses a pseudo-static slope stability analysis using a Peak Ground Acceleration (PGA) obtained from the USGS National Seismic Hazard Mapping Project Map for a 2% Probability of Exceedance in 50 years, and the resulting permanent deformation analysis for the Phase 7C Dam maximum condition at the Williamson Energy, LLC (Williamson), Pond Creek Coal Refuse Disposal Facility No. 2 (Pond Creek).

GAI performed engineering analyses and prepared a comment response for IDNR Comment No. 2 based on our discussions, understanding of the site conditions, and our experience performing similar analyses. GAI notes only Comment No. 2 is addressed herein.

INTRODUCTION

Plans have been developed by Alliance Consulting, Inc. (Alliance), Beaver, West Virginia for the construction of a coal refuse disposal facility located near Johnston City in Williamson County, Illinois. The proposed Pond Creek facility will provide disposal capacity for both coarse and fine coal refuse, and will be constructed in five (5) phases designated Phases 3 through 7.

The proposed Phases 3 through 6 impoundments will be constructed by downstream or centerline methods, and Phase 7 is partially constructed by upstream methods. The upstream and downstream slopes will be about three horizontal to one vertical (3H:1V) except for Phase 3, which will have 2.6H:1V upstream slopes. Maximum slope heights will range from 49 feet for Phase 3 to 100 feet for Phase 7. All of the embankments, with the exception of a portion of Phase 7 will be founded on 15 to 22 feet of medium stiff to stiff, sandy clay overlying shale

bedrock. The south facing slope of Phase 7 (designated 7A and 7C) will be founded on impounded fine coal refuse (FCR) of Phase 3.

A previous permanent deformation analysis was submitted by Civil & Environmental Consultants, Inc, (CEC) to IDNR in January 2008 for Phase 2, which is similar to the incised and/or dike geometry of Phases 3 – 6 founded on residual soil. Therefore, the combined upstream-constructed Phases 7A and 7C is considered the most critical geometry. GAI further notes that Phase 7A will be constructed in approximately 200 days, and thus is considered a temporary condition relative to the occurrence of a maximum design earthquake (MDE).

IDNR COMMENT NO. 2

IDNR noted in their October 2008 review that "The seismic acceleration used in the slope stability analyses does not meet the required values. The Peak Ground Acceleration should be obtained from the USGS National Seismic Hazard Mapping Project map for 2% probability of exceedance in 50 years. If this analysis does not produce satisfactory results, a deformation analysis may be necessary."

GAI RESPONSE TO COMMENT NO. 2

Determination of Seismic Factor of Safety (Fs) and Yield Acceleration (Ky)

In accordance with the IDNR guidelines Part 3702 Dam and Safety Rules, GAI performed pseudo-static slope stability analyses of the Phase 7 Dam to determine the seismic factor of safety (Fs) and yield acceleration (Ky). A site PGA = 0.54 g obtained from the USGS National Seismic Hazard Mapping Project map for 2% Probability of Exceedance in 50 years was used in the Fs slope stability analyses. Appendix A presents the seismic hazard assessment performed for the Pond Creek facility located in Williamson County, Illinois

Drained and undrained strengths were developed for the various coal refuse materials including coarse and fine coal refuse, and residual soil, and input in PCSTABL slope stability analyses to obtain Fs and Ky. In accordance with the guidelines presented in the Mine Safety and Health Administration (MSHA) Engineering Design Manual, Coal Refuse Disposal Facilities, 2nd Edition (Reference 10), 80 percent of the peak undrained shear strength (S_{up}) was used for the FCR based on an average effective stress ($\sigma'v$) of approximately 6,450 pounds per square foot (psf) and $S_{up}/\sigma'v$ relationship of 0.27. Engineering properties presented in Table 1 were provided by Alliance and/or derived from field and laboratory testing results of site-specific materials presented in Appendix B.

Table 1 – Refuse/Soil Properties Used in Pseudo-Static and Yield Acceleration Slope Stability Analyses

Description	Unit Weights (γ_t,γ_s) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion (c) (psf)	Shear Strength
Coarse Coal Refuse (CCR)	130, 140	33.7	0	Effective (Drained)
Fine Coal Refuse (FCR)	80, 90	0	1,393	80% of Peak (Undrained)
Residual Soil	125, 135	19.5	416	Total (Undrained)

The slope stability analyses resulted in a minimum factor of safety of 0.51 using a horizontal acceleration corresponding to the PGA value of 0.54g. Consequently, the results of the Phase 7 pseudo-static (seismic) slope stability analyses are not satisfactory, and thus a permanent deformation analysis is required per the IDNR guidelines.

GAI subsequently performed yield acceleration slope stability analyses, which varied the input horizontal acceleration in PCSTABL until a Factor of Safety equal to 1.0 was achieved. Based on these analyses, a yield acceleration of 0.18g was iteratively determined for the Phase 7 Dam soil mass and the downstream critical failure surface.

The yield acceleration is the acceleration level:

- Below which yielding of the embankment (soil mass) does not occur and the soil mass deforms elastic-plastic; and/or
- Above which yielding occurs causing permanent deformation.

The yield acceleration is used as input to subsequent permanent deformation analyses.

Hard copies of the PCSTABL output and plot files for the Fs and Ky pseudo-static slope stability analyses are presented in Appendix C.

Permanent Deformation Analyses

As previously noted, IDNR has required that a seismic slope stability analysis be performed for the Phase 7 Dam using equivalent static load methods and the appropriate PGA based on the USGS 2% Probability of Exceedance in 50 Years hazard maps. Since the required factor of safety was not met, i.e., Factor of Safety = 0.51, a permanent deformation evaluation must be completed.

Therefore, GAI performed permanent deformation analyses of the Phase 7 Dam constructed over the Phase 3 fine coal refuse to estimate the magnitude of Phase 7 crest settlements. Permanent deformations and the resulting crest settlements accumulate depending upon the acceleration levels above the defined yield acceleration during an earthquake event.

(Newmark, 1965). If the estimated crest settlements do not exceed the available Phase 7 freeboard, overtopping of the dam will not occur.

GAI utilized two (2) empirically-based methods including the Makdisi-Seed (Makdisi, ,F.I. and Seed, H.B., 1978) and the Hynes-Griffin Franklin (Hynes-Griffin, M.E., Franklin, A.G., 1984) procedures to estimate the magnitude of earthquake-induced permanent deformations. The results of these empirically-based analyses are compared to the results of the Phase 2 permanent deformation analyses previously submitted to IDNR in January 2008, which used the Newmark double-integration, sliding block method of calculating soil mass displacements from one-dimensional, dynamic site response analyses. Finally, GAI notes that the failure surface impacts only a portion of the approximate 400-foot wide Phase 7 crest width, as shown in the Appendix C slope stability results, which adds significantly to the downstream safety of the dam.

Makdisi-Seed Method

In order to use the Makdisi-Seed method, the minimum and maximum design spectral acceleration was estimated at 0.36g and 0.73g, respectively, using the procedures outlined in the International Building Code (IBC) 2006, specifically Section 1613 Earthquake Loads. Additionally, an IBC 2006 Site Class D was chosen based on shear wave velocity testing performed at the Pond Creek facility. Site Class D is a 'Stiff Soil Profile' with a shear wave velocity (V_s) between 600 and 1,200 feet per second (fps). The site class was based on the average properties within the upper 100 feet of the site that supports the Phase 7 embankment.

The fundamental period (T_0) of the Phase 7 dam was approximated from the permanent deformation site response analysis of Phase 2, which was 0.23 seconds. This value is compared to IBC 2000, $T_S = S_{D1}/S_{DS}$, which was estimated at 0.49 seconds, and it is conservatively assumed that $T_0 = T_S = 0.49$ seconds.

Based on the various data described above, the design charts in IBC 2006 and Makdisi-Seed (1984), permanent deformations due to a PGA with 2% probability of exceedance in 50 years were estimated to be 1.7 feet or about 20 inches.

Hynes-Griffin and Franklin Method

Alternatively, the Hynes-Griffin and Franklin (1984) method was also used to estimate permanent deformations of the Phase 7 dam. Hynes-Griffin and Franklin developed upper bound, mean plus one standard deviation and mean curves estimated for earthquake-induced slope displacements based on the results of Newmark analyses of 348 earthquake motions and six (6) synthetic acceleration time histories.

Slope displacements are estimated using the most conservative upper bound curve and the ratio of horizontal acceleration that reduces the factor of safety to 1.0, i.e., the yield acceleration (Ky) and the peak horizontal acceleration (PGA). Based on the various data for the Phase 7 Dam and Pond Creek facility, slope displacements were estimated at 16 inches.

Appendix D presents the calculations and results of the Makdisi-Seed and Hynes-Griffin Franklin permanent deformation analyses methods.

Conclusions and Recommendations

Permanent deformations of the Phase 7 Dam from the empirically-based Makdisi-Seed and Hynes-Griffin Franklin methods yielded crest settlements of 20 and 16 inches, respectively. Further, Phase 2 deformations were previously estimated at 17 inches based on dynamic site response analyses and Newmark sliding block methods, which is consistent with the empirically-based analyses and estimates of Phase 7 Dam crest settlement. Therefore, the maximum Phase 7 Dam crest settlement of 20 inches compares favorably to an available freeboard of the Phase 7 Dam of 96 inches above the maximum fines level.

Although permanent deformations are acceptable relative to the available freeboard, GAI recommends that the dam be thoroughly inspected following a seismic event to make observations and note any ground movement, scarps, sloughing, toe bulges, etc. on the exposed downstream and upstream slopes, increased piezometric groundwater levels, and any other issues that may suggest slope instability.

In preparing this letter report, GAI's professional services have been performed, findings obtained and conclusions prepared in accordance with generally accepted engineering principles and practices. No warranty, expressed or implied is made or intended by rendering of these services or by furnishing oral or written reports of our findings. This report was prepared for the exclusive use of Alliance.

GAI appreciates this opportunity to provide to Alliance geotechnical earthquake engineering services. Please do not hesitate to contact us if you have any questions concerning any of the information presented.

Respectfully submitted,
GAI CONSULTANTS, INC.

Blaise E. Genes
Manager of Geotechnical and Structural

BEG/tlg
09040301001-ltr rpt-ac-rtc-beg/tlg D1

Attachments

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APPENDIX A

SEISMIC HAZARD ASSESSMENT
POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Probabilistic Seismic Hazard Assessment – Source, Maximum Magnitude and Peak Ground Acceleration

PAGE 1 OF 11

MADE BY BEG DATE 1/3/08 CHECKED BY TJS DATE 1/23/08

CALCULATION BRIEF FOR PROBABILISTIC SEISMIC HAZARD ASSESSMENT – SOURCE, MAXIMUM MAGNITUDE, DISTANCE AND PEAK GROUND ACCELERATION

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE: Utilizing the 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps (Frankel, 2002), particularly the 2% Probability of Exceedance in 50 years recurrence interval, define the local and regional seismic events, maximum earthquake magnitudes, focal depths, epicentral distances and peak ground accelerations potentially impacting the Williamson Energy, Pond Creek coal refuse disposal site, Williamson County, Illinois.

METHODOLOGY: A probabilistic seismic hazard assessment (PSHA) is performed for the Pond Creek site located near Johnston City, Williamson County, Illinois. PSHA involves utilizing the 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps (Frankel, 2002), particularly the 2% Probability of Exceedance in 50 years maps for the site coordinates and the development of a particular seismic scenario upon which a ground motion hazard evaluation is based. The scenario consists of the postulated occurrence of an earthquake (i.e., 2% Probability of Exceedance in 50 years) of a specified size based on the latest USGS hazard mapping for the Pond Creek site. In general, PSHA involves four basic elements:

1. Evaluate earthquake sources;
2. Determine controlling earthquake(s): the maximum magnitude, maximum credible, or maximum considered earthquake;
3. Determination of ground motion attenuation relationships or distance from the site; and
4. Determination the peak ground acceleration (PGA).

PSHA determines the earthquakes that have the most significant impacts, and for engineering design and analyses of tailing dams, a design earthquake is desired.

Stochastic modeling, based on the published predictive relations of Atkinson and Boore (1995) is subsequently used to create synthetic acceleration-time histories

for the critical earthquake scenarios. The required input parameters for the critical earthquake source spectra, including moment magnitude, epicentral distance, and focal depth are developed from the published information discussed above, and summarized below.

Subsequently discussed in a separate calculation brief, a comparison of input parameters and site response will be made using both eastern US synthetic earthquake time histories and actual western US earthquake time histories. Available records are scaled in SHAKE (Schnabel, 1971) to the Pond Creek site PGA and the site response compared to published eastern US ground motion attenuation (GMA) response spectra to assess the reasonableness of the various time histories.

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SEISMIC HAZARD ASSESSMENT

General

Nuttli and Herrmann (1978) outline the input necessary for performing either a deterministic or probabilistic method of assessing seismic hazard, which requires that the seismic source zones be identified, that the maximum-magnitude earthquake for each source zone be estimated, that the magnitude-frequency recurrence rate for each source zone be determined, and that the attenuation of seismic wave energy with distance be known.

Based on the current ability to generate synthetic earthquake acceleration-time histories for eastern North American (ENA) earthquakes using the stochastic modeling techniques developed by Boore (1983) and Atkinson and Boore (1995), a PSHA approach was chosen to generate a design earthquake(s). Using this approach, the Maximum Design Earthquake (MDE) for the 2% Probability of Exceedance in 50 years was chosen, which for the Pond Creek site has a PGA of 0.54g. As discussed in Atkinson and Boore (1995 and 1998), the utilized ground motion relationships compared well to the limited database of recorded Eastern North America (ENA) earthquakes and large earthquakes from analogous intra-plate, hard rock sites. In a separate calculation brief, a comparison is made of the PGA from the various

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PROJECT Williamson Energy Pond Creek Deformation Evaluation PROJECT NO. 072046

Probabilistic Seismic Hazard Assessment – Source, Maximum Magnitude and Peak Ground Acceleration PAGE 4 OF 11

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ground motion attenuation relationships and the synthetic time-histories, as well as a comparison of the site response and response spectra of both the synthetic earthquake acceleration time histories and a scaled western U.S. acceleration-time history record to evaluate the consistency and results of the eastern and western time histories relative to the embankment response, i.e., frequency content, spectral acceleration, etc.

The PSHA methodology chosen for this evaluation represents a more refined approach to previous methods which used empirical, pseudostatic embankment analyses. Similarly, the PSHA developed specifically for the Pond Creek site also attempts to eliminate the potential for over-conservative, unrealistic strong ground motion associated with the "floating earthquake" concept. This approach is generally applied in regions where active earthquake-generating surface faults exist and the intensity-based peak acceleration relationships are from only long-period western U.S. and Japanese seismic activity and more importantly, the peak acceleration does not account for distance.

Selection of Maximum Credible Earthquake Scenarios and Peak Ground Acceleration

Based on the most critical regional and local seismic sources to the Pond Creek site as identified in the USGS Interactive Deaggregation Maps, two MDE scenarios have been selected for analysis including a magnitude (M) 8.0, which has boundary limits of about 83 km from the site and the potential to generate a high intensity earthquake. The Pond Creek site also has the potential to be impacted by a smaller magnitude earthquake or a comparable local "background" earthquake at a closer epicentral distance to the site, which based on the USGS seismic hazard program is an M6.8 at 13.5 km. The PGA associated with this hazard was defined at 0.54g. The 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps (Frankel, 2002), particularly the 2% Probability of Exceedance in 50 years maps are attached.

The rate at which the strength of earthquake ground motion attenuates and the amount of geometric spreading with distance from the epicenter are required for seismic hazard analyses. The focal depth of the earthquake and the near surface geological conditions have a significant influence on the intensity attenuation relationship. Information on earthquakes occurring in the eastern United States suggests that surface faulting does not occur and the center of energy release is deeper than the average of California earthquakes. The earthquake energy is therefore radiated over a larger area than is experienced in California, and California data cannot be extrapolated directly to this region. Several ENA and CEUS ground motion attenuation relationships including Toro, et.al. (1997), Atkinson & Boore (1997), Campbell (2003), Atkinson (2001) and Tavakoli & Pezeshk (2005) are used to compare the USGS PGA for the Pond Creek site to that of other ENA and CEUS ground motion relationships.

Therefore, these two MDE scenarios will be evaluated for their impact on the Pond Creek impoundment since the maximum ground accelerations, frequency contents, and durations of effective cycles will be notably different.

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Probabilistic Seismic Hazard Assessment – Source, Maximum Magnitude and Peak Ground Acceleration PAGE 5 OF 11

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

As previously discussed, utilizing the Atkinson and Boore (1995) empirically-derived earthquake source spectra model for eastern North American hard rock sites, quality synthetic acceleration-time histories have been created for the bedrock motions. Subsequently, the various input parameters from these synthetic earthquake records are compared to the Pond Creek site input and the time histories scaled accordingly to the PGA anticipated at the Pond Creek site. Also, selection of an earthquake time history record from the PEER Strong Motion Database for western U.S. and Japanese earthquake records, scaled to the PGA is performed. Finally (in another calculation brief), the corresponding response spectra curves of the site response due to the ENA/CEUS synthetic and PEER earthquake time histories are compared to the ENA and CEUS ground motion attenuation response spectra to assess the reasonableness of the time history.

CONCLUSION

A Probabilistic Seismic Hazard Assessment (PSHA) which utilized the 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps indicated local and regional seismic scenarios of potential impact to the Pond Creek coal refuse disposal site located in Williamson County, Illinois. Two MDE scenarios were chosen for analysis including M8.0 earthquake located at a epicentral distance of 83 km from the site was chosen for potential for a large intensity earthquake with a corresponding PGA of 0.54g. Additionally, an M6.8 earthquake at an epicentral distance of 13.5 km from the site was identified and will be used to model an earthquake that could "occur anywhere" with a PGA of 0.54g. These scenarios will be used to scale existing eastern U.S. synthetic acceleration-time histories, based on the source spectra models defined by Atkinson and Boore (1995) and a western U.S., PEER earthquake record. A comparison of the various input time histories, site response (spectra) and published eastern U.S. ground motion attenuation relationships spectra performed in a separate calculation brief.

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Probabilistic Seismic Hazard Assessment – Source, Maximum Magnitude and Peak Ground Acceleration — PAGE 6 OF 11

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FIGURES
2002 USGS EARTHQUAKE HAZARDS PROGRAM – PEAK GROUND ACCELERATION AND INTERACTIVE DEAGGRAGATION MAPS FOR 2% PROBABILITY OF EXCEEDANCE IN 50 YEARS RECURRENCE INTERVAL

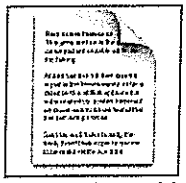
POND CREEK SITE
WILLIAMSON COUNTY, ILLINOIS

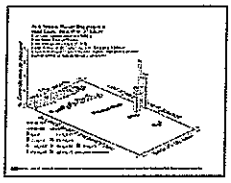
USGS science for a changing world

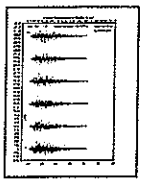
Earthquake Hazards Program

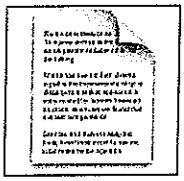
)2 Interactive Deaggragations

Generated Output:
Click a link below to view the output file.


Report (15 Kb)


Deagregation (59 Kb)


Seismograms (62 Kb)


Seismogram Data (1 Mb)

On this page you may select a return time, SA frequency, specify a latitude and longitude and request seismograms. Links to the following nformation will be returned:

- A plot of deaggregated distance, magnitude and ground-motion uncertainty for the specified parameters.
- An ascii text file of the hazard matrices, containing, but not limited to, the frequency selected.
- geographic deaggregation plot may also be specified (for designated frequencies only - see below). This is in addition to the plot mentioned above.
- An ascii text file and graph of the seismograms for the modal or mean event (if requested).

Please read the README file before trying to use this site. The README explains about the input parameters and also describes how the Deaggregation is done. Stochastic Seismograms and What is Epsilon? are articles which discuss the theory behind the seismograms.

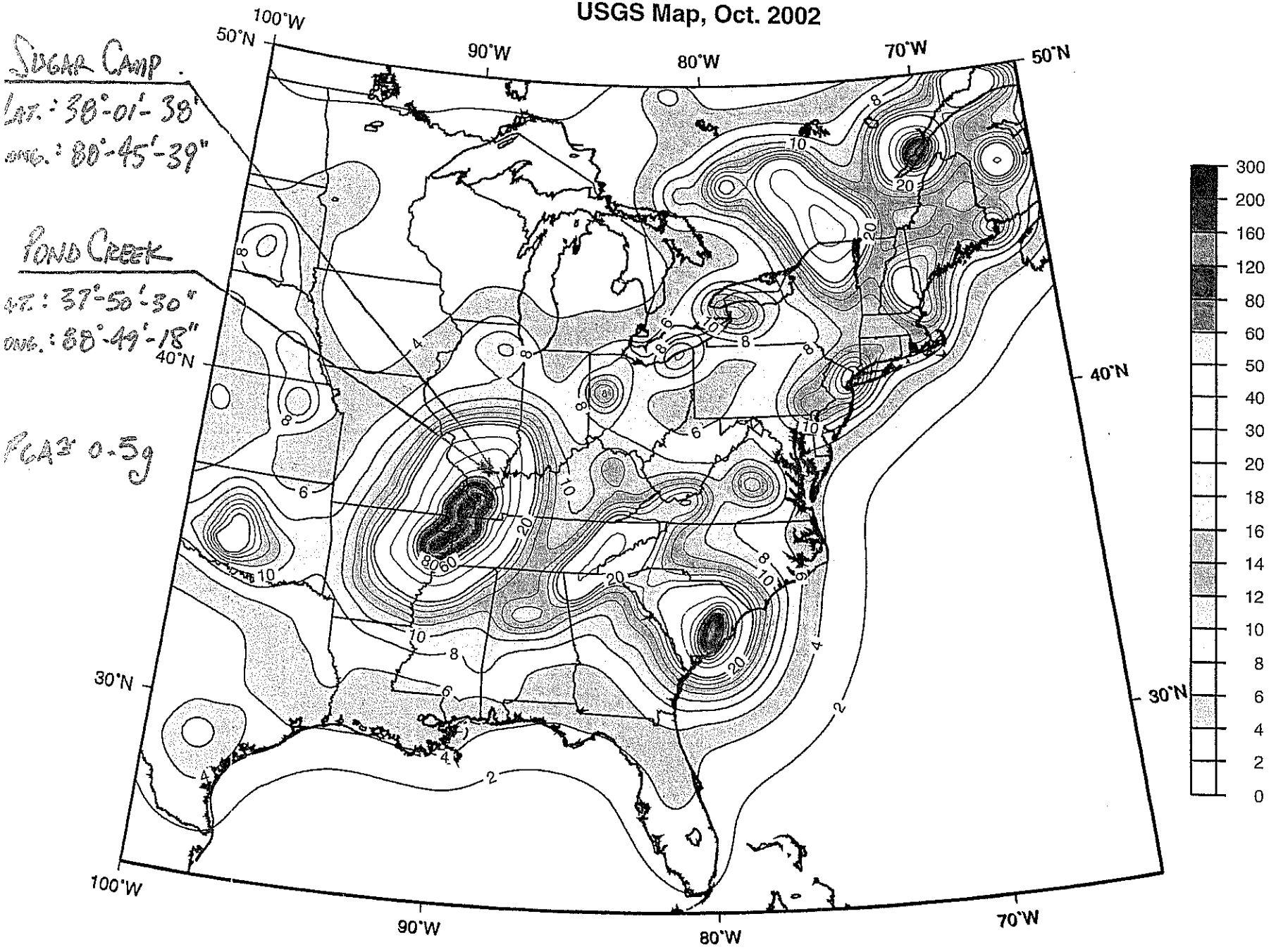
Choose parameters and click "Generate Output"

Site Name: (Help)	Pond_Creek
Latitude: (Help)	37.84
Longitude: (Help)	-88.82
Return Period: (Help)	2475 years (2% in 50 years)
Frequency: (Help)	PGA
Geographic Deaggs: (Help)	None
Stochastic Seismograms: (Help)	Modal, One-Corner Source

Start Over Generate Output

U.S. Department of the Interior | U.S. Geological Survey
URL: http://earthquake.usgs.gov/research/hazmaps/interactive/wrapper.php
Page Contact Information: Web Team
Page Last Modified: June 28, 2007 1:14:52 PM.

Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002



Sugar Camp
Lat.: 38°-01'-38"
Long.: 80°-45'-39"

Pond Creek
Lat.: 37°-50'-30"
Long.: 88°-49'-18"

PGA: 0.5g

8 of 11

R15367

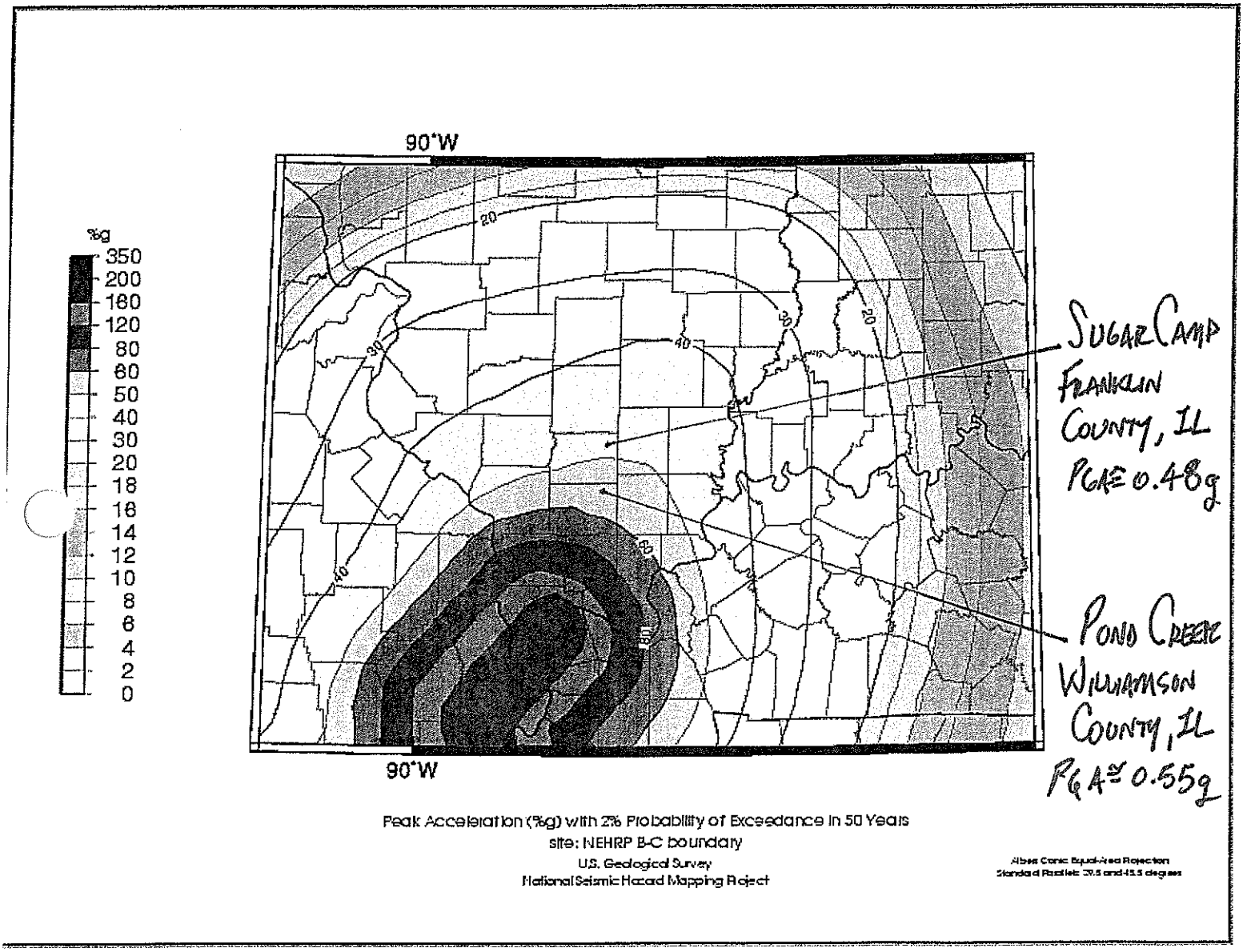
9 / 11
R15368

USGS
science for a changing world

Earthquake Hazards Program

)2 NSHMP Hazard Mapping

Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years

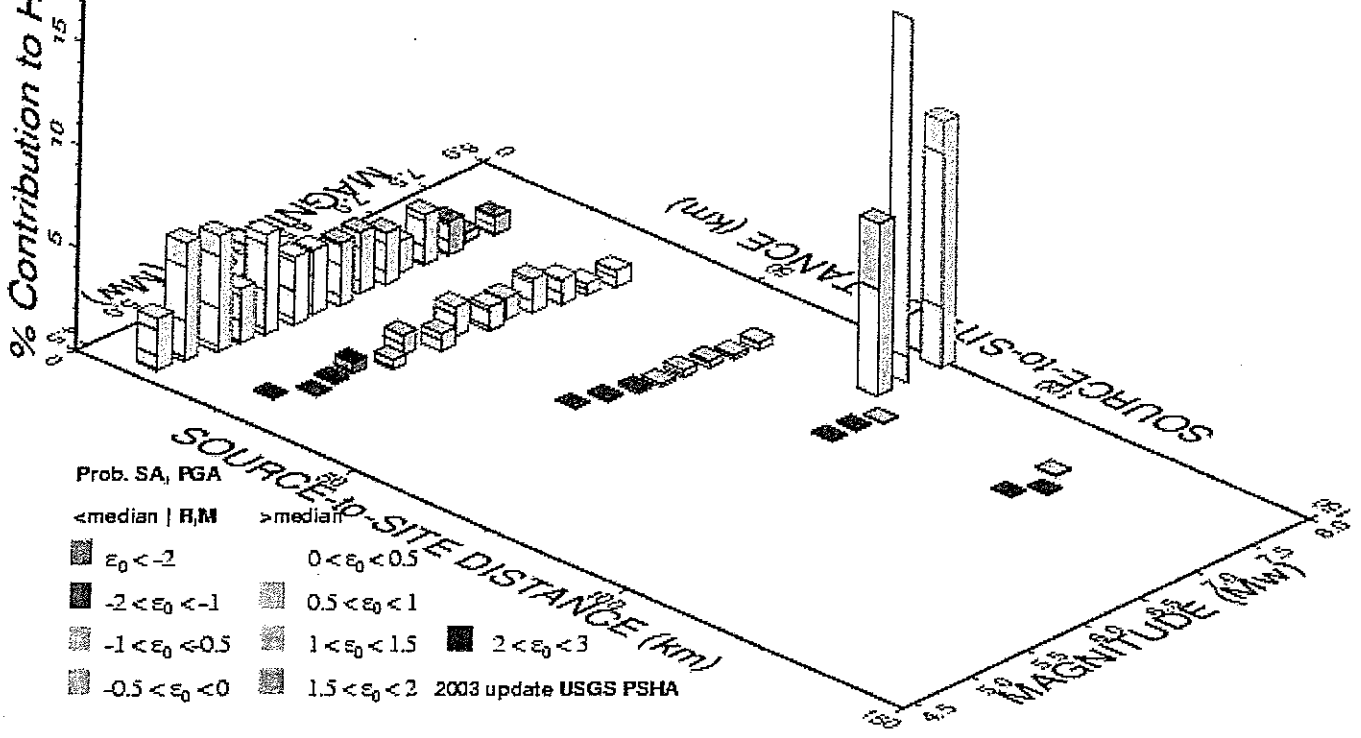


DF Version
ostscript Version

e above files will be deleted every hour on the hour.

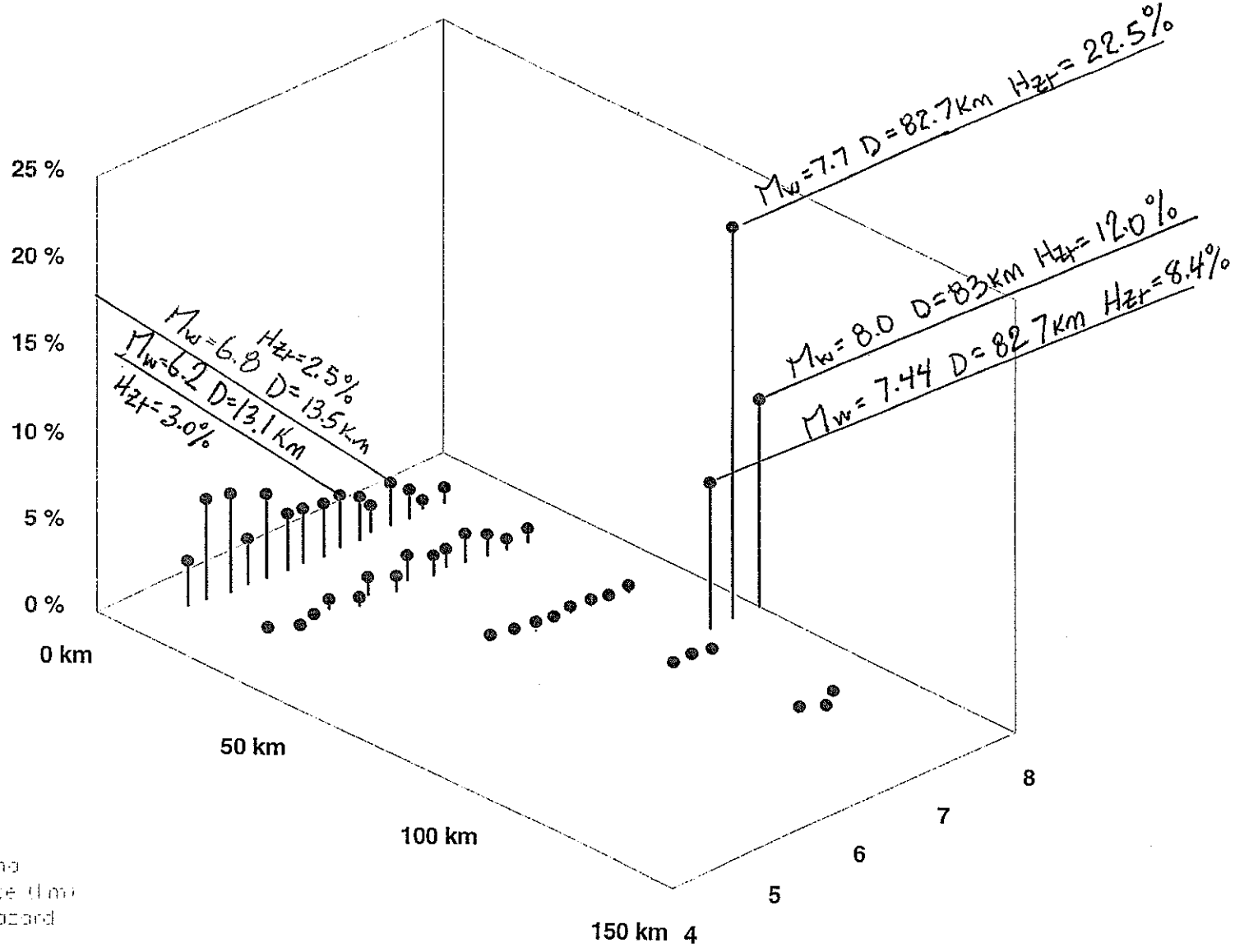
Prob. Seismic Hazard Deaggregation
Pond_Creek 88.820° W, 37.840 N.

Peak Horiz. Ground Accel.>=0.5401 g
Mean Return Time 2475 years
Mean (R,M,ε_0) 46.4 km, 6.67, 0.70
Modal (R,M,ε_0) = 82.7 km, 7.70, 1.19 (from peak R,M bin)
Modal (R,M,ε^*) = 82.7 km, 7.70, 1 to 2 sigma (from peak R,M,ε bin)
Binning: DeltaR 25. km, deltaM=0.2, Deltaε=1.0



GMT 2007 Dec 5 09:30:52 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on ROCK avg Vs=760 m/s top 30 m USGS CGHT PSHA2002v3 UPDATE Bins with 0.05% contrib. omitted

Probabilistic Seismic Hazard Deaggregation - Pond Creek (88.820° W , 37.840° N)



USE, M8.0 @ 83Km
AND M6.2 @ 13Km
OR
M6.8 @ 13.5Km

Epsilon Interval -All Sigma
Source to Site Distance (km)
% Contribution to Hazard
Magnitude (Mw)

Deaggregation of the PGA >= .5401 g for a 2475 year return period

R15370

APPENDIX B

CHARACTERIZATION OF THE SAND-LIKE AND CLAY-LIKE SUBSURFACE MATERIALS PREPARED BY CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

ESTIMATION AND SUMMARY OF ENGINEERING PROPERTIES INCLUDING PEAK AND STEADY-STATE UNDRAINED SHEAR STRENGTH FOR REFUSE AND SUBGRADE MATERIALS PREPARED BY CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

LABORATORY TESTING RESULTS PROVIDED BY ALLIANCE CONSULTING, INC.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 1 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/25/08

CALCULATION BRIEF FOR CHARACTERIZATION OF SAND-LIKE AND CLAY-LIKE SUBSURFACE MATERIALS

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH CELL

OBJECTIVE: To characterize subsurface materials including coarse coal refuse, fine coal refuse and residual soils encountered at the Pond Creek South Cell refuse disposal facility. Materials are characterized as either sand-like or clay-like in accordance with various pertinent references shown below and included within the "Draft" Mine Health and Safety Administration (MSHA) Engineering and Design Manual, specifically Chapter 7: Seismic Design: Stability and Deformation Analyses, March 2007.

REFERENCES:

1. Illinois Department of Natural Resources, Office of Water Resources, Construction and Maintenance of Dams, Part 3702, Chapter IX.

2. Mine Safety and Health Administration, "Draft - Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 – Seismic Design: Stability and Deformation Analyses," dated, March 13, 2007.

3. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Piezo-Cone Penetration Testing," Pond Creed Coal Refuse Disposal Site, BEG, dated 12/21/07.

4. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Normalized PS-CPT Data and Parameter Correlations," Pond Creek Coal Refuse Disposal Site, BEG, dated 12/28/07.

5. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Laboratory Testing," Pond Coal Refuse Disposal Site – South Pond, BEG, dated 7/8/08.

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GENERAL:

Reference (Ref.) Number (No.) 1 presents the following guidelines regarding the methods of testing, analyses and computations which must be completed and submitted with an application to support an owner's request for abandonment of a disposal impoundment dam:

1. The classification of the existing condition of the impounded material with respect to its fluid nature;
2. The liquefaction potential of the impounded material and the related stability of the containing dam;
3. The final surface configuration for the impounded materials, especially from any surface water impounding characteristics and the erosion potential of the surface material; and
4. The establishment of a follow-up inspection schedule to ensure the proposed plans have been effective and the submittal of record drawings.

This, and subsequent calculation briefs prepared by Civil & Environmental Consultants, Inc. (CEC), address the characterization of the impounded fine coal refuse and the liquefaction potential of the fine coal refuse and related stability (i.e., Requirements 1 and 2 above). Alliance Consulting, Inc. (Alliance) will provide the final surface configuration and the follow-up inspection schedule.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 3 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

From Ref. No. 2, the basic elements for seismic design and analysis are:

1. Characterize the subsurface materials;
2. Evaluate if design earthquake will trigger strength loss;
3. Evaluate seismic stability using post-earthquake strength parameters; and
4. Evaluate deformations.

Therefore, the first step for both abandonment and seismic design and analysis is to characterize the subsurface conditions to evaluate the fluid nature and whether any zones have the potential for strength loss due to earthquake shaking (i.e., liquefaction potential). Previously, the materials making up the coarse refuse dike and underlying residual soils were evaluated using piezo-seismic cone penetration testing (PSCPT) (Ref. Nos. 3 and 4) as part of the deformation analyses of the South Pond. Subsequently, and as part of the abandonment evaluation, laboratory testing (Ref. No. 5) and characterization of the fine coal refuse retained behind the embankment was performed as described below.

For many aspects of seismic stability analyses described in Ref. No. 2, coal refuse and natural soils are referred to as sand-like or clay-like depending on whether they exhibit monotonic and cyclic undrained shear loading behavior that is fundamentally more similar to that of either sand or clay. This differentiation is significant primarily if the material is loose enough (sands) or soft enough (clays) that it is potentially susceptible to strength loss.

SUMMARY OF POND CREEK FIELD AND LABORATORY TESTING/RESULTS:

CEC developed, implemented and oversaw a detailed and thorough field testing program consisting of performing PS-CPT at several sounding locations throughout the Pond Creek site, including the ongoing South Pond impoundment. PS-CPT was executed at Pond Creek by ConeTec, Inc. (ConeTec) of West Berlin, New Jersey. Also, Alliance provided bulk (bucket) samples of fine coal refuse, which were obtained for subsequent laboratory testing. Geotechnics, Inc. (Geotechnics) of Pittsburgh, Pennsylvania performed consolidated undrained triaxial shear strength laboratory testing of the fine coal refuse materials. Ref. Nos. 3 -5 present summaries of the field and laboratory testing programs and Appendixes A - C of the Pond Creek abandonment report present the results of the field and laboratory testing.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 4 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

PIEZO-SEISMIC CONE PENETRATION TEST RESULTS SUMMARY:

Generalized South Cell CPT Profiles from the October 2007 field testing presented in Ref. Nos. 3 and 4 indicated the following:

CPT-1	CPT-2
El. 482.19 – Surface Elevation	El. 494.21 – Surface Elevation
15.3 feet – Depth to Static Ground Water	38.8 feet – Depth to Static Ground Water
0 – 18.4 feet – Residual Soil	0 – 32 feet – Coarse Refuse
Refusal at 18.4 feet - Bedrock	32 – 45.3 feet – Residual Soil
	Refusal at 45.3 feet - Bedrock

CPT-2A	CPT-3
El. 492.40 – Surface Elevation	El. 466.98 – Surface Elevation
37.0 feet – Depth to Static Ground Water	11.1 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 22.2 feet – Residual Soil
29 – 41.7 feet – Residual Soil	Refusal at 22.2 feet – Bedrock
Refusal at 41.7 feet - Bedrock	

CPT-4	CPT-5
El. 482.55 – Surface Elevation	El. 482.55 – Surface Elevation
21.7 feet – Depth to Static Ground Water	34.4 feet – Depth to Static Ground Water
0 – 18.9 feet – Residual Soil	0 – 29 feet – Coarse Refuse
Refusal at 18.9 feet – Bedrock	29 – 49.2feet – Residual Soil
	Refusal at 49.2 feet - Bedrock

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 5 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-5A	CPT-5B
El. 483.00 – Surface Elevation	El. 479.90 – Surface Elevation
35.9 feet – Depth to Static Ground Water	28.0 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 19 feet – Coarse Refuse
29 – 53.2 feet – Residual Soil	19 – 39.7 feet – Residual Soil
Refusal at 53.2 feet - Bedrock	Refusal at 39.7 feet - Bedrock

Cone penetration testing results for CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A AND CPT-5B presented in Ref. Nos. 3 and 4 indicated the following:

CPT-1	CPT-3
Residual Soil (Layer Thickness = 18.4)	**Residual Soil (Layer Thickness = 22.2)**
Avg. Tip Stress, Qc avg. = 79 tsf	Avg. Tip Stress, Qc avg. = 43 tsf
Avg. Fines Content, FC avg. = 27%	Avg. Fines Content, FC avg. = 32%
Avg. SBT Index, Ic = 2.38	Avg. SBT Index, Ic = 2.49

CPT-4
Residual Soil (Layer Thickness = 18.9)
Avg. Tip Stress, Qc avg. = 64 tsf
Avg. Fines Content, FC avg. = 28%
Avg. SBT Index, Ic = 2.41

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PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 6 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MRS DATE 7/23/08

CPT-2	CPT-2A
Coarse Coal Refuse (Layer Thickness = 32')	**Coarse Coal Refuse (Layer Thickness = 29')**
Avg. Tip Stress, Qc avg. = 54 tsf	Avg. Tip Stress, Qc avg. = 45 tsf
Avg. Fines Content, FC avg. = 24%	Avg. Fines Content, FC avg. = 22%
Avg. SBT Index, Ic = 2.30	Avg. SBT Index, Ic = 2.23

Residual Soil (Layer Thickness = 13.3')	**Residual Soil (Layer Thickness = 12.7')**
Avg. Tip Stress, Qc avg. = 47 tsf	Avg. Tip Stress, Qc avg. = 86 tsf
Avg. Fines Content, FC avg. = 60%	Avg. Fines Content, FC avg. = 48%
Avg. SBT Index, Ic = 2.99	Avg. SBT Index, Ic = 2.80

CPT-5	CPT-5A
Coarse Coal Refuse (Layer Thickness = 29')	**Coarse Coal Refuse (Layer Thickness = 29')**
Avg. Tip Stress, Qc avg. = 50 tsf	Avg. Tip Stress, Qc avg. = 37 tsf
Avg. Fines Content, FC avg. = 23%	Avg. Fines Content, FC avg. = 24%
Avg. SBT Index, Ic = 2.24	Avg. SBT Index, Ic = 2.29

Residual Soil (Layer Thickness = 20.2')	**Residual Soil (Layer Thickness = 24.2')**
Avg. Tip Stress, Qc avg. = 66 tsf	Avg. Tip Stress, Qc avg. = 49 tsf
Avg. Fines Content, FC avg. = 64%	Avg. Fines Content, FC avg. = 56%
Avg. SBT Index, Ic = 3.04	Avg. SBT Index, Ic = 2.94

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PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 7 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-5B
Coarse Coal Refuse (Layer Thickness = 19')
Avg. Tip Stress, Qc avg. = 41 tsf
Avg. Fines Content, FC avg. = 19%
Avg. SBT Index, Ic = 2.15

Residual Soil (Layer Thickness = 20.7')
Avg. Tip Stress, Qc avg. = 63 tsf
Avg. Fines Content, FC avg. = 51%
Avg. SBT Index, Ic = 2.84

Cone Penetration Testing Results – Shear Wave Velocities

CPT No.	Shear Wave Velocity Coarse Coal Refuse (ft/sec)			Shear Wave Velocity Residual Soil (ft/sec)		
	Max.	Min.	Avg.	Max.	Min.	Avg.
CPT-1	NA			1402	645	905
CPT-2	1284	1029	1120	1173	795	957
CPT-2A	1169	895	1042	1256	780	918
CPT-3	NA			1058	569	765
CPT-4	NA			1242	476	817
CPT-5	1190	936	1063	1599	780	947
CPT-5A	1396	779	1064	1580	728	1005
CPT-5B	1517	818	1080	1649	686	978

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PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 8 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

LABORATORY TESTING RESULTS SUMMARY:

Ref. No. 4 and Appendix A present the details and results of the June 2008 laboratory testing program performed by Geotechnics. The following summarizes laboratory testing results of each of 2 buckets of fine coal refuse sampled from the South Pond impoundment.

Bucket 1	Bucket 2
Fine Coal Refuse	**Fine Coal Refuse**
Moisture = 85.8 %	Moisture = 94.4 %
Passing No. 200 = 92.8 %	Passing No. 200 = 92.6 %
Passing No. 40 = 99.4 %	Passing No. 40 = 99.3%
Plasticity Index = 17 %	Plasticity Index = 17 %
Avg. Strain to Peak = 15.1 %	Avg. Strain to Peak = 11.0 %

Normalized tip stress and fines content with depth for CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B including a summary of pertinent average field and laboratory test results for each material layer are attached.

CRITERIA AND METHODOLOGY:

From Ref. No. 2, the first step common to all approaches is to review the subsurface conditions at the embankment to evaluate whether any zones have the potential for strength loss. For this initial screening step, saturated to nearly saturated sand-like materials with $N_{1,60}$ values less than 15 blows per foot (bpf), or q_{c1} (or Qc) values less than 75 tons per square foot (tsf), should be considered potentially susceptible to strength loss. Ref. No. 2 noted these values are likely too conservative and apply only to clean sands. Their application to silty sands and sands with high fines content, which are more representative of fine coal refuse, will likely be overly conservative.

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 9 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MGS DATE 7/23/08

Generalized field-related CPT-derived criteria noted in various references within Reference 2 include:

Sand-like:	Fines content < 50% or PI < 12%
Loose:	SPT $N_{1,60}$ < 15 or CPT q_{c1} > 75 tsf, & SBT Ic < 2.6 or F_r < 2%).
Clay-like:	Fines content > 50% and PI >12%
Soft:	OCR < 5, S_u/σ'_v < 1.0, CPT Q_t < 20 tsf & SBT Ic > 2.6, SPT $N_{1,60}$ < 8

CPT data may be used in conjunction with Atterberg limit data (criteria shown below) to differentiate sand-like from clay-like material. CPT Soil Behavior Type Index (I_c), as described in Robertson and Wride 1998 and reproduced in Youd et al. 2001, values below 2.6 should be considered sand-like. I_c values above 2.6 may be considered clay-like.

Generalized laboratory results criteria noted in various references within and in Ref. No. 1 include the following Atterberg Limit and sieve criteria:

Atterberg Limits.

- Material should be considered sand-like if any of the following three (3) criteria apply:

  1. The material has less than 35% particles by dry weight passing the No. 40 sieve and less than 20% by dry weight passing the No. 200 sieve; or

  2. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 12%; or

  3. The material has 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 20%.

The material may be considered clay-like if any of the following two (2) criteria apply:

1. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 12% or higher; or

2. The material has 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 20% or higher.

Atterberg limit criteria include as sand-like some materials that are considered clay-like by some investigators (e.g. Boulanger and Idriss, 2004, who suggested a break between sand-like and clay-like behavior at a PI of 7%). The intent is to classify borderline materials as sand-like to be conservative.

Another key factor in differentiating loose sand-like material from soft or medium clay-like material, for the purposes of seismic stability and deformation analyses, are the strain at peak undrained strength and the abruptness of the drop-off in shearing resistance as strains increase beyond the strain at peak. Loose sands and highly sensitive clays can reach S_{up} at small strains, and experience abrupt drop-off in resistance at higher strains. Most clays tend to reach S_{up} at higher strains, and tend to experience more gradual and limited drop-off in shearing resistance at higher strains. Fine coal refuse deposits often include materials falling within both classifications, and near the boundary of these two types of behavior.

Loose materials with shear strain at peak strength of less than 2% in an undrained monotonic (non-cyclic) test, and a rapid drop-off in resistance after reaching peak strength, are considered sand-like. Loose or soft materials with shear strain at peak strength of more than about 5%, and a gradual drop-off in resistance after reaching peak strength are considered clay-like. Materials with strain behavior between these descriptions are considered borderline and, to be conservative, should generally be analyzed as sand-like. (Note that shear strain in an undrained triaxial test is 1.5 times axial strain.)

Soil, rock, and mixtures of soil and rock that are not coal refuse such as the underlying starter embankment will be referred to as natural soils. Natural soils may be described as sand-like, or clay-like, using the same general criteria as refuse.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

PAGE 11 OF 12

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A AND CPT-5B AVG. WEIGHTED AVERAGE FIELD AND LAB RESULTS SUMMARY
Coarse Coal Refuse (138')
Avg. Tip Stress, Qc avg. = 46 tsf
Avg. Fines Content, FC avg. = 23%
Avg. SBT Index, Ic = 2.25

Fine Coal Refuse
Avg. % Passing No. 200 = 92.7%
Avg. % Passing No. 40 = 99.4 %
Avg. Plasticity Index = 17%
Avg. Strain to Peak = 13.1 %

Residual Soil (150.6')
Avg. Tip Stress, Qc avg. = 61 tsf
Avg. Fines Content, FC avg. = 46%
Avg. SBT Index, Ic = 2.73

Plots of individual and average normalized tip stress with depth are included with an attached complete copy of Ref. No. 4.

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PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 12 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CONCLUSION

Based on the information presented in this calculation brief, the following material characteristic designations were determined for the coarse coal refuse, fine coal refuse and residual soil:

Coarse Coal Refuse: Medium Dense Sand-Like;

Fine Coal Refuse: Medium Stiff Clay-Like;

Residual Soil: Medium Dense Sand-Like and Medium Stiff Clay-Like.

Further, the results of the laboratory testing indicate that the fine coal refuse is clay-like based on an average 93% passing the No. 200 sieve and plasticity index of 17%. Peak and steady-state undrained strengths presented in Appendix A were reached at generally high strains (between 8 and 18%), and there was very little drop off from peak to steady-state with increasing strain. The results generally indicated a higher resistance to strength loss (and flow) due to the large strains required to exceed the peak strength and correspondingly small decrease to the steady-state strength at higher strains. Further, previous deformation analyses results indicated induced shear strains from the PGA at less than 0.1%, which is well below a threshold (peak) triggering strain of the material.

The susceptibility of the embankment and impoundment to a liquefaction flow failure is a function of both the undrained strength (worst case steady-state strength) and the in-situ driving shear stress on a critical failure plane passing through the critical layer fine coal refuse material, which is further addressed in subsequent calculation briefs.

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PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation — PROJECT NO. 080851

Estimation and Summary of Engineering Properties for Fine Coal Refuse — PAGE 1 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

CALCULATION BRIEF FOR

ESTIMATION AND SUMMARY OF ENGINEERING PROPERTIES INCLUDING PEAK AND STEADY-STATE UNDRAINED SHEAR STRENGTH FOR REFUSE AND SUBGRADE MATERIALS

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH POND STAGE 2

OBJECTIVE: To estimate and summarize engineering properties for fine coal refuse materials samples obtained at the Pond Creek Coal Refuse Disposal site including unit weight (γ), specific gravity (G_s), effective strength, i.e., angle of internal friction (ϕ') and cohesion (c'), total strength, peak undrained shear strength (S_{up}), and steady-state undrained shear strength (S_{us}). The various strengths will be used in the South Pond abandonment analyses model(s).

REFERENCES:

1. Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Summary of Piezo-Seismic Cone Penetration Testing," Pond Creek Coal Refuse Disposal Site," BEG, 12/21/07.

2. Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Summary of Laboratory Testing – Fine Coal Refuse," Pond Creek Coal Refuse Disposal Site – South Pond," BEG, 7/10/08.

3. Alliance Consulting, Inc., "Appendix C Laboratory Testing, Proposed Coal Refuse Disposal Facility No. 2, Pond Creek Mine No. 1, Williamson County, Illinois."

4. Poulos, S.J., Castro, G., France, J.W. (1985), "Liquefaction Evaluation Procedure," Journal of Geotechnical Engineering, ASCE, 111(6), pp. 772-791.

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PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation Estimation and Summary of Engineering Properties for Fine Coal Refuse

PROJECT NO. 080851

PAGE 2 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

5. Genes, B.E., Keller, T.O., and Laird, J.P. (2000) "Steady State Liquefaction Susceptibility of High Hazard Upstream-Constructed Coal Refuse Disposal Facilities," Proceedings of Tailings Dams 2000, ASDSO/USCOLD, Las Vegas, NV, March 28-30, pp. 47-58.

6. Almes, R. A. and Butail, A. (1976) "Coal Refuse: Its Behavior Related to the Design and Operation of Coal Refuse Disposal Facilities," Proceedings of the Ohio River Valley Soils Seminar, Lexington, Kentucky, October, 1976.

7. Bowles, Joseph E. (1984) "Physical and Geotechnical Properties of Soils," Mc-Graw Hill. New York: 367-369 and 393-396.

SOIL PROPERTIES:

The following soil properties were estimated based on laboratory testing [Reference Numbers (Ref. Nos.) 2 and 3] performed for abandonment analyses and/or provided by Alliance Consulting, Inc. for previous deformation analyses, which are used in the various slope stability analyses and attached for information:

Refuse/Soil Properties

Description	Unit Weight (γ) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion [1] (c) (psf)	Comment
Coarse Refuse	130	36	0	Frictional
Fine Coal Refuse	85	36.9	0	Effective Strength (Drained)
		18.8	0	Total Strength (Undrained)
		0	Varies (See Below)	Steady-State (Undrained)
Residual Soil	125	19.5	400	Total Strength (Undrained)
		0	3000	80% Peak Undrained

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PROJECT: Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation — PROJECT NO. 080851

Estimation and Summary of Engineering Properties for Fine Coal Refuse — PAGE 3 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

LABORATORY-DERIVED S_{up} and S_{us}:

Two (2) consolidated – undrained (CU) triaxial series tests (3 points each) were performed on reconstituted bulk fine coal refuse slurry to determine effective and total strength parameters as well as peak (S_{up}) and steady-state (S_{us}) undrained shear strengths. Samples were prepared in the laboratory to simulate in-situ placement and consolidation. Samples were consolidated to a range of vertical effective stresses of about 5, 10 and 20 pounds per square inch (psi) [or 720 to 2880 pounds per square foot (psf)]. All specimens exhibited contractive behavior when sheared under undrained conditions. In general, all specimens reached, or nearly reached, a steady-state of deformation within the strain limits of the test equipment.

A total of 6 CU points comprise the (2) series from which peak and steady-state shear strength state. S_{us} represents the liquefied shear strength [i.e., the minimum (residual) strength available following a rapid loading event, such as an earthquake].

The following equations (Ref. No. 4) were used to calculate peak (S_{up}) and steady-state (S_{us}) shear strengths from laboratory test specimens:

Peak:

$$S_{up} = q_{up} \cos \phi_p$$

Or

$$S_{up} = \sigma'_{3p} [\cos \phi_p \sin \phi_p] / (1 - \sin \phi_p)$$

Steady-State:

$$S_{us} = q_{us} \cos \phi_{us}$$

Or

$$S_{us} = \sigma'_{3s} [\cos \phi_{us} \sin \phi_{us}] / (1 - \sin \phi_{us})$$

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PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation Estimation and Summary of Engineering Properties for Fine Coal Refuse

PROJECT NO. 080851

PAGE 4 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

Where,

q_{up} = shear stress on 45-degree plane at peak strain

ϕ_p = friction angle at peak = arcsin (q/p) at peak strain

σ'_{3p} = lateral effective stress at peak strain

q_{us} = shear stress on 45-degree plane at steady-state (max) strain

ϕ_{us} = friction angle at steady-state = arcsin (q/p) at max strain

σ'_{3us} = lateral effective stress at steady-state (max) strain

The following peak and steady-state data is presented from CU testing on bulk fine coal refuse samples Bucket 1 and Bucket 2 and applying the equations above. CU laboratory test results are attached.

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PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Estimation and Summary of Engineering Properties
for Fine Coal Refuse

PROJECT NO. 080851

PAGE 5 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

Sample No.	Bucket 1 – Fine Coal Refuse			Bucket 2 – Fine Coal Refuse		
CU Test No. (Confining Pressure)	1 (5.2 psi)	2 (10.2 psi)	3 (20.4 psi)	1 (5.2 psi)	2 (10.4 psi)	3 (20.4 psi)
Parameter						
q_{up} (psi) @	4.61	7.54	10.82	3.37	5.73	11.67
Peak Strain (%)	18.4	13.4	13.5	10.3	14.2	8.4
ϕ_p (deg)	40.4	39.6	37.8	38.3	39.2	37.5
σ'_{3p} (psi)	2.5	4.3	6.8	2.1	3.3	7.5
S_{up} (psi)	3.51	5.81	8.55	2.64	4.44	9.26
q_{us} (psi) @	4.59	7.33	10.02	3.28	5.4	10.61
Max. Strain (%)	21.5	21.67	21.74	17.29	21.32	21.42
ϕ_{us} (deg)	40.4	39.0	36.7	36.3	38.6	35.7
σ'_{3us} (psi)	2.4	4.3	6.7	2.1	3.3	7.6
S_{us} (psi)	3.37	5.67	7.98	2.46	4.28	8.65

A plot of the S_{us} of the reconstituted coal refuse slurry samples versus vertical effective stress ($\sigma'v$) is presented in the attached Figure 1. The equivalent effective vertical stress was assumed to be 1.5 times the isotropic effective consolidation stress (i.e., 1.5*$\sigma'3$). A 2/3 – 1/3 relationship of the data was employed to yield an S_{us} to $\sigma'v$ relationship of $S_{us} = 0.28\ \sigma'v$. Ref. No. 5 and recent undisturbed/remolded fine coal refuse testing on other projects yielded a range of $S_{us} = 0.06$ to $0.28\ \sigma'v$, with an average of about $S_{us} = 0.22\ \sigma'v$. Since site specific testing was performed, a reasonable S_{us} to $\sigma'v$ relationship of $S_{us} = 0.24\ \sigma'v$ is considered realistic with some conservatism. The impounded/abandoned fine coal refuse in the South Pond will be modeled utilizing this relationship.

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PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation — PROJECT NO. 080851

Estimation and Summary of Engineering Properties for Fine Coal Refuse — PAGE 6 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

Subsequent slope stability analyses determine the magnitude of driving shear stress on a failure plane through the fine coal refuse impoundment to assess the required S_{us} to maintain equilibrium and assess the likelihood of a (liquefaction) flow failure. Post-earthquake slope stability of the embankment/impoundment is evaluated as well to assess the failure potential of the South Pond embankment using the abandonment geometry.

CONCLUSIONS

Laboratory undrained shear strength data from consolidated undrained triaxial tests of fine coal refuse were determined. Procedures were performed to estimate S_{up}, S_{us}, and a reasonable S_{us} to $\sigma'v$ relationship of $S_{us} = 0.24\ \sigma'v$ for the material. The results of the laboratory testing indicated Sup and Sus reach their peak and steady-state strength at high strains, and there is very little drop off with increasing strain. Further, Sup and Sus values generally indicated resistance to flow. Thus, the results suggest undrained strengths of the fine coal refuse will be maintained at or near peak levels during an undrained event such as an earthquake, and the susceptibility of the impounded fine coal refuse to a liquefaction flow failure is a function of both the undrained strength (worst case steady-state strength) and the in-situ driving shear stress on a critical failure plane through the fine refuse material.

Based on this information, the properties evaluated/developed in Ref. No. 2 for fine coal refuse, as well as coarse refuse and residual soil, indicated the South Pond fine coal refuse has sufficient steady-state shear strength to limit the flowability of the material. The likelihood of a flow failure associated with the abandonment scenario will be assessed in a subsequent calculation brief by evaluating the driving shear stress and factor of safety against liquefaction in the fine coal refuse.

POND CREEK PHASE 2 SOUTH POND
STEADY-STATE UNDRAINED SHEAR STRENGTH-TO-EFFECTIVE STRESS RELATIONSHIP

Pond Creek Phase 2 South Pond
Steady-State Undrained Strength vs. Vertical Effective Stress

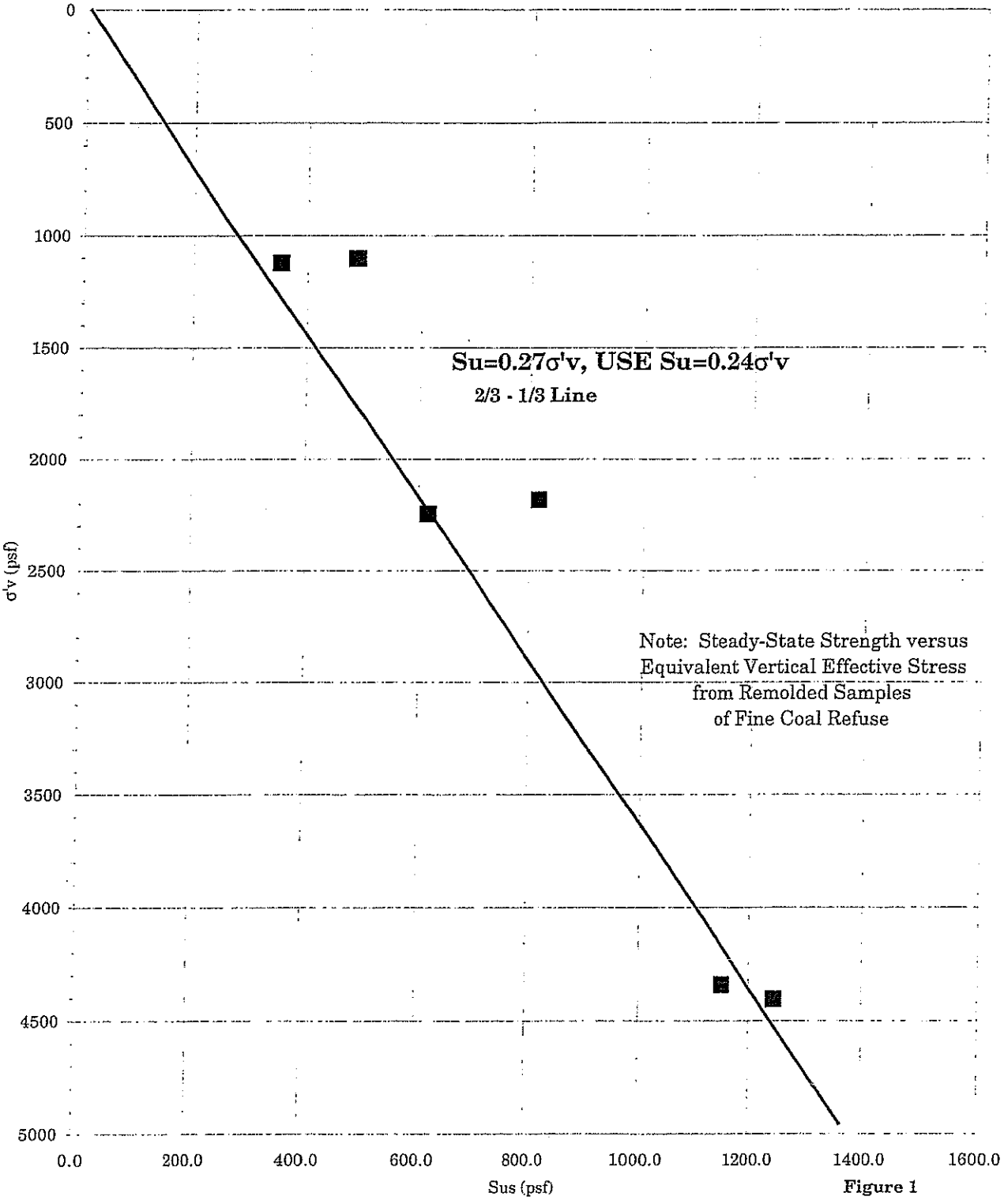

Figure 1

POND CREEK – SOUTH POND
CONSOLIDATED – UNDRAINED TRIAXIAL LABORATORY TESTING RESULTS FOR FINE COAL REFUSE

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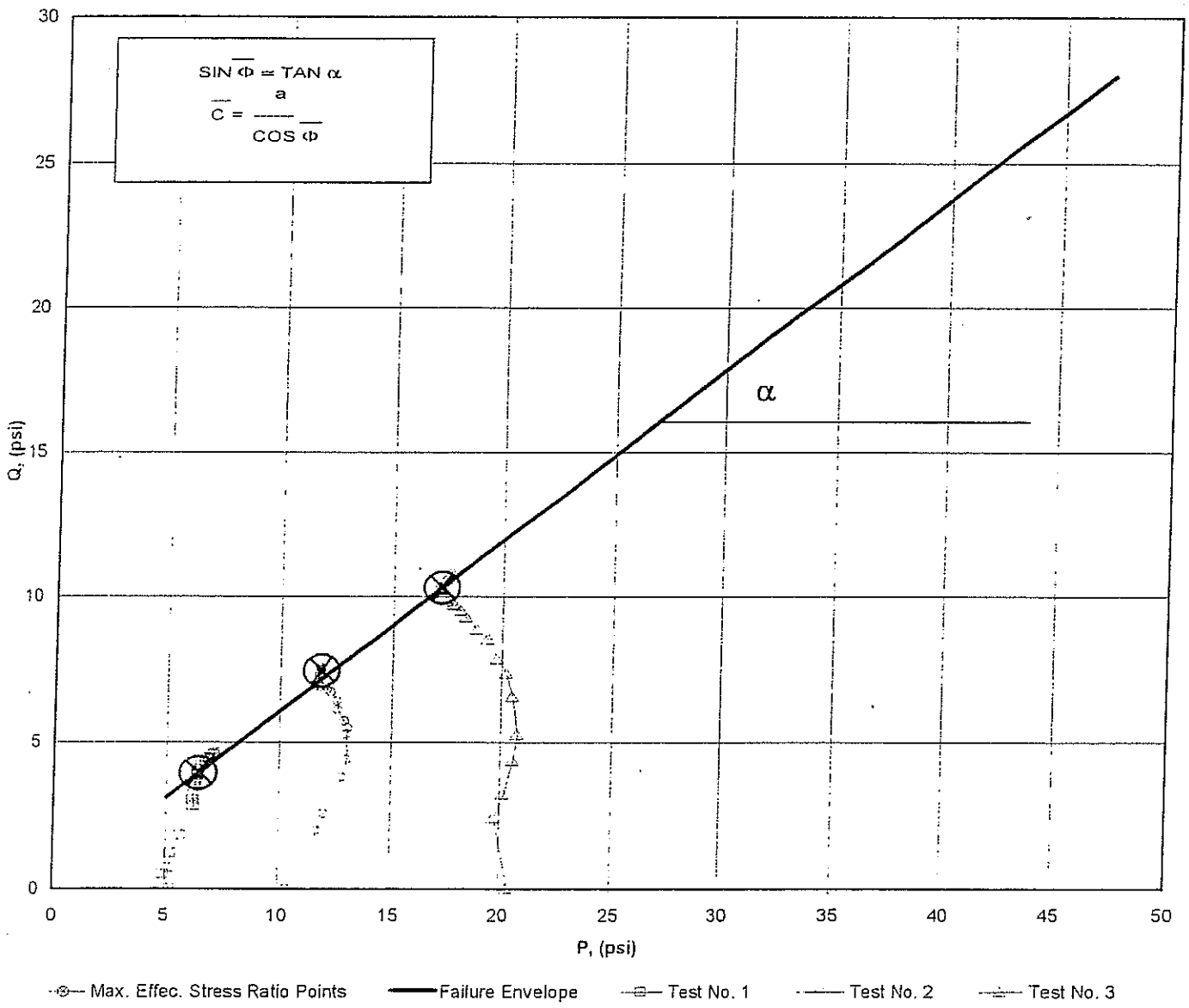
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	30.5	$\bar{\Phi}$	=	36.14

Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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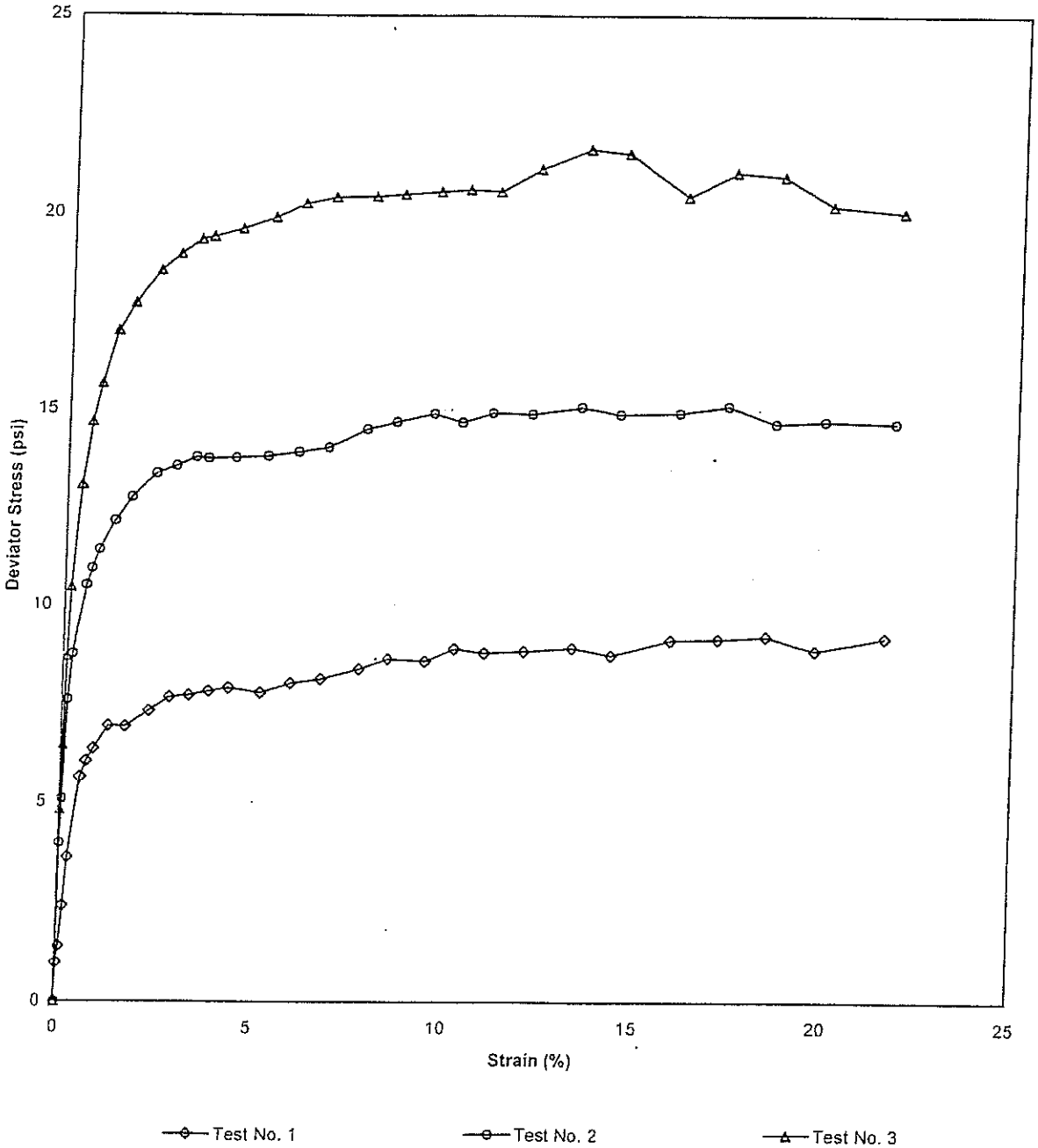
INTEGRITY IN TESTING

CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	1

PRESSURES (psi)

Cell Pressure(psi)	36.6
Back Pressure(psi)	31.4
Eff. Cons. Pressure(psi)	5.2
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	6.41
Q	=	3.95

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.140	Diameter 1	1.375
Length 2	3.148	Diameter 2	1.389
Length 3	3.151	Diameter 3	1.399
Avg Leng.=	3.146	Avg. Diam.=	1.388

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.7
Final Change (ml)	2.3

Initial Dial Reading (D.R.), mils	235
D.R. After Saturation, mils	250
D.R. After Consolidation, mils	294

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.4
8.2	0.001	32.1
8.8	0.002	32.1
10.3	0.005	32.5
12.1	0.008	32.8
15.1	0.016	33.2
15.8	0.020	33.4
16.2	0.026	33.6
17.1	0.038	33.7
17.2	0.051	33.8
17.8	0.069	33.9
18.4	0.085	34.0
18.5	0.101	34.0
18.8	0.116	34.1
19.0	0.132	34.1
18.9	0.158	34.1
19.4	0.182	34.2
19.6	0.205	34.2
20.2	0.236	34.2
20.7	0.260	34.2
20.8	0.292	34.1
21.4	0.316	34.3
21.4	0.340	34.1
21.6	0.371	34.1
22.0	0.411	34.1
21.8	0.443	34.1
22.8	0.490	34.1
23.1	0.530	34.2
23.5	0.569	34.1
23.1	0.610	34.1
24.0	0.664	34.2

Tested By JCM Date 05/21/08 Input Checked By MB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.2	*Stage No.*	1
		Test No	1

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.51
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.55
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.474

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	0.98	0.73	5.45	4.5	1.219	0.76	4.96	0.49
0.07	1.39	0.75	5.84	4.5	1.311	0.55	5.14	0.69
0.15	2.40	1.15	6.46	4.1	1.593	0.49	5.25	1.20
0.25	3.62	1.36	7.46	3.8	1.941	0.38	5.65	1.81
0.52	5.63	1.79	9.04	3.4	2.649	0.32	6.23	2.81
0.66	6.03	2.01	9.22	3.2	2.893	0.34	6.20	3.02
0.84	6.35	2.21	9.34	3.0	3.125	0.36	6.16	3.18
1.22	6.92	2.33	9.79	2.9	3.417	0.34	6.33	3.46
1.64	6.91	2.40	9.71	2.8	3.469	0.35	6.26	3.46
2.25	7.31	2.55	9.96	2.7	3.753	0.36	6.31	3.65
2.75	7.66	2.61	10.25	2.6	3.961	0.35	6.42	3.83
3.27	7.71	2.64	10.26	2.6	4.017	0.35	6.41	3.85
3.77	7.81	2.68	10.34	2.5	4.098	0.35	6.43	3.91
4.28	7.90	2.74	10.37	2.5	4.208	0.35	6.41	3.95
5.11	7.78	2.71	10.27	2.5	4.124	0.36	6.38	3.89
5.89	8.02	2.84	10.38	2.4	4.400	0.36	6.37	4.01
6.65	8.13	2.78	10.56	2.4	4.359	0.35	6.49	4.07
7.66	8.39	2.83	10.76	2.4	4.538	0.34	6.56	4.19
8.42	8.64	2.76	11.09	2.4	4.536	0.33	6.77	4.32
9.45	8.59	2.72	11.07	2.5	4.464	0.32	6.77	4.29
10.23	8.90	2.86	11.25	2.3	4.797	0.33	6.79	4.45
11.00	8.80	2.67	11.33	2.5	4.474	0.31	6.93	4.40
12.03	8.83	2.74	11.29	2.5	4.594	0.32	6.87	4.42
13.30	8.93	2.72	11.41	2.5	4.601	0.31	6.94	4.46
14.34	8.73	2.69	11.25	2.5	4.477	0.31	6.88	4.37
15.88	9.12	2.66	11.66	2.5	4.587	0.30	7.10	4.56
17.15	9.15	2.77	11.59	2.4	4.762	0.31	7.01	4.58
18.44	9.22	2.70	11.72	2.5	4.691	0.30	7.11	4.61
19.74	8.86	2.70	11.36	2.5	4.536	0.31	6.93	4.43
21.51	9.19	2.82	11.56	2.4	4.864	0.31	6.97	4.59

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

R15397

Geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	2

PRESSURES (psi)

Cell Pressure(psi)	46.5
Back Pressure(psi)	36.1
Eff. Cons. Pressure(ps	10.4
Pore Pressure Response (%)	100

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	11.84
Q	=	7.45

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.120	Diameter 1	1.396
Length 2	3.137	Diameter 2	1.398
Length 3	3.135	Diameter 3	1.344
Avg Leng.=	3.131	Avg. Diam.=	1.379

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	18.4
Final Change (ml)	5.6

Initial Dial Reading (D.R.), mils	77
D.R. After Saturation, mils	112
D.R. After Consolidation, mils	166

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.9	0.000	36.1
13.4	0.001	36.8
14.9	0.002	37.0
18.3	0.005	37.4
20.0	0.008	37.8
22.4	0.017	38.7
23.0	0.020	38.9
23.7	0.026	39.3
24.8	0.038	39.9
25.7	0.051	40.3
26.7	0.069	40.9
27.1	0.085	41.1
27.5	0.100	41.3
27.5	0.110	41.5
27.7	0.131	41.6
27.9	0.157	41.8
28.2	0.181	41.9
28.6	0.204	41.9
29.5	0.235	42.0
30.0	0.259	42.1
30.5	0.290	42.1
30.4	0.313	42.0
31.0	0.337	42.1
31.2	0.368	42.0
31.8	0.408	42.2
31.8	0.439	42.1
32.3	0.486	42.1
33.0	0.526	42.2
32.6	0.565	42.1
33.1	0.604	42.2
33.6	0.659	42.2

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

R15398
Geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.4	*Stage No.*	1
		Test No	2

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.49
Initial Sample Volume (in^3)	4.68

VOLUME CHANGE

Volume After Consolidation (in^3)	4.18
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma}_1$	$\overline{\sigma}_3$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.03	3.98	0.65	13.73	9.7	1.408	0.16	11.74	1.99
0.06	5.09	0.89	14.59	9.5	1.535	0.18	12.05	2.54
0.15	7.59	1.34	16.65	9.1	1.838	0.18	12.85	3.79
0.25	8.76	1.72	17.44	8.7	2.010	0.20	13.06	4.38
0.54	10.51	2.62	18.29	7.8	2.351	0.25	13.04	5.26
0.67	10.94	2.79	18.56	7.6	2.438	0.25	13.08	5.47
0.86	11.42	3.19	18.64	7.2	2.584	0.28	12.92	5.71
1.25	12.16	3.85	18.71	6.6	2.856	0.32	12.63	6.08
1.67	12.77	4.19	18.98	6.2	3.055	0.33	12.60	6.38
2.28	13.37	4.77	19.00	5.6	3.373	0.36	12.32	6.68
2.79	13.56	5.04	18.92	5.4	3.530	0.37	12.14	6.78
3.30	13.79	5.25	18.94	5.2	3.675	0.38	12.05	6.89
3.60	13.76	5.40	18.76	5.0	3.751	0.39	11.88	6.88
4.32	13.77	5.50	18.67	4.9	3.812	0.40	11.79	6.89
5.16	13.82	5.69	18.52	4.7	3.934	0.41	11.62	6.91
5.95	13.93	5.80	18.52	4.6	4.029	0.42	11.56	6.96
6.72	14.04	5.83	18.61	4.6	4.072	0.42	11.59	7.02
7.73	14.51	5.87	19.04	4.5	4.205	0.40	11.78	7.26
8.52	14.69	6.01	19.08	4.4	4.349	0.41	11.73	7.35
9.54	14.91	6.01	19.30	4.4	4.397	0.40	11.84	7.45
10.30	14.68	5.94	19.15	4.5	4.289	0.40	11.80	7.34
11.07	14.93	6.00	19.33	4.4	4.390	0.40	11.87	7.46
12.10	14.89	5.95	19.34	4.5	4.346	0.40	11.90	7.45
13.40	15.08	6.10	19.38	4.3	4.506	0.40	11.84	7.54
14.44	14.89	6.03	19.25	4.4	4.410	0.41	11.81	7.44
15.98	14.92	5.99	19.34	4.4	4.381	0.40	11.88	7.46
17.28	15.10	6.12	19.38	4.3	4.528	0.41	11.83	7.55
18.58	14.65	5.96	19.09	4.4	4.303	0.41	11.76	7.33
19.86	14.71	6.07	19.04	4.3	4.398	0.41	11.68	7.35
21.67	14.66	6.08	18.99	4.3	4.393	0.41	11.65	7.33

Tested By JCM Date 05/21/08 Input Checked By KB Date 10-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	3

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	20.4
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	17.19
Q	=	10.31

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.130	Diameter 1	1.404
Length 2	3.121	Diameter 2	1.373
Length 3	3.136	Diameter 3	1.371
Avg Leng.=	3.129	Avg. Diam.=	1.383

VOLUME CHANGE

Initial Burette Reading (ml)	48.0
Final Burette Reading (ml)	40.5
Final Change (ml)	7.5

Initial Dial Reading (D.R.), mils	60
D.R. After Saturation, mils	68
D.R. After Consolidation, mils	154

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.0
13.5	0.001	34.0
15.7	0.002	34.5
18.9	0.003	35.2
21.3	0.005	35.9
25.0	0.011	37.4
27.3	0.017	38.5
28.7	0.024	39.4
30.6	0.036	40.5
31.7	0.049	41.4
33.1	0.067	42.3
33.8	0.083	42.8
34.5	0.099	43.2
34.7	0.108	43.4
35.2	0.131	43.7
35.9	0.157	44.0
36.6	0.180	44.2
37.1	0.204	44.3
37.5	0.236	44.4
37.8	0.260	44.4
38.3	0.290	44.5
38.7	0.314	44.5
38.8	0.337	44.5
40.1	0.369	44.6
41.4	0.408	44.6
41.7	0.440	44.6
40.5	0.488	44.6
42.1	0.527	44.6
42.5	0.566	44.6
41.7	0.605	44.6
42.3	0.660	44.7

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.4	*Stage No.*	1
		Test No	3

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.20
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.385

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	4.82	3.04	22.17	17.4	1.278	0.64	19.76	2.41
0.05	6.44	3.45	23.39	16.9	1.380	0.54	20.17	3.22
0.10	8.70	4.15	24.95	16.2	1.536	0.48	20.60	4.35
0.17	10.46	4.86	26.01	15.5	1.673	0.47	20.77	5.23
0.37	13.09	6.38	27.10	14.0	1.934	0.49	20.56	6.54
0.58	14.68	7.49	27.59	12.9	2.137	0.52	20.25	7.34
0.80	15.66	8.40	27.66	12.0	2.305	0.54	19.83	7.83
1.18	17.01	9.52	27.89	10.9	2.563	0.57	19.38	8.50
1.61	17.71	10.40	27.71	10.0	2.772	0.59	18.85	8.86
2.22	18.54	11.31	27.63	9.1	3.039	0.62	18.36	9.27
2.74	18.96	11.76	27.60	8.6	3.196	0.63	18.12	9.48
3.26	19.34	12.21	27.53	8.2	3.361	0.64	17.86	9.67
3.57	19.40	12.35	27.45	8.0	3.411	0.64	17.75	9.70
4.31	19.60	12.73	27.27	7.7	3.556	0.66	17.47	9.80
5.17	19.89	12.96	27.33	7.4	3.676	0.66	17.38	9.95
5.94	20.25	13.15	27.50	7.2	3.795	0.66	17.37	10.13
6.73	20.42	13.27	27.54	7.1	3.864	0.66	17.34	10.21
7.78	20.44	13.38	27.46	7.0	3.912	0.66	17.24	10.22
8.55	20.50	13.40	27.50	7.0	3.928	0.66	17.25	10.25
9.57	20.57	13.48	27.49	6.9	3.973	0.66	17.20	10.28
10.34	20.62	13.52	27.50	6.9	3.995	0.66	17.19	10.31
11.11	20.56	13.51	27.45	6.9	3.982	0.66	17.17	10.28
12.15	21.14	13.55	27.99	6.8	4.088	0.65	17.42	10.57
13.45	21.64	13.57	28.47	6.8	4.170	0.63	17.65	10.82
14.49	21.53	13.56	28.36	6.8	4.149	0.64	17.60	10.76
16.07	20.44	13.58	27.26	6.8	3.997	0.67	17.04	10.22
17.35	21.06	13.58	27.88	6.8	4.086	0.65	17.35	10.53
18.64	20.95	13.63	27.72	6.8	4.094	0.66	17.25	10.48
19.92	20.20	13.64	26.96	6.8	3.988	0.68	16.86	10.10
21.74	20.03	13.67	26.77	6.7	3.975	0.69	16.75	10.02

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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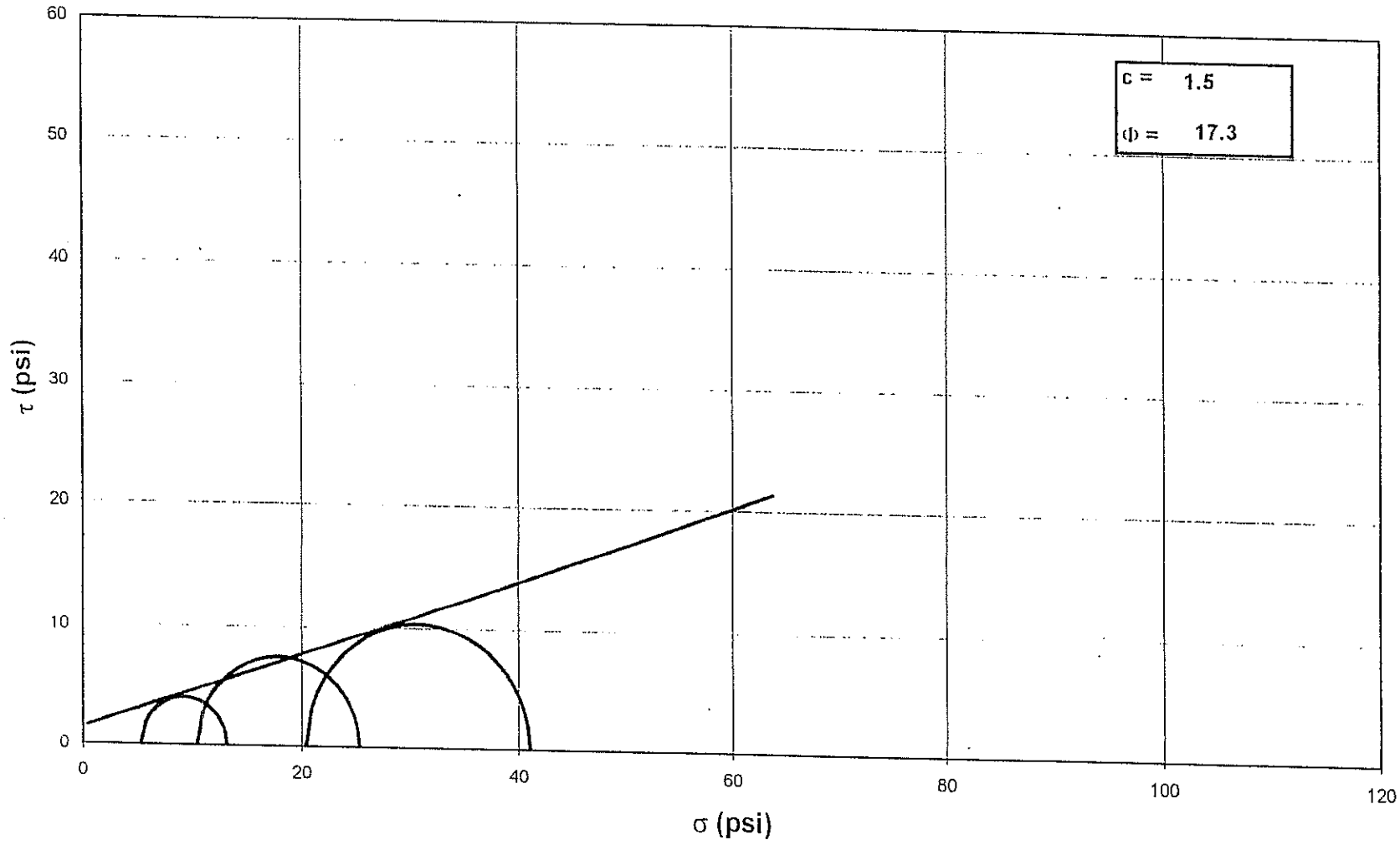
Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/19/08

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R15401

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	82.6	82.7	79.5
Total Unit Weight (pcf)	76.6	84.2	80.5
Dry Unit Weight (pcf)	42.0	46.1	44.8
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	2.333	2.035	2.119

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

DCN: CT-S28 DATE 6-25-98 REVISION: 1

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	41.7	43.3	42.4
Total Unit Weight (pcf)	102.0	102.5	101.8
Dry Unit Weight (pcf)	71.9	71.5	71.5
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	0.944	0.955	0.956

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

DCN: CT-S28 DATE 6-25-96 REVISION: 1

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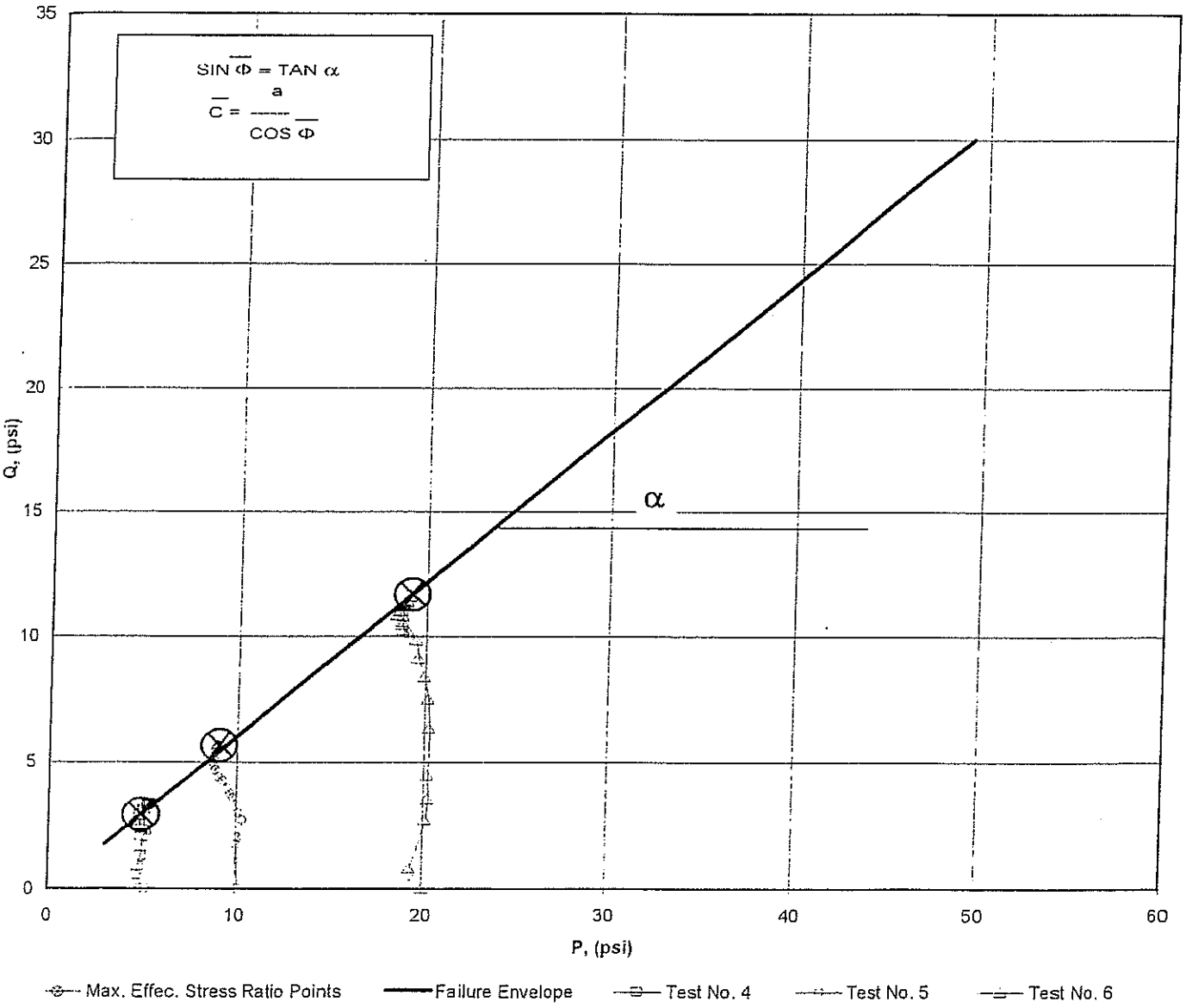
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	31.5	$\bar{\Phi}$	=	37.71

Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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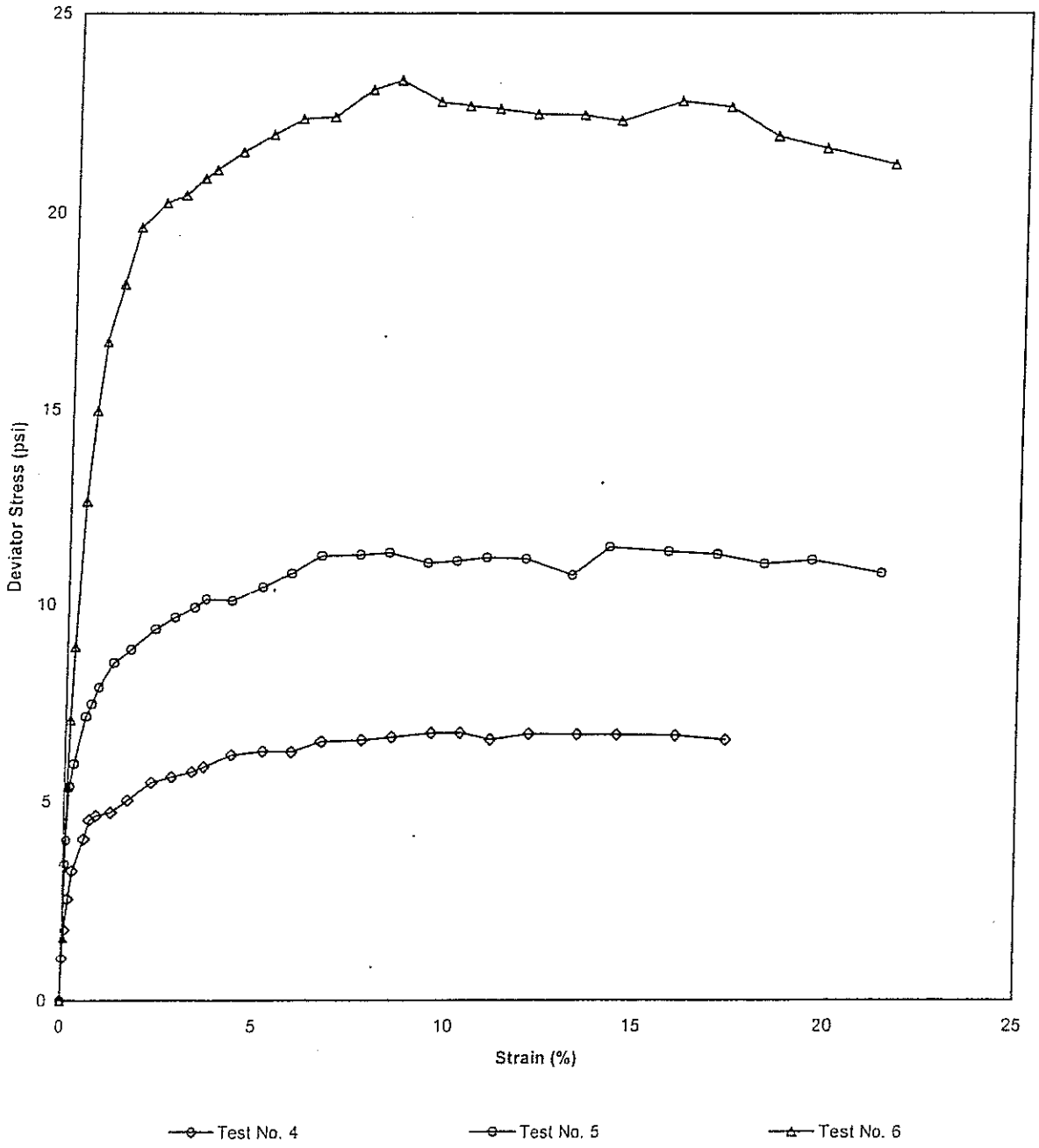
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

R15406

geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	4

PRESSURES (psi)

Cell Pressure(psi)	36.3
Back Pressure(psi)	31.2
Eff. Cons. Pressure(psi)	5.1
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	4.92
Q	=	2.94

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.150	Diameter 1	1.453
Length 2	3.142	Diameter 2	1.463
Length 3	3.147	Diameter 3	1.461
Avg Leng.=	3.146	Avg. Diam.=	1.459

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.9
Final Change (ml)	2.1

Initial Dial Reading (D.R.), mils	54
D.R. After Saturation, mils	110
D.R. After Consolidation, mils	130

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.6	0.000	31.2
9.3	0.001	32.1
10.4	0.002	32.3
11.6	0.005	32.6
12.8	0.008	32.9
14.0	0.016	33.3
14.8	0.020	33.3
15.0	0.025	33.6
15.2	0.037	33.8
15.7	0.050	33.9
16.5	0.068	34.2
16.7	0.084	34.2
17.0	0.100	34.2
17.2	0.110	34.3
17.8	0.133	34.2
18.1	0.159	34.3
18.1	0.182	34.3
18.6	0.205	34.2
18.8	0.237	34.2
19.0	0.261	34.3
19.3	0.293	34.3
19.5	0.316	34.2
19.3	0.340	34.3
19.7	0.372	34.2
19.8	0.412	34.3
19.9	0.445	34.3
20.1	0.491	34.2
20.1	0.531	34.2

Tested By JCM Date 05/27/08 Input Checked By JAB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics INTEGRITY IN TESTING

R15407

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.1	*Stage No.*	1
		Test No	4

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.46
Initial Sample Area (in^2)	1.67
Initial Sample Volume (in^3)	5.26

VOLUME CHANGE

Volume After Consolidation (in^3)	4.85
Length After Consolidation (in)	3.07
Area After Consolidation (in^2)	1.580

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	1.06	0.90	5.26	4.2	1.253	0.86	4.73	0.53
0.07	1.77	1.15	5.72	4.0	1.449	0.66	4.84	0.89
0.15	2.55	1.44	6.21	3.7	1.698	0.58	4.94	1.28
0.25	3.26	1.71	6.65	3.4	1.959	0.53	5.02	1.63
0.53	4.05	2.11	7.04	3.0	2.358	0.53	5.01	2.03
0.65	4.54	2.14	7.50	3.0	2.531	0.48	5.23	2.27
0.82	4.65	2.39	7.36	2.7	2.712	0.52	5.04	2.32
1.21	4.72	2.58	7.25	2.5	2.873	0.56	4.89	2.36
1.62	5.03	2.72	7.42	2.4	3.112	0.55	4.90	2.52
2.22	5.48	2.95	7.63	2.1	3.550	0.55	4.89	2.74
2.74	5.62	3.02	7.70	2.1	3.705	0.55	4.89	2.81
3.27	5.75	3.04	7.81	2.1	3.790	0.54	4.93	2.87
3.59	5.88	3.12	7.86	2.0	3.968	0.54	4.92	2.94
4.33	6.18	3.02	8.27	2.1	3.967	0.50	5.17	3.09
5.17	6.27	3.08	8.30	2.0	4.101	0.50	5.16	3.14
5.93	6.25	3.13	8.22	2.0	4.176	0.51	5.10	3.13
6.69	6.51	3.03	8.58	2.1	4.152	0.48	5.32	3.26
7.73	6.56	3.04	8.62	2.1	4.176	0.47	5.34	3.28
8.50	6.63	3.14	8.59	2.0	4.380	0.48	5.27	3.31
9.53	6.72	3.14	8.68	2.0	4.436	0.48	5.32	3.36
10.30	6.74	3.03	8.81	2.1	4.256	0.46	5.44	3.37
11.09	6.56	3.07	8.59	2.0	4.235	0.48	5.31	3.28
12.10	6.71	3.03	8.78	2.1	4.233	0.46	5.43	3.35
13.42	6.69	3.06	8.74	2.0	4.281	0.47	5.39	3.35
14.49	6.68	3.10	8.68	2.0	4.342	0.47	5.34	3.34
16.00	6.66	3.02	8.74	2.1	4.204	0.46	5.41	3.33
17.29	6.55	3.03	8.62	2.1	4.171	0.47	5.34	3.28

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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P15408

Client	CEC	Boring No.	SOUTH POND
lient Reference	POND CREEK 080851	Depth(ft.)	NA
roject No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	5

PRESSURES (psi)

Cell Pressure(psi)	41.1
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	10.1
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	9.00
Q	=	5.66

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.138	Diameter 1	1.407
Length 2	3.138	Diameter 2	1.383
Length 3	3.137	Diameter 3	1.378
Avg Leng.=	3.138	Avg. Diam.=	1.389

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	20.2
Final Change (ml)	3.8

Initial Dial Reading (D.R.), mils	88
D.R. After Saturation, mils	94
D.R. After Consolidation, mils	124

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
8.5	0.000	31.0
13.5	0.001	32.8
14.3	0.002	33.0
16.3	0.004	33.4
17.2	0.007	33.9
18.9	0.016	34.9
19.4	0.020	35.2
20.0	0.025	35.6
21.0	0.038	36.1
21.5	0.051	36.6
22.4	0.070	37.0
22.9	0.085	37.2
23.4	0.101	37.4
23.7	0.110	37.4
23.8	0.132	37.5
24.5	0.158	37.6
25.1	0.181	37.7
26.0	0.205	37.7
26.2	0.236	37.7
26.4	0.259	37.8
26.2	0.290	37.7
26.4	0.314	37.8
26.7	0.338	37.8
26.9	0.370	37.8
26.5	0.410	37.8
27.9	0.441	37.8
28.0	0.488	37.8
28.2	0.527	37.8
28.1	0.566	37.8
28.5	0.605	37.8
28.4	0.661	37.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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R15409

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.1	*Stage No.*	1
		Test No	5

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.52
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.50
Length After Consolidation (in)	3.10
Area After Consolidation (in^2)	1.450

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma}_1$	$\overline{\sigma}_3$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	3.42	1.75	11.77	8.3	1.410	0.52	10.06	1.71
0.06	4.03	2.01	12.12	8.1	1.497	0.50	10.11	2.01
0.13	5.39	2.43	13.05	7.7	1.703	0.46	10.36	2.69
0.23	5.96	2.92	13.13	7.2	1.830	0.50	10.16	2.98
0.51	7.15	3.87	13.37	6.2	2.148	0.55	9.80	3.57
0.64	7.46	4.19	13.37	5.9	2.262	0.57	9.64	3.73
0.82	7.88	4.57	13.41	5.5	2.427	0.59	9.47	3.94
1.21	8.51	5.13	13.48	5.0	2.714	0.61	9.22	4.26
1.63	8.84	5.57	13.38	4.5	2.950	0.64	8.96	4.42
2.24	9.37	5.97	13.50	4.1	3.271	0.64	8.81	4.69
2.75	9.67	6.18	13.59	3.9	3.468	0.65	8.75	4.84
3.25	9.92	6.35	13.66	3.7	3.648	0.65	8.70	4.96
3.56	10.14	6.40	13.83	3.7	3.741	0.64	8.76	5.07
4.26	10.10	6.55	13.65	3.6	3.843	0.66	8.60	5.05
5.08	10.44	6.59	13.95	3.5	3.978	0.64	8.73	5.22
5.85	10.80	6.68	14.21	3.4	4.161	0.63	8.81	5.40
6.60	11.25	6.70	14.65	3.4	4.304	0.60	9.03	5.62
7.60	11.27	6.75	14.63	3.4	4.363	0.60	8.99	5.64
8.34	11.32	6.76	14.66	3.3	4.395	0.60	9.00	5.66
9.36	11.06	6.74	14.42	3.4	4.292	0.62	8.89	5.53
10.13	11.11	6.76	14.46	3.3	4.323	0.61	8.90	5.56
10.91	11.20	6.81	14.49	3.3	4.401	0.61	8.89	5.60
11.94	11.17	6.80	14.47	3.3	4.383	0.62	8.88	5.58
13.21	10.75	6.76	14.09	3.3	4.214	0.64	8.72	5.37
14.21	11.47	6.77	14.80	3.3	4.445	0.60	9.06	5.73
15.72	11.35	6.78	14.67	3.3	4.418	0.60	9.00	5.68
16.98	11.28	6.79	14.59	3.3	4.411	0.61	8.95	5.64
18.25	11.04	6.80	14.33	3.3	4.350	0.62	8.81	5.52
19.51	11.13	6.82	14.40	3.3	4.397	0.62	8.84	5.56
21.32	10.80	6.85	14.05	3.3	4.318	0.64	8.65	5.40

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	6

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.3
Eff. Cons. Pressure(ps	20.1
Pore Pressure Response (%)	97

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	19.19
Q	=	11.67

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.142	Diameter 1	1.379
Length 2	3.130	Diameter 2	1.377
Length 3	3.141	Diameter 3	1.386
Avg Leng.=	3.138	Avg. Diam.=	1.381

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	17.7
Final Change (ml)	6.3

Initial Dial Reading (D.R.), mils	40
D.R. After Saturation, mils	56
D.R. After Consolidation, mils	91

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
4.3	0.000	31.3
6.5	0.001	32.8
11.7	0.002	33.9
14.0	0.004	34.7
16.6	0.006	35.6
21.7	0.012	37.4
25.0	0.019	38.7
27.5	0.026	39.8
29.6	0.038	40.9
31.7	0.051	41.7
32.8	0.070	42.4
33.2	0.085	42.8
33.9	0.101	43.1
34.3	0.110	43.2
35.2	0.132	43.4
36.1	0.157	43.7
37.0	0.181	43.7
37.3	0.205	43.8
38.7	0.236	43.8
39.3	0.259	43.9
38.9	0.291	43.8
39.0	0.316	43.9
39.2	0.340	43.9
39.4	0.371	43.8
39.9	0.410	43.8
40.1	0.441	43.9
41.5	0.489	43.8
41.9	0.528	43.7
41.2	0.568	43.8
41.3	0.608	43.8
41.4	0.663	43.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.1	*Stage No.*	1
		Test No	6

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.24
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma}_1$	$\overline{\sigma}_3$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	1.58	1.52	20.16	18.6	1.085	0.99	19.37	0.79
0.07	5.38	2.62	22.86	17.5	1.308	0.50	20.17	2.69
0.12	7.06	3.36	23.80	16.7	1.422	0.49	20.27	3.53
0.19	8.92	4.30	24.73	15.8	1.565	0.50	20.26	4.46
0.40	12.65	6.12	26.62	14.0	1.905	0.50	20.30	6.32
0.61	14.97	7.35	27.72	12.7	2.174	0.51	20.23	7.48
0.85	16.72	8.47	28.36	11.6	2.438	0.52	19.99	8.36
1.24	18.18	9.56	28.72	10.5	2.724	0.54	19.63	9.09
1.64	19.63	10.41	29.32	9.7	3.025	0.55	19.51	9.81
2.26	20.24	11.15	29.19	9.0	3.262	0.57	19.07	10.12
2.77	20.44	11.54	29.00	8.6	3.388	0.58	18.78	10.22
3.26	20.87	11.82	29.15	8.3	3.521	0.58	18.71	10.43
3.58	21.09	11.94	29.25	8.2	3.584	0.58	18.70	10.54
4.27	21.54	12.14	29.50	8.0	3.705	0.58	18.73	10.77
5.09	21.97	12.38	29.69	7.7	3.846	0.58	18.71	10.99
5.86	22.37	12.43	30.04	7.7	3.918	0.57	18.85	11.19
6.64	22.41	12.54	29.98	7.6	3.962	0.58	18.77	11.21
7.63	23.10	12.49	30.71	7.6	4.034	0.56	19.16	11.55
8.39	23.33	12.58	30.85	7.5	4.102	0.56	19.19	11.67
9.43	22.79	12.55	30.34	7.6	4.018	0.57	18.95	11.39
10.22	22.67	12.59	30.18	7.5	4.021	0.57	18.84	11.34
11.00	22.61	12.56	30.14	7.5	4.001	0.57	18.84	11.30
12.01	22.49	12.53	30.05	7.6	3.973	0.57	18.81	11.24
13.28	22.46	12.52	30.04	7.6	3.961	0.57	18.81	11.23
14.28	22.30	12.63	29.77	7.5	3.986	0.58	18.62	11.15
15.84	22.80	12.50	30.40	7.6	4.001	0.57	19.00	11.40
17.12	22.66	12.41	30.35	7.7	3.948	0.56	19.02	11.33
18.40	21.92	12.46	29.57	7.6	3.868	0.59	18.61	10.96
19.69	21.62	12.51	29.21	7.6	3.846	0.60	18.40	10.81
21.49	21.21	12.54	28.77	7.6	3.805	0.61	18.17	10.61

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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MOHR TOTAL STRENGTH ENVELOPE

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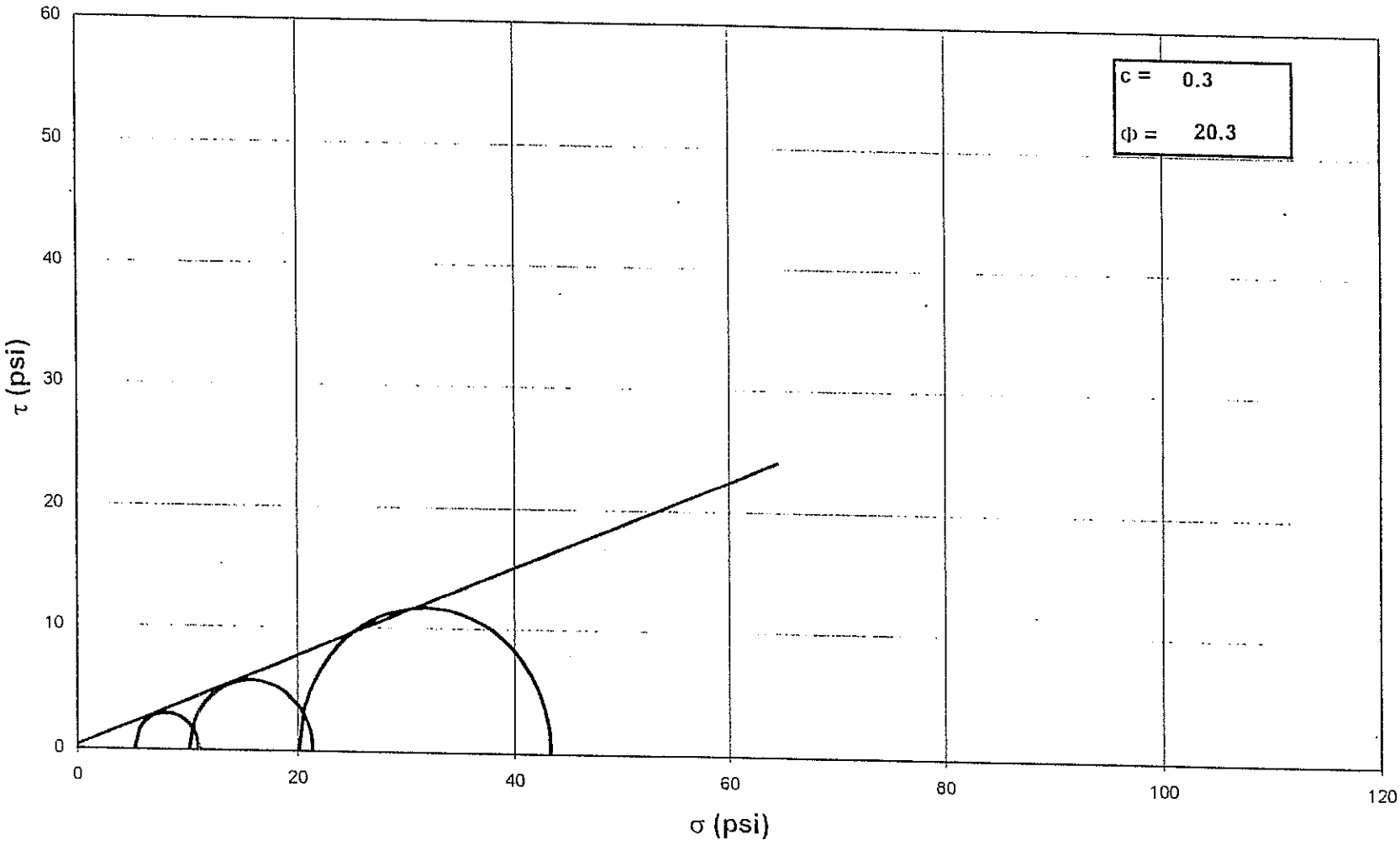
Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/14/08

#N/A

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R15412

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	82.9	85.7	83.0
Total Unit Weight (pcf)	82.6	82.2	84.5
Dry Unit Weight (pcf)	45.2	44.3	46.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	2.095	2.159	2.029

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-5-08

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INTEGRITY IN TESTING

UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	41.5	41.5	40.9
Total Unit Weight (pcf)	92.9	102.5	103.2
Dry Unit Weight (pcf)	65.7	72.4	73.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	1.129	0.931	0.910

Tested By JCM Date 05/27/08 Input Checked By Date

DCN: CT-S28 DATE 6-25-98 REVISION: 1

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REFERENCE 5 AND OTHER PERTINENT FINE COAL REFUSE DATA EFFECTIVE STRESS – TO – STEADY STATE STRENGTH RELATIONSHIPS

R15416

8114-10
Part 5

Tailing Dams 2000

PROCEEDINGS

Association of State Dam Safety Officials • U.S. Committee on Large Dams

March 28-30, 2000 • Las Vegas, Nevada

STEADY STATE LIQUEFACTION SUSCEPTIBILITY OF HIGH HAZARD UPSTREAM-CONSTRUCTED COAL REFUSE DISPOSAL FACILITIES

Blaise E. Genes[1], Thomas O. Keller, P.E.[2] and Joseph P. Laird, P.E.[3]

1.0 Introduction

Coal refuse disposal facilities are manifestations of deep mining and surface mining activities and the resulting need for the disposal of waste materials. Due to the massive volumes of materials produced annually by mining operations, these "tailings dams" are among the largest earth structures in the world and consequently, receive intense regulatory and public scrutiny. Coal refuse disposal facilities, their design, construction and operation are regulated by the U.S. Department of Labor, Mine Safety and Health Administration (MSHA). The concern for refuse disposal safety and environmental control by MSHA, the coal industry, engineering consultants and the public has led to the development of design procedures that address these concerns, particularly siting, material handling and placement techniques.

For the most part, tailings dams evaluations are similar to those of water retention dams and address geotechnical issues such as foundation materials, hydrology, hydraulics, seepage control, slope stability (static and seismic), construction practices and long-term monitoring. In the past, pseudo-static analyses were performed to address seismic stability using regional, historic seismic acceleration values and a slightly lowered factor of safety limit to assess adequacy. Empirical evaluations are sometimes performed to address seismic stability with adequacy based on comparison of limited field and laboratory test data with historical performance data of liquefaction and non-liquefaction sites from around the world. During the initial to intermediate stages of a refuse facility design, simplified analytical methods may be appropriate, such as those based on pseudo-static and cone penetration testing (CPT) or standard penetration testing (SPT). However, given the uniqueness and complexity of moderate to high hazard tailings dams, which are significantly influenced by factors such as the number and geometry of upstream stages, deposition history and cross-valley topography, simplified analyses are often inadequate to effectively address safety and cost issues. They often do not account for critical site-specific conditions and may either over-predict strengths leading to a potentially unconservative analysis or under-predict strengths leading to costly remediation efforts.

The focus of this paper is on the application of established steady-state liquefaction evaluation procedures to high hazard tailings dams, assessing liquefaction susceptibility using site-specific data to estimate the factor of safety against a liquefaction flow slide failure. A significant emphasis is placed on obtaining in-situ samples and developing

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properties of the hydraulically placed, fine coal refuse consolidated beneath multiple, upstream-constructed stages of coarse coal refuse. Detailed evaluations have been performed at five Appalachian coal refuse disposal facilities in southern West Virginia as part of the permitting process for the various facilities.

2.0 Analytical Approach

Coal refuse disposal facilities are generally constructed by three methods, either separately or in combination, and include upstream, downstream, and centerline construction. Downstream and centerline constructed facilities typically pose only minor liquefaction concerns since critical failure surfaces pass mainly through the compacted coarse refuse embankments. A typical high hazard, upstream constructed coal refuse facility, such as the one shown in Figure 1, is constructed over long periods of time (up to 25 to 30 years) to heights of 400-plus feet and includes multiple upstream stages "pushed out" into the previous stage's tailings pond. Fine coal refuse consolidated under upstream stages typically is loose to very loose, silty sand to sandy silt- and clay-sized particles, saturated and usually highly contractive. Thus, the potential exists for excess pore pressure generation and significant loss of strength during and following a rapid (undrained) loading event, such as an earthquake.

All five facilities evaluated and discussed in the context of this paper were all moderate to high hazard structures with downstream toe to crest heights varying from 300 to 440 feet. Detailed studies of liquefaction susceptibility were performed using the methodology presented by Poulos, Castro, and France (1985) to estimate in-situ void ratio and undrained steady-state strength of the critical layer, fine coal refuse. Presented below are the generalized results of field and laboratory testing at the various sites. Field testing included performing fixed-piston undisturbed sampling to measure in-situ void ratio and piezo-seismic cone penetration testing (PS-CPT) to evaluate stratigraphy and estimate shear wave velocity with depth. Laboratory strength testing of undisturbed, remolded and slurry fine coal refuse samples was performed to estimate in-situ, undrained steady-state shear strength (S_{us}) and develop a site-specific S_{us}-to-effective stress relationship.

Liquefaction susceptibility was assessed based on the results of limit-equilibrium slope stability analyses. Post-earthquake deformations were estimated using one-dimensional wave propagation and sliding block analysis techniques and the results compared to the available freeboard to assess the likelihood of overtopping. Based on the regional database of information related to S_{us}, various trends regarding the general behavior of fine coal refuse during undrained loading and the practical implications affecting liquefaction susceptibility of upstream-constructed coal refuse impoundments are discussed. Detailed discussions regarding post-earthquake deformation analyses and the seismic response of coal refuse facilities to acceleration time-histories from stochastic simulations of eastern North America earthquakes are reserved for another paper.

3.0 Field Investigations

Fixed Piston Sampling

The main purpose of the subsurface exploration program at the various sites was to obtain high quality "undisturbed" fine coal refuse samples of a character suitable for

laboratory steady-state strength testing. Multiple undisturbed samples were obtained at each site at various depths using a hydraulically actuated Gregory Undisturbed Sampler (GUS) fixed piston sampler. The GUS fixed piston sampler was used to advance a thin-wall galvanized steel sampling tube by delivering drilling fluid pressure to the top of the sampler, which subsequently advanced the tube around a fixed piston. Penetration of the tube into the soil was accurately measured to within ½ to 1 millimeter when "full penetration" of the sampler was achieved. Full penetration of the sampling tube was confirmed by observation of the fluid level in the borehole casing which would dramatically rise when fluid pressure applied to the top of the sampler vented through ports in the sampler. The technique used for undisturbed fixed piston sampling allowed samples to be obtained to depths as great as 344 feet below the ground surface.

Detailed measurements of the tube inside, outside and cutting edge diameters and length were made and volume changes that occurred during sampling calculated in the field from tube penetration and sample recovery measurements. Samples were selected for subsequent laboratory testing based on the quality of the "undisturbed" sample using a criteria for the change in soil volume ($\Delta V/V$). For the fine coal refuse, minimizing the tube clearance ratio [(ID-CE)/CE] minimized sample volume changes, which typically ranged from zero to 2.5 percent. All undisturbed samples were stored in specially designed padded wooden boxes and changes in volume routinely monitored during storage and prior to and following shipment. Prior to laboratory testing, the tube samples were x-rayed and reviewed to select portions of the sample that had a minimum amount of stratification.

Piezo-Seismic/Cone Penetrometer Testing

PS-CPT soundings were performed prior to or concurrently with undisturbed sampling to help delineate the depth to the top and bottom of fine coal refuse. As shown in Figure 2, fine coal refuse layers are characterized by significantly lower tip stresses and elevated pore pressure generation, while the coarse and coarse-fine mix typically yield much higher tip stresses and lower pore pressure generation. Using seismic downhole techniques, estimates of shear wave velocity were obtained at each site to correlate small strain shear modulus (G) with depth. These tests were generally conducted at 5-foot intervals throughout the soil profile to depths of 365 feet at one site. Shear wave velocities for coarse, coarse-fines mix and fine coal refuse ranged from about 1,000 to 2,300 feet per second (fps), 800 to 2,000 fps and 800 to 1,200 fps, respectively. These velocities were based on data from 14 PS-CPT soundings. Velocities varied dramatically with depth, consistent with variations in placement techniques and the micro-layering associated with the deposition history of the facility.

Stratification

Much of the coarse refuse embankment drilled and sampled was dense to very dense as expected due to the structural placement of the material. Loose deposits of fine coal refuse were typically encountered below a dense mixed zone of coarse and fine coal refuse. The fines were characterized by corrected cone tip resistance values between 300 to 1,000 pounds per square inch (psi). The CPT soundings (and visually verified in SPT samples) have shown that there are significantly thick zones of mixed coarse and fine coal refuse. Mixing apparently occurred during the various push-out phases of upstream embankment construction into the tailings pond and possibly from the "pumping" of fines

up into the coarse refuse during subsequent stage construction. Due to the infusion of coarse refuse into the fines, the mix zones typically exhibited significantly higher average cone tip resistance, as well as lower pore pressure generation during cone advancement.

In-Situ Void Ratio

A total of 34 undisturbed fine coal refuse samples were obtained from the various sites. In-situ void ratio was calculated for each based on the field measurements described previously combined with laboratory measurements of the volume of solids in the tube. Table 1 presents a summary of sample depth and calculated in-situ void ratio at each site. Samples were obtained from beneath about 65 to 344 feet of overlying refuse and in-situ void ratios varied from about 0.39 to 0.79, with most (82 percent) of the values between 0.43 and 0.59. While in-situ void ratio is influenced by mean effective stress and time rate of consolidation, the range of values is relatively narrow. Direct correlation between estimated mean effective stress and in-situ void ratio can not be inferred due to the unique and complex nature of each site's geometric constraints and deposition history.

4.0 Laboratory Testing

Steady-state liquefaction-related laboratory test programs of the coal refuse materials sampled from the five sites included performing index tests such as grain size distributions, Atterberg limits, and specific gravity, as well as triaxial shear strength tests on undisturbed, remolded and slurry samples of fine coal refuse. Table 1 presents a summary of laboratory test results from Sites 1 through 5.

Index Tests

Fine coal refuse particles vary in size from about 2 mm (No. 10 sieve) to 0.0005 mm (finer than clay fraction). It is analogous to silty sand to silty clay-sized material. Fines content (passing a No. 200 sieve) for fine coal refuse from the five sites varied from 35 to 76 percent. Fine refuse generally has a low plasticity, ranging from nonplastic to Plasticity Indices of 12 percent or less. Values are affected by the parent rock formation from which the coal was extracted and from clay layers near the coal seam that get mixed within the coal. The specific gravity of fine coal refuse is low and generally varied from about 1.4 to 2.4 for the sites tested. As a result, densities are also relatively low, with in-place total unit weight ranging from about 75 to 90 pounds per cubic foot (pcf).

Steady-State Strength Of Undisturbed Samples

Isotropically consolidated, undrained triaxial compression ($\overline{CU}$) tests were performed on undisturbed, remolded and slurry samples of fine coal refuse. The main purpose of the triaxial tests was to measure the undrained steady-state shear strength of the samples in the laboratory to allow in-situ steady-state shear strengths to be estimated based on void ratio corrections (from laboratory to field). A total of 34 $\overline{CU}$ tests were performed on undisturbed samples of fine coal refuse from the five sites. Specimens were typically consolidated to an isotropic, effective consolidation stress ($\bar{\sigma}_{3c}$) ranging from 8 to 16 kilograms per square centimeter (kg/cm^2) [16.3 to 32.7 kips per square foot (ksf)]. These relatively high confining pressures were used to ensure contractive behavior,

particularly since most samples were obtained from 200 to 344 feet below the ground surface. The samples exhibited contractive behavior and reached or approximately reached a steady-state of deformation within the strain limits of the test. Laboratory values of S_{us} were corrected to represent steady-state strengths at in-situ void ratios.

Steady-State Line and In-Situ Steady-State Strength

Triaxial tests were performed on compacted specimens to determine the steady-state line (SSL) of the fine coal refuse representative for each site. Samples of each batch mix were formed using two methods: 1) by placing layers of fine coal refuse in a split mold and compacting each layer to a target void ratio; and 2) by placing the material in a mold as a slurry subject to one-dimensional consolidation to simulate in-situ placement conditions. The various SSL's for each batch mix are shown in Figure 3 where the slope ($\Delta e/\Delta \log S_{us}$) varies from 0.11 to 0.13 for moist tamped batch samples with additional slurry prepared samples of the batch mix shown for comparison. As discussed by Poulos et. al (1985), the slope of the steady state line is dependent on the shape of the grains and the vertical position is affected by slight differences in grain-size distribution. In general, the variation of the fine refuse coal particle shape from site to site would not be expected to vary significantly since the coal was mined from the same region using generally similar cleaning techniques. However, the fines content of the coal refuse sampled from the region varies widely. Thus, the SSL's in Figure 3 are consistent with the above observations.

In-situ S_{us} for each site was estimated by "correcting" the steady-state strengths at laboratory void ratios to their respective in-situ void ratio along the slope of the SSL as defined by Poulos et. al (1985). In-situ S_{us} values ranged from 0.06 to 4.62 kg/cm^2 (0.122 ksf to 9.42 ksf) with 74 percent of the data falling between 0.25 and 2.1 kg/cm^2 (0.51 ksf to 4.28 ksf). Figure 4 presents correlated S_{us} versus in-situ void ratio for 34 tested samples at the 5 sites. Note that S_{us} values can vary by more than a factor of 10 for a given void ratio.

S_{us} Versus Effective Stress Relationship

The estimation of S_{us} values for fine coal refuse layers that are at in-situ conditions different from the samples obtained and tested were estimated using a correlation between S_{us} and effective vertical stress (σ'_v) determined for each site. This includes proposed upstream stages where sampling is not yet feasible or existing portions of the embankment not sampled due to budgetary constraints. By generally assuming that S_{us} values vary linearly with σ'_v, and estimating the in-situ effective stress conditions for proposed layers of fine coal refuse, the in-situ S_{us} values for the proposed additional zones of fine coal refuse can be approximated. Site-specific S_{us}/σ'_v relationships are presented in Figure 5 and varied from 0.06 to 0.27. The various relationships were approximated by conservatively drawing a line from zero through the location at which two-thirds of the data points at a particular site lie above the line.

The lowest strength relationship was achieved at a narrow valley fill with over 200 feet of coarse and mixed refuse placed above the fine coal refuse. It is deduced that significant arching may be occurring within the coarse refuse preventing the full height of

overburden from consolidating the critical fine coal refuse layer. Therefore, factors such as cross-valley topography and deposition history are significantly relevant to the S_{us}/σ'_v relationship. Similarly, the database of S_{us}/σ'_v relationships obtained from bulk fine coal refuse samples prepared as slurried samples may be used to investigate what kind of relationship with depth (or effective stress) may be expected in the slurry pond prior to any encroachment of coarse embankments. The effective consolidation stresses at which the laboratory tests were performed were converted into equivalent vertical effective stresses in the field, assuming that the lateral stresses are equal to one-half of the vertical stresses. As shown in Figure 6, an S_{us}/σ'_v ratio of 0.18 extends from the zero intercept to the point where two-thirds of the data falls above the straight line.

5.0 Liquefaction Susceptibility Evaluations

Liquefaction susceptibility depends on the S_{us} of all the soils along the potential failure surface compared to the driving stress along that failure surface. Zones of loose (contractive) cohesionless soils are critical to analyzing liquefaction potential because they can have an undrained strength that is significantly lower than their drained strength. Therefore, the embankment geometry was evaluated to assess the liquefaction potential of each stage of construction estimating the average driving shear stresses along the critical failure surface at each of the high hazard sites. Generally, as the construction of future upstream staging progresses, there is a corresponding increase in driving stress. For layers in which fixed-piston samples were obtained and tested, or layers where similar effective stresses are present, a weighted average of steady-state strength, such as the Two-Thirds Strength Method, was utilized. This method, utilized by Castro et. al. (1989) and recommended by the U.S. Army Corps of Engineers (1970) in their manual for analyzing the stability of earth dams, involves using a design shear strength value that is lower than two-thirds of the total test values selected. S_{us} values for fine coal refuse layers at in-situ σ'_v values that significantly differ from the σ'_v values at sample locations were estimated using the site specific S_{us}/σ'_v relationship as previously discussed. Limit equilibrium slope stability analyses were performed at each site with S_{us} values applied to fine coal refuse layers and frictional (drained) strengths applied to coarse and mixed refuse layers. Factors of safety against liquefaction (F_L) along the critical failure surfaces for the various sites ranged from 1.02 to 1.32.

6.0 Notable Trends From Completed Studies

Liquefaction evaluations have been performed at five different sites using steady-state techniques as well as other complementary analyses. Since most of the sites are in the same geographical region, it is useful to compare the results of the fine coal refuse tested to identify trends in its engineering properties. A discussion of notable trends for the presented data is discussed below.

1. Consistent with the sensitivity of S_{us} to void ratio, S_{us} values can vary over 10 times at the same void ratio illustrating the need for site specific testing. In-situ void ratios varied between 0.39 and 0.79, however, most ranged from 0.43 to 0.59.

2. In-situ S_{us} values for unsampled fine coal refuse layers can be estimated based on S_{us} versus σ'_v correlations developed for a particular site. S_{us}/σ'_v relationships used for the coal refuse impoundment sites have ranged from 0.06 to 0.27 also illustrating the need for site specific testing, particularly at facilities with proposed multiple upstream stages.
3. S_{us} and S_{us}/σ'_v are significantly influenced by factors such as cross-valley topography, deposition history, upstream embankment geometry and construction sequencing.

7.0 Conclusions

Steady-state methodology can be effectively applied for the detailed evaluation of the liquefaction susceptibility of high hazard coal refuse disposal facilities. The evaluation needs to be based on site specific geometry and subsurface conditions, and properties developed accounting for the uniqueness and complexity of each site. While it is often useful to express the steady-state strength with respect to an estimated vertical stress, proper caution should be exercised during its development. The database of slurried samples has shown that the behavior of newly deposited fine coal refuse can be reasonably predicted. The S_{us}/σ'_v ratio of fine coal refuse consolidated beneath multiple upstream embankment stages can vary significantly with age, loading history, arching, and geometric constraints. For initial or preliminary liquefaction assessments, it is recommended that a range of S_{us}/σ'_v ratios be used to investigate the sensitivity of the critical layer to liquefaction susceptibility. For detailed evaluations where significant driving stresses are present for multiple upstream stages, site-specific shear strength testing of high quality undisturbed samples is recommended to develop the site's S_{us}/σ'_v relationship and each individual stage evaluated to estimate the factor of safety against liquefaction susceptibility. In general, factors of safety against liquefaction susceptibility were above 1.0 for the existing and proposed staging at the various high hazard sites. Factors of safety below 1.0 indicated the need for remedial design of existing embankments or redesign of the staging for proposed expansions to lower driving stresses.

References

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Table 1: Summary of Strength and In[illegible]sts Performed on Fine Coal Refuse Samples

					Field Data			Laboratory Data												
												(CU) Triaxial Results at Peak			Consolidated-Undrained (CU) Triaxial Results at Steady-State (SS)					
Site No.	Sample Type	Percent Passing No. 200 Sieve	PI %	Specific Gravity	Depth to Top of Sample, Feet	Estimated In-Situ Vert. Effective Stress, kg/cm²	Void Ratio In-Situ (Sampled)	Void Ratio In Tube/Mold	Void Ratio During Shear	Lab Effective Consol Stress, kg/cm²	Estimated Equiv. Vert. Effect. Stress In Field [1], kg/cm²	Shear Stress at Peak, q, kg/cm²	Axial Strain, %	Peak Friction Angle	Shear Stress at SS, q, kg/cm²	Minor Principal Stress, kg/cm²	Axial Strain, %	Undrained SS Strength Sus, kg/cm²	SS Friction Friction Angle	Sus at In-Situ Void Ratio, kg/cm²
1	FP	29.4	NA	2.28	90.7	3.45	0.494	0.497	0.402	8.00	12.00	2.70	12.5	34.6	2.68	2.15	17.8	2.23	33.7	0.44
	FP	40.4	NA	2.02	70.3	3.19	0.511	0.515	0.397	8.00	12.00	2.81	12.2	34.7	2.71	2.22	22.6	2.26	33.4	0.19
	FP	44.7	NA	2.37	80.8	3.30	0.488	0.489	0.390	8.00	12.00	2.79	13.2	35.3	2.59	2.17	25.8	2.17	32.9	0.42
	FP	43.6	NA	1.94	75.8	3.25	0.496	0.502	0.384	8.00	12.00	3.38	16.0	33.7	3.20	2.93	22.8	2.79	32.0	0.63
2	FP	47.2	NP	1.76	100.3	4.61	0.565	0.567	0.443	8.00	12.00	3.60	17.9	35.3	3.36	2.75	24.5	2.81	33.4	0.36
	FP	38.8	7	2.01	105.8	4.68	0.460	0.462	0.414	8.00	12.00	3.20	15.1	34.2	3.00	2.65	24.4	2.54	32.1	1.30
	FP	83.9	11	1.63	65.0	4.10	0.553	0.543	0.454	8.00	12.00	2.95	14.2	32.7	2.89	2.58	22.8	2.45	31.9	0.53
	FP	87.0	4	1.64	75.5	4.27	0.541	0.529	0.421	8.00	12.00	3.41	16.7	34.1	3.29	2.78	23.3	2.77	32.8	0.38
1 & 2	BM	34.7	NP	1.98	NA	NA	NA	0.732	0.390	4.00	8.00	0.99	1.6	24.7	0.90	0.61	26.6	0.80	32.8	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.745	0.331	10.00	15.00	2.39	1.8	25.2	2.42	2.03	25.2	2.03	32.9	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.975	0.455	1.00	1.50	0.23	1.2	23.6	0.16	0.14	26.3	0.15	34.1	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.973	0.433	2.00	3.00	0.46	1.3	23.2	0.41	0.35	23.0	0.34	32.9	NA
3	FP	97.7	NA	1.88	310.5	11.02	0.514	0.562	0.510	16.10	24.15	5.07	6.3	30.1	5.07	5.64	6.3	4.91	30.1	4.65
	FP	70.5	NA	1.69	269.5	10.07	0.444	0.480	0.424	16.20	24.30	5.40	7.3	28.1	5.21	5.13	16.5	4.62	27.4	3.15
	FP	78.7	NA	1.85	329.4	11.17	0.443	0.482	0.439	16.10	24.15	5.87	9.4	29.8	5.69	5.12	18.1	4.89	28.8	4.62
	FP	91.7	11	1.88	343.3	11.62	0.641	0.605	0.545	12.00	18.00	4.87	10.2	30.9	4.81	4.68	18.0	4.14	30.5	4.47
	FP	66.6	NA	1.61	290.8	10.65	0.692	0.568	0.485	12.00	18.00	6.67	16.7	33.7	6.57	6.27	16.7	5.47	33.7	0.85
	FP	21.3	NA	1.49	276.8	10.37	0.789	0.790	0.681	8.00	12.00	3.77	19.8	35.0	3.77	2.81	19.8	3.09	35.0	0.06
3	BM	70.1	8	1.80	NA	NA	NA	0.513	0.363	16.20	24.30	5.44	10.3	29.7	5.44	5.56	19.7	4.72	29.7	NA
	BM	70.1	8	1.80	NA	NA	NA	0.483	0.390	8.00	12.00	3.08	20.3	31.2	3.08	2.84	20.3	2.61	31.2	NA
	BM	70.1	8	1.80	NA	NA	NA	0.633	0.479	2.00	3.00	0.65	16.8	33.4	0.65	0.53	16.8	0.54	33.4	NA
	BM	70.1	8	1.80	NA	NA	NA	0.616	0.456	3.00	4.50	1.00	18.5	33.0	1.00	0.83	16.5	0.84	33.0	NA
	BM/S	70.1	8	1.80	NA	NA	NA	1.270	0.407	7.00	10.50	2.31	12.8	32.2	2.31	2.02	12.8	1.95	32.2	NA
	BM/S	37.0	4	2.29	NA	NA	NA	1.070	0.362	7.00	10.50	2.52	17.9	33.4	2.52	2.06	17.9	2.10	33.4	NA
	BM/S	23.6	NA	1.48	NA	NA	NA	0.840	0.504	7.00	10.50	3.71	19.7	35.2	3.71	2.72	19.7	3.03	35.2	NA
4	FP	24.9	NA	1.45	210.0	7.47	0.657	0.695	0.517	12.00	18.00	4.74	19.9	36.1	4.74	3.30	19.9	3.83	36.1	1.78
	FP	15.7	NA	1.46	222.2	7.68	0.640	0.571	0.468	12.00	18.00	4.85	18.7	36.2	4.85	3.45	18.7	3.91	36.2	0.95
	FP	72.0	NA	1.76	135.5	5.49	0.486	0.520	0.466	8.00	12.00	3.41	13.9	33.3	3.37	2.89	18.2	2.84	32.6	1.60
	FP	39.1	NA	1.58	150.2	5.75	0.389	0.400	0.360	8.00	12.00	3.02	14.1	35.2	3.00	3.00	17.6	3.24	33.9	1.80
	FP	71.3	NA	1.70	170.2	6.08	0.467	0.498	0.448	8.00	12.00	3.85	17.3	33.6	3.84	3.30	18.9	3.24	32.5	2.16
	FP	81.9	NA	1.65	218.3	7.74	0.491	0.619	0.453	12.00	18.00	4.94	14.2	33.8	4.89	4.17	17.7	4.11	32.7	1.88
	FP	72.7	NA	1.71	223.3	7.83	0.485	0.482	0.415	12.00	18.00	4.75	13.1	32.4	4.60	4.23	18.3	3.93	31.4	1.50
	FP	75.8	NA	1.73	213.2	7.65	0.484	0.507	0.428	12.00	18.00	5.06	12.8	35.2	4.68	3.77	19.7	3.90	33.6	1.33
4	BM	75.1	12	1.72	NA	NA	NA	0.575	0.410	8.00	12.00	2.09	20.8	32.4	2.82	2.58	18.0	2.47	32.3	NA
	BM	75.1	12	1.72	NA	NA	NA	0.795	0.450	4.00	6.00	1.41	17.3	33.2	1.42	1.18	18.0	1.19	33.0	NA
	BM	75.1	12	1.72	NA	NA	NA	0.804	0.387	11.90	17.85	4.31	19.3	31.8	4.28	3.86	18.0	3.63	31.6	NA
	BM	75.1	12	1.72	NA	NA	NA	0.805	0.481	2.00	3.00	0.66	21.4	32.8	0.62	0.53	18.0	0.52	32.8	NA
	BM/S	75.1	12	1.72	NA	NA	NA	NA	0.455	5.00	7.50	1.88	19.0	34.3	1.85	3.48	18.0	1.65	33.3	NA
	BM/S	52.2	4	1.56	NA	NA	NA	NA	0.380	6.00	7.50	2.48	23.4	37.2	2.48	1.81	23.4	2.02	35.3	NA
5	FP	81.0	NA	1.77	219.9	9.54	0.562	0.580	0.480	12.00	18.00	4.43	10.9	32.9	4.14	3.76	22.2	3.53	31.6	0.63
	FP	48.8	NA	1.64	234.3	9.72	0.546	0.561	0.448	12.00	18.00	5.34	18.7	35.6	5.33	3.86	17.3	4.34	35.4	0.53
	FP	90.5	NA	1.96	250.0	9.93	0.560	0.586	0.505	12.00	18.00	4.33	8.7	28.9	4.22	4.62	13.9	3.71	28.5	1.16
	FP	87.0	NA	1.79	188.3	8.53	0.522	0.515	0.448	12.00	18.00	4.68	8.5	32.8	4.23	3.98	20.7	3.62	31.0	0.64
	FP	88.9	NA	1.96	194.0	8.81	0.658	0.665	0.547	12.00	18.00	4.00	3.5	26.7	3.97	4.70	4.0	3.53	27.1	0.33
	FP	35.5	NA	1.55	233.3	11.02	0.609	0.525	0.421	12.00	18.00	4.63	20.3	35.6	4.63	3.35	20.3	3.77	35.5	0.59
	FP	22.5	NA	1.41	241.0	11.12	0.547	0.551	0.483	12.00	18.00	4.56	20.5	33.7	4.56	3.67	20.8	3.79	33.7	0.98
	FP	34.4	NA	1.54	180.4	8.67	0.626	0.608	0.444	12.00	18.00	4.37	19.6	35.5	4.38	3.21	21.6	3.57	35.1	0.08
	FP	79.5	NA	1.87	165.0	8.05	0.612	0.600	0.448	12.00	18.00	4.37	9.0	32.0	4.01	3.88	21.3	3.46	30.5	0.11
	FP	74.0	NA	1.88	183.3	8.48	0.618	0.598	0.450	12.00	18.00	5.12	8.8	33.7	4.78	4.20	19.4	4.05	32.1	0.12
	FP	80.7	NA	1.68	200.4	10.13	0.562	0.575	0.466	12.00	18.00	4.04	11.0	33.8	3.85	3.21	21.7	3.23	33.0	0.43
	FP	25.5	NA	1.57	210.3	10.63	0.588	0.599	0.460	12.00	18.00	4.88	17.9	36.3	4.75	3.65	24.4	3.90	34.0	0.26
5	BM	62.0	9	1.70	NA	NA	NA	0.545	0.401	8.00	12.00	2.56	19.2	32.9	2.56	2.17	19.2	2.15	32.7	NA
	BM	62.0	9	1.70	NA	NA	NA	0.544	0.473	2.00	3.00	0.58	20.2	34.6	0.58	0.48	20.3	0.48	33.9	NA
	BM	62.0	9	1.70	NA	NA	NA	0.648	0.512	1.00	1.50	0.29	1.7	35.2	0.27	0.21	19.8	0.22	33.7	NA
	BM/S	62.0	9	1.70	NA	NA	NA	0.753	0.358	6.50	9.75	2.32	19.6	32.0	2.32	2.10	19.6	1.98	31.6	NA
	BM/S	85.1	NP	1.88	NA	NA	NA	NA	0.533	6.50	9.75	3.08	18.3	34.8	3.08	2.32	18.3	2.53	34.8	NA

NOTES: FP - Fixed Piston, Undisturbed Sample
BM - Reconstituted Batch Mix Sample Prepared by Moist Tamping
[1] K_o = 0.6 (Ratio of Horizontal to Vertical Effective Stress)

BM/S - Reconstituted Batch Mix Sample Prepared as Slurry
NA - Not Applicable

NP - Non-Plastic
PI - Plasticity Index

$q = (\sigma_1 - \sigma_3) / 2$

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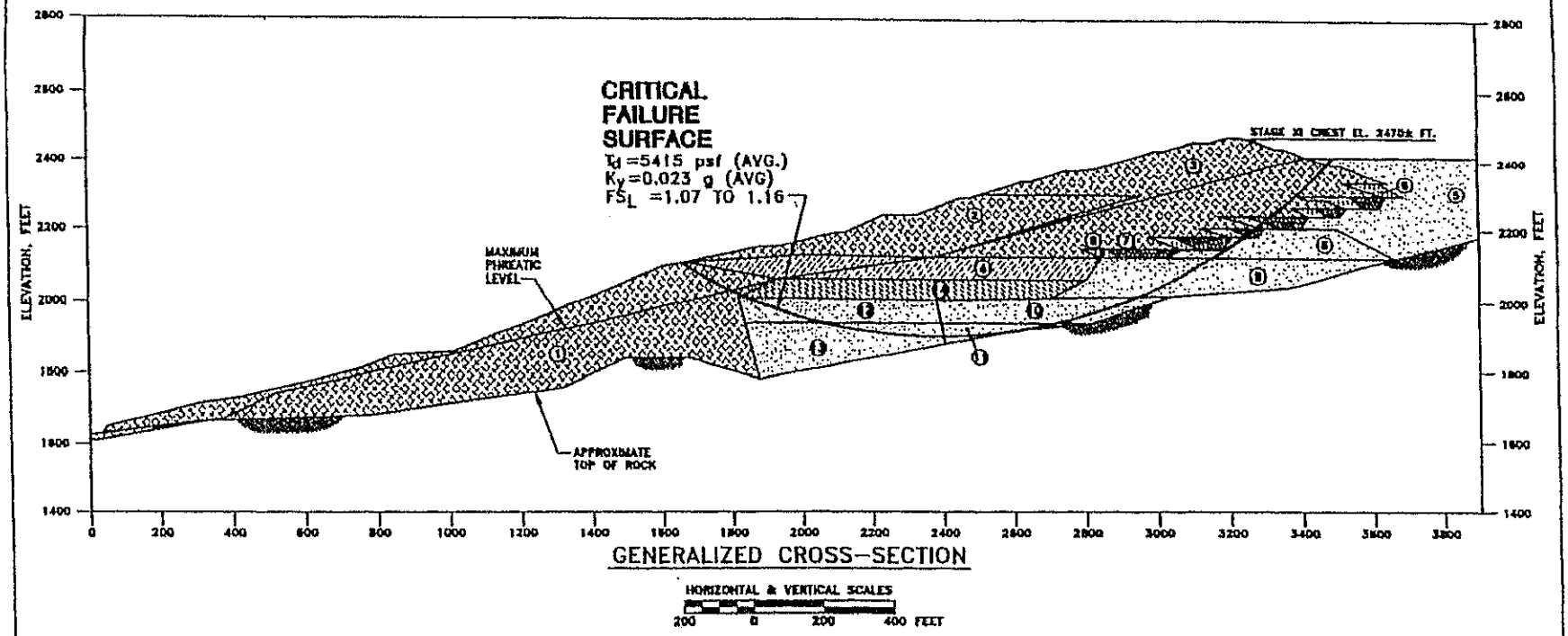


GENERALIZED CROSS-SECTION

HORIZONTAL & VERTICAL SCALES

200 0 200 400 FEET

LEGEND:

T_d (AVG.)	AVERAGE IN-SITU STATIC DRIVING SHEAR STRESS	FINE COAL REFUSE
K_y (AVG.)	AVERAGE YIELD ACCELERATION	FINE COAL REFUSE (BEACHED ZONES)
FS_L (AVG.)&(MAX.)	AVERAGE AND MAXIMUM FACTORS OF SAFETY AGAINST LIQUEFACTION	MIXED COARSE AND FINE COAL REFUSE
①	MATERIAL LAYER NO.	COARSE COAL REFUSE
		COMBINED COAL REFUSE
		MIXED COMBINED AND FINE COAL REFUSE

ALMES & ASSOCIATES, INC.
CONSULTING ENGINEERS
BECKLEY, WV
PITTSBURGH, PA

FIGURE 1
GENERALIZED CROSS-SECTION AND LIQUEFACTION SUSCEPTIBILITY EVALUATION SUMMARY

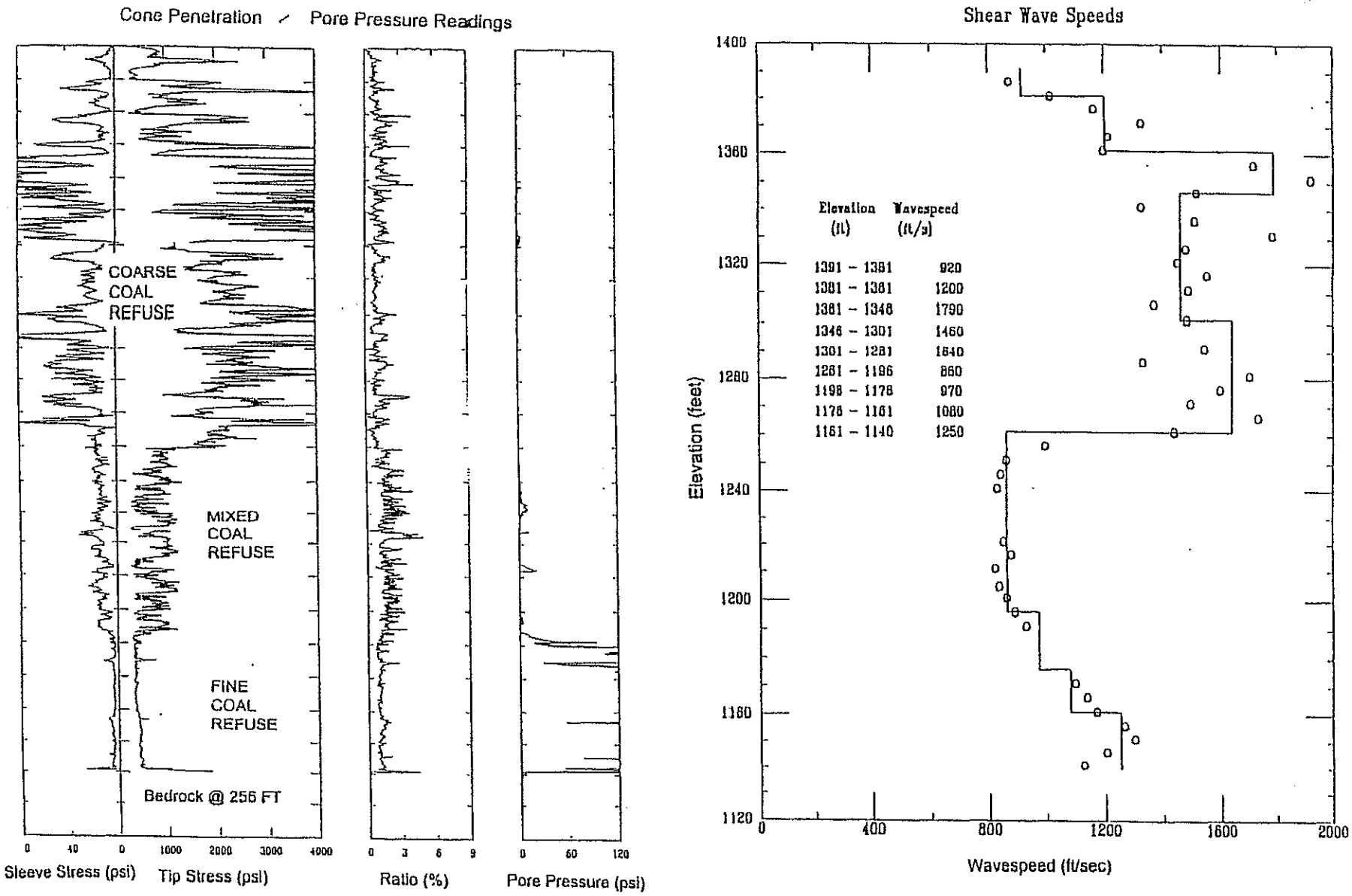


Figure 2 – CPT Log and Shear Wave Velocity Profile

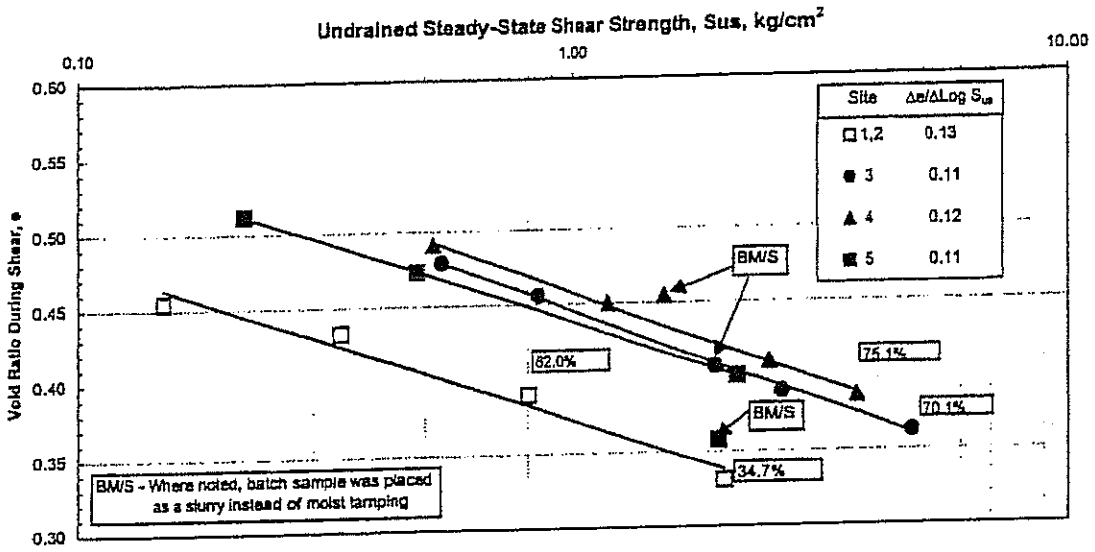


FIGURE 3 - Steady State Lines of Fine Coal Refuse Batch Samples

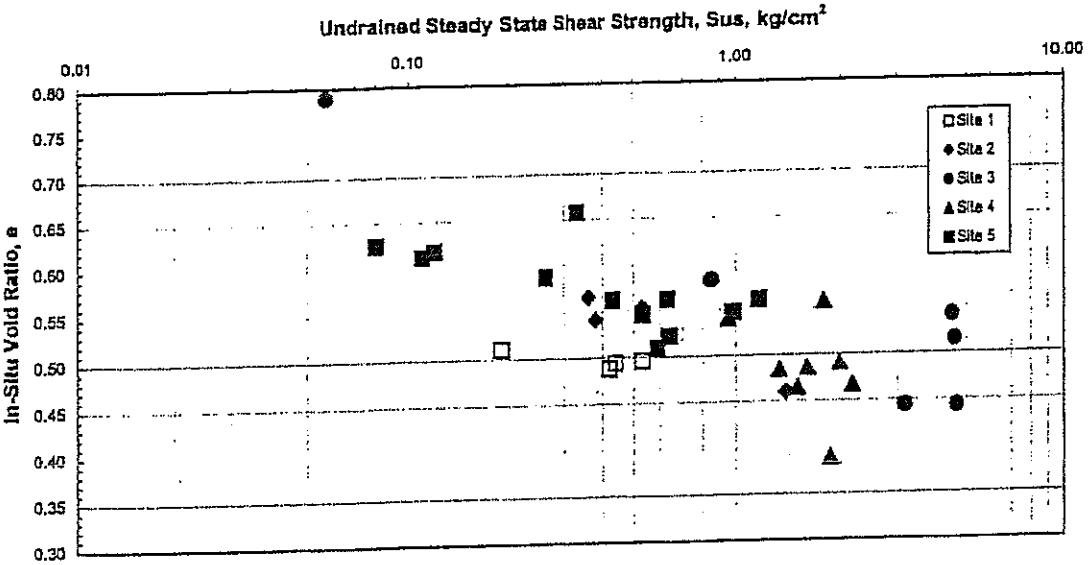


FIGURE 4 - S_{us} of Fixed Piston Samples at In-Situ Void Ratio, After Correction of Lab Void Ratio

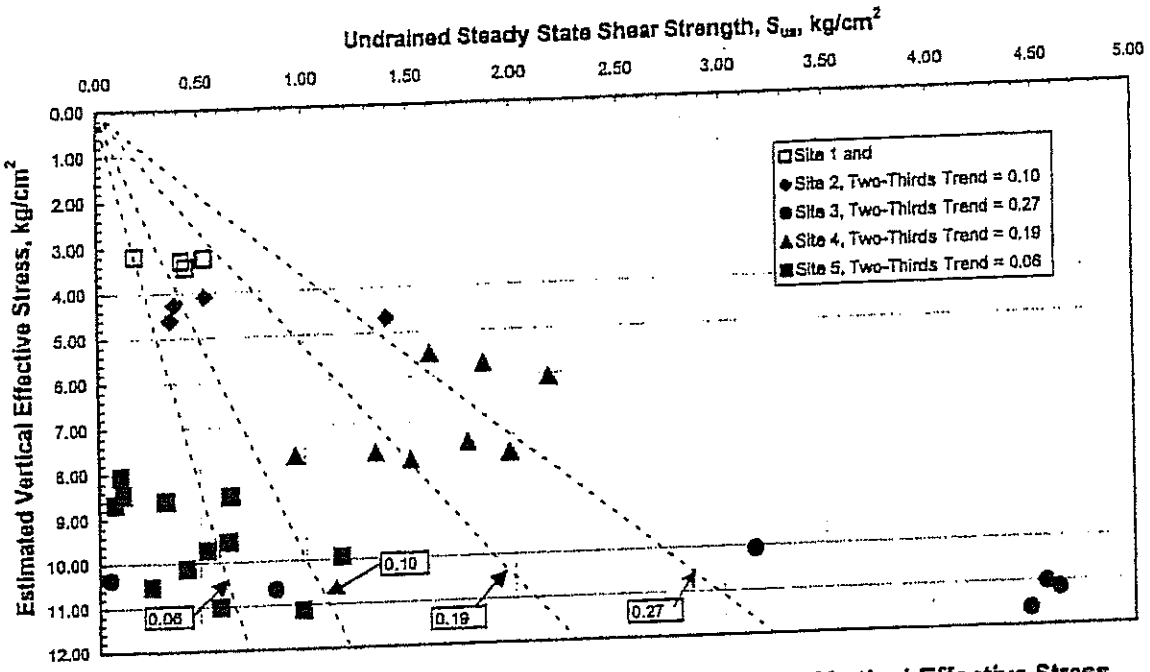


FIGURE 5 - S_{us} of Fixed Piston Samples Versus Estimated Vertical Effective Stress

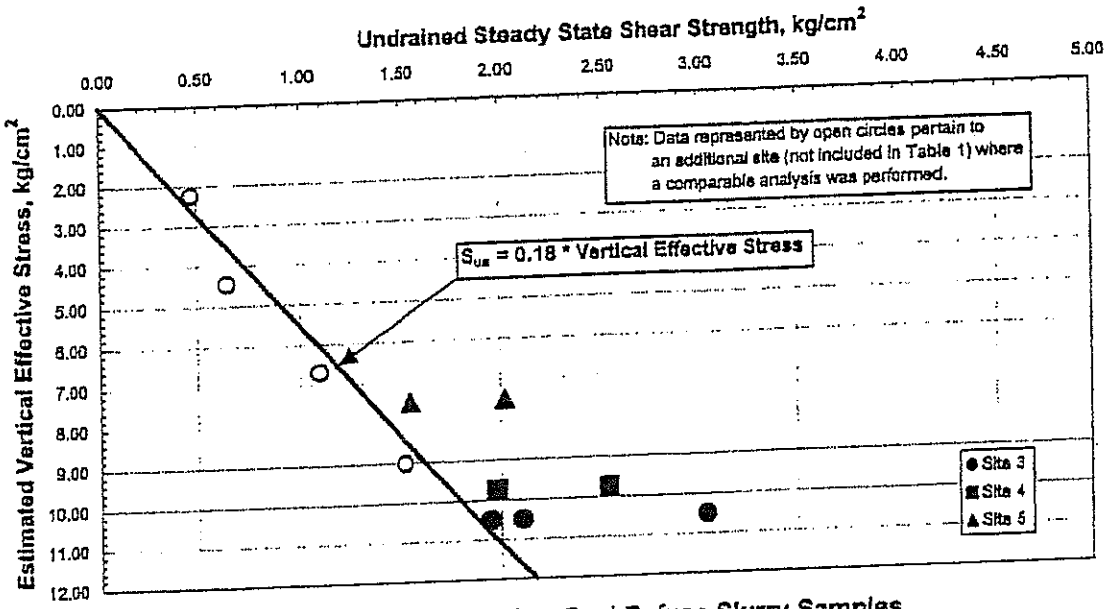
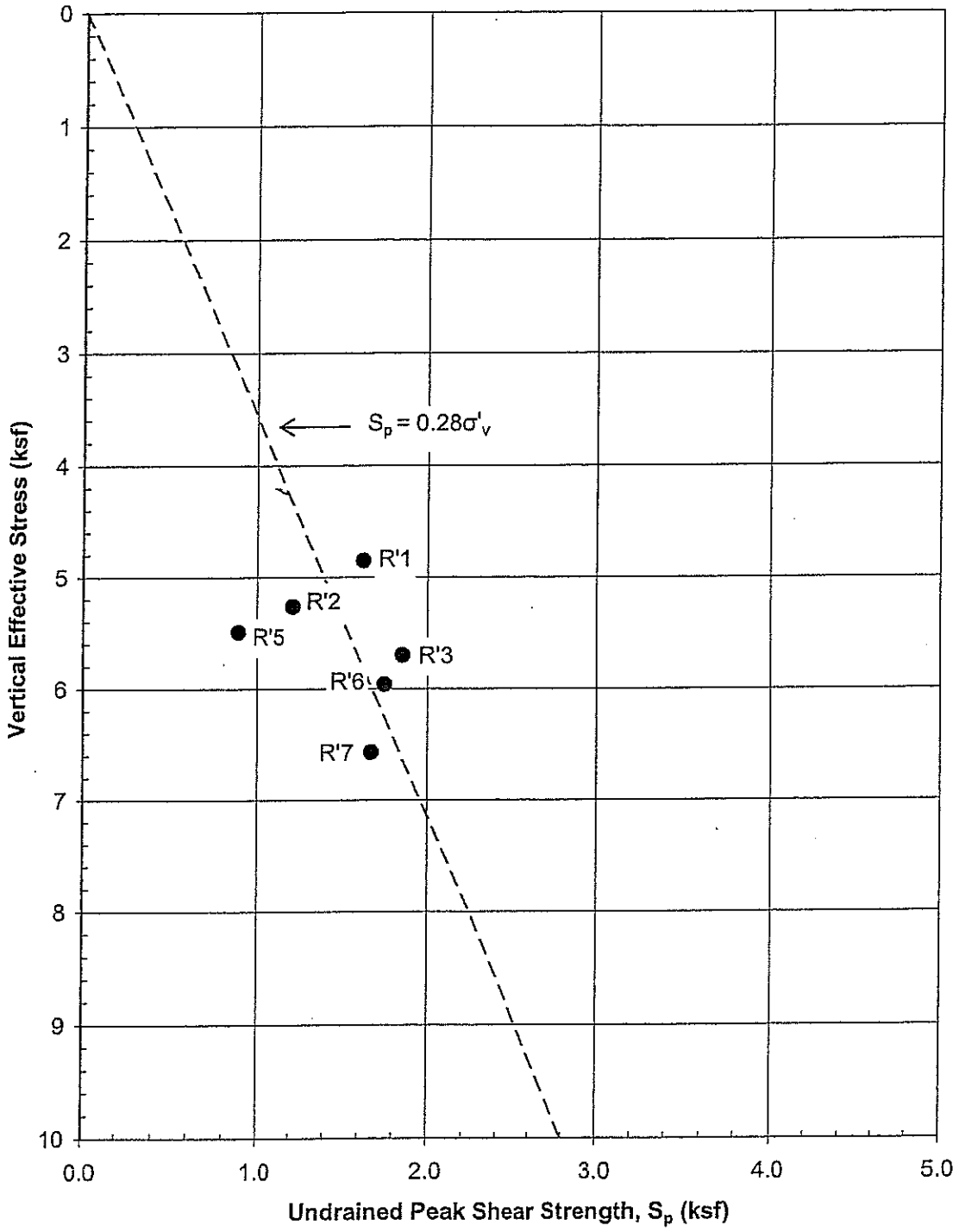
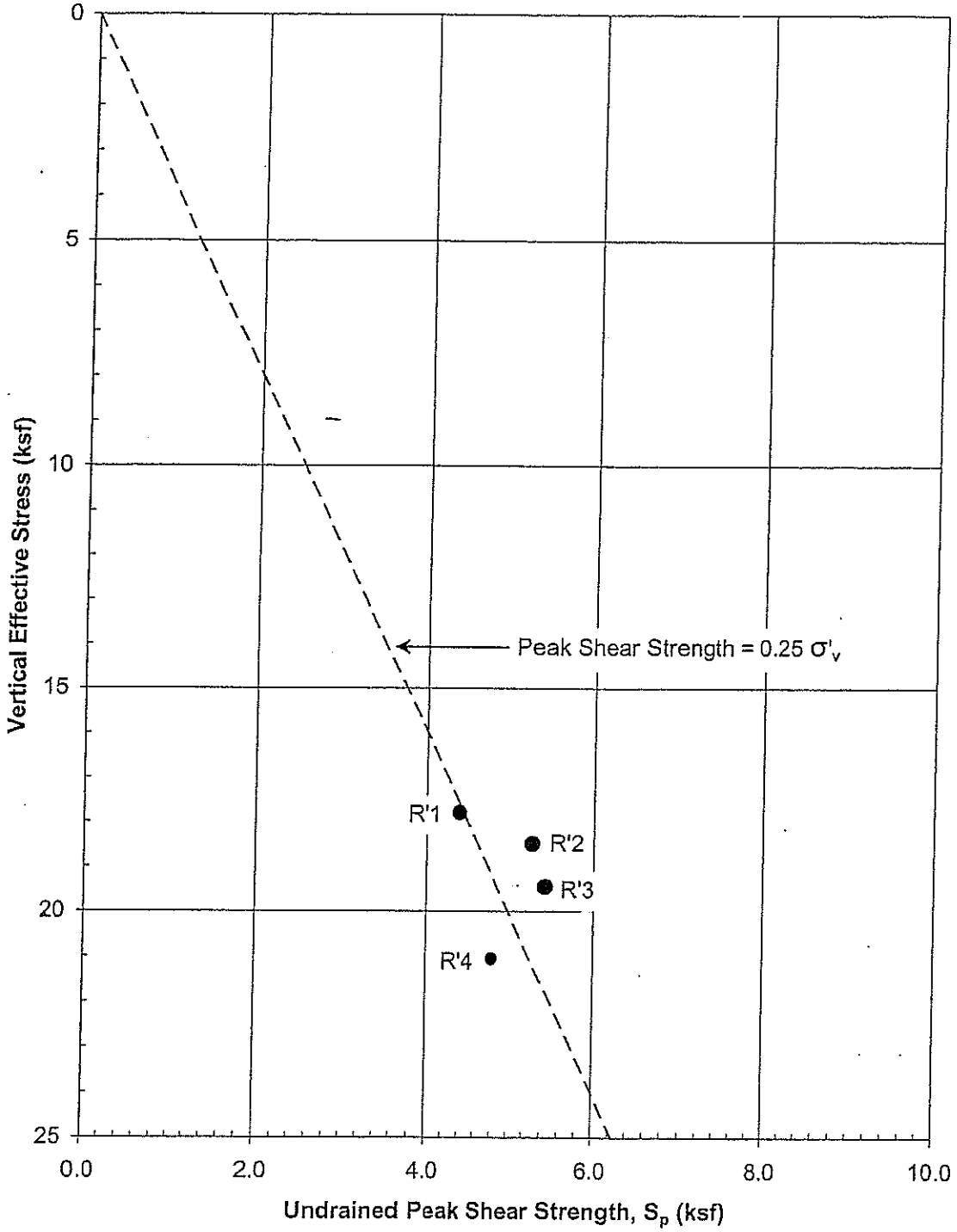


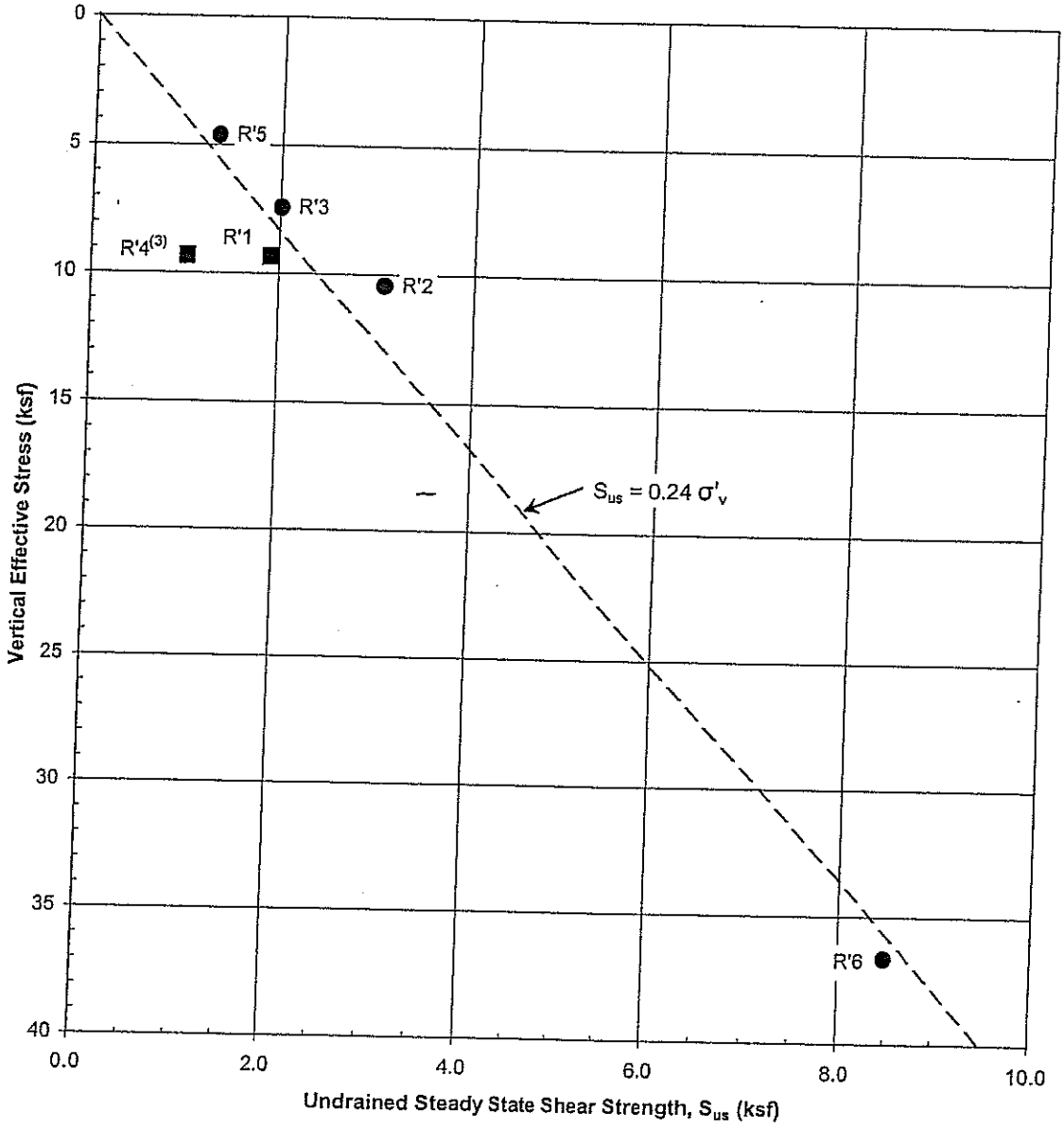
FIGURE 6 - S_{us} of Fine Coal Refuse Slurry Samples Versus Estimated In-Situ Vertical Effective Stress



Harvey Run No. 1 Slurry Impoundment Monongalia County, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_p VERSUS VERTICAL EFFECTIVE STRESS
Consolidation Coal Company Pittsburgh, Pennsylvania	Project 070810	June 2007 Figure 6



Wallace Cabin Branch Slurry Impoundment Wyoming County, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_p VERSUS VERTICAL EFFECTIVE STRESS
Kepler Processing Company Pineville, West Virginia	Project 063560	April 2007 Figure 4



LEGEND
- Reconstituted Coal Refuse Slurry Sample
- Undisturbed Tube Sample

NOTES
1. Vertical effective stress for reconstituted coal refuse samples assumed to be 1.5 times the isotropic effective consolidation stress.
2. Vertical effective stress of undisturbed tube samples estimated by CEC, Inc.
3. R'4 composed of two different soil types. S_{us} shown is uncertain.

Hughes Hollow Slurry Impoundment Wana, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_{us} VERSUS VERTICAL EFFECTIVE STRESS
Consolidation Coal Company Pittsburgh, Pennsylvania	Project 063570	February 2007 Figure 3

LABORATORY TESTING RESULTS – COARSE REFUSE AND RESIDUAL SOILS PROVIDED BY ALLIANCE CONSULTING, INC.

APPENDIX C

LABORATORY TESTING
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY, LLC
BECKLEY, WEST VIRGINIA

TABLE OF CONTENTS

	PAGE
SOIL TESTING	
Summary	1
Strength Test	3
Grain Size	10
Atterberg Limits Test Results	12
COARSE COAL REFUSE TESTING	
Summary	13
Grain Size	15
Proctor Test	17
Permeability Test	18
Strength Test	20

7 of 57

R15434

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

SHIPPING ADDRESS
Box 393 Wood Road
Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

February 10, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Soil Boring and Laboratory Tests
Boring #8874
Mach Mine #1
Johnston City, Illinois
HFE File H-05278
Mach Mining Purchase Order No. _____

Dear Sir:

In accordance with your instructions, on February 1, 2006, we drilled one soil boring and sampled the subsoils with Shelby tubes. The soil sample taken from 10 to 12 feet in depth was subjected to laboratory tests. Results of the tests are as follows:

Boring No.:	8874
Depth:	8.0-10.0'
Visual Classification:	Silty CLAY (CL)
Atterberg Limits:	LL = 41.8% PL = 17.7% PI = 24.1
Unit Weight:	105.3 PCF
Moisture Content:	21.5%
Effective Cohesion:	0 PSF
Effective Phi Angle:	26.8 Degrees

All Tubes From Boring 8874

The Boring Log and test results are enclosed. If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

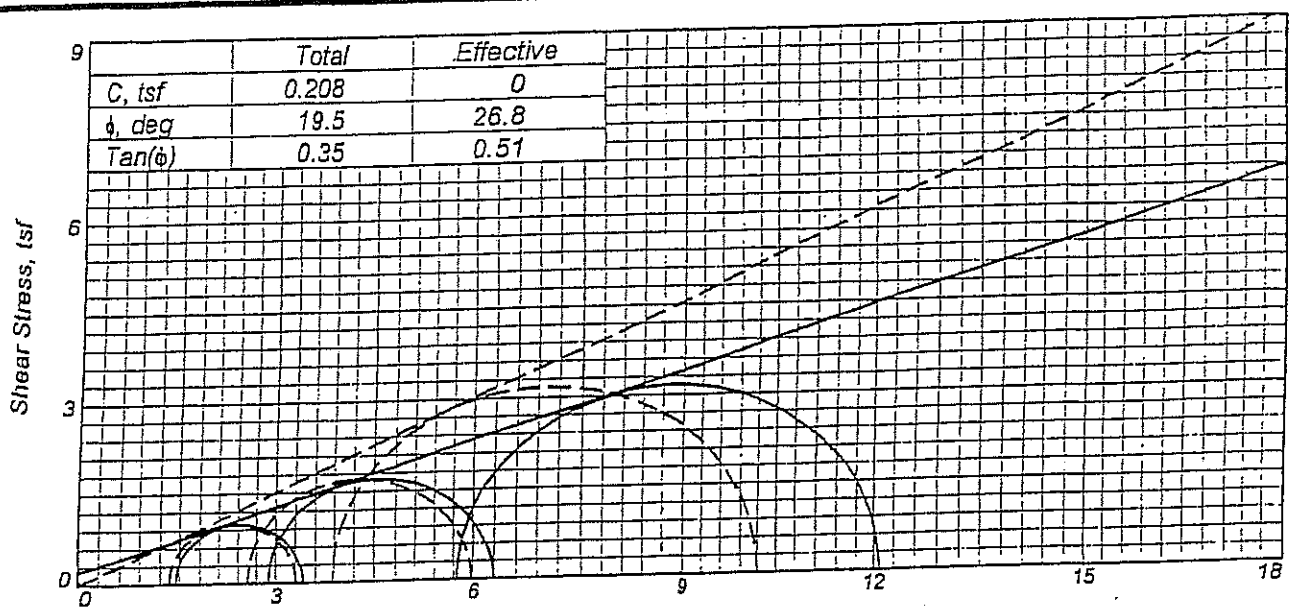
REGISTERED PROFESSIONAL ENGINEER
TIMOTHY J.
HOLCOMB
062-042149
2-10-06
ILLINOIS

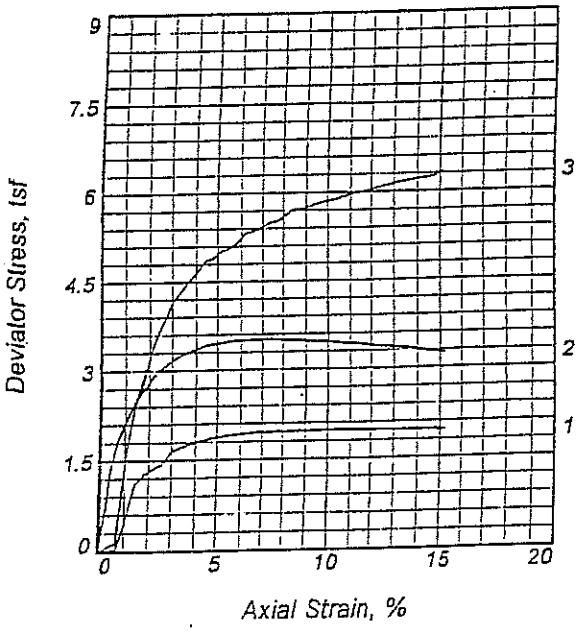
1 copy: Fred Vass - Alliance Consulting

R15436

3

	Total	Effective
C, tsf	0.208	0
ϕ, deg	19.5	26.8
Tan(ϕ)	0.35	0.51





Sample No.		1	2	3
Initial	Water Content,	21.5	20.8	17.6
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	99.7	98.9
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
At Test	Water Content,	21.5	20.9	17.8
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.6	3.6	2.2
Cell Pressure, tsf		5.0	6.5	7.9
Fail. Stress, tsf		2.0	3.4	6.3
Total Pore Pr., tsf		3.7	3.9	4.1
Ult. Stress, tsf		2.0	3.2	6.3
Total Pore Pr., tsf		3.6	3.8	4.1
$\bar{\sigma}_1$ Failure, tsf		3.3	6.0	10.2
$\bar{\sigma}_3$ Failure, tsf		1.3	2.6	3.9

Type of Test:
CU with Pore Pressures
Sample Type: Shelby Tube - Undisturbed
Description: Gray Mottled Brown Silty CLAY

LL= 41.8 PL= 17.7 PI= 24.1
Assumed Specific Gravity= 2.65
Remarks:

Client: Alliance Consulting

Project: Triaxial Test
Mach Mine #1
Location: Boring #8874
Sample Number: 3 **Depth:** 10.0-12.0'
Proj. No.: H-05278 **Date:** 2-1-05

TRIAXIAL SHEAR TEST REPORT

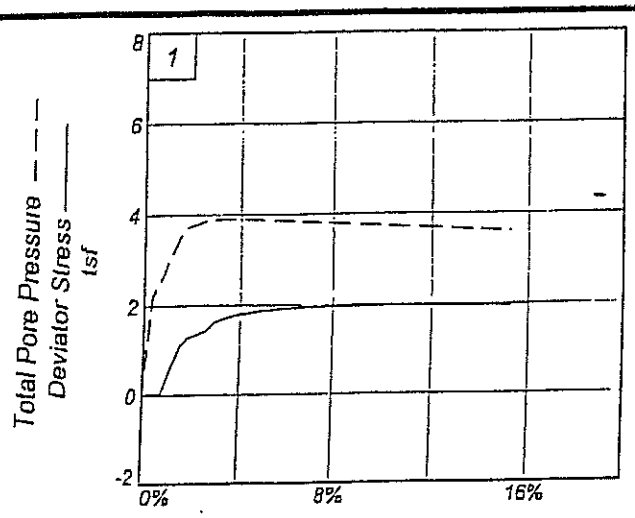
HOLCOMB FOUNDATION ENGINEERING CO.

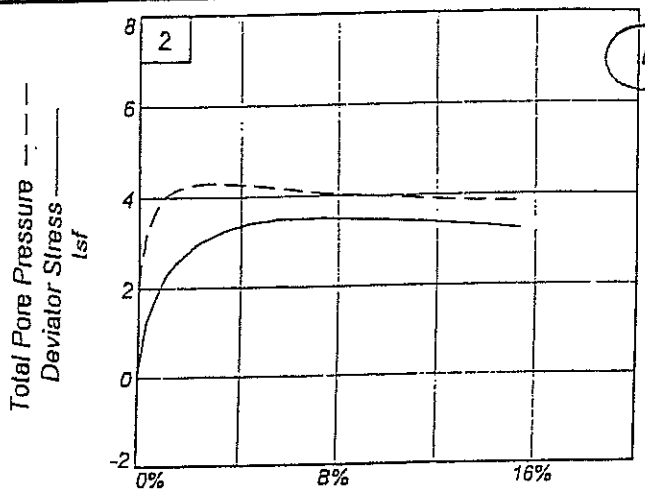
Plate _____

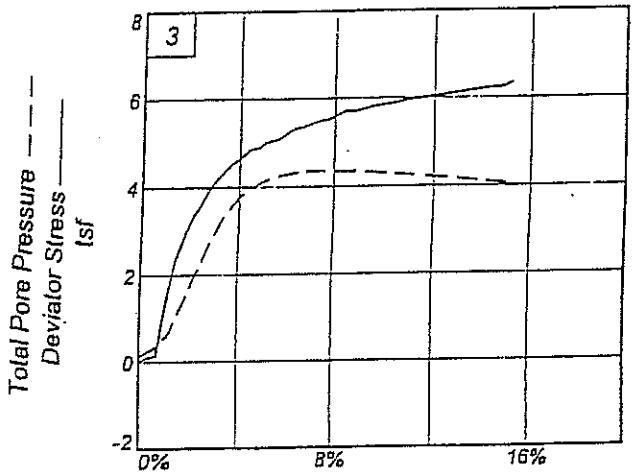
Tested By: LC Checked By: TH

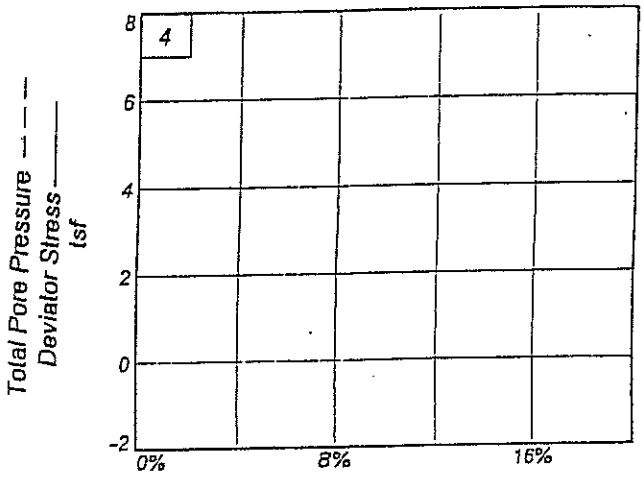
R15437

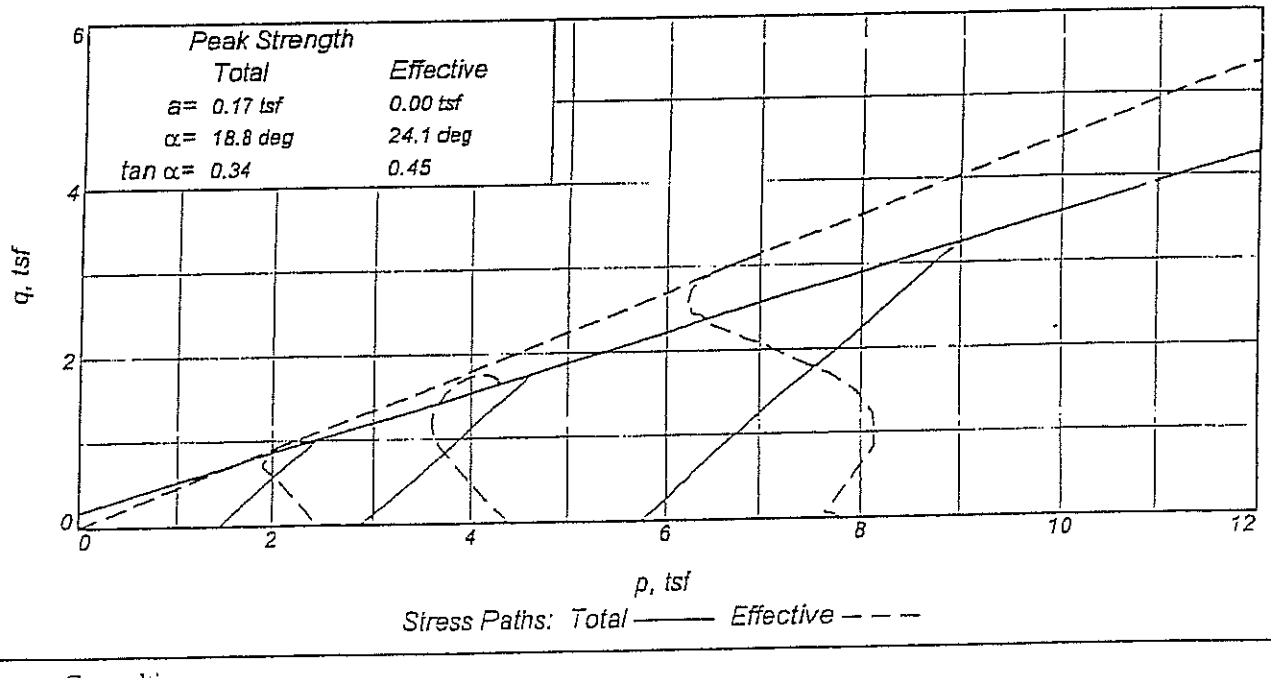
4











Client: Alliance Consulting
Project: Triaxial Test
Location: Boring #8874
Project No.: H-05278

Depth: 10.0-12.0'
Plate _____

Sample Number: 3

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC

Checked By: TH

5

2/9/2006
8:50 PM

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

Date:	2-1-05
Client:	Alliance Consulting
Project:	Triaxial Test Mach Mine #1 Johnston City, Illinois
Location:	Boring #8874
Depth:	10.0-12.0'
Sample Number:	3
Description:	Gray Mottled Brown Silty CLAY
Remarks:	
Type of Sample:	Shelby Tube - Undisturbed
Assumed Specific Gravity=2.65	LL=41.8 PL=17.7 PI=24.1
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consoildated	Final
Moisture content: Moist soil+tare, gms.	189.100			1279.000
Moisture content: Dry soil+tare, gms.	176.100			1072.200
Moisture content: Tare, gms.	115.700			103.200
Moisture, %	21.5	21.5	21.5	21.3
Moist specimen weight, gms.	1140.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.51	5.51	5.51	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.0	128.0	128.0	
Dry density, pcf	105.3	105.3	105.3	
Void ratio	0.5706	0.5706	0.5706	
Saturation, %	100.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.981 tsf at reading no. 24
Ult. Stress = 1.955 tsf at reading no. 30

12 of 57

R15439

(6)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	18.30	0.0	0.0	0.000	5.112	5.112	1.00	-1.00	5.112	0.000
1	0.0190	20.00	1.7	0.3	0.014	2.830	2.844	1.00	30.70	2.837	0.007
2	0.0400	21.60	3.3	0.7	0.026	2.426	2.452	1.01	36.30	2.439	0.013
3	0.0810	113.20	94.9	1.5	1.093	1.505	2.598	1.73	49.10	2.051	0.547
4	0.1010	129.80	111.5	1.8	1.280	1.318	2.597	1.97	51.70	1.958	0.640
5	0.1420	143.10	124.8	2.6	1.422	1.181	2.602	2.20	53.60	1.892	0.711
6	0.1620	161.50	143.2	2.9	1.625	1.159	2.784	2.40	53.90	1.972	0.813
7	0.1830	168.90	150.6	3.3	1.702	1.145	2.847	2.49	54.10	1.996	0.851
8	0.2030	174.80	156.5	3.7	1.763	1.138	2.900	2.55	54.20	2.019	0.881
9	0.2240	178.90	160.6	4.1	1.802	1.145	2.946	2.57	54.10	2.046	0.901
10	0.2440	182.30	164.0	4.4	1.833	1.145	2.978	2.60	54.10	2.061	0.916
11	0.2650	186.40	168.1	4.8	1.871	1.152	3.023	2.62	54.00	2.088	0.936
12	0.2850	188.10	169.8	5.2	1.883	1.166	3.049	2.61	53.80	2.108	0.941
13	0.3060	191.40	173.1	5.6	1.912	1.166	3.078	2.64	53.80	2.122	0.956
14	0.3260	193.10	174.8	5.9	1.923	1.181	3.104	2.63	53.60	2.142	0.962
15	0.3460	194.70	176.4	6.3	1.933	1.188	3.121	2.63	53.50	2.155	0.967
16	0.3670	196.40	178.1	6.7	1.944	1.202	3.146	2.62	53.30	2.174	0.972
17	0.3870	198.10	179.8	7.0	1.955	1.210	3.164	2.62	53.20	2.187	0.977
18	0.4080	198.10	179.8	7.4	1.947	1.224	3.171	2.59	53.00	2.197	0.973
19	0.4280	200.60	182.3	7.8	1.966	1.231	3.197	2.60	52.90	2.214	0.983
20	0.4490	200.60	182.3	8.1	1.958	1.238	3.196	2.58	52.80	2.217	0.979
21	0.4890	203.10	184.8	8.9	1.969	1.267	3.236	2.55	52.40	2.252	0.985
22	0.5300	204.70	186.4	9.6	1.970	1.289	3.259	2.53	52.10	2.274	0.985
23	0.5710	207.20	188.9	10.4	1.980	1.310	3.290	2.51	51.80	2.300	0.990
24	0.6120	208.90	190.6	11.1	1.981	1.332	3.313	2.49	51.50	2.323	0.991
25	0.6530	209.10	190.8	11.8	1.967	1.346	3.313	2.46	51.30	2.330	0.983
26	0.6940	211.40	193.1	12.6	1.974	1.361	3.334	2.45	51.10	2.348	0.987
27	0.7350	212.20	193.9	13.3	1.965	1.390	3.354	2.41	50.70	2.372	0.982
28	0.7790	213.90	195.6	14.1	1.964	1.404	3.368	2.40	50.50	2.386	0.982
29	0.8170	215.50	197.2	14.8	1.964	1.426	3.390	2.38	50.20	2.408	0.982
30	0.8380	215.50	197.2	15.2	1.955	1.433	3.388	2.36	50.10	2.410	0.978

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	154.800			1347.900
Moisture content: Dry soil+tare, gms.	145.800			1154.100
Moisture content: Tare, gms.	102.600			135.100
Moisture, %	20.8	20.9	20.9	19.0
Moist specimen weight, gms.	1142.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.49	5.49	5.49	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.7	128.7	128.7	
Dry density, pcf	106.5	106.5	106.5	
Void ratio	0.5536	0.5536	0.5536	
Saturation, %	99.7	100.0	100.0	

7

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 3.418 tsf at reading no. 24
Ult. Stress = 3.250 tsf at reading no. 29

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	27.50	0.0	0.0	0.000	4.385	4.385	1.00	29.10	4.385	0.000
1	0.0190	134.00	106.5	0.3	1.241	3.254	4.495	1.38	44.80	3.875	0.620
2	0.0400	183.10	155.6	0.7	1.806	2.750	4.557	1.66	51.80	3.653	0.903
3	0.0600	218.90	191.4	1.1	2.214	2.484	4.698	1.89	55.50	3.591	1.107
4	0.0810	243.80	216.3	1.5	2.492	2.340	4.832	2.06	57.50	3.586	1.246
5	0.1010	264.60	237.1	1.8	2.721	2.254	4.975	2.21	58.70	3.614	1.361
6	0.1220	282.10	254.6	2.2	2.911	2.210	5.121	2.32	59.30	3.666	1.455
7	0.1420	295.40	267.9	2.6	3.052	2.182	5.233	2.40	59.70	3.707	1.526
8	0.1620	305.40	277.9	2.9	3.154	2.182	5.335	2.45	59.70	3.758	1.577
9	0.1830	314.60	287.1	3.3	3.245	2.189	5.434	2.48	59.60	3.811	1.623
10	0.2030	322.10	294.6	3.7	3.317	2.196	5.513	2.51	59.50	3.855	1.659
11	0.2240	327.10	299.6	4.1	3.360	2.218	5.578	2.52	59.20	3.898	1.680
12	0.2440	332.90	305.4	4.4	3.412	2.232	5.644	2.53	59.00	3.938	1.706
13	0.2650	336.20	308.7	4.8	3.435	2.254	5.689	2.52	58.70	3.971	1.718
14	0.2850	339.50	312.0	5.2	3.459	2.275	5.734	2.52	58.40	4.005	1.729
15	0.3060	343.70	316.2	5.6	3.491	2.297	5.788	2.52	58.10	4.042	1.746
16	0.3260	345.40	317.9	5.9	3.497	2.318	5.815	2.51	57.80	4.067	1.748
17	0.3670	348.70	321.2	6.7	3.505	2.369	5.874	2.48	57.10	4.121	1.752
18	0.4080	352.00	324.5	7.4	3.512	2.412	5.924	2.46	56.50	4.168	1.756
19	0.4490	353.70	326.2	8.2	3.502	2.441	5.943	2.43	56.10	4.192	1.751
20	0.4890	354.50	327.0	8.9	3.483	2.470	5.953	2.41	55.70	4.211	1.742
21	0.5300	355.40	327.9	9.7	3.464	2.498	5.963	2.39	55.30	4.230	1.732

(4)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.5510	357.00	329.5	10.0	3.466	2.513	5.979	2.38	55.10	4.246	1.733
23	0.5920	356.20	328.7	10.8	3.429	2.534	5.964	2.35	54.80	4.249	1.715
24	0.6330	357.90	330.4	11.5	3.418	2.556	5.974	2.34	54.50	4.265	1.709
25	0.6730	357.00	329.5	12.3	3.381	2.585	5.966	2.31	54.10	4.275	1.690
26	0.7140	357.90	330.4	13.0	3.361	2.599	5.960	2.29	53.90	4.280	1.681
27	0.7550	357.90	330.4	13.7	3.332	2.614	5.946	2.27	53.70	4.280	1.666
28	0.7960	356.20	328.7	14.5	3.286	2.628	5.914	2.25	53.50	4.271	1.643
29	0.8370	355.40	327.9	15.2	3.250	2.635	5.885	2.23	53.40	4.260	1.625

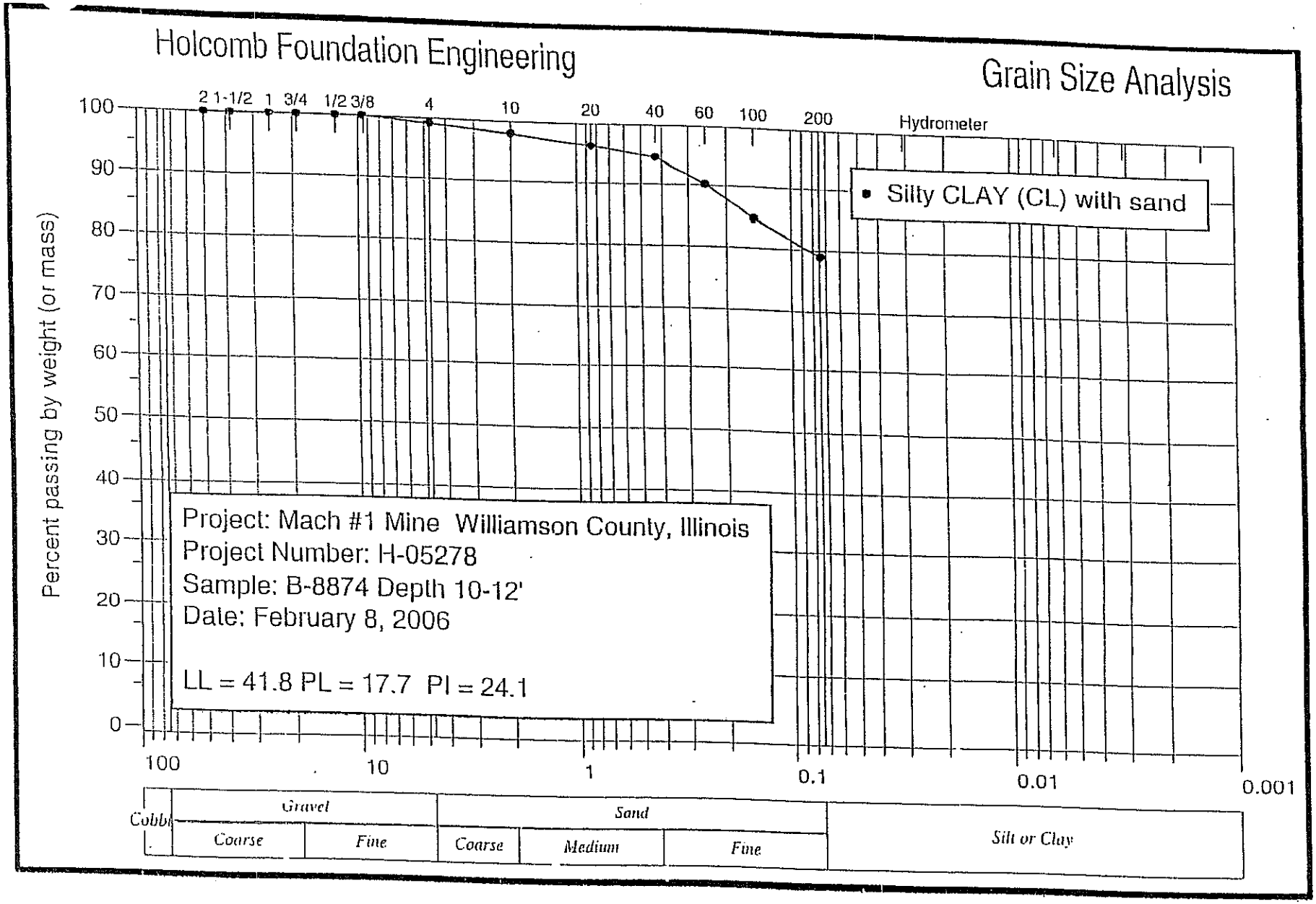
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	248.400			1374.500
Moisture content: Dry soil+tare, gms.	226.700			1195.400
Moisture content: Tare, gms.	103.200			127.700
Moisture, %	17.6	17.8	17.8	16.8
Moist specimen weight, gms.	1184.7			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.54	5.54	5.54	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	132.3	132.5	132.5	
Dry density, pcf	112.5	112.5	112.5	
Void ratio	0.4707	0.4707	0.4707	
Saturation, %	98.9	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 6.334 tsf at reading no. 33
Ult. Stress = 6.334 tsf at reading no. 33

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	31.60	0.0	0.0	0.000	7.812	7.812	1.00	1.50	7.812	0.000
1	0.0190	39.90	8.3	0.3	0.091	7.690	7.781	1.01	3.20	7.735	0.045
2	0.0400	44.10	12.5	0.7	0.133	7.574	7.707	1.02	4.80	7.641	0.066
3	0.0600	175.60	144.0	1.1	1.666	7.308	8.974	1.23	8.50	8.141	0.833
4	0.0810	240.50	208.9	1.5	2.407	6.926	9.333	1.35	13.80	8.130	1.203
5	0.1010	291.30	259.7	1.8	2.981	6.466	9.447	1.46	20.20	7.956	1.491
6	0.1220	329.60	298.0	2.2	3.408	5.983	9.391	1.57	26.90	7.687	1.704
7	0.1420	362.00	330.4	2.6	3.764	5.479	9.244	1.69	33.90	7.361	1.882
8	0.1620	392.00	360.4	2.9	4.091	5.040	9.131	1.81	40.00	7.085	2.045
9	0.1830	412.80	381.2	3.3	4.310	4.666	8.976	1.92	45.20	6.821	2.155

(9)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
10	0.2030	432.80	401.2	3.7	4.519	4.363	8.883	2.04	49.40	6.623	2.260
11	0.2240	446.90	415.3	4.0	4.660	4.140	8.800	2.13	52.50	6.470	2.330
12	0.2440	465.20	433.6	4.4	4.847	3.982	8.828	2.22	54.70	6.405	2.423
13	0.2650	471.00	439.4	4.8	4.892	3.852	8.744	2.27	56.50	6.298	2.446
14	0.2850	483.50	451.9	5.1	5.012	3.766	8.778	2.33	57.70	6.272	2.506
15	0.3060	490.20	458.6	5.5	5.066	3.694	8.760	2.37	58.70	6.227	2.533
16	0.3260	503.50	471.9	5.9	5.193	3.643	8.837	2.43	59.40	6.240	2.597
17	0.3460	516.80	485.2	6.2	5.319	3.607	8.926	2.47	59.90	6.267	2.660
18	0.3670	521.80	490.2	6.6	5.352	3.586	8.938	2.49	60.20	6.262	2.676
19	0.3870	530.10	498.5	7.0	5.422	3.571	8.993	2.52	60.40	6.282	2.711
20	0.4080	538.40	506.8	7.4	5.490	3.564	9.054	2.54	60.50	6.309	2.745
21	0.4280	543.40	511.8	7.7	5.522	3.564	9.086	2.55	60.50	6.325	2.761
22	0.4490	554.30	522.7	8.1	5.617	3.571	9.188	2.57	60.40	6.380	2.808
23	0.4690	565.90	534.3	8.5	5.719	3.578	9.297	2.60	60.30	6.438	2.859
24	0.4890	567.60	536.0	8.8	5.714	3.578	9.293	2.60	60.30	6.436	2.857
25	0.5300	581.70	550.1	9.6	5.817	3.600	9.417	2.62	60.00	6.509	2.909
26	0.5710	591.70	560.1	10.3	5.874	3.636	9.510	2.62	59.50	6.573	2.937
27	0.6120	605.00	573.4	11.0	5.964	3.665	9.629	2.63	59.10	6.647	2.982
28	0.6530	615.00	583.4	11.8	6.018	3.701	9.719	2.63	58.60	6.710	3.009
29	0.6940	626.70	595.1	12.5	6.087	3.737	9.824	2.63	58.10	6.780	3.044
30	0.7350	638.30	606.7	13.3	6.153	3.773	9.926	2.63	57.60	6.849	3.077
31	0.7760	649.10	617.5	14.0	6.209	3.816	10.025	2.63	57.00	6.921	3.105
32	0.8170	657.50	625.9	14.7	6.240	3.852	10.092	2.62	56.50	6.972	3.120
33	0.8390	669.90	638.3	15.1	6.334	3.866	10.200	2.64	56.30	7.033	3.167



16 of 57

R15443

Holcomb Foundation Engineering Company

Laboratory Testing Results

2/8/2006

Project: Mach #1 Mine

Project No: H-05278

Sieve Analysis - ASTM C136-96a

Sample: Silty CLAY (CL)

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
1.5000	38.1000	1 -1/2"	0.0	0.0	100.0
1.0000	25.4000	1"	0.0	0.0	100.0
0.7500	19.1000	3/4"	0.0	0.0	100.0
0.5000	12.7000	1/2"	0.0	0.0	100.0
3.7500	9.5200	3/8"	0.0	0.0	100.0
0.1870	4.7600	No. 4	2.1	0.9	99.1
0.0790	2.0000	No. 10	4.6	2.0	98.0
0.0469	1.1800	No. 16	4.6	2.0	98.0
0.0331	0.8500	No. 20	8.6	3.8	96.2
0.0165	0.4200	No. 40	12.6	5.5	94.5
0.0117	0.2980	No. 50	12.6	5.5	94.5
0.0083	0.2500	No. 60	22.2	9.8	90.2
0.0059	0.1490	No. 100	34.6	15.2	84.8
0.0029	0.0740	No. 200	47.7	21.0	79.0

Total Weight in Grams 227.20

18 7 57

R15445

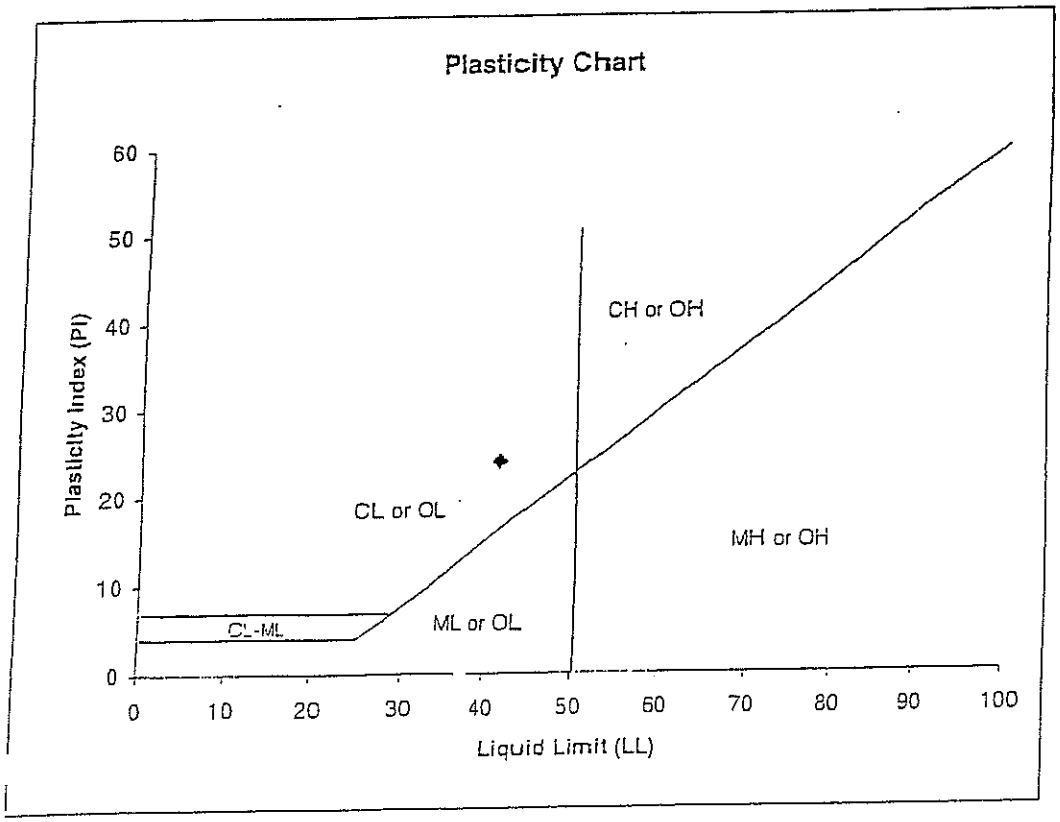
Holcomb Foundation Engineering Company

Laboratory Testing Results

Project: Mach #1 Mine
Project No: H-05278

Sample	1	2	3
Dish Number	LL_1	LL_2	LL_3
Mass of can, W_1 (g)	34.70		
Mass of can + moist soil, W_2 (g)	62.84		
Mass of can + dry soil, W_3 (g)	54.52		
Moisture content, w (%)	41.98		
Number of blows, N	24		
Liquid Limit, LL	41.8		

Dish Number	PL_1
Mass of can, W_1 (g)	39.76
Mass of can + moist soil, W_2 (g)	54.79
Mass of can + dry soil, W_3 (g)	52.53
Plastic Limit, PL	17.7
PI =	24.1



R15496

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

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800-333-1740
FAX 618-457-8991

November 30, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Pond Creek Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on November 17, 2006, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification: Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)

Proctor Test Results:
Maximum Dry Unit Weight: 124.6 PCF
Optimum Moisture Content: 9.3 %

Specific Gravity: 2.37

Triaxial Test Results:
Effective Cohesion: 0 PSF
Effective Phi Angle: 33.7 Degrees

Permeability: 2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

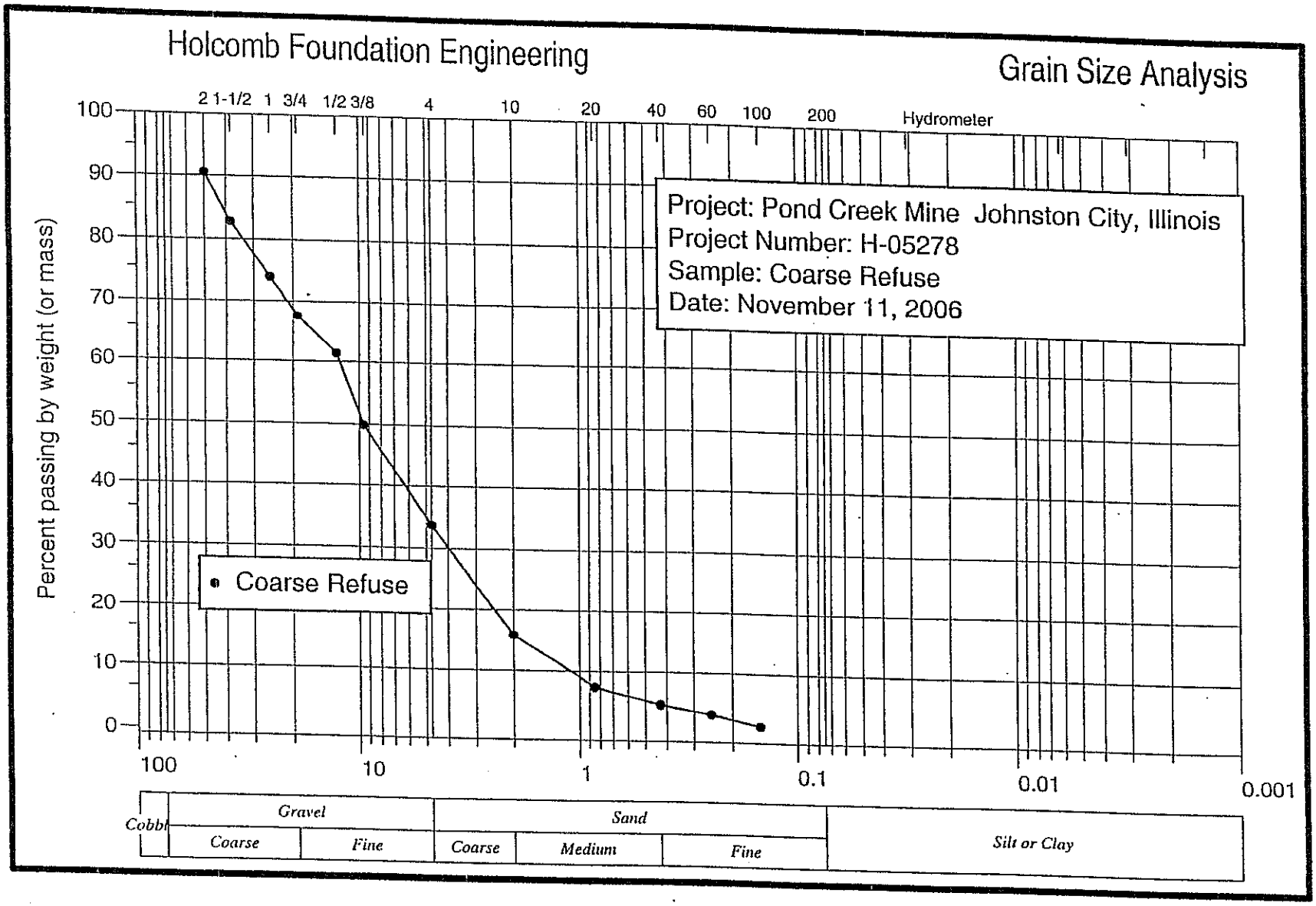
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting



21 of 57

R15448
13

Holcomb Foundation Engineering Company

Laboratory Testing Results

11/30/2006

Project: Coarse Refuse Disposal Area
Pond Creek Mine Johnston City, Illinois

Project No: H-05317

Sieve Analysis - ASTM C136-96a

Sample: Coarse Refuse

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
3	76.2	3"	0.0	0.0	100.0
2.0000	50.8100	2"	619.6	9.5	90.5
1.5000	38.1000	1 -1/2"	1124.0	17.2	82.8
1.0000	25.4000	1"	1696.2	25.9	74.1
0.7500	19.1000	3/4"	2110.9	32.3	67.7
0.5000	12.7000	1/2"	2513.0	38.4	61.6
3.7500	9.5200	3/8"	3263.7	49.9	50.1
0.1870	4.7600	No. 4	4310.7	65.9	34.1
0.0790	2.0000	No. 10	5470.5	83.6	16.4
0.0469	1.1800	No. 16			
0.0331	0.8500	No. 20	6004.4	91.8	8.2
0.0165	0.4200	No. 40	6178.9	94.4	5.6
0.0117	0.2980	No. 50			
0.0083	0.2500	No. 60	6267.8	95.8	4.2
0.0059	0.1490	No. 100			
0.0029	0.0740	No. 200	6372.4	97.4	2.6

Total Weight in Grams **6542.80**

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

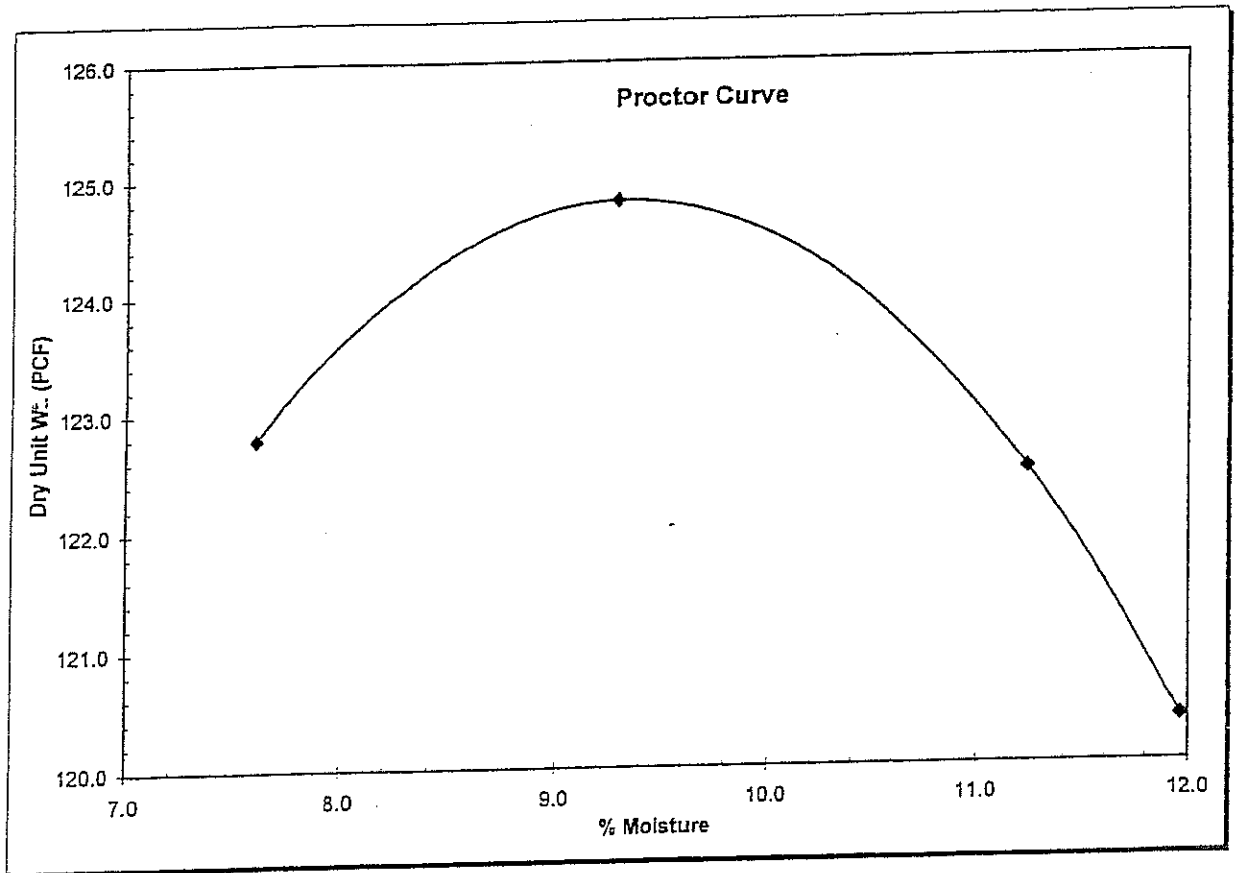
Date: 11/30/2006

Proctor Test Results

Soil Classification:	Gray Coarse Refuse
Maximum Dry Density (PCF)	124.8
Optimum Moisture Content (%)	9.3

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
7.6	122.8
11.2	122.5
12.0	120.4
9.3	124.8



HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

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Permeability Tests Results

Laboratory Tests
Coarse Refuse
Pond Creek Mine - Johnston City, Illinois

Date: 11/30/2006

Client: Pond Creek Mine
Johnston City, Illinois

Project No.: H-05278

Sample	Depth (Ft.)	Moisture Content (%) Before Test	After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse		7.7	11.8	119.3	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

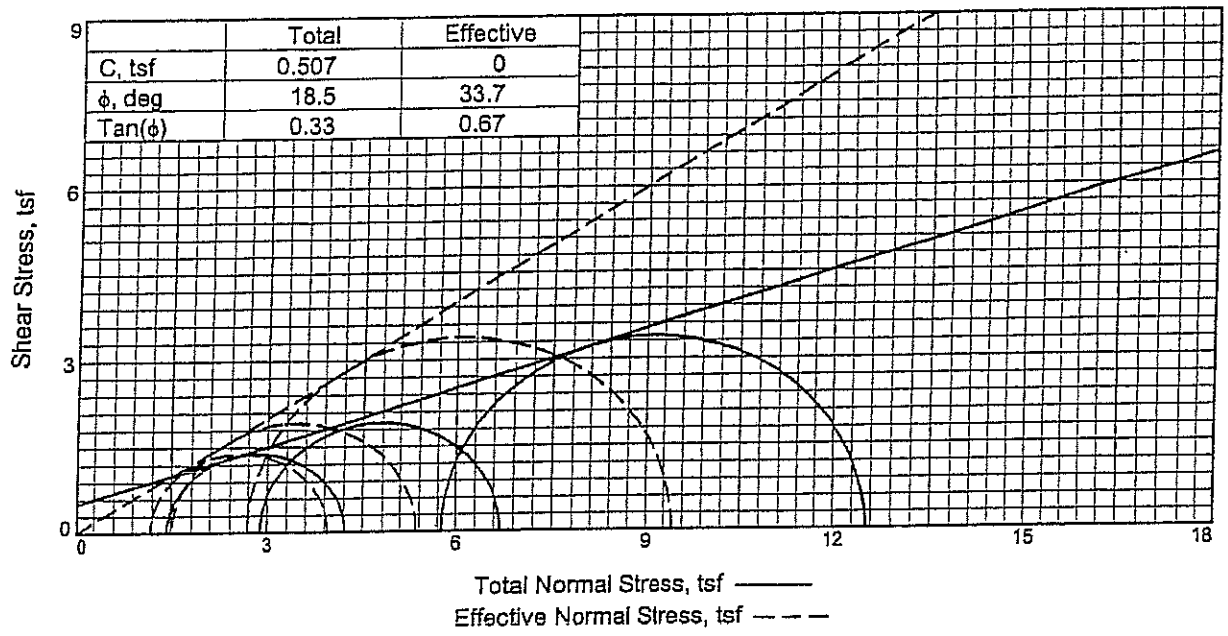
PERMEABILITY TEST RESULTS

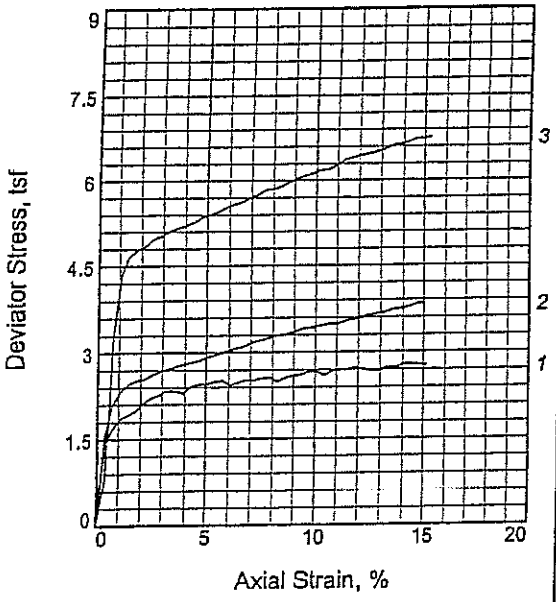
Project	Pond Creek Mine		Boring/Sample Depth	Coarse Refuse	
Project #	H-05278		Classification		
Date	11/30/2006		Diameter	2.8	Inch
			Length	5.6	Inch

In Place Mc		After Test Mc		Unit Weight (PCF)	
Wet Wt.	195.3	Wet Wt.	1300.4	Sample Wt.	1161.8
Pan	94.2	Pan	103.1		
Dry Wt.	188.1	Dry Wt.	1173.6	Wet UW=	128.5
Mc (%)	7.7	Mc (%)	11.8	Dry UW=	119.3

Time(hrs)	Time(min)	Quantity (cc)	Head (psi)	Permeability (cm/sec)
7	26	24.7		
7	34	8.2	1	1.75E-04
7	33	24.5		
7	45	2.7	1	1.54E-04
7	47	0.8	1	1.44E-04
9	16	24.4		
9	23	9.6	1	1.79E-04
9	30	0.9	1	1.43E-04
			Average Permeability	1.63E-04

	Total	Effective
C, tsf	0.507	0
ϕ, deg	18.5	33.7
Tan(ϕ)	0.33	0.67





Sample No.		1	2	3
Initial	Water Content,	10.1	10.8	10.3
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	97.0	99.8	99.3
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
At Test	Water Content,	10.4	10.8	10.4
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
Strain rate, in./min.		0.01	0.01	0.01
Back Pressure, tsf		3.60	3.60	2.16
Cell Pressure, tsf		5.04	6.48	7.92
Fail. Stress, tsf		2.78	3.83	6.76
Total Pore Pr., tsf		3.86	4.96	5.23
Ult. Stress, tsf		2.77	3.83	6.76
Total Pore Pr., tsf		3.85	4.95	5.23
$\bar{\sigma}_1$ Failure, tsf		3.96	5.35	9.44
$\bar{\sigma}_3$ Failure, tsf		1.18	1.52	2.69

Type of Test:
CU with Pore Pressures
Sample Type: Remolded
Description: Coarse Coal Refuse

Assumed Specific Gravity= 2.37
Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

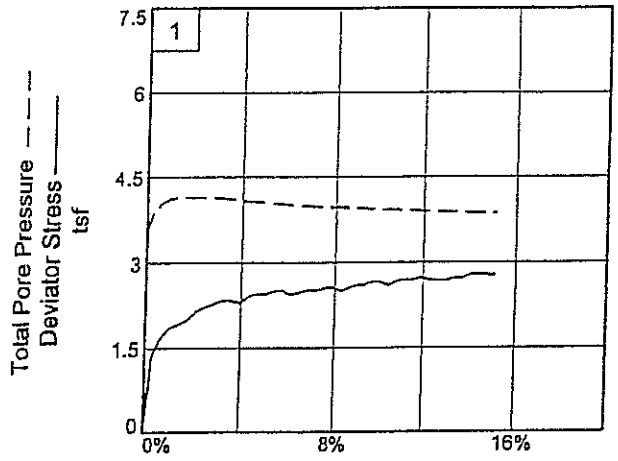
Location: Coarse Refuse Stockpile
Sample Number: Coarse Refuse
Proj. No.: H-05278 **Date:** 11/17/06

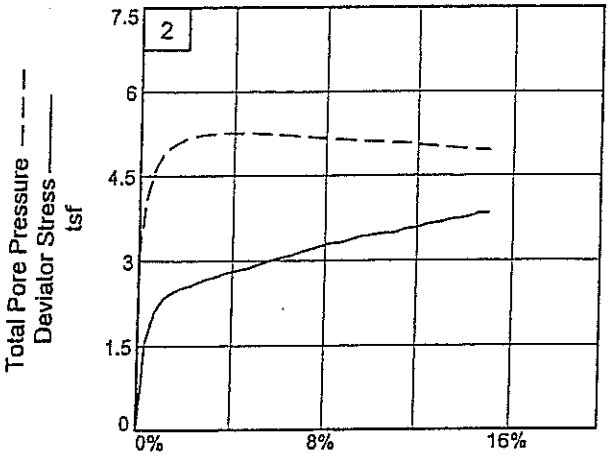
TRIAXIAL SHEAR TEST REPORT

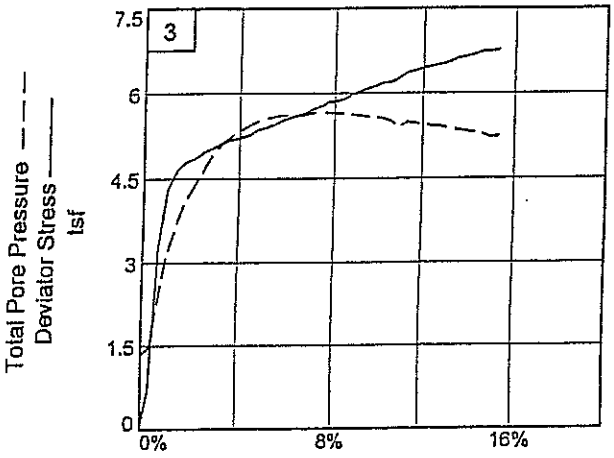
HOLCOMB FOUNDATION ENGINEERING CO.

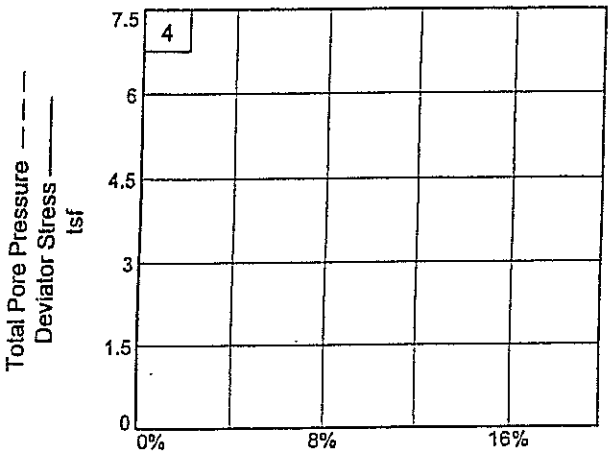
Plate _____

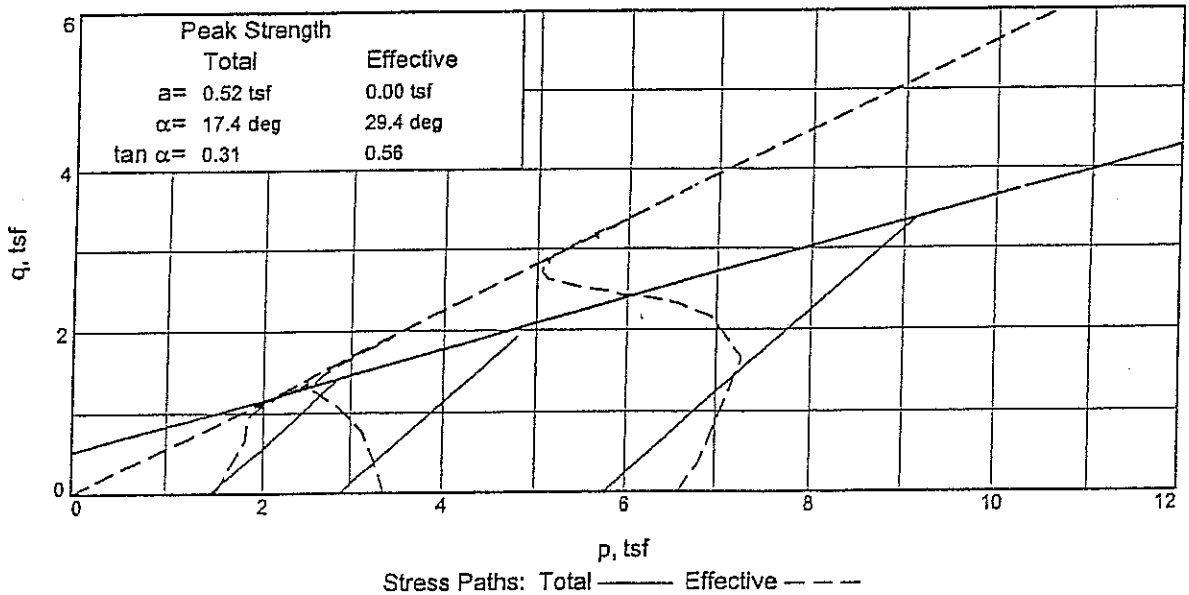
Tested By: LC Checked By: TH











Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Coarse Refuse Stockpile
Project No.: H-05278

Sample Number: Coarse Refuse
Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC _____ **Checked By:** TH _____

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

11/30/2006
10:19 AM

Date:	11/17/06
Client:	Pond Creek Mine
Project:	Coarse Refuse Laboratory Tests
Location:	Coarse Refuse Stockpile
Sample Number:	Coarse Refuse
Description:	Coarse Coal Refuse
Remarks:	
Type of Sample:	Remolded
Assumed Specific Gravity=2.37	**LL=** **PL=** **PI=**
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	226.800			1320.700
Moisture content: Dry soil+tare, gms.	218.600			1195.800
Moisture content: Tare, gms.	137.500			107.600
Moisture, %	10.1	10.4	10.4	11.5
Moist specimen weight, gms.	1193.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.65	5.65	5.65	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.6	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2470	0.2470	0.2470	
Saturation, %	97.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 2.778 tsf at reading no. 41
Ult. Stress = 2.767 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0010	46.60	0.0	0.0	0.000	1.498	1.498	1.00	49.20	1.498	0.000
1	0.0180	160.60	114.0	0.3	1.329	1.152	2.481	2.15	54.00	1.816	0.664
2	0.0390	189.70	143.1	0.7	1.662	1.001	2.663	2.66	56.10	1.832	0.831
3	0.0590	205.60	159.0	1.0	1.840	0.929	2.769	2.98	57.10	1.849	0.920
4	0.0800	212.20	165.6	1.4	1.909	0.907	2.816	3.10	57.40	1.862	0.955
5	0.1000	218.90	172.3	1.8	1.979	0.900	2.879	3.20	57.50	1.890	0.990
6	0.1200	232.20	185.6	2.1	2.125	0.900	3.025	3.36	57.50	1.962	1.062
7	0.1410	240.50	193.9	2.5	2.211	0.907	3.118	3.44	57.40	2.013	1.106
8	0.1610	245.50	198.9	2.8	2.260	0.914	3.174	3.47	57.30	2.044	1.130
9	0.1820	252.20	205.6	3.2	2.327	0.922	3.249	3.53	57.20	2.085	1.164
10	0.2020	253.80	207.2	3.6	2.337	0.936	3.273	3.50	57.00	2.104	1.168
11	0.2230	250.50	203.9	3.9	2.291	0.958	3.248	3.39	56.70	2.103	1.145
12	0.2430	261.30	214.7	4.3	2.403	0.972	3.375	3.47	56.50	2.173	1.201
13	0.2630	266.30	219.7	4.6	2.450	0.979	3.429	3.50	56.40	2.204	1.225
14	0.2840	266.30	219.7	5.0	2.440	0.994	3.434	3.46	56.20	2.214	1.220
15	0.3040	272.10	225.5	5.4	2.495	1.008	3.503	3.48	56.00	2.256	1.248
16	0.3250	274.60	228.0	5.7	2.513	1.022	3.536	3.46	55.80	2.279	1.257
17	0.3450	268.00	221.4	6.1	2.431	1.037	3.468	3.34	55.60	2.252	1.216
18	0.3660	273.00	226.4	6.5	2.476	1.051	3.527	3.36	55.40	2.289	1.238
19	0.3860	278.00	231.4	6.8	2.521	1.058	3.580	3.38	55.30	2.319	1.261
20	0.4070	278.00	231.4	7.2	2.511	1.066	3.577	3.36	55.20	2.321	1.256
21	0.4270	283.00	236.4	7.5	2.556	1.073	3.629	3.38	55.10	2.351	1.278
22	0.4470	284.60	238.0	7.9	2.563	1.080	3.643	3.37	55.00	2.362	1.282
23	0.4680	278.80	232.2	8.3	2.491	1.087	3.578	3.29	54.90	2.333	1.245
24	0.4880	286.30	239.7	8.6	2.561	1.087	3.648	3.36	54.90	2.368	1.281
25	0.5090	290.40	243.8	9.0	2.594	1.094	3.689	3.37	54.80	2.392	1.297
26	0.5290	292.10	245.5	9.3	2.602	1.102	3.704	3.36	54.70	2.403	1.301
27	0.5500	298.80	252.2	9.7	2.662	1.109	3.771	3.40	54.60	2.440	1.331
28	0.5700	299.60	253.0	10.1	2.660	1.116	3.776	3.38	54.50	2.446	1.330
29	0.5910	294.60	248.0	10.4	2.597	1.116	3.713	3.33	54.50	2.415	1.299
30	0.6110	302.10	255.5	10.8	2.665	1.123	3.788	3.37	54.40	2.456	1.333
31	0.6310	306.30	259.7	11.2	2.698	1.130	3.828	3.39	54.30	2.479	1.349
32	0.6520	306.30	259.7	11.5	2.687	1.130	3.817	3.38	54.30	2.474	1.343
33	0.6720	312.10	265.5	11.9	2.736	1.145	3.881	3.39	54.10	2.513	1.368
34	0.6930	309.60	263.0	12.2	2.699	1.145	3.843	3.36	54.10	2.494	1.349
35	0.7130	308.80	262.2	12.6	2.680	1.152	3.832	3.33	54.00	2.492	1.340
36	0.7340	309.60	263.0	13.0	2.676	1.159	3.835	3.31	53.90	2.497	1.338
37	0.7540	315.40	268.8	13.3	2.724	1.166	3.891	3.34	53.80	2.528	1.362
38	0.7750	316.20	269.6	13.7	2.721	1.166	3.887	3.33	53.80	2.527	1.360
39	0.7950	323.70	277.1	14.1	2.785	1.181	3.966	3.36	53.60	2.573	1.392
40	0.8150	325.40	278.8	14.4	2.790	1.181	3.971	3.36	53.60	2.576	1.395
41	0.8360	325.40	278.8	14.8	2.778	1.181	3.959	3.35	53.60	2.570	1.389
42	0.8560	325.40	278.8	15.1	2.767	1.188	3.955	3.33	53.50	2.571	1.383

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	211.600			1335.900
Moisture content: Dry soil+tare, gms.	203.200			1222.200
Moisture content: Tare, gms.	125.200			134.800
Moisture, %	10.8	10.8	10.8	10.5
Moist specimen weight, gms.	1175.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.57	5.57	5.57	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.5	130.5	130.5	
Dry density, pcf	117.8	117.8	117.8	
Void ratio	0.2558	0.2558	0.2558	
Saturation, %	99.8	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 3.829 tsf at reading no. 40
Ult. Stress = 3.828 tsf at reading no. 41

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	51.60	0.0	0.0	0.000	3.377	3.377	1.00	43.10	3.377	0.000
1	0.0190	185.60	134.0	0.3	1.562	2.340	3.902	1.67	57.50	3.121	0.781
2	0.0400	233.00	181.4	0.7	2.106	1.814	3.920	2.16	64.80	2.867	1.053
3	0.0600	253.00	201.4	1.1	2.330	1.562	3.892	2.49	68.30	2.727	1.165
4	0.0810	263.80	212.2	1.5	2.445	1.433	3.878	2.71	70.10	2.655	1.223
5	0.1010	270.50	218.9	1.8	2.513	1.346	3.860	2.87	71.30	2.603	1.257
6	0.1220	274.60	223.0	2.2	2.550	1.289	3.839	2.98	72.10	2.564	1.275
7	0.1420	281.30	229.7	2.5	2.617	1.260	3.877	3.08	72.50	2.569	1.309
8	0.1620	287.10	235.5	2.9	2.674	1.238	3.912	3.16	72.80	2.575	1.337
9	0.1830	291.30	239.7	3.3	2.711	1.231	3.942	3.20	72.90	2.587	1.355
10	0.2030	297.10	245.5	3.6	2.766	1.224	3.990	3.26	73.00	2.607	1.383
11	0.2240	301.30	249.7	4.0	2.802	1.224	4.026	3.29	73.00	2.625	1.401
12	0.2440	305.40	253.8	4.4	2.838	1.224	4.062	3.32	73.00	2.643	1.419
13	0.2650	309.60	258.0	4.8	2.873	1.224	4.097	3.35	73.00	2.661	1.437
14	0.2850	315.40	263.8	5.1	2.927	1.231	4.158	3.38	72.90	2.695	1.463
15	0.3060	320.40	268.8	5.5	2.970	1.238	4.209	3.40	72.80	2.724	1.485
16	0.3260	326.20	274.6	5.9	3.023	1.246	4.269	3.43	72.70	2.757	1.512
17	0.3460	330.40	278.8	6.2	3.058	1.253	4.310	3.44	72.60	2.782	1.529
18	0.3670	334.60	283.0	6.6	3.091	1.267	4.358	3.44	72.40	2.813	1.546
19	0.3870	341.20	289.6	6.9	3.151	1.282	4.433	3.46	72.20	2.857	1.576
20	0.4080	346.20	294.6	7.3	3.192	1.296	4.488	3.46	72.00	2.892	1.596
21	0.4280	351.20	299.6	7.7	3.234	1.310	4.544	3.47	71.80	2.927	1.617

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	357.00	305.4	8.1	3.283	1.318	4.601	3.49	71.70	2.959	1.642
23	0.4690	359.50	307.9	8.4	3.297	1.332	4.629	3.48	71.50	2.981	1.649
24	0.4890	362.80	311.2	8.8	3.319	1.339	4.659	3.48	71.40	2.999	1.660
25	0.5100	368.70	317.1	9.2	3.368	1.346	4.715	3.50	71.30	3.031	1.684
26	0.5300	374.50	322.9	9.5	3.416	1.361	4.777	3.51	71.10	3.069	1.708
27	0.5510	377.00	325.4	9.9	3.429	1.368	4.797	3.51	71.00	3.082	1.714
28	0.5710	381.20	329.6	10.2	3.459	1.368	4.827	3.53	71.00	3.098	1.730
29	0.5920	384.50	332.9	10.6	3.479	1.382	4.861	3.52	70.80	3.122	1.739
30	0.6120	386.20	334.6	11.0	3.483	1.390	4.872	3.51	70.70	3.131	1.741
31	0.6330	392.00	340.4	11.4	3.528	1.397	4.925	3.53	70.60	3.161	1.764
32	0.6530	397.00	345.4	11.7	3.565	1.411	4.977	3.53	70.40	3.194	1.783
33	0.6730	400.30	348.7	12.1	3.585	1.426	5.010	3.51	70.20	3.218	1.792
34	0.6940	406.10	354.5	12.5	3.629	1.440	5.069	3.52	70.00	3.254	1.814
35	0.7140	410.30	358.7	12.8	3.657	1.454	5.111	3.51	69.80	3.283	1.828
36	0.7350	413.60	362.0	13.2	3.674	1.469	5.143	3.50	69.60	3.306	1.837
37	0.7550	420.30	368.7	13.6	3.727	1.483	5.210	3.51	69.40	3.347	1.863
38	0.7760	423.60	372.0	13.9	3.744	1.498	5.242	3.50	69.20	3.370	1.872
39	0.7960	427.80	376.2	14.3	3.770	1.505	5.275	3.51	69.10	3.390	1.885
40	0.8170	435.30	383.7	14.7	3.829	1.519	5.348	3.52	68.90	3.434	1.914
41	0.8370	436.90	385.3	15.0	3.828	1.526	5.355	3.51	68.80	3.441	1.914

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	184.300			1333.800
Moisture content: Dry soil+tare, gms.	177.100			1230.400
Moisture content: Tare, gms.	107.500			135.300
Moisture, %	10.3	10.4	10.4	9.4
Moist specimen weight, gms.	1185.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.60	5.60	5.60	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.9	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2468	0.2468	0.2468	
Saturation, %	99.3	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 6.758 tsf at reading no. 42
Ult. Stress = 6.758 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	25.00	0.0	0.0	0.000	6.588	6.588	1.00	18.50	6.588	0.000
1	0.0190	88.20	63.2	0.3	0.736	6.458	7.195	1.11	20.30	6.827	0.368
2	0.0400	309.60	284.6	0.7	3.304	5.623	8.927	1.59	31.90	7.275	1.652
3	0.0600	397.00	372.0	1.1	4.303	4.795	9.098	1.90	43.40	6.947	2.152
4	0.0810	428.60	403.6	1.4	4.651	4.234	8.885	2.10	51.20	6.559	2.326
5	0.1010	441.90	416.9	1.8	4.787	3.830	8.617	2.25	56.80	6.224	2.393
6	0.1220	449.40	424.4	2.2	4.854	3.521	8.375	2.38	61.10	5.948	2.427
7	0.1420	460.20	435.2	2.5	4.960	3.283	8.243	2.51	64.40	5.763	2.480
8	0.1620	467.70	442.7	2.9	5.027	3.017	8.044	2.67	68.10	5.530	2.513
9	0.1830	476.00	451.0	3.3	5.101	2.837	7.938	2.80	70.60	5.387	2.551
10	0.2030	483.50	458.5	3.6	5.167	2.693	7.860	2.92	72.60	5.276	2.583
11	0.2240	489.30	464.3	4.0	5.212	2.585	7.797	3.02	74.10	5.191	2.606
12	0.2440	495.20	470.2	4.4	5.258	2.491	7.750	3.11	75.40	5.120	2.629
13	0.2650	505.20	480.2	4.7	5.349	2.419	7.768	3.21	76.40	5.094	2.675
14	0.2850	511.00	486.0	5.1	5.394	2.369	7.762	3.28	77.10	5.066	2.697
15	0.3060	518.50	493.5	5.5	5.455	2.333	7.788	3.34	77.60	5.060	2.728
16	0.3260	526.80	501.8	5.8	5.526	2.304	7.830	3.40	78.00	5.067	2.763
17	0.3460	533.50	508.5	6.2	5.579	2.297	7.875	3.43	78.10	5.086	2.789
18	0.3670	539.30	514.3	6.6	5.620	2.326	7.945	3.42	77.70	5.135	2.810
19	0.3870	548.40	523.4	6.9	5.697	2.275	7.972	3.50	78.40	5.124	2.849
20	0.4080	555.90	530.9	7.3	5.756	2.261	8.016	3.55	78.60	5.139	2.878
21	0.4280	565.90	540.9	7.6	5.841	2.261	8.102	3.58	78.60	5.181	2.921

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	569.20	544.2	8.0	5.853	2.268	8.121	3.58	78.50	5.195	2.927
23	0.4690	575.10	550.1	8.4	5.894	2.282	8.176	3.58	78.30	5.229	2.947
24	0.4890	584.20	559.2	8.7	5.968	2.297	8.265	3.60	78.10	5.281	2.984
25	0.5100	592.50	567.5	9.1	6.031	2.311	8.343	3.61	77.90	5.327	3.016
26	0.5300	599.20	574.2	9.5	6.079	2.333	8.411	3.61	77.60	5.372	3.039
27	0.5510	605.90	580.9	9.8	6.124	2.354	8.479	3.60	77.30	5.416	3.062
28	0.5710	613.30	588.3	10.2	6.178	2.362	8.539	3.62	77.20	5.450	3.089
29	0.5920	617.50	592.5	10.6	6.196	2.405	8.601	3.58	76.60	5.503	3.098
30	0.6120	626.70	601.7	10.9	6.267	2.527	8.794	3.48	74.90	5.661	3.133
31	0.6330	638.30	613.3	11.3	6.361	2.426	8.787	3.62	76.30	5.607	3.180
32	0.6530	644.10	619.1	11.7	6.395	2.448	8.843	3.61	76.00	5.646	3.198
33	0.6730	650.80	625.8	12.0	6.438	2.477	8.915	3.60	75.60	5.696	3.219
34	0.6940	656.60	631.6	12.4	6.470	2.498	8.968	3.59	75.30	5.733	3.235
35	0.7140	662.50	637.5	12.8	6.504	2.506	9.009	3.60	75.20	5.758	3.252
36	0.7350	669.10	644.1	13.1	6.543	2.542	9.085	3.57	74.70	5.813	3.271
37	0.7550	678.30	653.3	13.5	6.609	2.563	9.172	3.58	74.40	5.868	3.305
38	0.7760	684.10	659.1	13.9	6.639	2.585	9.224	3.57	74.10	5.904	3.319
39	0.7960	690.70	665.7	14.2	6.678	2.614	9.291	3.55	73.70	5.952	3.339
40	0.8170	699.10	674.1	14.6	6.732	2.635	9.367	3.55	73.40	6.001	3.366
41	0.8370	701.60	676.6	14.9	6.729	2.700	9.429	3.49	72.50	6.065	3.365
42	0.8570	707.40	682.4	15.3	6.758	2.686	9.444	3.52	72.70	6.065	3.379

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

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Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

April 9, 2007

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Mach Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on March 29, 2007, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification:	Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)
Proctor Test Results:	
Maximum Dry Unit Weight:	120.3 PCF
Optimum Moisture Content:	10.7 %
Specific Gravity:	2.50
Triaxial Test Results:	
Effective Cohesion:	152 PSF
Effective Phi Angle:	29.3 Degrees
Permeability (2 tests):	3 x 10-4 cm./sec.
	2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting



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Permeability Tests Results

Mach Mine
Johnston City, Illinois

Date: 4/9/2007 Client: Williamson Energy

Project No.: H-05278

Boring No.	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse Sample #1		10.9	14.6	115.7	3 x 10-4
Coarse Refuse Sample #2		10.1	14.3	114.7	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

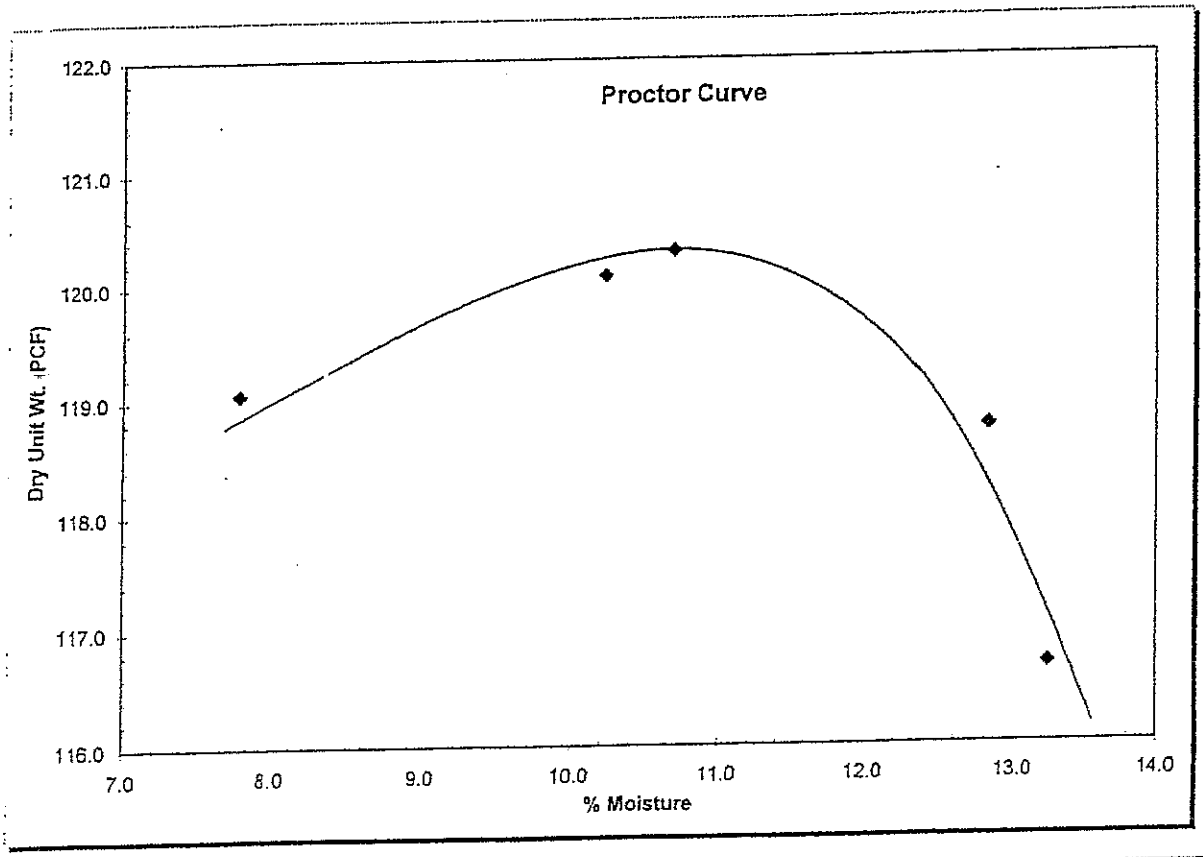
Date: 4/9/2007

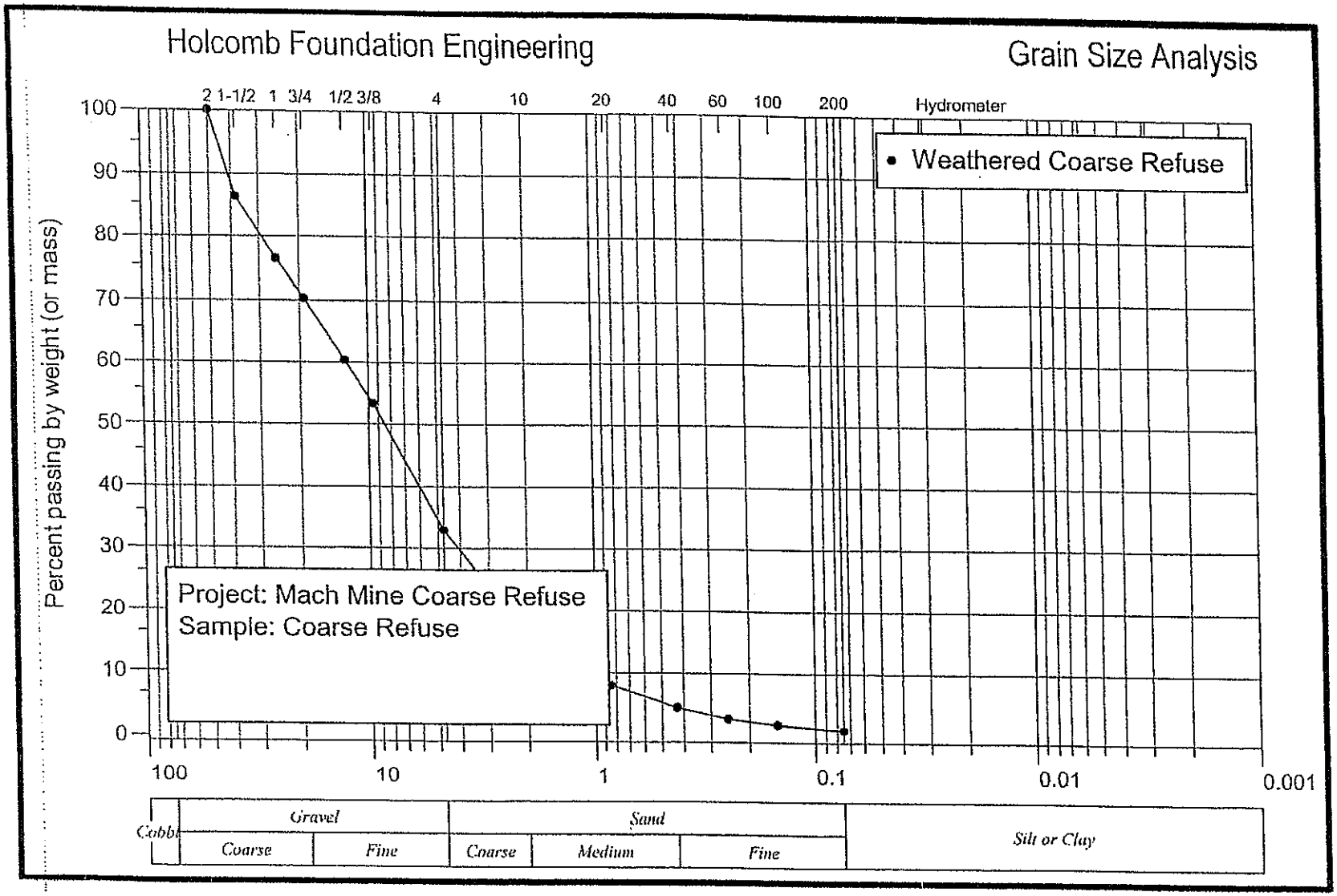
Proctor Test Results

Soil Classification:	Weathered Coarse Refuse
Maximum Dry Density (PCF)	120.3
Optimum Moisture Content (%)	10.7

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
12.8	118.7
13.2	116.7
10.2	120.1
7.8	119.1
10.7	120.3




Holcomb Foundation Engineering
Grain Size Analysis
Percent passing by weight (or mass)
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
100 90 80 70 60 50 40 30 20 10 0
• Weathered Coarse Refuse
Project: Mach Mine Coarse Refuse
Sample: Coarse Refuse
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

R15465

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SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

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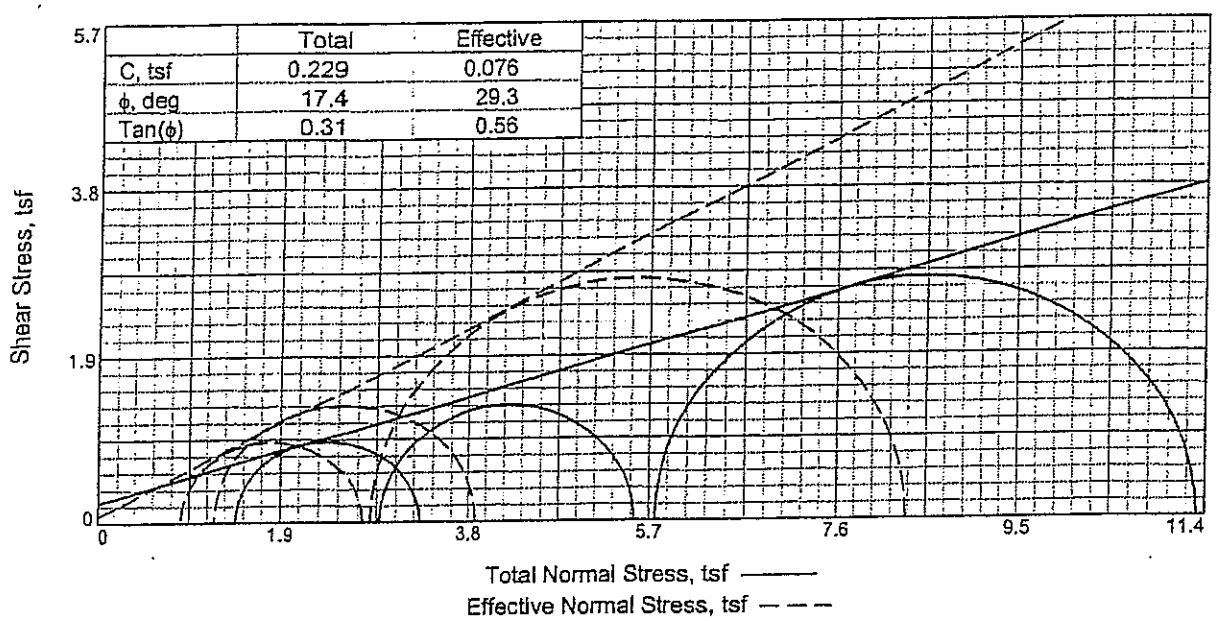
618-529-5262
800-333-1740
FAX 618-457-8991

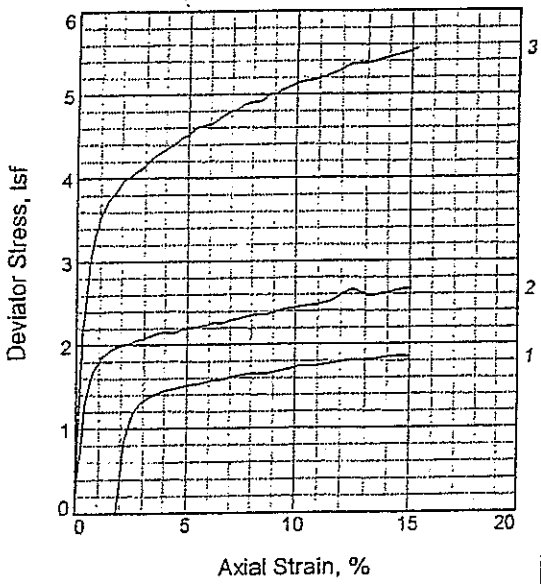
Grain Size Analysis

Project:	Mach Mine	Client:	Mach Mine
Project No.:	H-05278	Date:	4/9/2007
Sample No.	Coarse Refuse	Total Weight:	2290.30

Sieve	Wt. Retained	% Ret.	% Passing
2"	0.0	0.0	100.0
1.5"	314.4	13.7	86.3
1"	536.7	23.4	76.6
3/4"	674.8	29.5	70.5
1/2"	901.6	39.4	60.6
3/8"	1061.2	46.3	53.7
#4	1522.1	66.5	33.5
#10	1911.6	83.5	16.5
#20	2091.9	91.3	8.7
#40	2166.2	94.6	5.4
#60	2202.2	96.2	3.8
#100	2223.7	97.1	2.9
#200	2245.2	98.0	2.0

	Total	Effective
C, tsf	0.229	0.076
ϕ, deg	17.4	29.3
Tan(ϕ)	0.31	0.56





Sample No.		1	2	3
Initial	Water Content,	14.4	12.7	13.1
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	95.1	89.0	90.4
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
At Test	Water Content,	15.2	14.2	14.5
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.60	3.60	1.80
Cell Pressure, tsf		5.04	6.48	7.56
Fail. Stress, tsf		1.85	2.67	5.55
Total Pore Pr., tsf		4.18	5.27	4.77
Ult. Stress, tsf		1.85	2.66	5.55
Total Pore Pr., tsf		4.18	5.22	4.77
$\bar{\sigma}_1$ Failure, tsf		2.71	3.88	8.34
$\bar{\sigma}_3$ Failure, tsf		0.86	1.21	2.79

Type of Test:
CU with Pore Pressures
Sample Type: Coarse Refuse
Description:

Assumed Specific Gravity= 2.50
Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

Location: Weathered Coarse Refuse

Proj. No.: H-05278 **Date:** 4/2/07

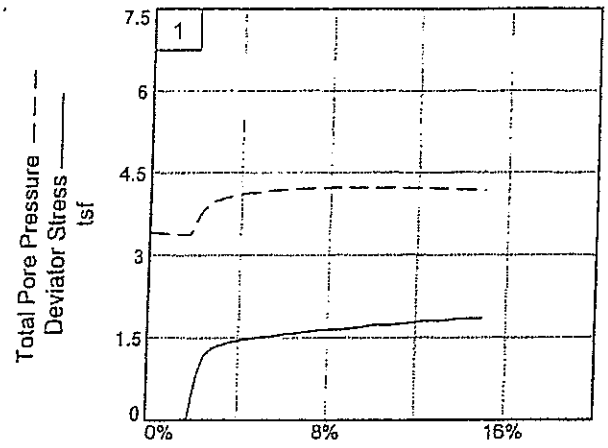
TRIAXIAL SHEAR TEST REPORT

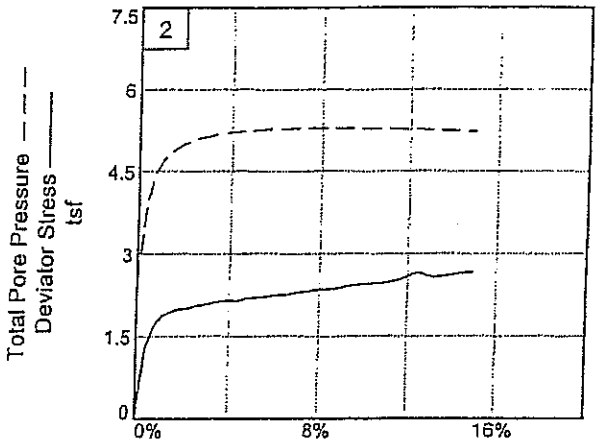
HOLCOMB FOUNDATION ENGINEERING CO.

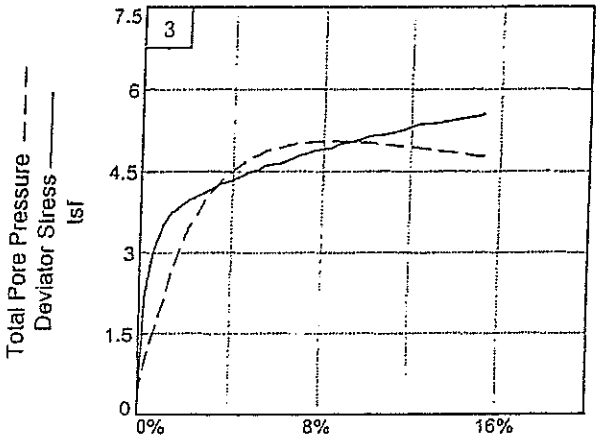
Plate _____

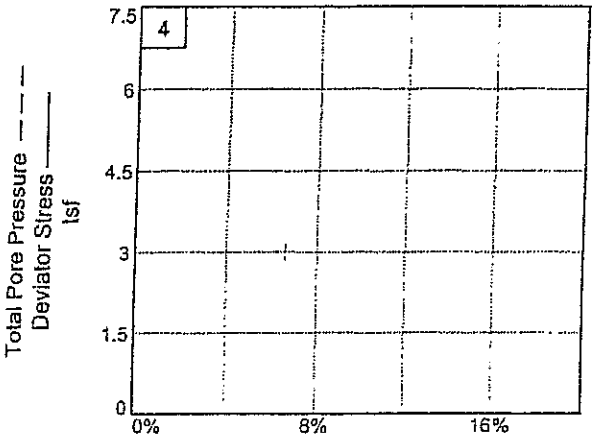
Tested By: LC Checked By: TH

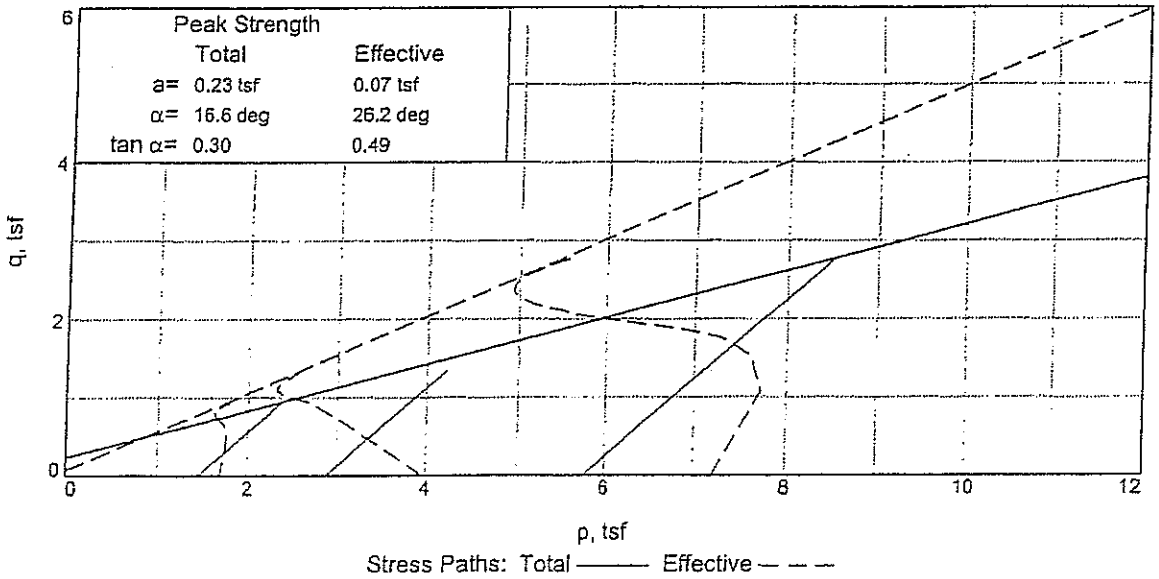
R15468











Stress Paths: Total ——— Effective — — —

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

Location: Weathered Coarse Refuse

Project No.: H-05278

Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

4/9/2007
11:10 AM

Date:	4/2/07
Client:	Pond Creek Mine
Project:	Coarse Refuse Laboratory Tests
Location:	Weathered Coarse Refuse
Description:	
Remarks:	
Type of Sample:	Coarse Refuse
Assumed Specific Gravity=2.50	**LL=** **PL=** **PI=**
Test Method:	COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	179.300			1255.500
Moisture content: Dry soil+tare, gms.	165.700			1117.500
Moisture content: Tare, gms.	71.400			79.600
Moisture, %	14.4	15.2	15.2	13.3
Moist specimen weight, gms.	1170.0			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.59	5.59	5.59	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.5	130.3	130.3	
Dry density, pcf	113.2	113.2	113.2	
Void ratio	0.3793	0.3793	0.3793	
Saturation, %	95.1	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.845 tsf at reading no. 31
Ult. Stress = 1.845 tsf at reading no. 31

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	19.10	0.0	0.0	0.000	1.627	1.627	1.00	47.40	1.627	0.000
1	0.0190	20.00	0.9	0.3	0.001	1.642	1.642	1.00	47.20	1.642	0.000
2	0.0400	20.00	0.9	0.7	0.000	1.656	1.656	1.00	47.00	1.656	0.000
3	0.0600	20.00	0.9	1.1	0.000	1.663	1.663	1.00	46.90	1.663	0.000
4	0.0810	20.00	0.9	1.4	0.000	1.678	1.678	1.00	46.70	1.678	0.000
5	0.1010	25.00	5.9	1.8	0.017	1.678	1.694	1.01	46.70	1.686	0.008
6	0.1220	99.00	79.9	2.2	0.857	1.318	2.175	1.65	51.70	1.746	0.429
7	0.1420	124.00	104.9	2.5	1.195	1.152	2.347	2.04	54.00	1.750	0.598
8	0.1620	134.80	115.7	2.9	1.314	1.058	2.372	2.24	55.30	1.715	0.657
9	0.1830	140.60	121.5	3.3	1.374	1.001	2.375	2.37	56.10	1.688	0.687
10	0.2030	144.80	125.7	3.6	1.416	0.965	2.381	2.47	56.60	1.673	0.708
11	0.2240	148.10	129.0	4.0	1.448	0.936	2.384	2.55	57.00	1.660	0.724
12	0.2440	150.60	131.5	4.4	1.471	0.914	2.385	2.61	57.30	1.650	0.735
13	0.2650	153.10	134.0	4.7	1.493	0.900	2.393	2.66	57.50	1.646	0.746
14	0.2850	155.60	136.5	5.1	1.515	0.878	2.393	2.72	57.80	1.636	0.757
15	0.3060	157.30	138.2	5.5	1.528	0.864	2.392	2.77	58.00	1.628	0.764
16	0.3260	159.80	140.7	5.8	1.549	0.857	2.406	2.81	58.10	1.631	0.775
17	0.3460	162.30	143.2	6.2	1.571	0.850	2.420	2.85	58.20	1.635	0.785
18	0.3670	163.10	144.0	6.6	1.573	0.835	2.408	2.88	58.40	1.622	0.787
19	0.3870	166.40	147.3	6.9	1.603	0.828	2.431	2.94	58.50	1.630	0.802
20	0.4080	168.90	149.8	7.3	1.624	0.821	2.445	2.98	58.60	1.633	0.812
21	0.4490	172.30	153.2	8.0	1.648	0.814	2.461	3.02	58.70	1.637	0.824
22	0.4890	173.90	154.8	8.7	1.652	0.806	2.458	3.05	58.80	1.632	0.826
23	0.5300	178.90	159.8	9.5	1.691	0.806	2.498	3.10	58.80	1.652	0.846
24	0.5710	184.80	165.7	10.2	1.740	0.814	2.553	3.14	58.70	1.683	0.870
25	0.6120	186.40	167.3	10.9	1.742	0.806	2.549	3.16	58.80	1.677	0.871
26	0.6530	190.60	171.5	11.7	1.771	0.821	2.592	3.16	58.60	1.706	0.886
27	0.6940	195.60	176.5	12.4	1.808	0.821	2.628	3.20	58.60	1.725	0.904
28	0.7350	197.20	178.1	13.1	1.809	0.835	2.644	3.17	58.40	1.740	0.904
29	0.7760	201.40	182.3	13.9	1.836	0.842	2.678	3.18	58.30	1.760	0.918
30	0.8170	204.70	185.6	14.6	1.853	0.857	2.710	3.16	58.10	1.783	0.927
31	0.8370	204.70	185.6	15.0	1.845	0.864	2.709	3.14	58.00	1.787	0.923

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	169.900			1238.700
Moisture content: Dry soil+tare, gms.	158.800			1117.200
Moisture content: Tare, gms.	71.200			73.100
Moisture, %	12.7	14.2	14.2	11.6
Moist specimen weight, gms.	1169.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.7	131.5	131.5	
Dry density, pcf	115.1	115.1	115.1	
Void ratio	0.3560	0.3560	0.3560	
Saturation, %	89.0	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²

Membrane thickness = 0.02 cm

Filter paper coefficient = 0.001926 kN/cm

Filter paper coverage = 50%

Consolidation cell pressure = 90.00 psi (6.480 tsf)

Consolidation back pressure = 50.00 psi (3.600 tsf)

Consolidation effective confining stress = 2.880 tsf

Strain rate, in./min. = 0.00

Fail. Stress = 2.666 tsf at reading no. 27

Ult. Stress = 2.663 tsf at reading no. 31

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	62.40	0.0	0.0	0.000	3.967	3.967	1.00	34.90	3.967	0.000
1	0.0220	173.10	110.7	0.4	1.289	2.484	3.773	1.52	55.50	3.129	0.645
2	0.0420	206.40	144.0	0.8	1.671	2.016	3.687	1.83	62.00	2.852	0.836
3	0.0620	223.00	160.6	1.1	1.857	1.764	3.621	2.05	65.50	2.693	0.929
4	0.0830	230.50	168.1	1.5	1.936	1.613	3.549	2.20	67.60	2.581	0.968
5	0.1030	235.50	173.1	1.8	1.987	1.512	3.499	2.31	69.00	2.505	0.993
6	0.1240	238.00	175.6	2.2	2.008	1.447	3.455	2.39	69.90	2.451	1.004
7	0.1440	242.20	179.8	2.6	2.048	1.390	3.438	2.47	70.70	2.414	1.024
8	0.1650	245.50	183.1	3.0	2.078	1.346	3.424	2.54	71.30	2.385	1.039
9	0.1850	248.80	186.4	3.3	2.107	1.310	3.418	2.61	71.80	2.364	1.054
10	0.2060	252.20	189.8	3.7	2.137	1.289	3.426	2.66	72.10	2.358	1.069
11	0.2260	254.70	192.3	4.0	2.158	1.267	3.425	2.70	72.40	2.346	1.079
12	0.2460	253.80	191.4	4.4	2.139	1.253	3.392	2.71	72.60	2.322	1.070
13	0.2670	258.80	196.4	4.8	2.187	1.238	3.425	2.77	72.80	2.332	1.093
14	0.2870	260.50	198.1	5.1	2.197	1.231	3.428	2.78	72.90	2.330	1.099
15	0.3080	263.00	200.6	5.5	2.216	1.217	3.433	2.82	73.10	2.325	1.108
16	0.3280	265.50	203.1	5.9	2.235	1.210	3.445	2.85	73.20	2.327	1.118
17	0.3490	268.80	206.4	6.3	2.263	1.210	3.472	2.87	73.20	2.341	1.131
18	0.3690	268.80	206.4	6.6	2.254	1.202	3.456	2.87	73.30	2.329	1.127
19	0.3900	273.00	210.6	7.0	2.290	1.195	3.486	2.92	73.40	2.340	1.145
20	0.4100	275.50	213.1	7.3	2.309	1.195	3.504	2.93	73.40	2.350	1.154
21	0.4510	281.30	218.9	8.1	2.353	1.188	3.541	2.98	73.50	2.364	1.176

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4920	284.60	222.2	8.8	2.369	1.195	3.564	2.98	73.40	2.380	1.185
23	0.5330	292.10	229.7	9.6	2.429	1.195	3.625	3.03	73.40	2.410	1.215
24	0.5740	296.30	233.9	10.3	2.454	1.202	3.656	3.04	73.30	2.429	1.227
25	0.6140	300.40	238.0	11.0	2.477	1.202	3.679	3.06	73.30	2.441	1.238
26	0.6440	305.40	243.0	11.5	2.514	1.217	3.730	3.07	73.10	2.474	1.257
27	0.6960	322.90	260.5	12.5	2.666	1.210	3.876	3.20	73.20	2.543	1.333
28	0.7370	316.20	253.8	13.2	2.576	1.238	3.814	3.08	72.80	2.526	1.288
29	0.7780	322.10	259.7	13.9	2.613	1.238	3.852	3.11	72.80	2.545	1.307
30	0.8190	328.70	266.3	14.7	2.657	1.253	3.910	3.12	72.60	2.581	1.328
31	0.8390	330.40	268.0	15.0	2.663	1.260	3.923	3.11	72.50	2.591	1.331

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	171.400			1284.500
Moisture content: Dry soil+tare, gms.	160.000			1180.500
Moisture content: Tare, gms.	72.800			134.900
Moisture, %	13.1	14.5	14.5	9.9
Moist specimen weight, gms.	1168.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.6	131.2	131.2	
Dry density, pcf	114.6	114.6	114.6	
Void ratio	0.3615	0.3615	0.3615	
Saturation, %	90.4	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 105.00 psi (7.560 tsf)
Consolidation back pressure = 25.00 psi (1.800 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 5.549 tsf at reading no. 35
Ult. Stress = 5.549 tsf at reading no. 35

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0020	102.40	0.0	0.0	0.000	7.207	7.207	1.00	4.90	7.207	0.000
1	0.0170	286.30	183.9	0.3	2.145	6.674	8.819	1.32	12.30	7.747	1.072
2	0.0370	364.50	262.1	0.6	3.046	6.113	9.158	1.50	20.10	7.636	1.523
3	0.0580	407.00	304.6	1.0	3.526	5.537	9.063	1.64	28.10	7.300	1.763
4	0.0780	426.10	323.7	1.4	3.733	4.997	8.730	1.75	35.60	6.864	1.867
5	0.0990	437.70	335.3	1.7	3.853	4.536	8.389	1.85	42.00	6.462	1.926
6	0.1190	449.40	347.0	2.1	3.972	4.133	8.105	1.96	47.60	6.119	1.986
7	0.1400	457.70	355.3	2.5	4.052	3.838	7.889	2.06	51.70	5.863	2.026

Test Readings for Specimen No. 3

No.	Def. Dial In.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
8	0.1600	464.40	362.0	2.8	4.113	3.593	7.706	2.14	55.10	5.649	2.056
9	0.1810	474.40	372.0	3.2	4.210	3.384	7.594	2.24	58.00	5.489	2.105
10	0.2010	481.90	379.5	3.6	4.279	3.211	7.490	2.33	60.40	5.351	2.140
11	0.2210	487.70	385.3	3.9	4.328	3.074	7.403	2.41	62.30	5.239	2.164
12	0.2420	495.20	392.8	4.3	4.395	2.959	7.355	2.49	63.90	5.157	2.198
13	0.2620	503.50	401.1	4.7	4.471	2.851	7.323	2.57	65.40	5.087	2.236
14	0.2830	509.30	406.9	5.0	4.518	2.772	7.290	2.63	66.50	5.031	2.259
15	0.3030	519.30	416.9	5.4	4.612	2.693	7.305	2.71	67.60	4.999	2.306
16	0.3240	522.60	420.2	5.8	4.630	2.650	7.279	2.75	68.20	4.965	2.315
17	0.3440	526.00	423.6	6.1	4.650	2.621	7.270	2.77	68.60	4.946	2.325
18	0.3650	534.30	431.9	6.5	4.722	2.578	7.299	2.83	69.20	4.938	2.361
19	0.3850	541.80	439.4	6.9	4.785	2.549	7.334	2.88	69.60	4.941	2.393
20	0.4050	546.80	444.4	7.2	4.821	2.534	7.355	2.90	69.80	4.945	2.411
21	0.4260	553.40	451.0	7.6	4.873	2.520	7.393	2.93	70.00	4.956	2.436
22	0.4460	558.40	456.0	8.0	4.908	2.506	7.413	2.96	70.20	4.959	2.454
23	0.4670	560.90	458.5	8.3	4.914	2.506	7.420	2.96	70.20	4.963	2.457
24	0.4870	569.20	466.8	8.7	4.984	2.506	7.489	2.99	70.20	4.997	2.492
25	0.5080	574.20	471.8	9.1	5.016	2.513	7.529	3.00	70.10	5.021	2.508
26	0.5280	580.10	477.7	9.4	5.059	2.520	7.579	3.01	70.00	5.050	2.530
27	0.5690	592.50	490.1	10.2	5.148	2.534	7.683	3.03	69.80	5.109	2.574
28	0.6100	600.00	497.6	10.9	5.184	2.570	7.755	3.02	69.30	5.163	2.592
29	0.6510	610.90	508.5	11.6	5.254	2.599	7.853	3.02	68.90	5.226	2.627
30	0.6920	625.80	523.4	12.4	5.363	2.628	7.991	3.04	68.50	5.310	2.682
31	0.7330	631.70	529.3	13.1	5.378	2.671	8.049	3.01	67.90	5.360	2.689
32	0.7730	641.60	539.2	13.8	5.434	2.707	8.141	3.01	67.40	5.424	2.717
33	0.8140	651.60	549.2	14.6	5.487	2.750	8.238	3.00	66.80	5.494	2.744
34	0.8350	656.60	554.2	14.9	5.513	2.772	8.285	2.99	66.50	5.528	2.756
35	0.8540	662.50	560.1	15.3	5.549	2.786	8.335	2.99	66.30	5.561	2.775

APPENDIX D

Boring Logs

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 8874

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6
Water Content (%)
Standard N Penetration, Blows/Ft.
10 20 30 40 50 60

Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Brown Silty CLAY (CL) with sand and pebbles
5	1	st		
	2	st		
10				Gray Mottled Brown Silty CLAY (CL)
	3	st		
15	4	st		
	5	st		
20				End of Boring @ -20.0'
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling and None Upon Completion.

Mach #1 Mine Soils Investigation
Mach #1 Mine Williamson County Illinois

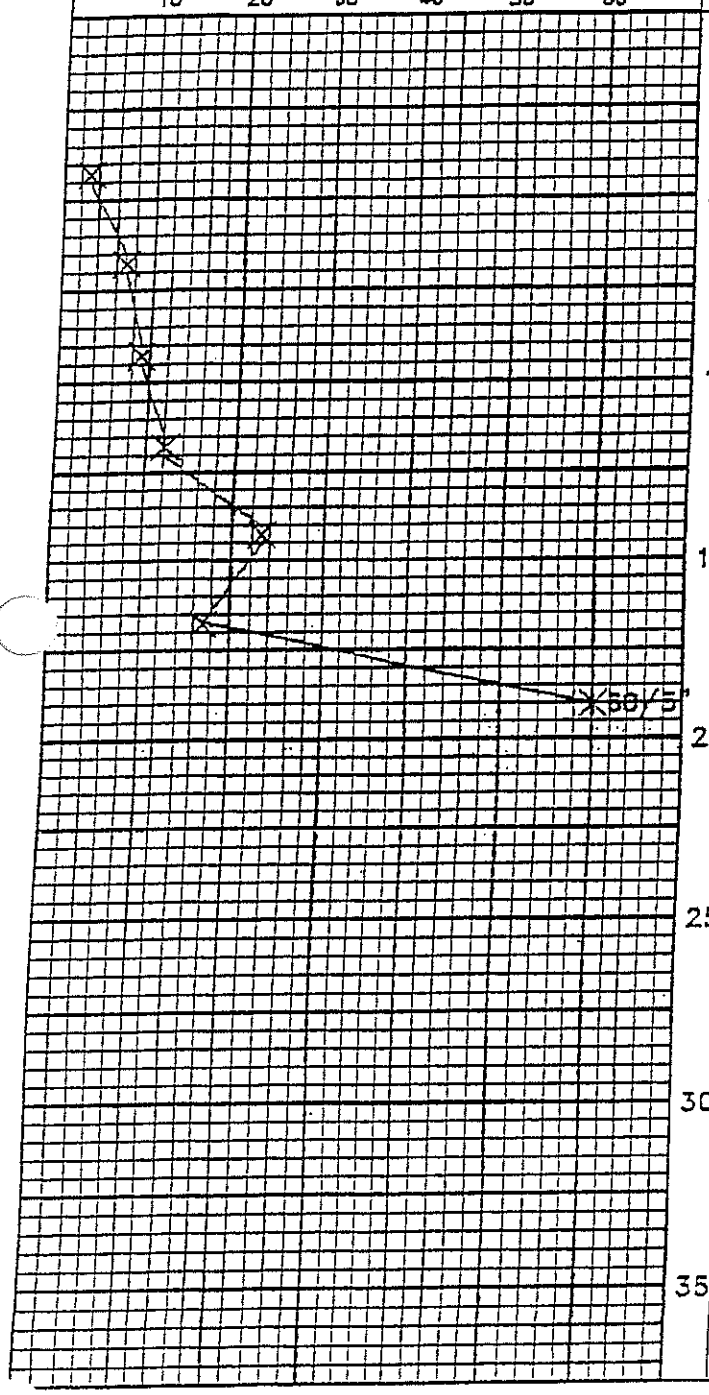
Date of Boring
February 1, 2006

Client:
Alliance Consulting, Inc.
Beaver, West Virginia

Project No.
H-05278

LOG of BORING B293

Holcomb Foundation Engineering Co.



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				7" Topsoil
				Gray Mottled Brown Silty CLAY (CL) with trace of sand
	1	ss		
	2	ss		
	3	ss		
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
	4	ss		
	5	ss		
	6	ss		
	7	ss		Gray SHALE
				End of Boring @ −19.0'

Ground Water Data
Ground Water Encountered @ −12.0' During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

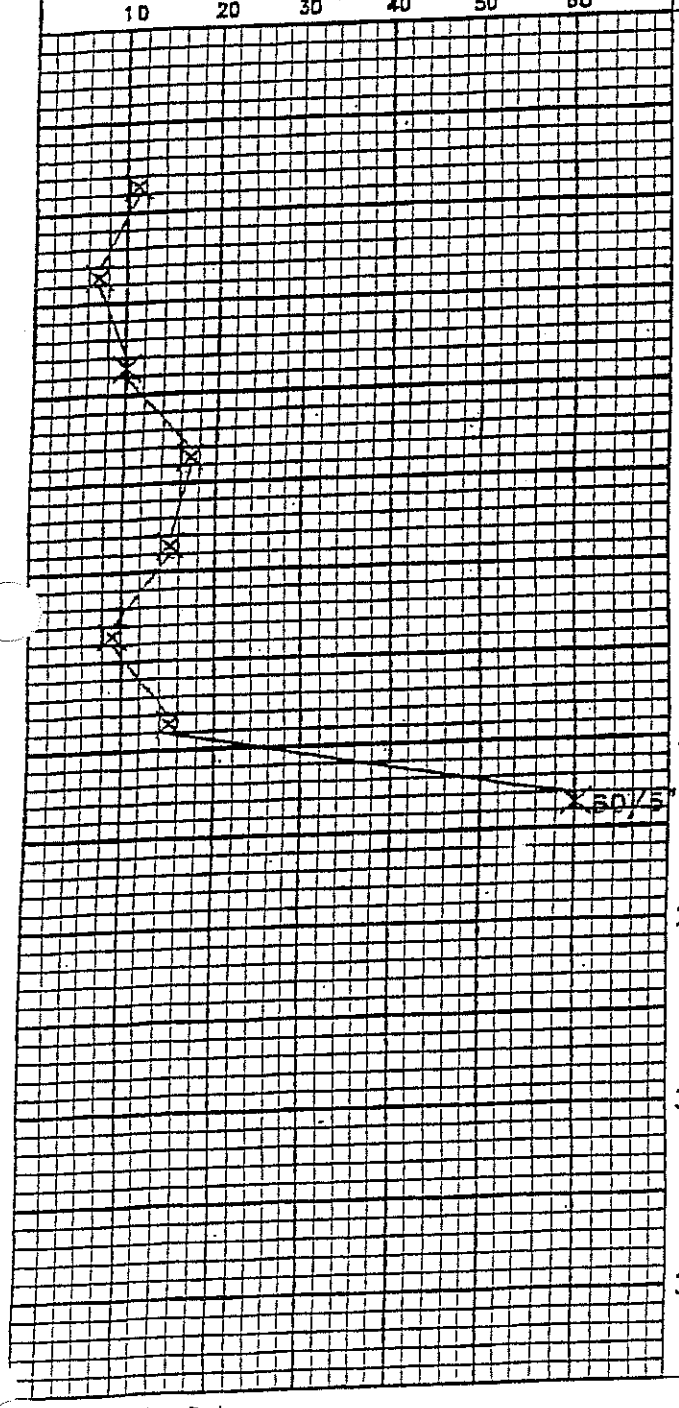
Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

LOG of BORING B294

Holcomb Foundation Engineering Co.

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6
Water Content (%)
Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				7" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
	1	ss		
5	2	ss		
	3	ss		
10	4	ss		
	5	ss		
15	6	ss		
	7	ss		
20	8	ss		Brown SHALE
				End of Boring @ -22.5'
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

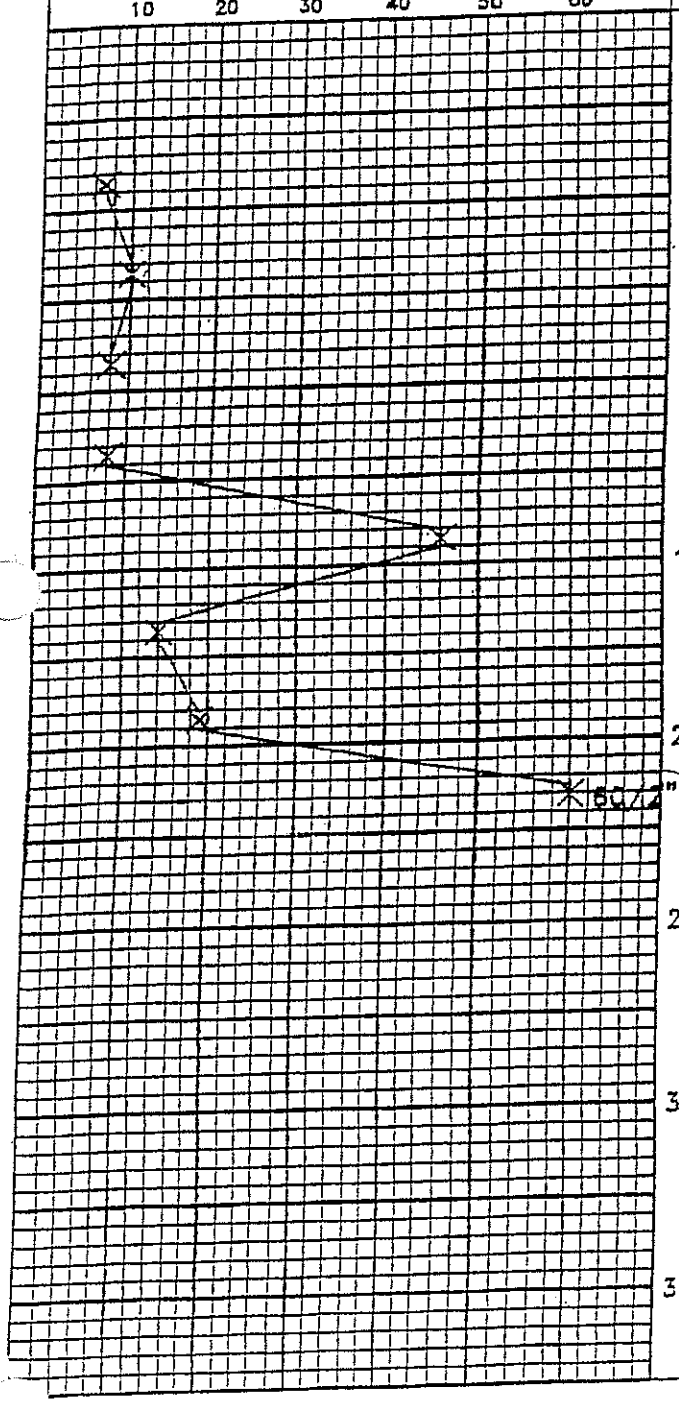
Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

LOG of BORING B295

Holcomb Foundation Engineering Co.

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6
Water Content (%)
Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				9" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
	1	SS		
5	2	SS		
	3	SS		
10	4	SS		
	5	SS		Brown SILT (ML)
15	6	SS		Brown Medium to Coarse SAND (SC-SP)
	7	SS		
20	8	SS		Gray Mottled Brown SHALE
				End of Boring @ -22.0'
25				
30				
35				

Ground Water Data
Ground Water Encountered @ -16.0' During Drilling/ @ -10.0' Upon Completion.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

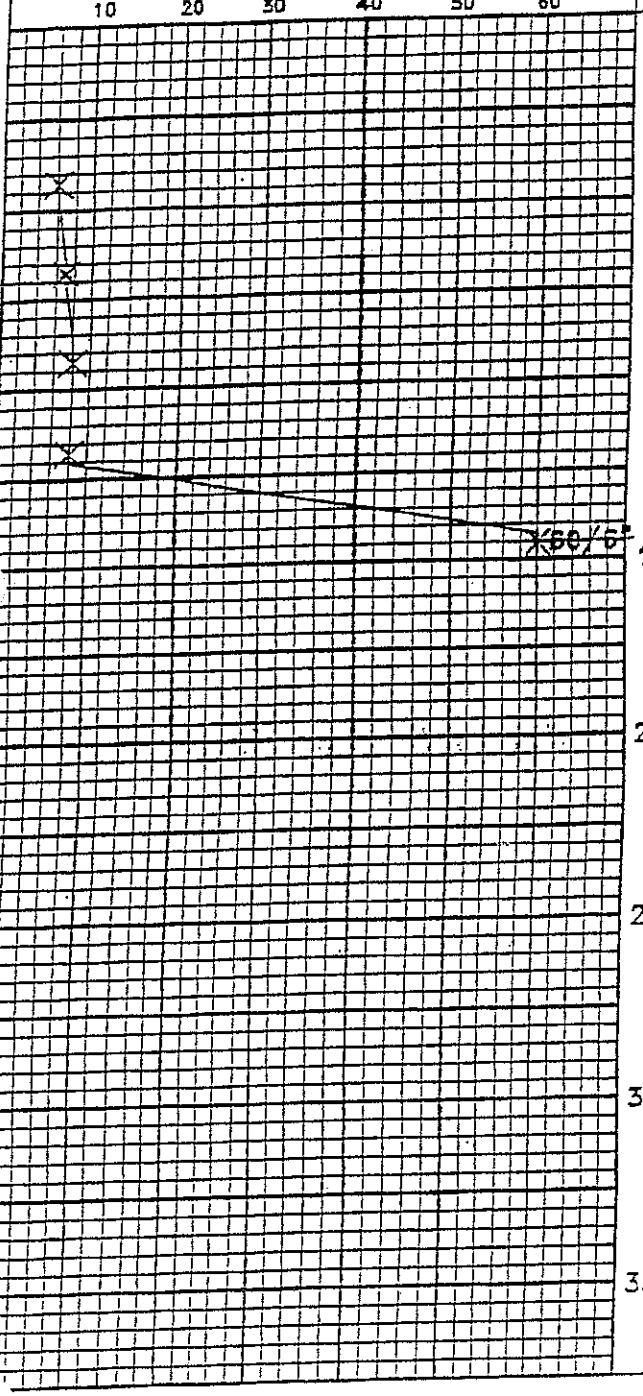
Date of Boring: December 5, 2005

Client: Williamson County Energy

Project No.: H-05278

LOG of BORING 8297

Holcomb Foundation Engineering Co.



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				9" Topsoil
				Gray Mottled Brown Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
	3	ss		Brown Mottled Gray Silty CLAY (CL) with trace of sand
10	4	ss		Gray Mottled Brown Silty CLAY (CL) with trace of sand
15	5	ss		Brown SHALE
				End of Boring @ -15.5'
20				
25				
30				
35				

und Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring: December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.: H-05278

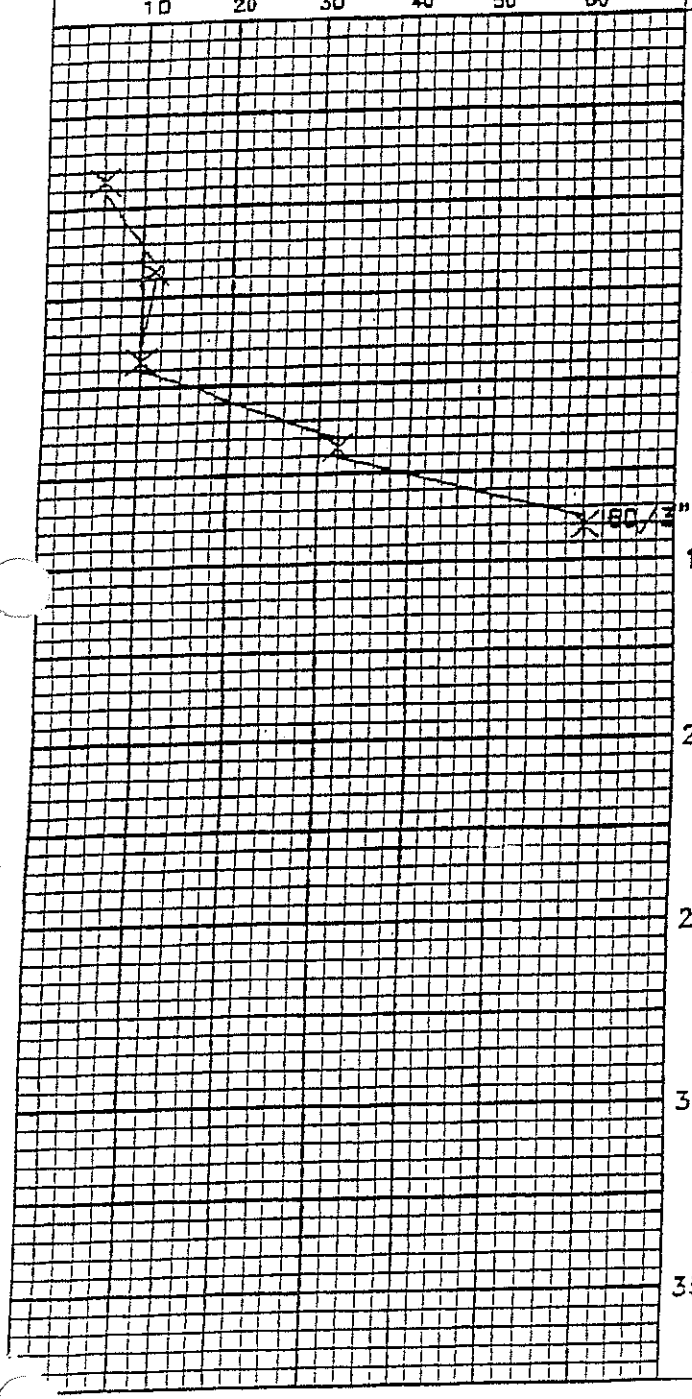
LOG of BORING 8298

Holcomb Foundation Engineering Co.

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				6" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
	3	ss		Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
10	4	ss		Brown Mottled Gray SHALE
	5	ss		Gray SHALE
15				End of Boring @ −14.5'
20				
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

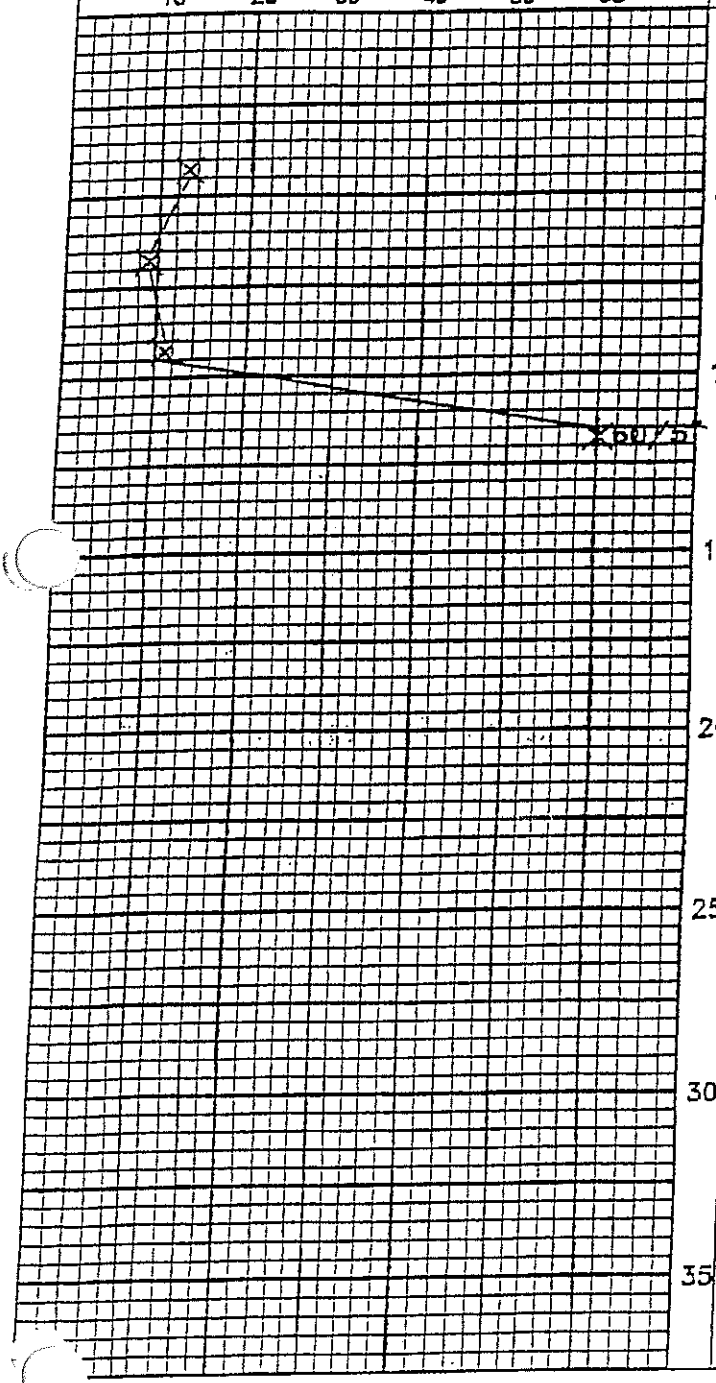
Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

LOG of BORING 8299

Holcomb Foundation Engineering Co.



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	SS		
	2	SS		
10	3	SS		
	4	SS		Brown SHALE
				End of Boring @ -12.5'
15				
20				
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

Client: Williamson County Energy

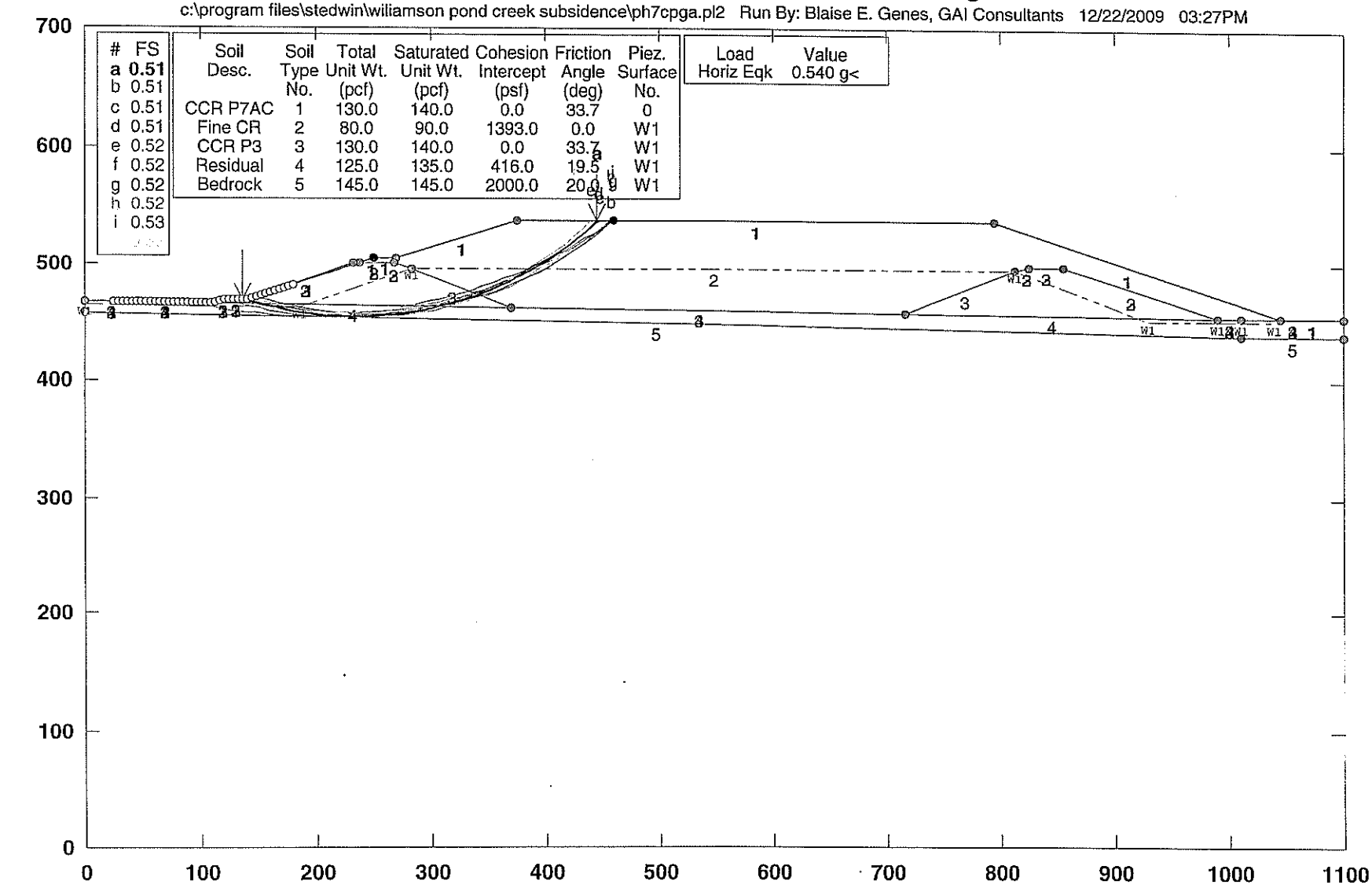
Project No.
H-05278

APPENDIX C

PSEUDO-STATIC SLOPE STABILITY ANALYSES RESULTS
SEISMIC FACTOR OF SAFETY AND YIELD ACCELERATION

Pond Creek, Phase 7C South - 80% Sup FCR- PGA=.54g Pseudo-Static

c:\program files\stedwin\wiliamson pond creek subsidence\ph7cpga.pl2 Run By: Blaise E. Genes, GAI Consultants 12/22/2009 03:27PM



#	FS
a	0.51
b	0.51
c	0.51
d	0.51
e	0.52
f	0.52
g	0.52
h	0.52
i	0.53

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR P7AC	1	130.0	140.0	0.0	33.7	0
Fine CR	2	80.0	90.0	1393.0	0.0	W1
CCR P3	3	130.0	140.0	0.0	33.7	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1

Load	Value
Horiz Eqk	0.540 g<

PCSTABL5M/si FSmin=0.51

Safety Factors Are Calculated By The Modified Bishop Method

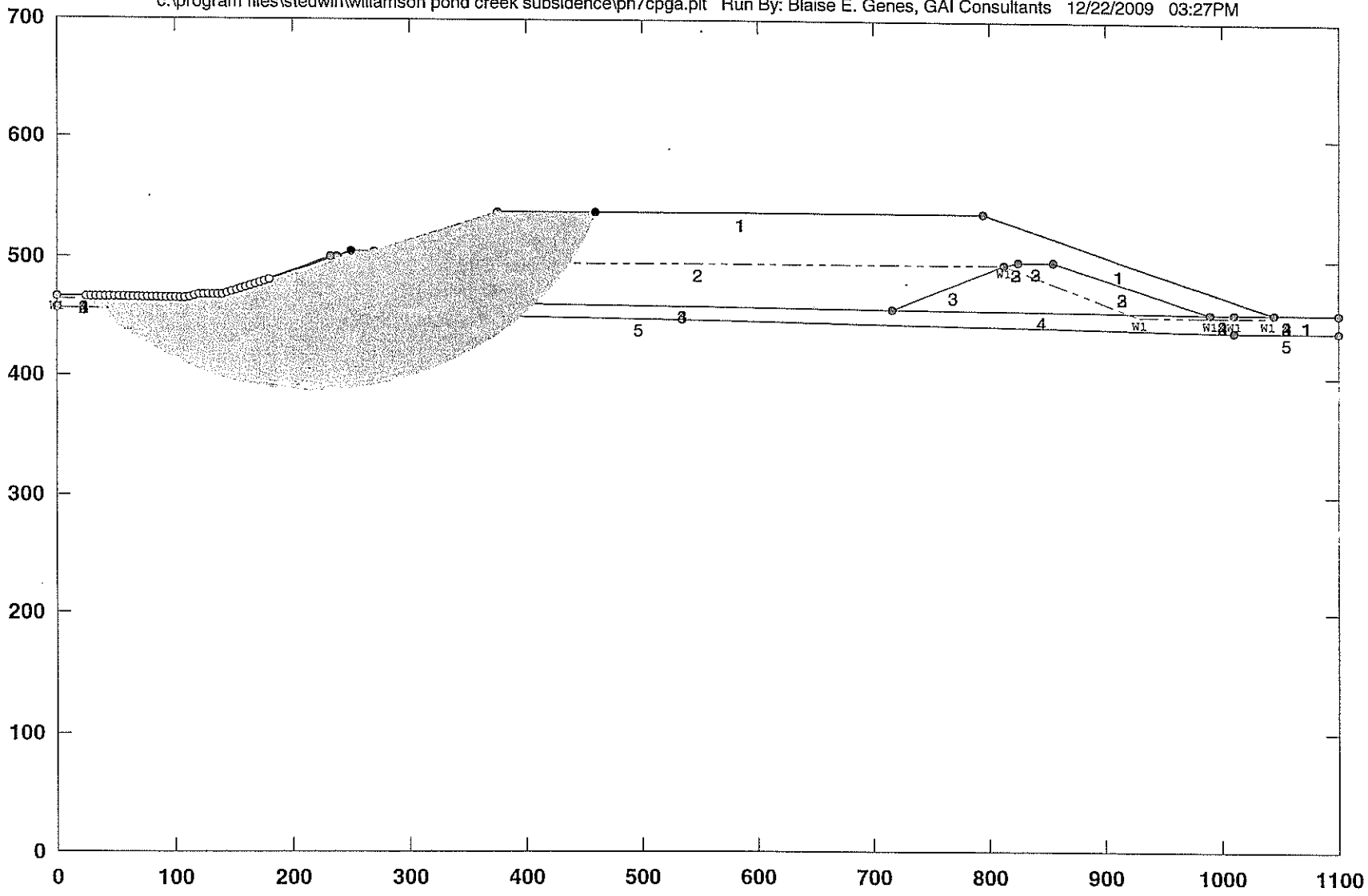
STED



R15483

Pond Creek, Phase 7C South - 80% Sup FCR- PGA=.54g Pseudo-Static

c:\program files\stedwin\williamson pond creek subsidence\ph7cpga.plt Run By: Blaise E. Genes, GAI Consultants 12/22/2009 03:27PM



STED

R15484

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 12/22/2009
Time of Run: 03:27PM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph7cPGA.in
Output Filename: C:ph7cPGA.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph7cPGA.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 7C South - 80% Sup FCR
- PGA=.54g Pseudo-Static
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

11 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1
5	140.00	468.00	238.00	500.00	1
6	238.00	500.00	250.00	505.00	1
7	250.00	505.00	270.00	505.00	1
8	270.00	505.00	375.00	538.00	1
9	375.00	538.00	795.00	538.00	1
10	795.00	538.00	1045.00	454.00	1
11	1045.00	454.00	1100.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1100.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1100.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4

45	990.00	454.00	1010.00	454.00	4
46	1010.00	454.00	1100.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1100.00	439.00	5

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	0
2	80.0	90.0	1393.0	.0	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Horizontal Earthquake Loading Coefficient
Of .540 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
1600 Trial Surfaces Have Been Generated.
40 Surfaces Initiate From Each Of 40 Points Equally Spaced
Along The Ground Surface Between X = 25.00 ft.
and X = 180.00 ft.
Each Surface Terminates Between X = 250.00 ft.
and X = 460.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.28	468.00
2	145.82	465.01
3	155.46	462.32
4	165.17	459.95
5	174.96	457.90
6	184.81	456.17
7	194.71	454.76
8	204.65	453.67
9	214.62	452.90
10	224.61	452.46
11	234.61	452.34
12	244.61	452.55
13	254.59	453.09
14	264.56	453.94
15	274.49	455.12
16	284.37	456.63
17	294.20	458.45

18	303.97	460.59
19	313.67	463.05
20	323.27	465.82
21	332.79	468.91
22	342.19	472.30
23	351.49	475.99
24	360.65	479.98
25	369.69	484.27
26	378.58	488.86
27	387.31	493.72
28	395.88	498.87
29	404.29	504.30
30	412.51	509.99
31	420.54	515.95
32	428.37	522.17
33	436.00	528.64
34	443.41	535.35
35	446.15	538.00

Circle Center At X = 233.2 ; Y = 760.0 and Radius, 307.7

*** .506 ***

Individual data on the 49 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.7	282.0	.0	.0	.0	.0	152.3	.0	.0
2	5.8	2295.1	.0	.0	.0	.0	1239.4	.0	.0
3	2.7	1985.6	.0	.0	.0	.0	1072.2	.0	.0
4	7.0	7764.7	.0	.0	.0	.0	4193.0	.0	.0
5	4.3	6636.2	.0	.0	.0	.0	3583.5	.0	.0
6	5.4	10302.5	.0	219.2	.0	.0	5563.4	.0	.0
7	9.8	24012.8	.0	1394.1	.0	.0	12966.9	.0	.0
8	9.8	30782.9	.0	2508.5	.0	.0	16622.8	.0	.0
9	.2	663.1	.0	58.6	.0	.0	358.1	.0	.0
10	7.0	25759.1	.0	2736.6	.0	.0	13909.9	.0	.0
11	2.7	10901.0	.0	1452.8	.0	.0	5886.6	.0	.0
12	9.9	43666.5	.0	7015.0	.0	.0	23579.9	.0	.0
13	10.0	49591.5	.0	9602.2	.0	.0	26779.4	.0	.0
14	10.0	55069.2	.0	12003.2	.0	.0	29737.3	.0	.0
15	8.4	50089.1	.0	11785.3	.0	.0	27048.1	.0	.0
16	1.6	9985.1	.0	2430.0	.0	.0	5392.0	.0	.0
17	3.4	21424.8	.0	5291.6	.0	.0	11569.4	.0	.0
18	6.6	43415.3	.0	10944.8	.0	.0	23444.2	.0	.0
19	5.4	37150.5	.0	9541.7	.0	.0	20061.3	.0	.0
20	4.6	32216.4	.0	8522.6	.0	.0	17396.9	.0	.0
21	10.0	69400.0	.0	19697.0	.0	.0	37476.0	.0	.0
22	3.4	23777.8	.0	7179.0	.0	.0	12840.0	.0	.0
23	2.0	13737.6	.0	4242.2	.0	.0	7418.3	.0	.0
24	4.5	31037.8	.0	9711.6	.0	.0	16760.4	.0	.0
25	8.5	60318.3	.0	19198.0	.0	.0	32571.9	.0	.0
26	1.4	9886.6	.0	3331.7	.0	.0	5338.8	.0	.0
27	9.8	70655.5	.0	23375.5	.0	.0	38154.0	.0	.0
28	9.8	69572.7	.0	22138.4	.0	.0	37569.3	.0	.0
29	2.5	17523.6	.0	5445.1	.0	.0	9462.7	.0	.0
30	7.2	50436.8	.0	15258.0	.0	.0	27235.9	.0	.0
31	9.6	65774.3	.0	19071.3	.0	.0	35518.1	.0	.0
32	9.5	63110.8	.0	17244.7	.0	.0	34079.8	.0	.0
33	8.0	50889.5	.0	13008.8	.0	.0	27480.4	.0	.0
34	1.5	9147.2	.0	2216.3	.0	.0	4939.5	.0	.0
35	9.3	58698.3	.0	13014.8	.0	.0	31697.1	.0	.0
36	9.2	58194.7	.0	10616.1	.0	.0	31425.1	.0	.0
37	9.0	57331.3	.0	8031.5	.0	.0	30958.9	.0	.0
38	5.3	33592.3	.0	3489.4	.0	.0	18139.9	.0	.0
39	3.6	22268.6	.0	1774.3	.0	.0	12025.1	.0	.0
40	8.7	51748.2	.0	2315.7	.0	.0	27944.0	.0	.0
41	2.1	12010.0	.0	98.9	.0	.0	6485.4	.0	.0
42	6.4	34410.7	.0	.0	.0	.0	18581.8	.0	.0

43	8.4	39769.7	.0	.0	.0	.0	21475.6	.0	.0
44	8.2	32972.9	.0	.0	.0	.0	17805.4	.0	.0
45	8.0	26130.1	.0	.0	.0	.0	14110.2	.0	.0
46	7.8	19287.2	.0	.0	.0	.0	10415.1	.0	.0
47	7.6	12491.4	.0	.0	.0	.0	6745.3	.0	.0
48	7.4	5790.1	.0	.0	.0	.0	3126.7	.0	.0
49	2.7	473.2	.0	.0	.0	.0	255.5	.0	.0

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.23	469.38
2	153.75	466.32
3	163.36	463.56
4	173.06	461.12
5	182.83	458.99
6	192.66	457.17
7	202.55	455.68
8	212.48	454.50
9	222.45	453.65
10	232.43	453.12
11	242.43	452.91
12	252.43	453.02
13	262.42	453.45
14	272.39	454.21
15	282.33	455.29
16	292.23	456.69
17	302.09	458.40
18	311.88	460.44
19	321.60	462.78
20	331.24	465.45
21	340.79	468.42
22	350.23	471.69
23	359.57	475.27
24	368.79	479.15
25	377.87	483.33
26	386.82	487.79
27	395.62	492.54
28	404.26	497.58
29	412.74	502.89
30	421.03	508.47
31	429.15	514.31
32	437.07	520.41
33	444.79	526.77
34	452.30	533.37
35	457.24	538.00

Circle Center At X = 244.0 ; Y = 762.9 and Radius, 310.0

*** .507 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.39	468.00
2	129.98	465.19
3	139.66	462.66
4	149.40	460.42
5	159.21	458.46
6	169.07	456.78
7	178.97	455.40
8	188.91	454.30
9	198.88	453.49
10	208.86	452.97
11	218.86	452.75
12	228.86	452.81
13	238.85	453.17
14	248.83	453.81
15	258.79	454.75
16	268.71	455.98
17	278.60	457.49

18	288.44	459.30
19	298.21	461.38
20	307.93	463.76
21	317.57	466.41
22	327.13	469.34
23	336.60	472.55
24	345.97	476.04
25	355.24	479.79
26	364.40	483.82
27	373.43	488.11
28	382.34	492.66
29	391.10	497.47
30	399.73	502.53
31	408.20	507.84
32	416.52	513.39
33	424.67	519.19
34	432.65	525.22
35	440.44	531.47
36	448.06	537.96
37	448.11	538.00

Circle Center At X = 221.6 ; Y = 796.1 and Radius, 343.4

*** .507 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.26	468.08
2	149.82	465.16
3	159.47	462.54
4	169.20	460.24
5	179.01	458.26
6	188.87	456.60
7	198.78	455.27
8	208.73	454.25
9	218.70	453.56
10	228.69	453.20
11	238.69	453.16
12	248.69	453.45
13	258.67	454.06
14	268.63	455.00
15	278.55	456.26
16	288.42	457.85
17	298.24	459.76
18	307.99	461.98
19	317.66	464.52
20	327.24	467.38
21	336.73	470.54
22	346.11	474.01
23	355.37	477.79
24	364.50	481.87
25	373.49	486.24
26	382.34	490.90
27	391.03	495.85
28	399.55	501.08
29	407.90	506.58
30	416.06	512.36
31	424.04	518.39
32	431.81	524.69
33	439.37	531.23
34	446.70	538.00

Circle Center At X = 234.9 ; Y = 760.0 and Radius, 306.9

*** .509 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.23	469.38
2	153.74	466.28
3	163.35	463.51

4	173.05	461.08
5	182.83	458.99
6	192.67	457.24
7	202.57	455.84
8	212.52	454.78
9	222.49	454.08
10	232.49	453.72
11	242.49	453.71
12	252.48	454.05
13	262.46	454.74
14	272.40	455.78
15	282.31	457.17
16	292.16	458.90
17	301.94	460.97
18	311.64	463.39
19	321.26	466.14
20	330.77	469.22
21	340.17	472.64
22	349.44	476.39
23	358.57	480.45
24	367.56	484.83
25	376.39	489.53
26	385.05	494.53
27	393.53	499.83
28	401.82	505.42
29	409.91	511.30
30	417.79	517.45
31	425.45	523.88
32	432.88	530.58
33	440.07	537.53
34	440.53	538.00

Circle Center At X = 237.7 ; Y = 739.7 and Radius, 286.0

*** .519 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.28	468.00
2	146.00	465.65
3	155.78	463.57
4	165.62	461.76
5	175.50	460.21
6	185.42	458.94
7	195.37	457.93
8	205.34	457.20
9	215.33	456.74
10	225.33	456.55
11	235.33	456.63
12	245.32	456.98
13	255.30	457.61
14	265.26	458.51
15	275.19	459.68
16	285.09	461.12
17	294.94	462.83
18	304.74	464.80
19	314.49	467.04
20	324.17	469.55
21	333.78	472.32
22	343.31	475.35
23	352.75	478.64
24	362.10	482.18
25	371.35	485.98
26	380.50	490.03
27	389.53	494.32
28	398.44	498.86
29	407.22	503.64
30	415.87	508.66
31	424.38	513.91

32	432.74	519.40
33	440.96	525.10
34	449.01	531.03
35	456.90	537.18
36	457.89	538.00

Circle Center At X = 227.3 ; Y = 823.7 and Radius, 367.1

*** .519 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.21	470.68
2	157.78	467.79
3	167.44	465.20
4	177.18	462.92
5	186.98	460.95
6	196.84	459.28
7	206.74	457.92
8	216.69	456.87
9	226.66	456.13
10	236.65	455.71
11	246.65	455.60
12	256.65	455.80
13	266.64	456.32
14	276.60	457.15
15	286.54	458.29
16	296.43	459.74
17	306.28	461.50
18	316.06	463.57
19	325.77	465.94
20	335.41	468.62
21	344.96	471.59
22	354.40	474.87
23	363.75	478.44
24	372.97	482.30
25	382.07	486.44
26	391.04	490.87
27	399.86	495.58
28	408.53	500.56
29	417.04	505.81
30	425.38	511.33
31	433.55	517.10
32	441.53	523.13
33	449.31	529.40
34	456.90	535.92
35	459.18	538.00

Circle Center At X = 245.2 ; Y = 774.8 and Radius, 319.2

*** .521 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.23	469.38
2	153.88	466.77
3	163.61	464.44
4	173.40	462.41
5	183.25	460.66
6	193.14	459.21
7	203.07	458.05
8	213.04	457.18
9	223.02	456.61
10	233.01	456.33
11	243.01	456.35
12	253.01	456.66
13	262.99	457.27
14	272.95	458.18
15	282.88	459.38
16	292.77	460.87
17	302.61	462.66

18	312.39	464.73
19	322.10	467.09
20	331.75	469.74
21	341.31	472.68
22	350.78	475.89
23	360.15	479.39
24	369.41	483.15
25	378.56	487.20
26	387.58	491.51
27	396.47	496.08
28	405.22	500.92
29	413.83	506.01
30	422.28	511.35
31	430.57	516.95
32	438.69	522.78
33	446.64	528.86
34	454.40	535.16
35	457.69	538.00

Circle Center At X = 237.4 ; Y = 794.4 and Radius, 338.1

*** .521 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	88.59	465.33
2	98.37	463.22
3	108.18	461.33
4	118.04	459.64
5	127.93	458.16
6	137.85	456.90
7	147.80	455.85
8	157.76	455.01
9	167.74	454.38
10	177.73	453.97
11	187.73	453.77
12	197.73	453.79
13	207.73	454.02
14	217.72	454.46
15	227.70	455.12
16	237.66	455.99
17	247.60	457.07
18	257.52	458.37
19	267.40	459.88
20	277.25	461.59
21	287.06	463.52
22	296.83	465.66
23	306.55	468.01
24	316.22	470.56
25	325.83	473.32
26	335.38	476.29
27	344.87	479.46
28	354.28	482.83
29	363.62	486.40
30	372.89	490.17
31	382.07	494.14
32	391.16	498.30
33	400.16	502.65
34	409.07	507.20
35	417.87	511.94
36	426.58	516.86
37	435.17	521.97
38	443.66	527.27
39	452.03	532.74
40	459.71	538.00

Circle Center At X = 192.0 ; Y = 921.3 and Radius, 467.5

*** .526 ***

Failure Surface Specified By 33 Coordinate Points

Point	X-Surf	Y-Surf

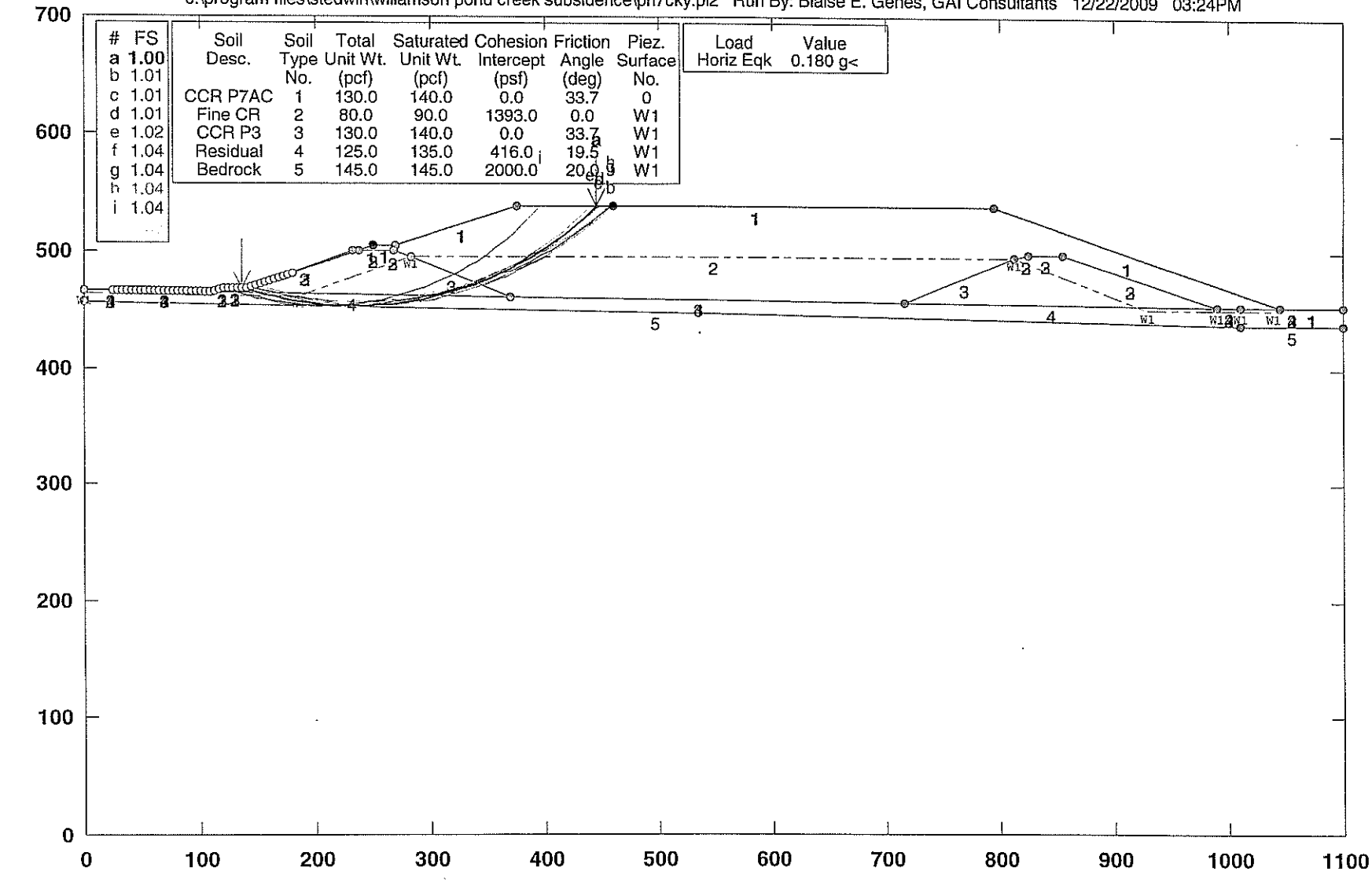
No.	(ft)	(ft)
1	128.33	468.00
2	137.98	465.35
3	147.70	463.01
4	157.49	460.99
5	167.35	459.28
6	177.25	457.89
7	187.19	456.83
8	197.16	456.09
9	207.16	455.67
10	217.15	455.57
11	227.15	455.80
12	237.14	456.35
13	247.10	457.22
14	257.03	458.42
15	266.91	459.93
16	276.74	461.77
17	286.51	463.92
18	296.20	466.38
19	305.81	469.16
20	315.32	472.25
21	324.72	475.64
22	334.02	479.34
23	343.18	483.33
24	352.22	487.62
25	361.11	492.20
26	369.85	497.06
27	378.42	502.21
28	386.83	507.62
29	395.05	513.31
30	403.09	519.26
31	410.93	525.47
32	418.56	531.93
33	425.29	538.00

Circle Center At X = 215.1 ; Y = 764.7 and Radius, 309.2

*** .532 ***

Pond Creek, Phase 7C South - 80% Sup FCR- Ky Yield Acceleration

c:\program files\stedwin\wiliamson pond creek subsidence\ph7cky.pl2 Run By: Blaise E. Genes, GAI Consultants 12/22/2009 03:24PM



PCSTABL5M/si FSmin=1.00

Safety Factors Are Calculated By The Modified Bishop Method

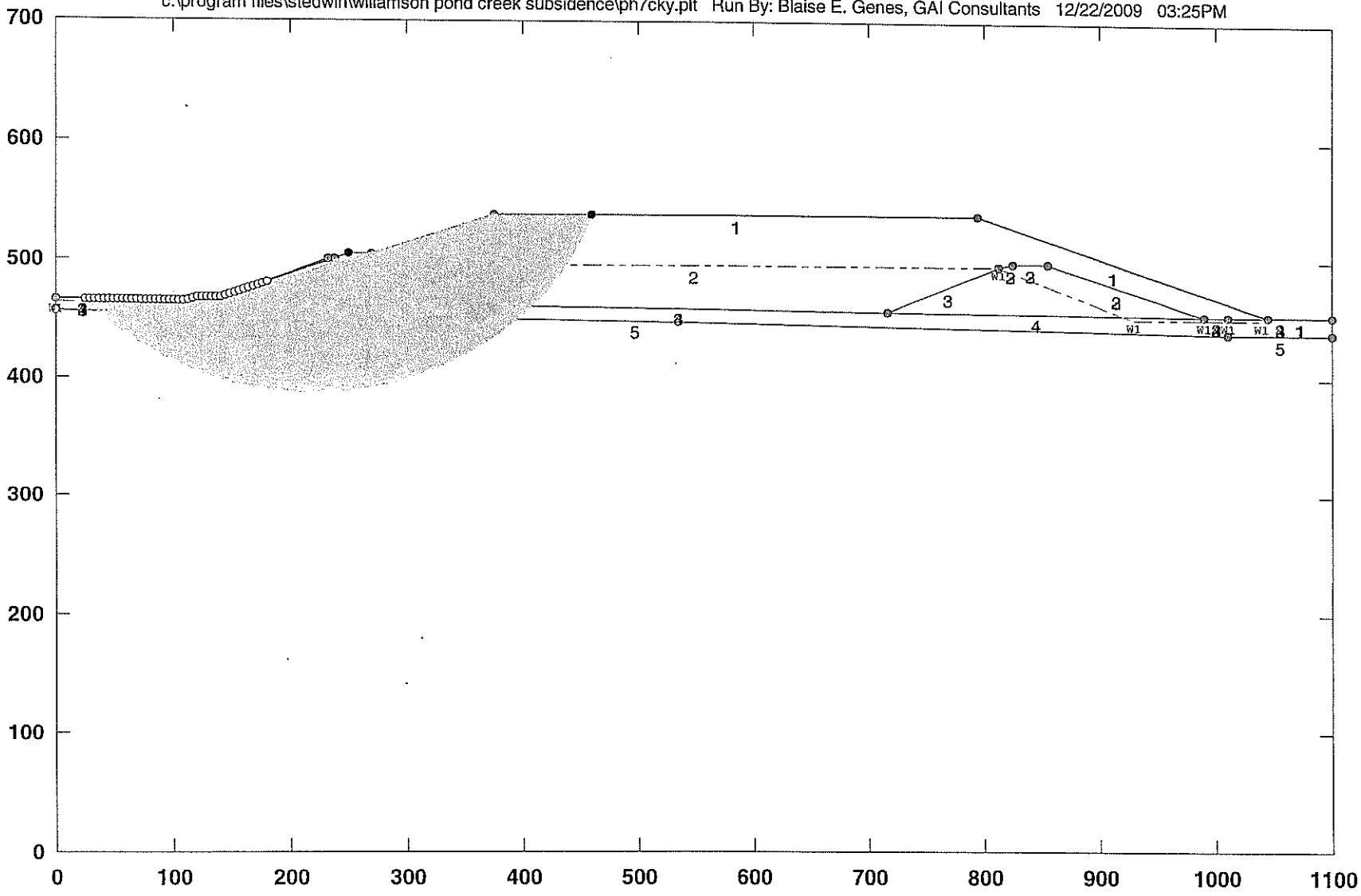
STED



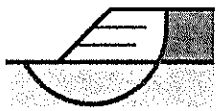
R15494

Pond Creek, Phase 7C South - 80% Sup FCR- Ky Yield Acceleration

c:\program files\stedwin\wiliamson pond creek subsidence\ph7cky.plt Run By: Blaise E. Genes, GAI Consultants 12/22/2009 03:25PM



STED



R15495

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 12/22/2009
Time of Run: 03:25PM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph7cky.in
Output Filename: C:ph7cky.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph7cky.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 7C South - 80% Sup FCR
- Ky Yield Acceleration
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

11 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1

5	140.00	468.00	238.00	500.00	1
6	238.00	500.00	250.00	505.00	1
7	250.00	505.00	270.00	505.00	1
8	270.00	505.00	375.00	538.00	1
9	375.00	538.00	795.00	538.00	1
10	795.00	538.00	1045.00	454.00	1
11	1045.00	454.00	1100.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1100.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1100.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4
46	1010.00	454.00	1100.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1100.00	439.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	0
2	80.0	90.0	1393.0	.0	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Horizontal Earthquake Loading Coefficient
Of .180 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
1600 Trial Surfaces Have Been Generated.
40 Surfaces Initiate From Each Of 40 Points Equally Spaced
Along The Ground Surface Between X = 25.00 ft.
and X = 180.00 ft.
Each Surface Terminates Between X = 250.00 ft.
and X = 460.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.28	468.00
2	145.82	465.01
3	155.46	462.32
4	165.17	459.95
5	174.96	457.90
6	184.81	456.17
7	194.71	454.76
8	204.65	453.67
9	214.62	452.90
10	224.61	452.46
11	234.61	452.34
12	244.61	452.55
13	254.59	453.09
14	264.56	453.94
15	274.49	455.12
16	284.37	456.63
17	294.20	458.45
18	303.97	460.59
19	313.67	463.05
20	323.27	465.82
21	332.79	468.91
22	342.19	472.30
23	351.49	475.99
24	360.65	479.98
25	369.69	484.27
26	378.58	488.86
27	387.31	493.72
28	395.88	498.87
29	404.29	504.30
30	412.51	509.99
31	420.54	515.95
32	428.37	522.17
33	436.00	528.64
34	443.41	535.35
35	446.15	538.00

Circle Center At X = 233.2 ; Y = 760.0 and Radius, 307.7
*** .998 ***
Individual data on the 49 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.7	282.0	.0	.0	.0	.0	50.8	.0	.0
2	5.8	2295.1	.0	.0	.0	.0	413.1	.0	.0

3	2.7	1985.6	.0	.0	.0	.0	357.4	.0	.0
4	7.0	7764.7	.0	.0	.0	.0	1397.7	.0	.0
5	4.3	6636.2	.0	.0	.0	.0	1194.5	.0	.0
6	5.4	10302.5	.0	219.2	.0	.0	1854.5	.0	.0
7	9.8	24012.8	.0	1394.1	.0	.0	4322.3	.0	.0
8	9.8	30782.9	.0	2508.5	.0	.0	5540.9	.0	.0
9	.2	663.1	.0	58.6	.0	.0	119.4	.0	.0
10	7.0	25759.1	.0	2736.6	.0	.0	4636.6	.0	.0
11	2.7	10901.0	.0	1452.8	.0	.0	1962.2	.0	.0
12	9.9	43666.5	.0	7015.0	.0	.0	7860.0	.0	.0
13	10.0	49591.5	.0	9602.2	.0	.0	8926.5	.0	.0
14	10.0	55069.2	.0	12003.2	.0	.0	9912.4	.0	.0
15	8.4	50089.1	.0	11785.3	.0	.0	9016.0	.0	.0
16	1.6	9985.1	.0	2430.0	.0	.0	1797.3	.0	.0
17	3.4	21424.8	.0	5291.6	.0	.0	3856.5	.0	.0
18	6.6	43415.3	.0	10944.8	.0	.0	7814.7	.0	.0
19	5.4	37150.5	.0	9541.7	.0	.0	6687.1	.0	.0
20	4.6	32216.4	.0	8522.6	.0	.0	5799.0	.0	.0
21	10.0	69400.0	.0	19697.0	.0	.0	12492.0	.0	.0
22	3.4	23777.8	.0	7179.0	.0	.0	4280.0	.0	.0
23	2.0	13737.6	.0	4242.2	.0	.0	2472.8	.0	.0
24	4.5	31037.8	.0	9711.6	.0	.0	5586.8	.0	.0
25	8.5	60318.3	.0	19198.0	.0	.0	10857.3	.0	.0
26	1.4	9886.6	.0	3331.7	.0	.0	1779.6	.0	.0
27	9.8	70655.5	.0	23375.5	.0	.0	12718.0	.0	.0
28	9.8	69572.7	.0	22138.4	.0	.0	12523.1	.0	.0
29	2.5	17523.6	.0	5445.1	.0	.0	3154.2	.0	.0
30	7.2	50436.8	.0	15258.0	.0	.0	9078.6	.0	.0
31	9.6	65774.3	.0	19071.3	.0	.0	11839.4	.0	.0
32	9.5	63110.8	.0	17244.7	.0	.0	11359.9	.0	.0
33	8.0	50889.5	.0	13008.8	.0	.0	9160.1	.0	.0
34	1.5	9147.2	.0	2216.3	.0	.0	1646.5	.0	.0
35	9.3	58698.3	.0	13014.8	.0	.0	10565.7	.0	.0
36	9.2	58194.7	.0	10616.1	.0	.0	10475.0	.0	.0
37	9.0	57331.3	.0	8031.5	.0	.0	10319.6	.0	.0
38	5.3	33592.3	.0	3489.4	.0	.0	6046.6	.0	.0
39	3.6	22268.6	.0	1774.3	.0	.0	4008.4	.0	.0
40	8.7	51748.2	.0	2315.7	.0	.0	9314.7	.0	.0
41	2.1	12010.0	.0	98.9	.0	.0	2161.8	.0	.0
42	6.4	34410.7	.0	.0	.0	.0	6193.9	.0	.0
43	8.4	39769.7	.0	.0	.0	.0	7158.5	.0	.0
44	8.2	32972.9	.0	.0	.0	.0	5935.1	.0	.0
45	8.0	26130.1	.0	.0	.0	.0	4703.4	.0	.0
46	7.8	19287.2	.0	.0	.0	.0	3471.7	.0	.0
47	7.6	12491.4	.0	.0	.0	.0	2248.4	.0	.0
48	7.4	5790.1	.0	.0	.0	.0	1042.2	.0	.0
49	2.7	473.2	.0	.0	.0	.0	85.2	.0	.0

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.23	469.38
2	153.75	466.32
3	163.36	463.56
4	173.06	461.12
5	182.83	458.99
6	192.66	457.17
7	202.55	455.68
8	212.48	454.50
9	222.45	453.65
10	232.43	453.12
11	242.43	452.91
12	252.43	453.02
13	262.42	453.45
14	272.39	454.21
15	282.33	455.29
16	292.23	456.69
17	302.09	458.40

18	311.88	460.44
19	321.60	462.78
20	331.24	465.45
21	340.79	468.42
22	350.23	471.69
23	359.57	475.27
24	368.79	479.15
25	377.87	483.33
26	386.82	487.79
27	395.62	492.54
28	404.26	497.58
29	412.74	502.89
30	421.03	508.47
31	429.15	514.31
32	437.07	520.41
33	444.79	526.77
34	452.30	533.37
35	457.24	538.00

Circle Center At X = 244.0 ; Y = 762.9 and Radius, 310.0

*** 1.005 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.26	468.08
2	149.82	465.16
3	159.47	462.54
4	169.20	460.24
5	179.01	458.26
6	188.87	456.60
7	198.78	455.27
8	208.73	454.25
9	218.70	453.56
10	228.69	453.20
11	238.69	453.16
12	248.69	453.45
13	258.67	454.06
14	268.63	455.00
15	278.55	456.26
16	288.42	457.85
17	298.24	459.76
18	307.99	461.98
19	317.66	464.52
20	327.24	467.38
21	336.73	470.54
22	346.11	474.01
23	355.37	477.79
24	364.50	481.87
25	373.49	486.24
26	382.34	490.90
27	391.03	495.85
28	399.55	501.08
29	407.90	506.58
30	416.06	512.36
31	424.04	518.39
32	431.81	524.69
33	439.37	531.23
34	446.70	538.00

Circle Center At X = 234.9 ; Y = 760.0 and Radius, 306.9

*** 1.006 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.39	468.00
2	129.98	465.19
3	139.66	462.66
4	149.40	460.42
5	159.21	458.46

6	169.07	456.78
7	178.97	455.40
8	188.91	454.30
9	198.88	453.49
10	208.86	452.97
11	218.86	452.75
12	228.86	452.81
13	238.85	453.17
14	248.83	453.81
15	258.79	454.75
16	268.71	455.98
17	278.60	457.49
18	288.44	459.30
19	298.21	461.38
20	307.93	463.76
21	317.57	466.41
22	327.13	469.34
23	336.60	472.55
24	345.97	476.04
25	355.24	479.79
26	364.40	483.82
27	373.43	488.11
28	382.34	492.66
29	391.10	497.47
30	399.73	502.53
31	408.20	507.84
32	416.52	513.39
33	424.67	519.19
34	432.65	525.22
35	440.44	531.47
36	448.06	537.96
37	448.11	538.00

Circle Center At X = 221.6 ; Y = 796.1 and Radius, 343.4

*** 1.007 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.23	469.38
2	153.74	466.28
3	163.35	463.51
4	173.05	461.08
5	182.83	458.99
6	192.67	457.24
7	202.57	455.84
8	212.52	454.78
9	222.49	454.08
10	232.49	453.72
11	242.49	453.71
12	252.48	454.05
13	262.46	454.74
14	272.40	455.78
15	282.31	457.17
16	292.16	458.90
17	301.94	460.97
18	311.64	463.39
19	321.26	466.14
20	330.77	469.22
21	340.17	472.64
22	349.44	476.39
23	358.57	480.45
24	367.56	484.83
25	376.39	489.53
26	385.05	494.53
27	393.53	499.83
28	401.82	505.42
29	409.91	511.30
30	417.79	517.45

31	425.45	523.88
32	432.88	530.58
33	440.07	537.53
34	440.53	538.00

Circle Center At X = 237.7 ; Y = 739.7 and Radius, 286.0

*** 1.018 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.21	470.68
2	157.78	467.79
3	167.44	465.20
4	177.18	462.92
5	186.98	460.95
6	196.84	459.28
7	206.74	457.92
8	216.69	456.87
9	226.66	456.13
10	236.65	455.71
11	246.65	455.60
12	256.65	455.80
13	266.64	456.32
14	276.60	457.15
15	286.54	458.29
16	296.43	459.74
17	306.28	461.50
18	316.06	463.57
19	325.77	465.94
20	335.41	468.62
21	344.96	471.59
22	354.40	474.87
23	363.75	478.44
24	372.97	482.30
25	382.07	486.44
26	391.04	490.87
27	399.86	495.58
28	408.53	500.56
29	417.04	505.81
30	425.38	511.33
31	433.55	517.10
32	441.53	523.13
33	449.31	529.40
34	456.90	535.92
35	459.18	538.00

Circle Center At X = 245.2 ; Y = 774.8 and Radius, 319.2

*** 1.036 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.23	469.38
2	153.88	466.77
3	163.61	464.44
4	173.40	462.41
5	183.25	460.66
6	193.14	459.21
7	203.07	458.05
8	213.04	457.18
9	223.02	456.61
10	233.01	456.33
11	243.01	456.35
12	253.01	456.66
13	262.99	457.27
14	272.95	458.18
15	282.88	459.38
16	292.77	460.87
17	302.61	462.66
18	312.39	464.73

19	322.10	467.09
20	331.75	469.74
21	341.31	472.68
22	350.78	475.89
23	360.15	479.39
24	369.41	483.15
25	378.56	487.20
26	387.58	491.51
27	396.47	496.08
28	405.22	500.92
29	413.83	506.01
30	422.28	511.35
31	430.57	516.95
32	438.69	522.78
33	446.64	528.86
34	454.40	535.16
35	457.69	538.00

Circle Center At X = 237.4 ; Y = 794.4 and Radius, 338.1

*** 1.040 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.28	468.00
2	146.00	465.65
3	155.78	463.57
4	165.62	461.76
5	175.50	460.21
6	185.42	458.94
7	195.37	457.93
8	205.34	457.20
9	215.33	456.74
10	225.33	456.55
11	235.33	456.63
12	245.32	456.98
13	255.30	457.61
14	265.26	458.51
15	275.19	459.68
16	285.09	461.12
17	294.94	462.83
18	304.74	464.80
19	314.49	467.04
20	324.17	469.55
21	333.78	472.32
22	343.31	475.35
23	352.75	478.64
24	362.10	482.18
25	371.35	485.98
26	380.50	490.03
27	389.53	494.32
28	398.44	498.86
29	407.22	503.64
30	415.87	508.66
31	424.38	513.91
32	432.74	519.40
33	440.96	525.10
34	449.01	531.03
35	456.90	537.18
36	457.89	538.00

Circle Center At X = 227.3 ; Y = 823.7 and Radius, 367.1

*** 1.042 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.39	468.00
2	129.85	464.76
3	139.43	461.90
4	149.12	459.42

5	158.89	457.32
6	168.75	455.62
7	178.66	454.30
8	188.62	453.38
9	198.60	452.85
10	208.60	452.72
11	218.60	452.98
12	228.58	453.64
13	238.52	454.69
14	248.42	456.14
15	258.25	457.97
16	268.00	460.20
17	277.65	462.80
18	287.19	465.79
19	296.61	469.15
20	305.89	472.89
21	315.01	476.98
22	323.96	481.44
23	332.73	486.24
24	341.31	491.39
25	349.67	496.87
26	357.81	502.68
27	365.71	508.81
28	373.36	515.25
29	380.76	521.98
30	387.88	529.00
31	394.72	536.30
32	396.19	538.00

Circle Center At X = 206.9 ; Y = 705.3 and Radius, 252.6

*** 1.042 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	152.18	471.98
2	161.52	468.41
3	171.01	465.24
4	180.61	462.45
5	190.32	460.06
6	200.12	458.06
7	209.99	456.47
8	219.92	455.29
9	229.89	454.51
10	239.88	454.14
11	249.88	454.18
12	259.87	454.63
13	269.84	455.49
14	279.76	456.76
15	289.62	458.43
16	299.40	460.50
17	309.09	462.97
18	318.67	465.84
19	328.12	469.09
20	337.44	472.73
21	346.60	476.75
22	355.58	481.14
23	364.38	485.89
24	372.98	491.00
25	381.36	496.46
26	389.51	502.25
27	397.41	508.38
28	405.06	514.82
29	412.44	521.57
30	419.53	528.61
31	426.34	535.94
32	428.09	538.00

Circle Center At X = 243.9 ; Y = 698.3 and Radius, 244.2

*** 1.046 ***

APPENDIX D

PERMANENT DEFORMATION ANALYSIS

MAKDISI-SEED PROCEDURE

AND

HYNES-GRIFFEN AND FRANKLIN PROCEDURE

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 7 Permanent Deformation Analyses – Makdisi-Seed and Hynes-Griffin Franklin Methods

BEG DATE 2009-DEC-028 PROJ. NO. C090403.01.001

SHEET 1 OF 5

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CALCULATION BRIEF
FOR
ESTIMATING PERMANENT DEFORMATIONS – MAKDISI-SEED AND HYNES-GRIFFIN AND FRANKLIN METHODS

POND CREEK COAL REFUSE DISPOSAL SITE – PHASE 7 DAM

OBJECTIVE: To estimate the permanent deformations of the Phase 7 Dam using the empirically-based Makdisi-Seed and Hynes-Griffin Franklin methods.

METHODOLOGY: In accordance with the IDNR guidelines Part 3702 Dam and Safety Rules, GAI performed permanent deformation analyses of the Phase 7 Dam to estimate crest settlement using the empirically-based Makdisi-Seed and Hynes-Griffin Franklin methods. The analyses were required since the Phase 7 seismic factor of safety (Fs), pseudo-static slope stability analyses using a peak ground acceleration (PGA) = 0.54 g yielded a Fs of 0.51. The site PGA was obtained from the USGS National Seismic Hazard Mapping Project map for 2% Probability of Exceedance in 50 years.

The Makdisi-Seed method (Reference 8) uses the yield acceleration (Ky) of 0.18 determined from pseudo-static slope stability analyses for a factor of safety of 1.0, the maximum spectral acceleration, and the fundamental period of the dam (To). The procedures outlined in the International Building Code (IBC) 2006, specifically Section 1613 Earthquake Loads are used to determine the maximum spectral acceleration. Based on the various data, design charts in Reference 8 provide estimates of permanent deformation.

Alternatively, the Hynes-Griffin and Franklin (1984) method was also used to estimate permanent deformations of the Phase 7 dam. Hynes-Griffin and Franklin developed upper bound, mean plus one standard deviation and mean curves estimated for earthquake-induced slope displacements based on the results of Newmark analyses of 348 earthquake motions and six (6) synthetic acceleration time histories.

Slope displacements are estimated using the conservative upper bound curve and the ratio of horizontal acceleration that reduces the factor of safety to 1.0, i.e., the yield acceleration (Ky) and the peak horizontal acceleration (PGA).

REFERENCES:

1. Civil & Environmental Consultants, Inc. Report, "Permanent Deformation Evaluation, Pond Creek No. 1 Coal Refuse Disposal Site, South Cell Slurry Impoundment, Johnston City, Williamson County, Illinois," January 23, 2008.
2. Civil & Environmental Consultants, Inc. Report, "Abandonment Evaluation, Pond Creek No. 1 Coal Refuse Disposal Site, South Cell Slurry Impoundment, Johnston City, Williamson County, Illinois," July 23, 2008.

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3. Hynes-Griffin, M.E., Franklin, A.G. 1984, "Rationalizing the Seismic Coefficient Method," Miscellaneous Paper GL-84-3, US Army Corp of Engineers Waterways Experiment Station, Vicksburg, Mississippi.

4. Illinois Department of Natural Resources, Office of Water Resources, Construction and Maintenance of Dams, Part 3702, Chapter IX.

5. International Building Code 2006 and 2000.

6. Kramer, S.L., 1996, "Geotechnical Earthquake Engineering," Prentice Hall Publishers.

7. Hynes-Griffin, M.E., Franklin, A.G. 1984, "Rationalizing the Seismic Coefficient Method," Miscellaneous Paper GL-84-3, US Army Corp of Engineers Waterways Experiment Station, Vicksburg, Mississippi.

8. Makdisi, F.I. and Seed, H.B., 1978, "Simplified Procedure for Estimating Dam and Embankment Earthquake Induced Deformations," Journal of the Geotechnical Engineering Division, ASCE, Vol. 104, No. GT7, pp 849-867.

9. Newmark, N.M., 1965, "Effects of Earthquakes on Dams and Embankments," Geotechnique 15, pp. 139-160.

10. U.S. Department of Labor, Mine Safety and Health Administration, "Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 Seismic Design: Stability and Deformation Analyses," May 2009.

ANALYSIS:

In accordance with the IDNR guidelines Part 3702 Dam and Safety Rules, GAI performed pseudo-static slope stability analyses of the Phase 7 Dam to determine the seismic factor of safety (Fs) and yield acceleration (Ky). A site PGA = 0.54 g obtained from the USGS National Seismic Hazard Mapping Project map for 2% Probability of Exceedance in 50 years was used in the Fs slope stability analyses.

Table 1 – Refuse/Soil Properties Used in Pseudo-Static and Yield Acceleration Slope Stability Analyses

Description	Unit Weights (γ_t,γ_s) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion (c) (psf)	Shear Strength
Coarse Coal Refuse (CCR)	130, 140	33.7	0	Effective (Drained)
Fine Coal Refuse (FCR)	80, 90	0	1,393	80% of Peak (Undrained)
Residual Soil	125, 135	19.5	416	Total (Undrained)

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 7 Permanent Deformation Analyses – Makdisi-Seed and Hynes-Griffin Franklin Methods

BEG DATE 2009-DEC-028 PROJ. NO. C090403.01.001

SHEET 3 OF 5

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The slope stability analyses resulted in a minimum factor of safety of 0.51 using a horizontal acceleration corresponding to the PGA value of 0.54g. Consequently, the results of the Phase 7 pseudo-static (seismic) slope stability analyses are not satisfactory, and thus a permanent deformation analysis is required per the IDNR guidelines.

GAI subsequently performed yield acceleration slope stability analyses, which varied the input horizontal acceleration in PCSTABL until a Factor of Safety equal to 1.0 was achieved. Based on these analyses, a yield acceleration of 0.18g was iteratively determined for the Phase 7 Dam soil mass and the downstream critical failure surface.

Hard copies of the input and output files for the Phase 7 pseudo-static slope stability analyses are attached.

MAKDISI-SEED DEFORMATION ANALYSES

Spectral Accelerations: (for use in calculating fundamental period)

Using the IBC 2006 the maximum spectral acceleration for Williamson County, IL is as follows:

0.2 second spectral response acceleration: Ss = 1.0 See IBC 2006 page 318 (attached)

1.0 second spectral response acceleration: S1 = 0.28 See IBC 2006 page 319 (attached)

Site Class:

Site Class D from IBC 2006 Table 1613.5.2 was assumed based on a stiff residual soil profile and shear wave velocity between 600 and 1,200 feet per second (fps) determined from field testing at the Pond Creek site within the top 100 feet beneath the proposed Phase 7 Dam.

Site Coefficients Fa and Fv: (for use in calculating fundamental period)

From IBC 2006 Table 1613.5.3(1): Fa = 1.1 (Site Class D)

From IBC 2006 Table 1613.5.3(2): Fv = 1.9 (Site Class D)

Design Spectral Response Acceleration Parameters: (for use in calculating fundamental period)

IBC 2006 Equation 16-37: $S_{MS} = F_a * S_S = 1.1*1.0 = 1.1g$

IBC 2006 Equation 16-38: $S_{M1} = F_v * S_1 = 1.9*0.28 = 0.53g$

IBC 2006 Equation 16-39: $S_{DS} = 2/3 * S_{MS} = 2/3*1.1 = 0.73g$

IBC 2006 Equation 16-40: $S_{D1} = 2/3 * S_{M1} = 2/3*0.53 = 0.36g$

Note: Although S_{DS} is larger than PGA (0.73g > 0.54g),

USE PGA = 0.54g = amax (as required by IDNR)

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 7 Permanent Deformation Analyses – Makdisi-Seed and Hynes-Griffin Franklin Methods

BEG DATE 2009-DEC-028 PROJ. NO. C090403.01.001

SHEET 4 OF 5

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Fundamental Period of the Dam:

From IBC 2000, and for the Phase 7 dam, it is assumed that the fundamental (predominant) period

To = Ts = S_{D1}/S_{DS} = 0.36/0.73 = 0.49 seconds

Note: From the Phase 2 dynamic site response deformation analyses, the fundamental frequency of the Phase 2 soil column was about 4.4 hertz (Hz) or 1 / 4.4 = 0.23 seconds.

USE To = Ts = 0.49 seconds (conservative)

Deformation Estimate: From Makdisi-Seed (1978) Figure 16 and:

Maximum Design Earthquake = M 8.0 (Reference 1); Assumed between M 7-1/2 and M 8-1/4 in Fig. 16

Yield/Maximum Acceleration = ay/amax = 0.18g/0.54g = 0.33;

ay=Ky = 0.18g and amax=PGA = 0.54g

To = 0.49 seconds:

From Figure 16 (attached), U/amax* To = 0.2 (approx.)

Therefore, U = amax* To*0.2*32.2 = 0.54g*0.49sec.*0.2*32.2ft/sec2 = 1.7 feet

U = 1.7 feet = 20 inches

HYNES-GRIFFEN FRANKLIN DEFORMATION ANALYSES

Based on the various data for the Phase 7 Dam and Pond Creek facility including:

N = Ky = 0.18g;

A = PGA = 0.54g; and,

Figure 7 of Reference 3:

Therefore,

U = slope displacements = about 40 centimeters = 16 inches.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 7 Permanent Deformation Analyses – Makdisi-Seed and Hynes-Griffin Franklin Methods

BEG DATE 2009-DEC-028 PROJ. NO. C090403.01.001

SHEET 5 OF 5

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CONCLUSIONS

GAI has completed permanent deformation analyses of the Phase 7 Dam using empirically-based Makdisi-Seed and Hynes-Griffin Franklin methods, which yielded crest settlements of 20 and 16 inches, respectively. Further, Phase 2 deformations were previously estimated at 17 inches based on dynamic site response analyses and Newmark sliding block methods, which is consistent with the empirically-based analyses and estimates of Phase 7 Dam crest settlement. Therefore, the maximum Phase 7 Dam crest settlement of 20 inches compares favorably to an available freeboard of the Phase 7 Dam of 96 inches above the Phase 7 maximum fines level. GAI notes that the failure surface impacts only a portion of the approximate 400-foot wide Phase 7 crest width, as shown in the slope stability results, which adds significantly to the downstream safety of the dam.

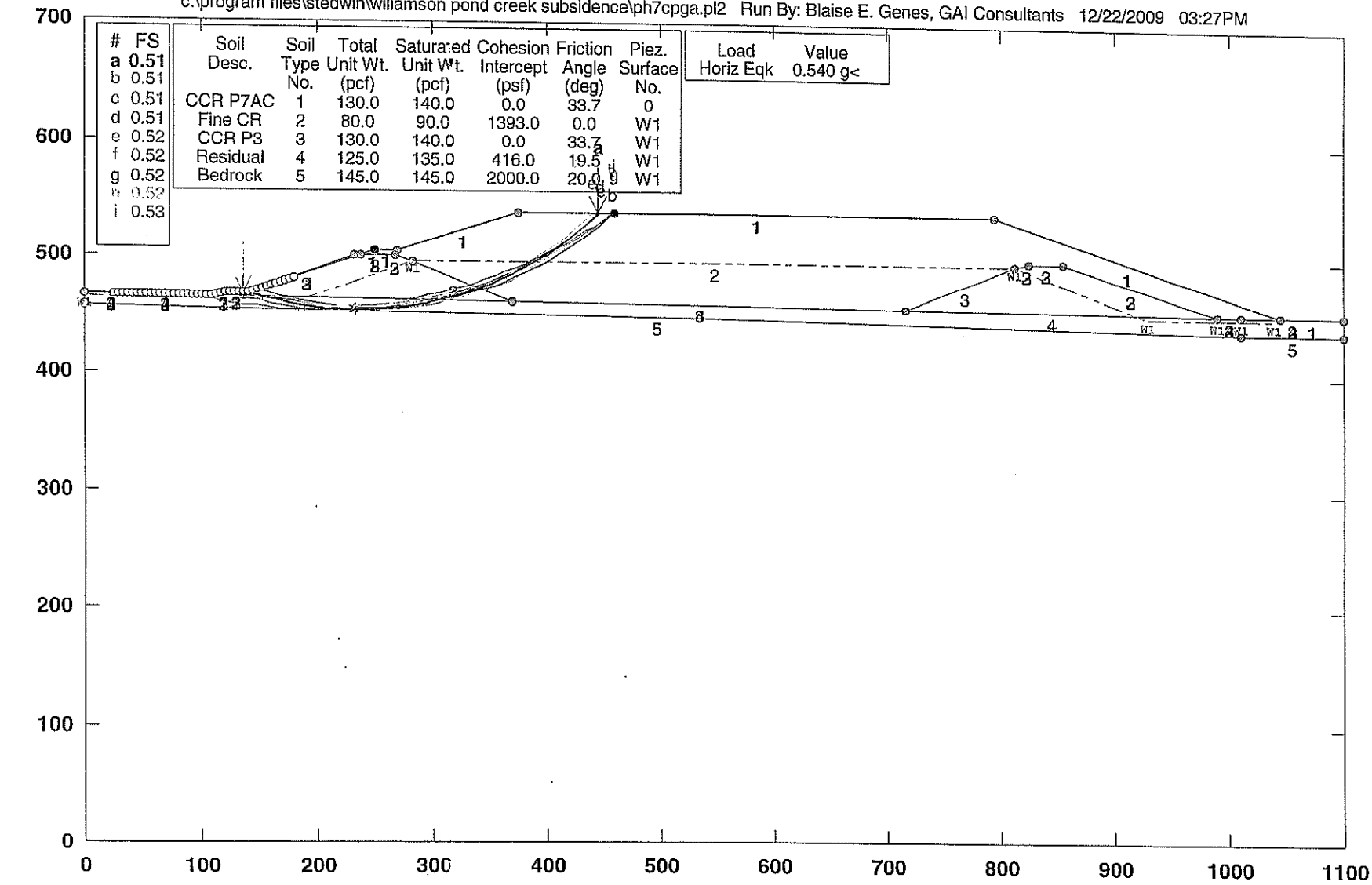
Although permanent deformations are acceptable relative to the available freeboard, GAI recommends that the dam be thoroughly inspected following a seismic event to make observations and note any ground movement, scarps, sloughing, toe bulges, etc. on the exposed downstream and upstream slopes, increased piezometric groundwater levels, and any other issues that may suggest slope instability.

ATTACHMENT 1

SEISMIC FACTOR OF SAFET AND YIELD ACCELERATION PSEUDO-STATIC SLOPE STABILITY ANALYSES RESULTS

Pond Creek, Phase 7C South - 80% Sup FCR- PGA=.54g Pseudo-Static

c:\program files\stedwin\wiliamson pond creek subsidence\ph7cpga.pl2 Run By: Blaise E. Genes, GAI Consultants 12/22/2009 03:27PM



#	FS
a	0.51
b	0.51
c	0.51
d	0.51
e	0.52
f	0.52
g	0.52
h	0.52
i	0.53

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR P7AC	1	130.0	140.0	0.0	33.7	0
Fine CR	2	80.0	90.0	1393.0	0.0	W1
CCR P3	3	130.0	140.0	0.0	33.7	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1

Load	Value
Horiz Eqk	0.540 g<

PCSTABL5M/si FSmin=0.51

Safety Factors Are Calculated By The Modified Bishop Method

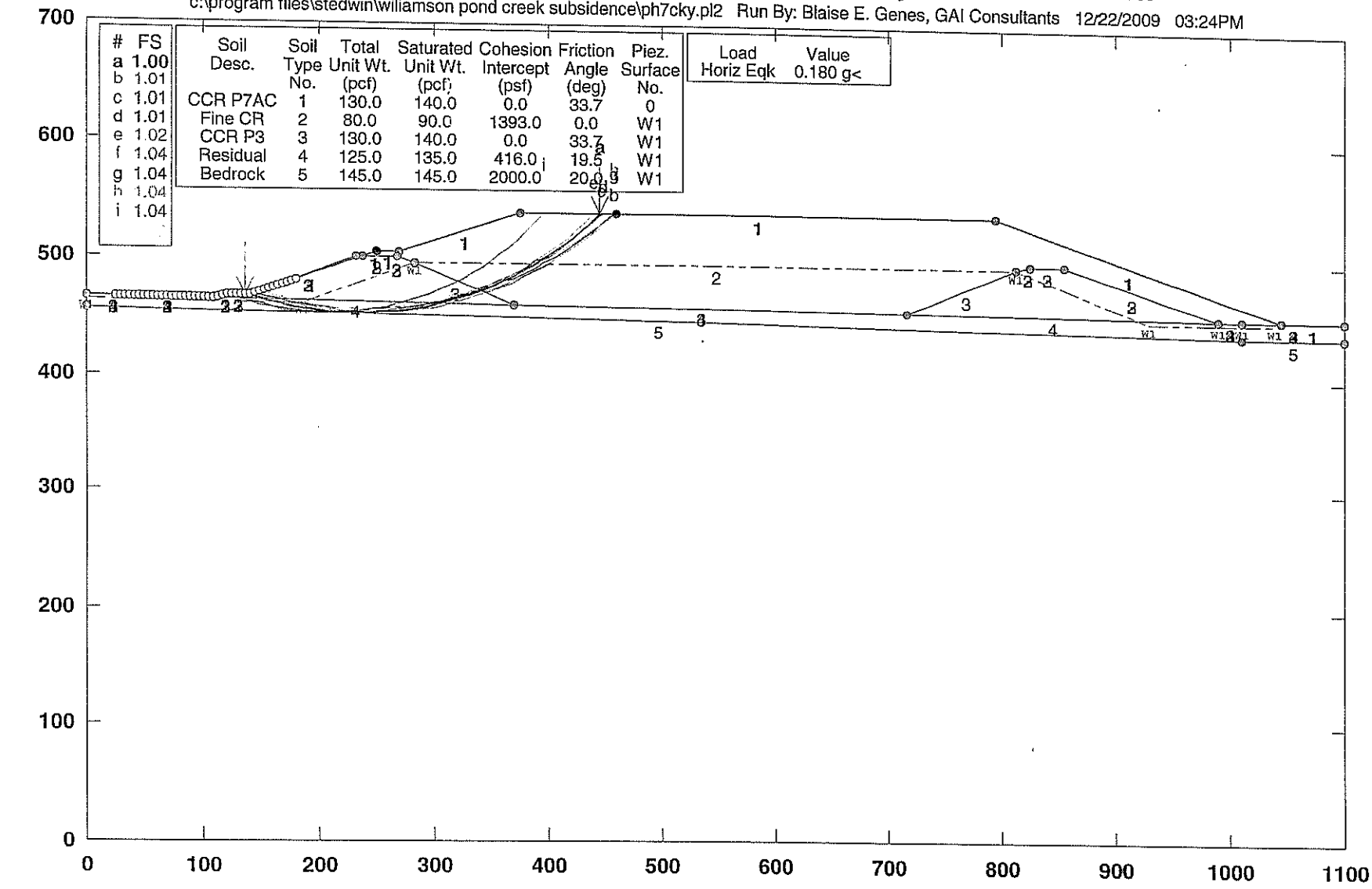
STED



R15512

Pond Creek, Phase 7C South - 80% Sup FCR- Ky Yield Acceleration

c:\program files\stedwin\williamson pond creek subsidence\ph7cky.pl2 Run By: Blaise E. Genes, GAI Consultants 12/22/2009 03:24PM



PCSTABL5M/si FSmin=1.00

Safety Factors Are Calculated By The Modified Bishop Method

STED

R15513

ATTACHMENT 2

IBC 2006 AND MAKDISI-SEED DESIGN CHART/CURVES

IBC (2006)

identified by the building official and that are the minimum necessary to assure safe living conditions.

2. Any alteration of a historic structure provided that the alteration will not preclude the structure's continued designation as a historic structure.

1612.3 Establishment of flood hazard areas. To establish flood hazard areas, the governing body shall adopt a flood hazard map and supporting data. The flood hazard map shall include, at a minimum, areas of special flood hazard as identified by the Federal Emergency Management Agency in an engineering report entitled "The Flood Insurance Study for [INSERT NAME OF JURISDICTION]," dated [INSERT DATE OF ISSUANCE], as amended or revised with the accompanying Flood Insurance Rate Map (FIRM) and Flood Boundary and Floodway Map (FBFM) and related supporting data along with any revisions thereto. The adopted flood hazard map and supporting data are hereby adopted by reference and declared to be part of this section.

1612.4 Design and construction. The design and construction of buildings and structures located in flood hazard areas, including flood hazard areas subject to high velocity wave action, shall be in accordance with ASCE 24.

1612.5 Flood hazard documentation. The following documentation shall be prepared and sealed by a registered design professional and submitted to the building official:

1. For construction in flood hazard areas not subject to high-velocity wave action:
   - 1.1. The elevation of the lowest floor, including the basement, as required by the lowest floor elevation inspection in Section 109.3.3.
   - 1.2. For fully enclosed areas below the design flood elevation where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.6.2.1 of ASCE 24, construction documents shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.6.2.2 of ASCE 24.
   - 1.3. For dry floodproofed nonresidential buildings, construction documents shall include a statement that the dry floodproofing is designed in accordance with ASCE 24.
2. For construction in flood hazard areas subject to high-velocity wave action:
   - 2.1. The elevation of the bottom of the lowest horizontal structural member as required by the lowest floor elevation inspection in Section 109.3.3.
   - 2.2. Construction documents shall include a statement that the building is designed in accordance with ASCE 24, including that the pile or column foundation and building or structure to be attached thereto is designed to be anchored to resist flotation, collapse and lateral movement due to the effects of wind and flood loads acting simultaneously on all building components, and other load requirements of Chapter 16.
   - 2.3. For breakaway walls designed to resist a nominal load of less than 10 psf (0.48 kN/m²) or more than 20 psf (0.96 kN/m²), construction documents shall include a statement that the breakaway wall is designed in accordance with ASCE 24.

SECTION 1613
EARTHQUAKE LOADS

1613.1 Scope. Every structure, and portion thereof, including nonstructural components that are permanently attached to structures and their supports and attachments, shall be designed and constructed to resist the effects of earthquake motions in accordance with ASCE 7, excluding Chapter 14 and Appendix 11A. The seismic design category for a structure is permitted to be determined in accordance with Section 1613 or ASCE 7.

Exceptions:

1. Detached one- and two-family dwellings, assigned to Seismic Design Category A, B or C, or located where the mapped short-period spectral response acceleration, S_S, is less than 0.4 g.
2. The seismic-force-resisting system of wood-frame buildings that conform to the provisions of Section 2308 are not required to be analyzed as specified in this section.
3. Agricultural storage structures intended only for incidental human occupancy.
4. Structures that require special consideration of their response characteristics and environment that are not addressed by this code or ASCE 7 and for which other regulations provide seismic criteria, such as vehicular bridges, electrical transmission towers, hydraulic structures, buried utility lines and their appurtenances and nuclear reactors.

1613.2 Definitions. The following words and terms shall, for the purposes of this section, have the meanings shown herein.

DESIGN EARTHQUAKE GROUND MOTION. The earthquake ground motion that buildings and structures are specifically proportioned to resist in Section 1613.

MAXIMUM CONSIDERED EARTHQUAKE GROUND MOTION. The most severe earthquake effects considered by this code.

MECHANICAL SYSTEMS. For the purposes of determining seismic loads in ASCE 7, mechanical systems shall include plumbing systems as specified therein.

ORTHOGONAL. To be in two horizontal directions, at 90 degrees (1.57 rad) to each other.

SEISMIC DESIGN CATEGORY. A classification assigned to a structure based on its occupancy category and the severity of the design earthquake ground motion at the site.

SEISMIC-FORCE-RESISTING SYSTEM. That part of the structural system that has been considered in the design to provide the required resistance to the prescribed seismic forces.

SITE CLASS. A classification assigned to a site based on the types of soils present and their engineering properties as defined in Section 1613.5.2.

SITE COEFFICIENTS. The values of F_a and F_v indicated in Tables 1613.5.3(1) and 1613.5.3(2), respectively.

1613.3 Existing buildings. Additions, alterations, modification, or change of occupancy of existing buildings shall be in accordance with Sections 3403.2.3 and 3406.4.

1613.4 Special inspections. Where required by Section 1705.3, the statement of special inspections shall include the special inspections required by Section 1705.3.1.

1613.5 Seismic ground motion values. Seismic ground motion values shall be determined in accordance with this section.

1613.5.1 Mapped acceleration parameters. The parameters S_s and S_1 shall be determined from the 0.2 and 1-second spectral response accelerations shown on Figures 1613.5(1) through 1613.5(14). Where S_1 is less than or equal to 0.04 and S_s is less than or equal to 0.15, the structure is permitted to be assigned to Seismic Design Category A.

1613.5.2 Site class definitions. Based on the site soil properties, the site shall be classified as either Site Class A, B, C, D, E or F in accordance with Table 1613.5.2. When the soil properties are not known in sufficient detail to determine the site class, Site Class D shall be used unless the building official or geotechnical data determines that Site Class E or F soil is likely to be present at the site.

1613.5.3 Site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters. The maximum considered earthquake spectral response acceleration for short periods, S_{MS}, and at 1-second period, S_{M1}, adjusted for site class effects shall be determined by Equations 16-37 and 16-38, respectively:

$$S_{MS} = F_a S_s \qquad \textbf{(Equation 16-37)}$$

$$S_{M1} = F_v S_1 \qquad \textbf{(Equation 16-38)}$$

where:

F_a = Site coefficient defined in Table 1613.5.3(1).

F_v = Site coefficient defined in Table 1613.5.3(2).

S_S = The mapped spectral accelerations for short periods as determined in Section 1613.5.1.

S_1 = The mapped spectral accelerations for a 1-second period as determined in Section 1613.5.1.

TABLE 1613.5.2
SITE CLASS DEFINITIONS

SITE CLASS	SOIL PROFILE NAME	AVERAGE PROPERTIES IN TOP 100 feet, SEE SECTION 1613.5.5		
		Soil shear wave velocity, $\bar{v}_s$, (ft/s)	Standard penetration resistance, $\bar{N}$	Soil undrained shear strength, $\bar{s}_u$, (psf)
A	Hard rock	$\bar{v}_s > 5{,}000$	N/A	N/A
B	Rock	$2{,}500 < \bar{v}_s \le 5{,}000$	N/A	N/A
C	Very dense soil and soft rock	$1{,}200 < \bar{v}_s \le 2{,}500$	$\bar{N} > 50$	$\bar{s}_u \ge 2{,}000$
D	Stiff soil profile	$600 \le \bar{v}_s \le 1{,}200$	$15 \le \bar{N} \le 50$	$1{,}000 \le \bar{s}_u \le 2{,}000$
E	Soft soil profile	$\bar{v}_s < 600$	$\bar{N} < 15$	$\bar{s}_u < 1{,}000$
E	—	Any profile with more than 10 feet of soil having the following characteristics: 1. Plasticity index $PI > 20$, 2. Moisture content $w \ge 40\%$, and 3. Undrained shear strength $\bar{s}_u < 500$ psf		
F	—	Any profile containing soils having one or more of the following characteristics: 1. Soils vulnerable to potential failure or collapse under seismic loading such as liquefiable soils, quick and highly sensitive clays, collapsible weakly cemented soils. 2. Peats and/or highly organic clays (H > 10 feet of peat and/or highly organic clay where H = thickness of soil) 3. Very high plasticity clays (H > 25 feet with plasticity index PI > 75) 4. Very thick soft/medium stiff clays (H > 120 feet)		

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m², 1 pound per square foot = 0.0479 kPa. N/A = Not applicable

TABLE 1613.5.3(1)
VALUES OF SITE COEFFICIENT F_a [a]

SITE CLASS	MAPPED SPECTRAL RESPONSE ACCELERATION AT SHORT PERIOD				
	$S_s \le 0.25$	$S_s = 0.50$	$S_s = 0.75$	$S_s = 1.00$	$S_s \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	Note b	Note b	Note b	Note b	Note b

a. Use straight-line interpolation for intermediate values of mapped spectral response acceleration at short period, S_s.
b. Values shall be determined in accordance with Section 11.4.7 of ASCE 7.

TABLE 1613.5.3(2)
VALUES OF SITE COEFFICIENT F_v [a]

SITE CLASS	MAPPED SPECTRAL RESPONSE ACCELERATION AT 1-SECOND PERIOD				
	$S_1 \le 0.1$	$S_1 = 0.2$	$S_1 = 0.3$	$S_1 = 0.4$	$S_1 \ge 0.5$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	Note b	Note b	Note b	Note b	Note b

a. Use straight-line interpolation for intermediate values of mapped spectral response acceleration at 1-second period, S_1.
b. Values shall be determined in accordance with Section 11.4.7 of ASCE 7.

1613.5.4 Design spectral response acceleration parameters. Five-percent damped design spectral response acceleration at short periods, S_{DS}, and at 1-second period, S_{D1}, shall be determined from Equations 16-39 and 16-40, respectively:

$$S_{DS} = \frac{2}{3} S_{MS} \qquad \text{(Equation 16-39)}$$

$$S_{D1} = \frac{2}{3} S_{M1} \qquad \text{(Equation 16-40)}$$

where:

S_{MS} = The maximum considered earthquake spectral response accelerations for short period as determined in Section 1613.5.3.

S_{M1} = The maximum considered earthquake spectral response accelerations for 1-second period as determined in Section 1613.5.3.

1613.5.5 Site classification for seismic design. Site classification for Site Class C, D or E shall be determined from Table 1613.5.5.

The notations presented below apply to the upper 100 feet (30 480 mm) of the site profile. Profiles containing distinctly different soil and/or rock layers shall be subdivided into those layers designated by a number that ranges from 1 to n at the bottom where there is a total of n distinct layers in the upper 100 feet (30 480 mm). The symbol i then refers to any one of the layers between 1 and n.

where:

v_{si} = The shear wave velocity in feet per second (m/s).

d_i = The thickness of any layer between 0 and 100 feet (30 480 mm).

where:

$$\bar{v}_s = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{v_{si}}} \qquad \text{(Equation 16-41)}$$

$$\sum_{i=1}^{n} d_i = 100 \text{ feet (30 480 mm)}$$

N_i is the Standard Penetration Resistance (ASTM D 1586) not to exceed 100 blows/foot (305 mm) as directly measured in the field without corrections. When refusal is met for a rock layer, N_i shall be taken as 100 blows/foot (305 mm).

$$\overline{N} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{N_i}} \qquad \textbf{(Equation 16-42)}$$

where N_i and d_i in Equation 16-42 are for cohesionless soil, cohesive soil and rock layers.

$$\overline{N}_{ch} = \frac{d_s}{\sum_{i=1}^{m} \frac{d_i}{N_i}} \qquad \textbf{(Equation 16-43)}$$

where:

$$\sum_{i=1}^{m} d_i = d_s$$

Use d_i and N_i for cohesionless soil layers only in Equation 16-43.

d_s = The total thickness of cohesionless soil layers in the top 100 feet (30 480 mm).

m = The number of cohesionless soil layers in the top 100 feet (30 480 mm).

s_{ui} = The undrained shear strength in psf (kPa), not to exceed 5,000 psf (240 kPa), ASTM D 2166 or D 2850.

$$\overline{s}_u = \frac{d_c}{\sum_{i=1}^{k} \frac{d_i}{s_{ui}}} \qquad \textbf{(Equation 16-44)}$$

where:

$$\sum_{i=1}^{k} d_i = d_c$$

d_c = The total thickness of cohesive soil layers in the top 100 feet (30 480 mm).

k = The number of cohesive soil layers in the top 100 feet (30 480 mm).

PI = The plasticity index, ASTM D 4318.

w = The moisture content in percent, ASTM D 2216.

Where a site does not qualify under the criteria for Site Class F and there is a total thickness of soft clay greater than 10 feet (3048 mm) where a soft clay layer is defined by: $s_u <$ 500 psf (24 kPa), $w \geq 40$ percent, and PI > 20, it shall be classified as Site Class E.

The shear wave velocity for rock, Site Class B, shall be either measured on site or estimated by a geotechnical engineer or engineering geologist/seismologist for competent rock with moderate fracturing and weathering. Softer and more highly fractured and weathered rock shall either be measured on site for shear wave velocity or classified as Site Class C.

The hard rock category, Site Class A, shall be supported by shear wave velocity measurements either on site or on profiles of the same rock type in the same formation with an equal or greater degree of weathering and fracturing. Where hard rock conditions are known to be continuous to a depth of 100 feet (30 480 mm), surficial shear wave velocity measurements are permitted to be extrapolated to assess v_s.

The rock categories, Site Classes A and B, shall not be used if there is more than 10 feet (3048 mm) of soil between the rock surface and the bottom of the spread footing or mat foundation.

1613.5.5.1 Steps for classifying a site.

1. Check for the four categories of Site Class F requiring site-specific evaluation. If the site corresponds to any of these categories, classify the site as Site Class F and conduct a site-specific evaluation.
2. Check for the existence of a total thickness of soft clay > 10 feet (3048 mm) where a soft clay layer is defined by: $\overline{s}_u < 500$ psf (24 kPa), $w \geq 40$ percent and $PI > 20$. If these criteria are satisfied, classify the site as Site Class E.
3. Categorize the site using one of the following three methods with $\overline{v}_s$, $\overline{N}$, and $\overline{s}_u$ and computed in all cases as specified.

TABLE 1613.5.5
SITE CLASSIFICATION[a]

SITE CLASS	$\overline{v}_s$	$\overline{N}$ or $\overline{N}_{ch}$	$\overline{s}_u$
E	< 600 ft/s	< 15	< 1,000 psf
D	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
C	1,200 to 2,500 ft/s	> 50	> 2,000

For SI: 1 foot per second = 304.8 mm per second, 1 pound per square foot = 0.0479 kN/m².

a. If the $\overline{s}_u$ method is used and the $\overline{N}_{ch}$ and $\overline{s}_u$ criteria differ, select the category with the softer soils (for example, use Site Class E instead of D).

3.1. $\overline{v_s}$ for the top 100 feet (30 480 mm) ($\overline{v_s}$ method).

3.2. $\overline{N_{ch}}$ for the top 100 feet (30 480 mm) ($\overline{N}$ method).

3.3. $\overline{N}$ for cohesionless soil layers ($PI < 20$) in the top 100 feet (30 480 mm) and average, s_u for cohesive soil layers ($PI > 20$) in the top 100 feet (30 480 mm) ($\overline{s_u}$ method).

1613.5.6 Determination of seismic design category. Occupancy Category I, II or III structures located where the mapped spectral response acceleration parameter at 1-second period, S_1, is greater than or equal to 0.75 shall be assigned to Seismic Design Category E. Occupancy Category IV structures located where the mapped spectral response acceleration parameter at 1-second period, S_1, is greater than or equal to 0.75 shall be assigned to Seismic Design Category F. All other structures shall be assigned to a seismic design category based on their occupancy category and the design spectral response acceleration coefficients, S_{DS} and S_{D1}, determined in accordance with Section 1613.5.4 or the site-specific procedures of ASCE 7. Each building and structure shall be assigned to the more severe seismic design category in accordance with Table 1613.5.6(1) or 1613.5.6(2), irrespective of the fundamental period of vibration of the structure, T.

TABLE 1613.5.6(1)
SEISMIC DESIGN CATEGORY BASED ON SHORT-PERIOD RESPONSE ACCELERATIONS

VALUE OF S_{DS}	OCCUPANCY CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

TABLE 1613.5.6(2)
SEISMIC DESIGN CATEGORY BASED ON 1-SECOND PERIOD RESPONSE ACCELERATION

VALUE OF S_{D1}	OCCUPANCY CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

1613.5.6.1 Alternative seismic design category determination. Where S_1 is less than 0.75, the seismic design category is permitted to be determined from Table 1613.5.6(1) alone when all of the following apply:

1. In each of the two orthogonal directions, the approximate fundamental period of the structure, T_a, in each of the two orthogonal directions determined in accordance with Section 12.8.2.1 of ASCE 7, is less than 0.8 T_s determined in accordance with Section 11.4.5 of ASCE 7.
2. In each of the two orthogonal directions, the fundamental period of the structure used to calculate the story drift is less than T_s.
3. Equation 12.8-2 of ASCE 7 is used to determine the seismic response coefficient, C_s.
4. The diaphragms are rigid as defined in Section 12.3.1 in ASCE 7 or for diaphragms that are flexible, the distance between vertical elements of the seismic-force-resisting system does not exceed 40 feet (12 192 mm).

1613.5.6.2 Simplified design procedure. Where the alternate simplified design procedure of ASCE 7 is used, the seismic design category shall be determined in accordance with ASCE 7.

1613.6 Alternatives to ASCE 7. The provisions of Section 1613.6 shall be permitted as alternatives to the relevant provisions of ASCE 7.

1613.6.1 Assumption of flexible diaphragm. Add the following text at the end of Section 12.3.1.1 of ASCE 7:

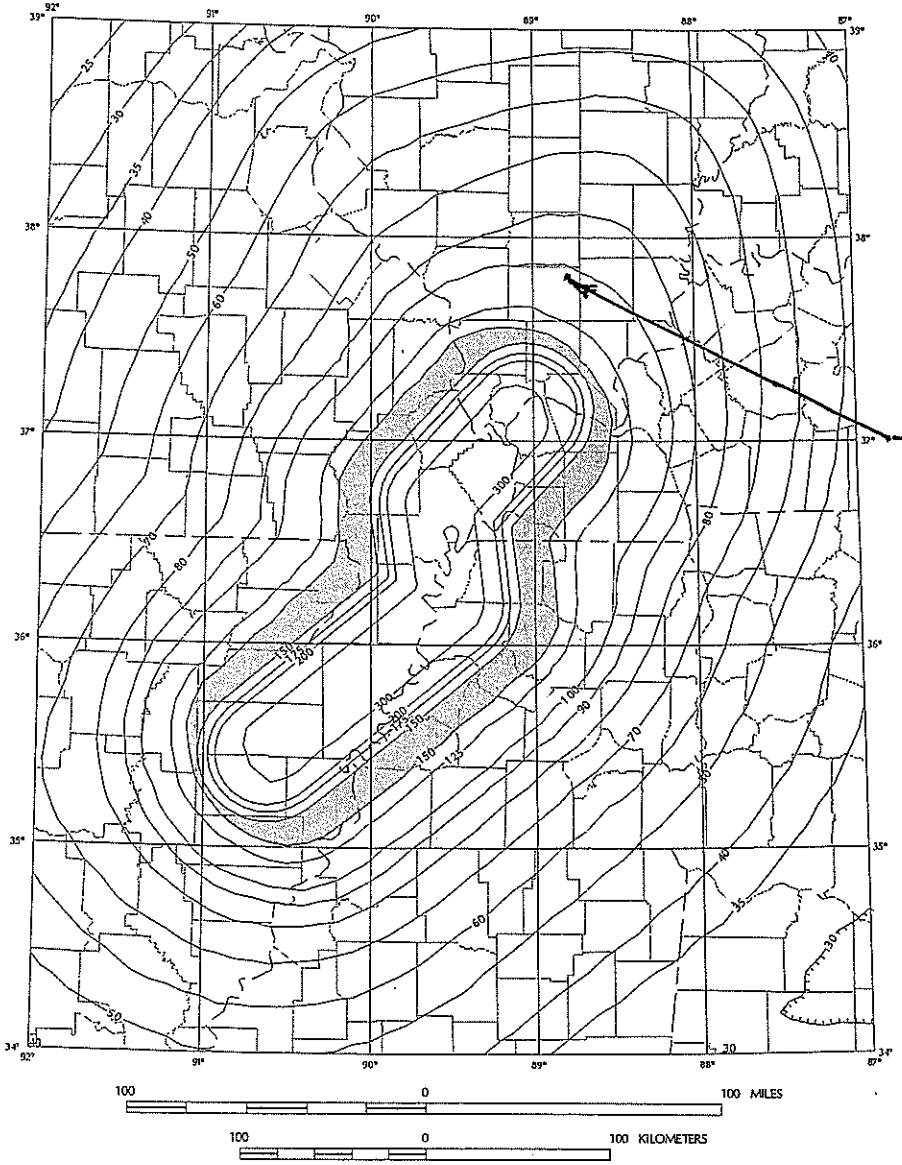
Diaphragms constructed of wood structural panels or untopped steel decking shall also be permitted to be idealized as flexible, provided all of the following conditions are met:

1. Toppings of concrete or similar materials are not placed over wood structural panel diaphragms except for nonstructural toppings no greater than $1^1/_2$ inches (38 mm) thick.
2. Each line of vertical elements of the lateral-force-resisting system complies with the allowable story drift of Table 12.12-1.
3. Vertical elements of the lateral-force-resisting system are light-framed walls sheathed with wood structural panels rated for shear resistance or steel sheets.
4. Portions of wood structural panel diaphragms that cantilever beyond the vertical elements of the lateral-force-resisting system are designed in accordance with Section 2305.2.5 of the *International Building Code*.

1613.6.2 Additional seismic-force-resisting systems for seismically isolated structures. Add the following exception to the end of Section 17.5.4.2 of ASCE 7:

Exception: For isolated structures designed in accordance with this standard, the Structural System Limitations and the Building Height Limitations in Table 12.2-1 for ordinary steel concentrically braced frames (OCBFs) as defined in Chapter 11 and ordinary moment frames (OMFs) as defined in Chapter 11 are permitted to be taken as 160 feet (48 768 mm) for structures assigned to Seismic Design Category D, E or F, provided that the following conditions are satisfied:

1. The value of R_I as defined in Chapter 17 is taken as 1.
2. For OMFs and OCBFs, design is in accordance with AISC 341.



Explanation

Contour intervals, % g

200
175
150
125
100
90
80
70
60
50
40
35
30
25
20
15
10
5
0

Note: contours are irregularly spaced

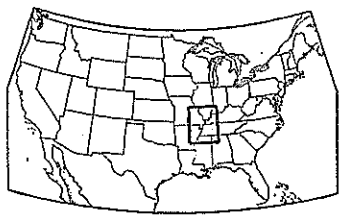
Areas with a constant spectral response acceleration of 150% g

+ 6.2 — Point value of spectral response acceleration expressed as a percent of gravity

10 — Contours of spectral response acceleration expressed as a percent of gravity. Hachures point in direction of decreasing values.

DISCUSSION

Refer to the map of Maximum Considered Earthquake Ground Motion for the Conterminous United States of 0.2 sec Spectral Response Acceleration (Figure 1612.5(1)) for discussion and references.



Index map showing location of study area

FIGURE 1613.5(7)
MAXIMUM CONSIDERED EARTHQUAKE GROUND MOTION FOR REGION 3 OF 0.2 SEC SPECTRAL RESPONSE ACCELERATION (5% PERCENT OF CRITICAL DAMPING), SITE CLASS B

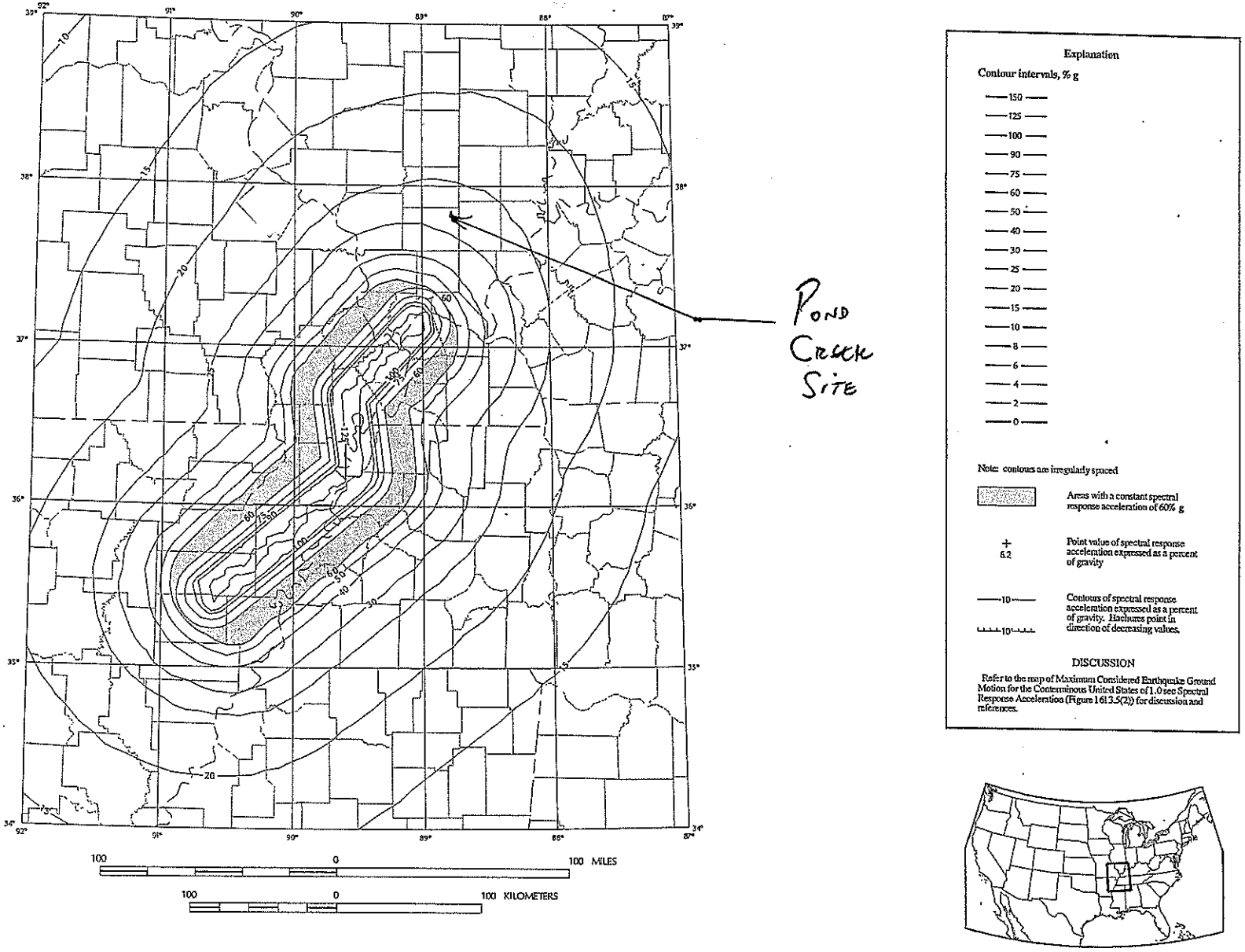


FIGURE 1613.5(8)
MAXIMUM CONSIDERED EARTHQUAKE GROUND MOTION FOR REGION 3 OF 1.0 SEC SPECTRAL RESPONSE ACCELERATION (5% OF CRITICAL DAMPING), SITE CLASS B

TABLE 1615.1.2(1)
VALUES OF SITE COEFFICIENT F_a AS A FUNCTION OF SITE CLASS AND MAPPED SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS (S_s)[a]

SITE CLASS	MAPPED SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS				
	$S_s \le 0.25$	$S_s = 0.50$	$S_s = 0.75$	$S_s = 1.00$	$S_s \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	Note b
F	Note b	Note b	Note b	Note b	Note b

a. Use straight line interpolation for intermediate values of mapped spectral acceleration at short period, S_s.
b. Site-specific geotechnical investigation and dynamic site response analyses shall be performed to determine appropriate values.

TABLE 1615.1.2(2)
VALUES OF SITE COEFFICIENT F_v AS A FUNCTION OF SITE CLASS AND MAPPED SPECTRAL RESPONSE ACCELERATION AT 1-SECOND PERIOD (S_1)[a]

SITE CLASS	MAPPED SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS				
	$S_1 \le 0.1$	$S_1 = 0.2$	$S_1 = 0.3$	$S_1 = 0.4$	$S_1 \ge 0.5$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	Note b
F	Note b	Note b	Note b	Note b	Note b

a. Use straight line interpolation for intermediate values of mapped spectral acceleration at 1-second period, S_1.
b. Site-specific geotechnical investigation and dynamic site response analyses shall be performed to determine appropriate values.

3. For periods greater than T_S, the design spectral response acceleration, S_a, shall be given by Equation 16-21.

$$S_a = 0.6\frac{S_{DS}}{T_0}T + 0.4S_{DS} \qquad \text{(Equation 16-20)}$$

$$S_a = \frac{S_{D1}}{T} \qquad \text{(Equation 16-21)}$$

where:

S_{DS} = The design spectral response acceleration at short periods as determined in Section 1615.1.3.

S_{D1} = The design spectral response acceleration at 1 second period as determined in Section 1615.1.3.

T = Fundamental period (in seconds) of the structure (Section 1617.4.2).

$T_0 = 0.2\,S_{D1}/S_{DS}$

$T_S = S_{D1}/S_{DS}$

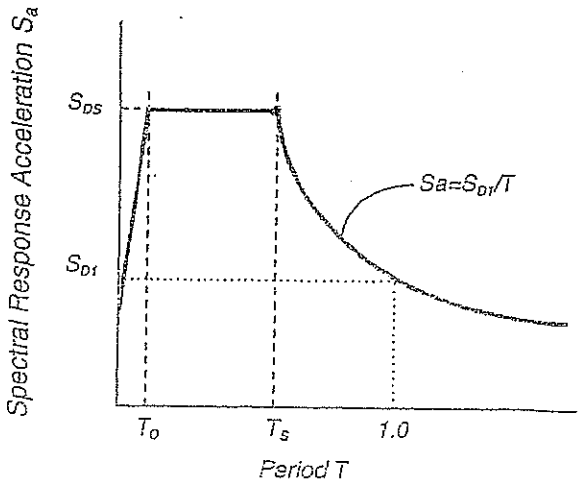


FIGURE 1615.1.4
DESIGN RESPONSE SPECTRUM

R15524

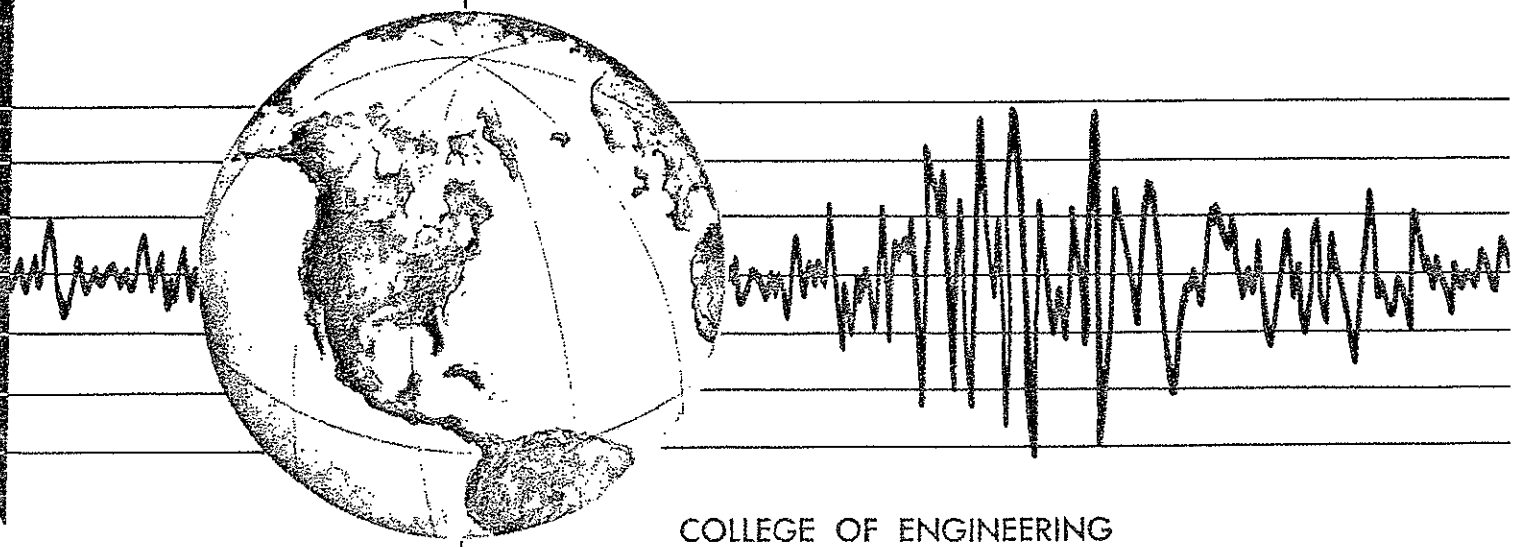
REPORT NO.
UCB/EERC-77/19
AUGUST 1977

EARTHQUAKE ENGINEERING RESEARCH CENTER

A SIMPLIFIED PROCEDURE FOR ESTIMATING EARTHQUAKE-INDUCED DEFORMATIONS IN DAMS AND EMBANKMENTS

by
F. I. MAKDISI
H. BOLTON SEED

A report on research sponsored by
the National Science Foundation



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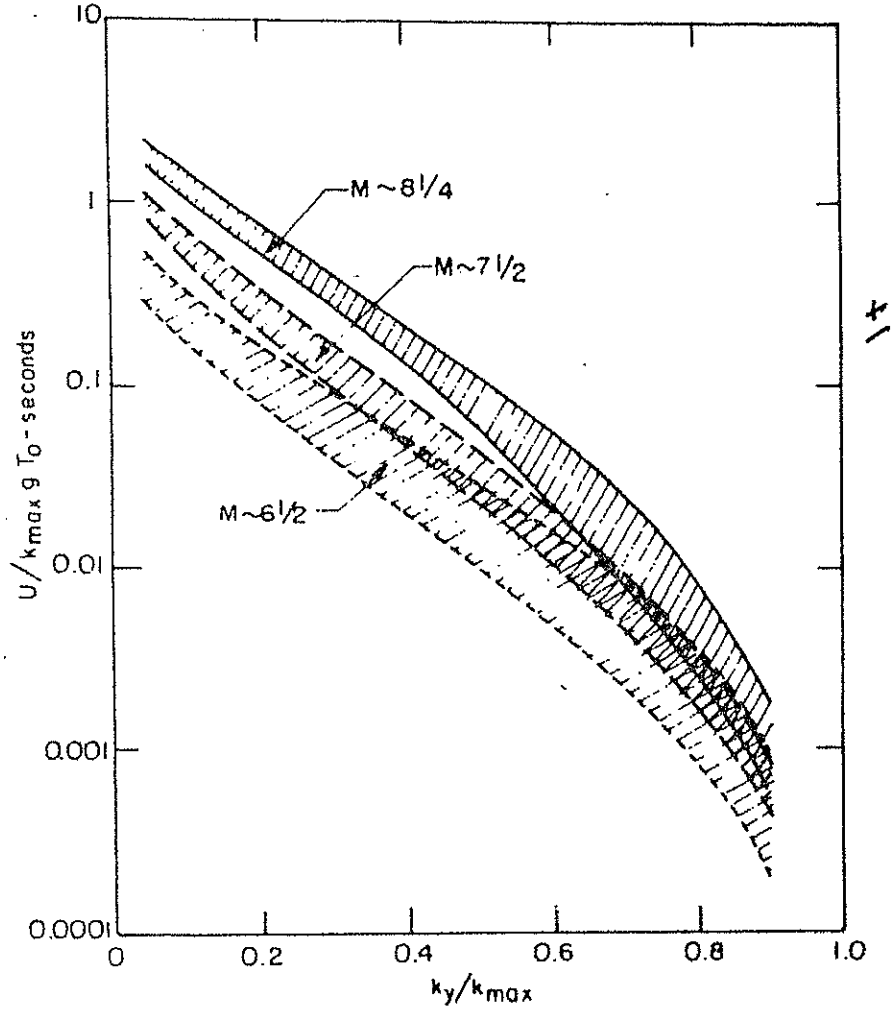

FIG. 15 VARIATION OF NORMALIZED PERMANENT DISPLACEMENT WITH YIELD ACCELERATION - SUMMARY OF ALL DATA

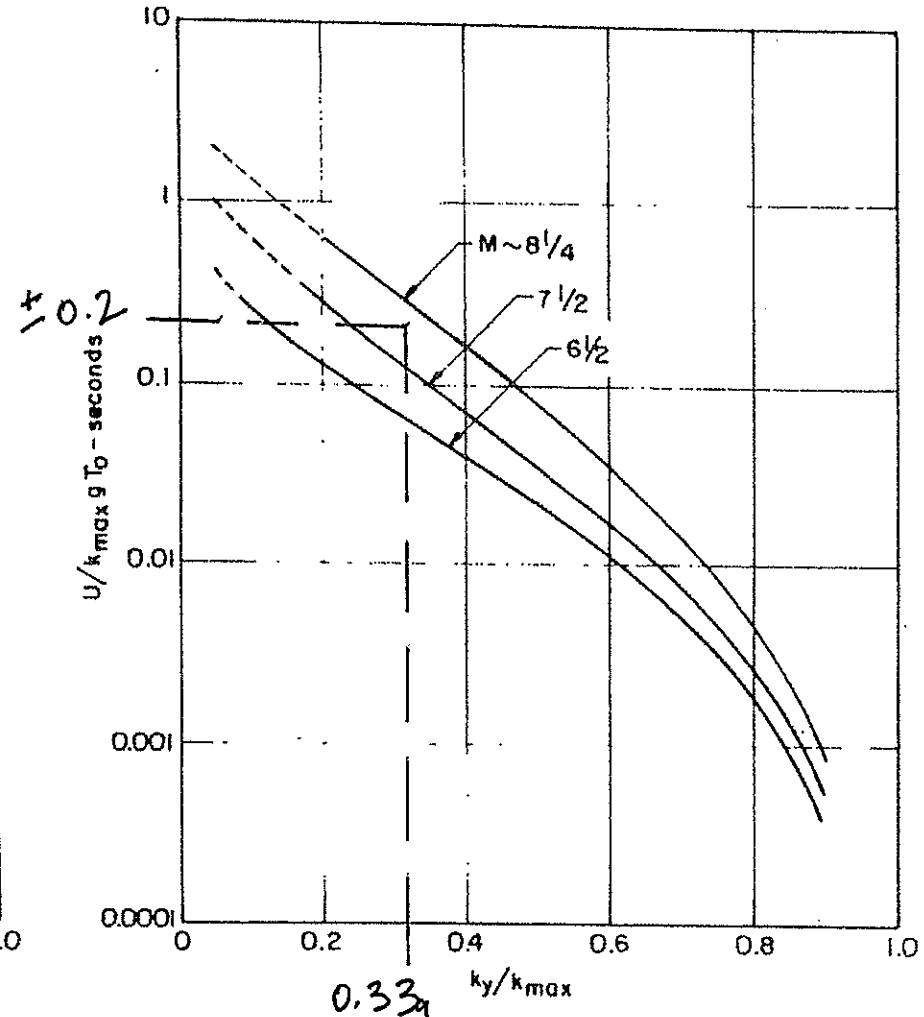

FIG. 16 VARIATION OF AVERAGE NORMALIZED DISPLACEMENT WITH YIELD ACCELERATION

ATTACHMENT 3

HYNES-GRIFFIN AND FRANKLIN DESIGN CURVE

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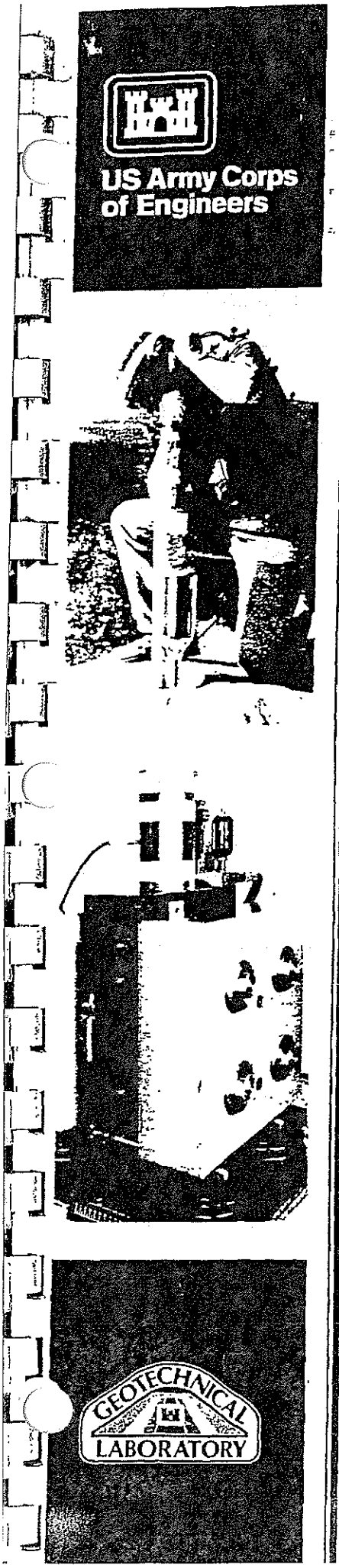

MISCELLANEOUS PAPER GL-84-13

RATIONALIZING THE SEISMIC COEFFICIENT METHOD

by

Mary E. Hynes-Griffin, Arley G. Franklin

Geotechnical Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
PO Box 631
Vicksburg, Mississippi 39180

July 1984
Final Report

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HYNES - GRIFFIN AND FRANKLIN (1984)

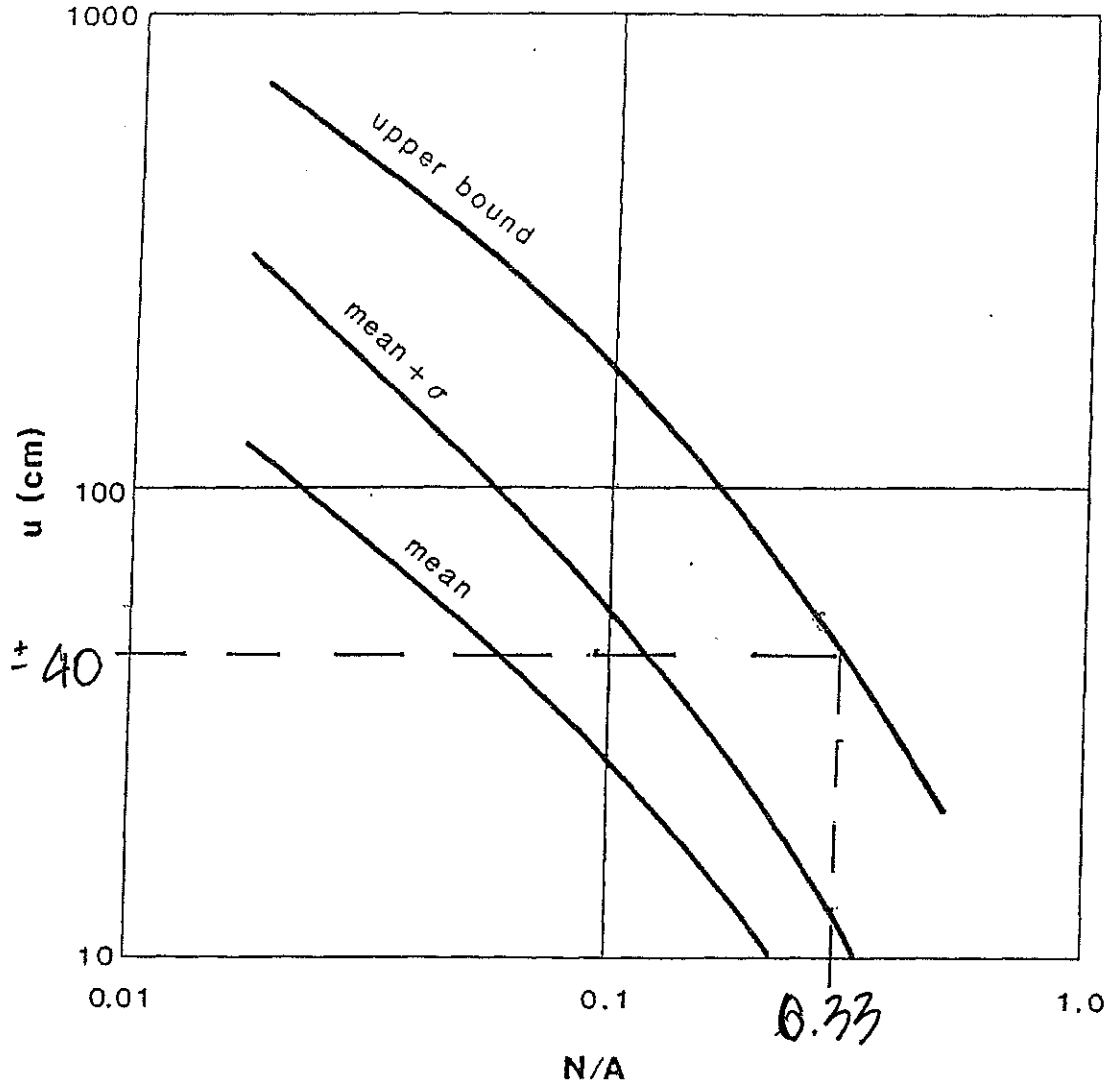

Figure 7. Permanent displacement u versus N/A , based on 348 horizontal components and 6 synthetic accelerograms

Embankment Response Analysis

21. Amplification of ground motions in the embankments may be examined by analysis of a shear-beam model of the embankment-foundation system. A closed-form solution has been obtained by Sarma (1979) for the problem illustrated by Figure 8. The model considered is an untruncated triangular wedge of height h_1 with a shear-wave velocity S_1 and density ρ_1 , underlain by a foundation layer with thickness h_2 , shear-wave velocity S_2 , and density ρ_2 . Both the wedge and foundation are linearly visco-elastic and have the same damping ratio D . The earthquake motions are considered to be rigid-body

8114-/10
Part 6

Alliance Consulting, Inc.
Engineers • Constructors • Scientists

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
MODIFICATION TO PERMIT NO. IL0078565
REPORT
PERMANENT DEFORMATION EVALUATION
VOLUME 3 OF 6

POND CREEK NO. 1 COAL REFUSE DISPOSAL SITE
SOUTH CELL SLURRY IMPOUNDMENT
JOHNSTON CITY, WILLIAMSON COUNTY, ILLINOIS

Prepared for

MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B10-148-1413
MARCH 2010

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PERMANENT DEFORMATION EVALUATION

POND CREEK NO. 1 COAL REFUSE DISPOSAL SITE
SOUTH CELL SLURRY IMPOUNDMENT
JOHNSTON CITY, WILLIAMSON COUNTY, ILLINOIS

Prepared For:

WILLIAMSON ENERGY, LLC
BECKLEY, WEST VIRGINIA

Prepared By:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
EXPORT, PENNSYLVANIA

CEC Project 072-046

January 23, 2008

EXECUTIVE SUMMARY

Plans have been developed for the construction of a coarse and fine coal refuse disposal facility to be located near Johnston City in Williamson County, Illinois. The proposed Pond Creek facility will provide disposal capacity for both coarse and fine coal refuse produced by the Pond Creek Mine No. 1 coal preparation plant located approximately 0.25 mile to the west. The location of the site is just southwest of the intersection of Dwina Road and Dean Road and is shown on Figure 1.

The design plans for the Phase 2 expansion of the Pond Creek facility, submitted under separate cover by Alliance Consulting, Inc. (Alliance) of Beckley, West Virginia, includes raising the embankment crest to Elevation (El.) 502 by constructing a coarse coal refuse embankment cell (South Cell). The corresponding minimum and maximum fine coal refuse slurry impoundment levels for the proposed South Cell are El. 474 and El. 496, respectively (along the Section A-A line shown in Figure 3).

The Illinois Department of Natural Resources (IDNR) has required that a revised (seismic) slope stability analysis be performed for the South Cell using equivalent static load methods and the appropriate peak acceleration based on the Peak Ground Acceleration (PGA) for the 2% Probability of Exceedance in 50 Years maps from the USGS. If the required factor of safety is not met, i.e., a minimum factor of safety of 1.0 with seismic forces for the steady seepage condition, a permanent deformation evaluation should be completed and submitted for review before an IDNR/OWR permit can be issued. Accordingly, Civil & Environmental Consultants, Inc. (CEC) has revised the seismic slope stability analyses and the minimum factors of safety do not meet the required 1.0 safety factor criteria. Subsequently, CEC has performed and completed a detailed deformation evaluation of the proposed Pond Creek South Cell impoundment addressing relevant issues such as material characterizations, seismic hazard, induced cyclic shear stresses and permanent deformations. CEC was authorized and performed this evaluation in accordance with the Williamson Energy, LLC (Williamson) Purchase Order (P.O.) Number 4175.

Permanent deformation analyses indicated that the South Cell is **NOT** susceptible to adverse post-earthquake permanent deformations. These conclusions are based on the results of high quality field testing and detailed seismically-related engineering and deformation analyses in both the upstream and downstream directions.

CEC, in cooperation with ConeTec, Inc. (ConeTec) developed and implemented a detailed field testing program, which utilized the most recent advances in piezo-seismic cone penetration testing (PS-CPT) to obtain a significant volume of credible field test results of the existing coarse coal refuse and residual soil materials at depth.

A probabilistic seismic hazard assessment (PSHA) was performed utilizing the 2002 USGS Earthquake Hazards Program, Interactive Deaggregation Maps (Frankel, 2002), specifically the 2% Probability of Exceedance in 50 Years recurrence interval to select the maximum design earthquake (MDE) and estimate the corresponding PGA for the Pond Creek site. A PGA value of 0.54g was estimated for two (2) controlling maximum design earthquake (MDE) events, including a magnitude (M) 8.0 New Madrid, Missouri regional earthquake located 83 kilometers (km) from the site, and a M6.8 Background earthquake located 13.5 km from the site, respectively.

Post-earthquake permanent deformation analyses were performed to estimate the anticipated maximum crest settlements for the two (2) MDE events. Based on the results of these analyses, the estimated maximum deformations are about 17 inches (1.4 feet) for both MDE scenarios. The relatively small deformations are attributable to the low frequency embankment response as compared to the predominantly higher frequency content of the applicable synthetic MDE acceleration time histories created for the Pond Creek site from eastern North American (ENA) earthquake ground motion attenuation (GMA) relationships. Given the minimum available freeboard of 6 feet, the post-earthquake deformations of 1.4 feet do not pose a threat to the integrity of the South Cell geometry.

Therefore, it is CEC's opinion the Pond Creek South Cell impoundment can be operated up to the proposed geometry with no appreciable risk of a release of tailings downstream or upstream due to permanent deformations expected from any site specific MDE event. It is also understood the Pond Creek facility will be operated with an impoundment level at the lowest practical elevation except during periods of intense rainfall. Analyses were not performed for the simultaneous occurrence of intense rainfall and an MDE due to the low probability of both events occurring at the same time.

TABLE OF CONTENTS

Page

Executive Summary

1.0 Introduction 1
1.1 Background and Authorization 1
1.2 Seismic Design and Analysis Methodology 2
1.3 Scope of Services 2

2.0 Existing Conditions and Coal Refuse Disposal Plan 5
2.1 Existing Conditions 5
2.2 Coal Refuse Expansion Plan 5

3.0 Geotechnical Field Investigations 6
3.1 General 6
3.2 Field Testing Procedures and Results Summary 8
3.2.1 In-Situ Piezo-Seismic Cone Penetration Testing 8
3.2.2 Shear Wave Velocity Measurements 8

4.0 Subsurface Conditions 11
4.1 Refuse and Residual Soil Boundaries 11
4.2 Groundwater Conditions 13

5.0 Seismic Hazard Assessment 14
5.1 Methodology 14
5.2 Pond Creek Probabilistic Seismic Hazard Assessment 15
5.2.1 Selection of Maximum Design Earthquake Events and Peak Ground Acceleration 15
5.3 Creation of Pond Creek Synthetic Acceleration-Time Histories 17
5.3.1 Stochastic Modeling 17
5.3.2 Source Spectrum Input 18
5.4 Comparative Assessment of Synthetic Eastern U.S. and Actual Western U.S. Earthquake Response Spectra 20
5.4.1 SHAKE Input Model 20
5.4.2 Discussion of SHAKE Output 21

6.0 Permanent Deformation Analyses 23
6.1 Analytical Approach 23
6.1.1 Newmark Analysis of Permanent Deformations 23
6.2 Determination of the Revised Pseudo-Static Seismic Factors of Safety and Yield Accelerations 24
6.3 SHAKE2000 Analyses 26
6.3.1 SHAKE2000 Input Summary 26

Table of Contents (Continued)
Page ii

Page

6.3.2 SHAKE2000 Results Summary 27
6.4 Analyses to Define Time-Histories of Acceleration 27
6.5 Critical Mass Displacements 28

7.0 Summary and Conclusions 30

References

TABLES

Table 1 – Source Zone Maximum Magnitude, Intensity and Depth
Table 2 – Source Zone Maximum Magnitude, Depth and PGA
Table 3 – Summary of Engineering Properties
Table 4 – Refuse/Soil Properties Used in Revised Pseudo-Static and Yield Acceleration Slope Stability Analyses

FIGURES

Figure 1 – Site Location Map
Figure 2 – CPT Sounding Location Plan
Figure 3 – Pseudo-Static and Yield Acceleration Slope Stability Analyses Results

APPENDICES

Appendix A – Piezo-Seismic Cone Penetration Testing (PS-CPT) and Results
A-1 – Summary of Piezo-Seismic Cone Penetration Testing
A-2 – ConeTec, Inc. Field Report
A-3 – Normalized PS-CPT Data and Parameter Correlations
A-4 – Photographs of October 2007 Field Testing

Appendix B – Characterization of Subsurface Conditions
B-1 – Shear Modulus Correlations for SHAKE Columns PCSC300E and PCSC300M
B-2 – Estimation and Summary of Engineering Properties including Peak Undrained Shear Strength for Refuse and Residual Soil Materials
B-3 – Laboratory Test Results Provided by Alliance Consulting, Inc.

Table of Contents (Continued)
Page iii

Appendix C – Seismic Hazard Assessment
C-1 – Probabilistic Seismic Hazard Assessment
C-2 – Simulation of Acceleration-Time Histories Using Stochastic Modeling and Comparative Assessment of Synthetic Eastern U.S. and PEER Database (Actual) Western U.S. Earthquake Records, Acceleration Time-Histories and Response Spectra

Appendix D – Permanent Deformation Analyses
D-1 – Estimation of the Pseudo-Static Seismic Factors of Safety and Yield Accelerations for the Downstream and Upstream Slope Geometries
D-2 – Estimating the Induced Cyclic Shear Stresses and Strains, and Time-Histories of Cyclic Shear Stress, SHAKE Columns PCSC300E and PCSC300M
D-3 – Estimates of Potential Embankment Settlements (Permanent Deformations)

1.0 INTRODUCTION

Plans have been developed for the construction of a coarse and fine coal refuse disposal facility to be located near Johnston City in Williamson County, Illinois. The proposed Pond Creek facility will provide disposal capacity for both coarse and fine coal refuse produced by the Pond Creek Mine No. 1 coal preparation plant located approximately 0.25 mile to the west. The location of the site is just southwest of the intersection of Dwina Road and Dean Road and is shown on Figure 1.

The design plans for the Phase 2 expansion of the Pond Creek facility, submitted under separate cover by Alliance Consulting, Inc. (Alliance) of Beckley, West Virginia, includes raising the embankment crest to Elevation (El.) 502 by constructing a coarse coal refuse embankment cell (South Cell). The corresponding minimum and maximum fine coal refuse slurry impoundment levels for the proposed South Cell are El. 474 and El. 496, respectively (along the Section A-A line shown in Figures 2 and 3).

1.1 BACKGROUND AND AUTHORIZATION

The Illinois Department of Natural Resources (IDNR) has required that a revised (seismic) slope stability analysis be performed for the South Cell using equivalent static load methods and the appropriate peak acceleration based on the Peak Ground Acceleration (PGA) for the 2% Probability of Exceedance in 50 Years maps from the USGS. If the required factor of safety is not met, i.e., a minimum factor of safety of 1.0 with seismic forces for the steady seepage condition, a permanent deformation evaluation should be completed and submitted for review before an IDNR/OWR permit can be issued.

Accordingly, Civil & Environmental Consultants, Inc. (CEC) has revised the seismic slope stability analyses and the minimum factors of safety do not meet the required 1.0 safety factor criteria. Subsequently, CEC performed and completed a detailed deformation evaluation of the proposed South Cell impoundment addressing relevant issues such as material characterizations,

seismic hazard, induced cyclic shear stresses and permanent deformations. CEC was authorized and performed this evaluation in accordance with the Williamson Energy, LLC (Williamson) Purchase Order (P.O.) Number 4175.

1.2 SEISMIC DESIGN AND ANALYSIS METHODOLOGY

The permanent deformation analyses performed by CEC for the proposed South Cell facility uses well-established field testing and analytical procedures developed by highly specialized and experienced authors. Pertinent references are cited throughout this report and a list of references is attached.

1.3 SCOPE OF SERVICES

In general, the scope of services performed by CEC for the South Cell included performing highly specialized cone penetration field testing, characterizing the coal refuse and residual soil materials, assessing seismic hazard, estimating induced cyclic shear stresses, evaluating yield accelerations, and estimating permanent deformations. More specifically, CEC's scope of services included:

1. Developing and implementing a detailed field testing program, which utilized the most recent advances in cone penetration testing (CPT) to obtain a significant volume of credible field test results of the available coarse refuse and underlying clayey/sandy residual soil materials, including:

    a. Piezo-seismic cone penetration testing (PS-CPT) at 15 sounding locations shown in Figure 2. PS-CPT obtains a continuous profile of tip stress, sleeve stress and pore-pressure to measure in-situ the consistency of the existing materials, and correlate field data to numerous in-situ static parameters. Also, PS-CPT measures shear wave velocities (at approximate 3-foot intervals) to correlate in-situ dynamic properties of the refuse and soil materials with depth;

2. A probabilistic seismic hazard assessment (PSHA) developed specifically for the Pond Creek site, which utilized the 2002 USGS Earthquake Hazards Program, Interactive Deaggregation Maps (Frankel, 2002) and the 2% Probability of Exceedance in 50 Years recurrence interval for the site coordinates, and evaluated both local and regional seismic source contributions. Based on the interactive deaggregation plots, the PSHA for the Pond Creek facility included contributions from two (2) Maximum Design Earthquake (MDE) scenarios: a high magnitude (M) 8.0 earthquake associated with a New Madrid, Missouri earthquake event located approximately 83 kilometers (km) from the site, and a smaller, M6.8 Background earthquake located about 13.5 km from the site. The USGS M8.0 and M6.8 MDE earthquake scenarios yielded a corresponding PGA of 0.54g for the site. Time histories and PGAs from both MDE events were used in the various seismic shear stress and deformation analyses to evaluate the response of the Pond Creek facility to the PGA, duration and frequency content.

3. Revising pseudo-static seismic slope stability analyses, and estimating yield accelerations and permanent deformations (crest settlements) as a function of time-history horizontal shear stresses generated within the embankment mass due to the anticipated MDE events and shear moduli developed from in-situ shear wave velocities measured during PS-CPT.

   Permanent deformation analyses included the use of stochastic modeling based on the published predictive relations of Atkinson and Boore (1995) and the program SIMSM (Boore, 1996) to create a synthetic acceleration-time history for each MDE scenario consistent with the most recent advances in development of eastern North American (ENA) earthquake response. The source ground motion was estimated using published criteria, such as moment magnitude, epicentral distance, focal depth, etc. The resulting synthetic time-histories are representative of the current state-of-the-art understanding for ENA earthquakes, as opposed to the previously used western United States (U.S.) earthquakes, which drastically differ in frequency content and source-distance attenuation relationships. Additionally, as a comparison, a western U.S. earthquake record from a

1989 Loma Prieta, California M6.9 earthquake and corresponding acceleration time-history was used to evaluate the site response (response spectra). Both the M6.8 Background and M6.9 Loma Prieta earthquakes response spectra were compared to five (5) published ENA and Central United States (CEUS) ground motion attenuation (GMA) relationships and corresponding response spectra to assess the reasonableness of the ENA/CEUS versus western U.S. earthquake record response.

4. Finally, based on the results of the aforementioned analyses, drawing conclusions regarding the likelihood of excessive downstream or upstream deformations resulting in overtopping of the South Cell crest due to the MDE events at the Pond Creek facility.

The following sections of this report include generalized descriptions of the existing conditions, CEC's understanding of the proposed coal refuse disposal plan, detailed descriptions of the field testing programs and subsurface conditions encountered at the Pond Creek site. Also presented are summaries of the analytical techniques and results of the material characterizations and various permanent deformation analyses. Figure 1 presents a site location map, Figure 2 presents the PS-CPT sounding plan and Figure 3 presents the Cross-Section A-A, Pond Creek South Cell embankment geometry and results of the yield acceleration analysis. Appendices A through D present supporting information including detailed calculation briefs for the various field and analytical procedures discussed herein.

2.0 EXISTING CONDITIONS AND COAL REFUSE DISPOSAL PLAN

2.1 EXISTING CONDITIONS

The proposed coal refuse disposal facility is located approximately seven (7) miles northeast of Johnston City, Illinois. The embankment is situated southwest of the intersection of Dwina Road and Dean Road. The Pond Creek Mine No. 1 coal preparation plant is located approximately 0.25 mile west of the embankment.

CEC understands the proposed South Cell impoundment area was previously used for agricultural purposes. Based on our observations, the area has relatively flat to mild slopes to the ridgeline at approximate El. 572. The surrounding landscape is characterized by extensive agricultural and rural residential land use.

2.2 COAL REFUSE EXPANSION PLAN

The Pond Creek disposal plan, as prepared by Alliance, provides for the disposal of approximately 1.6 years of coarse coal refuse and 3.2 years of fine coal refuse based on production rates provided by Williamson. The facility shall be constructed in two (2) phases consisting of an excavated starter cell (Phase 1) and a downstream coarse coal refuse embankment (Phase 2).

CEC understands, based on information provided by Alliance, that the proposed plan raises the crest to El. 502 by constructing a coarse coal refuse embankment. CEC also understands that the proposed plan was prepared in accordance with prudent engineering principles and practices, and interpretation of current Mine Safety and Health Administration (MSHA) and IDNR design criteria for coal refuse disposal facilities.

3.0 GEOTECHNICAL FIELD INVESTIGATIONS

3.1 GENERAL

CEC developed and implemented a subsurface exploration plan including performing a total of 15 PS-CPT soundings at the Pond Creek site on October 30 and 31, 2007 at the approximate locations shown in Figure 2. PS-CPT was performed by ConeTec, Inc. (ConeTec) of West Berlin, New Jersey using a 25-ton, unitized, track-mounted cone penetration rig. PS-CPT was also performed under the observation and guidance of experienced CEC personnel.

PS-CPT locations designated as CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A, CPT-5B, CPT-6, CPT-7, CPT-8, CPT-9, CPT-10, CPT-11 and CPT-12 were located by CEC within areas that included the proposed South Cell, North Central Cell and North Cell impoundment areas. CPT-2, CPT-2A, CPT-5, CPT-5A and CPT 5B soundings were located on an existing coarse coal refuse embankment, and were pushed through coarse refuse and the underlying residual soil. CPT-1, CPT-3, CPT-4, CPT-6, CPT-7, CPT-8, CPT-9, CPT-10, CPT-11 and CPT-12 were located throughout the facility at the approximate existing ground surface and were pushed exclusively through residual soil.

A total of eight (8) soundings were considered most applicable to the Pond Creek South Cell including CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B. Ground surface elevations of the soundings were provided by Williamson. The following presents a summary of the field testing, including the CPT sounding number, site coordinates, existing ground surface elevation, total depth, interpolated ground water depth and applicable slurry cell.

Table 1: Summary of October 2007 CPT Soundings – Pond Creek Coal Refuse Disposal Site

CPT No.	Northing (ft)	Easting (ft)	Ground Surface Elev.(ft)	Total Depth (ft)	GWT Interpolated (ft)	Applicable Slurry Cell
CPT-1	425784.32	358548.87	482.19	18.4	15.3	South
CPT-2	426832.42	357857.50	494.21	45.3	38.8	South, Central, North
CPT-2A	426828.92	358156.73	492.40	41.7	37.0	South, Central, North
CPT-3	426792.78	359207.80	466.98	22.2	11.1	South
CPT-4	426331.10	360108.80	482.55	18.9	21.7	South
CPT-5	427485.26	357913.86	482.55	49.2	34.4	South, Central, North
CPT-5A	427607.60	357920.84	483.00	53.2	35.9	South, Central, North
CPT-5B	427147.68	358343.06	479.90	39.7	28.0	South, Central, North
CPT-6	427450.46	358992.62	457.78	22.6	9.2	Central
CPT-7	427450.88	359850.00	457.83	16.7	9.2	Central
CPT-8	429006.12	358034.04	444.45	17.9	6.6	Central, North
CPT-9	429077.69	359026.20	445.68	22.0	7.8	Central, North
CPT-10	428965.83	359998.44	442.09	26.1	3.4	Central, North
CPT-11	430316.82	358810.96	440.59	27.6	11.4	North
CPT-12	430141.83	359852.30	442.08	22.6	11.7	North

A summary of the PS-CPT operations prepared by CEC and the complete report of field test data and various parameter correlations prepared by ConeTec are presented in Appendix A, Attachments A-1 and A-2, respectively. Groundwater depths were interpolated by CEC between groundwater well data provided by Williamson.

3.2 FIELD TESTING PROCEDURES AND RESULTS SUMMARY

3.2.1 In-Situ Piezo-Seismic Cone Penetration Testing

Determining the dynamic response of the South Cell embankment and underlying residual soils requires knowledge of the subsurface material's dynamic properties to accurately predict the horizontal shear stresses and strains induced in the various materials by a given earthquake loading. Of particular significance in the dynamic evaluation is the distribution of density of the coal refuse materials with depth. The low-amplitude, small strain shear modulus (G) with depth is an important parameter for characterizing the behavior and response of a soil column during earthquake shaking. The shear modulus is a function of the in-situ shear wave velocity estimated at the site with depth and was obtained in the field utilizing PS-CPT.

The main purpose of the PS-CPT was to measure in-situ shear wave (S-wave) travel times for subsequent calculation of shear wave velocity (V_S) and G; however, tip resistance (q_t), sleeve friction (f_s) and dynamic pore pressure (u_t) were also measured. CPT provides nearly continuous in-situ field data, which was correlated to classification and in-situ strength values based on established procedures such as those outlined in Robertson and Campanella (1988).

3.2.2 Shear Wave Velocity Measurements

The seismic wave form portion of the PS-CPT was conducted by ConeTec at about 3-foot intervals throughout the soil profile to the maximum depths indicated. The down-hole seismic survey is a reliable technique for obtaining shear wave and compression wave velocities accounting for the subsurface material's attenuation and anisotropic effect with depth (Hoar and Stokoe, 1978) (Dobry et al., 1981) (Stokoe and Nazarian, 1985). Only S-wave travel times were measured for each sounding with depth. These travel times were used to calculate the corresponding V_S and G used in the dynamic analyses of the Pond Creek facility. The in-situ seismic survey measured shear wave velocities at locations CPT-1 through CPT-12 from the

existing ground surface through coarse coal refuse, where applicable, and also through residual soil materials. Shear wave velocities in feet per second (fps) per material type were estimated by ConeTec and the minimum, maximum and weighted averages are summarized as follows:

Table 2: Summary of CPT Shear Wave Velocity Summary – Pond Coal Refuse Disposal Site

CPT No.	Shear Wave Velocity Max./Min./Avg. Coarse Coal Refuse (fps)	Shear Wave Velocity Max./Min./Avg. Residual Soil (fps)
CPT-1	NA	1402 645 905
CPT-2	1284 1029 1120	1173 795 957
CPT-2A	1169 895 1042	1256 780 918
CPT-3	NA	1058 569 765
CPT-4	NA	1242 476 817
CPT-5	1190 936 1063	1599 780 947
CPT-5A	1396 779 1064	1580 728 1005
CPT-5B	1517 818 1080	1649 686 978
CPT-6	NA	1022 514 796
CPT-7	NA	894 514 682
CPT-8	NA	1036 541 783
CPT-9	NA	1484 415 835
CPT-10	NA	1217 478 828
CPT-11	NA	1387 471 925
CPT-12	NA	1230 530 763

In general, shear wave velocities in coarse refuse ranged from about 779 to 1,517 fps with an average value of about 1,074 fps. For the residual soils, Vs ranged from 415 to 1,649 fps with an average value of about 860 fps. Measured values of V_S for coarse refuse and residual soil materials and the density of the respective material with depth are used to estimate the initial shear modulus, G, for use in the one-dimensional, dynamic SHAKE2000 (Ordonez, 2006) analysis of the embankment. G-values estimated are subsequently used in the calculation of

induced cyclic shear stress at a SHAKE soil column location (e.g., PCSC300) shown in Figure 3. Appendix A, Attachment A-2 presents the complete ConeTec report, and Appendix B, Attachment B-1 presents the computations of G for the SHAKE columns from in-situ measurements of V_S for the coarse refuse, residual soil and bedrock materials, and includes plots of V_S and G with depth.

4.0 SUBSURFACE CONDITIONS

4.1 REFUSE AND RESIDUAL SOIL BOUNDARIES

Figure 2 depicts the location of the 15 PS-CPT soundings conducted at the site in October 2007. Figure 3 presents a generalized cross-section (A-A) of the South Cell impoundment. In general, CPT-2, CPT-2A, CPT-5, CPT-5A and CPT-5B were advanced from the existing crest between approximately El. 480 and 495 through approximately 19 to 32 feet of coarse coal refuse. Residual soil materials were encountered in all CPT soundings below approximate El. 440 to 482. All CPT soundings were advanced until refusal at depths ranging from 16.4 to 53.2 feet below the existing ground surface.

The stratification lines at the various depths corresponding to the generalized cross-section described herein and as shown in Figure 3 were adjusted to account for conditions encountered in the field. Refuse and residual soil properties based on the Alliance expansion plan submittal and static stability analyses were reviewed by CEC and considered to be reasonably consistent with the observed field data, and as such, were used throughout our analyses. Site-specific refuse/soil profiles based on the October 2007 PSCPT data for the applicable South Cell CPT soundings are as follows:

CPT-1	CPT-2
El. 482.19 – Surface Elevation	El. 494.21 – Surface Elevation
15.3 feet – Depth to Static Ground Water	38.8 feet – Depth to Static Ground Water
0 – 18.4 feet – Residual Soil	0 – 32 feet – Coarse Refuse
Refusal at 18.4 feet – Bedrock	32 – 45.3 feet – Residual Soil
	Refusal at 45.3 feet – Bedrock

CPT-2A
El. 492.40 – Surface Elevation
37.0 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse
29 – 41.7feet – Residual Soil
Refusal at 41.7feet – Bedrock

CPT-3
El. 466.98 – Surface Elevation
11.1 feet – Depth to Static Ground Water
0 – 22.2 feet – Residual Soil
Refusal at 22.2 feet – Bedrock

CPT-4
El. 482.55 – Surface Elevation
21.7 feet – Depth to Static Ground Water
0 – 18.9 feet – Residual Soil
Refusal at 18.9 feet – Bedrock

CPT-5
El. 482.55 – Surface Elevation
34.4 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse
29 – 49.2feet – Residual Soil
Refusal at 49.2 feet – Bedrock

CPT-5A
El. 483.00 – Surface Elevation
35.9 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse
29 – 53.2 feet – Residual Soil
Refusal at 53.2 feet – Bedrock

CPT-5B
El. 479.90 – Surface Elevation
28.0 feet – Depth to Static Ground Water
0 – 19 feet – Coarse Refuse
19 – 39.7 feet – Residual Soil
Refusal at 39.7 feet – Bedrock

A generalized profile at Station (STA) 300 shown below was created based on the individual layer designations shown above for which data were weight averaged, and the critical South Cell embankment geometry shown in Figure 3 was correspondingly accounted for (including the maximum and minimum phreatic surface) to create the generalized profile.

GENERALIZED PROFILE FOR POND CREEK SOUTH CELL
El. 502 – Surface Elevation
14 to 32 feet – Depth to Ground Water Table
0 – 32 feet – Coarse Refuse
32 – 50 feet – Residual Soil

Figure 3 presents the generalized embankment Cross-Section A-A, which includes the surface and subsurface geometry, and incorporates variations in stratigraphy estimated during field testing and subsequent review of available data. The description of the subsurface conditions at the site, as presented herein, is generalized from the available plan submittal information and interpolated between the soundings pushed during this subsurface exploration. The boundary lines between soil types are also estimated based on existing plan information, available field test data, and the samples recovered from the borings (by others).

4.2 GROUNDWATER CONDITIONS

Groundwater levels were provided by Williamson for existing groundwater wells installed throughout the Pond Creek site and are presented in Appendix A, Attachment A-1. Groundwater levels at the various CPT soundings were estimated based on the latest groundwater information. Groundwater levels are typically also estimated from static pore pressure readings and pore pressure dissipation tests performed by ConeTec during PS-CPT; however, long-term pore pressure dissipation in the clayey residual soils was not fully realized due to the relative impermeability of the materials. Consequently, groundwater levels were interpolated between wells based on the piezometric levels measured in the field. The groundwater conditions noted represent conditions only at the actual time and location observed and may fluctuate with time and/or location.

5.0 SEISMIC HAZARD ASSESSMENT

5.1 METHODOLOGY

A probabilistic seismic hazard assessment (PSHA) was performed for the Pond Creek site located near Johnston City, Williamson County, Illinois. PSHA involved utilizing the 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps (Frankel, 2002), particularly the 2% Probability of Exceedance in 50 Years recurrence interval for the site coordinates and the development of a particular seismic scenario upon which the ground motion hazard evaluation was based. The scenario consisted of the postulated occurrence of an earthquake (i.e., 2% Probability of Exceedance in 50 Years) of a specified size based on the latest USGS hazard mapping surrounding the Pond Creek site. In general, PSHA involved four (4) basic elements:

1. Evaluate earthquake sources;
2. Determine controlling earthquake(s): the maximum magnitude and maximum design earthquake;
3. Determination of GMA relationships or distance from the site; and
4. Determination the peak ground acceleration (PGA).

PSHA, utilizing the deaggregation maps, determines the earthquakes that have the most significant impacts at the site, and for engineering design and analyses of tailing dams, a design earthquake is desired.

Stochastic modeling, based on the published predictive relations of Atkinson and Boore (1995), was subsequently used to create synthetic acceleration-time histories for the critical earthquake scenarios. The required input parameters for the critical earthquake source spectra, including moment magnitude, epicentral distance and focal depth were developed from the published information discussed above and summarized below.

Subsequently discussed below is a comparison of input parameters and site response made by CEC using both eastern U.S. synthetic earthquake time histories and actual western U.S. earthquake time histories. Available records were scaled in SHAKE to the Pond Creek site PGA and the site response compared to published eastern U.S. GMA response spectra to assess the reasonableness of the various time histories.

5.2 POND CREEK PROBABILISTIC SEISMIC HAZARD ASSESSMENT

The PSHA methodology chosen for this evaluation represents a more refined approach to previous methods which solely used empirical, pseudo-static embankment analyses. Similarly, the PSHA developed specifically for the Pond Creek site also attempts to eliminate the potential for over-conservative, unrealistic strong ground motion associated with the "floating earthquake" concept. This approach is generally applied in regions where active earthquake-generating surface faults exist and the intensity-based peak acceleration relationships are from only long-period western U.S. and Japanese seismic activity and more importantly, the peak acceleration does not account for distance.

5.2.1 Selection of Maximum Design Earthquake Events and Peak Ground Acceleration

Based on the most critical regional and local seismic events to the Pond Creek site as identified by the USGS deaggregation mapping, two (2) MDE scenarios were selected for analysis including a magnitude (M) 8.0, which has boundary limits of about 83 km from the site and the potential to generate a high intensity earthquake. The Pond Creek site also has the potential to be impacted by a smaller magnitude earthquake or a comparable local "background" earthquake at a closer epicentral distance to the site, which based on the USGS seismic hazard program is an M6.8 at 13.5 km. The PGA associated with this hazard was defined at 0.54g. Several other potential regional and local events were identified by the USGS deaggregation mapping; however, these two (2) MDE scenarios were considered the most critical and were subsequently used to evaluate their impact on the Pond Creek impoundments since the maximum ground

accelerations, frequency contents and durations of effective cycles will be notably different. The 2002 USGS Interactive Deaggregation Maps including the 2% Probability of Exceedance in 50 Years maps are presented in Appendix C, Attachment C-1.

The rate at which the strength of earthquake ground motion attenuates and the amount of geometric spreading with distance from the epicenter is required for seismic hazard analyses. The focal depth of the earthquake and the near surface geological conditions have a significant influence on the intensity attenuation relationship. Information on earthquakes occurring in the eastern U.S. suggests that surface faulting does not occur and the center of energy release is deeper than the average of California earthquakes. The earthquake energy is therefore radiated over a larger area than is experienced in California, and California data cannot be extrapolated directly to this region. Several ENA and CEUS GMA relationships including Toro, et.al. (1997), Atkinson & Boore (1997), Campbell (2003), Atkinson (2001) and Tavakoli & Pezeshk (2005) were used to compare the USGS PGA for the Pond Creek site to that of other ENA and CEUS ground motion relationships.

As previously discussed, CEC utilized the Atkinson and Boore (1995) empirically-derived earthquake source spectra model for ENA hard rock sites, and created quality synthetic acceleration-time histories for the bedrock motions. Subsequently, the various input parameters from these ENA synthetic earthquake records were compared to the input and time histories scaled accordingly to the PGA anticipated at the Pond Creek site. Also, selection of an earthquake time history record from the Pacific Earthquake Engineering Record (PEER) Strong Motion Database for western U.S. and Japanese earthquake records, scaled to the Pond Creek site PGA was performed. Finally, the corresponding response spectra curves of the South Cell site response due to the ENA synthetic and PEER earthquake time histories were compared to various ENA and CEUS GMA response spectra to assess the reasonableness of the time histories, and is described in Section 7.4.

5.3 CREATION OF POND CREEK SYNTHETIC ACCELERATION-TIME HISTORIES

Recent studies (Atkinson and Boore, 1995 and 1998) have also shown that the high frequency ground motions observed from a database of low to moderate magnitude earthquakes in the eastern U.S. and Canada can reasonably be predicted using stochastic modeling. In this method, synthetic time histories are characterized as finite-duration, bandlimited Gaussian noise, while known regional source and propagation parameters are utilized to identify the underlying amplitude spectrum.

Synthetic acceleration-time histories were created for the two (2) MDE events affecting the Pond Creek facility. The seismological computer program "SMSIM – Fortran Programs for Simulating Ground Motions from Earthquakes: Version 1.0," written by David Boore (1996), was utilized to predict ENA earthquake ground motions from stochastic modeling and empirically derived source spectra relationships. The calculation brief detailing the stochastic modeling methodology and the creation of acceleration-time histories for the design MDE scenarios is presented in Appendix C, Attachment C-2.

As discussed by Atkinson and Boore (1995 and 1998), recent understandings in the behavior of ENA earthquakes have resulted in a decrease in intermediate-frequency [$f \leq 1$ Hertz (Hz)] ground motions and a shift in expected motions toward the higher frequency range. Based on the comparison of simulated values with published values of Atkinson and Boore (1995), the use of these synthetic records as base motion provided reliable input for SHAKE trials in the permanent deformation analyses of the impoundment (described in detail in Chapter 8.0).

5.3.1 Stochastic Modeling

The stochastic method is initiated by defining the Fourier amplitude spectrum of ground acceleration with respect to seismic moment and distance. The amplitude spectrum also includes a diminution function which models the geometric and an elastic attenuation as a function of

hypocentral distance (R) and frequency (f), as well as filters to reduce high-frequency amplitudes and shape the response spectrum. The time series is a windowed Gaussian noise sequence with a zero mean amplitude. The duration of this window is limited as a function of earthquake magnitude and distance from the source. Once the windowed time series has been defined, its spectrum is multiplied by the amplitude spectrum then transformed back into the time domain, thus resulting in the simulated earthquake record.

5.3.2 Source Spectrum Input

The source spectrum model used to characterize the amplitude of ground motions for the two (2) critical earthquake scenarios represents the Atkinson source model. As discussed in Atkinson and Boore (1998), which compares the results of several source models with the ground motion database of ENA earthquakes and other earthquakes with similar geologic settings, the Atkinson source model provides the most accurate ground motion estimates over the frequency range of interest (0.1 to 10 Hz) for most engineered facilities. Atkinson and Boore conclude that most other ENA models tend to overpredict long-period motion. The use of the Atkinson model was also recommended by seismologist Dr. Martin Chapman of the Virginia Polytechnical Institute Seismological Observatory, in Blacksburg, Virginia, who previously consulted with CEC on similar projects in West Virginia and Kentucky. The source spectrum data used as input for two (2) MDE scenarios, including a M8.0 New Madrid, Missouri event at 83 km and a M6.8 Background event at 13.5 km, were taken directly from the input parameter file for Atkinson and Boore (1995), AB95.dat, which is presented as Appendix F of the SMSIM Open Report. These parameters, as well as the input magnitudes and attenuation distances, are summarized below.

MDE No. 1 – M6.8 Background Earthquake:

- Moment Magnitude, M = 6.8 based on Frankel (2002)
- Shear Wave Velocity, V_S = 3.8 km/sec
- Density of Rock Mass, ρ (Between Source and Site) = 2.8 g/cm^2
- Cutoff Frequency = 50 Hz

- Maximum Frequency, *f*max = 40 Hz
- Hypocenter Distance, R = 16.8 km, assuming Epicenter Distance = 13.5 km
- Focal Depth = 10 km
- Quality Factor, $Q = C * f^n$ where C = 680, $n = 0.36$, f = frequency
- Seed (Random Number) = 3
- Time Step = 0.01 seconds

MDE No. 2 - M8.0 New Madrid Earthquake:

- Moment Magnitude, M = 8.0 based on Frankel (2002)
- Shear Wave Velocity, V_S = 3.8 km/sec
- Density of Rock Mass, ρ (Between Source and Site) = 2.8 g/cm^2
- Cutoff Frequency = 50 Hz
- Maximum Frequency, *f*max = 40 Hz
- Hypocenter Distance, R = 83.6 km, assuming Epicenter Distance = 83 km
- Focal Depth = 10 km
- Quality Factor, $Q = C * f^n$ where C = 680, $n = 0.36$, f = frequency
- Seed (Random Number) = 3
- Time Step = 0.01 seconds

The PGA for the M6.8 Background and M8.0 New Madrid earthquake are 739 cm/sec^2 (0.754g) and 181 cm/sec^2 (0.184g), respectively. Higher acceleration values were expected for the Background MDE since there is less attenuation from the hypocenter to the site (13.5 km compared to 83 km). However, it is important to note that the duration of the acceleration record for the M8.0 earthquake is about 80 seconds, compared to about 15 seconds for the lower M6.8 Background earthquake. Additionally, the frequency contents of the two (2) simulations are quite different.

5.4 COMPARATIVE ASSESSMENT OF SYNTHETIC EASTERN U.S. AND ACTUAL WESTERN U.S. EARTHQUAKE RESPONSE SPECTRA

A comparison of site response (spectra) was made between synthetic acceleration time histories using SMSIM (Boore, 1996), based on the eastern U.S. Atkinson & Boore (1995) GMA relationship, and an actual time history record from the western U.S., PEER strong motion database. Response spectra from each earthquake time history are generated at the base and top of the South Cell embankment crest column PCSC300M using the one-dimensional wave propagation program SHAKE2000 (Ordonez, 2006), and the compatibility of each response spectra is assessed relative to response spectra for five (5) eastern U.S. GMA relationships. The eastern U.S. ground motion spectra should envelope the South Cell site response yielding similar frequency content and eliminating potential resonance effects.

Synthetic time histories were used to represent the Pond Creek PSHA MDE earthquakes including the M6.8 (13.5 km), which was scaled to USGS-derived PGA value of 0.54g for the site. Alternatively, a search of the PEER strong motion database of western U.S. earthquakes was performed for a range of magnitudes between M5.5 and M7.2, a radial distance between 10 km and 50 km and PGA between 0.40g and 0.65g to represent the Pond Creek M6.8 source. Three (3) earthquake records were reviewed and the 1989 Loma Prieta earthquake, LOMAP/G01000 record (M6.9 at 11 km) was chosen, with PGA of 0.41g, as a comparative time history. The LOMAP/G01000 record was subsequently converted in SHAKE2000 and scaled to 0.54g (from 0.41g), and the resulting response spectra was compared to the corresponding synthetic time history and eastern U.S. GMA response spectra.

5.4.1 SHAKE Input Model

To compare the Pond Creek site response from both the eastern U.S. synthetic time histories and the PEER database western U.S. time history, SHAKE was used to calculate the response spectra for each time history using the Pond Creek embankment (crest) SHAKE column PCSC300M. Analyses were performed using SHAKE2000 (Ordonez, 2006). SHAKE2000 integrates SHAKE

(Schnabel et al., 1972) and SHAKE91 (Idriss, I.M. and Sun, J.I., 1992) with ShakEdit (Ordonez, G., 2006) a pre- and post-processor for SHAKE and SHAKE91. SHAKE2000 utilizes a one-dimensional analysis for the vertical propagation of shear waves from the bedrock layer up through the soil profile, which is modeled as a series of horizontal layers, to estimate the maximum cyclic shear stress and strain with depth.

A layered SHAKE model was generated utilizing field and laboratory test data, and input information including layer thickness, unit weight and (small strain) shear modulus (Gmax). Time histories for the M6.8 (at 13.5 km) earthquake scenario, from both the Pond Creek synthetic eastern U.S. records and the western U.S. Loma Prieta PEER database time histories represent the respective eastern and western U.S. frequency content and PGA. Time histories associated with the M6.8 and M6.9 events were scaled to 0.54 g and input into SHAKE at the base of the PCSC300M SHAKE column.

5.4.2 Discussion of SHAKE Output

SHAKE output included generating and plotting response spectra curves for the Pond Creek site response for Layer 1 – at the top of the PCSC300M column, and Layer 17 – at the base of the same column. Additionally, the response spectra curves for five (5) published eastern U.S. GMA relationships were plotted, and are compared to the Pond Creek site response spectra due to the eastern and western U.S. time histories. The response spectra curves for the site response and comparative ground motion spectra are presented in Appendix C, Attachment C-2.

As shown in Attachment C-2 response spectra comparison, the eastern U.S. synthetic time history produced a frequency response (predominant period) within a range of periods between 0.01 and 0.1 seconds, as defined by the eastern U.S. GMA relationships. The western U.S. PEER database time history produced predominant periods about 5 to 10 times that of the eastern U.S. GMA relationships, between 0.1 and 1 second, and consistent with published information in Atkinson & Boore (1995 and 1998). Thus, the response spectra due to the western U.S. time history is not consistent with the anticipated eastern U.S. ground motion response spectra and

should not be used to represent eastern U.S. earthquake records or time histories. The eastern U.S. synthetic earthquake record and site response from the synthetic time histories input into SHAKE fell directly within the predominate period range of the multiple eastern U.S. GMA relationships as evidenced by the site response spectra curves for the M6.8 Background earthquake presented in Attachment C-2.

Therefore, eastern U.S. synthetic time histories for the M6.8 and M8.0 earthquakes, scaled to the Pond Creek MDE PGA of 0.54g were used in supplemental SHAKE analyses to estimate cyclic shear stresses/strains and time histories of horizontal cyclic shear stress for the SHAKE crest column.

6.0 PERMANENT DEFORMATION ANALYSES

6.1 ANALYTICAL APPROACH

As previously discussed, IDNR has required that a revised (seismic) slope stability analysis be performed for the South Cell using equivalent static load methods and the appropriate peak acceleration based on the PGA for 2% Probability of Exceedance in 50 Years maps from the USGS. If the required factor of safety is not met, i.e., a minimum factor of safety of 1.0 with seismic forces for the steady seepage condition, a permanent deformation evaluation should be completed. As described below, revised seismic stability analyses using a PGA value of 0.54g yielded factors of safety less than 1.0. Therefore, permanent deformations or crest settlement are evaluated, which can occur depending upon the acceleration levels above a defined yield acceleration, below which embankment response is assumed to behave elastic-plastic (Newmark, 1965). If crest settlements eliminate the available freeboard below the maximum tailings impoundment level, overtopping of the dam could result posing a threat to the embankment and ultimately downstream safety.

6.1.1 Newmark Analysis of Permanent Deformations

In a Newmark analysis (Newmark, 1965), deformations are analyzed by considering movements of a sliding mass over a sliding surface caused by yielding of the soil at its available strength. The basic assumption is that movement (or yielding) occurs when the sum of the static plus the seismic shear stresses along the sliding surface reaches the value of the available shear strength. Thus, the acceleration that can be transmitted to the sliding mass is limited to a value referred to as the yield acceleration.

The basic steps of the Newmark analysis involved the following:

1. For the critical failure surface associated with the proposed South Cell geometry, determine from a pseudo-static stability analysis the horizontal acceleration which produces a factor of safety of 1.0. This is referred to as the yield acceleration (K_y) with units of g. The results are presented in Appendix D, Attachment D-1;

2. Using the computer program SHAKE2000, determine a time history of horizontal shear stresses for the two (2) MDE scenarios. The time history of accelerations of the failure mass is computed from the time history of stresses and the total mass above the critical layer; and

3. Using the computer program SHAKE2000 and the Newmark analysis option (Houston et al., 1989), displacements are estimated and added each time the earthquake accelerations exceed the yield acceleration during the time history to obtain the accumulated displacements caused by the various earthquake loadings.

6.2 DETERMINATION OF THE REVISED PSEUDO-STATIC SEISMIC FACTORS OF SAFETY AND YIELD ACCELERATIONS

Pseudo-static stability analyses were performed for the proposed South Cell downstream and upstream geometries including the maximum fines (El. 496) and minimum fines (El. 474) conditions respectively using a PGA of 0.54g (as required by IDNR) to assess the revised seismic factor of safety (Fs), and to determine the yield acceleration (Ky).

The yield acceleration is the acceleration level:

- Below which yielding of the embankment (soil mass) does not occur and the soil mass deforms elastic-plastic; and/or

- Above which yielding occurs causing permanent deformation.

The yield acceleration is used as input to subsequent Newmark permanent deformation analyses performed within the computer program SHAKE2000.

Drained and undrained strengths were developed for the various coal refuse materials including coarse coal refuse and residual soil in the GSTABL analysis to obtain Fs and Ky.

Table 3: Refuse/Soil Properties Used in Revised Pseudo-Static and Yield Acceleration Slope Stability Analyses

Description	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Yield Strength (psf)
Coarse Refuse	130	33.7	0	Frictional
Fine Refuse	90	30	0	Frictional
Residual Soil	125	19.5 0	400 3000	Total (Undrained) Strength 80% Peak Undrained

Note: Refuse properties provided by Alliance Consulting, Inc. based on laboratory testing and/or literature values noted in the Alliance static/seismic slope stability analyses.

A horizontal acceleration corresponding to the PGA value of 0.54g was input into GSTABL to assess the revised seismic stability analyses safety factors. Revised Fs values less than 1.0 were determined for both the downstream and upstream slope conditions, thus permanent deformation analyses are required.

Additionally, the horizontal acceleration was subsequently varied in GSTABL until a Factor of Safety equal to 1.0 was achieved. Consequently, yield accelerations of 0.184g and 0.192g were iteratively determined for the soil mass corresponding to the downstream (maximum fines) and upstream (minimum fines) critical failure surfaces.

The revised seismic stability and yield acceleration GSTABL analyses runs and outputs files are presented in Appendix D, Attachment D-1. Finally, a yield acceleration of 0.18g was conservatively assumed for all downstream and upstream slope conditions, which was used as input for estimating the corresponding permanent deformations.

6.3 SHAKE2000 ANALYSES

6.3.1 SHAKE2000 Input Summary

Analyses were performed using SHAKE2000 (Ordonez, 2006), a computer program for the one-dimensional wave propagation analysis of geotechnical earthquake engineering problems. For the South Cell impoundment, a user-defined crest column (PCSC300) along an approximate centerline cross-section of the embankment was utilized. A total of one (1) SHAKE2000 column was chosen to analyze the induced acceleration of the coarse coal refuse and residual soil materials along the critical failure surface in the downstream and upstream directions. SHAKE2000 columns PCSC300E and PCSC300M were created based on shear wave velocities from eight (8) PS-CPT soundings performed within and surrounding the existing/proposed South Cell impoundment. The crest column location PCSC300 also included two (2) phreatic levels associated with: 1) the "end" (E) of construction, i.e., minimum fines El. 474; and 2) "maximum" (M) fines El. 496. Columns PCSC300E and PCSC300M were utilized for evaluating the permanent deformations in the upstream and downstream directions, respectively.

The modulus and damping reduction curves used in the analyses were from published references/relationships presented in Appendix D, Attachment D-2, and available curves from SHAKE2000 were utilized for the coarse refuse, residual soils and bedrock materials.

6.3.2 SHAKE2000 Results Summary

SHAKE2000 output files for the MDE events, including an M6.8 Background (at 13.5 km) and M8.0 (at 83 km) are presented in Appendix D, Attachment D-2. SHAKE2000 summaries of maximum shear stress and strain with depth for crest column PCSC300E/M, which become the input for permanent deformation analyses, are also presented in Appendix D, Attachment D-2.

Figure 3 presents the relative location of the crest SHAKE column PCSC300E/M. Appendix B, Attachment B-1 presents the corresponding layer geometry and input information, including material type, unit weight, groundwater depth, sub-layer thickness, and average initial G values. The maximum induced horizontal cyclic shear stresses estimated at the midpoint of each layer are plotted with depth for the Pond Creek – South Cell SHAKE2000 column and MDE scenario, and are presented in Appendix D, Attachment D-2.

SHAKE2000 analyses results allow for estimating the deformations accumulated at the interface of each layer within the crest column model, which were used to represent the downstream and upstream conditions during MDE loadings. Therefore, time histories of horizontal shear stresses (SHAKE2000 Option 7) at all soil layer interfaces were saved for subsequent permanent deformation analyses to envelope potential upstream and downstream failure surface scenarios. Plots of time histories of (horizontal) shear stress for each column and critical layer are presented in Appendix D, Attachment D-2.

6.4 ANALYSES TO DEFINE TIME-HISTORIES OF ACCELERATION

Analyses were performed to estimate the time history of horizontal shear stress at all of the layer interfaces. The (stress) time history data was subsequently converted to acceleration time histories in SHAKE2000 and subsequently used to estimate the maximum displacement associated with the respective sublayer within the crest column.

The analysis technique for determining time histories of accelerations corresponds to the techniques used by Castro et al., (1989) and Houston et al., (1989). The time histories of earthquake accelerations on the potential sliding mass were converted in SHAKE2000 by dividing each time step by the effective vertical stress on each layer, based on the equation Force (F) = mass (m) times acceleration (a) (F = ma) and solving for a at each time step. These time histories of acceleration become the input for the computer program SHAKE2000 (Houston et al., 1989 displacement option), which computes the layer specific displacement.

6.5 CRITICAL MASS DISPLACEMENTS

Horizontal displacements of the proposed South Cell geometry were computed in SHAKE2000, which double integrates the difference between the estimated accelerations and yield accelerations for the duration of the time history. The integration is performed assuming that movements of the sliding block can only occur in the downhill direction for estimated values of acceleration which exceed the yield acceleration. Movements in the uphill direction are not likely since the value of yield acceleration is notably higher due to the additive static weight resistance against pushing the sliding block uphill.

The anticipated maximum displacements of the soil mass were estimated as a function of earthquake acceleration for all layers in the soil column. A summary of ground motion response parameters and ground displacements estimated for the various layers within the South Cell crest column geometry is presented in Appendix D, Attachment D-3.

As shown in Appendix D, Attachment D-2, the mean square frequency of the M6.8 Background earthquake is 20.4 Hz, which is greater than the M8.0 New Madrid earthquake frequency of 14.6 Hz. The average fundamental frequencies of the SHAKE2000 columns are similar, ranging from about 3.70 to 4.35 Hertz. Due to the variation in frequency content between the low frequency South Cell SHAKE2000 column to the high frequency ENA earthquake scenarios, only moderate shear stresses and strains are induced into the soil column. The percentage of acceleration within the critical layer to that of the base acceleration is lower for the M6.8 and higher for the M8.0

earthquakes due to their higher mean square frequency. In other words, while the input acceleration is high, particularly for the Background M6.8 MDE (Amax = 0.54g), most of its energy is in the high frequency range and only a portion of the induced base acceleration affects the critical layer.

Based on the Newmark method, maximum permanent deformations in any layer within the soil column due to both MDE scenarios were estimated at about 17 inches. The resulting maximum deformation was due to the estimated acceleration values in the critical layers, as compared to the yield acceleration value of 0.18g. Since the maximum accelerations vary above and below the Ky value, there were displacements accumulated by performing the double integration of (Ay – A) of the Newmark method. The South Cell SHAKE2000 files presented in Appendix D-3 illustrate the sublayer acceleration-time history.

Finally, the proposed crest elevation for the South Cell is about El. 502 feet, while the maximum fines level is El. 496 feet. Therefore, given the amount of freeboard (about 6 feet), maximum permanent deformations of 17 inches (or about 1.4 feet) will not pose a threat to the integrity of the impoundment or adversely affect the South Cell impoundment.

7.0 SUMMARY AND CONCLUSIONS

The IDNR has required that a revised (seismic) slope stability analysis be performed for the Pond Creek facility using equivalent static load methods and the appropriate peak acceleration based on the PGA for 2% Probability of Exceedance in 50 Years maps from the USGS. CEC revised the seismic slope stability analyses and the minimum factors of safety do not meet the required 1.0 safety factor criteria.

CEC subsequently completed a permanent deformation evaluation of the proposed South Cell embankment geometry, and determined that the facility is **NOT** susceptible to adverse post-earthquake permanent deformations. These conclusions were based on the results of high quality field testing and detailed seismically-related engineering and deformation analyses in both the upstream and downstream directions.

CEC, in cooperation with ConeTec developed and implemented a detailed field testing program, which utilized the most recent advances in PS-CPT to obtain a significant volume of credible field test results of the existing coarse coal refuse and residual soil materials at depth.

A PSHA was performed utilizing the 2002 USGS Earthquake Hazards Program, Interactive Deaggregation Maps, specifically the 2% Probability of Exceedance in 50 Years recurrence interval to select the MDE and estimate the corresponding PGA for the Pond Creek site. A PGA value of 0.54g was estimated for the two (2) controlling MDE events, including an M8.0 New Madrid, Missouri regional earthquake located 83 km from the site and an M6.8 Background earthquake located 13.5 km from the site.

Post-earthquake permanent deformation analyses were performed to estimate the anticipated maximum crest settlement for the two (2) MDE events. Based on the results of the permanent deformation analyses, the estimated maximum deformations are about 1.4 feet. The relatively small deformations are attributable to the low frequency embankment response as compared to the predominantly higher frequency content of the applicable synthetic MDE acceleration time

histories created for the Pond Creek site from ENA earthquake GMA relationships. Given the minimum available freeboard of 6 feet, the 1.4 feet of post-earthquake deformations do not pose a threat to the integrity of the South Cell geometry.

Therefore, it is CEC's opinion the Pond Creek South Cell impoundment can be operated up to the proposed geometry with no appreciable risk of a release of tailings downstream or upstream due to permanent deformations expected from any site specific MDE event. It is also understood the Pond Creek facility will be operated with an impoundment level at the lowest practical elevation except during periods of intense rainfall. Analyses were not performed for the simultaneous occurrence of intense rainfall and an MDE due to the low probability of both events occurring at the same time.

In preparing this report, CEC's professional services have been performed, findings obtained and conclusions prepared in accordance with generally accepted engineering principles and practices. No warranty, expressed or implied is made or intended by rendering of these services or by furnishing oral or written reports of our findings. This report was prepared for the exclusive use of Williamson.

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APPENDIX A-1

SUMMARY OF PIEZO-SEISMIC CONE PENETRATION TESTING

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PROJECT Williamson Energy Pond Creek Deformation Evaluation PROJECT NO. 072046

Summary of PS-CPT PAGE 1 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY ZJS DATE 1/23/08

CALCULATION BRIEF
FOR
SUMMARY OF PIEZO-SEISMIC CONE PENETRATION TESTING

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE:

Summarize the piezo-seismic cone penetration testing (PS-CPT) activities performed by ConeTec, Inc. (ConeTec), West Berlin, in October 2007 as part of the subsurface exploration at the Williamson Energy Pond Creek facility, Williamson County, Illinois.

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1. ConeTec, Inc. (2007), Field Report Entitled "Presentation of CPTU Test Results for: Pond Creek Mine – Williamson County, Illinois, December 10, 2007.

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METHODOLOGY:

As part of the subsurface exploration, a total of 15 PS-CPT soundings were performed at the Pond Creek site on October 30 and 31, 2007, at approximate locations shown in Figure 2 of the Pond Creek Deformation Evaluation report. PS-CPT exploration was performed under the full-time observation and guidance of CEC personnel. PS-CPT locations designated as CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A, CPT-5B, CPT-6, CPT-7, CPT-8, CPT-9, CPT-10, CPT-11 and CPT-12 were located by CEC within areas that included existing coarse coal refuse and the proposed South Cell, North Central Cell and North Cell impoundments. CPT-2, CPT-

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PROJECT NO. 072046

Summary of PS-CPT

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

2A, CPT-5, CPT-5A and CPT-5B soundings were located on the existing coarse coal refuse embankment crest, and were pushed through coarse refuse and the underlying subgrade residual soil. CPT-1, CPT-3, CPT-4, CPT-6, CPT-7, CPT-8, CPT-9, CPT-10, CPT-11 and CPT-12 were located throughout the facility at approximate existing ground surface and pushed exclusively through residual soil. The following presents the CPT sounding, site coordinates, existing ground surface elevation, total depth, interpolated ground water depth and applicable slurry cell.

CPT No.	Northing (ft)	Easting (ft)	Ground Surface Elev.(ft)	Total Depth (ft)	GWT Interpolated (ft)	Applicable Slurry Cell
CPT-1	425784.316	358548.865	482.19	18.4	15.3	South
CPT-2	426832.420	357857.498	494.21	45.3	38.8	South, Central, North
CPT-2A	426828.920	358156.731	492.40	41.7	37.0	South, Central, North
CPT-3	426792.780	359207.797	466.98	22.2	11.1	South
CPT-4	426331.101	360108.800	482.55	18.9	21.7	South
CPT-5	427485.256	357913.863	482.55	49.2	34.4	South, Central, North
CPT-5A	427607.598	357920.844	483.00	53.2	35.9	South, Central, North
CPT-5B	427147.684	358343.061	479.90	39.7	28.0	South, Central, North
CPT-6	427450.461	358992.616	457.78	22.6	9.2	Central
CPT-7	427450.884	359850.004	457.83	16.7	9.2	Central
CPT-8	429006.116	358034.037	444.45	17.9	6.6	Central, North
CPT-9	429077.690	359026.204	445.68	22.0	7.8	Central, North
CPT-10	428965.827	359998.444	442.09	26.1	3.4	Central, North
CPT-11	430316.815	358810.964	440.59	27.6	11.4	North
CPT-12	430141.831	359852.299	442.08	22.6	11.7	North

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PROJECT Williamson Energy Pond Creek Deformation Evaluation PROJECT NO. 072046

Summary of PS-CPT PAGE 3 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY TJA DATE 1/23/08

Note: CPT coordinates and ground surface elevations were provided by Williamson Energy.

Determining the dynamic response of the Pond Creek facility and that of the coarse coal refuse and subgrade residual soils requires knowledge of the subsurface material's dynamic properties to accurately predict the horizontal shear stresses and strains induced in the material by a given earthquake loading. Of particular significance in the dynamic evaluation is the distribution of density of the coal refuse materials with depth. The low-amplitude, small strain shear modulus (G) with depth is an important parameter for characterizing the behavior and response of a soil column during earthquake shaking. It is a function of the in-situ shear wave velocity estimated at the site with depth and was obtained in the field utilizing PS-CPT.

The main purpose of the PS-CPT was to measure in-situ shear wave (S-wave) travel times for subsequent calculation of shear wave velocity (V_S) and G. Concurrently, CPT was also performed which provides nearly continuous, index-type information which can be correlated to classification and in-situ strength values based on established procedures such as those outlined in Robertson and Campanella (1988). Further, cone data is typically utilized to evaluate liquefaction potential based on Robertson and Campanella (1985) similar to the procedures described in Seed and Idriss (1983) and to compare with the results using steady-state principles; however, only permanent deformations are evaluated in response to regulatory comments.

The seismic wave form portion of the PS-CPT was conducted by ConeTec at about 3-foot intervals throughout the soil profile to the maximum depths indicated. The down-hole seismic survey is a reliable technique for obtaining shear wave and compression wave velocities accounting for the subsurface material's attenuation and anisotropic effect with depth (Hoar and Stokoe, 1978) (Dobry et al., 1981) (Stokoe and Nazarian, 1985). Only S-wave travel times were measured for each sounding with depth which was used to calculate the corresponding V_S and G used in the dynamic analyses of the Pond Creek facility.

RESULTS:

A total of 15 PS-CPT soundings were performed at the Pond Creek site in October 2007, at approximate locations shown in Figure 2. ConeTec measured tip stress, sleeve stress and pore water pressure, and shear wave velocities at the locations CPT-1 through CPT-12 from the existing ground surface through coarse coal refuse, where available and through residual soil materials.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation — PROJECT NO. 072046

Summary of PS-CPT — PAGE 4 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

Shear wave velocities per material type were measured and the minimum, maximum and weighted averages are summarized as follows:

CPT No.	Shear Wave Velocity Max./Min./Avg. Coarse Coal Refuse (ft/sec)	Shear Wave Velocity Max./Min./Avg. Residual Soil (ft/sec)
CPT-1	NA	1402 645 905
CPT-2	1284 1029 1120	1173 795 957
CPT-2A	1169 895 1042	1256 780 918
CPT-3	NA	1058 569 765
CPT-4	NA	1242 476 817
CPT-5	1190 936 1063	1599 780 947
CPT-5A	1396 779 1064	1580 728 1005
CPT-5B	1517 818 1080	1649 686 978
CPT-6	NA	1022 514 796
CPT-7	NA	894 514 682
CPT-8	NA	1036 541 783
CPT-9	NA	1484 415 835
CPT-10	NA	1217 478 828
CPT-11	NA	1387 471 925
CPT-12	NA	1230 530 763

In general, shear wave velocities in coarse refuse ranged from about 779 to 1517 fps with an average value of about 1074 fps. For subgrade residual soils, Vs ranged from 415 to 1599 fps with an approximate average value of 860 fps. Measured values of V_S for coarse refuse and residual soil materials and the density of the respective material with depth are used to estimate the initial shear modulus, G, for use in the one dimensional, dynamic SHAKE (Schnabel, et al., 1972) analysis of the embankment. G-values estimated from the four soundings are used in the calculation of induced cyclic shear stress at the SHAKE soil column locations (e.g. PCSC300) shown in Figure 3. Appendix A, Attachment A-2 presents the complete ConeTec report and Appendix B, Attachment B-1 presents the computations of G for the various SHAKE columns

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PROJECT Williamson Energy Pond Creek Deformation Evaluation PROJECT NO. 072046

Summary of PS-CPT PAGE 5 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

from in-situ measurements of V_S for the coarse refuse, residual soil and bedrock materials including plots of V_S and G with depth for both SHAKE columns.

CONCLUSIONS:

Summarizing, the PS-CPT field testing was performed as part of the subsurface exploration at the Pond Creek facility. The information gathered from the testing will be used to correlate index and strength parameters, as well as shear modulus for use in subsequent permanent deformation analyses.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 6 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY RJA DATE 1/23/08

SHEAR WAVE VELOCITY DATA REDUCTION
MINIMUM, MAXIMUM AND AVERAGE VELOCITY PER MATERIAL

Williamson Energy - Pond Creek - South Cell
Shear Wave Velocity versus Depth **CEC Project No. 072-046**

CPT-1

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
4.26	645	
7.54	656	
10.82	808	CLAY
14.1	1013	
16.73	1402	

CPT-1

	Max	Min	avg
Clay	1402	645	905

CPT-2

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	1204	
10.82	1284	
14.1	1152	
17.39	1085	CCR
20.67	1029	
23.95	1039	
27.23	1050	
30.51	1114	
33.79	950	
37.07	795	CLAY
40.35	908	
43.31	1173	

CPT-2

	Max	Min	avg
CCR	1284	1029	1120
CLAY	1173	795	957

CPT-2A

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	977	
10.82	973	
14.1	1121	
17.39	1051	CCR
20.67	1105	
23.95	1169	
27.23	895	
30.51	780	
33.79	845	CLAY
37.07	790	
39.86	1256	

CPT-2A

	Max	Min	avg
CCR	1169	895	1042
CLAY	1256	780	918

CPT-3

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.21	577	
10.50	569	CLAY
13.78	738	
17.06	883	
20.10	1058	

CPT-3

	Max	Min	avg
CLAY	1058	569	765

8 of 14

R15589

CPT-4

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
3.93	476	
7.21	673	CLAY
10.50	781	
13.78	913	
16.81	1242	

	CPT-4 Max	CPT-4 Min	CPT-4 avg
CLAY	1242	476	817

Williamson Energy - Pond Creek - North Central Cell
Shear Wave Velocity versus Depth **CEC Project No. 072-046**

CPT-5

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	1030	
10.82	1076	
14.10	991	
17.39	936	CCR
20.67	1148	
23.95	1190	
27.23	1067	
30.51	780	
33.79	780	
37.07	821	CLAY
40.35	780	
43.63	923	
46.91	1599	

CPT-5	Max	Min	avg
CCR	1190	936	1063
CLAY	1599	780	947

CPT-5A

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.21	844	
10.50	779	
13.78	1164	
17.06	1396	CCR
20.34	994	
23.63	1077	
26.90	1195	
30.18	1021	
33.46	784	
36.74	784	
40.02	728	CLAY
43.30	768	
46.67	961	
49.95	1411	
52.00	1580	

CPT-5A	Max	Min	avg
CCR	1396	779	1064
CLAY	1580	728	1005

CPT-5B

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	818	
10.82	900	
14.10	1517	CCR
17.39	1085	
20.67	856	
23.95	732	
27.23	686	CLAY
30.59	762	
33.79	1014	
37.07	1150	
38.88	1649	

CPT-5B	Max	Min	avg
CCR	1517	818	1080
CLAY	1649	686	978

CPT-6

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	514
7.54	769
10.82	706
14.10	945
17.39	819
20.51	1022

CLAY

	CPT-6 Max	CPT-6 Min	CPT-6 avg
CLAY	1022	514	796

CPT-7

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	514
7.54	575
10.82	745
14.10	894

CLAY

	CPT-7 Max	CPT-7 Min	CPT-7 avg
CLAY	894	514	682

CPT-8

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	541
7.54	652
10.82	708
14.10	979
16.48	1036

	CPT-8 Max	CPT-8 Min	CPT-8 avg
CLAY	1036	541	783

PT-9

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
3.93	415
7.21	904
10.50	757
13.78	647
17.06	805
20.01	1484

	CPT-9 Max	CPT-9 Min	CPT-9 avg
CLAY	1484	415	835

CPT-10

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	478
7.54	617
10.82	656
14.10	803
17.36	945
20.67	1080
23.87	1217

	CPT-10 Max	CPT-10 Min	CPT-10 avg
CLAY	1217	478	828

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R15592

Williamson Energy - Pond Creek - North Cell
Shear Wave Velocity versus Depth **CEC Project No. 072-046**

CPT-8

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	541
7.54	652
10.82	708
14.10	979
16.48	1036

CLAY

	CPT-8 Max	CPT-8 Min	CPT-8 avg
CLAY	1036	541	783

CPT-9

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
3.93	415
7.21	904
10.50	757
13.78	647
17.06	805
20.01	1484

CLAY

	CPT-9 Max	CPT-9 Min	CPT-9 avg
CLAY	1484	415	835

CPT-10

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	478
7.54	617
10.82	656
14.10	803
17.36	945
20.67	1080
23.87	1217

CLAY

	CPT-10 Max	CPT-10 Min	CPT-10 avg
CLAY	1217	478	828

CPT-11

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	471
7.54	628
10.82	719
14.10	817
17.36	926
20.67	1207
23.95	1387
26.25	1246

CLAY

	CPT-11 Max	CPT-11 Min	CPT-11 avg
CLAY	1387	471	925

CPT-12

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.02	530
7.30	596
10.50	601
13.78	748
17.06	871
20.34	1230

CLAY

	CPT-12 Max	CPT-12 Min	CPT-12 avg
CLAY	1230	530	763

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO 072046

Summary of PS-CPT

PAGE 13 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

GROUNDWATER WELL DATA (PROVIDED BY WILLIAMSON)

072-046

14 of 14

R15594

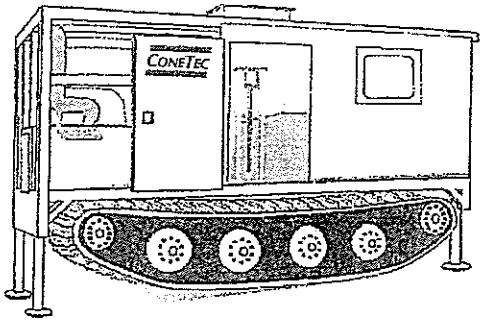
Pond Creek #1 Ground Water Sampling
Permit #375 NPDES# IL007766

Date	Sample Pnt	Easting	Northing	Stand Pipe Elevation	Water Elev.	inc g/L	Antimony mg/L	Beryllium mg/L	Cobalt mg/L	MANGANESE mg/L	Phenolics mg/L	Cyanide mg/L	Chlorides mg/L
12/29/05	GW-1	354,988	430,899	441.82	435.44	012	0.303	<.001	0.014	0.027	<.050	<0.010	20
12/29/05	GW-2	357,681	430,962	435.73	428.51	024	0.240	<.001	0.013	0.087	<.050	<0.010	42
12/29/05	GW-3	360,278	430,669	438.46	432.61	001	0.299	<.001	0.012	0.124	<.050	<0.010	26
12/29/05	GW-4	354,923	425,980	464.03	456.01	009	0.270	<.001	0.017	0.031	<.050	<0.010	17
12/29/05	GW-5	357,632	425,618	482.23	470.52	01	0.276	<.001	0.007	0.891	<.050	<0.010	40
12/29/05	GW-6	360,211	425,416	434.9	No Water	N				n/a			n/a
12/29/05	GW-7A	358,306	427,592	454.7	444.99	029	0.285	<.001	0.024	0.052	<.050	<0.010	33
2/24/06	GW-1	354,988	430,899	441.82	438.34	012	<0.002	<.001	<0.005	0.024	<.050	<0.010	<10
2/24/06	GW-2	357,681	430,962	435.73	431.31	016	<0.002	<.002	<0.002	0.027	<.050	<0.010	<10
2/24/06	GW-3	360,278	430,669	438.46	434.29	014	<0.002	<.001	<0.005	0.023	<.050	<0.010	<10
2/24/06	GW-4	354,923	425,980	464.03	459.45	01	<0.002	<.001	<0.005	0.03	<.050	<0.010	<10
2/24/06	GW-5	357,632	425,618	482.23	471.33	01	<0.002	<.001	<0.005	0.4	<.050	<0.010	<10
2/24/06	GW-6	360,211	425,416	434.9	No Water	N				n/a			n/a
2/24/06	GW-7A	358,306	427,592	454.7	447.05	018	<.002	<.001	<.005	0.045	<.050	<0.010	<10
6/28/06	GW-1	354,988	430,899	441.82	435.70	002	0.006	<.001	<.005	<.002	<.050	<0.010	33
6/28/06	GW-2	357,681	430,962	435.73	427.72	023	0.050	<.001	<.005	0.002	<.050	<0.010	44
6/28/06	GW-3	360,278	430,669	438.46	430.10	006	0.060	<.001	<.005	0.145	<.050	<0.010	75
6/28/06	GW-4	354,923	425,980	464.03	458.03	003	0.070	0.001	<.005	<.002	<.050	<0.010	122
6/28/06	GW-5	357,632	425,618	482.23	470.85	002	0.050	<.001	<.005	<.002	<.050	<0.010	160
6/28/06	GW-6	360,211	425,416	434.9	No Water	N							n/a
6/28/06	GW-7A	358,306	427,592	454.7	446.30	002	0.090	<.001	<.005	0.003	<.050	<0.010	75
7/31/06	GW-1	354,988	430,899	441.82	435.08	001	0.206	0.003	<.005	0.012	<.050	<0.010	37.5
7/31/06	GW-2	357,681	430,962	435.73	429.31	001	0.184	0.002	<.005	<.002	<.050	<0.010	50
7/31/06	GW-3	360,278	430,669	438.46	428.63	001	0.129	0.001	<.005	0.024	<.050	<0.010	88
7/31/06	GW-4	354,923	425,980	464.03	457.03	001	0.153	0.002	<.005	0.026	<.050	<0.010	139
7/31/06	GW-5	357,632	425,618	482.23	469.43	006	0.153	0.002	<.005	0.012	<.050	<0.010	150
7/31/06	GW-6	360,211	425,416	434.9	No Water	N							n/a
7/31/06	GW-7A	358,306	427,592	454.7	445.55	003	0.269	0.001	<.005	0.026	<.050	<0.010	85
8/31/06	GW-1	354,988	430,899	441.82	434.92	001	<.002	<.001	<.005	0.019	<.050	<0.010	20
8/31/06	GW-2	357,681	430,962	435.73	424.51	001	<.002	<.001	<.005	0.021	<.050	<0.010	22
8/31/06	GW-3	360,278	430,669	438.46	426.86	013	<.002	<.001	<.005	0.045	<.050	<0.010	44
8/31/06	GW-4	354,923	425,980	464.03	456.79	006	<.002	<.001	<.005	0.081	<.050	<0.010	42
8/31/06	GW-5	357,632	425,618	482.23	468.32	02	<.002	<.001	<.005	3.05	<.050	<0.010	105
8/31/06	GW-6	360,211	425,416	434.9	No Water	Nc							n/a
8/31/06	GW-7A	358,306	427,592	454.7	444.18	018	<.002	<.001	<.005	0.093	<.050	<0.010	8.7
10/2/06	GW-1	354,988	430,899	441.82	435.08	001	<.002	<.001	0.015	<.002	<.050	<0.010	14
10/2/06	GW-2	357,681	430,962	435.73	425.76	001	<.002	<.001	0.013	<.002	<.050	<0.010	38
10/2/06	GW-3	360,278	430,669	438.46	427.14	009	<.002	<.001	0.006	2.105	<.050	<0.010	28
10/2/06	GW-4	354,923	425,980	464.03	455.42	001	<.002	0.002	0.014	0.028	<.050	<0.010	84
10/2/06	GW-5	357,632	425,618	482.23	No Water	No							
10/2/06	GW-6	360,211	425,416	434.9	No Water	No							
10/2/06	GW-7A	358,306	427,592	454.7	443.95	001	<.002	<.001	0.005	0.181	<.050	<0.010	368
3/7/07	GW-1	354,988	430,899	441.82	438.62	001	<.002	<.001	<.005	0.005	<.050	<0.010	26
3/7/07	GW-2	357,681	430,962	435.73	431.41	001	<.002	<.001	<.005	0.003	<.050	<0.010	42
3/7/07	GW-3	360,278	430,669	438.46	434.29	01	<.002	0.001	<.005	0.028	<.050	<0.010	66
3/7/07	GW-4	354,923	425,980	464.03	458.05	001	<.002	<.001	<.005	0.005	<.050	<0.010	109
3/7/07	GW-5	357,632	425,618	482.23	473.86	001	<.002	<.001	0.013	0.007	<.050	<0.010	91
3/7/07	GW-6	360,211	425,416	434.9	No Water	No							
3/7/07	GW-7A	358,306	427,592	454.7	448.63	001	<.002	<.001	<.005	0.007	<.050	<0.010	86
5/21/07	GW-1	354,988	430,899	441.82	436.55	002	<.002	<.001	0.034	<.002	<.050	<0.010	42
5/21/07	GW-2	357,681	430,962	435.73	428.93	001	<.002	0.001	0.011	0.007	<.050	<0.010	46
5/21/07	GW-3	360,278	430,669	438.46	432.08	001	<.002	0.001	0.013	0.002	<.050	<0.010	62
5/21/07	GW-4	354,923	425,980	464.03	459.93	001	<.002	0.002	0.009	<.002	<.050	<0.010	100
5/21/07	GW-5	357,632	425,618	482.23	471.74	001	<.002	0.002	0.020	<.002	<.050	<0.010	132
5/21/07	GW-6	360,211	425,416	434.9	No Water	No							
5/21/07	GW-7A	358,306	427,592	454.7	448.05	001	<.002	<.001	0.017	0.002	<.050	<0.010	82
5/21/07	GW-8	359,568	426,786	467.85	462.23	001	<.002	<.001	0.020	0.544	<.050	<0.010	88
8/1/07	GW-1	354,988	430,899	441.82	433.29	003	<.002	0.001	<.005	0.007	<.050	<0.010	26
8/1/07	GW-2	357,681	430,962	435.73	424.74	009	0.105	0.001	<.005	0.196	<.050	<0.010	34
8/1/07	GW-3	360,278	430,669	438.46	426.09	01	0.370	0.001	<.005	0.524	<.050	<0.010	66
8/1/07	GW-4	354,923	425,980	464.03	458.16	002	0.141	0.001	<.005	0.003	<.050	<0.010	100
8/1/07	GW-5	357,632	425,618	482.23	469.06	005	0.080	0.002	<.005	0.198	<.050	<0.010	120
8/1/07	GW-6	360,211	425,416	434.9	No Water	No							
8/1/07	GW-7A	358,306	427,592	454.7	447.11	018	0.137	0.002	<.005	1.180	<.050	<0.010	108
8/1/07	GW-8	359,568	426,786	467.85	462.70	005	0.200	0.002	<.005	0.042	<.050	<0.010	112

8114-10
Part 7

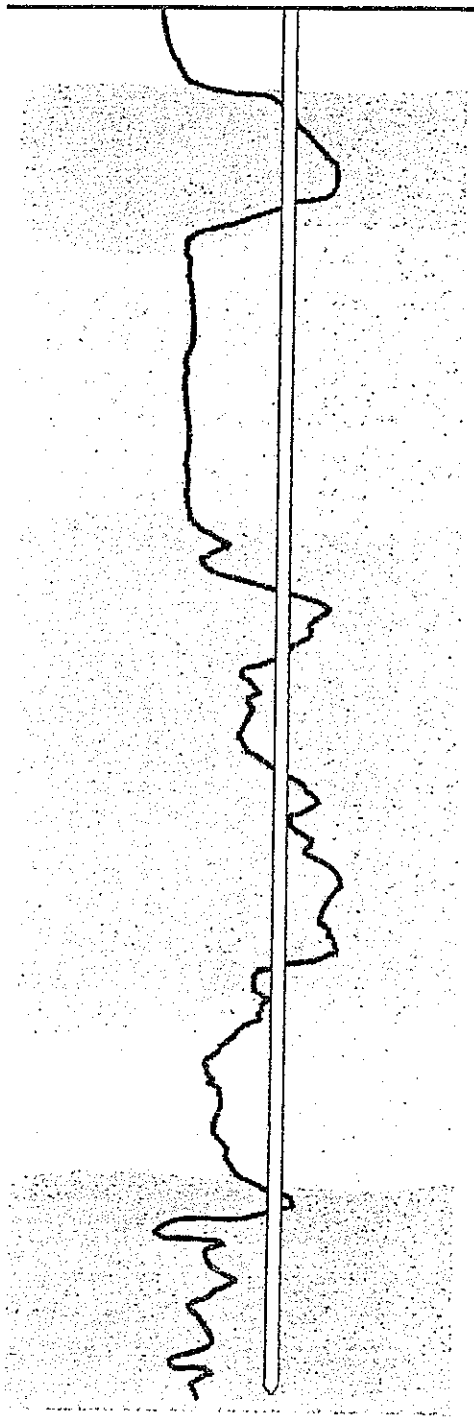
APPENDIX A-2

CONETEC, INC. FIELD REPORT



ConeTec

Geotechnical and Environmental In Situ Testing Contractors



ConeTec Field Report

Presentation of CPTU Test Results for:

Pond Creek Mine
Williamson County, Illinois

Presented to: C.E.C.

Date: December 10th, 2007

Presented by: ConeTec, Inc.
436 Commerce Lane, Unit C
West Berlin, NJ
(856) 767-8600

PRESENTATION OF IN SITU TESTING PROGRAM RESULTS

Pond Creek Mine
Williamson County, Illinois

October 30th, & 31st, 2007

Prepared for:

Civil & Environmental Consultants, Inc
Export, Pennsylvania

Prepared by:

ConeTec Inc.
West Berlin, NJ

December 10th, 2007

TABLE OF CONTENTS

1.0 INTRODUCTION **3**

2.0 FIELD EQUIPMENT AND PROCEDURES **4**

2.1 CONE PENETRATION TESTING 4
2.2 PORE PRESSURE DISSIPATION TESTS 6

3.0 CONE PENETRATION TEST DATA AND INTERPRETATION **8**

3.1 ANALYSIS OF PIEZOCONE DATA - GENERAL 8
3.2 CONE PLOTS 9
3.3 PORE PRESSURE DISSIPATION TEST RESULTS 9
3.4 SHEAR WAVE VELOCITY MEASUREMENTS 10
3.5 CPTSUMM DATA PROCESSING 10
3.6 DATA CD 10

5.0 REFERENCES **11**

TABLES

TABLE 1 Summary of CPT Soundings

FIGURES

FIGURE 1 Typical Cone Penetrometer
FIGURE 2 Schematic of Shear Wave Testing Configuration
FIGURE 3 Typical Dissipation Tests

APPENDICES

APPENDIX A CPT Plots (shear wave, non-normalized)
APPENDIX B CPT Data Interpretation Summery
APPENDIX C Shear Wave Velocity Data
APPENDIX D Dissipation Test Data
APPENDIX E Data CD

1.0 INTRODUCTION

This report presents the results of a piezo cone penetrometer testing (CPTU) program carried out at Pond Creek Mine located in Williamson County, Illinois. The work was performed under subcontract to Civil & Environmental Consultants, Inc. of Export, Pennsylvania. The CPTU program took place on October 30th, and 31st, 2007.

A total of fifteen soundings were completed at twelve different sounding locations. The CPT testing was performed to evaluate in situ geotechnical as well as seismic criteria relative to the proposed expansion.

While completing the CPT soundings, seismic shear wave velocity testing was conducted in all of the soundings. Seismic testing involved collecting shear wave velocity data at one-meter depth intervals.

CPT sounding locations were selected and numbered under the direction and supervision of C.E.C. Personnel.

2.0 FIELD EQUIPMENT AND PROCEDURES

2.1 CONE PENETRATION TESTING

The cone penetrometer tests were carried out using an integrated electronic piezo cone manufactured by ConeTec in Vancouver, Canada. The piezo cone used was a compression model cone penetrometer with a 15 cm^2 tip and a 225 cm^2 friction sleeve. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.80. The piezo cone dimensions and the operating procedure were in accordance with ASTM Standard D-5778-95. A diagram of the cone penetrometer used for this project is shown as Figure 1.

Pore pressure filter elements, made of porous plastic, were saturated under a vacuum using glycerin as the saturating fluid. The pore pressure element was six millimeters thick and was located immediately behind the tip (the u_2 location) for all soundings.

The cone was advanced using a 20 ton, unitized, track-mounted cone penetration rig. The following data were recorded onto magnetic media every five centimeters (approximately every two inches) as the cone was advanced into the ground:

- Tip Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (ut)

The field data recorded is included on the attached CD (appendix E).

Before each sounding a complete set of analog baseline readings are taken with a multi-meter and compared with the digitized value on the computer screen. This provides a check on the analog to digital conversion board.

Evaluation of the analog baselines is key to consistent readings. The baseline data should be stable and should not wander excessively during the course of a sounding. Baseline data can be used to apply corrections to the cone data where necessary. For this project, the baseline shift from sounding to sounding was small, typically less than 0.1% of full scale, and no data corrections were applied.

During seismic testing, the seismic signals were recorded using a geophone mounted in the cone as shown in Figure 1 and an up-hole digital oscilloscope. A sledge hammer hit against a beam was used for the seismic source. Normal reaction for the beam was provided by the dead weight of the rig placed upon the beam. A schematic of the shear wave testing configuration is shown in Figure 2.

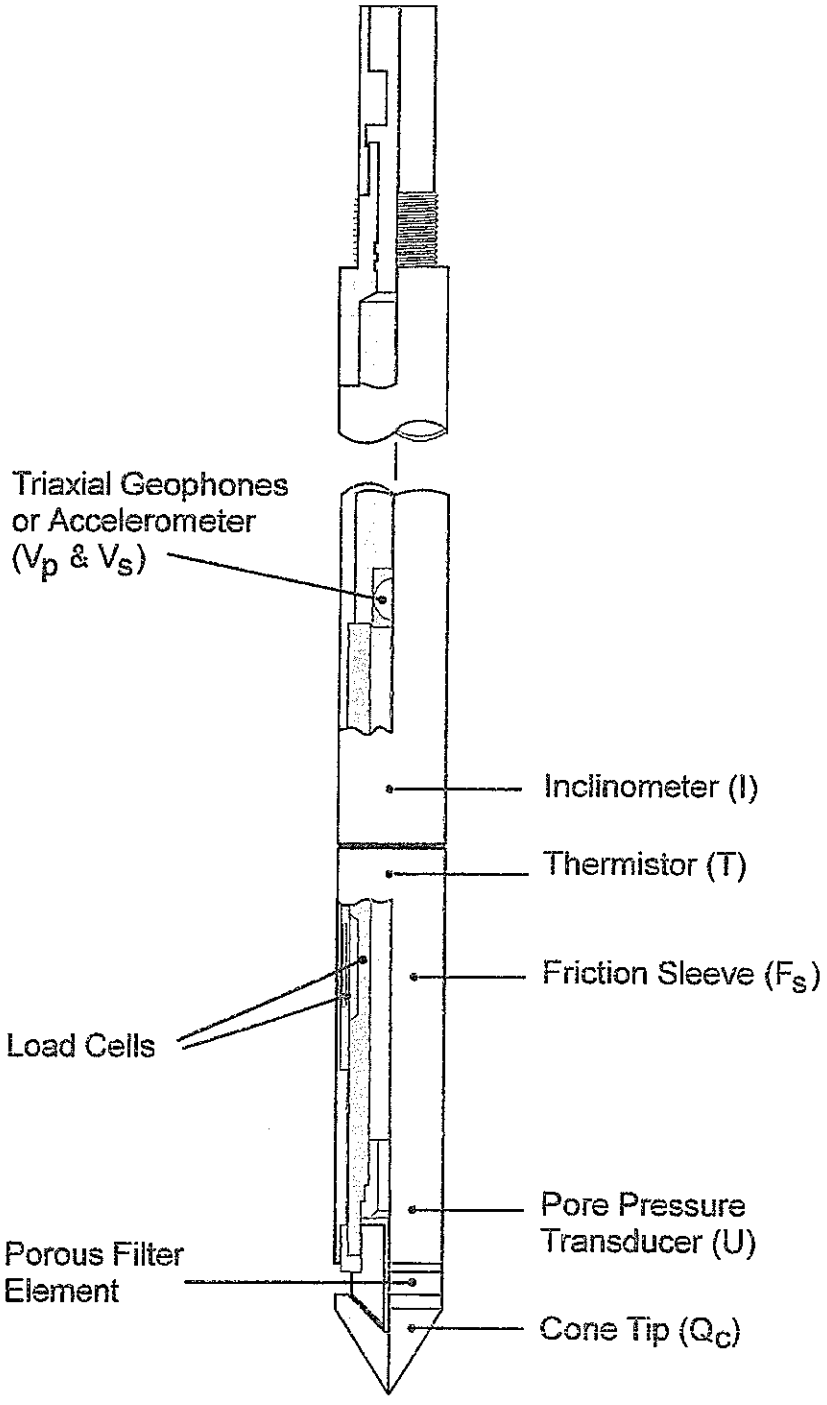


FIGURE 1 - TYPICAL CONE PENETROMETER

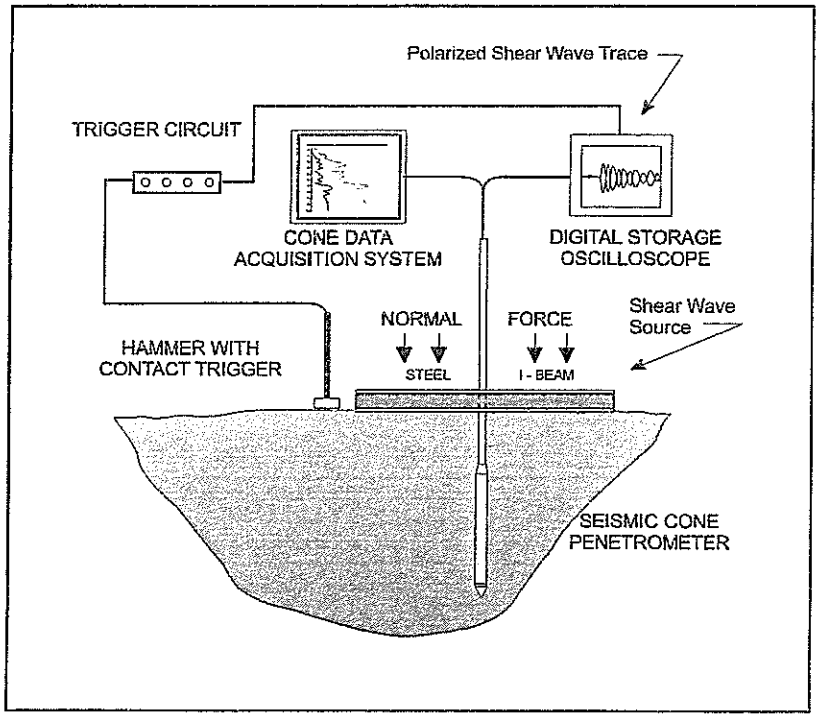


FIGURE 2 - SCHEMATIC OF SHEAR WAVE TESTING CONFIGURATION

2.2 PORE PRESSURE DISSIPATION TESTS

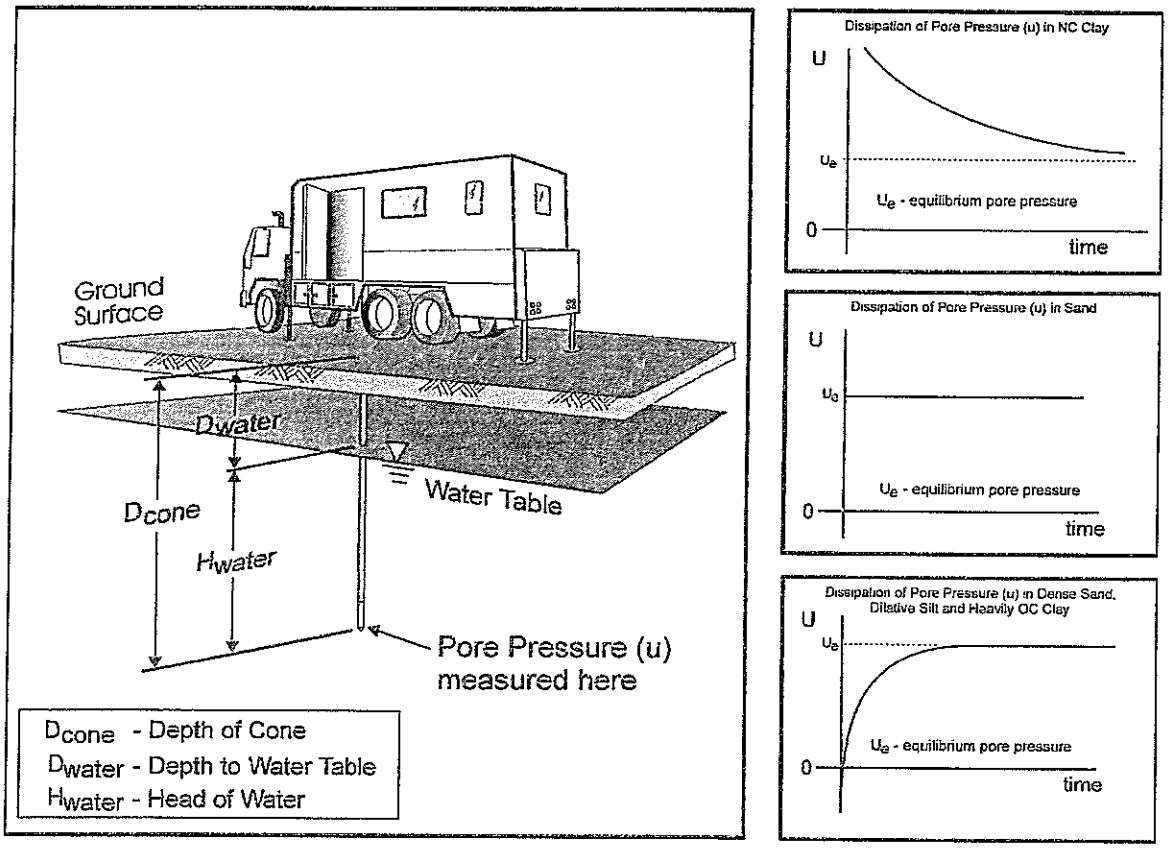
When cone penetration is stopped, the piezo cone essentially becomes a piezometer. While stopped, pore water pressures are automatically recorded at five-second intervals and the readings are stored in a dissipation file (.ppd). Dissipation data can then be plotted onto a dissipation curve consisting of pore water pressure (u) verses time (t). The shapes of dissipation curves are very useful in evaluating soil type, drainage and in situ static water level.

A flat curve that stabilizes quickly (i.e. less than 30 seconds) is typical of a free draining sand. In this case, the final measured pore water pressure is the static in situ water pressure.

Soils that generate excess dynamic pore water pressure during penetration will dissipate this excess pressure when penetration stops. The shape of the dissipation curve and the time of dissipation can be used to estimate C_h, the coefficient of consolidation that can in turn be used to calculate K_h, the horizontal permeability.

Figure 3 shows some idealized shapes of various pore water pressure dissipation curves. The reader is referred Robertson et. al., 1992 to reference dissipation test data analytical techniques.

Estimation of Ground Water Table from CPT Dissipation Tests



Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

Useful Conversion Factors:
1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

FIGURE 3 - TYPICAL DISSIPATION TESTS

3.0 CONE PENETRATION TEST DATA AND INTERPRETATION

3.1 ANALYSIS OF PIEZOCONE DATA - GENERAL

A total of fifteen CPT sounding involving 443.90 feet of testing, were completed.

The interpretation of cone data is based on the relationship between cone bearing, qc, sleeve friction, fs, and penetration pore water pressure, u. The friction ratio, Rf , (sleeve friction divided by cone bearing) is a calculated parameter which is used to infer soil behavior type. Generally, saturated cohesive soils have low tip resistance, high friction ratios and generate large excess pore water pressures. Cohesionless soils have higher tip resistances, lower friction ratios and do not generate significant excess pore water pressure.

The interpretation of soils encountered on this project was carried out using correlations developed by Robertson et al., 1992. It should be noted that it is not always possible to clearly identify a soil type based on qc, fs and ut. Occasionally soils will fall within different soil categories on the classification charts. In these situations, experience and judgment and an assessment of the pore pressure dissipation data should be used to infer the soil behavior type. Computer tabulations of the interpreted soil types along with certain other geotechnical parameters for each cone hole is presented in Appendix B.

Each of the parameters measured in the sounding is discussed briefly below. A detailed explanation of CPTU testing and interpretation of the results can be found in Robertson, 1989.

TIP RESISTANCE (q_c): The resistance to penetration, measured at the cone tip, provides an accurate profile of subsurface strata. The recorded tip resistance is a composite of the penetration resistance of the soils located five to ten cone diameters (7 to 14 inches) in front of and behind the tip. The actual resistance "sensed" by the tip depends on the soil properties and on the relative stiffness of the layers encountered. Tip resistance is often corrected for pore pressure effects when testing in soft saturated cohesive soils.

For this project the correction was made and the tip resistance shown, q_t is the corrected tip resistance.

The correction used is: $q_t = q_c + (1-a)u$

Where:
- q_t = corrected tip resistance
- q_c = measured tip resistance
- a = net area ratio for cone (0.80 for this project)
- u = dynamic pore water pressure measured behind tip

SLEEVE FRICTION (f_s) The resistance recorded on the friction sleeve, is a measure of the remolded strength of the soil. Values of sleeve friction in very soft soils (such as peat) may fluctuate due to the measured force being small relative to the capacity of the measuring load cell.

FRICTION RATIO (R_f) The ratio of sleeve friction to tip resistance expressed as a percentage, is an indicator of soil type. Cohesive soils generally have friction ratios that are greater than two, while sands and non-plastic silts have friction ratios that are lower than two.

PORE PRESSURE (u) Dynamic pore water pressure is measured during penetration. (dynamic pore water pressure data can be found in the .cor, .xls files. Static pore water pressure is measured when cone penetration is stopped (static pore water pressure data can be found in the .ppd files). The measured dynamic pore water pressure changes with the location of the porous filter and negative readings are possible when the filter is located behind the tip.

It is important to note that the CPT classifies soil by physical behavior, not by grain size; therefore, the CPT classification should be verified against samples obtained from a conventional drilling program. While the CPT soil classification may not always be accurate in terms of the actual label it applies to a particular soil, it is very accurate in grouping soils with similar mechanical properties.

Table 1 presents a summary of CPT soundings, including sounding depths.

3.2 CONE PLOTS

The data from each sounding was plotted using the computer program ScreenZ. The plots are included in Appendix A. ScreenZ was developed by ConeTec Inc. and it incorporates soil behavior type (SBT) classification as part of the plot. The soil classification is based on the classification chart reproduced chart in Appendix B.

3.3 PORE PRESSURE DISSIPATION TEST RESULTS

When conducting CPT investigations, pore water pressure dissipations are automatically recorded during pauses in penetration. The pore water pressure data is recorded at five second intervals. Dynamic and static pore pressure dissipation data for each CPT is included on the data CD. No dissipation tests were completed during this project. Water table depths used in the data interpretations were given to us by the client.

3.4 SHEAR WAVE VELOCITY MEASUREMENTS

Shear wave velocity measurements were conducted during all of the CPT soundings. Shear wave velocity measurements were recorded approximately every meter. The shear wave velocity data can be found in Appendix C.

3.5 CPTSUMM DATA PROCESSING

The electronic data files were processed using the program CPTSUMM. CPTSUMM is a program developed by ConeTec to calculate common engineering parameters from CPT data. The data files (xls) can be found on the data CD. The calculations used are summarized in the table found in Appendix B. Each calculation is derived according to the referenced article.

For this project, the depth to ground water was given to us by the client. The exact depth used is noted in the header of each CPTSUMM file.

3.6 DATA CD

One data CD is included in Appendix E. The CD includes all of the CPT, dynamic and static pore water pressure and CPTSUMM data.

5.0 REFERENCES

Robertson, P.K., 1989, "Soil Classification using the Cone Penetration Test", Canadian Geotechnical Journal, vol. 27, pages 151-158.

Robertson, P.K., Sully, J., Woeller, D.G., Lunne, T., Powell, J.M., and Gillespie, D.J., 1992, "Estimating Coefficient of Consolidation from Piezocone Tests", Canadian Geotechnical Journal, vol. 29, pages 539-550.

CONETEC

TABLE 1 - SUMMARY OF CPTU SOUNDINGS

Job No.: 07-804
Location: Pond Creek Mine - Williamson County, Illinois
Client: Civil & Environmental Consultants
Date: October 30, 31, 2007

Date	CPTU Sounding	File Name	CPT Total Depth (ft)	Shear wave Velocity Tests	Comments
31-Oct-07	CPT-1	804cp01.cor	18.37	6	
30-Oct-07	CPT-2	804cp02.cor	45.28	13	
30-Oct-07	CPT-2A	804cp02a.cor	41.67	12	
31-Oct-07	CPT-3	804cp03.cor	22.15	6	
31-Oct-07	CPT-4	804cp04.cor	18.86	6	
30-Oct-07	CPT-5	804cp05.cor	49.21	14	
30-Oct-07	CPT-5A	804cp05a.cor	53.15	16	
30-Oct-07	CPT-5B	804cp05b.cor	39.70	12	
31-Oct-07	CPT-6	804cp06.cor	22.64	7	
31-Oct-07	CPT-7	804cp07.cor	16.73	5	
31-Oct-07	CPT-8	804cp08.cor	17.88	6	
31-Oct-07	CPT-9	804cp09.cor	21.98	7	
31-Oct-07	CPT-10	804cp10.cor	26.08	8	
31-Oct-07	CPT-11	804cp11.cor	27.56	9	
31-Oct-07	CPT-12	804cp12.cor	22.64	7	
Job Totals:		15	443.90	134	

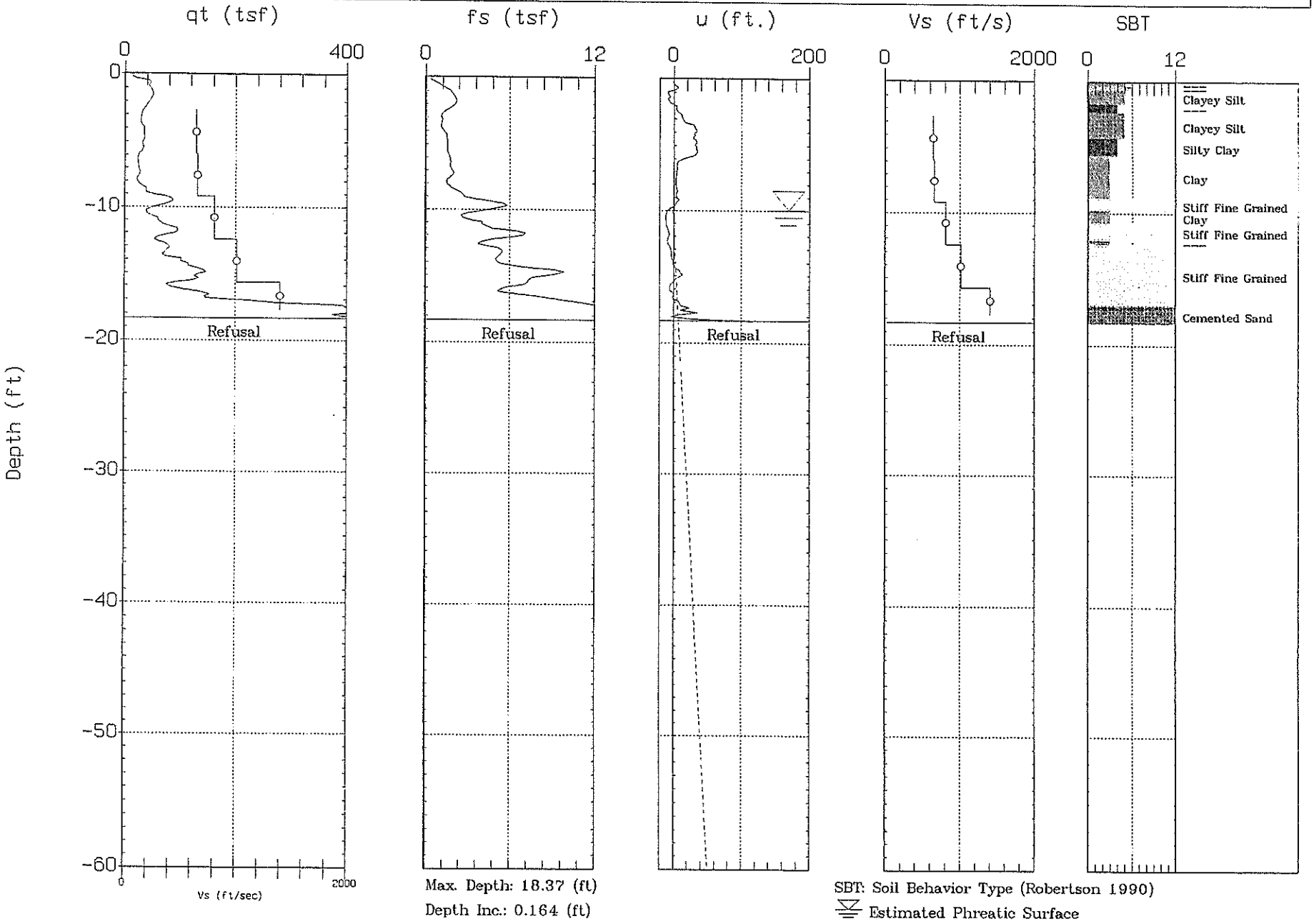
Shearwave CPT plots

CONETEC

C.E.C.

Sounding:CPT-1
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 13:23



Max. Depth: 18.37 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

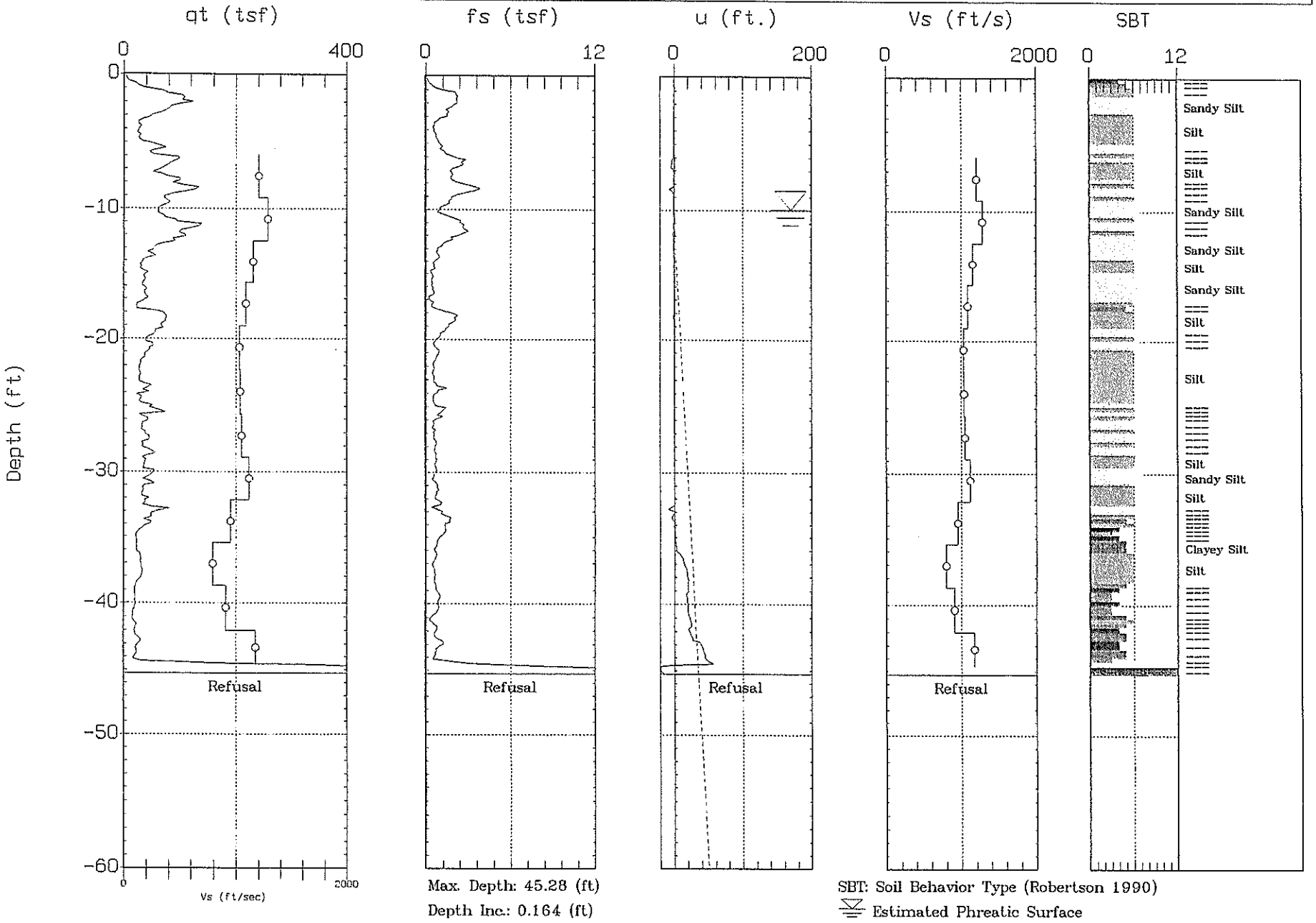
R15610

CONETEC

C.E.C.

Sounding:CPT-2
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 13:46



Max. Depth: 45.28 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

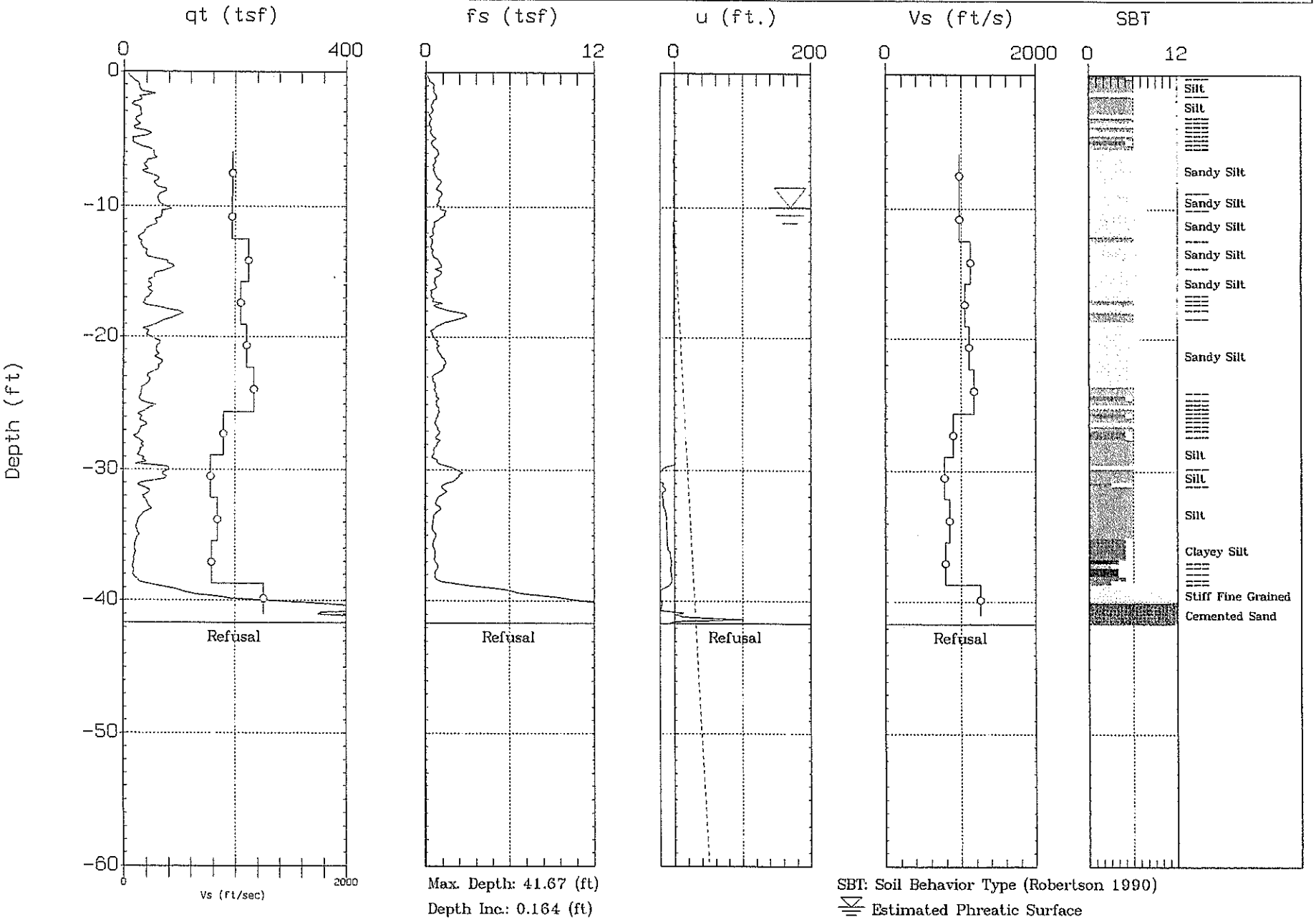
R15611

CONETEC

C.E.C.

Sounding:CPT-2A
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 14:50



Max. Depth: 41.67 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

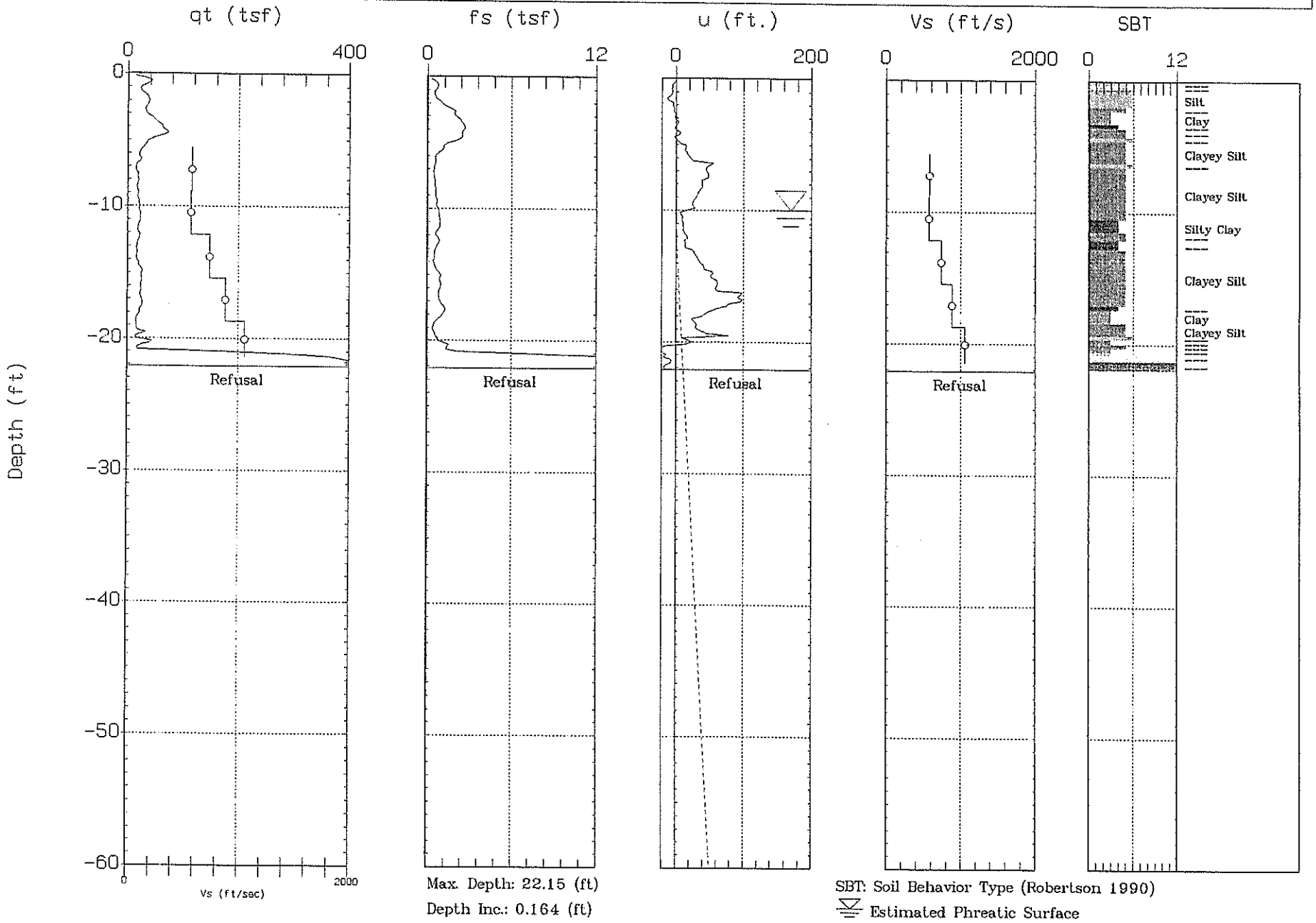
R15612

CONETEC

C.E.C.

Sounding:CPT-3
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:09



Max. Depth: 22.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

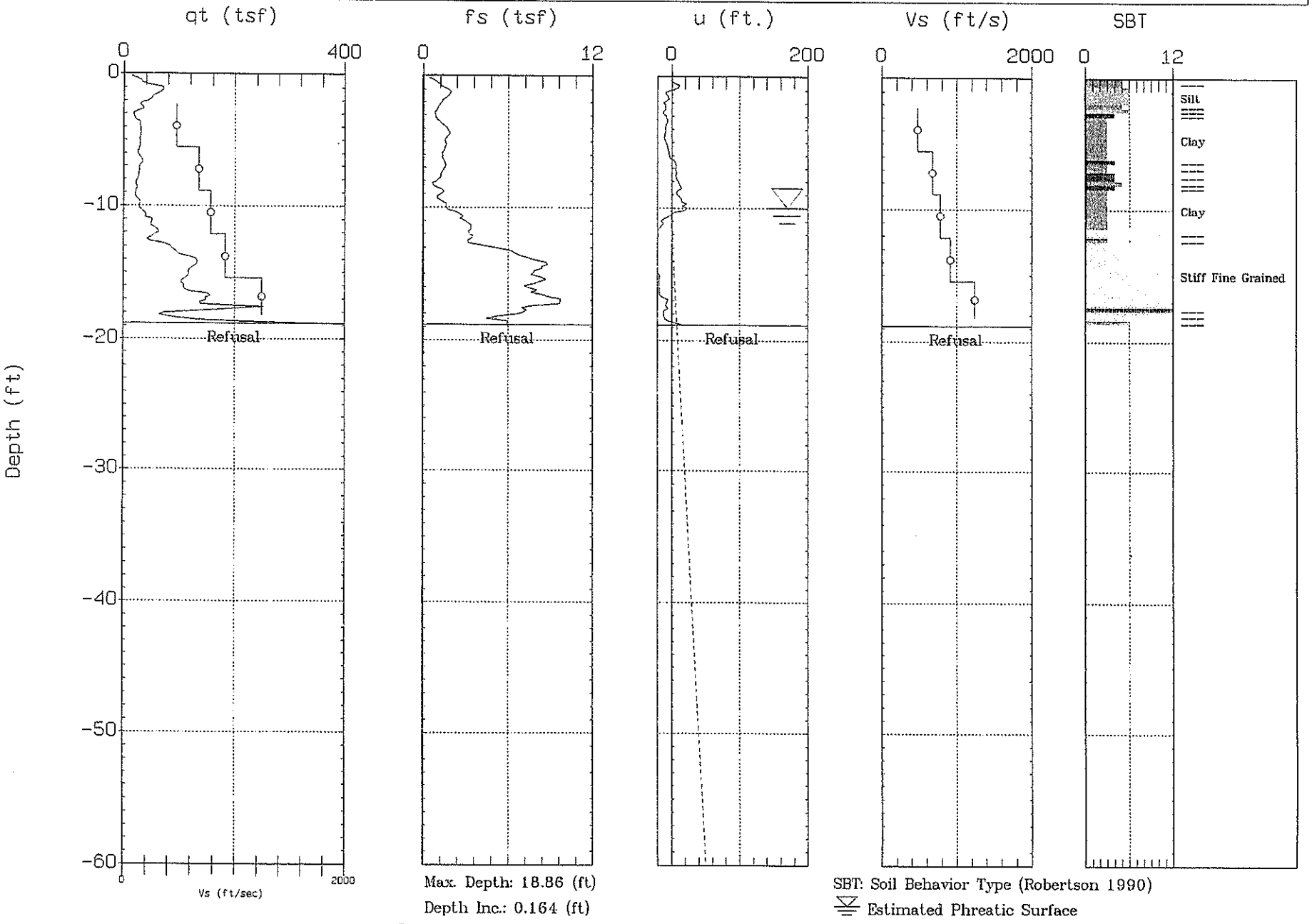
R15613

CONETEC

C.E.C.

Sounding:CPT-4
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:51



Max. Depth: 18.86 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

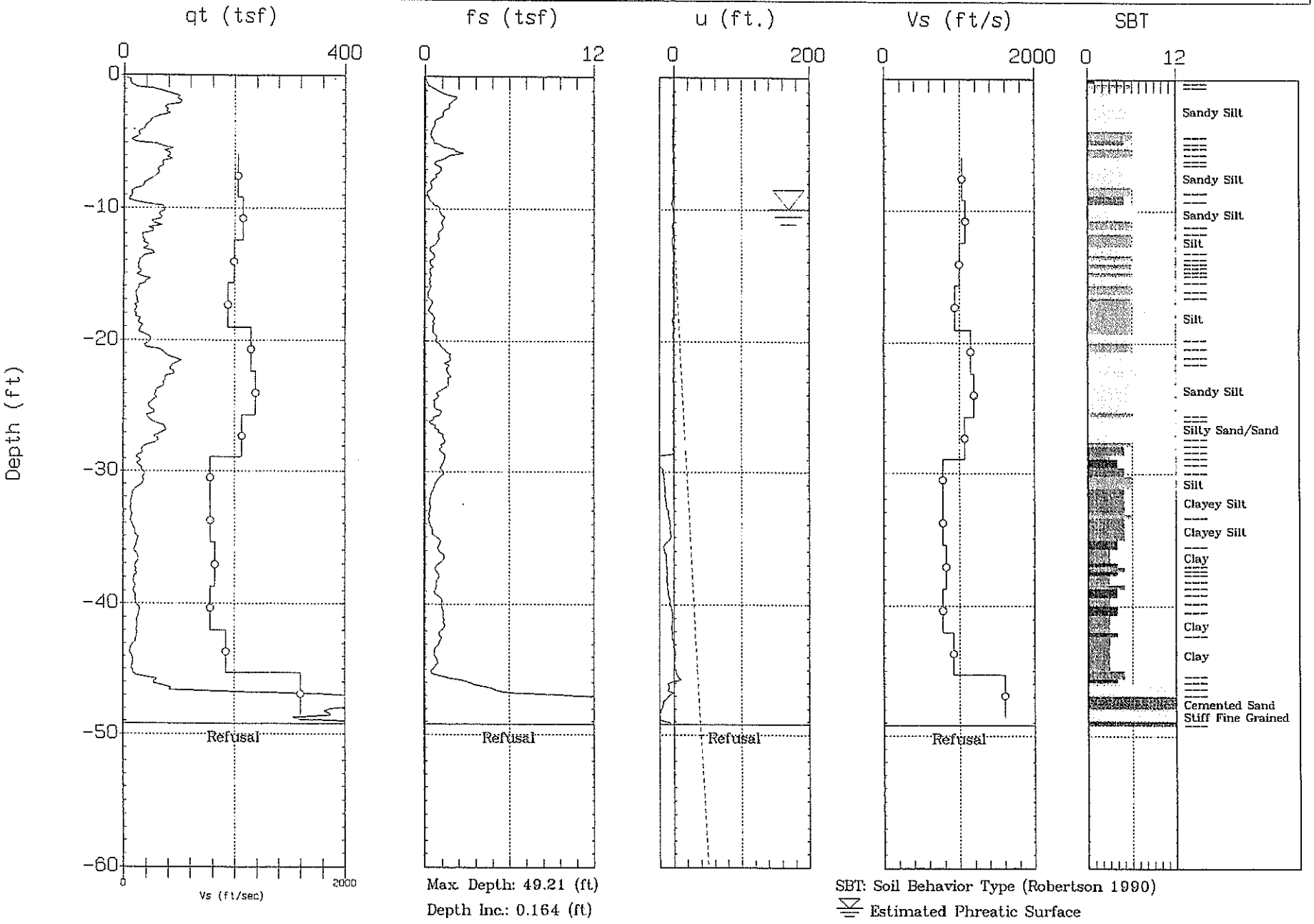
R15614

CONETEC

C.E.C.

Sounding:CPT-5
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 12:34



Max. Depth: 49.21 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

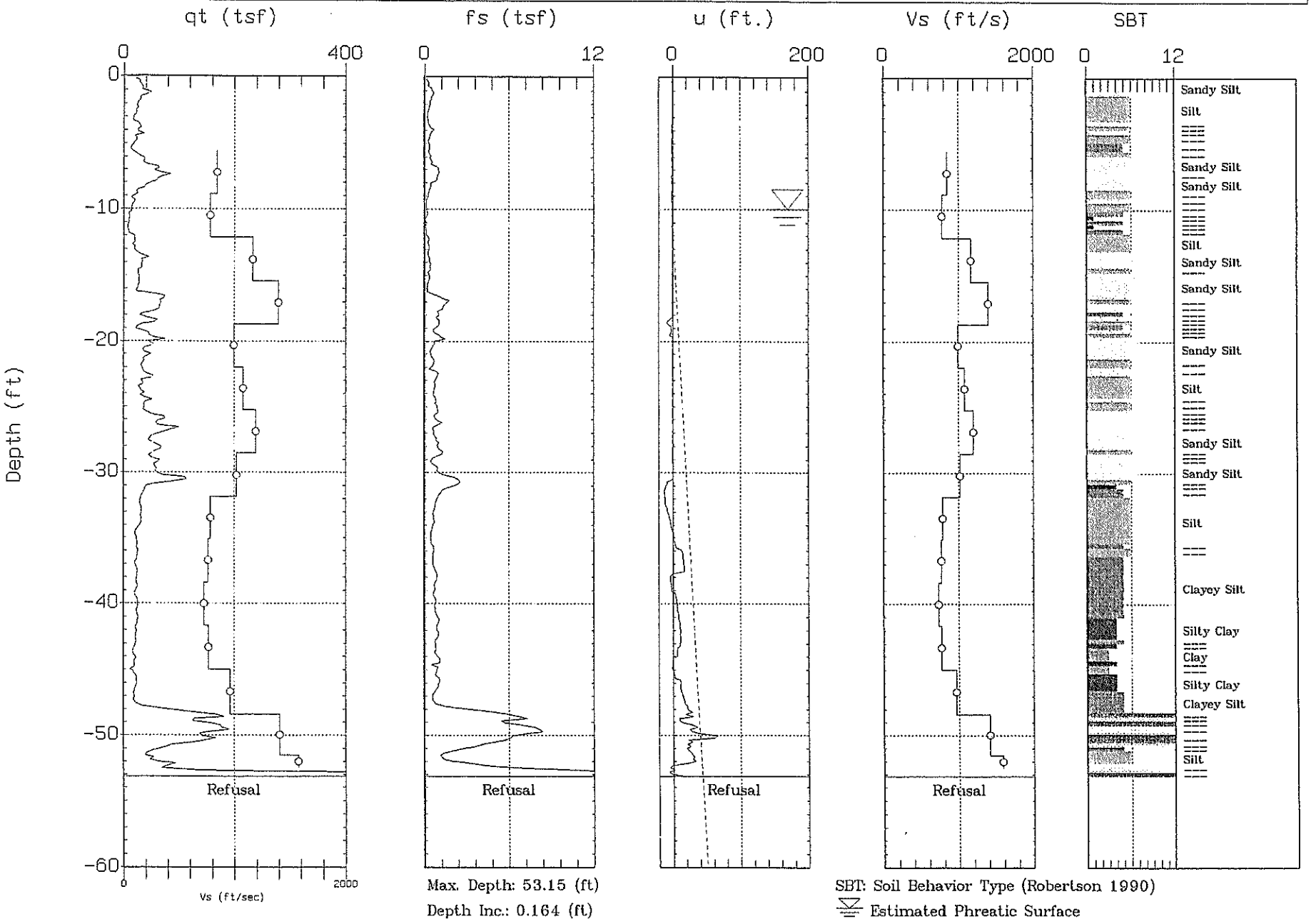
R15615

CONETEC

C.E.C.

Sounding:CPT-5A
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 10:44



Max. Depth: 53.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

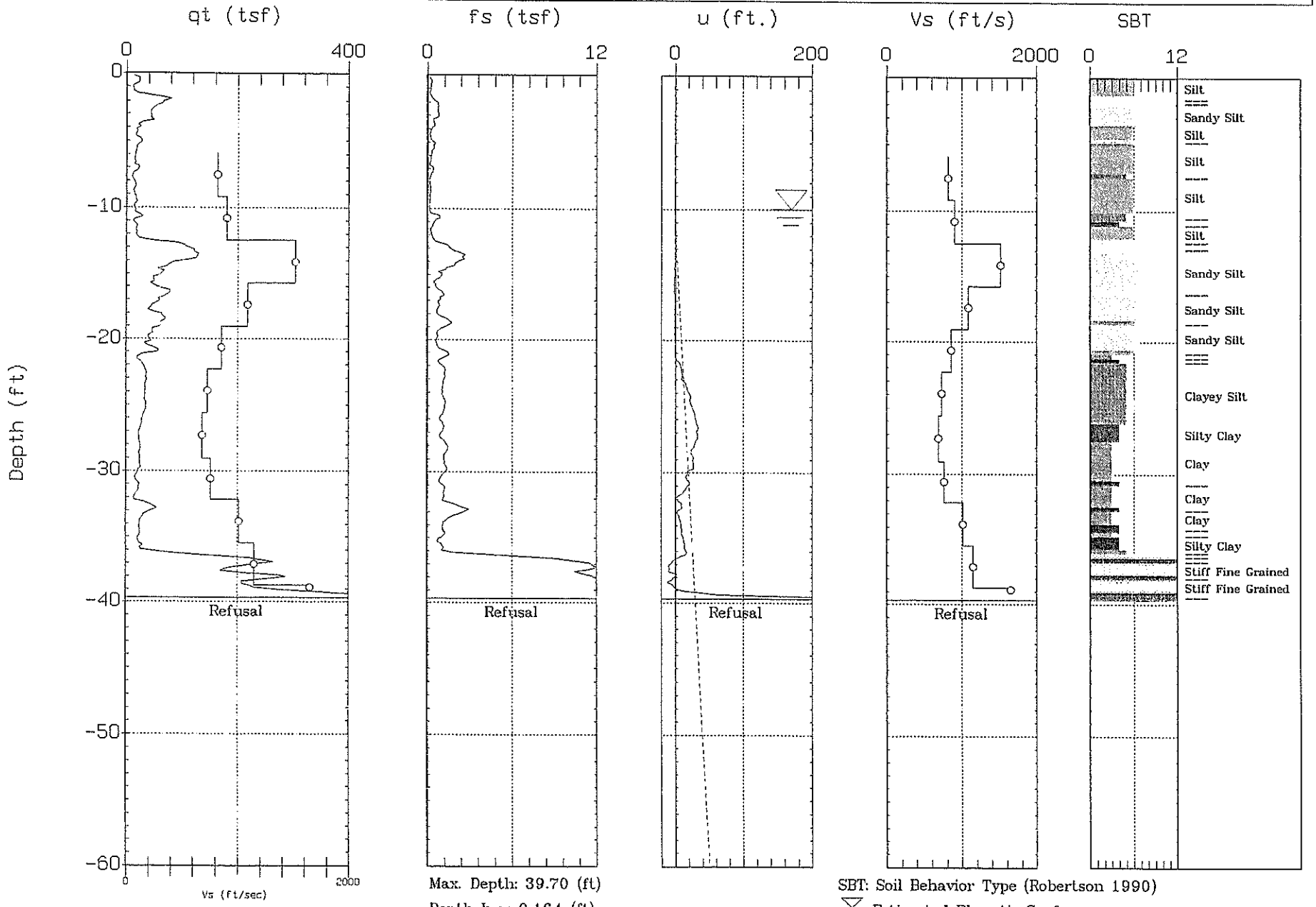
R15616

CONETEC

C.E.C.

Sounding:CPT-5B
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 15:44



Max. Depth: 39.70 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

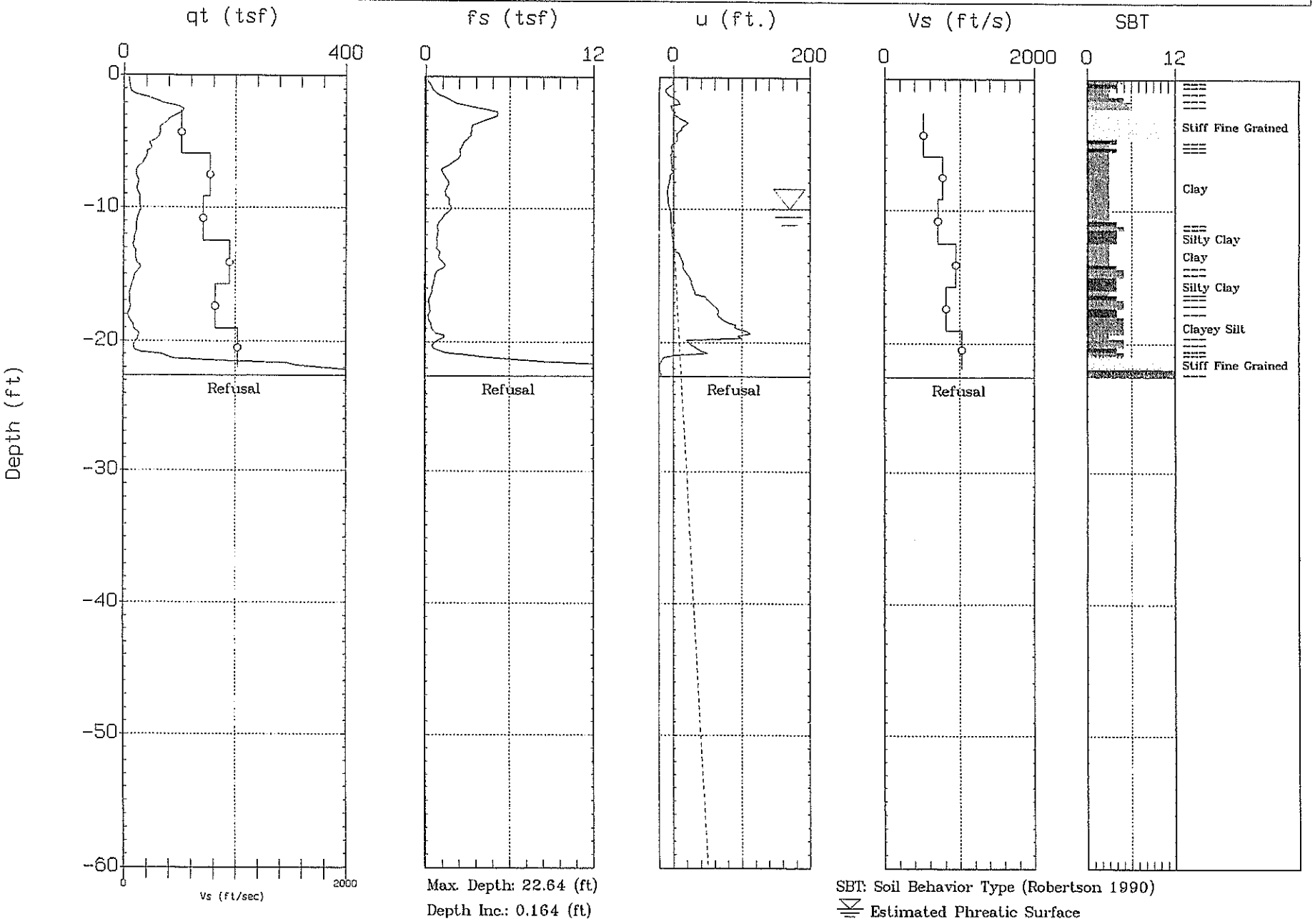
R15617

CONETEC

C.E.C.

Sounding:CPT-6
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:0C



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

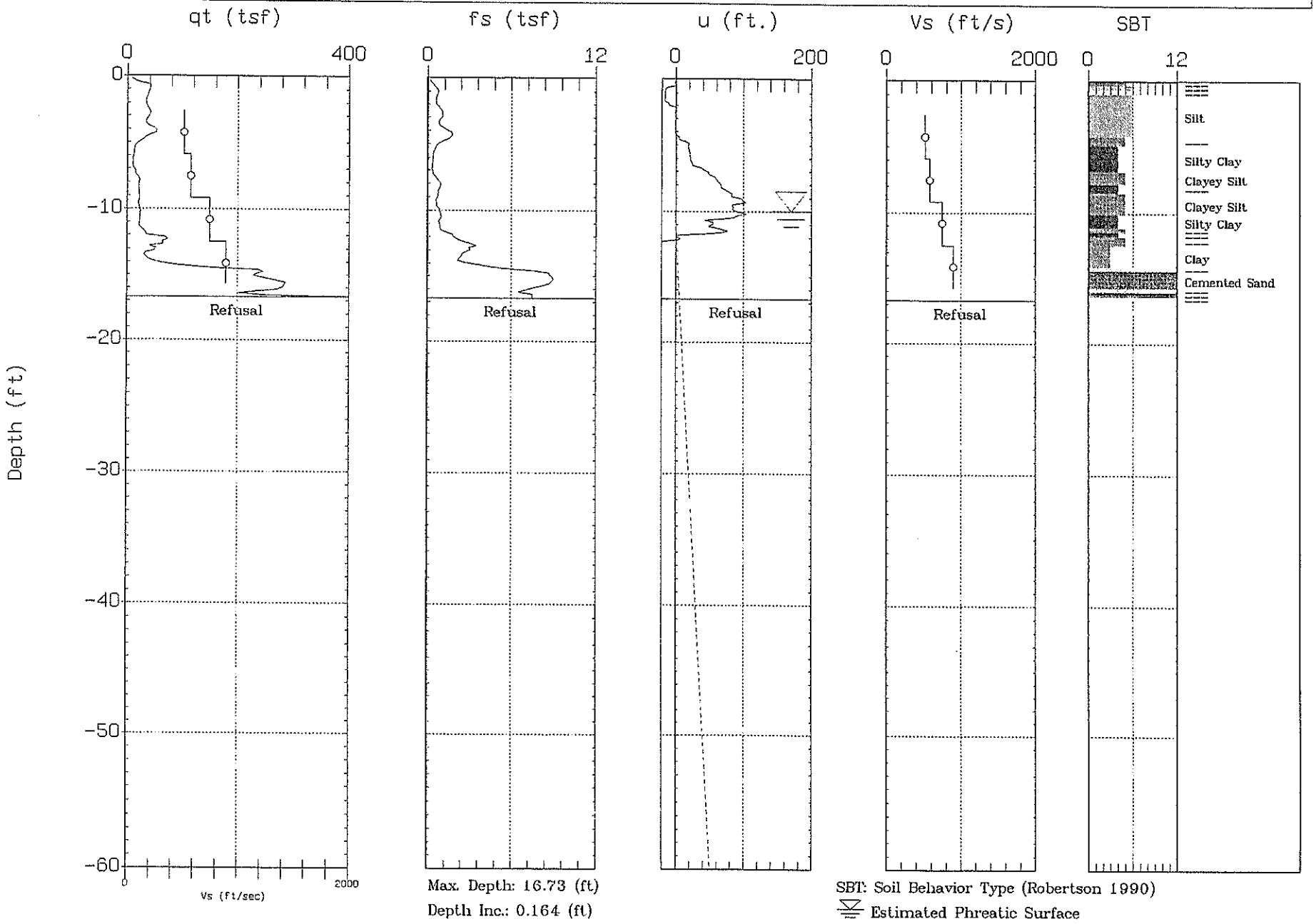
R15618

CONETEC

C.E.C.

Sounding:CPT-7
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:58



Max. Depth: 16.73 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

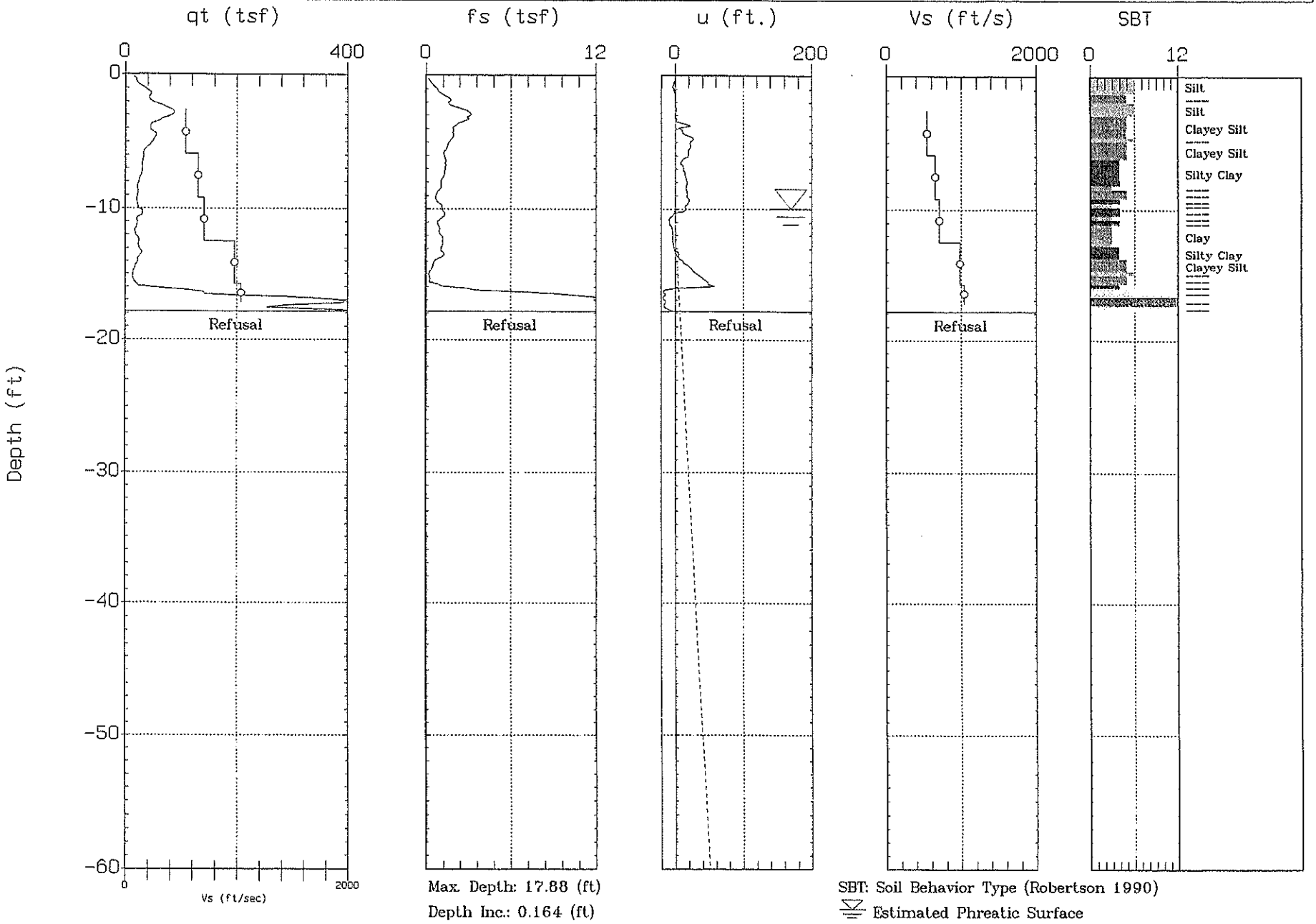
R15619

CONETEC

C.E.C.

Sounding:CPT-8
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:53



Max. Depth: 17.88 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

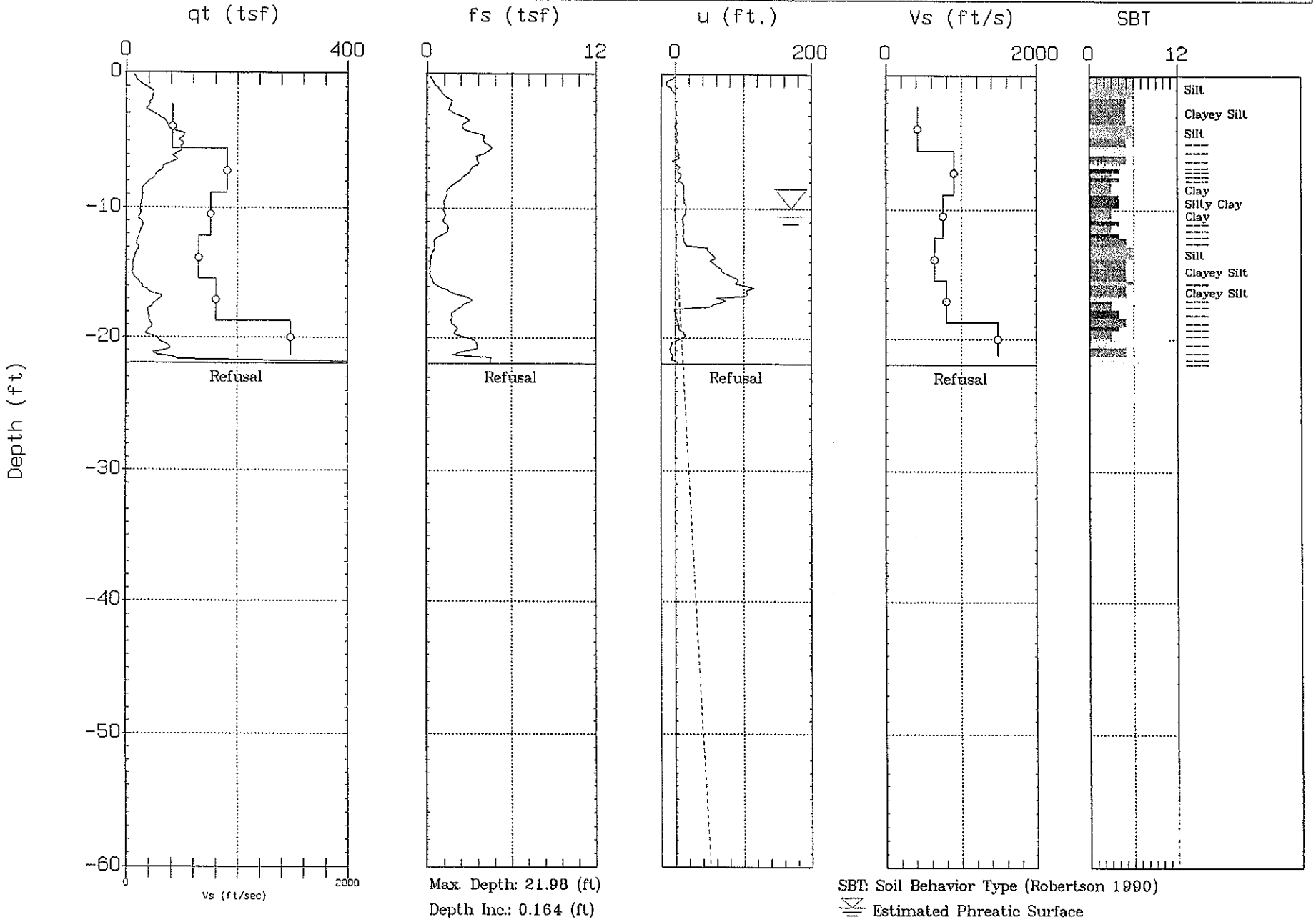
R15620

CONETEC

C.E.C.

Sounding:CPT-9
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:17



Max. Depth: 21.98 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

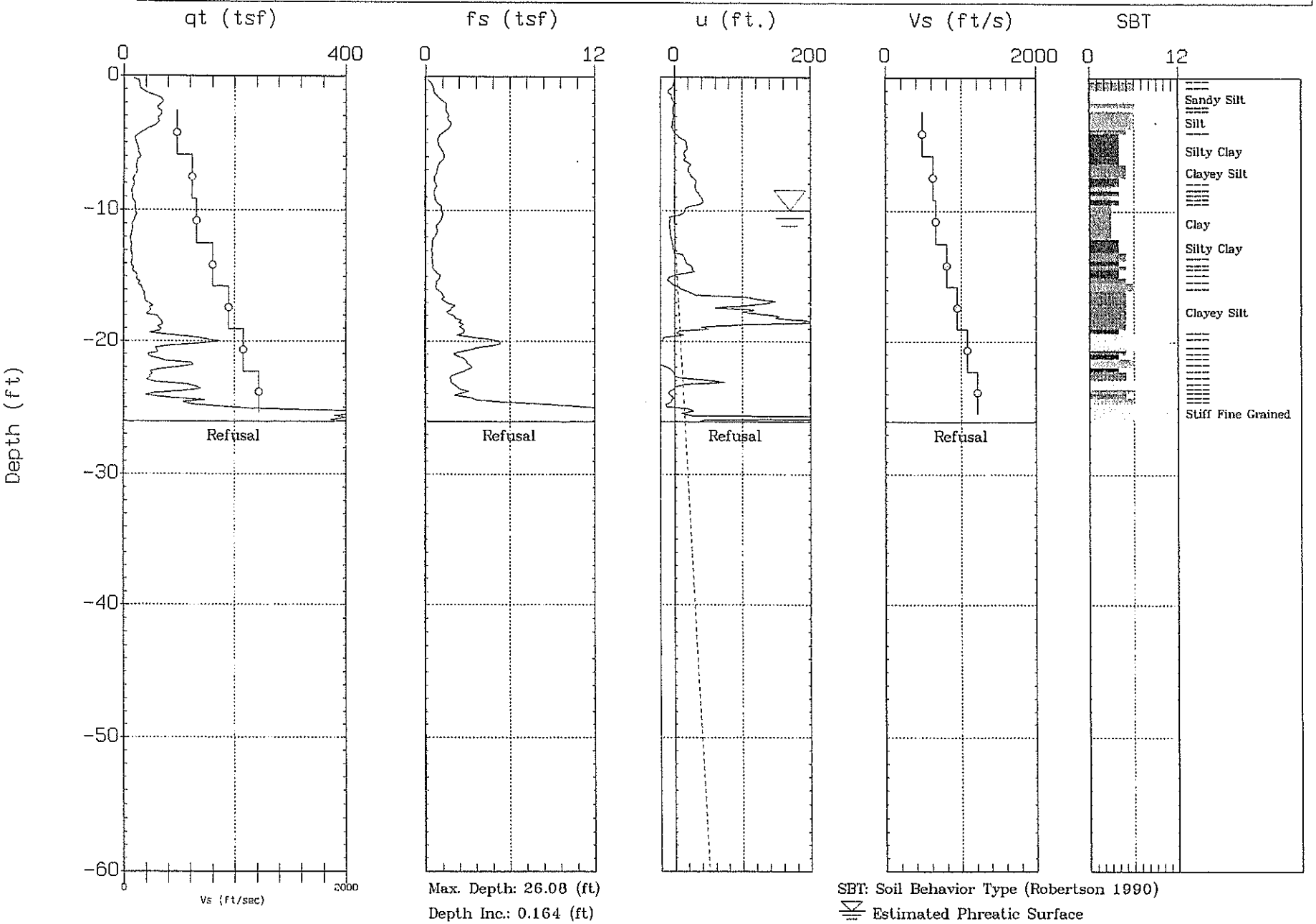
R15621

CONETEC

C.E.C.

Sounding:CPT-10
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 08:35



Max. Depth: 26.08 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

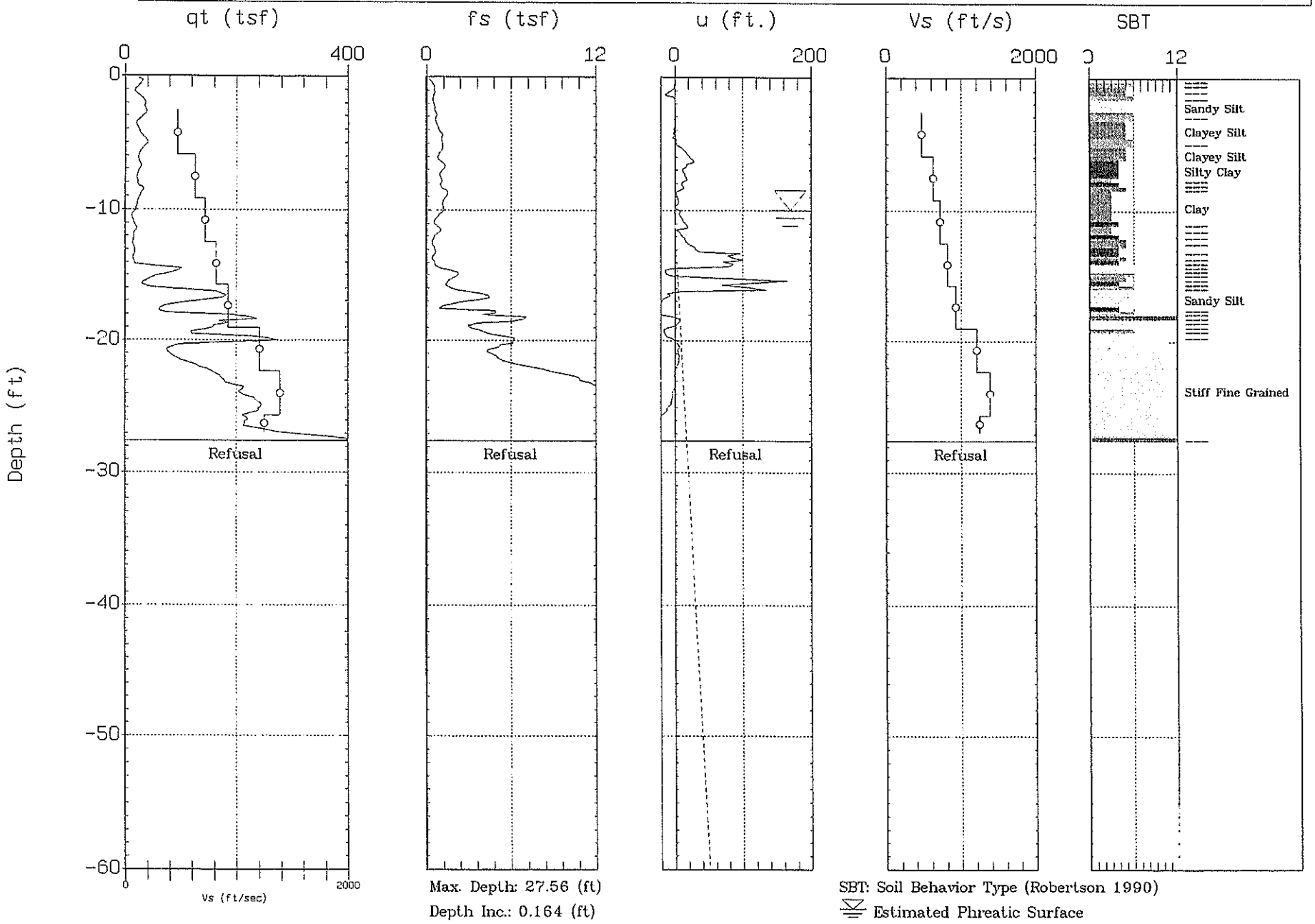
R15622

CONETEC

C.E.C.

Sounding:CPT-11
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 10:31



Max. Depth: 27.56 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

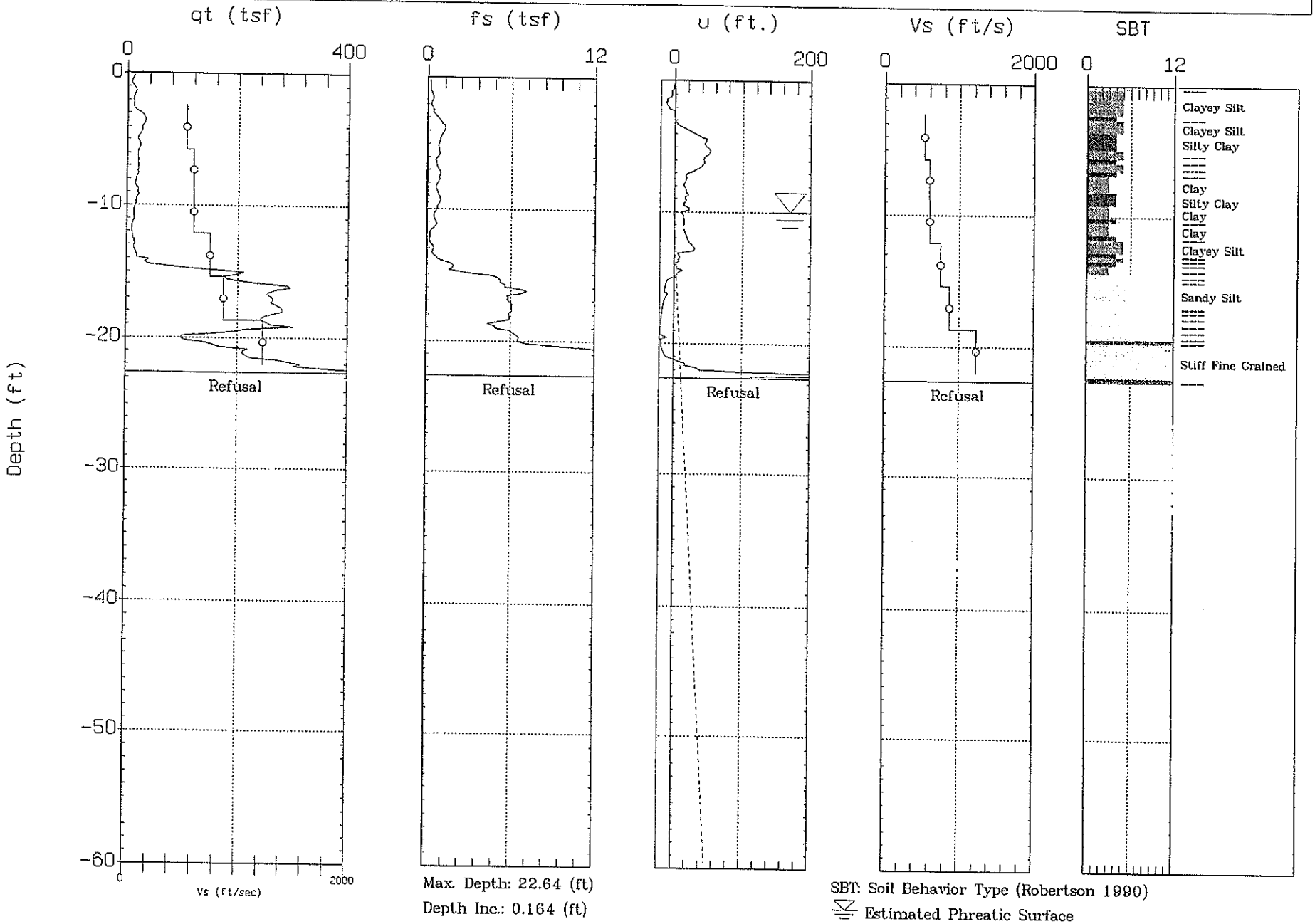
R15623

CONETEC

C.E.C.

Sounding:CPT-12
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 11:15



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

R15624

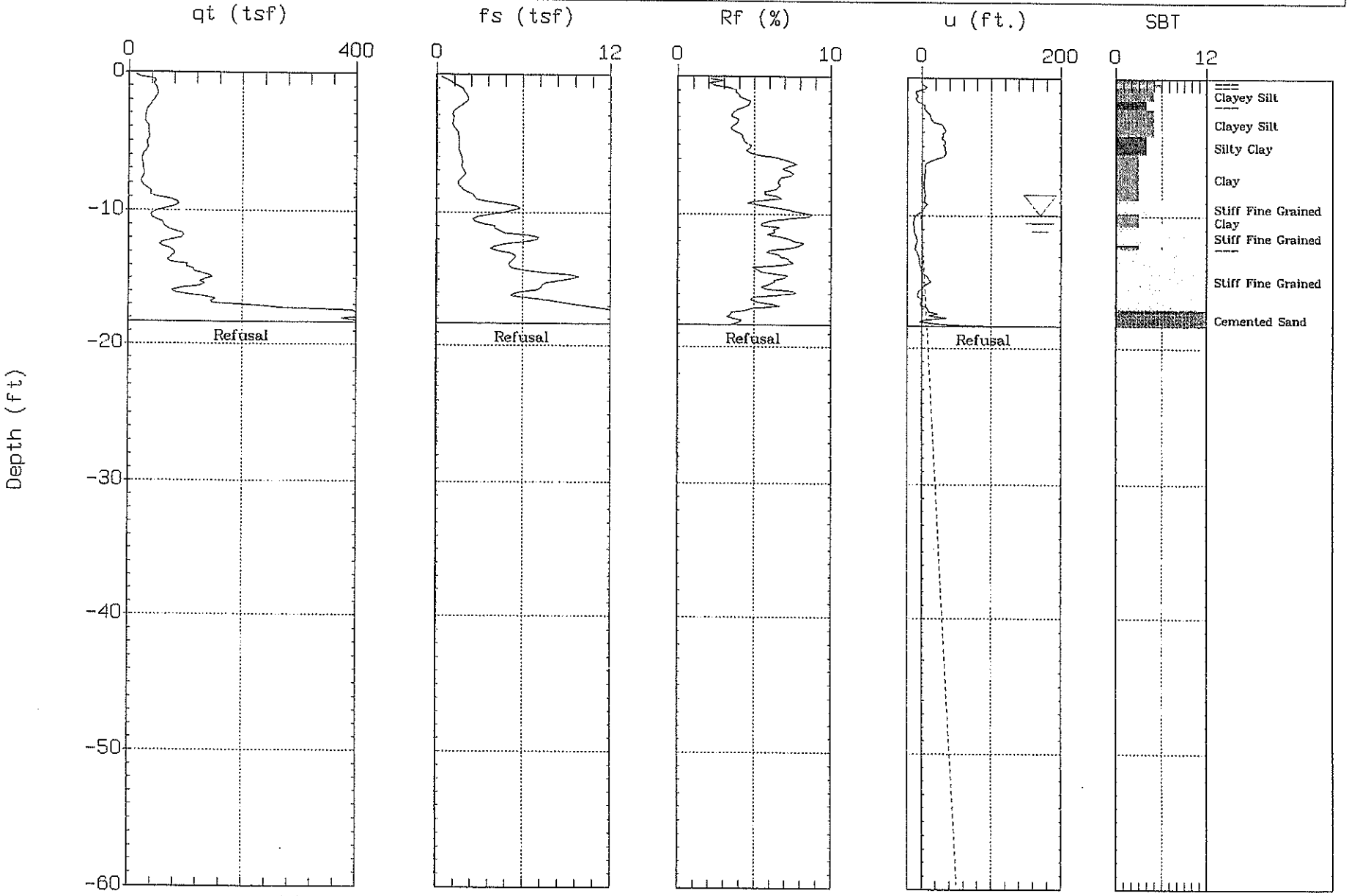
Non-normalized CPT plots

CONETEC

C.E.C.

Sounding:CPT-1
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 13:23



Max. Depth: 18.37 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

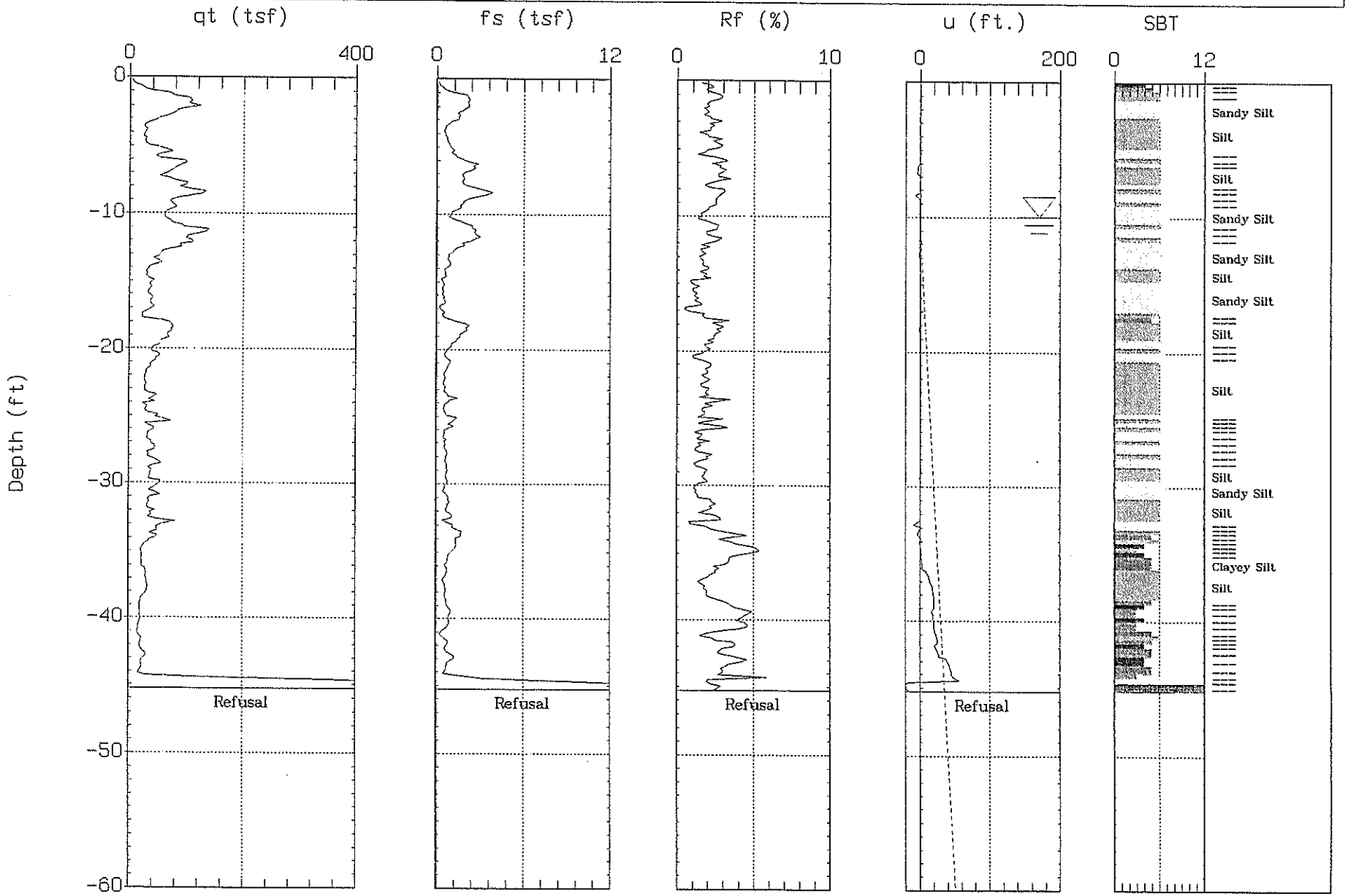
R15626

CONETEC

C.E.C.

Sounding:CPT-2
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 13:46



Max. Depth: 45.28 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

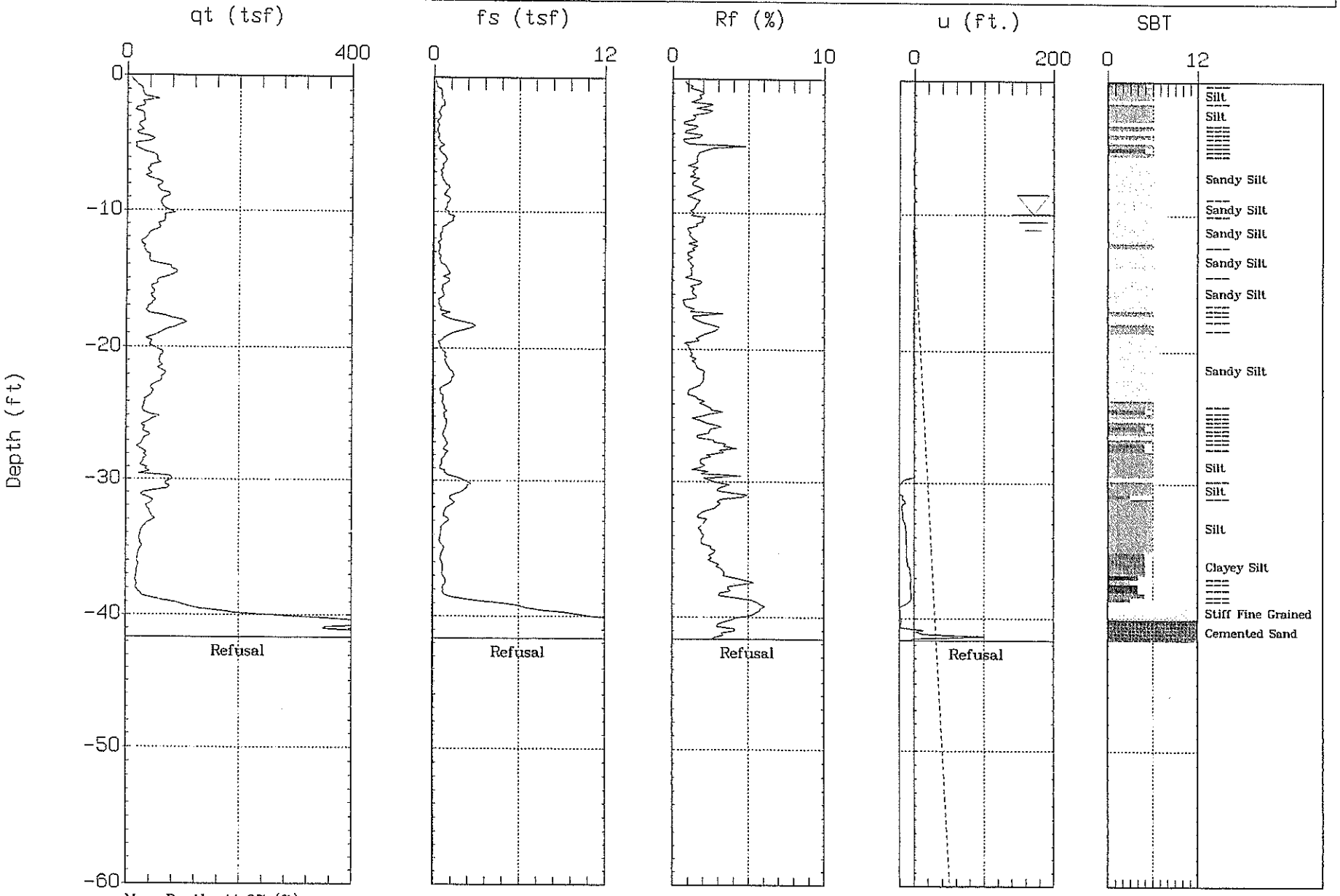
R15627

CONETEC

C.E.C.

Sounding:CPT-2A
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 14:50



Max. Depth: 41.67 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

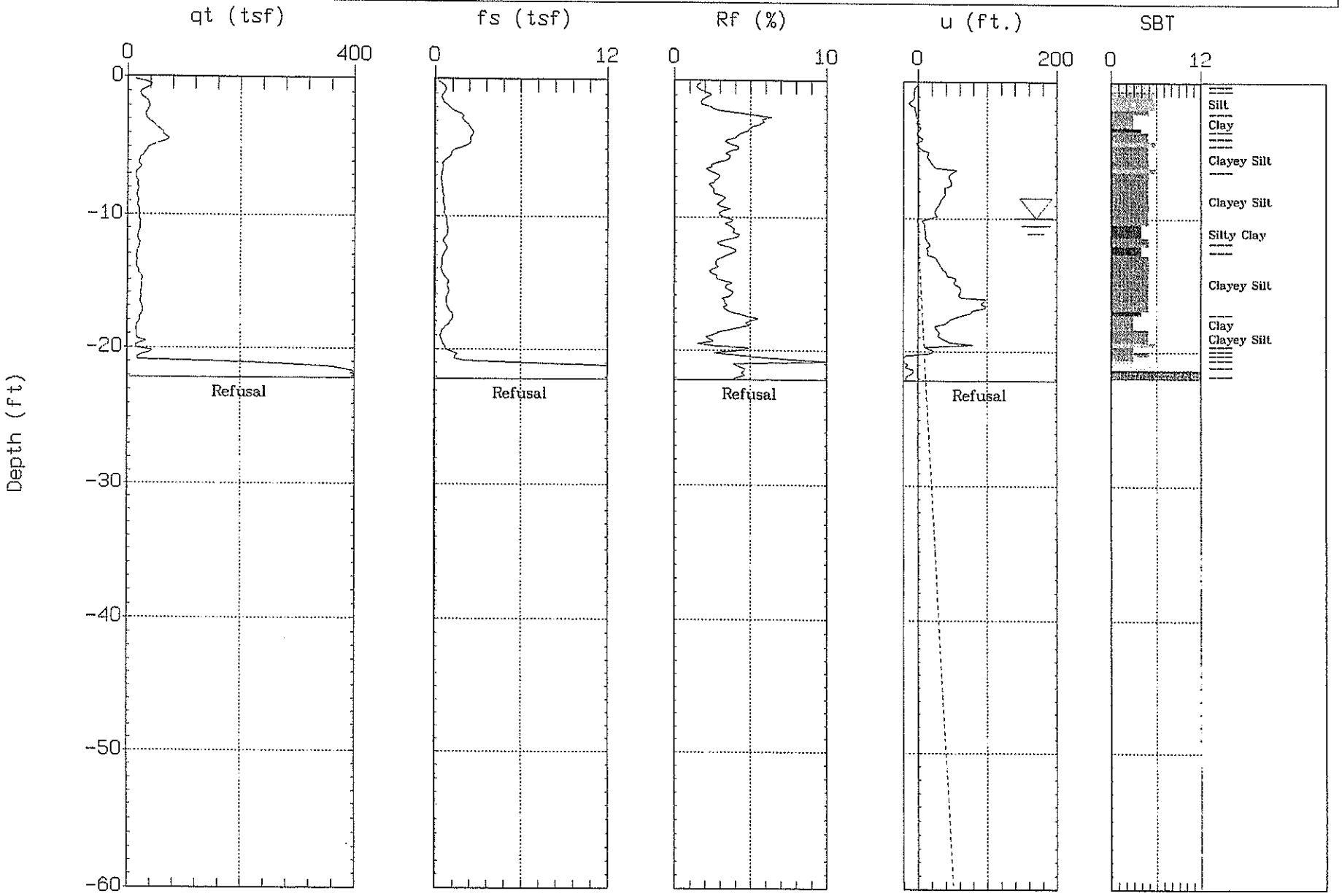
R15628

CONETEC

C.E.C.

Sounding:CPT-3
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:09



Max. Depth: 22.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

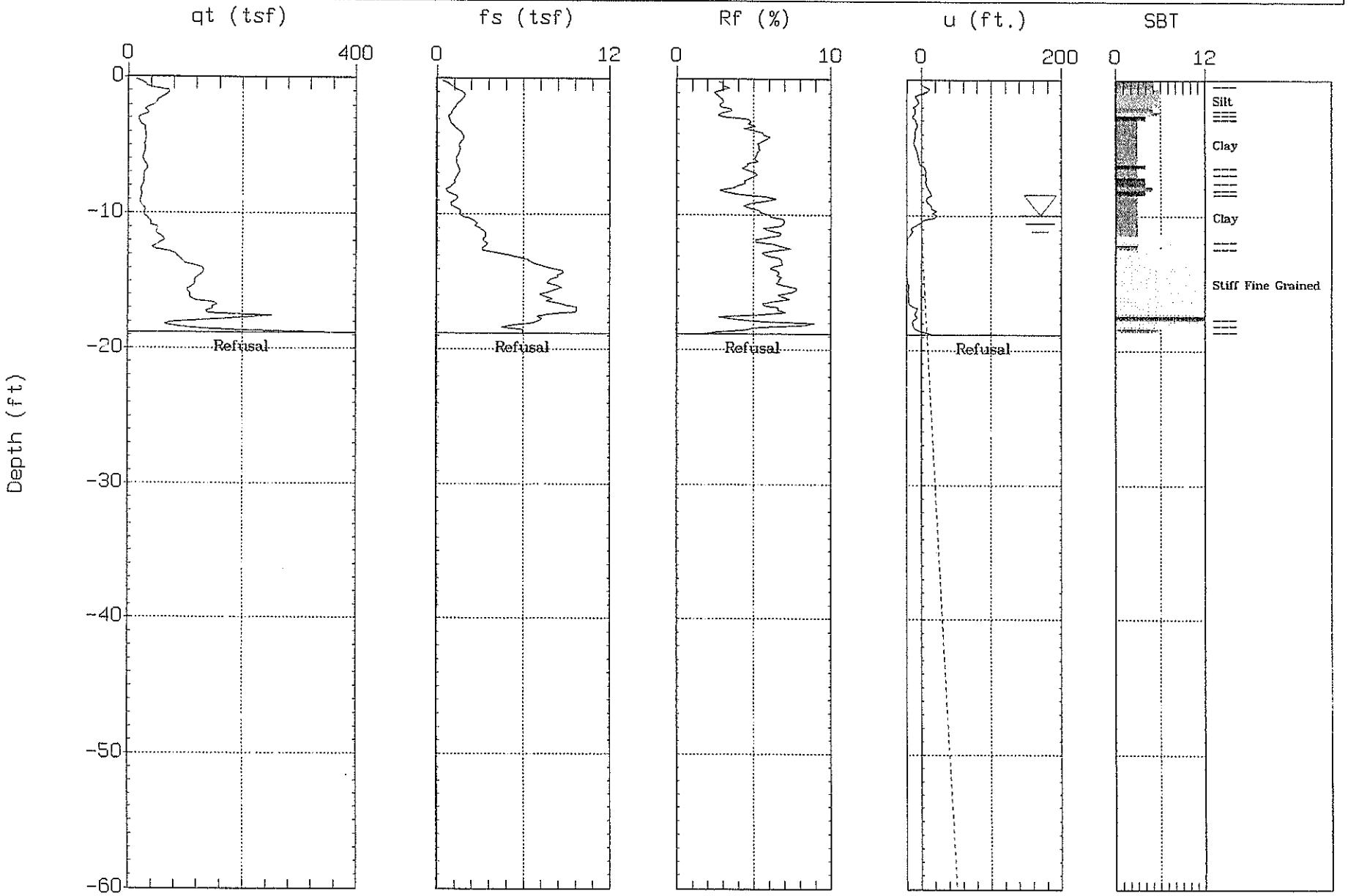
R15629

CONETEC

C.E.C.

Sounding:CPT-4
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:51



Max. Depth: 18.86 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

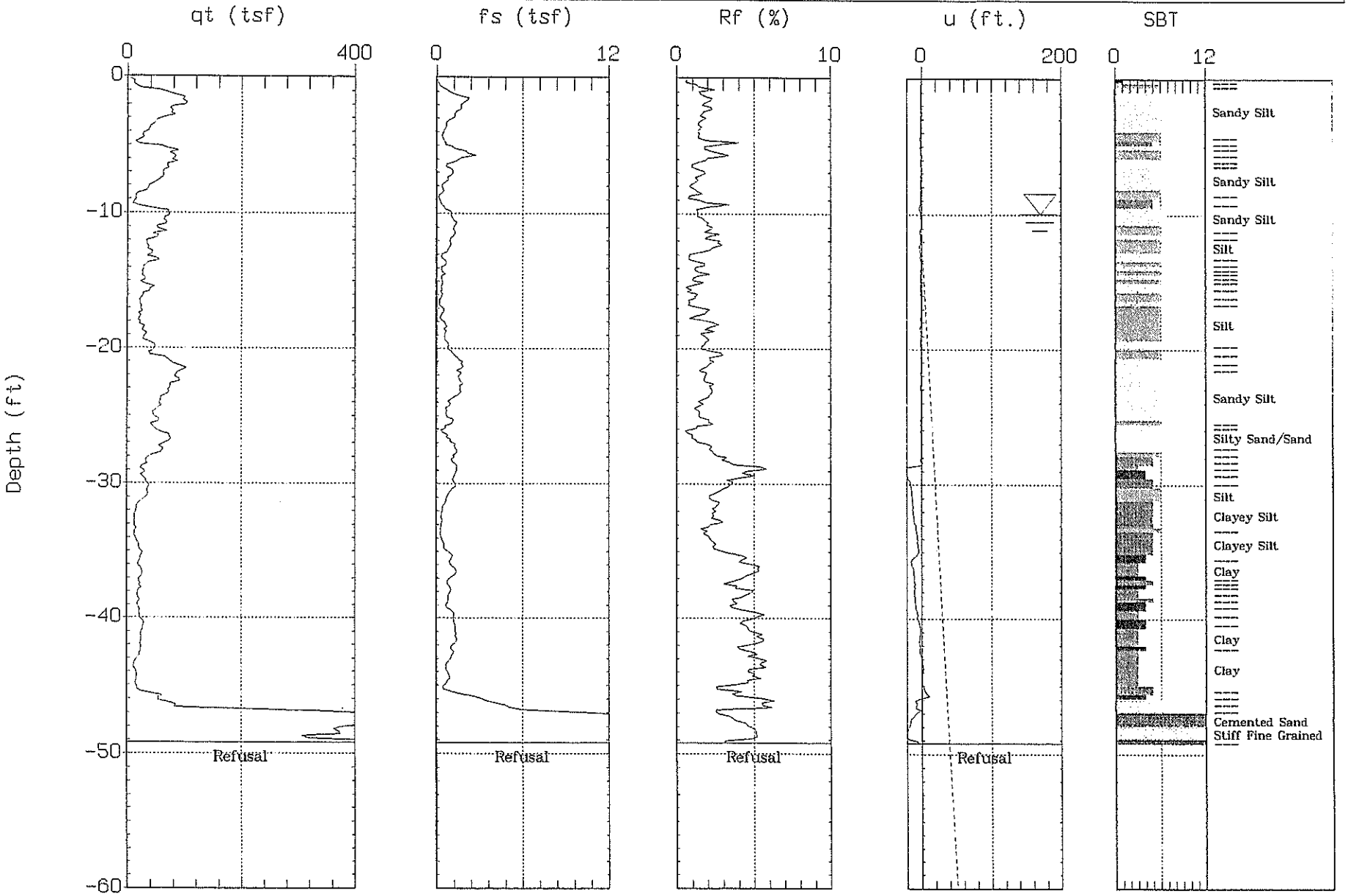
R15630

CONETEC

C.E.C.

Sounding:CPT-5
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 12:34



Max. Depth: 49.21 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

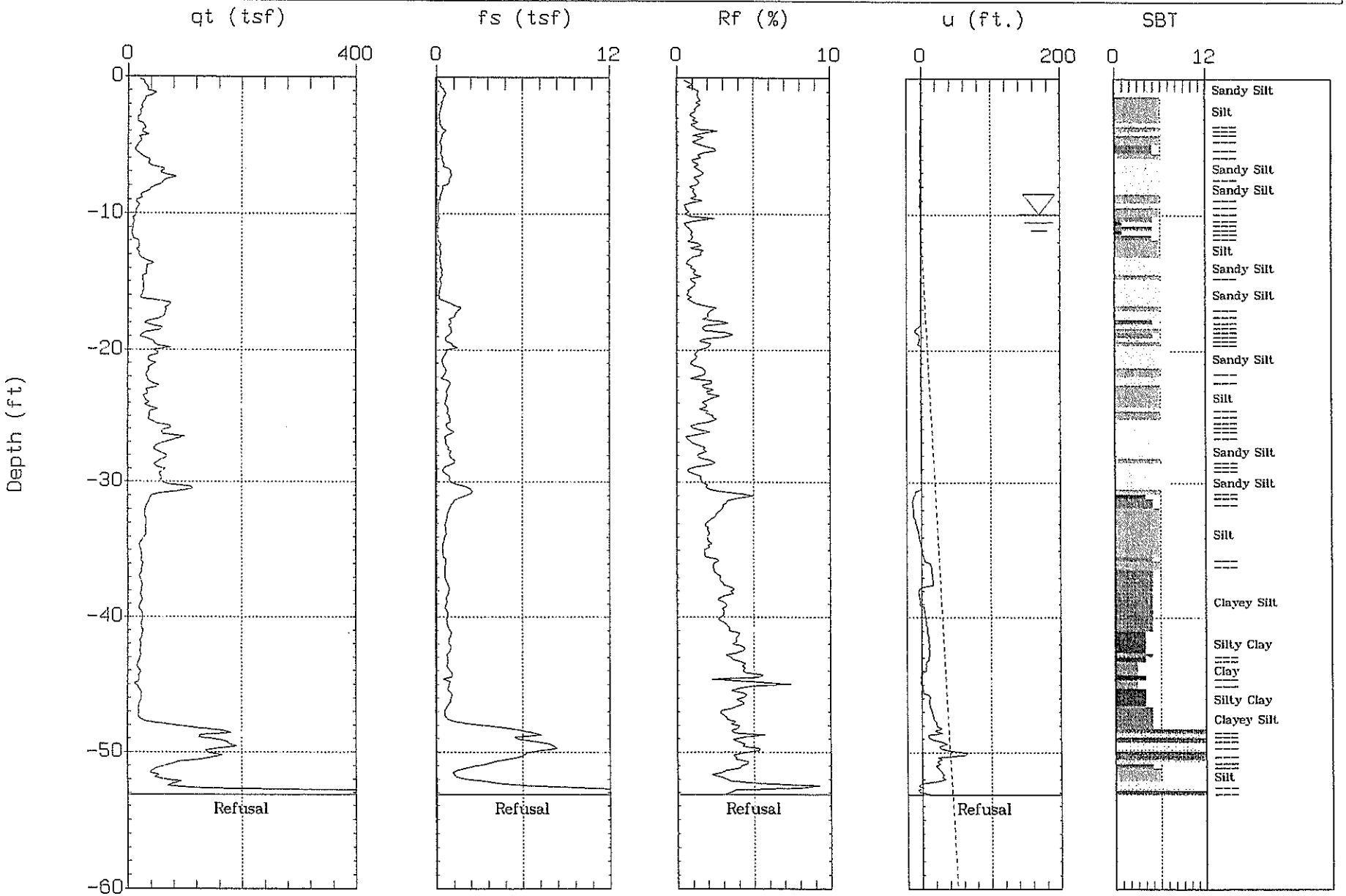
R15631

CONETEC

C.E.C.

Sounding:CPT-5A
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 10:44



Max. Depth: 53.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

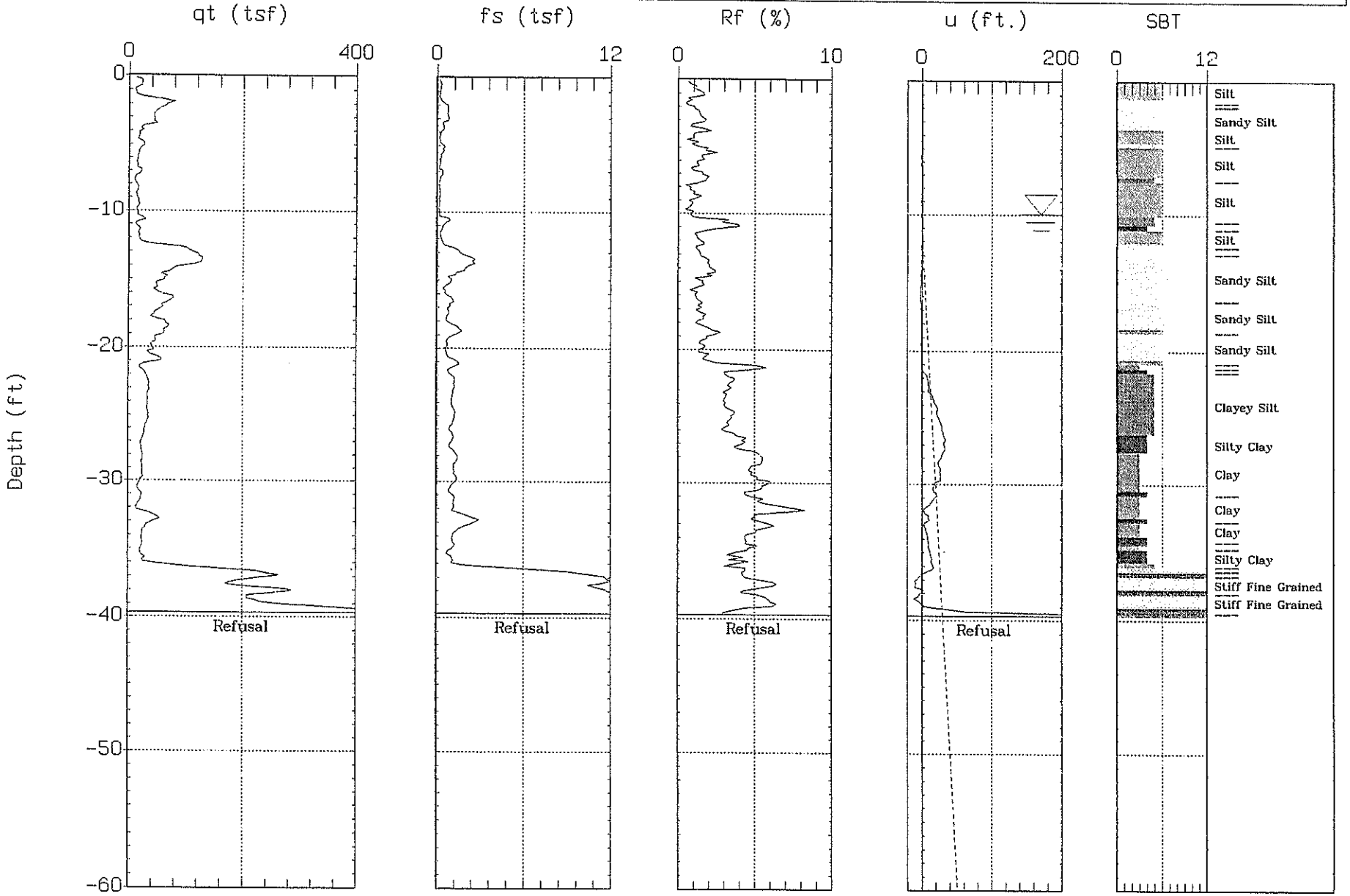
R15632

CONETEC

C.E.C.

Sounding:CPT-5B
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 15:44



Max. Depth: 39.70 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

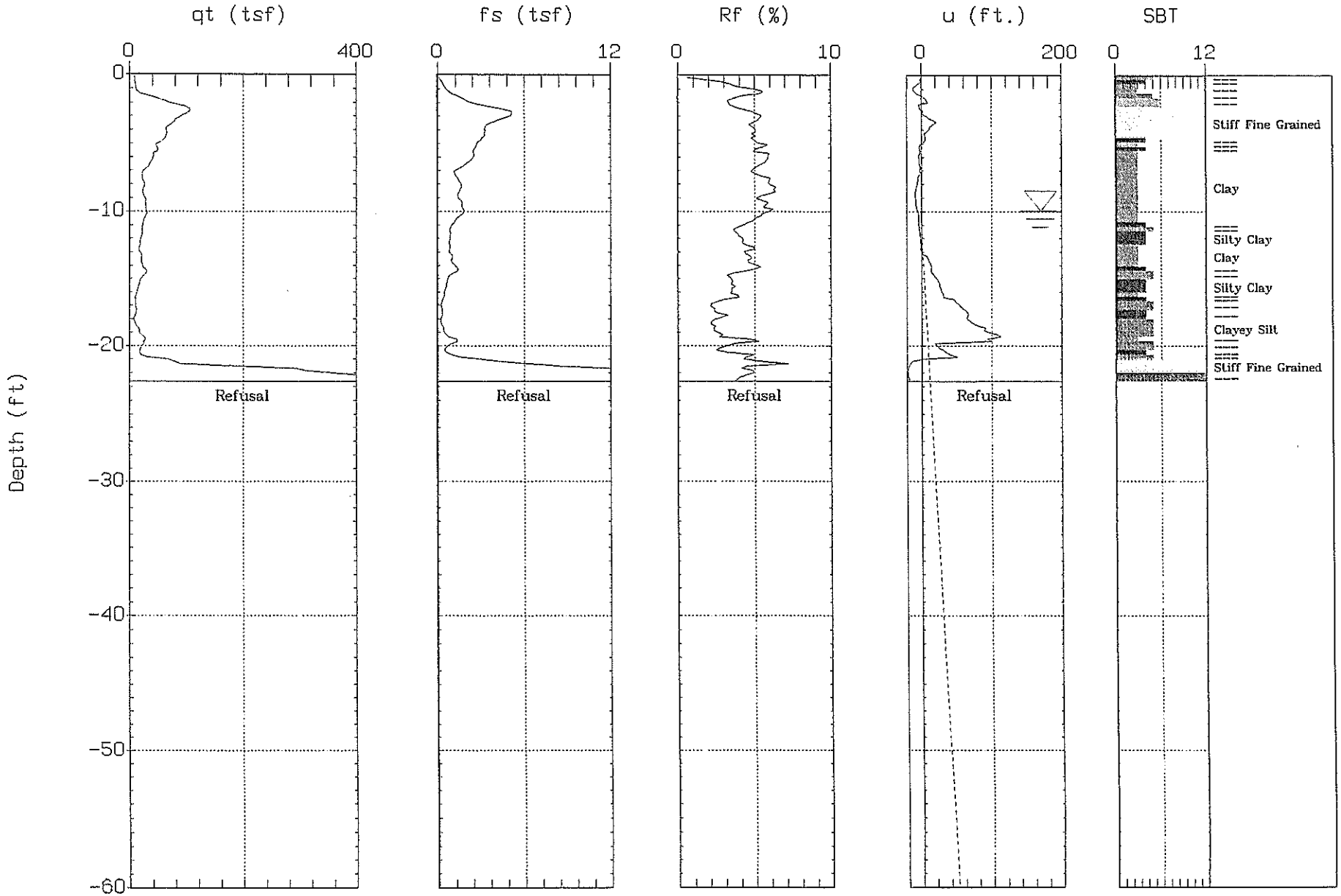
R15633

CONETEC

C.E.C.

Sounding:CPT-6
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:00



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

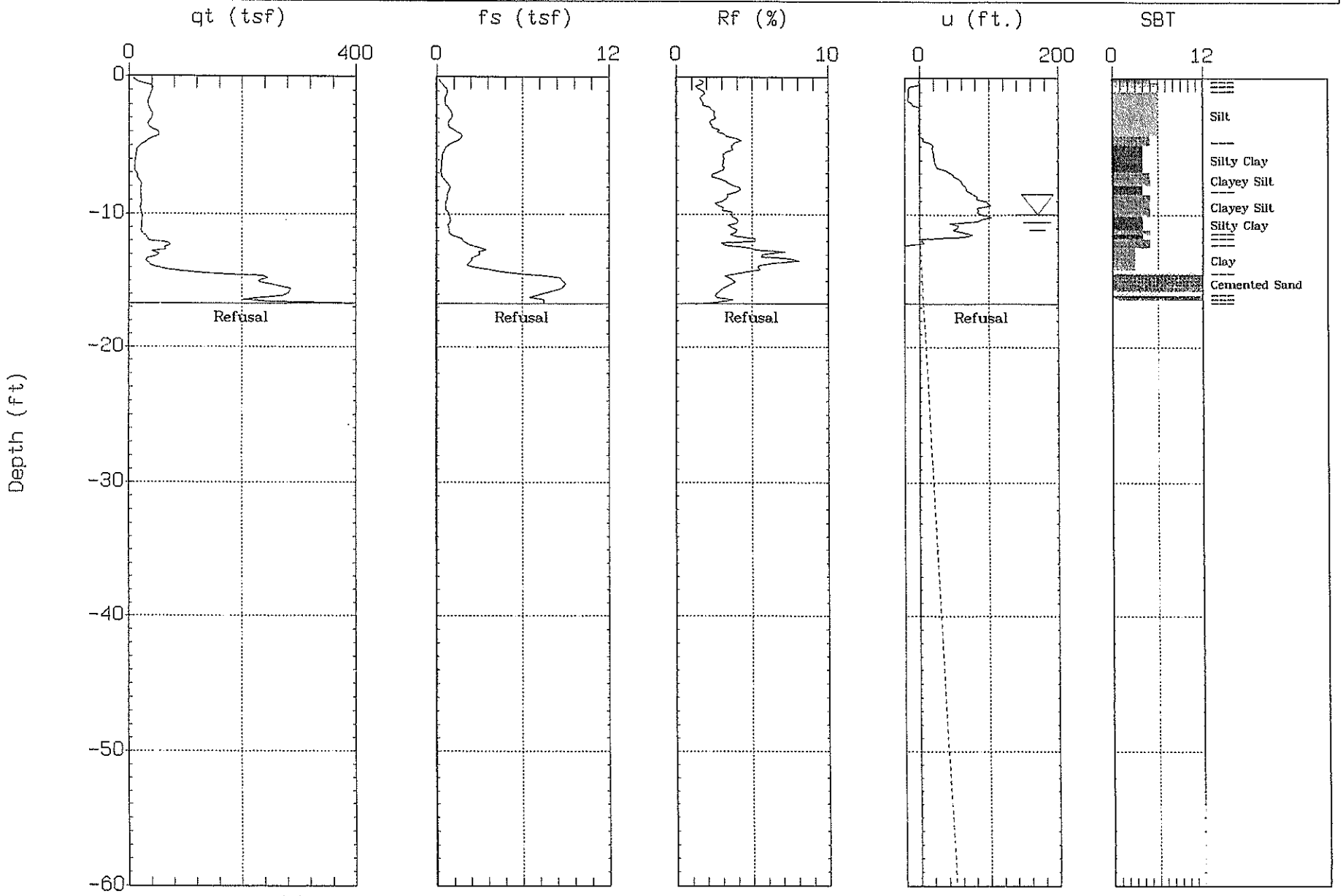
R15634

CONETEC

C.E.C.

Sounding:CPT-7
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:58



Max. Depth: 16.73 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

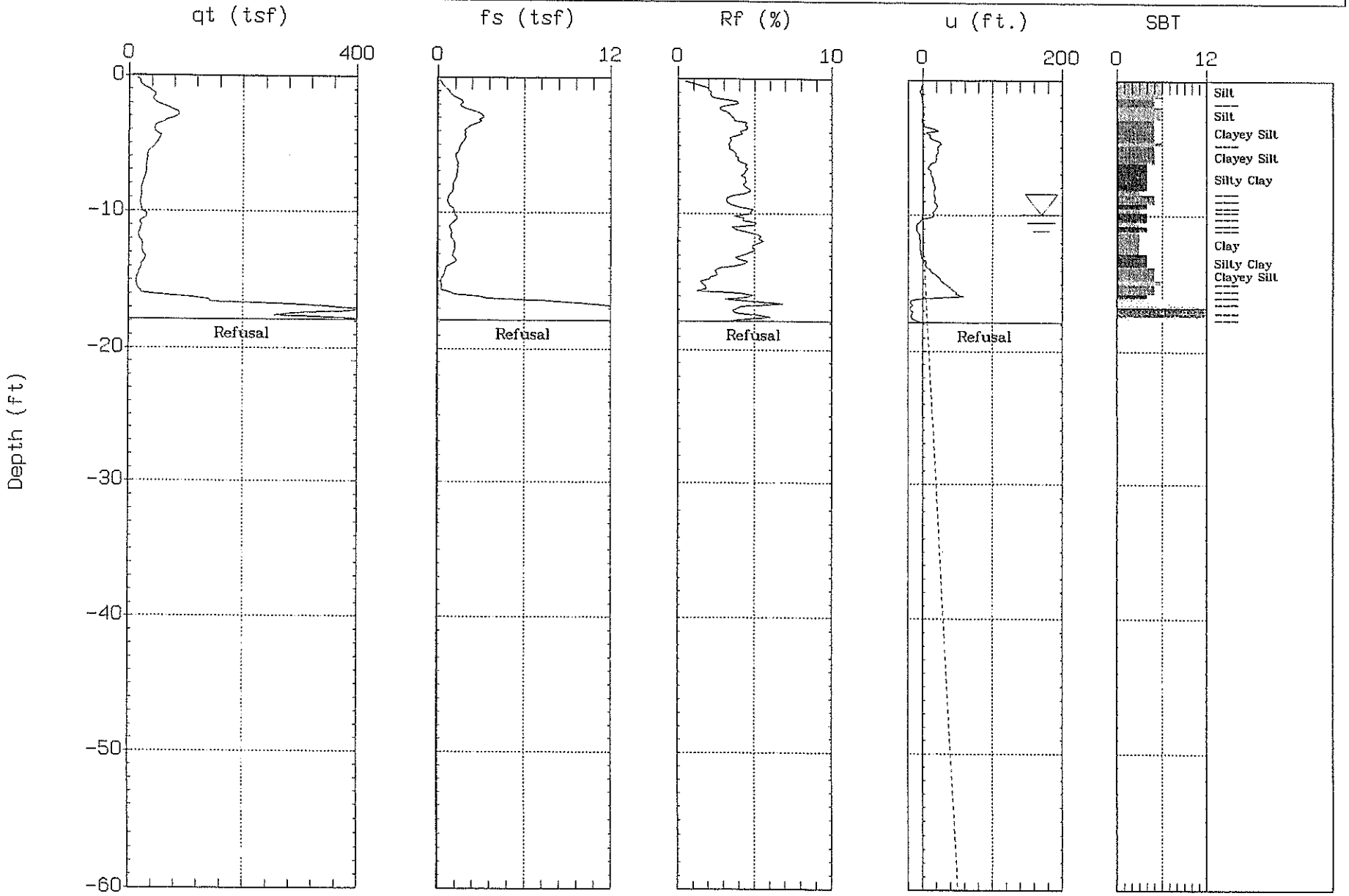
R15635

CONETEC

C.E.C.

Sounding:CPT-8
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:53



Max. Depth: 17.88 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

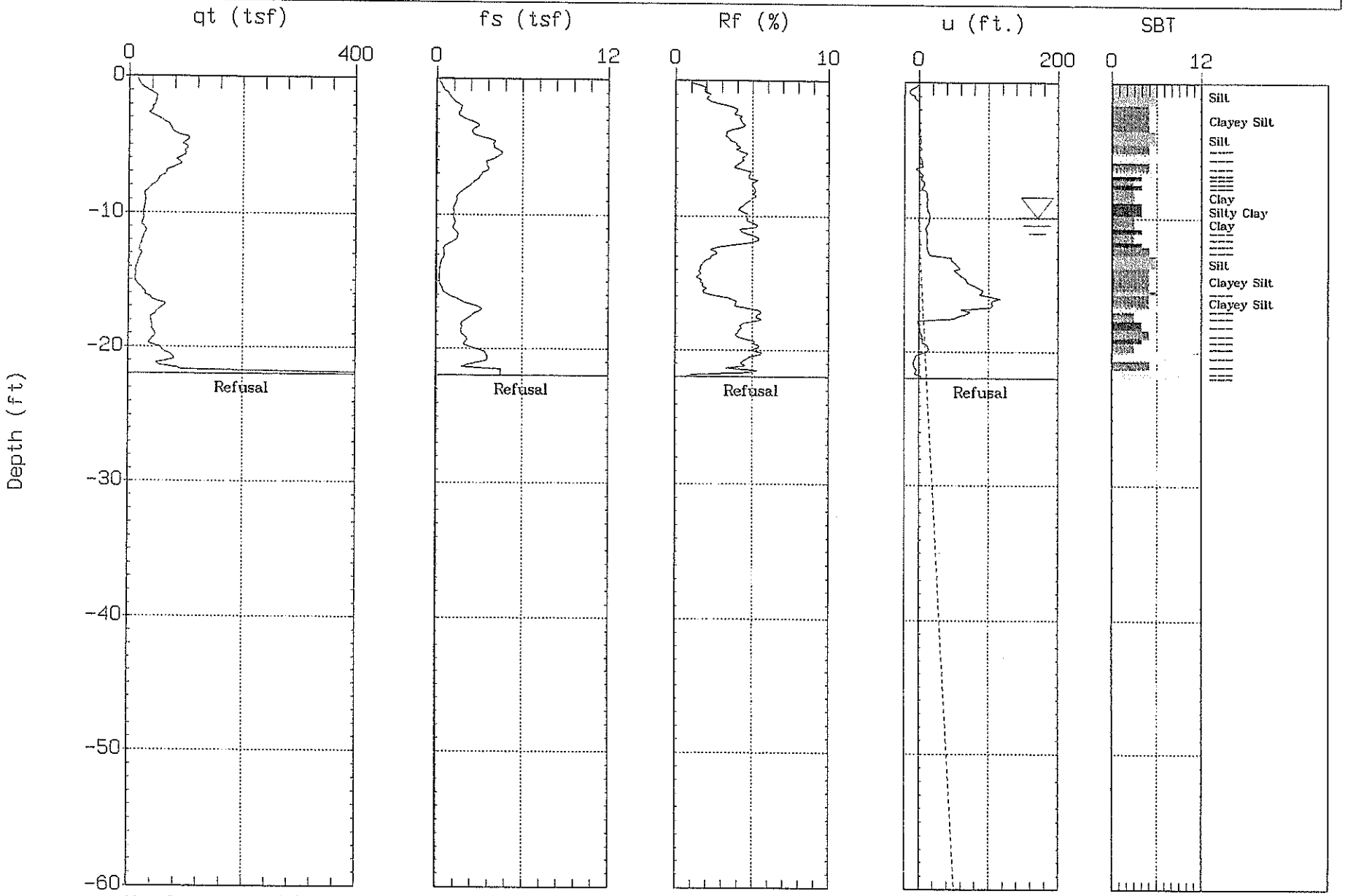
R15636

CONETEC

C.E.C.

Sounding:CPT-9
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:17



Max. Depth: 21.98 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

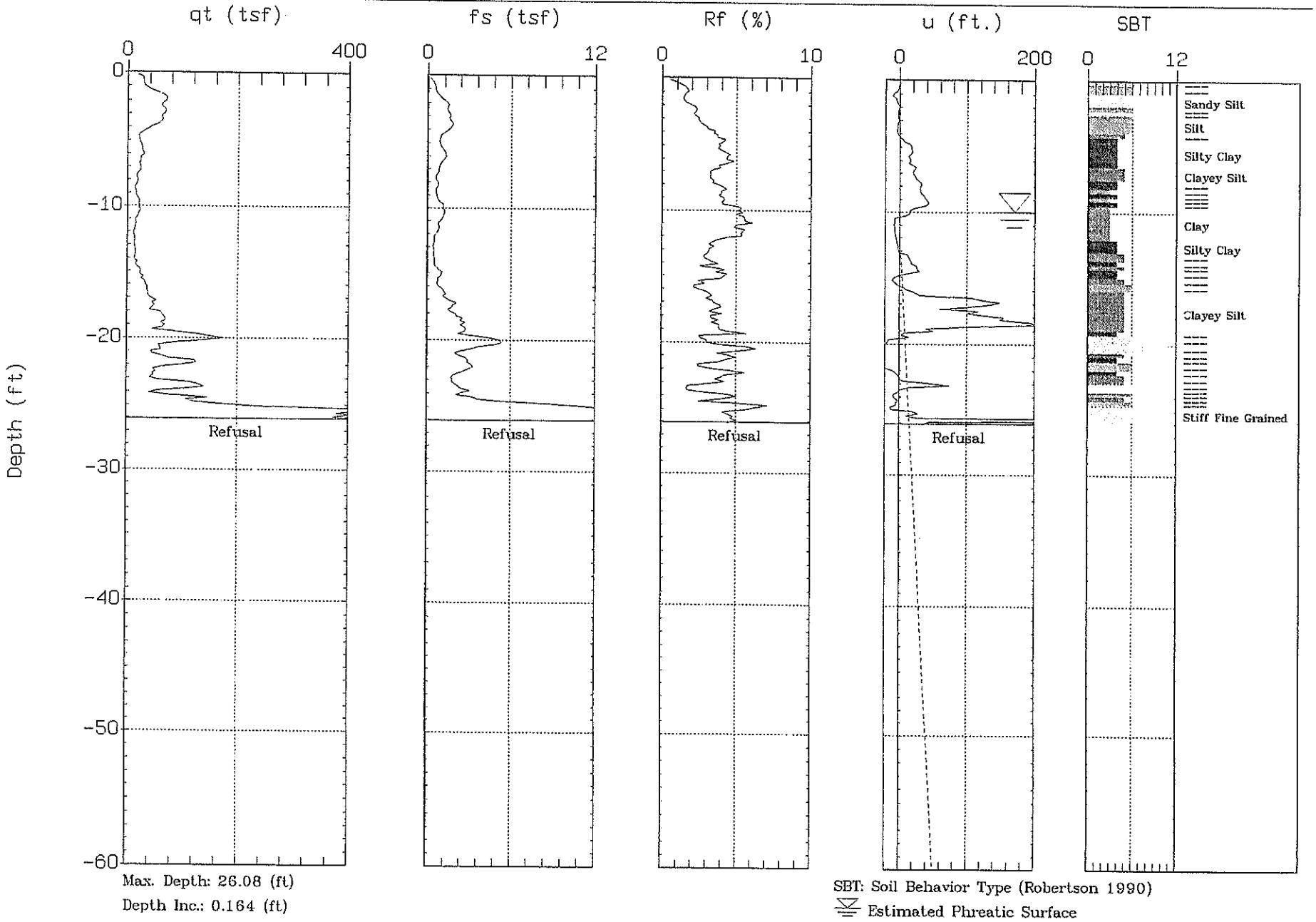
R15637

CONETEC

C.E.C.

Sounding:CPT-10
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 08:35



Max. Depth: 26.08 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

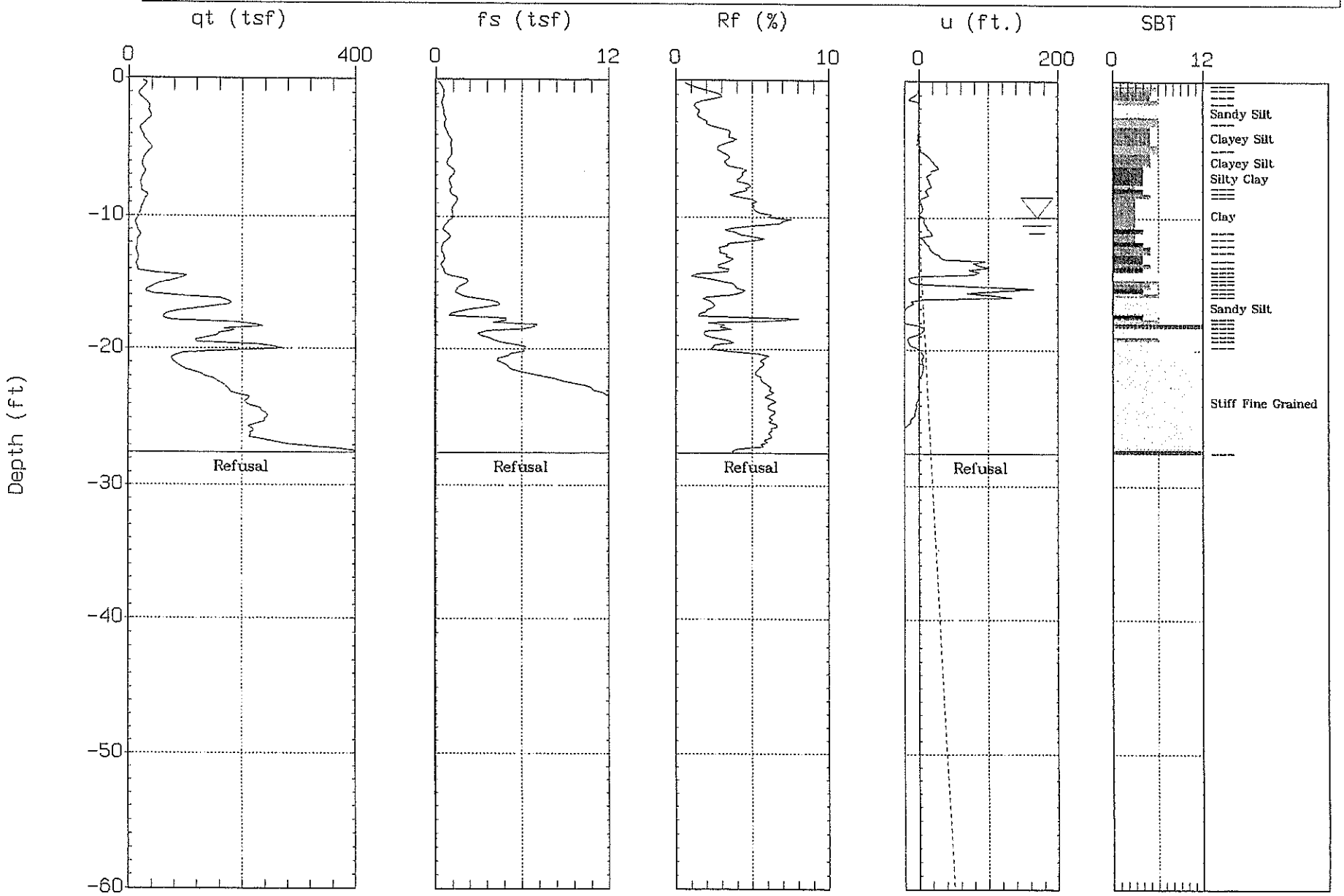
R15638

CONETEC

C.E.C.

Sounding:CPT-11
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 10:31



Max. Depth: 27.56 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

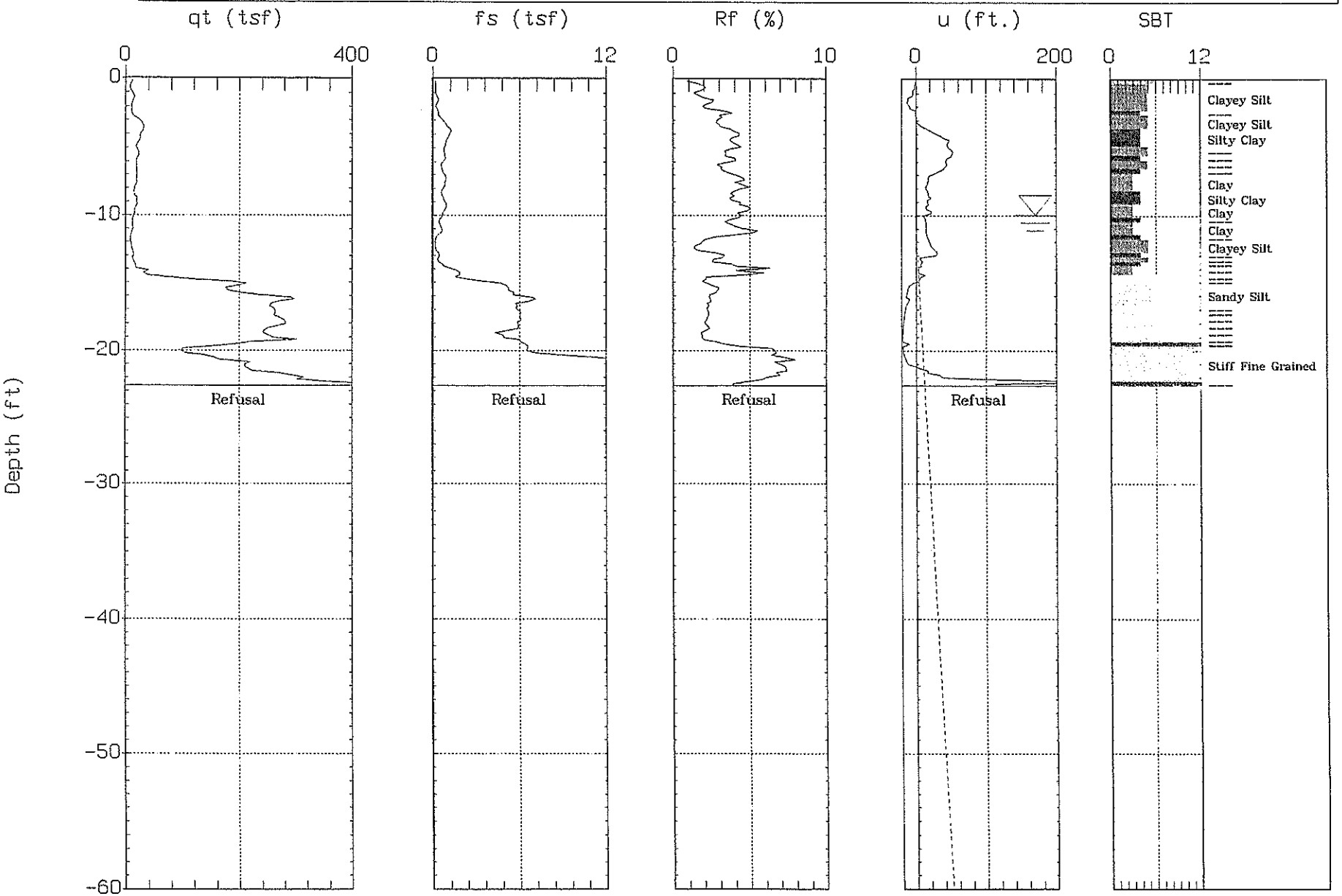
R15639

CONETEC

C.E.C.

Sounding:CPT-12
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 11:15



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

R15640

ConeTec
Environmental and Geotechnical Site Investigation Contractors

ConeTec Interpretations as of June 30, 2004 (Release 1.22A)

ConeTec's interpretation routine provides a tabular output of geotechnical parameters based on current published CPT correlations and is subject to change to reflect the current state of practice. The interpreted values are not considered valid for all soil types. The interpretations are presented only as a guide for geotechnical use and should be carefully scrutinized for consideration in any geotechnical design. Reference to current literature is strongly recommended. ConeTec does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the program and does not assume liability for any use of the results in any design or review. Representative hand calculations should be made for any parameter that is critical for design purposes. The end user of the interpreted output should also be fully aware of the techniques and the limitations of any method used in this program. The purpose of this document is to inform the user as to which methods were used and what the appropriate papers and/or publications are for further reference.

The CPT interpretations are based on values of tip, sleeve friction and pore pressure averaged over a user specified interval (e.g. 0.20m). Note that q_t is the tip resistance corrected for pore pressure effects and q_c is the recorded tip resistance. Since all ConeTec cones have equal end area friction sleeves, pore pressure corrections to sleeve friction, f_s, are not required.

The tip correction is: $q_t = q_c + (1-a) \bullet u_2$

where: q_t is the corrected tip resistance
q_c is the recorded tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the cone (typically 0.85 for ConeTec cones)

The total stress calculations are based on soil unit weights that have been assigned to the Soil Behavior Type zones, from a user defined unit weight profile or by using a single value throughout the profile. Effective vertical overburden stresses are calculated based on a hydrostatic distribution of equilibrium pore pressures below the water table or from a user defined equilibrium pore pressure profile (this can be obtained from CPT dissipation tests). For over water projects the effects of the column of water have been taken into account as has the appropriate unit weight of water. How this is done depends on where the instruments were zeroed (i.e. on deck or at mud line).

Details regarding the interpretation methods for all of the interpreted parameters are provided in Table 1. The appropriate references cited in Table 1 are listed in Table 2. Where methods are based on charts or techniques that are too complex to describe in this summary the user should refer to the cited material.

The estimated Soil Behavior Types (normalized and non-normalized) are based on the charts developed by Robertson and Campanella shown in Figures 1 and 2. The Bq classification charts are not reproduced in this document but can be reviewed in Lunne, Robertson and Powell (1997) or Robertson (1990).

Where the results of a calculation/interpretation are declared *'invalid'* the value will be represented by the text strings "-9999" or "-9999.0". In some cases the value 0 will be used. Invalid results will occur because of (and not limited to) one or a combination of:

1. Invalid or undefined CPT data (e.g. drilled out section or data gap).
2. Where the interpretation method is inappropriate, for example, drained parameters in an undrained material (and vice versa).
3. Where interpretation input values are beyond the range of the referenced charts or specified limitations of the interpretation method.
4. Where pre-requisite or intermediate interpretation calculations are invalid.

The parameters selected for output from the program are often specific to a particular project. As such, not all of the interpreted parameters listed in Table 1 may be included in the output files delivered with this report.

The output files are often delivered in one (or more) of the following three formats:

File Type	Typical Extensions	Description
Printable	IFP, NLP	ASCII files formatted for direct printing either by copying to a printer port, through a text editor or through a dedicated printing routine (such as ConeTec's CTPRINT). Typically formatted for 132 columns wide and 70 lines per page. Any printer would need to be set to have a compressed font (16cpi) as its default.
Importable	IFI, NLI	Tab delimited ASCII files (not for use with text editors) meant for importing into spreadsheet and database applications (e.g. Excel, Lotus, Quattro, Access). Some column and cell formatting maybe required depending on the quality of the application's import utility.
Spreadsheet	XLS	IFI, NLI files exported directly to Excel format. Column and cell formatting has been done. Header information is exported to start in Column C allowing the depth columns A and/or B to be duplicated on each printed page without repetition of part of the header information.

Table 1
CPT Interpretation Methods

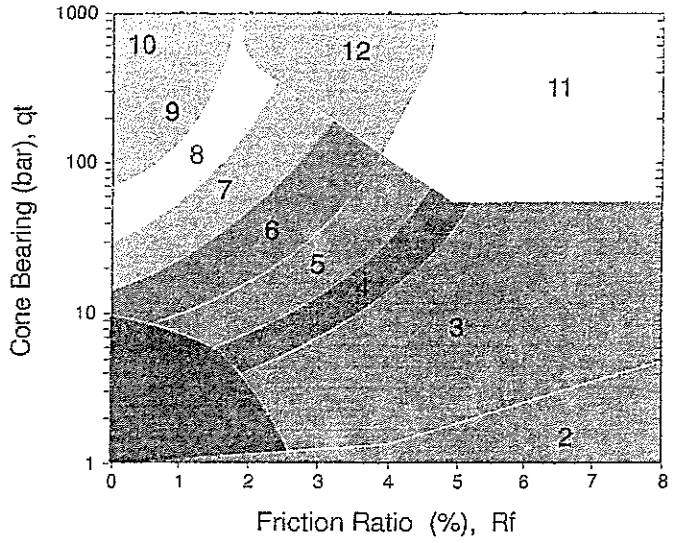
Interpreted Parameter	Description	Equation	Ref
Depth	Mid Layer Depth *(where interpretations are done at each point then Mid Layer Depth = Recorded Depth)*	*Depth (Layer Top) + Depth (Layer Bottom) / 2.0*	
Elevation	Elevation of Mid Layer based on sounding collar elevation supplied by client	Elevation = Collar Elevation - Depth	
Avgqc	Averaged recorded tip value (q_c)	$Avgqc = \frac{1}{n}\sum_{i=1}^{n} q_c$ *n=1 when interpretations are done at each point*	
Avgqt	Averaged corrected tip (q_t) where: $q_t = q_c + (1-a) \bullet u$	$Avgqt = \frac{1}{n}\sum_{i=1}^{n} q_t$ *n=1 when interpretations are done at each point*	
Avgfs	Averaged sleeve friction (f_s)	$Avgfs = \frac{1}{n}\sum_{i=1}^{n} fs$ *n=1 when interpretations are done at each point*	
AvgRf	Averaged friction ratio (Rf) where friction ratio is defined as: $Rf = 100\% \bullet \frac{fs}{qt}$	$AvgRf = 100\% \bullet \frac{Avgfs}{Avgqt}$ *n=1 when interpretations are done at each point*	
Avgu	Averaged dynamic pore pressure *(u)*	$Avgu = \frac{1}{n}\sum_{i=1}^{n} u_i$ *n=1 when interpretations are done at each point*	
AvgRes	Averaged Resistivity (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} RESISTIVITY_i$ *n=1 when interpretations are done at each point*	

Interpreted Parameter	Description	Equation	Ref
AvgUVIF	Averaged UVIF ultra-violet induced fluorescence (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} UVIF_i$ *n=1 when interpretations are done at each point*	
AvgTemp	Averaged Temperature (this data is not always available since it is a specialized test)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} TEMPERATURE_i$ *n=1 when interpretations are done at each point*	
AvgGamma	Averaged Gamma Counts (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} GAMMA_i$ *n=1 when interpretations are done at each point*	
SBT	Soil Behavior Type as defined by Robertson and Campanella	See Figure 1	2, 5
U.Wt.	Unit Weight of soil determined from one of the following user selectable options: 1) uniform value 2) value assigned to each SBT zone 3) user supplied unit weight profile	See references	5
T. Stress σ_v	Total vertical overburden stress at Mid Layer Depth. *A layer is defined as the averaging interval specified by the user. For data interpreted at each point the Mid Layer Depth is the same as the recorded depth.*	$TStress = \sum_{i=1}^{n} \gamma_i h_i$ *where* γ_i is layer unit weight h_i is layer thickness	
E. Stress σ_v'	Effective vertical overburden stress at Mid Layer Depth	$Estress = Tstress - u_{eq}$	
Ueq	Equilibrium pore pressure determined from one of the following user selectable options: 1) hydrostatic from water table depth 2) user supplied profile	For hydrostatic option: $u_{eq} = \gamma_w \bullet (D - D_{wt})$ where u_{eq} is equilibrium pore pressure γ_w is unit weight of water D is the current depth D_{wt} is the depth to the water table	
Cn	SPT N_{60} overburden correction factor	$Cn=(\sigma_v')^{-0.5}$ where σ_v' *is in tsf* $0.5 < C_n < 2.0$	
N_{60}	SPT N value at 60% energy calculated from qt/N ratios assigned to each SBT zone. This method has abrupt N value changes at zone boundaries.	*See Figure 1*	4, 5
$(N_1)_{60}$	SPT N_{60} value corrected for overburden pressure	$(N_1)_{60} = Cn \bullet N_{60}$	4
$N_{60}Ic$	SPT N_{60} values based on the Ic parameter	$(qt/pa)/ N_{60} = 8.5 (1 - Ic/4.6)$	5
$(N_1)_{60}Ic$	SPT N_{60} value corrected for overburden pressure (using N_{60} I_c). User has 2 options.	1) $(N_1)_{60}Ic = Cn \bullet (N_{60}Ic)$ 2) $q_{c1n}/ (N_1)_{60}Ic = 8.5 (1 - Ic/4.6)$	4 5
		1) $(N_1)_{60cs}Ic = \alpha + \beta((N_1)_{60}Ic)$ 2) $(N_1)_{60cs}Ic = K_{SPT} * ((N_1)_{60}Ic)$ 3) $q_{c1ncs})/ (N_1)_{60cs}Ic = 8.5 (1 - Ic/4.6)$	10 10 5
$(N_1)_{60cs}Ic$	Clean sand equivalent SPT $(N_1)_{60}Ic$. User has 3 options.	FC ≤ 5%: $\alpha = 0$, $\beta = 1.0$ FC ≥ 35% $\alpha = 5.0$, $\beta = 1.2$ 5% < FC < 35% $\alpha = \exp[1.76 - (190/FC^2)]$ $\beta = [0.99 + (FC^{1.5}/1000)]$	
Su	Undrained shear strength - N_{kt} is user selectable	$Su = \frac{qt - \sigma_v}{N_{kt}}$	1, 5
k	Coefficient of permeability (assigned to each SBT zone)		5

Interpreted Parameter	Description	Equation	Ref
Bq	Pore pressure parameter	$Bq = \frac{\Delta u}{qt - \sigma_v}$ *where:* $\Delta u = u - u_{eq}$ *and* u = *dynamic pore pressure* u_{eq} = *equilibrium pore pressure*	1, 5
Q_t	Normalized q_t for Soil Behavior Type classification as defined by Robertson, 1990	$Qt = \frac{qt - \sigma_v}{\sigma_v}$	2, 5
F_r	Normalized Friction Ratio for Soil Behavior Type classification as defined by Robertson, 1990	$Fr = 100\% \bullet \frac{fs}{qt - \sigma_v}$	2, 5
SBTn	Normalized Soil Behavior Type as defined by Robertson and Campanella	See Figure 2	2, 5
SBT-BQ	Non-normalized soil behavior type based on the Bq parameter	See Figure 5.7 (reference 5)	2, 5
SBT-BQn	Normalized Soil Behavior base on the Bq parameter	See Figure 5.8 (reference 5) or Figure 3 (reference 2)	2, 5
I_c	Soil index for estimating grain characteristics	$Ic = [(3.47 - \log_{10}Q)^2 + (\log_{10} Fr + 1.22)^2]^{0.5}$ *Where:* $Q = \left(\frac{qt - \sigma_v}{P_{a2}}\right)\left(\frac{P_a}{\sigma_v}\right)^n$ *And* *Fr is in percent* P_a = *atmospheric pressure* P_{a2} = *atmospheric pressure* *n varies from 0.5 to 1.0 and is selected in an iterative manner based on the resulting* I_c	3, 8
FC	Apparent fines content (%)	$FC=1.75(Ic^{3.25}) - 3.7$ *FC=100 for Ic > 3.5* *FC=0 for Ic < 1.26* *FC = 5% if 1.64 < Ic < 2.6 AND* F_r*<0.5*	3
Ic Zone	This parameter is the Soil Behavior Type zone based on the Ic parameter (valid for zones 2 through 7 on SBTn chart)	Ic < 1.31 Zone = 7 1.31 < Ic < 2.05 Zone = 6 2.05 < Ic < 2.60 Zone = 5 2.60 < Ic < 2.95 Zone = 4 2.95 < Ic < 3.60 Zone = 3 Ic > 3.60 Zone = 2	3
PHI ϕ	Friction Angle determined from one of the following user selectable options: a) Campanella and Robertson b) Durgunoglu and Mitchel c) Janbu	See reference	5
Dr	Relative Density determined from one of the following user selectable options: a) Ticino Sand b) Hokksund Sand c) Schmertmann 1976 d) Jamiolkowski - All Sands	See reference	5

Interpreted Parameter	Description	Equation	Ref
OCR	Over Consolidation Ratio	a) Based on Schmertmann's method involving a plot of S_u/σ_v' /($S_u/\sigma_v')_{NC}$ and OCR where the Su/p' ratio for NC clay is user selectable	9
State Parameter	The state parameter is used to describe whether a soil is contractive (SP is positive) or dilative (SP is negative) at large strains based on the work by Been and Jefferies	See reference	8, 6, 5
Es/qt	Intermediate parameter for calculating Youngs Modulus, E, in sands. It is the Y axis of the reference chart.	Based on Figure 5.59 in the reference	5
Youngs Modulus E	Youngs Modulus based on the work by Baldi. There are three types of sands considered in this technique. The user selects the appropriate type for the site from: a) OC Sands b) Aged NC Sands c) Recent NC Sands Each sand type has a family of curves that depend on mean normal stress. The program calculates mean normal stress and linearly interpolates between the two extremes provided in Baldi's chart.	Mean normal stress is evaluated from: $\sigma_m' = \frac{1}{3} \bullet (\sigma_v' + \sigma_h' + \sigma_h')$ where σ_v'= vertical effective stress σ_h'= horizontal effective stress and $\sigma_h = K_o * \sigma_v'$ with Ko assumed to be 0.5	5
q_{c1}	q_t normalized for overburden stress used for seismic analysis	$q_{c1} = q_t \bullet (Pa/\sigma_v')^{0.5}$ where: Pa = atm. Pressure q_t is in Mpa	3
q_{c1n}	q_{c1} in dimensionless form used for seismic analysis	$q_{c1n} = (q_{c1} / Pa)(Pa/\sigma_v')$ where: Pa = atm. Pressure and n ranges from 0.5 to 0.75 based on Ic.	3
K_{SPT}	Equivalent clean sand factor for $(N_1)60$	$K_{SPT} = 1 + ((0.75/30) * (FC - 5))$	10
K_{CPT}	Equivalent clean sand correction for q_{c1N}	$K_{cpt} = 1.0$ for $I_c \leq 1.64$ $K_{cpt} = f(I_c)$ for $I_c > 1.64$ *(see reference)*	10
q_{c1ncs}	Clean sand equivalent q_{c1n}	$q_{c1ncs} = q_{c1n} \bullet K_{cpt}$	3
CRR	Cyclic Resistance Ratio (for Magnitude 7.5)	$q_{c1ncs} < 50$: $CRR_{7.5} = 0.833\ [(q_{c1ncs}/1000] + 0.05$ $50 \leq q_{c1ncs} < 160$: $CRR_{7.5} = 93\ [(q_{c1ncs}/1000]^3 + 0.08$	10
CSR	Cyclic Stress Ratio	$CSR = (\tau_{av}/\sigma_v') = 0.65\ (a_{max} / g)\ (\sigma_v/ \sigma_v')\ r_d$ $r_d = 1.0 - 0.00765\ z$ $z \leq 9.15m$ $r_d = 1.174 - 0.0267\ z$ $9.15 < z \leq 23m$ $r_d = 0.744 - 0.008\ z$ $23 < z \leq 30m$ $r_d = 0.50$ $z > 30m$	10

Interpreted Parameter	Description	Equation	Ref
MSF	Magnitude Scaling Factor	See Reference	10
FofS	Factor of Safety against Liquefaction	FS = ($CRR_{7.5}$ / CSR) MSF	10
Liquefaction Status	Statement indicating possible liquefaction	Takes into account FofS and limitations based I_c and q_{c1ncs}.	10



Zone	qt / N	Soil Behavior Type
1	2	sensitive fine grained
2	1	organic material
3	1	clay
4	1.5	silty clay to clay
5	2	clayey silt to silty clay
6	2.5	sandy silt to clayey silt
7	3	silty sand to sandy silt
8	4	sand to silty sand
9	5	sand
10	6	gravelly sand to sand
11	1	very stiff fine grained *
12	2	sand to clayey sand *

* overconsolidated or cemented

Figure 1 Non-Normalized Behavior Type Classification Chart

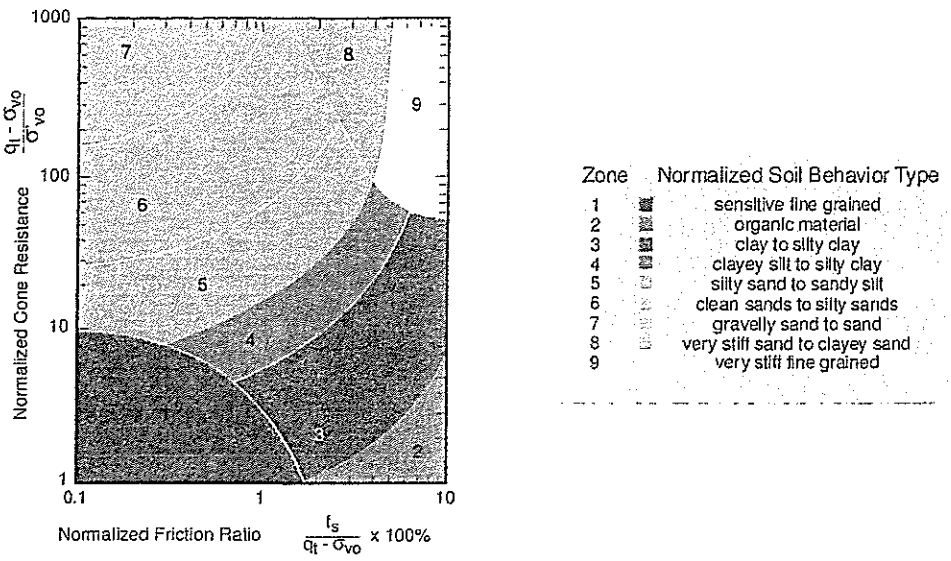


Figure 2 Normalized Behavior Type Classification Chart

Table 2 References

No.	References
1	Robertson, P.K., Campanella, R.G., Gillespie, D. and Greig, J., 1986, "Use of Piezometer Cone Data", Proceedings of InSitu 86, ASCE Specialty Conference, Blacksburg, Virginia.
2	Robertson, P.K., 1990, "Soil Classification Using the Cone Penetration Test", Canadian Geotechnical Journal, Volume 27.
3	Robertson, P.K. and Fear, C.E., 1998, "Evaluating cyclic liquefaction potential using the cone penetration test", Canadian Geotechnical Journal, 35: 442-459.
4	Robertson, P.K. and Wride, C.E., 1998, "Cyclic Liquefaction and its Evaluation Based on SPT and CPT", NCEER Workshop Paper, January 22, 1997
5	Lunne, T., Robertson, P.K. and Powell, J. J. M., 1997, " Cone Penetration Testing in Geotechnical Practice," Blackie Academic and Professional.
6	Plewes, H.D., Davies, M.P. and Jefferies, M.G., 1992, "CPT Based Screening Procedure for Evaluating Liquefaction Susceptibility", 45th Canadian Geotechnical Conference, Toronto, Ontario, October 1992.
7	Jefferies, M.G. and Davies, M.P., 1993. "Use of CPTu to Estimate equivalent N_{60}", Geotechnical Testing Journal, 16(4): 458-467.
8	Been, K. and Jefferies, M.P., 1985, "A state parameter for sands", Geotechnique, 35(2), 99-112.
9	Schmertmann, 1977, "Guidelines for Cone Penetration Test Performance and Design", Federal Highway Administration Report FHWA-TS-78-209, U.S. Department of Transportation
10	Proceedings of theNCEER Workshop on Evaluation of Liquefaction Resistance of Soils, Salt LakeCity, 1996. Chaired by Leslie Youd.

CONETEC

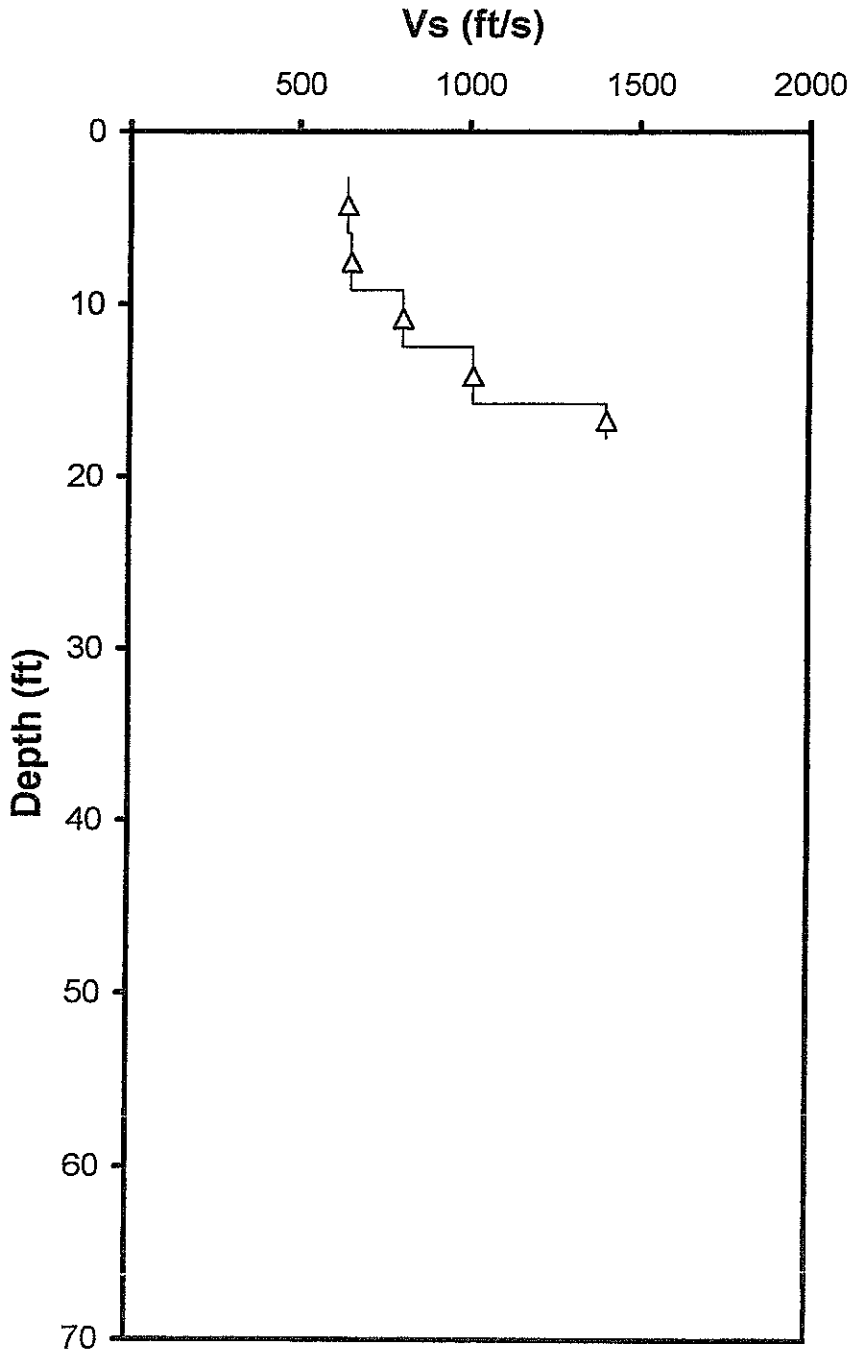
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-1
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	4.76	4.26	645
9.84	9.18	9.31	3.21	4.90	7.54	656
13.12	12.46	12.55	3.25	4.02	10.82	808
16.40	15.74	15.82	3.26	3.22	14.10	1013
18.37	17.71	17.78	1.96	1.40	16.73	1402

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-1
Date: October 31, 2007



CONETEC

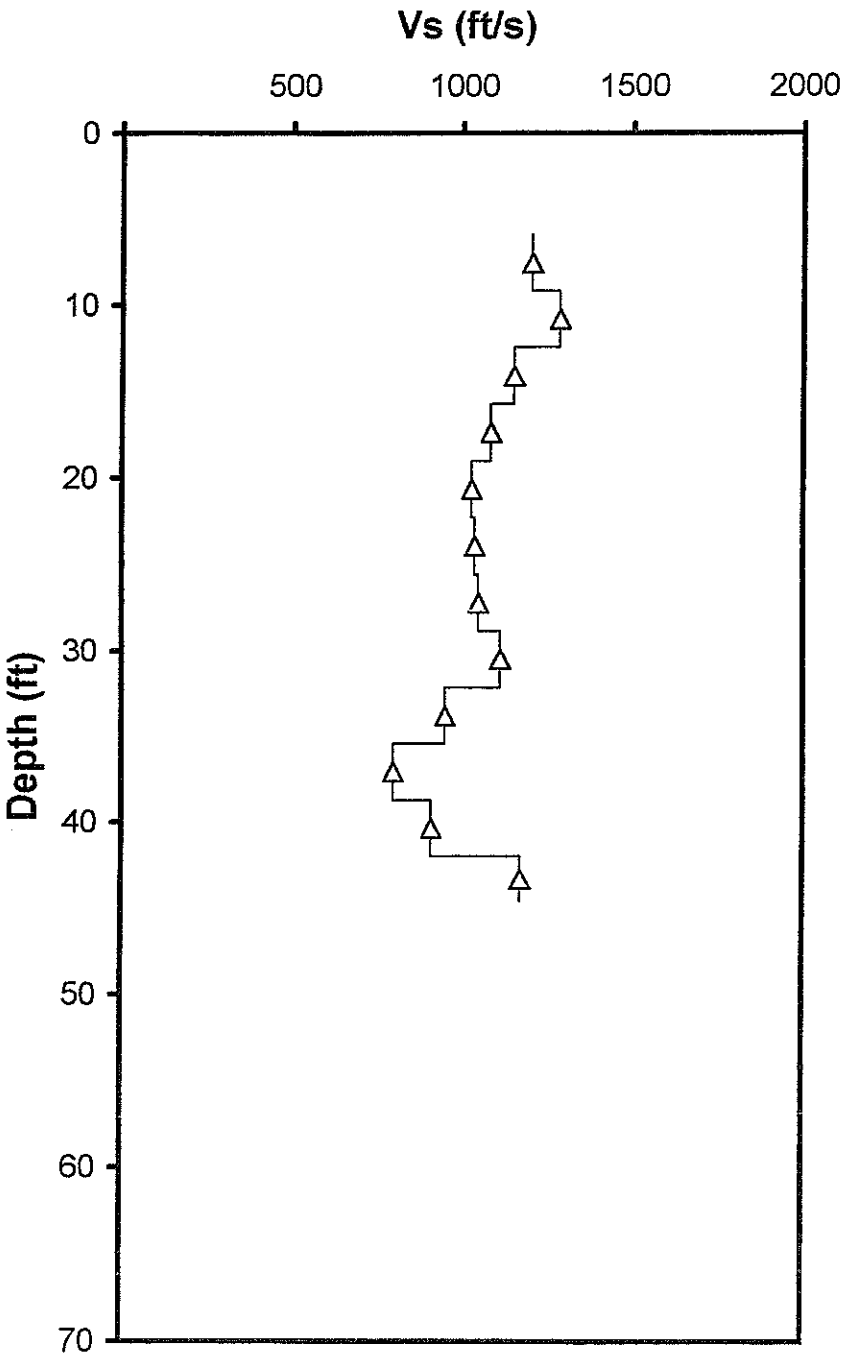
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-2
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	2.67	7.54	1204
13.12	12.46	12.55	3.25	2.53	10.82	1284
16.40	15.74	15.82	3.26	2.83	14.10	1152
19.69	19.03	19.09	3.28	3.02	17.39	1085
22.97	22.31	22.36	3.27	3.18	20.67	1029
26.25	25.59	25.64	3.27	3.15	23.95	1039
29.53	28.87	28.91	3.28	3.12	27.23	1050
32.81	32.15	32.19	3.28	2.94	30.51	1114
36.09	35.43	35.47	3.28	3.45	33.79	950
39.37	38.71	38.74	3.28	4.12	37.07	795
42.65	41.99	42.02	3.28	3.61	40.35	908
45.28	44.62	44.65	2.63	2.24	43.31	1173

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-2
Date: October 30, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-2A
Site	Williamson County, Illinois
Date	10/30/2007

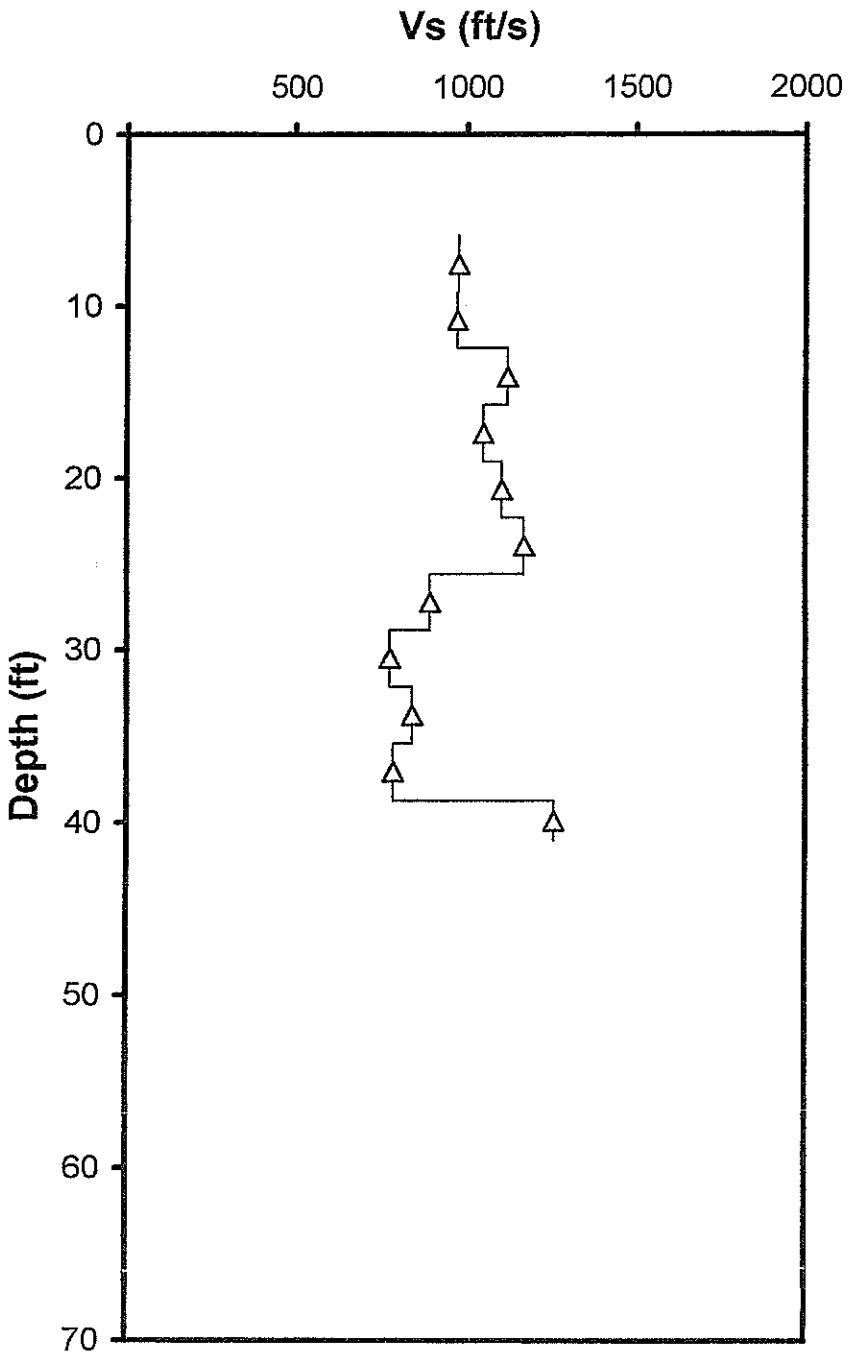
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	3.29	7.54	977
13.12	12.46	12.55	3.25	3.34	10.82	973
16.40	15.74	15.82	3.26	2.91	14.10	1121
19.69	19.03	19.09	3.28	3.12	17.39	1051
22.97	22.31	22.36	3.27	2.96	20.67	1105
26.25	25.59	25.64	3.27	2.80	23.95	1169
29.53	28.87	28.91	3.28	3.66	27.23	895
32.81	32.15	32.19	3.28	4.20	30.51	780
36.09	35.43	35.47	3.28	3.88	33.79	845
39.37	38.71	38.74	3.28	4.15	37.07	790
41.67	41.01	41.04	2.30	1.83	39.86	1256

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-2A
Date: October 30, 2007



CONETEC

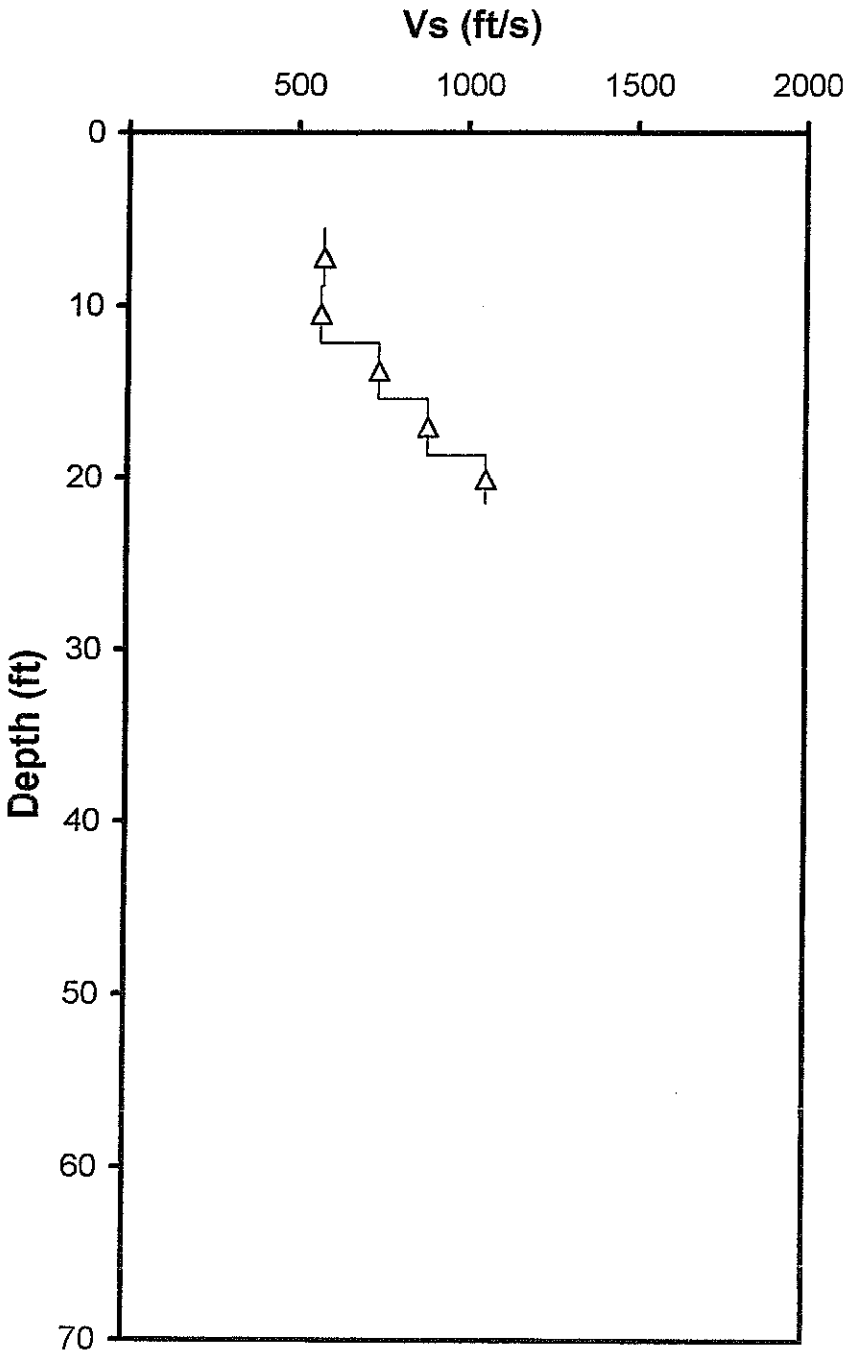
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-3
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.23	5.57	5.77				
9.51	8.85	8.98	3.21	5.56	7.21	577
12.80	12.14	12.24	3.26	5.72	10.50	569
16.08	15.42	15.50	3.26	4.42	13.78	738
19.36	18.70	18.76	3.27	3.70	17.06	883
22.15	21.49	21.55	2.78	2.63	20.10	1058

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-3
Date: October 31, 2007



CONETEC

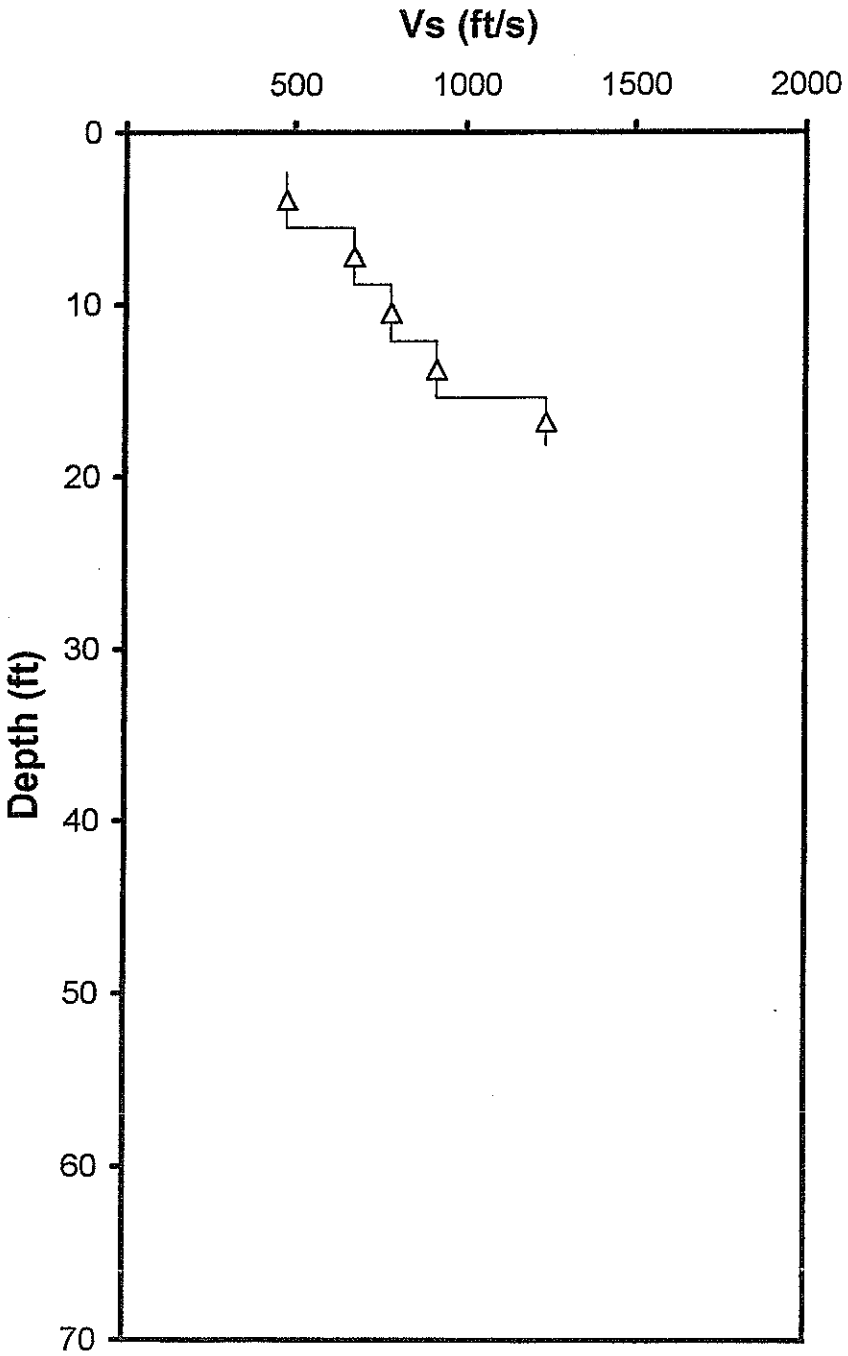
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-4
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
2.95	2.29	2.74				
6.23	5.57	5.77	3.03	6.37	3.93	476
9.51	8.85	8.98	3.21	4.77	7.21	673
12.80	12.14	12.24	3.26	4.17	10.50	781
16.08	15.42	15.50	3.26	3.57	13.78	913
18.86	18.20	18.27	2.77	2.23	16.81	1242

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-4
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-5
Site	Williamson County, Illinois
Date	10/30/2007

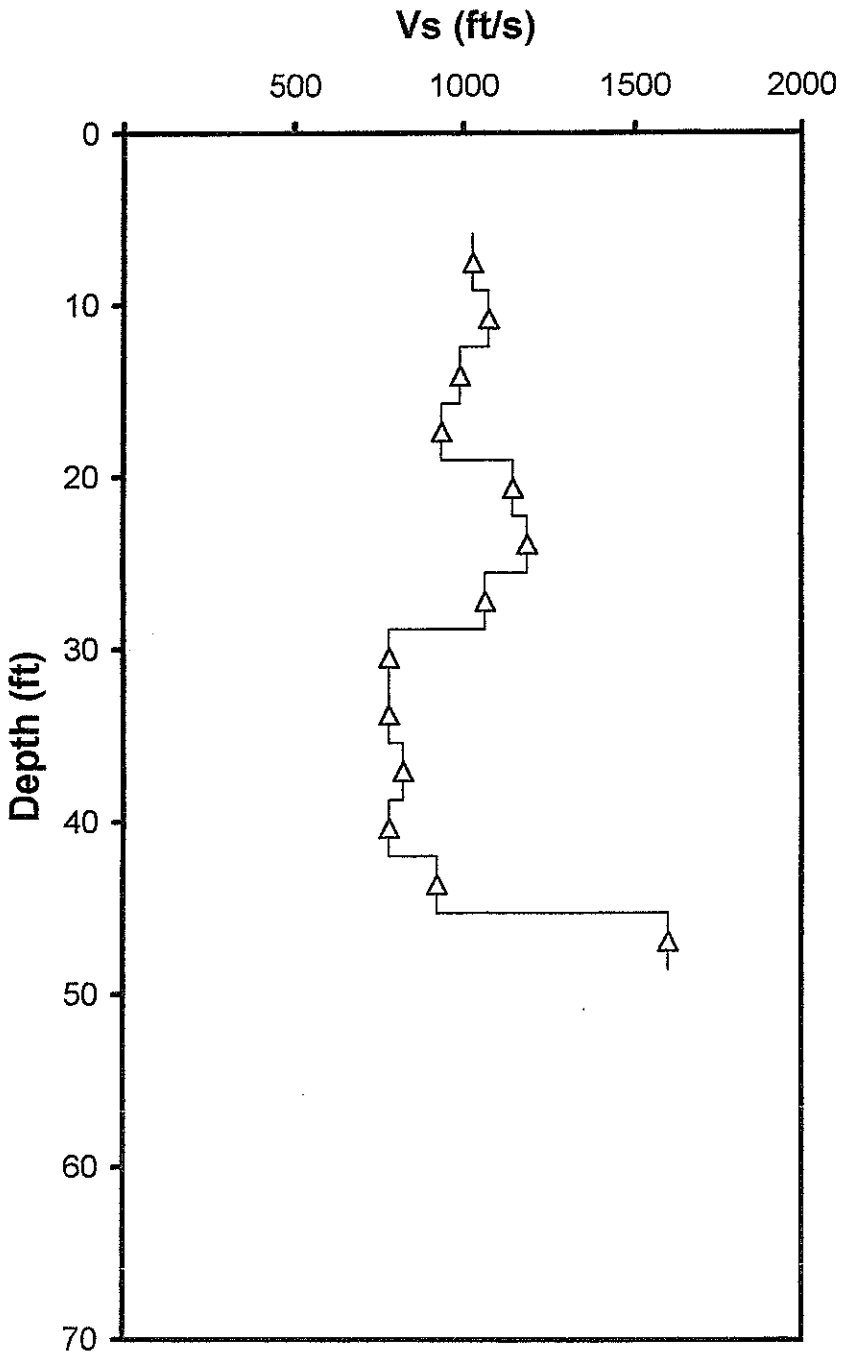
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	3.12	7.54	1030
13.12	12.46	12.55	3.25	3.02	10.82	1076
16.40	15.74	15.82	3.26	3.29	14.10	991
19.69	19.03	19.09	3.28	3.50	17.39	936
22.97	22.31	22.36	3.27	2.85	20.67	1148
26.25	25.59	25.64	3.27	2.75	23.95	1190
29.53	28.87	28.91	3.28	3.07	27.23	1067
32.81	32.15	32.19	3.28	4.20	30.51	780
36.09	35.43	35.47	3.28	4.20	33.79	780
39.37	38.71	38.74	3.28	3.99	37.07	821
42.65	41.99	42.02	3.28	4.20	40.35	780
45.93	45.27	45.30	3.28	3.55	43.63	923
49.21	48.55	48.58	3.28	2.05	46.91	1599

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-5
Date: October 30, 2007



CONETEC

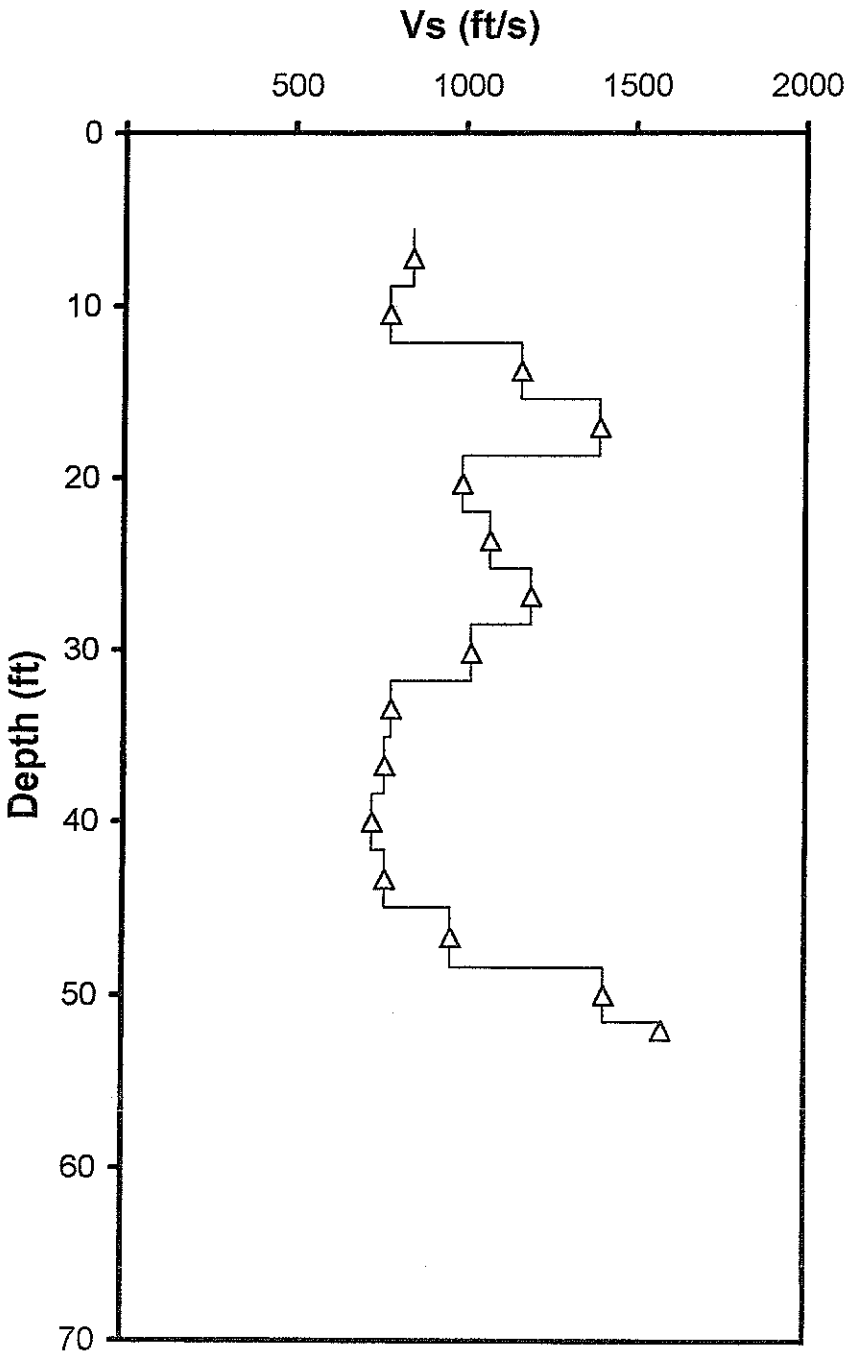
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-5A
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.23	5.57	5.77				
9.51	8.85	8.98	3.21	3.80	7.21	844
12.80	12.14	12.24	3.26	4.18	10.50	779
16.08	15.42	15.50	3.26	2.80	13.78	1164
19.36	18.70	18.76	3.27	2.34	17.06	1396
22.64	21.98	22.03	3.27	3.29	20.34	994
25.92	25.26	25.31	3.27	3.04	23.62	1077
29.20	28.54	28.58	3.27	2.74	26.90	1195
32.48	31.82	31.86	3.28	3.21	30.18	1021
35.76	35.10	35.14	3.28	4.18	33.46	784
39.04	38.38	38.41	3.28	4.29	36.74	764
42.32	41.66	41.69	3.28	4.50	40.02	728
45.60	44.94	44.97	3.28	4.27	43.30	768
49.05	48.39	48.42	3.45	3.59	46.67	961
52.17	51.51	51.54	3.12	2.21	49.95	1411
53.15	52.49	52.52	0.98	0.62	52.00	1580

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-5A
Date: October 30, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-5B
Site	Williamson County, Illinois
Date	10/30/2007

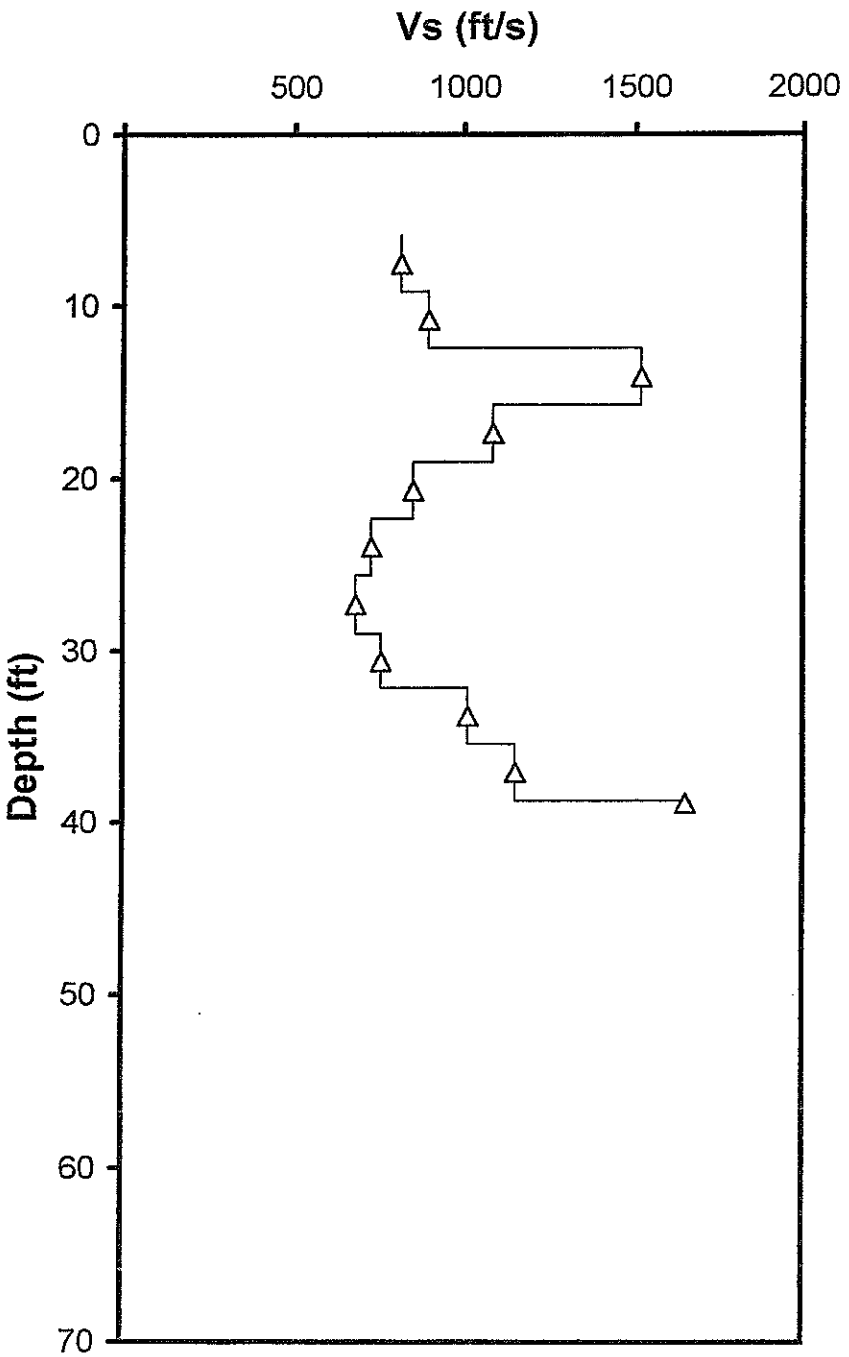
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	3.93	7.54	818
13.12	12.46	12.55	3.25	3.61	10.82	900
16.40	15.74	15.82	3.26	2.15	14.10	1517
19.69	19.03	19.09	3.28	3.02	17.39	1085
22.97	22.31	22.36	3.27	3.82	20.67	856
26.25	25.59	25.64	3.27	4.47	23.95	732
29.69	29.03	29.07	3.43	5.01	27.31	686
32.81	32.15	32.19	3.12	4.09	30.59	762
36.09	35.43	35.47	3.28	3.23	33.79	1014
39.37	38.71	38.74	3.28	2.85	37.07	1150
39.70	39.04	39.07	0.33	0.20	38.88	1649

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-5B
Date: October 30, 2007



CONETEC

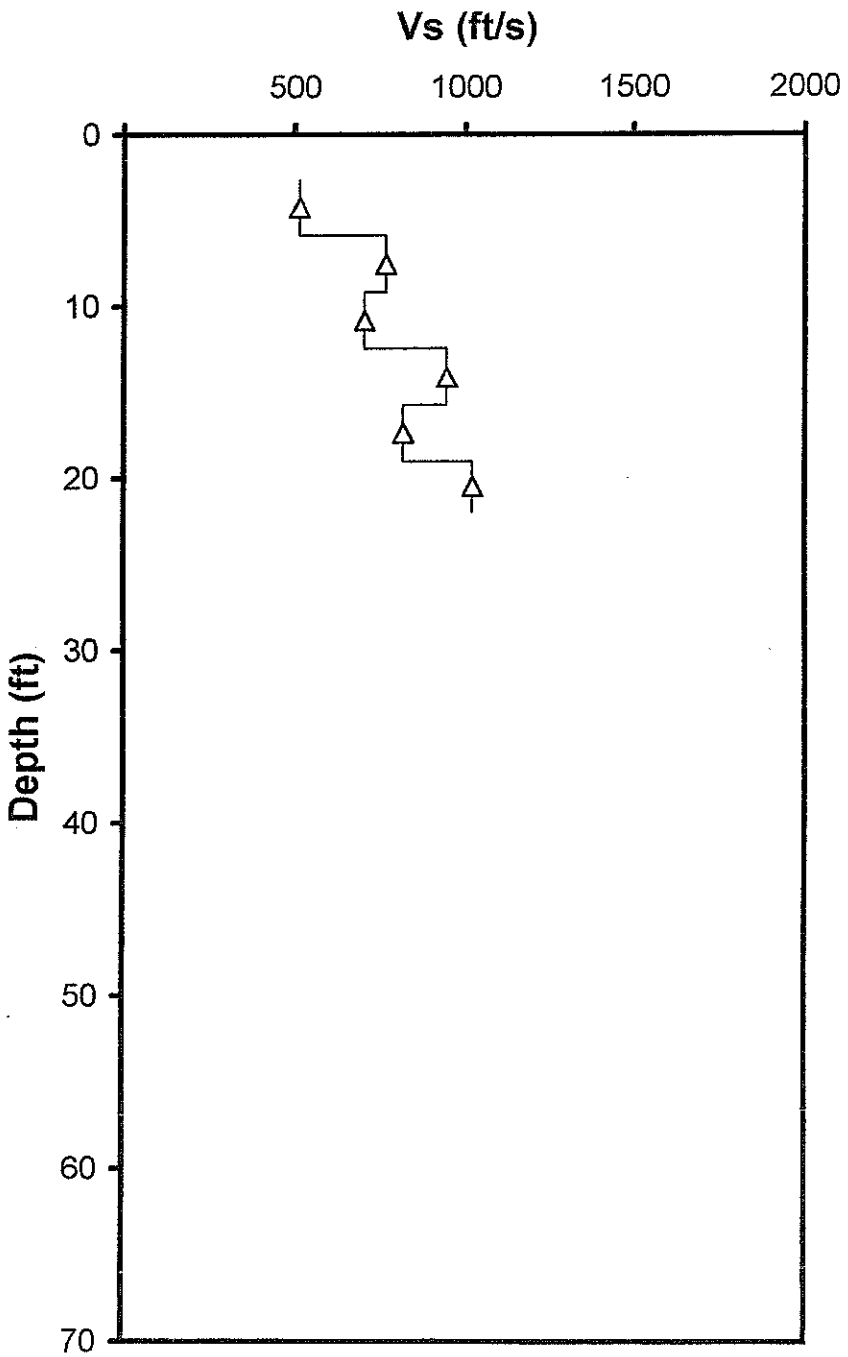
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-6
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	5.97	4.26	514
9.84	9.18	9.31	3.21	4.18	7.54	769
13.12	12.46	12.55	3.25	4.60	10.82	706
16.40	15.74	15.82	3.26	3.45	14.10	945
19.69	19.03	19.09	3.28	4.00	17.39	819
22.64	21.98	22.03	2.94	2.88	20.51	1022

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-6
Date: October 31, 2007



CONETEC

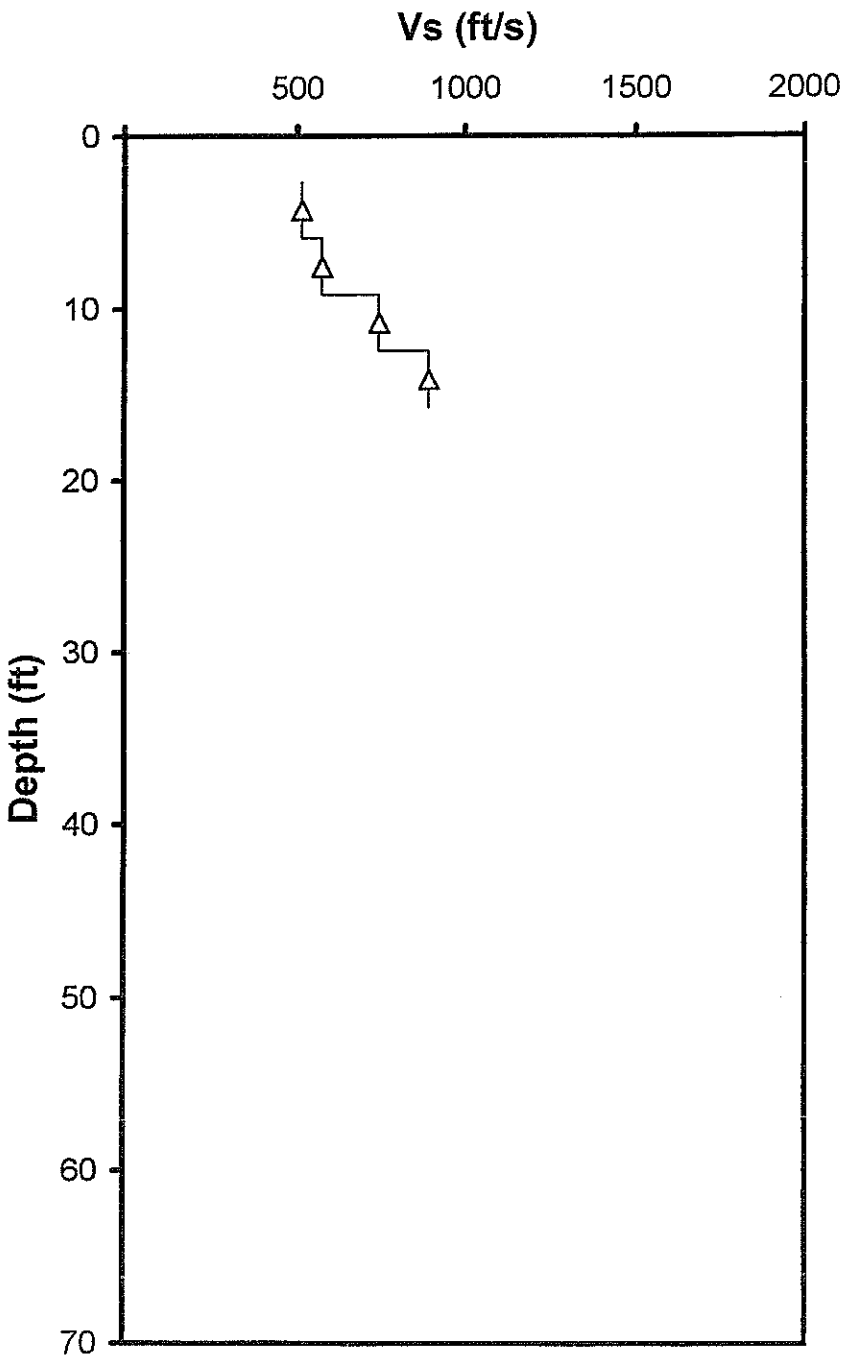
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-7
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	5.97	4.26	514
9.84	9.18	9.31	3.21	5.59	7.54	575
13.12	12.46	12.55	3.25	4.36	10.82	745
16.40	15.74	15.82	3.26	3.65	14.10	894

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-7
Date: October 31, 2007



CONETEC

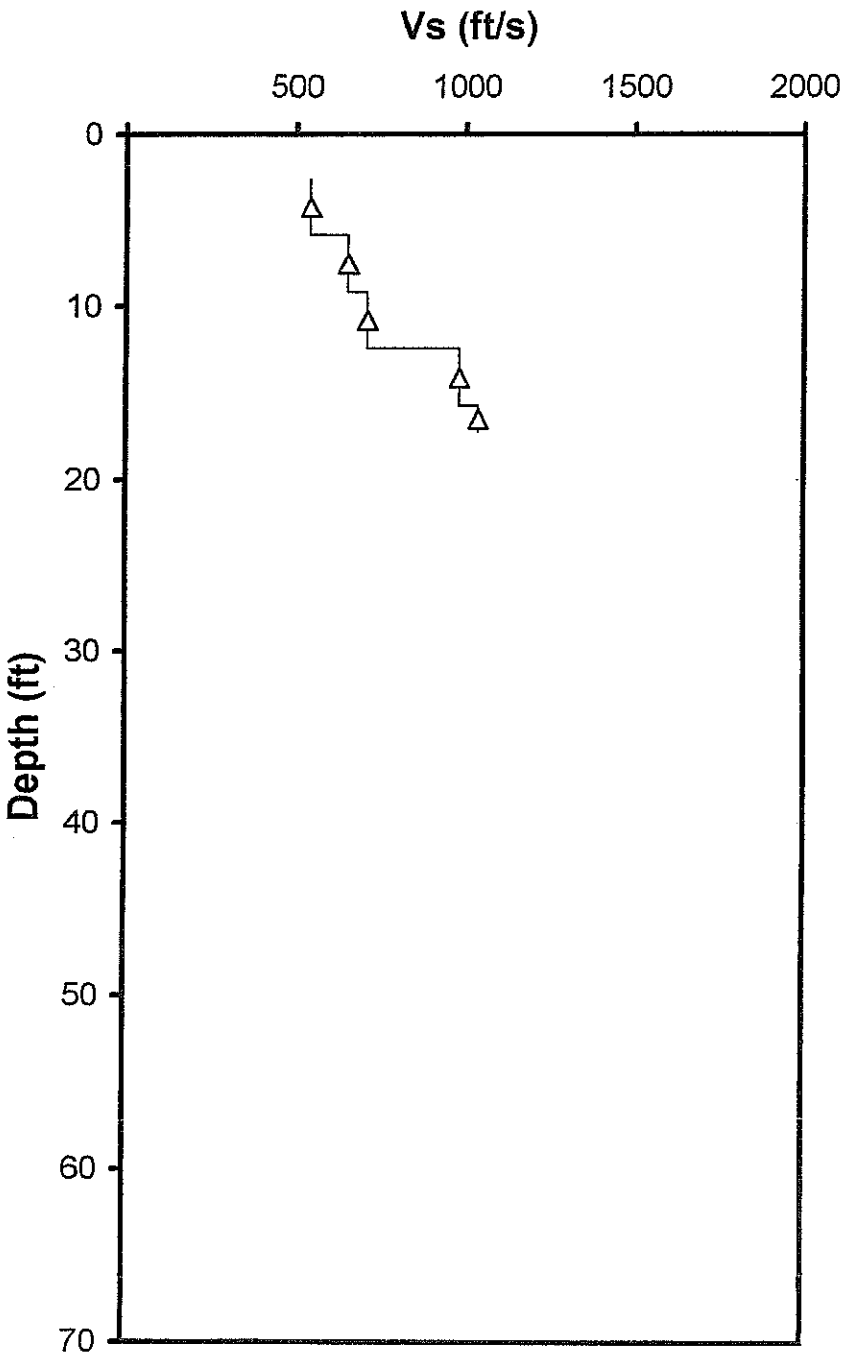
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-8
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	5.67	4.26	541
9.84	9.18	9.31	3.21	4.93	7.54	652
13.12	12.46	12.55	3.25	4.59	10.82	708
16.40	15.74	15.82	3.26	3.33	14.10	979
17.88	17.22	17.29	1.47	1.42	16.48	1038

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-8
Date: October 31, 2007



CONETEC

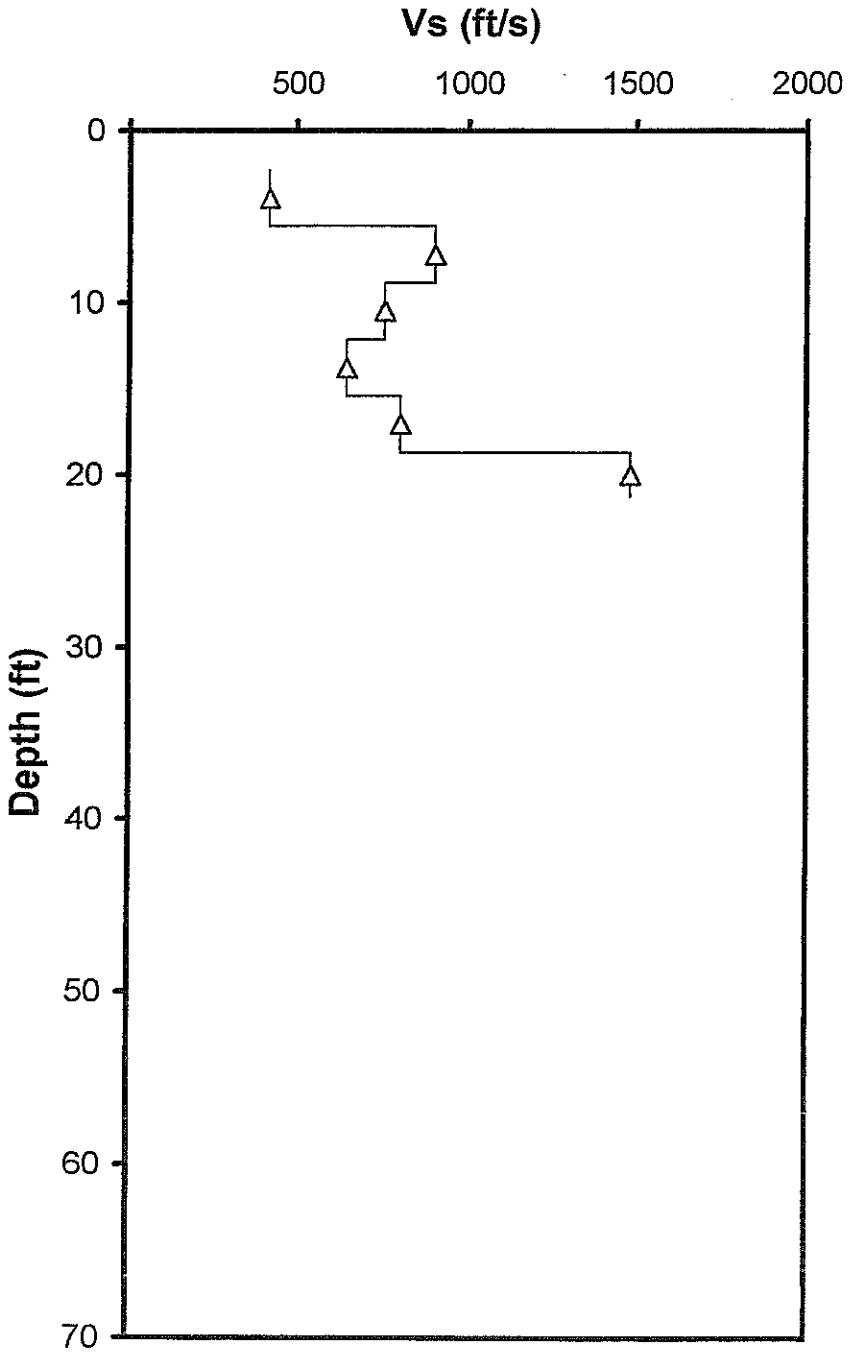
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-9
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
2.95	2.29	2.74				
6.23	5.57	5.77	3.03	7.30	3.93	415
9.51	8.85	8.98	3.21	3.55	7.21	904
12.80	12.14	12.24	3.26	4.30	10.50	757
16.08	15.42	15.50	3.26	5.04	13.78	647
19.36	18.70	18.76	3.27	4.06	17.06	805
21.98	21.32	21.38	2.61	1.76	20.01	1484

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-9
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-10
Site	Williamson County, Illinois
Date	10/31/2007

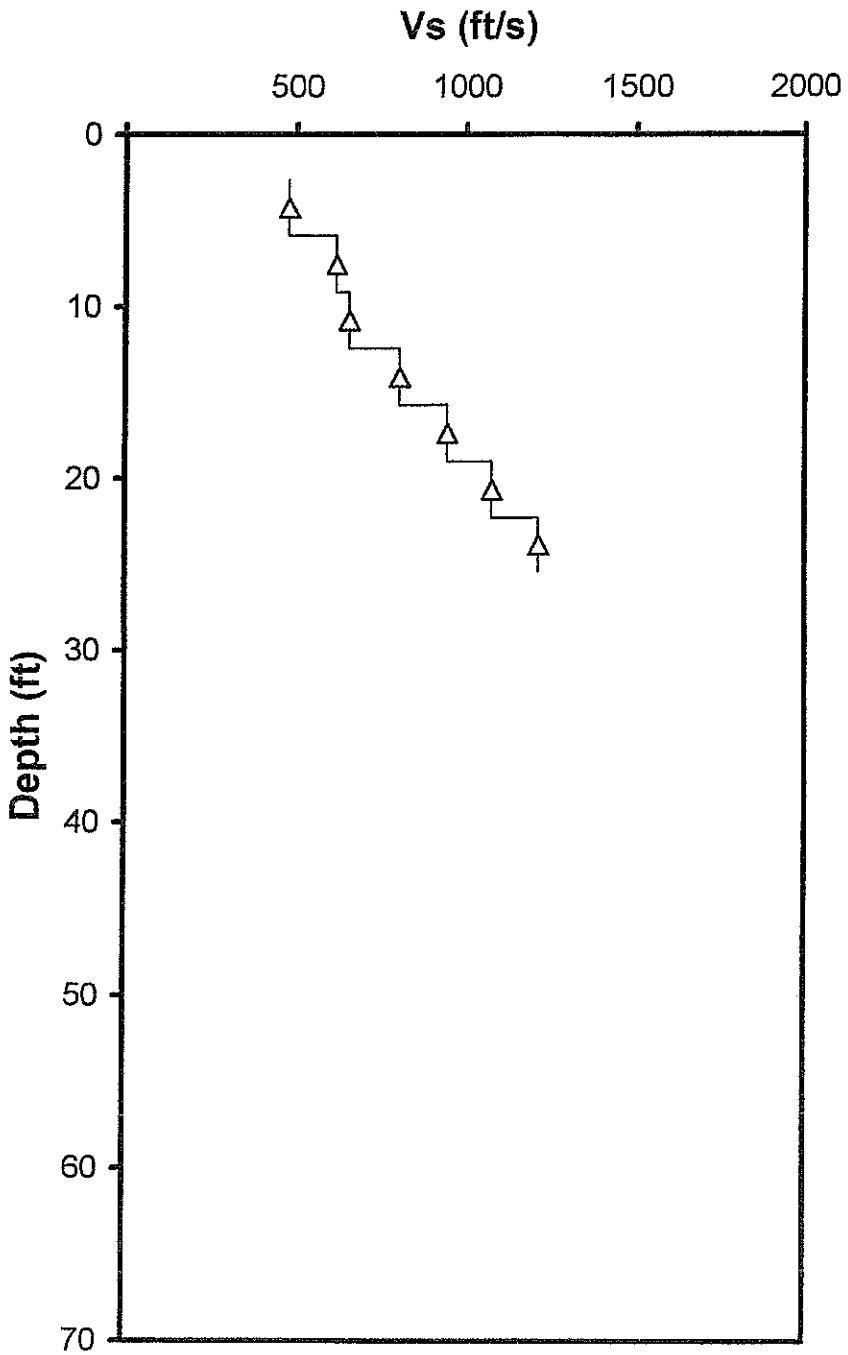
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	6.42	4.26	478
9.84	9.18	9.31	3.21	5.21	7.54	617
13.12	12.46	12.55	3.25	4.95	10.82	656
16.40	15.74	15.82	3.26	4.06	14.10	803
19.69	19.03	19.09	3.28	3.47	17.39	945
22.97	22.31	22.36	3.27	3.03	20.67	1080
26.08	25.42	25.47	3.10	2.55	23.87	1217

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-10
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-11
Site	Williamson County, Illinois
Date	10/31/2007

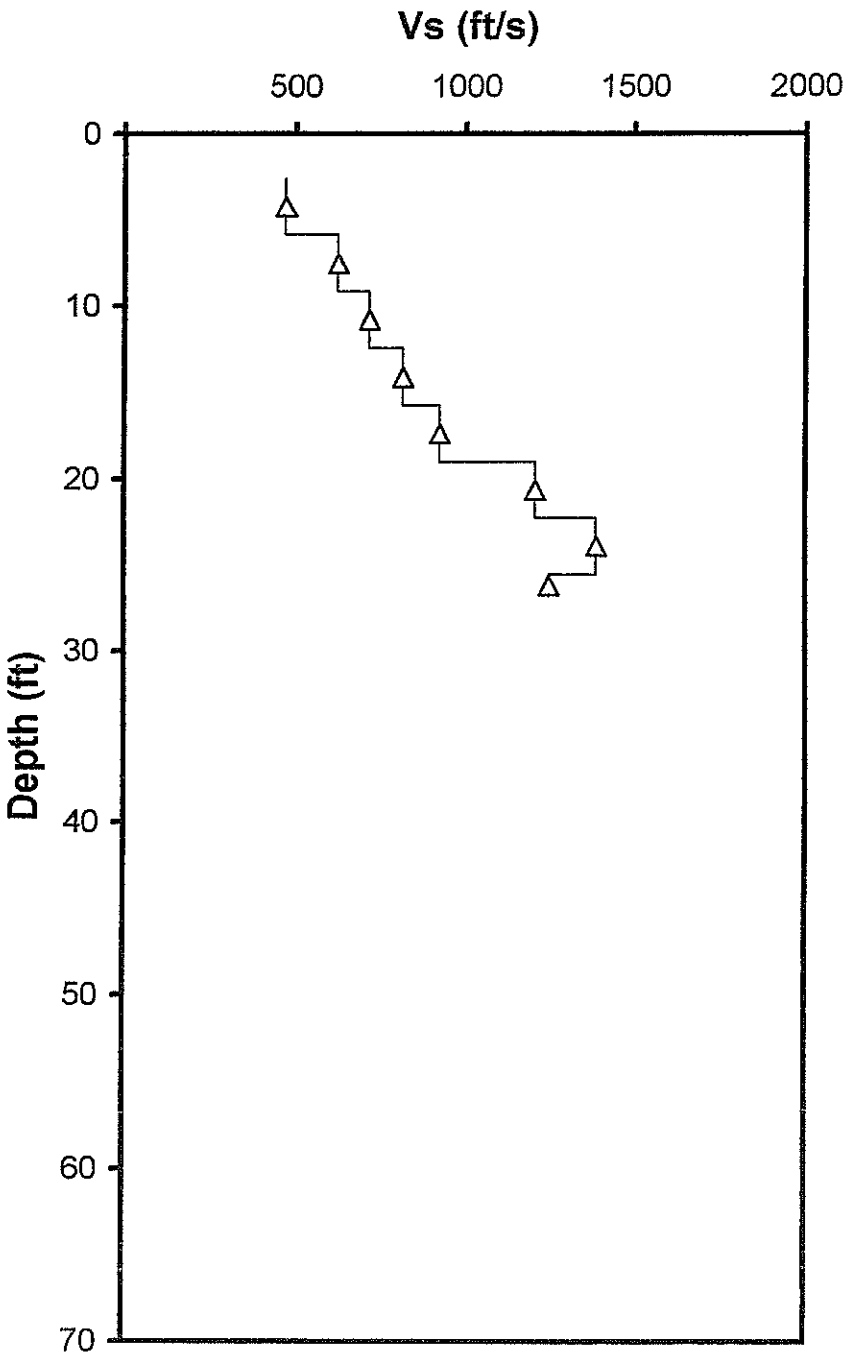
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	6.51	4.26	471
9.84	9.18	9.31	3.21	5.12	7.54	628
13.12	12.46	12.55	3.25	4.52	10.82	719
16.40	15.74	15.82	3.26	3.99	14.10	817
19.69	19.03	19.09	3.28	3.54	17.39	926
22.97	22.31	22.36	3.27	2.71	20.67	1207
26.25	25.59	25.64	3.27	2.36	23.95	1387
27.56	26.90	26.95	1.31	1.05	26.25	1246

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-11
Date: October 31, 2007



CONETEC

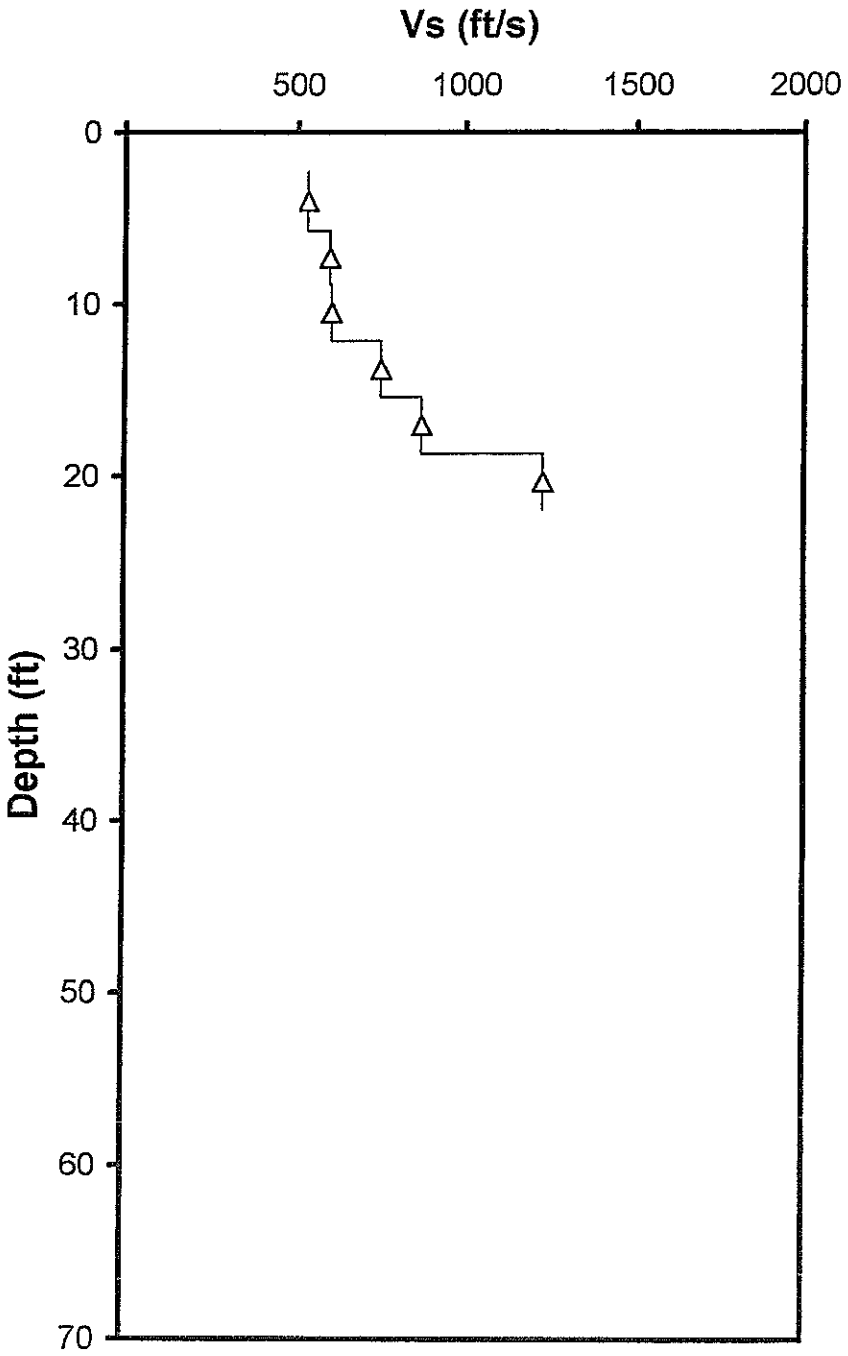
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-12
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
2.95	2.29	2.74				
6.40	5.74	5.94	3.20	6.03	4.02	530
9.51	8.85	8.98	3.04	5.11	7.30	596
12.80	12.14	12.24	3.26	5.42	10.50	601
16.08	15.42	15.50	3.26	4.36	13.78	748
19.36	18.70	18.76	3.27	3.75	17.06	871
22.64	21.98	22.03	3.27	2.66	20.34	1230

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-12
Date: October 31, 2007



No Dissipation Tests were performed

ConeTec Digital File Formats

CPT Data Files (COR Extension)

ConeTec CPT data files are named such that the first 3 characters contain the job number, the next two characters are CP followed by two characters indicating the sounding number. The last DOS character position is reserved for the letters a, b, c, d etc to uniquely identify multiple soundings at the same location. The CPT sounding file has the extensions COR, and pore pressure dissipation files have the extension PPD. As an example, for job number 99-127 the first sounding will have file names 127CP01.COR and 127CP01.PPD.

The CPT (COR) file consists of the following components:

1. Two lines of header information
2. Data records
3. End of data marker
4. Units information

Header Lines

Line 1: Columns 1-6 are blank (future use)
Columns 7-21 contain the sounding Date and Time
Columns 22-36 contain the sounding Operator

Line 2: Columns 1-16 contain the Job Location
Columns 17-31 contain the Cone ID
Columns 32-47 contain the sounding number

Data Records

The data records contain 4 or more columns of data in floating point format. A comma (and spaces) separates each data item:

Column 1: Sounding Depth (meters)
Column 2: Tip (q_c) data uncorrected for pore pressure effects. Recorded in units selected by the operator.
Column 3. Sleeve (f_s) data. Recorded in units selected by the operator
Column 4: Dynamic pore pressure readings. Recorded in units selected by the operator
Column 5: UVIF Data. See UVIF section.

End of Data Marker

After the last line of data a line containing ASCII 26 (CTL-Z) and a newline (carriage return/ line feed) character. This is used to mark the end of data.

Units Information

The last section of the file contains information about the units that were selected for the sounding. A separator bar makes up the first line. The second line contains the type of units used for depth, q_c, f_s and u. The third line contains the conversion values required for ConeTec's software to convert the recorded data to an internal set of base units (bar for q_c, bar for f_s and meters for u).

CPT Dissipation Files (PPD Extension)

CPT Dissipation files have the same naming convention as the CPT sounding files and have the extension PPD. PPD files consist of the following components:

1. Two lines of header information
2. Data records

Header Lines (same as COR file):

Line 1: Columns 1-6 are blank (future use)
Columns 7-21 contain the sounding Date and Time
Columns 22-36 contain the sounding Operator

Line 2: Columns 1-16 contain the Job Location
Columns 17-31 contain the Cone ID
Columns 32-47 contain the sounding number

Data Records

The data records immediately follow the header lines. Each data record can occupy several lines in the file and is a complete record of a dissipation test at a particular depth. Each data record starts with a line containing two values separated by spaces; the first value being an index number (not currently used by the Software) and the second being the dissipation test depth in meters. Following this line are the dissipation pore pressure values stored at 5 second intervals with a maximum of 12 entries per line. The last line of the dissipation record may not contain a full 12 entries. The data record is terminated with an ASCII 30 character (appears as a triangle in some editors).

This sequence is repeated for every dissipation test in the sounding. No marker is used to indicate end of file. Units information is not stored in this file. Users would have to check the CPT file for the units that were used.

CPT Basic Interpretations (TBL Extension)

ConeTec's basic CPT interpretation output files are generally delivered in text files with a TBL extension. The root file name is the same as the COR files. A number of calculated geotechnical parameters are presented in these files. The files are stored as ASCII text files that can be viewed using any text editor such as Notepad or Wordpad. The files do not contain any page formatting. These files are not distributed if the enhanced interpretation files are provided.

CPT Enhanced Interpretations (NLI, NLP, XLS Extension)

ConeTec's enhanced CPT interpretation output files are delivered in several formats, each file type containing the exact same information but formatted slightly differently. The files typically have any of the following file extensions:

1. NLI — an importable TAB delimited ASCII text file containing approximately 36 data columns of geotechnical interpretations. The file is designed for easy import to Excel. A companion document describes the techniques used for the interpretations (usually reproduced at the beginning of the Interpretation Appendix). Text editors can be used to view the file contents, however, they may remove the tabs or replace the tabs with spaces upon saving the file destroying the feature that makes them easy to import into Excel.

2. NLP — a printable ASCII text file containing the same 36 columns of geotechnical interpretations as the NLI file. This file type has been formatted as a multi-page document with up to 132 characters per line and up to 68 lines per page. Each page has been separated into multiple sections to accommodate all the data fields. Each physical page has a header section and a page/section number. The file is designed for direct printing to laser printers set into compressed font mode. This output is typically provided in the Interpretation Appendix.

3. XLS — an Excel format file that has been generated directly from the corresponding NLI file.

In each case root file name is the same as the COR files.

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Part 8
R15682

APPENDIX A-3

NORMALIZED PS-CPT DATA AND PARAMETER CORRELATIONS

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 1 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

CALCULATION BRIEF FOR NORMALIZED PS-CPT DATA AND PARAMETER CORRELATIONS

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE:

Use data recorded during the piezo-seismic cone penetration testing (PS-CPT) at the Williamson Energy, Pond Creek Coal Refuse Disposal facility located in Williamson County, Illinois to correlate various index and strength properties. Also, nearly continuous profiles with depth of various applicable engineering properties of the refuse and subgrade soil materials in the fifteen (15) soundings tested at the Pond Creek facility are tabulated and attached.

REFERENCES:

1. Bowles, Joseph E. (1984) "Physical and Geotechnical Properties of Soils," Mc-Graw Hill. New York: 367-369 and 393-396.

2. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Piezo-Cone Penetration Testing," Pond Creek Coal Refuse Disposal Site, BEG, dated 12/21/07.

3. ConeTec, Inc. (2007), Field Report Entitled "Presentation of CPTU Test Results for: Pond Creek Mine – Williamson County, Illinois, December 10, 2007.

4. Robertson, P.K (1998), "Applications Guide – CPT" **Fax**

5. Robertson, P.K., et.al. (1992) "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE 109 (11): 1449-1459.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 2 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

6. Robertson, P.K and Campanella, R.G, (1989), "Guidelines for Geotechnical Design Using CPT and CPTU", UBC Soil Mechanics Series No. 120, Civil Eng. Dept., Vancouver, B.C., Canada

7. Robertson, P.K and Campanella, R.G, (1983), "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE Vol. 109 No. 11, pp. 1449-1459.

8. Civil and Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak Undrained Shear Strength for Refuse and Subgrade Materials," Pond Creek Coal Refusal Site, BEG 12/28/07.

METHODOLOGY:

Using laboratory-derived unit weights for the coarse coal refuse and residual soil layers, provided by Alliance Consulting, Inc. (Alliance), the following parameters are correlated based on established CPT correlations (References 2, 3, 4, 5, 6 and 7) and the data collected during the Pond Creek Piezo-Seismic Cone Penetration Testing subsurface investigation (Ref. 2):

- Total stress (σ_v)
- Effective stress (σ_{vo}')
- Pore pressure (U_{eq})
- SPT N_{60} correction factor (C_n)
- SPT blow counts at 60% energy (N_{60})
- N_{60} corrected for overburden ($(N_1)_{60}$)
- Corrected tip resistance (q_c)
- Fines content (F_c)
- Effective friction angle (ϕ)
- Soil Behavior Index (I_c)

Undrained shear strength (S_u) was also correlated, and is discussed separately in the calculation brief entitled Estimation and Summary of Engineering Properties Including Peak Undrained Shear Strength for Refuse and Subgrade Materials," (Reference 8).

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 3 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY RJ DATE 1/23/08

ANALYSIS:

ConeTec, Inc. (ConeTec) performed the PS-CPT and correlated the above noted parameters based on various unit weights that were correlated directly from the Soil Behavior Type (SBT) (Robertson and Campanella, 1989). The unit weights used by ConeTec were based on data interpolation and thus require modification to reflect the laboratory derived unit weights of the coarse refuse and residual soil, which were provided by Alliance. Therefore, laboratory-derived unit weight for each of the layers was used to correlate the applicable parameters, particularly total and effective stresses, which are used throughout the calculations.

PSCPT correlations were based on much of the work described by Robertson and Campanella (1998, 1992, 1989, 1988, 1983). During field testing, ConeTec measured four parameters insitu, which were not correlated. They include the recorded tip resistance (AvgQt), the recorded side friction (AvgFs), the recorded friction ratio (AvgRf) and the pore pressure generated by the CPT probe (AvgUd), all of which were used in subsequent correlations. The soil behavior type (SBT) was also determined by the ConeTec, and was based on observations and readings of the four parameters just listed.

The following paragraphs briefly describe the parameters as well as providing a definition of the parameter and any additional calculations needed: Total stress and effective stress are both used in many of the correlations, and are related to each other by the presence of water in the form of pore water pressure. Total stress was defined as:

$$\sigma_v = (\gamma * H) / 2000 \text{ (lb/ton)}$$

where: σ_v = total stress (tsf)
γ = unit weight (pcf)
H = depth of the sample (ft)

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 4 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

Pore pressure is defined as:

$$U_{eq} = (\gamma_w * H) / 2000 \text{ (lb/ton)}$$

where: U_{eq} = pore pressure (tsf)
γ_w = unit weight of water (pcf)
= 62.5 pcf
H = depth of the sample (ft)

The difference between the two determines the effective stress:

$$\sigma_{vo}' = \sigma_v - U_{eq}$$

where: U_{eq} = pore pressure (tsf)
σ_v = total stress (tsf)

The PS-CPT sampler correlated the number of blows per foot, without the overburden correction, to the tip resistance measured as the probe was advanced. This gave measurements of N_{60} every 0.2 meters. Corrected for overburden, the measured tip resistance was then calculated:

$$q_c = \text{AvgQt} - (1 - 0.85) * U$$

where: AvgQt = measured tip resistance (tsf)
0.85 = area ratio of the PS-CPT probe
U = measured pore pressure (tsf)

This corrected tip resistance (q_c) was used along with the soil behavior type index (Ic) and atmospheric pressure to give the recorded N_{60} value by the equation:

$$N_{60} = (q_c / Pa) / 8.5 * (1 - (Ic / 4.6))$$

where: q_c = corrected tip resistance (tsf)
Pa = atmospheric pressure (tsf)
= 1.058 tsf
Ic = soil behavior type index (dim)

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 5 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

and: $Ic = ((3.47 - \text{Log}_{10}(Q))^2 + (\text{Log}_{10}(F) + 1.22)^2)^{0.5}$

where: Q = normalized cone penetration resistance (dim)
F = normalized friction ratio (pct)

and: $Q = (q_c - \sigma_v) / \sigma_{vo}'$

where: q_c = corrected tip resistance (tsf)
σ_v = total stress = (γ * H) / 2000(lb/ton) (tsf)
σ_{vo}' = vertical effective overburden (tsf)

and: $F = 100\% * \text{AvgFs} / (q_c - \sigma_{vo}')$

where: AvgFs= recorded side friction (tsf)
q_c = corrected tip resistance (tsf)
σ_{vo}' = vertical effective overburden (tsf)

Once N_{60} and σ_{vo}' had been calculated, a correction factor (Cn) was applied to N_{60} to give $(N_1)_{60}$:

$(N_1)_{60} = N_{60} * Cn$

where N_{60} = Number of blows/foot to advance 1.5 feet
Cn = $(\sigma_{vo}')^{-0.5}$ (dim)

Using tip resistance, corrected for overburden, and effective overburden the effective friction of the material in the Pond Creek facility could be calculated (Robertson, 1989). This was done using the following calculation:

$$\phi' = \tan^{-1}[(1/2.68) * (\text{Log}_{10}(q_c / \sigma_{vo}') + 0.29)]$$

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 6 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

where: q_c = corrected tip resistance (tsf)
σ_{vo}' = effective vertical stress (tsf)

Similarly, the fines content was correlated from PS-CPT data but was not used in any further analysis. The fines content was correlated using the soil behavior type index, I_c, as defined above. To determine the fines content of the material, the following relationship was used:

$$F_c = (1.75 * I_c^{3.25} - 3.7)$$

where: F_c = fines content (%)
I_c = soil behavior type index (dim)

RESULTS:

The results of the correlations between PS-CPT data recorded during field testing yield a profile of geotechnical parameters at the 15 sounding locations tested at the Pond Creek facility. Effective and total stresses provide an indication of the stresses being experienced insitu, and generally will increase as material is placed on top of the existing materials to the lines and grades of the proposed final geometry.

In-situ effective friction values were correlated using in-situ corrected tip resistance and effective overburden pressures for the 15 soundings tested at the Pond Creek facility.

CONCLUSIONS:

Summarizing, data recorded during PS-CPT field testing was used to correlate index and strength parameters for comparison to limited laboratory testing at discrete sample locations and to develop nearly continuous profile(s) of engineering properties with depth to model the variability of the insitu conditions at the Pond Creek facility.

Based on modified results, the correlated parameters from PS-CPT are generally consistent with each other and similar parameters determined from similar materials at other refuse facilities, and from laboratory testing of discrete samples. Therefore, in general, a reasonably high confidence level exists applying/using the results of the PS-CPT correlations to the 15 profiles shown in the attached tables.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 7 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-1

ConeTec Inc. Interpretation
Interpretation - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4622
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-1
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 13:23
CPT File: 804CP01.COR
Northing (m): 0.000000
Easting (m): 0.000000
Elevation (m): 482.2

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	41.95	2.43	78.91	26.81	2.38

User Inputs:
Assumed: Water Table Depth (ft): 15.3
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 482.2
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.026	16.61	0.44	2.66	0.11	1619.49	2.651	1.66	1619.49	2.65	5	125.00	0.010	0.010	0.000	2.000	2.89	5.79	0.514	16.61	5.45572	52.56
0.492	481.698	45.67	1.03	2.25	4.37	1484.2	2.257	1.60	1483.55	2.26	6	125.00	0.031	0.031	0.000	2.000	7.79	15.57	1.413	45.65	4.391	52.25
0.82	481.370	44.31	1.6	3.61	-3.26	863.585	3.615	1.86	863.98	3.61	5	125.00	0.051	0.051	0.000	2.000	8.26	16.52	1.370	44.33	9.36475	50.29
1.148	481.042	49.34	1.93	3.91	-6.42	686.666	3.917	1.92	687.22	3.91	5	125.00	0.072	0.072	0.000	2.000	9.42	18.84	1.525	49.38	10.8792	49.41
1.476	480.714	50.64	2.12	4.19	-7.64	547.943	4.194	1.98	548.49	4.19	5	125.00	0.092	0.092	0.000	2.000	9.90	19.80	1.565	50.69	12.4636	48.51
1.804	480.386	45.45	2.14	4.71	-0.65	402.104	4.720	2.08	402.10	4.72	4	125.00	0.113	0.113	0.000	2.000	9.23	18.46	1.404	45.45	15.2837	47.21
2.133	480.057	40.4	1.81	4.48	3.83	302.047	4.495	2.12	301.82	4.50	4	125.00	0.133	0.133	0.000	2.000	8.32	16.64	1.247	40.37	16.3803	45.96
2.461	479.729	34.96	1.32	3.78	8.22	226.29	3.792	2.12	225.96	3.80	5	125.00	0.154	0.154	0.000	2.000	7.19	14.38	1.078	34.91	16.3424	44.63
2.789	479.401	31.18	1.1	3.52	11.83	177.874	3.548	2.15	177.47	3.56	5	125.00	0.174	0.174	0.000	2.000	6.50	12.99	0.960	31.11	17.3915	43.48
3.117	479.073	29.29	1.15	3.92	14.97	149.35	3.953	2.23	148.89	3.96	5	125.00	0.195	0.195	0.000	2.000	6.31	12.62	0.901	29.2	20.1364	42.62
3.445	478.745	29.06	1.09	3.74	29.44	133.967	3.779	2.25	133.13	3.80	5	125.00	0.215	0.215	0.000	2.000	6.28	12.55	0.893	28.88	20.6255	42.05
3.773	478.417	32.91	1.15	3.49	32.84	138.56	3.520	2.21	137.67	3.54	5	125.00	0.236	0.236	0.000	2.000	7.01	14.02	1.012	32.7	19.4713	42.22
4.101	478.089	34.84	1.39	4	29.66	134.928	4.019	2.27	134.19	4.04	5	125.00	0.256	0.256	0.000	1.975	7.59	15.00	1.071	34.65	21.3078	42.09
4.429	477.761	35.38	1.49	4.22	29.72	126.812	4.245	2.30	126.16	4.27	4	125.00	0.277	0.277	0.000	1.901	7.83	14.88	1.087	35.2	22.5787	41.78
4.757	477.433	34.51	1.53	4.44	31.68	115.073	4.472	2.35	114.40	4.50	4	125.00	0.297	0.297	0.000	1.834	7.78	14.27	1.059	34.31	24.2407	41.27
5.085	477.105	32.05	1.52	4.75	32.73	99.8456	4.790	2.41	99.18	4.82	4	125.00	0.318	0.318	0.000	1.774	7.42	13.17	0.982	31.84	26.6972	40.52
5.413	476.777	33.07	1.53	4.62	33.55	96.7499	4.674	2.41	96.13	4.70	4	125.00	0.338	0.338	0.000	1.719	7.66	13.17	1.013	32.86	26.6937	40.36
5.741	476.449	28.11	1.63	5.81	25.35	77.3418	5.874	2.54	76.90	5.91	3	125.00	0.359	0.359	0.000	1.669	6.95	11.61	0.859	27.95	32.7178	39.15
6.069	476.121	23.82	1.72	7.24	8.62	61.7978	7.338	2.68	61.67	7.35	3	125.00	0.379	0.379	0.000	1.624	6.33	10.27	0.726	23.77	39.3343	37.91
6.398	475.792	23.35	1.75	7.49	4.73	57.3932	7.625	2.71	57.32	7.64	3	125.00	0.400	0.400	0.000	1.581	6.31	9.98	0.711	23.32	41.0639	37.49
6.726	475.464	25.01	1.76	7.04	4.71	58.4945	7.157	2.68	58.42	7.17	3	125.00	0.420	0.420	0.000	1.542	6.67	10.29	0.761	24.98	39.6542	37.60
7.054	475.136	26.32	1.96	7.47	4.23	58.6995	7.574	2.70	58.63	7.58	3	125.00	0.441	0.441	0.000	1.506	7.09	10.67	0.801	26.29	40.6073	37.62
7.382	474.808	26.5	1.77	6.7	3.32	56.437	6.798	2.68	56.39	6.80	3	125.00	0.461	0.461	0.000	1.472	7.04	10.37	0.806	26.48	39.2566	37.40
7.71	474.480	22.44	1.48	6.61	3	45.5681	6.740	2.74	45.53	6.75	3	125.00	0.482	0.482	0.000	1.441	6.15	8.86	0.680	22.42	42.3496	36.15
8.038	474.152	24.71	1.6	6.49	3.7	48.1864	6.609	2.71	48.15	6.61	3	125.00	0.502	0.502	0.000	1.411	6.69	9.44	0.749	24.69	41.1319	36.48
8.366	473.824	35.83	2.03	5.68	4.8	67.525	5.750	2.57	67.47	5.75	3	125.00	0.523	0.523	0.000	1.383	9.02	12.48	1.093	35.8	33.9863	38.42
8.694	473.496	39.18	2.59	6.61	3.46	71.1049	6.703	2.61	71.07	6.71	3	125.00	0.543	0.543	0.000	1.357	10.06	13.64	1.196	39.16	35.8018	38.71
9.022	473.168	64.62	3.1	4.8	6.26	113.6	4.840	2.37	113.53	4.84	11	125.00	0.564	0.564	0.000	1.332	14.83	19.75	1.983	64.58	25.3247	41.23
9.35	472.840	86.35	5.07	5.87	3.14	146.765	5.911	2.38	146.73	5.91	11	125.00	0.584	0.584	0.000	1.308	19.89	26.02	2.655	86.33	25.6191	42.54
9.678	472.512	73.23	5.54	7.56	-2.24	120.066	7.628	2.52	120.08	7.63	11	125.00	0.605	0.605	0.000	1.286	18.01	23.16	2.248	73.24	31.6127	41.52
10.006	472.184	46.41	4.03	8.68	-9.82	73.2115	8.802	2.69	73.31	8.79	0	125.00	0.625	0.625	0.000	1.265	12.47	15.77	1.417	46.47	40.1446	38.88
10.335	471.855	39.89	2.66	6.66	-11.18	60.7552	6.778	2.65	60.86	6.77	3	125.00	0.646	0.646	0.000	1.244	10.50	13.07	1.215	39.96	38.0706	37.83
10.663	471.527	54.17	2.97	5.48	-11.16	80.2829	5.551	2.51	80.39	5.54	3	125.00	0.666	0.666	0.000	1.225	13.28	16.26	1.656	54.24	31.1774	39.39
10.991	471.199	62.34	4.01	6.44	-10.85	89.7506	6.504	2.54	89.85	6.50	11	125.00	0.687	0.687	0.000	1.207	15.46	18.65	1.909	62.41	32.3205	39.99
11.319	470.871	75.65	4.58	6.06	-9.15	105.935	6.111	2.47	106.01	6.11	11	125.00	0.707	0.707	0.000	1.189	18.19	21.63	2.320	75.7	29.4445	40.87
11.647	470.543	96	6.72	7	-6.93	130.879	7.053	2.47	130.93	7.05	11	125.00	0.728	0.728	0.000	1.172	23.07	27.04	2.950	96.04	29.4226	41.97
11.975	470.215	83.38	6.59	7.9	-7.87	110.405	7.975	2.56	110.47	7.97	11	125.00	0.748	0.748	0.000	1.156	20.88	24.13	2.558	83.43	33.2785	41.09
12.303	469.887	57.02	4.42	7.74	-9.36	73.1543	7.858	2.66	73.23	7.85	3	125.00	0.769	0.769	0.000	1.140	15.01	17.11	1.742	57.08	38.1113	38.88
12.631	469.559	67.48	3.97	5.89	-6.63	84.4786	5.953	2.52	84.53	5.95	11	125.00	0.789	0.789	0.000	1.125	16.61	18.70	2.065	67.52	31.6601	39.66
12.959	469.231	79.63	5.29	6.64	-4.3	97.3162	6.711	2.53	97.35	6.71	11	125.00	0.810	0.810	0.000	1.111	19.65	21.83	2.440	79.66	31.8895	40.42
13.287	468.903	74.37	5.39	7.24	-3.35	88.5552	7.329	2.58	88.58	7.33	11	125.00	0.830	0.830	0.000	1.097	18.85	20.68	2.277	74.39	34.4742	39.92
13.615	468.575	71.75	5.08	7.08	-2.33	83.3188	7.165	2.59	83.34	7.16	11	125.00	0.851	0.851	0.000	1.084	18.25	19.79	2.195	71.77	34.6502	39.59
13.943	468.247	102.33	5.18	5.06	-0.76	116.427	5.106	2.38	116.44	5.11	11	125.00	0.871	0.871	0.000	1.071	23.62	25.31	3.141	102.34	25.8028	41.36
14.271	467.919	114.91	6.8	5.91	2.36	127.832	5.964	2.42	127.81	5.97	11	125.00	0.892	0.892	0.000	1.059	26.91	28.49	3.530	114.89	27.1057	41.84
14.6	467.590	134.53	9.49	7.06	8.8	146.43	7.102	2.45	146.36	7.11	11	125.00	0.913	0.913	0.000	1.047	31.95	33.45	4.137	134.47	28.4187	42.53
14.928	467.262	140.8	8.87	6.3	10.72	149.911	6.342	2.40	149.84	6.34	11	125.00	0.933	0.933	0.000	1.035	32.73	33.88	4.330	140.73	26.4588	42.65
15.256	466.934	130.39	7.43	5.7	2.1	135.749	5.740	2.39	135.74	5.74	11	125.00	0.954	0.954	0.000	1.024	30.14	30.87	4.007	130.38	25.9423	42.15

R15690

Depth (ft)	S... El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.W.. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.606	108.8	7.14	6.56	-4.18	111.721	6.622	2.49	111.74	6.62	11	135.00	0.974	0.965	0.009	1.018	26.34	26.81	3.338	108.62	30.1191	41.15
15.912	466.278	78.99	5.55	7.03	-5.77	79.8262	7.116	2.60	79.86	7.11	11	135.00	0.996	0.977	0.019	1.012	20.18	20.42	2.415	79.02	35.2737	39.35
16.24	465.950	119.1	5.81	4.88	-0.48	119.401	4.920	2.37	119.40	4.92	11	135.00	1.018	0.989	0.029	1.006	27.25	27.41	3.656	119.1	25.0315	41.50
16.568	465.622	148.8	8.34	5.6	-1.5	147.633	5.644	2.36	147.64	5.64	11	135.00	1.040	1.001	0.040	1.000	34.00	33.98	4.575	148.81	24.89	42.58
16.896	465.294	185.21	10.35	5.59	7.64	181.826	5.620	2.31	181.78	5.62	11	135.00	1.063	1.013	0.050	0.994	41.38	41.12	5.701	185.16	22.9713	43.60
17.224	464.966	333.69	12.91	3.87	16.63	324.597	3.881	2.05	324.50	3.88	12	135.00	1.085	1.025	0.060	0.988	66.82	66.01	10.297	333.59	14.2684	46.28
17.552	464.638	421.41	14.07	3.34	22.43	405.472	3.348	1.95	405.34	3.35	12	135.00	1.107	1.037	0.070	0.982	81.17	79.72	13.012	421.27	11.5386	47.25
17.88	464.310	395.49	15.59	3.94	0.37	376.125	3.953	2.03	376.12	3.95	12	135.00	1.129	1.048	0.080	0.977	78.54	76.70	12.209	395.49	13.6425	46.93

R15691

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 10 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/09

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-2

ConeTec I[illegible] Interpretation
Interpretati[illegible] ut - Release 1.22 Rev. Format: NLI Imperial
Run No. 07-1210-1008-4589
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-2
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 13:46
CPT File: 804CP02.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 494.21

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.31	1.63	53.64	24.15	2.30
125	Residual Soil	27.01	1.39	47.18	59.75	2.99

User Inputs:
Assumed: Water Table Depth (ft): 38.8
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 494.2
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	494.046	4.44	0.09	1.92	-0.14	415.51	2.032	1.75	415.51	2.03	4	130.00	0.011	0.011	0.000	2.000	0.80	1.59	0.137	4.44	7.06955	47.35
0.492	493.718	15.27	0.31	2	0	476.486	2.034	1.72	476.49	2.03	5	130.00	0.032	0.032	0.000	2.000	2.71	5.42	0.472	15.27	6.5252	47.93
0.82	493.390	32.2	0.81	2.51	0.41	603.128	2.520	1.76	603.13	2.52	6	130.00	0.053	0.053	0.000	2.000	5.80	11.60	0.995	32.2	7.32759	48.89
1.148	493.062	74.45	2.09	2.81	-0.28	996.722	2.810	1.73	996.88	2.81	6	130.00	0.075	0.075	0.000	2.000	13.28	26.57	2.303	74.46	8.76919	50.83
1.476	492.734	107.36	2.18	2.03	0.28	1118.03	2.032	1.59	1118.03	2.03	7	130.00	0.096	0.096	0.000	2.000	18.21	36.42	3.321	107.36	4.12002	51.25
1.804	492.406	114.67	2.19	1.91	-0.11	976.912	1.912	1.58	976.91	1.91	7	130.00	0.117	0.117	0.000	2.000	19.39	38.78	3.547	114.67	3.98073	50.75
2.133	492.077	93.71	1.85	1.98	-0.3	674.899	1.977	1.65	674.90	1.98	7	130.00	0.139	0.139	0.000	2.000	16.22	32.44	2.897	93.71	5.13754	49.34
2.461	491.749	78.06	1.5	1.92	-0.23	486.982	1.926	1.70	486.98	1.93	7	130.00	0.160	0.160	0.000	2.000	13.74	27.49	2.412	78.06	6.04007	48.02
2.789	491.421	58.8	1.47	2.51	-0.67	323.351	2.508	1.88	323.35	2.51	6	130.00	0.181	0.181	0.000	2.000	11.06	22.13	1.815	58.8	9.97805	46.26
3.117	491.093	40.59	0.92	2.26	-0.62	199.341	2.278	1.96	199.39	2.28	6	130.00	0.203	0.203	0.000	2.000	7.88	15.75	1.250	40.6	11.0985	44.04
3.445	490.765	26.44	0.57	2.16	-0.21	117.075	2.174	2.10	117.08	2.17	6	130.00	0.224	0.224	0.000	2.000	5.40	10.79	0.812	26.44	15.6626	41.39
3.773	490.437	29.6	0.5	1.68	-0.58	119.696	1.703	2.01	119.74	1.70	6	130.00	0.245	0.245	0.000	2.000	5.85	11.69	0.909	29.61	13.2397	41.61
4.101	490.109	25.33	0.62	2.43	-0.39	94.0237	2.474	2.20	94.02	2.47	6	130.00	0.267	0.267	0.000	1.937	5.40	10.46	0.776	25.33	19.0184	40.24
4.429	489.781	28.49	0.71	2.5	-0.44	97.9631	2.518	2.19	97.98	2.52	6	130.00	0.288	0.288	0.000	1.864	6.08	11.29	0.873	28.49	18.6025	40.46
4.757	489.453	31.04	0.87	2.79	-0.58	99.3865	2.831	2.23	99.42	2.83	6	130.00	0.309	0.309	0.000	1.798	6.69	12.04	0.951	31.05	19.9408	40.54
5.085	489.125	58.32	1.1	1.88	-0.53	175.447	1.897	1.94	175.45	1.90	7	130.00	0.331	0.331	0.000	1.739	11.19	19.47	1.795	58.32	11.2709	43.43
5.413	488.797	64.77	1.14	1.76	-0.39	183.087	1.770	1.90	183.12	1.77	7	130.00	0.352	0.352	0.000	1.686	12.27	20.69	1.994	64.78	10.4054	43.83
5.741	488.469	49.99	1.55	3.1	-0.19	132.962	3.124	2.18	132.96	3.12	6	130.00	0.373	0.373	0.000	1.637	10.56	17.29	1.536	49.99	18.3323	42.05
6.069	488.141	98.88	2.6	2.53	-1.89	249.656	2.538	1.95	249.68	2.54	7	130.00	0.394	0.394	0.000	1.592	19.06	30.34	3.049	98.89	11.5492	45.10
6.398	487.812	86.03	2.55	2.97	-3.23	205.868	2.978	2.05	205.92	2.98	6	130.00	0.416	0.416	0.000	1.551	17.26	26.77	2.651	86.05	14.3668	44.20
6.726	487.484	74.12	2.09	2.82	-2.7	168.537	2.836	2.08	168.56	2.84	6	130.00	0.437	0.437	0.000	1.512	15.07	22.79	2.281	74.13	15.335	43.23
7.054	487.156	57.9	1.76	3.03	-0.39	125.279	3.047	2.19	125.30	3.05	6	130.00	0.459	0.459	0.000	1.477	12.27	18.13	1.778	57.91	18.5782	41.74
7.382	486.828	73.94	1.79	2.42	-0.32	153.096	2.437	2.06	153.10	2.44	6	130.00	0.480	0.480	0.000	1.444	14.87	21.47	2.274	73.94	14.5642	42.75
7.71	486.500	100.23	1.95	1.95	-0.48	199	1.955	1.91	199.00	1.96	7	130.00	0.501	0.501	0.000	1.413	19.07	26.93	3.088	100.23	10.6813	44.03
8.038	486.172	96.56	2.95	3.06	-0.34	183.814	3.072	2.09	183.81	3.07	6	130.00	0.522	0.522	0.000	1.383	18.67	27.21	2.973	96.56	15.5135	43.65
8.366	485.844	130.73	3.63	2.78	-5.11	239.405	2.788	1.99	239.46	2.78	7	130.00	0.544	0.544	0.000	1.356	25.62	34.75	4.031	130.76	12.698	44.90
8.694	485.516	98.21	2.49	2.54	-0.94	172.789	2.550	2.04	172.81	2.55	7	130.00	0.565	0.565	0.000	1.330	19.62	26.10	3.023	98.22	14.0752	43.35
9.022	485.188	72.31	1.82	2.52	-0.92	122.305	2.536	2.13	122.32	2.54	6	130.00	0.586	0.586	0.000	1.306	14.99	19.57	2.221	72.32	16.6246	41.62
9.35	484.860	80.45	1.62	2.02	-0.93	131.974	2.029	2.04	131.99	2.03	7	130.00	0.608	0.608	0.000	1.283	16.07	20.61	2.472	80.46	14.0363	41.99
9.678	484.532	69.94	1.16	1.66	-0.99	110.18	1.674	2.03	110.20	1.67	7	130.00	0.629	0.629	0.000	1.261	13.92	17.55	2.146	69.95	13.7865	41.08
10.006	484.204	61.74	0.9	1.45	-0.39	93.9277	1.473	2.04	93.93	1.47	7	130.00	0.650	0.650	0.000	1.240	12.34	15.30	1.891	61.74	14.1065	40.23
10.335	483.875	66.65	1.35	2.02	-0.53	98.2148	2.046	2.13	98.23	2.05	7	130.00	0.672	0.672	0.000	1.220	13.79	16.82	2.043	66.66	16.6601	40.47
10.663	483.547	83.84	2.23	2.65	-0.46	119.965	2.682	2.16	119.96	2.68	6	130.00	0.693	0.693	0.000	1.201	17.55	21.08	2.574	83.84	17.5802	41.52
10.991	483.219	117.25	2.55	2.17	-0.83	163.12	2.188	2.00	163.12	2.19	7	130.00	0.714	0.714	0.000	1.183	23.09	27.32	3.608	117.25	13.0514	43.07
11.319	482.891	126.97	2.65	2.08	-0.44	171.576	2.099	1.98	171.58	2.10	7	130.00	0.736	0.736	0.000	1.166	24.74	28.84	3.908	126.97	12.3081	43.32
11.647	482.563	100.73	2.81	2.79	-1.16	132.055	2.811	2.15	132.07	2.81	6	130.00	0.757	0.757	0.000	1.149	20.99	24.12	3.095	100.74	17.2321	42.01
11.975	482.235	110.03	2.03	1.85	-0.79	140.359	1.858	1.99	140.37	1.86	7	130.00	0.778	0.778	0.000	1.133	21.57	24.45	3.382	110.04	12.7249	42.32
12.303	481.907	89.84	1.64	1.83	-0.58	111.343	1.842	2.06	111.36	1.84	7	130.00	0.800	0.800	0.000	1.118	18.07	20.20	2.757	89.85	14.5435	41.13
12.631	481.579	64.26	1.13	1.75	-1.04	77.269	1.781	2.18	77.28	1.78	7	130.00	0.821	0.821	0.000	1.104	13.47	14.88	1.964	64.27	17.6781	39.17
12.959	481.251	53.66	0.81	1.5	-0.76	62.7039	1.534	2.18	62.70	1.53	7	130.00	0.842	0.842	0.000	1.090	11.36	12.38	1.635	53.66	18.4929	38.00
13.287	480.923	47.49	0.8	1.68	-0.14	53.9872	1.716	2.27	54.00	1.72	7	130.00	0.864	0.864	0.000	1.078	10.41	11.20	1.444	47.5	21.2802	37.15
13.615	480.595	49.6	0.9	1.82	-0.26	55.0468	1.847	2.28	55.05	1.85	7	130.00	0.885	0.885	0.000	1.063	10.83	11.62	1.508	49.6	21.8025	37.26
13.943	480.267	33.73	0.59	1.74	-0.11	36.2175	1.797	2.41	36.22	1.80	6	130.00	0.906	0.906	0.000	1.050	7.89	8.29	1.016	33.73	26.9811	34.77
14.271	479.939	30.54	0.56	1.82	-0.3	31.9231	1.891	2.47	31.92	1.89	6	130.00	0.928	0.928	0.000	1.038	7.33	7.61	0.917	30.54	29.3952	34.00
14.6	479.610	31.88	0.48	1.49	0.09	32.5933	1.552	2.41	32.59	1.55	6	130.00	0.949	0.949	0.000	1.027	7.45	7.65	0.958	31.88	26.9209	34.13
14.928	479.282	41.36	0.41	0.98	-0.28	41.6251	1.015	2.22	41.63	1.02	7	130.00	0.970	0.970	0.000	1.015	8.89	9.02	1.250	41.36	19.6777	35.61
15.256	478.954	37.15	0.45	1.21	-0.14	36.4632	1.245	2.32	36.46	1.24	7	130.00	0.992	0.992	0.000	1.004	8.32	8.36	1.119	37.15	23.1707	34.81

R15693

Depth (ft)	El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.W.. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	478.626	35.51	0.42	1.19	-0.23	34.0557	1.217	2.34	34.07	1.22	7	130.00	1.013	1.013	0.000	0.994	8.02	7.97	1.068	35.52	23.8923	34.40
15.912	478.298	35.52	0.45	1.26	0.07	33.3427	1.305	2.36	33.34	1.30	7	130.00	1.034	1.034	0.000	0.983	8.11	7.98	1.068	35.52	24.8516	34.27
16.24	477.970	39.22	0.5	1.28	-0.18	36.1542	1.310	2.33	36.16	1.31	7	130.00	1.056	1.056	0.000	0.973	8.85	8.61	1.182	39.23	23.7631	34.76
16.568	477.642	38.39	0.42	1.08	0	34.648	1.126	2.31	34.65	1.13	7	130.00	1.077	1.077	0.000	0.964	8.56	8.27	1.155	38.39	22.946	34.50
16.896	477.314	40.69	0.25	0.6	0.04	36.0502	0.631	2.17	36.05	0.63	7	130.00	1.098	1.098	0.000	0.954	8.56	8.16	1.226	40.69	17.9445	34.74
17.224	476.986	26.93	0.46	1.71	0.18	23.0541	1.782	2.57	23.05	1.78	6	130.00	1.120	1.120	0.000	0.945	6.78	6.41	0.799	26.93	33.9054	31.95
17.552	476.658	23.41	0.62	2.63	0.25	19.5192	2.784	2.74	19.52	2.78	5	130.00	1.141	1.141	0.000	0.936	6.44	6.03	0.689	23.41	42.7557	30.87
17.88	476.330	65.32	1.62	2.49	0.04	65.2038	2.525	2.37	65.20	2.53	6	130.00	1.162	1.162	0.000	0.928	14.98	13.89	1.986	65.32	25.2127	37.27
18.208	476.002	75.66	2.12	2.8	-0.99	62.9279	2.84654	2.36561	62.9279	2.84654	6	130.00	1.18352	1.18352	0	0.9192	17.31394	15.91506	2.30577	75.66	25.0311	38.024
18.537	475.673	74.29	1.97	2.66	0.05	60.6563	2.69549	2.36029	60.6563	2.69549	6	130.00	1.20491	1.204905	0	0.911	16.96011	15.45084	2.2627	74.29	24.8219	37.815
18.865	475.345	68.95	1.6	2.4	-0.05	53.5985	2.43443	2.36877	53.5985	2.43443	6	130.00	1.22523	1.226225	0	0.9031	15.34246	13.85511	2.03479	68.95	25.156	37.104
19.193	475.017	63.56	1.37	2.16	0.04	49.9481	2.1986	2.36187	49.9481	2.1986	7	130.00	1.24755	1.247545	0	0.8953	14.62072	13.0005	1.92918	63.56	24.8839	36.693
19.521	474.689	54.9	1.01	1.84	0.12	42.267	1.88323	2.37383	42.267	1.88323	7	130.00	1.26887	1.268865	0	0.8878	12.80965	11.19426	1.66041	54.9	25.3589	35.705
19.849	474.361	41.75	0.84	2.02	0.51	31.3597	2.07613	2.50167	31.3597	2.07613	6	130.00	1.29019	1.290185	0	0.8804	10.17354	8.956661	1.25263	41.75	30.7577	33.887
20.177	474.033	45.14	0.57	1.25	0.28	33.4185	1.30052	2.35955	33.4108	1.30082	7	130.00	1.31151	1.311505	0	0.8732	10.29958	8.993624	1.35692	45.13	24.7928	34.278
20.505	473.705	50.75	0.66	1.29	0.28	37.077	1.33557	2.329	37.077	1.33557	7	130.00	1.33283	1.332825	0	0.8662	11.42634	9.897387	1.52994	50.75	23.6109	34.915
20.833	473.377	43.95	0.93	2.11	0.21	31.4559	2.18331	2.51412	31.4559	2.18331	6	130.00	1.35415	1.354145	0	0.8593	10.77365	9.25819	1.31876	43.95	31.3181	33.906
21.161	473.049	37.82	0.76	2	0.18	26.4962	2.08536	2.56096	26.4962	2.08536	6	130.00	1.37547	1.375465	0	0.8527	9.483875	8.086508	1.12831	37.82	33.4834	32.832
21.489	472.721	31.66	0.63	1.99	0.12	21.6663	2.08174	2.6309	21.6663	2.08174	6	130.00	1.39679	1.396785	0	0.8461	8.221135	6.956119	0.93694	31.66	36.886	31.548
21.817	472.393	29.26	0.51	1.75	0.11	19.6332	1.83177	2.63406	19.6332	1.83177	6	130.00	1.41811	1.418105	0	0.8397	7.610153	6.390564	0.86198	29.26	37.0446	30.91
22.145	472.065	27.79	0.57	2.04	0.16	18.3063	2.16314	2.70017	18.3063	2.16314	6	130.00	1.43943	1.439425	0	0.8335	7.479319	6.234011	0.81581	27.79	40.4629	30.453
22.473	471.737	29.87	0.47	1.58	0.21	19.4485	1.65439	2.61284	19.4485	1.65439	6	130.00	1.46075	1.460745	0	0.8274	7.685847	6.35923	0.87954	29.87	35.9877	30.848
22.802	471.408	28.42	0.58	2.03	0.16	18.1751	2.1531	2.70156	18.1751	2.1531	6	130.00	1.48213	1.48213	0	0.8214	7.654487	6.287427	0.83399	28.42	40.5369	30.406
23.13	471.080	31.05	0.62	1.99	0.28	19.6525	2.09838	2.66738	19.6525	2.09838	6	130.00	1.50345	1.50345	0	0.8156	8.214939	6.699769	0.91475	31.05	38.7438	30.916
23.458	470.752	46.22	1.11	2.4	0.37	29.3128	2.48349	2.57298	29.3128	2.48349	6	130.00	1.52477	1.52477	0	0.8098	11.65897	9.441869	1.38375	46.22	34.0532	33.467
23.786	470.424	39.92	0.83	2.08	0.37	24.82	2.16293	2.59318	24.82	2.16293	6	130.00	1.54609	1.54609	0	0.8042	10.1712	8.180027	1.18805	39.92	35.0255	32.418
24.114	470.096	27.53	0.53	1.93	0.37	16.564	2.0414	2.72157	16.564	2.0414	6	130.00	1.56741	1.56741	0	0.7987	7.493763	5.985613	0.8038	27.53	41.6107	29.796
24.442	469.768	29.77	0.51	1.72	0.37	17.7382	1.80971	2.66769	17.7382	1.80971	6	130.00	1.58873	1.58873	0	0.7934	7.877548	6.249799	0.87249	29.77	38.7598	30.247
24.77	469.440	42.36	0.65	1.53	0.32	25.3097	1.59509	2.50911	25.3097	1.59509	7	130.00	1.61005	1.61005	0	0.7881	10.35889	8.163824	1.26161	42.36	31.0917	32.542
25.098	469.112	53.82	1.3	2.41	0.39	31.9907	2.49096	2.54436	31.9907	2.49096	6	130.00	1.63137	1.63137	0	0.7829	13.38709	10.48117	1.61575	53.82	32.7057	34.01
25.426	468.784	51.08	0.9	1.77	0.53	29.9072	1.82086	2.4837	29.9011	1.82122	7	130.00	1.65269	1.65269	0	0.7779	12.33893	9.69802	1.53026	51.07	29.9596	33.691
25.754	468.456	40.34	0.96	2.39	0.39	23.0978	2.4828	2.65426	23.0978	2.4828	6	130.00	1.67401	1.67401	0	0.7729	10.60082	8.193331	1.19709	40.34	38.0689	31.959
26.082	468.128	38.33	0.52	1.36	0.09	21.6092	1.41942	2.5382	21.6092	1.41942	7	130.00	1.69533	1.69533	0	0.768	9.50564	7.300529	1.1342	38.33	32.4199	31.531
26.41	467.800	33.19	0.47	1.42	0.42	18.3342	1.49333	2.61024	18.3342	1.49333	7	130.00	1.71665	1.71665	0	0.7632	8.52896	6.509614	0.97441	33.19	35.8595	30.463
26.739	467.471	35.49	0.61	1.72	0.44	19.4196	1.8073	2.63471	19.4196	1.8073	6	130.00	1.73804	1.738035	0	0.7585	9.233542	7.003886	1.04495	35.49	37.0774	30.839
27.067	467.143	42.19	0.58	1.38	0.21	22.9804	1.43456	2.51828	22.9804	1.43456	7	130.00	1.75936	1.759355	0	0.7539	10.36277	7.812684	1.25172	42.19	31.5067	31.926
27.395	466.815	45.33	0.59	1.3	0.28	24.4566	1.35479	2.4822	24.451	1.3551	7	130.00	1.78068	1.780675	0	0.7494	10.94193	8.199766	1.34828	45.32	29.8936	32.323
27.723	466.487	34.11	0.71	2.09	0.25	17.929	2.1976	2.71151	17.929	2.1976	6	130.00	1.802	1.801995	0	0.7449	9.235424	6.879867	1.00025	34.11	41.0689	30.317
28.051	466.159	38.11	0.64	1.67	0.16	19.9015	1.76373	2.61995	19.9015	1.76373	7	130.00	1.82332	1.823315	0	0.7406	9.84131	7.28823	1.12343	38.11	36.3399	30.998
28.379	465.831	54.68	0.64	1.17	0.14	28.6427	1.21131	2.39804	28.6427	1.21131	7	130.00	1.84464	1.844635	0	0.7363	12.69719	9.348728	1.63577	54.68	26.331	33.322
28.707	465.503	38.3	0.68	1.78	0.12	19.5257	1.86639	2.64061	19.5257	1.86639	6	130.00	1.86596	1.865955	0	0.7321	9.994656	7.316734	1.12799	38.3	37.3751	30.674
29.035	465.175	39.55	0.71	1.8	0.09	19.9561	1.88515	2.63527	19.9561	1.88515	6	130.00	1.88728	1.887275	0	0.7279	10.29276	7.492285	1.16603	39.55	37.1054	31.016
29.363	464.847	36.83	0.63	1.71	-0.04	18.2969	1.80405	2.65573	18.2969	1.80405	6	130.00	1.9086	1.908595	0	0.7238	9.685775	7.01096	1.08116	36.83	38.1443	30.45
29.691	464.519	45.2	0.73	1.62	0.32	22.4207	1.68708	2.56649	22.4155	1.68747	7	130.00	1.92992	1.929915	0	0.7198	11.96248	8.179056	1.33963	45.19	33.742	31.767
30.019	464.191	50.69	0.58	1.15	0.3	24.9784	1.19002	2.44406	24.9784	1.19002	7	130.00	1.95124	1.951235	0	0.7159	12.02196	8.606381	1.50894	50.69	28.245	32.456
30.347	463.863	39.45	0.49	1.23	0.32	18.9994	1.30745	2.56664	18.9994	1.30745	7	130.00	1.97256	1.972555	0	0.712	9.920241	7.0633	1.16029	39.45	33.752	30.696
30.675	463.535	51.05	0.69	1.36	0.21	24.6034	1.40655	2.48892	24.5984	1.40684	7	130.00	1.99388	1.993875	0	0.7082	12.96218	8.754796	1.51877	51.04	30.1901	32.361
31.004	463.206	35.96	0.8	2.22	0.25	16.8439	2.35677	2.75119	16.8439	2.35677	6	130.00	2.01526	2.01526	0	0.7044	9.945252	7.005679	1.05092	35.96	43.233	29.907
31.332	462.878	34.69	0.81	2.33	0.23	16.0335	2.4806	2.78153	16.0335	2.4806	6	130.00	2.03658	2.03658	0	0.7007	9.754086	6.834958	1.01094	34.69	44.9361	29.581
31.66	462.550	32.8	0.69	2.11	0.04	14.9386	2.24448	2.78183	14.9386	2.24448	6	130.00	2.0579	2.0579	0	0.6971	9.224214	6.430093	0.95177	32.8	44.9535	29.113
31.988	462.222	41.84	0.77	1.83	0.11	19.1229	1.93658	2.65715	19.1229	1.93658	6	130.00	2.07922	2.07922	0	0.6935	11.01138	7.636449	1.23098	41.84	38.2171	30.738
32.316	461.894	37.05	1.05	2.83	0.04	16.6383	3.00434	2.81778	16.6363	3.00434	5	125.00	2.10054	2.10054	0	0.69	10.62955	7.334144	1.08203	37.05	47.0264	29.826
32.644	461.566	67.03	0.55	0.82	-6.6	30.6024	0.84734	2.29207	30.6213	0.84682	8	125.00	2.12104	2.12104	0	0.6866	14.85918	10.20282	2.00957	67.07	22.2286	33.739
32.972	461.238	54.68	1.11	2.03	0.21	24.533	2.11274	2.59114	24.533	2.11274	7	125.00	2.14154	2.14154	0	0.6833	13.91768	9.510511	1.62658	54.68	34.9261	32.344
33.3	460.910	49.23	1.53	3.11	-2.91	21.7702	3.25062	2.74669	21.7794	3.24924	6	125.00	2.16204	2.16204	0	0.6801	13.58773	9.240913	1.45721	49.25	42.984	31.581
33.628	460.582	42.89	1.67	3.9	-0.53	18.6514	4.10244	2.86303	18.6514	4.10244	5	125.00	2.18254	2.18254	0	0.6769	12.62559	8.54615	1.26029	42.89	49.722	30.575
33.956	460.254	42.8	1.32	3.09	0.12	18.4277	3.25147	2.80358	18.4277	3.25147	6	125.00	2.20304	2.20304	0	0.6737	12.18217	8.207546	1.25687	42.8	46.2004	30.497
34.284	459.926	30.89	1.35	4.37	0.37	12.8923	4.70934	3.02533	12.8878	4.71098	4	125.00	2.22354	2.22354	0	0.6706	10.02714	6.72442	0.88751	30.88	60.2073	28.127
34.612	459.598	24.22	1.28	5.28	0.81	9.79303	5.82455	3.1763	9.78868	5.8272	3	125.00	2.24404	2.24404	0	0.6676	8.694916	5.804303	0.68037	24.21	71.1657	26.273
34.941	459.269	21.73	0.96	4.43	1.31	8.5955	4.93183	3.17671	8.59109	4.93436	4	125.00	2.2646	2.264603	0	0.6645	7.802906	5.185139	0.60264	21.72	71.1974	25.388
35.269	458.941	23.04	0.79	3.42	1.73	9.0827	3.80633	3.09074	9.07832	3.80817	5	125.00	2.2851	2.285103	0	0.6615	7.80225	5.161394	0.64257	23.03	64.6082	25.762
35.597	458.613	22.63	0.74	3.26	2.47	8.81522	3.64094	3.09045	8.80655	3.64453	5	125.00	2.3056	2.305603	0	0.6586	7.658449	5.043693	0.62924	22.61	64.7868	25.556
35.925	458.285	23.37	0.6	2.57	3.4	9.04685	2.85118	3.02107	9.03825	2.8539	5	125.00	2.3261	2.326103	0	0.6557	7.56159	4.95791	0.65151	23.35	59.9152	25.732
36.253	457.957	29.16	0.73	2.49	9.07	11.4265	2.72252	2.9266	11.4009	2.72863	6	125.00	2.3466	2.346603	0	0.6528	8.891671	5.804484	0.83014	29.1	53.6748	27.303
36.581	457.629	30.74	0.64	2.07	12.21	11.9863	2.25567	2.86414	11.9525	2.26205	6	125.00	2.3671	2.367103	0	0.65	9.031228	5.870002	0.87842	30.66	49.7897	27.622
36.909	457.301	30.69	0.47	1.52	13.92	11.8539	1.66084	2.79759	11.8162	1.66593	6	125.00	2.3876	2.387603	0	0.6472	8.680726	5.617913	0.87624	30.6	45.8547	27.544
37.237	456.973	31.76	0.55	1.72	16.67	12.1888	1.87381	2.81505	12.1431	1.88086	6	125.00	2.4081	2.408103	0	0.6444	9.066453	5.842516	0.90873	31.65	46.8672	27.728
37.565	456.645	33.62	0.61	1.8	17.92	12.8434	1.95567	2.80566	12.7981	1.96259	6	125.00	2.4286	2.428603	0	0.6417	9.549031	6.127468	0.96568	33.51	46.3211	28.081

R15694

Depth (ft)	S… (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.W. (pcf)	Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	456.317	32.15	0.63	1.95	18.64	12.1273	2.12115	2.84602	12.0783	2.12975	6	125.00	2.4491	2.449103	0	0.639	9.337317	5.966486	0.91953	32.03	48.6978	27.692
38.221	455.989	25.87	0.58	2.25	19.84	9.47537	2.47859	2.97339	9.42678	2.49137	6	125.00	2.4696	2.469603	0	0.6363	8.094387	5.15075	0.72447	25.75	56.71	26.018
38.549	455.661	21.3	0.67	3.13	19.56	7.55386	3.56195	3.14336	7.50567	3.58482	5	125.00	2.4901	2.490103	0	0.6337	7.434711	4.711459	0.58235	21.18	68.672	24.471
38.877	455.333	19.83	0.72	3.64	19.54	6.90511	4.15719	3.21395	6.85727	4.18619	4	135.00	2.5106	2.5082	0.0024	0.6314	7.271031	4.591081	0.5362	19.71	74.0883	23.859
39.206	455.004	19.78	0.91	4.59	17.32	6.84374	5.27622	3.27716	6.80009	5.31009	3	135.00	2.53261	2.520143	0.0127	0.6299	7.602996	4.789302	0.53397	19.67	79.1712	23.806
39.534	454.676	20.68	0.93	4.48	18.01	7.15825	5.13102	3.25407	7.11481	5.16235	3	135.00	2.55495	2.532049	0.0229	0.6284	7.814492	4.91094	0.56115	20.57	77.2888	24.117
39.862	454.348	20.78	0.84	4.03	18.73	7.15536	4.61465	3.22705	7.11212	4.6427	4	135.00	2.57709	2.543956	0.0331	0.627	7.69793	4.826354	0.56356	20.67	75.1234	24.118
40.19	454.020	19.42	0.88	4.52	19.38	6.58125	5.23163	3.28913	6.5343	5.26922	3	135.00	2.59923	2.555862	0.0434	0.6255	7.528095	4.708868	0.52077	19.3	80.159	23.549
40.518	453.692	16.99	0.73	4.28	19.84	5.59577	5.08051	3.33962	5.54903	5.1233	3	135.00	2.62137	2.567768	0.0536	0.6241	6.843878	4.270948	0.44486	16.87	84.4156	22.454
40.846	453.364	16.52	0.38	2.28	21.46	5.37916	2.73844	3.20777	5.32489	2.76635	5	135.00	2.64351	2.579675	0.0638	0.6226	6.015767	3.745489	0.42961	16.38	73.6031	22.183
41.174	453.036	17.43	0.34	1.93	23.46	5.69704	2.30284	3.14792	5.63916	2.32648	6	135.00	2.66565	2.591581	0.0741	0.6212	6.084749	3.779725	0.4571	17.28	69.0136	22.571
41.502	452.708	22.29	0.68	3.06	24.25	7.52921	3.469	3.13915	7.46776	3.49754	5	135.00	2.68779	2.603488	0.0843	0.6198	7.745791	4.800517	0.60688	22.13	68.3574	24.466
41.83	452.380	19.58	0.73	3.74	20.72	6.4503	4.32719	3.24865	6.40059	4.36079	4	135.00	2.70993	2.615394	0.0945	0.6183	7.359357	4.550628	0.52229	19.45	76.8511	23.43
42.158	452.052	20.78	0.6	2.87	23.56	6.86938	3.32448	3.1617	6.8161	3.35047	5	135.00	2.73207	2.6273	0.1048	0.6169	7.337513	4.526829	0.55876	20.64	70.053	23.857
42.486	451.724	27.89	0.85	3.06	26.14	9.52399	3.38163	3.04802	9.45958	3.40466	5	135.00	2.75421	2.639207	0.115	0.6155	9.132647	5.6216	0.7782	27.72	61.7782	26.072
42.814	451.396	28.69	1.21	4.23	37.12	9.77463	4.66935	3.12299	9.68787	4.71117	4	135.00	2.77635	2.651113	0.1252	0.6142	9.852356	6.050983	0.80228	28.46	67.1585	26.236
43.143	451.067	21.75	0.81	3.73	40.41	7.11643	4.27408	3.214	7.02255	4.33122	4	135.00	2.79856	2.663056	0.1355	0.6128	7.931649	4.860415	0.58673	21.5	74.0922	24.069
43.471	450.739	22.78	0.69	3.01	41.96	7.46153	3.45703	3.14483	7.36059	3.50444	5	135.00	2.8207	2.674962	0.1457	0.6114	7.909522	4.836057	0.61794	22.51	68.7816	24.389
43.799	450.411	20.59	0.61	2.97	43.95	6.60515	3.43717	3.18878	6.50094	3.49227	5	135.00	2.84284	2.686869	0.156	0.6101	7.35876	4.489329	0.54945	20.31	72.126	23.557
44.127	450.083	23.42	1.1	4.71	47.39	7.61643	5.35149	3.24833	7.50897	5.42807	3	135.00	2.86498	2.698775	0.1662	0.6087	8.749722	5.32612	0.63638	23.13	76.8256	24.529
44.455	449.755	253.58	4.98	1.96	20.09	92.4833	1.98649	2.13724	92.4354	1.98753	8	135.00	2.88712	2.710682	0.1764	0.6074	52.62093	31.96092	7.76139	253.45	16.9566	40.151
44.783	449.427	555.99	13.9	2.5	-21.27	203.145	2.5132	1.99381	203.193	2.5126	12	135.00	2.90926	2.722588	0.1867	0.6061	109.1065	66.12409	17.1232	556.12	12.7819	44.134

R15695

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 14 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-2A

ConeTec In[illegible] Interpretation
Interpretatio[illegible] - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4556
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-2A
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 14:50
CPT File: 804CP02A.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 492.4

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.34	1.38	45.43	22.11	2.23
125	Residual Soil	30.69	2.60	86.31	48.14	2.80

User Inputs:
Water Table Depth (ft): 37
Ground Surface Elev. 492.4
Assumed: Nk: 32.3
State Parameter: 1.2
CPT area ratio: 0.85
Unit Weight of Soil (pcf): Varies See Below See Below Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	492.236	8.72	0.08	0.86	0.23	617.011	0.919	1.31	617.01	0.92	5	130.00	0.011	0.011	0.000	2.000	1.35	2.71	0.270	8.72	0.48799	50.08
0.492	491.908	16.38	0.2	1.22	-0.05	511.195	1.223	1.51	511.20	1.22	6	130.00	0.032	0.032	0.000	2.000	2.71	5.43	0.506	16.38	3.02371	48.22
0.82	491.580	25.84	0.5	1.94	-0.39	483.803	1.939	1.70	483.80	1.94	6	130.00	0.053	0.053	0.000	2.000	4.56	9.11	0.798	25.84	6.11479	47.09
1.148	491.252	28.08	0.61	1.82	-0.21	375.307	1.821	1.73	375.31	1.82	6	130.00	0.075	0.075	0.000	2.000	5.00	10.01	0.867	28.08	6.6951	46.92
1.476	490.924	44.3	0.61	1.37	-0.26	460.747	1.380	1.58	460.75	1.38	7	130.00	0.096	0.096	0.000	2.000	7.50	15.01	1.369	44.3	4.05565	47.79
1.804	490.596	29.51	0.72	2.43	-0.14	250.663	2.450	1.93	250.66	2.45	6	130.00	0.117	0.117	0.000	2.000	5.66	11.31	0.910	29.51	11.2006	45.12
2.133	490.267	24.15	0.47	1.95	0.02	173.186	1.957	1.95	173.19	1.96	6	130.00	0.139	0.139	0.000	2.000	4.66	9.32	0.743	24.15	11.6289	43.36
2.461	489.939	20.69	0.35	1.67	-0.39	128.341	1.705	1.99	128.40	1.70	6	130.00	0.160	0.160	0.000	2.000	4.06	8.11	0.636	20.7	12.6808	41.87
2.789	489.611	29.8	0.44	1.46	-0.02	163.382	1.486	1.88	163.38	1.49	6	130.00	0.181	0.181	0.000	2.000	5.59	11.18	0.917	29.8	9.80656	43.08
3.117	489.283	30.73	0.22	0.72	0.05	150.674	0.721	1.68	150.67	0.72	7	130.00	0.203	0.203	0.000	2.000	5.39	10.77	0.945	30.73	5.79201	42.68
3.445	488.955	21.3	0.33	1.55	-0.07	94.1211	1.566	2.06	94.12	1.57	6	130.00	0.224	0.224	0.000	2.000	4.29	8.57	0.653	21.3	14.6052	40.24
3.773	488.627	26.89	0.22	0.82	-0.09	108.645	0.826	1.83	108.69	0.83	7	130.00	0.245	0.245	0.000	2.000	4.96	9.93	0.825	26.9	8.76744	41.01
4.101	488.299	18.81	0.35	1.84	0.07	69.5644	1.887	2.21	69.56	1.89	6	130.00	0.267	0.267	0.000	1.937	4.03	7.80	0.574	18.81	19.3515	38.59
4.429	487.971	43.41	0.31	0.72	0.16	149.789	0.719	1.68	149.79	0.72	7	130.00	0.288	0.288	0.000	1.864	7.61	14.19	1.335	43.41	5.8155	42.65
4.757	487.643	28.43	0.59	2.06	0.16	90.9455	2.098	2.16	90.95	2.10	6	130.00	0.309	0.309	0.000	1.798	5.96	10.71	0.871	28.43	17.646	40.06
5.085	487.315	16	0.39	2.44	-0.49	47.4078	2.489	2.41	47.41	2.49	5	130.00	0.331	0.331	0.000	1.739	3.74	6.51	0.485	16	27.0118	36.39
5.413	486.987	29.13	0.49	1.69	0.72	81.7921	1.703	2.13	81.79	1.70	6	130.00	0.352	0.352	0.000	1.686	6.03	10.16	0.891	29.13	16.6865	39.48
5.741	486.659	49.67	0.79	1.59	-0.67	132.105	1.603	1.96	132.10	1.60	7	130.00	0.373	0.373	0.000	1.637	9.63	15.76	1.526	49.67	11.947	42.01
6.069	486.331	53.37	0.83	1.55	0.05	134.29	1.567	1.95	134.29	1.57	7	130.00	0.394	0.394	0.000	1.592	10.30	16.40	1.640	53.37	11.6376	42.10
6.398	486.002	49.98	0.63	1.26	-1.39	119.182	1.271	1.92	119.21	1.27	7	130.00	0.416	0.416	0.000	1.551	9.55	14.80	1.534	49.99	10.9396	41.49
6.726	485.674	38.17	0.52	1.35	-0.56	86.3078	1.378	2.05	86.31	1.38	7	130.00	0.437	0.437	0.000	1.512	7.65	11.57	1.168	38.17	14.3272	39.78
7.054	485.346	40.75	0.54	1.32	-0.74	87.8748	1.340	2.04	87.87	1.34	7	130.00	0.459	0.459	0.000	1.477	8.13	12.00	1.247	40.75	13.9337	39.87
7.382	485.018	37.01	0.6	1.62	-0.79	76.1315	1.642	2.14	76.15	1.64	7	130.00	0.480	0.480	0.000	1.444	7.70	11.11	1.131	37.02	17.0691	39.09
7.71	484.690	59.19	0.77	1.3	-0.23	117.108	1.312	1.94	117.11	1.31	7	130.00	0.501	0.501	0.000	1.413	11.37	16.06	1.817	59.19	11.3174	41.39
8.038	484.362	57.04	1.06	1.85	0.25	108.174	1.876	2.07	108.17	1.88	7	130.00	0.522	0.522	0.000	1.383	11.53	15.96	1.760	57.04	14.9626	40.98
8.366	484.034	57.87	0.86	1.48	-0.53	105.42	1.500	2.01	105.44	1.50	7	130.00	0.544	0.544	0.000	1.356	11.43	15.50	1.775	57.88	13.2395	40.85
8.694	483.706	75.82	0.89	1.16	-0.74	133.169	1.169	1.86	133.19	1.17	8	130.00	0.565	0.565	0.000	1.330	14.16	18.84	2.330	75.83	9.50987	42.05
9.022	483.378	63.21	1.11	1.75	0.44	106.788	1.772	2.06	106.79	1.77	7	130.00	0.586	0.586	0.000	1.306	12.71	16.60	1.939	63.21	14.5645	40.91
9.35	483.050	60.49	0.91	1.51	-0.93	98.5311	1.520	2.04	98.55	1.52	7	130.00	0.608	0.608	0.000	1.283	12.06	15.47	1.854	60.5	13.9359	40.49
9.678	482.722	64.51	0.83	1.28	-1.11	101.548	1.299	1.98	101.56	1.30	7	130.00	0.629	0.629	0.000	1.261	12.59	15.87	1.978	64.52	12.4093	40.65
10.006	482.394	80.55	1.03	1.28	-0.85	122.849	1.289	1.92	122.86	1.29	8	130.00	0.650	0.650	0.000	1.240	15.35	19.04	2.474	80.56	10.8105	41.64
10.335	482.065	67.71	1.98	2.04	-0.64	99.7927	2.059	2.12	99.79	2.06	7	130.00	0.672	0.672	0.000	1.220	13.99	17.07	2.075	67.71	16.5727	40.56
10.663	481.737	66.47	1.17	1.76	-0.6	94.9032	1.779	2.10	94.90	1.78	7	130.00	0.693	0.693	0.000	1.201	13.57	16.30	2.036	66.47	15.6621	40.29
10.991	481.409	56.44	0.72	1.28	-0.88	78.0017	1.292	2.06	78.00	1.29	7	130.00	0.714	0.714	0.000	1.183	11.38	13.47	1.725	56.44	14.7573	39.22
11.319	481.081	53.65	0.58	1.08	-0.95	71.9203	1.096	2.05	71.93	1.10	7	130.00	0.736	0.736	0.000	1.166	10.75	12.53	1.638	53.66	14.2461	38.78
11.647	480.753	39.63	0.46	1.15	-1.11	51.3476	1.183	2.18	51.36	1.18	7	130.00	0.757	0.757	0.000	1.149	8.39	9.64	1.203	39.64	18.4421	36.86
11.975	480.425	34.17	0.51	1.48	-1.16	42.8991	1.527	2.31	42.91	1.53	7	130.00	0.778	0.778	0.000	1.133	7.64	8.66	1.034	34.18	22.9801	35.80
12.303	480.097	26.38	0.35	1.33	-1.02	31.9876	1.368	2.39	31.99	1.37	6	130.00	0.800	0.800	0.000	1.118	6.10	6.82	0.792	26.38	25.9069	34.01
12.631	479.769	31.58	0.43	1.35	-1.16	37.4646	1.398	2.34	37.48	1.40	7	130.00	0.821	0.821	0.000	1.104	7.14	7.88	0.952	31.59	23.9035	34.98
12.959	479.441	33.88	0.34	0.99	-1.04	39.2215	1.029	2.24	39.23	1.03	7	130.00	0.842	0.842	0.000	1.090	7.36	8.02	1.023	33.89	20.5322	35.26
13.287	479.113	40.82	0.47	1.14	-0.55	46.2642	1.176	2.22	46.26	1.18	7	130.00	0.864	0.864	0.000	1.076	8.76	9.43	1.237	40.82	19.6264	36.24
13.615	478.785	40.88	0.48	1.18	-0.62	45.1934	1.200	2.23	45.19	1.20	7	130.00	0.885	0.885	0.000	1.063	8.83	9.38	1.238	40.88	20.0856	36.10
13.943	478.457	67.39	0.84	1.25	-0.51	73.3577	1.263	2.08	73.36	1.26	7	130.00	0.906	0.906	0.000	1.050	13.67	14.36	2.058	67.39	15.1748	38.68
14.271	478.129	83.33	1.06	1.27	-0.49	88.8326	1.286	2.02	88.83	1.29	8	130.00	0.928	0.928	0.000	1.036	16.52	17.15	2.551	83.33	13.5068	39.93
14.6	477.800	84.96	0.88	1.03	-0.44	88.5258	1.047	1.96	88.53	1.05	8	130.00	0.949	0.949	0.000	1.027	16.48	16.92	2.601	84.96	11.9944	39.91
14.928	477.472	62.57	1.08	1.72	-0.55	63.4839	1.753	2.22	63.48	1.75	7	130.00	0.970	0.970	0.000	1.015	13.44	13.64	1.907	62.57	19.6287	38.07
15.256	477.144	54.17	0.79	1.46	-0.62	53.6267	1.486	2.23	53.64	1.49	7	130.00	0.992	0.992	0.000	1.004	11.68	11.73	1.646	54.18	19.9666	37.11

R15697

Depth (ft)	S… (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.W… (pcf)	…Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	476.816	44.07	0.61	1.38	-0.69	42.5062	1.417	2.30	42.52	1.42	7	130.00	1.013	1.013	0.000	0.994	9.78	9.72	1.333	44.06	22.369	35.74
15.912	476.488	48.55	0.7	1.45	-0.58	45.9409	1.473	2.28	45.94	1.47	7	130.00	1.034	1.034	0.000	0.983	10.70	10.52	1.471	48.55	21.7636	36.20
16.24	476.160	44.39	0.49	1.11	-0.51	41.0519	1.131	2.25	41.06	1.13	7	130.00	1.056	1.056	0.000	0.973	9.67	9.41	1.342	44.4	20.757	35.53
16.568	475.832	49.03	0.37	0.75	-0.55	44.528	0.772	2.13	44.53	0.77	8	130.00	1.077	1.077	0.000	0.964	10.16	9.79	1.485	49.03	16.7798	36.02
16.896	475.504	41.84	0.47	1.13	-0.34	37.0973	1.154	2.29	37.10	1.15	7	130.00	1.098	1.098	0.000	0.954	9.27	8.85	1.261	41.84	22.2493	34.92
17.224	475.176	36.67	0.81	2.21	-0.18	31.7539	2.278	2.52	31.75	2.28	6	130.00	1.120	1.120	0.000	0.945	9.03	8.53	1.101	36.67	31.6967	33.96
17.552	474.848	53.97	0.73	1.35	-0.44	46.3056	1.382	2.26	46.31	1.38	7	130.00	1.141	1.141	0.000	0.936	11.79	11.04	1.636	53.98	21.0557	36.25
17.88	474.520	91.09	1.66	1.85	-0.88	77.3772	1.868	2.17	77.38	1.87	7	130.00	1.162	1.162	0.000	0.928	19.20	17.81	2.784	91.09	18.1251	39.18
18.208	474.192	100.89	2.85	2.82	-1.27	84.2457	2.85839	2.27913	84.2542	2.8581	6	130.00	1.18352	1.18352	0	0.9192	22.22949	20.43345	3.08689	100.9	21.7559	39.646
18.537	473.863	79.53	2.26	2.84	-0.71	65.0052	2.88541	2.35986	65.0052	2.88541	6	130.00	1.20491	1.204905	0	0.911	18.15282	16.53742	2.42493	79.53	24.8046	38.208
18.865	473.535	60.94	1.2	1.97	-0.49	48.6972	2.00959	2.3446	48.6972	2.00959	7	130.00	1.22823	1.226225	0	0.9031	13.81554	12.47621	1.84872	60.94	24.2101	36.545
19.193	473.207	41.14	0.68	1.66	-0.56	31.9768	1.70458	2.44317	31.9768	1.70458	7	130.00	1.24755	1.247545	0	0.8953	9.752974	8.731904	1.23506	41.14	28.207	34.008
19.521	472.879	43.98	0.41	0.92	-0.65	33.6609	0.95994	2.28476	33.6609	0.95994	7	130.00	1.26887	1.268865	0	0.8878	9.712904	8.622663	1.32233	43.98	21.9609	34.324
19.849	472.551	44.49	0.5	1.13	-0.23	33.4834	1.15741	2.33046	33.4834	1.15741	7	130.00	1.29019	1.290185	0	0.8804	10.02335	8.824437	1.33746	44.49	23.6666	34.292
20.177	472.223	60.56	0.75	1.23	-0.23	45.176	1.26585	2.24572	45.176	1.26585	7	130.00	1.31151	1.311505	0	0.8732	13.15276	11.48502	1.83432	60.56	20.563	36.102
20.505	471.895	62.15	0.84	1.35	-0.37	45.6303	1.38119	2.26465	45.6378	1.38096	7	130.00	1.33283	1.332825	0	0.8662	13.80969	11.78858	1.88288	62.16	21.234	36.152
20.833	471.567	58.16	0.81	1.4	-0.14	41.9496	1.42591	2.30229	41.9496	1.42591	7	130.00	1.35415	1.354145	0	0.8593	12.94251	11.12207	1.7587	58.16	22.6062	35.66
21.161	471.239	61.14	0.98	1.6	-0.23	43.4504	1.63977	2.32698	43.4504	1.63977	7	130.00	1.37547	1.375465	0	0.8527	13.75345	11.727	1.8503	61.14	23.5343	35.87
21.489	470.911	58.39	1.21	2.08	-0.09	40.8031	2.12306	2.4187	40.8031	2.12306	7	130.00	1.39679	1.396785	0	0.8461	13.68713	11.58104	1.7645	58.39	27.1802	35.494
21.817	470.583	68.58	1.4	2.05	-0.21	47.3603	2.08452	2.36412	47.3603	2.08452	7	130.00	1.41811	1.418105	0	0.8397	15.68334	13.16995	2.07932	68.58	24.9725	36.381
22.145	470.255	62.38	1.27	2.03	-0.14	42.3367	2.084	2.40123	42.3367	2.084	7	130.00	1.43943	1.439425	0	0.8335	14.50622	12.09093	1.88671	62.38	26.4611	35.715
22.473	469.927	56.41	1.04	1.85	-0.23	37.6173	1.89266	2.4147	37.6173	1.89266	7	130.00	1.46075	1.460745	0	0.8274	13.19979	10.92061	1.70122	56.41	27.0145	35.003
22.802	469.598	43.25	0.55	1.27	-0.21	28.181	1.3168	2.42382	28.181	1.3168	7	130.00	1.48213	1.48213	0	0.8214	10.16202	8.347122	1.29312	43.25	27.393	33.22
23.13	469.270	47.18	0.49	1.04	-0.09	30.3812	1.07276	2.34808	30.3812	1.07276	7	130.00	1.50345	1.503455	0	0.8156	10.7126	8.736759	1.41413	47.18	24.3451	33.69
23.458	468.942	41.56	0.66	1.58	-0.04	26.2566	1.64855	2.50417	26.2566	1.64855	7	130.00	1.52477	1.52477	0	0.8098	10.13933	8.21121	1.23948	41.56	30.8699	32.775
23.786	468.614	33	0.65	1.96	0.16	20.3442	2.06652	2.65126	20.3442	2.06652	6	130.00	1.54609	1.54609	0	0.8042	8.65873	6.963648	0.97381	33	37.9169	31.141
24.114	468.286	31.46	0.73	2.33	0.09	19.0713	2.44208	2.71649	19.0713	2.44208	6	130.00	1.56741	1.56741	0	0.7987	8.540436	6.821639	0.92547	31.46	41.3365	30.721
24.442	467.958	28.46	0.84	2.94	-0.07	16.9137	3.12602	2.82253	16.9137	3.12602	5	130.00	1.58873	1.58873	0	0.7934	8.186954	6.495271	0.83193	28.46	47.3052	29.934
24.77	467.630	36.73	0.76	2.06	0.19	21.813	2.16401	2.63841	21.813	2.16401	6	130.00	1.61005	1.61005	0	0.7881	9.574187	7.545399	1.0873	36.73	37.2639	31.591
25.098	467.302	53.09	0.84	1.58	-0.04	31.5432	1.63238	2.43684	31.5432	1.63238	7	130.00	1.63137	1.63137	0	0.8156	12.54912	9.825098	1.59315	53.09	27.8392	33.923
25.426	466.974	37.37	0.93	2.48	0.02	21.6116	2.60378	2.68975	21.6116	2.60378	6	130.00	1.65269	1.65269	0	0.7779	10.00261	7.780841	1.1058	37.37	39.9116	31.531
25.754	466.646	29.67	0.83	2.8	0.05	16.7239	2.96471	2.81252	16.7239	2.96471	5	130.00	1.67401	1.67401	0	0.7729	8.487242	6.559754	0.86675	29.67	46.7198	29.86
26.082	466.318	29.89	0.72	2.4	0.04	16.6308	2.55367	2.77598	16.6308	2.55367	6	130.00	1.69533	1.69533	0	0.768	8.378865	6.435141	0.8729	29.89	44.6215	29.823
26.41	465.990	40.76	0.67	1.65	0.51	22.7439	1.71604	2.56534	22.7439	1.71604	7	130.00	1.71665	1.71665	0	0.7632	10.24312	7.817922	1.20877	40.76	33.6905	31.86
26.739	465.661	31.14	0.85	2.72	0.6	16.9168	2.89096	2.80197	16.9168	2.89096	6	130.00	1.73804	1.738035	0	0.7585	8.855459	6.7171	0.91028	31.14	46.1075	29.935
27.067	465.333	27.6	0.95	3.45	0.11	14.6876	3.67638	2.91406	14.6876	3.67638	5	130.00	1.75936	1.759355	0	0.7539	8.370606	6.310738	0.80002	27.6	52.8796	29
27.395	465.005	20.8	0.75	3.59	0.09	10.681	3.94336	3.04266	10.681	3.94336	5	130.00	1.78068	1.780675	0	0.7494	6.829167	5.117707	0.58683	20.8	61.4043	26.853
27.723	464.677	32.97	0.92	2.78	0.41	17.2964	2.95174	2.79991	17.2908	2.95269	6	130.00	1.802	1.801995	0	0.7449	9.362277	6.974385	0.96495	32.96	45.9884	30.079
28.051	464.349	34.02	0.75	2.2	0.56	17.6583	2.32943	2.73173	17.6528	2.33016	6	130.00	1.82332	1.823315	0	0.7406	9.30799	6.893266	0.9968	34.01	42.1628	30.215
28.379	464.021	30.25	0.56	1.86	0.39	15.3989	1.97146	2.73942	15.3989	1.97146	6	130.00	1.84464	1.844635	0	0.7363	8.313169	6.120845	0.87942	30.25	42.5839	29.314
28.707	463.693	26.45	0.54	2.03	0.44	13.175	2.19655	2.82207	13.1697	2.19744	6	130.00	1.86596	1.865955	0	0.7321	7.603892	5.56654	0.78112	26.44	47.2781	28.272
29.035	463.365	35.65	0.64	1.79	0.42	17.8897	1.89558	2.67583	17.8897	1.89558	6	125.00	1.88726	1.887275	0	0.7279	9.473402	6.895859	1.04529	35.65	39.1825	30.303
29.363	463.037	31.91	0.9	2.81	0.93	15.7263	2.99978	2.83696	15.7263	2.99978	6	125.00	1.90778	1.907775	0	0.724	9.254513	6.700235	0.92886	31.91	48.1574	29.453
29.691	462.709	78.81	1.79	2.27	-13.37	39.8707	2.32825	2.45145	39.9174	2.32553	7	125.00	1.92828	1.928275	0	0.7201	18.77676	13.52185	2.38024	78.9	28.5599	35.362
30.019	462.381	75.42	2.46	3.26	-19.88	37.7012	3.34825	2.57393	37.7628	3.34279	6	125.00	1.94878	1.948775	0	0.7163	19.06391	13.65624	2.27465	75.54	34.0988	35.027
30.347	462.053	73.52	2.38	3.23	-21.24	36.3335	3.32631	2.58372	36.3996	3.32028	6	125.00	1.96928	1.969275	0	0.7126	18.67716	13.30937	2.21519	73.65	34.5679	34.803
30.675	461.725	61.35	2.05	3.35	-21.62	29.8326	3.45349	2.65802	29.903	3.44537	6	125.00	1.98978	1.989775	0	0.7089	16.19004	11.47746	1.83778	61.49	38.2614	33.591
31.004	461.396	28.32	1.36	4.8	-15.93	13.0872	5.1692	3.04324	13.1369	5.14963	3	125.00	2.01034	2.010338	0	0.7053	9.334539	6.583523	0.81454	28.42	61.4453	28.256
31.332	461.068	40.8	1.24	3.05	-12.77	19.0902	3.19842	2.78585	19.1296	3.19183	6	125.00	2.03084	2.030838	0	0.7017	11.52195	8.085156	1.20028	40.88	45.182	30.741
31.66	460.740	44.64	1.36	3.05	-16.6	20.7614	3.19334	2.75656	20.815	3.18511	6	125.00	2.05134	2.051338	0	0.6982	12.41234	8.66633	1.31853	44.75	43.5317	31.289
31.988	460.412	35.89	0.92	2.56	-16.6	16.3228	2.72043	2.79674	16.3759	2.71161	6	125.00	2.07184	2.071838	0	0.6947	10.20784	7.091796	1.047	36	45.8061	29.721
32.316	460.084	41.49	0.76	1.84	-15.52	18.8295	1.92905	2.6602	18.8773	1.92416	6	125.00	2.09234	2.092338	0	0.6913	10.96277	7.578869	1.21974	41.59	38.3734	30.654
32.644	459.756	44.62	0.87	1.94	-15.36	20.1185	2.04671	2.6514	20.1658	2.04191	6	125.00	2.11284	2.112838	0	0.688	11.73457	8.072984	1.31601	44.72	37.9227	31.084
32.972	459.428	46.81	0.97	2.07	-12.68	20.9421	2.17116	2.65248	20.9796	2.16728	6	125.00	2.13334	2.133338	0	0.6847	12.31082	8.428633	1.38318	46.89	37.978	31.34
33.3	459.100	34.78	0.63	1.82	-11.57	15.1479	1.93097	2.73912	15.1804	1.92683	6	125.00	2.15384	2.153838	0	0.6814	9.575763	6.524796	1.0101	34.85	42.5673	29.219
33.628	458.772	27.97	0.53	1.88	-11.11	11.8637	2.05461	2.84249	11.8959	2.04905	6	125.00	2.17434	2.174338	0	0.6782	8.157752	5.532317	0.79863	28.04	48.487	27.59
33.956	458.444	25.2	0.51	2.03	-10.93	10.4815	2.21689	2.90541	10.5134	2.21017	6	125.00	2.19484	2.194838	0	0.675	7.62481	5.146688	0.71223	25.27	52.3352	26.756
34.284	458.116	23.12	0.44	1.91	-10.81	9.43633	2.10479	2.93186	9.46793	2.09777	6	125.00	2.21534	2.215338	0	0.6719	7.108146	4.775693	0.6472	23.19	54.0101	26.047
34.612	457.788	24.88	0.56	2.24	-10.49	10.1278	2.47304	2.94368	10.1591	2.46542	6	125.00	2.23584	2.235838	0	0.6688	7.702224	5.151053	0.70106	24.95	54.7701	26.525
34.941	457.459	27.6	0.74	2.67	-10.42	11.2319	2.91987	2.94724	11.2585	2.91297	6	125.00	2.2564	2.2564	0	0.6657	8.557203	5.696706	0.78463	27.66	55.0001	27.219
35.269	457.131	22.71	0.58	2.56	-10.21	8.97409	2.83853	3.02029	9.00483	2.82884	5	125.00	2.2769	2.2769	0	0.6627	7.373349	4.886443	0.6326	22.78	59.8616	25.707
35.597	456.803	20.39	0.5	2.46	-9.49	7.87525	2.76356	3.06177	7.89701	2.75594	5	125.00	2.2974	2.2974	0	0.6598	6.794369	4.482609	0.56014	20.44	62.7431	24.816
35.925	456.475	20.1	0.58	2.89	-8.89	7.67164	3.26171	3.1108	7.69321	3.25256	5	125.00	2.3179	2.3179	0	0.6568	6.918507	4.54428	0.55053	20.15	66.264	24.639
36.253	456.147	21.46	0.65	3.04	-5.91	8.17722	3.3993	3.09836	8.19432	3.3922	5	125.00	2.3384	2.3384	0	0.6539	7.320835	4.787417	0.592	21.5	65.3582	25.067
36.581	455.819	18.81	0.64	3.38	-5.48	6.97406	3.89032	3.18867	6.98677	3.88324	5	125.00	2.3589	2.3589	0	0.6511	6.8256	4.444123	0.50932	18.84	72.1173	23.985
36.909	455.491	16.56	0.68	3.67	-4.62	6.80029	4.20256	3.21677	6.81289	4.19479	4	125.00	2.3794	2.3794	0	0.6483	6.871849	4.45492	0.50095	18.59	74.3104	23.814
37.237	455.163	16.65	0.84	5.06	-4.85	5.95614	5.8947	3.34912	5.96868	5.88231	3	135.00	2.3999	2.392506	0.0074	0.6465	6.818186	4.408008	0.44118	16.68	85.2328	22.923
37.565	454.835	18.46	0.76	4.13	-5.01	6.67022	4.73876	3.25373	6.6827	4.72991	4	135.00	2.42204	2.404412	0.0176	0.6449	7.022524	4.528859	0.49653	18.49	77.2612	23.691

R15698

Depth (ft)	Elev (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U... (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	454.507	17.57	0.66	3.77	-4.48	6.25986	4.3634	3.25552	6.27228	4.35476	4	135.00	2.44418	2.416318	0.0279	0.6433	6.693405	4.30596	0.46829	17.6	77.4062	23.267
38.221	454.179	23.26	0.72	3.08	-3.6	8.56333	3.46259	3.08679	8.57568	3.4576	5	135.00	2.46632	2.428225	0.0381	0.6417	7.869741	5.050286	0.64377	23.29	64.5241	25.388
38.549	453.851	35.17	1.71	4.86	-4.65	13.3934	5.23231	3.04061	13.4056	5.22751	3	135.00	2.48846	2.440131	0.0483	0.6402	11.54187	7.388724	1.01181	35.2	61.2619	28.401
38.877	453.523	74.79	4.27	5.7	-12.75	29.4773	5.90763	2.82205	29.5099	5.9011	11	135.00	2.5106	2.452038	0.0586	0.6386	21.5316	13.75032	2.23775	74.87	47.2766	33.514
39.206	453.194	104.68	6.22	5.94	-19.79	41.4562	6.08925	2.72869	41.5049	6.08211	11	135.00	2.53281	2.46398	0.0688	0.6371	28.63555	18.24261	3.16245	104.8	41.9974	35.6
39.534	452.866	152.53	8.46	5.55	-19.17	60.5743	5.64094	2.59462	60.6227	5.63643	11	135.00	2.55495	2.475887	0.0791	0.6355	38.92148	24.73568	4.64319	152.65	35.0952	37.815
39.862	452.538	232.67	10.79	4.64	-19.12	92.4888	4.68941	2.41592	92.533	4.68717	11	135.00	2.57709	2.487793	0.0893	0.634	54.49618	34.55087	7.12362	232.78	27.0649	40.155
40.19	452.210	391.32	13.96	3.57	-18.27	155.507	3.59127	2.18739	155.551	3.59025	12	135.00	2.59923	2.4997	0.0995	0.6325	82.95759	52.47014	12.0347	391.43	18.574	42.835
40.518	451.882	504.54	14.95	2.96	-19.14	199.84	2.97857	2.05825	199.888	2.97786	12	135.00	2.62137	2.511606	0.1098	0.631	101.5206	64.05876	15.5393	504.66	14.5769	44.055
40.846	451.554	352.83	14.47	4.1	7.69	138.769	4.13208	2.26597	138.754	4.13256	12	135.00	2.64351	2.523512	0.12	0.6295	77.28576	48.65156	10.8417	352.79	21.2814	42.264
41.174	451.226	428.29	14.1	3.29	55.96	167.871	3.31278	2.14021	167.733	3.31551	12	135.00	2.66565	2.535419	0.1302	0.628	88.95563	55.86613	13.1772	427.94	17.0501	43.207

R15699

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 18 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-3

ConeTec In[illegible] Interpretation
Interpretation [illegible]t - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4528
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-3
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 07:09
CPT File: 804CP03.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 466.98

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	36.95	1.32	43.13	32.39	2.49

User Inputs:
Assumed: Water Table Depth (ft): 11.1
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 467.0
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	466.816	22.8	0.36	1.56	-0.74	2223.39	1.580	1.42	2224.37	1.58	6	125.00	0.010	0.010	0.000	2.000	3.67	7.34	0.706	22.81	1.81602	53.62
0.492	466.488	42.45	0.67	1.58	-5.17	1379.49	1.579	1.46	1380.46	1.58	7	125.00	0.031	0.031	0.000	2.000	6.91	13.82	1.313	42.48	2.23467	52.00
0.82	466.160	28.94	0.66	2.29	-5.45	563.683	2.285	1.73	564.27	2.28	6	125.00	0.051	0.051	0.000	2.000	5.17	10.34	0.894	28.97	6.77422	48.62
1.148	465.832	23.43	0.46	1.97	-7.27	325.551	1.969	1.79	326.25	1.97	6	125.00	0.072	0.072	0.000	2.000	4.27	8.55	0.723	23.48	7.91559	46.30
1.476	465.504	32.54	0.58	1.77	-11.34	351.737	1.787	1.74	352.50	1.78	6	125.00	0.092	0.092	0.000	2.000	5.82	11.65	1.005	32.61	6.82459	46.64
1.804	465.176	38.02	0.94	2.47	-4.06	336.206	2.480	1.87	336.38	2.48	6	125.00	0.113	0.113	0.000	2.000	7.12	14.25	1.174	38.04	9.67104	46.44
2.133	464.847	36.61	1.27	3.46	-2.93	275.118	3.463	2.04	275.27	3.46	5	125.00	0.133	0.133	0.000	2.000	7.35	14.70	1.136	36.83	14.0176	45.54
2.461	464.519	32.44	1.88	5.81	-1.76	209.906	5.823	2.29	209.97	5.82	3	125.00	0.154	0.154	0.000	2.000	7.19	14.38	1.000	32.46	22.2623	44.29
2.789	464.191	33.21	1.93	5.82	-0.93	189.52	5.842	2.32	189.58	5.84	3	125.00	0.174	0.174	0.000	2.000	7.44	14.88	1.023	33.22	23.1469	43.80
3.117	463.863	41.98	2.26	5.38	1.78	214.489	5.409	2.26	214.44	5.41	3	125.00	0.195	0.195	0.000	2.000	9.17	18.35	1.294	41.97	21.0994	44.39
3.445	463.535	51.02	2.5	4.89	1.36	235.958	4.921	2.20	235.91	4.92	4	125.00	0.215	0.215	0.000	2.000	10.89	21.78	1.573	51.01	19.1479	44.83
3.773	463.207	61.43	2.63	4.28	0.26	259.504	4.298	2.13	259.46	4.30	5	125.00	0.236	0.236	0.000	2.000	12.73	25.46	1.895	61.42	16.8244	45.27
4.101	462.879	66.35	2.47	3.72	5.77	257.864	3.737	2.08	257.71	3.74	5	125.00	0.256	0.256	0.000	1.975	13.47	26.60	2.046	66.31	15.2758	45.24
4.429	462.551	70.01	2.46	3.51	-1.2	251.915	3.528	2.07	251.91	3.53	6	125.00	0.277	0.277	0.000	1.901	14.12	26.84	2.159	70.01	14.7869	45.14
4.757	462.223	47.34	1.98	4.19	4.97	158.226	4.209	2.24	158.09	4.21	5	125.00	0.297	0.297	0.000	1.834	10.25	18.80	1.456	47.3	20.3659	42.91
5.085	461.895	35.26	1.25	3.54	14.76	109.946	3.577	2.28	109.66	3.59	5	125.00	0.318	0.318	0.000	1.774	7.75	13.74	1.082	35.17	21.7542	41.05
5.413	461.567	29.45	1.07	3.63	14.25	86.0497	3.675	2.36	85.78	3.69	5	125.00	0.338	0.338	0.000	1.719	6.69	11.50	0.901	29.36	24.8747	39.74
5.741	461.239	22.73	0.72	3.15	18.2	62.3478	3.218	2.41	62.01	3.24	5	125.00	0.359	0.359	0.000	1.669	5.28	8.81	0.693	22.61	26.8102	37.94
6.069	460.911	20.62	0.5	2.43	23.72	53.3615	2.470	2.38	52.97	2.49	5	125.00	0.379	0.379	0.000	1.624	4.71	7.65	0.627	20.47	25.5653	37.04
6.398	460.582	23.44	0.52	2.22	51.64	57.6183	2.257	2.33	56.82	2.29	6	125.00	0.400	0.400	0.000	1.581	5.21	8.24	0.713	23.12	23.7246	37.44
6.726	460.254	16.44	0.47	2.84	44.02	38.1079	2.934	2.54	37.44	2.99	5	125.00	0.420	0.420	0.000	1.542	4.02	6.20	0.496	16.16	32.5769	34.97
7.054	459.926	14.75	0.41	2.79	45.61	32.4562	2.665	2.59	31.82	2.92	5	125.00	0.441	0.441	0.000	1.506	3.68	5.55	0.443	14.47	34.9073	33.98
7.382	459.598	17.38	0.43	2.45	47.02	36.67	2.542	2.52	36.04	2.59	5	125.00	0.461	0.461	0.000	1.472	4.19	6.17	0.524	17.09	31.3627	34.74
7.71	459.270	18.54	0.47	2.51	37.83	37.4747	2.603	2.51	36.98	2.64	5	125.00	0.482	0.482	0.000	1.441	4.48	6.46	0.559	18.3	31.2347	34.90
8.038	458.942	19.4	0.5	2.58	37.94	37.6166	2.646	2.52	37.16	2.68	5	125.00	0.502	0.502	0.000	1.411	4.70	6.63	0.585	19.17	31.3584	34.93
8.366	458.614	17.21	0.55	3.2	34.73	31.9142	3.296	2.63	31.49	3.34	5	125.00	0.523	0.523	0.000	1.383	4.41	6.11	0.517	16.99	36.9521	33.91
8.694	458.286	17.95	0.56	3.1	31.31	32.0343	3.217	2.62	31.68	3.25	5	125.00	0.543	0.543	0.000	1.357	4.59	6.23	0.539	17.76	36.4732	33.95
9.022	457.958	19.33	0.57	2.93	27.69	33.2806	3.037	2.59	32.98	3.07	5	125.00	0.564	0.564	0.000	1.332	4.88	6.50	0.581	19.16	34.995	34.20
9.35	457.630	16.87	0.64	3.4	23.97	31.2909	3.500	2.65	31.03	3.53	5	125.00	0.584	0.584	0.000	1.308	4.92	6.43	0.566	18.72	37.9977	33.82
9.678	457.302	20.7	0.61	2.95	26.23	33.2219	3.036	2.59	32.94	3.06	5	125.00	0.605	0.605	0.000	1.286	5.23	6.72	0.622	20.53	34.9967	34.19
10.006	456.974	20.8	0.74	3.57	10.97	32.26	3.668	2.65	32.15	3.68	5	125.00	0.625	0.625	0.000	1.265	5.45	6.89	0.625	20.73	38.0423	34.04
10.335	456.645	22.06	0.78	3.52	8.13	33.1519	3.642	2.64	33.07	3.65	5	125.00	0.646	0.646	0.000	1.244	5.75	7.15	0.663	22.01	37.4577	34.22
10.663	456.317	22.26	0.84	3.76	9.06	32.4015	3.690	2.67	32.31	3.90	4	125.00	0.666	0.666	0.000	1.225	5.88	7.20	0.669	22.2	38.8361	34.07
10.991	455.989	22.23	0.86	3.88	10.07	31.361	3.992	2.69	31.27	4.00	4	135.00	0.687	0.687	0.000	1.207	5.93	7.15	0.667	22.17	39.7776	33.87
11.319	455.661	19.23	0.81	4.2	10.53	26.3739	4.373	2.77	26.27	4.39	4	135.00	0.709	0.702	0.007	1.193	5.35	6.39	0.573	19.16	44.2873	32.78
11.647	455.333	18	0.62	3.43	12.28	24.1809	3.590	2.74	24.07	3.61	5	135.00	0.731	0.714	0.017	1.183	4.93	5.84	0.535	17.92	42.7427	32.23
11.975	455.005	21.25	0.62	2.92	16.42	28.2301	3.025	2.64	28.09	3.04	5	135.00	0.753	0.726	0.027	1.174	5.53	6.49	0.635	21.15	37.4988	33.21
12.303	454.677	21.1	0.8	3.8	12.7	27.5413	3.936	2.73	27.43	3.95	4	135.00	0.775	0.736	0.038	1.164	5.73	6.67	0.629	21.02	41.8264	33.06
12.631	454.349	17.94	0.7	3.88	13.37	22.8604	4.083	2.80	22.74	4.11	4	135.00	0.798	0.750	0.048	1.155	5.06	5.85	0.531	17.85	45.3564	31.88
12.959	454.021	16.67	0.53	3.19	25.01	20.8069	3.344	2.78	20.60	3.38	5	135.00	0.820	0.762	0.058	1.146	4.63	5.30	0.491	16.51	44.5307	31.24
13.287	453.693	17.08	0.47	2.76	28.87	20.988	2.894	2.73	20.76	2.93	5	135.00	0.842	0.774	0.068	1.137	4.63	5.27	0.503	16.9	42.3273	31.30
13.615	453.365	15.98	0.45	2.79	32.33	19.2415	2.977	2.77	18.99	3.02	5	135.00	0.864	0.786	0.078	1.128	4.42	4.98	0.468	15.78	44.472	30.73
13.943	453.037	17	0.42	2.45	36.95	20.2055	2.606	2.72	19.92	2.64	5	135.00	0.886	0.797	0.089	1.120	4.57	5.11	0.499	16.77	41.6351	31.04
14.271	452.709	20.35	0.53	2.61	41.32	24.0198	2.726	2.67	23.70	2.76	5	135.00	0.908	0.809	0.099	1.112	5.33	5.93	0.602	20.09	39.0883	32.16
14.6	452.380	24.99	0.7	2.79	53.19	29.2928	2.909	2.63	28.89	2.95	5	135.00	0.931	0.821	0.109	1.103	6.39	7.05	0.745	24.66	36.5088	33.40
14.928	452.052	25.84	0.92	3.55	51.01	29.8677	3.697	2.69	29.48	3.74	5	135.00	0.953	0.833	0.119	1.095	6.82	7.47	0.771	25.52	39.7482	33.53
15.256	451.724	25.35	0.86	3.38	59.49	28.841	3.528	2.69	28.40	3.58	5	135.00	0.975	0.845	0.130	1.088	6.67	7.26	0.755	24.98	39.714	33.30

Depth (ft)	e El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.... (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	451.396	25.2	0.94	3.72	60.14	28.2395	3.884	2.72	27.80	3.95	5	135.00	0.997	0.857	0.140	1.080	6.75	7.29	0.749	24.82	41.5723	33.17
15.912	451.068	23.53	0.87	3.69	59.12	25.9052	3.865	2.75	25.48	3.93	5	135.00	1.019	0.869	0.150	1.073	6.39	6.86	0.697	23.16	43.0523	32.63
16.24	450.740	24.42	0.79	3.22	95.41	26.5403	3.379	2.71	25.87	3.47	5	135.00	1.041	0.881	0.160	1.065	6.44	6.86	0.724	23.63	40.8417	32.73
16.568	450.412	23.13	0.79	3.4	93.16	24.7167	3.580	2.75	24.07	3.68	5	135.00	1.063	0.893	0.171	1.058	6.22	6.59	0.683	22.55	43.0416	32.27
16.896	450.084	25.8	0.86	3.32	86.21	27.3182	3.480	2.70	26.73	3.56	5	135.00	1.086	0.905	0.181	1.051	6.81	7.16	0.765	25.27	40.6511	32.94
17.224	449.756	27.36	1.09	3.99	68.75	28.6411	4.152	2.74	28.17	4.22	4	135.00	1.108	0.917	0.191	1.045	7.39	7.72	0.813	26.93	42.4068	33.26
17.552	449.428	23.92	1.23	5.16	49.52	24.5451	5.397	2.86	24.21	5.47	3	135.00	1.130	0.929	0.201	1.038	6.94	7.20	0.706	23.61	49.6011	32.32
17.88	449.100	22.38	1.09	4.86	39.24	22.5732	5.135	2.87	22.31	5.20	3	135.00	1.152	0.940	0.212	1.031	6.55	6.75	0.657	22.13	50.2616	31.80
18.208	448.772	17.75	0.82	4.63	24.36	17.4059	4.947	2.94	17.25	4.99	3	135.00	1.174	0.952	0.222	1.025	5.43	5.57	0.513	17.6	54.7916	30.15
18.537	448.443	16.18	0.53	3.25	29.47	15.5391	3.537	2.89	15.35	3.58	5	135.00	1.196	0.964	0.232	1.018	4.79	4.88	0.464	16	51.4876	29.40
18.865	448.115	16.38	0.38	2.32	30.44	15.5318	2.506	2.80	15.34	2.54	5	135.00	1.218	0.976	0.242	1.012	4.61	4.66	0.469	16.19	46.1677	29.39
19.193	447.787	17.22	0.42	2.44	41.84	16.1723	2.628	2.80	15.91	2.67	5	135.00	1.241	0.988	0.253	1.006	4.83	4.86	0.495	16.96	46.1732	29.64
19.521	447.459	27.26	0.55	2.02	43.37	25.9979	2.116	2.58	25.73	2.14	6	135.00	1.263	1.000	0.263	1.000	6.82	6.82	0.805	26.99	34.2771	32.71
19.849	447.131	15.42	0.71	4.62	19.56	13.9691	5.023	3.02	13.85	5.07	3	135.00	1.285	1.012	0.273	0.994	4.95	4.93	0.438	15.3	59.9097	28.74
20.177	446.803	42.76	1.36	3.19	-1.64	40.4898	3.281	2.55	40.50	3.28	5	135.00	1.307	1.024	0.283	0.988	10.65	10.52	1.283	42.77	32.7842	35.49
20.505	446.475	21.33	1.36	6.39	-21.13	19.3115	6.800	2.99	19.44	6.76	3	135.00	1.329	1.036	0.293	0.983	6.83	6.71	0.619	21.46	58.031	30.94
20.833	446.147	94.63	4.34	4.59	-16.03	89.0402	4.653	2.42	89.14	4.65	11	135.00	1.351	1.048	0.304	0.977	22.25	21.74	2.688	94.73	27.3675	39.97
21.161	445.819	325.72	14.52	4.46	-12.24	306.129	4.477	2.11	306.20	4.48	11	135.00	1.373	1.060	0.314	0.972	67.01	65.10	10.042	325.8	16.2306	46.03
21.489	445.491	395.71	17.73	4.48	-7.11	368.031	4.496	2.08	368.07	4.50	12	135.00	1.396	1.071	0.324	0.966	80.29	77.56	12.208	395.75	15.201	46.84
21.817	445.163	424.33	18.21	4.29	-16.47	390.385	4.306	2.05	390.48	4.30	12	135.00	1.418	1.083	0.334	0.961	85.16	81.82	13.093	424.43	14.3837	47.09

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 21 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-4

ConeTec I Interpretation
Interpretatio put - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4501
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-4
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 12:51
CPT File: 804CP04.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 482.55

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	40.98	1.95	63.49	28.02	2.41

User Inputs:
Water Table Depth (ft): 21.7
Assumed: Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 482.6
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.386	18.72	0.55	2.92	-0.12	1825.34	2.940	1.70	1825.34	2.94	5	125.00	0.010	0.010	0.000	2.000	3.30	6.60	0.579	18.72	6.13882	52.96
0.492	482.058	32.37	1.04	3.2	7.35	1051.68	3.216	1.79	1050.38	3.22	5	125.00	0.031	0.031	0.000	2.000	5.87	11.75	1.001	32.33	7.80728	51.02
0.82	481.730	59.25	1.53	2.59	5.03	1155.1	2.585	1.68	1154.51	2.59	6	125.00	0.051	0.051	0.000	2.000	10.38	20.76	1.833	59.22	5.79663	51.36
1.148	481.402	69.32	1.89	2.73	-7.9	965.132	2.729	1.73	965.83	2.73	6	125.00	0.072	0.072	0.000	2.000	12.34	24.68	2.144	69.37	6.60102	50.71
1.476	481.074	55.93	1.68	3.01	-4.6	605.287	3.009	1.83	605.61	3.01	6	125.00	0.092	0.092	0.000	2.000	10.34	20.68	1.729	55.96	8.8217	48.91
1.804	480.746	47.44	1.34	2.82	-9.26	419.754	2.831	1.87	420.29	2.83	6	125.00	0.113	0.113	0.000	2.000	8.91	17.82	1.465	47.5	9.76493	47.40
2.133	480.417	31.92	1.13	3.53	-8.69	238.437	3.555	2.08	238.81	3.55	5	125.00	0.133	0.133	0.000	2.000	6.49	12.97	0.984	31.97	15.2078	44.89
2.461	480.089	34.91	0.98	2.81	-9.96	225.965	2.820	2.01	226.35	2.81	6	125.00	0.154	0.154	0.000	2.000	6.90	13.80	1.076	34.97	13.1573	44.64
2.789	479.761	22.26	0.83	3.71	-10	126.702	3.758	2.25	127.05	3.75	4	125.00	0.174	0.174	0.000	2.000	4.87	9.73	0.684	22.32	20.8802	41.81
3.117	479.433	18.96	0.9	4.76	-6.79	96.3244	4.796	2.41	96.58	4.78	3	125.00	0.195	0.195	0.000	2.000	4.44	8.88	0.581	19.01	26.8756	40.38
3.445	479.105	26.28	1.23	4.69	-6.97	121.055	4.719	2.35	121.24	4.71	3	125.00	0.215	0.215	0.000	2.000	5.97	11.94	0.807	26.32	24.2842	41.57
3.773	478.777	29.78	1.59	5.34	-8.66	125.287	5.382	2.38	125.50	5.37	3	125.00	0.236	0.236	0.000	2.000	6.88	13.77	0.915	29.83	25.7669	41.75
4.101	478.449	30.45	1.78	5.86	-8.64	117.8	5.895	2.43	118.00	5.89	3	125.00	0.256	0.256	0.000	1.975	7.19	14.21	0.935	30.5	27.7303	41.43
4.429	478.121	31.27	1.79	5.72	-10.05	111.965	5.775	2.44	112.22	5.76	3	125.00	0.277	0.277	0.000	1.901	7.41	14.08	0.960	31.34	27.9465	41.17
4.757	477.793	29.3	1.55	5.3	-9.47	97.5495	5.344	2.45	97.75	5.33	3	125.00	0.297	0.297	0.000	1.834	6.97	12.78	0.898	29.36	28.3092	40.45
5.085	477.465	29.53	1.58	5.36	-6.95	91.9164	5.409	2.47	92.07	5.40	3	125.00	0.318	0.318	0.000	1.774	7.09	12.57	0.904	29.58	29.17	40.13
5.413	477.137	29.07	1.51	5.21	-5.13	84.9265	5.256	2.48	85.02	5.25	3	125.00	0.338	0.338	0.000	1.719	7.01	12.05	0.890	29.1	29.6819	39.69
5.741	476.809	26.51	1.35	5.1	-4.32	72.8826	5.162	2.51	72.97	5.16	3	125.00	0.359	0.359	0.000	1.669	6.50	10.86	0.810	26.54	31.275	38.86
6.069	476.481	27.29	1.35	4.94	-2.56	70.946	5.017	2.51	71.00	5.01	3	125.00	0.379	0.379	0.000	1.624	6.69	10.86	0.833	27.31	31.1947	38.70
6.398	476.152	32.7	1.45	4.43	4.16	80.7756	4.489	2.44	80.70	4.49	4	125.00	0.400	0.400	0.000	1.581	7.73	12.23	1.000	32.67	28.0404	39.41
6.726	475.824	32.33	1.57	4.85	6.33	75.9075	4.920	2.49	75.81	4.93	3	125.00	0.420	0.420	0.000	1.542	7.81	12.05	0.988	32.29	30.1186	39.07
7.054	475.496	27.79	1.42	5.1	5.89	62.0337	5.192	2.56	61.97	5.20	3	125.00	0.441	0.441	0.000	1.506	6.96	10.49	0.847	27.76	33.5207	37.94
7.382	475.168	27.8	1.26	4.54	6.3	59.2547	4.609	2.54	59.17	4.62	4	125.00	0.461	0.461	0.000	1.472	6.88	10.13	0.846	27.76	32.3359	37.67
7.71	474.840	26.97	1.13	4.2	7.16	54.9689	4.266	2.53	54.89	4.27	4	125.00	0.482	0.482	0.000	1.441	6.66	9.60	0.820	26.93	32.2137	37.24
8.038	474.512	23.35	0.77	3.28	9.98	45.4792	3.370	2.52	45.36	3.38	5	125.00	0.502	0.502	0.000	1.411	5.72	8.07	0.707	23.29	31.5492	36.13
8.366	474.184	23.34	0.89	3.8	13.65	43.6378	3.901	2.58	43.47	3.92	4	125.00	0.523	0.523	0.000	1.383	5.88	8.13	0.706	23.25	34.2563	35.87
8.694	473.856	23.05	1.41	6.13	7.81	41.4201	6.265	2.74	41.33	6.28	3	125.00	0.543	0.543	0.000	1.357	6.32	8.58	0.697	23	42.6219	35.57
9.022	473.528	21.04	1.1	5.22	9.84	36.3132	5.372	2.73	36.21	5.39	3	125.00	0.564	0.564	0.000	1.332	5.74	7.65	0.634	20.98	42.147	34.77
9.35	473.200	24.56	1.13	4.61	14	41.0278	4.713	2.65	40.87	4.73	3	125.00	0.584	0.584	0.000	1.308	6.43	8.41	0.742	24.47	38.0684	35.50
9.678	472.872	29.72	1.6	5.4	18.45	48.1341	5.495	2.66	47.95	5.52	3	125.00	0.605	0.605	0.000	1.286	7.78	10.01	0.901	29.61	38.1091	36.45
10.006	472.544	27.78	1.68	6.06	20.23	43.4213	6.187	2.72	43.23	6.21	3	125.00	0.625	0.625	0.000	1.265	7.54	9.53	0.841	27.66	41.7217	35.84
10.335	472.215	35.02	2.44	6.96	1.71	53.2158	7.098	2.71	53.20	7.10	3	125.00	0.646	0.646	0.000	1.244	9.46	11.77	1.064	35.01	40.8687	37.06
10.663	471.887	39.84	2.72	6.82	-8.71	58.7805	6.943	2.67	58.86	6.93	3	125.00	0.666	0.666	0.000	1.225	10.58	12.96	1.213	39.89	38.9729	37.64
10.991	471.559	51.44	3.01	5.85	-13.44	73.8831	5.931	2.56	74.00	5.92	3	125.00	0.687	0.687	0.000	1.207	12.89	15.55	1.571	51.52	33.2411	38.93
11.319	471.231	49.73	3.35	6.74	-15.68	69.296	6.834	2.62	69.44	6.82	3	125.00	0.707	0.707	0.000	1.189	12.87	15.31	1.518	49.83	36.392	38.58
11.647	470.903	59.48	3.27	5.5	-19.93	80.7103	5.566	2.51	80.88	5.55	11	125.00	0.728	0.728	0.000	1.172	14.58	17.09	1.819	59.6	31.1331	39.42
11.975	470.575	59.84	3.39	5.67	-19.21	78.9532	5.737	2.53	79.11	5.73	11	125.00	0.748	0.748	0.000	1.156	14.78	17.09	1.829	59.96	31.8713	39.30
12.303	470.247	46.27	3.26	7.05	-21.45	59.1739	7.165	2.68	59.36	7.14	3	125.00	0.769	0.769	0.000	1.140	12.36	14.09	1.409	46.41	39.3681	37.69
12.631	469.919	60.74	3.55	5.84	-21.71	75.9409	5.922	2.55	76.12	5.91	11	125.00	0.789	0.789	0.000	1.125	15.17	17.07	1.856	60.88	32.8461	39.09
12.959	469.591	85.44	5.35	6.27	-21.04	104.49	6.322	2.49	104.65	6.31	11	125.00	0.810	0.810	0.000	1.111	20.71	23.01	2.620	85.57	30.0976	40.81
13.287	469.263	93.83	6.4	6.82	-21.32	111.989	6.882	2.50	112.16	6.87	11	125.00	0.830	0.830	0.000	1.097	22.88	25.10	2.879	93.97	30.668	41.17
13.615	468.935	109.07	7.14	6.54	-21.2	127.176	6.598	2.45	127.33	6.59	11	125.00	0.851	0.851	0.000	1.084	26.01	28.20	3.350	109.2	28.6543	41.83
13.943	468.607	131.31	8.27	6.3	-20.49	149.682	6.340	2.40	149.83	6.33	11	125.00	0.871	0.871	0.000	1.071	30.56	32.73	4.038	131.44	26.4331	42.65
14.271	468.279	130.51	8.58	6.57	-20.11	145.322	6.619	2.42	145.47	6.61	11	125.00	0.892	0.892	0.000	1.059	30.69	32.49	4.013	130.64	27.3685	42.50
14.6	467.950	121.15	8.14	6.72	-19.98	131.767	6.770	2.45	131.91	6.76	11	125.00	0.913	0.913	0.000	1.047	28.90	30.26	3.723	121.28	28.6919	42.01
14.928	467.622	117.27	7.69	6.56	-18.71	124.691	6.610	2.46	124.81	6.60	11	125.00	0.933	0.933	0.000	1.035	28.04	29.03	3.602	117.38	28.8952	41.72
15.256	467.294	114.14	8.49	7.43	-17.94	118.706	7.501	2.52	118.82	7.49	11	125.00	0.954	0.954	0.000	1.024	28.04	28.72	3.504	114.25	31.4374	41.47

R15704

Depth (ft)	..e El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.... (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.966	104.36	7.93	7.6	-18.2	106.146	7.670	2.55	106.27	7.66	11	125.00	0.974	0.974	0.000	1.013	26.08	26.43	3.201	104.48	33.0563	40.89
15.912	466.638	108.46	7.37	6.8	-18.02	108.06	6.858	2.51	108.17	6.85	11	125.00	0.995	0.995	0.000	1.003	26.53	26.60	3.327	108.57	31.0225	40.98
16.24	466.310	113.79	7.8	6.86	-17.9	111.108	6.916	2.50	111.22	6.91	11	125.00	1.015	1.015	0.000	0.993	27.78	27.58	3.491	113.9	30.8499	41.13
16.568	465.982	153.77	8.7	5.66	-14.55	147.498	5.696	2.37	147.59	5.69	11	125.00	1.036	1.036	0.000	0.983	35.20	34.59	4.729	153.86	25.0169	42.57
16.896	465.654	147.94	9.72	6.57	-6	139.095	6.617	2.43	139.13	6.62	11	125.00	1.056	1.056	0.000	0.973	34.93	33.99	4.547	147.98	27.8141	42.28
17.224	465.326	138.28	8.74	6.32	-8.2	127.453	6.370	2.44	127.51	6.37	11	125.00	1.077	1.077	0.000	0.964	32.76	31.58	4.248	138.34	28.1122	41.83
17.552	464.998	221.55	7.13	3.22	-7.74	200.96	3.234	2.09	201.01	3.23	12	125.00	1.097	1.097	0.000	0.955	45.08	43.04	6.625	221.6	15.4029	44.08
17.88	464.670	100.12	6.85	6.84	-12.15	88.5928	6.919	2.56	88.66	6.91	11	125.00	1.118	1.118	0.000	0.946	25.13	23.77	3.065	100.2	33.4931	39.92
18.208	464.342	76.59	4.86	6.34	-10.09	66.3023	6.441	2.61	66.36	6.44	11	125.00	1.138	1.138	0.000	0.937	19.73	18.50	2.336	76.66	36.0279	38.32
18.537	464.013	175.62	5.94	3.38	2.08	150.584	3.405	2.18	150.58	3.40	6	125.00	1.159	1.159	0.000	0.929	37.06	34.43	5.401	175.61	18.2355	42.67

R15705

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 24 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5

ConeTec , Interpretation
Interpretat. ,put - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4462
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 12:34
CPT File: 804CP05.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 482.55

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.49	1.51	49.57	22.51	2.24
125	Soil Embankment	27.37	1.95	65.50	63.68	3.04

User Inputs:
Assumed: Water Table Depth (ft): 34.4
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 482.6
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.386	8.56	0.05	0.59	-0.16	802.002	0.585	1.14	802.00	0.58	1	130.00	0.011	0.011	0.000	2.000	1.26	2.53	0.265	8.56	-1.0364	50.01
0.492	482.058	13.06	0.18	1.38	-0.41	407.38	1.382	1.61	407.69	1.38	6	130.00	0.032	0.032	0.000	2.000	2.23	4.47	0.403	13.07	4.50958	47.27
0.82	481.730	39.92	0.69	1.73	-0.58	747.968	1.731	1.58	748.16	1.73	7	130.00	0.053	0.053	0.000	2.000	6.75	13.50	1.234	39.93	3.96322	49.74
1.148	481.402	81.09	1.4	1.72	-0.71	1085.71	1.728	1.52	1085.84	1.73	7	130.00	0.075	0.075	0.000	2.000	13.47	26.93	2.508	81.1	3.13579	51.14
1.476	481.074	98.28	2.17	2.21	-0.39	1023.39	2.210	1.63	1023.39	2.21	7	130.00	0.096	0.096	0.000	2.000	16.92	33.85	3.040	98.28	4.87426	50.92
1.804	480.746	102.52	1.75	1.71	-0.72	873.296	1.709	1.55	873.38	1.71	7	130.00	0.117	0.117	0.000	2.000	17.17	34.33	3.170	102.53	3.50958	50.33
2.133	480.417	76.33	1.69	2.22	-0.49	549.543	2.218	1.73	549.61	2.22	7	130.00	0.139	0.139	0.000	2.000	13.59	27.18	2.359	76.34	6.64681	48.52
2.461	480.089	77.26	1.31	1.7	-0.51	481.981	1.699	1.65	481.98	1.70	7	130.00	0.160	0.160	0.000	2.000	13.39	26.78	2.387	77.26	5.20939	47.98
2.789	479.761	73.62	1.23	1.67	-0.64	405.101	1.675	1.68	405.10	1.67	7	130.00	0.181	0.181	0.000	2.000	12.90	25.80	2.274	73.62	5.78223	47.24
3.117	479.433	51.07	0.77	1.5	-1.11	251.067	1.514	1.76	251.07	1.51	7	130.00	0.203	0.203	0.000	2.000	9.20	18.40	1.576	51.07	7.33445	45.12
3.445	479.105	43.47	0.65	1.49	-0.99	193.127	1.503	1.83	193.17	1.50	7	130.00	0.224	0.224	0.000	2.000	8.03	16.06	1.339	43.48	8.80013	43.89
3.773	478.777	37.71	0.53	1.4	-1.27	152.765	1.415	1.88	152.81	1.41	7	130.00	0.246	0.245	0.000	2.000	7.09	14.18	1.160	37.72	9.89985	42.75
4.101	478.449	27.27	0.39	1.43	-1.04	101.302	1.444	2.01	101.34	1.44	6	130.00	0.267	0.267	0.000	1.937	5.39	10.44	0.838	27.28	13.2675	40.64
4.429	478.121	26.38	0.42	1.6	-1.23	90.6338	1.610	2.08	90.63	1.61	6	130.00	0.288	0.288	0.000	1.864	5.35	9.97	0.808	26.38	15.1944	40.04
4.757	477.793	18.36	0.58	3.17	-1.09	58.3781	3.213	2.43	58.38	3.21	5	130.00	0.309	0.309	0.000	1.798	4.32	7.77	0.559	18.36	27.4805	37.60
5.085	477.465	64.13	1.14	1.77	-1.43	193.025	1.787	1.89	193.05	1.79	7	130.00	0.331	0.331	0.000	1.739	12.10	21.04	1.975	64.14	10.1362	43.89
5.413	477.137	80.68	2.1	2.6	-1.02	228.306	2.614	1.98	228.33	2.61	6	130.00	0.352	0.352	0.000	1.686	15.74	26.54	2.487	80.69	12.3846	44.88
5.741	476.809	82.5	2.19	2.65	-0.19	220.082	2.667	2.00	220.08	2.67	6	130.00	0.373	0.373	0.000	1.637	16.19	26.51	2.543	82.5	12.8165	44.51
6.069	476.481	62.21	1.32	1.6	-0.88	207.398	1.613	1.84	207.40	1.61	7	130.00	0.394	0.394	0.000	1.592	15.20	24.21	2.533	62.21	8.89156	44.23
6.398	476.152	59.65	0.67	0.96	-0.92	166.48	0.968	1.74	166.50	0.97	8	130.00	0.416	0.416	0.000	1.551	12.44	19.28	2.143	59.66	6.80329	43.17
6.726	475.824	67.23	1.03	1.54	-0.61	152.778	1.542	1.91	152.78	1.54	7	130.00	0.437	0.437	0.000	1.512	12.76	19.91	2.068	67.23	10.5504	42.74
7.054	475.496	62.5	1.02	1.64	-0.74	135.311	1.644	1.96	135.33	1.64	7	130.00	0.459	0.459	0.000	1.477	12.12	17.90	1.921	62.51	11.9694	42.14
7.382	475.168	58.83	0.75	1.27	-0.83	121.606	1.285	1.92	121.61	1.29	7	130.00	0.480	0.480	0.000	1.444	11.22	16.20	1.807	58.83	10.669	41.59
7.71	474.840	46.66	0.49	1.05	-1.29	92.1059	1.062	1.95	92.11	1.06	7	130.00	0.501	0.501	0.000	1.413	9.02	12.74	1.429	46.66	11.7456	40.13
8.038	474.512	37.02	0.37	0.99	-0.74	69.8557	1.014	2.04	69.86	1.01	7	130.00	0.522	0.522	0.000	1.383	7.38	10.21	1.130	37.02	13.9486	38.61
8.366	474.184	26.15	0.38	1.46	-1.04	47.0884	1.484	2.27	47.11	1.48	6	130.00	0.544	0.544	0.000	1.356	5.75	7.79	0.793	26.16	21.5182	36.35
8.694	473.856	15.2	0.12	0.79	-0.81	25.8974	0.820	2.35	25.90	0.82	5	130.00	0.565	0.565	0.000	1.330	3.45	4.59	0.453	15.2	24.3631	32.69
9.022	473.528	13.51	0.23	1.67	-1.09	22.0377	1.760	2.59	22.04	1.78	5	130.00	0.586	0.586	0.000	1.306	3.43	4.48	0.400	13.51	34.6587	31.66
9.35	473.200	16.76	0.4	2.39	-2.31	26.5771	2.476	2.61	26.59	2.47	5	130.00	0.608	0.608	0.000	1.283	4.30	5.51	0.500	16.77	35.6064	32.86
9.678	472.872	59.24	0.76	1.29	-1.66	93.1708	1.297	2.01	93.19	1.30	7	130.00	0.629	0.629	0.000	1.261	11.68	14.73	1.815	59.25	13.14	40.19
10.006	472.544	72.22	0.96	1.33	-0.79	110.041	1.341	1.96	110.04	1.34	7	130.00	0.650	0.650	0.000	1.240	14.01	17.37	2.216	72.22	11.9861	41.07
10.335	472.215	64.71	1.11	1.72	-0.51	95.3269	1.733	2.09	95.33	1.73	7	130.00	0.672	0.672	0.000	1.220	13.16	16.06	1.983	64.71	16.3858	40.31
10.663	471.887	67.23	1.33	1.98	-0.56	95.9997	1.998	2.13	96.00	2.00	7	130.00	0.693	0.693	0.000	1.201	13.90	16.70	2.060	67.23	16.6515	40.35
10.991	471.559	52.16	1.16	2.22	-1.01	72.0108	2.255	2.25	72.01	2.25	6	130.00	0.714	0.714	0.000	1.183	11.36	13.44	1.593	52.16	20.8129	38.78
11.319	471.231	58.94	1.24	2.17	-1.8	76.392	2.206	2.23	76.41	2.21	6	130.00	0.736	0.736	0.000	1.166	12.28	14.31	1.740	58.95	19.9382	39.11
11.647	470.903	52.44	1.04	1.99	-1.08	68.2684	2.012	2.24	68.28	2.01	7	130.00	0.757	0.757	0.000	1.149	11.34	13.03	1.600	52.45	20.2013	38.48
11.975	470.575	33.75	0.91	2.69	-0.92	42.3596	2.760	2.48	42.37	2.76	6	130.00	0.778	0.778	0.000	1.133	8.15	9.23	1.021	33.76	29.8333	35.72
12.303	470.247	35.95	0.93	2.58	-2.38	43.9546	2.646	2.46	43.96	2.64	6	130.00	0.800	0.800	0.000	1.118	8.58	9.59	1.088	35.97	28.7745	35.94
12.631	469.919	39.85	0.73	1.84	-1.87	47.5375	1.870	2.33	47.55	1.87	6	130.00	0.821	0.821	0.000	1.104	8.99	9.92	1.208	39.86	23.739	36.40
12.959	469.591	38.57	0.32	0.82	-1.48	44.7894	0.848	2.15	44.80	0.85	7	130.00	0.842	0.842	0.000	1.090	8.05	8.76	1.168	38.58	17.3896	36.05
13.287	469.263	53.21	0.49	0.91	-0.83	60.6102	0.936	2.07	60.61	0.94	7	130.00	0.864	0.864	0.000	1.076	10.74	11.55	1.621	53.21	14.7902	37.81
13.615	468.935	34.3	0.61	1.77	-0.69	37.7582	1.826	2.40	37.77	1.82	6	130.00	0.885	0.885	0.000	1.063	7.99	8.49	1.035	34.31	26.6559	35.03
13.943	468.607	28.16	0.33	1.17	-0.69	30.0716	1.211	2.38	30.08	1.21	7	130.00	0.906	0.906	0.000	1.050	6.49	6.82	0.844	28.17	25.6033	33.63
14.271	468.279	26.64	0.48	1.79	-0.69	27.7188	1.867	2.52	27.72	1.87	6	130.00	0.928	0.928	0.000	1.038	6.54	6.79	0.796	26.64	31.4282	33.12
14.6	467.950	28.1	0.34	1.19	-0.97	28.6101	1.252	2.41	28.62	1.25	7	130.00	0.949	0.949	0.000	1.027	6.55	6.73	0.841	28.11	26.6607	33.32
14.928	467.622	26.73	0.36	1.33	-0.67	26.5476	1.998	2.46	26.55	1.40	8	130.00	0.970	0.970	0.000	1.015	6.39	6.48	0.798	26.73	28.915	32.64
15.256	467.294	39.54	0.32	0.81	-0.79	38.8733	0.830	2.20	38.88	0.83	7	130.00	0.992	0.992	0.000	1.004	8.42	8.46	1.193	39.55	18.9383	35.20

R15707

Depth (ft)	Sa...el. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.966	38.96	0.32	0.81	-0.78	37.4615	0.843	2.22	37.46	0.84	7	130.00	1.013	1.013	0.000	0.994	8.96	8.90	1.175	38.96	19.527	34.98
15.912	466.638	27.47	0.35	1.28	-0.74	25.5595	1.324	2.46	25.56	1.32	6	130.00	1.034	1.034	0.000	0.983	6.57	6.46	0.818	27.47	28.9508	32.60
16.24	466.310	23.18	0.23	0.99	-0.74	20.9591	1.040	2.48	20.97	1.04	6	130.00	1.056	1.056	0.000	0.973	5.59	5.44	0.685	23.19	29.75	31.34
16.568	465.982	22.71	0.18	0.77	-0.46	20.0879	0.832	2.45	20.09	0.83	7	130.00	1.077	1.077	0.000	0.964	5.40	5.20	0.670	22.71	28.4423	31.06
16.896	465.654	24.05	0.41	1.71	-0.53	20.8987	1.788	2.61	20.90	1.79	6	130.00	1.098	1.098	0.000	0.954	6.17	5.88	0.711	24.05	35.6268	31.31
17.224	465.326	23.09	0.43	1.87	-0.51	19.6242	1.957	2.65	19.63	1.96	6	130.00	1.120	1.120	0.000	0.945	6.06	5.73	0.680	23.1	37.8641	30.91
17.552	464.998	22.68	0.23	1.02	-0.74	18.8794	1.068	2.52	18.88	1.07	6	130.00	1.141	1.141	0.000	0.936	5.59	5.23	0.667	22.68	31.7842	30.65
17.88	464.670	21.11	0.44	2.07	-0.46	17.1638	2.206	2.73	17.16	2.21	6	130.00	1.162	1.162	0.000	0.928	5.77	5.35	0.618	21.11	41.9564	30.03
18.208	464.342	25.83	0.62	2.41	-1.27	20.8247	2.51557	2.69328	20.8332	2.51455	6	130.00	1.18352	1.18352	0	0.9192	6.929377	6.369515	0.76305	25.84	40.0978	31.295
18.537	464.013	26.98	0.58	2.14	-1.5	21.3918	2.25023	2.65503	21.4001	2.24936	6	130.00	1.20491	1.204905	0	0.911	7.09544	6.464023	0.79799	26.99	38.1085	31.468
18.865	463.685	32.84	0.54	1.65	-0.37	25.7814	1.70812	2.51953	25.7814	1.70812	6	130.00	1.22623	1.226225	0	0.9031	8.07106	7.288623	0.97875	32.84	31.5636	32.659
19.193	463.357	28.01	0.56	2	-0.64	21.4521	2.09248	2.63571	21.4521	2.09248	6	130.00	1.24755	1.247545	0	0.8953	7.291148	6.527814	0.82856	28.01	37.1276	31.484
19.521	463.029	42.38	0.77	1.81	-1.09	32.3999	1.87297	2.463	32.4078	1.87252	7	130.00	1.26887	1.268865	0	0.8878	10.14259	9.004115	1.27279	42.39	29.0567	34.09
19.849	462.701	48.13	0.77	1.59	-0.46	36.3047	1.6439	2.38956	36.3047	1.6439	7	130.00	1.29019	1.290185	0	0.8804	11.13334	9.801657	1.45015	48.13	25.9872	34.787
20.177	462.373	40.56	1.01	2.5	-0.3	29.9263	2.57335	2.67572	29.9263	2.57335	6	130.00	1.31151	1.311505	0	0.8732	10.24512	8.946066	1.21512	40.56	34.1844	33.596
20.505	462.045	53.08	1.3	2.45	-0.41	38.8252	2.51221	2.4824	38.8252	2.51221	6	130.00	1.33283	1.332825	0	0.8662	12.61671	11.10171	1.60206	53.08	29.9025	35.195
20.833	461.717	72.85	1.66	2.28	-0.37	52.7978	2.32181	2.35962	52.8052	2.32149	7	130.00	1.35415	1.354145	0	0.8593	16.62862	14.28971	2.21349	72.86	24.7953	37.018
21.161	461.389	86.65	1.75	2.02	-0.63	61.9969	2.0522	2.27196	62.0041	2.05195	7	130.00	1.37547	1.375465	0	0.8527	19.03348	16.22904	2.64008	86.66	21.4966	37.941
21.489	461.061	99.74	1.53	1.53	-0.42	70.4068	1.55578	2.15069	70.414	1.55562	8	130.00	1.39679	1.396785	0	0.8461	20.8237	17.61948	3.04468	99.75	17.3821	38.657
21.817	460.733	86.18	1.62	1.88	-0.48	59.7712	1.91124	2.26316	59.7712	1.91124	7	130.00	1.41811	1.418105	0	0.8397	18.85677	15.83482	2.62421	86.18	21.1809	37.732
22.145	460.405	86.56	1.53	1.77	-0.55	59.1351	1.79745	2.24908	59.1351	1.79745	7	130.00	1.43943	1.439425	0	0.8335	18.82642	15.69181	2.63531	86.56	20.681	37.67
22.473	460.077	83.42	1.73	2.08	-0.6	56.1078	2.1108	2.3123	56.1147	2.11055	7	130.00	1.46075	1.460745	0	0.8274	18.64714	15.42855	2.53744	83.43	22.9798	37.869
22.802	459.748	74.32	1.6	2.15	-0.97	49.144	2.19666	2.36683	49.1508	2.19636	7	130.00	1.48213	1.48213	0	0.8214	17.01887	13.97937	2.25504	74.33	25.0792	36.599
23.13	459.420	71.29	1.63	2.28	-0.64	46.4176	2.33569	2.40313	46.4176	2.33569	7	130.00	1.50345	1.503445	0	0.8156	16.59253	13.63219	2.16057	71.29	26.5386	36.262
23.458	459.092	64.8	1.34	2.07	-0.51	41.4982	2.11773	2.41227	41.5048	2.1174	7	130.00	1.52477	1.52477	0	0.8098	15.14737	12.26691	1.95899	64.81	26.9142	35.596
23.786	458.764	57.97	0.87	1.5	-0.49	36.4946	1.5419	2.37112	36.4946	1.5419	7	130.00	1.54609	1.54609	0	0.8042	13.2986	10.69519	1.74687	57.97	25.2493	34.819
24.114	458.436	57.68	0.89	1.55	-0.58	35.7996	1.5861	2.38513	35.7996	1.5861	7	130.00	1.56741	1.56741	0	0.7987	13.31578	10.63593	1.73723	57.68	25.809	34.702
24.442	458.108	51.01	0.65	1.27	-0.53	31.1074	1.31522	2.38788	31.1074	1.31522	7	130.00	1.58873	1.58873	0	0.7934	11.79061	9.354301	1.53007	51.01	25.9197	33.837
24.77	457.780	45.04	0.65	1.45	-0.56	26.9743	1.49666	2.47065	26.9743	1.49666	7	130.00	1.61005	1.61005	0	0.7881	10.81533	8.523542	1.34458	45.04	29.3882	32.945
25.098	457.452	51.99	0.93	1.79	-0.67	30.8689	1.84675	2.47611	30.875	1.84639	7	130.00	1.63137	1.63137	0	0.7829	12.51872	9.8013	1.55909	52	29.6264	33.79
25.426	457.124	48.03	1.05	2.18	-0.67	28.0617	2.26404	2.56273	28.0678	2.26355	6	130.00	1.65269	1.65269	0	0.7779	12.05714	9.378831	1.43583	48.04	32.567	33.195
25.754	456.796	45.32	0.59	1.29	-0.49	26.0727	1.35179	2.45827	26.0727	1.35179	7	130.00	1.67401	1.67401	0	0.7729	10.81969	8.362491	1.35127	45.32	28.8526	32.73
26.082	456.468	55.38	0.34	0.62	-0.74	31.6662	0.63333	2.21862	31.6662	0.63333	8	130.00	1.69533	1.69533	0	0.768	11.89086	9.132429	1.66206	55.38	19.6243	33.947
26.41	456.140	73.15	0.73	0.99	-0.26	41.6121	1.02193	2.22191	41.6121	1.02193	8	130.00	1.71665	1.71665	0	0.7632	15.72803	12.00421	2.21156	73.15	19.7367	35.612
26.739	455.811	74.59	0.95	1.27	-0.07	41.9163	1.30401	2.27962	41.9163	1.30401	6	130.00	1.73804	1.738035	0	0.7585	16.43655	12.46758	2.25548	74.59	21.7737	35.656
27.067	455.483	59.6	1.26	2.11	-0.34	32.8761	2.1784	2.49849	32.8761	2.1784	7	130.00	1.75936	1.759355	0	0.7539	14.50122	10.93271	1.79073	59.6	30.6157	34.179
27.395	455.155	62.45	1.36	2.18	-0.02	34.071	2.24166	2.4942	34.071	2.24166	7	130.00	1.78068	1.780675	0	0.7494	15.16369	11.36351	1.87831	62.45	30.4245	34.399
27.723	454.827	50.82	1.25	2.47	-0.46	27.2021	2.55008	2.60548	27.2021	2.55008	6	130.00	1.802	1.801995	0	0.7449	13.02823	9.705289	1.51759	50.82	35.6254	32.998
28.051	454.499	35	1.08	3.08	-1.09	18.1958	3.2553	2.80804	18.2013	3.25432	6	130.00	1.82332	1.823315	0	0.7406	9.989687	7.398114	1.02714	35.01	46.4587	30.416
28.379	454.171	33.92	1.21	3.56	0.14	17.3885	3.77237	2.86349	17.3885	3.77237	5	130.00	1.84464	1.844635	0	0.7363	9.98773	7.353796	0.99305	33.92	49.75	30.116
28.707	453.843	24.82	1.39	5.59	-20.74	12.3015	6.05558	3.10673	12.3712	6.02148	3	130.00	1.86596	1.865955	0	0.7321	8.543187	6.264165	0.71065	24.95	65.9662	27.853
29.035	453.515	30.38	1.32	4.36	-20.28	15.0973	4.63276	2.96484	15.1609	4.61333	4	125.00	1.88728	1.887275	0	0.7279	9.53739	6.942437	0.88213	30.5	56.1472	29.211
29.363	453.187	26.39	1.19	4.5	-19.63	12.8329	4.86067	3.03231	12.8958	4.83696	4	125.00	1.90778	1.907775	0	0.724	8.646449	6.259998	0.75796	26.51	60.6874	28.132
29.691	452.859	32.99	1.13	3.43	-15.73	16.1086	3.63792	2.87768	16.1604	3.62624	5	125.00	1.92828	1.928275	0	0.7201	9.823652	7.074381	0.96166	33.09	50.616	29.634
30.019	452.531	38.04	1.29	3.39	-14.99	18.52	3.57428	2.82578	18.5713	3.5644	5	125.00	1.94878	1.948775	0	0.7163	10.99164	7.873748	1.11738	38.14	47.4962	30.547
30.347	452.203	35.49	1.02	2.88	-14.16	17.0219	3.04289	2.8116	17.0676	3.03475	6	125.00	1.96928	1.969275	0	0.7126	10.17256	7.248986	1.03779	35.58	46.666	29.994
30.675	451.875	36.01	0.81	2.24	-13.42	17.0975	2.38094	2.74704	17.1377	2.37535	6	125.00	1.98978	1.989775	0	0.7089	9.958889	7.060069	1.05326	36.09	43.0037	30.021
31.004	451.546	30.49	0.67	2.19	-12.68	14.1666	2.35256	2.81069	14.2064	2.34597	6	125.00	2.01034	2.010338	0	0.7053	8.735746	6.161203	0.88172	30.57	46.6132	28.778
31.332	451.218	20.88	0.57	2.71	-12.47	9.28147	3.02401	3.02299	9.32087	3.01123	5	125.00	2.03084	2.030838	0	0.7017	6.795869	4.768781	0.58357	20.96	60.0464	25.941
31.66	450.890	16.5	0.4	2.43	-12.06	7.04353	2.76842	3.10136	7.08253	2.75318	5	125.00	2.05134	2.051338	0	0.6982	5.656888	3.949654	0.44733	16.58	65.5763	24.077
31.988	450.562	15.2	0.37	2.41	-11.71	6.33648	2.81837	3.1445	6.37027	2.80342	5	125.00	2.07184	2.071838	0	0.6947	5.364346	3.726824	0.40644	15.27	68.7573	23.359
32.316	450.234	13.42	0.31	2.32	-10.81	5.41388	2.73666	3.19603	5.44256	2.72224	5	125.00	2.09234	2.092338	0	0.6913	4.909323	3.393952	0.3507	13.48	72.6878	22.298
32.644	449.906	13.41	0.39	2.88	-10.09	5.34691	3.45219	3.25342	5.38005	3.43094	5	125.00	2.11284	2.112838	0	0.689	5.118563	3.521397	0.34976	13.48	77.2366	22.221
32.972	449.578	13.24	0.28	2.12	-7.72	5.20624	2.52101	3.19282	5.22968	2.50971	5	125.00	2.13334	2.133338	0	0.6847	4.829065	3.306232	0.34386	13.29	72.4383	22.031
33.3	449.250	15.29	0.27	1.74	-7.34	6.09896	2.05539	3.08974	6.11753	2.04916	6	125.00	2.15384	2.153838	0	0.6814	5.190141	3.536492	0.40669	15.33	64.7359	23.086
33.628	448.922	12.74	0.24	1.85	-6.3	4.85926	2.27151	3.19655	4.87765	2.26294	5	125.00	2.17434	2.174338	0	0.6782	4.656115	3.157623	0.32711	12.78	72.7283	21.565
33.956	448.594	15.46	0.33	2.14	-5.57	6.0438	2.48772	3.13551	6.05747	2.48211	5	125.00	2.19484	2.194838	0	0.675	5.408217	3.650504	0.41069	15.49	66.086	23.019
34.284	448.266	19.07	0.47	2.44	-5.31	7.60817	2.78855	3.07707	7.62171	2.78359	5	125.00	2.21534	2.215338	0	0.6719	6.41274	4.308476	0.52182	19.1	63.8284	24.575
34.612	447.938	20.99	0.5	2.36	-4.73	8.41287	2.66607	3.02992	8.42633	2.66182	5	135.00	2.23584	2.229223	0.0066	0.6698	6.845399	4.584817	0.58062	21.02	60.5225	25.259
34.941	447.609	25.65	0.82	3.18	-4.43	10.4374	3.50548	3.01977	10.4508	3.50099	5	135.00	2.25805	2.241166	0.0169	0.668	8.309312	5.550448	0.72421	25.68	59.8266	26.721
35.269	447.281	24.21	1.06	4.37	-9.81	9.73329	4.8336	3.12648	9.75992	4.82041	4	135.00	2.28019	2.253072	0.0271	0.6662	8.421758	5.610676	0.67894	24.27	67.4162	26.261
35.597	446.953	22.27	0.91	4.1	-14.16	8.81583	4.55737	3.14431	8.85557	4.53692	4	135.00	2.30233	2.264979	0.0373	0.6645	7.854004	5.218661	0.61819	22.36	68.7426	25.606
35.925	446.625	19.46	0.98	5.05	-13.21	7.52587	5.71911	3.25807	7.5654	5.68923	3	135.00	2.32447	2.276885	0.0476	0.6627	7.449111	4.936668	0.53051	19.55	77.6125	24.544
36.253	446.297	24.68	1.3	5.26	-11.24	9.75772	5.82088	3.17489	9.79268	5.8001	3	135.00	2.34661	2.288791	0.0578	0.661	8.883668	5.872043	0.69144	24.76	71.058	26.293
36.581	445.969	26.57	1.26	4.75	-10.88	10.5191	5.20634	3.11986	10.5452	5.19347	3	135.00	2.36875	2.300698	0.068	0.6593	9.199371	6.064966	0.74926	26.63	66.9282	26.796
36.909	445.641	22.11	0.92	4.17	-10.16	8.5268	4.66552	3.16289	8.55275	4.65137	4	135.00	2.39089	2.312604	0.0783	0.6576	7.887958	5.186973	0.6105	22.17	70.1433	25.384
37.237	445.313	21.91	0.71	3.22	-9.52	8.38756	3.64159	3.10571	8.41337	3.63042	5	135.00	2.41303	2.324511	0.0885	0.6559	7.517677	4.930806	0.60362	21.97	65.8921	25.277
37.565	444.985	23	0.88	3.81	-9.38	8.80187	4.27915	3.12957	8.82755	4.2667	4	135.00	2.43517	2.336417	0.0987	0.6542	8.018715	5.246016	0.63668	23.06	67.6451	25.605

Depth (ft)	Sc... ...el. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	rStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	444.657	19.45	0.95	4.9	-10	7.2361	5.59064	3.26674	7.26165	5.57097	3	135.00	2.45731	2.348323	0.109	0.6526	7.482229	4.88261	0.52609	19.51	78.3181	24.29
38.221	444.329	18.24	0.79	4.34	-9.37	6.67755	5.01251	3.26644	6.70297	4.9935	3	135.00	2.47945	2.36023	0.1192	0.6509	7.016591	4.567189	0.48794	18.3	76.2934	23.755
38.549	444.001	21.57	0.78	3.6	-8.87	8.0385	4.09053	3.14988	8.06379	4.0777	5	135.00	2.50159	2.372136	0.1294	0.6493	7.626794	4.951904	0.59035	21.63	69.1608	25.004
38.877	443.673	18.25	0.67	3.65	-8.11	6.59647	4.26039	3.2302	6.61745	4.24688	4	135.00	2.52373	2.384043	0.1397	0.6477	6.83099	4.424117	0.48688	18.3	75.3741	23.677
39.206	443.344	20.75	0.81	3.91	-7.44	7.59774	4.44956	3.19132	7.61861	4.43737	4	135.00	2.54593	2.395985	0.1499	0.646	7.549899	4.87752	0.56359	20.8	72.3227	24.628
39.534	443.016	21.68	1.16	5.34	-5.68	7.9372	6.06951	3.25744	7.95382	6.05683	3	135.00	2.56807	2.407892	0.1602	0.6444	8.272102	5.330862	0.5917	21.72	77.562	24.921
39.862	442.688	22.71	1.16	5.1	-5.2	8.31466	5.76547	3.22788	8.33119	5.75403	3	135.00	2.59021	2.419798	0.1704	0.6429	8.477683	5.449889	0.6229	22.75	75.1893	25.237
40.19	442.360	28.63	1.19	4.17	-3.31	10.6993	4.57382	3.08047	10.7076	4.57031	4	135.00	2.61235	2.431705	0.1806	0.6413	9.640615	6.18229	0.8055	28.65	64.071	26.927
40.518	442.032	28.19	1.27	4.52	-2.28	10.4581	4.96957	3.11062	10.4622	4.96763	4	135.00	2.63449	2.443611	0.1909	0.6397	9.6813	6.193237	0.79119	28.2	66.2507	26.774
40.846	441.704	26.69	1.27	4.77	-1.8	9.7875	5.28432	3.14971	9.79157	5.28212	3	135.00	2.65663	2.455517	0.2011	0.6382	9.413383	6.007229	0.74407	26.7	69.146	26.331
41.174	441.376	24.58	1.31	5.34	-1.94	8.87615	5.9814	3.21633	8.8802	5.97867	3	135.00	2.67877	2.467424	0.2113	0.6366	9.086888	5.784866	0.67806	24.59	74.2759	25.678
41.502	441.048	24.83	1.39	5.59	-2.79	8.92543	6.28133	3.22741	8.9335	6.27565	3	135.00	2.70091	2.47933	0.2216	0.6351	9.257119	5.879071	0.68511	24.85	75.1525	25.721
41.83	440.720	23.62	1.17	4.95	-2.61	8.38818	5.5989	3.21797	8.3922	5.59623	3	135.00	2.72305	2.491237	0.2318	0.6336	8.742523	5.538974	0.64696	23.63	74.4055	25.304
42.158	440.392	24.48	0.98	4.01	-1.99	8.68301	4.5089	3.14929	8.687	4.50682	4	135.00	2.74519	2.503143	0.242	0.6321	8.631702	5.455739	0.6729	24.49	69.1162	25.538
42.486	440.064	22.76	1.14	5	-2.06	7.94921	5.70209	3.24129	7.95319	5.69924	3	135.00	2.76733	2.515049	0.2523	0.6306	8.568914	5.403219	0.61897	22.77	76.2598	24.949
42.814	439.736	20.25	0.99	4.9	-0.12	6.90971	5.66993	3.28858	6.90971	5.66993	3	135.00	2.78947	2.526956	0.2625	0.6291	7.89536	4.95676	0.54057	20.25	80.1137	24.011
43.143	439.407	14.05	0.79	5.63	-0.05	4.42646	7.02952	3.49955	4.42646	7.02952	3	135.00	2.81168	2.538898	0.2728	0.6276	6.528217	4.097056	0.34794	14.05	98.8834	21.08
43.471	439.079	11.7	0.65	5.57	1.64	3.47584	7.33123	3.59605	3.47192	7.33951	3	135.00	2.83382	2.550805	0.283	0.6261	5.953759	3.7278	0.27449	11.69	100	19.54
43.799	438.751	14.29	0.66	4.63	1.87	4.4617	5.77224	3.4474	4.45779	5.77729	3	135.00	2.85596	2.562711	0.2932	0.6247	6.334906	3.957221	0.354	14.28	93.9984	21.135
44.127	438.423	16.74	0.83	4.94	0.9	5.38406	5.98764	3.38977	5.38406	5.98764	3	135.00	2.8781	2.574618	0.3035	0.6232	7.072565	4.407787	0.42916	16.74	88.7893	22.371
44.455	438.095	16.83	0.84	5	0.58	5.38551	6.03025	3.39149	5.38551	6.03025	3	135.00	2.90024	2.586524	0.3137	0.6218	7.120717	4.427571	0.43126	16.83	88.9421	22.377
44.783	437.767	14.82	0.61	4.12	1.29	4.57877	5.12708	3.40827	4.57877	5.12708	3	135.00	2.92238	2.59843	0.3239	0.6204	6.358557	3.9446	0.36835	14.82	90.4396	21.323
45.111	437.439	17.14	0.44	2.57	3.14	5.43818	3.09958	3.22672	5.43052	3.10395	5	135.00	2.94452	2.610337	0.3342	0.6189	6.374336	3.94536	0.43949	17.12	75.0978	22.44
45.439	437.111	33.51	1.27	3.8	6.51	11.6478	4.15803	3.02727	11.6325	4.16348	5	135.00	2.96666	2.622243	0.3444	0.6175	10.88157	6.719778	0.94561	33.47	60.3406	27.515
45.767	436.783	58.12	2.69	4.62	3.76	20.9294	4.87927	2.87443	20.9218	4.88104	4	135.00	2.9888	2.63415	0.3547	0.6161	17.21601	10.60748	1.70685	58.1	50.4166	31.363
46.095	436.455	62.76	3.68	5.86	-7.46	22.588	6.15703	2.91763	22.6069	6.15189	11	135.00	3.01094	2.646056	0.3649	0.6148	19.09563	11.73909	1.85044	62.83	53.1048	31.86
46.423	436.127	83.6	4.9	5.86	-7.76	30.3115	6.0819	2.82272	30.3303	6.07813	11	135.00	3.03308	2.657962	0.3751	0.6134	24.06568	14.76127	2.49433	83.65	47.316	33.709
46.751	435.799	294.51	7.43	2.52	-2.96	109.164	2.54928	2.16692	109.168	2.54919	7	135.00	3.05522	2.669869	0.3854	0.612	61.8938	37.87932	9.02337	294.52	17.9036	41.036
47.079	435.471	443.15	13.54	3.06	-9.68	164.098	3.07676	2.11943	164.12	3.07635	12	135.00	3.07736	2.681775	0.3956	0.6106	91.3583	55.78749	13.6245	443.21	16.4028	43.103
47.408	435.142	441.36	16.48	3.73	-14.99	162.697	3.76032	2.19234	162.734	3.75946	12	135.00	3.09957	2.693718	0.4058	0.6093	93.75299	57.12275	13.5684	441.46	18.7382	43.062
47.736	434.814	430.27	19.31	4.49	-16.14	157.874	4.52068	2.2656	157.911	4.51962	12	135.00	3.12171	2.705624	0.4161	0.6079	94.26613	57.30888	13.2244	430.37	21.268	42.913
48.064	434.486	369.54	18.25	4.94	-18.24	134.827	4.98095	2.33911	134.867	4.97945	11	135.00	3.14385	2.717531	0.4263	0.6066	83.59886	50.71228	11.3435	369.65	23.9983	42.124
48.392	434.158	373.72	19.14	5.12	-23.12	135.762	5.16524	2.35029	135.817	5.16315	11	135.00	3.16599	2.729437	0.4366	0.6053	84.97333	51.4335	11.4723	373.87	24.4307	42.16
48.72	433.830	313.66	15.82	5.04	-20.02	113.255	5.09547	2.39117	113.303	5.09334	11	135.00	3.18813	2.741344	0.4468	0.604	72.63847	43.87175	9.61213	313.79	26.0526	41.23

R15709

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 28 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY TJS DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5A

ConeTec In Interpretation
Interpretation ...t - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4429
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5A
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 10:44
CPT File: 804CP05A.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 483

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	35.73	1.11	36.82	24.15	2.29
125	Soil Embankment	28.29	1.43	48.95	56.29	2.94

User Inputs:
Water Table Depth (ft): 35.9
Ground Surface Elev. 483.0
Assumed: Nk: 32.3
State Parameter: 1.2
CPT area ratio: 0.85
Unit Weight of Soil (pcf): Varies See Below
See Below
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.836	25.42	0.16	0.61	-0.04	2383.62	0.630	1.02	2383.62	0.63	7	130.00	0.011	0.011	0.000	2.000	3.63	7.27	0.787	25.42	1.8137	53.84
0.492	482.508	30.63	0.26	0.83	0.09	956.786	0.850	1.25	956.79	0.85	7	130.00	0.032	0.032	0.000	2.000	4.67	9.35	0.947	30.63	-0.0948	50.67
0.82	482.180	34.85	0.47	1.34	0.02	652.846	1.351	1.50	652.85	1.35	7	130.00	0.053	0.053	0.000	2.000	5.75	11.50	1.077	34.85	2.85185	49.21
1.148	481.852	45.55	0.61	1.33	0.55	609.426	1.341	1.51	609.43	1.34	7	130.00	0.075	0.075	0.000	2.000	7.54	15.08	1.408	45.55	3.00348	48.93
1.476	481.524	30.66	0.46	1.49	-0.16	318.575	1.505	1.70	318.57	1.51	6	130.00	0.096	0.096	0.000	2.000	5.40	10.81	0.946	30.66	6.10537	46.20
1.804	481.196	25.49	0.36	1.4	-0.21	216.38	1.419	1.78	216.38	1.42	6	130.00	0.117	0.117	0.000	2.000	4.62	9.24	0.786	25.49	7.70894	44.43
2.133	480.867	24.98	0.31	1.22	0.07	179.172	1.248	1.79	179.17	1.25	6	130.00	0.139	0.139	0.000	2.000	4.55	9.10	0.769	24.98	7.96054	43.53
2.461	480.539	22	0.24	1.07	-0.37	136.53	1.099	1.84	136.53	1.10	6	130.00	0.160	0.160	0.000	2.000	4.07	8.14	0.676	22	8.91183	42.18
2.789	480.211	19.96	0.2	1	-0.25	109.103	1.011	1.88	109.10	1.01	6	130.00	0.181	0.181	0.000	2.000	3.76	7.52	0.612	19.96	10.022	41.03
3.117	479.883	16.87	0.21	1.22	-0.14	82.2655	1.260	2.04	82.27	1.26	6	130.00	0.203	0.203	0.000	2.000	3.37	6.74	0.516	16.87	14.0492	39.52
3.445	479.555	27.63	0.29	1.05	-0.81	122.39	1.058	1.86	122.39	1.06	7	130.00	0.224	0.224	0.000	2.000	5.16	10.31	0.848	27.63	9.45051	41.62
3.773	479.227	28.29	0.55	1.95	-0.9	114.354	1.961	2.07	114.39	1.96	6	130.00	0.245	0.245	0.000	2.000	5.72	11.43	0.868	28.3	14.8825	41.27
4.101	478.899	31.49	0.42	1.32	-0.58	117.133	1.345	1.94	117.17	1.34	7	130.00	0.267	0.267	0.000	1.937	6.07	11.75	0.967	31.5	11.5005	41.40
4.429	478.571	21.53	0.34	1.58	-0.26	73.7868	1.601	2.14	73.79	1.60	6	130.00	0.288	0.288	0.000	1.864	4.48	8.35	0.658	21.53	17.1574	38.92
4.757	478.243	20.69	0.25	1.19	-1.01	65.9135	1.227	2.11	65.95	1.23	6	130.00	0.309	0.309	0.000	1.798	4.24	7.83	0.631	20.7	16.0068	38.29
5.085	477.915	15.26	0.33	2.14	-1.38	45.169	2.210	2.40	45.20	2.21	5	130.00	0.331	0.331	0.000	1.739	3.54	6.16	0.462	15.27	26.2447	36.10
5.413	477.587	14.21	0.29	2.05	-1.25	39.3871	2.093	2.43	39.39	2.09	5	130.00	0.352	0.352	0.000	1.686	3.34	5.64	0.429	14.21	27.5061	35.28
5.741	477.259	24.82	0.37	1.47	-0.26	65.5121	1.513	2.17	65.51	1.51	6	130.00	0.373	0.373	0.000	1.637	5.22	8.54	0.757	24.82	17.8966	38.25
6.069	476.931	37.94	0.39	1.02	-1.27	95.176	1.039	1.94	95.20	1.04	7	130.00	0.394	0.394	0.000	1.592	7.29	11.60	1.162	37.95	11.3095	40.30
6.398	476.602	38.71	0.49	1.26	-0.12	92.082	1.280	2.01	92.08	1.28	7	130.00	0.416	0.416	0.000	1.551	7.63	11.84	1.186	38.71	13.1428	40.13
6.726	476.274	62.69	0.91	1.45	-0.74	142.393	1.462	1.91	142.42	1.46	7	130.00	0.437	0.437	0.000	1.512	11.92	16.03	1.927	62.7	10.6517	42.99
7.054	475.946	61.96	1.01	1.63	-0.67	134.133	1.642	1.97	134.16	1.64	7	130.00	0.459	0.459	0.000	1.477	12.03	17.76	1.904	61.97	12.0278	42.09
7.382	475.618	77.1	0.92	1.19	-1.34	159.682	1.201	1.81	159.70	1.20	8	130.00	0.480	0.480	0.000	1.444	14.16	20.43	2.372	77.11	8.43681	42.96
7.71	475.290	60.49	0.84	1.38	-0.67	119.702	1.400	1.95	119.72	1.40	7	130.00	0.501	0.501	0.000	1.413	11.67	16.49	1.857	60.5	11.6404	41.51
8.038	474.962	43.58	0.42	0.95	-0.41	82.3732	0.976	1.97	82.39	0.98	7	130.00	0.522	0.522	0.000	1.383	8.47	11.72	1.332	43.57	12.1295	39.52
8.366	474.634	31.78	0.35	1.09	-0.72	57.4417	1.120	2.13	57.44	1.12	7	130.00	0.544	0.544	0.000	1.356	6.58	8.92	0.967	31.78	16.7393	37.60
8.694	474.306	23.44	0.25	1.07	-0.83	40.4767	1.093	2.25	40.50	1.09	6	130.00	0.565	0.565	0.000	1.330	5.10	6.78	0.706	23.45	20.6373	35.45
9.022	473.978	14.75	0.2	1.33	-1.36	24.1522	1.412	2.50	24.17	1.41	6	130.00	0.586	0.586	0.000	1.306	3.59	4.68	0.439	14.76	30.5056	32.25
9.35	473.650	18.93	0.1	0.53	-1.34	30.1477	0.546	2.21	30.16	0.55	7	130.00	0.608	0.608	0.000	1.283	4.05	5.19	0.567	18.94	19.2809	33.65
9.678	473.322	14.31	0.1	0.7	-0.39	21.7479	0.731	2.39	21.75	0.73	6	130.00	0.629	0.629	0.000	1.261	3.31	4.16	0.424	14.31	26.0949	31.57
10.006	472.994	13.41	0.1	0.75	-0.53	19.6184	0.784	2.45	19.63	0.78	6	130.00	0.650	0.650	0.000	1.240	3.18	3.95	0.395	13.42	28.3013	30.91
10.335	472.665	9.07	0.17	1.82	-0.74	12.5015	2.024	2.82	12.50	2.02	5	130.00	0.672	0.672	0.000	1.220	2.61	3.18	0.260	9.07	47.2437	27.92
10.663	472.337	9.3	0.05	0.54	-0.39	12.4161	0.581	2.57	12.42	0.58	1	130.00	0.693	0.693	0.000	1.201	2.34	2.82	0.266	9.3	33.9922	27.88
10.991	472.009	8.69	0.07	0.81	-0.46	11.1638	0.878	2.69	11.16	0.88	5	130.00	0.714	0.714	0.000	1.183	2.32	2.75	0.247	8.69	39.7705	27.16
11.319	471.681	6.9	0.07	0.94	-0.74	8.37638	1.136	2.85	8.38	1.14	1	130.00	0.736	0.736	0.000	1.166	2.01	2.35	0.191	6.9	48.8316	25.22
11.647	471.353	8.91	0.09	1.01	-0.44	10.7693	1.104	2.75	10.77	1.10	5	130.00	0.757	0.757	0.000	1.149	2.46	2.82	0.252	8.91	42.9199	26.92
11.975	471.025	18.87	0.21	1.09	-0.26	23.2428	1.161	2.46	23.26	1.16	6	130.00	0.778	0.778	0.000	1.133	4.52	5.12	0.560	18.88	29.1282	32.00
12.303	470.697	19.57	0.24	1.23	-0.51	23.4718	1.279	2.48	23.48	1.28	6	130.00	0.800	0.800	0.000	1.118	4.73	5.29	0.581	19.58	29.9383	32.07
12.631	470.369	17.34	0.28	1.62	-0.51	20.1202	1.695	2.61	20.13	1.69	6	130.00	0.821	0.821	0.000	1.104	4.45	4.91	0.511	17.35	35.652	31.07
12.959	470.041	19.9	0.26	1.28	-0.3	22.6248	1.364	2.51	22.62	1.36	6	130.00	0.842	0.842	0.000	1.090	4.87	5.31	0.590	19.9	31.2276	31.83
13.287	469.713	30.28	0.23	0.76	-0.3	34.0603	0.782	2.23	34.06	0.78	7	130.00	0.864	0.864	0.000	1.076	6.55	7.04	0.911	30.28	20.1787	34.40
13.615	469.385	38.96	0.31	0.78	-0.41	43.0238	0.814	2.16	43.02	0.81	7	130.00	0.885	0.885	0.000	1.063	8.15	8.67	1.179	38.98	17.5679	35.81
13.943	469.057	33.22	0.36	1.07	-0.44	35.6547	1.114	2.30	35.65	1.11	7	130.00	0.906	0.906	0.000	1.050	7.38	7.75	1.000	33.22	22.4677	34.68
14.271	468.729	32.32	0.37	1.13	-0.62	33.842	1.179	2.33	33.84	1.18	7	130.00	0.928	0.928	0.000	1.038	7.28	7.66	0.972	32.32	23.6858	34.36
14.6	468.400	25.81	0.32	1.24	-0.3	26.197	1.267	2.44	26.20	1.29	6	130.00	0.949	0.949	0.000	1.027	6.12	6.29	0.770	25.81	28.2811	32.76
14.928	468.072	26.82	0.29	1.08	-0.97	26.6404	1.122	2.41	26.65	1.12	7	130.00	0.970	0.970	0.000	1.015	6.25	6.35	0.800	26.83	26.6786	32.87
15.256	467.744	27.37	0.29	1.06	-0.53	26.6007	1.099	2.40	26.61	1.10	7	130.00	0.992	0.992	0.000	1.004	6.37	6.40	0.817	27.38	26.5119	32.86

27 of 45
R15711

Depth (ft)	Sa... el. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	467.416	27.05	0.21	0.76	-0.81	25.7039	0.807	2.35	25.71	0.81	7	130.00	1.013	1.013	0.000	0.994	6.14	6.10	0.806	27.06	24.3313	32.64
15.912	467.088	23.69	0.19	0.78	-0.58	21.9048	0.839	2.42	21.91	0.84	7	130.00	1.034	1.034	0.000	0.983	5.55	5.46	0.701	23.7	27.103	31.62
16.24	466.760	39.57	0.35	0.87	-0.32	36.4858	0.909	2.24	36.50	0.91	7	130.00	1.056	1.056	0.000	0.973	8.58	8.35	1.192	39.58	20.444	34.62
16.568	466.432	74.07	1.13	1.52	0	67.7795	1.548	2.16	67.78	1.55	7	130.00	1.077	1.077	0.000	0.964	15.53	14.97	2.260	74.07	17.7393	38.44
16.896	466.104	66.69	1.62	2.43	-0.62	59.7244	2.470	2.34	59.72	2.47	6	130.00	1.098	1.098	0.000	0.954	15.08	14.39	2.031	66.69	23.9649	37.73
17.224	465.776	65.22	1.33	2.04	-0.58	57.255	2.075	2.30	57.26	2.07	7	130.00	1.120	1.120	0.000	0.945	14.50	13.71	1.985	65.22	22.5529	37.49
17.552	465.448	57.68	1.09	1.89	-0.39	49.5575	1.928	2.33	49.56	1.93	7	130.00	1.141	1.141	0.000	0.936	12.98	12.15	1.750	57.68	23.5396	36.65
17.88	465.120	32	1.01	3.16	-0.39	26.534	3.275	2.68	26.53	3.28	5	130.00	1.162	1.162	0.000	0.928	8.53	7.92	0.955	32	39.5519	32.84
18.208	464.792	51.85	0.91	1.76	-3.51	42.81	1.79606	2.35635	42.8269	1.79535	7	130.00	1.18352	1.18352	0	0.9192	11.82081	10.86583	1.56862	51.87	24.5674	35.784
18.537	464.463	43.9	1.02	2.33	-7.82	35.4344	2.38903	2.49787	35.4759	2.38624	6	130.00	1.20491	1.204905	0	0.911	10.69025	9.739936	1.32183	43.95	30.5677	34.646
18.865	464.135	23.27	0.79	3.4	-2.63	17.9769	3.58378	2.83772	17.9933	3.58053	5	130.00	1.22623	1.226225	0	0.9031	6.757445	6.102354	0.68247	23.29	48.2023	30.34
19.193	463.807	39.72	0.64	1.62	-1.94	30.8385	1.66353	2.44929	30.8546	1.66266	7	130.00	1.24755	1.247545	0	0.8953	9.447888	8.458758	1.1911	39.74	28.4675	33.786
19.521	463.479	50.04	1.09	2.17	-2.24	38.4368	2.23493	2.45278	38.4447	2.23447	8	130.00	1.26887	1.268865	0	0.8878	11.91839	10.58059	1.50994	50.05	28.617	36.135
19.849	463.151	60.08	1.06	1.76	-0.18	45.567	1.80303	2.33657	45.567	1.80303	7	130.00	1.29019	1.290185	0	0.8804	13.57227	11.94886	1.82012	60.08	23.9008	36.153
20.177	462.823	52.92	0.86	1.24	0.07	39.3506	1.27886	2.29701	39.3506	1.27886	7	130.00	1.31151	1.311505	0	0.8732	11.74944	10.25965	1.59779	52.92	22.4107	35.276
20.505	462.495	36.79	0.47	1.27	-0.14	26.603	1.32554	2.44629	26.603	1.32554	7	130.00	1.33283	1.332825	0	0.8662	8.734366	7.565825	1.09775	36.79	28.3387	32.858
20.833	462.167	44.24	0.4	0.91	-0.16	31.6701	0.93271	2.30063	31.6701	0.93271	7	130.00	1.35415	1.354145	0	0.8593	9.838615	8.454762	1.32774	44.24	22.5522	33.948
21.161	461.839	38.42	0.52	1.36	-0.21	26.9324	1.40372	2.45559	26.9324	1.40372	7	130.00	1.37547	1.375465	0	0.8527	9.160918	7.811137	1.14689	38.42	28.7374	32.935
21.489	461.511	36.09	0.66	1.83	-0.49	24.8379	1.90239	2.55989	24.8379	1.90239	6	130.00	1.39679	1.396785	0	0.8461	9.045296	7.653463	1.07409	36.09	33.4329	32.423
21.817	461.183	32.39	0.51	1.56	-0.46	21.8403	1.64665	2.5698	21.8403	1.64665	6	130.00	1.41811	1.418105	0	0.8397	8.157585	6.850266	0.95888	32.39	33.9021	31.599
22.145	460.855	35.52	0.56	1.58	-0.65	23.6765	1.64316	2.54029	23.6765	1.64316	7	130.00	1.43943	1.439425	0	0.8335	8.817705	7.349555	1.05513	35.52	32.5166	32.117
22.473	460.527	48.51	0.94	1.93	-0.44	32.2091	1.99791	2.48214	32.2159	1.99748	7	130.00	1.46075	1.460745	0	0.8274	11.71422	9.692283	1.45663	48.52	29.8912	34.054
22.802	460.198	40.72	0.8	1.97	-0.09	26.474	2.03885	2.55538	26.474	2.03885	6	130.00	1.48213	1.48213	0	0.8214	10.1832	8.364521	1.21479	40.72	33.2208	32.827
23.13	459.870	34.78	0.69	1.97	-0.11	22.1335	2.07353	2.62238	22.1335	2.07353	6	130.00	1.50345	1.50345	0	0.8156	8.99242	7.333851	1.03023	34.78	36.4607	31.685
23.458	459.542	27.98	0.71	2.53	-0.02	17.3503	2.68378	2.77387	17.3503	2.68378	6	130.00	1.52477	1.52477	0	0.8098	7.83439	6.344582	0.81905	27.98	44.5023	30.102
23.786	459.214	34.88	0.64	1.83	-0.21	21.5601	1.91997	2.61226	21.5601	1.91997	6	130.00	1.54609	1.54609	0	0.8042	8.972323	7.215851	1.03201	34.88	35.9587	31.516
24.114	458.886	34.14	0.66	1.92	-0.04	20.7812	2.02624	2.63881	20.7812	2.02624	6	130.00	1.56741	1.56741	0	0.7987	8.900875	7.109538	1.00844	34.14	37.284	31.278
24.442	458.558	46.63	0.8	1.71	-0.12	28.3505	1.77615	2.49588	28.3505	1.77615	7	130.00	1.58873	1.58873	0	0.7934	11.33143	8.989997	1.39447	46.63	30.4993	33.258
24.77	458.230	37.3	0.79	2.12	-0.44	22.167	2.21351	2.63841	22.1732	2.21289	6	130.00	1.61005	1.61005	0	0.7881	9.725366	7.664543	1.10495	37.31	37.2636	31.697
25.098	457.902	36.41	0.89	2.45	-0.32	21.3187	2.55904	2.6899	21.3187	2.55904	6	130.00	1.63137	1.630137	0	0.7829	9.746595	7.630917	1.07674	36.41	39.8193	31.443
25.426	457.574	48.8	0.86	1.76	-0.18	28.5276	1.82407	2.50053	28.5276	1.82407	7	130.00	1.65269	1.65269	0	0.7779	11.88499	9.244918	1.45967	48.8	30.7065	33.297
25.754	457.246	74.39	0.71	0.96	-0.07	43.4382	0.9764	2.19543	43.4382	0.9764	8	130.00	1.67401	1.67401	0	0.7729	15.81851	12.22606	2.25127	74.39	18.841	35.869
26.082	456.918	60.47	1.1	1.82	-0.18	34.6686	1.87155	2.43963	34.6686	1.87155	7	130.00	1.69533	1.69533	0	0.768	14.31205	10.99195	1.81965	60.47	28.0573	34.505
26.41	456.590	80.94	0.74	0.91	-0.04	46.15	0.93407	2.16287	46.15	0.93407	8	130.00	1.71665	1.71665	0	0.7632	16.98142	12.96084	2.45274	80.94	17.7728	36.228
26.739	456.261	80.42	0.62	0.77	-0.07	45.2706	0.78798	2.13015	45.2764	0.78788	8	130.00	1.73804	1.738035	0	0.7585	16.85087	12.63012	2.43567	80.43	16.7349	36.115
27.067	455.933	55.83	0.67	1.2	-0.09	30.7332	1.23912	2.37784	30.7332	1.23912	7	130.00	1.75936	1.759365	0	0.7539	12.84642	9.685131	1.67401	55.83	25.5169	33.762
27.395	455.605	46.5	0.82	1.77	-0.14	25.1137	1.83366	2.54667	25.1137	1.83366	7	130.00	1.78068	1.780675	0	0.7494	11.5793	8.677407	1.3845	46.5	32.8129	32.493
27.723	455.277	57.97	0.96	1.65	0.23	31.1699	1.70916	2.45279	31.1699	1.70915	7	130.00	1.802	1.801995	0	0.7449	13.80444	10.28352	1.73895	57.97	26.6174	33.849
28.051	454.949	68	0.97	1.43	-0.22	36.2947	1.46577	2.36006	36.2947	1.46577	7	130.00	1.82332	1.823315	0	0.7406	15.52249	11.49557	2.04881	68	24.8126	34.786
28.379	454.621	53.43	1.26	2.35	-0.41	27.9651	2.44255	2.58442	27.9651	2.44255	6	130.00	1.84464	1.844635	0	0.7363	13.55423	9.979752	1.59707	53.43	34.6019	33.172
28.707	454.293	48.16	0.78	1.62	-0.58	24.8098	1.68488	2.52977	24.8098	1.68488	7	130.00	1.86596	1.865955	0	0.7321	11.89481	8.707769	1.43325	48.16	32.0316	32.415
29.035	453.965	64.33	0.45	0.69	-0.6	33.0862	0.72066	2.22831	33.0862	0.72066	8	125.00	1.88728	1.887275	0	0.7279	13.86901	10.0955	1.93321	64.33	19.9571	34.218
29.363	453.637	56.15	0.73	1.3	-0.09	28.4322	1.34581	2.42586	28.4322	1.34581	7	125.00	1.90778	1.907775	0	0.724	13.20537	9.560644	1.67933	56.15	27.4781	33.276
29.691	453.309	58.81	0.91	1.54	0.09	29.4988	1.59981	2.45535	29.4988	1.59981	7	125.00	1.92828	1.928275	0	0.7201	14.02117	10.09717	1.76104	58.81	28.7271	33.506
30.019	452.981	67.14	1.23	1.84	-0.11	33.4524	1.88676	2.45406	33.4524	1.88676	7	125.00	1.94878	1.948775	0	0.7163	15.99754	11.45968	2.0183	67.14	28.6717	34.286
30.347	452.653	112.05	2.2	1.96	-0.41	55.8991	1.99853	2.2978	55.8991	1.99853	7	125.00	1.96928	1.969275	0	0.7126	24.88619	17.73394	3.40807	112.05	22.4399	37.347
30.675	452.325	73.06	2.44	3.34	-8.34	35.7177	3.43322	2.59915	35.7428	3.43081	6	125.00	1.98978	1.989775	0	0.7089	18.6832	13.24492	2.20032	73.11	35.3158	34.692
31.004	451.996	39.96	1.78	4.47	-10.67	18.8773	4.69042	2.89568	18.9071	4.68302	4	125.00	2.01034	2.010338	0	0.7053	12.00648	8.468011	1.17491	40.02	51.728	30.664
31.332	451.668	36.72	1.19	3.25	-12.47	17.0812	3.43047	2.84264	17.1157	3.42356	5	125.00	2.03084	2.030838	0	0.7017	10.70429	7.511391	1.07397	36.79	48.4956	30.012
31.66	451.340	32.6	0.98	3	-11.92	14.8921	3.208	2.87199	14.9262	3.20066	5	125.00	2.05134	2.051338	0	0.6982	9.566982	6.749511	0.94578	32.67	50.2673	29.107
31.988	451.012	30.21	0.84	2.79	-11.04	13.5813	2.98527	2.8855	13.615	2.97786	6	125.00	2.07184	2.071838	0	0.6947	9.030418	6.27379	0.87115	30.28	51.0971	28.495
32.316	450.684	30.02	0.75	2.5	-10.81	13.3476	2.68551	2.86492	13.381	2.6788	6	125.00	2.09234	2.092338	0	0.6913	8.867287	6.130203	0.86463	30.09	49.8367	28.379
32.644	450.356	32.56	0.7	2.16	-8.52	14.4106	2.29906	2.79963	14.4342	2.2953	6	125.00	2.11284	2.112838	0	0.688	9.261455	6.371566	0.94264	32.61	45.9727	28.884
32.972	450.028	32.57	0.61	1.86	-7.05	14.2672	2.00416	2.77023	14.2859	2.00153	6	125.00	2.13334	2.133338	0	0.6847	9.112641	6.238993	0.94231	32.61	44.2973	28.816
33.3	449.700	31.3	0.63	2.02	-5.48	13.5322	2.16152	2.80746	13.5508	2.15856	6	125.00	2.15384	2.153838	0	0.6814	8.939627	6.091342	0.90236	31.34	46.4254	28.463
33.628	449.372	31.82	0.66	2.08	-3.97	13.6343	2.2263	2.81229	13.6435	2.22479	6	125.00	2.17434	2.174338	0	0.6782	9.106774	6.175912	0.91782	31.84	46.706	28.509
33.956	449.044	28.86	0.57	1.98	-2.68	12.149	2.13762	2.84432	12.1581	2.13602	6	125.00	2.19484	2.194838	0	0.675	8.41085	5.677259	0.82555	28.88	48.5957	27.736
34.284	448.716	23.21	0.5	2.14	-1.27	9.47696	2.38156	2.96057	9.48147	2.38042	6	125.00	2.21534	2.215338	0	0.6719	7.241997	4.865622	0.64999	23.22	55.8673	26.057
34.612	448.388	20.41	0.42	2.06	0.02	8.12857	2.31097	3.0103	8.12857	2.31097	6	125.00	2.23584	2.235838	0	0.6688	6.564749	4.390339	0.56267	20.41	59.1814	25.012
34.941	448.059	23.17	0.41	1.77	0.71	9.26857	1.96045	2.92469	9.26414	1.96138	6	125.00	2.2564	2.2564	0	0.6657	7.068599	4.705711	0.64748	23.16	53.5531	25.9
35.269	447.731	24.74	0.45	1.82	2.5	9.86565	2.00329	2.90667	9.85687	2.00507	6	125.00	2.2769	2.2769	0	0.6627	7.464431	4.946804	0.69545	24.72	52.4146	26.32
35.597	447.403	23.56	0.62	2.64	4.16	9.25507	2.91592	3.01828	9.24637	2.91866	5	125.00	2.2974	2.2974	0	0.6598	7.609665	5.020503	0.65828	23.54	59.7243	25.887
35.925	447.075	26.46	0.63	2.39	12.8	10.419	2.60955	2.95013	10.3845	2.61823	6	135.00	2.3179	2.31712	0.0008	0.6569	8.175519	5.370826	0.74743	26.38	55.1876	26.673
36.253	446.747	24.52	0.58	2.37	14.27	9.52328	2.61497	2.98363	9.48463	2.62563	6	135.00	2.34004	2.329026	0.011	0.6553	7.72807	5.063885	0.68669	24.43	57.3883	26.063
36.581	446.419	23.35	0.59	2.53	14.8	8.96558	2.81115	3.02295	8.92713	2.82326	5	135.00	2.36218	2.340933	0.0212	0.6536	7.541419	4.928997	0.64978	23.26	60.0438	25.655
36.909	446.091	20.73	0.59	2.83	15.59	7.79725	3.21602	3.10619	7.759	3.23187	5	135.00	2.38432	2.352839	0.0315	0.6519	7.064855	4.605822	0.56798	20.64	65.9272	24.708
37.237	445.763	23.32	0.68	2.92	16.49	8.84389	3.25148	3.06352	8.8016	3.2671	5	135.00	2.40646	2.364746	0.0417	0.6503	7.727244	5.024958	0.64748	23.22	62.8665	25.566
37.565	445.435	24.74	0.81	3.26	8.36	9.38774	3.63043	3.06819	9.36671	3.63859	5	135.00	2.4286	2.376652	0.0519	0.6487	8.24148	5.34592	0.69076	24.69	63.1968	25.99

Depth (ft)	S... (ft)	...I.	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.W. (pcf)	...Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	445.107	23.87	0.87	3.63	-3.35	8.96744	4.06176	3.11089	8.97582	4.05798	5	135.00	2.45074	2.388558	0.0622	0.647	8.203105	5.307748	0.66313	23.89	66.2702	25.705
38.221	444.779	22.91	0.77	3.37	-3.42	8.51382	3.76765	3.10987	8.52632	3.76213	5	135.00	2.47288	2.400465	0.0724	0.6454	7.871536	5.080663	0.63273	22.94	66.196	25.361
38.549	444.451	25.19	0.68	2.69	-2.47	9.40775	2.99626	3.01817	9.41189	2.99494	5	135.00	2.49502	2.412371	0.0826	0.6438	8.145735	5.24455	0.70263	25.2	59.717	26.032
38.877	444.123	22.12	0.7	3.15	-2.17	8.08605	3.57091	3.11545	8.09018	3.56909	5	135.00	2.51716	2.424278	0.0929	0.6423	7.62211	4.895353	0.6069	22.13	66.604	25.012
39.206	443.794	19.76	0.61	3.07	3.07	7.06859	3.54226	3.1627	7.06038	3.54638	5	135.00	2.53937	2.43622	0.1031	0.6407	7.022462	4.499157	0.53315	19.74	70.1291	24.097
39.534	443.466	24.4	0.75	3.06	4.32	8.92049	3.4343	3.07189	8.90824	3.43903	5	135.00	2.56151	2.448127	0.1134	0.6391	8.154368	5.211628	0.67611	24.37	63.4594	25.669
39.862	443.138	25.59	0.74	2.9	5.43	9.35205	3.2165	3.03903	9.33579	3.22211	5	135.00	2.58365	2.460033	0.1236	0.6376	8.369236	5.335994	0.71227	25.55	61.1526	25.988
40.19	442.810	25.05	0.72	2.86	6.14	9.0796	3.20795	3.04897	9.06341	3.21368	5	135.00	2.60579	2.47194	0.1338	0.636	8.244866	5.244024	0.69487	25.01	61.8447	25.792
40.518	442.482	23.27	0.76	3.25	7.14	8.31053	3.6818	3.11505	8.2904	3.69074	5	135.00	2.62793	2.483846	0.1441	0.6345	7.995391	5.073146	0.63907	23.22	66.5748	25.193
40.846	442.154	25.96	0.88	3.4	8.43	9.33984	3.77521	3.08008	9.3158	3.78496	5	135.00	2.65007	2.495752	0.1543	0.633	8.713036	5.515295	0.72167	25.9	64.0434	25.982
41.174	441.826	25.09	1.01	4.03	8.59	8.93973	4.50535	3.14056	8.91979	4.51542	4	135.00	2.67221	2.507659	0.1645	0.6315	8.772768	5.539906	0.69405	25.04	68.4623	25.693
41.502	441.498	23.31	0.9	3.85	10.14	8.18223	4.36561	3.16384	8.15841	4.37636	4	135.00	2.69435	2.519565	0.1748	0.63	8.27767	5.214892	0.63826	23.25	70.2152	25.095
41.83	441.170	22.11	0.83	3.76	10.72	7.66096	4.27978	3.18239	7.63331	4.29529	4	135.00	2.71649	2.531472	0.185	0.6285	7.949599	4.996417	0.60042	22.04	71.6336	24.65
42.158	440.842	22.65	0.97	4.29	10.46	7.82871	4.87159	3.20785	7.80119	4.88877	4	135.00	2.73863	2.543378	0.1952	0.627	8.293291	5.200217	0.61645	22.58	73.6096	24.8
42.486	440.514	21.66	0.88	4.07	10.99	7.39614	4.65627	3.21626	7.36874	4.67358	4	135.00	2.76077	2.555284	0.2055	0.6256	7.977884	4.990776	0.58512	21.59	74.2704	24.42
42.814	440.186	22.04	0.74	3.34	10.67	7.50123	3.84274	3.16291	7.47396	3.85676	5	135.00	2.78291	2.567191	0.2157	0.6241	7.8169	4.878716	0.59619	21.97	70.1447	24.518
43.143	439.857	19.95	0.77	3.87	8.24	6.64754	4.49114	3.24432	6.62815	4.50427	4	135.00	2.80512	2.579133	0.226	0.6227	7.505574	4.673551	0.5308	19.9	76.5026	23.717
43.471	439.529	17	0.74	4.34	6.35	5.46991	5.22129	3.35118	5.45447	5.23607	3	135.00	2.82726	2.59104	0.2362	0.6212	6.944066	4.313967	0.43878	16.96	85.4106	22.424
43.799	439.201	19.37	0.84	4.35	6.47	6.34689	5.08456	3.29171	6.33152	5.0969	3	135.00	2.8494	2.602946	0.2464	0.6198	7.554698	4.682573	0.51147	19.33	80.3734	23.418
44.127	438.873	21.4	1.06	4.94	0.86	7.08585	5.72093	3.28218	7.08585	5.72093	3	135.00	2.87154	2.614853	0.2567	0.6184	8.303236	5.134803	0.57364	21.4	79.585	24.174
44.455	438.545	19.64	0.74	3.76	-0.78	6.37528	4.41888	3.25299	6.37909	4.41624	4	135.00	2.89368	2.626759	0.2669	0.617	7.458995	4.60225	0.51846	19.65	77.2014	23.476
44.783	438.217	15.29	0.89	5.83	-1.04	4.68956	7.19239	3.48477	4.69335	7.18659	3	135.00	2.91582	2.638665	0.2771	0.6156	7.014631	4.318422	0.3831	15.3	97.4824	21.456
45.111	437.889	18.24	0.81	4.42	1.23	5.77311	5.29341	3.33425	5.76934	5.29687	3	135.00	2.93796	2.650572	0.2874	0.6142	7.364226	4.52332	0.47375	18.23	83.9559	22.816
45.439	437.561	23.11	0.9	3.9	2.4	7.5681	4.46652	3.19593	7.56059	4.47096	4	135.00	2.9601	2.662478	0.2976	0.6129	8.408624	5.153258	0.62384	23.09	72.6801	24.62
45.767	437.233	23.58	1.04	4.42	10.81	7.70187	5.04909	3.22274	7.6757	5.06631	4	135.00	2.98224	2.674385	0.3079	0.6115	8.728223	5.337205	0.6377	23.51	74.782	24.724
46.095	436.905	23.42	0.95	4.05	11.02	7.59993	4.6533	3.20639	7.57387	4.66931	4	135.00	3.00438	2.686291	0.3181	0.6101	8.56709	5.227052	0.63206	23.35	73.495	24.638
46.423	436.577	19.68	0.81	4.12	11.46	6.17208	4.86385	3.29142	6.14613	4.88438	4	135.00	3.02652	2.698197	0.3283	0.6088	7.662429	4.664763	0.51559	19.61	80.3493	23.25
46.751	436.249	18.67	0.6	3.22	13.05	5.76411	3.8409	3.25826	5.73459	3.86067	5	135.00	3.04866	2.710104	0.3386	0.6074	7.084343	4.303349	0.48363	18.59	77.6282	22.795
47.079	435.921	19.1	0.56	2.91	15.36	5.88874	3.49362	3.22851	5.852	3.51556	5	135.00	3.0708	2.72201	0.3488	0.6061	7.083552	4.293448	0.49626	19	75.2399	22.932
47.408	435.592	21.41	0.69	3.23	16.88	6.69982	3.76699	3.19955	6.66324	3.78767	5	135.00	3.093	2.733953	0.359	0.6048	7.780455	4.70554	0.56709	21.31	72.9815	23.796
47.736	435.264	49.22	1.77	3.6	20.42	16.7907	3.83907	2.88182	16.7433	3.84993	5	135.00	3.11514	2.745859	0.3693	0.6035	14.60876	8.816054	1.42739	49.09	50.8702	29.92
48.064	434.936	108.31	4.31	3.98	24.9	38.1369	4.09802	2.63254	38.0789	4.10426	5	135.00	3.13728	2.757766	0.3795	0.6022	28.10668	16.92509	3.25612	108.15	36.9683	35.099
48.392	434.608	174.86	6.35	3.63	23.46	61.9931	3.6983	2.45237	61.9389	3.70153	12	135.00	3.15942	2.769672	0.3898	0.6009	41.59558	24.99384	5.31581	174.71	28.5992	37.947
48.72	434.280	126.51	6.37	5.04	9.38	44.3376	5.16507	2.65754	44.316	5.16758	11	135.00	3.18156	2.781579	0.4	0.5996	33.2856	19.95771	3.81822	126.45	38.2371	36.007
49.048	433.952	166.9	6.34	3.8	22.06	58.5993	3.87303	2.48371	58.5492	3.87634	12	135.00	3.2037	2.793485	0.4102	0.5983	40.29083	24.10644	5.068	166.76	29.9602	37.628
49.376	433.624	185.28	8	4.32	29.84	64.8944	4.3943	2.49436	64.8267	4.39889	11	135.00	3.22584	2.805391	0.4205	0.597	44.94566	26.83435	5.63635	185.09	30.4315	38.206
49.704	433.296	146.4	7.86	5.37	33.05	50.8118	5.49067	2.63756	50.7373	5.49873	11	135.00	3.24798	2.817298	0.4307	0.5958	38.08986	22.69306	4.43195	146.19	37.2207	36.803
50.032	432.968	154.76	6.18	3.99	62.54	53.5451	4.07948	2.52808	53.4072	4.09001	12	135.00	3.27012	2.829204	0.4409	0.5945	38.09591	22.64885	4.69009	154.37	31.9538	37.1
50.36	432.640	137.82	5.3	3.84	25.31	47.3504	3.93971	2.55353	47.2941	3.9444	12	135.00	3.29226	2.841111	0.4512	0.5933	34.39466	20.40549	4.16495	137.66	33.1337	36.392
50.688	432.312	83.38	3.81	4.57	22.91	28.0635	4.7586	2.77386	28.0144	4.76693	11	135.00	3.3144	2.853017	0.4614	0.592	23.30703	13.79859	2.47881	83.24	44.5017	33.219
51.016	431.984	58.49	2.41	4.12	21.11	19.2513	4.36963	2.87161	19.2059	4.37995	5	135.00	3.33654	2.864923	0.4716	0.5908	17.26483	10.20013	1.70754	58.36	50.2442	30.822
51.345	431.655	40.89	1.24	3.03	26.95	13.0459	3.30391	2.92987	12.9868	3.31695	6	135.00	3.35875	2.876866	0.4819	0.5896	12.46659	7.350011	1.16196	40.72	53.9834	28.264
51.673	431.327	51.35	1.29	2.52	29.37	16.6054	2.68923	2.79202	16.5431	2.69936	6	135.00	3.38089	2.888772	0.4921	0.5884	14.47144	8.514418	1.48511	51.17	45.5351	29.856
52.001	430.999	79.13	2.66	3.36	27.12	26.1066	3.51262	2.70938	26.048	3.52052	6	135.00	3.40303	2.900679	0.5024	0.5872	21.35463	12.5384	2.34449	78.96	40.9545	32.766
52.329	430.671	74.91	5.41	7.23	-2.71	24.5434	7.56804	2.95489	24.5503	7.56592	11	135.00	3.42517	2.912585	0.5126	0.586	23.28897	13.64618	2.21316	74.93	55.4968	32.394
52.657	430.343	267.69	12.98	4.85	-1.85	90.3551	4.91215	2.43828	90.3585	4.91197	11	135.00	3.44731	2.924492	0.5228	0.5848	63.31944	37.02643	8.18089	267.7	27.9998	40.035

51 of 48
R15713

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 24 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5B

ConeTec Inc Interpretation

Interpretation - Release 1.22 Rev. Format: NLI Imperial

Run No: 07-1210-1008-4397
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5B
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 15:44
CPT File: 804CP05B.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 479.9

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	38.10	1.25	40.93	19.30	2.15
125	Soil Embankment	31.26	1.88	62.63	50.48	2.84

User Inputs:

Water Table Depth (ft): 28
Ground Surface Elev. 479.9

Assumed: Nk: 32.3
State Parameter: 1.2
CPT area ratio: 0.85
Unit Weight of Soil (pcf): Varies See Below See Below Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	479.736	18.44	0.14	0.76	0.34	1728.83	0.760	1.13	1727.89	0.76	6	130.00	0.011	0.011	0.000	2.000	2.71	5.42	0.571	18.43	-1.1328	52.78
0.492	479.408	23.22	0.26	1.12	0.21	725.079	1.121	1.41	725.08	1.12	6	130.00	0.032	0.032	0.000	2.000	3.72	7.44	0.718	23.22	1.62684	49.62
0.82	479.080	13.32	0.2	1.51	-0.32	248.906	1.508	1.76	248.91	1.51	6	130.00	0.053	0.053	0.000	2.000	2.40	4.80	0.411	13.32	7.35209	45.08
1.148	478.752	12.84	0.15	1.17	0.16	171.072	1.175	1.79	171.07	1.18	6	130.00	0.075	0.075	0.000	2.000	2.33	4.67	0.395	12.84	7.84987	43.30
1.476	478.424	38.97	0.24	0.62	0.39	405.191	0.617	1.33	405.09	0.62	7	130.00	0.096	0.096	0.000	2.000	6.09	12.18	1.204	38.96	0.7066	47.24
1.804	478.096	74.14	0.58	0.78	0.09	631.27	0.784	1.30	631.18	0.78	8	130.00	0.117	0.117	0.000	2.000	11.49	22.97	2.292	74.13	0.40522	49.07
2.133	477.767	60.91	0.73	1.2	0.14	438.323	1.201	1.54	438.32	1.20	7	130.00	0.139	0.139	0.000	2.000	10.18	20.36	1.881	60.91	3.43634	47.68
2.461	477.439	48.52	0.69	1.42	0.23	302.316	1.427	1.69	302.32	1.43	7	130.00	0.160	0.160	0.000	2.000	8.54	17.07	1.497	48.52	6.99658	45.97
2.789	477.111	43.89	0.75	1.7	0.09	241.105	1.716	1.82	241.10	1.72	7	130.00	0.181	0.181	0.000	2.000	8.06	16.12	1.353	43.89	8.4724	44.94
3.117	476.783	44.62	0.57	1.28	-0.05	219.231	1.283	1.74	219.23	1.28	7	130.00	0.203	0.203	0.000	2.000	7.99	15.97	1.375	44.62	6.95479	44.49
3.445	476.455	38.58	0.44	1.13	0.02	171.29	1.147	1.78	171.29	1.15	7	130.00	0.224	0.224	0.000	2.000	6.99	13.99	1.187	38.58	7.68466	43.31
3.773	476.127	23.25	0.37	1.57	-0.51	93.8032	1.608	2.07	93.80	1.61	6	130.00	0.245	0.245	0.000	2.000	4.70	9.39	0.712	23.25	14.8691	40.23
4.101	475.799	18.59	0.19	1.02	-0.32	68.7391	1.037	2.05	68.74	1.04	6	130.00	0.267	0.267	0.000	1.937	3.72	7.21	0.567	18.59	14.2745	38.62
4.429	475.471	17.34	0.16	0.92	-0.21	59.2324	0.938	2.07	59.23	0.94	6	130.00	0.288	0.288	0.000	1.864	3.51	6.64	0.528	17.34	15.0482	37.66
4.757	475.143	25.81	0.28	1.09	-0.09	82.4721	1.098	2.00	82.47	1.10	7	130.00	0.309	0.309	0.000	1.798	5.08	9.13	0.789	25.81	12.9698	39.53
5.085	474.815	24.43	0.46	1.87	-0.41	72.9127	1.909	2.20	72.91	1.91	6	130.00	0.331	0.331	0.000	1.739	5.20	9.05	0.746	24.43	18.9585	38.85
5.413	474.487	18.46	0.38	2.06	-0.64	51.4663	2.099	2.34	51.47	2.10	6	130.00	0.352	0.352	0.000	1.686	4.17	7.04	0.561	18.46	23.9842	36.87
5.741	474.159	16.54	0.27	1.61	-0.67	43.3236	1.670	2.33	43.35	1.67	6	130.00	0.373	0.373	0.000	1.637	3.73	6.11	0.501	16.55	23.7454	35.86
6.069	473.831	15.2	0.19	1.22	-0.62	37.5312	1.283	2.31	37.53	1.28	6	130.00	0.394	0.394	0.000	1.592	3.40	5.41	0.458	15.2	23.0694	34.99
6.398	473.502	15.29	0.17	1.08	-0.48	35.7663	1.143	2.30	35.79	1.14	6	130.00	0.416	0.416	0.000	1.551	3.41	5.28	0.460	15.3	22.6384	34.70
6.726	473.174	18.36	0.25	1.34	-0.09	40.9955	1.395	2.30	41.00	1.39	6	130.00	0.437	0.437	0.000	1.512	4.09	6.19	0.555	18.36	22.6837	35.52
7.054	472.846	20.73	0.37	1.77	-0.23	44.2117	1.825	2.35	44.21	1.83	6	130.00	0.459	0.459	0.000	1.477	4.71	6.96	0.628	20.73	24.4234	35.97
7.382	472.518	11.94	0.22	1.8	-0.14	23.8838	1.920	2.58	23.88	1.92	5	130.00	0.480	0.480	0.000	1.444	3.02	4.35	0.355	11.94	34.1973	32.17
7.71	472.190	11.14	0.1	0.85	-0.35	21.2289	0.940	2.45	21.25	0.94	6	130.00	0.501	0.501	0.000	1.413	2.65	3.75	0.329	11.15	28.5942	31.42
8.038	471.862	16.59	0.13	0.8	-0.44	28.839	0.863	2.32	28.84	0.86	6	130.00	0.522	0.522	0.000	1.383	3.49	4.83	0.466	16.59	23.2198	33.36
8.366	471.534	15.96	0.17	1.04	-0.67	28.3496	1.103	2.38	28.37	1.10	6	130.00	0.544	0.544	0.000	1.356	3.68	4.99	0.477	15.97	25.5639	33.26
8.694	471.206	13.31	0.18	1.32	-0.46	22.5529	1.412	2.52	22.57	1.41	6	130.00	0.565	0.565	0.000	1.330	3.28	4.36	0.395	13.32	31.6281	31.81
9.022	470.878	16.16	0.14	0.84	-0.64	26.5566	0.899	2.36	26.56	0.90	6	130.00	0.586	0.586	0.000	1.306	3.69	4.81	0.482	16.16	24.7561	32.85
9.35	470.550	17.95	0.14	0.78	-0.6	28.5352	0.807	2.31	28.54	0.81	6	130.00	0.608	0.608	0.000	1.283	4.01	5.14	0.537	17.95	22.8351	33.30
9.678	470.222	14.69	0.11	0.72	-0.51	22.3519	0.782	2.39	22.37	0.78	6	130.00	0.629	0.629	0.000	1.261	3.41	4.30	0.435	14.7	26.1982	31.75
10.006	469.894	15.13	0.13	0.83	-0.32	22.263	0.898	2.42	22.28	0.90	6	130.00	0.650	0.650	0.000	1.240	3.56	4.41	0.448	15.14	27.4287	31.73
10.335	469.565	19.67	0.48	2.45	-0.05	28.2806	2.527	2.59	28.28	2.53	5	130.00	0.672	0.672	0.000	1.220	5.00	6.10	0.588	19.67	34.8607	33.24
10.663	469.237	22.81	0.74	3.23	-0.67	31.9104	3.346	2.63	31.91	3.35	5	130.00	0.693	0.693	0.000	1.201	5.92	7.11	0.685	22.81	36.7532	33.99
10.991	468.909	13.41	0.42	3.14	-0.42	17.7706	3.308	2.82	17.77	3.31	4	130.00	0.714	0.714	0.000	1.183	3.85	4.56	0.393	13.41	47.1932	30.26
11.319	468.581	19.13	0.26	1.36	-0.67	25.0012	1.413	2.48	25.00	1.41	6	130.00	0.736	0.736	0.000	1.166	4.62	5.39	0.569	19.13	29.9799	32.46
11.647	468.253	17.75	0.22	1.21	-0.62	22.4461	1.295	2.50	22.48	1.29	6	130.00	0.757	0.757	0.000	1.149	4.33	4.98	0.526	17.76	30.7942	31.78
11.975	467.925	18.33	0.28	1.53	-0.32	22.5491	1.595	2.55	22.55	1.60	6	130.00	0.778	0.778	0.000	1.133	4.57	5.18	0.543	18.33	32.9971	31.60
12.303	467.597	33.79	0.45	1.32	-0.58	41.2536	1.364	2.30	41.25	1.36	7	130.00	0.800	0.800	0.000	1.118	7.50	8.39	1.021	33.79	22.3995	35.56
12.631	467.269	97.39	1.27	1.31	0.35	117.621	1.315	1.94	117.62	1.32	8	130.00	0.821	0.821	0.000	1.104	18.70	20.64	2.990	97.39	11.3008	41.42
12.959	466.941	115.69	1.69	1.46	0.39	136.344	1.472	1.93	136.34	1.47	8	130.00	0.842	0.842	0.000	1.090	22.12	24.10	3.556	115.69	11.0264	42.17
13.287	466.613	126.13	2.46	1.95	-0.69	145.042	1.964	2.00	145.04	1.96	7	130.00	0.864	0.864	0.000	1.076	24.81	26.70	3.878	126.13	12.9601	42.49
13.615	466.285	126.8	2.52	1.98	-0.67	142.281	2.001	2.01	142.28	2.00	7	130.00	0.885	0.885	0.000	1.063	25.05	26.63	3.898	126.8	13.2784	42.39
13.943	465.957	96.74	2.09	2.16	-0.09	105.742	2.181	2.13	105.74	2.18	7	130.00	0.906	0.906	0.000	1.050	19.99	21.00	2.967	96.74	16.6031	40.86
14.271	465.629	74.23	1.62	2.18	-1.2	79.0224	2.210	2.22	79.03	2.21	7	130.00	0.928	0.928	0.000	1.038	15.94	16.55	2.269	74.24	19.6985	39.30
14.6	465.300	62.31	1	1.61	-0.99	64.5686	1.630	2.19	64.67	1.63	7	130.00	0.949	0.949	0.000	1.027	13.23	13.58	1.900	62.32	18.7205	38.18
14.928	464.972	62.88	1	1.59	-0.92	63.8034	1.615	2.19	63.81	1.61	7	130.00	0.970	0.970	0.000	1.015	13.36	13.57	1.917	62.89	18.7826	38.10
15.256	464.644	49.08	0.73	1.48	-1.5	48.4938	1.518	2.27	48.50	1.52	7	130.00	0.992	0.992	0.000	1.004	10.77	10.81	1.489	49.09	21.3776	36.52

23 / 40

R15715

Depth (ft)	S	El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	464.316	46.97	0.47	1	-1.55	45.3691	1.023	2.19	45.38	1.02	7	130.00	1.013	1.013	0.000	0.994	9.97	9.91	1.423	46.98	18.6866	36.13
15.912	463.988	56.81	0.64	1.12	-1.5	53.9271	1.147	2.16	53.94	1.15	7	130.00	1.034	1.034	0.000	0.963	11.90	11.70	1.727	56.82	17.8279	37.14
16.24	463.660	78.21	1	1.28	-1.71	73.0906	1.296	2.09	73.10	1.30	8	130.00	1.056	1.056	0.000	0.973	15.91	15.49	2.389	78.22	15.4178	38.87
16.568	463.332	70.07	1.01	1.44	-0.58	64.0652	1.464	2.16	64.07	1.46	7	130.00	1.077	1.077	0.000	0.964	14.71	14.18	2.136	70.08	17.8331	38.13
16.896	463.004	58.9	0.8	1.36	-0.58	52.6313	1.084	2.22	52.63	1.38	7	130.00	1.098	1.098	0.000	0.954	12.63	12.05	1.790	58.9	19.6365	37.00
17.224	462.676	49.64	0.81	1.64	-0.21	43.3368	1.569	2.33	43.34	1.67	7	130.00	1.120	1.120	0.000	0.945	11.19	10.58	1.502	49.64	23.7509	35.85
17.552	462.348	41.77	0.69	1.64	-0.86	35.6121	1.698	2.40	35.62	1.70	7	130.00	1.141	1.141	0.000	0.936	9.73	9.11	1.258	41.78	26.5966	34.67
17.88	462.020	56.82	0.68	1.19	-0.42	47.89	1.222	2.22	47.89	1.22	7	130.00	1.162	1.162	0.000	0.928	12.19	11.31	1.723	56.82	19.5408	36.45
18.208	461.692	67.55	1.17	1.74	0.42	56.0755	1.76294	2.26108	56.0755	1.76294	7	130.00	1.18352	1.18352	0	0.9192	14.76722	13.57409	2.05469	67.55	21.1064	37.365
18.537	461.363	65.8	1.63	2.48	-0.64	53.6101	2.52341	2.3793	53.6101	2.52341	6	130.00	1.20491	1.204905	0	0.911	15.15043	13.80221	1.99985	65.8	25.5751	37.106
18.865	461.035	61.65	1.3	2.11	-0.87	49.2763	2.15147	2.36009	49.2763	2.15147	7	130.00	1.22623	1.226225	0	0.9031	14.07313	12.70883	1.87071	61.65	24.8137	36.614
19.193	460.707	47.05	0.79	1.67	-0.53	36.7141	1.7248	2.39828	36.7141	1.7248	7	125.00	1.24755	1.247545	0	0.8953	10.92664	9.782697	1.41803	47.05	26.3409	34.856
19.521	460.379	44.52	0.68	1.53	-0.9	34.1092	1.57218	2.39964	34.1171	1.57182	7	125.00	1.26805	1.268045	0	0.888	10.3478	9.189267	1.33907	44.53	26.3983	34.407
19.849	460.051	40.76	0.63	1.55	-0.25	30.6326	1.59609	2.44144	30.6326	1.59609	7	125.00	1.28855	1.288545	0	0.8809	9.655144	8.505678	1.22203	40.76	28.1337	33.741
20.177	459.723	38.62	0.63	1.64	-0.16	28.5024	1.68851	2.48112	28.5024	1.68851	7	125.00	1.30905	1.309045	0	0.874	9.319563	8.145509	1.15514	38.62	29.8463	33.291
20.505	459.395	44.39	0.75	1.69	-0.51	32.3874	1.74174	2.44416	32.3949	1.74133	7	125.00	1.32955	1.329545	0	0.8673	10.53065	9.132793	1.33314	44.4	28.2491	34.088
20.833	459.067	57.91	1.33	2.3	-0.41	41.8949	2.35149	2.43862	41.8949	2.35149	6	125.00	1.35005	1.350045	0	0.8606	13.69973	11.79066	1.75108	57.91	28.0145	35.652
21.161	458.739	25.08	1.34	5.36	-0.07	17.2993	5.65175	2.97846	17.2993	5.65175	3	125.00	1.37055	1.370545	0	0.8542	7.90839	6.75525	0.73404	25.08	57.0449	30.082
21.489	458.411	21.57	0.8	3.69	2.73	14.5063	3.96453	2.93879	14.4991	3.96649	4	125.00	1.39105	1.391045	0	0.8479	6.636117	5.626566	0.62474	21.56	54.455	28.914
21.817	458.083	29.59	0.95	3.2	6.9	19.9628	3.37137	2.78704	19.9345	3.37616	5	125.00	1.41155	1.411545	0	0.8417	8.334097	7.014733	0.8724	29.55	45.2501	31.009
22.145	457.755	33.08	1.22	3.68	8.57	22.0998	3.85491	2.79022	22.0649	3.86101	5	125.00	1.43205	1.432045	0	0.8356	9.331922	7.798171	0.97981	33.03	45.4317	31.665
22.473	457.427	36.31	1.19	3.29	9.54	23.9975	3.4139	2.72893	23.9562	3.41979	5	125.00	1.45255	1.452545	0	0.8297	9.906188	8.219431	1.07918	36.25	42.0101	32.192
22.802	457.098	35.83	1.22	3.4	9.26	23.3227	3.55096	2.74942	23.282	3.55717	5	125.00	1.47311	1.473108	0	0.8239	9.883284	8.142993	1.06368	35.77	43.1354	32.01
23.13	456.770	36.3	1.11	3.07	13.63	23.3036	3.18907	2.7202	23.25	3.19642	5	125.00	1.49361	1.493608	0	0.8182	9.852044	8.061356	1.0776	36.22	41.5368	32.001
23.458	456.442	34.31	1.06	3.08	15.82	21.6602	3.23211	2.74896	21.5942	3.242	5	125.00	1.51411	1.514108	0	0.8127	9.449872	7.679759	1.01535	34.21	43.1096	31.526
23.786	456.114	34.28	1.04	3.03	17.95	21.338	3.17602	2.74944	21.2663	3.18672	5	125.00	1.53461	1.534608	0	0.8072	9.441263	7.621342	1.01379	34.17	43.136	31.428
24.114	455.786	34.12	1.05	3.07	21.34	20.9406	3.22433	2.7603	20.857	3.23725	5	125.00	1.55511	1.555108	0	0.8019	9.44696	7.57551	1.0082	33.99	43.7399	31.302
24.442	455.458	33.09	1.19	3.59	20.71	20.0014	3.77605	2.8192	19.9189	3.79169	5	125.00	1.57561	1.575608	0	0.7967	9.463703	7.539406	0.97568	32.96	47.1098	31.004
24.77	455.130	35.21	1.24	3.53	21.94	21.0599	3.68895	2.79552	20.9722	3.70438	5	125.00	1.59611	1.596108	0	0.7915	9.937404	7.865781	1.04068	35.07	45.7358	31.338
25.098	454.802	35.32	1.2	3.39	24.9	20.8482	3.56047	2.78926	20.7554	3.57639	5	125.00	1.61661	1.616608	0	0.7865	9.93126	7.810917	1.04345	35.17	45.3767	31.27
25.426	454.474	33.07	1.09	3.29	27.37	19.2003	3.46771	2.81033	19.0964	3.48656	5	125.00	1.63711	1.637108	0	0.7816	9.399677	7.346396	0.97315	32.9	46.5923	30.729
25.754	454.146	30.14	0.89	2.96	28.13	17.1628	3.12474	2.82084	17.0742	3.14461	5	125.00	1.65761	1.657608	0	0.7767	8.610264	6.687682	0.88181	29.96	47.206	29.996
26.082	453.818	28.04	0.96	3.41	30.18	15.7093	3.64162	2.8929	15.5961	3.66806	5	125.00	1.67811	1.678108	0	0.772	8.341715	6.439401	0.81616	27.85	51.555	29.398
26.41	453.490	27.22	1.12	4.12	32.24	15.0249	4.38848	2.95894	14.9071	4.42314	4	125.00	1.69861	1.698608	0	0.7673	8.418813	6.459581	0.79014	27.02	55.761	29.099
26.739	453.161	25.07	1.08	4.3	31.06	13.5826	4.6251	3.00754	13.4721	4.66305	4	125.00	1.71917	1.71917	0	0.7627	7.988621	6.092736	0.72294	24.88	58.9941	28.424
27.067	452.833	22.52	0.88	3.89	31.69	11.945	4.23477	3.02853	11.83	4.27593	4	125.00	1.73967	1.73967	0	0.7582	7.262348	5.506094	0.64335	22.32	60.4271	27.552
27.395	452.505	23.13	1	4.33	31.09	12.1408	4.67949	3.04924	12.0328	4.72147	4	125.00	1.76017	1.76017	0	0.7537	7.563768	5.70113	0.6616	22.94	61.8634	27.667
27.723	452.177	24.42	1.29	5.28	27.74	12.7139	5.69805	3.08711	12.6129	5.74372	3	125.00	1.78067	1.78067	0	0.7494	8.192462	6.139354	0.70091	24.24	64.5468	27.983
28.051	451.849	25.99	1.44	5.53	25.13	13.4414	5.95316	3.07983	13.358	5.99031	3	135.00	1.80117	1.799579	0.0016	0.7454	8.691388	6.478936	0.74888	25.84	64.0251	28.368
28.379	451.521	24.42	1.32	5.42	22.7	12.4741	5.84156	3.09958	12.3913	5.8806	3	135.00	1.82331	1.811485	0.0118	0.743	8.270747	6.145077	0.69959	24.27	65.4465	27.867
28.707	451.193	24.47	1.16	4.75	25.24	12.4079	5.12717	3.05558	12.3202	5.16369	3	135.00	1.84545	1.823392	0.0221	0.7406	8.100847	5.99916	0.70045	24.31	63.0122	27.832
29.035	450.865	24.85	1.17	4.72	24.97	12.5224	5.09085	3.06047	12.4353	5.12654	3	135.00	1.86759	1.835298	0.0323	0.7382	8.200162	6.052979	0.71153	24.69	62.6514	27.897
29.363	450.537	25.04	1.24	4.96	25.89	12.6326	5.35631	3.07414	12.446	5.39359	3	135.00	1.88973	1.847204	0.0425	0.7358	8.337266	6.134317	0.71673	24.88	63.6191	27.906
29.691	450.209	24.64	1.36	5.51	22.33	12.2253	5.98377	3.1127	12.15	6.02086	3	135.00	1.91187	1.859111	0.0528	0.7334	8.422789	6.177365	0.70366	24.5	66.4024	27.747
30.019	449.881	19.78	1.13	5.7	16.6	9.53812	6.33195	3.21114	9.48467	6.36764	3	135.00	1.93401	1.871017	0.063	0.7311	7.245293	5.296842	0.55251	19.68	73.8677	25.083
30.347	449.553	16.42	0.86	5.37	15.59	7.68159	6.08413	3.27481	7.62848	6.12649	3	135.00	1.95615	1.882924	0.0732	0.7288	6.296958	4.588962	0.4478	16.32	78.9785	24.616
30.675	449.225	20.02	0.87	4.36	20.02	9.52155	4.82216	3.13916	9.45822	4.85445	4	135.00	1.97829	1.89483	0.0835	0.7265	6.965318	5.060062	0.55857	19.9	68.3583	26.072
31.004	448.896	23.04	1.19	5.16	16.63	11.0341	5.65603	3.1306	10.9816	5.68304	3	135.00	2.0005	1.906773	0.0937	0.7242	7.982538	5.780848	0.65138	22.94	67.7209	27.081
31.332	448.568	21.44	1.16	5.4	11.94	10.1202	5.97403	3.17402	10.0837	5.99565	3	135.00	2.02264	1.918679	0.104	0.7219	7.662654	5.531947	0.60116	21.37	70.991	26.51
31.66	448.240	16.83	1.16	6.88	4.5	7.65841	7.84567	3.34165	7.64287	7.86162	3	135.00	2.04478	1.930586	0.1142	0.7197	6.826488	4.913068	0.45775	16.8	84.59	24.646
31.988	447.912	14.1	1.08	7.64	2.65	6.19466	8.97526	3.44974	6.18437	8.9902	3	135.00	2.06692	1.942492	0.1244	0.7175	6.258887	4.490736	0.37254	14.08	94.2141	23.229
32.316	447.584	36.85	1.64	4.99	8.52	17.786	5.2933	2.95167	17.7553	5.30245	3	135.00	2.08906	1.954398	0.1347	0.7153	11.41236	8.163359	1.07619	36.79	55.2875	30.278
32.644	447.256	53.58	2.7	5.03	7.3	26.1754	5.2459	2.82443	26.15	5.251	4	135.00	2.1112	1.966305	0.1449	0.7131	15.41519	10.99318	1.59346	53.53	47.4168	32.767
32.972	446.928	41.03	2.46	5.99	2.4	19.6625	6.32445	2.97035	19.6524	6.3277	3	135.00	2.13334	1.978211	0.1551	0.711	12.86718	9.148439	1.20423	41.01	56.5089	30.942
33.3	446.600	30.73	1.67	5.43	5.52	14.3582	5.84437	3.04968	14.3431	5.85051	3	135.00	2.15548	1.990118	0.1654	0.7089	10.12526	7.177398	0.88466	30.7	61.8941	28.881
33.628	446.272	25.44	1.21	4.77	7.23	11.6194	5.20153	3.0884	11.5995	5.21049	3	135.00	2.17762	2.002024	0.1756	0.7057	8.591848	6.072283	0.7202	25.4	64.6397	27.47
33.956	445.944	24.48	1.07	4.38	8.06	11.0631	4.80246	3.08384	11.0382	4.81326	4	135.00	2.19976	2.01393	0.1858	0.7047	8.238887	5.80559	0.68979	24.43	64.3124	27.142
34.284	445.616	24.3	1.08	4.43	9.26	10.8983	4.89172	3.0942	10.8686	4.90505	4	135.00	2.2219	2.025837	0.1961	0.7026	8.231024	5.782979	0.68353	24.24	65.0574	27.041
34.612	445.288	25.03	1.22	4.87	9.17	11.182	5.35417	3.10955	11.1574	5.36595	3	135.00	2.24404	2.037743	0.2063	0.7005	8.569686	6.003302	0.70545	24.98	66.1725	27.219
34.941	444.959	21.34	0.88	4.11	11.34	9.3057	4.61367	3.13367	9.27155	4.63066	4	135.00	2.26625	2.049686	0.2166	0.6985	7.41695	5.180619	0.59052	21.27	67.9493	25.982
35.269	444.631	22.16	0.83	3.76	13.05	9.63896	4.17681	3.0961	9.59531	4.19582	4	135.00	2.28839	2.061592	0.2268	0.6965	7.503638	5.226013	0.61522	22.07	65.1947	26.215
35.597	444.303	27.65	1.08	3.92	12.93	12.2206	4.26212	3.01844	12.1821	4.27562	4	135.00	2.31053	2.073499	0.237	0.6945	8.913341	6.189971	0.7845	27.57	59.7354	27.812
35.925	443.975	41.71	1.36	3.26	15.45	18.8823	3.45376	2.81298	18.8392	3.46168	5	135.00	2.33267	2.085405	0.2473	0.6925	11.90861	8.246427	1.21911	41.62	46.7462	30.682
36.253	443.647	119.94	5.26	4.39	10.53	56.0647	4.47335	2.54245	56.0314	4.47602	11	135.00	2.35481	2.097311	0.2575	0.6905	29.78849	20.56918	3.64041	119.87	32.6167	37.373
36.581	443.319	232.84	9.81	4.21	-2.08	109.265	4.25665	2.33841	109.269	4.25646	12	135.00	2.37695	2.109218	0.2677	0.6886	52.64439	36.24861	7.13508	232.85	23.9715	41.04
36.909	442.991	245.39	11.65	4.75	-7.92	114.558	4.79442	2.36708	114.581	4.79343	11	135.00	2.39909	2.121124	0.278	0.6866	56.20318	38.59027	7.52294	245.44	25.0892	41.287
37.237	442.663	185.81	11.73	6.31	-9.21	85.9757	6.39625	2.54195	86.0038	6.39416	11	135.00	2.42123	2.133031	0.2882	0.6847	46.17875	31.61867	5.67767	185.87	32.5936	39.766
37.565	442.335	190.28	10.73	5.64	-3.88	87.5721	5.71241	2.49823	87.5814	5.7118	11	135.00	2.44337	2.144937	0.2984	0.6828	46.29593	31.61081	5.81538	190.3	30.6039	39.865

R15716

Depth (ft)	S... El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.W.. (pcf)	fStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	442.007	280.56	11.76	4.19	-0.79	128.936	4.22878	2.29261	128.941	4.22863	12	135.00	2.46551	2.156843	0.3087	0.6809	62.17955	42.33877	8.60974	280.57	22.2559	41.895
38.221	441.679	230.05	12.58	5.47	-8.43	104.928	5.52816	2.43946	104.951	5.52694	11	135.00	2.48765	2.16875	0.3189	0.679	54.45582	36.97767	7.04527	230.1	28.0501	40.829
38.549	441.351	214.58	12.79	5.96	-3.42	97.2506	6.03102	2.48953	97.2644	6.03017	11	135.00	2.50979	2.180656	0.3291	0.6772	51.99489	35.21008	6.56564	214.61	30.2173	40.427
38.877	441.023	252.97	15.89	6.28	5.22	114.222	6.34488	2.46678	114.208	6.34564	11	135.00	2.53193	2.192563	0.3394	0.6753	60.62771	40.94446	7.7535	252.94	29.2202	41.271
39.206	440.694	369.1	14.5	3.93	49.56	166.271	3.95585	2.20569	166.131	3.9592	12	135.00	2.55413	2.204505	0.3496	0.6735	78.75678	53.04353	11.3482	368.79	19.1854	43.163

R15717

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 28 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-6

ConeTec I[illegible]f Interpretation
Interpretati[illegible]ut - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4364
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-6
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 12:00
CPT File: 804CP06.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 457.8

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	37.16	1.38	45.31	35.45	2.55

User Inputs:
Assumed: Water Table Depth (ft): 9.2
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 457.8
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	457.636	8.56	0.1	1.11	-0.53	834.122	1.170	1.40	834.12	1.17	5	125.00	0.010	0.010	0.000	2.000	1.37	2.74	0.265	8.56	1.52433	50.16
0.492	457.308	9.31	0.29	3.12	-2.93	301.764	3.125	1.98	302.41	3.12	4	125.00	0.031	0.031	0.000	2.000	1.82	3.64	0.287	9.33	12.388	45.97
0.82	456.980	10.89	0.47	4.33	-10.58	211.488	4.336	2.18	212.85	4.31	3	125.00	0.051	0.051	0.000	2.000	2.31	4.63	0.336	10.96	18.2558	44.35
1.148	456.652	15.32	0.83	5.4	-7.37	212.519	5.443	2.26	213.08	5.43	3	125.00	0.072	0.072	0.000	2.000	3.36	6.72	0.472	15.36	21.1963	44.36
1.476	456.324	38.89	1.49	3.84	3.12	420.572	3.840	1.99	420.36	3.84	5	125.00	0.092	0.092	0.000	2.000	7.62	15.25	1.201	38.87	12.7664	47.40
1.804	455.996	64.95	2.12	3.26	8.39	575.053	3.270	1.87	574.61	3.27	6	125.00	0.113	0.113	0.000	2.000	12.18	24.35	2.007	64.9	9.79283	48.70
2.133	455.667	91.43	3.22	3.53	-3.19	684.832	3.527	1.88	684.98	3.53	6	125.00	0.133	0.133	0.000	2.000	17.18	34.35	2.827	91.45	9.86183	49.40
2.461	455.339	106.27	4.78	4.5	0.53	689.906	4.504	1.98	689.84	4.50	11	125.00	0.154	0.154	0.000	2.000	20.72	41.43	3.285	106.26	12.339	49.42
2.789	455.011	97.06	5.09	5.25	3.16	555.816	5.254	2.07	555.70	5.25	11	125.00	0.174	0.174	0.000	2.000	19.62	39.25	3.000	97.04	14.9656	48.56
3.117	454.683	83.61	4.4	5.26	13.6	428.182	5.275	2.12	427.72	5.28	11	125.00	0.195	0.195	0.000	2.000	17.19	34.38	2.583	83.52	16.2983	47.48
3.445	454.355	75.27	3.59	4.77	18.34	348.585	4.783	2.11	348.07	4.79	11	125.00	0.215	0.215	0.000	2.000	15.46	30.93	2.324	75.16	16.2656	46.59
3.773	454.027	65.07	3.24	4.98	11.57	274.94	4.997	2.18	274.64	5.00	11	125.00	0.236	0.236	0.000	2.000	13.73	27.45	2.007	65	18.2882	45.53
4.101	453.699	64.94	3.2	4.93	6.12	252.363	4.947	2.19	252.21	4.95	11	125.00	0.256	0.256	0.000	1.975	13.76	27.23	2.003	64.9	18.7426	45.14
4.429	453.371	63.37	3.12	4.93	5.33	227.928	4.945	2.21	227.82	4.95	11	125.00	0.277	0.277	0.000	1.901	13.57	25.80	1.953	63.34	19.4706	44.67
4.757	453.043	55.6	2.82	5.07	3.75	186.009	5.099	2.27	185.91	5.10	4	125.00	0.297	0.297	0.000	1.834	12.20	22.38	1.712	55.57	21.4653	43.71
5.085	452.715	46.31	2.63	5.68	-1.89	144.715	5.718	2.37	144.75	5.72	3	125.00	0.318	0.318	0.000	1.774	10.63	18.85	1.424	46.32	25.262	42.47
5.413	452.387	49.15	2.45	4.98	-2.28	144.28	5.019	2.33	144.31	5.02	4	125.00	0.338	0.338	0.000	1.719	11.05	19.00	1.511	49.16	23.4659	42.46
5.741	452.059	41.44	2.45	5.91	-3.05	114.492	5.964	2.44	114.55	5.96	3	125.00	0.359	0.359	0.000	1.669	9.83	16.41	1.272	41.46	28.2345	41.28
6.069	451.731	40.26	2.34	5.81	-3.23	105.139	5.868	2.46	105.19	5.86	3	125.00	0.379	0.379	0.000	1.624	9.62	15.62	1.235	40.28	28.9115	40.83
6.398	451.402	35.34	1.94	5.49	-2.68	87.3776	5.552	2.49	87.43	5.55	3	125.00	0.400	0.400	0.000	1.581	8.56	13.54	1.092	35.36	30.1842	39.85
6.726	451.074	29.43	1.47	4.99	-1.85	69.0089	5.067	2.52	69.06	5.06	3	125.00	0.420	0.420	0.000	1.542	7.25	11.18	0.898	29.45	31.6997	38.55
7.054	450.746	22.96	1.12	4.89	-1.15	51.0783	4.974	2.60	51.10	4.97	3	125.00	0.441	0.441	0.000	1.506	5.88	8.86	0.697	22.97	35.5076	36.83
7.382	450.418	22.39	1.27	5.66	-4.08	47.5289	5.792	2.67	47.59	5.78	3	125.00	0.461	0.461	0.000	1.472	5.95	8.76	0.679	22.42	39.0065	36.41
7.71	450.090	24.72	1.47	5.94	-5.27	50.2996	6.065	2.67	50.38	6.05	3	125.00	0.482	0.482	0.000	1.441	6.56	9.45	0.750	24.76	38.9216	36.74
8.038	449.762	25.96	1.6	6.18	-6.42	50.6745	6.285	2.68	50.75	6.28	3	125.00	0.502	0.502	0.000	1.411	6.93	9.77	0.788	26	39.4189	36.79
8.366	449.434	23.65	1.49	6.3	-8.13	44.2307	6.443	2.73	44.33	6.43	3	125.00	0.523	0.523	0.000	1.383	6.47	8.95	0.716	23.7	41.9185	35.99
8.694	449.106	24.35	1.37	5.64	-8.36	43.8125	5.755	2.69	43.90	5.74	3	125.00	0.543	0.543	0.000	1.357	6.55	8.88	0.737	24.4	40.1258	35.93
9.022	448.778	28.28	1.49	5.28	-7.83	49.153	5.376	2.64	49.24	5.37	3	125.00	0.564	0.564	0.000	1.332	7.38	9.83	0.858	28.33	37.2649	36.61
9.35	448.450	28.51	1.65	5.78	-7.81	48.173	5.909	2.67	48.24	5.90	3	135.00	0.584	0.580	0.005	1.313	7.58	9.96	0.865	28.55	39.1366	36.49
9.678	448.122	28.8	1.69	5.86	-6.77	47.6562	5.994	2.68	47.72	5.99	3	135.00	0.607	0.592	0.015	1.300	7.69	10.00	0.873	28.84	39.5436	36.43
10.006	447.794	30.8	1.75	5.68	-4.18	49.9933	5.800	2.66	50.03	5.80	3	135.00	0.629	0.604	0.025	1.287	8.12	10.45	0.934	30.82	38.2961	36.71
10.335	447.465	27.19	1.42	5.23	-3.86	43.1215	5.351	2.68	43.17	5.34	3	135.00	0.651	0.615	0.035	1.275	7.23	9.22	0.822	27.22	39.1905	35.84
10.663	447.137	24.41	1.15	4.72	-3.58	37.8365	4.845	2.68	37.87	4.84	3	135.00	0.673	0.627	0.046	1.263	6.52	8.23	0.735	24.43	39.6428	35.06
10.991	446.809	22.72	0.94	4.13	-3.23	34.4535	4.268	2.68	34.48	4.26	4	135.00	0.695	0.639	0.056	1.251	6.04	7.55	0.682	22.74	39.1418	34.49
11.319	446.481	22.41	0.82	3.65	-2.63	33.3135	3.780	2.65	33.33	3.78	5	135.00	0.717	0.651	0.066	1.239	5.88	7.28	0.672	22.42	37.8448	34.28
11.647	446.153	22.09	0.86	3.9	-2.01	32.1993	4.028	2.68	32.21	4.03	4	135.00	0.739	0.663	0.076	1.228	5.86	7.23	0.661	22.1	39.3712	34.08
11.975	445.825	19.57	0.82	4.2	-1.41	27.8651	4.360	2.75	27.88	4.36	4	135.00	0.762	0.675	0.087	1.217	5.41	6.58	0.582	19.58	43.1036	33.18
12.303	445.497	18.59	0.79	4.26	-0.78	25.9231	4.437	2.78	25.92	4.44	4	135.00	0.784	0.687	0.097	1.207	5.22	6.29	0.551	18.59	44.7056	32.73
12.631	445.169	16.32	0.81	4.95	-0.6	22.2013	5.221	2.87	22.20	5.22	3	135.00	0.806	0.699	0.107	1.196	4.84	5.79	0.480	16.32	50.4414	31.75
12.959	444.841	19.07	0.83	4.36	0.74	25.6676	4.550	2.79	25.67	4.55	3	135.00	0.828	0.711	0.117	1.186	5.38	6.38	0.565	19.07	45.3058	32.67
13.287	444.513	21.2	1	4.73	8.36	28.1617	4.914	2.78	28.09	4.93	3	135.00	0.850	0.723	0.128	1.176	5.95	7.00	0.630	21.15	45.0064	33.24
13.615	444.185	20.7	0.95	4.58	10.95	26.9943	4.791	2.79	26.91	4.81	3	135.00	0.872	0.735	0.138	1.167	5.83	6.80	0.614	20.64	45.3618	32.97
13.943	443.857	23.12	1.2	5.2	13.55	29.7762	5.399	2.79	29.66	5.42	3	135.00	0.894	0.746	0.148	1.157	6.52	7.55	0.688	23.03	45.6855	33.58
14.271	443.529	29.53	1.34	4.53	13.72	37.7323	4.683	2.68	37.63	4.70	4	135.00	0.917	0.758	0.158	1.148	7.83	8.99	0.886	29.45	39.2582	35.04
14.6	443.200	26.74	0.91	3.39	16.67	33.4964	3.527	2.63	33.37	3.54	5	135.00	0.939	0.770	0.168	1.139	6.92	7.88	0.799	26.64	36.8635	34.31
14.928	442.872	20.25	0.7	3.44	21.11	24.6608	3.629	2.74	24.49	3.65	5	135.00	0.961	0.782	0.179	1.131	5.53	6.25	0.597	20.12	42.6233	32.39
15.256	442.544	17.79	0.62	3.49	24.51	21.1653	3.689	2.80	20.96	3.72	4	135.00	0.983	0.794	0.189	1.122	5.00	5.61	0.520	17.63	45.8297	31.41

R15719

Depth (ft)	El. (m)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.W. (pcf)	Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	442.216	15.28	0.55	3.61	26.19	17.7109	3.853	2.87	17.50	3.90	4	135.00	1.005	0.806	0.199	1.114	4.47	4.98	0.442	15.11	50.169	30.25
15.912	441.888	12.73	0.44	3.46	28.8	14.3083	3.760	2.94	14.09	3.82	4	135.00	1.027	0.818	0.209	1.106	3.86	4.27	0.362	12.55	54.4336	28.84
16.24	441.560	10.69	0.43	3.91	30.79	11.8589	4.370	3.05	11.63	4.46	3	135.00	1.049	0.830	0.220	1.098	3.52	3.86	0.305	10.7	61.5912	27.59
16.568	441.232	10.9	0.3	2.76	46.79	11.6767	3.052	2.96	11.33	3.15	4	135.00	1.072	0.842	0.230	1.090	3.32	3.61	0.304	10.61	56.0979	27.42
16.896	440.904	10.8	0.23	2.13	52.75	11.3708	2.370	2.91	11.00	2.45	5	135.00	1.094	0.854	0.240	1.082	3.18	3.44	0.301	10.48	52.8448	27.23
17.224	440.576	11.97	0.28	2.35	59.86	12.5406	2.580	2.90	12.10	2.67	5	135.00	1.116	0.866	0.250	1.075	3.49	3.75	0.336	11.59	52.0107	27.86
17.552	440.248	10.88	0.31	2.86	64.85	11.1029	3.182	3.00	10.65	3.32	4	135.00	1.138	0.877	0.261	1.068	3.35	3.57	0.302	10.48	58.4614	27.03
17.88	439.920	8.13	0.21	2.59	64.13	7.83718	3.013	3.12	7.39	3.20	4	135.00	1.160	0.889	0.271	1.060	2.67	2.83	0.216	7.73	67.0317	24.64
18.208	439.592	9.83	0.21	2.14	70.88	9.59534	2.428	2.99	9.11	2.56	5	135.00	1.182	0.901	0.281	1.053	2.99	3.15	0.268	9.39	57.9642	26.01
18.537	439.263	14.59	0.35	2.37	85.33	14.6581	2.615	2.85	14.07	2.72	5	135.00	1.204	0.913	0.291	1.046	4.11	4.30	0.414	14.05	49.0242	28.86
18.865	438.935	17.47	0.43	2.47	91.62	17.5587	2.647	2.79	16.94	2.74	5	135.00	1.227	0.925	0.302	1.040	4.77	4.96	0.503	16.9	45.2968	30.07
19.193	438.607	23.8	0.66	2.76	108.66	24.0676	2.927	2.70	23.34	3.02	5	135.00	1.249	0.937	0.312	1.033	6.23	6.44	0.698	23.12	40.6187	32.12
19.521	438.279	26.5	1.31	4.94	95.15	26.5877	5.192	2.83	25.97	5.32	3	135.00	1.271	0.949	0.322	1.027	7.49	7.69	0.781	25.91	47.7672	32.79
19.849	437.951	23.66	0.83	3.52	20.44	23.2793	3.711	2.76	23.15	3.73	5	135.00	1.293	0.961	0.332	1.020	6.56	6.69	0.692	23.54	43.9821	32.07
20.177	437.623	18.99	0.49	2.56	28.01	18.1706	2.772	2.77	18.00	2.80	5	135.00	1.315	0.973	0.342	1.014	5.26	5.34	0.547	18.82	44.4019	30.47
20.505	437.295	18.95	0.78	4.1	37.55	17.8877	4.429	2.91	17.65	4.49	4	135.00	1.337	0.985	0.353	1.008	5.65	5.70	0.545	18.72	52.3926	30.35
20.833	436.967	49.87	2.16	4.32	27.3	48.6795	4.453	2.58	48.51	4.47	5	135.00	1.359	0.997	0.363	1.002	12.61	12.63	1.502	49.7	34.6157	36.57
21.161	436.639	83.66	5.29	6.33	-14.43	81.5902	6.429	2.56	81.68	6.42	11	135.00	1.382	1.008	0.373	0.996	20.96	20.87	2.547	83.75	33.2996	39.50
21.489	436.311	243.98	10.44	4.28	-17.83	237.74	4.304	2.15	237.85	4.30	11	135.00	1.404	1.020	0.383	0.990	50.99	50.48	7.510	244.09	17.4322	44.88
21.817	435.983	336.34	16.44	4.89	-19.33	324.451	4.909	2.14	324.57	4.91	11	135.00	1.426	1.032	0.394	0.984	69.87	68.77	10.369	336.46	16.9751	46.29
22.145	435.655	423.23	17.94	4.24	-18.68	403.946	4.253	2.04	404.05	4.25	12	135.00	1.448	1.044	0.404	0.979	84.57	82.76	13.058	423.34	14.0663	47.24

R15720

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 31 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY TJS DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-7

ConeTec T Interpretation

Interpretatic. Output - Release 1.22 Rev. Format: NLI Imperial

Run No: 07-1210-1008-4331
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-7
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 07:58
CPT File: 804CP07.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 457.8

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	39.96	1.80	58.51	25.19	2.31

User Inputs:

Assumed: Water Table Depth (ft): 9.2
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below

CPT area ratio: 0.85 See Below

Ground Surface Elev. 457.8

Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	457.636	9.8	0.17	1.69	-0.53	955.098	1.737	1.54	955.10	1.74	5	125.00	0.010	0.010	0.000	2.000	1.64	3.27	0.303	9.8	3.41567	50.67
0.492	457.308	30.91	0.44	1.41	-5.98	1004.2	1.425	1.45	1005.50	1.42	6	125.00	0.031	0.031	0.000	2.000	5.02	10.05	0.956	30.95	2.16306	50.86
0.82	456.980	42	0.69	1.65	-14.97	818.512	1.645	1.54	820.46	1.64	7	125.00	0.051	0.051	0.000	2.000	7.03	14.07	1.299	42.1	3.40523	50.09
1.148	456.652	38.42	0.68	1.76	-15.08	534.47	1.773	1.64	535.86	1.77	6	125.00	0.072	0.072	0.000	2.000	6.66	13.33	1.187	38.52	5.10589	48.41
1.476	456.324	35.13	0.57	1.61	-15.89	379.813	1.627	1.68	380.90	1.62	6	125.00	0.092	0.092	0.000	2.000	6.18	12.36	1.085	35.23	5.82026	46.98
1.804	455.996	33.61	0.6	1.77	-9.56	297.093	1.791	1.78	297.63	1.79	6	125.00	0.113	0.113	0.000	2.000	6.10	12.20	1.037	33.67	7.65399	45.90
2.133	455.667	35.29	0.79	2.24	-0.3	263.716	2.247	1.89	263.79	2.25	6	125.00	0.133	0.133	0.000	2.000	6.66	13.32	1.088	35.3	10.1362	45.35
2.461	455.339	39.86	1	2.5	-0.42	258.147	2.518	1.94	258.15	2.52	6	125.00	0.154	0.154	0.000	2.000	7.66	15.30	1.229	39.86	11.2767	45.25
2.789	455.011	41.14	1.05	2.55	-0.46	235.013	2.563	1.96	235.01	2.56	6	125.00	0.174	0.174	0.000	2.000	7.98	15.97	1.268	41.14	12.0156	44.82
3.117	454.683	36.47	0.82	2.25	-0.6	186.206	2.260	1.98	186.26	2.26	6	125.00	0.195	0.195	0.000	2.000	7.12	14.23	1.123	36.48	12.3943	43.72
3.445	454.355	34.59	0.81	2.35	-0.76	159.65	2.356	2.03	159.65	2.36	6	125.00	0.215	0.215	0.000	2.000	6.89	13.79	1.064	34.59	13.9069	42.96
3.773	454.027	45.16	1.24	2.75	-0.76	190.508	2.760	2.04	190.51	2.76	6	125.00	0.236	0.236	0.000	2.000	9.03	18.06	1.391	45.16	14.1489	43.82
4.101	453.699	52.95	1.71	3.23	-0.23	205.584	3.245	2.08	205.58	3.25	6	125.00	0.256	0.256	0.000	1.975	10.75	21.24	1.631	52.95	15.2795	44.19
4.429	453.371	39.45	1.59	4.04	4.97	141.515	4.059	2.26	141.41	4.06	5	125.00	0.277	0.277	0.000	1.901	8.60	16.34	1.213	39.42	20.8937	42.36
4.757	453.043	25.66	0.97	3.77	17.39	85.3065	3.825	2.37	84.94	3.84	5	125.00	0.297	0.297	0.000	1.834	5.87	10.76	0.785	25.55	25.3185	39.69
5.085	452.715	16.21	0.6	3.68	17.83	50.0049	3.775	2.53	49.63	3.80	4	125.00	0.318	0.318	0.000	1.774	3.97	7.04	0.492	16.09	31.9342	38.66
5.413	452.387	12.96	0.42	3.21	19.31	37.3078	3.328	2.58	36.95	3.36	4	125.00	0.338	0.338	0.000	1.719	3.25	5.59	0.391	12.84	34.5011	34.90
5.741	452.059	11.85	0.37	3.13	19.93	32.0256	3.220	2.62	31.66	3.26	4	125.00	0.359	0.359	0.000	1.669	3.03	5.06	0.356	11.72	36.5018	33.95
6.069	451.731	10.67	0.33	3.1	21.39	27.1298	3.207	2.68	26.79	3.25	4	125.00	0.379	0.379	0.000	1.624	2.80	4.55	0.319	10.54	39.2642	32.90
6.398	451.402	9.96	0.31	3.07	23.76	23.9078	3.243	2.72	23.53	3.29	4	125.00	0.400	0.400	0.000	1.581	2.67	4.23	0.296	9.81	41.7687	32.08
6.726	451.074	9.7	0.29	2.95	38.8	22.0746	3.125	2.75	21.50	3.21	4	125.00	0.420	0.420	0.000	1.542	2.61	4.03	0.287	9.46	43.0291	31.50
7.054	450.746	14.29	0.34	2.35	47.48	31.4128	2.455	2.56	30.73	2.51	5	125.00	0.441	0.441	0.000	1.506	3.51	5.28	0.429	13.99	33.4317	33.76
7.382	450.418	16.68	0.5	3	56.9	35.1528	3.083	2.59	34.37	3.15	5	125.00	0.461	0.461	0.000	1.472	4.15	6.10	0.502	16.32	34.7346	34.45
7.71	450.090	21.63	0.78	3.61	62.19	43.8872	3.688	2.57	43.08	3.76	5	125.00	0.482	0.482	0.000	1.441	5.34	7.70	0.655	21.24	33.789	35.82
8.038	449.762	21.3	0.89	4.19	65.68	41.3986	4.279	2.63	40.58	4.37	4	125.00	0.502	0.502	0.000	1.411	5.43	7.66	0.644	20.89	36.9226	35.46
8.366	449.434	20.62	0.75	3.62	74.41	38.4358	3.732	2.62	37.54	3.82	4	125.00	0.523	0.523	0.000	1.383	5.19	7.18	0.622	20.15	36.1207	34.99
8.694	449.106	21.71	0.73	3.35	81.34	38.954	3.449	2.59	38.03	3.53	5	125.00	0.543	0.543	0.000	1.357	5.39	7.31	0.655	21.21	34.7719	35.07
9.022	448.778	22.26	0.62	2.79	96.35	38.4766	2.858	2.54	37.41	2.94	5	125.00	0.564	0.564	0.000	1.332	5.37	7.16	0.672	21.66	32.4751	34.97
9.35	448.450	20.7	0.61	2.93	91.74	34.7004	3.032	2.59	33.70	3.12	5	135.00	0.584	0.580	0.005	1.313	5.12	6.73	0.623	20.12	34.9106	34.33
9.678	448.122	20.96	0.7	3.35	82.7	34.4041	3.439	2.63	33.53	3.53	5	135.00	0.607	0.592	0.015	1.300	5.30	6.89	0.630	20.44	36.7405	34.30
10.006	447.794	23.37	0.86	3.67	95.38	37.6819	3.782	2.63	36.70	3.88	5	135.00	0.629	0.604	0.025	1.287	5.90	7.60	0.704	22.78	36.7081	34.86
10.335	447.465	23.21	0.93	4.02	86.47	36.6547	4.122	2.66	35.79	4.22	4	135.00	0.651	0.615	0.035	1.275	5.98	7.62	0.698	22.68	38.3828	34.71
10.663	447.137	22.31	0.82	3.68	48.55	34.4891	3.790	2.65	34.01	3.84	4	135.00	0.673	0.627	0.046	1.263	5.77	7.28	0.670	22.01	37.7717	34.40
10.991	446.809	21.94	0.83	3.79	50.34	33.2333	3.907	2.67	32.73	3.97	4	135.00	0.695	0.639	0.056	1.251	5.73	7.16	0.658	21.62	38.8777	34.17
11.319	446.481	23.94	0.89	3.73	69.05	35.6631	3.832	2.64	35.00	3.90	5	135.00	0.717	0.651	0.066	1.239	6.15	7.62	0.719	23.51	37.5487	34.58
11.647	446.153	31.54	1.47	4.66	33.07	46.451	4.773	2.62	46.13	4.81	4	135.00	0.739	0.663	0.076	1.228	8.10	9.95	0.954	31.33	36.4723	36.24
11.975	445.825	52.03	1.94	3.73	5.47	75.9552	3.784	2.40	75.91	3.79	5	135.00	0.762	0.675	0.087	1.217	12.09	14.71	1.587	52	26.4167	39.08
12.303	445.497	68.4	2.67	3.91	-22.86	98.4385	3.949	2.34	98.66	3.94	5	135.00	0.784	0.687	0.097	1.207	15.51	18.71	2.093	68.55	24.0213	40.50
12.631	445.169	53.25	3.19	6	-25.04	75.0494	6.083	2.56	75.26	6.07	3	135.00	0.806	0.699	0.107	1.196	13.38	16.01	1.624	53.4	33.4083	39.04
12.959	444.841	50.44	2.84	5.63	-25.2	69.8071	5.724	2.56	70.03	5.71	3	135.00	0.828	0.711	0.117	1.186	12.67	15.03	1.536	50.6	33.3638	38.64
13.287	444.513	31.23	2.43	7.77	-27.34	42.042	7.999	2.81	42.28	7.95	3	135.00	0.850	0.723	0.128	1.176	8.97	10.55	0.941	31.4	46.5809	35.73
13.615	444.185	36.66	2.18	5.95	-26.55	48.723	6.091	2.68	48.94	6.06	3	135.00	0.872	0.735	0.138	1.167	9.80	11.44	1.108	36.82	39.3835	36.60
13.943	443.857	56.53	3.08	5.44	-25.93	74.5365	5.536	2.53	74.75	5.52	3	135.00	0.894	0.746	0.148	1.157	14.00	16.20	1.722	56.69	32.013	39.00
14.271	443.529	129.14	5.32	4.12	-25.68	169.087	4.149	2.22	169.30	4.14	11	135.00	0.917	0.758	0.158	1.148	27.75	31.86	3.970	129.3	19.5836	43.26
14.6	443.200	241.69	8.13	3.37	-25.73	312.554	3.377	2.00	312.76	3.37	12	135.00	0.939	0.770	0.168	1.139	47.59	54.23	7.454	241.85	12.9931	46.12
14.928	442.872	231.67	8.83	3.81	-25.66	294.958	3.827	2.06	295.16	3.82	12	135.00	0.961	0.782	0.179	1.131	46.69	52.80	7.143	231.83	14.6671	45.86
15.256	442.544	258.78	8.95	3.46	-26.07	324.647	3.472	2.00	324.85	3.47	12	135.00	0.983	0.794	0.189	1.122	51.01	57.24	7.981	258.94	13.0637	46.29

R15722

Depth (ft)	...ile El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	... (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	442.216	285.8	8.43	2.95	-26.9	353.348	2.960	1.93	353.55	2.96	12	135.00	1.005	0.806	0.199	1.114	54.68	60.90	8.817	285.96	11 0253	46.66
15.912	441.888	277.04	7.22	2.61	-28.01	337.467	2.616	1.89	337.67	2.61	7	135.00	1.027	0.818	0.209	1.106	52.28	57.81	8.545	277.21	10.1227	46.46
16.24	441.560	219.73	6.99	3.18	-28.89	263.533	3.196	2.02	263.75	3.19	12	135.00	1.049	0.830	0.220	1.098	43.55	47.81	6.770	219.91	13.4471	45.35

R15723

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 34 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-8

ConeTec In Interpretation
Interpretatic .t - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4303
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-8
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 09:53
CPT File: 804CP08.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 445

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.90	1.70	55.34	26.74	2.35

User Inputs:
Assumed: Water Table Depth (ft): 6.6
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 445.0
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	444.836	17.37	0.13	0.75	0.35	1693.63	0.749	1.12	1693.63	0.75	6	125.00	0.010	0.010	0.000	2.000	2.55	5.11	0.537	17.37	-1.1659	52.71
0.492	444.508	21.17	0.35	1.66	-1.57	687.455	1.656	1.57	687.78	1.65	6	125.00	0.031	0.031	0.000	2.000	3.58	7.15	0.654	21.18	3.90719	49.41
0.82	444.180	31.35	0.66	2.09	-3.09	610.707	2.109	1.69	611.10	2.11	6	125.00	0.051	0.051	0.000	2.000	5.51	11.02	0.969	31.37	5.90214	48.94
1.148	443.852	43.85	0.95	2.17	-1.25	610.15	2.170	1.70	610.29	2.17	6	125.00	0.072	0.072	0.000	2.000	7.73	15.47	1.355	43.86	6.12164	48.94
1.476	443.524	44.4	1.46	3.29	-0.37	480.301	3.295	1.91	480.30	3.30	5	125.00	0.092	0.092	0.000	2.000	8.43	16.87	1.372	44.4	10.5965	47.96
1.804	443.196	47.24	1.66	3.51	0.21	417.98	3.522	1.96	417.98	3.52	5	125.00	0.113	0.113	0.000	2.000	9.15	18.30	1.459	47.24	11.8951	47.36
2.133	442.867	63.62	1.74	2.74	-0.23	476.225	2.741	1.84	476.22	2.74	6	125.00	0.133	0.133	0.000	2.000	11.78	23.55	1.966	63.62	8.93891	47.93
2.461	442.539	81.01	2.67	3.29	1.8	525.68	3.302	1.89	525.62	3.30	6	125.00	0.154	0.154	0.000	2.000	15.30	30.60	2.503	81	10.2349	48.33
2.789	442.211	87.64	3.13	3.57	-0.02	501.775	3.579	1.93	501.78	3.58	6	125.00	0.174	0.174	0.000	2.000	16.80	33.61	2.708	87.64	11.2144	48.14
3.117	441.883	72.36	2.94	4.06	0.81	370.434	4.074	2.04	370.38	4.07	5	125.00	0.195	0.195	0.000	2.000	14.45	28.90	2.234	72.35	14.0558	46.86
3.445	441.555	54.96	2.44	4.43	7.57	254.257	4.457	2.15	254.02	4.46	5	125.00	0.215	0.215	0.000	2.000	11.47	22.93	1.695	54.91	17.4107	45.18
3.773	441.227	45.6	1.94	4.26	13.4	192.374	4.277	2.20	192.03	4.28	5	125.00	0.236	0.236	0.000	2.000	9.70	19.39	1.404	45.52	18.9745	43.86
4.101	440.899	47.91	1.89	3.94	10.16	185.92	3.966	2.18	185.69	3.97	5	125.00	0.256	0.256	0.000	1.975	10.11	19.97	1.475	47.85	18.3226	43.70
4.429	440.571	55.66	1.91	3.43	18.45	200.075	3.449	2.11	199.64	3.46	5	125.00	0.277	0.277	0.000	1.901	11.41	21.70	1.715	55.64	16.1775	44.05
4.757	440.243	51.39	1.71	3.33	24.18	171.848	3.347	2.14	171.31	3.36	6	125.00	0.297	0.297	0.000	1.834	10.65	19.52	1.582	51.23	17.0225	43.31
5.085	439.915	45.68	1.53	3.36	21.34	142.733	3.373	2.19	142.32	3.38	5	125.00	0.318	0.318	0.000	1.774	9.66	17.14	1.404	45.55	18.6417	42.39
5.413	439.587	37.97	1.4	3.7	20.18	111.234	3.720	2.29	110.88	3.73	5	125.00	0.338	0.338	0.000	1.719	8.38	14.40	1.165	37.85	22.1372	41.11
5.741	439.259	32.73	1.25	3.83	18.96	90.2176	3.861	2.36	89.88	3.88	5	125.00	0.359	0.359	0.000	1.669	7.44	12.43	1.002	32.61	24.8088	40.00
6.069	438.931	32.51	1.3	3.99	14.67	84.7077	4.046	2.39	84.47	4.06	5	125.00	0.379	0.379	0.000	1.624	7.51	12.19	0.995	32.42	26.1077	39.66
6.398	438.602	30.81	1.37	4.44	8.27	76.0491	4.505	2.46	75.92	4.51	4	125.00	0.400	0.400	0.000	1.581	7.34	11.61	0.941	30.76	28.8283	39.08
6.726	438.274	30.16	1.35	4.47	11.29	71.4133	4.539	2.48	71.25	4.55	4	135.00	0.420	0.416	0.004	1.550	7.25	11.24	0.921	30.09	29.7266	38.72
7.054	437.946	30.78	1.3	4.22	12.22	70.824	4.285	2.46	70.64	4.30	4	135.00	0.443	0.428	0.014	1.528	7.34	11.22	0.939	30.7	29.0142	38.68
7.382	437.618	28.58	1.25	4.38	14.3	63.8613	4.446	2.50	63.66	4.46	4	135.00	0.465	0.440	0.024	1.507	6.95	10.48	0.870	28.49	30.8671	38.09
7.71	437.290	25.37	1.1	4.35	16	55.0315	4.421	2.55	54.81	4.44	4	135.00	0.487	0.452	0.035	1.487	6.29	9.36	0.770	25.27	32.7937	37.24
8.038	436.962	23.17	1.04	4.48	16.81	48.8312	4.589	2.59	48.59	4.61	4	135.00	0.509	0.464	0.045	1.468	5.88	8.63	0.702	23.06	35.0715	36.54
8.366	436.634	21.72	0.99	4.55	15.7	44.5168	4.672	2.63	44.31	4.69	3	135.00	0.531	0.476	0.055	1.449	5.60	8.12	0.656	21.62	36.7119	36.00
8.694	436.306	22.5	0.76	3.39	17	44.9838	3.463	2.53	44.76	3.48	5	135.00	0.553	0.488	0.065	1.432	5.54	7.93	0.679	22.39	32.1478	36.06
9.022	435.978	20.87	0.66	3.17	17.39	40.6065	3.252	2.55	40.41	3.27	5	135.00	0.575	0.500	0.076	1.415	5.17	7.31	0.628	20.77	32.7685	35.46
9.35	435.650	20.28	0.77	3.78	19.44	38.4653	3.912	2.62	38.23	3.94	4	135.00	0.597	0.512	0.086	1.398	5.20	7.27	0.609	20.16	36.2763	35.13
9.678	435.322	22.23	1.07	4.83	14.64	41.2726	4.951	2.67	41.08	4.97	3	135.00	0.620	0.524	0.096	1.382	5.86	8.10	0.669	22.13	38.7923	35.56
10.006	434.994	27.84	1.15	4.14	14.22	50.7896	4.228	2.56	50.62	4.24	4	135.00	0.642	0.536	0.106	1.367	6.94	9.48	0.842	27.75	33.2318	36.79
10.335	434.665	30.49	1.3	4.26	-2.51	54.4817	4.359	2.54	54.50	4.36	4	135.00	0.664	0.547	0.117	1.352	7.58	10.24	0.923	30.5	32.5983	37.22
10.663	434.337	20.58	1.04	5.04	-8.43	35.5656	5.228	2.73	35.67	5.21	3	135.00	0.686	0.559	0.127	1.337	5.63	7.53	0.616	20.64	41.8344	34.72
10.991	434.009	21.64	0.79	3.66	-8.2	36.6411	3.774	2.62	36.73	3.77	4	135.00	0.708	0.571	0.137	1.323	5.60	7.40	0.648	21.69	36.2422	34.90
11.319	433.681	18.91	0.92	4.85	-4.78	31.1738	5.061	2.76	31.23	5.05	3	135.00	0.730	0.583	0.147	1.309	5.26	6.88	0.563	18.94	43.5695	33.91
11.647	433.353	17	0.91	5.34	-3.97	27.3032	5.601	2.83	27.35	5.59	3	135.00	0.753	0.595	0.157	1.296	4.92	6.37	0.503	17.03	47.693	33.09
11.975	433.025	20.2	1.09	5.41	-3.4	32.0031	5.611	2.78	32.04	5.61	3	135.00	0.775	0.607	0.168	1.284	5.68	7.30	0.601	20.22	44.908	34.07
12.303	432.697	23.77	1.16	4.87	-3.74	37.12	5.049	2.70	37.15	5.04	3	135.00	0.797	0.619	0.178	1.271	6.41	8.15	0.711	23.79	40.6258	34.97
12.631	432.369	23.53	1.14	4.86	-2.66	36.0038	5.020	2.71	36.02	5.02	3	135.00	0.819	0.631	0.188	1.259	6.37	8.02	0.703	23.54	41.0417	34.79
12.959	432.041	25.86	1.03	3.99	-1.59	38.9277	4.117	2.63	38.94	4.12	4	135.00	0.841	0.643	0.198	1.247	6.70	8.36	0.775	25.87	36.659	35.26
13.287	431.713	28.74	1.22	4.25	4.68	42.5854	4.376	2.62	42.54	4.38	4	135.00	0.863	0.655	0.209	1.236	7.41	9.16	0.863	28.71	36.2582	35.79
13.615	431.385	23.7	0.95	4.02	4.89	34.2297	4.164	2.67	34.18	4.17	4	135.00	0.885	0.667	0.219	1.225	6.27	7.69	0.706	23.67	38.9362	34.48
13.943	431.057	21.82	0.56	2.55	10.93	30.8252	2.678	2.58	30.72	2.69	5	135.00	0.908	0.678	0.229	1.214	5.50	6.68	0.647	21.75	34.3343	33.83
14.271	430.729	17.59	0.45	2.54	19.05	24.134	2.701	2.67	23.96	2.72	5	135.00	0.930	0.690	0.239	1.204	4.62	5.56	0.516	17.47	38.6783	32.28
14.6	430.400	15.35	0.32	2.09	24.25	20.5023	2.223	2.67	20.29	2.25	5	135.00	0.952	0.702	0.250	1.193	4.03	4.81	0.446	15.2	39.0527	31.24
14.928	430.072	13.48	0.21	1.52	31.31	17.5111	1.679	2.66	17.25	1.71	6	135.00	0.974	0.714	0.260	1.183	3.51	4.15	0.387	13.29	38.5544	30.20
15.256	429.744	13.47	0.25	1.82	40.37	17.1797	2.004	2.72	16.84	2.05	5	135.00	0.996	0.726	0.270	1.174	3.59	4.21	0.386	13.22	41.3202	30.05

R15725

Depth (ft)	El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	429.416	16.28	0.5	2.74	47	23.3902	2.897	2.70	22.98	2.95	5	135.00	1.018	0.738	0.280	1.164	4.84	5.64	0.534	17.98	40.5576	32.03
15.912	429.088	44.7	2.02	4.53	28.04	58.2209	4.627	2.54	57.98	4.65	4	135.00	1.040	0.750	0.291	1.155	11.07	12.79	1.352	44.52	32.7068	37.60
16.24	428.760	126.44	5.34	4.22	-16.4	164.58	4.259	2.23	164.72	4.26	11	135.00	1.063	0.762	0.301	1.146	27.34	31.33	3.882	126.55	20.1417	43.13
16.568	428.432	213.9	10.81	5.05	-15.7	275.059	5.080	2.18	275.19	5.08	11	136.00	1.085	0.774	0.311	1.137	45.29	51.49	6.589	214	18.4606	45.55
16.896	428.104	378.56	14.03	3.71	-15.73	480.355	3.717	1.96	480.48	3.72	12	137.00	1.107	0.786	0.321	1.128	73.23	82.61	11.686	378.66	11.787	47.97
17.224	427.776	341.19	15.02	4.4	-15.91	426.134	4.417	2.05	426.26	4.42	12	138.00	1.129	0.798	0.331	1.119	68.32	76.47	10.528	341.29	14.2134	47.46
17.552	427.448	312.91	15.43	4.93	-12.1	384.691	4.949	2.11	384.79	4.95	11	139.00	1.152	0.810	0.342	1.111	64.25	71.37	9.652	312.99	16.0829	47.03

R15726

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 37 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-9

ConeTec In Interpretation
Interpretatio. .t - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4276
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-9
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 09:17
CPT File: 804CP09.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 445.7

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	39.25	1.38	45.19	28.02	2.40

User Inputs:
Water Table Depth (ft): 7.8
Ground Surface Elev. 445.7
Assumed: Nk: 32.3
State Parameter: 1.2
CPT area ratio: 0.85
Unit Weight of Soil (pcf): Varies See Below
See Below
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	445.536	15.38	0.2	1.27	-2.59	1499.49	1.301	1.37	1501.44	1.30	6	125.00	0.010	0.010	0.000	2.000	2.43	4.87	0.476	15.4	1.11893	52.29
0.492	445.208	19.82	0.38	1.92	-12.01	643.553	1.920	1.64	646.15	1.91	6	125.00	0.031	0.031	0.000	2.000	3.44	6.88	0.613	19.9	5.03728	49.17
0.82	444.880	30.1	0.63	2.1	-9.01	586.317	2.097	1.69	587.29	2.09	6	125.00	0.051	0.051	0.000	2.000	5.30	10.61	0.930	30.15	5.98332	48.78
1.148	444.552	43.87	0.91	2.07	-3.21	610.429	2.078	1.69	610.71	2.08	6	125.00	0.072	0.072	0.000	2.000	7.69	15.39	1.356	43.89	5.7973	48.94
1.476	444.224	47.66	1.19	2.49	0.07	515.64	2.502	1.79	515.64	2.50	6	125.00	0.092	0.092	0.000	2.000	8.66	17.33	1.473	47.66	7.8425	48.25
1.804	443.896	45.87	1.66	3.62	0.07	405.829	3.628	1.98	405.83	3.63	5	125.00	0.113	0.113	0.000	2.000	8.94	17.89	1.417	45.87	12.3416	47.25
2.133	443.567	41.72	1.66	3.98	0.25	311.949	3.992	2.07	311.95	3.99	5	125.00	0.133	0.133	0.000	2.000	8.42	16.84	1.288	41.72	14.8063	46.11
2.461	443.239	37.44	1.52	4.06	0.39	242.413	4.077	2.13	242.41	4.08	5	125.00	0.154	0.154	0.000	2.000	7.74	15.49	1.154	37.44	16.6663	44.96
2.789	442.911	44.47	1.87	4.2	0.86	254.117	4.222	2.13	254.06	4.22	5	125.00	0.174	0.174	0.000	2.000	9.21	18.41	1.371	44.46	16.7567	45.18
3.117	442.583	59.57	2.65	4.44	0.23	304.781	4.463	2.11	304.78	4.46	5	125.00	0.195	0.195	0.000	2.000	12.25	24.50	1.838	59.57	16.2268	46.00
3.445	442.255	70.47	2.79	3.95	1.85	326.292	3.971	2.06	326.25	3.97	5	125.00	0.215	0.215	0.000	2.000	14.16	28.31	2.175	70.46	14.487	46.30
3.773	441.927	74.67	2.46	3.29	-0.62	315.65	3.305	1.99	315.69	3.30	6	125.00	0.236	0.236	0.000	2.000	14.64	29.28	2.304	74.68	12.725	46.16
4.101	441.599	84.53	2.85	3.37	1.85	328.793	3.382	1.99	328.75	3.38	6	125.00	0.256	0.256	0.000	1.975	16.57	32.73	2.609	84.52	12.7342	46.34
4.429	441.271	104.33	3.88	3.72	1.8	375.898	3.729	2.00	375.86	3.73	6	125.00	0.277	0.277	0.000	1.901	20.54	39.03	3.221	104.32	13.0225	46.92
4.757	440.943	96.44	3.96	4.11	2.45	323.373	4.119	2.07	323.34	4.12	5	125.00	0.297	0.297	0.000	1.834	19.50	35.76	2.977	96.43	14.9462	46.26
5.085	440.615	102.25	4.19	4.1	0.62	320.731	4.111	2.07	320.70	4.11	5	125.00	0.318	0.318	0.000	1.774	20.68	36.68	3.156	102.24	14.9718	46.23
5.413	440.287	98.2	4.51	4.59	1.13	289.264	4.609	2.14	289.23	4.61	11	125.00	0.338	0.338	0.000	1.719	20.38	35.04	3.030	98.19	16.9403	45.77
5.741	439.959	94.73	4.11	4.34	4.32	263.01	4.355	2.14	262.93	4.36	11	125.00	0.359	0.359	0.000	1.669	19.65	32.60	2.922	94.7	16.894	45.33
6.069	439.631	84.93	3.46	4.08	5.01	222.905	4.092	2.15	222.83	4.09	5	125.00	0.379	0.379	0.000	1.624	17.71	28.75	2.618	84.9	17.3092	44.57
6.398	439.302	87.66	3.56	4.07	-2.24	218.219	4.080	2.15	218.24	4.08	5	125.00	0.400	0.400	0.000	1.581	18.31	28.96	2.702	87.67	17.4182	44.47
6.726	438.974	69.12	3.37	4.87	4.69	163.425	4.905	2.29	163.35	4.91	11	125.00	0.420	0.420	0.000	1.542	15.27	23.56	2.127	69.09	22.0488	43.08
7.054	438.646	63.77	3.03	4.76	3.08	143.644	4.785	2.31	143.60	4.79	4	125.00	0.441	0.441	0.000	1.506	14.23	21.43	1.961	63.75	22.8724	42.43
7.382	438.318	53.39	2.77	5.19	7.53	114.719	5.233	2.40	114.61	5.24	3	125.00	0.461	0.461	0.000	1.472	12.39	18.24	1.639	53.34	26.3327	41.28
7.71	437.990	48.17	2.41	4.99	4.9	98.9637	5.054	2.42	98.90	5.06	4	125.00	0.482	0.482	0.000	1.441	11.31	16.30	1.476	48.14	27.4055	40.51
8.038	437.662	38.46	1.98	5.15	10.26	76.6899	5.216	2.50	76.55	5.23	3	135.00	0.502	0.495	0.007	1.421	9.37	13.31	1.175	38.39	30.8807	39.12
8.366	437.334	30.22	1.55	5.12	11.57	58.5876	5.220	2.58	58.45	5.23	3	135.00	0.525	0.507	0.018	1.405	7.63	10.72	0.919	30.15	34.4169	37.61
8.694	437.006	28.4	1.39	4.89	12.03	53.6919	4.990	2.59	53.56	5.00	3	135.00	0.547	0.519	0.028	1.388	7.21	10.01	0.862	28.33	34.9372	37.11
9.022	436.678	29.4	1.32	4.5	11.46	54.33	4.578	2.56	54.20	4.59	4	135.00	0.569	0.531	0.038	1.373	7.35	10.09	0.893	29.33	33.449	37.18
9.35	436.350	28.31	1.17	4.14	11.87	51.088	4.221	2.55	50.94	4.23	4	135.00	0.591	0.543	0.048	1.358	7.05	9.57	0.858	28.23	33.1117	36.82
9.678	436.022	26.35	1.19	4.53	15.1	46.4162	4.624	2.61	46.24	4.64	4	135.00	0.613	0.554	0.059	1.343	6.75	9.06	0.797	26.25	35.9001	36.25
10.006	435.694	25.07	1.15	4.6	14.55	43.1414	4.706	2.64	42.98	4.72	3	135.00	0.635	0.566	0.069	1.329	6.51	8.65	0.756	24.98	37.2699	35.82
10.335	435.365	25.89	1.24	4.78	13.4	43.63	4.914	2.65	43.49	4.93	3	135.00	0.657	0.578	0.079	1.315	6.76	8.89	0.781	25.81	37.7669	35.89
10.663	435.037	22.8	1.2	5.28	9.91	37.4772	5.425	2.72	37.38	5.44	3	135.00	0.680	0.590	0.089	1.302	6.20	8.07	0.685	22.74	41.7846	34.99
10.991	434.709	27.92	1.18	4.22	10.86	45.2024	4.335	2.60	45.09	4.35	4	135.00	0.702	0.602	0.100	1.289	7.11	9.17	0.843	27.85	35.267	36.11
11.319	434.381	29.42	1.45	4.92	10.68	46.7326	5.053	2.64	46.62	5.07	3	135.00	0.724	0.614	0.110	1.276	7.64	9.75	0.898	29.35	37.1499	36.31
11.647	434.053	26.23	1.41	5.39	11.38	40.7121	5.533	2.71	40.60	5.55	3	135.00	0.746	0.626	0.120	1.264	7.06	8.93	0.789	26.16	40.7787	35.49
11.975	433.725	23.16	0.99	4.29	10.95	35.1046	4.421	2.68	34.99	4.44	4	135.00	0.768	0.638	0.130	1.252	6.16	7.71	0.693	23.09	39.5208	34.60
12.303	433.397	20.42	0.52	2.55	11.83	30.2103	2.649	2.58	30.10	2.66	5	135.00	0.790	0.650	0.140	1.241	5.16	6.40	0.608	20.35	34.5204	33.68
12.631	433.069	18.58	0.49	2.64	14.43	26.8524	2.758	2.63	26.72	2.77	5	135.00	0.812	0.662	0.151	1.229	4.81	5.91	0.550	18.49	37.0571	32.94
12.959	432.741	22.2	0.51	2.28	45.47	31.7192	2.387	2.54	31.29	2.42	6	135.00	0.835	0.674	0.161	1.218	5.45	6.64	0.661	21.91	32.6826	33.92
13.287	432.413	18.14	0.35	1.91	50.26	25.2132	2.025	2.58	24.75	2.06	6	135.00	0.857	0.685	0.171	1.208	4.52	5.45	0.535	17.82	34.4848	32.46
13.615	432.085	15.81	0.26	1.65	56.56	21.4099	1.741	2.60	20.91	1.78	6	135.00	0.879	0.697	0.181	1.197	3.96	4.74	0.462	15.46	35.5971	31.40
13.943	431.757	12.95	0.21	1.59	52.01	16.9872	1.743	2.69	16.52	1.79	5	135.00	0.901	0.709	0.192	1.187	3.38	4.01	0.373	12.62	39.9818	29.89
14.271	431.429	11.94	0.19	1.55	59.86	15.2756	1.725	2.73	14.75	1.79	5	135.00	0.923	0.721	0.202	1.178	3.16	3.73	0.341	11.56	42.1627	29.15
14.6	431.100	12.26	0.19	1.51	66.28	15.433	1.679	2.72	14.87	1.74	5	135.00	0.945	0.733	0.212	1.168	3.23	3.77	0.350	11.85	41.679	29.21
14.928	430.772	11.19	0.19	1.7	73.44	13.7205	1.859	2.80	13.10	1.95	5	135.00	0.967	0.745	0.222	1.159	3.04	3.52	0.316	10.73	45.7108	28.39
15.256	430.444	15.59	0.3	1.9	87.39	19.2881	2.055	2.69	18.56	2.14	5	135.00	0.990	0.757	0.233	1.149	4.03	4.63	0.452	15.04	40.03	30.65

R15728

Depth (ft)	S. . El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	430.116	23.74	0.44	1.84	87.72	29.5606	1.936	2.52	28.85	1.98	6	135.00	1.012	0.769	0.243	1.140	5.70	6.50	0.704	23.19	31.5153	33.43
15.912	429.788	29.33	0.85	2.89	108.61	36.2411	3.004	2.57	35.37	3.08	5	135.00	1.034	0.781	0.253	1.132	7.22	8.17	0.876	28.65	33.9566	34.68
16.24	429.460	38.72	1.48	3.83	103.37	47.5146	3.929	2.56	46.71	4.00	5	135.00	1.056	0.793	0.263	1.123	9.55	10.73	1.166	38.08	33.507	36.34
16.568	429.132	56.19	2.18	3.88	102.93	68.4969	3.956	2.45	67.69	4.00	5	136.00	1.078	0.805	0.274	1.115	13.22	14.73	1.706	55.54	28.5538	38.46
16.896	428.804	60.78	3.03	4.98	65.61	73.0777	5.077	2.51	72.58	5.11	11	137.00	1.100	0.817	0.284	1.107	14.78	16.36	1.848	60.37	31.2128	38.85
17.224	428.476	50.94	2.78	5.46	60.44	60.1007	5.580	2.60	59.64	5.62	3	138.00	1.123	0.829	0.294	1.098	12.92	14.19	1.542	50.56	35.2823	37.75
17.552	428.148	43.07	2.33	5.4	23.93	49.8334	5.558	2.65	49.66	5.58	3	139.00	1.146	0.841	0.304	1.090	11.26	12.26	1.298	42.92	37.7709	36.70
17.88	427.820	39.51	1.86	4.71	-0.56	44.9042	4.851	2.63	44.90	4.85	4	140.00	1.168	0.854	0.314	1.082	10.27	11.12	1.187	39.51	37.026	36.11
18.208	427.492	41.11	1.74	4.23	0.62	46.0646	4.359	2.59	46.06	4.36	4	141.00	1.191	0.867	0.325	1.074	10.47	11.25	1.236	41.11	34.9935	36.27
18.537	427.163	41.12	1.68	4.1	2.12	45.3724	4.210	2.59	45.35	4.21	5	142.00	1.215	0.880	0.335	1.066	10.44	11.13	1.235	41.1	34.7084	36.17
18.865	426.835	45.7	1.83	4	4.37	49.814	4.116	2.55	49.79	4.12	5	143.00	1.238	0.893	0.345	1.058	11.40	12.07	1.377	45.68	33.0275	36.72
19.193	426.507	43.86	2.11	4.81	4.87	47.0298	4.953	2.63	47.00	4.96	4	144.00	1.261	0.906	0.355	1.051	11.36	11.93	1.319	43.83	36.6851	36.38
19.521	426.179	36.52	1.92	5.26	11.85	38.3338	5.449	2.72	38.25	5.46	3	145.00	1.285	0.919	0.366	1.043	9.91	10.33	1.091	36.44	41.4759	35.17
19.849	425.851	49.37	2.52	5.1	12.88	51.5286	5.243	2.62	51.43	5.25	3	146.00	1.309	0.933	0.376	1.035	12.72	13.17	1.488	49.28	36.286	36.91
20.177	425.523	60.49	3.37	5.58	-1.34	62.5064	5.697	2.59	62.52	5.70	11	147.00	1.333	0.946	0.386	1.028	15.39	15.82	1.831	60.5	34.8428	38.02
20.505	425.195	75.15	3.54	4.72	-5.82	76.8443	4.797	2.47	76.89	4.79	11	148.00	1.357	0.960	0.396	1.020	18.09	18.46	2.285	75.19	29.5495	39.17
20.833	424.867	74.98	3.23	4.31	-7.5	75.5377	4.389	2.45	75.59	4.39	5	149.00	1.381	0.974	0.407	1.013	17.84	18.07	2.279	75.03	28.4777	39.08
21.161	424.539	51.59	2	3.88	-4.69	50.7665	3.985	2.53	50.80	3.98	5	150.00	1.405	0.989	0.417	1.006	12.78	12.85	1.554	51.62	32.2646	36.84
21.489	424.211	88.98	4.5	5.06	-4.99	87.2965	5.140	2.46	87.34	5.14	11	151.00	1.430	1.003	0.427	0.999	21.30	21.27	2.711	89.02	29.0451	39.87

R15729

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 40 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-10

ConeTec Inc Interpretation
Interpretation - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4243
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-10
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 08:35
CPT File: 804CP10.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 442.1

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.49	1.77	57.88	26.87	2.36

User Inputs:
Water Table Depth (ft): 3.4
Assumed: Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 442.1
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	441.936	22.84	0.17	0.75	0.53	2227.29	0.745	1.10	2227.29	0.74	7	125.00	0.010	0.010	0.000	2.000	3.34	6.67	0.707	22.84	-1.3233	53.62
0.492	441.608	28.68	0.4	1.4	-1.45	931.683	1.396	1.45	931.68	1.40	6	125.00	0.031	0.031	0.000	2.000	4.66	9.32	0.887	28.68	2.20569	50.57
0.82	441.280	30.14	0.52	1.73	-6.33	587.098	1.728	1.62	587.88	1.73	6	125.00	0.051	0.051	0.000	2.000	5.17	10.35	0.932	30.18	4.63942	48.79
1.148	440.952	41.06	0.62	1.5	-7.39	571.265	1.513	1.57	571.96	1.51	7	125.00	0.072	0.072	0.000	2.000	6.94	13.88	1.269	41.11	3.88432	48.68
1.476	440.624	62.23	0.9	1.44	-3.79	673.58	1.448	1.52	673.91	1.45	7	125.00	0.092	0.092	0.000	2.000	10.34	20.69	1.924	62.26	3.15876	49.33
1.804	440.296	70.49	1.29	1.83	-0.76	624.188	1.833	1.63	624.28	1.83	7	125.00	0.113	0.113	0.000	2.000	12.13	24.27	2.179	70.5	4.85185	49.03
2.133	439.967	63.39	1.44	2.28	-1.34	474.499	2.276	1.77	474.57	2.28	6	125.00	0.133	0.133	0.000	2.000	11.44	22.87	1.958	63.4	7.40369	47.91
2.461	439.639	64.76	1.42	2.19	-1.66	420.032	2.198	1.78	420.10	2.20	7	125.00	0.154	0.154	0.000	2.000	11.73	23.46	2.000	64.77	7.63043	47.40
2.789	439.311	67.64	1.58	2.34	-1.64	387.039	2.342	1.82	387.10	2.34	6	125.00	0.174	0.174	0.000	2.000	12.43	24.87	2.089	67.65	8.50804	47.05
3.117	438.983	62.08	1.55	2.49	-2.26	317.665	2.505	1.89	317.77	2.50	6	125.00	0.195	0.195	0.000	2.000	11.70	23.40	1.916	62.1	10.0559	46.19
3.445	438.655	61.6	1.76	2.86	-2.61	286.967	2.867	1.96	287.01	2.87	6	125.00	0.215	0.214	0.001	2.000	11.93	23.86	1.900	61.61	11.8668	45.73
3.773	438.327	49.8	1.64	3.29	-3.46	221.096	3.309	2.07	221.23	3.31	6	125.00	0.236	0.224	0.012	2.000	10.08	20.15	1.534	49.83	14.9652	44.54
4.101	437.999	35.16	1.26	3.59	-0.53	148.88	3.610	2.20	148.92	3.61	5	125.00	0.256	0.234	0.022	2.000	7.49	14.99	1.081	35.17	19.0045	42.62
4.429	437.671	23.8	0.94	3.96	5.47	96.1277	3.996	2.35	95.96	4.00	4	125.00	0.277	0.245	0.032	2.000	5.41	10.81	0.728	23.76	24.5219	40.35
4.757	437.343	20.99	0.83	3.94	15.36	81.166	4.011	2.40	80.76	4.03	4	125.00	0.297	0.255	0.042	1.980	4.86	9.63	0.641	20.89	26.5321	39.43
5.085	437.015	23.58	0.9	3.8	17.32	87.7022	3.869	2.37	87.29	3.89	4	125.00	0.318	0.265	0.053	1.942	5.38	10.45	0.720	23.47	25.1707	39.85
5.413	436.687	26.07	1.08	4.15	16.35	93.3976	4.197	2.38	93.03	4.21	4	125.00	0.338	0.276	0.063	1.905	5.98	11.39	0.797	25.97	25.5391	40.19
5.741	436.359	28	1.25	4.46	13.72	96.7242	4.522	2.39	96.44	4.54	4	125.00	0.359	0.286	0.073	1.871	6.47	12.10	0.856	27.92	26.1485	40.39
6.069	436.031	27.78	1.26	4.55	13.97	92.5575	4.598	2.41	92.25	4.61	4	125.00	0.379	0.296	0.083	1.838	6.47	11.89	0.848	27.69	26.8768	40.15
6.398	435.702	23.67	0.97	4.09	20.99	75.9624	4.168	2.43	75.54	4.19	4	125.00	0.400	0.306	0.094	1.807	5.56	10.04	0.720	23.54	27.8545	39.07
6.726	435.374	22.65	0.83	3.65	20.09	70.2128	3.734	2.42	69.80	3.76	5	125.00	0.420	0.317	0.104	1.777	5.29	9.40	0.688	22.52	27.3099	38.63
7.054	435.046	23.86	0.78	3.26	20.76	71.6466	3.331	2.38	71.25	3.35	5	125.00	0.441	0.327	0.114	1.749	5.46	9.56	0.725	23.73	25.568	38.75
7.382	434.718	19.8	0.64	3.24	24.65	57.3614	3.309	2.45	56.89	3.34	5	125.00	0.461	0.337	0.124	1.722	4.65	8.03	0.599	19.64	28.3064	37.49
7.71	434.390	17.31	0.59	3.42	30.58	48.4398	3.506	2.52	47.89	3.65	4	125.00	0.482	0.347	0.134	1.697	4.20	7.13	0.521	17.12	31.4473	36.49
8.038	434.062	18.65	0.73	3.9	29.81	50.7385	4.023	2.54	50.21	4.07	4	135.00	0.502	0.358	0.145	1.672	4.59	7.68	0.562	18.46	32.7232	36.77
8.366	433.734	15.11	0.63	4.15	30.69	39.4655	4.319	2.65	38.95	4.38	3	135.00	0.525	0.370	0.155	1.645	3.90	6.42	0.452	14.92	37.5988	35.28
8.694	433.406	14.94	0.58	3.89	35.5	37.7301	4.030	2.64	37.15	4.09	4	135.00	0.547	0.381	0.165	1.619	3.84	6.22	0.446	14.72	37.3103	35.00
9.022	433.078	15.71	0.66	4.15	39.67	38.4892	4.293	2.65	37.85	4.36	3	135.00	0.569	0.393	0.175	1.594	4.06	6.47	0.469	15.46	38.0083	35.11
9.35	432.750	20.24	0.82	4.06	39.19	48.4809	4.173	2.57	47.86	4.23	4	135.00	0.591	0.405	0.186	1.571	5.04	7.91	0.608	19.99	33.9763	36.50
9.678	432.422	21.26	1.1	5.19	18.66	49.4891	5.328	2.84	49.23	5.36	3	135.00	0.613	0.417	0.196	1.548	5.51	8.53	0.639	21.15	37.2394	36.66
10.006	432.094	21.52	1.14	5.29	14.2	48.6703	5.459	2.85	48.46	5.48	3	135.00	0.635	0.429	0.206	1.527	5.62	8.58	0.647	21.43	37.8499	36.57
10.335	431.765	22.36	1.16	5.2	0.19	49.2066	5.345	2.84	49.21	5.34	3	135.00	0.657	0.441	0.216	1.506	5.83	8.77	0.672	22.36	37.2112	36.66
10.663	431.437	18.99	1.06	5.57	-6.84	40.4242	5.789	2.72	40.53	5.77	3	135.00	0.680	0.453	0.227	1.486	5.18	7.69	0.567	19.04	41.4795	35.53
10.991	431.109	14.81	0.82	5.55	-7.21	30.3493	5.812	2.81	30.44	5.80	3	135.00	0.702	0.465	0.237	1.467	4.23	6.21	0.437	14.85	46.4001	33.80
11.319	430.781	15.17	0.79	5.19	-6.65	30.3001	5.469	2.79	30.38	5.45	3	135.00	0.724	0.477	0.247	1.448	4.29	6.22	0.447	15.21	45.3583	33.80
11.647	430.453	13.83	0.74	5.37	-5.98	26.7744	5.656	2.84	26.84	5.64	3	135.00	0.746	0.489	0.257	1.431	4.02	5.75	0.405	13.86	48.2129	33.04
11.975	430.125	11.53	0.56	4.82	-4.81	21.4987	5.204	2.88	21.56	5.19	3	135.00	0.768	0.501	0.268	1.413	3.44	4.86	0.333	11.56	50.9108	31.67
12.303	429.797	12.82	0.45	3.52	-3.23	23.4732	3.741	2.76	23.51	3.73	4	135.00	0.790	0.512	0.278	1.397	3.57	4.98	0.372	12.84	43.714	32.22
12.631	429.469	13.05	0.43	3.3	-2.06	23.3366	3.514	2.74	23.37	3.51	4	135.00	0.812	0.524	0.288	1.381	3.60	4.97	0.379	13.07	42.8475	32.18
12.959	429.141	13.03	0.41	3.16	-0.78	22.7399	3.362	2.74	22.74	3.36	4	135.00	0.835	0.536	0.298	1.366	3.58	4.90	0.378	13.03	42.7021	32.01
13.287	428.813	14.48	0.43	2.98	12.21	24.8506	3.156	2.70	24.70	3.17	5	135.00	0.857	0.548	0.308	1.351	3.87	5.23	0.422	14.4	40.3482	32.53
13.615	428.485	14.54	0.43	2.97	15.45	24.39	3.148	2.70	24.21	3.17	5	135.00	0.879	0.560	0.319	1.336	3.90	5.20	0.423	14.44	40.6879	32.41
13.943	428.157	13.29	0.47	3.55	20.09	21.6584	3.794	2.80	21.43	3.83	4	135.00	0.901	0.572	0.329	1.322	3.73	4.94	0.384	13.16	45.8728	31.65
14.271	427.829	16.42	0.51	3.08	25.66	26.5391	3.291	2.69	26.27	3.33	5	135.00	0.923	0.584	0.339	1.309	4.35	5.70	0.480	16.26	39.9534	32.91
14.6	427.500	19.35	0.75	3.86	19.79	30.8871	4.075	2.70	30.69	4.10	4	135.00	0.945	0.596	0.349	1.295	5.18	6.71	0.570	19.23	40.477	33.87
14.928	427.172	23.7	1.01	4.25	-5.33	37.4028	4.443	2.66	37.45	4.44	4	135.00	0.967	0.608	0.360	1.283	6.26	8.03	0.704	23.73	38.4335	35.07
15.256	426.844	26.27	0.82	3.11	-8.01	40.7957	3.244	2.54	40.88	3.24	5	135.00	0.990	0.620	0.370	1.270	6.53	8.30	0.783	26.32	32.4669	35.59

R15731

Depth (ft)	S… El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	426.516	28.43	0.71	2.5	1.06	43.4116	2.590	2.45	43.40	2.59	6	135.00	1.012	0.632	0.380	1.258	6.77	8.52	0.849	28.42	28.7045	35.94
15.912	426.188	34.11	0.83	2.42	14.23	51.4007	2.509	2.39	51.26	2.52	6	135.00	1.034	0.643	0.390	1.247	7.88	9.82	1.024	34.02	26.1157	36.91
16.24	425.860	36.87	1.15	3.11	26.79	54.6443	3.211	2.45	54.38	3.23	5	135.00	1.056	0.655	0.401	1.235	8.72	10.78	1.109	36.7	28.4501	37.25
16.568	425.532	38.02	1.21	3.18	114.11	55.3595	3.275	2.46	54.30	3.34	5	136.00	1.078	0.667	0.411	1.224	8.91	10.91	1.144	37.31	28.9263	37.24
16.896	425.204	42.17	1.45	3.45	138.77	60.4516	3.531	2.46	59.17	3.61	5	137.00	1.100	0.679	0.421	1.213	9.86	11.96	1.272	41.3	28.8349	37.73
17.224	424.876	49.75	1.96	3.95	80.34	70.3096	4.031	2.45	69.59	4.07	5	138.00	1.123	0.692	0.431	1.202	11.71	14.08	1.505	49.25	28.4507	38.64
17.552	424.548	47.56	1.6	3.37	107.39	65.9285	3.447	2.42	64.98	3.50	5	139.00	1.146	0.704	0.442	1.192	11.00	13.11	1.437	46.89	27.2425	38.26
17.88	424.220	51.6	1.85	3.59	140.27	70.3788	3.668	2.42	69.15	3.73	5	140.00	1.168	0.717	0.452	1.181	11.91	14.07	1.561	50.72	27.3444	38.61
18.208	423.892	65.03	2.32	3.57	168.7	87.5341	3.634	2.36	86.09	3.69	5	141.00	1.191	0.729	0.462	1.171	14.58	17.07	1.976	63.98	24.6627	39.80
18.537	423.563	70.02	2.53	3.61	155.08	92.701	3.677	2.34	91.39	3.73	5	142.00	1.215	0.742	0.472	1.161	15.64	18.15	2.130	69.05	24.1296	40.12
18.865	423.235	65.59	2.53	3.86	43.83	85.2026	3.931	2.38	84.85	3.95	5	143.00	1.238	0.755	0.483	1.151	15.06	17.33	1.992	65.32	25.6929	39.72
19.193	422.907	55.6	2.73	4.9	4.71	70.7073	5.024	2.51	70.67	5.03	4	144.00	1.261	0.769	0.493	1.141	13.62	15.54	1.682	55.57	31.2954	38.73
19.521	422.579	110.1	2.81	2.55	-0.67	139.17	2.582	2.10	139.17	2.58	7	145.00	1.285	0.782	0.503	1.131	22.55	25.50	3.369	110.1	15.903	42.30
19.849	422.251	160.51	4.84	3.02	-18.41	200.145	3.040	2.06	200.30	3.04	7	146.00	1.309	0.795	0.513	1.121	32.40	36.33	4.929	160.63	14.7692	44.08
20.177	421.923	111.07	5.1	4.59	-23.58	135.622	4.647	2.31	135.79	4.64	11	147.00	1.333	0.809	0.523	1.112	24.86	27.63	3.397	111.21	22.9849	42.18
20.505	421.595	58.81	3.39	5.76	-23.83	69.8082	5.900	2.57	69.99	5.89	11	148.00	1.357	0.823	0.534	1.102	14.84	16.36	1.779	58.96	33.8626	38.67
20.833	421.267	53.52	2.16	4.03	-22.7	62.2887	4.143	2.48	62.46	4.13	5	149.00	1.381	0.837	0.544	1.093	12.97	14.18	1.614	53.66	30.0156	38.04
21.161	420.939	55.22	2.52	4.56	-21.43	63.2178	4.683	2.52	63.37	4.67	4	150.00	1.405	0.851	0.554	1.084	13.61	14.75	1.666	55.35	31.6051	38.12
21.489	420.611	99.33	2.92	2.94	-20.71	113.098	2.983	2.21	113.25	2.98	6	151.00	1.430	0.868	0.564	1.075	21.26	22.85	3.031	99.46	19.2589	41.25
21.817	420.283	112.37	3.22	2.86	-15.47	126.018	2.903	2.17	126.13	2.90	6	152.00	1.455	0.880	0.575	1.066	23.66	25.22	3.434	112.47	17.9771	41.80
22.145	419.955	57.05	2.85	4.99	-4.13	62.1002	5.129	2.56	62.13	5.13	4	153.00	1.480	0.895	0.585	1.057	14.28	15.10	1.720	57.08	33.269	38.01
22.473	419.627	49.22	2.02	4.1	-0.05	52.4512	4.233	2.54	52.45	4.23	5	154.00	1.505	0.910	0.595	1.048	12.24	12.84	1.477	49.22	32.7044	37.05
22.802	419.298	45.2	1.76	3.89	26.33	47.2222	4.030	2.56	47.04	4.05	5	155.00	1.530	0.925	0.605	1.040	11.30	11.75	1.352	45.03	33.5817	36.42
23.13	418.970	86.55	1.89	2.18	44.16	90.4233	2.224	2.18	90.13	2.23	7	156.00	1.556	0.940	0.616	1.031	18.23	18.81	2.631	86.27	18.3567	40.05
23.458	418.642	135.75	2.31	1.7	0.11	140.445	1.722	1.97	140.43	1.72	8	157.00	1.581	0.955	0.626	1.023	26.36	26.97	4.154	135.74	12.0719	42.35
23.786	418.314	80.31	2.82	3.51	-7.76	81.0682	3.583	2.36	81.12	3.58	6	158.00	1.607	0.971	0.636	1.015	18.37	18.64	2.437	80.36	24.9247	39.48
24.114	417.986	60.5	2.64	4.36	-3.63	59.6725	4.485	2.52	59.70	4.48	5	159.00	1.633	0.987	0.646	1.007	14.91	15.01	1.823	60.53	31.782	37.79
24.442	417.658	127.06	4.56	3.59	-4.92	125.108	3.636	2.25	125.14	3.64	6	160.00	1.659	1.002	0.657	0.999	27.63	27.60	3.882	127.09	20.6506	41.76
24.77	417.330	149.98	9.93	6.62	-11.87	145.622	6.696	2.43	145.70	6.69	11	161.00	1.685	1.018	0.667	0.991	35.31	34.99	4.591	150.06	27.5358	42.53
25.098	417.002	328.34	15.26	4.65	23.26	315.728	4.672	2.12	315.58	4.67	11	162.00	1.712	1.035	0.677	0.983	67.79	66.65	10.112	328.19	16.5598	46.17
25.426	416.674	419.75	19.4	4.62	18.11	397.781	4.641	2.08	397.68	4.64	11	163.00	1.738	1.051	0.687	0.976	85.07	82.99	12.942	419.64	15.1488	47.17
25.754	416.346	389.73	18.71	4.8	438.91	363.482	4.823	2.11	360.92	4.86	11	164.00	1.765	1.067	0.697	0.968	79.58	77.03	12.011	386.99	16.2214	46.75

R15732

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 43 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-11

ConeTec In Interpretation
Interpretation ut - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4215
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-11
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 10:31
CPT File: 804CP11.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 440.6

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.88	2.75	89.72	26.76	2.35

User Inputs:
Assumed: Water Table Depth (ft): 11.4
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 440.6
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	440.436	28.5	0.22	0.76	0.16	2779.49	0.772	1.11	2778.51	0.77	7	125.00	0.010	0.010	0.000	2.000	4.17	8.34	0.882	28.49	-1.2563	54.33
0.492	440.108	28.29	0.44	1.56	-0.67	919	1.557	1.50	919.33	1.56	6	125.00	0.031	0.031	0.000	2.000	4.67	9.34	0.875	28.3	2.63968	50.52
0.82	439.780	20.17	0.54	2.66	-2.66	392.561	2.684	1.87	392.76	2.68	5	125.00	0.051	0.051	0.000	2.000	3.78	7.55	0.623	20.18	9.60794	47.11
1.148	439.452	19.6	0.52	2.63	-12.35	272.171	2.663	1.94	273.29	2.65	5	125.00	0.072	0.072	0.000	2.000	3.79	7.57	0.605	19.68	11.4161	45.51
1.476	439.124	28.99	0.42	1.43	-1.13	313.255	1.453	1.69	313.36	1.45	6	125.00	0.092	0.092	0.000	2.000	5.10	10.19	0.895	29	5.94772	46.13
1.804	438.796	36.06	0.45	1.25	-0.07	318.823	1.252	1.63	318.82	1.25	7	125.00	0.113	0.113	0.000	2.000	6.22	12.43	1.113	36.06	4.93192	46.20
2.133	438.467	35.17	0.54	1.52	-0.16	262.816	1.541	1.76	262.82	1.54	7	125.00	0.133	0.133	0.000	2.000	6.32	12.65	1.085	35.17	7.21826	45.33
2.461	438.139	37.91	0.55	1.44	-0.05	245.469	1.457	1.76	245.47	1.46	7	125.00	0.154	0.154	0.000	2.000	6.81	13.63	1.169	37.91	7.18838	45.02
2.789	437.811	36.47	0.68	1.87	-0.34	208.222	1.874	1.89	208.22	1.87	6	125.00	0.174	0.174	0.000	2.000	6.87	13.74	1.124	36.47	10.0384	44.25
3.117	437.483	27.44	0.59	2.16	-0.37	139.853	2.166	2.04	139.85	2.17	6	125.00	0.195	0.195	0.000	2.000	5.49	10.97	0.844	27.44	14.139	42.30
3.445	437.155	20.54	0.66	3.22	-0.44	94.3962	3.247	2.29	94.40	3.25	5	125.00	0.215	0.215	0.000	2.000	4.54	9.08	0.629	20.54	22.0663	40.26
3.773	436.827	22.61	0.8	3.52	-1.01	94.8813	3.576	2.32	94.88	3.58	5	125.00	0.236	0.236	0.000	2.000	5.07	10.13	0.693	22.61	23.1951	40.29
4.101	436.499	26.22	0.98	3.73	-1.36	101.297	3.775	2.32	101.30	3.77	5	125.00	0.256	0.256	0.000	1.975	5.88	11.60	0.804	26.22	23.1946	40.63
4.429	436.171	31.36	1.08	3.45	-1.09	112.29	3.475	2.26	112.33	3.47	5	125.00	0.277	0.277	0.000	1.901	6.86	13.04	0.962	31.37	21.1287	41.18
4.757	435.843	38.92	1.07	2.74	1.76	129.906	2.770	2.15	129.84	2.77	6	125.00	0.297	0.297	0.000	1.834	8.11	14.66	1.196	38.9	17.2319	41.92
5.085	435.515	38.04	1.11	2.93	4.37	118.693	2.943	2.19	118.60	2.94	6	125.00	0.318	0.318	0.000	1.774	8.07	14.31	1.168	38.01	18.7018	41.46
5.413	435.187	30.78	1.06	3.45	13.37	89.981	3.482	2.33	89.71	3.49	5	125.00	0.338	0.338	0.000	1.719	6.90	11.86	0.942	30.69	23.4971	39.99
5.741	434.859	25.89	0.85	3.29	18.5	71.1547	3.329	2.38	70.85	3.34	5	125.00	0.359	0.359	0.000	1.669	5.94	9.91	0.790	25.78	25.6136	38.69
6.069	434.531	23.4	0.79	3.36	23.9	60.6906	3.432	2.44	60.30	3.45	5	125.00	0.379	0.379	0.000	1.624	5.50	8.93	0.713	23.25	28.015	37.78
6.398	434.202	25.75	1.15	4.46	22.01	63.3951	4.536	2.51	63.07	4.56	4	125.00	0.400	0.400	0.000	1.581	6.28	9.93	0.785	25.62	31.3104	38.04
6.726	433.874	29.09	1.27	4.36	14.11	68.2001	4.430	2.48	68.01	4.44	4	125.00	0.420	0.420	0.000	1.542	7.01	10.81	0.898	29.01	29.9625	38.46
7.054	433.546	24	1	4.16	11.96	53.4372	4.245	2.54	53.28	4.26	4	125.00	0.441	0.441	0.000	1.506	5.94	8.95	0.729	23.93	32.5699	37.07
7.382	433.218	21.53	0.94	4.35	14.92	45.6649	4.462	2.61	45.45	4.48	4	125.00	0.461	0.461	0.000	1.472	5.49	8.09	0.652	21.43	35.6188	36.14
7.71	432.890	22.03	1.05	4.75	14.57	44.7173	4.873	2.64	44.53	4.89	3	125.00	0.482	0.482	0.000	1.441	5.72	8.24	0.667	21.94	37.2891	36.02
8.038	432.562	22.77	0.99	4.34	10.23	44.3247	4.446	2.61	44.21	4.46	4	125.00	0.502	0.502	0.000	1.411	5.84	8.24	0.689	22.71	35.9462	35.97
8.366	432.234	32.54	1.27	3.9	8.77	61.2328	3.967	2.48	61.12	3.97	5	125.00	0.523	0.523	0.000	1.383	7.83	10.83	0.991	32.48	29.7484	37.86
8.694	431.906	28.72	1.47	5.13	1.57	51.8548	5.217	2.61	51.84	5.22	3	125.00	0.543	0.543	0.000	1.357	7.39	10.03	0.872	28.71	36.0689	36.91
9.022	431.578	25.38	1.28	5.04	3.58	44.01	5.158	2.66	43.97	5.16	3	125.00	0.564	0.564	0.000	1.332	6.68	8.90	0.768	25.36	38.3383	35.94
9.35	431.250	21.81	1.12	5.12	4.5	36.3219	5.277	2.72	36.27	5.28	3	125.00	0.584	0.584	0.000	1.308	5.94	7.77	0.657	21.78	41.7898	34.78
9.678	430.922	19.77	1.16	5.88	0.32	31.6844	6.053	2.81	31.68	6.05	3	125.00	0.605	0.605	0.000	1.286	5.64	7.25	0.593	19.77	46.4618	33.95
10.006	430.594	16.91	1.13	6.7	7.09	26.0398	6.939	2.91	25.98	6.96	3	125.00	0.625	0.625	0.000	1.265	5.11	6.46	0.504	16.87	52.7324	32.71
10.335	430.265	12.18	0.84	6.91	7.27	17.8563	7.283	3.05	17.78	7.31	3	125.00	0.646	0.646	0.000	1.244	3.99	4.96	0.357	12.13	61.5745	30.26
10.663	429.937	13.61	0.58	4.27	11.11	19.422	4.481	2.88	19.32	4.51	3	125.00	0.666	0.666	0.000	1.225	4.02	4.92	0.401	13.54	50.6152	30.80
10.991	429.609	16.16	0.58	3.6	16.15	22.5247	3.748	2.78	22.38	3.77	4	125.00	0.687	0.687	0.000	1.207	4.51	5.44	0.479	16.06	44.7951	31.76
11.319	429.281	20.35	0.95	4.66	10.23	27.7658	4.836	2.78	27.67	4.85	3	125.00	0.707	0.707	0.000	1.189	5.71	6.79	0.608	20.28	45.0299	33.10
11.647	428.953	15.41	0.83	5.37	7.37	20.3852	5.653	2.93	20.33	5.67	3	135.00	0.728	0.720	0.008	1.176	4.70	5.54	0.455	15.37	53.7104	31.14
11.975	428.625	15.03	0.51	3.4	12.31	19.5044	3.571	2.81	19.40	3.59	4	135.00	0.750	0.732	0.018	1.169	4.28	5.00	0.442	14.95	46.7592	30.84
12.303	428.297	13.48	0.39	2.86	16.05	17.0793	3.069	2.82	16.94	3.09	5	135.00	0.772	0.744	0.028	1.159	3.84	4.45	0.393	13.38	47.1053	29.96
12.631	427.969	14.27	0.45	3.13	24.68	17.8261	3.339	2.83	17.61	3.38	5	135.00	0.794	0.756	0.038	1.150	4.07	4.69	0.417	14.11	47.7069	30.22
12.959	427.641	16.62	0.59	3.53	32.75	20.5813	3.733	2.81	20.31	3.78	4	135.00	0.816	0.768	0.049	1.141	4.69	5.36	0.489	16.41	46.6978	31.15
13.287	427.313	15.45	0.53	3.41	85.75	18.7382	3.627	2.85	18.06	3.76	4	135.00	0.839	0.780	0.059	1.132	4.36	4.94	0.452	14.92	48.9421	30.39
13.615	426.985	14.31	0.4	2.77	92.79	16.9884	2.974	2.83	16.26	3.11	5	135.00	0.861	0.792	0.069	1.124	3.98	4.47	0.416	13.73	48.0254	29.71
13.943	426.657	16.27	0.56	3.45	78.04	19.1483	3.639	2.84	18.54	3.76	4	135.00	0.883	0.804	0.079	1.116	4.59	5.12	0.476	15.78	48.3929	30.57
14.271	426.329	75.29	0.83	1.1	37.25	91.2159	1.116	1.97	90.93	1.12	8	135.00	0.905	0.815	0.090	1.107	14.61	16.18	2.303	75.06	12.2389	40.07
14.6	426.000	92.32	1.92	2.08	-13.9	110.454	2.101	2.10	110.55	2.10	7	135.00	0.927	0.827	0.100	1.099	18.90	20.78	2.829	92.4	15.8278	41.10
14.928	425.672	64.03	2.18	3.4	-6.84	75.1558	3.456	2.37	75.22	3.45	6	135.00	0.949	0.839	0.110	1.092	14.71	16.06	1.953	64.08	25.3244	39.03
15.256	425.344	42.81	1.68	3.92	119.63	49.1501	4.015	2.56	48.27	4.09	5	135.00	0.972	0.851	0.120	1.084	10.53	11.42	1.295	42.06	33.3652	36.51

R15734

Depth (ft)	El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	425.016	31.18	1.38	4.44	88.96	34.9725	4.572	2.70	34.34	4.66	4	135.00	0.994	0.863	0.131	1.076	8.26	8.89	0.935	30.63	40.6127	34.47
15.912	424.688	74.09	1.85	2.5	119.6	83.4971	2.532	2.25	82.64	2.56	6	135.00	1.016	0.875	0.141	1.069	15.96	17.05	2.262	73.33	20.7052	39.55
16.24	424.360	168.1	3.39	2.02	-0.74	188.354	2.029	1.94	188.35	2.03	7	135.00	1.038	0.887	0.151	1.062	32.30	34.30	5.172	168.1	11.3615	43.77
16.568	424.032	179.25	4.43	2.47	-10.55	198.239	2.486	2.00	198.32	2.49	7	136.00	1.060	0.899	0.161	1.055	35.21	37.14	5.517	179.32	12.8438	44.02
16.896	423.704	134.23	3.06	2.28	-18.82	146.166	2.298	2.05	146.30	2.30	7	137.00	1.082	0.911	0.171	1.048	26.94	28.22	4.122	134.35	14.3363	42.53
17.224	423.376	78.48	1.39	1.78	-20.86	83.8148	1.796	2.14	83.96	1.79	7	138.00	1.105	0.923	0.182	1.041	16.31	16.98	2.396	78.61	16.912	39.64
17.552	423.048	61.76	2.91	4.71	-21.8	64.6083	4.799	2.52	64.96	4.79	4	139.00	1.128	0.936	0.192	1.034	15.23	15.74	1.877	61.9	31.6498	38.22
17.88	422.720	131.97	4.46	3.38	-22.01	137.977	3.409	2.20	138.12	3.41	6	140.00	1.150	0.948	0.202	1.027	28.14	28.90	4.050	132.11	18.9817	42.25
18.208	422.392	229.79	6.98	3.04	1.89	237.93	3.053	2.03	237.92	3.05	12	141.00	1.173	0.961	0.212	1.020	45.63	46.55	7.078	229.78	13.6451	44.68
18.537	422.063	178.23	4.87	2.73	5.5	181.799	2.751	2.05	181.77	2.75	7	142.00	1.196	0.974	0.223	1.013	35.79	36.27	5.481	178.2	14.4578	43.60
18.865	421.735	158.32	3.05	1.93	-5.91	159.195	1.941	1.97	159.24	1.94	8	143.00	1.220	0.987	0.233	1.007	30.79	31.00	4.864	158.36	12.157	42.96
19.193	421.407	129.65	3.89	3	-15.68	128.399	3.029	2.18	128.49	3.03	6	144.00	1.243	1.000	0.243	1.000	27.40	27.40	3.975	129.74	18.2843	41.88
19.521	421.079	173.42	5.09	2.94	-12.86	169.87	2.957	2.10	169.95	2.96	7	145.00	1.267	1.013	0.253	0.993	35.43	35.20	5.330	173.5	15.7016	43.28
19.849	420.751	263.85	6.2	2.35	-1.66	255.66	2.361	1.91	255.67	2.36	7	146.00	1.291	1.027	0.264	0.987	50.25	49.58	8.129	263.86	10.7536	45.21
20.177	420.423	128.37	5.69	4.43	4.11	122.087	4.478	2.33	122.06	4.48	11	147.00	1.315	1.041	0.274	0.980	28.87	28.30	3.934	128.34	23.5384	41.62
20.505	420.095	79.4	4.72	5.95	5.06	74.0219	6.047	2.56	73.99	6.05	11	148.00	1.339	1.055	0.284	0.974	19.92	19.40	2.417	79.37	33.5824	38.95
20.833	419.767	78.64	4.44	5.65	4.76	72.3155	5.746	2.55	72.29	5.75	11	149.00	1.363	1.069	0.294	0.967	19.63	18.99	2.392	78.61	33.0698	38.82
21.161	419.439	69.37	5.02	5.61	5.8	81.2538	5.706	2.52	81.23	5.71	11	150.00	1.387	1.083	0.305	0.961	21.94	21.09	2.724	69.34	31.4994	39.47
21.489	419.111	108.25	5.71	5.27	5.22	97.3752	5.345	2.45	97.35	5.35	11	151.00	1.412	1.097	0.315	0.955	25.71	24.54	3.308	108.22	28.3906	40.44
21.817	418.783	132	7.15	5.41	2.48	117.444	5.476	2.41	117.43	5.48	11	152.00	1.437	1.112	0.325	0.948	30.78	29.19	4.042	131.98	26.7224	41.42
22.145	418.455	152.55	8.54	5.6	-0.62	134.133	5.652	2.39	134.13	5.65	11	153.00	1.462	1.126	0.335	0.942	35.23	33.19	4.678	152.55	25.8345	42.10
22.473	418.127	166.92	10.03	6.01	-0.81	144.956	6.063	2.39	144.96	6.06	11	154.00	1.487	1.141	0.345	0.936	38.66	36.19	5.122	166.92	26.1022	42.49
22.802	417.798	175.61	10.85	6.18	-0.16	150.561	6.232	2.39	150.56	6.23	11	155.00	1.512	1.156	0.356	0.930	40.69	37.84	5.390	175.61	26.1461	42.68
23.13	417.470	186.83	11.72	6.27	0.3	159.165	6.325	2.39	158.16	6.33	11	156.00	1.537	1.172	0.366	0.924	43.17	39.89	5.737	186.82	25.9033	42.93
23.458	417.142	212.47	12.86	6.05	-0.81	177.701	6.097	2.35	177.70	6.10	11	157.00	1.563	1.187	0.376	0.918	48.23	44.27	6.530	212.47	24.3144	43.50
23.786	416.814	206.47	13.26	6.42	-3.42	170.396	6.472	2.38	170.42	6.47	11	158.00	1.589	1.202	0.386	0.912	47.54	43.35	6.343	206.5	25.5551	43.29
24.114	416.486	224.17	13.55	6.04	-3.65	182.713	6.088	2.34	182.73	6.09	11	159.00	1.615	1.218	0.397	0.906	50.73	45.97	6.890	224.19	24.049	43.63
24.442	416.158	237.64	15.41	6.48	-5.54	191.262	6.530	2.36	191.29	6.53	11	160.00	1.641	1.234	0.407	0.900	54.17	48.76	7.306	237.67	24.6695	43.85
24.77	415.830	244.94	15.19	6.2	-7.81	194.633	6.244	2.34	194.66	6.24	11	161.00	1.667	1.250	0.417	0.894	55.32	49.48	7.532	244.98	23.8705	43.94
25.098	415.502	239.96	14.94	6.23	-11.57	188.192	6.270	2.34	188.25	6.27	11	162.00	1.693	1.266	0.427	0.889	54.42	48.36	7.377	240.03	24.2139	43.78
25.426	415.174	217.85	14.42	6.62	-17.67	168.534	6.672	2.39	168.62	6.67	11	163.00	1.720	1.282	0.438	0.883	50.48	44.58	6.691	217.96	26.1001	43.24
25.754	414.846	219.37	13.74	6.26	-20.97	167.543	6.314	2.37	167.64	6.31	11	164.00	1.747	1.299	0.448	0.877	50.40	44.22	6.738	219.5	25.3316	43.21
26.082	414.518	214.66	13.21	6.15	-22.49	161.82	6.205	2.37	161.93	6.20	11	165.00	1.774	1.316	0.458	0.872	49.36	43.03	6.591	214.8	25.3928	43.04
26.41	414.190	225.44	13.56	6.01	-24.85	167.847	6.063	2.36	167.97	6.06	11	166.00	1.801	1.332	0.468	0.866	51.45	44.57	6.924	225.6	24.7228	43.22
26.739	413.861	268.44	15.56	5.8	-24.92	197.572	5.836	2.31	197.68	5.83	11	167.00	1.828	1.349	0.479	0.861	59.89	51.56	8.254	268.59	22.7802	44.01
27.067	413.533	344.83	16.55	4.8	-25.2	250.97	4.825	2.18	251.09	4.82	11	168.00	1.855	1.367	0.489	0.855	73.00	62.45	10.618	344.99	18.4477	45.13

R15735

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 46 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-12

ConeTec I[illegible] Interpretation
Interpretatio[illegible]ut - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4182
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-12
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 11:15
CPT File: 804CP12.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 442.1

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.01	2.80	91.11	27.69	2.37

User Inputs:
Assumed: Water Table Depth (ft): 11.7
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 442.1
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	441.936	11.62	0.14	1.16	-0.32	1132.66	1.206	1.37	1132.66	1.21	6	125.00	0.010	0.010	0.000	2.000	1.84	3.67	0.359	11.62	1.12402	51.29
0.492	441.608	7.94	0.16	2.02	-1.8	257.211	2.023	1.86	257.54	2.02	5	125.00	0.031	0.031	0.000	2.000	1.48	2.96	0.245	7.95	9.3841	45.24
0.82	441.280	9.78	0.15	1.54	-4.83	189.829	1.542	1.84	190.41	1.54	5	125.00	0.051	0.051	0.000	2.000	1.82	3.64	0.301	9.81	9.05791	43.82
1.148	440.952	14.93	0.28	1.85	-7.94	207.084	1.884	1.89	207.78	1.88	5	125.00	0.072	0.072	0.000	2.000	2.82	5.65	0.460	14.98	10.0719	44.24
1.476	440.624	13.35	0.35	2.59	-11.59	143.715	2.640	2.10	144.47	2.63	5	125.00	0.092	0.092	0.000	2.000	2.74	5.49	0.410	13.42	15.7665	42.47
1.804	440.296	10.42	0.21	2.02	-9.49	91.4169	2.037	2.14	91.95	2.03	5	125.00	0.113	0.113	0.000	2.000	2.18	4.36	0.319	10.48	17.1922	40.12
2.133	439.967	11.15	0.3	2.65	-4.09	82.6381	2.723	2.27	82.86	2.72	5	125.00	0.133	0.133	0.000	2.000	2.45	4.90	0.341	11.18	21.347	39.56
2.461	439.639	11.4	0.39	3.39	-0.6	73.1162	3.468	2.38	73.12	3.47	4	125.00	0.154	0.154	0.000	2.000	2.63	5.26	0.348	11.4	25.7091	38.87
2.789	439.311	19.33	0.58	3.01	0.23	109.893	3.028	2.22	109.89	3.03	5	125.00	0.174	0.174	0.000	2.000	4.16	8.31	0.593	19.33	19.7298	41.06
3.117	438.983	28.85	0.84	2.89	2.91	147.604	2.921	2.13	147.55	2.92	5	125.00	0.195	0.195	0.000	2.000	5.99	11.98	0.890	28.94	16.7116	42.57
3.445	438.655	31.92	1.09	3.41	12.38	147.25	3.438	2.19	146.92	3.45	5	125.00	0.215	0.215	0.000	2.000	6.75	13.50	0.982	31.85	18.5805	42.55
3.773	438.327	29.03	1.2	4.13	24.36	122.106	4.168	2.31	121.47	4.19	4	125.00	0.236	0.236	0.000	2.000	6.43	12.87	0.891	28.88	22.7083	41.58
4.101	437.999	26.16	1.06	4.04	36.19	101.063	4.092	2.35	100.20	4.13	4	125.00	0.256	0.256	0.000	1.975	5.90	11.65	0.802	25.94	24.4642	40.58
4.429	437.671	24.24	0.91	3.76	45.54	86.5683	3.797	2.37	85.56	3.84	4	125.00	0.277	0.277	0.000	1.901	5.50	10.45	0.742	23.96	25.2412	39.73
4.757	437.343	19.02	0.82	4.29	43.88	62.9731	4.380	2.51	62.06	4.44	4	125.00	0.297	0.297	0.000	1.834	4.59	8.41	0.580	18.75	31.1432	37.95
5.085	437.015	21.3	0.75	3.53	49.65	66.0206	3.574	2.43	65.05	3.63	5	125.00	0.318	0.318	0.000	1.774	4.95	8.78	0.650	20.99	27.7143	38.21
5.413	436.687	23.02	0.78	3.4	49.79	67.0436	3.439	2.41	66.13	3.49	5	125.00	0.338	0.338	0.000	1.719	5.31	9.13	0.702	22.71	26.9846	38.30
5.741	436.359	19.94	0.81	4.05	42.61	54.5722	4.137	2.53	53.82	4.19	4	125.00	0.359	0.359	0.000	1.669	4.87	8.13	0.606	19.67	32.2135	37.13
6.069	436.031	19.3	0.6	3.12	42.66	49.8815	3.171	2.48	49.20	3.22	5	125.00	0.379	0.379	0.000	1.624	4.59	7.45	0.586	19.04	29.7477	36.60
6.398	435.702	19.44	0.61	3.15	38.64	47.6152	3.204	2.50	47.02	3.24	5	125.00	0.400	0.400	0.000	1.581	4.67	7.38	0.589	19.2	30.4945	36.34
6.726	435.374	19.51	0.69	3.55	28.89	45.4109	3.615	2.55	44.98	3.65	4	125.00	0.420	0.420	0.000	1.542	4.81	7.42	0.591	19.33	32.7392	36.08
7.054	435.046	19.87	0.87	4.39	16.93	44.0695	4.478	2.62	43.84	4.50	3	125.00	0.441	0.441	0.000	1.506	5.10	7.68	0.602	19.77	36.2175	35.92
7.382	434.718	19.53	0.85	4.34	16.6	41.33	4.458	2.64	41.09	4.48	3	125.00	0.461	0.461	0.000	1.472	5.06	7.44	0.590	19.42	37.1432	35.54
7.71	434.390	17.5	0.83	4.73	14.09	35.3165	4.877	2.71	35.13	4.90	3	125.00	0.482	0.482	0.000	1.441	4.71	6.79	0.527	17.41	41.075	34.59
8.038	434.062	15.42	0.64	4.16	15.08	29.6942	4.290	2.73	29.52	4.32	3	125.00	0.502	0.502	0.000	1.411	4.19	5.91	0.462	15.33	41.9523	33.51
8.366	433.734	15.44	0.6	3.86	17.32	28.529	4.022	2.72	28.32	4.05	4	125.00	0.523	0.523	0.000	1.383	4.18	5.77	0.462	15.33	41.6655	33.25
8.694	433.406	19.79	0.74	3.75	18.06	35.4205	3.845	2.64	35.22	3.87	4	125.00	0.543	0.543	0.000	1.357	5.13	6.96	0.595	19.68	37.304	34.60
9.022	433.078	19.84	0.86	4.34	16.61	34.1851	4.461	2.69	34.01	4.48	4	125.00	0.564	0.564	0.000	1.332	5.30	7.05	0.597	19.74	40.1678	34.39
9.35	432.750	17.62	0.88	4.98	13.99	29.1519	5.166	2.79	29.01	5.19	3	125.00	0.584	0.584	0.000	1.308	4.95	6.48	0.527	17.54	45.3203	33.40
9.678	432.422	16.33	0.72	4.42	21.5	25.9973	4.579	2.79	25.77	4.62	3	125.00	0.605	0.605	0.000	1.286	4.58	5.88	0.487	16.19	45.491	32.66
10.006	432.094	13.67	0.59	4.33	11.13	20.8589	4.523	2.86	20.75	4.55	3	125.00	0.625	0.625	0.000	1.265	3.99	5.04	0.404	13.6	49.3482	31.27
10.335	431.765	12.63	0.44	3.49	13.16	18.553	3.672	2.84	18.43	3.70	4	125.00	0.646	0.646	0.000	1.244	3.64	4.53	0.371	12.55	48.2363	30.50
10.663	431.437	12.67	0.5	3.92	14.21	18.0115	4.165	2.88	17.89	4.19	3	125.00	0.666	0.666	0.000	1.225	3.75	4.59	0.372	12.59	50.9429	30.30
10.991	431.109	12.7	0.63	4.97	13.9	17.4879	5.244	2.96	17.37	5.28	3	125.00	0.687	0.687	0.000	1.207	3.93	4.74	0.372	12.62	55.6721	30.11
11.319	430.781	10.22	0.46	4.51	14.5	13.4465	4.836	3.02	13.31	4.89	3	125.00	0.707	0.707	0.000	1.189	3.28	3.91	0.295	10.12	60.1558	28.34
11.647	430.453	8.57	0.2	2.34	16.35	10.773	2.550	2.94	10.64	2.58	4	125.00	0.728	0.728	0.000	1.172	2.61	3.05	0.243	8.47	54.4211	26.83
11.975	430.125	9.06	0.17	1.83	18.91	11.234	2.045	2.87	11.07	2.08	5	135.00	0.748	0.740	0.009	1.163	2.64	3.08	0.257	8.94	50.2538	27.11
12.303	429.797	10.52	0.15	1.38	22.7	12.9687	1.539	2.75	12.78	1.56	5	135.00	0.771	0.752	0.019	1.153	2.87	3.32	0.302	10.38	43.3766	28.09
12.631	429.469	13.05	0.29	2.23	28.38	16.0505	2.366	2.78	15.81	2.40	5	135.00	0.793	0.764	0.029	1.144	3.61	4.13	0.379	12.87	44.7486	29.51
12.959	429.141	13.23	0.43	3.26	16.7	16.0076	3.464	2.87	15.88	3.49	4	135.00	0.815	0.776	0.039	1.136	3.89	4.42	0.384	13.13	50.3648	29.54
13.287	428.813	13.91	0.36	2.56	7.57	16.601	2.754	2.80	16.54	2.76	5	135.00	0.837	0.787	0.050	1.127	3.93	4.43	0.405	13.86	45.6936	29.81
13.615	428.485	17.32	0.69	3.96	6.49	20.5918	4.192	2.84	20.54	4.20	4	135.00	0.859	0.799	0.060	1.118	5.01	5.61	0.510	17.28	48.2013	31.23
13.943	428.157	28.85	1.37	4.74	1.25	34.4741	4.898	2.72	34.46	4.90	3	135.00	0.881	0.811	0.070	1.110	7.83	8.70	0.866	28.84	41.3835	34.48
14.271	427.829	35.76	1.81	5.06	8.08	42.3427	5.193	2.67	42.26	5.20	3	135.00	0.903	0.823	0.080	1.102	9.48	10.45	1.079	35.71	39.0642	35.72
14.6	427.500	93.11	1.97	2.12	5.47	110.381	2.137	2.11	110.35	2.14	7	135.00	0.926	0.835	0.090	1.094	19.09	20.89	2.854	93.08	16.0213	41.09
14.928	427.172	198.6	4.08	2.06	-1.59	233.341	2.064	1.89	233.35	2.06	8	135.00	0.948	0.847	0.101	1.087	37.46	40.71	6.119	198.61	10.1383	44.79
15.256	426.844	186.18	5.12	2.75	-9.91	215.622	2.764	2.01	215.70	2.76	7	135.00	0.970	0.859	0.111	1.079	36.81	39.72	5.734	186.25	13.2966	44.42

R15737

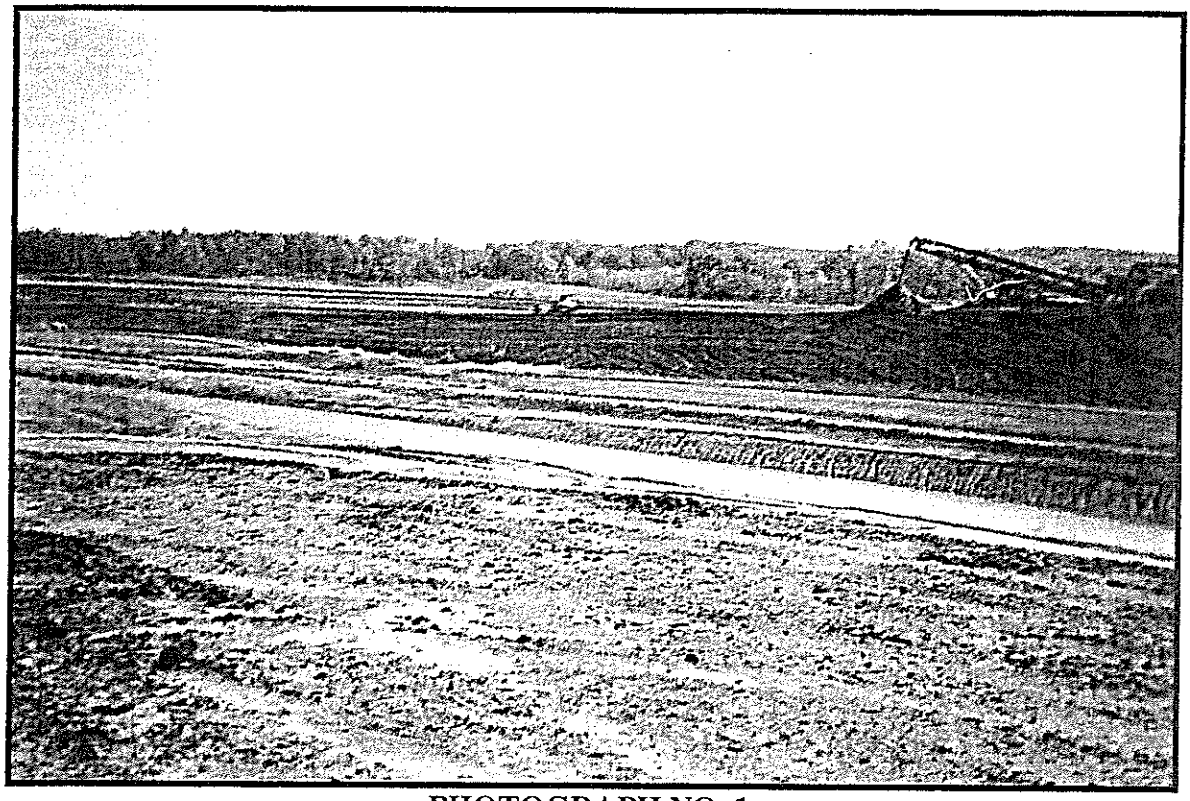
Depth (ft)	S. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.W. (pcf)	Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	426.516	190.04	5.38	2.83	-11.83	217.081	2.846	2.02	217.16	2.84	7	135.00	0.992	0.871	0.121	1.072	37.70	40.40	5.853	190.11	13.5387	44.45
15.912	426.188	263.65	6.16	2.34	-13.14	297.513	2.345	1.88	297.60	2.34	7	135.00	1.014	0.883	0.131	1.064	49.51	52.70	8.131	263.73	9.83312	45.90
16.24	425.860	284.27	6.89	2.42	-9.63	316.576	2.433	1.88	316.64	2.43	7	135.00	1.036	0.895	0.142	1.057	53.37	56.42	8.769	284.33	9.8196	46.17
16.568	425.532	255.09	5.78	2.27	-12.84	280.208	2.275	1.88	280.30	2.27	7	136.00	1.058	0.907	0.152	1.050	47.96	50.37	7.865	255.17	9.90035	45.63
16.896	425.204	262.69	5.83	2.22	-14.73	284.775	2.229	1.87	284.87	2.23	8	137.00	1.081	0.919	0.162	1.043	49.18	51.31	8.099	262.78	9.63384	45.70
17.224	424.876	262.49	6.06	2.31	-15.84	280.793	2.318	1.89	280.90	2.32	7	138.00	1.103	0.931	0.172	1.036	49.47	51.27	8.092	262.59	10.0493	45.64
17.552	424.548	275.92	6.07	2.2	-16.9	291.316	2.209	1.86	291.43	2.21	8	139.00	1.126	0.943	0.183	1.030	51.50	53.02	8.508	276.03	9.43529	45.80
17.88	424.220	282.44	5.86	2.07	-17.67	294.284	2.083	1.84	294.40	2.08	8	140.00	1.149	0.956	0.193	1.023	52.26	53.45	8.709	282.55	8.89784	45.85
18.208	423.892	257.04	5.91	2.3	-18.27	264.17	2.310	1.90	264.28	2.31	7	141.00	1.172	0.969	0.203	1.016	48.68	49.46	7.922	257.15	10.3624	45.36
18.537	423.563	242.82	4.68	1.93	-18.43	246.178	1.937	1.85	246.30	1.94	8	142.00	1.195	0.982	0.213	1.009	45.22	45.65	7.481	242.94	9.29281	45.04
18.865	423.235	257.45	4.85	1.88	-18.64	257.634	1.893	1.83	257.75	1.89	8	143.00	1.218	0.995	0.224	1.003	47.61	47.74	7.933	257.57	8.85195	45.25
19.193	422.907	260.77	6.02	2.31	-18.77	257.525	2.320	1.91	257.64	2.32	7	144.00	1.242	1.008	0.234	0.996	49.52	49.33	8.035	260.89	10.5471	45.25
19.521	422.579	170.7	6.5	3.81	-14.05	165.924	3.836	2.19	166.01	3.83	12	145.00	1.265	1.021	0.244	0.990	36.30	35.92	5.246	170.79	18.807	43.16
19.849	422.251	99.48	6.5	6.53	-18.39	94.8975	6.620	2.53	95.00	6.61	11	146.00	1.289	1.035	0.254	0.983	24.57	24.16	3.040	99.59	31.9422	40.31
20.177	421.923	121.55	7.95	6.54	-17.74	114.684	6.612	2.48	114.80	6.61	11	147.00	1.313	1.048	0.264	0.977	29.34	28.66	3.723	121.67	29.7886	41.30
20.505	421.595	160.73	12.29	7.65	-14.95	150.046	7.711	2.47	150.13	7.71	11	148.00	1.337	1.062	0.275	0.970	38.65	37.50	4.935	160.82	29.4577	42.67
20.833	421.267	215.14	14.59	6.78	-12.33	198.618	6.825	2.36	198.69	6.82	11	149.00	1.361	1.076	0.285	0.964	49.23	47.45	6.619	215.22	24.995	44.03
21.161	420.939	213.16	15.63	7.33	2.1	194.194	7.380	2.40	194.18	7.38	11	150.00	1.386	1.091	0.295	0.958	49.52	47.42	6.556	213.14	26.385	43.92
21.489	420.611	245.28	17.26	7.04	16.49	220.717	7.078	2.36	220.62	7.08	11	151.00	1.410	1.105	0.305	0.951	55.88	53.16	7.550	245.17	24.68	44.53
21.817	420.283	304.39	19.87	6.53	34.99	270.633	6.559	2.29	270.44	6.56	11	152.00	1.435	1.119	0.316	0.945	67.22	63.53	9.379	304.17	22.0175	45.47
22.145	419.955	331.65	17.77	5.36	221.32	291.141	5.382	2.20	289.92	5.40	11	153.00	1.460	1.134	0.326	0.939	70.29	66.00	10.223	330.27	18.9079	45.78

R15738

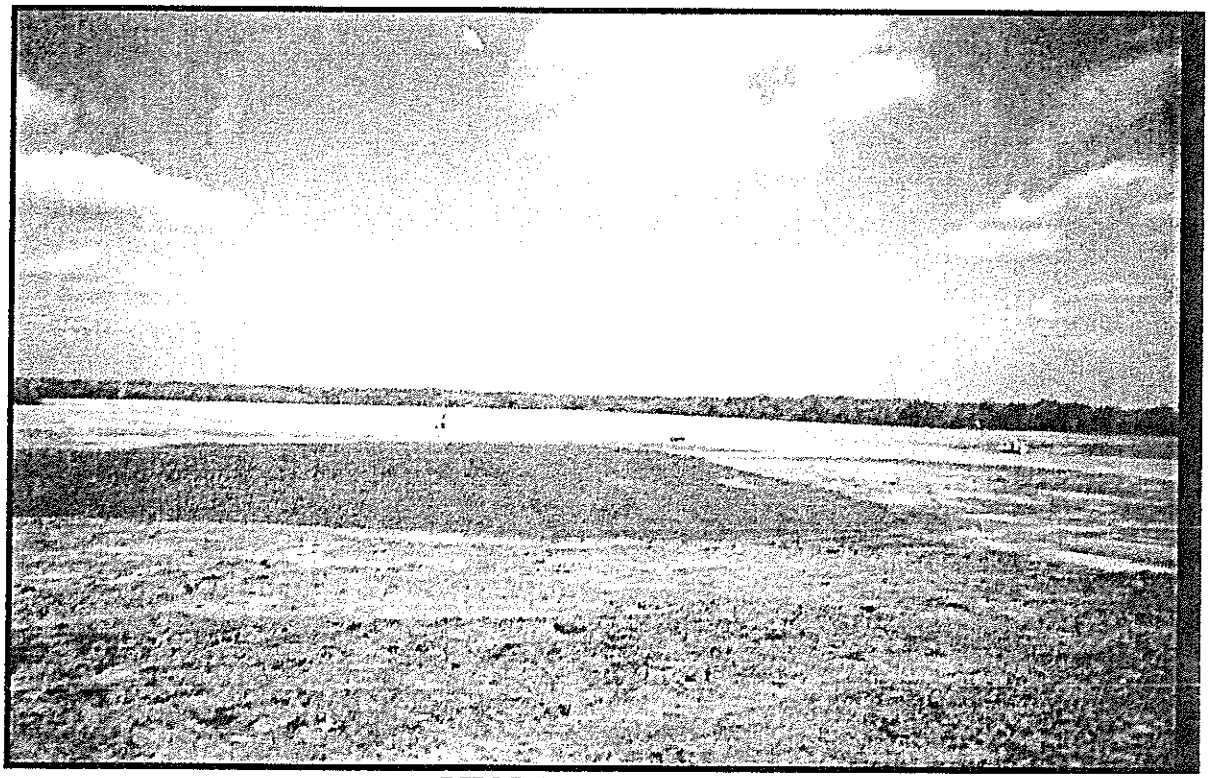
APPENDIX A-4

PHOTOGRAPHS OF OCTOBER 2007 FIELD TESTING

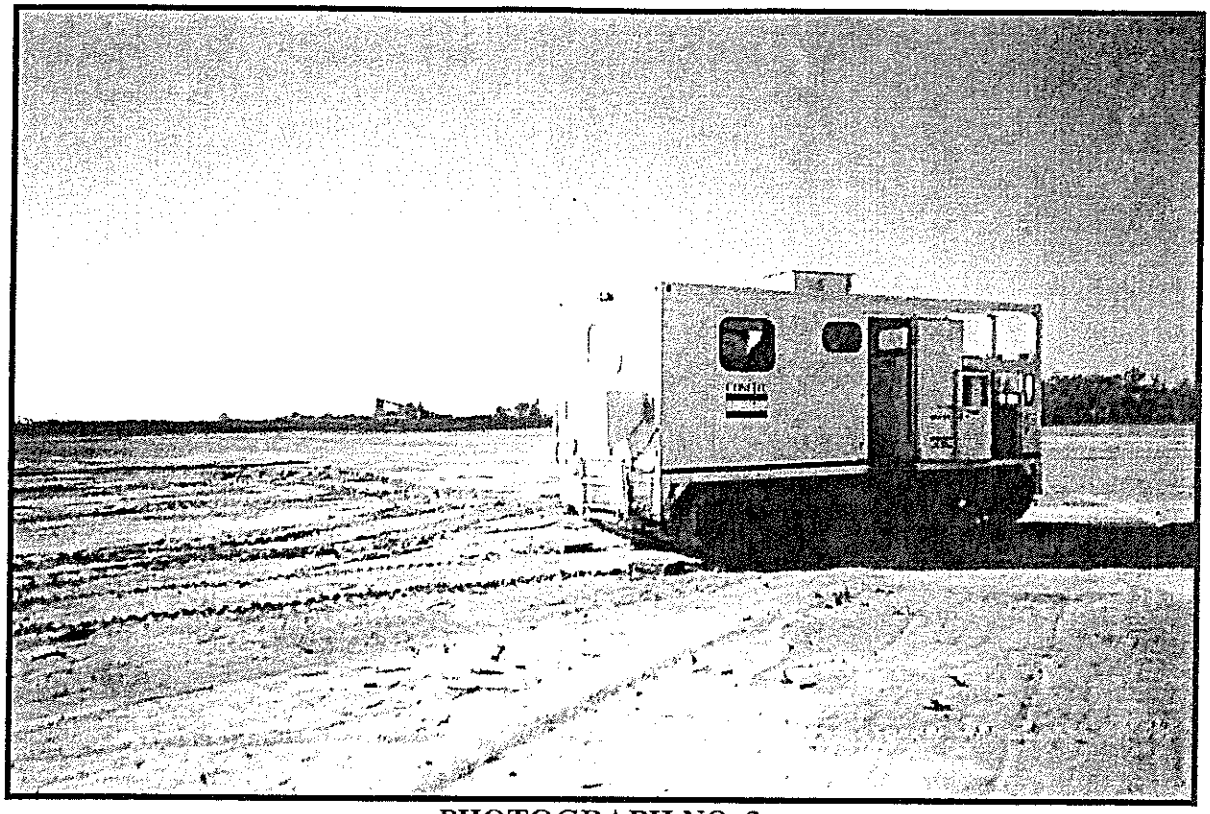
R15740



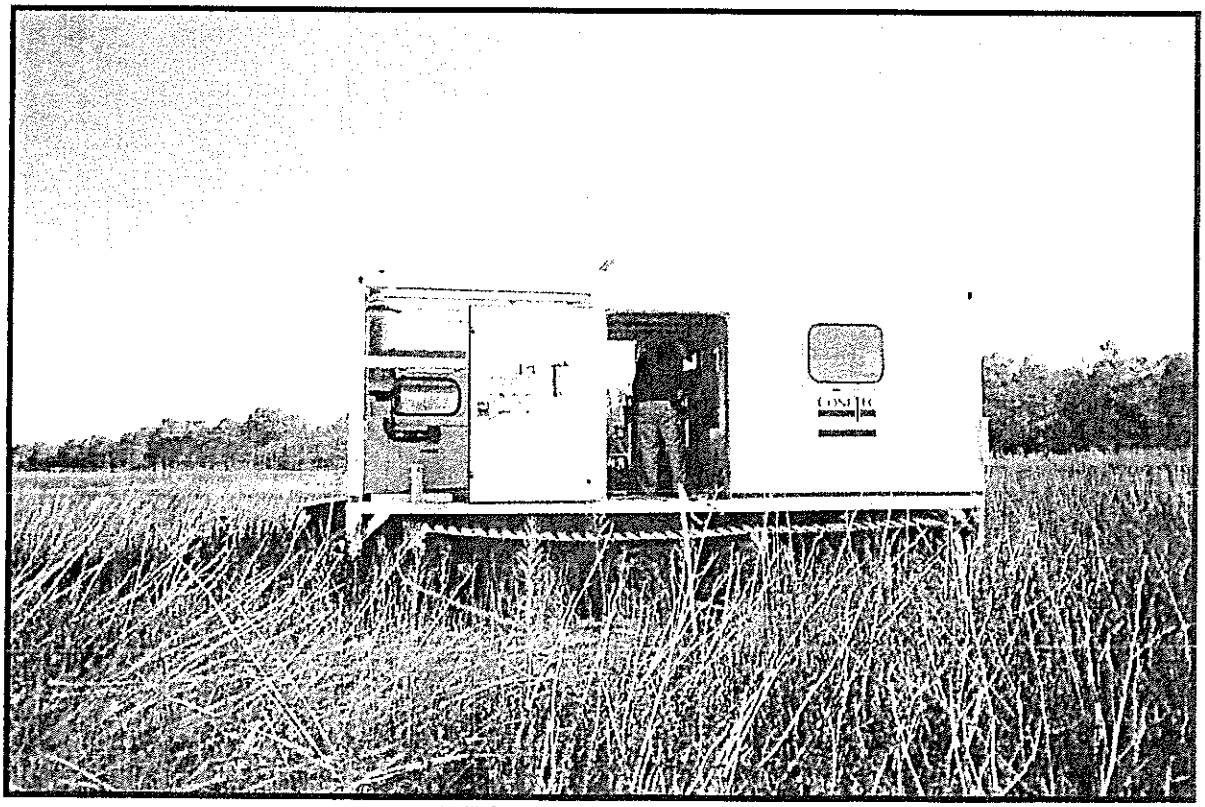
PHOTOGRAPH NO. 1
View of the Pond Creek facility and South Cell refuse looking southeast. (October 2007)



PHOTOGRAPH NO. 2
View of Pond Creek facility from existing coarse refuse crest at El. 482± looking north toward proposed Central and North Cells. ConeTec rig at CPT-6 middle right. (October 2007)

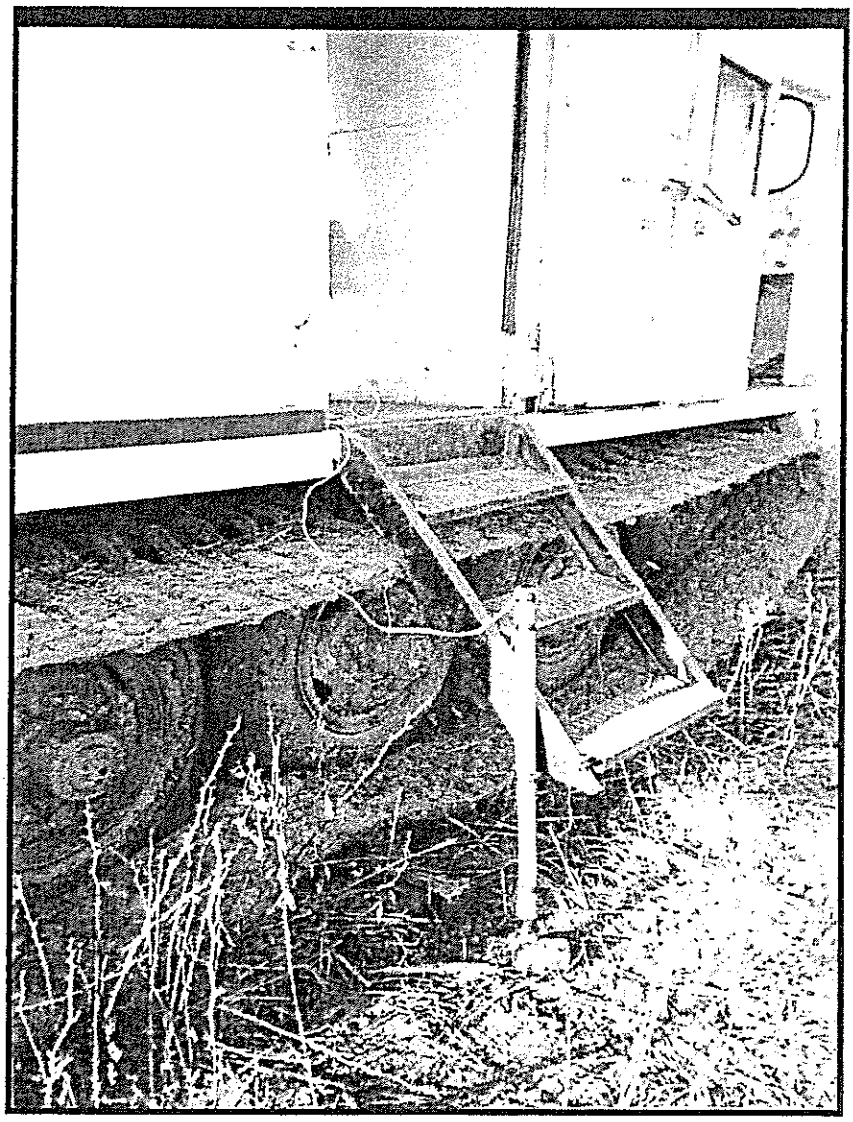


PHOTOGRAPH NO. 3
ConeTec CPT track rig at CPT-9 and proposed Central/North Cells
looking south. (October 2007)



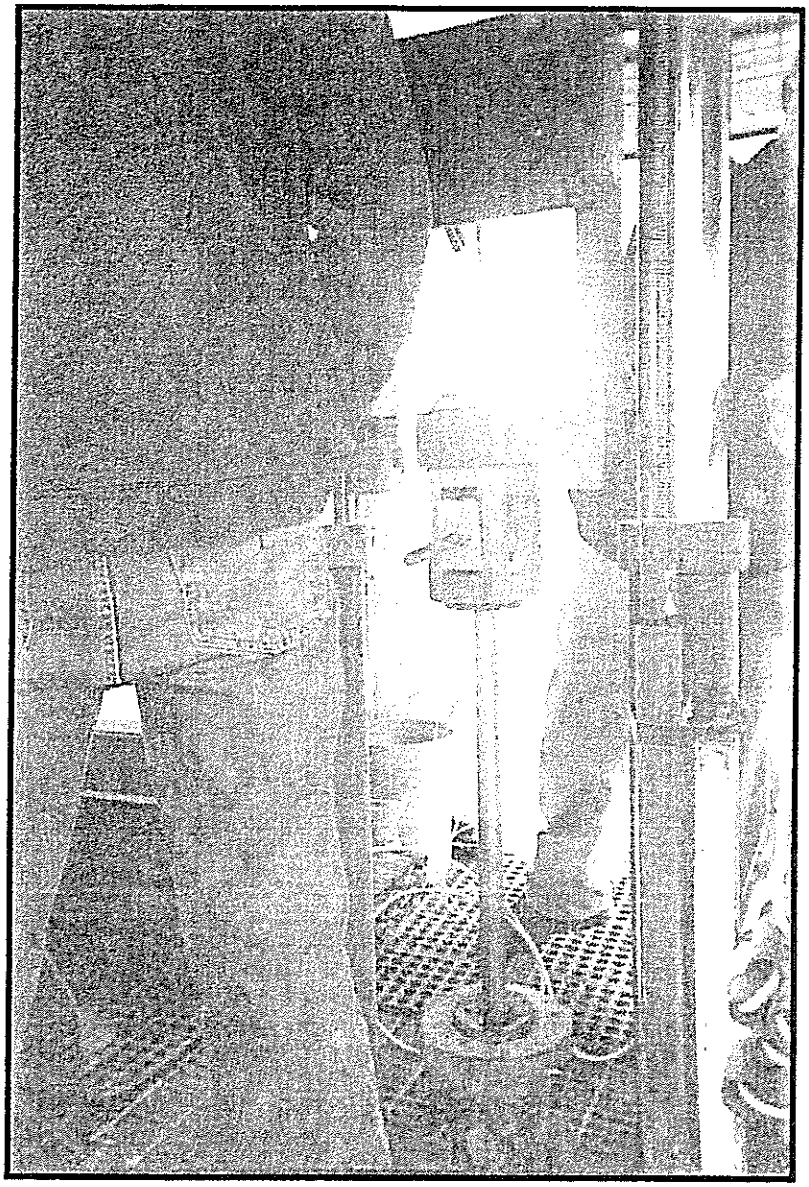
PHOTOGRAPH NO. 4
ConeTec CPT track rig at CPT-7 and proposed Central Cell
looking northeast. (October 2007)

R15742



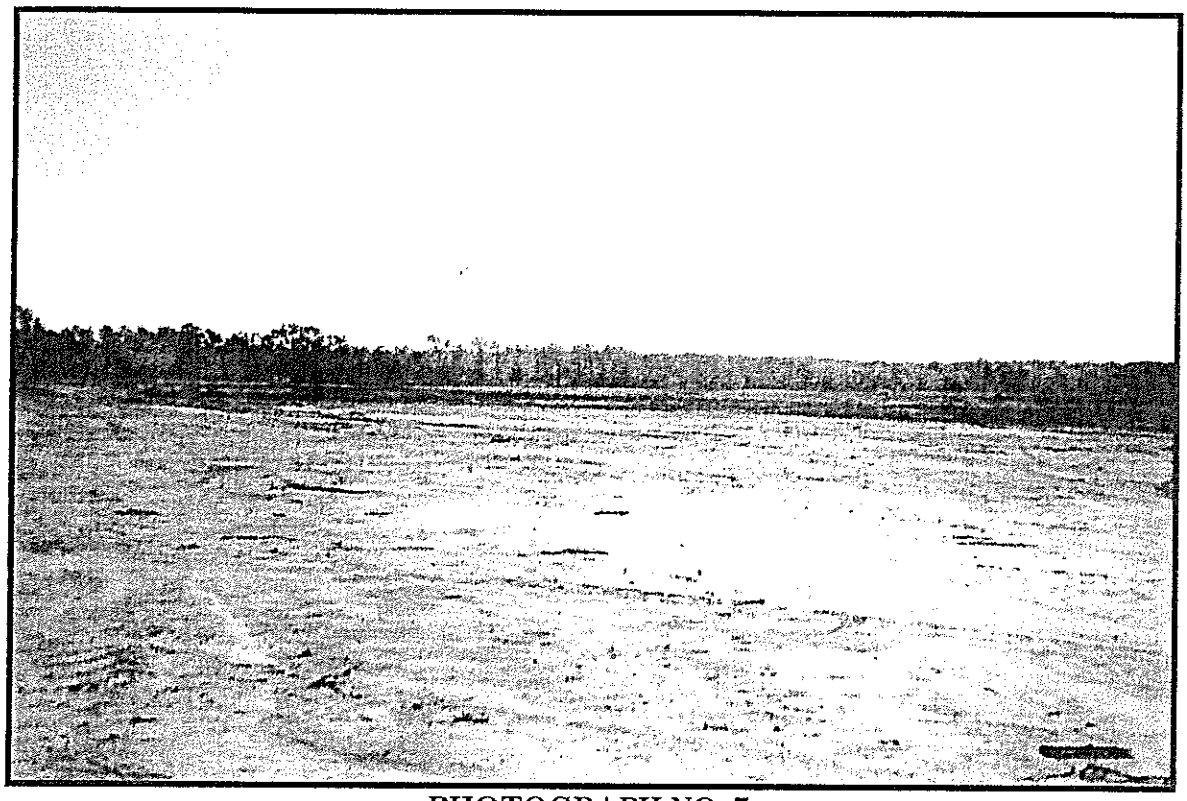
PHOTOGRAPH NO. 5
View of ConeTec seismic source beam beneath track and hammer with grounding cable. (October 2007)

R15743

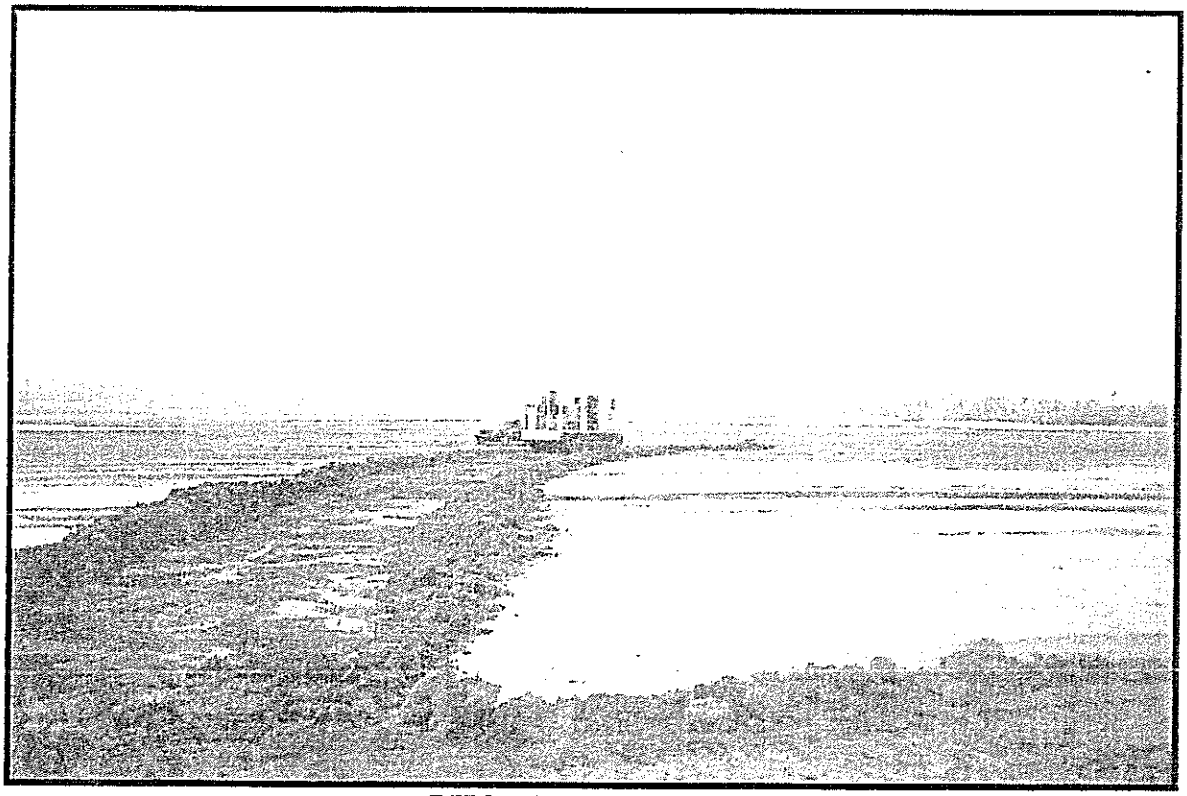


PHOTOGRAPH NO. 6
View of ConeTec CPT ram, rods and instrumentation cable from inside track rig. (October 2007)

R15744



PHOTOGRAPH NO. 7
View of ConeTec track rig (in far left background) at CPT-8 looking northwest toward proposed North Cell. (October 2007)



PHOTOGRAPH NO. 8
View of ConeTec track rig at CPT-11 and proposed North Cell looking south. (October 2007)

8 11 4 10 R15745
Part 9

APPENDIX B

CHARACTERIZATION OF SUBSURFACE CONDITIONS

APPENDIX B-1

SHEAR MODULUS CORRELATIONS FOR SHAKE COLUMNS PCSC300E AND PCSC300M

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation

PROJECT NO. 072046

Shear Modulus Calculations for SHAKE Columns PCSC300E and PCSC300M

PAGE 1 OF 29

MADE BY BEG DATE 1/3/08 CHECKED BY RJS DATE 1/23/08

CALCULATION BRIEF FOR SHEAR MODULUS CORRELATIONS FOR SHAKE COLUMNS PCSC300E AND PCSC300M

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH CELL

OBJECTIVE: Calculate elastic shear modulus (G_{max}) values for coarse coal refuse, coarse/fine mixed refuse, and fine coal refuse at the Pond Creek site from shear wave velocities measured at the site. Also, correlate these shear modulus values for SHAKE modeling of the proposed Pond Creek – South Cell embankment cross section, as shown in Figure 3.

METHODOLOGY: From the measured shear wave velocities (V_S) with depth at Piezo-Seismic Cone Penetrometer Test (PSCPT) sounding locations CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B, shear modulus is determined using the relationship $G = \gamma/g\ V_S^2$. To estimate induced cyclic shear stresses in the South Cell impoundment at the final geometry, SHAKE analyses are performed in which shear modulus and/or shear wave velocity are input parameters.

The seismic data from CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B were utilized and modified according to the projected cross-section of the future South Cell embankment/fines elevations. Columns PCSC300E/M were created from the CPT data at STA 300 along the South Cell cross-section shown in Figure 3. The SHAKE columns account for proposed maximum South Cell geometry by translating data of corresponding material types to the projected embankment geometry. The translated shear modulus data was modified according to the change in vertical effective stress (σ'_v) of the new column profile using Log G_{max} versus Log σ'_v relationships. Further, shear modulus correlations were performed accounting for changes in effective stress due to variations in ground water levels at the End of Construction (E) and Maximum fines elevation (M) conditions, which model the worst case upstream and downstream embankment scenarios, respectively. Finally, shear wave velocities were correlated from the literature (Reference 2) for bedrock as necessary input to SHAKE.

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PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation PROJECT NO. 072046

Shear Modulus Calculations for SHAKE PAGE 2 OF 29

Columns PCSC300E and PCSC300M

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REFERENCES:

1. ConeTec, Inc. (2007), Field Report Entitled "Presentation of CPTU Test Results for: Pond Creek Mine – Williamson County, Illinois, December 10, 2007.

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3. Hunt, R. E., 1984, "Geotechnical Engineering Investigation Manual," McGraw Hill Book Company, Copyright 1984.

4. Schnabel, P. B., Lysmer, J. and Seed, H. B. (1972) "SHAKE: A Computer Program for Earthquake Response Analysis of Horizontally Layered Sites," Report No. EERC 72-12, University of California, Berkeley.

5. Hardin, B.O. (1978) The Nature of Stress-Strain Behavior in Soils," Proceedings, Geotechnical Engineering Division Specialty Conference on Earthquake Engineering and Soil Dynamics, Vol. 1, ASCE,. Pasadena, CA., June, p.p. 3-90.

SHEAR MODULUS CORRELATION FOR EXISTING REFUSE MATERIALS

ConeTec, Inc. (ConeTec) performed PS-CPT at 15 locations throughout the Pond Creek site as shown in Figure 2 of the report, with locations associated with the South Cell, designated as CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B also as shown in Figure 2. Based on the information provided by ConeTec which is presented in Appendix A, Attachment A-1, measured shear wave velocities were used to determine shear modulus (G) values with depth using the relationship:

$$G = (V_S^2 * \gamma)/g$$

Since low-amplitude (less than 0.001 %) shear strains were measured during seismic downhole testing, the shear modulus values obtained from the equation above equal the elastic shear modulus, G_{max}. The G_{max} - values estimated by ConeTec in their report were subsequently modified by CEC, due to our interpretations of the applicable unit weights for the strata encountered during the piezo-seismic cone penetrometer tests. The refuse/soil material properties and the generalized subsurface profile, based on the results of the continuous CPT profile as well as the seismic downhole tests which were completed at every three-foot depth interval, are tabulated below. The field measured shear wave velocities and modified initial shear modulus data (Modulus Calculations From Field Geophysical Data) for each South Cell CPT sounding are attached.

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PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation

PROJECT NO. 072046

Shear Modulus Calculations for SHAKE

PAGE 3 OF 29

Columns PCSC300E and PCSC300M

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Generalized South Cell CPT Profiles from 10/2007 Field Testing:

CPT-1
El. 482.19 – Surface Elevation
15.3 feet – Depth to Static Ground Water
0 – 18.4 feet – Residual Soil
Refusal at 18.4 feet - Bedrock

CPT-2
El. 494.21 – Surface Elevation
38.8 feet – Depth to Static Ground Water
0 – 32 feet – Coarse Refuse
32 – 45.3 feet – Residual Soil
Refusal at 45.3 feet - Bedrock

CPT-2A
El. 492.40 – Surface Elevation
37.0 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse
29 – 41.7feet – Residual Soil
Refusal at 41.7feet - Bedrock

CPT-3
El. 466.98 – Surface Elevation
11.1 feet – Depth to Static Ground Water
0 – 22.2 feet – Residual Soil
Refusal at 22.2 feet - Bedrock

CPT-4
El. 482.55 – Surface Elevation
21.7 feet – Depth to Static Ground Water
0 – 18.9 feet – Residual Soil
Refusal at 18.9 feet - Bedrock

CPT-5
El. 482.55 – Surface Elevation
34.4 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse
29 – 49.2feet – Residual Soil
Refusal at 49.2 feet - Bedrock

CPT-5A
El. 483.00 – Surface Elevation
35.9 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse
29 – 53.2 feet – Residual Soil
Refusal at 53.2 feet - Bedrock

CPT-5B
El. 479.90 – Surface Elevation
28.0 feet – Depth to Static Ground Water
0 – 19 feet – Coarse Refuse
19 – 39.7 feet – Residual Soil
Refusal at 39.7 feet - Bedrock

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PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation PROJECT NO. 072046

Shear Modulus Calculations for SHAKE PAGE 4 OF 29

Columns PCSC300E and PCSC300M

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Refuse/Soil Properties (Provided by Alliance Consulting, Inc. based on laboratory testing)

Description	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Comment
Coarse Refuse	130	36	0	Frictional
Fine Coal Refuse	80	30		Frictional
Residual Soil	125	19.5 0	400 3000	Total Strength 80% Peak Undrained

SHEAR MODULUS CORRELATION FOR MATERIALS AT PROPOSED SOUTH CELL

Based on the generalized impoundment profiles of the applicable CPT soundings and the existing site topographic conditions, initial moduli were calculated. However, there will be an additional 25 to 55 feet of coarse coal refuse that will be placed above the existing South Cell ground surface. Therefore, PSCPT data was "transformed" to represent the proposed conditions. This was accomplished by translating data (grouped by strata) to the crest location using the respective strata thicknesses for the future South Cell geometry. Further, translations were performed as described below for the effective stress variations due to ground water levels associated with the End of Construction (E) and the Maximum fines (M) conditions. SHAKE column PSCS300E/M were created from CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B data based on the generalized profiles presented in the following table.

Generalized Profile of the South Cell SHAKE column PSCS300E and PSCS300M:

PCSC300E (Upstream Min Fines)

El. 502 - Surface Elevation
32 feet – Depth to Ground Water Table
(Min. Fines Elevation - 474)
0 – 32 feet - Coarse Refuse
32 – 50 feet - Residual Soil
Below 50 feet - Bedrock

PCSC300M (Downstream Max Fines)

El. 502 - Surface Elevation
14 feet – Depth to Ground Water Table
(Max. Fines Elevation - 496)
0 – 32 feet - Coarse Refuse
32 – 50 feet - Residual Soil
Below 50 feet - Bedrock

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PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation PROJECT NO. 072046

Shear Modulus Calculations for SHAKE PAGE 5 OF 29

Columns PCSC300E and PCSC300M

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

Due to the changes in the South Cell embankment profile from the existing conditions to the final geometry conditions, as well as the change in the piezometric surface associated with the upstream min. fines and downstream max. fines conditions and the corresponding change in vertical effective stress. The change in shear modulus with variations in vertical effective stress has been well documented for most types of soils. Hardin (1978) presented a design equation which relates Log G_{max} versus Log σ'_v for sands. The isotropic stress component, *n*, (or slope) of this relationship was developed for the coarse coal refuse and residual soil based on the recorded seismic data from CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B with respect to their corresponding σ'_v values and Vs, and was used to modify G_{max} for PSCS300. This relationship is illustrated graphically presented in this calculation brief.

The resulting shear modulus values of PCSC300 modified for the proposed maximum South Cell effective stresses are presented herein.

SHEAR VELOCITY CORRELATION FOR "OTHER" MATERIALS

Based on the boring logs and generalized cross section shown in Figure 3, weathered rock to competent rock (bedrock) exists beneath the bottom of the site and South Cell. The bedrock layer is accounted for in the SHAKE columns and shear wave velocities are correlated from Hunt, R. E., 1984 (Reference 3).

SHAKE column input parameters for each, including the soil type, depth, layer thickness, layer number and initial shear modulus and/or correlated shear wave velocity are attached to this calculation brief. The latter information (shear wave velocity) correlated from Hunt for bedrock was estimated as follows:

> From Table 2.9, Hunt presents compression wave velocity (V_p) ranges for various materials including Colluvium (firm to medium coarse), Shale (soft to hard) and Sandstone (soft to hard). It is assumed that the shale and sandstone sedimentary rock ranges are assumed for the bedrock beneath the site. Further, Hunt correlates V_p to shear wave velocity (V_S) using the relationships:
>
> $V_S = 0.45$ to $0.58\ V_p$ (poorly to well consolidated soils, respectively)

Consequently, the following values are correlated. Note, it is assumed that the rock stratum is medium hard.

Material	V_p Range Hunt (1984)	V_p Assumed	V_S Factor Hunt (1984)	V_S Used in SHAKE
Bedrock	4,000 to 10,000 fps	7,000 fps	0.58	4,000 fps

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PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation PROJECT NO. 072046

Shear Modulus Calculations for SHAKE PAGE 6 OF 29

Columns PCSC300E and PCSC300M

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SHAKE DYNAMIC PROFILES

In order to utilize the correlated and assumed dynamic properties of the impoundment for SHAKE analyses, the tabulated data was separated into common material types with a total of sixteen (16) layers. Average shear modulus values were obtained by averaging the values for each newly created layer, as shown on the attached spreadsheets. In addition, the assumed shear velocity value for bedrock (presented above) was utilized for the basal layer (17). The averaged dynamic profiles and tabulated SHAKE input are attached to this calculation brief.

CONCLUSION

Based on the information presented in this calculation brief, estimates of shear modulus from measured shear wave velocities for the Pond Creek – South Cell impoundment were performed. SHAKE columns PCSC300E (Crest Column – Upstream Min. Fines) and PCSC300M (Crest Column – Downstream Max. Fines) were created by translating the initial shear modulus values from CPT-1 through CPT-5B and modifying them with respect to changes in vertical effective stress associated with the final South Cell geometry. The Log G_{max} versus Log σ'_v relationships for coarse refuse and residual soil were developed from the downhole seismic data from this study. Additionally, correlations presented for "other" materials not directly tested were utilized. The correlated shear modulus values subdivided into layers and averaged for use as SHAKE input. The created dynamic profiles will be utilized to estimate induced cyclic shear stress with depth for the proposed maximum South Cell geometry.

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PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation PROJECT NO. 072046

Shear Modulus Calculations for SHAKE PAGE 7 OF 29

Columns PCSC300E and PCSC300M

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CORRELATED CPT-1 THROUGH CPT-5B SHEAR WAVE VELOCITY DATA MODIFIED BY CEC TO OBTAIN SHEAR MODULUS BASED ON REFUSE/SOIL DENSITIES AND SOUTH POND VERTICAL EFFECTIVE STRESS FOR SHAKE COLUMNS PCSC300E AND PCSC300M

R15754

Project: Williamson Energy - Pond Creek South Cell Deformation Analysis
Subject: Determination of Shear Moduli for Coarse Refuse and Soil - PCSC300M (StageVII Crest Column)
South Cell - Crest at El. 502; Fines at El. 496 (MAXIMUM FINES LEVEL)

Objective: Calculate in-situ values of Shear Modulus for coarse refuse and subgrade soils at the Williamson Energy Pond Creek South Cell coal refuse disposal site from shear wave velocities measured in various CPT soundinds conducted at the site.

Pond Creek Refuse Properties:	Coarse	Residual
(provided by Alliance Consulting Inc. from slope stability analyses)	Refuse	Soil
Total Unit Weight (pcf) =	130.0	125.0
Total Sat. Unit Weight (pcf) =	140.0	135.0
Effective Unit Weight (pcf) =	77.6	72.6

Generalized Subsurface Profiles: Cone Penetration Testing (CPT) performed by ConeTec, Inc. and CEC November 2007.

CPT-1

Generalized Profile - CPT-1 Sounding 11/07

482.2	Surface Elev.,ft
15.3	Depth to Groundwater Table, ft
0 - 18.4 ft	Clay
18.40	Refusal

CPT-2

Generalized Profile - CPT-2 Sounding 11/07

484.2	Surface Elev.,ft
38.8	Depth to Groundwater Table, ft
0 - 32.0 ft	Coarse Refuse
32.0 - 45.3 ft	Clay
45.30	Refusal

CPT-2A

Generalized Profile - CPT-2A Sounding 11/07

492.4	Surface Elev.,ft
37.0	Depth to Groundwater Table, ft
0 - 29.0 ft	Coarse Refuse
29.0 - 41.7 ft	Clay
41.70	Refusal

CPT-3

Generalized Profile - CPT-3 Sounding 11/07

467.0	Surface Elev.,ft
11.1	Depth to Groundwater Table, ft
0 - 22.2.0 ft	Coarse Refuse
22.20	Refusal

CPT-4

Generalized Profile - CPT-4 Sounding 11/07

482.6	Surface Elev.,ft
21.7	Depth to Groundwater Table, ft
0 - 18.4 ft	Coarse Refuse
18.40	Refusal

CPT-5

Generalized Profile - CPT-5 Sounding 11/07

482.6	Surface Elev.,ft
34.4	Depth to Groundwater Table, ft
0 - 29.0 ft	Coarse Refuse
29.0 - 49.2 ft	Clay
49.20	Refusal

CPT-5A

Generalized Profile - CPT-5A Sounding 11/07

484.2	Surface Elev.,ft
38.8	Depth to Groundwater Table, ft
0 - 29.0 ft	Coarse Refuse
29.0 - 53.2 ft	Clay
53.20	Refusal

CPT-5B

Generalized Profile - CPT-5B Sounding 11/07

484.2	Surface Elev.,ft
38.8	Depth to Groundwater Table, ft
0 - 19.0 ft	Coarse Refuse
19.0 - 39.7 ft	Clay
39.10	Refusal

Generalized Profile For PCSC300M Stage VII CREST COLUMN (Crest El. 502, Max. Fines El. 496)

502.0	Surface Elev.,ft
14.0	Depth to Groundwater Table, ft
0 - 32 ft	Coarse Refuse
32 - 50 ft	Residual Soil
Below 50 ft	Bedrock

R15755

WILLIAMSON ENERGY - POND CREEK SOUTH CELL IMPOUNDMENT
SHAKE CREST COLUMN PCSC300M (CREST EL. 502, MAX. FINES EL. 496)
CPT-1, 2, 2A, 3, 4, 5, 5A, 5B

MODULUS CALCULATIONS FROM FIELD GEOPHYSICAL DATA:

	CPT-1	CPT-2	CPT-2A	CPT-3	CPT-4	CPT-5	CPT-5A	CPT-5B
Ex. Surf. El:	482.2	484.2	492.4	467.0	482.6	482.6	484.2	484.2
GWT:	466.9	445.4	455.4	455.9	460.9	448.2	445.4	445.4

CCR AND SOIL
CPT-1, 2, 2A, 3, 4, 5, 5A, 5B

															Based		
	CPT Mid Layer Depth	Stage VII Depth	Stage VII Elevation	CPT-1 Shear Wave Velocity	CPT-2 Shear Wave Velocity	CPT-2A Shear Wave Velocity	CPT-3 Shear Wave Velocity	CPT-4 Shear Wave Velocity	CPT-5 Shear Wave Velocity	CPT-5A Shear Wave Velocity	CPT-5B Shear Wave Velocity	Average Shear Wave Velocity	Average Initial Effective Stress	Average Stage VII Effective Stress	Average Initial SHEAR MODULUS	10X Corr SHEAR MODULUS	Corrected SHEAR MODULUS	Average Stage VII Gmax For Layer	
	z	z	El.	Vs	Vs	Vs	Vs	Vs	Vs	Vs	Vs	Vs	σ'	σ'	Gmax	Gmax	Gmax	Gmax	
	(ft)	(ft)	(ft)	(fps)	(fps)	(fps)	(fps)	(fps)	(fps)	(fps)	(fps)	(fps)	(psf)	(psf)	(ksf)	dim	(ksf)	(ksf)	LAYER NO.
	7.54	4.00	498.0	NA	1204	977	NA	NA	1030	844	818	975	980.2	520.0	3913	3.54	3454	3454	1
	7.54	7.00	495.0	NA	1204	977	NA	NA	1030	844	818	975	980.2	910.0	3913	3.59	3856	3856	2
	10.82	10.00	492.0	NA	1284	973	NA	NA	1076	779	900	1002	1406.6	1300.0	4175	3.61	4110	4110	3
	14.10	13.00	489.0	NA	1152	1121	NA	NA	991	1164	1517	1189	1833.0	1690.0	5831	3.76	5739	5739	4
	17.39	16.00	486.0	NA	1085	1051	NA	NA	936	1396	1085	1111	2260.7	1975.2	5074	3.69	4941	4941	5
CCR	20.67	19.00	483.0	NA	1029	1105	NA	NA	1148	994	NA	1069	2687.1	2208.0	4629	3.65	4453	4453	6
	23.95	22.00	480.0	NA	1039	1169	NA	NA	1190	1077	NA	1119	3113.5	2440.8	5069	3.68	4832	4832	7
	27.23	25.00	477.0	NA	1050	895	NA	NA	1067	1195	NA	1052	3539.9	2673.6	4512	3.63	4269	4269	8
	30.51	28.00	474.0	NA	1114	NA	NA	NA	NA	NA	NA	1114	3966.3	2906.4	5010	3.67	4713	4713	9
	30.51	32.00	470.0	NA	1114	NA	NA	NA	NA	NA	NA	1114	3966.3	3216.8	5010	3.68	4808	4808	10
	4.26	35.00	467.0	645	NA	NA	NA	476	NA	NA	NA	561	532.5	3344.6	1220	3.41	2570		
	33.79	35.00	467.0	NA	950	845	NA	NA	780	784	1014	875	4223.8	3344.6	2969	3.43	2701	2635	11
	7.54	38.00	464.0	656	NA	NA	577	673	NA	NA	NA	635	942.5	3562.4	1567	3.43	2687		
	37.07	38.00	464.0	NA	795	790	NA	NA	821	784	1150	868	4605.0	3562.4	2925	3.42	2636	2661	12
	10.82	41.00	461.0	808	NA	NA	569	781	NA	NA	NA	719	1352.5	3780.2	2009	3.48	3048		
SOIL	40.35	41.00	461.0	NA	908	1256	NA	NA	780	728	NA	918	4881.3	3780.2	3271	3.47	2949	2998	13
	14.10	44.00	458.0	1013	NA	NA	738	913	NA	NA	NA	888	1710.1	3998.0	3061	3.64	4320		
	43.30	44.00	458.0	NA	1173	NA	NA	NA	923	768	NA	955	5099.8	3998.0	3538	3.51	3205	3763	14
	17.06	47.00	455.0	1402	NA	NA	883	1242	NA	NA	NA	1176	1997.7	4215.8	5366	3.86	7264		
	46.67	47.00	455.0	NA	NA	NA	NA	NA	1599	961	NA	1280	5306.1	4215.8	6360	3.76	5794	6529	15
	20.10	50.00	452.0	NA	NA	NA	1058	NA	NA	NA	NA	1058	2040.9	4433.6	4345	3.77	5952		
	49.95	50.00	452.0	NA	NA	NA	NA	NA	NA	1411	NA	1411	5659.5	4433.6	7729	3.85	7000	6476	16

R15756

INITIAL EFFECTIVE STRESS CALCULATION:

		Ex. Surf. El:	482.2	484.2	492.4	467.0	482.6	482.6	484.2	484.2	
		GWT:	466.9	445.4	455.4	455.9	460.9	448.2	445.4	445.4	
	CPT Mid Layer Depth z (ft)	Stage VII Depth z (ft)	Stage VII Elevation El. (ft)	CPT-1 Initial Effective Stress σ' (psf)	CPT-2 Initial Effective Stress σ' (psf)	CPT-2A Initial Effective Stress σ' (psf)	CPT-3 Initial Effective Stress σ' (psf)	CPT-4 Initial Effective Stress σ' (psf)	CPT-5 Initial Effective Stress σ' (psf)	CPT-5A Initial Effective Stress σ' (psf)	CPT-5B Initial Effective Stress σ' (psf)	Average Initial Effective Stress σ' (psf)
CCR	7.54	4.00	498.0	NA	980.2	980.2	NA	NA	980.2	980.2	980.2	980.2
	7.54	7.00	495.0	NA	980.2	980.2	NA	NA	980.2	980.2	980.2	980.2
	10.82	10.00	492.0	NA	1406.6	1406.6	NA	NA	1406.6	1406.6	1406.6	1406.6
	14.10	13.00	489.0	NA	1833.0	1833.0	NA	NA	1833.0	1833.0	1833.0	1833.0
	17.39	16.00	486.0	NA	2260.7	2260.7	NA	NA	2260.7	2260.7	2260.7	2260.7
	20.67	19.00	483.0	NA	2687.1	2687.1	NA	NA	2687.1	2687.1	NA	2687.1
	23.95	22.00	480.0	NA	3113.5	3113.5	NA	NA	3113.5	3113.5	NA	3113.5
	27.23	25.00	477.0	NA	3539.9	3539.9	NA	NA	3539.9	3539.9	NA	3539.9
	30.51	28.00	474.0	NA	3966.3	NA	NA	NA	NA	NA	NA	3966.3
	30.51	32.00	470.0	NA	3966.3	NA	NA	NA	NA	NA	NA	3966.3
	4.26	35.00	467.0	532.5	NA	NA	NA	532.5	NA	NA	NA	532.5
	33.79	35.00	467.0	NA	4223.8	4223.8	NA	NA	4223.8	4223.8	4223.8	4223.8
	7.54	38.00	464.0	942.5	NA	NA	942.5	942.5	NA	NA	NA	942.5
	37.07	38.00	464.0	NA	4633.8	4630.1	NA	NA	4493.8	4633.8	4633.8	4605.0
SOIL	10.82	41.00	461.0	1352.5	NA	NA	1352.5	1352.5	NA	NA	NA	1352.5
	40.35	41.00	461.0	NA	4962.5	4868.2	NA	NA	4732.0	4962.5	NA	4881.3
	14.10	44.00	458.0	1762.5	NA	NA	1605.3	1762.5	NA	NA	NA	1710.1
	43.30	44.00	458.0	NA	5176.7	NA	NA	NA	4946.1	5176.7	NA	5099.8
	17.06	47.00	455.0	2040.3	NA	NA	1820.2	2132.5	NA	NA	NA	1997.7
	46.67	47.00	455.0	NA	NA	NA	NA	NA	5190.8	5421.4	NA	5306.1
	20.10	50.00	452.0	NA	NA	NA	2040.9	NA	NA	NA	NA	2040.9
	49.95	50.00	452.0	NA	NA	NA	NA	NA	NA	5659.5	NA	5659.5

R15757

INITIAL SHEAR MODULUS CALCULATION:

	CPT Mid Layer Depth z (ft)	Stage VII Depth z (ft)	Stage VII Elevation El. (ft)	CPT-1 Initial Shear Modulus Gmax (ksf)	CPT-2 Initial Shear Modulus Gmax (ksf)	CPT-2A Initial Shear Modulus Gmax (ksf)	CPT-3 Initial Shear Modulus Gmax (ksf)	CPT-4 Initial Shear Modulus Gmax (ksf)	CPT-5 Initial Shear Modulus Gmax (ksf)	CPT-5A Initial Shear Modulus Gmax (ksf)	CPT-5B Initial Shear Modulus Gmax (ksf)	Average Initial Shear Modulus Gmax (ksf)
CCR	7.54	4.00	498.0	NA	5852	3854	NA	NA	4283	2876	2701	3913
	7.54	7.00	495.0	NA	5852	3854	NA	NA	4283	2876	2701	3913
	10.82	10.00	492.0	NA	6656	3822	NA	NA	4674	2450	3270	4175
	14.10	13.00	489.0	NA	5358	5073	NA	NA	3965	5470	9291	5831
	17.39	16.00	486.0	NA	4753	4460	NA	NA	3537	7868	4753	5074
	20.67	19.00	483.0	NA	4275	4930	NA	NA	5321	3989	NA	4629
	23.95	22.00	480.0	NA	4358	5517	NA	NA	5717	4683	NA	5069
	27.23	25.00	477.0	NA	4451	3234	NA	NA	4596	5765	NA	4512
	30.51	28.00	474.0	NA	5010	NA	NA	NA	NA	NA	NA	5010
	30.51	32.00	470.0	NA	5010	NA	NA	NA	NA	NA	NA	5010
SOIL	4.26	35.00	467.0	1615	NA	NA	NA	880	NA	NA	NA	1220
	33.79	35.00	467.0	NA	3503	2772	NA	NA	2362	2386	3991	2969
	7.54	38.00	464.0	1671	NA	NA	1292	1758	NA	NA	NA	1567
	37.07	38.00	464.0	NA	2454	2423	NA	NA	2617	2386	5134	2925
	10.82	41.00	461.0	2534	NA	NA	1257	2368	NA	NA	NA	2009
	40.35	41.00	461.0	NA	3201	6124	NA	NA	2362	2057	NA	3271
	14.10	44.00	458.0	3984	NA	NA	2114	3236	NA	NA	NA	3061
	43.30	44.00	458.0	NA	5341	NA	NA	NA	3307	2290	NA	3538
	17.06	47.00	455.0	7630	NA	NA	3027	5988	NA	NA	NA	5366
	46.67	47.00	455.0	NA	NA	NA	NA	NA	9925	3585	NA	6360
	20.10	50.00	452.0	NA	NA	NA	4345	NA	NA	NA	NA	4345
	49.95	50.00	452.0	NA	NA	NA	NA	NA	NA	7729	NA	7729

R15758

Project: Williamson Energy - Pond Creek South Cell Deformation Analysis
Subject: Determination of Shear Moduli for Coarse Refuse and Soil - PCSC300E (StageVII Crest Column)
South Cell - Crest at El. 502; Fines at El. 474 (MINIMUM FINES LEVEL)

Objective: Calculate in-situ values of Shear Modulus for coarse refuse and subgrade soils at the Williamson Energy Pond Creek South Cell coal refuse disposal site from shear wave velocities measured in various CPT soundinds conducted at the site.

Pond Creek Refuse Properties:	Coarse	Residual
(provided by Alliance Consulting Inc. from slope stability analyses)	Refuse	Soil
Total Unit Weight (pcf) =	130.0	125.0
Total Sat. Unit Weight (pcf) =	140.0	135.0
Effective Unit Weight (pcf) =	77.6	72.6

Generalized Subsurface Profiles: Cone Penetration Testing (CPT) performed by ConeTec, Inc. and CEC November 2007.

CPT-1

Generalized Profile - CPT-1 Sounding 11/07

482.2	Surface Elev.,ft
15.3	Depth to Groundwater Table, ft
0 - 18.4 ft	Clay
18.40	Refusal

CPT-2

Generalized Profile - CPT-2 Sounding 11/07

484.2	Surface Elev.,ft
38.8	Depth to Groundwater Table, ft
0 - 32.0 ft	Coarse Refuse
32.0 - 45.3 ft	Clay
45.30	Refusal

CPT-2A

Generalized Profile - CPT-2A Sounding 11/07

492.4	Surface Elev.,ft
37.0	Depth to Groundwater Table, ft
0 - 29.0 ft	Coarse Refuse
29.0 - 41.7 ft	Clay
41.70	Refusal

CPT-3

Generalized Profile - CPT-3 Sounding 11/07

467.0	Surface Elev.,ft
11.1	Depth to Groundwater Table, ft
0 - 22.2.0 ft	Coarse Refuse
22.20	Refusal

CPT-4

Generalized Profile - CPT-4 Sounding 11/07

482.6	Surface Elev.,ft
21.7	Depth to Groundwater Table, ft
0 - 18.4 ft	Coarse Refuse
18.40	Refusal

CPT-5

Generalized Profile - CPT-5 Sounding 11/07

482.6	Surface Elev.,ft
34.4	Depth to Groundwater Table, ft
0 - 29.0 ft	Coarse Refuse
29.0 - 49.2 ft	Clay
49.20	Refusal

CPT-5A

Generalized Profile - CPT-5A Sounding 11/07

484.2	Surface Elev.,ft
38.8	Depth to Groundwater Table, ft
0 - 29.0 ft	Coarse Refuse
29.0 - 53.2 ft	Clay
53.20	Refusal

CPT-5B

Generalized Profile - CPT-5B Sounding 11/07

484.2	Surface Elev.,ft
38.8	Depth to Groundwater Table, ft
0 - 19.0 ft	Coarse Refuse
19.0 - 39.7 ft	Clay
39.10	Refusal

Generalized Profile For PCSC300E Stage VII CREST COLUMN (Crest El. 502, Max. Fines El. 474)

502.0	Surface Elev.,ft
32.0	Depth to Groundwater Table, ft
0 - 32 ft	Coarse Refuse
32 - 50 ft	Residual Soil
Below 50 ft	Bedrock

R15759

WILLIAMSON ENERGY - POND CREEK SOUTH CELL IMPOUNDMENT
SHAKE CREST COLUMN PCSC300E (CREST EL. 502, MIN FINES EL. 474)
CPT-1, 2, 2A, 3, 4, 5, 5A, 5B

MODULUS CALCULATIONS FROM FIELD GEOPHYSICAL DATA:

	CPT-1	CPT-2	CPT-2A	CPT-3	CPT-4	CPT-5	CPT-5A	CPT-5B
Ex. Surf. El:	482.2	484.2	492.4	467.0	482.6	482.6	484.2	484.2
GWT:	466.9	445.4	455.4	455.9	460.9	448.2	445.4	445.4

CCR AND SOIL
CPT-1, 2, 2A, 3, 4, 5, 5A, 5B

CPT Mid Layer Depth z (ft)	Stage VII Depth z (ft)	Stage VII Elevation El. (ft)	CPT-1 Shear Wave Velocity Vs (fps)	CPT-2 Shear Wave Velocity Vs (fps)	CPT-2A Shear Wave Velocity Vs (fps)	CPT-3 Shear Wave Velocity Vs (fps)	CPT-4 Shear Wave Velocity Vs (fps)	CPT-5 Shear Wave Velocity Vs (fps)	CPT-5A Shear Wave Velocity Vs (fps)	CPT-5B Shear Wave Velocity Vs (fps)	Average Shear Wave Velocity Vs (fps)	Average Initial Effective Stress σ' (psf)	Average Stage VII Effective Stress σ' (psf)	Average Initial SHEAR MODULUS Gmax (ksf)	Based 10X Corr SHEAR MODULUS Gmax dim	Based Corrected SHEAR MODULUS Gmax (ksf)	Average Stage VII Gmax For Layer Gmax (ksf)	LAYER NO.
7.54	4.00	498.0	NA	1204	977	NA	NA	1030	844	818	975	980.2	520.0	3913	3.54	3454	3454	1
7.54	7.00	495.0	NA	1204	977	NA	NA	1030	844	818	975	980.2	910.0	3913	3.59	3856	3856	2
10.82	10.00	492.0	NA	1284	973	NA	NA	1076	779	900	1002	1406.6	1300.0	4175	3.61	4110	4110	3
14.10	13.00	489.0	NA	1152	1121	NA	NA	991	1164	1517	1189	1833.0	1690.0	5831	3.76	5739	5739	4
17.39	16.00	486.0	NA	1085	1051	NA	NA	936	1396	1085	1111	2260.7	2080.0	5074	3.70	4991	4991	5
20.67	19.00	483.0	NA	1029	1105	NA	NA	1148	994	NA	1069	2687.1	2470.0	4629	3.66	4552	4552	6
23.95	22.00	480.0	NA	1039	1169	NA	NA	1190	1077	NA	1119	3113.5	2860.0	5069	3.70	4985	4985	7
27.23	25.00	477.0	NA	1050	895	NA	NA	1067	1195	NA	1052	3539.9	3250.0	4512	3.65	4436	4436	8
30.51	28.00	474.0	NA	1114	NA	NA	NA	NA	NA	NA	1114	3966.3	3640.0	5010	3.69	4926	4926	9
30.51	32.00	470.0	NA	1114	NA	NA	NA	NA	NA	NA	1114	3966.3	4160.0	5010	3.70	5058	5058	10
4.26	35.00	467.0	645	NA	NA	NA	476	NA	NA	NA	561	532.5	4377.8	1220	3.46	2866		
33.79	35.00	467.0	NA	950	845	NA	NA	780	784	1014	875	4223.8	4377.8	2969	3.48	3013	2940	11
7.54	38.00	464.0	656	NA	NA	577	673	NA	NA	NA	635	942.5	4595.6	1567	3.47	2979		
37.07	38.00	464.0	NA	795	790	NA	NA	821	784	1150	868	4605.0	4595.6	2925	3.47	2922	2951	12
10.82	41.00	461.0	808	NA	NA	569	781	NA	NA	NA	719	1352.5	4813.4	2009	3.53	3361		
40.35	41.00	461.0	NA	908	1256	NA	NA	780	728	NA	918	4881.3	4813.4	3271	3.51	3253	3307	13
14.10	44.00	458.0	1013	NA	NA	738	913	NA	NA	NA	888	1710.1	5031.2	3061	3.68	4742		
43.30	44.00	458.0	NA	1173	NA	NA	NA	923	768	NA	955	5099.8	5031.2	3538	3.55	3519	4130	14
17.06	47.00	455.0	1402	NA	NA	883	1242	NA	NA	NA	1176	1997.7	5249.0	5366	3.90	7940		
46.67	47.00	455.0	NA	NA	NA	NA	NA	1599	961	NA	1280	5306.1	5249.0	6360	3.80	6332	7136	15
20.10	50.00	452.0	NA	NA	NA	1058	NA	NA	NA	NA	1058	2040.9	5466.8	4345	3.81	6480		
49.95	50.00	452.0	NA	NA	NA	NA	NA	NA	1411	NA	1411	5659.5	5466.8	7729	3.88	7621	7051	16

CCR

SOIL

R15760

INITIAL EFFECTIVE STRESS CALCULATION:

		Ex. Surf. El:	482.2	484.2	492.4	467.0	482.6	482.6	484.2	484.2	
		GWT:	466.9	445.4	455.4	455.9	460.9	448.2	445.4	445.4	
	CPT Mid Layer Depth z (ft)	Stage VII Depth z (ft)	Stage VII Elevation El. (ft)	CPT-1 Initial Effective Stress σ' (psf)	CPT-2 Initial Effective Stress σ' (psf)	CPT-2A Initial Effective Stress σ' (psf)	CPT-3 Initial Effective Stress σ' (psf)	CPT-4 Initial Effective Stress σ' (psf)	CPT-5 Initial Effective Stress σ' (psf)	CPT-5A Initial Effective Stress σ' (psf)	CPT-5B Initial Effective Stress σ' (psf)	Average Initial Effective Stress σ' (psf)
CCR	7.54	4.00	498.0	NA	980.2	980.2	NA	NA	980.2	980.2	980.2	980.2
	7.54	7.00	495.0	NA	980.2	980.2	NA	NA	980.2	980.2	980.2	980.2
	10.82	10.00	492.0	NA	1406.6	1406.6	NA	NA	1406.6	1406.6	1406.6	1406.6
	14.10	13.00	489.0	NA	1833.0	1833.0	NA	NA	1833.0	1833.0	1833.0	1833.0
	17.39	16.00	486.0	NA	2260.7	2260.7	NA	NA	2260.7	2260.7	2260.7	2260.7
	20.67	19.00	483.0	NA	2687.1	2687.1	NA	NA	2687.1	2687.1	NA	2687.1
	23.95	22.00	480.0	NA	3113.5	3113.5	NA	NA	3113.5	3113.5	NA	3113.5
	27.23	25.00	477.0	NA	3539.9	3539.9	NA	NA	3539.9	3539.9	NA	3539.9
	30.51	28.00	474.0	NA	3966.3	NA	NA	NA	NA	NA	NA	3966.3
	30.51	32.00	470.0	NA	3966.3	NA	NA	NA	NA	NA	NA	3966.3
	4.26	35.00	467.0	532.5	NA	NA	NA	532.5	NA	NA	NA	532.5
	33.79	35.00	467.0	NA	4223.8	4223.8	NA	NA	4223.8	4223.8	4223.8	4223.8
	7.54	38.00	464.0	942.5	NA	NA	942.5	942.5	NA	NA	NA	942.5
	37.07	38.00	464.0	NA	4633.8	4630.1	NA	NA	4493.8	4633.8	4633.8	4605.0
SOIL	10.82	41.00	461.0	1352.5	NA	NA	1352.5	1352.5	NA	NA	NA	1352.5
	40.35	41.00	461.0	NA	4962.5	4868.2	NA	NA	4732.0	4962.5	NA	4881.3
	14.10	44.00	458.0	1762.5	NA	NA	1605.3	1762.5	NA	NA	NA	1710.1
	43.30	44.00	458.0	NA	5176.7	NA	NA	NA	4946.1	5176.7	NA	5099.8
	17.06	47.00	455.0	2040.3	NA	NA	1820.2	2132.5	NA	NA	NA	1997.7
	46.67	47.00	455.0	NA	NA	NA	NA	NA	5190.8	5421.4	NA	5306.1
	20.10	50.00	452.0	NA	NA	NA	2040.9	NA	NA	NA	NA	2040.9
	49.95	50.00	452.0	NA	NA	NA	NA	NA	NA	5659.5	NA	5659.5

R15761

INITIAL SHEAR MODULUS CALCULATION:

	CPT Mid Layer Depth z (ft)	Stage VII Depth z (ft)	Stage VII Elevation El. (ft)	CPT-1 Initial Shear Modulus Gmax (ksf)	CPT-2 Initial Shear Modulus Gmax (ksf)	CPT-2A Initial Shear Modulus Gmax (ksf)	CPT-3 Initial Shear Modulus Gmax (ksf)	CPT-4 Initial Shear Modulus Gmax (ksf)	CPT-5 Initial Shear Modulus Gmax (ksf)	CPT-5A Initial Shear Modulus Gmax (ksf)	CPT-5B Initial Shear Modulus Gmax (ksf)	Average Initial Shear Modulus Gmax (ksf)
CCR	7.54	4.00	498.0	NA	5852	3854	NA	NA	4283	2876	2701	3913
	7.54	7.00	495.0	NA	5852	3854	NA	NA	4283	2876	2701	3913
	10.82	10.00	492.0	NA	6656	3822	NA	NA	4674	2450	3270	4175
	14.10	13.00	489.0	NA	5358	5073	NA	NA	3965	5470	9291	5831
	17.39	16.00	486.0	NA	4753	4460	NA	NA	3537	7868	4753	5074
	20.67	19.00	483.0	NA	4275	4930	NA	NA	5321	3989	NA	4629
	23.95	22.00	480.0	NA	4358	5517	NA	NA	5717	4683	NA	5069
	27.23	25.00	477.0	NA	4451	3234	NA	NA	4596	5765	NA	4512
	30.51	28.00	474.0	NA	5010	NA	NA	NA	NA	NA	NA	5010
	30.51	32.00	470.0	NA	5010	NA	NA	NA	NA	NA	NA	5010
SOIL	4.26	35.00	467.0	1615	NA	NA	NA	880	NA	NA	NA	1220
	33.79	35.00	467.0	NA	3503	2772	NA	NA	2362	2386	3991	2969
	7.54	38.00	464.0	1671	NA	NA	1292	1758	NA	NA	NA	1567
	37.07	38.00	464.0	NA	2454	2423	NA	NA	2617	2386	5134	2925
	10.82	41.00	461.0	2534	NA	NA	1257	2368	NA	NA	NA	2009
	40.35	41.00	461.0	NA	3201	6124	NA	NA	2362	2057	NA	3271
	14.10	44.00	458.0	3984	NA	NA	2114	3236	NA	NA	NA	3061
	43.30	44.00	458.0	NA	5341	NA	NA	NA	3307	2290	NA	3538
	17.06	47.00	455.0	7630	NA	NA	3027	5988	NA	NA	NA	5366
	46.67	47.00	455.0	NA	NA	NA	NA	NA	9925	3585	NA	6360
	20.10	50.00	452.0	NA	NA	NA	4345	NA	NA	NA	NA	4345
	49.95	50.00	452.0	NA	NA	NA	NA	NA	NA	7729	NA	7729

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation

PROJECT NO. 072046

Shear Modulus Calculations for SHAKE

PAGE 16 OF 29

Columns PCSC300E and PCSC300M

MADE BY BEG DATE 1/3/08 CHECKED BY TJL DATE 1/23/08

CONETEC, INC.
CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A AND CPT-5B
FIELD MEASURED SHEAR WAVE VELOCITY PLOTS AND
PLOTS OF CORRELATED INITIAL SHEAR MODULUS

Project: WILLIAMSON ENERGY - POND CREEK SOUTH CELL DEFORMATION ANALYSES

Subject: Determination of Shear Moduli for Coarse Refuse and Soil Materials, and Regression Analyses Relationships

Objective: Calculate in-situ values of Shear Modulus for coarse refuse and soils at the Williamson Energy Pond Creek site, and perform regression analyses to develop regression relationships for each material for extrapolating shear modulus at different effective stresses.

Pond Creek Refuse Properties:	Coarse	Residual
(provided by Alliance Consulting, Inc.)	Refuse	Soil
Total Unit Weight (pcf) =	130.0	125.0
Total Sat. Unit Weight (pcf) =	140.0	135.0
Effective Unit Weight (pcf) =	77.6	72.6

WILLIAMSON ENERGY - POND CREEK SOUTH CELL IMPOUNDMENT
SHAKE CREST COLUMN PCSC300 (CREST EL. 502, MAX. FINES EL. 496)
CPT-1, 2, 2A, 3, 4, 5, 5A, 5B
MODULUS CALCULATIONS FROM FIELD GEOPHYSICAL DATA:

Gmax vs. Vertical Effective Stress
CPT-1 Coarse Refuse
+
Gmax vs. Vertical Effective Stress
CPT-2 Coarse Refuse
+
Gmax vs. Vertical Effective Stress
CPT-2A Coarse Refuse
+
Gmax vs. Vertical Effective Stress
CPT-3 Coarse Refuse

Gmax vs. Vertical Effective Stress
CPT-1 Residual Soil
+
Gmax vs. Vertical Effective Stress
CPT-2 Residual Soil
+
Gmax vs. Vertical Effective Stress
CPT-2A Residual Soil
+
Gmax vs. Vertical Effective Stress
CPT-3 Residual Soil

Gmax vs. Vertical Effective Stress
CPT-4 Coarse Refuse
+
Gmax vs. Vertical Effective Stress
CPT-5 Coarse Refuse
+
Gmax vs. Vertical Effective Stress
CPT-5A Coarse Refuse
+
Gmax vs. Vertical Effective Stress
CPT-5B Coarse Refuse

Gmax vs. Vertical Effective Stress
CPT-4 Residual Soil
+
Gmax vs. Vertical Effective Stress
CPT-5 Residual Soil
+
Gmax vs. Vertical Effective Stress
CPT-5A Residual Soil
+
Gmax vs. Vertical Effective Stress
CPT-5B Residual Soil

WILLIAMSON ENERGY - POND CREEK SOUTH CELL IMPOUNDMENT
SHAKE CREST COLUMN PCSC300 (CREST EL. 502, MAX. FINES EL. 496)
CPT-1, 2, 2A, 3, 4, 5, 5A, 5B
MODULUS CALCULATIONS FROM FIELD GEOPHYSICAL DATA:

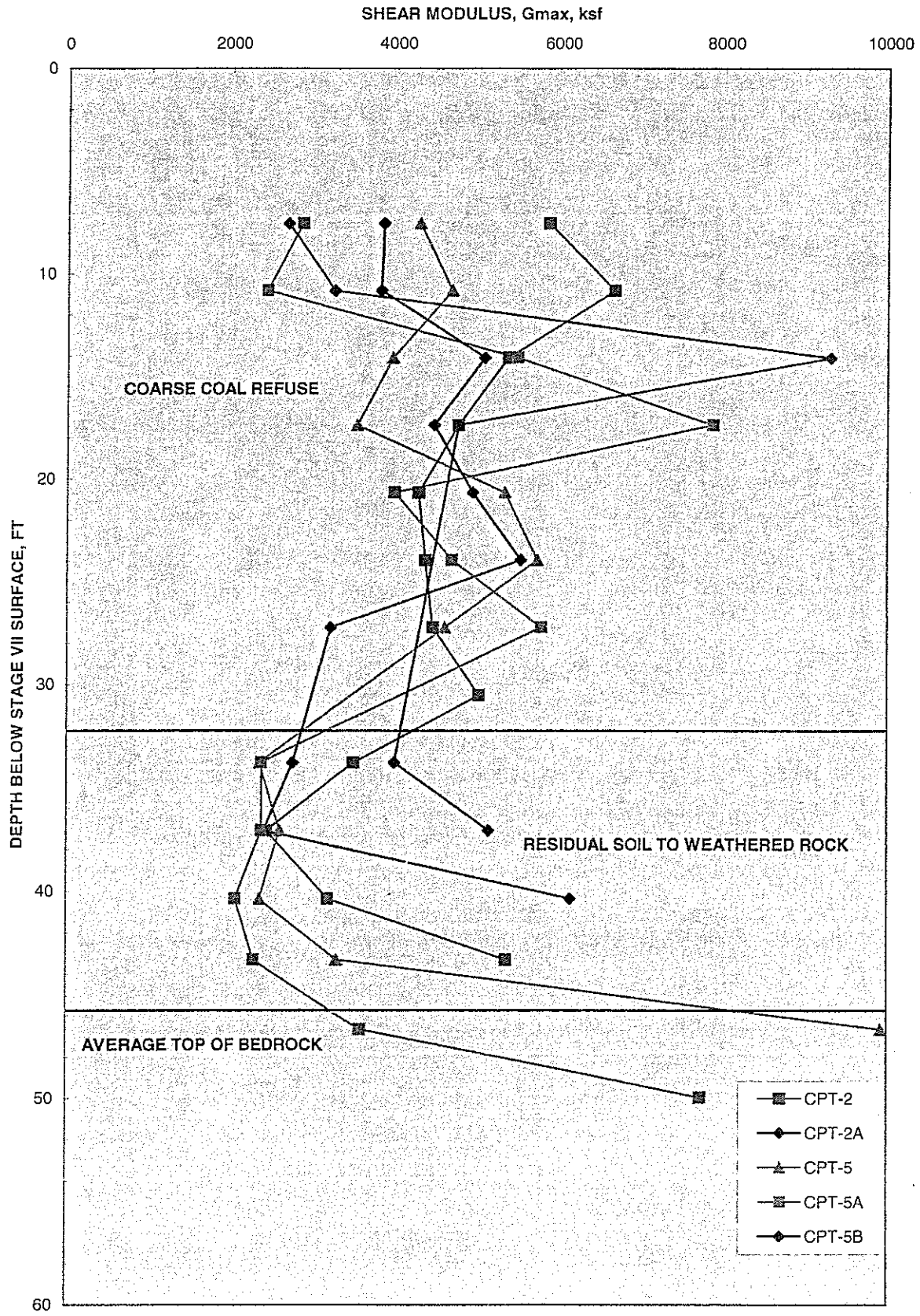
COARSE COAL REFUSE

Initial Effective Stress σ' (ksf)	Initial Effective Stress σ' (psf)	S-Wave Velocity Vs (fps)	Initial SHEAR MODULUS Gmax (ksf)
NA	NA	NA	NA
0.98	980.2	1204	5852
0.98	980.2	1204	5852
1.41	1406.6	1284	6656
1.83	1833.0	1152	5358
2.26	2260.7	1085	4753
2.69	2687.1	1029	4275
3.11	3113.5	1039	4358
3.54	3539.9	1050	4451
3.97	3966.3	1114	5010
3.97	3966.3	1114	5010
0.98	980.2	977	3854
0.98	980.2	977	3854
1.41	1406.6	973	3822
1.83	1833.0	1121	5073
2.26	2260.7	1051	4460
2.69	2687.1	1105	4930
3.11	3113.5	1169	5517
3.54	3539.9	895	3234
NA	NA	NA	NA
NA	NA	NA	NA
0.98	980.2	1030.0	4283.1
0.98	980.2	1030.0	4283.1
1.41	1406.6	1076.0	4674.3
1.83	1833.0	991.0	3964.9
2.26	2260.7	936.0	3537.0
2.69	2687.1	1148.0	5320.7
3.11	3113.5	1190.0	5717.2
3.54	3539.9	1067.0	4596.4
0.98	980.2	844.0	2875.9
0.98	980.2	844.0	2875.9
1.41	1406.6	779.0	2450.0
1.83	1833.0	1164.0	5470.1
2.26	2260.7	1396.0	7867.9
2.69	2687.1	994.0	3989.0
3.11	3113.5	1077.0	4682.9
3.54	3539.9	1195.0	5765.3
0.98	980.2	818.0	2701.4
0.98	980.2	818.0	2701.4
1.41	1406.6	900.0	3270.2
1.83	1833.0	1517.0	9290.9
2.26	2260.7	1085.0	4752.8

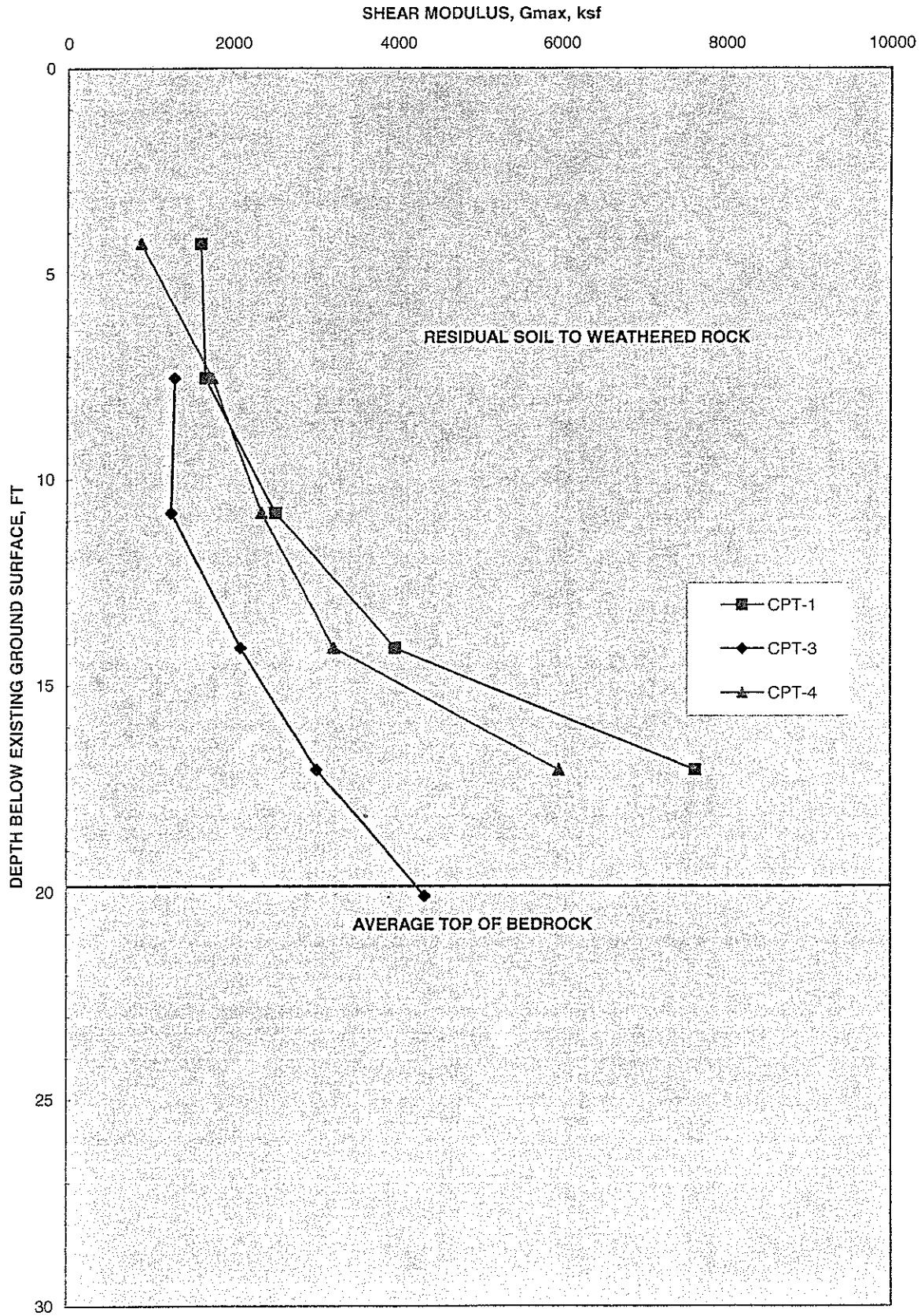
RESIDUAL SOIL

Initial Effective Stress σ' (ksf)	Initial Effective Stress σ' (psf)	S-Wave Velocity Vs (fps)	Initial SHEAR MODULUS Gmax (ksf)
0.53	532.5	645.0	1615.0
0.94	942.5	656.0	1670.6
1.35	1352.5	808.0	2534.4
1.76	1762.5	1013.0	3983.6
1.35	1352.5	808.0	2534.4
2.04	2040.3	1402.0	7630.5
4.22	4223.8	950.0	3503.5
4.63	4633.8	795.0	2453.5
4.96	4962.5	908.0	3200.6
5.18	5176.7	1173.0	5341.3
4.22	4223.8	845.0	2771.8
4.63	4630.1	790.0	2422.7
4.87	4868.2	1256.0	6124.0
0.94	942.5	577.0	1292.4
1.35	1352.5	569.0	1256.8
1.61	1605.3	738.0	2114.3
1.82	1820.2	883.0	3026.7
1.35	1352.5	569.0	1256.8
0.53	532.5	476.0	879.6
0.94	942.5	673.0	1758.3
1.35	1352.5	781.0	2367.9
1.76	1762.5	913.0	3235.9
2.13	2132.5	1242.0	5988.2
4.22	4223.8	780.0	2361.8
4.49	4493.8	821.0	2616.6
4.73	4732.0	780.0	2361.8
4.95	4946.1	923.0	3307.2
5.19	5190.8	1599.0	9925.5
4.22	4223.8	784.0	2386.1
4.63	4633.8	784.0	2386.1
4.96	4962.5	728.0	2057.4
5.18	5176.7	768.0	2289.7
5.42	5421.4	961.0	3585.1
4.2	4223.8	1014.0	3991.4
4.6	4633.8	1150.0	5133.9

INITIAL SHEAR MODULUS VS. DEPTH
WILLIAMSON ENERGY - POND CREEK SOUTH CELL
CPT-2, CPT-2A, CPT-5, CPT-5A AND CPT-5B



INITIAL SHEAR MODULUS VS. DEPTH
WILLIAMSON ENERGY - POND CREEK SOUTH CELL
CPT-1, CPT-3 AND CPT-4



Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation

PROJECT NO. 072046

Shear Modulus Calculations for SHAKE

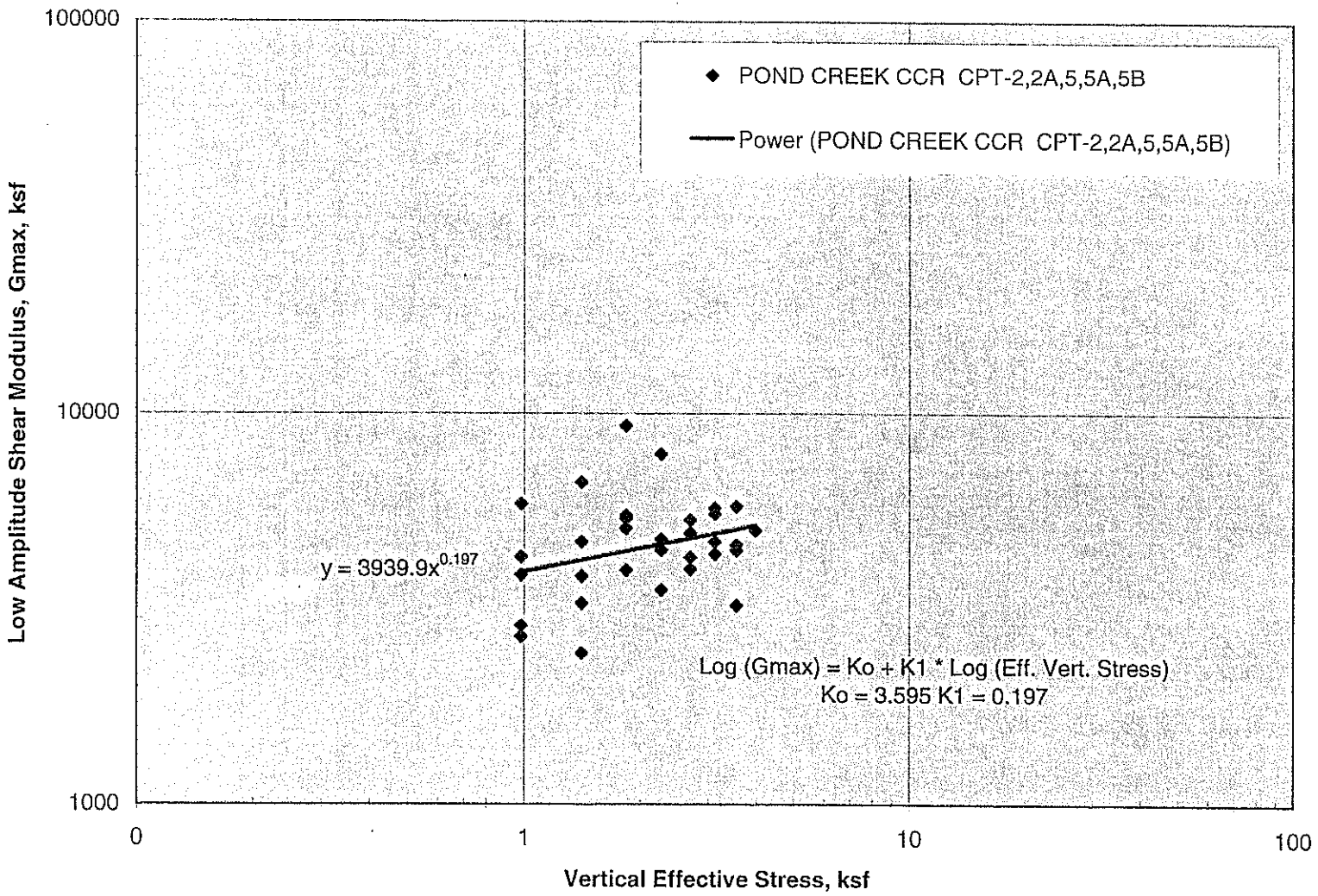
PAGE 21 OF 29

Columns PCSC300E and PCSC300M

MADE BY BEG DATE 1/3/08 CHECKED BY KJS DATE 1/23/08

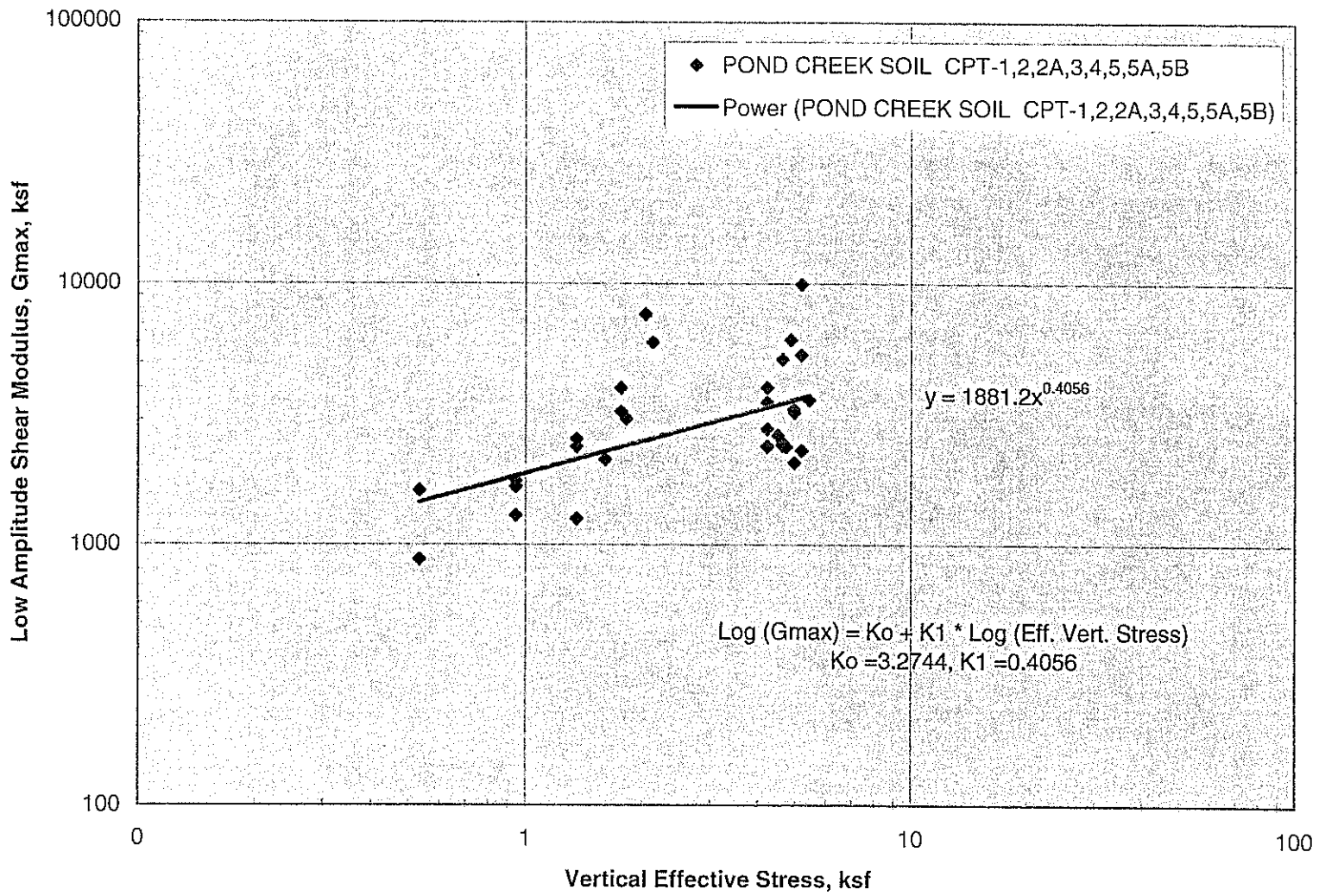
ELASTIC SHEAR MODULUS VERSUS EFFECTIVE CONFINING PRESSURE RELATIONSHIPS USED IN GMAX CORRELATIONS FOR COARSE REFUSE AND RESIDUAL SOIL MATERIALS

SHEAR MODULUS VS. VERTICAL EFFECTIVE STRESS
POND CREEK SOUTH CELL - COARSE REFUSE - CPT- 2, 2A, 5, 5A AND 5B



R15768

SHEAR MODULUS VS. VERTICAL EFFECTIVE STRESS
POND CREEK SOUTH CELL - RESIDUAL SOIL - CPT- 1, 2, 2A, 3, 4, 5, 5A AND 5B



Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation PROJECT NO. 072046

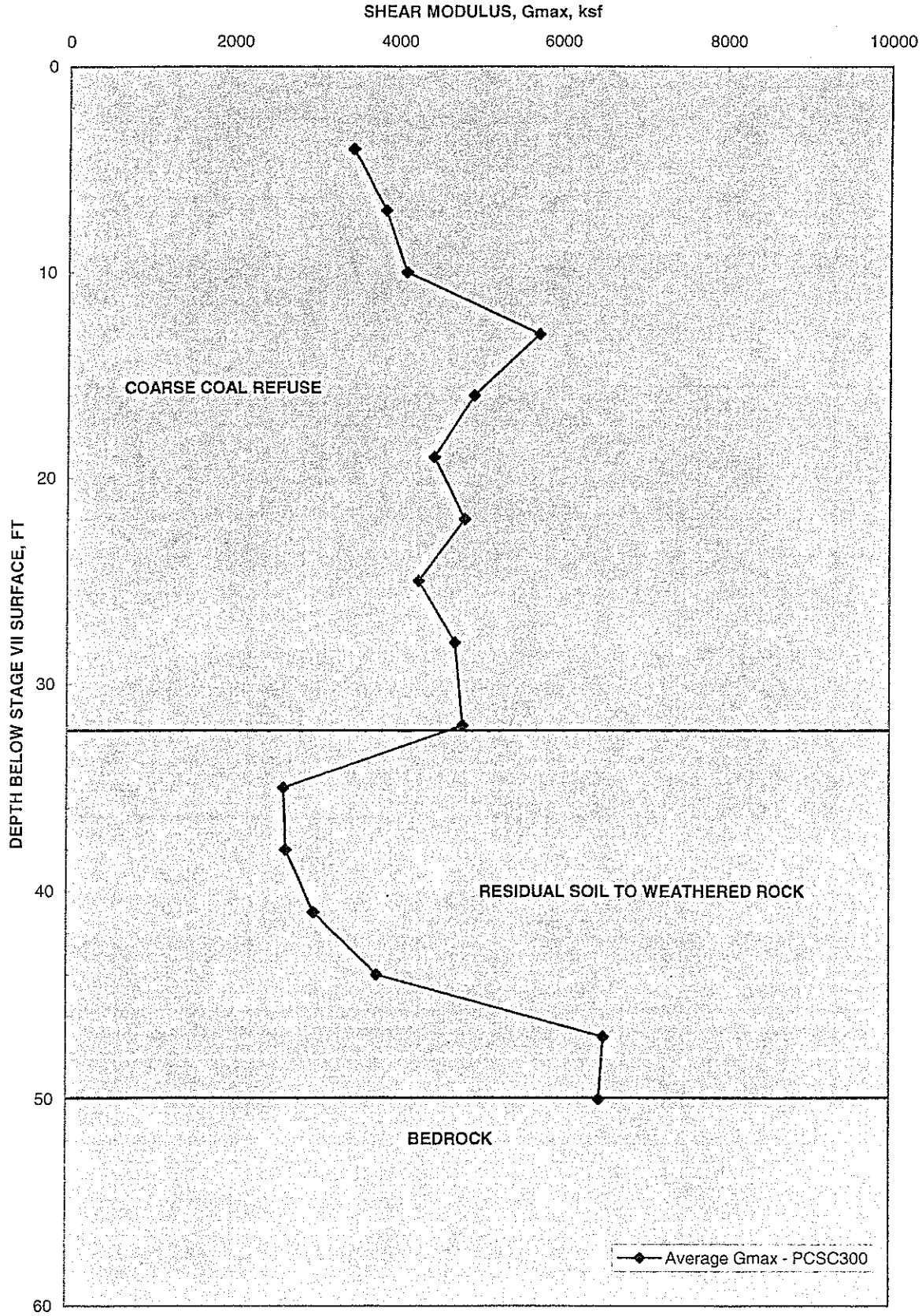
Shear Modulus Calculations for SHAKE PAGE 24 OF 29

Columns PCSC300E and PCSC300M

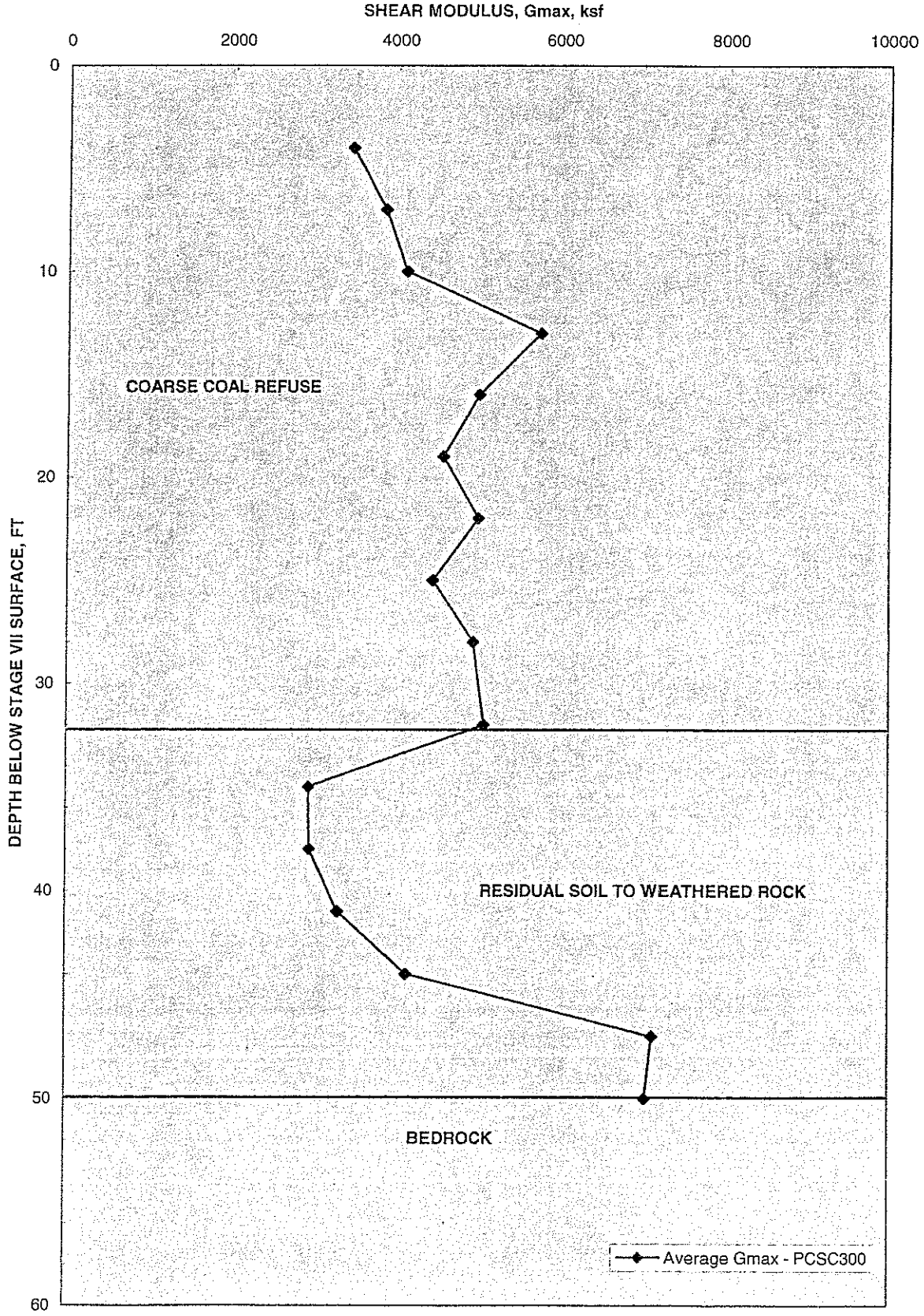
MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

CORRELATED AVERAGE GMAX PROFILES FOR PCSC300E AND PCSC300M SHAKE COLUMNS

AVERAGE SHEAR MODULUS VS. DEPTH
WILLIAMSON ENERGY - POND CREEK SOUTH CELL
SHAKE CREST COLUMN PCSC300M - STAGE VII MAX FINES EL. 496



AVERAGE SHEAR MODULUS VS. DEPTH
WILLIAMSON ENERGY - POND CREEK SOUTH CELL
SHAKE CREST COLUMN PCSC300E - STAGE VII MIN FINES EL. 474



Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation

PROJECT NO. 072046

Shear Modulus Calculations for SHAKE

PAGE 27 OF 29

Columns PCSC300E and PCSC300M

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

SHAKE COLUMN INPUT FOR PCSC300E AND PCSC300M

WILLIAMSON ENERGY - POND CREEK SOUTH CELL IMPOUNDMENT
SUMMARY OF SHAKE INPUT PARAMETERS
STAGE VII CREST SHAKE COLUMN PCSC300E - MIN FINES EL. 474
SURFACE EL. = 502 FT; GWT DEPTH = 32 FEET; 5% DAMPING

MATERIAL TYPE	LAYER THICKNESS (FT)	LAYER NO.	DEPTH BELOW GROUND SURFACE (FT)	LAYER AVERAGE SHEAR MODULUS, G (KSF)	AVG. LAYER DEPTH (FT)
COARSE COAL REFUSE (Total Unit Wt.=130 pcf) (Saturated Unit Wt.=140 pcf)	4	1	4	3454	2.0
	3	2	7	3856	5.5
	3	3	10	4110	8.5
	3	4	13	5739	11.5
	3	5	16	4991	14.5
	3	6	19	4552	17.5
	3	7	22	4985	20.5
	3	8	25	4436	23.5
	3	9	28	4926	26.5
	4	10	32	5058	30.0
RESIDUAL SOIL (Total Unit Wt.=125 pcf) (Saturated Unit Wt.=135 pcf)	3	11	35	2940	33.5
	3	12	38	2951	36.5
	3	13	41	3307	39.5
	3	14	44	4130	42.5
	3	15	47	7136	45.5
	3	16	50	7051	48.5
BEDROCK		17		Vs=4000 fps	

WILLIAMSON ENERGY - POND CREEK SOUTH CELL IMPOUNDMENT
SUMMARY OF SHAKE INPUT PARAMETERS
STAGE VII CREST SHAKE COLUMN PCSC300M - MAX FINES EL. 496
SURFACE EL. = 502 FT; GWT DEPTH = 14 FEET; 5% DAMPING

MATERIAL TYPE	LAYER THICKNESS (FT)	LAYER NO.	DEPTH BELOW GROUND SURFACE (FT)	LAYER AVERAGE SHEAR MODULUS, G (KSF)	AVG. LAYER DEPTH (FT)
COARSE COAL REFUSE (Total Unit Wt.=130 pcf) (Saturated Unit Wt.=140 pcf)	4	1	4	3454	2.0
	3	2	7	3856	5.5
	3	3	10	4110	8.5
	3	4	13	5739	11.5
	3	5	16	4941	14.5
	3	6	19	4453	17.5
	3	7	22	4832	20.5
	3	8	25	4269	23.5
	3	9	28	4713	26.5
	4	10	32	4808	30.0
RESIDUAL SOIL (Total Unit Wt.=125 pcf) (Saturated Unit Wt.=135 pcf)	3	11	35	2635	33.5
	3	12	38	2661	36.5
	3	13	41	2998	39.5
	3	14	44	3763	42.5
	3	15	47	6529	45.5
	3	16	50	6476	48.5
BEDROCK		17		Vs=4000 fps	

8114-10
Part 10

APPENDIX B-2

ESTIMATION AND SUMMARY OF ENGINEERING PROPERTIES INCLUDING PEAK UNDRAINED SHEAR STRENGTH FOR REFUSE AND RESIDUAL SOIL MATERIALS

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation PROJECT NO. 072046

Estimation and Summary of Engineering Properties for Refuse and Subgrade Materials PAGE 1 OF 8.

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

CALCULATION BRIEF
FOR

ESTIMATION AND SUMMARY OF ENGINEERING PROPERTIES INCLUDING PEAK UNDRAINED SHEAR STRENGTH FOR REFUSE AND SUBGRADE MATERIALS

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH CELL

OBJECTIVE: Summarize engineering properties for the various coal refuse materials encountered at the Pond Creek Coal Refuse Disposal site including unit weight (γ), specific gravity (G_s), effective angle of internal friction (ϕ') and cohesion (c') and peak undrained shear strength (S_{up}). The various strengths will be used in the Pond Creek deformation analyses model(s) were provided by Alliance Consulting, Inc. (Alliance) based on laboratory testing or derived herein.

REFERENCES:

1. Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Summary of Piezo-Seismic Cone Penetration Testing," Pond Creek Coal Refuse Disposal Site," BEG, 12/21/07.

2. Alliance Consulting, Inc., "Appendix C Laboratory Testing, Proposed Coal Refuse Disposal Facility No. 2, Pond Creek Mine No. 1, Williamson County, Illinois"

3. Almes, R. A. and Butail, A. (1976) "Coal Refuse: Its Behavior Related to the Design and Operation of Coal Refuse Disposal Facilities," Proceedings of the Ohio River Valley Soils Seminar, Lexington, Kentucky, October, 1976.

4. Bowles, Joseph E. (1984) "Physical and Geotechnical Properties of Soils," Mc-Graw Hill. New York: 367-369 and 393-396.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Cell Deformation Evaluation PROJECT NO. 072046

Estimation and Summary of Engineering Properties PAGE 2 OF 8

for Refuse and Subgrade Materials

MADE BY BEG DATE 12/28/07 CHECKED BY TJS DATE 1/23/08

5. Mayne, Paul W., (2001) "Stress-Strain-Strength-Flow Parameters from Enhanced In-Situ Tests", Proceedings - International Conference on In-Situ Measurement of Soil Properties & Case Histories, 21-24 May 2001, Bali, Indonesia.

6. Robertson, P.K (1998), "Applications Guide – CPT" **Fax**

7. Robertson, P.K., et.al. (1992) "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE 109 (11): 1449-1459.

METHODOLOGY AND ANALYSES:

A significant volume of field data was obtained from the various refuse and subgrade materials. Field and laboratory data is summarized in References 1 and 2, which was reduced and analyzed in accordance with established procedures for estimating and correlating field and laboratory parameters as described below and in the corresponding references shown above.

- Total (γ_t) and saturated (γ_s) unit weight;
- Effective strength parameters, friction angle (ϕ') and cohesion (c'); and
- Peak undrained shear strength (Sup).

SOIL PROPERTIES

The following soil properties were estimated based on laboratory testing (Reference 2) provided by Alliance Consulting, Inc., and/or derived herein, which are used in the various seismic/liquefaction slope stability analyses:

Refuse/Soil Properties

Description	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion [1] (psf)	Comment
Coarse Refuse	130	36	0	Frictional
Fine Coal Refuse	85	39	0	Frictional
Residual Soil	125	19.5 0	400 3000	Total Strength 80% Peak Undrained

Williamson Pond Creek Clay Subgrade Nk (Peak Strength) CPT - CU

CEC: Project No. 072046
BEG 1/7/08

Use Su/σ'v data from CPT-1, CPT-3, CPT-4, CPT-6, CPT-7, CPT-8, CPT-9, CPT-10, CPT-11, CPT-12 at 10' TO 12' depth. Su/σ'v data from respective Normalized CPT data files. Sup=Q/2 at max deviator stress from CU point. σ'v =1.5*σ3.

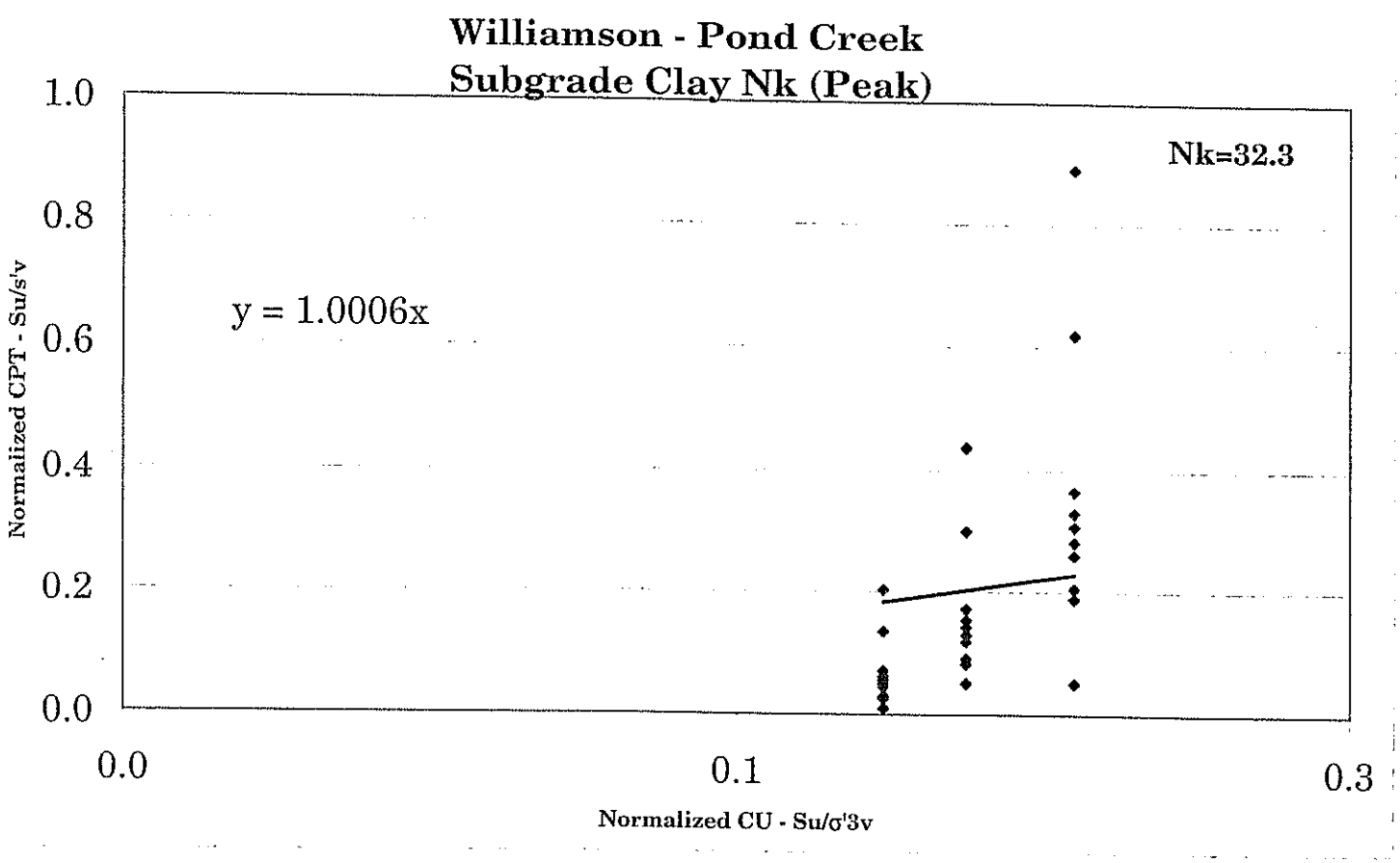
CPT No.	Su/σ'v	Qt	CU σt	CU σ'v	PSCPT Depth	CU Sup/σ'v	CU Test Depth	CU TEST POINT NO.
1	0.889	65.40	2.2	2.2	10 - 12	0.229	10 - 12	1
3	0.262	20.8	2.2	2.2	10 - 12	0.229	10 - 12	1
4	0.619	46.2	2.2	2.2	10 - 12	0.229	10 - 12	1
6	0.310	24.20	2.2	2.2	10 - 12	0.229	10 - 12	1
7	0.367	28.30	2.2	2.2	10 - 12	0.229	10 - 12	1
8	0.284	22.40	2.2	2.2	10 - 12	0.229	10 - 12	1
9	0.332	25.8	2.2	2.2	10 - 12	0.229	10 - 12	1
10	0.207	16.90	2.2	2.2	10 - 12	0.229	10 - 12	1
11	0.190	15.70	2.2	2.2	10 - 12	0.229	10 - 12	1
12	0.051	11.40	4.3	4.3	10 - 12	0.229	10 - 12	1
1	0.440	65.40	4.3	4.3	10 - 12	0.203	10 - 12	2
3	0.119	20.8	4.3	4.3	10 - 12	0.203	10 - 12	2
4	0.302	46.2	4.3	4.3	10 - 12	0.203	10 - 12	2
6	0.143	24.20	4.3	4.3	10 - 12	0.203	10 - 12	2
7	0.173	28.30	4.3	4.3	10 - 12	0.203	10 - 12	2
8	0.130	22.40	4.3	4.3	10 - 12	0.203	10 - 12	2
9	0.155	25.8	4.3	4.3	10 - 12	0.203	10 - 12	2
10	0.091	16.90	4.3	4.3	10 - 12	0.203	10 - 12	2
11	0.082	15.70	4.3	4.3	10 - 12	0.203	10 - 12	2
12	0.051	11.40	4.3	4.3	10 - 12	0.203	10 - 12	2
1	0.204	65.40	8.6	8.6	10 - 12	0.183	10 - 12	3
3	0.044	20.8	8.6	8.6	10 - 12	0.183	10 - 12	3
4	0.135	46.2	8.6	8.6	10 - 12	0.183	10 - 12	3
6	0.056	24.20	8.6	8.6	10 - 12	0.183	10 - 12	3
7	0.071	28.30	8.6	8.6	10 - 12	0.183	10 - 12	3
8	0.050	22.40	8.6	8.6	10 - 12	0.183	10 - 12	3
9	0.062	25.8	8.6	8.6	10 - 12	0.183	10 - 12	3
10	0.030	16.90	8.6	8.6	10 - 12	0.183	10 - 12	3
11	0.026	15.70	8.6	8.6	10 - 12	0.183	10 - 12	3
12	0.010	11.40	8.6	8.6	10 - 12	0.183	10 - 12	3

6.1.8

R15779

Nk= 32.3

FCR	
PSCPT	*LAB*
0.889	0.229
0.262	0.229
0.619	0.229
0.310	0.229
0.367	0.229
0.284	0.229
0.332	0.229
0.207	0.229
0.190	0.229
0.051	0.229
0.440	0.203
0.119	0.203
0.302	0.203
0.143	0.203
0.173	0.203
0.130	0.203
0.155	0.203
0.091	0.203
0.082	0.203
0.051	0.203
0.204	0.183
0.044	0.183
0.135	0.183
0.056	0.183
0.071	0.183
0.050	0.183
0.062	0.183
0.030	0.183
0.026	0.183
0.010	0.183



APPENDIX B-3

LABORATORY TEST RESULTS
PROVIDED BY ALLIANCE CONSULTING, INC.

APPENDIX C

LABORATORY TESTING
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY, LLC
BECKLEY, WEST VIRGINIA

TABLE OF CONTENTS

	PAGE
SOIL TESTING	
Summary	1
Strength Test	3
Grain Size	10
Atterberg Limits Test Results	12
COARSE COAL REFUSE TESTING	
Summary	13
Grain Size	15
Proctor Test	17
Permeability Test	18
Strength Test	20

R15783

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

SHIPPING ADDRESS
Box 393 Wood Road
Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

February 10, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Soil Boring and Laboratory Tests
Boring #8874
Mach Mine #1
Johnston City, Illinois
HFE File H-05278
Mach Mining Purchase Order No. _____

Dear Sir:

In accordance with your instructions, on February 1, 2006, we drilled one soil boring and sampled the subsoils with Shelby tubes. The soil sample taken from 10 to 12 feet in depth was subjected to laboratory tests. Results of the tests are as follows:

Boring No.:	8874
Depth:	8.0-10.0'
Visual Classification:	Silty CLAY (CL)
Atterberg Limits:	LL = 41.8% PL = 17.7% PI = 24.1
Unit Weight:	105.3 PCF
Moisture Content:	21.5%
Effective Cohesion:	0 PSF
Effective Phi Angle:	26.8 Degrees

All Tubes From Boring 8874

The Boring Log and test results are enclosed. If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

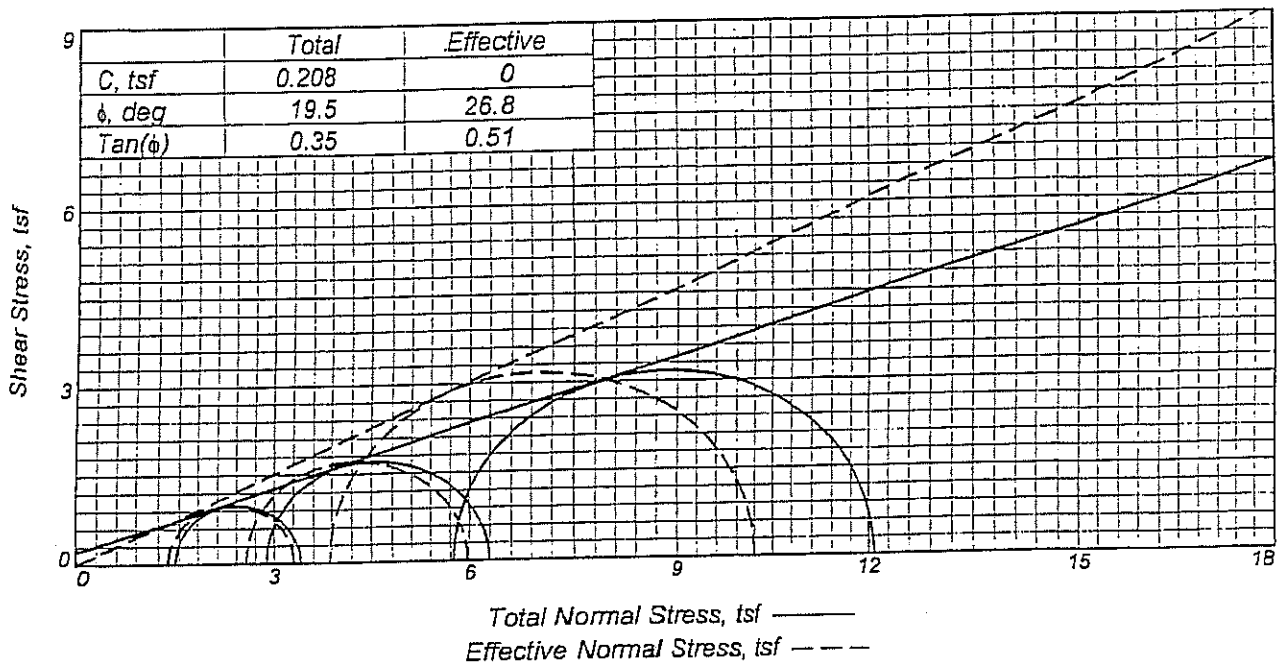
HOLCOMB FOUNDATION ENGINEERING CO.

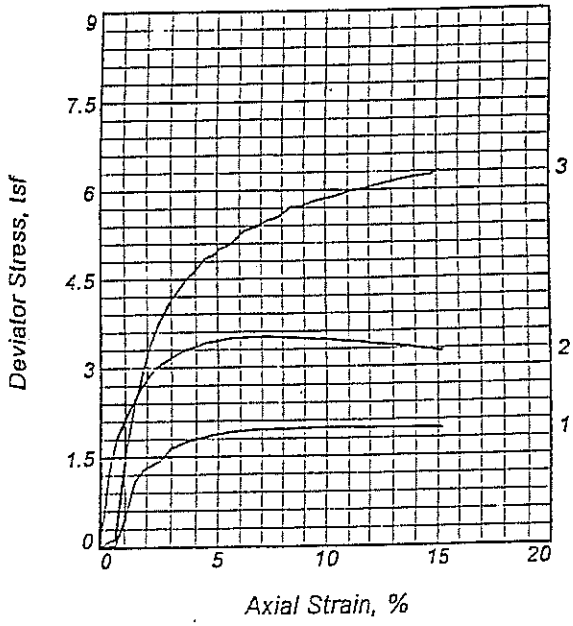
Timothy J. Holcomb, P.E.

REGISTERED PROFESSIONAL ENGINEER
TIMOTHY J.
HOLCOMB
062-042149
2-10-06
ILLINOIS

1 copy: Fred Vass - Alliance Consulting

3 R15735





Sample No.		1	2	3
Initial	Water Content,	21.5	20.8	17.6
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	99.7	98.9
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
At Test	Water Content,	21.5	20.9	17.8
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.6	3.6	2.2
Cell Pressure, tsf		5.0	6.5	7.9
Fail. Stress, tsf		2.0	3.4	6.3
Total Pore Pr., tsf		3.7	3.9	4.1
Ult. Stress, tsf		2.0	3.2	6.3
Total Pore Pr., tsf		3.6	3.8	4.1
$\bar{\sigma}_1$ Failure, tsf		3.3	6.0	10.2
$\bar{\sigma}_3$ Failure, tsf		1.3	2.6	3.9

Type of Test:
CU with Pore Pressures
Sample Type: Shelby Tube - Undisturbed
Description: Gray Mottled Brown Silty CLAY

LL= 41.8 PL= 17.7 PI= 24.1
Assumed Specific Gravity= 2.65
Remarks:

Client: Alliance Consulting

Project: Triaxial Test
Mach Mine #1
Location: Boring #8874
Sample Number: 3 **Depth:** 10.0-12.0'
Proj. No.: H-05278 **Date:** 2-1-05

TRIAXIAL SHEAR TEST REPORT

HOLCOMB FOUNDATION ENGINEERING CO.

Plate _____

Tested By: LC Checked By: TH

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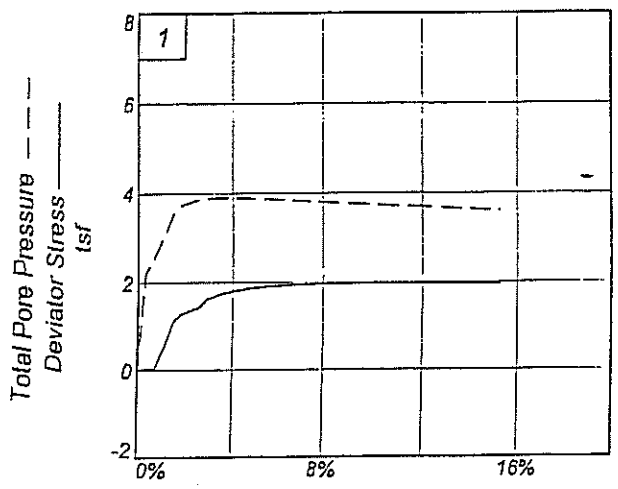
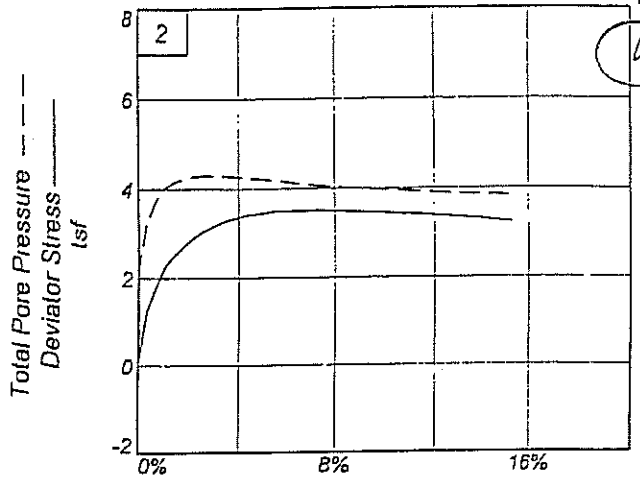
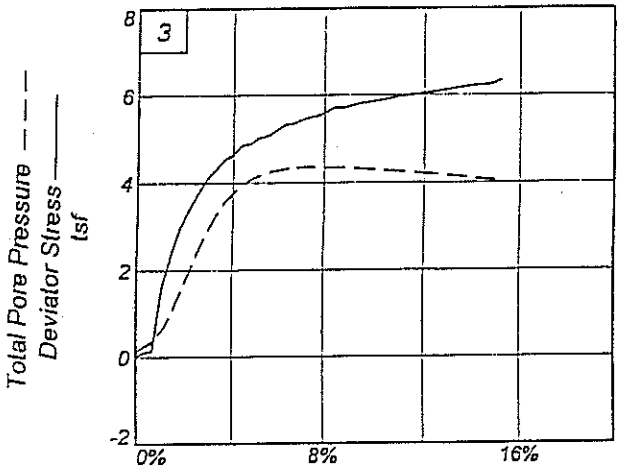
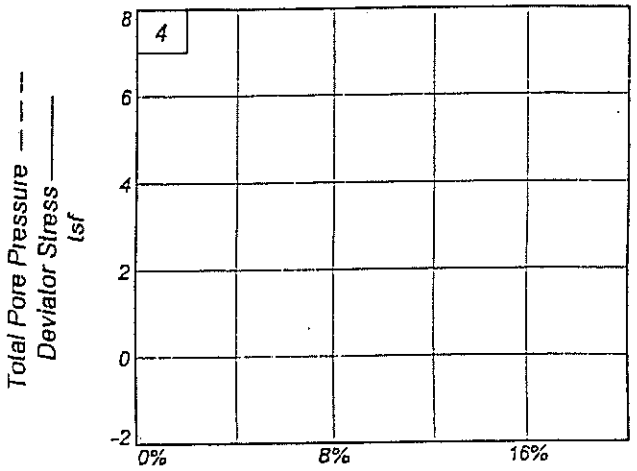
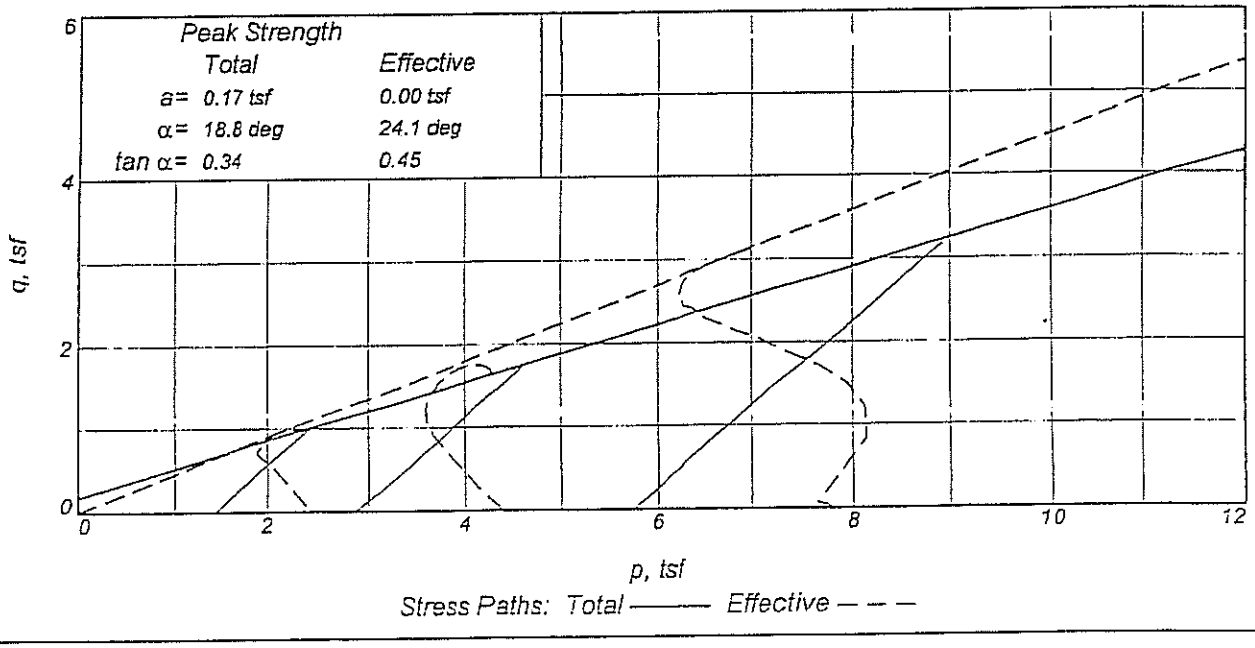










Client: Alliance Consulting
Project: Triaxial Test
Location: Boring #8874
Project No.: H-05278

Depth: 10.0-12.0'
Plate _____

Sample Number: 3

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC

Checked By: TH

R15787

5

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

2/9/2006
8:50 PM

Date:	2-1-05
Client:	Alliance Consulting
Project:	Triaxial Test
	Mach Mine #1
	Johnston City, Illinois
Location:	Boring #8874
Depth:	10.0-12.0'
Sample Number:	3
Description:	Gray Mottled Brown Silty CLAY
Remarks:	
Type of Sample:	Shelby Tube - Undisturbed
Assumed Specific Gravity=2.65	LL=41.8 PL=17.7 PI=24.1
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	189.100			1279.000
Moisture content: Dry soil+tare, gms.	176.100			1072.200
Moisture content: Tare, gms.	115.700			103.200
Moisture, %	21.5	21.5	21.5	21.3
Moist specimen weight, gms.	1140.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.51	5.51	5.51	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.0	128.0	128.0	
Dry density, pcf	105.3	105.3	105.3	
Void ratio	0.5706	0.5706	0.5706	
Saturation, %	100.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.981 tsf at reading no. 24
Ult. Stress = 1.955 tsf at reading no. 30

(6)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	18.30	0.0	0.0	0.000	5.112	5.112	1.00	-1.00	5.112	0.000
1	0.0190	20.00	1.7	0.3	0.014	2.830	2.844	1.00	30.70	2.837	0.007
2	0.0400	21.60	3.3	0.7	0.026	2.426	2.452	1.01	36.30	2.439	0.013
3	0.0810	113.20	94.9	1.5	1.093	1.505	2.598	1.73	49.10	2.051	0.547
4	0.1010	129.80	111.5	1.8	1.280	1.318	2.597	1.97	51.70	1.958	0.640
5	0.1420	143.10	124.8	2.6	1.422	1.181	2.602	2.20	53.60	1.892	0.711
6	0.1620	161.50	143.2	2.9	1.625	1.159	2.784	2.40	53.90	1.972	0.813
7	0.1830	168.90	150.6	3.3	1.702	1.145	2.847	2.49	54.10	1.996	0.851
8	0.2030	174.80	156.5	3.7	1.763	1.138	2.900	2.55	54.20	2.019	0.881
9	0.2240	178.90	160.6	4.1	1.802	1.145	2.946	2.57	54.10	2.046	0.901
10	0.2440	182.30	164.0	4.4	1.833	1.145	2.978	2.60	54.10	2.061	0.916
11	0.2650	186.40	168.1	4.8	1.871	1.152	3.023	2.62	54.00	2.088	0.936
12	0.2850	188.10	169.8	5.2	1.883	1.166	3.049	2.61	53.80	2.108	0.941
13	0.3060	191.40	173.1	5.6	1.912	1.166	3.078	2.64	53.80	2.122	0.956
14	0.3260	193.10	174.8	5.9	1.923	1.181	3.104	2.63	53.60	2.142	0.962
15	0.3460	194.70	176.4	6.3	1.933	1.188	3.121	2.63	53.50	2.155	0.967
16	0.3670	196.40	178.1	6.7	1.944	1.202	3.146	2.62	53.30	2.174	0.972
17	0.3870	198.10	179.8	7.0	1.955	1.210	3.164	2.62	53.20	2.187	0.977
18	0.4080	198.10	179.8	7.4	1.947	1.224	3.171	2.59	53.00	2.197	0.973
19	0.4280	200.60	182.3	7.8	1.966	1.231	3.197	2.60	52.90	2.214	0.983
20	0.4490	200.60	182.3	8.1	1.958	1.238	3.196	2.58	52.80	2.217	0.979
21	0.4890	203.10	184.8	8.9	1.969	1.267	3.236	2.55	52.40	2.252	0.985
22	0.5300	204.70	186.4	9.6	1.970	1.289	3.259	2.53	52.10	2.274	0.985
23	0.5710	207.20	188.9	10.4	1.980	1.310	3.290	2.51	51.80	2.300	0.990
24	0.6120	208.90	190.6	11.1	1.981	1.332	3.313	2.49	51.50	2.323	0.991
25	0.6520	209.10	190.8	11.8	1.967	1.346	3.313	2.46	51.30	2.330	0.983
26	0.6940	211.40	193.1	12.6	1.974	1.361	3.334	2.45	51.10	2.348	0.987
27	0.7350	212.20	193.9	13.3	1.965	1.390	3.354	2.41	50.70	2.372	0.982
28	0.7790	213.90	195.6	14.1	1.964	1.404	3.368	2.40	50.50	2.386	0.982
29	0.8170	215.50	197.2	14.8	1.964	1.426	3.390	2.38	50.20	2.408	0.982
30	0.8380	215.50	197.2	15.2	1.955	1.433	3.388	2.36	50.10	2.410	0.978

(7)

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	154.800			1347.900
Moisture content: Dry soil+tare, gms.	145.800			1154.100
Moisture content: Tare, gms.	102.600			135.100
Moisture, %	20.8	20.9	20.9	19.0
Moist specimen weight, gms.	1142.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.49	5.49	5.49	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.7	128.7	128.7	
Dry density, pcf	106.5	106.5	106.5	
Void ratio	0.5536	0.5536	0.5536	
Saturation, %	99.7	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 3.418 tsf at reading no. 24
Ult. Stress = 3.250 tsf at reading no. 29

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	27.50	0.0	0.0	0.000	4.385	4.385	1.00	29.10	4.385	0.000
1	0.0190	134.00	106.5	0.3	1.241	3.254	4.495	1.38	44.80	3.875	0.620
2	0.0400	183.10	155.6	0.7	1.806	2.750	4.557	1.66	51.80	3.653	0.903
3	0.0600	218.90	191.4	1.1	2.214	2.484	4.698	1.89	55.50	3.591	1.107
4	0.0810	243.80	216.3	1.5	2.492	2.340	4.832	2.06	57.50	3.586	1.246
5	0.1010	264.60	237.1	1.8	2.721	2.254	4.975	2.21	58.70	3.614	1.361
6	0.1220	282.10	254.6	2.2	2.911	2.210	5.121	2.32	59.30	3.666	1.455
7	0.1420	295.40	267.9	2.6	3.052	2.182	5.233	2.40	59.70	3.707	1.526
8	0.1620	305.40	277.9	2.9	3.154	2.182	5.335	2.45	59.70	3.758	1.577
9	0.1830	314.60	287.1	3.3	3.245	2.189	5.434	2.48	59.60	3.811	1.623
10	0.2030	322.10	294.6	3.7	3.317	2.196	5.513	2.51	59.50	3.855	1.659
11	0.2240	327.10	299.6	4.1	3.360	2.218	5.578	2.52	59.20	3.898	1.680
12	0.2440	332.90	305.4	4.4	3.412	2.232	5.644	2.53	59.00	3.938	1.706
13	0.2650	336.20	308.7	4.8	3.435	2.254	5.689	2.52	58.70	3.971	1.718
14	0.2850	339.50	312.0	5.2	3.459	2.275	5.734	2.52	58.40	4.005	1.729
15	0.3060	343.70	316.2	5.6	3.491	2.297	5.788	2.52	58.10	4.042	1.746
16	0.3260	345.40	317.9	5.9	3.497	2.318	5.815	2.51	57.80	4.067	1.748
17	0.3670	348.70	321.2	6.7	3.505	2.369	5.874	2.48	57.10	4.121	1.752
18	0.4080	352.00	324.5	7.4	3.512	2.412	5.924	2.46	56.50	4.168	1.756
19	0.4490	353.70	326.2	8.2	3.502	2.441	5.943	2.43	56.10	4.192	1.751
20	0.4890	354.50	327.0	8.9	3.483	2.470	5.953	2.41	55.70	4.211	1.742
21	0.5300	355.40	327.9	9.7	3.464	2.498	5.963	2.39	55.30	4.230	1.732

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.5510	357.00	329.5	10.0	3.466	2.513	5.979	2.38	55.10	4.246	1.733
23	0.5920	356.20	328.7	10.8	3.429	2.534	5.964	2.35	54.80	4.249	1.715
24	0.6330	357.90	330.4	11.5	3.418	2.556	5.974	2.34	54.50	4.265	1.709
25	0.6730	357.00	329.5	12.3	3.381	2.585	5.966	2.31	54.10	4.275	1.690
26	0.7140	357.90	330.4	13.0	3.361	2.599	5.960	2.29	53.90	4.280	1.681
27	0.7550	357.90	330.4	13.7	3.332	2.614	5.946	2.27	53.70	4.280	1.666
28	0.7960	356.20	328.7	14.5	3.286	2.628	5.914	2.25	53.50	4.271	1.643
29	0.8370	355.40	327.9	15.2	3.250	2.635	5.885	2.23	53.40	4.260	1.625

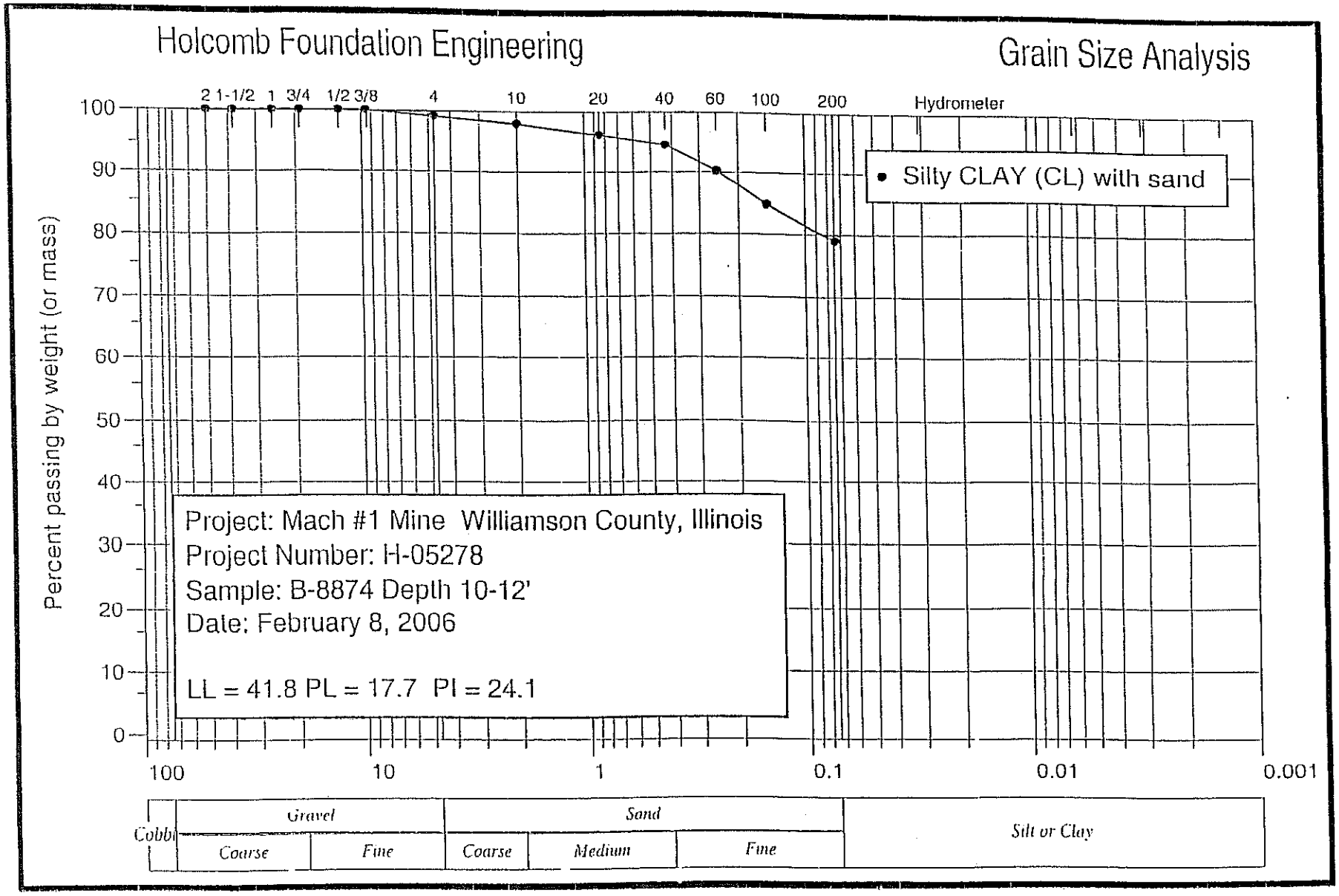
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	248.400			1374.500
Moisture content: Dry soil+tare, gms.	226.700			1195.400
Moisture content: Tare, gms.	103.200			127.700
Moisture, %	17.6	17.8	17.8	16.8
Moist specimen weight, gms.	1184.7			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.54	5.54	5.54	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	132.3	132.5	132.5	
Dry density, pcf	112.5	112.5	112.5	
Void ratio	0.4707	0.4707	0.4707	
Saturation, %	98.9	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 6.334 tsf at reading no. 33
Ult. Stress = 6.334 tsf at reading no. 33

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	31.60	0.0	0.0	0.000	7.812	7.812	1.00	1.50	7.812	0.000
1	0.0190	39.90	8.3	0.3	0.091	7.690	7.781	1.01	3.20	7.735	0.045
2	0.0400	44.10	12.5	0.7	0.133	7.574	7.707	1.02	4.80	7.641	0.066
3	0.0600	175.60	144.0	1.1	1.666	7.308	8.974	1.23	8.50	8.141	0.833
4	0.0810	240.50	208.9	1.5	2.407	6.926	9.333	1.35	13.80	8.130	1.203
5	0.1010	291.30	259.7	1.8	2.981	6.466	9.447	1.46	20.20	7.956	1.491
6	0.1220	329.60	298.0	2.2	3.408	5.983	9.391	1.57	26.90	7.687	1.704
7	0.1420	362.00	330.4	2.6	3.764	5.479	9.244	1.69	33.90	7.361	1.882
8	0.1620	392.00	360.4	2.9	4.091	5.040	9.131	1.81	40.00	7.085	2.045
9	0.1830	412.80	381.2	3.3	4.310	4.666	8.976	1.92	45.20	6.821	2.155

(9)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
10	0.2030	432.80	401.2	3.7	4.519	4.363	8.883	2.04	49.40	6.623	2.260
11	0.2240	446.90	415.3	4.0	4.660	4.140	8.800	2.13	52.50	6.470	2.330
12	0.2440	465.20	433.6	4.4	4.847	3.982	8.828	2.22	54.70	6.405	2.423
13	0.2650	471.00	439.4	4.8	4.892	3.852	8.744	2.27	56.50	6.298	2.446
14	0.2850	483.50	451.9	5.1	5.012	3.766	8.778	2.33	57.70	6.272	2.506
15	0.3060	490.20	458.6	5.5	5.066	3.694	8.760	2.37	58.70	6.227	2.533
16	0.3260	503.50	471.9	5.9	5.193	3.643	8.837	2.43	59.40	6.240	2.597
17	0.3460	516.80	485.2	6.2	5.319	3.607	8.926	2.47	59.90	6.267	2.660
18	0.3670	521.80	490.2	6.6	5.352	3.586	8.938	2.49	60.20	6.262	2.676
19	0.3870	530.10	498.5	7.0	5.422	3.571	8.993	2.52	60.40	6.282	2.711
20	0.4080	538.40	506.8	7.4	5.490	3.564	9.054	2.54	60.50	6.309	2.745
21	0.4280	543.40	511.8	7.7	5.522	3.564	9.086	2.55	60.50	6.325	2.761
22	0.4490	554.30	522.7	8.1	5.617	3.571	9.188	2.57	60.40	6.380	2.808
23	0.4690	565.90	534.3	8.5	5.719	3.578	9.297	2.60	60.30	6.438	2.859
24	0.4890	567.60	536.0	8.8	5.714	3.578	9.293	2.60	60.30	6.436	2.857
25	0.5300	581.70	550.1	9.6	5.817	3.600	9.417	2.62	60.00	6.509	2.909
26	0.5710	591.70	560.1	10.3	5.874	3.636	9.510	2.62	59.50	6.573	2.937
27	0.6120	605.00	573.4	11.0	5.964	3.665	9.629	2.63	59.10	6.647	2.982
28	0.6530	615.00	583.4	11.8	6.018	3.701	9.719	2.63	58.60	6.710	3.009
29	0.6940	626.70	595.1	12.5	6.087	3.737	9.824	2.63	58.10	6.780	3.044
30	0.7350	638.30	606.7	13.3	6.153	3.773	9.926	2.63	57.60	6.849	3.077
31	0.7760	649.10	617.5	14.0	6.209	3.816	10.025	2.63	57.00	6.921	3.105
32	0.8170	657.50	625.9	14.7	6.240	3.852	10.092	2.62	56.50	6.972	3.120
33	0.8390	669.90	638.3	15.1	6.334	3.866	10.200	2.64	56.30	7.033	3.167


Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
Silty CLAY (CL) with sand
Project: Mach #1 Mine Williamson County, Illinois
Project Number: H-05278
Sample: B-8874 Depth 10-12'
Date: February 8, 2006
LL = 41.8 PL = 17.7 PI = 24.1
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

Holcomb Foundation Engineering Company

Laboratory Testing Results

2/8/2006

Project: Mach #1 Mine

Project No: H-05278

Sieve Analysis - ASTM C136-96a

Sample: Silty CLAY (CL)

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
1.5000	38.1000	1 -1/2"	0.0	0.0	100.0
1.0000	25.4000	1"	0.0	0.0	100.0
0.7500	19.1000	3/4"	0.0	0.0	100.0
0.5000	12.7000	1/2"	0.0	0.0	100.0
3.7500	9.5200	3/8"	0.0	0.0	100.0
0.1870	4.7600	No. 4	2.1	0.9	99.1
0.0790	2.0000	No. 10	4.6	2.0	98.0
0.0469	1.1800	No. 16	4.6	2.0	98.0
0.0331	0.8500	No. 20	8.6	3.8	96.2
0.0165	0.4200	No. 40	12.6	5.5	94.5
0.0117	0.2980	No. 50	12.6	5.5	94.5
0.0083	0.2500	No. 60	22.2	9.8	90.2
0.0059	0.1490	No. 100	34.6	15.2	84.8
0.0029	0.0740	No. 200	47.7	21.0	79.0

Total Weight in Grams 227.20

Holcomb Foundation Engineering Company

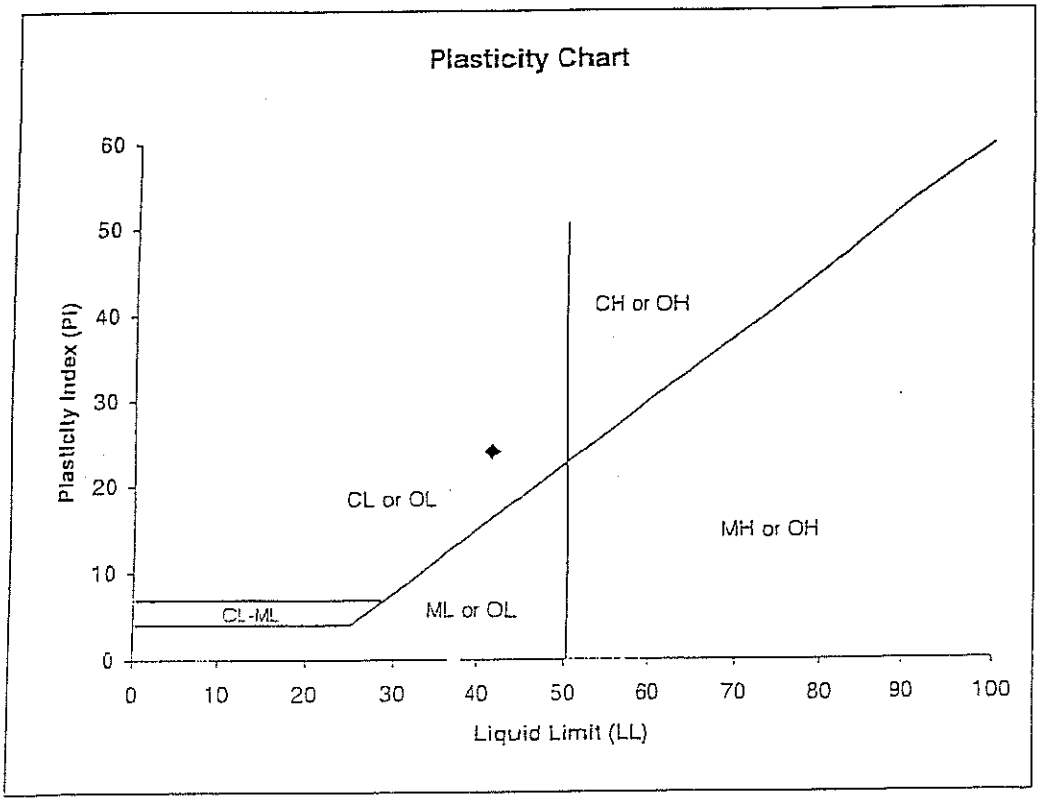
Laboratory Testing Results

Project: Mach #1 Mine
Project No: H-05278

Sample	1	2	3
Dish Number	LL_1	LL_2	LL_3
Mass of can, W_1 (g)	34.70		
Mass of can + moist soil, W_2 (g)	62.84		
Mass of can + dry soil, W_3 (g)	54.52		
Moisture content, w (%)	41.98		
Number of blows, N	24		
Liquid Limit, LL	41.8		

Dish Number	PL_1
Mass of can, W_1 (g)	39.76
Mass of can + moist soil, W_2 (g)	54.79
Mass of can + dry soil, W_3 (g)	52.53
Plastic Limit, PL	17.7

PI = 24.1



HOLCOMB FOUNDATION ENGINEERING CO., INC.

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November 30, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Pond Creek Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on November 17, 2006, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification: Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)

Proctor Test Results:
Maximum Dry Unit Weight: 124.6 PCF
Optimum Moisture Content: 9.3 %

Specific Gravity: 2.37

Triaxial Test Results:
Effective Cohesion: 0 PSF
Effective Phi Angle: 33.7 Degrees

Permeability: 2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

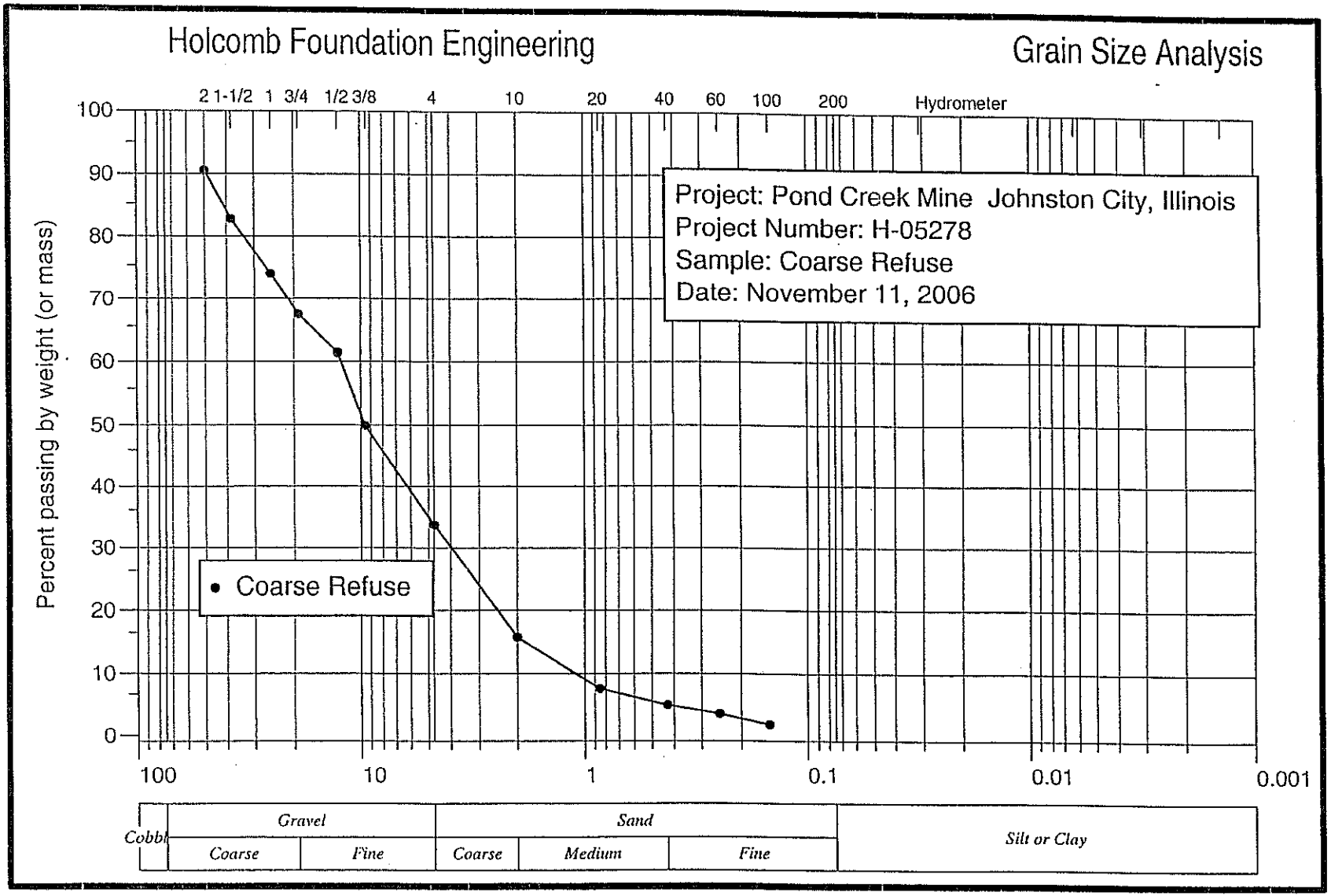
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting


Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Project: Pond Creek Mine Johnston City, Illinois
Project Number: H-05278
Sample: Coarse Refuse
Date: November 11, 2006
Coarse Refuse
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

21 of 57

R 5/95

Holcomb Foundation Engineering Company

Laboratory Testing Results 11/30/2006

Project: Coarse Refuse Disposal Area
Pond Creek Mine Johnston City, Illinois

Project No: H-05317

Sieve Analysis - ASTM C136-96a

Sample: Coarse Refuse

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
3	76.2	3"	0.0	0.0	100.0
2.0000	50.8100	2"	619.6	9.5	90.5
1.5000	38.1000	1 -1/2"	1124.0	17.2	82.8
1.0000	25.4000	1"	1696.2	25.9	74.1
0.7500	19.1000	3/4"	2110.9	32.3	67.7
0.5000	12.7000	1/2"	2513.0	38.4	61.6
3.7500	9.5200	3/8"	3263.7	49.9	50.1
0.1870	4.7600	No. 4	4310.7	65.9	34.1
0.0790	2.0000	No. 10	5470.5	83.6	16.4
0.0469	1.1800	No. 16			
0.0331	0.8500	No. 20	6004.4	91.8	8.2
0.0165	0.4200	No. 40	6178.9	94.4	5.6
0.0117	0.2980	No. 50			
0.0083	0.2500	No. 60	6267.8	95.8	4.2
0.0059	0.1490	No. 100			
0.0029	0.0740	No. 200	6372.4	97.4	2.6

Total Weight in Grams **6542.80**

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

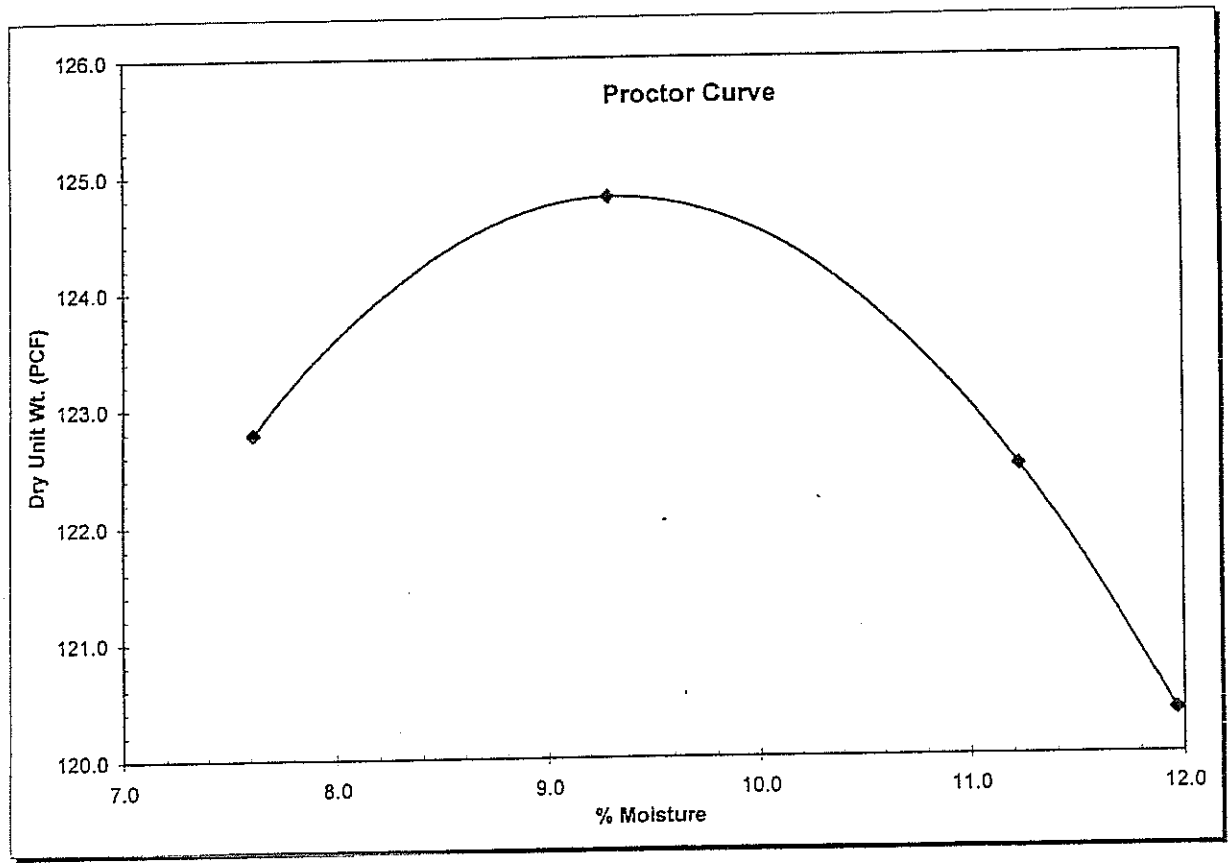
Date: 11/30/2006

Proctor Test Results

Soil Classification:	**Gray Coarse Refuse**
Maximum Dry Density (PCF)	**124.8**
Optimum Moisture Content (%)	**9.3**

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
7.6	122.8
11.2	122.5
12.0	120.4
9.3	124.8



HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

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Permeability Tests Results

Laboratory Tests
Coarse Refuse
Pond Creek Mine - Johnston City, Illinois

Date: 11/30/2006

Client: Pond Creek Mine
Johnston City, Illinois

Project No.: H-05278

Sample	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse		7.7	11.8	119.3	2 x 10-4

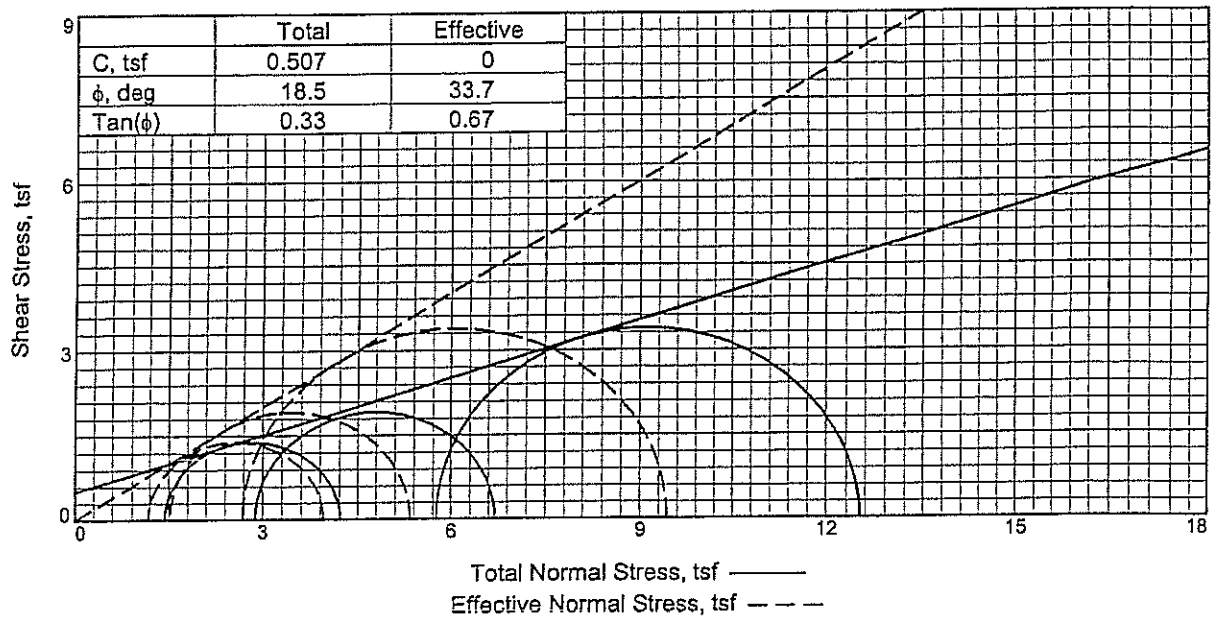
Permeability Tests performed in accordance with ASTM D-5084

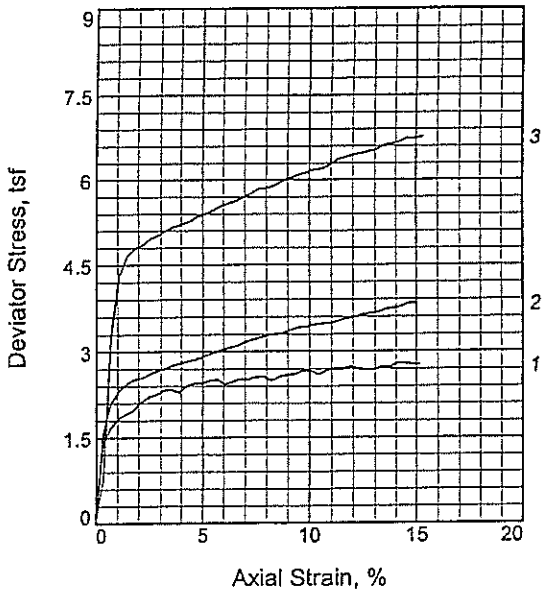
PERMEABILITY TEST RESULTS

Project	Pond Creek Mine	Boring/Sample Depth	Coarse Refuse
Project #	H-05278	Classification	
Date	11/30/2006	Diameter	2.8 Inch
		Length	5.6 Inch

In Place Mc		After Test Mc		Unit Weight (PCF)	
Wet Wt.	195.3	Wet Wt.	1300.4	Sample Wt.	1161.8
Pan	94.2	Pan	103.1		
Dry Wt.	188.1	Dry Wt.	1173.6	Wet UW=	128.5
Mc (%)	7.7	Mc (%)	11.8	Dry UW=	119.3

Time(hrs)	Time(min)	Quantity (cc)	Head (psi)	Permeability (cm/sec)
7	26	24.7		
7	34	8.2	1	1.75E-04
7	33	24.5		
7	45	2.7	1	1.54E-04
7	47	0.8	1	1.44E-04
9	16	24.4		
9	23	9.6	1	1.79E-04
9	30	0.9	1	1.43E-04
			Average Permeability	1.63E-04





Sample No.		1	2	3
Initial	Water Content,	10.1	10.8	10.3
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	97.0	99.8	99.3
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
At Test	Water Content,	10.4	10.8	10.4
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
Strain rate, in./min.		0.01	0.01	0.01
Back Pressure, tsf		3.60	3.60	2.16
Cell Pressure, tsf		5.04	6.48	7.92
Fail. Stress, tsf		2.78	3.83	6.76
Total Pore Pr., tsf		3.86	4.96	5.23
Ult. Stress, tsf		2.77	3.83	6.76
Total Pore Pr., tsf		3.85	4.95	5.23
$\bar{\sigma}_1$ Failure, tsf		3.96	5.35	9.44
$\bar{\sigma}_3$ Failure, tsf		1.18	1.52	2.69

Type of Test:
CU with Pore Pressures
Sample Type: Remolded
Description: Coarse Coal Refuse

Assumed Specific Gravity= 2.37
Remarks:

Plate _____

Client: Pond Creek Mine

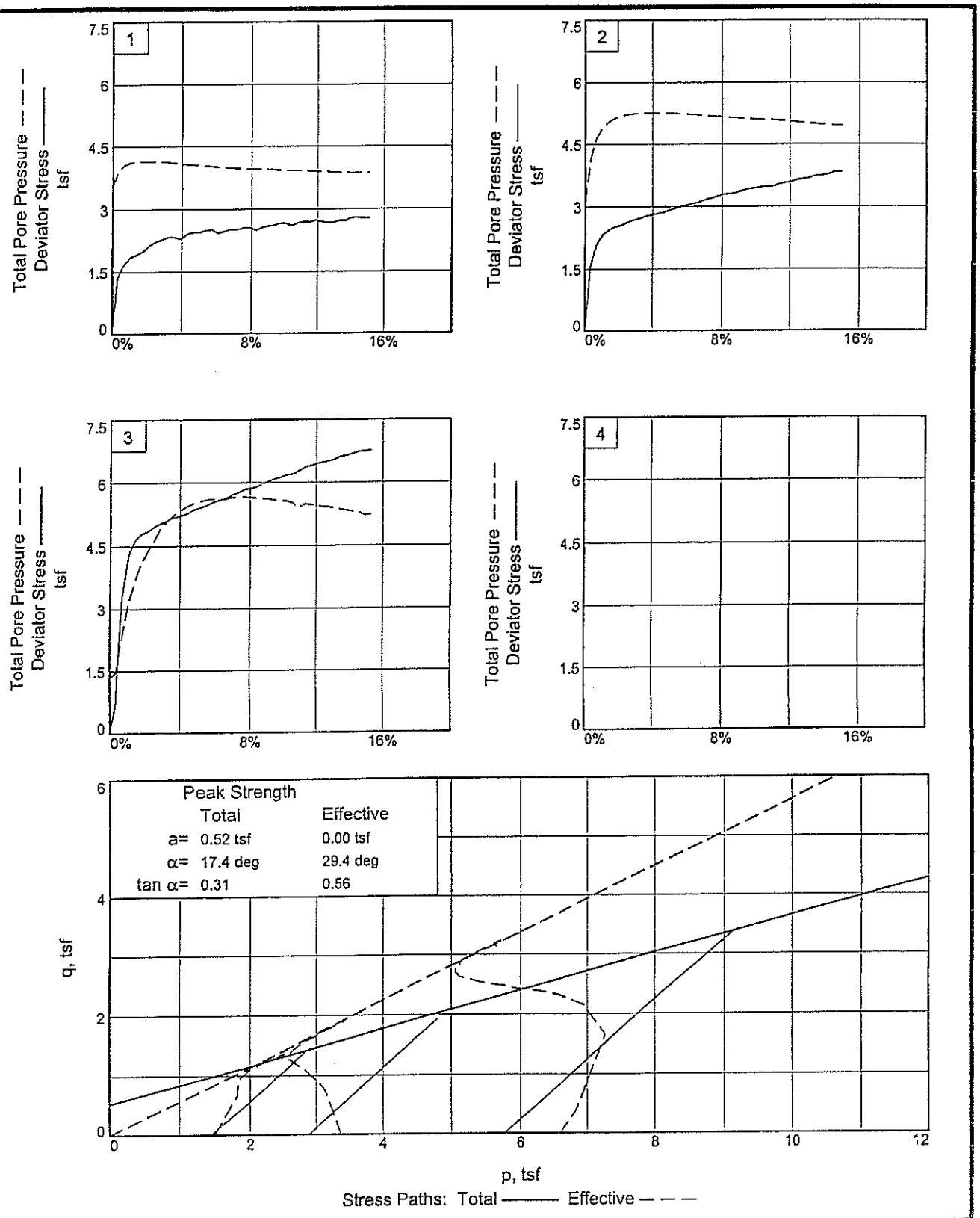
Project: Coarse Refuse Laboratory Tests

Location: Coarse Refuse Stockpile
Sample Number: Coarse Refuse
Proj. No.: H-05278 **Date:** 11/17/06

TRIAXIAL SHEAR TEST REPORT

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH



Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Coarse Refuse Stockpile
Project No.: H-05278
Sample Number: Coarse Refuse
Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC **Checked By:** TH

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

11/30/2006
10:19 AM

Date: 11/17/06
Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Coarse Refuse Stockpile
Sample Number: Coarse Refuse
Description: Coarse Coal Refuse
Remarks:
Type of Sample: Remolded
Assumed Specific Gravity=2.37 **LL=** **PL=** **PI=**
Test Method: COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	226.800			1320.700
Moisture content: Dry soil+tare, gms.	218.600			1195.800
Moisture content: Tare, gms.	137.500			107.600
Moisture, %	10.1	10.4	10.4	11.5
Moist specimen weight, gms.	1193.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.65	5.65	5.65	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.6	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2470	0.2470	0.2470	
Saturation, %	97.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 2.778 tsf at reading no. 41
Ult. Stress = 2.767 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0010	46.60	0.0	0.0	0.000	1.498	1.498	1.00	49.20	1.498	0.000
1	0.0180	160.60	114.0	0.3	1.329	1.152	2.481	2.15	54.00	1.816	0.664
2	0.0390	189.70	143.1	0.7	1.662	1.001	2.663	2.66	56.10	1.832	0.831
3	0.0590	205.60	159.0	1.0	1.840	0.929	2.769	2.98	57.10	1.849	0.920
4	0.0800	212.20	165.6	1.4	1.909	0.907	2.816	3.10	57.40	1.862	0.955
5	0.1000	218.90	172.3	1.8	1.979	0.900	2.879	3.20	57.50	1.890	0.990
6	0.1200	232.20	185.6	2.1	2.125	0.900	3.025	3.36	57.50	1.962	1.062
7	0.1410	240.50	193.9	2.5	2.211	0.907	3.118	3.44	57.40	2.013	1.106
8	0.1610	245.50	198.9	2.8	2.260	0.914	3.174	3.47	57.30	2.044	1.130
9	0.1820	252.20	205.6	3.2	2.327	0.922	3.249	3.53	57.20	2.085	1.164
10	0.2020	253.80	207.2	3.6	2.337	0.936	3.273	3.50	57.00	2.104	1.168
11	0.2230	250.50	203.9	3.9	2.291	0.958	3.248	3.39	56.70	2.103	1.145
12	0.2430	261.30	214.7	4.3	2.403	0.972	3.375	3.47	56.50	2.173	1.201
13	0.2630	266.30	219.7	4.6	2.450	0.979	3.429	3.50	56.40	2.204	1.225
14	0.2840	266.30	219.7	5.0	2.440	0.994	3.434	3.46	56.20	2.214	1.220
15	0.3040	272.10	225.5	5.4	2.495	1.008	3.503	3.48	56.00	2.256	1.248
16	0.3250	274.60	228.0	5.7	2.513	1.022	3.536	3.46	55.80	2.279	1.257
17	0.3450	268.00	221.4	6.1	2.431	1.037	3.468	3.34	55.60	2.252	1.216
18	0.3660	273.00	226.4	6.5	2.476	1.051	3.527	3.36	55.40	2.289	1.238
19	0.3860	278.00	231.4	6.8	2.521	1.058	3.580	3.38	55.30	2.319	1.261
20	0.4070	278.00	231.4	7.2	2.511	1.066	3.577	3.36	55.20	2.321	1.256
21	0.4270	283.00	236.4	7.5	2.556	1.073	3.629	3.38	55.10	2.351	1.278
22	0.4470	284.60	238.0	7.9	2.563	1.080	3.643	3.37	55.00	2.362	1.282
23	0.4680	278.80	232.2	8.3	2.491	1.087	3.578	3.29	54.90	2.333	1.245
24	0.4880	286.30	239.7	8.6	2.561	1.087	3.648	3.36	54.90	2.368	1.281
25	0.5090	290.40	243.8	9.0	2.594	1.094	3.689	3.37	54.80	2.392	1.297
26	0.5290	292.10	245.5	9.3	2.602	1.102	3.704	3.36	54.70	2.403	1.301
27	0.5500	298.80	252.2	9.7	2.662	1.109	3.771	3.40	54.60	2.440	1.331
28	0.5700	299.60	253.0	10.1	2.660	1.116	3.776	3.38	54.50	2.446	1.330
29	0.5910	294.60	248.0	10.4	2.597	1.116	3.713	3.33	54.50	2.415	1.299
30	0.6110	302.10	255.5	10.8	2.665	1.123	3.788	3.37	54.40	2.456	1.333
31	0.6310	306.30	259.7	11.2	2.698	1.130	3.828	3.39	54.30	2.479	1.349
32	0.6520	306.30	259.7	11.5	2.687	1.130	3.817	3.38	54.30	2.474	1.343
33	0.6720	312.10	265.5	11.9	2.736	1.145	3.881	3.39	54.10	2.513	1.368
34	0.6930	309.60	263.0	12.2	2.699	1.145	3.843	3.36	54.10	2.494	1.349
35	0.7130	308.80	262.2	12.6	2.680	1.152	3.832	3.33	54.00	2.492	1.340
36	0.7340	309.60	263.0	13.0	2.676	1.159	3.835	3.31	53.90	2.497	1.338
37	0.7540	315.40	268.8	13.3	2.724	1.166	3.891	3.34	53.80	2.528	1.362
38	0.7750	316.20	269.6	13.7	2.721	1.166	3.887	3.33	53.80	2.527	1.360
39	0.7950	323.70	277.1	14.1	2.785	1.181	3.966	3.36	53.60	2.573	1.392
40	0.8150	325.40	278.8	14.4	2.790	1.181	3.971	3.36	53.60	2.576	1.395
41	0.8360	325.40	278.8	14.8	2.778	1.181	3.959	3.35	53.60	2.570	1.389
42	0.8560	325.40	278.8	15.1	2.767	1.188	3.955	3.33	53.50	2.571	1.383

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	211.600			1335.900
Moisture content: Dry soil+tare, gms.	203.200			1222.200
Moisture content: Tare, gms.	125.200			134.800
Moisture, %	10.8	10.8	10.8	10.5
Moist specimen weight, gms.	1175.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.57	5.57	5.57	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.5	130.5	130.5	
Dry density, pcf	117.8	117.8	117.8	
Void ratio	0.2558	0.2558	0.2558	
Saturation, %	99.8	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 3.829 tsf at reading no. 40
Ult. Stress = 3.828 tsf at reading no. 41

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	51.60	0.0	0.0	0.000	3.377	3.377	1.00	43.10	3.377	0.000
1	0.0190	185.60	134.0	0.3	1.562	2.340	3.902	1.67	57.50	3.121	0.781
2	0.0400	233.00	181.4	0.7	2.106	1.814	3.920	2.16	64.80	2.867	1.053
3	0.0600	253.00	201.4	1.1	2.330	1.562	3.892	2.49	68.30	2.727	1.165
4	0.0810	263.80	212.2	1.5	2.445	1.433	3.878	2.71	70.10	2.655	1.223
5	0.1010	270.50	218.9	1.8	2.513	1.346	3.860	2.87	71.30	2.603	1.257
6	0.1220	274.60	223.0	2.2	2.550	1.289	3.839	2.98	72.10	2.564	1.275
7	0.1420	281.30	229.7	2.5	2.617	1.260	3.877	3.08	72.50	2.569	1.309
8	0.1620	287.10	235.5	2.9	2.674	1.238	3.912	3.16	72.80	2.575	1.337
9	0.1830	291.30	239.7	3.3	2.711	1.231	3.942	3.20	72.90	2.587	1.355
10	0.2030	297.10	245.5	3.6	2.766	1.224	3.990	3.26	73.00	2.607	1.383
11	0.2240	301.30	249.7	4.0	2.802	1.224	4.026	3.29	73.00	2.625	1.401
12	0.2440	305.40	253.8	4.4	2.838	1.224	4.062	3.32	73.00	2.643	1.419
13	0.2650	309.60	258.0	4.8	2.873	1.224	4.097	3.35	73.00	2.661	1.437
14	0.2850	315.40	263.8	5.1	2.927	1.231	4.158	3.38	72.90	2.695	1.463
15	0.3060	320.40	268.8	5.5	2.970	1.238	4.209	3.40	72.80	2.724	1.485
16	0.3260	326.20	274.6	5.9	3.023	1.246	4.269	3.43	72.70	2.757	1.512
17	0.3460	330.40	278.8	6.2	3.058	1.253	4.310	3.44	72.60	2.782	1.529
18	0.3670	334.60	283.0	6.6	3.091	1.267	4.358	3.44	72.40	2.813	1.546
19	0.3870	341.20	289.6	6.9	3.151	1.282	4.433	3.46	72.20	2.857	1.576
20	0.4080	346.20	294.6	7.3	3.192	1.296	4.488	3.46	72.00	2.892	1.596
21	0.4280	351.20	299.6	7.7	3.234	1.310	4.544	3.47	71.80	2.927	1.617

No.	Def. Dial In.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	357.00	305.4	8.1	3.283	1.318	4.601	3.49	71.70	2.959	1.642
23	0.4690	359.50	307.9	8.4	3.297	1.332	4.629	3.48	71.50	2.981	1.649
24	0.4890	362.80	311.2	8.8	3.319	1.339	4.659	3.48	71.40	2.999	1.660
25	0.5100	368.70	317.1	9.2	3.368	1.346	4.715	3.50	71.30	3.031	1.684
26	0.5300	374.50	322.9	9.5	3.416	1.361	4.777	3.51	71.10	3.069	1.708
27	0.5510	377.00	325.4	9.9	3.429	1.368	4.797	3.51	71.00	3.082	1.714
28	0.5710	381.20	329.6	10.2	3.459	1.368	4.827	3.53	71.00	3.098	1.730
29	0.5920	384.50	332.9	10.6	3.479	1.382	4.861	3.52	70.80	3.122	1.739
30	0.6120	386.20	334.6	11.0	3.483	1.390	4.872	3.51	70.70	3.131	1.741
31	0.6330	392.00	340.4	11.4	3.528	1.397	4.925	3.53	70.60	3.161	1.764
32	0.6530	397.00	345.4	11.7	3.565	1.411	4.977	3.53	70.40	3.194	1.783
33	0.6730	400.30	348.7	12.1	3.585	1.426	5.010	3.51	70.20	3.218	1.792
34	0.6940	406.10	354.5	12.5	3.629	1.440	5.069	3.52	70.00	3.254	1.814
35	0.7140	410.30	358.7	12.8	3.657	1.454	5.111	3.51	69.80	3.283	1.828
36	0.7350	413.60	362.0	13.2	3.674	1.469	5.143	3.50	69.60	3.306	1.837
37	0.7550	420.30	368.7	13.6	3.727	1.483	5.210	3.51	69.40	3.347	1.863
38	0.7760	423.60	372.0	13.9	3.744	1.498	5.242	3.50	69.20	3.370	1.872
39	0.7960	427.80	376.2	14.3	3.770	1.505	5.275	3.51	69.10	3.390	1.885
40	0.8170	435.30	383.7	14.7	3.829	1.519	5.348	3.52	68.90	3.434	1.914
41	0.8370	436.90	385.3	15.0	3.828	1.526	5.355	3.51	68.80	3.441	1.914

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	184.300			1333.800
Moisture content: Dry soil+tare, gms.	177.100			1230.400
Moisture content: Tare, gms.	107.500			135.300
Moisture, %	10.3	10.4	10.4	9.4
Moist specimen weight, gms.	1185.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.60	5.60	5.60	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.9	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2468	0.2468	0.2468	
Saturation, %	99.3	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 6.758 tsf at reading no. 42
Ult. Stress = 6.758 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	25.00	0.0	0.0	0.000	6.588	6.588	1.00	18.50	6.588	0.000
1	0.0190	88.20	63.2	0.3	0.736	6.458	7.195	1.11	20.30	6.827	0.368
2	0.0400	309.60	284.6	0.7	3.304	5.623	8.927	1.59	31.90	7.275	1.652
3	0.0600	397.00	372.0	1.1	4.303	4.795	9.098	1.90	43.40	6.947	2.152
4	0.0810	428.60	403.6	1.4	4.651	4.234	8.885	2.10	51.20	6.559	2.326
5	0.1010	441.90	416.9	1.8	4.787	3.830	8.617	2.25	56.80	6.224	2.393
6	0.1220	449.40	424.4	2.2	4.854	3.521	8.375	2.38	61.10	5.948	2.427
7	0.1420	460.20	435.2	2.5	4.960	3.283	8.243	2.51	64.40	5.763	2.480
8	0.1620	467.70	442.7	2.9	5.027	3.017	8.044	2.67	68.10	5.530	2.513
9	0.1830	476.00	451.0	3.3	5.101	2.837	7.938	2.80	70.60	5.387	2.551
10	0.2030	483.50	458.5	3.6	5.167	2.693	7.860	2.92	72.60	5.276	2.583
11	0.2240	489.30	464.3	4.0	5.212	2.585	7.797	3.02	74.10	5.191	2.606
12	0.2440	495.20	470.2	4.4	5.258	2.491	7.750	3.11	75.40	5.120	2.629
13	0.2650	505.20	480.2	4.7	5.349	2.419	7.768	3.21	76.40	5.094	2.675
14	0.2850	511.00	486.0	5.1	5.394	2.369	7.762	3.28	77.10	5.066	2.697
15	0.3060	518.50	493.5	5.5	5.455	2.333	7.788	3.34	77.60	5.060	2.728
16	0.3260	526.80	501.8	5.8	5.526	2.304	7.830	3.40	78.00	5.067	2.763
17	0.3460	533.50	508.5	6.2	5.579	2.297	7.875	3.43	78.10	5.086	2.789
18	0.3670	539.30	514.3	6.6	5.620	2.326	7.945	3.42	77.70	5.135	2.810
19	0.3870	548.40	523.4	6.9	5.697	2.275	7.972	3.50	78.40	5.124	2.849
20	0.4080	555.90	530.9	7.3	5.756	2.261	8.016	3.55	78.60	5.139	2.878
21	0.4280	565.90	540.9	7.6	5.841	2.261	8.102	3.58	78.60	5.181	2.921

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	569.20	544.2	8.0	5.853	2.268	8.121	3.58	78.50	5.195	2.927
23	0.4690	575.10	550.1	8.4	5.894	2.282	8.176	3.58	78.30	5.229	2.947
24	0.4890	584.20	559.2	8.7	5.968	2.297	8.265	3.60	78.10	5.281	2.984
25	0.5100	592.50	567.5	9.1	6.031	2.311	8.343	3.61	77.90	5.327	3.016
26	0.5300	599.20	574.2	9.5	6.079	2.333	8.411	3.61	77.60	5.372	3.039
27	0.5510	605.90	580.9	9.8	6.124	2.354	8.479	3.60	77.30	5.416	3.062
28	0.5710	613.30	588.3	10.2	6.178	2.362	8.539	3.62	77.20	5.450	3.089
29	0.5920	617.50	592.5	10.6	6.196	2.405	8.601	3.58	76.60	5.503	3.098
30	0.6120	626.70	601.7	10.9	6.267	2.527	8.794	3.48	74.90	5.661	3.133
31	0.6330	638.30	613.3	11.3	6.361	2.426	8.787	3.62	76.30	5.607	3.180
32	0.6530	644.10	619.1	11.7	6.395	2.448	8.843	3.61	76.00	5.646	3.198
33	0.6730	650.80	625.8	12.0	6.438	2.477	8.915	3.60	75.60	5.696	3.219
34	0.6940	656.60	631.6	12.4	6.470	2.498	8.968	3.59	75.30	5.733	3.235
35	0.7140	662.50	637.5	12.8	6.504	2.506	9.009	3.60	75.20	5.758	3.252
36	0.7350	669.10	644.1	13.1	6.543	2.542	9.085	3.57	74.70	5.813	3.271
37	0.7550	678.30	653.3	13.5	6.609	2.563	9.172	3.58	74.40	5.868	3.305
38	0.7760	684.10	659.1	13.9	6.639	2.585	9.224	3.57	74.10	5.904	3.319
39	0.7960	690.70	665.7	14.2	6.678	2.614	9.291	3.55	73.70	5.952	3.339
40	0.8170	699.10	674.1	14.6	6.732	2.635	9.367	3.55	73.40	6.001	3.366
41	0.8370	701.60	676.6	14.9	6.729	2.700	9.429	3.49	72.50	6.065	3.365
42	0.8570	707.40	682.4	15.3	6.758	2.686	9.444	3.52	72.70	6.065	3.379

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

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Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

April 9, 2007

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Mach Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on March 29, 2007, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification:	Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)
Proctor Test Results:	
Maximum Dry Unit Weight:	120.3 PCF
Optimum Moisture Content:	10.7 %
Specific Gravity:	2.50
Triaxial Test Results:	
Effective Cohesion:	152 PSF
Effective Phi Angle:	29.3 Degrees
Permeability (2 tests):	3 x 10-4 cm./sec.
	2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

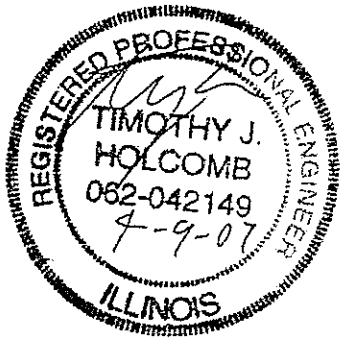
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting



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Permeability Tests Results

Mach Mine
Johnston City, Illinois

Date: 4/9/2007 Client: Williamson Energy

Project No.: H-05278

Boring No.	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse Sample #1		10.9	14.6	115.7	3 x 10-4
Coarse Refuse Sample #2		10.1	14.3	114.7	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

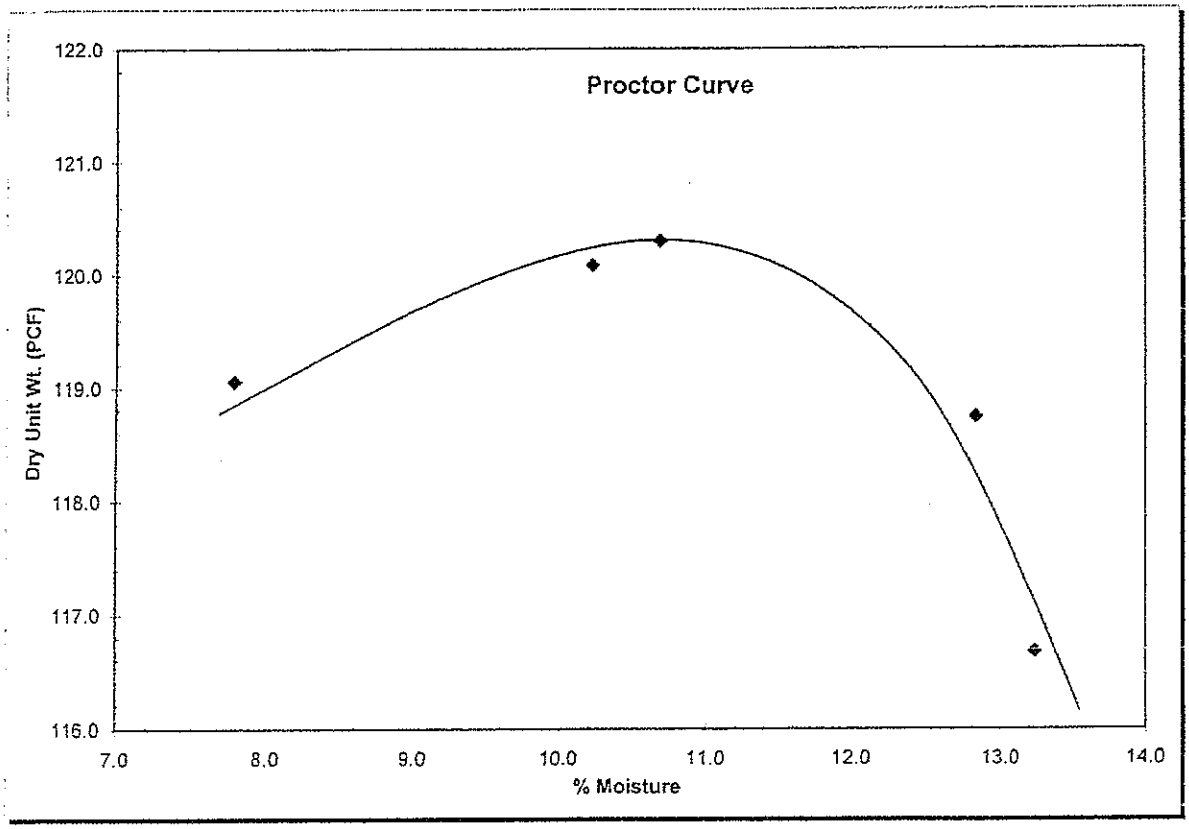
Date: 4/9/2007

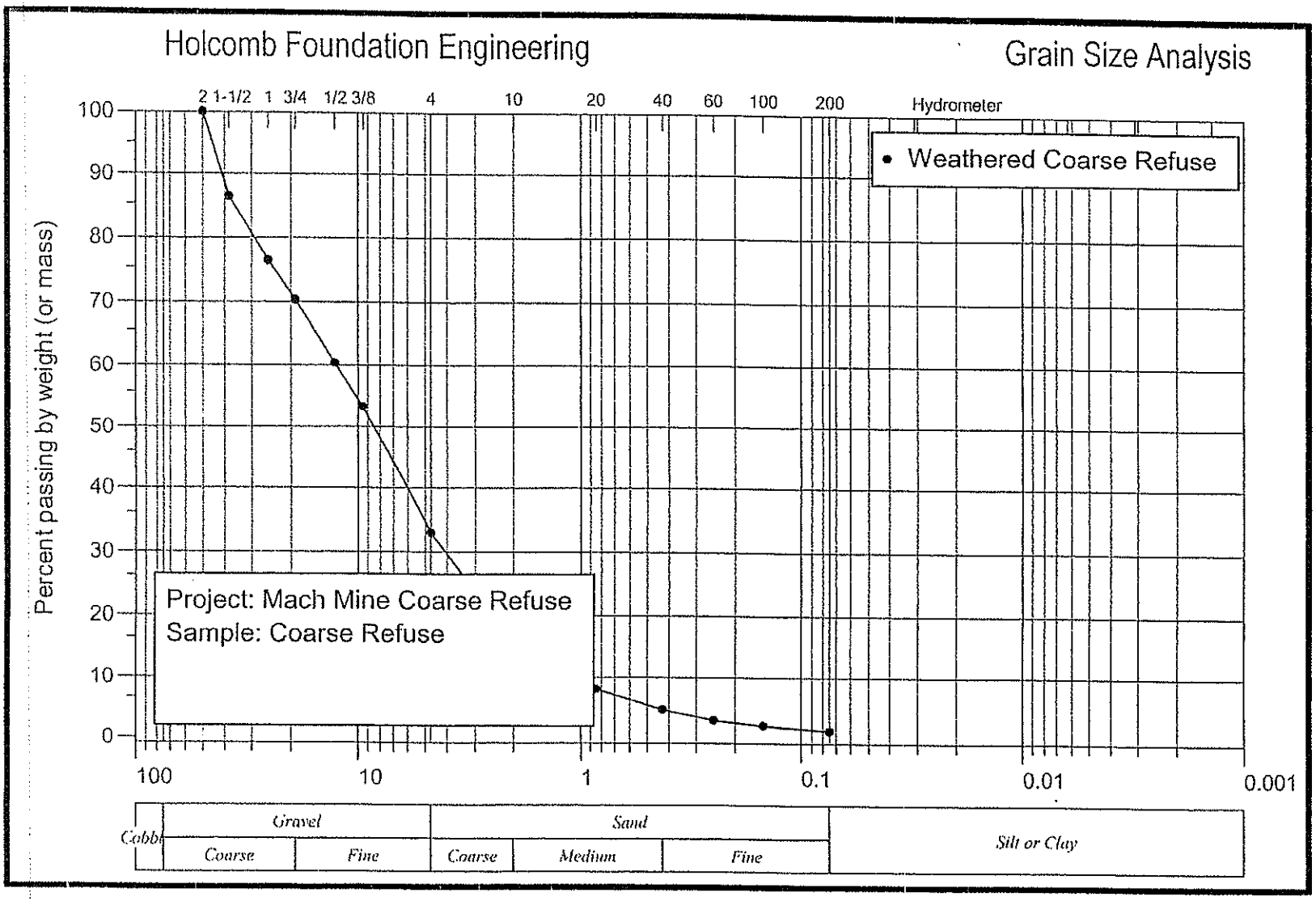
Proctor Test Results

Soil Classification:	**Weathered Coarse Refuse**
Maximum Dry Density (PCF)	**120.3**
Optimum Moisture Content (%)	**10.7**

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
12.8	118.7
13.2	116.7
10.2	120.1
7.8	119.1
10.7	120.3




Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
Weathered Coarse Refuse
Project: Mach Mine Coarse Refuse
Sample: Coarse Refuse
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

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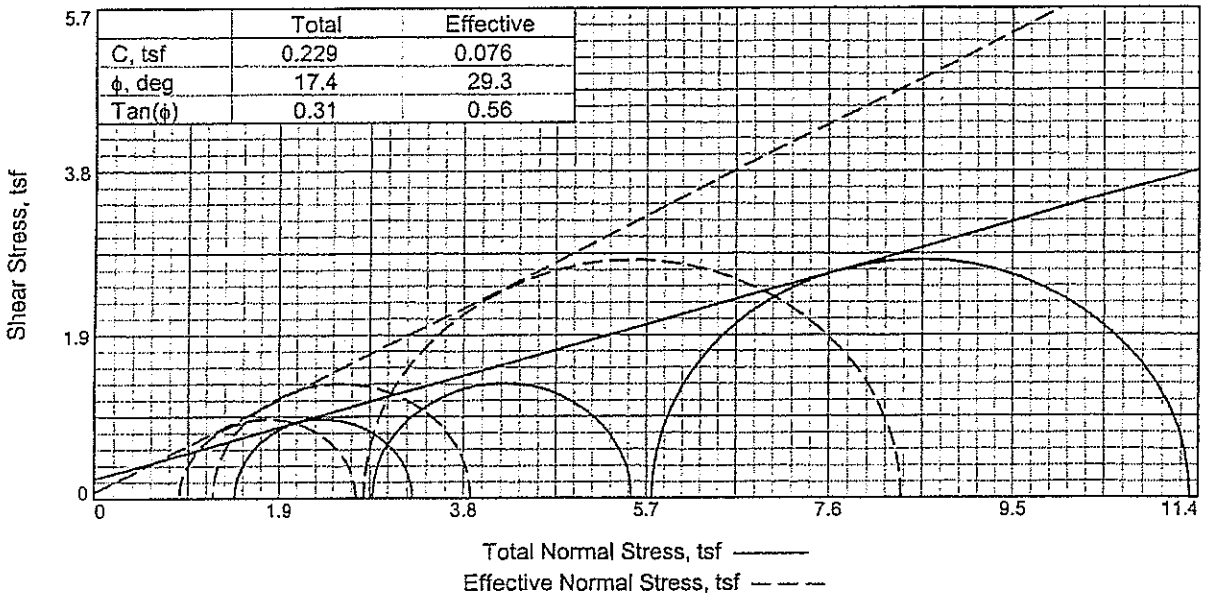
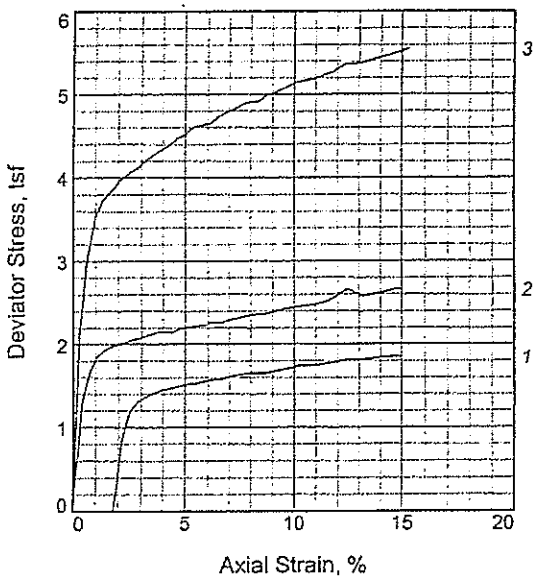
Grain Size Analysis

Project:	Mach Mine	Client:	Mach Mine
Project No.:	H-05278	Date:	4/9/2007
Sample No.	Coarse Refuse	Total Weight:	2290.30

Sieve	Wt. Retained	% Ret.	% Passing
2"	0.0	0.0	100.0
1.5"	314.4	13.7	86.3
1"	536.7	23.4	76.6
3/4"	674.8	29.5	70.5
1/2"	901.6	39.4	60.6
3/8"	1061.2	46.3	53.7
#4	1522.1	66.5	33.5
#10	1911.6	83.5	16.5
#20	2091.9	91.3	8.7
#40	2166.2	94.6	5.4
#60	2202.2	96.2	3.8
#100	2223.7	97.1	2.9
#200	2245.2	98.0	2.0





Sample No.		1	2	3
Initial	Water Content,	14.4	12.7	13.1
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	95.1	89.0	90.4
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
At Test	Water Content,	15.2	14.2	14.5
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.60	3.60	1.80
Cell Pressure, tsf		5.04	6.48	7.56
Fail. Stress, tsf		1.85	2.67	5.55
Total Pore Pr., tsf		4.18	5.27	4.77
Ult. Stress, tsf		1.85	2.66	5.55
Total Pore Pr., tsf		4.18	5.22	4.77
$\bar{\sigma}_1$ Failure, tsf		2.71	3.88	8.34
$\bar{\sigma}_3$ Failure, tsf		0.86	1.21	2.79

Type of Test:
CU with Pore Pressures

Sample Type: Coarse Refuse

Description:

Assumed Specific Gravity= 2.50

Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

Location: Weathered Coarse Refuse

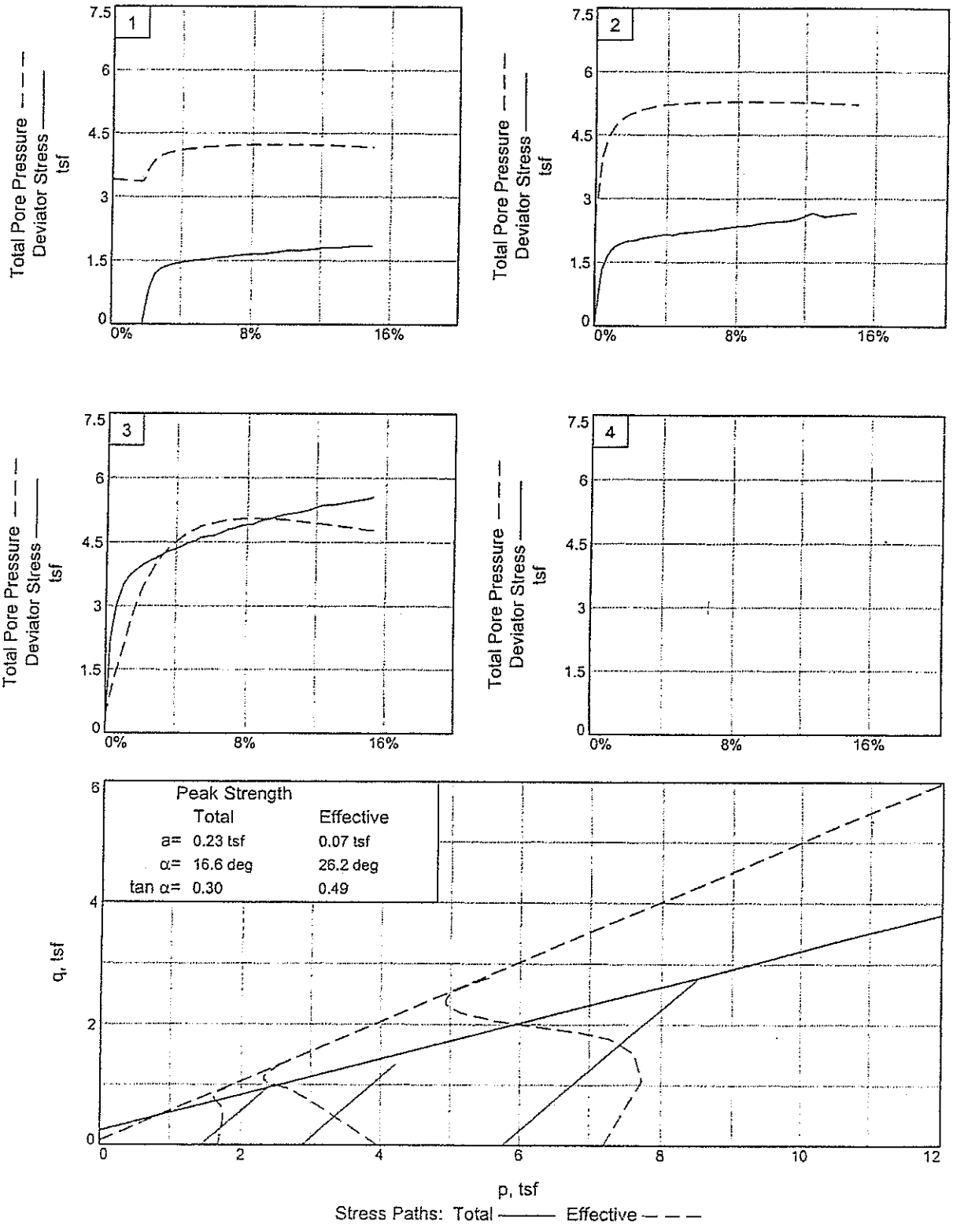
Proj. No.: H-05278 **Date:** 4/2/07

TRIAXIAL SHEAR TEST REPORT

HOLCOMB FOUNDATION ENGINEERING CO.

Plate _____

Tested By: LC Checked By: TH



Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Weathered Coarse Refuse
Project No.: H-05278

Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH

42 / 51

R15818

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

4/9/2007
11:10 AM

Date:	4/2/07
Client:	Pond Creek Mine
Project:	Coarse Refuse Laboratory Tests
Location:	Weathered Coarse Refuse
Description:	
Remarks:	
Type of Sample:	Coarse Refuse

Assumed Specific Gravity=2.50 **LL=** **PL=** **PI=**

Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	179.300			1255.500
Moisture content: Dry soil+tare, gms.	165.700			1117.500
Moisture content: Tare, gms.	71.400			79.600
Moisture, %	14.4	15.2	15.2	13.3
Moist specimen weight, gms.	1170.0			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.59	5.59	5.59	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.5	130.3	130.3	
Dry density, pcf	113.2	113.2	113.2	
Void ratio	0.3793	0.3793	0.3793	
Saturation, %	95.1	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm^2

Membrane thickness = 0.02 cm

Filter paper coefficient = 0.001926 kN/cm

Filter paper coverage = 50%

Consolidation cell pressure = 70.00 psi (5.040 tsf)

Consolidation back pressure = 50.00 psi (3.600 tsf)

Consolidation effective confining stress = 1.440 tsf

Strain rate, in./min. = 0.00

Fail. Stress = 1.845 tsf at reading no. 31

Ult. Stress = 1.845 tsf at reading no. 31

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	19.10	0.0	0.0	0.000	1.627	1.627	1.00	47.40	1.627	0.000
1	0.0190	20.00	0.9	0.3	0.001	1.642	1.642	1.00	47.20	1.642	0.000
2	0.0400	20.00	0.9	0.7	0.000	1.656	1.656	1.00	47.00	1.656	0.000
3	0.0600	20.00	0.9	1.1	0.000	1.663	1.663	1.00	46.90	1.663	0.000
4	0.0810	20.00	0.9	1.4	0.000	1.678	1.678	1.00	46.70	1.678	0.000
5	0.1010	25.00	5.9	1.8	0.017	1.678	1.694	1.01	46.70	1.686	0.008
6	0.1220	99.00	79.9	2.2	0.857	1.318	2.175	1.65	51.70	1.746	0.429
7	0.1420	124.00	104.9	2.5	1.195	1.152	2.347	2.04	54.00	1.750	0.598
8	0.1620	134.80	115.7	2.9	1.314	1.058	2.372	2.24	55.30	1.715	0.657
9	0.1830	140.60	121.5	3.3	1.374	1.001	2.375	2.37	56.10	1.688	0.687
10	0.2030	144.80	125.7	3.6	1.416	0.965	2.381	2.47	56.60	1.673	0.708
11	0.2240	148.10	129.0	4.0	1.448	0.936	2.384	2.55	57.00	1.660	0.724
12	0.2440	150.60	131.5	4.4	1.471	0.914	2.385	2.61	57.30	1.650	0.735
13	0.2650	153.10	134.0	4.7	1.493	0.900	2.393	2.66	57.50	1.646	0.746
14	0.2850	155.60	136.5	5.1	1.515	0.878	2.393	2.72	57.80	1.636	0.757
15	0.3060	157.30	138.2	5.5	1.528	0.864	2.392	2.77	58.00	1.628	0.764
16	0.3260	159.80	140.7	5.8	1.549	0.857	2.406	2.81	58.10	1.631	0.775
17	0.3460	162.30	143.2	6.2	1.571	0.850	2.420	2.85	58.20	1.635	0.785
18	0.3670	163.10	144.0	6.6	1.573	0.835	2.408	2.88	58.40	1.622	0.787
19	0.3870	166.40	147.3	6.9	1.603	0.828	2.431	2.94	58.50	1.630	0.802
20	0.4080	168.90	149.8	7.3	1.624	0.821	2.445	2.98	58.60	1.633	0.812
21	0.4490	172.30	153.2	8.0	1.648	0.814	2.461	3.02	58.70	1.637	0.824
22	0.4890	173.90	154.8	8.7	1.652	0.806	2.458	3.05	58.80	1.632	0.826
23	0.5300	178.90	159.8	9.5	1.691	0.806	2.498	3.10	58.80	1.652	0.846
24	0.5710	184.80	165.7	10.2	1.740	0.814	2.553	3.14	58.70	1.683	0.870
25	0.6120	186.40	167.3	10.9	1.742	0.806	2.549	3.16	58.80	1.677	0.871
26	0.6530	190.60	171.5	11.7	1.771	0.821	2.592	3.16	58.60	1.706	0.886
27	0.6940	195.60	176.5	12.4	1.808	0.821	2.628	3.20	58.60	1.725	0.904
28	0.7350	197.20	178.1	13.1	1.809	0.835	2.644	3.17	58.40	1.740	0.904
29	0.7760	201.40	182.3	13.9	1.836	0.842	2.678	3.18	58.30	1.760	0.918
30	0.8170	204.70	185.6	14.6	1.853	0.857	2.710	3.16	58.10	1.783	0.927
31	0.8370	204.70	185.6	15.0	1.845	0.864	2.709	3.14	58.00	1.787	0.923

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	169.900			1238.700
Moisture content: Dry soil+tare, gms.	158.800			1117.200
Moisture content: Tare, gms.	71.200			73.100
Moisture, %	12.7	14.2	14.2	11.6
Moist specimen weight, gms.	1169.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.7	131.5	131.5	
Dry density, pcf	115.1	115.1	115.1	
Void ratio	0.3560	0.3560	0.3560	
Saturation, %	89.0	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 2.666 tsf at reading no. 27
Ult. Stress = 2.663 tsf at reading no. 31

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	62.40	0.0	0.0	0.000	3.967	3.967	1.00	34.90	3.967	0.000
1	0.0220	173.10	110.7	0.4	1.289	2.484	3.773	1.52	55.50	3.129	0.645
2	0.0420	206.40	144.0	0.8	1.671	2.016	3.687	1.83	62.00	2.852	0.836
3	0.0620	223.00	160.6	1.1	1.857	1.764	3.621	2.05	65.50	2.693	0.929
4	0.0830	230.50	168.1	1.5	1.936	1.613	3.549	2.20	67.60	2.581	0.968
5	0.1030	235.50	173.1	1.8	1.987	1.512	3.499	2.31	69.00	2.505	0.993
6	0.1240	238.00	175.6	2.2	2.008	1.447	3.455	2.39	69.90	2.451	1.004
7	0.1440	242.20	179.8	2.6	2.048	1.390	3.438	2.47	70.70	2.414	1.024
8	0.1650	245.50	183.1	3.0	2.078	1.346	3.424	2.54	71.30	2.385	1.039
9	0.1850	248.80	186.4	3.3	2.107	1.310	3.418	2.61	71.80	2.364	1.054
10	0.2060	252.20	189.8	3.7	2.137	1.289	3.426	2.66	72.10	2.358	1.069
11	0.2260	254.70	192.3	4.0	2.158	1.267	3.425	2.70	72.40	2.346	1.079
12	0.2460	253.80	191.4	4.4	2.139	1.253	3.392	2.71	72.60	2.322	1.070
13	0.2670	258.80	196.4	4.8	2.187	1.238	3.425	2.77	72.80	2.332	1.093
14	0.2870	260.50	198.1	5.1	2.197	1.231	3.428	2.78	72.90	2.330	1.099
15	0.3080	263.00	200.6	5.5	2.216	1.217	3.433	2.82	73.10	2.325	1.108
16	0.3280	265.50	203.1	5.9	2.235	1.210	3.445	2.85	73.20	2.327	1.118
17	0.3490	268.80	206.4	6.3	2.263	1.210	3.472	2.87	73.20	2.341	1.131
18	0.3690	268.80	206.4	6.6	2.254	1.202	3.456	2.87	73.30	2.329	1.127
19	0.3900	273.00	210.6	7.0	2.290	1.195	3.486	2.92	73.40	2.340	1.145
20	0.4100	275.50	213.1	7.3	2.309	1.195	3.504	2.93	73.40	2.350	1.154
21	0.4510	281.30	218.9	8.1	2.353	1.188	3.541	2.98	73.50	2.364	1.176

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4920	284.60	222.2	8.8	2.369	1.195	3.564	2.98	73.40	2.380	1.185
23	0.5330	292.10	229.7	9.6	2.429	1.195	3.625	3.03	73.40	2.410	1.215
24	0.5740	296.30	233.9	10.3	2.454	1.202	3.656	3.04	73.30	2.429	1.227
25	0.6140	300.40	238.0	11.0	2.477	1.202	3.679	3.06	73.30	2.441	1.238
26	0.6440	305.40	243.0	11.5	2.514	1.217	3.730	3.07	73.10	2.474	1.257
27	0.6960	322.90	260.5	12.5	2.666	1.210	3.876	3.20	73.20	2.543	1.333
28	0.7370	316.20	253.8	13.2	2.576	1.238	3.814	3.08	72.80	2.526	1.288
29	0.7780	322.10	259.7	13.9	2.613	1.238	3.852	3.11	72.80	2.545	1.307
30	0.8190	328.70	266.3	14.7	2.657	1.253	3.910	3.12	72.60	2.581	1.328
31	0.8390	330.40	268.0	15.0	2.663	1.260	3.923	3.11	72.50	2.591	1.331

Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	171.400			1284.500
Moisture content: Dry soil+tare, gms.	160.000			1180.500
Moisture content: Tare, gms.	72.800			134.900
Moisture, %	13.1	14.5	14.5	9.9
Moist specimen weight, gms.	1168.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.6	131.2	131.2	
Dry density, pcf	114.6	114.6	114.6	
Void ratio	0.3615	0.3615	0.3615	
Saturation, %	90.4	100.0	100.0	

Test Readings for Specimen No. 3

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 105.00 psi (7.560 tsf)
Consolidation back pressure = 25.00 psi (1.800 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 5.549 tsf at reading no. 35
Ult. Stress = 5.549 tsf at reading no. 35

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0020	102.40	0.0	0.0	0.000	7.207	7.207	1.00	4.90	7.207	0.000
1	0.0170	286.30	183.9	0.3	2.145	6.674	8.819	1.32	12.30	7.747	1.072
2	0.0370	364.50	262.1	0.6	3.046	6.113	9.158	1.50	20.10	7.636	1.523
3	0.0580	407.00	304.6	1.0	3.526	5.537	9.063	1.64	28.10	7.300	1.763
4	0.0780	426.10	323.7	1.4	3.733	4.997	8.730	1.75	35.60	6.864	1.867
5	0.0990	437.70	335.3	1.7	3.853	4.536	8.389	1.85	42.00	6.462	1.926
6	0.1190	449.40	347.0	2.1	3.972	4.133	8.105	1.96	47.60	6.119	1.986
7	0.1400	457.70	355.3	2.5	4.052	3.838	7.889	2.06	51.70	5.863	2.026

Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
8	0.1600	464.40	362.0	2.8	4.113	3.593	7.706	2.14	55.10	5.649	2.056
9	0.1810	474.40	372.0	3.2	4.210	3.384	7.594	2.24	58.00	5.489	2.105
10	0.2010	481.90	379.5	3.6	4.279	3.211	7.490	2.33	60.40	5.351	2.140
11	0.2210	487.70	385.3	3.9	4.328	3.074	7.403	2.41	62.30	5.239	2.164
12	0.2420	495.20	392.8	4.3	4.395	2.959	7.355	2.49	63.90	5.157	2.198
13	0.2620	503.50	401.1	4.7	4.471	2.851	7.323	2.57	65.40	5.087	2.236
14	0.2830	509.30	406.9	5.0	4.518	2.772	7.290	2.63	66.50	5.031	2.259
15	0.3030	519.30	416.9	5.4	4.612	2.693	7.305	2.71	67.60	4.999	2.306
16	0.3240	522.60	420.2	5.8	4.630	2.650	7.279	2.75	68.20	4.965	2.315
17	0.3440	526.00	423.6	6.1	4.650	2.621	7.270	2.77	68.60	4.946	2.325
18	0.3650	534.30	431.9	6.5	4.722	2.578	7.299	2.83	69.20	4.938	2.361
19	0.3850	541.80	439.4	6.9	4.785	2.549	7.334	2.88	69.60	4.941	2.393
20	0.4050	546.80	444.4	7.2	4.821	2.534	7.355	2.90	69.80	4.945	2.411
21	0.4260	553.40	451.0	7.6	4.873	2.520	7.393	2.93	70.00	4.956	2.436
22	0.4460	558.40	456.0	8.0	4.908	2.506	7.413	2.96	70.20	4.959	2.454
23	0.4670	560.90	458.5	8.3	4.914	2.506	7.420	2.96	70.20	4.963	2.457
24	0.4870	569.20	466.8	8.7	4.984	2.506	7.489	2.99	70.20	4.997	2.492
25	0.5080	574.20	471.8	9.1	5.016	2.513	7.529	3.00	70.10	5.021	2.508
26	0.5280	580.10	477.7	9.4	5.059	2.520	7.579	3.01	70.00	5.050	2.530
27	0.5690	592.50	490.1	10.2	5.148	2.534	7.683	3.03	69.80	5.109	2.574
28	0.6100	600.00	497.6	10.9	5.184	2.570	7.755	3.02	69.30	5.163	2.592
29	0.6510	610.90	508.5	11.6	5.254	2.599	7.853	3.02	68.90	5.226	2.627
30	0.6920	625.80	523.4	12.4	5.363	2.628	7.991	3.04	68.50	5.310	2.682
31	0.7330	631.70	529.3	13.1	5.378	2.671	8.049	3.01	67.90	5.360	2.689
32	0.7730	641.60	539.2	13.8	5.434	2.707	8.141	3.01	67.40	5.424	2.717
33	0.8140	651.60	549.2	14.6	5.487	2.750	8.238	3.00	66.80	5.494	2.744
34	0.8350	656.60	554.2	14.9	5.513	2.772	8.285	2.99	66.50	5.528	2.756
35	0.8540	662.50	560.1	15.3	5.549	2.786	8.335	2.99	66.30	5.561	2.775

APPENDIX D

Boring Logs

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 8874

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6
Water Content (%)
Standard N Penetration, Blows/Ft.
10 20 30 40 50 60

Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Brown Silty CLAY (CL) with sand and pebbles
5	1	st		
	2	st		
10				Gray Mottled Brown Silty CLAY (CL)
	3	st		
15				
	4	st		
	5	st		
20				End of Boring @ -20.0'
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling and None Upon Completion.

at: Mach #1 Mine Soils Investigation
Mach #1 Mine Williamson County Illinois

Date of Boring
February 1, 2006

Client: Alliance Consulting, Inc.
Beaver, West Virginia

Project No.
H-05278

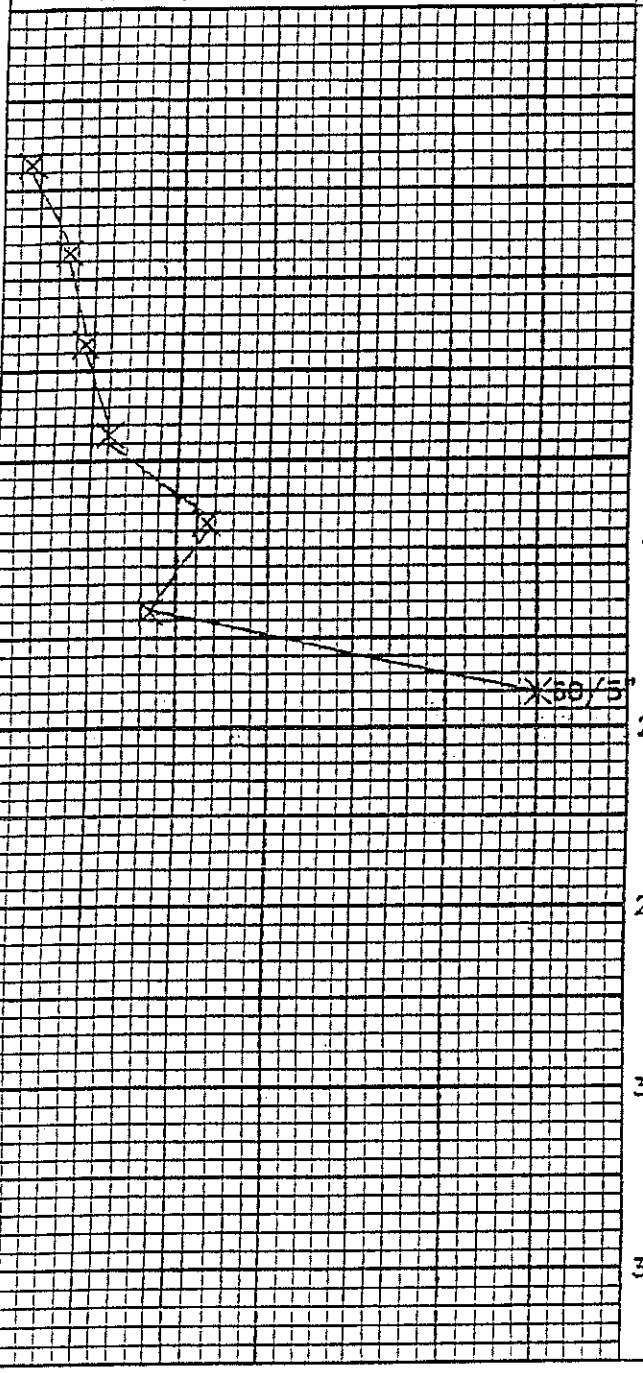
LOG of BORING 8293

Holcomb Foundation Engineering Co.

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				7" Topsoil
				Gray Mottled Brown Silty CLAY (CL) with trace of sand
5	1	ss		
	2	ss		
	3	ss		
10				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
	4	ss		
15	5	ss		
	6	ss		
	7	ss		Gray SHALE
20				End of Boring ▽ −19.0'
25				
30				
35				

Ground Water Data
Ground Water Encountered ▽ −12.0' During Drilling.

Project: Rock Probes for Mach Mine Johnston City, Illinois	Date of Boring December 5, 2005
Client: Williamson County Energy Marion, Illinois	Project No. H-05278

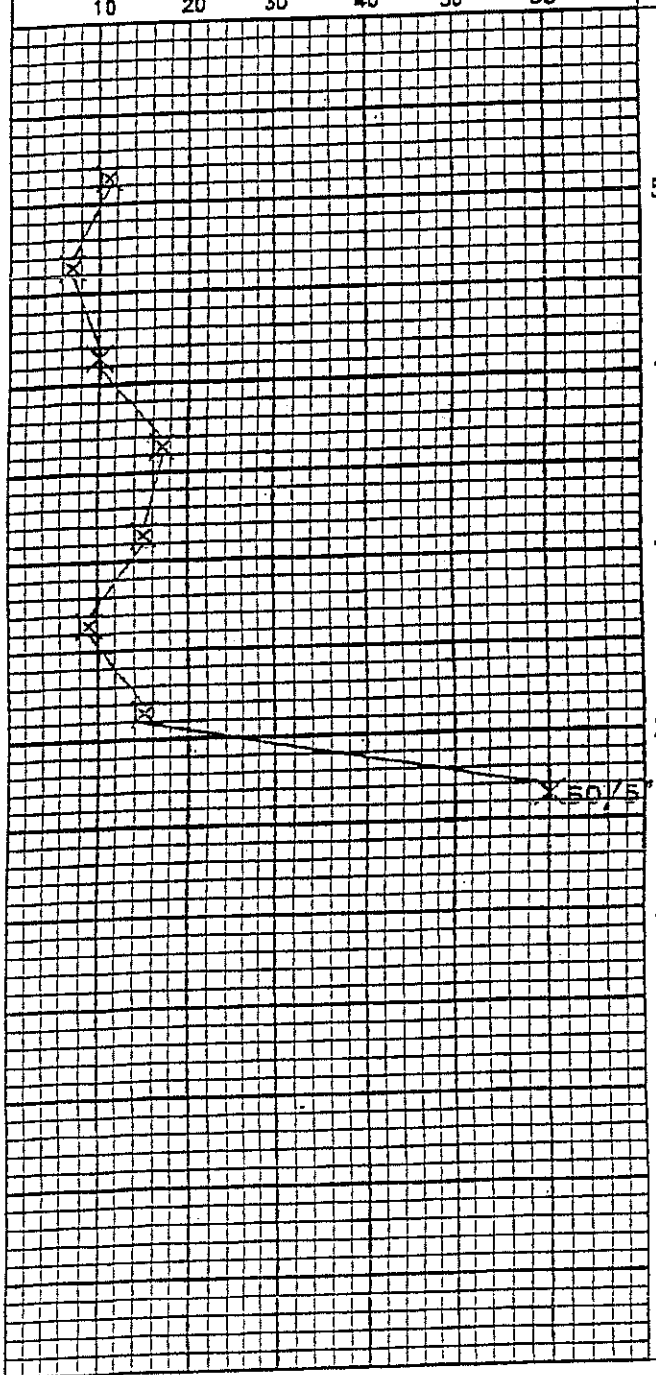
LOG of BORING B294

Holcomb Foundation Engineering Co.

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				7" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
10	3	ss		
	4	ss		
15	5	ss		
	6	ss		
20	7	ss		
	8	ss		Brown SHALE
25				End of Boring @ -22.5'
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

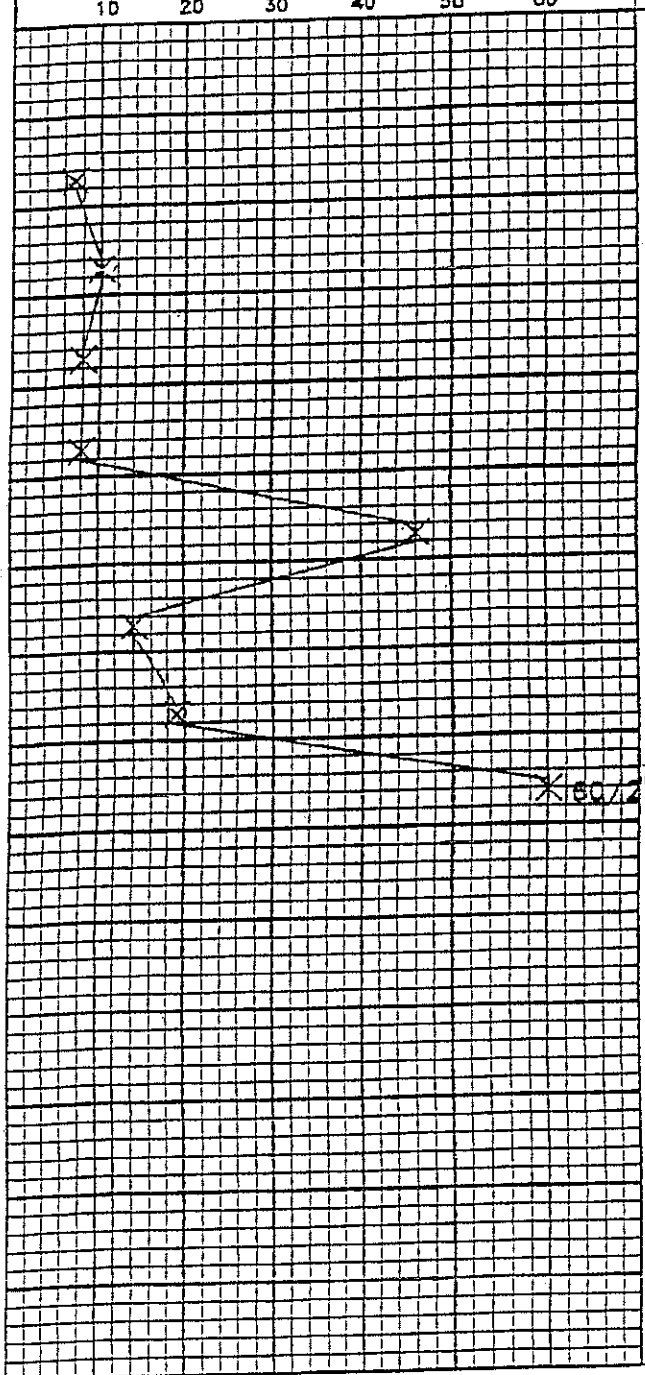
Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

LOG of BORING B295

Holcomb Foundation Engineering Co.



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				9" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
10	3	ss		
	4	ss		
15	5	ss		Brown SILT (ML)
	6	ss		Brown Medium to Coarse SAND (SC-SP)
20	7	ss		
	8	ss		Gray Mottled Brown SHALE
				End of Boring @ -22.0'
25				
30				
35				

Ground Water Data
Ground Water Encountered @ -16.0' During Drilling/ @ -10.0' Upon Completion.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

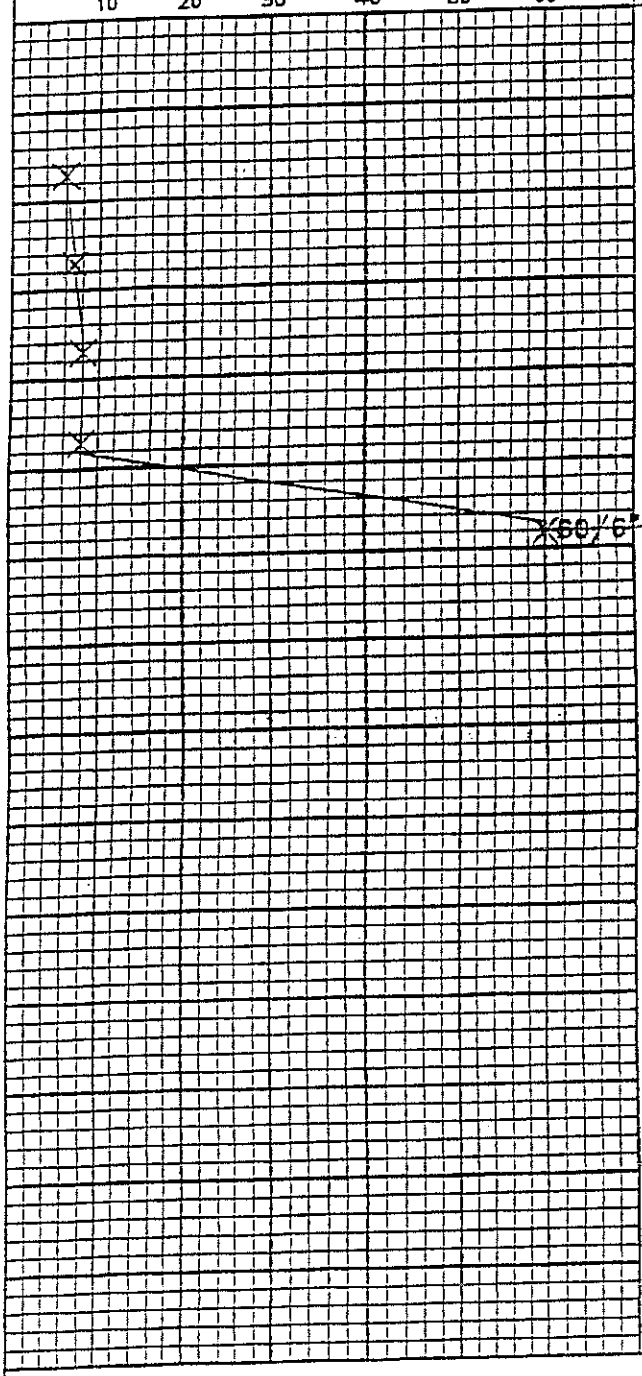
Date of Boring: December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.: H-05278

LOG of BORING 8297

Holcomb Foundation Engineering Co.



Sample No.	Type Sample	Sample Distance	Description of Material
			Surface Elevation
			9" Topsoil
			Gray Mottled Brown Silty CLAY (CL) with sand and pebbles
1	ss		
2	ss		
3	ss		Brown Mottled Gray Silty CLAY (CL) with trace of sand
4	ss		Gray Mottled Brown Silty CLAY (CL) with trace of sand
5	ss		Brown SHALE
			End of Boring @ -15.5'

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

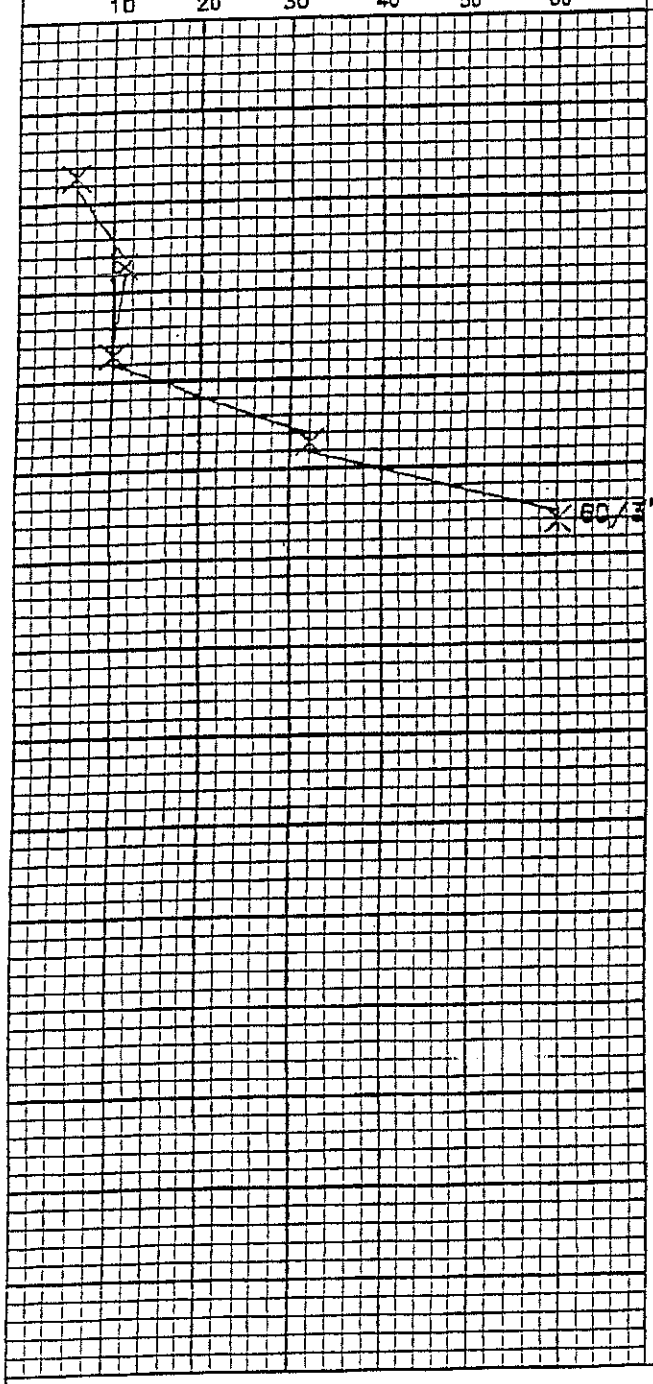
Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-0527B

LOG of BORING B298

Holcomb Foundation Engineering Co.



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				6" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
10	3	ss		Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
	4	ss		Brown Mottled Gray SHALE
	5	ss		Gray SHALE
15				End of Boring ▽ −14.5'
20				
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

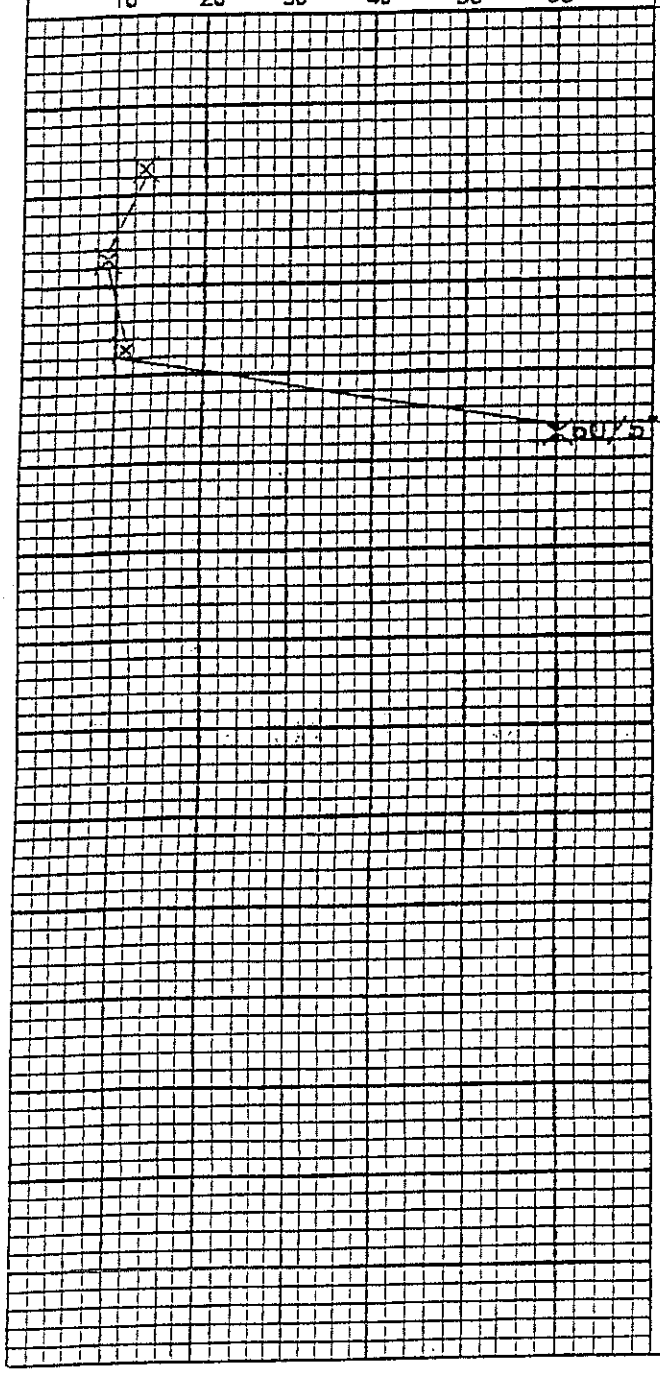
LOG of BORING B299

Holcomb Foundation Engineering Co.

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	SS		
	2	SS		
10	3	SS		
	4	SS		Brown SHALE
				End of Boring @ -12.5'
15				
20				
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

APPENDIX C

SEISMIC HAZARD ASSESSMENT

APPENDIX C-1

PROBABILISTIC SEISMIC HAZARD ASSESSMENT

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Probabilistic Seismic Hazard Assessment – Source, Maximum Magnitude and Peak Ground Acceleration

PAGE 1 OF 11

MADE BY BEG DATE 1/3/08 CHECKED BY TJS DATE 1/23/08

CALCULATION BRIEF FOR PROBABILISTIC SEISMIC HAZARD ASSESSMENT – SOURCE, MAXIMUM MAGNITUDE, DISTANCE AND PEAK GROUND ACCELERATION

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE: Utilizing the 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps (Frankel, 2002), particularly the 2% Probability of Exceedance in 50 years recurrence interval, define the local and regional seismic events, maximum earthquake magnitudes, focal depths, epicentral distances and peak ground accelerations potentially impacting the Williamson Energy, Pond Creek coal refuse disposal site, Williamson County, Illinois.

METHODOLOGY: A probabilistic seismic hazard assessment (PSHA) is performed for the Pond Creek site located near Johnston City, Williamson County, Illinois. PSHA involves utilizing the 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps (Frankel, 2002), particularly the 2% Probability of Exceedance in 50 years maps for the site coordinates and the development of a particular seismic scenario upon which a ground motion hazard evaluation is based. The scenario consists of the postulated occurrence of an earthquake (i.e., 2% Probability of Exceedance in 50 years) of a specified size based on the latest USGS hazard mapping for the Pond Creek site. In general, PSHA involves four basic elements:

1. Evaluate earthquake sources;
2. Determine controlling earthquake(s): the maximum magnitude, maximum credible, or maximum considered earthquake;
3. Determination of ground motion attenuation relationships or distance from the site; and
4. Determination the peak ground acceleration (PGA).

PSHA determines the earthquakes that have the most significant impacts, and for engineering design and analyses of tailing dams, a design earthquake is desired.

Stochastic modeling, based on the published predictive relations of Atkinson and Boore (1995) is subsequently used to create synthetic acceleration-time histories

for the critical earthquake scenarios. The required input parameters for the critical earthquake source spectra, including moment magnitude, epicentral distance, and focal depth are developed from the published information discussed above, and summarized below.

Subsequently discussed in a separate calculation brief, a comparison of input parameters and site response will be made using both eastern US synthetic earthquake time histories and actual western US earthquake time histories. Available records are scaled in SHAKE (Schnabel, 1971) to the Pond Creek site PGA and the site response compared to published eastern US ground motion attenuation (GMA) response spectra to assess the reasonableness of the various time histories.

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SEISMIC HAZARD ASSESSMENT

General

Nuttli and Herrmann (1978) outline the input necessary for performing either a deterministic or probabilistic method of assessing seismic hazard, which requires that the seismic source zones be identified, that the maximum-magnitude earthquake for each source zone be estimated, that the magnitude-frequency recurrence rate for each source zone be determined, and that the attenuation of seismic wave energy with distance be known.

Based on the current ability to generate synthetic earthquake acceleration-time histories for eastern North American (ENA) earthquakes using the stochastic modeling techniques developed by Boore (1983) and Atkinson and Boore (1995), a PSHA approach was chosen to generate a design earthquake(s). Using this approach, the Maximum Design Earthquake (MDE) for the 2% Probability of Exceedance in 50 years was chosen, which for the Pond Creek site has a PGA of 0.54g. As discussed in Atkinson and Boore (1995 and 1998), the utilized ground motion relationships compared well to the limited database of recorded Eastern North America (ENA) earthquakes and large earthquakes from analogous intra-plate, hard rock sites. In a separate calculation brief, a comparison is made of the PGA from the various

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation PROJECT NO. 072046

Probabilistic Seismic Hazard Assessment – Source, Maximum Magnitude and Peak Ground Acceleration PAGE 4 OF 11

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

ground motion attenuation relationships and the synthetic time-histories, as well as a comparison of the site response and response spectra of both the synthetic earthquake acceleration time histories and a scaled western U.S. acceleration-time history record to evaluate the consistency and results of the eastern and western time histories relative to the embankment response, i.e., frequency content, spectral acceleration, etc.

The PSHA methodology chosen for this evaluation represents a more refined approach to previous methods which used empirical, pseudostatic embankment analyses. Similarly, the PSHA developed specifically for the Pond Creek site also attempts to eliminate the potential for over-conservative, unrealistic strong ground motion associated with the "floating earthquake" concept. This approach is generally applied in regions where active earthquake-generating surface faults exist and the intensity-based peak acceleration relationships are from only long-period western U.S. and Japanese seismic activity and more importantly, the peak acceleration does not account for distance.

Selection of Maximum Credible Earthquake Scenarios and Peak Ground Acceleration

Based on the most critical regional and local seismic sources to the Pond Creek site as identified in the USGS Interactive Deaggregation Maps, two MDE scenarios have been selected for analysis including a magnitude (M) 8.0, which has boundary limits of about 83 km from the site and the potential to generate a high intensity earthquake. The Pond Creek site also has the potential to be impacted by a smaller magnitude earthquake or a comparable local "background" earthquake at a closer epicentral distance to the site, which based on the USGS seismic hazard program is an M6.8 at 13.5 km. The PGA associated with this hazard was defined at 0.54g. The 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps (Frankel, 2002), particularly the 2% Probability of Exceedance in 50 years maps are attached.

The rate at which the strength of earthquake ground motion attenuates and the amount of geometric spreading with distance from the epicenter are required for seismic hazard analyses. The focal depth of the earthquake and the near surface geological conditions have a significant influence on the intensity attenuation relationship. Information on earthquakes occurring in the eastern United States suggests that surface faulting does not occur and the center of energy release is deeper than the average of California earthquakes. The earthquake energy is therefore radiated over a larger area than is experienced in California, and California data cannot be extrapolated directly to this region. Several ENA and CEUS ground motion attenuation relationships including Toro, et.al. (1997), Atkinson & Boore (1997), Campbell (2003), Atkinson (2001) and Tavakoli & Pezeshk (2005) are used to compare the USGS PGA for the Pond Creek site to that of other ENA and CEUS ground motion relationships.

Therefore, these two MDE scenarios will be evaluated for their impact on the Pond Creek impoundment since the maximum ground accelerations, frequency contents, and durations of effective cycles will be notably different.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation PROJECT NO. 072046

Probabilistic Seismic Hazard Assessment – Source, Maximum Magnitude and Peak Ground Acceleration PAGE 5 OF 11

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

As previously discussed, utilizing the Atkinson and Boore (1995) empirically-derived earthquake source spectra model for eastern North American hard rock sites, quality synthetic acceleration-time histories have been created for the bedrock motions. Subsequently, the various input parameters from these synthetic earthquake records are compared to the Pond Creek site input and the time histories scaled accordingly to the PGA anticipated at the Pond Creek site. Also, selection of an earthquake time history record from the PEER Strong Motion Database for western U.S. and Japanese earthquake records, scaled to the PGA is performed. Finally (in another calculation brief), the corresponding response spectra curves of the site response due to the ENA/CEUS synthetic and PEER earthquake time histories are compared to the ENA and CEUS ground motion attenuation response spectra to assess the reasonableness of the time history.

CONCLUSION

A Probabilistic Seismic Hazard Assessment (PSHA) which utilized the 2002 USGS Earthquake Hazard Program, Interactive Deaggregation Maps indicated local and regional seismic scenarios of potential impact to the Pond Creek coal refuse disposal site located in Williamson County, Illinois. Two MDE scenarios were chosen for analysis including M8.0 earthquake located at a epicentral distance of 83 km from the site was chosen for potential for a large intensity earthquake with a corresponding PGA of 0.54g. Additionally, an M6.8 earthquake at an epicentral distance of 13.5 km from the site was identified and will be used to model an earthquake that could "occur anywhere" with a PGA of 0.54g. These scenarios will be used to scale existing eastern U.S. synthetic acceleration-time histories, based on the source spectra models defined by Atkinson and Boore (1995) and a western U.S., PEER earthquake record. A comparison of the various input time histories, site response (spectra) and published eastern U.S. ground motion attenuation relationships spectra performed in a separate calculation brief.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation — PROJECT NO. 072046

Probabilistic Seismic Hazard Assessment – Source, Maximum Magnitude and Peak Ground Acceleration — PAGE 6 OF 11

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

FIGURES
2002 USGS EARTHQUAKE HAZARDS PROGRAM – PEAK GROUND ACCELERATION AND INTERACTIVE DEAGGRAGATION MAPS FOR 2% PROBABILITY OF EXCEEDANCE IN 50 YEARS RECURRENCE INTERVAL

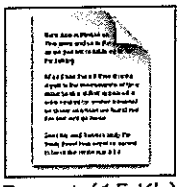
POND CREEK SITE
WILLIAMSON COUNTY, ILLINOIS

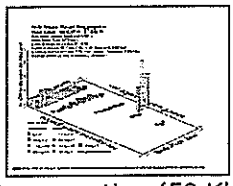
USGS science for a changing world

Earthquake Hazards Program

2 2 Interactive Deaggragations

Generated Output:
Click a link below to view the output file.


Report (15 Kb)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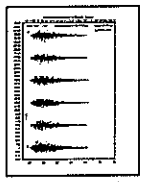
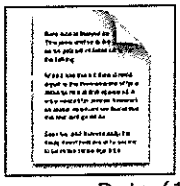

Seismograms (62 Kb)


Seismogram Data (1 Mb)

On this page you may select a return time, SA frequency, specify a latitude and longitude and request seismograms. Links to the following information will be returned:

- A plot of deaggregated distance, magnitude and ground-motion uncertainty for the specified parameters.
- ascii text file of the hazard matrices, containing, but not limited to, the frequency selected.
- geographic deaggregation plot may also be specified (for designated frequencies only - see below). This is in addition to the plot mentioned above.
- An ascii text file and graph of the seismograms for the modal or mean event (if requested).

Please read the README file before trying to use this site. The README explains about the input parameters and also describes how the deaggregation is done. Stochastic Seismograms and What is Epsilon? are articles which discuss the theory behind the seismograms.

Choose parameters and click "Generate Output"

Site Name: (Help)	Pond_Creek
Latitude: (Help)	37.84
Longitude: (Help)	-88.82
Return Period: (Help)	2475 years (2% in 50 years)
Frequency: (Help)	PGA
Geographic Deaggs: (Help)	None
Stochastic Seismograms: (Help)	Modal, One-Corner Source

Start Over | Generate Output

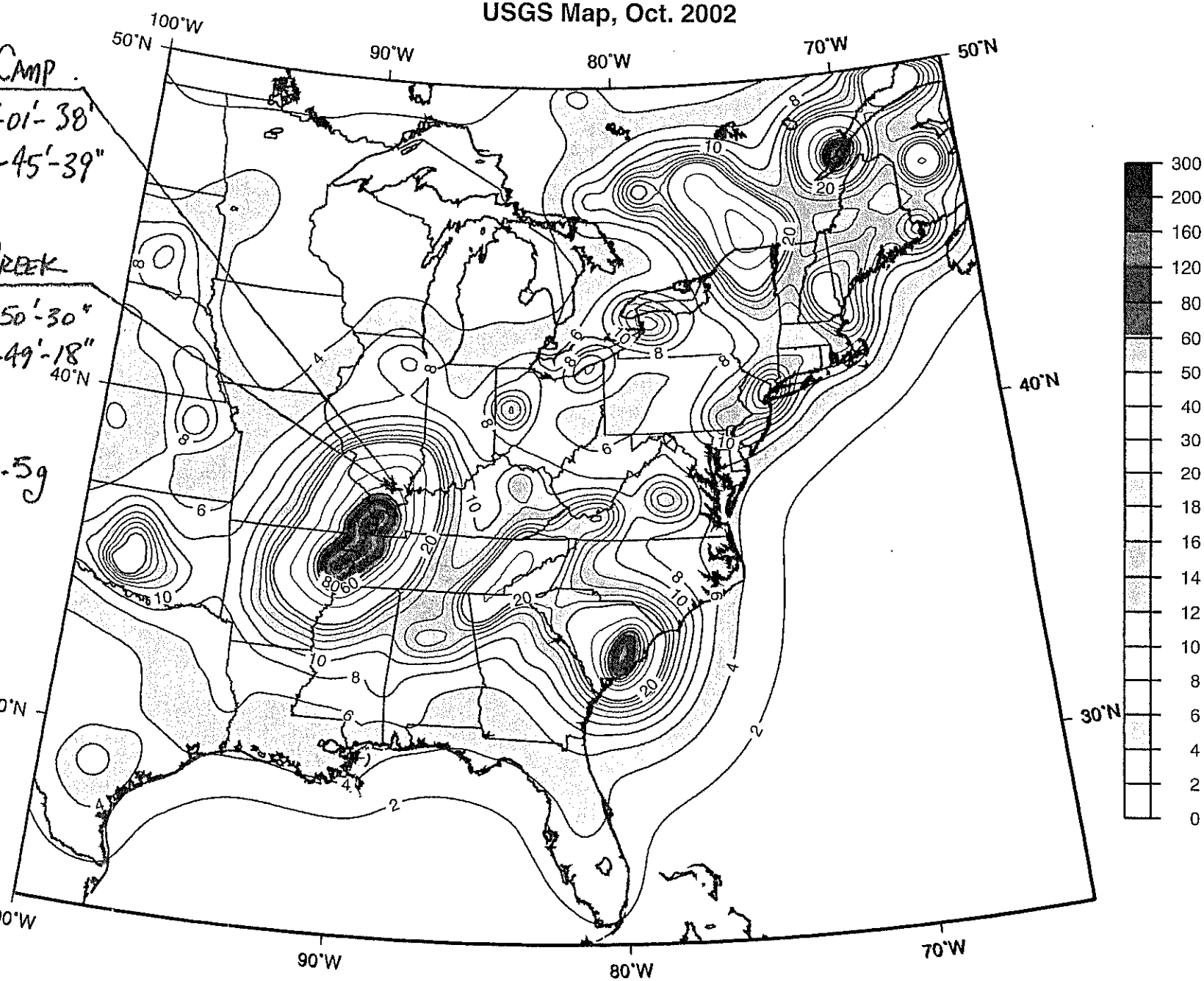
U.S. Department of the Interior | U.S. Geological Survey
URL: http://earthquake.usgs.gov/research/hazmaps/interactive/wrapper.php
Page Contact Information: Web Team
Page Last Modified: June 28, 2007 1:14:52 PM.

Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002

SUGAR CAMP
LAT.: 38°-01'-38"
LONG.: 80°-45'-39"

POND CREEK
LAT.: 37°-50'-30"
LONG.: 88°-49'-18"

PGA ≅ 0.5g



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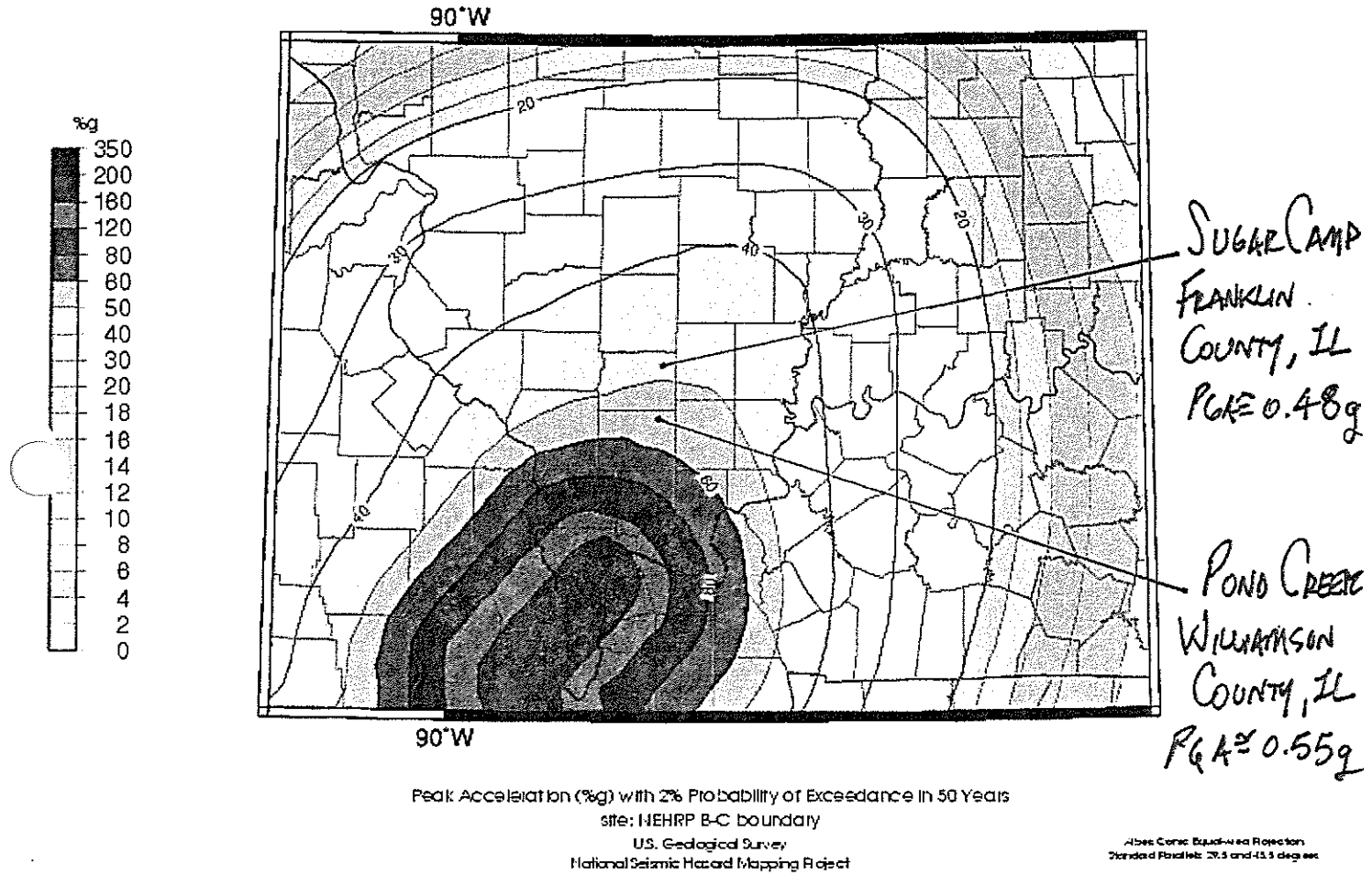
Earthquake Hazards Program

2 2 NSHMP Hazard Mapping

Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years



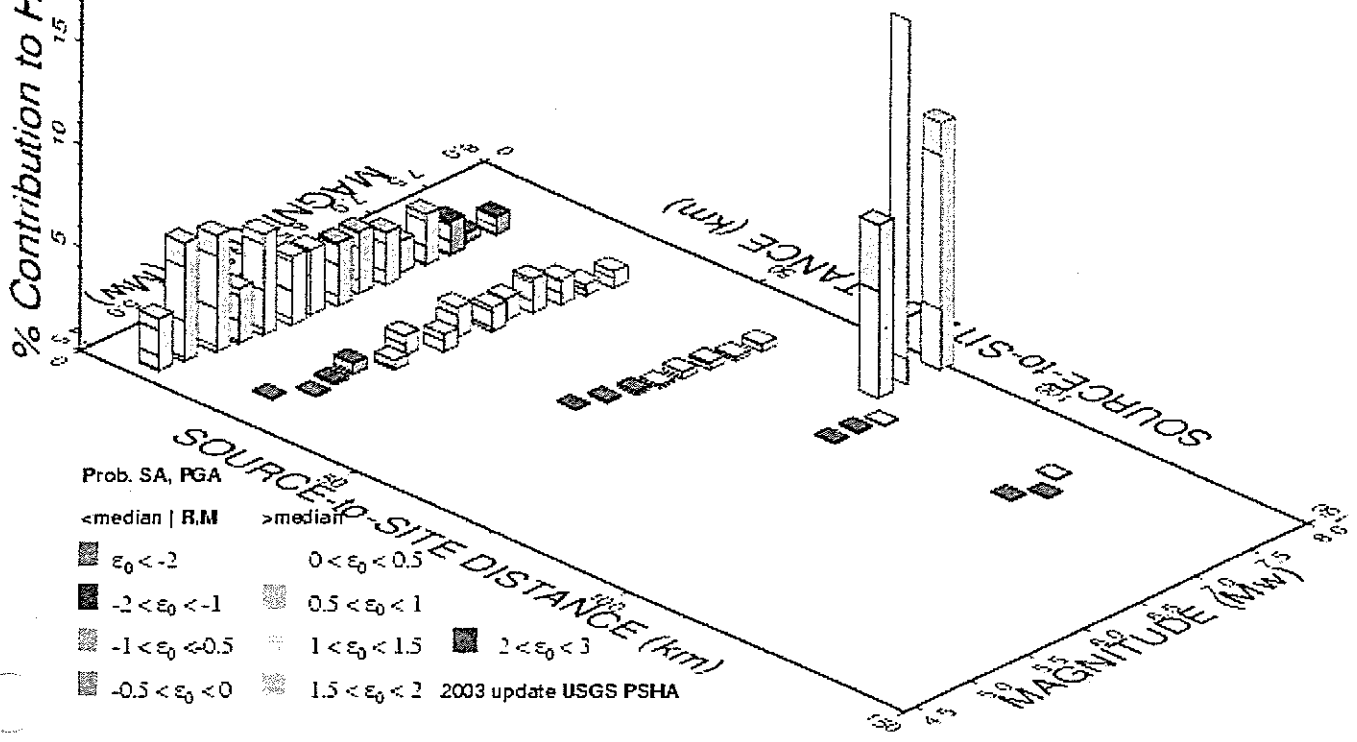
DF Version

ostscript Version

e above files will be deleted every hour on the hour.

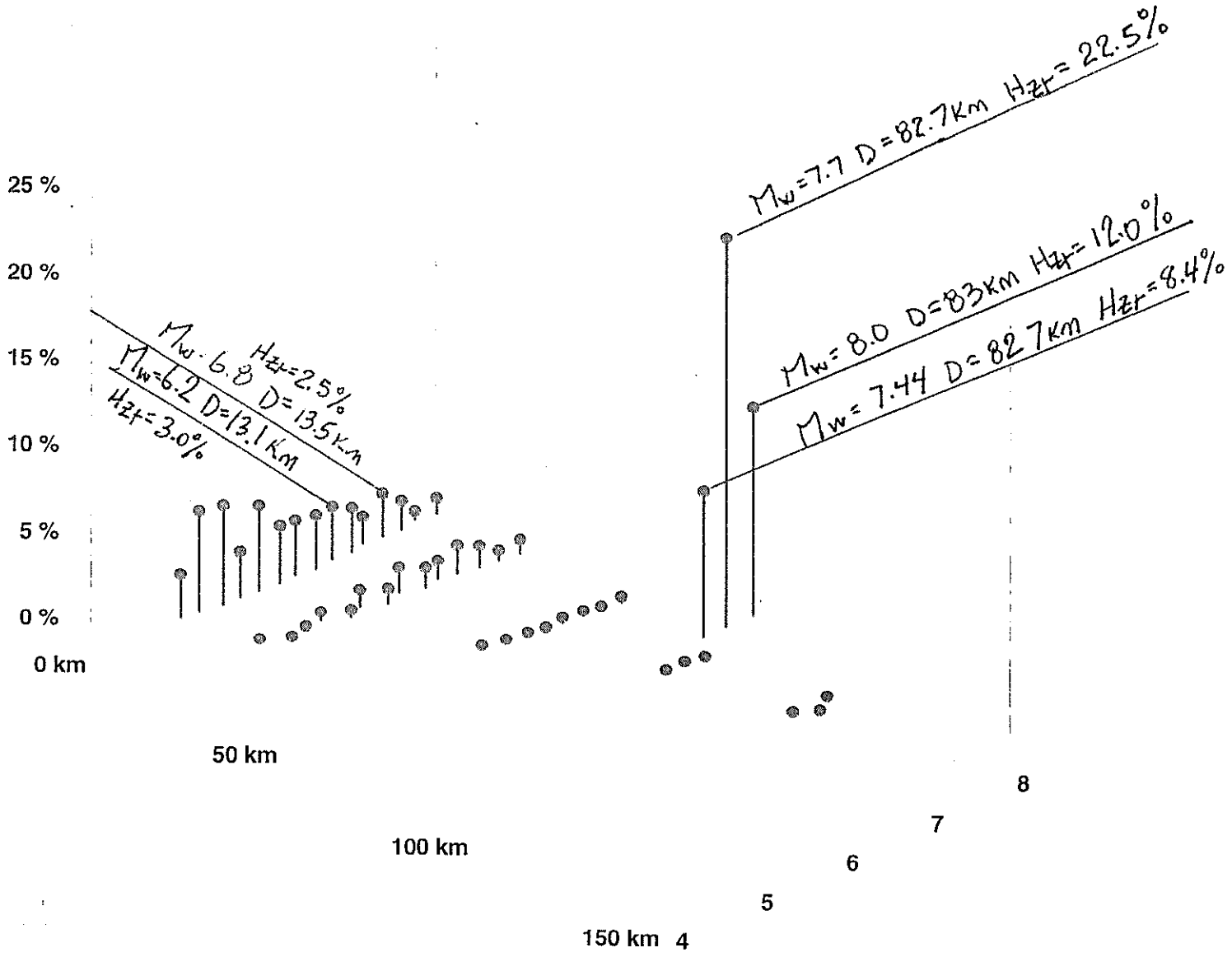
Prob. Seismic Hazard Deaggregation
Pond_Creek 88.820° W, 37.840 N.

Peak Horiz. Ground Accel.>=0.5401 g
Mean Return Time 2475 years
Mean (R,M,ε_0) 46.4 km, 6.67, 0.70
Modal (R,M,ε_0) = 82.7 km, 7.70, 1.19 (from peak R,M bin)
Modal (R,M,ε^*) = 82.7 km, 7.70, 1 to 2 sigma (from peak R,M,ε bin)
Binning: DeltaR 25. km, deltaM=0.2, Deltaε=1.0



GMT 2007 Dec 5 09:50:52 Distance (R), magnitude (M), epsilon (E0_E) deaggregation for a site on ROCK avg Vs=760 m/s top 30 m USGS CGHT PSHA2002v3 UPDATE Bins with 0.05% contrib. omitted

Probabilistic Seismic Hazard Deaggregation - Pond Creek (88.820° W , 37.840° N)



USE, M8.0 @ 83KM
AND M6.2 @ 13KM
OR
M6.8 @ 13.5KM

Deaggregation of the PGA >= .5401 g for a 2475 year return period

R15843

8114-10
Part II

APPENDIX C-2

SIMULATION OF ACCELERATION-TIME HISTORIES USING STOCHASTIC MODELING AND COMPARATIVE ASSESSMENT OF SYNTHETIC EASTERN U.S. AND PEER DATABASE (ACTUAL) WESTERN U.S. EARTHQUAKE RECORDS, ACCELERATION TIME-HISTORIES AND RESPONSE SPECTRA

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PROJECT Williamson Energy Pond Creek Deformation Evaluation Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PROJECT NO. 072046

PAGE 1 OF 131

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

CALCULATION BRIEF FOR SIMULATION OF ACCELERATION-TIME HISTORIES USING STOCHASTIC MODELING AND COMPARATIVE ASSESSMENT OF SYNTHETIC EASTERN U.S. AND PEER DATABASE (ACTUAL) WESTERN U.S. EARTHQUAKE RECORDS, ACCELERATION TIME HISTORIES AND RESPONSE SPECTRA

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE: Create synthetic acceleration-time histories for two maximum design earthquake (MDE) sources, and evaluate synthetic eastern U.S. and an actual western U.S. earthquake acceleration time histories, the site response spectra of each, and determine the appropriate time history to be used to evaluate the Pond Creek coal refuse disposal facility.

METHODOLOGY: Utilize the seismological computer program SMSIM written by David Boore of the U.S. Geological Survey (Reference 3). This program is based on the stochastic modeling method described in Reference 4, in which the radiation from a fault is assumed to be distributed randomly over a time interval and whose duration is related to the source size and the distance from the source to the site.

A comparison of site response (spectra) is also made between synthetic acceleration time histories using SMSIM (Boore, 1996), based on the eastern U.S. Atkinson & Boore (1995) ground motion attenuation relationship, and an actual time history record from the western U.S., Pacific Earthquake Engineering Research (PEER) strong motion database. Response spectra from each earthquake time history are generated at the base and top of the Pond Creek embankment crest using the 1-dimensional wave propagation program SHAKE 2000 (Schnabel, et.al., 1972), and the compatibility of each spectra is assessed relative to response spectra for five (5) eastern U.S. ground motion attenuation relationships.

Reference 1 presents the PSHA for the proposed Pond Creek coal refuse disposal facility located near Johnston City, Williamson County, Illinois, which indicated two MDE scenarios including a magnitude (M) 8.0 source (83 km from the site) and an "occur anywhere" M6.8 Background source (13.5 km from the site). The

Pond Creek PSHA also generated average peak ground accelerations (PGA) of 0.54g

Recent advances in ground-motion prediction for eastern North America (ENA) include the ability to generate synthetic earthquake acceleration-time history records, based on the stochastic simulation of high-frequency ground motions such as the method developed by Boore, 1983. Several recent studies, including Atkinson and Boore (1995) and Hwang and Huo (1997), have discussed the findings of numerous earthquake simulations and expanded the knowledge of ENA earthquake ground behavior which generally has a higher frequency content than western United States earthquakes.

Synthetic time histories are used to represent the Pond Creek PSHA MDE scenarios including the M6.8 (13.5 km), which will be scaled to Pond Creek PGA value of 0.54g. Alternatively, a search of the PEER strong motion database of western U.S. earthquakes was performed for a range of magnitudes between M5.5 and M7.2, a radial distance between 10 km and 50 km and PGA between 0.4g and 0.65g to represent the Pond Creek M6.8 source. Three (3) earthquake records were reviewed and the 1989 Loma Prieta earthquake, LOMAP/G01000 record (M6.9 @11km) was chosen, with PGA of 0.41g, as a comparative time history. The LOMAP/G01000 record will be scaled to 0.54g (from 0.41g) and response spectra compared to the corresponding synthetic time history and eastern U.S. ground motion attenuation response spectra.

SHAKE analyses were performed for the PCSC300M crest column and response spectra at the base and top of the Pond Creek – South cell embankment are compared to the response spectra for five (5) eastern U.S. ground motion attenuation relationships, which represent regional ground motion response. Site response spectra should fall within the envelope of response spectra of the ground motion relationships indicating similar frequency content and eliminating overly conservative resonance effects.

REFERENCES:

1. Civil & Environmental Consultants, Inc., "Calculation Brief for Probabilistic Seismic Hazard Assessment – Pond Creek Coal Refuse Disposal Site," BEG, 1/03/08.

2. Civil & Environmental Consultants, Inc., "Calculation Brief for Shear Modulus Correlations for SHAKE Columns PCSC300E and PCSC300M – Pond Creek – Coal Refuse Disposal Site – South Cell," BEG, 1/02/08.

3. Boore, D. M., "SMSIM – Fortran Programs for Simulating Ground Motions from Earthquakes: Version 1.0,"U.S.G.S. Open-File report 96-80-A, 1996

4. Boore, D. M. (1983). "Stochastic Simulation of High-Frequency Ground Motions based on Seismological Models of the Radiated Spectra," Bull. Seis. Soc. Am. 73, No. 6, p.p. 1865-1894, December

5. Atkinson, G. M. and Boore, D. M. (1995) "Ground-Motion Relationships for Eastern North America," Bull. Seis. Soc. Am. 85, No. 1 p.p. 17-30, February

6. Atkinson, G. M. and Boore, D. M. (1998) "Evaluation of Models for Earthquake Source Spectra in Eastern North America," Bull. Seis. Soc. Am. 88, No. 4 p.p. 917-934, August.

7. Schnabel, P. B., Lysmer, J. and Seed, H. B. (1972) "SHAKE88: A Computer Program Earthquake Response Analysis of Horizontally Layered Sites," Report No. EERC 72-12, University of California, Berkeley.

8. Hwang, Howard and Huo, Jun-Rong. (1997) "Attenuation Relations of Ground Motion for Rock and Soil Sites in Eastern United States," Soil Dynamics and Earthquake Engineering," 16, p.p. 363-372.

9. Hanks, T.C. and Kanamori, H. (1979) "A Moment Magnitude Scale," Journal of Geophysical Research, 84, p.p. 2348-2350.

STOCHASTIC MODELING

From Reference 4, recent studies have shown that the high frequency ground motions observed from a database of low to moderate magnitude earthquakes in the eastern United States and Canada can reasonably be predicted using stochastic modeling. In the stochastic ground motion model, synthetic time histories are characterized as finite-duration bandlimited Gaussian noise, while known regional source and propagation parameters are utilized to identify the underlying amplitude spectrum.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PROJECT NO. 072046

PAGE 4 OF 131

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

The stochastic method is initiated by defining the Fourier amplitude spectrum of ground acceleration with respect to seismic moment and distance. The amplitude spectrum also includes a diminuation function which models the geometric and anelastic attenuation as a function of hypocentral distance (R) and frequency (f), as well as filters to reduce high-frequency amplitudes and shape the response spectrum as required. The time series is a windowed Gaussian noise sequence with a zero mean amplitude. The duration of this window is limited as a function of earthquake magnitude and distance from the source. Once the windowed time series has been defined, it's spectrum is multiplied by the amplitude spectrum, then transformed back into the time domain, thus resulting in the simulated earthquake record.

SOURCE SPECTRUM INPUT

From Reference 4, the source spectrum model used to characterize the amplitude of ground motions for two critical earthquake scenarios is the Atkinson source model (Reference 5). As discussed in Atkinson and Boore (1998) which compares the results of several source models with the ground motion database of ENA earthquakes and other earthquakes with similar geologic settings, the Atkinson source model provides the most accurate ground motion estimates over the frequency of interest (0.1 to 10 Hertz) for most engineered facilities. They conclude that most other ENA models tend to overpredict long-period motion. The use of the Atkinson model was also recommended by Seismologist Dr. Martin Chapman of the Virginia Polytechnical Institute Seismological Observatory, in Blacksburg, VA, who consulted with CEC on this and similar projects in West Virginia and Kentucky. The source spectrum data used in Reference 3 as input for two MDE scenarios, including a M6.8 Background source at 13.5 km and M8.0 New Madrid @ 83km were taken directly from the input parameter file for Atkinson and Boore (1995), AB95.dat, which is presented as Appendix F of the SMSIM open report (Reference 3). These parameters, as well as the input magnitudes and attenuation distances are summarized below.

MDE No. 1) M6.8 Background Earthquake Source

Moment Magnitude, M = 6.8 based on Frankel (2002)

Shear Wave Velocity, V_S = 3.8 km/sec

Density of Rock Mass, ρ (Between Source and Site) = 2.8 g/cm^2

Cutoff Frequency = 50 Hertz

Maximum Frequency, $f$max = 40 Hertz

Hypocenter Distance, R = 16.8 km Assuming Epicenter Distance = 13.5 km

Focal Depth = 10 km

Quality Factor, $Q = C * f^n$ where $C = 680$, $n = 0.36$, f = frequency

Seed (Random Number) = 3

Time Step = 0.01 seconds

MDE No. 2) M8.0 New Madrid Earthquake Source

Moment Magnitude, M = 6.8 based on Frankel (2002)

Shear Wave Velocity, V_S = 3.8 km/sec

Density of Rock Mass, ρ (Between Source and Site) = 2.8 g/cm^2

Cutoff Frequency = 50 Hertz

Maximum Frequency, $f$max = 40 Hertz

Hypocenter Distance, R = 83.6 km Assuming Epicenter Distance = 83 km

Focal Depth = 10 km

Quality Factor, $Q = C * f^n$ where $C = 680$, $n = 0.36$, f = frequency

Seed (Random Number) = 3

Time Step = 0.01 seconds

DISCUSSION OF SMSIM OUTPUT

The output summaries from SMSIM, which include the simulation results such as peak ground acceleration and frequencies for the M6.8 and M8.0 earthquakes are attached. Acceleration – time histories were created for theses earthquakes using SMSIM and are illustrated graphically.

The peak amplitude accelerations for the M6.8 Background and M8.0 New Madrid earthquake are 739 cm/sec^2 (0.754g) and 181 cm/sec^2 (0.184g), respectively. Higher acceleration values were expected for the background MDE since there is less attenuation from the hypocenter to the site (13.5 km compared to 83 km). However, it is important to note that the duration of the acceleration record for the New Madrid earthquake is about 80 seconds, compared to about 15 seconds for the lower moment magnitude Background earthquake. Additionally, the frequency contents of the two simulations are quite different.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation
Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PROJECT NO. 072046

PAGE 6 OF 131

MADE BY BEG DATE 1/3/08 CHECKED BY [signature] DATE 1/23/08

SHAKE MODEL INPUT

To compare the Pond Creek site response from both the eastern U.S. synthetic time histories and the PEER database western U.S. time history, the 1-dimensional wave propagation program, SHAKE, was used to calculate the response spectra for each time history using the Pond Creek embankment (crest) SHAKE column PSCS300M. A layered SHAKE model was generated utilizing field and laboratory test data, and input information including layer thickness, unit weight and (small strain) shear modulus (Gmax), which are presented in Reference 2. Time histories for the M6.8 (at 13.5 km) earthquake scenario, from both the synthetic eastern U.S. record (Reference 4) and the western U.S. Loma Prieta PEER database time histories represent the respective eastern and western U.S. frequency content and PGA. Time histories associated with the M6.8 source were scaled to 0.54 g and input into SHAKE at the base of the PSCS300M SHAKE column.

DISCUSSION OF SHAKE OUTPUT

SHAKE output included generating and plotting response spectra curves for the Pond Creek site response for Layer 1 – at the top of the PCSC300M column, and Layer 17 – at the base of the same column. Additionally, the response spectra curves for five (5) published eastern U.S. ground motion attenuation relationships (Reference 4) were plotted, and are compared to the Pond Creek site response spectra due to the eastern and western U.S. time histories. The response spectra curves for the site response and comparative ground motion spectra are attached to this calculation brief.

POND CREEK SITE RESPONSE SPECTRA COMPARISON OF EASTERN U.S. (SYNTHETIC) AND WESTERN U.S. (PEER DATABASE)

As previously discussed, an existing eastern U.S. synthetic and western U.S. PEER database time history, scaled to 0.54g was used as input to evaluate the site response spectra at the top and bottom of the Pond Creek crest SHAKE column PCSC300M. Each site response spectra was compared to published response spectra from five (5) eastern U.S. ground motion attenuation relationships to assess the frequency content and spectral accelerations for each. As shown in the attached response spectra comparison, the eastern U.S. synthetic time history produced a frequency response (predominant period) within a range of periods between 0.01 and 0.1 seconds, as defined by the eastern U.S. ground motion attenuation relationships. The western U.S., PEER database time history produced predominant periods about 10 times that of the eastern U.S. ground motion attenuation relationships, between 0.1 and 1 second, and consistent with published information in Atkinson & Boore (1995 and 1998). Thus, the response spectra due to the western U.S. time history is not consistent with the anticipated eastern U.S. ground motion response spectra and should not be used to represent eastern U.S. earthquake records or

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PROJECT Williamson Energy Pond Creek Deformation Evaluation
Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PROJECT NO. 072046

PAGE 7 OF 131

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

time histories. The eastern U.S. synthetic earthquake record and site response from the synthetic time histories input into SHAKE fell directly within the predominate period range of the multiple eastern U.S. ground motion attenuation relationships as evidenced by the attached site response spectra curves for the M6.8 earthquake. Therefore, available eastern U.S. synthetic time histories from the M6.8 and M8.0 earthquakes, scaled to the Pond Creek MDE PGA of 0.54g will be used in supplemental SHAKE analyses to estimate cyclic shear stresses and strains for the SHAKE crest column.

CONCLUSION

Based on the information presented in this calculation brief, synthetic earthquake records were created for the M6.8 Background and M8.0 New Madrid earthquake sources. The resulting acceleration-time histories are based on stochastic modeling using the Atkinson 1995 source model, which is considered the most accurate model currently available to characterize ground motions for Eastern North America earthquakes. Further, the eastern U.S. synthetic earthquake record created from the M6.8 earthquake source and resulting acceleration-time history (Reference 4) scaled to the Pond Creek MDE PGA of 0.54g is considered the more accurate model (as compared to a western U.S. earthquake record) to characterize ground motions for Eastern North America earthquakes and the Pond Creek site response. The site response of the synthetic earthquake records also correlated well when compared to the work of five (5) published ground motion attenuation relationships specifically corresponding to the anticipated eastern U.S. response spectra. Therefore, the use of these synthetic records as base motion input for SHAKE trials should provide reliable results for determining induced cyclic shear stresses and strains and permanent deformation analyses for seismic analyses of the Pond Creek impoundment.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation
Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PROJECT NO. 072046

PAGE 8 OF 131

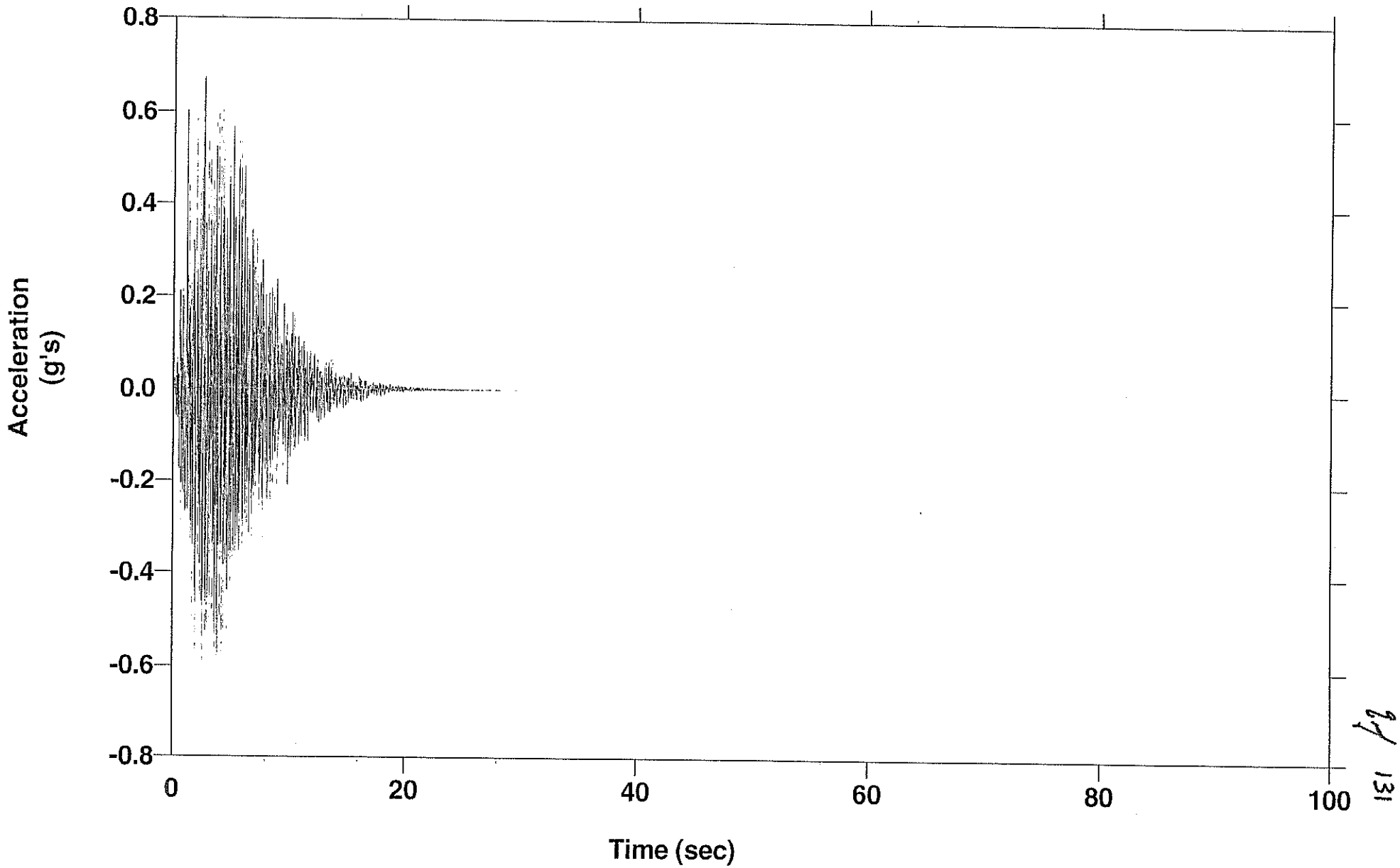
MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

ENA/POND CREEK SYNTHETIC RECORD FOR AN M6.8 BACKGROUND EARTHQUAKE AT 13.5 KM

AND

PEER DATABASE EARTHQUAKE RECORD FOR AN M6.9 EARTHQUAKE AT 11 KM LOMA PRIETA, CALIFORNIA, G01000

Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt



131

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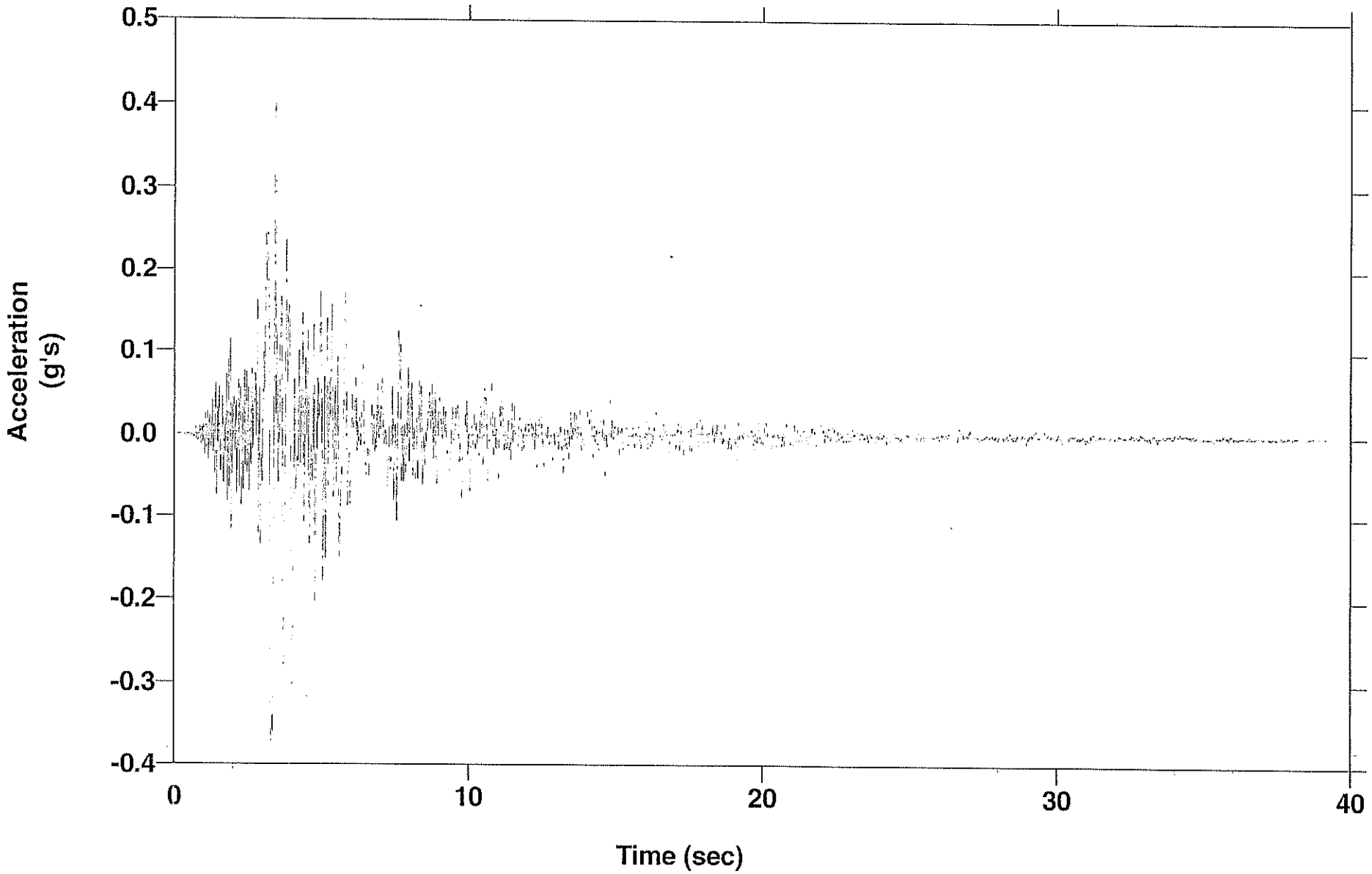

Source File: LomaP.G01000 AT2.txt - M6.9 Loma Prieta, CA @11km PEER Record
Acceleration (g's)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
10
20
30
40
Time (sec)

R15854

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PROJECT NO. 072046

PAGE 11 OF 131

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

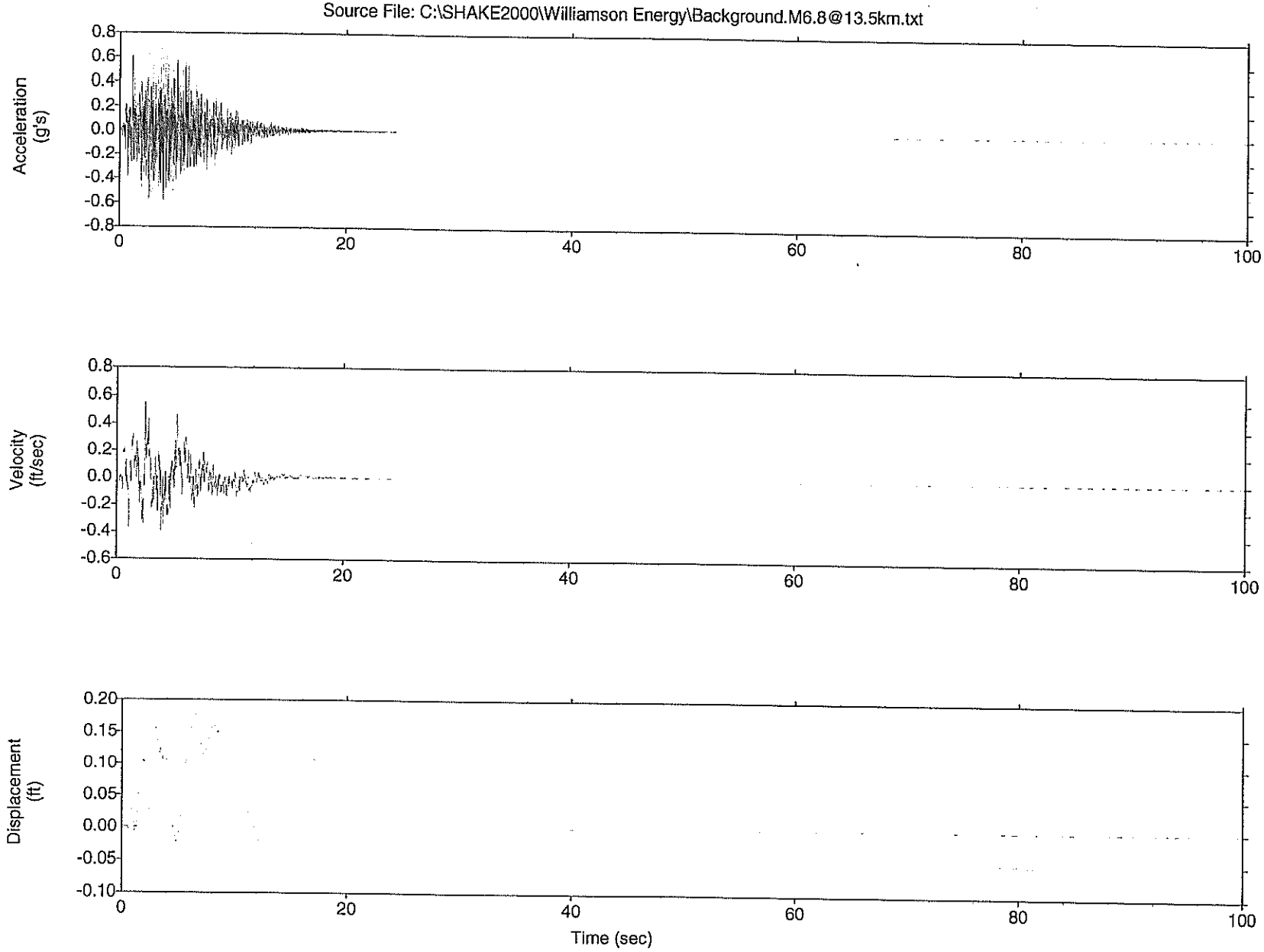
COMPARISON OF POND CREEK CREST SHAKE COLUMN RESPSONSE SPECTRA, PREDOMINANT PERIOD AND SPECTRAL ACCELERATION VALUES (AT 5 % DAMPING) FROM THE M6.8 BACKGROUND EASTERN U.S. SYNTHETIC TIME HISTORY AND THE WESTERN U.S. PEER DATABASE LOMA PRIETA, CA EARTHQUAKE TIME HISTORY

PCSC300M Crest Column
Williamson - Pond Creek South Cell - Surf. El. 502, GWT 14ft., Fines El. 496
M8.0 New Madrid Synthetic @83km, PGA=0.54g - Atkinson & Boore (1995)

Layer	Depth to Middle of Layer (ft)	Total Unit Weight (kcf)	Damping Used (%)	Shear Modulus (ksf)	Maximum Shear Strain (%)	Maximum Shear Stress (psf)	Shear Wave Velocity (fps)	Depth to Top of Layer (ft)	Peak Acceleration (g)	G/Gmax Curve	Damping Curve
1	2	.13	2.6	3011.9	.00656	197.47	863.7271	0	.75475	Coarse	Coarse
2	5.5	.13	4.4	2764.1	.019	525.07	827.4336	4	.70138	Coarse	Coarse
3	8.5	.13	5.3	2634.9	.02891	761.69	807.8641	7	.65623	Coarse	Coarse
4	11.5	.13	5.1	3768.3	.02654	1000	966.1154	10	.63991	Coarse	Coarse
5	14.5	.14	6.5	2764.2	.04445	1228.7	797.3494	13	.65636	Coarse	Coarse
6	17.5	.14	7.8	2154.6	.06592	1420.3	703.9588	16	.64637	Coarse	Coarse
7	20.5	.14	8.2	2228.9	.07416	1653.05	715.9937	19	.59333	Coarse	Coarse
8	23.5	.14	9.700001	1617.7	.11434	1849.71	609.9762	22	.57039	Coarse	Coarse
9	26.5	.14	9.5	1841.1	.10723	1974.16	650.7327	25	.55506	Coarse	Coarse
10	30	.14	9.6	1848.3	.11091	2050.01	652.0038	28	.59901	Coarse	Coarse
11	33.5	.135	10.7	1056.3	.19765	2087.75	501.9433	32	.6765	Residual	Residual
12	36.5	.135	11.3	998.5	.22343	2230.89	488.0172	35	.64739	Residual	Residual
13	39.5	.135	10.7	1207	.19636	2370.16	536.5555	38	.71677	Residual	Residual
14	42.5	.135	8.7	1853.6	.12973	2404.61	664.9195	41	.59839	Residual	Residual
15	45.5	.135	5.3	4401	.05567	2449.9	1024.558	44	.52211	Residual	Residual
16	48.5	.135	5.4	4313.4	.05803	2503.04	1014.31	47	.51594	Residual	Residual
17	Base							50	.52906		
17	Outcrop							50	.57825		

Notes:
Period for Soil Column: .27 sec
Average Shear Wave Velocity for Soil Column: 740 ft/sec

R15856


Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt
Acceleration (g's)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0
20
40
60
80
100
Velocity (ft/sec)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
0
20
40
60
80
100
Displacement (ft)
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
0
20
40
60
80
100
Time (sec)

R15857

```
************************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*    LAYERED SITES by Per Schnable & John Lysmer - 1970  *
* ---------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
* ---------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added  *
*     using results from Sun et al (1988) by J. I. Sun   *
*     & Ramin Golesorkhi February 26, 1988            *
* ----------------------------------------------------*
* SHAKE90/91: Adjust last iteration; Input now is either  *
*     Gmax or max Vs; up to 13 materials can be specified*
*     by user; up to 50 Layers can be specified; object  *
*     motion can be read in from a separate file and can *
*     user specified format; Different periods for res-  *
*     ponse spectral calculations;options are renumbered;*
*     and general cleanup by: J. I. Sun, I. M. Idriss &  *
*     P. Dirrim June 1990 - February 1991             *
* ---------------------------------------------------- *
* SHAKE91: General cleanup and finalization of input out- *
*     output format ... etc by: I. M. Idriss Dec. 1991   *
* ---------------------------------------------------- *
* SHAKE2000: Fix the incorrect output of Tot. Stress in   *
* Option 2. Changed path of ground motion file in         *
* SHAKE91.  Control file to input file names.  Modified   *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
*        RUN DATE  1/02/2008                              *
*        RUN TIME 11:01                                   *
************************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =    32768
 NECESSARY LENGTH OF BLANK COMMON X       =   204819

1****** OPTION  1  *** READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

**********************
 MATERIAL TYPE NO. 1
**********************

CURVE NO.  1:   Coarse    G/Gmax - Gravel (Mean) - Rollins et al. JGGE
CURVE NO.  2:   Coarse    Damping for Gravel (Mean) - Rollins et al. J
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.90
0.0002	0.995	0.0003	1.11
0.0005	0.980	0.0006	1.30
0.0008	0.970	0.0010	1.50
0.0010	0.960	0.0020	1.91
0.0020	0.930	0.0030	2.24
0.0030	0.905	0.0040	2.54
0.0040	0.880	0.0060	3.05
0.0070	0.810	0.0080	3.50
0.0100	0.755	0.0100	3.89
0.0200	0.630	0.0200	5.45
0.0700	0.390	0.0300	6.61
0.1000	0.325	0.0500	8.28
0.2000	0.205	0.1000	10.79
0.3000	0.150	0.2000	13.23

0.4000	0.115	0.3000	14.47
0.5000	0.095	0.4000	15.24
0.6000	0.080	0.6000	16.14
0.8000	0.070	0.8000	16.66
1.0000	0.050	1.0000	17.01

****
MATERIAL TYPE NO. 2
****

CURVE NO. 3: Fine Refuse Moduli for Fine Refuse (Ellison & Cho, 1976)
CURVE NO. 4: Fine Refuse Damping Values for Fine Refuse (Ellison & Ch

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.75
0.0004	1.000	0.0004	0.65
0.0010	0.995	0.0010	0.70
0.0020	0.992	0.0020	0.80
0.0040	0.989	0.0040	0.90
0.0060	0.981	0.0060	1.10
0.0080	0.965	0.0080	1.30
0.0100	0.955	0.0100	1.40
0.0200	0.905	0.0200	2.00
0.0400	0.828	0.0400	3.10
0.0600	0.750	0.0600	4.00
0.0800	0.670	0.0800	5.20
0.1000	0.610	0.1000	6.00
0.2000	0.610	0.2000	6.00

****
MATERIAL TYPE NO. 3
****

CURVE NO. 5: Residual G/Gmax PI=15% - Effective Confining Pressure
CURVE NO. 6: Residual Damping PI=15% - Effective Confining Pressur

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0000	1.000	0.0000	0.67
0.0000	1.000	0.0000	0.67
0.0000	0.999	0.0000	0.68
0.0001	0.998	0.0001	0.68
0.0002	0.996	0.0002	0.70
0.0005	0.991	0.0005	0.75
0.0010	0.983	0.0010	0.83
0.0022	0.965	0.0022	1.02
0.0048	0.931	0.0048	1.43
0.0100	0.873	0.0100	2.17
0.0220	0.770	0.0220	3.68
0.0484	0.618	0.0484	6.24
0.1000	0.454	0.1000	9.48
0.2200	0.287	0.2200	13.40
0.4840	0.163	0.4840	16.87
1.0000	0.091	1.0000	19.16

```
**********************
 MATERIAL TYPE NO. 4
**********************

CURVE NO. 7:   Rock    G/Gmax - ROCK (Schnabel 1973)
CURVE NO. 8:   Rock    Damping for ROCK (Schnabel 1973)
```

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.40
0.0003	1.000	0.0010	0.80
0.0010	0.990	0.0100	1.50
0.0030	0.950	0.1000	3.00
0.0100	0.900	1.0000	4.60
0.0300	0.810	0.0000	0.00
0.1000	0.725	0.0000	0.00
1.0000	0.550	0.0000	0.00

```
1****** OPTION  2 *** READ SOIL PROFILE
NEW SOIL PROFILE NO.    1    IDENTIFICATION  PSCS300E Crest Column
NUMBER OF LAYERS          17      DEPTH TO BEDROCK      50.00
```

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	1	4.0000	2.0000	0.26	3454.	0.050	0.130	924.9
2	1	3.0000	5.5000	0.71	3856.	0.050	0.130	977.3
3	1	3.0000	8.5000	1.11	4110.	0.050	0.130	1009.0
4	1	3.0000	11.5000	1.50	5739.	0.050	0.130	1192.3
5	1	3.0000	14.5000	1.90	4941.	0.050	0.140	1066.0
6	1	3.0000	17.5000	2.32	4453.	0.050	0.140	1012.0
7	1	3.0000	20.5000	2.74	4832.	0.050	0.140	1054.2
8	1	3.0000	23.5000	3.16	4269.	0.050	0.140	990.9
9	1	3.0000	26.5000	3.58	4713.	0.050	0.140	1041.1
10	1	4.0000	30.0000	4.07	4808.	0.050	0.140	1051.6
11	3	3.0000	33.5000	4.55	2635.	0.050	0.135	792.8
12	3	3.0000	36.5000	4.96	2661.	0.050	0.135	796.7
13	3	3.0000	39.5000	5.36	2998.	0.050	0.135	845.6
14	3	3.0000	42.5000	5.77	3763.	0.050	0.135	947.4
15	3	3.0000	45.5000	6.17	6529.	0.050	0.135	1247.9
16	3	3.0000	48.5000	6.58	6476.	0.050	0.135	1242.8
17	BASE				74534.	0.050	0.150	4000.0

```
PERIOD = 0.20 FROM AVERAGE SHEAR VEL. =   1011.


 FREQUENCY    AMPLITUDE
MAXIMUM AMPLIFICATION =  12.34
FOR FREQUENCY       =  4.85 C/SEC.
  PERIOD            =  0.21 SEC.

1****** OPTION  3 *** READ INPUT MOTION

FILE NAME FOR INPUT MOTION = C:\SHAKE2000\Williamson Energy\Background6.8.eq
 NO. OF INPUT ACC. POINTS = 8192
NO. OF POINTS USED IN FFT = 16384
   NO. OF HEADING LINES =   4
  NO. OF POINTS PER LINE =   8
```

```
 TIME STEP FOR INPUT MOTION = 0.0100
   FORMAT FOR TIME HISTORY =     (8f9.6)


 *****HEADER*****
Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt
SHAKE2000 Conversion:   8192    .01     4       8       9       (8f9.6
Acceleration Units: (g's) - No. Values: 8192 - Time Step: .01 (secs)
Data Format: (8f9.6) - No. Header Lines: 4
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

   1  0.000068-0.000484 0.004440-0.000089 0.002476-0.002297-0.001876 0.007725
   2  0.009680 0.020998-0.014349-0.012924 0.018874-0.019831-0.000946 0.024811
   3 -0.016894-0.002461 0.007682-0.006573-0.008604-0.018410 0.024194-0.064656
   4 -0.017516 0.023926-0.061566 0.003326 0.022873 0.052730 0.049159 0.008778
   5 -0.041034 0.029324-0.005991 0.066674-0.051336 0.029966-0.067257 0.001274
  .....INPUT MOTION READ NOT ECHOED.....
1020 -0.000017 0.000017-0.000018 0.000017-0.000019 0.000019-0.000020 0.000020
1021 -0.000021 0.000021-0.000022 0.000022-0.000024 0.000023-0.000025 0.000025
1022 -0.000027 0.000027-0.000028 0.000028-0.000030 0.000030-0.000032 0.000032
1023 -0.000034 0.000034-0.000035 0.000035-0.000037 0.000037-0.000038 0.000038
1024 -0.000038 0.000037-0.000036 0.000032-0.000026 0.000014 0.000006-0.000045

 MAXIMUM ACCELERATION =  0.75473
 AT TIME              =  3.64 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  0.715
 TO GIVE NEW MAXIMUM ACCELERATION          =  0.54000
 MEAN SQUARE FREQUENCY =     20.41 C/SEC.
 MAX ACCELERATION =    0.55791 FOR FREQUENCIES REMOVED ABOVE     40.00 C/SEC.
1******  OPTION  4  ***  READ WHERE OBJECT MOTION IS GIVEN
 OBJECT MOTION IN LAYER NUMBER   17 OUTCROPPING

1******  OPTION  5  ***  OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
 MAXIMUM NUMBER OF ITERATIONS             =   10
 FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN =    0.65

   EARTHQUAKE   - C:\SHAKE2000\Williamson Energy\Background6.8.eq
   SOIL PROFILE - PSCS300E Crest Column

  ITERATION NUMBER  1

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ----->  <---- SHEAR MODULUS ----->   G/Go
     (FT)  STRAIN  NEW   USED  ERROR     NEW    USED   ERROR  RATIO
--- ---- ---- -------- ----- ------- ------  -------  ------  -------  -----
 1  1    2.0 0.00351 0.024  0.050  -108.1   3078.9   3454.0   -12.2   1.000
 2  1    5.5 0.00785 0.035  0.050   -44.1   3055.2   3856.0   -26.2   1.000
 3  1    8.5 0.00986 0.039  0.050   -29.4   3112.0   4110.0   -32.1   1.000
 4  1   11.5 0.00805 0.035  0.050   -42.5   4525.4   5739.0   -26.8   1.000
 5  1   14.5 0.01151 0.042  0.050   -18.9   3605.0   4941.0   -37.1   1.000
 6  1   17.5 0.01524 0.048  0.050    -3.3   3023.5   4453.0   -47.3   1.000
 7  1   20.5 0.01605 0.050  0.050    -0.9   3235.9   4832.0   -49.3   1.000
 8  1   23.5 0.02052 0.055  0.050     9.5   2668.7   4269.0   -60.0   1.000
 9  1   26.5 0.02025 0.055  0.050     8.8   2958.1   4713.0   -59.3   1.000
10  1   30.0 0.02107 0.056  0.050    10.7   2980.8   4808.0   -61.3   1.000
11  3   33.5 0.03946 0.056  0.050    10.3   1732.1   2635.0   -52.1   1.000
12  3   36.5 0.03887 0.055  0.050     9.5   1756.9   2661.0   -51.5   1.000
13  3   39.5 0.03374 0.051  0.050     1.3   2061.4   2998.0   -45.4   1.000
14  3   42.5 0.02773 0.044  0.050   -12.8   2729.6   3763.0   -37.9   1.000
15  3   45.5 0.01672 0.032  0.050   -58.3   5261.4   6529.0   -24.1   1.000
```

16 3 48.5 0.01790 0.033 0.050 -52.0 5160.9 6476.0 -25.5 1.000

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00433	0.026	0.024	8.9	3005.7	3078.9	-2.4	0.891
2	1	5.5	0.01076	0.041	0.035	14.4	2860.4	3055.2	-6.8	0.792
3	1	8.5	0.01356	0.046	0.039	15.5	2877.3	3112.0	-8.2	0.757
4	1	11.5	0.01116	0.041	0.035	15.2	4219.2	4525.4	-7.3	0.789
5	1	14.5	0.01611	0.050	0.042	15.2	3305.5	3605.0	-9.1	0.730
6	1	17.5	0.02293	0.058	0.048	17.2	2688.9	3023.5	-12.4	0.679
7	1	20.5	0.02391	0.060	0.050	16.9	2878.8	3235.9	-12.4	0.670
8	1	23.5	0.03112	0.067	0.055	17.9	2328.0	2668.7	-14.6	0.625
9	1	26.5	0.02861	0.065	0.055	15.3	2646.0	2958.1	-11.8	0.628
10	1	30.0	0.02760	0.064	0.056	12.1	2732.5	2980.8	-9.1	0.620
11	3	33.5	0.04460	0.060	0.056	6.6	1669.9	1732.1	-3.7	0.657
12	3	36.5	0.04332	0.059	0.055	6.0	1701.4	1756.9	-3.3	0.660
13	3	39.5	0.03826	0.055	0.051	7.4	1988.7	2061.4	-3.7	0.688
14	3	42.5	0.03202	0.049	0.044	9.5	2625.2	2729.6	-4.0	0.725
15	3	45.5	0.01907	0.034	0.032	7.4	5149.3	5261.4	-2.2	0.806
16	3	48.5	0.02074	0.036	0.033	7.9	5036.3	5160.9	-2.5	0.797

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00460	0.027	0.026	2.9	2979.0	3005.7	-0.9	0.870
2	1	5.5	0.01185	0.043	0.041	5.1	2793.0	2860.4	-2.4	0.742
3	1	8.5	0.01514	0.048	0.046	5.1	2795.6	2877.3	-2.9	0.700
4	1	11.5	0.01171	0.042	0.041	2.5	4169.5	4219.2	-1.2	0.735
5	1	14.5	0.01732	0.051	0.050	3.2	3241.1	3305.5	-2.0	0.669
6	1	17.5	0.02575	0.062	0.058	5.4	2589.8	2688.9	-3.8	0.604
7	1	20.5	0.02687	0.063	0.060	5.3	2770.8	2878.8	-3.9	0.596
8	1	23.5	0.03516	0.071	0.067	5.6	2228.1	2328.0	-4.5	0.545
9	1	26.5	0.03072	0.067	0.065	3.2	2581.7	2646.0	-2.5	0.561
10	1	30.0	0.02818	0.064	0.064	0.9	2713.3	2732.5	-0.7	0.568
11	3	33.5	0.04444	0.060	0.060	-0.2	1671.8	1669.9	0.1	0.634
12	3	36.5	0.04493	0.060	0.059	2.0	1682.6	1701.4	-1.1	0.639
13	3	39.5	0.04084	0.057	0.055	3.7	1950.9	1988.7	-1.9	0.663
14	3	42.5	0.03430	0.051	0.049	4.3	2575.4	2625.2	-1.9	0.698
15	3	45.5	0.01855	0.034	0.034	-1.6	5173.0	5149.3	0.5	0.789
16	3	48.5	0.02042	0.035	0.036	-0.8	5049.4	5036.3	0.3	0.778

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00456	0.027	0.027	-0.4	2982.5	2979.0	0.1	0.862
2	1	5.5	0.01191	0.043	0.043	0.3	2789.6	2793.0	-0.1	0.724
3	1	8.5	0.01531	0.048	0.048	0.5	2787.6	2795.6	-0.3	0.680
4	1	11.5	0.01166	0.042	0.042	-0.2	4174.2	4169.5	0.1	0.727
5	1	14.5	0.01740	0.051	0.051	0.2	3236.7	3241.1	-0.1	0.656
6	1	17.5	0.02642	0.062	0.062	1.2	2567.9	2589.8	-0.9	0.582
7	1	20.5	0.02762	0.064	0.063	1.2	2745.2	2770.8	-0.9	0.573
8	1	23.5	0.03637	0.072	0.071	1.5	2200.3	2228.1	-1.3	0.522
9	1	26.5	0.03115	0.067	0.067	0.7	2569.2	2581.7	-0.5	0.548
10	1	30.0	0.02787	0.064	0.064	-0.5	2723.4	2713.3	0.4	0.564
11	3	33.5	0.04402	0.059	0.060	-0.5	1676.6	1671.8	0.3	0.634
12	3	36.5	0.04564	0.060	0.060	0.8	1674.6	1682.6	-0.5	0.632
13	3	39.5	0.04189	0.058	0.057	1.4	1936.2	1950.9	-0.8	0.651
14	3	42.5	0.03519	0.052	0.051	1.6	2556.7	2575.4	-0.7	0.684
15	3	45.5	0.01837	0.033	0.034	-0.5	5181.0	5173.0	0.2	0.792
16	3	48.5	0.02016	0.035	0.035	-0.7	5060.6	5049.4	0.2	0.780

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00455	0.027	0.027	-0.2	2984.2	2982.5	0.1	0.863
2	1	5.5	0.01189	0.043	0.043	-0.1	2790.6	2789.6	0.0	0.723
3	1	8.5	0.01532	0.048	0.048	0.0	2787.0	2787.6	0.0	0.678
4	1	11.5	0.01161	0.042	0.042	-0.2	4178.3	4174.2	0.1	0.727
5	1	14.5	0.01735	0.051	0.051	-0.1	3239.3	3236.7	0.1	0.655
6	1	17.5	0.02655	0.063	0.062	0.2	2563.6	2567.9	-0.2	0.577
7	1	20.5	0.02780	0.064	0.064	0.3	2739.2	2745.2	-0.2	0.568
8	1	23.5	0.03675	0.073	0.072	0.5	2191.9	2200.3	-0.4	0.515
9	1	26.5	0.03122	0.067	0.067	0.1	2567.1	2569.2	-0.1	0.545
10	1	30.0	0.02767	0.064	0.064	-0.3	2730.0	2723.4	0.2	0.566
11	3	33.5	0.04382	0.059	0.059	-0.2	1678.9	1676.6	0.1	0.636
12	3	36.5	0.04592	0.061	0.060	0.3	1671.5	1674.6	-0.2	0.629
13	3	39.5	0.04225	0.058	0.058	0.5	1931.3	1936.2	-0.3	0.646
14	3	42.5	0.03545	0.052	0.052	0.5	2551.4	2556.7	-0.2	0.679
15	3	45.5	0.01834	0.033	0.033	-0.1	5182.3	5181.0	0.0	0.794
16	3	48.5	0.02008	0.035	0.035	-0.2	5063.8	5060.6	0.1	0.781

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 6

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.2	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.9	2790.6	0.0	0.724

3	1	8.5	0.01532	0.049	0.048	0.0	2786.7	2787.0	0.0	0.678
4	1	11.5	0.01160	0.042	0.042	-0.1	4179.6	4178.3	0.0	0.728
5	1	14.5	0.01732	0.051	0.051	-0.1	3241.0	3239.3	0.1	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.8	2563.6	0.0	0.576
7	1	20.5	0.02785	0.064	0.064	0.1	2737.8	2739.2	-0.1	0.567
8	1	23.5	0.03687	0.073	0.073	0.2	2189.2	2191.9	-0.1	0.513
9	1	26.5	0.03123	0.067	0.067	0.0	2566.9	2567.1	0.0	0.545
10	1	30.0	0.02758	0.064	0.064	-0.1	2732.9	2730.0	0.1	0.568
11	3	33.5	0.04375	0.059	0.059	-0.1	1679.7	1678.9	0.0	0.637
12	3	36.5	0.04602	0.061	0.061	0.1	1670.4	1671.5	-0.1	0.628
13	3	39.5	0.04237	0.058	0.058	0.2	1929.7	1931.3	-0.1	0.644
14	3	42.5	0.03552	0.052	0.052	0.1	2550.0	2551.4	-0.1	0.678
15	3	45.5	0.01834	0.033	0.033	0.0	5182.7	5182.3	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.5	5063.8	0.0	0.782

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 7

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.4	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.9	2790.9	0.0	0.724
3	1	8.5	0.01533	0.049	0.049	0.0	2786.5	2786.7	0.0	0.678
4	1	11.5	0.01159	0.042	0.042	0.0	4180.0	4179.6	0.0	0.728
5	1	14.5	0.01731	0.051	0.051	0.0	3241.7	3241.0	0.0	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.7	2562.8	0.0	0.576
7	1	20.5	0.02786	0.064	0.064	0.0	2737.5	2737.8	0.0	0.567
8	1	23.5	0.03692	0.073	0.073	0.1	2188.2	2189.2	0.0	0.513
9	1	26.5	0.03122	0.067	0.067	0.0	2567.0	2566.9	0.0	0.545
10	1	30.0	0.02755	0.064	0.064	-0.1	2734.0	2732.9	0.0	0.568
11	3	33.5	0.04373	0.059	0.059	0.0	1680.0	1679.7	0.0	0.637
12	3	36.5	0.04605	0.061	0.061	0.0	1670.0	1670.4	0.0	0.628
13	3	39.5	0.04240	0.058	0.058	0.0	1929.3	1929.7	0.0	0.644
14	3	42.5	0.03554	0.052	0.052	0.0	2549.7	2550.0	0.0	0.678
15	3	45.5	0.01833	0.033	0.033	0.0	5182.8	5182.7	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.7	5064.5	0.0	0.782

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 8

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.4	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.8	2790.9	0.0	0.724
3	1	8.5	0.01533	0.049	0.049	0.0	2786.4	2786.5	0.0	0.678
4	1	11.5	0.01159	0.042	0.042	0.0	4180.1	4180.0	0.0	0.728
5	1	14.5	0.01730	0.051	0.051	0.0	3242.0	3241.7	0.0	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.8	2562.7	0.0	0.576
7	1	20.5	0.02786	0.064	0.064	0.0	2737.4	2737.5	0.0	0.567
8	1	23.5	0.03693	0.073	0.073	0.0	2187.9	2188.2	0.0	0.513
9	1	26.5	0.03122	0.067	0.067	0.0	2567.1	2567.0	0.0	0.545

10	1	30.0	0.02754	0.064	0.064	0.0	2734.4	2734.0	0.0	0.569
11	3	33.5	0.04372	0.059	0.059	0.0	1680.1	1680.0	0.0	0.638
12	3	36.5	0.04606	0.061	0.061	0.0	1669.9	1670.0	0.0	0.628
13	3	39.5	0.04241	0.058	0.058	0.0	1929.1	1929.3	0.0	0.644
14	3	42.5	0.03554	0.052	0.052	0.0	2549.6	2549.7	0.0	0.678
15	3	45.5	0.01833	0.033	0.033	0.0	5182.9	5182.8	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.7	5064.7	0.0	0.782

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 9

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.4	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.8	2790.8	0.0	0.724
3	1	8.5	0.01533	0.049	0.049	0.0	2786.4	2786.4	0.0	0.678
4	1	11.5	0.01159	0.042	0.042	0.0	4180.1	4180.1	0.0	0.728
5	1	14.5	0.01730	0.051	0.051	0.0	3242.1	3242.0	0.0	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.8	2562.8	0.0	0.576
7	1	20.5	0.02786	0.064	0.064	0.0	2737.4	2737.4	0.0	0.567
8	1	23.5	0.03694	0.073	0.073	0.0	2187.7	2187.9	0.0	0.513
9	1	26.5	0.03122	0.067	0.067	0.0	2567.1	2567.1	0.0	0.545
10	1	30.0	0.02753	0.064	0.064	0.0	2734.6	2734.4	0.0	0.569
11	3	33.5	0.04372	0.059	0.059	0.0	1680.1	1680.1	0.0	0.638
12	3	36.5	0.04607	0.061	0.061	0.0	1669.8	1669.9	0.0	0.628
13	3	39.5	0.04241	0.058	0.058	0.0	1929.1	1929.1	0.0	0.643
14	3	42.5	0.03554	0.052	0.052	0.0	2549.6	2549.6	0.0	0.678
15	3	45.5	0.01833	0.033	0.033	0.0	5182.9	5182.9	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.7	5064.7	0.0	0.782

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 10

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.4	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.8	2790.8	0.0	0.724
3	1	8.5	0.01533	0.049	0.049	0.0	2786.4	2786.4	0.0	0.678
4	1	11.5	0.01159	0.042	0.042	0.0	4180.1	4180.1	0.0	0.728
5	1	14.5	0.01730	0.051	0.051	0.0	3242.1	3242.1	0.0	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.8	2562.8	0.0	0.576
7	1	20.5	0.02786	0.064	0.064	0.0	2737.4	2737.4	0.0	0.567
8	1	23.5	0.03694	0.073	0.073	0.0	2187.7	2187.7	0.0	0.512
9	1	26.5	0.03122	0.067	0.067	0.0	2567.1	2567.1	0.0	0.545
10	1	30.0	0.02753	0.064	0.064	0.0	2734.6	2734.6	0.0	0.569
11	3	33.5	0.04372	0.059	0.059	0.0	1680.1	1680.1	0.0	0.638
12	3	36.5	0.04607	0.061	0.061	0.0	1669.8	1669.8	0.0	0.628
13	3	39.5	0.04241	0.058	0.058	0.0	1929.1	1929.1	0.0	0.643
14	3	42.5	0.03554	0.052	0.052	0.0	2549.6	2549.6	0.0	0.678
15	3	45.5	0.01833	0.033	0.033	0.0	5182.9	5182.9	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.7	5064.7	0.0	0.782

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	1	4.0000	2.0000	0.00699	208.65	2.66
2	1	3.0000	5.5000	0.01829	510.56	2.66
3	1	3.0000	8.5000	0.02359	657.19	2.66
4	1	3.0000	11.5000	0.01783	745.46	3.70
5	1	3.0000	14.5000	0.02661	862.84	2.53
6	1	3.0000	17.5000	0.04089	1047.93	2.53
7	1	3.0000	20.5000	0.04286	1173.22	2.53
8	1	3.0000	23.5000	0.05683	1243.29	2.53
9	1	3.0000	26.5000	0.04803	1232.98	2.53
10	1	4.0000	30.0000	0.04236	1158.30	2.52
11	3	3.0000	33.5000	0.06726	1130.04	2.52
12	3	3.0000	36.5000	0.07088	1183.52	2.51
13	3	3.0000	39.5000	0.06525	1258.79	2.50
14	3	3.0000	42.5000	0.05468	1394.02	2.62
15	3	3.0000	45.5000	0.02820	1461.76	2.62
16	3	3.0000	48.5000	0.03086	1562.90	2.49

PERIOD = 0.24 FROM AVERAGE SHEAR VEL. = 823.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 10.74
FOR FREQUENCY = 3.87 C/SEC.
PERIOD = 0.26 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE	TH SAVED ACC. RECORD
OUTCR.	0.0000	0.82118	2.66	15.92	0.000	2048
WITHIN	4.0000	0.66221	2.66	12.85	0.000	2048
WITHIN	7.0000	0.45724	2.53	9.08	0.000	2048
WITHIN	10.0000	0.49140	2.53	12.60	0.001	2048
WITHIN	13.0000	0.47695	2.53	15.09	0.001	2048
WITHIN	16.0000	0.48874	2.64	14.93	0.000	2048
WITHIN	19.0000	0.46491	2.64	15.27	0.001	2048
WITHIN	22.0000	0.51703	2.60	16.98	0.001	2048
WITHIN	25.0000	0.52919	2.63	16.94	0.000	2048
WITHIN	28.0000	0.52041	2.63	16.49	0.001	2048
WITHIN	32.0000	0.76846	2.62	17.02	0.000	2048
WITHIN	35.0000	0.80342	2.62	18.94	0.000	2048
WITHIN	38.0000	0.73631	2.61	20.52	0.001	2048
WITHIN	41.0000	0.65050	2.59	20.50	0.001	2048
WITHIN	44.0000	0.53855	3.91	20.21	0.001	2048

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE	TH SAVED ACC. RECORD
WITHIN	47.0000	0.52173	3.91	19.79	0.001	2048
WITHIN	50.0000	0.49204	2.58	19.33	0.001	2048

OUTCR. 50.0000 0.55791 2.58 20.41 0.001 2048

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 1 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 1 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 2 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 2 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 3 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 3 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 4 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 4 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 5 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 5 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC330M Layer 6 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PSCS300M Layer 6 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 7 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 7 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 8 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 8 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 9 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PSCS300E Layer 9 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 10 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 10 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 11 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 11 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 12 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 12 Strain

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1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  13
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 13 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  13
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 13 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  14
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 14 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  14
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 14 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  15
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 15 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  15
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 15 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  16
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 16 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  16
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 16 Strain

1******  OPTION  9  ***  COMPUTE RESPONSE SPECTRUM
 RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER       1
CALCULATED FOR DAMPING       0.050

  TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
     TD = TIME FOR MAX. RELATIVE DISP.
     TV = TIME FOR MAX. RELATIVE VEL.
     TA = TIME FOR MAX. ABSOLUTE ACC.
  DAMPING RATIO = 0.050
  PER = 0.01    TIMES FOR MAXIMA --  TD =  2.6500  TV =  2.6500  TA =  2.6500
  PER = 0.02    TIMES FOR MAXIMA --  TD =  2.6500  TV =  2.6400  TA =  2.6500
  PER = 0.03    TIMES FOR MAXIMA --  TD =  3.0100  TV =  3.0200  TA =  3.0100
  PER = 0.04    TIMES FOR MAXIMA --  TD =  2.6600  TV =  2.6700  TA =  3.6900
  PER = 0.05    TIMES FOR MAXIMA --  TD =  4.9300  TV =  4.9400  TA =  4.9000
  PER = 0.06    TIMES FOR MAXIMA --  TD =  4.3800  TV =  4.3900  TA =  4.3800
  PER = 0.07    TIMES FOR MAXIMA --  TD =  5.2600  TV =  5.2800  TA =  5.2600
  PER = 0.08    TIMES FOR MAXIMA --  TD =  5.2700  TV =  5.2900  TA =  5.2700
  PER = 0.09    TIMES FOR MAXIMA --  TD =  2.5900  TV =  2.7000  TA =  2.7200
  PER = 0.10    TIMES FOR MAXIMA --  TD =  2.6000  TV =  2.6600  TA =  2.5900
  PER = 0.11    TIMES FOR MAXIMA --  TD =  2.6000  TV =  2.5800  TA =  2.6000
  PER = 0.12    TIMES FOR MAXIMA --  TD =  2.6100  TV =  2.5800  TA =  2.6100
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PER = 0.13	TIMES FOR MAXIMA --	TD = 3.7200	TV = 5.1900	TA = 3.7200
PER = 0.14	TIMES FOR MAXIMA --	TD = 3.7300	TV = 2.5800	TA = 3.7300
PER = 0.15	TIMES FOR MAXIMA --	TD = 4.1600	TV = 2.5800	TA = 4.1600
PER = 0.16	TIMES FOR MAXIMA --	TD = 2.6200	TV = 2.5800	TA = 2.6100
PER = 0.17	TIMES FOR MAXIMA --	TD = 4.2800	TV = 4.3200	TA = 4.2800
PER = 0.18	TIMES FOR MAXIMA --	TD = 1.4300	TV = 2.5900	TA = 1.4300
PER = 0.19	TIMES FOR MAXIMA --	TD = 2.7500	TV = 2.7100	TA = 2.7500
PER = 0.20	TIMES FOR MAXIMA --	TD = 7.1100	TV = 6.7400	TA = 7.1100
PER = 0.21	TIMES FOR MAXIMA --	TD = 7.1400	TV = 7.0900	TA = 7.1300
PER = 0.22	TIMES FOR MAXIMA --	TD = 7.2700	TV = 7.1000	TA = 7.1500
PER = 0.23	TIMES FOR MAXIMA --	TD = 7.4200	TV = 2.3500	TA = 7.4100
PER = 0.24	TIMES FOR MAXIMA --	TD = 7.5600	TV = 2.3700	TA = 7.5600
PER = 0.25	TIMES FOR MAXIMA --	TD = 1.6100	TV = 6.3700	TA = 1.6100
PER = 0.26	TIMES FOR MAXIMA --	TD = 6.3200	TV = 6.3800	TA = 6.3200
PER = 0.27	TIMES FOR MAXIMA --	TD = 1.6400	TV = 1.7100	TA = 1.6300
PER = 0.28	TIMES FOR MAXIMA --	TD = 1.6500	TV = 1.3200	TA = 1.6500
PER = 0.29	TIMES FOR MAXIMA --	TD = 5.2100	TV = 5.1500	TA = 5.2100
PER = 0.30	TIMES FOR MAXIMA --	TD = 5.2400	TV = 5.1600	TA = 5.2300
PER = 0.31	TIMES FOR MAXIMA --	TD = 2.9800	TV = 2.9000	TA = 2.9700
PER = 0.32	TIMES FOR MAXIMA --	TD = 3.0000	TV = 2.9100	TA = 2.9900
PER = 0.33	TIMES FOR MAXIMA --	TD = 3.0100	TV = 2.9100	TA = 3.0000
PER = 0.34	TIMES FOR MAXIMA --	TD = 3.0100	TV = 2.7900	TA = 3.0100
PER = 0.35	TIMES FOR MAXIMA --	TD = 3.0200	TV = 2.7900	TA = 3.0200
PER = 0.36	TIMES FOR MAXIMA --	TD = 2.8800	TV = 2.7900	TA = 2.8700
PER = 0.37	TIMES FOR MAXIMA --	TD = 2.7200	TV = 2.7900	TA = 2.7100
PER = 0.38	TIMES FOR MAXIMA --	TD = 2.7300	TV = 2.6600	TA = 2.7200
PER = 0.39	TIMES FOR MAXIMA --	TD = 2.7300	TV = 2.6600	TA = 4.1300
PER = 0.40	TIMES FOR MAXIMA --	TD = 4.1500	TV = 2.6600	TA = 4.1400
PER = 0.41	TIMES FOR MAXIMA --	TD = 4.1600	TV = 4.0900	TA = 4.1600
PER = 0.42	TIMES FOR MAXIMA --	TD = 3.9900	TV = 4.0900	TA = 3.9800
PER = 0.43	TIMES FOR MAXIMA --	TD = 4.0000	TV = 4.0900	TA = 3.9900
PER = 0.44	TIMES FOR MAXIMA --	TD = 4.6800	TV = 4.1000	TA = 4.6700
PER = 0.45	TIMES FOR MAXIMA --	TD = 4.6900	TV = 4.1000	TA = 4.6800
PER = 0.46	TIMES FOR MAXIMA --	TD = 4.7100	TV = 4.1000	TA = 4.7100
PER = 0.47	TIMES FOR MAXIMA --	TD = 4.7300	TV = 4.6400	TA = 4.7200
PER = 0.48	TIMES FOR MAXIMA --	TD = 4.7400	TV = 4.6500	TA = 4.7300
PER = 0.49	TIMES FOR MAXIMA --	TD = 5.5500	TV = 4.6500	TA = 5.5400
PER = 0.50	TIMES FOR MAXIMA --	TD = 5.5700	TV = 2.6700	TA = 5.5600
PER = 0.51	TIMES FOR MAXIMA --	TD = 5.5800	TV = 2.6700	TA = 5.5700
PER = 0.52	TIMES FOR MAXIMA --	TD = 5.5800	TV = 2.6700	TA = 5.5700
PER = 0.53	TIMES FOR MAXIMA --	TD = 2.7600	TV = 2.6700	TA = 2.7500
PER = 0.54	TIMES FOR MAXIMA --	TD = 2.7700	TV = 2.6700	TA = 2.7600
PER = 0.55	TIMES FOR MAXIMA --	TD = 2.7700	TV = 2.6700	TA = 2.7600
PER = 0.56	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.6700	TA = 2.5600
PER = 0.57	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.6700	TA = 2.5600
PER = 0.58	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.6700	TA = 2.5600
PER = 0.60	TIMES FOR MAXIMA --	TD = 2.5800	TV = 2.6700	TA = 2.5700
PER = 0.62	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.6700	TA = 2.5800
PER = 0.64	TIMES FOR MAXIMA --	TD = 2.6100	TV = 2.5400	TA = 2.6000
PER = 0.66	TIMES FOR MAXIMA --	TD = 2.6200	TV = 2.5400	TA = 2.6100
PER = 0.68	TIMES FOR MAXIMA --	TD = 2.6400	TV = 2.5400	TA = 2.6200
PER = 0.70	TIMES FOR MAXIMA --	TD = 3.4700	TV = 2.5500	TA = 3.4600
PER = 0.72	TIMES FOR MAXIMA --	TD = 3.4800	TV = 2.5500	TA = 3.4700
PER = 0.74	TIMES FOR MAXIMA --	TD = 3.4900	TV = 2.5500	TA = 3.4800
PER = 0.76	TIMES FOR MAXIMA --	TD = 3.4900	TV = 1.6100	TA = 3.4800
PER = 0.78	TIMES FOR MAXIMA --	TD = 1.8200	TV = 1.6100	TA = 1.8000
PER = 0.80	TIMES FOR MAXIMA --	TD = 1.5200	TV = 1.2700	TA = 1.5100
PER = 0.82	TIMES FOR MAXIMA --	TD = 1.5300	TV = 1.2700	TA = 1.5100
PER = 0.84	TIMES FOR MAXIMA --	TD = 3.5000	TV = 6.3000	TA = 3.4800
PER = 0.86	TIMES FOR MAXIMA --	TD = 3.5000	TV = 5.9400	TA = 3.4800
PER = 0.88	TIMES FOR MAXIMA --	TD = 3.5100	TV = 5.9400	TA = 3.4900

PER = 0.90	TIMES FOR MAXIMA --	TD = 4.0300	TV = 3.3000	TA = 4.0200
PER = 0.92	TIMES FOR MAXIMA --	TD = 4.0600	TV = 4.2900	TA = 4.0500
PER = 0.94	TIMES FOR MAXIMA --	TD = 4.0700	TV = 4.3500	TA = 4.0600
PER = 0.96	TIMES FOR MAXIMA --	TD = 4.0700	TV = 4.3500	TA = 4.0600
PER = 0.98	TIMES FOR MAXIMA --	TD = 3.1800	TV = 4.3500	TA = 3.1700
PER = 1.00	TIMES FOR MAXIMA --	TD = 3.1900	TV = 3.9700	TA = 3.1800
PER = 1.05	TIMES FOR MAXIMA --	TD = 3.2100	TV = 3.9700	TA = 3.1900
PER = 1.10	TIMES FOR MAXIMA --	TD = 3.2500	TV = 2.5500	TA = 3.2400
PER = 1.15	TIMES FOR MAXIMA --	TD = 3.2700	TV = 2.5500	TA = 3.2500
PER = 1.20	TIMES FOR MAXIMA --	TD = 3.3500	TV = 2.5500	TA = 3.2800
PER = 1.25	TIMES FOR MAXIMA --	TD = 3.3900	TV = 2.5500	TA = 3.3800
PER = 1.30	TIMES FOR MAXIMA --	TD = 2.8800	TV = 2.5500	TA = 2.8700
PER = 1.35	TIMES FOR MAXIMA --	TD = 2.8900	TV = 2.5500	TA = 2.8700
PER = 1.40	TIMES FOR MAXIMA --	TD = 2.8900	TV = 2.5500	TA = 2.8700
PER = 1.45	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5500	TA = 2.8700
PER = 1.50	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5500	TA = 2.8700
PER = 1.55	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5500	TA = 2.8700
PER = 1.60	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5500	TA = 2.8700
PER = 1.65	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.5500	TA = 2.8700
PER = 1.70	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.5500	TA = 2.8700
PER = 1.75	TIMES FOR MAXIMA --	TD = 5.9000	TV = 2.5500	TA = 5.8900
PER = 1.80	TIMES FOR MAXIMA --	TD = 5.9100	TV = 2.5500	TA = 5.8900
PER = 1.85	TIMES FOR MAXIMA --	TD = 5.9200	TV = 2.5500	TA = 5.8900
PER = 1.90	TIMES FOR MAXIMA --	TD = 6.1200	TV = 2.5500	TA = 6.1000
PER = 1.95	TIMES FOR MAXIMA --	TD = 6.1200	TV = 2.5500	TA = 6.1100
PER = 2.00	TIMES FOR MAXIMA --	TD = 5.4200	TV = 2.5500	TA = 5.4100
PER = 2.05	TIMES FOR MAXIMA --	TD = 5.4300	TV = 2.5500	TA = 5.4100
PER = 2.10	TIMES FOR MAXIMA --	TD = 5.4300	TV = 2.5500	TA = 5.4100
PER = 2.15	TIMES FOR MAXIMA --	TD = 8.7600	TV = 2.5500	TA = 5.4100
PER = 2.20	TIMES FOR MAXIMA --	TD = 8.7700	TV = 2.5500	TA = 5.4100
PER = 2.25	TIMES FOR MAXIMA --	TD = 8.9500	TV = 2.5500	TA = 8.9400
PER = 2.30	TIMES FOR MAXIMA --	TD = 8.9700	TV = 2.5500	TA = 8.9400
PER = 2.35	TIMES FOR MAXIMA --	TD = 7.9000	TV = 2.5500	TA = 7.8800
PER = 2.40	TIMES FOR MAXIMA --	TD = 7.9400	TV = 2.5500	TA = 7.8800
PER = 2.50	TIMES FOR MAXIMA --	TD = 8.0900	TV = 2.5500	TA = 7.9400
PER = 2.60	TIMES FOR MAXIMA --	TD = 8.1100	TV = 2.5500	TA = 8.0800
PER = 2.70	TIMES FOR MAXIMA --	TD = 6.9700	TV = 2.5500	TA = 6.9400
PER = 2.80	TIMES FOR MAXIMA --	TD = 7.0000	TV = 2.5500	TA = 6.9400
PER = 2.90	TIMES FOR MAXIMA --	TD = 7.0000	TV = 2.5500	TA = 6.9400
PER = 3.00	TIMES FOR MAXIMA --	TD = 7.0100	TV = 2.5500	TA = 6.9400
PER = 3.10	TIMES FOR MAXIMA --	TD = 7.2400	TV = 2.5500	TA = 7.1900
PER = 3.20	TIMES FOR MAXIMA --	TD = 7.2500	TV = 2.5500	TA = 7.2000
PER = 3.30	TIMES FOR MAXIMA --	TD = 7.2500	TV = 2.5500	TA = 7.2000
PER = 3.40	TIMES FOR MAXIMA --	TD = 7.2600	TV = 2.5500	TA = 7.2000
PER = 3.50	TIMES FOR MAXIMA --	TD = 7.2600	TV = 2.5500	TA = 7.2400
PER = 3.60	TIMES FOR MAXIMA --	TD = 7.5200	TV = 2.5500	TA = 7.2400
PER = 3.70	TIMES FOR MAXIMA --	TD = 7.5200	TV = 2.5500	TA = 7.5000
PER = 3.80	TIMES FOR MAXIMA --	TD = 7.5200	TV = 2.5500	TA = 7.5000
PER = 3.90	TIMES FOR MAXIMA --	TD = 7.5300	TV = 2.5500	TA = 7.5000
PER = 4.00	TIMES FOR MAXIMA --	TD = 7.5300	TV = 2.5500	TA = 7.5000
PER = 4.10	TIMES FOR MAXIMA --	TD = 6.2300	TV = 2.5500	TA = 6.0000
PER = 4.20	TIMES FOR MAXIMA --	TD = 6.2400	TV = 2.5500	TA = 6.2100
PER = 4.30	TIMES FOR MAXIMA --	TD = 6.2400	TV = 2.5500	TA = 6.2100
PER = 4.40	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5500	TA = 6.2100
PER = 4.50	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5500	TA = 6.2100
PER = 4.60	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5500	TA = 6.2100
PER = 4.70	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5500	TA = 6.2100
PER = 4.80	TIMES FOR MAXIMA --	TD = 6.2600	TV = 2.5500	TA = 6.2100
PER = 4.90	TIMES FOR MAXIMA --	TD = 6.2600	TV = 2.5500	TA = 6.2100
PER = 5.00	TIMES FOR MAXIMA --	TD = 6.2600	TV = 2.5500	TA = 6.2100
PER = 5.10	TIMES FOR MAXIMA --	TD = 6.2600	TV = 2.5500	TA = 6.2200

PER = 5.20 TIMES FOR MAXIMA -- TD = 6.2600 TV = 2.5500 TA = 6.2200
PER = 5.40 TIMES FOR MAXIMA -- TD = 6.2600 TV = 2.5500 TA = 6.2200
PER = 5.60 TIMES FOR MAXIMA -- TD = 6.4700 TV = 2.5500 TA = 6.2200
PER = 5.80 TIMES FOR MAXIMA -- TD = 6.4700 TV = 2.5500 TA = 6.2200
PER = 6.00 TIMES FOR MAXIMA -- TD = 6.4800 TV = 2.5500 TA = 6.2200
PER = 6.20 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.5300
PER = 6.40 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 6.60 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 6.80 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 7.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 7.30 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 7.60 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 8.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 8.50 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 9.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 9.50 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER =10.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900

SPECTRAL VALUES--

(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00007	0.00171	0.04195	0.82192	0.81858	100.00
2	0.02	0.00027	0.04335	0.08336	0.82243	0.81328	50.00
3	0.03	0.00110	0.18379	0.22974	1.51822	1.49432	33.33
4	0.04	0.00217	0.31642	0.34155	1.74493	1.66617	25.00
5	0.05	0.00366	0.44677	0.45974	1.82459	1.79417	20.00
6	0.06	0.00428	0.41585	0.44797	1.42638	1.45686	16.67
7	0.07	0.00581	0.47802	0.52194	1.47018	1.45494	14.29
8	0.08	0.01091	0.79906	0.85696	2.13704	2.09023	12.50
9	0.09	0.01380	0.91960	0.96375	2.07701	2.08952	11.11
10	0.10	0.01203	0.70258	0.75557	1.50682	1.47435	10.00
11	0.11	0.01243	0.73464	0.71011	1.28682	1.25967	9.09
12	0.12	0.01009	0.54647	0.52809	0.85116	0.85872	8.33
13	0.13	0.01069	0.46673	0.51688	0.78573	0.77583	7.69
14	0.14	0.01281	0.55624	0.57507	0.81192	0.80152	7.14
15	0.15	0.01487	0.56239	0.62302	0.80252	0.81046	6.67
16	0.16	0.01884	0.75229	0.73986	0.91472	0.90230	6.25
17	0.17	0.02303	0.86039	0.85120	0.97551	0.97703	5.88
18	0.18	0.02485	0.86020	0.86750	0.93942	0.94042	5.56
19	0.19	0.02857	0.87770	0.94490	0.97165	0.97042	5.26
20	0.20	0.02938	0.95448	0.92312	0.90821	0.90064	5.00
21	0.21	0.03784	1.14946	1.13222	1.05638	1.05204	4.76
22	0.22	0.03804	1.12843	1.08630	0.97513	0.96349	4.55
23	0.23	0.04244	1.13944	1.15933	0.98812	0.98357	4.35
24	0.24	0.04588	1.22517	1.20103	0.98291	0.97648	4.17
25	0.25	0.05505	1.45180	1.38356	1.07767	1.07990	4.00
26	0.26	0.06352	1.64419	1.53498	1.15887	1.15200	3.85
27	0.27	0.06397	1.49739	1.48854	1.07894	1.07578	3.70
28	0.28	0.06108	1.44705	1.37074	0.96463	0.95526	3.57
29	0.29	0.06330	1.50041	1.37148	0.92871	0.92282	3.45
30	0.30	0.06799	1.58132	1.42398	0.92831	0.92621	3.33
31	0.31	0.07450	1.56110	1.50998	0.95436	0.95046	3.23
32	0.32	0.07866	1.60487	1.54449	0.94665	0.94180	3.13
33	0.33	0.07637	1.45088	1.45416	0.86887	0.85985	3.03
34	0.34	0.07200	1.33968	1.33047	0.77205	0.76357	2.94
35	0.35	0.06812	1.34283	1.22295	0.68539	0.68181	2.86
36	0.36	0.06715	1.33822	1.17200	0.64080	0.63526	2.78
37	0.37	0.06656	1.28137	1.13028	0.60109	0.59609	2.70
38	0.38	0.06468	1.25981	1.06944	0.55415	0.54916	2.63
39	0.39	0.06068	1.23910	0.97764	0.49358	0.48915	2.56
40	0.40	0.06370	1.17128	1.00062	0.49250	0.48813	2.50

41	0.41	0.06256	1.18616	0.95865	0.45808	0.45625	2.44
42	0.42	0.06037	1.19616	0.90309	0.42280	0.41957	2.38
43	0.43	0.05966	1.15192	0.87180	0.39751	0.39561	2.33
44	0.44	0.05930	1.07742	0.84685	0.37888	0.37556	2.27
45	0.45	0.05866	0.99663	0.81904	0.35661	0.35515	2.22
46	0.46	0.05718	0.90387	0.78104	0.33309	0.33131	2.17
47	0.47	0.05473	0.84874	0.73170	0.30536	0.30378	2.13
48	0.48	0.05130	0.84985	0.67155	0.27399	0.27300	2.08
49	0.49	0.05240	0.81367	0.67192	0.26905	0.26757	2.04
50	0.50	0.05402	0.80880	0.67886	0.26657	0.26493	2.00
51	0.51	0.05288	0.83519	0.65150	0.25161	0.24927	1.96
52	0.52	0.05027	0.87985	0.60736	0.22945	0.22791	1.92
53	0.53	0.05172	0.93855	0.61319	0.22691	0.22576	1.89
54	0.54	0.05617	1.00433	0.65351	0.23851	0.23615	1.85
55	0.55	0.06000	1.06884	0.68548	0.24516	0.24320	1.82
56	0.56	0.06644	1.12386	0.74544	0.26427	0.25974	1.79
57	0.57	0.07374	1.16245	0.81287	0.28269	0.27827	1.75
58	0.58	0.08007	1.17982	0.86741	0.29612	0.29182	1.72
59	0.60	0.08866	1.14420	0.92849	0.30613	0.30196	1.67
60	0.62	0.09140	1.02596	0.92630	0.29378	0.29153	1.61
61	0.64	0.08974	1.03125	0.88106	0.26991	0.26863	1.56
62	0.66	0.08366	1.08019	0.79642	0.23773	0.23546	1.52
63	0.68	0.07428	1.06790	0.68631	0.19773	0.19694	1.47
64	0.70	0.06678	1.00885	0.59944	0.16771	0.16710	1.43
65	0.72	0.06933	0.92792	0.60506	0.16570	0.16398	1.39
66	0.74	0.06680	0.83311	0.56721	0.15157	0.14957	1.35
67	0.76	0.06220	0.75200	0.51422	0.13421	0.13203	1.32
68	0.78	0.05906	0.72919	0.47575	0.12066	0.11902	1.28
69	0.80	0.06091	0.71267	0.47839	0.11739	0.11669	1.25
70	0.82	0.06283	0.70235	0.48142	0.11542	0.11456	1.22
71	0.84	0.06816	0.71704	0.50982	0.12036	0.11843	1.19
72	0.86	0.07687	0.74262	0.56162	0.12907	0.12743	1.16
73	0.88	0.08600	0.77734	0.61406	0.13751	0.13616	1.14
74	0.90	0.09759	0.79993	0.68129	0.14881	0.14771	1.11
75	0.92	0.10954	0.86595	0.74812	0.15920	0.15868	1.09
76	0.94	0.11962	0.95982	0.79954	0.16788	0.16597	1.06
77	0.96	0.12541	1.02877	0.82083	0.16974	0.16684	1.04
78	0.98	0.12810	1.05347	0.82127	0.16447	0.16353	1.02
79	1.00	0.13647	1.06090	0.85746	0.16889	0.16732	1.00
80	1.05	0.14854	1.12673	0.88885	0.16702	0.16518	0.95
81	1.10	0.15387	1.13175	0.87890	0.15746	0.15591	0.91
82	1.15	0.14959	1.17120	0.81732	0.14084	0.13868	0.87
83	1.20	0.14036	1.18130	0.73495	0.12010	0.11951	0.83
84	1.25	0.13601	1.17059	0.68368	0.10739	0.10672	0.80
85	1.30	0.13061	1.14666	0.63128	0.09671	0.09475	0.77
86	1.35	0.12893	1.11542	0.60008	0.08915	0.08674	0.74
87	1.40	0.12537	1.08104	0.56265	0.08085	0.07842	0.71
88	1.45	0.12030	1.04630	0.52129	0.07258	0.07015	0.69
89	1.50	0.11476	1.01286	0.48069	0.06478	0.06253	0.67
90	1.55	0.10878	0.98162	0.44095	0.05766	0.05551	0.65
91	1.60	0.10271	0.95297	0.40335	0.05129	0.04919	0.63
92	1.65	0.09704	0.92697	0.36955	0.04565	0.04370	0.61
93	1.70	0.09180	0.90352	0.33927	0.04070	0.03894	0.59
94	1.75	0.09076	0.88242	0.32585	0.03720	0.03633	0.57
95	1.80	0.09549	0.86342	0.33334	0.03725	0.03614	0.56
96	1.85	0.09582	0.84627	0.32543	0.03556	0.03432	0.54
97	1.90	0.09635	0.83074	0.31862	0.03353	0.03272	0.53
98	1.95	0.09936	0.81662	0.32016	0.03318	0.03204	0.51
99	2.00	0.10823	0.80374	0.34003	0.03435	0.03317	0.50
100	2.05	0.11706	0.79193	0.35877	0.03544	0.03415	0.49
101	2.10	0.12401	0.78107	0.37104	0.03586	0.03448	0.48

102	2.15	0.12967	0.77105	0.37894	0.03573	0.03439	0.47
103	2.20	0.13671	0.76177	0.39044	0.03518	0.03463	0.45
104	2.25	0.14201	0.75315	0.39657	0.03481	0.03439	0.44
105	2.30	0.14953	0.74515	0.40849	0.03535	0.03466	0.43
106	2.35	0.15353	0.73769	0.41049	0.03452	0.03408	0.43
107	2.40	0.15782	0.73074	0.41317	0.03399	0.03359	0.42
108	2.50	0.16052	0.71820	0.40344	0.03180	0.03149	0.40
109	2.60	0.16493	0.70726	0.39857	0.03037	0.02991	0.38
110	2.70	0.16824	0.69772	0.39151	0.02956	0.02829	0.37
111	2.80	0.17313	0.68944	0.38851	0.02827	0.02707	0.36
112	2.90	0.17573	0.68225	0.38075	0.02670	0.02562	0.34
113	3.00	0.17624	0.67604	0.36911	0.02498	0.02401	0.33
114	3.10	0.18240	0.67068	0.36968	0.02391	0.02327	0.32
115	3.20	0.18800	0.66610	0.36914	0.02315	0.02251	0.31
116	3.30	0.19088	0.66221	0.36343	0.02213	0.02149	0.30
117	3.40	0.19114	0.65890	0.35323	0.02089	0.02027	0.29
118	3.50	0.18855	0.65614	0.33849	0.01960	0.01887	0.29
119	3.60	0.18358	0.65386	0.32040	0.01815	0.01737	0.28
120	3.70	0.18463	0.65196	0.31354	0.01716	0.01654	0.27
121	3.80	0.18252	0.65044	0.30178	0.01623	0.01550	0.26
122	3.90	0.17770	0.64924	0.28629	0.01514	0.01432	0.26
123	4.00	0.17042	0.64831	0.26769	0.01393	0.01306	0.25
124	4.10	0.17053	0.64762	0.26134	0.01297	0.01244	0.24
125	4.20	0.17579	0.64713	0.26299	0.01273	0.01222	0.24
126	4.30	0.17994	0.64684	0.26293	0.01248	0.01193	0.23
127	4.40	0.18295	0.64670	0.26125	0.01217	0.01159	0.23
128	4.50	0.18495	0.64668	0.25824	0.01180	0.01120	0.22
129	4.60	0.18589	0.64682	0.25391	0.01140	0.01077	0.22
130	4.70	0.18585	0.64703	0.24845	0.01096	0.01032	0.21
131	4.80	0.18495	0.64733	0.24209	0.01050	0.00984	0.21
132	4.90	0.18336	0.64771	0.23511	0.01004	0.00936	0.20
133	5.00	0.18105	0.64813	0.22752	0.00956	0.00888	0.20
134	5.10	0.17813	0.64865	0.21946	0.00909	0.00840	0.20
135	5.20	0.17468	0.64916	0.21107	0.00862	0.00792	0.19
136	5.40	0.16651	0.65031	0.19375	0.00771	0.00700	0.19
137	5.60	0.16025	0.65159	0.17980	0.00686	0.00627	0.18
138	5.80	0.15264	0.65291	0.16536	0.00607	0.00556	0.17
139	6.00	0.14415	0.65430	0.15096	0.00536	0.00491	0.17
140	6.20	0.14369	0.65562	0.14562	0.00501	0.00458	0.16
141	6.40	0.14541	0.65698	0.14276	0.00478	0.00435	0.16
142	6.60	0.14651	0.65833	0.13947	0.00455	0.00412	0.15
143	6.80	0.14706	0.65959	0.13588	0.00433	0.00390	0.15
144	7.00	0.14716	0.66086	0.13209	0.00411	0.00368	0.14
145	7.30	0.14656	0.66269	0.12615	0.00380	0.00337	0.14
146	7.60	0.14526	0.66446	0.12009	0.00351	0.00308	0.13
147	8.00	0.14272	0.66661	0.11209	0.00316	0.00273	0.13
148	8.50	0.13864	0.66906	0.10248	0.00277	0.00235	0.12
149	9.00	0.13396	0.67127	0.09352	0.00243	0.00203	0.11
150	9.50	0.12900	0.67322	0.08532	0.00214	0.00175	0.11
151	10.00	0.12397	0.67505	0.07789	0.00190	0.00152	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.
AREA OF ACC. RESPONSE SPECTRUM = 0.495
AREA OF VEL. RESPONSE SPECTRUM = 2.289
MAX. ACCELERATION RESPONSE VALUE = 1.507
MAX. VELOCITY RESPONSE VALUE = 1.644

1****** OPTION 9 *** COMPUTE RESPONSE SPECTRUM
RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER 17
CALCULATED FOR DAMPING 0.050

TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
TD = TIME FOR MAX. RELATIVE DISP.
TV = TIME FOR MAX. RELATIVE VEL.
TA = TIME FOR MAX. ABSOLUTE ACC.
DAMPING RATIO = 0.050

PER = 0.01	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5700	TA = 2.5700
PER = 0.02	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5800	TA = 2.5700
PER = 0.03	TIMES FOR MAXIMA --	TD = 2.9500	TV = 2.9400	TA = 2.9500
PER = 0.04	TIMES FOR MAXIMA --	TD = 3.6300	TV = 2.6100	TA = 3.6300
PER = 0.05	TIMES FOR MAXIMA --	TD = 4.8700	TV = 4.8300	TA = 4.8400
PER = 0.06	TIMES FOR MAXIMA --	TD = 4.3200	TV = 4.3300	TA = 1.9700
PER = 0.07	TIMES FOR MAXIMA --	TD = 4.3300	TV = 4.3100	TA = 4.3300
PER = 0.08	TIMES FOR MAXIMA --	TD = 2.5200	TV = 2.5400	TA = 2.5200
PER = 0.09	TIMES FOR MAXIMA --	TD = 2.5300	TV = 2.6000	TA = 2.5300
PER = 0.10	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.6100	TA = 2.5900
PER = 0.11	TIMES FOR MAXIMA --	TD = 2.5500	TV = 2.5800	TA = 2.5500
PER = 0.12	TIMES FOR MAXIMA --	TD = 4.8000	TV = 2.5800	TA = 4.8000
PER = 0.13	TIMES FOR MAXIMA --	TD = 3.6600	TV = 4.7900	TA = 3.6600
PER = 0.14	TIMES FOR MAXIMA --	TD = 3.6700	TV = 3.7100	TA = 3.6700
PER = 0.15	TIMES FOR MAXIMA --	TD = 3.6800	TV = 3.7200	TA = 3.6800
PER = 0.16	TIMES FOR MAXIMA --	TD = 4.1800	TV = 4.1500	TA = 4.1800
PER = 0.17	TIMES FOR MAXIMA --	TD = 4.1100	TV = 4.1500	TA = 4.1100
PER = 0.18	TIMES FOR MAXIMA --	TD = 2.5600	TV = 2.5200	TA = 2.5600
PER = 0.19	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5300	TA = 2.5700
PER = 0.20	TIMES FOR MAXIMA --	TD = 6.6100	TV = 2.5300	TA = 6.6000
PER = 0.21	TIMES FOR MAXIMA --	TD = 2.5800	TV = 2.5300	TA = 7.0500
PER = 0.22	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5500	TA = 2.5000
PER = 0.23	TIMES FOR MAXIMA --	TD = 3.4200	TV = 7.0400	TA = 6.9800
PER = 0.24	TIMES FOR MAXIMA --	TD = 2.2400	TV = 2.2900	TA = 2.2300
PER = 0.25	TIMES FOR MAXIMA --	TD = 6.2400	TV = 6.3100	TA = 6.2400
PER = 0.26	TIMES FOR MAXIMA --	TD = 1.5600	TV = 6.3200	TA = 6.2500
PER = 0.27	TIMES FOR MAXIMA --	TD = 1.1900	TV = 1.2600	TA = 1.1900
PER = 0.28	TIMES FOR MAXIMA --	TD = 1.2100	TV = 1.2600	TA = 1.2000
PER = 0.29	TIMES FOR MAXIMA --	TD = 1.2100	TV = 5.1000	TA = 1.2100
PER = 0.30	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.8400	TA = 2.9100
PER = 0.31	TIMES FOR MAXIMA --	TD = 2.9400	TV = 2.8500	TA = 2.9400
PER = 0.32	TIMES FOR MAXIMA --	TD = 2.9500	TV = 2.5600	TA = 2.9500
PER = 0.33	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5600	TA = 2.5000
PER = 0.34	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5600	TA = 2.5000
PER = 0.35	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.5600	TA = 2.5000
PER = 0.36	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.9300	TA = 2.5000
PER = 0.37	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6000	TA = 2.5000
PER = 0.38	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.8000	TA = 2.5100
PER = 0.39	TIMES FOR MAXIMA --	TD = 2.5200	TV = 4.0300	TA = 2.5100
PER = 0.40	TIMES FOR MAXIMA --	TD = 3.9400	TV = 4.0300	TA = 3.9400
PER = 0.41	TIMES FOR MAXIMA --	TD = 3.9500	TV = 4.0400	TA = 3.9500
PER = 0.42	TIMES FOR MAXIMA --	TD = 3.9600	TV = 4.0400	TA = 3.9500
PER = 0.43	TIMES FOR MAXIMA --	TD = 3.9700	TV = 4.0500	TA = 3.9600
PER = 0.44	TIMES FOR MAXIMA --	TD = 3.9800	TV = 3.9100	TA = 3.9700
PER = 0.45	TIMES FOR MAXIMA --	TD = 4.6900	TV = 3.9100	TA = 4.6900
PER = 0.46	TIMES FOR MAXIMA --	TD = 4.7000	TV = 3.9100	TA = 4.6900
PER = 0.47	TIMES FOR MAXIMA --	TD = 4.7100	TV = 3.9100	TA = 4.7000
PER = 0.48	TIMES FOR MAXIMA --	TD = 4.7100	TV = 3.9100	TA = 4.7000
PER = 0.49	TIMES FOR MAXIMA --	TD = 5.5200	TV = 5.4100	TA = 5.5100
PER = 0.50	TIMES FOR MAXIMA --	TD = 5.5500	TV = 5.4100	TA = 5.5400
PER = 0.51	TIMES FOR MAXIMA --	TD = 5.5600	TV = 5.4100	TA = 5.5600
PER = 0.52	TIMES FOR MAXIMA --	TD = 2.5100	TV = 5.4400	TA = 2.5000
PER = 0.53	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6100	TA = 2.5000
PER = 0.54	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6300	TA = 2.5000
PER = 0.55	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6400	TA = 2.5000
PER = 0.56	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6400	TA = 2.5000

PER = 0.57	TIMES FOR MAXIMA --	TD = 2.5200	TV = 2.6400	TA = 2.5100
PER = 0.58	TIMES FOR MAXIMA --	TD = 2.5200	TV = 2.6400	TA = 2.5100
PER = 0.60	TIMES FOR MAXIMA --	TD = 2.5400	TV = 2.4800	TA = 2.5300
PER = 0.62	TIMES FOR MAXIMA --	TD = 2.5600	TV = 2.4800	TA = 2.5500
PER = 0.64	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.4800	TA = 2.5800
PER = 0.66	TIMES FOR MAXIMA --	TD = 2.6000	TV = 2.4900	TA = 2.5900
PER = 0.68	TIMES FOR MAXIMA --	TD = 3.4100	TV = 2.4900	TA = 3.4000
PER = 0.70	TIMES FOR MAXIMA --	TD = 3.4200	TV = 2.4900	TA = 3.4100
PER = 0.72	TIMES FOR MAXIMA --	TD = 3.4300	TV = 3.6100	TA = 3.4200
PER = 0.74	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.6100	TA = 3.4300
PER = 0.76	TIMES FOR MAXIMA --	TD = 1.8100	TV = 3.6100	TA = 1.7500
PER = 0.78	TIMES FOR MAXIMA --	TD = 1.4700	TV = 3.6100	TA = 1.8100
PER = 0.80	TIMES FOR MAXIMA --	TD = 1.4700	TV = 3.6100	TA = 1.4600
PER = 0.82	TIMES FOR MAXIMA --	TD = 1.4900	TV = 3.6100	TA = 1.4700
PER = 0.84	TIMES FOR MAXIMA --	TD = 6.4900	TV = 3.6200	TA = 6.4800
PER = 0.86	TIMES FOR MAXIMA --	TD = 3.4700	TV = 4.2200	TA = 3.4700
PER = 0.88	TIMES FOR MAXIMA --	TD = 4.0000	TV = 4.2200	TA = 3.9700
PER = 0.90	TIMES FOR MAXIMA --	TD = 4.0100	TV = 4.2200	TA = 4.0000
PER = 0.92	TIMES FOR MAXIMA --	TD = 4.0100	TV = 4.2900	TA = 4.0000
PER = 0.94	TIMES FOR MAXIMA --	TD = 3.1200	TV = 4.2900	TA = 3.1100
PER = 0.96	TIMES FOR MAXIMA --	TD = 3.1200	TV = 3.9100	TA = 3.1100
PER = 0.98	TIMES FOR MAXIMA --	TD = 3.1300	TV = 3.9100	TA = 3.1200
PER = 1.00	TIMES FOR MAXIMA --	TD = 3.1500	TV = 3.9100	TA = 3.1200
PER = 1.05	TIMES FOR MAXIMA --	TD = 3.2000	TV = 3.9100	TA = 3.1800
PER = 1.10	TIMES FOR MAXIMA --	TD = 3.2300	TV = 2.4900	TA = 3.2200
PER = 1.15	TIMES FOR MAXIMA --	TD = 3.3000	TV = 2.4900	TA = 3.2900
PER = 1.20	TIMES FOR MAXIMA --	TD = 3.3300	TV = 2.4900	TA = 3.3100
PER = 1.25	TIMES FOR MAXIMA --	TD = 3.3500	TV = 2.4900	TA = 3.3300
PER = 1.30	TIMES FOR MAXIMA --	TD = 3.3700	TV = 2.4900	TA = 3.3600
PER = 1.35	TIMES FOR MAXIMA --	TD = 2.8400	TV = 2.4900	TA = 2.8200
PER = 1.40	TIMES FOR MAXIMA --	TD = 2.8700	TV = 2.4900	TA = 2.8300
PER = 1.45	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.4900	TA = 2.8600
PER = 1.50	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.4900	TA = 2.8900
PER = 1.55	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.4900	TA = 2.9100
PER = 1.60	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.4900	TA = 2.9100
PER = 1.65	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.4900	TA = 2.9100
PER = 1.70	TIMES FOR MAXIMA --	TD = 2.9900	TV = 2.4900	TA = 2.3700
PER = 1.75	TIMES FOR MAXIMA --	TD = 2.3900	TV = 2.4900	TA = 2.3700
PER = 1.80	TIMES FOR MAXIMA --	TD = 5.9300	TV = 2.4900	TA = 5.9200
PER = 1.85	TIMES FOR MAXIMA --	TD = 6.0000	TV = 2.4900	TA = 5.9900
PER = 1.90	TIMES FOR MAXIMA --	TD = 6.0500	TV = 5.7600	TA = 6.0400
PER = 1.95	TIMES FOR MAXIMA --	TD = 5.3500	TV = 5.7600	TA = 5.3400
PER = 2.00	TIMES FOR MAXIMA --	TD = 5.3600	TV = 5.7600	TA = 5.3400
PER = 2.05	TIMES FOR MAXIMA --	TD = 5.3600	TV = 5.7600	TA = 5.3400
PER = 2.10	TIMES FOR MAXIMA --	TD = 5.3600	TV = 5.7600	TA = 5.3400
PER = 2.15	TIMES FOR MAXIMA --	TD = 8.7100	TV = 5.7600	TA = 5.3400
PER = 2.20	TIMES FOR MAXIMA --	TD = 8.8100	TV = 5.7600	TA = 7.6700
PER = 2.25	TIMES FOR MAXIMA --	TD = 8.8900	TV = 5.7600	TA = 8.8800
PER = 2.30	TIMES FOR MAXIMA --	TD = 7.8200	TV = 5.7600	TA = 8.8800
PER = 2.35	TIMES FOR MAXIMA --	TD = 7.8800	TV = 5.7600	TA = 7.7900
PER = 2.40	TIMES FOR MAXIMA --	TD = 7.9100	TV = 5.7600	TA = 7.8800
PER = 2.50	TIMES FOR MAXIMA --	TD = 8.0300	TV = 7.3100	TA = 8.0100
PER = 2.60	TIMES FOR MAXIMA --	TD = 8.0600	TV = 7.6400	TA = 8.0200
PER = 2.70	TIMES FOR MAXIMA --	TD = 6.9400	TV = 7.6400	TA = 6.8800
PER = 2.80	TIMES FOR MAXIMA --	TD = 6.9400	TV = 7.6500	TA = 6.8800
PER = 2.90	TIMES FOR MAXIMA --	TD = 7.0600	TV = 7.6500	TA = 6.9300
PER = 3.00	TIMES FOR MAXIMA --	TD = 7.1500	TV = 7.6500	TA = 7.0400
PER = 3.10	TIMES FOR MAXIMA --	TD = 7.1900	TV = 5.3000	TA = 7.1400
PER = 3.20	TIMES FOR MAXIMA --	TD = 7.2000	TV = 5.3000	TA = 7.1400
PER = 3.30	TIMES FOR MAXIMA --	TD = 7.2100	TV = 5.3000	TA = 7.1800
PER = 3.40	TIMES FOR MAXIMA --	TD = 7.2100	TV = 5.3000	TA = 7.1800

PER = 3.50 TIMES FOR MAXIMA -- TD = 7.2200 TV = 5.3000 TA = 7.1900
PER = 3.60 TIMES FOR MAXIMA -- TD = 7.4500 TV = 5.3000 TA = 7.3800
PER = 3.70 TIMES FOR MAXIMA -- TD = 7.4600 TV = 5.3000 TA = 7.3900
PER = 3.80 TIMES FOR MAXIMA -- TD = 7.5000 TV = 5.3000 TA = 7.4400
PER = 3.90 TIMES FOR MAXIMA -- TD = 7.5100 TV = 5.3000 TA = 7.4500
PER = 4.00 TIMES FOR MAXIMA -- TD = 7.6200 TV = 5.3000 TA = 7.4500
PER = 4.10 TIMES FOR MAXIMA -- TD = 6.1600 TV = 5.3000 TA = 6.0900
PER = 4.20 TIMES FOR MAXIMA -- TD = 6.1600 TV = 5.3000 TA = 6.1400
PER = 4.30 TIMES FOR MAXIMA -- TD = 6.1700 TV = 5.3000 TA = 6.1500
PER = 4.40 TIMES FOR MAXIMA -- TD = 6.1900 TV = 5.3000 TA = 6.1500
PER = 4.50 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.60 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.70 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.80 TIMES FOR MAXIMA -- TD = 6.3400 TV = 5.3000 TA = 6.1500
PER = 4.90 TIMES FOR MAXIMA -- TD = 6.3400 TV = 5.3000 TA = 6.1500
PER = 5.00 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.10 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.20 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.40 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.60 TIMES FOR MAXIMA -- TD = 6.5400 TV = 5.3000 TA = 6.3200
PER = 5.80 TIMES FOR MAXIMA -- TD = 6.5500 TV = 5.3000 TA = 6.5000
PER = 6.00 TIMES FOR MAXIMA -- TD = 6.5500 TV = 5.3000 TA = 6.5000
PER = 6.20 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.5200
PER = 6.40 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.7300
PER = 6.60 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.7300
PER = 6.80 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.30 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.60 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 8.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 8.50 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 9.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 9.50 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER =10.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300

SPECTRAL VALUES--

(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00005	0.00136	0.02849	0.55850	0.55584	100.00
2	0.02	0.00018	0.04499	0.05569	0.55907	0.54337	50.00
3	0.03	0.00100	0.17299	0.21036	1.35502	1.36825	33.33
4	0.04	0.00178	0.23944	0.27972	1.41661	1.36454	25.00
5	0.05	0.00238	0.31660	0.29913	1.19625	1.16738	20.00
6	0.06	0.00324	0.37402	0.33931	1.11290	1.10350	16.67
7	0.07	0.00410	0.42586	0.36768	1.00192	1.02494	14.29
8	0.08	0.00662	0.49285	0.51989	1.30592	1.26808	12.50
9	0.09	0.01058	0.74261	0.73891	1.61391	1.60203	11.11
10	0.10	0.00992	0.62974	0.62356	1.19459	1.21675	10.00
11	0.11	0.00945	0.61752	0.53978	0.94469	0.95753	9.09
12	0.12	0.00955	0.45760	0.49991	0.83422	0.81289	8.33
13	0.13	0.00942	0.48076	0.45526	0.67574	0.68335	7.69
14	0.14	0.01238	0.51781	0.55546	0.77129	0.77420	7.14
15	0.15	0.01197	0.53788	0.50127	0.65502	0.65209	6.67
16	0.16	0.01428	0.62039	0.56072	0.68796	0.68383	6.25
17	0.17	0.01619	0.69957	0.59823	0.69353	0.68666	5.88
18	0.18	0.01573	0.57102	0.54919	0.60640	0.59536	5.56
19	0.19	0.01745	0.63990	0.57695	0.59795	0.59253	5.26
20	0.20	0.01613	0.56661	0.50682	0.50024	0.49448	5.00
21	0.21	0.01674	0.60435	0.50091	0.46688	0.46544	4.76
22	0.22	0.01774	0.54424	0.50670	0.46072	0.44942	4.55
23	0.23	0.01530	0.47636	0.41797	0.35437	0.35460	4.35

24	0.24	0.01639	0.46797	0.42917	0.35591	0.34893	4.17
25	0.25	0.01736	0.48167	0.43619	0.34254	0.34046	4.00
26	0.26	0.01916	0.51490	0.46302	0.35118	0.34750	3.85
27	0.27	0.02110	0.53368	0.49104	0.35711	0.35488	3.70
28	0.28	0.02280	0.53679	0.51153	0.35936	0.35648	3.57
29	0.29	0.02363	0.56432	0.51192	0.34832	0.34445	3.45
30	0.30	0.02424	0.55960	0.50764	0.33261	0.33018	3.33
31	0.31	0.02969	0.62717	0.60171	0.38143	0.37875	3.23
32	0.32	0.03087	0.64924	0.60610	0.37197	0.36959	3.13
33	0.33	0.02956	0.62054	0.56290	0.33676	0.33284	3.03
34	0.34	0.02988	0.59171	0.55227	0.32331	0.31695	2.94
35	0.35	0.03145	0.58062	0.56451	0.32000	0.31472	2.86
36	0.36	0.03369	0.56893	0.58806	0.32211	0.31875	2.78
37	0.37	0.03527	0.58074	0.59894	0.31687	0.31587	2.70
38	0.38	0.03518	0.57848	0.58166	0.30335	0.29868	2.63
39	0.39	0.03387	0.62913	0.54565	0.27671	0.27301	2.56
40	0.40	0.03589	0.68918	0.56383	0.27621	0.27505	2.50
41	0.41	0.03816	0.69282	0.58485	0.27999	0.27835	2.44
42	0.42	0.03860	0.65645	0.57750	0.26954	0.26830	2.38
43	0.43	0.03804	0.60516	0.55578	0.25364	0.25221	2.33
44	0.44	0.03681	0.59581	0.52568	0.23464	0.23313	2.27
45	0.45	0.03653	0.60067	0.51004	0.22154	0.22117	2.22
46	0.46	0.03729	0.59047	0.50937	0.21665	0.21607	2.17
47	0.47	0.03606	0.57052	0.48207	0.20332	0.20014	2.13
48	0.48	0.03349	0.54379	0.43835	0.18014	0.17820	2.08
49	0.49	0.03413	0.51793	0.43769	0.17566	0.17430	2.04
50	0.50	0.03500	0.52157	0.43985	0.17218	0.17165	2.00
51	0.51	0.03473	0.49075	0.42793	0.16499	0.16373	1.96
52	0.52	0.03363	0.45429	0.40638	0.15517	0.15249	1.92
53	0.53	0.03853	0.46746	0.45674	0.17096	0.16816	1.89
54	0.54	0.04389	0.51448	0.51070	0.18737	0.18454	1.85
55	0.55	0.04926	0.55886	0.56278	0.20245	0.19966	1.82
56	0.56	0.05415	0.59863	0.60760	0.21441	0.21172	1.79
57	0.57	0.05848	0.62378	0.64468	0.22381	0.22070	1.75
58	0.58	0.06184	0.63106	0.66986	0.22829	0.22536	1.72
59	0.60	0.06544	0.70068	0.68529	0.22393	0.22287	1.67
60	0.62	0.06573	0.79556	0.66617	0.21124	0.20966	1.61
61	0.64	0.06527	0.83826	0.64083	0.19701	0.19538	1.56
62	0.66	0.06037	0.83336	0.57472	0.17238	0.16992	1.52
63	0.68	0.05937	0.78867	0.54857	0.15814	0.15742	1.47
64	0.70	0.06308	0.71314	0.56623	0.15969	0.15784	1.43
65	0.72	0.06124	0.63612	0.53441	0.14674	0.14483	1.39
66	0.74	0.05637	0.58189	0.47867	0.12760	0.12622	1.35
67	0.76	0.05182	0.52189	0.42839	0.11039	0.10999	1.32
68	0.78	0.05224	0.48141	0.42084	0.10620	0.10528	1.28
69	0.80	0.05347	0.46947	0.41997	0.10299	0.10244	1.25
70	0.82	0.05454	0.48106	0.41789	0.09999	0.09944	1.22
71	0.84	0.05857	0.50396	0.43810	0.10258	0.10177	1.19
72	0.86	0.06521	0.56033	0.47640	0.10880	0.10809	1.16
73	0.88	0.07540	0.63272	0.53836	0.11994	0.11938	1.14
74	0.90	0.08642	0.69483	0.60330	0.13206	0.13080	1.11
75	0.92	0.09546	0.73421	0.65194	0.14025	0.13828	1.09
76	0.94	0.10261	0.79469	0.68589	0.14302	0.14238	1.06
77	0.96	0.11124	0.85758	0.72810	0.14917	0.14799	1.04
78	0.98	0.11832	0.92962	0.75859	0.15264	0.15105	1.02
79	1.00	0.12378	0.97242	0.77774	0.15296	0.15176	1.00
80	1.05	0.13543	0.94462	0.81038	0.15223	0.15060	0.95
81	1.10	0.13936	0.91425	0.79602	0.14229	0.14121	0.91
82	1.15	0.13942	0.92776	0.76173	0.12990	0.12925	0.87
83	1.20	0.13742	0.91717	0.71955	0.11796	0.11700	0.83
84	1.25	0.13052	0.89112	0.65605	0.10342	0.10241	0.80

85	1.30	0.12014	0.85653	0.58064	0.08786	0.08715	0.77
86	1.35	0.11483	0.81840	0.53443	0.07843	0.07725	0.74
87	1.40	0.11078	0.78000	0.49719	0.06994	0.06930	0.71
88	1.45	0.10667	0.74332	0.46222	0.06255	0.06220	0.69
89	1.50	0.10247	0.70939	0.42921	0.05627	0.05583	0.67
90	1.55	0.09800	0.67864	0.39727	0.05054	0.05001	0.65
91	1.60	0.09315	0.65110	0.36578	0.04533	0.04461	0.63
92	1.65	0.08827	0.62659	0.33614	0.04056	0.03975	0.61
93	1.70	0.08406	0.60485	0.31070	0.03642	0.03566	0.59
94	1.75	0.08232	0.58554	0.29557	0.03416	0.03296	0.57
95	1.80	0.08511	0.56835	0.29710	0.03252	0.03221	0.56
96	1.85	0.09046	0.55299	0.30724	0.03299	0.03241	0.54
97	1.90	0.09369	0.55264	0.30982	0.03228	0.03182	0.53
98	1.95	0.09719	0.57669	0.31317	0.03199	0.03134	0.51
99	2.00	0.10618	0.59049	0.33357	0.03334	0.03254	0.50
100	2.05	0.11329	0.59503	0.34724	0.03395	0.03305	0.49
101	2.10	0.11848	0.59178	0.35449	0.03395	0.03294	0.48
102	2.15	0.12507	0.58239	0.36551	0.03345	0.03317	0.47
103	2.20	0.13231	0.56849	0.37788	0.03396	0.03352	0.45
104	2.25	0.14127	0.55156	0.39451	0.03461	0.03421	0.44
105	2.30	0.14555	0.53286	0.39762	0.03432	0.03373	0.43
106	2.35	0.15032	0.51341	0.40191	0.03358	0.03337	0.43
107	2.40	0.15378	0.49399	0.40260	0.03307	0.03273	0.42
108	2.50	0.16045	0.47493	0.40326	0.03175	0.03148	0.40
109	2.60	0.16086	0.46775	0.38874	0.02958	0.02918	0.38
110	2.70	0.16244	0.48295	0.37802	0.02799	0.02732	0.37
111	2.80	0.16553	0.48384	0.37144	0.02643	0.02589	0.36
112	2.90	0.16738	0.47446	0.36265	0.02483	0.02440	0.34
113	3.00	0.17264	0.45662	0.36159	0.02380	0.02352	0.33
114	3.10	0.17811	0.44595	0.36099	0.02309	0.02272	0.32
115	3.20	0.18202	0.45345	0.35740	0.02213	0.02179	0.31
116	3.30	0.18346	0.46135	0.34931	0.02109	0.02065	0.30
117	3.40	0.18236	0.46940	0.33701	0.01986	0.01934	0.29
118	3.50	0.17866	0.47735	0.32073	0.01848	0.01788	0.29
119	3.60	0.17795	0.48496	0.31058	0.01717	0.01683	0.28
120	3.70	0.17716	0.49200	0.30084	0.01615	0.01587	0.27
121	3.80	0.17389	0.49830	0.28752	0.01510	0.01476	0.26
122	3.90	0.16892	0.50375	0.27215	0.01394	0.01362	0.26
123	4.00	0.16257	0.50827	0.25536	0.01270	0.01246	0.25
124	4.10	0.16720	0.51183	0.25624	0.01240	0.01220	0.24
125	4.20	0.17130	0.51442	0.25627	0.01215	0.01191	0.24
126	4.30	0.17439	0.51608	0.25482	0.01186	0.01156	0.23
127	4.40	0.17660	0.51685	0.25219	0.01151	0.01118	0.23
128	4.50	0.17784	0.51679	0.24832	0.01111	0.01077	0.22
129	4.60	0.17820	0.51597	0.24340	0.01069	0.01033	0.22
130	4.70	0.17762	0.51446	0.23745	0.01023	0.00986	0.21
131	4.80	0.17619	0.51234	0.23064	0.00976	0.00938	0.21
132	4.90	0.17586	0.50969	0.22550	0.00929	0.00898	0.20
133	5.00	0.17475	0.50658	0.21959	0.00889	0.00857	0.20
134	5.10	0.17300	0.50308	0.21314	0.00850	0.00815	0.20
135	5.20	0.17062	0.49924	0.20616	0.00810	0.00774	0.19
136	5.40	0.16427	0.49084	0.19114	0.00731	0.00691	0.19
137	5.60	0.15767	0.48179	0.17690	0.00653	0.00616	0.18
138	5.80	0.15136	0.47242	0.16397	0.00581	0.00552	0.17
139	6.00	0.14395	0.46299	0.15074	0.00521	0.00490	0.17
140	6.20	0.14150	0.45370	0.14340	0.00485	0.00451	0.16
141	6.40	0.14276	0.44470	0.14015	0.00459	0.00427	0.16
142	6.60	0.14344	0.43607	0.13655	0.00436	0.00404	0.15
143	6.80	0.14364	0.42789	0.13273	0.00413	0.00381	0.15
144	7.00	0.14346	0.42018	0.12877	0.00392	0.00359	0.14
145	7.30	0.14249	0.40956	0.12264	0.00361	0.00328	0.14

146	7.60	0.14087	0.40837	0.11646	0.00332	0.00299	0.13
147	8.00	0.13798	0.41060	0.10837	0.00297	0.00264	0.13
148	8.50	0.13357	0.41312	0.09873	0.00259	0.00227	0.12
149	9.00	0.12865	0.41537	0.08981	0.00226	0.00195	0.11
150	9.50	0.12352	0.41738	0.08169	0.00198	0.00168	0.11
151	10.00	0.11835	0.41917	0.07436	0.00175	0.00145	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.
AREA OF ACC. RESPONSE SPECTRUM = 0.331
AREA OF VEL. RESPONSE SPECTRUM = 1.567
MAX. ACCELERATION RESPONSE VALUE = 1.195
MAX. VELOCITY RESPONSE VALUE = 0.972

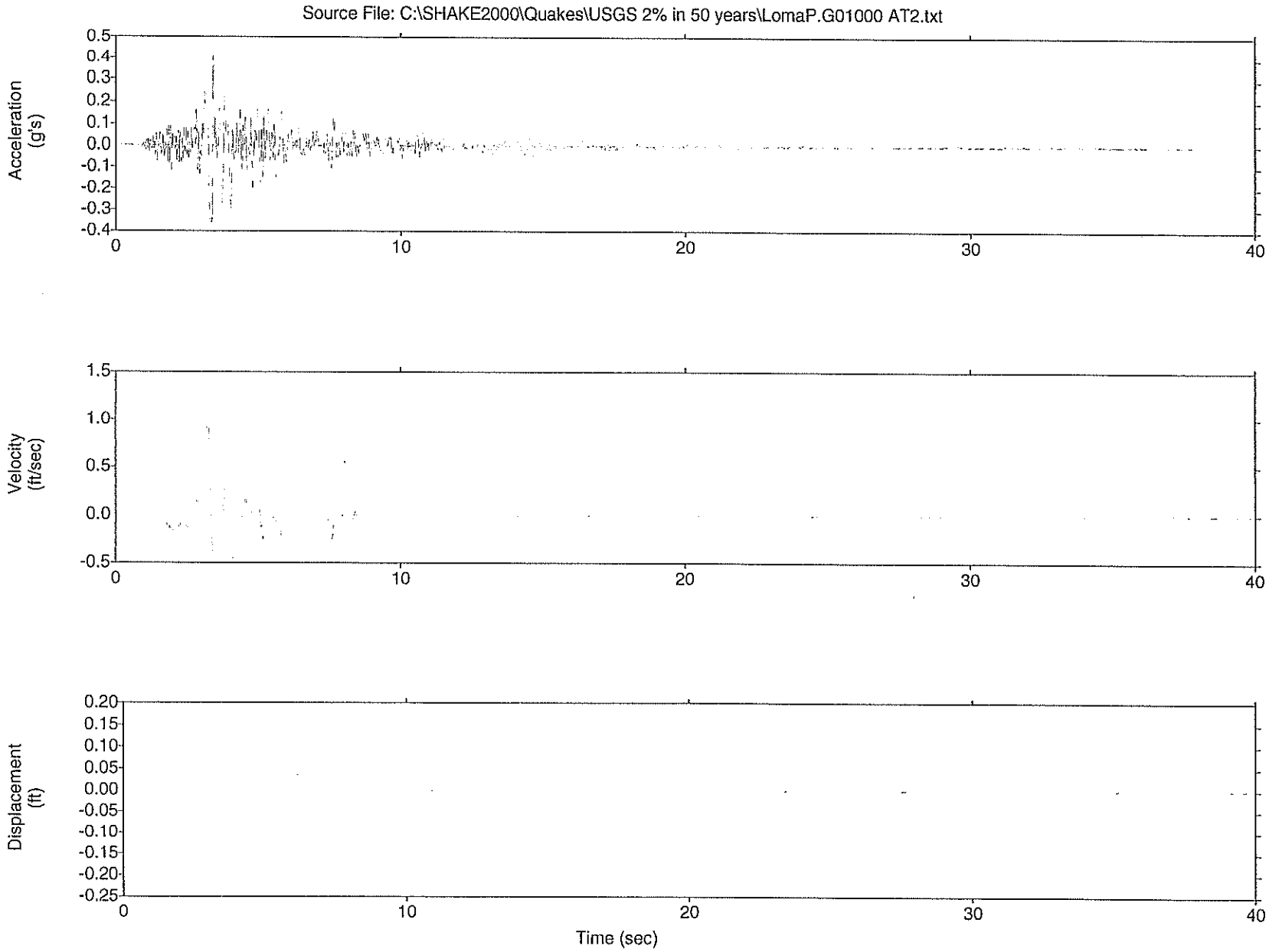
*** End of Output File No. 1 ***

PCSC300M Crest Column
Williamson - Pond Creek South Cell - Surf. El. 502, GWT 14ft., Flnes El. 496
M6.9 Loma Prieta, CA PEER Record @11km Scaled to 0.54g

Layer	Depth to Middle of Layer (ft)	Total Unit Weight (kcf)	Damping Used (%)	Shear Modulus (ksf)	Maximum Shear Strain (%)	Maximum Shear Stress (psf)	Shear Wave Velocity (fps)	Depth to Top of Layer (ft)	Peak Acceleration (g)	G/Gmax Curve	Damping Curve
1	2	.13	2.9	2930.6	.00792	232.15	851.9901	0	.87811	Coarse	Coarse
2	5.5	.13	5	2573.9	.025	643.55	798.4581	4	.87436	Coarse	Coarse
3	8.5	.13	6.4	2332.2	.04267	995.07	760.0447	7	.86558	Coarse	Coarse
4	11.5	.13	6.2	3325.9	.04006	1332.31	907.6342	10	.85627	Coarse	Coarse
5	14.5	.14	8.2	2281.9	.07402	1688.99	724.4564	13	.84551	Coarse	Coarse
6	17.5	.14	10.1	1593.9	.12834	2045.62	605.4725	16	.82977	Coarse	Coarse
7	20.5	.14	10.7	1600.6	.14858	2378.17	606.7438	19	.80559	Coarse	Coarse
8	23.5	.14	13	923.9	.29079	2686.52	460.974	22	.7816	Coarse	Coarse
9	26.5	.14	12.9	1038.1	.28336	2941.63	488.6338	25	.74268	Coarse	Coarse
10	30	.14	13.7	892	.35757	3189.67	452.9459	28	.69783	Coarse	Coarse
11	33.5	.135	17.2	406	.82045	3330.7	311.1889	32	.61347	Residual	Residual
12	36.5	.135	17.1	412	.80875	3332.28	313.4799	35	.50219	Residual	Residual
13	39.5	.135	14.9	699.1	.46907	3279.36	408.3482	38	.43122	Residual	Residual
14	42.5	.135	11.9	1327.4	.24441	3244.31	562.6806	41	.50765	Residual	Residual
15	45.5	.135	6.9	3820.1	.08596	3283.76	954.5494	44	.51826	Residual	Residual
16	48.5	.135	6.9	3776.5	.08675	3275.96	949.0865	47	.50559	Residual	Residual
17	Base							50	.49907		
17	Outcrop							50	.53173		

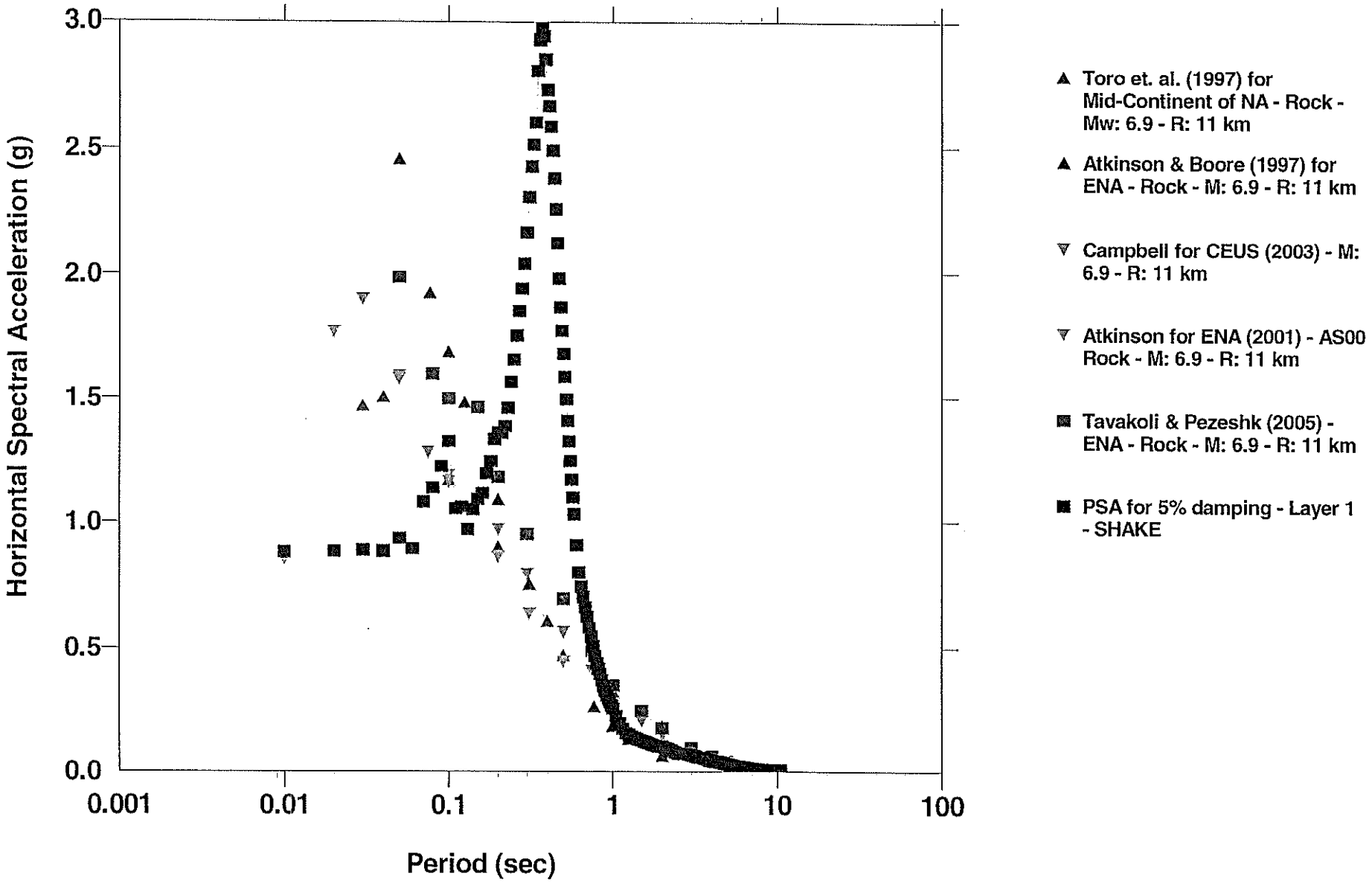
Notes:
Period for Soil Column: .31 sec
Average Shear Wave Velocity for Soil Column: 636 ft/sec

37 / 131
R15881


Source File: C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.G01000 AT2.txt
Acceleration (g's)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
10
20
30
40
Velocity (ft/sec)
1.5
1.0
0.5
0.0
-0.5
0
10
20
30
40
Displacement (ft)
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
-0.25
0
10
20
30
40
Time (sec)

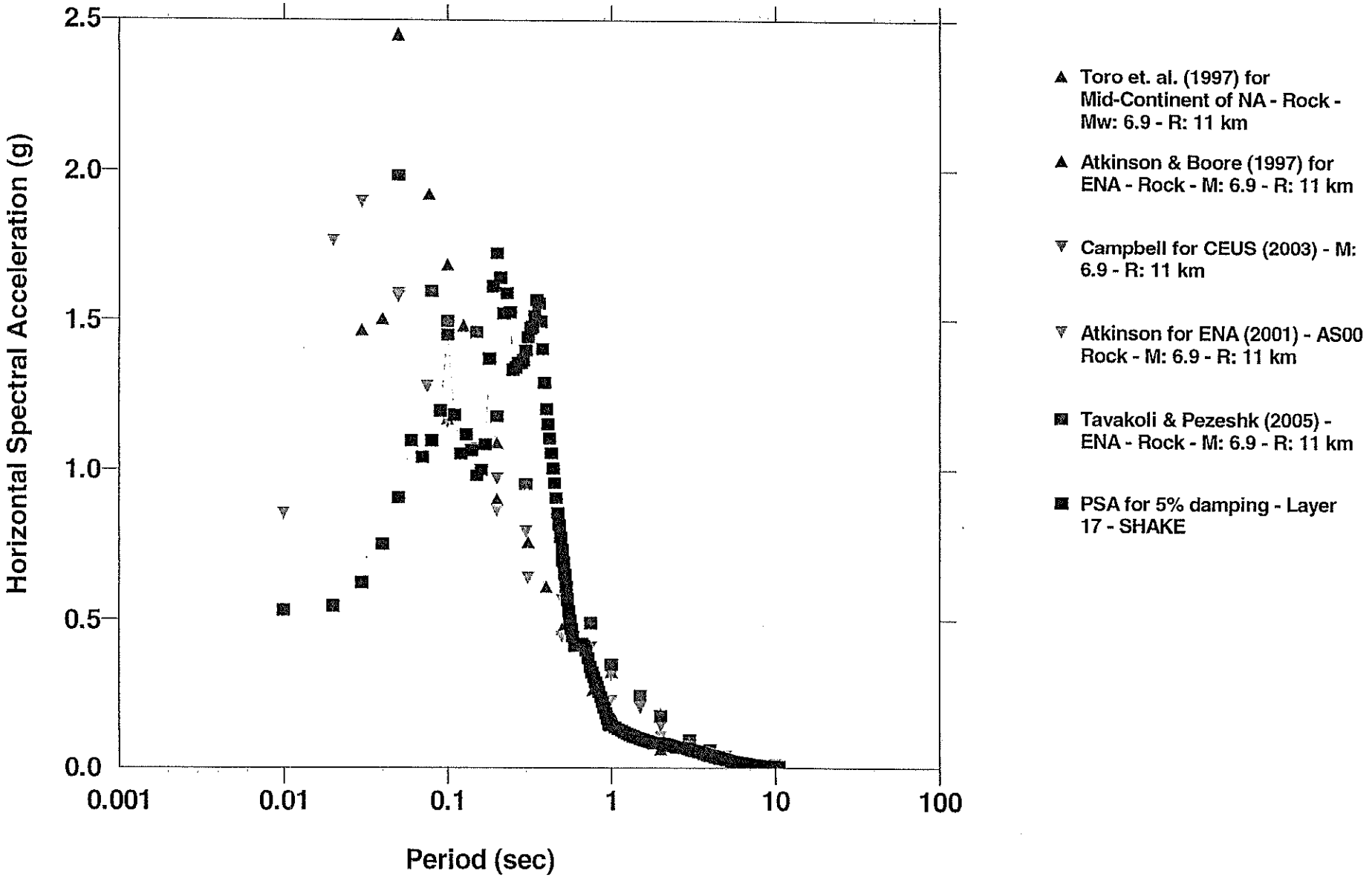
R15882

PCSC300M Crest Column - M6.9 Loma Prieta, CA PEER Record @11km



R15883

PCSC300M Crest Column - M6.9 Loma Prieta, CA PEER Record @11km



R15884

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************************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*    LAYERED SITES by Per Schnable & John Lysmer - 1970  *
* ---------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
* ---------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added  *
*     using results from Sun et al (1988) by J. I. Sun   *
*     & Ramin Golesorkhi February 26, 1988               *
* ----------------------------------------------------*
* SHAKE90/91: Adjust last iteration; Input now is either  *
*     Gmax or max Vs; up to 13 materials can be specified*
*     by user; up to 50 Layers can be specified; object  *
*     motion can be read in from a separate file and can *
*     user specified format; Different periods for res-  *
*     ponse spectral calculations;options are renumbered;*
*     and general cleanup by: J. I. Sun, I. M. Idriss &  *
*     P. Dirrim June 1990 - February 1991                *
* ---------------------------------------------------- *
* SHAKE91: General cleanup and finalization of input out- *
*     output format ... etc by: I. M. Idriss Dec. 1991   *
* ---------------------------------------------------- *
* SHAKE2000: Fix the incorrect output of Tot. Stress in   *
* Option 2. Changed path of ground motion file in         *
* SHAKE91.  Control file to input file names.  Modified   *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
*         RUN DATE  1/17/2008                             *
*         RUN TIME 11:27                                  *
************************************************************
MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =    32768
NECESSARY LENGTH OF BLANK COMMON X       =   204819

1****** OPTION  1 *** READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

**********************
 MATERIAL TYPE NO. 1
**********************

CURVE NO. 1:   Coarse    G/Gmax - Gravel (Mean) - Rollins et al. JGGE
CURVE NO. 2:   Coarse    Damping for Gravel (Mean) - Rollins et al. J
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.90
0.0002	0.995	0.0003	1.11
0.0005	0.980	0.0006	1.30
0.0008	0.970	0.0010	1.50
0.0010	0.960	0.0020	1.91
0.0020	0.930	0.0030	2.24
0.0030	0.905	0.0040	2.54
0.0040	0.880	0.0060	3.05
0.0070	0.810	0.0080	3.50
0.0100	0.755	0.0100	3.89
0.0200	0.630	0.0200	5.45
0.0700	0.390	0.0300	6.61
0.1000	0.325	0.0500	8.28
0.2000	0.205	0.1000	10.79
0.3000	0.150	0.2000	13.23

0.4000	0.115	0.3000	14.47
0.5000	0.095	0.4000	15.24
0.6000	0.080	0.6000	16.14
0.8000	0.070	0.8000	16.66
1.0000	0.050	1.0000	17.01

****
MATERIAL TYPE NO. 2
****

CURVE NO. 3: Fine Refuse Moduli for Fine Refuse (Ellison & Cho, 1976)
CURVE NO. 4: Fine Refuse Damping Values for Fine Refuse (Ellison & Ch

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.75
0.0004	1.000	0.0004	0.65
0.0010	0.995	0.0010	0.70
0.0020	0.992	0.0020	0.80
0.0040	0.989	0.0040	0.90
0.0060	0.981	0.0060	1.10
0.0080	0.965	0.0080	1.30
0.0100	0.955	0.0100	1.40
0.0200	0.905	0.0200	2.00
0.0400	0.828	0.0400	3.10
0.0600	0.750	0.0600	4.00
0.0800	0.670	0.0800	5.20
0.1000	0.610	0.1000	6.00
0.2000	0.610	0.2000	6.00

****
MATERIAL TYPE NO. 3
****

CURVE NO. 5: Residual G/Gmax PI=15% - Effective Confining Pressure
CURVE NO. 6: Residual Damping PI=15% - Effective Confining Pressur

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0000	1.000	0.0000	0.67
0.0000	1.000	0.0000	0.67
0.0000	0.999	0.0000	0.68
0.0001	0.998	0.0001	0.68
0.0002	0.996	0.0002	0.70
0.0005	0.991	0.0005	0.75
0.0010	0.983	0.0010	0.83
0.0022	0.965	0.0022	1.02
0.0048	0.931	0.0048	1.43
0.0100	0.873	0.0100	2.17
0.0220	0.770	0.0220	3.68
0.0484	0.618	0.0484	6.24
0.1000	0.454	0.1000	9.48
0.2200	0.287	0.2200	13.40
0.4840	0.163	0.4840	16.87
1.0000	0.091	1.0000	19.16

****
MATERIAL TYPE NO. 4
****

CURVE NO. 7: Rock G/Gmax - ROCK (Schnabel 1973)
CURVE NO. 8: Rock Damping for ROCK (Schnabel 1973)

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.40
0.0003	1.000	0.0010	0.80
0.0010	0.990	0.0100	1.50
0.0030	0.950	0.1000	3.00
0.0100	0.900	1.0000	4.60
0.0300	0.810	0.0000	0.00
0.1000	0.725	0.0000	0.00
1.0000	0.550	0.0000	0.00

1****** OPTION 2 *** READ SOIL PROFILE
NEW SOIL PROFILE NO. 1 IDENTIFICATION PCSC300M Crest Column
NUMBER OF LAYERS 17 DEPTH TO BEDROCK 50.00

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	1	4.0000	2.0000	0.26	3454.	0.050	0.130	924.9
2	1	3.0000	5.5000	0.71	3856.	0.050	0.130	977.3
3	1	3.0000	8.5000	1.11	4110.	0.050	0.130	1009.0
4	1	3.0000	11.5000	1.50	5739.	0.050	0.130	1192.3
5	1	3.0000	14.5000	1.90	4941.	0.050	0.140	1066.0
6	1	3.0000	17.5000	2.32	4453.	0.050	0.140	1012.0
7	1	3.0000	20.5000	2.74	4832.	0.050	0.140	1054.2
8	1	3.0000	23.5000	3.16	4269.	0.050	0.140	990.9
9	1	3.0000	26.5000	3.58	4713.	0.050	0.140	1041.1
10	1	4.0000	30.0000	4.07	4808.	0.050	0.140	1051.6
11	3	3.0000	33.5000	4.55	2635.	0.050	0.135	792.8
12	3	3.0000	36.5000	4.96	2661.	0.050	0.135	796.7
13	3	3.0000	39.5000	5.36	2998.	0.050	0.135	845.6
14	3	3.0000	42.5000	5.77	3763.	0.050	0.135	947.4
15	3	3.0000	45.5000	6.17	6529.	0.050	0.135	1247.9
16	3	3.0000	48.5000	6.58	6476.	0.050	0.135	1242.8
17	BASE				74534.	0.050	0.150	4000.0

PERIOD = 0.20 FROM AVERAGE SHEAR VEL. = 1011.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 12.34
FOR FREQUENCY = 4.85 C/SEC.
PERIOD = 0.21 SEC.

1****** OPTION 3 *** READ INPUT MOTION

FILE NAME FOR INPUT MOTION = C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
NO. OF INPUT ACC. POINTS = 7986
NO. OF POINTS USED IN FFT = 16384
NO. OF HEADING LINES = 8
NO. OF POINTS PER LINE = 6

```
 TIME STEP FOR INPUT MOTION = 0.0050
   FORMAT FOR TIME HISTORY =    (6F15.8)


 *****HEADER*****
Source File: C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.G01000_AT2.txt
SHAKE2000 Conversion:   7986    .005    8       6       15      (6F15.
Acceleration Units: (g's) - No. Values: 7986 - Time Step: .005 (secs)
Data Format: (6F15.8) - No. Header Lines:  8
PEER STRONG MOTION DATABASE RECORD. PROCESSING BY PACIFIC ENGINEERING.
LOMA PRIETA 10/18/89 00:05, GILROY ARRAY #1, 000 (CDMG STATION 47379)
ACCELERATION TIME HISTORY IN UNITS OF G. FILTER POINTS: HP=0.2 Hz LP=50.0 Hz
NPTS= 7989, DT= .00500 SEC
 ** FIRST AND LAST 5 LINES OF INPUT MOTION *****

    1 0.005126 0.005640 0.002756-0.001308-0.000650-0.000681
    2 -0.000754-0.000848-0.000917-0.000943-0.000964-0.001005
    3 -0.001043-0.001062-0.001089-0.001142-0.001196-0.001236
    4 -0.001261-0.001274-0.001273-0.001242-0.001152-0.001012
    5 -0.000888-0.000801-0.000713-0.000637-0.000622-0.000652
  .....INPUT MOTION READ NOT ECHOED.....
 1327 -0.000097-0.000099-0.000100-0.000101-0.000102-0.000103
 1328 -0.000105-0.000106-0.000107-0.000108-0.000109-0.000110
 1329 -0.000111-0.000112-0.000113-0.000114-0.000115-0.000116
 1330 -0.000117-0.000118-0.000119-0.000120-0.000121-0.000122
 1331 -0.000123-0.000124-0.000125-0.000126-0.000127-0.000128

 MAXIMUM ACCELERATION =  0.41088
 AT TIME          = 3.42 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  1.314
 TO GIVE NEW MAXIMUM ACCELERATION        = 0.54000
 MEAN SQUARE FREQUENCY =      5.52 C/SEC.
 MAX ACCELERATION =    0.53173 FOR FREQUENCIES REMOVED ABOVE     40.00 C/SEC.
 |******  OPTION  4  ***  READ WHERE OBJECT MOTION IS GIVEN
  OBJECT MOTION IN LAYER NUMBER  17 OUTCROPPING

 |******  OPTION  5  ***  OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
  MAXIMUM NUMBER OF ITERATIONS          =   10
  FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN  =    0.65

    EARTHQUAKE   - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
    SOIL PROFILE - PCSC300M Crest Column

  ITERATION NUMBER  1

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ----->  <---- SHEAR MODULUS ----->   G/Go
      (FT)  STRAIN NEW   USED  ERROR     NEW    USED   ERROR  RATIO
--- ---- ---- -------- ----- ------  ------  -------  ------  ------  -----
 1  1    2.0 0.00564 0.030  0.050    -68.2   2890.9   3454.0   -19.5  1.000
 2  1    5.5 0.01387 0.046  0.050     -8.1   2683.6   3856.0   -43.7  1.000
 3  1    8.5 0.02004 0.055  0.050      8.4   2587.7   4110.0   -58.8  1.000
 4  1   11.5 0.01929 0.054  0.050      6.9   3653.0   5739.0   -57.1  1.000
 5  1   14.5 0.02822 0.064  0.050     22.3   2786.9   4941.0   -77.3  1.000
 6  1   17.5 0.03765 0.074  0.050     32.0   2265.6   4453.0   -96.5  1.000
 7  1   20.5 0.04005 0.076  0.050     33.8   2401.4   4832.0  -101.2  1.000
 8  1   23.5 0.05070 0.083  0.050     40.0   1928.8   4269.0  -121.3  1.000
 9  1   26.5 0.05013 0.083  0.050     39.7   2139.5   4713.0  -120.3  1.000
10  1   30.0 0.05330 0.085  0.050     41.3   2126.2   4808.0  -126.1  1.000
11  3   33.5 0.10337 0.096  0.050     48.2   1177.8   2635.0  -123.7  1.000
```

12	3	36.5	0.10650	0.098	0.050	49.0	1172.6	2661.0	-126.9	1.000
13	3	39.5	0.09785	0.094	0.050	46.7	1375.8	2998.0	-117.9	1.000
14	3	42.5	0.08030	0.085	0.050	41.2	1895.0	3763.0	-98.6	1.000
15	3	45.5	0.04738	0.062	0.050	18.9	4061.6	6529.0	-60.7	1.000
16	3	48.5	0.04902	0.063	0.050	20.5	3983.6	6476.0	-62.6	1.000

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EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00590	0.030	0.030	1.9	2871.5	2890.9	-0.7	0.837
2	1	5.5	0.01732	0.051	0.046	9.7	2529.5	2683.6	-6.1	0.696
3	1	8.5	0.02777	0.064	0.055	14.6	2331.0	2587.7	-11.0	0.630
4	1	11.5	0.02651	0.063	0.054	14.2	3305.8	3653.0	-10.5	0.637
5	1	14.5	0.04412	0.079	0.064	18.2	2363.9	2786.9	-17.9	0.564
6	1	17.5	0.06609	0.093	0.074	20.9	1785.7	2265.6	-26.9	0.509
7	1	20.5	0.07318	0.097	0.076	21.8	1845.3	2401.4	-30.1	0.497
8	1	23.5	0.10458	0.109	0.083	23.9	1354.3	1928.8	-42.4	0.452
9	1	26.5	0.10599	0.110	0.083	24.6	1484.3	2139.5	-44.1	0.454
10	1	30.0	0.12003	0.114	0.085	25.6	1410.6	2126.2	-50.7	0.442
11	3	33.5	0.23995	0.138	0.096	30.0	720.3	1177.8	-63.5	0.447
12	3	36.5	0.25725	0.141	0.098	30.5	698.3	1172.6	-67.9	0.441
13	3	39.5	0.23094	0.136	0.094	31.1	837.6	1375.8	-64.3	0.459
14	3	42.5	0.17437	0.122	0.085	30.6	1265.2	1895.0	-49.8	0.504
15	3	45.5	0.08367	0.087	0.062	29.0	3227.2	4061.6	-25.9	0.622
16	3	48.5	0.08815	0.089	0.063	29.4	3124.6	3983.6	-27.5	0.615

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EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00587	0.030	0.030	-0.2	2873.9	2871.5	0.1	0.831
2	1	5.5	0.01856	0.053	0.051	3.0	2481.3	2529.5	-1.9	0.656
3	1	8.5	0.03133	0.068	0.064	5.4	2235.8	2331.0	-4.3	0.567
4	1	11.5	0.02978	0.066	0.063	5.0	3178.0	3305.8	-4.0	0.576
5	1	14.5	0.05319	0.085	0.079	7.4	2186.9	2363.9	-8.1	0.478
6	1	17.5	0.08607	0.102	0.093	9.3	1569.0	1785.7	-13.8	0.401
7	1	20.5	0.09759	0.107	0.097	9.7	1591.9	1845.3	-15.9	0.382
8	1	23.5	0.15202	0.123	0.109	10.7	1077.9	1354.3	-25.6	0.317
9	1	26.5	0.15440	0.123	0.110	10.7	1177.3	1484.3	-26.1	0.315
10	1	30.0	0.18007	0.129	0.114	11.1	1073.0	1410.6	-31.5	0.293
11	3	33.5	0.38412	0.159	0.138	13.0	525.3	720.3	-37.1	0.273
12	3	36.5	0.41343	0.162	0.141	12.9	499.7	698.3	-39.7	0.262
13	3	39.5	0.35298	0.155	0.136	12.0	637.5	837.6	-31.4	0.279
14	3	42.5	0.23683	0.137	0.122	10.8	1036.3	1265.2	-22.1	0.336
15	3	45.5	0.09394	0.092	0.087	5.6	3056.4	3227.2	-5.6	0.494
16	3	48.5	0.09792	0.094	0.089	5.0	2970.9	3124.6	-5.2	0.482

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EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq

SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00543	0.029	0.030	-3.3	2907.1	2873.9	1.1	0.832
2	1	5.5	0.01747	0.051	0.053	-2.6	2523.3	2481.3	1.7	0.643
3	1	8.5	0.03004	0.066	0.068	-2.1	2269.0	2235.8	1.5	0.544
4	1	11.5	0.02839	0.065	0.066	-2.1	3230.3	3178.0	1.6	0.554
5	1	14.5	0.05244	0.085	0.085	-0.6	2200.4	2186.9	0.6	0.443
6	1	17.5	0.08875	0.104	0.102	1.1	1544.0	1569.0	-1.6	0.352
7	1	20.5	0.10154	0.108	0.107	1.3	1557.6	1591.9	-2.2	0.329
8	1	23.5	0.17016	0.127	0.123	3.1	994.6	1077.9	-8.4	0.252
9	1	26.5	0.17134	0.127	0.123	2.9	1092.4	1177.3	-7.8	0.250
10	1	30.0	0.20582	0.133	0.129	3.4	966.9	1073.0	-11.0	0.223
11	3	33.5	0.44716	0.165	0.159	4.0	462.3	525.3	-13.6	0.199
12	3	36.5	0.47875	0.168	0.162	3.8	438.3	499.7	-14.0	0.188
13	3	39.5	0.37345	0.157	0.155	1.6	610.9	637.5	-4.3	0.213
14	3	42.5	0.22666	0.135	0.137	-1.4	1062.3	1036.3	2.4	0.275
15	3	45.5	0.07710	0.083	0.092	-10.6	3347.9	3056.4	8.7	0.468
16	3	48.5	0.07874	0.084	0.094	-11.6	3290.0	2970.9	9.7	0.459

1

EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00519	0.029	0.029	-2.0	2926.9	2907.1	0.7	0.842
2	1	5.5	0.01659	0.050	0.051	-2.3	2559.1	2523.3	1.4	0.654
3	1	8.5	0.02855	0.065	0.066	-2.3	2309.0	2269.0	1.7	0.552
4	1	11.5	0.02686	0.063	0.065	-2.5	3291.2	3230.3	1.9	0.563
5	1	14.5	0.05002	0.083	0.085	-2.1	2245.1	2200.4	2.0	0.445
6	1	17.5	0.08633	0.103	0.104	-1.0	1566.6	1544.0	1.4	0.347
7	1	20.5	0.09947	0.108	0.108	-0.7	1575.1	1557.6	1.1	0.322
8	1	23.5	0.17592	0.128	0.127	0.9	970.0	994.6	-2.5	0.233
9	1	26.5	0.17582	0.128	0.127	0.7	1071.3	1092.4	-2.0	0.232
10	1	30.0	0.21609	0.135	0.133	1.1	935.2	966.9	-3.4	0.201
11	3	33.5	0.47499	0.168	0.165	1.6	437.3	462.3	-5.7	0.175
12	3	36.5	0.50503	0.170	0.168	1.1	422.5	438.3	-3.7	0.165
13	3	39.5	0.35695	0.155	0.157	-1.3	632.2	610.9	3.4	0.204
14	3	42.5	0.20113	0.130	0.135	-4.5	1151.5	1062.3	7.7	0.282
15	3	45.5	0.06423	0.075	0.083	-10.9	3617.4	3347.9	7.5	0.513
16	3	48.5	0.06484	0.075	0.084	-11.5	3574.2	3290.0	8.0	0.508

1

EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 6

VALUES IN TIME DOMAIN

NO TYPE DEPTH UNIFRM. <---- DAMPING ----> <---- SHEAR MODULUS -----> G/Go

		(FT)	STRAIN NEW	USED	ERROR	NEW	USED	ERROR	RATIO
1	1	2.0	0.00514 0.029	0.029	-0.4	2930.9	2926.9	0.1	0.847
2	1	5.5	0.01631 0.050	0.050	-0.8	2571.0	2559.1	0.5	0.664
3	1	8.5	0.02796 0.064	0.065	-0.9	2325.5	2309.0	0.7	0.562
4	1	11.5	0.02627 0.062	0.063	-1.0	3315.7	3291.2	0.7	0.573
5	1	14.5	0.04883 0.082	0.083	-1.0	2267.8	2245.1	1.0	0.454
6	1	17.5	0.08477 0.102	0.103	-0.6	1581.3	1566.6	0.9	0.352
7	1	20.5	0.09798 0.107	0.108	-0.5	1588.3	1575.1	0.8	0.326
8	1	23.5	0.17968 0.129	0.128	0.6	954.3	970.0	-1.6	0.227
9	1	26.5	0.17836 0.128	0.128	0.4	1059.6	1071.3	-1.1	0.227
10	1	30.0	0.22194 0.135	0.135	0.6	917.7	935.2	-1.9	0.195
11	3	33.5	0.49749 0.170	0.168	1.0	422.3	437.3	-3.5	0.166
12	3	36.5	0.51712 0.171	0.170	0.4	416.3	422.5	-1.5	0.159
13	3	39.5	0.34000 0.153	0.155	-1.4	655.2	632.2	3.5	0.211
14	3	42.5	0.18350 0.125	0.130	-3.6	1224.6	1151.5	6.0	0.306
15	3	45.5	0.05899 0.071	0.075	-5.3	3743.0	3617.4	3.4	0.554
16	3	48.5	0.05939 0.072	0.075	-5.5	3702.7	3574.2	3.5	0.552

1

EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 7

VALUES IN TIME DOMAIN

NO TYPE DEPTH UNIFRM. <---- DAMPING ----> <---- SHEAR MODULUS -----> G/Go

		(FT)	STRAIN NEW	USED	ERROR	NEW	USED	ERROR	RATIO
1	1	2.0	0.00514 0.029	0.029	0.0	2931.3	2930.9	0.0	0.849
2	1	5.5	0.01624 0.050	0.050	-0.2	2574.1	2571.0	0.1	0.667
3	1	8.5	0.02777 0.064	0.064	-0.3	2331.0	2325.5	0.2	0.566
4	1	11.5	0.02608 0.062	0.062	-0.3	3323.9	3315.7	0.2	0.578
5	1	14.5	0.04834 0.082	0.082	-0.4	2277.5	2267.8	0.4	0.459
6	1	17.5	0.08396 0.102	0.102	-0.3	1589.1	1581.3	0.5	0.355
7	1	20.5	0.09716 0.107	0.107	-0.3	1595.8	1588.3	0.5	0.329
8	1	23.5	0.18264 0.129	0.129	0.4	942.3	954.3	-1.3	0.224
9	1	26.5	0.18025 0.129	0.128	0.3	1051.0	1059.6	-0.8	0.225
10	1	30.0	0.22587 0.136	0.135	0.4	906.3	917.7	-1.3	0.191
11	3	33.5	0.51365 0.171	0.170	0.6	414.0	422.3	-2.0	0.160
12	3	36.5	0.52230 0.171	0.171	0.2	413.6	416.3	-0.6	0.156
13	3	39.5	0.32649 0.151	0.153	-1.2	674.3	655.2	2.8	0.219
14	3	42.5	0.17218 0.122	0.125	-2.6	1275.3	1224.6	4.0	0.325
15	3	45.5	0.05699 0.070	0.071	-2.2	3793.9	3743.0	1.3	0.573
16	3	48.5	0.05739 0.070	0.072	-2.2	3752.9	3702.7	1.3	0.572

1

EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 8

VALUES IN TIME DOMAIN

NO TYPE DEPTH UNIFRM. <---- DAMPING ----> <---- SHEAR MODULUS -----> G/Go

		(FT)	STRAIN NEW	USED	ERROR	NEW	USED	ERROR	RATIO
1	1	2.0	0.00514 0.029	0.029	0.0	2930.9	2931.3	0.0	0.849
2	1	5.5	0.01624 0.050	0.050	0.0	2574.3	2574.1	0.0	0.668
3	1	8.5	0.02772 0.064	0.064	-0.1	2332.2	2331.0	0.1	0.567
4	1	11.5	0.02603 0.062	0.062	-0.1	3325.8	3323.9	0.1	0.579
5	1	14.5	0.04816 0.082	0.082	-0.1	2280.9	2277.5	0.1	0.461

6	1	17.5	0.08360	0.101	0.102	-0.2	1592.6	1589.1	0.2	0.357
7	1	20.5	0.09678	0.107	0.107	-0.1	1599.2	1595.8	0.2	0.330
8	1	23.5	0.18513	0.130	0.129	0.4	932.2	942.3	-1.1	0.221
9	1	26.5	0.18182	0.129	0.129	0.2	1043.9	1051.0	-0.7	0.223
10	1	30.0	0.22875	0.136	0.136	0.3	898.0	906.3	-0.9	0.188
11	3	33.5	0.52355	0.171	0.171	0.4	409.0	414.0	-1.2	0.157
12	3	36.5	0.52457	0.171	0.171	0.1	412.5	413.6	-0.3	0.155
13	3	39.5	0.31668	0.150	0.151	-0.9	688.7	674.3	2.1	0.225
14	3	42.5	0.16536	0.120	0.122	-1.7	1307.5	1275.3	2.5	0.339
15	3	45.5	0.05626	0.069	0.070	-0.8	3812.9	3793.9	0.5	0.581
16	3	48.5	0.05670	0.069	0.070	-0.8	3770.5	3752.9	0.5	0.580

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EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 9

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00515	0.029	0.029	0.0	2930.6	2930.9	0.0	0.849
2	1	5.5	0.01624	0.050	0.050	0.0	2573.9	2574.3	0.0	0.668
3	1	8.5	0.02772	0.064	0.064	0.0	2332.2	2332.2	0.0	0.567
4	1	11.5	0.02603	0.062	0.062	0.0	3325.9	3325.8	0.0	0.580
5	1	14.5	0.04811	0.082	0.082	0.0	2281.9	2280.9	0.0	0.462
6	1	17.5	0.08346	0.101	0.101	-0.1	1593.9	1592.6	0.1	0.358
7	1	20.5	0.09663	0.107	0.107	-0.1	1600.6	1599.2	0.1	0.331
8	1	23.5	0.18724	0.130	0.130	0.3	923.9	932.2	-0.9	0.218
9	1	26.5	0.18312	0.129	0.129	0.2	1038.1	1043.9	-0.6	0.222
10	1	30.0	0.23087	0.137	0.136	0.2	892.0	898.0	-0.7	0.187
11	3	33.5	0.52961	0.172	0.171	0.2	406.0	409.0	-0.7	0.155
12	3	36.5	0.52549	0.171	0.171	0.0	412.0	412.5	-0.1	0.155
13	3	39.5	0.30975	0.149	0.150	-0.7	699.1	688.7	1.5	0.230
14	3	42.5	0.16129	0.119	0.120	-1.0	1327.4	1307.5	1.5	0.347
15	3	45.5	0.05599	0.069	0.069	-0.3	3820.1	3812.9	0.2	0.584
16	3	48.5	0.05647	0.069	0.069	-0.3	3776.5	3770.5	0.2	0.582

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EARTHQUAKE - C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL PROFILE - PCSC300M Crest Column

ITERATION NUMBER 10

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00515	0.029	0.029	0.0	2930.4	2930.6	0.0	0.848
2	1	5.5	0.01625	0.050	0.050	0.0	2573.6	2573.9	0.0	0.668
3	1	8.5	0.02773	0.064	0.064	0.0	2331.9	2332.2	0.0	0.567
4	1	11.5	0.02604	0.062	0.062	0.0	3325.5	3325.9	0.0	0.580
5	1	14.5	0.04811	0.082	0.082	0.0	2281.9	2281.9	0.0	0.462
6	1	17.5	0.08342	0.101	0.101	0.0	1594.3	1593.9	0.0	0.358
7	1	20.5	0.09658	0.107	0.107	0.0	1601.1	1600.6	0.0	0.331
8	1	23.5	0.18901	0.130	0.130	0.3	916.9	923.9	-0.8	0.216
9	1	26.5	0.18419	0.129	0.129	0.2	1033.4	1038.1	-0.5	0.220
10	1	30.0	0.23242	0.137	0.137	0.1	887.7	892.0	-0.5	0.186
11	3	33.5	0.53330	0.172	0.172	0.1	404.1	406.0	-0.4	0.154
12	3	36.5	0.52569	0.171	0.171	0.0	411.9	412.0	0.0	0.155

13	3	39.5	0.30490	0.148	0.149	-0.5	706.6	699.1	1.1	0.233
14	3	42.5	0.15887	0.118	0.119	-0.6	1339.5	1327.4	0.9	0.353
15	3	45.5	0.05587	0.069	0.069	-0.1	3823.0	3820.1	0.1	0.585
16	3	48.5	0.05638	0.069	0.069	-0.1	3778.7	3776.5	0.1	0.583

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	1	4.0000	2.0000	0.00792	232.15	3.44
2	1	3.0000	5.5000	0.02500	643.55	3.44
3	1	3.0000	8.5000	0.04267	995.07	3.44
4	1	3.0000	11.5000	0.04006	1332.31	3.44
5	1	3.0000	14.5000	0.07402	1688.99	3.44
6	1	3.0000	17.5000	0.12834	2045.62	3.44
7	1	3.0000	20.5000	0.14858	2378.17	3.44
8	1	3.0000	23.5000	0.29079	2686.52	3.44
9	1	3.0000	26.5000	0.28336	2941.63	3.43
10	1	4.0000	30.0000	0.35757	3189.67	3.43
11	3	3.0000	33.5000	0.82045	3330.70	3.43
12	3	3.0000	36.5000	0.80875	3332.28	3.42
13	3	3.0000	39.5000	0.46907	3279.36	3.41
14	3	3.0000	42.5000	0.24441	3244.31	3.40
15	3	3.0000	45.5000	0.08596	3283.76	3.39
16	3	3.0000	48.5000	0.08675	3275.96	3.39

PERIOD = 0.31 FROM AVERAGE SHEAR VEL. = 636.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 3.98
FOR FREQUENCY = 2.32 C/SEC.
PERIOD = 0.43 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL DEPOSIT - PCSC300M Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	QUIET ZONE	ACC. RATIO ACC. RECORD	TH SAVED
OUTCR.	0.0000	0.87811	3.44	3.10	0.000	2048	
WITHIN	4.0000	0.87436	3.44	3.04	0.000	2048	
WITHIN	7.0000	0.86558	3.44	2.93	0.000	2048	
WITHIN	10.0000	0.85627	3.43	2.79	0.000	2048	
WITHIN	13.0000	0.84551	3.43	2.70	0.000	2048	
WITHIN	16.0000	0.82977	3.43	2.64	0.000	2048	
WITHIN	19.0000	0.80559	3.42	2.70	0.000	2048	
WITHIN	22.0000	0.78160	3.42	2.90	0.000	2048	
WITHIN	25.0000	0.74268	3.41	3.39	0.000	2048	
WITHIN	28.0000	0.69783	3.41	3.78	0.000	2048	
WITHIN	32.0000	0.61347	3.40	4.28	0.000	2048	
WITHIN	35.0000	0.50219	3.39	6.13	0.000	2048	
WITHIN	38.0000	0.43122	3.42	7.25	0.000	2048	
WITHIN	41.0000	0.50765	3.42	6.76	0.000	2048	
WITHIN	44.0000	0.51826	3.41	6.19	0.000	2048	

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.eq
SOIL DEPOSIT - PCSC300M Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	C/SEC	MEAN SQ. FR. QUIET ZONE	ACC. RATIO ACC. RECORD	TH SAVED
WITHIN	47.0000	0.50559	3.41	5.86	0.000	2048	
WITHIN	50.0000	0.49907	3.42	5.46	0.000	2048	
OUTCR.	50.0000	0.53173	3.42	5.52	0.000	2048	

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 1 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 1 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 2 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 2 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 3 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 3 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 4 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 4 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 5 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 5 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC330M Layer 6 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PSCS300M Layer 6 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 7 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 7 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 8 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 8 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 9 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PSCS300E Layer 9 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 10 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 10 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 11 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 11 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 12 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 12 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 13
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 13 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 13
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 13 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 14
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 14 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 14
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 14 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 15
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 15 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 15
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 15 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 16
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 16 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 16
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 16 Strain

1****** OPTION 9 *** COMPUTE RESPONSE SPECTRUM
RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER 1
CALCULATED FOR DAMPING 0.050

TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
TD = TIME FOR MAX. RELATIVE DISP.
TV = TIME FOR MAX. RELATIVE VEL.
TA = TIME FOR MAX. ABSOLUTE ACC.
DAMPING RATIO = 0.050

PER = 0.01	TIMES FOR MAXIMA --	TD = 3.4350	TV = 3.4700	TA = 3.4350
PER = 0.02	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.4700	TA = 3.4400
PER = 0.03	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.4750	TA = 3.4400
PER = 0.04	TIMES FOR MAXIMA --	TD = 3.4250	TV = 3.4750	TA = 3.4250
PER = 0.05	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.4800	TA = 3.4400
PER = 0.06	TIMES FOR MAXIMA --	TD = 3.4200	TV = 2.0150	TA = 3.4200
PER = 0.07	TIMES FOR MAXIMA --	TD = 3.4400	TV = 2.0600	TA = 3.4400
PER = 0.08	TIMES FOR MAXIMA --	TD = 3.5900	TV = 3.5700	TA = 3.5900

PER = 0.09	TIMES FOR MAXIMA --	TD = 3.6000	TV = 3.5800	TA = 3.6000
PER = 0.10	TIMES FOR MAXIMA --	TD = 3.6150	TV = 3.4950	TA = 3.6150
PER = 0.11	TIMES FOR MAXIMA --	TD = 3.8000	TV = 3.7650	TA = 3.7950
PER = 0.12	TIMES FOR MAXIMA --	TD = 3.8150	TV = 3.5000	TA = 3.8150
PER = 0.13	TIMES FOR MAXIMA --	TD = 3.4050	TV = 3.5050	TA = 3.4000
PER = 0.14	TIMES FOR MAXIMA --	TD = 3.4050	TV = 3.5050	TA = 3.4050
PER = 0.15	TIMES FOR MAXIMA --	TD = 3.4150	TV = 3.5050	TA = 3.4150
PER = 0.16	TIMES FOR MAXIMA --	TD = 3.4150	TV = 3.5050	TA = 3.4150
PER = 0.17	TIMES FOR MAXIMA --	TD = 3.4200	TV = 3.5050	TA = 3.4200
PER = 0.18	TIMES FOR MAXIMA --	TD = 3.4250	TV = 3.5050	TA = 3.4200
PER = 0.19	TIMES FOR MAXIMA --	TD = 3.4300	TV = 3.8950	TA = 3.4250
PER = 0.20	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.5100	TA = 3.4350
PER = 0.21	TIMES FOR MAXIMA --	TD = 3.4450	TV = 3.5150	TA = 3.4400
PER = 0.22	TIMES FOR MAXIMA --	TD = 3.4450	TV = 3.5150	TA = 3.4400
PER = 0.23	TIMES FOR MAXIMA --	TD = 3.5850	TV = 3.5200	TA = 3.5850
PER = 0.24	TIMES FOR MAXIMA --	TD = 3.5950	TV = 3.5200	TA = 3.5900
PER = 0.25	TIMES FOR MAXIMA --	TD = 3.6000	TV = 3.5250	TA = 3.5950
PER = 0.26	TIMES FOR MAXIMA --	TD = 3.6050	TV = 3.5250	TA = 3.6000
PER = 0.27	TIMES FOR MAXIMA --	TD = 3.6150	TV = 3.5300	TA = 3.6100
PER = 0.28	TIMES FOR MAXIMA --	TD = 3.6200	TV = 3.5350	TA = 3.6150
PER = 0.29	TIMES FOR MAXIMA --	TD = 3.6250	TV = 3.5400	TA = 3.6200
PER = 0.30	TIMES FOR MAXIMA --	TD = 3.6300	TV = 3.5450	TA = 3.6250
PER = 0.31	TIMES FOR MAXIMA --	TD = 3.6400	TV = 3.5550	TA = 3.6350
PER = 0.32	TIMES FOR MAXIMA --	TD = 3.6450	TV = 3.5650	TA = 3.6400
PER = 0.33	TIMES FOR MAXIMA --	TD = 3.6550	TV = 3.5700	TA = 3.6500
PER = 0.34	TIMES FOR MAXIMA --	TD = 4.2100	TV = 4.1250	TA = 4.2050
PER = 0.35	TIMES FOR MAXIMA --	TD = 4.2250	TV = 4.1350	TA = 4.2200
PER = 0.36	TIMES FOR MAXIMA --	TD = 4.2400	TV = 4.1500	TA = 4.2350
PER = 0.37	TIMES FOR MAXIMA --	TD = 4.2600	TV = 4.1650	TA = 4.2500
PER = 0.38	TIMES FOR MAXIMA --	TD = 4.2750	TV = 4.1800	TA = 4.2700
PER = 0.39	TIMES FOR MAXIMA --	TD = 4.2900	TV = 4.0050	TA = 4.2850
PER = 0.40	TIMES FOR MAXIMA --	TD = 3.9200	TV = 4.0150	TA = 3.9150
PER = 0.41	TIMES FOR MAXIMA --	TD = 3.9300	TV = 4.0300	TA = 3.9250
PER = 0.42	TIMES FOR MAXIMA --	TD = 3.9400	TV = 4.0400	TA = 3.9350
PER = 0.43	TIMES FOR MAXIMA --	TD = 3.9500	TV = 4.0450	TA = 3.9400
PER = 0.44	TIMES FOR MAXIMA --	TD = 3.9600	TV = 3.8550	TA = 3.9500
PER = 0.45	TIMES FOR MAXIMA --	TD = 3.9650	TV = 3.8600	TA = 3.9600
PER = 0.46	TIMES FOR MAXIMA --	TD = 3.9750	TV = 3.8700	TA = 3.9700
PER = 0.47	TIMES FOR MAXIMA --	TD = 3.9850	TV = 3.8750	TA = 3.9750
PER = 0.48	TIMES FOR MAXIMA --	TD = 3.7750	TV = 3.8800	TA = 3.7700
PER = 0.49	TIMES FOR MAXIMA --	TD = 3.7850	TV = 3.8900	TA = 3.7750
PER = 0.50	TIMES FOR MAXIMA --	TD = 3.7900	TV = 3.8950	TA = 3.7800
PER = 0.51	TIMES FOR MAXIMA --	TD = 3.7950	TV = 3.9000	TA = 3.7850
PER = 0.52	TIMES FOR MAXIMA --	TD = 3.8000	TV = 3.9100	TA = 3.7900
PER = 0.53	TIMES FOR MAXIMA --	TD = 3.8000	TV = 3.9150	TA = 3.7950
PER = 0.54	TIMES FOR MAXIMA --	TD = 3.8050	TV = 3.7000	TA = 3.8000
PER = 0.55	TIMES FOR MAXIMA --	TD = 3.8100	TV = 3.7050	TA = 3.8000
PER = 0.56	TIMES FOR MAXIMA --	TD = 3.8150	TV = 3.7050	TA = 3.8050
PER = 0.57	TIMES FOR MAXIMA --	TD = 3.8200	TV = 3.7100	TA = 3.8100
PER = 0.58	TIMES FOR MAXIMA --	TD = 3.8200	TV = 3.7150	TA = 3.8100
PER = 0.60	TIMES FOR MAXIMA --	TD = 3.8300	TV = 3.7200	TA = 3.8200
PER = 0.62	TIMES FOR MAXIMA --	TD = 3.8350	TV = 3.7200	TA = 3.8250
PER = 0.64	TIMES FOR MAXIMA --	TD = 5.1850	TV = 3.7250	TA = 5.1750
PER = 0.66	TIMES FOR MAXIMA --	TD = 5.2100	TV = 3.7300	TA = 5.2000
PER = 0.68	TIMES FOR MAXIMA --	TD = 4.9250	TV = 3.7300	TA = 4.9150
PER = 0.70	TIMES FOR MAXIMA --	TD = 4.9500	TV = 3.7300	TA = 4.9350
PER = 0.72	TIMES FOR MAXIMA --	TD = 4.9700	TV = 3.7350	TA = 4.9600
PER = 0.74	TIMES FOR MAXIMA --	TD = 4.6500	TV = 3.4800	TA = 4.6350
PER = 0.76	TIMES FOR MAXIMA --	TD = 4.6650	TV = 3.4800	TA = 4.6500
PER = 0.78	TIMES FOR MAXIMA --	TD = 4.6750	TV = 3.4800	TA = 4.6650
PER = 0.80	TIMES FOR MAXIMA --	TD = 4.3500	TV = 3.4800	TA = 4.3400

PER = 0.82	TIMES FOR MAXIMA --	TD = 4.3600	TV = 3.4800	TA = 4.3500
PER = 0.84	TIMES FOR MAXIMA --	TD = 4.3700	TV = 3.4850	TA = 4.3600
PER = 0.86	TIMES FOR MAXIMA --	TD = 4.3800	TV = 3.4850	TA = 4.3650
PER = 0.88	TIMES FOR MAXIMA --	TD = 4.3900	TV = 3.4850	TA = 4.3750
PER = 0.90	TIMES FOR MAXIMA --	TD = 3.6200	TV = 3.4850	TA = 3.6100
PER = 0.92	TIMES FOR MAXIMA --	TD = 3.6250	TV = 3.4850	TA = 3.6100
PER = 0.94	TIMES FOR MAXIMA --	TD = 3.6250	TV = 3.4850	TA = 3.6100
PER = 0.96	TIMES FOR MAXIMA --	TD = 3.6300	TV = 3.4850	TA = 3.6150
PER = 0.98	TIMES FOR MAXIMA --	TD = 3.6300	TV = 3.4850	TA = 3.6150
PER = 1.00	TIMES FOR MAXIMA --	TD = 3.6350	TV = 3.4850	TA = 3.6150
PER = 1.05	TIMES FOR MAXIMA --	TD = 3.6400	TV = 3.4850	TA = 3.6200
PER = 1.10	TIMES FOR MAXIMA --	TD = 3.6400	TV = 3.4850	TA = 3.6250
PER = 1.15	TIMES FOR MAXIMA --	TD = 3.6450	TV = 3.4850	TA = 3.6250
PER = 1.20	TIMES FOR MAXIMA --	TD = 3.3950	TV = 3.4850	TA = 3.3750
PER = 1.25	TIMES FOR MAXIMA --	TD = 3.3950	TV = 3.4850	TA = 3.3750
PER = 1.30	TIMES FOR MAXIMA --	TD = 3.3950	TV = 3.4900	TA = 3.3750
PER = 1.35	TIMES FOR MAXIMA --	TD = 3.3950	TV = 3.4900	TA = 3.3750
PER = 1.40	TIMES FOR MAXIMA --	TD = 3.3950	TV = 3.4900	TA = 3.3750
PER = 1.45	TIMES FOR MAXIMA --	TD = 3.4000	TV = 3.4900	TA = 3.3750
PER = 1.50	TIMES FOR MAXIMA --	TD = 3.4000	TV = 3.4900	TA = 3.3750
PER = 1.55	TIMES FOR MAXIMA --	TD = 3.4000	TV = 3.4900	TA = 3.3750
PER = 1.60	TIMES FOR MAXIMA --	TD = 3.4000	TV = 3.4900	TA = 3.3750
PER = 1.65	TIMES FOR MAXIMA --	TD = 3.4000	TV = 3.4900	TA = 3.3750
PER = 1.70	TIMES FOR MAXIMA --	TD = 3.4000	TV = 3.4900	TA = 3.3750
PER = 1.75	TIMES FOR MAXIMA --	TD = 3.4050	TV = 3.4900	TA = 3.3800
PER = 1.80	TIMES FOR MAXIMA --	TD = 3.4050	TV = 3.4900	TA = 3.3800
PER = 1.85	TIMES FOR MAXIMA --	TD = 3.4050	TV = 3.4900	TA = 3.3800
PER = 1.90	TIMES FOR MAXIMA --	TD = 4.4100	TV = 3.4900	TA = 3.3800
PER = 1.95	TIMES FOR MAXIMA --	TD = 4.4150	TV = 3.4900	TA = 4.3850
PER = 2.00	TIMES FOR MAXIMA --	TD = 4.4200	TV = 3.4900	TA = 4.3900
PER = 2.05	TIMES FOR MAXIMA --	TD = 4.4250	TV = 3.4900	TA = 4.3950
PER = 2.10	TIMES FOR MAXIMA --	TD = 4.4300	TV = 3.4900	TA = 4.4000
PER = 2.15	TIMES FOR MAXIMA --	TD = 4.4350	TV = 3.4900	TA = 4.4050
PER = 2.20	TIMES FOR MAXIMA --	TD = 4.4400	TV = 3.4900	TA = 4.4100
PER = 2.25	TIMES FOR MAXIMA --	TD = 4.4500	TV = 3.4900	TA = 4.4150
PER = 2.30	TIMES FOR MAXIMA --	TD = 4.4550	TV = 3.4900	TA = 3.3800
PER = 2.35	TIMES FOR MAXIMA --	TD = 4.4650	TV = 3.3200	TA = 3.3800
PER = 2.40	TIMES FOR MAXIMA --	TD = 3.4150	TV = 3.3200	TA = 3.3800
PER = 2.50	TIMES FOR MAXIMA --	TD = 3.4150	TV = 3.3200	TA = 3.3800
PER = 2.60	TIMES FOR MAXIMA --	TD = 4.9200	TV = 3.3200	TA = 3.3800
PER = 2.70	TIMES FOR MAXIMA --	TD = 4.9600	TV = 3.3200	TA = 4.9150
PER = 2.80	TIMES FOR MAXIMA --	TD = 4.9950	TV = 3.3200	TA = 4.9500
PER = 2.90	TIMES FOR MAXIMA --	TD = 5.0200	TV = 3.3200	TA = 4.9850
PER = 3.00	TIMES FOR MAXIMA --	TD = 5.0300	TV = 3.3200	TA = 5.0000
PER = 3.10	TIMES FOR MAXIMA --	TD = 5.0450	TV = 3.3200	TA = 5.0100
PER = 3.20	TIMES FOR MAXIMA --	TD = 5.0550	TV = 3.3200	TA = 5.0150
PER = 3.30	TIMES FOR MAXIMA --	TD = 5.3700	TV = 3.3200	TA = 5.0200
PER = 3.40	TIMES FOR MAXIMA --	TD = 5.3850	TV = 3.3200	TA = 5.3450
PER = 3.50	TIMES FOR MAXIMA --	TD = 5.3950	TV = 3.3200	TA = 5.3550
PER = 3.60	TIMES FOR MAXIMA --	TD = 5.4100	TV = 3.3200	TA = 5.3600
PER = 3.70	TIMES FOR MAXIMA --	TD = 5.4200	TV = 3.3200	TA = 5.3700
PER = 3.80	TIMES FOR MAXIMA --	TD = 5.4250	TV = 3.3200	TA = 5.3800
PER = 3.90	TIMES FOR MAXIMA --	TD = 5.4350	TV = 3.3200	TA = 5.3850
PER = 4.00	TIMES FOR MAXIMA --	TD = 5.4450	TV = 3.3200	TA = 5.3900
PER = 4.10	TIMES FOR MAXIMA --	TD = 5.8750	TV = 3.3200	TA = 5.8350
PER = 4.20	TIMES FOR MAXIMA --	TD = 5.8850	TV = 3.3200	TA = 5.8400
PER = 4.30	TIMES FOR MAXIMA --	TD = 5.8900	TV = 3.3200	TA = 5.8400
PER = 4.40	TIMES FOR MAXIMA --	TD = 5.8950	TV = 3.3200	TA = 5.8450
PER = 4.50	TIMES FOR MAXIMA --	TD = 5.9000	TV = 3.3200	TA = 5.8450
PER = 4.60	TIMES FOR MAXIMA --	TD = 5.9050	TV = 3.3200	TA = 5.8500
PER = 4.70	TIMES FOR MAXIMA --	TD = 5.9100	TV = 3.3200	TA = 5.8500

PER = 4.80 TIMES FOR MAXIMA -- TD = 5.9150 TV = 3.3200 TA = 5.8500
PER = 4.90 TIMES FOR MAXIMA -- TD = 5.9200 TV = 3.3200 TA = 5.8550
PER = 5.00 TIMES FOR MAXIMA -- TD = 6.2650 TV = 3.3200 TA = 5.8550
PER = 5.10 TIMES FOR MAXIMA -- TD = 6.2750 TV = 3.3200 TA = 6.2150
PER = 5.20 TIMES FOR MAXIMA -- TD = 6.2900 TV = 3.3200 TA = 6.2200
PER = 5.40 TIMES FOR MAXIMA -- TD = 6.3050 TV = 3.3200 TA = 6.2250
PER = 5.60 TIMES FOR MAXIMA -- TD = 9.4150 TV = 3.3200 TA = 9.3550
PER = 5.80 TIMES FOR MAXIMA -- TD = 9.4450 TV = 3.3200 TA = 9.3800
PER = 6.00 TIMES FOR MAXIMA -- TD = 9.8250 TV = 3.3200 TA = 9.3950
PER = 6.20 TIMES FOR MAXIMA -- TD = 9.8450 TV = 3.3200 TA = 9.7900
PER = 6.40 TIMES FOR MAXIMA -- TD = 9.8600 TV = 3.3200 TA = 9.8050
PER = 6.60 TIMES FOR MAXIMA -- TD = 9.8750 TV = 3.3200 TA = 9.8100
PER = 6.80 TIMES FOR MAXIMA -- TD = 9.8900 TV = 3.3200 TA = 4.0850
PER = 7.00 TIMES FOR MAXIMA -- TD = 4.1650 TV = 3.3200 TA = 4.0850
PER = 7.30 TIMES FOR MAXIMA -- TD = 4.1700 TV = 3.3200 TA = 4.0850
PER = 7.60 TIMES FOR MAXIMA -- TD = 4.1700 TV = 3.3200 TA = 4.0850
PER = 8.00 TIMES FOR MAXIMA -- TD = 4.1700 TV = 3.3200 TA = 4.0850
PER = 8.50 TIMES FOR MAXIMA -- TD = 4.1750 TV = 3.3200 TA = 4.0800
PER = 9.00 TIMES FOR MAXIMA -- TD = 4.1750 TV = 3.3200 TA = 4.0800
PER = 9.50 TIMES FOR MAXIMA -- TD = 4.1750 TV = 3.3200 TA = 4.0800
PER =10.00 TIMES FOR MAXIMA -- TD = 4.1750 TV = 3.3200 TA = 4.0800

SPECTRAL VALUES--
(Acceleration of gravity used = 32.20)

PCSC300M Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00007	0.00243	0.04499	0.87812	0.87795	100.00
2	0.02	0.00029	0.01005	0.09040	0.88173	0.88201	50.00
3	0.03	0.00065	0.02393	0.13620	0.88577	0.88592	33.33
4	0.04	0.00115	0.05153	0.18085	0.88219	0.88225	25.00
5	0.05	0.00190	0.07594	0.23891	0.93242	0.93237	20.00
6	0.06	0.00262	0.13350	0.27438	0.89308	0.89233	16.67
7	0.07	0.00432	0.16955	0.38766	1.08359	1.08064	14.29
8	0.08	0.00594	0.27142	0.46618	1.14800	1.13708	12.50
9	0.09	0.00810	0.34570	0.56517	1.23523	1.22535	11.11
10	0.10	0.01081	0.45652	0.67920	1.32316	1.32532	10.00
11	0.11	0.01040	0.41880	0.59377	1.05933	1.05329	9.09
12	0.12	0.01246	0.41769	0.65253	1.06229	1.06106	8.33
13	0.13	0.01336	0.44921	0.64585	0.97111	0.96942	7.69
14	0.14	0.01678	0.45214	0.75311	1.05235	1.04967	7.14
15	0.15	0.02002	0.52306	0.83874	1.09125	1.09109	6.67
16	0.16	0.02332	0.59111	0.91564	1.11793	1.11668	6.25
17	0.17	0.02817	0.69869	1.04127	1.19624	1.19519	5.88
18	0.18	0.03290	0.82484	1.14853	1.24650	1.24507	5.56
19	0.19	0.03929	1.01323	1.29920	1.33534	1.33427	5.26
20	0.20	0.04443	1.18464	1.39568	1.36488	1.36170	5.00
21	0.21	0.04883	1.29725	1.46109	1.36109	1.35763	4.76
22	0.22	0.05468	1.41508	1.56153	1.38742	1.38501	4.55
23	0.23	0.06297	1.56972	1.72017	1.46297	1.45937	4.35
24	0.24	0.07347	1.72462	1.92347	1.56973	1.56386	4.17
25	0.25	0.08429	1.86265	2.11835	1.65858	1.65342	4.00
26	0.26	0.09651	2.01865	2.33227	1.75548	1.75037	3.85
27	0.27	0.10992	2.18626	2.55791	1.85639	1.84861	3.70
28	0.28	0.12402	2.34934	2.78310	1.94708	1.93952	3.57
29	0.29	0.13987	2.54595	3.03050	2.04689	2.03911	3.45
30	0.30	0.15888	2.80154	3.32759	2.17268	2.16437	3.33
31	0.31	0.18053	3.10612	3.65906	2.31266	2.30320	3.23
32	0.32	0.20256	3.41352	3.97727	2.43554	2.42527	3.13
33	0.33	0.22331	3.68939	4.25178	2.52502	2.51409	3.03
34	0.34	0.24551	4.35903	4.53707	2.61538	2.60388	2.94
35	0.35	0.28073	4.90942	5.03964	2.82297	2.80967	2.86
36	0.36	0.30976	5.30060	5.40637	2.94543	2.93040	2.78

37	0.37	0.33192	5.53497	5.63658	2.98673	2.97261	2.70
38	0.38	0.34673	5.66923	5.73313	2.95711	2.94396	2.63
39	0.39	0.35413	5.74610	5.70522	2.86789	2.85451	2.56
40	0.40	0.35665	5.83915	5.60225	2.74508	2.73292	2.50
41	0.41	0.36587	5.85423	5.60690	2.68064	2.66847	2.44
42	0.42	0.37218	5.79615	5.56780	2.59871	2.58677	2.38
43	0.43	0.37547	5.67023	5.48638	2.50225	2.48967	2.33
44	0.44	0.37552	5.55088	5.36239	2.39208	2.37810	2.27
45	0.45	0.37235	5.47675	5.19900	2.26852	2.25440	2.22
46	0.46	0.36612	5.36397	5.00085	2.13348	2.12134	2.17
47	0.47	0.35679	5.21569	4.76976	1.99183	1.98026	2.13
48	0.48	0.35027	5.03775	4.58507	1.87540	1.86393	2.08
49	0.49	0.34654	4.84383	4.44368	1.78143	1.76958	2.04
50	0.50	0.34182	4.64679	4.29538	1.68753	1.67631	2.00
51	0.51	0.33611	4.44590	4.14086	1.59516	1.58433	1.96
52	0.52	0.32964	4.24761	3.98307	1.50522	1.49465	1.92
53	0.53	0.32258	4.04926	3.82416	1.41825	1.40794	1.89
54	0.54	0.31520	3.87757	3.66757	1.33451	1.32528	1.85
55	0.55	0.30747	3.79424	3.51252	1.25467	1.24618	1.82
56	0.56	0.29943	3.71004	3.35964	1.17918	1.17065	1.79
57	0.57	0.29115	3.62987	3.20944	1.10715	1.09870	1.75
58	0.58	0.28289	3.54806	3.06454	1.03859	1.03101	1.72
59	0.60	0.26632	3.38849	2.78894	0.91428	0.90701	1.67
60	0.62	0.25023	3.23379	2.53585	0.80461	0.79810	1.61
61	0.64	0.24833	3.09058	2.43796	0.74726	0.74331	1.56
62	0.66	0.24925	2.95681	2.37287	0.70611	0.70154	1.52
63	0.68	0.24904	2.83915	2.30113	0.66374	0.66032	1.47
64	0.70	0.24895	2.73437	2.23457	0.62626	0.62290	1.43
65	0.72	0.24507	2.64613	2.13864	0.58275	0.57960	1.39
66	0.74	0.24349	2.56927	2.06739	0.54828	0.54515	1.35
67	0.76	0.23957	2.53474	1.98059	0.51182	0.50852	1.32
68	0.78	0.23272	2.50849	1.87466	0.47229	0.46898	1.28
69	0.80	0.22889	2.48866	1.79770	0.44166	0.43848	1.25
70	0.82	0.22905	2.47371	1.75505	0.42067	0.41764	1.22
71	0.84	0.22728	2.46278	1.70002	0.39776	0.39491	1.19
72	0.86	0.22364	2.45497	1.63393	0.37341	0.37073	1.16
73	0.88	0.21818	2.44903	1.55780	0.34815	0.34543	1.14
74	0.90	0.21437	2.44421	1.49662	0.32858	0.32448	1.11
75	0.92	0.21414	2.43985	1.46250	0.31418	0.31019	1.09
76	0.94	0.21346	2.43534	1.42685	0.30011	0.29619	1.06
77	0.96	0.21244	2.43019	1.39040	0.28640	0.28261	1.04
78	0.98	0.21101	2.42402	1.35285	0.27311	0.26937	1.02
79	1.00	0.20912	2.41660	1.31394	0.26007	0.25639	1.00
80	1.05	0.20298	2.39236	1.21460	0.22923	0.22572	0.95
81	1.10	0.19527	2.36176	1.11538	0.20115	0.19786	0.91
82	1.15	0.18682	2.32853	1.02072	0.17626	0.17319	0.87
83	1.20	0.18307	2.29597	0.95853	0.15994	0.15586	0.83
84	1.25	0.18991	2.26583	0.95461	0.15305	0.14902	0.80
85	1.30	0.19702	2.23837	0.95224	0.14693	0.14293	0.77
86	1.35	0.20454	2.21332	0.95195	0.14159	0.13760	0.74
87	1.40	0.21247	2.18898	0.95355	0.13690	0.13290	0.71
88	1.45	0.22075	2.16445	0.95654	0.13272	0.12872	0.69
89	1.50	0.22930	2.13915	0.96049	0.12891	0.12495	0.67
90	1.55	0.23791	2.11287	0.96439	0.12534	0.12141	0.65
91	1.60	0.24644	2.08564	0.96777	0.12195	0.11803	0.63
92	1.65	0.25482	2.05767	0.97036	0.11868	0.11476	0.61
93	1.70	0.26300	2.02921	0.97206	0.11551	0.11158	0.59
94	1.75	0.27104	2.00055	0.97314	0.11244	0.10851	0.57
95	1.80	0.27891	1.97192	0.97358	0.10947	0.10554	0.56
96	1.85	0.28657	1.94349	0.97328	0.10658	0.10266	0.54
97	1.90	0.29765	1.91537	0.98430	0.10379	0.10109	0.53

98	1.95	0.31087	1.88762	1.00166	0.10182	0.10023	0.51
99	2.00	0.32234	1.86027	1.01267	0.10042	0.09880	0.50
100	2.05	0.33208	1.83331	1.01780	0.09853	0.09688	0.49
101	2.10	0.34007	1.80672	1.01747	0.09624	0.09454	0.48
102	2.15	0.34634	1.78047	1.01214	0.09361	0.09186	0.47
103	2.20	0.35092	1.75453	1.00222	0.09069	0.08889	0.45
104	2.25	0.35387	1.72887	0.98819	0.08752	0.08570	0.44
105	2.30	0.35529	1.70347	0.97059	0.08472	0.08234	0.43
106	2.35	0.35524	1.70482	0.94980	0.08267	0.07887	0.43
107	2.40	0.36057	1.72110	0.94396	0.08067	0.07675	0.42
108	2.50	0.37164	1.75318	0.93404	0.07682	0.07290	0.40
109	2.60	0.38908	1.78445	0.94025	0.07313	0.07057	0.38
110	2.70	0.42250	1.81464	0.98321	0.07159	0.07106	0.37
111	2.80	0.45139	1.84353	1.01292	0.07117	0.07059	0.36
112	2.90	0.47536	1.87093	1.02992	0.06991	0.06930	0.34
113	3.00	0.49292	1.89670	1.03237	0.06801	0.06715	0.33
114	3.10	0.50371	1.92071	1.02093	0.06537	0.06426	0.32
115	3.20	0.50807	1.94293	0.99760	0.06211	0.06083	0.31
116	3.30	0.50776	1.96335	0.96677	0.05842	0.05717	0.30
117	3.40	0.53200	1.98197	0.98314	0.05726	0.05642	0.29
118	3.50	0.55000	1.99886	0.98735	0.05601	0.05505	0.29
119	3.60	0.56202	2.01408	0.98091	0.05422	0.05317	0.28
120	3.70	0.56836	2.02771	0.96516	0.05203	0.05090	0.27
121	3.80	0.56955	2.03985	0.94173	0.04956	0.04836	0.26
122	3.90	0.56610	2.05058	0.91203	0.04690	0.04563	0.26
123	4.00	0.55862	2.06001	0.87748	0.04412	0.04281	0.25
124	4.10	0.57600	2.06825	0.88271	0.04322	0.04201	0.24
125	4.20	0.59158	2.07537	0.88500	0.04245	0.04112	0.24
126	4.30	0.60227	2.08149	0.88004	0.04135	0.03994	0.23
127	4.40	0.60843	2.08669	0.86884	0.04002	0.03853	0.23
128	4.50	0.61057	2.09105	0.85252	0.03851	0.03697	0.22
129	4.60	0.60914	2.09465	0.83203	0.03688	0.03529	0.22
130	4.70	0.60459	2.09756	0.80824	0.03517	0.03356	0.21
131	4.80	0.59730	2.09985	0.78187	0.03341	0.03178	0.21
132	4.90	0.58769	2.10159	0.75359	0.03164	0.03001	0.20
133	5.00	0.58727	2.10283	0.73799	0.02988	0.02880	0.20
134	5.10	0.58886	2.10362	0.72547	0.02852	0.02776	0.20
135	5.20	0.58804	2.10402	0.71054	0.02745	0.02666	0.19
136	5.40	0.58028	2.10379	0.67519	0.02520	0.02440	0.19
137	5.60	0.57713	2.10243	0.64754	0.02295	0.02256	0.18
138	5.80	0.58561	2.10021	0.63440	0.02185	0.02134	0.17
139	6.00	0.57892	2.09731	0.60624	0.02015	0.01972	0.17
140	6.20	0.58678	2.09392	0.59465	0.01911	0.01872	0.16
141	6.40	0.57837	2.09015	0.56782	0.01782	0.01731	0.16
142	6.60	0.55721	2.08612	0.53046	0.01627	0.01568	0.15
143	6.80	0.52675	2.08193	0.48671	0.01525	0.01397	0.15
144	7.00	0.51511	2.07761	0.46237	0.01435	0.01289	0.14
145	7.30	0.50802	2.07106	0.43726	0.01313	0.01169	0.14
146	7.60	0.50047	2.06450	0.41376	0.01205	0.01062	0.13
147	8.00	0.49001	2.05598	0.38485	0.01078	0.00939	0.13
148	8.50	0.47683	2.04578	0.35247	0.00945	0.00809	0.12
149	9.00	0.46398	2.03630	0.32392	0.00835	0.00702	0.11
150	9.50	0.45166	2.02751	0.29872	0.00743	0.00614	0.11
151	10.00	0.44008	2.01943	0.27651	0.00665	0.00540	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.

AREA OF ACC. RESPONSE SPECTRUM = 1.283

AREA OF VEL. RESPONSE SPECTRUM = 5.706

MAX. ACCELERATION RESPONSE VALUE = 2.987

MAX. VELOCITY RESPONSE VALUE = 5.854

1****** OPTION 9 *** COMPUTE RESPONSE SPECTRUM
RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER 17
CALCULATED FOR DAMPING 0.050

TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
TD = TIME FOR MAX. RELATIVE DISP.
TV = TIME FOR MAX. RELATIVE VEL.
TA = TIME FOR MAX. ABSOLUTE ACC.
DAMPING RATIO = 0.050

PER = 0.01	TIMES FOR MAXIMA --	TD = 3.4150	TV = 3.3850	TA = 3.4150
PER = 0.02	TIMES FOR MAXIMA --	TD = 3.4200	TV = 3.3850	TA = 3.4200
PER = 0.03	TIMES FOR MAXIMA --	TD = 3.4000	TV = 2.2250	TA = 3.4000
PER = 0.04	TIMES FOR MAXIMA --	TD = 3.4050	TV = 3.3900	TA = 3.4050
PER = 0.05	TIMES FOR MAXIMA --	TD = 3.4100	TV = 3.3950	TA = 3.4100
PER = 0.06	TIMES FOR MAXIMA --	TD = 3.4150	TV = 1.9300	TA = 3.4150
PER = 0.07	TIMES FOR MAXIMA --	TD = 3.4150	TV = 1.9750	TA = 3.4150
PER = 0.08	TIMES FOR MAXIMA --	TD = 3.4250	TV = 3.5250	TA = 3.4250
PER = 0.09	TIMES FOR MAXIMA --	TD = 3.4300	TV = 3.4550	TA = 3.4250
PER = 0.10	TIMES FOR MAXIMA --	TD = 3.4350	TV = 3.4600	TA = 3.4300
PER = 0.11	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.4650	TA = 3.4400
PER = 0.12	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.4700	TA = 3.4400
PER = 0.13	TIMES FOR MAXIMA --	TD = 4.0200	TV = 5.1100	TA = 4.0150
PER = 0.14	TIMES FOR MAXIMA --	TD = 4.0350	TV = 4.0750	TA = 4.0300
PER = 0.15	TIMES FOR MAXIMA --	TD = 3.4450	TV = 4.0850	TA = 3.4400
PER = 0.16	TIMES FOR MAXIMA --	TD = 4.0500	TV = 4.0900	TA = 4.0500
PER = 0.17	TIMES FOR MAXIMA --	TD = 3.8300	TV = 4.1050	TA = 3.8300
PER = 0.18	TIMES FOR MAXIMA --	TD = 3.8400	TV = 3.7950	TA = 3.8350
PER = 0.19	TIMES FOR MAXIMA --	TD = 3.8500	TV = 3.8050	TA = 3.8450
PER = 0.20	TIMES FOR MAXIMA --	TD = 3.8650	TV = 3.8150	TA = 3.8600
PER = 0.21	TIMES FOR MAXIMA --	TD = 3.8800	TV = 3.8300	TA = 3.8800
PER = 0.22	TIMES FOR MAXIMA --	TD = 4.0200	TV = 3.8400	TA = 4.0150
PER = 0.23	TIMES FOR MAXIMA --	TD = 4.0400	TV = 4.1000	TA = 4.0350
PER = 0.24	TIMES FOR MAXIMA --	TD = 4.0600	TV = 4.1150	TA = 4.0550
PER = 0.25	TIMES FOR MAXIMA --	TD = 3.4850	TV = 3.4300	TA = 3.4850
PER = 0.26	TIMES FOR MAXIMA --	TD = 3.4900	TV = 3.4300	TA = 3.4900
PER = 0.27	TIMES FOR MAXIMA --	TD = 3.5000	TV = 3.4350	TA = 3.4950
PER = 0.28	TIMES FOR MAXIMA --	TD = 3.5050	TV = 3.4350	TA = 3.5000
PER = 0.29	TIMES FOR MAXIMA --	TD = 3.5100	TV = 3.4350	TA = 3.5050
PER = 0.30	TIMES FOR MAXIMA --	TD = 3.5150	TV = 3.4400	TA = 3.5100
PER = 0.31	TIMES FOR MAXIMA --	TD = 3.5200	TV = 3.4400	TA = 3.5150
PER = 0.32	TIMES FOR MAXIMA --	TD = 3.5300	TV = 3.4450	TA = 3.5250
PER = 0.33	TIMES FOR MAXIMA --	TD = 3.5350	TV = 3.4500	TA = 3.5300
PER = 0.34	TIMES FOR MAXIMA --	TD = 4.0850	TV = 3.4600	TA = 4.0800
PER = 0.35	TIMES FOR MAXIMA --	TD = 4.1000	TV = 4.0200	TA = 4.0950
PER = 0.36	TIMES FOR MAXIMA --	TD = 4.1150	TV = 4.0350	TA = 4.1100
PER = 0.37	TIMES FOR MAXIMA --	TD = 4.1300	TV = 4.0450	TA = 4.1250
PER = 0.38	TIMES FOR MAXIMA --	TD = 4.1500	TV = 4.0550	TA = 4.1400
PER = 0.39	TIMES FOR MAXIMA --	TD = 4.1650	TV = 4.0600	TA = 4.1600
PER = 0.40	TIMES FOR MAXIMA --	TD = 3.8050	TV = 3.9050	TA = 3.8000
PER = 0.41	TIMES FOR MAXIMA --	TD = 3.4150	TV = 3.9150	TA = 3.4100
PER = 0.42	TIMES FOR MAXIMA --	TD = 3.4200	TV = 3.7400	TA = 3.4150
PER = 0.43	TIMES FOR MAXIMA --	TD = 3.4250	TV = 3.7500	TA = 3.4150
PER = 0.44	TIMES FOR MAXIMA --	TD = 3.4250	TV = 3.7550	TA = 3.4200
PER = 0.45	TIMES FOR MAXIMA --	TD = 3.4300	TV = 3.7600	TA = 3.4250
PER = 0.46	TIMES FOR MAXIMA --	TD = 3.4350	TV = 3.7650	TA = 3.4250
PER = 0.47	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.7700	TA = 3.4300
PER = 0.48	TIMES FOR MAXIMA --	TD = 3.6850	TV = 3.3700	TA = 3.6800
PER = 0.49	TIMES FOR MAXIMA --	TD = 3.6950	TV = 3.3700	TA = 3.6850
PER = 0.50	TIMES FOR MAXIMA --	TD = 3.7000	TV = 3.3750	TA = 3.6900
PER = 0.51	TIMES FOR MAXIMA --	TD = 3.7050	TV = 3.3750	TA = 3.6950
PER = 0.52	TIMES FOR MAXIMA --	TD = 3.7100	TV = 3.3750	TA = 3.7000

PER = 0.53	TIMES FOR MAXIMA --	TD = 3.7150	TV = 3.3750	TA = 3.7050
PER = 0.54	TIMES FOR MAXIMA --	TD = 3.7200	TV = 3.3750	TA = 3.7100
PER = 0.55	TIMES FOR MAXIMA --	TD = 3.7250	TV = 3.3750	TA = 3.7150
PER = 0.56	TIMES FOR MAXIMA --	TD = 3.4750	TV = 3.3800	TA = 3.4650
PER = 0.57	TIMES FOR MAXIMA --	TD = 3.4750	TV = 3.3800	TA = 3.4700
PER = 0.58	TIMES FOR MAXIMA --	TD = 3.4800	TV = 3.3800	TA = 3.4700
PER = 0.60	TIMES FOR MAXIMA --	TD = 5.0650	TV = 3.3800	TA = 5.0550
PER = 0.62	TIMES FOR MAXIMA --	TD = 5.0950	TV = 3.3800	TA = 5.0850
PER = 0.64	TIMES FOR MAXIMA --	TD = 4.8400	TV = 3.3800	TA = 4.8300
PER = 0.66	TIMES FOR MAXIMA --	TD = 4.8650	TV = 3.3800	TA = 4.8550
PER = 0.68	TIMES FOR MAXIMA --	TD = 4.8850	TV = 3.3800	TA = 4.8750
PER = 0.70	TIMES FOR MAXIMA --	TD = 4.9100	TV = 3.3800	TA = 4.9000
PER = 0.72	TIMES FOR MAXIMA --	TD = 4.9350	TV = 3.3800	TA = 4.9200
PER = 0.74	TIMES FOR MAXIMA --	TD = 4.9500	TV = 3.3800	TA = 4.9400
PER = 0.76	TIMES FOR MAXIMA --	TD = 4.2600	TV = 3.3800	TA = 4.2500
PER = 0.78	TIMES FOR MAXIMA --	TD = 4.2750	TV = 3.3800	TA = 4.2600
PER = 0.80	TIMES FOR MAXIMA --	TD = 4.2950	TV = 3.3800	TA = 4.2800
PER = 0.82	TIMES FOR MAXIMA --	TD = 4.3100	TV = 3.3800	TA = 4.2950
PER = 0.84	TIMES FOR MAXIMA --	TD = 4.3250	TV = 3.3800	TA = 4.3100
PER = 0.86	TIMES FOR MAXIMA --	TD = 4.3350	TV = 3.3800	TA = 4.3200
PER = 0.88	TIMES FOR MAXIMA --	TD = 4.3450	TV = 3.3800	TA = 4.3300
PER = 0.90	TIMES FOR MAXIMA --	TD = 4.3500	TV = 3.3800	TA = 4.3350
PER = 0.92	TIMES FOR MAXIMA --	TD = 4.3550	TV = 3.3800	TA = 4.3450
PER = 0.94	TIMES FOR MAXIMA --	TD = 4.3650	TV = 3.3850	TA = 4.3500
PER = 0.96	TIMES FOR MAXIMA --	TD = 4.3700	TV = 3.3850	TA = 4.3500
PER = 0.98	TIMES FOR MAXIMA --	TD = 3.2900	TV = 3.3850	TA = 3.2750
PER = 1.00	TIMES FOR MAXIMA --	TD = 3.2900	TV = 3.3850	TA = 3.2750
PER = 1.05	TIMES FOR MAXIMA --	TD = 3.2900	TV = 3.3850	TA = 3.2750
PER = 1.10	TIMES FOR MAXIMA --	TD = 3.2900	TV = 3.3850	TA = 3.2750
PER = 1.15	TIMES FOR MAXIMA --	TD = 3.2900	TV = 3.3850	TA = 3.2750
PER = 1.20	TIMES FOR MAXIMA --	TD = 3.2950	TV = 3.3850	TA = 3.2750
PER = 1.25	TIMES FOR MAXIMA --	TD = 3.2950	TV = 3.3850	TA = 3.2750
PER = 1.30	TIMES FOR MAXIMA --	TD = 3.2950	TV = 3.3850	TA = 3.2750
PER = 1.35	TIMES FOR MAXIMA --	TD = 3.2950	TV = 3.3850	TA = 3.2750
PER = 1.40	TIMES FOR MAXIMA --	TD = 3.3000	TV = 3.3850	TA = 3.2750
PER = 1.45	TIMES FOR MAXIMA --	TD = 3.3000	TV = 3.3850	TA = 3.2750
PER = 1.50	TIMES FOR MAXIMA --	TD = 3.3000	TV = 3.3850	TA = 3.2750
PER = 1.55	TIMES FOR MAXIMA --	TD = 3.3000	TV = 3.3850	TA = 3.2750
PER = 1.60	TIMES FOR MAXIMA --	TD = 3.3000	TV = 3.3850	TA = 3.2800
PER = 1.65	TIMES FOR MAXIMA --	TD = 3.3050	TV = 3.3850	TA = 3.2800
PER = 1.70	TIMES FOR MAXIMA --	TD = 3.3050	TV = 3.3850	TA = 3.2800
PER = 1.75	TIMES FOR MAXIMA --	TD = 3.3050	TV = 3.3850	TA = 3.2800
PER = 1.80	TIMES FOR MAXIMA --	TD = 4.3450	TV = 3.3850	TA = 3.2800
PER = 1.85	TIMES FOR MAXIMA --	TD = 4.3500	TV = 3.3850	TA = 4.3300
PER = 1.90	TIMES FOR MAXIMA --	TD = 4.3600	TV = 3.3850	TA = 4.3350
PER = 1.95	TIMES FOR MAXIMA --	TD = 4.3650	TV = 3.2250	TA = 4.3400
PER = 2.00	TIMES FOR MAXIMA --	TD = 4.4400	TV = 3.2250	TA = 4.3450
PER = 2.05	TIMES FOR MAXIMA --	TD = 4.4500	TV = 3.2250	TA = 4.4350
PER = 2.10	TIMES FOR MAXIMA --	TD = 4.4600	TV = 3.2250	TA = 4.4400
PER = 2.15	TIMES FOR MAXIMA --	TD = 4.4750	TV = 3.2250	TA = 4.4450
PER = 2.20	TIMES FOR MAXIMA --	TD = 4.4950	TV = 3.2250	TA = 4.4500
PER = 2.25	TIMES FOR MAXIMA --	TD = 4.5100	TV = 3.2250	TA = 4.4550
PER = 2.30	TIMES FOR MAXIMA --	TD = 4.5200	TV = 3.2250	TA = 4.5000
PER = 2.35	TIMES FOR MAXIMA --	TD = 4.5300	TV = 3.2250	TA = 4.5050
PER = 2.40	TIMES FOR MAXIMA --	TD = 4.5400	TV = 3.2250	TA = 4.5100
PER = 2.50	TIMES FOR MAXIMA --	TD = 4.7200	TV = 3.2250	TA = 4.7000
PER = 2.60	TIMES FOR MAXIMA --	TD = 4.8750	TV = 3.2250	TA = 4.8550
PER = 2.70	TIMES FOR MAXIMA --	TD = 4.9050	TV = 3.2250	TA = 4.8600
PER = 2.80	TIMES FOR MAXIMA --	TD = 4.9350	TV = 3.2300	TA = 4.8850
PER = 2.90	TIMES FOR MAXIMA --	TD = 4.9550	TV = 3.2300	TA = 4.9250
PER = 3.00	TIMES FOR MAXIMA --	TD = 4.9650	TV = 3.2300	TA = 4.9350

PER = 3.10 TIMES FOR MAXIMA -- TD = 4.9800 TV = 3.2300 TA = 4.9400
PER = 3.20 TIMES FOR MAXIMA -- TD = 5.1950 TV = 3.2300 TA = 5.1650
PER = 3.30 TIMES FOR MAXIMA -- TD = 5.2650 TV = 3.2300 TA = 5.1700
PER = 3.40 TIMES FOR MAXIMA -- TD = 5.2900 TV = 3.2300 TA = 5.2500
PER = 3.50 TIMES FOR MAXIMA -- TD = 5.3200 TV = 3.2300 TA = 5.2600
PER = 3.60 TIMES FOR MAXIMA -- TD = 5.3350 TV = 3.2300 TA = 5.3050
PER = 3.70 TIMES FOR MAXIMA -- TD = 5.3450 TV = 3.2300 TA = 5.3100
PER = 3.80 TIMES FOR MAXIMA -- TD = 7.3550 TV = 3.2300 TA = 7.3100
PER = 3.90 TIMES FOR MAXIMA -- TD = 7.4500 TV = 3.2300 TA = 7.4250
PER = 4.00 TIMES FOR MAXIMA -- TD = 5.7750 TV = 3.2300 TA = 5.7450
PER = 4.10 TIMES FOR MAXIMA -- TD = 5.7850 TV = 3.2300 TA = 5.7500
PER = 4.20 TIMES FOR MAXIMA -- TD = 5.7900 TV = 3.2300 TA = 5.7550
PER = 4.30 TIMES FOR MAXIMA -- TD = 5.8000 TV = 3.2300 TA = 5.7600
PER = 4.40 TIMES FOR MAXIMA -- TD = 5.8100 TV = 3.2300 TA = 5.7600
PER = 4.50 TIMES FOR MAXIMA -- TD = 5.8150 TV = 3.2300 TA = 5.7650
PER = 4.60 TIMES FOR MAXIMA -- TD = 5.8250 TV = 3.2300 TA = 5.7650
PER = 4.70 TIMES FOR MAXIMA -- TD = 6.0800 TV = 3.2300 TA = 5.7650
PER = 4.80 TIMES FOR MAXIMA -- TD = 6.1150 TV = 3.2300 TA = 6.0300
PER = 4.90 TIMES FOR MAXIMA -- TD = 6.1350 TV = 3.2300 TA = 6.0350
PER = 5.00 TIMES FOR MAXIMA -- TD = 6.1500 TV = 3.2300 TA = 6.1000
PER = 5.10 TIMES FOR MAXIMA -- TD = 6.1650 TV = 3.2300 TA = 6.1100
PER = 5.20 TIMES FOR MAXIMA -- TD = 6.1800 TV = 3.2300 TA = 6.1200
PER = 5.40 TIMES FOR MAXIMA -- TD = 6.2900 TV = 3.2300 TA = 6.1350
PER = 5.60 TIMES FOR MAXIMA -- TD = 9.3450 TV = 3.2300 TA = 9.2800
PER = 5.80 TIMES FOR MAXIMA -- TD = 9.4000 TV = 3.2300 TA = 9.3050
PER = 6.00 TIMES FOR MAXIMA -- TD = 9.7200 TV = 3.2300 TA = 9.6600
PER = 6.20 TIMES FOR MAXIMA -- TD = 9.7600 TV = 3.2300 TA = 9.6750
PER = 6.40 TIMES FOR MAXIMA -- TD = 9.7800 TV = 3.2300 TA = 9.7250
PER = 6.60 TIMES FOR MAXIMA -- TD = 9.9900 TV = 3.2300 TA = 9.7350
PER = 6.80 TIMES FOR MAXIMA -- TD = 10.0350 TV = 3.2300 TA = 3.9750
PER = 7.00 TIMES FOR MAXIMA -- TD = 10.0550 TV = 3.2300 TA = 3.9750
PER = 7.30 TIMES FOR MAXIMA -- TD = 4.0400 TV = 3.2300 TA = 3.9700
PER = 7.60 TIMES FOR MAXIMA -- TD = 4.0450 TV = 3.2300 TA = 3.9700
PER = 8.00 TIMES FOR MAXIMA -- TD = 4.0450 TV = 3.2300 TA = 3.9700
PER = 8.50 TIMES FOR MAXIMA -- TD = 4.0450 TV = 3.2300 TA = 3.9700
PER = 9.00 TIMES FOR MAXIMA -- TD = 4.0450 TV = 3.2300 TA = 3.9700
PER = 9.50 TIMES FOR MAXIMA -- TD = 4.0500 TV = 3.2300 TA = 3.9700
PER =10.00 TIMES FOR MAXIMA -- TD = 4.0500 TV = 3.2300 TA = 3.9700

SPECTRAL VALUES--

(Acceleration of gravity used = 32.20)

PCSC300M Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00004	0.00344	0.02723	0.53173	0.53137	100.00
2	0.02	0.00018	0.01498	0.05597	0.54644	0.54604	50.00
3	0.03	0.00046	0.04299	0.09541	0.62698	0.62058	33.33
4	0.04	0.00098	0.07450	0.15339	0.74265	0.74829	25.00
5	0.05	0.00185	0.11438	0.23188	0.90186	0.90494	20.00
6	0.06	0.00323	0.21636	0.33796	1.09325	1.09910	16.67
7	0.07	0.00417	0.26957	0.37428	1.04604	1.04334	14.29
8	0.08	0.00574	0.36004	0.45084	1.09593	1.09966	12.50
9	0.09	0.00793	0.46547	0.55381	1.20729	1.20072	11.11
10	0.10	0.01184	0.65897	0.74391	1.45586	1.45159	10.00
11	0.11	0.01171	0.58300	0.66872	1.18724	1.18625	9.09
12	0.12	0.01240	0.55739	0.64908	1.06784	1.05547	8.33
13	0.13	0.01544	0.57856	0.74634	1.12466	1.12025	7.69
14	0.14	0.01706	0.68136	0.76544	1.06872	1.06686	7.14
15	0.15	0.01801	0.70930	0.75423	0.98064	0.98116	6.67
16	0.16	0.02089	0.80674	0.82053	1.00651	1.00069	6.25
17	0.17	0.02562	0.81415	0.94686	1.08817	1.08683	5.88
18	0.18	0.03629	1.14590	1.26681	1.37972	1.37329	5.56
19	0.19	0.04746	1.50605	1.56961	1.61717	1.61199	5.26

20	0.20	0.05622	1.76231	1.76627	1.72911	1.72326	5.00
21	0.21	0.05900	1.77538	1.76536	1.64688	1.64036	4.76
22	0.22	0.06011	1.66750	1.71685	1.52662	1.52277	4.55
23	0.23	0.06855	1.77125	1.87279	1.59324	1.58885	4.35
24	0.24	0.07171	1.75936	1.87725	1.53512	1.52628	4.17
25	0.25	0.06812	1.64597	1.71210	1.34162	1.33632	4.00
26	0.26	0.07414	1.74473	1.79156	1.35117	1.34456	3.85
27	0.27	0.08077	1.85374	1.87951	1.36525	1.35833	3.70
28	0.28	0.08697	1.94060	1.95166	1.36680	1.36010	3.57
29	0.29	0.09386	2.02854	2.03354	1.37519	1.36829	3.45
30	0.30	0.10278	2.16374	2.15263	1.40737	1.40014	3.33
31	0.31	0.11314	2.31754	2.29317	1.45097	1.44344	3.23
32	0.32	0.12301	2.45521	2.41523	1.48044	1.47276	3.13
33	0.33	0.13119	2.54419	2.49779	1.48493	1.47695	3.03
34	0.34	0.14271	2.59575	2.63735	1.52138	1.51360	2.94
35	0.35	0.15651	2.68723	2.80967	1.57393	1.56643	2.86
36	0.36	0.16429	2.90887	2.86740	1.56142	1.55421	2.78
37	0.37	0.16698	3.00594	2.83558	1.50270	1.49542	2.70
38	0.38	0.16550	2.97128	2.73644	1.41208	1.40516	2.63
39	0.39	0.16053	2.81259	2.58633	1.29996	1.29402	2.56
40	0.40	0.15743	2.60673	2.47295	1.21458	1.20637	2.50
41	0.41	0.15845	2.55928	2.42821	1.16465	1.15565	2.44
42	0.42	0.15930	2.55244	2.38318	1.11507	1.10721	2.38
43	0.43	0.15941	2.57190	2.32929	1.06456	1.05701	2.33
44	0.44	0.15879	2.55400	2.26755	1.01406	1.00561	2.27
45	0.45	0.15773	2.50222	2.20231	0.96199	0.95497	2.22
46	0.46	0.15595	2.42166	2.13016	0.90953	0.90361	2.17
47	0.47	0.15361	2.31736	2.05350	0.85825	0.85255	2.13
48	0.48	0.15256	2.28031	1.99700	0.81642	0.81182	2.08
49	0.49	0.15098	2.26787	1.93595	0.77628	0.77094	2.04
50	0.50	0.14885	2.24825	1.87049	0.73500	0.72998	2.00
51	0.51	0.14607	2.22793	1.79955	0.69341	0.68852	1.96
52	0.52	0.14275	2.20266	1.72490	0.65210	0.64727	1.92
53	0.53	0.13899	2.17393	1.64778	0.61147	0.60666	1.89
54	0.54	0.13486	2.14284	1.56913	0.57181	0.56701	1.85
55	0.55	0.13040	2.11020	1.48967	0.53328	0.52851	1.82
56	0.56	0.12738	2.07877	1.42920	0.50120	0.49800	1.79
57	0.57	0.12463	2.04816	1.37386	0.47333	0.47032	1.75
58	0.58	0.12200	2.01723	1.32169	0.44768	0.44466	1.72
59	0.60	0.12140	1.95582	1.27134	0.41666	0.41346	1.67
60	0.62	0.13002	1.89681	1.31761	0.41668	0.41469	1.61
61	0.64	0.13822	1.84194	1.35697	0.41587	0.41373	1.56
62	0.66	0.14955	1.79284	1.42367	0.42321	0.42091	1.52
63	0.68	0.15620	1.75093	1.44329	0.41665	0.41416	1.47
64	0.70	0.15867	1.71699	1.42420	0.39922	0.39701	1.43
65	0.72	0.15780	1.69088	1.37709	0.37538	0.37321	1.39
66	0.74	0.15343	1.67168	1.30274	0.34603	0.34352	1.35
67	0.76	0.15320	1.65801	1.26652	0.32713	0.32518	1.32
68	0.78	0.15301	1.64842	1.23255	0.30987	0.30834	1.28
69	0.80	0.15226	1.64164	1.19583	0.29295	0.29168	1.25
70	0.82	0.15089	1.63668	1.15619	0.27649	0.27513	1.22
71	0.84	0.14873	1.63281	1.11252	0.25978	0.25844	1.19
72	0.86	0.14558	1.62945	1.06365	0.24283	0.24134	1.16
73	0.88	0.14112	1.62616	1.00756	0.22519	0.22341	1.14
74	0.90	0.13537	1.62256	0.94504	0.20669	0.20490	1.11
75	0.92	0.12834	1.61831	0.87653	0.18783	0.18591	1.09
76	0.94	0.12036	1.61322	0.80451	0.16882	0.16700	1.06
77	0.96	0.11165	1.60771	0.73076	0.15011	0.14853	1.04
78	0.98	0.11349	1.60100	0.72764	0.14794	0.14488	1.02
79	1.00	0.11644	1.59306	0.73164	0.14580	0.14277	1.00
80	1.05	0.12348	1.56865	0.73890	0.14033	0.13732	0.95

81	1.10	0.12986	1.54016	0.74176	0.13461	0.13158	0.91
82	1.15	0.13570	1.51097	0.74142	0.12886	0.12580	0.87
83	1.20	0.14142	1.48339	0.74049	0.12341	0.12041	0.83
84	1.25	0.14724	1.45826	0.74011	0.11850	0.11553	0.80
85	1.30	0.15335	1.43523	0.74118	0.11420	0.11125	0.77
86	1.35	0.15983	1.41340	0.74390	0.11047	0.10752	0.74
87	1.40	0.16665	1.39181	0.74794	0.10720	0.10425	0.71
88	1.45	0.17378	1.36977	0.75301	0.10425	0.10133	0.69
89	1.50	0.18098	1.34690	0.75810	0.10151	0.09862	0.67
90	1.55	0.18816	1.32314	0.76273	0.09890	0.09602	0.65
91	1.60	0.19520	1.29861	0.76656	0.09637	0.09349	0.63
92	1.65	0.20214	1.27355	0.76975	0.09391	0.09103	0.61
93	1.70	0.20890	1.24823	0.77208	0.09149	0.08862	0.59
94	1.75	0.21543	1.22290	0.77348	0.08911	0.08624	0.57
95	1.80	0.22339	1.19773	0.77979	0.08679	0.08453	0.56
96	1.85	0.23776	1.17287	0.80752	0.08626	0.08517	0.54
97	1.90	0.25054	1.14839	0.82851	0.08632	0.08509	0.53
98	1.95	0.26172	1.13281	0.84331	0.08571	0.08439	0.51
99	2.00	0.27257	1.14823	0.85631	0.08452	0.08355	0.50
100	2.05	0.28498	1.16341	0.87345	0.08373	0.08314	0.49
101	2.10	0.29601	1.17839	0.88566	0.08310	0.08229	0.48
102	2.15	0.30571	1.19320	0.89342	0.08200	0.08108	0.47
103	2.20	0.31441	1.20787	0.89794	0.08049	0.07964	0.45
104	2.25	0.32242	1.22239	0.90038	0.07866	0.07808	0.44
105	2.30	0.32923	1.23679	0.89939	0.07693	0.07630	0.43
106	2.35	0.33460	1.25103	0.89462	0.07510	0.07428	0.43
107	2.40	0.33846	1.26513	0.88609	0.07300	0.07204	0.42
108	2.50	0.35730	1.29276	0.89799	0.07057	0.07009	0.40
109	2.60	0.38457	1.31949	0.92934	0.07027	0.06975	0.38
110	2.70	0.41352	1.34513	0.96229	0.07028	0.06955	0.37
111	2.80	0.43768	1.36969	0.98216	0.06906	0.06845	0.36
112	2.90	0.45613	1.39299	0.98826	0.06726	0.06650	0.34
113	3.00	0.46805	1.41472	0.98027	0.06477	0.06376	0.33
114	3.10	0.47360	1.43479	0.95991	0.06160	0.06042	0.32
115	3.20	0.48779	1.45321	0.95778	0.05918	0.05840	0.31
116	3.30	0.50549	1.46998	0.96244	0.05761	0.05691	0.30
117	3.40	0.52070	1.48510	0.96226	0.05576	0.05523	0.29
118	3.50	0.53182	1.49866	0.95472	0.05380	0.05323	0.29
119	3.60	0.53822	1.51072	0.93938	0.05148	0.05092	0.28
120	3.70	0.53955	1.52137	0.91625	0.04909	0.04832	0.27
121	3.80	0.54419	1.53070	0.89980	0.04663	0.04620	0.26
122	3.90	0.54414	1.53879	0.87665	0.04412	0.04386	0.26
123	4.00	0.54512	1.54575	0.85627	0.04232	0.04177	0.25
124	4.10	0.55984	1.55166	0.85795	0.04157	0.04083	0.24
125	4.20	0.56968	1.55662	0.85224	0.04048	0.03959	0.24
126	4.30	0.57511	1.56072	0.84036	0.03913	0.03813	0.23
127	4.40	0.57652	1.56402	0.82327	0.03759	0.03651	0.23
128	4.50	0.57443	1.56661	0.80206	0.03592	0.03478	0.22
129	4.60	0.56932	1.56857	0.77764	0.03416	0.03299	0.22
130	4.70	0.57317	1.56996	0.76624	0.03235	0.03181	0.21
131	4.80	0.57662	1.57082	0.75479	0.03103	0.03068	0.21
132	4.90	0.57803	1.57124	0.74120	0.02981	0.02952	0.20
133	5.00	0.57721	1.57124	0.72535	0.02862	0.02831	0.20
134	5.10	0.57417	1.57088	0.70738	0.02743	0.02706	0.20
135	5.20	0.56916	1.57020	0.68772	0.02621	0.02581	0.19
136	5.40	0.55830	1.56804	0.64961	0.02377	0.02347	0.19
137	5.60	0.56648	1.56501	0.63559	0.02245	0.02215	0.18
138	5.80	0.56912	1.56134	0.61654	0.02111	0.02074	0.17
139	6.00	0.57671	1.55717	0.60393	0.01986	0.01964	0.17
140	6.20	0.57675	1.55267	0.58449	0.01867	0.01840	0.16
141	6.40	0.56236	1.54794	0.55210	0.01720	0.01683	0.16

142	6.60	0.54027	1.54307	0.51434	0.01554	0.01521	0.15
143	6.80	0.51948	1.53813	0.48000	0.01439	0.01377	0.15
144	7.00	0.49104	1.53316	0.44075	0.01351	0.01229	0.14
145	7.30	0.46985	1.52577	0.40441	0.01231	0.01081	0.14
146	7.60	0.46077	1.51853	0.38094	0.01126	0.00978	0.13
147	8.00	0.44872	1.50926	0.35242	0.01004	0.00860	0.13
148	8.50	0.43399	1.49836	0.32080	0.00877	0.00736	0.12
149	9.00	0.41998	1.48832	0.29320	0.00772	0.00636	0.11
150	9.50	0.40682	1.47913	0.26907	0.00684	0.00553	0.11
151	10.00	0.39463	1.47073	0.24796	0.00611	0.00484	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.
AREA OF ACC. RESPONSE SPECTRUM = 0.827
AREA OF VEL. RESPONSE SPECTRUM = 3.619
MAX. ACCELERATION RESPONSE VALUE = 1.729
MAX. VELOCITY RESPONSE VALUE = 3.006

*** End of Output File No. 1 ***

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

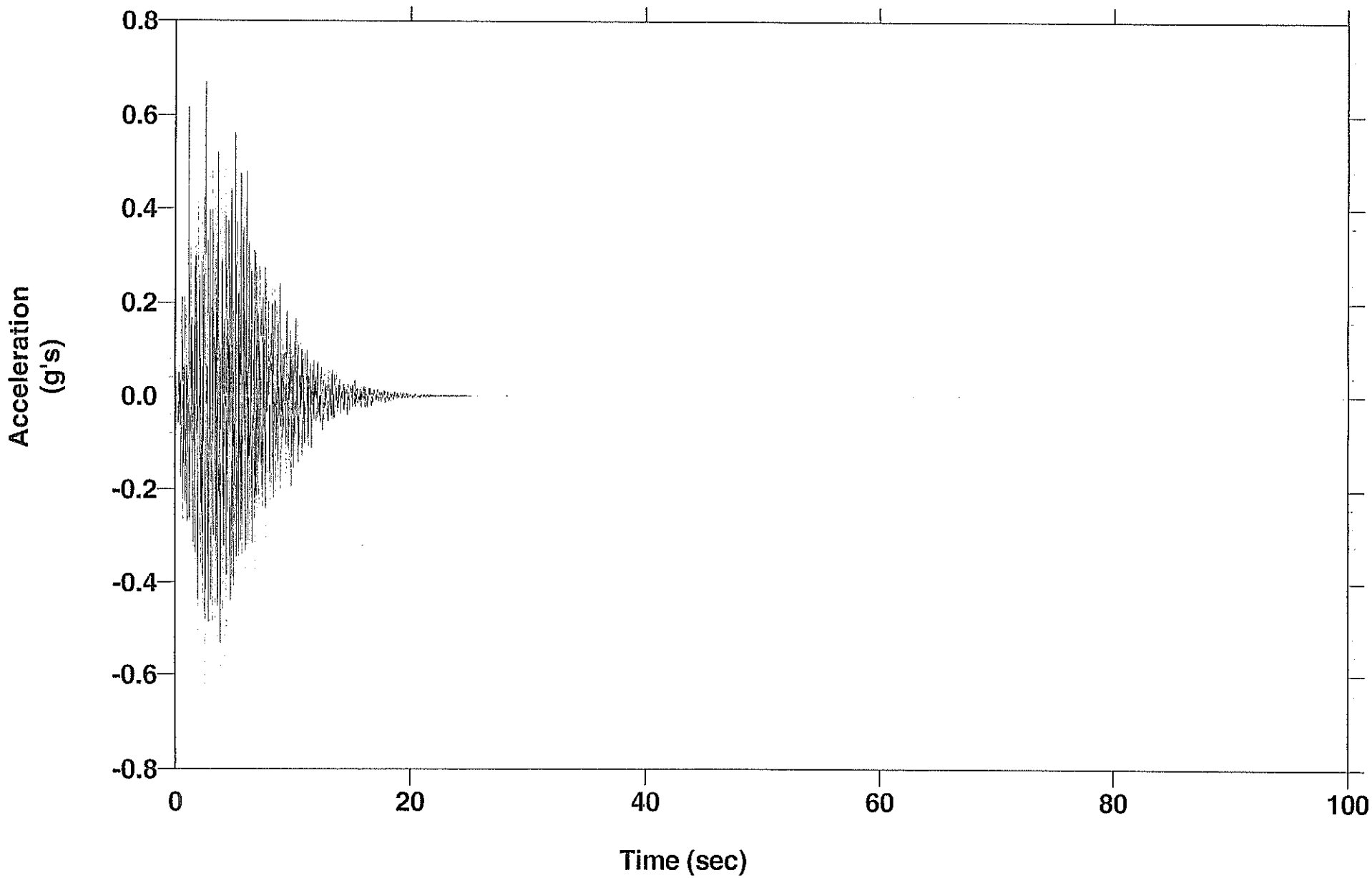
PROJECT NO. 072046

PAGE 64 OF 131

MADE BY BEG DATE 1/3/08 CHECKED BY [illegible] DATE 1/23/08

SIMSIM OUTPUT AND SHAKE PLOTS OF ACCELERATION TIME HISTORY M6.8 BACKGROUND EARTHQUAKE AT 13.5KM

Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt



64A of 131

R15909

Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt
SHAKE2000 Conversion: 8192 .01 4 8 9 (8f9.6)
Acceleration Units: (g's) - No. Values: 8192 - Time Step: .01 (secs)
Data Format: (8f9.6) - No. Header Lines: 4

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Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation

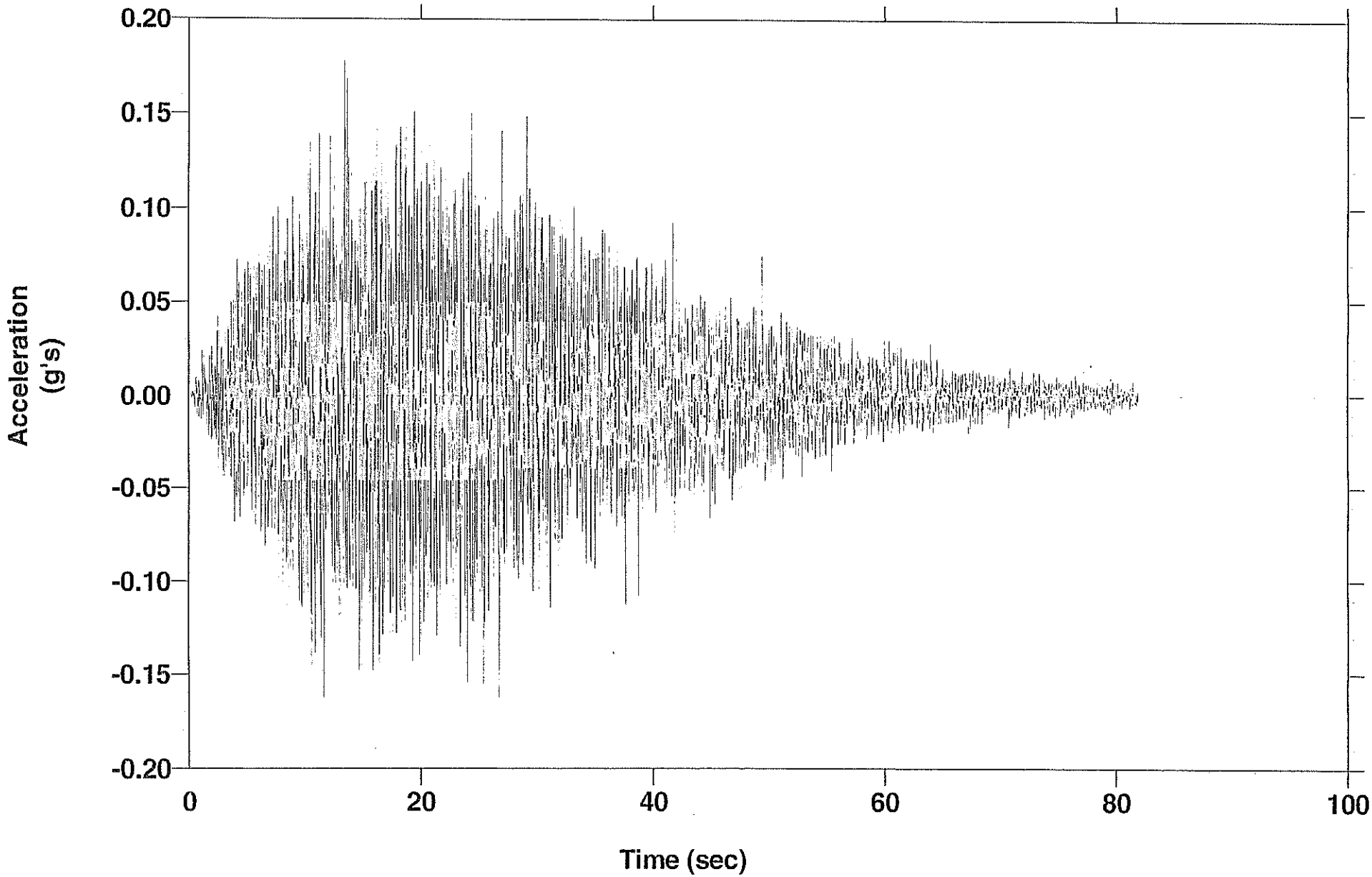
PROJECT NO. 072046

Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PAGE 85 OF 131

MADE BY BEG DATE 1/3/08 CHECKED BY [signature] DATE 1/23/08

SIMSIM OUTPUT AND SHAKE PLOTS OF ACCELERATION -IME HISTORY M8.0 NEW MADRID EARTHQUAKE AT 83 KM



BSA OP 131

R15931

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Acceleration Units: (g's) - No. Values: 8184 - Time Step: .01 (secs)
Data Format: (8f9.6) - No. Header Lines: 4

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Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

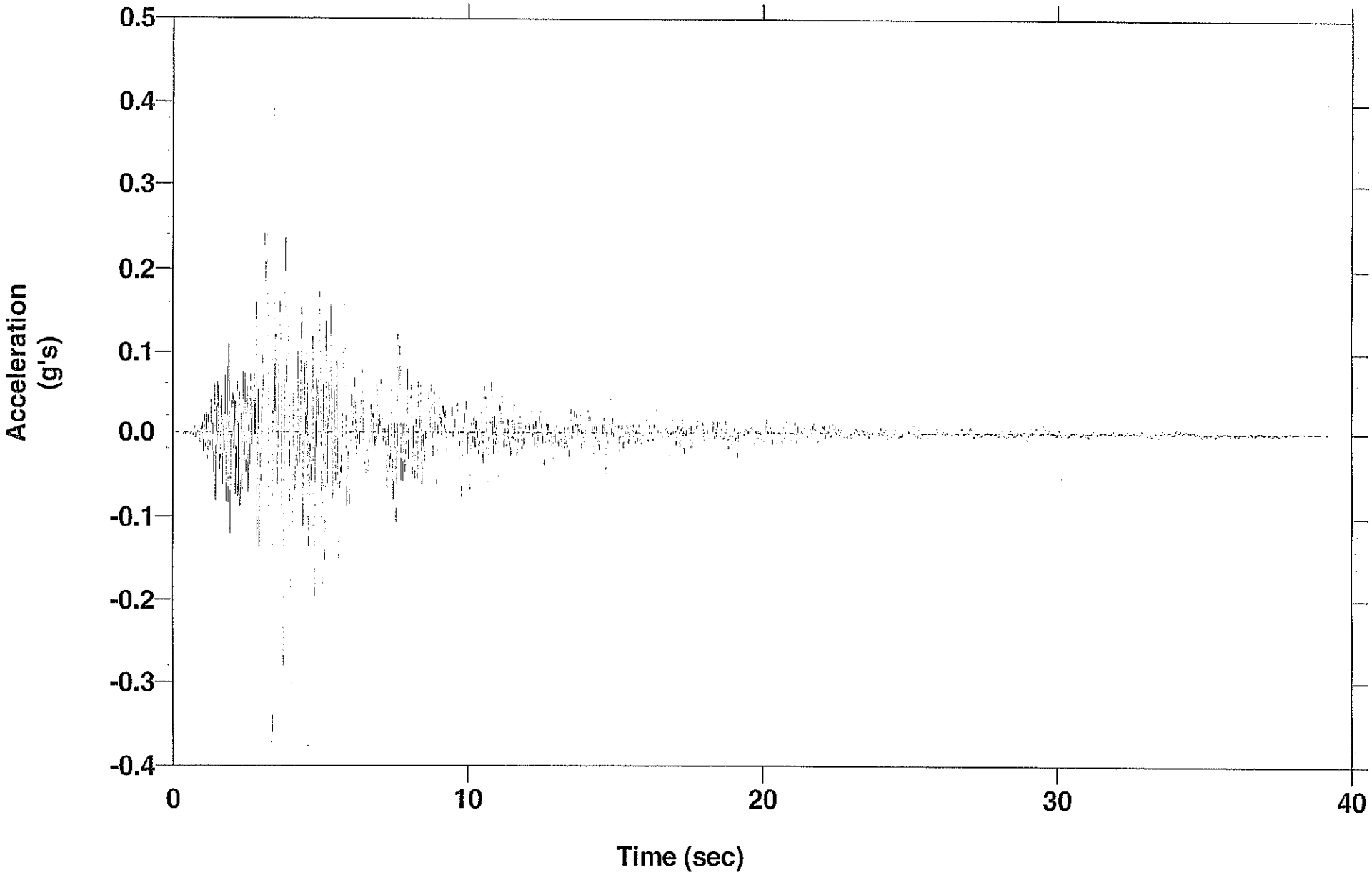
Simulation of Acceleration-Time Histories and Comparative Assessment of Eastern U.S. Synthetic and Western U.S. Time Histories and Response Spectra

PAGE 106 OF 131

MADE BY BEG DATE 1/3/08 CHECKED BY [signature] DATE 1/23/08

PEER DATABASE EARTHQUAKE RECORD FOR A M6.8 BACKGROUND EARTHQUAKE LOMA PRIETA, CALIFORNIA, G01000

Source File: C:\SHAKE2000\Quakes\USGS 2% in 50 years\LomaP.G01000 AT2.txt



R15953

PEER Strong Motion Database

P0733 : Earthquake and Station Details

Loma Prieta 1989/10/18 00:05 Magnitude: M (6.9) Ml ( ) Ms (7.1)	Station: 47379 Gilroy Array #1 Data Source: CDMG
Distance (km): Closest to fault rupture (11.2) Hypocentral ( ) Closest to surface projection of rupture (10.5)	Site conditions: Geomatrix or CWB (A) USGS (A)

A newer version of this record is available in the PEER NGA database: NGA0765

Download Files

Record/Component	HP (Hz)	LP (Hz)	PGA (g)	PGV (cm/s)	PGD (cm)	Acceleration	Velocity	Displacement	Spectra
AP/G01-UP	0.2	52.0	0.209	14.0	5.59	ATH	VTH	DTH	0.5% 1% 2% 3% 5% 7% 10% 15% 20%
LOMAP/G01000	0.2	50.0	0.411	31.6	6.38	ATH	VTH	DTH	0.5% 1% 2% 3% 5% 7% 10% 15% 20%
LOMAP/G01090	0.2	50.0	0.473	33.9	8.03	ATH	VTH	DTH	0.5% 1% 2% 3% 5% 7% 10% 15% 20%

HP = High Pass and LP = Low Pass Filters
Spectra are available for 0.5 - 20% damping.
Source record processed by Pacific Engineering.

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PEER STRONG MOTION DATABASE RECORD. PROCESSING BY PACIFIC ENGINEERING.
LOMA PRIETA 10/18/89 00:05, GILROY ARRAY #1, 000 (CDMG STATION 47379)
ACCELERATION TIME HISTORY IN UNITS OF G. FILTER POINTS: HP=0.2 Hz LP=50.0 Hz
NPTS= 7989, DT= .00500 SEC

105 9 131

R15955

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-.6811371E-03	-.7538926E-03	-.8475488E-03	-.9173378E-03	-.9434138E-03
-.9635164E-03	-.1004710E-02	-.1043088E-02	-.1061912E-02	-.1089371E-02
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.1272698E-02	-.1241747E-02	-.1151629E-02	-.1012129E-02	-.8881325E-03
-.8013140E-03	-.7128263E-03	-.6367177E-03	-.6215747E-03	-.6518230E-03
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-.2485315E-03	-.2725700E-03	-.5362648E-03	-.8637757E-03	-.1114311E-02
-.1345029E-02	-.1548192E-02	-.1633081E-02	-.1617579E-02	-.1554284E-02
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.3623343E-03	.1441276E-03	-.2276718E-03	-.8038015E-03	-.1599270E-02
-.2418264E-02	-.2781967E-02	-.2412678E-02	-.1595949E-02	-.7727762E-03
-.1980250E-03	-.1440375E-05	-.1020799E-03	-.2278426E-03	-.3753702E-03
-.8163438E-03	-.1491490E-02	-.1959093E-02	-.2003623E-02	-.1992603E-02
-.2378156E-02	-.3074140E-02	-.3533091E-02	-.3109064E-02	-.1845726E-02
-.8006441E-03	-.5999215E-03	-.5917658E-03	-.3574144E-03	-.5275683E-03
-.1368800E-02	-.2188474E-02	-.2374888E-02	-.1814372E-02	-.7505837E-03
.2511738E-03	.8185070E-03	.1096188E-02	.1463359E-02	.1907826E-02
.1774600E-02	.7432509E-03	-.6648917E-03	-.1942745E-02	-.2922394E-02
-.3528983E-02	-.4058257E-02	-.4687263E-02	-.4786290E-02	-.3998003E-02
-.2917729E-02	-.2080907E-02	-.1631922E-02	-.1801217E-02	-.2302014E-02
-.2169823E-02	-.1255318E-02	-.4421582E-03	-.9180594E-04	.2793393E-03
.8368755E-03	.8820577E-03	-.1586407E-03	-.1415350E-02	-.1700737E-02
-.1699340E-02	-.2811499E-02	-.4604466E-02	-.5189655E-02	-.3774773E-02
-.1922089E-02	-.1687603E-02	-.3093448E-02	-.4510621E-02	-.5001234E-02
-.4590599E-02	-.3410452E-02	-.1865622E-02	-.9869928E-04	.2252749E-02
.5035301E-02	.7264725E-02	.7970343E-02	.7035095E-02	.4845384E-02
.1423738E-02	-.2958739E-02	-.6772649E-02	-.8030651E-02	-.6118226E-02
-.3982881E-02	-.1392657E-02	-.1602103E-02	-.2172011E-02	-.3105521E-02
-.5026245E-02	-.7543124E-02	-.9869120E-02	-.1021539E-01	-.7006410E-02
-.2239940E-02	.6974296E-03	.1183379E-02	.5525251E-03	-.2363542E-03
-.8632735E-03	-.6855988E-03	.7895015E-03	.2879021E-02	.4943918E-02
.6854554E-02	.7845768E-02	.7026399E-02	.4621499E-02	.1926546E-02
-.6250647E-03	-.4147868E-02	-.8845942E-02	-.1319724E-01	-.1520589E-01
-.1334065E-01	-.8154208E-02	-.2611079E-02	.1016914E-02	.2855542E-02
.4362354E-02	.6531307E-02	.7119703E-02	.2974634E-02	-.4245701E-02
-.9967761E-02	-.1182740E-01	-.9724923E-02	-.4857154E-02	.1174191E-02
.7407392E-02	.1153188E-01	.1015557E-01	.4165014E-02	-.2097721E-02
-.8009654E-02	-.1523047E-01	-.2223572E-01	-.2586513E-01	-.2387724E-01
-.1571059E-01	-.3077338E-02	.1091336E-01	.2159266E-01	.2433431E-01
.1974344E-01	.1191444E-01	.1992727E-02	-.9534817E-02	-.1903953E-01
-.2306971E-01	-.2060402E-01	-.1334942E-01	-.3787695E-02	.8474556E-02
.2134887E-01	.2670266E-01	.2084258E-01	.9530165E-02	-.1633075E-02
-.1175162E-01	-.2086357E-01	-.2864376E-01	-.3321546E-01	-.3193953E-01
-.2490916E-01	-.1533524E-01	-.5834230E-02	.3879780E-02	.1382384E-01
.2055917E-01	.2058104E-01	.1580416E-01	.1136313E-01	.8987288E-02
.6087777E-02	.4066025E-05	-.7805318E-02	-.1303716E-01	-.1358425E-01
-.1142873E-01	-.1181730E-01	-.1647496E-01	-.1980215E-01	-.1663775E-01
-.8247962E-02	.5869280E-03	.8387722E-02	.1832358E-01	.3126759E-01
.4038436E-01	.3639467E-01	.1949170E-01	-.7524456E-03	-.1643482E-01
-.2357293E-01	-.2127010E-01	-.1278945E-01	-.2117584E-02	.7682110E-02
.1198931E-01	.7515619E-02	-.2273565E-02	-.1358142E-01	-.2737444E-01
-.4147919E-01	-.4970335E-01	-.4735488E-01	-.3228677E-01	-.6988422E-02
.2178978E-01	.4678145E-01	.6065952E-01	.5867988E-01	.4340249E-01
.2004549E-01	-.1026451E-01	-.4428341E-01	-.7177387E-01	-.8466389E-01
-.1076499E-01	-.6543902E-01	-.3984424E-01	-.9631271E-02	.1769249E-01
.3164720E-01	.2799117E-01	.1301762E-01	-.2909330E-02	-.1246066E-01
-.1493594E-01	-.1281991E-01	-.4389901E-02	.1494136E-01	.4184680E-01
.6157112E-01	.6402520E-01	.5389987E-01	.3777703E-01	.1875162E-01
.3409031E-02	-.3638216E-02	-.7795400E-02	-.1714506E-01	-.3205433E-01
-.4500285E-01	-.4710574E-01	-.3695246E-01	-.2575499E-01	-.2588813E-01

R15956

-.3503004E-01	-.4113824E-01	-.3799995E-01	-.2758160E-01	-.1147221E-01
.1107723E-01	.3443361E-01	.4527485E-01	.3664327E-01	.1718283E-01
.3416817E-02	.4866374E-02	.1585682E-01	.1990909E-01	.4410211E-02
-.2607778E-01	-.5312333E-01	-.6203763E-01	-.5280853E-01	-.3551196E-01
-.2197128E-01	-.1782226E-01	-.1633164E-01	-.7222827E-02	.5985070E-02
.9628084E-02	-.2272187E-04	-.1401016E-01	-.2400017E-01	-.2600482E-01
.1720651E-01	-.1619851E-03	.1812167E-01	.3436954E-01	.4892407E-01
.257836E-01	.7185874E-01	.6719612E-01	.4332032E-01	.3687635E-02
.205532E-01	-.7595828E-01	-.8391897E-01	-.7131610E-01	-.5081690E-01
-.2607265E-01	.4794165E-02	.4173632E-01	.7701724E-01	.9392400E-01
.7948653E-01	.3618234E-01	-.2098816E-01	-.6961925E-01	-.8860621E-01
-.7732077E-01	-.5254559E-01	-.2166231E-01	.1705729E-01	.5785907E-01
.9255739E-01	.1144478E+00	.1137465E+00	.8528413E-01	.3386947E-01
-.2612903E-01	-.7537390E-01	-.1048997E+00	-.1188033E+00	-.1221478E+00
-.1156009E+00	-.9640803E-01	-.6253752E-01	-.2218374E-01	.1229767E-01
.3742891E-01	.4525786E-01	.2803095E-01	.2878859E-02	-.8358122E-02
-.6396497E-02	-.1983018E-02	-.5992373E-03	-.1224378E-02	.2852739E-02
.1690905E-01	.3621772E-01	.4847387E-01	.4564861E-01	.3313862E-01
.2143216E-01	.9613697E-02	-.7770024E-02	-.2150211E-01	-.1690799E-01
.4339163E-02	.2601860E-01	.3205580E-01	.2040983E-01	.1028042E-01
.2078047E-01	.3944945E-01	.3281532E-01	-.1014694E-01	-.5968678E-01
-.7511426E-01	-.5166947E-01	-.2358670E-01	-.1839634E-01	-.3162369E-01
-.4450320E-01	-.4515351E-01	-.2950721E-01	.2319312E-02	.3934058E-01
.6252475E-01	.6423025E-01	.5592225E-01	.5367169E-01	.5798386E-01
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-.7446642E-02	.3053094E-01	.4227499E-01	.4312180E-01	.4877743E-01
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.3732377E-01	.9544122E-03	-.3018104E-01	-.4105437E-01	-.2995762E-01
.1337386E-01	-.1670080E-02	.1381587E-01	.3938460E-01	.6572457E-01
.700079E-01	.6701184E-01	.3746861E-01	.4350126E-02	-.2188676E-01
-.98654E-01	-.4820985E-01	-.5232231E-01	-.4867576E-01	-.3083319E-01
-.7249775E-04	.3359637E-01	.5586047E-01	.5999055E-01	.5192764E-01
.3516172E-01	.6105879E-02	-.3197619E-01	-.6334495E-01	-.7464692E-01
-.6530901E-01	-.4135250E-01	-.1407149E-01	.3585182E-02	.9210412E-02
.7519446E-02	.1173072E-02	-.7012098E-02	-.1560304E-01	-.2517153E-01
-.3408632E-01	-.3945326E-01	-.3650949E-01	-.2181446E-01	.3491662E-02
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.4371806E-01	.3602875E-01	.3396750E-01	.3614668E-01	.4416091E-01
.5867040E-01	.7359940E-01	.7929953E-01	.7081037E-01	.4922386E-01
.2062450E-01	-.1160624E-02	-.3408077E-02	.1371420E-01	.4486223E-01
.8199749E-01	.1147312E+00	.1410844E+00	.1600842E+00	.1648001E+00
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-.4362795E-01	.3032529E-02	.3673582E-01	.5499202E-01	.5348391E-01
.2898651E-01	-.9179883E-02	-.5150568E-01	-.9256645E-01	-.1232825E+00
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.8547562E-01	.9678312E-01	.9745688E-01	.9181002E-01	.8462018E-01
.7527133E-01	.6288253E-01	.5168245E-01	.5014454E-01	.6432728E-01
.8980871E-01	.1150010E+00	.1355448E+00	.1586534E+00	.1892860E+00
.2210128E+00	.2410335E+00	.2447635E+00	.2403852E+00	.2334284E+00
.17670E+00	.2021997E+00	.1870124E+00	.1836716E+00	.1898067E+00
.19015E+00	.2095890E+00	.2245179E+00	.2396337E+00	.2449710E+00
.2418585E+00	.2378745E+00	.2297327E+00	.2122439E+00	.1933033E+00
.1827946E+00	.1777906E+00	.1698315E+00	.1548354E+00	.1317887E+00
.1003514E+00	.6114395E-01	.1189380E-01	-.4854695E-01	-.1115099E+00
-.1629876E+00	-.1958231E+00	-.2203029E+00	-.2505217E+00	-.2847479E+00
-.3152785E+00	-.3405943E+00	-.3609469E+00	-.3733924E+00	-.3762266E+00

-.3735915E+00	-.3715657E+00	-.3719672E+00	-.3728036E+00	-.3720089E+00
-.3685211E+00	-.3624413E+00	-.3539077E+00	-.3446139E+00	-.3403036E+00
-.3451498E+00	-.3550808E+00	-.3623037E+00	-.3585851E+00	-.3350472E+00
-.2836262E+00	-.1966876E+00	-.7631155E-01	.6516815E-01	.2142496E+00
.3376959E+00	.3922531E+00	.3903307E+00	.3901161E+00	.4085181E+00
.4108756E+00	.3689534E+00	.2867989E+00	.1893281E+00	.1038614E+00
.4633249E-01	.2159356E-01	.2839419E-01	.5627371E-01	.8860796E-01
.1115440E+00	.1208181E+00	.1223982E+00	.1212060E+00	.1142751E+00
.9706649E-01	.6802372E-01	.2845511E-01	-.1210836E-01	-.4007021E-01
-.5385511E-01	-.6190498E-01	-.6568776E-01	-.5851398E-01	-.4017646E-01
-.1988928E-01	-.5441263E-02	.1340079E-02	-.2207173E-03	-.7941803E-02
-.7723233E-02	.1509580E-01	.5402198E-01	.8974393E-01	.1115044E+00
.1208059E+00	.1254634E+00	.1323428E+00	.1428455E+00	.1543474E+00
.1632082E+00	.1665947E+00	.1612345E+00	.1455056E+00	.1236066E+00
.1010738E+00	.8104994E-01	.6261324E-01	.4033604E-01	.1151218E-01
-.2116775E-01	-.5449790E-01	-.8907994E-01	-.1277150E+00	-.1695753E+00
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-.2838719E+00	-.2827316E+00	-.2717632E+00	-.2486081E+00	-.2153821E+00
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.1383020E-01	.6032339E-01	.1179149E+00	.1774086E+00	.2220029E+00
.2374799E+00	.2230500E+00	.1930742E+00	.1658513E+00	.1523309E+00
.1472396E+00	.1344381E+00	.1086081E+00	.8133839E-01	.6354121E-01
.5812326E-01	.6629055E-01	.8376524E-01	.1017766E+00	.1177421E+00
.1327006E+00	.1446439E+00	.1520546E+00	.1559078E+00	.1567145E+00
.1548921E+00	.1498166E+00	.1362006E+00	.1107982E+00	.8213038E-01
.6180578E-01	.5060945E-01	.4109808E-01	.2696020E-01	.6951661E-02
-.1476798E-01	-.3333975E-01	-.5068027E-01	-.7363002E-01	-.1032283E+00
-.1363847E+00	-.1742666E+00	-.2141033E+00	-.2485836E+00	-.2744646E+00
-.2914816E+00	-.3014937E+00	-.3059514E+00	-.3053388E+00	-.3021701E+00
-.2982009E+00	-.2912392E+00	-.2773441E+00	-.2555571E+00	-.2260397E+00
-.1872356E+00	-.1401572E+00	-.8450057E-01	-.2025258E-01	.3729813E-01
.6708103E-01	.6886938E-01	.5915089E-01	.4876461E-01	.3711562E-01
.2012306E-01	-.5097756E-03	-.1965806E-01	-.3485714E-01	-.4706687E-01
.5890098E-01	-.6890016E-01	-.7116566E-01	-.6330046E-01	-.5078570E-01
.1078085E-01	-.3524517E-01	-.3267304E-01	-.3209702E-01	-.3302325E-01
.396123E-01	-.3178211E-01	-.2739235E-01	-.2756221E-01	-.3306049E-01
-.3771546E-01	-.3965226E-01	-.4081125E-01	-.3782656E-01	-.2220099E-01
.1204305E-01	.5996324E-01	.9726937E-01	.9970879E-01	.7684695E-01
.5811584E-01	.5242707E-01	.4671534E-01	.3116045E-01	.8878903E-02
-.1205691E-01	-.2867600E-01	-.3841675E-01	-.3582854E-01	-.2386494E-01
-.1176157E-01	-.4332887E-02	-.2671479E-02	-.5079799E-02	-.2744225E-02
.1399909E-01	.4323151E-01	.7317844E-01	.9639142E-01	.1175171E+00
.1410694E+00	.1595321E+00	.1577872E+00	.1283804E+00	.8604733E-01
.5338797E-01	.3206300E-01	.8179300E-02	-.2557127E-01	-.6449406E-01
-.9502696E-01	-.1096468E+00	-.1136658E+00	-.1110299E+00	-.1009372E+00
-.8223131E-01	-.5419801E-01	-.2049765E-01	.1456036E-01	.4886615E-01
.7528595E-01	.8826939E-01	.9095065E-01	.8441607E-01	.6870932E-01
.5040492E-01	.3423613E-01	.1982707E-01	.6912268E-02	-.2557232E-02
-.3493166E-02	.8022316E-02	.3045160E-01	.5772163E-01	.8305942E-01
.1023658E+00	.1163961E+00	.1255661E+00	.1248033E+00	.1109933E+00
.8443331E-01	.4831596E-01	.1134763E-01	-.2226236E-01	-.5322170E-01
-.7975127E-01	-.1033012E+00	-.1234763E+00	-.1344971E+00	-.1363165E+00
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-.1604497E-01	-.2324841E-01	-.3155619E-01	-.3750664E-01	-.3978023E-01
-.4098554E-01	-.4542132E-01	-.5290628E-01	-.5832492E-01	-.5598862E-01
-.4140870E-01	-.1519145E-01	.1474079E-01	.4260019E-01	.6940821E-01
.9697072E-01	.1214067E+00	.1308885E+00	.1168274E+00	.8474715E-01
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-.2297254E-01	-.4463066E-02	.9666643E-02	.1347566E-01	.2530500E-02
.81795E-01	-.1995881E-01	.1927937E-02	.4146232E-01	.7026333E-01
.7227234E-01	.5779339E-01	.4713979E-01	.4953720E-01	.5852717E-01
.6120568E-01	.5054284E-01	.3245619E-01	.1942394E-01	.1728835E-01
.2481169E-01	.3875190E-01	.5655658E-01	.7716705E-01	.9744902E-01
.1167785E+00	.1381994E+00	.1598013E+00	.1734530E+00	.1710893E+00
.1542172E+00	.1346020E+00	.1201930E+00	.1102173E+00	.1010843E+00

.8889968E-01	.6997448E-01	.4209122E-01	.1075250E-01	-.1811760E-01
-.4613425E-01	-.7455248E-01	-.1021268E+00	-.1285270E+00	-.1548629E+00
-.1761871E+00	-.1842308E+00	-.1815638E+00	-.1758511E+00	-.1658350E+00
-.1439241E+00	-.1077145E+00	-.6322283E-01	-.1601777E-01	.2959094E-01
.6192588E-01	.6861311E-01	.4789670E-01	.4850562E-02	-.4493540E-01
-.7822443E-01	-.9459144E-01	-.1124649E+00	-.1359633E+00	-.1537640E+00
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.8131627E-01	.4543947E-01	.1655703E-01	-.1097243E-01	-.3875447E-01
-.5650902E-01	-.6370176E-01	-.6410550E-01	-.5581182E-01	-.3821198E-01
-.1370111E-01	.1289610E-01	.3647776E-01	.5342008E-01	.6181599E-01
.6332456E-01	.5880640E-01	.4703052E-01	.3236575E-01	.2240268E-01
.1828258E-01	.1912158E-01	.2743191E-01	.4258669E-01	.6098021E-01
.8276384E-01	.1099397E+00	.1390418E+00	.1594632E+00	.1641540E+00
.1538603E+00	.1287383E+00	.9618770E-01	.7164896E-01	.5658959E-01
.3998958E-01	.1766263E-01	-.7765841E-02	-.3466262E-01	-.5976910E-01
-.7573459E-01	-.7931996E-01	-.7593713E-01	-.7251890E-01	-.7319782E-01
-.7506700E-01	-.6814476E-01	-.5005931E-01	-.2909333E-01	-.1017549E-01
.1025957E-01	.3368359E-01	.5168451E-01	.5802205E-01	.5416033E-01
.4041537E-01	.1862883E-01	-.4923710E-02	-.2406568E-01.	-.3752270E-01
-.4935664E-01	-.5983936E-01	-.6223903E-01	-.4958221E-01	-.2260418E-01
.8110376E-02	.3651696E-01	.6248435E-01	.8122147E-01	.9164771E-01
.9417608E-01	.8301973E-01	.5720316E-01	.2430048E-01	-.8618394E-02
-.3934104E-01	-.6913186E-01	-.9604654E-01	-.1154301E+00	-.1291972E+00
-.1411651E+00	-.1500341E+00	-.1532614E+00	-.1507949E+00	-.1461787E+00
-.1417569E+00	-.1333913E+00	-.1172465E+00	-.9871362E-01	-.8600907E-01
-.7825331E-01	-.6966738E-01	-.6146456E-01	-.5911000E-01	-.6067237E-01
-.5815649E-01	-.4905537E-01	-.4054484E-01	-.4061793E-01	-.4687991E-01
-.5024263E-01	-.4684782E-01	-.3865335E-01	-.2847060E-01	-.2031677E-01
-.1673057E-01	-.1423218E-01	-.7529723E-02	.4971649E-02	.1965941E-01
.3254999E-01	.4705470E-01	.6853634E-01	.9539459E-01	.1218987E+00
.1450180E+00	.1627351E+00	.1722210E+00	.1751156E+00	.1758691E+00
.1752573E+00	.1705600E+00	.1603514E+00	.1473236E+00	.1361884E+00
[illegible]271705E+00	.1149462E+00	.9612012E-01	.7366034E-01	.5196865E-01
[illegible]059848E-01	.8894109E-02	-.8772192E-02	-.2002428E-01	-.2986436E-01
-.4295256E-01	-.5787471E-01	-.7182568E-01	-.8336281E-01	-.8970127E-01
-.8539464E-01	-.6911164E-01	-.4952355E-01	-.3617029E-01	-.3020179E-01
-.2846815E-01	-.2808022E-01	-.2611700E-01	-.2373021E-01	-.2784218E-01
-.3968260E-01	-.5209930E-01	-.6323391E-01	-.7497745E-01	-.8422165E-01
-.8729811E-01	-.8384755E-01	-.7683935E-01	-.6918725E-01	-.6010215E-01
-.4841246E-01	-.3593898E-01	-.2378046E-01	-.1137278E-01	.1002687E-02
.1240744E-01	.2233782E-01	.3251067E-01	.4220962E-01	.4713146E-01
.4508139E-01	.3784002E-01	.2946368E-01	.2268721E-01	.1679187E-01
.1032170E-01	.5995623E-02	.6864971E-02	.1047849E-01	.1250673E-01
.1310529E-01	.1530690E-01	.1965933E-01	.2502233E-01	.2997687E-01
.3173864E-01	.2995498E-01	.3077268E-01	.3889405E-01	.5038789E-01
.5942675E-01	.6519994E-01	.6869219E-01	.6822578E-01	.6181326E-01
.4982589E-01	.3437798E-01	.1871436E-01	.4974908E-02	-.8315939E-02
-.2040187E-01	-.2608102E-01	-.2387013E-01	-.1652780E-01	-.6100010E-02
.5003755E-02	.1274910E-01	.1467472E-01	.1130464E-01	.4765464E-02
-.2346337E-02	-.8135305E-02	-.1019844E-01	-.6090158E-02	.5156119E-03
.2990368E-02	.2400724E-02	.4276353E-02	.9156121E-02	.1499480E-01
.1983937E-01	.1855987E-01	.8089818E-02	-.5145110E-02	-.1292476E-01
-.1490916E-01	-.1394138E-01	-.9524814E-02	-.9290045E-03	.8842226E-02
.1605043E-01	.2069367E-01	.2546146E-01	.3051269E-01	.3431541E-01
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.8108575E-01	.8300827E-01	.7979830E-01	.7503887E-01	.7114474E-01
.6676522E-01	.5859880E-01	.4537485E-01	.2867206E-01	.1089183E-01
-.5203818E-02	-.1842008E-01	-.2788346E-01	-.3227513E-01	-.3371696E-01
-.3493091E-01	-.3616031E-01	-.3741450E-01	-.3814741E-01	-.3709091E-01
[illegible]529432E-01	-.3612765E-01	-.4113488E-01	-.4772479E-01	-.5132951E-01
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-.3504736E-01	-.3112918E-01	-.2803010E-01	-.2487497E-01	-.2111292E-01
-.1811691E-01	-.1897075E-01	-.2469594E-01	-.3142273E-01	-.3552245E-01
-.3888696E-01	-.4402295E-01	-.4900201E-01	-.5108967E-01	-.4857538E-01
-.4048660E-01	-.3007032E-01	-.2300381E-01	-.2092534E-01	-.2040095E-01
-.1779080E-01	-.1339424E-01	-.1017908E-01	-.9297311E-02	-.8694569E-02
-.6410199E-02	-.2838122E-02	.1962326E-02	.9454871E-02	.1890664E-01

.2680941E-01	.3171572E-01	.3435360E-01	.3402142E-01	.2975325E-01
.2132865E-01	.9771023E-02	-.1734663E-02	-.1036153E-01	-.1432470E-01
-.1113628E-01	-.6697374E-03	.1110248E-01	.1812777E-01	.2106563E-01
.2298579E-01	.2360746E-01	.2086150E-01	.1404770E-01	.4085430E-02
-.6491852E-02	-.1581104E-01	-.2319324E-01	-.2489585E-01	-.1808601E-01
-.8779522E-02	-.5231547E-02	-.7854980E-02	-.1250039E-01	-.1558033E-01
-.1590806E-01	-.1605498E-01	-.1746336E-01	-.1747615E-01	-.1284161E-01
204423E-02	.8977057E-02	.2208078E-01	.3550351E-01	.4790315E-01
796790E-01	.6350474E-01	.6211946E-01	.5625524E-01	.4956306E-01
.4057951E-01	.2821462E-01	.1506747E-01	.3621027E-02	-.4761452E-02
-.7042198E-02	-.1086272E-02	.8366367E-02	.1521806E-01	.1847036E-01
.1946798E-01	.2006932E-01	.2044967E-01	.1764912E-01	.1161610E-01
.6729579E-02	.5139045E-02	.6729085E-02	.1216813E-01	.2162954E-01
.3499030E-01	.4889339E-01	.5675765E-01	.5957931E-01	.6387712E-01
.6858877E-01	.6849972E-01	.6350072E-01	.5696833E-01	.5089837E-01
.4503651E-01	.3932581E-01	.3409582E-01	.2820829E-01	.2051745E-01
.1258421E-01	.6811207E-02	.3211397E-02	-.3582795E-03	-.5147857E-02
-.9663962E-02	-.1241240E-01	-.1208695E-01	-.8221326E-02	-.5195819E-02
-.6272243E-02	-.6677606E-02	-.2166789E-02	.3358411E-02	.5066244E-02
.3306334E-02	.1140500E-02	.8374803E-03	.1437084E-02	-.5681907E-03
-.5935216E-02	-.1140660E-01	-.1503870E-01	-.1821040E-01	-.2315383E-01
-.2993417E-01	-.3860112E-01	-.4979660E-01	-.6043201E-01	-.6752799E-01
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.8433219E-02	.2449520E-02	-.7418162E-02	-.1914775E-01	-.3054330E-01
-.3813836E-01	-.4229845E-01	-.4417237E-01	-.4166013E-01	-.3564004E-01
-.3057181E-01	-.2922635E-01	-.3129597E-01	-.3329325E-01	-.3122758E-01
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.6133282E-02	.1098264E-01	.1208142E-01	.9243225E-02	.1372534E-02
1245539E-01	-.3102184E-01	-.5035283E-01	-.6763823E-01	-.8326018E-01
502149E-01	-.1038556E+00	-.1071087E+00	-.1058361E+00	-.9810546E-01
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.8167728E-01	.1000719E+00	.1153432E+00	.1241700E+00	.1237564E+00
.1170957E+00	.1077225E+00	.9537702E-01	.7962750E-01	.6651363E-01
.6208966E-01	.6541427E-01	.7429291E-01	.8677751E-01	.9813735E-01
.1051801E+00	.1082241E+00	.1064917E+00	.9793820E-01	.8172624E-01
.5786303E-01	.2822920E-01	-.2835653E-02	-.3043665E-01	-.4985099E-01
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-.1958129E-01	-.3655850E-01	-.5194059E-01	-.6047924E-01	-.5735612E-01
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-.3385752E-01	-.2803908E-01	-.2387542E-01	-.2031024E-01	-.1724022E-01
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.9907878E-02	.9736251E-02	.6910417E-02	.2293196E-02	.3352369E-02
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.3440929E-02	.1185632E-01	.1762746E-01	.2302342E-01	.2892334E-01
.3213110E-01	.3041321E-01	.2575243E-01	.1975500E-01	.1205096E-01
.3961158E-02	-.2402821E-02	-.6675037E-02	-.8271224E-02	-.6365068E-02
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.5728040E-02	.7232239E-02	.6923286E-02	.4322546E-02	.2183266E-02
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.2962619E-01	.3269337E-01	.3415022E-01	.3355298E-01	.3118082E-01
.2847837E-01	.2646138E-01	.2531350E-01	.2488434E-01	.2468018E-01
.2455312E-01	.2713328E-01	.3303078E-01	.3724129E-01	.3478319E-01
.2511450E-01	.1234335E-01	.1428767E-02	-.7101753E-02	-.1566903E-01
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.2268986E-01	.2352920E-01	.1962006E-01	.1360231E-01	.9763881E-02
.1029490E-01	.1442050E-01	.1955791E-01	.2413239E-01	.2819152E-01
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.7193980E-02	.6448881E-02	.4034470E-02	-.1560797E-02	-.7904354E-02
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0025015E-02	-.5907995E-02	-.2135436E-02	.7389091E-03	.5510989E-03
-.2936576E-02	-.8169432E-02	-.1333654E-01	-.1720148E-01	-.2056605E-01
-.2442911E-01	-.2729651E-01	-.2813924E-01	-.2773541E-01	-.2556721E-01
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.2066450E-01	.2628009E-01	.3117481E-01	.3399421E-01	.3415380E-01
.3334282E-01	.3129645E-01	.2647082E-01	.2044761E-01	.1541656E-01
.1074947E-01	.5281427E-02	-.5195006E-03	-.5422203E-02	-.9598339E-02
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.2056444E-01	.3394076E-01	.4480029E-01	.5349467E-01	.5763889E-01
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.1442824E-01	.6259395E-02	-.2112162E-02	-.1035407E-01	-.1786238E-01
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.1979262E-01	.2084312E-01	.1902271E-01	.1765633E-01	.1845217E-01
.1970402E-01	.1949724E-01	.1830577E-01	.1735371E-01	.1642243E-01
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-.1562863E-01	-.1808808E-01	-.1878252E-01	-.1708126E-01	-.1426949E-01
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-.5698357E-02	-.5472705E-02	-.5568173E-02	-.4519599E-02	-.1857467E-02
.1125925E-02	.3621327E-02	.5391694E-02	.6482043E-02	.7042345E-02
.7044555E-02	.7033384E-02	.7692408E-02	.8113682E-02	.7185136E-02
.477384E-02	.8011097E-02	.1033952E-01	.1068707E-01	.1008733E-01
.1036429E-01	.9271744E-02	.5404720E-02	.1365970E-02	-.1325128E-02
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.9627982E-02	.1175396E-01	.1171588E-01	.1116911E-01	.1029591E-01
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-.8775166E-03	-.2187567E-02	-.4165186E-02	-.7072983E-02	-.1144714E-01
-.1560086E-01	-.1748253E-01	-.1697091E-01	-.1378558E-01	-.8258351E-02
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.5801844E-03	-.5088304E-03	.9838603E-03	.1824831E-02	-.2572334E-03
-.4692853E-02	-.9227133E-02	-.1173354E-01	-.1210460E-01	-.1173808E-01
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-.1663199E-01	-.1547140E-01	-.1332593E-01	-.1104467E-01	-.8396146E-02
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.2724524E-02	.2780862E-02	.1283151E-02	-.1904979E-02	-.4278636E-02
-.4422543E-02	-.4263338E-02	-.4545010E-02	-.3705767E-02	-.1963540E-02
-.1066376E-02	-.1491044E-02	-.2462900E-02	-.3554486E-02	-.3604996E-02
.9352087E-03	.3334911E-02	.7130313E-02	.1058397E-01	.1413625E-01
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-.1372137E-01	-.1270642E-01	-.8472629E-02	-.3254751E-02	.4235933E-03
.2072302E-02	.1273555E-02	-.2096483E-02	-.6355010E-02	-.9139531E-02
-.9795570E-02	-.9047969E-02	-.7875412E-02	-.7885007E-02	-.9540815E-02
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.9262379E-02	.7125617E-02	.4918303E-02	.5695115E-02	.8634026E-02
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.1412630E-01	.1031920E-01	.7970156E-02	.5921122E-02	.4102312E-02
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.6546811E-02	.5028582E-02	.6029164E-02	.7883827E-02	.9611419E-02
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.6609409E-02	.3290877E-02	-.1132279E-02	-.3325243E-02	-.3157408E-02
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.9591306E-02	.9843634E-02	.9916301E-02	.9169926E-02	.7462955E-02
.6100382E-02	.5609241E-02	.5298997E-02	.4964822E-02	.5350073E-02
.6296405E-02	.6919998E-02	.6765261E-02	.5924070E-02	.5229263E-02
.5422642E-02	.5402288E-02	.3385285E-02	-.4471912E-04	-.3037200E-02

-.1519033E-01	-.1280688E-01	-.9176760E-02	-.5975841E-02	-.3762622E-02
-.1164149E-02	.1009644E-02	.3200092E-03	-.1356431E-02	-.8721790E-03
.4047248E-03	.2808556E-03	-.3855633E-03	-.3840649E-03	.3924882E-04
.8549209E-03	.2202750E-02	.3036449E-02	.2331946E-02	.1166295E-04
-.3228238E-02	-.5983824E-02	-.7810649E-02	-.9258563E-02	-.1055918E-01
-.1197777E-01	-.1343451E-01	-.1380160E-01	-.1262426E-01	-.1164161E-01
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.1821793E-02	.2057778E-02	.9862314E-03	-.1478188E-03	-.1211681E-02
-.2070535E-02	-.2180752E-02	-.1885389E-02	-.1689168E-02	-.1196587E-02
-.7317076E-03	-.9896946E-03	-.1324232E-02	-.1146314E-02	-.9381865E-03
-.1014082E-02	-.1083686E-02	-.1049139E-02	-.1055765E-02	-.1337153E-02
-.2412164E-02	-.4410676E-02	-.6656857E-02	-.8546691E-02	-.1030826E-01
-.1207172E-01	-.1355044E-01	-.1403679E-01	-.1247949E-01	-.9007146E-02
-.4644135E-02	-.4249347E-03	.2794444E-02	.5251984E-02	.7815978E-02
.9268247E-02	.7541509E-02	.3970126E-02	.9355444E-03	-.2081113E-02
-.5744234E-02	-.8858025E-02	-.1077543E-01	-.1176544E-01	-.1197899E-01
-.1114830E-01	-.8796775E-02	-.5690060E-02	-.2806190E-02	.2648500E-03
.4166318E-02	.8549418E-02	.1151145E-01	.1226204E-01	.1260702E-01
.1375091E-01	.1505696E-01	.1506596E-01	.1328645E-01	.1135872E-01
.1123710E-01	.1264361E-01	.1331028E-01	.1241720E-01	.1176036E-01
.1315264E-01	.1599349E-01	.1829650E-01	.1963853E-01	.2073372E-01
.2196798E-01	.2305152E-01	.2365760E-01	.2370917E-01	.2257005E-01
.2013835E-01	.1678783E-01	.1276624E-01	.9149518E-02	.6272638E-02
.3098864E-02	-.1569602E-03	-.2358647E-02	-.4127939E-02	-.6912785E-02
-.9682688E-02	-.9961712E-02	-.8816159E-02	-.9336997E-02	-.1071544E-01
-.1136433E-01	-.1292203E-01	-.1555234E-01	-.1701016E-01	-.1746979E-01
-.1814372E-01	-.1862058E-01	-.1898217E-01	-.1907296E-01	-.1766903E-01
-.1489771E-01	-.1214359E-01	-.1060183E-01	-.1059624E-01	-.1109793E-01
-.1077425E-01	-.9497344E-02	-.8430795E-02	-.7731761E-02	-.5382763E-02
-.1174342E-02	.2878934E-02	.6868247E-02	.1099797E-01	.1361197E-01
.1384267E-01	.1151708E-01	.7519213E-02	.3539184E-02	-.2722036E-03
4370489E-02	-.8807445E-02	-.1231809E-01	-.1337374E-01	-.1309703E-01
[illegible]270809E-01	-.1155551E-01	-.9182416E-02	-.6337227E-02	-.3842160E-02
[illegible]73172E-02	.2270329E-02	.5848044E-02	.8020130E-02	.7743651E-02
.6093462E-02	.4594882E-02	.2906073E-02	.2505127E-03	-.2800540E-02
-.5524190E-02	-.7928222E-02	-.9400050E-02	-.8526924E-02	-.5978991E-02
-.4483537E-02	-.4212207E-02	-.3719819E-02	-.2972796E-02	-.1615890E-02
.2847915E-03	.1791656E-02	.2430878E-02	.2116475E-02	.1816387E-02
.2250897E-02	.2471593E-02	.1432253E-02	-.6715746E-03	-.2709844E-02
-.3848847E-02	-.4733236E-02	-.5768912E-02	-.6033545E-02	-.5480229E-02
-.4844762E-02	-.4377738E-02	-.3710721E-02	-.1646876E-02	.1976897E-02
.4632338E-02	.5161615E-02	.5581237E-02	.6374847E-02	.6515360E-02
.6061831E-02	.5279207E-02	.5062960E-02	.5835028E-02	.6103124E-02
.5491851E-02	.5168919E-02	.6035645E-02	.7652386E-02	.8444906E-02
.8544442E-02	.8572187E-02	.7628131E-02	.5919248E-02	.4378304E-02
.2335544E-02	-.6849103E-03	-.3437978E-02	-.4881209E-02	-.5125888E-02
-.4892117E-02	-.5102941E-02	-.5037859E-02	-.3785044E-02	-.2665775E-02
-.2628163E-02	-.3933505E-02	-.6516848E-02	-.8808156E-02	-.1031766E-01
-.1153759E-01	-.1154232E-01	-.1033067E-01	-.9974721E-02	-.1064934E-01
-.1022452E-01	-.8319902E-02	-.6103855E-02	-.4078767E-02	-.2209124E-02
-.2885938E-03	.2150016E-02	.4719726E-02	.5905723E-02	.5832316E-02
.5498722E-02	.4511377E-02	.2977806E-02	.1421426E-02	.3265358E-03
.4282917E-03	.1367270E-02	.2441126E-02	.3598559E-02	.5222771E-02
.7473595E-02	.9216544E-02	.8591453E-02	.5843632E-02	.3930136E-02
.4286746E-02	.5630220E-02	.6966317E-02	.8601328E-02	.1104845E-01
.1335581E-01	.1388489E-01	.1255296E-01	.1029168E-01	.7892882E-02
.6446740E-02	.5834740E-02	.4653505E-02	.3328486E-02	.3261427E-02
.4325270E-02	.5376732E-02	.5430449E-02	.3756580E-02	.1145376E-02
-.8827189E-03	-.2879334E-02	-.5700085E-02	-.8605461E-02	-.1056477E-01
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-.1068705E-01	-.9171014E-02	-.9166898E-02	-.9176676E-02	-.7761504E-02
-.6299640E-02	-.5252025E-02	-.4375135E-02	-.4366841E-02	-.5196983E-02
-.6792717E-02	-.8842851E-02	-.9959582E-02	-.9815993E-02	-.9545963E-02
-.9420426E-02	-.7952106E-02	-.4629132E-02	-.1339485E-02	.1107568E-02
.4562623E-02	.9199215E-02	.1256442E-01	.1387947E-01	.1436269E-01

.1121431E-01	.1088316E-01	.9244264E-02	.7319293E-02	.6251973E-02
.6420922E-02	.6616691E-02	.5251011E-02	.3590182E-02	.4497295E-02
.7262938E-02	.8504639E-02	.7579947E-02	.6409038E-02	.5191586E-02
.2782390E-02	-.3107068E-03	-.2929499E-02	-.4884155E-02	-.6274392E-02
-.6740439E-02	-.5668720E-02	-.3416480E-02	-.9518772E-03	.1099757E-02
.2406629E-02	.3412248E-02	.4470070E-02	.4940277E-02	.4816812E-02
.5334269E-02	.6557306E-02	.6622987E-02	.5219793E-02	.4263406E-02
.4133974E-02	.3204552E-02	.1310517E-02	.7543799E-04	-.5911349E-03
-.1317920E-02	-.5287671E-03	.2020215E-02	.3845286E-02	.4865964E-02
.7199444E-02	.9579130E-02	.9439791E-02	.7199945E-02	.4033690E-02
.1201138E-02	-.3342818E-03	-.2032926E-02	-.4167997E-02	-.4660614E-02
-.3958439E-02	-.4018377E-02	-.4089210E-02	-.2857216E-02	-.2029260E-02
-.3213030E-02	-.4614106E-02	-.4191094E-02	-.2690664E-02	-.1606238E-02
-.1058319E-03	.2825856E-02	.5960451E-02	.8106365E-02	.9060073E-02
.9505396E-02	.1074939E-01	.1214887E-01	.1203349E-01	.1070442E-01
.9135337E-02	.7213820E-02	.5490603E-02	.5366896E-02	.5432855E-02
.4109846E-02	.3633605E-02	.4626700E-02	.5054788E-02	.5750605E-02
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.4009929E-02	.2060781E-02	.9263088E-03	-.2184313E-03	-.1762287E-02
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.2882108E-02	.1376388E-02	-.5877916E-03	-.2203506E-02	-.3153017E-02
-.3877497E-02	-.3762328E-02	-.2674006E-02	-.1852513E-02	-.1176514E-02
.1733202E-03	.1421344E-02	.2293691E-02	.3498619E-02	.4145230E-02
.3643381E-02	.3350257E-02	.3762643E-02	.4084875E-02	.3885450E-02
.2623963E-02	.2803260E-03	-.1400226E-02	-.1541976E-02	-.1593604E-02
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.9413798E-03	.1037929E-02	.9436930E-03	-.1577290E-03	-.3123054E-02
-.6488566E-02	-.8228274E-02	-.8345252E-02	-.7965954E-02	-.7115472E-02
-.5362456E-02	-.3727940E-02	-.2914921E-02	-.2385115E-02	-.1619053E-02
-.2361169E-03	.1011434E-02	.1058184E-02	.1085896E-02	.2184062E-02
.3432816E-02	.4403805E-02	.4530736E-02	.2392895E-02	-.1206145E-02
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-.1831775E-02	-.6328103E-03	.7505050E-03	.1697147E-02	.2089633E-02
.2958715E-02	.4527687E-02	.4808719E-02	.3618110E-02	.3415035E-02
.3656971E-02	.2803195E-02	.2748501E-02	.3533918E-02	.2805646E-02
.1684127E-02	.2386942E-02	.3467009E-02	.2725484E-02	.1096215E-02
-.3319658E-04	-.1101990E-02	-.2071404E-02	-.2187043E-02	-.2262599E-02
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.510572E-02	.4604097E-02	.4591124E-02	.3449608E-02	.2040486E-02
.352922E-02	.1703841E-02	.1538505E-02	-.2075605E-03	-.1764415E-02
-.1955803E-02	-.2567642E-02	-.4436584E-02	-.5684247E-02	-.5278512E-02
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.4114121E-02	.3387020E-02	.2200757E-02	.1744971E-02	.1656760E-02
.1509913E-02	.1483193E-02	.1514185E-02	.1474949E-02	.8249279E-03

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-.6395630E-02	-.8924004E-02	-.1036776E-01	-.9758590E-02	-.8969641E-02
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.7807693E-02	.5153469E-02	.1832644E-02	-.3183426E-03	-.1427572E-02
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-.1078905E-02	-.1881661E-03	-.1044022E-02	-.2536330E-02	-.3073875E-02
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.2298551E-02	.2967714E-02	.3489232E-02	.2613453E-02	.6933252E-03
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.3855731E-02	.3723826E-02	.3728005E-02	.2953245E-02	.1434042E-02
.8788242E-03	.1365902E-02	.7388534E-03	-.1198971E-02	-.2330489E-02
-.2141375E-02	-.1788658E-02	-.2394221E-02	-.4067145E-02	-.5029524E-02
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-.5148181E-02	-.4323012E-02	-.2974912E-02	-.1673644E-02	-.1193410E-02
-.1070904E-02	-.1389062E-02	-.2845049E-02	-.4335610E-02	-.4636216E-02
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.4208954E-02	.4456026E-02	.3022543E-02	.9554610E-03	-.1978221E-03
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-.3210257E-02	-.2599527E-02	-.2761362E-02	-.2371644E-02	-.1903695E-02
-.2116296E-02	-.2380933E-02	-.2318858E-02	-.1971337E-02	-.1406614E-02
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.1934223E-02	.9485568E-03	.4418114E-03	.1724928E-02	.3435022E-02
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.5504530E-03	.7808062E-03	.1512820E-02	.2410781E-02	.3426194E-02
.5421178E-02	.7683863E-02	.8840273E-02	.9610305E-02	.1087862E-01
.1166600E-01	.1140700E-01	.1116134E-01	.1145951E-01	.1148973E-01
.1042230E-01	.8838318E-02	.8327439E-02	.8944369E-02	.9182306E-02
.8675840E-02	.8648524E-02	.9441084E-02	.9463922E-02	.8215070E-02
.6938949E-02	.5810884E-02	.4801015E-02	.4388635E-02	.3663912E-02
.1833275E-02	-.1261400E-04	-.1096900E-02	-.2497906E-02	-.4695893E-02
-.5821183E-02	-.4846748E-02	-.3212399E-02	-.2033754E-02	-.1426585E-02
-.1166367E-02	-.2205681E-03	.1036507E-02	.9966753E-03	.4089572E-03
.142291E-04	-.1680746E-02	-.4312060E-02	-.5753232E-02	-.5270210E-02
-.3622620E-02	-.4442489E-02	-.2702095E-02	.5051218E-03	.2362669E-02
.2708514E-02	.3738463E-02	.5472560E-02	.5757929E-02	.4018407E-02
.1775042E-02	.2463161E-03	-.2926290E-03	-.8333125E-03	-.2131521E-02
-.3188663E-02	-.3648969E-02	-.4281614E-02	-.5134419E-02	-.5515352E-02
-.5280661E-02	-.5175836E-02	-.5133069E-02	-.4083985E-02	-.2561421E-02
-.2326397E-02	-.3104931E-02	-.2954846E-02	-.1522407E-02	-.7052002E-03

.1147175E-02	.2947232E-02	.3587474E-02	.2855845E-02	.2257289E-02
.1891480E-02	.1354816E-02	.7542645E-03	.1541165E-03	-.8347052E-03
-.2424035E-02	-.3996796E-02	-.4882396E-02	-.4842144E-02	-.4113703E-02
-.3403795E-02	-.3070097E-02	-.2376382E-02	-.8201152E-03	.5215912E-03
.5214660E-03	-.1180337E-03	-.5005875E-03	-.1268149E-02	-.2741943E-02
-.4215691E-02	-.5721254E-02	-.7003626E-02	-.7065937E-02	-.6530395E-02
5908948E-02	-.4632623E-02	-.3212201E-02	-.2518748E-02	-.2193828E-02
1092856E-02	.3600936E-03	.1951947E-03	-.1005839E-02	-.1021586E-02
-.5939697E-03	-.5514939E-03	.4141865E-03	.1427817E-02	.9237053E-03
.2216332E-03	.1372309E-03	.8985699E-04	.1119004E-03	-.2153643E-03
-.1177680E-02	-.1245166E-02	.4821901E-03	.2049631E-02	.2525691E-02
.3458012E-02	.4805569E-02	.5427939E-02	.5389965E-02	.4833737E-02
.3196651E-02	.7907158E-03	-.4179627E-03	.1907740E-03	.3546225E-03
-.1075207E-02	-.2444397E-02	-.2809225E-02	-.2667727E-02	-.2516461E-02
-.2940676E-02	-.3600206E-02	-.3578871E-02	-.3285575E-02	-.3407388E-02
-.3636359E-02	-.3243682E-02	-.2204247E-02	-.1022658E-02	-.5292719E-03
-.9990600E-03	-.9740260E-03	-.5332997E-03	-.8588630E-03	-.1210356E-02
-.1390688E-02	-.1314285E-02	-.4767054E-04	.1006515E-02	.4894061E-03
.1078368E-02	.4177488E-02	.6631477E-02	.7096737E-02	.7341949E-02
.7359105E-02	.6129050E-02	.4447975E-02	.2921207E-02	.1029186E-02
-.3552505E-03	-.1454746E-03	.8638872E-03	.1874185E-02	.2631882E-02
.3006673E-02	.3501638E-02	.4000552E-02	.3526789E-02	.1619731E-02
-.8808805E-03	-.2402603E-02	-.2603697E-02	-.2409384E-02	-.2506209E-02
-.2859354E-02	-.3073517E-02	-.3023693E-02	-.2964594E-02	-.3434026E-02
-.4830098E-02	-.6129575E-02	-.5630849E-02	-.3635007E-02	-.1976520E-02
-.1225399E-02	-.7844777E-03	-.2087577E-03	.1044100E-02	.2878478E-02
.3951146E-02	.3284796E-02	.1905816E-02	.1319012E-02	.8400063E-03
-.6001899E-03	-.1525462E-02	-.5948235E-03	.3670668E-03	.2535401E-03
.8728981E-03	.2360530E-02	.2709350E-02	.1984437E-02	.1439936E-02
.9984391E-03	.3512520E-03	-.3237524E-03	-.5894863E-03	-.3777263E-03
-.2843933E-03	-.5465268E-03	-.1113299E-02	-.1522464E-02	-.9624106E-03
-.1481896E-03	.4290501E-03	.1588938E-02	.2401433E-02	.2299521E-02
2371326E-02	.2249524E-02	.1800789E-02	.1919543E-02	.1861179E-02
061328E-03	-.9777864E-03	-.9183534E-03	-.1155074E-03	-.1310988E-03
509023E-03	-.7529579E-03	-.5537877E-03	-.5380549E-03	-.6283689E-03
-.9907254E-04	.1371465E-02	.2571334E-02	.2933685E-02	.3733422E-02
.4490223E-02	.3715519E-02	.2397088E-02	.1473510E-02	.3295147E-03
-.1147572E-02	-.2480564E-02	-.3164317E-02	-.3037255E-02	-.2815559E-02
-.3068817E-02	-.3291227E-02	-.2747924E-02	-.1720237E-02	-.1071942E-02
-.1153658E-02	-.1374711E-02	-.8312979E-03	-.2661730E-03	-.5276977E-03
-.2802572E-03	.1341192E-02	.2707400E-02	.2972993E-02	.3727274E-02
.5042202E-02	.5229872E-02	.4620360E-02	.4617846E-02	.5050781E-02
.5155276E-02	.4995961E-02	.4942518E-02	.5028364E-02	.5080734E-02
.5146082E-02	.5665689E-02	.6004252E-02	.4681230E-02	.2496848E-02
.1229379E-02	.4933409E-03	-.8027019E-03	-.2405240E-02	-.3239252E-02
-.3043491E-02	-.2697005E-02	-.2519194E-02	-.2545852E-02	-.3154643E-02
-.3861728E-02	-.4832651E-02	-.6147107E-02	-.6411655E-02	-.6299058E-02
-.7143113E-02	-.7582823E-02	-.6586048E-02	-.5300075E-02	-.4254477E-02
-.3429281E-02	-.3922578E-02	-.4421480E-02	-.2096555E-02	.1301931E-02
.2516410E-02	.2634303E-02	.3775475E-02	.5257094E-02	.6622415E-02
.8617664E-02	.1031770E-01	.1052915E-01	.9760876E-02	.8530893E-02
.7195690E-02	.6081950E-02	.5187837E-02	.5077353E-02	.5336607E-02
.4671226E-02	.4022487E-02	.4866351E-02	.6379023E-02	.7381594E-02
.7017130E-02	.5206722E-02	.4146894E-02	.4971433E-02	.5622179E-02
.4717202E-02	.3931166E-02	.4206546E-02	.4118077E-02	.3497778E-02
.2923247E-02	.2218715E-02	.1343894E-02	-.5810313E-05	-.1422026E-02
-.1306760E-02	-.1617591E-03	-.5375513E-03	-.1622967E-02	-.1044774E-02
.1064899E-03	.5810497E-03	.8322237E-03	.6031872E-03	-.3341061E-03
-.9438867E-03	-.5695977E-03	-.1410227E-03	-.1239865E-03	.3524829E-03
.1093061E-02	.1058635E-02	.6410685E-03	.7048217E-03	.1049615E-02
128896E-02	.9364480E-03	.1038603E-02	.1624504E-02	.1593482E-02
324779E-03	.4084332E-03	.9654660E-03	.1200987E-02	.6935456E-03
-.3029487E-03	-.9297810E-03	-.3654301E-03	.8405645E-03	.1517449E-02
.1926426E-02	.3441602E-02	.5399899E-02	.5004933E-02	.3091961E-02
.3649850E-02	.5806984E-02	.5945381E-02	.4951167E-02	.5745162E-02
.7851776E-02	.8366458E-02	.6499474E-02	.4580241E-02	.4631292E-02
.5510195E-02	.4757063E-02	.2475648E-02	.7004877E-03	.7849484E-04

.3065283E-04	.1842273E-03	.1001315E-03	-.1898789E-03	-.3540886E-03
-.2992681E-03	-.5340496E-03	-.1215596E-02	-.1344417E-02	-.1425284E-02
-.2760675E-02	-.4057129E-02	-.4641414E-02	-.5610966E-02	-.6303141E-02
-.5412009E-02	-.3462795E-02	-.2523300E-02	-.3027359E-02	-.2543068E-02
-.6733441E-03	.3644823E-05	-.5183452E-03	.4190229E-04	.8285695E-03
.1533004E-03	-.1024222E-03	.9597073E-03	.1314703E-02	.3371690E-03
-.4915045E-03	-.1660203E-03	.6936244E-04	-.3049043E-03	-.5966755E-04
.2952974E-04	-.7196237E-03	-.9481862E-03	-.2038624E-03	.4909012E-03
-.1503765E-04	-.1016040E-02	-.1234799E-02	-.1457394E-02	-.2299955E-02
-.3127163E-02	-.3423925E-02	-.3240495E-02	-.3125350E-02	-.3284792E-02
-.3804297E-02	-.4444599E-02	-.4079518E-02	-.3101282E-02	-.3149378E-02
-.3455188E-02	-.2885464E-02	-.2556432E-02	-.2521398E-02	-.2018586E-02
-.1803942E-02	-.2063545E-02	-.2401030E-02	-.3099550E-02	-.3634272E-02
-.3343483E-02	-.3017072E-02	-.2936721E-02	-.2330984E-02	-.1371094E-02
-.1027424E-02	-.1734311E-02	-.2137770E-02	-.1550981E-02	-.2180973E-02
-.4121870E-02	-.4977831E-02	-.4594929E-02	-.3952178E-02	-.3343177E-02
-.2527624E-02	-.1115143E-02	-.1569519E-03	-.6134421E-03	-.1144138E-02
-.7517045E-03	-.3073227E-03	-.3999849E-03	-.9400765E-03	-.1523722E-02
-.1146902E-02	.7712018E-04	.8692042E-03	.8024961E-03	.4682535E-03
.1916071E-03	-.3533026E-03	-.7932881E-03	-.5729899E-03	-.3241282E-03
-.2548982E-03	.6770908E-03	.2213344E-02	.2242295E-02	.9250419E-03
.7324519E-03	.1635063E-02	.1916406E-02	.8680677E-03	-.8246979E-03
-.2041583E-02	-.2960775E-02	-.3456965E-02	-.3093989E-02	-.2457613E-02
-.1912055E-02	-.1392034E-02	-.8306907E-03	-.5269291E-03	-.6851922E-03
-.4779031E-03	.1806581E-03	.2885350E-03	-.7862504E-04	-.5368184E-03
-.8422114E-03	-.6806819E-03	-.8443017E-03	-.1416443E-02	-.1086194E-02
-.6223935E-03	-.1136931E-02	-.1140467E-02	-.3869740E-03	-.2641295E-03
-.2240775E-03	.1620704E-03	.3189246E-03	.1097086E-02	.1908222E-02
.1081479E-02	.6945635E-04	.4498149E-06	-.3443636E-03	-.1258708E-02
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-.3116876E-02	-.2696629E-02	-.1376316E-02	-.7020413E-03	-.1289663E-02
-.1215968E-02	-.9421606E-03	-.2361235E-02	-.3749146E-02	-.2368683E-02
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-.3549209E-03	-.2193748E-02	-.2886556E-02	-.3069785E-02	-.2938293E-02
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-.3238157E-02	-.3241597E-02	-.3192066E-02	-.3255761E-02	-.3191047E-02
-.2612892E-02	-.2424526E-02	-.3345355E-02	-.3771047E-02	-.2493925E-02
-.5424210E-03	.4851060E-03	.2100318E-04	-.4632589E-03	.5920493E-03
.1933986E-02	.1784011E-02	.1310581E-02	.1923083E-02	.2424014E-02
.2048554E-02	.1752129E-02	.2127935E-02	.3224165E-02	.4538281E-02
.4938337E-02	.4419582E-02	.4183305E-02	.4536596E-02	.4821422E-02
.4764761E-02	.4651822E-02	.4645475E-02	.4923202E-02	.5429157E-02
.5220947E-02	.3911286E-02	.2271648E-02	.1150530E-02	.4843234E-03
-.7478744E-03	-.2579066E-02	-.3796892E-02	-.3823194E-02	-.3121620E-02
-.2039578E-02	-.9772086E-03	-.8701356E-03	-.1467671E-02	-.1529838E-02
-.1039046E-02	-.1127389E-02	-.2479719E-02	-.4039163E-02	-.4509121E-02
-.4287606E-02	-.4155885E-02	-.4646199E-02	-.5153157E-02	-.3999589E-02
-.2045219E-02	-.1360800E-02	-.9962285E-03	.5141518E-03	.1565756E-02
.1021982E-02	.9181250E-03	.1851137E-02	.1678254E-02	-.6149539E-04
-.1433653E-02	-.1994902E-02	-.3057010E-02	-.3955167E-02	-.3608168E-02
-.2795163E-02	-.1828081E-02	-.4759828E-03	.8927285E-03	.2456665E-02
.4199890E-02	.4752686E-02	.4100050E-02	.3982519E-02	.4549227E-02
.4272676E-02	.3228546E-02	.3394186E-02	.4381002E-02	.4415358E-02
.4251219E-02	.4047737E-02	.2621251E-02	.7657437E-03	-.2902067E-03
-.6299684E-03	-.5496485E-03	-.5562942E-03	-.1317035E-02	-.1838397E-02
-.6324607E-03	.5982837E-03	.4964337E-03	.5183772E-03	.5586601E-03
.1388111E-03	-.4493128E-03	-.1786717E-02	-.3427919E-02	-.3971970E-02
-.3199018E-02	-.1652444E-02	-.3111259E-03	.2070760E-03	.7647703E-03
.1105733E-02	.2804929E-03	-.8001964E-03	-.1062778E-02	-.7687109E-03
-.1311142E-02	-.3101947E-02	-.4230472E-02	-.3709755E-02	-.2974623E-02
-.2643459E-02	-.2413897E-02	-.2927769E-02	-.3245749E-02	-.1697914E-02
-.1881973E-03	-.6521555E-03	-.1342591E-02	.2564312E-03	.2331612E-02
.1552531E-02	-.4644968E-03	-.3861880E-03	.1032063E-02	.1892414E-02
.1944638E-02	.1570978E-02	.1663928E-02	.2515750E-02	.2640357E-02
.1652670E-02	.1080275E-02	.9111205E-03	.2210407E-03	-.7240240E-03
-.1238789E-02	-.1094409E-02	-.8953442E-03	-.1139504E-02	-.1416964E-02
-.1388893E-02	-.1263659E-02	-.1502750E-02	-.2141305E-02	-.2363611E-02
-.2064922E-02	-.1747325E-02	-.1186184E-02	-.1396813E-03	.1036460E-02

.2994164E-02	.1510495E-02	.3469331E-03	.3956335E-03	.8665670E-03
.9643162E-03	.9439490E-03	.1224359E-02	.1594808E-02	.2280475E-02
.2623774E-02	.1624192E-02	.7605492E-03	.1288215E-02	.1898953E-02
.1656097E-02	.1311361E-02	.1071628E-02	.6832953E-03	.7345279E-03
.5118692E-03	-.1191332E-02	-.3144902E-02	-.4512031E-02	-.6312660E-02
-.8302514E-02	-.9259034E-02	-.8857303E-02	-.7463392E-02	-.6001603E-02
[illegible]010402E-02	-.4308882E-02	-.3769000E-02	-.2756475E-02	-.1569956E-02
.923104E-02	-.3402713E-02	-.4153284E-02	-.3959763E-02	-.3326603E-02
-.2197309E-02	-.1024086E-02	-.9240686E-03	-.1608397E-02	-.1382794E-02
.2499876E-04	.1127923E-02	.9952964E-03	.3468100E-04	-.4094174E-03
.5495110E-03	.1948414E-02	.2926478E-02	.4065226E-02	.5581869E-02
.6943797E-02	.7746130E-02	.7844791E-02	.7256193E-02	.6008738E-02
.4144915E-02	.2452617E-02	.1893048E-02	.1707227E-02	.4153801E-03
-.1236017E-02	-.1458347E-02	-.7270250E-03	-.1167712E-03	.8173730E-03
.1691013E-02	.1165671E-02	.2871997E-03	.6056041E-03	.1293721E-02
.1752010E-02	.2463470E-02	.3652967E-02	.4582618E-02	.4478415E-02
.4534184E-02	.5477555E-02	.5539564E-02	.4693340E-02	.4596900E-02
.4632600E-02	.4261229E-02	.4224701E-02	.4358763E-02	.4372622E-02
.4886650E-02	.5906768E-02	.6664568E-02	.7019522E-02	.6897737E-02
.5954014E-02	.4510806E-02	.3714969E-02	.3448633E-02	.2361628E-02
.1177046E-02	.1153836E-02	.1002722E-02	-.2838088E-04	-.4361785E-03
.7415524E-04	.1313042E-03	-.8436919E-03	-.2071143E-02	-.2497420E-02
-.1813355E-02	-.9647504E-03	-.1148756E-02	-.1587736E-02	-.8308118E-03
.2492921E-03	.1443803E-03	-.4496124E-03	-.3539457E-03	-.1486648E-03
-.1075040E-02	-.2507020E-02	-.2294163E-02	-.8585848E-03	-.6553203E-03
-.1294104E-02	-.5068375E-03	.1380186E-02	.2349635E-02	.2789664E-02
.3597710E-02	.3762720E-02	.3686580E-02	.4596793E-02	.6097298E-02
.7299560E-02	.7473764E-02	.6946430E-02	.6833855E-02	.7497275E-02
.8898023E-02	.1031002E-01	.1045197E-01	.9778401E-02	.9065811E-02
.7738075E-02	.6813619E-02	.7066861E-02	.6344688E-02	.4859152E-02
.5252145E-02	.6424474E-02	.5790233E-02	.4559143E-02	.4720361E-02
.5065832E-02	.4530559E-02	.3778757E-02	.2687668E-02	.1516958E-02
.1387449E-02	.1521495E-02	.9838862E-03	.1030309E-02	.1340932E-02
[illegible]303169E-03	-.4941616E-03	.4064440E-03	.1821553E-02	.1536529E-02
[illegible]91804E-03	.7043629E-03	.1841506E-02	.1773523E-02	.1146335E-02
.1175228E-02	.2065369E-02	.3577109E-02	.4571851E-02	.4197718E-02
.3591615E-02	.3791443E-02	.3669581E-02	.2227306E-02	.8914415E-03
.5735823E-03	-.1795832E-03	-.1413255E-02	-.1557445E-02	-.1014490E-02
-.1057627E-02	-.1465130E-02	-.1466337E-02	-.5332931E-03	.9701475E-03
.1287731E-02	.4256828E-03	.1029283E-03	-.5859012E-05	-.6361091E-03
-.7083297E-03	.1886338E-03	.3987302E-03	-.8446094E-03	-.1763941E-02
-.9487169E-03	-.7196589E-04	-.2525119E-03	.4045645E-03	.1751573E-02
.1758122E-02	.9078081E-03	.3145437E-03	.3056337E-04	-.1057923E-04
-.4061558E-03	-.1630016E-02	-.3324691E-02	-.4335925E-02	-.4183967E-02
-.4221936E-02	-.4259577E-02	-.3300332E-02	-.2929287E-02	-.3433724E-02
-.2850450E-02	-.1661758E-02	-.1665507E-02	-.2283653E-02	-.2242843E-02
-.1819964E-02	-.1923182E-02	-.2818498E-02	-.3574070E-02	-.2887703E-02
-.1097262E-02	-.3538961E-03	-.1183248E-02	-.1684554E-02	-.1197404E-02
-.1743311E-03	.1437641E-02	.2369786E-02	.1977298E-02	.2545645E-02
.4499601E-02	.5256232E-02	.4464972E-02	.3812651E-02	.3148991E-02
.1999059E-02	.1612454E-02	.1927236E-02	.1296599E-02	-.5215178E-04
-.9137514E-03	-.1022864E-02	-.7312095E-03	-.6816700E-03	-.9326510E-03
-.1372147E-02	-.2215072E-02	-.2787140E-02	-.2481344E-02	-.2100085E-02
-.2609120E-02	-.3816520E-02	-.4682588E-02	-.4982967E-02	-.5499902E-02
-.6419522E-02	-.6924219E-02	-.6673209E-02	-.6182134E-02	-.5322920E-02
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-.1774378E-02	-.1447855E-02	-.1343576E-02	-.1480467E-02	-.1573780E-02
-.1507016E-02	-.1434553E-02	-.1451900E-02	-.1453611E-02	-.1722780E-02
-.2905043E-02	-.4398435E-02	-.4948169E-02	-.5369256E-02	-.6684572E-02
-.7159769E-02	-.5530029E-02	-.3548042E-02	-.2569341E-02	-.2065407E-02
[illegible]62111E-02	-.1983265E-02	-.1914941E-02	-.1917463E-02	-.2988031E-02
[illegible]53291E-02	-.4876915E-02	-.4166802E-02	-.3712539E-02	-.2983842E-02
-.2022883E-02	-.2194521E-02	-.2878979E-02	-.2778839E-02	-.1956202E-02
-.1644841E-02	-.2453169E-02	-.2888697E-02	-.2441708E-02	-.1877640E-02
-.1175914E-02	-.1421768E-03	.9106335E-03	.1222200E-02	.8444025E-03
.3436352E-03	-.6586295E-03	-.1529045E-02	-.1089195E-02	-.4772936E-03
-.1370171E-03	.8563834E-03	.1437010E-02	.8347750E-03	.4785302E-03

.1656878E-02	.1396512E-02	.9606554E-03	.1528355E-02	.1439285E-02
.5836997E-03	.5857808E-03	.1131306E-02	.1140119E-02	.8171940E-03
.3649656E-03	-.3960072E-04	.1046959E-03	.4037703E-03	.7023559E-03
.1397443E-02	.2122189E-02	.2292880E-02	.2004042E-02	.1499260E-02
.8599257E-03	.6691327E-03	.1394132E-02	.1995115E-02	.1280066E-02
.3672017E-03	.5695199E-03	.7328831E-03	.1587191E-03	-.4747770E-03
517310E-02	-.2742191E-02	-.3269253E-02	-.3626239E-02	-.3952493E-02
-.3119663E-02	-.1639941E-02	-.1020042E-02	-.5097745E-03	.1562516E-03
-.4607183E-03	-.1779978E-02	-.2235431E-02	-.1923440E-02	-.2182169E-02
-.3303741E-02	-.3799579E-02	-.3222009E-02	-.2517721E-02	-.2453074E-02
-.2802332E-02	-.2500658E-02	-.1915271E-02	-.2043620E-02	-.2358988E-02
-.2190610E-02	-.1503455E-02	-.1137072E-02	-.1920216E-02	-.2601337E-02
-.2159242E-02	-.1722126E-02	-.1890321E-02	-.1652105E-02	-.1254096E-02
-.1866828E-02	-.1993370E-02	-.3271824E-03	.6948917E-03	-.4153676E-04
-.1826777E-03	.6381660E-03	.8158077E-03	.4929117E-03	.3689007E-03
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-.2311039E-02	-.3773522E-02	-.4680853E-02	-.4890719E-02	-.5431621E-02
-.6288252E-02	-.6928800E-02	-.6659090E-02	-.5222827E-02	-.4082646E-02
-.3813782E-02	-.3087888E-02	-.2609524E-02	-.3534796E-02	-.3933608E-02
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-.3269100E-02	-.3398450E-02	-.3828147E-02	-.4485128E-02	-.5014914E-02
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-.7837956E-03	.7374526E-03	.2740087E-02	.3685941E-02	.3023945E-02
.2494465E-02	.3050345E-02	.3615175E-02	.3198187E-02	.2332642E-02
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.1205625E-02	-.5450903E-03	-.7227389E-03	-.7818247E-03	-.2153840E-02
-.3550808E-02	-.2979352E-02	-.1395167E-02	-.4218672E-03	-.1450805E-03
4881418E-03	-.7231431E-03	-.7128468E-03	-.1325272E-02	-.1905664E-02
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.1292128E-02	.1647994E-02	.2567298E-02	.2927594E-02	.1725257E-02
.1260580E-03	.1443234E-03	.1071533E-02	.1116155E-02	.5617997E-03
.4563585E-03	.7417714E-03	.7657613E-03	-.3191222E-03	-.2210872E-02
-.3194204E-02	-.3096727E-02	-.3004743E-02	-.3103767E-02	-.2796989E-02
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-.2127700E-02	-.1161264E-02	-.5298151E-03	-.3257044E-03	-.5762902E-03
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.5662650E-02	.5499482E-02	.4607044E-02	.3489680E-02	.2523936E-02
.1997114E-02	.1250575E-02	-.1323876E-03	-.7739976E-03	.4326109E-04
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52345E-03	.2001946E-02	.1238512E-02	.2491523E-03	.1452348E-02
.2934681E-02	.2158671E-02	.7690761E-03	.1028737E-02	.1558743E-02
.1205445E-02	.1208182E-02	.1468767E-02	.1676882E-02	.2162690E-02
.2242197E-02	.1531263E-02	.9429332E-03	.1590336E-02	.2605908E-02
.2458349E-02	.1820103E-02	.1835699E-02	.2190316E-02	.2216607E-02
.2072732E-02	.1750504E-02	.9002777E-03	.3844883E-03	.4900718E-03
-.5368687E-04	-.1244715E-02	-.1710944E-02	-.1245313E-02	-.1010864E-02

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8114-10
Part 12

APPENDIX D

PERMANENT DEFORMATION ANALYSES

APPENDIX D-1

ESTIMATION OF THE SEISMIC PSEUDO-STATIC FACTORS OF SAFETY AND YIELD ACCELERATIONS FOR THE DOWNSTREAM AND UPSTREAM SLOPE GEOMETRIES

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Estimation of the Seismic Pseudo-Static Factors of Safety and Yield Accelerations for the South Cell Downstream and Upstream Slope Geometries PAGE 1 OF 65

MADE BY BEG DATE 1/22/08 CHECKED BY [illegible] DATE 1/23/08

CALCULATION BRIEF FOR

ESTIMATION OF THE SEISMIC PSEUDO-STATIC FACTORS OF SAFETY AND YIELD ACCELERATIONS FOR THE DOWNSTREAM AND UPSTREAM SLOPE GEOMETRIES

POND CREEK COAL REFUSE DISPOSAL SITE - SOUTH CELL

OBJECTIVE: Estimate downstream and upstream seismic factors of safety and yield accelerations for the Pond Creek – South Cell embankment and impoundment.

METHODOLOGY: In accordance with Reference 1, use GSTABL slope stability computer software (Reference 2) to revise the Alliance Consulting, Inc. pseudo-static (seismic) stability analyses and, based on the results, approximate yield accelerations of the Pond Creek – South Cell embankment for both downstream and upstream critical failure surfaces.

REFERENCES:

1. Illinois Department of Natural Resources Letter "Application No. 20061019, Pond Creek Mine No. 1, Phase 2 Refuse Disposal Dam," dated September 19, 2007.

2. Gregory, P.E., Garry H., "GSTABL7 with STEDwin Slope Stability Analysis System, Version 2.0," dated September 2001.

3. Ordonez, Gustavo A.(2006) "SHAKE2000: A Computer Program for the 1-D Analysis of Geotechnical Earthquake Engineering Problems," February 2006.

4. Newmark, N. M. (1965) "Effects of Earthquake on Dams and Embankments," Geotechnique, London, Vol. 5, No. 2, June, 1965.

5. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Estimation of the Seismic Pseudo-Static Factors of Safety and Yield Accelerations for the South Cell Downstream and Upstream Slope Geometries

MADE BY BEG DATE 1/22/08 CHECKED BY [illegible] DATE 1/23/08

Undrained Shear Strengths For Refuse and Subgrade Materials, Pond Creek Coal Refuse Disposal Site", BEG, 12/28/07.

ANALYSIS:

The Illinois Department of Natural Resources (IDNR) has required that a revised (seismic) slope stability analysis be performed for the Pond Creek facility using equivalent static load (pseudo-static) methods and the appropriate peak acceleration based on the Peak Ground Acceleration (PGA) for 2% Probability of Exceedance in 50 Years map from the USGS. If the required factor of safety is not met, i.e., a minimum factor of safety of 1.0 with seismic forces for the steady seepage condition, a permanent deformation evaluation should be completed and submitted for review before an IDNR/OWR permit can be issued. Accordingly, CEC revised the seismic slope stability analyses and as shown below, the minimum factor of safety does not meet the required 1.0 safety factor criteria. Therefore, CEC will perform a detailed deformation evaluation of the proposed Pond Creek South Cell impoundment addressing relevant issues such as material characterizations, seismic hazard, induced cyclic shear stresses and permanent deformations.

Permanent deformations or crest settlement can occur depending upon the acceleration levels above a defined yield acceleration, below which embankment response is assumed to behave elastic-plastic (Newmark, 1965). If crest settlements are large enough resulting in the loss of freeboard below the maximum tailings impoundment level, overtopping of the dam could result posing a threat to the embankment and ultimately downstream safety. Appendix D, Attachments D-2 and D-3 present analyses to estimate induced cyclic shear stresses, settlements along for the proposed South Cell embankment geometry and determine the potential for overtopping as a result of permanent deformations.

Revised Pseudo-Static (Seismic) Stability Analyses and Estimation of Yield Accelerations:

Pseudo-static stability analyses were performed for the proposed South Cell downstream and upstream geometries including the maximum fines (El. 496) and minimum fines (El. 474) conditions respectively using a PGA of 0.54g (as required by IDNR) to assess the revised seismic factor of safety (Fs), and to determine the yield acceleration (Ky) of the critical soil mass.

The yield acceleration is the acceleration level:

- Below which yielding of the embankment (soil mass) does not occur and the soil mass deforms elastic-plastic; and/or,

- Above which yielding occurs causing permanent deformation.

The yield acceleration is used as input to subsequent Newmark-type permanent deformation analyses. The following graphically illustrates the concept of the Newmark analysis and the relative significance of the yield acceleration (Note, $K_y = N_d$ in the attached figure).

Yield strengths for the various materials included drained strengths for coarse and fine refuse and undrained strength (both total strength and 80% peak undrained) for residual soil in the GSTABL analysis to obtain Ky.

Refuse/Soil Properties Used in Revised Pseudo-Static and Yield Acceleration Slope Stability Analyses

Description	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Yield Strength (psf)
Coarse Refuse	130	33.7	0	Frictional
Fine Refuse	90	30	0	Frictional
Residual Soil	125	19.5 0	400 3000	Total (Undrained) Strength 80% Peak Undrained

Note: Refuse properties provided by Alliance Consulting, Inc. based on laboratory testing and/or literature values noted in the Alliance static/seismic slope stability analyses.

A horizontal acceleration corresponding to the PGA value of 0.54g was input into GSTABL to assess the revised seismic stability analyses safety factors. Revised Fs values less than 1.0 were determined for both the downstream and upstream slope conditions, thus permanent deformation analyses are required, which are presented in Appendices D-2 and D-3.

Additionally, a horizontal acceleration was subsequently varied in GSTABL until a Factor of Safety equal to 1.0 was achieved. Consequently, yield accelerations of 0.184g and 0.24g were iteratively determined for the soil mass corresponding to the downstream (maximum fines) critical failure surface using total strength and 80% peak strength, respectively, and 0.19g for the upstream (minimum fines) failure surface for both strength parameters.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Estimation of the Seismic Pseudo-Static Factors of Safety and Yield Accelerations for the South Cell PAGE 4 OF 65

Downstream and Upstream Slope Geometries

MADE BY BEG DATE 1/22/08 CHECKED BY [signature] DATE 1/23/08

CONCLUSION

Based on the information presented in this calculation brief, the minimum factors of safety for the revised pseudo-static (seismic) analyses (with PGA=0.54g) are less than 1.0. Therefore, per the IDNR September 19, 2007 comment, a permanent deformation analysis is required. Additionally, the minimum yield acceleration for the Pond Creek – South Cell embankment in the downstream and upstream directions was estimated at 0.18g. The revised seismic stability and yield acceleration GSTABL analyses runs and outputs files are attached. Finally, a yield acceleration of 0.018g is conservatively assumed for all downstream and upstream slope conditions, which will be used as input for estimating the corresponding permanent deformations.

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PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Estimation of the Seismic Pseudo-Static Factors of Safety and Yield Accelerations for the South Cell Downstream and Upstream Slope Geometries PAGE 5 OF 65

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POND CREEK – SOUTH CELL IMPOUNDMENT
GSTABL PSEUDO-STATIC (SEISMIC)
STABILITY ANALYSIS OUTPUT FILES
DOWNSTREAM (MAXIMUM FINES CONDITION)
UPSTREAM (MINIMUM FINES CONDITION)

Pond Creek, South Cell, DS (PGA = 0.54g)CEC Project No. 072-046 (Total Strength)

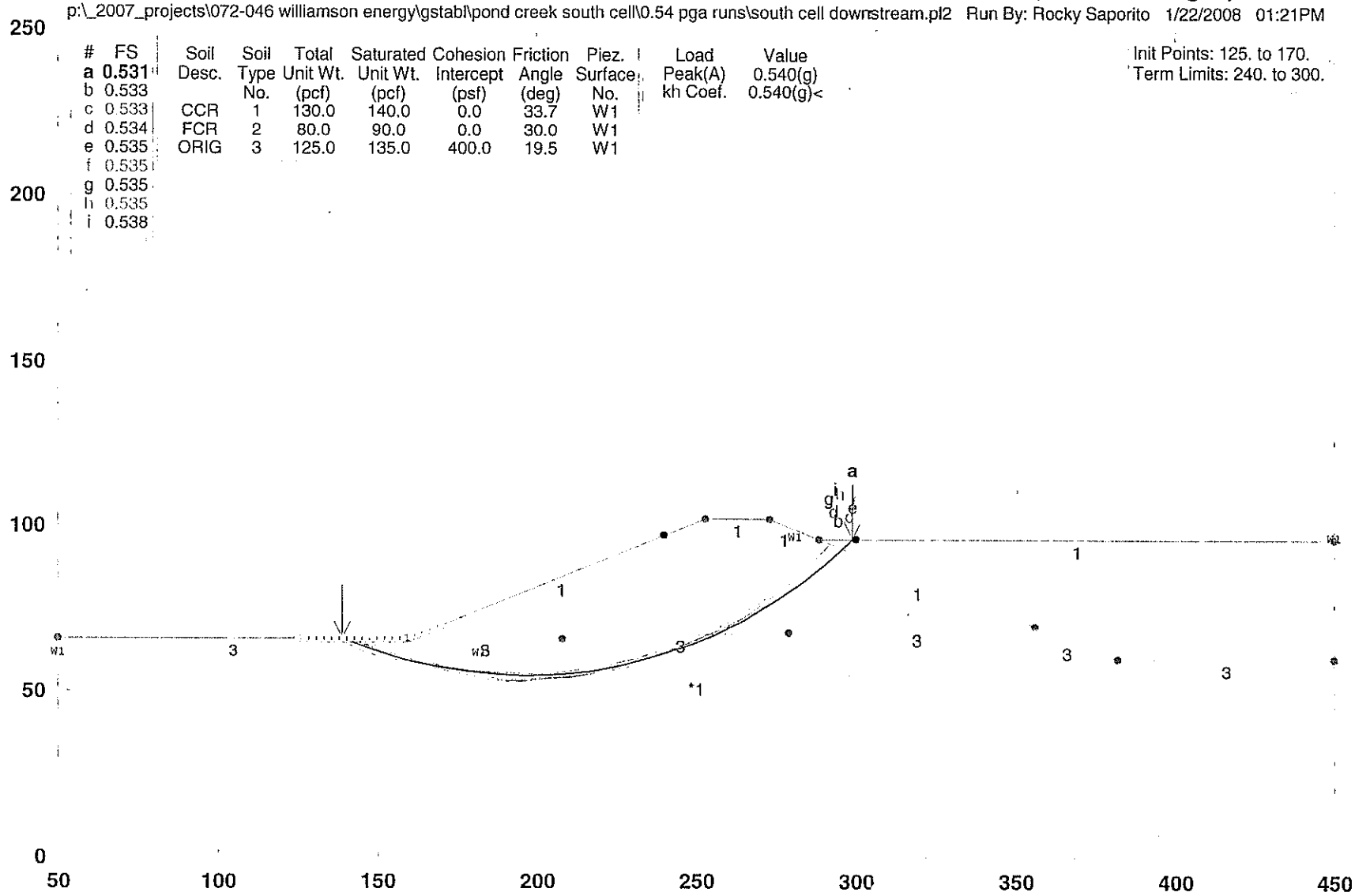
p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\0.54 pga runs\south cell downstream.pl2 Run By: Rocky Saporito 1/22/2008 01:21PM

#	FS
a	0.531
b	0.533
c	0.533
d	0.534
e	0.535
f	0.535
g	0.535
h	0.535
i	0.538

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	30.0	W1
ORIG	3	125.0	135.0	400.0	19.5	W1

Load Peak(A) kh Coef. | Value 0.540(g) 0.540(g)<

Init Points: 125. to 170.
Term Limits: 240. to 300.



GSTABL7 v.2 FSmin=0.531
Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R15986

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                    ***  GSTABL7  ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
              (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                  SLOPE STABILITY ANALYSIS SYSTEM
       Modified Bishop, Simplified Janbu, or GLE Method of Slices.
       (Includes Spencer & Morgenstern-Price Type Analysis)
       Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
   Analysis Run Date:        1/22/2008
   Time of Run:              01:21PM
   Run By:                   Rocky Saporito
   Input Data Filename:      P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\0.54 PGA Runs\south cell downstream.in
   Output Filename:          P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\0.54 PGA Runs\south cell downstream.OUT
   Unit System:              English
   Plotted Output Filename:  P:\_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek South
Cell\0.54 PGA Runs\south cell downstream.PLT
   PROBLEM DESCRIPTION:  Pond Creek, South Cell, DS (PGA = 0.54g)
                         CEC Project No. 072-046 (Total Strength)
   BOUNDARY COORDINATES
       5 Top   Boundaries
      11 Total Boundaries
   Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
      No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
       1         50.00      66.00     159.40      66.00        3
       2        159.40      66.00     253.00     102.00        1
       3        253.00     102.00     273.00     102.00        1
       4        273.00     102.00     288.60      96.00        1
       5        288.60      96.00     450.00      96.00        1
       6        159.40      66.00     208.00      66.00        3
       7        208.00      66.00     279.00      68.00        3
       8        288.60      96.00     356.20      70.00        1
       9        279.00      68.00     356.20      70.00        3
      10        356.20      70.00     382.20      60.00        3
      11        382.20      60.00     450.00      60.00        3
   Default Y-Origin = 0.00(ft)
   Default X-Plus Value = 0.00(ft)
   Default Y-Plus Value = 0.00(ft)
  ISOTROPIC SOIL PARAMETERS
    3 Type(s) of Soil
   Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
   Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
    No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
     1   130.0    140.0       0.0     33.7    0.00       0.0      1
     2    80.0     90.0       0.0     30.0    0.00       0.0      1
     3   125.0    135.0     400.0     19.5    0.00       0.0      1
   1 PIEZOMETRIC SURFACE(S) SPECIFIED
   Unit Weight of Water =  62.40 (pcf)
   Piezometric Surface No.  1 Specified by  4 Coordinate Points
   Pore Pressure Inclination Factor =  0.50
     Point      X-Water     Y-Water
      No.         (ft)        (ft)
       1         50.00       64.00
       2        182.00       64.00
       3        280.80       99.00
       4        450.00       99.00
  Searching Routine Will Be Limited To An Area Defined By  1 Boundaries
   Of Which The First  1 Boundaries Will Deflect Surfaces Upward
   Boundary     X-Left     Y-Left    X-Right    Y-Right
      No.        (ft)       (ft)       (ft)       (ft)
       1         50.00      50.00     450.00      58.00
```

Specified Peak Ground Acceleration Coefficient (A) = 0.540(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.540(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 125.00(ft)
and X = 170.00(ft)
Each Surface Terminates Between X = 240.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Statistical Data On All Valid FS Values:
FS Max = 0.876 FS Min = 0.531 FS Ave = 0.650
Standard Deviation = 0.076 Coefficient of Variation = 11.64 %
Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	139.21	66.00
2	148.57	62.48
3	158.14	59.59
4	167.89	57.36
5	177.77	55.78
6	187.73	54.87
7	197.72	54.63
8	207.71	55.06
9	217.65	56.17
10	227.49	57.93
11	237.20	60.36
12	246.71	63.43
13	256.00	67.13
14	265.02	71.45
15	273.73	76.36
16	282.09	81.85
17	290.07	87.88
18	297.62	94.44
19	299.19	96.00

Circle Center At X = 196.28 ; Y = 203.49 ; and Radius = 148.86
Factor of Safety
*** 0.531 ***
Individual data on the 29 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	5.3	664.5	0.0	0.0	0.	0.	358.8	0.0	0.0
2	4.0	1426.2	0.0	205.1	0.	0.	770.2	0.0	0.0
3	9.6	6224.9	0.0	1849.5	0.	0.	3361.5	0.0	0.0
4	1.3	1084.9	0.0	365.7	0.	0.	585.9	0.0	0.0
5	8.5	10423.7	0.0	3081.6	0.	0.	5628.8	0.0	0.0
6	9.9	19005.1	0.0	4636.6	0.	0.	10262.8	0.0	0.0
7	4.2	10201.7	0.0	2231.4	0.	0.	5508.9	0.0	0.0
8	5.6	15368.7	0.0	3294.7	0.	0.	8299.1	0.0	0.0
9	0.1	231.1	0.0	52.3	0.	0.	124.8	0.0	0.0
10	10.0	31944.8	0.0	7687.4	0.	0.	17250.2	0.0	0.0
11	10.0	37120.4	0.0	9716.5	0.	0.	20045.0	0.0	0.0
12	0.3	1136.4	0.0	307.7	0.	0.	613.7	0.0	0.0
13	9.7	40043.5	0.0	11036.5	0.	0.	21623.5	0.0	0.0
14	9.8	44061.4	0.0	12563.3	0.	0.	23793.1	0.0	0.0

15	9.7	45741.7	0.0	13368.3	0.	0.	24700.5	0.0	0.0
16	9.5	46222.2	0.0	13755.6	0.	0.	24960.0	0.0	0.0
17	6.3	30818.9	0.0	9313.5	0.	0.	16642.2	0.0	0.0
18	3.0	14491.5	0.0	4409.9	0.	0.	7825.4	0.0	0.0
19	0.5	2333.6	0.0	742.2	0.	0.	1260.2	0.0	0.0
20	8.5	37941.9	0.0	12529.5	0.	0.	20488.6	0.0	0.0
21	8.0	30941.2	0.0	11400.5	0.	0.	16708.2	0.0	0.0
22	0.7	2589.3	0.0	1002.2	0.	0.	1398.2	0.0	0.0
23	7.1	21189.7	0.0	9497.4	0.	0.	11442.5	0.0	0.0
24	1.3	3137.6	21.5	1696.8	0.	0.	1694.3	0.0	0.0
25	6.5	11788.6	760.7	7480.6	0.	0.	6365.8	0.0	0.0
26	1.5	1780.4	274.5	1339.6	0.	0.	961.4	0.0	0.0
27	6.0	4640.6	1128.3	4234.1	0.	0.	2505.9	0.0	0.0
28	1.5	473.4	285.0	657.1	0.	0.	255.7	0.0	0.0
29	1.6	171.3	293.8	521.8	0.	0.	92.5	0.0	0.0

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.11	66.00
2	141.36	62.21
3	150.85	59.07
4	160.54	56.59
5	170.38	54.78
6	180.31	53.65
7	190.30	53.21
8	200.30	53.46
9	210.26	54.39
10	220.12	56.01
11	229.86	58.30
12	239.41	61.26
13	248.74	64.87
14	257.80	69.11
15	266.54	73.96
16	274.93	79.40
17	282.92	85.41
18	290.48	91.95
19	294.56	96.00

Circle Center At X = 191.71 ; Y = 198.47 ; and Radius = 145.26

Factor of Safety
*** 0.533 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.84	66.00
2	146.23	62.55
3	155.82	59.72
4	165.57	57.52
5	175.45	55.97
6	185.41	55.07
7	195.41	54.83
8	205.40	55.24
9	215.34	56.31
10	225.20	58.03
11	234.91	60.39
12	244.45	63.38
13	253.78	66.99
14	262.85	71.20
15	271.62	76.01
16	280.06	81.37
17	288.13	87.28
18	295.79	93.71
19	298.18	96.00

Circle Center At X = 194.12 ; Y = 207.18 ; and Radius = 152.35

Factor of Safety
*** 0.533 ***

Failure Surface Specified By 18 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	141.58	66.00
2	150.76	62.05
3	160.23	58.81
4	169.91	56.32
5	179.76	54.59
6	189.71	53.61
7	199.71	53.42
8	209.69	53.99
9	219.60	55.33
10	229.38	57.43
11	238.96	60.29
12	248.30	63.87
13	257.33	68.16
14	266.00	73.14
15	274.27	78.78
16	282.07	85.03
17	289.37	91.87
18	293.14	96.00

Circle Center At X = 197.26 ; Y = 182.55 ; and Radius = 129.17

Factor of Safety

*** 0.534 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.05	66.00
2	160.25	62.06
3	169.72	58.87
4	179.42	56.45
5	189.29	54.80
6	199.25	53.94
7	209.25	53.88
8	219.22	54.61
9	229.11	56.14
10	238.84	58.44
11	248.35	61.52
12	257.59	65.34
13	266.50	69.88
14	275.02	75.12
15	283.09	81.02
16	290.67	87.54
17	297.71	94.65
18	298.85	96.00

Circle Center At X = 205.01 ; Y = 179.24 ; and Radius = 125.44

Factor of Safety

*** 0.535 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	134.47	66.00
2	143.92	62.71
3	153.55	60.01
4	163.32	57.92
5	173.21	56.43
6	183.17	55.55
7	193.17	55.29
8	203.16	55.64
9	213.12	56.62
10	222.99	58.20
11	232.75	60.39
12	242.35	63.18
13	251.76	66.56
14	260.95	70.51
15	269.87	75.03
16	278.50	80.08
17	286.80	85.66
18	294.74	91.74

19 299.65 96.00
Circle Center At X = 192.39 ; Y = 217.19 ; and Radius = 161.91
Factor of Safety
*** 0.535 ***
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.84	66.00
2	146.04	62.07
3	155.50	58.85
4	165.19	56.34
5	175.03	54.56
6	184.97	53.53
7	194.97	53.24
8	204.96	53.70
9	214.88	54.91
10	224.69	56.86
11	234.33	59.53
12	243.74	62.92
13	252.86	67.01
14	261.66	71.76
15	270.08	77.16
16	278.07	83.18
17	285.58	89.78
18	291.68	96.00

Circle Center At X = 193.80 ; Y = 186.64 ; and Radius = 133.41
Factor of Safety
*** 0.535 ***
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	143.95	66.00
2	153.25	62.33
3	162.80	59.37
4	172.54	57.11
5	182.43	55.59
6	192.40	54.81
7	202.40	54.76
8	212.37	55.46
9	222.27	56.90
10	232.03	59.06
11	241.61	61.95
12	250.94	65.53
13	259.98	69.80
14	268.69	74.73
15	277.00	80.29
16	284.87	86.45
17	292.27	93.18
18	294.95	96.00

Circle Center At X = 197.95 ; Y = 189.19 ; and Radius = 134.51
Factor of Safety
*** 0.535 ***
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.58	66.00
2	150.93	62.46
3	160.51	59.60
4	170.28	57.44
5	180.17	55.99
6	190.15	55.25
7	200.15	55.24
8	210.12	55.94
9	220.02	57.36
10	229.79	59.48
11	239.38	62.31
12	248.75	65.81

13	257.84	69.98
14	266.60	74.80
15	275.00	80.23
16	282.98	86.25
17	290.51	92.83
18	293.65	96.00

Circle Center At X = 195.36 ; Y = 193.80 ; and Radius = 138.66

Factor of Safety

*** 0.538 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	153.42	66.00
2	162.89	62.79
3	172.57	60.28
4	182.41	58.47
5	192.35	57.38
6	202.34	57.00
7	212.33	57.35
8	222.28	58.41
9	232.12	60.19
10	241.80	62.68
11	251.29	65.85
12	260.51	69.70
13	269.44	74.21
14	278.02	79.35
15	286.20	85.10
16	293.95	91.42
17	298.81	96.00

Circle Center At X = 202.55 ; Y = 195.58 ; and Radius = 138.58

Factor of Safety

*** 0.539 ***

**** END OF GSTABL7 OUTPUT ****

Pond Creek, South Cell, DS (PGA = 0.54g)CEC Project No. 072-046 (80% Peak Str.)

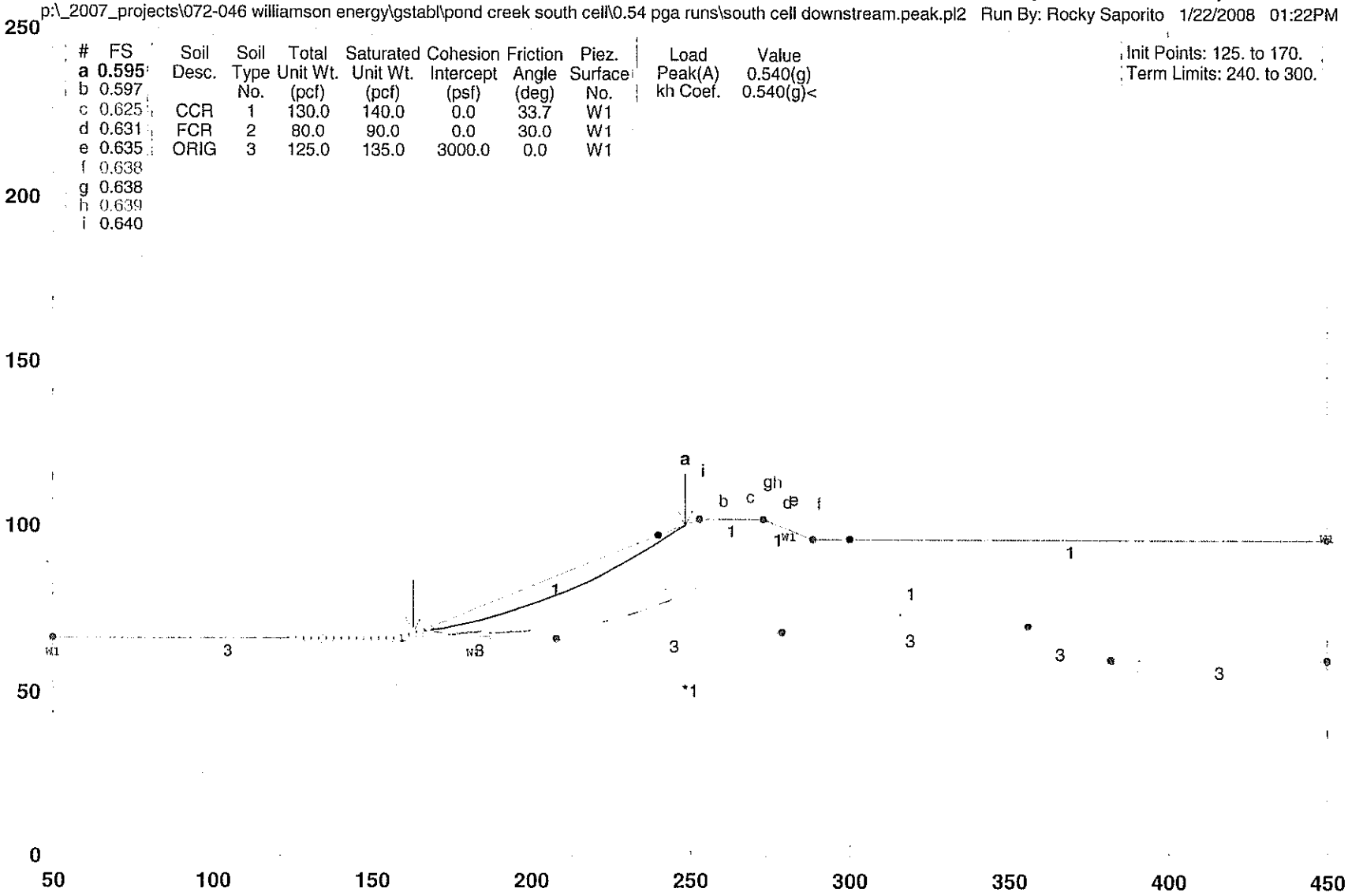
p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\0.54 pga runs\south cell downstream.peak.pl2 Run By: Rocky Saporito 1/22/2008 01:22PM

#	FS
a	**0.595**
b	0.597
c	0.625
d	0.631
e	0.635
f	0.638
g	0.638
h	0.639
i	0.640

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	30.0	W1
ORIG	3	125.0	135.0	3000.0	0.0	W1

Load	Value
Peak(A)	0.540(g)
kh Coef.	0.540(g)<

Init Points: 125. to 170.
Term Limits: 240. to 300.



GSTABL7 v.2 FSmin=0.595
Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

134 65

R15993

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
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****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 1/22/2008
Time of Run: 01:22PM
Run By: Rocky Saporito
Input Data Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek South Cell\0.54 PGA Runs\south cell downstream.peak.in
Output Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek South Cell\0.54 PGA Runs\south cell downstream.peak.OUT
Unit System: English
Plotted Output Filename: P:_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek South Cell\0.54 PGA Runs\south cell downstream.peak.PLT
PROBLEM DESCRIPTION: Pond Creek, South Cell, DS (PGA = 0.54g)
CEC Project No. 072-046 (80% Peak Str.)

BOUNDARY COORDINATES
Note: User origin value specified.
Add 50.00 to X-values and 0.00 to Y-values listed.

5 Top Boundaries
11 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	50.00	66.00	159.40	66.00	3
2	159.40	66.00	253.00	102.00	1
3	253.00	102.00	273.00	102.00	1
4	273.00	102.00	288.60	96.00	1
5	288.60	96.00	450.00	96.00	1
6	159.40	66.00	208.00	66.00	3
7	208.00	66.00	279.00	68.00	3
8	288.60	96.00	356.20	70.00	1
9	279.00	68.00	356.20	70.00	3
10	356.20	70.00	382.20	60.00	3
11	382.20	60.00	450.00	60.00	3

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	0.0	30.0	0.00	0.0	1
3	125.0	135.0	3000.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 4 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	50.00	64.00
2	182.00	64.00
3	280.80	99.00
4	450.00	99.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	50.00	50.00	450.00	58.00

Specified Peak Ground Acceleration Coefficient (A) = 0.540(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.540(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 125.00(ft)
and X = 170.00(ft)
Each Surface Terminates Between X = 240.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Statistical Data On All Valid FS Values:
FS Max = 2.529 FS Min = 0.595 FS Ave = 1.539
Standard Deviation = 0.367 Coefficient of Variation = 23.82 %
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	162.89	67.34
2	172.77	68.90
3	182.56	70.97
4	192.22	73.52
5	201.75	76.57
6	211.11	80.10
7	220.27	84.10
8	229.22	88.56
9	237.93	93.47
10	246.38	98.82
11	248.35	100.21

Circle Center At X = 137.21 ; Y = 261.94 ; and Radius = 196.28
Factor of Safety
*** 0.595 ***
Individual data on the 10 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.9	1437.0	0.0	0.0	0.	0.	776.0	0.0	0.0
2	9.8	3929.4	0.0	0.0	0.	0.	2121.9	0.0	0.0
3	9.7	5680.8	0.0	0.0	0.	0.	3067.6	0.0	0.0
4	9.5	6697.2	0.0	0.0	0.	0.	3616.5	0.0	0.0
5	9.4	6997.8	0.0	0.0	0.	0.	3778.8	0.0	0.0
6	9.2	6614.0	0.0	0.0	0.	0.	3571.5	0.0	0.0
7	8.9	5589.4	0.0	0.0	0.	0.	3018.3	0.0	0.0
8	8.7	3979.3	0.0	0.0	0.	0.	2148.8	0.0	0.0
9	8.4	1849.8	0.0	0.0	0.	0.	998.9	0.0	0.0
10	2.0	81.2	0.0	0.0	0.	0.	43.9	0.0	0.0

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	170.00	70.08
2	179.69	72.54
3	189.33	75.20
4	198.91	78.06
5	208.43	81.12
6	217.89	84.38

7	227.27	87.84
8	236.58	91.49
9	245.81	95.33
10	254.96	99.36
11	260.62	102.00

Circle Center At X = 56.68 ; Y = 536.71 ; and Radius = 480.20

Factor of Safety

*** 0.597 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	162.89	67.34
2	172.55	69.94
3	182.18	72.63
4	191.78	75.43
5	201.36	78.32
6	210.90	81.32
7	220.40	84.42
8	229.88	87.62
9	239.32	90.92
10	248.72	94.32
11	258.09	97.81
12	267.42	101.41
13	268.91	102.00

Circle Center At X = -77.81 ; Y = 983.35 ; and Radius = 947.10

Factor of Safety

*** 0.625 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	165.26	68.26
2	175.19	67.08
3	185.18	66.57
4	195.18	66.74
5	205.14	67.59
6	215.03	69.11
7	224.79	71.29
8	234.38	74.13
9	243.75	77.61
10	252.87	81.71
11	261.69	86.42
12	270.17	91.72
13	278.28	97.57
14	280.25	99.21

Circle Center At X = 187.67 ; Y = 214.08 ; and Radius = 147.53

Factor of Safety

*** 0.631 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	167.63	69.17
2	177.57	68.06
3	187.56	67.59
4	197.56	67.76
5	207.52	68.58
6	217.42	70.05
7	227.19	72.14
8	236.82	74.87
9	246.24	78.20
10	255.44	82.14
11	264.35	86.66
12	272.96	91.75
13	281.23	97.38
14	282.48	98.36

Circle Center At X = 189.83 ; Y = 222.34 ; and Radius = 154.77

Factor of Safety

*** 0.635 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	167.63	69.17
2	177.51	67.59
3	187.46	66.64
4	197.46	66.31
5	207.45	66.60
6	217.41	67.52
7	227.29	69.05
8	237.06	71.20
9	246.67	73.95
10	256.10	77.30
11	265.29	81.22
12	274.23	85.72
13	282.86	90.76
14	290.68	96.00

Circle Center At X = 197.76 ; Y = 226.55 ; and Radius = 160.24

Factor of Safety

*** 0.638 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	165.26	68.26
2	175.23	67.43
3	185.23	67.31
4	195.21	67.88
5	205.13	69.15
6	214.94	71.10
7	224.59	73.73
8	234.03	77.03
9	243.22	80.97
10	252.11	85.55
11	260.66	90.73
12	268.83	96.50
13	274.75	101.33

Circle Center At X = 182.02 ; Y = 210.81 ; and Radius = 143.54

Factor of Safety

*** 0.638 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	165.26	68.26
2	175.25	67.77
3	185.25	67.87
4	195.23	68.58
5	205.14	69.88
6	214.96	71.77
7	224.65	74.24
8	234.18	77.28
9	243.50	80.89
10	252.60	85.04
11	261.43	89.74
12	269.96	94.95
13	277.57	100.24

Circle Center At X = 178.44 ; Y = 235.26 ; and Radius = 167.52

Factor of Safety

*** 0.639 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.53	66.43
2	170.53	66.51
3	180.49	67.35
4	190.36	68.95
5	200.08	71.29
6	209.60	74.37

7	218.85	78.17
8	227.78	82.66
9	236.35	87.82
10	244.50	93.61
11	252.19	100.01
12	254.23	102.00

Circle Center At X = 164.58 ; Y = 196.97 ; and Radius = 130.60

Factor of Safety

*** 0.640 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	170.00	70.08
2	179.90	71.46
3	189.75	73.20
4	199.53	75.28
5	209.24	77.70
6	218.85	80.46
7	228.36	83.55
8	237.75	86.98
9	247.02	90.73
10	256.15	94.81
11	265.13	99.21
12	270.36	102.00

Circle Center At X = 135.72 ; Y = 351.56 ; and Radius = 283.56

Factor of Safety

*** 0.642 ***

**** END OF GSTABL7 OUTPUT ****

Pond Creek, South Cell, US (PGA = 0.54g)CEC Project No. 072-046 (Total Strength)

p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\0.54 pga runs\south cell upstream.pl2 Run By: Rocky Saporito 1/22/2008 01:23PM

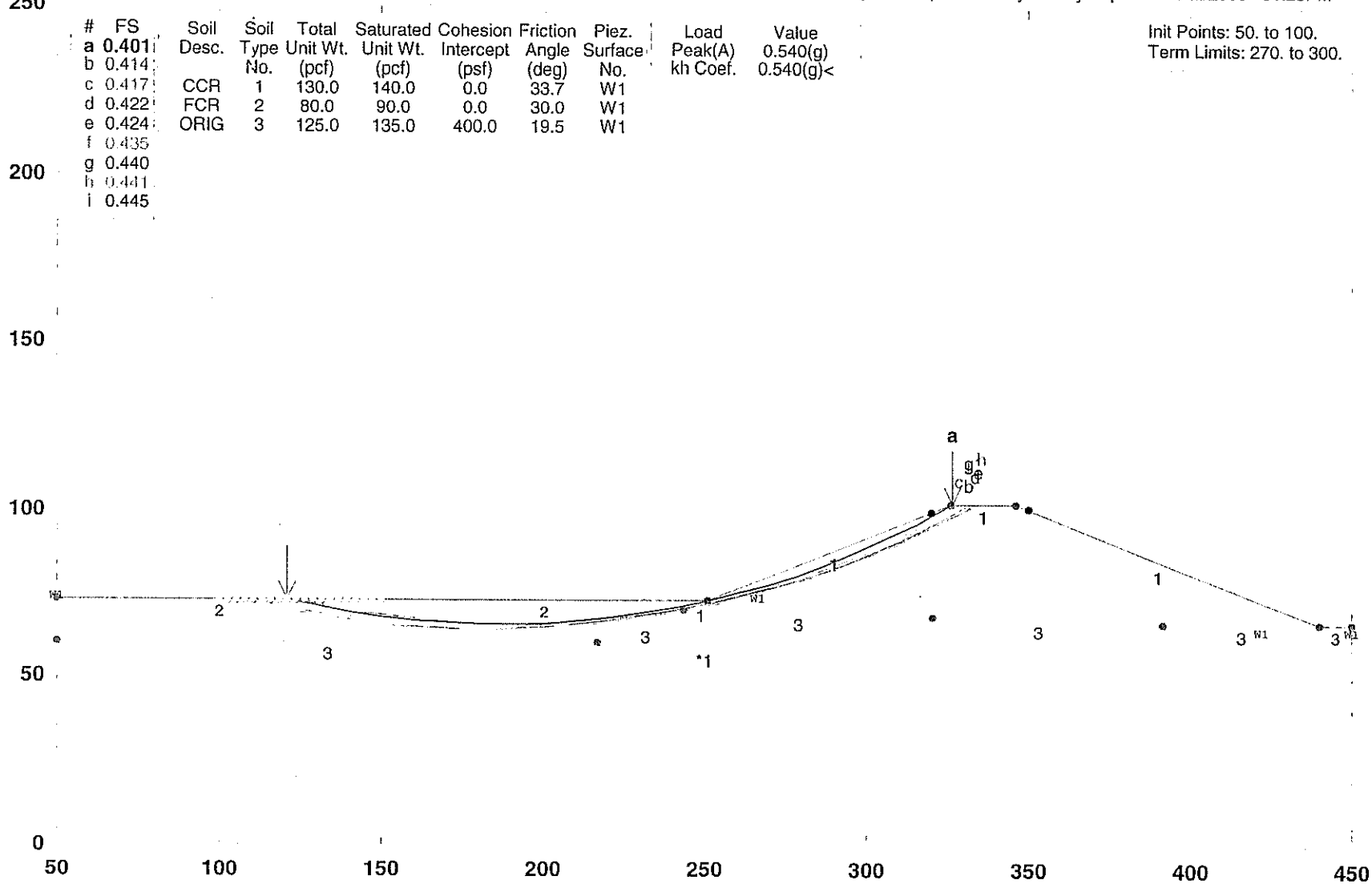
#	FS
a	0.401
b	0.414
c	0.417
d	0.422
e	0.424
f	0.435
g	0.440
h	0.441
i	0.445

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	30.0	W1
ORIG	3	125.0	135.0	400.0	19.5	W1

Load: Peak(A) kh Coef.

Value: 0.540(g) 0.540(g)<

Init Points: 50. to 100.
Term Limits: 270. to 300.



GSTABL7 v.2 FSmin=0.401
Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R15999

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                    *** GSTABL7 ***
                ** GSTABL7 by Garry H. Gregory, P.E. **
      ** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
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 ********************************************************************************
                    SLOPE STABILITY ANALYSIS SYSTEM
        Modified Bishop, Simplified Janbu, or GLE Method of Slices.
        (Includes Spencer & Morgenstern-Price Type Analysis)
        Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
        Nonlinear Undrained Shear Strength, Curved Phi Envelope,
        Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
        Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
 ********************************************************************************
 Analysis Run Date:        1/22/2008
 Time of Run:              01:23PM
 Run By:                   Rocky Saporito
 Input Data Filename:      P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\0.54 PGA Runs\south cell upstream.in
 Output Filename:          P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\0.54 PGA Runs\south cell upstream.OUT
 Unit System:              English
 Plotted Output Filename:  P:\_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek South
Cell\0.54 PGA Runs\south cell upstream.PLT
 PROBLEM DESCRIPTION:  Pond Creek, South Cell, US (PGA = 0.54g)
                       CEC Project No. 072-046 (Total Strength)
 BOUNDARY COORDINATES
      Note: User origin value specified.
      Add 50.00 to X-values and 0.00 to Y-values listed.

     6 Top   Boundaries
    12 Total Boundaries
 Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
    No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
     1          0.00      73.00     100.00      73.00        2
     2        100.00      73.00     200.84      73.00        2
     3        200.84      73.00     276.24     102.00        1
     4        276.24     102.00     296.24     102.00        1
     5        296.24     102.00     389.84      66.00        1
     6        389.84      66.00     400.00      66.00        3
     7          0.00      60.00     167.04      60.00        3
     8        167.04      60.00     193.46      70.16        3
     9        193.46      70.16     200.84      73.00        1
    10        193.46      70.16     270.39      68.00        3
    11        270.39      68.00     341.70      66.00        3
    12        341.70      66.00     389.84      66.00        3
 Default Y-Origin = 0.00(ft)
 Default X-Plus Value = 0.00(ft)
 Default Y-Plus Value = 0.00(ft)
 ISOTROPIC SOIL PARAMETERS
  3 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.  (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)     No.
   1   130.0    140.0      0.0      33.7    0.00      0.0       1
   2    80.0     90.0      0.0      30.0    0.00      0.0       1
   3   125.0    135.0    400.0      19.5    0.00      0.0       1
 1 PIEZOMETRIC SURFACE(S) SPECIFIED
 Unit Weight of Water =  62.40 (pcf)
 Piezometric Surface No.  1 Specified by  4 Coordinate Points
 Pore Pressure Inclination Factor =  0.50
   Point      X-Water    Y-Water
    No.         (ft)       (ft)
     1          0.00      76.00
     2        216.44      76.00
     3        371.84      66.00
     4        400.00      66.00
 Searching Routine Will Be Limited To An Area Defined By  1 Boundaries
```

Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	0.00	58.00	400.00	58.00

Specified Peak Ground Acceleration Coefficient (A) = 0.540(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.540(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00(ft)
and X = 100.00(ft)
Each Surface Terminates Between X = 270.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Statistical Data On All Valid FS Values:
FS Max = 0.677 FS Min = 0.401 FS Ave = 0.581
Standard Deviation = 0.056 Coefficient of Variation = 9.62 %
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	71.05	73.00
2	80.83	70.88
3	90.67	69.11
4	100.56	67.68
5	110.51	66.59
6	120.48	65.86
7	130.47	65.47
8	140.47	65.44
9	150.47	65.75
10	160.44	66.41
11	170.39	67.42
12	180.30	68.78
13	190.15	70.49
14	199.94	72.54
15	209.65	74.92
16	219.27	77.65
17	228.79	80.71
18	238.20	84.11
19	247.48	87.83
20	256.63	91.87
21	265.63	96.23
22	274.47	100.90
23	276.39	102.00

Circle Center At X = 136.50 ; Y = 351.34 ; and Radius = 285.93
Factor of Safety
*** 0.401 ***
Individual data on the 27 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.8	931.6	1829.5	2532.9	0.	0.	503.1	0.0	0.0
2	9.8	2662.5	1842.3	3747.8	0.	0.	1437.7	0.0	0.0
3	9.3	3837.1	1747.2	4453.3	0.	0.	2072.0	0.0	0.0
4	0.6	268.2	105.6	294.6	0.	0.	144.8	0.0	0.0
5	9.9	5247.9	1861.0	5532.1	0.	0.	2833.8	0.0	0.0
6	10.0	6080.6	1866.9	6099.3	0.	0.	3283.5	0.0	0.0

7	10.0	6596.4	1870.6	6448.9	0.	0.	3562.1	0.0	0.0
8	10.0	6791.0	1872.0	6580.5	0.	0.	3667.2	0.0	0.0
9	10.0	6662.9	1871.1	6493.9	0.	0.	3598.0	0.0	0.0
10	10.0	6213.0	1867.9	6189.2	0.	0.	3355.0	0.0	0.0
11	9.9	5445.1	1862.4	5666.7	0.	0.	2940.3	0.0	0.0
12	9.9	4365.7	1854.6	4927.2	0.	0.	2357.5	0.0	0.0
13	9.9	2983.8	1844.6	3971.5	0.	0.	1611.2	0.0	0.0
14	9.1	1278.6	1705.8	2648.5	0.	0.	690.5	0.0	0.0
15	0.7	34.6	126.5	152.3	0.	0.	18.7	0.0	0.0
16	0.9	36.8	168.2	193.7	0.	0.	19.8	0.0	0.0
17	8.8	1053.6	769.1	1222.8	0.	0.	569.0	0.0	0.0
18	3.8	837.6	0.0	132.3	0.	0.	452.3	0.0	0.0
19	5.8	1623.5	0.0	0.0	0.	0.	876.7	0.0	0.0
20	9.5	3388.3	0.0	0.0	0.	0.	1829.7	0.0	0.0
21	9.4	3852.5	0.0	0.0	0.	0.	2080.3	0.0	0.0
22	9.3	3847.2	0.0	0.0	0.	0.	2077.5	0.0	0.0
23	9.1	3390.5	0.0	0.0	0.	0.	1830.9	0.0	0.0
24	9.0	2504.2	0.0	0.0	0.	0.	1352.3	0.0	0.0
25	8.8	1213.9	0.0	0.0	0.	0.	655.5	0.0	0.0
26	1.8	58.3	0.0	0.0	0.	0.	31.5	0.0	0.0
27	0.1	0.8	0.0	0.0	0.	0.	0.4	0.0	0.0

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.26	73.00
2	65.03	70.84
3	74.85	68.98
4	84.73	67.42
5	94.65	66.17
6	104.61	65.23
7	114.59	64.60
8	124.58	64.27
9	134.58	64.26
10	144.58	64.55
11	154.56	65.15
12	164.52	66.06
13	174.44	67.28
14	184.33	68.81
15	194.16	70.64
16	203.93	72.77
17	213.63	75.20
18	223.25	77.93
19	232.78	80.96
20	242.21	84.28
21	251.54	87.89
22	260.75	91.78
23	269.83	95.96
24	278.78	100.42
25	281.72	102.00

Circle Center At X = 130.09 ; Y = 387.75 ; and Radius = 323.52

Factor of Safety

*** 0.414 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.32	73.00
2	86.09	70.88
3	95.93	69.12
4	105.83	67.70
5	115.78	66.65
6	125.75	65.94
7	135.74	65.60
8	145.74	65.61
9	155.74	65.98
10	165.71	66.71
11	175.65	67.79
12	185.55	69.23

13	195.39	71.03
14	205.15	73.17
15	214.84	75.66
16	224.43	78.49
17	233.91	81.67
18	243.27	85.18
19	252.51	89.03
20	261.59	93.20
21	270.53	97.70
22	278.37	102.00

Circle Center At X = 140.38 ; Y = 345.04 ; and Radius = 279.48

Factor of Safety

*** 0.417 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.26	73.00
2	65.02	70.83
3	74.85	68.95
4	84.72	67.38
5	94.64	66.11
6	104.60	65.15
7	114.57	64.50
8	124.57	64.15
9	134.57	64.10
10	144.56	64.37
11	154.55	64.94
12	164.51	65.82
13	174.44	67.00
14	184.33	68.49
15	194.17	70.28
16	203.94	72.37
17	213.65	74.76
18	223.29	77.45
19	232.83	80.44
20	242.28	83.71
21	251.62	87.27
22	260.85	91.12
23	269.96	95.25
24	278.94	99.66
25	283.36	102.00

Circle Center At X = 130.94 ; Y = 389.72 ; and Radius = 325.64

Factor of Safety

*** 0.422 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	73.00
2	59.77	70.87
3	69.60	69.02
4	79.48	67.46
5	89.39	66.19
6	99.35	65.21
7	109.32	64.52
8	119.31	64.13
9	129.31	64.02
10	139.31	64.21
11	149.30	64.70
12	159.27	65.47
13	169.21	66.54
14	179.12	67.89
15	188.99	69.54
16	198.80	71.47
17	208.55	73.69
18	218.23	76.19
19	227.83	78.98
20	237.35	82.04

21	246.78	85.38
22	256.10	89.00
23	265.31	92.89
24	274.41	97.04
25	283.38	101.46
26	284.40	102.00

Circle Center At X = 127.83 ; Y = 405.74 ; and Radius = 341.72

Factor of Safety

*** 0.424 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.68	73.00
2	83.45	70.87
3	93.29	69.08
4	103.19	67.62
5	113.12	66.51
6	123.09	65.74
7	133.09	65.32
8	143.09	65.24
9	153.08	65.50
10	163.06	66.11
11	173.02	67.06
12	182.93	68.36
13	192.80	69.99
14	202.60	71.96
15	212.33	74.28
16	221.98	76.92
17	231.52	79.89
18	240.96	83.20
19	250.28	86.82
20	259.47	90.77
21	268.52	95.02
22	277.42	99.59
23	281.73	102.00

Circle Center At X = 140.42 ; Y = 355.48 ; and Radius = 290.25

Factor of Safety

*** 0.435 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.53	73.00
2	70.27	70.74
3	80.08	68.79
4	89.94	67.17
5	99.86	65.88
6	109.81	64.91
7	119.79	64.27
8	129.79	63.96
9	139.79	63.97
10	149.78	64.32
11	159.76	64.99
12	169.71	65.99
13	179.62	67.32
14	189.48	68.97
15	199.29	70.95
16	209.02	73.25
17	218.67	75.86
18	228.23	78.79
19	237.69	82.04
20	247.04	85.59
21	256.26	89.45
22	265.36	93.61
23	274.31	98.06
24	281.61	102.00

Circle Center At X = 134.27 ; Y = 368.02 ; and Radius = 304.10

Factor of Safety

*** 0.440 ***
Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.53	73.00
2	70.32	70.96
3	80.16	69.21
4	90.06	67.76
5	99.99	66.61
6	109.95	65.75
7	119.94	65.20
8	129.93	64.95
9	139.93	65.01
10	149.93	65.36
11	159.91	66.01
12	169.86	66.97
13	179.78	68.22
14	189.66	69.78
15	199.49	71.63
16	209.25	73.77
17	218.95	76.21
18	228.57	78.94
19	238.11	81.96
20	247.54	85.27
21	256.88	88.86
22	266.10	92.72
23	275.20	96.87
24	284.17	101.28
25	285.52	102.00

Circle Center At X = 133.21 ; Y = 396.63 ; and Radius = 331.69
Factor of Safety
*** 0.441 ***
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.68	73.00
2	83.47	70.95
3	93.32	69.22
4	103.22	67.82
5	113.17	66.76
6	123.14	66.02
7	133.13	65.61
8	143.13	65.54
9	153.13	65.80
10	163.11	66.39
11	173.07	67.31
12	182.99	68.56
13	192.86	70.14
14	202.68	72.05
15	212.43	74.28
16	222.09	76.84
17	231.67	79.71
18	241.15	82.91
19	250.52	86.41
20	259.76	90.22
21	268.87	94.34
22	277.84	98.76
23	283.90	102.00

Circle Center At X = 140.34 ; Y = 366.57 ; and Radius = 301.05
Factor of Safety
*** 0.445 ***
Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.16	73.00
2	72.92	70.83
3	82.75	68.97

4	92.63	67.43
5	102.55	66.20
6	112.51	65.30
7	122.49	64.71
8	132.49	64.44
9	142.49	64.49
10	152.48	64.87
11	162.46	65.56
12	172.41	66.57
13	182.32	67.91
14	192.18	69.55
15	201.99	71.52
16	211.72	73.79
17	221.38	76.38
18	230.95	79.27
19	240.43	82.47
20	249.80	85.98
21	259.04	89.78
22	268.17	93.87
23	277.16	98.25
24	284.25	102.00

Circle Center At X = 135.81 ; Y = 376.36 ; and Radius = 311.94

Factor of Safety

*** 0.452 ***

**** END OF GSTABL7 OUTPUT ****

Pond Creek, South Cell, US (PGA = 0.54g)CEC Project No. 072-046 (80% Peak Str.)

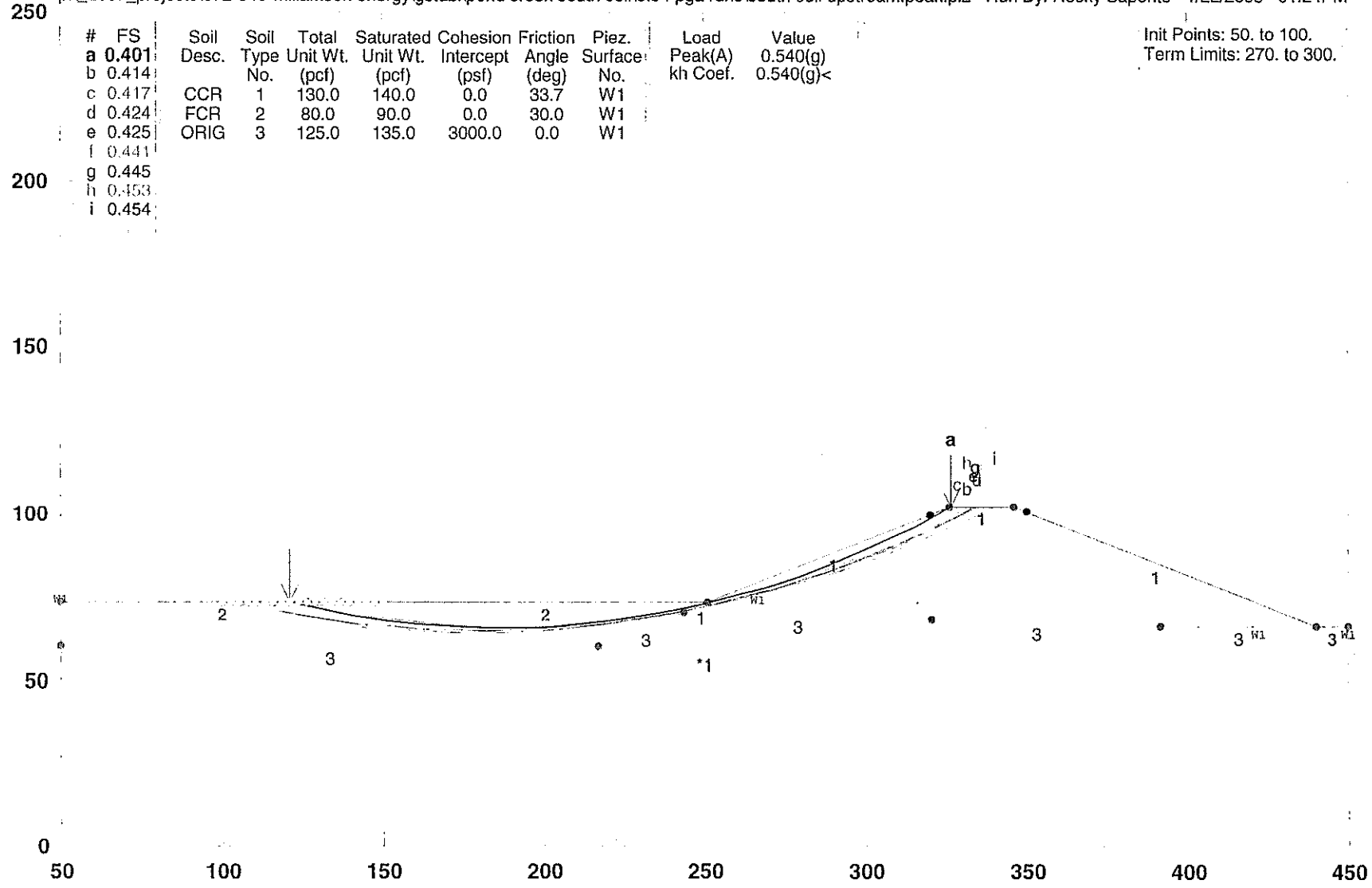
p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\0.54 pga runs\south cell upstream.peak.pl2 Run By: Rocky Saporito 1/22/2008 01:24PM

#	FS
a	**0.401**
b	0.414
c	0.417
d	0.424
e	0.425
f	0.441
g	0.445
h	0.453
i	0.454

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	30.0	W1
ORIG	3	125.0	135.0	3000.0	0.0	W1

Load	Value
Peak(A)	0.540(g)
kh Coef.	0.540(g)<

Init Points: 50. to 100.
Term Limits: 270. to 300.



GSTABL7 v.2 FSmin=0.401
Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R16007

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                    ***  GSTABL7  ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
              (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                  SLOPE STABILITY ANALYSIS SYSTEM
       Modified Bishop, Simplified Janbu, or GLE Method of Slices.
       (Includes Spencer & Morgenstern-Price Type Analysis)
       Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
   Analysis Run Date:        1/22/2008
   Time of Run:              01:24PM
   Run By:                   Rocky Saporito
   Input Data Filename:      P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\0.54 PGA Runs\south cell upstream.peak.in
   Output Filename:          P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\0.54 PGA Runs\south cell upstream.peak.OUT
   Unit System:              English
   Plotted Output Filename:  P:\_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek South
Cell\0.54 PGA Runs\south cell upstream.peak.PLT
   PROBLEM DESCRIPTION:  Pond Creek, South Cell, US (PGA = 0.54g)
                         CEC Project No. 072-046 (80% Peak Str.)
   BOUNDARY COORDINATES
        Note: User origin value specified.
        Add 50.00 to X-values and 0.00 to Y-values listed.

       6 Top   Boundaries
      12 Total Boundaries
   Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
      No.        (ft)       (ft)        (ft)       (ft)     Below Bnd
       1         0.00      73.00      100.00      73.00        2
       2       100.00      73.00      200.84      73.00        2
       3       200.84      73.00      276.24     102.00        1
       4       276.24     102.00      296.24     102.00        1
       5       296.24     102.00      389.84      66.00        1
       6       389.84      66.00      400.00      66.00        3
       7         0.00      60.00      167.04      60.00        3
       8       167.04      60.00      193.46      70.16        3
       9       193.46      70.16      200.84      73.00        1
      10       193.46      70.16      270.39      68.00        3
      11       270.39      68.00      341.70      66.00        3
      12       341.70      66.00      389.84      66.00        3
   Default Y-Origin = 0.00(ft)
   Default X-Plus Value = 0.00(ft)
   Default Y-Plus Value = 0.00(ft)
  ISOTROPIC SOIL PARAMETERS
    3 Type(s) of Soil
   Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
   Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
    No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
     1   130.0    140.0       0.0     33.7    0.00       0.0      1
     2    80.0     90.0       0.0     30.0    0.00       0.0      1
     3   125.0    135.0    3000.0      0.0    0.00       0.0      1
   1 PIEZOMETRIC SURFACE(S) SPECIFIED
   Unit Weight of Water =  62.40 (pcf)
   Piezometric Surface No.  1 Specified by  4 Coordinate Points
   Pore Pressure Inclination Factor =  0.50
     Point      X-Water     Y-Water
      No.         (ft)        (ft)
       1          0.00       76.00
       2        216.44       76.00
       3        371.84       66.00
       4        400.00       66.00
  Searching Routine Will Be Limited To An Area Defined By  1 Boundaries
```

Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	0.00	58.00	400.00	58.00

Specified Peak Ground Acceleration Coefficient (A) = 0.540(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.540(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00(ft)
and X = 100.00(ft)
Each Surface Terminates Between X = 270.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Statistical Data On All Valid FS Values:
FS Max = 2.730 FS Min = 0.401 FS Ave = 1.535
Standard Deviation = 0.636 Coefficient of Variation = 41.41 %
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	71.05	73.00
2	80.83	70.88
3	90.67	69.11
4	100.56	67.68
5	110.51	66.59
6	120.48	65.86
7	130.47	65.47
8	140.47	65.44
9	150.47	65.75
10	160.44	66.41
11	170.39	67.42
12	180.30	68.78
13	190.15	70.49
14	199.94	72.54
15	209.65	74.92
16	219.27	77.65
17	228.79	80.71
18	238.20	84.11
19	247.48	87.83
20	256.63	91.87
21	265.63	96.23
22	274.47	100.90
23	276.39	102.00

Circle Center At X = 136.50 ; Y = 351.34 ; and Radius = 285.93
Factor of Safety
*** 0.401 ***
Individual data on the 27 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.8	931.6	1829.5	2532.9	0.	0.	503.1	0.0	0.0
2	9.8	2662.5	1842.3	3747.8	0.	0.	1437.7	0.0	0.0
3	9.3	3837.1	1747.2	4453.3	0.	0.	2072.0	0.0	0.0
4	0.6	268.2	105.6	294.6	0.	0.	144.8	0.0	0.0
5	9.9	5247.9	1861.0	5532.1	0.	0.	2833.8	0.0	0.0
6	10.0	6080.6	1866.9	6099.3	0.	0.	3283.5	0.0	0.0

7	10.0	6596.4	1870.6	6448.9	0.	0.	3562.1	0.0	0.0	
8	10.0	6791.0	1872.0	6580.5	0.	0.	3667.2	0.0	0.0	
9	10.0	6662.9	1871.1	6493.9	0.	0.	3598.0	0.0	0.0	
10	10.0	6213.0	1867.9	6189.2	0.	0.	3355.0	0.0	0.0	
11	9.9	5445.1	1862.4	5666.7	0.	0.	2940.3	0.0	0.0	
12	9.9	4365.7	1854.6	4927.2	0.	0.	2357.5	0.0	0.0	
13	9.9	2983.8	1844.6	3971.5	0.	0.	1611.2	0.0	0.0	
14	9.1	1278.6	1705.8	2648.5	0.	0.	690.5	0.0	0.0	
15	0.7	34.6	126.5	152.3	0.	0.	18.7	0.0	0.0	
16	0.9	36.8	168.2	193.7	0.	0.	19.8	0.0	0.0	
17	8.8	1053.6	769.1	1222.8	0.	0.	569.0	0.0	0.0	
18	3.8	837.6	0.0	132.3	0.	0.	452.3	0.0	0.0	
19	5.8	1623.5	0.0	0.0	0.	0.	876.7	0.0	0.0	
20	9.5	3388.3	0.0	0.0	0.	0.	1829.7	0.0	0.0	
21	9.4	3852.5	0.0	0.0	0.	0.	2080.3	0.0	0.0	
22	9.3	3847.2	0.0	0.0	0.	0.	2077.5	0.0	0.0	
23	9.1	3390.5	0.0	0.0	0.	0.	1830.9	0.0	0.0	
24	9.0	2504.2	0.0	0.0	0.	0.	1352.3	0.0	0.0	
25	8.8	1213.9	0.0	0.0	0.	0.	655.5	0.0	0.0	
26	1.8	58.3	0.0	0.0	0.	0.	31.5	0.0	0.0	
27	0.1	0.8	0.0	0.0	0.	0.	0.4	0.0	0.0	

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.26	73.00
2	65.03	70.84
3	74.85	68.98
4	84.73	67.42
5	94.65	66.17
6	104.61	65.23
7	114.59	64.60
8	124.58	64.27
9	134.58	64.26
10	144.58	64.55
11	154.56	65.15
12	164.52	66.06
13	174.44	67.28
14	184.33	68.81
15	194.16	70.64
16	203.93	72.77
17	213.63	75.20
18	223.25	77.93
19	232.78	80.96
20	242.21	84.28
21	251.54	87.89
22	260.75	91.78
23	269.83	95.96
24	278.78	100.42
25	281.72	102.00

Circle Center At X = 130.09 ; Y = 387.75 ; and Radius = 323.52

Factor of Safety

*** 0.414 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.32	73.00
2	86.09	70.88
3	95.93	69.12
4	105.83	67.70
5	115.78	66.65
6	125.75	65.94
7	135.74	65.60
8	145.74	65.61
9	155.74	65.98
10	165.71	66.71
11	175.65	67.79
12	185.55	69.23

13	195.39	71.03
14	205.15	73.17
15	214.84	75.66
16	224.43	78.49
17	233.91	81.67
18	243.27	85.18
19	252.51	89.03
20	261.59	93.20
21	270.53	97.70
22	278.37	102.00

Circle Center At X = 140.38 ; Y = 345.04 ; and Radius = 279.48

Factor of Safety

*** 0.417 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	73.00
2	59.77	70.87
3	69.60	69.02
4	79.48	67.46
5	89.39	66.19
6	99.35	65.21
7	109.32	64.52
8	119.31	64.13
9	129.31	64.02
10	139.31	64.21
11	149.30	64.70
12	159.27	65.47
13	169.21	66.54
14	179.12	67.89
15	188.99	69.54
16	198.80	71.47
17	208.55	73.69
18	218.23	76.19
19	227.83	78.98
20	237.35	82.04
21	246.78	85.38
22	256.10	89.00
23	265.31	92.89
24	274.41	97.04
25	283.38	101.46
26	284.40	102.00

Circle Center At X = 127.83 ; Y = 405.74 ; and Radius = 341.72

Factor of Safety

*** 0.424 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.26	73.00
2	65.02	70.83
3	74.85	68.95
4	84.72	67.38
5	94.64	66.11
6	104.60	65.15
7	114.57	64.50
8	124.57	64.15
9	134.57	64.10
10	144.56	64.37
11	154.55	64.94
12	164.51	65.82
13	174.44	67.00
14	184.33	68.49
15	194.17	70.28
16	203.94	72.37
17	213.65	74.76
18	223.29	77.45
19	232.83	80.44

20	242.28	83.71
21	251.62	87.27
22	260.85	91.12
23	269.96	95.25
24	278.94	99.66
25	283.36	102.00

Circle Center At X = 130.94 ; Y = 389.72 ; and Radius = 325.64

Factor of Safety

*** 0.425 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.53	73.00
2	70.32	70.96
3	80.16	69.21
4	90.06	67.76
5	99.99	66.61
6	109.95	65.75
7	119.94	65.20
8	129.93	64.95
9	139.93	65.01
10	149.93	65.36
11	159.91	66.01
12	169.86	66.97
13	179.78	68.22
14	189.66	69.78
15	199.49	71.63
16	209.25	73.77
17	218.95	76.21
18	228.57	78.94
19	238.11	81.96
20	247.54	85.27
21	256.88	88.86
22	266.10	92.72
23	275.20	96.87
24	284.17	101.28
25	285.52	102.00

Circle Center At X = 133.21 ; Y = 396.63 ; and Radius = 331.69

Factor of Safety

*** 0.441 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.68	73.00
2	83.47	70.95
3	93.32	69.22
4	103.22	67.82
5	113.17	66.76
6	123.14	66.02
7	133.13	65.61
8	143.13	65.54
9	153.13	65.80
10	163.11	66.39
11	173.07	67.31
12	182.99	68.56
13	192.86	70.14
14	202.68	72.05
15	212.43	74.28
16	222.09	76.84
17	231.67	79.71
18	241.15	82.91
19	250.52	86.41
20	259.76	90.22
21	268.87	94.34
22	277.84	98.76
23	283.90	102.00

Circle Center At X = 140.34 ; Y = 366.57 ; and Radius = 301.05

Factor of Safety
*** 0.445 ***
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.68	73.00
2	83.45	70.87
3	93.29	69.08
4	103.19	67.62
5	113.12	66.51
6	123.09	65.74
7	133.09	65.32
8	143.09	65.24
9	153.08	65.50
10	163.06	66.11
11	173.02	67.06
12	182.93	68.36
13	192.80	69.99
14	202.60	71.96
15	212.33	74.28
16	221.98	76.92
17	231.52	79.89
18	240.96	83.20
19	250.28	86.82
20	259.47	90.77
21	268.52	95.02
22	277.42	99.59
23	281.73	102.00

Circle Center At X = 140.42 ; Y = 355.48 ; and Radius = 290.25

Factor of Safety
*** 0.453 ***
Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	52.63	73.00
2	62.43	71.01
3	72.28	69.29
4	82.18	67.84
5	92.11	66.66
6	102.07	65.76
7	112.05	65.14
8	122.04	64.79
9	132.04	64.71
10	142.04	64.91
11	152.03	65.39
12	162.00	66.15
13	171.95	67.17
14	181.86	68.48
15	191.74	70.05
16	201.56	71.90
17	211.34	74.02
18	221.05	76.40
19	230.69	79.06
20	240.25	81.98
21	249.73	85.16
22	259.12	88.60
23	268.41	92.30
24	277.60	96.26
25	286.67	100.46
26	289.75	102.00

Circle Center At X = 129.70 ; Y = 426.73 ; and Radius = 362.03

Factor of Safety
*** 0.454 ***
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	78.95	73.00

```
     2          88.78        71.19
     3          98.67        69.70
     4         108.60        68.52
     5         118.56        67.67
     6         128.55        67.14
     7         138.55        66.93
     8         148.55        67.04
     9         158.54        67.48
    10         168.51        68.23
    11         178.45        69.31
    12         188.35        70.71
    13         198.20        72.43
    14         208.00        74.46
    15         217.72        76.81
    16         227.36        79.47
    17         236.90        82.44
    18         246.35        85.71
    19         255.69        89.29
    20         264.91        93.17
    21         274.00        97.34
    22         282.95       101.80
    23         283.31       102.00
Circle Center At X =   140.04 ; Y =   377.13 ; and Radius =   310.21
      Factor of Safety
     ***    0.454    ***
         **** END OF GSTABL7 OUTPUT ****
```

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Estimation of the Seismic Pseudo-Static Factors of Safety and Yield Accelerations for the South Cell Downstream and Upstream Slope Geometries PAGE 35 OF 65

MADE BY BEG DATE 1/22/08 CHECKED BY [signature] DATE 1/23/08

POND CREEK – SOUTH CELL IMPOUNDMENT
GSTABL YIELD ACCELERATION
STABILITY ANALYSIS OUTPUT FILES
DOWNSTREAM (MAXIMUM FINES CONDITION)

Pond Creek, South Cell, Downstream CEC Project No. 072-046 (Total Strength)

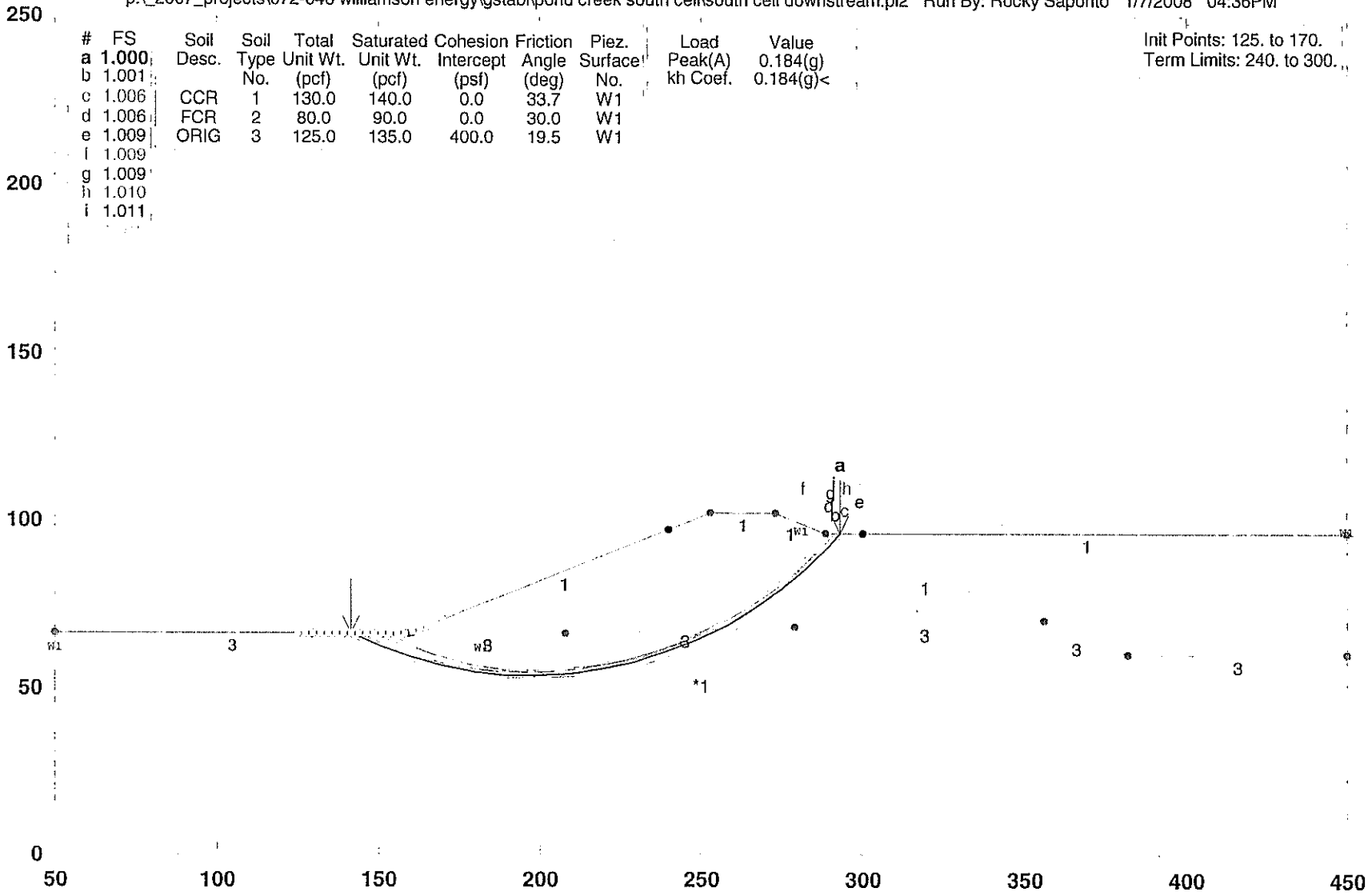
p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\south cell downstream.pl2 Run By: Rocky Saporito 1/7/2008 04:36PM

#	FS	Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
a	1.000							
b	1.001							
c	1.006	CCR	1	130.0	140.0	0.0	33.7	W1
d	1.006	FCR	2	80.0	90.0	0.0	30.0	W1
e	1.009	ORIG	3	125.0	135.0	400.0	19.5	W1
f	1.009							
g	1.009							
h	1.010							
i	1.011							

Load: Peak(A) kh Coef.

Value: 0.184(g) 0.184(g)<

Init Points: 125. to 170.
Term Limits: 240. to 300.



GSTABL7 v.2 FSmin=1.000

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

36 of 65

R16016

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
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****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 1/7/2008
Time of Run: 04:36PM
Run By: Rocky Saporito
Input Data Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek South Cell\south cell downstream.in
Output Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek South Cell\south cell downstream.OUT
Unit System: English
Plotted Output Filename: P:_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek South Cell\south cell downstream.PLT
PROBLEM DESCRIPTION: Pond Creek, South Cell, Downstream
CEC Project No. 072-046 (Total Strength)

BOUNDARY COORDINATES
Note: User origin value specified.
Add 50.00 to X-values and 0.00 to Y-values listed.

5 Top Boundaries
11 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	50.00	66.00	159.40	66.00	3
2	159.40	66.00	253.00	102.00	1
3	253.00	102.00	273.00	102.00	1
4	273.00	102.00	288.60	96.00	1
5	288.60	96.00	450.00	96.00	1
6	159.40	66.00	208.00	66.00	3
7	208.00	66.00	279.00	68.00	3
8	288.60	96.00	356.20	70.00	1
9	279.00	68.00	356.20	70.00	3
10	356.20	70.00	382.20	60.00	3
11	382.20	60.00	450.00	60.00	3

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	0.0	30.0	0.00	0.0	1
3	125.0	135.0	400.0	19.5	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 4 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	50.00	64.00
2	182.00	64.00
3	280.80	99.00
4	450.00	99.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	50.00	50.00	450.00	58.00

Specified Peak Ground Acceleration Coefficient (A) = 0.184(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.184(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 125.00(ft)
and X = 170.00(ft)
Each Surface Terminates Between X = 240.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Statistical Data On All Valid FS Values:
FS Max = 1.559 FS Min = 1.000 FS Ave = 1.175
Standard Deviation = 0.114 Coefficient of Variation = 9.73 %
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.58	66.00
2	150.76	62.05
3	160.23	58.81
4	169.91	56.32
5	179.76	54.59
6	189.71	53.61
7	199.71	53.42
8	209.69	53.99
9	219.60	55.33
10	229.38	57.43
11	238.96	60.29
12	248.30	63.87
13	257.33	68.16
14	266.00	73.14
15	274.27	78.78
16	282.07	85.03
17	289.37	91.87
18	293.14	96.00

Circle Center At X = 197.26 ; Y = 182.55 ; and Radius = 129.17
Factor of Safety
*** 1.000 ***
Individual data on the 28 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	4.6	580.9	0.0	0.0	0.	0.	106.6	0.0	0.0
2	4.5	1733.1	0.0	301.1	0.	0.	318.0	0.0	0.0
3	8.6	6155.6	0.0	1952.1	0.	0.	1129.5	0.0	0.0
4	0.8	787.5	0.0	275.3	0.	0.	144.5	0.0	0.0
5	9.7	13575.4	0.0	4013.3	0.	0.	2491.1	0.0	0.0
6	9.8	21424.4	0.0	5332.6	0.	0.	3931.4	0.0	0.0
7	2.2	5845.3	0.0	1337.4	0.	0.	1072.6	0.0	0.0
8	5.6	16161.7	0.0	3645.8	0.	0.	2965.7	0.0	0.0
9	2.1	6447.4	0.0	1548.1	0.	0.	1183.1	0.0	0.0
10	10.0	34670.5	0.0	8831.2	0.	0.	6362.0	0.0	0.0
11	8.3	32633.6	0.0	8849.3	0.	0.	5988.3	0.0	0.0
12	1.7	7056.7	0.0	1957.2	0.	0.	1294.9	0.0	0.0

13	9.9	43368.7	0.0	12318.3	0.	0.	7958.2	0.0	0.0
14	9.8	45640.6	0.0	13357.6	0.	0.	8375.1	0.0	0.0
15	9.6	46489.6	0.0	13918.2	0.	0.	8530.8	0.0	0.0
16	9.3	45942.3	0.0	13996.7	0.	0.	8430.4	0.0	0.0
17	4.7	23043.0	0.0	7153.6	0.	0.	4228.4	0.0	0.0
18	2.6	12476.9	0.0	3882.4	0.	0.	2289.5	0.0	0.0
19	1.7	8081.1	0.0	2556.8	0.	0.	1482.9	0.0	0.0
20	8.7	37107.4	0.0	12708.6	0.	0.	6809.2	0.0	0.0
21	7.0	25360.9	0.0	9713.3	0.	0.	4653.7	0.0	0.0
22	1.3	4071.6	0.0	1636.4	0.	0.	747.1	0.0	0.0
23	6.5	17034.6	0.0	8114.9	0.	0.	3125.8	0.0	0.0
24	1.3	2529.2	20.7	1469.5	0.	0.	464.1	0.0	0.0
25	6.5	8379.3	761.5	6092.8	0.	0.	1537.6	0.0	0.0
26	0.8	481.1	143.3	490.3	0.	0.	88.3	0.0	0.0
27	2.6	984.8	485.7	1370.5	0.	0.	180.7	0.0	0.0
28	1.2	106.8	221.1	398.3	0.	0.	19.6	0.0	0.0

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.84	66.00
2	146.04	62.07
3	155.50	58.85
4	165.19	56.34
5	175.03	54.56
6	184.97	53.53
7	194.97	53.24
8	204.96	53.70
9	214.88	54.91
10	224.69	56.86
11	234.33	59.53
12	243.74	62.92
13	252.86	67.01
14	261.66	71.76
15	270.08	77.16
16	278.07	83.18
17	285.58	89.78
18	291.68	96.00

Circle Center At X = 193.80 ; Y = 186.64 ; and Radius = 133.41

Factor of Safety

*** 1.001 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.11	66.00
2	141.36	62.21
3	150.85	59.07
4	160.54	56.59
5	170.38	54.78
6	180.31	53.65
7	190.30	53.21
8	200.30	53.46
9	210.26	54.39
10	220.12	56.01
11	229.86	58.30
12	239.41	61.26
13	248.74	64.87
14	257.80	69.11
15	266.54	73.96
16	274.93	79.40
17	282.92	85.41
18	290.48	91.95
19	294.56	96.00

Circle Center At X = 191.71 ; Y = 198.47 ; and Radius = 145.26

Factor of Safety

*** 1.006 ***

Failure Surface Specified By 17 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	143.95	66.00
2	153.18	62.15
3	162.68	59.05
4	172.41	56.72
5	182.29	55.18
6	192.26	54.44
7	202.26	54.49
8	212.22	55.36
9	222.08	57.01
10	231.78	59.46
11	241.25	62.67
12	250.43	66.63
13	259.27	71.32
14	267.70	76.70
15	275.67	82.74
16	283.13	89.40
17	289.42	96.00

Circle Center At X = 196.52 ; Y = 178.92 ; and Radius = 124.56

Factor of Safety

*** 1.006 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.05	66.00
2	160.25	62.06
3	169.72	58.87
4	179.42	56.45
5	189.29	54.80
6	199.25	53.94
7	209.25	53.88
8	219.22	54.61
9	229.11	56.14
10	238.84	58.44
11	248.35	61.52
12	257.59	65.34
13	266.50	69.88
14	275.02	75.12
15	283.09	81.02
16	290.67	87.54
17	297.71	94.65
18	298.85	96.00

Circle Center At X = 205.01 ; Y = 179.24 ; and Radius = 125.44

Factor of Safety

*** 1.009 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	139.21	66.00
2	148.30	61.83
3	157.72	58.48
4	167.40	55.97
5	177.27	54.33
6	187.24	53.56
7	197.24	53.67
8	207.19	54.67
9	217.01	56.53
10	226.63	59.26
11	235.98	62.82
12	244.97	67.19
13	253.54	72.34
14	261.63	78.22
15	269.17	84.80
16	276.09	92.01
17	281.50	98.73

Circle Center At X = 190.96 ; Y = 166.86 ; and Radius = 113.36

Factor of Safety

*** 1.009 ***
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	153.42	66.00
2	162.43	61.67
3	171.81	58.19
4	181.47	55.60
5	191.33	53.92
6	201.30	53.17
7	211.30	53.35
8	221.23	54.45
9	231.03	56.48
10	240.59	59.41
11	249.83	63.22
12	258.69	67.88
13	267.07	73.33
14	274.90	79.55
15	282.12	86.46
16	288.67	94.02
17	290.09	96.00

Circle Center At X = 204.39 ; Y = 160.43 ; and Radius = 107.30
Factor of Safety
*** 1.009 ***
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	143.95	66.00
2	153.25	62.33
3	162.80	59.37
4	172.54	57.11
5	182.43	55.59
6	192.40	54.81
7	202.40	54.76
8	212.37	55.46
9	222.27	56.90
10	232.03	59.06
11	241.61	61.95
12	250.94	65.53
13	259.98	69.80
14	268.69	74.73
15	277.00	80.29
16	284.87	86.45
17	292.27	93.18
18	294.95	96.00

Circle Center At X = 197.95 ; Y = 189.19 ; and Radius = 134.51
Factor of Safety
*** 1.010 ***
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.68	66.00
2	157.95	62.25
3	167.50	59.26
4	177.25	57.05
5	187.15	55.65
6	197.13	55.05
7	207.13	55.26
8	217.08	56.28
9	226.91	58.10
10	236.56	60.72
11	245.97	64.11
12	255.07	68.25
13	263.81	73.12
14	272.12	78.68
15	279.96	84.89
16	287.26	91.72

```
   17        291.16       96.00
Circle Center At X =   199.53 ; Y =   178.26 ; and Radius =   123.23
      Factor of Safety
     ***    1.011   ***
Failure Surface Specified By 19 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        139.21       66.00
    2        148.57       62.48
    3        158.14       59.59
    4        167.89       57.36
    5        177.77       55.78
    6        187.73       54.87
    7        197.72       54.63
    8        207.71       55.06
    9        217.65       56.17
   10        227.49       57.93
   11        237.20       60.36
   12        246.71       63.43
   13        256.00       67.13
   14        265.02       71.45
   15        273.73       76.36
   16        282.09       81.85
   17        290.07       87.88
   18        297.62       94.44
   19        299.19       96.00
Circle Center At X =   196.28 ; Y =   203.49 ; and Radius =   148.86
      Factor of Safety
     ***    1.012   ***
         **** END OF GSTABL7 OUTPUT ****
```

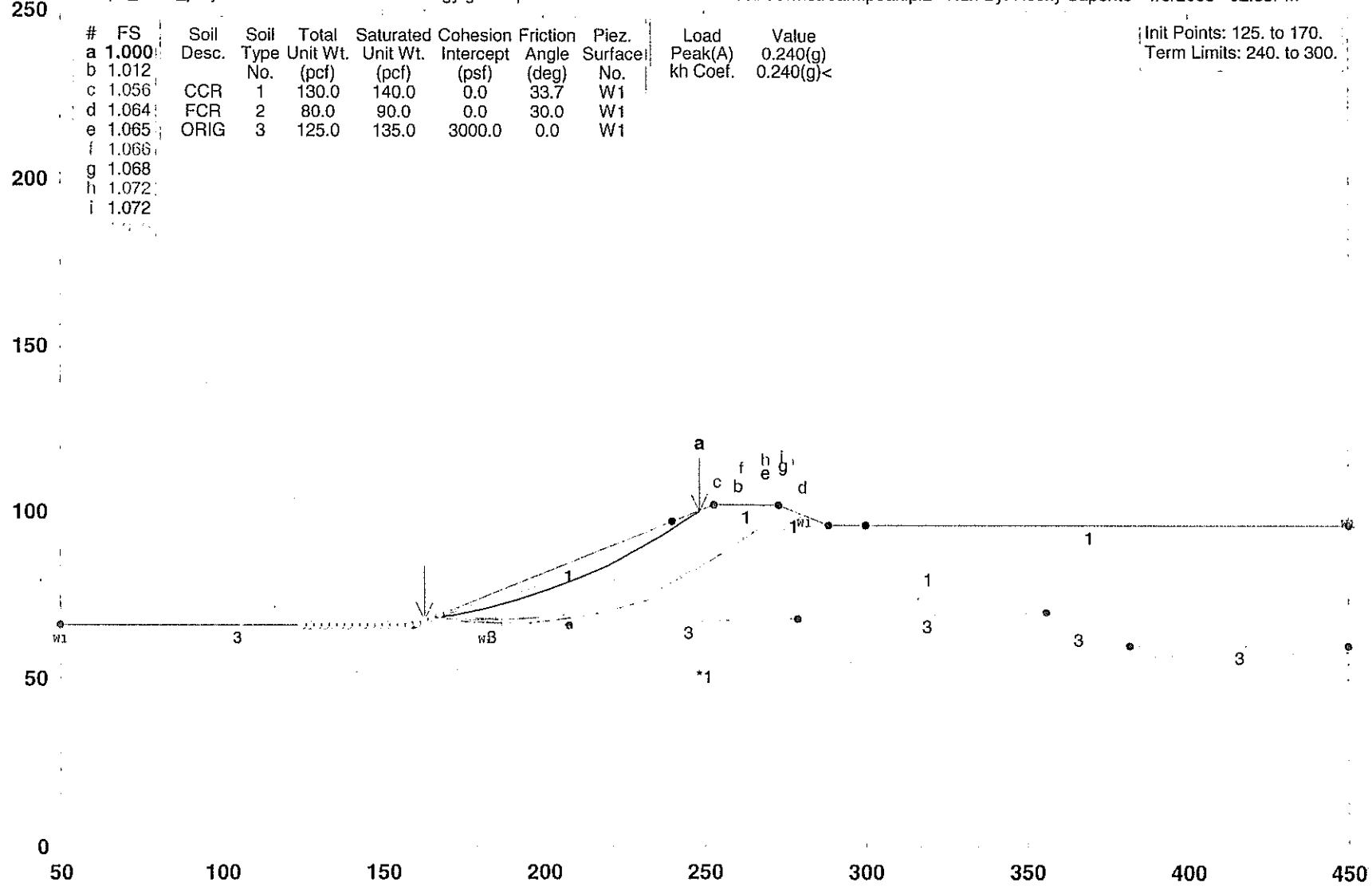
Pond Creek, South Cell, Downstream CEC Project No. 072-046 (80% Peak Str.)

p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\south cell downstream.peak.pf2 Run By: Rocky Saporito 1/8/2008 02:33PM

#	FS	Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
a	1.000							
b	1.012							
c	1.056	CCR	1	130.0	140.0	0.0	33.7	W1
d	1.064	FCR	2	80.0	90.0	0.0	30.0	W1
e	1.065	ORIG	3	125.0	135.0	3000.0	0.0	W1
f	1.066							
g	1.068							
h	1.072							
i	1.072							

Load: Peak(A) kh Coef.
Value: 0.240(g) 0.240(g)<

Init Points: 125. to 170.
Term Limits: 240. to 300.



GSTABL7 v.2 FSmin=1.000
Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R16023

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                    ***  GSTABL7  ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
              (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                  SLOPE STABILITY ANALYSIS SYSTEM
       Modified Bishop, Simplified Janbu, or GLE Method of Slices.
       (Includes Spencer & Morgenstern-Price Type Analysis)
       Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
   Analysis Run Date:        1/8/2008
   Time of Run:              02:33PM
   Run By:                   Rocky Saporito
   Input Data Filename:      P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\south cell downstream.peak.in
   Output Filename:          P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\south cell downstream.peak.OUT
   Unit System:              English
   Plotted Output Filename:  P:\_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek South
Cell\south cell downstream.peak.PLT
   PROBLEM DESCRIPTION:  Pond Creek, South Cell, Downstream
                         CEC Project No. 072-046 (80% Peak Str.)
   BOUNDARY COORDINATES
       5 Top   Boundaries
      11 Total Boundaries
   Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
      No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
       1         50.00      66.00     159.40      66.00        3
       2        159.40      66.00     253.00     102.00        1
       3        253.00     102.00     273.00     102.00        1
       4        273.00     102.00     288.60      96.00        1
       5        288.60      96.00     450.00      96.00        1
       6        159.40      66.00     208.00      66.00        3
       7        208.00      66.00     279.00      68.00        3
       8        288.60      96.00     356.20      70.00        1
       9        279.00      68.00     356.20      70.00        3
      10        356.20      70.00     382.20      60.00        3
      11        382.20      60.00     450.00      60.00        3
   Default Y-Origin = 0.00(ft)
   Default X-Plus Value = 0.00(ft)
   Default Y-Plus Value = 0.00(ft)
  ISOTROPIC SOIL PARAMETERS
    3 Type(s) of Soil
   Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
   Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
    No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
     1   130.0    140.0       0.0     33.7    0.00       0.0      1
     2    80.0     90.0       0.0     30.0    0.00       0.0      1
     3   125.0    135.0    3000.0      0.0    0.00       0.0      1
   1 PIEZOMETRIC SURFACE(S) SPECIFIED
   Unit Weight of Water =  62.40 (pcf)
   Piezometric Surface No.  1 Specified by  4 Coordinate Points
   Pore Pressure Inclination Factor =  0.50
     Point      X-Water     Y-Water
      No.         (ft)        (ft)
       1         50.00       64.00
       2        182.00       64.00
       3        280.80       99.00
       4        450.00       99.00
  Searching Routine Will Be Limited To An Area Defined By  1 Boundaries
   Of Which The First  1 Boundaries Will Deflect Surfaces Upward
   Boundary     X-Left     Y-Left    X-Right    Y-Right
      No.        (ft)       (ft)       (ft)       (ft)
       1         50.00      50.00     450.00      58.00
```

Specified Peak Ground Acceleration Coefficient (A) = 0.240(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.240(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 125.00(ft)
and X = 170.00(ft)
Each Surface Terminates Between X = 240.00(ft)
and X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 400
Statistical Data On All Valid FS Values:
FS Max = 3.868 FS Min = 1.000 FS Ave = 2.379
Standard Deviation = 0.521 Coefficient of Variation = 21.88 %
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	162.89	67.34
2	172.77	68.90
3	182.56	70.97
4	192.22	73.52
5	201.75	76.57
6	211.11	80.10
7	220.27	84.10
8	229.22	88.56
9	237.93	93.47
10	246.38	98.82
11	248.35	100.21

Circle Center At X = 137.21 ; Y = 261.94 ; and Radius = 196.28
Factor of Safety
*** 1.000 ***
Individual data on the 10 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.9	1437.0	0.0	0.0	0.	0.	344.6	0.0	0.0
2	9.8	3929.4	0.0	0.0	0.	0.	942.3	0.0	0.0
3	9.7	5680.8	0.0	0.0	0.	0.	1362.2	0.0	0.0
4	9.5	6697.2	0.0	0.0	0.	0.	1606.0	0.0	0.0
5	9.4	6997.8	0.0	0.0	0.	0.	1678.1	0.0	0.0
6	9.2	6614.0	0.0	0.0	0.	0.	1586.0	0.0	0.0
7	8.9	5589.4	0.0	0.0	0.	0.	1340.3	0.0	0.0
8	8.7	3979.3	0.0	0.0	0.	0.	954.2	0.0	0.0
9	8.4	1849.8	0.0	0.0	0.	0.	443.6	0.0	0.0
10	2.0	81.2	0.0	0.0	0.	0.	19.5	0.0	0.0

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	170.00	70.08
2	179.69	72.54
3	189.33	75.20
4	198.91	78.06
5	208.43	81.12
6	217.89	84.38
7	227.27	87.84
8	236.58	91.49
9	245.81	95.33

10	254.96	99.36
11	260.62	102.00

Circle Center At X = 56.68 ; Y = 536.71 ; and Radius = 480.20

Factor of Safety

*** 1.012 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	160.53	66.43
2	170.53	66.51
3	180.49	67.35
4	190.36	68.95
5	200.08	71.29
6	209.60	74.37
7	218.85	78.17
8	227.78	82.66
9	236.35	87.82
10	244.50	93.61
11	252.19	100.01
12	254.23	102.00

Circle Center At X = 164.58 ; Y = 196.97 ; and Radius = 130.60

Factor of Safety

*** 1.056 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	165.26	68.26
2	175.19	67.08
3	185.18	66.57
4	195.18	66.74
5	205.14	67.59
6	215.03	69.11
7	224.79	71.29
8	234.38	74.13
9	243.75	77.61
10	252.87	81.71
11	261.69	86.42
12	270.17	91.72
13	278.28	97.57
14	280.25	99.21

Circle Center At X = 187.67 ; Y = 214.08 ; and Radius = 147.53

Factor of Safety

*** 1.064 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	162.89	67.34
2	172.55	69.94
3	182.18	72.63
4	191.78	75.43
5	201.36	78.32
6	210.90	81.32
7	220.40	84.42
8	229.88	87.62
9	239.32	90.92
10	248.72	94.32
11	258.09	97.81
12	267.42	101.41
13	268.91	102.00

Circle Center At X = -77.81 ; Y = 983.35 ; and Radius = 947.10

Factor of Safety

*** 1.065 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	170.00	70.08
2	179.99	70.40

3	189.94	71.41
4	199.80	73.09
5	209.52	75.45
6	219.06	78.46
7	228.36	82.12
8	237.40	86.40
9	246.12	91.30
10	254.49	96.77
11	261.39	102.00

Circle Center At X = 170.24 ; Y = 216.35 ; and Radius = 146.28

Factor of Safety

*** 1.066 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	165.26	68.26
2	175.23	67.43
3	185.23	67.31
4	195.21	67.88
5	205.13	69.15
6	214.94	71.10
7	224.59	73.73
8	234.03	77.03
9	243.22	80.97
10	252.11	85.55
11	260.66	90.73
12	268.83	96.50
13	274.75	101.33

Circle Center At X = 182.02 ; Y = 210.81 ; and Radius = 143.54

Factor of Safety

*** 1.068 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	167.63	69.17
2	177.47	67.37
3	187.43	66.53
4	197.43	66.66
5	207.37	67.75
6	217.16	69.81
7	226.70	72.80
8	235.91	76.71
9	244.69	81.48
10	252.97	87.09
11	260.67	93.47
12	267.72	100.57
13	268.89	102.00

Circle Center At X = 191.10 ; Y = 169.57 ; and Radius = 103.11

Factor of Safety

*** 1.072 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	167.63	69.17
2	177.56	67.95
3	187.55	67.52
4	197.54	67.89
5	207.47	69.05
6	217.28	70.99
7	226.91	73.70
8	236.29	77.17
9	245.36	81.37
10	254.08	86.27
11	262.38	91.85
12	270.21	98.07
13	274.00	101.61

Circle Center At X = 187.93 ; Y = 193.60 ; and Radius = 126.08

```
       Factor of Safety
      ***    1.072   ***
Failure Surface Specified By 13 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        165.26       68.26
    2        175.25       67.77
    3        185.25       67.87
    4        195.23       68.58
    5        205.14       69.88
    6        214.96       71.77
    7        224.65       74.24
    8        234.18       77.28
    9        243.50       80.89
   10        252.60       85.04
   11        261.43       89.74
   12        269.96       94.95
   13        277.57      100.24
Circle Center At X =   178.44 ; Y =   235.26 ; and Radius =   167.52
       Factor of Safety
      ***    1.079   ***
          **** END OF GSTABL7 OUTPUT ****
```

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation

PROJECT NO. 072046

Estimation of the Seismic Pseudo-Static Factors of Safety and Yield Accelerations for the South Cell Downstream and Upstream Slope Geometries

PAGE 49 OF 65

MADE BY BEG DATE 1/22/08 CHECKED BY [signature] DATE 1/23/08

POND CREEK – SOUTH CELL IMPOUNDMENT
GSTABL YIELD ACCELERATION
STABILITY ANALYSIS OUTPUT FILES
UPSTREAM (MINIMUM FINES CONDITION)

Pond Creek, South Cell, Upstream CEC Project No. 072-046 (Total Strength)

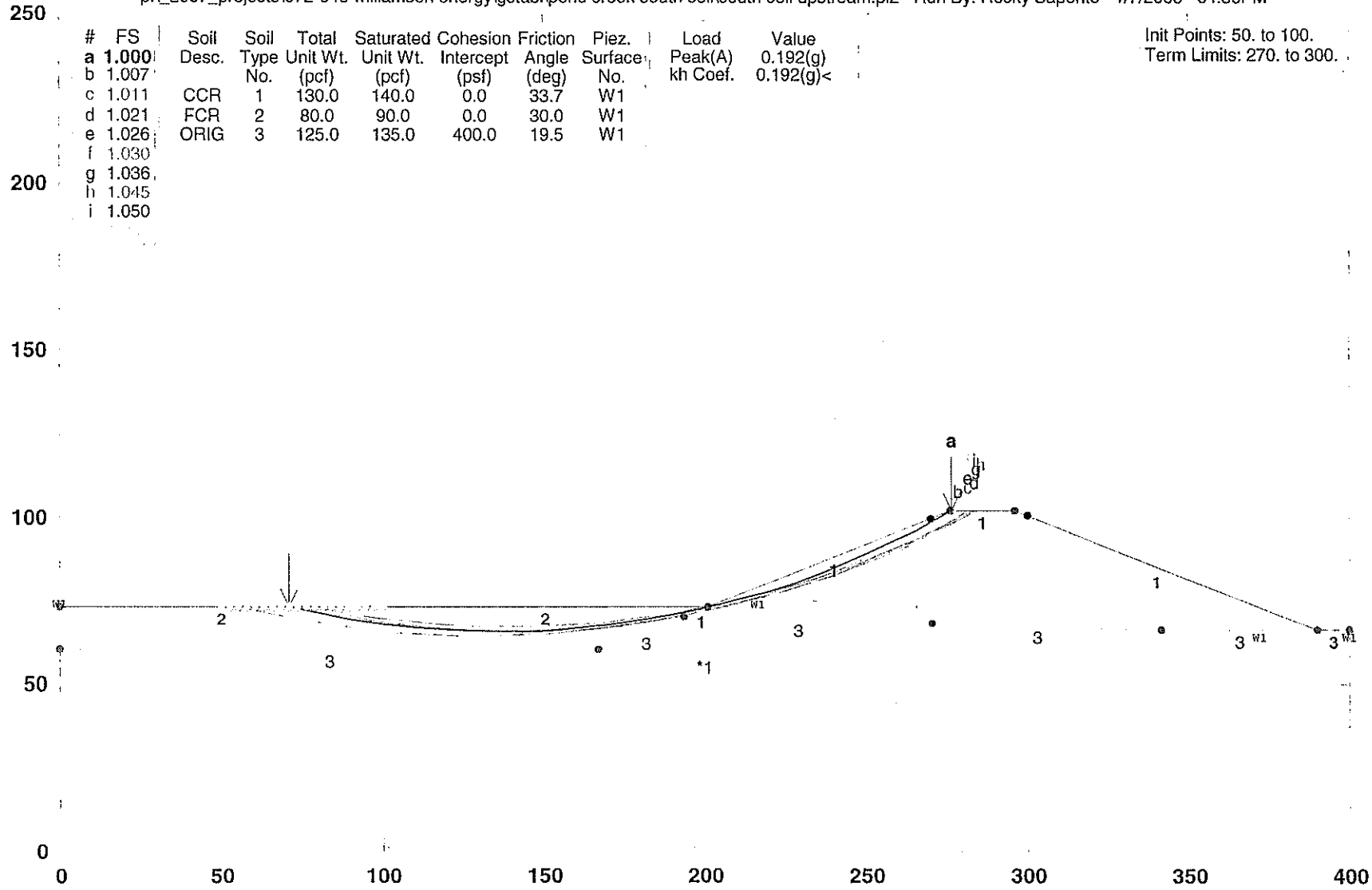
p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\south cell upstream.pl2 Run By: Rocky Saporito 1/7/2008 04:36PM

#	FS	Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
a	**1.000**							
b	1.007							
c	1.011	CCR	1	130.0	140.0	0.0	33.7	W1
d	1.021	FCR	2	80.0	90.0	0.0	30.0	W1
e	1.026	ORIG	3	125.0	135.0	400.0	19.5	W1
f	1.030							
g	1.036							
h	1.045							
i	1.050							

Load: Peak(A) kh Coef.

Value: 0.192(g) 0.192(g)<

Init Points: 50. to 100.
Term Limits: 270. to 300.



GSTABL7 v.2 FSmin=1.000

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R16030

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
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SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

Analysis Run Date: 1/7/2008
Time of Run: 04:36PM
Run By: Rocky Saporito
Input Data Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek South Cell\south cell upstream.in
Output Filename: P:_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek South Cell\south cell upstream.OUT
Unit System: English
Plotted Output Filename: P:_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek South Cell\south cell upstream.PLT
PROBLEM DESCRIPTION: Pond Creek, South Cell, Upstream
CEC Project No. 072-046 (Total Strength)

BOUNDARY COORDINATES
6 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	73.00	100.00	73.00	2
2	100.00	73.00	200.84	73.00	2
3	200.84	73.00	276.24	102.00	1
4	276.24	102.00	296.24	102.00	1
5	296.24	102.00	389.84	66.00	1
6	389.84	66.00	400.00	66.00	3
7	0.00	60.00	167.04	60.00	3
8	167.04	60.00	193.46	70.16	3
9	193.46	70.16	200.84	73.00	1
10	193.46	70.16	270.39	68.00	3
11	270.39	68.00	341.70	66.00	3
12	341.70	66.00	389.84	66.00	3

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	0.0	33.7	0.00	0.0	1
2	80.0	90.0	0.0	30.0	0.00	0.0	1
3	125.0	135.0	400.0	19.5	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 4 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	76.00
2	216.44	76.00
3	371.84	66.00
4	400.00	66.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)

```
    1          0.00      58.00     400.00      58.00
Specified Peak Ground Acceleration Coefficient (A) =   0.192(g)
Specified Horizontal Earthquake Coefficient (kh) =   0.192(g)
Specified Vertical Earthquake Coefficient (kv) =   0.000(g)
Specified Seismic Pore-Pressure Factor =   0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
 400 Trial Surfaces Have Been Generated.
  20 Surface(s) Initiate(s) From Each Of    20 Points Equally Spaced
Along The Ground Surface Between  X =  50.00(ft)
                             and  X = 100.00(ft)
Each Surface Terminates Between   X = 270.00(ft)
                            and   X = 300.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is  Y =      0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
      Failure Surfaces Evaluated. They Are
      Ordered - Most Critical First.
      * * Safety Factors Are Calculated By The Modified Bishop Method * *
      Total Number of Trial Surfaces Evaluated =   400
      Statistical Data On All Valid FS Values:
         FS Max =   1.575   FS Min =   1.000   FS Ave =   1.269
         Standard Deviation =    0.114   Coefficient of Variation =    8.99 %
      Failure Surface Specified By 23 Coordinate Points
```

Point No.	X-Surf (ft)	Y-Surf (ft)
1	71.05	73.00
2	80.83	70.88
3	90.67	69.11
4	100.56	67.68
5	110.51	66.59
6	120.48	65.86
7	130.47	65.47
8	140.47	65.44
9	150.47	65.75
10	160.44	66.41
11	170.39	67.42
12	180.30	68.78
13	190.15	70.49
14	199.94	72.54
15	209.65	74.92
16	219.27	77.65
17	228.79	80.71
18	238.20	84.11
19	247.48	87.83
20	256.63	91.87
21	265.63	96.23
22	274.47	100.90
23	276.39	102.00

```
      Circle Center At X =   136.50 ; Y =   351.34 ; and Radius =   285.93
            Factor of Safety
           ***    1.000   ***
          Individual data on the    27  slices
```

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.8	931.6	1829.5	2532.9	0.	0.	178.5	0.0	0.0
2	9.8	2662.5	1842.3	3747.8	0.	0.	510.1	0.0	0.0
3	9.3	3837.1	1747.2	4453.3	0.	0.	735.2	0.0	0.0
4	0.6	268.2	105.6	294.6	0.	0.	51.4	0.0	0.0
5	9.9	5247.9	1861.0	5532.1	0.	0.	1005.5	0.0	0.0
6	10.0	6080.6	1866.9	6099.3	0.	0.	1165.0	0.0	0.0
7	10.0	6596.4	1870.6	6448.9	0.	0.	1263.9	0.0	0.0
8	10.0	6791.0	1872.0	6580.5	0.	0.	1301.2	0.0	0.0
9	10.0	6662.9	1871.1	6493.9	0.	0.	1276.6	0.0	0.0

10	10.0	6213.0	1867.9	6189.2	0.	0.	1190.4	0.0	0.0
11	9.9	5445.1	1862.4	5666.7	0.	0.	1043.3	0.0	0.0
12	9.9	4365.7	1854.6	4927.2	0.	0.	836.5	0.0	0.0
13	9.9	2983.8	1844.6	3971.5	0.	0.	571.7	0.0	0.0
14	9.1	1278.6	1705.8	2648.5	0.	0.	245.0	0.0	0.0
15	0.7	34.6	126.5	152.3	0.	0.	6.6	0.0	0.0
16	0.9	36.8	168.2	193.7	0.	0.	7.0	0.0	0.0
17	8.8	1053.6	769.1	1222.8	0.	0.	201.9	0.0	0.0
18	3.8	837.6	0.0	132.3	0.	0.	160.5	0.0	0.0
19	5.8	1623.5	0.0	0.0	0.	0.	311.1	0.0	0.0
20	9.5	3388.3	0.0	0.0	0.	0.	649.2	0.0	0.0
21	9.4	3852.5	0.0	0.0	0.	0.	738.1	0.0	0.0
22	9.3	3847.2	0.0	0.0	0.	0.	737.1	0.0	0.0
23	9.1	3390.5	0.0	0.0	0.	0.	649.6	0.0	0.0
24	9.0	2504.2	0.0	0.0	0.	0.	479.8	0.0	0.0
25	8.8	1213.9	0.0	0.0	0.	0.	232.6	0.0	0.0
26	1.8	58.3	0.0	0.0	0.	0.	11.2	0.0	0.0
27	0.1	0.8	0.0	0.0	0.	0.	0.2	0.0	0.0

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.32	73.00
2	86.09	70.88
3	95.93	69.12
4	105.83	67.70
5	115.78	66.65
6	125.75	65.94
7	135.74	65.60
8	145.74	65.61
9	155.74	65.98
10	165.71	66.71
11	175.65	67.79
12	185.55	69.23
13	195.39	71.03
14	205.15	73.17
15	214.84	75.66
16	224.43	78.49
17	233.91	81.67
18	243.27	85.18
19	252.51	89.03
20	261.59	93.20
21	270.53	97.70
22	278.37	102.00

Circle Center At X = 140.38 ; Y = 345.04 ; and Radius = 279.48

Factor of Safety

*** 1.007 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.26	73.00
2	65.03	70.84
3	74.85	68.98
4	84.73	67.42
5	94.65	66.17
6	104.61	65.23
7	114.59	64.60
8	124.58	64.27
9	134.58	64.26
10	144.58	64.55
11	154.56	65.15
12	164.52	66.06
13	174.44	67.28
14	184.33	68.81
15	194.16	70.64
16	203.93	72.77
17	213.63	75.20
18	223.25	77.93

19	232.78	80.96
20	242.21	84.28
21	251.54	87.89
22	260.75	91.78
23	269.83	95.96
24	278.78	100.42
25	281.72	102.00

Circle Center At X = 130.09 ; Y = 387.75 ; and Radius = 323.52

Factor of Safety

*** 1.011 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.26	73.00
2	65.02	70.83
3	74.85	68.95
4	84.72	67.38
5	94.64	66.11
6	104.60	65.15
7	114.57	64.50
8	124.57	64.15
9	134.57	64.10
10	144.56	64.37
11	154.55	64.94
12	164.51	65.82
13	174.44	67.00
14	184.33	68.49
15	194.17	70.28
16	203.94	72.37
17	213.65	74.76
18	223.29	77.45
19	232.83	80.44
20	242.28	83.71
21	251.62	87.27
22	260.85	91.12
23	269.96	95.25
24	278.94	99.66
25	283.36	102.00

Circle Center At X = 130.94 ; Y = 389.72 ; and Radius = 325.64

Factor of Safety

*** 1.021 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.68	73.00
2	83.45	70.87
3	93.29	69.08
4	103.19	67.62
5	113.12	66.51
6	123.09	65.74
7	133.09	65.32
8	143.09	65.24
9	153.08	65.50
10	163.06	66.11
11	173.02	67.06
12	182.93	68.36
13	192.80	69.99
14	202.60	71.96
15	212.33	74.28
16	221.98	76.92
17	231.52	79.89
18	240.96	83.20
19	250.28	86.82
20	259.47	90.77
21	268.52	95.02
22	277.42	99.59
23	281.73	102.00

Circle Center At X = 140.42 ; Y = 355.48 ; and Radius = 290.25

Factor of Safety

*** 1.026 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	73.00
2	59.77	70.87
3	69.60	69.02
4	79.48	67.46
5	89.39	66.19
6	99.35	65.21
7	109.32	64.52
8	119.31	64.13
9	129.31	64.02
10	139.31	64.21
11	149.30	64.70
12	159.27	65.47
13	169.21	66.54
14	179.12	67.89
15	188.99	69.54
16	198.80	71.47
17	208.55	73.69
18	218.23	76.19
19	227.83	78.98
20	237.35	82.04
21	246.78	85.38
22	256.10	89.00
23	265.31	92.89
24	274.41	97.04
25	283.38	101.46
26	284.40	102.00

Circle Center At X = 127.83 ; Y = 405.74 ; and Radius = 341.72

Factor of Safety

*** 1.030 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.68	73.00
2	83.47	70.95
3	93.32	69.22
4	103.22	67.82
5	113.17	66.76
6	123.14	66.02
7	133.13	65.61
8	143.13	65.54
9	153.13	65.80
10	163.11	66.39
11	173.07	67.31
12	182.99	68.56
13	192.86	70.14
14	202.68	72.05
15	212.43	74.28
16	222.09	76.84
17	231.67	79.71
18	241.15	82.91
19	250.52	86.41
20	259.76	90.22
21	268.87	94.34
22	277.84	98.76
23	283.90	102.00

Circle Center At X = 140.34 ; Y = 366.57 ; and Radius = 301.05

Factor of Safety

*** 1.036 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	60.53	73.00
2	70.32	70.96
3	80.16	69.21
4	90.06	67.76
5	99.99	66.61
6	109.95	65.75
7	119.94	65.20
8	129.93	64.95
9	139.93	65.01
10	149.93	65.36
11	159.91	66.01
12	169.86	66.97
13	179.78	68.22
14	189.66	69.78
15	199.49	71.63
16	209.25	73.77
17	218.95	76.21
18	228.57	78.94
19	238.11	81.96
20	247.54	85.27
21	256.88	88.86
22	266.10	92.72
23	275.20	96.87
24	284.17	101.28
25	285.52	102.00

Circle Center At X = 133.21 ; Y = 396.63 ; and Radius = 331.69

Factor of Safety

*** 1.045 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	78.95	73.00
2	88.78	71.19
3	98.67	69.70
4	108.60	68.52
5	118.56	67.67
6	128.55	67.14
7	138.55	66.93
8	148.55	67.04
9	158.54	67.48
10	168.51	68.23
11	178.45	69.31
12	188.35	70.71
13	198.20	72.43
14	208.00	74.46
15	217.72	76.81
16	227.36	79.47
17	236.90	82.44
18	246.35	85.71
19	255.69	89.29
20	264.91	93.17
21	274.00	97.34
22	282.95	101.80
23	283.31	102.00

Circle Center At X = 140.04 ; Y = 377.13 ; and Radius = 310.21

Factor of Safety

*** 1.050 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.53	73.00
2	70.27	70.74
3	80.08	68.79
4	89.94	67.17
5	99.86	65.88
6	109.81	64.91
7	119.79	64.27

```
     8         129.79        63.96
     9         139.79        63.97
    10         149.78        64.32
    11         159.76        64.99
    12         169.71        65.99
    13         179.62        67.32
    14         189.48        68.97
    15         199.29        70.95
    16         209.02        73.25
    17         218.67        75.86
    18         228.23        78.79
    19         237.69        82.04
    20         247.04        85.59
    21         256.26        89.45
    22         265.36        93.61
    23         274.31        98.06
    24         281.61       102.00
Circle Center At X =   134.27 ; Y =   368.02 ; and Radius =   304.10
       Factor of Safety
      ***    1.058   ***
          **** END OF GSTABL7 OUTPUT ****
```

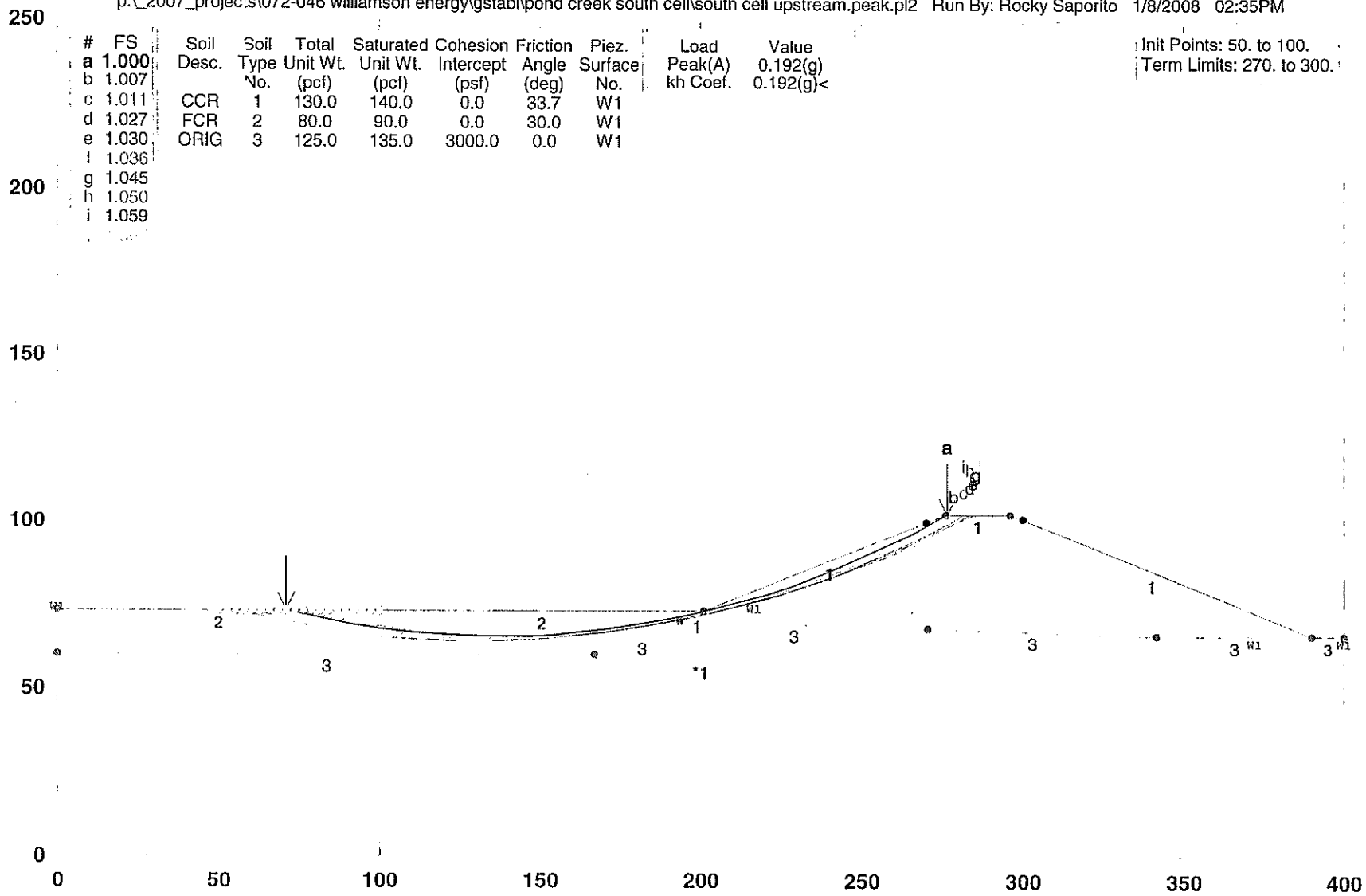
Pond Creek, South Cell, Upstream CEC Project No. 072-046 (80% Peak Str.)

p:_2007_projects\072-046 williamson energy\gstabl\pond creek south cell\south cell upstream.peak.pl2 Run By: Rocky Saporito 1/8/2008 02:35PM

#	FS	Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
a	1.000							
b	1.007							
c	1.011	CCR	1	130.0	140.0	0.0	33.7	W1
d	1.027	FCR	2	80.0	90.0	0.0	30.0	W1
e	1.030	ORIG	3	125.0	135.0	3000.0	0.0	W1
f	1.036							
g	1.045							
h	1.050							
i	1.059							

Load Peak(A) kh Coef. | Value 0.192(g) 0.192(g)<

Init Points: 50. to 100.
Term Limits: 270. to 300.



GSTABL7 v.2 FSmin=1.000

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

R16038

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                    *** GSTABL7 ***
                ** GSTABL7 by Garry H. Gregory, P.E. **
        ** Original Version 1.0, January 1996; Current Version 2.003, June 2002 **
                (All Rights Reserved-Unauthorized Use Prohibited)
    ************************************************************************
                    SLOPE STABILITY ANALYSIS SYSTEM
          Modified Bishop, Simplified Janbu, or GLE Method of Slices.
          (Includes Spencer & Morgenstern-Price Type Analysis)
          Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
          Nonlinear Undrained Shear Strength, Curved Phi Envelope,
          Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
          Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
    ************************************************************************
    Analysis Run Date:        1/8/2008
    Time of Run:              02:35PM
    Run By:                   Rocky Saporito
    Input Data Filename:      P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\south cell upstream.peak.in
    Output Filename:          P:\_2007_Projects\072-046 Williamson Energy\GStabl\Pond Creek
South Cell\south cell upstream.peak.OUT
    Unit System:              English
    Plotted Output Filename:  P:\_2007_Projects\072-046 Willia Energy\GStabl\Pond Creek South
Cell\south cell upstream.peak.PLT
    PROBLEM DESCRIPTION:  Pond Creek, South Cell, Upstream
                          CEC Project No. 072-046 (80% Peak Str.)
    BOUNDARY COORDINATES
        6 Top   Boundaries
       12 Total Boundaries
    Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
       No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
        1          0.00      73.00     100.00      73.00        2
        2        100.00      73.00     200.84      73.00        2
        3        200.84      73.00     276.24     102.00        1
        4        276.24     102.00     296.24     102.00        1
        5        296.24     102.00     389.84      66.00        1
        6        389.84      66.00     400.00      66.00        3
        7          0.00      60.00     167.04      60.00        3
        8        167.04      60.00     193.46      70.16        3
        9        193.46      70.16     200.84      73.00        1
       10        193.46      70.16     270.39      68.00        3
       11        270.39      68.00     341.70      66.00        3
       12        341.70      66.00     389.84      66.00        3
    Default Y-Origin = 0.00(ft)
    Default X-Plus Value = 0.00(ft)
    Default Y-Plus Value = 0.00(ft)
   ISOTROPIC SOIL PARAMETERS
     3 Type(s) of Soil
    Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
    Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
     No.  (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)     No.
      1   130.0    140.0       0.0     33.7    0.00       0.0      1
      2    80.0     90.0       0.0     30.0    0.00       0.0      1
      3   125.0    135.0    3000.0      0.0    0.00       0.0      1
    1 PIEZOMETRIC SURFACE(S) SPECIFIED
    Unit Weight of Water =  62.40 (pcf)
    Piezometric Surface No.  1 Specified by  4 Coordinate Points
    Pore Pressure Inclination Factor =  0.50
      Point      X-Water    Y-Water
       No.         (ft)       (ft)
        1          0.00      76.00
        2        216.44      76.00
        3        371.84      66.00
        4        400.00      66.00
   Searching Routine Will Be Limited To An Area Defined By  1 Boundaries
    Of Which The First  1 Boundaries Will Deflect Surfaces Upward
    Boundary     X-Left     Y-Left     X-Right    Y-Right
       No.        (ft)       (ft)       (ft)       (ft)
```

```
    1          0.00      58.00     400.00      58.00
 Specified Peak Ground Acceleration Coefficient (A) =   0.192(g)
 Specified Horizontal Earthquake Coefficient (kh) =   0.192(g)
 Specified Vertical Earthquake Coefficient (kv) =   0.000(g)
 Specified Seismic Pore-Pressure Factor =   0.000
 A Critical Failure Surface Searching Method, Using A Random
 Technique For Generating Circular Surfaces, Has Been Specified.
  400 Trial Surfaces Have Been Generated.
   20 Surface(s) Initiate(s) From Each Of    20 Points Equally Spaced
 Along The Ground Surface Between  X =  50.00(ft)
                              and  X = 100.00(ft)
 Each Surface Terminates Between   X = 270.00(ft)
                              and  X = 300.00(ft)
 Unless Further Limitations Were Imposed, The Minimum Elevation
 At Which A Surface Extends Is  Y =      0.00(ft)
 10.00(ft) Line Segments Define Each Trial Failure Surface.
 Following Are Displayed The Ten Most Critical Of The Trial
       Failure Surfaces Evaluated. They Are
       Ordered - Most Critical First.
       * * Safety Factors Are Calculated By The Modified Bishop Method * *
       Total Number of Trial Surfaces Evaluated =   400
       Statistical Data On All Valid FS Values:
          FS Max =   6.036   FS Min =   1.000   FS Ave =   3.117
          Standard Deviation =    1.310   Coefficient of Variation =   42.04 %
       Failure Surface Specified By 23 Coordinate Points
         Point      X-Surf      Y-Surf
          No.        (ft)        (ft)
           1         71.05       73.00
           2         80.83       70.88
           3         90.67       69.11
           4        100.56       67.68
           5        110.51       66.59
           6        120.48       65.86
           7        130.47       65.47
           8        140.47       65.44
           9        150.47       65.75
          10        160.44       66.41
          11        170.39       67.42
          12        180.30       68.78
          13        190.15       70.49
          14        199.94       72.54
          15        209.65       74.92
          16        219.27       77.65
          17        228.79       80.71
          18        238.20       84.11
          19        247.48       87.83
          20        256.63       91.87
          21        265.63       96.23
          22        274.47      100.90
          23        276.39      102.00
       Circle Center At X =   136.50 ; Y =   351.34 ; and Radius =   285.93
             Factor of Safety
            ***    1.000   ***
          Individual data on the    27  slices
                     Water  Water     Tie     Tie     Earthquake
                     Force  Force     Force   Force      Force    Surcharge
Slice  Width  Weight  Top    Bot     Norm    Tan     Hor    Ver     Load
 No.    (ft)   (lbs)  (lbs)  (lbs)   (lbs)   (lbs)   (lbs)  (lbs)   (lbs)
  1      9.8    931.6 1829.5 2532.9      0.      0.   178.5    0.0     0.0
  2      9.8   2662.5 1842.3 3747.8      0.      0.   510.1    0.0     0.0
  3      9.3   3837.1 1747.2 4453.3      0.      0.   735.2    0.0     0.0
  4      0.6    268.2  105.6  294.6      0.      0.    51.4    0.0     0.0
  5      9.9   5247.9 1861.0 5532.1      0.      0.  1005.5    0.0     0.0
  6     10.0   6080.6 1866.9 6099.3      0.      0.  1165.0    0.0     0.0
  7     10.0   6596.4 1870.6 6448.9      0.      0.  1263.9    0.0     0.0
  8     10.0   6791.0 1872.0 6580.5      0.      0.  1301.2    0.0     0.0
  9     10.0   6662.9 1871.1 6493.9      0.      0.  1276.6    0.0     0.0
```

10	10.0	6213.0	1867.9	6189.2	0.	0.	1190.4	0.0	0.0
11	9.9	5445.1	1862.4	5666.7	0.	0.	1043.3	0.0	0.0
12	9.9	4365.7	1854.6	4927.2	0.	0.	836.5	0.0	0.0
13	9.9	2983.8	1844.6	3971.5	0.	0.	571.7	0.0	0.0
14	9.1	1278.6	1705.8	2648.5	0.	0.	245.0	0.0	0.0
15	0.7	34.6	126.5	152.3	0.	0.	6.6	0.0	0.0
16	0.9	36.8	168.2	193.7	0.	0.	7.0	0.0	0.0
17	8.8	1053.6	769.1	1222.8	0.	0.	201.9	0.0	0.0
18	3.8	837.6	0.0	132.3	0.	0.	160.5	0.0	0.0
19	5.8	1623.5	0.0	0.0	0.	0.	311.1	0.0	0.0
20	9.5	3388.3	0.0	0.0	0.	0.	649.2	0.0	0.0
21	9.4	3852.5	0.0	0.0	0.	0.	738.1	0.0	0.0
22	9.3	3847.2	0.0	0.0	0.	0.	737.1	0.0	0.0
23	9.1	3390.5	0.0	0.0	0.	0.	649.6	0.0	0.0
24	9.0	2504.2	0.0	0.0	0.	0.	479.8	0.0	0.0
25	8.8	1213.9	0.0	0.0	0.	0.	232.6	0.0	0.0
26	1.8	58.3	0.0	0.0	0.	0.	11.2	0.0	0.0
27	0.1	0.8	0.0	0.0	0.	0.	0.2	0.0	0.0

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.32	73.00
2	86.09	70.88
3	95.93	69.12
4	105.83	67.70
5	115.78	66.65
6	125.75	65.94
7	135.74	65.60
8	145.74	65.61
9	155.74	65.98
10	165.71	66.71
11	175.65	67.79
12	185.55	69.23
13	195.39	71.03
14	205.15	73.17
15	214.84	75.66
16	224.43	78.49
17	233.91	81.67
18	243.27	85.18
19	252.51	89.03
20	261.59	93.20
21	270.53	97.70
22	278.37	102.00

Circle Center At X = 140.38 ; Y = 345.04 ; and Radius = 279.48

Factor of Safety

*** 1.007 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.26	73.00
2	65.03	70.84
3	74.85	68.98
4	84.73	67.42
5	94.65	66.17
6	104.61	65.23
7	114.59	64.60
8	124.58	64.27
9	134.58	64.26
10	144.58	64.55
11	154.56	65.15
12	164.52	66.06
13	174.44	67.28
14	184.33	68.81
15	194.16	70.64
16	203.93	72.77
17	213.63	75.20
18	223.25	77.93

19	232.78	80.96
20	242.21	84.28
21	251.54	87.89
22	260.75	91.78
23	269.83	95.96
24	278.78	100.42
25	281.72	102.00

Circle Center At X = 130.09 ; Y = 387.75 ; and Radius = 323.52

Factor of Safety

*** 1.011 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.26	73.00
2	65.02	70.83
3	74.85	68.95
4	84.72	67.38
5	94.64	66.11
6	104.60	65.15
7	114.57	64.50
8	124.57	64.15
9	134.57	64.10
10	144.56	64.37
11	154.55	64.94
12	164.51	65.82
13	174.44	67.00
14	184.33	68.49
15	194.17	70.28
16	203.94	72.37
17	213.65	74.76
18	223.29	77.45
19	232.83	80.44
20	242.28	83.71
21	251.62	87.27
22	260.85	91.12
23	269.96	95.25
24	278.94	99.66
25	283.36	102.00

Circle Center At X = 130.94 ; Y = 389.72 ; and Radius = 325.64

Factor of Safety

*** 1.027 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	73.00
2	59.77	70.87
3	69.60	69.02
4	79.48	67.46
5	89.39	66.19
6	99.35	65.21
7	109.32	64.52
8	119.31	64.13
9	129.31	64.02
10	139.31	64.21
11	149.30	64.70
12	159.27	65.47
13	169.21	66.54
14	179.12	67.89
15	188.99	69.54
16	198.80	71.47
17	208.55	73.69
18	218.23	76.19
19	227.83	78.98
20	237.35	82.04
21	246.78	85.38
22	256.10	89.00
23	265.31	92.89

24	274.41	97.04
25	283.38	101.46
26	284.40	102.00

Circle Center At X = 127.83 ; Y = 405.74 ; and Radius = 341.72

Factor of Safety

*** 1.030 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.68	73.00
2	83.47	70.95
3	93.32	69.22
4	103.22	67.82
5	113.17	66.76
6	123.14	66.02
7	133.13	65.61
8	143.13	65.54
9	153.13	65.80
10	163.11	66.39
11	173.07	67.31
12	182.99	68.56
13	192.86	70.14
14	202.68	72.05
15	212.43	74.28
16	222.09	76.84
17	231.67	79.71
18	241.15	82.91
19	250.52	86.41
20	259.76	90.22
21	268.87	94.34
22	277.84	98.76
23	283.90	102.00

Circle Center At X = 140.34 ; Y = 366.57 ; and Radius = 301.05

Factor of Safety

*** 1.036 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.53	73.00
2	70.32	70.96
3	80.16	69.21
4	90.06	67.76
5	99.99	66.61
6	109.95	65.75
7	119.94	65.20
8	129.93	64.95
9	139.93	65.01
10	149.93	65.36
11	159.91	66.01
12	169.86	66.97
13	179.78	68.22
14	189.66	69.78
15	199.49	71.63
16	209.25	73.77
17	218.95	76.21
18	228.57	78.94
19	238.11	81.96
20	247.54	85.27
21	256.88	88.86
22	266.10	92.72
23	275.20	96.87
24	284.17	101.28
25	285.52	102.00

Circle Center At X = 133.21 ; Y = 396.63 ; and Radius = 331.69

Factor of Safety

*** 1.045 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	78.95	73.00
2	88.78	71.19
3	98.67	69.70
4	108.60	68.52
5	118.56	67.67
6	128.55	67.14
7	138.55	66.93
8	148.55	67.04
9	158.54	67.48
10	168.51	68.23
11	178.45	69.31
12	188.35	70.71
13	198.20	72.43
14	208.00	74.46
15	217.72	76.81
16	227.36	79.47
17	236.90	82.44
18	246.35	85.71
19	255.69	89.29
20	264.91	93.17
21	274.00	97.34
22	282.95	101.80
23	283.31	102.00

Circle Center At X = 140.04 ; Y = 377.13 ; and Radius = 310.21

Factor of Safety

*** 1.050 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.68	73.00
2	83.45	70.87
3	93.29	69.08
4	103.19	67.62
5	113.12	66.51
6	123.09	65.74
7	133.09	65.32
8	143.09	65.24
9	153.08	65.50
10	163.06	66.11
11	173.02	67.06
12	182.93	68.36
13	192.80	69.99
14	202.60	71.96
15	212.33	74.28
16	221.98	76.92
17	231.52	79.89
18	240.96	83.20
19	250.28	86.82
20	259.47	90.77
21	268.52	95.02
22	277.42	99.59
23	281.73	102.00

Circle Center At X = 140.42 ; Y = 355.48 ; and Radius = 290.25

Factor of Safety

*** 1.059 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	84.21	73.00
2	94.05	71.22
3	103.94	69.76
4	113.88	68.62
5	123.85	67.80
6	133.83	67.31
7	143.83	67.15

8	153.83	67.30
9	163.82	67.78
10	173.79	68.59
11	183.72	69.72
12	193.62	71.17
13	203.46	72.94
14	213.24	75.03
15	222.94	77.43
16	232.57	80.15
17	242.10	83.18
18	251.52	86.52
19	260.84	90.16
20	270.03	94.10
21	279.08	98.34
22	286.28	102.00

Circle Center At X = 143.98 ; Y = 375.04 ; and Radius = 307.90

Factor of Safety

*** 1.067 ***

**** END OF GSTABL7 OUTPUT ****

APPENDIX D-2

ESTIMATING THE INDUCED CYCLIC SHEAR STRESSES AND STRAINS, AND TIME-HISTORY OF CYCLIC SHEAR STRESS, SHAKE COLUMNS PCSC300E AND PCSC300M

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Induced Cyclic Shear Stresses and Strains, and Time Histories of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M PAGE 1 OF 187

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CALCULATION BRIEF
FOR
INDUCED CYCLIC SHEAR STRESSES AND STRAINS, AND TIME-HISTORIES OF CYCLIC SHEAR STRESS SHAKE COLUMNS PCSC300E AND PCSC300M

POND CREEK COAL REFUSE DISPOSAL SITE - SOUTH CELL

OBJECTIVE: Estimate the induced cyclic shear stresses and shear strains for the proposed Pond Creek South Cell crest SHAKE2000 (Ordonez G., 2006) column location (PCSC300). Also, generate time histories of cyclic shear stress for the various layers which will be used as input for estimating permanent deformations.

METHODOLOGY: Induced cyclic shear stresses with depth are estimated using program SHAKE (Schnabel et al., 1972) and SHAKE2000. Input to each SHAKE2000 column includes layer stratigraphy and unit weights, initial shear modulus (G) with depth, which were obtained/correlated from site specific, in-situ field testing (Reference 2), correlated modulus and damping degradation curves (Reference 3) for coarse, refuse and residual soil, and synthetic acceleration-time earthquake records (Reference 5) representing maximum design earthquake (MDE) scenarios.

As shown in Figure 3 of the permanent deformation evaluation report, maximum induced cyclic shear stresses are estimated at a crest column location, designated PCSC300, for the critical South Cell embankment/impoundment cross-section geometry and for two (2) MDE scenarios. The crest column location PCSC300 includes phreatic levels associated with the end of construction (E) condition, i.e., minimum fines elevation (El.) at 474, and the maximum fines (M) condition at El. 496.

Attached to this calculation brief are hard copies of the SHAKE2000 output files and plots of cyclic shear stress time histories (for all layers within the SHAKE column) for each of the (synthetic) MDE earthquakes scenarios including an M6.8 Background (at 13.5 km) and M8.0 New Madrid (at 83 km). Synthetic time histories were scaled to the Pond Creek peak ground accelerations (PGA) of 0.54g (References 5 and 6). The SHAKE2000 time histories of shear stress for each column become the input for (Newmark, 1965) permanent deformation analyses subsequently described in Appendix D, Attachment D-3.

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Induced Cyclic Shear Stresses and Strains, and Time Histories PAGE 2 OF 187

of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M

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REFERENCES:

1. Schnabel, P. B., Lysmer, J. and Seed, H. B. (1972) "SHAKE: A Computer Program for Earthquake Response Analysis of Horizontally Layered Sites," Report No. EERC 72-12, University of California, Berkeley.

2. Ordonez, Gustavo A.(2006) "SHAKE2000: A Computer Program for the 1-D Analysis of Geotechnical Earthquake Engineering Problems," February 2006.

3. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Shear Modulus Calculations for SHAKE Columns PCSC300E and PCSC300M," Pond Creek Coal Refuse Disposal Site – South Cell " BEG, 12/28/07.

4. Ellison, R. D. and Cho, Y. Y. (1976) "Dynamic Design Considerations of Loose Fine Coal Refuse," E. D'Appolonia Consulting Engineers, Inc., Proceedings of the Ohio River Soils Seminar, Lexington, Kentucky, October, 1976.

5. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Deterministic Seismic Hazard Assessment, Pond Creek Coal Refuse Disposal Site," BEG, 1/2/08.

6. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Comparative Assessment of Synthetic Eastern U.S. and PEER Database (Actual) Western U.S. Earthquake Records, Acceleration Time Histories and Response Spectra," Pond Creek Coal Refuse Disposal Site," BEG, 1/3/08.

7. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimating Shear Modulus and Damping Versus Shear Strain (Modulus and Damping Degradation) for Refuse, Soil and Rock," BEG, 1/2/08.

8. Castro, G. (1987) "On the Behavior of Soils During Earthquakes – Liquefaction,' Soil Dynamics and Liquefaction, A.S. Cakmak, Editor, Elsevier.

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PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Induced Cyclic Shear Stresses and Strains, and Time Histories of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M

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INDUCED CYCLIC SHEAR STRESSES AND STRAINS

SHAKE 2000 INPUT SUMMARY:

Analyses were performed using the computer program SHAKE2000 (Ordonez, 2006), a computer program for the 1-dimensional analysis of geotechnical earthquake engineering problems, which integrates SHAKE (Schnabel et al., 1972) and SHAKE91 (Idriss, I.M. and Sun, J.I., 1992) with ShakEdit (Ordonez, G., 2006) a pre- and post-processor for SHAKE and SHAKE91. SHAKE2000 utilizes a one-dimensional analysis for the vertical propagation of shear waves from the bedrock layer up through the soil profile, which is modeled as a series of horizontal layers, to estimate the maximum cyclic shear stress and strain with depth for the Pond Creek South Cell impoundment at a user-defined (PCSC300) column location along a maximum cross section of the embankment.

Synthetic acceleration-time histories of the MDE scenarios, an M6.8 Background (at 13.5 km) and M8.0 New Madrid, Missouri (at 83 km) generated in Reference 6 were scaled to the Pond Creek MDE PGA of 0.54 g determined in Reference 5. Initial shear modulus (G) values determined as a function of the measured shear wave velocities with depth (Reference 3) were used to simulate the ground shaking and embankment response.

The modulus and damping reduction curves used in the analyses were from published references/relationships presented in Reference 7 for the coarse refuse, residual soil and rock materials. The shear modulus and damping ratios versus cyclic shear strain curves from SHAKE2000 were utilized for the coarse (gravel) and residual soil (clay) materials.

Regarding pore pressures, it should be noted that at strains above approximately 0.01 percent, there are pore pressure increases in the resonant column tests (see Castro, 1987, Figure 3), and the measured values of shear modulus do reflect the pore pressure increase. Since the pore pressure increases are a function of the number of cycles, the modulus reduction curves are also a function of the number of cycles that are applied before the modulus is measured. Although pore pressures are not explicitly modeled in SHAKE, they are implicitly accounted for in the shear modulus degradation relationships used as input.

RESULTS SUMMARY:

Figure 3 presents the relative location of the South Cell crest (PCSC300) SHAKE column. Reference 3 presents the corresponding layer geometry and input information, including material type, unit weight, ground water depth, sub-layer thicknesses, and average initial G-value for each sub-layer. The maximum induced horizontal cyclic shear stresses estimated at the midpoint of each layer are presented with depth for the Pond Creek SHAKE2000 columns PCSC300E and PCSC300M and MDE scenarios,

and are attached to this calculation brief. SHAKE2000 output files for each of these columns and each of the MDEs are also attached. Again note that the E and M designation for the crest Pond Creek SHAKE2000 column location correspond to "End of construction," i.e., minimum fines level, and "Maximum" fines level for the proposed South Cell impoundment.

In general, the maximum induced cyclic shear stresses for all materials estimated at the midpoint of each layer varying from about 204 to 1562 psf for the M6.8 Background MDE, and are similar for the M8.0 New Madrid MDE, varying from about 198 to 2503 psf. The estimated induced cyclic strains are generally low from less than 0.1 to 0.22 percent. The cyclic strain threshold, conservatively assumed to be about 0.25 percent, is the lowest threshold strain anticipated for a "clean sand." (Reference 9). Therefore, the estimated maximum induced strains do not exceed the most conservative threshold strain for both MDE earthquake scenarios.

The mean square frequency of the M6.8 Background earthquake is 20.4 and 14.6 Hz for the M8.0 MDE scenario. The average fundamental frequencies of the SHAKE2000 columns are similar, ranging from about 3.70 to 4.35 Hertz for each columns and MDE scenario. Values for each of the 10 trials are tabulated in the attached SHAKE2000 results summary. Due to the large difference in frequency content between the low frequency SHAKE columns to the high frequency Eastern North American earthquake scenarios, low cyclic shear stresses and strains are induced to the soil columns and corresponding low accelerations within the critical layers. The percentage of acceleration within the critical layer to that of the base acceleration is lower for the M6.8 earthquake due to its higher mean square frequency. In other words, while the input acceleration is high for the "Background" MDE (Amax = 0.54 g), most of its energy is in the high frequency range and only a fraction of the induced base acceleration affects the critical layer.

Maximum cyclic shear stresses induced at any time during the time history by the input acceleration range following iterations to achieve strain compatible properties are shown in the attached plots for each of the soil columns. A comparison of the average cyclic shear stress (taken as 0.65 times the maximum cyclic shear stress) using the initial shear modulus values was evaluated, and there is good agreement in the stress magnitudes between the maximum and average shear stress values for the initial and final iterations, respectively.

SHAKE2000 analyses results also allow for estimating the deformations accumulated in the coarse refuse and residual soil layers. All layers were evaluated to envelope representing downstream, crest and upstream conditions during MDE earthquake loadings. A Newmark-type analysis (Newmark, 1965) will subsequently be performed to estimate permanent deformations of the potential sliding mass in all layers. The basic assumption in this type of analysis is that displacements are initiated only when the earthquake-induced accelerations of the potential sliding mass exceed the yield acceleration of the mass. Consequently, time histories of horizontal shear stresses (Option 7) at all layers are saved for subsequent

permanent deformation analyses. Plots of time histories of (horizontal) shear stress for each column and critical layer are attached for information.

CONCLUSION

Based on the information presented in this calculation brief, maximum induced cyclic shear stresses and strains for SHAKE2000 columns PCSC300E and PCSC300M, with depth were estimated from 1-D wave propagation analyses, which utilized shear modulus and damping degradation curves for coarse coal refuse, residual soils and rock, and acceleration-time histories for the two (2) synthetic MDE scenarios including the M6.8 Background and M8.0 New Madrid earthquakes. Copies of the SHAKE2000 output and plots of shear stress time histories are presented herein.

Based on the results of these analyses, a separate analysis will be performed using the time histories of shear stresses at the various layers to estimate the earthquake-induced deformation of the South Cell embankment (Appendix D, Attachments D-1 and D-3).

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PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Induced Cyclic Shear Stresses and Strains, and Time Histories PAGE 6 OF 187

of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M

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CALCULATION BRIEF
FOR

ESTIMATING SHEAR MODULUS AND DAMPING VERSUS SHEAR STRAIN (MODULUS AND DAMPING DEGREDATION) FOR REFUSE, SOIL AND ROCK

POND CREEK COAL REFUSE DISPOSAL SITE - SOUTH CELL (IN ITS ENTIRETY)

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PROJECT Williamson Energy Pond Creek Deformation Evaluation PROJECT NO. 072046

Estimating Shear Modulus and Damping Versus Shear Strain (Modulus and Damping Degradation) PAGE 7 OF 187

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CALCULATION BRIEF FOR

ESTIMATING SHEAR MODULUS AND DAMPING VERSUS SHEAR STRAIN (MODULUS AND DAMPING DEGREDATION) FOR REFUSE, SOIL AND ROCK

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE: Present shear modulus (G) and damping (D) versus shear strain (γ) degradation relationships normalized to small strain shear modulus (Gmax) at $\gamma = 0.001$ percent and damping for use in SHAKE2000 for the following materials:

- Fine coal refuse, as defined by Ellison and Cho (1976);
- Coarse coal refuse and coarse/fine coal refuse mix: Gravel (Mean), as defined by Rollins et al. JGGE, Vol. 124, No. 5, May 1998;
- Embankment soil with assumed PI=15% and Effective Confining Pressure = 4 atm., as defined by Darendeli, M. (2001); and
- Rock, as defined by Schnabel, 1973.

Coarse coal refuse, coarse/fine refuse mix, embankment soils and rock degradation relationships from cited references and contained as input within SHAKE2000.

REFERENCES:

1. Ellison, R. D. and Cho, Y. Y. (1976) "Dynamic Design Considerations of Loose Fine Coal Refuse," E. D'Appolonia Consulting Engineers, Inc., Proceedings of the Ohio River Soils Seminar, Lexington, Kentucky, October, 1976.

2. Rollins, K.M.; Evens, M.D.; Diehl, N.B. and Daily, W.D. III. (1998) "Shear Modulus and Damping Relationships for Gravels," Journal of Geotechnical and Geoenvironmental Engineering, Vol. 124, No. 5, pp. 396 – 405, May 1998.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation PROJECT NO. 072046

Estimating Shear Modulus and Damping Versus Shear Strain (Modulus and Damping Degradation) PAGE 8 OF 187

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3. Darendeli, M. (2001) "Development of a New Family of Normalized Modulus Reduction and Material Damping Curves," Ph.D. Dissertation, The University of Texas at Austin, August 2001.

4. Schnabel, P.B. (1973) "Effects of Local Geology and Distance From Source on Earthquake Ground Motions," Ph.D. Thesis, University of California, Berkeley, California.

5. Schnabel, P. B., Lysmer, J. and Seed, H. B. (1972) "SHAKE: A Computer Program for Earthquake Response Analysis of Horizontally Layered Sites," Report No. EERC 72-12, University of California, Berkeley.

6. Ordonez, Gustavo A.(2006) "SHAKE2000: A Computer Program for the 1-D Analysis of Geotechnical Earthquake Engineering Problems," February 2006.

SHAKE2000 allows for the use of existing shear modulus and damping degradation relationships for various materials from corresponding published references. Also, SHAKE2000 allows for the input of material specific shear modulus and damping degradation relationships. Therefore, as previously noted, coarse coal refuse, coarse/fine coal refuse mix, embankment soils and rock material types encountered at the site utilize existing published degradation relationships contained within SHAKE2000.

Shear modulus and damping degradation relationships for fine coal refuse were input into SHAKE2000 based on resonant column laboratory testing defined by Ellison & Cho (1976) and shown on the following pages. Finally, all shear modulus and damping degradation curves were plotted in SHAKE2000 and attached to this calculation brief.

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Induced Cyclic Shear Stresses and Strains, and Time Histories of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M

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MDE SYNTHETIC TIME HISTORIES FROM REFERENCE 6

M6.8 BACKGROUND (AT 13.5 KM) AND M8.0 NEW MADRID, MISSOURI (AT 83 KM)

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Induced Cyclic Shear Stresses and Strains, and Time Histories PAGE 10 OF 187

of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M

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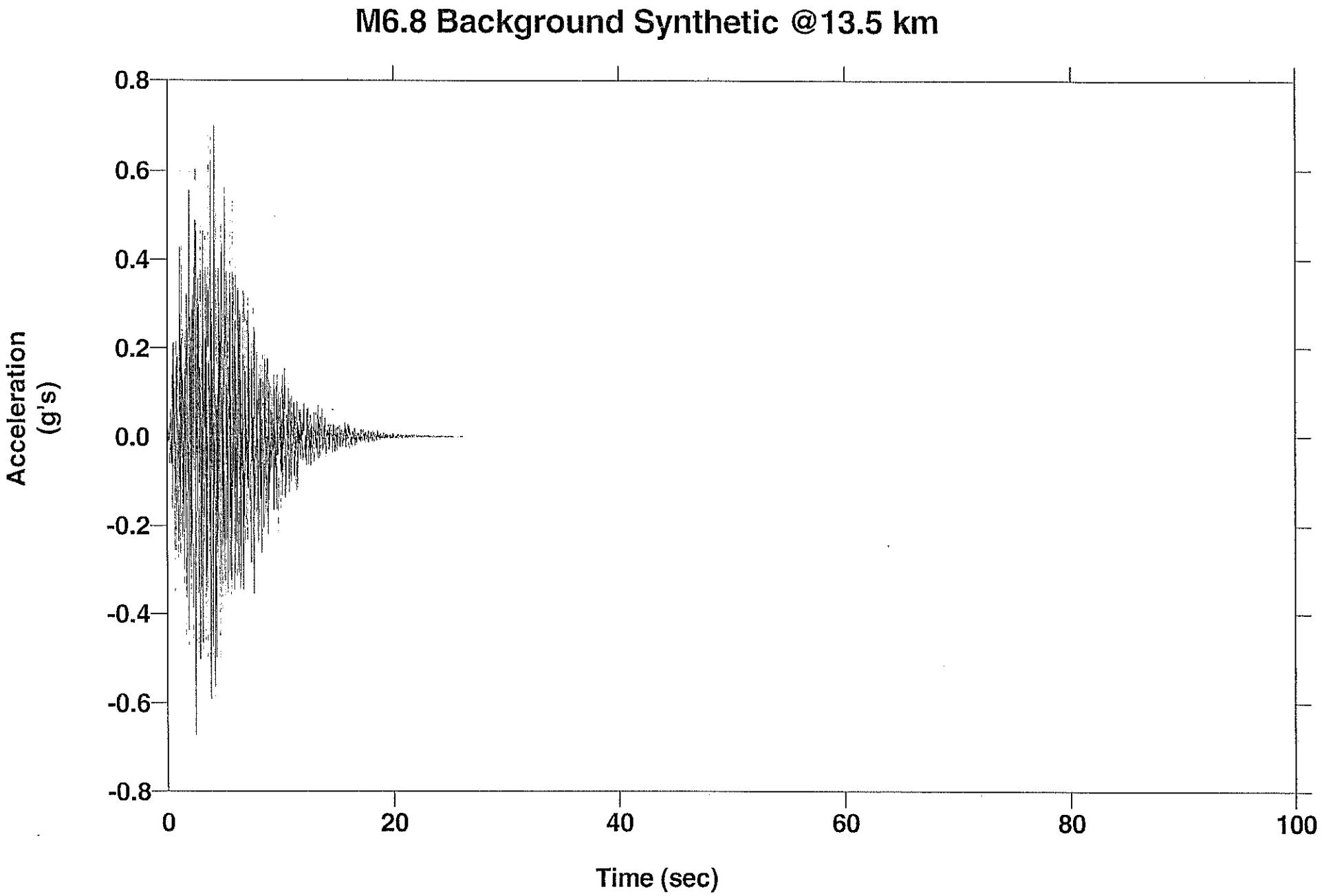
SUMMARY OF EARTHQUAKE INDUCED CYCLIC SHEAR STRESS AND STRAIN SHAKE2000 ANALYSES OUTPUT FILES FOR M6.8 BACKGROUND MDE AT 13.5 KM SHAKE2000 COLUMN PCSC300E

PSCS300E Crest Column
Williamson - Pond Creek South Cell - Surf. El. 502, GWT 32 ft., Fines El. 474
M6.8 Background Synthetic @13.5km, PGA=0.54g, Atkinson & Boore (1995)

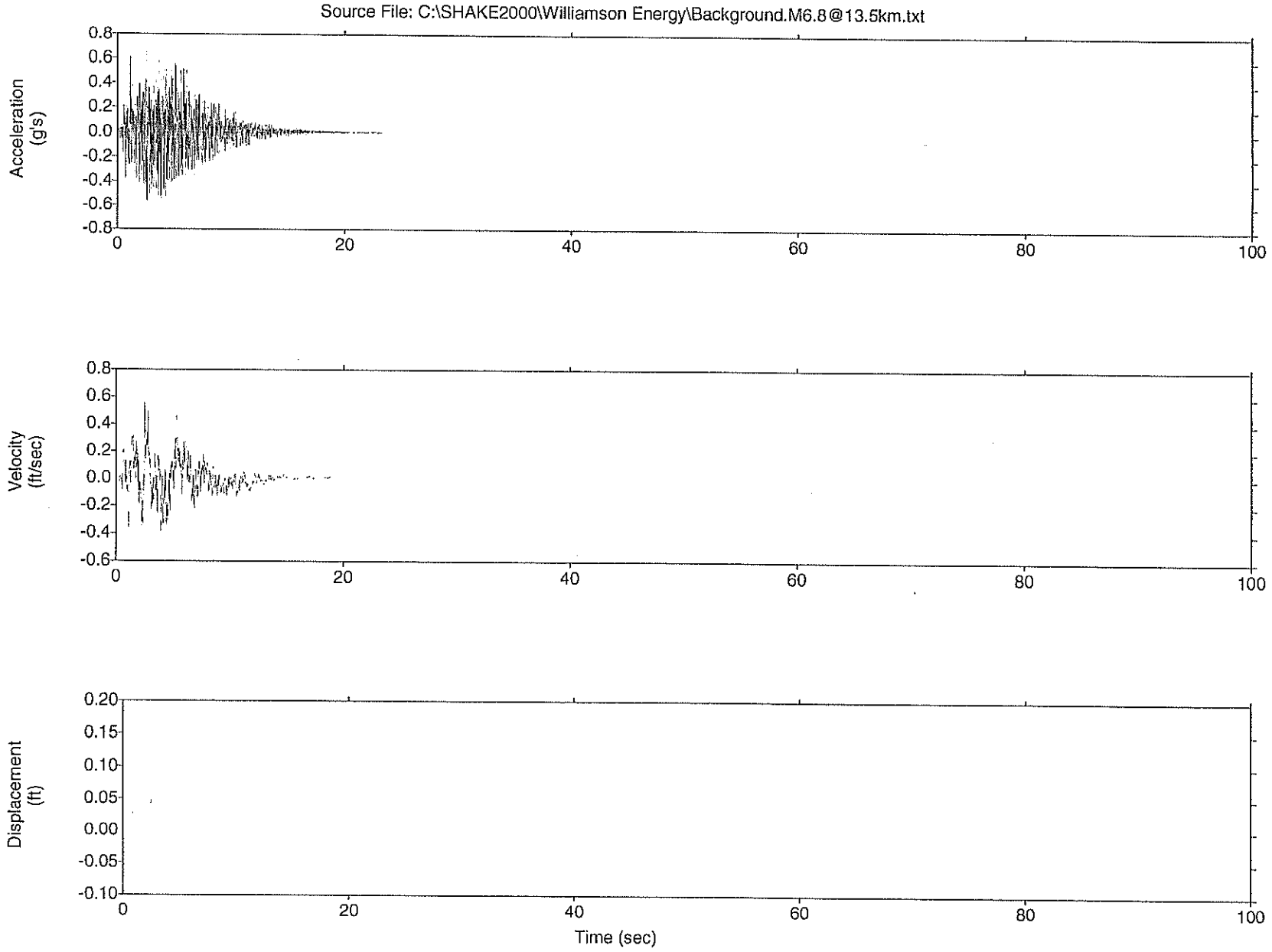
Layer	Depth to Middle of Layer (ft)	Total Unit Weight (kcf)	Damping Used (%)	Shear Modulus (ksf)	Maximum Shear Strain (%)	Maximum Shear Stress (psf)	Shear Wave Velocity (fps)	Depth to Top of Layer (ft)	Peak Acceleration (g)	G/Gmax Curve	Damping Curve
1	2	.13	2.7	2996.3	.0068	203.83	861.4874	0	.78263	Coarse	Coarse
2	5.5	.13	4.2	2804.3	.01795	503.32	833.4288	4	.62639	Coarse	Coarse
3	8.5	.13	4.8	2812.7	.02277	640.4	834.6761	7	.49396	Coarse	Coarse
4	11.5	.13	4.3	4166.6	.01807	752.8	1015.891	10	.51802	Coarse	Coarse
5	14.5	.13	5.3	3185	.02941	936.76	888.2004	13	.56972	Coarse	Coarse
6	17.5	.13	6.4	2588.7	.04238	1097.16	800.7504	16	.59373	Coarse	Coarse
7	20.5	.13	6.4	2834	.04242	1202.23	837.8306	19	.52701	Coarse	Coarse
8	23.5	.13	7.2	2302.3	.05493	1264.58	755.157	22	.56754	Coarse	Coarse
9	26.5	.13	6.6	2719.3	.04621	1256.7	820.7007	25	.50592	Coarse	Coarse
10	30	.13	6.4	2870.6	.04262	1223.56	843.2233	28	.54159	Coarse	Coarse
11	33.5	.135	5.5	1945.3	.05937	1154.87	681.1682	32	.72089	Residual	Residual
12	36.5	.135	5.6	1928.5	.06194	1194.58	678.2205	35	.6694	Residual	Residual
13	39.5	.135	5.4	2210.5	.05733	1267.25	726.1165	38	.81377	Residual	Residual
14	42.5	.135	4.7	2928	.04645	1360.19	835.6926	41	.68058	Residual	Residual
15	45.5	.135	3.3	5695.1	.0273	1554.78	1165.499	44	.53553	Residual	Residual
16	48.5	.135	3.4	5544.8	.02986	1655.45	1150.016	47	.48479	Residual	Residual
17	Base							50	.48665		
17	Outcrop							50	.55791		

Notes:
Period for Soil Column: .23 sec
Average Shear Wave Velocity for Soil Column: 858 ft/sec

R16057


M6.8 Background Synthetic @13.5 km
Acceleration (g's)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0
20
40
60
80
100
Time (sec)

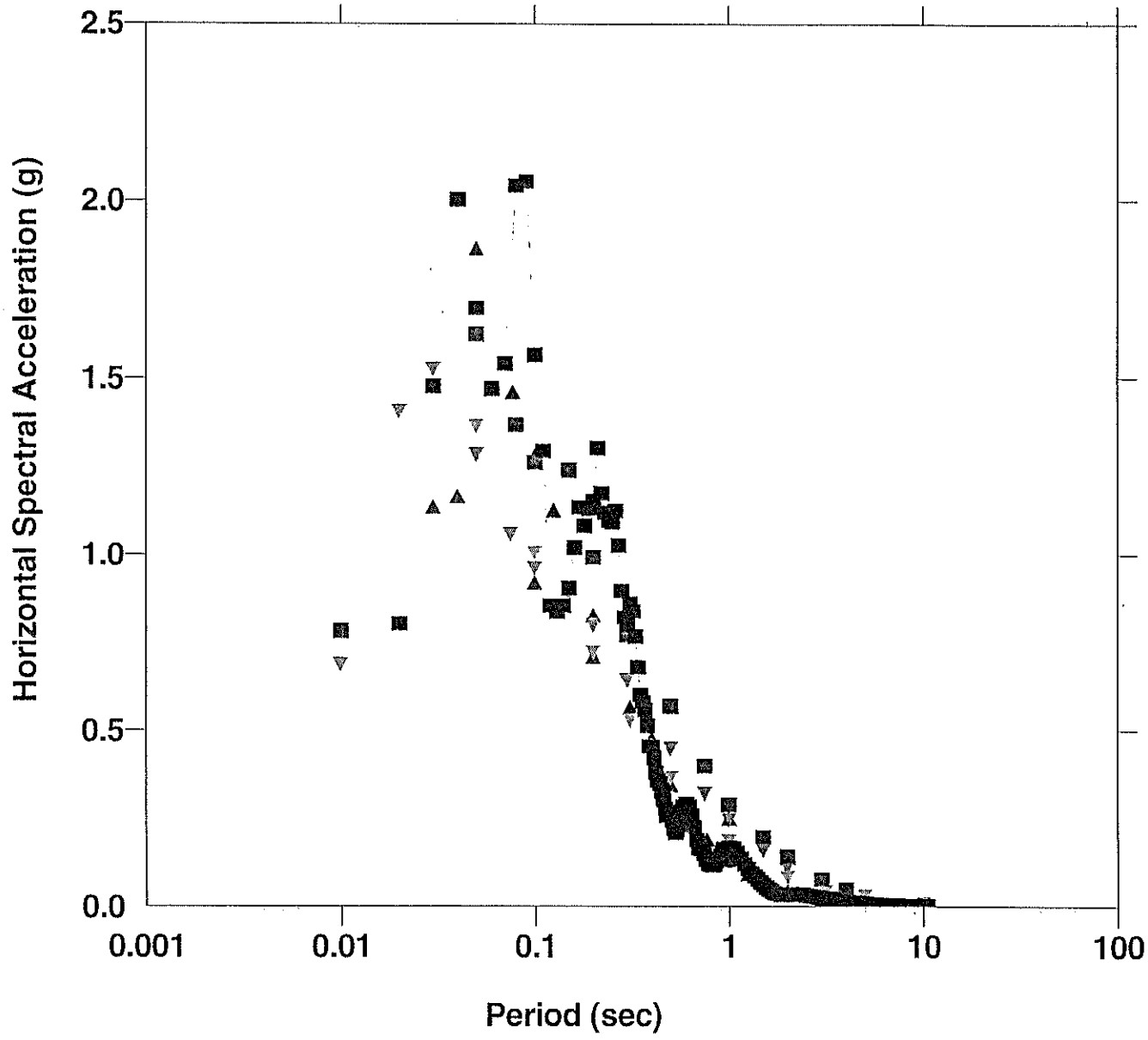
R16058



15 of 18

R16059

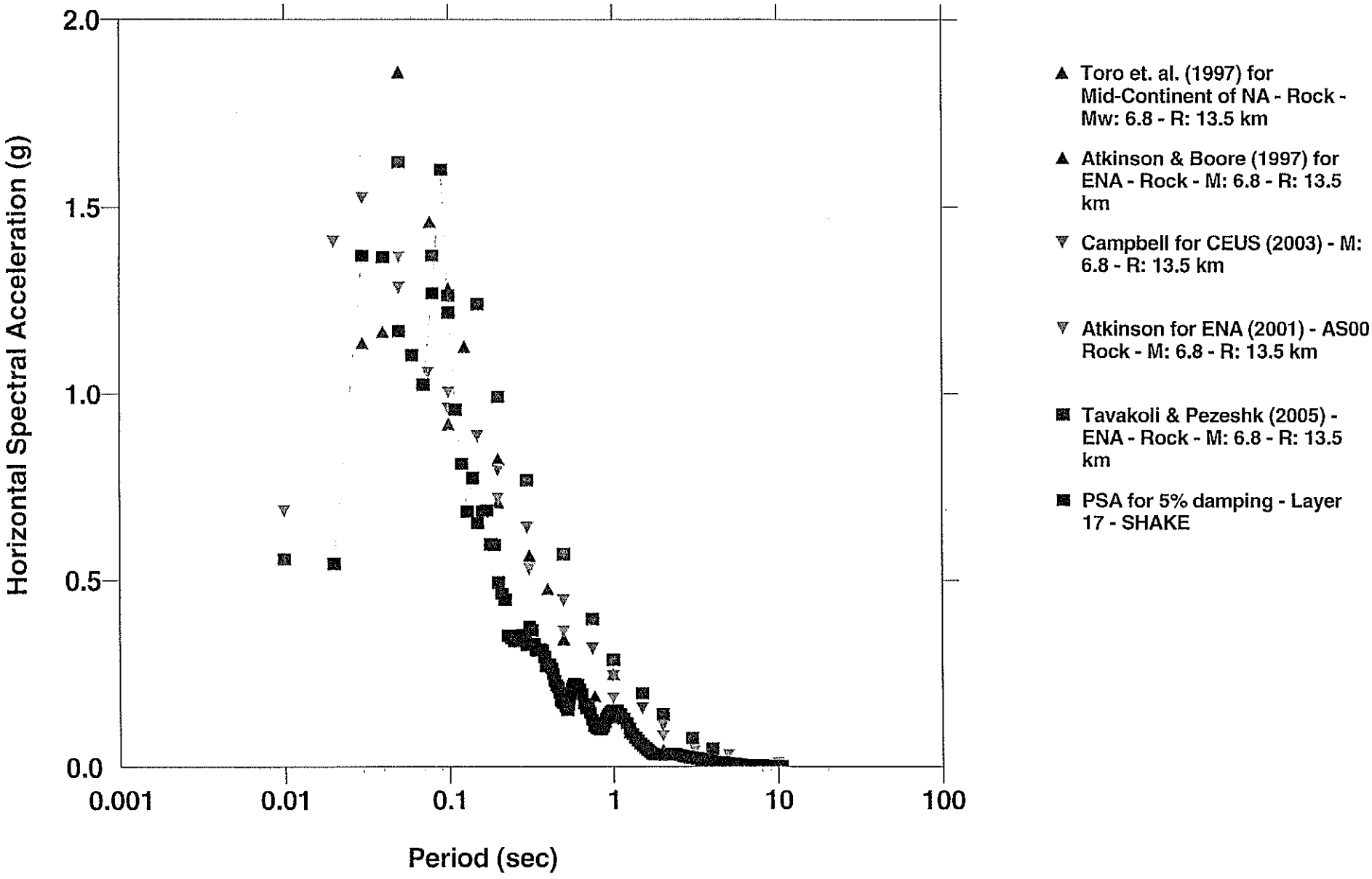
PSCS300E Crest Column - M6.8 Background Synthetic @13.5km



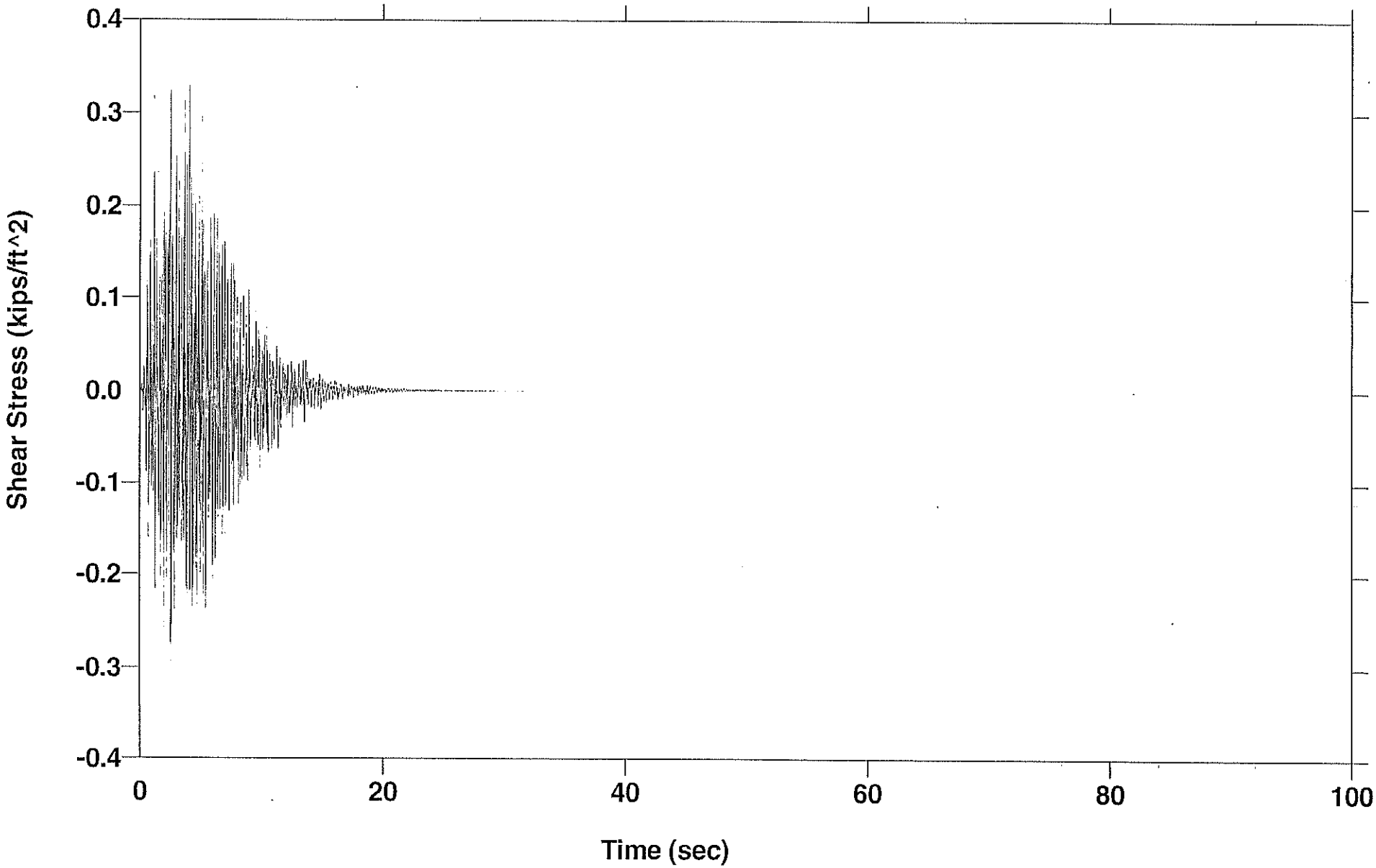
- ▲ Toro et. al. (1997) for Mid-Continent of NA - Rock - Mw: 6.8 - R: 13.5 km
- ▲ Atkinson & Boore (1997) for ENA - Rock - M: 6.8 - R: 13.5 km
- ▼ Campbell for CEUS (2003) - M: 6.8 - R: 13.5 km
- ▼ Atkinson for ENA (2001) - AS00 Rock - M: 6.8 - R: 13.5 km
- ■ Tavakoli & Pezeshk (2005) - ENA - Rock - M: 6.8 - R: 13.5 km
- ■ PSA for 5% damping - Layer 1 - SHAKE

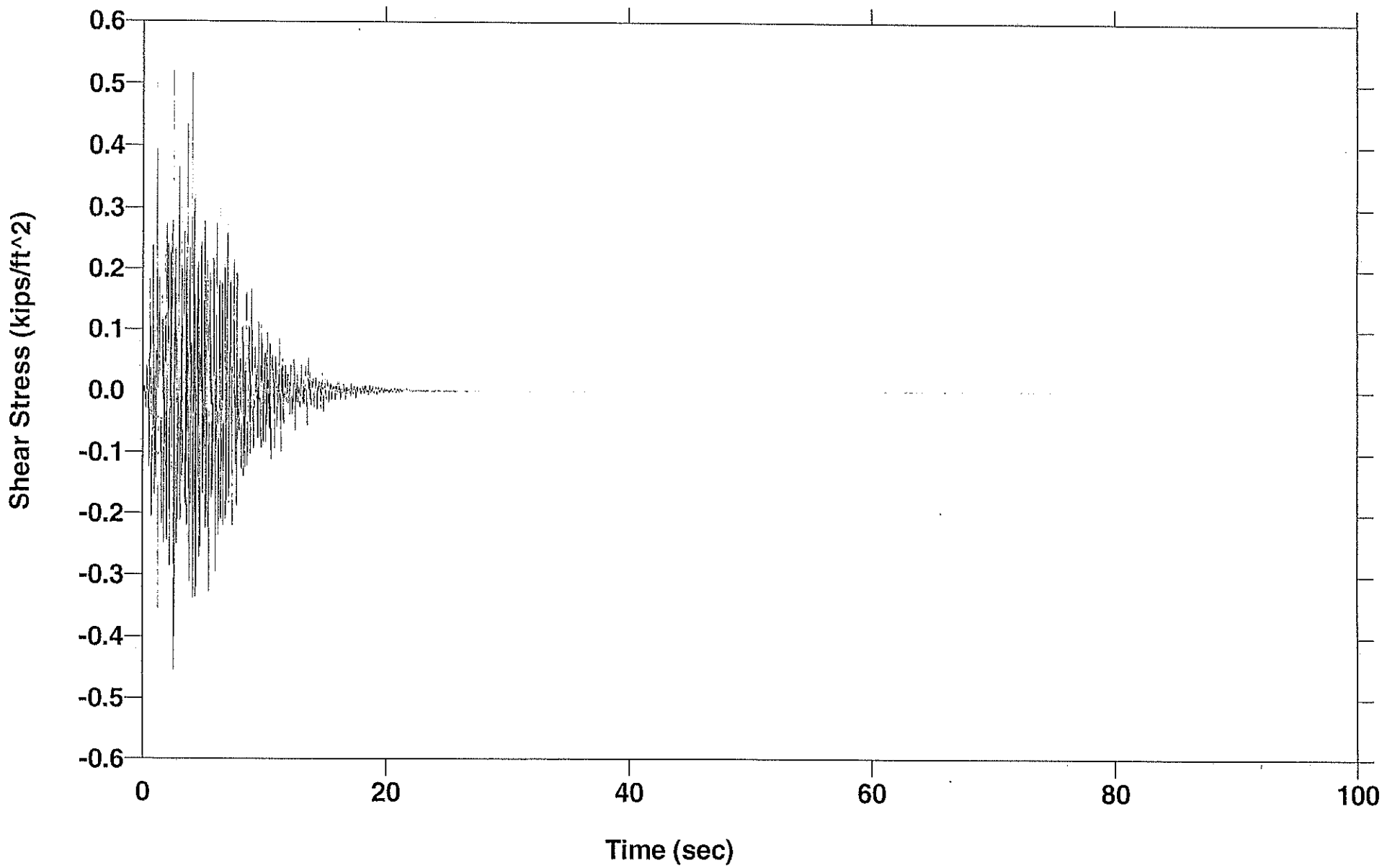
R16060

PSCS300E Crest Column - M6.8 Background Synthetic @13.5km

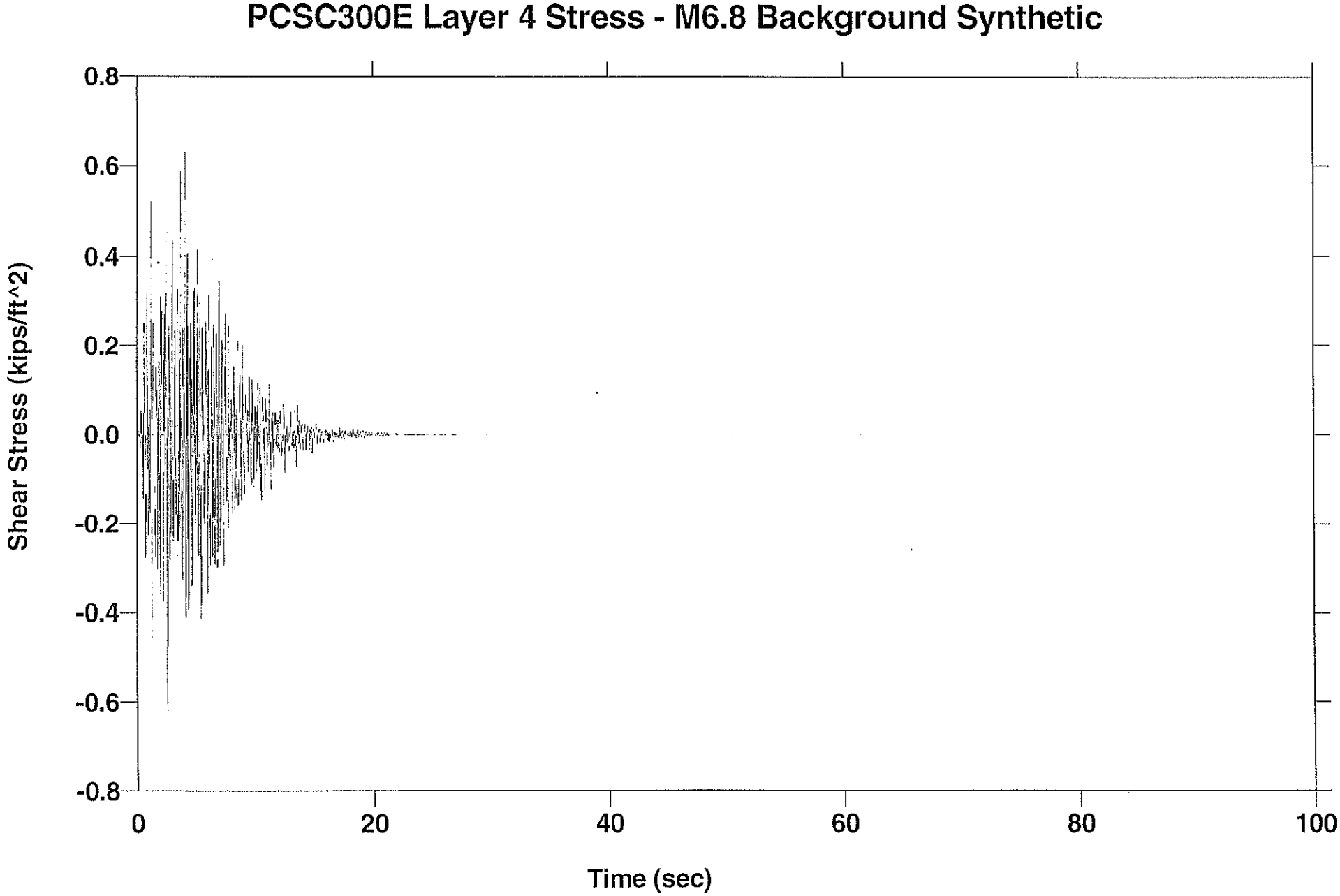


PCSC300E Layer 2 Stress - M6.8 Background Synthetic @13.5km

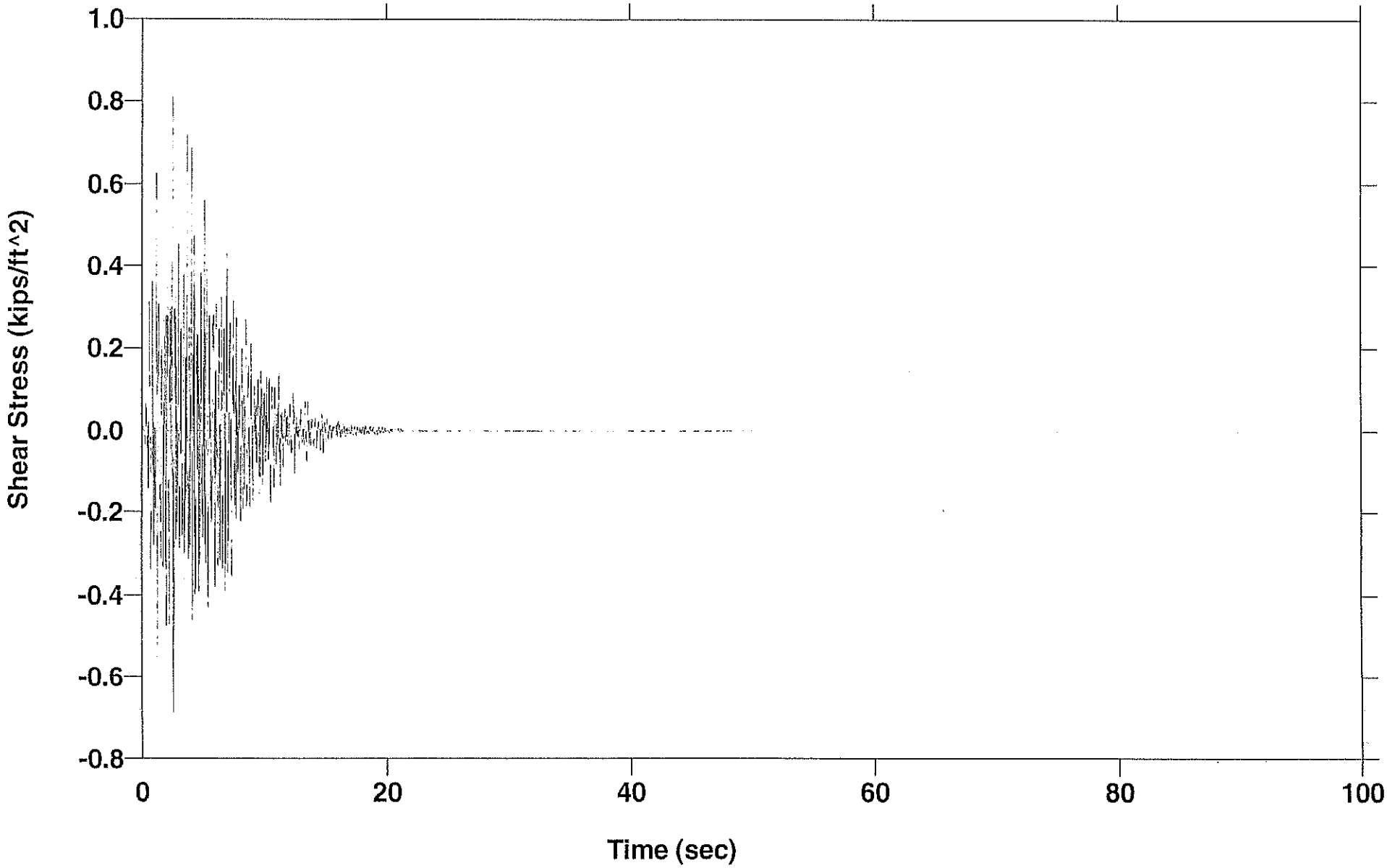



PCSC300E Layer 3 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
0
20
40
60
80
100
Time (sec)

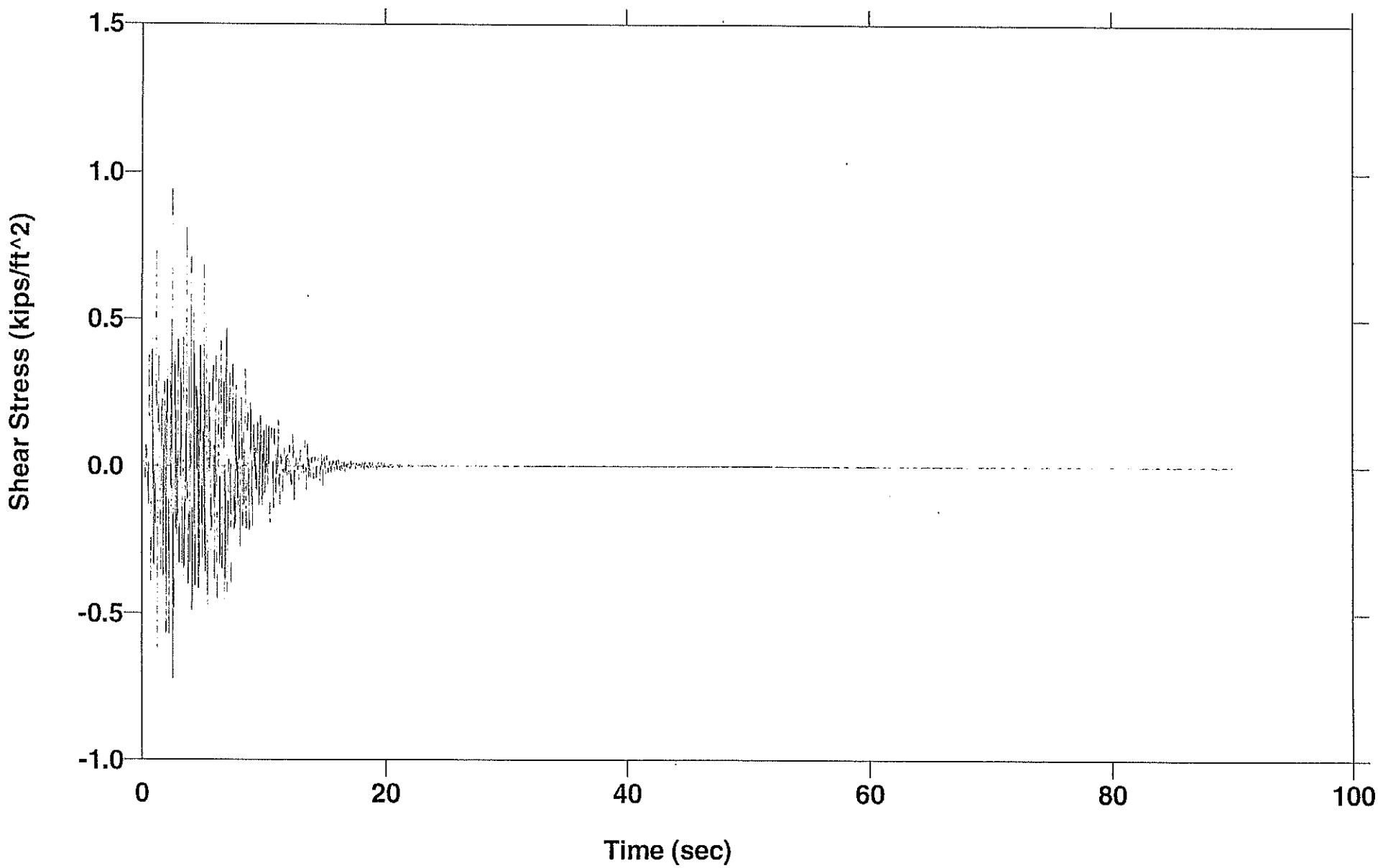
R16063


PCSC300E Layer 4 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0
20
40
60
80
100
Time (sec)

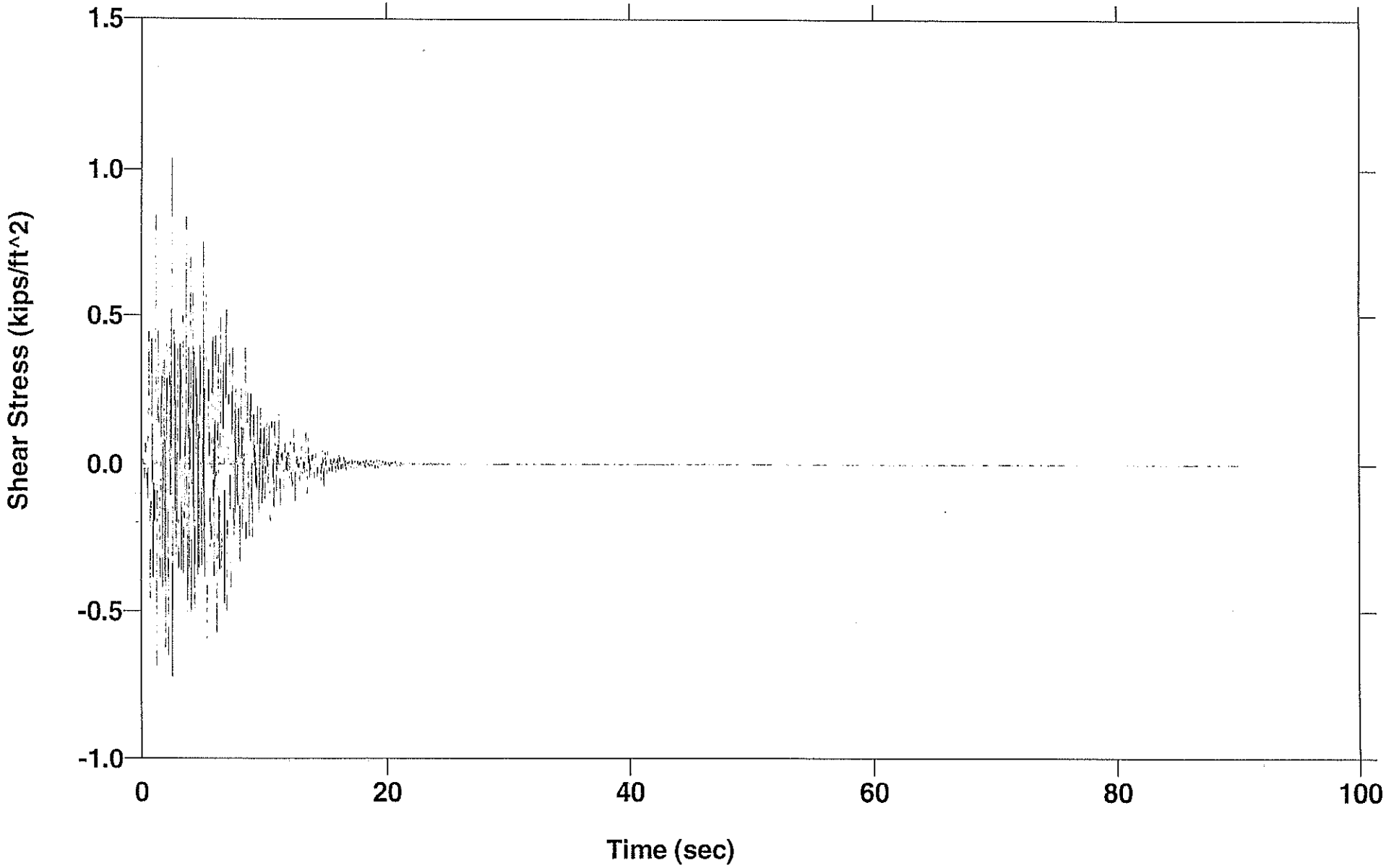
R16064


PCSC300E Layer 5 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0
20
40
60
80
100
Time (sec)

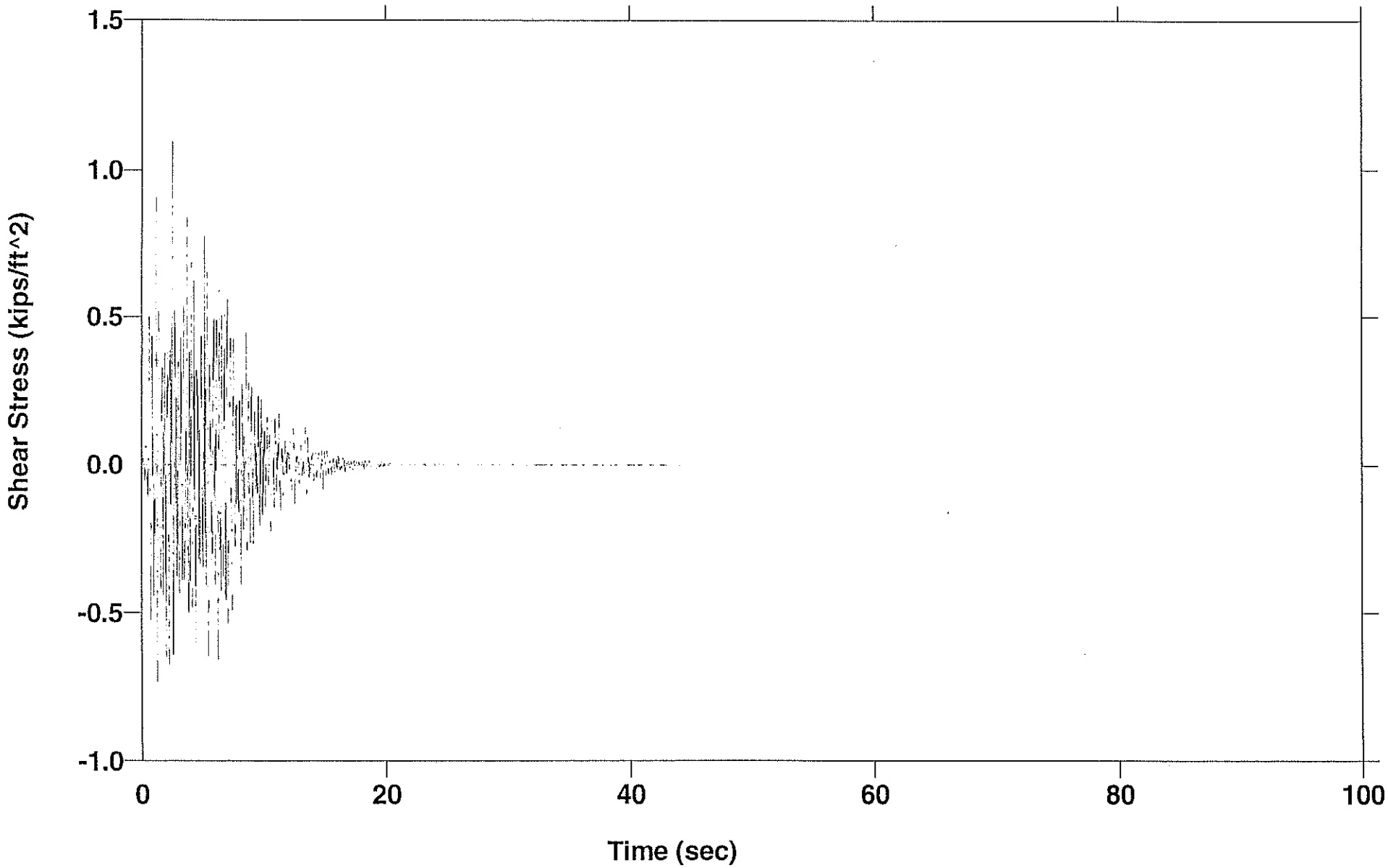
R16065

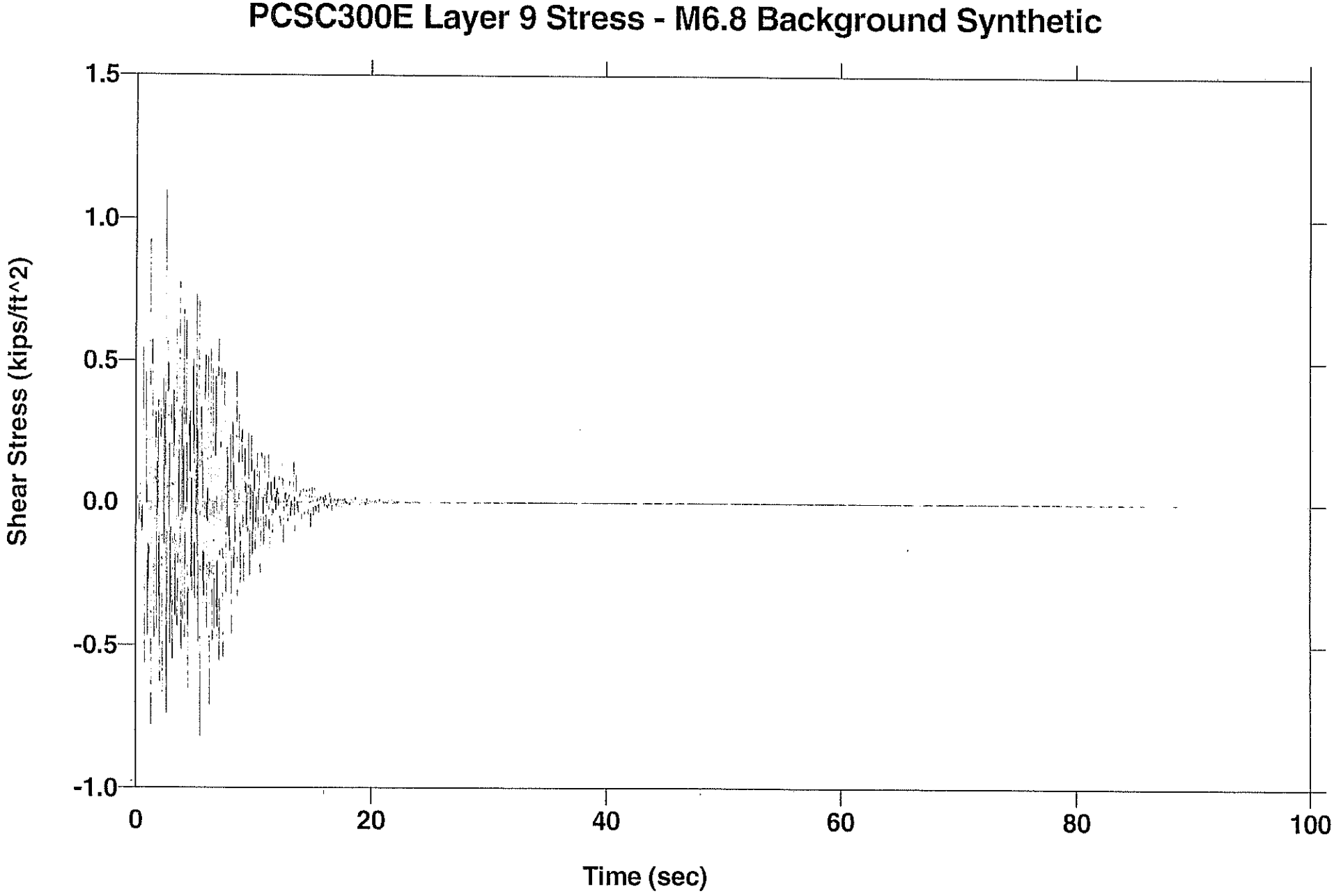

PCSC300E Layer 6 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
0
20
40
60
80
100
Time (sec)

PCSC300E Layer 7 Stress - M6.8 Background Synthetic

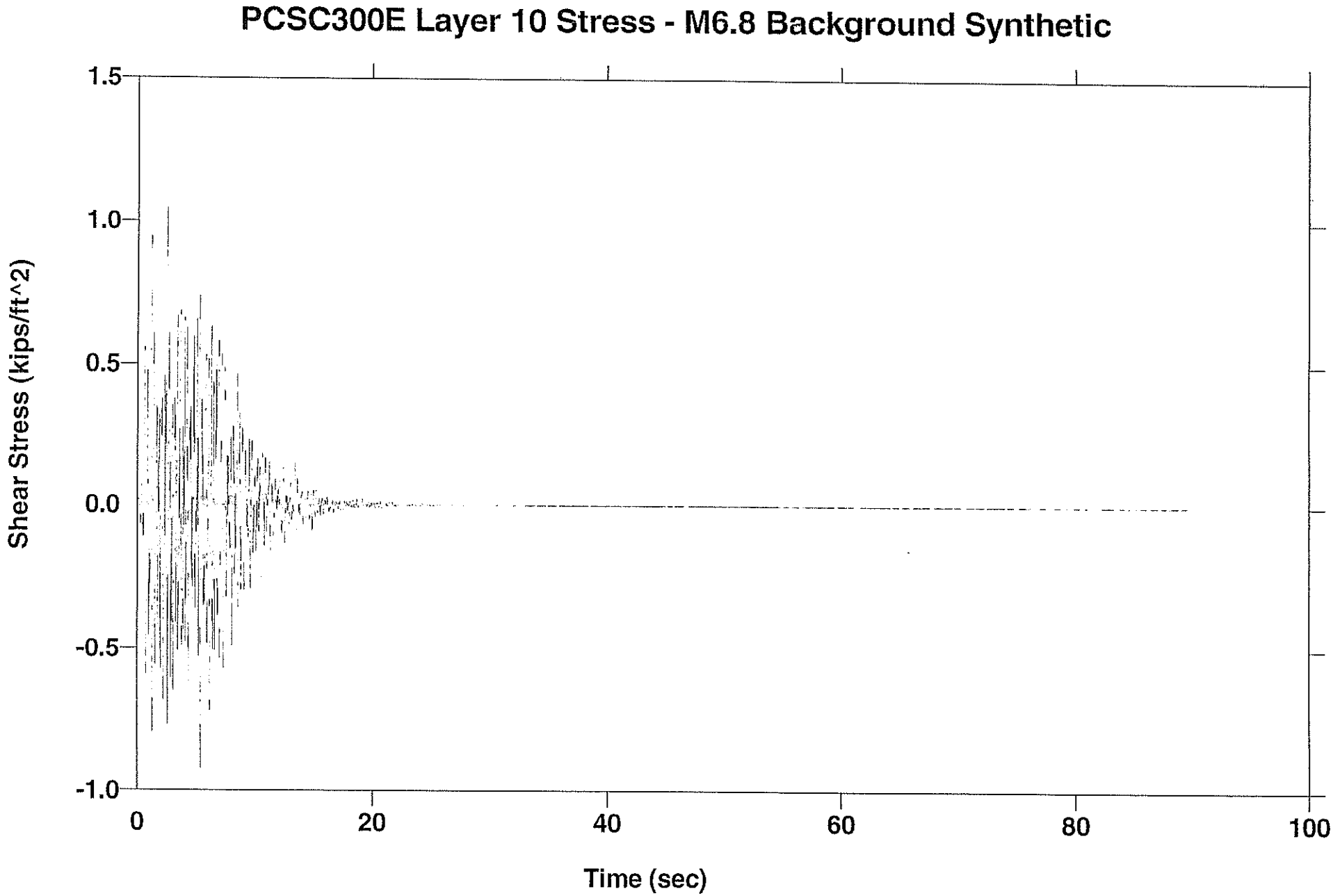


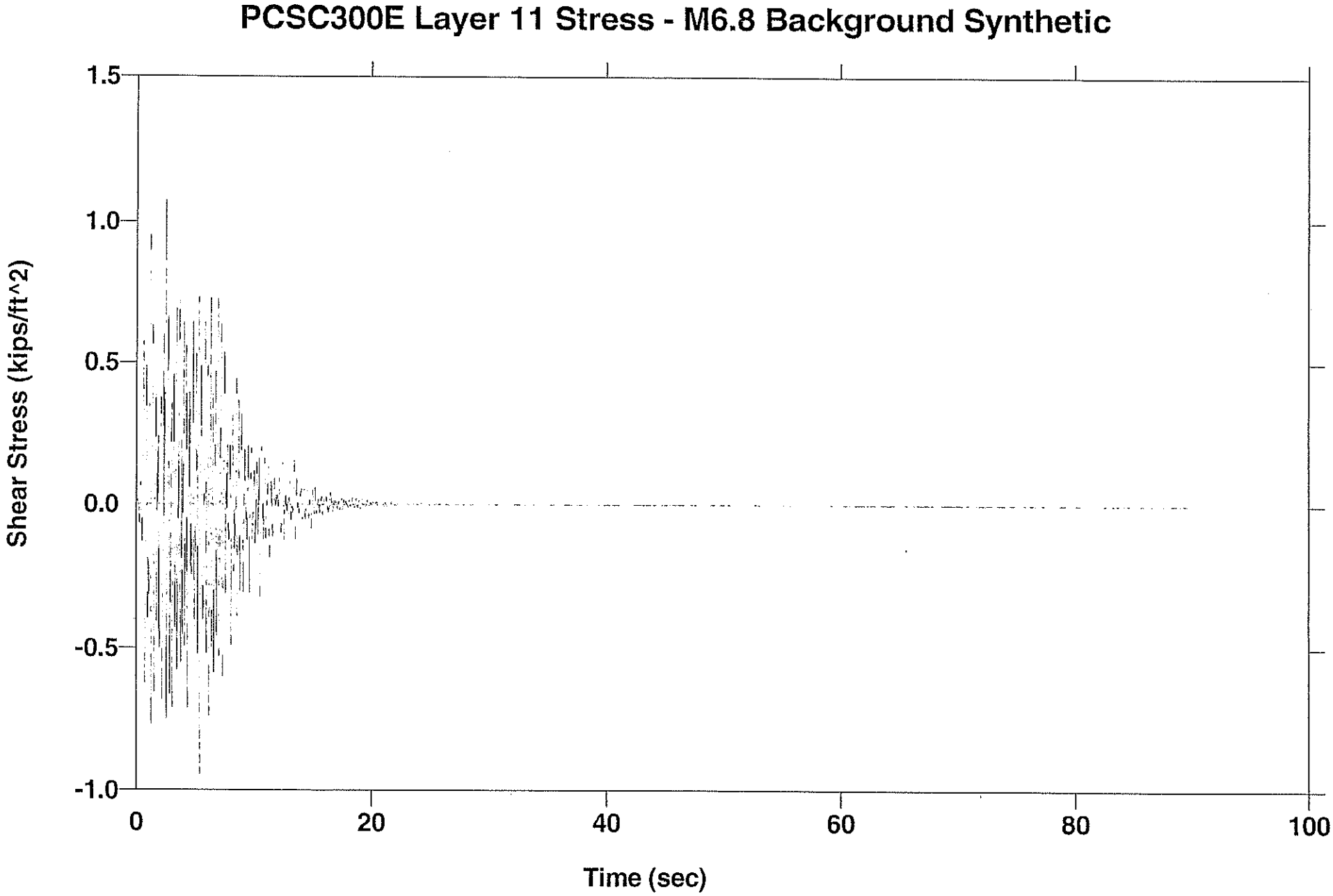
R16067


PCSC300E Layer 8 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
0
20
40
60
80
100
Time (sec)

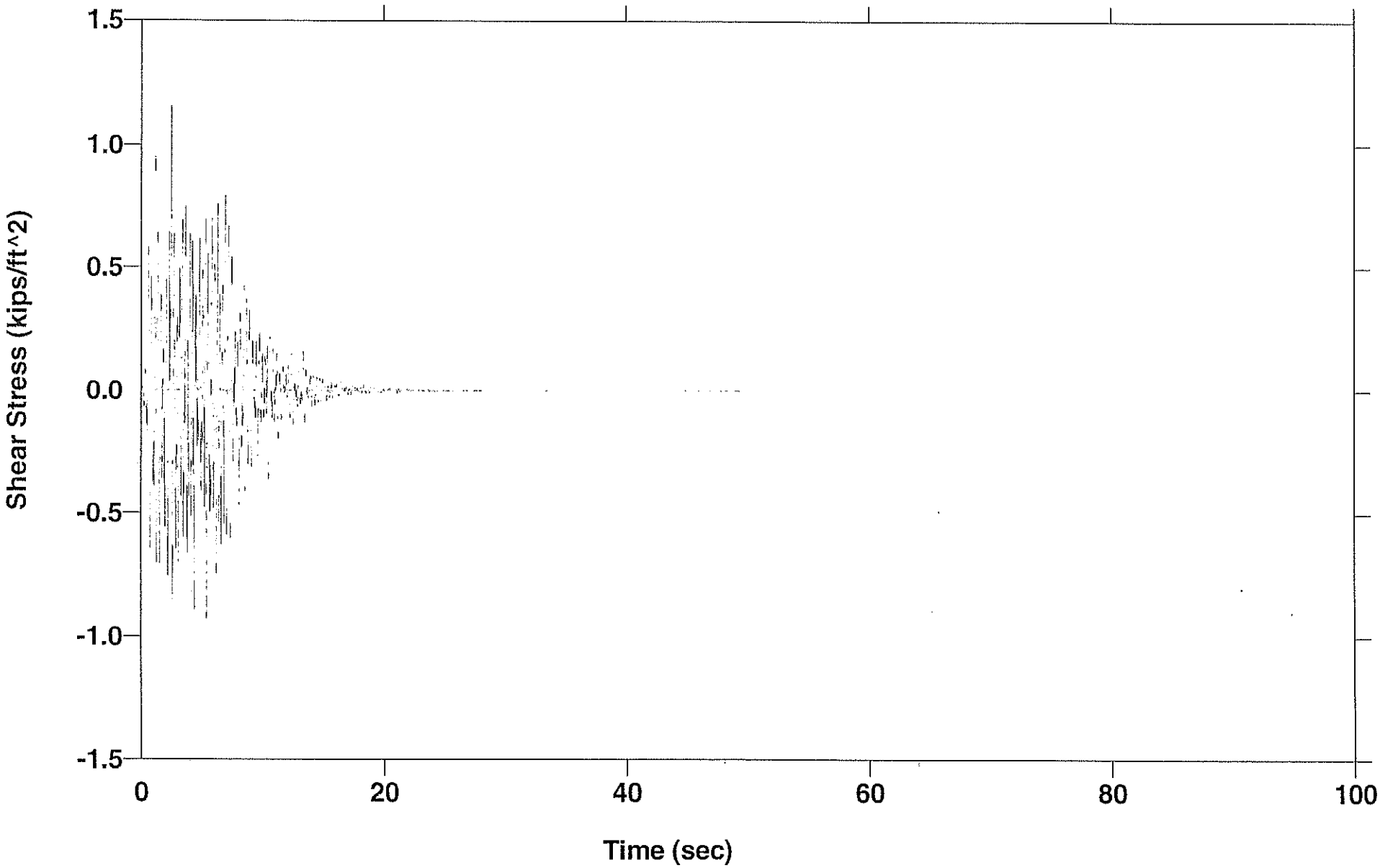

PCSC300E Layer 9 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
0
20
40
60
80
100
Time (sec)

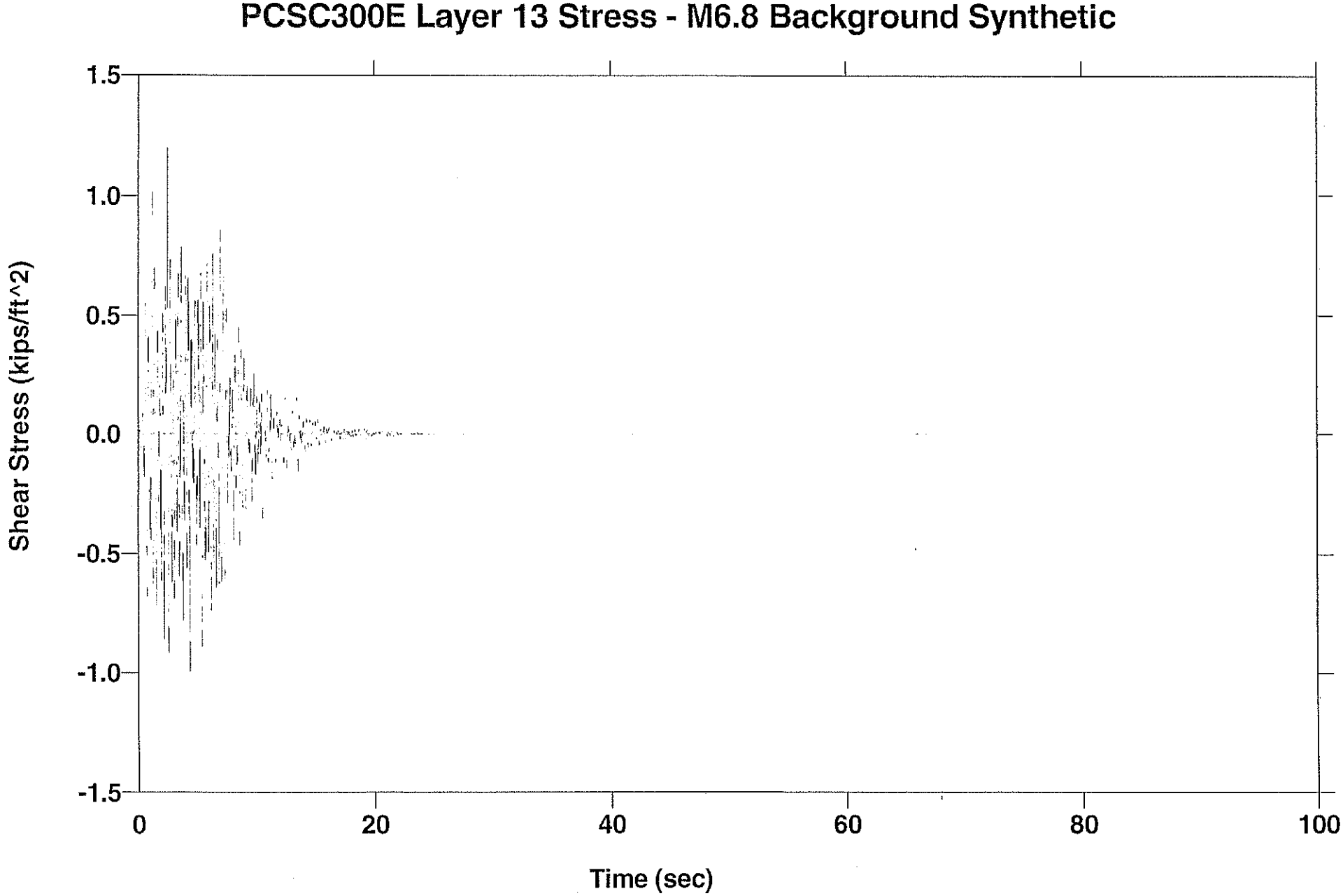
R16069

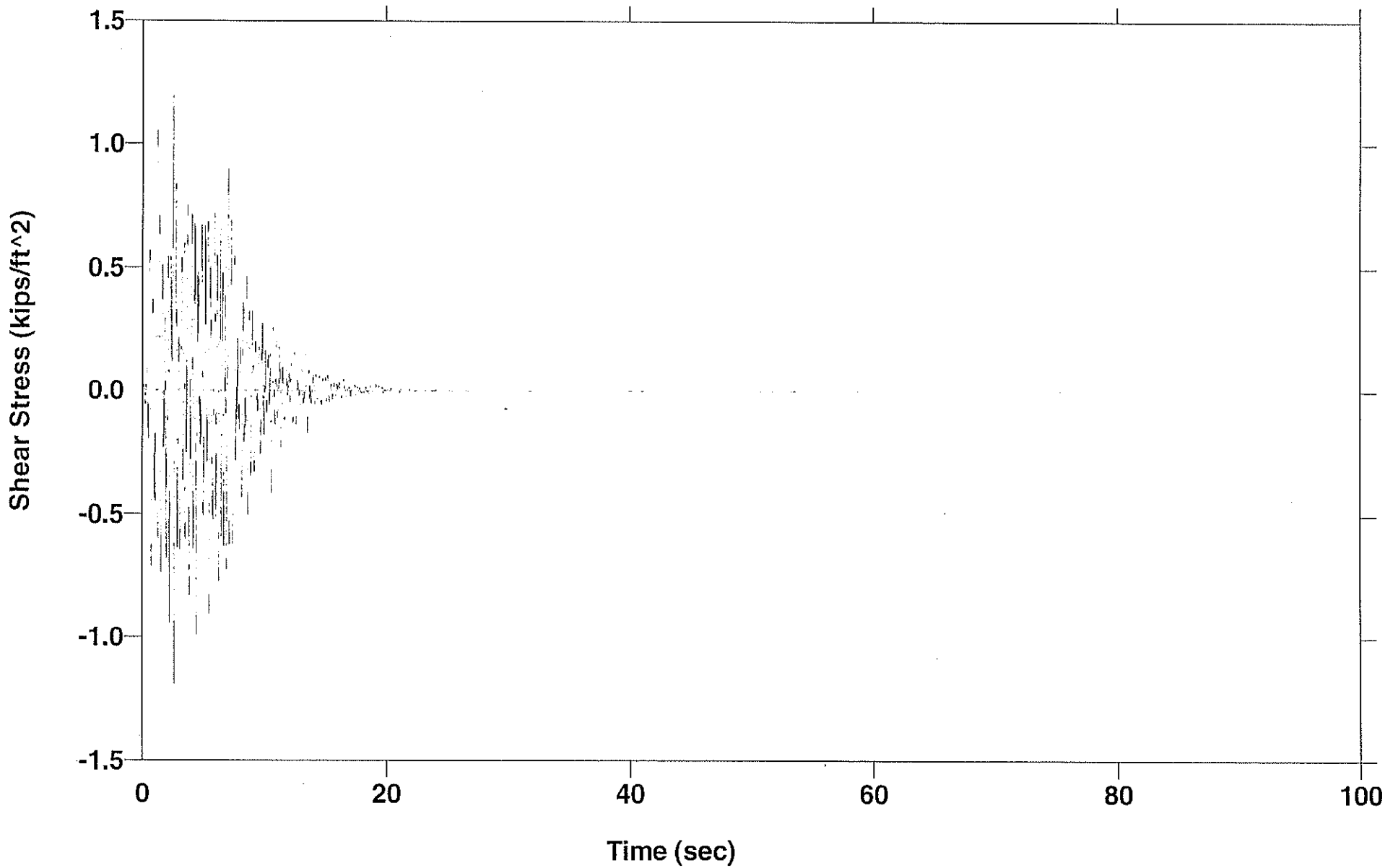

PCSC300E Layer 10 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
0
20
40
60
80
100
Time (sec)


PCSC300E Layer 11 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
0
20
40
60
80
100
Time (sec)

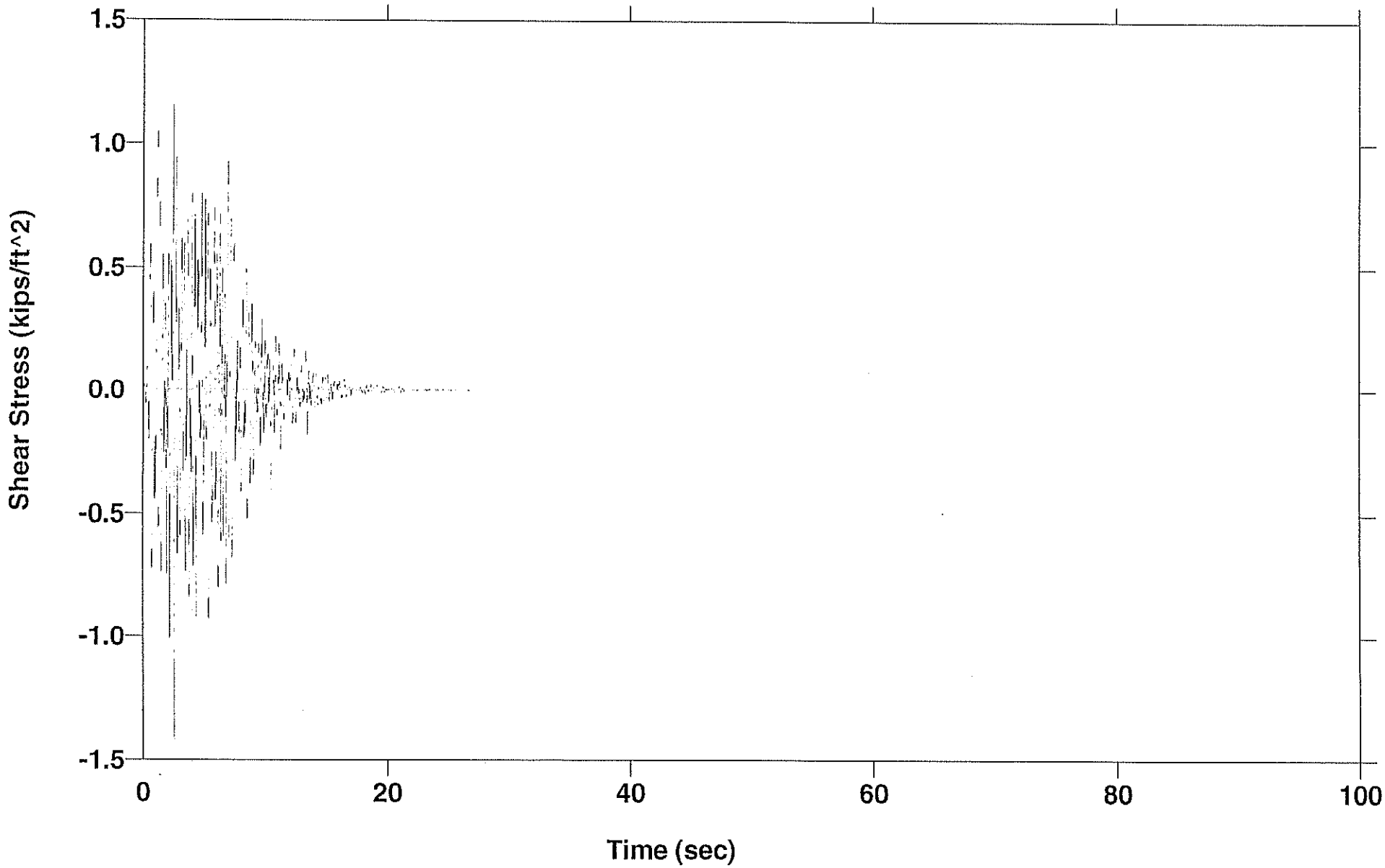
R16071


PCSC300E Layer 12 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0
20
40
60
80
100
Time (sec)

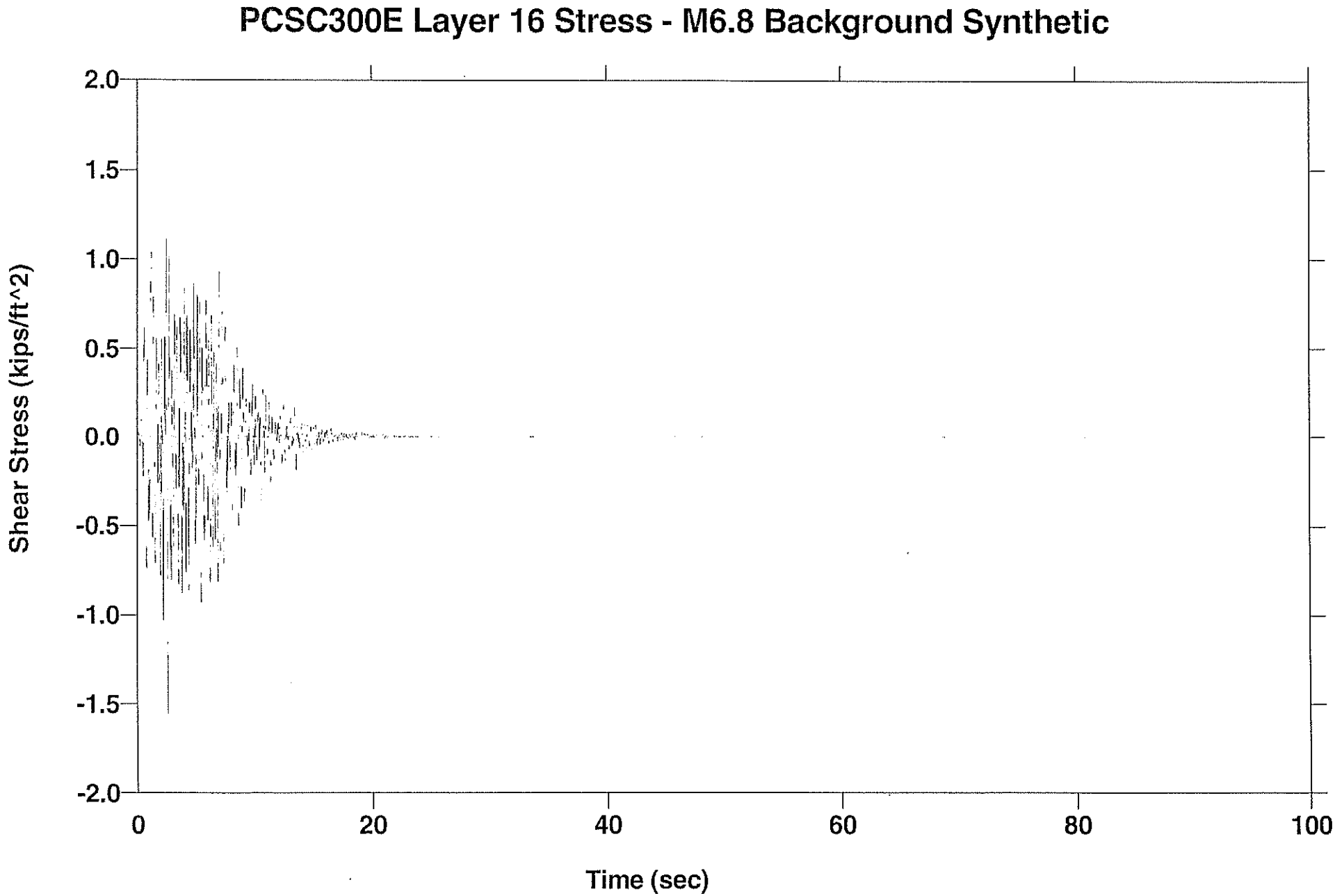

PCSC300E Layer 13 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0
20
40
60
80
100
Time (sec)


PCSC300E Layer 14 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0
20
40
60
80
100
Time (sec)

R16074


PCSC300E Layer 15 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0
20
40
60
80
100
Time (sec)

R16075


PCSC300E Layer 16 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0
20
40
60
80
100
Time (sec)

R16076

PCSC300E-1a.out

```
************************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*    LAYERED SITES by Per Schnable & John Lysmer - 1970  *
* ---------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
* ---------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added  *
*     using results from Sun et al (1988) by J. I. Sun   *
*     & Ramin Golesorkhi February 26, 1988               *
* ----------------------------------------------------*
* SHAKE90/91: Adjust last iteration; Input now is either  *
*     Gmax or max Vs; up to 13 materials can be specified*
*     by user; up to 50 Layers can be specified; object  *
*     motion can be read in from a separate file and can *
*     user specified format; Different periods for res-  *
*     ponse spectral calculations;options are renumbered;*
*     and general cleanup by: J. I. Sun, I. M. Idriss &  *
*     P. Dirrim June 1990 - February 1991                *
* ---------------------------------------------------- *
* SHAKE91: General cleanup and finalization of input out- *
*     output format ... etc by: I. M. Idriss Dec. 1991   *
* ---------------------------------------------------- *
* SHAKE2000: Fix the incorrect output of Tot. Stress in  *
* Option 2. Changed path of ground motion file in        *
* SHAKE91.  Control file to input file names.  Modified  *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
*        RUN DATE  1/02/2008                             *
*        RUN TIME 11:10                                  *
************************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =    32768
 NECESSARY LENGTH OF BLANK COMMON X       =   204819

1****** OPTION  1 *** READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

**********************
 MATERIAL TYPE NO. 1
**********************

CURVE NO. 1:   Coarse    G/Gmax - Gravel (Mean) - Rollins et al. JGGE
CURVE NO. 2:   Coarse    Damping for Gravel (Mean) - Rollins et al. J
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.90
0.0002	0.995	0.0003	1.11
0.0005	0.980	0.0006	1.30
0.0008	0.970	0.0010	1.50
0.0010	0.960	0.0020	1.91
0.0020	0.930	0.0030	2.24
0.0030	0.905	0.0040	2.54
0.0040	0.880	0.0060	3.05
0.0070	0.810	0.0080	3.50
0.0100	0.755	0.0100	3.89
0.0200	0.630	0.0200	5.45
0.0700	0.390	0.0300	6.61
0.1000	0.325	0.0500	8.28
0.2000	0.205	0.1000	10.79
0.3000	0.150	0.2000	13.23

0.4000	0.115	0.3000	14.47
0.5000	0.095	0.4000	15.24
0.6000	0.080	0.6000	16.14
0.8000	0.070	0.8000	16.66
1.0000	0.050	1.0000	17.01

****
MATERIAL TYPE NO. 2
****

CURVE NO. 3: Fine Refuse Moduli for Fine Refuse (Ellison & Cho, 1976)
CURVE NO. 4: Fine Refuse Damping Values for Fine Refuse (Ellison & Ch

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.75
0.0004	1.000	0.0004	0.65
0.0010	0.995	0.0010	0.70
0.0020	0.992	0.0020	0.80
0.0040	0.989	0.0040	0.90
0.0060	0.981	0.0060	1.10
0.0080	0.965	0.0080	1.30
0.0100	0.955	0.0100	1.40
0.0200	0.905	0.0200	2.00
0.0400	0.828	0.0400	3.10
0.0600	0.750	0.0600	4.00
0.0800	0.670	0.0800	5.20
0.1000	0.610	0.1000	6.00
0.2000	0.610	0.2000	6.00

****
MATERIAL TYPE NO. 3
****

CURVE NO. 5: Residual G/Gmax PI=15% - Effective Confining Pressure
CURVE NO. 6: Residual Damping PI=15% - Effective Confining Pressur

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0000	1.000	0.0000	0.67
0.0000	1.000	0.0000	0.67
0.0000	0.999	0.0000	0.68
0.0001	0.998	0.0001	0.68
0.0002	0.996	0.0002	0.70
0.0005	0.991	0.0005	0.75
0.0010	0.983	0.0010	0.83
0.0022	0.965	0.0022	1.02
0.0048	0.931	0.0048	1.43
0.0100	0.873	0.0100	2.17
0.0220	0.770	0.0220	3.68
0.0484	0.618	0.0484	6.24
0.1000	0.454	0.1000	9.48
0.2200	0.287	0.2200	13.40
0.4840	0.163	0.4840	16.87
1.0000	0.091	1.0000	19.16

****
MATERIAL TYPE NO. 4
****

CURVE NO. 7: Rock G/Gmax - ROCK (Schnabel 1973)
CURVE NO. 8: Rock Damping for ROCK (Schnabel 1973)

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.40
0.0003	1.000	0.0010	0.80
0.0010	0.990	0.0100	1.50
0.0030	0.950	0.1000	3.00
0.0100	0.900	1.0000	4.60
0.0300	0.810	0.0000	0.00
0.1000	0.725	0.0000	0.00
1.0000	0.550	0.0000	0.00

1****** OPTION 2 *** READ SOIL PROFILE
NEW SOIL PROFILE NO. 1 IDENTIFICATION PSCS300E Crest Column
NUMBER OF LAYERS 17 DEPTH TO BEDROCK 50.00

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	1	4.0000	2.0000	0.26	3454.	0.050	0.130	924.9
2	1	3.0000	5.5000	0.71	3856.	0.050	0.130	977.3
3	1	3.0000	8.5000	1.11	4110.	0.050	0.130	1009.0
4	1	3.0000	11.5000	1.50	5739.	0.050	0.130	1192.3
5	1	3.0000	14.5000	1.88	4991.	0.050	0.130	1111.9
6	1	3.0000	17.5000	2.28	4552.	0.050	0.130	1061.8
7	1	3.0000	20.5000	2.66	4985.	0.050	0.130	1111.2
8	1	3.0000	23.5000	3.05	4436.	0.050	0.130	1048.2
9	1	3.0000	26.5000	3.44	4926.	0.050	0.130	1104.6
10	1	4.0000	30.0000	3.90	5058.	0.050	0.130	1119.3
11	3	3.0000	33.5000	4.36	2940.	0.050	0.135	837.4
12	3	3.0000	36.5000	4.77	2951.	0.050	0.135	839.0
13	3	3.0000	39.5000	5.17	3307.	0.050	0.135	888.1
14	3	3.0000	42.5000	5.58	4130.	0.050	0.135	992.5
15	3	3.0000	45.5000	5.98	7136.	0.050	0.135	1304.6
16	3	3.0000	48.5000	6.39	7051.	0.050	0.135	1296.8
17	BASE				74534.	0.050	0.150	4000.0

PERIOD = 0.19 FROM AVERAGE SHEAR VEL. = 1050.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 12.49
FOR FREQUENCY = 5.15 C/SEC.
PERIOD = 0.19 SEC.

1****** OPTION 3 *** READ INPUT MOTION

FILE NAME FOR INPUT MOTION = C:\SHAKE2000\Williamson Energy\Background6.8.eq
NO. OF INPUT ACC. POINTS = 8192
NO. OF POINTS USED IN FFT = 16384
NO. OF HEADING LINES = 4
NO. OF POINTS PER LINE = 8

TIME STEP FOR INPUT MOTION = 0.0100
FORMAT FOR TIME HISTORY = (8f9.6)

*****HEADER*****
Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt
SHAKE2000 Conversion: 8192 .01 4 8 9 (8f9.6
Acceleration Units: (g's) - No. Values: 8192 - Time Step: .01 (secs)
Data Format: (8f9.6) - No. Header Lines: 4
** FIRST AND LAST 5 LINES OF INPUT MOTION *****

1 0.000068-0.000484 0.004440-0.000089 0.002476-0.002297-0.001876 0.007725
2 0.009680 0.020998-0.014349-0.012924 0.018874-0.019831-0.000946 0.024811
3 -0.016894-0.002461 0.007682-0.006573-0.008604-0.018410 0.024194-0.064656
4 -0.017516 0.023926-0.061566 0.003326 0.022873 0.052730 0.049159 0.008778
5 -0.041034 0.029324-0.005991 0.066674-0.051336 0.029966-0.067257 0.001274
.....INPUT MOTION READ NOT ECHOED.....
1020 -0.000017 0.000017-0.000018 0.000017-0.000019 0.000019-0.000020 0.000020
1021 -0.000021 0.000021-0.000022 0.000022-0.000024 0.000023-0.000025 0.000025
1022 -0.000027 0.000027-0.000028 0.000028-0.000030 0.000030-0.000032 0.000032
1023 -0.000034 0.000034-0.000035 0.000035-0.000037 0.000037-0.000038 0.000038
1024 -0.000038 0.000037-0.000036 0.000032-0.000026 0.000014 0.000006-0.000045

MAXIMUM ACCELERATION = 0.75473
AT TIME = 3.64 SEC
THE VALUES WILL BE MULTIPLIED BY A FACTOR = 0.715
TO GIVE NEW MAXIMUM ACCELERATION = 0.54000
MEAN SQUARE FREQUENCY = 20.41 C/SEC.
MAX ACCELERATION = 0.55791 FOR FREQUENCIES REMOVED ABOVE 40.00 C/SEC.
!****** OPTION 4 *** READ WHERE OBJECT MOTION IS GIVEN
OBJECT MOTION IN LAYER NUMBER 17 OUTCROPPING

!****** OPTION 5 *** OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
MAXIMUM NUMBER OF ITERATIONS = 10
FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN = 0.65

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 1

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00356	0.024	0.050	-106.7	3074.5	3454.0	-12.3	1.000
2	1	5.5	0.00786	0.035	0.050	-44.0	3054.2	3856.0	-26.3	1.000
3	1	8.5	0.00966	0.038	0.050	-30.5	3124.7	4110.0	-31.5	1.000
4	1	11.5	0.00814	0.035	0.050	-41.7	4515.4	5739.0	-27.1	1.000
5	1	14.5	0.01168	0.042	0.050	-18.0	3628.7	4991.0	-37.5	1.000
6	1	17.5	0.01477	0.048	0.050	-4.9	3116.7	4552.0	-46.1	1.000
7	1	20.5	0.01539	0.049	0.050	-2.9	3376.1	4985.0	-47.7	1.000
8	1	23.5	0.01948	0.054	0.050	7.2	2815.8	4436.0	-57.5	1.000
9	1	26.5	0.01902	0.053	0.050	6.3	3148.1	4926.0	-56.5	1.000
10	1	30.0	0.01960	0.054	0.050	7.5	3204.8	5058.0	-57.8	1.000
11	3	33.5	0.03457	0.051	0.050	2.9	2007.6	2940.0	-46.4	1.000
12	3	36.5	0.03572	0.053	0.050	4.8	1996.5	2951.0	-47.8	1.000
13	3	39.5	0.03387	0.051	0.050	1.6	2271.4	3307.0	-45.6	1.000
14	3	42.5	0.02722	0.044	0.050	-14.3	3010.5	4130.0	-37.2	1.000
15	3	45.5	0.01592	0.031	0.050	-63.2	5796.4	7136.0	-23.1	1.000

16 3 48.5 0.01718 0.032 0.050 -55.7 5656.9 7051.0 -24.6 1.000

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00418	0.026	0.024	6.8	3020.9	3074.5	-1.8	0.890
2	1	5.5	0.01024	0.039	0.035	11.9	2895.1	3054.2	-5.5	0.792
3	1	8.5	0.01293	0.045	0.038	14.3	2912.8	3124.7	-7.3	0.760
4	1	11.5	0.01090	0.041	0.035	13.6	4244.1	4515.4	-6.4	0.787
5	1	14.5	0.01643	0.050	0.042	15.3	3321.5	3628.7	-9.2	0.727
6	1	17.5	0.02367	0.059	0.048	19.6	2721.0	3116.7	-14.5	0.685
7	1	20.5	0.02492	0.061	0.049	20.1	2930.4	3376.1	-15.2	0.677
8	1	23.5	0.03198	0.068	0.054	21.0	2395.7	2815.8	-17.5	0.635
9	1	26.5	0.02894	0.065	0.053	18.0	2754.8	3148.1	-14.3	0.639
10	1	30.0	0.02759	0.064	0.054	15.1	2875.0	3204.8	-11.5	0.634
11	3	33.5	0.04145	0.057	0.051	10.2	1904.8	2007.6	-5.4	0.683
12	3	36.5	0.03989	0.056	0.053	6.4	1933.8	1996.5	-3.2	0.677
13	3	39.5	0.03636	0.053	0.051	4.3	2226.2	2271.4	-2.0	0.687
14	3	42.5	0.02969	0.047	0.044	6.0	2941.4	3010.5	-2.4	0.729
15	3	45.5	0.01743	0.032	0.031	5.4	5711.9	5796.4	-1.5	0.812
16	3	48.5	0.01905	0.034	0.032	5.8	5562.0	5656.9	-1.7	0.802

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00420	0.026	0.026	0.2	3018.9	3020.9	-0.1	0.875
2	1	5.5	0.01085	0.041	0.039	3.2	2854.6	2895.1	-1.4	0.751
3	1	8.5	0.01386	0.046	0.045	3.4	2861.3	2912.8	-1.8	0.709
4	1	11.5	0.01148	0.042	0.041	2.8	4189.7	4244.1	-1.3	0.740
5	1	14.5	0.01816	0.052	0.050	4.3	3231.1	3321.5	-2.8	0.665
6	1	17.5	0.02586	0.062	0.059	4.1	2643.5	2721.0	-2.9	0.598
7	1	20.5	0.02639	0.062	0.061	2.6	2875.6	2930.4	-1.9	0.588
8	1	23.5	0.03446	0.071	0.068	3.5	2332.4	2395.7	-2.7	0.540
9	1	26.5	0.03034	0.066	0.065	2.1	2710.2	2754.8	-1.6	0.559
10	1	30.0	0.02815	0.064	0.064	0.9	2855.2	2875.0	-0.7	0.568
11	3	33.5	0.03977	0.056	0.057	-2.4	1928.3	1904.8	1.2	0.648
12	3	36.5	0.03991	0.056	0.056	0.0	1933.4	1933.8	0.0	0.655
13	3	39.5	0.03668	0.053	0.053	0.5	2220.5	2226.2	-0.3	0.673
14	3	42.5	0.03012	0.047	0.047	1.0	2930.1	2941.4	-0.4	0.712
15	3	45.5	0.01771	0.033	0.032	0.9	5697.1	5711.9	-0.3	0.800
16	3	48.5	0.01938	0.034	0.034	1.0	5545.9	5562.0	-0.3	0.789

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00431	0.026	0.026	1.3	3006.9	3018.9	-0.4	0.874
2	1	5.5	0.01129	0.042	0.041	2.1	2827.1	2854.6	-1.0	0.740
3	1	8.5	0.01437	0.047	0.046	1.8	2834.1	2861.3	-1.0	0.696
4	1	11.5	0.01168	0.042	0.042	0.9	4172.6	4189.7	-0.4	0.730
5	1	14.5	0.01877	0.053	0.052	1.4	3201.4	3231.1	-0.9	0.647
6	1	17.5	0.02683	0.063	0.062	1.7	2611.6	2643.5	-1.2	0.581
7	1	20.5	0.02706	0.063	0.062	1.1	2851.8	2875.6	-0.8	0.577
8	1	23.5	0.03519	0.071	0.071	1.0	2314.6	2332.4	-0.8	0.526
9	1	26.5	0.03040	0.067	0.066	0.1	2708.4	2710.2	-0.1	0.550
10	1	30.0	0.02802	0.064	0.064	-0.2	2859.8	2855.2	0.2	0.565
11	3	33.5	0.03893	0.055	0.056	-1.2	1940.4	1928.3	0.6	0.656
12	3	36.5	0.04001	0.056	0.056	0.1	1932.0	1933.4	-0.1	0.655
13	3	39.5	0.03696	0.054	0.053	0.5	2215.6	2220.5	-0.2	0.671
14	3	42.5	0.03018	0.047	0.047	0.1	2928.5	2930.1	-0.1	0.709
15	3	45.5	0.01774	0.033	0.033	0.1	5695.6	5697.1	0.0	0.798
16	3	48.5	0.01941	0.034	0.034	0.1	5544.8	5545.9	0.0	0.787

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00438	0.027	0.026	0.7	3000.8	3006.9	-0.2	0.871
2	1	5.5	0.01150	0.042	0.042	1.0	2814.1	2827.1	-0.5	0.733
3	1	8.5	0.01462	0.047	0.047	0.8	2821.6	2834.1	-0.4	0.690
4	1	11.5	0.01173	0.042	0.042	0.2	4167.9	4172.6	-0.1	0.727
5	1	14.5	0.01899	0.053	0.053	0.5	3191.0	3201.4	-0.3	0.641
6	1	17.5	0.02725	0.063	0.063	0.7	2598.1	2611.6	-0.5	0.574
7	1	20.5	0.02736	0.063	0.063	0.5	2841.4	2851.8	-0.4	0.572
8	1	23.5	0.03549	0.072	0.071	0.4	2307.2	2314.6	-0.3	0.522
9	1	26.5	0.03027	0.066	0.067	-0.2	2712.4	2708.4	0.1	0.550
10	1	30.0	0.02787	0.064	0.064	-0.2	2864.8	2859.8	0.2	0.565
11	3	33.5	0.03868	0.055	0.055	-0.4	1944.0	1940.4	0.2	0.660
12	3	36.5	0.04013	0.056	0.056	0.2	1930.3	1932.0	-0.1	0.655
13	3	39.5	0.03713	0.054	0.054	0.3	2212.7	2215.6	-0.1	0.670
14	3	42.5	0.03019	0.047	0.047	0.0	2928.2	2928.5	0.0	0.709
15	3	45.5	0.01774	0.033	0.033	0.0	5695.3	5695.6	0.0	0.798
16	3	48.5	0.01941	0.034	0.034	0.0	5544.8	5544.8	0.0	0.786

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 6

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00440	0.027	0.027	0.3	2998.1	3000.8	-0.1	0.869
2	1	5.5	0.01160	0.042	0.042	0.4	2808.3	2814.1	-0.2	0.730

3	1	8.5	0.01472	0.048	0.047	0.3	2816.3	2821.6	-0.2	0.687
4	1	11.5	0.01174	0.043	0.042	0.1	4166.8	4167.9	0.0	0.726
5	1	14.5	0.01907	0.053	0.053	0.2	3187.2	3191.0	-0.1	0.639
6	1	17.5	0.02742	0.064	0.063	0.3	2592.5	2598.1	-0.2	0.571
7	1	20.5	0.02748	0.064	0.063	0.2	2837.0	2841.4	-0.2	0.570
8	1	23.5	0.03562	0.072	0.072	0.2	2304.2	2307.2	-0.1	0.520
9	1	26.5	0.03016	0.066	0.066	-0.2	2715.8	2712.4	0.1	0.551
10	1	30.0	0.02779	0.064	0.064	-0.1	2867.9	2864.8	0.1	0.566
11	3	33.5	0.03861	0.055	0.055	-0.1	1945.0	1944.0	0.1	0.661
12	3	36.5	0.04020	0.056	0.056	0.1	1929.3	1930.3	-0.1	0.654
13	3	39.5	0.03721	0.054	0.054	0.1	2211.4	2212.7	-0.1	0.669
14	3	42.5	0.03019	0.047	0.047	0.0	2928.1	2928.2	0.0	0.709
15	3	45.5	0.01774	0.033	0.033	0.0	5695.2	5695.3	0.0	0.798
16	3	48.5	0.01941	0.034	0.034	0.0	5544.8	5544.8	0.0	0.786

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 7

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00441	0.027	0.027	0.1	2996.9	2998.1	0.0	0.868
2	1	5.5	0.01164	0.042	0.042	0.2	2805.8	2808.3	-0.1	0.728
3	1	8.5	0.01477	0.048	0.048	0.1	2814.0	2816.3	-0.1	0.685
4	1	11.5	0.01174	0.043	0.043	0.0	4166.6	4166.8	0.0	0.726
5	1	14.5	0.01910	0.053	0.053	0.1	3185.8	3187.2	0.0	0.639
6	1	17.5	0.02750	0.064	0.064	0.1	2590.1	2592.5	-0.1	0.570
7	1	20.5	0.02754	0.064	0.064	0.1	2835.1	2837.0	-0.1	0.569
8	1	23.5	0.03567	0.072	0.072	0.1	2303.0	2304.2	-0.1	0.519
9	1	26.5	0.03009	0.066	0.066	-0.1	2717.8	2715.8	0.1	0.551
10	1	30.0	0.02774	0.064	0.064	-0.1	2869.5	2867.9	0.1	0.567
11	3	33.5	0.03859	0.055	0.055	0.0	1945.3	1945.0	0.0	0.662
12	3	36.5	0.04023	0.056	0.056	0.1	1928.8	1929.3	0.0	0.654
13	3	39.5	0.03724	0.054	0.054	0.1	2210.8	2211.4	0.0	0.669
14	3	42.5	0.03019	0.047	0.047	0.0	2928.0	2928.1	0.0	0.709
15	3	45.5	0.01774	0.033	0.033	0.0	5695.1	5695.2	0.0	0.798
16	3	48.5	0.01941	0.034	0.034	0.0	5544.8	5544.8	0.0	0.786

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 8

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00442	0.027	0.027	0.1	2996.5	2996.9	0.0	0.868
2	1	5.5	0.01166	0.042	0.042	0.1	2804.7	2805.8	0.0	0.728
3	1	8.5	0.01479	0.048	0.048	0.1	2813.1	2814.0	0.0	0.685
4	1	11.5	0.01174	0.043	0.043	0.0	4166.5	4166.6	0.0	0.726
5	1	14.5	0.01911	0.053	0.053	0.0	3185.3	3185.8	0.0	0.638
6	1	17.5	0.02753	0.064	0.064	0.1	2589.1	2590.1	0.0	0.569
7	1	20.5	0.02756	0.064	0.064	0.0	2834.3	2835.1	0.0	0.569
8	1	23.5	0.03569	0.072	0.072	0.0	2302.5	2303.0	0.0	0.519
9	1	26.5	0.03006	0.066	0.066	-0.1	2718.8	2717.8	0.0	0.552

10	1	30.0	0.02772	0.064	0.064	0.0	2870.3	2869.5	0.0	0.567
11	3	33.5	0.03859	0.055	0.055	0.0	1945.3	1945.3	0.0	0.662
12	3	36.5	0.04025	0.056	0.056	0.0	1928.6	1928.8	0.0	0.654
13	3	39.5	0.03726	0.054	0.054	0.0	2210.6	2210.8	0.0	0.669
14	3	42.5	0.03019	0.047	0.047	0.0	2928.0	2928.0	0.0	0.709
15	3	45.5	0.01774	0.033	0.033	0.0	5695.1	5695.1	0.0	0.798
16	3	48.5	0.01941	0.034	0.034	0.0	5544.8	5544.8	0.0	0.786

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 9

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00442	0.027	0.027	0.0	2996.3	2996.5	0.0	0.868
2	1	5.5	0.01166	0.042	0.042	0.0	2804.3	2804.7	0.0	0.727
3	1	8.5	0.01480	0.048	0.048	0.0	2812.7	2813.1	0.0	0.684
4	1	11.5	0.01174	0.043	0.043	0.0	4166.6	4166.5	0.0	0.726
5	1	14.5	0.01912	0.053	0.053	0.0	3185.0	3185.3	0.0	0.638
6	1	17.5	0.02754	0.064	0.064	0.0	2588.7	2589.1	0.0	0.569
7	1	20.5	0.02757	0.064	0.064	0.0	2834.0	2834.3	0.0	0.569
8	1	23.5	0.03570	0.072	0.072	0.0	2302.3	2302.5	0.0	0.519
9	1	26.5	0.03005	0.066	0.066	0.0	2719.3	2718.8	0.0	0.552
10	1	30.0	0.02771	0.064	0.064	0.0	2870.6	2870.3	0.0	0.567
11	3	33.5	0.03859	0.055	0.055	0.0	1945.3	1945.3	0.0	0.662
12	3	36.5	0.04026	0.056	0.056	0.0	1928.5	1928.6	0.0	0.654
13	3	39.5	0.03726	0.054	0.054	0.0	2210.5	2210.6	0.0	0.668
14	3	42.5	0.03020	0.047	0.047	0.0	2928.0	2928.0	0.0	0.709
15	3	45.5	0.01775	0.033	0.033	0.0	5695.1	5695.1	0.0	0.798
16	3	48.5	0.01941	0.034	0.034	0.0	5544.8	5544.8	0.0	0.786

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 10

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00442	0.027	0.027	0.0	2996.2	2996.3	0.0	0.867
2	1	5.5	0.01167	0.042	0.042	0.0	2804.1	2804.3	0.0	0.727
3	1	8.5	0.01480	0.048	0.048	0.0	2812.5	2812.7	0.0	0.684
4	1	11.5	0.01174	0.043	0.043	0.0	4166.6	4166.6	0.0	0.726
5	1	14.5	0.01912	0.053	0.053	0.0	3185.0	3185.0	0.0	0.638
6	1	17.5	0.02755	0.064	0.064	0.0	2588.5	2588.7	0.0	0.569
7	1	20.5	0.02757	0.064	0.064	0.0	2833.9	2834.0	0.0	0.569
8	1	23.5	0.03570	0.072	0.072	0.0	2302.2	2302.3	0.0	0.519
9	1	26.5	0.03004	0.066	0.066	0.0	2719.5	2719.3	0.0	0.552
10	1	30.0	0.02771	0.064	0.064	0.0	2870.7	2870.6	0.0	0.568
11	3	33.5	0.03859	0.055	0.055	0.0	1945.3	1945.3	0.0	0.662
12	3	36.5	0.04026	0.056	0.056	0.0	1928.4	1928.5	0.0	0.653
13	3	39.5	0.03726	0.054	0.054	0.0	2210.4	2210.5	0.0	0.668
14	3	42.5	0.03020	0.047	0.047	0.0	2928.0	2928.0	0.0	0.709
15	3	45.5	0.01775	0.033	0.033	0.0	5695.1	5695.1	0.0	0.798
16	3	48.5	0.01941	0.034	0.034	0.0	5544.8	5544.8	0.0	0.786

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	1	4.0000	2.0000	0.00680	203.83	2.66
2	1	3.0000	5.5000	0.01795	503.32	2.66
3	1	3.0000	8.5000	0.02277	640.40	2.66
4	1	3.0000	11.5000	0.01807	752.80	3.70
5	1	3.0000	14.5000	0.02941	936.76	2.53
6	1	3.0000	17.5000	0.04238	1097.16	2.53
7	1	3.0000	20.5000	0.04242	1202.23	2.53
8	1	3.0000	23.5000	0.05493	1264.58	2.53
9	1	3.0000	26.5000	0.04621	1256.70	2.52
10	1	4.0000	30.0000	0.04262	1223.56	2.52
11	3	3.0000	33.5000	0.05937	1154.87	2.51
12	3	3.0000	36.5000	0.06194	1194.58	2.51
13	3	3.0000	39.5000	0.05733	1267.25	2.50
14	3	3.0000	42.5000	0.04645	1360.19	2.61
15	3	3.0000	45.5000	0.02730	1554.78	2.61
16	3	3.0000	48.5000	0.02986	1655.45	2.61

PERIOD = 0.23 FROM AVERAGE SHEAR VEL. = 858.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 11.36
FOR FREQUENCY = 4.16 C/SEC.
PERIOD = 0.24 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	QUIET ZONE	ACC. RATIO ACC. RECORD	TH SAVED
OUTCR.	0.0000	0.78263	2.66	16.34	0.000	2048	
WITHIN	4.0000	0.62639	2.66	13.00	0.000	2048	
WITHIN	7.0000	0.49396	2.53	9.03	0.000	2048	
WITHIN	10.0000	0.51802	2.52	13.18	0.001	2048	
WITHIN	13.0000	0.56972	2.64	15.80	0.001	2048	
WITHIN	16.0000	0.59373	2.64	15.62	0.000	2048	
WITHIN	19.0000	0.52701	2.60	15.73	0.001	2048	
WITHIN	22.0000	0.56754	2.60	17.30	0.001	2048	
WITHIN	25.0000	0.50592	5.10	17.66	0.000	2048	
WITHIN	28.0000	0.54159	5.10	17.27	0.001	2048	
WITHIN	32.0000	0.72089	2.62	17.70	0.001	2048	
WITHIN	35.0000	0.66940	2.62	19.11	0.000	2048	
WITHIN	38.0000	0.81377	2.61	20.61	0.001	2048	
WITHIN	41.0000	0.68058	2.61	21.13	0.001	2048	
WITHIN	44.0000	0.53553	2.59	20.65	0.001	2048	

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	QUIET ZONE	ACC. RATIO ACC. RECORD	TH SAVED
WITHIN	47.0000	0.48479	3.91	19.81	0.001	2048	
WITHIN	50.0000	0.48665	2.58	19.10	0.001	2048	

OUTCR.	50.0000	0.55791	2.58	20.41	0.001	2048

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 1 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 1 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 2 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 2 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 3 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 3 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 4 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 4 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 5 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 5 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 6 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC3005 Layer 6 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 7 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 7 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 8 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 8 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 9 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 9 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 10 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 10 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 11 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 11 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 12 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 12 Strain

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1****** OPTION  7 *** COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  13
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 13 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  13
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 13 Strain

1****** OPTION  7 *** COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  14
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 14 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  14
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 14 Strain

1****** OPTION  7 *** COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  15
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 15 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  15
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 15 Strain

1****** OPTION  7 *** COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  16
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 16 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  16
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 16 Strain

1****** OPTION  9 *** COMPUTE RESPONSE SPECTRUM
 RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER      1
CALCULATED FOR DAMPING      0.050

  TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
    TD = TIME FOR MAX. RELATIVE DISP.
    TV = TIME FOR MAX. RELATIVE VEL.
    TA = TIME FOR MAX. ABSOLUTE ACC.
  DAMPING RATIO = 0.050
  PER = 0.01   TIMES FOR MAXIMA --  TD =  2.6500  TV =  2.5600  TA =  2.6500
  PER = 0.02   TIMES FOR MAXIMA --  TD =  2.6500  TV =  2.6400  TA =  2.6500
  PER = 0.03   TIMES FOR MAXIMA --  TD =  3.0100  TV =  2.6600  TA =  3.6900
  PER = 0.04   TIMES FOR MAXIMA --  TD =  3.6900  TV =  2.6700  TA =  3.6900
  PER = 0.05   TIMES FOR MAXIMA --  TD =  4.9000  TV =  4.9100  TA =  4.9000
  PER = 0.06   TIMES FOR MAXIMA --  TD =  4.3800  TV =  4.3900  TA =  4.3700
  PER = 0.07   TIMES FOR MAXIMA --  TD =  2.5200  TV =  4.3700  TA =  2.5200
  PER = 0.08   TIMES FOR MAXIMA --  TD =  5.2700  TV =  2.9200  TA =  5.2700
  PER = 0.09   TIMES FOR MAXIMA --  TD =  2.5900  TV =  2.6100  TA =  2.5800
  PER = 0.10   TIMES FOR MAXIMA --  TD =  2.5900  TV =  2.5700  TA =  2.5900
  PER = 0.11   TIMES FOR MAXIMA --  TD =  2.6000  TV =  2.5800  TA =  2.6000
  PER = 0.12   TIMES FOR MAXIMA --  TD =  2.6100  TV =  2.5800  TA =  2.6000
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PER = 0.13	TIMES FOR MAXIMA --	TD = 5.4500	TV = 3.7500	TA = 5.4500
PER = 0.14	TIMES FOR MAXIMA --	TD = 2.6000	TV = 3.7700	TA = 2.6000
PER = 0.15	TIMES FOR MAXIMA --	TD = 4.1500	TV = 4.2000	TA = 4.1500
PER = 0.16	TIMES FOR MAXIMA --	TD = 2.6100	TV = 4.2100	TA = 2.6100
PER = 0.17	TIMES FOR MAXIMA --	TD = 4.2800	TV = 4.3200	TA = 4.2700
PER = 0.18	TIMES FOR MAXIMA --	TD = 1.4300	TV = 2.5800	TA = 1.4200
PER = 0.19	TIMES FOR MAXIMA --	TD = 2.7500	TV = 2.7000	TA = 2.7400
PER = 0.20	TIMES FOR MAXIMA --	TD = 6.6800	TV = 6.7400	TA = 6.6800
PER = 0.21	TIMES FOR MAXIMA --	TD = 7.1300	TV = 7.0800	TA = 7.1300
PER = 0.22	TIMES FOR MAXIMA --	TD = 7.1500	TV = 7.0900	TA = 7.1400
PER = 0.23	TIMES FOR MAXIMA --	TD = 7.2800	TV = 3.4400	TA = 7.2800
PER = 0.24	TIMES FOR MAXIMA --	TD = 2.4100	TV = 2.3500	TA = 2.2900
PER = 0.25	TIMES FOR MAXIMA --	TD = 6.4100	TV = 6.4800	TA = 6.4100
PER = 0.26	TIMES FOR MAXIMA --	TD = 6.3100	TV = 6.3700	TA = 6.3100
PER = 0.27	TIMES FOR MAXIMA --	TD = 1.6200	TV = 6.2700	TA = 1.6200
PER = 0.28	TIMES FOR MAXIMA --	TD = 1.6400	TV = 1.3200	TA = 1.6400
PER = 0.29	TIMES FOR MAXIMA --	TD = 5.2000	TV = 1.3200	TA = 5.2000
PER = 0.30	TIMES FOR MAXIMA --	TD = 5.2300	TV = 5.1500	TA = 5.2200
PER = 0.31	TIMES FOR MAXIMA --	TD = 2.9700	TV = 2.9000	TA = 2.9600
PER = 0.32	TIMES FOR MAXIMA --	TD = 2.9900	TV = 2.9000	TA = 2.9800
PER = 0.33	TIMES FOR MAXIMA --	TD = 3.0000	TV = 2.9100	TA = 3.0000
PER = 0.34	TIMES FOR MAXIMA --	TD = 3.0100	TV = 2.7800	TA = 3.0000
PER = 0.35	TIMES FOR MAXIMA --	TD = 3.0100	TV = 2.7800	TA = 3.0100
PER = 0.36	TIMES FOR MAXIMA --	TD = 2.7100	TV = 2.7800	TA = 2.7000
PER = 0.37	TIMES FOR MAXIMA --	TD = 2.7100	TV = 2.7900	TA = 2.7100
PER = 0.38	TIMES FOR MAXIMA --	TD = 2.7200	TV = 2.6600	TA = 2.7100
PER = 0.39	TIMES FOR MAXIMA --	TD = 4.1300	TV = 2.6600	TA = 2.7200
PER = 0.40	TIMES FOR MAXIMA --	TD = 4.1400	TV = 2.6600	TA = 4.1300
PER = 0.41	TIMES FOR MAXIMA --	TD = 4.1600	TV = 4.0800	TA = 4.1500
PER = 0.42	TIMES FOR MAXIMA --	TD = 4.1700	TV = 4.0900	TA = 3.9800
PER = 0.43	TIMES FOR MAXIMA --	TD = 4.0000	TV = 4.0900	TA = 3.9900
PER = 0.44	TIMES FOR MAXIMA --	TD = 4.6700	TV = 4.0900	TA = 4.6600
PER = 0.45	TIMES FOR MAXIMA --	TD = 4.6900	TV = 4.1000	TA = 4.6800
PER = 0.46	TIMES FOR MAXIMA --	TD = 4.7100	TV = 4.1000	TA = 4.7000
PER = 0.47	TIMES FOR MAXIMA --	TD = 4.5100	TV = 2.6600	TA = 4.5000
PER = 0.48	TIMES FOR MAXIMA --	TD = 4.5200	TV = 2.6600	TA = 5.5300
PER = 0.49	TIMES FOR MAXIMA --	TD = 5.5500	TV = 2.6600	TA = 5.5400
PER = 0.50	TIMES FOR MAXIMA --	TD = 5.5600	TV = 2.6600	TA = 5.5500
PER = 0.51	TIMES FOR MAXIMA --	TD = 5.5700	TV = 2.6600	TA = 5.5600
PER = 0.52	TIMES FOR MAXIMA --	TD = 5.5700	TV = 2.6600	TA = 5.5700
PER = 0.53	TIMES FOR MAXIMA --	TD = 2.7500	TV = 2.6600	TA = 2.7500
PER = 0.54	TIMES FOR MAXIMA --	TD = 2.7600	TV = 2.6600	TA = 2.7500
PER = 0.55	TIMES FOR MAXIMA --	TD = 2.5600	TV = 2.6600	TA = 2.5600
PER = 0.56	TIMES FOR MAXIMA --	TD = 2.5600	TV = 2.6600	TA = 2.5600
PER = 0.57	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.6600	TA = 2.5600
PER = 0.58	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.6600	TA = 2.5600
PER = 0.60	TIMES FOR MAXIMA --	TD = 2.5800	TV = 2.6600	TA = 2.5700
PER = 0.62	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.6600	TA = 2.5700
PER = 0.64	TIMES FOR MAXIMA --	TD = 2.6100	TV = 2.5400	TA = 2.6000
PER = 0.66	TIMES FOR MAXIMA --	TD = 2.6200	TV = 2.5400	TA = 2.6100
PER = 0.68	TIMES FOR MAXIMA --	TD = 2.6300	TV = 2.5400	TA = 2.6100
PER = 0.70	TIMES FOR MAXIMA --	TD = 3.4700	TV = 2.5400	TA = 3.4600
PER = 0.72	TIMES FOR MAXIMA --	TD = 3.4800	TV = 2.5400	TA = 3.4700
PER = 0.74	TIMES FOR MAXIMA --	TD = 3.4900	TV = 2.5400	TA = 3.4800
PER = 0.76	TIMES FOR MAXIMA --	TD = 3.4900	TV = 1.6000	TA = 3.4800
PER = 0.78	TIMES FOR MAXIMA --	TD = 1.5000	TV = 1.6000	TA = 1.4900
PER = 0.80	TIMES FOR MAXIMA --	TD = 1.5100	TV = 1.6000	TA = 1.5000
PER = 0.82	TIMES FOR MAXIMA --	TD = 1.5100	TV = 6.2900	TA = 1.5000
PER = 0.84	TIMES FOR MAXIMA --	TD = 3.5000	TV = 6.2900	TA = 3.4800
PER = 0.86	TIMES FOR MAXIMA --	TD = 3.5000	TV = 6.3000	TA = 3.4800
PER = 0.88	TIMES FOR MAXIMA --	TD = 3.5100	TV = 5.9400	TA = 3.4900

PER = 0.90	TIMES FOR MAXIMA --	TD = 4.0400	TV = 4.2900	TA = 4.0200
PER = 0.92	TIMES FOR MAXIMA --	TD = 4.0600	TV = 4.2900	TA = 4.0500
PER = 0.94	TIMES FOR MAXIMA --	TD = 4.0600	TV = 4.2900	TA = 4.0600
PER = 0.96	TIMES FOR MAXIMA --	TD = 4.0700	TV = 4.3500	TA = 4.0600
PER = 0.98	TIMES FOR MAXIMA --	TD = 3.1800	TV = 4.3500	TA = 3.1700
PER = 1.00	TIMES FOR MAXIMA --	TD = 3.1800	TV = 3.4600	TA = 3.1700
PER = 1.05	TIMES FOR MAXIMA --	TD = 3.2100	TV = 3.4600	TA = 3.1800
PER = 1.10	TIMES FOR MAXIMA --	TD = 3.2500	TV = 2.5400	TA = 3.2400
PER = 1.15	TIMES FOR MAXIMA --	TD = 3.2700	TV = 2.5400	TA = 3.2400
PER = 1.20	TIMES FOR MAXIMA --	TD = 3.3700	TV = 2.5400	TA = 3.3500
PER = 1.25	TIMES FOR MAXIMA --	TD = 3.4000	TV = 2.5400	TA = 3.3800
PER = 1.30	TIMES FOR MAXIMA --	TD = 3.4100	TV = 2.5400	TA = 2.8600
PER = 1.35	TIMES FOR MAXIMA --	TD = 2.8800	TV = 2.5400	TA = 2.8600
PER = 1.40	TIMES FOR MAXIMA --	TD = 2.8800	TV = 2.5400	TA = 2.8700
PER = 1.45	TIMES FOR MAXIMA --	TD = 2.8900	TV = 2.5400	TA = 2.8700
PER = 1.50	TIMES FOR MAXIMA --	TD = 2.8900	TV = 2.5400	TA = 2.8700
PER = 1.55	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5400	TA = 2.8700
PER = 1.60	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5400	TA = 2.8700
PER = 1.65	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.5400	TA = 2.8700
PER = 1.70	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.5400	TA = 2.8700
PER = 1.75	TIMES FOR MAXIMA --	TD = 5.9000	TV = 2.5400	TA = 5.8600
PER = 1.80	TIMES FOR MAXIMA --	TD = 5.9000	TV = 2.5400	TA = 5.8900
PER = 1.85	TIMES FOR MAXIMA --	TD = 5.9200	TV = 2.5400	TA = 5.8900
PER = 1.90	TIMES FOR MAXIMA --	TD = 6.1100	TV = 2.5400	TA = 6.1000
PER = 1.95	TIMES FOR MAXIMA --	TD = 6.1200	TV = 2.5400	TA = 6.1000
PER = 2.00	TIMES FOR MAXIMA --	TD = 5.4200	TV = 2.5400	TA = 5.4000
PER = 2.05	TIMES FOR MAXIMA --	TD = 5.4200	TV = 2.5400	TA = 5.4000
PER = 2.10	TIMES FOR MAXIMA --	TD = 5.4300	TV = 2.5400	TA = 5.4000
PER = 2.15	TIMES FOR MAXIMA --	TD = 5.4300	TV = 2.5400	TA = 5.4100
PER = 2.20	TIMES FOR MAXIMA --	TD = 8.7600	TV = 2.5400	TA = 5.4100
PER = 2.25	TIMES FOR MAXIMA --	TD = 8.9500	TV = 2.5400	TA = 8.9400
PER = 2.30	TIMES FOR MAXIMA --	TD = 8.9600	TV = 2.5400	TA = 8.9400
PER = 2.35	TIMES FOR MAXIMA --	TD = 7.8900	TV = 2.5400	TA = 8.9400
PER = 2.40	TIMES FOR MAXIMA --	TD = 7.9300	TV = 2.5400	TA = 7.8800
PER = 2.50	TIMES FOR MAXIMA --	TD = 8.0900	TV = 2.5400	TA = 8.0700
PER = 2.60	TIMES FOR MAXIMA --	TD = 8.1100	TV = 2.5400	TA = 6.9300
PER = 2.70	TIMES FOR MAXIMA --	TD = 6.9600	TV = 2.5400	TA = 6.9300
PER = 2.80	TIMES FOR MAXIMA --	TD = 6.9900	TV = 2.5400	TA = 6.9300
PER = 2.90	TIMES FOR MAXIMA --	TD = 7.0000	TV = 2.5400	TA = 6.9400
PER = 3.00	TIMES FOR MAXIMA --	TD = 7.2100	TV = 2.5400	TA = 6.9400
PER = 3.10	TIMES FOR MAXIMA --	TD = 7.2100	TV = 2.5400	TA = 7.1900
PER = 3.20	TIMES FOR MAXIMA --	TD = 7.2400	TV = 2.5400	TA = 7.1900
PER = 3.30	TIMES FOR MAXIMA --	TD = 7.2400	TV = 2.5400	TA = 7.2000
PER = 3.40	TIMES FOR MAXIMA --	TD = 7.2500	TV = 2.5400	TA = 7.2000
PER = 3.50	TIMES FOR MAXIMA --	TD = 7.2500	TV = 2.5400	TA = 7.2000
PER = 3.60	TIMES FOR MAXIMA --	TD = 7.5100	TV = 2.5400	TA = 7.2000
PER = 3.70	TIMES FOR MAXIMA --	TD = 7.5100	TV = 2.5400	TA = 7.4500
PER = 3.80	TIMES FOR MAXIMA --	TD = 7.5100	TV = 2.5400	TA = 7.4500
PER = 3.90	TIMES FOR MAXIMA --	TD = 7.5200	TV = 2.5400	TA = 7.5000
PER = 4.00	TIMES FOR MAXIMA --	TD = 7.5200	TV = 2.5400	TA = 7.5000
PER = 4.10	TIMES FOR MAXIMA --	TD = 6.2200	TV = 2.5400	TA = 6.2100
PER = 4.20	TIMES FOR MAXIMA --	TD = 6.2300	TV = 2.5400	TA = 6.2100
PER = 4.30	TIMES FOR MAXIMA --	TD = 6.2300	TV = 2.5400	TA = 6.2100
PER = 4.40	TIMES FOR MAXIMA --	TD = 6.2300	TV = 2.5400	TA = 6.2100
PER = 4.50	TIMES FOR MAXIMA --	TD = 6.2300	TV = 2.5400	TA = 6.2100
PER = 4.60	TIMES FOR MAXIMA --	TD = 6.2400	TV = 2.5400	TA = 6.2100
PER = 4.70	TIMES FOR MAXIMA --	TD = 6.2400	TV = 2.5400	TA = 6.2100
PER = 4.80	TIMES FOR MAXIMA --	TD = 6.2400	TV = 2.5400	TA = 6.2100
PER = 4.90	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5400	TA = 6.2100
PER = 5.00	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5400	TA = 6.2100
PER = 5.10	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5400	TA = 6.2100

PER = 5.20 TIMES FOR MAXIMA -- TD = 6.2500 TV = 2.5400 TA = 6.2100
PER = 5.40 TIMES FOR MAXIMA -- TD = 6.4600 TV = 2.5400 TA = 6.2100
PER = 5.60 TIMES FOR MAXIMA -- TD = 6.4600 TV = 2.5400 TA = 6.3900
PER = 5.80 TIMES FOR MAXIMA -- TD = 6.4600 TV = 2.5400 TA = 6.3900
PER = 6.00 TIMES FOR MAXIMA -- TD = 6.4600 TV = 2.5400 TA = 6.3900
PER = 6.20 TIMES FOR MAXIMA -- TD = 4.8300 TV = 2.5400 TA = 6.3900
PER = 6.40 TIMES FOR MAXIMA -- TD = 4.8300 TV = 2.5400 TA = 4.7900
PER = 6.60 TIMES FOR MAXIMA -- TD = 4.8300 TV = 2.5400 TA = 4.7900
PER = 6.80 TIMES FOR MAXIMA -- TD = 4.8300 TV = 2.5400 TA = 4.7900
PER = 7.00 TIMES FOR MAXIMA -- TD = 4.8300 TV = 2.5400 TA = 4.7900
PER = 7.30 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5400 TA = 4.7900
PER = 7.60 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5400 TA = 4.7900
PER = 8.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5400 TA = 4.7900
PER = 8.50 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5400 TA = 4.7900
PER = 9.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5400 TA = 4.7900
PER = 9.50 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5400 TA = 4.7900
PER =10.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5400 TA = 4.7900

SPECTRAL VALUES--

(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00006	0.00167	0.03999	0.78322	0.78033	100.00
2	0.02	0.00026	0.05122	0.08202	0.78382	0.80027	50.00
3	0.03	0.00108	0.18078	0.22704	1.46295	1.47675	33.33
4	0.04	0.00261	0.33750	0.41034	2.03526	2.00174	25.00
5	0.05	0.00346	0.43096	0.43462	1.70397	1.69616	20.00
6	0.06	0.00431	0.46003	0.45174	1.47295	1.46914	16.67
7	0.07	0.00615	0.54324	0.55221	1.55899	1.53933	14.29
8	0.08	0.01065	0.80833	0.83680	2.02947	2.04107	12.50
9	0.09	0.01356	0.85832	0.94684	2.01865	2.05284	11.11
10	0.10	0.01276	0.74314	0.80165	1.59232	1.56426	10.00
11	0.11	0.01277	0.71906	0.72965	1.30370	1.29433	9.09
12	0.12	0.01000	0.54267	0.52376	0.86058	0.85167	8.33
13	0.13	0.01151	0.49621	0.55634	0.82406	0.83507	7.69
14	0.14	0.01363	0.58469	0.61172	0.86870	0.85261	7.14
15	0.15	0.01657	0.60758	0.69410	0.92263	0.90293	6.67
16	0.16	0.02129	0.85233	0.83605	1.02896	1.01962	6.25
17	0.17	0.02672	1.01990	0.98753	1.14421	1.13351	5.88
18	0.18	0.02858	0.97764	0.99756	1.09703	1.08141	5.56
19	0.19	0.03328	1.01787	1.10039	1.13696	1.13010	5.26
20	0.20	0.03758	1.20226	1.18046	1.16338	1.15172	5.00
21	0.21	0.04688	1.39571	1.40259	1.29816	1.30327	4.76
22	0.22	0.04632	1.35634	1.32282	1.17897	1.17328	4.55
23	0.23	0.04824	1.31203	1.31791	1.12619	1.11811	4.35
24	0.24	0.05152	1.41194	1.34885	1.10178	1.09667	4.17
25	0.25	0.05566	1.43482	1.39900	1.10188	1.09195	4.00
26	0.26	0.06195	1.64751	1.49710	1.12229	1.12357	3.85
27	0.27	0.06099	1.45329	1.41927	1.03721	1.02571	3.70
28	0.28	0.05723	1.37387	1.28419	0.89448	0.89494	3.57
29	0.29	0.05611	1.36106	1.21572	0.81849	0.81801	3.45
30	0.30	0.05850	1.40043	1.22528	0.79896	0.79696	3.33
31	0.31	0.06736	1.44272	1.36525	0.85946	0.85936	3.23
32	0.32	0.06993	1.46762	1.37298	0.83833	0.83722	3.13
33	0.33	0.06795	1.34520	1.29370	0.76518	0.76497	3.03
34	0.34	0.06392	1.24361	1.18127	0.68514	0.67794	2.94
35	0.35	0.05989	1.23583	1.07521	0.60655	0.59945	2.86
36	0.36	0.06142	1.21751	1.07195	0.58678	0.58103	2.78
37	0.37	0.06228	1.17271	1.05757	0.56103	0.55774	2.70
38	0.38	0.06054	1.19764	1.00098	0.51705	0.51400	2.63
39	0.39	0.05648	1.19037	0.90989	0.45839	0.45525	2.56
40	0.40	0.05927	1.13687	0.93100	0.45649	0.45417	2.50

41	0.41	0.05807	1.11252	0.88994	0.42508	0.42354	2.44
42	0.42	0.05475	1.11034	0.81908	0.38329	0.38054	2.38
43	0.43	0.05411	1.07704	0.79066	0.36065	0.35879	2.33
44	0.44	0.05536	1.01131	0.79050	0.35287	0.35057	2.27
45	0.45	0.05402	0.93265	0.75428	0.32910	0.32707	2.22
46	0.46	0.05219	0.84886	0.71285	0.30333	0.30239	2.17
47	0.47	0.05029	0.81371	0.67236	0.28053	0.27914	2.13
48	0.48	0.04866	0.79753	0.63693	0.26020	0.25893	2.08
49	0.49	0.05246	0.79265	0.67269	0.26992	0.26788	2.04
50	0.50	0.05342	0.80355	0.67134	0.26334	0.26200	2.00
51	0.51	0.05180	0.83231	0.63818	0.24561	0.24417	1.96
52	0.52	0.04865	0.87758	0.58785	0.22337	0.22059	1.92
53	0.53	0.04809	0.93468	0.57015	0.21116	0.20991	1.89
54	0.54	0.05221	0.99654	0.60750	0.22103	0.21952	1.85
55	0.55	0.05734	1.05505	0.65507	0.23612	0.23241	1.82
56	0.56	0.06460	1.10247	0.72476	0.25724	0.25254	1.79
57	0.57	0.07177	1.13256	0.79118	0.27543	0.27085	1.75
58	0.58	0.07805	1.14124	0.84547	0.28887	0.28444	1.72
59	0.60	0.08629	1.09042	0.90361	0.29756	0.29387	1.67
60	0.62	0.08911	0.96299	0.90302	0.28616	0.28421	1.61
61	0.64	0.08740	1.03335	0.85802	0.26334	0.26160	1.56
62	0.66	0.08103	1.08367	0.77141	0.23066	0.22807	1.52
63	0.68	0.07125	1.07394	0.65838	0.19145	0.18893	1.47
64	0.70	0.06624	1.01706	0.59460	0.16660	0.16575	1.43
65	0.72	0.06915	0.93131	0.60346	0.16570	0.16354	1.39
66	0.74	0.06691	0.83529	0.56812	0.15191	0.14981	1.35
67	0.76	0.06248	0.74695	0.51658	0.13491	0.13263	1.32
68	0.78	0.06052	0.72138	0.48750	0.12300	0.12196	1.28
69	0.80	0.06240	0.69158	0.49011	0.12056	0.11954	1.25
70	0.82	0.06393	0.68875	0.48986	0.11777	0.11657	1.22
71	0.84	0.06860	0.72531	0.51310	0.12115	0.11919	1.19
72	0.86	0.07725	0.73539	0.56441	0.12974	0.12806	1.16
73	0.88	0.08634	0.75330	0.61647	0.13813	0.13669	1.14
74	0.90	0.09561	0.82006	0.66746	0.14571	0.14471	1.11
75	0.92	0.10819	0.90389	0.73890	0.15775	0.15672	1.09
76	0.94	0.11793	0.95555	0.78826	0.16560	0.16363	1.06
77	0.96	0.12368	1.00369	0.80949	0.16762	0.16454	1.04
78	0.98	0.12910	1.02913	0.82769	0.16611	0.16480	1.02
79	1.00	0.13715	1.02909	0.86174	0.17011	0.16815	1.00
80	1.05	0.14851	1.09174	0.88866	0.16757	0.16515	0.95
81	1.10	0.15169	1.14814	0.86643	0.15494	0.15370	0.91
82	1.15	0.14667	1.18178	0.80136	0.13795	0.13597	0.87
83	1.20	0.13956	1.18699	0.73072	0.11941	0.11882	0.83
84	1.25	0.13697	1.17242	0.68849	0.10845	0.10748	0.80
85	1.30	0.12986	1.14560	0.62762	0.09566	0.09421	0.77
86	1.35	0.12730	1.11229	0.59250	0.08769	0.08564	0.74
87	1.40	0.12316	1.07650	0.55275	0.07933	0.07704	0.71
88	1.45	0.11805	1.04084	0.51153	0.07117	0.06884	0.69
89	1.50	0.11217	1.00684	0.46984	0.06347	0.06112	0.67
90	1.55	0.10598	0.97530	0.42959	0.05643	0.05408	0.65
91	1.60	0.09997	0.94654	0.39258	0.05013	0.04788	0.63
92	1.65	0.09422	0.92055	0.35879	0.04455	0.04243	0.61
93	1.70	0.08902	0.89719	0.32901	0.03966	0.03776	0.59
94	1.75	0.08824	0.87622	0.31683	0.03614	0.03533	0.57
95	1.80	0.09274	0.85738	0.32372	0.03612	0.03509	0.56
96	1.85	0.09291	0.84041	0.31557	0.03449	0.03328	0.54
97	1.90	0.09713	0.82507	0.32121	0.03378	0.03299	0.53
98	1.95	0.09974	0.81115	0.32139	0.03327	0.03216	0.51
99	2.00	0.11000	0.79846	0.34557	0.03500	0.03372	0.50
100	2.05	0.11860	0.78684	0.36350	0.03599	0.03460	0.49
101	2.10	0.12550	0.77617	0.37549	0.03631	0.03489	0.48

102	2.15	0.13066	0.76632	0.38184	0.03615	0.03466	0.47
103	2.20	0.13623	0.75722	0.38908	0.03558	0.03451	0.45
104	2.25	0.14321	0.74877	0.39992	0.03514	0.03468	0.44
105	2.30	0.15035	0.74093	0.41073	0.03568	0.03485	0.43
106	2.35	0.15338	0.73362	0.41008	0.03466	0.03405	0.43
107	2.40	0.15665	0.72682	0.41012	0.03379	0.03334	0.42
108	2.50	0.16142	0.71456	0.40569	0.03190	0.03167	0.40
109	2.60	0.16553	0.70389	0.40001	0.03065	0.03002	0.38
110	2.70	0.16897	0.69461	0.39320	0.02977	0.02842	0.37
111	2.80	0.17331	0.68654	0.38890	0.02840	0.02710	0.36
112	2.90	0.17569	0.67956	0.38066	0.02681	0.02561	0.34
113	3.00	0.17608	0.67353	0.36878	0.02508	0.02399	0.33
114	3.10	0.18292	0.66836	0.37074	0.02395	0.02334	0.32
115	3.20	0.18759	0.66394	0.36832	0.02314	0.02246	0.31
116	3.30	0.19006	0.66019	0.36188	0.02208	0.02140	0.30
117	3.40	0.18998	0.65703	0.35108	0.02084	0.02015	0.29
118	3.50	0.18704	0.65439	0.33578	0.01942	0.01872	0.29
119	3.60	0.18307	0.65219	0.31952	0.01787	0.01732	0.28
120	3.70	0.18376	0.65042	0.31206	0.01699	0.01646	0.27
121	3.80	0.18131	0.64898	0.29979	0.01592	0.01539	0.26
122	3.90	0.17627	0.64785	0.28398	0.01480	0.01421	0.26
123	4.00	0.16871	0.64700	0.26501	0.01360	0.01293	0.25
124	4.10	0.17178	0.64637	0.26325	0.01297	0.01253	0.24
125	4.20	0.17688	0.64596	0.26462	0.01280	0.01229	0.24
126	4.30	0.18085	0.64571	0.26426	0.01254	0.01199	0.23
127	4.40	0.18364	0.64563	0.26224	0.01223	0.01163	0.23
128	4.50	0.18531	0.64568	0.25874	0.01186	0.01122	0.22
129	4.60	0.18596	0.64581	0.25400	0.01145	0.01077	0.22
130	4.70	0.18577	0.64607	0.24835	0.01101	0.01031	0.21
131	4.80	0.18472	0.64641	0.24179	0.01055	0.00983	0.21
132	4.90	0.18295	0.64680	0.23459	0.01008	0.00934	0.20
133	5.00	0.18053	0.64728	0.22687	0.00960	0.00885	0.20
134	5.10	0.17752	0.64776	0.21870	0.00912	0.00837	0.20
135	5.20	0.17397	0.64834	0.21021	0.00865	0.00789	0.19
136	5.40	0.16800	0.64955	0.19547	0.00773	0.00706	0.19
137	5.60	0.16164	0.65082	0.18135	0.00692	0.00632	0.18
138	5.80	0.15390	0.65217	0.16672	0.00620	0.00561	0.17
139	6.00	0.14528	0.65349	0.15214	0.00554	0.00495	0.17
140	6.20	0.14320	0.65491	0.14512	0.00493	0.00457	0.16
141	6.40	0.14484	0.65625	0.14219	0.00467	0.00434	0.16
142	6.60	0.14586	0.65757	0.13886	0.00445	0.00411	0.15
143	6.80	0.14635	0.65892	0.13523	0.00423	0.00388	0.15
144	7.00	0.14639	0.66019	0.13140	0.00401	0.00366	0.14
145	7.30	0.14572	0.66202	0.12542	0.00371	0.00335	0.14
146	7.60	0.14443	0.66371	0.11940	0.00342	0.00307	0.13
147	8.00	0.14189	0.66588	0.11144	0.00307	0.00272	0.13
148	8.50	0.13782	0.66835	0.10188	0.00268	0.00234	0.12
149	9.00	0.13316	0.67056	0.09296	0.00235	0.00202	0.11
150	9.50	0.12821	0.67256	0.08480	0.00207	0.00174	0.11
151	10.00	0.12318	0.67429	0.07740	0.00183	0.00151	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.
AREA OF ACC. RESPONSE SPECTRUM = 0.499
AREA OF VEL. RESPONSE SPECTRUM = 2.275
MAX. ACCELERATION RESPONSE VALUE = 1.592
MAX. VELOCITY RESPONSE VALUE = 1.648

I****** OPTION 9 *** COMPUTE RESPONSE SPECTRUM
RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER 17
CALCULATED FOR DAMPING 0.050

TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
TD = TIME FOR MAX. RELATIVE DISP.
TV = TIME FOR MAX. RELATIVE VEL.
TA = TIME FOR MAX. ABSOLUTE ACC.
DAMPING RATIO = 0.050

PER = 0.01	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5700	TA = 2.5700
PER = 0.02	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5800	TA = 2.5700
PER = 0.03	TIMES FOR MAXIMA --	TD = 2.9500	TV = 2.9400	TA = 2.9500
PER = 0.04	TIMES FOR MAXIMA --	TD = 3.6300	TV = 2.6100	TA = 3.6300
PER = 0.05	TIMES FOR MAXIMA --	TD = 4.8700	TV = 4.8300	TA = 4.8400
PER = 0.06	TIMES FOR MAXIMA --	TD = 4.3200	TV = 4.3300	TA = 1.9700
PER = 0.07	TIMES FOR MAXIMA --	TD = 4.3300	TV = 4.3100	TA = 4.3300
PER = 0.08	TIMES FOR MAXIMA --	TD = 2.5200	TV = 2.5400	TA = 2.5200
PER = 0.09	TIMES FOR MAXIMA --	TD = 2.5300	TV = 2.6000	TA = 2.5300
PER = 0.10	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.6100	TA = 2.5900
PER = 0.11	TIMES FOR MAXIMA --	TD = 2.5500	TV = 2.5800	TA = 2.5500
PER = 0.12	TIMES FOR MAXIMA --	TD = 4.8000	TV = 2.5800	TA = 4.8000
PER = 0.13	TIMES FOR MAXIMA --	TD = 3.6600	TV = 4.7900	TA = 3.6600
PER = 0.14	TIMES FOR MAXIMA --	TD = 3.6700	TV = 3.7100	TA = 3.6700
PER = 0.15	TIMES FOR MAXIMA --	TD = 3.6800	TV = 3.7200	TA = 3.6800
PER = 0.16	TIMES FOR MAXIMA --	TD = 4.1800	TV = 4.1500	TA = 4.1800
PER = 0.17	TIMES FOR MAXIMA --	TD = 4.1100	TV = 4.1500	TA = 4.1100
PER = 0.18	TIMES FOR MAXIMA --	TD = 2.5600	TV = 2.5200	TA = 2.5600
PER = 0.19	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5300	TA = 2.5700
PER = 0.20	TIMES FOR MAXIMA --	TD = 6.6100	TV = 2.5300	TA = 6.6000
PER = 0.21	TIMES FOR MAXIMA --	TD = 2.5800	TV = 2.5300	TA = 7.0500
PER = 0.22	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5500	TA = 2.5000
PER = 0.23	TIMES FOR MAXIMA --	TD = 3.4200	TV = 7.0400	TA = 6.9800
PER = 0.24	TIMES FOR MAXIMA --	TD = 2.2400	TV = 2.2900	TA = 2.2300
PER = 0.25	TIMES FOR MAXIMA --	TD = 6.2400	TV = 6.3100	TA = 6.2400
PER = 0.26	TIMES FOR MAXIMA --	TD = 1.5600	TV = 6.3200	TA = 6.2500
PER = 0.27	TIMES FOR MAXIMA --	TD = 1.1900	TV = 1.2600	TA = 1.1900
PER = 0.28	TIMES FOR MAXIMA --	TD = 1.2100	TV = 1.2600	TA = 1.2000
PER = 0.29	TIMES FOR MAXIMA --	TD = 1.2100	TV = 5.1000	TA = 1.2100
PER = 0.30	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.8400	TA = 2.9100
PER = 0.31	TIMES FOR MAXIMA --	TD = 2.9400	TV = 2.8500	TA = 2.9400
PER = 0.32	TIMES FOR MAXIMA --	TD = 2.9500	TV = 2.5600	TA = 2.9500
PER = 0.33	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5600	TA = 2.5000
PER = 0.34	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5600	TA = 2.5000
PER = 0.35	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.5600	TA = 2.5000
PER = 0.36	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.9300	TA = 2.5000
PER = 0.37	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6000	TA = 2.5000
PER = 0.38	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.8000	TA = 2.5100
PER = 0.39	TIMES FOR MAXIMA --	TD = 2.5200	TV = 4.0300	TA = 2.5100
PER = 0.40	TIMES FOR MAXIMA --	TD = 3.9400	TV = 4.0300	TA = 3.9400
PER = 0.41	TIMES FOR MAXIMA --	TD = 3.9500	TV = 4.0400	TA = 3.9500
PER = 0.42	TIMES FOR MAXIMA --	TD = 3.9600	TV = 4.0400	TA = 3.9500
PER = 0.43	TIMES FOR MAXIMA --	TD = 3.9700	TV = 4.0500	TA = 3.9600
PER = 0.44	TIMES FOR MAXIMA --	TD = 3.9800	TV = 3.9100	TA = 3.9700
PER = 0.45	TIMES FOR MAXIMA --	TD = 4.6900	TV = 3.9100	TA = 4.6900
PER = 0.46	TIMES FOR MAXIMA --	TD = 4.7000	TV = 3.9100	TA = 4.6900
PER = 0.47	TIMES FOR MAXIMA --	TD = 4.7100	TV = 3.9100	TA = 4.7000
PER = 0.48	TIMES FOR MAXIMA --	TD = 4.7100	TV = 3.9100	TA = 4.7000
PER = 0.49	TIMES FOR MAXIMA --	TD = 5.5200	TV = 5.4100	TA = 5.5100
PER = 0.50	TIMES FOR MAXIMA --	TD = 5.5500	TV = 5.4100	TA = 5.5400
PER = 0.51	TIMES FOR MAXIMA --	TD = 5.5600	TV = 5.4100	TA = 5.5600
PER = 0.52	TIMES FOR MAXIMA --	TD = 2.5100	TV = 5.4400	TA = 2.5000
PER = 0.53	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6100	TA = 2.5000
PER = 0.54	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6300	TA = 2.5000
PER = 0.55	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6400	TA = 2.5000
PER = 0.56	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6400	TA = 2.5000

PER = 0.57 TIMES FOR MAXIMA -- TD = 2.5200 TV = 2.6400 TA = 2.5100
PER = 0.58 TIMES FOR MAXIMA -- TD = 2.5200 TV = 2.6400 TA = 2.5100
PER = 0.60 TIMES FOR MAXIMA -- TD = 2.5400 TV = 2.4800 TA = 2.5300
PER = 0.62 TIMES FOR MAXIMA -- TD = 2.5600 TV = 2.4800 TA = 2.5500
PER = 0.64 TIMES FOR MAXIMA -- TD = 2.5900 TV = 2.4800 TA = 2.5800
PER = 0.66 TIMES FOR MAXIMA -- TD = 2.6000 TV = 2.4900 TA = 2.5900
PER = 0.68 TIMES FOR MAXIMA -- TD = 3.4100 TV = 2.4900 TA = 3.4000
PER = 0.70 TIMES FOR MAXIMA -- TD = 3.4200 TV = 2.4900 TA = 3.4100
PER = 0.72 TIMES FOR MAXIMA -- TD = 3.4300 TV = 3.6100 TA = 3.4200
PER = 0.74 TIMES FOR MAXIMA -- TD = 3.4400 TV = 3.6100 TA = 3.4300
PER = 0.76 TIMES FOR MAXIMA -- TD = 1.8100 TV = 3.6100 TA = 1.7500
PER = 0.78 TIMES FOR MAXIMA -- TD = 1.4700 TV = 3.6100 TA = 1.8100
PER = 0.80 TIMES FOR MAXIMA -- TD = 1.4700 TV = 3.6100 TA = 1.4600
PER = 0.82 TIMES FOR MAXIMA -- TD = 1.4900 TV = 3.6100 TA = 1.4700
PER = 0.84 TIMES FOR MAXIMA -- TD = 6.4900 TV = 3.6200 TA = 6.4800
PER = 0.86 TIMES FOR MAXIMA -- TD = 3.4700 TV = 4.2200 TA = 3.4700
PER = 0.88 TIMES FOR MAXIMA -- TD = 4.0000 TV = 4.2200 TA = 3.9700
PER = 0.90 TIMES FOR MAXIMA -- TD = 4.0100 TV = 4.2200 TA = 4.0000
PER = 0.92 TIMES FOR MAXIMA -- TD = 4.0100 TV = 4.2900 TA = 4.0000
PER = 0.94 TIMES FOR MAXIMA -- TD = 3.1200 TV = 4.2900 TA = 3.1100
PER = 0.96 TIMES FOR MAXIMA -- TD = 3.1200 TV = 3.9100 TA = 3.1100
PER = 0.98 TIMES FOR MAXIMA -- TD = 3.1300 TV = 3.9100 TA = 3.1200
PER = 1.00 TIMES FOR MAXIMA -- TD = 3.1500 TV = 3.9100 TA = 3.1200
PER = 1.05 TIMES FOR MAXIMA -- TD = 3.2000 TV = 3.9100 TA = 3.1800
PER = 1.10 TIMES FOR MAXIMA -- TD = 3.2300 TV = 2.4900 TA = 3.2200
PER = 1.15 TIMES FOR MAXIMA -- TD = 3.3000 TV = 2.4900 TA = 3.2900
PER = 1.20 TIMES FOR MAXIMA -- TD = 3.3300 TV = 2.4900 TA = 3.3100
PER = 1.25 TIMES FOR MAXIMA -- TD = 3.3500 TV = 2.4900 TA = 3.3300
PER = 1.30 TIMES FOR MAXIMA -- TD = 3.3700 TV = 2.4900 TA = 3.3600
PER = 1.35 TIMES FOR MAXIMA -- TD = 2.8400 TV = 2.4900 TA = 2.8200
PER = 1.40 TIMES FOR MAXIMA -- TD = 2.8700 TV = 2.4900 TA = 2.8300
PER = 1.45 TIMES FOR MAXIMA -- TD = 2.9000 TV = 2.4900 TA = 2.8600
PER = 1.50 TIMES FOR MAXIMA -- TD = 2.9200 TV = 2.4900 TA = 2.8900
PER = 1.55 TIMES FOR MAXIMA -- TD = 2.9200 TV = 2.4900 TA = 2.9100
PER = 1.60 TIMES FOR MAXIMA -- TD = 2.9200 TV = 2.4900 TA = 2.9100
PER = 1.65 TIMES FOR MAXIMA -- TD = 2.9300 TV = 2.4900 TA = 2.9100
PER = 1.70 TIMES FOR MAXIMA -- TD = 2.9900 TV = 2.4900 TA = 2.3700
PER = 1.75 TIMES FOR MAXIMA -- TD = 2.3900 TV = 2.4900 TA = 2.3700
PER = 1.80 TIMES FOR MAXIMA -- TD = 5.9300 TV = 2.4900 TA = 5.9200
PER = 1.85 TIMES FOR MAXIMA -- TD = 6.0000 TV = 2.4900 TA = 5.9900
PER = 1.90 TIMES FOR MAXIMA -- TD = 6.0500 TV = 5.7600 TA = 6.0400
PER = 1.95 TIMES FOR MAXIMA -- TD = 5.3500 TV = 5.7600 TA = 5.3400
PER = 2.00 TIMES FOR MAXIMA -- TD = 5.3600 TV = 5.7600 TA = 5.3400
PER = 2.05 TIMES FOR MAXIMA -- TD = 5.3600 TV = 5.7600 TA = 5.3400
PER = 2.10 TIMES FOR MAXIMA -- TD = 5.3600 TV = 5.7600 TA = 5.3400
PER = 2.15 TIMES FOR MAXIMA -- TD = 8.7100 TV = 5.7600 TA = 5.3400
PER = 2.20 TIMES FOR MAXIMA -- TD = 8.8100 TV = 5.7600 TA = 7.6700
PER = 2.25 TIMES FOR MAXIMA -- TD = 8.8900 TV = 5.7600 TA = 8.8800
PER = 2.30 TIMES FOR MAXIMA -- TD = 7.8200 TV = 5.7600 TA = 8.8800
PER = 2.35 TIMES FOR MAXIMA -- TD = 7.8800 TV = 5.7600 TA = 7.7900
PER = 2.40 TIMES FOR MAXIMA -- TD = 7.9100 TV = 5.7600 TA = 7.8800
PER = 2.50 TIMES FOR MAXIMA -- TD = 8.0300 TV = 7.3100 TA = 8.0100
PER = 2.60 TIMES FOR MAXIMA -- TD = 8.0600 TV = 7.6400 TA = 8.0200
PER = 2.70 TIMES FOR MAXIMA -- TD = 6.9400 TV = 7.6400 TA = 6.8800
PER = 2.80 TIMES FOR MAXIMA -- TD = 6.9400 TV = 7.6500 TA = 6.8800
PER = 2.90 TIMES FOR MAXIMA -- TD = 7.0600 TV = 7.6500 TA = 6.9300
PER = 3.00 TIMES FOR MAXIMA -- TD = 7.1500 TV = 7.6500 TA = 7.0400
PER = 3.10 TIMES FOR MAXIMA -- TD = 7.1900 TV = 5.3000 TA = 7.1400
PER = 3.20 TIMES FOR MAXIMA -- TD = 7.2000 TV = 5.3000 TA = 7.1400
PER = 3.30 TIMES FOR MAXIMA -- TD = 7.2100 TV = 5.3000 TA = 7.1800
PER = 3.40 TIMES FOR MAXIMA -- TD = 7.2100 TV = 5.3000 TA = 7.1800

PER = 3.50 TIMES FOR MAXIMA -- TD = 7.2200 TV = 5.3000 TA = 7.1900
PER = 3.60 TIMES FOR MAXIMA -- TD = 7.4500 TV = 5.3000 TA = 7.3800
PER = 3.70 TIMES FOR MAXIMA -- TD = 7.4600 TV = 5.3000 TA = 7.3900
PER = 3.80 TIMES FOR MAXIMA -- TD = 7.5000 TV = 5.3000 TA = 7.4400
PER = 3.90 TIMES FOR MAXIMA -- TD = 7.5100 TV = 5.3000 TA = 7.4500
PER = 4.00 TIMES FOR MAXIMA -- TD = 7.6200 TV = 5.3000 TA = 7.4500
PER = 4.10 TIMES FOR MAXIMA -- TD = 6.1600 TV = 5.3000 TA = 6.0900
PER = 4.20 TIMES FOR MAXIMA -- TD = 6.1600 TV = 5.3000 TA = 6.1400
PER = 4.30 TIMES FOR MAXIMA -- TD = 6.1700 TV = 5.3000 TA = 6.1500
PER = 4.40 TIMES FOR MAXIMA -- TD = 6.1900 TV = 5.3000 TA = 6.1500
PER = 4.50 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.60 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.70 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.80 TIMES FOR MAXIMA -- TD = 6.3400 TV = 5.3000 TA = 6.1500
PER = 4.90 TIMES FOR MAXIMA -- TD = 6.3400 TV = 5.3000 TA = 6.1500
PER = 5.00 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.10 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.20 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.40 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.60 TIMES FOR MAXIMA -- TD = 6.5400 TV = 5.3000 TA = 6.3200
PER = 5.80 TIMES FOR MAXIMA -- TD = 6.5500 TV = 5.3000 TA = 6.5000
PER = 6.00 TIMES FOR MAXIMA -- TD = 6.5500 TV = 5.3000 TA = 6.5000
PER = 6.20 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.5200
PER = 6.40 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.7300
PER = 6.60 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.7300
PER = 6.80 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.30 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.60 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 8.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 8.50 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 9.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 9.50 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER =10.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300

SPECTRAL VALUES--
(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00005	0.00136	0.02849	0.55850	0.55584	100.00
2	0.02	0.00018	0.04499	0.05569	0.55907	0.54337	50.00
3	0.03	0.00100	0.17299	0.21036	1.35502	1.36825	33.33
4	0.04	0.00178	0.23944	0.27972	1.41661	1.36454	25.00
5	0.05	0.00238	0.31660	0.29913	1.19625	1.16738	20.00
6	0.06	0.00324	0.37402	0.33931	1.11290	1.10350	16.67
7	0.07	0.00410	0.42586	0.36768	1.00192	1.02494	14.29
8	0.08	0.00662	0.49285	0.51989	1.30592	1.26808	12.50
9	0.09	0.01058	0.74261	0.73891	1.61391	1.60203	11.11
10	0.10	0.00992	0.62974	0.62356	1.19459	1.21675	10.00
11	0.11	0.00945	0.61752	0.53978	0.94469	0.95753	9.09
12	0.12	0.00955	0.45760	0.49991	0.83422	0.81289	8.33
13	0.13	0.00942	0.48076	0.45527	0.67574	0.68335	7.69
14	0.14	0.01238	0.51781	0.55546	0.77129	0.77420	7.14
15	0.15	0.01197	0.53788	0.50127	0.65502	0.65209	6.67
16	0.16	0.01428	0.62039	0.56072	0.68796	0.68383	6.25
17	0.17	0.01619	0.69957	0.59823	0.69353	0.68666	5.88
18	0.18	0.01573	0.57102	0.54919	0.60640	0.59536	5.56
19	0.19	0.01745	0.63990	0.57695	0.59795	0.59253	5.26
20	0.20	0.01613	0.56661	0.50682	0.50024	0.49448	5.00
21	0.21	0.01674	0.60435	0.50091	0.46688	0.46544	4.76
22	0.22	0.01774	0.54424	0.50670	0.46072	0.44942	4.55
23	0.23	0.01530	0.47636	0.41797	0.35437	0.35460	4.35

24	0.24	0.01639	0.46797	0.42917	0.35591	0.34893	4.17
25	0.25	0.01736	0.48167	0.43619	0.34254	0.34046	4.00
26	0.26	0.01916	0.51490	0.46302	0.35118	0.34750	3.85
27	0.27	0.02110	0.53368	0.49104	0.35711	0.35488	3.70
28	0.28	0.02280	0.53679	0.51153	0.35936	0.35648	3.57
29	0.29	0.02363	0.56432	0.51192	0.34832	0.34445	3.45
30	0.30	0.02424	0.55960	0.50764	0.33261	0.33018	3.33
31	0.31	0.02969	0.62717	0.60171	0.38143	0.37875	3.23
32	0.32	0.03087	0.64924	0.60610	0.37197	0.36959	3.13
33	0.33	0.02956	0.62054	0.56290	0.33676	0.33284	3.03
34	0.34	0.02988	0.59171	0.55227	0.32331	0.31695	2.94
35	0.35	0.03145	0.58062	0.56451	0.32000	0.31472	2.86
36	0.36	0.03369	0.56893	0.58806	0.32211	0.31875	2.78
37	0.37	0.03527	0.58074	0.59894	0.31687	0.31587	2.70
38	0.38	0.03518	0.57848	0.58166	0.30335	0.29868	2.63
39	0.39	0.03387	0.62913	0.54565	0.27671	0.27301	2.56
40	0.40	0.03589	0.68918	0.56383	0.27621	0.27505	2.50
41	0.41	0.03816	0.69282	0.58485	0.27999	0.27835	2.44
42	0.42	0.03860	0.65645	0.57750	0.26954	0.26830	2.38
43	0.43	0.03804	0.60516	0.55578	0.25364	0.25221	2.33
44	0.44	0.03681	0.59581	0.52568	0.23464	0.23313	2.27
45	0.45	0.03653	0.60067	0.51004	0.22154	0.22117	2.22
46	0.46	0.03729	0.59047	0.50937	0.21665	0.21607	2.17
47	0.47	0.03606	0.57052	0.48207	0.20332	0.20014	2.13
48	0.48	0.03349	0.54379	0.43835	0.18014	0.17820	2.08
49	0.49	0.03413	0.51793	0.43769	0.17566	0.17430	2.04
50	0.50	0.03500	0.52157	0.43985	0.17218	0.17165	2.00
51	0.51	0.03473	0.49075	0.42793	0.16499	0.16373	1.96
52	0.52	0.03363	0.45429	0.40638	0.15517	0.15249	1.92
53	0.53	0.03853	0.46746	0.45674	0.17096	0.16816	1.89
54	0.54	0.04389	0.51448	0.51070	0.18737	0.18454	1.85
55	0.55	0.04926	0.55886	0.56278	0.20245	0.19966	1.82
56	0.56	0.05415	0.59863	0.60760	0.21441	0.21172	1.79
57	0.57	0.05848	0.62378	0.64468	0.22381	0.22070	1.75
58	0.58	0.06184	0.63106	0.66986	0.22829	0.22536	1.72
59	0.60	0.06544	0.70068	0.68529	0.22393	0.22287	1.67
60	0.62	0.06573	0.79556	0.66617	0.21124	0.20966	1.61
61	0.64	0.06527	0.83826	0.64083	0.19701	0.19538	1.56
62	0.66	0.06037	0.83336	0.57472	0.17238	0.16992	1.52
63	0.68	0.05937	0.78867	0.54857	0.15814	0.15742	1.47
64	0.70	0.06308	0.71314	0.56623	0.15969	0.15784	1.43
65	0.72	0.06124	0.63612	0.53441	0.14674	0.14483	1.39
66	0.74	0.05637	0.58189	0.47867	0.12760	0.12622	1.35
67	0.76	0.05182	0.52189	0.42839	0.11039	0.10999	1.32
68	0.78	0.05224	0.48141	0.42084	0.10620	0.10528	1.28
69	0.80	0.05347	0.46947	0.41997	0.10299	0.10244	1.25
70	0.82	0.05454	0.48106	0.41789	0.09999	0.09944	1.22
71	0.84	0.05857	0.50396	0.43810	0.10258	0.10177	1.19
72	0.86	0.06521	0.56033	0.47640	0.10880	0.10809	1.16
73	0.88	0.07540	0.63272	0.53836	0.11994	0.11938	1.14
74	0.90	0.08642	0.69483	0.60330	0.13206	0.13080	1.11
75	0.92	0.09546	0.73421	0.65194	0.14025	0.13828	1.09
76	0.94	0.10261	0.79469	0.68589	0.14302	0.14238	1.06
77	0.96	0.11124	0.85758	0.72810	0.14917	0.14799	1.04
78	0.98	0.11832	0.92962	0.75859	0.15264	0.15105	1.02
79	1.00	0.12378	0.97242	0.77774	0.15296	0.15176	1.00
80	1.05	0.13543	0.94462	0.81038	0.15223	0.15060	0.95
81	1.10	0.13936	0.91425	0.79602	0.14229	0.14121	0.91
82	1.15	0.13942	0.92776	0.76173	0.12990	0.12925	0.87
83	1.20	0.13742	0.91717	0.71955	0.11796	0.11700	0.83
84	1.25	0.13052	0.89112	0.65605	0.10342	0.10241	0.80

85	1.30	0.12014	0.85653	0.58064	0.08786	0.08715	0.77
86	1.35	0.11483	0.81840	0.53443	0.07843	0.07725	0.74
87	1.40	0.11078	0.78000	0.49719	0.06994	0.06930	0.71
88	1.45	0.10667	0.74332	0.46222	0.06255	0.06220	0.69
89	1.50	0.10247	0.70939	0.42921	0.05627	0.05583	0.67
90	1.55	0.09800	0.67864	0.39727	0.05054	0.05001	0.65
91	1.60	0.09315	0.65110	0.36578	0.04533	0.04461	0.63
92	1.65	0.08827	0.62659	0.33614	0.04056	0.03975	0.61
93	1.70	0.08406	0.60485	0.31070	0.03642	0.03566	0.59
94	1.75	0.08232	0.58554	0.29557	0.03416	0.03296	0.57
95	1.80	0.08511	0.56835	0.29710	0.03252	0.03221	0.56
96	1.85	0.09046	0.55299	0.30724	0.03299	0.03241	0.54
97	1.90	0.09369	0.55264	0.30982	0.03228	0.03182	0.53
98	1.95	0.09719	0.57669	0.31317	0.03199	0.03134	0.51
99	2.00	0.10618	0.59049	0.33357	0.03334	0.03254	0.50
100	2.05	0.11329	0.59503	0.34724	0.03395	0.03305	0.49
101	2.10	0.11848	0.59178	0.35449	0.03395	0.03294	0.48
102	2.15	0.12507	0.58239	0.36551	0.03345	0.03317	0.47
103	2.20	0.13231	0.56849	0.37788	0.03396	0.03352	0.45
104	2.25	0.14127	0.55156	0.39451	0.03461	0.03421	0.44
105	2.30	0.14555	0.53286	0.39762	0.03432	0.03373	0.43
106	2.35	0.15032	0.51341	0.40191	0.03358	0.03337	0.43
107	2.40	0.15378	0.49399	0.40261	0.03307	0.03273	0.42
108	2.50	0.16045	0.47493	0.40326	0.03175	0.03148	0.40
109	2.60	0.16086	0.46775	0.38874	0.02958	0.02918	0.38
110	2.70	0.16244	0.48295	0.37802	0.02799	0.02732	0.37
111	2.80	0.16553	0.48384	0.37144	0.02643	0.02589	0.36
112	2.90	0.16738	0.47446	0.36265	0.02483	0.02440	0.34
113	3.00	0.17264	0.45662	0.36159	0.02380	0.02352	0.33
114	3.10	0.17811	0.44595	0.36099	0.02309	0.02272	0.32
115	3.20	0.18202	0.45345	0.35740	0.02213	0.02179	0.31
116	3.30	0.18346	0.46135	0.34931	0.02109	0.02065	0.30
117	3.40	0.18236	0.46940	0.33701	0.01986	0.01934	0.29
118	3.50	0.17866	0.47735	0.32073	0.01848	0.01788	0.29
119	3.60	0.17795	0.48496	0.31058	0.01717	0.01683	0.28
120	3.70	0.17716	0.49200	0.30084	0.01615	0.01587	0.27
121	3.80	0.17389	0.49830	0.28752	0.01510	0.01476	0.26
122	3.90	0.16892	0.50375	0.27215	0.01394	0.01362	0.26
123	4.00	0.16257	0.50827	0.25536	0.01270	0.01246	0.25
124	4.10	0.16720	0.51183	0.25624	0.01240	0.01220	0.24
125	4.20	0.17130	0.51442	0.25627	0.01215	0.01191	0.24
126	4.30	0.17439	0.51608	0.25482	0.01186	0.01156	0.23
127	4.40	0.17660	0.51685	0.25219	0.01151	0.01118	0.23
128	4.50	0.17784	0.51679	0.24832	0.01111	0.01077	0.22
129	4.60	0.17820	0.51597	0.24340	0.01069	0.01033	0.22
130	4.70	0.17762	0.51446	0.23745	0.01023	0.00986	0.21
131	4.80	0.17619	0.51234	0.23064	0.00976	0.00938	0.21
132	4.90	0.17586	0.50969	0.22550	0.00929	0.00898	0.20
133	5.00	0.17475	0.50658	0.21959	0.00889	0.00857	0.20
134	5.10	0.17300	0.50308	0.21314	0.00850	0.00815	0.20
135	5.20	0.17062	0.49924	0.20616	0.00810	0.00774	0.19
136	5.40	0.16427	0.49084	0.19114	0.00731	0.00691	0.19
137	5.60	0.15767	0.48179	0.17690	0.00653	0.00616	0.18
138	5.80	0.15136	0.47242	0.16397	0.00581	0.00552	0.17
139	6.00	0.14395	0.46299	0.15074	0.00521	0.00490	0.17
140	6.20	0.14150	0.45370	0.14340	0.00485	0.00451	0.16
141	6.40	0.14276	0.44470	0.14015	0.00459	0.00427	0.16
142	6.60	0.14344	0.43607	0.13655	0.00436	0.00404	0.15
143	6.80	0.14364	0.42789	0.13273	0.00413	0.00381	0.15
144	7.00	0.14346	0.42018	0.12877	0.00392	0.00359	0.14
145	7.30	0.14249	0.40956	0.12264	0.00361	0.00328	0.14

146	7.60	0.14087	0.40837	0.11646	0.00332	0.00299	0.13
147	8.00	0.13798	0.41060	0.10837	0.00297	0.00264	0.13
148	8.50	0.13357	0.41312	0.09873	0.00259	0.00227	0.12
149	9.00	0.12865	0.41537	0.08981	0.00226	0.00195	0.11
150	9.50	0.12352	0.41738	0.08169	0.00198	0.00168	0.11
151	10.00	0.11835	0.41917	0.07436	0.00175	0.00145	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.

AREA OF ACC. RESPONSE SPECTRUM = 0.331

AREA OF VEL. RESPONSE SPECTRUM = 1.567

MAX. ACCELERATION RESPONSE VALUE = 1.195

MAX. VELOCITY RESPONSE VALUE = 0.972

*** End of Output File No. 1 ***

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Induced Cyclic Shear Stresses and Strains, and Time Histories PAGE 54 OF 187

of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M

MADE BY BEG DATE 1/7/08 CHECKED BY [illegible] DATE 1/23/08

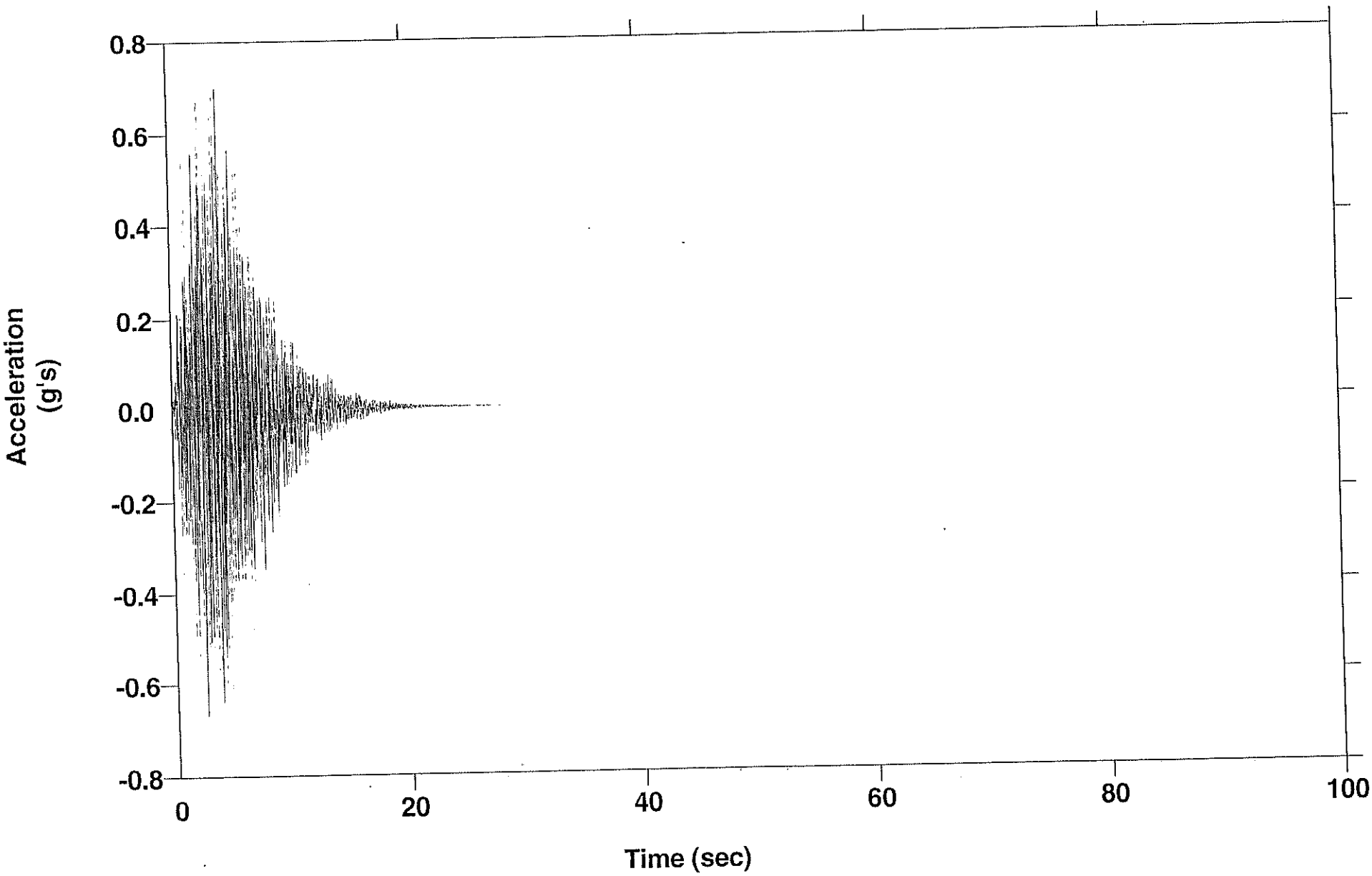
SUMMARY OF EARTHQUAKE INDUCED CYCLIC SHEAR STRESS AND STRAIN SHAKE2000 ANALYSES OUTPUT FILES FOR M6.8 BACKGROUND MDE AT 13.5 KM SHAKE2000 COLUMN PCSC300M

PCSC300M Crest Column
Williamson - Pond Creek South Cell - Surf. El. 502, GWT 32ft., Fines El. 474
M6.8 Background Synthetic @13.5km, PGA=0.54g - Atkinson & Boore (1995)

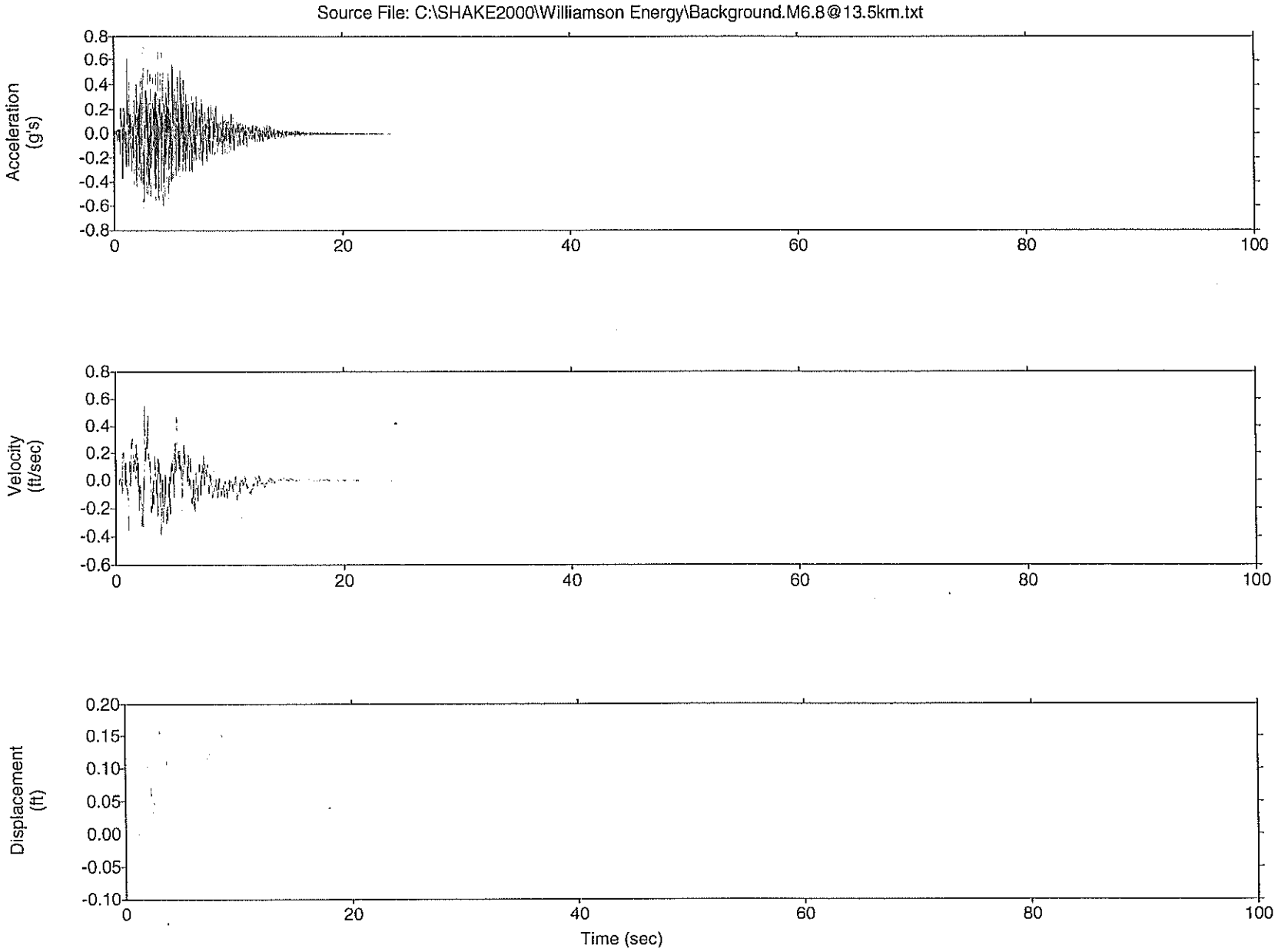
Layer	Depth to Middle of Layer (ft)	Total Unit Weight (kcf)	Damping Used (%)	Shear Modulus (ksf)	Maximum Shear Strain (%)	Maximum Shear Stress (psf)	Shear Wave Velocity (fps)	Depth to Top of Layer (ft)	Peak Acceleration (g)	G/Gmax Curve	Damping Curve
1	2	.13	2.7	2984.4	.00699	208.65	859.775	0	.82118	Coarse	Coarse
2	5.5	.13	4.3	2790.8	.01829	510.56	831.4203	4	.66221	Coarse	Coarse
3	8.5	.13	4.9	2786.4	.02359	657.19	830.7646	7	.45724	Coarse	Coarse
4	11.5	.13	4.2	4180.1	.01783	745.46	1017.536	10	.4914	Coarse	Coarse
5	14.5	.14	5.1	3242.1	.02661	862.84	863.5294	13	.47695	Coarse	Coarse
6	17.5	.14	6.3	2562.8	.04089	1047.93	767.7526	16	.48874	Coarse	Coarse
7	20.5	.14	6.4	2737.4	.04286	1173.22	793.4746	19	.46491	Coarse	Coarse
8	23.5	.14	7.3	2187.7	.05683	1243.29	709.3455	22	.51703	Coarse	Coarse
9	26.5	.14	6.7	2567.1	.04803	1232.98	768.3964	25	.52919	Coarse	Coarse
10	30	.14	6.4	2734.6	.04236	1158.3	793.0687	28	.52041	Coarse	Coarse
11	33.5	.135	5.9	1680.1	.06726	1130.04	633.0363	32	.76846	Residual	Residual
12	36.5	.135	6.1	1669.8	.07088	1183.52	631.0929	35	.80342	Residual	Residual
13	39.5	.135	5.8	1929.1	.06525	1258.79	678.3259	38	.73631	Residual	Residual
14	42.5	.135	5.2	2549.6	.05468	1394.02	779.8249	41	.6505	Residual	Residual
15	45.5	.135	3.3	5182.9	.0282	1461.76	1111.853	44	.53855	Residual	Residual
16	48.5	.135	3.5	5064.7	.03086	1562.9	1099.102	47	.52173	Residual	Residual
17	Base							50	.49204		
17	Outcrop							50	.55791		

Notes:
Period for Soil Column: .24 sec
Average Shear Wave Velocity for Soil Column: 823 ft/sec

55 / 187
R16101

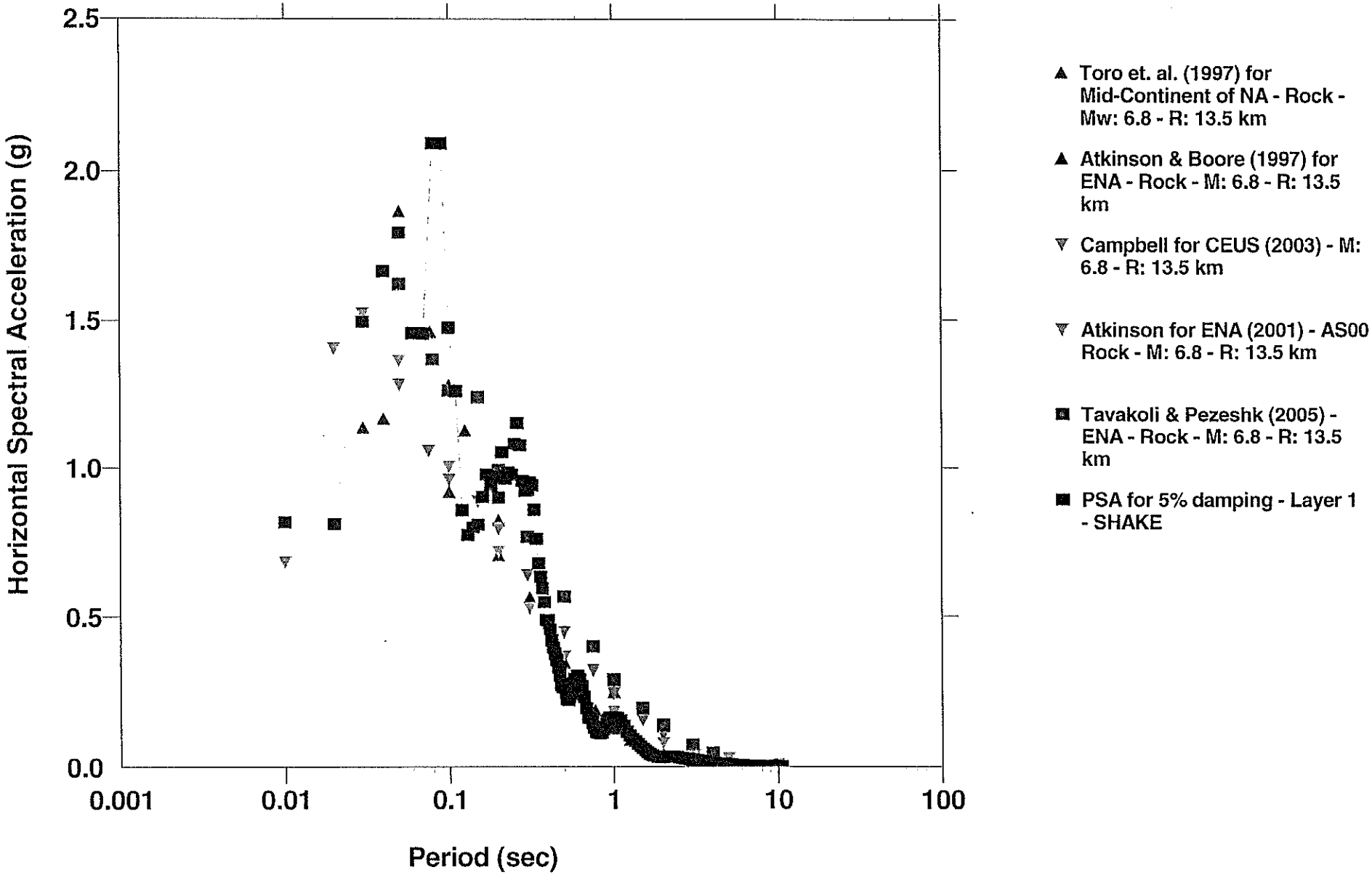

M6.8 Background Synthetic @13.5km - Atkinson & Boore (1995)
Acceleration (g's)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0
20
40
60
80
100
Time (sec)

R16102


Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt
Acceleration (g's)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0
20
40
60
80
100
Velocity (ft/sec)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
0
20
40
60
80
100
Displacement (ft)
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
0
20
40
60
80
100
Time (sec)

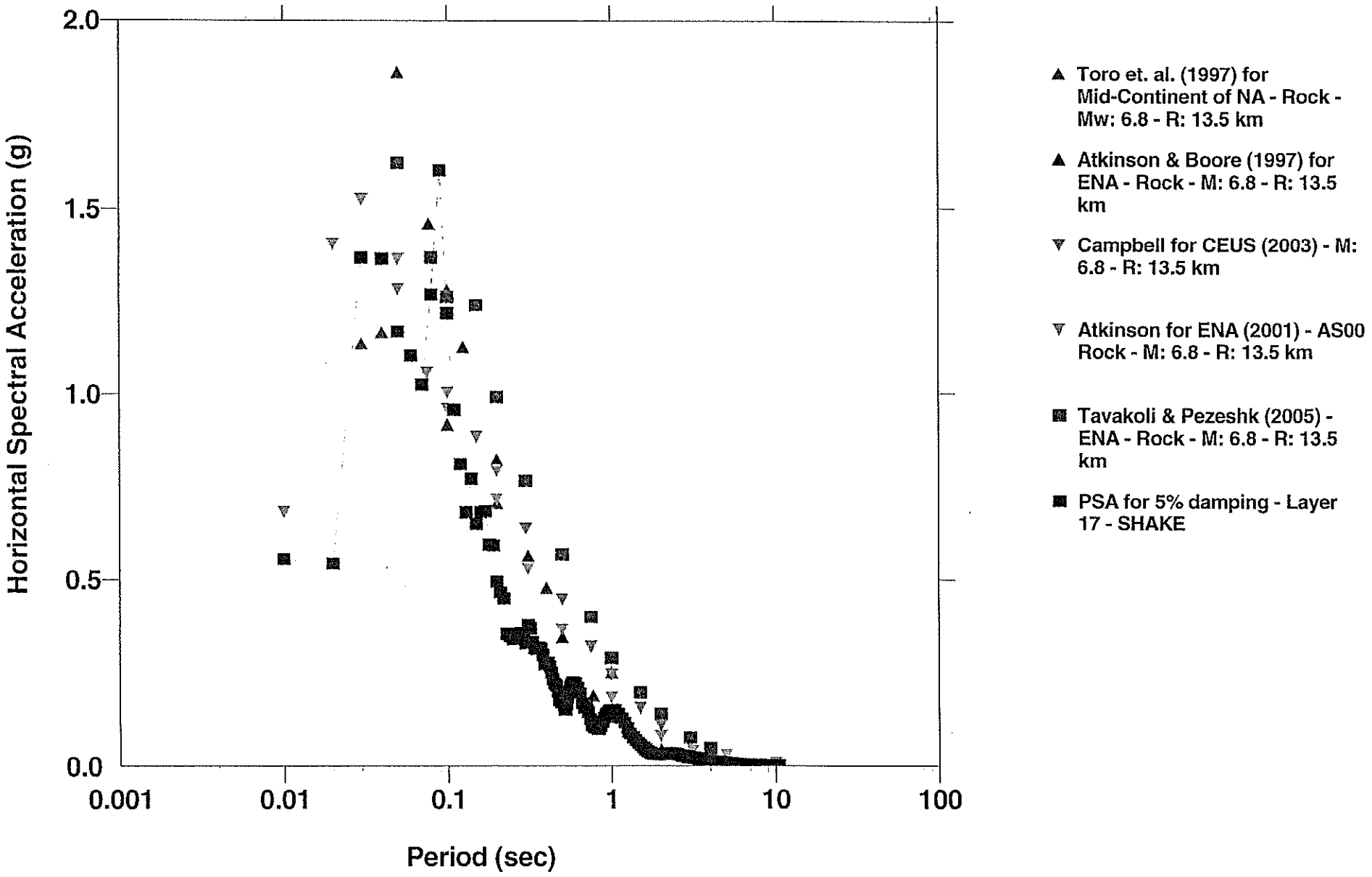
R16103

PSCS300M Crest Column - M6.8 Background Synthetic @13.5km



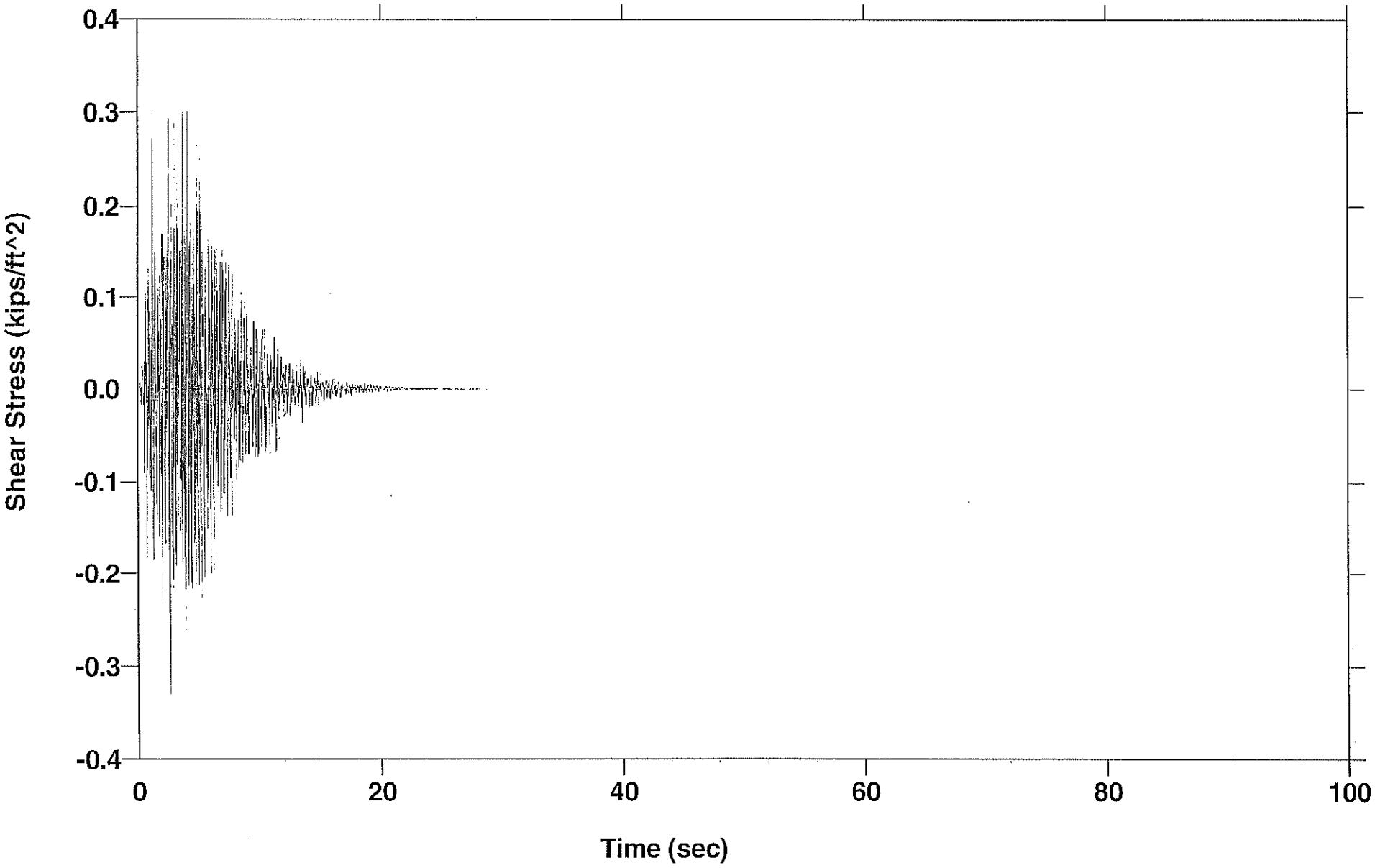
R16104

PSCS300M Crest Column - M6.8 Background Synthetic @13.5km

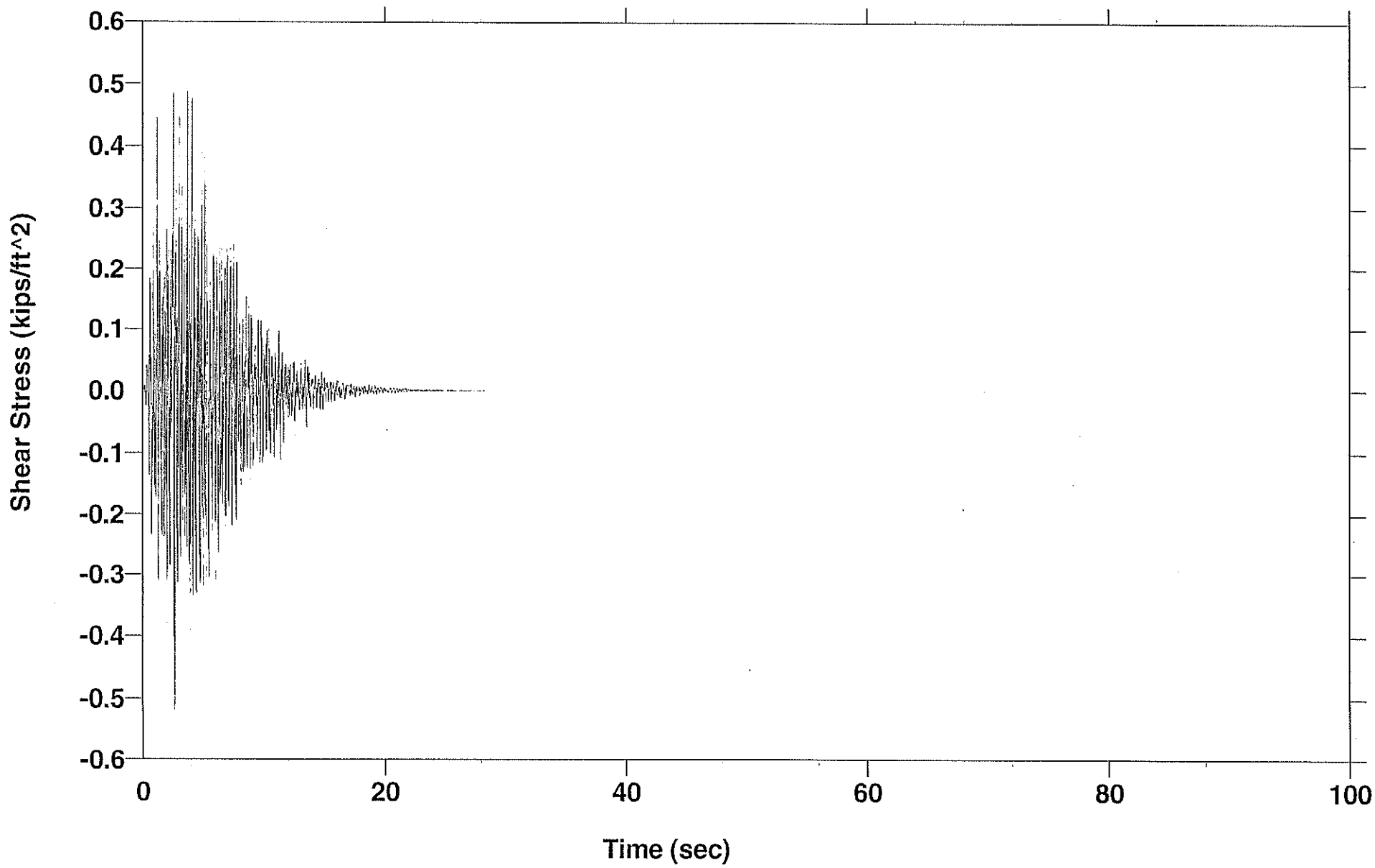


R16105

PCSC300M Layer 2 Stress - M6.8 Background Synthetic

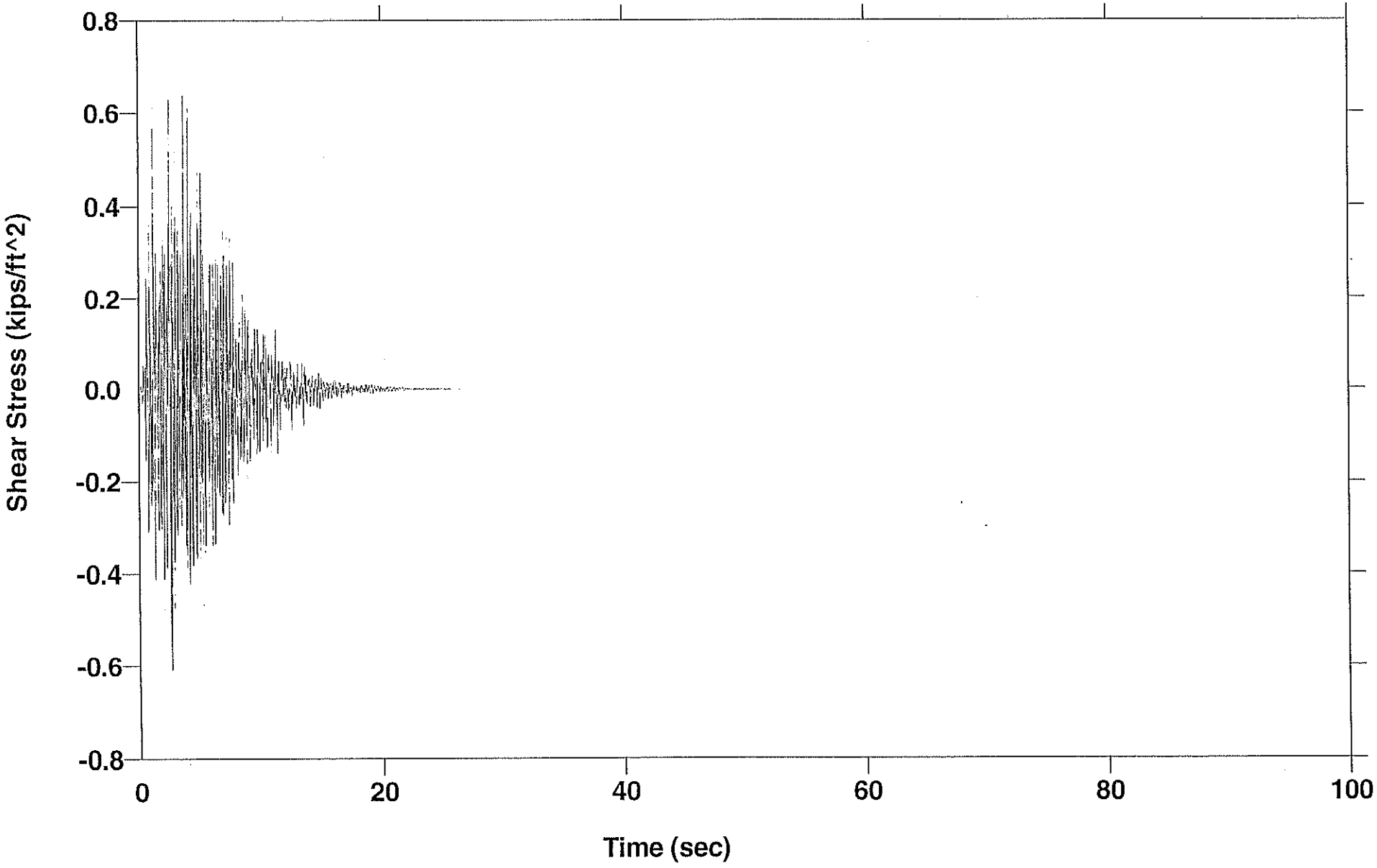


R16106


PCSC300M Layer 3 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
0
20
40
60
80
100
Time (sec)

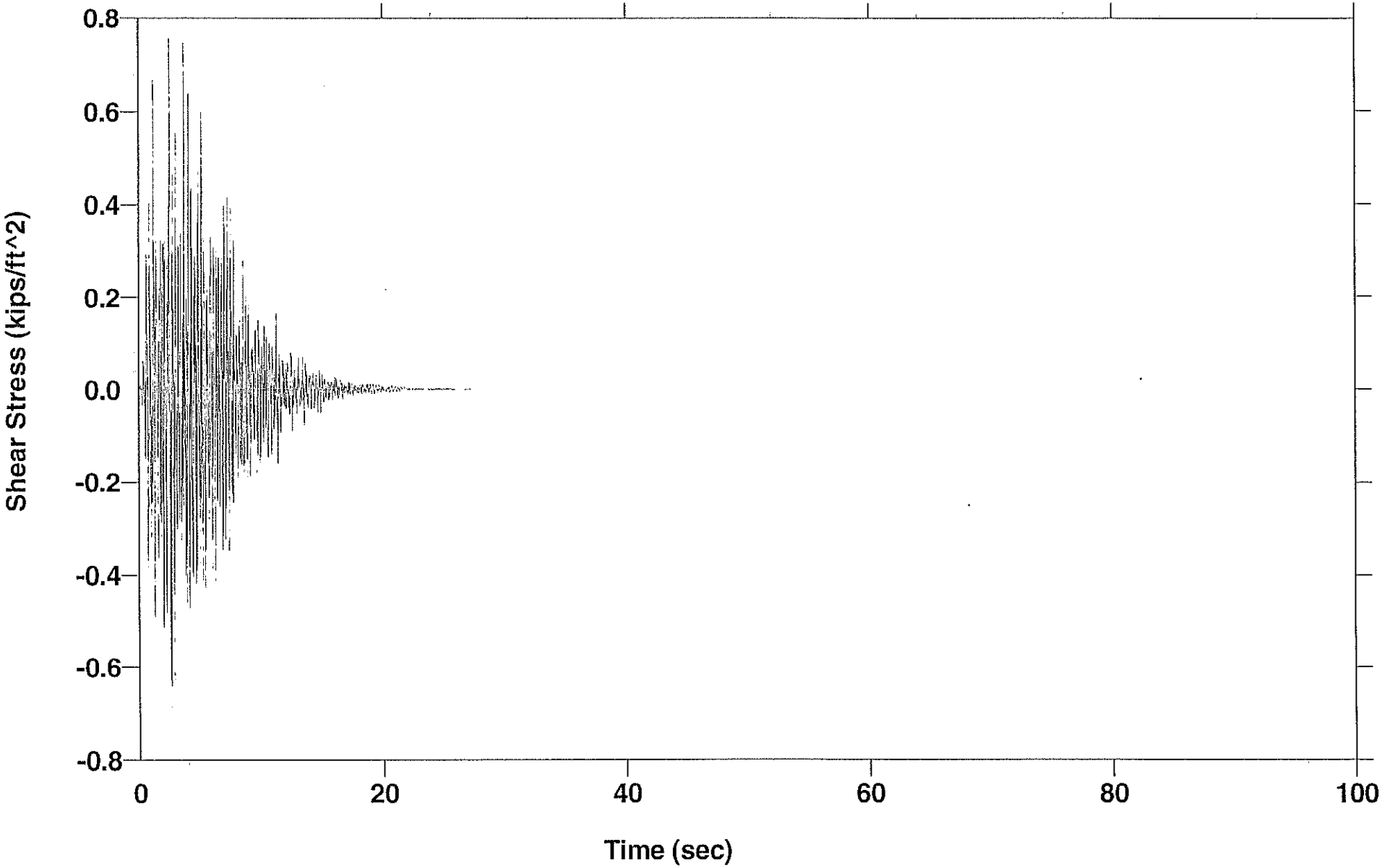
R16107

PCSC300M Layer 4 Stress - M6.8 Background Synthetic



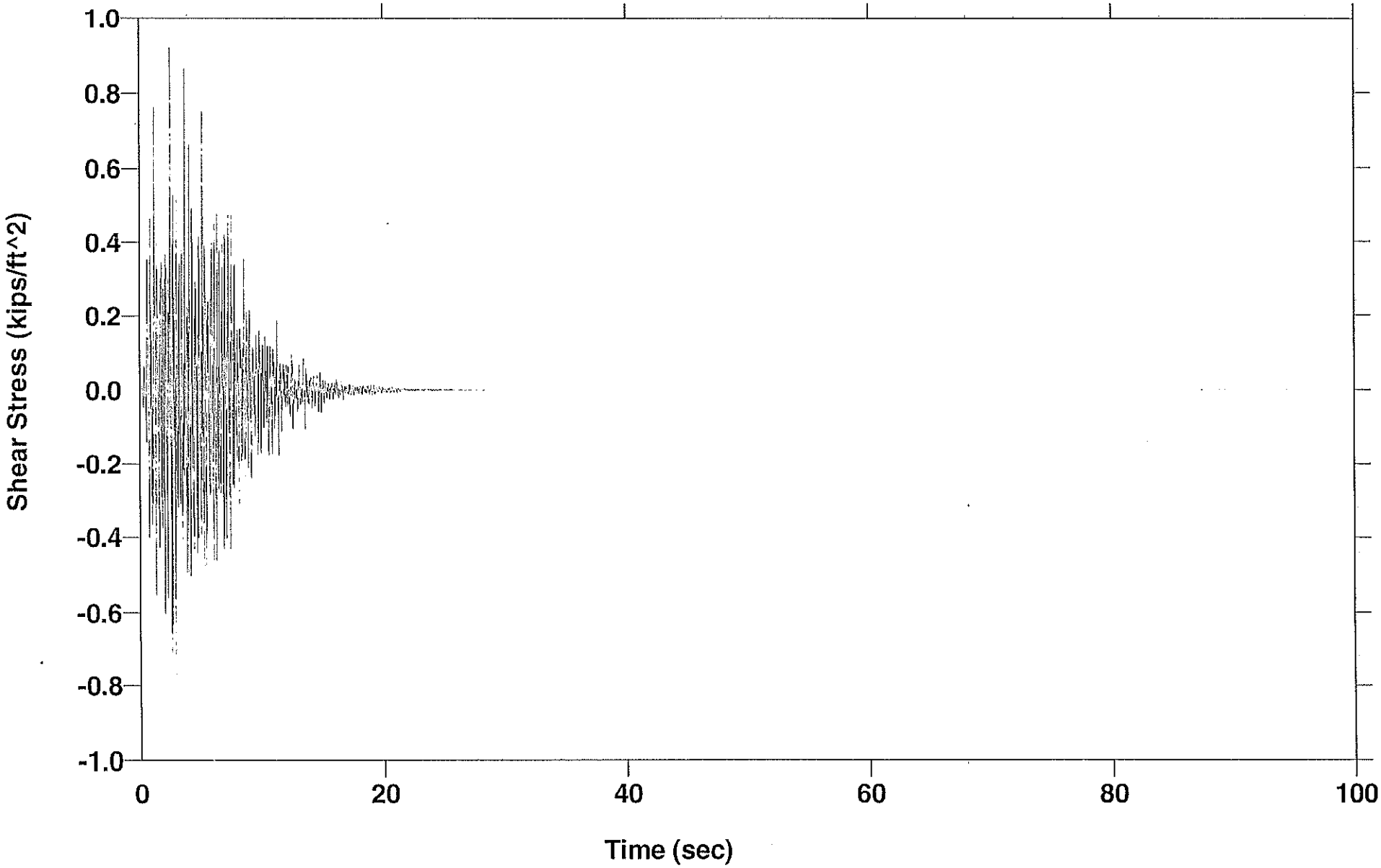
R16108

PCSC300M Layer 5 Stress - M6.8 Background Synthetic



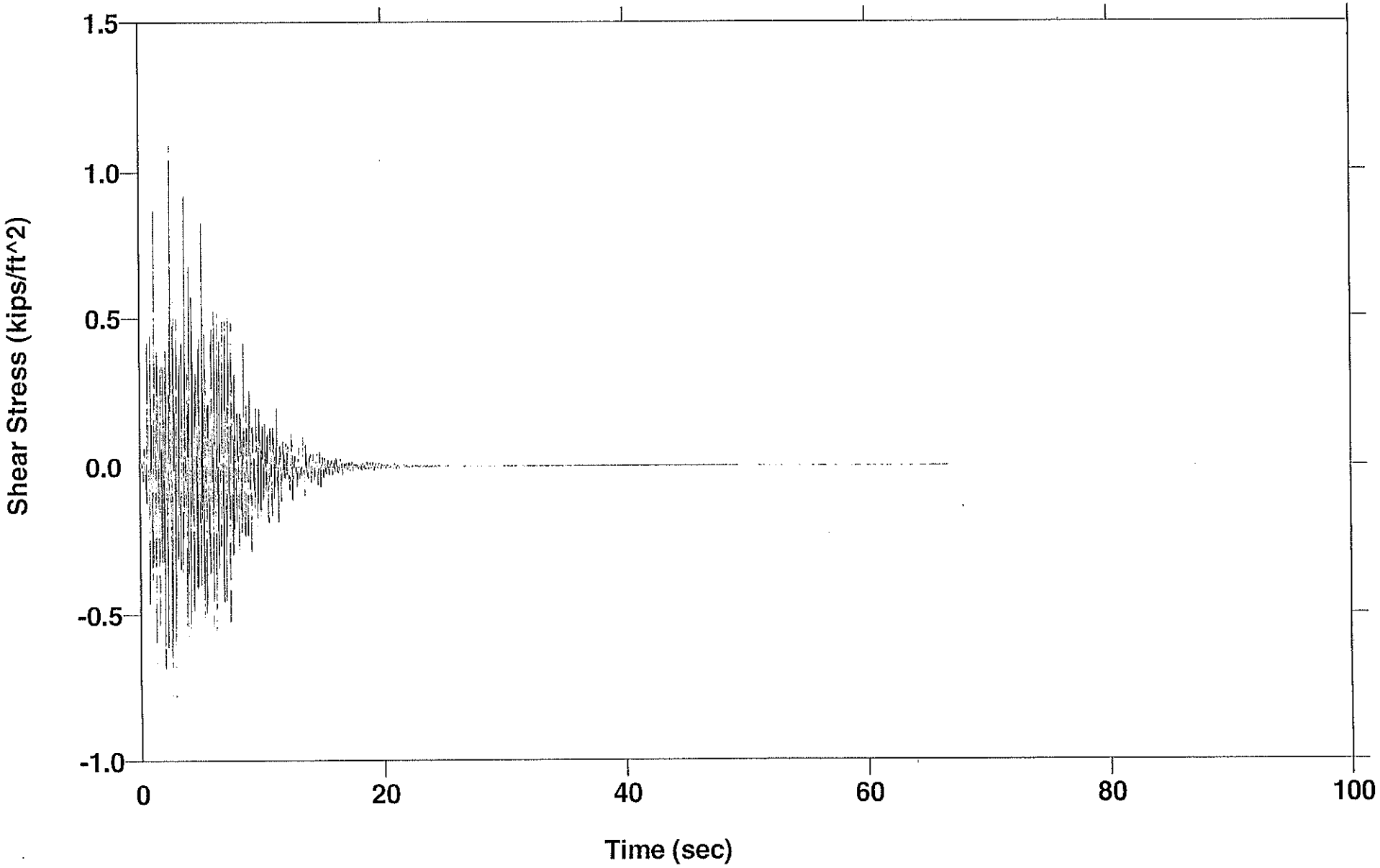
R16109

PCSC330M Layer 6 Stress - M6.8 Background Synthetic

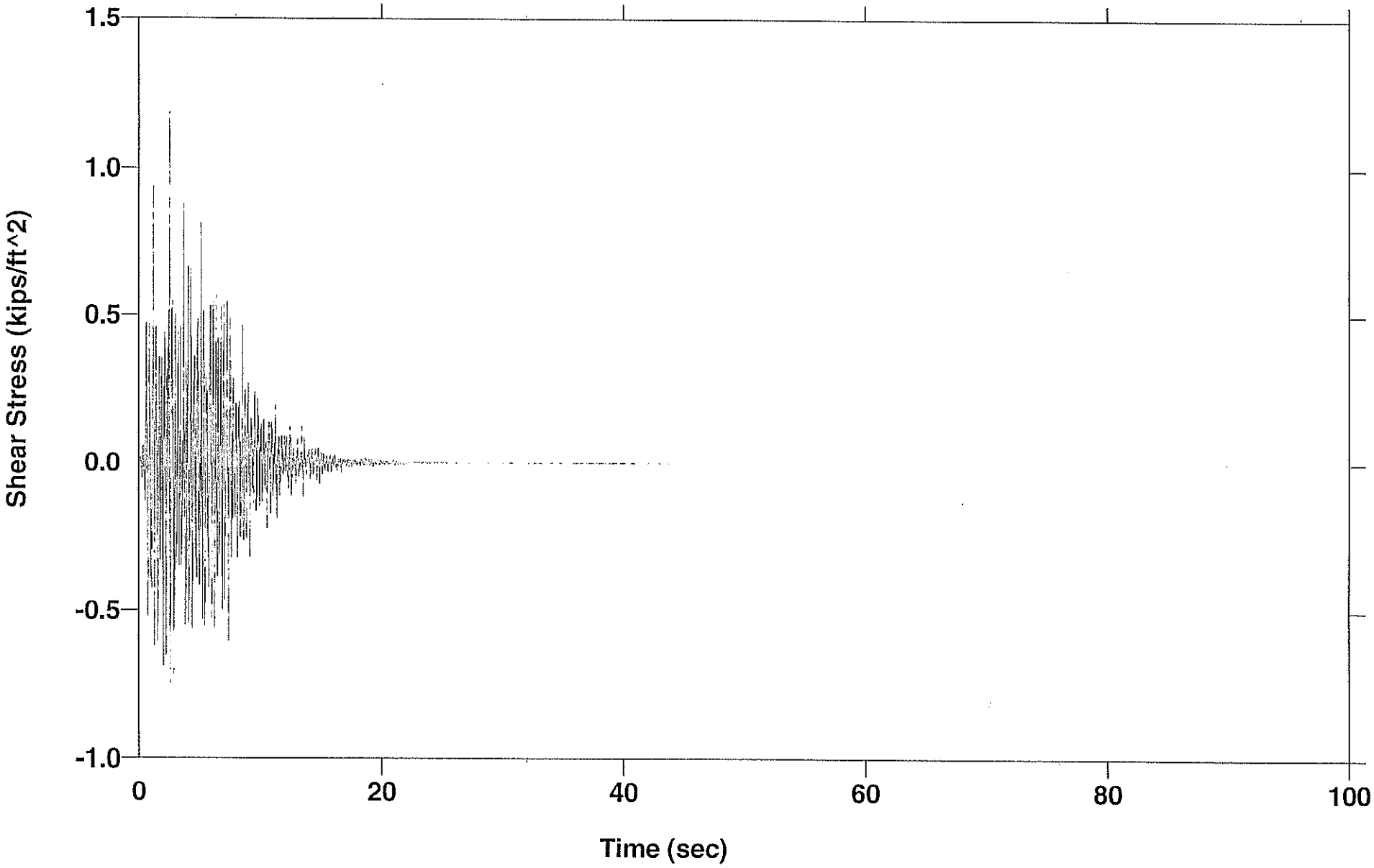


R16110

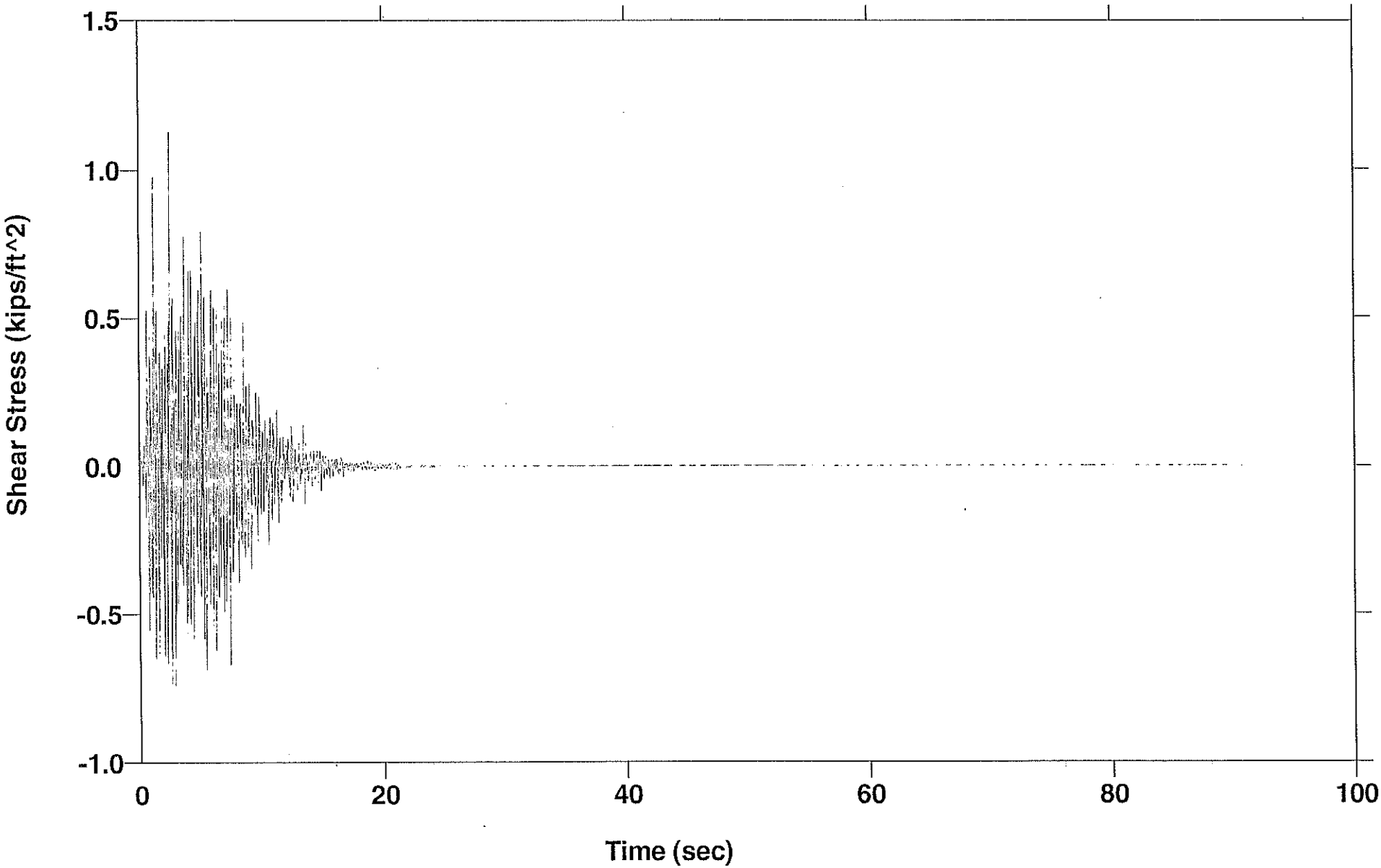
PCSC300M Layer 7 Stress - M6.8 Background Synthetic



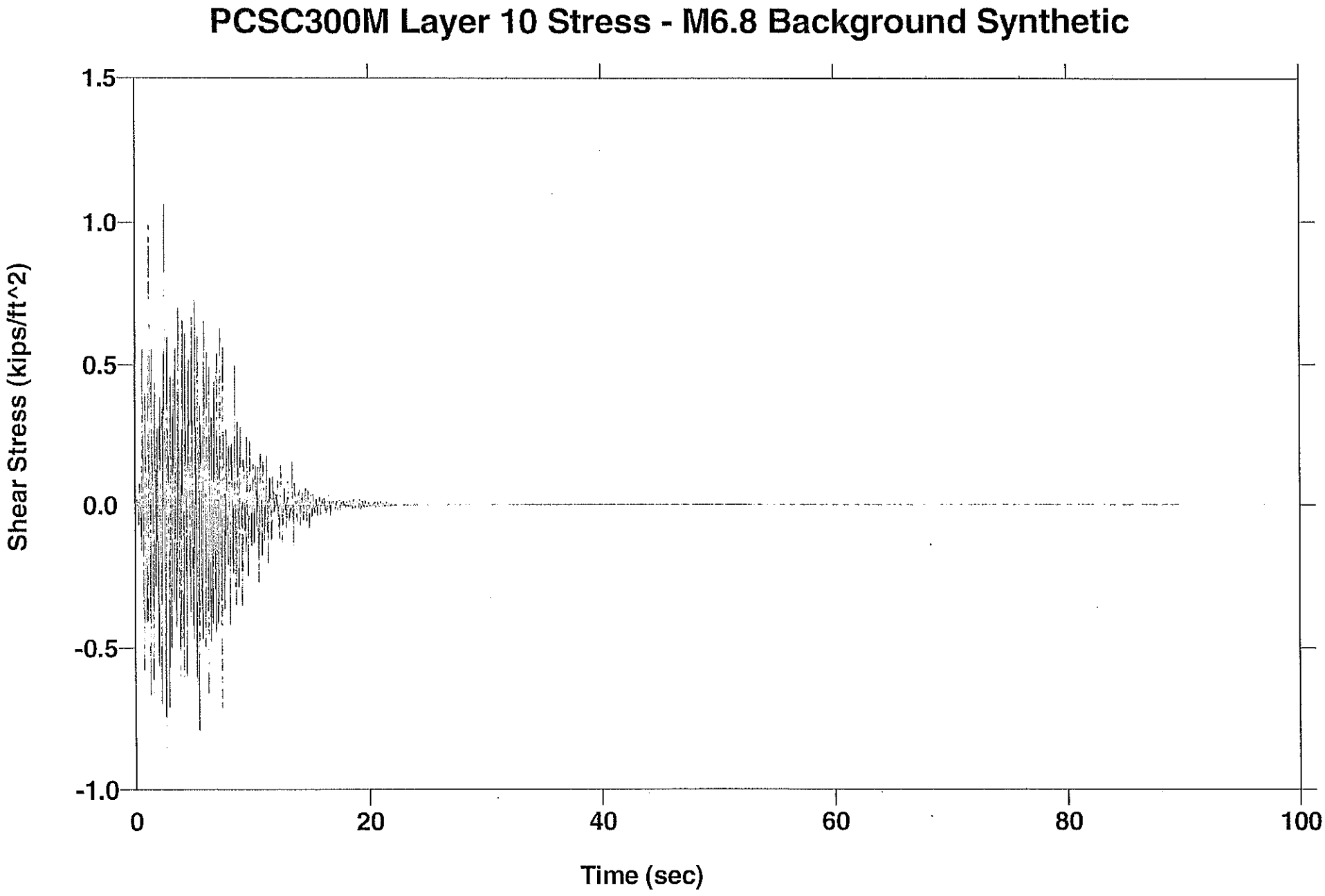
R16111


PCSC300M Layer 8 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
0
20
40
60
80
100
Time (sec)

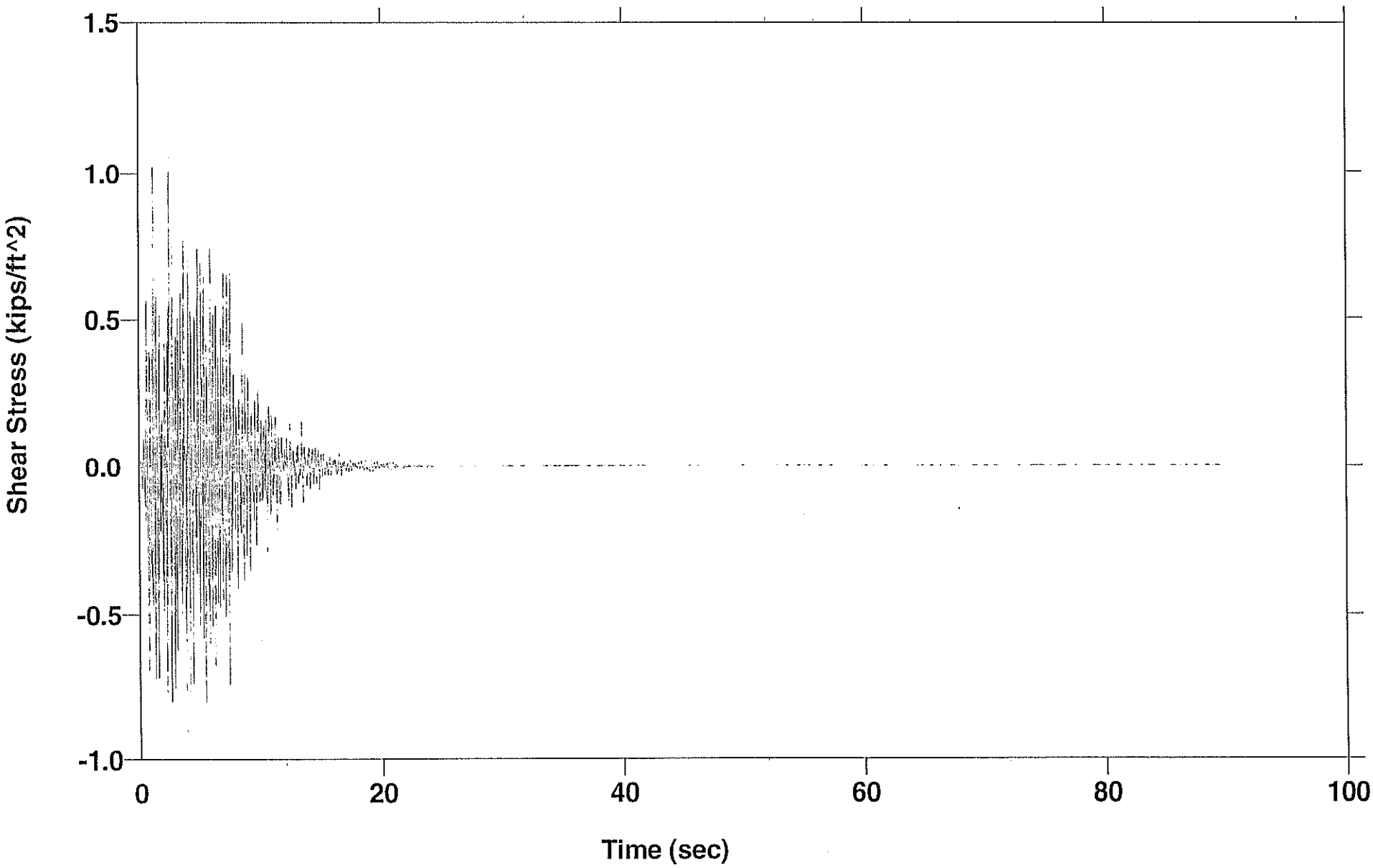
R16112


PCSC300M Layer 9 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
0
20
40
60
80
100
Time (sec)

R16113

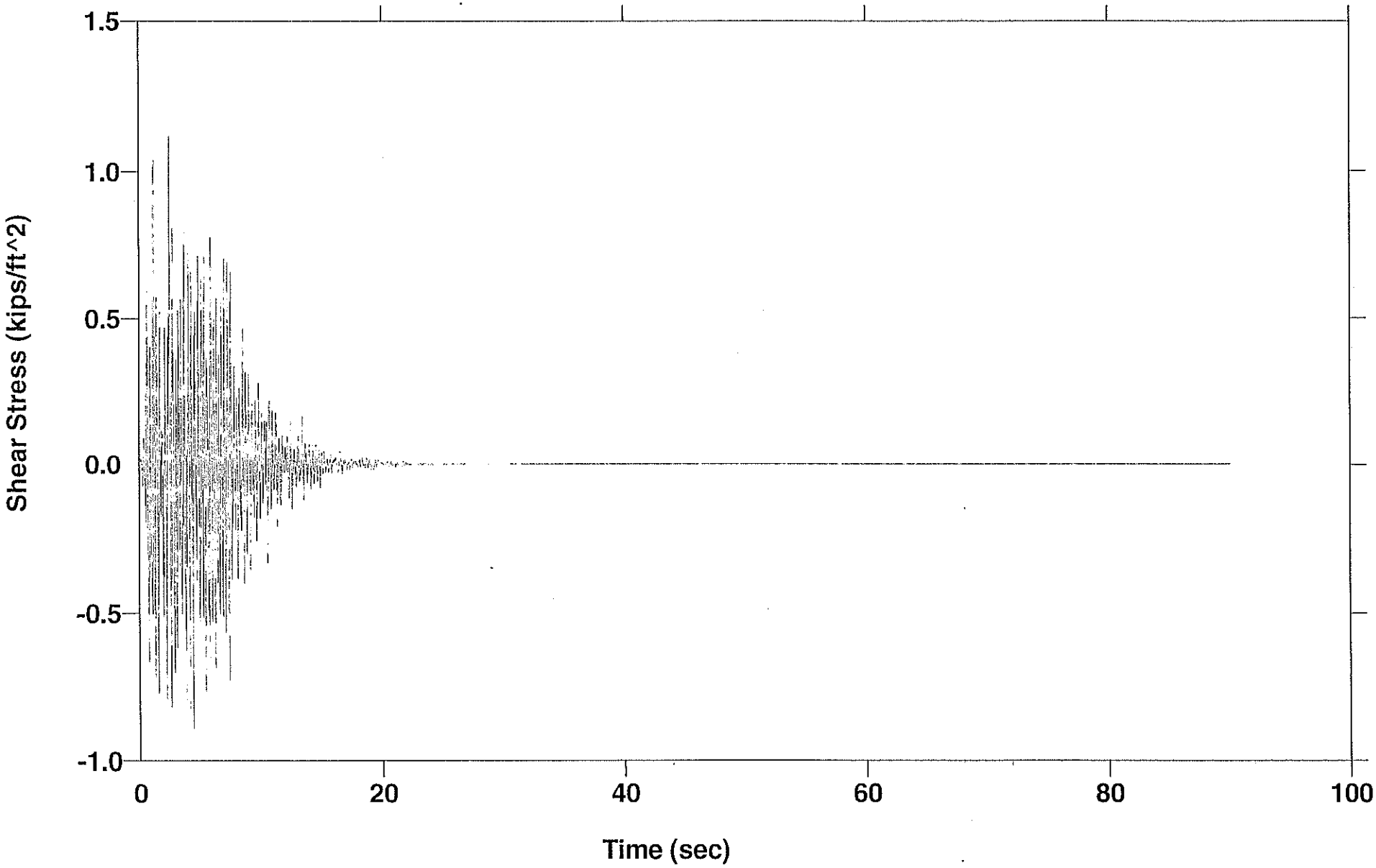

PCSC300M Layer 10 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
0
20
40
60
80
100
Time (sec)

R16114


PCSC300M Layer 11 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
0
20
40
60
80
100
Time (sec)

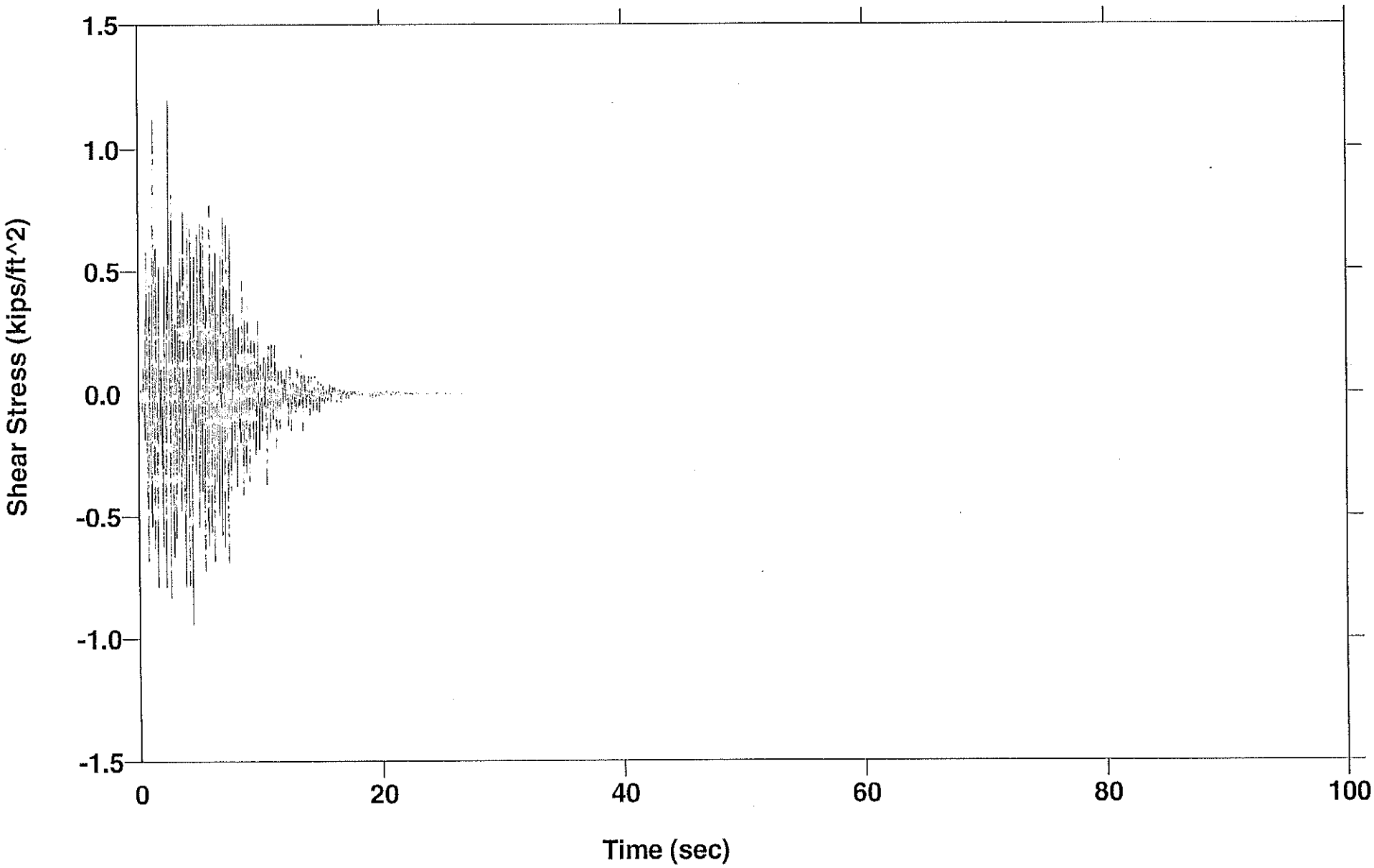
R16115

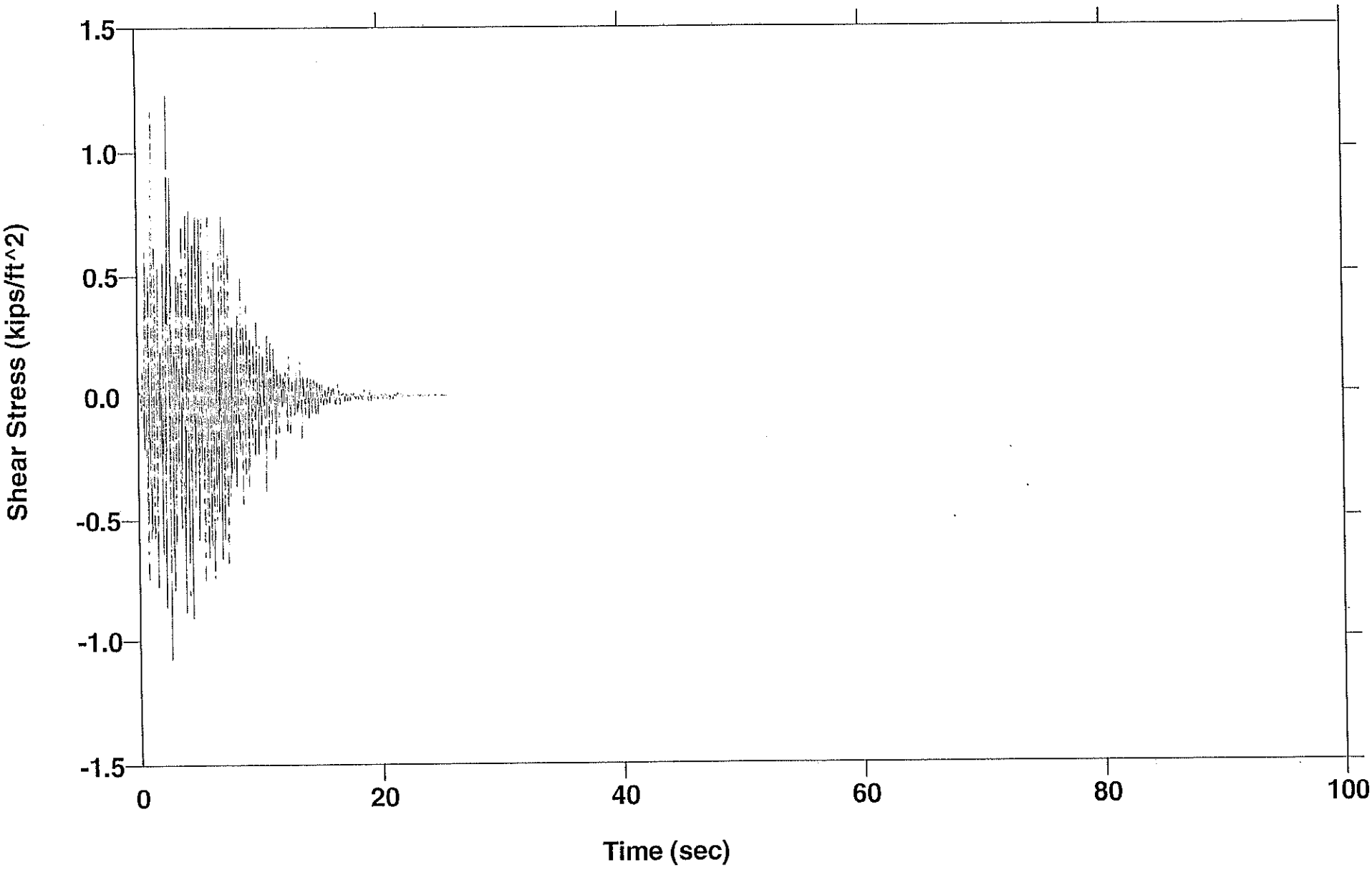
PCSC300M Layer 12 Stress - M6.8 Background Synthetic



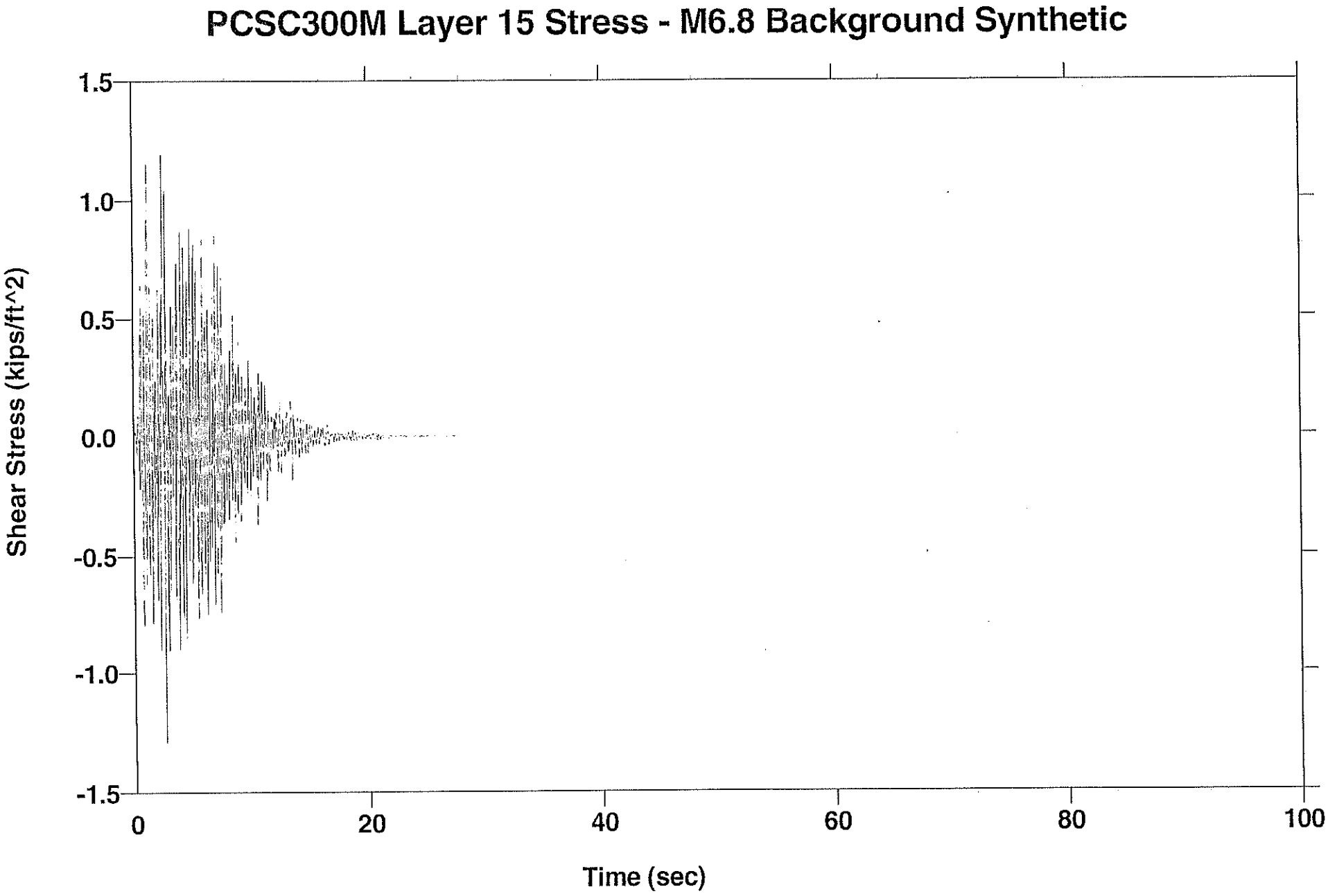
R16116

PCSC300M Layer 13 Stress - M6.8 Background Synthetic

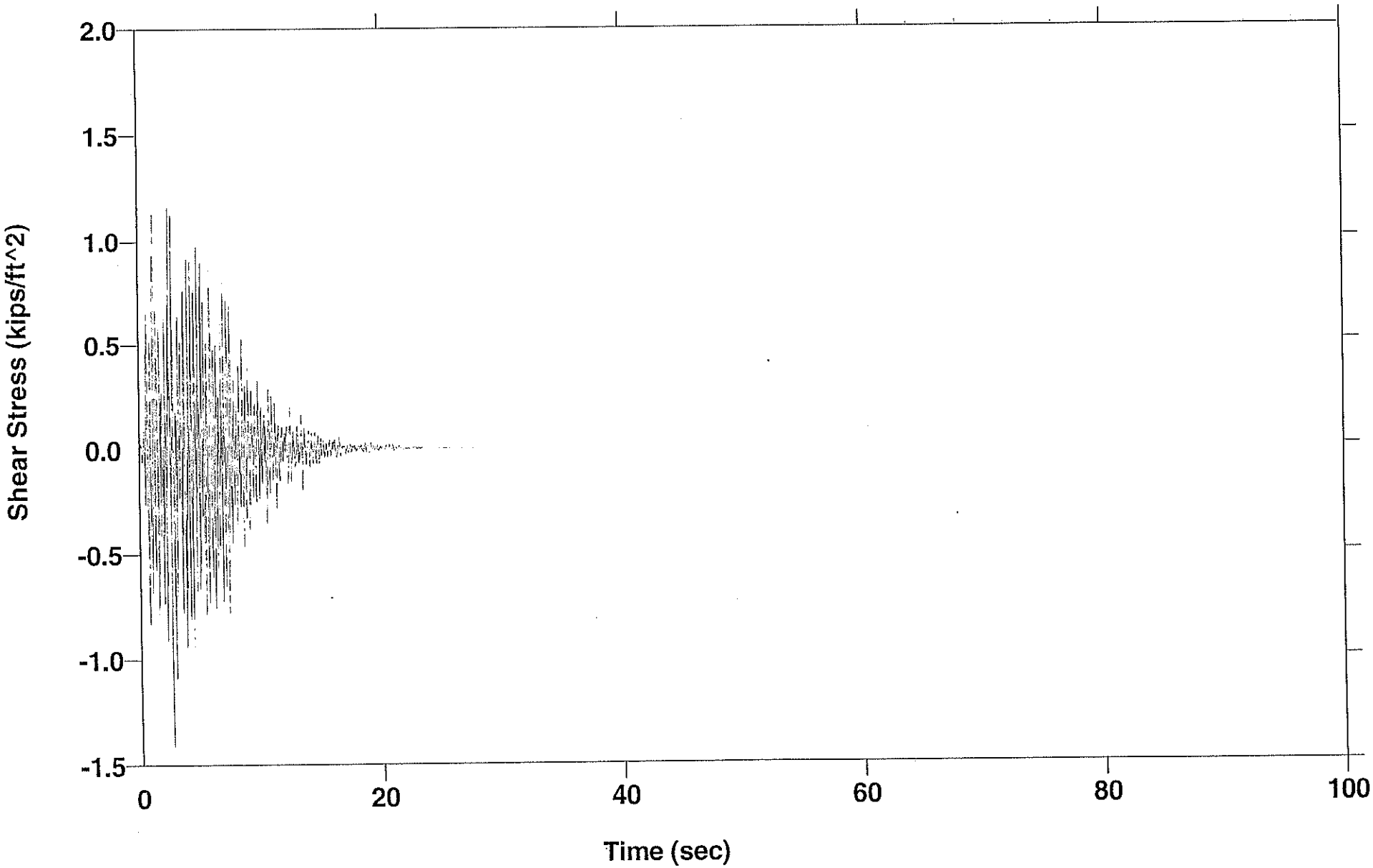



PCSC300M Layer 14 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0
20
40
60
80
100
Time (sec)

R16118


PCSC300M Layer 15 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0
20
40
60
80
100
Time (sec)

R16119


PCSC300M Layer 16 Stress - M6.8 Background Synthetic
Shear Stress (kips/ft^2)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0
20
40
60
80
100
Time (sec)

```
************************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*    LAYERED SITES by Per Schnable & John Lysmer - 1970  *
* ---------------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
* ---------------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added   *
*     using results from Sun et al (1988) by J. I. Sun    *
*     & Ramin Golesorkhi February 26, 1988                *
* ----------------------------------------------------------*
* SHAKE90/91: Adjust last iteration; Input now is either  *
*     Gmax or max Vs; up to 13 materials can be specified*
*     by user; up to 50 Layers can be specified; object   *
*     motion can be read in from a separate file and can  *
*     user specified format; Different periods for res-   *
*     ponse spectral calculations;options are renumbered;*
*     and general cleanup by: J. I. Sun, I. M. Idriss &   *
*     P. Dirrim June 1990 - February 1991                 *
* ---------------------------------------------------------- *
* SHAKE91: General cleanup and finalization of input out- *
*     output format ... etc by: I. M. Idriss Dec. 1991    *
* ---------------------------------------------------------- *
* SHAKE2000: Fix the incorrect output of Tot. Stress in   *
* Option 2. Changed path of ground motion file in         *
* SHAKE91.  Control file to input file names.  Modified   *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
*         RUN DATE  1/02/2008                             *
*         RUN TIME 11:01                                  *
************************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =    32768
 NECESSARY LENGTH OF BLANK COMMON X       =   204819

1****** OPTION  1 *** READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

**********************
 MATERIAL TYPE NO. 1
**********************

CURVE NO. 1:    Coarse    G/Gmax - Gravel (Mean) - Rollins et al. JGGE
CURVE NO. 2:    Coarse    Damping for Gravel (Mean) - Rollins et al. J
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.90
0.0002	0.995	0.0003	1.11
0.0005	0.980	0.0006	1.30
0.0008	0.970	0.0010	1.50
0.0010	0.960	0.0020	1.91
0.0020	0.930	0.0030	2.24
0.0030	0.905	0.0040	2.54
0.0040	0.880	0.0060	3.05
0.0070	0.810	0.0080	3.50
0.0100	0.755	0.0100	3.89
0.0200	0.630	0.0200	5.45
0.0700	0.390	0.0300	6.61
0.1000	0.325	0.0500	8.28
0.2000	0.205	0.1000	10.79
0.3000	0.150	0.2000	13.23

0.4000	0.115	0.3000	14.47
0.5000	0.095	0.4000	15.24
0.6000	0.080	0.6000	16.14
0.8000	0.070	0.8000	16.66
1.0000	0.050	1.0000	17.01

****
MATERIAL TYPE NO. 2
****

CURVE NO. 3: Fine Refuse Moduli for Fine Refuse (Ellison & Cho, 1976)
CURVE NO. 4: Fine Refuse Damping Values for Fine Refuse (Ellison & Ch

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.75
0.0004	1.000	0.0004	0.65
0.0010	0.995	0.0010	0.70
0.0020	0.992	0.0020	0.80
0.0040	0.989	0.0040	0.90
0.0060	0.981	0.0060	1.10
0.0080	0.965	0.0080	1.30
0.0100	0.955	0.0100	1.40
0.0200	0.905	0.0200	2.00
0.0400	0.828	0.0400	3.10
0.0600	0.750	0.0600	4.00
0.0800	0.670	0.0800	5.20
0.1000	0.610	0.1000	6.00
0.2000	0.610	0.2000	6.00

****
MATERIAL TYPE NO. 3
****

CURVE NO. 5: Residual G/Gmax PI=15% - Effective Confining Pressure
CURVE NO. 6: Residual Damping PI=15% - Effective Confining Pressur

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0000	1.000	0.0000	0.67
0.0000	1.000	0.0000	0.67
0.0000	0.999	0.0000	0.68
0.0001	0.998	0.0001	0.68
0.0002	0.996	0.0002	0.70
0.0005	0.991	0.0005	0.75
0.0010	0.983	0.0010	0.83
0.0022	0.965	0.0022	1.02
0.0048	0.931	0.0048	1.43
0.0100	0.873	0.0100	2.17
0.0220	0.770	0.0220	3.68
0.0484	0.618	0.0484	6.24
0.1000	0.454	0.1000	9.48
0.2200	0.287	0.2200	13.40
0.4840	0.163	0.4840	16.87
1.0000	0.091	1.0000	19.16

****
MATERIAL TYPE NO. 4
****

CURVE NO. 7: Rock G/Gmax - ROCK (Schnabel 1973)
CURVE NO. 8: Rock Damping for ROCK (Schnabel 1973)

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.40
0.0003	1.000	0.0010	0.80
0.0010	0.990	0.0100	1.50
0.0030	0.950	0.1000	3.00
0.0100	0.900	1.0000	4.60
0.0300	0.810	0.0000	0.00
0.1000	0.725	0.0000	0.00
1.0000	0.550	0.0000	0.00

1****** OPTION 2 *** READ SOIL PROFILE
NEW SOIL PROFILE NO. 1 IDENTIFICATION PSCS300E Crest Column
NUMBER OF LAYERS 17 DEPTH TO BEDROCK 50.00

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	1	4.0000	2.0000	0.26	3454.	0.050	0.130	924.9
2	1	3.0000	5.5000	0.71	3856.	0.050	0.130	977.3
3	1	3.0000	8.5000	1.11	4110.	0.050	0.130	1009.0
4	1	3.0000	11.5000	1.50	5739.	0.050	0.130	1192.3
5	1	3.0000	14.5000	1.90	4941.	0.050	0.140	1066.0
6	1	3.0000	17.5000	2.32	4453.	0.050	0.140	1012.0
7	1	3.0000	20.5000	2.74	4832.	0.050	0.140	1054.2
8	1	3.0000	23.5000	3.16	4269.	0.050	0.140	990.9
9	1	3.0000	26.5000	3.58	4713.	0.050	0.140	1041.1
10	1	4.0000	30.0000	4.07	4808.	0.050	0.140	1051.6
11	3	3.0000	33.5000	4.55	2635.	0.050	0.135	792.8
12	3	3.0000	36.5000	4.96	2661.	0.050	0.135	796.7
13	3	3.0000	39.5000	5.36	2998.	0.050	0.135	845.6
14	3	3.0000	42.5000	5.77	3763.	0.050	0.135	947.4
15	3	3.0000	45.5000	6.17	6529.	0.050	0.135	1247.9
16	3	3.0000	48.5000	6.58	6476.	0.050	0.135	1242.8
17	BASE				74534.	0.050	0.150	4000.0

PERIOD = 0.20 FROM AVERAGE SHEAR VEL. = 1011.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 12.34
FOR FREQUENCY = 4.85 C/SEC.
PERIOD = 0.21 SEC.

1****** OPTION 3 *** READ INPUT MOTION

FILE NAME FOR INPUT MOTION = C:\SHAKE2000\Williamson Energy\Background6.8.eq
NO. OF INPUT ACC. POINTS = 8192
NO. OF POINTS USED IN FFT = 16384
NO. OF HEADING LINES = 4
NO. OF POINTS PER LINE = 8

TIME STEP FOR INPUT MOTION = 0.0100
FORMAT FOR TIME HISTORY = (8f9.6)

*****HEADER*****
Source File: C:\SHAKE2000\Williamson Energy\Background.M6.8@13.5km.txt
SHAKE2000 Conversion: 8192 .01 4 8 9 (8f9.6
Acceleration Units: (g's) - No. Values: 8192 - Time Step: .01 (secs)
Data Format: (8f9.6) - No. Header Lines: 4
** FIRST AND LAST 5 LINES OF INPUT MOTION *****

1 0.000068-0.000484 0.004440-0.000089 0.002476-0.002297-0.001876 0.007725
2 0.009680 0.020998-0.014349-0.012924 0.018874-0.019831-0.000946 0.024811
3 -0.016894-0.002461 0.007682-0.006573-0.008604-0.018410 0.024194-0.064656
4 -0.017516 0.023926-0.061566 0.003326 0.022873 0.052730 0.049159 0.008778
5 -0.041034 0.029324-0.005991 0.066674-0.051336 0.029966-0.067257 0.001274
.....INPUT MOTION READ NOT ECHOED.....
1020 -0.000017 0.000017-0.000018 0.000017-0.000019 0.000019-0.000020 0.000020
1021 -0.000021 0.000021-0.000022 0.000022-0.000024 0.000023-0.000025 0.000025
1022 -0.000027 0.000027-0.000028 0.000028-0.000030 0.000030-0.000032 0.000032
1023 -0.000034 0.000034-0.000035 0.000035-0.000037 0.000037-0.000038 0.000038
1024 -0.000038 0.000037-0.000036 0.000032-0.000026 0.000014 0.000006-0.000045

MAXIMUM ACCELERATION = 0.75473
AT TIME = 3.64 SEC
THE VALUES WILL BE MULTIPLIED BY A FACTOR = 0.715
TO GIVE NEW MAXIMUM ACCELERATION = 0.54000
MEAN SQUARE FREQUENCY = 20.41 C/SEC.
MAX ACCELERATION = 0.55791 FOR FREQUENCIES REMOVED ABOVE 40.00 C/SEC.
1****** OPTION 4 *** READ WHERE OBJECT MOTION IS GIVEN
OBJECT MOTION IN LAYER NUMBER 17 OUTCROPPING

1****** OPTION 5 *** OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
MAXIMUM NUMBER OF ITERATIONS = 10
FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN = 0.65

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 1

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	NEW	<---- DAMPING ----> USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00351	0.024	0.050	-108.1	3078.9	3454.0	-12.2	1.000
2	1	5.5	0.00785	0.035	0.050	-44.1	3055.2	3856.0	-26.2	1.000
3	1	8.5	0.00986	0.039	0.050	-29.4	3112.0	4110.0	-32.1	1.000
4	1	11.5	0:00805	0.035	0.050	-42.5	4525.4	5739.0	-26.8	1.000
5	1	14.5	0.01151	0.042	0.050	-18.9	3605.0	4941.0	-37.1	1.000
6	1	17.5	0.01524	0.048	0.050	-3.3	3023.5	4453.0	-47.3	1.000
7	1	20.5	0.01605	0.050	0.050	-0.9	3235.9	4832.0	-49.3	1.000
8	1	23.5	0.02052	0.055	0.050	9.5	2668.7	4269.0	-60.0	1.000
9	1	26.5	0.02025	0.055	0.050	8.8	2958.1	4713.0	-59.3	1.000
10	1	30.0	0.02107	0.056	0.050	10.7	2980.8	4808.0	-61.3	1.000
11	3	33.5	0.03946	0.056	0.050	10.3	1732.1	2635.0	-52.1	1.000
12	3	36.5	0.03887	0.055	0.050	9.5	1756.9	2661.0	-51.5	1.000
13	3	39.5	0.03374	0.051	0.050	1.3	2061.4	2998.0	-45.4	1.000
14	3	42.5	0.02773	0.044	0.050	-12.8	2729.6	3763.0	-37.9	1.000
15	3	45.5	0.01672	0.032	0.050	-58.3	5261.4	6529.0	-24.1	1.000

16 3 48.5 0.01790 0.033 0.050 -52.0 5160.9 6476.0 -25.5 1.000

1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00433	0.026	0.024	8.9	3005.7	3078.9	-2.4	0.891
2	1	5.5	0.01076	0.041	0.035	14.4	2860.4	3055.2	-6.8	0.792
3	1	8.5	0.01356	0.046	0.039	15.5	2877.3	3112.0	-8.2	0.757
4	1	11.5	0.01116	0.041	0.035	15.2	4219.2	4525.4	-7.3	0.789
5	1	14.5	0.01611	0.050	0.042	15.2	3305.5	3605.0	-9.1	0.730
6	1	17.5	0.02293	0.058	0.048	17.2	2688.9	3023.5	-12.4	0.679
7	1	20.5	0.02391	0.060	0.050	16.9	2878.8	3235.9	-12.4	0.670
8	1	23.5	0.03112	0.067	0.055	17.9	2328.0	2668.7	-14.6	0.625
9	1	26.5	0.02861	0.065	0.055	15.3	2646.0	2958.1	-11.8	0.628
10	1	30.0	0.02760	0.064	0.056	12.1	2732.5	2980.8	-9.1	0.620
11	3	33.5	0.04460	0.060	0.056	6.6	1669.9	1732.1	-3.7	0.657
12	3	36.5	0.04332	0.059	0.055	6.0	1701.4	1756.9	-3.3	0.660
13	3	39.5	0.03826	0.055	0.051	7.4	1988.7	2061.4	-3.7	0.688
14	3	42.5	0.03202	0.049	0.044	9.5	2625.2	2729.6	-4.0	0.725
15	3	45.5	0.01907	0.034	0.032	7.4	5149.3	5261.4	-2.2	0.806
16	3	48.5	0.02074	0.036	0.033	7.9	5036.3	5160.9	-2.5	0.797

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00460	0.027	0.026	2.9	2979.0	3005.7	-0.9	0.870
2	1	5.5	0.01185	0.043	0.041	5.1	2793.0	2860.4	-2.4	0.742
3	1	8.5	0.01514	0.048	0.046	5.1	2795.6	2877.3	-2.9	0.700
4	1	11.5	0.01171	0.042	0.041	2.5	4169.5	4219.2	-1.2	0.735
5	1	14.5	0.01732	0.051	0.050	3.2	3241.1	3305.5	-2.0	0.669
6	1	17.5	0.02575	0.062	0.058	5.4	2589.8	2688.9	-3.8	0.604
7	1	20.5	0.02687	0.063	0.060	5.3	2770.8	2878.8	-3.9	0.596
8	1	23.5	0.03516	0.071	0.067	5.6	2228.1	2328.0	-4.5	0.545
9	1	26.5	0.03072	0.067	0.065	3.2	2581.7	2646.0	-2.5	0.561
10	1	30.0	0.02818	0.064	0.064	0.9	2713.3	2732.5	-0.7	0.568
11	3	33.5	0.04444	0.060	0.060	-0.2	1671.8	1669.9	0.1	0.634
12	3	36.5	0.04493	0.060	0.059	2.0	1682.6	1701.4	-1.1	0.639
13	3	39.5	0.04084	0.057	0.055	3.7	1950.9	1988.7	-1.9	0.663
14	3	42.5	0.03430	0.051	0.049	4.3	2575.4	2625.2	-1.9	0.698
15	3	45.5	0.01855	0.034	0.034	-1.6	5173.0	5149.3	0.5	0.789
16	3	48.5	0.02042	0.035	0.036	-0.8	5049.4	5036.3	0.3	0.778

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00456	0.027	0.027	-0.4	2982.5	2979.0	0.1	0.862
2	1	5.5	0.01191	0.043	0.043	0.3	2789.6	2793.0	-0.1	0.724
3	1	8.5	0.01531	0.048	0.048	0.5	2787.6	2795.6	-0.3	0.680
4	1	11.5	0.01166	0.042	0.042	-0.2	4174.2	4169.5	0.1	0.727
5	1	14.5	0.01740	0.051	0.051	0.2	3236.7	3241.1	-0.1	0.656
6	1	17.5	0.02642	0.062	0.062	1.2	2567.9	2589.8	-0.9	0.582
7	1	20.5	0.02762	0.064	0.063	1.2	2745.2	2770.8	-0.9	0.573
8	1	23.5	0.03637	0.072	0.071	1.5	2200.3	2228.1	-1.3	0.522
9	1	26.5	0.03115	0.067	0.067	0.7	2569.2	2581.7	-0.5	0.548
10	1	30.0	0.02787	0.064	0.064	-0.5	2723.4	2713.3	0.4	0.564
11	3	33.5	0.04402	0.059	0.060	-0.5	1676.6	1671.8	0.3	0.634
12	3	36.5	0.04564	0.060	0.060	0.8	1674.6	1682.6	-0.5	0.632
13	3	39.5	0.04189	0.058	0.057	1.4	1936.2	1950.9	-0.8	0.651
14	3	42.5	0.03519	0.052	0.051	1.6	2556.7	2575.4	-0.7	0.684
15	3	45.5	0.01837	0.033	0.034	-0.5	5181.0	5173.0	0.2	0.792
16	3	48.5	0.02016	0.035	0.035	-0.7	5060.6	5049.4	0.2	0.780

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00455	0.027	0.027	-0.2	2984.2	2982.5	0.1	0.863
2	1	5.5	0.01189	0.043	0.043	-0.1	2790.6	2789.6	0.0	0.723
3	1	8.5	0.01532	0.048	0.048	0.0	2787.0	2787.6	0.0	0.678
4	1	11.5	0.01161	0.042	0.042	-0.2	4178.3	4174.2	0.1	0.727
5	1	14.5	0.01735	0.051	0.051	-0.1	3239.3	3236.7	0.1	0.655
6	1	17.5	0.02655	0.063	0.062	0.2	2563.6	2567.9	-0.2	0.577
7	1	20.5	0.02780	0.064	0.064	0.3	2739.2	2745.2	-0.2	0.568
8	1	23.5	0.03675	0.073	0.072	0.5	2191.9	2200.3	-0.4	0.515
9	1	26.5	0.03122	0.067	0.067	0.1	2567.1	2569.2	-0.1	0.545
10	1	30.0	0.02767	0.064	0.064	-0.3	2730.0	2723.4	0.2	0.566
11	3	33.5	0.04382	0.059	0.059	-0.2	1678.9	1676.6	0.1	0.636
12	3	36.5	0.04592	0.061	0.060	0.3	1671.5	1674.6	-0.2	0.629
13	3	39.5	0.04225	0.058	0.058	0.5	1931.3	1936.2	-0.3	0.646
14	3	42.5	0.03545	0.052	0.052	0.5	2551.4	2556.7	-0.2	0.679
15	3	45.5	0.01834	0.033	0.033	-0.1	5182.3	5181.0	0.0	0.794
16	3	48.5	0.02008	0.035	0.035	-0.2	5063.8	5060.6	0.1	0.781

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 6

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.2	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.9	2790.6	0.0	0.724

3	1	8.5	0.01532	0.049	0.048	0.0	2786.7	2787.0	0.0	0.678
4	1	11.5	0.01160	0.042	0.042	-0.1	4179.6	4178.3	0.0	0.728
5	1	14.5	0.01732	0.051	0.051	-0.1	3241.0	3239.3	0.1	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.8	2563.6	0.0	0.576
7	1	20.5	0.02785	0.064	0.064	0.1	2737.8	2739.2	-0.1	0.567
8	1	23.5	0.03687	0.073	0.073	0.2	2189.2	2191.9	-0.1	0.513
9	1	26.5	0.03123	0.067	0.067	0.0	2566.9	2567.1	0.0	0.545
10	1	30.0	0.02758	0.064	0.064	-0.1	2732.9	2730.0	0.1	0.568
11	3	33.5	0.04375	0.059	0.059	-0.1	1679.7	1678.9	0.0	0.637
12	3	36.5	0.04602	0.061	0.061	0.1	1670.4	1671.5	-0.1	0.628
13	3	39.5	0.04237	0.058	0.058	0.2	1929.7	1931.3	-0.1	0.644
14	3	42.5	0.03552	0.052	0.052	0.1	2550.0	2551.4	-0.1	0.678
15	3	45.5	0.01834	0.033	0.033	0.0	5182.7	5182.3	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.5	5063.8	0.0	0.782

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 7

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.4	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.9	2790.9	0.0	0.724
3	1	8.5	0.01533	0.049	0.049	0.0	2786.5	2786.7	0.0	0.678
4	1	11.5	0.01159	0.042	0.042	0.0	4180.0	4179.6	0.0	0.728
5	1	14.5	0.01731	0.051	0.051	0.0	3241.7	3241.0	0.0	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.7	2562.8	0.0	0.576
7	1	20.5	0.02786	0.064	0.064	0.0	2737.5	2737.8	0.0	0.567
8	1	23.5	0.03692	0.073	0.073	0.1	2188.2	2189.2	0.0	0.513
9	1	26.5	0.03122	0.067	0.067	0.0	2567.0	2566.9	0.0	0.545
10	1	30.0	0.02755	0.064	0.064	-0.1	2734.0	2732.9	0.0	0.568
11	3	33.5	0.04373	0.059	0.059	0.0	1680.0	1679.7	0.0	0.637
12	3	36.5	0.04605	0.061	0.061	0.0	1670.0	1670.4	0.0	0.628
13	3	39.5	0.04240	0.058	0.058	0.0	1929.3	1929.7	0.0	0.644
14	3	42.5	0.03554	0.052	0.052	0.0	2549.7	2550.0	0.0	0.678
15	3	45.5	0.01833	0.033	0.033	0.0	5182.8	5182.7	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.7	5064.5	0.0	0.782

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 8

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.4	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.8	2790.9	0.0	0.724
3	1	8.5	0.01533	0.049	0.049	0.0	2786.4	2786.5	0.0	0.678
4	1	11.5	0.01159	0.042	0.042	0.0	4180.1	4180.0	0.0	0.728
5	1	14.5	0.01730	0.051	0.051	0.0	3242.0	3241.7	0.0	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.8	2562.7	0.0	0.576
7	1	20.5	0.02786	0.064	0.064	0.0	2737.4	2737.5	0.0	0.567
8	1	23.5	0.03693	0.073	0.073	0.0	2187.9	2188.2	0.0	0.513
9	1	26.5	0.03122	0.067	0.067	0.0	2567.1	2567.0	0.0	0.545

10	1	30.0	0.02754	0.064	0.064	0.0	2734.4	2734.0	0.0	0.569
11	3	33.5	0.04372	0.059	0.059	0.0	1680.1	1680.0	0.0	0.638
12	3	36.5	0.04606	0.061	0.061	0.0	1669.9	1670.0	0.0	0.628
13	3	39.5	0.04241	0.058	0.058	0.0	1929.1	1929.3	0.0	0.644
14	3	42.5	0.03554	0.052	0.052	0.0	2549.6	2549.7	0.0	0.678
15	3	45.5	0.01833	0.033	0.033	0.0	5182.9	5182.8	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.7	5064.7	0.0	0.782

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 9

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.4	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.8	2790.8	0.0	0.724
3	1	8.5	0.01533	0.049	0.049	0.0	2786.4	2786.4	0.0	0.678
4	1	11.5	0.01159	0.042	0.042	0.0	4180.1	4180.1	0.0	0.728
5	1	14.5	0.01730	0.051	0.051	0.0	3242.1	3242.0	0.0	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.8	2562.8	0.0	0.576
7	1	20.5	0.02786	0.064	0.064	0.0	2737.4	2737.4	0.0	0.567
8	1	23.5	0.03694	0.073	0.073	0.0	2187.7	2187.9	0.0	0.513
9	1	26.5	0.03122	0.067	0.067	0.0	2567.1	2567.1	0.0	0.545
10	1	30.0	0.02753	0.064	0.064	0.0	2734.6	2734.4	0.0	0.569
11	3	33.5	0.04372	0.059	0.059	0.0	1680.1	1680.1	0.0	0.638
12	3	36.5	0.04607	0.061	0.061	0.0	1669.8	1669.9	0.0	0.628
13	3	39.5	0.04241	0.058	0.058	0.0	1929.1	1929.1	0.0	0.643
14	3	42.5	0.03554	0.052	0.052	0.0	2549.6	2549.6	0.0	0.678
15	3	45.5	0.01833	0.033	0.033	0.0	5182.9	5182.9	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.7	5064.7	0.0	0.782

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 10

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00454	0.027	0.027	0.0	2984.4	2984.4	0.0	0.864
2	1	5.5	0.01189	0.043	0.043	0.0	2790.8	2790.8	0.0	0.724
3	1	8.5	0.01533	0.049	0.049	0.0	2786.4	2786.4	0.0	0.678
4	1	11.5	0.01159	0.042	0.042	0.0	4180.1	4180.1	0.0	0.728
5	1	14.5	0.01730	0.051	0.051	0.0	3242.1	3242.1	0.0	0.656
6	1	17.5	0.02658	0.063	0.063	0.0	2562.8	2562.8	0.0	0.576
7	1	20.5	0.02786	0.064	0.064	0.0	2737.4	2737.4	0.0	0.567
8	1	23.5	0.03694	0.073	0.073	0.0	2187.7	2187.7	0.0	0.512
9	1	26.5	0.03122	0.067	0.067	0.0	2567.1	2567.1	0.0	0.545
10	1	30.0	0.02753	0.064	0.064	0.0	2734.6	2734.6	0.0	0.569
11	3	33.5	0.04372	0.059	0.059	0.0	1680.1	1680.1	0.0	0.638
12	3	36.5	0.04607	0.061	0.061	0.0	1669.8	1669.8	0.0	0.628
13	3	39.5	0.04241	0.058	0.058	0.0	1929.1	1929.1	0.0	0.643
14	3	42.5	0.03554	0.052	0.052	0.0	2549.6	2549.6	0.0	0.678
15	3	45.5	0.01833	0.033	0.033	0.0	5182.9	5182.9	0.0	0.794
16	3	48.5	0.02006	0.035	0.035	0.0	5064.7	5064.7	0.0	0.782

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	1	4.0000	2.0000	0.00699	208.65	2.66
2	1	3.0000	5.5000	0.01829	510.56	2.66
3	1	3.0000	8.5000	0.02359	657.19	2.66
4	1	3.0000	11.5000	0.01783	745.46	3.70
5	1	3.0000	14.5000	0.02661	862.84	2.53
6	1	3.0000	17.5000	0.04089	1047.93	2.53
7	1	3.0000	20.5000	0.04286	1173.22	2.53
8	1	3.0000	23.5000	0.05683	1243.29	2.53
9	1	3.0000	26.5000	0.04803	1232.98	2.53
10	1	4.0000	30.0000	0.04236	1158.30	2.52
11	3	3.0000	33.5000	0.06726	1130.04	2.52
12	3	3.0000	36.5000	0.07088	1183.52	2.51
13	3	3.0000	39.5000	0.06525	1258.79	2.50
14	3	3.0000	42.5000	0.05468	1394.02	2.62
15	3	3.0000	45.5000	0.02820	1461.76	2.62
16	3	3.0000	48.5000	0.03086	1562.90	2.49

PERIOD = 0.24 FROM AVERAGE SHEAR VEL. = 823.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 10.74
FOR FREQUENCY = 3.87 C/SEC.
PERIOD = 0.26 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE	TH SAVED ACC. RECORD
OUTCR.	0.0000	0.82118	2.66	15.92	0.000	2048
WITHIN	4.0000	0.66221	2.66	12.85	0.000	2048
WITHIN	7.0000	0.45724	2.53	9.08	0.000	2048
WITHIN	10.0000	0.49140	2.53	12.60	0.001	2048
WITHIN	13.0000	0.47695	2.53	15.09	0.001	2048
WITHIN	16.0000	0.48874	2.64	14.93	0.000	2048
WITHIN	19.0000	0.46491	2.64	15.27	0.001	2048
WITHIN	22.0000	0.51703	2.60	16.98	0.001	2048
WITHIN	25.0000	0.52919	2.63	16.94	0.000	2048
WITHIN	28.0000	0.52041	2.63	16.49	0.001	2048
WITHIN	32.0000	0.76846	2.62	17.02	0.000	2048
WITHIN	35.0000	0.80342	2.62	18.94	0.000	2048
WITHIN	38.0000	0.73631	2.61	20.52	0.001	2048
WITHIN	41.0000	0.65050	2.59	20.50	0.001	2048
WITHIN	44.0000	0.53855	3.91	20.21	0.001	2048

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\Background6.8.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE	TH SAVED ACC. RECORD
WITHIN	47.0000	0.52173	3.91	19.79	0.001	2048
WITHIN	50.0000	0.49204	2.58	19.33	0.001	2048

OUTCR. 50.0000 0.55791 2.58 20.41 0.001 2048

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 1 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 1 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 2 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 2 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 3 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 3 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 4 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 4 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 5 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 5 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC330M Layer 6 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PSCS300M Layer 6 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 7 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 7 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 8 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 8 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 9 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PSCS300E Layer 9 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 10 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 10 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 11 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 11 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 12 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 12 Strain

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1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER   13
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 13 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER   13
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 13 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER   14
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 14 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER   14
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 14 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER   15
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 15 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER   15
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 15 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER   16
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 16 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER   16
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 16 Strain

1******  OPTION  9  ***  COMPUTE RESPONSE SPECTRUM
 RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER       1
CALCULATED FOR DAMPING       0.050

   TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
      TD = TIME FOR MAX. RELATIVE DISP.
      TV = TIME FOR MAX. RELATIVE VEL.
      TA = TIME FOR MAX. ABSOLUTE ACC.
   DAMPING RATIO = 0.050
   PER = 0.01    TIMES FOR MAXIMA --  TD =  2.6500  TV =  2.6500  TA =  2.6500
   PER = 0.02    TIMES FOR MAXIMA --  TD =  2.6500  TV =  2.6400  TA =  2.6500
   PER = 0.03    TIMES FOR MAXIMA --  TD =  3.0100  TV =  3.0200  TA =  3.0100
   PER = 0.04    TIMES FOR MAXIMA --  TD =  2.6600  TV =  2.6700  TA =  3.6900
   PER = 0.05    TIMES FOR MAXIMA --  TD =  4.9300  TV =  4.9400  TA =  4.9000
   PER = 0.06    TIMES FOR MAXIMA --  TD =  4.3800  TV =  4.3900  TA =  4.3800
   PER = 0.07    TIMES FOR MAXIMA --  TD =  5.2600  TV =  5.2800  TA =  5.2600
   PER = 0.08    TIMES FOR MAXIMA --  TD =  5.2700  TV =  5.2900  TA =  5.2700
   PER = 0.09    TIMES FOR MAXIMA --  TD =  2.5900  TV =  2.7000  TA =  2.7200
   PER = 0.10    TIMES FOR MAXIMA --  TD =  2.6000  TV =  2.6600  TA =  2.5900
   PER = 0.11    TIMES FOR MAXIMA --  TD =  2.6000  TV =  2.5800  TA =  2.6000
   PER = 0.12    TIMES FOR MAXIMA --  TD =  2.6100  TV =  2.5800  TA =  2.6100
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PER = 0.13	TIMES FOR MAXIMA --	TD = 3.7200	TV = 5.1900	TA = 3.7200
PER = 0.14	TIMES FOR MAXIMA --	TD = 3.7300	TV = 2.5800	TA = 3.7300
PER = 0.15	TIMES FOR MAXIMA --	TD = 4.1600	TV = 2.5800	TA = 4.1600
PER = 0.16	TIMES FOR MAXIMA --	TD = 2.6200	TV = 2.5800	TA = 2.6100
PER = 0.17	TIMES FOR MAXIMA --	TD = 4.2800	TV = 4.3200	TA = 4.2800
PER = 0.18	TIMES FOR MAXIMA --	TD = 1.4300	TV = 2.5900	TA = 1.4300
PER = 0.19	TIMES FOR MAXIMA --	TD = 2.7500	TV = 2.7100	TA = 2.7500
PER = 0.20	TIMES FOR MAXIMA --	TD = 7.1100	TV = 6.7400	TA = 7.1100
PER = 0.21	TIMES FOR MAXIMA --	TD = 7.1400	TV = 7.0900	TA = 7.1300
PER = 0.22	TIMES FOR MAXIMA --	TD = 7.2700	TV = 7.1000	TA = 7.1500
PER = 0.23	TIMES FOR MAXIMA --	TD = 7.4200	TV = 2.3500	TA = 7.4100
PER = 0.24	TIMES FOR MAXIMA --	TD = 7.5600	TV = 2.3700	TA = 7.5600
PER = 0.25	TIMES FOR MAXIMA --	TD = 1.6100	TV = 6.3700	TA = 1.6100
PER = 0.26	TIMES FOR MAXIMA --	TD = 6.3200	TV = 6.3800	TA = 6.3200
PER = 0.27	TIMES FOR MAXIMA --	TD = 1.6400	TV = 1.7100	TA = 1.6300
PER = 0.28	TIMES FOR MAXIMA --	TD = 1.6500	TV = 1.3200	TA = 1.6500
PER = 0.29	TIMES FOR MAXIMA --	TD = 5.2100	TV = 5.1500	TA = 5.2100
PER = 0.30	TIMES FOR MAXIMA --	TD = 5.2400	TV = 5.1600	TA = 5.2300
PER = 0.31	TIMES FOR MAXIMA --	TD = 2.9800	TV = 2.9000	TA = 2.9700
PER = 0.32	TIMES FOR MAXIMA --	TD = 3.0000	TV = 2.9100	TA = 2.9900
PER = 0.33	TIMES FOR MAXIMA --	TD = 3.0100	TV = 2.9100	TA = 3.0000
PER = 0.34	TIMES FOR MAXIMA --	TD = 3.0100	TV = 2.7900	TA = 3.0100
PER = 0.35	TIMES FOR MAXIMA --	TD = 3.0200	TV = 2.7900	TA = 3.0200
PER = 0.36	TIMES FOR MAXIMA --	TD = 2.8800	TV = 2.7900	TA = 2.8700
PER = 0.37	TIMES FOR MAXIMA --	TD = 2.7200	TV = 2.7900	TA = 2.7100
PER = 0.38	TIMES FOR MAXIMA --	TD = 2.7300	TV = 2.6600	TA = 2.7200
PER = 0.39	TIMES FOR MAXIMA --	TD = 2.7300	TV = 2.6600	TA = 4.1300
PER = 0.40	TIMES FOR MAXIMA --	TD = 4.1500	TV = 2.6600	TA = 4.1400
PER = 0.41	TIMES FOR MAXIMA --	TD = 4.1600	TV = 4.0900	TA = 4.1600
PER = 0.42	TIMES FOR MAXIMA --	TD = 3.9900	TV = 4.0900	TA = 3.9800
PER = 0.43	TIMES FOR MAXIMA --	TD = 4.0000	TV = 4.0900	TA = 3.9900
PER = 0.44	TIMES FOR MAXIMA --	TD = 4.6800	TV = 4.1000	TA = 4.6700
PER = 0.45	TIMES FOR MAXIMA --	TD = 4.6900	TV = 4.1000	TA = 4.6800
PER = 0.46	TIMES FOR MAXIMA --	TD = 4.7100	TV = 4.1000	TA = 4.7100
PER = 0.47	TIMES FOR MAXIMA --	TD = 4.7300	TV = 4.6400	TA = 4.7200
PER = 0.48	TIMES FOR MAXIMA --	TD = 4.7400	TV = 4.6500	TA = 4.7300
PER = 0.49	TIMES FOR MAXIMA --	TD = 5.5500	TV = 4.6500	TA = 5.5400
PER = 0.50	TIMES FOR MAXIMA --	TD = 5.5700	TV = 2.6700	TA = 5.5600
PER = 0.51	TIMES FOR MAXIMA --	TD = 5.5800	TV = 2.6700	TA = 5.5700
PER = 0.52	TIMES FOR MAXIMA --	TD = 5.5800	TV = 2.6700	TA = 5.5700
PER = 0.53	TIMES FOR MAXIMA --	TD = 2.7600	TV = 2.6700	TA = 2.7500
PER = 0.54	TIMES FOR MAXIMA --	TD = 2.7700	TV = 2.6700	TA = 2.7600
PER = 0.55	TIMES FOR MAXIMA --	TD = 2.7700	TV = 2.6700	TA = 2.7600
PER = 0.56	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.6700	TA = 2.5600
PER = 0.57	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.6700	TA = 2.5600
PER = 0.58	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.6700	TA = 2.5600
PER = 0.60	TIMES FOR MAXIMA --	TD = 2.5800	TV = 2.6700	TA = 2.5700
PER = 0.62	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.6700	TA = 2.5800
PER = 0.64	TIMES FOR MAXIMA --	TD = 2.6100	TV = 2.5400	TA = 2.6000
PER = 0.66	TIMES FOR MAXIMA --	TD = 2.6200	TV = 2.5400	TA = 2.6100
PER = 0.68	TIMES FOR MAXIMA --	TD = 2.6400	TV = 2.5400	TA = 2.6200
PER = 0.70	TIMES FOR MAXIMA --	TD = 3.4700	TV = 2.5500	TA = 3.4600
PER = 0.72	TIMES FOR MAXIMA --	TD = 3.4800	TV = 2.5500	TA = 3.4700
PER = 0.74	TIMES FOR MAXIMA --	TD = 3.4900	TV = 2.5500	TA = 3.4800
PER = 0.76	TIMES FOR MAXIMA --	TD = 3.4900	TV = 1.6100	TA = 3.4800
PER = 0.78	TIMES FOR MAXIMA --	TD = 1.8200	TV = 1.6100	TA = 1.8000
PER = 0.80	TIMES FOR MAXIMA --	TD = 1.5200	TV = 1.2700	TA = 1.5100
PER = 0.82	TIMES FOR MAXIMA --	TD = 1.5300	TV = 1.2700	TA = 1.5100
PER = 0.84	TIMES FOR MAXIMA --	TD = 3.5000	TV = 6.3000	TA = 3.4800
PER = 0.86	TIMES FOR MAXIMA --	TD = 3.5000	TV = 5.9400	TA = 3.4800
PER = 0.88	TIMES FOR MAXIMA --	TD = 3.5100	TV = 5.9400	TA = 3.4900

PER = 0.90	TIMES FOR MAXIMA --	TD = 4.0300	TV = 3.3000	TA = 4.0200
PER = 0.92	TIMES FOR MAXIMA --	TD = 4.0600	TV = 4.2900	TA = 4.0500
PER = 0.94	TIMES FOR MAXIMA --	TD = 4.0700	TV = 4.3500	TA = 4.0600
PER = 0.96	TIMES FOR MAXIMA --	TD = 4.0700	TV = 4.3500	TA = 4.0600
PER = 0.98	TIMES FOR MAXIMA --	TD = 3.1800	TV = 4.3500	TA = 3.1700
PER = 1.00	TIMES FOR MAXIMA --	TD = 3.1900	TV = 3.9700	TA = 3.1800
PER = 1.05	TIMES FOR MAXIMA --	TD = 3.2100	TV = 3.9700	TA = 3.1900
PER = 1.10	TIMES FOR MAXIMA --	TD = 3.2500	TV = 2.5500	TA = 3.2400
PER = 1.15	TIMES FOR MAXIMA --	TD = 3.2700	TV = 2.5500	TA = 3.2500
PER = 1.20	TIMES FOR MAXIMA --	TD = 3.3500	TV = 2.5500	TA = 3.2800
PER = 1.25	TIMES FOR MAXIMA --	TD = 3.3900	TV = 2.5500	TA = 3.3800
PER = 1.30	TIMES FOR MAXIMA --	TD = 2.8800	TV = 2.5500	TA = 2.8700
PER = 1.35	TIMES FOR MAXIMA --	TD = 2.8900	TV = 2.5500	TA = 2.8700
PER = 1.40	TIMES FOR MAXIMA --	TD = 2.8900	TV = 2.5500	TA = 2.8700
PER = 1.45	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5500	TA = 2.8700
PER = 1.50	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5500	TA = 2.8700
PER = 1.55	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5500	TA = 2.8700
PER = 1.60	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.5500	TA = 2.8700
PER = 1.65	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.5500	TA = 2.8700
PER = 1.70	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.5500	TA = 2.8700
PER = 1.75	TIMES FOR MAXIMA --	TD = 5.9000	TV = 2.5500	TA = 5.8900
PER = 1.80	TIMES FOR MAXIMA --	TD = 5.9100	TV = 2.5500	TA = 5.8900
PER = 1.85	TIMES FOR MAXIMA --	TD = 5.9200	TV = 2.5500	TA = 5.8900
PER = 1.90	TIMES FOR MAXIMA --	TD = 6.1200	TV = 2.5500	TA = 6.1000
PER = 1.95	TIMES FOR MAXIMA --	TD = 6.1200	TV = 2.5500	TA = 6.1100
PER = 2.00	TIMES FOR MAXIMA --	TD = 5.4200	TV = 2.5500	TA = 5.4100
PER = 2.05	TIMES FOR MAXIMA --	TD = 5.4300	TV = 2.5500	TA = 5.4100
PER = 2.10	TIMES FOR MAXIMA --	TD = 5.4300	TV = 2.5500	TA = 5.4100
PER = 2.15	TIMES FOR MAXIMA --	TD = 8.7600	TV = 2.5500	TA = 5.4100
PER = 2.20	TIMES FOR MAXIMA --	TD = 8.7700	TV = 2.5500	TA = 5.4100
PER = 2.25	TIMES FOR MAXIMA --	TD = 8.9500	TV = 2.5500	TA = 8.9400
PER = 2.30	TIMES FOR MAXIMA --	TD = 8.9700	TV = 2.5500	TA = 8.9400
PER = 2.35	TIMES FOR MAXIMA --	TD = 7.9000	TV = 2.5500	TA = 7.8800
PER = 2.40	TIMES FOR MAXIMA --	TD = 7.9400	TV = 2.5500	TA = 7.8800
PER = 2.50	TIMES FOR MAXIMA --	TD = 8.0900	TV = 2.5500	TA = 7.9400
PER = 2.60	TIMES FOR MAXIMA --	TD = 8.1100	TV = 2.5500	TA = 8.0800
PER = 2.70	TIMES FOR MAXIMA --	TD = 6.9700	TV = 2.5500	TA = 6.9400
PER = 2.80	TIMES FOR MAXIMA --	TD = 7.0000	TV = 2.5500	TA = 6.9400
PER = 2.90	TIMES FOR MAXIMA --	TD = 7.0000	TV = 2.5500	TA = 6.9400
PER = 3.00	TIMES FOR MAXIMA --	TD = 7.0100	TV = 2.5500	TA = 6.9400
PER = 3.10	TIMES FOR MAXIMA --	TD = 7.2400	TV = 2.5500	TA = 7.1900
PER = 3.20	TIMES FOR MAXIMA --	TD = 7.2500	TV = 2.5500	TA = 7.2000
PER = 3.30	TIMES FOR MAXIMA --	TD = 7.2500	TV = 2.5500	TA = 7.2000
PER = 3.40	TIMES FOR MAXIMA --	TD = 7.2600	TV = 2.5500	TA = 7.2000
PER = 3.50	TIMES FOR MAXIMA --	TD = 7.2600	TV = 2.5500	TA = 7.2400
PER = 3.60	TIMES FOR MAXIMA --	TD = 7.5200	TV = 2.5500	TA = 7.2400
PER = 3.70	TIMES FOR MAXIMA --	TD = 7.5200	TV = 2.5500	TA = 7.5000
PER = 3.80	TIMES FOR MAXIMA --	TD = 7.5200	TV = 2.5500	TA = 7.5000
PER = 3.90	TIMES FOR MAXIMA --	TD = 7.5300	TV = 2.5500	TA = 7.5000
PER = 4.00	TIMES FOR MAXIMA --	TD = 7.5300	TV = 2.5500	TA = 7.5000
PER = 4.10	TIMES FOR MAXIMA --	TD = 6.2300	TV = 2.5500	TA = 6.0000
PER = 4.20	TIMES FOR MAXIMA --	TD = 6.2400	TV = 2.5500	TA = 6.2100
PER = 4.30	TIMES FOR MAXIMA --	TD = 6.2400	TV = 2.5500	TA = 6.2100
PER = 4.40	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5500	TA = 6.2100
PER = 4.50	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5500	TA = 6.2100
PER = 4.60	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5500	TA = 6.2100
PER = 4.70	TIMES FOR MAXIMA --	TD = 6.2500	TV = 2.5500	TA = 6.2100
PER = 4.80	TIMES FOR MAXIMA --	TD = 6.2600	TV = 2.5500	TA = 6.2100
PER = 4.90	TIMES FOR MAXIMA --	TD = 6.2600	TV = 2.5500	TA = 6.2100
PER = 5.00	TIMES FOR MAXIMA --	TD = 6.2600	TV = 2.5500	TA = 6.2100
PER = 5.10	TIMES FOR MAXIMA --	TD = 6.2600	TV = 2.5500	TA = 6.2200

PER = 5.20 TIMES FOR MAXIMA -- TD = 6.2600 TV = 2.5500 TA = 6.2200
PER = 5.40 TIMES FOR MAXIMA -- TD = 6.2600 TV = 2.5500 TA = 6.2200
PER = 5.60 TIMES FOR MAXIMA -- TD = 6.4700 TV = 2.5500 TA = 6.2200
PER = 5.80 TIMES FOR MAXIMA -- TD = 6.4700 TV = 2.5500 TA = 6.2200
PER = 6.00 TIMES FOR MAXIMA -- TD = 6.4800 TV = 2.5500 TA = 6.2200
PER = 6.20 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.5300
PER = 6.40 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 6.60 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 6.80 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 7.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 7.30 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 7.60 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 8.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 8.50 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 9.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER = 9.50 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900
PER =10.00 TIMES FOR MAXIMA -- TD = 4.8400 TV = 2.5500 TA = 4.7900

SPECTRAL VALUES--
(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00007	0.00171	0.04195	0.82192	0.81858	100.00
2	0.02	0.00027	0.04335	0.08336	0.82243	0.81328	50.00
3	0.03	0.00110	0.18379	0.22974	1.51822	1.49432	33.33
4	0.04	0.00217	0.31642	0.34155	1.74493	1.66617	25.00
5	0.05	0.00366	0.44677	0.45974	1.82459	1.79417	20.00
6	0.06	0.00428	0.41585	0.44797	1.42638	1.45686	16.67
7	0.07	0.00581	0.47802	0.52194	1.47018	1.45494	14.29
8	0.08	0.01091	0.79906	0.85696	2.13704	2.09023	12.50
9	0.09	0.01380	0.91960	0.96375	2.07701	2.08952	11.11
10	0.10	0.01203	0.70258	0.75557	1.50682	1.47435	10.00
11	0.11	0.01243	0.73464	0.71011	1.28682	1.25967	9.09
12	0.12	0.01009	0.54647	0.52809	0.85116	0.85872	8.33
13	0.13	0.01069	0.46673	0.51688	0.78573	0.77583	7.69
14	0.14	0.01281	0.55624	0.57507	0.81192	0.80152	7.14
15	0.15	0.01487	0.56239	0.62302	0.80252	0.81046	6.67
16	0.16	0.01884	0.75229	0.73986	0.91472	0.90230	6.25
17	0.17	0.02303	0.86039	0.85120	0.97551	0.97703	5.88
18	0.18	0.02485	0.86020	0.86750	0.93942	0.94042	5.56
19	0.19	0.02857	0.87770	0.94490	0.97165	0.97042	5.26
20	0.20	0.02938	0.95448	0.92312	0.90821	0.90064	5.00
21	0.21	0.03784	1.14946	1.13222	1.05638	1.05204	4.76
22	0.22	0.03804	1.12843	1.08630	0.97513	0.96349	4.55
23	0.23	0.04244	1.13944	1.15933	0.98812	0.98357	4.35
24	0.24	0.04588	1.22517	1.20103	0.98291	0.97648	4.17
25	0.25	0.05505	1.45180	1.38356	1.07767	1.07990	4.00
26	0.26	0.06352	1.64419	1.53498	1.15887	1.15200	3.85
27	0.27	0.06397	1.49739	1.48854	1.07894	1.07578	3.70
28	0.28	0.06108	1.44705	1.37074	0.96463	0.95526	3.57
29	0.29	0.06330	1.50041	1.37148	0.92871	0.92282	3.45
30	0.30	0.06799	1.58132	1.42398	0.92831	0.92621	3.33
31	0.31	0.07450	1.56110	1.50998	0.95436	0.95046	3.23
32	0.32	0.07866	1.60487	1.54449	0.94665	0.94180	3.13
33	0.33	0.07637	1.45088	1.45416	0.86887	0.85985	3.03
34	0.34	0.07200	1.33968	1.33047	0.77205	0.76357	2.94
35	0.35	0.06812	1.34283	1.22295	0.68539	0.68181	2.86
36	0.36	0.06715	1.33822	1.17200	0.64080	0.63526	2.78
37	0.37	0.06656	1.28137	1.13028	0.60109	0.59609	2.70
38	0.38	0.06468	1.25981	1.06944	0.55415	0.54916	2.63
39	0.39	0.06068	1.23910	0.97764	0.49358	0.48915	2.56
40	0.40	0.06370	1.17128	1.00062	0.49250	0.48813	2.50

41	0.41	0.06256	1.18616	0.95865	0.45808	0.45625	2.44
42	0.42	0.06037	1.19616	0.90309	0.42280	0.41957	2.38
43	0.43	0.05966	1.15192	0.87180	0.39751	0.39561	2.33
44	0.44	0.05930	1.07742	0.84685	0.37888	0.37556	2.27
45	0.45	0.05866	0.99663	0.81904	0.35661	0.35515	2.22
46	0.46	0.05718	0.90387	0.78104	0.33309	0.33131	2.17
47	0.47	0.05473	0.84874	0.73170	0.30536	0.30378	2.13
48	0.48	0.05130	0.84985	0.67155	0.27399	0.27300	2.08
49	0.49	0.05240	0.81367	0.67192	0.26905	0.26757	2.04
50	0.50	0.05402	0.80880	0.67886	0.26657	0.26493	2.00
51	0.51	0.05288	0.83519	0.65150	0.25161	0.24927	1.96
52	0.52	0.05027	0.87985	0.60736	0.22945	0.22791	1.92
53	0.53	0.05172	0.93855	0.61319	0.22691	0.22576	1.89
54	0.54	0.05617	1.00433	0.65351	0.23851	0.23615	1.85
55	0.55	0.06000	1.06884	0.68548	0.24516	0.24320	1.82
56	0.56	0.06644	1.12386	0.74544	0.26427	0.25974	1.79
57	0.57	0.07374	1.16245	0.81287	0.28269	0.27827	1.75
58	0.58	0.08007	1.17982	0.86741	0.29612	0.29182	1.72
59	0.60	0.08866	1.14420	0.92849	0.30613	0.30196	1.67
60	0.62	0.09140	1.02596	0.92630	0.29378	0.29153	1.61
61	0.64	0.08974	1.03125	0.88106	0.26991	0.26863	1.56
62	0.66	0.08366	1.08019	0.79642	0.23773	0.23546	1.52
63	0.68	0.07428	1.06790	0.68631	0.19773	0.19694	1.47
64	0.70	0.06678	1.00885	0.59944	0.16771	0.16710	1.43
65	0.72	0.06933	0.92792	0.60506	0.16570	0.16398	1.39
66	0.74	0.06680	0.83311	0.56721	0.15157	0.14957	1.35
67	0.76	0.06220	0.75200	0.51422	0.13421	0.13203	1.32
68	0.78	0.05906	0.72919	0.47575	0.12066	0.11902	1.28
69	0.80	0.06091	0.71267	0.47839	0.11739	0.11669	1.25
70	0.82	0.06283	0.70235	0.48142	0.11542	0.11456	1.22
71	0.84	0.06816	0.71704	0.50982	0.12036	0.11843	1.19
72	0.86	0.07687	0.74262	0.56162	0.12907	0.12743	1.16
73	0.88	0.08600	0.77734	0.61406	0.13751	0.13616	1.14
74	0.90	0.09759	0.79993	0.68129	0.14881	0.14771	1.11
75	0.92	0.10954	0.86595	0.74812	0.15920	0.15868	1.09
76	0.94	0.11962	0.95982	0.79954	0.16788	0.16597	1.06
77	0.96	0.12541	1.02877	0.82083	0.16974	0.16684	1.04
78	0.98	0.12810	1.05347	0.82127	0.16447	0.16353	1.02
79	1.00	0.13647	1.06090	0.85746	0.16889	0.16732	1.00
80	1.05	0.14854	1.12673	0.88885	0.16702	0.16518	0.95
81	1.10	0.15387	1.13175	0.87890	0.15746	0.15591	0.91
82	1.15	0.14959	1.17120	0.81732	0.14084	0.13868	0.87
83	1.20	0.14036	1.18130	0.73495	0.12010	0.11951	0.83
84	1.25	0.13601	1.17059	0.68368	0.10739	0.10672	0.80
85	1.30	0.13061	1.14666	0.63128	0.09671	0.09475	0.77
86	1.35	0.12893	1.11542	0.60008	0.08915	0.08674	0.74
87	1.40	0.12537	1.08104	0.56265	0.08085	0.07842	0.71
88	1.45	0.12030	1.04630	0.52129	0.07258	0.07015	0.69
89	1.50	0.11476	1.01286	0.48069	0.06478	0.06253	0.67
90	1.55	0.10878	0.98162	0.44095	0.05766	0.05551	0.65
91	1.60	0.10271	0.95297	0.40335	0.05129	0.04919	0.63
92	1.65	0.09704	0.92697	0.36955	0.04565	0.04370	0.61
93	1.70	0.09180	0.90352	0.33927	0.04070	0.03894	0.59
94	1.75	0.09076	0.88242	0.32585	0.03720	0.03633	0.57
95	1.80	0.09549	0.86342	0.33334	0.03725	0.03614	0.56
96	1.85	0.09582	0.84627	0.32543	0.03556	0.03432	0.54
97	1.90	0.09635	0.83074	0.31862	0.03353	0.03272	0.53
98	1.95	0.09936	0.81662	0.32016	0.03318	0.03204	0.51
99	2.00	0.10823	0.80374	0.34003	0.03435	0.03317	0.50
100	2.05	0.11706	0.79193	0.35877	0.03544	0.03415	0.49
101	2.10	0.12401	0.78107	0.37104	0.03586	0.03448	0.48

102	2.15	0.12967	0.77105	0.37894	0.03573	0.03439	0.47
103	2.20	0.13671	0.76177	0.39044	0.03518	0.03463	0.45
104	2.25	0.14201	0.75315	0.39657	0.03481	0.03439	0.44
105	2.30	0.14953	0.74515	0.40849	0.03535	0.03466	0.43
106	2.35	0.15353	0.73769	0.41049	0.03452	0.03408	0.43
107	2.40	0.15782	0.73074	0.41317	0.03399	0.03359	0.42
108	2.50	0.16052	0.71820	0.40344	0.03180	0.03149	0.40
109	2.60	0.16493	0.70726	0.39857	0.03037	0.02991	0.38
110	2.70	0.16824	0.69772	0.39151	0.02956	0.02829	0.37
111	2.80	0.17313	0.68944	0.38851	0.02827	0.02707	0.36
112	2.90	0.17573	0.68225	0.38075	0.02670	0.02562	0.34
113	3.00	0.17624	0.67604	0.36911	0.02498	0.02401	0.33
114	3.10	0.18240	0.67068	0.36968	0.02391	0.02327	0.32
115	3.20	0.18800	0.66610	0.36914	0.02315	0.02251	0.31
116	3.30	0.19088	0.66221	0.36343	0.02213	0.02149	0.30
117	3.40	0.19114	0.65890	0.35323	0.02089	0.02027	0.29
118	3.50	0.18855	0.65614	0.33849	0.01960	0.01887	0.29
119	3.60	0.18358	0.65386	0.32040	0.01815	0.01737	0.28
120	3.70	0.18463	0.65196	0.31354	0.01716	0.01654	0.27
121	3.80	0.18252	0.65044	0.30178	0.01623	0.01550	0.26
122	3.90	0.17770	0.64924	0.28629	0.01514	0.01432	0.26
123	4.00	0.17042	0.64831	0.26769	0.01393	0.01306	0.25
124	4.10	0.17053	0.64762	0.26134	0.01297	0.01244	0.24
125	4.20	0.17579	0.64713	0.26299	0.01273	0.01222	0.24
126	4.30	0.17994	0.64684	0.26293	0.01248	0.01193	0.23
127	4.40	0.18295	0.64670	0.26125	0.01217	0.01159	0.23
128	4.50	0.18495	0.64668	0.25824	0.01180	0.01120	0.22
129	4.60	0.18589	0.64682	0.25391	0.01140	0.01077	0.22
130	4.70	0.18585	0.64703	0.24845	0.01096	0.01032	0.21
131	4.80	0.18495	0.64733	0.24209	0.01050	0.00984	0.21
132	4.90	0.18336	0.64771	0.23511	0.01004	0.00936	0.20
133	5.00	0.18105	0.64813	0.22752	0.00956	0.00888	0.20
134	5.10	0.17813	0.64865	0.21946	0.00909	0.00840	0.20
135	5.20	0.17468	0.64916	0.21107	0.00862	0.00792	0.19
136	5.40	0.16651	0.65031	0.19375	0.00771	0.00700	0.19
137	5.60	0.16025	0.65159	0.17980	0.00686	0.00627	0.18
138	5.80	0.15264	0.65291	0.16536	0.00607	0.00556	0.17
139	6.00	0.14415	0.65430	0.15096	0.00536	0.00491	0.17
140	6.20	0.14369	0.65562	0.14562	0.00501	0.00458	0.16
141	6.40	0.14541	0.65698	0.14276	0.00478	0.00435	0.16
142	6.60	0.14651	0.65833	0.13947	0.00455	0.00412	0.15
143	6.80	0.14706	0.65959	0.13588	0.00433	0.00390	0.15
144	7.00	0.14716	0.66086	0.13209	0.00411	0.00368	0.14
145	7.30	0.14656	0.66269	0.12615	0.00380	0.00337	0.14
146	7.60	0.14526	0.66446	0.12009	0.00351	0.00308	0.13
147	8.00	0.14272	0.66661	0.11209	0.00316	0.00273	0.13
148	8.50	0.13864	0.66906	0.10248	0.00277	0.00235	0.12
149	9.00	0.13396	0.67127	0.09352	0.00243	0.00203	0.11
150	9.50	0.12900	0.67322	0.08532	0.00214	0.00175	0.11
151	10.00	0.12397	0.67505	0.07789	0.00190	0.00152	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.
AREA OF ACC. RESPONSE SPECTRUM = 0.495
AREA OF VEL. RESPONSE SPECTRUM = 2.289
MAX. ACCELERATION RESPONSE VALUE = 1.507
MAX. VELOCITY RESPONSE VALUE = 1.644

1****** OPTION 9 *** COMPUTE RESPONSE SPECTRUM
RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER 17
CALCULATED FOR DAMPING 0.050

TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
TD = TIME FOR MAX. RELATIVE DISP.
TV = TIME FOR MAX. RELATIVE VEL.
TA = TIME FOR MAX. ABSOLUTE ACC.
DAMPING RATIO = 0.050

PER = 0.01	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5700	TA = 2.5700
PER = 0.02	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5800	TA = 2.5700
PER = 0.03	TIMES FOR MAXIMA --	TD = 2.9500	TV = 2.9400	TA = 2.9500
PER = 0.04	TIMES FOR MAXIMA --	TD = 3.6300	TV = 2.6100	TA = 3.6300
PER = 0.05	TIMES FOR MAXIMA --	TD = 4.8700	TV = 4.8300	TA = 4.8400
PER = 0.06	TIMES FOR MAXIMA --	TD = 4.3200	TV = 4.3300	TA = 1.9700
PER = 0.07	TIMES FOR MAXIMA --	TD = 4.3300	TV = 4.3100	TA = 4.3300
PER = 0.08	TIMES FOR MAXIMA --	TD = 2.5200	TV = 2.5400	TA = 2.5200
PER = 0.09	TIMES FOR MAXIMA --	TD = 2.5300	TV = 2.6000	TA = 2.5300
PER = 0.10	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.6100	TA = 2.5900
PER = 0.11	TIMES FOR MAXIMA --	TD = 2.5500	TV = 2.5800	TA = 2.5500
PER = 0.12	TIMES FOR MAXIMA --	TD = 4.8000	TV = 2.5800	TA = 4.8000
PER = 0.13	TIMES FOR MAXIMA --	TD = 3.6600	TV = 4.7900	TA = 3.6600
PER = 0.14	TIMES FOR MAXIMA --	TD = 3.6700	TV = 3.7100	TA = 3.6700
PER = 0.15	TIMES FOR MAXIMA --	TD = 3.6800	TV = 3.7200	TA = 3.6800
PER = 0.16	TIMES FOR MAXIMA --	TD = 4.1800	TV = 4.1500	TA = 4.1800
PER = 0.17	TIMES FOR MAXIMA --	TD = 4.1100	TV = 4.1500	TA = 4.1100
PER = 0.18	TIMES FOR MAXIMA --	TD = 2.5600	TV = 2.5200	TA = 2.5600
PER = 0.19	TIMES FOR MAXIMA --	TD = 2.5700	TV = 2.5300	TA = 2.5700
PER = 0.20	TIMES FOR MAXIMA --	TD = 6.6100	TV = 2.5300	TA = 6.6000
PER = 0.21	TIMES FOR MAXIMA --	TD = 2.5800	TV = 2.5300	TA = 7.0500
PER = 0.22	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5500	TA = 2.5000
PER = 0.23	TIMES FOR MAXIMA --	TD = 3.4200	TV = 7.0400	TA = 6.9800
PER = 0.24	TIMES FOR MAXIMA --	TD = 2.2400	TV = 2.2900	TA = 2.2300
PER = 0.25	TIMES FOR MAXIMA --	TD = 6.2400	TV = 6.3100	TA = 6.2400
PER = 0.26	TIMES FOR MAXIMA --	TD = 1.5600	TV = 6.3200	TA = 6.2500
PER = 0.27	TIMES FOR MAXIMA --	TD = 1.1900	TV = 1.2600	TA = 1.1900
PER = 0.28	TIMES FOR MAXIMA --	TD = 1.2100	TV = 1.2600	TA = 1.2000
PER = 0.29	TIMES FOR MAXIMA --	TD = 1.2100	TV = 5.1000	TA = 1.2100
PER = 0.30	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.8400	TA = 2.9100
PER = 0.31	TIMES FOR MAXIMA --	TD = 2.9400	TV = 2.8500	TA = 2.9400
PER = 0.32	TIMES FOR MAXIMA --	TD = 2.9500	TV = 2.5600	TA = 2.9500
PER = 0.33	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5600	TA = 2.5000
PER = 0.34	TIMES FOR MAXIMA --	TD = 2.5000	TV = 2.5600	TA = 2.5000
PER = 0.35	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.5600	TA = 2.5000
PER = 0.36	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.9300	TA = 2.5000
PER = 0.37	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6000	TA = 2.5000
PER = 0.38	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.8000	TA = 2.5100
PER = 0.39	TIMES FOR MAXIMA --	TD = 2.5200	TV = 4.0300	TA = 2.5100
PER = 0.40	TIMES FOR MAXIMA --	TD = 3.9400	TV = 4.0300	TA = 3.9400
PER = 0.41	TIMES FOR MAXIMA --	TD = 3.9500	TV = 4.0400	TA = 3.9500
PER = 0.42	TIMES FOR MAXIMA --	TD = 3.9600	TV = 4.0400	TA = 3.9500
PER = 0.43	TIMES FOR MAXIMA --	TD = 3.9700	TV = 4.0500	TA = 3.9600
PER = 0.44	TIMES FOR MAXIMA --	TD = 3.9800	TV = 3.9100	TA = 3.9700
PER = 0.45	TIMES FOR MAXIMA --	TD = 4.6900	TV = 3.9100	TA = 4.6900
PER = 0.46	TIMES FOR MAXIMA --	TD = 4.7000	TV = 3.9100	TA = 4.6900
PER = 0.47	TIMES FOR MAXIMA --	TD = 4.7100	TV = 3.9100	TA = 4.7000
PER = 0.48	TIMES FOR MAXIMA --	TD = 4.7100	TV = 3.9100	TA = 4.7000
PER = 0.49	TIMES FOR MAXIMA --	TD = 5.5200	TV = 5.4100	TA = 5.5100
PER = 0.50	TIMES FOR MAXIMA --	TD = 5.5500	TV = 5.4100	TA = 5.5400
PER = 0.51	TIMES FOR MAXIMA --	TD = 5.5600	TV = 5.4100	TA = 5.5600
PER = 0.52	TIMES FOR MAXIMA --	TD = 2.5100	TV = 5.4400	TA = 2.5000
PER = 0.53	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6100	TA = 2.5000
PER = 0.54	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6300	TA = 2.5000
PER = 0.55	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6400	TA = 2.5000
PER = 0.56	TIMES FOR MAXIMA --	TD = 2.5100	TV = 2.6400	TA = 2.5000

PER = 0.57	TIMES FOR MAXIMA --	TD = 2.5200	TV = 2.6400	TA = 2.5100
PER = 0.58	TIMES FOR MAXIMA --	TD = 2.5200	TV = 2.6400	TA = 2.5100
PER = 0.60	TIMES FOR MAXIMA --	TD = 2.5400	TV = 2.4800	TA = 2.5300
PER = 0.62	TIMES FOR MAXIMA --	TD = 2.5600	TV = 2.4800	TA = 2.5500
PER = 0.64	TIMES FOR MAXIMA --	TD = 2.5900	TV = 2.4800	TA = 2.5800
PER = 0.66	TIMES FOR MAXIMA --	TD = 2.6000	TV = 2.4900	TA = 2.5900
PER = 0.68	TIMES FOR MAXIMA --	TD = 3.4100	TV = 2.4900	TA = 3.4000
PER = 0.70	TIMES FOR MAXIMA --	TD = 3.4200	TV = 2.4900	TA = 3.4100
PER = 0.72	TIMES FOR MAXIMA --	TD = 3.4300	TV = 3.6100	TA = 3.4200
PER = 0.74	TIMES FOR MAXIMA --	TD = 3.4400	TV = 3.6100	TA = 3.4300
PER = 0.76	TIMES FOR MAXIMA --	TD = 1.8100	TV = 3.6100	TA = 1.7500
PER = 0.78	TIMES FOR MAXIMA --	TD = 1.4700	TV = 3.6100	TA = 1.8100
PER = 0.80	TIMES FOR MAXIMA --	TD = 1.4700	TV = 3.6100	TA = 1.4600
PER = 0.82	TIMES FOR MAXIMA --	TD = 1.4900	TV = 3.6100	TA = 1.4700
PER = 0.84	TIMES FOR MAXIMA --	TD = 6.4900	TV = 3.6200	TA = 6.4800
PER = 0.86	TIMES FOR MAXIMA --	TD = 3.4700	TV = 4.2200	TA = 3.4700
PER = 0.88	TIMES FOR MAXIMA --	TD = 4.0000	TV = 4.2200	TA = 3.9700
PER = 0.90	TIMES FOR MAXIMA --	TD = 4.0100	TV = 4.2200	TA = 4.0000
PER = 0.92	TIMES FOR MAXIMA --	TD = 4.0100	TV = 4.2900	TA = 4.0000
PER = 0.94	TIMES FOR MAXIMA --	TD = 3.1200	TV = 4.2900	TA = 3.1100
PER = 0.96	TIMES FOR MAXIMA --	TD = 3.1200	TV = 3.9100	TA = 3.1100
PER = 0.98	TIMES FOR MAXIMA --	TD = 3.1300	TV = 3.9100	TA = 3.1200
PER = 1.00	TIMES FOR MAXIMA --	TD = 3.1500	TV = 3.9100	TA = 3.1200
PER = 1.05	TIMES FOR MAXIMA --	TD = 3.2000	TV = 3.9100	TA = 3.1800
PER = 1.10	TIMES FOR MAXIMA --	TD = 3.2300	TV = 2.4900	TA = 3.2200
PER = 1.15	TIMES FOR MAXIMA --	TD = 3.3000	TV = 2.4900	TA = 3.2900
PER = 1.20	TIMES FOR MAXIMA --	TD = 3.3300	TV = 2.4900	TA = 3.3100
PER = 1.25	TIMES FOR MAXIMA --	TD = 3.3500	TV = 2.4900	TA = 3.3300
PER = 1.30	TIMES FOR MAXIMA --	TD = 3.3700	TV = 2.4900	TA = 3.3600
PER = 1.35	TIMES FOR MAXIMA --	TD = 2.8400	TV = 2.4900	TA = 2.8200
PER = 1.40	TIMES FOR MAXIMA --	TD = 2.8700	TV = 2.4900	TA = 2.8300
PER = 1.45	TIMES FOR MAXIMA --	TD = 2.9000	TV = 2.4900	TA = 2.8600
PER = 1.50	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.4900	TA = 2.8900
PER = 1.55	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.4900	TA = 2.9100
PER = 1.60	TIMES FOR MAXIMA --	TD = 2.9200	TV = 2.4900	TA = 2.9100
PER = 1.65	TIMES FOR MAXIMA --	TD = 2.9300	TV = 2.4900	TA = 2.9100
PER = 1.70	TIMES FOR MAXIMA --	TD = 2.9900	TV = 2.4900	TA = 2.3700
PER = 1.75	TIMES FOR MAXIMA --	TD = 2.3900	TV = 2.4900	TA = 2.3700
PER = 1.80	TIMES FOR MAXIMA --	TD = 5.9300	TV = 2.4900	TA = 5.9200
PER = 1.85	TIMES FOR MAXIMA --	TD = 6.0000	TV = 2.4900	TA = 5.9900
PER = 1.90	TIMES FOR MAXIMA --	TD = 6.0500	TV = 5.7600	TA = 6.0400
PER = 1.95	TIMES FOR MAXIMA --	TD = 5.3500	TV = 5.7600	TA = 5.3400
PER = 2.00	TIMES FOR MAXIMA --	TD = 5.3600	TV = 5.7600	TA = 5.3400
PER = 2.05	TIMES FOR MAXIMA --	TD = 5.3600	TV = 5.7600	TA = 5.3400
PER = 2.10	TIMES FOR MAXIMA --	TD = 5.3600	TV = 5.7600	TA = 5.3400
PER = 2.15	TIMES FOR MAXIMA --	TD = 8.7100	TV = 5.7600	TA = 5.3400
PER = 2.20	TIMES FOR MAXIMA --	TD = 8.8100	TV = 5.7600	TA = 7.6700
PER = 2.25	TIMES FOR MAXIMA --	TD = 8.8900	TV = 5.7600	TA = 8.8800
PER = 2.30	TIMES FOR MAXIMA --	TD = 7.8200	TV = 5.7600	TA = 8.8800
PER = 2.35	TIMES FOR MAXIMA --	TD = 7.8800	TV = 5.7600	TA = 7.7900
PER = 2.40	TIMES FOR MAXIMA --	TD = 7.9100	TV = 5.7600	TA = 7.8800
PER = 2.50	TIMES FOR MAXIMA --	TD = 8.0300	TV = 7.3100	TA = 8.0100
PER = 2.60	TIMES FOR MAXIMA --	TD = 8.0600	TV = 7.6400	TA = 8.0200
PER = 2.70	TIMES FOR MAXIMA --	TD = 6.9400	TV = 7.6400	TA = 6.8800
PER = 2.80	TIMES FOR MAXIMA --	TD = 6.9400	TV = 7.6500	TA = 6.8800
PER = 2.90	TIMES FOR MAXIMA --	TD = 7.0600	TV = 7.6500	TA = 6.9300
PER = 3.00	TIMES FOR MAXIMA --	TD = 7.1500	TV = 7.6500	TA = 7.0400
PER = 3.10	TIMES FOR MAXIMA --	TD = 7.1900	TV = 5.3000	TA = 7.1400
PER = 3.20	TIMES FOR MAXIMA --	TD = 7.2000	TV = 5.3000	TA = 7.1400
PER = 3.30	TIMES FOR MAXIMA --	TD = 7.2100	TV = 5.3000	TA = 7.1800
PER = 3.40	TIMES FOR MAXIMA --	TD = 7.2100	TV = 5.3000	TA = 7.1800

PER = 3.50 TIMES FOR MAXIMA -- TD = 7.2200 TV = 5.3000 TA = 7.1900
PER = 3.60 TIMES FOR MAXIMA -- TD = 7.4500 TV = 5.3000 TA = 7.3800
PER = 3.70 TIMES FOR MAXIMA -- TD = 7.4600 TV = 5.3000 TA = 7.3900
PER = 3.80 TIMES FOR MAXIMA -- TD = 7.5000 TV = 5.3000 TA = 7.4400
PER = 3.90 TIMES FOR MAXIMA -- TD = 7.5100 TV = 5.3000 TA = 7.4500
PER = 4.00 TIMES FOR MAXIMA -- TD = 7.6200 TV = 5.3000 TA = 7.4500
PER = 4.10 TIMES FOR MAXIMA -- TD = 6.1600 TV = 5.3000 TA = 6.0900
PER = 4.20 TIMES FOR MAXIMA -- TD = 6.1600 TV = 5.3000 TA = 6.1400
PER = 4.30 TIMES FOR MAXIMA -- TD = 6.1700 TV = 5.3000 TA = 6.1500
PER = 4.40 TIMES FOR MAXIMA -- TD = 6.1900 TV = 5.3000 TA = 6.1500
PER = 4.50 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.60 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.70 TIMES FOR MAXIMA -- TD = 6.2000 TV = 5.3000 TA = 6.1500
PER = 4.80 TIMES FOR MAXIMA -- TD = 6.3400 TV = 5.3000 TA = 6.1500
PER = 4.90 TIMES FOR MAXIMA -- TD = 6.3400 TV = 5.3000 TA = 6.1500
PER = 5.00 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.10 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.20 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.40 TIMES FOR MAXIMA -- TD = 6.3500 TV = 5.3000 TA = 6.3200
PER = 5.60 TIMES FOR MAXIMA -- TD = 6.5400 TV = 5.3000 TA = 6.3200
PER = 5.80 TIMES FOR MAXIMA -- TD = 6.5500 TV = 5.3000 TA = 6.5000
PER = 6.00 TIMES FOR MAXIMA -- TD = 6.5500 TV = 5.3000 TA = 6.5000
PER = 6.20 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.5200
PER = 6.40 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.7300
PER = 6.60 TIMES FOR MAXIMA -- TD = 4.7700 TV = 5.3000 TA = 4.7300
PER = 6.80 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.30 TIMES FOR MAXIMA -- TD = 4.7800 TV = 5.3000 TA = 4.7300
PER = 7.60 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 8.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 8.50 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 9.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER = 9.50 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300
PER =10.00 TIMES FOR MAXIMA -- TD = 4.7800 TV = 2.4900 TA = 4.7300

SPECTRAL VALUES--
(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00005	0.00136	0.02849	0.55850	0.55584	100.00
2	0.02	0.00018	0.04499	0.05569	0.55907	0.54337	50.00
3	0.03	0.00100	0.17299	0.21036	1.35502	1.36825	33.33
4	0.04	0.00178	0.23944	0.27972	1.41661	1.36454	25.00
5	0.05	0.00238	0.31660	0.29913	1.19625	1.16738	20.00
6	0.06	0.00324	0.37402	0.33931	1.11290	1.10350	16.67
7	0.07	0.00410	0.42586	0.36768	1.00192	1.02494	14.29
8	0.08	0.00662	0.49285	0.51989	1.30592	1.26808	12.50
9	0.09	0.01058	0.74261	0.73891	1.61391	1.60203	11.11
10	0.10	0.00992	0.62974	0.62356	1.19459	1.21675	10.00
11	0.11	0.00945	0.61752	0.53978	0.94469	0.95753	9.09
12	0.12	0.00955	0.45760	0.49991	0.83422	0.81289	8.33
13	0.13	0.00942	0.48076	0.45526	0.67574	0.68335	7.69
14	0.14	0.01238	0.51781	0.55546	0.77129	0.77420	7.14
15	0.15	0.01197	0.53788	0.50127	0.65502	0.65209	6.67
16	0.16	0.01428	0.62039	0.56072	0.68796	0.68383	6.25
17	0.17	0.01619	0.69957	0.59823	0.69353	0.68666	5.88
18	0.18	0.01573	0.57102	0.54919	0.60640	0.59536	5.56
19	0.19	0.01745	0.63990	0.57695	0.59795	0.59253	5.26
20	0.20	0.01613	0.56661	0.50682	0.50024	0.49448	5.00
21	0.21	0.01674	0.60435	0.50091	0.46688	0.46544	4.76
22	0.22	0.01774	0.54424	0.50670	0.46072	0.44942	4.55
23	0.23	0.01530	0.47636	0.41797	0.35437	0.35460	4.35

24	0.24	0.01639	0.46797	0.42917	0.35591	0.34893	4.17
25	0.25	0.01736	0.48167	0.43619	0.34254	0.34046	4.00
26	0.26	0.01916	0.51490	0.46302	0.35118	0.34750	3.85
27	0.27	0.02110	0.53368	0.49104	0.35711	0.35488	3.70
28	0.28	0.02280	0.53679	0.51153	0.35936	0.35648	3.57
29	0.29	0.02363	0.56432	0.51192	0.34832	0.34445	3.45
30	0.30	0.02424	0.55960	0.50764	0.33261	0.33018	3.33
31	0.31	0.02969	0.62717	0.60171	0.38143	0.37875	3.23
32	0.32	0.03087	0.64924	0.60610	0.37197	0.36959	3.13
33	0.33	0.02956	0.62054	0.56290	0.33676	0.33284	3.03
34	0.34	0.02988	0.59171	0.55227	0.32331	0.31695	2.94
35	0.35	0.03145	0.58062	0.56451	0.32000	0.31472	2.86
36	0.36	0.03369	0.56893	0.58806	0.32211	0.31875	2.78
37	0.37	0.03527	0.58074	0.59894	0.31687	0.31587	2.70
38	0.38	0.03518	0.57848	0.58166	0.30335	0.29868	2.63
39	0.39	0.03387	0.62913	0.54565	0.27671	0.27301	2.56
40	0.40	0.03589	0.68918	0.56383	0.27621	0.27505	2.50
41	0.41	0.03816	0.69282	0.58485	0.27999	0.27835	2.44
42	0.42	0.03860	0.65645	0.57750	0.26954	0.26830	2.38
43	0.43	0.03804	0.60516	0.55578	0.25364	0.25221	2.33
44	0.44	0.03681	0.59581	0.52568	0.23464	0.23313	2.27
45	0.45	0.03653	0.60067	0.51004	0.22154	0.22117	2.22
46	0.46	0.03729	0.59047	0.50937	0.21665	0.21607	2.17
47	0.47	0.03606	0.57052	0.48207	0.20332	0.20014	2.13
48	0.48	0.03349	0.54379	0.43835	0.18014	0.17820	2.08
49	0.49	0.03413	0.51793	0.43769	0.17566	0.17430	2.04
50	0.50	0.03500	0.52157	0.43985	0.17218	0.17165	2.00
51	0.51	0.03473	0.49075	0.42793	0.16499	0.16373	1.96
52	0.52	0.03363	0.45429	0.40638	0.15517	0.15249	1.92
53	0.53	0.03853	0.46746	0.45674	0.17096	0.16816	1.89
54	0.54	0.04389	0.51448	0.51070	0.18737	0.18454	1.85
55	0.55	0.04926	0.55886	0.56278	0.20245	0.19966	1.82
56	0.56	0.05415	0.59863	0.60760	0.21441	0.21172	1.79
57	0.57	0.05848	0.62378	0.64468	0.22381	0.22070	1.75
58	0.58	0.06184	0.63106	0.66986	0.22829	0.22536	1.72
59	0.60	0.06544	0.70068	0.68529	0.22393	0.22287	1.67
60	0.62	0.06573	0.79556	0.66617	0.21124	0.20966	1.61
61	0.64	0.06527	0.83826	0.64083	0.19701	0.19538	1.56
62	0.66	0.06037	0.83336	0.57472	0.17238	0.16992	1.52
63	0.68	0.05937	0.78867	0.54857	0.15814	0.15742	1.47
64	0.70	0.06308	0.71314	0.56623	0.15969	0.15784	1.43
65	0.72	0.06124	0.63612	0.53441	0.14674	0.14483	1.39
66	0.74	0.05637	0.58189	0.47867	0.12760	0.12622	1.35
67	0.76	0.05182	0.52189	0.42839	0.11039	0.10999	1.32
68	0.78	0.05224	0.48141	0.42084	0.10620	0.10528	1.28
69	0.80	0.05347	0.46947	0.41997	0.10299	0.10244	1.25
70	0.82	0.05454	0.48106	0.41789	0.09999	0.09944	1.22
71	0.84	0.05857	0.50396	0.43810	0.10258	0.10177	1.19
72	0.86	0.06521	0.56033	0.47640	0.10880	0.10809	1.16
73	0.88	0.07540	0.63272	0.53836	0.11994	0.11938	1.14
74	0.90	0.08642	0.69483	0.60330	0.13206	0.13080	1.11
75	0.92	0.09546	0.73421	0.65194	0.14025	0.13828	1.09
76	0.94	0.10261	0.79469	0.68589	0.14302	0.14238	1.06
77	0.96	0.11124	0.85758	0.72810	0.14917	0.14799	1.04
78	0.98	0.11832	0.92962	0.75859	0.15264	0.15105	1.02
79	1.00	0.12378	0.97242	0.77774	0.15296	0.15176	1.00
80	1.05	0.13543	0.94462	0.81038	0.15223	0.15060	0.95
81	1.10	0.13936	0.91425	0.79602	0.14229	0.14121	0.91
82	1.15	0.13942	0.92776	0.76173	0.12990	0.12925	0.87
83	1.20	0.13742	0.91717	0.71955	0.11796	0.11700	0.83
84	1.25	0.13052	0.89112	0.65605	0.10342	0.10241	0.80

85	1.30	0.12014	0.85653	0.58064	0.08786	0.08715	0.77
86	1.35	0.11483	0.81840	0.53443	0.07843	0.07725	0.74
87	1.40	0.11078	0.78000	0.49719	0.06994	0.06930	0.71
88	1.45	0.10667	0.74332	0.46222	0.06255	0.06220	0.69
89	1.50	0.10247	0.70939	0.42921	0.05627	0.05583	0.67
90	1.55	0.09800	0.67864	0.39727	0.05054	0.05001	0.65
91	1.60	0.09315	0.65110	0.36578	0.04533	0.04461	0.63
92	1.65	0.08827	0.62659	0.33614	0.04056	0.03975	0.61
93	1.70	0.08406	0.60485	0.31070	0.03642	0.03566	0.59
94	1.75	0.08232	0.58554	0.29557	0.03416	0.03296	0.57
95	1.80	0.08511	0.56835	0.29710	0.03252	0.03221	0.56
96	1.85	0.09046	0.55299	0.30724	0.03299	0.03241	0.54
97	1.90	0.09369	0.55264	0.30982	0.03228	0.03182	0.53
98	1.95	0.09719	0.57669	0.31317	0.03199	0.03134	0.51
99	2.00	0.10618	0.59049	0.33357	0.03334	0.03254	0.50
100	2.05	0.11329	0.59503	0.34724	0.03395	0.03305	0.49
101	2.10	0.11848	0.59178	0.35449	0.03395	0.03294	0.48
102	2.15	0.12507	0.58239	0.36551	0.03345	0.03317	0.47
103	2.20	0.13231	0.56849	0.37788	0.03396	0.03352	0.45
104	2.25	0.14127	0.55156	0.39451	0.03461	0.03421	0.44
105	2.30	0.14555	0.53286	0.39762	0.03432	0.03373	0.43
106	2.35	0.15032	0.51341	0.40191	0.03358	0.03337	0.43
107	2.40	0.15378	0.49399	0.40260	0.03307	0.03273	0.42
108	2.50	0.16045	0.47493	0.40326	0.03175	0.03148	0.40
109	2.60	0.16086	0.46775	0.38874	0.02958	0.02918	0.38
110	2.70	0.16244	0.48295	0.37802	0.02799	0.02732	0.37
111	2.80	0.16553	0.48384	0.37144	0.02643	0.02589	0.36
112	2.90	0.16738	0.47446	0.36265	0.02483	0.02440	0.34
113	3.00	0.17264	0.45662	0.36159	0.02380	0.02352	0.33
114	3.10	0.17811	0.44595	0.36099	0.02309	0.02272	0.32
115	3.20	0.18202	0.45345	0.35740	0.02213	0.02179	0.31
116	3.30	0.18346	0.46135	0.34931	0.02109	0.02065	0.30
117	3.40	0.18236	0.46940	0.33701	0.01986	0.01934	0.29
118	3.50	0.17866	0.47735	0.32073	0.01848	0.01788	0.29
119	3.60	0.17795	0.48496	0.31058	0.01717	0.01683	0.28
120	3.70	0.17716	0.49200	0.30084	0.01615	0.01587	0.27
121	3.80	0.17389	0.49830	0.28752	0.01510	0.01476	0.26
122	3.90	0.16892	0.50375	0.27215	0.01394	0.01362	0.26
123	4.00	0.16257	0.50827	0.25536	0.01270	0.01246	0.25
124	4.10	0.16720	0.51183	0.25624	0.01240	0.01220	0.24
125	4.20	0.17130	0.51442	0.25627	0.01215	0.01191	0.24
126	4.30	0.17439	0.51608	0.25482	0.01186	0.01156	0.23
127	4.40	0.17660	0.51685	0.25219	0.01151	0.01118	0.23
128	4.50	0.17784	0.51679	0.24832	0.01111	0.01077	0.22
129	4.60	0.17820	0.51597	0.24340	0.01069	0.01033	0.22
130	4.70	0.17762	0.51446	0.23745	0.01023	0.00986	0.21
131	4.80	0.17619	0.51234	0.23064	0.00976	0.00938	0.21
132	4.90	0.17586	0.50969	0.22550	0.00929	0.00898	0.20
133	5.00	0.17475	0.50658	0.21959	0.00889	0.00857	0.20
134	5.10	0.17300	0.50308	0.21314	0.00850	0.00815	0.20
135	5.20	0.17062	0.49924	0.20616	0.00810	0.00774	0.19
136	5.40	0.16427	0.49084	0.19114	0.00731	0.00691	0.19
137	5.60	0.15767	0.48179	0.17690	0.00653	0.00616	0.18
138	5.80	0.15136	0.47242	0.16397	0.00581	0.00552	0.17
139	6.00	0.14395	0.46299	0.15074	0.00521	0.00490	0.17
140	6.20	0.14150	0.45370	0.14340	0.00485	0.00451	0.16
141	6.40	0.14276	0.44470	0.14015	0.00459	0.00427	0.16
142	6.60	0.14344	0.43607	0.13655	0.00436	0.00404	0.15
143	6.80	0.14364	0.42789	0.13273	0.00413	0.00381	0.15
144	7.00	0.14346	0.42018	0.12877	0.00392	0.00359	0.14
145	7.30	0.14249	0.40956	0.12264	0.00361	0.00328	0.14

146	7.60	0.14087	0.40837	0.11646	0.00332	0.00299	0.13
147	8.00	0.13798	0.41060	0.10837	0.00297	0.00264	0.13
148	8.50	0.13357	0.41312	0.09873	0.00259	0.00227	0.12
149	9.00	0.12865	0.41537	0.08981	0.00226	0.00195	0.11
150	9.50	0.12352	0.41738	0.08169	0.00198	0.00168	0.11
151	10.00	0.11835	0.41917	0.07436	0.00175	0.00145	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.

AREA OF ACC. RESPONSE SPECTRUM = 0.331

AREA OF VEL. RESPONSE SPECTRUM = 1.567

MAX. ACCELERATION RESPONSE VALUE = 1.195

MAX. VELOCITY RESPONSE VALUE = 0.972

*** End of Output File No. 1 ***

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Induced Cyclic Shear Stresses and Strains, and Time Histories PAGE 98 OF 187

of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M

MADE BY BEG DATE 1/7/08 CHECKED BY TPS DATE 1/23/08

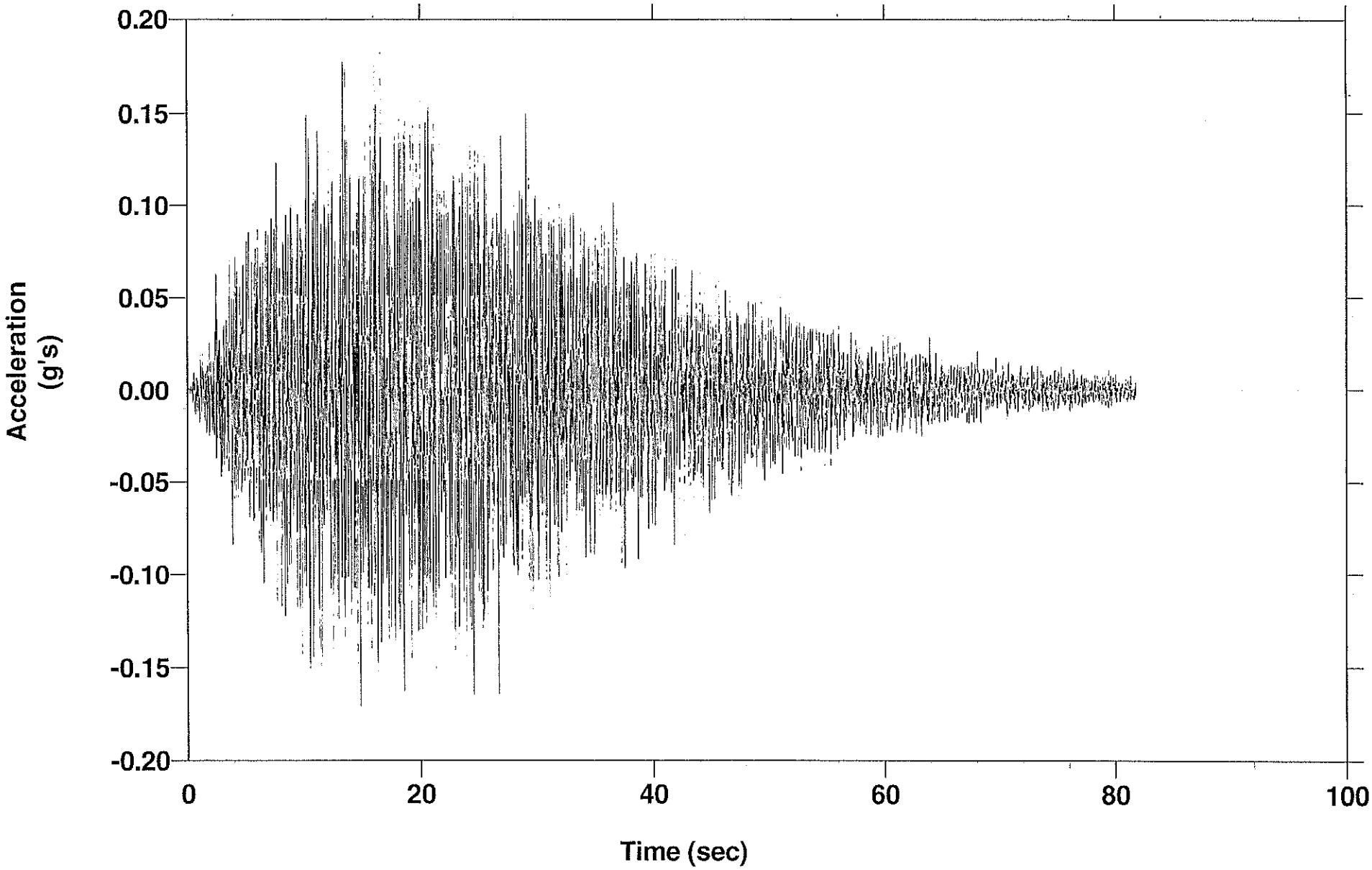
SUMMARY OF EARTHQUAKE INDUCED CYCLIC SHEAR STRESS AND STRAIN SHAKE2000 ANALYSES OUTPUT FILES FOR M8.0 NEW MADRID, MO MDE AT 83 KM SHAKE2000 COLUMN PCSC300E

PSCS300E Crest Column
Williamson - Pond Creek South Cell - Surf. El. 502, GWT 32ft., Fines El. 474
M8.0 New Madrid Synthetic @83km, PGA 0.54g, Atkinson & Boore (1995)

Layer	Depth to Middle of Layer (ft)	Total Unit Weight (kcf)	Damping Used (%)	Shear Modulus (ksf)	Maximum Shear Strain (%)	Maximum Shear Stress (psf)	Shear Wave Velocity (fps)	Depth to Top of Layer (ft)	Peak Acceleration (g)	G/Gmax Curve	Damping Curve
1	2	.13	2.8	2936.6	.00781	229.28	852.8618	0	.88444	Coarse	Coarse
2	5.5	.13	4.8	2625.1	.02321	609.39	806.3604	4	.82933	Coarse	Coarse
3	8.5	.13	5.9	2463.4	.0361	889.22	781.1307	7	.71118	Coarse	Coarse
4	11.5	.13	5.4	3620.9	.03061	1108.37	947.0317	10	.68971	Coarse	Coarse
5	14.5	.13	6.6	2752.4	.04636	1276.05	825.6805	13	.70046	Coarse	Coarse
6	17.5	.13	7.8	2187.7	.06713	1468.56	736.1226	16	.70832	Coarse	Coarse
7	20.5	.13	8.1	2328.9	.072	1676.72	759.5068	19	.72553	Coarse	Coarse
8	23.5	.13	9.6	1701.8	.1116	1899.25	649.2479	22	.64994	Coarse	Coarse
9	26.5	.13	9.5	1928.4	.10693	2062.11	691.1222	25	.59498	Coarse	Coarse
10	30	.13	9.6	1952.4	.11012	2149.98	695.4096	28	.60985	Coarse	Coarse
11	33.5	.135	10	1272.2	.17006	2163.55	550.8568	32	.67343	Residual	Residual
12	36.5	.135	10	1272.9	.17118	2178.85	551.0084	35	.70548	Residual	Residual
13	39.5	.135	8.900001	1596.4	.13549	2162.95	617.0664	38	.71515	Residual	Residual
14	42.5	.135	7.5	2296.9	.0979	2248.68	740.171	41	.56671	Residual	Residual
15	45.5	.135	4.6	5110.6	.04475	2286.77	1104.071	44	.53756	Residual	Residual
16	48.5	.135	4.8	4981.3	.04706	2344.02	1090.015	47	.52869	Residual	Residual
17	Base							50	.52663		
17	Outcrop							50	.57825		

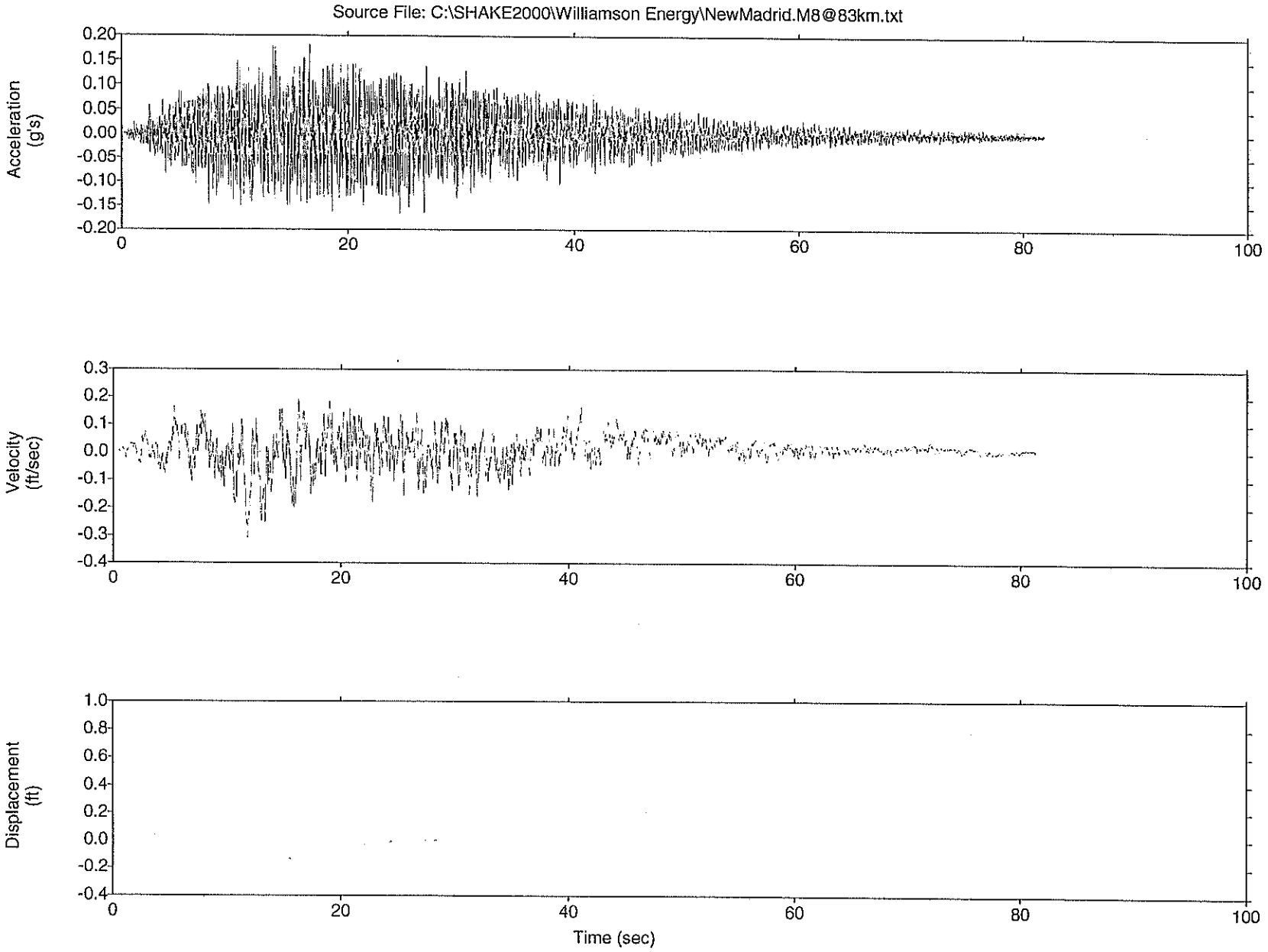
Notes:
Period for Soil Column: .25 sec
Average Shear Wave Velocity for Soil Column: 775 ft/sec

99 / 187
R16145

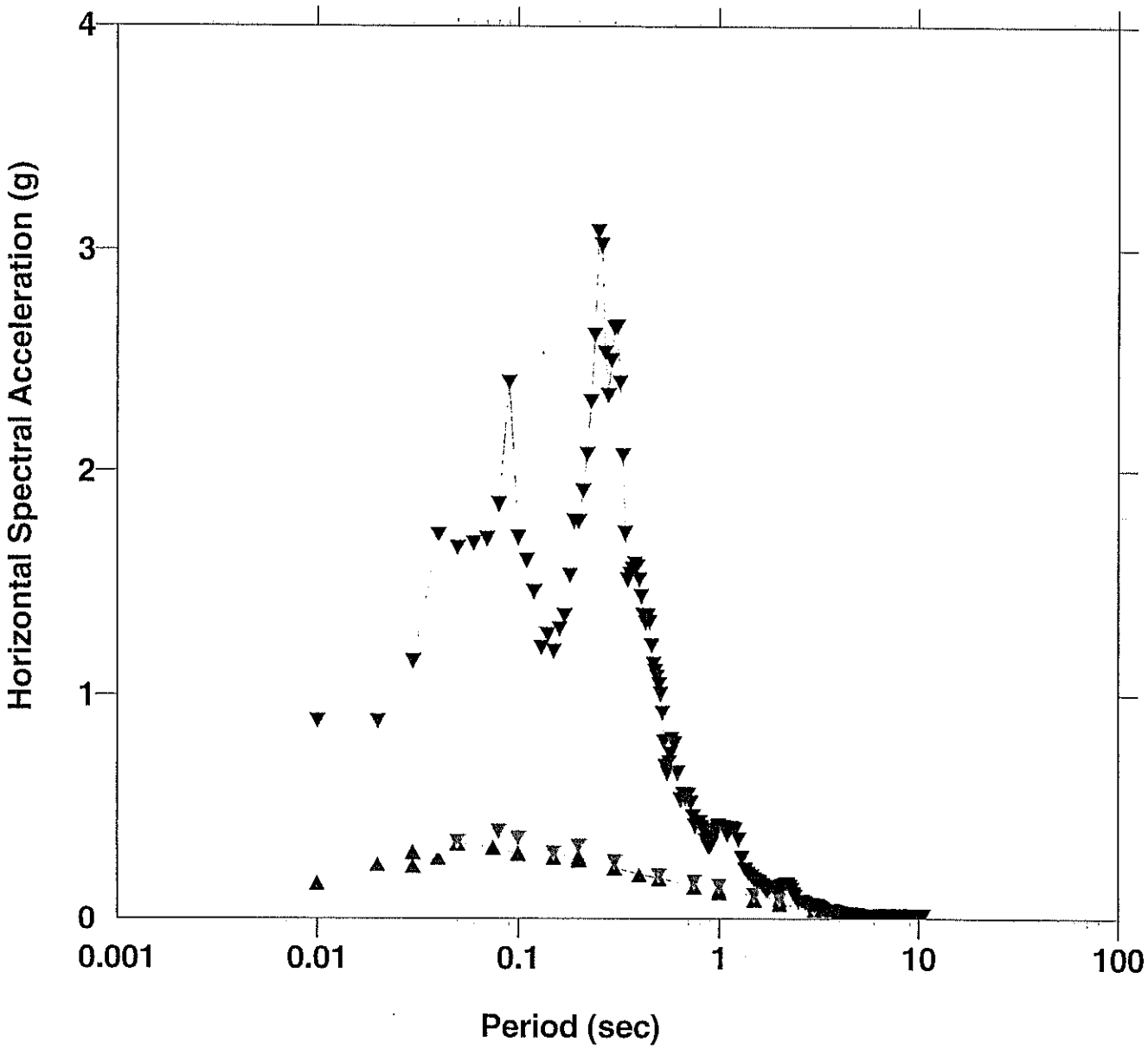


100 / 187

R16146

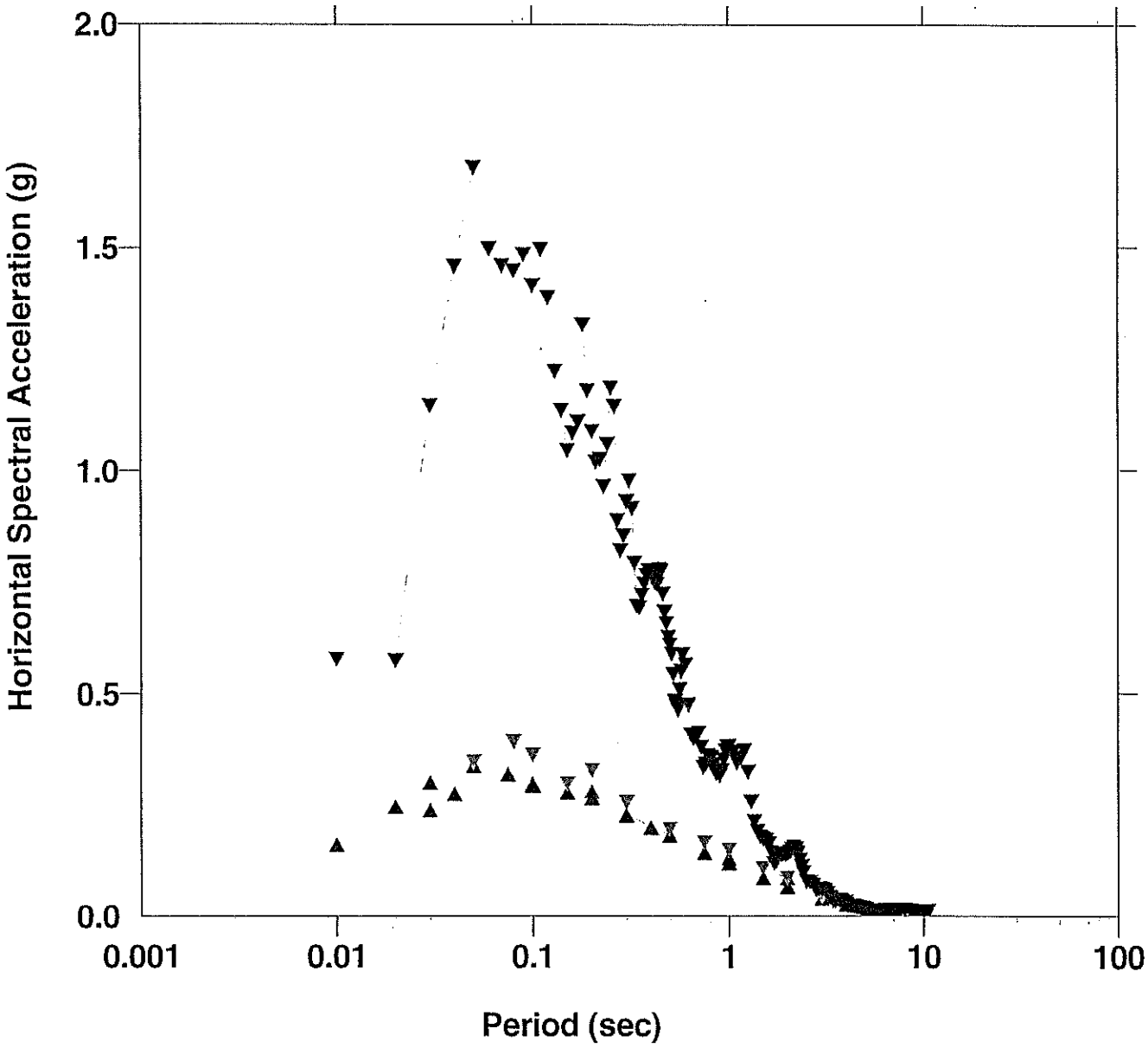

Source File: C:\SHAKE2000\Williamson Energy\NewMadrid.M8@83km.txt
Acceleration (g's)
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
0
20
40
60
80
100
Velocity (ft/sec)
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
20
40
60
80
100
Displacement (ft)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
0
20
40
60
80
100
Time (sec)

PSCS300E Crest Column - M8.0 New Madrid Synthetic @83km



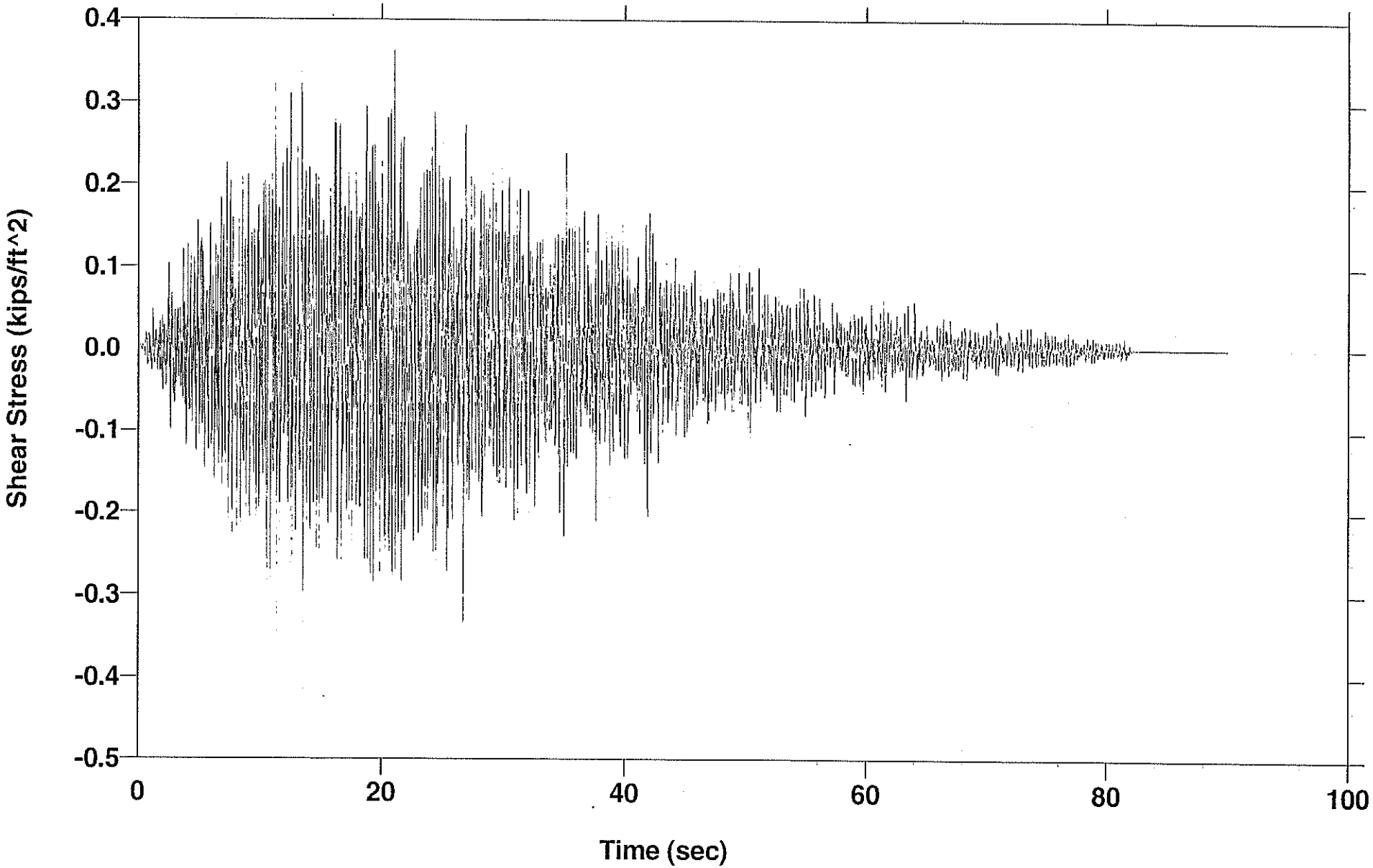
- ▲ Toro et. al. (1997) for Mid-Continent of NA - Rock - Mw: 8 - R: 83 km
- ▲ Campbell for CEUS (2003) - M: 8 - R: 83 km
- ▼ Tavakoli & Pezeshk (2005) - ENA - Rock - M: 8 - R: 83 km
- ▼ PSA for 5% damping - Layer 1 - SHAKE

PSCS300E Crest Column - M8.0 New Madrid Synthetic @83km

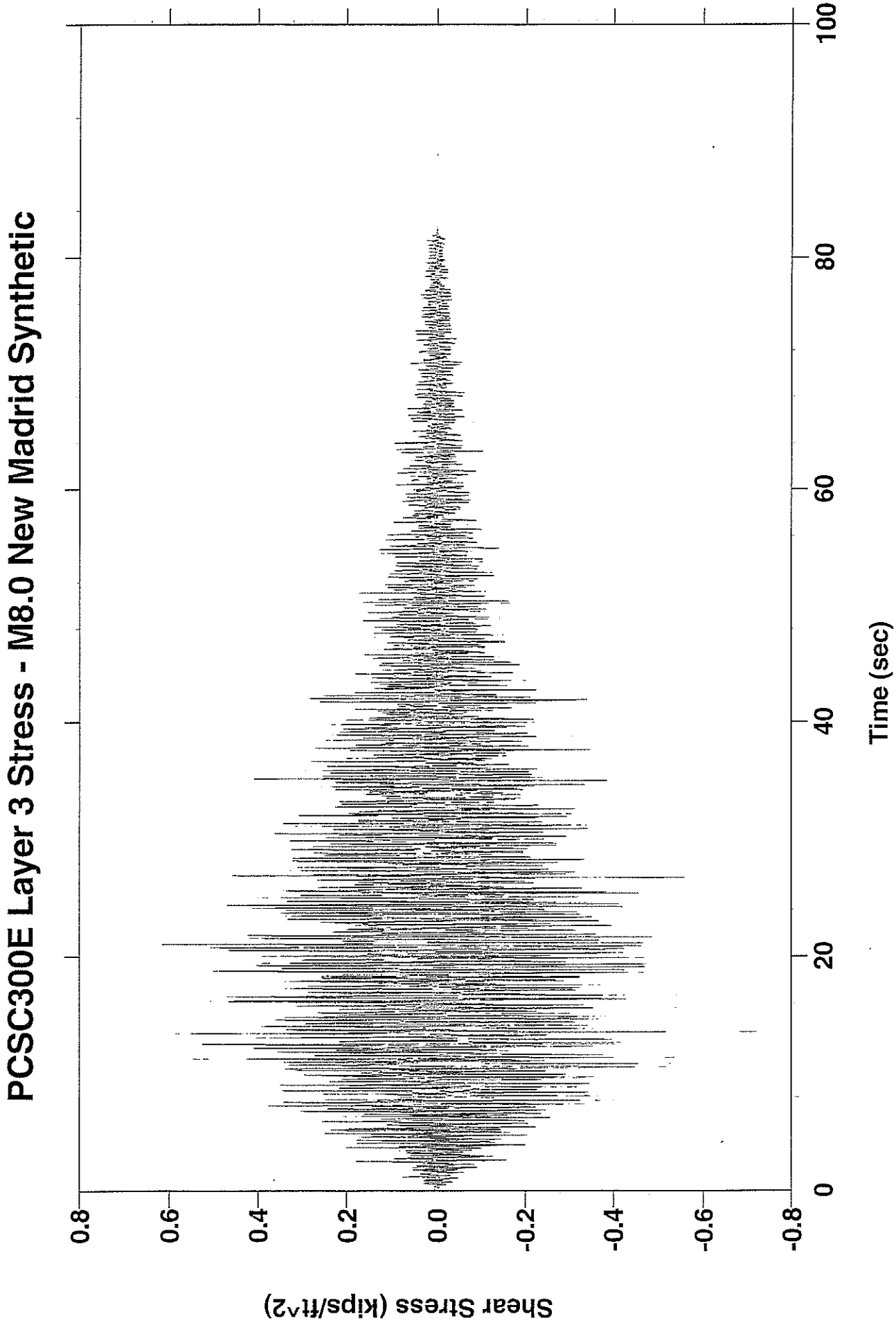


- ▲ Toro et. al. (1997) for Mid-Continent of NA - Rock - Mw: 8 - R: 83 km
- ▲ Campbell for CEUS (2003) - M: 8 - R: 83 km
- ▼ Tavakoli & Pezeshk (2005) - ENA - Rock - M: 8 - R: 83 km
- ▼ PSA for 5% damping - Layer 17 - SHAKE

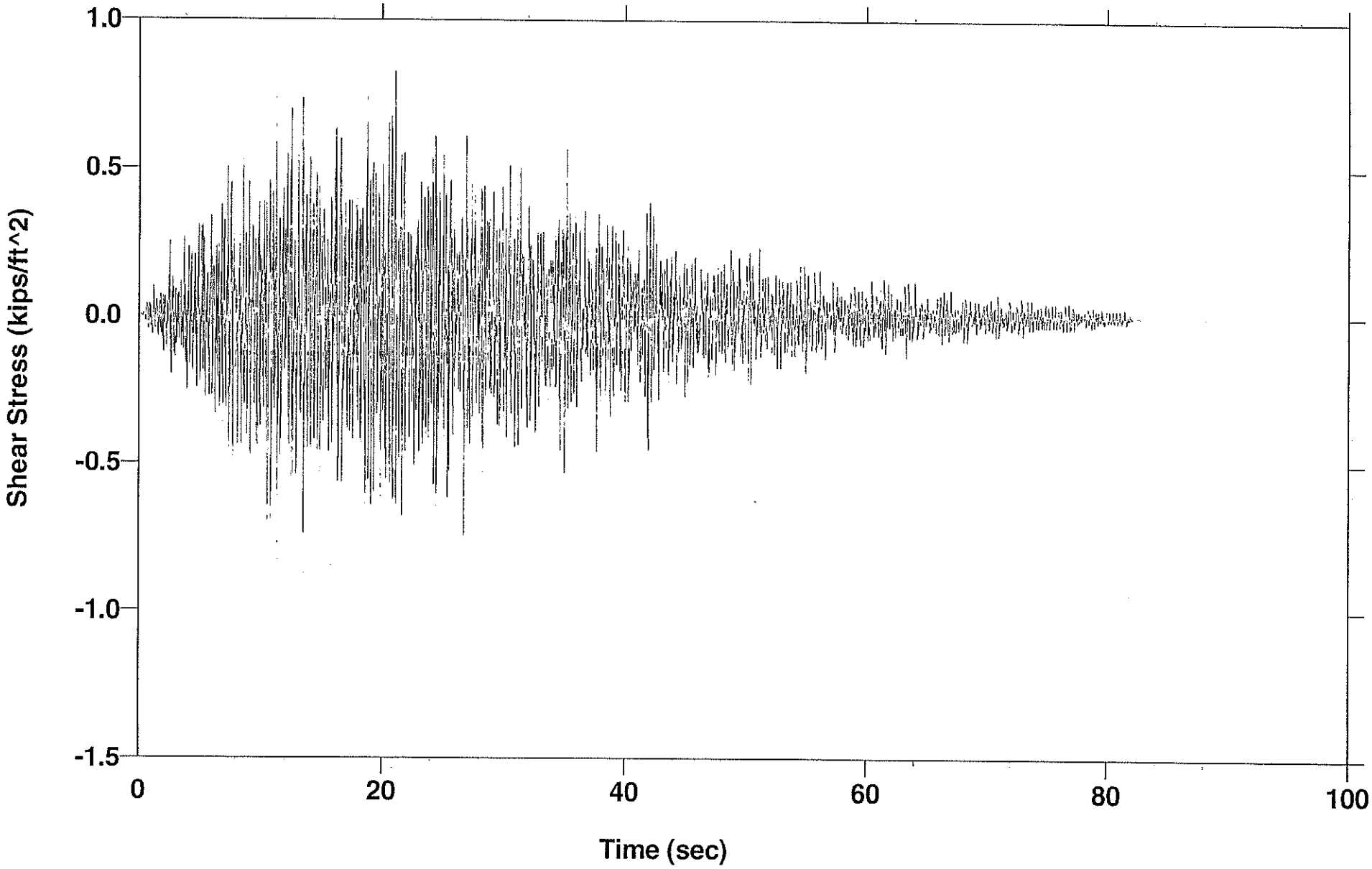
PCSC300E Layer 2 Stress - M8.0 New Madrid Synthetic



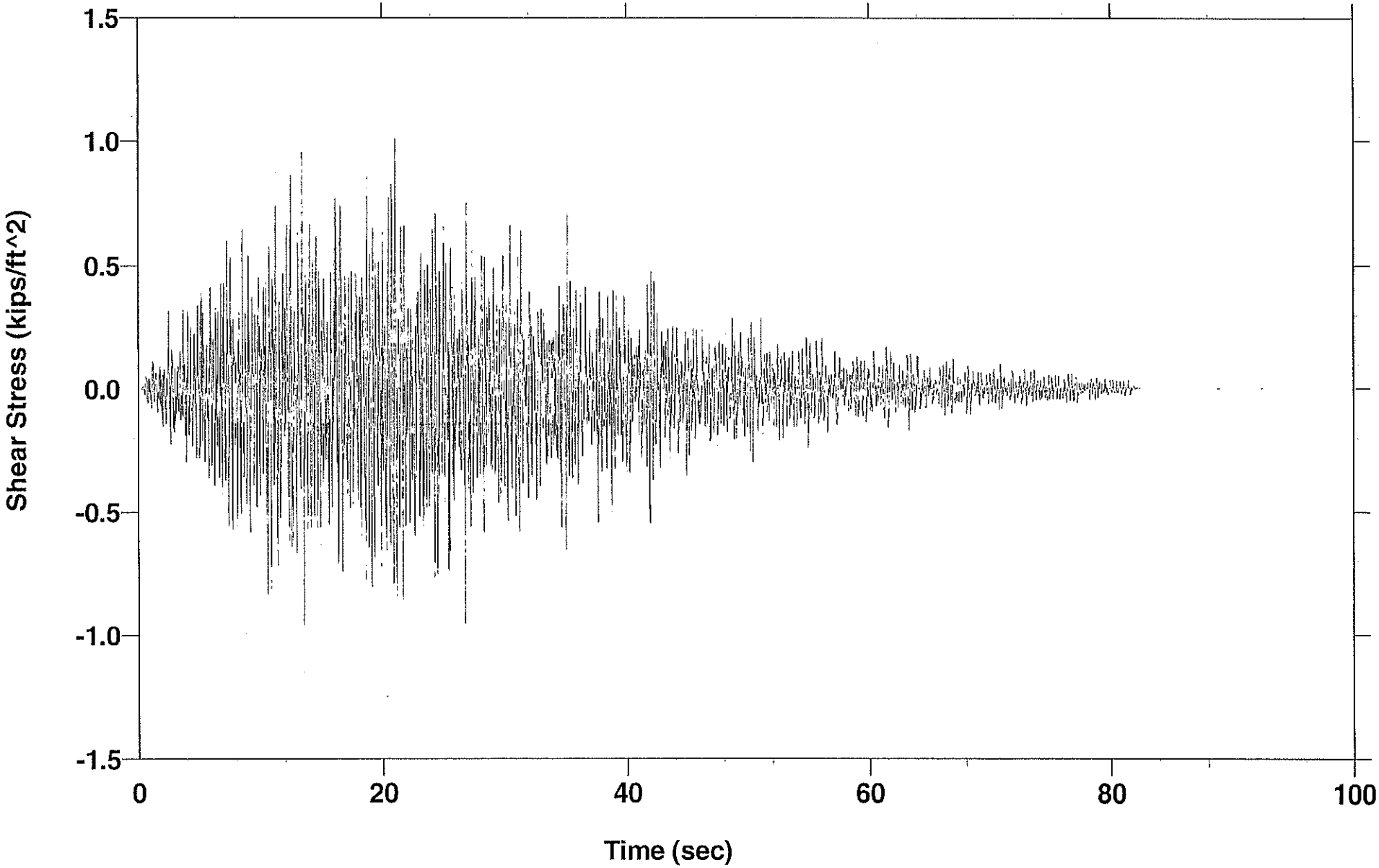
R16150


PCSC300E Layer 3 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0
20
40
60
80
100
Time (sec)

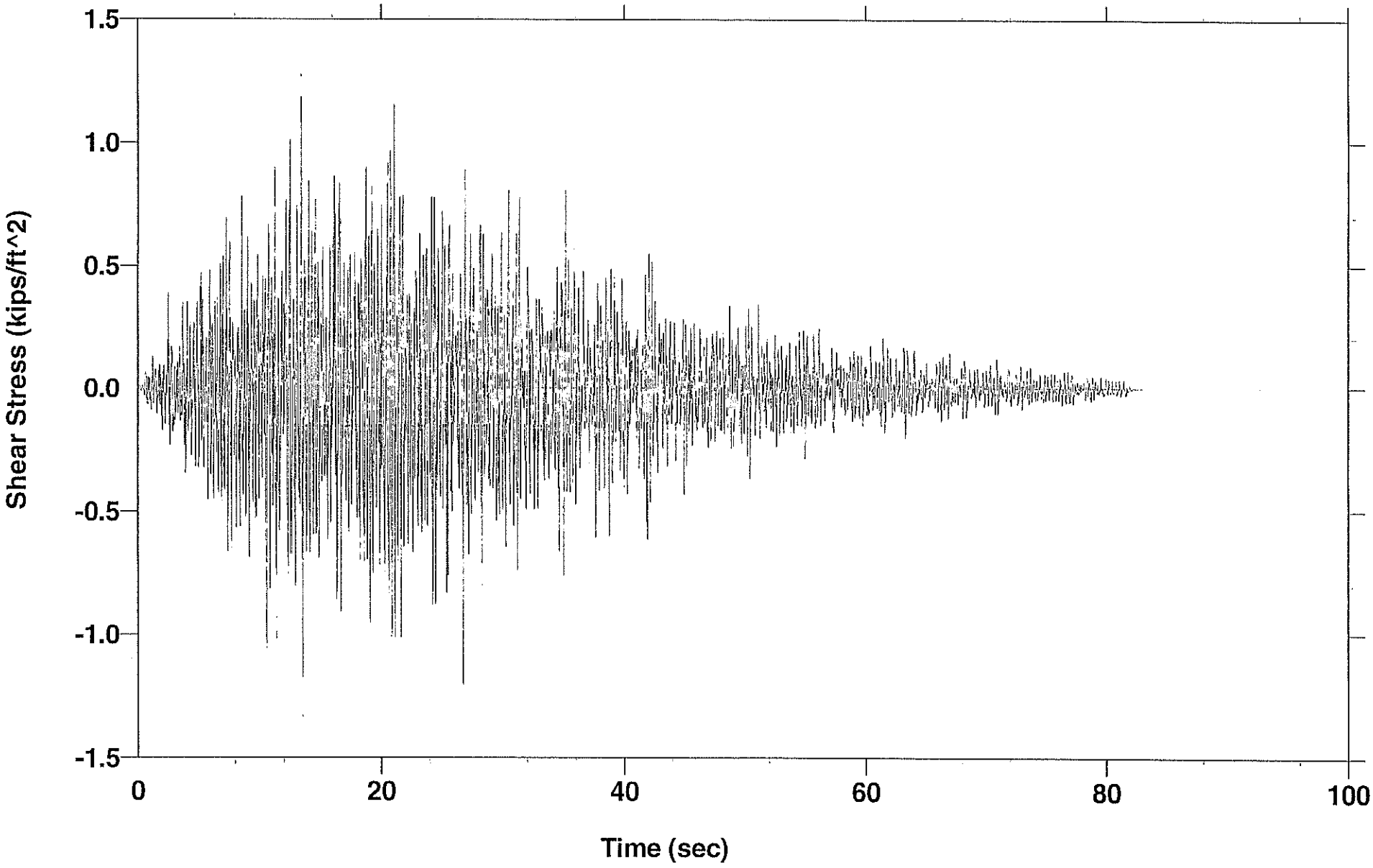
PCSC300E Layer 4 Stress - M8.0 New Madrid Synthetic



PCSC300E Layer 5 Stress - M8.0 New Madrid Synthetic

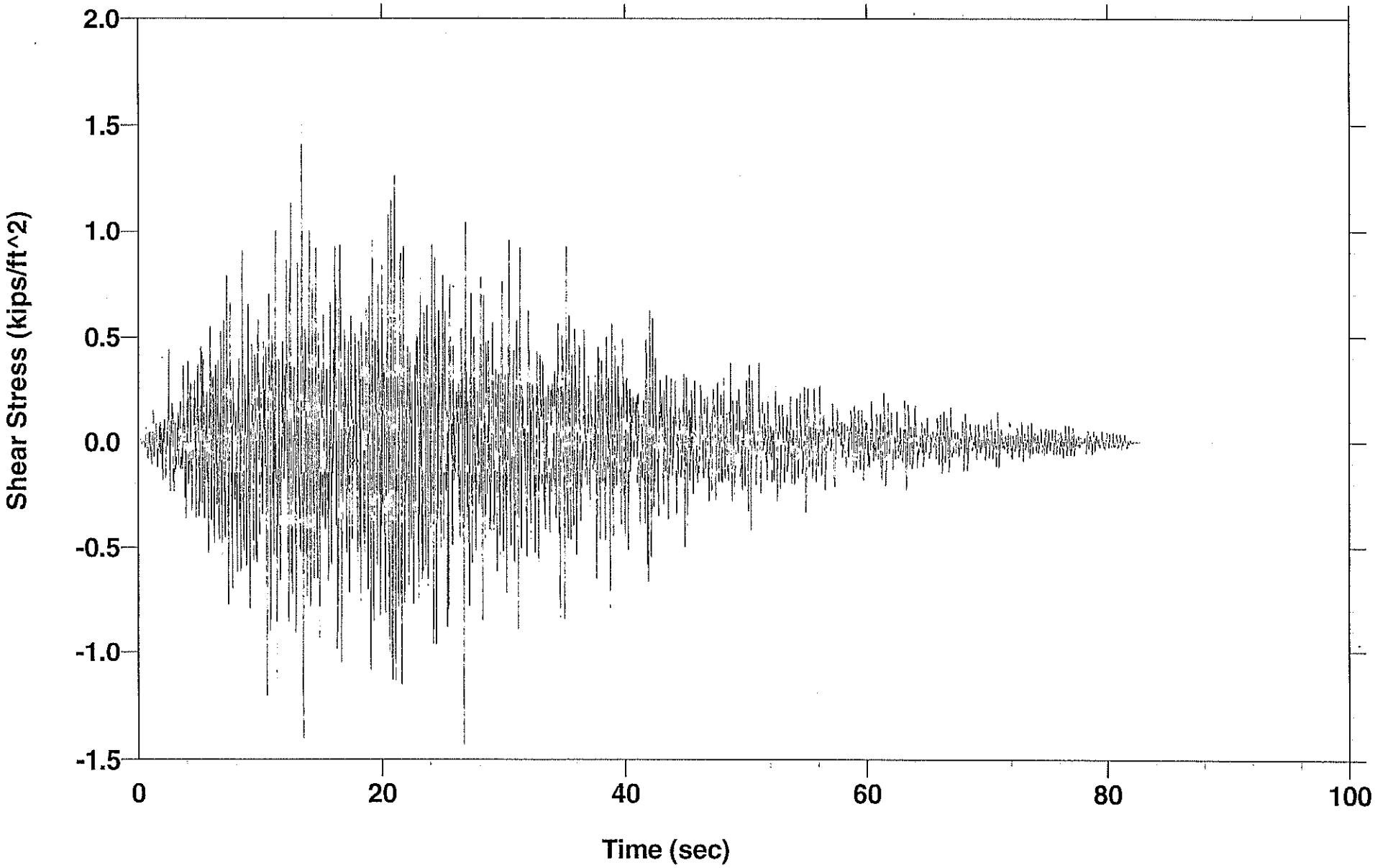


PCSC300E Layer 6 Stress - M8.0 New Madrid Synthetic

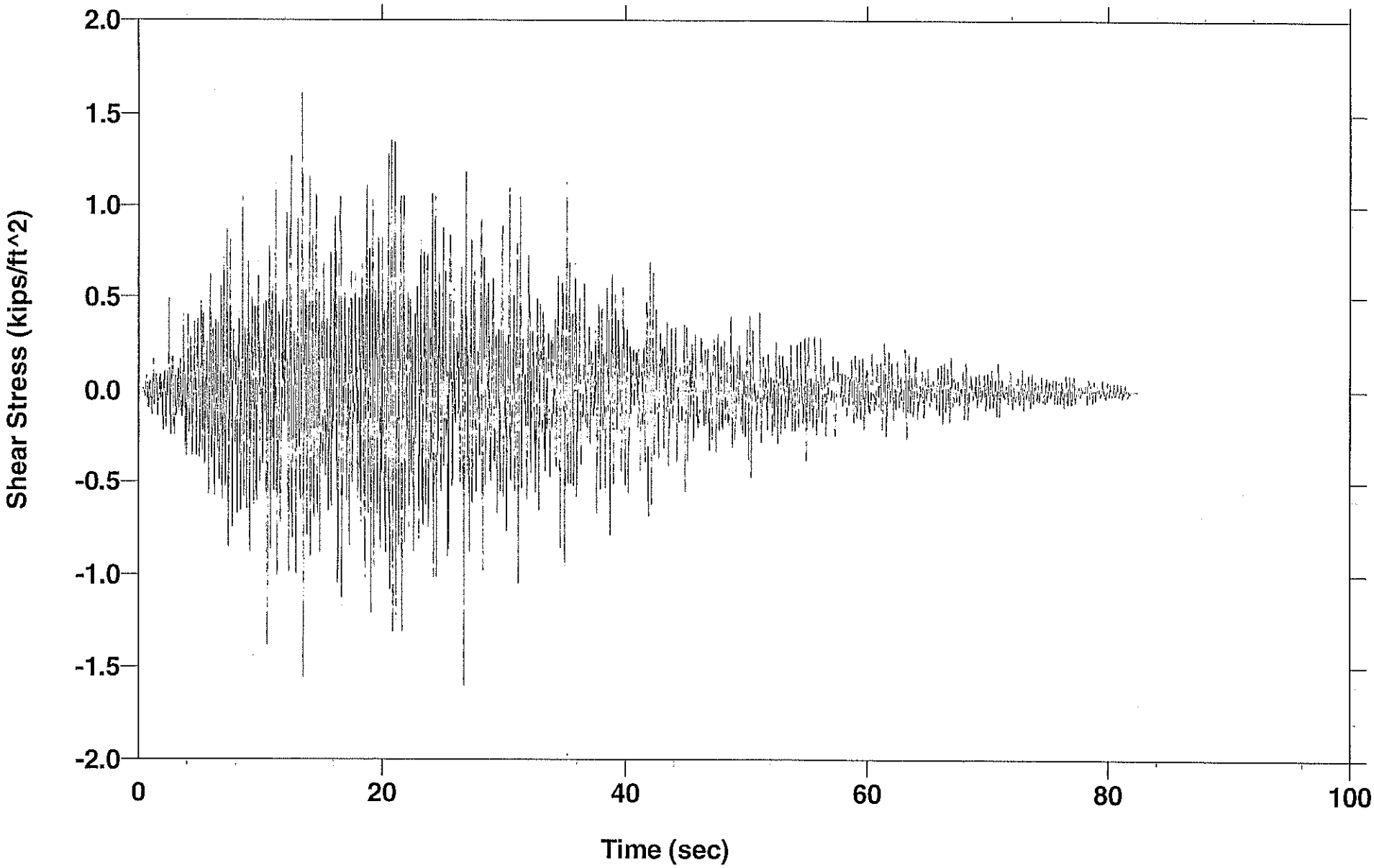


108 of 187
R16154

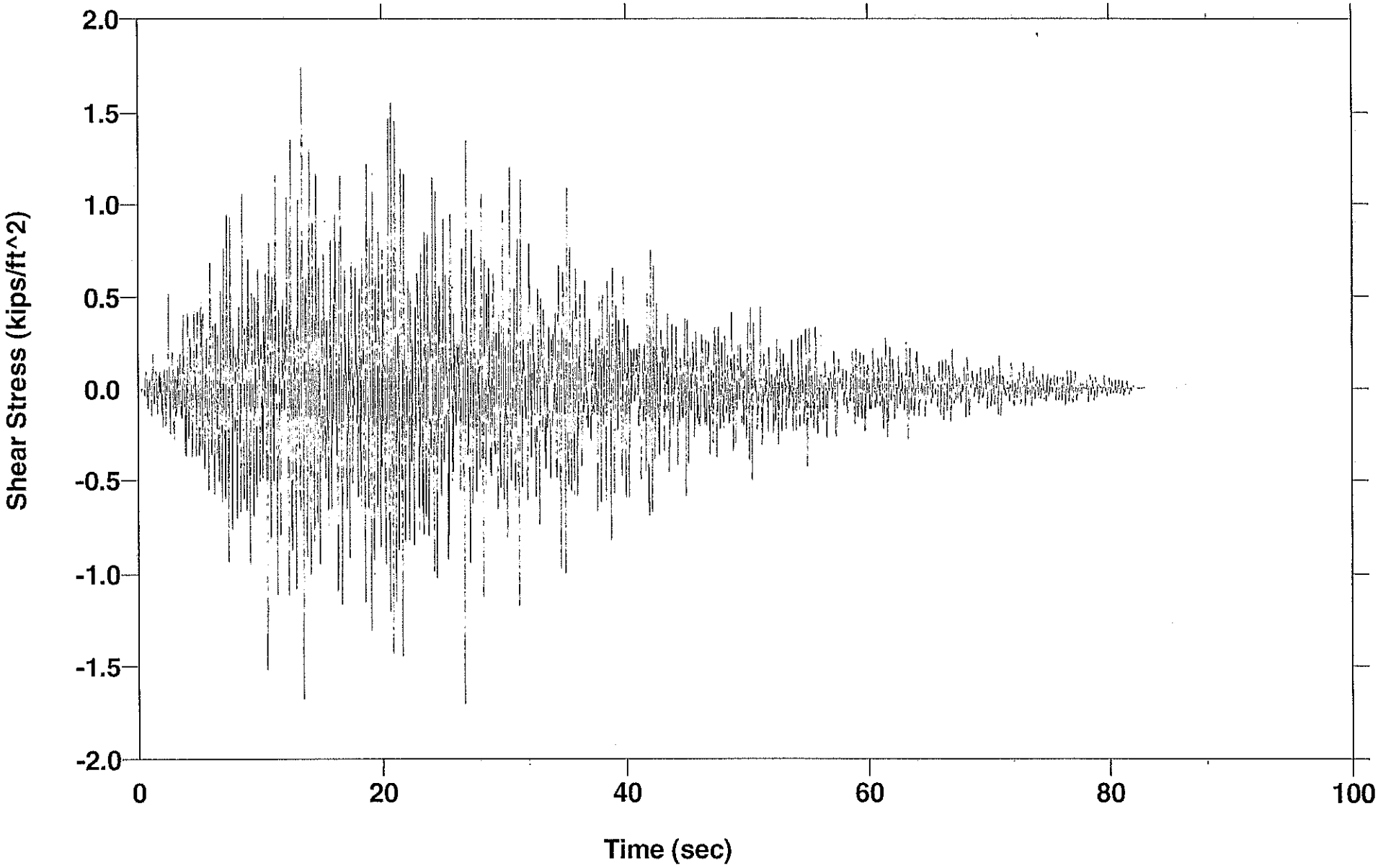
PCSC300E Layer 7 Stress - M8.0 New Madrid Synthetic



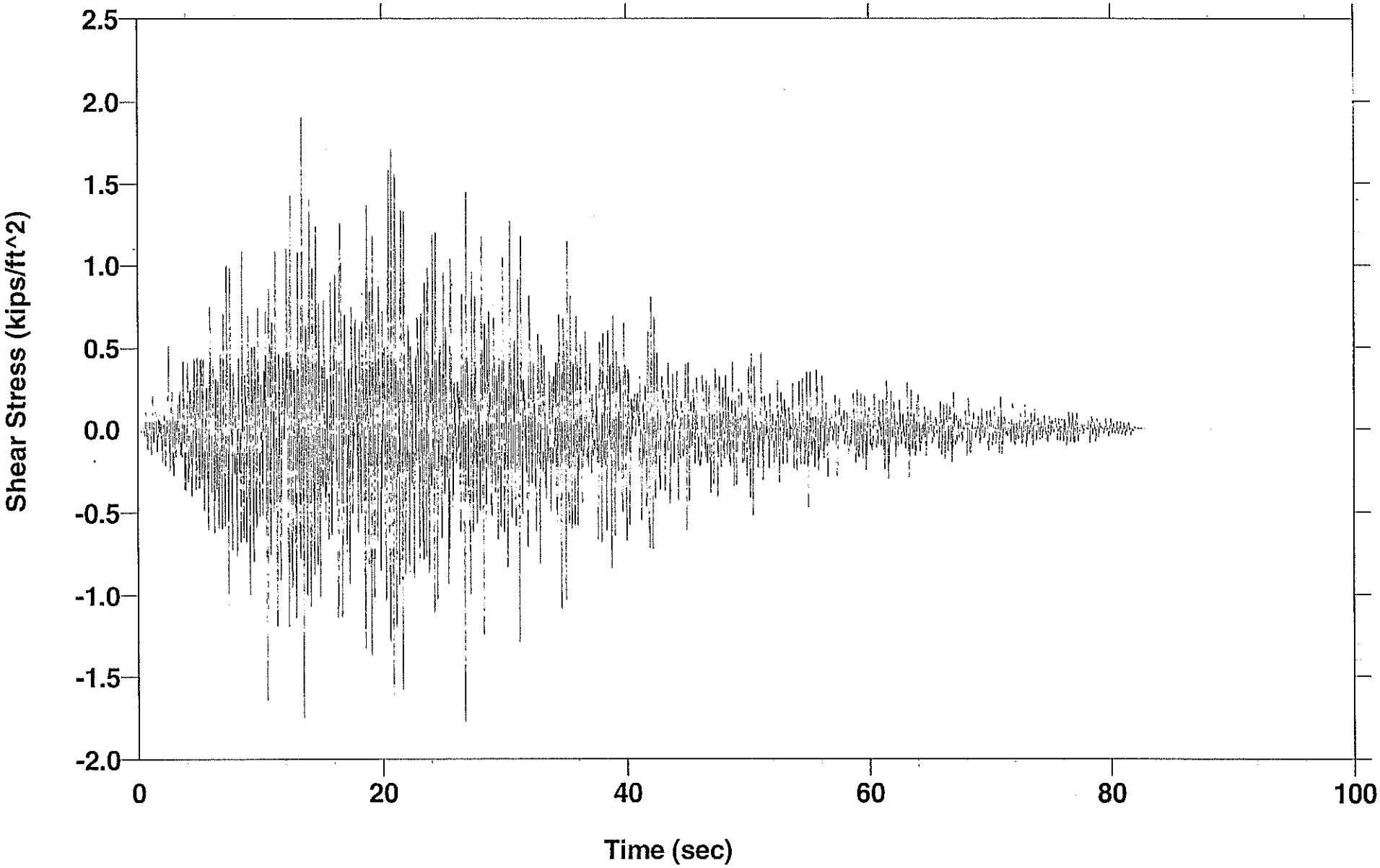
R16155


PCSC300E Layer 8 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0
20
40
60
80
100
Time (sec)

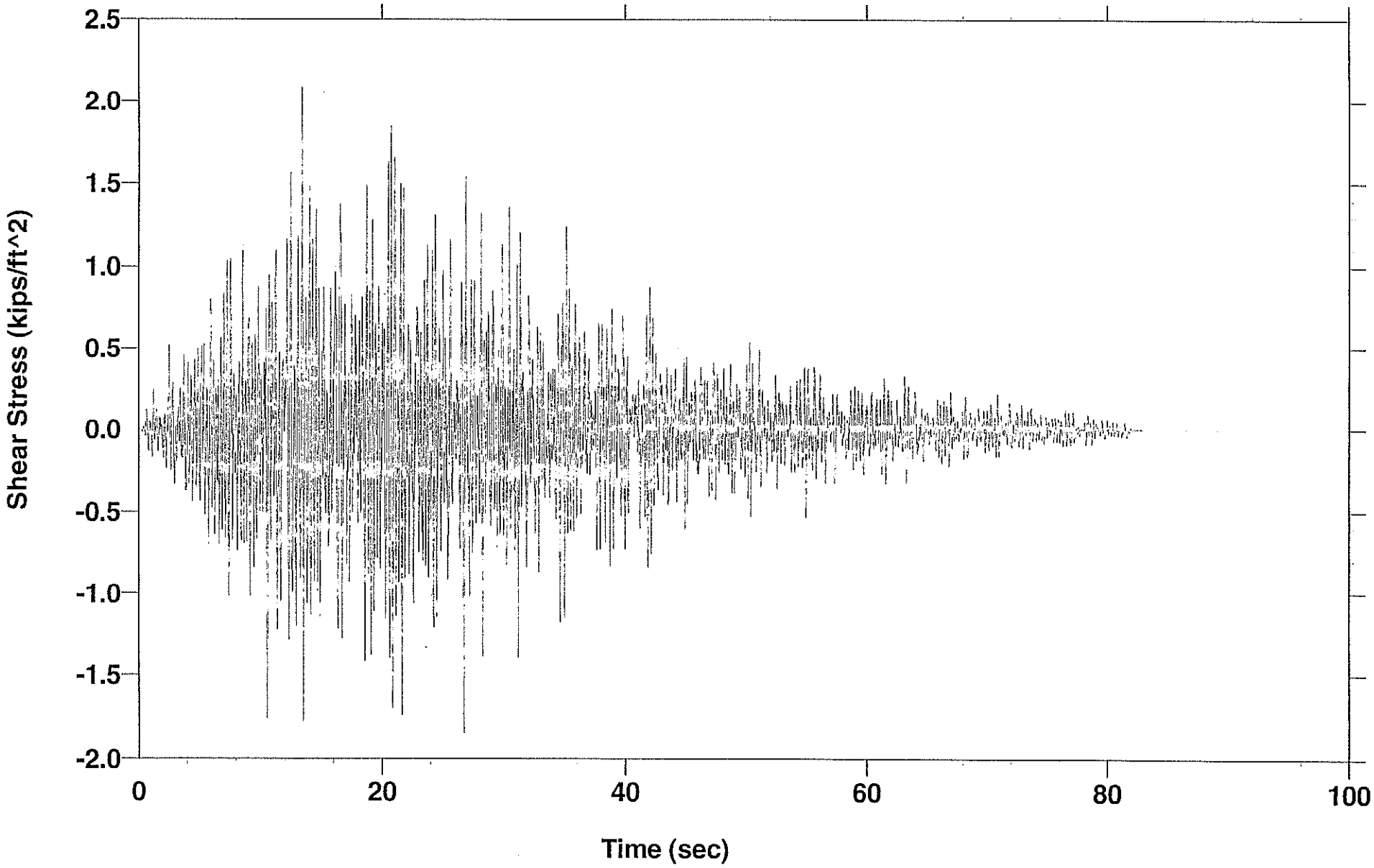
PCSC300E Layer 9 Stress - M8.0 New Madrid Synthetic

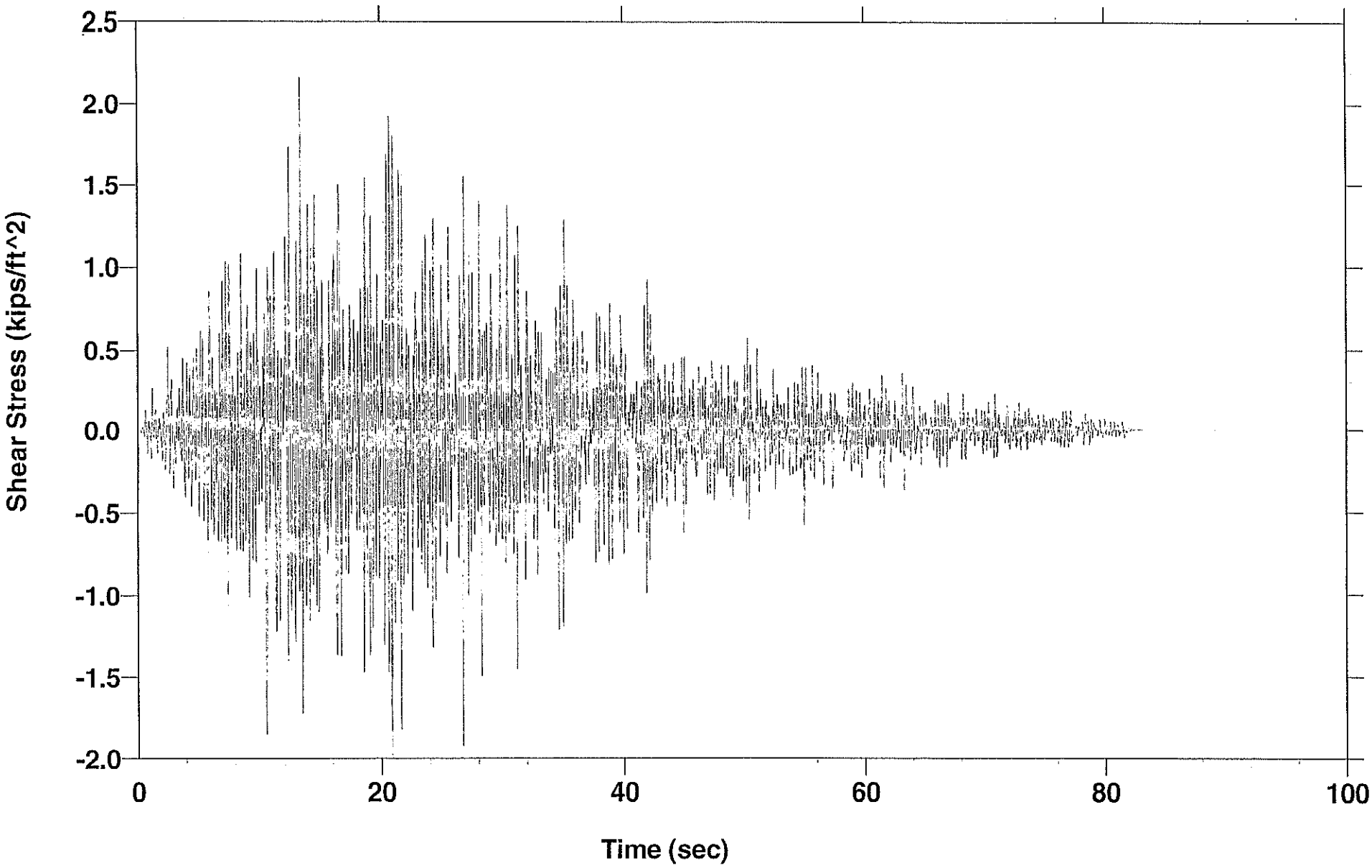


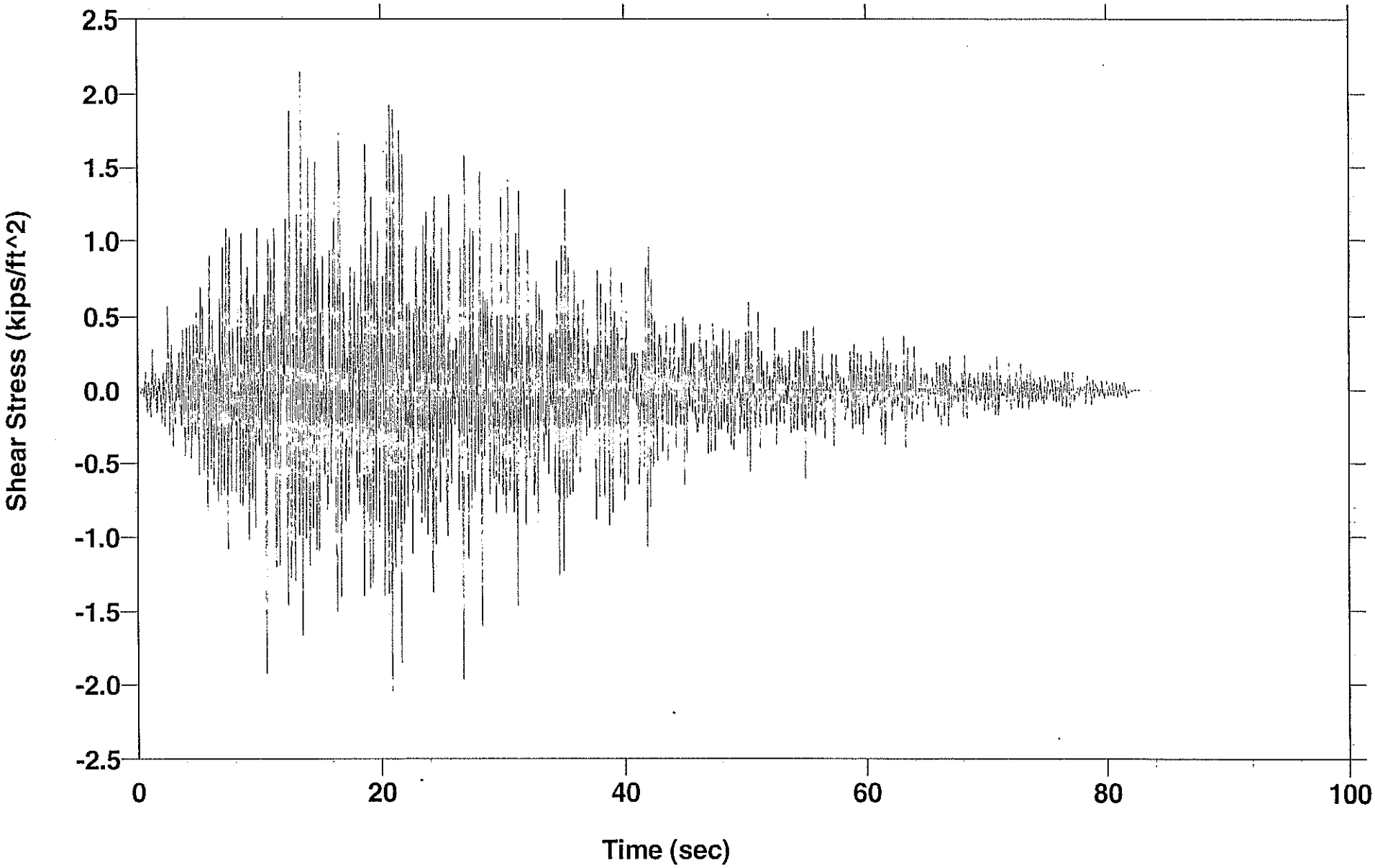
PCSC300E Layer 10 Stress - M8.0 New Madrid Synthetic



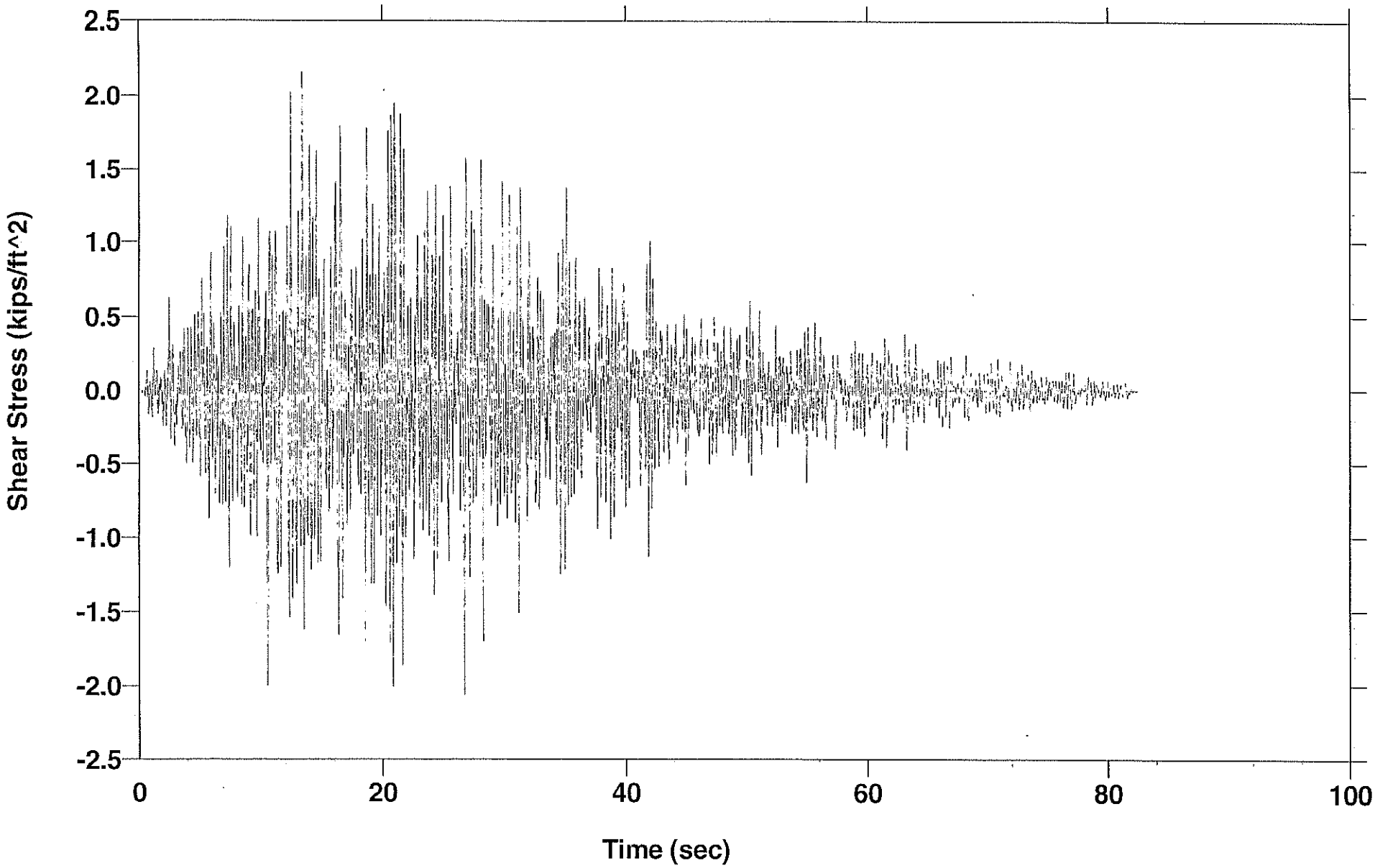
PCSC300E Layer 11 Stress - M8.0 New Madrid Synthetic

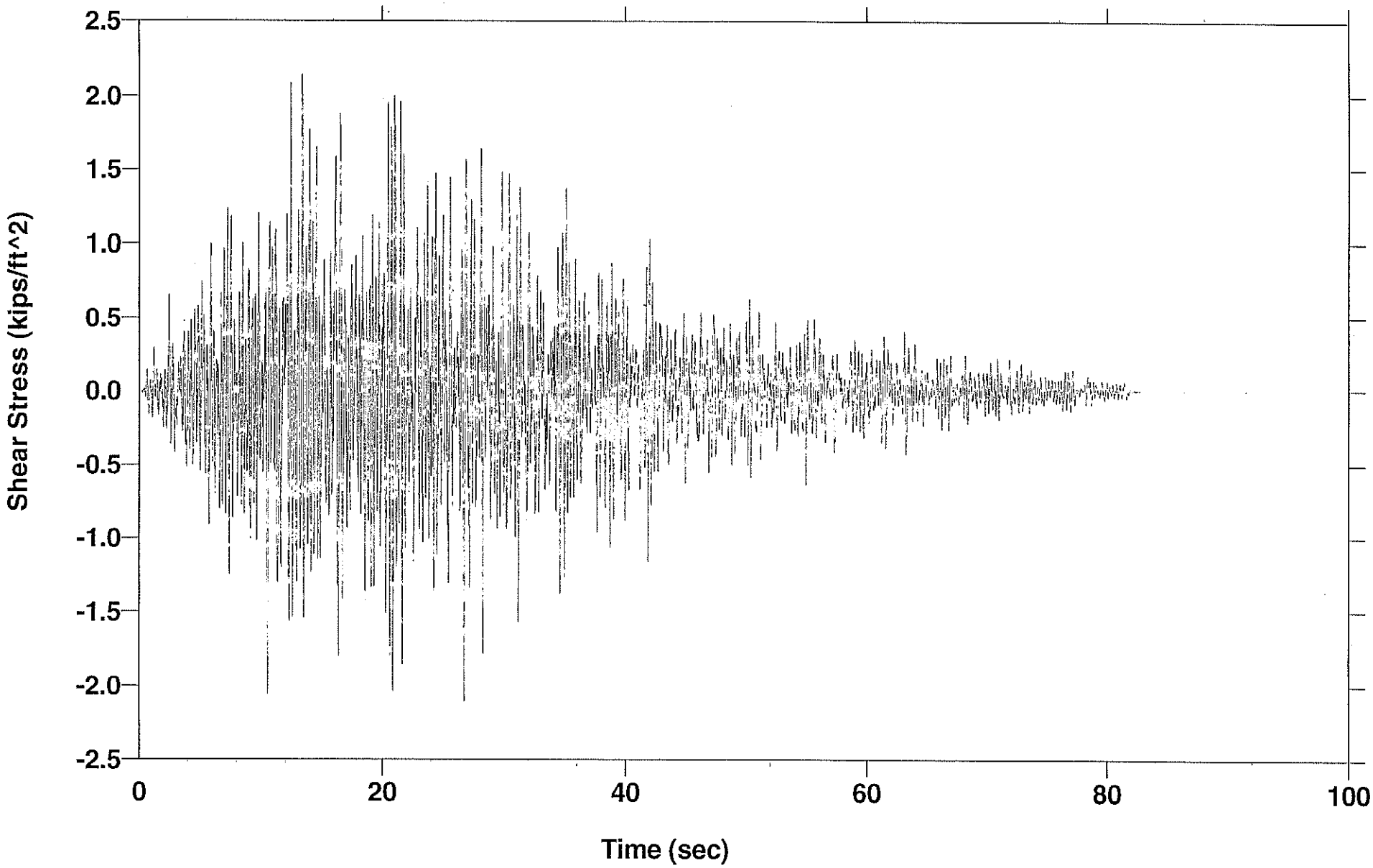



PCSC300E Layer 12 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0
20
40
60
80
100
Time (sec)

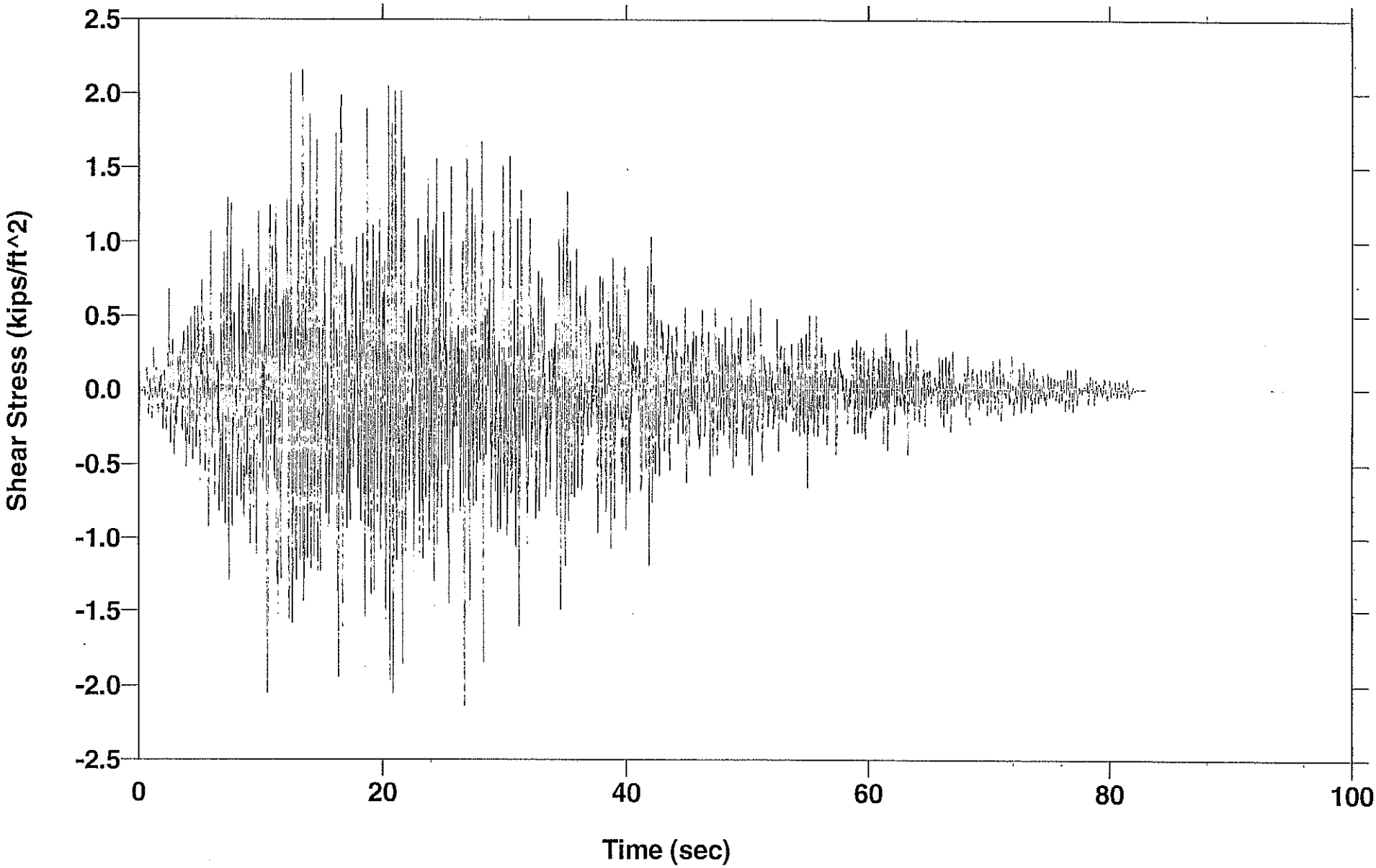

PCSC300E Layer 13 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
0
20
40
60
80
100
Time (sec)

PCSC300E Layer 14 Stress - M8.0 New Madrid Synthetic




PCSC300E Layer 15 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
0
20
40
60
80
100
Time (sec)

PCSC300E Layer 16 Stress - M8.0 New Madrid Synthetic



```
************************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*   LAYERED SITES by Per Schnable & John Lysmer - 1970  *
* ---------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
* ---------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added  *
*    using results from Sun et al (1988) by J. I. Sun   *
*    & Ramin Golesorkhi February 26, 1988              *
* ----------------------------------------------------*
* SHAKE90/91: Adjust last iteration; Input now is either  *
*    Gmax or max Vs; up to 13 materials can be specified*
*    by user; up to 50 Layers can be specified; object  *
*    motion can be read in from a separate file and can *
*    user specified format; Different periods for res-  *
*    ponse spectral calculations;options are renumbered;*
*    and general cleanup by: J. I. Sun, I. M. Idriss &  *
*    P. Dirrim June 1990 - February 1991               *
* ---------------------------------------------------- *
* SHAKE91: General cleanup and finalization of input out- *
*    output format ... etc by: I. M. Idriss Dec. 1991   *
* ---------------------------------------------------- *
* SHAKE2000: Fix the incorrect output of Tot. Stress in   *
* Option 2. Changed path of ground motion file in         *
* SHAKE91.  Control file to input file names.  Modified   *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
*       RUN DATE  1/02/2008                               *
*       RUN TIME 11:11                                    *
************************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =    32768
 NECESSARY LENGTH OF BLANK COMMON X       =   204819

1****** OPTION  1 *** READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

**********************
 MATERIAL TYPE NO. 1
**********************

 CURVE NO. 1:   Coarse    G/Gmax - Gravel (Mean) - Rollins et al. JGGE
 CURVE NO. 2:   Coarse    Damping for Gravel (Mean) - Rollins et al. J


   CURVE NO. 1          CURVE NO. 2
 ================    ================
  STRAIN   G/GMAX      STRAIN   DAMPING
 --------  -------    --------  --------
  0.0001   1.000       0.0001    0.90
  0.0002   0.995       0.0003    1.11
  0.0005   0.980       0.0006    1.30
  0.0008   0.970       0.0010    1.50
  0.0010   0.960       0.0020    1.91
  0.0020   0.930       0.0030    2.24
  0.0030   0.905       0.0040    2.54
  0.0040   0.880       0.0060    3.05
  0.0070   0.810       0.0080    3.50
  0.0100   0.755       0.0100    3.89
  0.0200   0.630       0.0200    5.45
  0.0700   0.390       0.0300    6.61
  0.1000   0.325       0.0500    8.28
  0.2000   0.205       0.1000   10.79
  0.3000   0.150       0.2000   13.23
```

0.4000	0.115	0.3000	14.47
0.5000	0.095	0.4000	15.24
0.6000	0.080	0.6000	16.14
0.8000	0.070	0.8000	16.66
1.0000	0.050	1.0000	17.01

****
MATERIAL TYPE NO. 2
****

CURVE NO. 3: Fine Refuse Moduli for Fine Refuse (Ellison & Cho, 1976)
CURVE NO. 4: Fine Refuse Damping Values for Fine Refuse (Ellison & Ch

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.75
0.0004	1.000	0.0004	0.65
0.0010	0.995	0.0010	0.70
0.0020	0.992	0.0020	0.80
0.0040	0.989	0.0040	0.90
0.0060	0.981	0.0060	1.10
0.0080	0.965	0.0080	1.30
0.0100	0.955	0.0100	1.40
0.0200	0.905	0.0200	2.00
0.0400	0.828	0.0400	3.10
0.0600	0.750	0.0600	4.00
0.0800	0.670	0.0800	5.20
0.1000	0.610	0.1000	6.00
0.2000	0.610	0.2000	6.00

****
MATERIAL TYPE NO. 3
****

CURVE NO. 5: Residual G/Gmax PI=15% - Effective Confining Pressure
CURVE NO. 6: Residual Damping PI=15% - Effective Confining Pressur

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0000	1.000	0.0000	0.67
0.0000	1.000	0.0000	0.67
0.0000	0.999	0.0000	0.68
0.0001	0.998	0.0001	0.68
0.0002	0.996	0.0002	0.70
0.0005	0.991	0.0005	0.75
0.0010	0.983	0.0010	0.83
0.0022	0.965	0.0022	1.02
0.0048	0.931	0.0048	1.43
0.0100	0.873	0.0100	2.17
0.0220	0.770	0.0220	3.68
0.0484	0.618	0.0484	6.24
0.1000	0.454	0.1000	9.48
0.2200	0.287	0.2200	13.40
0.4840	0.163	0.4840	16.87
1.0000	0.091	1.0000	19.16

****
MATERIAL TYPE NO. 4
****

CURVE NO. 7: Rock G/Gmax - ROCK (Schnabel 1973)
CURVE NO. 8: Rock Damping for ROCK (Schnabel 1973)

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.40
0.0003	1.000	0.0010	0.80
0.0010	0.990	0.0100	1.50
0.0030	0.950	0.1000	3.00
0.0100	0.900	1.0000	4.60
0.0300	0.810	0.0000	0.00
0.1000	0.725	0.0000	0.00
1.0000	0.550	0.0000	0.00

1****** OPTION 2 *** READ SOIL PROFILE
NEW SOIL PROFILE NO. 1 IDENTIFICATION PSCS300E Crest Column
NUMBER OF LAYERS 17 DEPTH TO BEDROCK 50.00

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	1	4.0000	2.0000	0.26	3454.	0.050	0.130	924.9
2	1	3.0000	5.5000	0.71	3856.	0.050	0.130	977.3
3	1	3.0000	8.5000	1.11	4110.	0.050	0.130	1009.0
4	1	3.0000	11.5000	1.50	5739.	0.050	0.130	1192.3
5	1	3.0000	14.5000	1.88	4991.	0.050	0.130	1111.9
6	1	3.0000	17.5000	2.28	4552.	0.050	0.130	1061.8
7	1	3.0000	20.5000	2.66	4985.	0.050	0.130	1111.2
8	1	3.0000	23.5000	3.05	4436.	0.050	0.130	1048.2
9	1	3.0000	26.5000	3.44	4926.	0.050	0.130	1104.6
10	1	4.0000	30.0000	3.90	5058.	0.050	0.130	1119.3
11	3	3.0000	33.5000	4.36	2940.	0.050	0.135	837.4
12	3	3.0000	36.5000	4.77	2951.	0.050	0.135	839.0
13	3	3.0000	39.5000	5.17	3307.	0.050	0.135	888.1
14	3	3.0000	42.5000	5.58	4130.	0.050	0.135	992.5
15	3	3.0000	45.5000	5.98	7136.	0.050	0.135	1304.6
16	3	3.0000	48.5000	6.39	7051.	0.050	0.135	1296.8
17	BASE				74534.	0.050	0.150	4000.0

PERIOD = 0.19 FROM AVERAGE SHEAR VEL. = 1050.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 12.49
FOR FREQUENCY = 5.15 C/SEC.
PERIOD = 0.19 SEC.

1****** OPTION 3 *** READ INPUT MOTION

FILE NAME FOR INPUT MOTION = C:\SHAKE2000\Williamson Energy\NewMadrid.eq
NO. OF INPUT ACC. POINTS = 8184
NO. OF POINTS USED IN FFT = 16384
NO. OF HEADING LINES = 4
NO. OF POINTS PER LINE = 8

```
 TIME STEP FOR INPUT MOTION = 0.0100
   FORMAT FOR TIME HISTORY =     (8f9.6)


 *****HEADER*****
Source File: C:\SHAKE2000\Williamson Energy\NewMadrid.M8@83km.txt
SHAKE2000 Conversion:   8184     .01      4       8       9       (8f9.6
Acceleration Units: (g's) - No. Values: 8184 - Time Step: .01 (secs)
Data Format: (8f9.6) - No. Header Lines: 4
 ** FIRST AND LAST 5 LINES OF INPUT MOTION *****

    1 -0.000279 0.000491 0.000916 0.001028 0.001072 0.001012 0.000914 0.001178
    2  0.001267 0.001643 0.000738 0.000404 0.001162 0.000325 0.000442 0.001287
    3  0.000332 0.000352 0.000667 0.000333 0.000100-0.000289 0.000774-0.001450
    4 -0.001068 0.000422-0.001711-0.000650 0.000432 0.001691 0.002168 0.001175
    5 -0.000695 0.000756 0.000277 0.002243-0.000523 0.000775-0.001563-0.000602
  .....INPUT MOTION READ NOT ECHOED.....
 1019  0.002157 0.001240-0.001104 0.000476-0.001755-0.000138 0.000159-0.003048
 1020 -0.003913 0.000251 0.002962-0.003793-0.003142-0.004436-0.001657-0.000252
 1021  0.001471 0.001823-0.000479-0.000738-0.002774-0.005429-0.002747 0.002040
 1022 -0.000940-0.002779-0.004528-0.001675 0.001024-0.002927-0.001433 0.002515
 1023  0.000569-0.002711-0.002134-0.001855 0.001529 0.003698 0.004083-0.003032

 MAXIMUM ACCELERATION =  0.18389
 AT TIME              = 16.61 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  2.937
 TO GIVE NEW MAXIMUM ACCELERATION         =  0.54000
 MEAN SQUARE FREQUENCY =     14.61 C/SEC.
 MAX ACCELERATION =    0.57825 FOR FREQUENCIES REMOVED ABOVE     40.00 C/SEC.
1****** OPTION  4 *** READ WHERE OBJECT MOTION IS GIVEN
 OBJECT MOTION IN LAYER NUMBER  17 OUTCROPPING

1****** OPTION  5 *** OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
 MAXIMUM NUMBER OF ITERATIONS            =  10
 FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN =    0.65

    EARTHQUAKE   - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
    SOIL PROFILE - PSCS300E Crest Column

  ITERATION NUMBER  1

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ----> <---- SHEAR MODULUS -----> G/Go
      (FT)  STRAIN NEW   USED  ERROR     NEW    USED   ERROR  RATIO
--- ---- ----  -------- ----- ------  ------  -------  ------  ------  -----
  1  1   2.0 0.00468 0.027  0.050   -82.7   2971.7   3454.0   -16.2   1.000
  2  1   5.5 0.01102 0.041  0.050   -21.7   2843.7   3856.0   -35.6   1.000
  3  1   8.5 0.01499 0.048  0.050    -4.1   2802.8   4110.0   -46.6   1.000
  4  1  11.5 0.01387 0.046  0.050    -8.1   3994.5   5739.0   -43.7   1.000
  5  1  14.5 0.01927 0.054  0.050     6.8   3177.8   4991.0   -57.1   1.000
  6  1  17.5 0.02455 0.060  0.050    17.2   2689.0   4552.0   -69.3   1.000
  7  1  20.5 0.02579 0.062  0.050    19.1   2897.9   4985.0   -72.0   1.000
  8  1  23.5 0.03295 0.069  0.050    27.7   2370.3   4436.0   -87.1   1.000
  9  1  26.5 0.03309 0.069  0.050    27.9   2628.2   4926.0   -87.4   1.000
 10  1  30.0 0.03577 0.072  0.050    30.4   2623.1   5058.0   -92.8   1.000
 11  3  33.5 0.06665 0.077  0.050    34.8   1604.3   2940.0   -83.3   1.000
 12  3  36.5 0.06911 0.078  0.050    36.1   1586.2   2951.0   -86.0   1.000
 13  3  39.5 0.06240 0.074  0.050    32.2   1853.9   3307.0   -78.4   1.000
 14  3  42.5 0.04960 0.063  0.050    21.2   2529.5   4130.0   -63.3   1.000
 15  3  45.5 0.02941 0.046  0.050    -8.1   5095.2   7136.0   -40.1   1.000
```

16 3 48.5 0.03031 0.047 0.050 -5.9 4993.8 7051.0 -41.2 1.000

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00493	0.028	0.027	2.3	2949.2	2971.7	-0.8	0.860
2	1	5.5	0.01365	0.046	0.041	10.5	2694.9	2843.7	-5.5	0.737
3	1	8.5	0.02058	0.055	0.048	13.2	2566.7	2802.8	-9.2	0.682
4	1	11.5	0.01847	0.053	0.046	12.2	3697.7	3994.5	-8.0	0.696
5	1	14.5	0.02740	0.064	0.054	15.5	2843.4	3177.8	-11.8	0.637
6	1	17.5	0.03652	0.073	0.060	16.8	2342.7	2689.0	-14.8	0.591
7	1	20.5	0.03830	0.074	0.062	16.6	2520.0	2897.9	-15.0	0.581
8	1	23.5	0.05277	0.085	0.069	18.4	1970.2	2370.3	-20.3	0.534
9	1	26.5	0.05152	0.084	0.069	17.4	2210.3	2628.2	-18.9	0.534
10	1	30.0	0.05542	0.087	0.072	17.0	2198.9	2623.1	-19.3	0.519
11	3	33.5	0.09518	0.093	0.077	17.2	1367.6	1604.3	-17.3	0.546
12	3	36.5	0.09600	0.093	0.078	15.8	1367.0	1586.2	-16.0	0.538
13	3	39.5	0.08485	0.087	0.074	15.7	1624.2	1853.9	-14.1	0.561
14	3	42.5	0.06425	0.075	0.063	15.4	2288.0	2529.5	-10.6	0.612
15	3	45.5	0.03230	0.049	0.046	6.1	4966.6	5095.2	-2.6	0.714
16	3	48.5	0.03317	0.050	0.047	5.8	4871.3	4993.8	-2.5	0.708

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00518	0.029	0.028	2.1	2928.2	2949.2	-0.7	0.854
2	1	5.5	0.01508	0.048	0.046	4.7	2625.6	2694.9	-2.6	0.699
3	1	8.5	0.02302	0.059	0.055	5.5	2478.4	2566.7	-3.6	0.624
4	1	11.5	0.01973	0.054	0.053	2.7	3629.4	3697.7	-1.9	0.644
5	1	14.5	0.02937	0.065	0.064	3.0	2777.0	2843.4	-2.4	0.570
6	1	17.5	0.04080	0.076	0.073	4.8	2246.0	2342.7	-4.3	0.515
7	1	20.5	0.04313	0.078	0.074	5.0	2406.7	2520.0	-4.7	0.506
8	1	23.5	0.06290	0.091	0.085	7.0	1820.9	1970.2	-8.2	0.444
9	1	26.5	0.06112	0.090	0.084	6.9	2049.1	2210.3	-7.9	0.449
10	1	30.0	0.06434	0.092	0.087	5.9	2054.3	2198.9	-7.0	0.435
11	3	33.5	0.10581	0.098	0.093	5.1	1299.6	1367.6	-5.2	0.465
12	3	36.5	0.10664	0.098	0.093	5.1	1299.6	1367.0	-5.2	0.463
13	3	39.5	0.08772	0.089	0.087	1.7	1599.3	1624.2	-1.6	0.491
14	3	42.5	0.06349	0.074	0.075	-0.7	2299.1	2288.0	0.5	0.554
15	3	45.5	0.02982	0.047	0.049	-5.5	5076.4	4966.6	2.2	0.696
16	3	48.5	0.03122	0.048	0.050	-4.1	4953.5	4871.3	1.7	0.691

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00516	0.029	0.029	-0.1	2929.5	2928.2	0.0	0.848
2	1	5.5	0.01530	0.048	0.048	0.7	2615.4	2625.6	-0.4	0.681
3	1	8.5	0.02361	0.059	0.059	1.2	2458.7	2478.4	-0.8	0.603
4	1	11.5	0.01999	0.054	0.054	0.5	3615.8	3629.4	-0.4	0.632
5	1	14.5	0.02998	0.066	0.065	0.9	2757.1	2777.0	-0.7	0.556
6	1	17.5	0.04246	0.077	0.076	1.7	2211.3	2246.0	-1.6	0.493
7	1	20.5	0.04528	0.080	0.078	2.0	2360.3	2406.7	-2.0	0.483
8	1	23.5	0.06799	0.094	0.091	3.0	1754.8	1820.9	-3.8	0.410
9	1	26.5	0.06569	0.093	0.090	2.8	1981.1	2049.1	-3.4	0.416
10	1	30.0	0.06842	0.094	0.092	2.4	1994.8	2054.3	-3.0	0.406
11	3	33.5	0.10946	0.099	0.098	1.7	1278.5	1299.6	-1.6	0.442
12	3	36.5	0.11027	0.100	0.098	1.7	1278.6	1299.6	-1.6	0.440
13	3	39.5	0.08781	0.089	0.089	0.1	1598.6	1599.3	0.0	0.484
14	3	42.5	0.06348	0.074	0.074	0.0	2299.3	2299.1	0.0	0.557
15	3	45.5	0.02924	0.046	0.047	-1.4	5103.1	5076.4	0.5	0.711
16	3	48.5	0.03074	0.048	0.048	-1.0	4974.4	4953.5	0.4	0.703

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00512	0.028	0.029	-0.4	2933.2	2929.5	0.1	0.848
2	1	5.5	0.01523	0.048	0.048	-0.2	2618.6	2615.4	0.1	0.678
3	1	8.5	0.02362	0.059	0.059	0.0	2458.3	2458.7	0.0	0.598
4	1	11.5	0.01998	0.054	0.054	0.0	3616.7	3615.8	0.0	0.630
5	1	14.5	0.03012	0.066	0.066	0.2	2752.9	2757.1	-0.2	0.552
6	1	17.5	0.04313	0.078	0.077	0.7	2197.6	2211.3	-0.6	0.486
7	1	20.5	0.04618	0.080	0.080	0.8	2341.3	2360.3	-0.8	0.473
8	1	23.5	0.07044	0.095	0.094	1.4	1724.9	1754.8	-1.7	0.396
9	1	26.5	0.06778	0.094	0.093	1.2	1951.6	1981.1	-1.5	0.402
10	1	30.0	0.07022	0.095	0.094	1.0	1969.7	1994.8	-1.3	0.394
11	3	33.5	0.11048	0.100	0.099	0.5	1272.7	1278.5	-0.5	0.435
12	3	36.5	0.11127	0.100	0.100	0.4	1273.0	1278.6	-0.4	0.433
13	3	39.5	0.08787	0.089	0.089	0.0	1598.0	1598.6	0.0	0.483
14	3	42.5	0.06355	0.075	0.074	0.1	2298.2	2299.3	0.0	0.557
15	3	45.5	0.02912	0.046	0.046	-0.3	5109.0	5103.1	0.1	0.715
16	3	48.5	0.03063	0.048	0.048	-0.3	4979.4	4974.4	0.1	0.705

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 6

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00509	0.028	0.028	-0.2	2935.3	2933.2	0.1	0.849
2	1	5.5	0.01516	0.048	0.048	-0.2	2622.0	2618.6	0.1	0.679

3	1	8.5	0.02355	0.059	0.059	-0.1	2460.5	2458.3	0.1	0.598
4	1	11.5	0.01994	0.054	0.054	-0.1	3618.9	3616.7	0.1	0.630
5	1	14.5	0.03013	0.066	0.066	0.0	2752.4	2752.9	0.0	0.552
6	1	17.5	0.04342	0.078	0.078	0.3	2191.8	2197.6	-0.3	0.483
7	1	20.5	0.04655	0.080	0.080	0.3	2333.7	2341.3	-0.3	0.470
8	1	23.5	0.07161	0.096	0.095	0.6	1711.7	1724.9	-0.8	0.389
9	1	26.5	0.06873	0.094	0.094	0.5	1938.4	1951.6	-0.7	0.396
10	1	30.0	0.07102	0.096	0.095	0.4	1959.3	1969.7	-0.5	0.389
11	3	33.5	0.11068	0.100	0.100	0.1	1271.6	1272.7	-0.1	0.433
12	3	36.5	0.11144	0.100	0.100	0.1	1272.0	1273.0	-0.1	0.431
13	3	39.5	0.08796	0.089	0.089	0.1	1597.3	1598.0	0.0	0.483
14	3	42.5	0.06360	0.075	0.075	0.0	2297.4	2298.2	0.0	0.556
15	3	45.5	0.02909	0.046	0.046	-0.1	5110.2	5109.0	0.0	0.716
16	3	48.5	0.03060	0.048	0.048	-0.1	4980.6	4979.4	0.0	0.706

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 7

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00508	0.028	0.028	-0.1	2936.2	2935.3	0.0	0.850
2	1	5.5	0.01512	0.048	0.048	-0.1	2623.9	2622.0	0.1	0.680
3	1	8.5	0.02350	0.059	0.059	-0.1	2462.2	2460.5	0.1	0.599
4	1	11.5	0.01991	0.054	0.054	0.0	3620.1	3618.9	0.0	0.631
5	1	14.5	0.03013	0.066	0.066	0.0	2752.4	2752.4	0.0	0.551
6	1	17.5	0.04354	0.078	0.078	0.1	2189.3	2191.8	-0.1	0.482
7	1	20.5	0.04670	0.081	0.080	0.1	2330.7	2333.7	-0.1	0.468
8	1	23.5	0.07214	0.096	0.096	0.3	1705.7	1711.7	-0.3	0.386
9	1	26.5	0.06916	0.095	0.094	0.2	1932.5	1938.4	-0.3	0.394
10	1	30.0	0.07135	0.096	0.096	0.2	1955.0	1959.3	-0.2	0.387
11	3	33.5	0.11066	0.100	0.100	0.0	1271.7	1271.6	0.0	0.433
12	3	36.5	0.11141	0.100	0.100	0.0	1272.2	1272.0	0.0	0.431
13	3	39.5	0.08802	0.089	0.089	0.0	1596.8	1597.3	0.0	0.483
14	3	42.5	0.06363	0.075	0.075	0.0	2297.0	2297.4	0.0	0.556
15	3	45.5	0.02909	0.046	0.046	0.0	5110.4	5110.2	0.0	0.716
16	3	48.5	0.03060	0.048	0.048	0.0	4981.0	4980.6	0.0	0.706

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 8

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00508	0.028	0.028	0.0	2936.5	2936.2	0.0	0.850
2	1	5.5	0.01510	0.048	0.048	-0.1	2624.7	2623.9	0.0	0.680
3	1	8.5	0.02348	0.059	0.059	-0.1	2463.0	2462.2	0.0	0.599
4	1	11.5	0.01990	0.054	0.054	0.0	3620.7	3620.1	0.0	0.631
5	1	14.5	0.03013	0.066	0.066	0.0	2752.4	2752.4	0.0	0.551
6	1	17.5	0.04360	0.078	0.078	0.1	2188.2	2189.3	-0.1	0.481
7	1	20.5	0.04676	0.081	0.081	0.1	2329.4	2330.7	-0.1	0.468
8	1	23.5	0.07238	0.096	0.096	0.1	1703.0	1705.7	-0.2	0.385
9	1	26.5	0.06937	0.095	0.095	0.1	1929.7	1932.5	-0.1	0.392

10	1	30.0	0.07149	0.096	0.096	0.1	1953.2	1955.0	-0.1	0.387
11	3	33.5	0.11060	0.100	0.100	0.0	1272.0	1271.7	0.0	0.433
12	3	36.5	0.11134	0.100	0.100	0.0	1272.6	1272.2	0.0	0.431
13	3	39.5	0.08805	0.089	0.089	0.0	1596.5	1596.8	0.0	0.483
14	3	42.5	0.06364	0.075	0.075	0.0	2296.9	2297.0	0.0	0.556
15	3	45.5	0.02909	0.046	0.046	0.0	5110.5	5110.4	0.0	0.716
16	3	48.5	0.03059	0.048	0.048	0.0	4981.1	4981.0	0.0	0.706

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 9

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00508	0.028	0.028	0.0	2936.6	2936.5	0.0	0.850
2	1	5.5	0.01509	0.048	0.048	0.0	2625.1	2624.7	0.0	0.681
3	1	8.5	0.02347	0.059	0.059	0.0	2463.4	2463.0	0.0	0.599
4	1	11.5	0.01990	0.054	0.054	0.0	3620.9	3620.7	0.0	0.631
5	1	14.5	0.03013	0.066	0.066	0.0	2752.4	2752.4	0.0	0.551
6	1	17.5	0.04362	0.078	0.078	0.0	2187.7	2188.2	0.0	0.481
7	1	20.5	0.04679	0.081	0.081	0.0	2328.9	2329.4	0.0	0.467
8	1	23.5	0.07249	0.096	0.096	0.1	1701.8	1703.0	-0.1	0.384
9	1	26.5	0.06946	0.095	0.095	0.1	1928.4	1929.7	-0.1	0.392
10	1	30.0	0.07155	0.096	0.096	0.0	1952.4	1953.2	0.0	0.386
11	3	33.5	0.11056	0.100	0.100	0.0	1272.2	1272.0	0.0	0.433
12	3	36.5	0.11129	0.100	0.100	0.0	1272.9	1272.6	0.0	0.431
13	3	39.5	0.08806	0.089	0.089	0.0	1596.4	1596.5	0.0	0.483
14	3	42.5	0.06364	0.075	0.075	0.0	2296.9	2296.9	0.0	0.556
15	3	45.5	0.02909	0.046	0.046	0.0	5110.6	5110.5	0.0	0.716
16	3	48.5	0.03059	0.048	0.048	0.0	4981.3	4981.1	0.0	0.706

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 10

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00507	0.028	0.028	0.0	2936.7	2936.6	0.0	0.850
2	1	5.5	0.01509	0.048	0.048	0.0	2625.2	2625.1	0.0	0.681
3	1	8.5	0.02346	0.059	0.059	0.0	2463.6	2463.4	0.0	0.599
4	1	11.5	0.01990	0.054	0.054	0.0	3620.9	3620.9	0.0	0.631
5	1	14.5	0.03014	0.066	0.066	0.0	2752.3	2752.4	0.0	0.551
6	1	17.5	0.04363	0.078	0.078	0.0	2187.5	2187.7	0.0	0.481
7	1	20.5	0.04680	0.081	0.081	0.0	2328.7	2328.9	0.0	0.467
8	1	23.5	0.07254	0.096	0.096	0.0	1701.2	1701.8	0.0	0.384
9	1	26.5	0.06951	0.095	0.095	0.0	1927.8	1928.4	0.0	0.391
10	1	30.0	0.07158	0.096	0.096	0.0	1952.1	1952.4	0.0	0.386
11	3	33.5	0.11054	0.100	0.100	0.0	1272.4	1272.2	0.0	0.433
12	3	36.5	0.11126	0.100	0.100	0.0	1273.0	1272.9	0.0	0.431
13	3	39.5	0.08807	0.089	0.089	0.0	1596.3	1596.4	0.0	0.483
14	3	42.5	0.06364	0.075	0.075	0.0	2296.9	2296.9	0.0	0.556
15	3	45.5	0.02908	0.046	0.046	0.0	5110.7	5110.6	0.0	0.716
16	3	48.5	0.03059	0.048	0.048	0.0	4981.3	4981.3	0.0	0.706

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	1	4.0000	2.0000	0.00781	229.28	13.59
2	1	3.0000	5.5000	0.02321	609.39	13.59
3	1	3.0000	8.5000	0.03610	889.22	13.59
4	1	3.0000	11.5000	0.03061	1108.37	13.59
5	1	3.0000	14.5000	0.04636	1276.05	13.59
6	1	3.0000	17.5000	0.06713	1468.56	13.46
7	1	3.0000	20.5000	0.07200	1676.72	13.45
8	1	3.0000	23.5000	0.11160	1899.25	13.45
9	1	3.0000	26.5000	0.10693	2062.11	13.45
10	1	4.0000	30.0000	0.11012	2149.98	13.45
11	3	3.0000	33.5000	0.17006	2163.55	13.44
12	3	3.0000	36.5000	0.17118	2178.85	13.44
13	3	3.0000	39.5000	0.13549	2162.95	13.47
14	3	3.0000	42.5000	0.09790	2248.68	13.47
15	3	3.0000	45.5000	0.04475	2286.77	13.47
16	3	3.0000	48.5000	0.04706	2344.02	13.47

PERIOD = 0.26 FROM AVERAGE SHEAR VEL. = 775.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 7.03
FOR FREQUENCY = 3.56 C/SEC.
PERIOD = 0.28 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE	TH SAVED ACC. RECORD
OUTCR.	0.0000	0.88444	13.59	8.87	0.001	2048
WITHIN	4.0000	0.82933	13.59	7.47	0.000	2048
WITHIN	7.0000	0.71118	13.59	5.76	0.000	2048
WITHIN	10.0000	0.68971	13.44	6.00	0.001	2048
WITHIN	13.0000	0.70046	13.44	6.71	0.001	2048
WITHIN	16.0000	0.70832	13.57	7.10	0.000	2048
WITHIN	19.0000	0.72553	13.57	7.99	0.001	2048
WITHIN	22.0000	0.64994	13.57	8.95	0.001	2048
WITHIN	25.0000	0.59498	11.38	9.77	0.001	2048
WITHIN	28.0000	0.60985	12.50	10.67	0.001	2048
WITHIN	32.0000	0.67343	16.20	11.73	0.001	2048
WITHIN	35.0000	0.70548	16.19	13.87	0.002	2048
WITHIN	38.0000	0.71515	16.19	15.38	0.002	2048
WITHIN	41.0000	0.56671	18.60	15.37	0.002	2048
WITHIN	44.0000	0.53756	20.00	15.23	0.002	2048

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE	TH SAVED ACC. RECORD
WITHIN	47.0000	0.52869	20.00	14.54	0.002	2048
WITHIN	50.0000	0.52663	24.57	13.47	0.002	2048

OUTCR.	50.0000	0.57825	24.57	14.61	0.002	2048

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 1 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 1 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 2 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 2 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 3 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 3 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 4 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 4 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 5 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 5 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 6 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC3005 Layer 6 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 7 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 7 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 8 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 8 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 9 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 9 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 10 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 10 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 11 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 11 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 12 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 12 Strain

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1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   13
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 13 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   13
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 13 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   14
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 14 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   14
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 14 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   15
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 15 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   15
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 15 Strain

1******  OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   16
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 16 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   16
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300E Layer 16 Strain

1******  OPTION  9  ***  COMPUTE RESPONSE SPECTRUM
 RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER       1
CALCULATED FOR DAMPING      0.050

  TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
     TD = TIME FOR MAX. RELATIVE DISP.
     TV = TIME FOR MAX. RELATIVE VEL.
     TA = TIME FOR MAX. ABSOLUTE ACC.
  DAMPING RATIO = 0.050
  PER = 0.01    TIMES FOR MAXIMA --  TD = 13.5800  TV = 18.6700  TA = 13.5800
  PER = 0.02    TIMES FOR MAXIMA --  TD = 13.5800  TV = 18.6600  TA = 13.5800
  PER = 0.03    TIMES FOR MAXIMA --  TD = 13.5800  TV = 20.0700  TA = 13.5800
  PER = 0.04    TIMES FOR MAXIMA --  TD = 18.7600  TV = 27.0100  TA = 18.7600
  PER = 0.05    TIMES FOR MAXIMA --  TD = 20.5800  TV = 13.6100  TA = 20.5800
  PER = 0.06    TIMES FOR MAXIMA --  TD = 18.3000  TV = 18.2800  TA = 18.3000
  PER = 0.07    TIMES FOR MAXIMA --  TD = 24.7500  TV = 24.7700  TA = 24.7500
  PER = 0.08    TIMES FOR MAXIMA --  TD = 16.1600  TV = 16.2600  TA = 16.1600
  PER = 0.09    TIMES FOR MAXIMA --  TD = 11.4300  TV = 11.4100  TA = 11.4300
  PER = 0.10    TIMES FOR MAXIMA --  TD = 20.7500  TV = 20.0900  TA = 20.7500
  PER = 0.11    TIMES FOR MAXIMA --  TD = 20.7600  TV = 25.5700  TA = 25.5900
  PER = 0.12    TIMES FOR MAXIMA --  TD = 21.6700  TV = 21.2200  TA = 21.6700
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PER = 0.13	TIMES FOR MAXIMA --	TD = 16.7500	TV = 15.2200	TA = 16.7500
PER = 0.14	TIMES FOR MAXIMA --	TD = 16.7500	TV = 16.7900	TA = 16.7500
PER = 0.15	TIMES FOR MAXIMA --	TD = 14.1800	TV = 11.3400	TA = 14.1800
PER = 0.16	TIMES FOR MAXIMA --	TD = 20.6300	TV = 20.5900	TA = 20.6300
PER = 0.17	TIMES FOR MAXIMA --	TD = 19.3300	TV = 19.3000	TA = 19.3300
PER = 0.18	TIMES FOR MAXIMA --	TD = 13.5800	TV = 13.6400	TA = 13.5800
PER = 0.19	TIMES FOR MAXIMA --	TD = 13.6000	TV = 13.6500	TA = 13.5900
PER = 0.20	TIMES FOR MAXIMA --	TD = 13.6100	TV = 13.6500	TA = 13.6000
PER = 0.21	TIMES FOR MAXIMA --	TD = 24.5200	TV = 24.5700	TA = 24.5200
PER = 0.22	TIMES FOR MAXIMA --	TD = 24.5300	TV = 19.4400	TA = 24.5300
PER = 0.23	TIMES FOR MAXIMA --	TD = 21.9300	TV = 21.8700	TA = 21.9200
PER = 0.24	TIMES FOR MAXIMA --	TD = 21.9400	TV = 21.8800	TA = 21.9400
PER = 0.25	TIMES FOR MAXIMA --	TD = 21.8400	TV = 21.9000	TA = 21.8300
PER = 0.26	TIMES FOR MAXIMA --	TD = 21.8600	TV = 21.9200	TA = 21.8500
PER = 0.27	TIMES FOR MAXIMA --	TD = 21.2400	TV = 21.1800	TA = 21.2300
PER = 0.28	TIMES FOR MAXIMA --	TD = 21.2500	TV = 21.1800	TA = 21.2400
PER = 0.29	TIMES FOR MAXIMA --	TD = 14.8000	TV = 21.1900	TA = 14.8000
PER = 0.30	TIMES FOR MAXIMA --	TD = 14.2400	TV = 14.3200	TA = 14.2400
PER = 0.31	TIMES FOR MAXIMA --	TD = 14.1200	TV = 13.5900	TA = 13.6500
PER = 0.32	TIMES FOR MAXIMA --	TD = 13.6700	TV = 13.6000	TA = 13.6700
PER = 0.33	TIMES FOR MAXIMA --	TD = 13.6900	TV = 13.6100	TA = 13.5300
PER = 0.34	TIMES FOR MAXIMA --	TD = 13.5500	TV = 20.9500	TA = 13.5400
PER = 0.35	TIMES FOR MAXIMA --	TD = 16.8100	TV = 20.8000	TA = 16.8100
PER = 0.36	TIMES FOR MAXIMA --	TD = 16.8200	TV = 20.8100	TA = 16.8200
PER = 0.37	TIMES FOR MAXIMA --	TD = 16.8300	TV = 16.7400	TA = 16.8300
PER = 0.38	TIMES FOR MAXIMA --	TD = 16.8400	TV = 16.7400	TA = 16.8300
PER = 0.39	TIMES FOR MAXIMA --	TD = 16.8500	TV = 16.7500	TA = 16.8400
PER = 0.40	TIMES FOR MAXIMA --	TD = 16.8600	TV = 16.9700	TA = 16.8500
PER = 0.41	TIMES FOR MAXIMA --	TD = 16.8700	TV = 16.9700	TA = 16.8600
PER = 0.42	TIMES FOR MAXIMA --	TD = 16.8800	TV = 16.9800	TA = 16.8700
PER = 0.43	TIMES FOR MAXIMA --	TD = 16.8800	TV = 16.9800	TA = 16.8800
PER = 0.44	TIMES FOR MAXIMA --	TD = 16.8900	TV = 16.7900	TA = 16.8900
PER = 0.45	TIMES FOR MAXIMA --	TD = 16.9100	TV = 16.7900	TA = 16.9000
PER = 0.46	TIMES FOR MAXIMA --	TD = 16.9200	TV = 16.8100	TA = 16.9100
PER = 0.47	TIMES FOR MAXIMA --	TD = 16.7100	TV = 16.8200	TA = 16.7000
PER = 0.48	TIMES FOR MAXIMA --	TD = 16.7100	TV = 16.8200	TA = 16.7100
PER = 0.49	TIMES FOR MAXIMA --	TD = 16.7200	TV = 16.8300	TA = 16.7100
PER = 0.50	TIMES FOR MAXIMA --	TD = 16.7200	TV = 16.8300	TA = 16.7200
PER = 0.51	TIMES FOR MAXIMA --	TD = 16.7300	TV = 16.6200	TA = 16.7200
PER = 0.52	TIMES FOR MAXIMA --	TD = 16.7400	TV = 16.6400	TA = 16.7300
PER = 0.53	TIMES FOR MAXIMA --	TD = 16.5400	TV = 16.6700	TA = 16.5300
PER = 0.54	TIMES FOR MAXIMA --	TD = 16.5500	TV = 16.6700	TA = 16.5400
PER = 0.55	TIMES FOR MAXIMA --	TD = 29.5500	TV = 21.5900	TA = 29.5400
PER = 0.56	TIMES FOR MAXIMA --	TD = 32.1900	TV = 28.3400	TA = 32.1800
PER = 0.57	TIMES FOR MAXIMA --	TD = 30.5300	TV = 28.3400	TA = 30.5200
PER = 0.58	TIMES FOR MAXIMA --	TD = 30.5400	TV = 30.6800	TA = 30.5300
PER = 0.60	TIMES FOR MAXIMA --	TD = 30.5800	TV = 30.4700	TA = 30.5700
PER = 0.62	TIMES FOR MAXIMA --	TD = 30.6000	TV = 30.4900	TA = 30.5900
PER = 0.64	TIMES FOR MAXIMA --	TD = 16.7400	TV = 28.1800	TA = 16.7300
PER = 0.66	TIMES FOR MAXIMA --	TD = 16.7600	TV = 16.6700	TA = 16.7500
PER = 0.68	TIMES FOR MAXIMA --	TD = 16.5200	TV = 16.6700	TA = 16.5100
PER = 0.70	TIMES FOR MAXIMA --	TD = 16.5400	TV = 16.6800	TA = 16.5200
PER = 0.72	TIMES FOR MAXIMA --	TD = 16.5500	TV = 16.6800	TA = 16.5400
PER = 0.74	TIMES FOR MAXIMA --	TD = 16.5600	TV = 16.6800	TA = 16.5500
PER = 0.76	TIMES FOR MAXIMA --	TD = 16.5700	TV = 16.4700	TA = 16.5500
PER = 0.78	TIMES FOR MAXIMA --	TD = 32.7400	TV = 16.4700	TA = 32.7200
PER = 0.80	TIMES FOR MAXIMA --	TD = 32.7600	TV = 16.4700	TA = 32.7400
PER = 0.82	TIMES FOR MAXIMA --	TD = 33.6400	TV = 16.4700	TA = 33.6300
PER = 0.84	TIMES FOR MAXIMA --	TD = 33.6700	TV = 16.4700	TA = 33.6600
PER = 0.86	TIMES FOR MAXIMA --	TD = 16.3100	TV = 16.4800	TA = 16.2900
PER = 0.88	TIMES FOR MAXIMA --	TD = 12.2300	TV = 12.4200	TA = 12.2200

PER = 0.90	TIMES FOR MAXIMA --	TD = 12.2400	TV = 12.4200	TA = 12.2300
PER = 0.92	TIMES FOR MAXIMA --	TD = 12.2400	TV = 12.4200	TA = 12.2300
PER = 0.94	TIMES FOR MAXIMA --	TD = 12.2500	TV = 12.4200	TA = 12.2400
PER = 0.96	TIMES FOR MAXIMA --	TD = 12.2600	TV = 12.4200	TA = 12.2500
PER = 0.98	TIMES FOR MAXIMA --	TD = 12.2800	TV = 12.4300	TA = 12.2600
PER = 1.00	TIMES FOR MAXIMA --	TD = 12.2900	TV = 12.4300	TA = 12.2700
PER = 1.05	TIMES FOR MAXIMA --	TD = 12.3200	TV = 13.1600	TA = 12.3100
PER = 1.10	TIMES FOR MAXIMA --	TD = 13.5500	TV = 13.1900	TA = 13.5300
PER = 1.15	TIMES FOR MAXIMA --	TD = 13.5700	TV = 13.2000	TA = 13.5600
PER = 1.20	TIMES FOR MAXIMA --	TD = 13.6100	TV = 13.9600	TA = 13.5800
PER = 1.25	TIMES FOR MAXIMA --	TD = 13.1100	TV = 13.4800	TA = 13.0800
PER = 1.30	TIMES FOR MAXIMA --	TD = 13.1300	TV = 13.5200	TA = 13.1100
PER = 1.35	TIMES FOR MAXIMA --	TD = 13.8500	TV = 13.5200	TA = 13.8300
PER = 1.40	TIMES FOR MAXIMA --	TD = 13.8600	TV = 13.5200	TA = 13.8400
PER = 1.45	TIMES FOR MAXIMA --	TD = 13.8800	TV = 13.5200	TA = 13.8600
PER = 1.50	TIMES FOR MAXIMA --	TD = 13.1900	TV = 13.5200	TA = 13.8700
PER = 1.55	TIMES FOR MAXIMA --	TD = 13.3800	TV = 13.5200	TA = 13.3600
PER = 1.60	TIMES FOR MAXIMA --	TD = 13.4100	TV = 13.5200	TA = 13.3900
PER = 1.65	TIMES FOR MAXIMA --	TD = 13.4200	TV = 13.0200	TA = 13.4000
PER = 1.70	TIMES FOR MAXIMA --	TD = 13.4300	TV = 13.0200	TA = 13.4100
PER = 1.75	TIMES FOR MAXIMA --	TD = 16.3700	TV = 18.6600	TA = 16.3500
PER = 1.80	TIMES FOR MAXIMA --	TD = 17.4700	TV = 18.6600	TA = 17.4500
PER = 1.85	TIMES FOR MAXIMA --	TD = 17.4900	TV = 17.9200	TA = 17.4600
PER = 1.90	TIMES FOR MAXIMA --	TD = 18.5500	TV = 17.9200	TA = 18.5200
PER = 1.95	TIMES FOR MAXIMA --	TD = 18.5700	TV = 20.9600	TA = 18.5400
PER = 2.00	TIMES FOR MAXIMA --	TD = 18.5800	TV = 19.1600	TA = 18.5500
PER = 2.05	TIMES FOR MAXIMA --	TD = 19.7100	TV = 19.1600	TA = 19.6800
PER = 2.10	TIMES FOR MAXIMA --	TD = 17.7100	TV = 16.2500	TA = 19.7000
PER = 2.15	TIMES FOR MAXIMA --	TD = 17.7700	TV = 16.2500	TA = 17.7500
PER = 2.20	TIMES FOR MAXIMA --	TD = 17.8200	TV = 16.2500	TA = 17.7900
PER = 2.25	TIMES FOR MAXIMA --	TD = 19.0800	TV = 16.2500	TA = 19.0500
PER = 2.30	TIMES FOR MAXIMA --	TD = 19.1100	TV = 16.2500	TA = 19.0900
PER = 2.35	TIMES FOR MAXIMA --	TD = 17.0700	TV = 16.6800	TA = 17.0600
PER = 2.40	TIMES FOR MAXIMA --	TD = 16.0600	TV = 16.6800	TA = 16.0400
PER = 2.50	TIMES FOR MAXIMA --	TD = 12.9100	TV = 12.5600	TA = 12.8700
PER = 2.60	TIMES FOR MAXIMA --	TD = 12.0200	TV = 12.5600	TA = 12.0000
PER = 2.70	TIMES FOR MAXIMA --	TD = 12.0900	TV = 12.5600	TA = 12.0700
PER = 2.80	TIMES FOR MAXIMA --	TD = 17.1000	TV = 16.6800	TA = 17.0700
PER = 2.90	TIMES FOR MAXIMA --	TD = 17.1300	TV = 16.6800	TA = 17.0900
PER = 3.00	TIMES FOR MAXIMA --	TD = 16.0700	TV = 16.6800	TA = 16.0400
PER = 3.10	TIMES FOR MAXIMA --	TD = 16.1200	TV = 16.6800	TA = 16.0400
PER = 3.20	TIMES FOR MAXIMA --	TD = 16.1300	TV = 16.6800	TA = 16.1100
PER = 3.30	TIMES FOR MAXIMA --	TD = 16.1400	TV = 16.6800	TA = 16.1200
PER = 3.40	TIMES FOR MAXIMA --	TD = 16.1400	TV = 16.6800	TA = 16.1200
PER = 3.50	TIMES FOR MAXIMA --	TD = 45.5600	TV = 16.6800	TA = 45.4800
PER = 3.60	TIMES FOR MAXIMA --	TD = 45.7200	TV = 16.6800	TA = 45.6600
PER = 3.70	TIMES FOR MAXIMA --	TD = 44.2500	TV = 16.6800	TA = 44.2300
PER = 3.80	TIMES FOR MAXIMA	TD = 44.2900	TV = 16.6800	TA = 44.2300
PER = 3.90	TIMES FOR MAXIMA --	TD = 44.4000	TV = 16.6800	TA = 46.2200
PER = 4.00	TIMES FOR MAXIMA --	TD = 44.6100	TV = 16.6800	TA = 44.3900
PER = 4.10	TIMES FOR MAXIMA --	TD = 16.1500	TV = 16.6800	TA = 16.1200
PER = 4.20	TIMES FOR MAXIMA --	TD = 14.9200	TV = 16.6800	TA = 14.8800
PER = 4.30	TIMES FOR MAXIMA --	TD = 14.9200	TV = 12.5600	TA = 14.8800
PER = 4.40	TIMES FOR MAXIMA --	TD = 14.9200	TV = 15.7200	TA = 14.8900
PER = 4.50	TIMES FOR MAXIMA --	TD = 14.9300	TV = 15.7200	TA = 14.8900
PER = 4.60	TIMES FOR MAXIMA --	TD = 14.9300	TV = 14.6600	TA = 14.8900
PER = 4.70	TIMES FOR MAXIMA --	TD = 32.0400	TV = 14.6600	TA = 14.8900
PER = 4.80	TIMES FOR MAXIMA --	TD = 32.0500	TV = 26.8100	TA = 32.0000
PER = 4.90	TIMES FOR MAXIMA --	TD = 32.0800	TV = 26.8100	TA = 32.0000
PER = 5.00	TIMES FOR MAXIMA --	TD = 32.0900	TV = 26.8100	TA = 32.0000
PER = 5.10	TIMES FOR MAXIMA --	TD = 28.0900	TV = 26.8100	TA = 32.0000

PER = 5.20 TIMES FOR MAXIMA -- TD = 28.0900 TV = 26.8100 TA = 28.0600
PER = 5.40 TIMES FOR MAXIMA -- TD = 9.8500 TV = 26.8100 TA = 9.7800
PER = 5.60 TIMES FOR MAXIMA -- TD = 9.8500 TV = 26.8100 TA = 9.7800
PER = 5.80 TIMES FOR MAXIMA -- TD = 9.8600 TV = 12.5600 TA = 9.7800
PER = 6.00 TIMES FOR MAXIMA -- TD = 14.9200 TV = 12.5600 TA = 14.8800
PER = 6.20 TIMES FOR MAXIMA -- TD = 14.9200 TV = 12.5600 TA = 14.8800
PER = 6.40 TIMES FOR MAXIMA -- TD = 14.9200 TV = 12.5600 TA = 14.8800
PER = 6.60 TIMES FOR MAXIMA -- TD = 14.9200 TV = 12.5600 TA = 14.8800
PER = 6.80 TIMES FOR MAXIMA -- TD = 14.9300 TV = 12.5600 TA = 14.8800
PER = 7.00 TIMES FOR MAXIMA -- TD = 14.9300 TV = 12.5600 TA = 14.8800
PER = 7.30 TIMES FOR MAXIMA -- TD = 15.3900 TV = 12.5600 TA = 14.8800
PER = 7.60 TIMES FOR MAXIMA -- TD = 15.4000 TV = 12.5600 TA = 15.3500
PER = 8.00 TIMES FOR MAXIMA -- TD = 15.4500 TV = 12.5600 TA = 15.3500
PER = 8.50 TIMES FOR MAXIMA -- TD = 15.5600 TV = 14.6600 TA = 15.3500
PER = 9.00 TIMES FOR MAXIMA -- TD = 16.7700 TV = 14.6600 TA = 16.6800
PER = 9.50 TIMES FOR MAXIMA -- TD = 17.1200 TV = 14.6600 TA = 16.6800
PER =10.00 TIMES FOR MAXIMA -- TD = 17.1300 TV = 14.6600 TA = 16.6800

SPECTRAL VALUES--
(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00007	0.00162	0.04521	0.88469	0.88226	100.00
2	0.02	0.00029	0.02448	0.09022	0.88457	0.88018	50.00
3	0.03	0.00084	0.11368	0.17674	1.15665	1.14954	33.33
4	0.04	0.00224	0.26450	0.35226	1.69734	1.71839	25.00
5	0.05	0.00339	0.43475	0.42596	1.69653	1.66236	20.00
6	0.06	0.00493	0.43930	0.51672	1.65029	1.68045	16.67
7	0.07	0.00680	0.53118	0.61010	1.72996	1.70069	14.29
8	0.08	0.00967	0.66552	0.75965	1.85850	1.85289	12.50
9	0.09	0.01588	1.01170	1.10894	2.43771	2.40430	11.11
10	0.10	0.01392	0.75444	0.87471	1.72961	1.70681	10.00
11	0.11	0.01583	0.77282	0.90409	1.61125	1.60378	9.09
12	0.12	0.01718	0.70809	0.89976	1.44876	1.46308	8.33
13	0.13	0.01669	0.64237	0.80683	1.20634	1.21105	7.69
14	0.14	0.02029	0.70091	0.91060	1.28686	1.26918	7.14
15	0.15	0.02194	0.80547	0.91884	1.19663	1.19528	6.67
16	0.16	0.02709	0.98643	1.06368	1.31004	1.29722	6.25
17	0.17	0.03196	1.08053	1.18126	1.37371	1.35588	5.88
18	0.18	0.04061	1.35903	1.41752	1.54569	1.53667	5.56
19	0.19	0.05237	1.72532	1.73194	1.78480	1.77870	5.26
20	0.20	0.05801	1.82442	1.82245	1.77765	1.77807	5.00
21	0.21	0.06878	1.78704	2.05791	1.90841	1.91219	4.76
22	0.22	0.08194	2.20406	2.34007	2.09973	2.07554	4.55
23	0.23	0.09997	2.59270	2.73103	2.31275	2.31698	4.35
24	0.24	0.12316	3.15870	3.22420	2.63270	2.62141	4.17
25	0.25	0.15686	4.02617	3.94226	3.11519	3.07701	4.00
26	0.26	0.16642	4.06351	4.02165	3.03217	3.01825	3.85
27	0.27	0.15099	3.50836	3.51375	2.54003	2.53940	3.70
28	0.28	0.14992	3.44354	3.36413	2.36295	2.34444	3.57
29	0.29	0.17192	3.86748	3.72481	2.51630	2.50628	3.45
30	0.30	0.19488	4.17024	4.08147	2.67455	2.65472	3.33
31	0.31	0.20840	4.37387	4.22392	2.67581	2.65875	3.23
32	0.32	0.20073	4.35173	3.94124	2.42234	2.40330	3.13
33	0.33	0.18382	3.89455	3.49997	2.08016	2.06954	3.03
34	0.34	0.16282	3.28428	3.00890	1.73723	1.72684	2.94
35	0.35	0.15163	3.07962	2.72214	1.52233	1.51763	2.86
36	0.36	0.16310	2.73950	2.84668	1.54817	1.54298	2.78
37	0.37	0.17492	2.90359	2.97047	1.57026	1.56656	2.70
38	0.38	0.18727	3.03641	3.09646	1.59281	1.59003	2.63
39	0.39	0.19573	3.09348	3.15332	1.58249	1.57771	2.56
40	0.40	0.19817	3.12881	3.11283	1.52666	1.51851	2.50

41	0.41	0.19781	3.12847	3.03143	1.45166	1.44274	2.44
42	0.42	0.19553	3.07504	2.92508	1.36688	1.35898	2.38
43	0.43	0.19970	3.05538	2.91797	1.33031	1.32415	2.33
44	0.44	0.21410	3.18111	3.05735	1.36313	1.35586	2.27
45	0.45	0.21944	3.21896	3.06393	1.33751	1.32859	2.22
46	0.46	0.21073	3.07841	2.87837	1.22911	1.22099	2.17
47	0.47	0.20515	2.96726	2.74248	1.14497	1.13860	2.13
48	0.48	0.20805	2.94250	2.72333	1.11632	1.10709	2.08
49	0.49	0.21171	2.90325	2.71478	1.08902	1.08109	2.04
50	0.50	0.21303	2.83354	2.67699	1.05423	1.04472	2.00
51	0.51	0.21291	2.76686	2.62301	1.01089	1.00358	1.96
52	0.52	0.20289	2.71755	2.45151	0.92604	0.91993	1.92
53	0.53	0.18103	2.62710	2.14606	0.79665	0.79012	1.89
54	0.54	0.16196	2.39962	1.88454	0.68697	0.68098	1.85
55	0.55	0.16061	2.12608	1.83486	0.65455	0.65097	1.82
56	0.56	0.17830	2.15307	2.00048	0.70039	0.69706	1.79
57	0.57	0.19490	2.31606	2.14841	0.74001	0.73547	1.75
58	0.58	0.21968	2.46230	2.37977	0.80523	0.80063	1.72
59	0.60	0.22951	2.36487	2.40340	0.78617	0.78163	1.67
60	0.62	0.20419	2.38136	2.06925	0.65586	0.65125	1.61
61	0.64	0.17857	2.02978	1.75312	0.53919	0.53451	1.56
62	0.66	0.19855	2.29758	1.89015	0.56188	0.55883	1.52
63	0.68	0.20384	2.58326	1.88344	0.54544	0.54046	1.47
64	0.70	0.22247	2.60616	1.99687	0.56092	0.55664	1.43
65	0.72	0.21968	2.41282	1.91704	0.52393	0.51954	1.39
66	0.74	0.20576	2.15920	1.74710	0.46443	0.46069	1.35
67	0.76	0.19776	2.01496	1.63495	0.42305	0.41977	1.32
68	0.78	0.21543	2.04485	1.73537	0.43747	0.43413	1.28
69	0.80	0.22642	2.16380	1.77833	0.43709	0.43376	1.25
70	0.82	0.22615	2.36168	1.73282	0.41471	0.41235	1.22
71	0.84	0.22816	2.46266	1.70665	0.39872	0.39645	1.19
72	0.86	0.21523	2.36504	1.57250	0.36010	0.35679	1.16
73	0.88	0.20813	2.25229	1.48606	0.33040	0.32952	1.14
74	0.90	0.21667	2.25370	1.51263	0.32931	0.32795	1.11
75	0.92	0.23529	2.32383	1.60695	0.34247	0.34083	1.09
76	0.94	0.26701	2.44503	1.78476	0.37224	0.37049	1.06
77	0.96	0.30007	2.51276	1.96398	0.40130	0.39920	1.04
78	0.98	0.32552	2.49169	2.08705	0.41788	0.41556	1.02
79	1.00	0.34288	2.39869	2.15440	0.42284	0.42039	1.00
80	1.05	0.37072	2.32275	2.21837	0.41565	0.41226	0.95
81	1.10	0.37626	2.36139	2.14918	0.38524	0.38125	0.91
82	1.15	0.43986	2.36340	2.40322	0.41253	0.40777	0.87
83	1.20	0.47417	2.61047	2.48275	0.40899	0.40372	0.83
84	1.25	0.45663	2.92361	2.29525	0.36178	0.35830	0.80
85	1.30	0.38072	2.69034	1.84009	0.27888	0.27620	0.77
86	1.35	0.33504	2.47567	1.55936	0.22790	0.22539	0.74
87	1.40	0.32858	2.39300	1.47466	0.20790	0.20554	0.71
88	1.45	0.33092	2.36311	1.43393	0.19495	0.19297	0.69
89	1.50	0.32725	2.31073	1.37079	0.17982	0.17832	0.67
90	1.55	0.33777	2.16537	1.36922	0.17327	0.17237	0.65
91	1.60	0.35224	1.91605	1.38324	0.17027	0.16869	0.63
92	1.65	0.34112	1.83969	1.29899	0.15622	0.15362	0.61
93	1.70	0.31002	1.69562	1.14584	0.13464	0.13152	0.59
94	1.75	0.32133	1.77498	1.15370	0.13133	0.12864	0.57
95	1.80	0.37514	1.80200	1.30949	0.14377	0.14196	0.56
96	1.85	0.40807	1.71844	1.38594	0.14840	0.14618	0.54
97	1.90	0.42454	1.68995	1.40392	0.14568	0.14418	0.53
98	1.95	0.44700	1.72463	1.44030	0.14603	0.14413	0.51
99	2.00	0.47167	1.83758	1.48180	0.14637	0.14457	0.50
100	2.05	0.51428	1.94446	1.57626	0.15243	0.15004	0.49
101	2.10	0.55060	2.03638	1.64740	0.15426	0.15308	0.48

102	2.15	0.59783	2.23409	1.74710	0.15939	0.15856	0.47
103	2.20	0.61910	2.35829	1.76815	0.15826	0.15683	0.45
104	2.25	0.59931	2.35412	1.67359	0.14627	0.14514	0.44
105	2.30	0.57243	2.21310	1.56377	0.13475	0.13267	0.43
106	2.35	0.51023	2.06246	1.36419	0.11383	0.11327	0.43
107	2.40	0.47344	2.03374	1.23947	0.10246	0.10077	0.42
108	2.50	0.40221	1.85006	1.01085	0.07932	0.07890	0.40
109	2.60	0.43136	1.89756	1.04244	0.07895	0.07824	0.38
110	2.70	0.42310	1.76273	0.98460	0.07188	0.07116	0.37
111	2.80	0.38647	1.61794	0.86725	0.06139	0.06044	0.36
112	2.90	0.43621	1.81473	0.94511	0.06469	0.06359	0.34
113	3.00	0.45622	1.89744	0.95550	0.06373	0.06215	0.33
114	3.10	0.47128	1.84423	0.95521	0.06172	0.06013	0.32
115	3.20	0.44498	1.70647	0.87371	0.05433	0.05328	0.31
116	3.30	0.39333	1.55338	0.74890	0.04564	0.04428	0.30
117	3.40	0.33998	1.43465	0.62829	0.03748	0.03606	0.29
118	3.50	0.34496	1.36838	0.61927	0.03531	0.03453	0.29
119	3.60	0.38815	1.34667	0.67745	0.03708	0.03672	0.28
120	3.70	0.40047	1.34846	0.68006	0.03652	0.03586	0.27
121	3.80	0.41400	1.35166	0.68454	0.03617	0.03515	0.26
122	3.90	0.38699	1.34063	0.62347	0.03199	0.03119	0.26
123	4.00	0.34307	1.30893	0.53889	0.02645	0.02629	0.25
124	4.10	0.31681	1.25834	0.48551	0.02453	0.02311	0.24
125	4.20	0.33732	1.19591	0.50463	0.02490	0.02344	0.24
126	4.30	0.35545	1.15211	0.51938	0.02508	0.02357	0.23
127	4.40	0.36425	1.11772	0.52015	0.02464	0.02307	0.23
128	4.50	0.36362	1.08790	0.50770	0.02366	0.02202	0.22
129	4.60	0.35463	1.08060	0.48440	0.02223	0.02055	0.22
130	4.70	0.34728	1.09383	0.46426	0.02053	0.01927	0.21
131	4.80	0.35988	1.12501	0.47108	0.02046	0.01915	0.21
132	4.90	0.34542	1.16697	0.44293	0.01900	0.01764	0.20
133	5.00	0.31399	1.18672	0.39458	0.01673	0.01540	0.20
134	5.10	0.28415	1.18983	0.35008	0.01427	0.01339	0.20
135	5.20	0.28355	1.18399	0.34262	0.01363	0.01286	0.19
136	5.40	0.28420	1.16958	0.33068	0.01290	0.01195	0.19
137	5.60	0.30689	1.16205	0.34433	0.01297	0.01200	0.18
138	5.80	0.32224	1.19908	0.34909	0.01272	0.01174	0.17
139	6.00	0.33764	1.24291	0.35357	0.01271	0.01150	0.17
140	6.20	0.39242	1.27869	0.39769	0.01371	0.01252	0.16
141	6.40	0.44751	1.30537	0.43934	0.01459	0.01340	0.16
142	6.60	0.49824	1.32312	0.47432	0.01525	0.01402	0.15
143	6.80	0.54183	1.33279	0.50065	0.01563	0.01437	0.15
144	7.00	0.57653	1.33559	0.51749	0.01573	0.01443	0.14
145	7.30	0.62892	1.32979	0.54132	0.01543	0.01447	0.14
146	7.60	0.67527	1.31560	0.55827	0.01501	0.01433	0.13
147	8.00	0.71082	1.28918	0.55827	0.01436	0.01362	0.13
148	8.50	0.72495	1.30925	0.53588	0.01296	0.01230	0.12
149	9.00	0.74183	1.34853	0.51789	0.01281	0.01123	0.11
150	9.50	0.82449	1.37083	0.54531	0.01261	0.01120	0.11
151	10.00	0.89170	1.38046	0.56027	0.01199	0.01093	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.
AREA OF ACC. RESPONSE SPECTRUM = 1.273
AREA OF VEL. RESPONSE SPECTRUM = 5.457
MAX. ACCELERATION RESPONSE VALUE = 3.115
MAX. VELOCITY RESPONSE VALUE = 4.374

1****** OPTION 9 *** COMPUTE RESPONSE SPECTRUM
RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER 17
CALCULATED FOR DAMPING 0.050

TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
TD = TIME FOR MAX. RELATIVE DISP.
TV = TIME FOR MAX. RELATIVE VEL.
TA = TIME FOR MAX. ABSOLUTE ACC.
DAMPING RATIO = 0.050

PER = 0.01	TIMES FOR MAXIMA --	TD = 24.5600	TV = 18.6000	TA = 24.5600
PER = 0.02	TIMES FOR MAXIMA --	TD = 24.5600	TV = 11.4800	TA = 24.5600
PER = 0.03	TIMES FOR MAXIMA --	TD = 23.3800	TV = 23.3700	TA = 23.3800
PER = 0.04	TIMES FOR MAXIMA --	TD = 24.6700	TV = 24.6800	TA = 24.6700
PER = 0.05	TIMES FOR MAXIMA --	TD = 10.4700	TV = 10.4600	TA = 10.4700
PER = 0.06	TIMES FOR MAXIMA --	TD = 18.2300	TV = 18.2200	TA = 18.2300
PER = 0.07	TIMES FOR MAXIMA --	TD = 18.2800	TV = 24.6700	TA = 18.2800
PER = 0.08	TIMES FOR MAXIMA --	TD = 16.0900	TV = 24.6500	TA = 16.0900
PER = 0.09	TIMES FOR MAXIMA --	TD = 11.3700	TV = 11.3500	TA = 11.3700
PER = 0.10	TIMES FOR MAXIMA --	TD = 13.6400	TV = 20.0800	TA = 13.6400
PER = 0.11	TIMES FOR MAXIMA --	TD = 25.5300	TV = 25.5100	TA = 25.5300
PER = 0.12	TIMES FOR MAXIMA --	TD = 21.3600	TV = 21.3900	TA = 21.3600
PER = 0.13	TIMES FOR MAXIMA --	TD = 15.1900	TV = 15.2900	TA = 15.1900
PER = 0.14	TIMES FOR MAXIMA --	TD = 16.6900	TV = 16.0000	TA = 16.6900
PER = 0.15	TIMES FOR MAXIMA --	TD = 14.1100	TV = 14.1500	TA = 14.1100
PER = 0.16	TIMES FOR MAXIMA --	TD = 20.5600	TV = 20.5200	TA = 20.5600
PER = 0.17	TIMES FOR MAXIMA --	TD = 13.8400	TV = 13.8800	TA = 13.8400
PER = 0.18	TIMES FOR MAXIMA --	TD = 22.8300	TV = 22.7900	TA = 22.8300
PER = 0.19	TIMES FOR MAXIMA --	TD = 22.8500	TV = 22.8100	TA = 22.8500
PER = 0.20	TIMES FOR MAXIMA --	TD = 22.2200	TV = 13.5800	TA = 22.2200
PER = 0.21	TIMES FOR MAXIMA --	TD = 24.3200	TV = 24.5800	TA = 24.3200
PER = 0.22	TIMES FOR MAXIMA --	TD = 24.3400	TV = 19.2400	TA = 24.3300
PER = 0.23	TIMES FOR MAXIMA --	TD = 24.4600	TV = 21.8900	TA = 24.4600
PER = 0.24	TIMES FOR MAXIMA --	TD = 21.8600	TV = 21.8000	TA = 21.8500
PER = 0.25	TIMES FOR MAXIMA --	TD = 21.7500	TV = 21.6900	TA = 21.7500
PER = 0.26	TIMES FOR MAXIMA --	TD = 21.6500	TV = 21.7100	TA = 21.6500
PER = 0.27	TIMES FOR MAXIMA --	TD = 21.0300	TV = 21.6100	TA = 21.6600
PER = 0.28	TIMES FOR MAXIMA --	TD = 21.0400	TV = 21.1100	TA = 21.0300
PER = 0.29	TIMES FOR MAXIMA --	TD = 21.0500	TV = 21.1200	TA = 21.0400
PER = 0.30	TIMES FOR MAXIMA --	TD = 13.4300	TV = 13.5200	TA = 13.4300
PER = 0.31	TIMES FOR MAXIMA --	TD = 13.4500	TV = 13.5300	TA = 13.4500
PER = 0.32	TIMES FOR MAXIMA --	TD = 13.4700	TV = 13.5300	TA = 13.4600
PER = 0.33	TIMES FOR MAXIMA --	TD = 13.4800	TV = 13.4100	TA = 13.4700
PER = 0.34	TIMES FOR MAXIMA --	TD = 21.6700	TV = 13.4100	TA = 21.6700
PER = 0.35	TIMES FOR MAXIMA --	TD = 16.7700	TV = 16.6800	TA = 16.7700
PER = 0.36	TIMES FOR MAXIMA --	TD = 16.7800	TV = 16.6800	TA = 16.7800
PER = 0.37	TIMES FOR MAXIMA --	TD = 16.7900	TV = 16.6800	TA = 16.7900
PER = 0.38	TIMES FOR MAXIMA --	TD = 16.8000	TV = 16.9100	TA = 16.8000
PER = 0.39	TIMES FOR MAXIMA --	TD = 16.8200	TV = 16.9200	TA = 16.8100
PER = 0.40	TIMES FOR MAXIMA --	TD = 16.8300	TV = 16.9200	TA = 16.8300
PER = 0.41	TIMES FOR MAXIMA --	TD = 16.8400	TV = 16.9300	TA = 16.8400
PER = 0.42	TIMES FOR MAXIMA --	TD = 27.2100	TV = 27.3100	TA = 27.2000
PER = 0.43	TIMES FOR MAXIMA --	TD = 16.8600	TV = 27.3100	TA = 16.8500
PER = 0.44	TIMES FOR MAXIMA --	TD = 16.8700	TV = 16.9900	TA = 16.8600
PER = 0.45	TIMES FOR MAXIMA --	TD = 16.8800	TV = 16.9900	TA = 16.8800
PER = 0.46	TIMES FOR MAXIMA --	TD = 16.8900	TV = 16.7800	TA = 16.8900
PER = 0.47	TIMES FOR MAXIMA --	TD = 16.9000	TV = 16.7800	TA = 16.8900
PER = 0.48	TIMES FOR MAXIMA --	TD = 16.9100	TV = 16.8200	TA = 16.9000
PER = 0.49	TIMES FOR MAXIMA --	TD = 16.6900	TV = 16.6100	TA = 16.9100
PER = 0.50	TIMES FOR MAXIMA --	TD = 16.7000	TV = 16.6100	TA = 16.6900
PER = 0.51	TIMES FOR MAXIMA --	TD = 16.7100	TV = 16.6100	TA = 16.7000
PER = 0.52	TIMES FOR MAXIMA --	TD = 16.7300	TV = 16.6100	TA = 16.7200
PER = 0.53	TIMES FOR MAXIMA --	TD = 29.4900	TV = 16.6100	TA = 29.4800
PER = 0.54	TIMES FOR MAXIMA --	TD = 29.5100	TV = 16.6200	TA = 29.5000
PER = 0.55	TIMES FOR MAXIMA --	TD = 29.5300	TV = 29.1200	TA = 29.5200
PER = 0.56	TIMES FOR MAXIMA --	TD = 32.1700	TV = 29.4300	TA = 32.1600

PER = 0.57	TIMES FOR MAXIMA --	TD = 30.4900	TV = 30.6500	TA = 30.4800
PER = 0.58	TIMES FOR MAXIMA --	TD = 30.5200	TV = 30.6600	TA = 30.5100
PER = 0.60	TIMES FOR MAXIMA --	TD = 30.5600	TV = 30.4200	TA = 30.5500
PER = 0.62	TIMES FOR MAXIMA --	TD = 30.5900	TV = 30.4300	TA = 30.5800
PER = 0.64	TIMES FOR MAXIMA --	TD = 15.6700	TV = 16.6100	TA = 15.6600
PER = 0.66	TIMES FOR MAXIMA --	TD = 16.7500	TV = 16.6100	TA = 16.7400
PER = 0.68	TIMES FOR MAXIMA --	TD = 16.4800	TV = 16.6200	TA = 16.4700
PER = 0.70	TIMES FOR MAXIMA --	TD = 16.5100	TV = 16.6200	TA = 16.5000
PER = 0.72	TIMES FOR MAXIMA --	TD = 16.5300	TV = 16.4100	TA = 16.5200
PER = 0.74	TIMES FOR MAXIMA --	TD = 16.5400	TV = 16.4100	TA = 16.5300
PER = 0.76	TIMES FOR MAXIMA --	TD = 32.6800	TV = 16.4100	TA = 32.6700
PER = 0.78	TIMES FOR MAXIMA --	TD = 32.7100	TV = 16.4100	TA = 32.7000
PER = 0.80	TIMES FOR MAXIMA --	TD = 32.7400	TV = 16.4200	TA = 32.7200
PER = 0.82	TIMES FOR MAXIMA --	TD = 33.6100	TV = 16.4200	TA = 33.6000
PER = 0.84	TIMES FOR MAXIMA --	TD = 33.6600	TV = 16.4200	TA = 33.6400
PER = 0.86	TIMES FOR MAXIMA --	TD = 12.1700	TV = 16.4300	TA = 12.1600
PER = 0.88	TIMES FOR MAXIMA --	TD = 12.1900	TV = 12.3600	TA = 12.1800
PER = 0.90	TIMES FOR MAXIMA --	TD = 12.2000	TV = 12.3600	TA = 12.1800
PER = 0.92	TIMES FOR MAXIMA --	TD = 12.2000	TV = 12.3600	TA = 12.1900
PER = 0.94	TIMES FOR MAXIMA --	TD = 12.2100	TV = 12.3600	TA = 12.2000
PER = 0.96	TIMES FOR MAXIMA --	TD = 12.2200	TV = 12.3700	TA = 12.2000
PER = 0.98	TIMES FOR MAXIMA --	TD = 12.2500	TV = 12.4500	TA = 12.2300
PER = 1.00	TIMES FOR MAXIMA --	TD = 12.2600	TV = 16.1800	TA = 12.2500
PER = 1.05	TIMES FOR MAXIMA --	TD = 12.3000	TV = 13.1700	TA = 12.2800
PER = 1.10	TIMES FOR MAXIMA --	TD = 13.5000	TV = 13.2000	TA = 13.4900
PER = 1.15	TIMES FOR MAXIMA --	TD = 13.5400	TV = 13.8400	TA = 13.5100
PER = 1.20	TIMES FOR MAXIMA --	TD = 13.6200	TV = 13.4000	TA = 13.6000
PER = 1.25	TIMES FOR MAXIMA --	TD = 13.0900	TV = 13.4100	TA = 13.0700
PER = 1.30	TIMES FOR MAXIMA --	TD = 13.7800	TV = 13.4100	TA = 13.7600
PER = 1.35	TIMES FOR MAXIMA --	TD = 13.8100	TV = 13.4600	TA = 13.7800
PER = 1.40	TIMES FOR MAXIMA --	TD = 13.8200	TV = 13.4600	TA = 13.8000
PER = 1.45	TIMES FOR MAXIMA --	TD = 13.1900	TV = 13.4600	TA = 13.1500
PER = 1.50	TIMES FOR MAXIMA --	TD = 13.2300	TV = 13.5900	TA = 13.1900
PER = 1.55	TIMES FOR MAXIMA --	TD = 13.3200	TV = 12.9500	TA = 13.3000
PER = 1.60	TIMES FOR MAXIMA --	TD = 13.3500	TV = 12.9500	TA = 13.3400
PER = 1.65	TIMES FOR MAXIMA --	TD = 13.3700	TV = 13.0000	TA = 13.3400
PER = 1.70	TIMES FOR MAXIMA --	TD = 13.3800	TV = 13.0000	TA = 13.3500
PER = 1.75	TIMES FOR MAXIMA --	TD = 18.2300	TV = 18.5900	TA = 18.2100
PER = 1.80	TIMES FOR MAXIMA --	TD = 17.4300	TV = 17.8500	TA = 17.4000
PER = 1.85	TIMES FOR MAXIMA --	TD = 17.4700	TV = 17.9300	TA = 17.4400
PER = 1.90	TIMES FOR MAXIMA --	TD = 18.5100	TV = 17.9400	TA = 18.4800
PER = 1.95	TIMES FOR MAXIMA --	TD = 18.5300	TV = 17.9400	TA = 18.5100
PER = 2.00	TIMES FOR MAXIMA --	TD = 19.6300	TV = 20.1700	TA = 19.6100
PER = 2.05	TIMES FOR MAXIMA --	TD = 19.6600	TV = 20.1700	TA = 19.6200
PER = 2.10	TIMES FOR MAXIMA --	TD = 17.7000	TV = 19.3000	TA = 17.6800
PER = 2.15	TIMES FOR MAXIMA --	TD = 17.7500	TV = 17.3100	TA = 17.7100
PER = 2.20	TIMES FOR MAXIMA --	TD = 17.7800	TV = 17.3100	TA = 17.7500
PER = 2.25	TIMES FOR MAXIMA --	TD = 19.0300	TV = 17.3200	TA = 18.9800
PER = 2.30	TIMES FOR MAXIMA --	TD = 19.0600	TV = 16.2700	TA = 19.0300
PER = 2.35	TIMES FOR MAXIMA --	TD = 17.0200	TV = 16.6100	TA = 17.0000
PER = 2.40	TIMES FOR MAXIMA --	TD = 16.0500	TV = 16.6100	TA = 15.9800
PER = 2.50	TIMES FOR MAXIMA --	TD = 12.8600	TV = 12.4900	TA = 12.8400
PER = 2.60	TIMES FOR MAXIMA --	TD = 12.0000	TV = 12.4900	TA = 11.9500
PER = 2.70	TIMES FOR MAXIMA --	TD = 12.0800	TV = 12.5000	TA = 12.0100
PER = 2.80	TIMES FOR MAXIMA --	TD = 17.0500	TV = 11.7800	TA = 17.0400
PER = 2.90	TIMES FOR MAXIMA --	TD = 17.1000	TV = 16.6100	TA = 17.0500
PER = 3.00	TIMES FOR MAXIMA --	TD = 16.0600	TV = 16.6100	TA = 15.9800
PER = 3.10	TIMES FOR MAXIMA --	TD = 16.0800	TV = 16.6100	TA = 16.0500
PER = 3.20	TIMES FOR MAXIMA --	TD = 16.1000	TV = 16.6200	TA = 16.0600
PER = 3.30	TIMES FOR MAXIMA --	TD = 16.1100	TV = 16.6200	TA = 16.0600
PER = 3.40	TIMES FOR MAXIMA --	TD = 16.1200	TV = 15.7000	TA = 16.0600

PER = 3.50 TIMES FOR MAXIMA -- TD = 45.5300 TV = 16.6200 TA = 45.4900
PER = 3.60 TIMES FOR MAXIMA -- TD = 45.6800 TV = 16.6200 TA = 45.6000
PER = 3.70 TIMES FOR MAXIMA -- TD = 44.1900 TV = 16.6200 TA = 44.1600
PER = 3.80 TIMES FOR MAXIMA -- TD = 44.3200 TV = 16.6200 TA = 44.2900
PER = 3.90 TIMES FOR MAXIMA -- TD = 44.3600 TV = 16.6200 TA = 44.3200
PER = 4.00 TIMES FOR MAXIMA -- TD = 44.5500 TV = 15.8300 TA = 44.4500
PER = 4.10 TIMES FOR MAXIMA -- TD = 44.5800 TV = 15.8300 TA = 14.8100
PER = 4.20 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 4.30 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 4.40 TIMES FOR MAXIMA -- TD = 14.8600 TV = 15.8300 TA = 14.8100
PER = 4.50 TIMES FOR MAXIMA -- TD = 14.8600 TV = 15.8300 TA = 14.8200
PER = 4.60 TIMES FOR MAXIMA -- TD = 14.9400 TV = 15.8300 TA = 14.8200
PER = 4.70 TIMES FOR MAXIMA -- TD = 32.0400 TV = 15.8300 TA = 14.8200
PER = 4.80 TIMES FOR MAXIMA -- TD = 32.0600 TV = 15.8300 TA = 32.0200
PER = 4.90 TIMES FOR MAXIMA -- TD = 32.0700 TV = 15.8300 TA = 32.0200
PER = 5.00 TIMES FOR MAXIMA -- TD = 32.1300 TV = 15.8300 TA = 32.0200
PER = 5.10 TIMES FOR MAXIMA -- TD = 28.0300 TV = 15.8300 TA = 28.0000
PER = 5.20 TIMES FOR MAXIMA -- TD = 28.0300 TV = 15.8300 TA = 28.0000
PER = 5.40 TIMES FOR MAXIMA -- TD = 9.7900 TV = 11.2400 TA = 28.0000
PER = 5.60 TIMES FOR MAXIMA -- TD = 9.7900 TV = 11.2400 TA = 9.7500
PER = 5.80 TIMES FOR MAXIMA -- TD = 9.8200 TV = 15.8300 TA = 9.7500
PER = 6.00 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 6.20 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 6.40 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 6.60 TIMES FOR MAXIMA -- TD = 14.8600 TV = 15.8300 TA = 14.8100
PER = 6.80 TIMES FOR MAXIMA -- TD = 14.8600 TV = 15.8300 TA = 14.8100
PER = 7.00 TIMES FOR MAXIMA -- TD = 14.9800 TV = 12.5000 TA = 14.8100
PER = 7.30 TIMES FOR MAXIMA -- TD = 15.3900 TV = 17.3200 TA = 14.8100
PER = 7.60 TIMES FOR MAXIMA -- TD = 15.4000 TV = 17.3200 TA = 15.3100
PER = 8.00 TIMES FOR MAXIMA -- TD = 15.4900 TV = 17.3200 TA = 15.3700
PER = 8.50 TIMES FOR MAXIMA -- TD = 15.5300 TV = 14.6000 TA = 15.4700
PER = 9.00 TIMES FOR MAXIMA -- TD = 16.8100 TV = 14.6000 TA = 16.6200
PER = 9.50 TIMES FOR MAXIMA -- TD = 17.0600 TV = 14.6000 TA = 16.7400
PER =10.00 TIMES FOR MAXIMA -- TD = 17.1500 TV = 14.6000 TA = 17.0400

SPECTRAL VALUES--
(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00005	0.00137	0.02954	0.57869	0.57636	100.00
2	0.02	0.00019	0.03246	0.05874	0.57851	0.57313	50.00
3	0.03	0.00084	0.16225	0.17610	1.10556	1.14542	33.33
4	0.04	0.00190	0.26915	0.29880	1.48423	1.45761	25.00
5	0.05	0.00342	0.38292	0.43034	1.68897	1.67944	20.00
6	0.06	0.00440	0.46805	0.46042	1.55729	1.49736	16.67
7	0.07	0.00583	0.52196	0.52342	1.45432	1.45906	14.29
8	0.08	0.00756	0.58863	0.59363	1.49438	1.44794	12.50
9	0.09	0.00981	0.68527	0.68468	1.49214	1.48446	11.11
10	0.10	0.01133	0.67832	0.72473	1.39533	1.41416	10.00
11	0.11	0.01476	0.77760	0.84282	1.51649	1.49509	9.09
12	0.12	0.01629	0.83139	0.85295	1.40540	1.38697	8.33
13	0.13	0.01684	0.79261	0.81412	1.22022	1.22200	7.69
14	0.14	0.01815	0.79492	0.81472	1.12382	1.13554	7.14
15	0.15	0.01917	0.78885	0.80311	1.04837	1.04474	6.67
16	0.16	0.02264	0.87808	0.88913	1.08719	1.08435	6.25
17	0.17	0.02615	0.95564	0.96640	1.11464	1.10926	5.88
18	0.18	0.03507	1.12475	1.22425	1.32698	1.32716	5.56
19	0.19	0.03470	1.15550	1.14761	1.17936	1.17860	5.26
20	0.20	0.03549	1.24968	1.11510	1.08628	1.08794	5.00
21	0.21	0.03665	1.13296	1.09655	1.02129	1.01890	4.76
22	0.22	0.04047	1.20959	1.15594	1.03249	1.02527	4.55
23	0.23	0.04161	1.16229	1.13658	0.97652	0.96427	4.35

24	0.24	0.04975	1.29290	1.30247	1.06242	1.05896	4.17
25	0.25	0.06040	1.56475	1.51813	1.19290	1.18493	4.00
26	0.26	0.06309	1.61978	1.52473	1.14568	1.14431	3.85
27	0.27	0.05277	1.29989	1.22801	0.89238	0.88749	3.70
28	0.28	0.05245	1.28803	1.17691	0.82117	0.82018	3.57
29	0.29	0.05858	1.42125	1.26924	0.85688	0.85402	3.45
30	0.30	0.06833	1.51338	1.43100	0.93704	0.93077	3.33
31	0.31	0.07664	1.71775	1.55334	0.97975	0.97775	3.23
32	0.32	0.07644	1.62581	1.50080	0.92328	0.91516	3.13
33	0.33	0.07036	1.46608	1.33963	0.79885	0.79213	3.03
34	0.34	0.06555	1.29567	1.21135	0.69574	0.69521	2.94
35	0.35	0.06914	1.36883	1.24114	0.69509	0.69195	2.86
36	0.36	0.07611	1.43229	1.32829	0.72534	0.71997	2.78
37	0.37	0.08321	1.46923	1.41300	0.74916	0.74518	2.70
38	0.38	0.09015	1.54982	1.49059	0.76953	0.76542	2.63
39	0.39	0.09619	1.64563	1.54976	0.77692	0.77539	2.56
40	0.40	0.10071	1.66299	1.58202	0.77619	0.77175	2.50
41	0.41	0.10438	1.61478	1.59959	0.76625	0.76129	2.44
42	0.42	0.10761	1.63710	1.60983	0.75221	0.74792	2.38
43	0.43	0.11229	1.61004	1.64084	0.74872	0.74460	2.33
44	0.44	0.12294	1.71041	1.75551	0.78269	0.77853	2.27
45	0.45	0.12786	1.77832	1.78529	0.77785	0.77414	2.22
46	0.46	0.12471	1.71825	1.70342	0.72783	0.72258	2.17
47	0.47	0.12287	1.65704	1.64265	0.68560	0.68198	2.13
48	0.48	0.12350	1.63243	1.61656	0.66244	0.65717	2.08
49	0.49	0.12258	1.70238	1.57185	0.63005	0.62595	2.04
50	0.50	0.12409	1.78871	1.55941	0.61130	0.60858	2.00
51	0.51	0.12464	1.86376	1.53559	0.59053	0.58753	1.96
52	0.52	0.11959	1.85372	1.44501	0.54442	0.54224	1.92
53	0.53	0.11048	1.70483	1.30978	0.48598	0.48222	1.89
54	0.54	0.11235	1.47125	1.30726	0.47394	0.47238	1.85
55	0.55	0.11423	1.38020	1.30494	0.46612	0.46297	1.82
56	0.56	0.12991	1.43053	1.45756	0.51070	0.50788	1.79
57	0.57	0.14552	1.58598	1.60414	0.55167	0.54915	1.75
58	0.58	0.16090	1.75597	1.74305	0.58929	0.58642	1.72
59	0.60	0.16552	1.90732	1.73336	0.56612	0.56372	1.67
60	0.62	0.14914	1.71916	1.51142	0.47783	0.47568	1.61
61	0.64	0.13615	1.46806	1.33669	0.40996	0.40754	1.56
62	0.66	0.14161	1.75359	1.34813	0.40145	0.39858	1.52
63	0.68	0.15367	1.85258	1.41993	0.41058	0.40746	1.47
64	0.70	0.16446	1.75202	1.47616	0.41334	0.41149	1.43
65	0.72	0.16040	1.64248	1.39978	0.38212	0.37936	1.39
66	0.74	0.14915	1.61251	1.26642	0.33597	0.33394	1.35
67	0.76	0.16057	1.57224	1.32750	0.34338	0.34084	1.32
68	0.78	0.17913	1.59266	1.44299	0.36327	0.36099	1.28
69	0.80	0.18584	1.69089	1.45956	0.35775	0.35600	1.25
70	0.82	0.19547	1.83473	1.49779	0.35886	0.35642	1.22
71	0.84	0.19510	1.85877	1.45935	0.34022	0.33900	1.19
72	0.86	0.19321	1.71122	1.41159	0.32171	0.32028	1.16
73	0.88	0.20256	1.67547	1.44626	0.32247	0.32069	1.14
74	0.90	0.20867	1.64417	1.45683	0.31757	0.31586	1.11
75	0.92	0.22540	1.68543	1.53941	0.32824	0.32651	1.09
76	0.94	0.25264	1.75116	1.68869	0.35247	0.35055	1.06
77	0.96	0.27876	1.75505	1.82446	0.37302	0.37084	1.04
78	0.98	0.29797	1.72103	1.91040	0.38186	0.38038	1.02
79	1.00	0.31142	1.70665	1.95673	0.38400	0.38182	1.00
80	1.05	0.33056	1.86700	1.97809	0.37049	0.36760	0.95
81	1.10	0.34010	1.98275	1.94264	0.34638	0.34461	0.91
82	1.15	0.38232	2.18670	2.08887	0.35752	0.35444	0.87
83	1.20	0.43710	2.43040	2.28867	0.37540	0.37216	0.83
84	1.25	0.41217	2.48596	2.07178	0.32532	0.32341	0.80

85	1.30	0.35374	2.07796	1.70971	0.25849	0.25663	0.77
86	1.35	0.31529	1.82241	1.46742	0.21360	0.21210	0.74
87	1.40	0.30429	1.71927	1.36566	0.19212	0.19034	0.71
88	1.45	0.30631	1.66137	1.32732	0.18009	0.17862	0.69
89	1.50	0.31859	1.66658	1.33450	0.17445	0.17360	0.67
90	1.55	0.33532	1.63453	1.35927	0.17193	0.17112	0.65
91	1.60	0.33890	1.61066	1.33085	0.16392	0.16231	0.63
92	1.65	0.31778	1.50173	1.21009	0.14561	0.14311	0.61
93	1.70	0.28140	1.35995	1.04004	0.12177	0.11938	0.59
94	1.75	0.30802	1.33546	1.10590	0.12463	0.12331	0.57
95	1.80	0.35605	1.46700	1.24285	0.13603	0.13473	0.56
96	1.85	0.38459	1.54226	1.30617	0.13881	0.13777	0.54
97	1.90	0.41120	1.54079	1.35982	0.14101	0.13965	0.53
98	1.95	0.42776	1.50608	1.37831	0.13955	0.13792	0.51
99	2.00	0.45877	1.58228	1.44128	0.14253	0.14062	0.50
100	2.05	0.49417	1.68678	1.51462	0.14614	0.14417	0.49
101	2.10	0.54015	1.79415	1.61614	0.15074	0.15017	0.48
102	2.15	0.58631	1.97185	1.71343	0.15668	0.15551	0.47
103	2.20	0.59876	2.08291	1.71005	0.15348	0.15167	0.45
104	2.25	0.59010	2.04481	1.64786	0.14423	0.14291	0.44
105	2.30	0.54691	1.88205	1.49406	0.12852	0.12675	0.43
106	2.35	0.50389	1.76316	1.34725	0.11256	0.11187	0.43
107	2.40	0.45720	1.68962	1.19696	0.09891	0.09732	0.42
108	2.50	0.39717	1.45197	0.99821	0.07839	0.07791	0.40
109	2.60	0.42222	1.44539	1.02035	0.07780	0.07658	0.38
110	2.70	0.41356	1.27860	0.96239	0.07028	0.06955	0.37
111	2.80	0.37799	1.27516	0.84821	0.05970	0.05911	0.36
112	2.90	0.42097	1.45197	0.91208	0.06234	0.06137	0.34
113	3.00	0.44342	1.50548	0.92870	0.06150	0.06041	0.33
114	3.10	0.45766	1.42670	0.92760	0.05970	0.05839	0.32
115	3.20	0.42651	1.27704	0.83745	0.05273	0.05107	0.31
116	3.30	0.37342	1.12135	0.71100	0.04371	0.04204	0.30
117	3.40	0.32021	1.01441	0.59175	0.03557	0.03396	0.29
118	3.50	0.33969	0.94441	0.60981	0.03443	0.03400	0.29
119	3.60	0.38484	0.92642	0.67168	0.03683	0.03641	0.28
120	3.70	0.39485	0.92955	0.67051	0.03594	0.03536	0.27
121	3.80	0.40968	0.93190	0.67740	0.03518	0.03478	0.26
122	3.90	0.38228	0.91874	0.61588	0.03143	0.03081	0.26
123	4.00	0.34203	0.92697	0.53726	0.02642	0.02621	0.25
124	4.10	0.30825	0.96203	0.47239	0.02341	0.02248	0.24
125	4.20	0.32556	0.98725	0.48703	0.02406	0.02263	0.24
126	4.30	0.34146	0.99738	0.49894	0.02413	0.02264	0.23
127	4.40	0.34807	0.99104	0.49705	0.02358	0.02204	0.23
128	4.50	0.34534	0.97000	0.48218	0.02249	0.02091	0.22
129	4.60	0.33556	0.93804	0.45834	0.02099	0.01944	0.22
130	4.70	0.33170	0.89990	0.44343	0.01925	0.01841	0.21
131	4.80	0.34522	0.86035	0.45189	0.01886	0.01837	0.21
132	4.90	0.33190	0.82347	0.42559	0.01758	0.01695	0.20
133	5.00	0.30064	0.79241	0.37780	0.01543	0.01474	0.20
134	5.10	0.28033	0.76907	0.34537	0.01383	0.01321	0.20
135	5.20	0.27769	0.75443	0.33554	0.01330	0.01259	0.19
136	5.40	0.27310	0.77836	0.31776	0.01207	0.01148	0.19
137	5.60	0.29401	0.79628	0.32988	0.01202	0.01149	0.18
138	5.80	0.30778	0.80794	0.33342	0.01178	0.01122	0.17
139	6.00	0.32463	0.84580	0.33995	0.01222	0.01106	0.17
140	6.20	0.37930	0.87676	0.38439	0.01325	0.01210	0.16
141	6.40	0.43335	0.89546	0.42544	0.01413	0.01297	0.16
142	6.60	0.48253	0.89989	0.45937	0.01477	0.01358	0.15
143	6.80	0.52393	0.89041	0.48411	0.01512	0.01389	0.15
144	7.00	0.55920	0.87529	0.50194	0.01518	0.01399	0.14
145	7.30	0.62005	0.88042	0.53368	0.01482	0.01427	0.14

146	7.60	0.66716	0.90825	0.55156	0.01449	0.01416	0.13
147	8.00	0.70847	0.90727	0.55643	0.01389	0.01357	0.13
148	8.50	0.72253	0.93252	0.53409	0.01272	0.01226	0.12
149	9.00	0.72748	0.96895	0.50788	0.01163	0.01101	0.11
150	9.50	0.81580	0.98875	0.53956	0.01146	0.01108	0.11
151	10.00	0.88090	0.99633	0.55349	0.01116	0.01080	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.

AREA OF ACC. RESPONSE SPECTRUM = 0.859

AREA OF VEL. RESPONSE SPECTRUM = 4.045

MAX. ACCELERATION RESPONSE VALUE = 1.516

MAX. VELOCITY RESPONSE VALUE = 2.486

*** End of Output File No. 1 ***

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy – Pond Creek South Cell Deformation Evaluation PROJECT NO. 072046

Induced Cyclic Shear Stresses and Strains, and Time Histories PAGE 142 OF 187

of Cyclic Shear Stress - SHAKE PCSC300E and PCSC300M

MADE BY BEG DATE 1/7/08 CHECKED BY [signature] DATE 1/23/08

SUMMARY OF EARTHQUAKE INDUCED CYCLIC SHEAR STRESS AND STRAIN SHAKE2000 ANALYSES OUTPUT FILES FOR M8.0 NEW MADRID, MO MDE AT 83 KM SHAKE2000 COLUMN PCSC300M

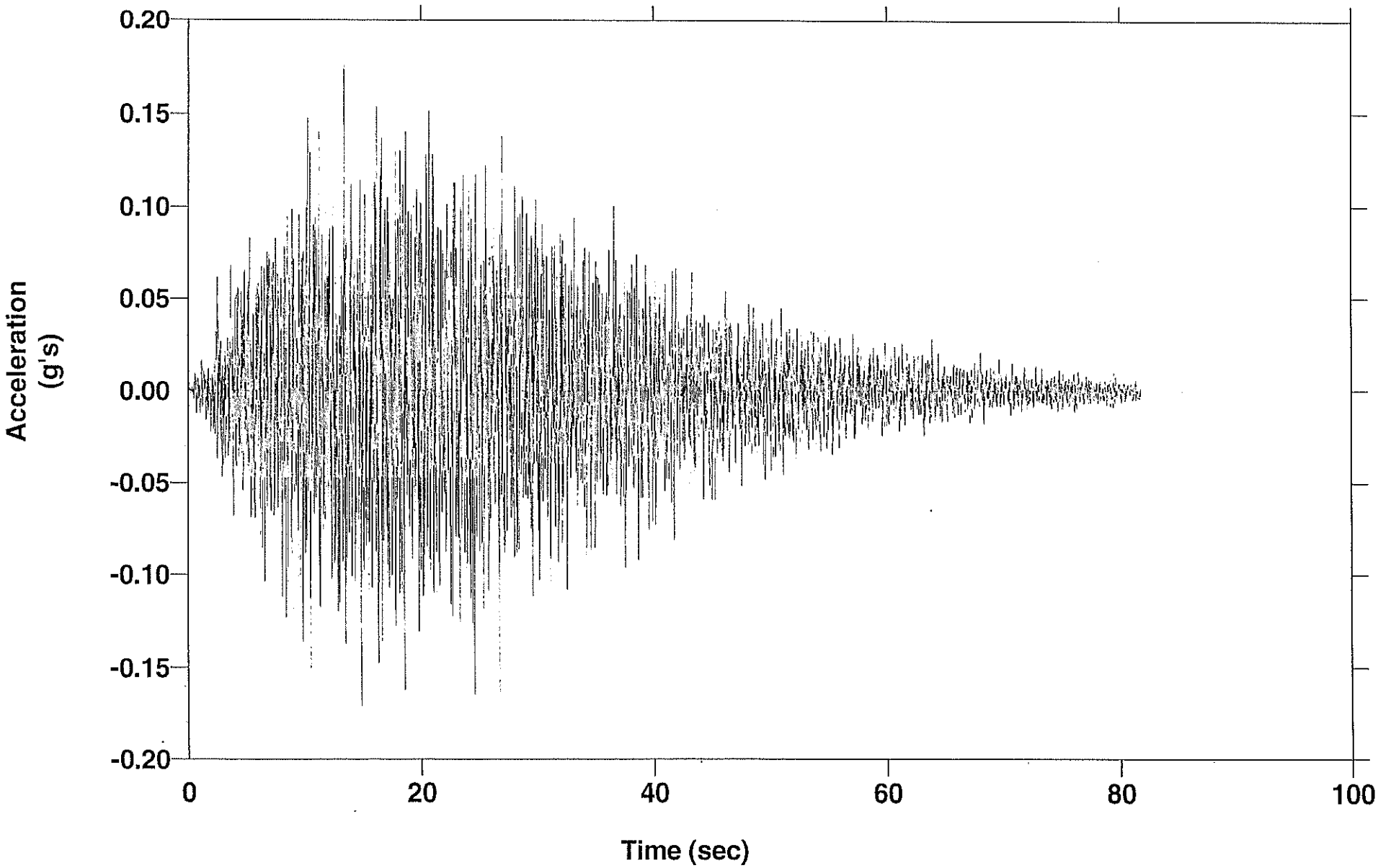
PCSC300M Crest Column
Williamson - Pond Creek South Cell - Surf. El. 502, GWT 14ft., Fines El. 496
M8.0 New Madrid Synthetic @83km, PGA=0.54g - Atkinson & Boore (1995)

Layer	Depth to Middle of Layer (ft)	Total Unit Weight (kcf)	Damping Used (%)	Shear Modulus (ksf)	Maximum Shear Strain (%)	Maximum Shear Stress (psf)	Shear Wave Velocity (fps)	Depth to Top of Layer (ft)	Peak Acceleration (g)	G/Gmax Curve	Damping Curve
1	2	.13	2.6	3011.9	.00656	197.47	863.7271	0	.75475	Coarse	Coarse
2	5.5	.13	4.4	2764.1	.019	525.07	827.4336	4	.70138	Coarse	Coarse
3	8.5	.13	5.3	2634.9	.02891	761.69	807.8641	7	.65623	Coarse	Coarse
4	11.5	.13	5.1	3768.3	.02654	1000	966.1154	10	.63991	Coarse	Coarse
5	14.5	.14	6.5	2764.2	.04445	1228.7	797.3494	13	.65636	Coarse	Coarse
6	17.5	.14	7.8	2154.6	.06592	1420.3	703.9588	16	.64637	Coarse	Coarse
7	20.5	.14	8.2	2228.9	.07416	1653.05	715.9937	19	.59333	Coarse	Coarse
8	23.5	.14	9.700001	1617.7	.11434	1849.71	609.9762	22	.57039	Coarse	Coarse
9	26.5	.14	9.5	1841.1	.10723	1974.16	650.7327	25	.55506	Coarse	Coarse
10	30	.14	9.6	1848.3	.11091	2050.01	652.0038	28	.59901	Coarse	Coarse
11	33.5	.135	10.7	1056.3	.19765	2087.75	501.9433	32	.6765	Residual	Residual
12	36.5	.135	11.3	998.5	.22343	2230.89	488.0172	35	.64739	Residual	Residual
13	39.5	.135	10.7	1207	.19636	2370.16	536.5555	38	.71677	Residual	Residual
14	42.5	.135	8.7	1853.6	.12973	2404.61	664.9195	41	.59839	Residual	Residual
15	45.5	.135	5.3	4401	.05567	2449.9	1024.558	44	.52211	Residual	Residual
16	48.5	.135	5.4	4313.4	.05803	2503.04	1014.31	47	.51594	Residual	Residual
17	Base							50	.52906		
17	Outcrop							50	.57825		

Notes:
Period for Soil Column: .27 sec
Average Shear Wave Velocity for Soil Column: 740 ft/sec

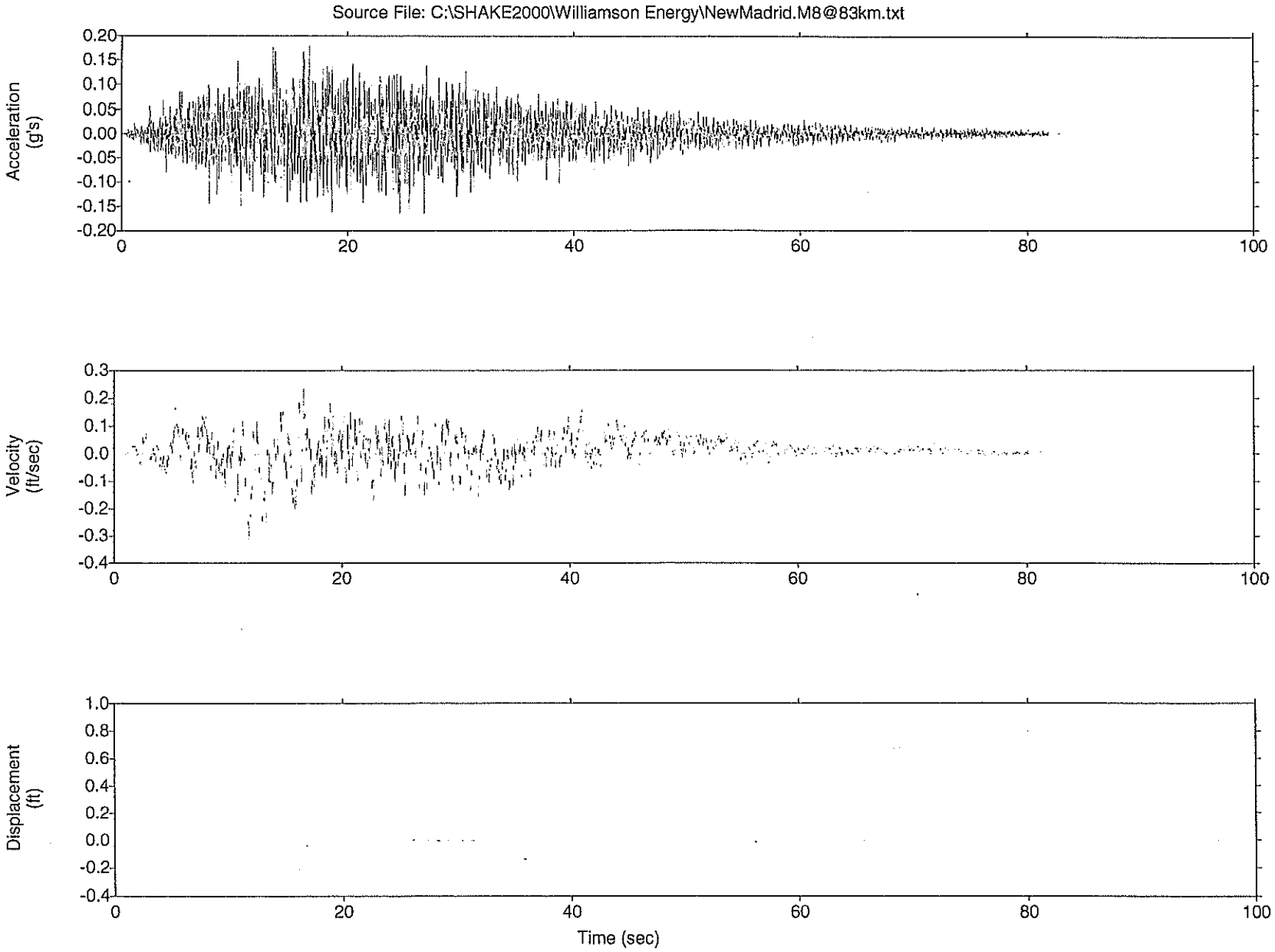
143 of 187
R16189

M8.0 New Madrid Synthetic @83km - Atkinson & Boore (1995)

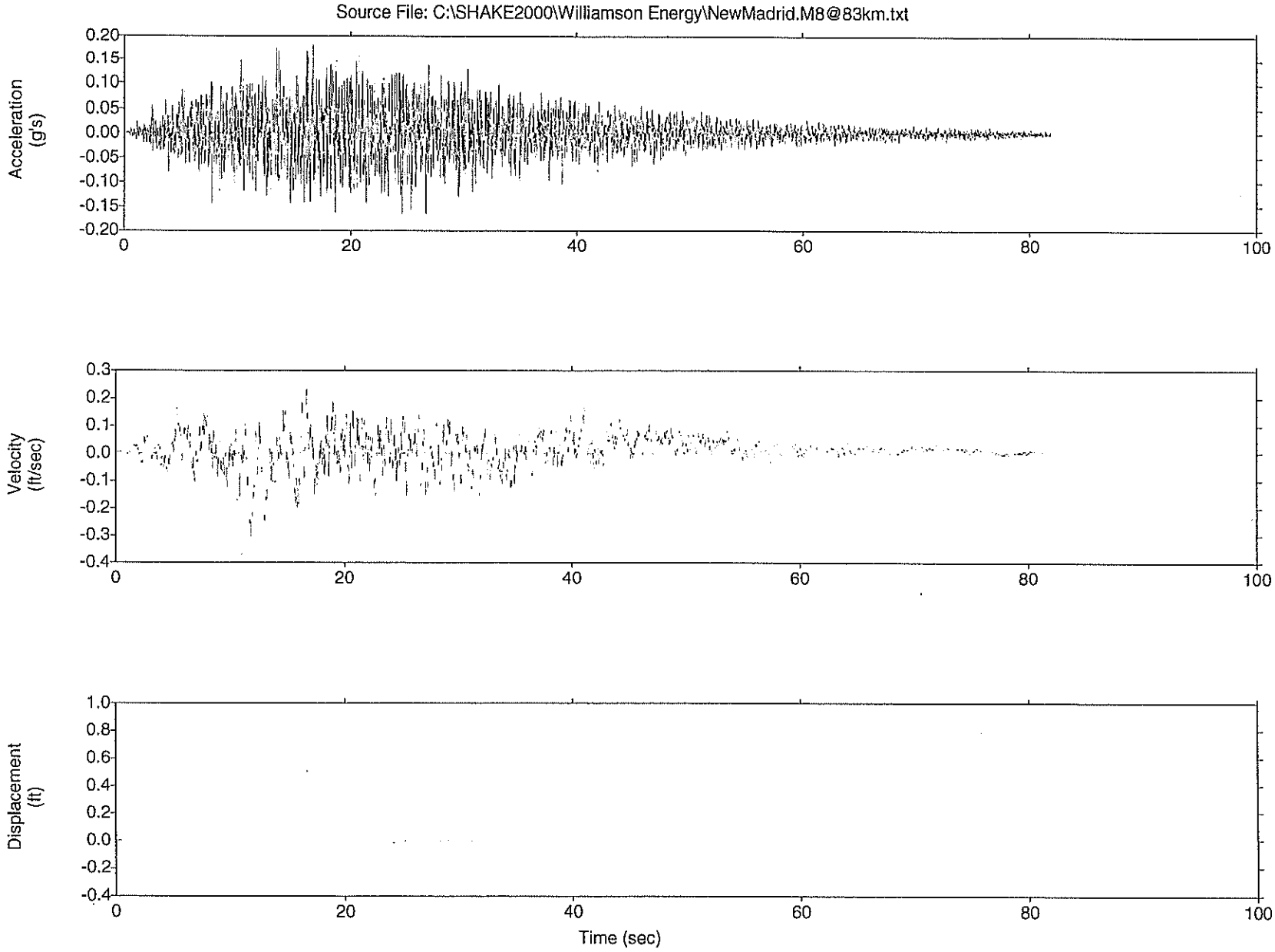


144 of 187

R16190.

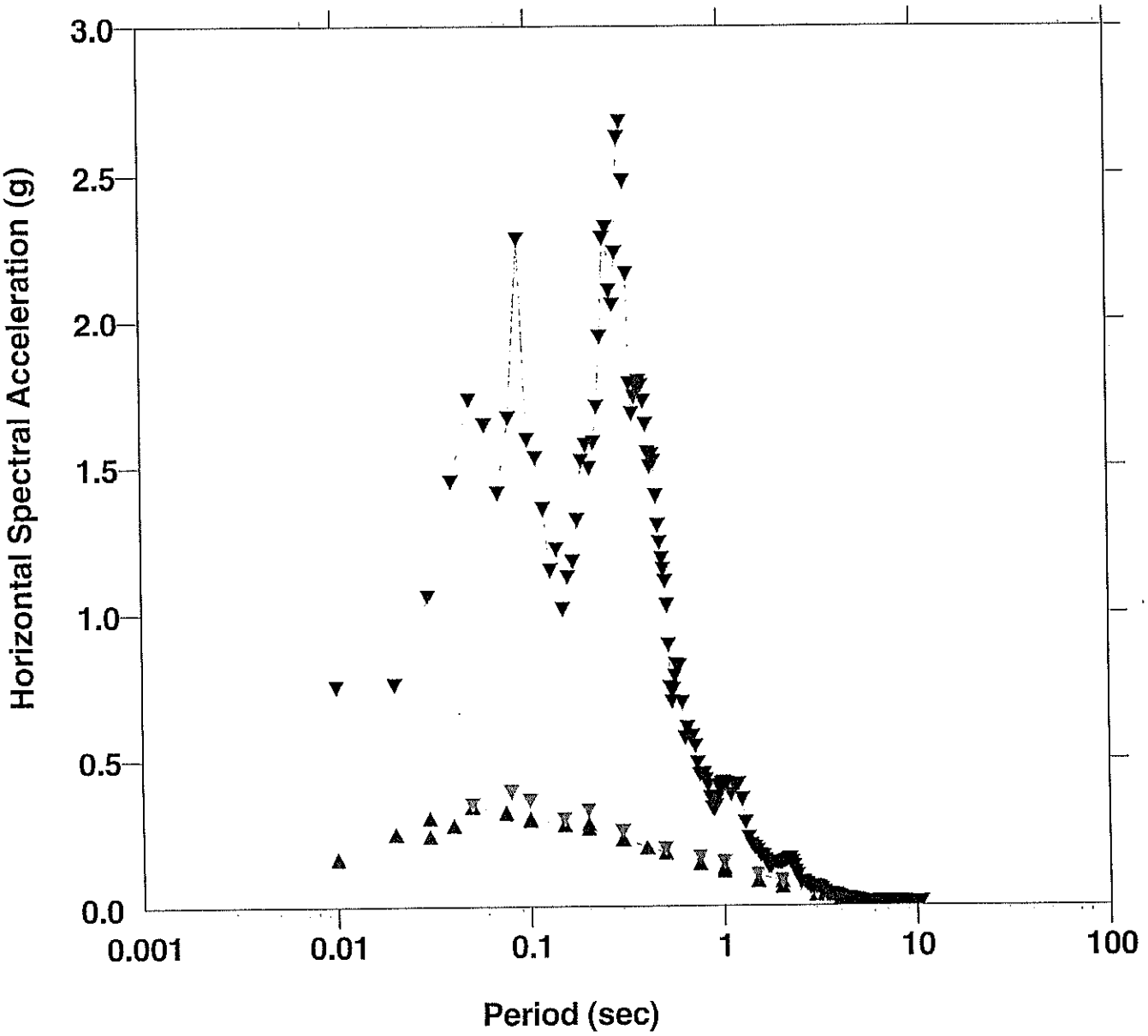

Source File: C:\SHAKE2000\Williamson Energy\NewMadrid.M8@83km.txt
Acceleration (g's)
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
0
20
40
60
80
100
Velocity (ft/sec)
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
Displacement (ft)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
Time (sec)

R16191


Source File: C:\SHAKE2000\Williamson Energy\NewMadrid.M8@83km.txt
Acceleration (g's)
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
0
20
40
60
80
100
Velocity (ft/sec)
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
20
40
60
80
100
Displacement (ft)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
0
20
40
60
80
100
Time (sec)

R16192

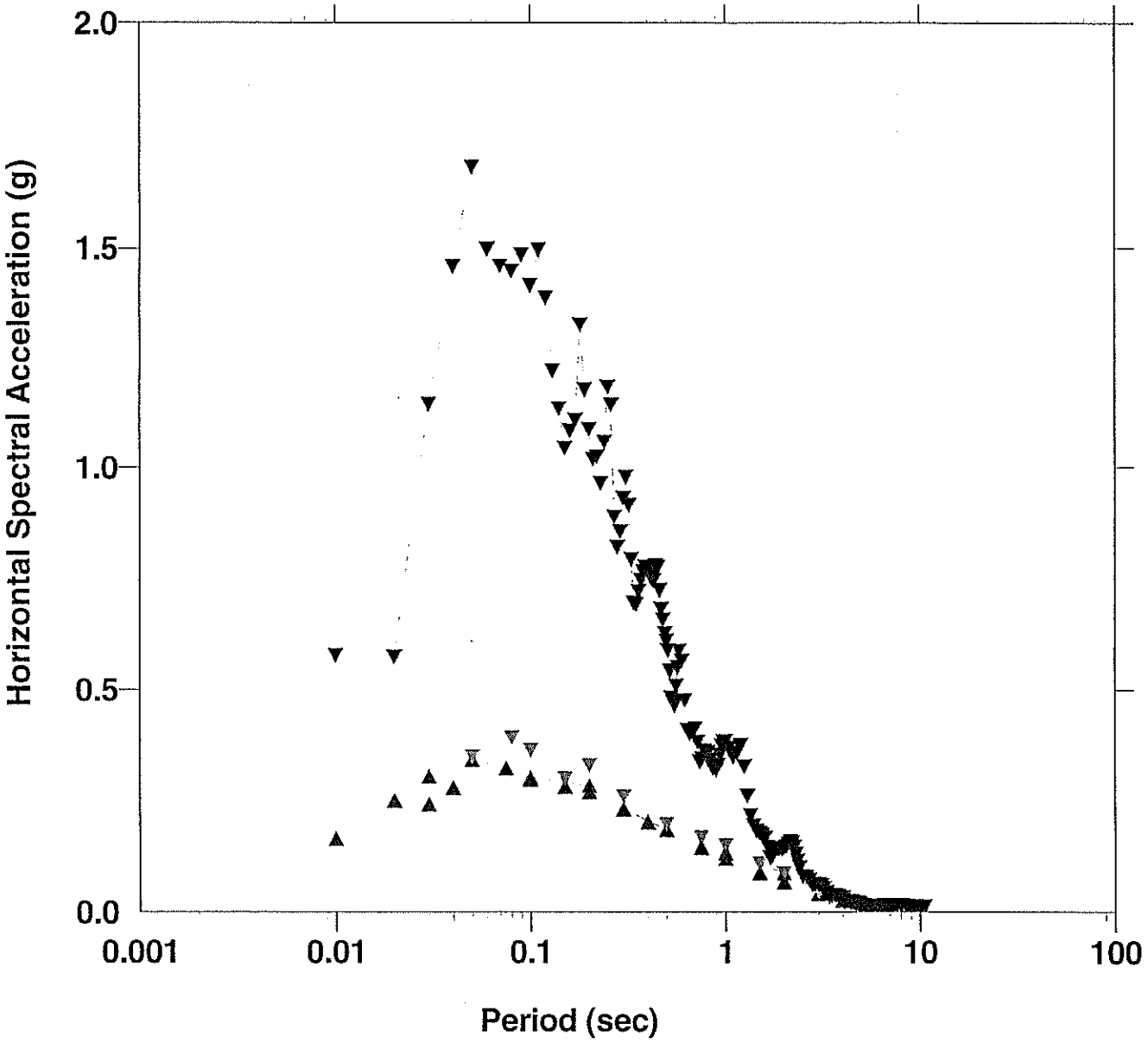
PSCS300M Crest Column - M8.0 New Madrid Synthetic @83km



- ▲ Toro et. al. (1997) for Mid-Continent of NA - Rock - Mw: 8 - R: 83 km
- ▲ Campbell for CEUS (2003) - M: 8 - R: 83 km
- ▼ Tavakoli & Pezeshk (2005) - ENA - Rock - M: 8 - R: 83 km
- ▼ PSA for 5% damping - Layer 1 - SHAKE

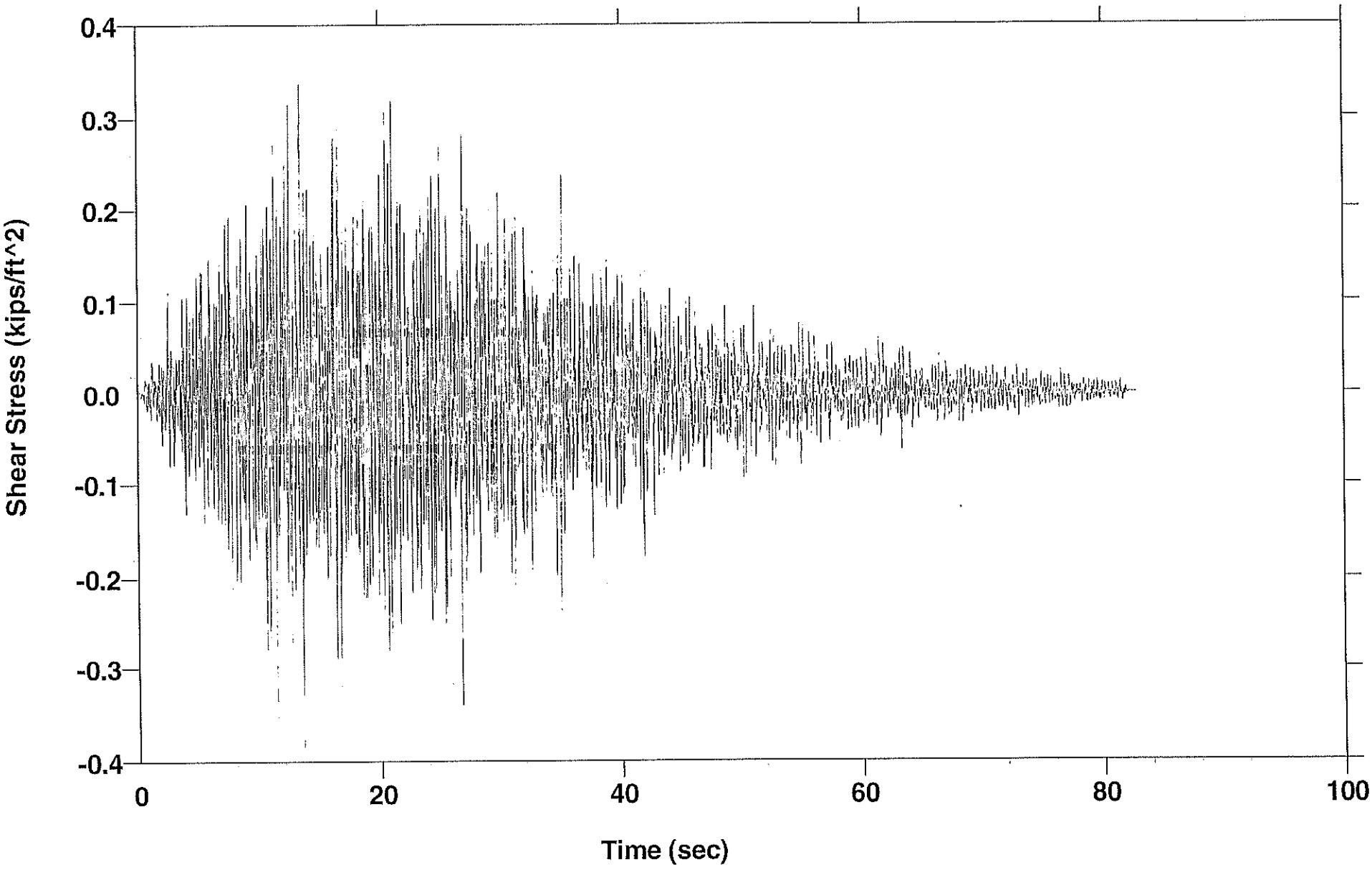
R16193

PSCS300M Crest Column - M8.0 New Madrid Synthetic @83km

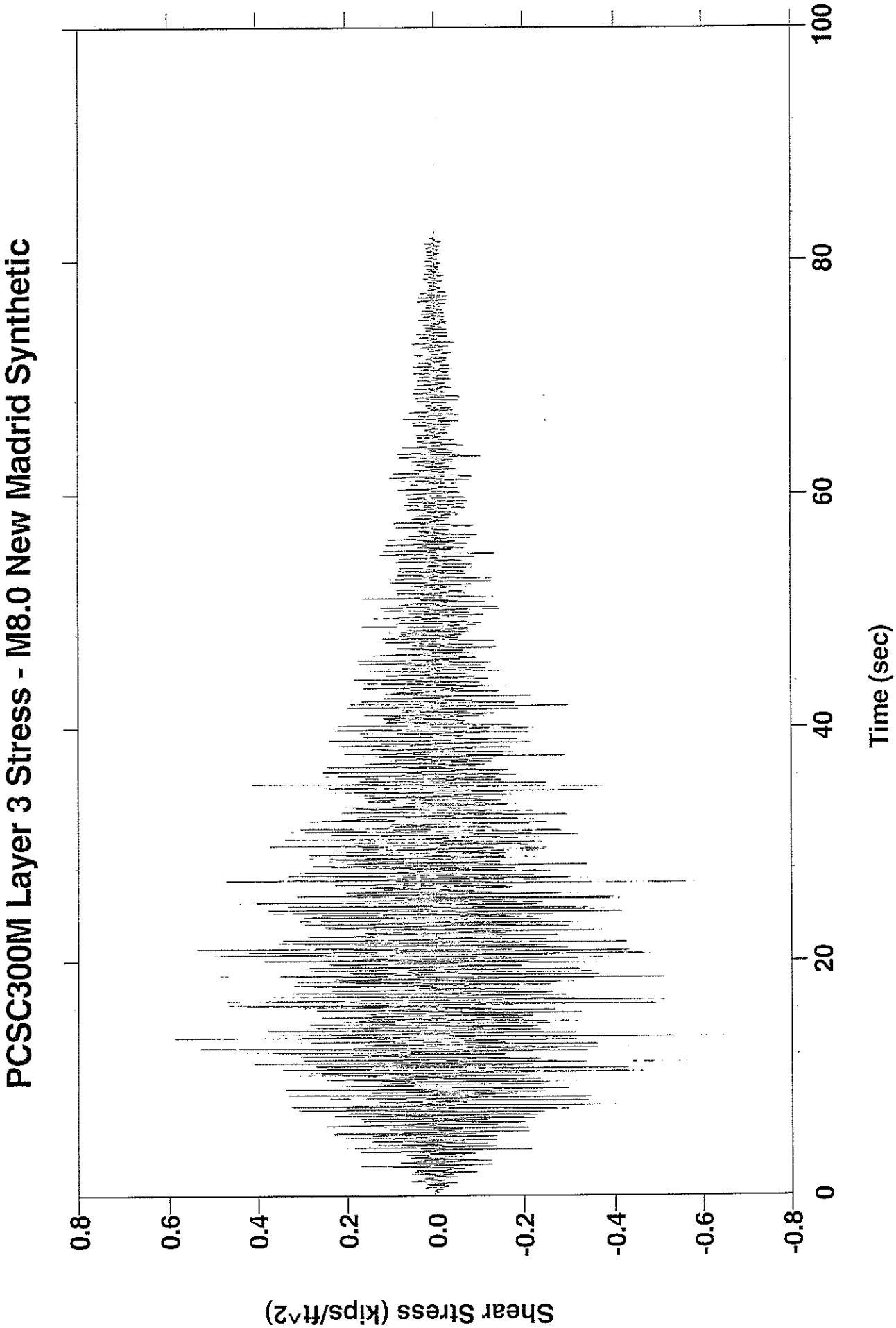


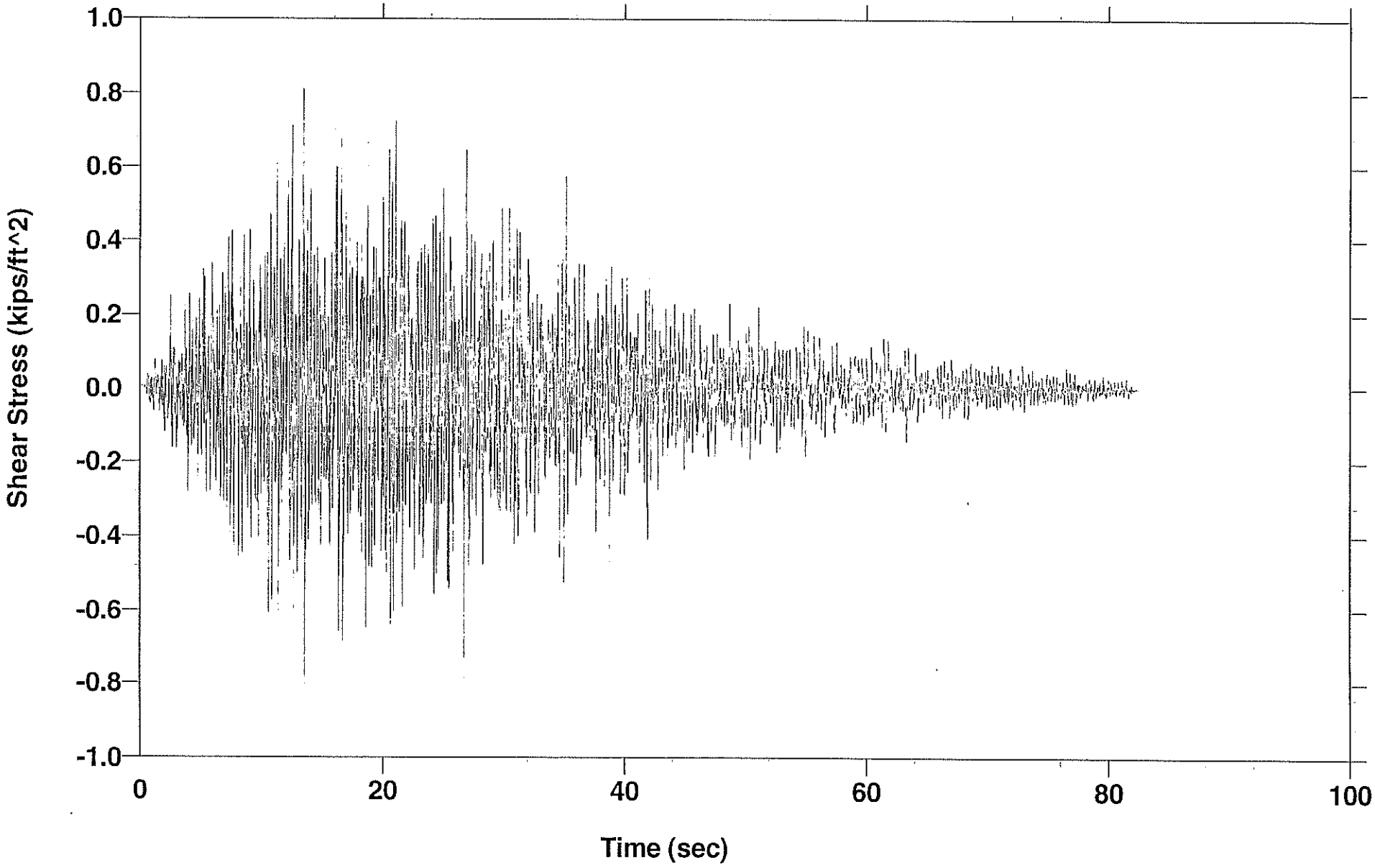
- ▲ Toro et. al. (1997) for Mid-Continent of NA - Rock - Mw: 8 - R: 83 km
- ▲ Campbell for CEUS (2003) - M: 8 - R: 83 km
- ▼ Tavakoli & Pezeshk (2005) - ENA - Rock - M: 8 - R: 83 km
- ▼ PSA for 5% damping - Layer 17 - SHAKE

R16194

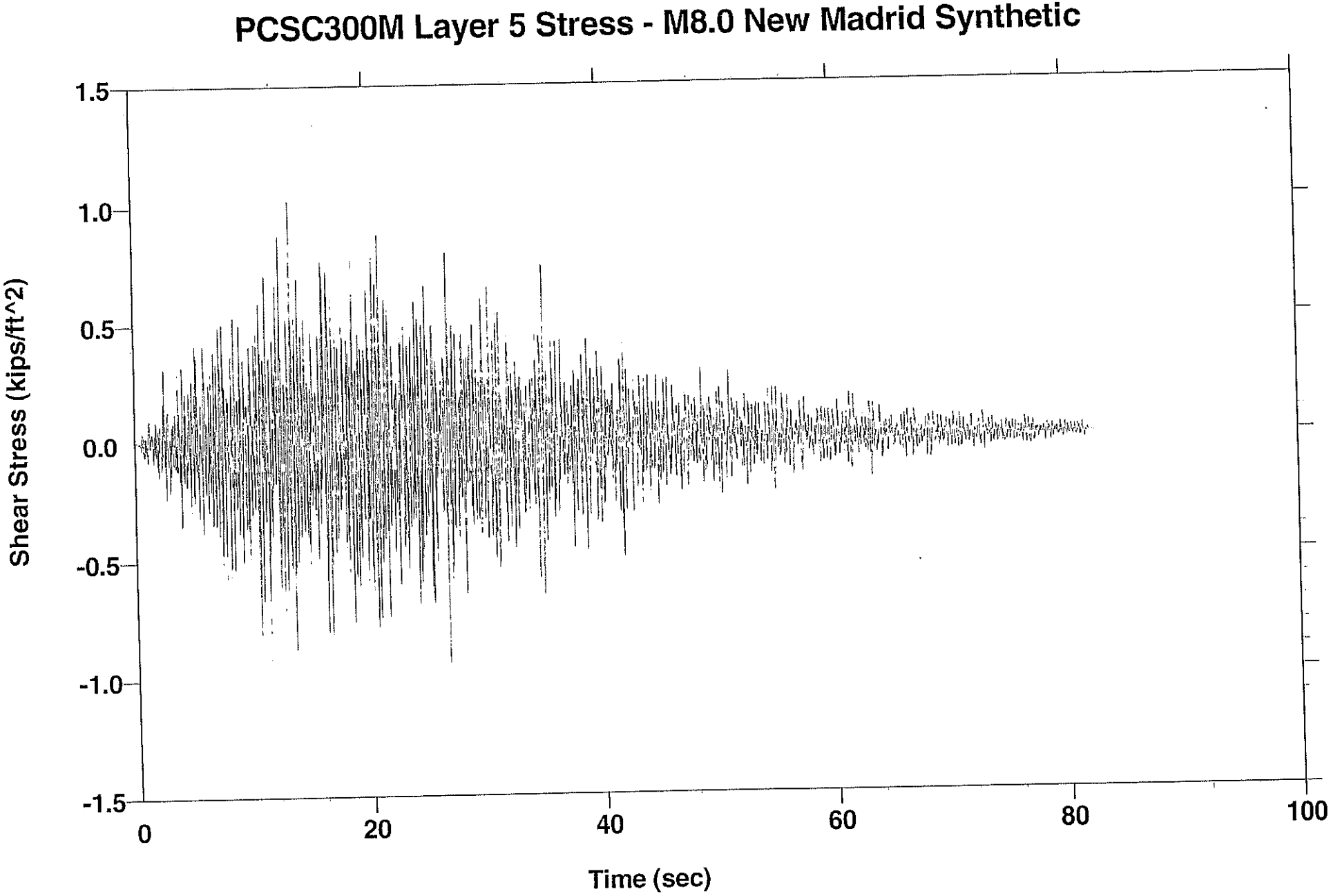

PCSC300M Layer 2 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
20
40
60
80
100
Time (sec)

R16195


PCSC300M Layer 3 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0
20
40
60
80
100
Time (sec)

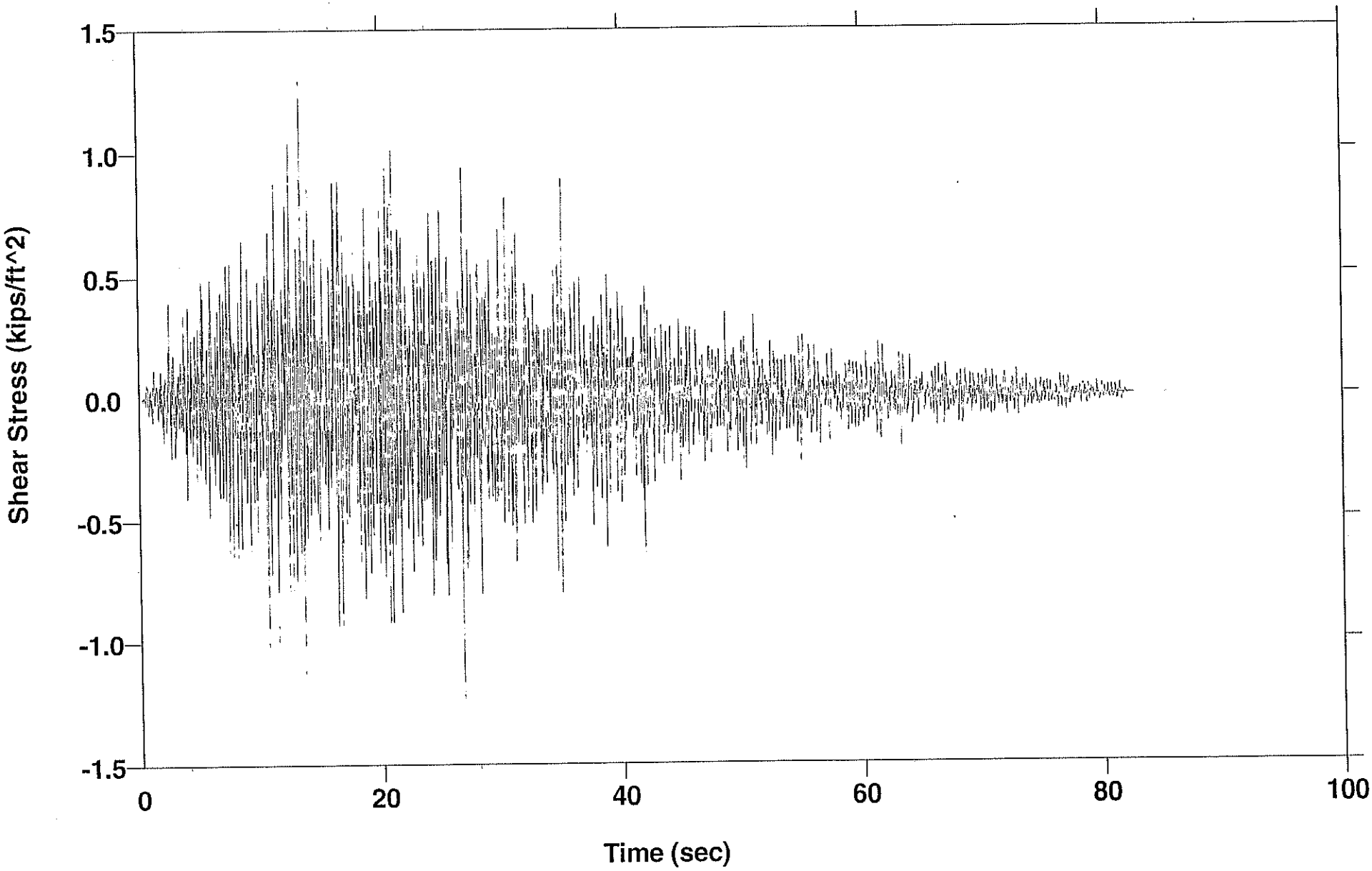

PCSC300M Layer 4 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0
20
40
60
80
100
Time (sec)

R16197


PCSC300M Layer 5 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0
20
40
60
80
100
Time (sec)

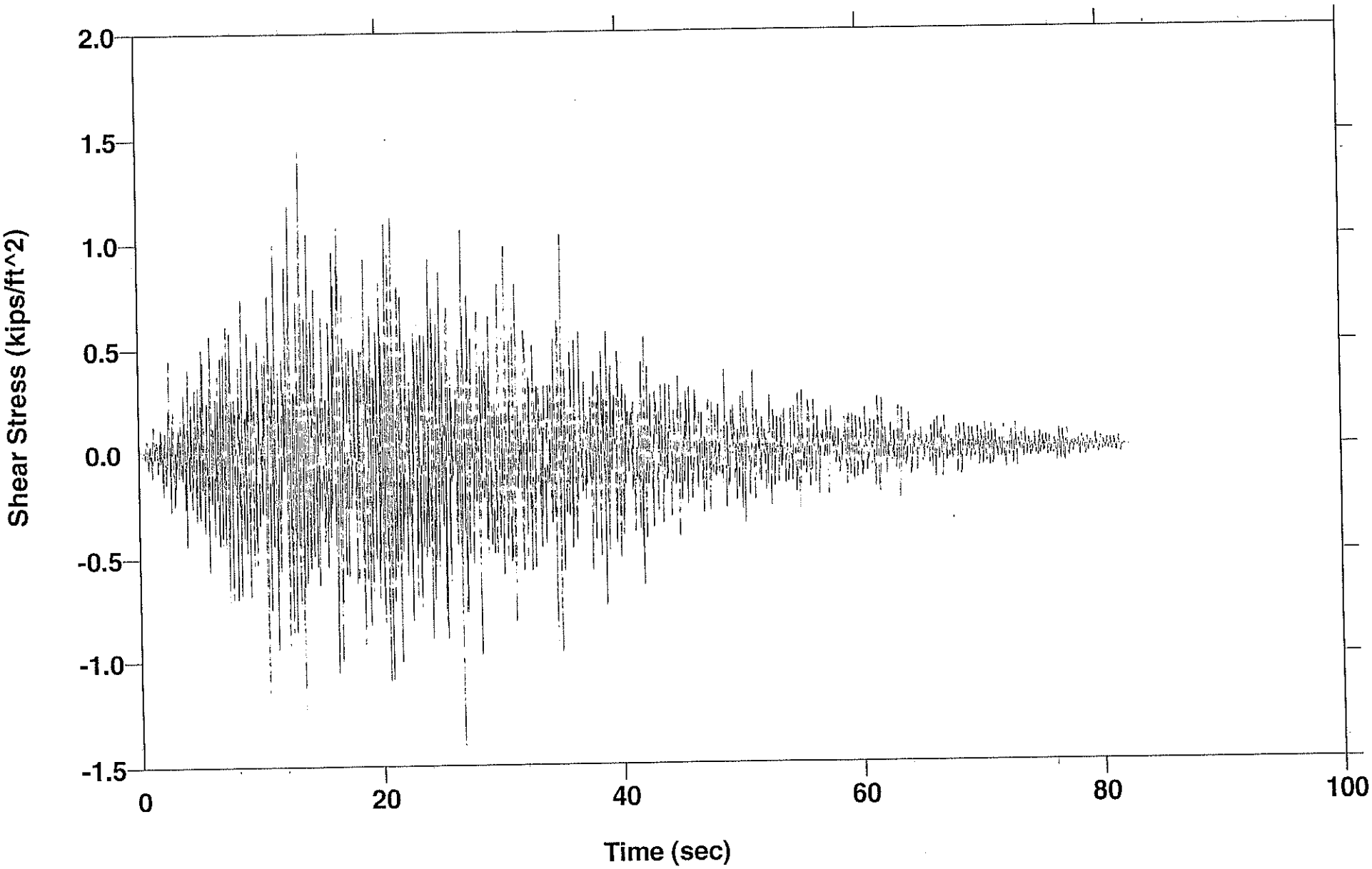
R16198

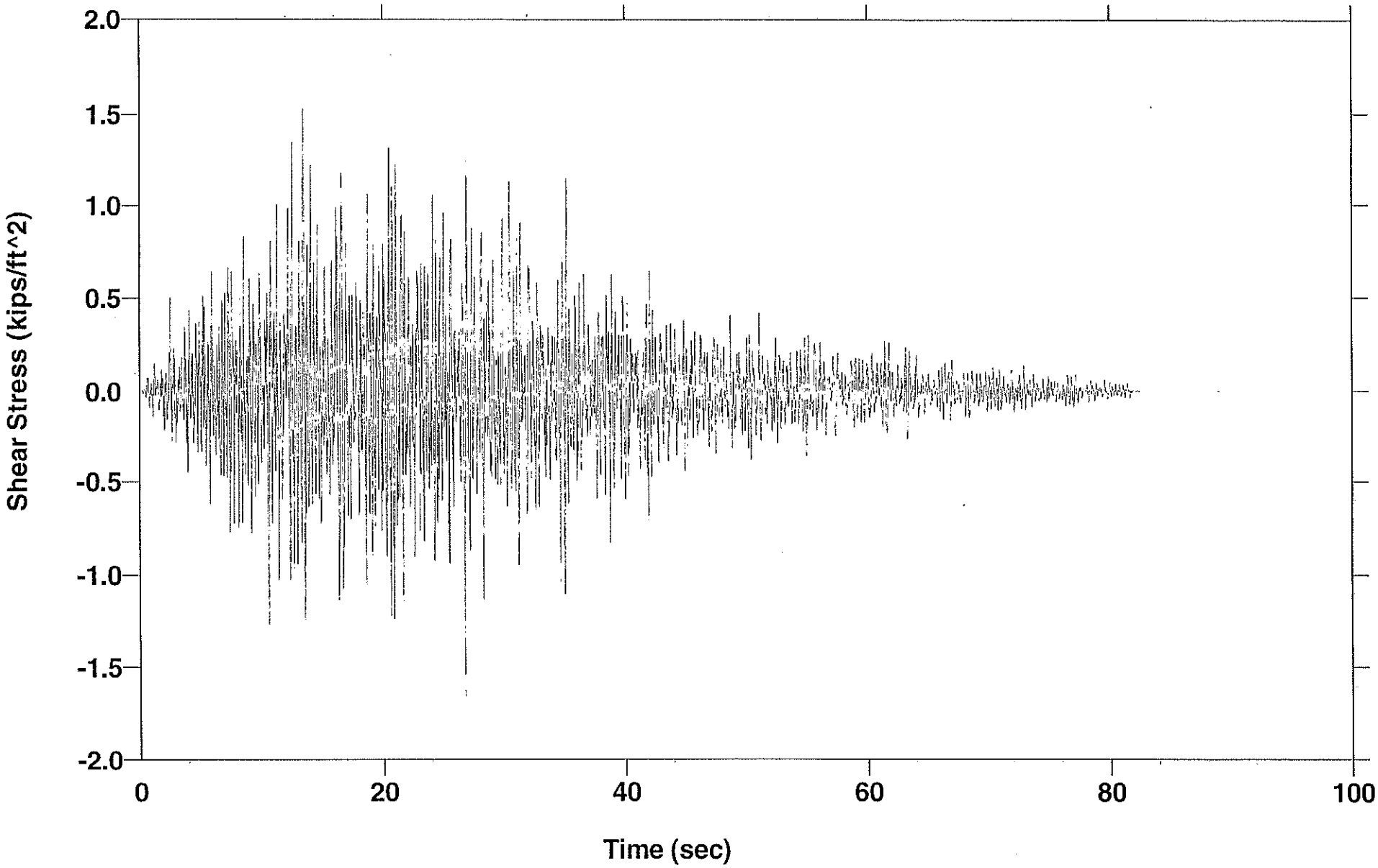
PCSC330M Layer 6 Stress - M8.0 New Madrid Synthetic



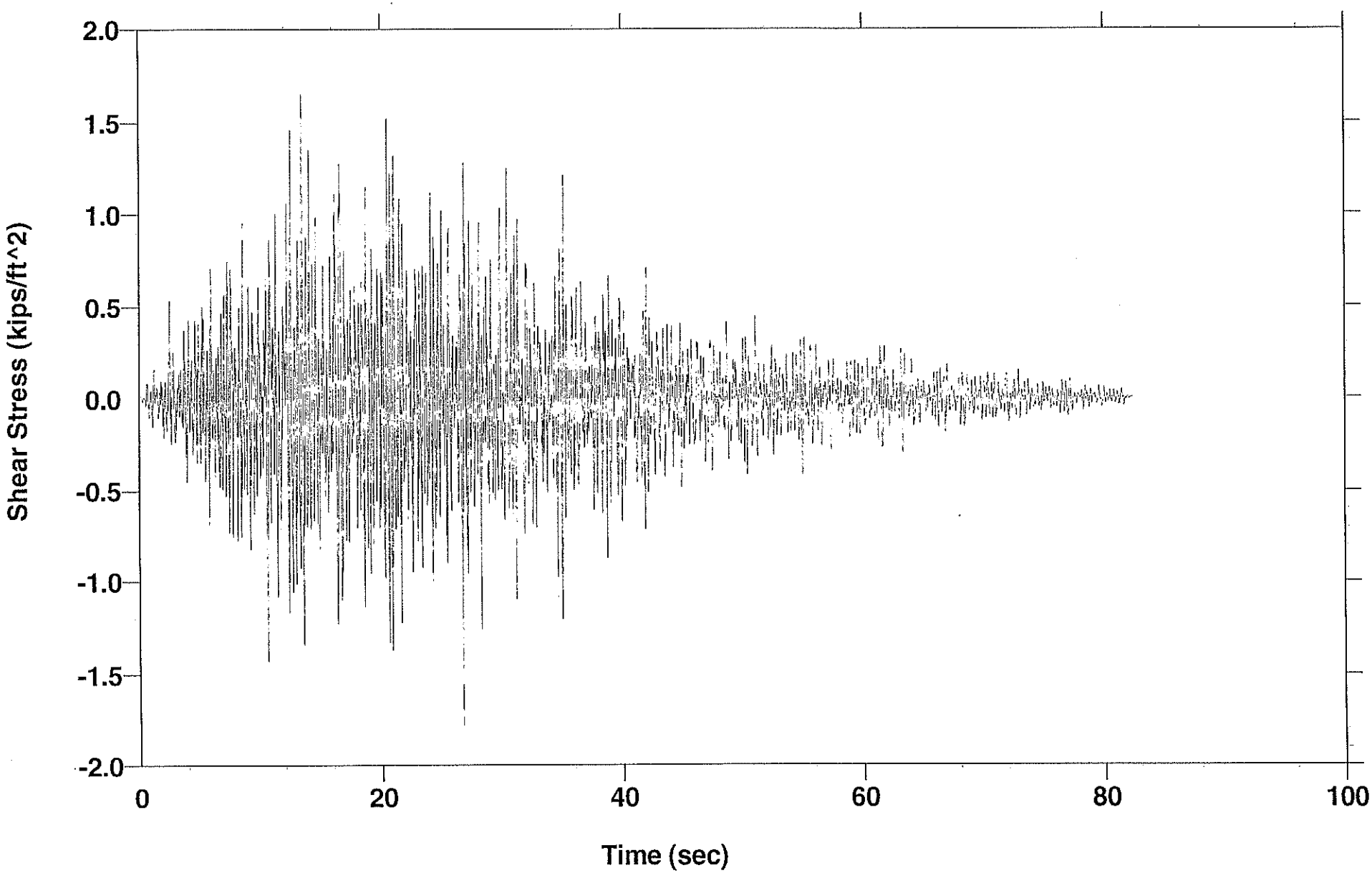
R16199

PCSC300M Layer 7 Stress - M8.0 New Madrid Synthetic

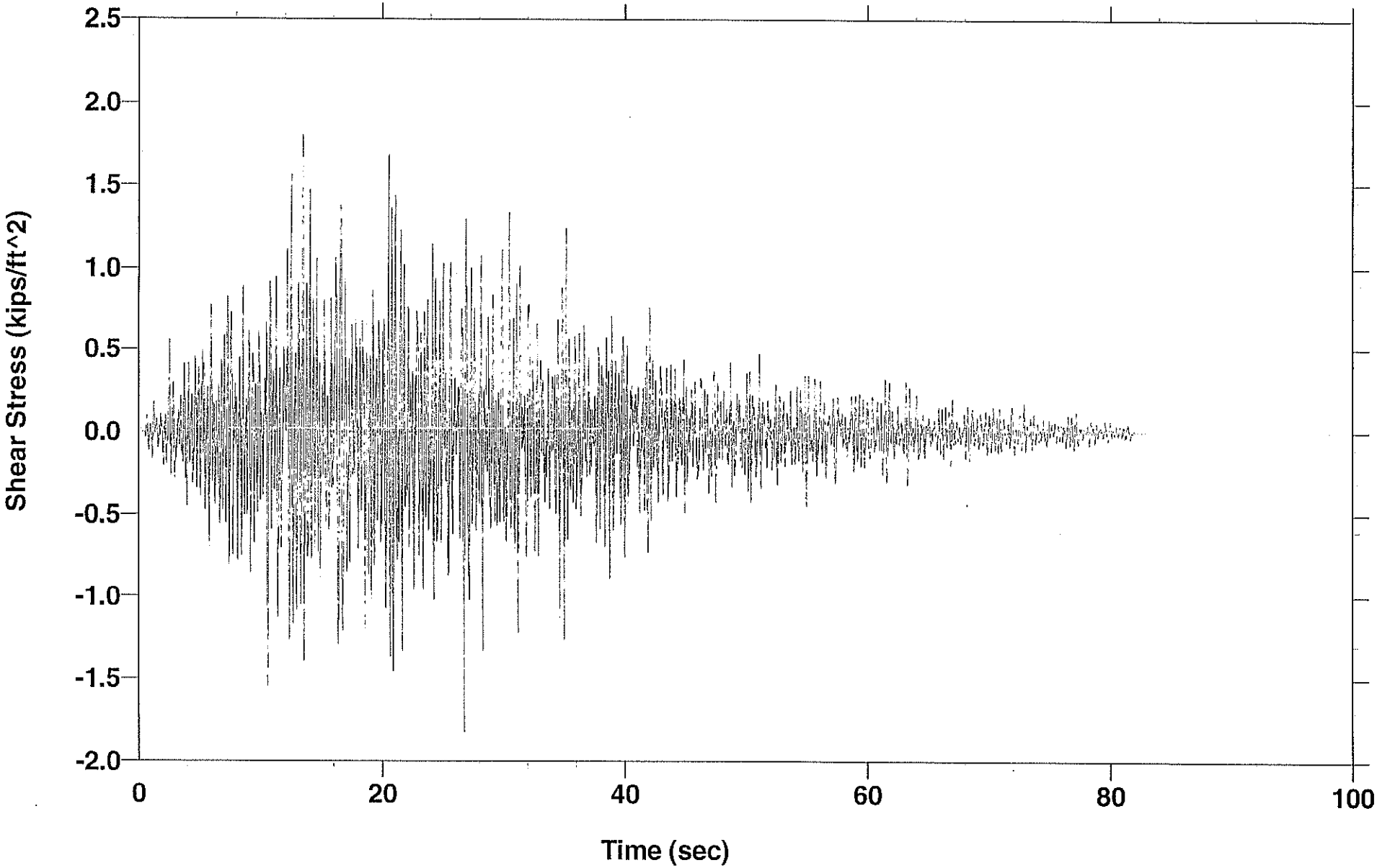



PCSC300M Layer 8 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0
20
40
60
80
100
Time (sec)

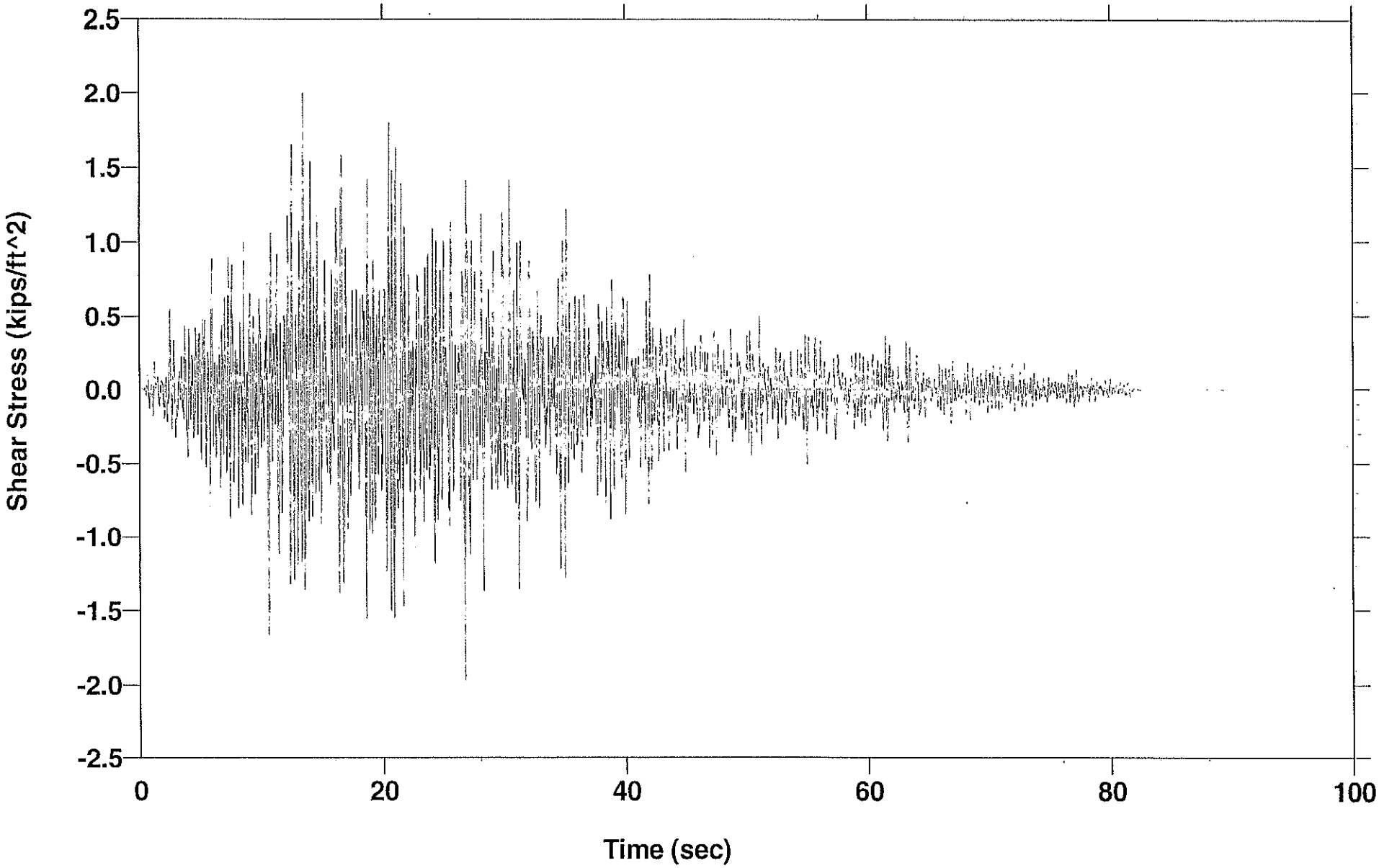
R16201


PCSC300M Layer 9 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0
20
40
60
80
100
Time (sec)

PCSC300M Layer 10 Stress - M8.0 New Madrid Synthetic

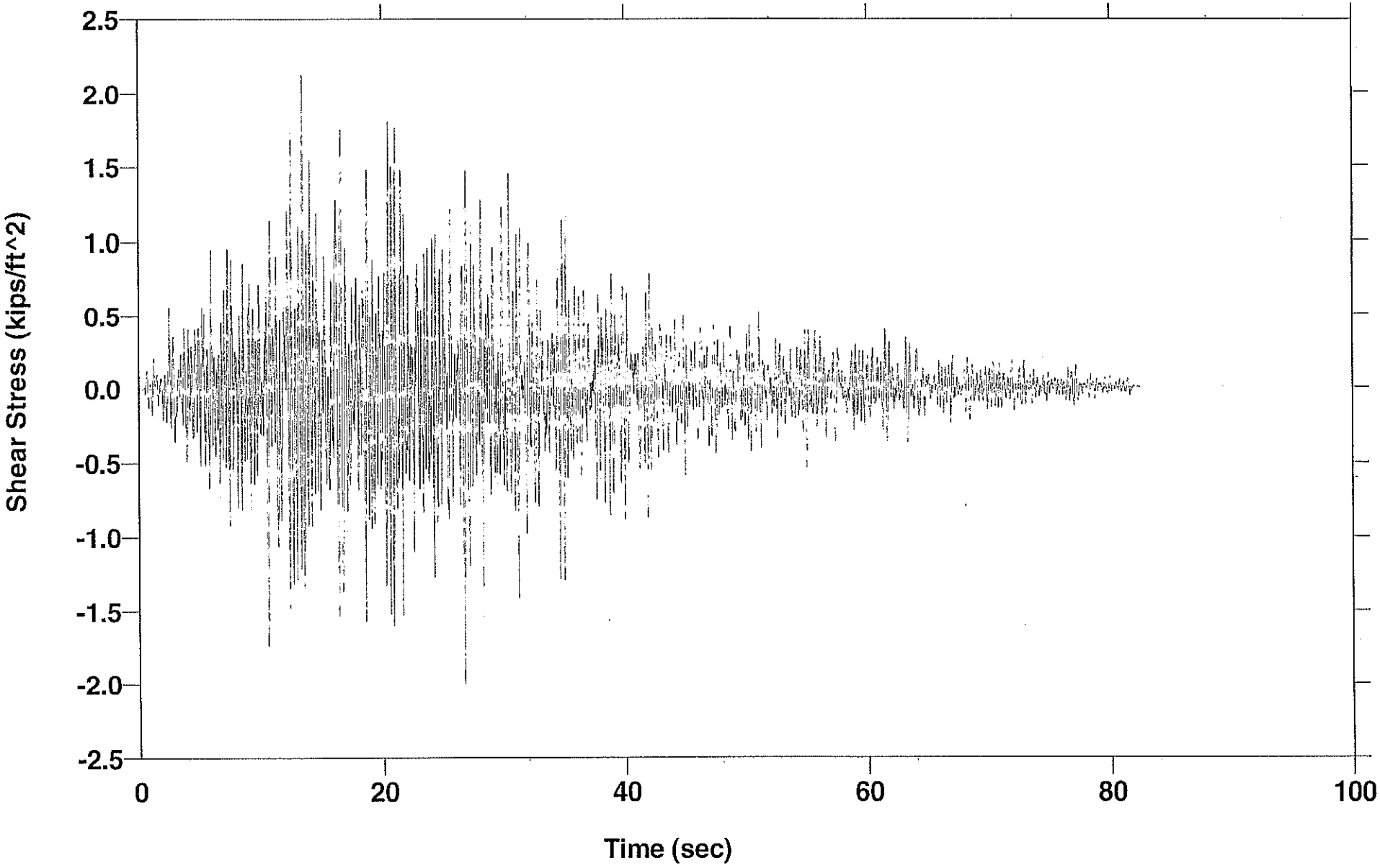


R16203


PCSC300M Layer 11 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
0
20
40
60
80
100
Time (sec)

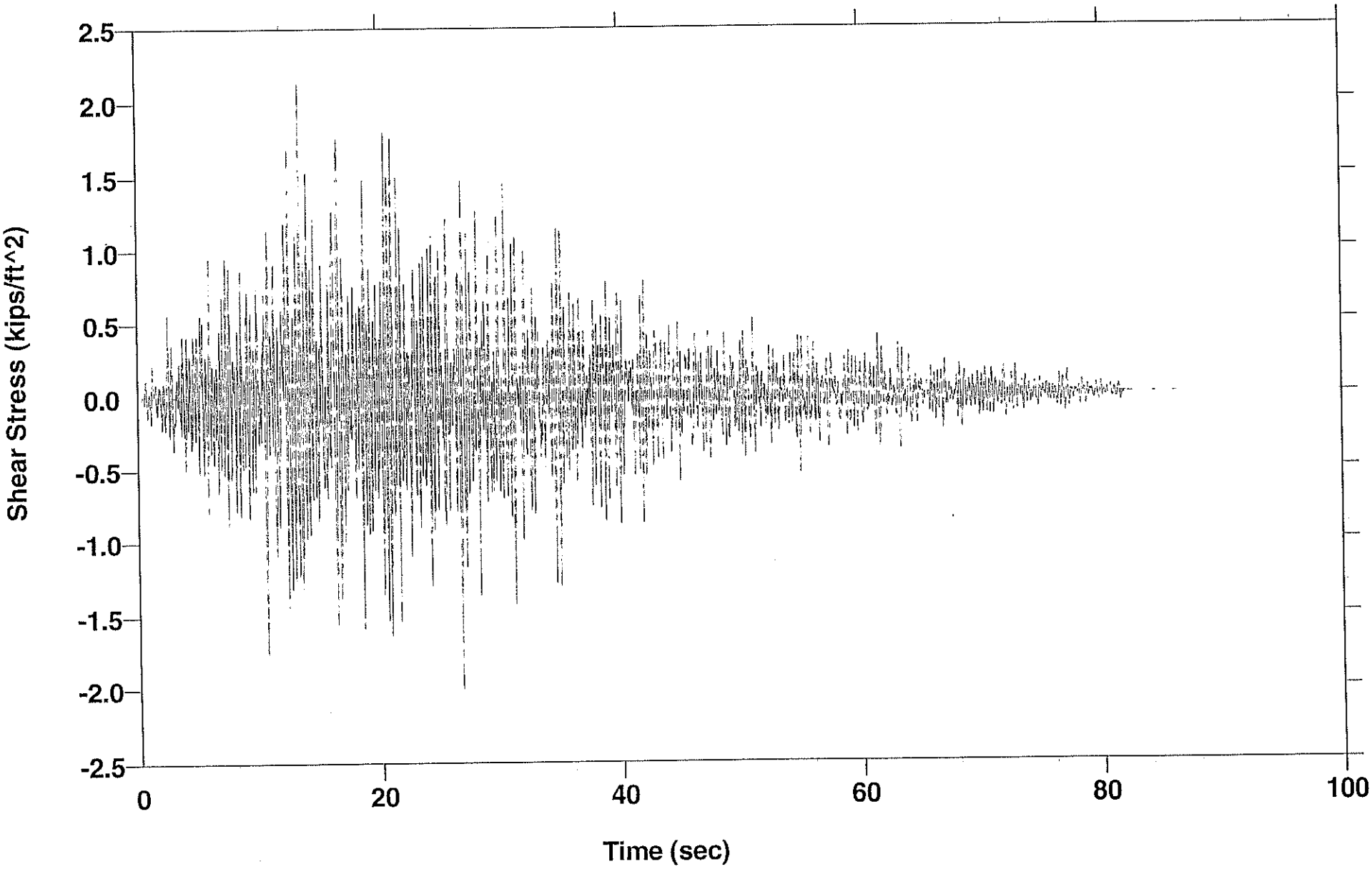
R16204

PCSC300M Layer 12 Stress - M8.0 New Madrid Synthetic



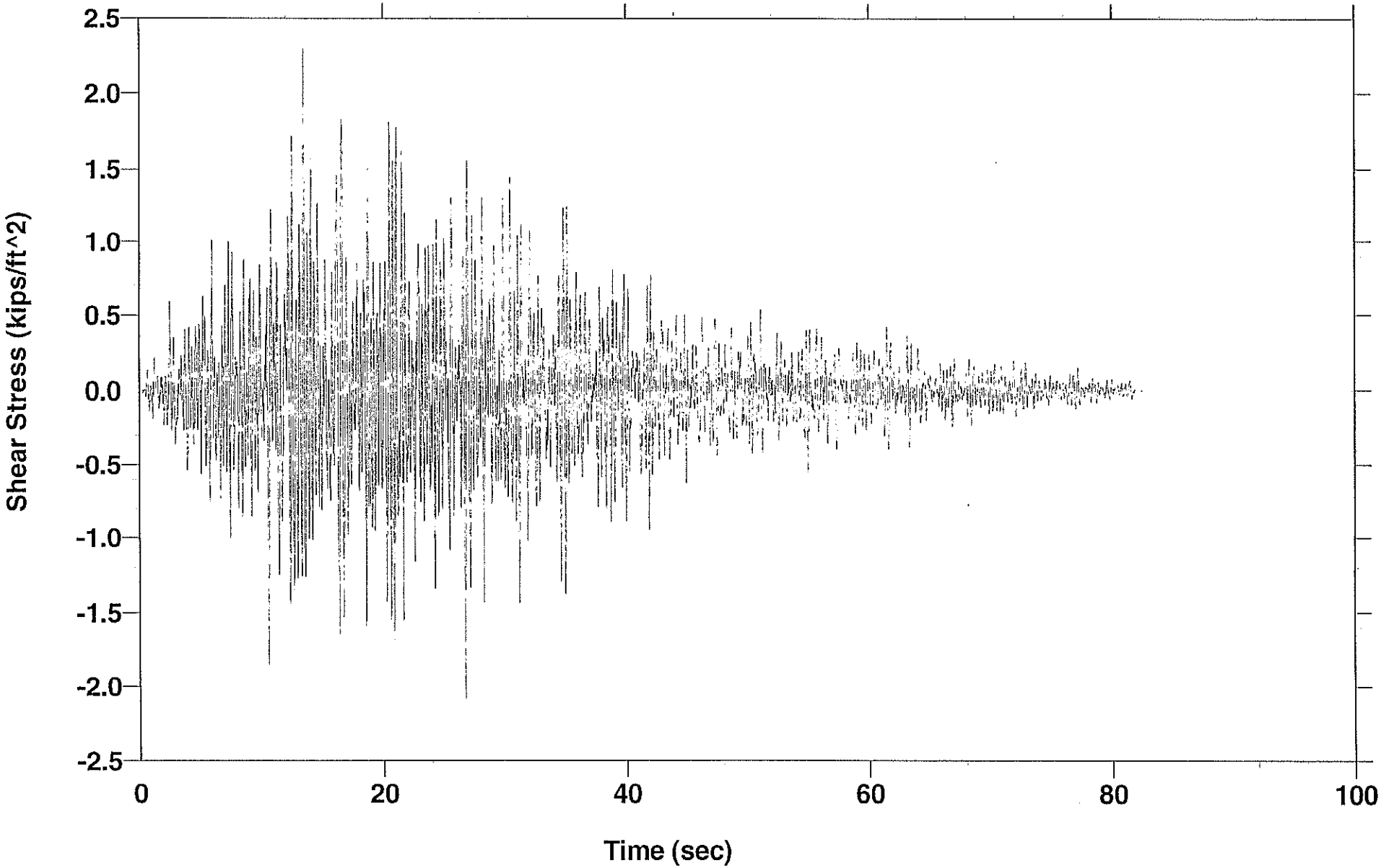
R16205

PCSC300M Layer 12 Stress - M8.0 New Madrid Synthetic

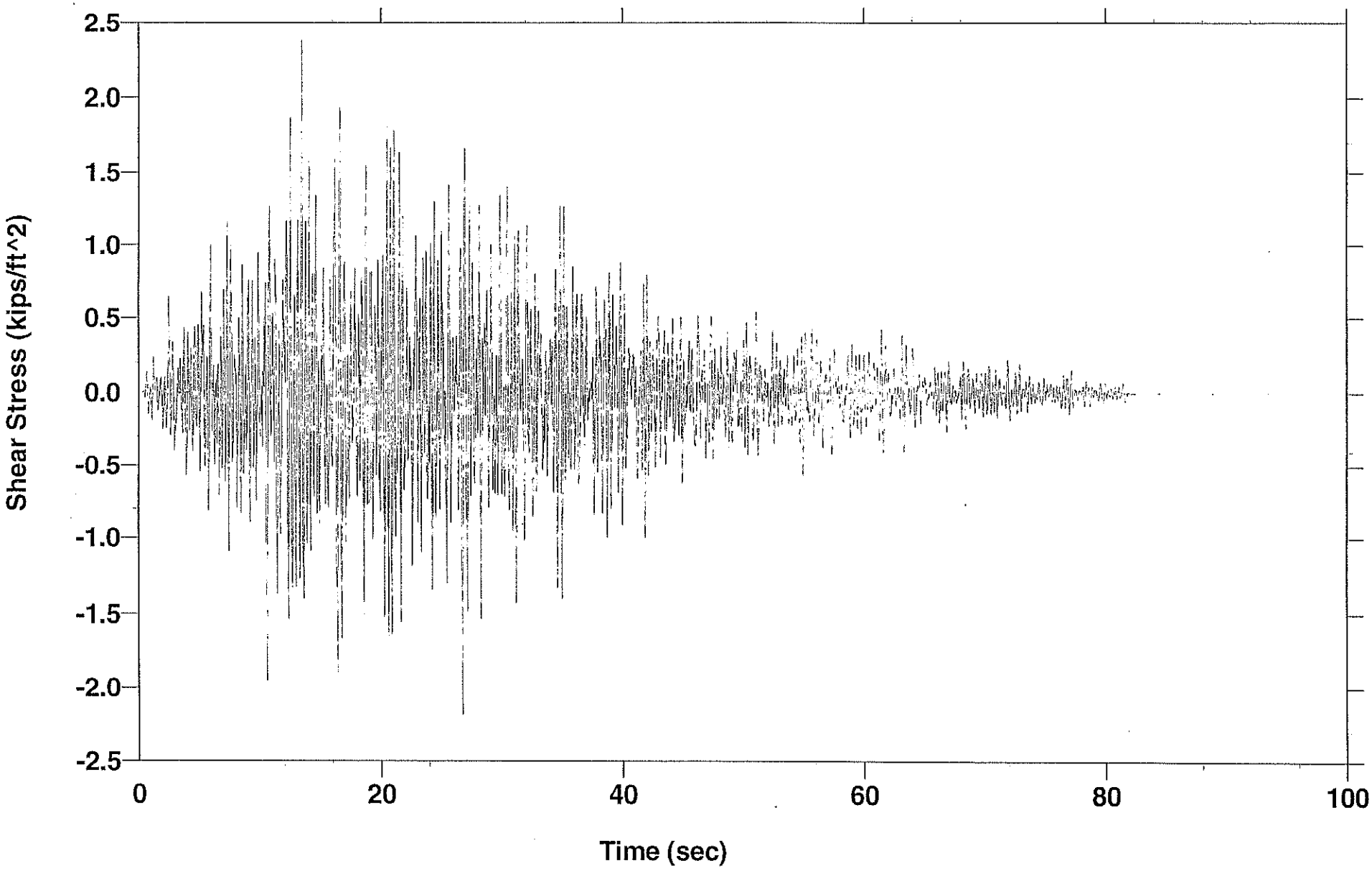


R16206

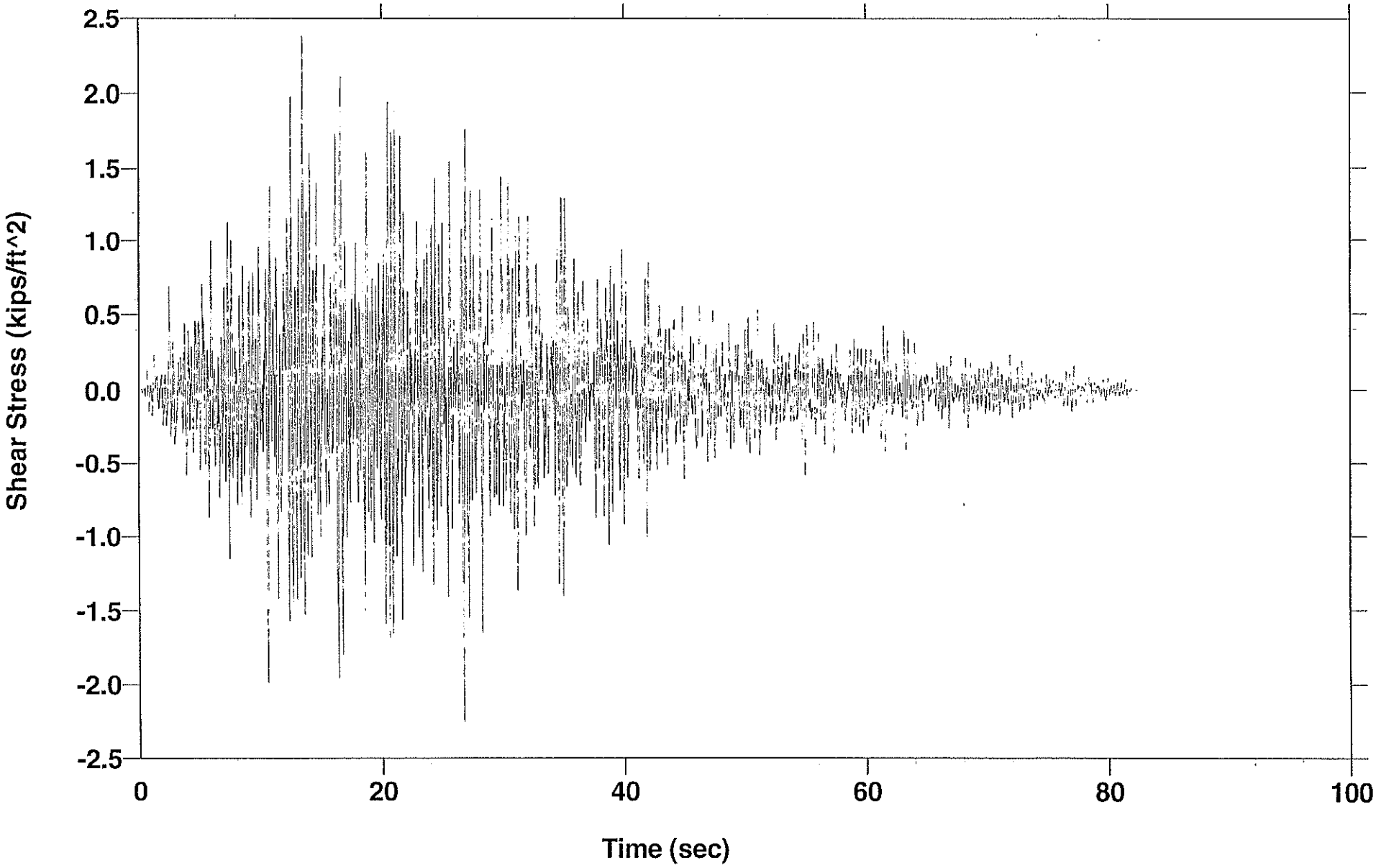
PCSC300M Layer 13 Stress - M8.0 New Madrid Synthetic



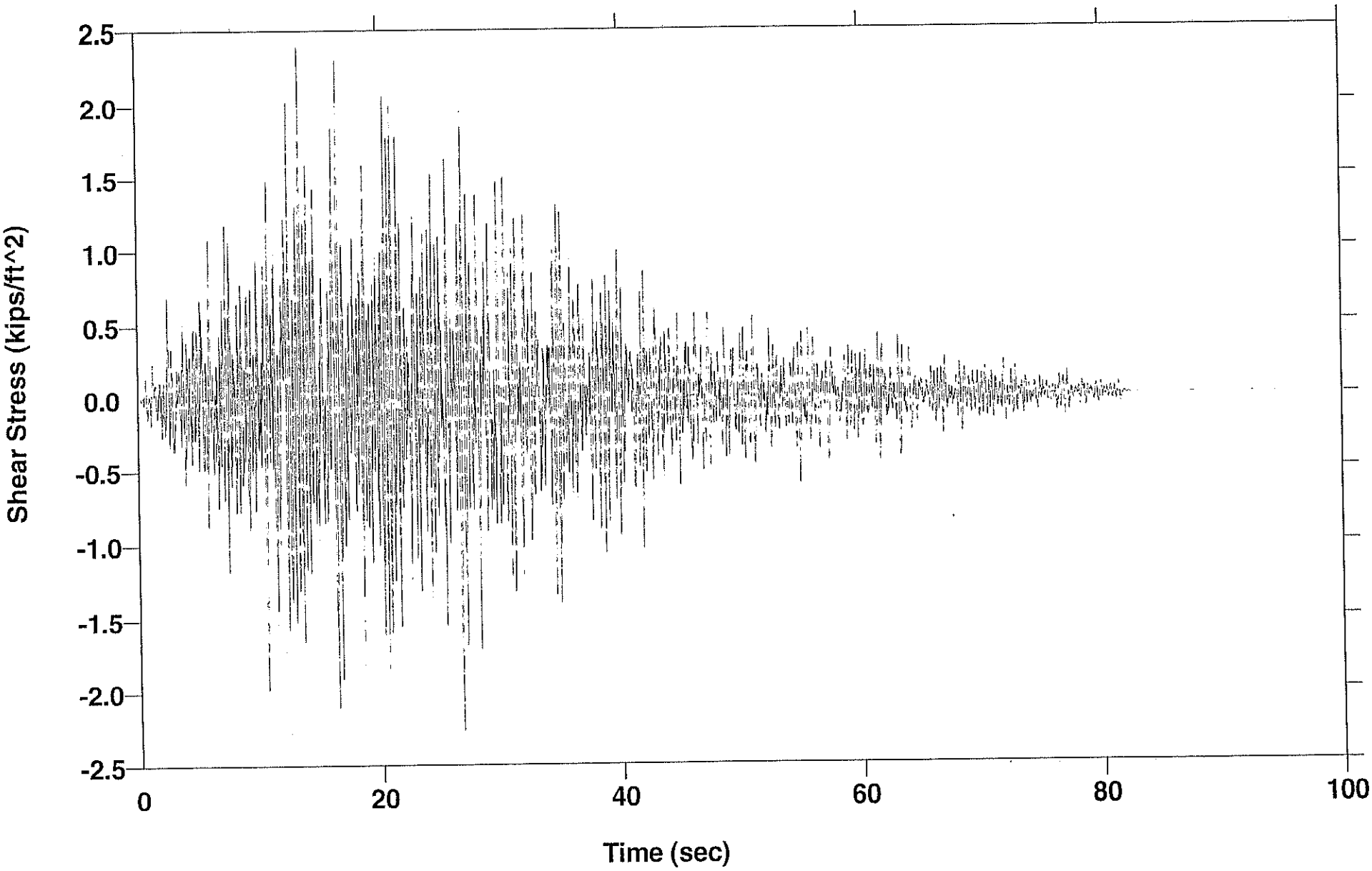
PCSC300M Layer 14 Stress - M8.0 New Madrid Synthetic



R16208


PCSC300M Layer 15 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
0
20
40
60
80
100
Time (sec)

R16209


PCSC300M Layer 16 Stress - M8.0 New Madrid Synthetic
Shear Stress (kips/ft^2)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
0
20
40
60
80
100
Time (sec)

R16210

```
************************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*    LAYERED SITES by Per Schnable & John Lysmer - 1970  *
* ---------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
* ---------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added  *
*     using results from Sun et al (1988) by J. I. Sun   *
*     & Ramin Golesorkhi February 26, 1988               *
* ----------------------------------------------------*
* SHAKE90/91: Adjust last iteration; Input now is either  *
*     Gmax or max Vs; up to 13 materials can be specified*
*     by user; up to 50 Layers can be specified; object  *
*     motion can be read in from a separate file and can *
*     user specified format; Different periods for res-  *
*     ponse spectral calculations;options are renumbered;*
*     and general cleanup by: J. I. Sun, I. M. Idriss &  *
*     P. Dirrim June 1990 - February 1991                *
* ---------------------------------------------------- *
* SHAKE91: General cleanup and finalization of input out- *
*     output format ... etc by: I. M. Idriss Dec. 1991   *
* ---------------------------------------------------- *
* SHAKE2000: Fix the incorrect output of Tot. Stress in   *
* Option 2. Changed path of ground motion file in         *
* SHAKE91.  Control file to input file names.  Modified   *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
*        RUN DATE  1/02/2008                              *
*        RUN TIME 11:03                                   *
************************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =    32768
 NECESSARY LENGTH OF BLANK COMMON X       =   204819

 |******  OPTION  1  *** READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
  MATERIAL TYPE NO. 1
 **********************

 CURVE NO. 1:   Coarse    G/Gmax - Gravel (Mean) - Rollins et al. JGGE
 CURVE NO. 2:   Coarse    Damping for Gravel (Mean) - Rollins et al. J
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.90
0.0002	0.995	0.0003	1.11
0.0005	0.980	0.0006	1.30
0.0008	0.970	0.0010	1.50
0.0010	0.960	0.0020	1.91
0.0020	0.930	0.0030	2.24
0.0030	0.905	0.0040	2.54
0.0040	0.880	0.0060	3.05
0.0070	0.810	0.0080	3.50
0.0100	0.755	0.0100	3.89
0.0200	0.630	0.0200	5.45
0.0700	0.390	0.0300	6.61
0.1000	0.325	0.0500	8.28
0.2000	0.205	0.1000	10.79
0.3000	0.150	0.2000	13.23

0.4000	0.115	0.3000	14.47
0.5000	0.095	0.4000	15.24
0.6000	0.080	0.6000	16.14
0.8000	0.070	0.8000	16.66
1.0000	0.050	1.0000	17.01

****
MATERIAL TYPE NO. 2
****

CURVE NO. 3: Fine Refuse Moduli for Fine Refuse (Ellison & Cho, 1976)
CURVE NO. 4: Fine Refuse Damping Values for Fine Refuse (Ellison & Ch

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.75
0.0004	1.000	0.0004	0.65
0.0010	0.995	0.0010	0.70
0.0020	0.992	0.0020	0.80
0.0040	0.989	0.0040	0.90
0.0060	0.981	0.0060	1.10
0.0080	0.965	0.0080	1.30
0.0100	0.955	0.0100	1.40
0.0200	0.905	0.0200	2.00
0.0400	0.828	0.0400	3.10
0.0600	0.750	0.0600	4.00
0.0800	0.670	0.0800	5.20
0.1000	0.610	0.1000	6.00
0.2000	0.610	0.2000	6.00

****
MATERIAL TYPE NO. 3
****

CURVE NO. 5: Residual G/Gmax PI=15% - Effective Confining Pressure
CURVE NO. 6: Residual Damping PI=15% - Effective Confining Pressur

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0000	1.000	0.0000	0.67
0.0000	1.000	0.0000	0.67
0.0000	0.999	0.0000	0.68
0.0001	0.998	0.0001	0.68
0.0002	0.996	0.0002	0.70
0.0005	0.991	0.0005	0.75
0.0010	0.983	0.0010	0.83
0.0022	0.965	0.0022	1.02
0.0048	0.931	0.0048	1.43
0.0100	0.873	0.0100	2.17
0.0220	0.770	0.0220	3.68
0.0484	0.618	0.0484	6.24
0.1000	0.454	0.1000	9.48
0.2200	0.287	0.2200	13.40
0.4840	0.163	0.4840	16.87
1.0000	0.091	1.0000	19.16

****
MATERIAL TYPE NO. 4
****

CURVE NO. 7: Rock G/Gmax - ROCK (Schnabel 1973)
CURVE NO. 8: Rock Damping for ROCK (Schnabel 1973)

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	0.40
0.0003	1.000	0.0010	0.80
0.0010	0.990	0.0100	1.50
0.0030	0.950	0.1000	3.00
0.0100	0.900	1.0000	4.60
0.0300	0.810	0.0000	0.00
0.1000	0.725	0.0000	0.00
1.0000	0.550	0.0000	0.00

1****** OPTION 2 *** READ SOIL PROFILE
NEW SOIL PROFILE NO. 1 IDENTIFICATION PSCS300E Crest Column
NUMBER OF LAYERS 17 DEPTH TO BEDROCK 50.00

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	1	4.0000	2.0000	0.26	3454.	0.050	0.130	924.9
2	1	3.0000	5.5000	0.71	3856.	0.050	0.130	977.3
3	1	3.0000	8.5000	1.11	4110.	0.050	0.130	1009.0
4	1	3.0000	11.5000	1.50	5739.	0.050	0.130	1192.3
5	1	3.0000	14.5000	1.90	4941.	0.050	0.140	1066.0
6	1	3.0000	17.5000	2.32	4453.	0.050	0.140	1012.0
7	1	3.0000	20.5000	2.74	4832.	0.050	0.140	1054.2
8	1	3.0000	23.5000	3.16	4269.	0.050	0.140	990.9
9	1	3.0000	26.5000	3.58	4713.	0.050	0.140	1041.1
10	1	4.0000	30.0000	4.07	4808.	0.050	0.140	1051.6
11	3	3.0000	33.5000	4.55	2635.	0.050	0.135	792.8
12	3	3.0000	36.5000	4.96	2661.	0.050	0.135	796.7
13	3	3.0000	39.5000	5.36	2998.	0.050	0.135	845.6
14	3	3.0000	42.5000	5.77	3763.	0.050	0.135	947.4
15	3	3.0000	45.5000	6.17	6529.	0.050	0.135	1247.9
16	3	3.0000	48.5000	6.58	6476.	0.050	0.135	1242.8
17	BASE				74534.	0.050	0.150	4000.0

PERIOD = 0.20 FROM AVERAGE SHEAR VEL. = 1011.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 12.34
FOR FREQUENCY = 4.85 C/SEC.
PERIOD = 0.21 SEC.

1****** OPTION 3 *** READ INPUT MOTION

FILE NAME FOR INPUT MOTION = C:\SHAKE2000\Williamson Energy\NewMadrid.eq
NO. OF INPUT ACC. POINTS = 8184
NO. OF POINTS USED IN FFT = 16384
NO. OF HEADING LINES = 4
NO. OF POINTS PER LINE = 8

```
 TIME STEP FOR INPUT MOTION = 0.0100
   FORMAT FOR TIME HISTORY =     (8f9.6)


 *****HEADER*****
Source File: C:\SHAKE2000\Williamson Energy\NewMadrid.M8@83km.txt
SHAKE2000 Conversion:   8184     .01      4       8       9       (8f9.6
Acceleration Units: (g's) - No. Values: 8184 - Time Step: .01 (secs)
Data Format: (8f9.6) - No. Header Lines:  4
 ** FIRST AND LAST 5 LINES OF INPUT MOTION *****

   1 -0.000279 0.000491 0.000916 0.001028 0.001072 0.001012 0.000914 0.001178
   2  0.001267 0.001643 0.000738 0.000404 0.001162 0.000325 0.000442 0.001287
   3  0.000332 0.000352 0.000667 0.000333 0.000100-0.000289 0.000774-0.001450
   4 -0.001068 0.000422-0.001711-0.000650 0.000432 0.001691 0.002168 0.001175
   5 -0.000695 0.000756 0.000277 0.002243-0.000523 0.000775-0.001563-0.000602
  .....INPUT MOTION READ NOT ECHOED.....
1019  0.002157 0.001240-0.001104 0.000476-0.001755-0.000138 0.000159-0.003048
1020 -0.003913 0.000251 0.002962-0.003793-0.003142-0.004436-0.001657-0.000252
1021  0.001471 0.001823-0.000479-0.000738-0.002774-0.005429-0.002747 0.002040
1022 -0.000940-0.002779-0.004528-0.001675 0.001024-0.002927-0.001433 0.002515
1023  0.000569-0.002711-0.002134-0.001855 0.001529 0.003698 0.004083-0.003032

 MAXIMUM ACCELERATION =  0.18389
 AT TIME              = 16.61 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  2.937
 TO GIVE NEW MAXIMUM ACCELERATION         =  0.54000
 MEAN SQUARE FREQUENCY =     14.61 C/SEC.
 MAX ACCELERATION =    0.57825 FOR FREQUENCIES REMOVED ABOVE     40.00 C/SEC.
1******  OPTION  4  ***  READ WHERE OBJECT MOTION IS GIVEN
 OBJECT MOTION IN LAYER NUMBER   17 OUTCROPPING

1******  OPTION  5  ***  OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
 MAXIMUM NUMBER OF ITERATIONS              =   10
 FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN  =    0.65

    EARTHQUAKE   - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
   SOIL PROFILE - PSCS300E Crest Column

 ITERATION NUMBER  1

 VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ----> <---- SHEAR MODULUS -----> G/Go
     (FT)  STRAIN NEW   USED  ERROR     NEW    USED   ERROR  RATIO
--- ---- ----- -------- ----- ------ ------  -------  ------  ------  -----
 1  1    2.0 0.00461 0.027  0.050   -83.9   2978.1   3454.0   -16.0  1.000
 2  1    5.5 0.01094 0.041  0.050   -22.2   2848.9   3856.0   -35.4  1.000
 3  1    8.5 0.01510 0.048  0.050    -3.8   2797.7   4110.0   -46.9  1.000
 4  1   11.5 0.01386 0.046  0.050    -8.1   3995.3   5739.0   -43.6  1.000
 5  1   14.5 0.01946 0.054  0.050     7.2   3137.2   4941.0   -57.5  1.000
 6  1   17.5 0.02527 0.061  0.050    18.3   2605.8   4453.0   -70.9  1.000
 7  1   20.5 0.02663 0.063  0.050    20.2   2779.1   4832.0   -73.9  1.000
 8  1   23.5 0.03437 0.071  0.050    29.1   2246.6   4269.0   -90.0  1.000
 9  1   26.5 0.03469 0.071  0.050    29.4   2471.9   4713.0   -90.7  1.000
10  1   30.0 0.03753 0.073  0.050    31.9   2449.2   4808.0   -96.3  1.000
11  3   33.5 0.07359 0.081  0.050    38.3   1378.9   2635.0   -91.1  1.000
12  3   36.5 0.07541 0.082  0.050    39.2   1377.8   2661.0   -93.1  1.000
13  3   39.5 0.06759 0.077  0.050    35.3   1626.5   2998.0   -84.3  1.000
14  3   42.5 0.05330 0.067  0.050    25.0   2243.6   3763.0   -67.7  1.000
15  3   45.5 0.03114 0.048  0.050    -4.0   4589.9   6529.0   -42.2  1.000
```

16 3 48.5 0.03254 0.050 0.050 -1.0 4497.8 6476.0 -44.0 1.000
1

EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00529	0.029	0.027	6.0	2918.7	2978.1	-2.0	0.862
2	1	5.5	0.01469	0.048	0.041	14.0	2643.7	2848.9	-7.8	0.739
3	1	8.5	0.02173	0.057	0.048	15.3	2523.9	2797.7	-10.8	0.681
4	1	11.5	0.01880	0.053	0.046	12.9	3679.7	3995.3	-8.6	0.696
5	1	14.5	0.02751	0.064	0.054	15.3	2811.1	3137.2	-11.6	0.635
6	1	17.5	0.03794	0.074	0.061	17.1	2259.2	2605.8	-15.3	0.585
7	1	20.5	0.04016	0.076	0.063	17.1	2398.9	2779.1	-15.8	0.575
8	1	23.5	0.05732	0.088	0.071	19.6	1828.3	2246.6	-22.9	0.526
9	1	26.5	0.05743	0.088	0.071	19.3	2016.7	2471.9	-22.6	0.524
10	1	30.0	0.06134	0.090	0.073	18.6	1996.8	2449.2	-22.7	0.509
11	3	33.5	0.11183	0.100	0.081	19.2	1133.9	1378.9	-21.6	0.523
12	3	36.5	0.11292	0.101	0.082	18.5	1139.6	1377.8	-20.9	0.518
13	3	39.5	0.09290	0.092	0.077	15.5	1411.0	1626.5	-15.3	0.543
14	3	42.5	0.06870	0.078	0.067	14.6	2027.7	2243.6	-10.6	0.596
15	3	45.5	0.03450	0.051	0.048	6.5	4460.9	4589.9	-2.9	0.703
16	3	48.5	0.03620	0.053	0.050	6.5	4364.8	4497.8	-3.0	0.695

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00475	0.028	0.029	-4.9	2965.5	2918.7	1.6	0.845
2	1	5.5	0.01390	0.046	0.048	-2.7	2682.1	2643.7	1.4	0.686
3	1	8.5	0.02141	0.056	0.057	-0.8	2535.7	2523.9	0.5	0.614
4	1	11.5	0.01863	0.053	0.053	-0.4	3689.2	3679.7	0.3	0.641
5	1	14.5	0.02895	0.065	0.064	2.2	2762.9	2811.1	-1.7	0.569
6	1	17.5	0.04291	0.078	0.074	5.2	2154.2	2259.2	-4.9	0.507
7	1	20.5	0.04652	0.080	0.076	6.0	2262.8	2398.9	-6.0	0.496
8	1	23.5	0.06862	0.094	0.088	6.9	1681.3	1828.3	-8.7	0.428
9	1	26.5	0.06795	0.094	0.088	6.5	1864.9	2016.7	-8.1	0.428
10	1	30.0	0.07245	0.096	0.090	6.3	1845.0	1996.8	8.2	0.415
11	3	33.5	0.12841	0.107	0.100	6.4	1056.7	1133.9	-7.3	0.430
12	3	36.5	0.12873	0.107	0.101	6.1	1065.8	1139.6	-6.9	0.428
13	3	39.5	0.10845	0.099	0.092	7.4	1309.6	1411.0	-7.7	0.471
14	3	42.5	0.07848	0.084	0.078	7.1	1914.4	2027.7	-5.9	0.539
15	3	45.5	0.03657	0.053	0.051	3.5	4387.7	4460.9	-1.7	0.683
16	3	48.5	0.03825	0.055	0.053	3.3	4296.1	4364.8	-1.6	0.674

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00444	0.027	0.028	-3.2	2994.8	2965.5	1.0	0.859
2	1	5.5	0.01306	0.045	0.046	-3.1	2725.5	2682.1	1.6	0.696
3	1	8.5	0.02003	0.055	0.056	-3.5	2588.1	2535.7	2.0	0.617
4	1	11.5	0.01781	0.052	0.053	-2.0	3735.7	3689.2	1.2	0.643
5	1	14.5	0.02917	0.065	0.065	0.3	2755.5	2762.9	-0.3	0.559
6	1	17.5	0.04389	0.079	0.078	0.9	2134.9	2154.2	-0.9	0.484
7	1	20.5	0.04854	0.082	0.080	1.7	2223.4	2262.8	-1.8	0.468
8	1	23.5	0.07304	0.097	0.094	2.3	1631.9	1681.3	-3.0	0.394
9	1	26.5	0.07019	0.095	0.094	1.2	1835.8	1864.9	-1.6	0.396
10	1	30.0	0.07452	0.097	0.096	1.1	1820.2	1845.0	-1.4	0.384
11	3	33.5	0.13094	0.108	0.107	0.9	1045.9	1056.7	-1.0	0.401
12	3	36.5	0.13677	0.110	0.107	2.7	1031.6	1065.8	-3.3	0.401
13	3	39.5	0.11811	0.103	0.099	4.1	1255.4	1309.6	-4.3	0.437
14	3	42.5	0.08203	0.086	0.084	2.3	1876.8	1914.4	-2.0	0.509
15	3	45.5	0.03673	0.053	0.053	0.3	4382.2	4387.7	-0.1	0.672
16	3	48.5	0.03835	0.055	0.055	0.2	4292.8	4296.1	-0.1	0.663

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00433	0.026	0.027	-1.1	3004.9	2994.8	0.3	0.867
2	1	5.5	0.01267	0.044	0.045	-1.6	2746.9	2725.5	0.8	0.707
3	1	8.5	0.01935	0.054	0.055	-1.5	2614.0	2588.1	1.0	0.630
4	1	11.5	0.01748	0.051	0.052	-0.8	3754.7	3735.7	0.5	0.651
5	1	14.5	0.02911	0.065	0.065	-0.1	2757.5	2755.5	0.1	0.558
6	1	17.5	0.04365	0.078	0.079	-0.2	2139.7	2134.9	0.2	0.479
7	1	20.5	0.04877	0.082	0.082	0.2	2219.0	2223.4	-0.2	0.460
8	1	23.5	0.07433	0.097	0.097	0.7	1618.2	1631.9	-0.8	0.382
9	1	26.5	0.07045	0.095	0.095	0.1	1832.5	1835.8	-0.2	0.390
10	1	30.0	0.07390	0.097	0.097	-0.3	1827.6	1820.2	0.4	0.379
11	3	33.5	0.13009	0.108	0.108	-0.3	1049.5	1045.9	0.3	0.397
12	3	36.5	0.14090	0.112	0.110	1.3	1014.8	1031.6	-1.7	0.388
13	3	39.5	0.12289	0.105	0.103	1.9	1230.2	1255.4	-2.0	0.419
14	3	42.5	0.08343	0.087	0.086	0.9	1862.4	1876.8	-0.8	0.499
15	3	45.5	0.03646	0.053	0.053	-0.5	4391.5	4382.2	0.2	0.671
16	3	48.5	0.03803	0.055	0.055	-0.5	4303.2	4292.8	0.2	0.663

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 6

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00429	0.026	0.026	-0.4	3009.0	3004.9	0.1	0.870
2	1	5.5	0.01249	0.044	0.044	-0.7	2756.7	2746.9	0.4	0.712

3	1	8.5	0.01904	0.053	0.054	-0.7	2625.8	2614.0	0.5	0.636
4	1	11.5	0.01735	0.051	0.051	-0.3	3762.7	3754.7	0.2	0.654
5	1	14.5	0.02902	0.065	0.065	-0.1	2760.3	2757.5	0.1	0.558
6	1	17.5	0.04331	0.078	0.078	-0.3	2146.2	2139.7	0.3	0.481
7	1	20.5	0.04861	0.082	0.082	-0.1	2222.0	2219.0	0.1	0.459
8	1	23.5	0.07458	0.097	0.097	0.1	1615.6	1618.2	-0.2	0.379
9	1	26.5	0.07025	0.095	0.095	-0.1	1835.0	1832.5	0.1	0.389
10	1	30.0	0.07312	0.097	0.097	-0.4	1836.9	1827.6	0.5	0.380
11	3	33.5	0.12922	0.108	0.108	-0.3	1053.2	1049.5	0.4	0.398
12	3	36.5	0.14301	0.113	0.112	0.7	1006.4	1014.8	-0.8	0.381
13	3	39.5	0.12526	0.106	0.105	0.9	1218.1	1230.2	-1.0	0.410
14	3	42.5	0.08396	0.087	0.087	0.3	1857.0	1862.4	-0.3	0.495
15	3	45.5	0.03629	0.053	0.053	-0.3	4397.5	4391.5	0.1	0.673
16	3	48.5	0.03784	0.054	0.055	-0.3	4309.6	4303.2	0.1	0.664

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EARTHQUAKE - C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 7

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00428	0.026	0.026	-0.2	3010.7	3009.0	0.1	0.871
2	1	5.5	0.01241	0.044	0.044	-0.3	2761.0	2756.7	0.2	0.715
3	1	8.5	0.01890	0.053	0.053	-0.3	2631.1	2625.8	0.2	0.639
4	1	11.5	0.01729	0.051	0.051	-0.1	3766.0	3762.7	0.1	0.656
5	1	14.5	0.02896	0.065	0.065	-0.1	2762.3	2760.3	0.1	0.559
6	1	17.5	0.04309	0.078	0.078	-0.2	2150.6	2146.2	0.2	0.482
7	1	20.5	0.04844	0.082	0.082	-0.1	2225.2	2222.0	0.1	0.460
8	1	23.5	0.07455	0.097	0.097	0.0	1615.9	1615.6	0.0	0.378
9	1	26.5	0.07003	0.095	0.095	-0.1	1837.7	1835.0	0.1	0.389
10	1	30.0	0.07262	0.096	0.097	-0.3	1842.9	1836.9	0.3	0.382
11	3	33.5	0.12880	0.107	0.108	-0.2	1055.0	1053.2	0.2	0.400
12	3	36.5	0.14413	0.113	0.113	0.3	1002.1	1006.4	-0.4	0.378
13	3	39.5	0.12648	0.106	0.106	0.5	1211.9	1218.1	-0.5	0.406
14	3	42.5	0.08418	0.087	0.087	0.1	1854.9	1857.0	-0.1	0.494
15	3	45.5	0.03622	0.053	0.053	-0.1	4399.9	4397.5	0.1	0.674
16	3	48.5	0.03776	0.054	0.054	-0.1	4312.2	4309.6	0.1	0.665

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 8

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00427	0.026	0.026	-0.1	3011.5	3010.7	0.0	0.872
2	1	5.5	0.01238	0.044	0.044	-0.2	2763.1	2761.0	0.1	0.716
3	1	8.5	0.01884	0.053	0.053	-0.1	2633.6	2631.1	0.1	0.640
4	1	11.5	0.01727	0.051	0.051	-0.1	3767.6	3766.0	0.0	0.656
5	1	14.5	0.02893	0.065	0.065	-0.1	2763.5	2762.3	0.0	0.559
6	1	17.5	0.04296	0.078	0.078	-0.1	2153.2	2150.6	0.1	0.483
7	1	20.5	0.04833	0.082	0.082	-0.1	2227.5	2225.2	0.1	0.461
8	1	23.5	0.07446	0.097	0.097	0.0	1616.9	1615.9	0.1	0.379
9	1	26.5	0.06987	0.095	0.095	-0.1	1839.8	1837.7	0.1	0.390

10	1	30.0	0.07233	0.096	0.096	-0.1	1846.4	1842.9	0.2	0.383
11	3	33.5	0.12860	0.107	0.107	-0.1	1055.9	1055.0	0.1	0.400
12	3	36.5	0.14473	0.113	0.113	0.2	999.7	1002.1	-0.2	0.377
13	3	39.5	0.12712	0.107	0.106	0.2	1208.7	1211.9	-0.3	0.404
14	3	42.5	0.08427	0.087	0.087	0.1	1854.0	1854.9	0.0	0.493
15	3	45.5	0.03619	0.053	0.053	0.0	4400.8	4399.9	0.0	0.674
16	3	48.5	0.03773	0.054	0.054	0.0	4313.1	4312.2	0.0	0.666

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 9

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00426	0.026	0.026	0.0	3011.9	3011.5	0.0	0.872
2	1	5.5	0.01236	0.044	0.044	-0.1	2764.1	2763.1	0.0	0.717
3	1	8.5	0.01881	0.053	0.053	-0.1	2634.9	2633.6	0.0	0.641
4	1	11.5	0.01726	0.051	0.051	0.0	3768.3	3767.6	0.0	0.656
5	1	14.5	0.02891	0.065	0.065	0.0	2764.2	2763.5	0.0	0.559
6	1	17.5	0.04289	0.078	0.078	-0.1	2154.6	2153.2	0.1	0.484
7	1	20.5	0.04825	0.082	0.082	-0.1	2228.9	2227.5	0.1	0.461
8	1	23.5	0.07438	0.097	0.097	0.0	1617.7	1616.9	0.1	0.379
9	1	26.5	0.06976	0.095	0.095	-0.1	1841.1	1839.8	0.1	0.390
10	1	30.0	0.07218	0.096	0.096	-0.1	1848.3	1846.4	0.1	0.384
11	3	33.5	0.12851	0.107	0.107	0.0	1056.3	1055.9	0.0	0.401
12	3	36.5	0.14505	0.113	0.113	0.1	998.5	999.7	-0.1	0.376
13	3	39.5	0.12746	0.107	0.107	0.1	1207.0	1208.7	-0.1	0.403
14	3	42.5	0.08430	0.087	0.087	0.0	1853.6	1854.0	0.0	0.493
15	3	45.5	0.03618	0.053	0.053	0.0	4401.0	4400.8	0.0	0.674
16	3	48.5	0.03772	0.054	0.054	0.0	4313.4	4313.1	0.0	0.666

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SOIL PROFILE - PSCS300E Crest Column

ITERATION NUMBER 10

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	G/Go RATIO
1	1	2.0	0.00426	0.026	0.026	0.0	3012.1	3011.9	0.0	0.872
2	1	5.5	0.01235	0.044	0.044	0.0	2764.6	2764.1	0.0	0.717
3	1	8.5	0.01879	0.053	0.053	0.0	2635.6	2634.9	0.0	0.641
4	1	11.5	0.01725	0.051	0.051	0.0	3768.7	3768.3	0.0	0.657
5	1	14.5	0.02889	0.065	0.065	0.0	2764.6	2764.2	0.0	0.559
6	1	17.5	0.04285	0.078	0.078	0.0	2155.4	2154.6	0.0	0.484
7	1	20.5	0.04821	0.082	0.082	0.0	2229.8	2228.9	0.0	0.461
8	1	23.5	0.07432	0.097	0.097	0.0	1618.3	1617.7	0.0	0.379
9	1	26.5	0.06970	0.095	0.095	0.0	1842.0	1841.1	0.0	0.391
10	1	30.0	0.07209	0.096	0.096	0.0	1849.3	1848.3	0.1	0.384
11	3	33.5	0.12847	0.107	0.107	0.0	1056.5	1056.3	0.0	0.401
12	3	36.5	0.14523	0.113	0.113	0.1	997.8	998.5	-0.1	0.375
13	3	39.5	0.12763	0.107	0.107	0.1	1206.2	1207.0	-0.1	0.403
14	3	42.5	0.08432	0.087	0.087	0.0	1853.4	1853.6	0.0	0.493
15	3	45.5	0.03618	0.053	0.053	0.0	4401.1	4401.0	0.0	0.674
16	3	48.5	0.03772	0.054	0.054	0.0	4313.4	4313.4	0.0	0.666

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	1	4.0000	2.0000	0.00656	197.47	13.60
2	1	3.0000	5.5000	0.01900	525.07	13.60
3	1	3.0000	8.5000	0.02891	761.69	13.60
4	1	3.0000	11.5000	0.02654	1000.00	13.47
5	1	3.0000	14.5000	0.04445	1228.70	13.47
6	1	3.0000	17.5000	0.06592	1420.30	13.46
7	1	3.0000	20.5000	0.07416	1653.05	13.46
8	1	3.0000	23.5000	0.11434	1849.71	13.46
9	1	3.0000	26.5000	0.10723	1974.16	13.46
10	1	4.0000	30.0000	0.11091	2050.01	13.45
11	3	3.0000	33.5000	0.19765	2087.75	26.78
12	3	3.0000	36.5000	0.22343	2230.89	13.48
13	3	3.0000	39.5000	0.19636	2370.16	13.48
14	3	3.0000	42.5000	0.12973	2404.61	13.48
15	3	3.0000	45.5000	0.05567	2449.90	13.47
16	3	3.0000	48.5000	0.05803	2503.04	13.47

PERIOD = 0.27 FROM AVERAGE SHEAR VEL. = 740.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 6.29
FOR FREQUENCY = 3.22 C/SEC.
PERIOD = 0.31 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE	TH SAVED ACC. RECORD
OUTCR.	0.0000	0.75475	13.60	8.54	0.001	2048
WITHIN	4.0000	0.70138	13.60	7.22	0.000	2048
WITHIN	7.0000	0.65623	13.47	5.56	0.000	2048
WITHIN	10.0000	0.63991	13.45	5.53	0.001	2048
WITHIN	13.0000	0.65636	13.45	6.13	0.001	2048
WITHIN	16.0000	0.64637	13.45	6.55	0.000	2048
WITHIN	19.0000	0.59333	13.45	7.41	0.001	2048
WITHIN	22.0000	0.57039	18.63	8.36	0.001	2048
WITHIN	25.0000	0.55506	16.57	9.15	0.001	2048
WITHIN	28.0000	0.59901	16.56	9.97	0.001	2048
WITHIN	32.0000	0.67650	16.20	10.98	0.001	2048
WITHIN	35.0000	0.64739	16.20	13.92	0.002	2048
WITHIN	38.0000	0.71677	16.19	15.30	0.001	2048
WITHIN	41.0000	0.59839	20.01	15.65	0.002	2048
WITHIN	44.0000	0.52211	24.58	15.50	0.002	2048

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\SHAKE2000\Williamson Energy\NewMadrid.eq
SOIL DEPOSIT - PSCS300E Crest Column

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE	TH SAVED ACC. RECORD
WITHIN	47.0000	0.51594	16.61	14.54	0.002	2048
WITHIN	50.0000	0.52906	24.57	13.40	0.002	2048

OUTCR.	50.0000	0.57825	24.57	14.61	0.002	2048

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 1 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 1
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 1 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 2 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 2
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 2 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 3 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 3
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 3 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 4 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 4
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 4 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 5 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 5
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 5 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC330M Layer 6 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 6
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PSCS300M Layer 6 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 7 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 7
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 7 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 8 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 8
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 8 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 9 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 9
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PSCS300E Layer 9 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 10 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 10
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300E Layer 10 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 11 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 11 Strain

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 12 Stress

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 12
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - PCSC300M Layer 12 Strain

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1****** OPTION  7 *** COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  13
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 13 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  13
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 13 Strain

1****** OPTION  7 *** COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  14
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 14 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  14
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 14 Strain

1****** OPTION  7 *** COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  15
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 15 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  15
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 15 Strain

1****** OPTION  7 *** COMPUTE STRESS/STRAIN HISTORY

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  16
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 16 Stress

 COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER  16
 SCALE FOR PLOTTING    0.0000
IDENTIFICATION - PCSC300M Layer 16 Strain

1****** OPTION  9 *** COMPUTE RESPONSE SPECTRUM
 RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER       1
CALCULATED FOR DAMPING       0.050

  TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
     TD = TIME FOR MAX. RELATIVE DISP.
     TV = TIME FOR MAX. RELATIVE VEL.
     TA = TIME FOR MAX. ABSOLUTE ACC.
  DAMPING RATIO = 0.050
  PER = 0.01    TIMES FOR MAXIMA --  TD = 13.5900  TV = 18.6700  TA = 13.5900
  PER = 0.02    TIMES FOR MAXIMA --  TD = 13.5900  TV = 18.6600  TA = 13.5900
  PER = 0.03    TIMES FOR MAXIMA --  TD = 16.7300  TV = 23.4400  TA = 16.7300
  PER = 0.04    TIMES FOR MAXIMA --  TD = 18.7600  TV = 24.7500  TA = 18.7600
  PER = 0.05    TIMES FOR MAXIMA --  TD = 10.5400  TV = 10.5300  TA = 10.5400
  PER = 0.06    TIMES FOR MAXIMA --  TD = 18.3000  TV = 18.6800  TA = 18.3000
  PER = 0.07    TIMES FOR MAXIMA --  TD = 18.3500  TV = 18.3300  TA = 24.1300
  PER = 0.08    TIMES FOR MAXIMA --  TD = 11.4200  TV = 16.2700  TA = 11.4200
  PER = 0.09    TIMES FOR MAXIMA --  TD = 11.4400  TV = 11.4200  TA = 11.4400
  PER = 0.10    TIMES FOR MAXIMA --  TD = 20.7600  TV = 13.7300  TA = 20.7600
  PER = 0.11    TIMES FOR MAXIMA --  TD = 25.6000  TV = 25.5700  TA = 25.5900
  PER = 0.12    TIMES FOR MAXIMA --  TD = 20.7800  TV = 20.1100  TA = 20.7800
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PER = 0.13	TIMES FOR MAXIMA --	TD = 16.7500	TV = 25.5800	TA = 16.7500
PER = 0.14	TIMES FOR MAXIMA --	TD = 16.7600	TV = 16.7900	TA = 16.7500
PER = 0.15	TIMES FOR MAXIMA --	TD = 14.1800	TV = 14.1500	TA = 14.1800
PER = 0.16	TIMES FOR MAXIMA --	TD = 13.4700	TV = 20.6000	TA = 13.4700
PER = 0.17	TIMES FOR MAXIMA --	TD = 13.4800	TV = 8.6400	TA = 13.4700
PER = 0.18	TIMES FOR MAXIMA --	TD = 13.4800	TV = 13.6400	TA = 13.4800
PER = 0.19	TIMES FOR MAXIMA --	TD = 13.6000	TV = 13.6500	TA = 13.6000
PER = 0.20	TIMES FOR MAXIMA --	TD = 13.6100	TV = 13.6600	TA = 13.6100
PER = 0.21	TIMES FOR MAXIMA --	TD = 24.4100	TV = 24.3600	TA = 24.4100
PER = 0.22	TIMES FOR MAXIMA --	TD = 24.5400	TV = 24.4900	TA = 24.5400
PER = 0.23	TIMES FOR MAXIMA --	TD = 21.8200	TV = 21.8800	TA = 21.8200
PER = 0.24	TIMES FOR MAXIMA --	TD = 21.8300	TV = 21.8900	TA = 21.8300
PER = 0.25	TIMES FOR MAXIMA --	TD = 21.8500	TV = 21.9100	TA = 21.8400
PER = 0.26	TIMES FOR MAXIMA --	TD = 21.1000	TV = 21.1800	TA = 21.1000
PER = 0.27	TIMES FOR MAXIMA --	TD = 21.2600	TV = 21.1900	TA = 21.2500
PER = 0.28	TIMES FOR MAXIMA --	TD = 21.2600	TV = 21.1900	TA = 21.2600
PER = 0.29	TIMES FOR MAXIMA --	TD = 21.2800	TV = 21.2000	TA = 21.2700
PER = 0.30	TIMES FOR MAXIMA --	TD = 13.6600	TV = 14.1900	TA = 13.6500
PER = 0.31	TIMES FOR MAXIMA --	TD = 14.1400	TV = 13.6000	TA = 14.1400
PER = 0.32	TIMES FOR MAXIMA --	TD = 13.7000	TV = 13.6100	TA = 13.6900
PER = 0.33	TIMES FOR MAXIMA --	TD = 13.7100	TV = 13.6300	TA = 13.7100
PER = 0.34	TIMES FOR MAXIMA --	TD = 21.8900	TV = 20.9600	TA = 13.7200
PER = 0.35	TIMES FOR MAXIMA --	TD = 17.0100	TV = 21.8300	TA = 17.0000
PER = 0.36	TIMES FOR MAXIMA --	TD = 17.2000	TV = 17.3000	TA = 17.2000
PER = 0.37	TIMES FOR MAXIMA --	TD = 17.2200	TV = 17.1300	TA = 17.2100
PER = 0.38	TIMES FOR MAXIMA --	TD = 17.2300	TV = 17.1400	TA = 17.2300
PER = 0.39	TIMES FOR MAXIMA --	TD = 17.0600	TV = 17.1600	TA = 17.0500
PER = 0.40	TIMES FOR MAXIMA --	TD = 17.0700	TV = 17.1700	TA = 17.0700
PER = 0.41	TIMES FOR MAXIMA --	TD = 17.0800	TV = 16.9800	TA = 17.0800
PER = 0.42	TIMES FOR MAXIMA --	TD = 17.0900	TV = 16.9900	TA = 17.0900
PER = 0.43	TIMES FOR MAXIMA --	TD = 16.9000	TV = 16.9900	TA = 16.8900
PER = 0.44	TIMES FOR MAXIMA --	TD = 16.9000	TV = 17.0000	TA = 16.9000
PER = 0.45	TIMES FOR MAXIMA --	TD = 16.9200	TV = 16.8200	TA = 16.9100
PER = 0.46	TIMES FOR MAXIMA --	TD = 16.9300	TV = 16.8200	TA = 16.9200
PER = 0.47	TIMES FOR MAXIMA --	TD = 16.9300	TV = 16.8300	TA = 16.9300
PER = 0.48	TIMES FOR MAXIMA --	TD = 16.9400	TV = 16.8300	TA = 16.9300
PER = 0.49	TIMES FOR MAXIMA --	TD = 16.7300	TV = 16.8400	TA = 16.7200
PER = 0.50	TIMES FOR MAXIMA --	TD = 16.7300	TV = 16.8400	TA = 16.7300
PER = 0.51	TIMES FOR MAXIMA --	TD = 16.7400	TV = 16.8500	TA = 16.7300
PER = 0.52	TIMES FOR MAXIMA --	TD = 16.7500	TV = 16.6500	TA = 16.7400
PER = 0.53	TIMES FOR MAXIMA --	TD = 16.7600	TV = 16.6700	TA = 16.7600
PER = 0.54	TIMES FOR MAXIMA --	TD = 16.5500	TV = 16.6800	TA = 16.5400
PER = 0.55	TIMES FOR MAXIMA --	TD = 29.2800	TV = 16.6800	TA = 29.2700
PER = 0.56	TIMES FOR MAXIMA --	TD = 32.2000	TV = 29.1800	TA = 32.1900
PER = 0.57	TIMES FOR MAXIMA --	TD = 32.2200	TV = 30.6800	TA = 32.2200
PER = 0.58	TIMES FOR MAXIMA --	TD = 30.5500	TV = 30.6900	TA = 30.5400
PER = 0.60	TIMES FOR MAXIMA --	TD = 30.5900	TV = 30.7200	TA = 30.5800
PER = 0.62	TIMES FOR MAXIMA --	TD = 30.6100	TV = 30.4900	TA = 30.6000
PER = 0.64	TIMES FOR MAXIMA --	TD = 16.7500	TV = 16.8900	TA = 16.7400
PER = 0.66	TIMES FOR MAXIMA --	TD = 16.7700	TV = 16.6700	TA = 16.7600
PER = 0.68	TIMES FOR MAXIMA --	TD = 16.7900	TV = 16.6800	TA = 16.7800
PER = 0.70	TIMES FOR MAXIMA --	TD = 16.5400	TV = 16.6800	TA = 16.5300
PER = 0.72	TIMES FOR MAXIMA --	TD = 16.5600	TV = 16.6800	TA = 16.5500
PER = 0.74	TIMES FOR MAXIMA --	TD = 16.5700	TV = 16.6800	TA = 16.5600
PER = 0.76	TIMES FOR MAXIMA --	TD = 16.5800	TV = 16.6800	TA = 16.5600
PER = 0.78	TIMES FOR MAXIMA --	TD = 32.7400	TV = 16.4800	TA = 32.7300
PER = 0.80	TIMES FOR MAXIMA --	TD = 32.7600	TV = 16.4800	TA = 32.7500
PER = 0.82	TIMES FOR MAXIMA --	TD = 32.7800	TV = 16.4800	TA = 16.5800
PER = 0.84	TIMES FOR MAXIMA --	TD = 33.6700	TV = 16.4800	TA = 33.6600
PER = 0.86	TIMES FOR MAXIMA --	TD = 16.3200	TV = 16.4800	TA = 16.3000
PER = 0.88	TIMES FOR MAXIMA --	TD = 12.1700	TV = 16.4800	TA = 16.3100

PER = 0.90 TIMES FOR MAXIMA -- TD = 12.2400 TV = 12.4300 TA = 12.2300
PER = 0.92 TIMES FOR MAXIMA -- TD = 12.2400 TV = 12.4300 TA = 12.2300
PER = 0.94 TIMES FOR MAXIMA -- TD = 12.2500 TV = 12.4300 TA = 12.2400
PER = 0.96 TIMES FOR MAXIMA -- TD = 12.2600 TV = 12.4300 TA = 12.2500
PER = 0.98 TIMES FOR MAXIMA -- TD = 12.2800 TV = 12.4400 TA = 12.2700
PER = 1.00 TIMES FOR MAXIMA -- TD = 12.3000 TV = 12.4400 TA = 12.2800
PER = 1.05 TIMES FOR MAXIMA -- TD = 12.3300 TV = 13.7000 TA = 12.3200
PER = 1.10 TIMES FOR MAXIMA -- TD = 12.3500 TV = 13.2000 TA = 12.3300
PER = 1.15 TIMES FOR MAXIMA -- TD = 13.5900 TV = 13.2400 TA = 13.5700
PER = 1.20 TIMES FOR MAXIMA -- TD = 13.6300 TV = 13.9700 TA = 13.5900
PER = 1.25 TIMES FOR MAXIMA -- TD = 13.1200 TV = 13.5200 TA = 13.1000
PER = 1.30 TIMES FOR MAXIMA -- TD = 13.1500 TV = 13.5300 TA = 13.1200
PER = 1.35 TIMES FOR MAXIMA -- TD = 13.1500 TV = 13.5300 TA = 13.1300
PER = 1.40 TIMES FOR MAXIMA -- TD = 13.1600 TV = 13.5300 TA = 13.1400
PER = 1.45 TIMES FOR MAXIMA -- TD = 13.1700 TV = 13.5300 TA = 13.1500
PER = 1.50 TIMES FOR MAXIMA -- TD = 13.1900 TV = 13.5300 TA = 13.1700
PER = 1.55 TIMES FOR MAXIMA -- TD = 13.2300 TV = 13.5300 TA = 13.1900
PER = 1.60 TIMES FOR MAXIMA -- TD = 13.4200 TV = 13.5300 TA = 13.4000
PER = 1.65 TIMES FOR MAXIMA -- TD = 13.4300 TV = 13.0600 TA = 13.4100
PER = 1.70 TIMES FOR MAXIMA -- TD = 13.4400 TV = 13.0600 TA = 13.4100
PER = 1.75 TIMES FOR MAXIMA -- TD = 16.3800 TV = 18.6600 TA = 16.3600
PER = 1.80 TIMES FOR MAXIMA -- TD = 17.4800 TV = 18.6600 TA = 17.4600
PER = 1.85 TIMES FOR MAXIMA -- TD = 17.5000 TV = 17.9200 TA = 17.4700
PER = 1.90 TIMES FOR MAXIMA -- TD = 18.5500 TV = 17.9200 TA = 18.5300
PER = 1.95 TIMES FOR MAXIMA -- TD = 18.5800 TV = 16.2500 TA = 18.5500
PER = 2.00 TIMES FOR MAXIMA -- TD = 18.5900 TV = 16.2500 TA = 18.5600
PER = 2.05 TIMES FOR MAXIMA -- TD = 19.7100 TV = 16.2500 TA = 19.6800
PER = 2.10 TIMES FOR MAXIMA -- TD = 17.7100 TV = 16.2500 TA = 19.7100
PER = 2.15 TIMES FOR MAXIMA -- TD = 17.7800 TV = 16.2500 TA = 17.7600
PER = 2.20 TIMES FOR MAXIMA -- TD = 17.8200 TV = 16.2600 TA = 17.8000
PER = 2.25 TIMES FOR MAXIMA -- TD = 16.8100 TV = 16.2600 TA = 16.7700
PER = 2.30 TIMES FOR MAXIMA -- TD = 19.1100 TV = 16.2600 TA = 19.0900
PER = 2.35 TIMES FOR MAXIMA -- TD = 17.0900 TV = 16.6800 TA = 17.0600
PER = 2.40 TIMES FOR MAXIMA -- TD = 16.0700 TV = 16.6800 TA = 16.0500
PER = 2.50 TIMES FOR MAXIMA -- TD = 11.9300 TV = 16.6800 TA = 11.8600
PER = 2.60 TIMES FOR MAXIMA -- TD = 12.0100 TV = 12.5700 TA = 11.9400
PER = 2.70 TIMES FOR MAXIMA -- TD = 12.0900 TV = 12.5700 TA = 12.0200
PER = 2.80 TIMES FOR MAXIMA -- TD = 17.1100 TV = 16.6800 TA = 17.0700
PER = 2.90 TIMES FOR MAXIMA -- TD = 17.1400 TV = 16.6800 TA = 17.1000
PER = 3.00 TIMES FOR MAXIMA -- TD = 16.0800 TV = 16.6800 TA = 16.0500
PER = 3.10 TIMES FOR MAXIMA -- TD = 16.1300 TV = 16.6800 TA = 16.0500
PER = 3.20 TIMES FOR MAXIMA -- TD = 16.1400 TV = 16.6800 TA = 16.1200
PER = 3.30 TIMES FOR MAXIMA -- TD = 16.1500 TV = 16.6800 TA = 16.1200
PER = 3.40 TIMES FOR MAXIMA -- TD = 16.1500 TV = 16.6800 TA = 16.1200
PER = 3.50 TIMES FOR MAXIMA -- TD = 45.5600 TV = 16.6800 TA = 45.4800
PER = 3.60 TIMES FOR MAXIMA -- TD = 45.7200 TV = 16.6800 TA = 45.6600
PER = 3.70 TIMES FOR MAXIMA -- TD = 44.2600 TV = 16.6800 TA = 44.2300
PER = 3.80 TIMES FOR MAXIMA -- TD = 44.3000 TV = 16.6800 TA = 44.2400
PER = 3.90 TIMES FOR MAXIMA -- TD = 46.2900 TV = 16.6800 TA = 46.2200
PER = 4.00 TIMES FOR MAXIMA -- TD = 44.6200 TV = 16.6800 TA = 16.1200
PER = 4.10 TIMES FOR MAXIMA -- TD = 16.1500 TV = 16.6800 TA = 16.1200
PER = 4.20 TIMES FOR MAXIMA -- TD = 14.9100 TV = 16.6800 TA = 14.8800
PER = 4.30 TIMES FOR MAXIMA -- TD = 14.9200 TV = 16.6800 TA = 14.8800
PER = 4.40 TIMES FOR MAXIMA -- TD = 14.9200 TV = 16.6800 TA = 14.8800
PER = 4.50 TIMES FOR MAXIMA -- TD = 14.9200 TV = 16.6800 TA = 14.8900
PER = 4.60 TIMES FOR MAXIMA -- TD = 14.9300 TV = 16.6800 TA = 14.8900
PER = 4.70 TIMES FOR MAXIMA -- TD = 32.0500 TV = 16.6800 TA = 32.0000
PER = 4.80 TIMES FOR MAXIMA -- TD = 32.0700 TV = 26.8200 TA = 32.0000
PER = 4.90 TIMES FOR MAXIMA -- TD = 32.0900 TV = 26.8200 TA = 32.0000
PER = 5.00 TIMES FOR MAXIMA -- TD = 32.1000 TV = 26.8200 TA = 32.0000
PER = 5.10 TIMES FOR MAXIMA -- TD = 28.0900 TV = 26.8200 TA = 32.0000

PER = 5.20 TIMES FOR MAXIMA -- TD = 28.1000 TV = 26.8200 TA = 28.0700
PER = 5.40 TIMES FOR MAXIMA -- TD = 9.8600 TV = 26.8200 TA = 9.7900
PER = 5.60 TIMES FOR MAXIMA -- TD = 9.8600 TV = 26.8200 TA = 9.7900
PER = 5.80 TIMES FOR MAXIMA -- TD = 9.8700 TV = 26.8200 TA = 9.8100
PER = 6.00 TIMES FOR MAXIMA -- TD = 14.9200 TV = 12.5700 TA = 14.8800
PER = 6.20 TIMES FOR MAXIMA -- TD = 14.9200 TV = 12.5700 TA = 14.8800
PER = 6.40 TIMES FOR MAXIMA -- TD = 14.9200 TV = 12.5700 TA = 14.8800
PER = 6.60 TIMES FOR MAXIMA -- TD = 14.9200 TV = 12.5700 TA = 14.8800
PER = 6.80 TIMES FOR MAXIMA -- TD = 14.9300 TV = 12.5700 TA = 14.8800
PER = 7.00 TIMES FOR MAXIMA -- TD = 14.9300 TV = 12.5700 TA = 14.8800
PER = 7.30 TIMES FOR MAXIMA -- TD = 15.4000 TV = 12.5700 TA = 15.3500
PER = 7.60 TIMES FOR MAXIMA -- TD = 15.4200 TV = 12.5700 TA = 15.3500
PER = 8.00 TIMES FOR MAXIMA -- TD = 15.4500 TV = 12.5700 TA = 15.3500
PER = 8.50 TIMES FOR MAXIMA -- TD = 15.5600 TV = 14.6700 TA = 15.3500
PER = 9.00 TIMES FOR MAXIMA -- TD = 16.7900 TV = 14.6700 TA = 16.6900
PER = 9.50 TIMES FOR MAXIMA -- TD = 17.1300 TV = 14.6700 TA = 16.6900
PER =10.00 TIMES FOR MAXIMA -- TD = 17.1400 TV = 16.6800 TA = 16.6900

SPECTRAL VALUES--
(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00006	0.00148	0.03859	0.75485	0.75291	100.00
2	0.02	0.00025	0.02224	0.07796	0.75500	0.76065	50.00
3	0.03	0.00078	0.11720	0.16261	1.03737	1.05770	33.33
4	0.04	0.00189	0.22142	0.29725	1.49386	1.45006	25.00
5	0.05	0.00353	0.36329	0.44334	1.72141	1.73017	20.00
6	0.06	0.00483	0.44388	0.50543	1.65995	1.64373	16.67
7	0.07	0.00564	0.47782	0.50625	1.41515	1.41122	14.29
8	0.08	0.00871	0.58053	0.68370	1.68512	1.66764	12.50
9	0.09	0.01508	0.96101	1.05299	2.26021	2.28299	11.11
10	0.10	0.01299	0.72198	0.81629	1.56974	1.59283	10.00
11	0.11	0.01511	0.75961	0.86325	1.51221	1.53132	9.09
12	0.12	0.01593	0.71575	0.83428	1.34972	1.35661	8.33
13	0.13	0.01582	0.62295	0.76445	1.16305	1.14744	7.69
14	0.14	0.01950	0.63144	0.87519	1.21278	1.21982	7.14
15	0.15	0.01864	0.67126	0.78082	1.02964	1.01574	6.67
16	0.16	0.02349	0.86132	0.92251	1.13603	1.12506	6.25
17	0.17	0.02777	0.90208	1.02633	1.17499	1.17804	5.88
18	0.18	0.03486	1.06543	1.21697	1.32473	1.31927	5.56
19	0.19	0.04476	1.40113	1.48005	1.53362	1.52001	5.26
20	0.20	0.05135	1.48010	1.61313	1.59068	1.57385	5.00
21	0.21	0.05378	1.40334	1.60911	1.50057	1.49517	4.76
22	0.22	0.06247	1.68568	1.78428	1.58991	1.58257	4.55
23	0.23	0.07357	1.91656	2.00969	1.70152	1.70500	4.35
24	0.24	0.09137	2.33734	2.39194	1.95066	1.94475	4.17
25	0.25	0.11652	2.94881	2.92858	2.30515	2.28582	4.00
26	0.26	0.12800	3.02688	3.09326	2.34448	2.32149	3.85
27	0.27	0.12504	2.99262	2.90987	2.12452	2.10298	3.70
28	0.28	0.13141	3.03524	2.94874	2.07401	2.05496	3.57
29	0.29	0.15347	3.42825	3.32509	2.24634	2.23732	3.45
30	0.30	0.19268	4.03283	4.03556	2.64720	2.62486	3.33
31	0.31	0.20983	4.47487	4.25300	2.68072	2.67706	3.23
32	0.32	0.20696	4.25418	4.06370	2.48767	2.47797	3.13
33	0.33	0.19217	3.75961	3.65883	2.18322	2.16348	3.03
34	0.34	0.16818	3.26236	3.10792	1.79320	1.78367	2.94
35	0.35	0.16793	3.20433	3.01476	1.69344	1.68077	2.86
36	0.36	0.18371	3.12146	3.20641	1.74523	1.73796	2.78
37	0.37	0.19763	3.36541	3.35610	1.77853	1.76994	2.70
38	0.38	0.21096	3.55027	3.48817	1.80305	1.79118	2.63
39	0.39	0.22040	3.63331	3.55073	1.78392	1.77655	2.56
40	0.40	0.22485	3.69214	3.53190	1.72705	1.72295	2.50

41	0.41	0.22536	3.65259	3.45358	1.65110	1.64365	2.44
42	0.42	0.22255	3.54459	3.32938	1.55420	1.54681	2.38
43	0.43	0.22619	3.51520	3.30516	1.50884	1.49985	2.33
44	0.44	0.24333	3.58677	3.47469	1.55138	1.54094	2.27
45	0.45	0.25076	3.58192	3.50127	1.52911	1.51823	2.22
46	0.46	0.24164	3.47798	3.30053	1.40986	1.40007	2.17
47	0.47	0.23406	3.37542	3.12904	1.30713	1.29908	2.13
48	0.48	0.23328	3.35192	3.05362	1.24660	1.24136	2.08
49	0.49	0.23208	3.32575	2.97592	1.19463	1.18509	2.04
50	0.50	0.23446	3.26179	2.94635	1.15763	1.14984	2.00
51	0.51	0.23536	3.14001	2.89964	1.11697	1.10942	1.96
52	0.52	0.22644	3.03081	2.73608	1.03255	1.02671	1.92
53	0.53	0.20464	2.94390	2.42606	0.89792	0.89320	1.89
54	0.54	0.17782	2.68504	2.06905	0.75226	0.74765	1.85
55	0.55	0.17279	2.35637	1.97391	0.70502	0.70031	1.82
56	0.56	0.18963	2.26618	2.12761	0.74412	0.74136	1.79
57	0.57	0.20836	2.39709	2.29681	0.78980	0.78627	1.75
58	0.58	0.22669	2.66539	2.45580	0.83077	0.82621	1.72
59	0.60	0.24149	2.62894	2.52889	0.82756	0.82244	1.67
60	0.62	0.21879	2.42628	2.21730	0.70270	0.69784	1.61
61	0.64	0.19260	2.06369	1.89080	0.58082	0.57649	1.56
62	0.66	0.21707	2.48272	2.06651	0.61478	0.61097	1.52
63	0.68	0.21999	2.78608	2.03270	0.58776	0.58329	1.47
64	0.70	0.23315	2.82933	2.09279	0.58841	0.58338	1.43
65	0.72	0.23178	2.61336	2.02264	0.55220	0.54816	1.39
66	0.74	0.21850	2.34059	1.85522	0.49252	0.48920	1.35
67	0.76	0.21042	2.16903	1.73960	0.45021	0.44664	1.32
68	0.78	0.22309	2.13432	1.79706	0.45295	0.44956	1.28
69	0.80	0.23577	2.25645	1.85170	0.45490	0.45165	1.25
70	0.82	0.23552	2.46660	1.80462	0.43393	0.42943	1.22
71	0.84	0.23594	2.58781	1.76482	0.41263	0.40996	1.19
72	0.86	0.22187	2.48884	1.62096	0.37085	0.36779	1.16
73	0.88	0.21006	2.33420	1.49985	0.33389	0.33257	1.14
74	0.90	0.21609	2.27460	1.50858	0.32804	0.32708	1.11
75	0.92	0.23488	2.35067	1.60410	0.34148	0.34023	1.09
76	0.94	0.26691	2.48294	1.78408	0.37188	0.37035	1.06
77	0.96	0.30028	2.56589	1.96533	0.40160	0.39947	1.04
78	0.98	0.32639	2.54769	2.09262	0.41885	0.41667	1.02
79	1.00	0.34474	2.46579	2.16605	0.42491	0.42266	1.00
80	1.05	0.37607	2.36155	2.25040	0.42136	0.41821	0.95
81	1.10	0.37369	2.42711	2.13453	0.38205	0.37865	0.91
82	1.15	0.44233	2.50484	2.41675	0.41528	0.41007	0.87
83	1.20	0.48888	2.59708	2.55975	0.41871	0.41624	0.83
84	1.25	0.46177	2.85322	2.32110	0.36556	0.36233	0.80
85	1.30	0.38996	2.70824	1.88476	0.28546	0.28290	0.77
86	1.35	0.34167	2.50267	1.59021	0.23213	0.22985	0.74
87	1.40	0.33081	2.42499	1.48467	0.20902	0.20693	0.71
88	1.45	0.33516	2.40128	1.45233	0.19733	0.19544	0.69
89	1.50	0.34051	2.35661	1.42631	0.18699	0.18554	0.67
90	1.55	0.33300	2.21880	1.34989	0.17078	0.16994	0.65
91	1.60	0.34984	1.97367	1.37380	0.16938	0.16754	0.63
92	1.65	0.34094	1.83003	1.29831	0.15644	0.15354	0.61
93	1.70	0.31162	1.71375	1.15175	0.13541	0.13220	0.59
94	1.75	0.32900	1.75582	1.18124	0.13427	0.13171	0.57
95	1.80	0.37390	1.78172	1.30517	0.14309	0.14149	0.56
96	1.85	0.40832	1.76324	1.38679	0.14828	0.14627	0.54
97	1.90	0.42440	1.73356	1.40346	0.14562	0.14414	0.53
98	1.95	0.44906	1.71742	1.44692	0.14647	0.14479	0.51
99	2.00	0.47550	1.77268	1.49383	0.14750	0.14575	0.50
100	2.05	0.51275	1.90190	1.57155	0.15154	0.14959	0.49
101	2.10	0.54946	2.09561	1.64398	0.15386	0.15276	0.48

102	2.15	0.59857	2.29334	1.74927	0.15955	0.15876	0.47
103	2.20	0.62244	2.42372	1.77767	0.15911	0.15767	0.45
104	2.25	0.60487	2.42782	1.68911	0.14863	0.14649	0.44
105	2.30	0.56825	2.29373	1.55237	0.13338	0.13170	0.43
106	2.35	0.51158	2.16262	1.36781	0.11455	0.11357	0.43
107	2.40	0.47300	2.13297	1.23832	0.10226	0.10068	0.42
108	2.50	0.40057	1.82526	1.00674	0.07968	0.07858	0.40
109	2.60	0.43355	1.81593	1.04772	0.07951	0.07863	0.38
110	2.70	0.42170	1.68762	0.98134	0.07168	0.07092	0.37
111	2.80	0.39019	1.71376	0.87559	0.06217	0.06102	0.36
112	2.90	0.44155	1.91046	0.95667	0.06579	0.06437	0.34
113	3.00	0.45601	1.99271	0.95507	0.06361	0.06212	0.33
114	3.10	0.47532	1.93884	0.96340	0.06185	0.06064	0.32
115	3.20	0.45002	1.80040	0.88360	0.05513	0.05388	0.31
116	3.30	0.39849	1.64675	0.75873	0.04644	0.04486	0.30
117	3.40	0.34537	1.52765	0.63824	0.03824	0.03663	0.29
118	3.50	0.34585	1.46112	0.62087	0.03541	0.03461	0.29
119	3.60	0.38778	1.43922	0.67680	0.03705	0.03668	0.28
120	3.70	0.40027	1.44089	0.67971	0.03652	0.03585	0.27
121	3.80	0.41610	1.44393	0.68801	0.03621	0.03533	0.26
122	3.90	0.38890	1.43272	0.62655	0.03211	0.03135	0.26
123	4.00	0.34298	1.40085	0.53876	0.02659	0.02628	0.25
124	4.10	0.32261	1.35007	0.49440	0.02509	0.02353	0.24
125	4.20	0.33552	1.28748	0.50193	0.02433	0.02332	0.24
126	4.30	0.35346	1.22218	0.51648	0.02452	0.02344	0.23
127	4.40	0.36225	1.16271	0.51729	0.02409	0.02294	0.23
128	4.50	0.36139	1.11530	0.50460	0.02310	0.02188	0.22
129	4.60	0.35233	1.08319	0.48125	0.02169	0.02041	0.22
130	4.70	0.34994	1.06690	0.46782	0.02067	0.01942	0.21
131	4.80	0.36366	1.12886	0.47603	0.02067	0.01935	0.21
132	4.90	0.35074	1.17140	0.44974	0.01920	0.01791	0.20
133	5.00	0.31965	1.19172	0.40168	0.01692	0.01568	0.20
134	5.10	0.28175	1.19536	0.34712	0.01445	0.01328	0.20
135	5.20	0.28122	1.18986	0.33981	0.01336	0.01275	0.19
136	5.40	0.28226	1.17590	0.32843	0.01256	0.01187	0.19
137	5.60	0.30531	1.16881	0.34256	0.01265	0.01194	0.18
138	5.80	0.32103	1.15075	0.34777	0.01244	0.01170	0.17
139	6.00	0.33548	1.16305	0.35132	0.01228	0.01143	0.17
140	6.20	0.39029	1.19910	0.39552	0.01329	0.01245	0.16
141	6.40	0.44539	1.22615	0.43726	0.01419	0.01333	0.16
142	6.60	0.49611	1.24427	0.47230	0.01486	0.01396	0.15
143	6.80	0.53946	1.25423	0.49846	0.01525	0.01430	0.15
144	7.00	0.57413	1.25733	0.51534	0.01536	0.01437	0.14
145	7.30	0.63071	1.25193	0.54286	0.01516	0.01451	0.14
146	7.60	0.67786	1.23807	0.56041	0.01512	0.01439	0.13
147	8.00	0.71450	1.21192	0.56116	0.01446	0.01369	0.13
148	8.50	0.72441	1.21511	0.53549	0.01306	0.01229	0.12
149	9.00	0.75099	1.25493	0.52429	0.01297	0.01137	0.11
150	9.50	0.82840	1.27770	0.54789	0.01277	0.01125	0.11
151	10.00	0.89637	1.29458	0.56321	0.01215	0.01099	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.
AREA OF ACC. RESPONSE SPECTRUM = 1.256
AREA OF VEL. RESPONSE SPECTRUM = 5.565
MAX. ACCELERATION RESPONSE VALUE = 2.681
MAX. VELOCITY RESPONSE VALUE = 4.475

1****** OPTION 9 *** COMPUTE RESPONSE SPECTRUM
RESPONSE SPECTRUM ANALYSIS FOR LAYER NUMBER 17
CALCULATED FOR DAMPING 0.050

TIMES AT WHICH MAX. SPECTRAL VALUES OCCUR
TD = TIME FOR MAX. RELATIVE DISP.
TV = TIME FOR MAX. RELATIVE VEL.
TA = TIME FOR MAX. ABSOLUTE ACC.
DAMPING RATIO = 0.050

PER = 0.01	TIMES FOR MAXIMA --	TD = 24.5600	TV = 18.6000	TA = 24.5600
PER = 0.02	TIMES FOR MAXIMA --	TD = 24.5600	TV = 11.4800	TA = 24.5600
PER = 0.03	TIMES FOR MAXIMA --	TD = 23.3800	TV = 23.3700	TA = 23.3800
PER = 0.04	TIMES FOR MAXIMA --	TD = 24.6700	TV = 24.6800	TA = 24.6700
PER = 0.05	TIMES FOR MAXIMA --	TD = 10.4700	TV = 10.4600	TA = 10.4700
PER = 0.06	TIMES FOR MAXIMA --	TD = 18.2300	TV = 18.2200	TA = 18.2300
PER = 0.07	TIMES FOR MAXIMA --	TD = 18.2800	TV = 24.6700	TA = 18.2800
PER = 0.08	TIMES FOR MAXIMA --	TD = 16.0900	TV = 24.6500	TA = 16.0900
PER = 0.09	TIMES FOR MAXIMA --	TD = 11.3700	TV = 11.3500	TA = 11.3700
PER = 0.10	TIMES FOR MAXIMA --	TD = 13.6400	TV = 20.0800	TA = 13.6400
PER = 0.11	TIMES FOR MAXIMA --	TD = 25.5300	TV = 25.5100	TA = 25.5300
PER = 0.12	TIMES FOR MAXIMA --	TD = 21.3600	TV = 21.3900	TA = 21.3600
PER = 0.13	TIMES FOR MAXIMA --	TD = 15.1900	TV = 15.2900	TA = 15.1900
PER = 0.14	TIMES FOR MAXIMA --	TD = 16.6900	TV = 16.0000	TA = 16.6900
PER = 0.15	TIMES FOR MAXIMA --	TD = 14.1100	TV = 14.1500	TA = 14.1100
PER = 0.16	TIMES FOR MAXIMA --	TD = 20.5600	TV = 20.5200	TA = 20.5600
PER = 0.17	TIMES FOR MAXIMA --	TD = 13.8400	TV = 13.8800	TA = 13.8400
PER = 0.18	TIMES FOR MAXIMA --	TD = 22.8300	TV = 22.7900	TA = 22.8300
PER = 0.19	TIMES FOR MAXIMA --	TD = 22.8500	TV = 22.8100	TA = 22.8500
PER = 0.20	TIMES FOR MAXIMA --	TD = 22.2200	TV = 13.5800	TA = 22.2200
PER = 0.21	TIMES FOR MAXIMA --	TD = 24.3200	TV = 24.5800	TA = 24.3200
PER = 0.22	TIMES FOR MAXIMA --	TD = 24.3400	TV = 19.2400	TA = 24.3300
PER = 0.23	TIMES FOR MAXIMA --	TD = 24.4600	TV = 21.8900	TA = 24.4600
PER = 0.24	TIMES FOR MAXIMA --	TD = 21.8600	TV = 21.8000	TA = 21.8500
PER = 0.25	TIMES FOR MAXIMA --	TD = 21.7500	TV = 21.6900	TA = 21.7500
PER = 0.26	TIMES FOR MAXIMA --	TD = 21.6500	TV = 21.7100	TA = 21.6500
PER = 0.27	TIMES FOR MAXIMA --	TD = 21.0300	TV = 21.6100	TA = 21.6600
PER = 0.28	TIMES FOR MAXIMA --	TD = 21.0400	TV = 21.1100	TA = 21.0300
PER = 0.29	TIMES FOR MAXIMA --	TD = 21.0500	TV = 21.1200	TA = 21.0400
PER = 0.30	TIMES FOR MAXIMA --	TD = 13.4300	TV = 13.5200	TA = 13.4300
PER = 0.31	TIMES FOR MAXIMA --	TD = 13.4500	TV = 13.5300	TA = 13.4500
PER = 0.32	TIMES FOR MAXIMA --	TD = 13.4700	TV = 13.5300	TA = 13.4600
PER = 0.33	TIMES FOR MAXIMA --	TD = 13.4800	TV = 13.4100	TA = 13.4700
PER = 0.34	TIMES FOR MAXIMA --	TD = 21.6700	TV = 13.4100	TA = 21.6700
PER = 0.35	TIMES FOR MAXIMA --	TD = 16.7700	TV = 16.6800	TA = 16.7700
PER = 0.36	TIMES FOR MAXIMA --	TD = 16.7800	TV = 16.6800	TA = 16.7800
PER = 0.37	TIMES FOR MAXIMA --	TD = 16.7900	TV = 16.6800	TA = 16.7900
PER = 0.38	TIMES FOR MAXIMA --	TD = 16.8000	TV = 16.9100	TA = 16.8000
PER = 0.39	TIMES FOR MAXIMA --	TD = 16.8200	TV = 16.9200	TA = 16.8100
PER = 0.40	TIMES FOR MAXIMA --	TD = 16.8300	TV = 16.9200	TA = 16.8300
PER = 0.41	TIMES FOR MAXIMA --	TD = 16.8400	TV = 16.9300	TA = 16.8400
PER = 0.42	TIMES FOR MAXIMA --	TD = 27.2100	TV = 27.3100	TA = 27.2000
PER = 0.43	TIMES FOR MAXIMA --	TD = 16.8600	TV = 27.3100	TA = 16.8500
PER = 0.44	TIMES FOR MAXIMA --	TD = 16.8700	TV = 16.9900	TA = 16.8600
PER = 0.45	TIMES FOR MAXIMA --	TD = 16.8800	TV = 16.9900	TA = 16.8800
PER = 0.46	TIMES FOR MAXIMA --	TD = 16.8900	TV = 16.7800	TA = 16.8900
PER = 0.47	TIMES FOR MAXIMA --	TD = 16.9000	TV = 16.7800	TA = 16.8900
PER = 0.48	TIMES FOR MAXIMA --	TD = 16.9100	TV = 16.8200	TA = 16.9000
PER = 0.49	TIMES FOR MAXIMA --	TD = 16.6900	TV = 16.6100	TA = 16.9100
PER = 0.50	TIMES FOR MAXIMA --	TD = 16.7000	TV = 16.6100	TA = 16.6900
PER = 0.51	TIMES FOR MAXIMA --	TD = 16.7100	TV = 16.6100	TA = 16.7000
PER = 0.52	TIMES FOR MAXIMA --	TD = 16.7300	TV = 16.6100	TA = 16.7200
PER = 0.53	TIMES FOR MAXIMA --	TD = 29.4900	TV = 16.6100	TA = 29.4800
PER = 0.54	TIMES FOR MAXIMA --	TD = 29.5100	TV = 16.6200	TA = 29.5000
PER = 0.55	TIMES FOR MAXIMA --	TD = 29.5300	TV = 29.1200	TA = 29.5200
PER = 0.56	TIMES FOR MAXIMA --	TD = 32.1700	TV = 29.4300	TA = 32.1600

PER = 0.57	TIMES FOR MAXIMA --	TD = 30.4900	TV = 30.6500	TA = 30.4800
PER = 0.58	TIMES FOR MAXIMA --	TD = 30.5200	TV = 30.6600	TA = 30.5100
PER = 0.60	TIMES FOR MAXIMA --	TD = 30.5600	TV = 30.4200	TA = 30.5500
PER = 0.62	TIMES FOR MAXIMA --	TD = 30.5900	TV = 30.4300	TA = 30.5800
PER = 0.64	TIMES FOR MAXIMA --	TD = 15.6700	TV = 16.6100	TA = 15.6600
PER = 0.66	TIMES FOR MAXIMA --	TD = 16.7500	TV = 16.6100	TA = 16.7400
PER = 0.68	TIMES FOR MAXIMA --	TD = 16.4800	TV = 16.6200	TA = 16.4700
PER = 0.70	TIMES FOR MAXIMA --	TD = 16.5100	TV = 16.6200	TA = 16.5000
PER = 0.72	TIMES FOR MAXIMA --	TD = 16.5300	TV = 16.4100	TA = 16.5200
PER = 0.74	TIMES FOR MAXIMA --	TD = 16.5400	TV = 16.4100	TA = 16.5300
PER = 0.76	TIMES FOR MAXIMA --	TD = 32.6800	TV = 16.4100	TA = 32.6700
PER = 0.78	TIMES FOR MAXIMA --	TD = 32.7100	TV = 16.4100	TA = 32.7000
PER = 0.80	TIMES FOR MAXIMA --	TD = 32.7400	TV = 16.4200	TA = 32.7200
PER = 0.82	TIMES FOR MAXIMA --	TD = 33.6100	TV = 16.4200	TA = 33.6000
PER = 0.84	TIMES FOR MAXIMA --	TD = 33.6600	TV = 16.4200	TA = 33.6400
PER = 0.86	TIMES FOR MAXIMA --	TD = 12.1700	TV = 16.4300	TA = 12.1600
PER = 0.88	TIMES FOR MAXIMA --	TD = 12.1900	TV = 12.3600	TA = 12.1800
PER = 0.90	TIMES FOR MAXIMA --	TD = 12.2000	TV = 12.3600	TA = 12.1800
PER = 0.92	TIMES FOR MAXIMA --	TD = 12.2000	TV = 12.3600	TA = 12.1900
PER = 0.94	TIMES FOR MAXIMA --	TD = 12.2100	TV = 12.3600	TA = 12.2000
PER = 0.96	TIMES FOR MAXIMA --	TD = 12.2200	TV = 12.3700	TA = 12.2000
PER = 0.98	TIMES FOR MAXIMA --	TD = 12.2500	TV = 12.4500	TA = 12.2300
PER = 1.00	TIMES FOR MAXIMA --	TD = 12.2600	TV = 16.1800	TA = 12.2500
PER = 1.05	TIMES FOR MAXIMA --	TD = 12.3000	TV = 13.1700	TA = 12.2800
PER = 1.10	TIMES FOR MAXIMA --	TD = 13.5000	TV = 13.2000	TA = 13.4900
PER = 1.15	TIMES FOR MAXIMA --	TD = 13.5400	TV = 13.8400	TA = 13.5100
PER = 1.20	TIMES FOR MAXIMA --	TD = 13.6200	TV = 13.4000	TA = 13.6000
PER = 1.25	TIMES FOR MAXIMA --	TD = 13.0900	TV = 13.4100	TA = 13.0700
PER = 1.30	TIMES FOR MAXIMA --	TD = 13.7800	TV = 13.4100	TA = 13.7600
PER = 1.35	TIMES FOR MAXIMA --	TD = 13.8100	TV = 13.4600	TA = 13.7800
PER = 1.40	TIMES FOR MAXIMA --	TD = 13.8200	TV = 13.4600	TA = 13.8000
PER = 1.45	TIMES FOR MAXIMA --	TD = 13.1900	TV = 13.4600	TA = 13.1500
PER = 1.50	TIMES FOR MAXIMA --	TD = 13.2300	TV = 13.5900	TA = 13.1900
PER = 1.55	TIMES FOR MAXIMA --	TD = 13.3200	TV = 12.9500	TA = 13.3000
PER = 1.60	TIMES FOR MAXIMA --	TD = 13.3500	TV = 12.9500	TA = 13.3400
PER = 1.65	TIMES FOR MAXIMA --	TD = 13.3700	TV = 13.0000	TA = 13.3400
PER = 1.70	TIMES FOR MAXIMA --	TD = 13.3800	TV = 13.0000	TA = 13.3500
PER = 1.75	TIMES FOR MAXIMA --	TD = 18.2300	TV = 18.5900	TA = 18.2100
PER = 1.80	TIMES FOR MAXIMA --	TD = 17.4300	TV = 17.8500	TA = 17.4000
PER = 1.85	TIMES FOR MAXIMA --	TD = 17.4700	TV = 17.9300	TA = 17.4400
PER = 1.90	TIMES FOR MAXIMA --	TD = 18.5100	TV = 17.9400	TA = 18.4800
PER = 1.95	TIMES FOR MAXIMA --	TD = 18.5300	TV = 17.9400	TA = 18.5100
PER = 2.00	TIMES FOR MAXIMA --	TD = 19.6300	TV = 20.1700	TA = 19.6100
PER = 2.05	TIMES FOR MAXIMA --	TD = 19.6600	TV = 20.1700	TA = 19.6200
PER = 2.10	TIMES FOR MAXIMA --	TD = 17.7000	TV = 19.3000	TA = 17.6800
PER = 2.15	TIMES FOR MAXIMA --	TD = 17.7500	TV = 17.3100	TA = 17.7100
PER = 2.20	TIMES FOR MAXIMA --	TD = 17.7800	TV = 17.3100	TA = 17.7500
PER = 2.25	TIMES FOR MAXIMA --	TD = 19.0300	TV = 17.3200	TA = 18.9800
PER = 2.30	TIMES FOR MAXIMA --	TD = 19.0600	TV = 16.2700	TA = 19.0300
PER = 2.35	TIMES FOR MAXIMA --	TD = 17.0200	TV = 16.6100	TA = 17.0000
PER = 2.40	TIMES FOR MAXIMA --	TD = 16.0500	TV = 16.6100	TA = 15.9800
PER = 2.50	TIMES FOR MAXIMA --	TD = 12.8600	TV = 12.4900	TA = 12.8400
PER = 2.60	TIMES FOR MAXIMA --	TD = 12.0000	TV = 12.4900	TA = 11.9500
PER = 2.70	TIMES FOR MAXIMA --	TD = 12.0800	TV = 12.5000	TA = 12.0100
PER = 2.80	TIMES FOR MAXIMA --	TD = 17.0500	TV = 11.7800	TA = 17.0400
PER = 2.90	TIMES FOR MAXIMA --	TD = 17.1000	TV = 16.6100	TA = 17.0500
PER = 3.00	TIMES FOR MAXIMA --	TD = 16.0600	TV = 16.6100	TA = 15.9800
PER = 3.10	TIMES FOR MAXIMA --	TD = 16.0800	TV = 16.6100	TA = 16.0500
PER = 3.20	TIMES FOR MAXIMA --	TD = 16.1000	TV = 16.6200	TA = 16.0600
PER = 3.30	TIMES FOR MAXIMA --	TD = 16.1100	TV = 16.6200	TA = 16.0600
PER = 3.40	TIMES FOR MAXIMA --	TD = 16.1200	TV = 15.7000	TA = 16.0600

PER = 3.50 TIMES FOR MAXIMA -- TD = 45.5300 TV = 16.6200 TA = 45.4900
PER = 3.60 TIMES FOR MAXIMA -- TD = 45.6800 TV = 16.6200 TA = 45.6000
PER = 3.70 TIMES FOR MAXIMA -- TD = 44.1900 TV = 16.6200 TA = 44.1600
PER = 3.80 TIMES FOR MAXIMA -- TD = 44.3200 TV = 16.6200 TA = 44.2900
PER = 3.90 TIMES FOR MAXIMA -- TD = 44.3600 TV = 16.6200 TA = 44.3200
PER = 4.00 TIMES FOR MAXIMA -- TD = 44.5500 TV = 15.8300 TA = 44.4500
PER = 4.10 TIMES FOR MAXIMA -- TD = 44.5800 TV = 15.8300 TA = 14.8100
PER = 4.20 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 4.30 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 4.40 TIMES FOR MAXIMA -- TD = 14.8600 TV = 15.8300 TA = 14.8100
PER = 4.50 TIMES FOR MAXIMA -- TD = 14.8600 TV = 15.8300 TA = 14.8200
PER = 4.60 TIMES FOR MAXIMA -- TD = 14.9400 TV = 15.8300 TA = 14.8200
PER = 4.70 TIMES FOR MAXIMA -- TD = 32.0400 TV = 15.8300 TA = 14.8200
PER = 4.80 TIMES FOR MAXIMA -- TD = 32.0600 TV = 15.8300 TA = 32.0200
PER = 4.90 TIMES FOR MAXIMA -- TD = 32.0700 TV = 15.8300 TA = 32.0200
PER = 5.00 TIMES FOR MAXIMA -- TD = 32.1300 TV = 15.8300 TA = 32.0200
PER = 5.10 TIMES FOR MAXIMA -- TD = 28.0300 TV = 15.8300 TA = 28.0000
PER = 5.20 TIMES FOR MAXIMA -- TD = 28.0300 TV = 15.8300 TA = 28.0000
PER = 5.40 TIMES FOR MAXIMA -- TD = 9.7900 TV = 11.2400 TA = 28.0000
PER = 5.60 TIMES FOR MAXIMA -- TD = 9.7900 TV = 11.2400 TA = 9.7500
PER = 5.80 TIMES FOR MAXIMA -- TD = 9.8200 TV = 15.8300 TA = 9.7500
PER = 6.00 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 6.20 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 6.40 TIMES FOR MAXIMA -- TD = 14.8500 TV = 15.8300 TA = 14.8100
PER = 6.60 TIMES FOR MAXIMA -- TD = 14.8600 TV = 15.8300 TA = 14.8100
PER = 6.80 TIMES FOR MAXIMA -- TD = 14.8600 TV = 15.8300 TA = 14.8100
PER = 7.00 TIMES FOR MAXIMA -- TD = 14.9800 TV = 12.5000 TA = 14.8100
PER = 7.30 TIMES FOR MAXIMA -- TD = 15.3900 TV = 17.3200 TA = 14.8100
PER = 7.60 TIMES FOR MAXIMA -- TD = 15.4000 TV = 17.3200 TA = 15.3100
PER = 8.00 TIMES FOR MAXIMA -- TD = 15.4900 TV = 17.3200 TA = 15.3700
PER = 8.50 TIMES FOR MAXIMA -- TD = 15.5300 TV = 14.6000 TA = 15.4700
PER = 9.00 TIMES FOR MAXIMA -- TD = 16.8100 TV = 14.6000 TA = 16.6200
PER = 9.50 TIMES FOR MAXIMA -- TD = 17.0600 TV = 14.6000 TA = 16.7400
PER =10.00 TIMES FOR MAXIMA -- TD = 17.1500 TV = 14.6000 TA = 17.0400

SPECTRAL VALUES--
(Acceleration of gravity used = 32.20)

PSCS300E Crest Column DAMPING RATIO = 0.050

NO.	PERIOD	REL. DISP.	REL. VEL.	PSU.REL.VEL.	ABS. ACC.	PSU.ABS.ACC.	FREQ.
1	0.01	0.00005	0.00137	0.02954	0.57869	0.57636	100.00
2	0.02	0.00019	0.03246	0.05874	0.57851	0.57313	50.00
3	0.03	0.00084	0.16225	0.17610	1.10556	1.14542	33.33
4	0.04	0.00190	0.26915	0.29880	1.48423	1.45761	25.00
5	0.05	0.00342	0.38292	0.43034	1.68897	1.67944	20.00
6	0.06	0.00440	0.46805	0.46042	1.55729	1.49736	16.67
7	0.07	0.00583	0.52196	0.52342	1.45432	1.45906	14.29
8	0.08	0.00756	0.58863	0.59363	1.49438	1.44794	12.50
9	0.09	0.00981	0.68527	0.68468	1.49214	1.48446	11.11
10	0.10	0.01153	0.67832	0.72473	1.39533	1.41416	10.00
11	0.11	0.01476	0.77760	0.84282	1.51649	1.49509	9.09
12	0.12	0.01629	0.83139	0.85295	1.40540	1.38697	8.33
13	0.13	0.01684	0.79261	0.81412	1.22022	1.22200	7.69
14	0.14	0.01815	0.79492	0.81472	1.12382	1.13554	7.14
15	0.15	0.01917	0.78885	0.80311	1.04837	1.04474	6.67
16	0.16	0.02264	0.87808	0.88913	1.08719	1.08435	6.25
17	0.17	0.02615	0.95564	0.96640	1.11464	1.10926	5.88
18	0.18	0.03507	1.12475	1.22425	1.32698	1.32716	5.56
19	0.19	0.03470	1.15550	1.14761	1.17936	1.17860	5.26
20	0.20	0.03549	1.24968	1.11510	1.08628	1.08794	5.00
21	0.21	0.03665	1.13296	1.09655	1.02129	1.01890	4.76
22	0.22	0.04047	1.20959	1.15594	1.03249	1.02527	4.55
23	0.23	0.04161	1.16229	1.13658	0.97652	0.96427	4.35

24	0.24	0.04975	1.29290	1.30247	1.06242	1.05896	4.17
25	0.25	0.06040	1.56475	1.51813	1.19290	1.18493	4.00
26	0.26	0.06309	1.61978	1.52473	1.14568	1.14431	3.85
27	0.27	0.05277	1.29989	1.22801	0.89238	0.88749	3.70
28	0.28	0.05245	1.28803	1.17691	0.82117	0.82018	3.57
29	0.29	0.05858	1.42125	1.26924	0.85688	0.85402	3.45
30	0.30	0.06833	1.51338	1.43100	0.93704	0.93077	3.33
31	0.31	0.07664	1.71775	1.55334	0.97975	0.97775	3.23
32	0.32	0.07644	1.62581	1.50080	0.92328	0.91516	3.13
33	0.33	0.07036	1.46608	1.33963	0.79885	0.79213	3.03
34	0.34	0.06555	1.29567	1.21135	0.69574	0.69521	2.94
35	0.35	0.06914	1.36883	1.24114	0.69509	0.69195	2.86
36	0.36	0.07611	1.43229	1.32829	0.72534	0.71997	2.78
37	0.37	0.08321	1.46923	1.41300	0.74916	0.74518	2.70
38	0.38	0.09015	1.54982	1.49059	0.76953	0.76542	2.63
39	0.39	0.09619	1.64563	1.54976	0.77692	0.77539	2.56
40	0.40	0.10071	1.66299	1.58202	0.77619	0.77175	2.50
41	0.41	0.10438	1.61478	1.59959	0.76625	0.76129	2.44
42	0.42	0.10761	1.63710	1.60983	0.75221	0.74792	2.38
43	0.43	0.11229	1.61004	1.64084	0.74872	0.74460	2.33
44	0.44	0.12294	1.71041	1.75551	0.78269	0.77853	2.27
45	0.45	0.12786	1.77832	1.78529	0.77785	0.77414	2.22
46	0.46	0.12471	1.71825	1.70342	0.72783	0.72258	2.17
47	0.47	0.12287	1.65704	1.64265	0.68560	0.68198	2.13
48	0.48	0.12350	1.63243	1.61656	0.66244	0.65717	2.08
49	0.49	0.12258	1.70238	1.57185	0.63005	0.62595	2.04
50	0.50	0.12409	1.78871	1.55941	0.61130	0.60858	2.00
51	0.51	0.12464	1.86376	1.53559	0.59053	0.58753	1.96
52	0.52	0.11959	1.85372	1.44501	0.54442	0.54224	1.92
53	0.53	0.11048	1.70483	1.30978	0.48598	0.48222	1.89
54	0.54	0.11235	1.47125	1.30725	0.47394	0.47238	1.85
55	0.55	0.11423	1.38020	1.30494	0.46612	0.46297	1.82
56	0.56	0.12991	1.43053	1.45756	0.51070	0.50788	1.79
57	0.57	0.14553	1.58598	1.60414	0.55167	0.54915	1.75
58	0.58	0.16090	1.75597	1.74305	0.58929	0.58642	1.72
59	0.60	0.16552	1.90732	1.73336	0.56612	0.56372	1.67
60	0.62	0.14914	1.71916	1.51142	0.47783	0.47568	1.61
61	0.64	0.13615	1.46806	1.33669	0.40996	0.40754	1.56
62	0.66	0.14161	1.75359	1.34813	0.40145	0.39858	1.52
63	0.68	0.15367	1.85258	1.41993	0.41058	0.40746	1.47
64	0.70	0.16446	1.75202	1.47616	0.41334	0.41149	1.43
65	0.72	0.16040	1.64248	1.39978	0.38212	0.37936	1.39
66	0.74	0.14915	1.61251	1.26642	0.33597	0.33394	1.35
67	0.76	0.16057	1.57224	1.32750	0.34338	0.34084	1.32
68	0.78	0.17913	1.59266	1.44299	0.36327	0.36099	1.28
69	0.80	0.18584	1.69089	1.45955	0.35775	0.35600	1.25
70	0.82	0.19547	1.83473	1.49779	0.35886	0.35642	1.22
71	0.84	0.19510	1.85877	1.45935	0.34022	0.33900	1.19
72	0.86	0.19321	1.71122	1.41159	0.32171	0.32028	1.16
73	0.88	0.20256	1.67547	1.44626	0.32247	0.32069	1.14
74	0.90	0.20867	1.64417	1.45683	0.31757	0.31586	1.11
75	0.92	0.22540	1.68543	1.53941	0.32824	0.32651	1.09
76	0.94	0.25264	1.75116	1.68869	0.35247	0.35055	1.06
77	0.96	0.27876	1.75505	1.82446	0.37302	0.37084	1.04
78	0.98	0.29797	1.72103	1.91040	0.38186	0.38038	1.02
79	1.00	0.31142	1.70665	1.95673	0.38400	0.38182	1.00
80	1.05	0.33056	1.86700	1.97809	0.37049	0.36760	0.95
81	1.10	0.34010	1.98275	1.94264	0.34638	0.34461	0.91
82	1.15	0.38232	2.18670	2.08887	0.35752	0.35444	0.87
83	1.20	0.43710	2.43040	2.28867	0.37540	0.37216	0.83
84	1.25	0.41217	2.48596	2.07178	0.32532	0.32341	0.80

85	1.30	0.35374	2.07796	1.70971	0.25849	0.25663	0.77
86	1.35	0.31529	1.82241	1.46742	0.21360	0.21210	0.74
87	1.40	0.30429	1.71927	1.36566	0.19212	0.19034	0.71
88	1.45	0.30631	1.66137	1.32732	0.18009	0.17862	0.69
89	1.50	0.31859	1.66658	1.33450	0.17445	0.17360	0.67
90	1.55	0.33532	1.63453	1.35927	0.17193	0.17112	0.65
91	1.60	0.33890	1.61066	1.33085	0.16392	0.16231	0.63
92	1.65	0.31778	1.50173	1.21009	0.14561	0.14311	0.61
93	1.70	0.28140	1.35995	1.04004	0.12177	0.11938	0.59
94	1.75	0.30802	1.33546	1.10590	0.12463	0.12331	0.57
95	1.80	0.35605	1.46700	1.24286	0.13603	0.13473	0.56
96	1.85	0.38459	1.54226	1.30617	0.13881	0.13777	0.54
97	1.90	0.41120	1.54079	1.35982	0.14101	0.13965	0.53
98	1.95	0.42776	1.50608	1.37831	0.13955	0.13792	0.51
99	2.00	0.45877	1.58228	1.44128	0.14253	0.14062	0.50
100	2.05	0.49417	1.68678	1.51462	0.14614	0.14417	0.49
101	2.10	0.54015	1.79416	1.61614	0.15074	0.15017	0.48
102	2.15	0.58631	1.97185	1.71343	0.15668	0.15551	0.47
103	2.20	0.59876	2.08291	1.71005	0.15348	0.15167	0.45
104	2.25	0.59010	2.04481	1.64786	0.14423	0.14291	0.44
105	2.30	0.54691	1.88205	1.49406	0.12852	0.12675	0.43
106	2.35	0.50389	1.76316	1.34725	0.11256	0.11187	0.43
107	2.40	0.45720	1.68962	1.19696	0.09891	0.09732	0.42
108	2.50	0.39717	1.45197	0.99821	0.07839	0.07791	0.40
109	2.60	0.42222	1.44539	1.02035	0.07780	0.07658	0.38
110	2.70	0.41356	1.27860	0.96239	0.07028	0.06955	0.37
111	2.80	0.37799	1.27516	0.84821	0.05970	0.05911	0.36
112	2.90	0.42097	1.45197	0.91208	0.06234	0.06137	0.34
113	3.00	0.44342	1.50548	0.92870	0.06150	0.06041	0.33
114	3.10	0.45766	1.42670	0.92760	0.05970	0.05839	0.32
115	3.20	0.42651	1.27704	0.83745	0.05273	0.05107	0.31
116	3.30	0.37342	1.12135	0.71100	0.04371	0.04204	0.30
117	3.40	0.32021	1.01441	0.59175	0.03557	0.03396	0.29
118	3.50	0.33969	0.94441	0.60981	0.03443	0.03400	0.29
119	3.60	0.38484	0.92642	0.67168	0.03683	0.03641	0.28
120	3.70	0.39485	0.92955	0.67051	0.03594	0.03536	0.27
121	3.80	0.40968	0.93190	0.67740	0.03518	0.03478	0.26
122	3.90	0.38228	0.91874	0.61588	0.03143	0.03081	0.26
123	4.00	0.34203	0.92697	0.53726	0.02642	0.02621	0.25
124	4.10	0.30825	0.96203	0.47239	0.02341	0.02248	0.24
125	4.20	0.32556	0.98725	0.48703	0.02406	0.02263	0.24
126	4.30	0.34146	0.99738	0.49894	0.02413	0.02264	0.23
127	4.40	0.34807	0.99104	0.49705	0.02358	0.02204	0.23
128	4.50	0.34534	0.97000	0.48218	0.02249	0.02091	0.22
129	4.60	0.33556	0.93804	0.45834	0.02099	0.01944	0.22
130	4.70	0.33170	0.89990	0.44343	0.01925	0.01841	0.21
131	4.80	0.34522	0.86035	0.45189	0.01886	0.01837	0.21
132	4.90	0.33190	0.82347	0.42559	0.01758	0.01695	0.20
133	5.00	0.30064	0.79241	0.37780	0.01543	0.01474	0.20
134	5.10	0.28033	0.76907	0.34537	0.01383	0.01321	0.20
135	5.20	0.27769	0.75443	0.33554	0.01330	0.01259	0.19
136	5.40	0.27310	0.77836	0.31776	0.01207	0.01148	0.19
137	5.60	0.29401	0.79628	0.32988	0.01202	0.01149	0.18
138	5.80	0.30778	0.80794	0.33342	0.01178	0.01122	0.17
139	6.00	0.32463	0.84580	0.33995	0.01222	0.01106	0.17
140	6.20	0.37930	0.87676	0.38439	0.01325	0.01210	0.16
141	6.40	0.43335	0.89546	0.42544	0.01413	0.01297	0.16
142	6.60	0.48253	0.89989	0.45937	0.01477	0.01358	0.15
143	6.80	0.52393	0.89041	0.48411	0.01512	0.01389	0.15
144	7.00	0.55920	0.87529	0.50194	0.01518	0.01399	0.14
145	7.30	0.62005	0.88042	0.53368	0.01482	0.01427	0.14

146	7.60	0.66716	0.90825	0.55156	0.01449	0.01416	0.13
147	8.00	0.70847	0.90727	0.55643	0.01389	0.01357	0.13
148	8.50	0.72253	0.93252	0.53409	0.01272	0.01226	0.12
149	9.00	0.72748	0.96895	0.50788	0.01163	0.01101	0.11
150	9.50	0.81580	0.98875	0.53956	0.01146	0.01108	0.11
151	10.00	0.88090	0.99633	0.55348	0.01116	0.01080	0.10
152	10.50	0.00000	0.00000	0.00000	0.00000	0.00000	0.10

VALUES IN PERIOD RANGE .1 TO 2.5 SEC.

AREA OF ACC. RESPONSE SPECTRUM = 0.859

AREA OF VEL. RESPONSE SPECTRUM = 4.045

MAX. ACCELERATION RESPONSE VALUE = 1.516

MAX. VELOCITY RESPONSE VALUE = 2.486

*** End of Output File No. 1 ***

8114-10 R16234
Part 15

APPENDIX D-3

ESTIMATES OF POTENTIAL EMBANKMENT SETTLEMENTS (PERMANENT DEFORMATIONS)

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PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation — PROJECT NO. 072047

Estimate of Potential Embankment Settlements (Permanent Deformations) — PAGE 1 OF 68

MADE BY BEG DATE 1/22/08 CHECKED BY [illegible] DATE 1/23/08

CALCULATION BRIEF FOR

ESTIMATE OF POTENTIAL EMBANKMENT SETTLEMENTS (PERMANENT DEFORMATIONS)

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH CELL

OBJECTIVE: Estimate maximum anticipated settlements for the Pond Creek – South Cell embankment and impoundment geometry.

METHODOLOGY: Use SHAKE2000 (Ordonez, G., 2006) (Reference 1) to determine time history of accelerations from time history of horizontal shear stresses (Reference 7) at the critical layer-to-failure surface interface, and estimate permanent deformations based on (Houston, et al., 1987), for the critical soil mass. Cumulative deformations are estimated from stress-to-acceleration time histories, above the yield accelerations (determined in Reference 8), using the techniques presented by Newmark (1965).

REFERENCES:

1. Ordonez, Gustavo A.(2006) "SHAKE2000: A Computer Program for the 1-D Analysis of Geotechnical Earthquake Engineering Problems," February 2006.

2. Schnabel, P. B., Lysmer, J. and Seed, H. B. (1972) "SHAKE: A Computer Program for Earthquake Response Analysis of Horizontally Layered Sites," Report No. EERC 72-12, University of California, Berkeley.

3. Houston, S. L., Houston, W. N., and Padilla, J. M. (1987) "Microcomputer-Aided Evaluation of Earthquake-Induced Permanent Slope Displacements," Arizona State University, Microcomputers in Civil Engineering 2, Elsevier.

4. Newmark, N. M. (1965) "Effects of Earthquake on Dams and Embankments," Geotechnique, London, Vol. 5, No. 2, June, 1965.

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PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation PROJECT NO. 072047

Estimate of Potential Embankment PAGE 2 OF 68

Settlements (Permanent Deformations)

MADE BY BEG DATE 1/22/08 CHECKED BY [illegible] DATE 1/23/08

5. Poulos, S. J., Robinsky, E. I., Keller, T. O. (1986) "Liquefaction Resistance of Thickened Tailings," Journal of Geotechnical Engineering, ASCE, Vol. 111, No. 12, Paper No. 20213, pp. 1380-1394.

6. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Shear Modulus Calculations for SHAKE Columns PCSC300E and PCSC300M," Pond Creek Coal Refuse Disposal Site – South Cell" BEG, 12/28/07.

7. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Induced Cyclic Shear Stresses and Strains and Time History of Cyclic Shear Stress, SHAKE Columns PCSC300E and PCSC300M," Pond Creek Coal Refuse Disposal Site – South Cell," BEG, 1/7/07.

8. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Estimation of the Seismic Pseudo-Static Factors of Safety and Yield Accelerations for the Downstream and Upstream Slope Geometries, Pond Creek Coal Refuse Disposal Site, South Cell," BEG, 1/22/08.

Pseudo-Static (Seismic) Factor of Safety and Estimation of Yield Accelerations:

Based on the information presented in Reference 8 and shown in Figure 3 of the permanent deformation report, the minimum pseudo-static (seismic) factors of safety were less than 1.0, thus permanent deformation analyses are required. Also shown in Reference 8, the minimum yield acceleration for the Pond Creek – South Cell embankment in the downstream and upstream directions was estimated at 0.18g. A yield acceleration of 0.18g is assumed for all downstream and upstream slope conditions, which will be used as input for estimating the corresponding permanent deformations.

SHAKE2000 Input Summary

A SHAKE2000 crest column was chosen to analyze the induced acceleration of the coal refuse/subgrade soil materials. SHAKE2000 column PCSC300E and PCSC300M were created based on shear wave velocities from eight (8) piezo-seismic cone penetration test (PSCPT) holes performed throughout the Pond Creek facility, particularly in the vicinity of the South Cell (Reference 6) including CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B. Columns PCSC300E and PCSC300M are utilized for the permanent deformation analyses in the upstream (min. fines) and downstream (max. fines) directions, respectively, and all (16) layers were evaluated to assess maximum permanent deformations in the both the upstream and downstream directions.

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PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation — PROJECT NO. 072047

Estimate of Potential Embankment — PAGE 3 OF 68

Settlements (Permanent Deformations)

MADE BY BEG DATE 1/22/08 CHECKED BY TJL DATE 1/23/08

Maximum Design Earthquake (MDE)

As discussed in Reference 7, two synthetic acceleration-time histories were created utilizing Eastern North American (ENA) earthquake source and propagation parameters for the site maximum design earthquakes (MDE). The New Madrid earthquake source has a maximum magnitude (M) of 8.0 and an epicenter distance of 83 km from the site. The Background earthquake, which could occur practically anywhere in this region has a magnitude of M6.8 and was placed 13.5 km from the site. Since the two MDE scenarios are markedly different in terms of maximum acceleration, duration, and frequency content, both records were used in SHAKE2000 to investigate the response of the embankment to these earthquakes. The resulting ground motion parameters and the response of the embankment to these MDE's are discussed in the Critical Mass Displacement subsection of this calculation brief.

Analysis to Define Time History of Accelerations:

Analyses were performed to estimate the time history of horizontal shear stress at various layer interfaces (Option 7 of SHAKE2000, See Reference 7). The (stress) time history data is subsequently converted to acceleration time histories in SHAKE2000 and subsequently used in SHAKE2000 to estimate the maximum displacement associated with the center of gravity of the failure mass based on Houston, et al., 1989.

The analysis technique for determining time histories of accelerations corresponds to the techniques used by Castro et al., (1989) and Houston et al., (1989). The time histories of earthquake accelerations on the potential sliding mass were converted in SHAKE2000 by dividing each time step by the effective vertical stress on each layer, based on the equation F = ma and solving for acceleration, a, at each time step.

Critical Mass Displacements:

Horizontal displacements of the proposed South Cell geometry were computed using SHAKE2000 which double integrates the difference between the estimated accelerations and yield accelerations for the duration of the time history. The integration is performed assuming that movements of the sliding block can only occur in the downhill direction for estimated values of acceleration which exceeds the yield acceleration. Movements in the uphill direction are not likely since the value of yield acceleration is notably higher due to the additive static weight resistance against pushing the sliding block uphill.

The anticipated maximum displacements of the soil mass were estimated as a function of earthquake acceleration for the corresponding critical failure surface. A summary of ground motion response

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PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation — PROJECT NO. 072047

Estimate of Potential Embankment — PAGE 4 OF 68

Settlements (Permanent Deformations)

MADE BY BEG DATE 1/22/08 CHECKED BY [illegible] DATE 1/23/08

parameters and ground displacements estimated for the critical South Cell geometry is presented in the following tables.

Upstream (E) Downstream (M) Permanent Deformation Analysis, Yield Acceleration (Ay = 0.18 g)

M6.8 @ 13.5 km Epicenter (A_{max} = 0.54 g, f_M = 20.4 Hz) (SHAKE Option 3)

SHAKE2000 Column	(Option 5) Average f_N of Column, Hz	(Option 6) A_{max} in Any Critical Layer, g (Layer No.)	A_{max} Critical Layer / A_{max} Earthquake, %	Maximum Permanent Deformation, in
PCSC300E	4.35	0.81 (14)	144	1.19
PCSC300M	4.17	0.80(12)	148	1.09

f_M = Mean Square Frequency = $\frac{\Sigma C_i^2 f_i}{\Sigma C_i^2}$

where C_i = Fourier amplitudes of the entire accelogram, and
f_i = discrete Fourier frequencies.

f_N = Average Fundamental frequency of the SHAKE column = V_S / (4 * H)

Where H = Height of the SHAKE column, and
V_S = Average Shear Velocity of the SHAKE column.

M8.0@ 83 km Epicenter (A_{max} = 0.54 g, f_M = 14.6 Hz) (SHAKE Option 3)

SHAKE2000 Column	(Option 5) Average f_N of Column, Hz	(Option 6) A_{max} in Any Critical Layer, g (Layer No.)	A_{max} Critical Layer / A_{max} Earthquake, %	Maximum Permanent Deformation, in.
PCSC300E	3.85	0.88 (2)	163	16.7
PCSC300M	3.70	0.75 (2)	139	13.7

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PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation PROJECT NO. 072047

Estimate of Potential Embankment PAGE 5 OF 68

Settlements (Permanent Deformations)

MADE BY BEG DATE 1/22/08 CHECKED BY [signature] DATE 1/23/08

As shown in the tables above, the mean square frequency of the M6.8 Background earthquake (20.4 Hz) is greater than the M8.0 earthquake (14.6 Hz). The average fundamental frequencies of the SHAKE2000 columns are similar, ranging from about 3.70 to 4.35Hertz. Due to the large variation in frequency content between the low frequency Pond Creek – South Cell SHAKE2000 columns to the high frequency ENA earthquake scenarios, moderate shear stresses and strains are induced into the soil columns. The percentage of acceleration within the critical layer to that of the base acceleration is lower for the M6.8 and higher for the M8.0 earthquake due to their higher mean square frequency. In other words, while the input acceleration is high, particularly for both MDE scenarios (Amax = 0.54 g), most of its energy is in the high frequency range and only a portion of the induced base acceleration affects the critical layer.

Based on the Newmark method, the amount of permanent deformation for the downstream and upstream directions varies from about 1 inches to 17 inches for both columns and both MDE scenarios. The deformation is a maximum value associated with all 16 layers and should envelope any condition within the embankment at any one particular critical failure surface location. Since the maximum accelerations are higher than the 0.18g yield acceleration, there is some displacement accumulated [following performing the double integration of (Ay – A)] of the Newmark method. The Pond Creek – South Pond SHAKE2000 time histories of shear stress are presented in Appendix D, Attachment D-2, and displacement plots and output files for each layer of the permanent deformation analyses are attached.

The crest elevation (El.) for South Cell is about 502 feet, while the maximum fines level is El. 496 ft. Consequently, 6 feet of freeboard exists relative to the 17 inches (or 1.4 feet) of maximum deformation, which is more than enough to prevent overtopping in the event of either MDE scenario.

CONCLUSION

Based on the information presented in this calculation brief, the anticipated maximum permanent deformation of the Pond Creek – South Cell soil mass was estimated to be about 1.4 feet for both the downstream and upstream slope conditions and both M6.8 Background (at 13.5 km) and M8.0 New Madrid (at 83 km) MDE scenarios with maximum accelerations of 0.54g. Limited displacements in the downstream and upstream directions are anticipated since the ground motion response of the embankment only slightly exceeds the 0.18g yield acceleration in both directions. Given the amount of freeboard (about 6 feet), 1.4 feet of permanent deformations would not pose a threat to the integrity of the impoundment or adversely affect the Pond Creek – South Cell impoundment.

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PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation

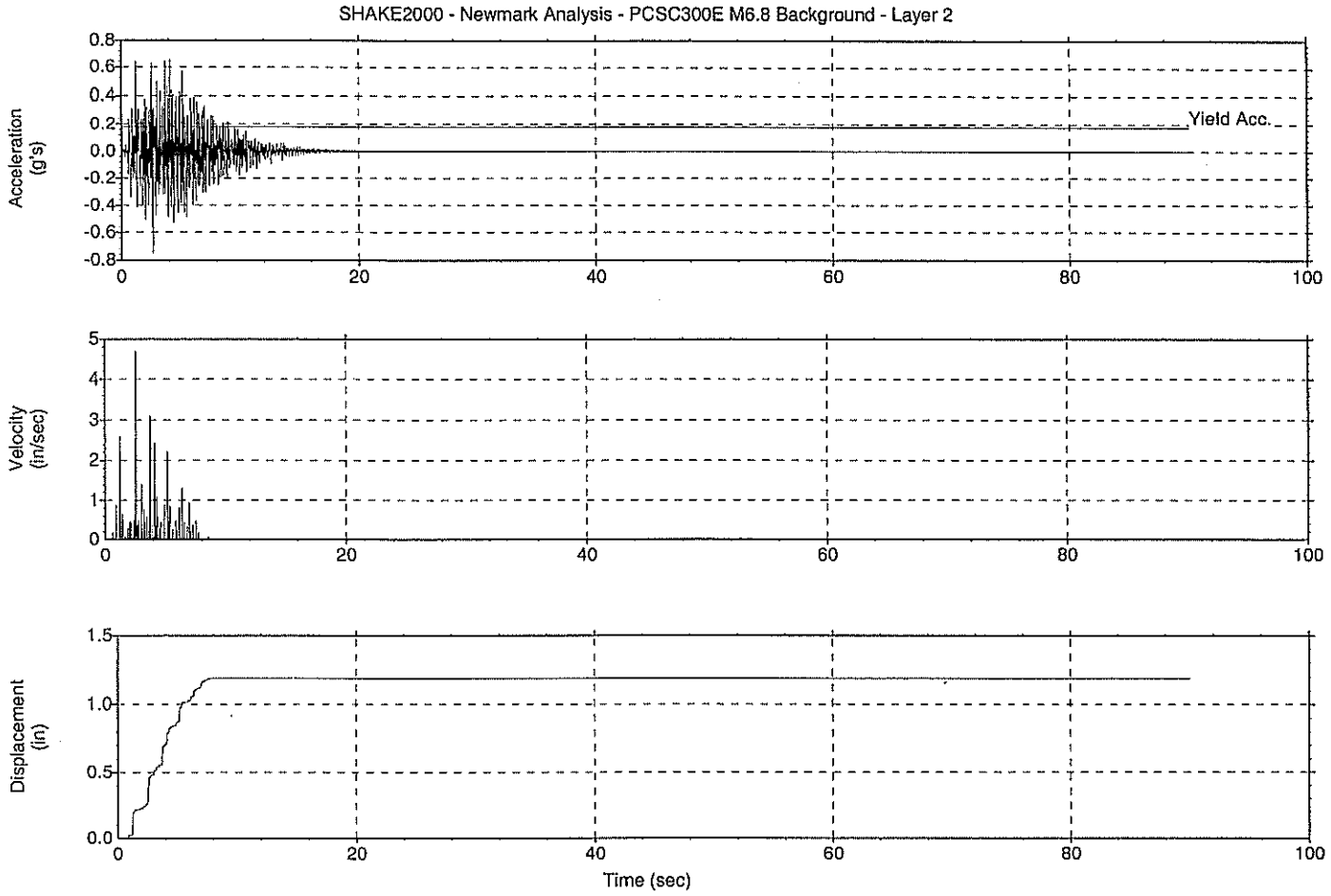
PROJECT NO. 072047

Estimate of Potential Embankment Settlements (Permanent Deformations)

PAGE 6 OF 68

MADE BY BEG DATE 1/22/08 CHECKED BY [illegible] DATE 1/23/08

SHAKE2000 PERMANENT DEFORMATION OUTPUT FILE
PCSC300E – LAYERS 1 THROUGH 16
M6.8 BACKGROUND MDE @ 13.5 KM

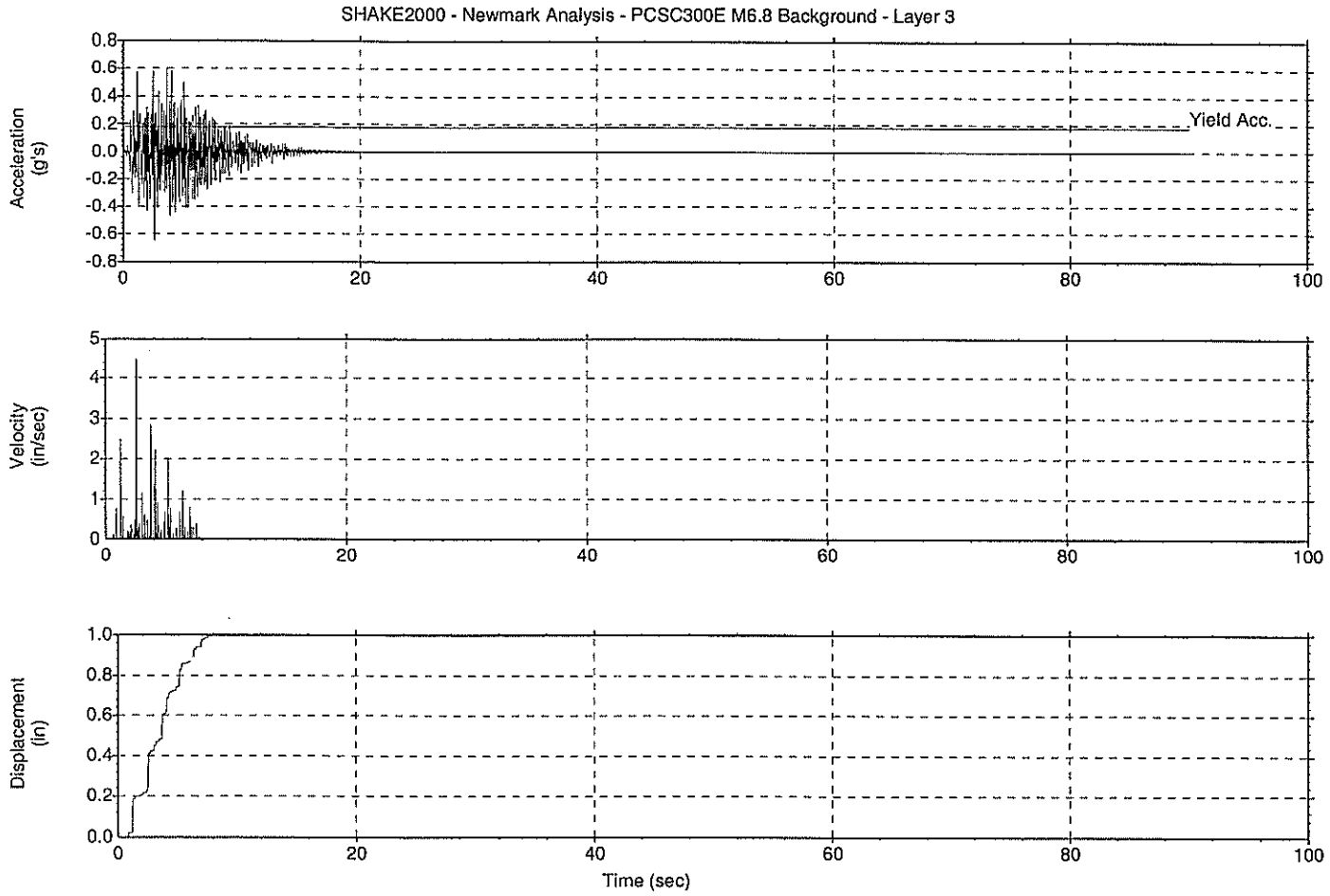


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 - Newmark Analysis - PCSC300E M6.8 Background - Layer 2

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 2 Stress - HEA - Layer: 2 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l2a1d1-21.hea
Peak Acceleration Value: .751025 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 1.188367 in

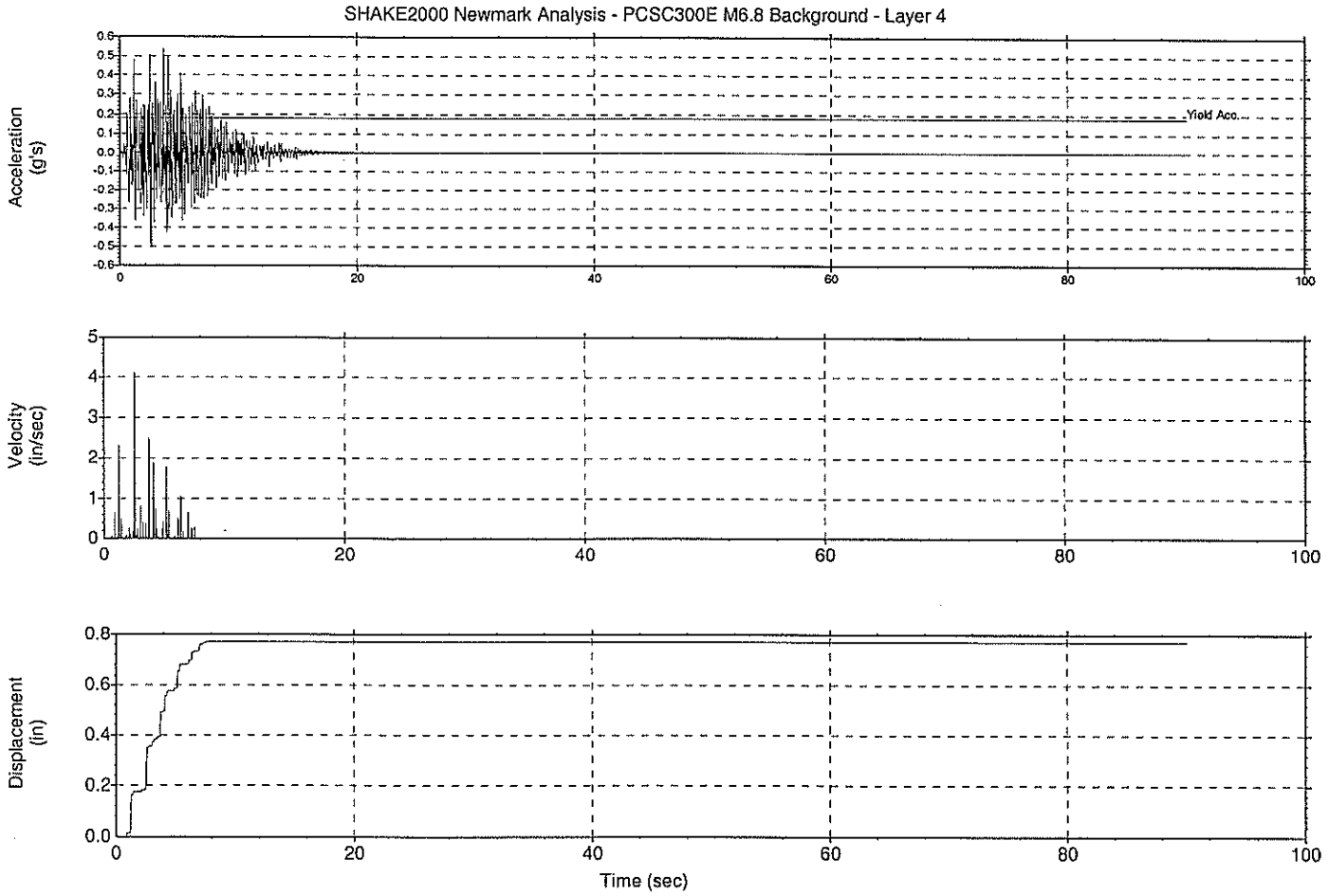


Notes:
Displacement Analysis - Newmark Method
Project: SHAKE2000 - Newmark Analysis - PCSC300E M6.8 Background - Layer 3

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 3 Stress - HEA - Layer: 3 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l3a1d1-23.hea
Peak Acceleration Value: .6469341 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .9947649 in

R16242

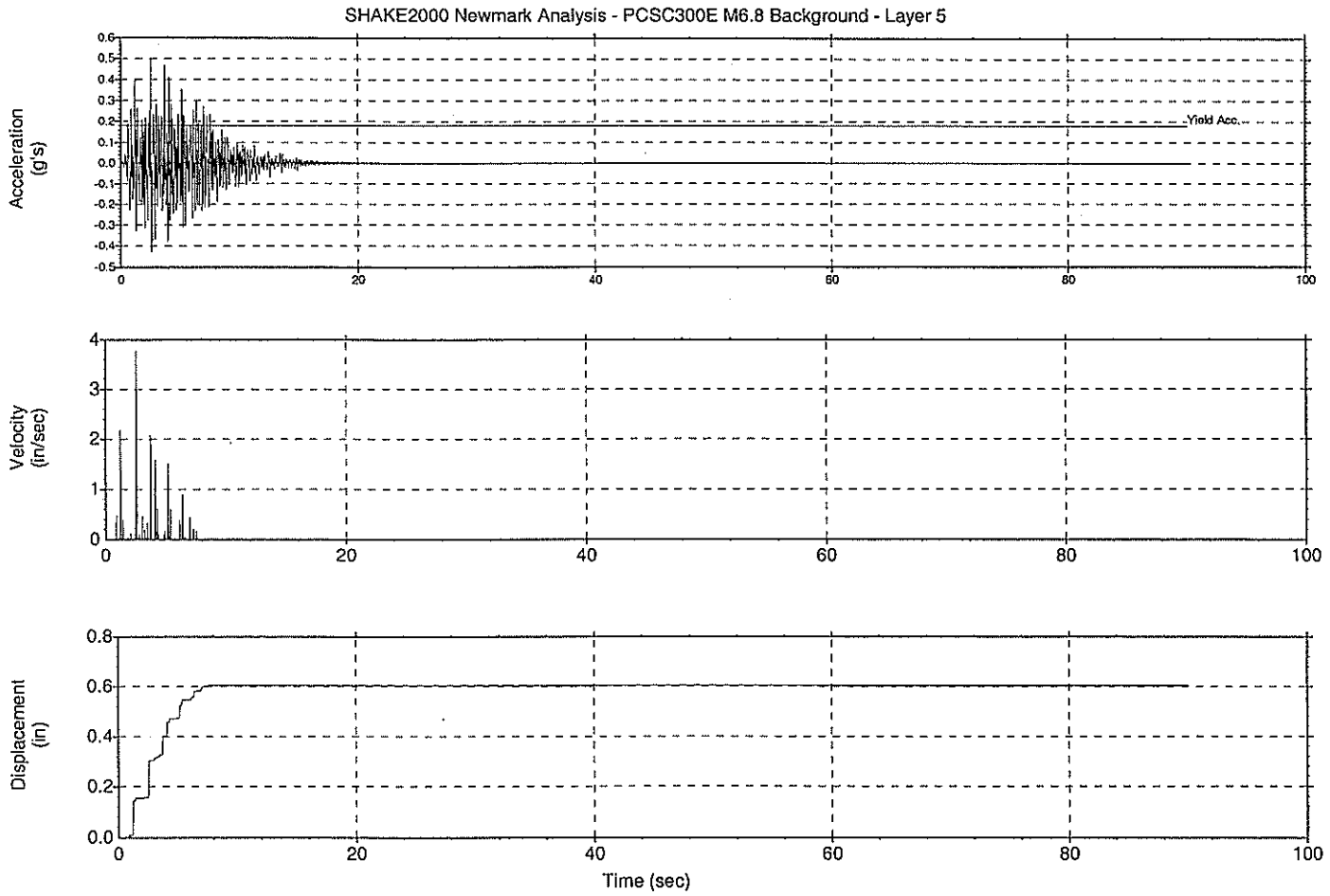


Notes:
Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 4

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 4 Stress - HEA - Layer: 4 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l4a1d1-25.hea
Peak Acceleration Value: .5376392 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .7707678 in

R16243



Notes:

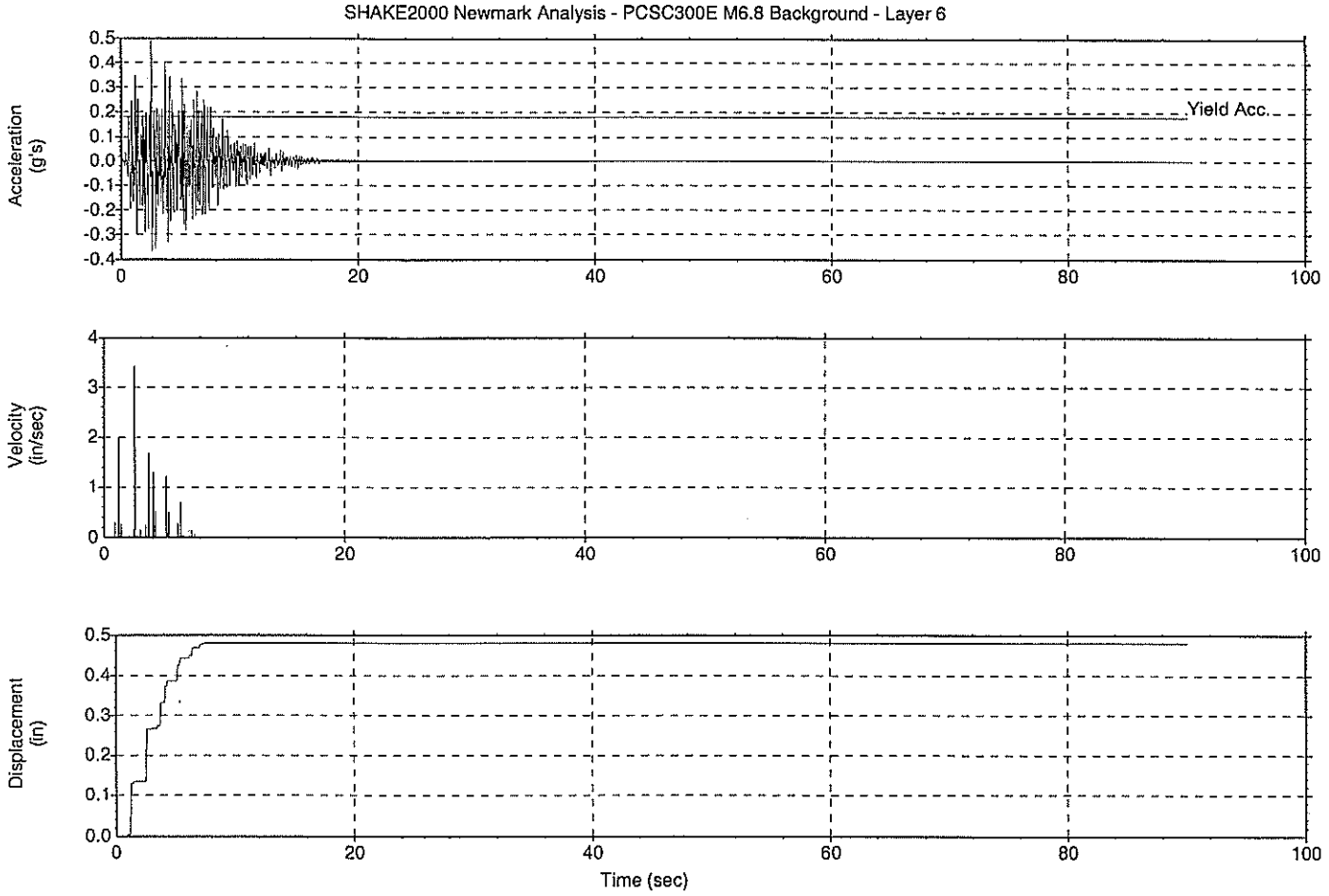
Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 5

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 5 Stress - HEA - Layer: 5 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\15a1d1-27.hea
Peak Acceleration Value: .5017272 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .6051853 in

9 of 68

R16244

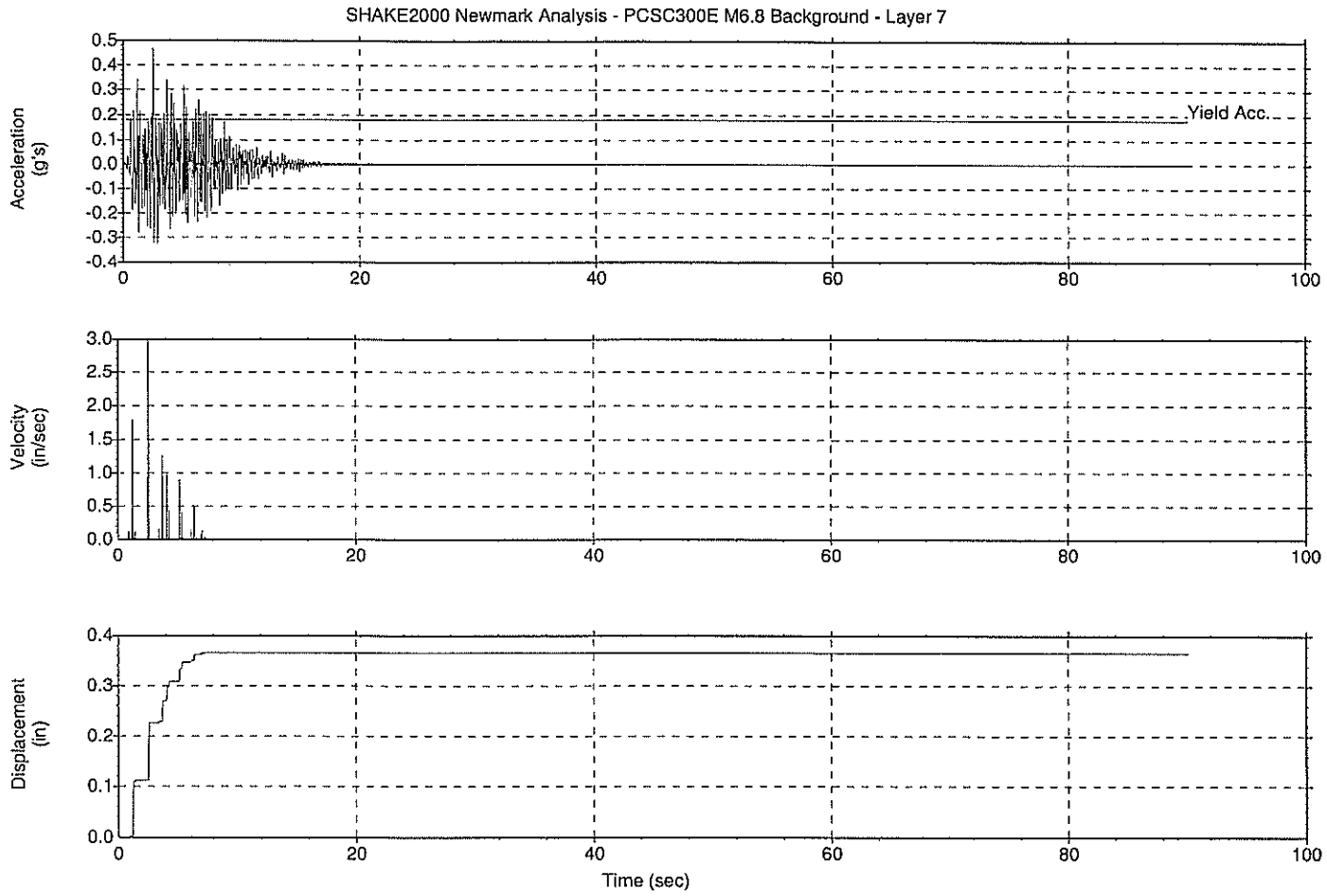


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 6

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 6 Stress - HEA - Layer: 6 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\16a1d1-29.hea
Peak Acceleration Value: .4929173 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .4800507 in



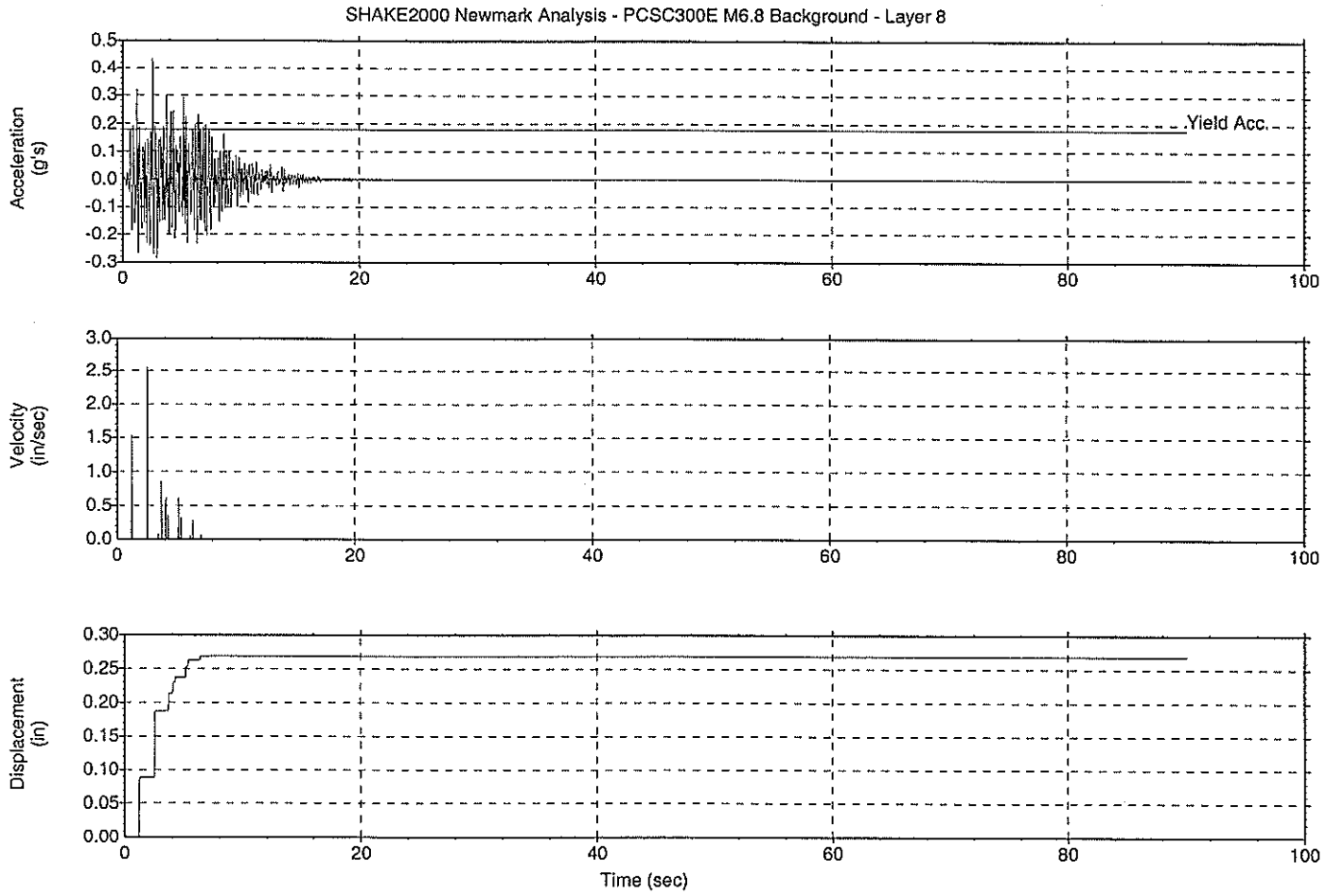
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 7

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 7 Stress - HEA - Layer: 7 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\17aldl-31.hea
Peak Acceleration Value: .4681036 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .3661694 in

R16246



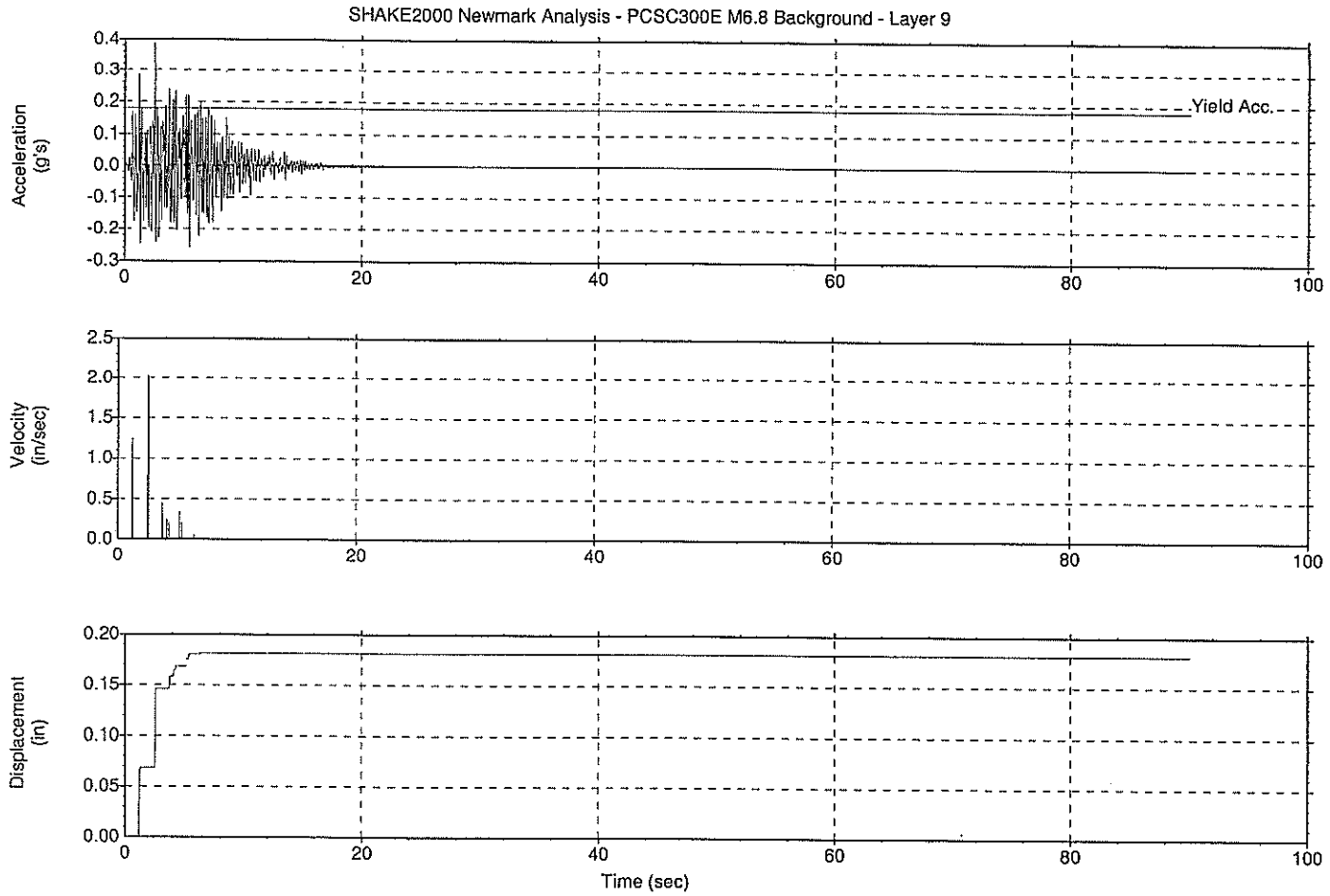
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 8

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 8 Stress - HEA - Layer: 8 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\18ald1-33.hea
Peak Acceleration Value: .4352388 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .2687874 in

R16247

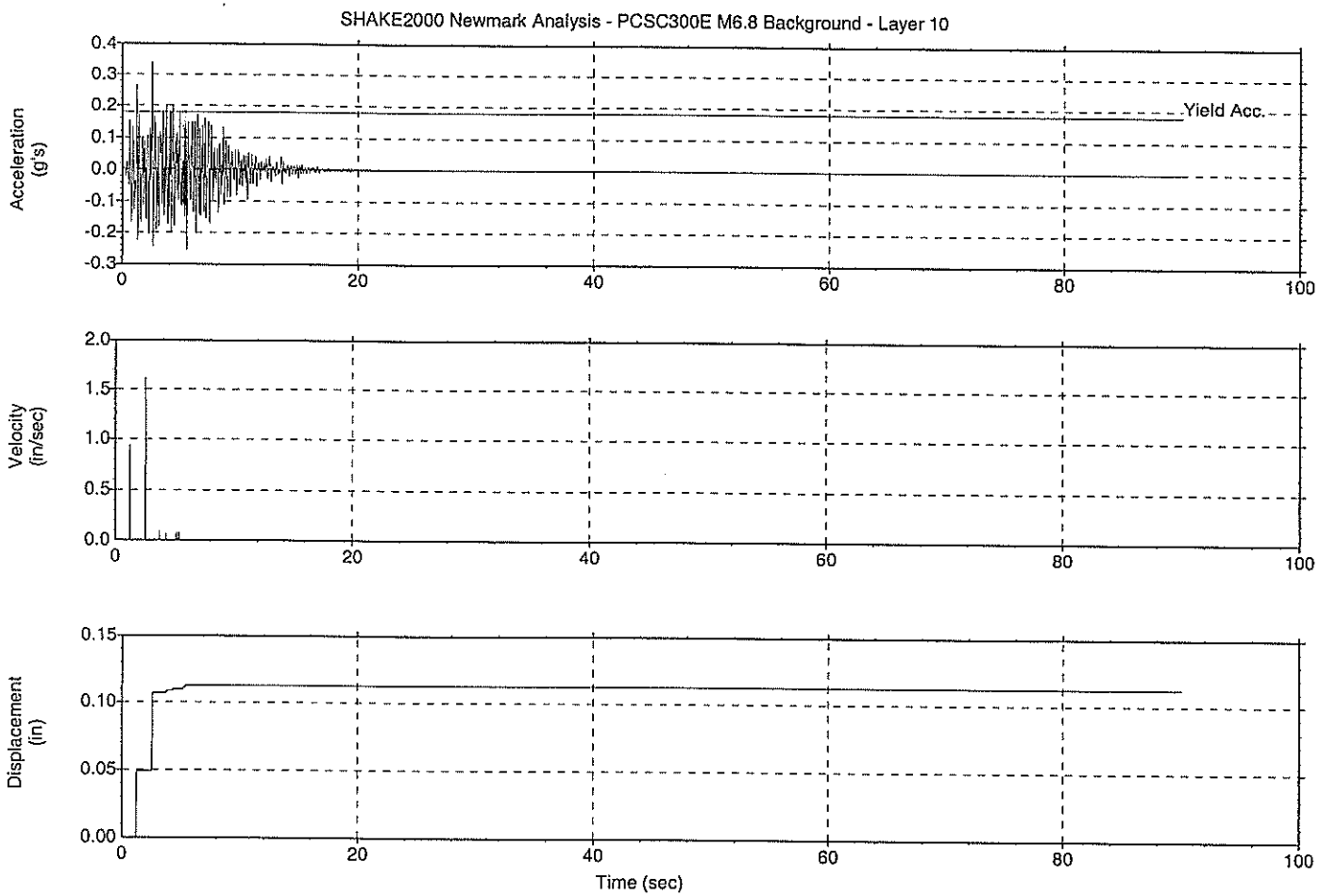


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 9

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 9 Stress - HEA - Layer: 9 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\19a1d1-35.hea
Peak Acceleration Value: .3880689 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .1818185 in

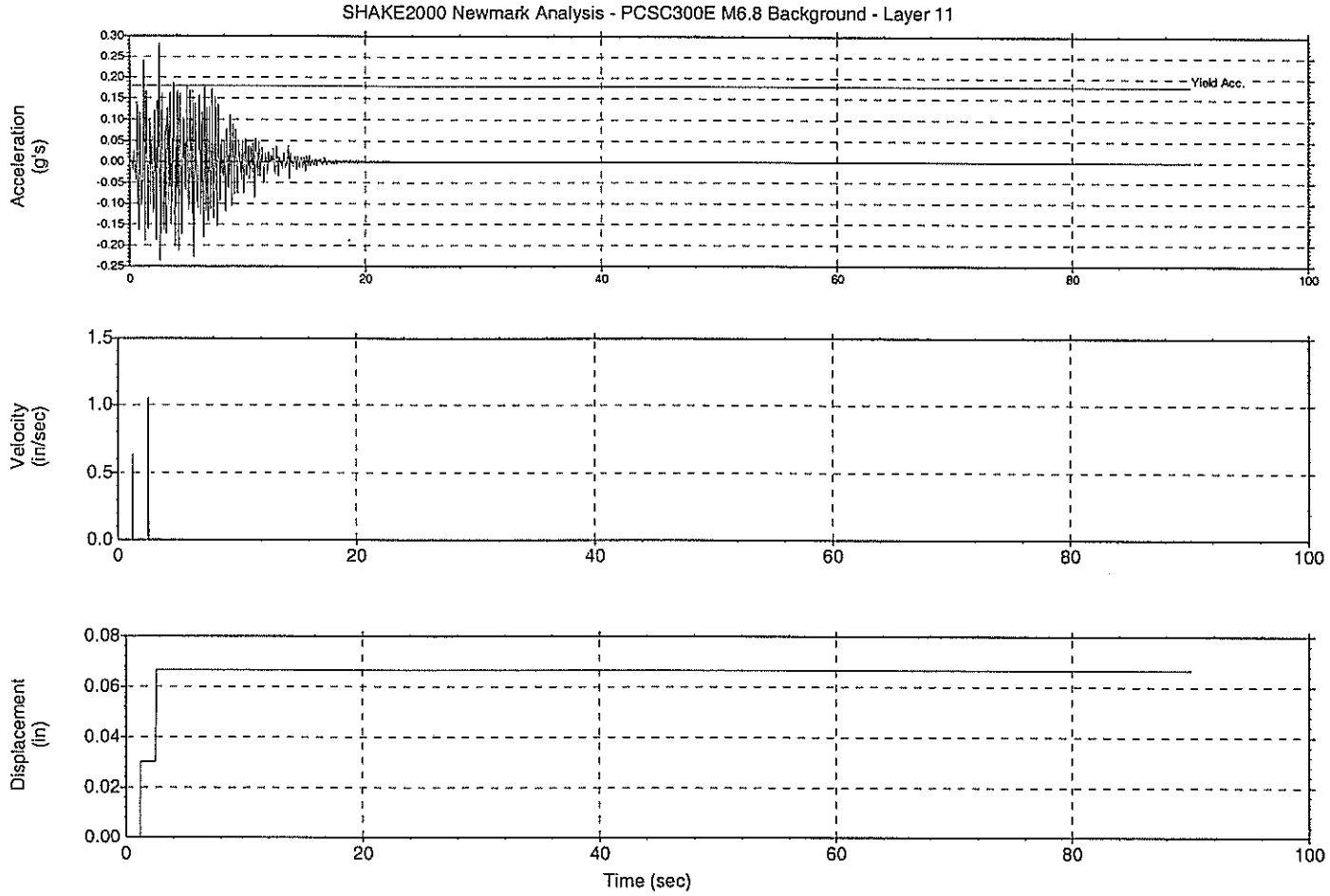


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 10

Newmark Method by Hcuston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 10 Stress - HEA - Layer: 10 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\110a1d1-37.hea
Peak Acceleration Value: .3427745 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .1125055 in



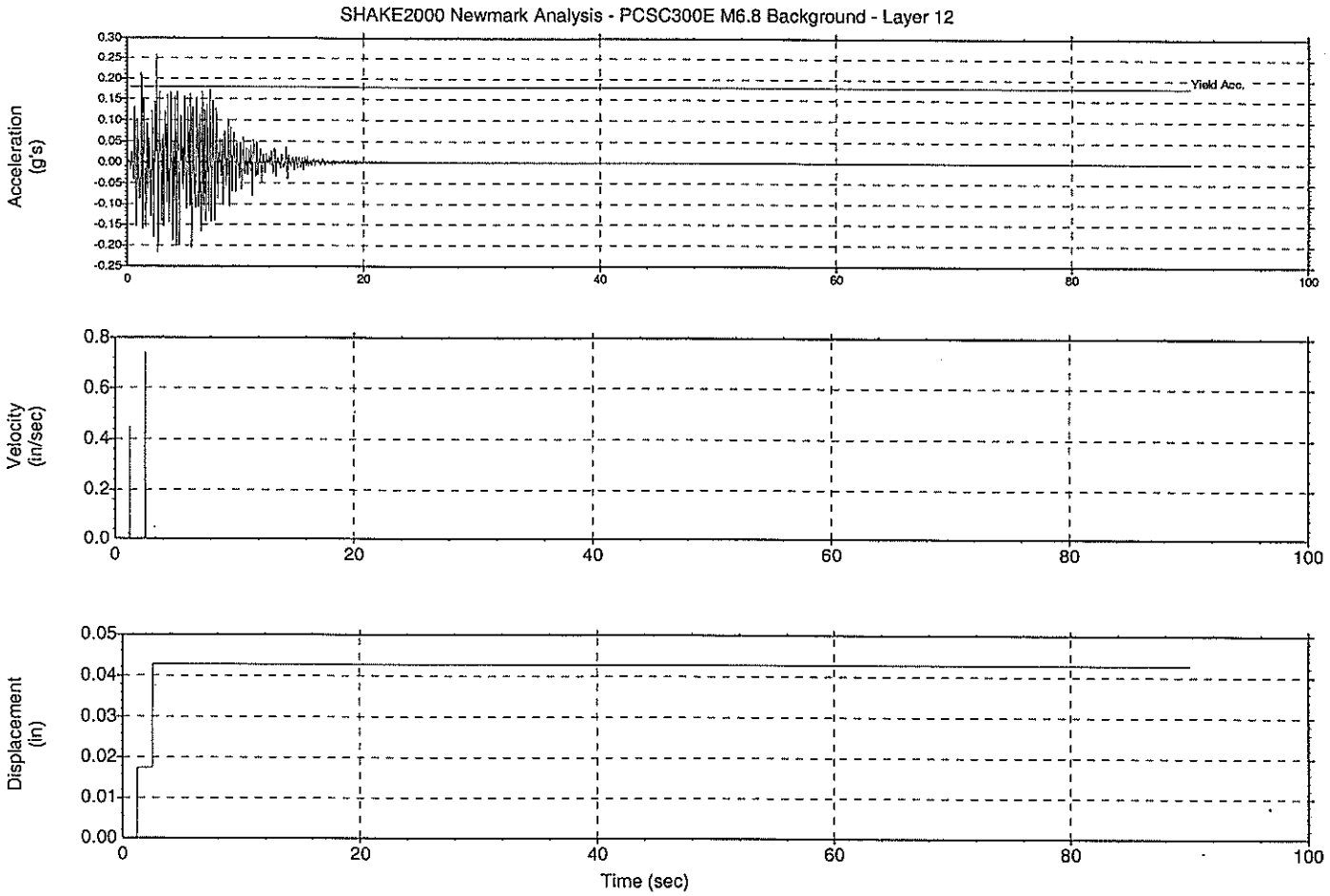
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 11

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 11 Stress - HEA - Layer: 11 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\111a1d1-39.hea
Peak Acceleration Value: .2842841 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 6.657416E-02 in

R16250



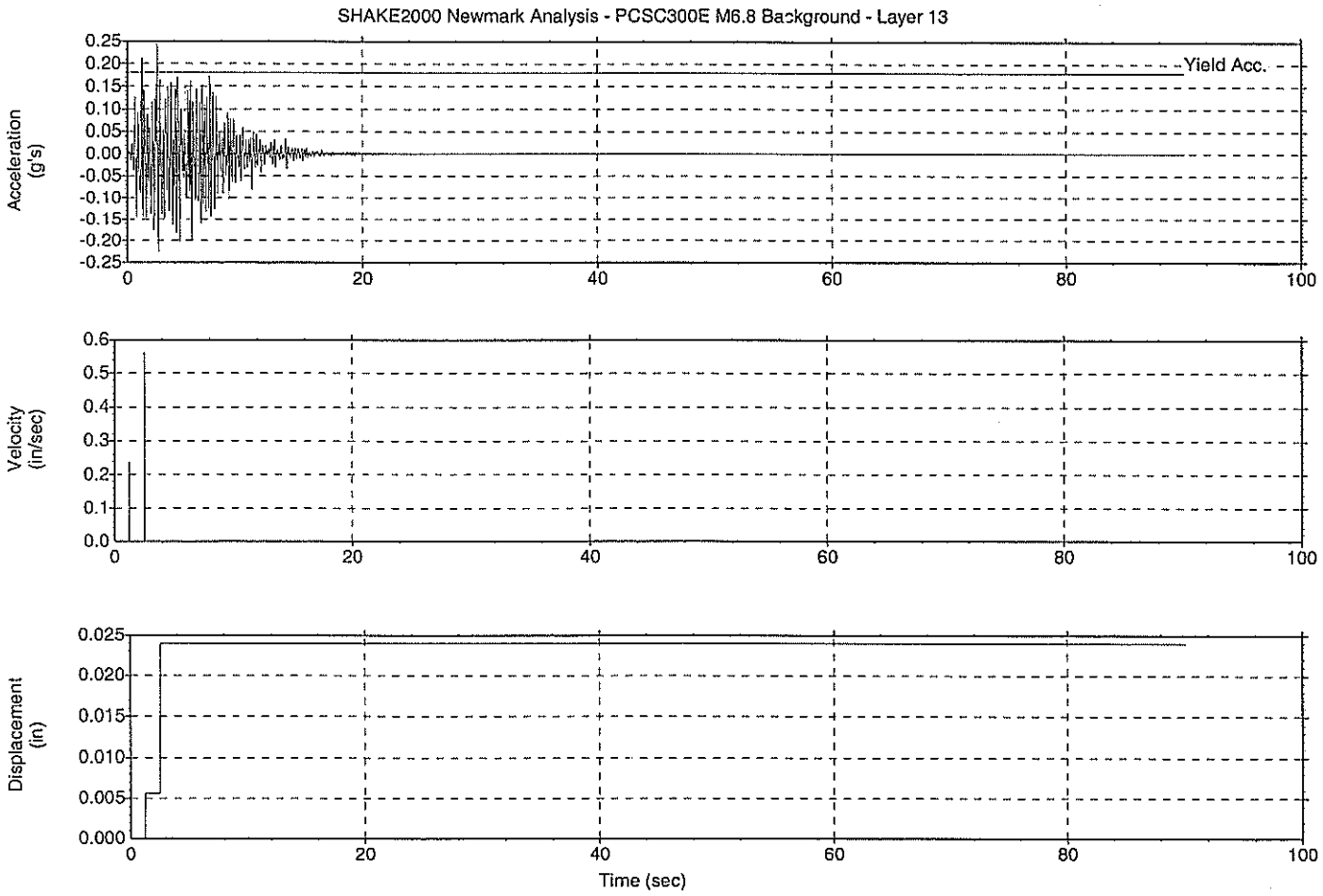
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 12

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 12 Stress - HEA - Layer: 12 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\112a1d1-41.hea
Peak Acceleration Value: .2584438 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 4.273162E-02 in

R16251



Notes:

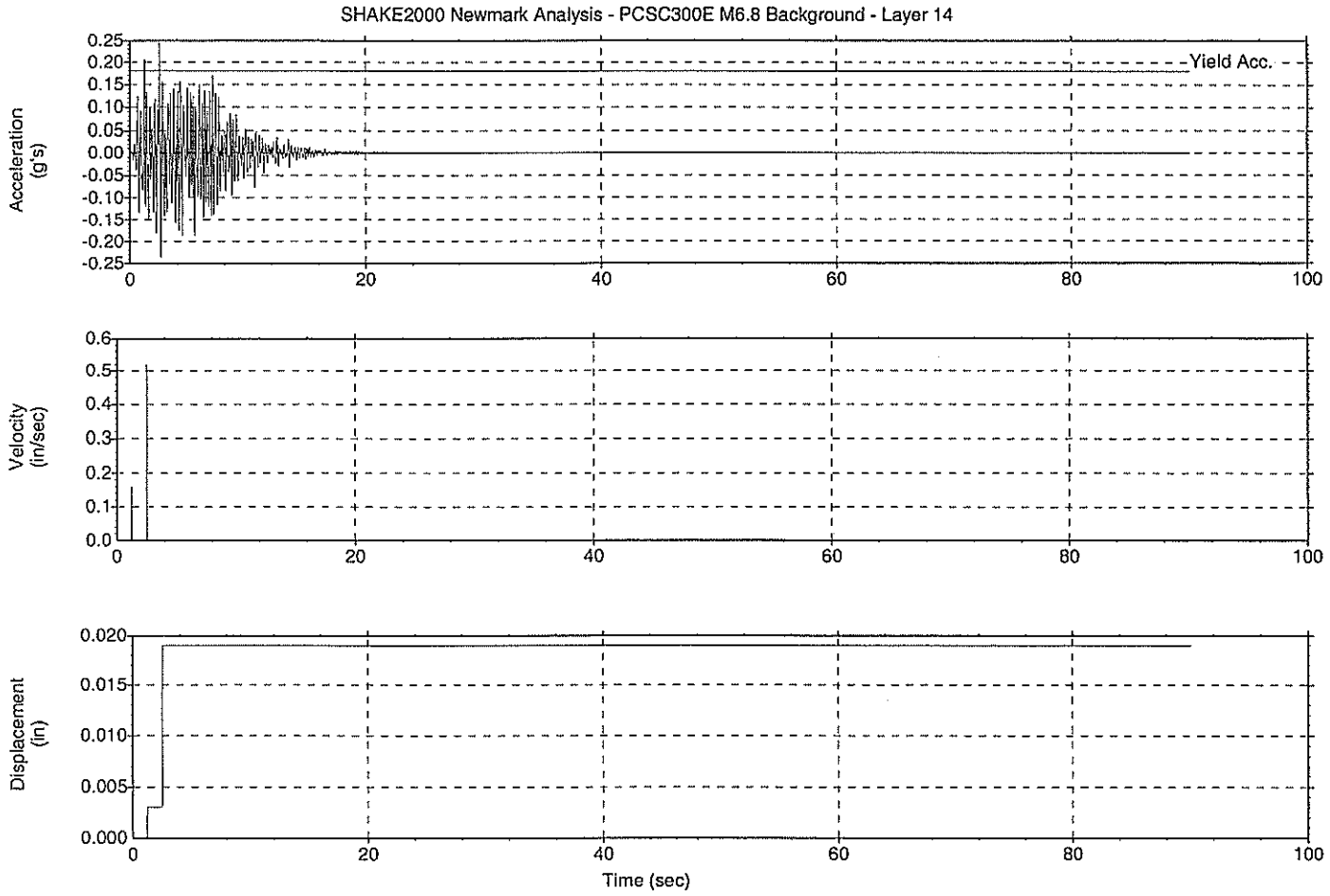
Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 13

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 13 Stress - HEA - Layer: 13 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\113a1d1-43.hea
Peak Acceleration Value: .2430648 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 2.399014E-02 in

17 of 68

R16252



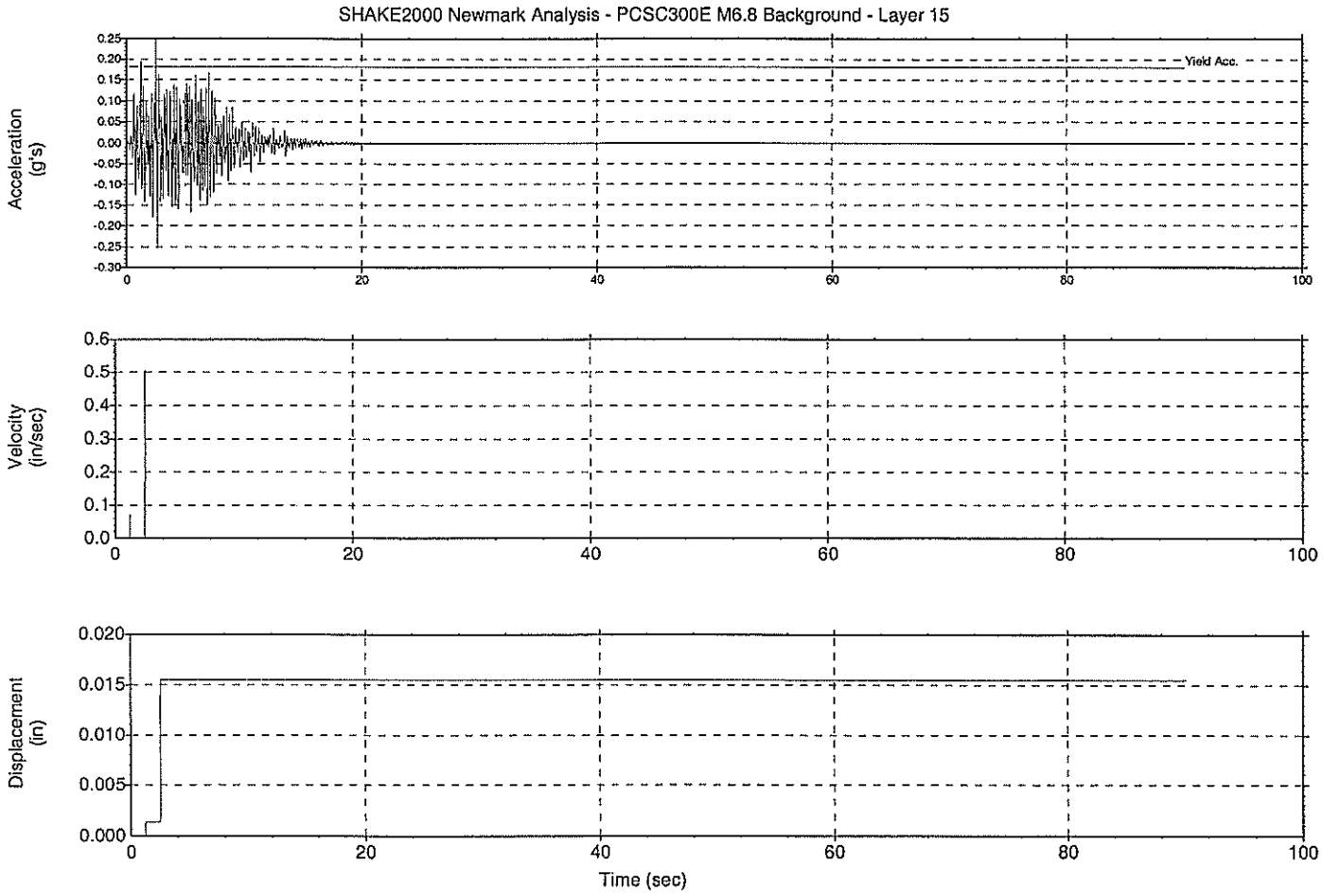
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 14

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 14 Stress - HEA - Layer: 14 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\114ald1-45.hea
Peak Acceleration Value: .2440292 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 1.901044E-02 in

R16253



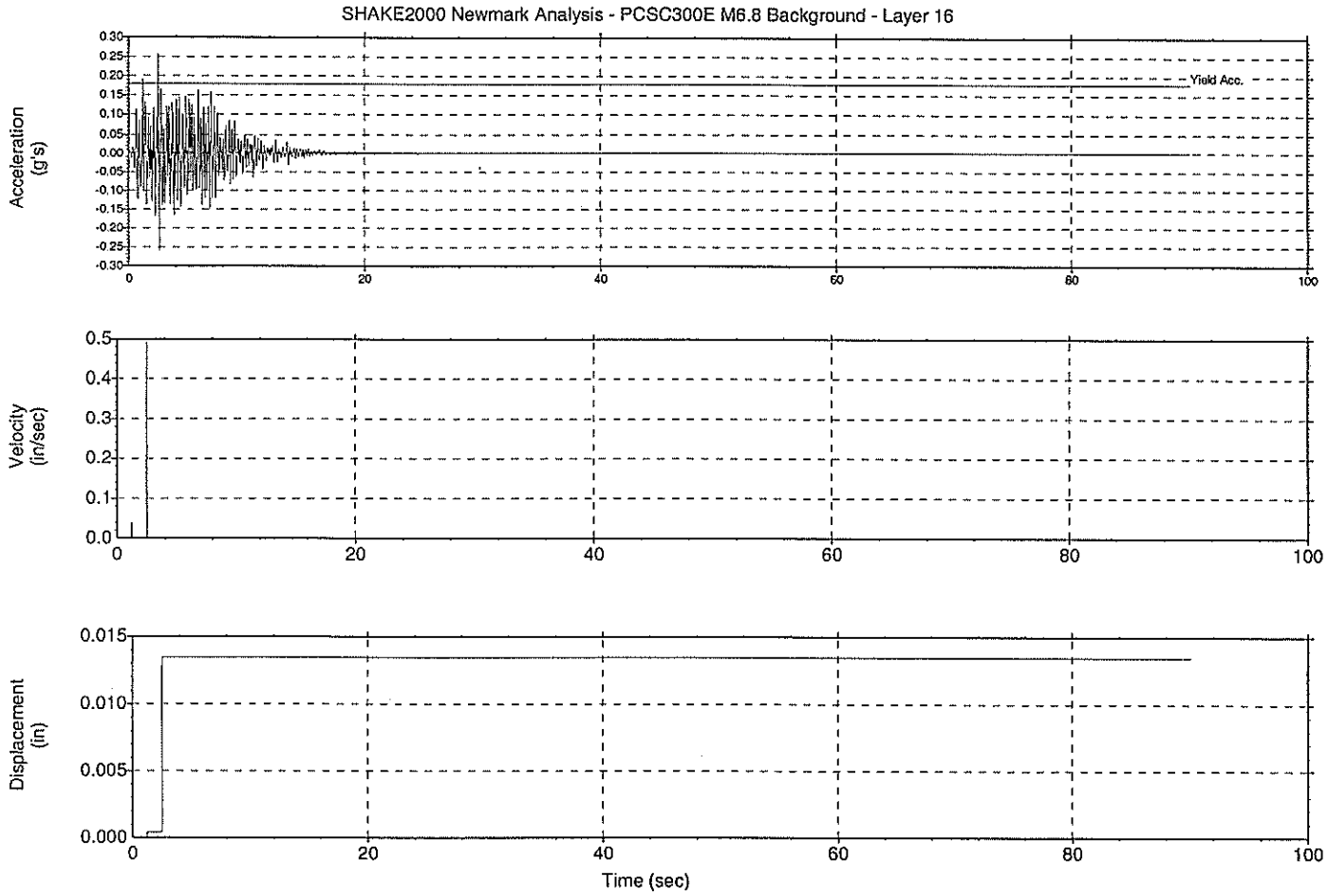
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 15

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 15 Stress - HEA - Layer: 15 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\115a1d1-47.hea
Peak Acceleration Value: .2555991 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 1.554617E-02 in

R16254



Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M6.8 Background - Layer 16

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 16 Stress - HEA - Layer: 16 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\116a1d1-49.hea
Peak Acceleration Value: .2608154 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 1.346898E-02 in

R16255

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation

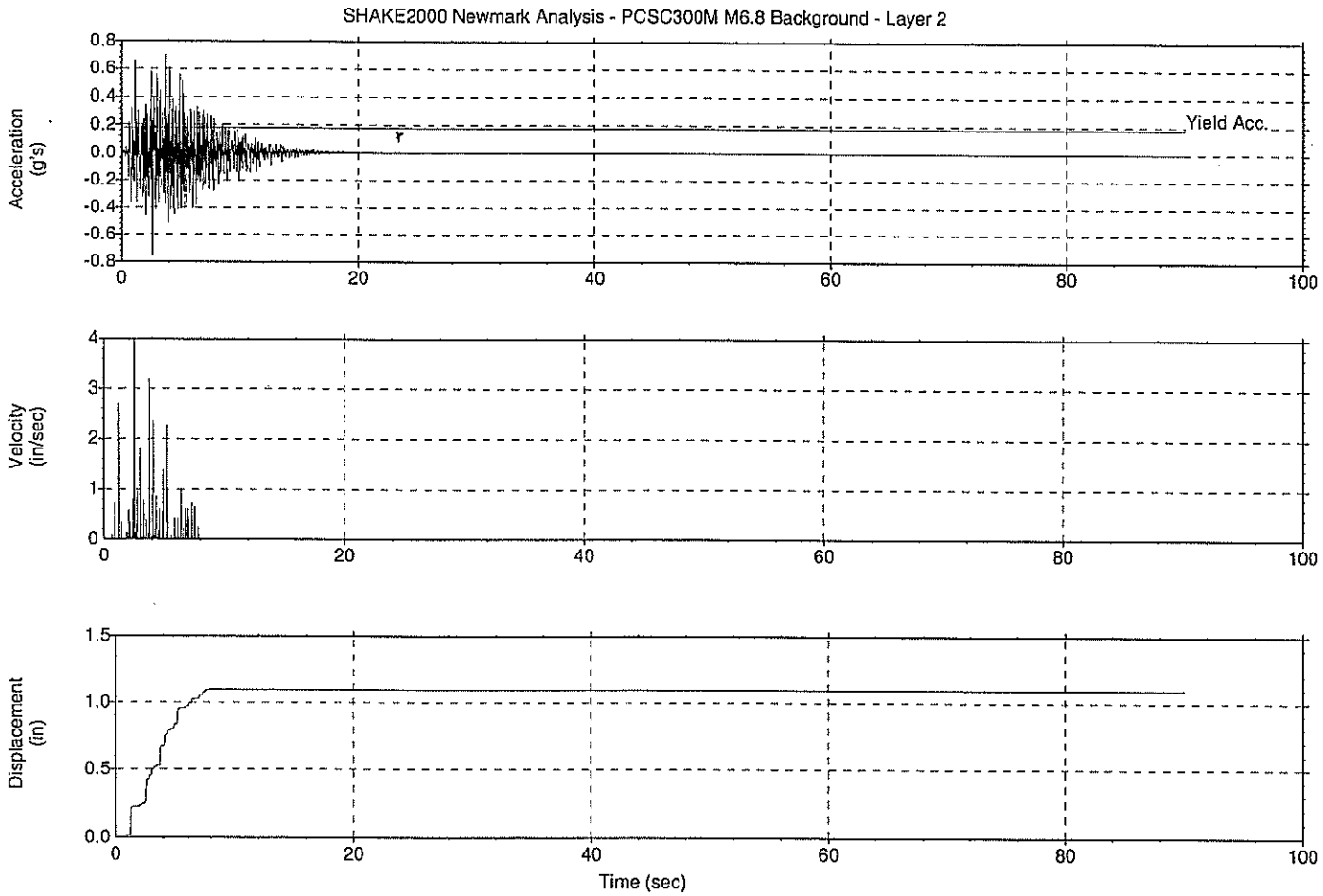
PROJECT NO. 072047

Estimate of Potential Embankment Settlements (Permanent Deformations)

PAGE 21 OF 68

MADE BY BEG DATE 1/22/08 CHECKED BY [signature] DATE 1/23/08

SHAKE2000 PERMANENT DEFORMATION OUTPUT FILE
PCSC300M – LAYERS 1 THROUGH 16
M6.8 BACKGROUND MDE @ 13.5 KM



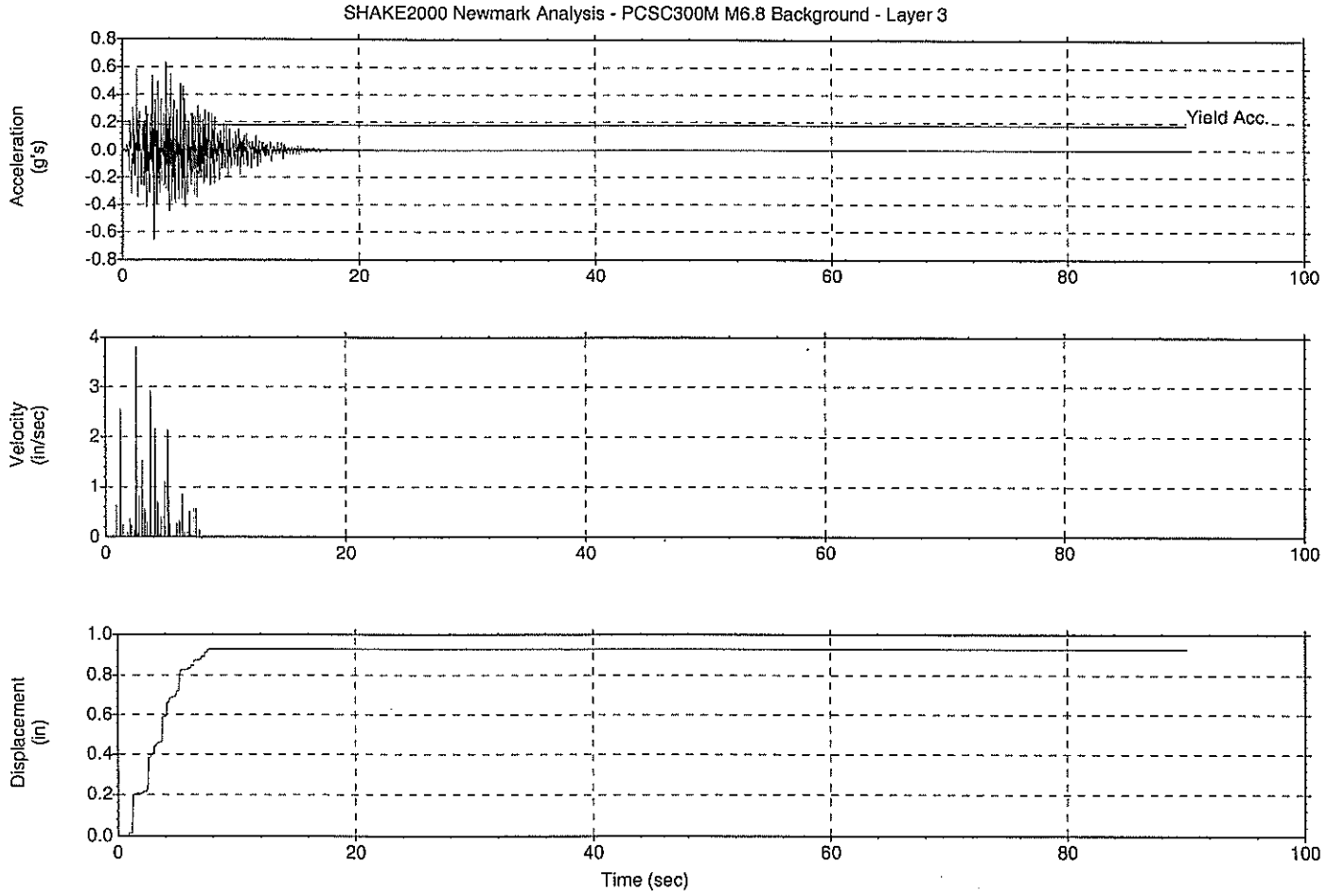
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 2

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 2 Stress - HEA - Layer: 2 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\12a1d1-21.hea
Peak Acceleration Value: .7591308 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 1.096441 in

R16257

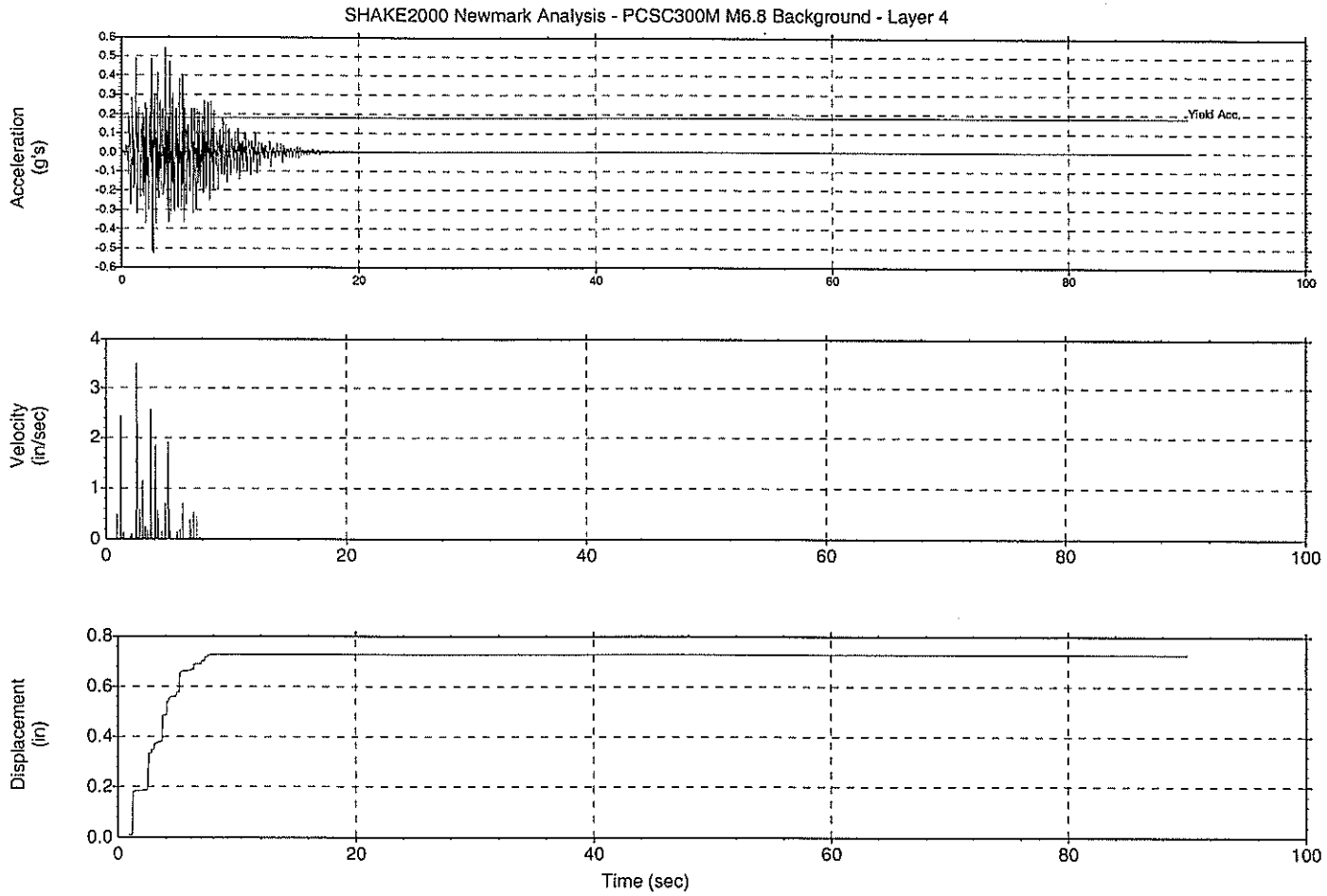


Notes:
Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 3

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 3 Stress - HEA - Layer: 3 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\13ald1-23.hea
Peak Acceleration Value: .6572132 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .928295 in

R16258



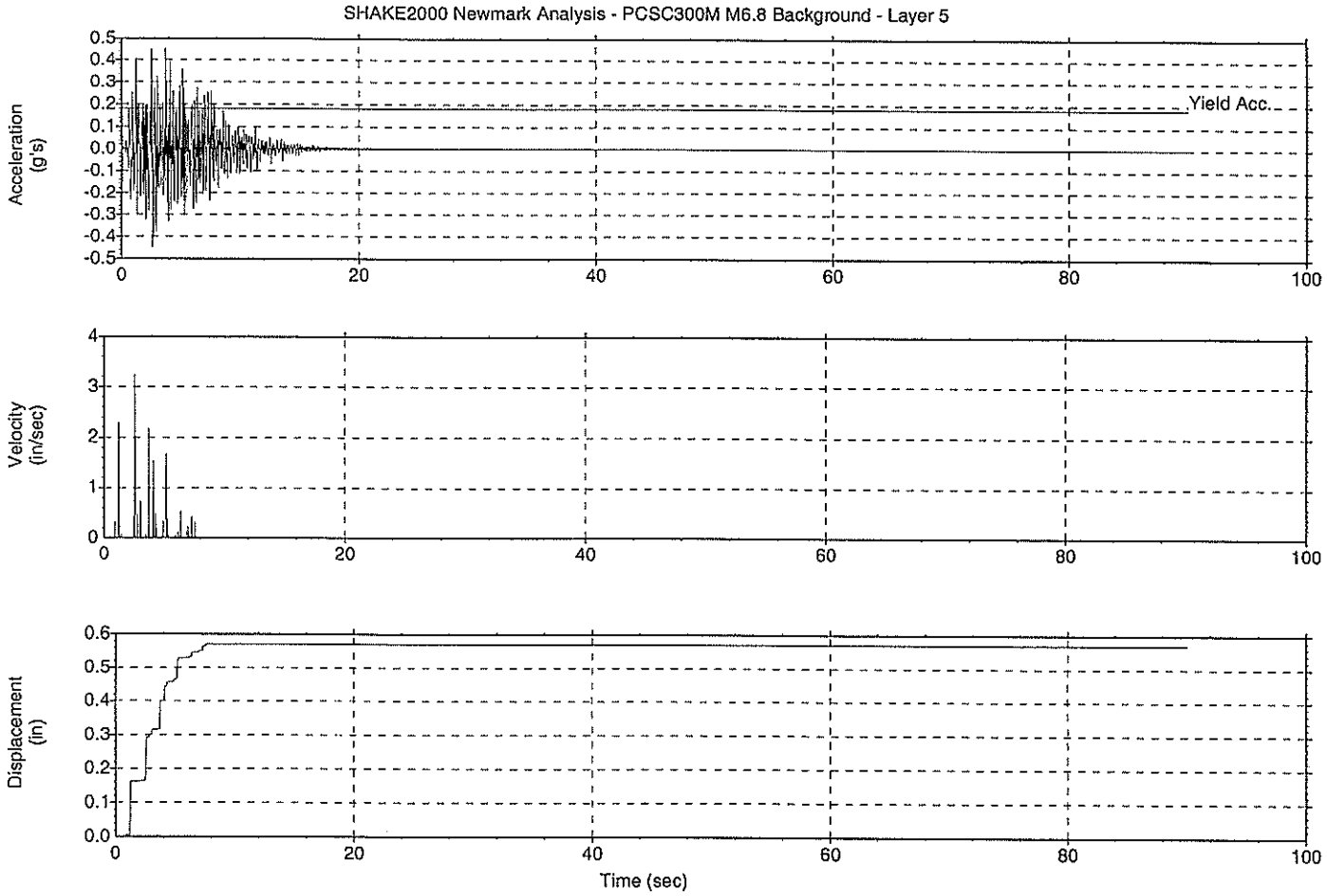
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 4

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 4 Stress - HEA - Layer: 4 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l4a1d1-25.hea
Peak Acceleration Value: .5447469 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .7276583 in

R16259



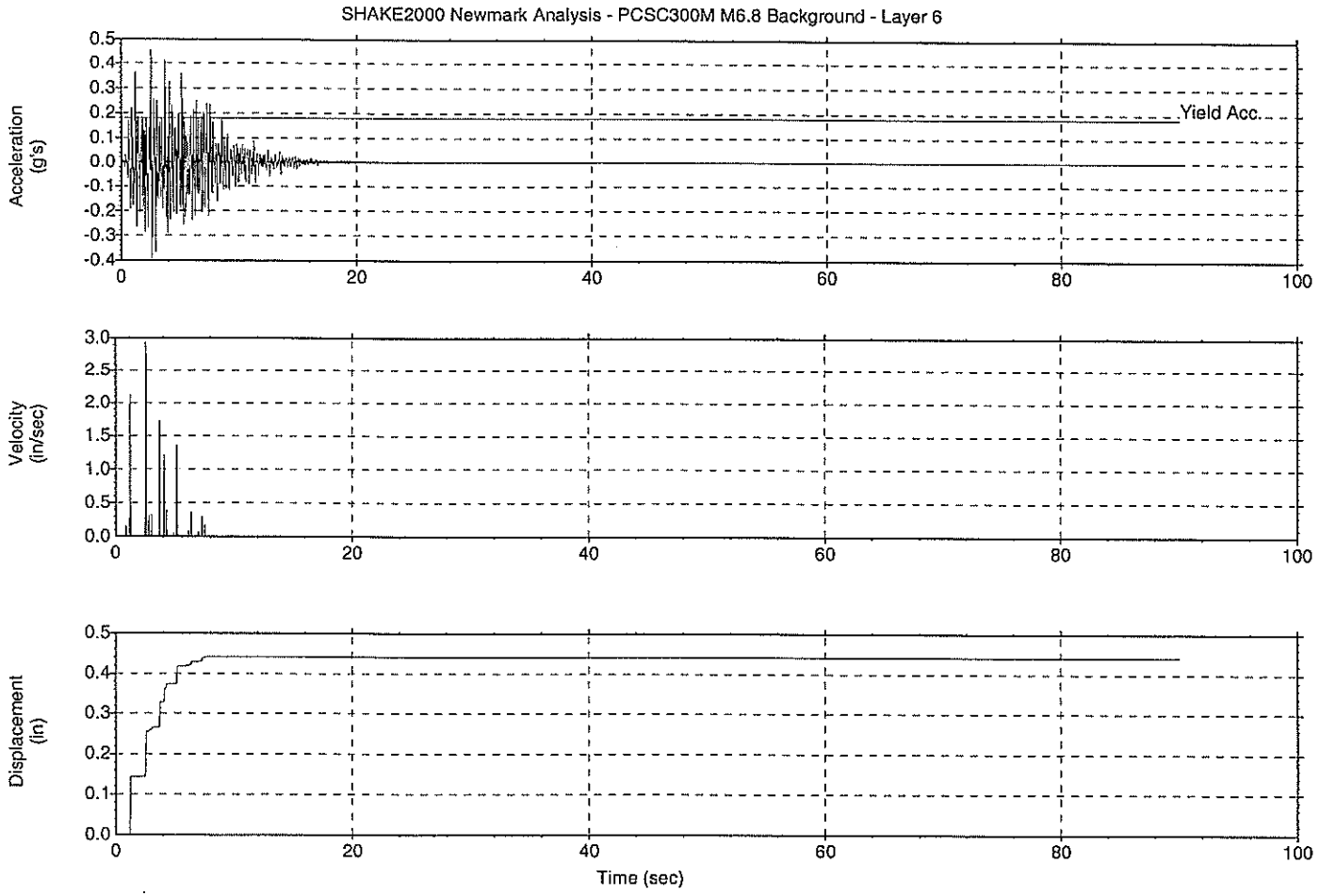
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 5

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 5 Stress - HEA - Layer: 5 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l5aldl-27.hea
Peak Acceleration Value: .4537432 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .5699688 in

R16260

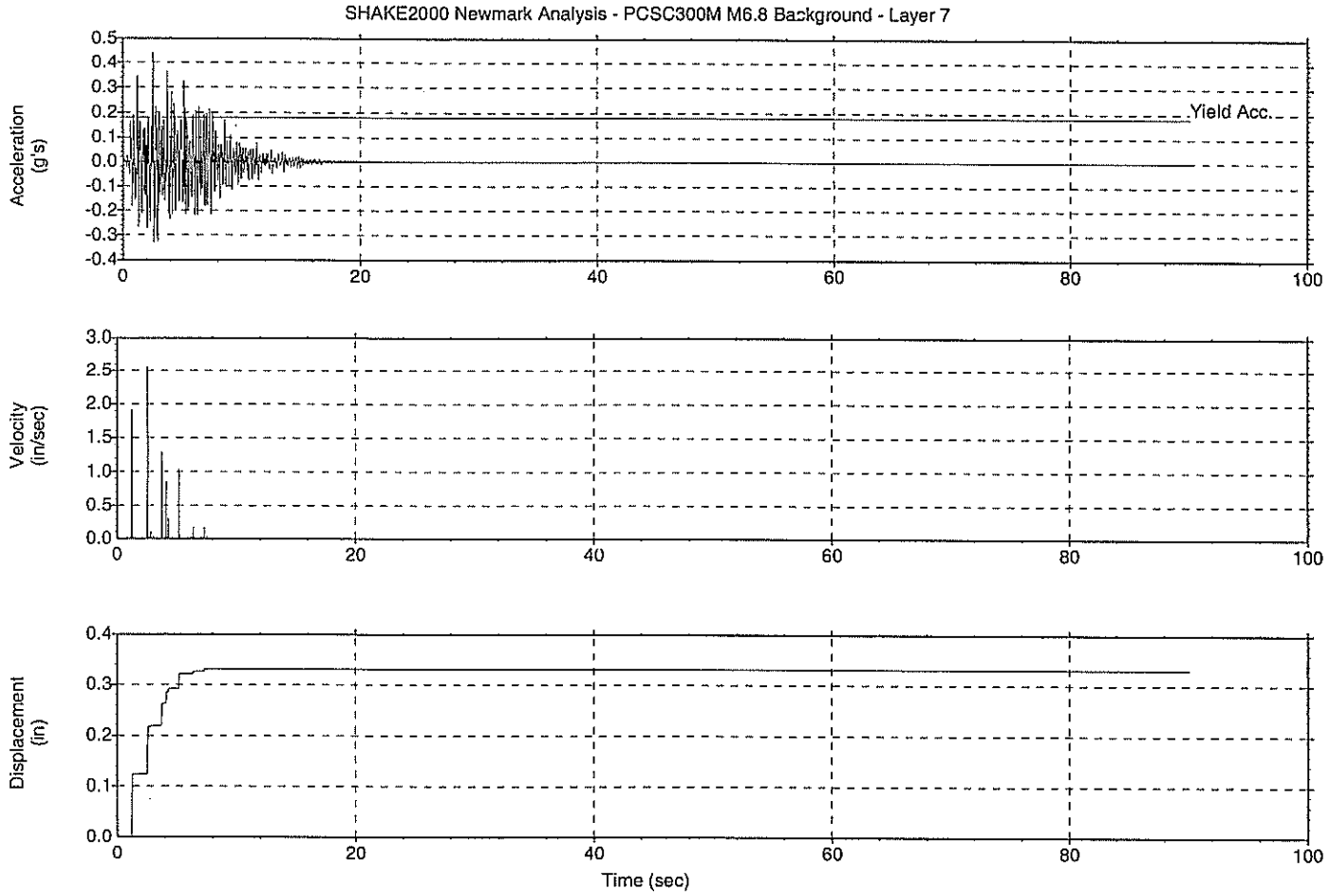


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 6

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC330M Layer 6 Stress - HEA - Layer: 6 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\16a1d1-29.hea
Peak Acceleration Value: .4564626 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .4413362 in



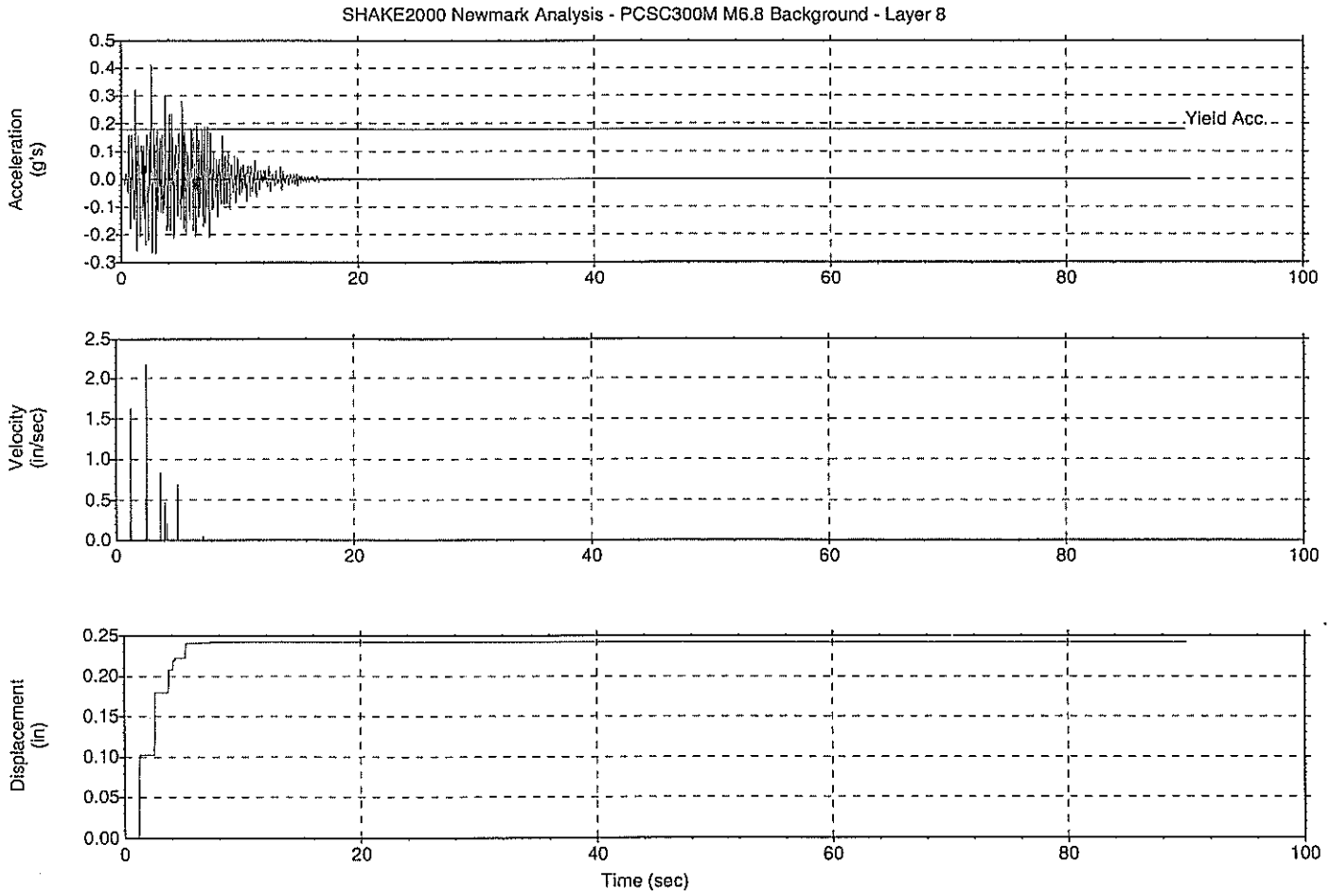
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 7

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 7 Stress - HEA - Layer: 7 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l7ald1-31.hea
Peak Acceleration Value: .4421774 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .3306053 in

R16262



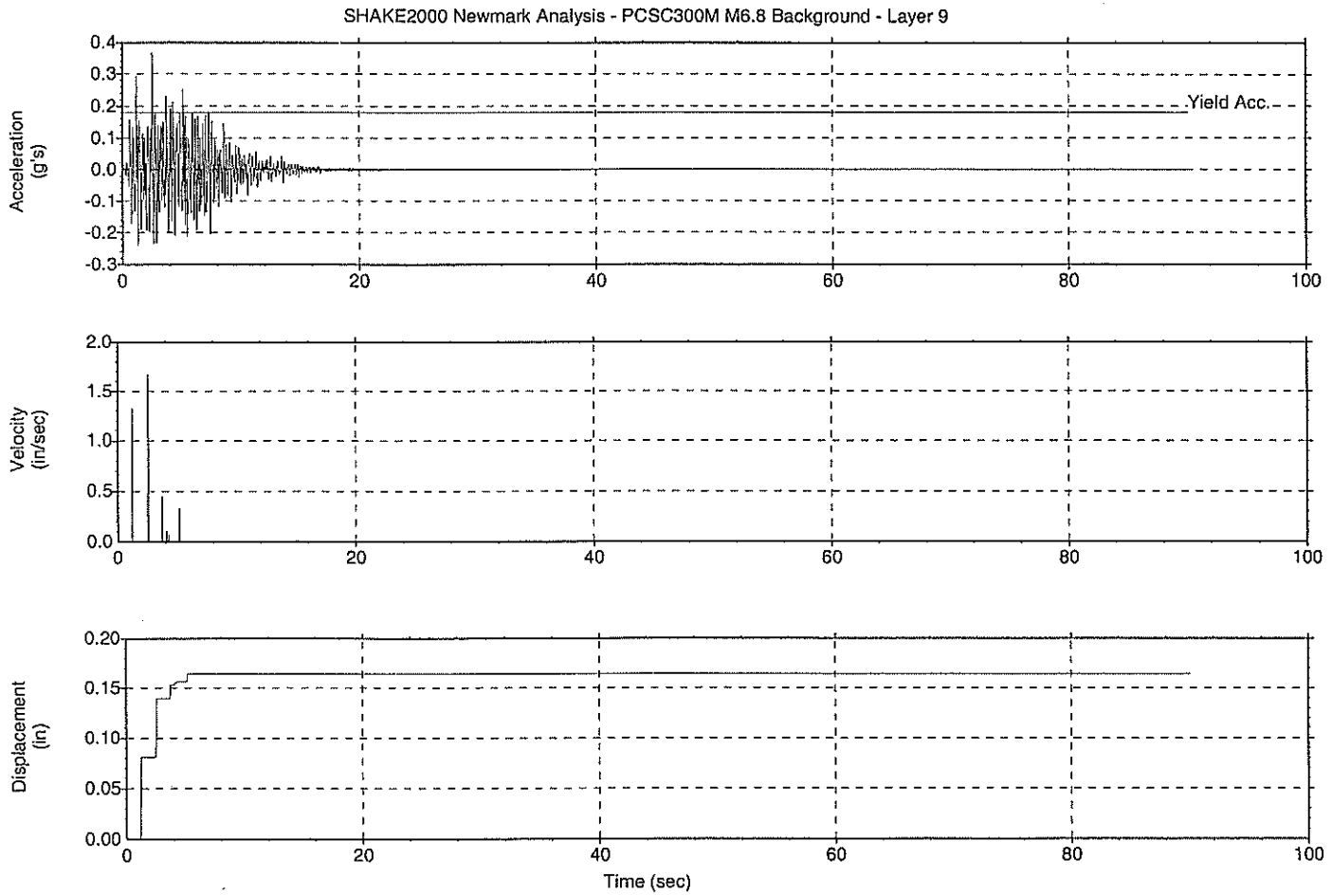
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 8

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 8 Stress - HEA - Layer: 8 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\18a1d1-33.hea
Peak Acceleration Value: .4134678 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .2417877 in

R16263

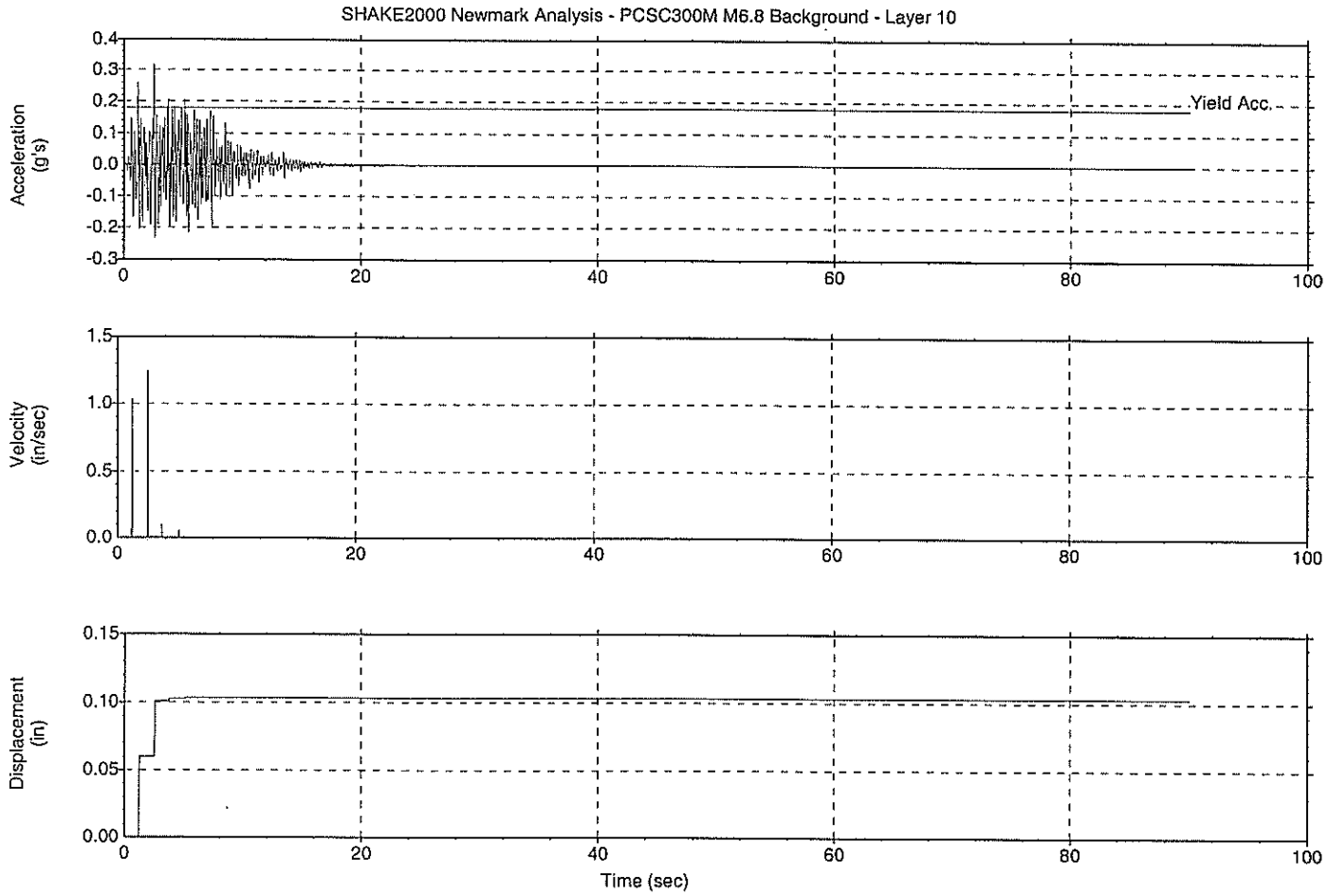


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 9

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 9 Stress - HEA - Layer: 9 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\19ald1-35.hea
Peak Acceleration Value: .3690042 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .1643203 in



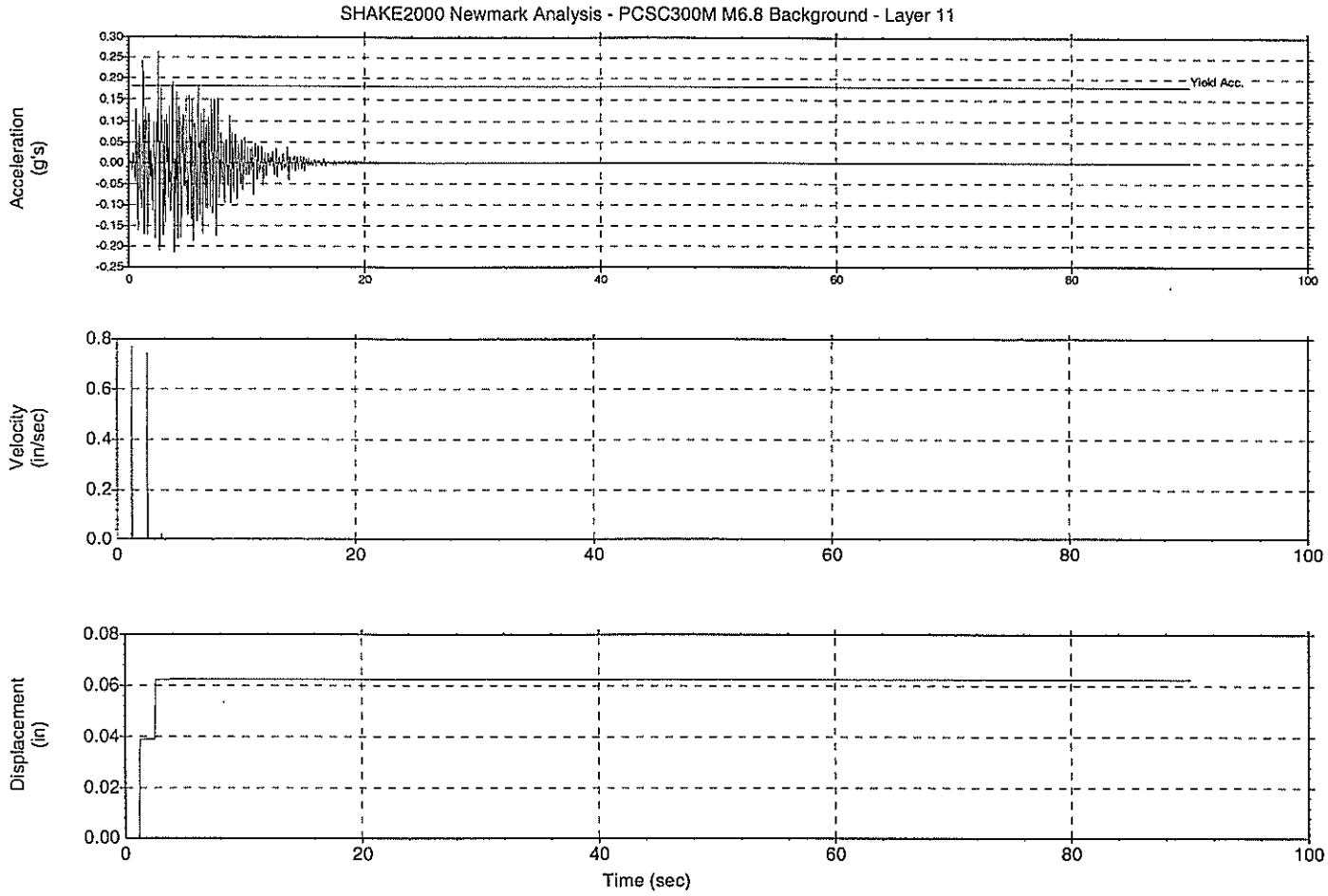
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 10

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 10 Stress - HEA - Layer: 10 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\110a1d1-37.hea
Peak Acceleration Value: .3174475 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .1034276 in

R16265



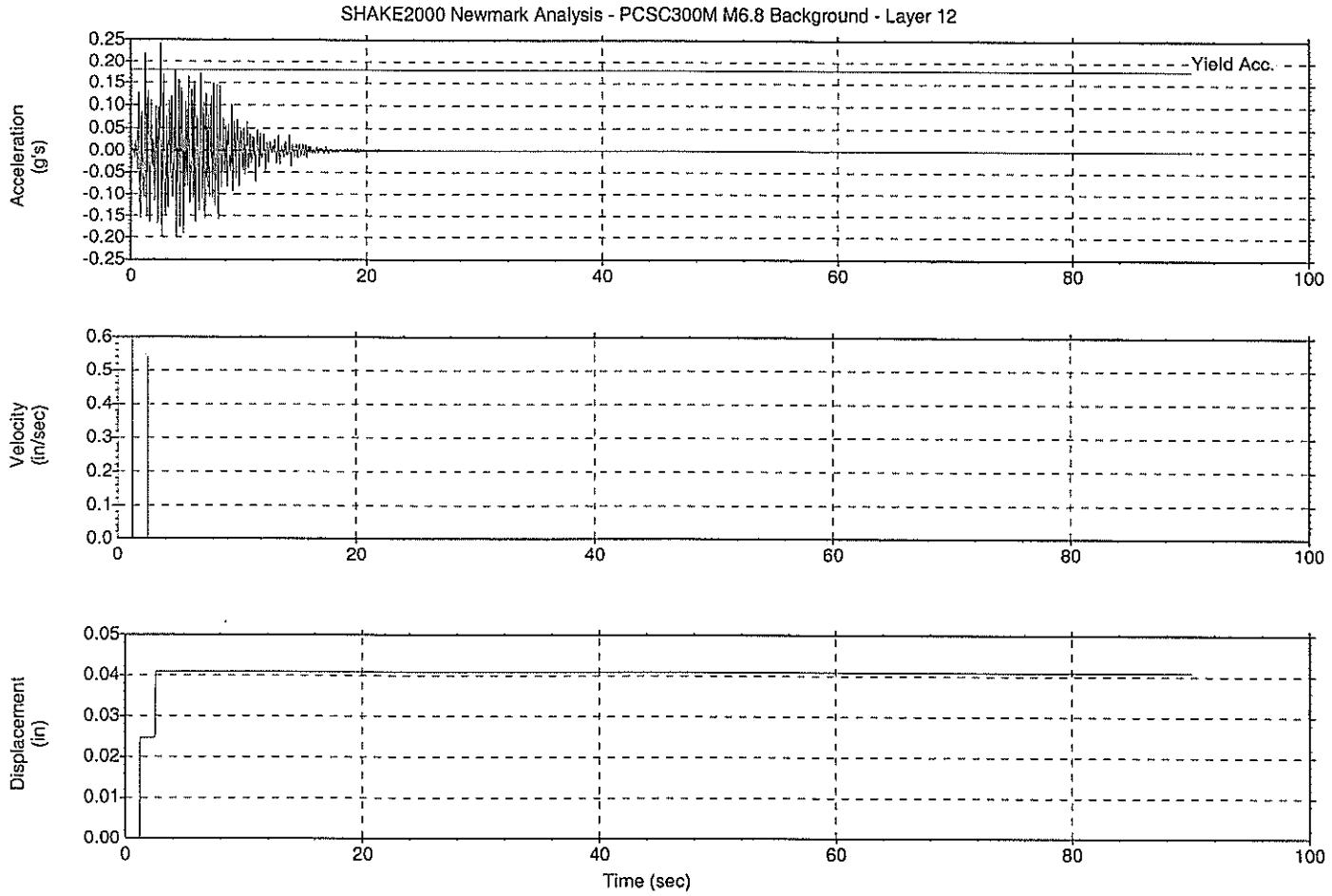
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 11

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 11 Stress - HEA - Layer: 11 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l11ald1-39.hea
Peak Acceleration Value: .2632202 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 6.246461E-02 in

R16266



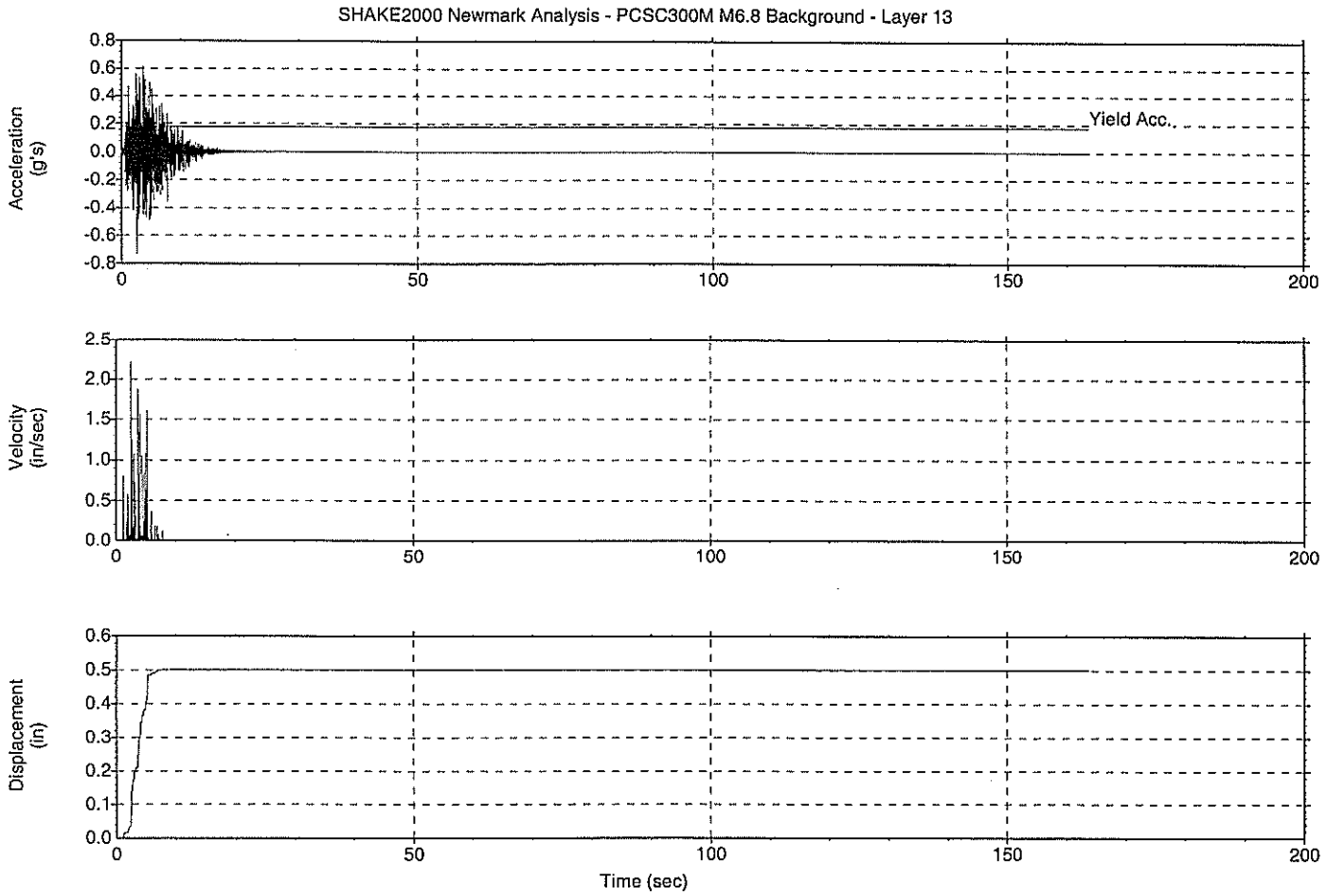
Notes:

Displacement Analys_s - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 12

Newmark Method by Houston et.al. (1987)
Constant Yield Acce_eration: .18 (g)
Acceleration Time H_story: PCSC300M Layer 12 Stress - HEA - Layer: 12 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time H_story File: C:\SHAKE2000\Williamson Energy\l12a1d1-41.hea
Peak Acceleration Value: .2418566 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 4.078336E-02 in

R16267

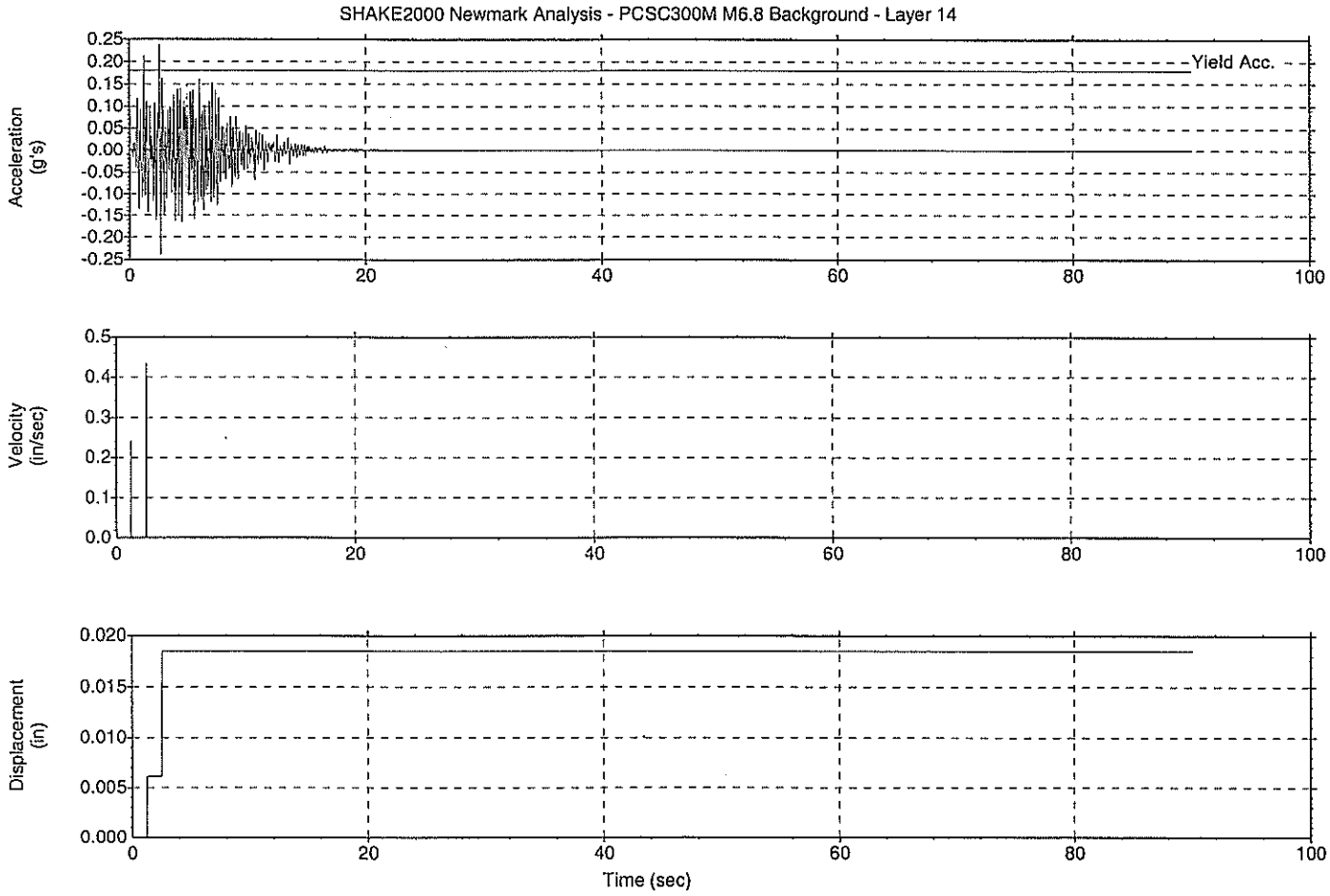


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 13

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: Within - PSCS300E Crest Column - AHL -
Layer: 13 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l13a1d1-13.ahl
Peak Acceleration Value: .736312 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: .5018111 in



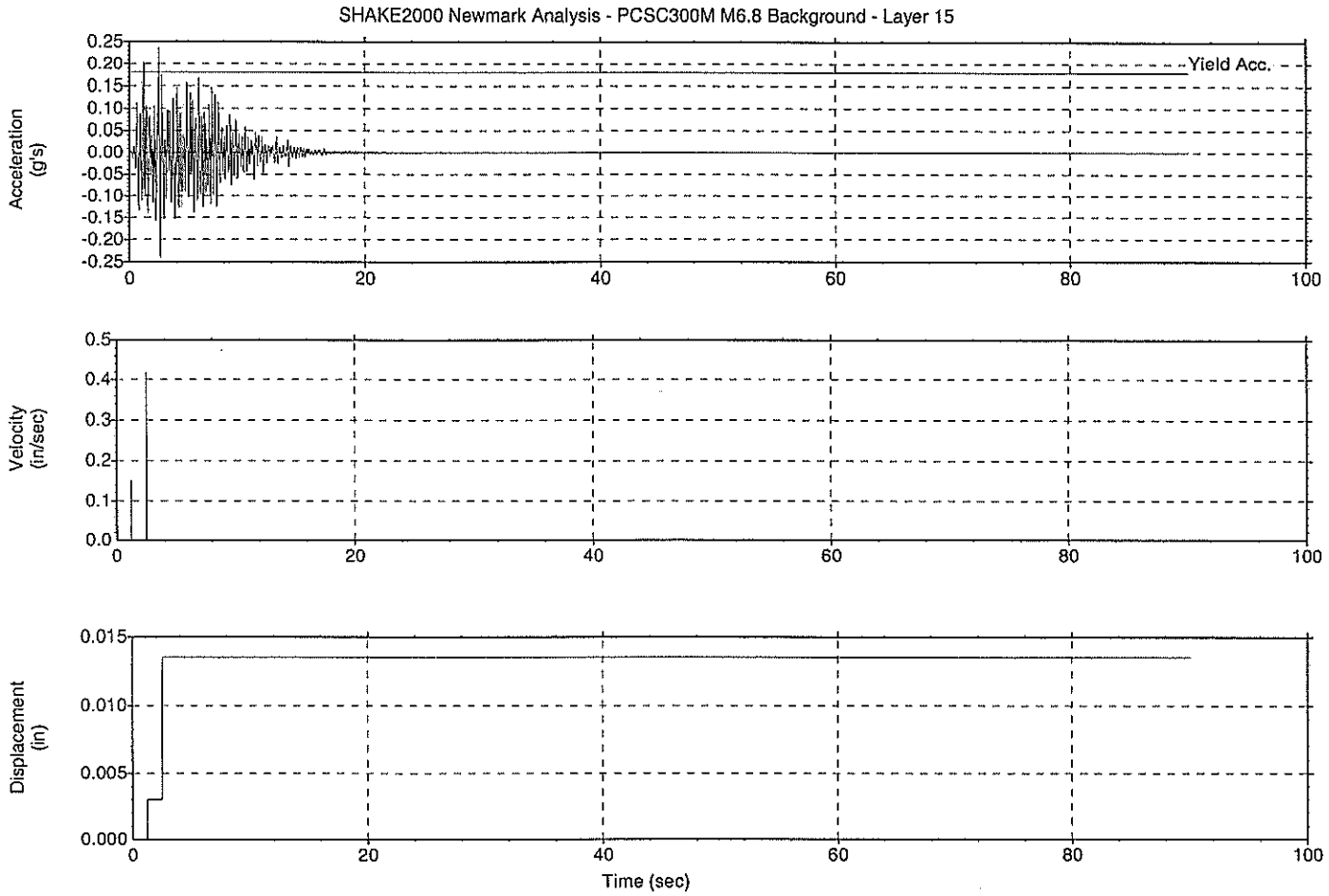
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 14

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 14 Stress - HEA - Layer: 14 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\114a1d1-45.hea
Peak Acceleration Value: .2398237 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 1.851576E-02 in

R16269



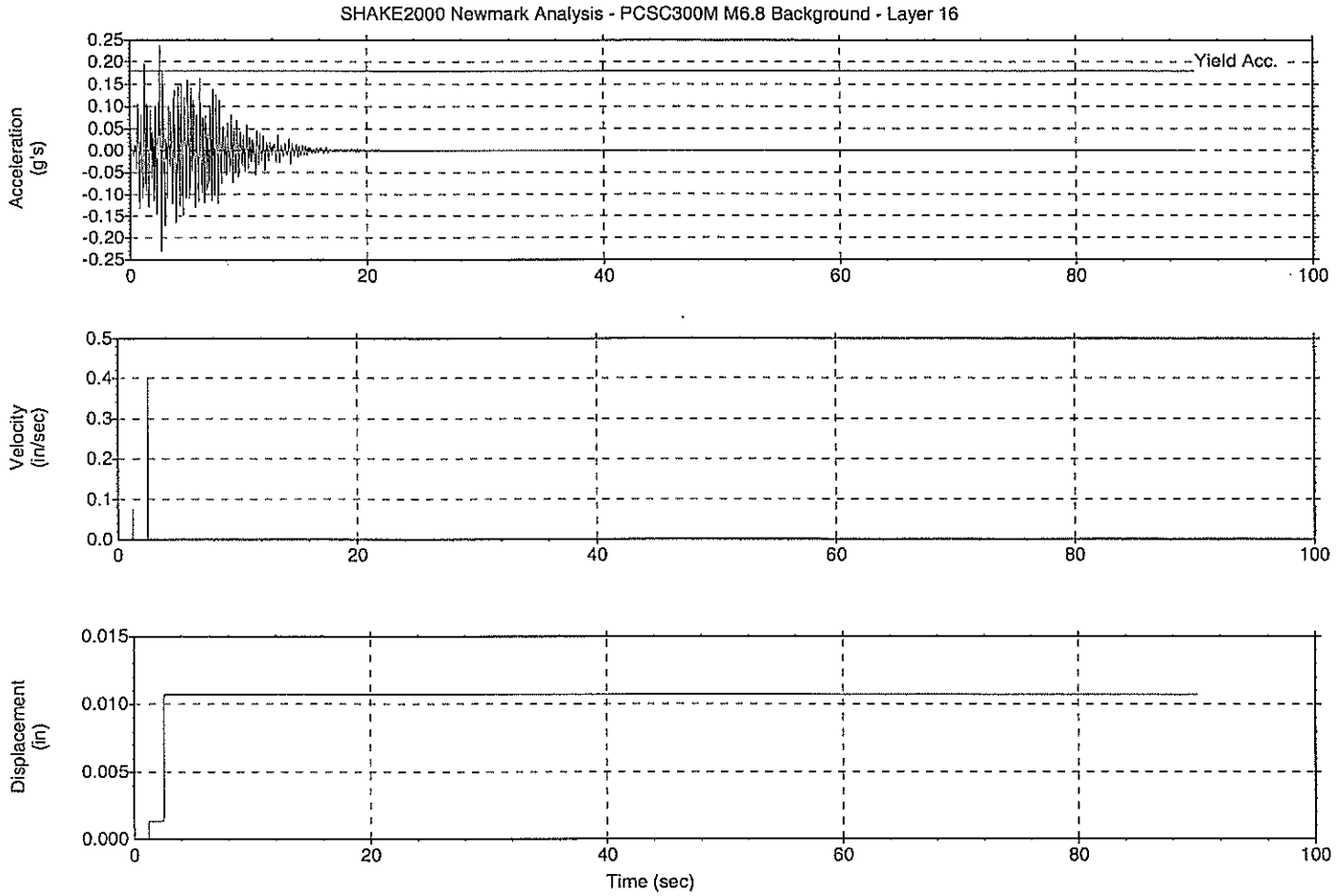
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 15

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 15 Stress - HEA - Layer: 15 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l15ald1-47.hea
Peak Acceleration Value: .2405543 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 1.355834E-02 in

R16270



Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M6.8 Background - Layer 16

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 16 Stress - HEA - Layer: 16 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\116ald1-49.hea
Peak Acceleration Value: .2372678 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 1.073878E-02 in

R16271

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation

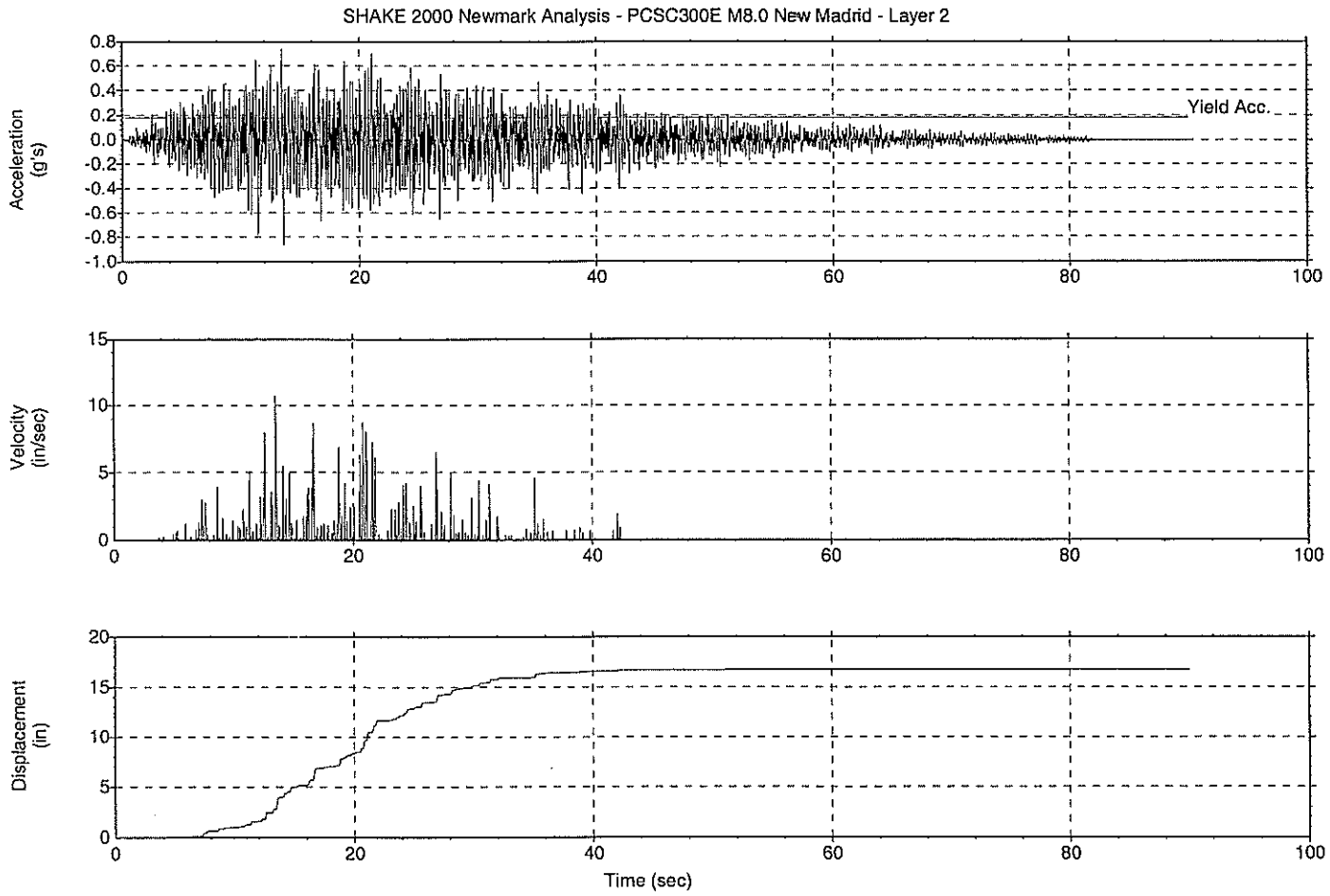
PROJECT NO. 072047

Estimate of Potential Embankment Settlements (Permanent Deformations)

PAGE 37 OF 68

MADE BY BEG DATE 1/22/08 CHECKED BY [signature] DATE 1/23/08

SHAKE2000 PERMANENT DEFORMATION OUTPUT FILE
PCSC300E – LAYERS 1 THROUGH 16
M8.0 NEW MADRID MDE @ 83 KM



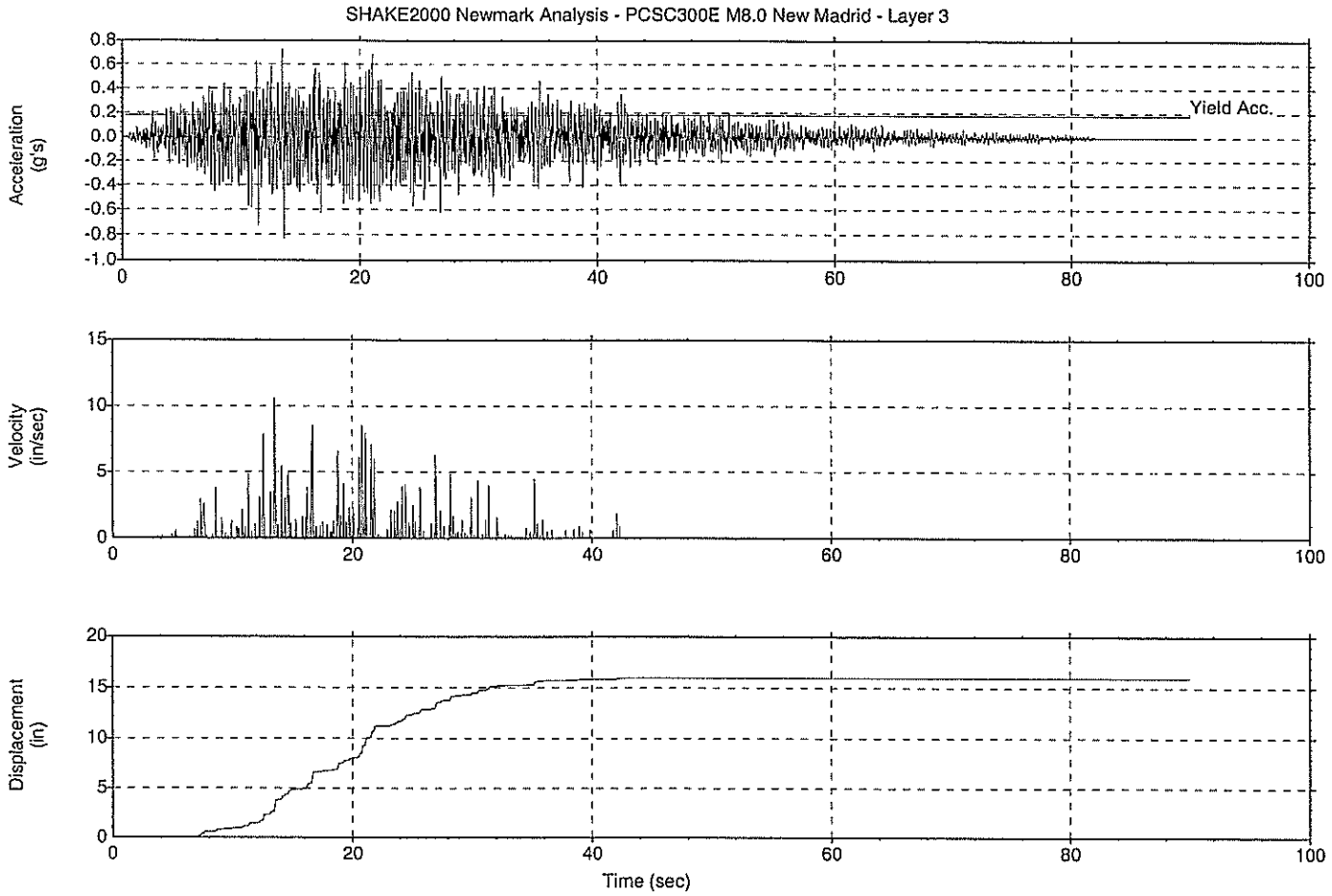
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE 2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 2

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 2 Stress - HEA - Layer: 2 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l2a1dl-21.hea
Peak Acceleration Value: .86835 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 16.7?)38 in

R16273



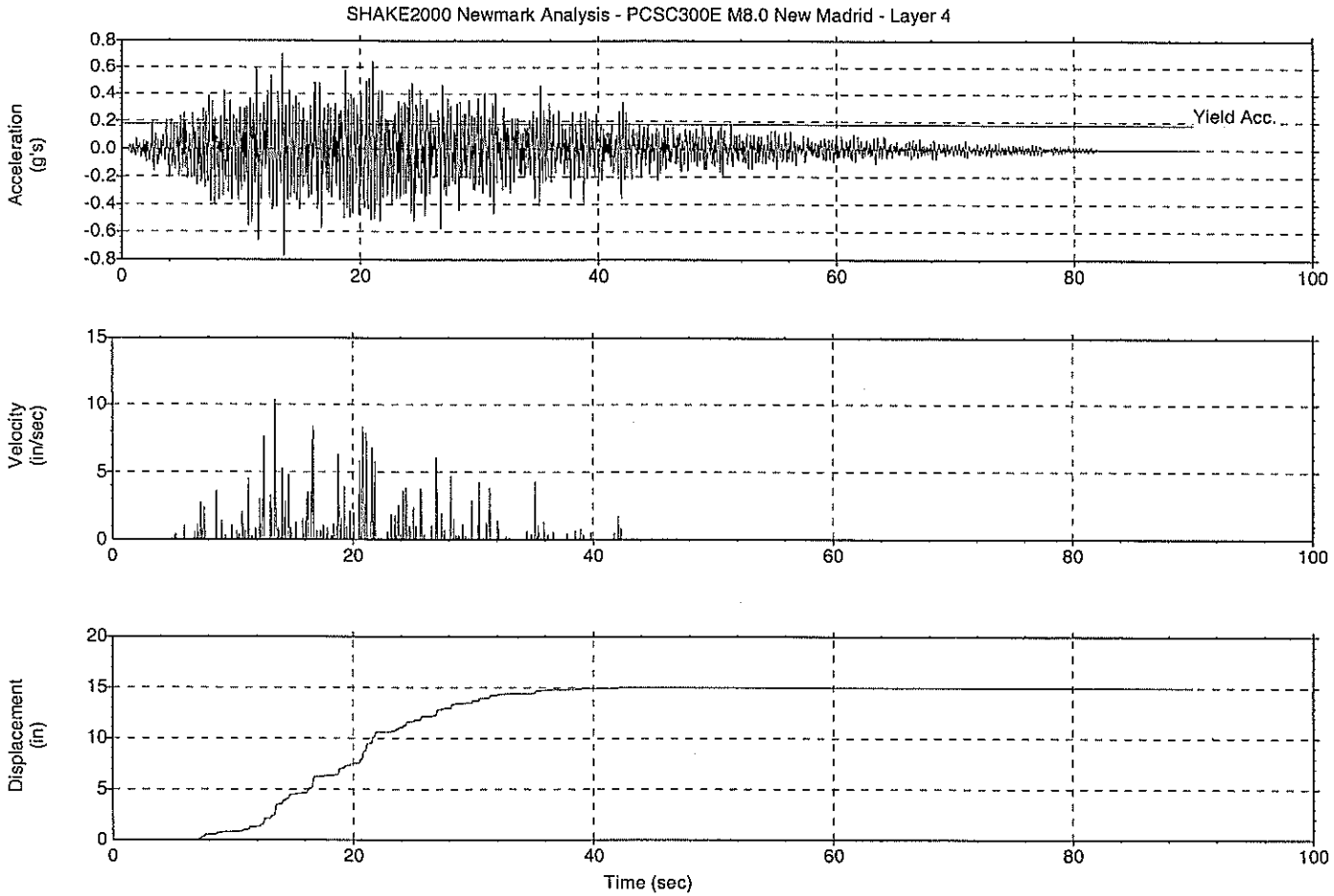
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 3

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 3 Stress - HEA - Layer: 3 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l3a1d1-23.hea
Peak Acceleration Value: .8308055 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 15.98448 in

R16274



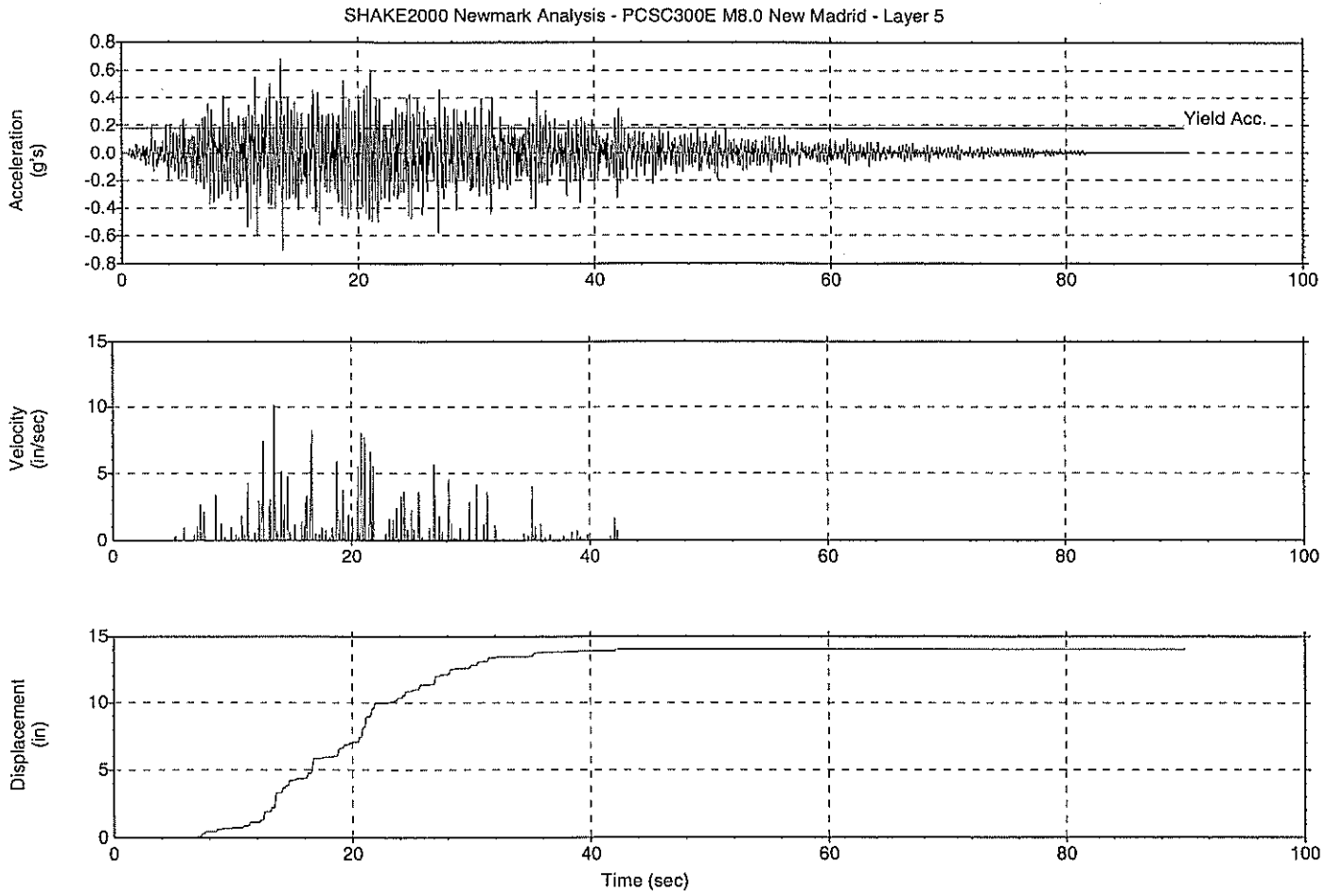
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 4

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 4 Stress - HEA - Layer: 4 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\14a1d1-25.hea
Peak Acceleration Value: .7739446 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 15.02532 in

R16275



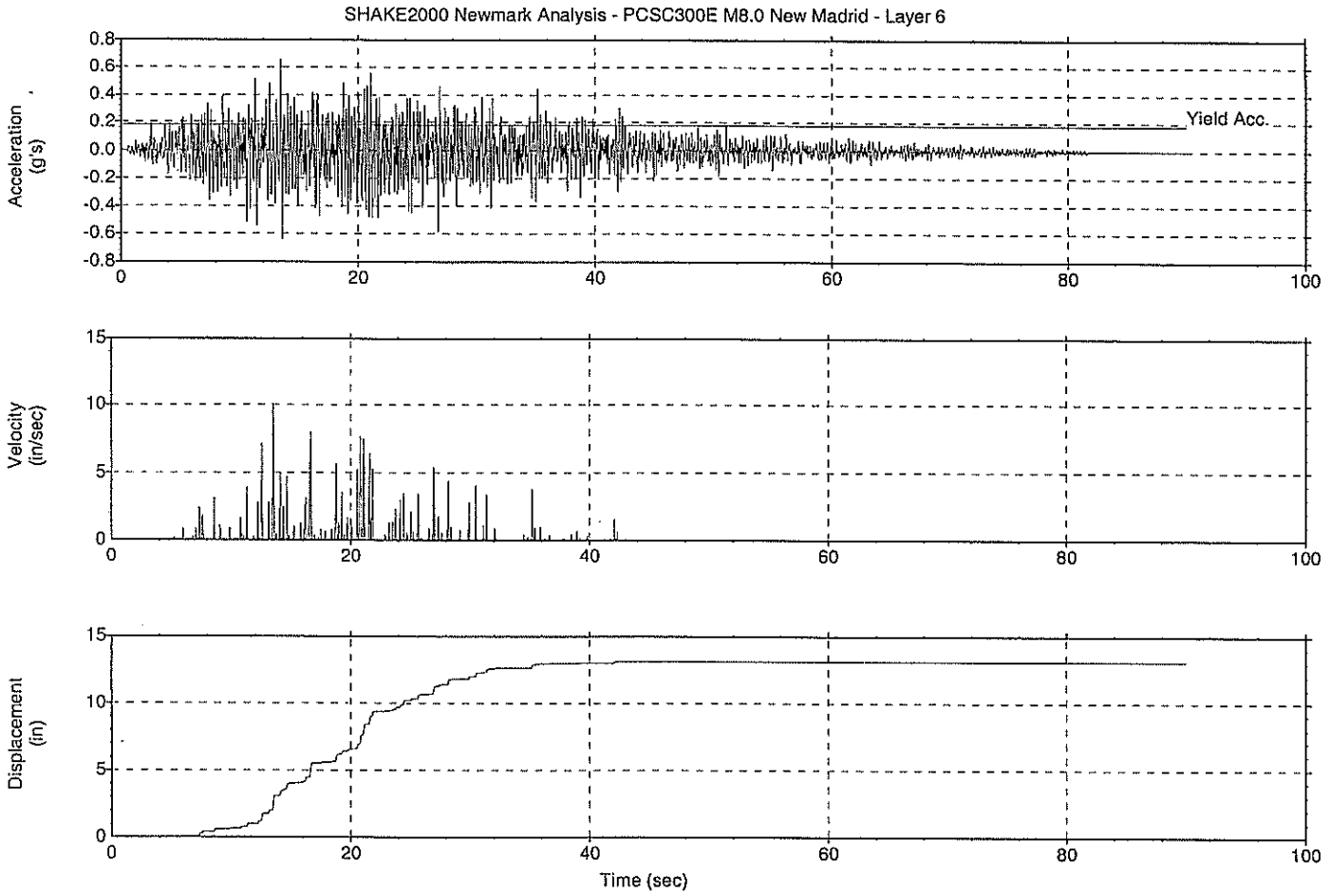
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 5

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 5 Stress - HEA - Layer: 5 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\15a1d1-27.hea
Peak Acceleration Value: .7099189 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 14.04136 in

R16276



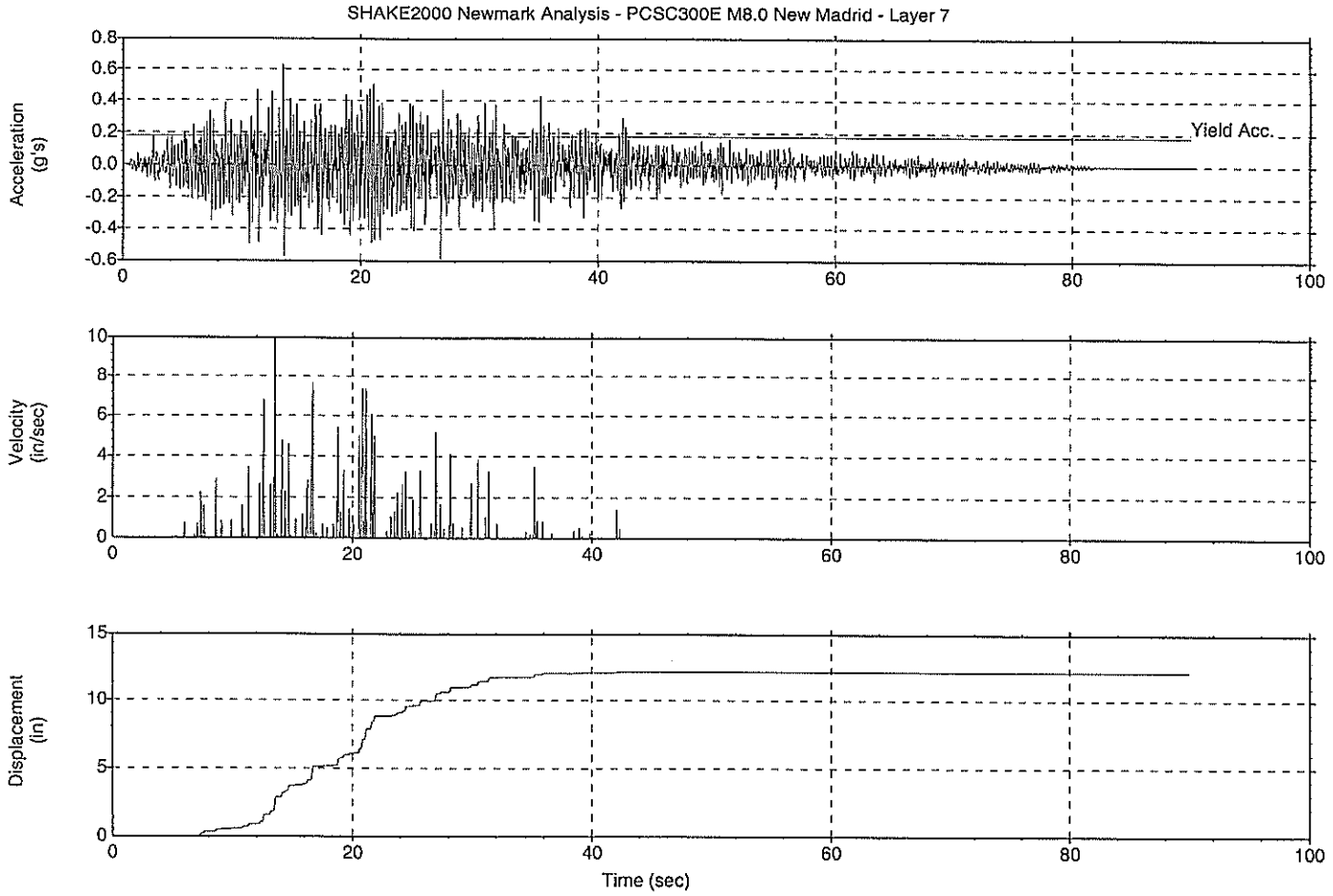
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 6

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 6 Stress - HEA - Layer: 6 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\16a1d1~29.hea
Peak Acceleration Value: .6580572 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 13.13006 in

R16277

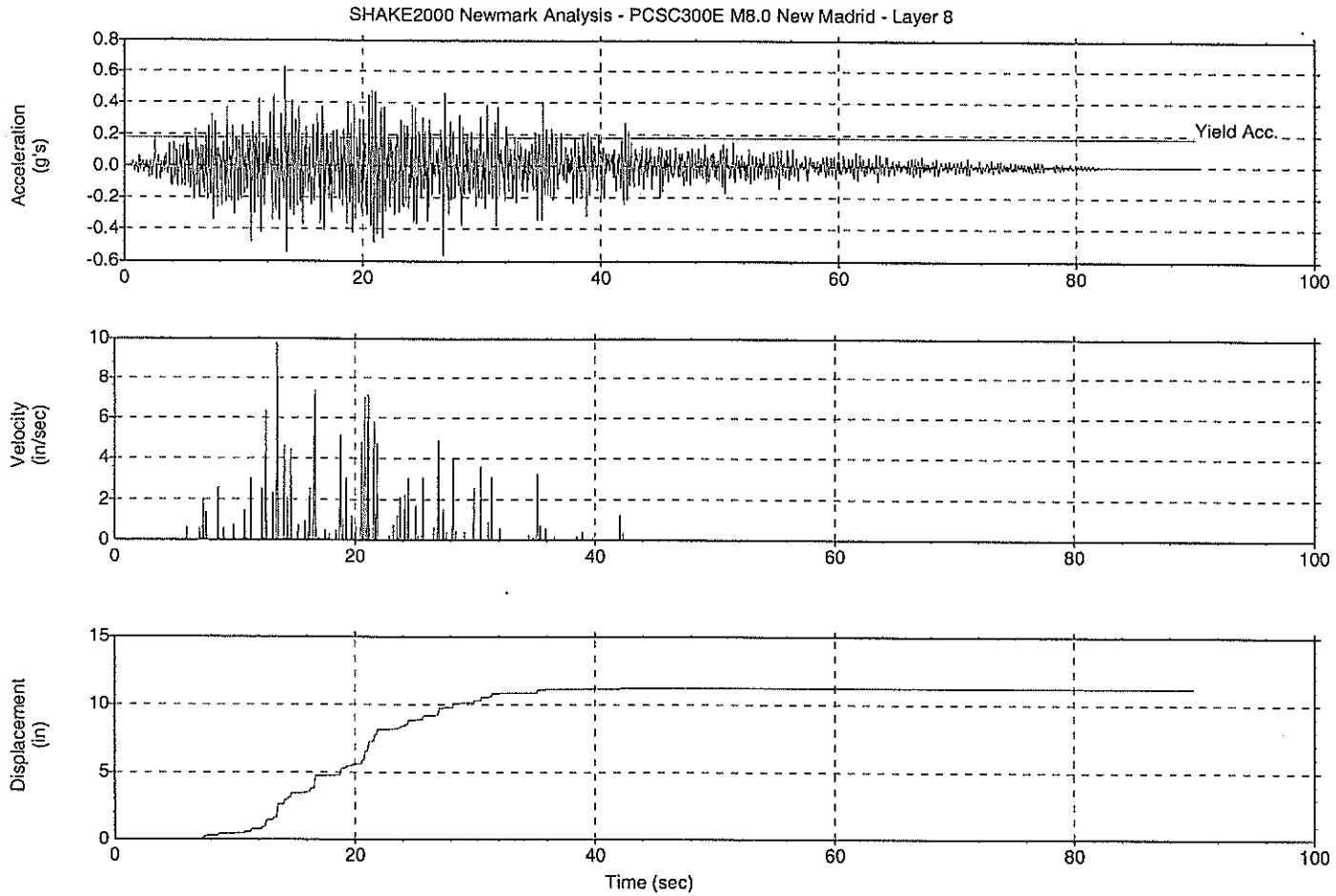


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 7

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 7 Stress - HEA - Layer: 7 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\17aldl-31.hea
Peak Acceleration Value: .6326251 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 12.19506 in



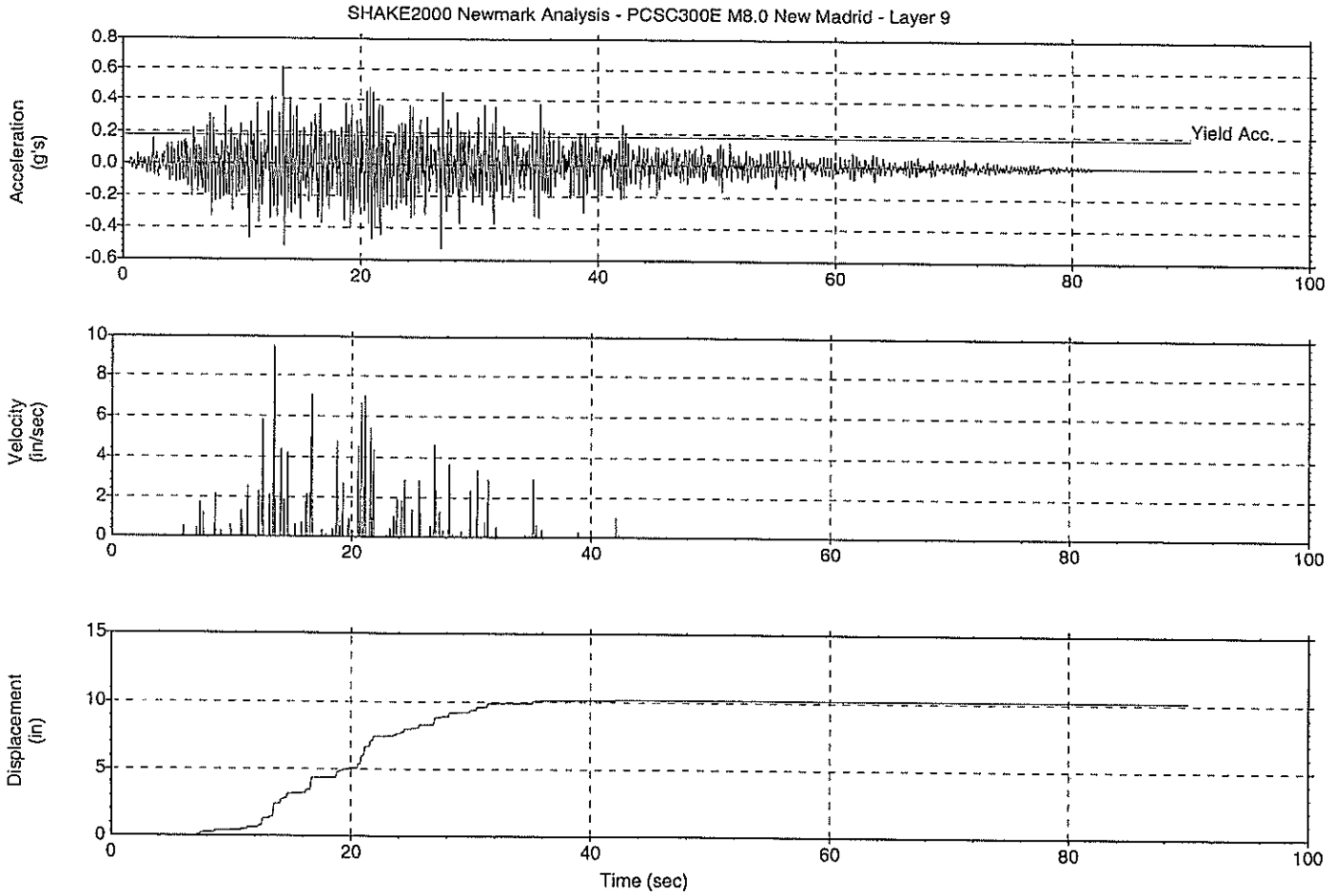
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 8

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 8 Stress - HEA - Layer: 8 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\18a1d1-33.hea
Peak Acceleration Value: .6261951 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 11.22001 in

R16279



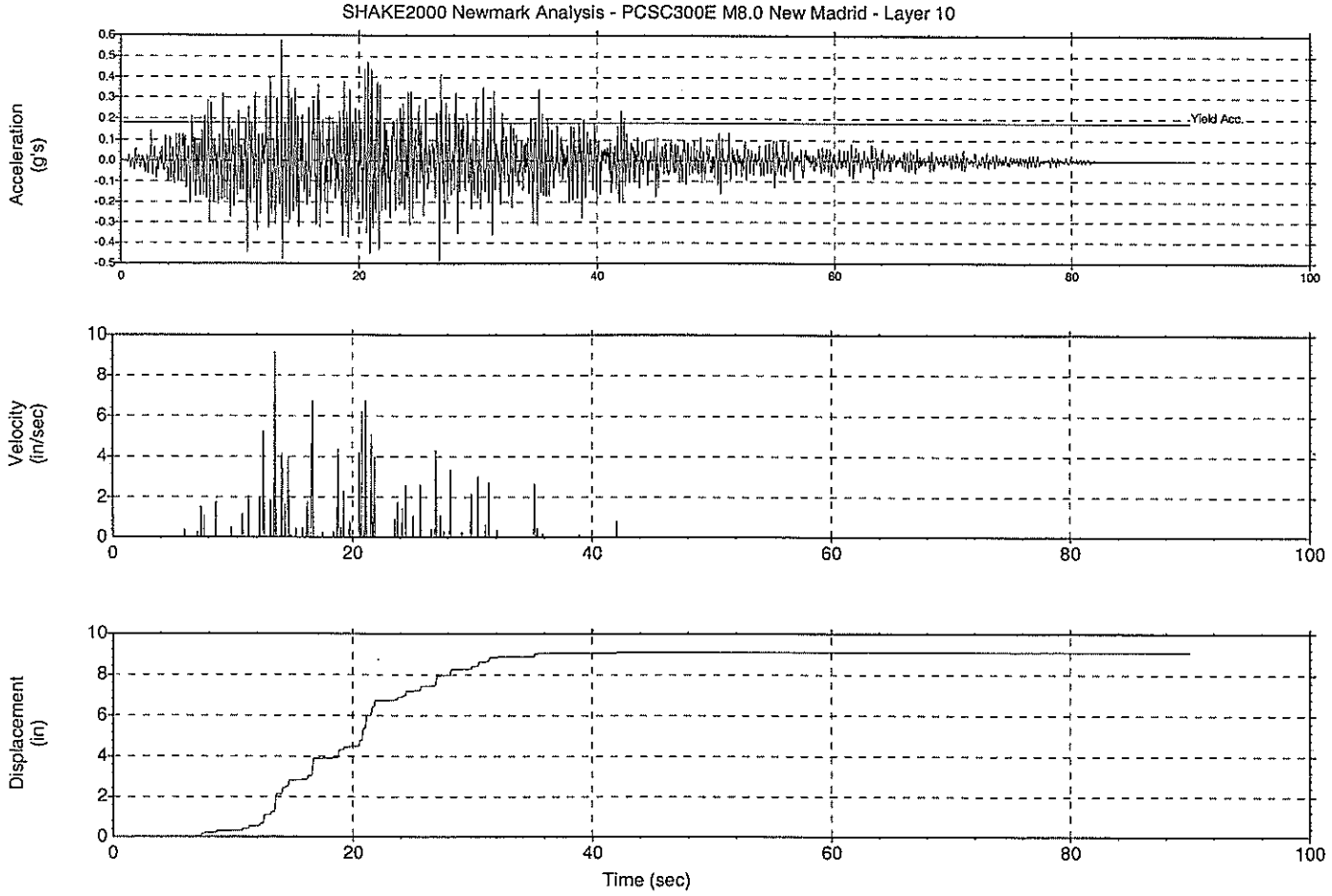
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 9

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 9 Stress - HEA - Layer: 9 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\19aldl-35.hea
Peak Acceleration Value: .6125532 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 10.18864 in

R16280



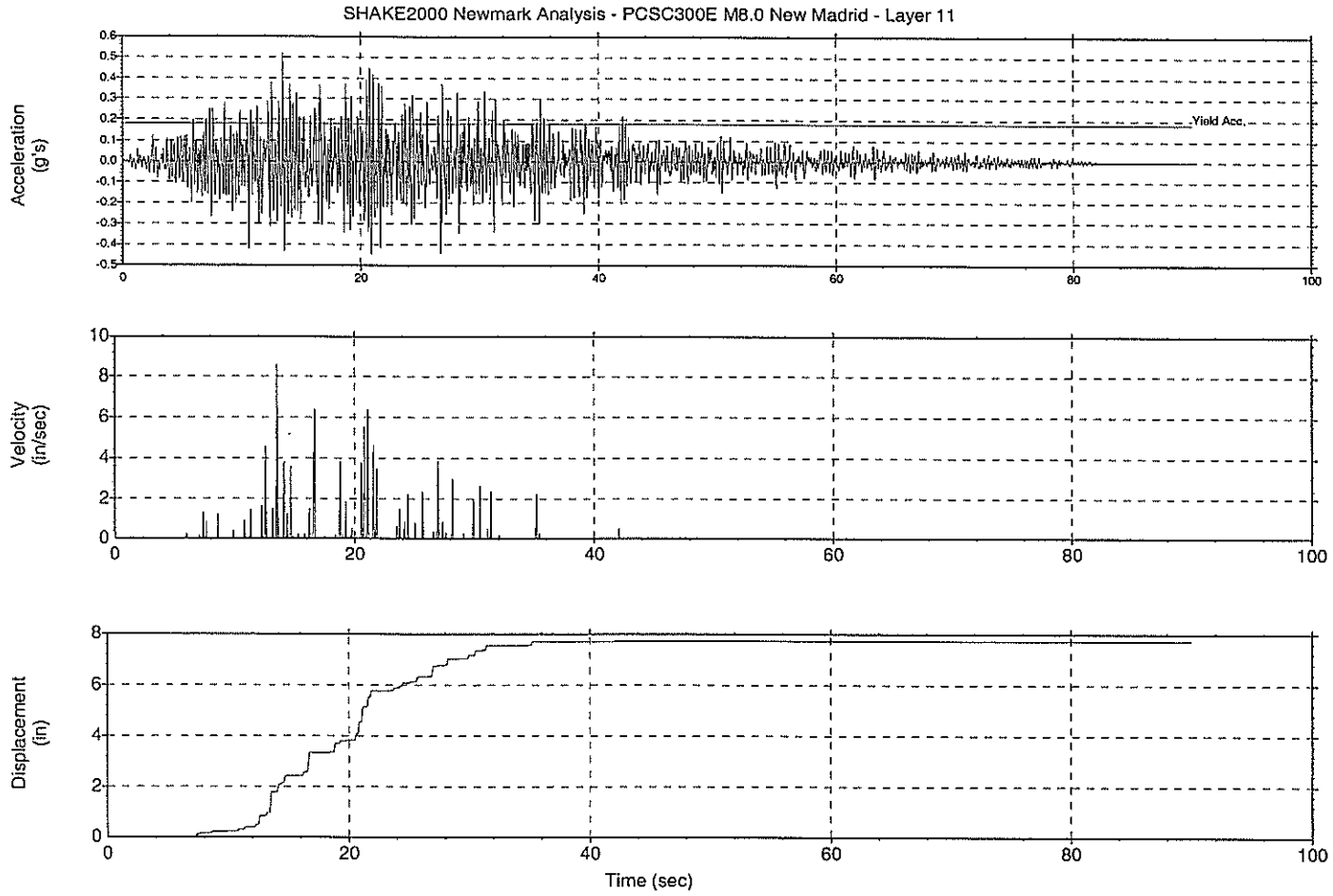
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 10

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 10 Stress - HEA - Layer: 10 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l10a1d1-37.hea
Peak Acceleration Value: .5804698 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 9.100734 in

R16281

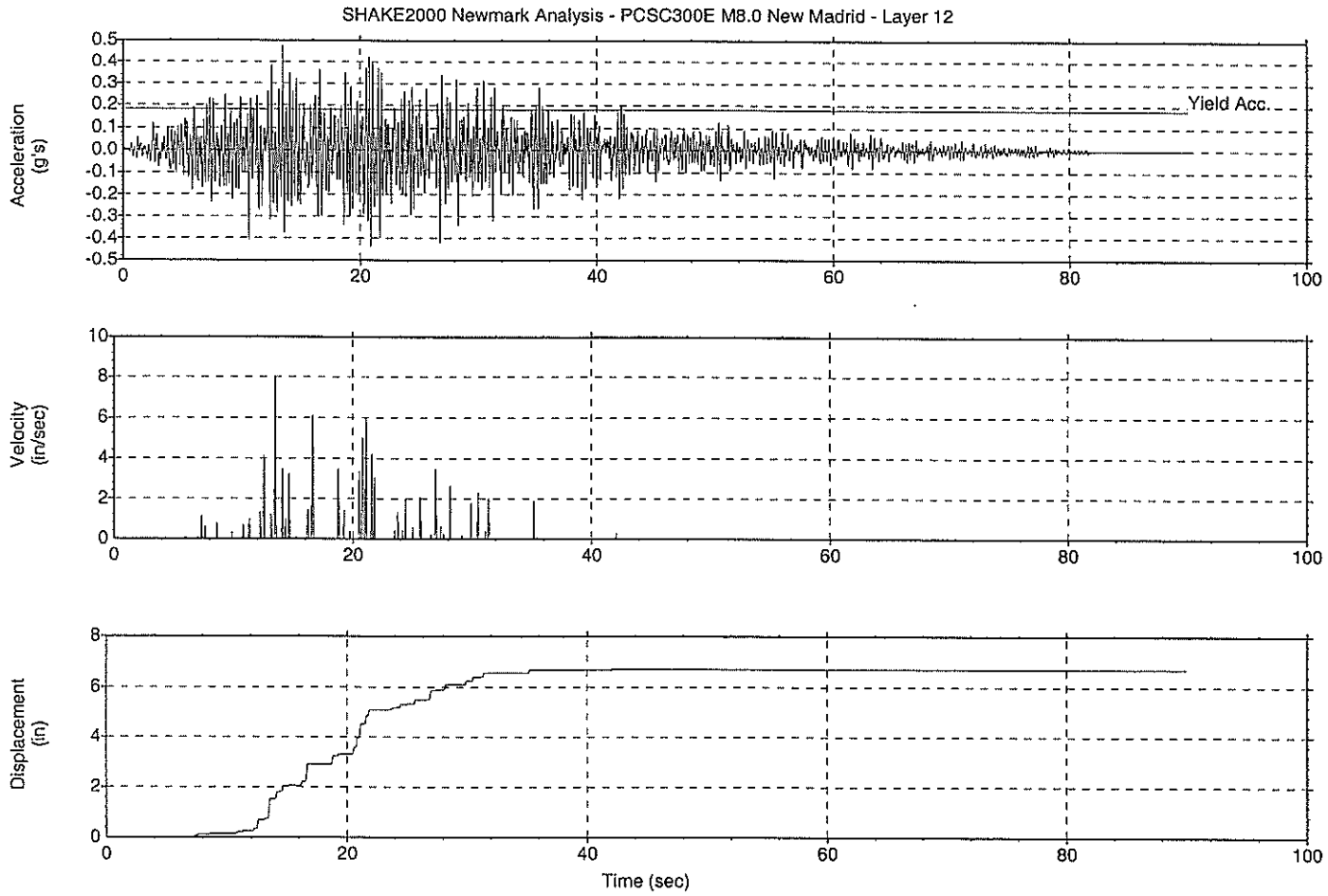


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 11

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 11 Stress - HEA - Layer: 11 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\lllaldl-39.hea
Peak Acceleration Value: .5182784 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 7.725144 in



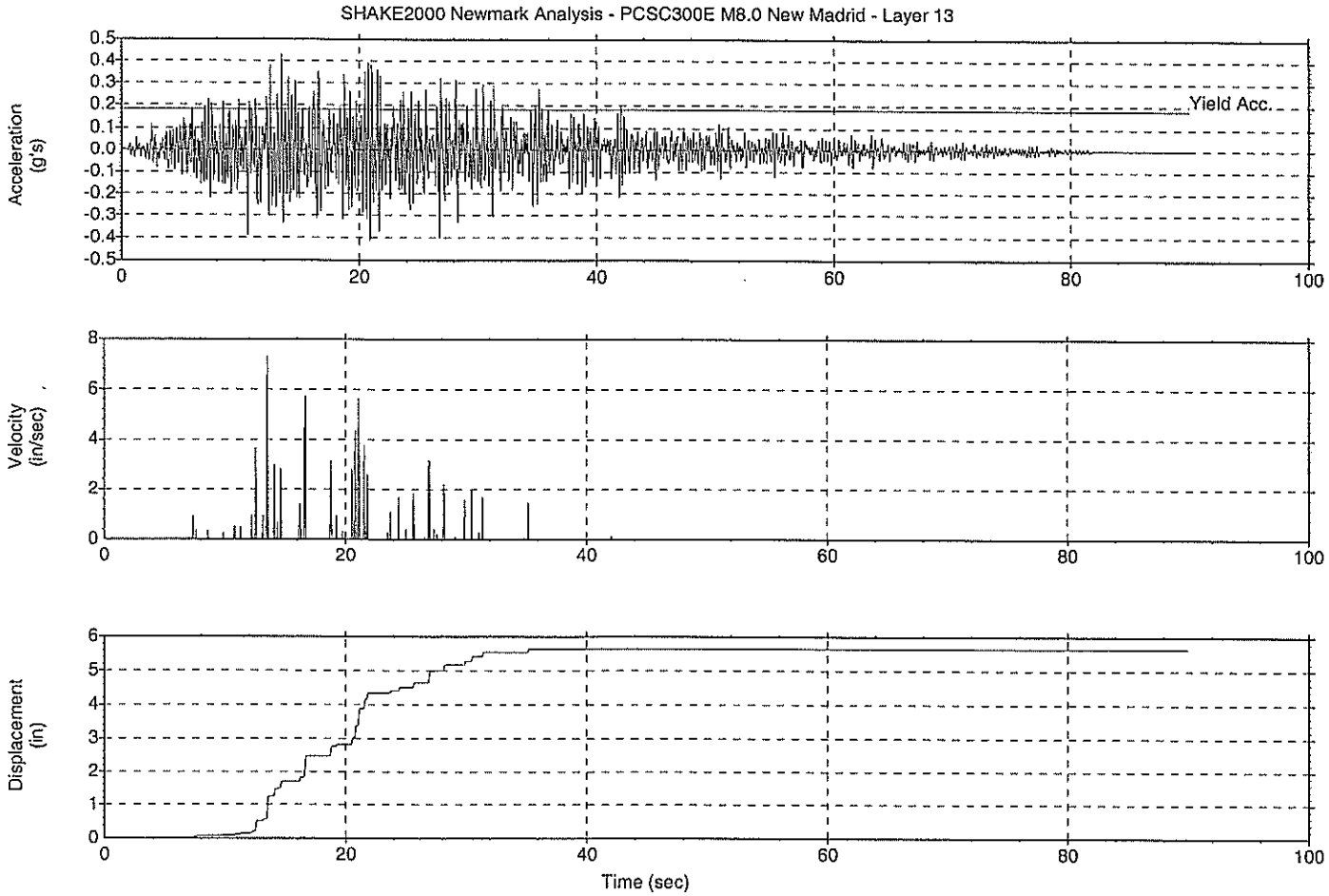
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 12

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 12 Stress - HEA - Layer: 12 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l12a1d1-41.hea
Peak Acceleration Value: .4786401 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 6.693882 in

R16283



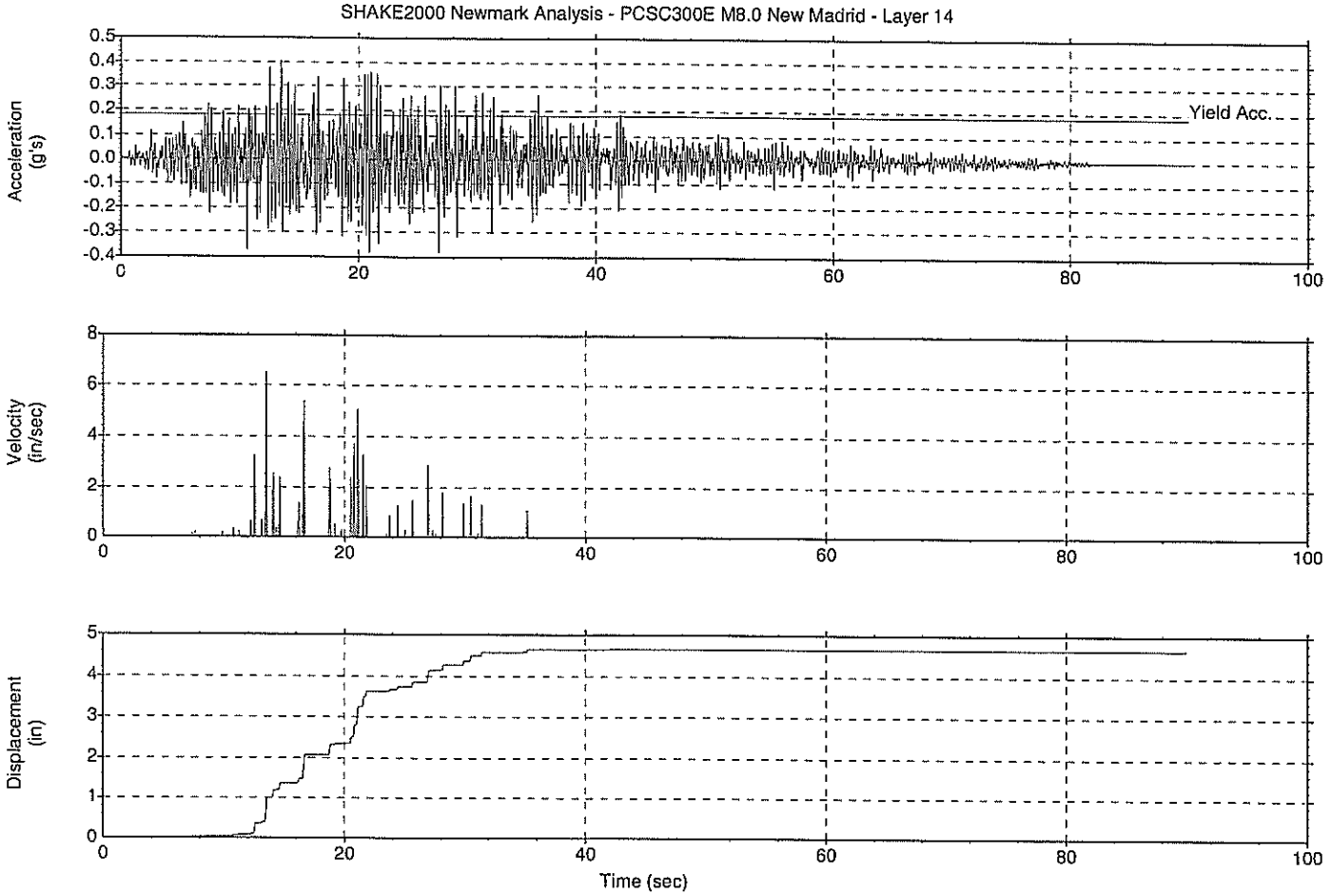
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 13

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 13 Stress - HEA - Layer: 13 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\113ald1-43.hea
Peak Acceleration Value: .434305 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 5.65029 in

R16284



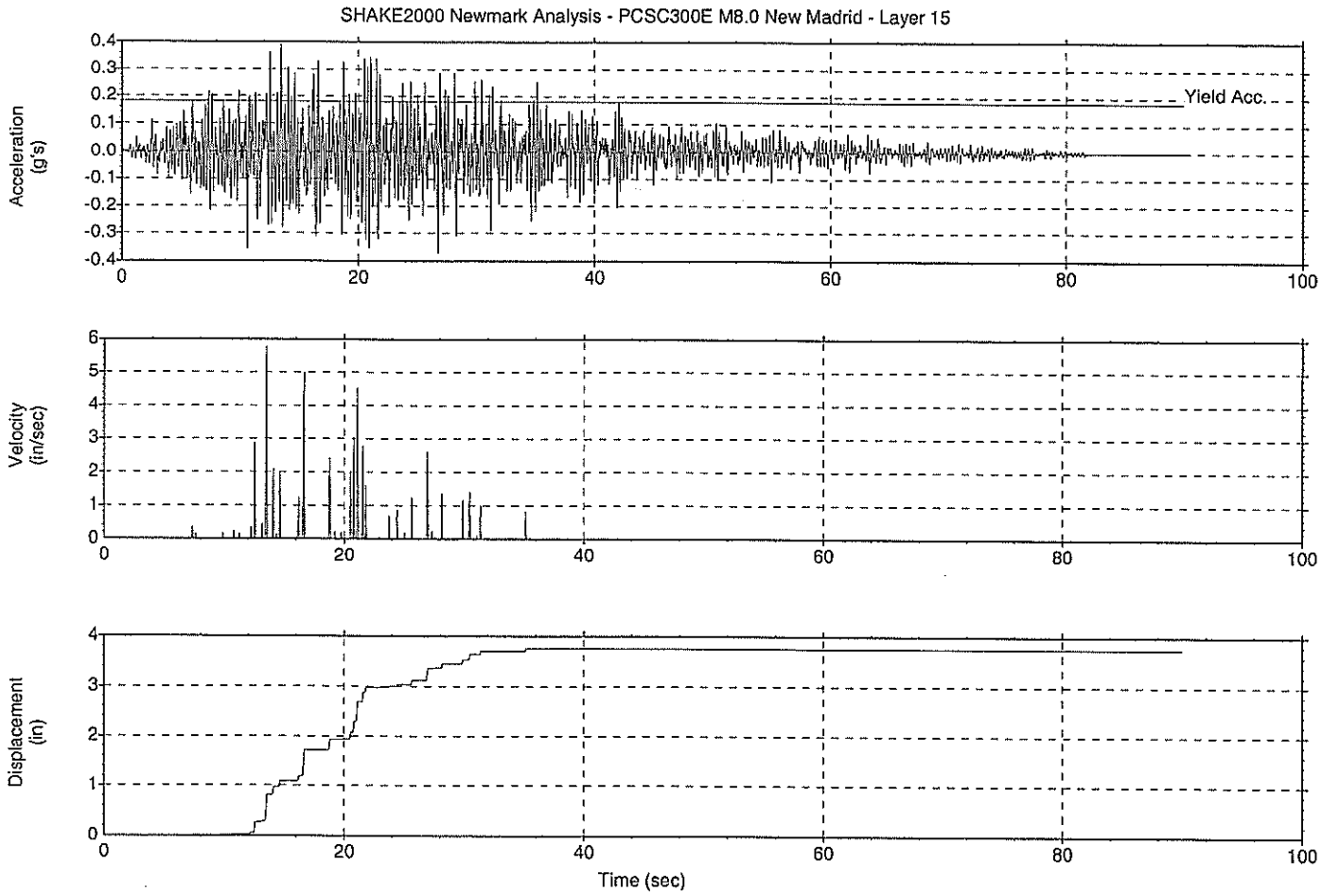
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 14

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 14 Stress - HEA - Layer: 14 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l14a1d1-45.hea
Peak Acceleration Value: .4086577 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 4.652216 in

R16285

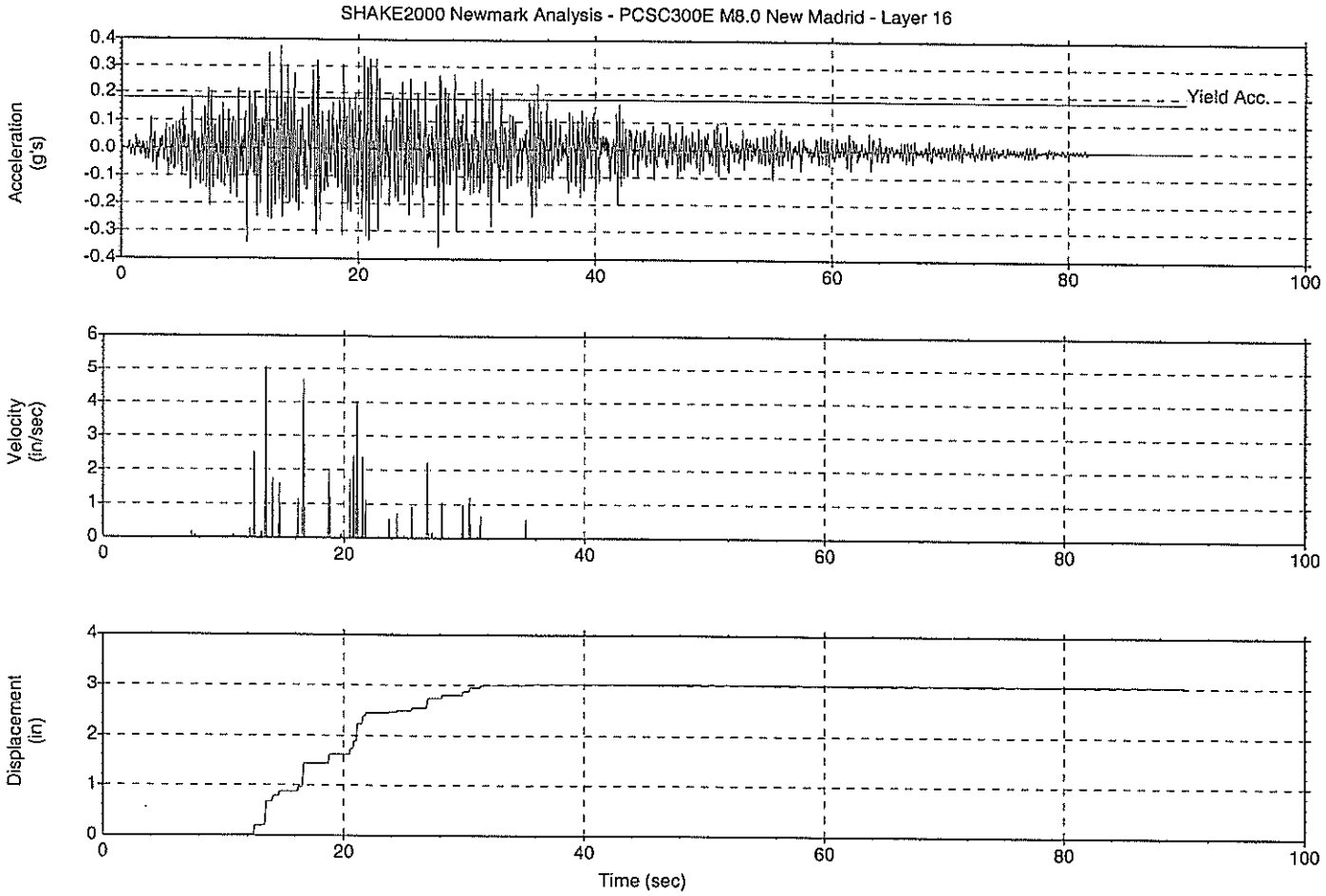


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 15

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 15 Stress - HEA - Layer: 15 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\115a1d1-47.hea
Peak Acceleration Value: .3889318 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 3.752027 in



Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300E M8.0 New Madrid - Layer 16

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300E Layer 16 Stress - HEA - Layer: 16 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\116a1d1-49.hea
Peak Acceleration Value: .3753596 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 3.017025 in

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek South Cell Deformation Evaluation

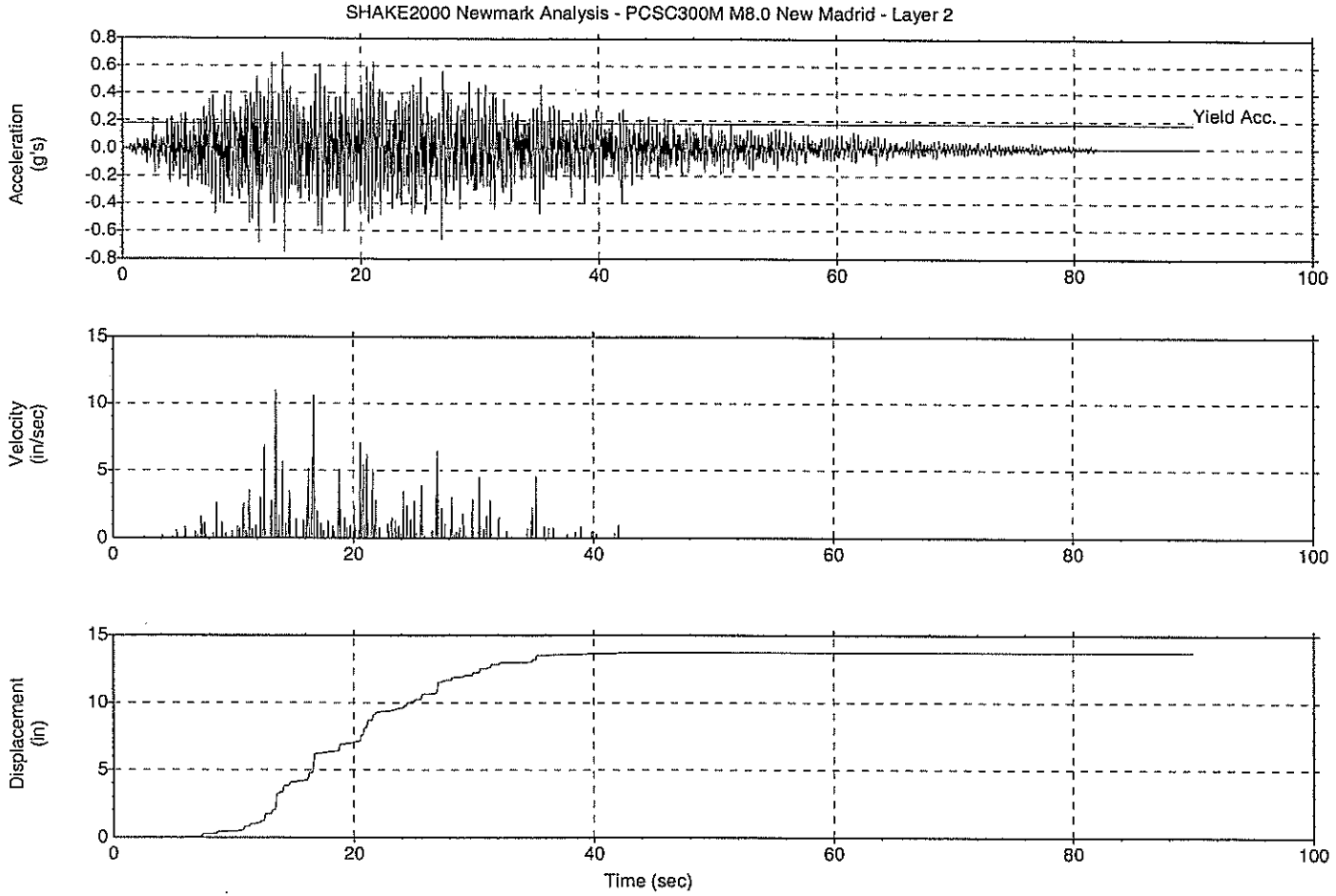
PROJECT NO. 072047

Estimate of Potential Embankment Settlements (Permanent Deformations)

PAGE 53 OF 68

MADE BY BEG DATE 1/22/08 CHECKED BY [signature] DATE 1/23/08

SHAKE2000 PERMANENT DEFORMATION OUTPUT FILE
PCSC300M – LAYERS 1 THROUGH 16
M8.0 NEW MADRID MDE @ 83 KM



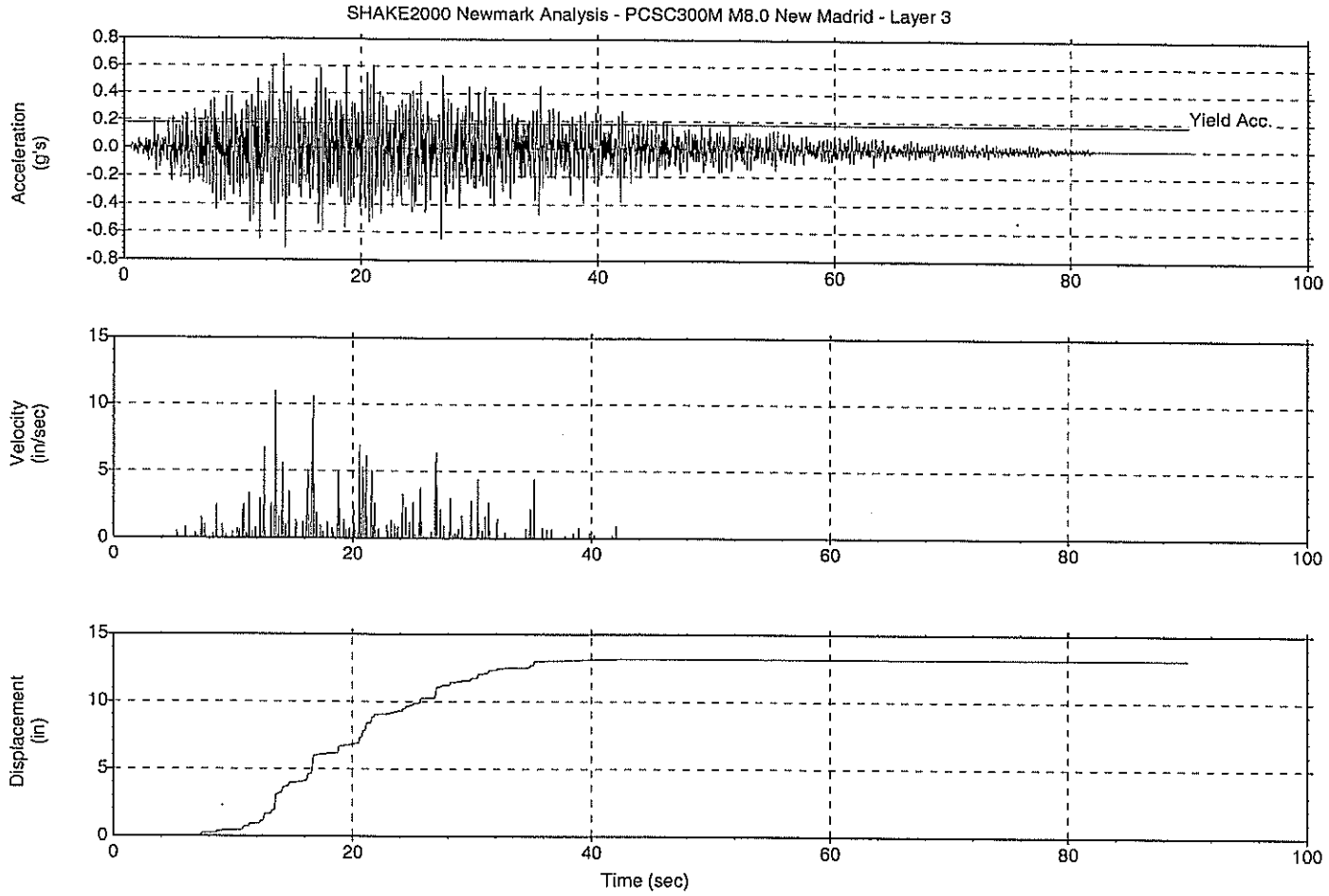
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 2

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 2 Stress - HEA - Layer: 2 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\12a1d1-21.hea
Peak Acceleration Value: .7507865 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 13.72214 in

R16289

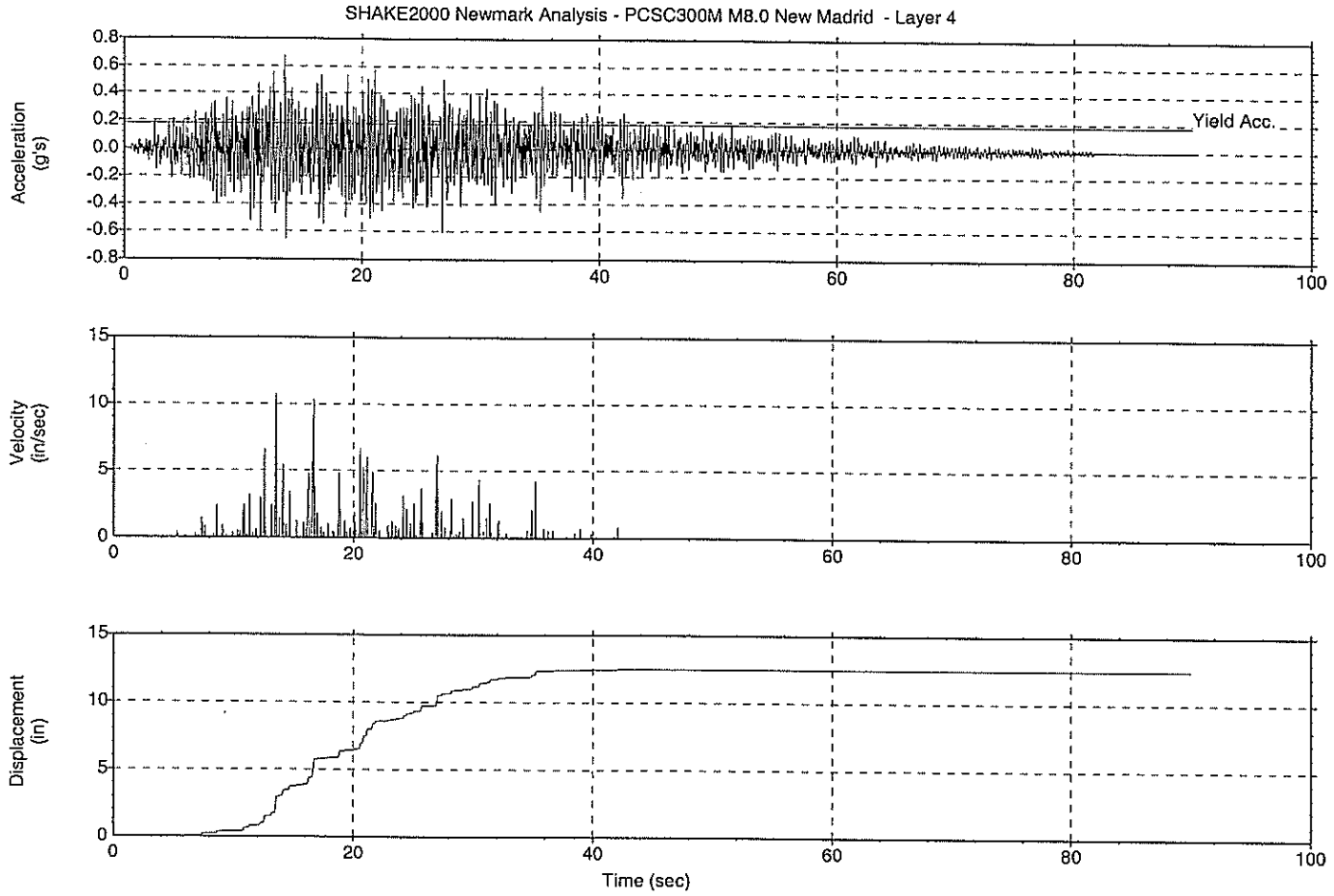


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 3

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 3 Stress - HEA - Layer: 3 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l3a1d1-23.hea
Peak Acceleration Value: .715133 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 13.18699 in



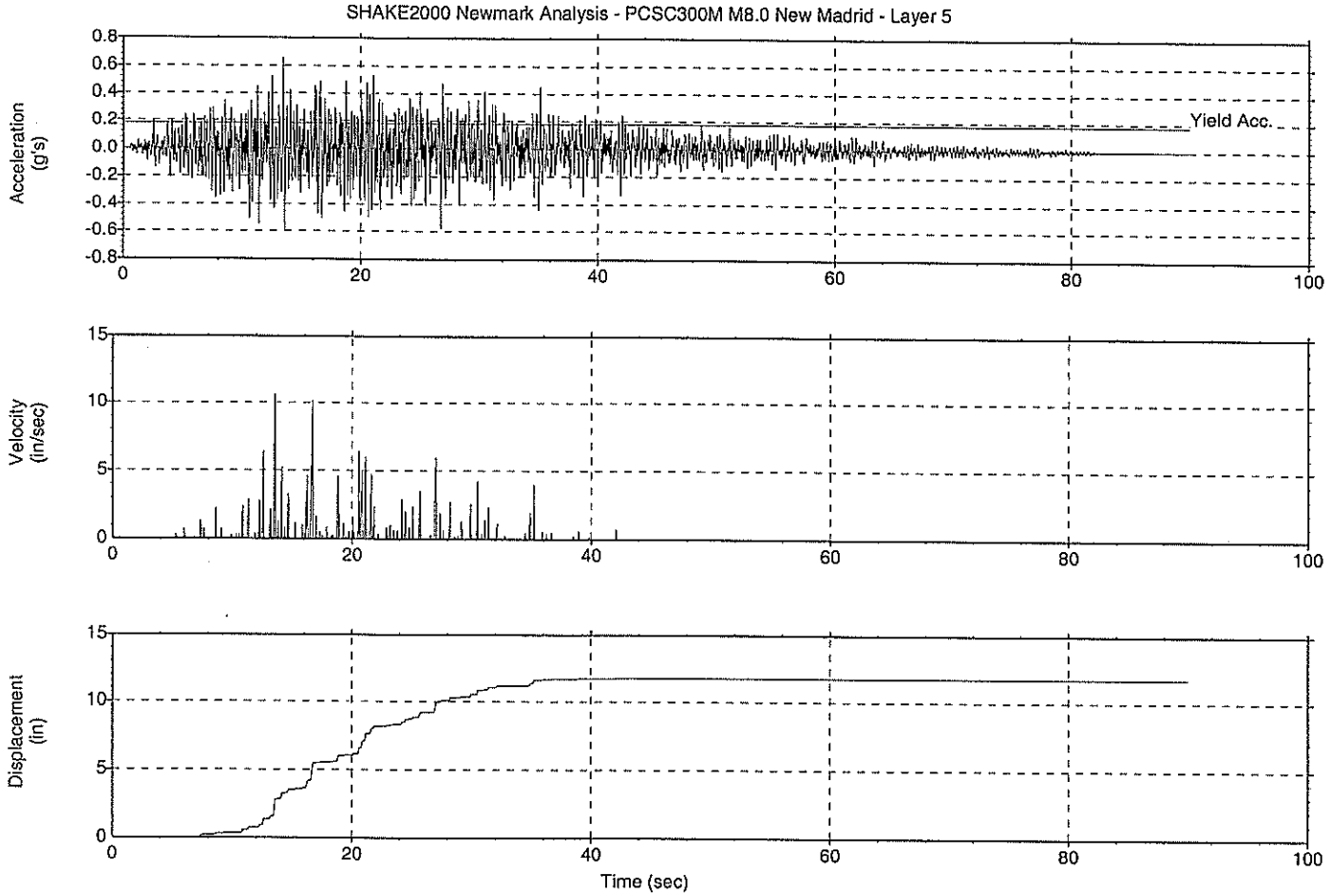
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 4

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 4 Stress - HEA - Layer: 4 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\14a1d1-25.hea
Peak Acceleration Value: .6784577 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 12.47359 in

R16291

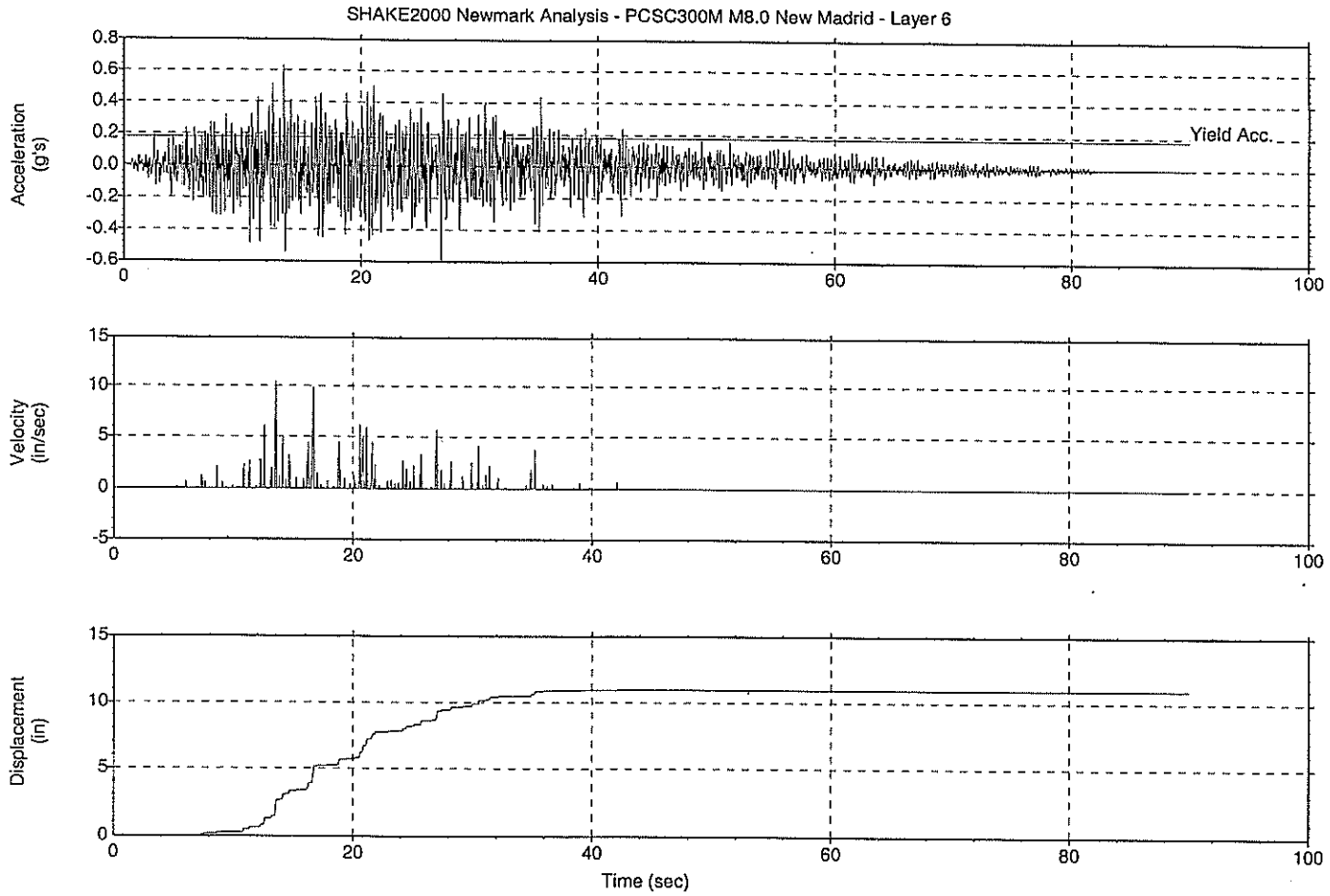


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 5

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 5 Stress - HEA - Layer: 5 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\15a1d1-27.hea
Peak Acceleration Value: .6613527 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 11.74253 in



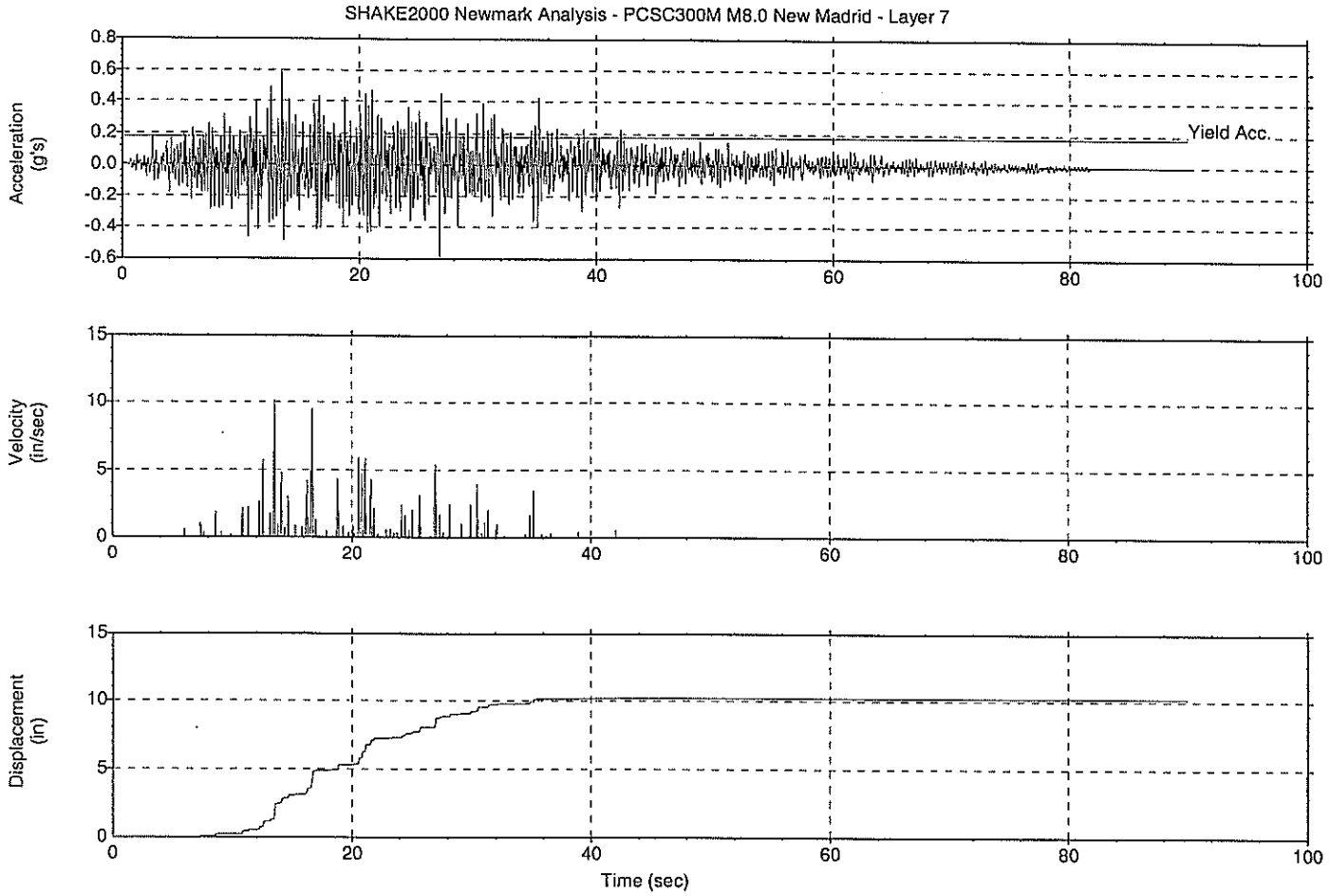
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 6

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC330M Layer 6 Stress - HEA - Layer: 6 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\16aldl-29.hea
Peak Acceleration Value: .6320943 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 10.96653 in

R16293

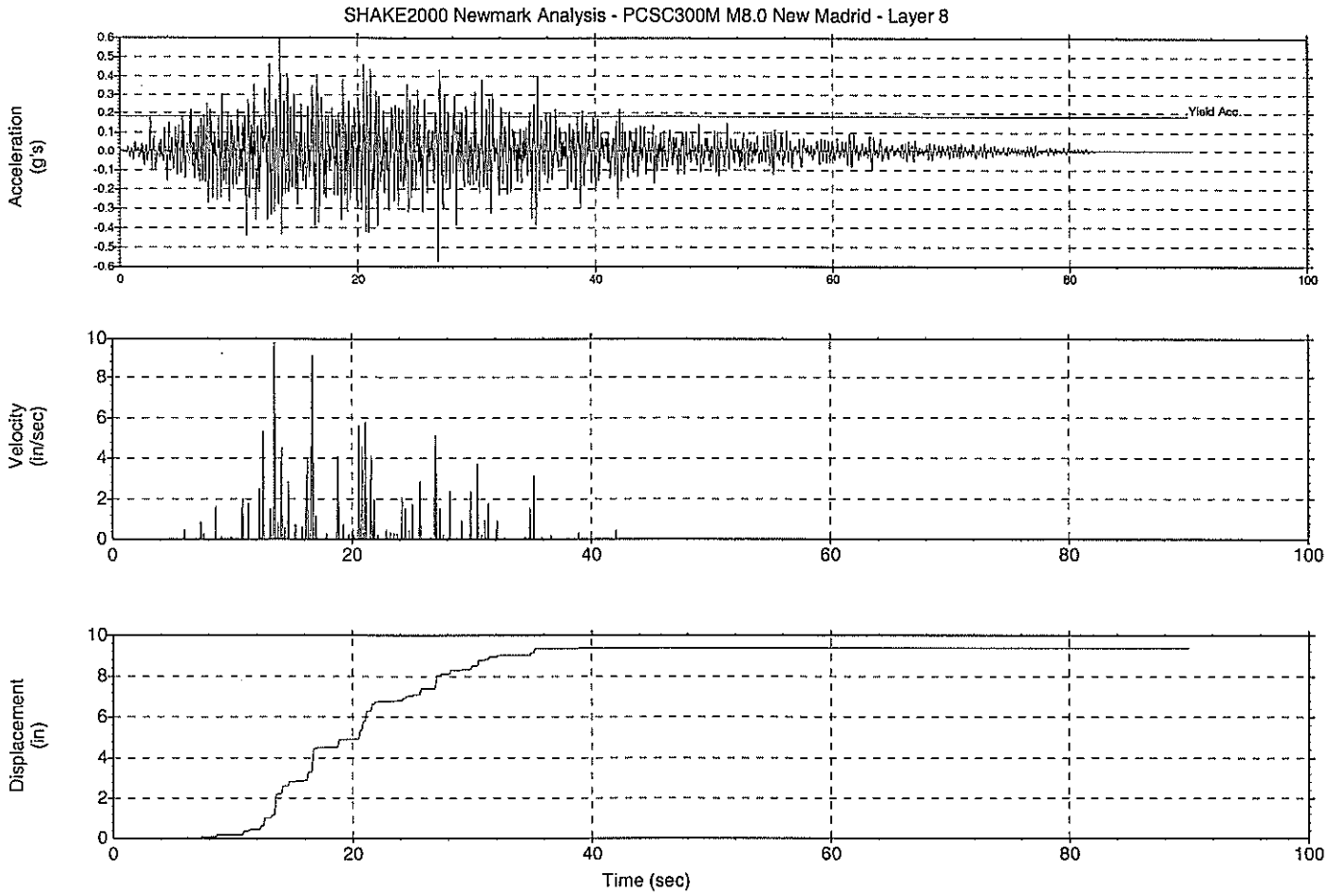


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 7

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 7 Stress - HEA - Layer: 7 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\17a1d1-31.hea
Peak Acceleration Value: .6079099 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 10.20521 in



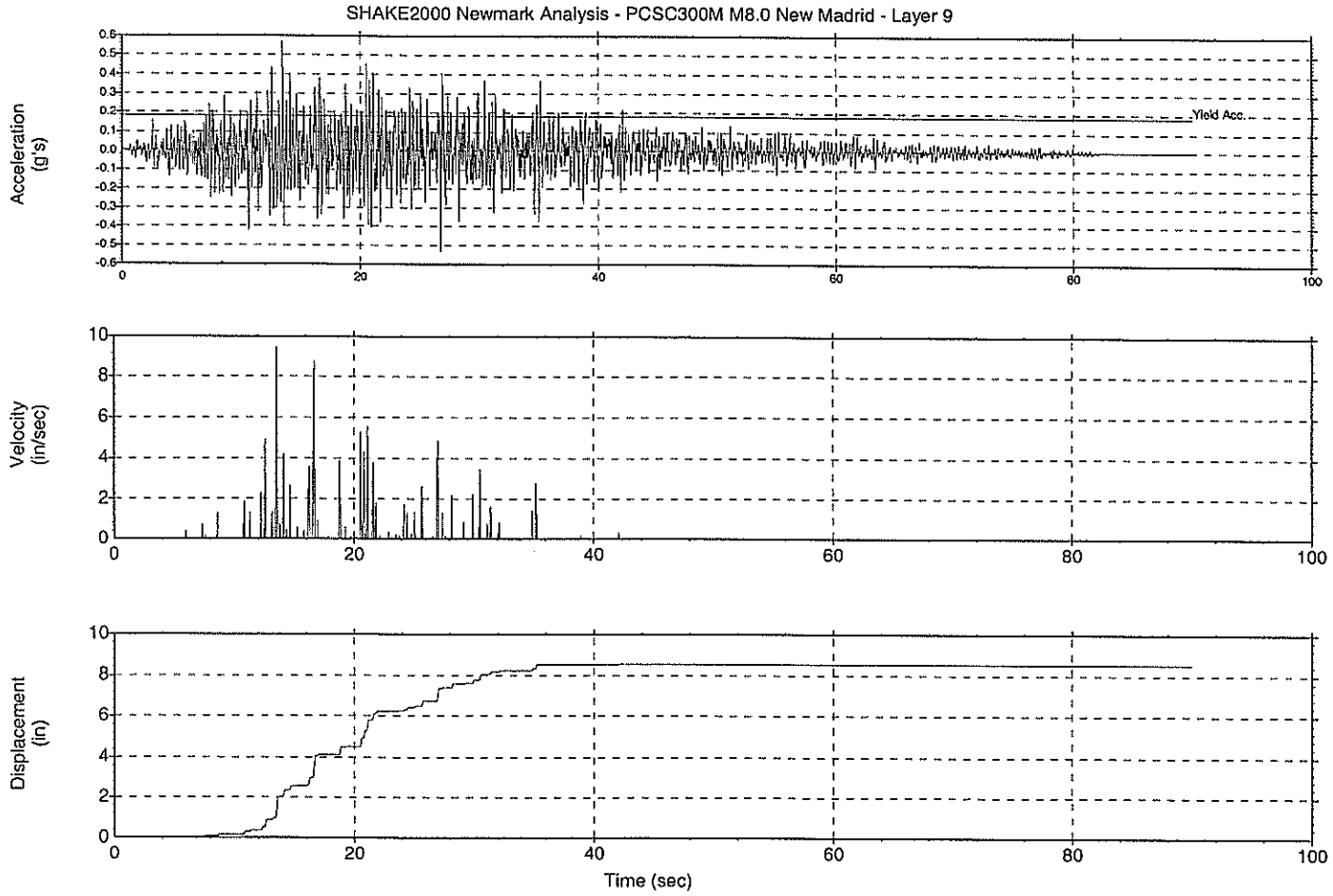
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 8

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 8 Stress - HEA - Layer: 8 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\18a1d1-33.hea
Peak Acceleration Value: .5953542 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 9.3784 in

R16295



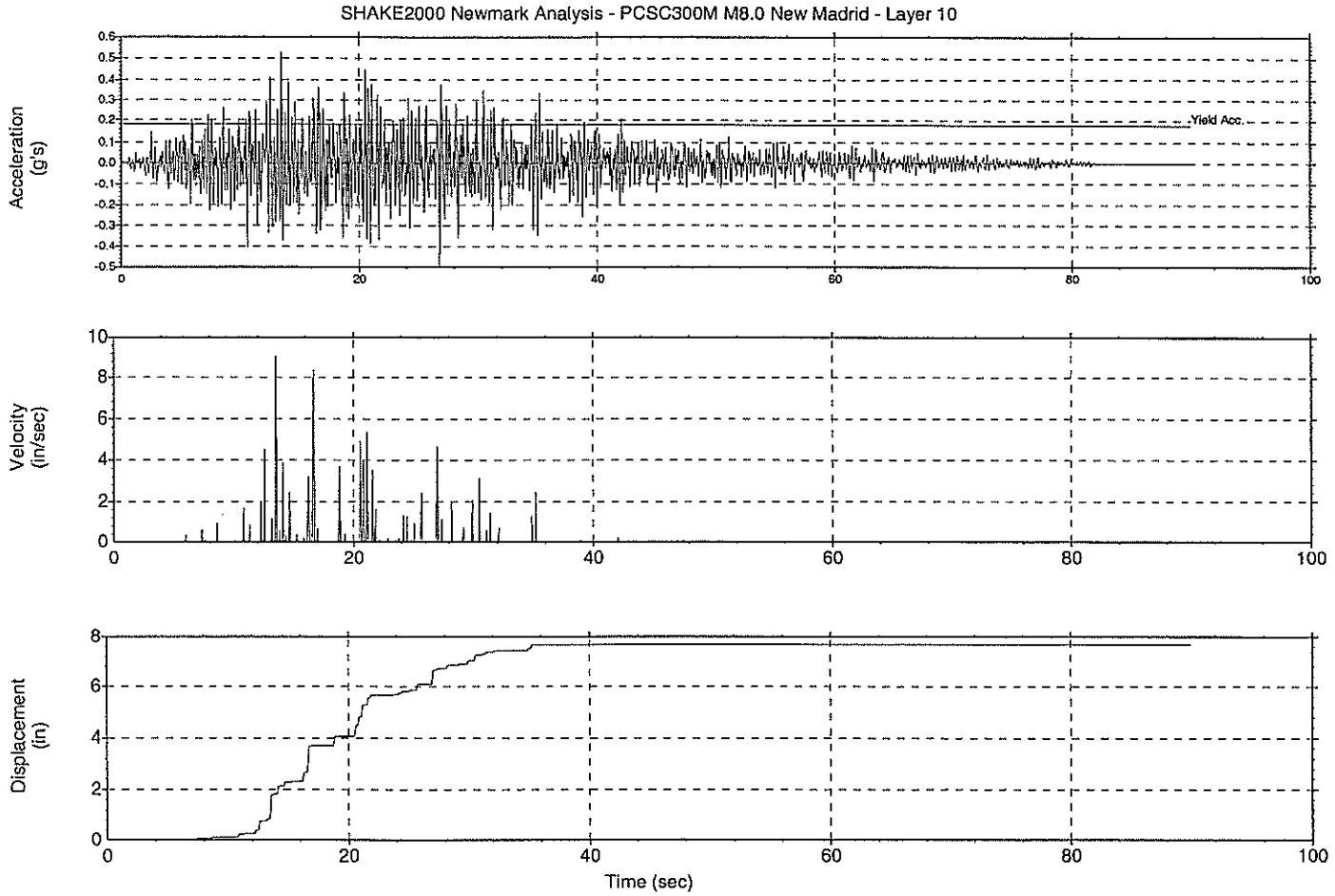
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 9

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 9 Stress - REA - Layer: 9 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l9a1d1-35.hea
Peak Acceleration Value: .5705632 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 8.528267 in

R16296

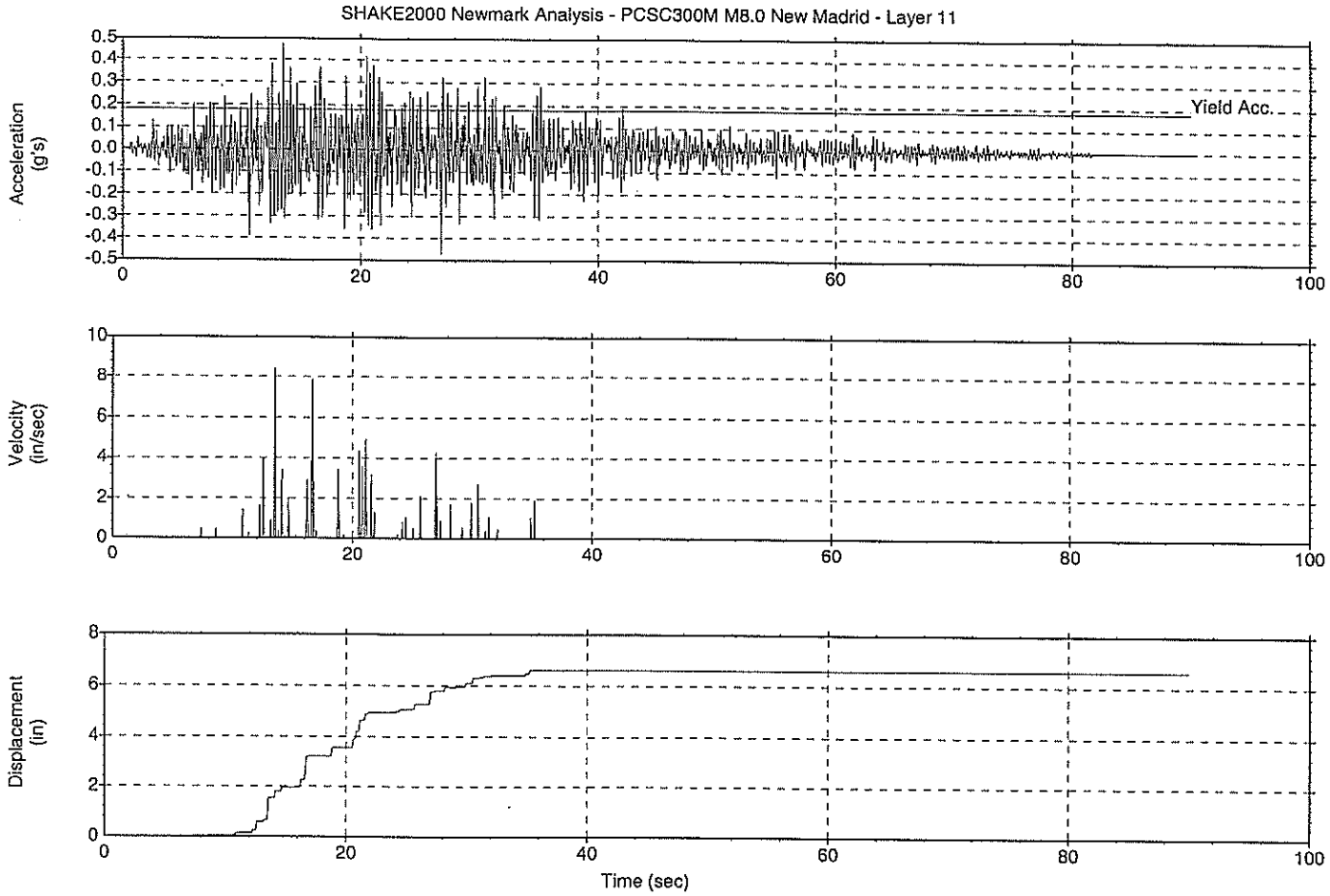


Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 10

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 10 Stress - HEA - Layer: 10 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\110ald1~37.hea
Peak Acceleration Value: .529552 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 7.681901 in



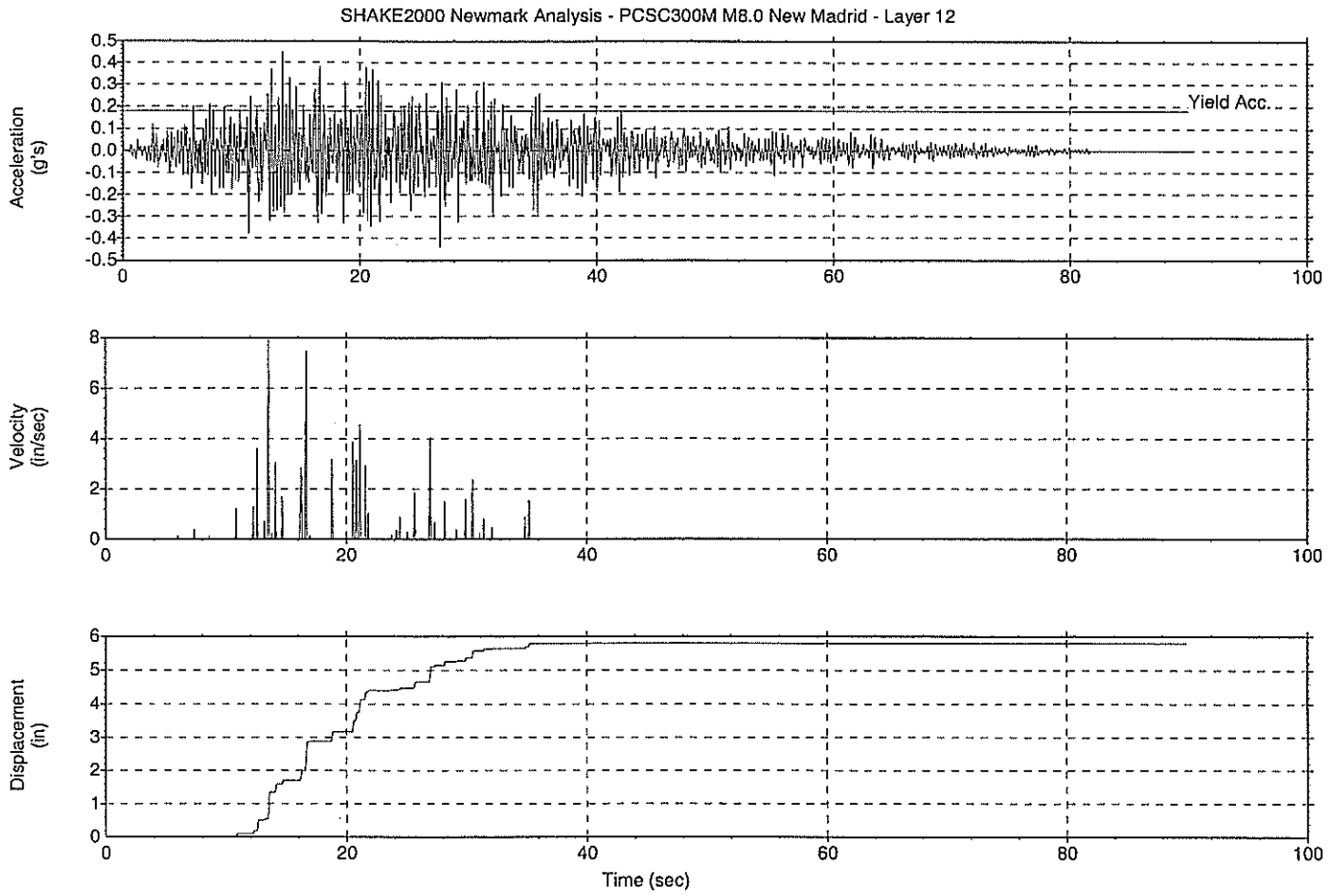
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 11

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 11 Stress - HEA - Layer: 11 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\111a1d1-39.hea
Peak Acceleration Value: .4746651 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 6.6054 in

R16298



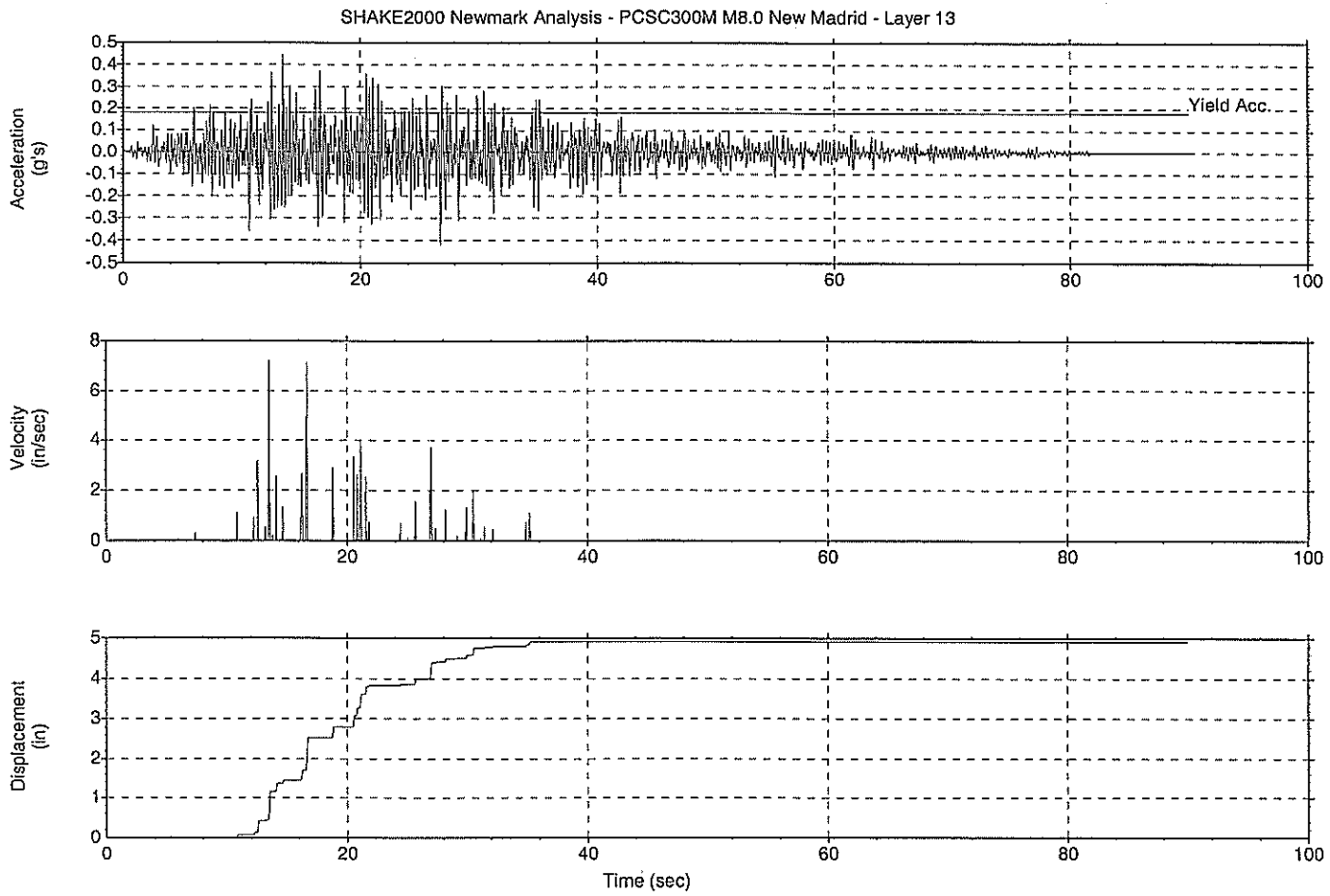
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 12

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 12 Stress - HEA - Layer: 12 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\112a1d1-41.hea
Peak Acceleration Value: .4513214 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 5.79074 in

R16299



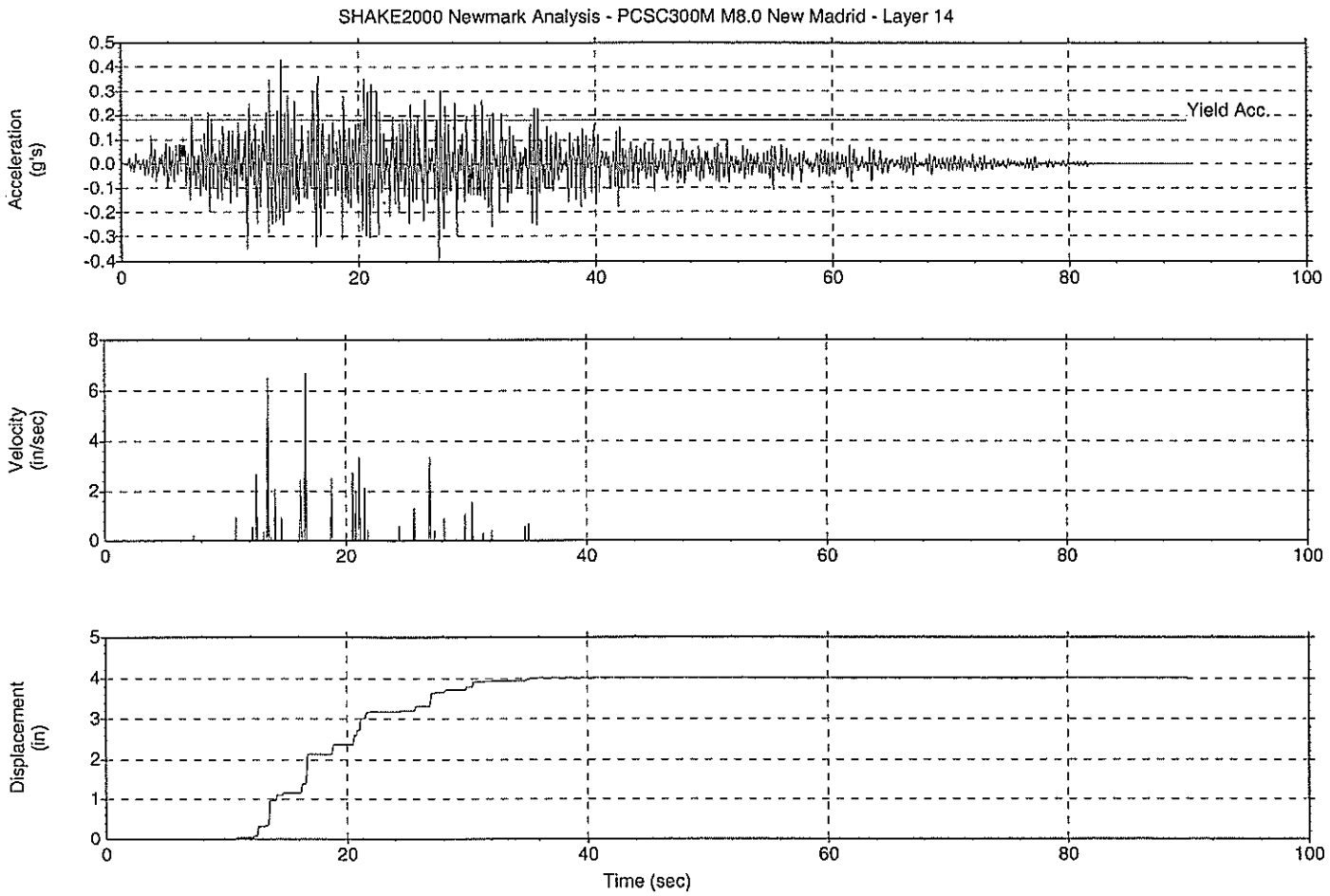
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 13

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 13 Stress - HEA - Layer: 13 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\113a1d1-43.hea
Peak Acceleration Value: .4466568 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 4.90984 in

R16300



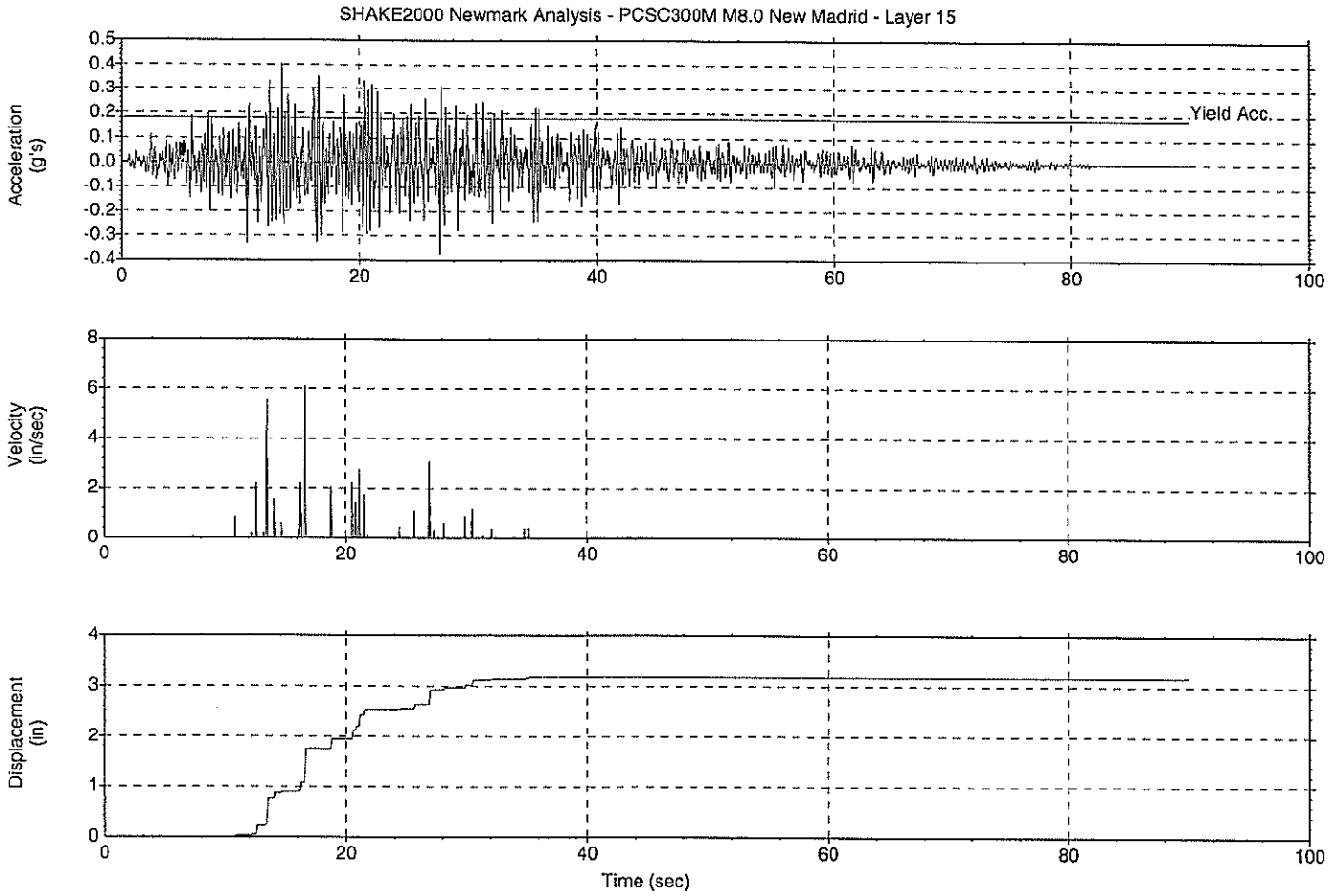
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 14

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 14 Stress - HEA - Layer: 14 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l14ald1-45.hea
Peak Acceleration Value: .4295509 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 4.012906 in

R16301



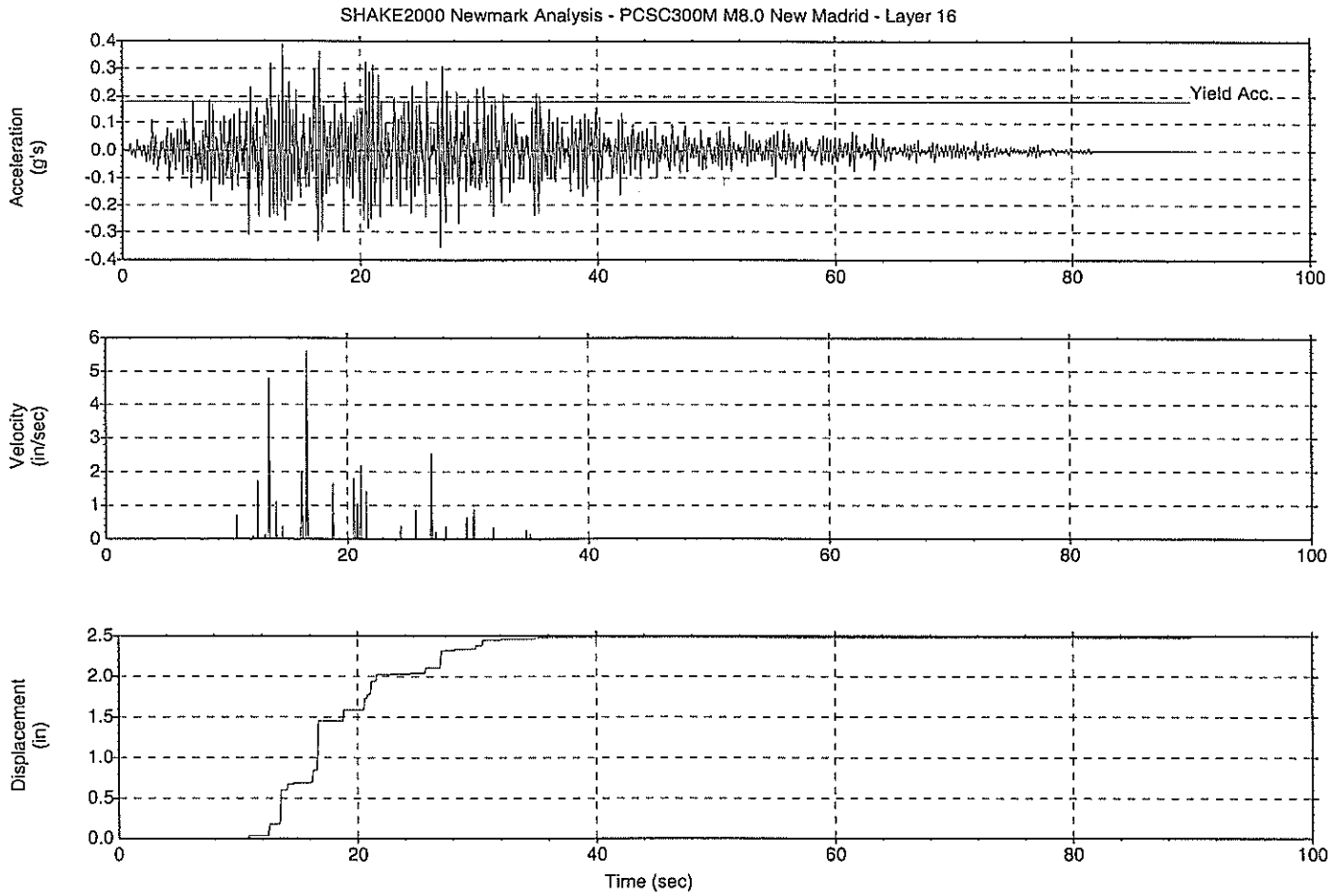
Notes:

Displacement Analysis - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 15

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 15 Stress - HEA - Layer: 15 - Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l15ald1-47.hea
Peak Acceleration Value: .4038821 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 3.174503 in

R16302



Notes:

Displacement Analys_s - Newmark Method
Project: SHAKE2000 Newmark Analysis - PCSC300M M8.0 New Madrid - Layer 16

Newmark Method by Houston et.al. (1987)
Constant Yield Acceleration: .18 (g)
Acceleration Time History: PCSC300M Layer 16 Stress - HEA - Layer: 16 -
Analysis: 1 - Soil Deposit: 1
Acceleration Time History File: C:\SHAKE2000\Williamson Energy\l16a1d1-49.hea
Peak Acceleration Value: .38933 (g)
Upslope Movement not Included in Analysis
Acceleration due to gravity: 386.4 (in/sec^2)

Displacement computed: 2.475344 in

R16304
8114-/10
Part 16

Alliance Consulting, Inc.
Engineers • Constructors • Scientists

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
MODIFICATION TO PERMIT NO. IL0078565
ADDITIONAL MSHA INFORMATION
COMMENTS 1, 3, 7, AND 8
VOLUME 4 OF 6

COAL REFUSE DISPOSAL FACILITY NO. 2
PHASE 3 THROUGH 7
IMPOUNDMENT I.D. NO. 1211-IL08-0341-02
MSHA I.D. NO. 11-03141
WILLIAMSON COUNTY, ILLINOIS

Prepared for

MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B10-148-1413
MARCH 2010

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
MODIFICATION TO PERMIT NO. IL0078565
ADDITIONAL MSHA INFORMATION
COMMENTS 1, 3, 7, AND 8
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MARCH 2010

U.S. Department of Labor

Mine Safety and Health Administration
Pittsburgh Safety & Health Technology Center
P.O. Box 18233
Pittsburgh, PA 15236

November 12, 2009

MEMORANDUM FOR JOSEPH O'DONNELL
Acting District Manager, District 8
Coal Mine Safety and Health

THROUGH: JOHN W. FREDLAND
Acting Chief, Pittsburgh Safety and Health Technology Center

FROM: STANLEY J. MICHALEK
Chief, Mine Waste and Geotechnical Engineering Division

SUBJECT: Recommendation for Approval of Design Plans for Phases 3 through 6, and Request for Additional Information for Phase 7, Refuse Disposal Facility No. 2, Impoundment I.D. No. 1211-IL08-03141-02, Mach Mining, LLC, Mach Mine No. 1, Mine I.D. No. 11-03141, Williamson County, Illinois

As requested by your office, a technical review of the subject proposed impoundment plans has been completed. Our review included an initial submittal and two revisions submitted in response to our requests for additional information. Report No. MW09-077, which is attached, indicates that the subject plans appear to be technically acceptable only through Phase 6 and approval through Phase 6 is recommended. Additional information will be required before we can recommend approval of Phase 7.

The proposed mining under Phase 3 will be the most significant event at this facility. Phase 3 must be closed and covered with a stable cap of coarse refuse, be incapable of impounding water or slurry, and all the proposed instrumentation must be in place and operational before the proposed longwall mining is advanced within 100 feet of any part of the Phase 3 embankment.

The Impoundment and IRPI data sheets have been completed for Phases 3 through 6 and are included with the report. Please contact this office if there are any questions regarding this review.

Attachment

cc: L. Zeiler – Acting Director, TS
M. Smith – Acting Chief, Safety Div., CMS&H

UNITED STATES DEPARTMENT OF LABOR

MINE SAFETY AND HEALTH ADMINISTRATION

PITTSBURGH SAFETY AND HEALTH TECHNOLOGY CENTER
MINE WASTE AND GEOTECHNICAL ENGINEERING DIVISION
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P.O. BOX 18233
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REPORT NO. MW09-077

REVIEW OF DESIGN PLANS FOR PHASES 3 THROUGH 7 REFUSE DISPOSAL AREA NO. 2 MSHA I.D. NO. 1211-IL08-03141-02 MACH MINING LLC MINE I.D. NO. 11-03141 WILLIAMSON COUNTY, ILLINOIS

NOVEMBER 12, 2009

BY

PAUL J. DONAHUE, P.E.
CIVIL ENGINEER

REPORT NUMBER MW09-077

OWNERSHIP AND LOCATION

The Refuse Disposal Area No. 2 is owned and operated by Mach Mining, LLC and receives coarse and fine coal refuse from the preparation plant for the Mach No. 1 Mine. The site can be found on the USGS 7.5 Minute Pittsburg (IL) quadrangle map at geographic coordinates N 37°50'30" latitude and W 88°49'17" longitude. This facility is located on a tract comprising the east half of Section 12, Township 8S, and Range 3E, Third Principal Meridian.

MATERIAL REVIEWED

Original Design Submittal

The original submitted design documents were prepared for Mach Mining, LLC by Alliance Consulting, Incorporated (Alliance) and included the following.

1. A report entitled "Engineering Design Plan – Proposed Coal Refuse Disposal, Facility No. 2, Williamson County, Illinois, dated January 2007." The report included a narrative description of the proposed design, and the testing and analyses performed. Appendices to the report included construction specifications, calculations, geotechnical test boring and laboratory test data.

2. Thirteen drawings depicting plans, profiles and details of the proposed facility dated January 16, 2007.

During our review of this plan, Mr. Duffy Stradner, former District 8 Impoundment Specialist, notified this reviewer in a phone conversation on October 23, 2007, that the impoundment layout and geometry would be substantially revised and a new plan submitted. Due to proposed mining under the impoundments and other issues that would similarly affect the new design, we completed the review and requested additional information in a memorandum to Robert Phillips, District Manager, Coal Mine Safety and Health (CMS&H) District 8, dated December 13, 2007. The memorandum identified 14 design issues to be addressed in the revised design submittal.

First Revised Design Submittal

The revised design package for the coal refuse impoundments was hand delivered to our office on August 19, 2008, in conjunction with a meeting with Mach Mining and Alliance Consulting personnel to discuss the new design.

The design documents received at this meeting included the following items.

1. A report entitled "Response to February 11, 2008, Comments, I.D. No. IL08-03141-02, Mach Mining, LLC – Mach No. 1 Mine ID No. 11-03141, Williamson County, Illinois – Coal Refuse Disposal Facility No. 2 Phases 3 through 7," dated August 2008. Appendices to

the report contained construction specifications, various design calculations, geotechnical test boring logs, laboratory test data and a CISPM Mine Subsidence Analysis Report prepared by Dr. Syd Peng of West Virginia University.

2. Nineteen drawings, with revision dates from February 14, 2008, to July 7, 2008, depicting plans, profiles and details of the proposed facility.

In addition, the following additional materials were submitted concurrent with the review of this submittal.

1. A set of three drawings depicting longwall panel surface subsidence measurements at Baselines "A" through "D" located over the eastern end of longwall Panel No. 1 of the subject mine. These drawings are dated August 29, 2008, and were received by the Mine Waste and Geotechnical Engineering Division (MWGED) on September 3, 2008,

2. Two Drawings entitled "Map 6 UG - Operations Plan Map" and "Map 10 – Geologic columns," prepared by Alliance and dated December 3, 2004, and November 29, 2004, respectively, and received by MWGED on September 3, 2008.

In addition to the submitted document, we also gathered additional information, concurrent with the review, through phone and e-mail communication with Mr. Claudio Yon of Alliance and Dan Barkley of the Illinois DNR.

We completed our review of the new design and found eleven items requiring additional substantiating data or calculations and/or design changes. These were outlined in our memorandum to Robert Phillips, District Manager, CMS&H District 8, dated November 10, 2008.

Second Revised Design Submittal

The second revised design submittal was received by MWGED on July 20, 2009, and included the following.

1. A report volume entitled "Additional information- Volume 1 of 3, Comments 2, 4, 5, 6, 9, 10 and 11, Coal Refuse Disposal Facility No. 2 Phases 3 through 7," Impoundment ID No. IL08-03141-02 (MSHA ID No. 11-03141), Williamson County, Illinois," dated July 2009. This volume included new, revised and copies of previously submitted materials from the earlier August 2008 submittal and was prepared by Alliance.

2. A second report volume entitled "Additional information- Volume 2 of 3, Comments 1, 3, 7 and 8, Coal Refuse Disposal Facility No. 2 Phases 3 through 7," Impoundment ID No. IL08-03141-02 (MSHA ID No. 11-03141), Williamson County, Illinois," dated July 2009. This volume contained new calculations and analysis performed by GAI consultants for Alliance.
3. A third volume containing 22 drawings, with revision dates from July 8, 2009, to July 13, 2009, depicting plans, profiles, and details of the proposed facility.

4. An addendum to the submittal, received on August 21, 2009. This addendum included corrected transmittal letters and tables of contents, a revised drawing B05-330-M32 – Phase 5 Plan View, revised August 18, 2009, and revised Phase 5 dam underdrain calculations.

Additionally, prior to the receipt of this submittal, we received electronically transmitted drawings depicting a longitudinal dynamic subsidence survey over the advancing face of Longwall Panel No. 1 at a location immediately to the east of the future Phase 5. These drawings were received in our office on February 10, 2009. This survey was performed in response to comment No. 4 in the November 10, 2008, memorandum.

The results of our review of this revised design are discussed in this report.

BACKGROUND

The revised Refuse Disposal Facility No. 2 will provide for the disposal of about 3 ½ years of coarse coal refuse (CCR) and 6 years of fine coal refuse (FCR) that will be produced from the Pond Creek No. 1 Mine following closure of previously approved Facility No. 1 which included Phases 1 and 2. This facility is to be constructed in five phases – Phase 3 through Phase 7.

As planned, the facility will consist of three, approximately rectangular, diked impoundments aligned in a north-south direction and sharing common embankments between them. The southernmost impoundment will be constructed during Phase 3, with fine refuse placement starting upon completion of the embankment to the design crest height. The central impoundment will be constructed in three Phases (Phases 4, 6 and 7) with fine refuse placement starting during Phase 7, when the embankment will be about 50 percent of the total completed height. The northernmost impoundment will be constructed during Phase 5 and will be partly incised by excavating the footprint of the impoundment. Fine refuse placement in this impoundment will begin once Phase 3 is filled to capacity, and the Phase 5 embankment is about 80 percent complete.

The impoundments will cover about 200 acres, and all the impounding embankments will be raised longitudinally in segments using belt-delivered coarse coal refuse. The upstream and downstream slopes will be 3 horizontal to 1 vertical (3H:1V) except for Phase 3 which will have 2.6H:1V upstream slopes. Maximum embankment heights will range from 49 feet for Phase 3 to 100 feet for Phase 7. All embankments, with the exception of a portion of the Phase 7 central impoundment, will be founded on 15 to 22 feet of medium to stiff clay deposits overlying shale bedrock. The south-facing slope of the Phase 7 embankment will be founded on the impounded fine refuse of the adjoining Phase 3.

The designer considered the impoundments to be of high hazard potential classification for the purposes of hydrologic/hydraulic design. Following one year from the start of construction, all phases will be able to accommodate a rainfall volume of two PMF's with pumping capacity capable of drawing down one 72-hour PMF in 30 days. When the final crest elevation is reached, an 18-inch-diameter HDPE SDR 26 decant spillway will be installed and be capable of

drawing down 90 percent of one PMF in less than 10 days. The only exception is the Phase 3 impoundment. Because of an expected life of less than 1 year, this phase was designed to handle at least one half of a 72-hour PMF, but less than a full 72-hour PMF.

The most significant consideration for these impoundments will be the concurrent mining of three longwall panels in the 6.5-foot-thick Herrin No. 6 coal seam beneath the impoundment footprints. There are 430 to 450 feet of overburden, with at least 420 feet of this being rock, between the embankment foundations or impoundment bottoms and the Herrin No. 6 seam. Boring data indicates that about 75 to 90 percent of the overburden rock is shale. A sandstone unit, 200 to 240 feet above the No. 6 seam and ranging from 21 to 54 feet thick, is the only persistent competent unit encountered in the borings.

The development entries for the longwall mining have a calculated minimum pillar safety factor of 2.3 as calculated by the program ALPS. A minimum rock overburden thickness of about 65 times the mine height is present above the seam. Therefore, this facility complies with the guidance contained in Bureau of Mines publication IC 8741 for limiting breakthrough risk. However, subsidence from the longwall mining will considerably impact surface structures over the mine.

The subsidence effects on the proposed coal refuse impoundments will be largely mitigated by the proposed phasing of the impoundments. Except for Phases 3 and 4, all refuse placement will take place after mining has been completed beneath the impoundment and subsidence is substantially complete. For Phase 3, FCR placement will be completed to an elevation of 5 feet below the crest, about 9 months prior to longwall mining beneath the impoundment. A 5-foot-thick cover of coarse refuse, level with the crest, will be placed over the fine refuse in order to eliminate any impounded water before the mining advances beneath the impoundment. Phase 4 will consist of a 45-foot-high non-impounding embankment placed prior to mining. After the mining, the 300-foot-wide Phase 6 embankment will buttress the downstream slope of the Phase 4 embankment. The width of this embankment is expected to mitigate any possible effects of subsidence-related damage to the Phase 4 embankment.

The planned mining beneath the Phase 3 impoundment, a short time after filling and capping of this impoundment, is the most significant issue in evaluating the subsidence impacts. There is currently little engineering experience in accommodating longwall mining under a coal refuse impoundment and a conservative consideration of all possible potential failure modes and mitigatory measures was the primary item of concern in the review of this plan.

REVIEW DISCUSSION

The submittal received on July 20, 2009, provided responses to the eleven items of additional information that were requested in the November 10, 2008, memorandum. Additionally the submitted addendum included a revised plan for the Phase 5, which will be enlarged by locating its north dike approximately 250 feet further north.

Phase 7 Stability

The submittal did not satisfactorily address comment Nos. 7 and 8 in the November 10, 2008, memorandum. These comments noted that a stability analysis of the Phase 7 south dike, which will be founded on the settled Phase 3 FCR, had not been performed and requested this analysis be performed along with a seismic liquefaction and deformation analysis. The submitted analysis in response to these comments included only an analysis of the less-critical completed Phase 7C configuration, and not the critical Phase 7A, which will entail advancing the 38-foot-high south dike embankment over the thin cover overlying the consolidating fine refuse. An independent check calculation using the "SlopeW" stability analysis program and normalized undrained strength parameters for the FCR developed in the submittal indicated a short-term post construction safety factor for the south dike of Phase 7A of considerably less than one. Therefore, Phase 7A, as currently planned, will require design revisions before MWGED can recommend approval.

Subsidence Impacts - Phase 3 Impoundment

The largest part of the most recent submittal consisted of various analyses and new test data submitted as justification for the proposed longwall mining beneath the capped Phase 3 impoundment, as requested in items 1 through 3 of the November 10, 2008, memorandum. MWGED performed this review in conjunction with a literature review of soil behavior when subjected to tensile strains and a published case-study of longwall mining under an impoundment in West Virginia.(1)

The Phase 3 impoundment is located so the dike bounding the FCR pool to the north is centered over the Panel's 2 and 3 gateroad development entries, the east and west dikes extend southward to approximately the center of the longwall panel, and the south dike runs along the center portion of the panel. The panel width (1,400 feet) with respect to depth is such that subsidence is supercritical, so the south dike will be subjected only to transient tensile, then compressive, strains in a longitudinal direction as the mine face advances east to west. The east and west dikes will be subjected to permanent tensile strains near the northwest and northeast corners of the impoundment and the north dike will be subjected to significant strains only near the inside toe.

Assuming the impoundment is capped and no longer impounding water at the time the longwall panel is advanced, the specific potential failure mechanisms that were examined for the Phase 3 impoundment included:

(1) Choi, D. S., et al, 1997, "A Case Study of Undermining Impoundment Embankment by the Longwall Mining Method," Proc. 36th US Rock Mechanics Symposium

1. Stability failure of the CCR embankment due to deformations and weakening from subsidence-induced shear strains and cracking.

2. The potential for the development of large, persistent transverse cracks in the CCR embankment or foundation materials capable of releasing flowable FCR. The calculated horizontal strains induced by the subsidence, using revised CISPM model calculations calibrated to actual subsidence measurements at this mine, is about 30 microstrain (3 percent).

3. Weakening and/or liquefaction of the FCR due to subsidence strain-induced pore pressures in conjunction with transverse cracking, possibly resulting in flow into, and/or erosion of, cracks in the CCR.

CCR Embankment Stability Under Subsidence Condition

In order to evaluate the possibility of the first of these mechanisms, a separate analysis performed by GAI Consultants for Alliance applied data from existing triaxial test data of the coarse refuse (CU with pore pressures) to the formula developed for the double-punch shear test developed by Fang and Chen[(2)] to determine a tensile strength for the CCR. The consolidation stresses for each test point were then corrected for equivalent effective vertical stress (σ'_v) and used to develop a "normalized tensile strength" ratio (σ_t/ σ'_v) of 0.15 for the CCR. Using this ratio, an average tensile strength of C=475 psf and φ=0 degrees was used in a slope stability analysis to obtain a worst-case stability safety factor for the subsidence disturbed embankment of 1.10. We do not believe the derivation of this strength is technically correct. However, the strength parameter derived appears to be very conservative for coarse coal refuse in even the loosest condition. An independent analysis showed a factor of safety of 1.3 was achieved with φ=19 degrees, which is lower than CCR in its loosest condition based on the typical angle of repose of this material. Therefore, slope failure of the CCR embankment from subsidence-induced shear is very unlikely.

CCR and Foundation Cracking Susceptibility Under Subsidence

The second failure mechanism that was evaluated was the potential for large persistent cracks through the CCR embankment which, in conjunction with the third mechanism, could result in a breach and release of flowable FCR. The submitted data showed the CCR produced at the plant is a well graded gravel material (USCS classification GW) with very little fines (2.0 to 2.5 percent passing the No. 200 sieve). The gradation of oven-dried, compacted Proctor test specimens prepared by Alliance was somewhat higher, with an average of 30 percent passing the No. 200 sieve and was classified under the USCS system as "SC," a clayey sand. However, the lab sample preparation and oven drying likely produced a material with more fines than in the constructed embankment.

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(2) Fang, H.Y. and Chen, Wai-Fai, "Determination of Tensile Strength of Soil by Unconfined Penetration Test," ASTM STP-740, R.N Young Ed., 1981

The gradation of the CCR and the foundation soil was compared to published correlations of deformation cracking and piping potential. The CCR as delivered to the impoundment prior to compaction is a cohesionless material and is not subject to cracking. The laboratory compacted and oven-dried CCR material was evaluated as having a medium deformation and cracking potential. However, this material is not likely to be representative of the material in the embankment which will have less fines; therefore, the overall deformation cracking susceptibility of the CCR was evaluated to be low.

The foundation soils are moderately plastic clays (USCS classification CL with a plasticity index of 24). These materials were evaluated as having low cracking potential because such materials in a saturated condition are subject to deformation rather than cracking under the expected strains. Mr. Harold Owens reported, in a phone conversation on June 4, 2009, that aside from a 1-inch-wide crack in desiccated materials, no obvious cracking was observed in the clayey native soils over the previously advanced Longwall Panel No. 1 in the future Phase 5 area. Considerable cracking was observed in a more brittle asphalt and chip pavement that crossed the edge of the panel. Due to the possibility of localized higher than predicted tensile deformations at any surface point over longwall panel edges, the development of significant cracks in the foundation and embankments is low but cannot be excluded.

A similar evaluation was performed for the piping resistance of the foundation and CCR materials. Piping resistance was evaluated as "high" for the foundation clay and plant-run CCR materials, and medium for the laboratory compacted materials. While not addressed in the submittal, we believe that if the impoundment is capped and not impounding water, there will be insufficient seepage water to erosively propagate any piping even if persistent cracks develop in the embankment. Therefore, for a capped impoundment, cracking and subsequent internal erosion via seepage piping is an unlikely possible failure mode.

Subsidence Induced FCR Flow Through Cracks

The third potential subsidence induced failure mechanism examined was the possibility of flowage of fluid FCR through large transverse cracks in the embankment or foundation. As described above, such cracks are unlikely, but cannot be precluded. However, if the FCR is not in a sufficiently flowable state, the cracking will be inconsequential, and this mode of failure can be precluded.

The most recent submittal provided the results of laboratory testing and an analysis of the potential for triggering strength loss (liquefaction) for the FCR under cyclic stresses from either earthquakes or the advancing subsidence across the impoundment. The FCR produced at the Mach Mine preparation plant was bulk-sampled and characterized as a fine grained plastic material with 93 percent passing the No. 200 sieve and more than 99 percent passing the No. 40 sieve. The liquid limit was 36 and the plasticity index was 17 and the material was classified under the USCS classification system as "CL."

The submittal included calculations from two triaxial tests performed on remolded FCR specimens prepared from bucket samples of the slurry produced by the preparation plant. These calculations showed a post-seismic strength ratio (S_{us}/ σ'_v) of 0.24, which is only slightly less than the peak (S_u/ σ'_v) value of 0.27. If fully consolidated, these materials are not flowable under any anticipated seismic or mine subsidence conditions. However, the fine grained FCR at this facility is likely to dissipate excess pore pressure and consolidate under self-weight very slowly, so the undrained strength of the FCR at the time of mining is likely to be the most critical condition, with a very weak upper FCR layer being potentially flowable through cracks extending through the embankment. The submittal did not include specific calculations addressing this scenario; however, a CCR cap with a minimum thickness of 5 feet is specified to be placed over the impoundment prior to mining. It is expected, based on MWGED's previous observations and independent calculations, that when CCR is pushed-out over the FCR, the upper materials with undrained strength (S_u) less than at least 150 pounds per square foot will be displaced during the pushout process and therefore are unlikely to be present beneath the pushout. The FCR and/or mixed FCR and CCR material that has reached an S_u of at least 150 psf is not flowable through a cracked embankment except in conjunction with erosive water flow, which will be precluded by the CCR cover. Therefore, provided that the Phase 3 impoundment is capped as shown in the submitted design, a failure by FCR flowage through cracks in the CCR embankment is also unlikely.

CONCLUSIONS AND RECOMMENDATIONS

MWGED noted some deficiencies in the submitted responses to our request for information; however, check calculations show the results of the analyses are conservative and the construction of this facility through Phase 6 is technically satisfactory. However, the submittal did not substantiate the stability of the Phase 7A south embankment which will be constructed over Phase 3A fine refuse, and an independent analysis performed in this office found that the design as currently planned will not be stable under static or seismic conditions. Therefore, approval is recommended through Phase 6 only. Additional information and design revisions as needed to substantiate the static and seismic stability of Phase7A will be needed before approval of this stage can be recommended.

Our recommendation for approval assumes the facility is constructed strictly in accordance with the submitted plan. In particular, the Phase 3 impoundment must be capped with a stable CCR cover and incapable of impounding water before longwall mining approaches the impoundment. Also, per the submitted Specification 6.03 for enhanced monitoring, the operability of all the specified instrumentation and preparations for the contingency buttress shall be verified by the operator's engineer before the longwall mining face is within 100 feet of any part of the Phase 3 capped impoundment.

The CCR embankments at this facility will be constructed in 500- to 600-foot-long longitudinal segments in order to take advantage of belt delivery of the CCR to the placement location. In order to assure the segments are adequately compacted and keyed into the adjoining segments, a specific placement plan was developed and is included in Appendix E of Volume 1 of the

submitted plan. This placement plan, particularly the use of the specified equipment, maximum push distances, and excavation of keys into the adjoining segment should be strictly followed.

The design report narratives and test data should also be considered part of the approved plan. If dam or foundation materials or conditions are discovered that are different than those described in the submitted reports, the plan should be modified as needed to address the changed conditions and submitted to MSHA for approval. In particular, the safety of this facility is contingent on the adherence to the specific mining schedule shown in Drawing B05-330-M36 -Mining/Impoundment Construction Timing Map, revised July 10, 2009.

Approved Plan Documents

Care should be taken to assure the most recent revisions to the drawings and specifications are incorporated into the revised plan documents. The approved plan consists of all the documents listed in the section of this report titled "Second Revised Design Submittal" with the exception of drawing B05-330-M33 – Phase 7 – Plan View and any other Phase 7 details shown on other drawings.

Report Prepared by:

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Report Approved by:

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Supervisory Civil Engineer

ADDITIONAL INFORMATION
VOLUME 2 OF 3
COMMENTS 1, 3, 7, AND 8

COAL REFUSE DISPOSAL FACILITY NO. 2
PHASE 3 THROUGH 7
IMPOUNDMENT I.D. NO. 1211-IL08-0341-02
MSHA I.D. NO. 11-03141
WILLIAMSON COUNTY, ILLINOIS

Prepared for

MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B05 330 1413
JULY 2009

gai consultants
transforming ideas into reality®

May 12, 2009

Project C090403.01

Mr. Claudio Yon, P.E.
Alliance Consulting, Inc.
124 Philpott Lane
Raleigh County Airport Industrial Park
Beaver, West Virginia 25813-9502

Letter Report
Response to MSHA Comments Nos. 1, 3, 7 and 8
Pond Creek Mine No. 1 Coal Refuse Disposal Facility No.2 – Phases 3 and 7
Williamson Energy, LLC
Williamson County, Illinois
GAI Project C090403.01

Dear Mr. Yon:

In accordance with our Work Order Memorandum No. 001, dated March 25, 2009, GAI Consultants, Inc. (GAI) has prepared comment responses for the Draft Mine Safety and Health Administration (MSHA) Memorandum and request for additional information, dated November 10, 2008. In general, this comment response addresses site-specific fine coal refuse testing, evaluates the potential for subsidence-induced triggering of the Phase 3 fine coal refuse impoundment, as well as the stability of proposed Phase 7 South embankment at the Williamson Energy, LLC (Williamson), Pond Creek Coal Refuse Disposal Facility No. 2 (Pond Creek).

GAI performed engineering analyses and prepared detailed comment responses for MSHA Comment Nos. 1, 3, 7 and 8 based on our discussions, our understanding of the site conditions, and our experience performing similar analyses. MSHA Comment Nos. 1 and 3 pertain to site-specific laboratory testing and characterization of fine coal refuse materials (FCR), and liquefaction (flow) potential of the Phase 3 fine refuse due to longwall mining beneath the Phase 3 impoundment. Comment Nos. 7 and 8 are associated with performing static and liquefaction (seismic) stability analyses of the Phase 7 South slope, respectively.

GAI notes only Comment Nos. 1, 3, 7 and 8 are addressed herein. Further, GAI understands responses to Comment Nos. 2, 4, 5 and 6 were prepared by others, and will be submitted under separate cover.

INTRODUCTION

Plans have been developed by Alliance Consulting, Inc. (Alliance), Beaver, West Virginia for the construction of a coal refuse disposal facility located near Johnston City in Williamson County, Illinois. The proposed Pond Creek facility will provide disposal capacity for both coarse and fine coal refuse, and will provide for approximately 3 ½ years of coarse coal refuse (CCR) and

six (6) years of fine coal refuse (FCR) produced from the Pond Creek No. 1 mine. The facility will be constructed in five (5) phases designated Phase 3 through 7.

The design plans for the Pond Creek facility, submitted under separate cover by Alliance includes constructing three (3) four-sided impoundments aligned in a north-south direction, which share common embankments in between. The southernmost impoundment, Phase 3 will include FCR placement, starting upon completion of the embankment to the design crest elevation (El.) 500 feet. The central impoundment will be constructed during Phases 4, 6 and 7 with FCR placement starting during Phase 7 when the embankment will be about 50 percent of the total proposed height. The northernmost impoundment will be constructed during Phase 5 and will be partly incised by excavating the bottom of the impoundment. FCR placement during Phase 5 will begin when the embankment is about 80 percent complete.

The proposed Phases 3 through 7 impoundments will occupy an area approximately 200 acres, and all of the impounding CCR embankments will be constructed by downstream or centerline methods. The upstream and downstream slopes will be about three horizontal to one vertical (3H:1V) except for Phase 3, which will have 2.6H:1V upstream slopes. Maximum slope heights will range from 49 feet for Phase 3 to 100 feet for Phase 7. All of the embankments, with the exception of a portion of Phase 7 will be founded on 15 to 22 feet of medium stiff to stiff, sandy clay overlying shale bedrock. The south facing slope of Phase 7 (designated 7A and 7C) will be founded on impounded FCR of Phase 3.

NOTED MSHA CONCERNS

MSHA noted in their November 2008 information request that the most significant consideration for the impoundments will be the concurrent mining of three (3) longwall panels in the 6.5-foot Herrin No. 6 Coal Seam beneath the impoundment footprints. GAI understands there is 430 to 450 feet of overburden between the base of the embankments/impoundments and the Herron No. 6 seam, with at least 420 feet of the overburden being rock. MSHA also noted that the breakthrough or sinkhole potential was low, but surface subsidence will considerably impact the facility.

Similarly, MSHA noted the construction is to be phased such that, with the exception of Phases 3 and 4, all refuse placement will take place after mining has been completed beneath the impoundment and subsidence is substantially complete. For Phase 3, FCR placement will be completed to an elevation five (5) feet below the crest, and about ten (10) months prior to longwall mining beneath the impoundment. A 5-foot thick cover of CCR, level with the crest, will be placed over the FCR to eliminate any impounded water before the mining advances beneath the impoundment. Phase 4 will consist of a 45-foot high, non-impounding embankment placed prior to mining. After the mining and treatment of any subsidence related surface cracks, the 300-foot wide Phase 6 embankment will buttress the downstream slope of the Phase 4 embankment. The width of this embankment is expected to mitigate the effects of any subsidence-induced cracking of the Phase 4 embankment. MSHA considers the proposed longwall mining beneath the Phase 3 impoundment to be a short time line after filling and capping, and a critical issue.

SUBSIDENCE PREDICTION EVALUATION AND SURFACE SURVEY MONITORING DATA

Alliance subcontracted Dr. Syd S. Peng of the Department of Mining Engineering at the West Virginia University to perform a subsidence study for the prediction of ground movement parameters due to longwall mining during the various phases of impoundment construction at

the Pond Creek facility. Final surface movements and deformations along a north-south trending cross-section through the proposed facility were predicted using the subsidence prediction program CSIPM version 2.01, and a complete copy of the Peng evaluation, and related figures prepared by Alliance are presented in Appendix A.

As previously noted, longwall mining will occur beneath only the Phase 3 impoundment approximately 10 months following its completion and the construction of a 5-foot thick CCR cap (part of Phase 6) to eliminate the Phase 3 impounding capability. In general, the results of the subsidence prediction evaluation suggest the magnitude of surface deformations was about 4 feet with surface strains estimated at just over one (1) percent.

GAI understands that survey monitoring was performed during the initial stages of mining Longwall Panel No. 1, which indicated surface deformations of about 5 feet, of which approximately 50 percent occurred within two (2) days, and total deformation occurred within about three (3) days.

MSHA noted that their independent subsidence verification analyses, which incorporated parameters in the SDPS computer program calibrated to the actual measured subsidence profiles, resulted in potential strains of 3.3 percent. MSHA further noted in their November 2008 request for information (Comment No. 2) that updated subsidence-related deformations and surface strains should be recalculated based on actual survey measurements.

The following sections of this letter report include generalized descriptions of the analytical approach and responses to the MSHA Comment Nos. 1, 3, 7 and 8. Included in the comment responses are summaries of previous deformation and abandonment analyses reports, where appropriate, prepared by Civil & Environmental Consultants, Inc. (CEC), pertinent laboratory testing results, summaries of our engineering analyses pertaining to the development and use of the various material engineering properties, liquefaction (flow) susceptibility and slope stability, our conclusions and recommendations, and a reference list.

Pertinent copies of figures from previous analyses are also included, as appropriate, including the results of the subsidence evaluation prepared by Dr. Peng. Appendices A through F present supporting information including detailed calculation briefs for development of pertinent engineering parameters, and the slope stability analyses results for the various liquefaction (flow slide), subsidence-induced embankment cracking, and static and post-earthquake seismic failure scenarios discussed herein.

ANALYTICAL APPROACH

In general, the procedure utilized by GAI for evaluating the susceptibility of the Phase 3 impoundment to a flow-type (liquefaction) failure is presented by Poulos, Castro and France (1985) and the Draft MSHA Engineering and Design Manual, particularly Chapter 7, "Seismic Design: Stability and Deformation." Our analyses included characterizing the impounded FCR material and assessing the susceptibility of the impoundment and embankment to a liquefaction (flow slide) failure. Liquefaction susceptibility was determined by evaluating whether or not the Phase 3 FCR would resist triggering a loss of strength, and subsequently estimating the factor of safety against post-subsidence instability. The analysis requires the in-situ static driving shear stress be determined in the critical layer FCR and a "zero-strength" stability analysis of the FCR employed to conservatively represent the undrained shear strength of the FCR, and asses the factors of safety against a liquefaction (flow slide) failure.

Poulos, et al (1985) states a soil mass susceptible to liquefaction will only experience a flow slide failure when a sufficiently large triggering event causes the strength of the soil to decrease to the undrained steady-state strength. Conversely, a soil mass which is not susceptible to liquefaction physically cannot fail by liquefaction since the minimum undrained strength exceeds the in-situ driving shear stress along the critical failure surface. If stable, a zero-strength analysis is considered the most conservative type of analysis since the FCR will possess some minimum strength (greater than zero) when subject to a rapid loading event such as an earthquake or subsidence-induced disturbance.

Additionally, the possibilities of failures resulting from FCR flowing and/or hydrostatic pressures from flowable FCR or water in subsidence-induced embankment cracks was evaluated in conjunction with the results of the liquefaction susceptibility analyses previously described. The procedure for evaluating the potential for and resistance to embankment cracking from subsidence-related disturbance includes evaluating the tensile strength (σ_t) of site-specific CCR material, based on Winterkorn and Fang, (1975), from six (6) consolidated-undrained (CU) triaxial test points of compacted CCR at various confining pressures. CCR tensile strength is normalized to equivalent vertical effective stress (σ'_v) and a 2/3-1/3 relationship of σ_t-to-σ'_v determined. Post-subsidence slope stability analyses are performed, which includes a conservatively derived tensile strength of the CCR embankment and the factor of safety against embankment cracking estimated.

Based on the results of these analyses, conclusions are drawn as to the likelihood of failure from a flow slide and/or embankment cracking. Recommendations are provided for remedial measures, if necessary, and monitoring pore pressure, verticality and deformation before, during and following longwall mining to quantify the impact of subsidence on the embankment.

RESPONSE TO MSHA COMMENT NOS. 1 and 3

In accordance with this letter report, GAI has performed various analyses, prepared comment responses and provide pertinent field and laboratory data, calculation briefs, etc. as appendices. To expedite further review, MSHA comments are presented below in **bold** type, followed by GAI's response.

COMMENT NO. 1: Characterization of Fine Refuse

The submittal does not include any site-specific fine refuse strength test data. Laboratory and/or in-situ testing of fine refuse should be performed and submitted as appropriate to address the additional analyses requested in items 3, 7 and 8 below.

RESPONSE TO COMMENT NO.1:

Laboratory Testing of FCR

In May 2008, Alliance obtained bulk fine coal refuse slurry samples from the Phase 2 impoundment for subsequent laboratory index and strength testing. Surface samples of fine coal refuse slurry were obtained from the existing tailings pond adjacent to the upstream slope of the coarse embankment. The samples were generally fine-grained, very soft and wet. The slurry material was shipped to CEC's Export, Pennsylvania office and subsequently hand-delivered to the laboratory.

CEC retained Geotechnics, Inc. (Geotechnics) of East Pittsburgh, Pennsylvania to perform laboratory tests and characterize the FCR. Laboratory testing performed included moisture

content, Atterberg limit, grain size and specific gravity testing on slurry samples to aid in soil classification and evaluation of the material properties. The FCR material was composited in the laboratory to form two (2) remolded slurry samples. The sample preparation was designed to simulate the in-situ hydraulic deposition process, and estimate the in-situ undrained shear strength after consolidation to various effective stresses. CU triaxial strength tests on the remolded slurry samples were performed to estimate peak and steady-state undrained shear strength data of the FCR and assess liquefaction susceptibility of the Phase 2 abandonment geometry. Effective and total strength parameters were also determined for the slurry samples. Laboratory testing procedures and results are summarized in Appendix B. Similarly, the results of the site-specific FCR laboratory testing are used to address liquefaction (flow slide) susceptibility of the Phase 3 impoundment as discussed below in the response to Comment No. 3.

In general, the as-received moisture contents of the sampled fine coal refuse ranged from about 86 to 94 percent. Liquid and plastic limits were 36 and 19, respectively, yielding a plasticity index of 17. CU triaxial shear strength testing was performed at confining pressures of about 5, 10 and 20 pounds per square inch (psi). The CU testing produced peak undrained shear strengths (S_{up}) ranging from about 2.6 to 9.3 psi [375 to 1,340 pounds per square foot (psf)]. Peak (axial) strains ranged from about 8.4 to 18.4 percent. Steady-state (or residual) undrained shear strengths (S_{us}) ranged from about 2.5 to 8.7 psi (360 to 1250 psf) at maximum strains of about 17.3 to 21.7 percent.

Response to Comment No. 1 Conclusions

The results of the laboratory testing indicated the fine coal refuse is clay-like based on an average 93 percent passing the No. 200 sieve and plasticity index of 17. Peak and steady-state undrained strengths, presented and discussed in Appendix B were reached at generally high strains (between 8 and 18 percent), and there was very little drop-off from peak to steady-state with increasing strain. The results generally indicated a higher resistance to strength loss (and flow) due to the large strains required to exceed the peak strength and correspondingly small decrease to the steady-state strength at higher strains. The results will be incorporated, as appropriate into the engineering analyses performed to address MSHA Comment Nos. 3, 7 and 8.

COMMENT NO. 3: Fine Refuse Behavior when Subject to Subsidence

The mining of the westernmost 2,300 feet of Longwall Panel No. 3 is scheduled to occur beneath the Phase 3 impoundment about nine months after completion of fine refuse placement, and an unspecified time after a 5-foot coarse refuse cover is placed. The submitted subsidence measurements indicate that somewhat higher-than-predicted tensile strains will occur in conjunction with a transient lowering of the eastern embankment crest to the approximate fine-refuse elevation as the mine face advances beneath the embankment. The degree that the fine refuse will consolidate, gain strength, or resist possible strength loss under subsidence-related disturbance is not known. The possibilities of fine refuse flowage through large cracks in the embankment, or failures resulting from hydrostatic pressures from flowable slurry or water in subsidence-induced embankment cracks have not been analyzed or excluded.

Appropriate field and/or lab test analyses and calculations should be furnished that exclude the failure mode described above. Mitigatory (sic.) measures to preclude a cracking and fine refuse flowage failure mode should also be provided if needed. Such measures may include provisions to dewater or accelerate the consolidation of the fine refuse prior to subsidence, or measures to prevent continuous cracks through the embankment.

RESPONSE TO COMMENT NO.3:

Liquefaction (flow slide) susceptibility is determined by evaluating whether or not the Phase 3 FCR would resist triggering a loss of strength due to a rapid loading event such as subsidence-related disturbance, and subsequently estimating the factor of safety against post-subsidence instability. The analysis requires the in-situ static driving shear stress be determined within the critical layer Phase 3 FCR impoundment, and the appropriate undrained peak (S_{up}) and/or steady-state (S_{us}) shear strength of the FCR to evaluate post-subsidence factors of safety.

Phase 3 In-Situ Driving Shear Stress and Subsidence-Induced Liquefaction Susceptibility

Estimating the in-situ static driving shear stress in the critical soil layer (i.e., fine coal refuse) is one of the steps for evaluating liquefaction susceptibility. The driving shear stress in the critical fine coal refuse layer is equal to the minimum shear resistance the layer must have to simply maintain stability of the slope (i.e., factor of safety of 1.0). The driving stress assumes fully mobilized shear strengths in the structurally-placed, dense CCR and underlying stiff residual soil layers comprising the model. The fully mobilized strengths are those that would act while deformation of the slope is occurring and thus, would be available to resist a massive flow slide. These shear strengths are quantified by performing a stability analysis for the Phase 3 slope in question.

The driving shear stress (τ_d) acting along the critical failure surface is determined by assuming the shearing resistance (i.e., shear strength) of the material through which the failure surface passes is provided solely by cohesion [i.e., angle of internal friction (ϕ) = 0]. The driving stress is determined by varying the cohesion value used in the analysis until a factor of safety of 1.0 is obtained. For this condition, the driving stress acting along the failure surface analyzed is equal to the cohesion value used for the material.

A series of PCSTABL analyses were performed to identify the most critical circular failure surface passing through the Phase 3 impoundment in both the downstream and upstream conditions. The range of starting and ending points for failure circle generation were iteratively analyzed to evaluate the critical failure surface and included the entire impoundment surface. Effective strength of the CCR and total strength parameters of the residual soil described above were used while the cohesion values for the FCR layers were modeled and varied until a factor of safety of 1.0 was obtained.

The following soil properties were estimated based on previous field and laboratory testing and used in the various driving stress and post-subsidence liquefaction slope stability analyses. Appendix B presents summaries of laboratory testing of coarse and fine coal refuse and residual soil. Appendix B also presents a summary of previous field testing at the Pond Creek

facility, particularly piezo-seismic cone penetration testing (PS-CPT) performed by CEC and ConeTec, Inc., West Berlin, New Jersey as part of an evaluation by CEC to address comments by Illinois Department of Natural Resources (IDNR) pertaining to Phase 2 permanent deformations. Appendix C presents summaries of the various analyses to develop pertinent engineering parameters.

Table 1
Summary of Coarse and Fine Coal Refuse and Residual Soil Engineering Properties

Description	Unit Weights (γ_t,γ_s) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion (c) (psf)	Strength
Coarse Coal Refuse (CCR)	130, 140	33.7 18.0 0	0 736 σ_t/σ'_v=0.15 (See Below)	Effective Strength (Drained) Total Strength (Undrained) Tensile Strength
Fine Coal Refuse (FCR)	80, 90	36.9 18.8 0	0 0 S_u/σ'_v=0 (Assumed)	Effective Strength (Drained) Total Strength (Undrained) Zero-Strength (Undrained)
Residual Soil	125, 135	26.8 19.5	0 416	Effective Strength (Drained) Total Strength (Undrained)

The results of the driving shear stress slope stability analyses indicate the Phase 3 embankment and impoundment geometry is very favorable, and there is zero (0) in-situ driving shear stress along the critical failure surface passing through the Phase 3 FCR in both the upstream and downstream directions. Utilizing this zero-strength approach in FCR, effective strengths parameters for CCR and total strength parameters for residual soil, minimum factors of safety for the critical Phase 3 downstream and upstream impoundment conditions were 2.2 and 1.3, respectively.

The results indicate that a rapid loading event such as subsidence-related disturbance will not trigger a strength loss in FCR, and is therefore NOT susceptible to a flow slide failure.

Engineering properties derived from laboratory testing of site specific materials are presented in Appendix C. Hard copies of the input and output files for the driving stress analyses are presented in Appendix D.

Phase 3 Factors of Safety Against Embankment Cracking and Failure

As previously discussed, GAI evaluated the possibility of a flow slide failure of the Phase 3 FCR impoundment, and based on the results of the analyses, triggering a FCR strength loss and/or

flow slide failure is not a feasible failure mode. Additionally, the susceptibility of the Phase 3 CCR embankment to cracking from subsidence-induced disturbance, and/or failure of the embankment due to elevated hydrostatic (pore) pressures from water in embankment cracks were evaluated.

GAI's analysis of embankment cracking included evaluating the tensile strength (σ_t) of site-specific CCR material, based on Winterkorn and Fang (1975), from six (6) consolidated-undrained (CU) triaxial test points of compacted CCR at various confining pressures. CCR tensile strength was subsequently normalized to equivalent vertical effective stress (σ'_v) and a conservative 2/3-1/3 relationship of σ_t-to-σ'_v (σ_t/σ'_v) estimated at 0.15. Appendix C presents calculations deriving CCR σ_t as a function of σ'_v for the Phase 3 embankment, and the corresponding average CCR σ_t was estimated at 475 psf. This σ_t is considered to be a reasonable, low tensile strength value for the Phase 3 structurally-placed CCR embankment.

Phase 3 post-subsidence slope stability analyses were performed to evaluate the potential for embankment cracking, and included using a conservatively-derived CCR σ_t value as cohesion (ϕ=0 condition) for the embankment, a conservative zero (0) strength value for the FCR, and total undrained shear strength values for residual soil. The minimum factor of safety against embankment cracking was estimated at 1.1.

Additional Phase 3 post-subsidence, undrained slope stability analyses were performed to evaluate the possibility of failure due to the subsidence event. The analyses include using total undrained strength parameters for the CCR embankment and residual soil, which assumes an increase in pore pressure of the saturated portions of the embankment and underlying soil due to the rapid loading subsidence event and corresponding decrease in strength from drained to undrained, and a conservative zero (0) strength cohesion value for the FCR. The minimum factor of safety against post-subsidence embankment failure using these consecutive shear strengths was estimated at 2.4. Hard copies of the input and output files for the embankment cracking stability analyses are presented in Appendix E.

The results of the post-subsidence analyses suggest that marginal stability exists against embankment cracking and adequate factor of safety against embankment failure due to increase pore pressure in the embankment and residual soil. Conservatisms inherent in the engineering properties used in the post-subsidence stability analyses, which will increase the estimated factor of safety, include the following:

- CCR strength estimates discount negative pore pressures that will undoubtedly develop during the initial stages of the subsidence rapid loading event due to the compacted, dense initial state of stress of the CCR;
- CU testing results of all six (6) CCR points suggest that the peak strain for the CCR material ranges from about 12.5 to 15.3 percent, which is attributed to the claystone and shale rock materials in the CCR; and
- Peak strain for the CCR material is significantly higher than the range of predicted subsidence threshold strains of about 1 to 3 percent.

Response to Comment No. 3 Conclusions

GAI has completed an evaluation of the liquefaction susceptibility of the proposed Pond Creek Phase 3 impoundment geometry. Based on this evaluation, the impoundment is not susceptible to a liquefaction (flow) failure. Additional stability analyses were performed to evaluate the potential for embankment cracking and embankment failure due to subsidence-related disturbance. Based on conservatively-derived strength parameters, adequate factor of safety exists relative to a failure of the Phase 3 embankment. Marginal factor of safety exists relative to Phase 3 embankment cracking; however, conservatisms in the analyses exist. Additionally, the following conclusions are noted:

- FCR was characterized as clay-like, which typically is more resistant to strength loss (or flow) than sand-like materials;
- In-situ driving shear stresses through the FCR are 0 psf;
- Site-specific FCR and CCR laboratory testing results indicate high peak and steady-state undrained shear strains of about 12 to 15 percent relative to the strains induced from subsidence of approximately 1 to 3 percent;
- Phase 3 minimum factors of safety against flow slide susceptibility, with zero-strength FCR in the downstream and upstream directions of 2.2 and 1.3, respectively;
- Phase 3 factor of safety against embankment failure of 2.4; and
- Phase 3 factor of safety against embankment cracking of 1.1.

Response to Comment No. 3 Recommendations

Based on the results of the Phase 3 subsidence-related stability analyses, adequate factors of safety exist relative to catastrophic failure scenarios including a potential flow slide and embankment failure. Marginal stability exists relative to potential cracking of the Phase 3 embankment due to the proposed longwall mining beneath the impoundment; however, some conservatism exists in the analyses as previously noted, including derivation of tensile strength properties, negative pore pressure and increased strength during loading, and high strain capability of the CCR embankment materials relative to estimated induced subsidence strain. Consequently, GAI does not anticipate significant embankment cracking, if any. However, there are various unknowns relative to the actual performance of the impoundment that require attention.

Therefore, GAI recommends that instrumentation installations and monitoring of the Phase 3 embankment be performed prior to, during and following longwall mining beneath the Phase 3 impoundment including installing pore pressure transducers and inclinometers. Also, GAI recommends that detailed inspections of the embankment, cap, toe areas and outlet structures be performed two (2) times/days prior to, daily during, and daily following longwall mining beneath the Phase 3 impoundment for a period of two (2) weeks following completion of mining, and any deviations noted.

Further, GAI recommends that a CCR buttress or sealing layer remedial alternative, such as that proposed for the northern slope of the Phase 7 impoundment (Phase 7B) be designed, and construction implementation provisions made based on the results of the Phase 3 detailed inspections and instrumentation monitoring. If extensive cracking, seepage and/or other noticeable surface features are noted, and the magnitude of pore pressure and deformation are deemed potentially detrimental to the short- or long-term performance of the Phase 3 impoundment, then the implementation of the buttress/seal remedial alternative should be employed.

If the post-subsidence instrumentation monitoring and inspection results indicate that the Phase 3 embankment/impoundment distress is not a concern, i.e., no adverse cracking, seepage, excess pore pressure or deformation, then monitoring of the Phase 3 should continue twice a week for a period of two (2) months. If after an additional two (2) months of satisfactory monitoring results, and the embankment/impoundment continues to exhibit adequate performance characteristics, i.e., the magnitudes of pore pressure and deformation decrease, level off, or approach normal operating levels, and no increased seepage conditions or cracking exist, then monitoring of the Phase 3 embankment could be discontinued.

RESPONSE TO MSHA COMMENT NOS. 7 and 8

In accordance with this letter report, GAI has performed various analyses, prepared comment responses and provide pertinent figures, field and laboratory data, calculation briefs, etc. as appendices. To expedite further review, MSHA comments are presented below in **bold** type, followed by GAI's response.

COMMENT NO. 7: **Stability of Phase 7 South Slope**

The Phase 7 embankment will be founded on the impounded FCR from Phase 3 and therefore is the most critical stability analysis case. However, no stability analysis was furnished for this slope.

A stability analysis should be provided for a section through the Phase 7 and underlying Stage 3, using site-specific FCR strength parameters as requested in item No. 1 above. Because of the anticipated speed at which the Stage 7 embankment will be raised, analyses should be run for both the short-term end-of-construction and long-term steady-state conditions. Note that for loading of the consolidating, saturated FCR, appropriate undrained (phi=0) strength parameters should be used.

RESPONSE TO COMMENT NO.7:

Static slope stability analyses were performed for the Phase 7 South slope geometry (Phase 7C), which includes the underlying Phase 3 impoundment FCR. The short-term, end-of-construction analysis condition includes using effective strength parameters for the CCR, total undrained shear strengths for the residual soil, and zero (0) strength for the FCR. A "zero-strength" type analysis of the FCR, if stable, is considered the most conservative analysis because a true zero strength condition physically cannot occur. Some minimum strength, i.e.,

steady-state undrained exists even if the material is susceptible to a strength loss triggering event. Effective strength for CCR and total undrained strength for FCR and residual soil are utilized for the long-term, steady-state conditions stability analyses of the Phase 7C South slope geometry.

Soil properties, presented above in Response to Comment No. 3, were estimated based on previous field and laboratory testing and used in the appropriate static and liquefaction susceptibility slope stability analyses. Laboratory testing procedures and results are summarized in Appendix B and estimates of engineering properties are presented in Appendix C.

The results of the Phase 7C static slope stability analyses indicate the Phase 7C embankment and underlying Phase 3 impoundment geometry is stable under both short-term, end-of-construction and long-term, steady-state conditions. Utilizing conservative strength parameters for the various materials including "zero-strength" for FCR, the end-of-construction and steady-state static factors of safety are 1.6 and 1.8, respectively. Hard copies of the input and output files for the Phase 7C end-of-construction and long-term steady-state slope stability analyses are presented in Appendix F.

COMMENT NO. 8: **Seismic Stability of Phase 7 South Slope**

The fine refuse on which Phase 7 will be founded may be subject to triggering strength loss (liquefaction) under earthquake shaking.

An evaluation of the susceptibility of the fine refuse to strength loss under appropriate earthquake shaking should be performed, and if required, the post-seismic stability evaluated using estimate reduced post-seismic strengths. Alternatively, stability analyses can be performed using conservatively estimated post-earthquake strengths for the fine and coarse refuse. If a factor of safety of 1.20 or greater can be obtained with this conservative analysis, than (sic.) additional liquefaction analyses will not be needed.

RESPONSE TO COMMENT NO.8:

Liquefaction susceptibility of the proposed Phase 7C slope geometry and the FCR hydraulically placed beneath the Phase 7 CCR embankment depends on the strength of all the soils along the critical failure surface. Zones of loose (contractive) soils are critical to analyzing liquefaction potential since only loose soils can have an undrained strength that is significantly lower than their drained strength. For the purpose of this evaluation, a conservative, simplified approach was employed, and assumes the FCR will lose strength during an earthquake, which changes the condition from drained to undrained.

Liquefaction susceptibility was determined by evaluating the Phase 7C embankment and underlying Phase 3 FCR utilizing a zero-strength to very low strength approach for the FCR to evaluate the post-earthquake factors of safety. The post-earthquake analyses included using effective strength parameters for the CCR, total undrained shear strengths for the residual soil, and zero (0) strength for the FCR for a deep failure and 260 psf for a shallow failure. The 260 psf equates to $Sus/\sigma'_v=0.05$, far less than the site-specific laboratory testing $Sus/\sigma'_v=0.24$. Soil properties used in the post-earthquake slope stability analyses are summarized in Appendix C.

The results of the Phase 7C post-earthquake stability analyses indicate the Phase 7C embankment and underlying Phase 3 impoundment geometry is stable. Utilizing conservative strength parameters for the various materials including zero-strength to 260 psf for FCR, the post-earthquake factor of safety ranges from 1.2 to 1.6 for shallow and deep failure circles, respectively. Hard copies of the input and output files for the Phase 7C post-earthquake slope stability analyses are also presented in Appendix F.

Poulos, et al (1985) states a soil mass that is not susceptible to liquefaction physically cannot fail by liquefaction since the minimum undrained strength exceeds the in-situ driving shear stress along the critical failure surface. Permanent deformation analyses were not considered pertinent to the Phase 7C geometry since there is no impounded FCR or freeboard. Therefore, permanent deformation analyses were not performed.

GAI appreciates this opportunity to provide to Alliance specialized subsidence and seismic engineering services. Please do not hesitate to contact us if you have any questions concerning any of the information presented.

Respectfully submitted,
GAI CONSULTANTS, INC.

Blaise E. Genes
Manager of Geotechnical and Structural

BEG /tlg
0943001-ltr rpt-rtmc-beg/tlg D1

Attachments

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2. Civil & Environmental Consultants, Inc. Report, "Permanent Deformation Evaluation, Pond Creek No. 1 Coal Refuse Disposal Site, South Cell Slurry Impoundment, Johnston City, Williamson County, Illinois," January 23, 2008.

3. Civil & Environmental Consultants, Inc. Report, "Abandonment Evaluation, Pond Creek No. 1 Coal Refuse Disposal Site, South Cell Slurry Impoundment, Johnston City, Williamson County, Illinois," July 23, 2008.

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5. Illinois Department of Natural Resources, Office of Water Resources, Construction and Maintenance of Dams, Part 3702, Chapter IX.

6. Poulos, S.J., Castro, G., and France, J.W. (1985) "Liquefaction Evaluation Procedure," Journal of the Geotechnical Engineering Division, ASCE, Vol. 111, No. GT6, pp. 772-792.

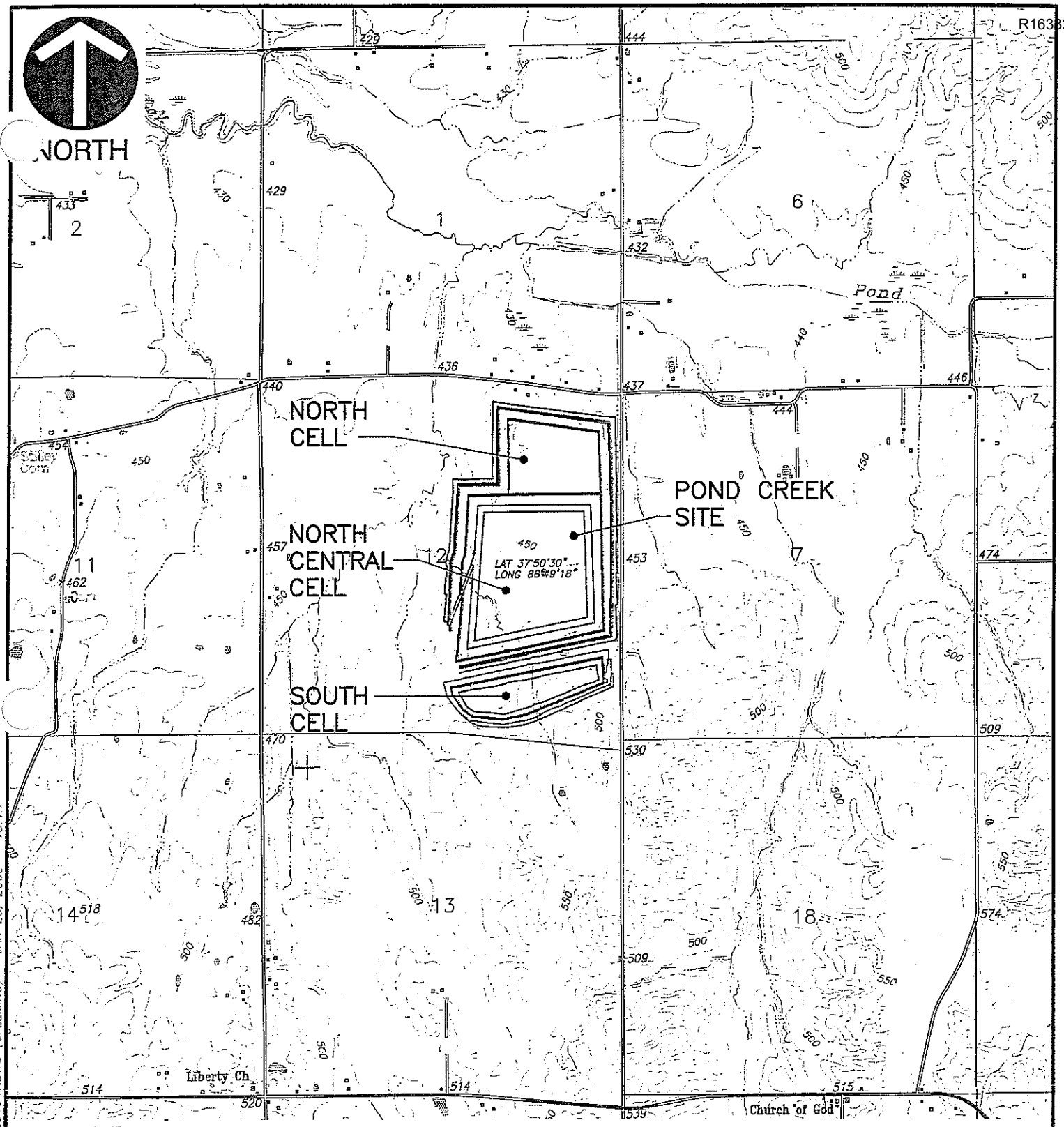
7. Peng, S., Ray, A. and Du, T., "Prediction of Ground Movement Parameters Due to Longwall Mining During Different Phases of Impoundments," Department of Mining Engineering, West Virginia University, March 2008.

8. U.S. Department of Labor, Mine Safety and Health Administration, "Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 Seismic Design: Stability and Deformation Analyses," Final Draft Dated December 2007, Updated August 1, 2008.

9. Winterkorn and Fang, (1975), "Foundation Engineering Handbook," Van Nostrand Reinhold Publishers.

FIGURES

R16382



REFERENCE
U.S.G.S. 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAP OF PITTSBURG, IL
DATE: 1963

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Civil & Environmental Consultants, Inc.
Four Triangle Lane, Suite 200, Export, PA 15632-9522
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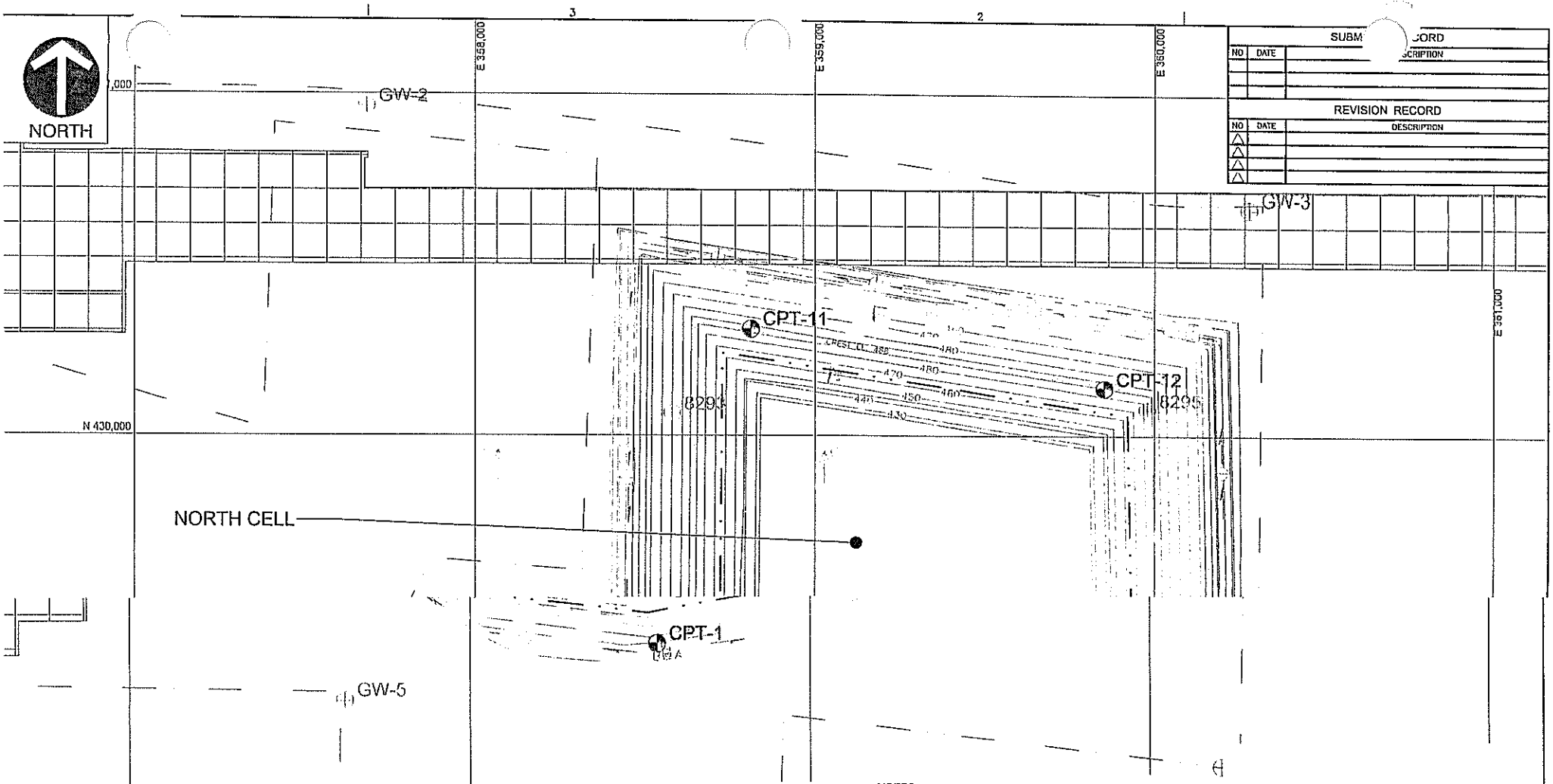
Pittsburgh, PA
Cincinnati, OH
Columbus, OH
Indianapolis, IN
Nashville, TN
Chicago, IL
St. Louis, MO
Detroit, MI

SITE LOCATION MAP
POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY LLC.

QUALITY MANAGER APPROVAL:	BEG*	*HAND SIGNATURE ON FILE		PROJECT NO:	072-046	FIGURE NO:	1
DRAWN BY:	CAF	CHKD BY:	RJS	DWG SCALE:	1"=2000'	LAST EDIT DATE:	JAN. 21, 2008



SUBMISSION RECORD		
NO	DATE	DESCRIPTION

REVISION RECORD		
NO	DATE	DESCRIPTION
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CPT SOUNDING LOCATIONS

	NORTHING	EASTING	ELEVATION
CPT-1	425784.16	358548.87	482.19
CPT-2	426832.42	357857.50	494.21
CPT-2A	426828.92	358156.73	492.40
CPT-3	426792.78	359207.60	466.98
CPT-4	425331.10	360108.80	462.55
CPT-5	427485.25	357913.86	482.55
CPT-5A	427007.60	357920.84	483.00
CPT-6	427450.46	358992.62	457.78
CPT-7	427450.88	359850.00	457.83
CPT-8	429008.12	359034.04	444.95
CPT-9	429077.69	359026.20	445.88
CPT-10	428955.83	359998.45	442.09
CPT-11	430316.82	358810.06	440.59
CPT-12	430141.63	359852.30	442.08

PREVIOUS BORING / WELL LOCATIONS

	NORTHING	EASTING
GW-6	425414.53	360201.23
GW-5	425606.81	357626.97
8299	426148.35	358205.38
8298	426471.27	359601.65
GW-1A	427584.82	358263.84
8294	428248.64	358131.20
8874	428255.56	358150.19
8297	428029.69	359955.38
8293	430004.93	358579.92
8295	430077.80	359979.43

NOTES

1. SITE LAYOUT PROVIDED BY ALLIANCE CONSULTING INC.
2. CPT SOUNDING AND PREVIOUS BORING/WELL LOCATIONS AND ELEVATIONS PROVIDED BY WILLIAMSON ENERGY LLC.
3. REFER TO FIGURE 3 FOR REVISED PSEUDO-STATIC (PGA=0.54g) AND YIELD ACCELERATION SLOPE STABILITY ANALYSES RESULTS FOR CROSS SECTION A-A.

LEGEND

8874 — PREVIOUS BORINGS (BY OTHERS)

GW-6 — PREVIOUS WELLS (BY OTHERS)

CPT-3 — CPT SOUNDING LOCATIONS (OCT. 2007)

SCALE IN FEET
0 200 400

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POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY LLC.

QUALITY MANAGER APPROVAL:	* HAND SIGNATURE ON FILE		BEG
LAST EDIT DATE:	JAN. 22, 2008	DWG SCALE:	1"=200'
DRAWN BY: CAF	CHECKED BY: RJS	PROJECT NO:	072-046
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CPT SOUNDING LOCATION PLAN

DWG NO: FIG. 2

R6333

8114-10
Part 17

APPENDIX A

PREDICTION OF GROUND MOVEMENT PARAMETERS DUE TO LONGWALL MINING DURING DIFFERENT PHASES OF IMPOUNDMENTS

BY SYD S. PENG, ANIL RAY AND THOMAS DU
DEPARTMENT OF MINING ENGINEERING, WEST VIRGINIA UNIVERSITY

MARCH 2008

SUBMITTED TO AND PROVIDED BY ALLIANCE CONSULTING, INC.

gai consultants
transforming ideas into reality

Prediction of Ground Movement Parameters due to Longwall Mining During different Phases of Impoundments

A report
submitted to

Alliance Consulting, Inc.

by

Syd S. Peng, Charles E. Lawall Chair of Mining Engineering
Anil Ray, Graduate Research Assistant
Thomas Du, Graduate Research Assistant

Department of Mining Engineering
West Virginia University
March 2008

1.0 INTRODUCTION

The Williamson Energy has proposed construction of four impoundments over the longwall panels located near the end of the panels. These four impoundments will be constructed and used during different phase with respect to longwall mining. The phase sequences for these impoundments are given in Figure 1. The phase 2 and 3 impoundment (impoundment 1 and 2) constructions are over panel 3 and 4. The impoundments 3 and 4 are over longwall panel 2 and 1, respectively.

From the information and details of different phase provided in Figure 1, it is obvious that phase 2 and 3 will be completed much before the longwall mining, i.e. over virgin area. In relation to longwall mining retreat, only in phase 5, the longwall retreat will be done towards the end of longwall panel 1, prior to any impoundment construction over it. During Phase 4 and 6, the longwall retreat will be at the end of panel 2.

The objective of this study is to predict the ground movement parameters associated with longwall mining in different phase of impoundments. To predict these parameters, the subsidence prediction program CISPM version 2.01 developed by the senior author [1] has been used.

The input parameter for this software has been used from our earlier report [2].

2.0 Longwall Panels Parameters

Figure 1 shows the location of impoundments and longwall panels 1 to 4. The gateroads of the longwall panels are orientated towards east-west direction. Table 1 shows the mining conditions for the four longwall panels over which impoundment will be constructed. The panel widths are 1,250 for the first two longwall panels and 1,400 ft for the third and fourth longwall panel. The width of chain pillar /gateroad system is 220 ft for all the panels.

A cross section 'A-A' (Figure 1) parallel to the longwall panel width and in center of the impoundment has been considered to predict the subsidence parameters. Table 1 shows the longwall panel parameters.

Table 1 Longwall panels parameters

Panel No.	Panel Length, ft	Panel Width, ft	Overburden Depth, ft			Mining Height, ft		
			Max.	Min.	Average	Max.	Min.	Average
Panel 1	17,200	1,250	498	470	482	5.8	5.8	5.8
Panel 2	17,200	1,250	522	486	501	5.8	5.8	5.8
Panel 3	17,200	1,400	522	490	506	5.8	5.8	5.8
Panel 4	18,000	1,400	504	464	475	6.0	6.0	6.0

3.0 Prediction of Final Subsidence Parameters

In order to estimate the ground movement parameters associated with longwall mining over the surface where impoundments are located, a local coordinate system has been selected with origin (0, 0) at the right edge of 1st longwall panel gateroad system (Figure 1). The X-axis is parallel to the mining direction and the distance is measured from the setup room. The Y-axis is along the panel width direction or along section A-A.

The prediction of surface subsidence and subsidence parameters due to mining on the surface has been done at a distance of 20 ft across the panel width. The total width along the cross section A-A is 6,360 ft covering all four longwall panels and gateroad systems. The prediction points along the cross section A-A are shown in Figure 1.

The final surface movements and deformations along the cross-section AA have been predicted using the subsidence prediction program CISPM version 2.01. Average mining parameters of longwall panels (Table 1) were used for this subsidence prediction.

3.1 Subsidence Parameters during Phase 2 and 3

The predicted final subsidence profile across the impoundments after phase 2 and 3 and before phase 5 is shown in Figures 2. Since there is no longwall workings below phase 2 and 3 before phase 2 and 3 gets eliminated, no ground movement effect will be observed during phase 2 and 3 period.

3.2 Subsidence Parameters during Phase 4

Phase 4 will be built before completion of longwall retreat in panel 1. So during construction it won't be influenced by mining induced subsidence.

3.3 Subsidence Parameters during Phase 5

Before Phase 5 construction starts, the surface will experience mining induced ground movements. The subsidence, horizontal displacement, slopes and horizontal strain profiles are shown in Figure 2, 3, 4, and 5.

1.15% STRAIN

The maximum subsidence may be 3.87 ft at the center of the panel with a flat bottom. The predicted value of maximum horizontal displacement, slopes and horizontal strain are 1.27 ft, 2.37% and 11.5×10^{-3} ft/ft, respectively.

3.4 Subsidence Parameters during 6 Phase

During Phase 4 and 6 the longwall retreat will be below the impoundments in panel 2. Hence it may be affected by the mining induced subsidence and other ground movement parameters. During Phase 4 and 6 the final subsidence parameters are shown in Figures 6, 7, 8 and 9.

The Final subsidence parameters after mining all four longwall panels are given in Appendix 1.

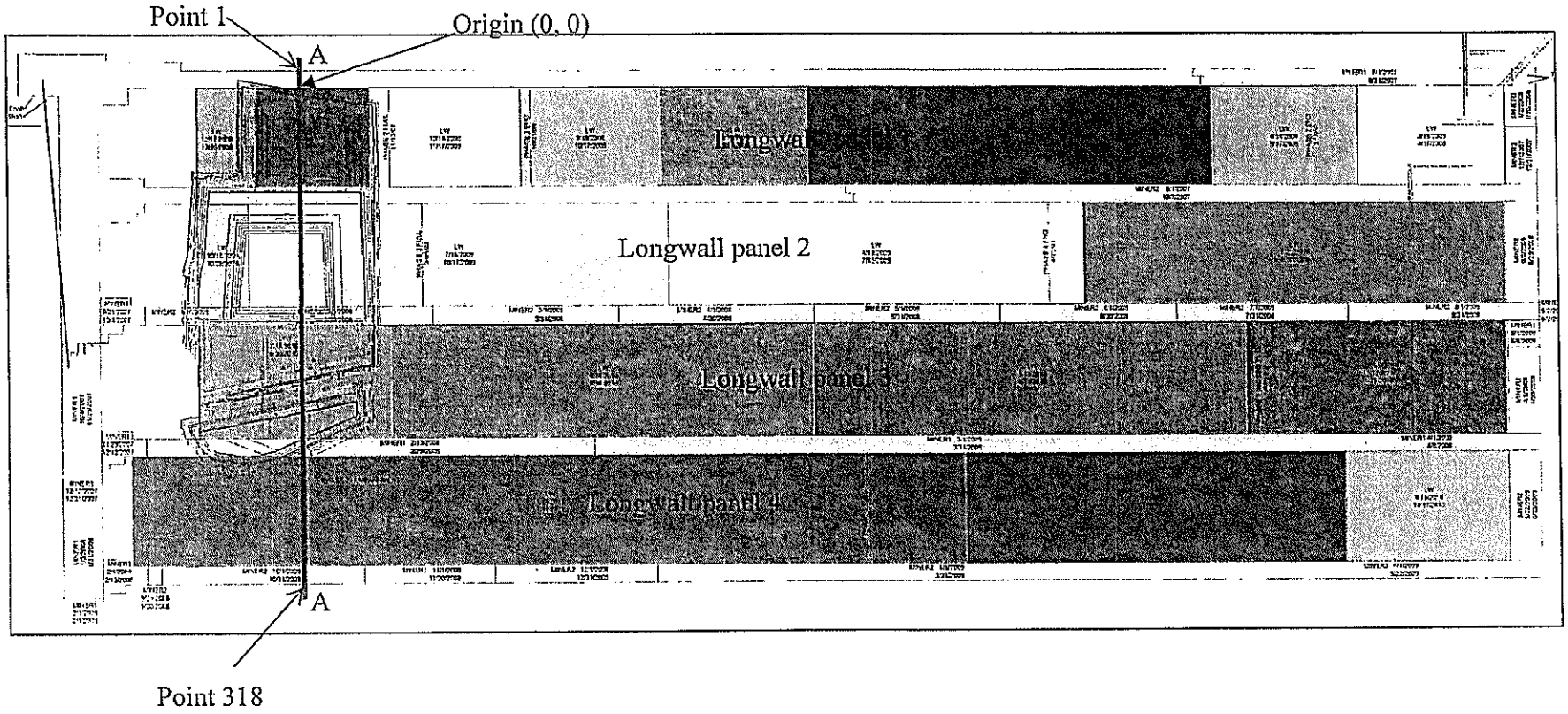

Figure 1 Plan showing cross section A-A across the longwall panels along with origin and first and last prediction points on the cross section

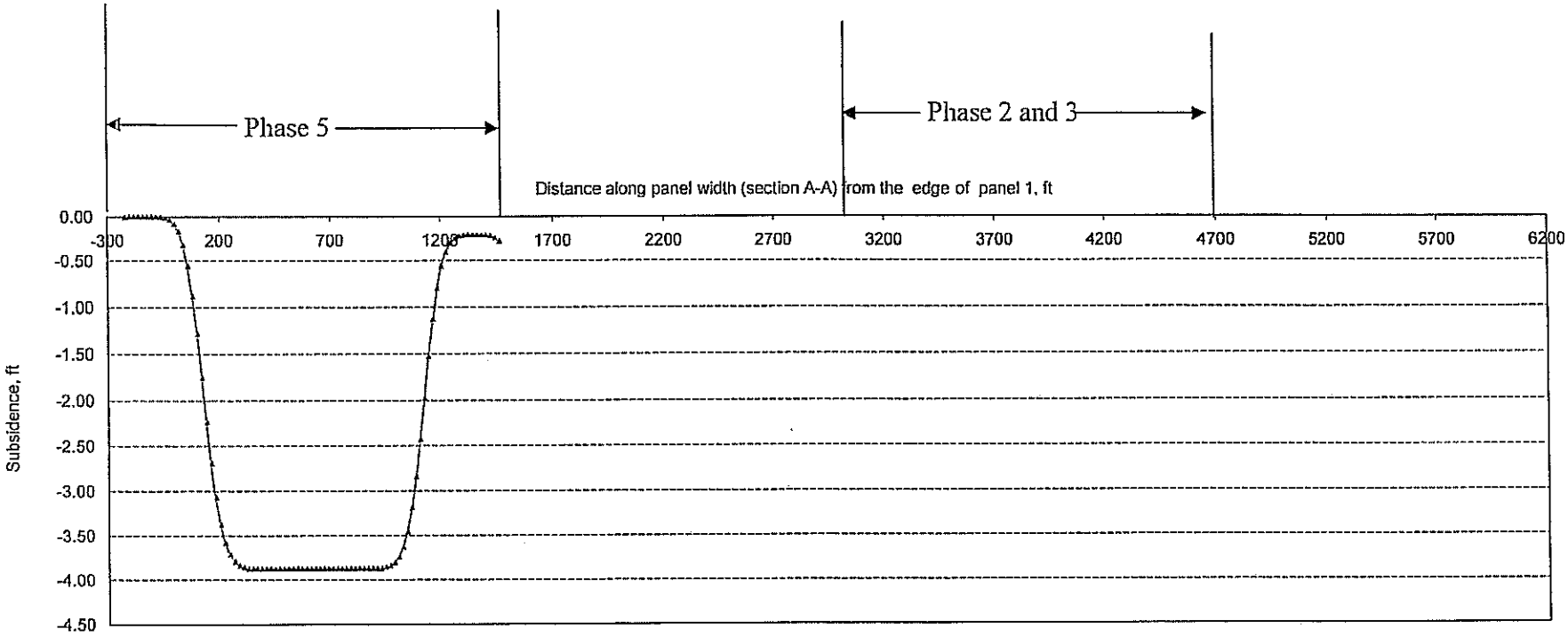

Figure 2 Subsidence profile after phase 2 and 3 and before phase 5(No longwall mining below phase 2 workings)

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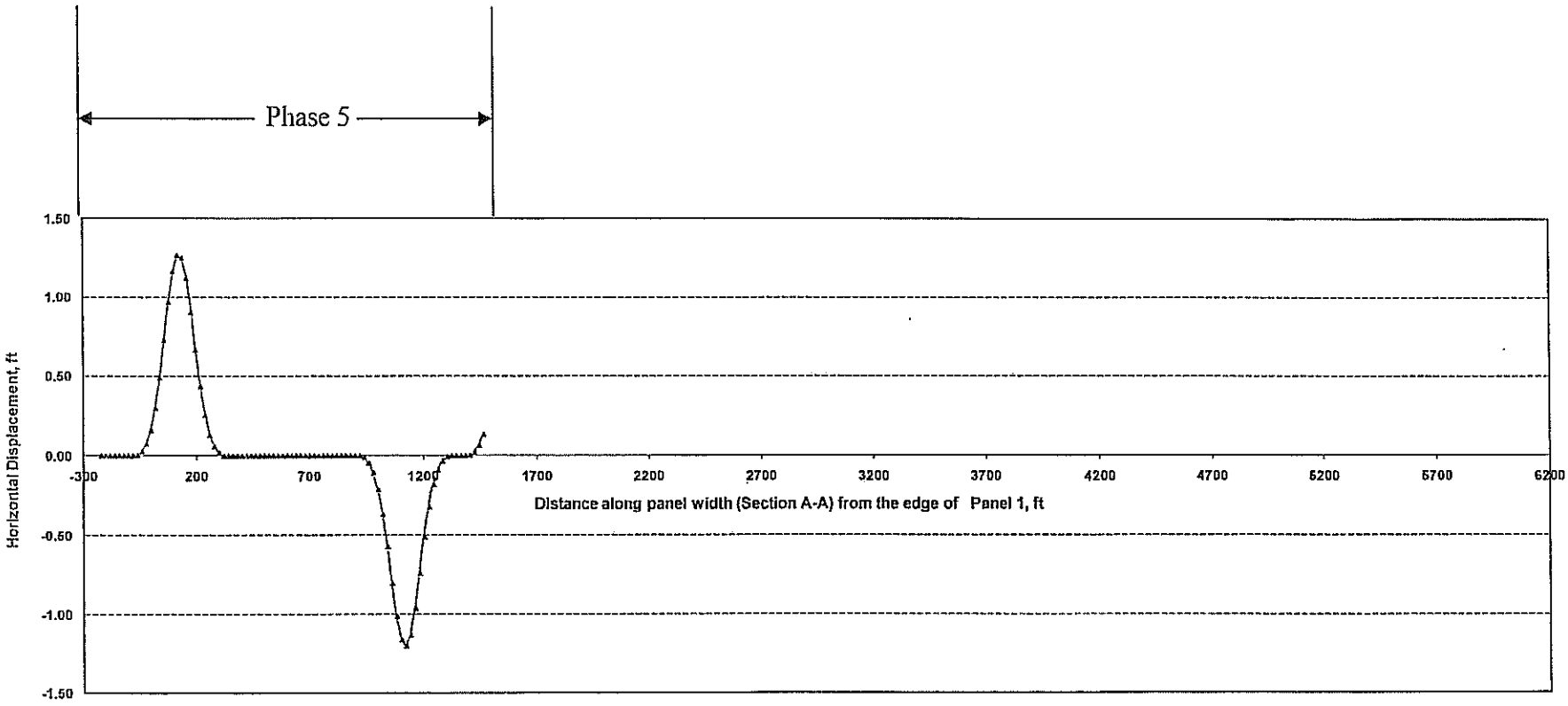

Figure 3 Horizontal distance profile before phase 5 begins

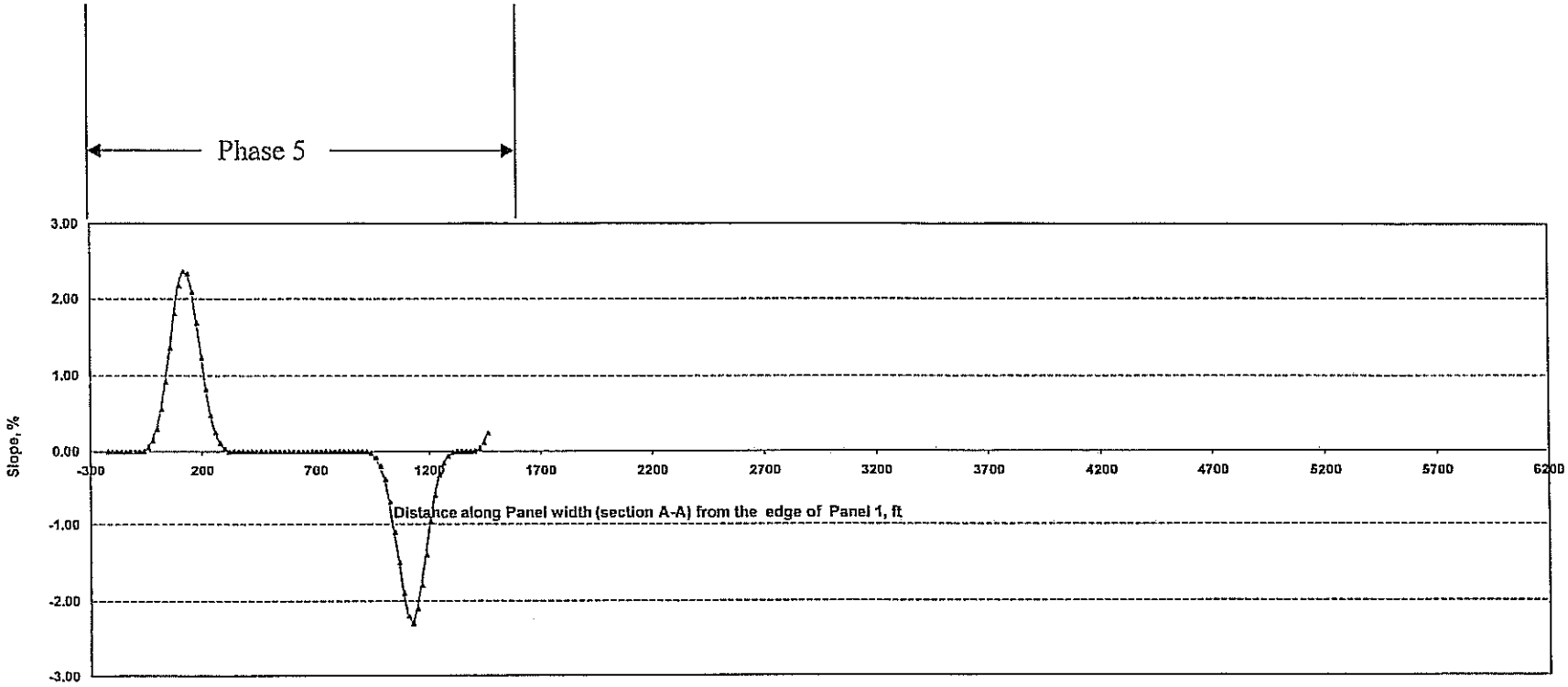

Figure 4 Slope profile before phase 5 begins

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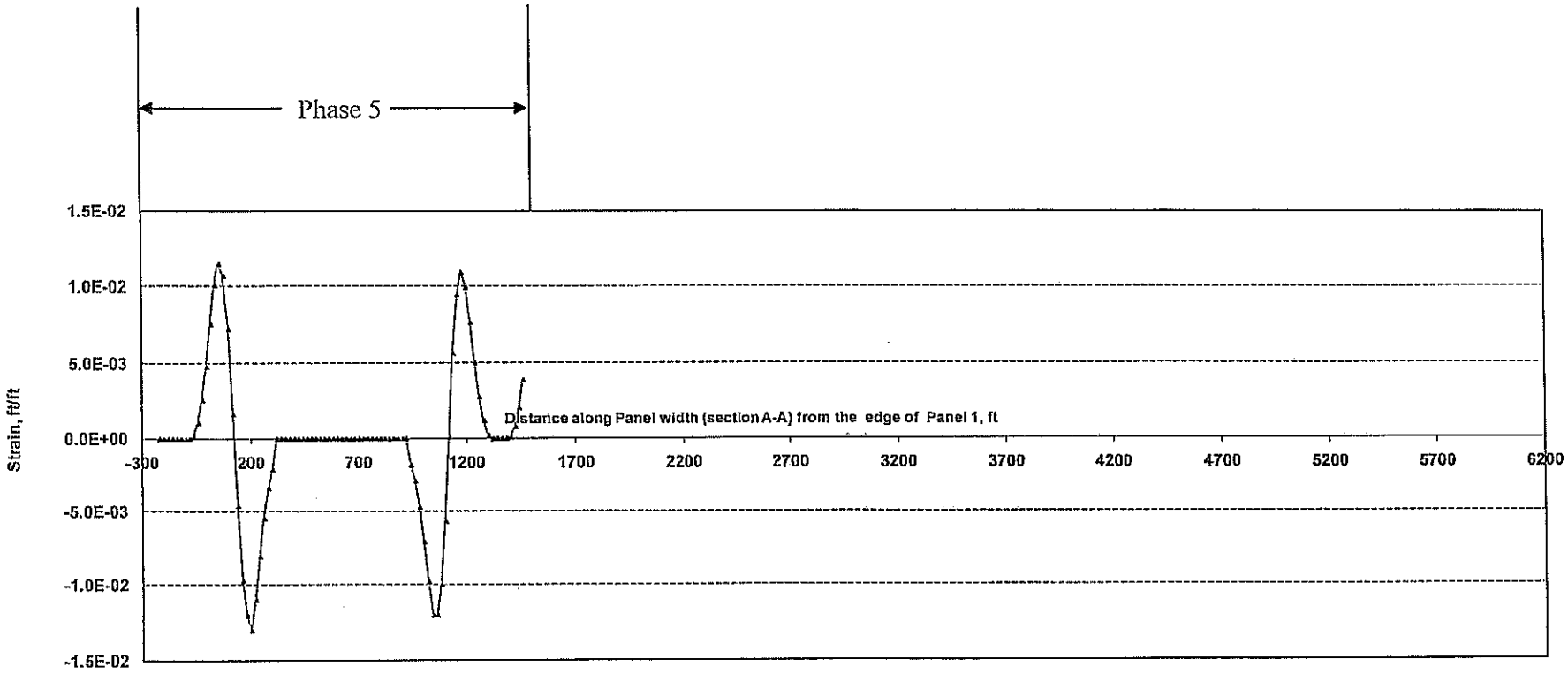


Figure 5 Horizontal strain profile before phase 5 begins

R16342

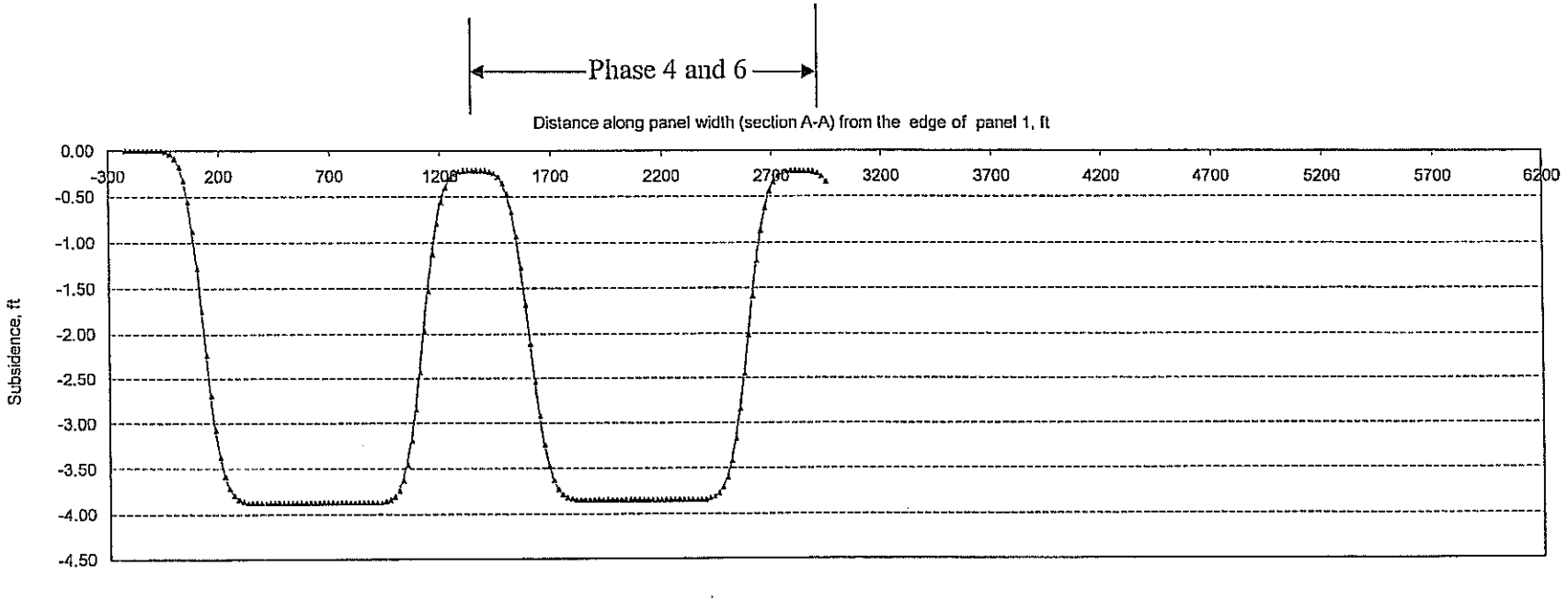


Figure 6 Subsidence profile during phase 4 and 6

R16343

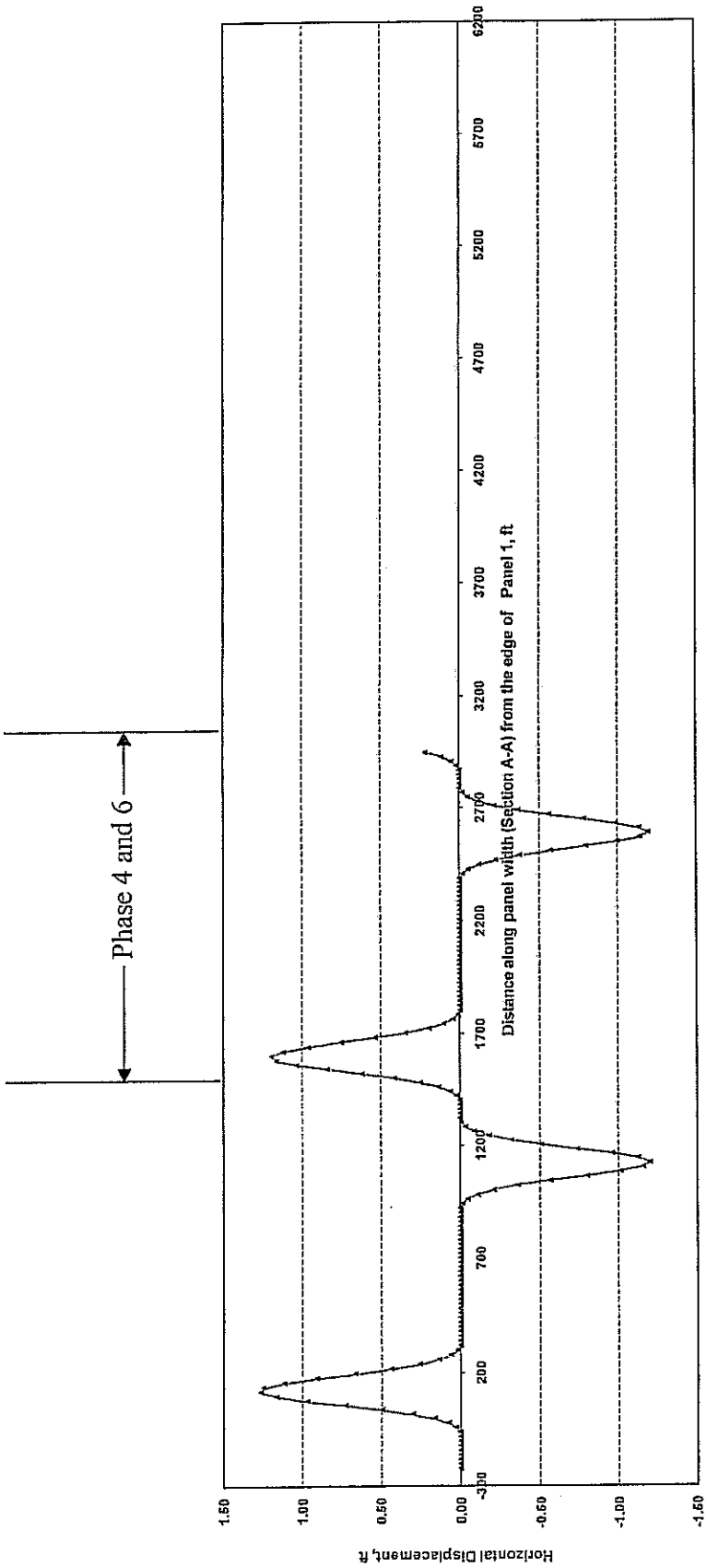


Figure 7 Horizontal displacement profile during phase 4 and 6

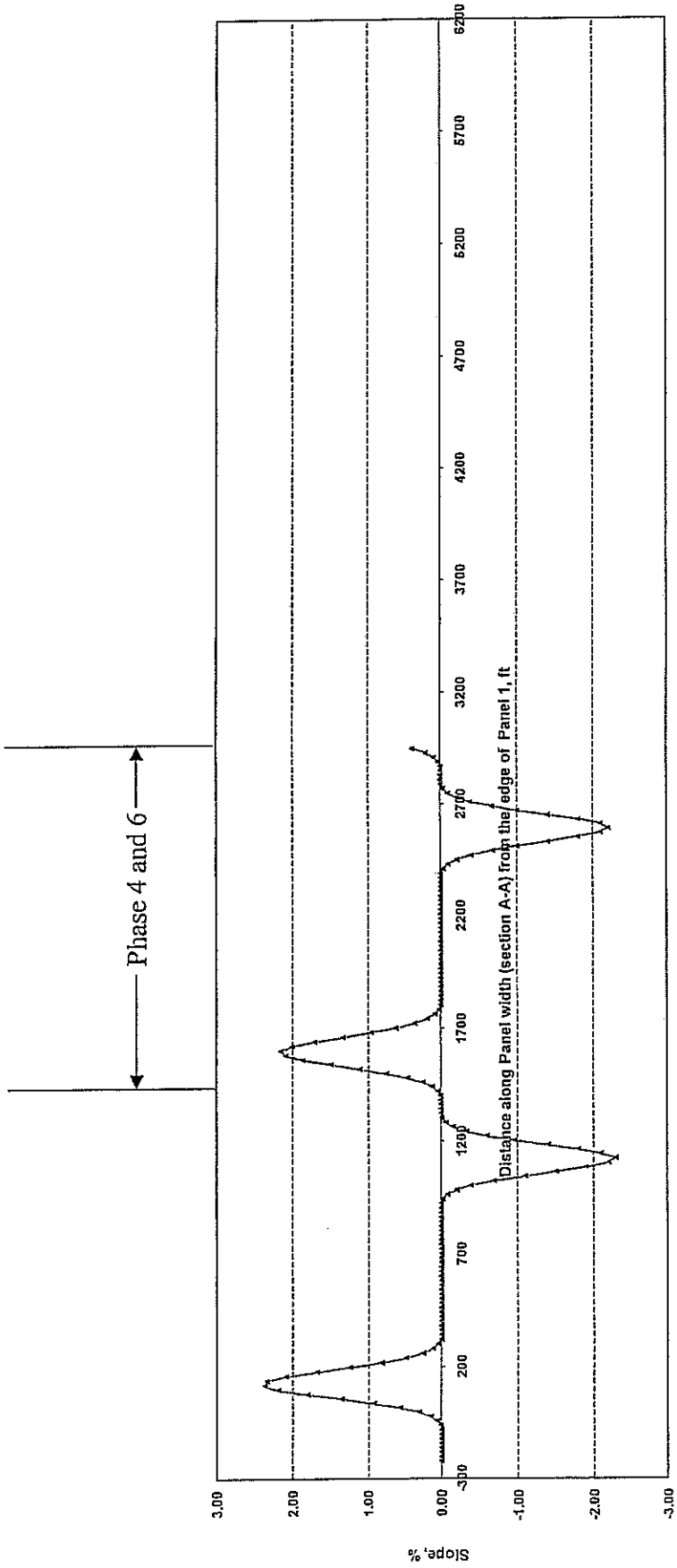


Figure 8 Slope profile during phase 4 and 6

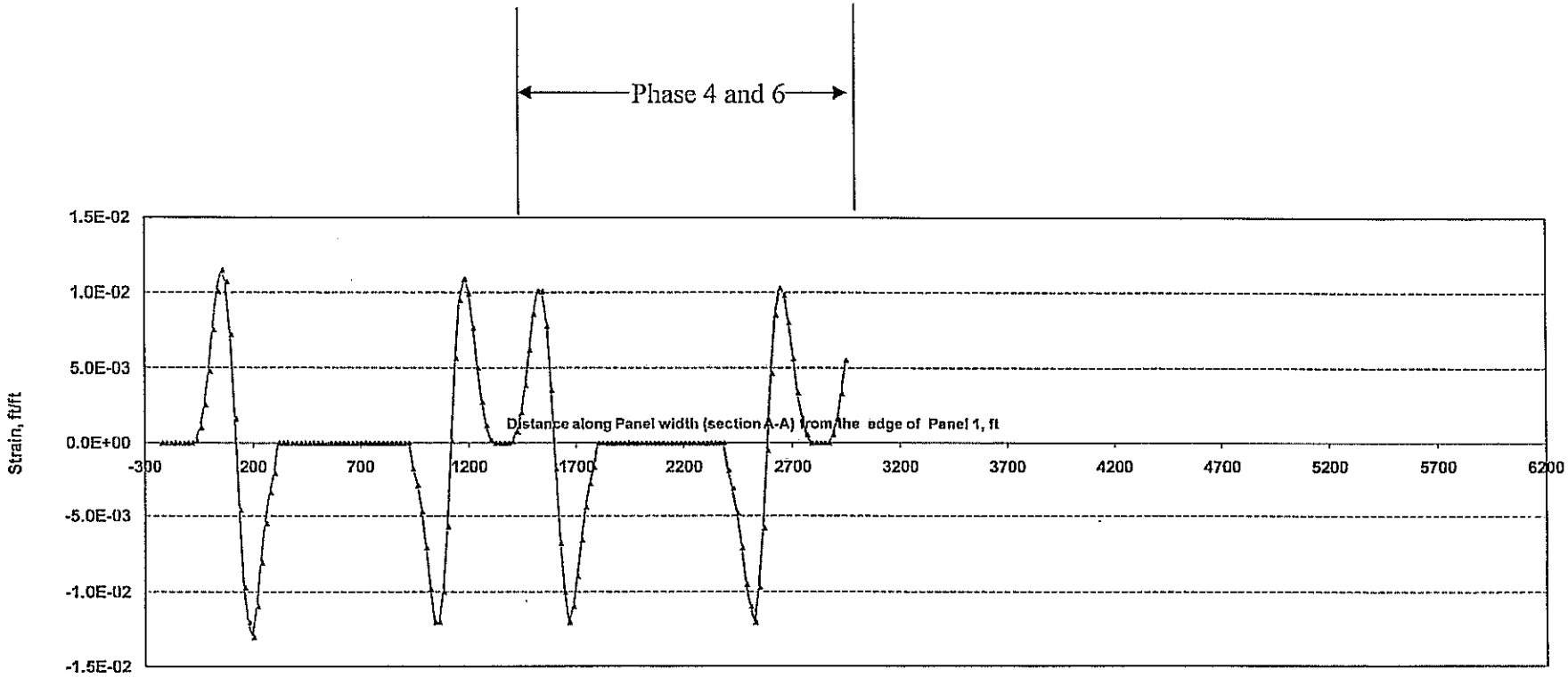


Figure 9 Horizontal strain profile during phase 4 and 6

R16346

4.0 Time Required to Attain Majority of Final Subsidence Parameters

From the past field experience, the final subsidence at any points/cross section takes place after 2 to 3 weeks of longwall face passing. Further the final subsidence also depends upon the face retreat rate.

The dynamic subsidence prediction has been performed for three face retreat rate 60, 80 and 100 ft/day [2] as shown in figure 10.

There is 0.06 inch of subsidence when the longwall face is directly under the point of interest. Thereafter, the subsidence process accelerates and reaches about one half of its final amount when the face is about 200 ft passed the point of interest. During this phase of time, the subsidence process is most active. A deceleration process is followed. The ground surface re-establishes the stable condition in vertical direction when the face has passed the point of interest a distance about 500 ft. Figure 10 also shows that a slower advance rate induces a steeper subsidence development curve. However, the differences between the subsidence development curves are not significant for the range of high face advance rates used in the dynamic subsidence predictions.

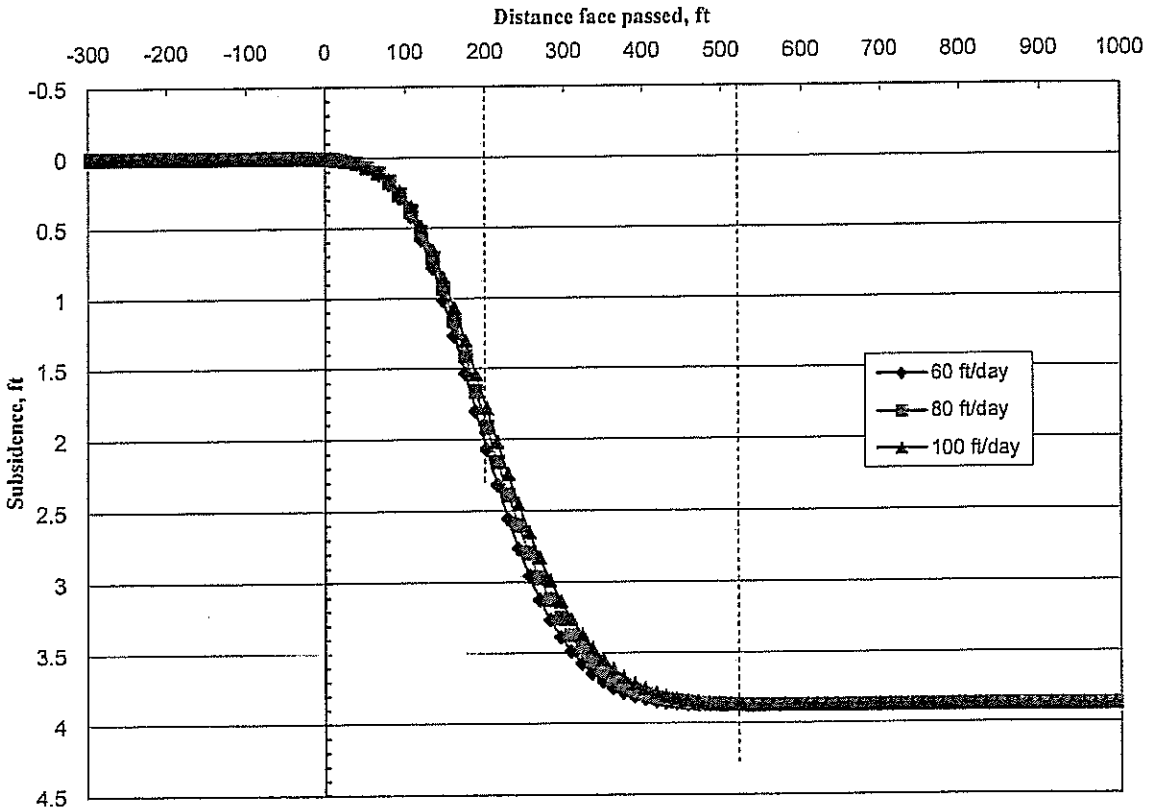


Figure 10 Predicted Dynamic Subsidence Development Curves

Based on dynamic subsidence prediction for a face retreat of 60 ft/day, more than 10 working days will be sufficient to attain the dynamic subsidence almost equal to the final subsidence value. Hence 2 weeks can be on the safer side.

5.0 Reference

1. S.S. Peng and Y Luo, Instruction Manual for CISPM software for Subsidence prediction

2. S.S. Peng, Khaled Morsey, Anil Ray and Thomas Du, "Assessment of Subsidence Influence on Buried Pipelines due to Longwall Mining" Williamson Energy, Johnson City, IL, July 2007

Appendix 1

Final subsidence parameters along cross section A-A after mining all four longwall panels (note -the distance is measured from the right edge of panel1)

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
1	-220	0	0	0	0.00E+00	0.00E+00
2	-200	0	0	0	0.00E+00	0.00E+00
3	-180	0	0	0	0.00E+00	0.00E+00
4	-160	0	0	0	0.00E+00	0.00E+00
5	-140	0	0	0	0.00E+00	0.00E+00
6	-120	0	0	0	0.00E+00	0.00E+00
7	-100	0	0	0	0.00E+00	0.00E+00
8	-80	0	0	0	0.00E+00	0.00E+00
9	-59	0	0	0	0.00E+00	0.00E+00
10	-39	0.00	0.00	0.01	1.22E-04	2.03E-06
11	-19	0.01	0.02	0.04	8.11E-04	1.35E-05
12	1	0.03	0.06	0.10	1.94E-03	3.23E-05
13	21	0.06	0.11	0.21	3.57E-03	5.96E-05
14	41	0.13	0.21	0.39	5.64E-03	9.41E-05
15	61	0.23	0.34	0.63	7.84E-03	1.31E-04
16	81	0.40	0.51	0.95	9.62E-03	1.60E-04
17	101	0.63	0.70	1.30	1.03E-02	1.72E-04
18	121	0.93	0.88	1.65	9.27E-03	1.55E-04
19	141	1.29	1.04	1.94	6.38E-03	1.06E-04
20	161	1.71	1.12	2.10	2.00E-03	3.34E-05
21	181	2.14	1.13	2.11	-3.00E-03	-4.90E-05
22	201	2.55	1.04	1.95	-7.40E-03	-1.20E-04
23	221	2.92	0.89	1.67	-1.00E-02	-1.70E-04
24	241	3.22	0.70	1.32	-1.10E-02	-1.90E-04
25	262	3.46	0.51	0.96	-1.10E-02	-1.80E-04
26	282	3.62	0.34	0.65	-9.10E-03	-1.50E-04
27	302	3.73	0.21	0.40	-6.90E-03	-1.20E-04
28	322	3.79	0.12	0.22	-4.80E-03	-8.10E-05
29	342	3.83	0.06	0.11	-3.20E-03	-5.30E-05
30	362	3.85	0.02	0.04	-2.00E-03	-3.40E-05
31	382	3.86	0.00	0.01	-1.30E-03	-2.20E-05
32	402	3.87	0.00	0.00	0.00E+00	0.00E+00
33	422	3.87	0.00	0.00	0.00E+00	0.00E+00
34	442	3.87	0.00	0.00	0.00E+00	0.00E+00
35	462	3.87	0.00	0.00	0.00E+00	0.00E+00
36	482	3.87	0.00	0.00	0.00E+00	0.00E+00
37	502	3.87	0.00	0.00	0.00E+00	0.00E+00
38	522	3.87	0.00	0.00	0.00E+00	0.00E+00
39	542	3.87	0.00	0.00	0.00E+00	0.00E+00
40	562	3.87	0.00	0.00	0.00E+00	0.00E+00
41	583	3.87	0.00	0.00	0.00E+00	0.00E+00
42	603	3.87	0.00	0.00	0.00E+00	0.00E+00

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
43	623	3.87	0.00	0.00	0.00E+00	0.00E+00
44	643	3.87	0.00	0.00	0.00E+00	0.00E+00
45	663	3.87	0.00	0.00	0.00E+00	0.00E+00
46	683	3.87	0.00	0.00	0.00E+00	0.00E+00
47	703	3.87	0.00	0.00	0.00E+00	0.00E+00
48	723	3.87	0.00	0.00	0.00E+00	0.00E+00
49	743	3.87	0.00	0.00	0.00E+00	0.00E+00
50	763	3.87	0.00	0.00	0.00E+00	0.00E+00
51	783	3.87	0.00	0.00	0.00E+00	0.00E+00
52	803	3.87	0.00	0.00	0.00E+00	0.00E+00
53	823	3.87	0.00	0.00	0.00E+00	0.00E+00
54	843	3.87	0.00	0.00	0.00E+00	0.00E+00
55	863	3.87	0.00	0.00	0.00E+00	0.00E+00
56	883	3.87	0.00	0.00	0.00E+00	0.00E+00
57	904	3.87	0.00	0.00	0.00E+00	0.00E+00
58	924	3.87	0.00	0.00	0.00E+00	0.00E+00
59	944	3.87	0.00	0.00	0.00E+00	0.00E+00
60	964	3.87	0.00	0.00	0.00E+00	0.00E+00
61	984	3.87	0.00	0.00	0.00E+00	0.00E+00
62	1004	3.87	0.00	0.00	0.00E+00	0.00E+00
63	1024	3.87	0.00	0.00	0.00E+00	0.00E+00
64	1044	3.87	0.00	0.00	0.00E+00	0.00E+00
65	1064	3.87	0.00	0.00	0.00E+00	0.00E+00
66	1084	3.86	-0.01	-0.01	-1.50E-03	-2.50E-05
67	1104	3.85	-0.03	-0.06	-2.30E-03	-3.80E-05
68	1124	3.82	-0.07	-0.13	-3.50E-03	-5.80E-05
69	1144	3.78	-0.14	-0.25	-5.20E-03	-8.70E-05
70	1164	3.71	-0.23	-0.44	-7.30E-03	-1.20E-04
71	1184	3.59	-0.37	-0.70	-9.30E-03	-1.50E-04
72	1204	3.42	-0.54	-1.00	-1.10E-02	-1.80E-04
73	1225	3.18	-0.72	-1.40	-1.10E-02	-1.80E-04
74	1245	2.87	-0.89	-1.70	-9.10E-03	-1.50E-04
75	1265	2.50	-1.02	-1.90	-5.80E-03	-9.70E-05
76	1285	2.10	-1.07	-2.00	-1.40E-03	-2.30E-05
77	1305	1.70	-1.04	-2.00	3.24E-03	5.42E-05
78	1325	1.32	-0.94	-1.80	7.01E-03	1.17E-04
79	1345	0.99	-0.78	-1.50	9.20E-03	1.54E-04
80	1365	0.73	-0.60	-1.10	9.61E-03	1.60E-04
81	1385	0.53	-0.42	-0.79	8.58E-03	1.43E-04
82	1405	0.40	-0.28	-0.52	6.70E-03	1.12E-04
83	1425	0.31	-0.16	-0.31	4.61E-03	7.69E-05
84	1445	0.26	-0.09	-0.16	2.76E-03	4.61E-05
85	1465	0.24	-0.04	-0.07	1.37E-03	2.29E-05
86	1485	0.22	-0.01	-0.02	4.50E-04	7.53E-06
87	1505	0.22	0.00	0.00	-6.80E-05	-1.10E-06
88	1525	0.22	0.00	0.00	0.00E+00	0.00E+00

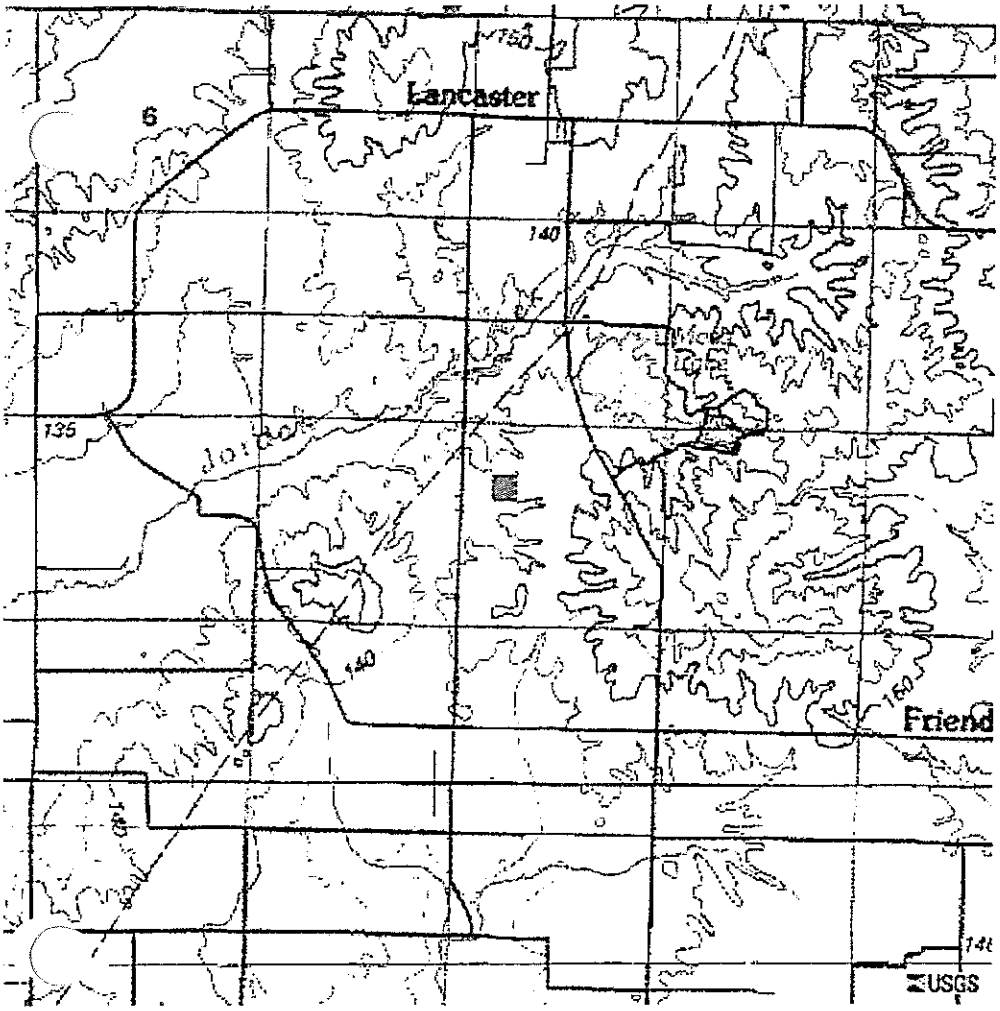
Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
89	1546	0.22	0.00	0.00	0.00E+00	0.00E+00
90	1566	0.22	0.00	0.00	0.00E+00	0.00E+00
91	1586	0.22	0.00	0.00	0.00E+00	0.00E+00
92	1606	0.22	0.00	0.01	4.63E-05	7.23E-07
93	1626	0.22	0.02	0.03	6.37E-04	1.02E-05
94	1646	0.24	0.05	0.09	1.59E-03	2.54E-05
95	1666	0.27	0.10	0.18	2.96E-03	4.75E-05
96	1686	0.32	0.18	0.32	4.72E-03	7.56E-05
97	1706	0.41	0.29	0.52	6.64E-03	1.06E-04
98	1726	0.55	0.44	0.78	8.30E-03	1.33E-04
99	1746	0.74	0.60	1.08	9.18E-03	1.47E-04
100	1766	0.99	0.78	1.40	8.76E-03	1.40E-04
101	1786	1.30	0.93	1.67	6.78E-03	1.09E-04
102	1806	1.66	1.03	1.85	3.39E-03	5.43E-05
103	1826	2.05	1.06	1.92	-8.20E-04	-1.30E-05
104	1846	2.43	1.02	1.84	-5.00E-03	-8.00E-05
105	1867	2.78	0.91	1.64	-8.20E-03	-1.30E-04
106	1887	3.09	0.76	1.36	-1.00E-02	-1.60E-04
107	1907	3.34	0.59	1.05	-1.00E-02	-1.70E-04
108	1927	3.52	0.42	0.75	-9.30E-03	-1.50E-04
109	1947	3.65	0.28	0.50	-7.60E-03	-1.20E-04
110	1967	3.73	0.17	0.30	-5.70E-03	-9.10E-05
111	1987	3.79	0.09	0.17	-4.00E-03	-6.40E-05
112	2007	3.81	0.05	0.08	-2.70E-03	-4.30E-05
113	2027	3.83	0.02	0.03	-1.70E-03	-2.80E-05
114	2047	3.84	0.00	0.00	-1.20E-03	-1.90E-05
115	2067	3.85	0.00	0.00	0.00E+00	0.00E+00
116	2087	3.85	0.00	0.00	0.00E+00	0.00E+00
117	2107	3.85	0.00	0.00	0.00E+00	0.00E+00
118	2127	3.85	0.00	0.00	0.00E+00	0.00E+00
119	2147	3.85	0.00	0.00	0.00E+00	0.00E+00
120	2168	3.85	0.00	0.00	0.00E+00	0.00E+00
121	2188	3.85	0.00	0.00	0.00E+00	0.00E+00
122	2208	3.85	0.00	0.00	0.00E+00	0.00E+00
123	2228	3.85	0.00	0.00	0.00E+00	0.00E+00
124	2248	3.85	0.00	0.00	0.00E+00	0.00E+00
125	2268	3.85	0.00	0.00	0.00E+00	0.00E+00
126	2288	3.85	0.00	0.00	0.00E+00	0.00E+00
127	2308	3.85	0.00	0.00	0.00E+00	0.00E+00
128	2328	3.85	0.00	0.00	0.00E+00	0.00E+00
129	2348	3.85	0.00	0.00	0.00E+00	0.00E+00
130	2368	3.85	0.00	0.00	0.00E+00	0.00E+00
131	2388	3.85	0.00	0.00	0.00E+00	0.00E+00
132	2408	3.85	0.00	0.00	0.00E+00	0.00E+00
133	2428	3.85	0.00	0.00	0.00E+00	0.00E+00
134	2448	3.85	0.00	0.00	0.00E+00	0.00E+00

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
135	2468	3.85	0.00	0.00	0.00E+00	0.00E+00
136	2489	3.85	0.00	0.00	0.00E+00	0.00E+00
137	2509	3.85	0.00	0.00	0.00E+00	0.00E+00
138	2529	3.85	0.00	0.00	0.00E+00	0.00E+00
139	2549	3.85	0.00	0.00	0.00E+00	0.00E+00
140	2569	3.85	0.00	0.00	0.00E+00	0.00E+00
141	2589	3.85	0.00	0.00	0.00E+00	0.00E+00
142	2609	3.85	0.00	0.00	0.00E+00	0.00E+00
143	2629	3.85	0.00	0.00	0.00E+00	0.00E+00
144	2649	3.85	0.00	0.00	0.00E+00	0.00E+00
145	2669	3.85	0.00	0.00	0.00E+00	0.00E+00
146	2689	3.85	0.00	0.00	0.00E+00	0.00E+00
147	2709	3.85	0.00	0.00	6.96E-07	1.11E-08
148	2729	3.83	-0.01	-0.02	-1.60E-03	-2.60E-05
149	2749	3.82	-0.04	-0.07	-2.40E-03	-3.90E-05
150	2769	3.79	-0.08	-0.15	-3.70E-03	-5.90E-05
151	2789	3.75	-0.15	-0.27	-5.40E-03	-8.60E-05
152	2810	3.67	-0.25	-0.46	-7.30E-03	-1.20E-04
153	2830	3.55	-0.39	-0.70	-9.10E-03	-1.50E-04
154	2850	3.38	-0.55	-0.99	-1.00E-02	-1.60E-04
155	2870	3.14	-0.73	-1.30	-1.00E-02	-1.60E-04
156	2890	2.85	-0.89	-1.60	-8.70E-03	-1.40E-04
157	2910	2.50	-1.01	-1.80	-5.60E-03	-9.10E-05
158	2930	2.12	-1.06	-1.90	-1.60E-03	-2.60E-05
159	2950	1.73	-1.04	-1.90	2.68E-03	4.29E-05
160	2970	1.37	-0.95	-1.70	6.27E-03	1.01E-04
161	2990	1.05	-0.80	-1.40	8.52E-03	1.37E-04
162	3010	0.78	-0.63	-1.10	9.21E-03	1.48E-04
163	3030	0.58	-0.46	-0.83	8.52E-03	1.37E-04
164	3050	0.44	-0.31	-0.56	6.95E-03	1.11E-04
165	3070	0.34	-0.19	-0.35	5.04E-03	8.08E-05
166	3090	0.28	-0.11	-0.20	3.23E-03	5.19E-05
167	3110	0.25	-0.06	-0.10	1.79E-03	2.87E-05
168	3131	0.23	-0.02	-0.04	7.66E-04	1.23E-05
169	3151	0.22	-0.01	-0.01	1.22E-04	1.97E-06
170	3171	0.22	0.00	0.00	0.00E+00	0.00E+00
171	3191	0.22	0.00	0.00	0.00E+00	0.00E+00
172	3211	0.22	0.00	0.00	0.00E+00	0.00E+00
173	3231	0.22	0.00	0.00	0.00E+00	0.00E+00
174	3251	0.22	0.00	0.00	-3.50E-05	-5.50E-07
175	3271	0.23	0.02	0.03	4.86E-04	7.71E-06
176	3291	0.24	0.04	0.07	1.34E-03	2.12E-05
177	3311	0.27	0.09	0.15	2.59E-03	4.12E-05
178	3331	0.32	0.16	0.28	4.24E-03	6.73E-05
179	3351	0.39	0.26	0.46	6.11E-03	9.69E-05
180	3371	0.51	0.40	0.70	7.84E-03	1.25E-04

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
181	3391	0.69	0.56	0.99	8.95E-03	1.42E-04
182	3411	0.92	0.73	1.30	8.90E-03	1.41E-04
183	3431	1.22	0.89	1.58	7.38E-03	1.17E-04
184	3452	1.56	1.00	1.79	4.40E-03	6.99E-05
185	3472	1.93	1.06	1.89	4.36E-04	6.91E-06
186	3492	2.32	1.04	1.85	-3.70E-03	-5.90E-05
187	3512	2.68	0.95	1.69	-7.30E-03	-1.20E-04
188	3532	3.00	0.81	1.44	-9.50E-03	-1.50E-04
189	3552	3.26	0.64	1.14	-1.00E-02	-1.60E-04
190	3572	3.46	0.47	0.84	-9.70E-03	-1.50E-04
191	3592	3.61	0.32	0.57	-8.20E-03	-1.30E-04
192	3612	3.70	0.20	0.36	-6.30E-03	-1.00E-04
193	3632	3.76	0.12	0.21	-4.50E-03	-7.20E-05
194	3652	3.80	0.06	0.11	-3.10E-03	-4.90E-05
195	3672	3.82	0.03	0.05	-2.00E-03	-3.20E-05
196	3692	3.83	0.01	0.01	-1.40E-03	-2.10E-05
197	3712	3.84	0.00	0.00	0.00E+00	0.00E+00
198	3732	3.84	0.00	0.00	0.00E+00	0.00E+00
199	3752	3.84	0.00	0.00	0.00E+00	0.00E+00
200	3773	3.84	0.00	0.00	0.00E+00	0.00E+00
201	3793	3.84	0.00	0.00	0.00E+00	0.00E+00
202	3813	3.84	0.00	0.00	0.00E+00	0.00E+00
203	3833	3.84	0.00	0.00	0.00E+00	0.00E+00
204	3853	3.84	0.00	0.00	0.00E+00	0.00E+00
205	3873	3.84	0.00	0.00	0.00E+00	0.00E+00
206	3893	3.84	0.00	0.00	0.00E+00	0.00E+00
207	3913	3.84	0.00	0.00	0.00E+00	0.00E+00
208	3933	3.84	0.00	0.00	0.00E+00	0.00E+00
209	3953	3.84	0.00	0.00	0.00E+00	0.00E+00
210	3973	3.84	0.00	0.00	0.00E+00	0.00E+00
211	3993	3.84	0.00	0.00	0.00E+00	0.00E+00
212	4013	3.84	0.00	0.00	0.00E+00	0.00E+00
213	4033	3.84	0.00	0.00	0.00E+00	0.00E+00
214	4053	3.84	0.00	0.00	0.00E+00	0.00E+00
215	4074	3.84	0.00	0.00	0.00E+00	0.00E+00
216	4094	3.84	0.00	0.00	0.00E+00	0.00E+00
217	4114	3.84	0.00	0.00	0.00E+00	0.00E+00
218	4134	3.84	0.00	0.00	0.00E+00	0.00E+00
219	4154	3.84	0.00	0.00	0.00E+00	0.00E+00
220	4174	3.84	0.00	0.00	0.00E+00	0.00E+00
221	4194	3.84	0.00	0.00	0.00E+00	0.00E+00
222	4214	3.84	0.00	0.00	0.00E+00	0.00E+00
223	4234	3.84	0.00	0.00	0.00E+00	0.00E+00
224	4254	3.84	0.00	0.00	0.00E+00	0.00E+00
225	4274	3.84	0.00	0.00	0.00E+00	0.00E+00
226	4294	3.84	0.00	0.00	0.00E+00	0.00E+00

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
227	4314	3.84	0.00	0.00	0.00E+00	0.00E+00
228	4334	3.84	0.00	0.00	0.00E+00	0.00E+00
229	4354	3.84	0.00	0.00	0.00E+00	0.00E+00
230	4374	3.82	-0.01	-0.02	-1.50E-03	-2.50E-05
231	4395	3.81	-0.04	-0.06	-2.30E-03	-3.70E-05
232	4415	3.79	-0.08	-0.14	-3.50E-03	-5.60E-05
233	4435	3.75	-0.14	-0.25	-5.10E-03	-8.10E-05
234	4455	3.68	-0.24	-0.42	-6.90E-03	-1.10E-04
235	4475	3.56	-0.37	-0.66	-8.70E-03	-1.40E-04
236	4495	3.40	-0.53	-0.94	-1.00E-02	-1.60E-04
237	4515	3.18	-0.70	-1.20	-1.00E-02	-1.60E-04
238	4535	2.90	-0.86	-1.50	-8.90E-03	-1.40E-04
239	4555	2.56	-0.99	-1.80	-6.20E-03	-9.90E-05
240	4575	2.19	-1.06	-1.90	-2.40E-03	-3.80E-05
241	4595	1.81	-1.05	-1.90	1.79E-03	2.83E-05
242	4615	1.44	-0.97	-1.70	5.50E-03	8.71E-05
243	4635	1.11	-0.84	-1.50	8.03E-03	1.27E-04
244	4655	0.84	-0.67	-1.20	9.06E-03	1.44E-04
245	4675	0.62	-0.50	-0.90	8.69E-03	1.38E-04
246	4695	0.47	-0.35	-0.62	7.33E-03	1.16E-04
247	4716	0.36	-0.22	-0.40	5.51E-03	8.73E-05
248	4736	0.30	-0.13	-0.23	3.68E-03	5.83E-05
249	4756	0.26	-0.07	-0.12	2.15E-03	3.41E-05
250	4776	0.23	-0.03	-0.06	1.03E-03	1.63E-05
251	4796	0.22	-0.01	-0.02	2.92E-04	4.61E-06
252	4816	0.22	0.00	0.00	0.00E+00	0.00E+00
253	4836	0.22	0.00	0.00	0.00E+00	0.00E+00
254	4856	0.22	0.00	0.00	0.00E+00	0.00E+00
255	4876	0.22	0.00	0.00	0.00E+00	0.00E+00
256	4896	0.22	0.00	0.00	0.00E+00	0.00E+00
257	4916	0.22	0.01	0.01	1.39E-04	2.40E-06
258	4936	0.23	0.03	0.05	9.02E-04	1.53E-05
259	4956	0.25	0.06	0.12	2.14E-03	3.62E-05
260	4976	0.29	0.13	0.24	3.89E-03	6.60E-05
261	4996	0.36	0.23	0.43	6.05E-03	1.03E-04
262	5016	0.48	0.37	0.70	8.24E-03	1.40E-04
263	5037	0.66	0.54	1.03	9.83E-03	1.67E-04
264	5057	0.91	0.73	1.40	1.01E-02	1.71E-04
265	5077	1.23	0.91	1.74	8.52E-03	1.44E-04
266	5097	1.61	1.05	2.00	5.08E-03	8.61E-05
267	5117	2.03	1.11	2.11	3.49E-04	5.96E-06
268	5137	2.45	1.08	2.06	-4.60E-03	-7.80E-05
269	5157	2.85	0.97	1.86	-8.70E-03	-1.50E-04
270	5177	3.20	0.81	1.54	-1.10E-02	-1.90E-04
271	5197	3.48	0.62	1.17	-1.10E-02	-1.90E-04
272	5217	3.68	0.43	0.82	-1.00E-02	-1.70E-04

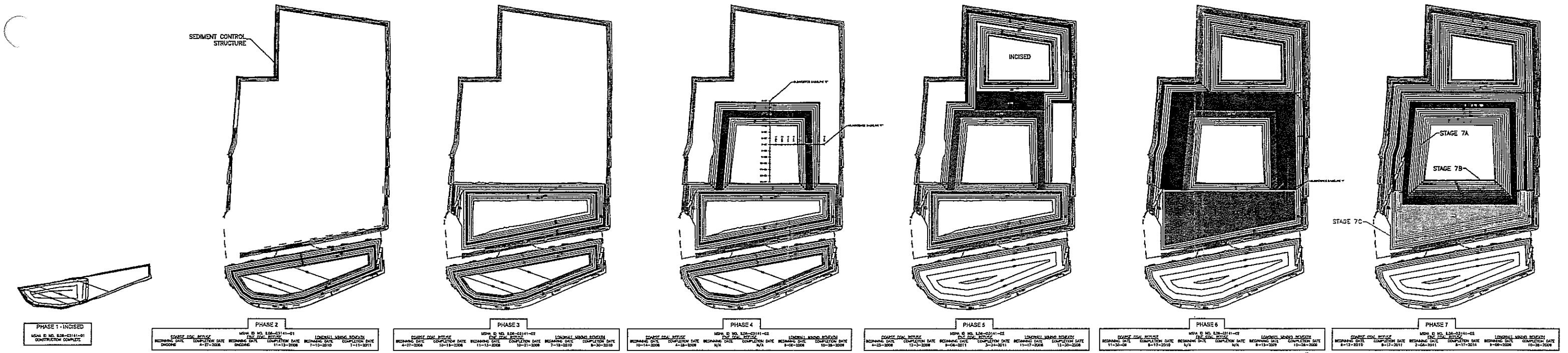
Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
273	5237	3.82	0.28	0.53	-8.20E-03	-1.40E-04
274	5257	3.91	0.16	0.31	-6.00E-03	-1.00E-04
275	5277	3.96	0.09	0.16	-4.10E-03	-6.90E-05
276	5297	3.98	0.04	0.07	-2.60E-03	-4.40E-05
277	5317	4.00	0.01	0.02	-1.70E-03	-2.90E-05
278	5337	4.01	0.00	0.00	4.20E-06	6.89E-08
279	5358	4.01	0.00	0.00	0.00E+00	0.00E+00
280	5378	4.01	0.00	0.00	0.00E+00	0.00E+00
281	5398	4.01	0.00	0.00	0.00E+00	0.00E+00
282	5418	4.01	0.00	0.00	0.00E+00	0.00E+00
283	5438	4.01	0.00	0.00	0.00E+00	0.00E+00
284	5458	4.01	0.00	0.00	0.00E+00	0.00E+00
285	5478	4.01	0.00	0.00	0.00E+00	0.00E+00
286	5498	4.01	0.00	0.00	0.00E+00	0.00E+00
287	5518	4.01	0.00	0.00	0.00E+00	0.00E+00
288	5538	4.01	0.00	0.00	0.00E+00	0.00E+00
289	5558	4.01	0.00	0.00	0.00E+00	0.00E+00
290	5578	4.01	0.00	0.00	0.00E+00	0.00E+00
291	5598	4.01	0.00	0.00	0.00E+00	0.00E+00
292	5618	4.01	0.00	0.00	0.00E+00	0.00E+00
293	5638	4.01	0.00	0.00	0.00E+00	0.00E+00
294	5658	4.01	0.00	0.00	0.00E+00	0.00E+00
295	5679	4.01	0.00	0.00	0.00E+00	0.00E+00
296	5699	4.01	0.00	0.00	0.00E+00	0.00E+00
297	5719	4.01	0.00	0.00	0.00E+00	0.00E+00
298	5739	4.01	0.00	0.00	0.00E+00	0.00E+00
299	5759	4.01	0.00	0.00	0.00E+00	0.00E+00
300	5779	4.01	0.00	0.00	0.00E+00	0.00E+00
301	5799	4.01	0.00	0.00	0.00E+00	0.00E+00
302	5819	4.01	0.00	0.00	0.00E+00	0.00E+00
303	5839	4.01	0.00	0.00	0.00E+00	0.00E+00
304	5859	4.01	0.00	0.00	0.00E+00	0.00E+00
305	5879	4.01	0.00	0.00	0.00E+00	0.00E+00
306	5899	4.01	0.00	0.00	0.00E+00	0.00E+00
307	5919	4.01	0.00	0.00	0.00E+00	0.00E+00
308	5939	4.01	0.00	0.00	0.00E+00	0.00E+00
309	5959	4.01	0.00	0.00	0.00E+00	0.00E+00
310	5979	4.01	0.00	0.00	0.00E+00	0.00E+00
311	6000	4.01	0.00	0.00	0.00E+00	0.00E+00
312	6020	4.01	0.00	0.00	0.00E+00	0.00E+00
313	6040	4.01	0.00	0.00	0.00E+00	0.00E+00
314	6060	4.01	0.00	0.00	0.00E+00	0.00E+00
315	6080	4.01	0.00	0.00	0.00E+00	0.00E+00
316	6100	4.01	0.00	0.00	0.00E+00	0.00E+00
317	6120	4.01	0.00	0.00	0.00E+00	0.00E+00
318	6140	4.01	0.00	0.00	0.00E+00	0.00E+00

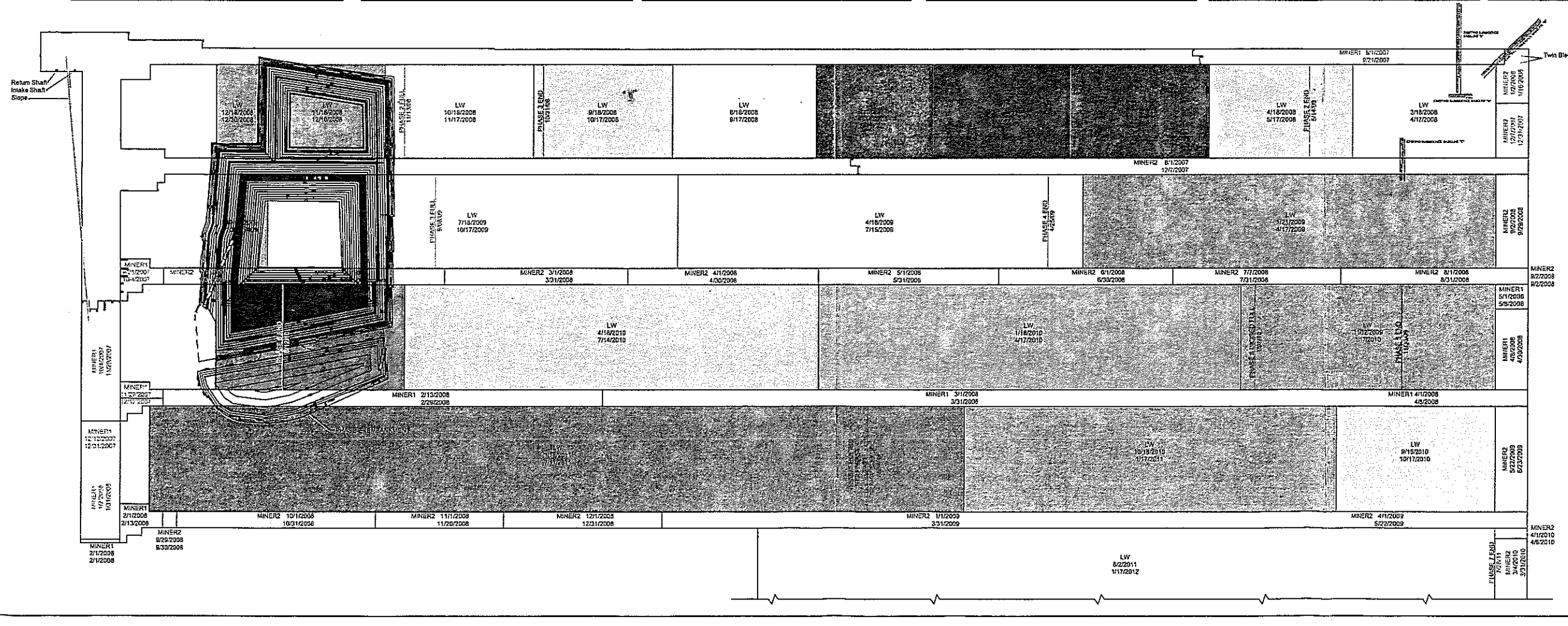


USGS Topographic Map, Resolution: 16.0 meters/pixel

1 km

R16357





REV.	DATE	DESCRIPTION	P.E.

RECEIVED BY

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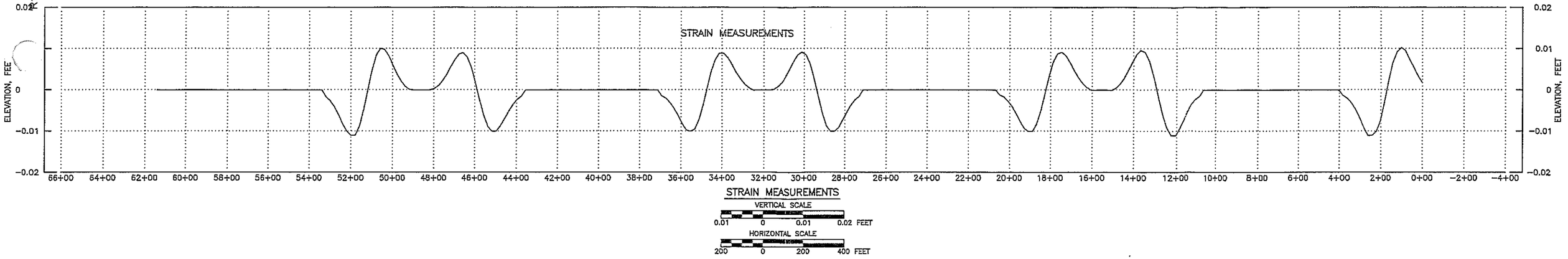
Engineers • Constructors • Scientists
CANONSBURG, PA

MSHA I.D. NO. 826-03141-02
MINING / IMPOUNDMENT CONSTRUCTION TIMING MAP
MACH #1 MINE
WILLIAMSON COUNTY, ILLINOIS
Prepared For:
WILLIAMSON ENERGY, LLC.
P.O. BOX 99, JOHNSTON CITY, ILLINOIS 62951

CAD BY	AS, 03/14/08	PROJECT NO.	805-330-M38
CHECKED BY		DRAWING NO.	805-330-M38
APPROVED BY			

216358



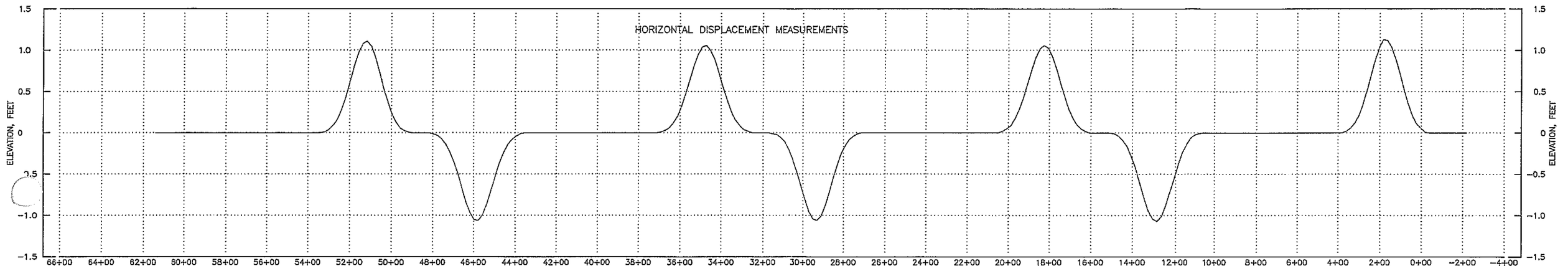
STRAIN MEASUREMENTS

VERTICAL SCALE

0.01 0 0.01 0.02 FEET

HORIZONTAL SCALE

200 0 200 400 FEET



HORIZONTAL DISPLACEMENT MEASUREMENTS

VERTICAL SCALE

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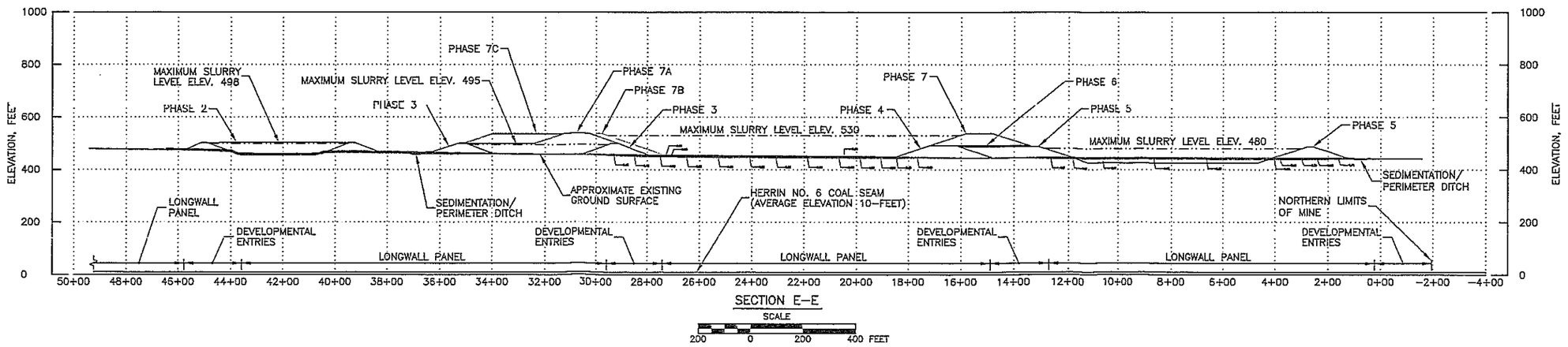
HORIZONTAL SCALE

200 0 200 400 FEET



SECTION E–E

SCALE

200 0 200 400 FEET

REV.	DATE	DESCRIPTION	P.M.

ECKLEY, WV (81) 253-0481

Alliance Consulting, Inc.

Engineers • Constructors • Scientists

RALEIGH, NC (919) 861-2257

ILLINOIS DEPARTMENT OF NATURAL RESOURCES PERMIT NO. 375

PHASE II IMPOUNDMENT

STRAIN/HORIZONTAL/VERTICAL DISPLACEMENT

POND CREEK MINE NO. 1

PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2

WILLIAMSON COUNTY, ILLINOIS

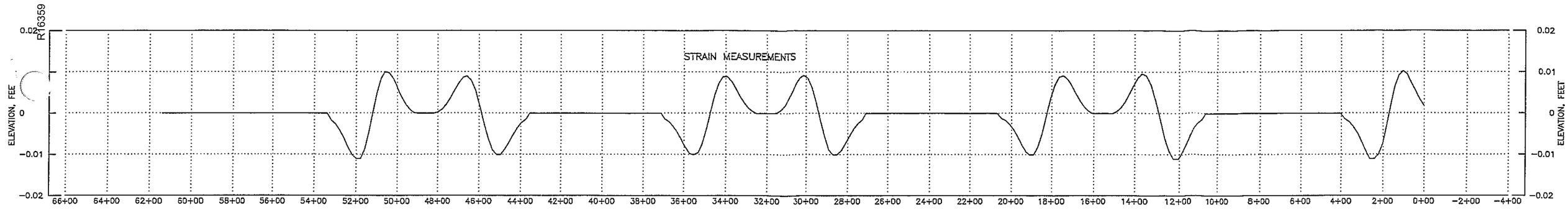
Prepared For

WILLIAMSON ENERGY, LLC.

BOX 99, JOHNSTON CITY, ILLINOIS 62951

D BY	DSM 04/15/08	PROJECT NO. B05-330-1413
ECKED BY		
PROVED BY		DRAWING NO. B05-330-E38

R16359



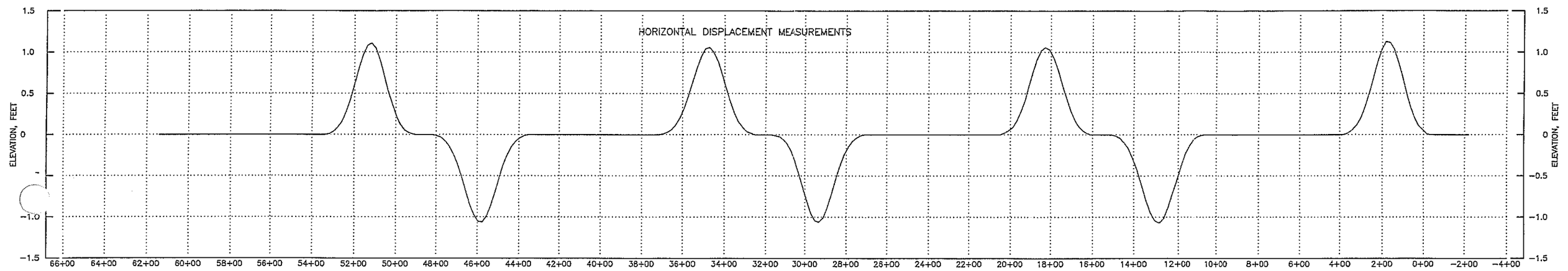
STRAIN MEASUREMENTS

VERTICAL SCALE

0.01 0 0.01 0.02 FEET

HORIZONTAL SCALE

200 0 200 400 FEET



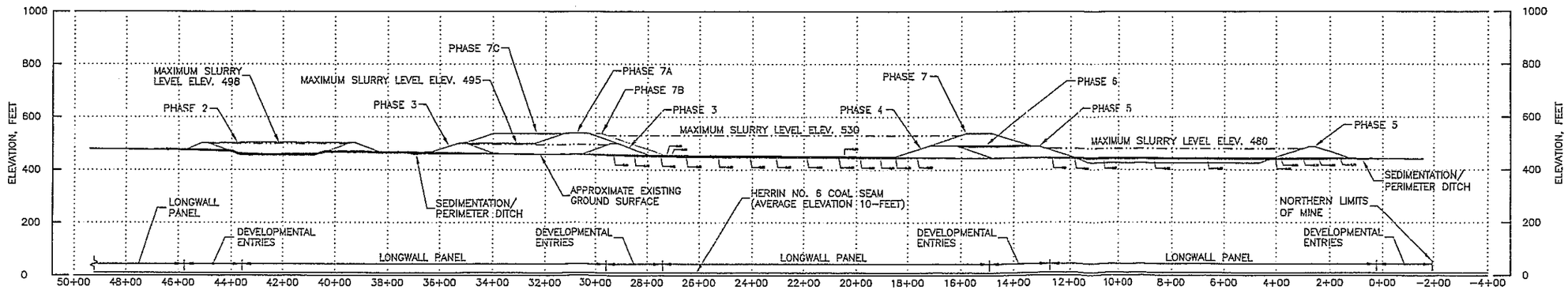
HORIZONTAL DISPLACEMENT MEASUREMENTS

VERTICAL SCALE

0.5 0 0.5 1 FEET

HORIZONTAL SCALE

200 0 200 400 FEET



SECTION E−E

SCALE

200 0 200 400 FEET

V.	DATE	DESCRIPTION	P.M.

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RALEIGH, NC (919) 851-2257

INOIS DEPARTMENT OF NATURAL RESOURCES PERMIT NO. 375

PHASE II IMPOUNDMENT

TRAIN/HORIZONTAL/VERTICAL DISPLACEMENT

POND CREEK MINE NO. 1

PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2

WILLIAMSON COUNTY, ILLINOIS

Prepared For

WILLIAMSON ENERGY, LLC.

OX 99, JOHNSTON CITY, ILLINOIS 62951

BY	DSM 04/15/08	PROJECT NO. B05-330-1413
CKED BY		
ROVED BY		DRAWING NO. B05-330-E38

R16360

8114-10
Part 18

APPENDIX B

SUMMARY OF LABORATORY TESTING RESULTS AND SUPPLEMENTAL CHARACTERIZATION OF THE SUBSURFACE MATERIALS PREPARED BY GAI, CHARACTERIZATION OF THE SUBSURFACE MATERIALS PREPARED BY CEC SUMMARY OF PIEZO-SEISMIC CONE PENETRATION TESTING PREPARED BY CEC

gai consultants
transforming ideas into reality

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Summary of Laboratory Testing

BY BEG DATE 2009-MAR-30 PROJ. NO. C090403.01.001

CHKD. BY _____ DATE _____ SHEET NO. 2 OF 2

gai consultants

Engineers • Geologists • Planners
Environmental Specialists

b. Shear strength tests on remolded slurried fine refuse samples:
   - (6) Consolidated-Undrained Triaxial points including (6) additional moisture contents and (6) total and dry density..

FEBRUARY 2006 – APRIL 2007: Holcolm Foundation Engineering Company, Inc.

Holcolm Foundation Engineering Company, Inc. (Holcolm) was retained in 2006 and 2007 (Reference Nos. 2, 3 and 4) by Williamson Energy, LLC. (Williamson) to perform laboratory testing on an undisturbed (Shelby tube) sample of residual soil and two (2) remolded bulk samples of coarse coal refuse materials collected from the Pond Creek site. The laboratory testing was performed between February 2006 and April 2007 at Holcolm. The purpose of the testing program was to determine index, strength, density and permeability parameters, and summarize the results for the residual and coarse refuse materials.

The laboratory testing program performed by Holcolm included:

a. Index tests on undisturbed residual soil sample:
   - (1) Moisture content;
   - (1) Grain-size distributions;
   - (1) Atterberg limits;
   - (1) Total and dry density;

b. Shear strength test on undisturbed residual soil sample:
   - (3) Consolidated Undrained Triaxial points;

c. Index tests on remolded coarse refuse samples:
   - (2) Moisture content;
   - (2) Grain-size distributions;
   - (2) Standard proctor maximum dry density and optimum moisture content;

d. Shear strength test on remolded coarse refuse samples:
   - (6) Consolidated Undrained Triaxial points; and

e. Permeability tests on remolded coarse refuse samples:
   - (3) Falling head permeability tests.

SUMMARY OF LABORATORY TESTING RESULTS:

The attached table presents a results summary of the various laboratory tests, and copies of the laboratory testing data performed by Geotechnics and Holcolm are attached.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Summary of Laboratory Testing

BY BEG DATE 2009-MAR-30 PROJ. NO. C090403.01.001

CHKD. BY [illegible] DATE 5/1/09 SHEET NO. 1 OF 2

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Environmental Specialists

CALCULATION BRIEF
FOR
SUMMARY OF LABORATORY TESTING

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE: Summarize the laboratory testing program and results obtained for coarse coal refuse, fine coal refuse and residual soil materials sampled at the Pond Creek Coal Refuse Disposal Facility. A laboratory testing summary table is attached, as well as laboratory testing results.

REFERENCES:

1. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Laboratory Testing," Pond Creek Coal Refuse Disposal Site – South Pond, BEG, dated 7/8/08.

2. Holcolm Foundation Engineering Company, Inc., "Soil Boring and Laboratory Tests Boring #8874," Mach Mine No. 1, dated February 10, 2006.

3. Holcolm Foundation Engineering Company, Inc., "Coarse Refuse Laboratory Tests," Pond Creek Mine, dated November 30, 2006.

4. Holcolm Foundation Engineering Company, Inc., "Coarse Refuse Laboratory Tests," Mach Mine, dated April 9, 2007.

LABORATORY TESTING PROGRAMS:

MAY – JUNE 2008: Civil & Environmental Consultants, Inc.

Civil & Environmental Consultants, Inc. (CEC) retained Geotechnics, Inc. (Geotechnics) of East Pittsburgh, Pennsylvania in May 2008 to perform laboratory testing on bulk samples of fine coal refuse materials collected from the South Pond (Phase 2) impoundment at the Pond Creek Coal Refuse Disposal Facility in Williamson County, Illinois (Reference No. 1). The laboratory testing was performed between May 2008 and June 2008 at Geotechnics. The purpose of the testing program was to determine index and strength parameters, and summarize the results for the fine coal refuse materials.

The laboratory testing program performed by Geotechnics included:

a. Index tests on bulk/slurried fine refuse samples:
   - (2) Moisture content;
   - (2) Grain-size distributions;
   - (2) Hydrometers;
   - (2) Atterberg limits; and
   - (2) Specific gravity.

BOREHOLE STATISTICS						SHEAR STRENGTH					
						Steady-State		Effective Strength		Total Strength	
Sample Type	Sample No.	Depth (ft)	Material	Wat. Con. (w) (%)	Tot	ε_{us} (%)	q_s (ksf)	ϕ (Deg)	c (ksf)	ϕ (Deg)	c (ksf)
Bucket	1	Remold	FCR	82.60	7	21.51	0.485				
Test No.	1		See Note 1								
Bucket	1	Remold	FCR	82.70	8	21.67	0.817	36.14	0.000	17.30	0.216
Test No.	2		See Note 1								
Bucket	1	Remold	FCR	79.50	8	21.74	1.149				
Test No.	3		See Note 1								
Bucket	1	Bulk	FCR	85.80							
			See Note 1								
Bucket	2	Remold	FCR	82.90	8	17.29	0.354				
Test No.	1		See Note 1								
Bucket	2	Remold	FCR	85.70	8	21.32	0.616	37.71	0.000	20.30	0.013
Test No.	2		See Note 1								
Bucket	2	Remold	FCR	83.00	8	21.49	1.245				
Test No.	3		See Note 1								
Bucket	2	Bulk	FCR	94.40							
Boring 8874	2	8-10	Residual	21.50	12						
Undisturbed	3	10-12	See Note 2					26.80	0.000	19.50	0.416
						k (cm/sec)					
11/30/06		Remold	CCR	9.30		2x10-4		33.70	0.000	18.50	1.014
Bulk			See Note 3								
04/09/07		Remold	CCR	10.70		2x10-4		29.30	0.152	17.40	0.458
Bulk			See Note 3			3x10-4					

Notes:

1. Fine coal refuse (FCR) testing performed by Civil & Environmei
2. Residual soil testing performed by Holcolm Foundation Enginee
3. Coarse Coal Refuse (CCR) testing perfomed by Holcolm Found

ATTACHMENT 1

LABORATORY TESTING RESULTS – FINE COAL REFUSE
GEOTECHNICS, INC.

Geotechnics
.....GEOTECHNICAL AND
GEOSYNTHETIC SERVICES

June 5, 2008

Project No. 2008-210-01

Mr. Blaise Genes
Civil & Environmental Consultants
4 Triangle Dr, Suite 200
Export, PA 15632-9255

Transmittal
Laboratory Test Results
Pond Creek

Please find attached the laboratory test results for the above referenced project. The tests were outlined on the Project Verification Form that was faxed to your firm prior to the testing. The testing was performed in general accordance with the methods listed on the enclosed data sheets. The test results are believed to be representative of the samples that were submitted for testing and are indicative only of the specimens which were evaluated. We have no direct knowledge of the origin of the samples and imply no position with regard to the nature of the test results, i.e. pass/fail and no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization by our Client. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please contact our office.

Respectively submitted,
Geotechnics, Inc.

David R. Backstrom
Laboratory Director

We understand that you have a choice in your laboratory services and we thank you for choosing Geotechnics.

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geotechnics
INTEGRITY IN TESTING

MOISTURE CONTENT

ASTM D 2216 (SOP-S1)

Client	CEC
Client Reference	POND CREEK 080851
Project No.	2008-210-01

Lab ID	01	02
Boring No.	SOUTH POND	SOUTH POND
Depth (ft)	NA	NA
Sample No.	BUCKET 1	BUCKET 2
Tare Number	877	729
Wt. of Tare & WS (gm)	621.7	578.3
Wt. of Tare & DS (gm)	385.56	339.54
Wt. of Tare (gm)	110.33	86.52
Wt. of Water (gm)	236.14	238.76
Wt. of DS (gm)	275.23	253.02
Water Content (%)	**85.8**	**94.4**

Notes : *NA*

Tested By PC *Date* 5/13/08 *Checked By* KB *Date* 5-14-08

DCN: CT-S1 DATE 6-30-98 REVISION: 2

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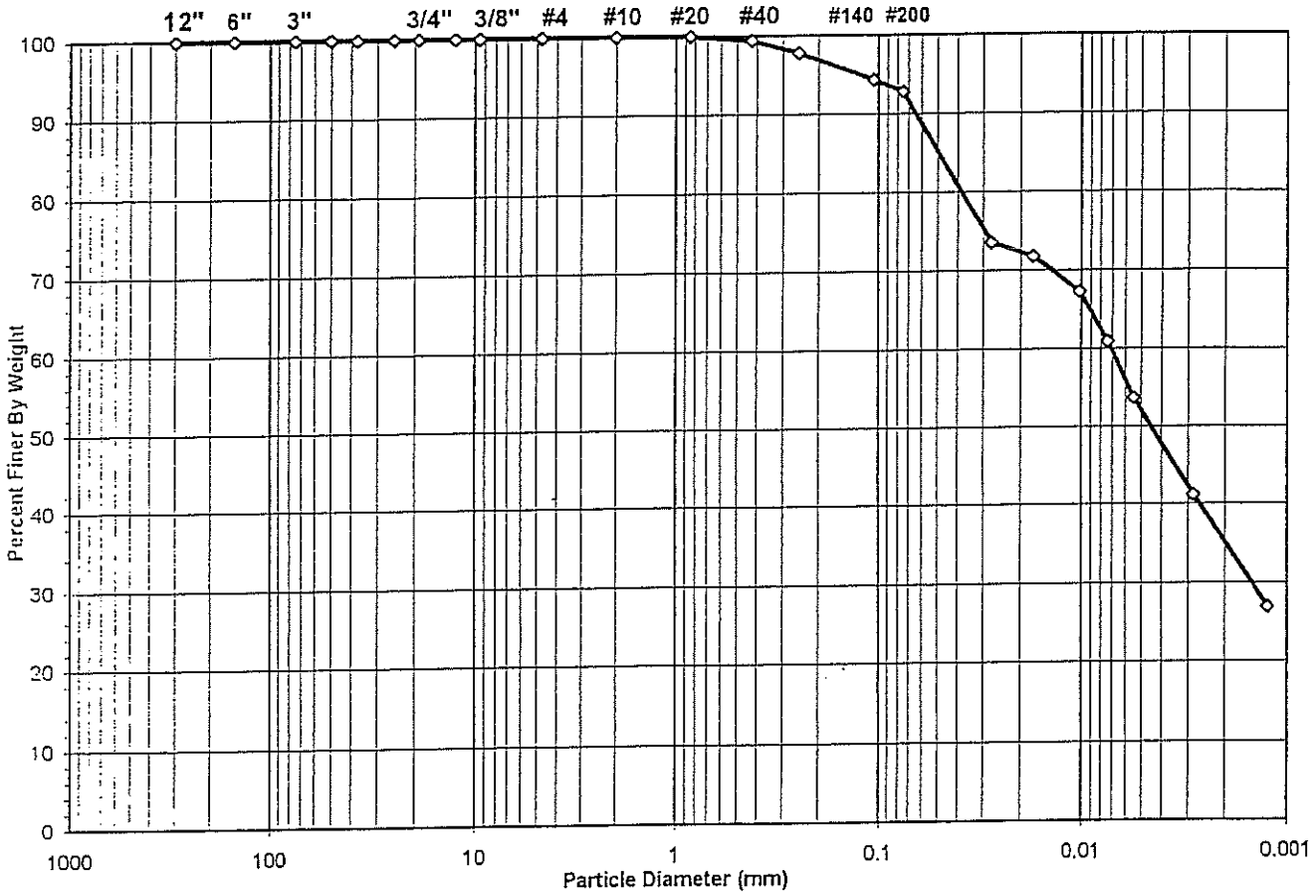
INTEGRITY IN TESTING

SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Color	BLACK

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	7.17
Finer Than #200	*Silt & Clay*	92.83

USCS Symbol	*CL, TESTED*
USCS Classification	*LEAN CLAY*

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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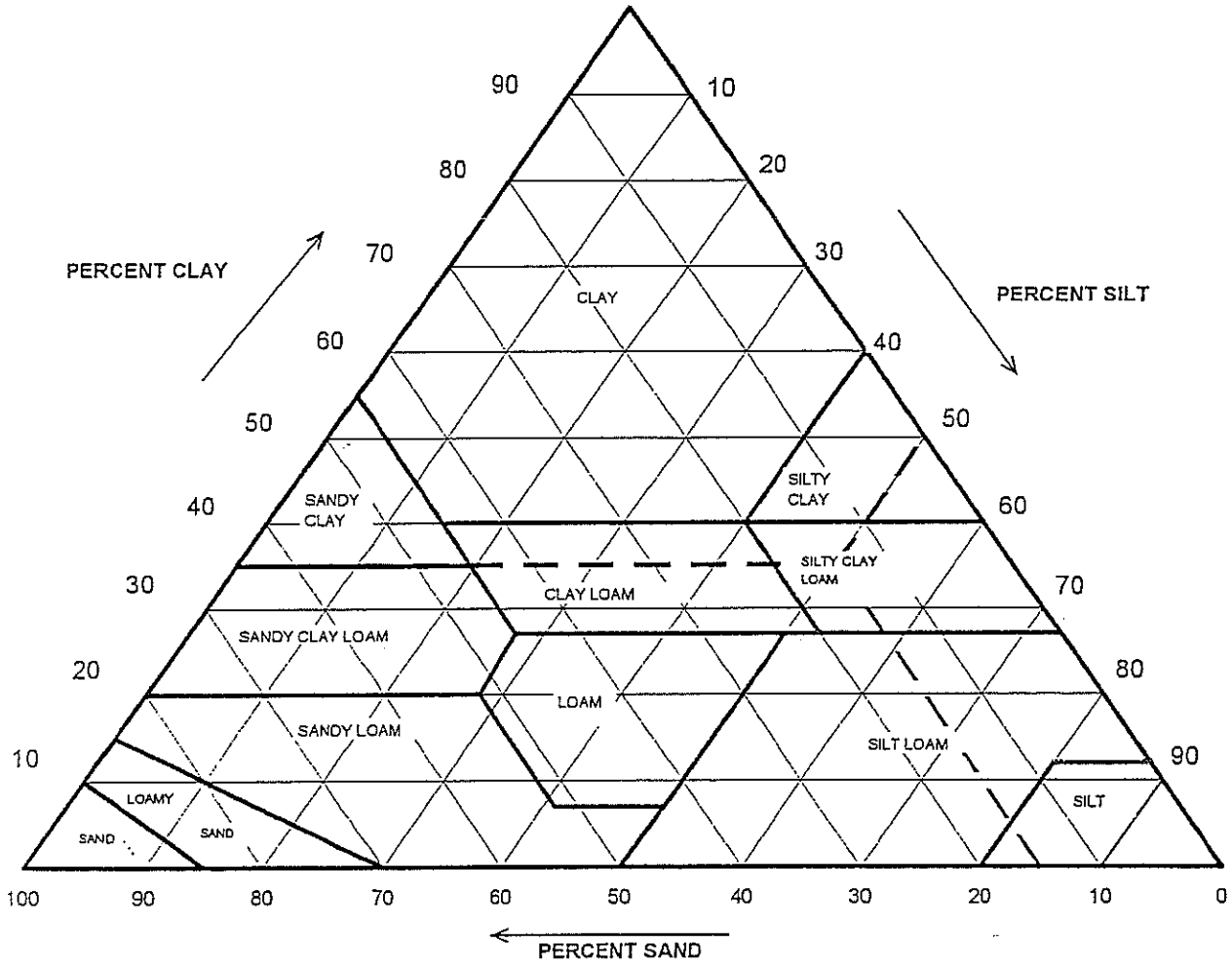
Geotechnics
INTEGRITY IN TESTING

USDA CLASSIFICATION CHART

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Color	BLACK



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.00	**0.00**
2	100.00	*Sand*	14.88	**14.88**
0.05	85.12	*Silt*	50.02	**50.02**
0.002	35.10	*Clay*	35.10	**35.10**

USDA Classification: *SILTY CLAY LOAM*

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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INTEGRITY IN TESTING

WASH SIEVE ANALYSIS

ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Color	BLACK

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	703	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	1020.20	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	609.00	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	100.40	Weight of Tare (gm)	NA
Weight of Water (gm)	411.20	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	508.60	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**80.8**	**Moisture Content (%)**	NA

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	508.60
Dry Weight - 3/4" Sample (gm)	36.47	Weight of minus #200 material (gm)	472.13
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	36.47
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	100.00
6"	150	0.00	0.00	0.00	100.00	100.00
3"	75	0.00	0.00	0.00	100.00	100.00
2"	50	0.00	0.00	0.00	100.00	100.00
1 1/2"	37.5	0.00	0.00	0.00	100.00	100.00
1"	25.0	0.00	0.00	0.00	100.00	100.00
3/4"	19.0	0.00	0.00	0.00	100.00	100.00
1/2"	12.5	0.00	0.00	0.00	100.00	100.00
3/8"	9.50	0.00	0.00	0.00	100.00	100.00
#4	4.75	0.00	0.00	0.00	100.00	100.00
#10	2.00	0.00	0.00	0.00	100.00	100.00
#20	0.85	0.12	0.02	0.02	99.98	99.98
#40	0.425	2.90	0.57	0.59	99.41	99.41
#60	0.250	7.89	1.55	2.15	97.85	97.85
#140	0.106	17.74	3.49	5.63	94.37	94.37
#200	0.075	7.82	1.54	7.17	92.83	92.83
Pan	-	472.13	92.83	100.00	-	-

Tested By JP Date 5/21/08 Checked By KR Date 5-23-08

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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INTEGRITY IN TESTING

HYDROMETER ANALYSIS

ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Color	BLACK

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	47.0	21.9	6.02	41.0	79.2	0.01314	0.0272	**73.6**
5	46.0	21.9	6.02	40.0	77.3	0.01314	0.0174	**71.8**
15	43.5	21.9	6.02	37.5	72.5	0.01314	0.0103	**67.3**
31	40.0	21.9	6.02	34.0	65.7	0.01314	0.0074	**61.0**
60	36.0	21.8	6.07	29.9	57.9	0.01316	0.0055	**53.7**
250	29.0	21.7	6.11	22.9	44.3	0.01317	0.0028	**41.1**
1440	21.0	21.9	6.02	15.0	29.0	0.01314	0.0012	**26.9**

Soil Specimen Data		Other Corrections	
Tare No.	2487		
Tare + Dry Material (gm)	151.2	a - Factor	0.99
Weight of Tare (gm)	95.01		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 200	92.83
Weight of Dry Material (gm)	51.19		
		Specific Gravity	2.7 Assumed

Note: Hydrometer test is performed on - # 200 sieve material.

Tested By TO Date 5/21/08 Checked By KB Date 5-23-08

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Soil Description	**BLACK LEAN CLAY**

Note: *The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.*

(Minus No. 40 sieve material, Airdried)

Liquid Limit Test	1	2	3
Tare Number	110	37	40
Wt. of Tare & WS (gm)	36.10	35.31	37.89
Wt. of Tare & DS (gm)	30.53	29.82	31.72
Wt. of Tare (gm)	14.96	14.83	15.54
Wt. of Water (gm)	5.6	5.5	6.2
Wt. of DS (gm)	15.6	15.0	16.2
Moisture Content (%)	**35.8**	**36.6**	**38.1**
Number of Blows	**28**	**23**	**15**

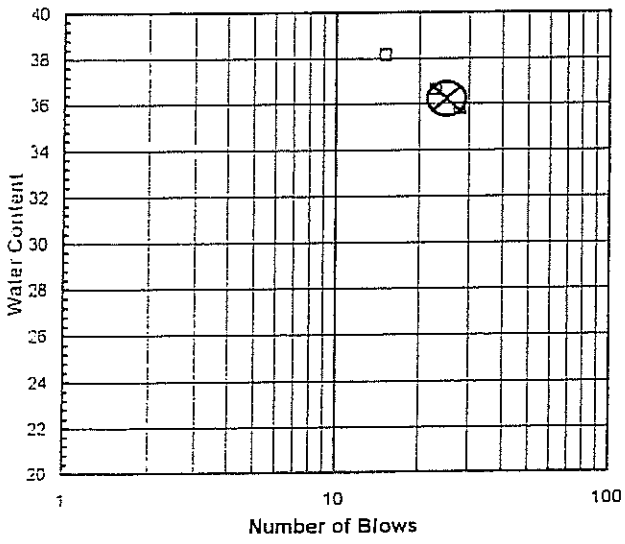
MULTIPOINT

Plastic Limit Test	1	2	Range
Tare Number	134	267	
Wt. of Tare & WS (gm)	21.41	20.16	
Wt. of Tare & DS (gm)	20.44	19.10	
Wt. of Tare (gm)	15.29	13.36	
Wt. of Water (gm)	1.0	1.1	
Wt. of DS (gm)	5.2	5.7	
Moisture Content (%)	**18.8**	**18.5**	**0.4**

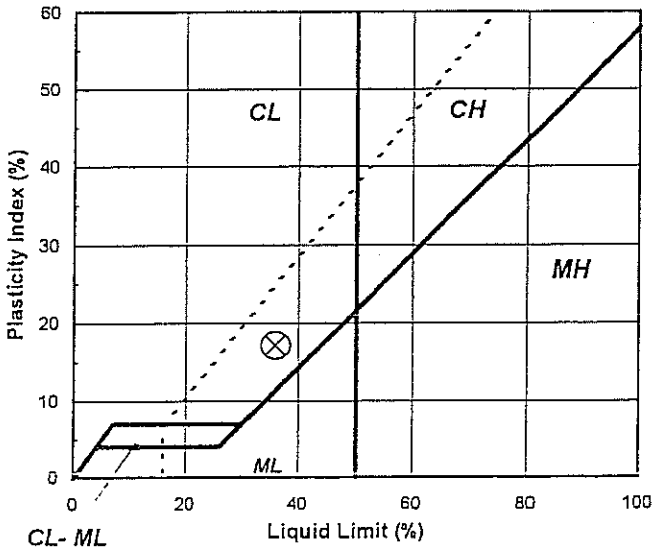
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	36
Plastic Limit (%)	19
Plasticity Index (%)	17
USCS Symbol	CL

Flow Curve



Plasticity Chart



Tested By TO *Date* 5/21/08 *Checked By* HB *Date* 5-23-08

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SPECIFIC GRAVITY

ASTM D 854-02, AASHTO T100-03 (SOP - S5)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Visual Description	BLACK SLUDGE (Minus No.4 sieve material, airdried)

Replicate Number	1	2
Pycnometer ID	G 1155	G 1156
Weight of Pycnometer + Soil + Water (gm)	737.55	736.34
Temperature, T (°Celsius)	26.4	25.5
Weight of Pycnometer + Water (gm)	682.36	681.04
Tare Number	674	2487
Weight of Tare + Dry Soil (gm)	199.03	195.46
Weight of Tare (gm)	99.26	95.76
Weight of Dry Soil (gm)	99.77	99.70
Specific Gravity of Soil @ T	2.238	2.246
Specific Gravity of Water @ T	0.9967	0.9969
Conversion Factor for Temperature T	0.9985	0.9987
Specific Gravity @ 20° Celsius	2.241	2.248

Average Specific Gravity @ 20° Celsius	2.24

Tested By TO *Date* 05/20/08 *Checked By* KB *Date* 5-23-08

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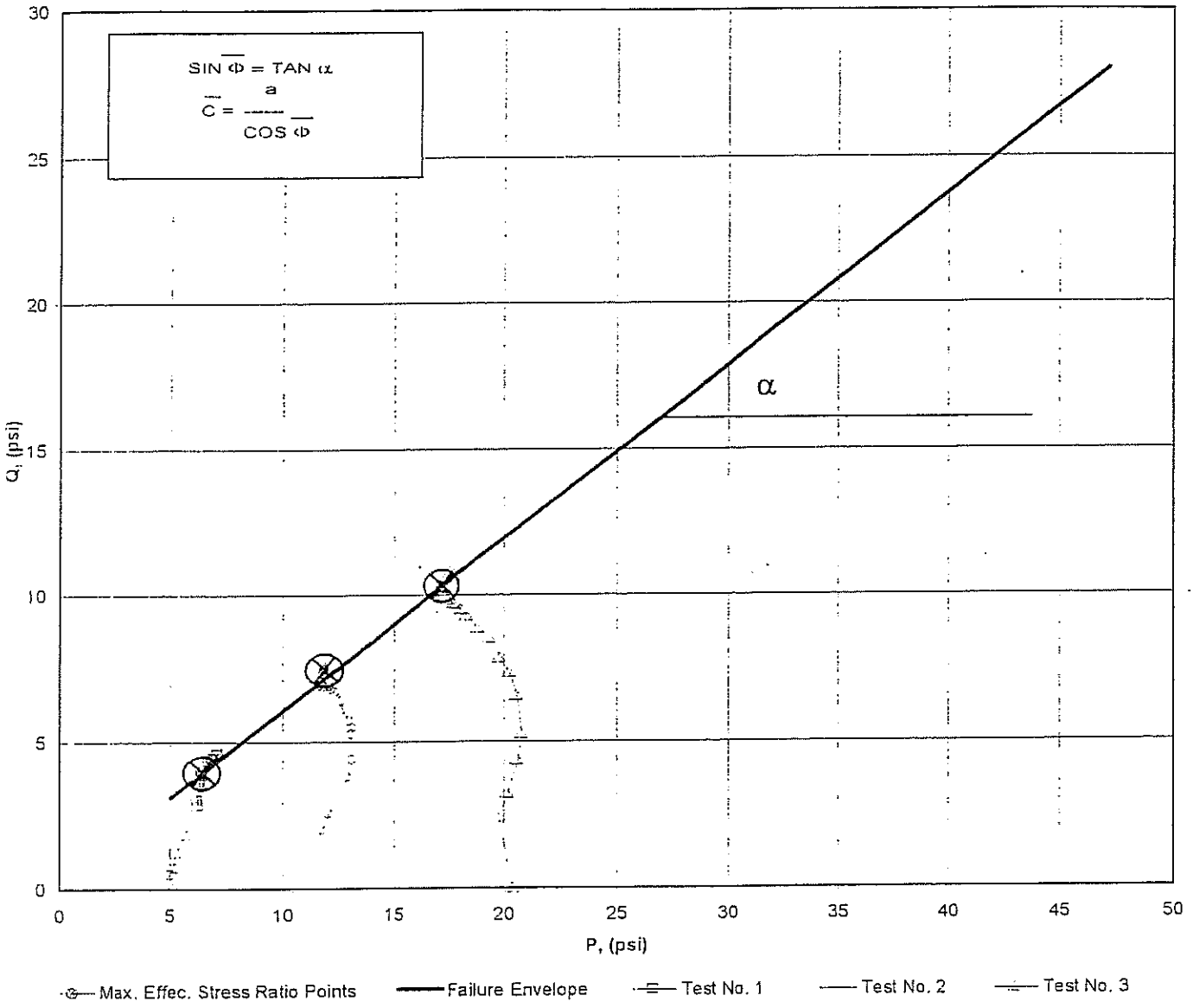
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	30.5	$\bar{\Phi}$	=	36.14

Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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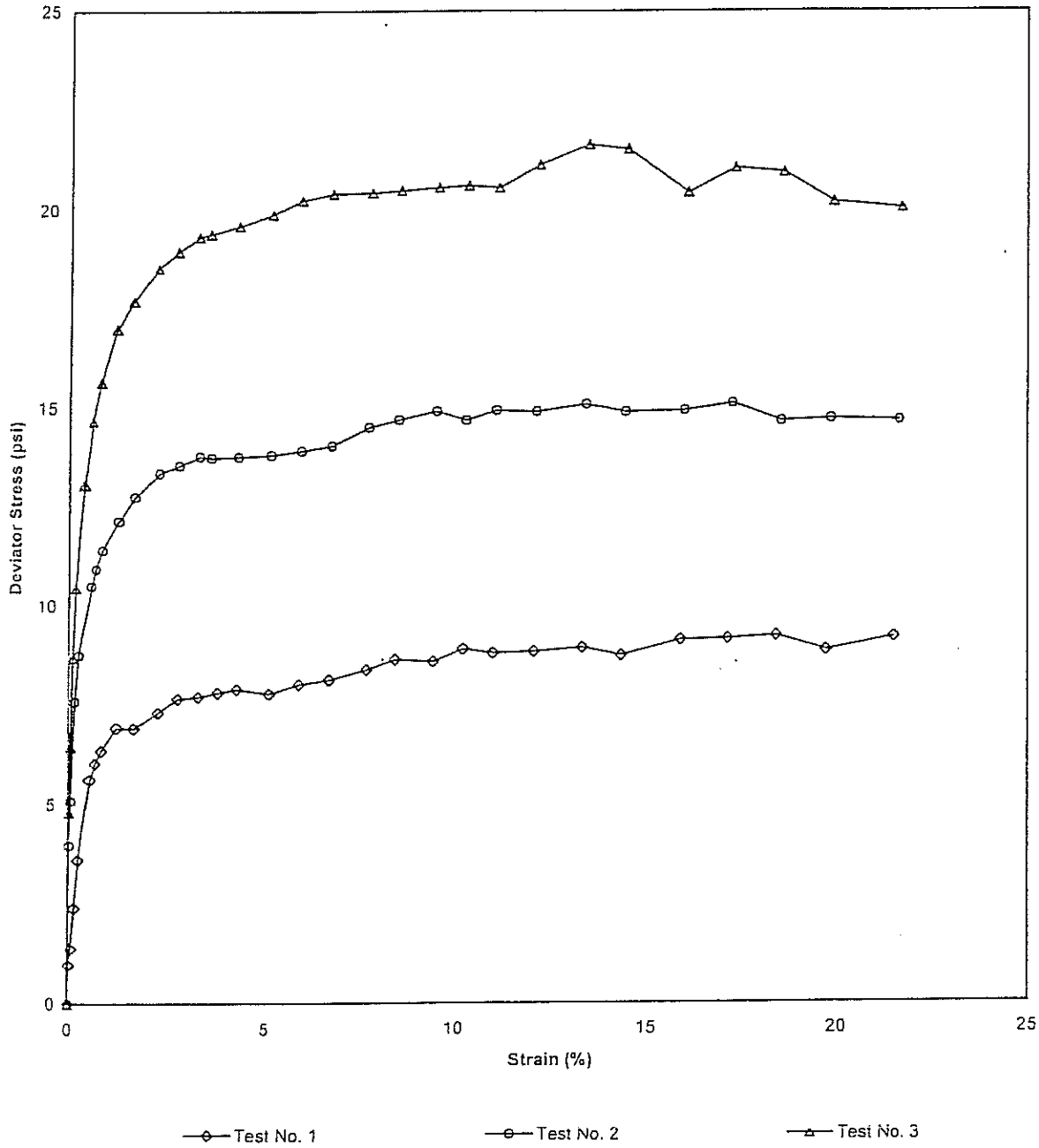
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	1

PRESSURES (psi)

Cell Pressure(psi)	36.6
Back Pressure(psi)	31.4
Eff. Cons. Pressure(psi)	5.2
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	6.41
Q	=	3.95

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.140	Diameter 1	1.375
Length 2	3.148	Diameter 2	1.389
Length 3	3.151	Diameter 3	1.399
Avg Leng.=	3.146	Avg. Diam.=	1.388

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.7
Final Change (ml)	2.3

Initial Dial Reading (D.R.), mils	235
D.R. After Saturation, mils	250
D.R. After Consolidation, mils	294

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.4
8.2	0.001	32.1
8.8	0.002	32.1
10.3	0.005	32.5
12.1	0.008	32.8
15.1	0.016	33.2
15.8	0.020	33.4
16.2	0.026	33.6
17.1	0.038	33.7
17.2	0.051	33.8
17.8	0.069	33.9
18.4	0.085	34.0
18.5	0.101	34.0
18.8	0.116	34.1
19.0	0.132	34.1
18.9	0.158	34.1
19.4	0.182	34.2
19.6	0.205	34.2
20.2	0.236	34.2
20.7	0.260	34.2
20.8	0.292	34.1
21.4	0.316	34.3
21.4	0.340	34.1
21.6	0.371	34.1
22.0	0.411	34.1
21.8	0.443	34.1
22.8	0.490	34.1
23.1	0.530	34.2
23.5	0.569	34.1
23.1	0.610	34.1
24.0	0.664	34.2

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.2	*Stage No.*	1
		Test No	1

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.51
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.55
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.474

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	0.98	0.73	5.45	4.5	1.219	0.76	4.96	0.49
0.07	1.39	0.75	5.84	4.5	1.311	0.55	5.14	0.69
0.15	2.40	1.15	6.46	4.1	1.593	0.49	5.25	1.20
0.25	3.62	1.36	7.46	3.8	1.941	0.38	5.65	1.81
0.52	5.63	1.79	9.04	3.4	2.649	0.32	6.23	2.81
0.66	6.03	2.01	9.22	3.2	2.893	0.34	6.20	3.02
0.84	6.35	2.21	9.34	3.0	3.125	0.36	6.16	3.18
1.22	6.92	2.33	9.79	2.9	3.417	0.34	6.33	3.46
1.64	6.91	2.40	9.71	2.8	3.469	0.35	6.26	3.46
2.25	7.31	2.55	9.96	2.7	3.753	0.36	6.31	3.65
2.75	7.66	2.61	10.25	2.6	3.961	0.35	6.42	3.83
3.27	7.71	2.64	10.26	2.6	4.017	0.35	6.41	3.85
3.77	7.81	2.68	10.34	2.5	4.098	0.35	6.43	3.91
4.28	7.90	2.74	10.37	2.5	4.208	0.35	6.41	3.95
5.11	7.78	2.71	10.27	2.5	4.124	0.36	6.38	3.89
5.89	8.02	2.84	10.38	2.4	4.400	0.36	6.37	4.01
6.65	8.13	2.78	10.56	2.4	4.359	0.35	6.49	4.07
7.66	8.39	2.83	10.76	2.4	4.538	0.34	6.56	4.19
8.42	8.64	2.76	11.09	2.4	4.536	0.33	6.77	4.32
9.45	8.59	2.72	11.07	2.5	4.464	0.32	6.77	4.29
10.23	8.90	2.86	11.25	2.3	4.797	0.33	6.79	4.45
11.00	8.80	2.67	11.33	2.5	4.474	0.31	6.93	4.40
12.03	8.83	2.74	11.29	2.5	4.594	0.32	6.87	4.42
13.30	8.93	2.72	11.41	2.5	4.601	0.31	6.94	4.46
14.34	8.73	2.69	11.25	2.5	4.477	0.31	6.88	4.37
15.88	9.12	2.66	11.66	2.5	4.587	0.30	7.10	4.56
17.15	9.15	2.77	11.59	2.4	4.762	0.31	7.01	4.58
18.44	9.22	2.70	11.72	2.5	4.691	0.30	7.11	4.61
19.74	8.86	2.70	11.36	2.5	4.536	0.31	6.93	4.43
21.51	9.19	2.82	11.56	2.4	4.864	0.31	6.97	4.59

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	2

PRESSURES (psi)

Cell Pressure(psi)	46.5
Back Pressure(psi)	36.1
Eff. Cons. Pressure(ps	10.4
Pore Pressure Response (%)	100

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	11.84
Q	=	7.45

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.120	Diameter 1	1.396
Length 2	3.137	Diameter 2	1.398
Length 3	3.135	Diameter 3	1.344
Avg Leng.=	3.131	Avg. Diam.=	1.379

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	18.4
Final Change (ml)	5.6

Initial Dial Reading (D.R.), mils	77
D.R. After Saturation, mils	112
D.R. After Consolidation, mils	166

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.9	0.000	36.1
13.4	0.001	36.8
14.9	0.002	37.0
18.3	0.005	37.4
20.0	0.008	37.8
22.4	0.017	38.7
23.0	0.020	38.9
23.7	0.026	39.3
24.8	0.038	39.9
25.7	0.051	40.3
26.7	0.069	40.9
27.1	0.085	41.1
27.5	0.100	41.3
27.5	0.110	41.5
27.7	0.131	41.6
27.9	0.157	41.8
28.2	0.181	41.9
28.6	0.204	41.9
29.5	0.235	42.0
30.0	0.259	42.1
30.5	0.290	42.1
30.4	0.313	42.0
31.0	0.337	42.1
31.2	0.368	42.0
31.8	0.408	42.2
31.8	0.439	42.1
32.3	0.486	42.1
33.0	0.526	42.2
32.6	0.565	42.1
33.1	0.604	42.2
33.6	0.659	42.2

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: GT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.4	*Stage No.*	1
		Test No	2

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.49
Initial Sample Volume (in^3)	4.68

VOLUME CHANGE

Volume After Consolidation (in^3)	4.18
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma}_1$	$\overline{\sigma}_3$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.03	3.98	0.65	13.73	9.7	1.408	0.16	11.74	1.99
0.06	5.09	0.89	14.59	9.5	1.535	0.18	12.05	2.54
0.15	7.59	1.34	16.65	9.1	1.838	0.18	12.85	3.79
0.25	8.76	1.72	17.44	8.7	2.010	0.20	13.06	4.38
0.54	10.51	2.62	18.29	7.8	2.351	0.25	13.04	5.26
0.67	10.94	2.79	18.56	7.6	2.438	0.25	13.08	5.47
0.86	11.42	3.19	18.64	7.2	2.584	0.28	12.92	5.71
1.25	12.16	3.85	18.71	6.6	2.856	0.32	12.63	6.08
1.67	12.77	4.19	18.98	6.2	3.055	0.33	12.60	6.38
2.28	13.37	4.77	19.00	5.6	3.373	0.36	12.32	6.68
2.79	13.56	5.04	18.92	5.4	3.530	0.37	12.14	6.78
3.30	13.79	5.25	18.94	5.2	3.675	0.38	12.05	6.89
3.60	13.76	5.40	18.76	5.0	3.751	0.39	11.88	6.88
4.32	13.77	5.50	18.67	4.9	3.812	0.40	11.79	6.89
5.16	13.82	5.69	18.52	4.7	3.934	0.41	11.62	6.91
5.95	13.93	5.80	18.52	4.6	4.029	0.42	11.56	6.96
6.72	14.04	5.83	18.61	4.6	4.072	0.42	11.59	7.02
7.73	14.51	5.87	19.04	4.5	4.205	0.40	11.78	7.26
8.52	14.69	6.01	19.08	4.4	4.349	0.41	11.73	7.35
9.54	14.91	6.01	19.30	4.4	4.397	0.40	11.84	7.45
10.30	14.68	5.94	19.15	4.5	4.289	0.40	11.80	7.34
11.07	14.93	6.00	19.33	4.4	4.390	0.40	11.87	7.46
12.10	14.89	5.95	19.34	4.5	4.346	0.40	11.90	7.45
13.40	15.08	6.10	19.38	4.3	4.506	0.40	11.84	7.54
14.44	14.89	6.03	19.25	4.4	4.410	0.41	11.81	7.44
15.98	14.92	5.99	19.34	4.4	4.381	0.40	11.88	7.46
17.26	15.10	6.12	19.38	4.3	4.528	0.41	11.83	7.55
18.58	14.65	5.96	19.09	4.4	4.303	0.41	11.76	7.33
19.86	14.71	6.07	19.04	4.3	4.398	0.41	11.68	7.35
21.67	14.66	6.08	18.99	4.3	4.393	0.41	11.65	7.33

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	3

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	20.4
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	17.19
Q	=	10.31

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.130	Diameter 1	1.404
Length 2	3.121	Diameter 2	1.373
Length 3	3.136	Diameter 3	1.371
Avg Leng.=	3.129	Avg. Diam.=	1.383

VOLUME CHANGE

Initial Burette Reading (ml)	48.0
Final Burette Reading (ml)	40.5
Final Change (ml)	7.5

Initial Dial Reading (D.R.), mils	60
D.R. After Saturation, mils	68
D.R. After Consolidation, mils	154

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.0
13.5	0.001	34.0
15.7	0.002	34.5
18.9	0.003	35.2
21.3	0.005	35.9
25.0	0.011	37.4
27.3	0.017	38.5
28.7	0.024	39.4
30.6	0.036	40.5
31.7	0.049	41.4
33.1	0.067	42.3
33.8	0.083	42.8
34.5	0.099	43.2
34.7	0.108	43.4
35.2	0.131	43.7
35.9	0.157	44.0
36.6	0.180	44.2
37.1	0.204	44.3
37.5	0.236	44.4
37.8	0.260	44.4
38.3	0.290	44.5
38.7	0.314	44.5
38.8	0.337	44.5
40.1	0.369	44.6
41.4	0.408	44.6
41.7	0.440	44.6
40.5	0.488	44.6
42.1	0.527	44.6
42.5	0.566	44.6
41.7	0.605	44.6
42.3	0.660	44.7

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN CT-S28 DATE 6-25-98 REVISION 1

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INTEGRITY IN TESTING

CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.4	*Stage No.*	1
		Test No	3

INITIAL DIMENSIONS

Initial Sample Length (in.)	.3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.20
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.385

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	4.82	3.04	22.17	17.4	1.278	0.64	19.76	2.41
0.05	6.44	3.45	23.39	16.9	1.380	0.54	20.17	3.22
0.10	8.70	4.15	24.95	16.2	1.536	0.48	20.60	4.35
0.17	10.46	4.86	26.01	15.5	1.673	0.47	20.77	5.23
0.37	13.09	6.38	27.10	14.0	1.934	0.49	20.56	6.54
0.58	14.68	7.49	27.59	12.9	2.137	0.52	20.25	7.34
0.80	15.66	8.40	27.66	12.0	2.305	0.54	19.83	7.83
1.18	17.01	9.52	27.89	10.9	2.563	0.57	19.38	8.50
1.61	17.71	10.40	27.71	10.0	2.772	0.59	18.85	8.86
2.22	18.54	11.31	27.63	9.1	3.039	0.62	18.36	9.27
2.74	18.96	11.76	27.60	8.6	3.196	0.63	18.12	9.48
3.26	19.34	12.21	27.53	8.2	3.361	0.64	17.86	9.67
3.57	19.40	12.35	27.45	8.0	3.411	0.64	17.75	9.70
4.31	19.60	12.73	27.27	7.7	3.556	0.66	17.47	9.80
5.17	19.89	12.96	27.33	7.4	3.676	0.66	17.38	9.95
5.94	20.25	13.15	27.50	7.2	3.795	0.66	17.37	10.13
6.73	20.42	13.27	27.54	7.1	3.864	0.66	17.34	10.21
7.78	20.44	13.38	27.46	7.0	3.912	0.66	17.24	10.22
8.55	20.50	13.40	27.50	7.0	3.928	0.66	17.25	10.25
9.57	20.57	13.48	27.49	6.9	3.973	0.66	17.20	10.28
10.34	20.62	13.52	27.50	6.9	3.995	0.66	17.19	10.31
11.11	20.56	13.51	27.45	6.9	3.982	0.66	17.17	10.28
12.15	21.14	13.55	27.99	6.8	4.088	0.65	17.42	10.57
13.45	21.64	13.57	28.47	6.8	4.170	0.63	17.65	10.82
14.49	21.53	13.56	28.36	6.8	4.149	0.64	17.60	10.76
16.07	20.44	13.58	27.26	6.8	3.997	0.67	17.04	10.22
17.35	21.06	13.58	27.88	6.8	4.086	0.65	17.35	10.53
18.64	20.95	13.63	27.72	6.8	4.094	0.66	17.25	10.48
19.92	20.20	13.64	26.96	6.8	3.988	0.68	16.86	10.10
21.74	20.03	13.67	26.77	6.7	3.975	0.69	16.75	10.02

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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MOHR TOTAL STRENGTH ENVELOPE

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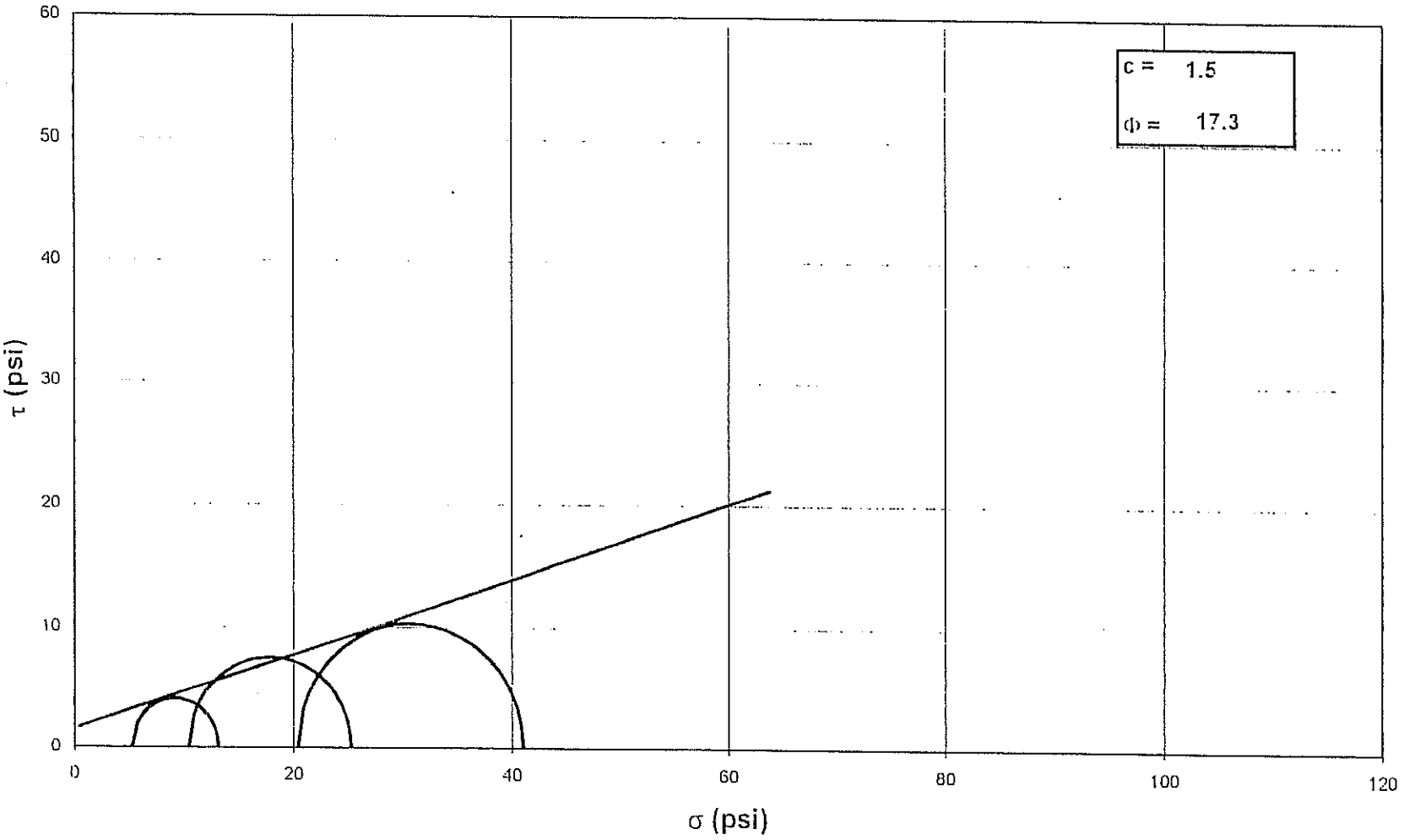
Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/19/08

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	82.6	82.7	79.5
Total Unit Weight (pcf)	76.6	84.2	80.5
Dry Unit Weight (pcf)	42.0	46.1	44.8
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	2.333	2.035	2.119

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

DCN CT-S28 DATE 6-25-98 REVISION: 1

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	41.7	43.3	42.4
Total Unit Weight (pcf)	102.0	102.5	101.8
Dry Unit Weight (pcf)	71.9	71.5	71.5
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	0.944	0.955	0.956

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

DCN CT-S28 DATE 6-25-96 REVISION 1

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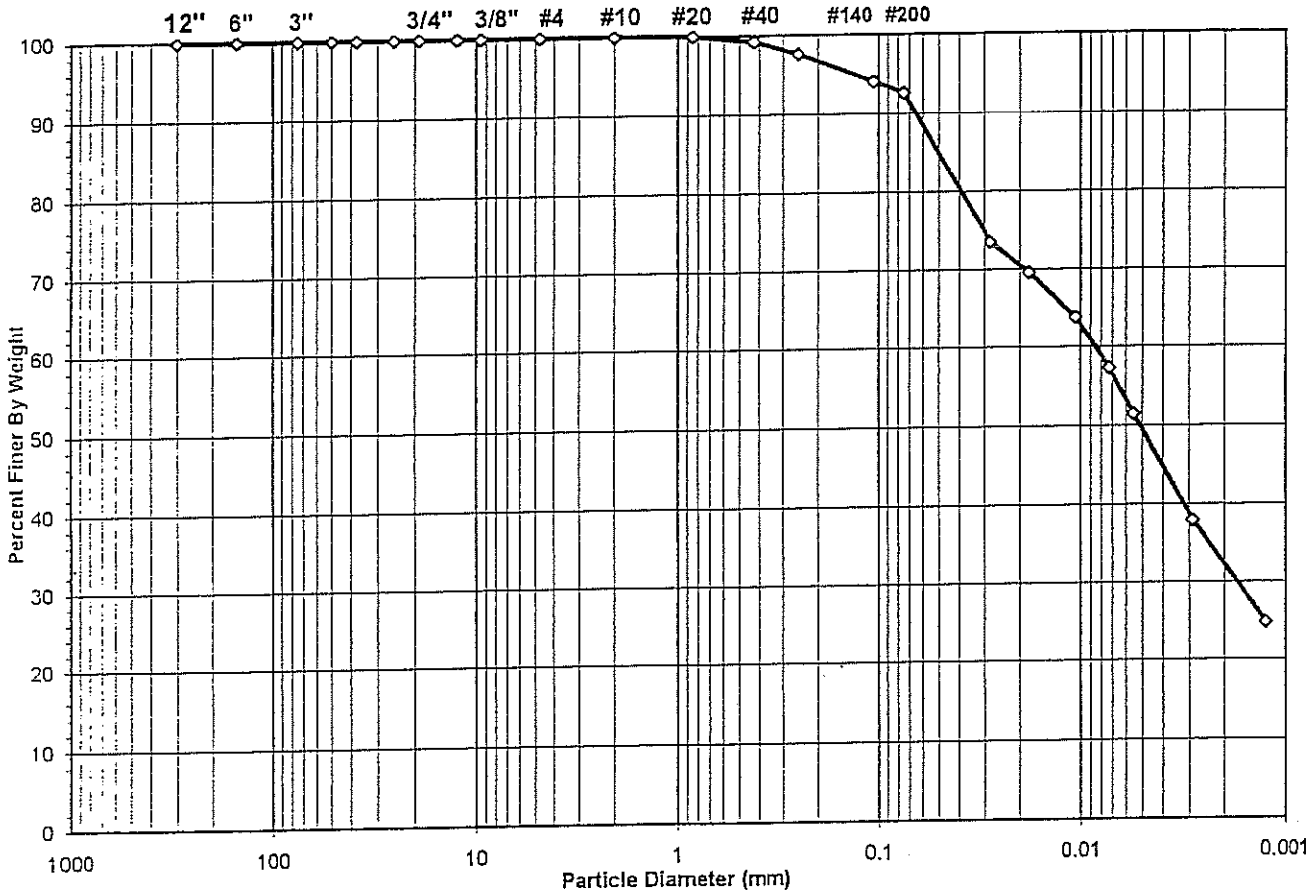
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Color	BLACK

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	7.38
Finer Than #200	*Silt & Clay*	92.62

USCS Symbol	*CL, TESTED*
USCS Classification	*LEAN CLAY*

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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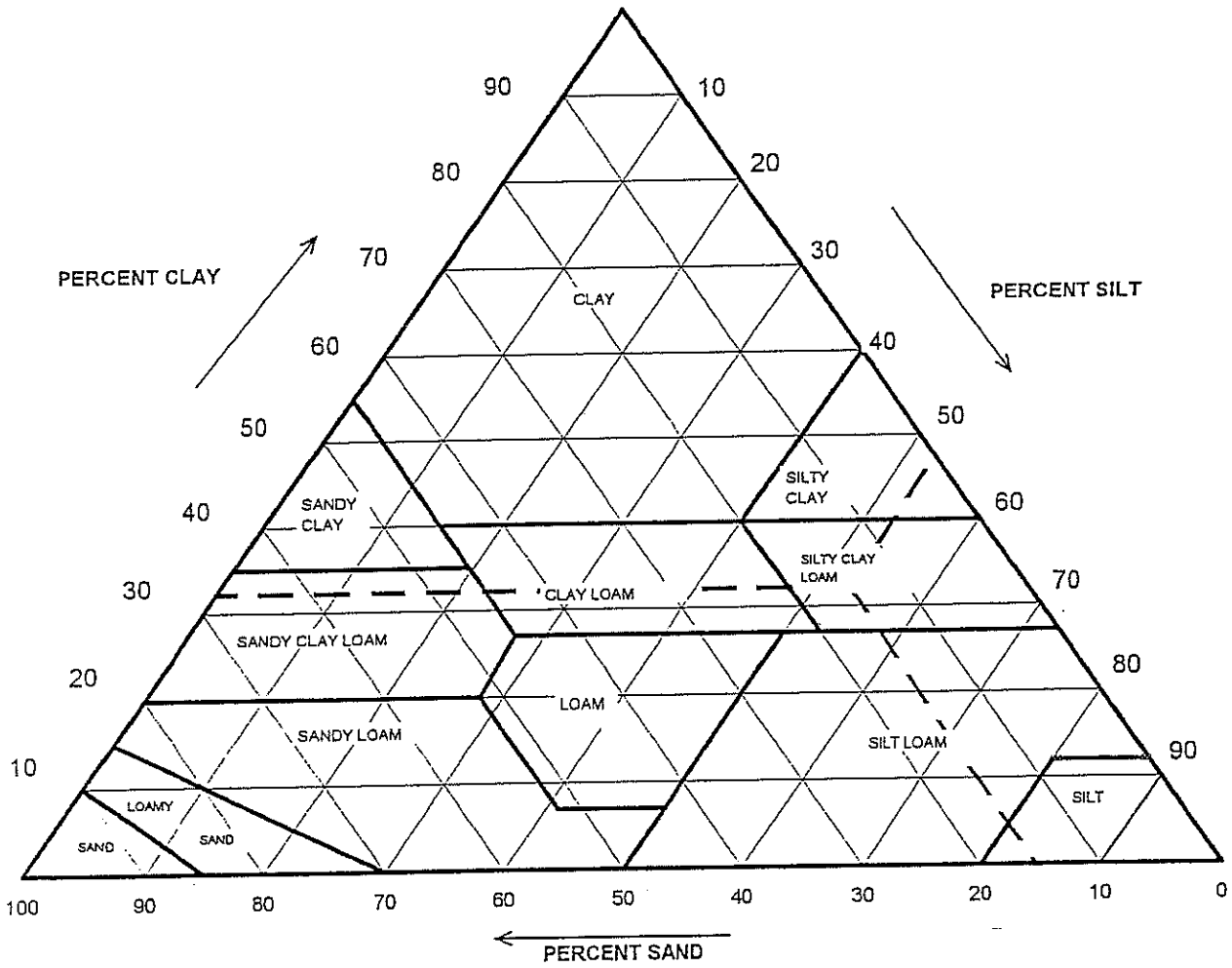
USDA CLASSIFICATION CHART

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Color	BLACK



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.00	0.00
2	100.00	*Sand*	15.22	15.22
0.05	84.78	*Silt*	52.64	52.64
0.002	32.14	*Clay*	32.14	32.14

USDA Classification: *SILTY CLAY LOAM*

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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WASH SIEVE ANALYSIS

ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Color	BLACK

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	517	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	1095.30	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	630.20	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	97.36	Weight of Tare (gm)	NA
Weight of Water (gm)	465.10	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	532.84	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**87.3**	**Moisture Content (%)**	NA

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	532.84
Dry Weight - 3/4" Sample (gm)	39.31	Weight of minus #200 material (gm)	493.53
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	39.31
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	100.00
6"	150	0.00	0.00	0.00	100.00	100.00
3"	75	0.00	0.00	0.00	100.00	100.00
2"	50	0.00	0.00	0.00	100.00	100.00
1 1/2"	37.5	0.00	0.00	0.00	100.00	100.00
1"	25.0	0.00	0.00	0.00	100.00	100.00
3/4"	19.0	0.00	0.00	0.00	100.00	100.00
1/2"	12.5	0.00	0.00	0.00	100.00	100.00
3/8"	9.50	0.00	0.00	0.00	100.00	100.00
#4	4.75	0.00	0.00	0.00	100.00	100.00
#10	2.00	0.00	0.00	0.00	100.00	100.00
#20	0.85	0.13	0.02	0.02	99.98	99.98
#40	0.425	3.63	0.68	0.71	99.29	99.29
#60	0.250	8.79	1.65	2.36	97.64	97.64
#140	0.106	19.00	3.57	5.92	94.08	94.08
#200	0.075	7.76	1.46	7.38	92.62	92.62
Pan	-	493.53	92.62	100.00	-	-

Tested By JP Date 5/21/08 Checked By KB Date 5-23-08

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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HYDROMETER ANALYSIS

ASTM D 422-63/AASHTO T88-00 (SOP-S3)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Color	BLACK

Elapsed Time (min)	R Measured	Temp. (° C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	44.5	21.9	6.02	38.5	79.3	0.01314	0.0279	**73.5**
5	42.5	21.9	6.02	36.5	75.2	0.01314	0.0180	**69.7**
15	39.5	21.9	6.02	33.5	69.0	0.01314	0.0106	**63.9**
34	36.0	21.9	6.02	30.0	61.8	0.01314	0.0073	**57.2**
62	33.0	21.8	6.07	26.9	55.5	0.01316	0.0055	**51.4**
250	26.0	21.7	6.11	19.9	41.0	0.01317	0.0029	**38.0**
1440	19.0	21.9	6.02	13.0	26.8	0.01314	0.0013	**24.8**

Soil Specimen Data		Other Corrections	
Tare No.	2343		
Tare + Dry Material (gm)	151.6	a - Factor	0.99
Weight of Tare (gm)	98.58		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 200	92.62
Weight of Dry Material (gm)	48.02		
		Specific Gravity	2.7 Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 5/21/08 Checked By KB Date 5-23-08

DCN: CT-S3A DATE:2/20/08 REVISION: 8

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ATTERBERG LIMITS

ASTM D 4318-05 / AASHTO T89 (SOP - S4A)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Soil Description	BLACK LEAN CLAY

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

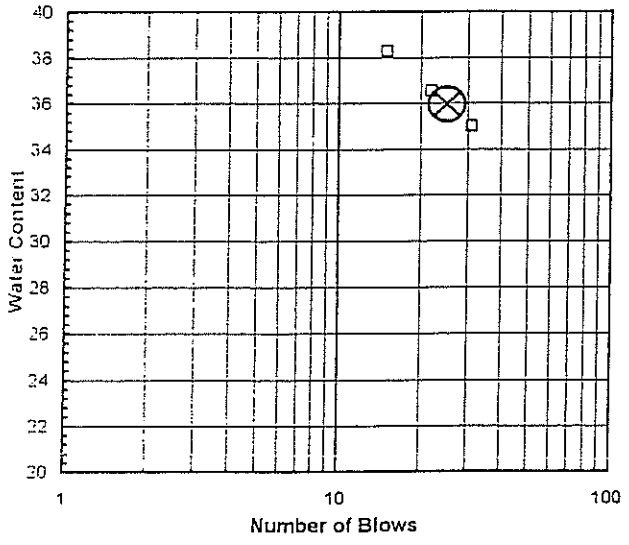
Liquid Limit Test	1	2	3	
				M
Tare Number	250	20	284	U
Wt. of Tare & WS (gm)	37.67	39.66	39.57	L
Wt. of Tare & DS (gm)	32.45	34.22	33.70	T
Wt. of Tare (gm)	17.54	19.33	18.37	I
Wt. of Water (gm)	5.2	5.4	5.9	P
Wt. of DS (gm)	14.9	14.9	15.3	O
				I
Moisture Content (%)	**35.0**	**36.5**	**38.3**	N
Number of Blows	**31**	**22**	**15**	T

Plastic Limit Test	1	2	Range
Tare Number	43	274	
Wt. of Tare & WS (gm)	25.49	26.20	
Wt. of Tare & DS (gm)	24.45	25.21	
Wt. of Tare (gm)	19.03	19.96	
Wt. of Water (gm)	1.0	1.0	
Wt. of DS (gm)	5.4	5.3	
Moisture Content (%)	**19.2**	**18.9**	**0.3**

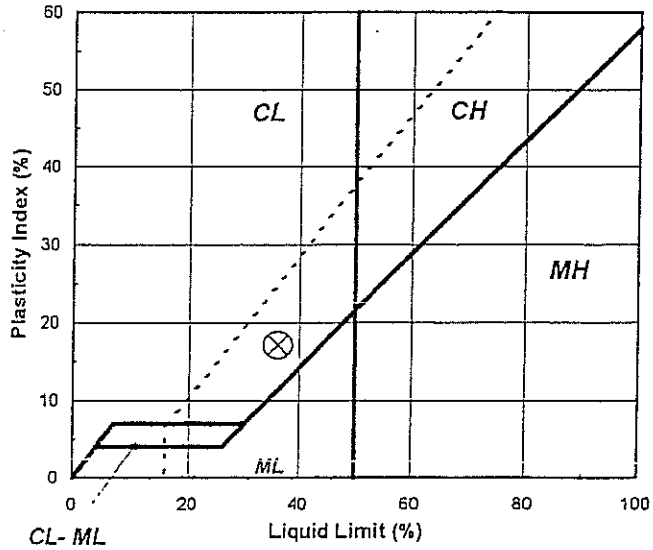
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	36
Plastic Limit (%)	19
Plasticity Index (%)	17
USCS Symbol	CL

Flow Curve



Plasticity Chart



Tested By TO *Date* 5/21/08 *Checked By* AR *Date* 5-23-08

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SPECIFIC GRAVITY

ASTM D 854-02, AASHTO T100-03 (SOP - S5)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth (ft)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Visual Description	BLACK SLUDGE
			(Minus No.4 sieve material, airdried)

Replicate Number	1	2
Pycnometer ID	G 1155	G 1156
Weight of Pycnometer + Soil + Water (gm)	738.67	736.62
Temperature, T (°Celsius)	23.6	22.8
Weight of Pycnometer + Water (gm)	682.72	681.37
Tare Number	932	966
Weight of Tare + Dry Soil (gm)	203.65	202.41
Weight of Tare (gm)	102.67	102.57
Weight of Dry Soil (gm)	100.98	99.84
Specific Gravity of Soil @ T	2.242	2.239
Specific Gravity of Water @ T	0.9974	0.9976
Conversion Factor for Temperature T	0.9992	0.9994
Specific Gravity @ 20° Celsius	2.244	2.240

Average Specific Gravity @ 20° Celsius	2.24

Tested By TO *Date* 05/20/08 *Checked By* KB *Date* 5-23-08

DCN: CT-S5 Date 09/25/06 Revision: 12

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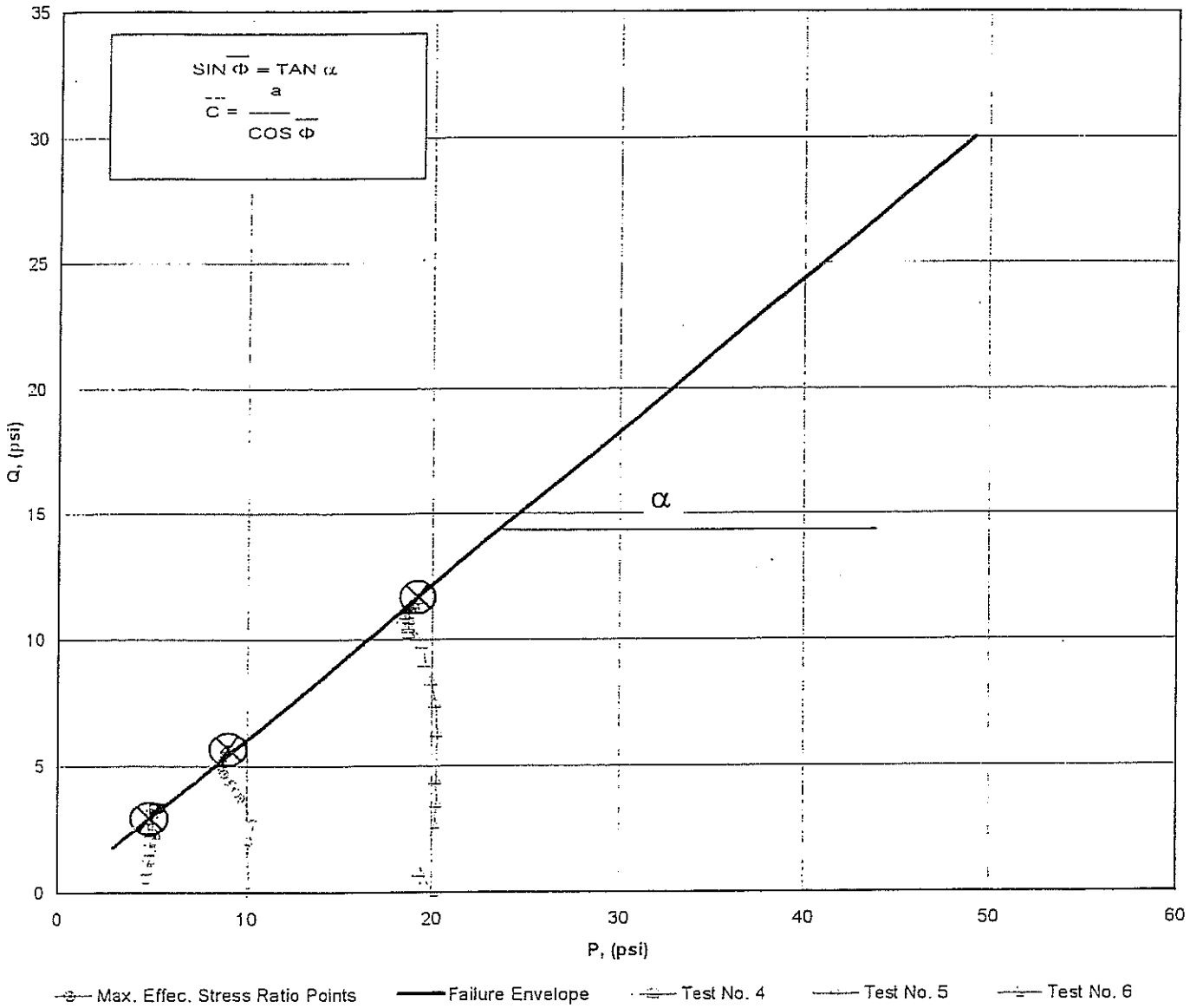
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\overline{C}$	=	0.00
α	=	31.5	$\overline{\Phi}$	=	37.71

Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

DCN CT-S28 DATE 6-25-96 REVISION 1

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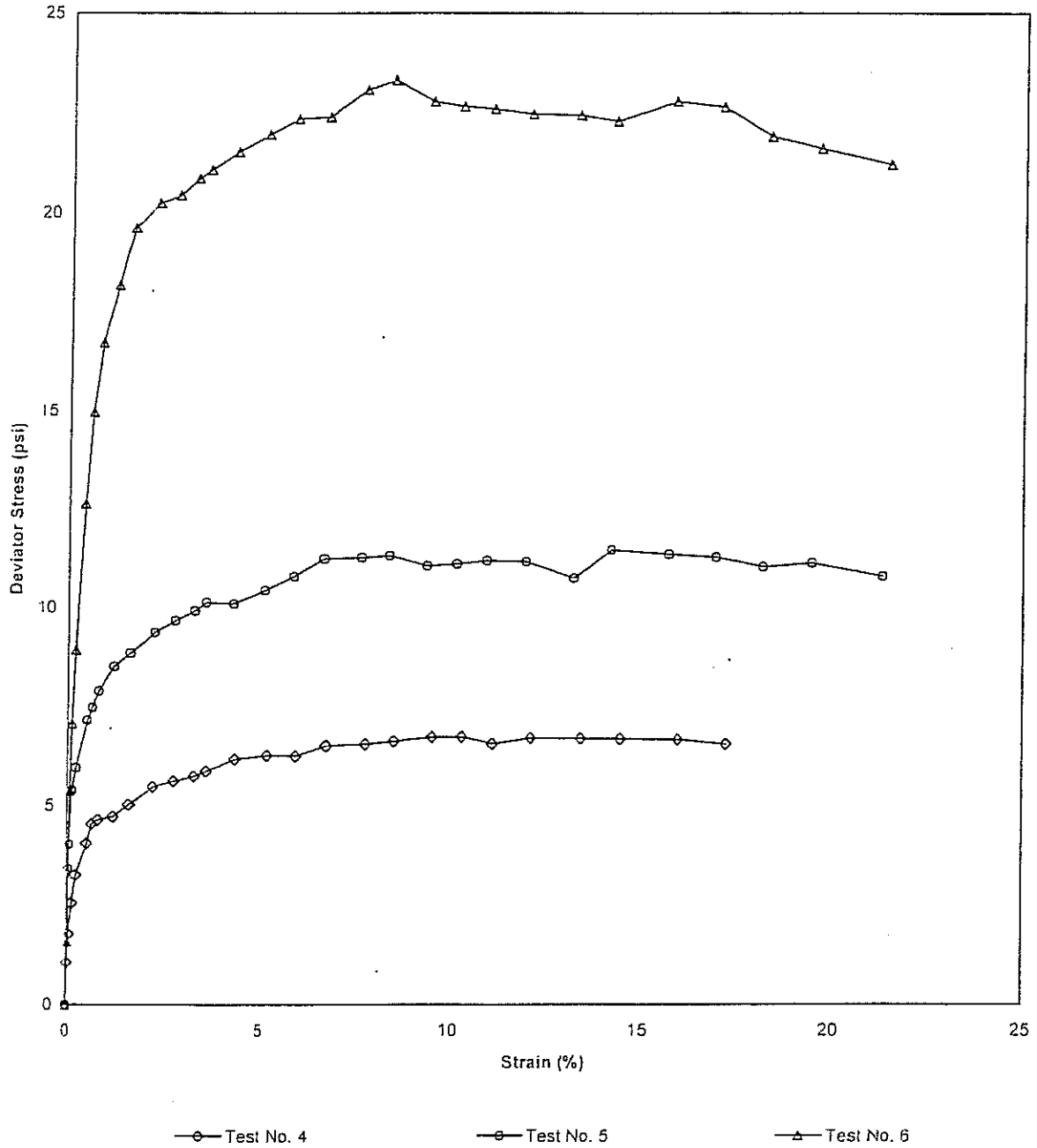
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	4

PRESSURES (psi)

Cell Pressure(psi)	36.3
Back Pressure(psi)	31.2
Eff. Cons. Pressure(psi)	5.1
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\bar{P}$	=	4.92
Q	=	2.94

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.150	Diameter 1	1.453
Length 2	3.142	Diameter 2	1.463
Length 3	3.147	Diameter 3	1.461
Avg Leng.=	3.146	Avg. Diam.=	1.459

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.9
Final Change (ml)	2.1

Initial Dial Reading (D.R.), mils	54
D.R. After Saturation, mils	110
D.R. After Consolidation, mils	130

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.6	0.000	31.2
9.3	0.001	32.1
10.4	0.002	32.3
11.6	0.005	32.6
12.8	0.008	32.9
14.0	0.016	33.3
14.8	0.020	33.3
15.0	0.025	33.6
15.2	0.037	33.8
15.7	0.050	33.9
16.5	0.068	34.2
16.7	0.084	34.2
17.0	0.100	34.2
17.2	0.110	34.3
17.8	0.133	34.2
18.1	0.159	34.3
18.1	0.182	34.3
18.6	0.205	34.2
18.8	0.237	34.2
19.0	0.261	34.3
19.3	0.293	34.3
19.5	0.316	34.2
19.3	0.340	34.3
19.7	0.372	34.2
19.8	0.412	34.3
19.9	0.445	34.3
20.1	0.491	34.2
20.1	0.531	34.2

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.1	*Stage No.*	1
		Test No	4

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.46
Initial Sample Area (in^2)	1.67
Initial Sample Volume (in^3)	5.26

VOLUME CHANGE

Volume After Consolidation (in^3)	4.85
Length After Consolidation (in)	3.07
Area After Consolidation (in^2)	1.580

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	1.06	0.90	5.26	4.2	1.253	0.86	4.73	0.53
0.07	1.77	1.15	5.72	4.0	1.449	0.66	4.84	0.89
0.15	2.55	1.44	6.21	3.7	1.698	0.58	4.94	1.28
0.25	3.26	1.71	6.65	3.4	1.959	0.53	5.02	1.63
0.53	4.05	2.11	7.04	3.0	2.358	0.53	5.01	2.03
0.65	4.54	2.14	7.50	3.0	2.531	0.48	5.23	2.27
0.82	4.65	2.39	7.36	2.7	2.712	0.52	5.04	2.32
1.21	4.72	2.58	7.25	2.5	2.873	0.56	4.89	2.36
1.62	5.03	2.72	7.42	2.4	3.112	0.55	4.90	2.52
2.22	5.48	2.95	7.63	2.1	3.550	0.55	4.89	2.74
2.74	5.62	3.02	7.70	2.1	3.705	0.55	4.89	2.81
3.27	5.75	3.04	7.81	2.1	3.790	0.54	4.93	2.87
3.59	5.88	3.12	7.86	2.0	3.968	0.54	4.92	2.94
4.33	6.18	3.02	8.27	2.1	3.967	0.50	5.17	3.09
5.17	6.27	3.08	8.30	2.0	4.101	0.50	5.16	3.14
5.93	6.25	3.13	8.22	2.0	4.176	0.51	5.10	3.13
6.69	6.51	3.03	8.58	2.1	4.152	0.48	5.32	3.26
7.73	6.56	3.04	8.62	2.1	4.176	0.47	5.34	3.28
8.50	6.63	3.14	8.59	2.0	4.380	0.48	5.27	3.31
9.53	6.72	3.14	8.68	2.0	4.436	0.48	5.32	3.36
10.30	6.74	3.03	8.81	2.1	4.256	0.46	5.44	3.37
11.09	6.56	3.07	8.59	2.0	4.235	0.48	5.31	3.28
12.10	6.71	3.03	8.78	2.1	4.233	0.46	5.43	3.35
13.42	6.69	3.06	8.74	2.0	4.281	0.47	5.39	3.35
14.49	6.68	3.10	8.68	2.0	4.342	0.47	5.34	3.34
16.00	6.66	3.02	8.74	2.1	4.204	0.46	5.41	3.33
17.29	6.55	3.03	8.62	2.1	4.171	0.47	5.34	3.28

Tested By JCM Date 05/27/08 Input Checked By KR Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	5

PRESSURES (psi)

Cell Pressure(psi)	41.1
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	10.1
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	9.00
Q	=	5.66

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.138	Diameter 1	1.407
Length 2	3.138	Diameter 2	1.383
Length 3	3.137	Diameter 3	1.378
Avg Leng.=	3.138	Avg. Diam.=	1.389

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	20.2
Final Change (ml)	3.8

Initial Dial Reading (D.R.), mils	88
D.R. After Saturation, mils	94
D.R. After Consolidation, mils	124

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
8.5	0.000	31.0
13.5	0.001	32.8
14.3	0.002	33.0
16.3	0.004	33.4
17.2	0.007	33.9
18.9	0.016	34.9
19.4	0.020	35.2
20.0	0.025	35.6
21.0	0.038	36.1
21.5	0.051	36.6
22.4	0.070	37.0
22.9	0.085	37.2
23.4	0.101	37.4
23.7	0.110	37.4
23.8	0.132	37.5
24.5	0.158	37.6
25.1	0.181	37.7
26.0	0.205	37.7
26.2	0.236	37.7
26.4	0.259	37.8
26.2	0.290	37.7
26.4	0.314	37.8
26.7	0.338	37.8
26.9	0.370	37.8
26.5	0.410	37.8
27.9	0.441	37.8
28.0	0.488	37.8
28.2	0.527	37.8
28.1	0.566	37.8
28.5	0.605	37.8
28.4	0.661	37.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.1	*Stage No.*	1
		Test No	5

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.52
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.50
Length After Consolidation (in)	3.10
Area After Consolidation (in^2)	1.450

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	3.42	1.75	11.77	8.3	1.410	0.52	10.06	1.71
0.06	4.03	2.01	12.12	8.1	1.497	0.50	10.11	2.01
0.13	5.39	2.43	13.05	7.7	1.703	0.46	10.36	2.69
0.23	5.96	2.92	13.13	7.2	1.830	0.50	10.16	2.98
0.51	7.15	3.87	13.37	6.2	2.148	0.55	9.80	3.57
0.64	7.46	4.19	13.37	5.9	2.262	0.57	9.64	3.73
0.82	7.88	4.57	13.41	5.5	2.427	0.59	9.47	3.94
1.21	8.51	5.13	13.48	5.0	2.714	0.61	9.22	4.26
1.63	8.84	5.57	13.38	4.5	2.950	0.64	8.96	4.42
2.24	9.37	5.97	13.50	4.1	3.271	0.64	8.81	4.69
2.75	9.67	6.18	13.59	3.9	3.468	0.65	8.75	4.84
3.25	9.92	6.35	13.66	3.7	3.648	0.65	8.70	4.96
3.56	10.14	6.40	13.83	3.7	3.741	0.64	8.76	5.07
4.26	10.10	6.55	13.65	3.6	3.843	0.66	8.60	5.05
5.08	10.44	6.59	13.95	3.5	3.978	0.64	8.73	5.22
5.85	10.80	6.68	14.21	3.4	4.161	0.63	8.81	5.40
6.60	11.25	6.70	14.65	3.4	4.304	0.60	9.03	5.62
7.60	11.27	6.75	14.63	3.4	4.363	0.60	8.99	5.64
8.34	11.32	6.76	14.66	3.3	4.395	0.60	9.00	5.66
9.36	11.06	6.74	14.42	3.4	4.292	0.62	8.89	5.53
10.13	11.11	6.76	14.46	3.3	4.323	0.61	8.90	5.56
10.91	11.20	6.81	14.49	3.3	4.401	0.61	8.89	5.60
11.94	11.17	6.80	14.47	3.3	4.383	0.62	8.88	5.58
13.21	10.75	6.76	14.09	3.3	4.214	0.64	8.72	5.37
14.21	11.47	6.77	14.80	3.3	4.445	0.60	9.06	5.73
15.72	11.35	6.78	14.67	3.3	4.418	0.60	9.00	5.68
16.98	11.28	6.79	14.59	3.3	4.411	0.61	8.95	5.64
18.25	11.04	6.80	14.33	3.3	4.350	0.62	8.81	5.52
19.51	11.13	6.82	14.40	3.3	4.397	0.62	8.84	5.56
21.32	10.80	6.85	14.05	3.3	4.318	0.64	8.65	5.40

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	6

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.3
Eff. Cons. Pressure(ps	20.1
Pore Pressure Response (%)	97

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	19.19
Q	=	11.67

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.142	Diameter 1	1.379
Length 2	3.130	Diameter 2	1.377
Length 3	3.141	Diameter 3	1.386
Avg Leng.=	3.138	Avg. Diam.=	1.381

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	17.7
Final Change (ml)	6.3
Initial Dial Reading (D.R.), mils	40
D.R. After Saturation, mils	56
D.R. After Consolidation, mils	91

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
4.3	0.000	31.3
6.5	0.001	32.8
11.7	0.002	33.9
14.0	0.004	34.7
16.6	0.006	35.6
21.7	0.012	37.4
25.0	0.019	38.7
27.5	0.026	39.8
29.6	0.038	40.9
31.7	0.051	41.7
32.8	0.070	42.4
33.2	0.085	42.8
33.9	0.101	43.1
34.3	0.110	43.2
35.2	0.132	43.4
36.1	0.157	43.7
37.0	0.181	43.7
37.3	0.205	43.8
38.7	0.236	43.8
39.3	0.259	43.9
38.9	0.291	43.8
39.0	0.316	43.9
39.2	0.340	43.9
39.4	0.371	43.8
39.9	0.410	43.8
40.1	0.441	43.9
41.5	0.489	43.8
41.9	0.528	43.7
41.2	0.568	43.8
41.3	0.608	43.8
41.4	0.663	43.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

DCN. CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.1	*Stage No.*	1
		Test No	6

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.24
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	1.58	1.52	20.16	18.6	1.085	0.99	19.37	0.79
0.07	5.38	2.62	22.86	17.5	1.308	0.50	20.17	2.69
0.12	7.06	3.36	23.80	16.7	1.422	0.49	20.27	3.53
0.19	8.92	4.30	24.73	15.8	1.565	0.50	20.26	4.46
0.40	12.65	6.12	26.62	14.0	1.905	0.50	20.30	6.32
0.61	14.97	7.35	27.72	12.7	2.174	0.51	20.23	7.48
0.85	16.72	8.47	28.36	11.6	2.438	0.52	19.99	8.36
1.24	18.18	9.56	28.72	10.5	2.724	0.54	19.63	9.09
1.64	19.63	10.41	29.32	9.7	3.025	0.55	19.51	9.81
2.26	20.24	11.15	29.19	9.0	3.262	0.57	19.07	10.12
2.77	20.44	11.54	29.00	8.6	3.388	0.58	18.78	10.22
3.26	20.87	11.82	29.15	8.3	3.521	0.58	18.71	10.43
3.58	21.09	11.94	29.25	8.2	3.584	0.58	18.70	10.54
4.27	21.54	12.14	29.50	8.0	3.705	0.58	18.73	10.77
5.09	21.97	12.38	29.69	7.7	3.846	0.58	18.71	10.99
5.86	22.37	12.43	30.04	7.7	3.918	0.57	18.85	11.19
6.64	22.41	12.54	29.98	7.6	3.962	0.58	18.77	11.21
7.63	23.10	12.49	30.71	7.6	4.034	0.56	19.16	11.55
8.39	23.33	12.58	30.85	7.5	4.102	0.56	19.19	11.67
9.43	22.79	12.55	30.34	7.6	4.018	0.57	18.95	11.39
10.22	22.67	12.59	30.18	7.5	4.021	0.57	18.84	11.34
11.00	22.61	12.56	30.14	7.5	4.001	0.57	18.84	11.30
12.01	22.49	12.53	30.05	7.6	3.973	0.57	18.81	11.24
13.28	22.46	12.52	30.04	7.6	3.961	0.57	18.81	11.23
14.28	22.30	12.63	29.77	7.5	3.986	0.58	18.62	11.15
15.84	22.80	12.50	30.40	7.6	4.001	0.57	19.00	11.40
17.12	22.66	12.41	30.35	7.7	3.948	0.56	19.02	11.33
18.40	21.92	12.46	29.57	7.6	3.868	0.59	18.61	10.96
19.69	21.62	12.51	29.21	7.6	3.846	0.60	18.40	10.81
21.49	21.21	12.54	28.77	7.6	3.805	0.61	18.17	10.61

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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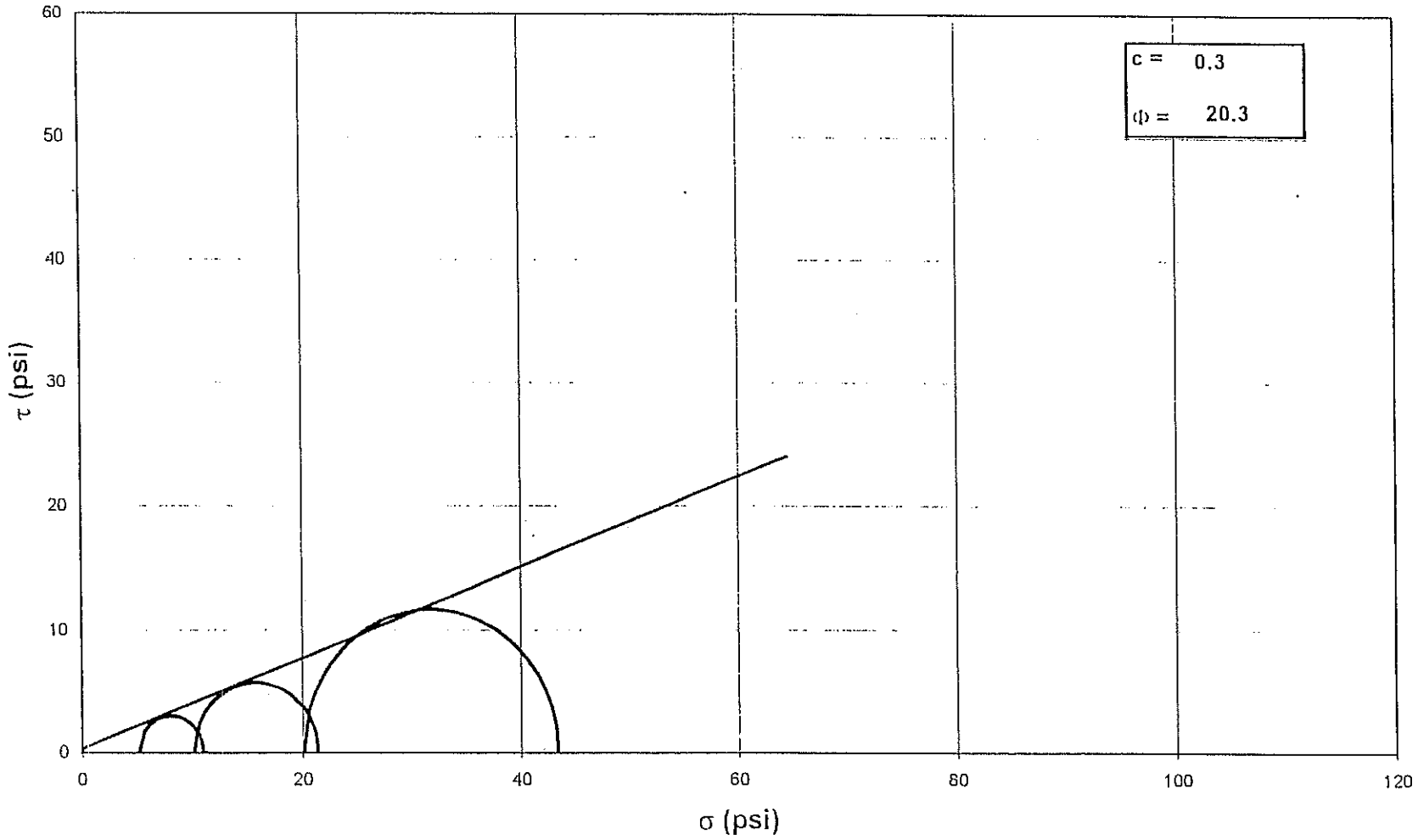
Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/16/08

#N/A

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	82.9	85.7	83.0
Total Unit Weight (pcf)	82.6	82.2	84.5
Dry Unit Weight (pcf)	45.2	44.3	46.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	2.095	2.159	2.029

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-5-08

DCN CT-S28 DATE 6-25-98 REVISION 1 C:\MSOFFICE\Excel\Printq\[F186.xls]Sheet1

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	41.5	41.5	40.9
Total Unit Weight (pcf)	92.9	102.5	103.2
Dry Unit Weight (pcf)	65.7	72.4	73.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	1.129	0.931	0.910

Tested By JCM Date 05/27/08 Input Checked By Date

544 Braddock Avenue • East Pittsburgh, PA 15112 • 412-823-7600 • FAX 412-823-8999 • www.geotechnics.net

ATTACHMENT 2

LABORATORY TESTING RESULTS – RESIDUAL SOIL AND COARSE COAL REFUSE
HOLCOLM FOUNDATION ENGINEERING COMPANY, INC.
(PROVIDED BY ALLIANCE CONSULTING, INC.)

R16402

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

SHIPPING ADDRESS
Box 393 Wood Road
Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

February 10, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Soil Boring and Laboratory Tests
Boring #8874
Mach Mine #1
Johnston City, Illinois
HFE File H-05278
Mach Mining Purchase Order No. _____

Dear Sir:

In accordance with your instructions, on February 1, 2006, we drilled one soil boring and sampled the subsoils with Shelby tubes. The soil sample taken from 10 to 12 feet in depth was subjected to laboratory tests. Results of the tests are as follows:

Boring No.:	8874
Depth:	8.0-10.0'
Visual Classification:	Silty CLAY (CL)
Atterberg Limits:	LL = 41.8% PL = 17.7% PI = 24.1
Unit Weight:	105.3 PCF
Moisture Content:	21.5%
Effective Cohesion:	0 PSF
Effective Phi Angle:	26.8 Degrees

All Tubes From Boring 8874

8 of 51

R26403

The Boring Log and test results are enclosed. If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

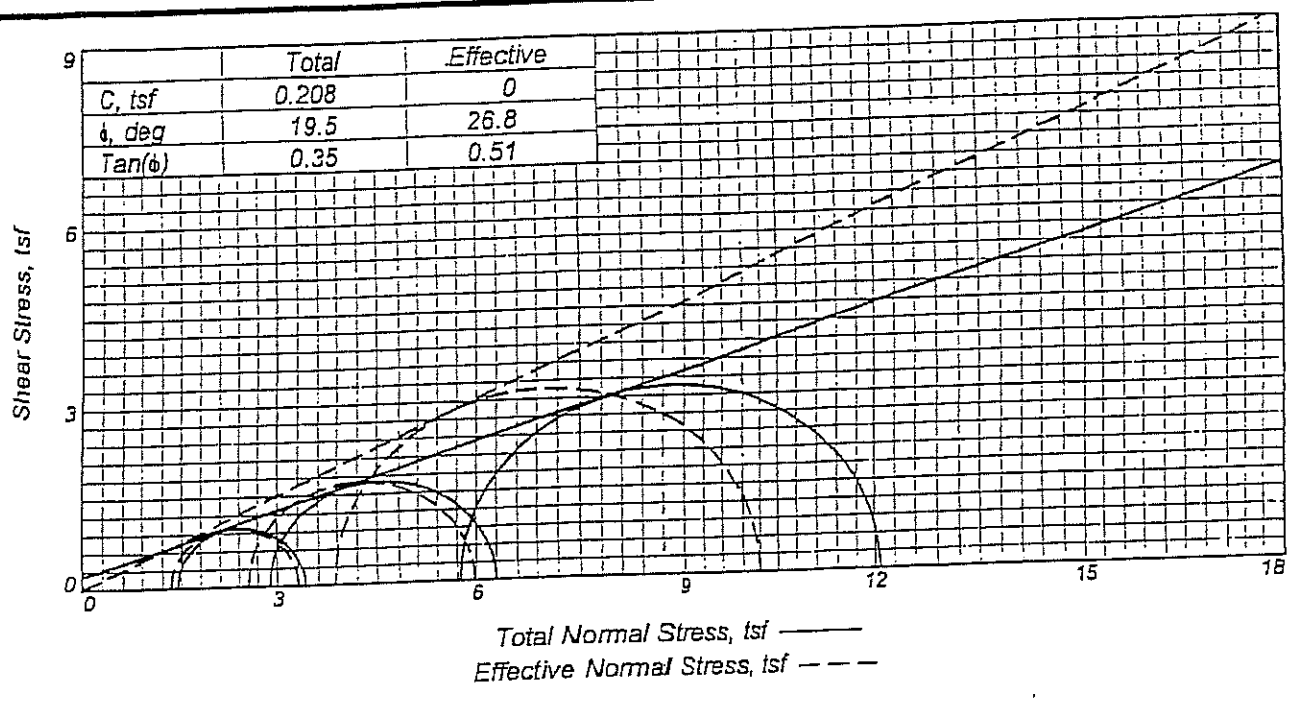
Sincerely,

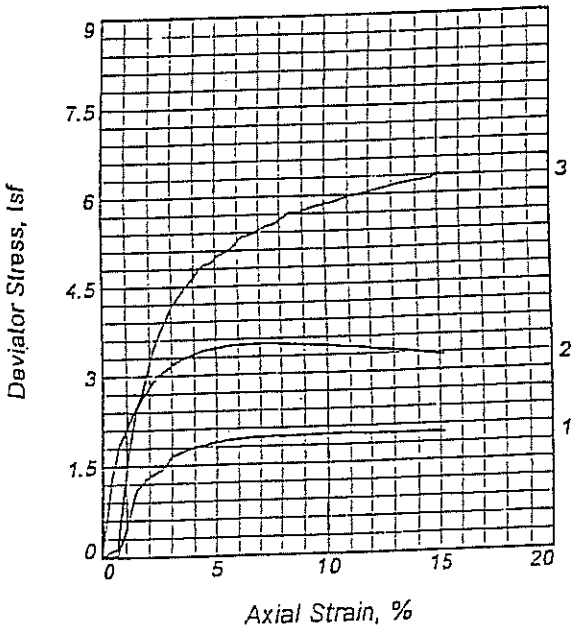
HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

REGISTERED PROFESSIONAL ENGINEER
TIMOTHY J.
HOLCOMB
062-042149
2-10-06
ILLINOIS

1 copy: Fred Vass - Alliance Consulting





Sample No.		1	2	3
Initial	Water Content,	21.5	20.8	17.6
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	99.7	98.9
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
At Test	Water Content,	21.5	20.9	17.8
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.6	3.6	2.2
Cell Pressure, tsf		5.0	6.5	7.9
Fail. Stress, tsf		2.0	3.4	6.3
Total Pore Pr., tsf		3.7	3.9	4.1
Ult. Stress, tsf		2.0	3.2	6.3
Total Pore Pr., tsf		3.6	3.8	4.1
$\bar{\sigma}_1$ Failure, tsf		3.3	6.0	10.2
$\bar{\sigma}_3$ Failure, tsf		1.3	2.6	3.9

Type of Test:
CU with Pore Pressures
Sample Type: Shelby Tube - Undisturbed
Description: Gray Mottled Brown Silty CLAY

LL= 41.8 PL= 17.7 PI= 24.1
Assumed Specific Gravity= 2.65
Remarks:

Client: Alliance Consulting

Project: Triaxial Test
Mach Mine #1
Location: Boring #8874
Sample Number: 3 **Depth:** 10.0-12.0'
Proj. No.: H-05278 **Date:** 2-1-05

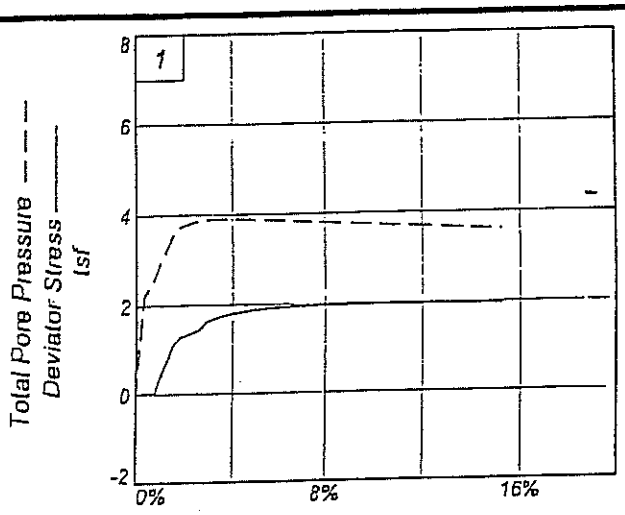
TRIAXIAL SHEAR TEST REPORT
HOLCOMB FOUNDATION ENGINEERING CO.

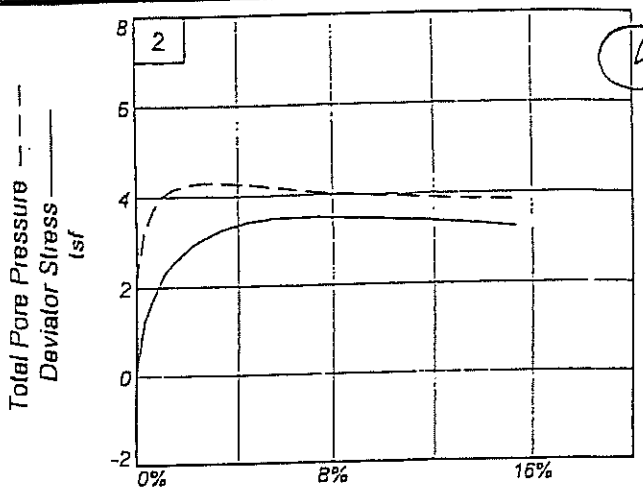
Plate _____

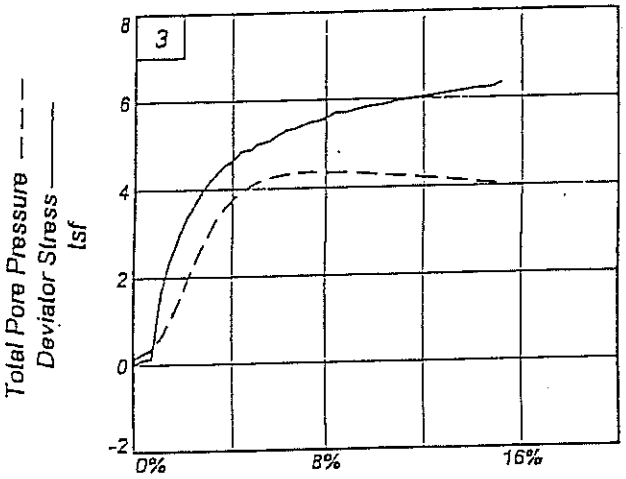
Tested By: LC Checked By: TH

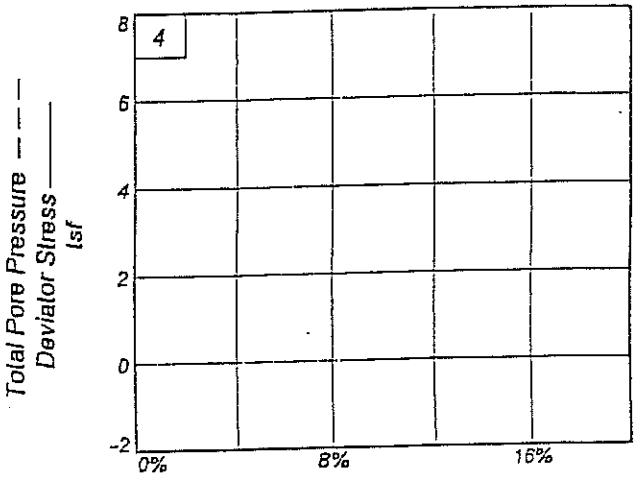
R16405

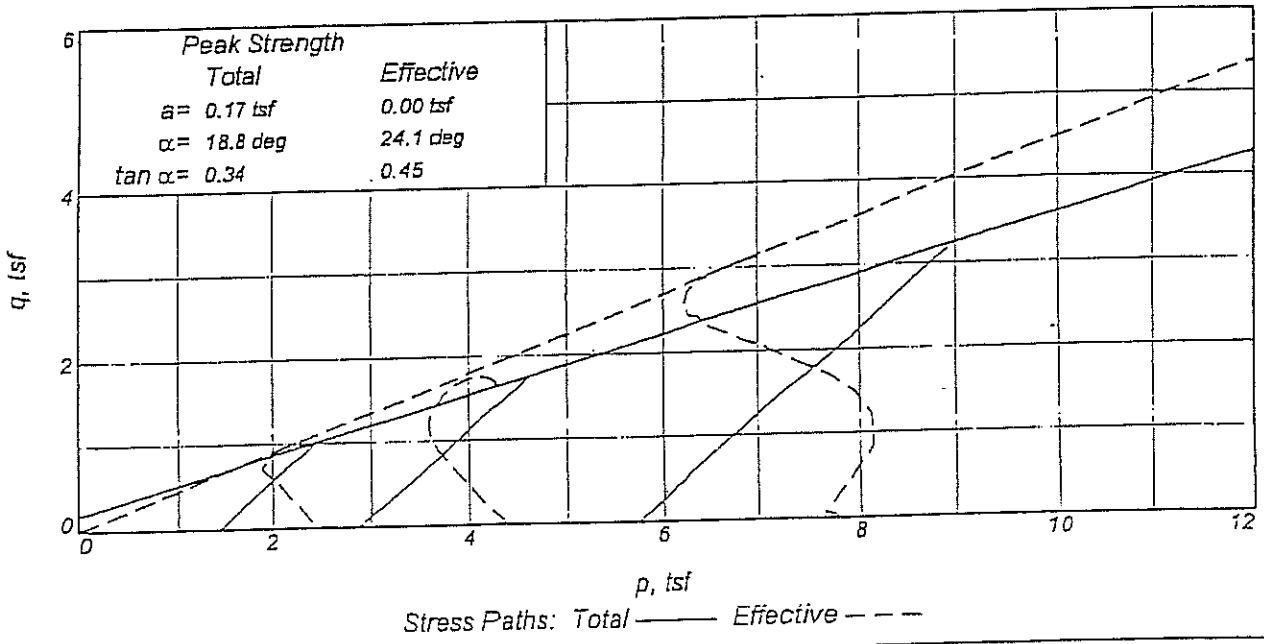
4











Client: Alliance Consulting
Project: Triaxial Test
Location: Boring #8874
Project No.: H-05278

Depth: 10.0-12.0'
Plate _____

Sample Number: 3

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC

Checked By: TH

5

2/9/2006
8:50 PM

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

Date:	2-1-05
Client:	Alliance Consulting
Project:	Triaxial Test Mach Mine #1 Johnston City, Illinois
Location:	Boring #8874
Depth:	10.0-12.0'
Sample Number:	3
Description:	Gray Mottled Brown Silty CLAY
Remarks:	
Type of Sample:	Shelby Tube - Undisturbed
Assumed Specific Gravity=2.65	LL=41.8 PL=17.7 PI=24.1
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	189.100			1279.000
Moisture content: Dry soil+tare, gms.	176.100			1072.200
Moisture content: Tare, gms.	115.700			103.200
Moisture, %	21.5	21.5	21.5	21.3
Moist specimen weight, gms.	1140.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.51	5.51	5.51	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.0	128.0	128.0	
Dry density, pcf	105.3	105.3	105.3	
Void ratio	0.5706	0.5706	0.5706	
Saturation, %	100.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.981 tsf at reading no. 24
Ult. Stress = 1.955 tsf at reading no. 30

R10407

(6)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	18.30	0.0	0.0	0.000	5.112	5.112	1.00	-1.00	5.112	0.000
1	0.0190	20.00	1.7	0.3	0.014	2.830	2.844	1.00	30.70	2.837	0.007
2	0.0400	21.60	3.3	0.7	0.026	2.426	2.452	1.01	36.30	2.439	0.013
3	0.0810	113.20	94.9	1.5	1.093	1.505	2.598	1.73	49.10	2.051	0.547
4	0.1010	129.80	111.5	1.8	1.280	1.318	2.597	1.97	51.70	1.958	0.640
5	0.1420	143.10	124.8	2.6	1.422	1.181	2.602	2.20	53.60	1.892	0.711
6	0.1620	161.50	143.2	2.9	1.625	1.159	2.784	2.40	53.90	1.972	0.813
7	0.1830	168.90	150.6	3.3	1.702	1.145	2.847	2.49	54.10	1.996	0.851
8	0.2030	174.80	156.5	3.7	1.763	1.138	2.900	2.55	54.20	2.019	0.881
9	0.2240	178.90	160.6	4.1	1.802	1.145	2.946	2.57	54.10	2.046	0.901
10	0.2440	182.30	164.0	4.4	1.833	1.145	2.978	2.60	54.10	2.061	0.916
11	0.2650	186.40	168.1	4.8	1.871	1.152	3.023	2.62	54.00	2.088	0.936
12	0.2850	188.10	169.8	5.2	1.883	1.166	3.049	2.61	53.80	2.108	0.941
13	0.3060	191.40	173.1	5.6	1.912	1.166	3.078	2.64	53.80	2.122	0.956
14	0.3260	193.10	174.8	5.9	1.923	1.181	3.104	2.63	53.60	2.142	0.962
15	0.3460	194.70	176.4	6.3	1.933	1.188	3.121	2.63	53.50	2.155	0.967
16	0.3670	196.40	178.1	6.7	1.944	1.202	3.146	2.62	53.30	2.174	0.972
17	0.3870	198.10	179.8	7.0	1.955	1.210	3.164	2.62	53.20	2.187	0.977
18	0.4080	198.10	179.8	7.4	1.947	1.224	3.171	2.59	53.00	2.197	0.973
19	0.4280	200.60	182.3	7.8	1.966	1.231	3.197	2.60	52.90	2.214	0.983
20	0.4490	200.60	182.3	8.1	1.958	1.238	3.196	2.58	52.80	2.217	0.979
21	0.4890	203.10	184.8	8.9	1.969	1.267	3.236	2.55	52.40	2.252	0.985
22	0.5300	204.70	186.4	9.6	1.970	1.289	3.259	2.53	52.10	2.274	0.985
23	0.5710	207.20	188.9	10.4	1.980	1.310	3.290	2.51	51.80	2.300	0.990
24	0.6120	208.90	190.6	11.1	1.981	1.332	3.313	2.49	51.50	2.323	0.991
25	0.6530	209.10	190.8	11.8	1.967	1.346	3.313	2.46	51.30	2.330	0.983
26	0.6940	211.40	193.1	12.6	1.974	1.361	3.334	2.45	51.10	2.348	0.987
27	0.7350	212.20	193.9	13.3	1.965	1.390	3.354	2.41	50.70	2.372	0.982
28	0.7790	213.90	195.6	14.1	1.964	1.404	3.368	2.40	50.50	2.386	0.982
29	0.8170	215.50	197.2	14.8	1.964	1.426	3.390	2.38	50.20	2.408	0.982
30	0.8380	215.50	197.2	15.2	1.955	1.433	3.388	2.36	50.10	2.410	0.978

7

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	154.800			1347.900
Moisture content: Dry soil+tare, gms.	145.800			1154.100
Moisture content: Tare, gms.	102.600			135.100
Moisture, %	20.8	20.9	20.9	19.0
Moist specimen weight, gms.	1142.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.49	5.49	5.49	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.7	128.7	128.7	
Dry density, pcf	106.5	106.5	106.5	
Void ratio	0.5536	0.5536	0.5536	
Saturation, %	99.7	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 3.418 tsf at reading no. 24
Ult. Stress = 3.250 tsf at reading no. 29

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	27.50	0.0	0.0	0.000	4.385	4.385	1.00	29.10	4.385	0.000
1	0.0190	134.00	106.5	0.3	1.241	3.254	4.495	1.38	44.80	3.875	0.620
2	0.0400	183.10	155.6	0.7	1.806	2.750	4.557	1.66	51.80	3.653	0.903
3	0.0600	218.90	191.4	1.1	2.214	2.484	4.698	1.89	55.50	3.591	1.107
4	0.0810	243.80	216.3	1.5	2.492	2.340	4.832	2.06	57.50	3.586	1.246
5	0.1010	264.60	237.1	1.8	2.721	2.254	4.975	2.21	58.70	3.614	1.361
6	0.1220	282.10	254.6	2.2	2.911	2.210	5.121	2.32	59.30	3.666	1.455
7	0.1420	295.40	267.9	2.6	3.052	2.182	5.233	2.40	59.70	3.707	1.526
8	0.1620	305.40	277.9	2.9	3.154	2.182	5.335	2.45	59.70	3.758	1.577
9	0.1830	314.60	287.1	3.3	3.245	2.189	5.434	2.48	59.60	3.811	1.623
10	0.2030	322.10	294.6	3.7	3.317	2.196	5.513	2.51	59.50	3.855	1.659
11	0.2240	327.10	299.6	4.1	3.360	2.218	5.578	2.52	59.20	3.898	1.680
12	0.2440	332.90	305.4	4.4	3.412	2.232	5.644	2.53	59.00	3.938	1.706
13	0.2650	336.20	308.7	4.8	3.435	2.254	5.689	2.52	58.70	3.971	1.718
14	0.2850	339.50	312.0	5.2	3.459	2.275	5.734	2.52	58.40	4.005	1.729
15	0.3060	343.70	316.2	5.6	3.491	2.297	5.788	2.52	58.10	4.042	1.746
16	0.3260	345.40	317.9	5.9	3.497	2.318	5.815	2.51	57.80	4.067	1.748
17	0.3670	348.70	321.2	6.7	3.505	2.369	5.874	2.48	57.10	4.121	1.752
18	0.4080	352.00	324.5	7.4	3.512	2.412	5.924	2.46	56.50	4.168	1.756
19	0.4490	353.70	326.2	8.2	3.502	2.441	5.943	2.43	56.10	4.192	1.751
20	0.4890	354.50	327.0	8.9	3.483	2.470	5.953	2.41	55.70	4.211	1.742
21	0.5300	355.40	327.9	9.7	3.464	2.498	5.963	2.39	55.30	4.230	1.732

(8)

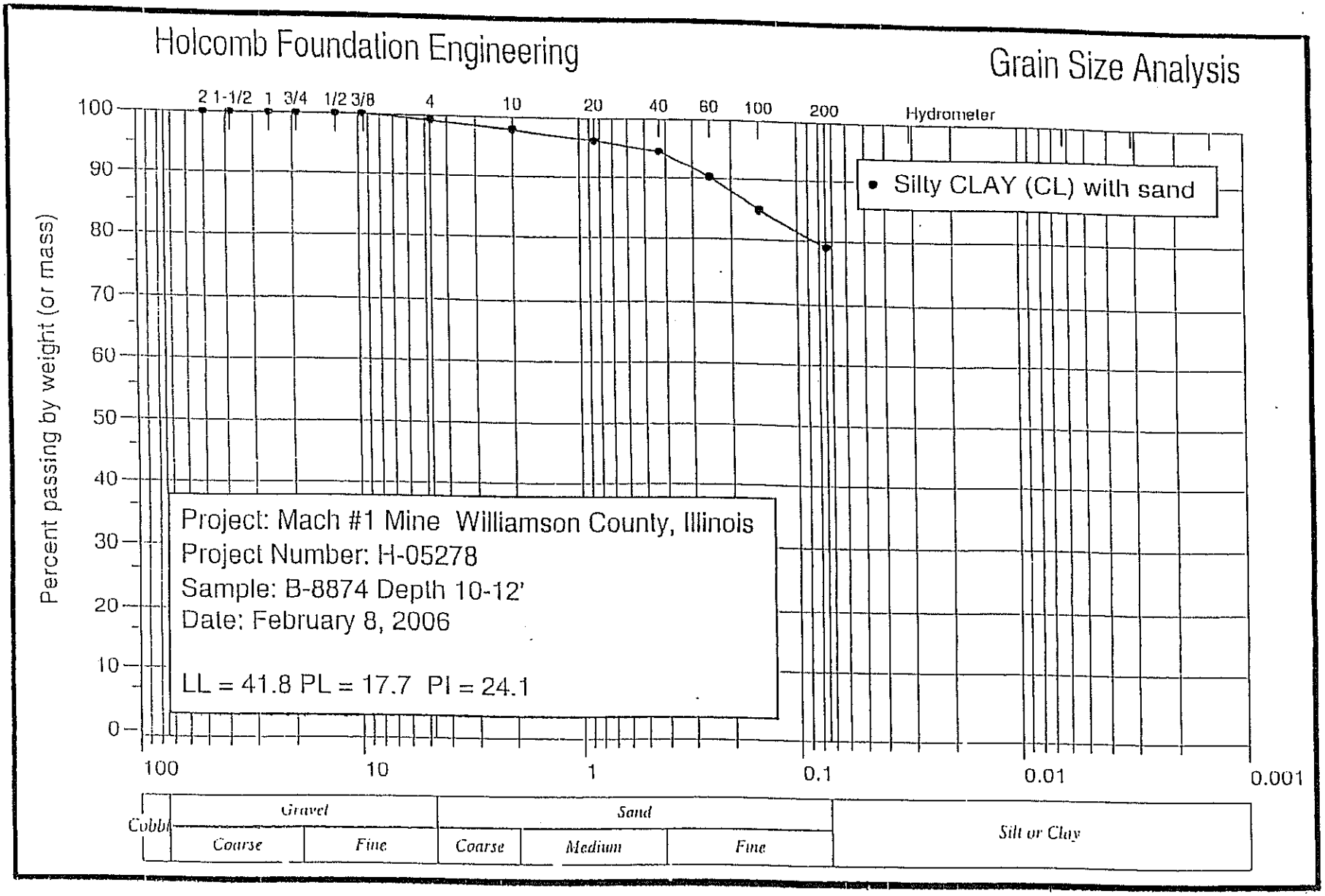
No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.5510	357.00	329.5	10.0	3.466	2.513	5.979	2.38	55.10	4.246	1.733
23	0.5920	356.20	328.7	10.8	3.429	2.534	5.964	2.35	54.80	4.249	1.715
24	0.6330	357.90	330.4	11.5	3.418	2.556	5.974	2.34	54.50	4.265	1.709
25	0.6730	357.00	329.5	12.3	3.381	2.585	5.966	2.31	54.10	4.275	1.690
26	0.7140	357.90	330.4	13.0	3.361	2.599	5.960	2.29	53.90	4.280	1.681
27	0.7550	357.90	330.4	13.7	3.332	2.614	5.946	2.27	53.70	4.280	1.666
28	0.7960	356.20	328.7	14.5	3.286	2.628	5.914	2.25	53.50	4.271	1.643
29	0.8370	355.40	327.9	15.2	3.250	2.635	5.885	2.23	53.40	4.260	1.625

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	248.400			1374.500
Moisture content: Dry soil+tare, gms.	226.700			1195.400
Moisture content: Tare, gms.	103.200			127.700
Moisture, %	17.6	17.8	17.8	16.8
Moist specimen weight, gms.	1184.7			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.54	5.54	5.54	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	132.3	132.5	132.5	
Dry density, pcf	112.5	112.5	112.5	
Void ratio	0.4707	0.4707	0.4707	
Saturation, %	98.9	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 6.334 tsf at reading no. 33
Ult. Stress = 6.334 tsf at reading no. 33

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	31.60	0.0	0.0	0.000	7.812	7.812	1.00	1.50	7.812	0.000
1	0.0190	39.90	8.3	0.3	0.091	7.690	7.781	1.01	3.20	7.735	0.045
2	0.0400	44.10	12.5	0.7	0.133	7.574	7.707	1.02	4.80	7.641	0.066
3	0.0600	175.60	144.0	1.1	1.666	7.308	8.974	1.23	8.50	8.141	0.833
4	0.0810	240.50	208.9	1.5	2.407	6.926	9.333	1.35	13.80	8.130	1.203
5	0.1010	291.30	259.7	1.8	2.981	6.466	9.447	1.46	20.20	7.956	1.491
6	0.1220	329.60	298.0	2.2	3.408	5.983	9.391	1.57	26.90	7.687	1.704
7	0.1420	362.00	330.4	2.6	3.764	5.479	9.244	1.69	33.90	7.361	1.882
8	0.1620	392.00	360.4	2.9	4.091	5.040	9.131	1.81	40.00	7.085	2.045
9	0.1830	412.80	381.2	3.3	4.310	4.666	8.976	1.92	45.20	6.821	2.155

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
10	0.2030	432.80	401.2	3.7	4.519	4.363	8.883	2.04	49.40	6.623	2.260
11	0.2240	446.90	415.3	4.0	4.660	4.140	8.800	2.13	52.50	6.470	2.330
12	0.2440	465.20	433.6	4.4	4.847	3.982	8.828	2.22	54.70	6.405	2.423
13	0.2650	471.00	439.4	4.8	4.892	3.852	8.744	2.27	56.50	6.298	2.446
14	0.2850	483.50	451.9	5.1	5.012	3.766	8.778	2.33	57.70	6.272	2.506
15	0.3060	490.20	458.6	5.5	5.066	3.694	8.760	2.37	58.70	6.227	2.533
16	0.3260	503.50	471.9	5.9	5.193	3.643	8.837	2.43	59.40	6.240	2.597
17	0.3460	516.80	485.2	6.2	5.319	3.607	8.926	2.47	59.90	6.267	2.660
18	0.3670	521.80	490.2	6.6	5.352	3.586	8.938	2.49	60.20	6.262	2.676
19	0.3870	530.10	498.5	7.0	5.422	3.571	8.993	2.52	60.40	6.282	2.711
20	0.4080	538.40	506.8	7.4	5.490	3.564	9.054	2.54	60.50	6.309	2.745
21	0.4280	543.40	511.8	7.7	5.522	3.564	9.086	2.55	60.50	6.325	2.761
22	0.4490	554.30	522.7	8.1	5.617	3.571	9.188	2.57	60.40	6.380	2.808
23	0.4690	565.90	534.3	8.5	5.719	3.578	9.297	2.60	60.30	6.438	2.859
24	0.4890	567.60	536.0	8.8	5.714	3.578	9.293	2.60	60.30	6.436	2.857
25	0.5300	581.70	550.1	9.6	5.817	3.600	9.417	2.62	60.00	6.509	2.909
26	0.5710	591.70	560.1	10.3	5.874	3.636	9.510	2.62	59.50	6.573	2.937
27	0.6120	605.00	573.4	11.0	5.964	3.665	9.629	2.63	59.10	6.647	2.982
28	0.6530	615.00	583.4	11.8	6.018	3.701	9.719	2.63	58.60	6.710	3.009
29	0.6940	626.70	595.1	12.5	6.087	3.737	9.824	2.63	58.10	6.780	3.044
30	0.7350	638.30	606.7	13.3	6.153	3.773	9.926	2.63	57.60	6.849	3.077
31	0.7760	649.10	617.5	14.0	6.209	3.816	10.025	2.63	57.00	6.921	3.105
32	0.8170	657.50	625.9	14.7	6.240	3.852	10.092	2.62	56.50	6.972	3.120
33	0.8390	669.90	638.3	15.1	6.334	3.866	10.200	2.64	56.30	7.033	3.167


Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
Silty CLAY (CL) with sand
Project: Mach #1 Mine Williamson County, Illinois
Project Number: H-05278
Sample: B-8874 Depth 10-12'
Date: February 8, 2006
LL = 41.8 PL = 17.7 PI = 24.1
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

17 of 57

R16412

Holcomb Foundation Engineering Company

Laboratory Testing Results

2/8/2006

Project: Mach #1 Mine

Project No: H-05278

Sieve Analysis - ASTM C136-96a

Sample: Silty CLAY (CL)

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
1.5000	38.1000	1 -1/2"	0.0	0.0	100.0
1.0000	25.4000	1"	0.0	0.0	100.0
0.7500	19.1000	3/4"	0.0	0.0	100.0
0.5000	12.7000	1/2"	0.0	0.0	100.0
3.7500	9.5200	3/8"	0.0	0.0	100.0
0.1870	4.7600	No. 4	2.1	0.9	99.1
0.0790	2.0000	No. 10	4.6	2.0	98.0
0.0469	1.1800	No. 16	4.6	2.0	98.0
0.0331	0.8500	No. 20	8.6	3.8	96.2
0.0165	0.4200	No. 40	12.6	5.5	94.5
0.0117	0.2980	No. 50	12.6	5.5	94.5
0.0083	0.2500	No. 60	22.2	9.8	90.2
0.0059	0.1490	No. 100	34.6	15.2	84.8
0.0029	0.0740	No. 200	47.7	21.0	79.0

Total Weight in Grams 227.20

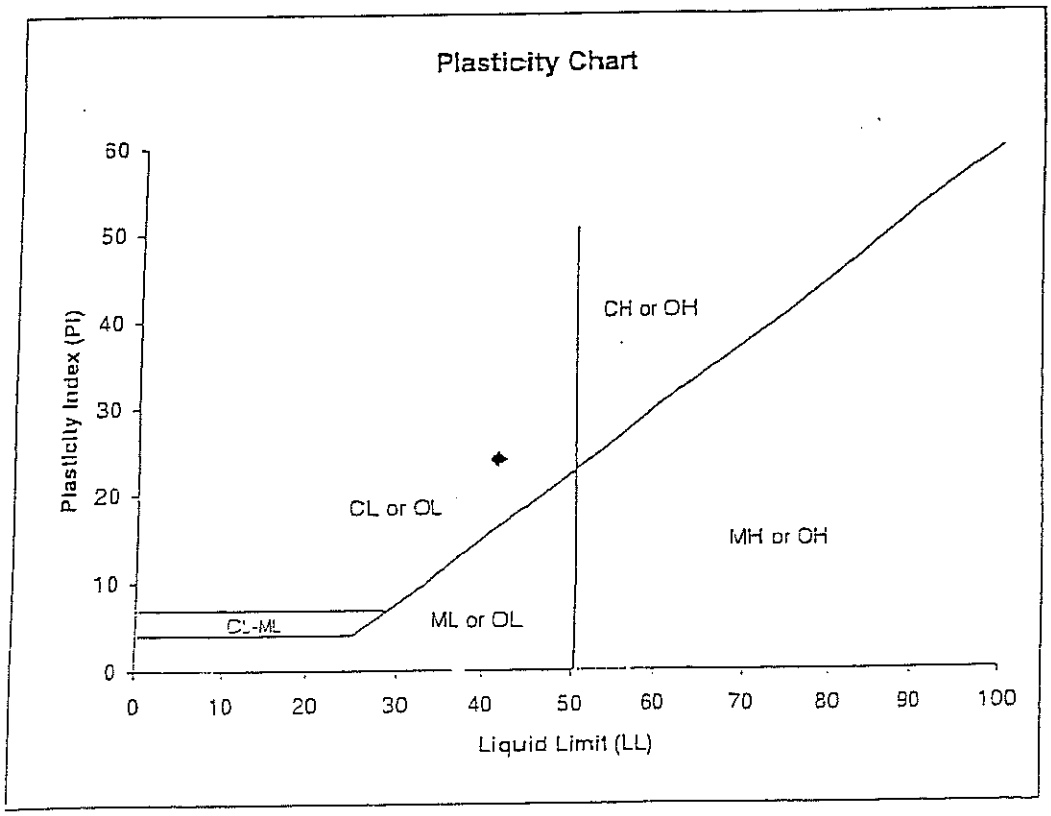
Holcomb Foundation Engineering Company

Laboratory Testing Results

Project: Mach #1 Mine
Project No: H-05278

Sample	1	2	3
Dish Number	LL_1	LL_2	LL_3
Mass of can, W_1 (g)	34.70		
Mass of can + moist soil, W_2 (g)	62.84		
Mass of can + dry soil, W_3 (g)	54.52		
Moisture content, w (%)	41.98		
Number of blows, N	24		
Liquid Limit, LL	41.8		

Dish Number	PL_1
Mass of can, W_1 (g)	39.76
Mass of can + moist soil, W_2 (g)	54.79
Mass of can + dry soil, W_3 (g)	52.53
Plastic Limit, PL	17.7
PI =	24.1



19 of 57

R10414

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

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Box 393 Wood Road
Carbondale, IL 62901

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P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

November 30, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Pond Creek Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on November 17, 2006, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification: Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)

Proctor Test Results:
Maximum Dry Unit Weight: 124.6 PCF
Optimum Moisture Content: 9.3 %

Specific Gravity: 2.37

Triaxial Test Results:
Effective Cohesion: 0 PSF
Effective Phi Angle: 33.7 Degrees

Permeability: 2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

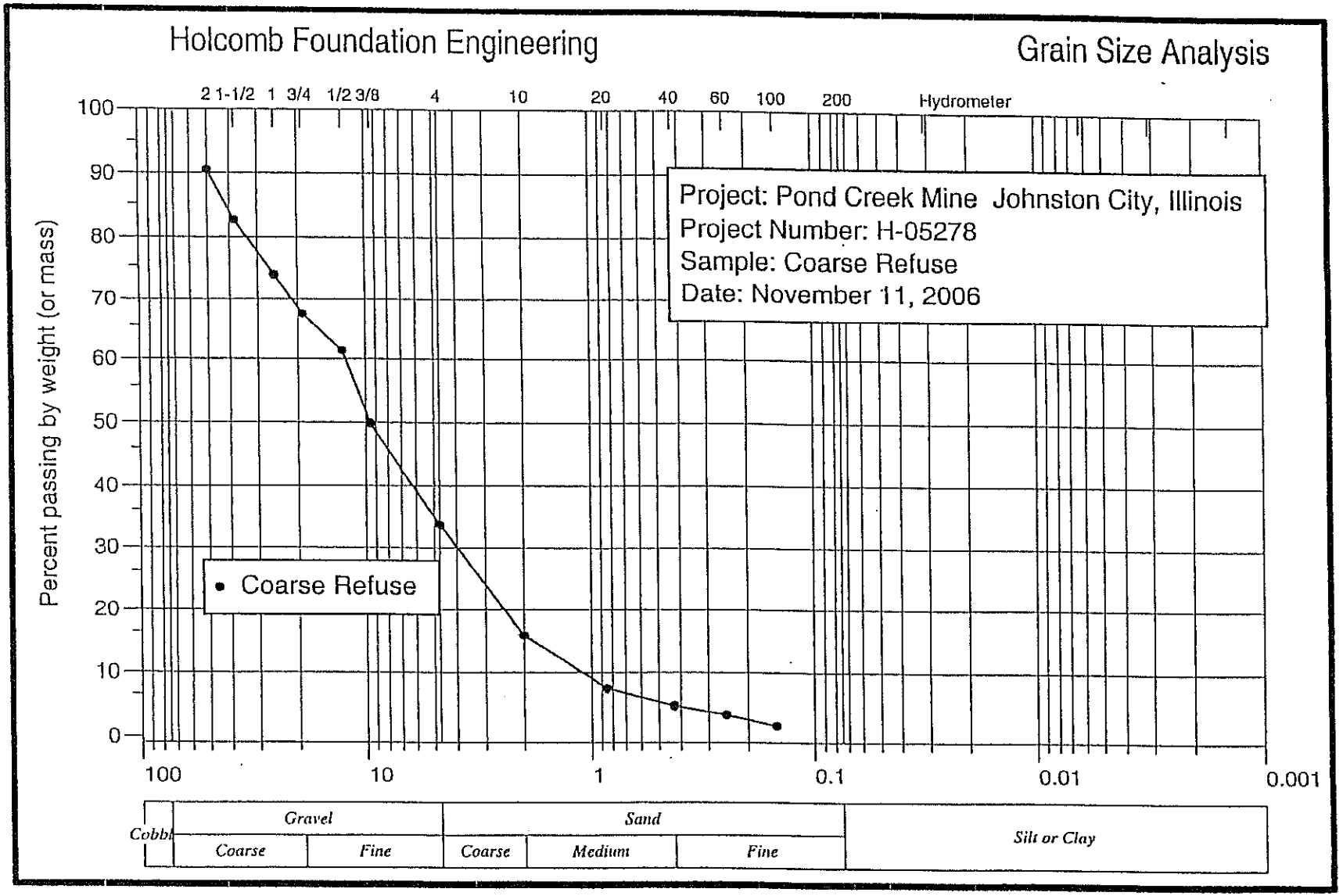
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting



21 of 57

R16416
15

22 / 51 (16) R16417

Holcomb Foundation Engineering Company

Laboratory Testing Results

11/30/2006

Project: Coarse Refuse Disposal Area
Pond Creek Mine Johnston City, Illinois

Project No: H-05317

Sieve Analysis - ASTM C136-96a

Sample: Coarse Refuse

Sieve Openings Inches	Sieve Openings Millimeters	US Standard Sieve Size	Weight Retained	Percent Retained	Percent Finer
3	76.2	3"	0.0	0.0	100.0
2.0000	50.8100	2"	619.6	9.5	90.5
1.5000	38.1000	1 -1/2"	1124.0	17.2	82.8
1.0000	25.4000	1"	1696.2	25.9	74.1
0.7500	19.1000	3/4"	2110.9	32.3	67.7
0.5000	12.7000	1/2"	2513.0	38.4	61.6
3.7500	9.5200	3/8"	3263.7	49.9	50.1
0.1870	4.7600	No. 4	4310.7	65.9	34.1
0.0790	2.0000	No. 10	5470.5	83.6	16.4
0.0469	1.1800	No. 16			
0.0331	0.8500	No. 20	6004.4	91.8	8.2
0.0165	0.4200	No. 40	6178.9	94.4	5.6
0.0117	0.2980	No. 50			
0.0083	0.2500	No. 60	6267.8	95.8	4.2
0.0059	0.1490	No. 100			
0.0029	0.0740	No. 200	6372.4	97.4	2.6

Total Weight in Grams **6542.80**

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

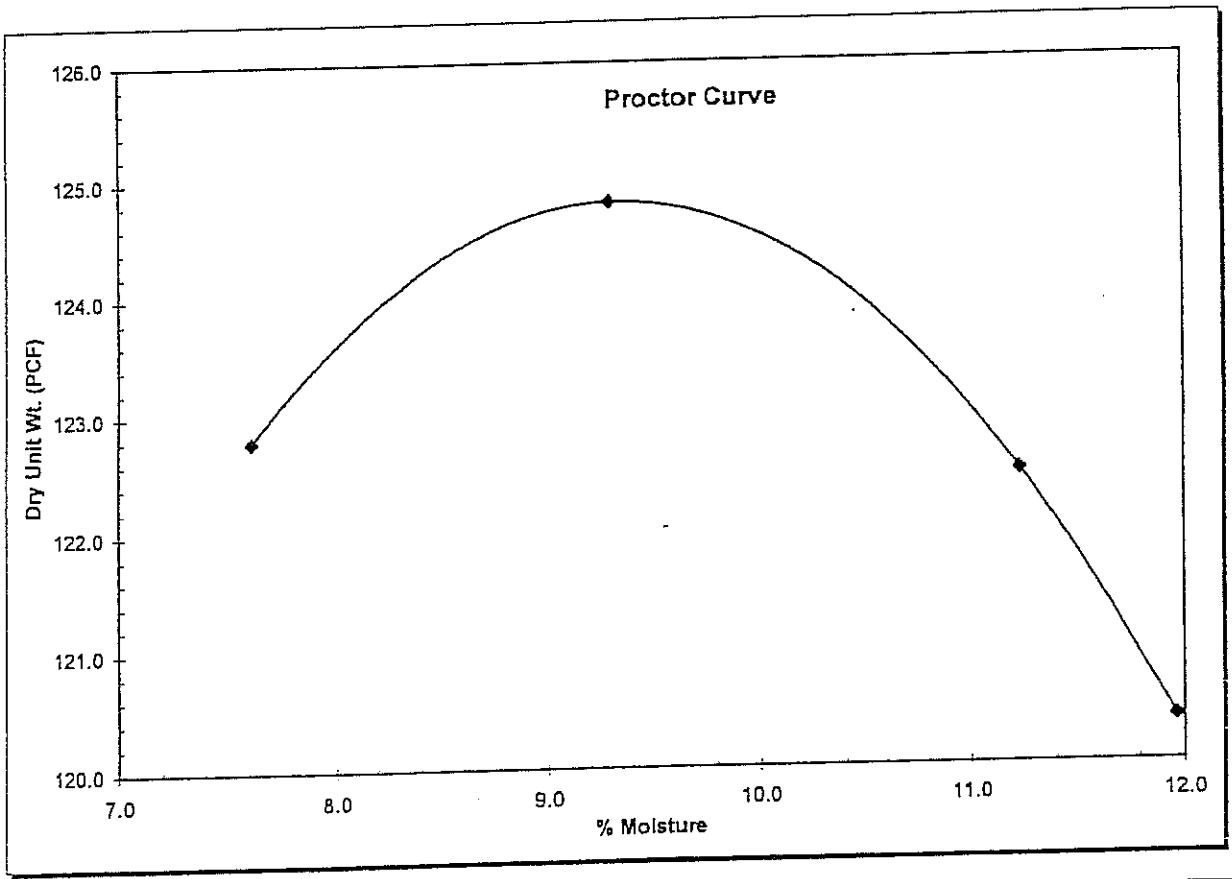
Date: 11/30/2006

Proctor Test Results

Soil Classification:	Gray Coarse Refuse
Maximum Dry Density (PCF)	124.8
Optimum Moisture Content (%)	9.3

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
7.6	122.8
11.2	122.5
12.0	120.4
9.3	124.8



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Permeability Tests Results

Laboratory Tests
Coarse Refuse
Pond Creek Mine - Johnston City, Illinois

Date: 11/30/2006

Client: Pond Creek Mine
Johnston City, Illinois

Project No.: H-05278

Sample	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse		7.7	11.8	119.3	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

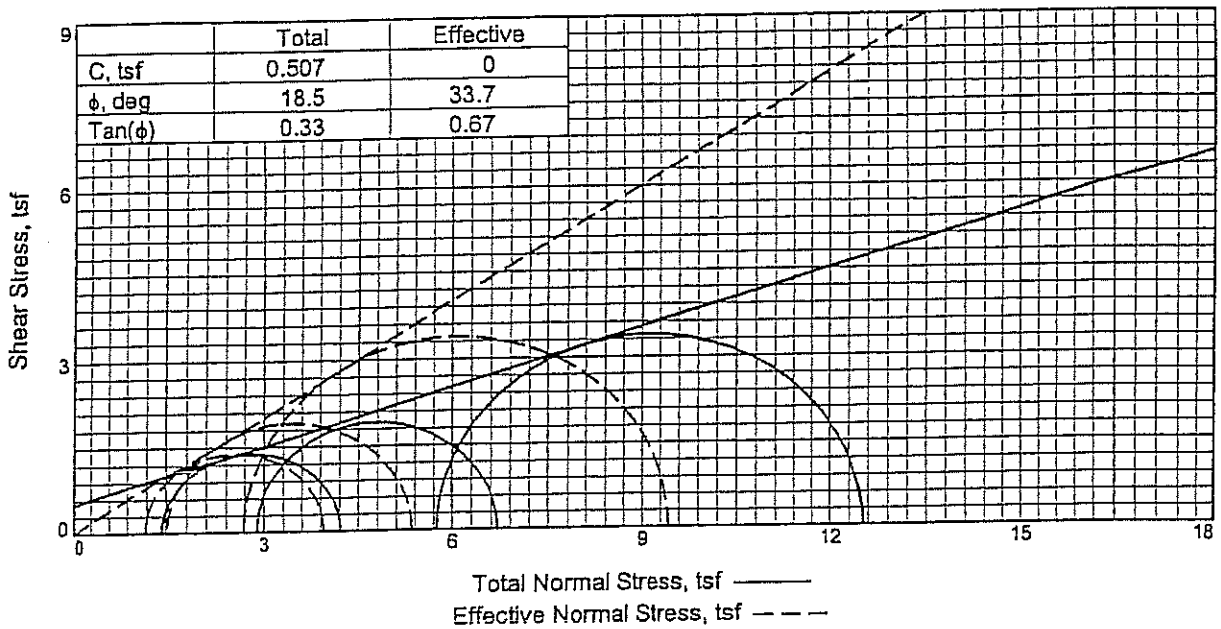
PERMEABILITY TEST RESULTS

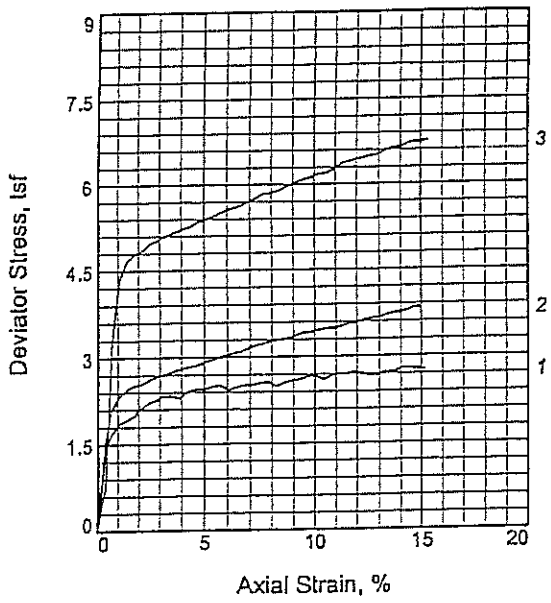
Project	Pond Creek Mine	Boring/Sample Depth		Coarse Refuse	
Project #	H-05278	Classification			
Date	11/30/2006	Diameter	2.8	Inch	
		Length	5.6	Inch	

In Place Mc		After Test Mc		Unit Weight (PCF)	
Wet Wt.	195.3	Wet Wt.	1300.4	Sample Wt.	1161.8
Pan	94.2	Pan	103.1		
Dry Wt.	188.1	Dry Wt.	1173.6	Wet UW=	128.5
Mc (%)	7.7	Mc (%)	11.8	Dry UW=	119.3

Time(hrs)	Time(min)	Quantity (cc)	Head (psi)	Permeability (cm/sec)
7	26	24.7		
7	34	8.2	1	1.75E-04
7	33	24.5		
7	45	2.7	1	1.54E-04
7	47	0.8	1	1.44E-04
9	16	24.4		
9	23	9.6	1	1.79E-04
9	30	0.9	1	1.43E-04
		Average Permeability		1.63E-04

	Total	Effective
C, tsf	0.507	0
ϕ, deg	18.5	33.7
Tan(ϕ)	0.33	0.67





Sample No.		1	2	3
Initial	Water Content,	10.1	10.8	10.3
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	97.0	99.8	99.3
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
At Test	Water Content,	10.4	10.8	10.4
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
Strain rate, in./min.		0.01	0.01	0.01
Back Pressure, tsf		3.60	3.60	2.16
Cell Pressure, tsf		5.04	6.48	7.92
Fail. Stress, tsf		2.78	3.83	6.76
Total Pore Pr., tsf		3.86	4.96	5.23
Ult. Stress, tsf		2.77	3.83	6.76
Total Pore Pr., tsf		3.85	4.95	5.23
$\bar{\sigma}_1$ Failure, tsf		3.96	5.35	9.44
$\bar{\sigma}_3$ Failure, tsf		1.18	1.52	2.69

Type of Test: CU with Pore Pressures
Sample Type: Remolded
Description: Coarse Coal Refuse

Assumed Specific Gravity= 2.37
Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

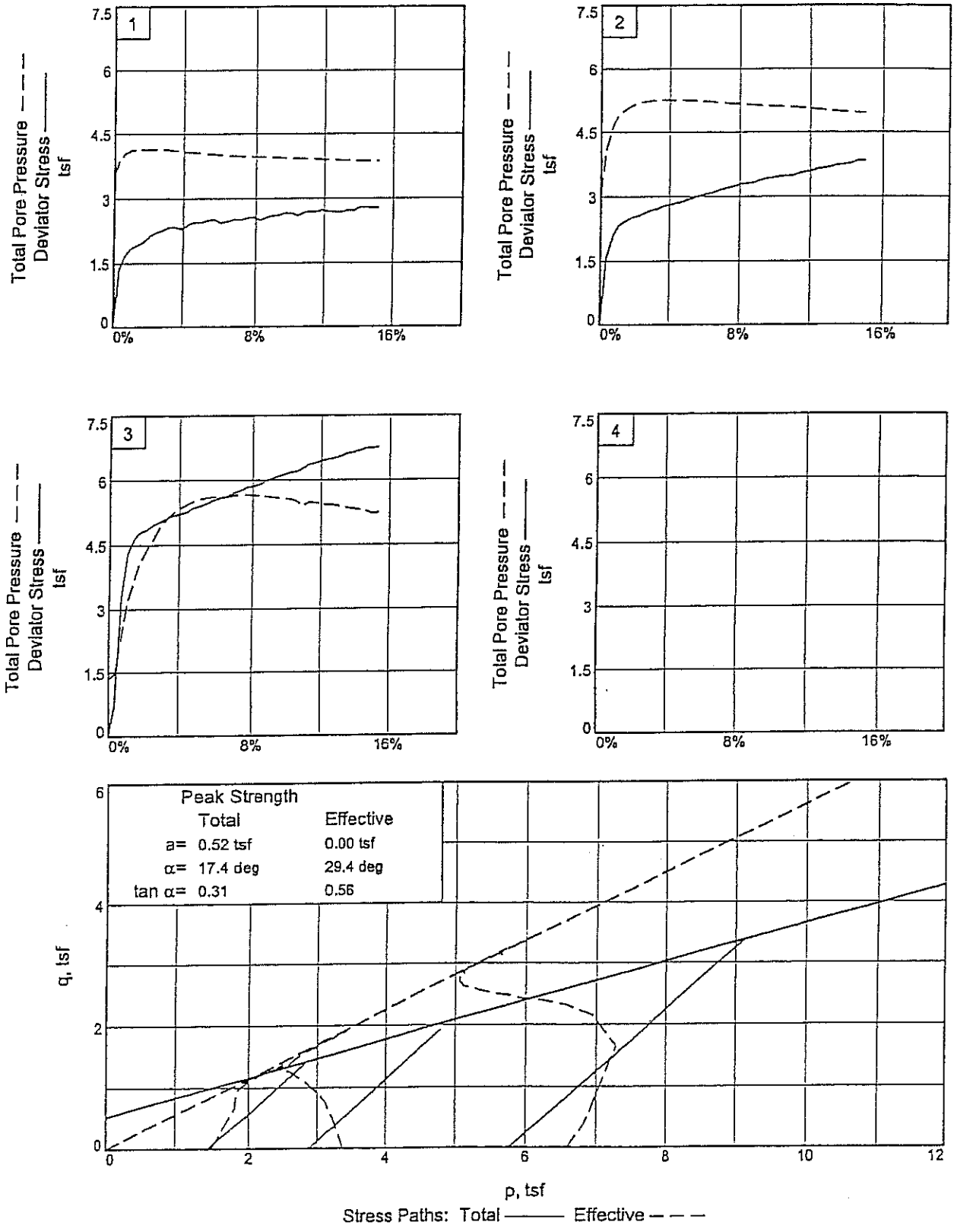
Location: Coarse Refuse Stockpile
Sample Number: Coarse Refuse
Proj. No.: H-05278 **Date:** 11/17/06

TRIAXIAL SHEAR TEST REPORT

HOLCOMB FOUNDATION ENGINEERING CO.

Plate _____

Tested By: LC **Checked By:** TH



Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Coarse Refuse Stockpile
Project No.: H-05278
Sample Number: Coarse Refuse
Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC **Checked By:** TH

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

11/30/2006
10:19 AM

Date:	11/17/06
Client:	Pond Creek Mine
Project:	Coarse Refuse Laboratory Tests
Location:	Coarse Refuse Stockpile
Sample Number:	Coarse Refuse
Description:	Coarse Coal Refuse
Remarks:	
Type of Sample:	Remolded
Assumed Specific Gravity=2.37	LL= PL= PI=
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	226.800			1320.700
Moisture content: Dry soil+tare, gms.	218.600			1195.800
Moisture content: Tare, gms.	137.500			107.600
Moisture, %	10.1	10.4	10.4	11.5
Moist specimen weight, gms.	1193.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.65	5.65	5.65	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.6	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2470	0.2470	0.2470	
Saturation, %	97.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 2.778 tsf at reading no. 41
Ult. Stress = 2.767 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0010	46.60	0.0	0.0	0.000	1.498	1.498	1.00	49.20	1.498	0.000
1	0.0180	160.60	114.0	0.3	1.329	1.152	2.481	2.15	54.00	1.816	0.664
2	0.0390	189.70	143.1	0.7	1.662	1.001	2.663	2.66	56.10	1.832	0.831
3	0.0590	205.60	159.0	1.0	1.840	0.929	2.769	2.98	57.10	1.849	0.920
4	0.0800	212.20	165.6	1.4	1.909	0.907	2.816	3.10	57.40	1.862	0.955
5	0.1000	218.90	172.3	1.8	1.979	0.900	2.879	3.20	57.50	1.890	0.990
6	0.1200	232.20	185.6	2.1	2.125	0.900	3.025	3.36	57.50	1.962	1.062
7	0.1410	240.50	193.9	2.5	2.211	0.907	3.118	3.44	57.40	2.013	1.106
8	0.1610	245.50	198.9	2.8	2.260	0.914	3.174	3.47	57.30	2.044	1.130
9	0.1820	252.20	205.6	3.2	2.327	0.922	3.249	3.53	57.20	2.085	1.164
10	0.2020	253.80	207.2	3.6	2.337	0.936	3.273	3.50	57.00	2.104	1.168
11	0.2230	250.50	203.9	3.9	2.291	0.958	3.248	3.39	56.70	2.103	1.145
12	0.2430	261.30	214.7	4.3	2.403	0.972	3.375	3.47	56.50	2.173	1.201
13	0.2630	266.30	219.7	4.6	2.450	0.979	3.429	3.50	56.40	2.204	1.225
14	0.2840	266.30	219.7	5.0	2.440	0.994	3.434	3.46	56.20	2.214	1.220
15	0.3040	272.10	225.5	5.4	2.495	1.008	3.503	3.48	56.00	2.256	1.248
16	0.3250	274.60	228.0	5.7	2.513	1.022	3.536	3.46	55.80	2.279	1.257
17	0.3450	268.00	221.4	6.1	2.431	1.037	3.468	3.34	55.60	2.252	1.216
18	0.3660	273.00	226.4	6.5	2.476	1.051	3.527	3.36	55.40	2.289	1.238
19	0.3860	278.00	231.4	6.8	2.521	1.058	3.580	3.38	55.30	2.319	1.261
20	0.4070	278.00	231.4	7.2	2.511	1.066	3.577	3.36	55.20	2.321	1.256
21	0.4270	283.00	236.4	7.5	2.556	1.073	3.629	3.38	55.10	2.351	1.278
22	0.4470	284.60	238.0	7.9	2.563	1.080	3.643	3.37	55.00	2.362	1.282
23	0.4680	278.80	232.2	8.3	2.491	1.087	3.578	3.29	54.90	2.333	1.245
24	0.4880	286.30	239.7	8.6	2.561	1.087	3.648	3.36	54.90	2.368	1.281
25	0.5090	290.40	243.8	9.0	2.594	1.094	3.689	3.37	54.80	2.392	1.297
26	0.5290	292.10	245.5	9.3	2.602	1.102	3.704	3.36	54.70	2.403	1.301
27	0.5500	298.80	252.2	9.7	2.662	1.109	3.771	3.40	54.60	2.440	1.331
28	0.5700	299.60	253.0	10.1	2.660	1.116	3.776	3.38	54.50	2.446	1.330
29	0.5910	294.60	248.0	10.4	2.597	1.116	3.713	3.33	54.50	2.415	1.299
30	0.6110	302.10	255.5	10.8	2.665	1.123	3.788	3.37	54.40	2.456	1.333
31	0.6310	306.30	259.7	11.2	2.698	1.130	3.828	3.39	54.30	2.479	1.349
32	0.6520	306.30	259.7	11.5	2.687	1.130	3.817	3.38	54.30	2.474	1.343
33	0.6720	312.10	265.5	11.9	2.736	1.145	3.881	3.39	54.10	2.513	1.368
34	0.6930	309.60	263.0	12.2	2.699	1.145	3.843	3.36	54.10	2.494	1.349
35	0.7130	308.80	262.2	12.6	2.680	1.152	3.832	3.33	54.00	2.492	1.340
36	0.7340	309.60	263.0	13.0	2.676	1.159	3.835	3.31	53.90	2.497	1.338
37	0.7540	315.40	268.8	13.3	2.724	1.166	3.891	3.34	53.80	2.528	1.362
38	0.7750	316.20	269.6	13.7	2.721	1.166	3.887	3.33	53.80	2.527	1.360
39	0.7950	323.70	277.1	14.1	2.785	1.181	3.966	3.36	53.60	2.573	1.392
40	0.8150	325.40	278.8	14.4	2.790	1.181	3.971	3.36	53.60	2.576	1.395
41	0.8360	325.40	278.8	14.8	2.778	1.181	3.959	3.35	53.60	2.570	1.389
42	0.8560	325.40	278.8	15.1	2.767	1.188	3.955	3.33	53.50	2.571	1.383

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	211.600			1335.900
Moisture content: Dry soil+tare, gms.	203.200			1222.200
Moisture content: Tare, gms.	125.200			134.800
Moisture, %	10.8	10.8	10.8	10.5
Moist specimen weight, gms.	1175.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.57	5.57	5.57	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.5	130.5	130.5	
Dry density, pcf	117.8	117.8	117.8	
Void ratio	0.2558	0.2558	0.2558	
Saturation, %	99.8	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 3.829 tsf at reading no. 40
Ult. Stress = 3.828 tsf at reading no. 41

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	51.60	0.0	0.0	0.000	3.377	3.377	1.00	43.10	3.377	0.000
1	0.0190	185.60	134.0	0.3	1.562	2.340	3.902	1.67	57.50	3.121	0.781
2	0.0400	233.00	181.4	0.7	2.106	1.814	3.920	2.16	64.80	2.867	1.053
3	0.0600	253.00	201.4	1.1	2.330	1.562	3.892	2.49	68.30	2.727	1.165
4	0.0810	263.80	212.2	1.5	2.445	1.433	3.878	2.71	70.10	2.655	1.223
5	0.1010	270.50	218.9	1.8	2.513	1.346	3.860	2.87	71.30	2.603	1.257
6	0.1220	274.60	223.0	2.2	2.550	1.289	3.839	2.98	72.10	2.564	1.275
7	0.1420	281.30	229.7	2.5	2.617	1.260	3.877	3.08	72.50	2.569	1.309
8	0.1620	287.10	235.5	2.9	2.674	1.238	3.912	3.16	72.80	2.575	1.337
9	0.1830	291.30	239.7	3.3	2.711	1.231	3.942	3.20	72.90	2.587	1.355
10	0.2030	297.10	245.5	3.6	2.766	1.224	3.990	3.26	73.00	2.607	1.383
11	0.2240	301.30	249.7	4.0	2.802	1.224	4.026	3.29	73.00	2.625	1.401
12	0.2440	305.40	253.8	4.4	2.838	1.224	4.062	3.32	73.00	2.643	1.419
13	0.2650	309.60	258.0	4.8	2.873	1.224	4.097	3.35	73.00	2.661	1.437
14	0.2850	315.40	263.8	5.1	2.927	1.231	4.158	3.38	72.90	2.695	1.463
15	0.3060	320.40	268.8	5.5	2.970	1.238	4.209	3.40	72.80	2.724	1.485
16	0.3260	326.20	274.6	5.9	3.023	1.246	4.269	3.43	72.70	2.757	1.512
17	0.3460	330.40	278.8	6.2	3.058	1.253	4.310	3.44	72.60	2.782	1.529
18	0.3670	334.60	283.0	6.6	3.091	1.267	4.358	3.44	72.40	2.813	1.546
19	0.3870	341.20	289.6	6.9	3.151	1.282	4.433	3.46	72.20	2.857	1.576
20	0.4080	346.20	294.6	7.3	3.192	1.296	4.488	3.46	72.00	2.892	1.596
21	0.4280	351.20	299.6	7.7	3.234	1.310	4.544	3.47	71.80	2.927	1.617

No.	Def. Dial In.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	357.00	305.4	8.1	3.283	1.318	4.601	3.49	71.70	2.959	1.642
23	0.4690	359.50	307.9	8.4	3.297	1.332	4.629	3.48	71.50	2.981	1.649
24	0.4890	362.80	311.2	8.8	3.319	1.339	4.659	3.48	71.40	2.999	1.660
25	0.5100	368.70	317.1	9.2	3.368	1.346	4.715	3.50	71.30	3.031	1.684
26	0.5300	374.50	322.9	9.5	3.416	1.361	4.777	3.51	71.10	3.069	1.708
27	0.5510	377.00	325.4	9.9	3.429	1.368	4.797	3.51	71.00	3.082	1.714
28	0.5710	381.20	329.6	10.2	3.459	1.368	4.827	3.53	71.00	3.098	1.730
29	0.5920	384.50	332.9	10.6	3.479	1.382	4.861	3.52	70.80	3.122	1.739
30	0.6120	386.20	334.6	11.0	3.483	1.390	4.872	3.51	70.70	3.131	1.741
31	0.6330	392.00	340.4	11.4	3.528	1.397	4.925	3.53	70.60	3.161	1.764
32	0.6530	397.00	345.4	11.7	3.565	1.411	4.977	3.53	70.40	3.194	1.783
33	0.6730	400.30	348.7	12.1	3.585	1.426	5.010	3.51	70.20	3.218	1.792
34	0.6940	406.10	354.5	12.5	3.629	1.440	5.069	3.52	70.00	3.254	1.814
35	0.7140	410.30	358.7	12.8	3.657	1.454	5.111	3.51	69.80	3.283	1.828
36	0.7350	413.60	362.0	13.2	3.674	1.469	5.143	3.50	69.60	3.306	1.837
37	0.7550	420.30	368.7	13.6	3.727	1.483	5.210	3.51	69.40	3.347	1.863
38	0.7760	423.60	372.0	13.9	3.744	1.498	5.242	3.50	69.20	3.370	1.872
39	0.7960	427.80	376.2	14.3	3.770	1.505	5.275	3.51	69.10	3.390	1.885
40	0.8170	435.30	383.7	14.7	3.829	1.519	5.348	3.52	68.90	3.434	1.914
41	0.8370	436.90	385.3	15.0	3.828	1.526	5.355	3.51	68.80	3.441	1.914

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	184.300			1333.800
Moisture content: Dry soil+tare, gms.	177.100			1230.400
Moisture content: Tare, gms.	107.500			135.300
Moisture, %	10.3	10.4	10.4	9.4
Moist specimen weight, gms.	1185.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.60	5.60	5.60	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.9	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2468	0.2468	0.2468	
Saturation, %	99.3	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 6.758 tsf at reading no. 42
Ult. Stress = 6.758 tsf at reading no. 42

No.	Def. Dial In.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	25.00	0.0	0.0	0.000	6.588	6.588	1.00	18.50	6.588	0.000
1	0.0190	88.20	63.2	0.3	0.736	6.458	7.195	1.11	20.30	6.827	0.368
2	0.0400	309.60	284.6	0.7	3.304	5.623	8.927	1.59	31.90	7.275	1.652
3	0.0600	397.00	372.0	1.1	4.303	4.795	9.098	1.90	43.40	6.947	2.152
4	0.0810	428.60	403.6	1.4	4.651	4.234	8.885	2.10	51.20	6.559	2.326
5	0.1010	441.90	416.9	1.8	4.787	3.830	8.617	2.25	56.80	6.224	2.393
6	0.1220	449.40	424.4	2.2	4.854	3.521	8.375	2.38	61.10	5.948	2.427
7	0.1420	460.20	435.2	2.5	4.960	3.283	8.243	2.51	64.40	5.763	2.480
8	0.1620	467.70	442.7	2.9	5.027	3.017	8.044	2.67	68.10	5.530	2.513
9	0.1830	476.00	451.0	3.3	5.101	2.837	7.938	2.80	70.60	5.387	2.551
10	0.2030	483.50	458.5	3.6	5.167	2.693	7.860	2.92	72.60	5.276	2.583
11	0.2240	489.30	464.3	4.0	5.212	2.585	7.797	3.02	74.10	5.191	2.606
12	0.2440	495.20	470.2	4.4	5.258	2.491	7.750	3.11	75.40	5.120	2.629
13	0.2650	505.20	480.2	4.7	5.349	2.419	7.768	3.21	76.40	5.094	2.675
14	0.2850	511.00	486.0	5.1	5.394	2.369	7.762	3.28	77.10	5.066	2.697
15	0.3060	518.50	493.5	5.5	5.455	2.333	7.788	3.34	77.60	5.060	2.728
16	0.3260	526.80	501.8	5.8	5.526	2.304	7.830	3.40	78.00	5.067	2.763
17	0.3460	533.50	508.5	6.2	5.579	2.297	7.875	3.43	78.10	5.086	2.789
18	0.3670	539.30	514.3	6.6	5.620	2.326	7.945	3.42	77.70	5.135	2.810
19	0.3870	548.40	523.4	6.9	5.697	2.275	7.972	3.50	78.40	5.124	2.849
20	0.4080	555.90	530.9	7.3	5.756	2.261	8.016	3.55	78.60	5.139	2.878
21	0.4280	565.90	540.9	7.6	5.841	2.261	8.102	3.58	78.60	5.181	2.921

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	569.20	544.2	8.0	5.853	2.268	8.121	3.58	78.50	5.195	2.927
23	0.4690	575.10	550.1	8.4	5.894	2.282	8.176	3.58	78.30	5.229	2.947
24	0.4890	584.20	559.2	8.7	5.968	2.297	8.265	3.60	78.10	5.281	2.984
25	0.5100	592.50	567.5	9.1	6.031	2.311	8.343	3.61	77.90	5.327	3.016
26	0.5300	599.20	574.2	9.5	6.079	2.333	8.411	3.61	77.60	5.372	3.039
27	0.5510	605.90	580.9	9.8	6.124	2.354	8.479	3.60	77.30	5.416	3.062
28	0.5710	613.30	588.3	10.2	6.178	2.362	8.539	3.62	77.20	5.450	3.089
29	0.5920	617.50	592.5	10.6	6.196	2.405	8.601	3.58	76.60	5.503	3.098
30	0.6120	626.70	601.7	10.9	6.267	2.527	8.794	3.48	74.90	5.661	3.133
31	0.6330	638.30	613.3	11.3	6.361	2.426	8.787	3.62	76.30	5.607	3.180
32	0.6530	644.10	619.1	11.7	6.395	2.448	8.843	3.61	76.00	5.646	3.198
33	0.6730	650.80	625.8	12.0	6.438	2.477	8.915	3.60	75.60	5.696	3.219
34	0.6940	656.60	631.6	12.4	6.470	2.498	8.968	3.59	75.30	5.733	3.235
35	0.7140	662.50	637.5	12.8	6.504	2.506	9.009	3.60	75.20	5.758	3.252
36	0.7350	669.10	644.1	13.1	6.543	2.542	9.085	3.57	74.70	5.813	3.271
37	0.7550	678.30	653.3	13.5	6.609	2.563	9.172	3.58	74.40	5.868	3.305
38	0.7760	684.10	659.1	13.9	6.639	2.585	9.224	3.57	74.10	5.904	3.319
39	0.7960	690.70	665.7	14.2	6.678	2.614	9.291	3.55	73.70	5.952	3.339
40	0.8170	699.10	674.1	14.6	6.732	2.635	9.367	3.55	73.40	6.001	3.366
41	0.8370	701.60	676.6	14.9	6.729	2.700	9.429	3.49	72.50	6.065	3.365
42	0.8570	707.40	682.4	15.3	6.758	2.686	9.444	3.52	72.70	6.065	3.379

HOLCOMB FOUNDATION ENGINEERING CO., INC.

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Carbondale, IL 62901

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P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

April 9, 2007

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Mach Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on March 29, 2007, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification:	Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)
Proctor Test Results:	
Maximum Dry Unit Weight:	120.3 PCF
Optimum Moisture Content:	10.7 %
Specific Gravity:	2.50
Triaxial Test Results:	
Effective Cohesion:	152 PSF
Effective Phi Angle:	29.3 Degrees
Permeability (2 tests):	3 x 10-4 cm./sec.
	2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting



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Permeability Tests Results

Mach Mine
Johnston City, Illinois

Date: 4/9/2007 Client: Williamson Energy

Project No.: H-05278

Boring No.	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse Sample #1		10.9	14.6	115.7	3 x 10-4
Coarse Refuse Sample #2		10.1	14.3	114.7	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

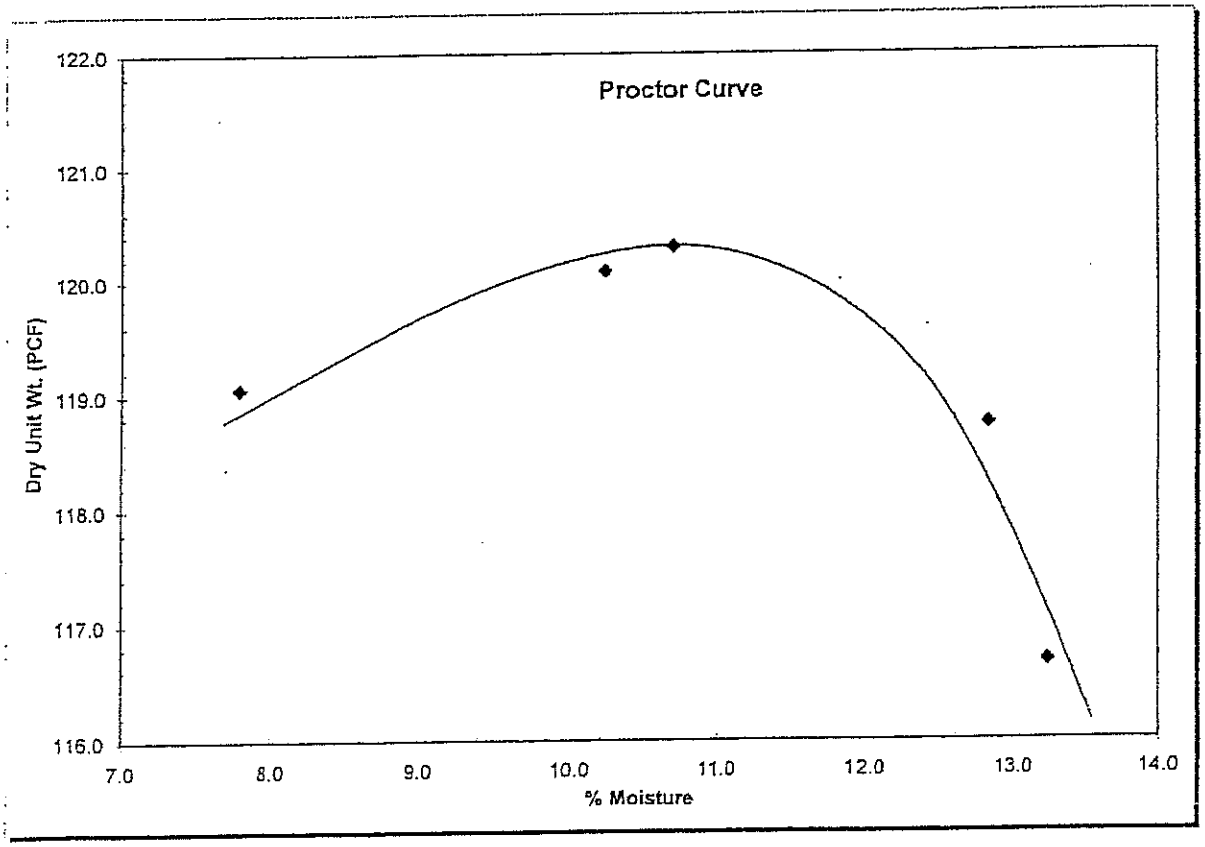
Date: 4/9/2007

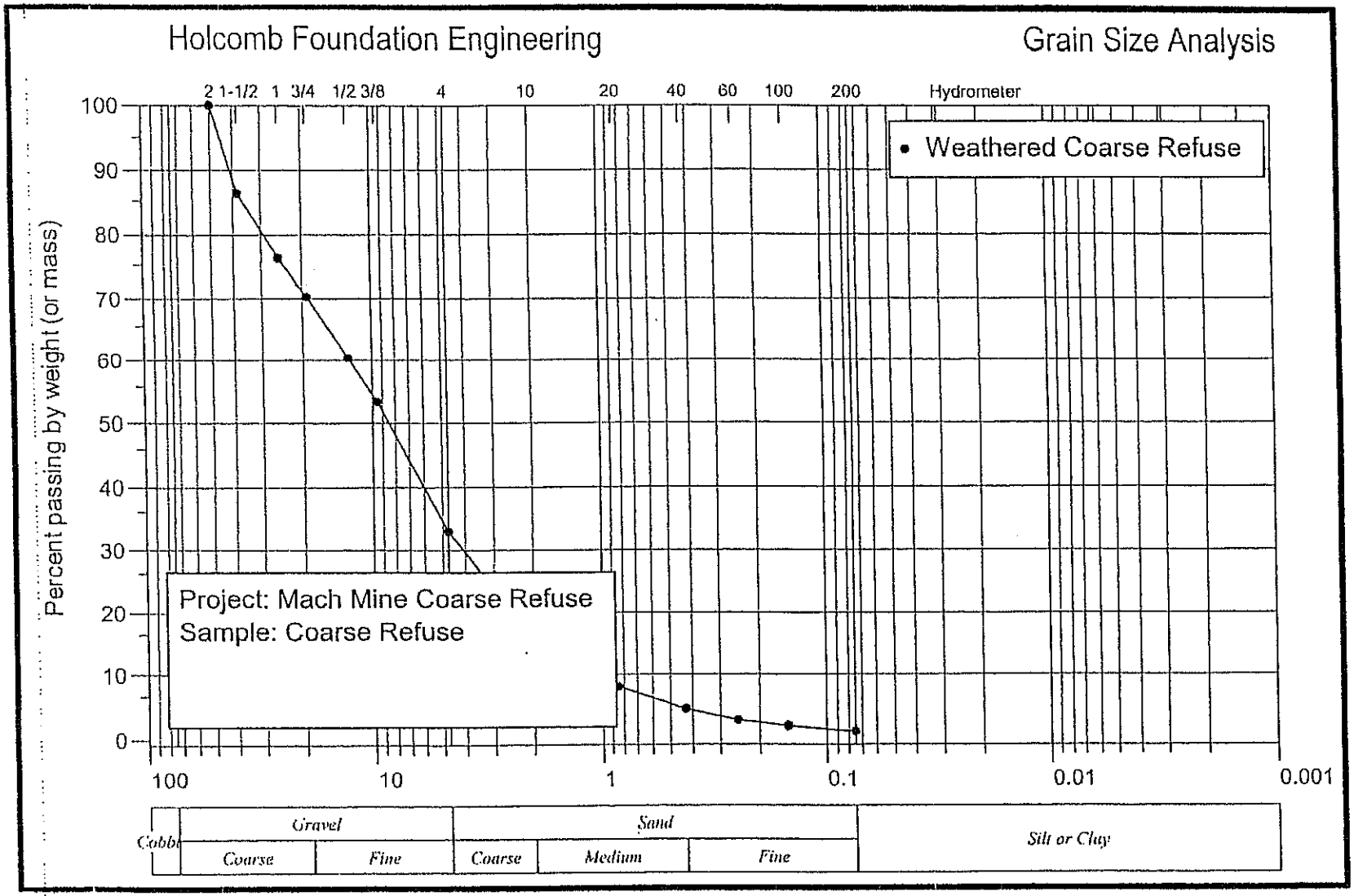
Proctor Test Results

Soil Classification:	Weathered Coarse Refuse
Maximum Dry Density (PCF)	120.3
Optimum Moisture Content (%)	10.7

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
12.8	118.7
13.2	116.7
10.2	120.1
7.8	119.1
10.7	120.3




Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
Weathered Coarse Refuse
Project: Mach Mine Coarse Refuse
Sample: Coarse Refuse
100 10 1 0.1 0.01 0.001
Cobble
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

R16433

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SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

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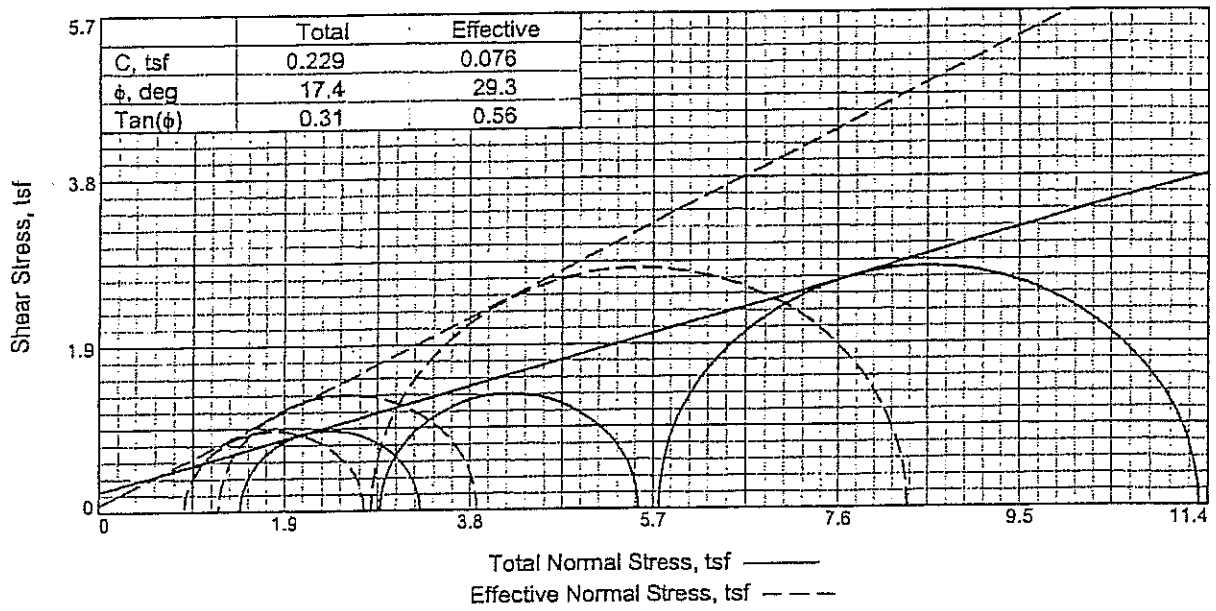
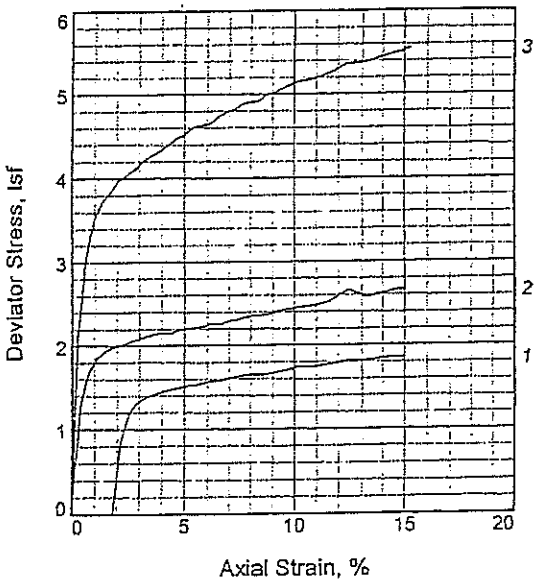
800-333-1740
FAX 618-457-8991

Grain Size Analysis

Project:	Mach Mine	Client:	Mach Mine
Project No.:	H-05278	Date:	4/9/2007
Sample No.	Coarse Refuse	Total Weight:	2290.30

Sieve	Wt. Retained	% Ret.	% Passing
2"	0.0	0.0	100.0
1.5"	314.4	13.7	86.3
1"	536.7	23.4	76.6
3/4"	674.8	29.5	70.5
1/2"	901.6	39.4	60.6
3/8"	1061.2	46.3	53.7
#4	1522.1	66.5	33.5
#10	1911.6	83.5	16.5
#20	2091.9	91.3	8.7
#40	2166.2	94.6	5.4
#60	2202.2	96.2	3.8
#100	2223.7	97.1	2.9
#200	2245.2	98.0	2.0





Sample No.		1	2	3
Initial	Water Content,	14.4	12.7	13.1
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	95.1	89.0	90.4
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
At Test	Water Content,	15.2	14.2	14.5
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.60	3.60	1.80
Cell Pressure, tsf		5.04	6.48	7.56
Fail. Stress, tsf		1.85	2.67	5.55
Total Pore Pr., tsf		4.18	5.27	4.77
Ult. Stress, tsf		1.85	2.66	5.55
Total Pore Pr., tsf		4.18	5.22	4.77
$\bar{\sigma}_1$ Failure, tsf		2.71	3.88	8.34
$\bar{\sigma}_3$ Failure, tsf		0.86	1.21	2.79

Type of Test:
CU with Pore Pressures
Sample Type: Coarse Refuse
Description:

Assumed Specific Gravity= 2.50
Remarks:

Plate _____

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

Location: Weathered Coarse Refuse

Proj. No.: H-05278 **Date:** 4/2/07

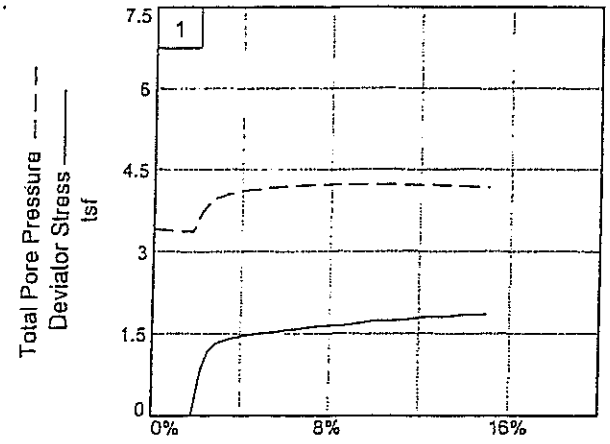
TRIAXIAL SHEAR TEST REPORT

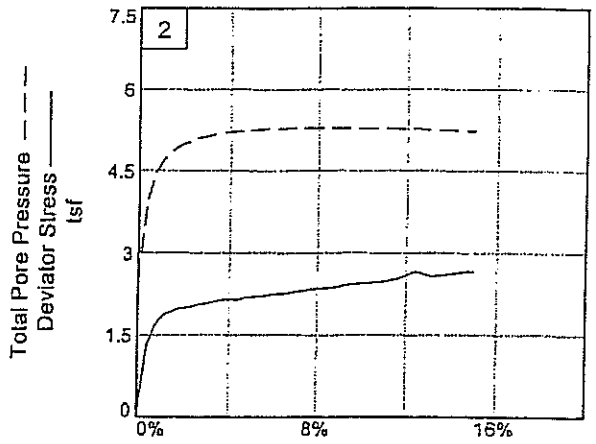
HOLCOMB FOUNDATION ENGINEERING CO.

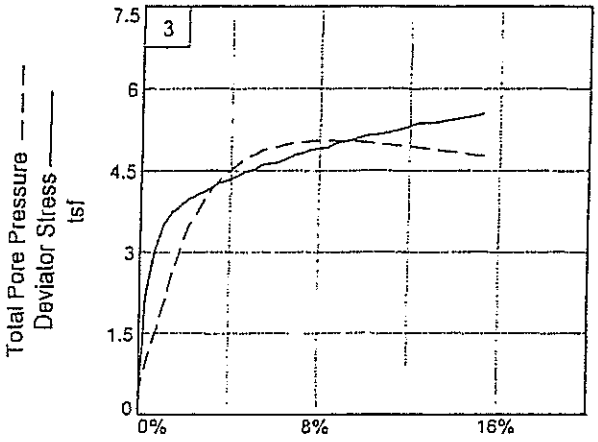
Tested By: LC Checked By: TH

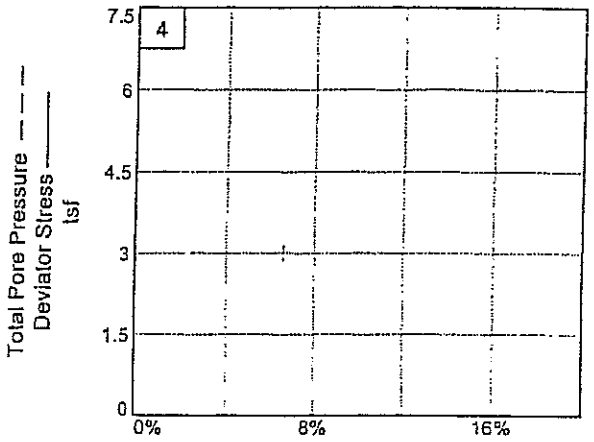
41 7 51

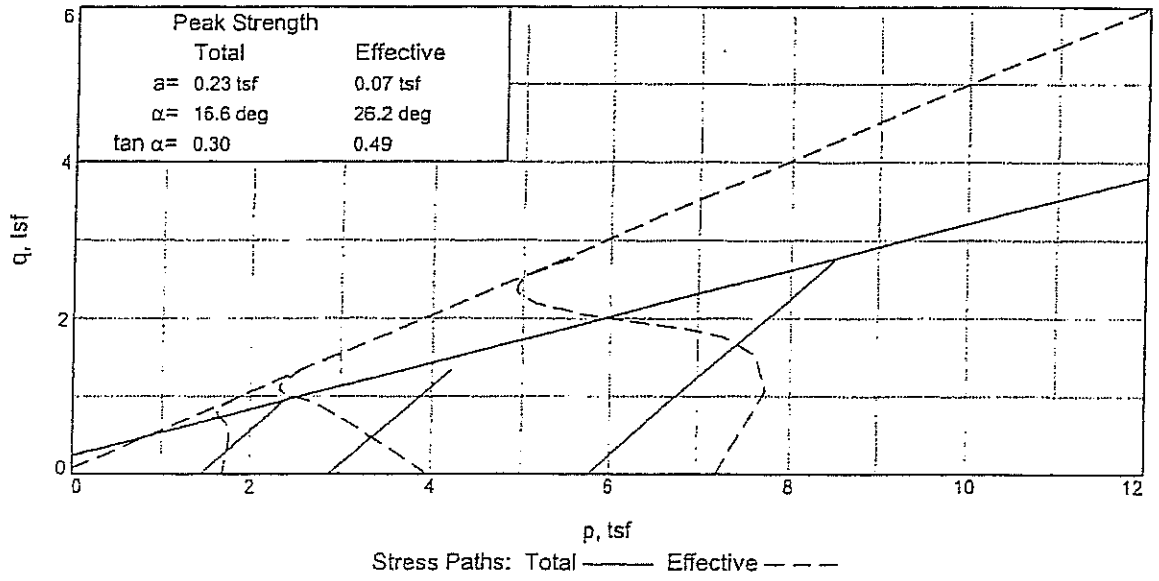
R16436











Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

Location: Weathered Coarse Refuse

Project No.: H-05278

Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

4/9/2007
11:10 AM

Date: 4/2/07
Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Weathered Coarse Refuse
Description:
Remarks:
Type of Sample: Coarse Refuse
Assumed Specific Gravity=2.50 LL= PL= PI=
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	179.300			1255.500
Moisture content: Dry soil+tare, gms.	165.700			1117.500
Moisture content: Tare, gms.	71.400			79.600
Moisture, %	14.4	15.2	15.2	13.3
Moist specimen weight, gms.	1170.0			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.59	5.59	5.59	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.5	130.3	130.3	
Dry density, pcf	113.2	113.2	113.2	
Void ratio	0.3793	0.3793	0.3793	
Saturation, %	95.1	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.845 tsf at reading no. 31
Ult. Stress = 1.845 tsf at reading no. 31

Test Readings for Specimen No.

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	19.10	0.0	0.0	0.000	1.627	1.627	1.00	47.40	1.627	0.000
1	0.0190	20.00	0.9	0.3	0.001	1.642	1.642	1.00	47.20	1.642	0.000
2	0.0400	20.00	0.9	0.7	0.000	1.656	1.656	1.00	47.00	1.656	0.000
3	0.0600	20.00	0.9	1.1	0.000	1.663	1.663	1.00	46.90	1.663	0.000
4	0.0810	20.00	0.9	1.4	0.000	1.678	1.678	1.00	46.70	1.678	0.000
5	0.1010	25.00	5.9	1.8	0.017	1.678	1.694	1.01	46.70	1.686	0.008
6	0.1220	99.00	79.9	2.2	0.857	1.318	2.175	1.65	51.70	1.746	0.429
7	0.1420	124.00	104.9	2.5	1.195	1.152	2.347	2.04	54.00	1.750	0.598
8	0.1620	134.80	115.7	2.9	1.314	1.058	2.372	2.24	55.30	1.715	0.657
9	0.1830	140.60	121.5	3.3	1.374	1.001	2.375	2.37	56.10	1.688	0.687
10	0.2030	144.80	125.7	3.6	1.416	0.965	2.381	2.47	56.60	1.673	0.708
11	0.2240	148.10	129.0	4.0	1.448	0.936	2.384	2.55	57.00	1.660	0.724
12	0.2440	150.60	131.5	4.4	1.471	0.914	2.385	2.61	57.30	1.650	0.735
13	0.2650	153.10	134.0	4.7	1.493	0.900	2.393	2.66	57.50	1.646	0.746
14	0.2850	155.60	136.5	5.1	1.515	0.878	2.393	2.72	57.80	1.636	0.757
15	0.3060	157.30	138.2	5.5	1.528	0.864	2.392	2.77	58.00	1.628	0.764
16	0.3260	159.80	140.7	5.8	1.549	0.857	2.406	2.81	58.10	1.631	0.775
17	0.3460	162.30	143.2	6.2	1.571	0.850	2.420	2.85	58.20	1.635	0.785
18	0.3670	163.10	144.0	6.6	1.573	0.835	2.408	2.88	58.40	1.622	0.787
19	0.3870	166.40	147.3	6.9	1.603	0.828	2.431	2.94	58.50	1.630	0.802
20	0.4080	168.90	149.8	7.3	1.624	0.821	2.445	2.98	58.60	1.633	0.812
21	0.4490	172.30	153.2	8.0	1.648	0.814	2.461	3.02	58.70	1.637	0.824
22	0.4890	173.90	154.8	8.7	1.652	0.806	2.458	3.05	58.80	1.632	0.826
23	0.5300	178.90	159.8	9.5	1.691	0.806	2.498	3.10	58.80	1.652	0.846
24	0.5710	184.80	165.7	10.2	1.740	0.814	2.553	3.14	58.70	1.683	0.870
25	0.6120	186.40	167.3	10.9	1.742	0.806	2.549	3.16	58.80	1.677	0.871
26	0.6530	190.60	171.5	11.7	1.771	0.821	2.592	3.16	58.60	1.706	0.886
27	0.6940	195.60	176.5	12.4	1.808	0.821	2.628	3.20	58.60	1.725	0.904
28	0.7350	197.20	178.1	13.1	1.809	0.835	2.644	3.17	58.40	1.740	0.904
29	0.7760	201.40	182.3	13.9	1.836	0.842	2.678	3.18	58.30	1.760	0.918
30	0.8170	204.70	185.6	14.6	1.853	0.857	2.710	3.16	58.10	1.783	0.927
31	0.8370	204.70	185.6	15.0	1.845	0.864	2.709	3.14	58.00	1.787	0.923

Parameters for Specimen No. 2				
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	169.900			1238.700
Moisture content: Dry soil+tare, gms.	158.800			1117.200
Moisture content: Tare, gms.	71.200			73.100
Moisture, %	12.7	14.2	14.2	11.6
Moist specimen weight, gms.	1169.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.7	131.5	131.5	
Dry density, pcf	115.1	115.1	115.1	
Void ratio	0.3560	0.3560	0.3560	
Saturation, %	89.0	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²

Membrane thickness = 0.02 cm

Filter paper coefficient = 0.001926 kN/cm

Filter paper coverage = 50%

Consolidation cell pressure = 90.00 psi (6.480 tsf)

Consolidation back pressure = 50.00 psi (3.600 tsf)

Consolidation effective confining stress = 2.880 tsf

Strain rate, in./min. = 0.00

Fail. Stress = 2.666 tsf at reading no. 27

Ult. Stress = 2.663 tsf at reading no. 31

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	62.40	0.0	0.0	0.000	3.967	3.967	1.00	34.90	3.967	0.000
1	0.0220	173.10	110.7	0.4	1.289	2.484	3.773	1.52	55.50	3.129	0.645
2	0.0420	206.40	144.0	0.8	1.671	2.016	3.687	1.83	62.00	2.852	0.836
3	0.0620	223.00	160.6	1.1	1.857	1.764	3.621	2.05	65.50	2.693	0.929
4	0.0830	230.50	168.1	1.5	1.936	1.613	3.549	2.20	67.60	2.581	0.968
5	0.1030	235.50	173.1	1.8	1.987	1.512	3.499	2.31	69.00	2.505	0.993
6	0.1240	238.00	175.6	2.2	2.008	1.447	3.455	2.39	69.90	2.451	1.004
7	0.1440	242.20	179.8	2.6	2.048	1.390	3.438	2.47	70.70	2.414	1.024
8	0.1650	245.50	183.1	3.0	2.078	1.346	3.424	2.54	71.30	2.385	1.039
9	0.1850	248.80	186.4	3.3	2.107	1.310	3.418	2.61	71.80	2.364	1.054
10	0.2060	252.20	189.8	3.7	2.137	1.289	3.426	2.66	72.10	2.358	1.069
11	0.2260	254.70	192.3	4.0	2.158	1.267	3.425	2.70	72.40	2.346	1.079
12	0.2460	253.80	191.4	4.4	2.139	1.253	3.392	2.71	72.60	2.322	1.070
13	0.2670	258.80	196.4	4.8	2.187	1.238	3.425	2.77	72.80	2.332	1.093
14	0.2870	260.50	198.1	5.1	2.197	1.231	3.428	2.78	72.90	2.330	1.099
15	0.3080	263.00	200.6	5.5	2.216	1.217	3.433	2.82	73.10	2.325	1.108
16	0.3280	265.50	203.1	5.9	2.235	1.210	3.445	2.85	73.20	2.327	1.118
17	0.3490	268.80	206.4	6.3	2.263	1.210	3.472	2.87	73.20	2.341	1.131
18	0.3690	268.80	206.4	6.6	2.254	1.202	3.456	2.87	73.30	2.329	1.127
19	0.3900	273.00	210.6	7.0	2.290	1.195	3.486	2.92	73.40	2.340	1.145
20	0.4100	275.50	213.1	7.3	2.309	1.195	3.504	2.93	73.40	2.350	1.154
21	0.4510	281.30	218.9	8.1	2.353	1.188	3.541	2.98	73.50	2.364	1.176

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4920	284.60	222.2	8.8	2.369	1.195	3.564	2.98	73.40	2.380	1.185
23	0.5330	292.10	229.7	9.6	2.429	1.195	3.625	3.03	73.40	2.410	1.215
24	0.5740	296.30	233.9	10.3	2.454	1.202	3.656	3.04	73.30	2.429	1.227
25	0.6140	300.40	238.0	11.0	2.477	1.202	3.679	3.06	73.30	2.441	1.238
26	0.6440	305.40	243.0	11.5	2.514	1.217	3.730	3.07	73.10	2.474	1.257
27	0.6960	322.90	260.5	12.5	2.666	1.210	3.876	3.20	73.20	2.543	1.333
28	0.7370	316.20	253.8	13.2	2.576	1.238	3.814	3.08	72.80	2.526	1.288
29	0.7780	322.10	259.7	13.9	2.613	1.238	3.852	3.11	72.80	2.545	1.307
30	0.8190	328.70	266.3	14.7	2.657	1.253	3.910	3.12	72.60	2.581	1.328
31	0.8390	330.40	268.0	15.0	2.663	1.260	3.923	3.11	72.50	2.591	1.331

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	171.400			1284.500
Moisture content: Dry soil+tare, gms.	160.000			1180.500
Moisture content: Tare, gms.	72.800			134.900
Moisture, %	13.1	14.5	14.5	9.9
Moist specimen weight, gms.	1168.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.6	131.2	131.2	
Dry density, pcf	114.6	114.6	114.6	
Void ratio	0.3615	0.3615	0.3615	
Saturation, %	90.4	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 105.00 psi (7.560 tsf)
Consolidation back pressure = 25.00 psi (1.800 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 5.549 tsf at reading no. 35
Ult. Stress = 5.549 tsf at reading no. 35

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0020	102.40	0.0	0.0	0.000	7.207	7.207	1.00	4.90	7.207	0.000
1	0.0170	286.30	183.9	0.3	2.145	6.674	8.819	1.32	12.30	7.747	1.072
2	0.0370	364.50	262.1	0.6	3.046	6.113	9.158	1.50	20.10	7.636	1.523
3	0.0580	407.00	304.6	1.0	3.526	5.537	9.063	1.64	28.10	7.300	1.763
4	0.0780	426.10	323.7	1.4	3.733	4.997	8.730	1.75	35.60	6.864	1.867
5	0.0990	437.70	335.3	1.7	3.853	4.536	8.389	1.85	42.00	6.462	1.926
6	0.1190	449.40	347.0	2.1	3.972	4.133	8.105	1.96	47.60	6.119	1.986
7	0.1400	457.70	355.3	2.5	4.052	3.838	7.889	2.06	51.70	5.863	2.026

Test Readings for Specimen No. 1

No.	Def. Dial In.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
8	0.1600	464.40	362.0	2.8	4.113	3.593	7.706	2.14	55.10	5.649	2.056
9	0.1810	474.40	372.0	3.2	4.210	3.384	7.594	2.24	58.00	5.489	2.105
10	0.2010	481.90	379.5	3.6	4.279	3.211	7.490	2.33	60.40	5.351	2.140
11	0.2210	487.70	385.3	3.9	4.328	3.074	7.403	2.41	62.30	5.239	2.164
12	0.2420	495.20	392.8	4.3	4.395	2.959	7.355	2.49	63.90	5.157	2.198
13	0.2620	503.50	401.1	4.7	4.471	2.851	7.323	2.57	65.40	5.087	2.236
14	0.2830	509.30	406.9	5.0	4.518	2.772	7.290	2.63	66.50	5.031	2.259
15	0.3030	519.30	416.9	5.4	4.612	2.693	7.305	2.71	67.60	4.999	2.306
16	0.3240	522.60	420.2	5.8	4.630	2.650	7.279	2.75	68.20	4.965	2.315
17	0.3440	526.00	423.6	6.1	4.650	2.621	7.270	2.77	68.60	4.946	2.325
18	0.3650	534.30	431.9	6.5	4.722	2.578	7.299	2.83	69.20	4.938	2.361
19	0.3850	541.80	439.4	6.9	4.785	2.549	7.334	2.88	69.60	4.941	2.393
20	0.4050	546.80	444.4	7.2	4.821	2.534	7.355	2.90	69.80	4.945	2.411
21	0.4260	553.40	451.0	7.6	4.873	2.520	7.393	2.93	70.00	4.956	2.436
22	0.4460	558.40	456.0	8.0	4.908	2.506	7.413	2.96	70.20	4.959	2.454
23	0.4670	560.90	458.5	8.3	4.914	2.506	7.420	2.96	70.20	4.963	2.457
24	0.4870	569.20	466.8	8.7	4.984	2.506	7.489	2.99	70.20	4.997	2.492
25	0.5080	574.20	471.8	9.1	5.016	2.513	7.529	3.00	70.10	5.021	2.508
26	0.5280	580.10	477.7	9.4	5.059	2.520	7.579	3.01	70.00	5.050	2.530
27	0.5690	592.50	490.1	10.2	5.148	2.534	7.683	3.03	69.80	5.109	2.574
28	0.6100	600.00	497.6	10.9	5.184	2.570	7.755	3.02	69.30	5.163	2.592
29	0.6510	610.90	508.5	11.6	5.254	2.599	7.853	3.02	68.90	5.226	2.627
30	0.6920	625.80	523.4	12.4	5.363	2.628	7.991	3.04	68.50	5.310	2.682
31	0.7330	631.70	529.3	13.1	5.378	2.671	8.049	3.01	67.90	5.360	2.689
32	0.7730	641.60	539.2	13.8	5.434	2.707	8.141	3.01	67.40	5.424	2.717
33	0.8140	651.60	549.2	14.6	5.487	2.750	8.238	3.00	66.80	5.494	2.744
34	0.8350	656.60	554.2	14.9	5.513	2.772	8.285	2.99	66.50	5.528	2.756
35	0.8540	662.50	560.1	15.3	5.549	2.786	8.335	2.99	66.30	5.561	2.775

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Characterization of Subsurface Materials

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY TJM DATE 5/1/09 SHEET NO. 1 OF 6

gai consultants

Engineers • Geologists • Planners
Environmental Specialists

CALCULATION BRIEF
FOR
SUPPLEMENTAL CHARACTERIZATION OF SUBSURFACE MATERIALS – COARSE REFUSE AND RESIDUAL SOIL

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE: To supplement characterization of the subsurface materials Reference (Ref.) Number (No.) 1, particularly from coarse coal refuse and residual soil laboratory testing from site-specific samples/testing from the Pond Creek Coal Refuse Disposal Facility. Materials are characterized as either sand-like or clay-like in accordance with various pertinent references shown below and included within the "Draft" Mine Health and Safety Administration (MSHA) Engineering and Design Manual, specifically Chapter 7: Seismic Design: Stability and Deformation Analyses (Ref. No. 2).

REFERENCES:

1. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Characterization of Sand-Like and Clay-Like Subsurface Materials," Pond Creek Coal Refuse Disposal Site – South Cell, BEG, dated 7/11/08.

2. Mine Safety and Health Administration, "Draft - Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 – Seismic Design: Stability and Deformation Analyses," dated, December 2007 (Updated August 2008).

3. GAI Consultants, Inc. Calculation Brief Entitled "Summary of Laboratory Testing," Pond Creek Coal Refuse Disposal Site, BEG, dated 3/30/09.

4. Civil & Environmental Consultants, Inc. Report Entitled "Abandonment Evaluation, Pond Creek No. 1 Coal Refuse Disposal Facility, Phase 2 South Pond Slurry Impoundment, Johnston City, Williamson County, Illinois," dated July 23, 2008

5. Civil & Environmental Consultants, Inc. Report Entitled "Permanent Deformation Evaluation, Pond Creek No. 1 Coal Refuse Disposal Facility, South Cell Slurry Impoundment, Johnston City, Williamson County, Illinois," dated January 23, 2008.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Characterization of Subsurface Materials

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY [illegible] DATE 5/1/05 SHEET NO. 2 OF 6

gai consultants

Engineers • Geologists • Planners
Environmental Specialists

GENERAL:

Reference (Ref.) Number (No.) 1 presents the analyses prepared by Civil & Environmental Consultants, Inc. (CEC) addressing the characterization of coarse and fine coal refuse, and residual soil materials previously required for evaluating Illinois Department of Natural Resources (IDNR) comments pertaining to an abandonment evaluation of the Phase 2 South Cell. A similar characterization approach will be utilized to assess the characterization of the coarse and fine coal refuse and residual soils relative to assessing the likelihood of flow failure (liquefaction) following a subsidence related loading event associated with the mining of Longwall Panel No. 3 beneath the Phase 3 impoundment at the Pond Creek site.

Therefore, the first step of this and previous analyses is to characterize the subsurface conditions to evaluate the fluid nature and whether any zones have the potential for strength loss (i.e., liquefaction potential) due to a rapid loading event such as surface strains from subsidence or an earthquake. Previously (Ref. No. 5), the materials making up the existing Pond Creek South Cell (Phases 2/3) coarse refuse dike and underlying site residual soils were evaluated using piezo-seismic cone penetration testing (PSCPT) as part of a permanent deformation analyses of the South Cell. Subsequently, and as part of the abandonment evaluation (Ref. No. 4), laboratory testing and characterization of site specific fine coal refuse (Ref. No. 1) was performed by CEC.

Coal refuse and residual soils are referred to as sand-like or clay-like depending on whether they exhibit monotonic and cyclic undrained shear loading behavior that is fundamentally more similar to that of either sand or clay. This differentiation is significant primarily if the material is loose enough (sands) or soft enough (clays) that it is potentially susceptible to strength loss.

SUMMARY OF SITE-SPECIFIC FIELD AND LABORATORY TESTING AND RESULTS:

In November 2007, CEC developed, implemented and oversaw a detailed field testing program consisting of performing PS-CPT at several sounding locations throughout the Pond Creek site, including the South Cell. PS-CPT was performed by ConeTec, Inc. (ConeTec) of West Berlin, New Jersey. Subsequently, Alliance Consulting, Inc. (Alliance) provided bulk (bucket) samples of fine coal refuse, which were obtained for abandonment-related laboratory testing. Geotechnics, Inc. (Geotechnics) of Pittsburgh, Pennsylvania performed consolidated undrained triaxial shear strength laboratory testing of the fine coal refuse materials. Ref. Nos. 1, 3, 4 and 5 present summaries of the field and laboratory testing programs, and appropriate calculation briefs are attached for information.

PIEZO-SEISMIC CONE PENETRATION TEST RESULTS SUMMARY:

Ref. Nos. 1 and 5 presents the details and results of the November 2007 PS-CPT program performed by CEC/ConeTec at the Pond Creek site, which are generalized/summarized below.

LABORATORY TESTING RESULTS SUMMARY:

Ref. Nos. 1 and 4 presents the details and results of the June 2008 laboratory testing program performed by CEC/Geotechnics on bulk samples of fine coal refuse. In general, the following summarizes laboratory testing results of each of 2 buckets of fine coal refuse sampled from the South Pond impoundment.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Characterization of Subsurface Materials

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY [illegible] DATE 5/1/09 SHEET NO. 3 OF 6

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Bucket 1	Bucket 2
Fine Coal Refuse	**Fine Coal Refuse**
Moisture = 85.8 %	Moisture = 94.4 %
Passing No. 200 = 92.8 %	Passing No. 200 = 92.6 %
Passing No. 40 = 99.4 %	Passing No. 40 = 99.3%
Plasticity Index = 17 %	Plasticity Index = 17 %
Avg. Strain to Peak = 15.1 %	Avg. Strain to Peak = 11.0 %

Ref. Nos. 3 and 4 present the details and results of the November 2006 and April 2007 laboratory testing program performed by Holcolm Foundation Engineering Company, Inc. (Holcolm) on bulk samples of coarse coal refuse from the Pond Creek site:

November 2006	April 2007
Coarse Coal Refuse	**Coarse Coal Refuse**
Maximum Dry Density = 124.6 pcf	Maximum Dry Density = 120.3 pcf
Optimum Moisture = 9.3%	Moisture = 10.7%
Passing No. 200 = 2.6%	Passing No. 200 = 2.0%
Passing No. 40 = 5.6%	Passing No. 40 = 5.4%
Effective Friction = 33.7 degrees	Effective Friction = 29.3 degrees
Effective Cohesion = 0 psf	Effective Cohesion = 152 psf
Total Friction = 18.5 degrees	Total Friction = 17.4 degrees
Cohesion = 1,014 psf	Cohesion = 458 psf
Avg. Strain to Peak = 14.8 %	Avg. Strain to Peak = 14.1 %

Ref. Nos. 3 and 4 also present the details and results of the February 2006 laboratory testing program performed by Holcolm on an undisturbed sample of residual soil from the Pond Creek site:

February 2006 – Boring 8874
Residual Soil
Dry Density = 105.3 pcf
Moisture = 21.5%
Passing No. 200 = 79%
Passing No. 40 = 94.5%
Plasticity Index = 24%
Avg. Strain to Peak = 12.6%

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Characterization of Subsurface Materials

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY BG DATE 5/1/09 SHEET NO. 4 OF 6

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CHARACTERIZATION CRITERIA AND METHODOLOGY:

From Ref. No. 2, the first step common to evaluating liquefaction potential (and correspondingly, subsidence-related flowability) is to review the subsurface conditions of the embankment, subgrade and impoundment contents to evaluate whether any zones have the potential for strength loss.

Generalized field-related CPT-derived criteria noted in various references within Ref. No. 2 include:

Sand-like: Fines content < 50% or PI < 12%
Loose: SPT $N_{1,60}$ < 15 or CPT q_{c1} > 75 tsf, & SBT Ic < 2.6 or F_r < 2%).

Clay-like: Fines content > 50% and PI >12%
Soft: OCR < 5, S_u/σ'_v < 1.0, CPT Q_t < 20 tsf & SBT Ic > 2.6, SPT $N_{1,60}$ < 8

CPT data may be used in conjunction with Atterberg limit data (criteria shown below) to differentiate sand-like from clay-like material. CPT Soil Behavior Type Index (I_c), as described in Robertson and Wride 1998 and reproduced in Youd et al. 2001, values below 2.6 should be considered sand-like. I_c values above 2.6 may be considered clay-like.

Generalized laboratory results criteria noted in various references within and in Ref. No. 1 and 3 include the following Atterberg Limit and sieve criteria:

Atterberg Limits.

Material should be considered sand-like if any of the following three (3) criteria apply:

1. The material has less than 35% particles by dry weight passing the No. 40 sieve and less than 20% by dry weight passing the No. 200 sieve; or

2. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 12%; or

3. The material has 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 20%.

The material may be considered clay-like if any of the following two (2) criteria apply:

1. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 12% or higher; or

2. The material has 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 20% or higher.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Characterization of Subsurface Materials

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY TDS DATE 5/1/09 SHEET NO. 5 OF 6

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Atterberg limit criteria include as sand-like some materials that are considered clay-like by some investigators (e.g. Boulanger and Idriss, 2004, who suggested a break between sand-like and clay-like behavior at a PI of 7%). The intent is to classify borderline materials as sand-like to be conservative.

Another key factor in differentiating loose sand-like material from soft or medium clay-like material, for the purposes of liquefaction analyses, are the strain at peak undrained strength and the abruptness of the drop-off in shearing resistance as strains increase beyond the strain at peak. Loose sands and highly sensitive clays can reach S_{up} at small strains, and experience abrupt drop-off in resistance at higher strains. Most clays tend to reach S_{up} at higher strains, and tend to experience more gradual and limited drop-off in shearing resistance at higher strains. Fine coal refuse deposits often include materials falling within both classifications, and near the boundary of these two types of behavior.

Loose materials with shear strain at peak strength of less than 2% in an undrained monotonic (non-cyclic) test, and a rapid drop-off in resistance after reaching peak strength, are considered sand-like. Loose or soft materials with shear strain at peak strength of more than about 5%, and a gradual drop-off in resistance after reaching peak strength are considered clay-like. Materials with strain behavior between these descriptions are considered borderline and, to be conservative, should generally be analyzed as sand-like. (Note that shear strain in an undrained triaxial test is 1.5 times axial strain.)

SUMMARY OF PREVIOUS AND SUPPLEMENTAL MATERIAL CHARACTERIZATIONS

WEIGHTED AVERAGE FIELD AND LAB RESULTS SUMMARY
Coarse Coal Refuse (138')
Avg. Tip Stress, Qc avg. = 46 tsf
Avg. Fines Content, FC avg. = 23%
Avg. SBT Index, Ic = 2.25
Avg. % Passing No. 200 = 2.3%
Avg. % Passing No. 40 = 5.5 %
Avg. Strain to Peak = 14.5 %

Fine Coal Refuse
Avg. % Passing No. 200 = 92.7%
Avg. % Passing No. 40 = 99.4 %
Avg. Plasticity Index = 17%
Avg. Strain to Peak = 13.1 %

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Characterization of Subsurface Materials

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY TDS DATE 5/1/09 SHEET NO. 6 OF 6

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Residual Soil (150.6')
Avg. Tip Stress, Qc avg. = 61 tsf
Avg. Fines Content, FC avg. = 46%
Avg. SBT Index, Ic = 2.73
Avg. % Passing No. 200 = 79%
Avg. % Passing No. 40 = 94.5%
Avg. Strain to Peak = 12.6%

Plots of individual and average normalized tip stress with depth are included with an attached copy of Ref. No. 1 with copies of the appropriate references also attached.

CONCLUSION

Based on the information presented in this supplemental and previous calculation briefs, the following material characteristic designations were determined for the coarse coal refuse, fine coal refuse and residual soil:

Coarse Coal Refuse: Medium Dense Sand-Like to Medium Stiff Clay-Like (based on peak strain);

Fine Coal Refuse: Medium Stiff Clay-Like;

Residual Soil: Medium Dense Sand-Like and Medium Stiff Clay-Like.

Further, the results of the laboratory testing indicate that the fine coal refuse is clay-like based on an average 93% passing the No. 200 sieve and plasticity index of 17%. Peak and steady-state undrained strengths presented in Ref. No. 3 were reached at generally high strains (between 8 and 18%), and there was very little drop off from peak to steady-state with increasing strain. Similar peak undrained shear strains were observed for coarse refuse and residual soil testing results. The results generally indicated a higher resistance to strength loss (and flow) due to the large strains required to exceed the peak strength and correspondingly small decrease to the steady-state strength at higher strains, particularly for the fine coal refuse.

The susceptibility of the embankment and impoundment to a liquefaction flow failure is a function of both the undrained strength (worst case steady-state strength) and the in-situ driving shear stress on a critical failure plane passing through the critical layer fine coal refuse material, which is further addressed in subsequent calculation briefs. Similarly, subsidence induced strains are subsequently compared to (peak) triggering strains of the coarse and fine coal refuse to further assess flowability of fines and potential embankment cracking.

ATTACHMENT 1
Reference No. 1

Civil & Environmental Consultants, Inc., Calculation Brief Entitled "Characterization of Sand-Like and Clay-Like Subsurface Materials," Pond Creek Coal Refuse Disposal Site – South Cell, BEG, dated 7/11/08.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 1 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CALCULATION BRIEF FOR CHARACTERIZATION OF SAND-LIKE AND CLAY-LIKE SUBSURFACE MATERIALS

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH CELL

OBJECTIVE: To characterize subsurface materials including coarse coal refuse, fine coal refuse and residual soils encountered at the Pond Creek South Cell refuse disposal facility. Materials are characterized as either sand-like or clay-like in accordance with various pertinent references shown below and included within the "Draft" Mine Health and Safety Administration (MSHA) Engineering and Design Manual, specifically Chapter 7: Seismic Design: Stability and Deformation Analyses, March 2007.

REFERENCES:

1. Illinois Department of Natural Resources, Office of Water Resources, Construction and Maintenance of Dams, Part 3702, Chapter IX.

2. Mine Safety and Health Administration, "Draft - Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 – Seismic Design: Stability and Deformation Analyses," dated, March 13, 2007.

3. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Piezo-Cone Penetration Testing," Pond Creed Coal Refuse Disposal Site, BEG, dated 12/21/07.

4. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Normalized PS-CPT Data and Parameter Correlations," Pond Creek Coal Refuse Disposal Site, BEG, dated 12/28/07.

5. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Laboratory Testing," Pond Coal Refuse Disposal Site – South Pond, BEG, dated 7/8/08.

6. Boulanger, R.W. and Idriss, I.M. (2004). "Evaluating the Potential for Liquefaction or Cyclic Failure of Silts and Clays," Report No. UCD/CGM-04/01, Center for Geotechnical Modeling, Department of Civil and Environmental Engineering, University of California, Davis, California.

7. Robertson, P.K., (Fear) Wride, C.E., List, B.R., Atukorala, U., Biggar, K.W., Byrne, P.M., Campanella, R.G., Cathro, D.C., Chan, D.H., Czajewski, K., Finn, W.D.L., Gu, W.H., Hammamji, Y., Hofmann, B.A., Howie, J.A., Hughes, J., Imrie, A.S., Konrad, J.-M., Küpper, A., Law, T., Lord, E.R.F., Monahan, P.A., Morgenstern, N.R., Phillips, R., Piché, Plewes, H.D., Scott, D., Sego, D.C., Sobkowicz, J., Stewart, R.A., Tan, S., Vaid, Y.P., Watts, B.D., Woeller, D.J., Youd, T.L., and Zavodni, Z., The CANLEX Project: Summary and Conclusions. Canadian Geotechnical Journal, 2000, Vol. 37, No. 3, June, pp. 499-504

8. Youd, T. L. et al. (2001). "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 127, No. 10, pp. 817-833.

9. Blight, G. E. and Bentel, G. M., (1983) "The Behaviour of Mine Tailings During Hydraulic Deposition," Journal of the South African Institute of Mining and Metallurgy, April 1983.

GENERAL:

Reference (Ref.) Number (No.) 1 presents the following guidelines regarding the methods of testing, analyses and computations which must be completed and submitted with an application to support an owner's request for abandonment of a disposal impoundment dam:

1. The classification of the existing condition of the impounded material with respect to its fluid nature;
2. The liquefaction potential of the impounded material and the related stability of the containing dam;
3. The final surface configuration for the impounded materials, especially from any surface water impounding characteristics and the erosion potential of the surface material; and
4. The establishment of a follow-up inspection schedule to ensure the proposed plans have been effective and the submittal of record drawings.

This, and subsequent calculation briefs prepared by Civil & Environmental Consultants, Inc. (CEC), address the characterization of the impounded fine coal refuse and the liquefaction potential of the fine coal refuse and related stability (i.e., Requirements 1 and 2 above). Alliance Consulting, Inc. (Alliance) will provide the final surface configuration and the follow-up inspection schedule.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 3 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

From Ref. No. 2, the basic elements for seismic design and analysis are:

1. Characterize the subsurface materials;
2. Evaluate if design earthquake will trigger strength loss;
3. Evaluate seismic stability using post-earthquake strength parameters; and
4. Evaluate deformations.

Therefore, the first step for both abandonment and seismic design and analysis is to characterize the subsurface conditions to evaluate the fluid nature and whether any zones have the potential for strength loss due to earthquake shaking (i.e., liquefaction potential). Previously, the materials making up the coarse refuse dike and underlying residual soils were evaluated using piezo-seismic cone penetration testing (PSCPT) (Ref. Nos. 3 and 4) as part of the deformation analyses of the South Pond. Subsequently, and as part of the abandonment evaluation, laboratory testing (Ref. No. 5) and characterization of the fine coal refuse retained behind the embankment was performed as described below.

For many aspects of seismic stability analyses described in Ref. No. 2, coal refuse and natural soils are referred to as sand-like or clay-like depending on whether they exhibit monotonic and cyclic undrained shear loading behavior that is fundamentally more similar to that of either sand or clay. This differentiation is significant primarily if the material is loose enough (sands) or soft enough (clays) that it is potentially susceptible to strength loss.

SUMMARY OF POND CREEK FIELD AND LABORATORY TESTING/RESULTS:

CEC developed, implemented and oversaw a detailed and thorough field testing program consisting of performing PS-CPT at several sounding locations throughout the Pond Creek site, including the ongoing South Pond impoundment. PS-CPT was executed at Pond Creek by ConeTec, Inc. (ConeTec) of West Berlin, New Jersey. Also, Alliance provided bulk (bucket) samples of fine coal refuse, which were obtained for subsequent laboratory testing. Geotechnics, Inc. (Geotechnics) of Pittsburgh, Pennsylvania performed consolidated undrained triaxial shear strength laboratory testing of the fine coal refuse materials. Ref. Nos. 3 -5 present summaries of the field and laboratory testing programs and Appendixes A - C of the Pond Creek abandonment report present the results of the field and laboratory testing.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 4 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

PIEZO-SEISMIC CONE PENETRATION TEST RESULTS SUMMARY:

Generalized South Cell CPT Profiles from the October 2007 field testing presented in Ref. Nos. 3 and 4 indicated the following:

CPT-1	CPT-2
El. 482.19 – Surface Elevation	El. 494.21 – Surface Elevation
15.3 feet – Depth to Static Ground Water	38.8 feet – Depth to Static Ground Water
0 – 18.4 feet – Residual Soil	0 – 32 feet – Coarse Refuse
Refusal at 18.4 feet - Bedrock	32 – 45.3 feet – Residual Soil
	Refusal at 45.3 feet - Bedrock

CPT-2A	CPT-3
El. 492.40 – Surface Elevation	El. 466.98 – Surface Elevation
37.0 feet – Depth to Static Ground Water	11.1 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 22.2 feet – Residual Soil
29 – 41.7 feet – Residual Soil	Refusal at 22.2 feet – Bedrock
Refusal at 41.7 feet - Bedrock	

CPT-4	CPT-5
El. 482.55 – Surface Elevation	El. 482.55 – Surface Elevation
21.7 feet – Depth to Static Ground Water	34.4 feet – Depth to Static Ground Water
0 – 18.9 feet – Residual Soil	0 – 29 feet – Coarse Refuse
Refusal at 18.9 feet – Bedrock	29 – 49.2feet – Residual Soil
	Refusal at 49.2 feet - Bedrock

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 5 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-5A	CPT-5B
El. 483.00 – Surface Elevation	El. 479.90 – Surface Elevation
35.9 feet – Depth to Static Ground Water	28.0 feet – Depth to Static Ground Water
0 – 29 feet – Coarse Refuse	0 – 19 feet – Coarse Refuse
29 – 53.2 feet – Residual Soil	19 – 39.7 feet – Residual Soil
Refusal at 53.2 feet - Bedrock	Refusal at 39.7 feet - Bedrock

Cone penetration testing results for CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A AND CPT-5B presented in Ref. Nos. 3 and 4 indicated the following:

CPT-1	CPT-3
Residual Soil (Layer Thickness = 18.4)	**Residual Soil (Layer Thickness = 22.2)**
Avg. Tip Stress, Qc avg. = 79 tsf	Avg. Tip Stress, Qc avg. = 43 tsf
Avg. Fines Content, FC avg. = 27%	Avg. Fines Content, FC avg. = 32%
Avg. SBT Index, Ic = 2.38	Avg. SBT Index, Ic = 2.49

CPT-4
Residual Soil (Layer Thickness = 18.9)
Avg. Tip Stress, Qc avg. = 64 tsf
Avg. Fines Content, FC avg. = 28%
Avg. SBT Index, Ic = 2.41

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 6 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-2	CPT-2A
Coarse Coal Refuse (Layer Thickness = 32')	**Coarse Coal Refuse (Layer Thickness = 29')**
Avg. Tip Stress, Qc avg. = 54 tsf	Avg. Tip Stress, Qc avg. = 45 tsf
Avg. Fines Content, FC avg. = 24%	Avg. Fines Content, FC avg. = 22%
Avg. SBT Index, Ic = 2.30	Avg. SBT Index, Ic = 2.23

Residual Soil (Layer Thickness = 13.3')	**Residual Soil (Layer Thickness = 12.7')**
Avg. Tip Stress, Qc avg. = 47 tsf	Avg. Tip Stress, Qc avg. = 86 tsf
Avg. Fines Content, FC avg. = 60%	Avg. Fines Content, FC avg. = 48%
Avg. SBT Index, Ic = 2.99	Avg. SBT Index, Ic = 2.80

CPT-5	CPT-5A
Coarse Coal Refuse (Layer Thickness = 29')	**Coarse Coal Refuse (Layer Thickness = 29')**
Avg. Tip Stress, Qc avg. = 50 tsf	Avg. Tip Stress, Qc avg. = 37 tsf
Avg. Fines Content, FC avg. = 23%	Avg. Fines Content, FC avg. = 24%
Avg. SBT Index, Ic = 2.24	Avg. SBT Index, Ic = 2.29

Residual Soil (Layer Thickness = 20.2')	**Residual Soil (Layer Thickness = 24.2')**
Avg. Tip Stress, Qc avg. = 66 tsf	Avg. Tip Stress, Qc avg. = 49 tsf
Avg. Fines Content, FC avg. = 64%	Avg. Fines Content, FC avg. = 56%
Avg. SBT Index, Ic = 3.04	Avg. SBT Index, Ic = 2.94

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 7 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-5B
Coarse Coal Refuse (Layer Thickness = 19')
Avg. Tip Stress, Qc avg. = 41 tsf
Avg. Fines Content, FC avg. = 19%
Avg. SBT Index, Ic = 2.15

Residual Soil (Layer Thickness = 20.7')
Avg. Tip Stress, Qc avg. = 63 tsf
Avg. Fines Content, FC avg. = 51%
Avg. SBT Index, Ic = 2.84

Cone Penetration Testing Results – Shear Wave Velocities

CPT No.	Shear Wave Velocity Coarse Coal Refuse (ft/sec)			Shear Wave Velocity Residual Soil (ft/sec)		
	Max.	Min.	Avg.	Max.	Min.	Avg.
CPT-1	NA			1402	645	905
CPT-2	1284	1029	1120	1173	795	957
CPT-2A	1169	895	1042	1256	780	918
CPT-3	NA			1058	569	765
CPT-4	NA			1242	476	817
CPT-5	1190	936	1063	1599	780	947
CPT-5A	1396	779	1064	1580	728	1005
CPT-5B	1517	818	1080	1649	686	978

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 8 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

LABORATORY TESTING RESULTS SUMMARY:

Ref. No. 4 and Appendix A present the details and results of the June 2008 laboratory testing program performed by Geotechnics. The following summarizes laboratory testing results of each of 2 buckets of fine coal refuse sampled from the South Pond impoundment.

Bucket 1	Bucket 2
Fine Coal Refuse	**Fine Coal Refuse**
Moisture = 85.8 %	Moisture = 94.4 %
Passing No. 200 = 92.8 %	Passing No. 200 = 92.6 %
Passing No. 40 = 99.4 %	Passing No. 40 = 99.3%
Plasticity Index = 17 %	Plasticity Index = 17 %
Avg. Strain to Peak = 15.1 %	Avg. Strain to Peak = 11.0 %

Normalized tip stress and fines content with depth for CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A and CPT-5B including a summary of pertinent average field and laboratory test results for each material layer are attached.

CRITERIA AND METHODOLOGY:

From Ref. No. 2, the first step common to all approaches is to review the subsurface conditions at the embankment to evaluate whether any zones have the potential for strength loss. For this initial screening step, saturated to nearly saturated sand-like materials with $N_{1,60}$ values less than 15 blows per foot (bpf), or q_{c1} (or Qc) values less than 75 tons per square foot (tsf), should be considered potentially susceptible to strength loss. Ref. No. 2 noted these values are likely too conservative and apply only to clean sands. Their application to silty sands and sands with high fines content, which are more representative of fine coal refuse, will likely be overly conservative.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond PROJECT NO. 080-851

Phase 2 Abandonment Evaluation PAGE 9 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

Generalized field-related CPT-derived criteria noted in various references within Reference 2 include:

Sand-like:	Fines content < 50% or PI < 12%
Loose:	SPT $N_{1,60}$ < 15 or CPT q_{c1} > 75 tsf, & SBT Ic < 2.6 or F_r < 2%).
Clay-like:	Fines content > 50% and PI >12%
Soft:	OCR < 5, S_u/σ'_v < 1.0, CPT Q_t < 20 tsf & SBT Ic > 2.6, SPT $N_{1,60}$ < 8

CPT data may be used in conjunction with Atterberg limit data (criteria shown below) to differentiate sand-like from clay-like material. CPT Soil Behavior Type Index (I_c), as described in Robertson and Wride 1998 and reproduced in Youd et al. 2001, values below 2.6 should be considered sand-like. I_c values above 2.6 may be considered clay-like.

Generalized laboratory results criteria noted in various references within and in Ref. No. 1 include the following Atterberg Limit and sieve criteria:

Atterberg Limits.

- Material should be considered sand-like if any of the following three (3) criteria apply:

  1. The material has less than 35% particles by dry weight passing the No. 40 sieve and less than 20% by dry weight passing the No. 200 sieve; or

  2. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 12%; or

  3. The material has 20% or more particles by dry weight passing the No. 200 sieve, but the fraction finer than the No. 40 sieve has a PI of less than 20%.

The material may be considered clay-like if any of the following two (2) criteria apply:

1. The material has 35% or more particles by dry weight passing the No. 40 sieve and 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 12% or higher; or

2. The material has 20% or more particles by dry weight passing the No. 200 sieve, and the fraction finer than the No. 40 sieve has a PI of 20% or higher.

Atterberg limit criteria include as sand-like some materials that are considered clay-like by some investigators (e.g. Boulanger and Idriss, 2004, who suggested a break between sand-like and clay-like behavior at a PI of 7%). The intent is to classify borderline materials as sand-like to be conservative.

Another key factor in differentiating loose sand-like material from soft or medium clay-like material, for the purposes of seismic stability and deformation analyses, are the strain at peak undrained strength and the abruptness of the drop-off in shearing resistance as strains increase beyond the strain at peak. Loose sands and highly sensitive clays can reach S_{up} at small strains, and experience abrupt drop-off in resistance at higher strains. Most clays tend to reach S_{up} at higher strains, and tend to experience more gradual and limited drop-off in shearing resistance at higher strains. Fine coal refuse deposits often include materials falling within both classifications, and near the boundary of these two types of behavior.

Loose materials with shear strain at peak strength of less than 2% in an undrained monotonic (non-cyclic) test, and a rapid drop-off in resistance after reaching peak strength, are considered sand-like. Loose or soft materials with shear strain at peak strength of more than about 5%, and a gradual drop-off in resistance after reaching peak strength are considered clay-like. Materials with strain behavior between these descriptions are considered borderline and, to be conservative, should generally be analyzed as sand-like. (Note that shear strain in an undrained triaxial test is 1.5 times axial strain.)

Soil, rock, and mixtures of soil and rock that are not coal refuse such as the underlying starter embankment will be referred to as natural soils. Natural soils may be described as sand-like, or clay-like, using the same general criteria as refuse.

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PROJECT Williamson Energy Pond Creek – South Pond | PROJECT NO. 080-851

Phase 2 Abandonment Evaluation | PAGE 11 OF 12

Characterization of Subsurface Materials

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A AND CPT-5B AVG. WEIGHTED AVERAGE FIELD AND LAB RESULTS SUMMARY
Coarse Coal Refuse (138')
Avg. Tip Stress, Qc avg. = 46 tsf
Avg. Fines Content, FC avg. = 23%
Avg. SBT Index, Ic = 2.25

Fine Coal Refuse
Avg. % Passing No. 200 = 92.7%
Avg. % Passing No. 40 = 99.4 %
Avg. Plasticity Index = 17%
Avg. Strain to Peak = 13.1 %

Residual Soil (150.6')
Avg. Tip Stress, Qc avg. = 61 tsf
Avg. Fines Content, FC avg. = 46%
Avg. SBT Index, Ic = 2.73

Plots of individual and average normalized tip stress with depth are included with an attached complete copy of Ref. No. 4.

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Phase 2 Abandonment Evaluation
Characterization of Subsurface Materials

PROJECT NO. 080-851

PAGE 12 OF 12

MADE BY BEG DATE 7/11/08 CHECKED BY MJS DATE 7/23/08

CONCLUSION

Based on the information presented in this calculation brief, the following material characteristic designations were determined for the coarse coal refuse, fine coal refuse and residual soil:

Coarse Coal Refuse: Medium Dense Sand-Like;

Fine Coal Refuse: Medium Stiff Clay-Like;

Residual Soil: Medium Dense Sand-Like and Medium Stiff Clay-Like.

Further, the results of the laboratory testing indicate that the fine coal refuse is clay-like based on an average 93% passing the No. 200 sieve and plasticity index of 17%. Peak and steady-state undrained strengths presented in Appendix A were reached at generally high strains (between 8 and 18%), and there was very little drop off from peak to steady-state with increasing strain. The results generally indicated a higher resistance to strength loss (and flow) due to the large strains required to exceed the peak strength and correspondingly small decrease to the steady-state strength at higher strains. Further, previous deformation analyses results indicated induced shear strains from the PGA at less than 0.1%, which is well below a threshold (peak) triggering strain of the material.

The susceptibility of the embankment and impoundment to a liquefaction flow failure is a function of both the undrained strength (worst case steady-state strength) and the in-situ driving shear stress on a critical failure plane passing through the critical layer fine coal refuse material, which is further addressed in subsequent calculation briefs.

ATTACHMENT 2

Reference Nos. 3 and 4 of Reference No. 1

APPENDIX A-1

SUMMARY OF PIEZO-SEISMIC CONE PENETRATION TESTING

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 1 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

CALCULATION BRIEF
FOR
SUMMARY OF PIEZO-SEISMIC CONE PENETRATION TESTING

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE:

Summarize the piezo-seismic cone penetration testing (PS-CPT) activities performed by ConeTec, Inc. (ConeTec), West Berlin, in October 2007 as part of the subsurface exploration at the Williamson Energy Pond Creek facility, Williamson County, Illinois.

REFERENCES:

1. ConeTec, Inc. (2007), Field Report Entitled "Presentation of CPTU Test Results for: Pond Creek Mine – Williamson County, Illinois, December 10, 2007.

2. Robertson, P.K., et.al. (1992) "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE 109 (11): 1449-1459.

3. Robertson, P.K and Campanella, R.G, (1989), "Guidelines for Geotechnical Design Using CPT and CPTU", UBC Soil Mechanics Series No. 120, Civil Eng. Dept., Vancouver, B.C., Canada

4. Robertson, P.K and Campanella, R.G, (1983), "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE Vol. 109 No. 11, pp. 1449-1459.

METHODOLOGY:

As part of the subsurface exploration, a total of 15 PS-CPT soundings were performed at the Pond Creek site on October 30 and 31, 2007, at approximate locations shown in Figure 2 of the Pond Creek Deformation Evaluation report. PS-CPT exploration was performed under the full-time observation and guidance of CEC personnel. PS-CPT locations designated as CPT-1, CPT-2, CPT-2A, CPT-3, CPT-4, CPT-5, CPT-5A, CPT-5B, CPT-6, CPT-7, CPT-8, CPT-9, CPT-10, CPT-11 and CPT-12 were located by CEC within areas that included existing coarse coal refuse and the proposed South Cell, North Central Cell and North Cell impoundments. CPT-2, CPT-

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO. 072046

Summary of PS-CPT

PAGE 2 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

2A, CPT-5, CPT-5A and CPT-5B soundings were located on the existing coarse coal refuse embankment crest, and were pushed through coarse refuse and the underlying subgrade residual soil. CPT-1, CPT-3, CPT-4, CPT-6, CPT-7, CPT-8, CPT-9, CPT-10, CPT-11 and CPT-12 were located throughout the facility at approximate existing ground surface and pushed exclusively through residual soil. The following presents the CPT sounding, site coordinates, existing ground surface elevation, total depth, interpolated ground water depth and applicable slurry cell.

CPT No.	Northing (ft)	Easting (ft)	Ground Surface Elev.(ft)	Total Depth (ft)	GWT Interpolated (ft)	Applicable Slurry Cell
CPT-1	425784.316	358548.865	482.19	18.4	15.3	South
CPT-2	426832.420	357857.498	494.21	45.3	38.8	South, Central, North
CPT-2A	426828.920	358156.731	492.40	41.7	37.0	South, Central, North
CPT-3	426792.780	359207.797	466.98	22.2	11.1	South
CPT-4	426331.101	360108.800	482.55	18.9	21.7	South
CPT-5	427485.256	357913.863	482.55	49.2	34.4	South, Central, North
CPT-5A	427607.598	357920.844	483.00	53.2	35.9	South, Central, North
CPT-5B	427147.684	358343.061	479.90	39.7	28.0	South, Central, North
CPT-6	427450.461	358992.616	457.78	22.6	9.2	Central
CPT-7	427450.884	359850.004	457.83	16.7	9.2	Central
CPT-8	429006.116	358034.037	444.45	17.9	6.6	Central, North
CPT-9	429077.690	359026.204	445.68	22.0	7.8	Central, North
CPT-10	428965.827	359998.444	442.09	26.1	3.4	Central, North
CPT-11	430316.815	358810.964	440.59	27.6	11.4	North
CPT-12	430141.831	359852.299	442.08	22.6	11.7	North

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PROJECT Williamson Energy Pond Creek Deformation Evaluation PROJECT NO. 072046

Summary of PS-CPT PAGE 3 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY TJK DATE 1/23/08

Note: CPT coordinates and ground surface elevations were provided by Williamson Energy.

Determining the dynamic response of the Pond Creek facility and that of the coarse coal refuse and subgrade residual soils requires knowledge of the subsurface material's dynamic properties to accurately predict the horizontal shear stresses and strains induced in the material by a given earthquake loading. Of particular significance in the dynamic evaluation is the distribution of density of the coal refuse materials with depth. The low-amplitude, small strain shear modulus (G) with depth is an important parameter for characterizing the behavior and response of a soil column during earthquake shaking. It is a function of the in-situ shear wave velocity estimated at the site with depth and was obtained in the field utilizing PS-CPT.

The main purpose of the PS-CPT was to measure in-situ shear wave (S-wave) travel times for subsequent calculation of shear wave velocity (V_S) and G. Concurrently, CPT was also performed which provides nearly continuous, index-type information which can be correlated to classification and in-situ strength values based on established procedures such as those outlined in Robertson and Campanella (1988). Further, cone data is typically utilized to evaluate liquefaction potential based on Robertson and Campanella (1985) similar to the procedures described in Seed and Idriss (1983) and to compare with the results using steady-state principles; however, only permanent deformations are evaluated in response to regulatory comments.

The seismic wave form portion of the PS-CPT was conducted by ConeTec at about 3-foot intervals throughout the soil profile to the maximum depths indicated. The down-hole seismic survey is a reliable technique for obtaining shear wave and compression wave velocities accounting for the subsurface material's attenuation and anisotropic effect with depth (Hoar and Stokoe, 1978) (Dobry et al., 1981) (Stokoe and Nazarian, 1985). Only S-wave travel times were measured for each sounding with depth which was used to calculate the corresponding V_S and G used in the dynamic analyses of the Pond Creek facility.

RESULTS:

A total of 15 PS-CPT soundings were performed at the Pond Creek site in October 2007, at approximate locations shown in Figure 2. ConeTec measured tip stress, sleeve stress and pore water pressure, and shear wave velocities at the locations CPT-1 through CPT-12 from the existing ground surface through coarse coal refuse, where available and through residual soil materials.

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PROJECT Williamson Energy Pond Creek Deformation Evaluation — PROJECT NO. 072046

Summary of PS-CPT — PAGE 4 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

Shear wave velocities per material type were measured and the minimum, maximum and weighted averages are summarized as follows:

CPT No.	Shear Wave Velocity Max./Min./Avg. Coarse Coal Refuse (ft/sec)	Shear Wave Velocity Max./Min./Avg. Residual Soil (ft/sec)
CPT-1	NA	1402 645 905
CPT-2	1284 1029 1120	1173 795 957
CPT-2A	1169 895 1042	1256 780 918
CPT-3	NA	1058 569 765
CPT-4	NA	1242 476 817
CPT-5	1190 936 1063	1599 780 947
CPT-5A	1396 779 1064	1580 728 1005
CPT-5B	1517 818 1080	1649 686 978
CPT-6	NA	1022 514 796
CPT-7	NA	894 514 682
CPT-8	NA	1036 541 783
CPT-9	NA	1484 415 835
CPT-10	NA	1217 478 828
CPT-11	NA	1387 471 925
CPT-12	NA	1230 530 763

In general, shear wave velocities in coarse refuse ranged from about 779 to 1517 fps with an average value of about 1074 fps. For subgrade residual soils, Vs ranged from 415 to 1599 fps with an approximate average value of 860 fps. Measured values of V_S for coarse refuse and residual soil materials and the density of the respective material with depth are used to estimate the initial shear modulus, G, for use in the one dimensional, dynamic SHAKE (Schnabel, et al., 1972) analysis of the embankment. G-values estimated from the four soundings are used in the calculation of induced cyclic shear stress at the SHAKE soil column locations (e.g. PCSC300) shown in Figure 3. Appendix A, Attachment A-2 presents the complete ConeTec report and Appendix B, Attachment B-1 presents the computations of G for the various SHAKE columns

from in-situ measurements of V_S for the coarse refuse, residual soil and bedrock materials including plots of V_S and G with depth for both SHAKE columns.

CONCLUSIONS:

Summarizing, the PS-CPT field testing was performed as part of the subsurface exploration at the Pond Creek facility. The information gathered from the testing will be used to correlate index and strength parameters, as well as shear modulus for use in subsequent permanent deformation analyses.

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PROJECT Williamson Energy Pond Creek
Deformation Evaluation
Summary of PS-CPT

PROJECT NO. 072046

PAGE 6 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY RJ DATE 1/23/08

SHEAR WAVE VELOCITY DATA REDUCTION
MINIMUM, MAXIMUM AND AVERAGE VELOCITY PER MATERIAL

Williamson Energy - Pond Creek - South Cell
Shear Wave Velocity versus Depth **CEC Project No. 072-046**

CPT-1

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
4.26	645	
7.54	656	
10.82	808	CLAY
14.1	1013	
16.73	1402	

CPT-1

	Max	Min	avg
Clay	1402	645	905

CPT-2

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	1204	
10.82	1284	
14.1	1152	
17.39	1085	CCR
20.67	1029	
23.95	1039	
27.23	1050	
30.51	1114	
33.79	950	
37.07	795	CLAY
40.35	908	
43.31	1173	

CPT-2

	Max	Min	avg
CCR	1284	1029	1120
CLAY	1173	795	957

CPT-2A

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	977	
10.82	973	
14.1	1121	
17.39	1051	CCR
20.67	1105	
23.95	1169	
27.23	895	
30.51	780	
33.79	845	CLAY
37.07	790	
39.86	1256	

CPT-2A

	Max	Min	avg
CCR	1169	895	1042
CLAY	1256	780	918

CPT-3

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.21	577	
10.50	569	CLAY
13.78	738	
17.06	883	
20.10	1058	

CPT-3

	Max	Min	avg
CLAY	1058	569	765

CPT-4

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
3.93	476	
7.21	673	CLAY
10.50	781	
13.78	913	
16.81	1242	

		CPT-4		
	Max	Min	avg	
CLAY	1242	476	817	

Williamson Energy - Pond Creek - North Central Cell
Shear Wave Velocity versus Depth **CEC Project No. 072-046**

CPT-5

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	1030	
10.82	1076	
14.10	991	
17.39	936	CCR
20.67	1148	
23.95	1190	
27.23	1067	
30.51	780	
33.79	780	
37.07	821	CLAY
40.35	780	
43.63	923	
46.91	1599	

CPT-5

	Max	Min	avg
CCR	1190	936	1063
CLAY	1599	780	947

CPT-5A

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.21	844	
10.50	779	
13.78	1164	
17.06	1396	CCR
20.34	994	
23.63	1077	
26.90	1195	
30.18	1021	
33.46	784	
36.74	784	
40.02	728	CLAY
43.30	768	
46.67	961	
49.95	1411	
52.00	1580	

CPT-5A

	Max	Min	avg
CCR	1396	779	1064
CLAY	1580	728	1005

CPT-5B

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)	
7.54	818	
10.82	900	
14.10	1517	CCR
17.39	1085	
20.67	856	
23.95	732	
27.23	686	CLAY
30.59	762	
33.79	1014	
37.07	1150	
38.88	1649	

CPT-5B

	Max	Min	avg
CCR	1517	818	1080
CLAY	1649	686	978

CPT-6

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	514
7.54	769
10.82	706
14.10	945
17.39	819
20.51	1022

CLAY

CPT-6	Max	Min	avg
CLAY	1022	514	796

CPT-7

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	514
7.54	575
10.82	745
14.10	894

CLAY

CPT-7	Max	Min	avg
CLAY	894	514	682

CPT-8

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	541
7.54	652
10.82	708
14.10	979
16.48	1036

CPT-8	Max	Min	avg
CLAY	1036	541	783

CPT-9

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
3.93	415
7.21	904
10.50	757
13.78	647
17.06	805
20.01	1484

CPT-9	Max	Min	avg
CLAY	1484	415	835

CPT-10

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	478
7.54	617
10.82	656
14.10	803
17.36	945
20.67	1080
23.87	1217

CPT-10	Max	Min	avg
CLAY	1217	478	828

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Williamson Energy - Pond Creek - North Cell
Shear Wave Velocity versus Depth **CEC Project No. 072-046**

CPT-8

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	541
7.54	652
10.82	708
14.10	979
16.48	1036

CLAY

		CPT-8		
		Max	Min	avg
CLAY	CLAY	1036	541	783

CPT-9

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
3.93	415
7.21	904
10.50	757
13.78	647
17.06	805
20.01	1484

CLAY

		CPT-9		
		Max	Min	avg
CLAY	CLAY	1484	415	835

CPT-10

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	478
7.54	617
10.82	656
14.10	803
17.36	945
20.67	1080
23.87	1217

CLAY

		CPT-10		
		Max	Min	avg
CLAY	CLAY	1217	478	828

CPT-11

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.26	471
7.54	628
10.82	719
14.10	817
17.36	926
20.67	1207
23.95	1387
26.25	1246

CLAY

		CPT-11		
		Max	Min	avg
CLAY	CLAY	1387	471	925

CPT-12

Mid-Layer Depth (ft)	Vs Interval Velocity (ft/s)
4.02	530
7.30	596
10.50	601
13.78	748
17.06	871
20.34	1230

CLAY

		CPT-12		
		Max	Min	avg
CLAY	CLAY	1230	530	763

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PROJECT Williamson Energy Pond Creek Deformation Evaluation

PROJECT NO 072046

Summary of PS-CPT

PAGE 13 OF 14

MADE BY BEG DATE 12/21/07 CHECKED BY [illegible] DATE 1/23/08

GROUNDWATER WELL DATA (PROVIDED BY WILLIAMSON)

072-046

14 of 14

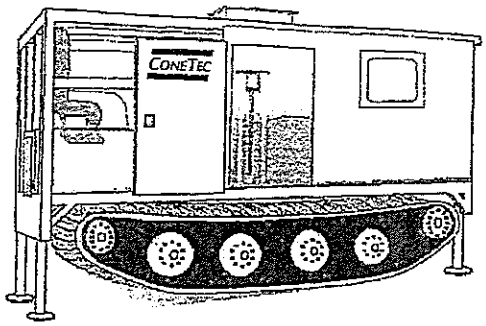
R16477

Pond Creek #1 Ground Water Sampling
Permit #375 NPDES# IL007766

Date	Sample Pnt	Easting	Northing	Stand Pipe Elevation	Water Elev.	Zinc mg/L	Antimony mg/L	Beryllium mg/L	Cobalt mg/L	MANGANESE mg/L	Phenolics mg/L	Cyanide mg/L	Chlorides mg/L
12/29/05	GW-1	354,988	430,899	441.82	435.44	0.012	0.303	<.001	0.014	0.027	<.050	<0.010	20
12/29/05	GW-2	357,681	430,962	435.73	428.51	0.024	0.240	<.001	0.013	0.087	<.050	<0.010	42
12/29/05	GW-3	360,278	430,669	438.46	432.61	0.001	0.299	<.001	0.012	0.124	<.050	<0.010	26
12/29/05	GW-4	354,923	425,980	464.03	456.01	0.009	0.270	<.001	0.017	0.031	<.050	<0.010	17
12/29/05	GW-5	357,632	425,618	482.23	470.52	0.01	0.276	<.001	0.007	0.891	<.050	<0.010	40
12/29/05	GW-6	360,211	425,416	434.9	No Water	No				n/a			n/a
12/29/05	GW-7A	358,306	427,592	454.7	444.99	0.029	0.285	<.001	0.024	0.052	<.050	<0.010	33
2/24/06	GW-1	354,988	430,899	441.82	438.34	0.012	<0.002	<.001	<0.005	0.024	<.050	<0.010	<10
2/24/06	GW-2	357,681	430,962	435.73	431.31	0.016	<0.002	<.002	<0.002	0.027	<.050	<0.010	<10
2/24/06	GW-3	360,278	430,669	438.46	434.29	0.014	<0.002	<.001	<0.005	0.023	<.050	<0.010	<10
2/24/06	GW-4	354,923	425,980	464.03	459.45	0.01	<0.002	<.001	<0.005	0.03	<.050	<0.010	<10
2/24/06	GW-5	357,632	425,618	482.23	471.33	0.01	<0.002	<.001	<0.005	0.4	<.050	<0.010	<10
2/24/06	GW-6	360,211	425,416	434.9	No Water	No				n/a			n/a
2/24/06	GW-7A	358,306	427,592	454.7	447.05	0.018	<.002	<.001	<.005	0.045	<.050	<0.010	<10
6/28/06	GW-1	354,988	430,899	441.82	435.70	0.002	0.006	<.001	<.005	<.002	<.050	<0.010	33
6/28/06	GW-2	357,681	430,962	435.73	427.72	0.023	0.050	<.001	<.005	0.002	<.050	<0.010	44
6/28/06	GW-3	360,278	430,669	438.46	430.10	0.006	0.060	<.001	<.005	0.145	<.050	<0.010	75
6/28/06	GW-4	354,923	425,980	464.03	458.03	0.003	0.070	0.001	<.005	<.002	<.050	<0.010	122
6/28/06	GW-5	357,632	425,618	482.23	470.85	<.002	0.050	<.001	<.005	<.002	<.050	<0.010	160
6/28/06	GW-6	360,211	425,416	434.9	No Water	No							n/a
6/28/06	GW-7A	358,306	427,592	454.7	446.30	0.002	0.090	<.001	<.005	0.003	<.050	<0.010	75
7/31/06	GW-1	354,988	430,899	441.82	435.08	0.001	0.206	0.003	<.005	0.012	<.050	<0.010	37.5
7/31/06	GW-2	357,681	430,962	435.73	429.31	<0.001	0.184	0.002	<.005	<.002	<.050	<0.010	50
7/31/06	GW-3	360,278	430,669	438.46	428.63	<0.001	0.129	0.001	<.005	0.024	<.050	<0.010	88
7/31/06	GW-4	354,923	425,980	464.03	457.03	0.001	0.153	0.002	<.005	0.026	<.050	<0.010	139
7/31/06	GW-5	357,632	425,618	482.23	469.43	0.006	0.153	0.002	<.005	0.012	<.050	<0.010	150
7/31/06	GW-6	360,211	425,416	434.9	No Water	No							n/a
7/31/06	GW-7A	358,306	427,592	454.7	445.55	0.003	0.269	0.001	<.005	0.026	<.050	<0.010	85
8/31/06	GW-1	354,988	430,899	441.82	434.92	0.001	<.002	<.001	<.005	0.019	<.050	<0.010	20
8/31/06	GW-2	357,681	430,962	435.73	424.51	0.001	<.002	<.001	<.005	0.021	<.050	<0.010	22
8/31/06	GW-3	360,278	430,669	438.46	426.86	0.013	<.002	<.001	<.005	0.045	<.050	<0.010	44
8/31/06	GW-4	354,923	425,980	464.03	456.79	0.006	<.002	<.001	<.005	0.081	<.050	<0.010	42
8/31/06	GW-5	357,632	425,618	482.23	468.32	0.02	<.002	<.001	<.005	3.05	<.050	<0.010	105
8/31/06	GW-6	360,211	425,416	434.9	No Water	No							n/a
8/31/06	GW-7A	358,306	427,592	454.7	444.18	0.018	<.002	<.001	<.005	0.093	<.050	<0.010	8.7
10/2/06	GW-1	354,988	430,899	441.82	435.08	0.001	<.002	<.001	0.015	<.002	<.050	<0.010	14
10/2/06	GW-2	357,681	430,962	435.73	425.76	0.001	<.002	<.001	0.013	<.002	<.050	<0.010	38
10/2/06	GW-3	360,278	430,669	438.46	427.14	0.009	<.002	<.001	0.006	2.105	<.050	<0.010	28
10/2/06	GW-4	354,923	425,980	464.03	455.42	0.001	<.002	0.002	0.014	0.028	<.050	<0.010	84
10/2/06	GW-5	357,632	425,618	482.23	No Water	No							
10/2/06	GW-6	360,211	425,416	434.9	No Water	No							
10/2/06	GW-7A	358,306	427,592	454.7	443.95	0.001	<.002	<.001	0.005	0.181	<.050	<0.010	368
3/7/07	GW-1	354,988	430,899	441.82	438.62	0.001	<.002	<.001	<.005	0.005	<.050	<0.010	26
3/7/07	GW-2	357,681	430,962	435.73	431.41	0.001	<.002	<.001	<.005	0.003	<.050	<0.010	42
3/7/07	GW-3	360,278	430,669	438.46	434.29	0.001	<.002	0.001	<.005	0.028	<.050	<0.010	66
3/7/07	GW-4	354,923	425,980	464.03	458.05	0.001	<.002	<.001	<.005	0.005	<.050	<0.010	109
3/7/07	GW-5	357,632	425,618	482.23	473.86	0.001	<.002	<.001	0.013	0.007	<.050	<0.010	91
3/7/07	GW-6	360,211	425,416	434.9	No Water	No							
3/7/07	GW-7A	358,306	427,592	454.7	448.63	0.001	<.002	<.001	<.005	0.007	<.050	<0.010	86
5/21/07	GW-1	354,988	430,899	441.82	436.55	.002	<.002	<.001	0.034	<.002	<.050	<0.010	42
5/21/07	GW-2	357,681	430,962	435.73	428.93	0.001	<.002	0.001	0.011	0.007	<.050	<0.010	46
5/21/07	GW-3	360,278	430,669	438.46	432.08	0.001	<.002	0.001	0.013	0.002	<.050	<0.010	62
5/21/07	GW-4	354,923	425,980	464.03	459.93	0.001	<.002	0.002	0.009	<.002	<.050	<0.010	100
5/21/07	GW-5	357,632	425,618	482.23	471.74	0.001	<.002	0.002	0.020	<.002	<.050	<0.010	132
5/21/07	GW-6	360,211	425,416	434.9	No Water	No							
5/21/07	GW-7A	358,306	427,592	454.7	448.05	0.001	<.002	<.001	0.017	0.002	<.050	<0.010	82
5/21/07	GW-8	359,568	426,786	467.85	462.23	0.001	<.002	<.001	0.020	0.544	<.050	<0.010	88
8/1/07	GW-1	354,988	430,899	441.82	433.29	.003	<.002	0.001	<.005	0.007	<.050	<0.010	26
8/1/07	GW-2	357,681	430,962	435.73	424.74	.009	0.105	0.001	<.005	0.196	<.050	<0.010	34
8/1/07	GW-3	360,278	430,669	438.46	426.09	0.01	0.370	0.001	<.005	0.524	<.050	<0.010	66
8/1/07	GW-4	354,923	425,980	464.03	458.16	.002	0.141	0.001	<.005	0.003	<.050	<0.010	100
8/1/07	GW-5	357,632	425,618	482.23	469.06	.005	0.080	0.002	<.005	0.198	<.050	<0.010	120
8/1/07	GW-6	360,211	425,416	434.9	No Water	No							
8/1/07	GW-7A	358,306	427,592	454.7	447.11	.018	0.137	0.002	<.005	1.180	<.050	<0.010	108
8/1/07	GW-8	359,568	426,786	467.85	462.70	.005	0.200	0.002	<.005	0.042	<.050	<0.010	112

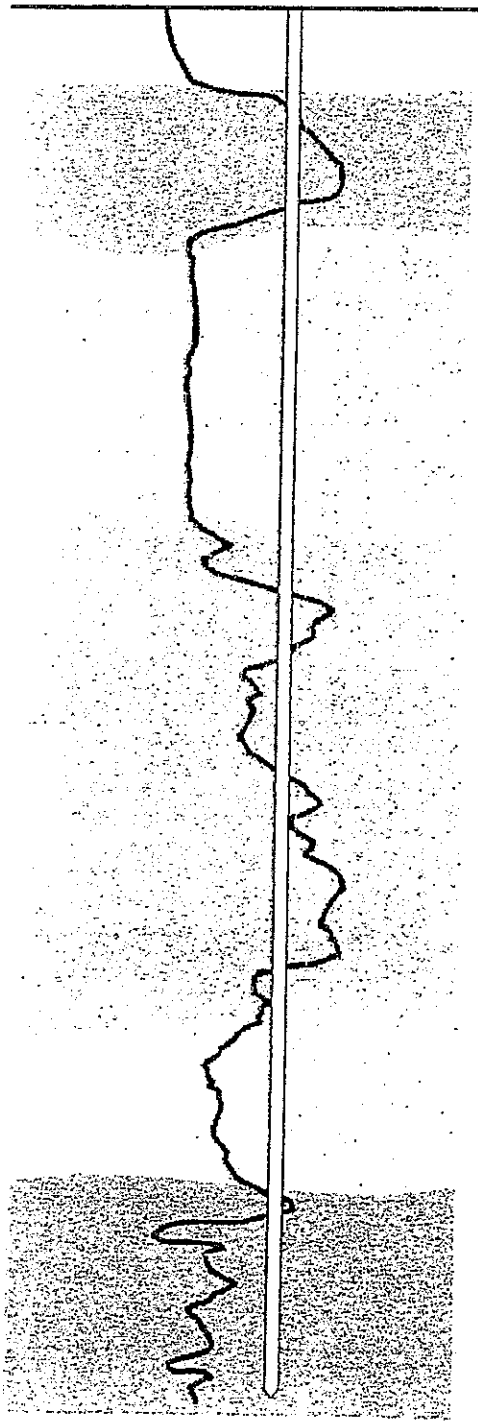
APPENDIX A-2

CONETEC, INC. FIELD REPORT



ConeTec

Geotechnical and Environmental In Situ Testing Contractors



ConeTec Field Report

Presentation of CPTU Test Results for:

Pond Creek Mine
Williamson County, Illinois

Presented to: C.E.C.

Date: December 10th, 2007

Presented by: ConeTec, Inc.
436 Commerce Lane, Unit C
West Berlin, NJ
(856) 767-8600

PRESENTATION OF IN SITU TESTING PROGRAM RESULTS

Pond Creek Mine
Williamson County, Illinois

October 30th, & 31st, 2007

Prepared for:

Civil & Environmental Consultants, Inc
Export, Pennsylvania

Prepared by:

ConeTec Inc.
West Berlin, NJ

December 10th, 2007

TABLE OF CONTENTS

1.0 INTRODUCTION 3

2.0 FIELD EQUIPMENT AND PROCEDURES 4

2.1 CONE PENETRATION TESTING 4
2.2 PORE PRESSURE DISSIPATION TESTS 6

3.0 CONE PENETRATION TEST DATA AND INTERPRETATION 8

3.1 ANALYSIS OF PIEZOCONE DATA - GENERAL 8
3.2 CONE PLOTS 9
3.3 PORE PRESSURE DISSIPATION TEST RESULTS 9
3.4 SHEAR WAVE VELOCITY MEASUREMENTS 10
3.5 CPTSUMM DATA PROCESSING 10
3.6 DATA CD 10

5.0 REFERENCES 11

TABLES

TABLE 1 Summary of CPT Soundings

FIGURES

FIGURE 1 Typical Cone Penetrometer
FIGURE 2 Schematic of Shear Wave Testing Configuration
FIGURE 3 Typical Dissipation Tests

APPENDICES

APPENDIX A CPT Plots (shear wave, non-normalized)
APPENDIX B CPT Data Interpretation Summery
APPENDIX C Shear Wave Velocity Data
APPENDIX D Dissipation Test Data
APPENDIX E Data CD

1.0 INTRODUCTION

This report presents the results of a piezo cone penetrometer testing (CPTU) program carried out at Pond Creek Mine located in Williamson County, Illinois. The work was performed under subcontract to Civil & Environmental Consultants, Inc. of Export, Pennsylvania. The CPTU program took place on October 30th, and 31st, 2007.

A total of fifteen soundings were completed at twelve different sounding locations. The CPT testing was performed to evaluate in situ geotechnical as well as seismic criteria relative to the proposed expansion.

While completing the CPT soundings, seismic shear wave velocity testing was conducted in all of the soundings. Seismic testing involved collecting shear wave velocity data at one-meter depth intervals.

CPT sounding locations were selected and numbered under the direction and supervision of C.E.C. Personnel.

2.0 FIELD EQUIPMENT AND PROCEDURES

2.1 CONE PENETRATION TESTING

The cone penetrometer tests were carried out using an integrated electronic piezo cone manufactured by ConeTec in Vancouver, Canada. The piezo cone used was a compression model cone penetrometer with a 15 cm^2 tip and a 225 cm^2 friction sleeve. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.80. The piezo cone dimensions and the operating procedure were in accordance with ASTM Standard D-5778-95. A diagram of the cone penetrometer used for this project is shown as Figure 1.

Pore pressure filter elements, made of porous plastic, were saturated under a vacuum using glycerin as the saturating fluid. The pore pressure element was six millimeters thick and was located immediately behind the tip (the u_2 location) for all soundings.

The cone was advanced using a 20 ton, unitized, track-mounted cone penetration rig. The following data were recorded onto magnetic media every five centimeters (approximately every two inches) as the cone was advanced into the ground:

- Tip Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (ut)

The field data recorded is included on the attached CD (appendix E).

Before each sounding a complete set of analog baseline readings are taken with a multi-meter and compared with the digitized value on the computer screen. This provides a check on the analog to digital conversion board.

Evaluation of the analog baselines is key to consistent readings. The baseline data should be stable and should not wander excessively during the course of a sounding. Baseline data can be used to apply corrections to the cone data where necessary. For this project, the baseline shift from sounding to sounding was small, typically less than 0.1% of full scale, and no data corrections were applied.

During seismic testing, the seismic signals were recorded using a geophone mounted in the cone as shown in Figure 1 and an up-hole digital oscilloscope. A sledge hammer hit against a beam was used for the seismic source. Normal reaction for the beam was provided by the dead weight of the rig placed upon the beam. A schematic of the shear wave testing configuration is shown in Figure 2.

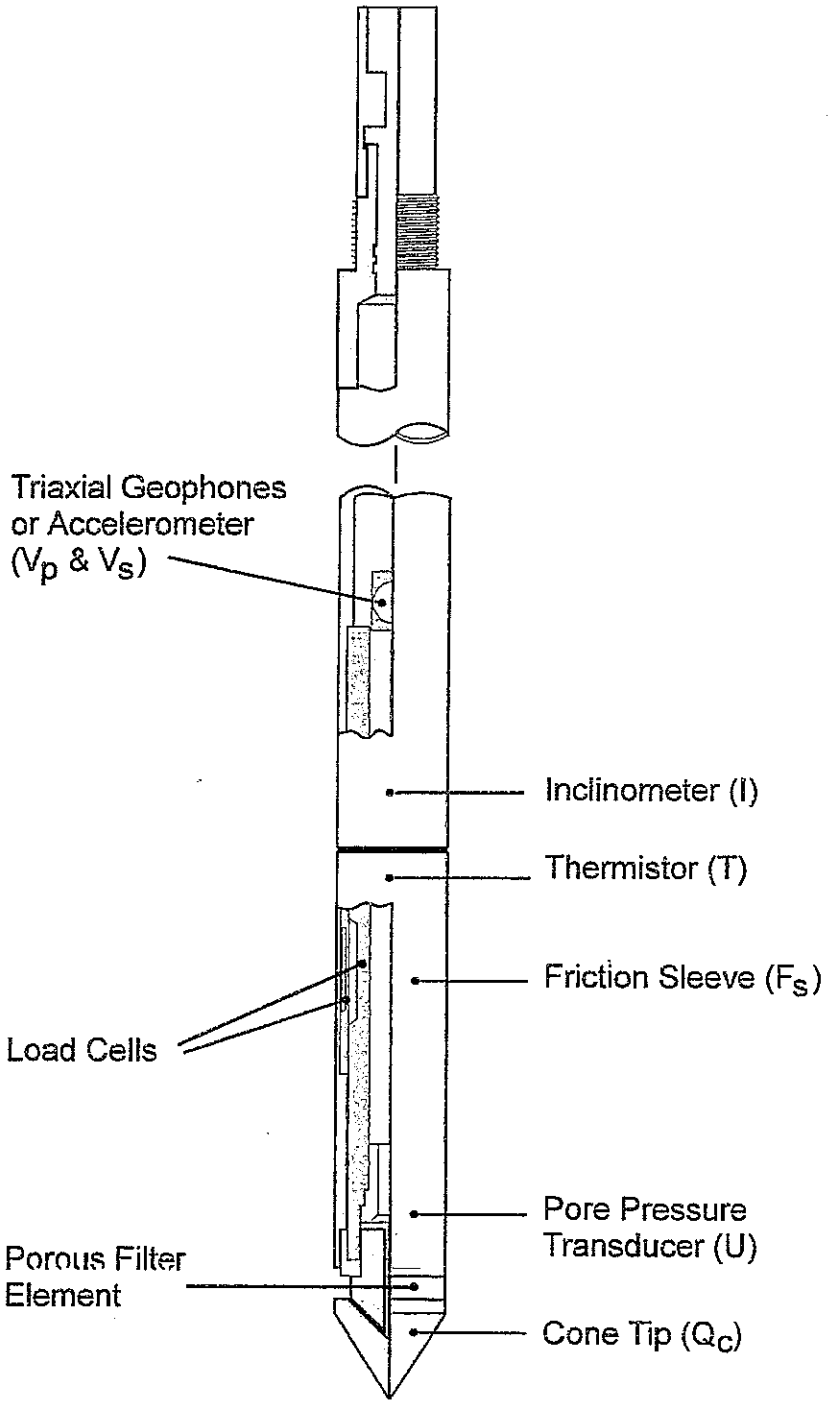


FIGURE 1 - TYPICAL CONE PENETROMETER

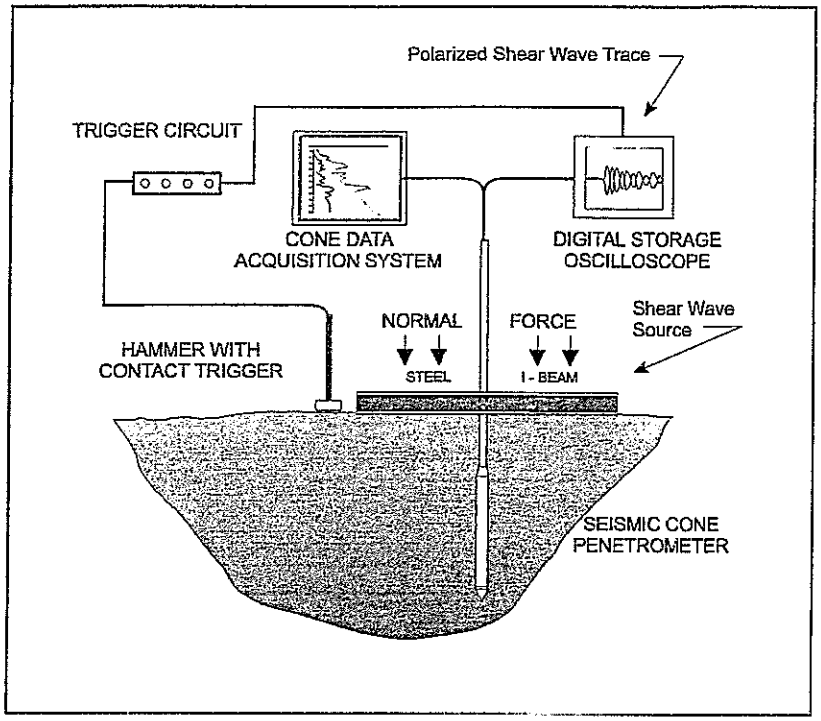


FIGURE 2 - SCHEMATIC OF SHEAR WAVE TESTING CONFIGURATION

2.2 PORE PRESSURE DISSIPATION TESTS

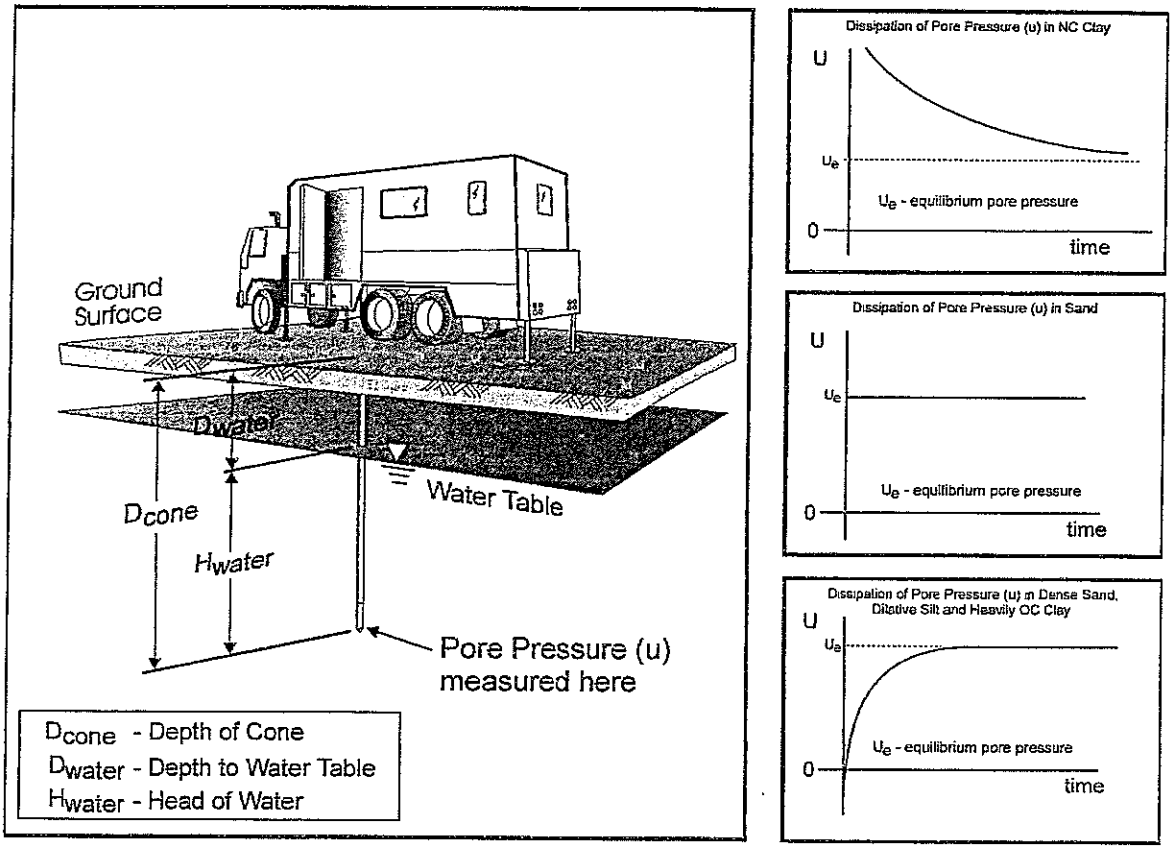
When cone penetration is stopped, the piezo cone essentially becomes a piezometer. While stopped, pore water pressures are automatically recorded at five-second intervals and the readings are stored in a dissipation file (.ppd). Dissipation data can then be plotted onto a dissipation curve consisting of pore water pressure (u) verses time (t). The shapes of dissipation curves are very useful in evaluating soil type, drainage and in situ static water level.

A flat curve that stabilizes quickly (i.e. less than 30 seconds) is typical of a free draining sand. In this case, the final measured pore water pressure is the static in situ water pressure.

Soils that generate excess dynamic pore water pressure during penetration will dissipate this excess pressure when penetration stops. The shape of the dissipation curve and the time of dissipation can be used to estimate C_h, the coefficient of consolidation that can in turn be used to calculate K_h, the horizontal permeability.

Figure 3 shows some idealized shapes of various pore water pressure dissipation curves. The reader is referred Robertson et. al., 1992 to reference dissipation test data analytical techniques.

Estimation of Ground Water Table from CPT Dissipation Tests



Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

Useful Conversion Factors:
1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

FIGURE 3 - TYPICAL DISSIPATION TESTS

3.0 CONE PENETRATION TEST DATA AND INTERPRETATION

3.1 ANALYSIS OF PIEZOCONE DATA - GENERAL

A total of fifteen CPT sounding involving 443.90 feet of testing, were completed.

The interpretation of cone data is based on the relationship between cone bearing, qc, sleeve friction, fs, and penetration pore water pressure, u. The friction ratio, Rf , (sleeve friction divided by cone bearing) is a calculated parameter which is used to infer soil behavior type. Generally, saturated cohesive soils have low tip resistance, high friction ratios and generate large excess pore water pressures. Cohesionless soils have higher tip resistances, lower friction ratios and do not generate significant excess pore water pressure.

The interpretation of soils encountered on this project was carried out using correlations developed by Robertson et al., 1992. It should be noted that it is not always possible to clearly identify a soil type based on qc, fs and ut. Occasionally soils will fall within different soil categories on the classification charts. In these situations, experience and judgment and an assessment of the pore pressure dissipation data should be used to infer the soil behavior type. Computer tabulations of the interpreted soil types along with certain other geotechnical parameters for each cone hole is presented in Appendix B.

Each of the parameters measured in the sounding is discussed briefly below. A detailed explanation of CPTU testing and interpretation of the results can be found in Robertson, 1989.

TIP RESISTANCE (q_c): The resistance to penetration, measured at the cone tip, provides an accurate profile of subsurface strata. The recorded tip resistance is a composite of the penetration resistance of the soils located five to ten cone diameters (7 to 14 inches) in front of and behind the tip. The actual resistance "sensed" by the tip depends on the soil properties and on the relative stiffness of the layers encountered. Tip resistance is often corrected for pore pressure effects when testing in soft saturated cohesive soils.

For this project the correction was made and the tip resistance shown, q_t is the corrected tip resistance.

The correction used is: $q_t = q_c + (1-a)u$

Where:
- q_t = corrected tip resistance
- q_c = measured tip resistance
- a = net area ratio for cone (0.80 for this project)
- u = dynamic pore water pressure measured behind tip

SLEEVE FRICTION (f_s) The resistance recorded on the friction sleeve, is a measure of the remolded strength of the soil. Values of sleeve friction in very soft soils (such as peat) may fluctuate due to the measured force being small relative to the capacity of the measuring load cell.

FRICTION RATIO (R_f) The ratio of sleeve friction to tip resistance expressed as a percentage, is an indicator of soil type. Cohesive soils generally have friction ratios that are greater than two, while sands and non-plastic silts have friction ratios that are lower than two.

PORE PRESSURE (u) Dynamic pore water pressure is measured during penetration. (dynamic pore water pressure data can be found in the .cor, .xls files. Static pore water pressure is measured when cone penetration is stopped (static pore water pressure data can be found in the .ppd files). The measured dynamic pore water pressure changes with the location of the porous filter and negative readings are possible when the filter is located behind the tip.

It is important to note that the CPT classifies soil by physical behavior, not by grain size; therefore, the CPT classification should be verified against samples obtained from a conventional drilling program. While the CPT soil classification may not always be accurate in terms of the actual label it applies to a particular soil, it is very accurate in grouping soils with similar mechanical properties.

Table 1 presents a summary of CPT soundings, including sounding depths.

3.2 CONE PLOTS

The data from each sounding was plotted using the computer program ScreenZ. The plots are included in Appendix A. ScreenZ was developed by ConeTec Inc. and it incorporates soil behavior type (SBT) classification as part of the plot. The soil classification is based on the classification chart reproduced chart in Appendix B.

3.3 PORE PRESSURE DISSIPATION TEST RESULTS

When conducting CPT investigations, pore water pressure dissipations are automatically recorded during pauses in penetration. The pore water pressure data is recorded at five second intervals. Dynamic and static pore pressure dissipation data for each CPT is included on the data CD. No dissipation tests were completed during this project. Water table depths used in the data interpretations were given to us by the client.

3.4 SHEAR WAVE VELOCITY MEASUREMENTS

Shear wave velocity measurements were conducted during all of the CPT soundings. Shear wave velocity measurements were recorded approximately every meter. The shear wave velocity data can be found in Appendix C.

3.5 CPTSUMM DATA PROCESSING

The electronic data files were processed using the program CPTSUMM. CPTSUMM is a program developed by ConeTec to calculate common engineering parameters from CPT data. The data files (xls) can be found on the data CD. The calculations used are summarized in the table found in Appendix B. Each calculation is derived according to the referenced article.

For this project, the depth to ground water was given to us by the client. The exact depth used is noted in the header of each CPTSUMM file.

3.6 DATA CD

One data CD is included in Appendix E. The CD includes all of the CPT, dynamic and static pore water pressure and CPTSUMM data.

5.0 REFERENCES

Robertson, P.K., 1989, "Soil Classification using the Cone Penetration Test", Canadian Geotechnical Journal, vol. 27, pages 151-158.

Robertson, P.K., Sully, J., Woeller, D.G., Lunne, T., Powell, J.M., and Gillespie, D.J., 1992, "Estimating Coefficient of Consolidation from Piezocone Tests", Canadian Geotechnical Journal, vol. 29, pages 539-550.

CONETEC

TABLE 1 - SUMMARY OF CPTU SOUNDINGS

Job No.: 07-804
Location: Pond Creek Mine - Williamson County, Illinois
Client: Civil & Environmental Consultants
Date: October 30, 31, 2007

Date	CPTU Sounding	File Name	CPT Total Depth (ft)	Shear wave Velocity Tests	Comments
31-Oct-07	CPT-1	804cp01.cor	18.37	6	
30-Oct-07	CPT-2	804cp02.cor	45.28	13	
30-Oct-07	CPT-2A	804cp02a.cor	41.67	12	
31-Oct-07	CPT-3	804cp03.cor	22.15	6	
31-Oct-07	CPT-4	804cp04.cor	18.86	6	
30-Oct-07	CPT-5	804cp05.cor	49.21	14	
30-Oct-07	CPT-5A	804cp05a.cor	53.15	16	
30-Oct-07	CPT-5B	804cp05b.cor	39.70	12	
31-Oct-07	CPT-6	804cp06.cor	22.64	7	
31-Oct-07	CPT-7	804cp07.cor	16.73	5	
31-Oct-07	CPT-8	804cp08.cor	17.88	6	
31-Oct-07	CPT-9	804cp09.cor	21.98	7	
31-Oct-07	CPT-10	804cp10.cor	26.08	8	
31-Oct-07	CPT-11	804cp11.cor	27.56	9	
31-Oct-07	CPT-12	804cp12.cor	22.64	7	
Job Totals:		15	443.90	134	

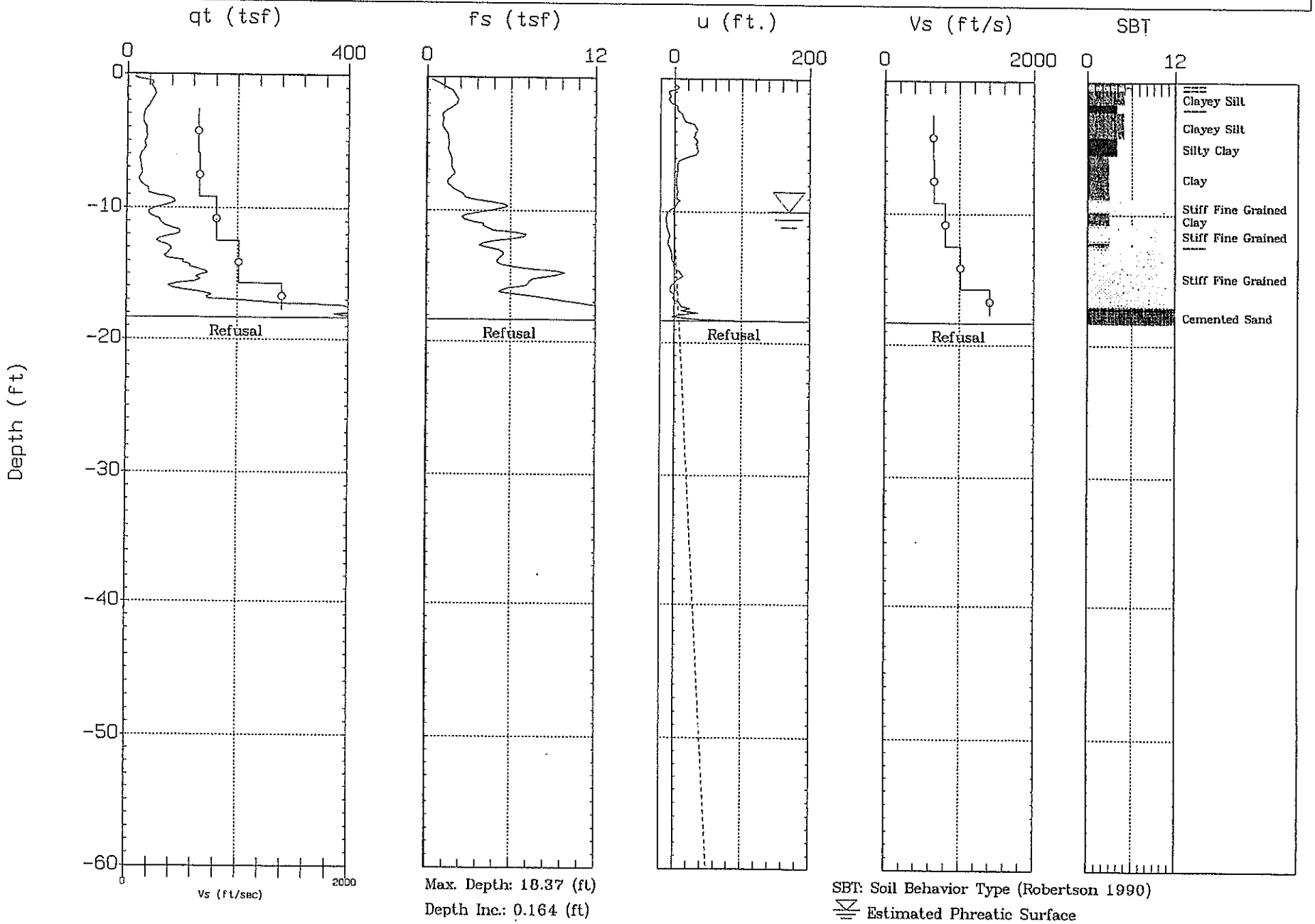
Shearwave CPT plots

CONETEC

C.E.C.

Sounding:CPT-1
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 13:23



Max. Depth: 18.37 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

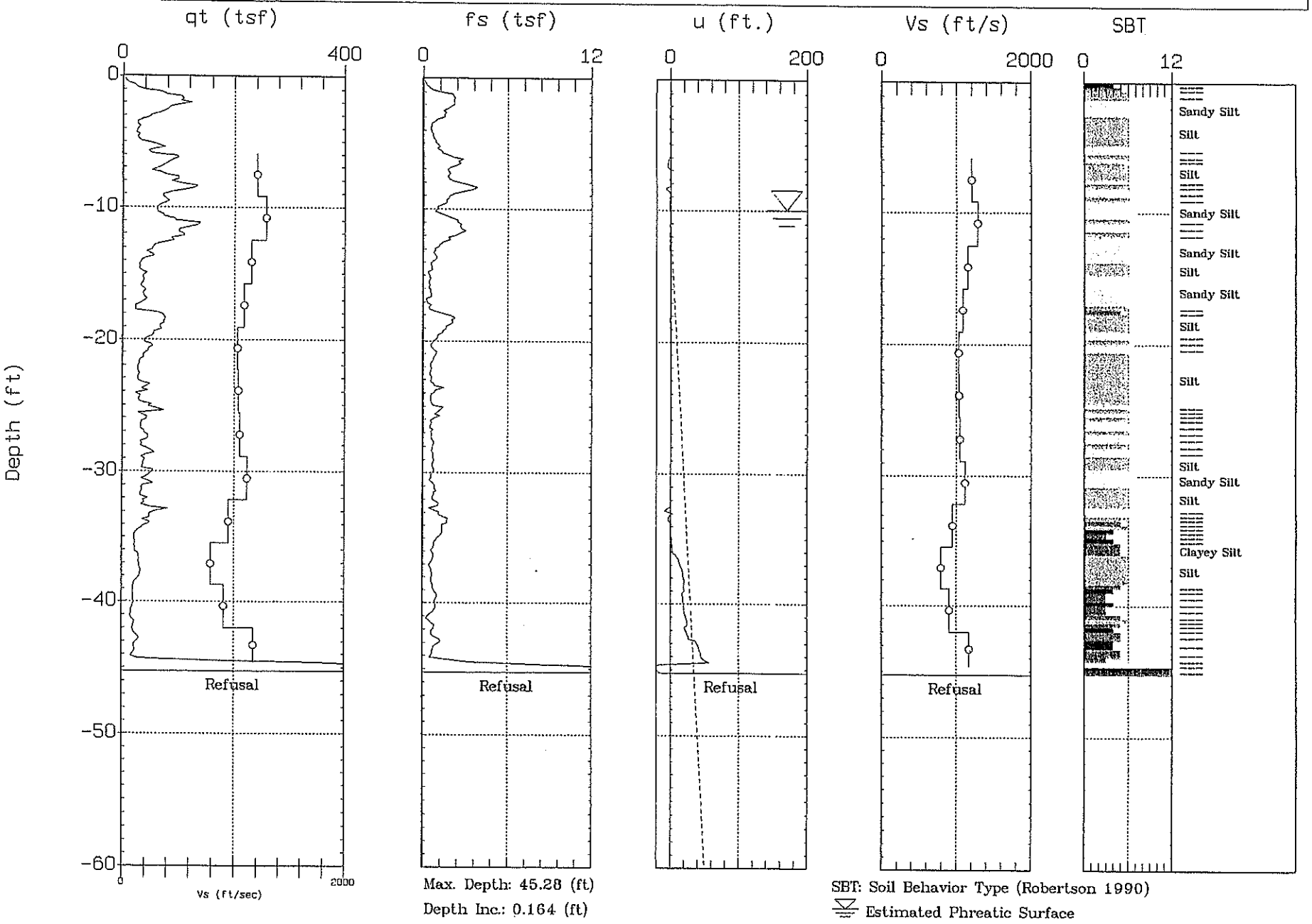
R16493

CONETEC

C.E.C.

Sounding:CPT-2
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 13:46



Max. Depth: 45.28 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

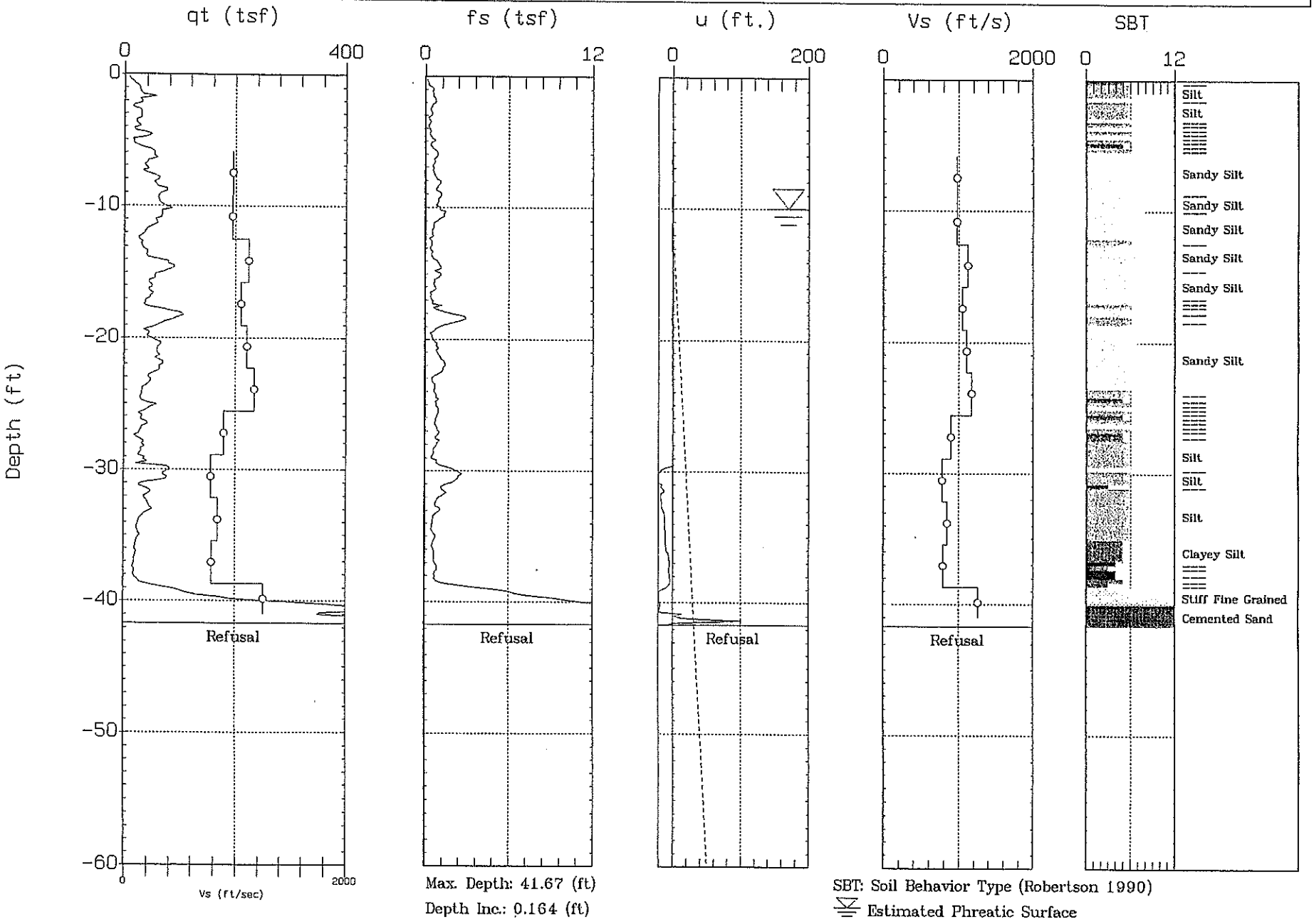
R16494

CONETEC

C.E.C.

Sounding:CPT-2A
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 14:50



Max. Depth: 41.67 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

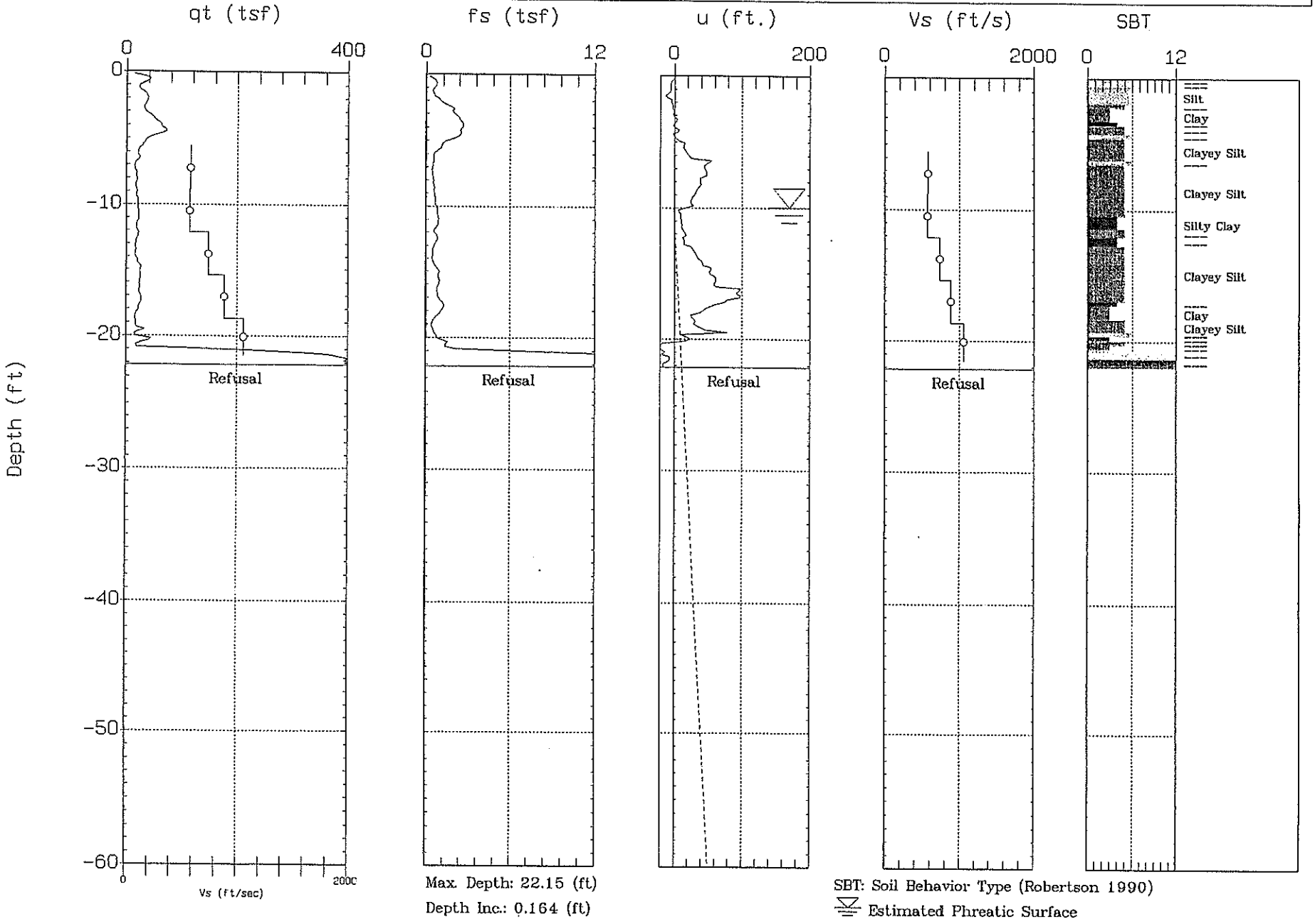
R16495

CONETEC

C.E.C.

Sounding:CPT-3
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:09



Max. Depth: 22.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

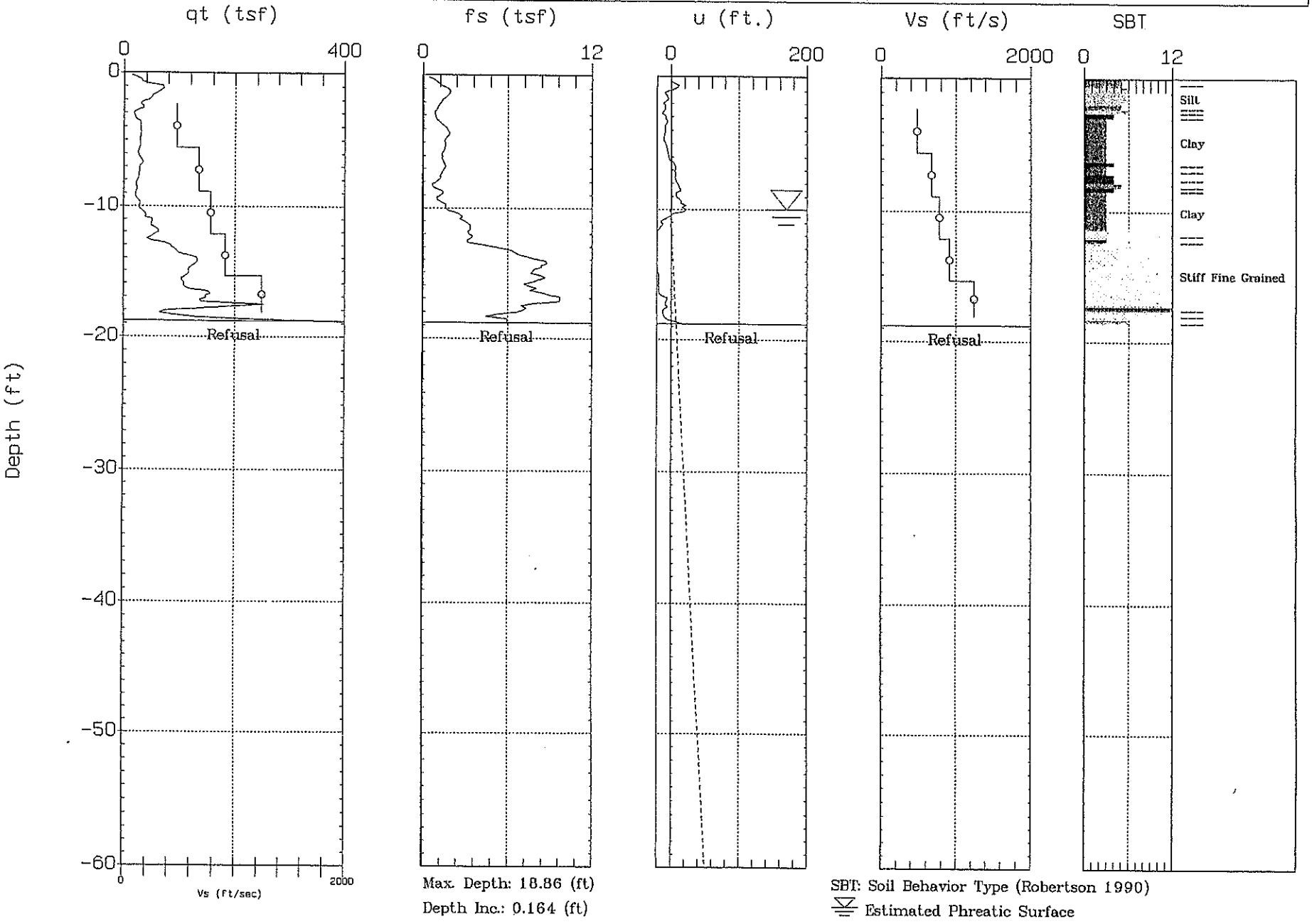
R16496

CONETEC

C.E.C.

Sounding:CPT-4
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:51



Max. Depth: 18.86 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

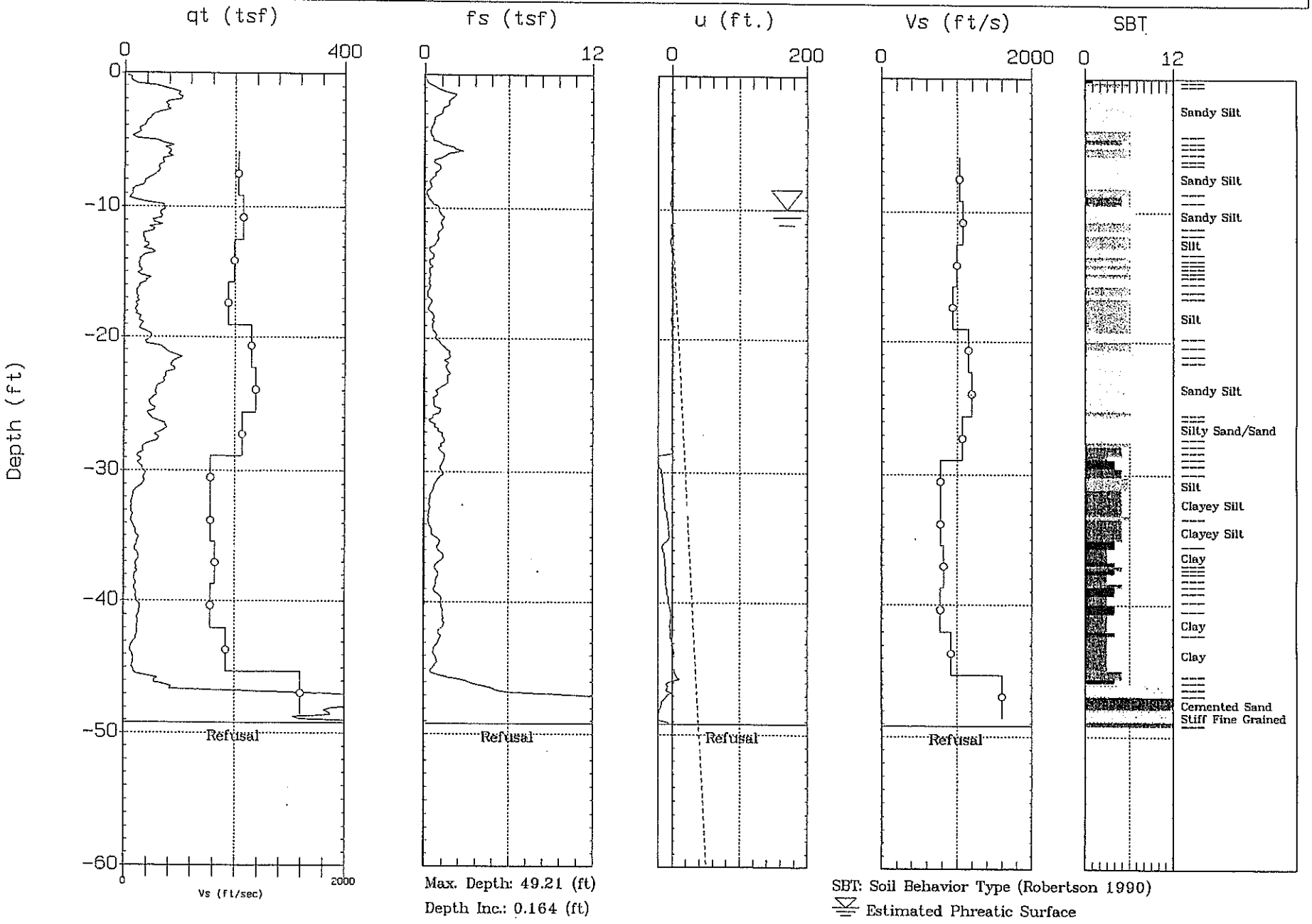
R16497

CONETEC

C.E.C.

Sounding:CPT-5
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 12:34



Max. Depth: 49.21 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

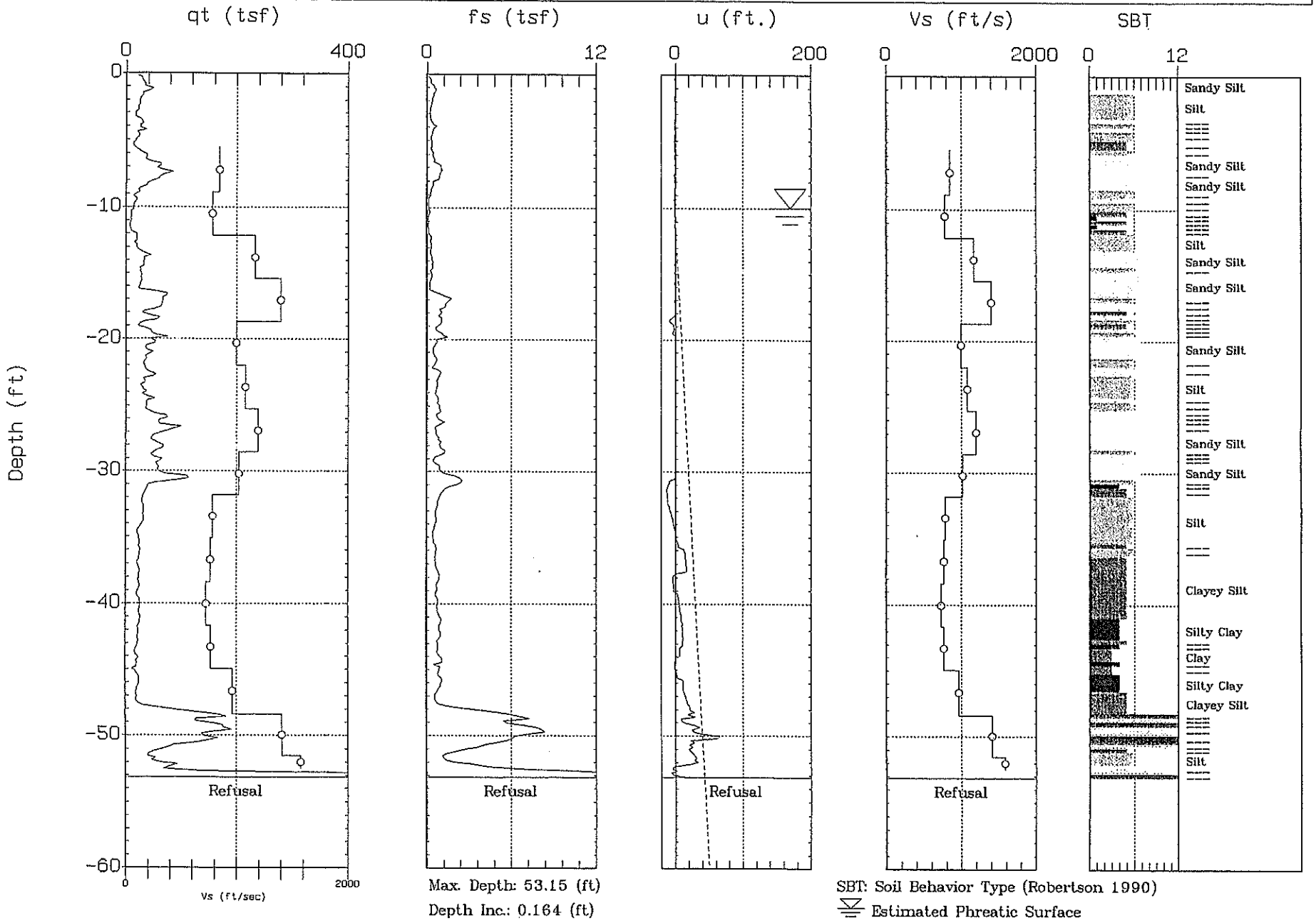
R16498

CONETEC

C.E.C.

Sounding:CPT-5A
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 10:44



Max. Depth: 53.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

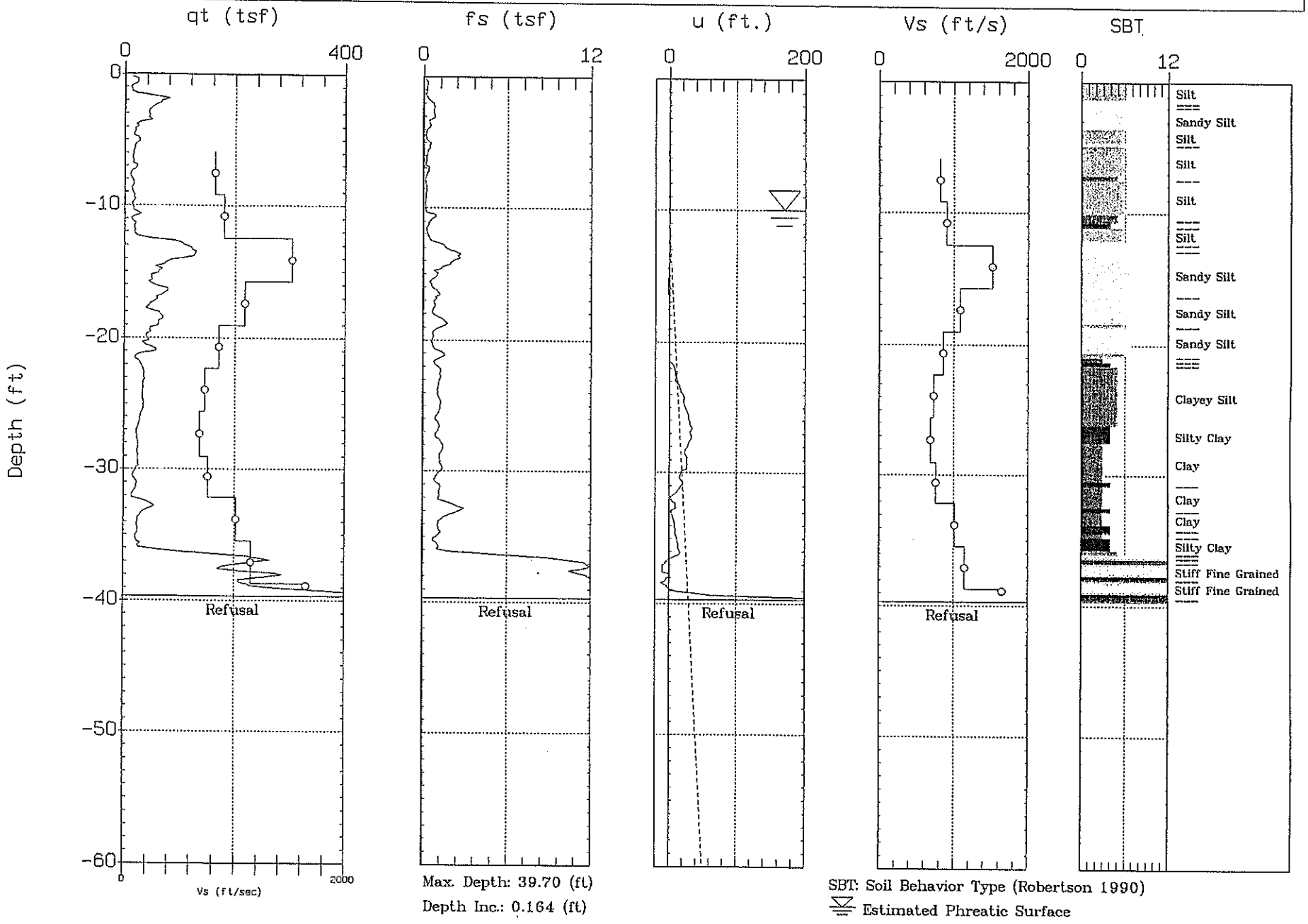
R16499

CONETEC

C.E.C.

Sounding:CPT-5B
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 15:44



Max. Depth: 39.70 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

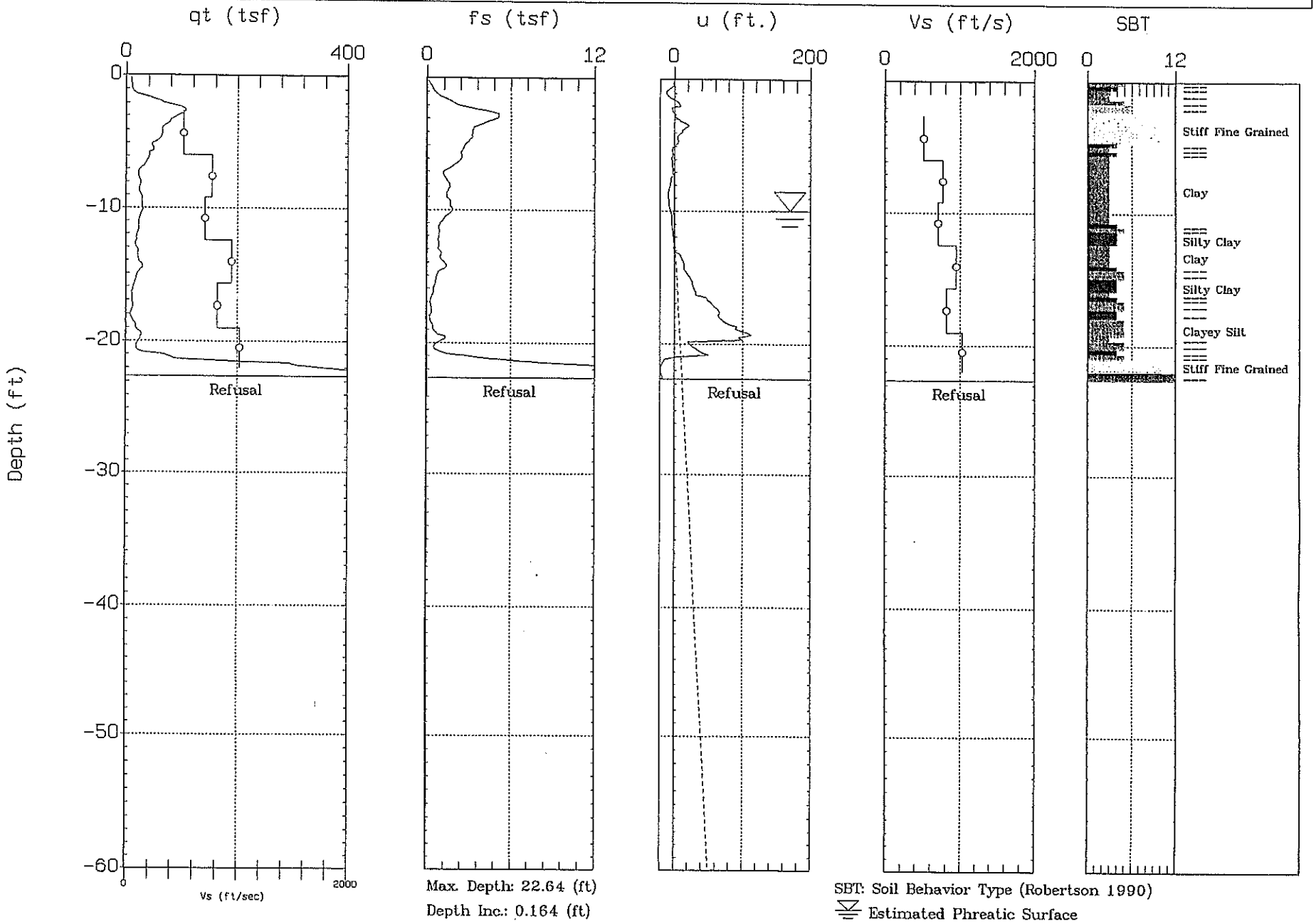
R16500

CONETEC

C.E.C.

Sounding:CPT-6
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:00



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

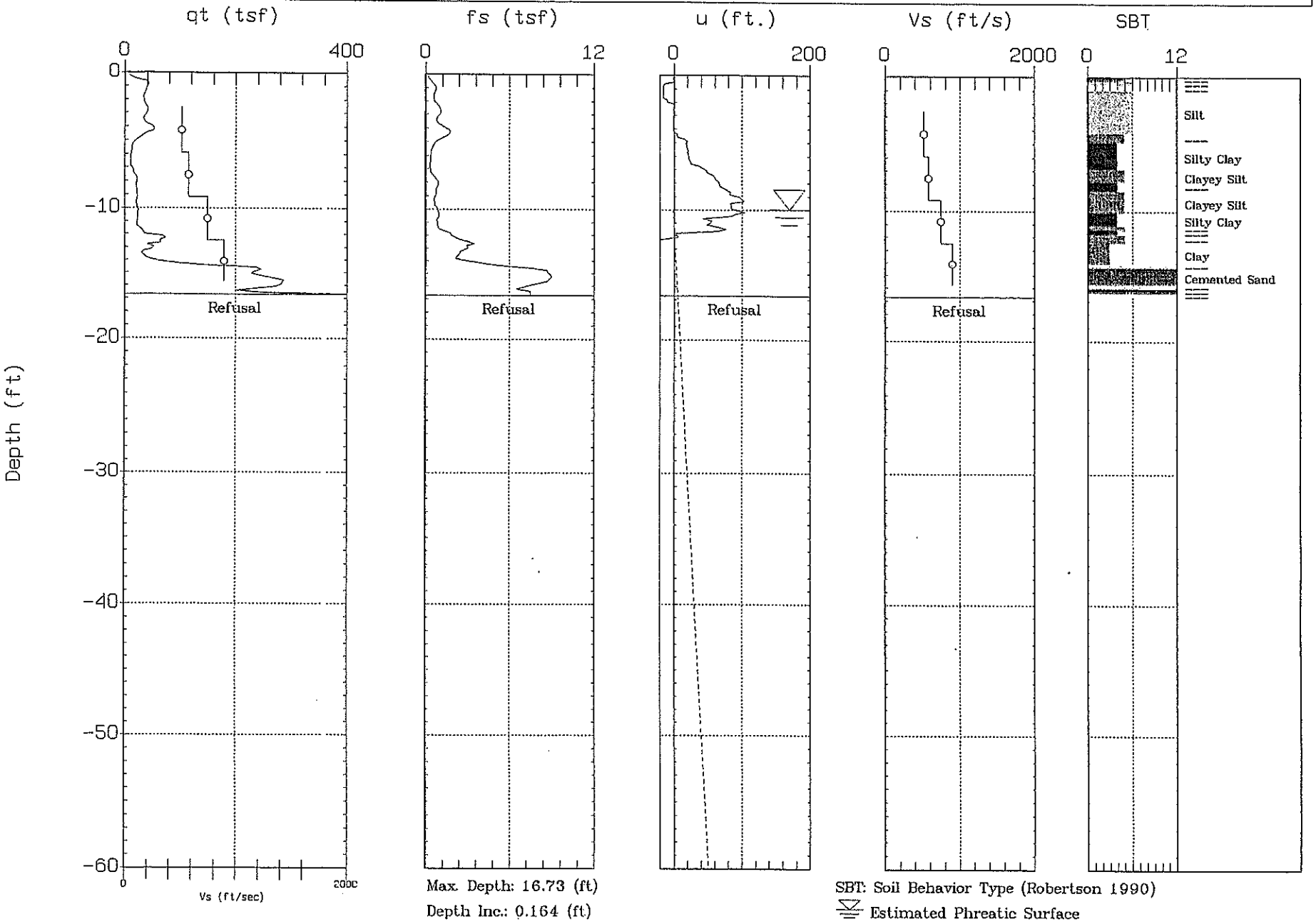
R16501

CONETEC

C.E.C.

Sounding:CPT-7
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:58



Max. Depth: 16.73 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

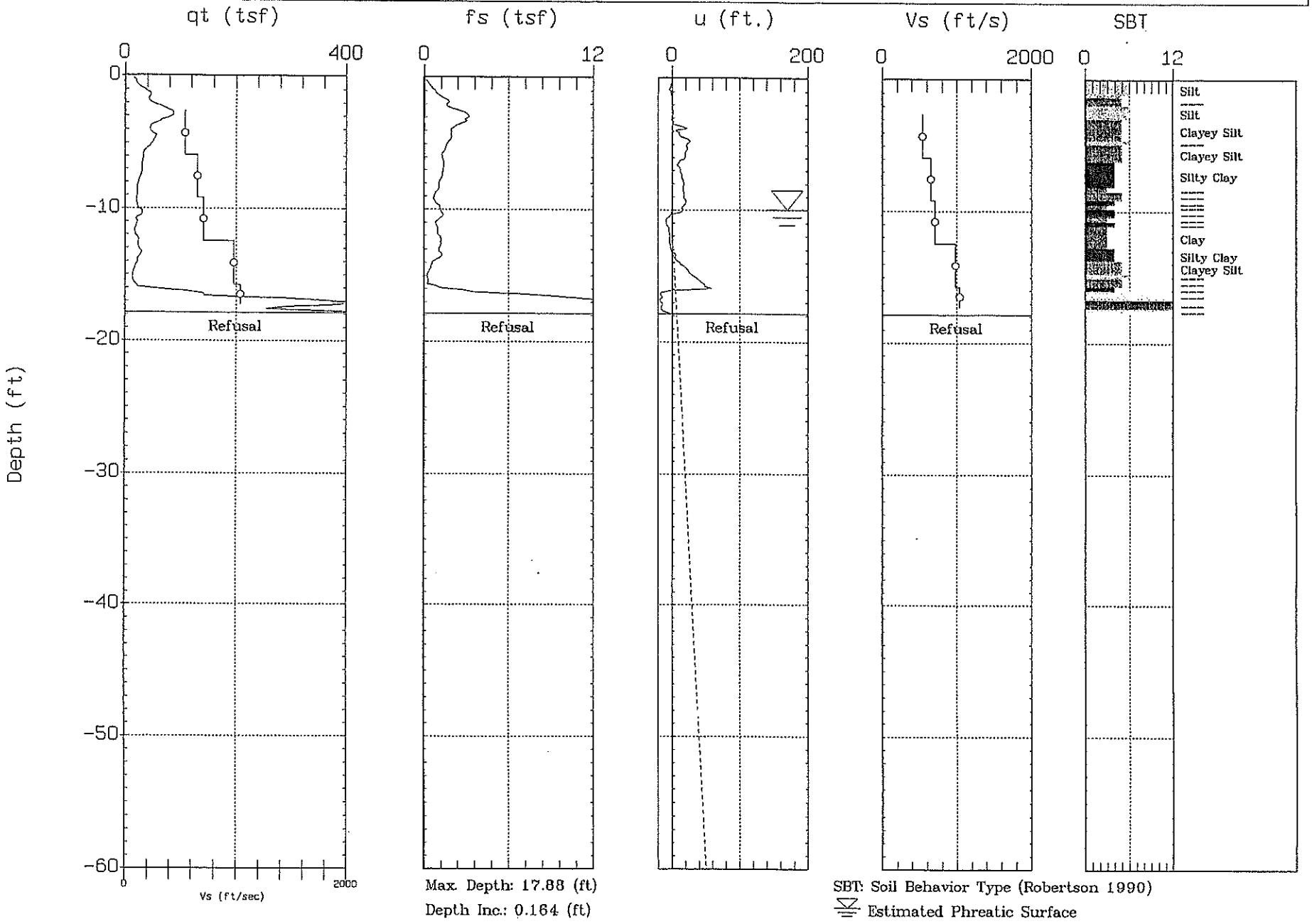
R16502

CONETEC

C.E.C.

Sounding:CPT-8
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:53



Max. Depth: 17.88 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

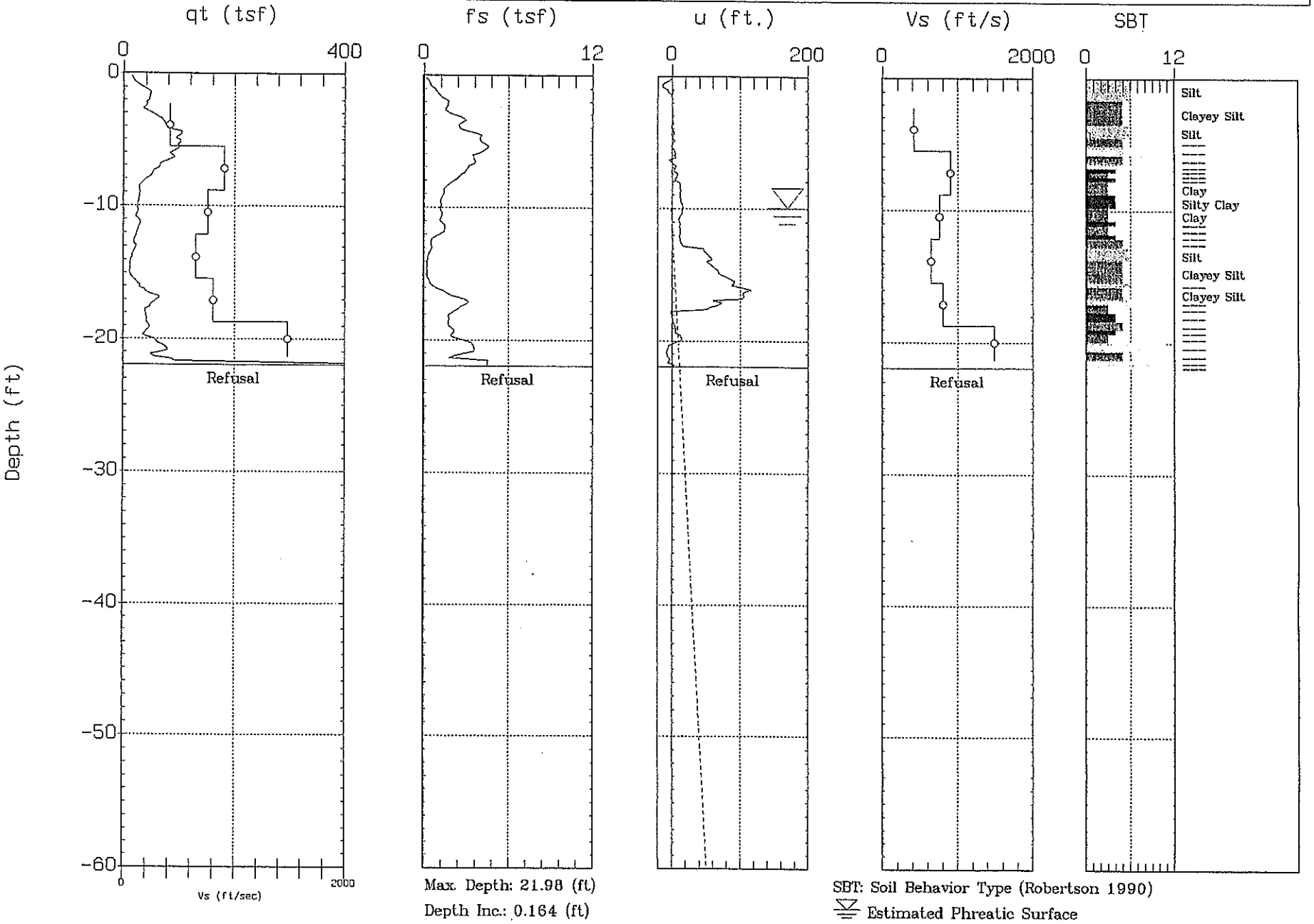
R16503

CONETEC

C.E.C.

Sounding:CPT-9
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:17



Max. Depth: 21.98 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

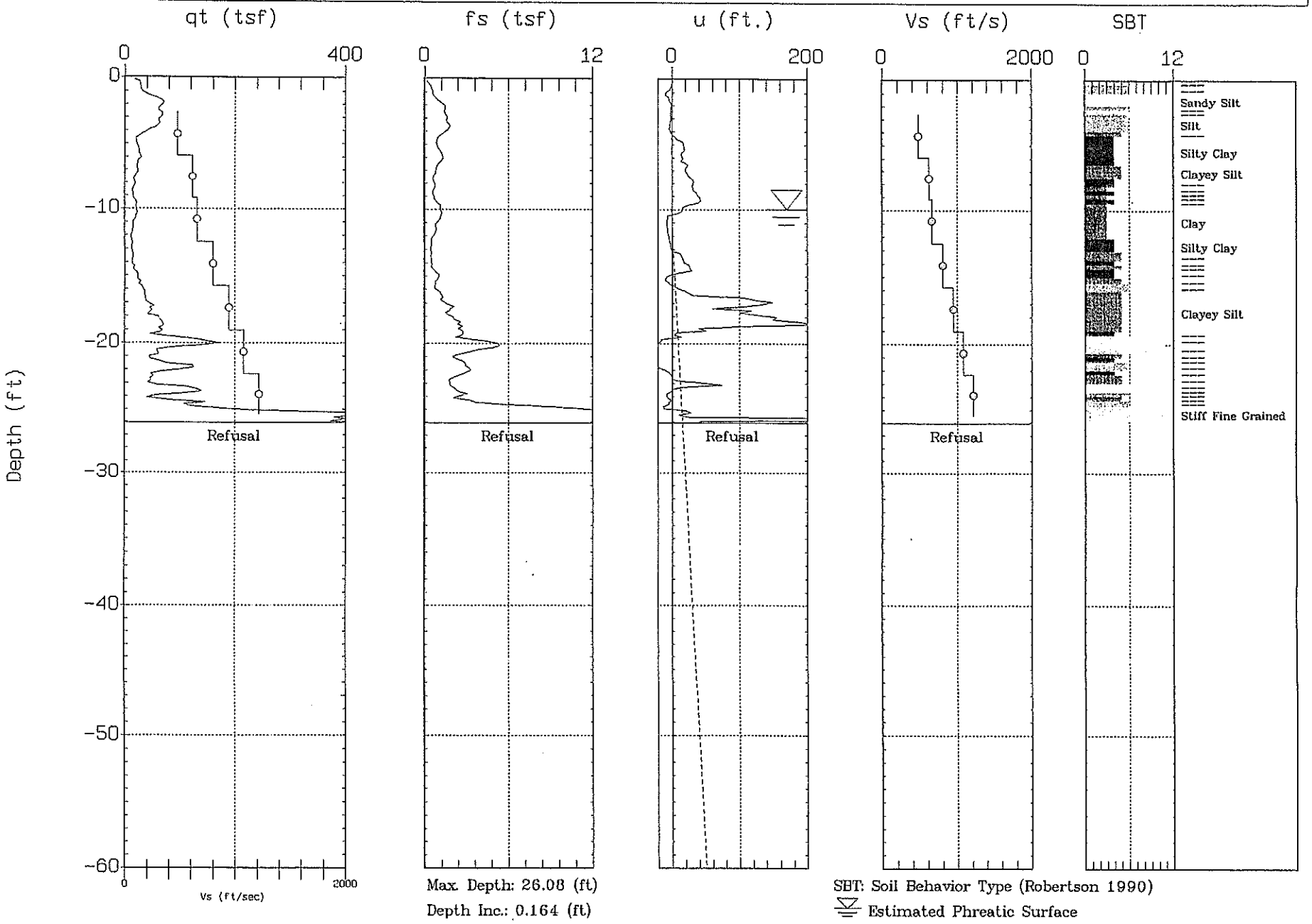
R16504

CONETEC

C.E.C.

Sounding:CPT-10
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 08:35



Max. Depth: 26.08 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

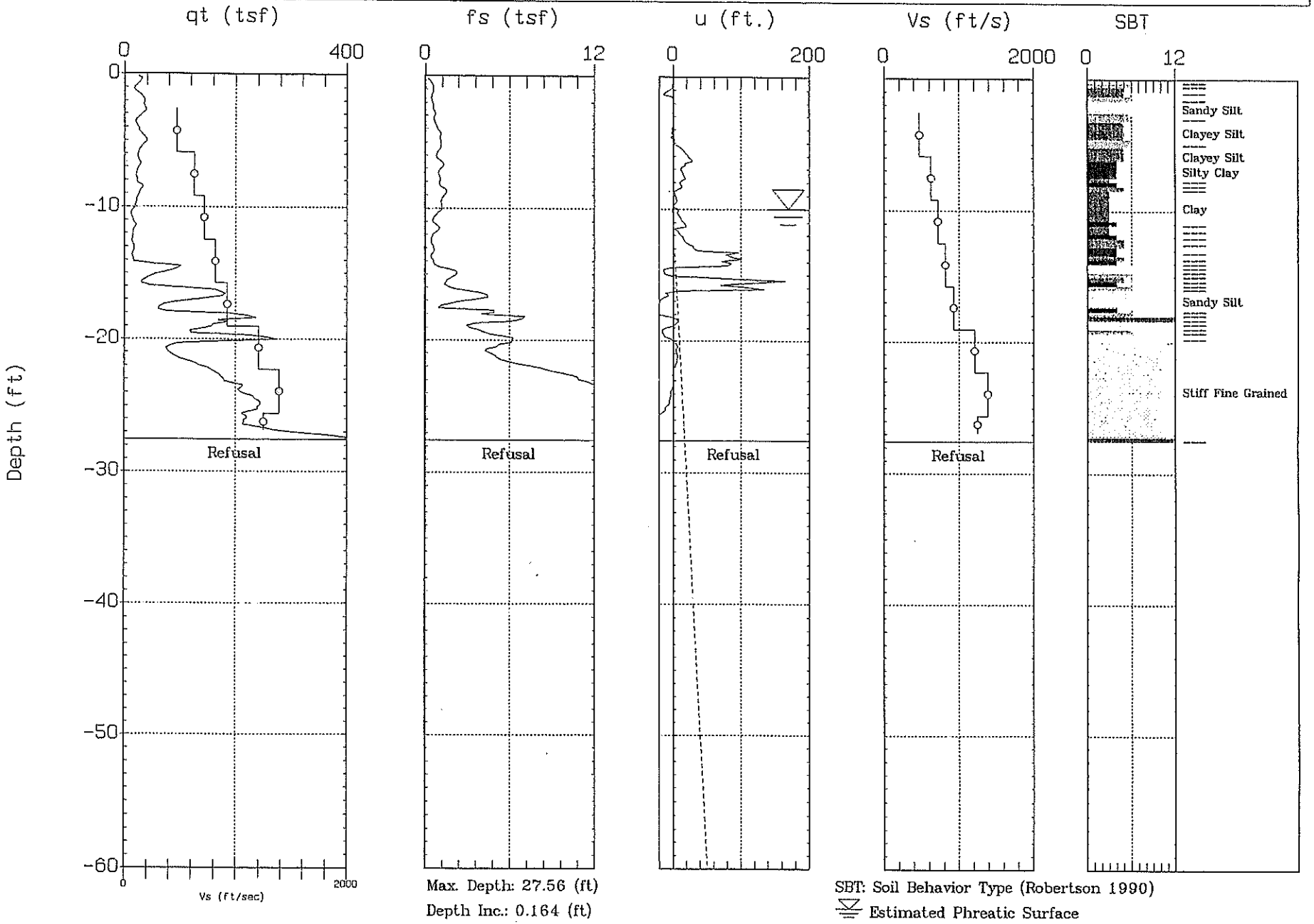
R16505

CONETEC

C.E.C.

Sounding:CPT-11
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 10:31



Max. Depth: 27.56 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

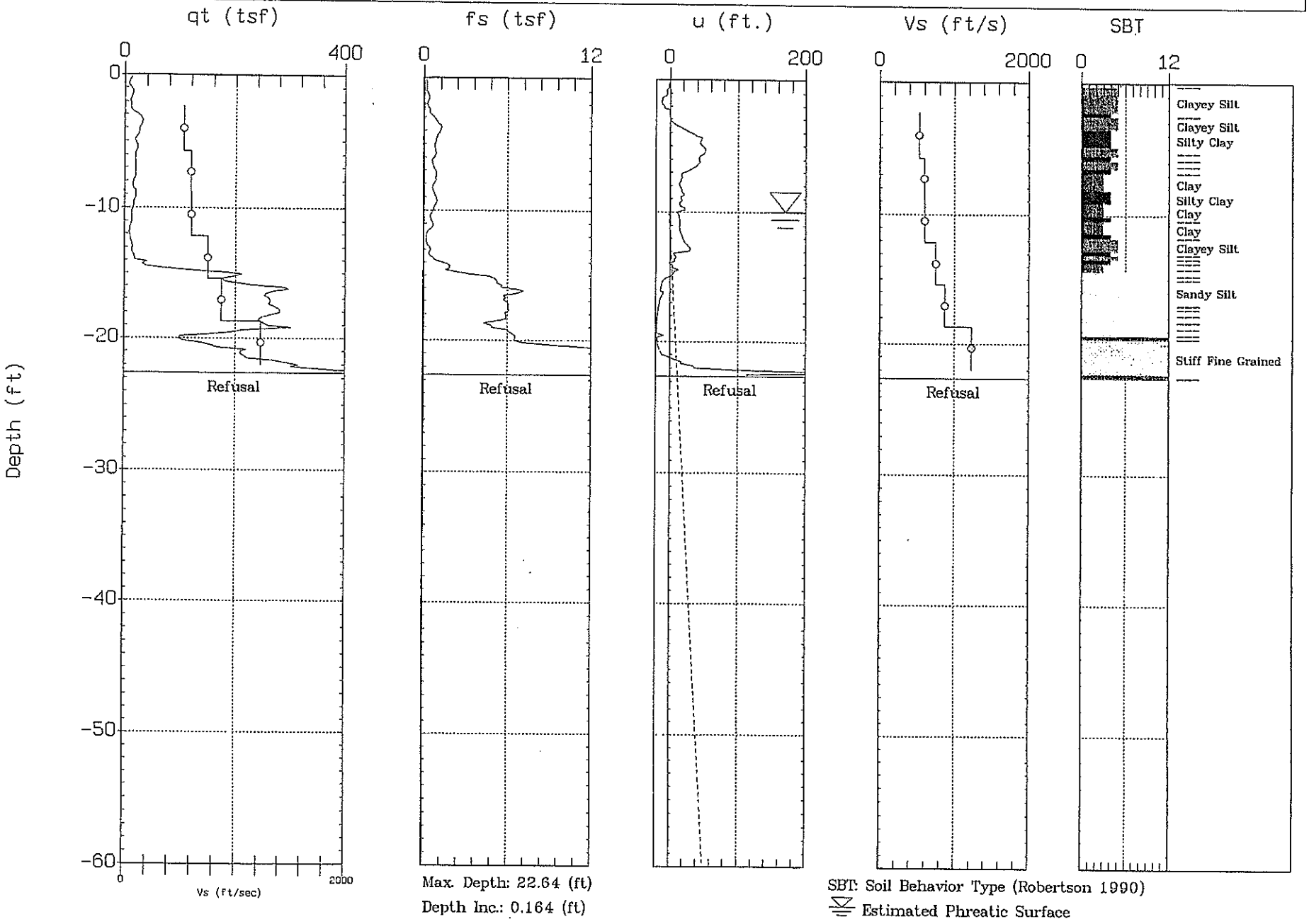
R16506

CONETEC

C.E.C.

Sounding:CPT-12
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 11:15



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

R16507

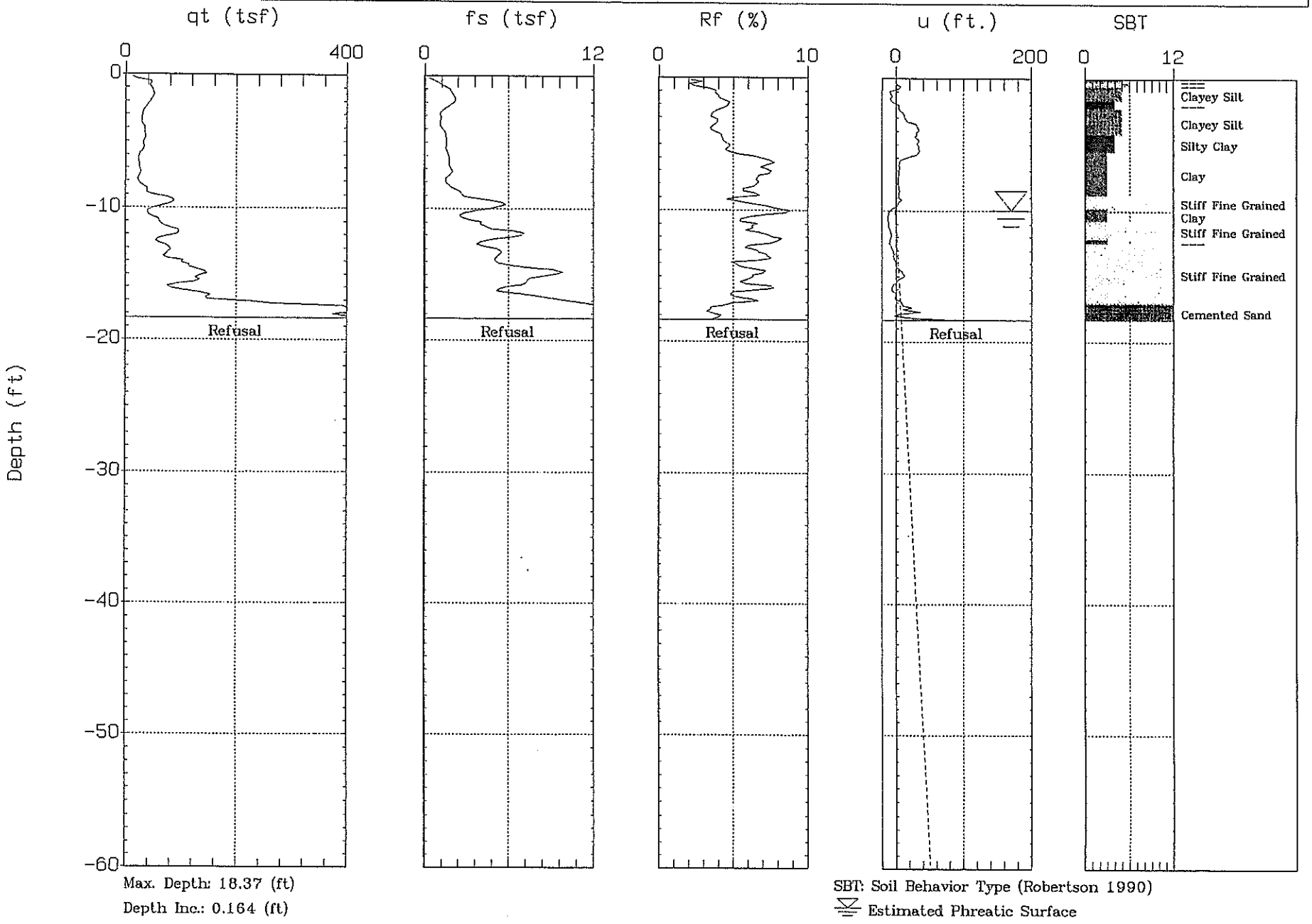
Non-normalized CPT plots

CONETEC

C.E.C.

Sounding:CPT-1
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 13:23



Max. Depth: 18.37 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

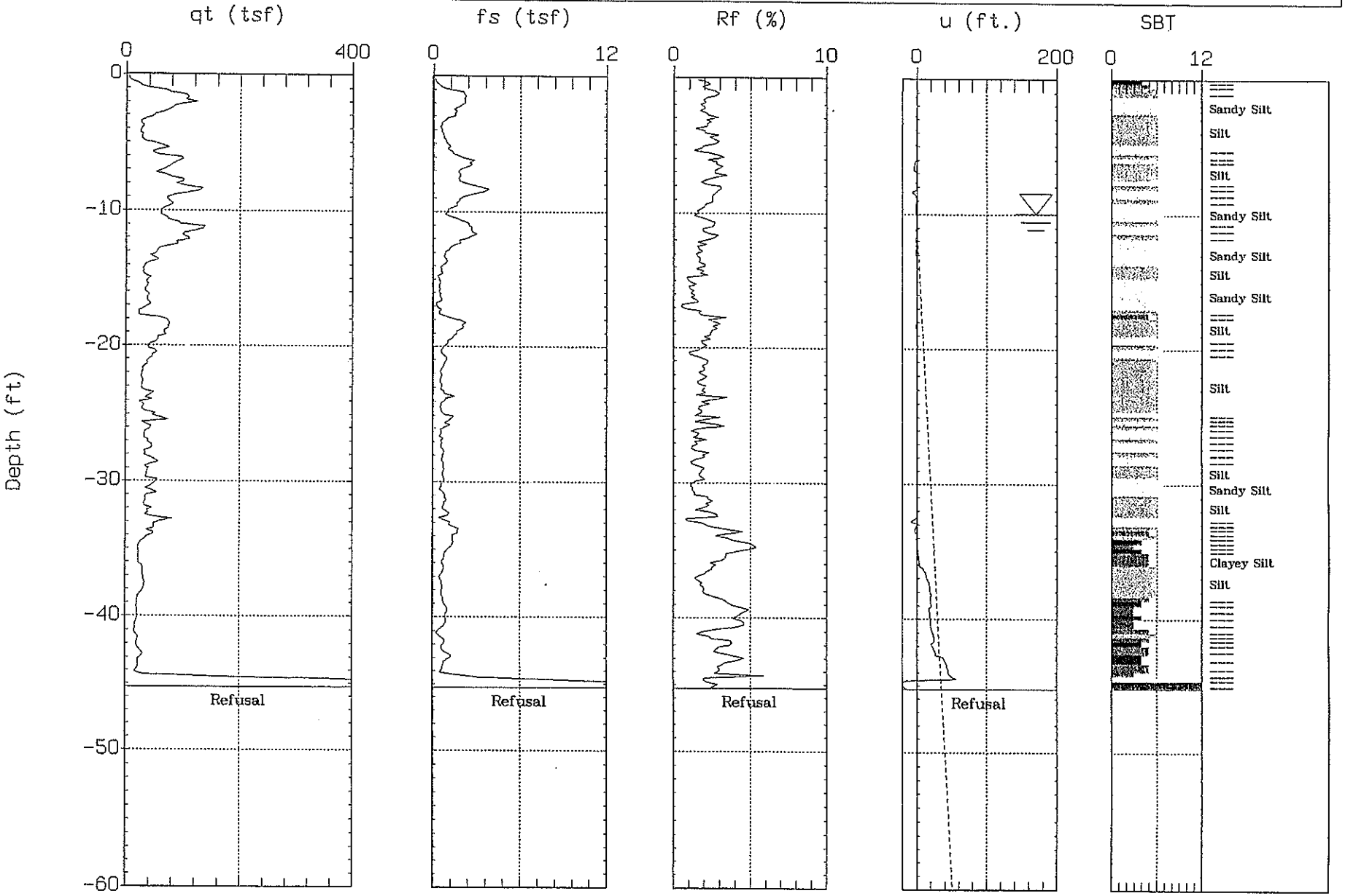
R16509

CONETEC

C.E.C.

Sounding:CPT-2
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 13:46



Max. Depth: 45.28 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

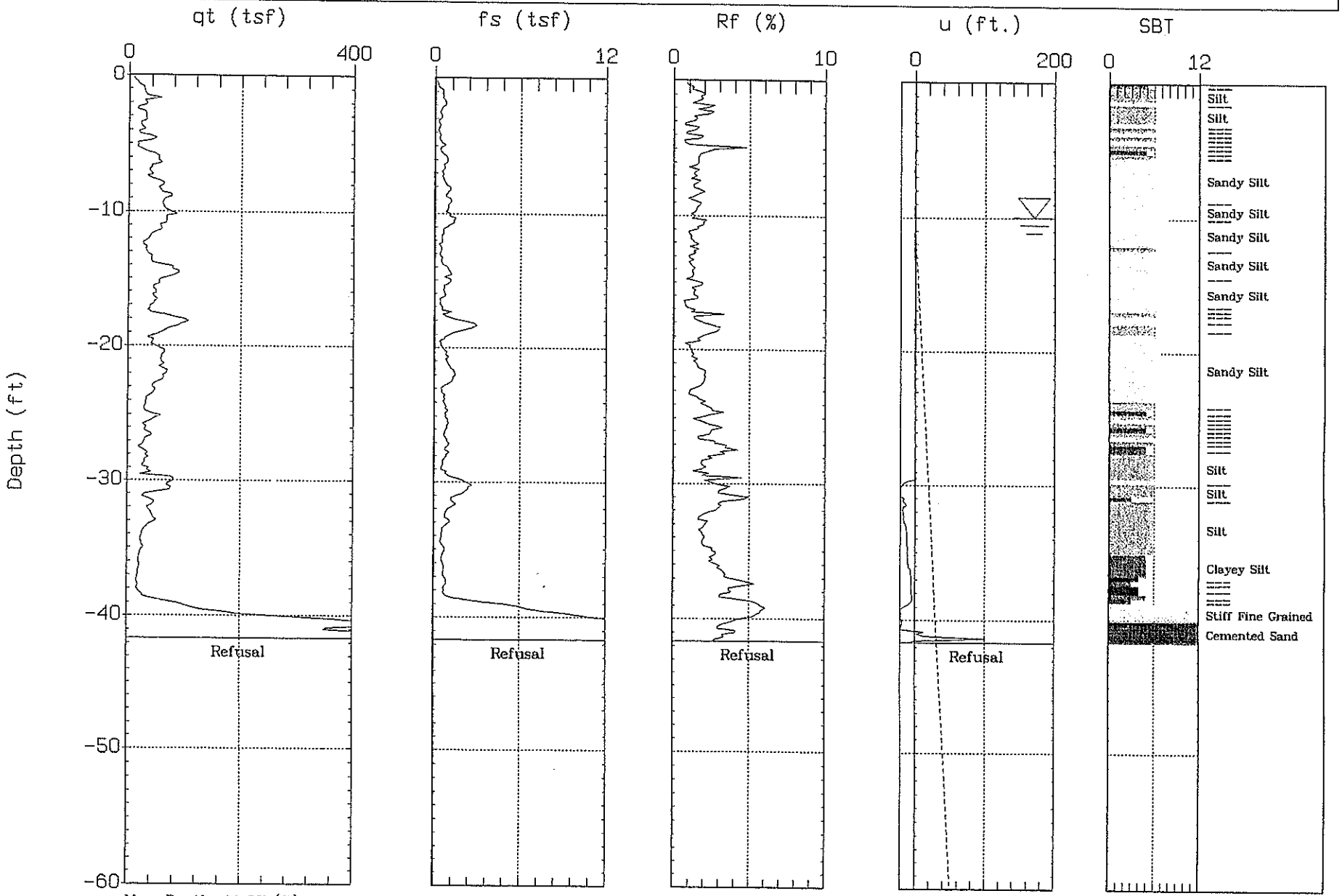
R16510

CONETEC

C.E.C.

Sounding:CPT-2A
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 14:50



Max. Depth: 41.67 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

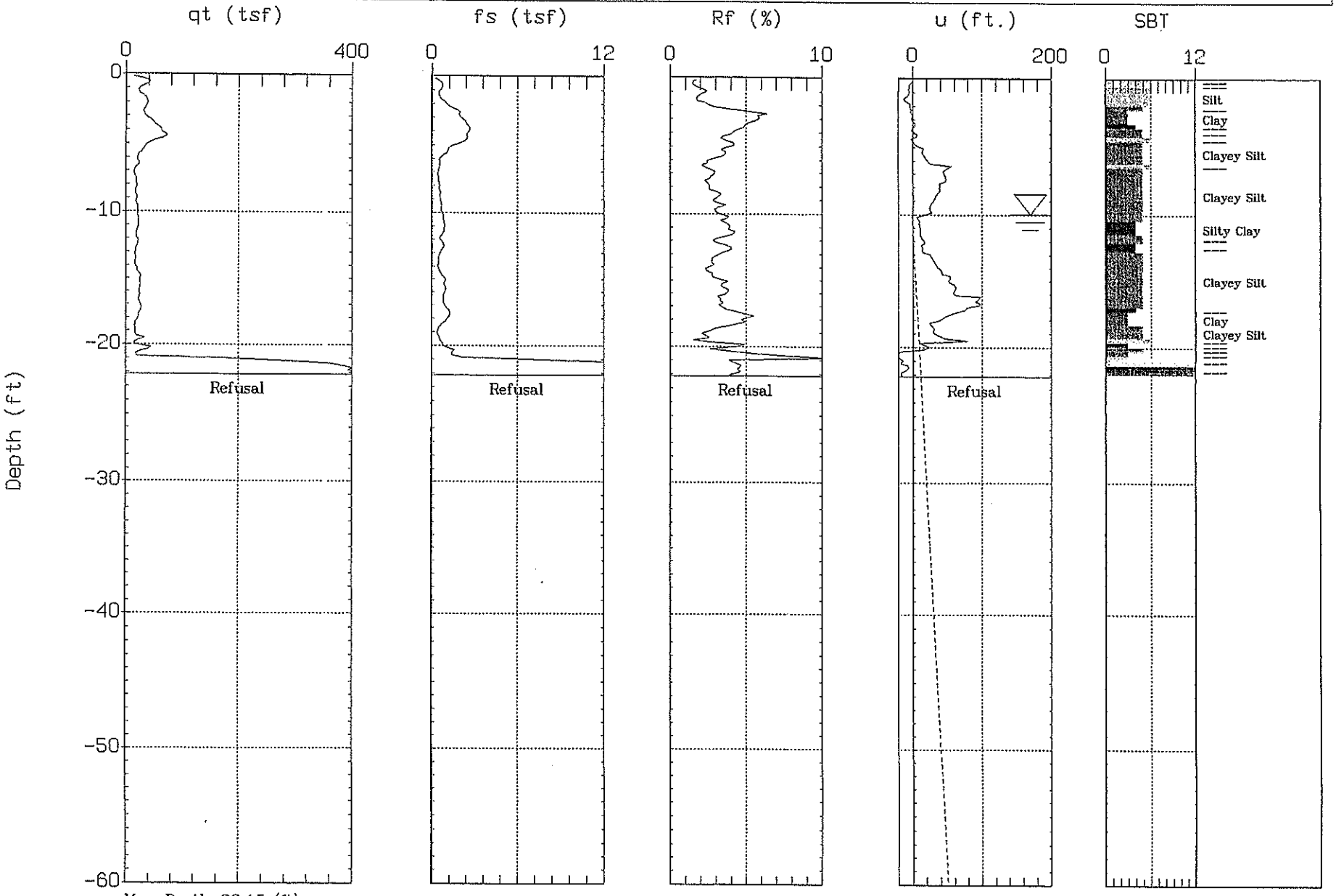
R16511

CONETEC

C.E.C.

Sounding:CPT-3
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:09



Max. Depth: 22.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

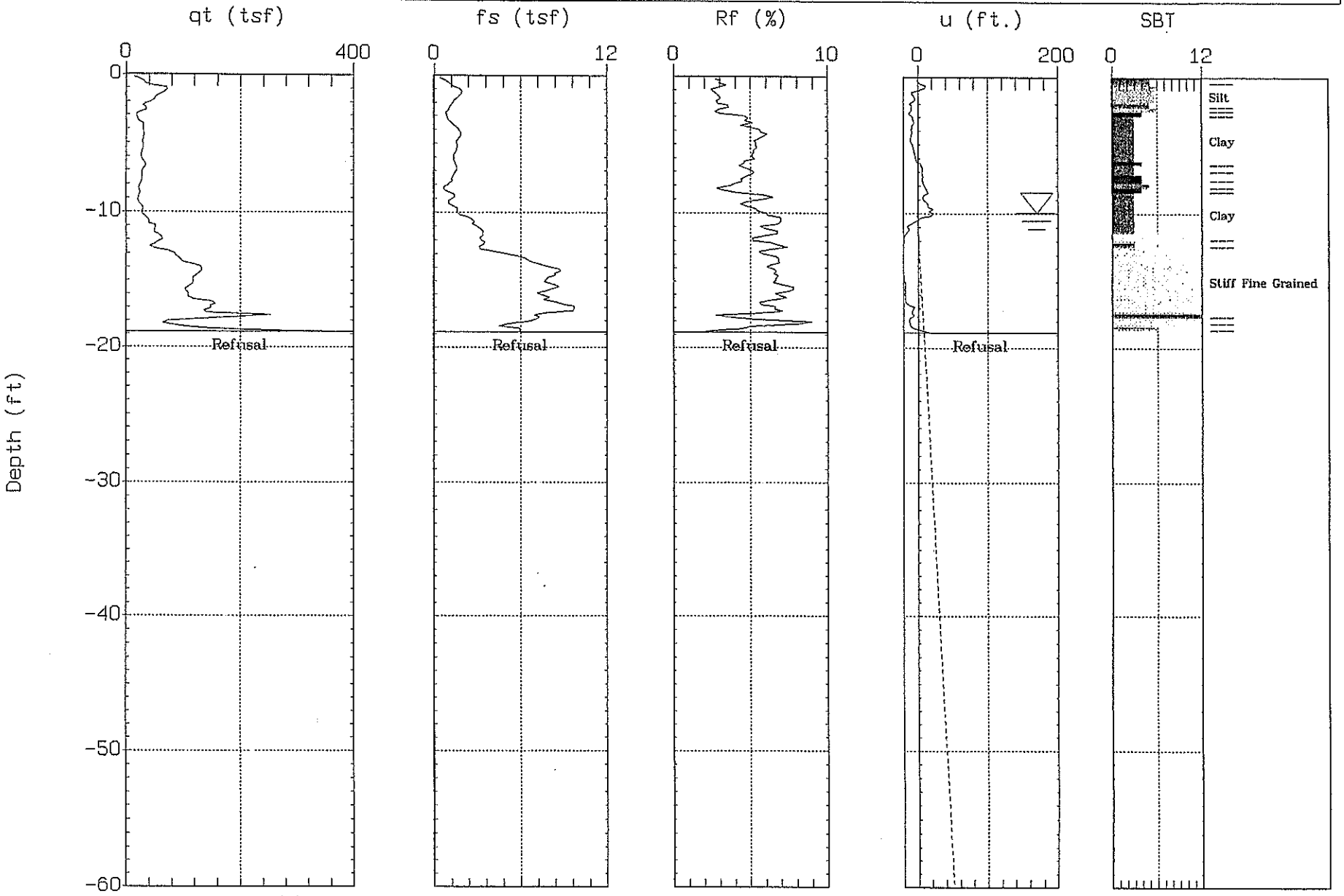
R16512

CONETEC

C.E.C.

Sounding:CPT-4
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:51



Max. Depth: 18.86 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

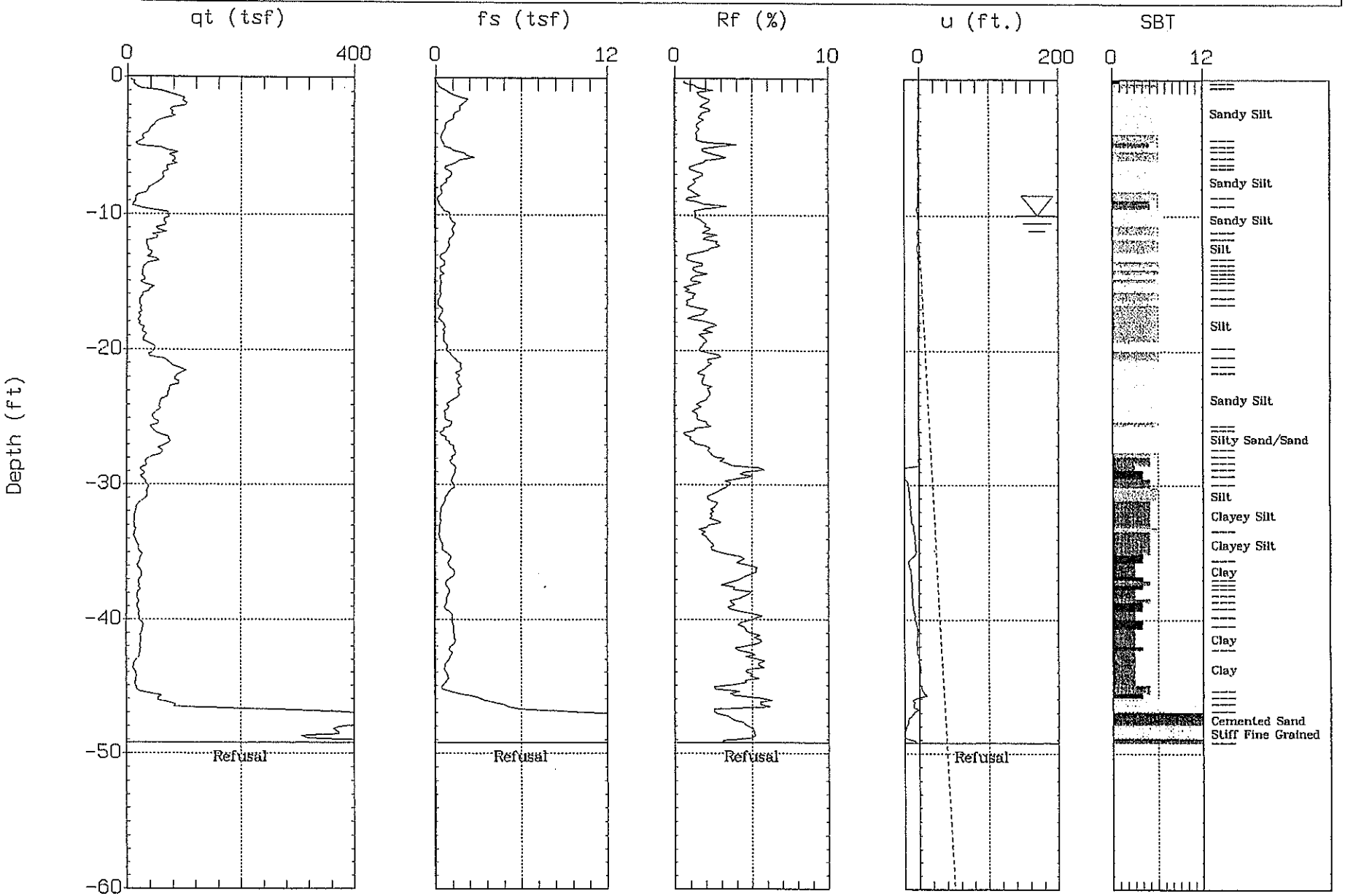
R16513

CONETEC

C.E.C.

Sounding:CPT-5
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 12:34



Max. Depth: 49.21 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

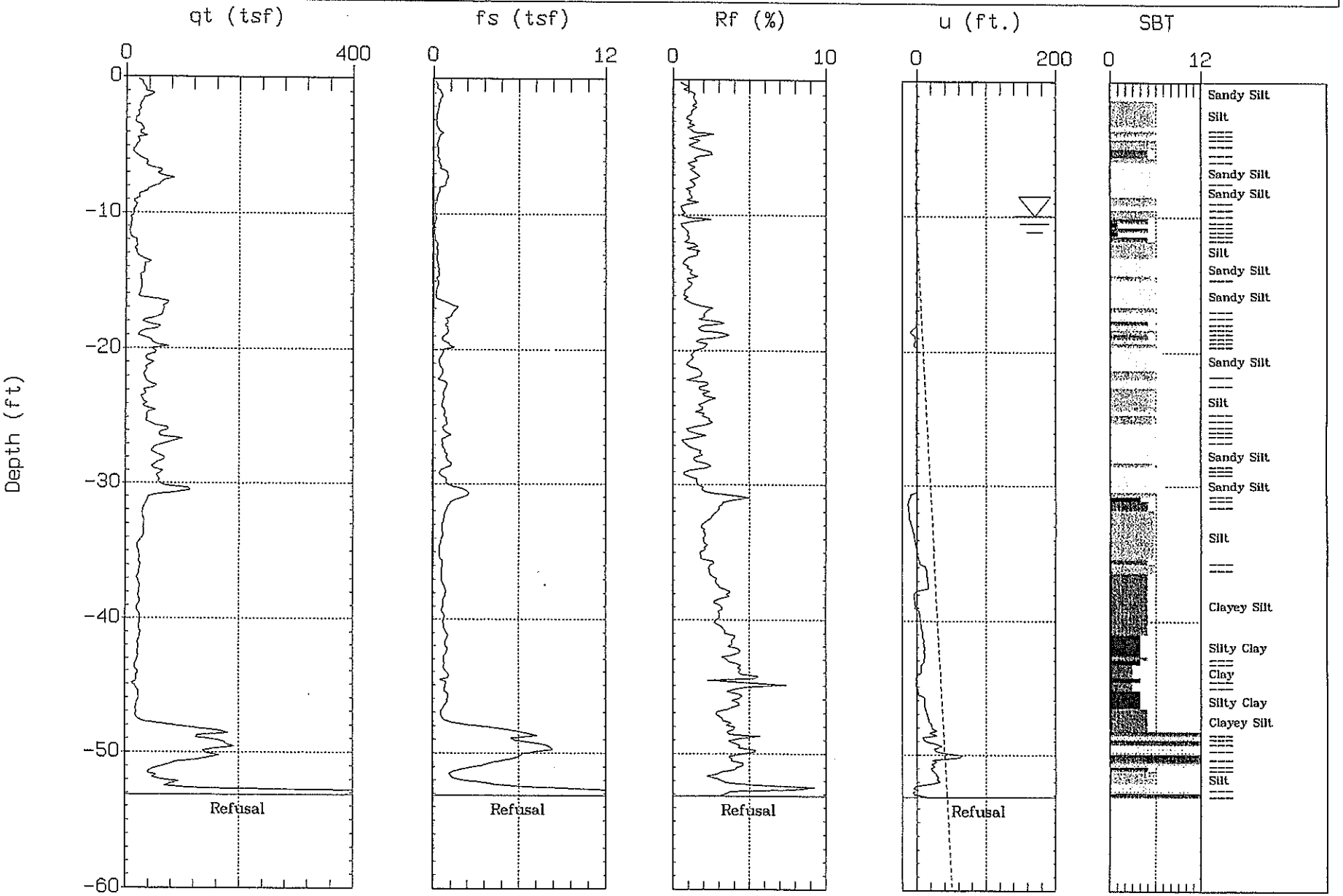
R16514

CONETEC

C.E.C.

Sounding:CPT-5A
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 10:44



Max. Depth: 53.15 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

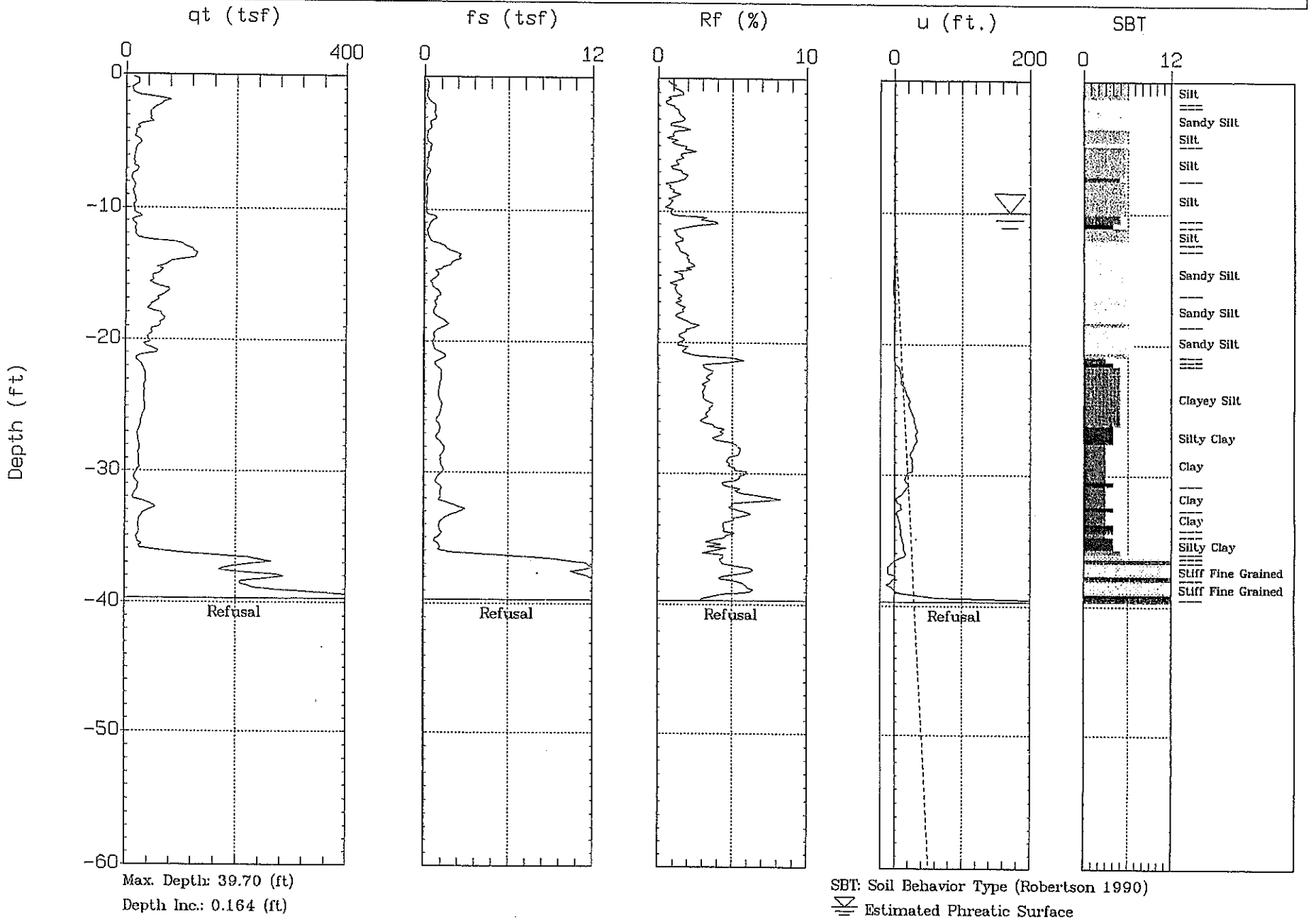
R16515

CONETEC

C.E.C.

Sounding:CPT-5B
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:30:07 15:44



Max. Depth: 39.70 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

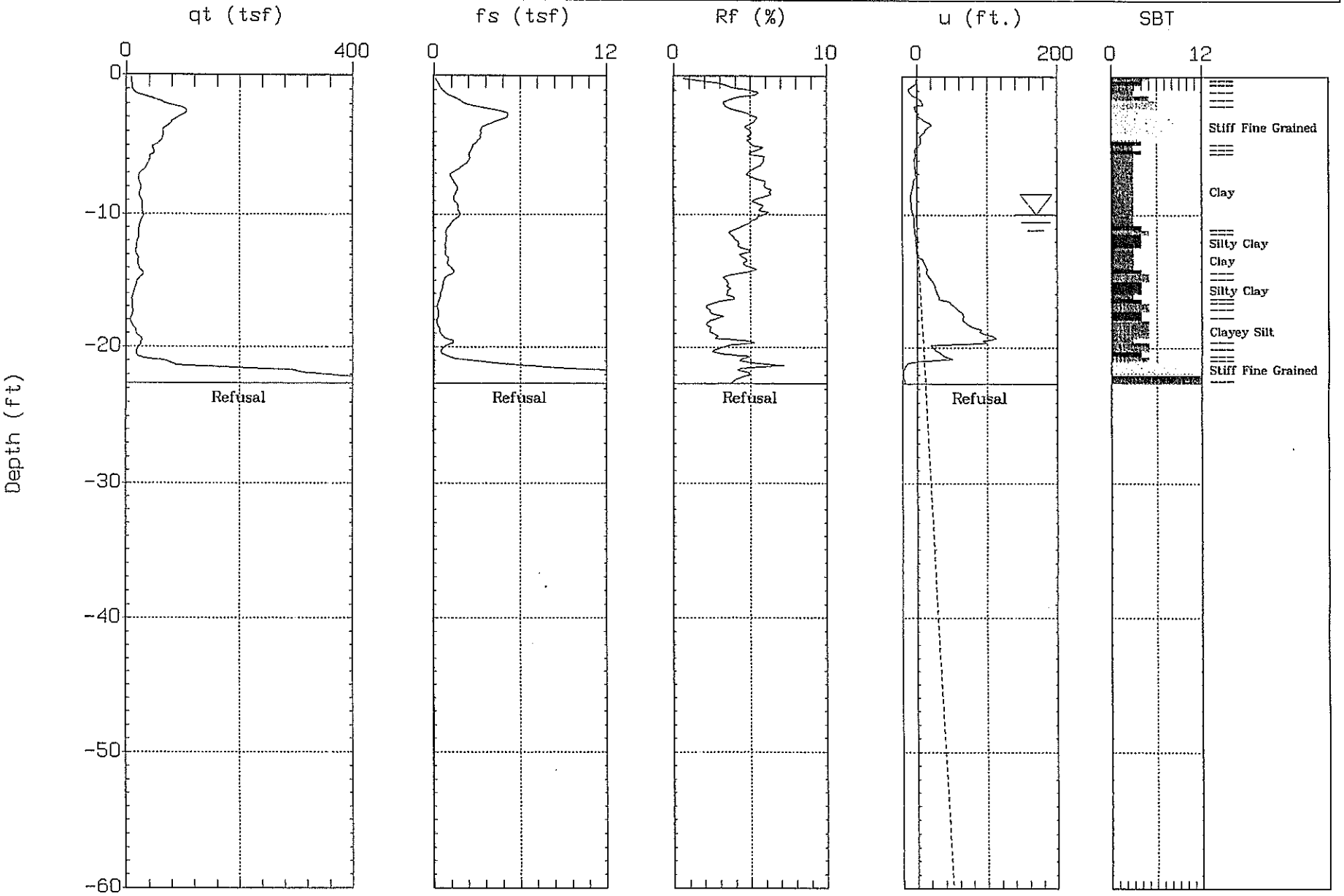
R16516

CONETEC

C.E.C.

Sounding:CPT-6
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 12:00



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

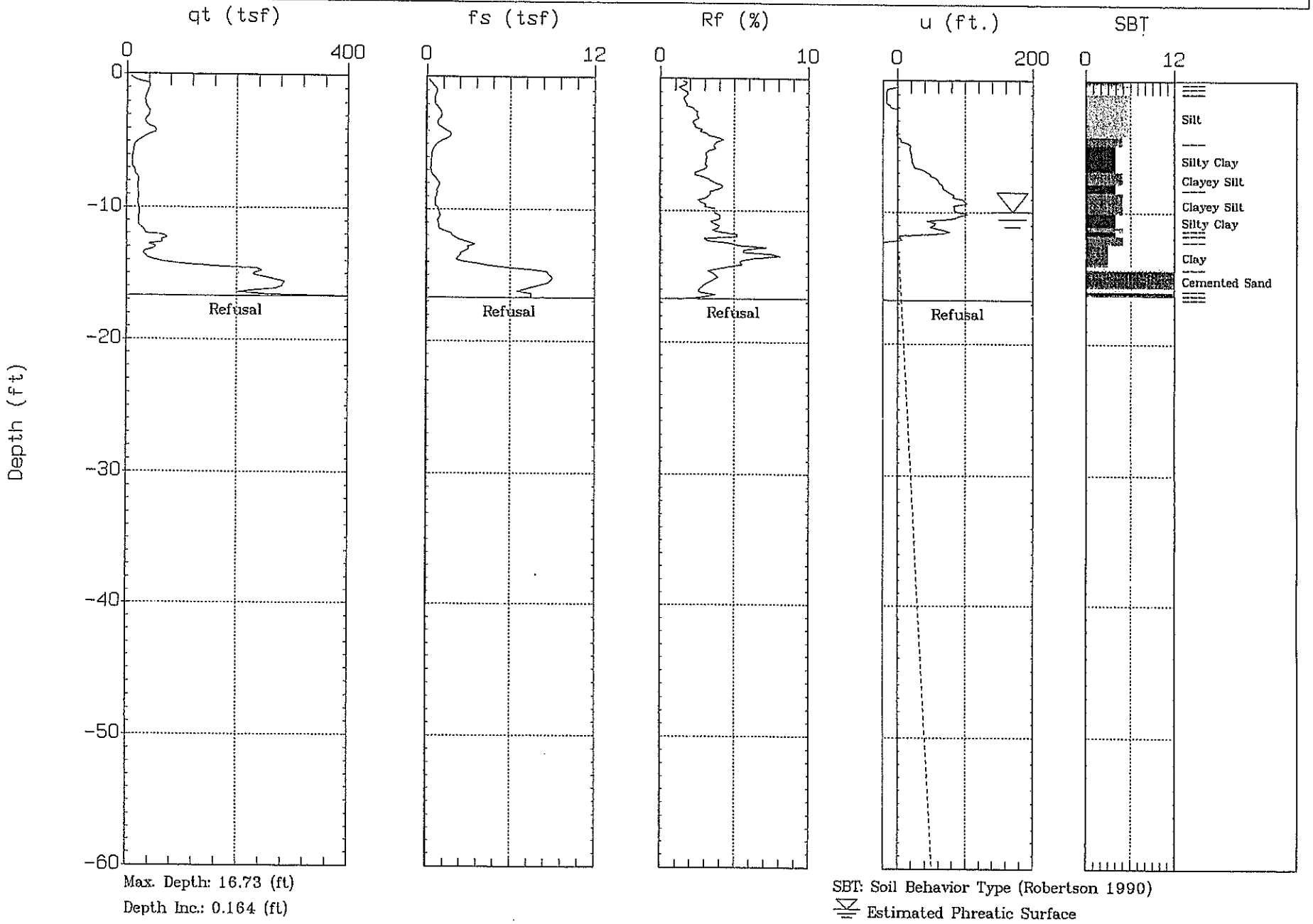
R16517

CONETEC

C.E.C.

Sounding:CPT-7
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 07:58



Max. Depth: 16.73 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

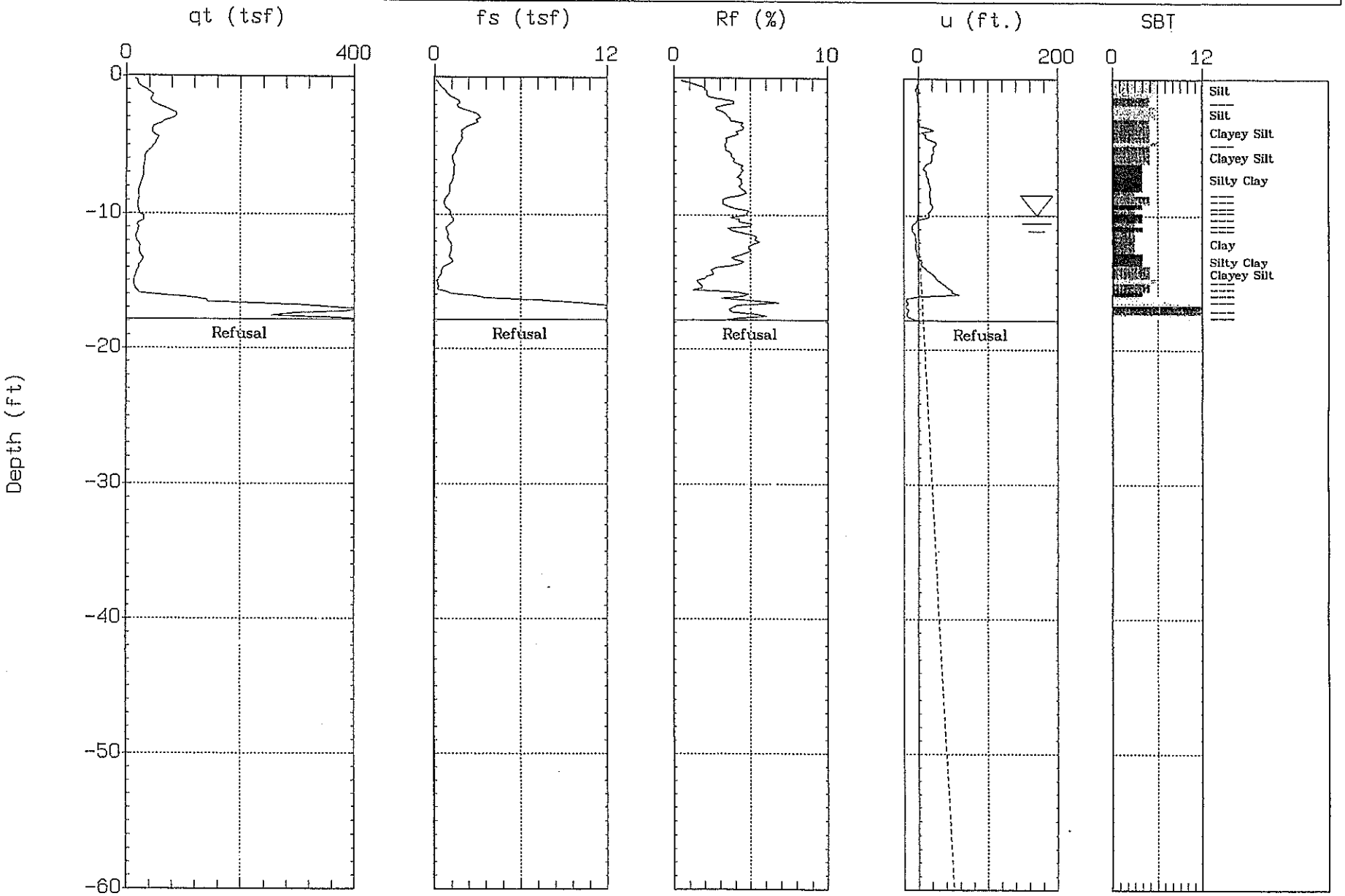
R16518

CONETEC

C.E.C.

Sounding:CPT-8
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:53



Max. Depth: 17.88 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

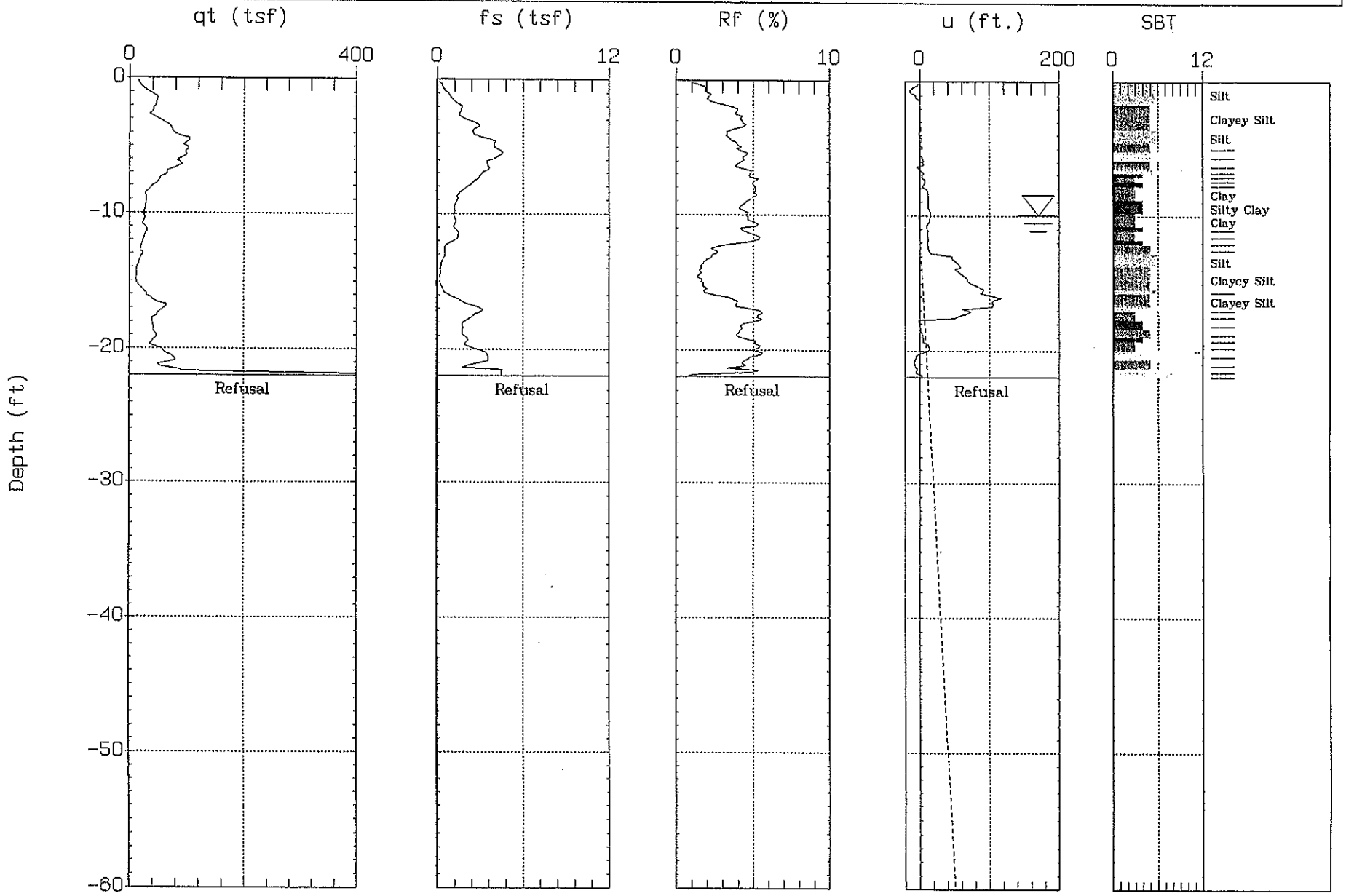
R16519

CONETEC

C.E.C.

Sounding:CPT-9
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 09:17



Max. Depth: 21.98 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

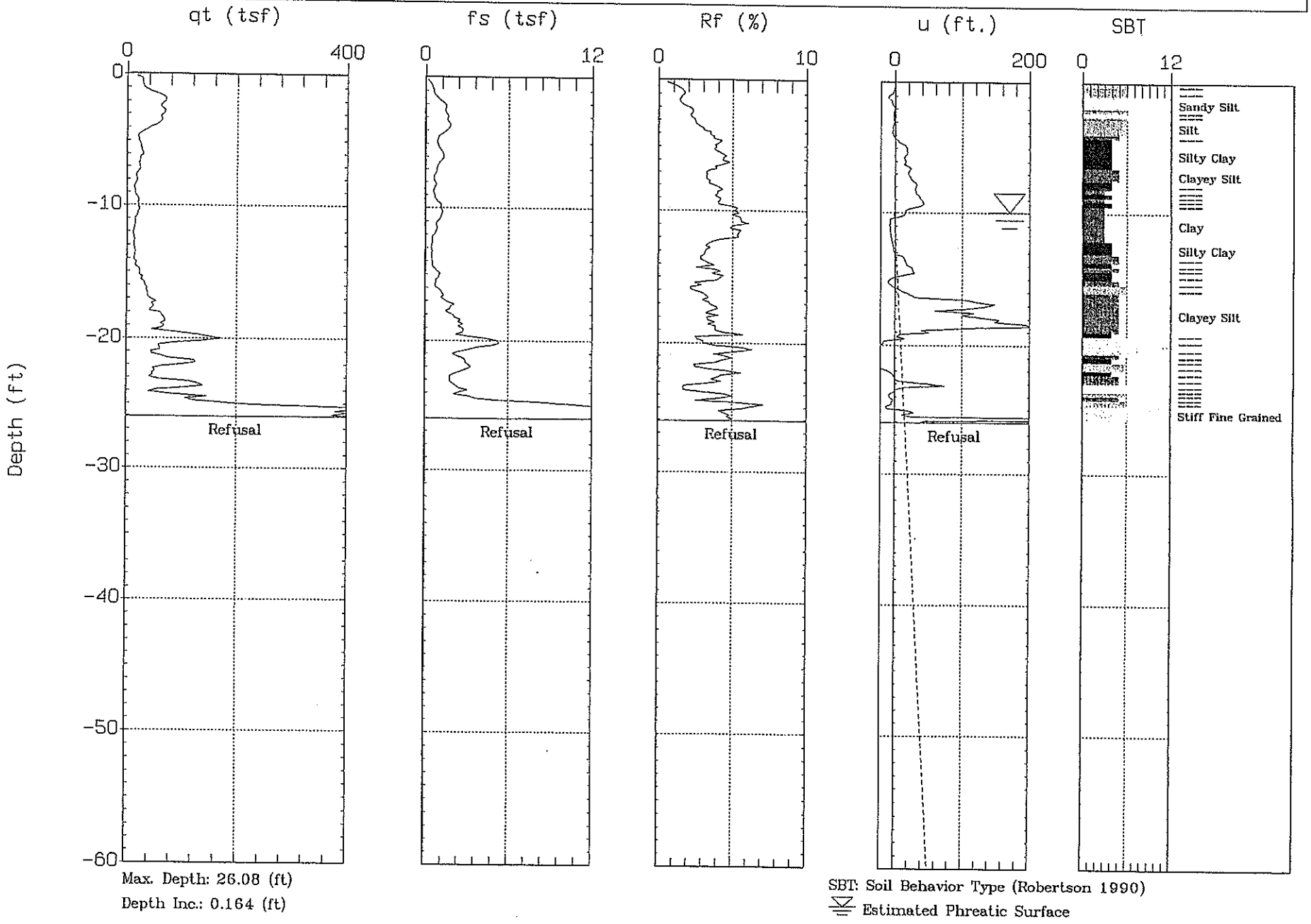
R16520

CONETEC

C.E.C.

Sounding:CPT-10
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 08:35



Max. Depth: 26.08 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

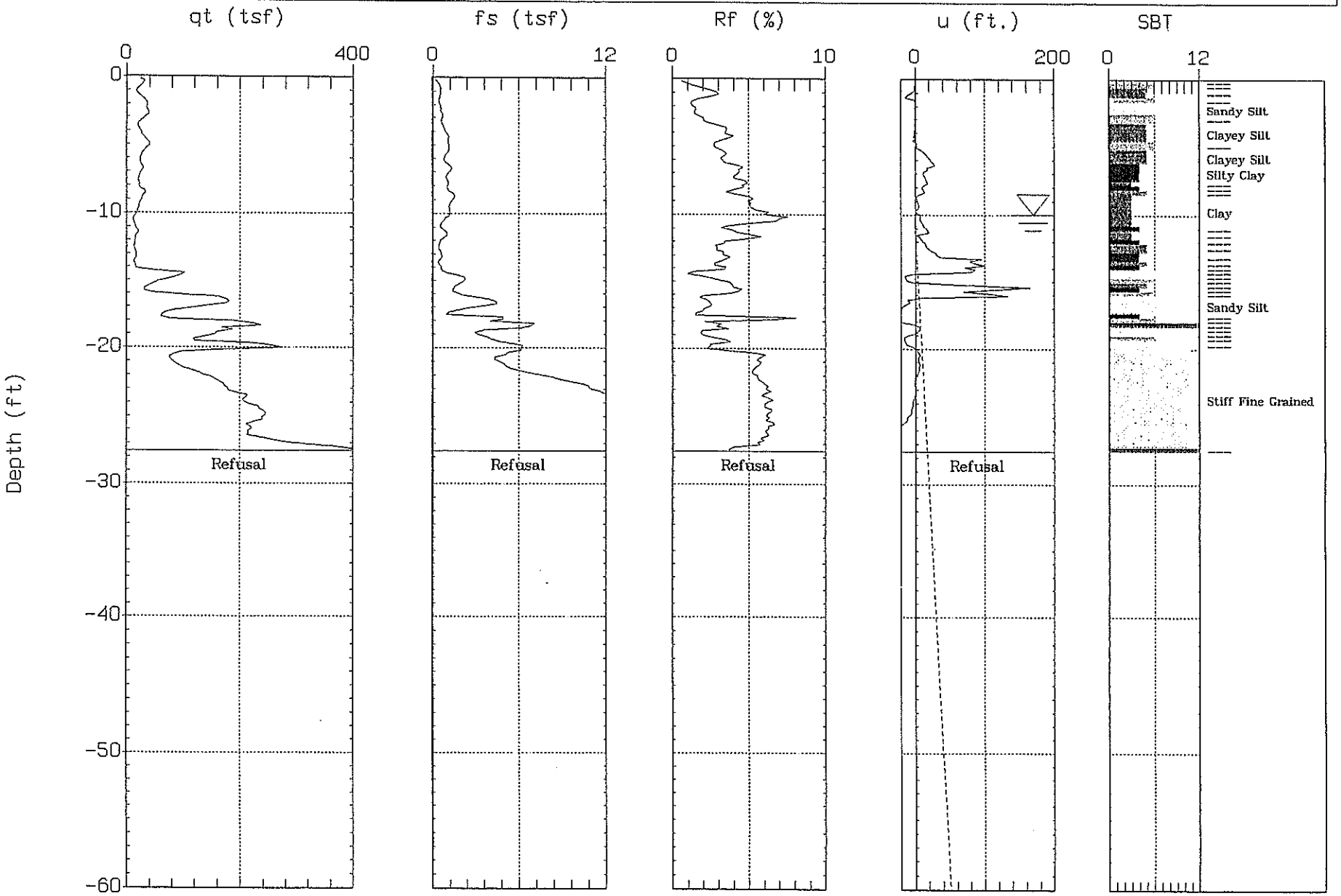
R16521

CONETEC

C.E.C.

Sounding:CPT-11
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 10:31



Max. Depth: 27.56 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Estimated Phreatic Surface

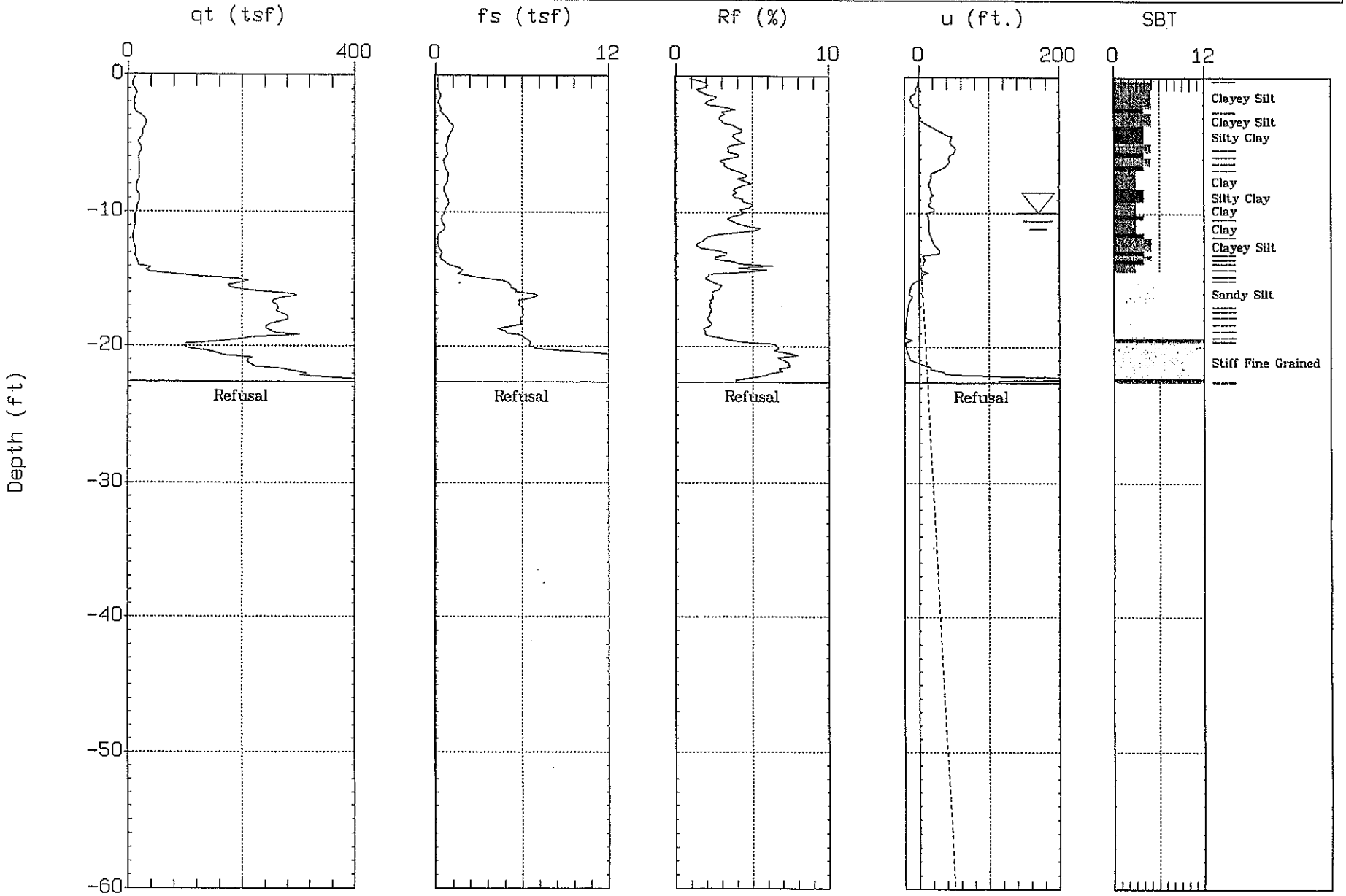
R16522

CONETEC

C.E.C.

Sounding:CPT-12
Site:Pond Creek Mine

Piezocone:20 TON AD211
Date:10:31:07 11:15



Max. Depth: 22.64 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)
Estimated Phreatic Surface

R16523

ConeTec
Environmental and Geotechnical Site Investigation Contractors

ConeTec Interpretations as of June 30, 2004 (Release 1.22A)

ConeTec's interpretation routine provides a tabular output of geotechnical parameters based on current published CPT correlations and is subject to change to reflect the current state of practice. The interpreted values are not considered valid for all soil types. The interpretations are presented only as a guide for geotechnical use and should be carefully scrutinized for consideration in any geotechnical design. Reference to current literature is strongly recommended. ConeTec does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the program and does not assume liability for any use of the results in any design or review. Representative hand calculations should be made for any parameter that is critical for design purposes. The end user of the interpreted output should also be fully aware of the techniques and the limitations of any method used in this program. The purpose of this document is to inform the user as to which methods were used and what the appropriate papers and/or publications are for further reference.

The CPT interpretations are based on values of tip, sleeve friction and pore pressure averaged over a user specified interval (e.g. 0.20m). Note that q_t is the tip resistance corrected for pore pressure effects and q_c is the recorded tip resistance. Since all ConeTec cones have equal end area friction sleeves, pore pressure corrections to sleeve friction, f_s, are not required.

The tip correction is: $q_t = q_c + (1-a) \bullet u_2$

where: q_t is the corrected tip resistance
q_c is the recorded tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the cone (typically 0.85 for ConeTec cones)

The total stress calculations are based on soil unit weights that have been assigned to the Soil Behavior Type zones, from a user defined unit weight profile or by using a single value throughout the profile. Effective vertical overburden stresses are calculated based on a hydrostatic distribution of equilibrium pore pressures below the water table or from a user defined equilibrium pore pressure profile (this can be obtained from CPT dissipation tests). For over water projects the effects of the column of water have been taken into account as has the appropriate unit weight of water. How this is done depends on where the instruments were zeroed (i.e. on deck or at mud line).

Details regarding the interpretation methods for all of the interpreted parameters are provided in Table 1. The appropriate references cited in Table 1 are listed in Table 2. Where methods are based on charts or techniques that are too complex to describe in this summary the user should refer to the cited material.

The estimated Soil Behavior Types (normalized and non-normalized) are based on the charts developed by Robertson and Campanella shown in Figures 1 and 2. The Bq classification charts are not reproduced in this document but can be reviewed in Lunne, Robertson and Powell (1997) or Robertson (1990).

Where the results of a calculation/interpretation are declared *'invalid'* the value will be represented by the text strings "-9999" or "-9999.0". In some cases the value 0 will be used. Invalid results will occur because of (and not limited to) one or a combination of:

1. Invalid or undefined CPT data (e.g. drilled out section or data gap).

2. Where the interpretation method is inappropriate, for example, drained parameters in an undrained material (and vice versa).

3. Where interpretation input values are beyond the range of the referenced charts or specified limitations of the interpretation method.

4. Where pre-requisite or intermediate interpretation calculations are invalid.

The parameters selected for output from the program are often specific to a particular project. As such, not all of the interpreted parameters listed in Table 1 may be included in the output files delivered with this report.

The output files are often delivered in one (or more) of the following three formats:

File Type	Typical Extensions	Description
Printable	IFP, NLP	ASCII files formatted for direct printing either by copying to a printer port, through a text editor or through a dedicated printing routine (such as ConeTec's CTPRINT). Typically formatted for 132 columns wide and 70 lines per page. Any printer would need to be set to have a compressed font (16cpi) as its default.
Importable	IFI, NLI	Tab delimited ASCII files (not for use with text editors) meant for importing into spreadsheet and database applications (e.g. Excel, Lotus, Quattro, Access). Some column and cell formatting maybe required depending on the quality of the application's import utility.
Spreadsheet	XLS	IFI, NLI files exported directly to Excel format. Column and cell formatting has been done. Header information is exported to start in Column C allowing the depth columns A and/or B to be duplicated on each printed page without repetition of part of the header information.

Table 1
CPT Interpretation Methods

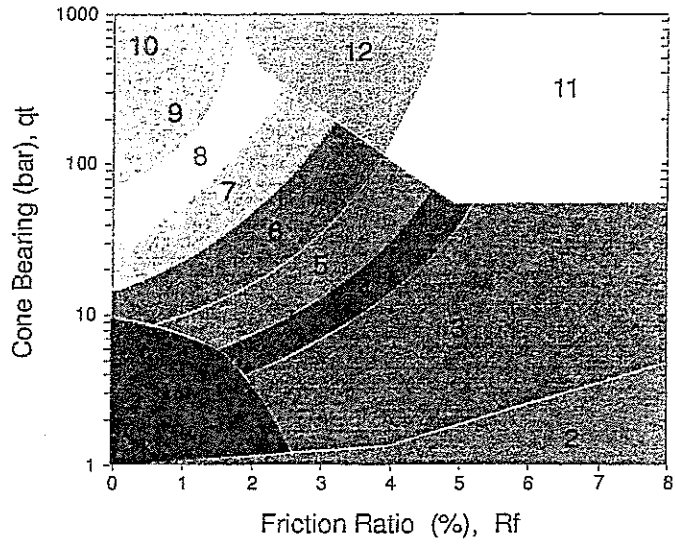
Interpreted Parameter	Description	Equation	Ref
Depth	Mid Layer Depth *(where interpretations are done at each point then Mid Layer Depth = Recorded Depth)*	*Depth (Layer Top) + Depth (Layer Bottom) / 2.0*	
Elevation	Elevation of Mid Layer based on sounding collar elevation supplied by client	Elevation = Collar Elevation - Depth	
Avgqc	Averaged recorded tip value (q_c)	$Avgqc = \frac{1}{n}\sum_{i=1}^{n} q_c$ *n=1 when interpretations are done at each point*	
Avgqt	Averaged corrected tip (q_t) where: $q_t = q_c + (1-a) \bullet u$	$Avgqt = \frac{1}{n}\sum_{i=1}^{n} q_t$ *n=1 when interpretations are done at each point*	
Avgfs	Averaged sleeve friction (f_s)	$Avgfs = \frac{1}{n}\sum_{i=1}^{n} fs$ *n=1 when interpretations are done at each point*	
AvgRf	Averaged friction ratio (Rf) where friction ratio is defined as: $Rf = 100\% \bullet \frac{fs}{qt}$	$AvgRf = 100\% \bullet \frac{Avgfs}{Avgqt}$ *n=1 when interpretations are done at each point*	
Avgu	Averaged dynamic pore pressure *(u)*	$Avgu = \frac{1}{n}\sum_{i=1}^{n} u_i$ *n=1 when interpretations are done at each point*	
AvgRes	Averaged Resistivity (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} RESISTIVITY_i$ *n=1 when interpretations are done at each point*	

Interpreted Parameter	Description	Equation	Ref
AvgUVIF	Averaged UVIF ultra-violet induced fluorescence (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} UVIF_i$ *n=1 when interpretations are done at each point*	
AvgTemp	Averaged Temperature (this data is not always available since it is a specialized test)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} TEMPERATURE_i$ *n=1 when interpretations are done at each point*	
AvgGamma	Averaged Gamma Counts (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} GAMMA_i$ *n=1 when interpretations are done at each point*	
SBT	Soil Behavior Type as defined by Robertson and Campanella	See Figure 1	2, 5
U.Wt.	Unit Weight of soil determined from one of the following user selectable options: 1) uniform value 2) value assigned to each SBT zone 3) user supplied unit weight profile	See references	5
T. Stress σ_V	Total vertical overburden stress at Mid Layer Depth. *A layer is defined as the averaging interval specified by the user. For data interpreted at each point the Mid Layer Depth is the same as the recorded depth.*	$TStress = \sum_{i=1}^{n} \gamma_i h_i$ where γ_i is layer unit weight h_i is layer thickness	
E. Stress σ_V'	Effective vertical overburden stress at Mid Layer Depth	$Estress = Tstress - u_{eq}$	
Ueq	Equilibrium pore pressure determined from one of the following user selectable options: 1) hydrostatic from water table depth 2) user supplied profile	For hydrostatic option: $u_{eq} = \gamma_w \bullet (D - D_{wt})$ where u_{eq} is equilibrium pore pressure γ_w is unit weight of water D is the current depth D_{wt} is the depth to the water table	
Cn	SPT N_{60} overburden correction factor	$Cn = (\sigma_V')^{-0.5}$ where σ_V' *is in tsf* $0.5 < C_n < 2.0$	
N_{60}	SPT N value at 60% energy calculated from qt/N ratios assigned to each SBT zone. This method has abrupt N value changes at zone boundaries.	*See Figure 1*	4, 5
$(N_1)_{60}$	SPT N_{60} value corrected for overburden pressure	$(N_1)_{60} = Cn \bullet N_{60}$	4
$N_{60}Ic$	SPT N_{60} values based on the Ic parameter	$(qt/pa)/ N_{60} = 8.5 (1 - Ic/4.6)$	5
$(N_1)_{60}Ic$	SPT N_{60} value corrected for overburden pressure (using N_{60} I_c). User has 2 options.	1) $(N_1)_{60}Ic = Cn \bullet (N_{60}Ic)$ 2) $q_{c1n}/ (N_1)_{60}Ic = 8.5 (1 - Ic/4.6)$	4 5
		1) $(N_1)_{60cs}Ic = \alpha + \beta((N_1)_{60}Ic)$ 2) $(N_1)_{60cs}Ic = K_{SPT} * ((N_1)_{60}Ic)$ 3) $q_{c1ncs})/ (N_1)_{60cs}Ic = 8.5 (1 - Ic/4.6)$	10 10 5
$(N_1)_{60cs}Ic$	Clean sand equivalent SPT $(N_1)_{60}Ic$. User has 3 options.	FC ≤ 5%: $\alpha = 0$, $\beta = 1.0$ FC ≥ 35% $\alpha = 5.0$, $\beta = 1.2$ 5% < FC < 35% $\alpha = \exp[1.76 - (190/FC^2)]$ $\beta = [0.99 + (FC^{1.5}/1000)]$	
Su	Undrained shear strength - N_{kt} is user selectable	$Su = \frac{qt - \sigma_v}{N_{kt}}$	1, 5
k	Coefficient of permeability (assigned to each SBT zone)		5

Interpreted Parameter	Description	Equation	Ref
Bq	Pore pressure parameter	$Bq = \frac{\Delta u}{qt - \sigma_v}$ where: $\Delta u = u - u_{eq}$ and u = dynamic pore pressure u_{eq} = equilibrium pore pressure	1, 5
Q_t	Normalized q_t for Soil Behavior Type classification as defined by Robertson, 1990	$Qt = \frac{qt - \sigma_v}{\sigma_v}$	2, 5
F_r	Normalized Friction Ratio for Soil Behavior Type classification as defined by Robertson, 1990	$Fr = 100\% \bullet \frac{fs}{qt - \sigma_v}$	2, 5
SBTn	Normalized Soil Behavior Type as defined by Robertson and Campanella	See Figure 2	2, 5
SBT-BQ	Non-normalized soil behavior type based on the Bq parameter	See Figure 5.7 (reference 5)	2, 5
SBT-BQn	Normalized Soil Behavior base on the Bq parameter	See Figure 5.8 (reference 5) or Figure 3 (reference 2)	2, 5
I_c	Soil index for estimating grain characteristics	$Ic = [(3.47 - \log_{10}Q)^2 + (\log_{10} Fr + 1.22)^2]^{0.5}$ Where: $Q = \left(\frac{qt - \sigma_v}{P_{a2}}\right)\left(\frac{P_a}{\sigma_v}\right)^n$ And Fr is in percent P_a = atmospheric pressure P_{a2} = atmospheric pressure n varies from 0.5 to 1.0 and is selected in an iterative manner based on the resulting I_c	3, 8
FC	Apparent fines content (%)	$FC = 1.75(Ic^{3.25}) - 3.7$ FC=100 for Ic > 3.5 FC=0 for Ic < 1.26 FC = 5% if 1.64 < Ic < 2.6 AND F_r<0.5	3
Ic Zone	This parameter is the Soil Behavior Type zone based on the Ic parameter (valid for zones 2 through 7 on SBTn chart)	Ic < 1.31 Zone = 7 1.31 < Ic < 2.05 Zone = 6 2.05 < Ic < 2.60 Zone = 5 2.60 < Ic < 2.95 Zone = 4 2.95 < Ic < 3.60 Zone = 3 Ic > 3.60 Zone = 2	3
PHI ϕ	Friction Angle determined from one of the following user selectable options: a) Campanella and Robertson b) Durgunoglu and Mitchel c) Janbu	See reference	5
Dr	Relative Density determined from one of the following user selectable options: a) Ticino Sand b) Hokksund Sand c) Schmertmann 1976 d) Jamiolkowski - All Sands	See reference	5

Interpreted Parameter	Description	Equation	Ref
OCR	Over Consolidation Ratio	a) Based on Schmertmann's method involving a plot of $S_u/\sigma_v' / (S_u/\sigma_v')_{NC}$ and OCR where the Su/p' ratio for NC clay is user selectable	9
State Parameter	The state parameter is used to describe whether a soil is contractive (SP is positive) or dilative (SP is negative) at large strains based on the work by Been and Jefferies	See reference	8, 6, 5
Es/qt	Intermediate parameter for calculating Youngs Modulus, E, in sands. It is the Y axis of the reference chart.	Based on Figure 5.59 in the reference	5
Youngs Modulus E	Youngs Modulus based on the work by Baldi. There are three types of sands considered in this technique. The user selects the appropriate type for the site from: a) OC Sands b) Aged NC Sands c) Recent NC Sands Each sand type has a family of curves that depend on mean normal stress. The program calculates mean normal stress and linearly interpolates between the two extremes provided in Baldi's chart.	Mean normal stress is evaluated from: $\sigma'_m = \frac{1}{3} \bullet (\sigma'_v + \sigma'_h + \sigma'_h)$ where σ_v'= vertical effective stress σ_h'= horizontal effective stress and $\sigma_h = K_o * \sigma_v'$ with Ko assumed to be 0.5	5
q_{c1}	q_t normalized for overburden stress used for seismic analysis	$q_{c1} = q_t \bullet (Pa/\sigma_v')^{0.5}$ where: Pa = atm. Pressure q_t is in Mpa	3
q_{c1n}	q_{c1} in dimensionless form used for seismic analysis	$q_{c1n} = (q_{c1} / Pa)(Pa/\sigma_v')$ where: Pa = atm. Pressure and n ranges from 0.5 to 0.75 based on Ic.	3
K_{SPT}	Equivalent clean sand factor for $(N_1)60$	$K_{SPT} = 1 + ((0.75/30) * (FC - 5))$	10
K_{CPT}	Equivalent clean sand correction for q_{c1N}	$K_{cpt} = 1.0$ for $I_c \leq 1.64$ $K_{cpt} = f(I_c)$ for $I_c > 1.64$ (see reference)	10
q_{c1ncs}	Clean sand equivalent q_{c1n}	$q_{c1ncs} = q_{c1n} \bullet K_{cpt}$	3
CRR	Cyclic Resistance Ratio (for Magnitude 7.5)	$q_{c1ncs} < 50$: $CRR_{7.5} = 0.833 [(q_{c1ncs}/1000] + 0.05$ $50 \leq q_{c1ncs} < 160$: $CRR_{7.5} = 93 [(q_{c1ncs}/1000]^3 + 0.08$	10
CSR	Cyclic Stress Ratio	$CSR = (\tau_{av}/\sigma_v') = 0.65 (a_{max} / g) (\sigma_v / \sigma_v') r_d$ $r_d = 1.0 - 0.00765\ z$ $z \leq 9.15m$ $r_d = 1.174 - 0.0267\ z$ $9.15 < z \leq 23m$ $r_d = 0.744 - 0.008\ z$ $23 < z \leq 30m$ $r_d = 0.50$ $z > 30m$	10

Interpreted Parameter	Description	Equation	Ref
MSF	Magnitude Scaling Factor	See Reference	10
FofS	Factor of Safety against Liquefaction	FS = ($CRR_{7.5}$ / CSR) MSF	10
Liquefaction Status	Statement indicating possible liquefaction	Takes into account FofS and limitations based I_c and q_{c1ncs}.	10



Zone	qt / N	Soil Behavior Type
1	2	sensitive fine grained
2	1	organic material
3	1	clay
4	1.5	silty clay to clay
5	2	clayey silt to silty clay
6	2.5	sandy silt to clayey silt
7	3	silty sand to sandy silt
8	4	sand to silty sand
9	5	sand
10	6	gravelly sand to sand
11	1	very stiff fine grained *
12	2	sand to clayey sand *

* overconsolidated or cemented

Figure 1 Non-Normalized Behavior Type Classification Chart

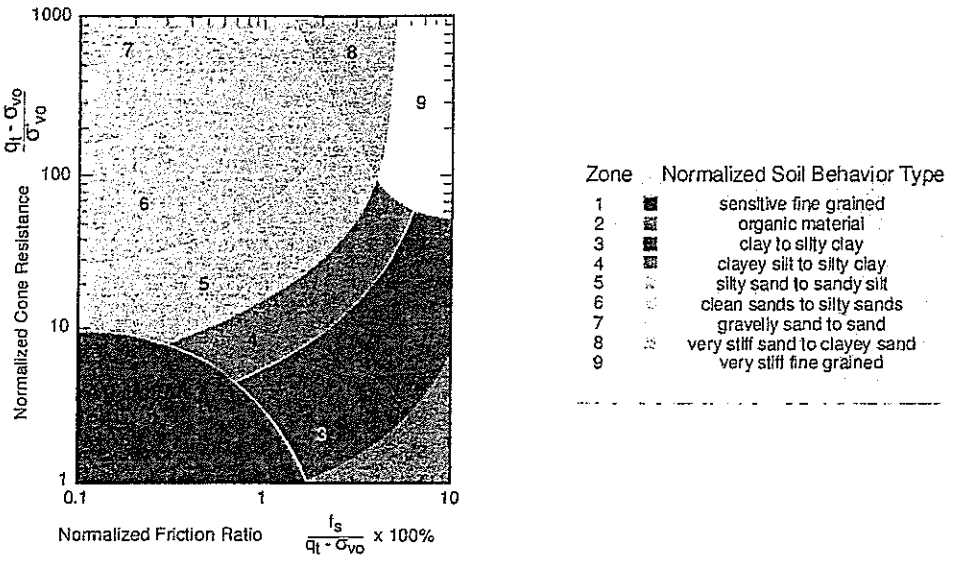


Figure 2 Normalized Behavior Type Classification Chart

Table 2 References

No.	References
1	Robertson, P.K., Campanella, R.G., Gillespie, D. and Greig, J., 1986, "Use of Piezometer Cone Data", Proceedings of inSitu 86, ASCE Specialty Conference, Blacksburg, Virginia.
2	Robertson, P.K., 1990, "Soil Classification Using the Cone Penetration Test", Canadian Geotechnical Journal, Volume 27.
3	Robertson, P.K. and Fear, C.E., 1998, "Evaluating cyclic liquefaction potential using the cone penetration test", Canadian Geotechnical Journal, 35: 442-459.
4	Robertson, P.K. and Wride, C.E., 1998, "Cyclic Liquefaction and its Evaluation Based on SPT and CPT", NCEER Workshop Paper, January 22, 1997
5	Lunne, T., Robertson, P.K. and Powell, J. J. M., 1997, " Cone Penetration Testing in Geotechnical Practice," Blackie Academic and Professional.
6	Plewes, H.D., Davies, M.P. and Jefferies, M.G., 1992, "CPT Based Screening Procedure for Evaluating Liquefaction Susceptibility", 45th Canadian Geotechnical Conference, Toronto, Ontario, October 1992.
7	Jefferies, M.G. and Davies, M.P., 1993. "Use of CPTu to Estimate equivalent N_{60}", Geotechnical Testing Journal, 16(4): 458-467.
8	Been, K. and Jefferies, M.P., 1985, "A state parameter for sands", Geotechnique, 35(2), 99-112.
9	Schmertmann, 1977, "Guidelines for Cone Penetration Test Performance and Design", Federal Highway Administration Report FHWA-TS-78-209, U.S. Department of Transportation
10	Proceedings of theNCEER Workshop on Evaluation of Liquefaction Resistance of Soils, Salt LakeCity, 1996. Chaired by Leslie Youd.

CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-1
Site	Williamson County, Illinois
Date	10/31/2007

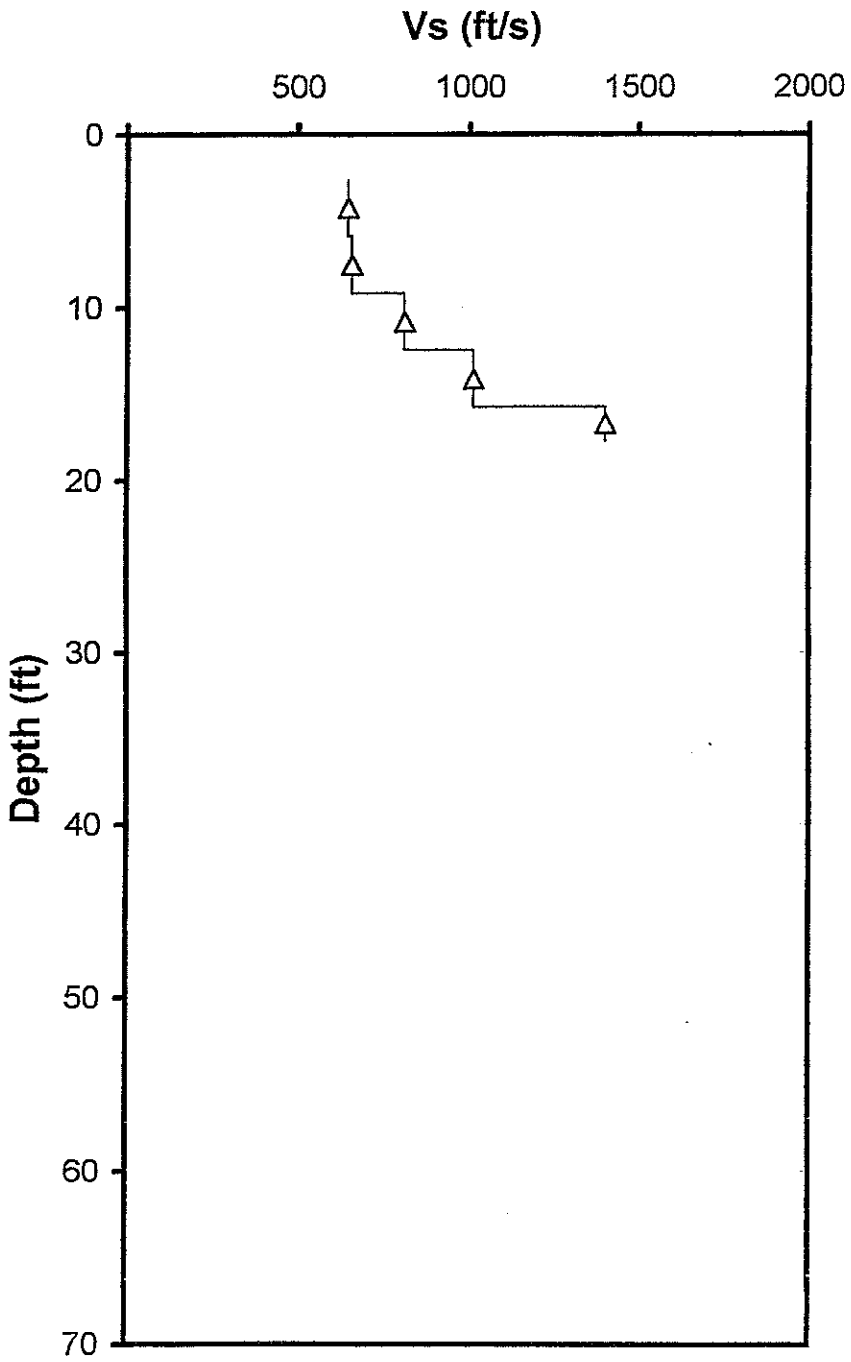
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	4.76	4.26	645
9.84	9.18	9.31	3.21	4.90	7.54	656
13.12	12.46	12.55	3.25	4.02	10.82	808
16.40	15.74	15.82	3.26	3.22	14.10	1013
18.37	17.71	17.78	1.96	1.40	16.73	1402

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-1
Date: October 31, 2007



CONETEC

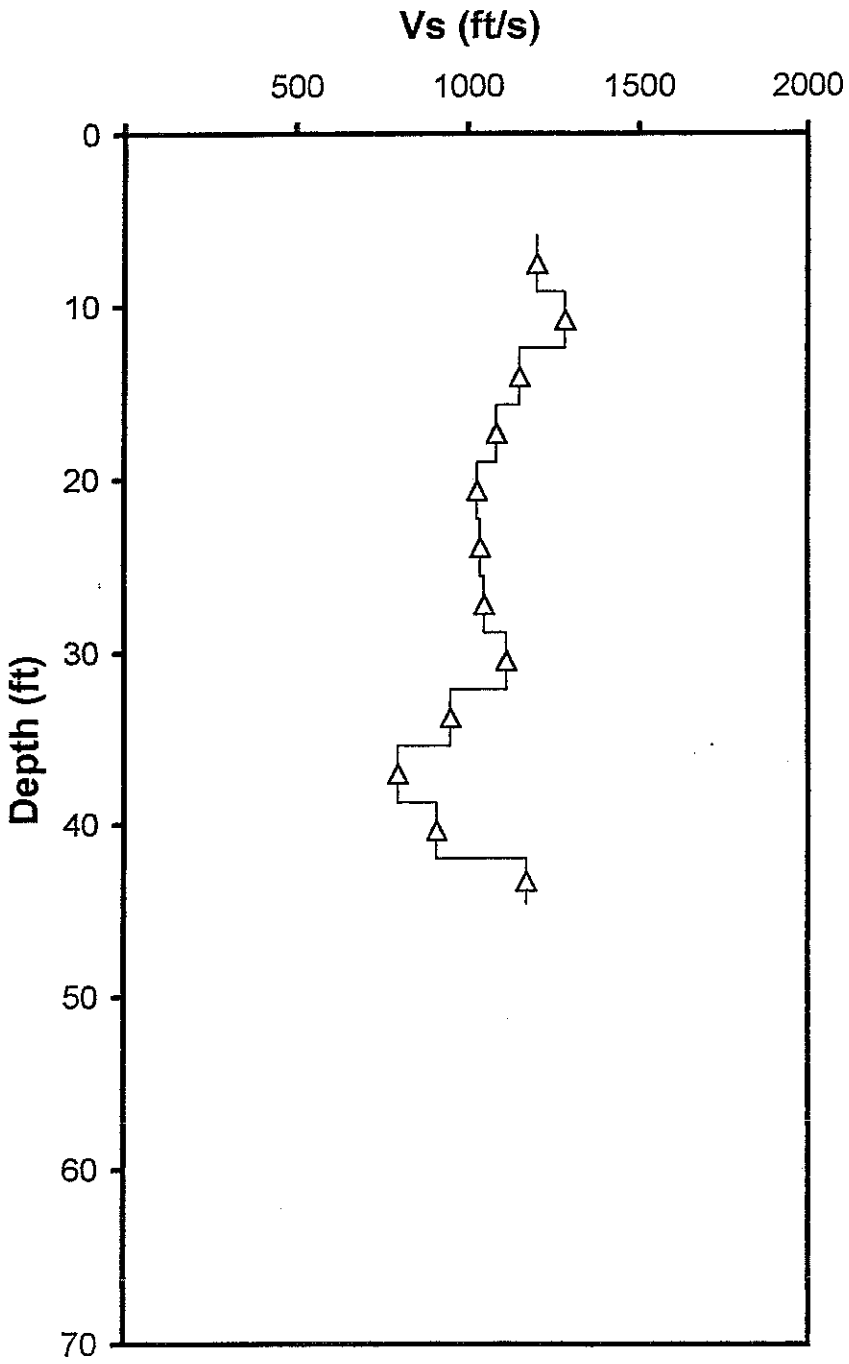
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-2
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	2.67	7.54	1204
13.12	12.46	12.55	3.25	2.53	10.82	1284
16.40	15.74	15.82	3.26	2.83	14.10	1152
19.69	19.03	19.09	3.28	3.02	17.39	1085
22.97	22.31	22.36	3.27	3.18	20.67	1029
26.25	25.59	25.64	3.27	3.15	23.95	1039
29.53	28.87	28.91	3.28	3.12	27.23	1050
32.81	32.15	32.19	3.28	2.94	30.51	1114
36.09	35.43	35.47	3.28	3.45	33.79	950
39.37	38.71	38.74	3.28	4.12	37.07	795
42.65	41.99	42.02	3.28	3.61	40.35	908
45.28	44.62	44.65	2.63	2.24	43.31	1173

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-2
Date: October 30, 2007



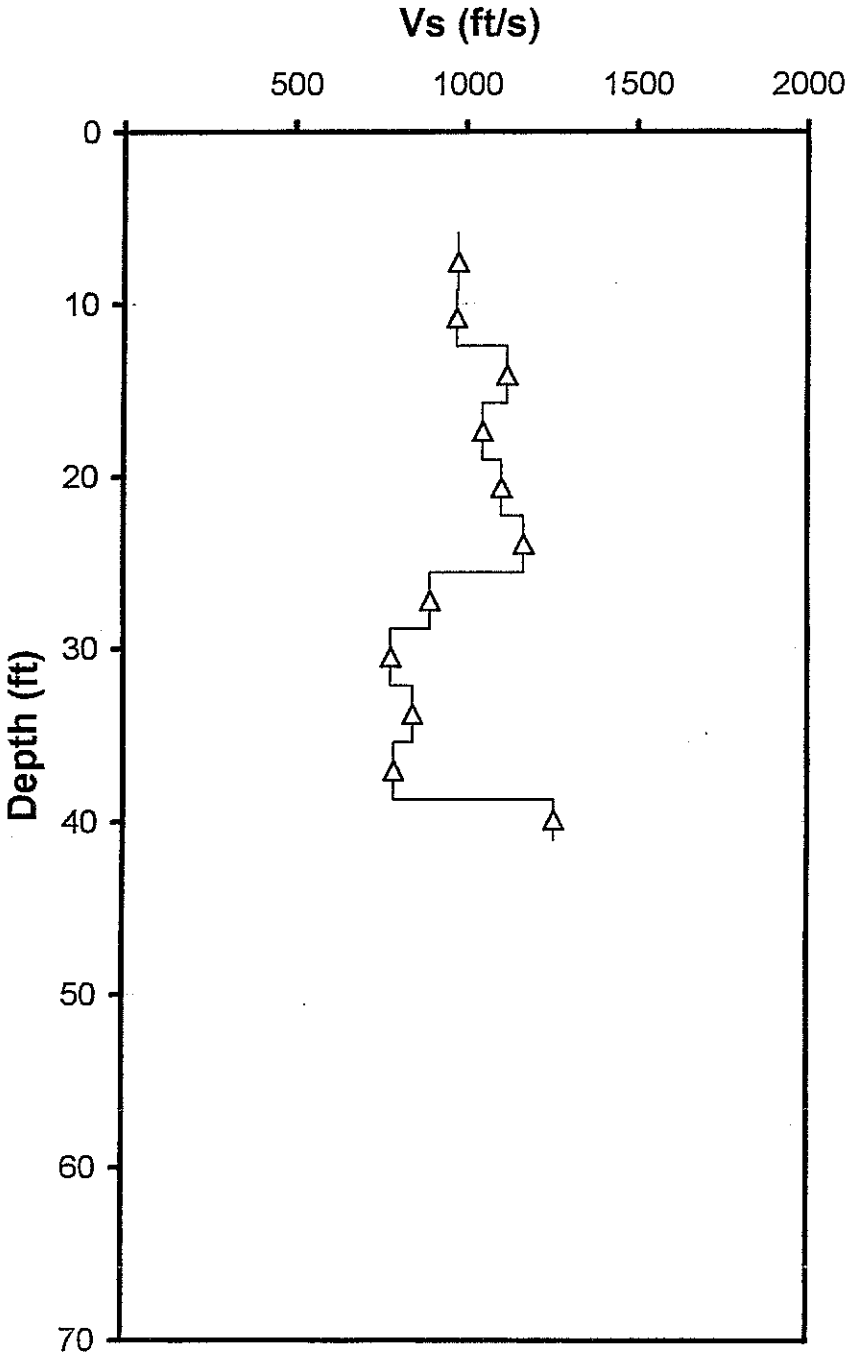
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-2A
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	3.29	7.54	977
13.12	12.46	12.55	3.25	3.34	10.82	973
16.40	15.74	15.82	3.26	2.91	14.10	1121
19.69	19.03	19.09	3.28	3.12	17.39	1051
22.97	22.31	22.36	3.27	2.96	20.67	1105
26.25	25.59	25.64	3.27	2.80	23.95	1169
29.53	28.87	28.91	3.28	3.66	27.23	895
32.81	32.15	32.19	3.28	4.20	30.51	780
36.09	35.43	35.47	3.28	3.88	33.79	845
39.37	38.71	38.74	3.28	4.15	37.07	790
41.67	41.01	41.04	2.30	1.83	39.86	1256

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-2A
Date: October 30, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-3
Site	Williamson County, Illinois
Date	10/31/2007

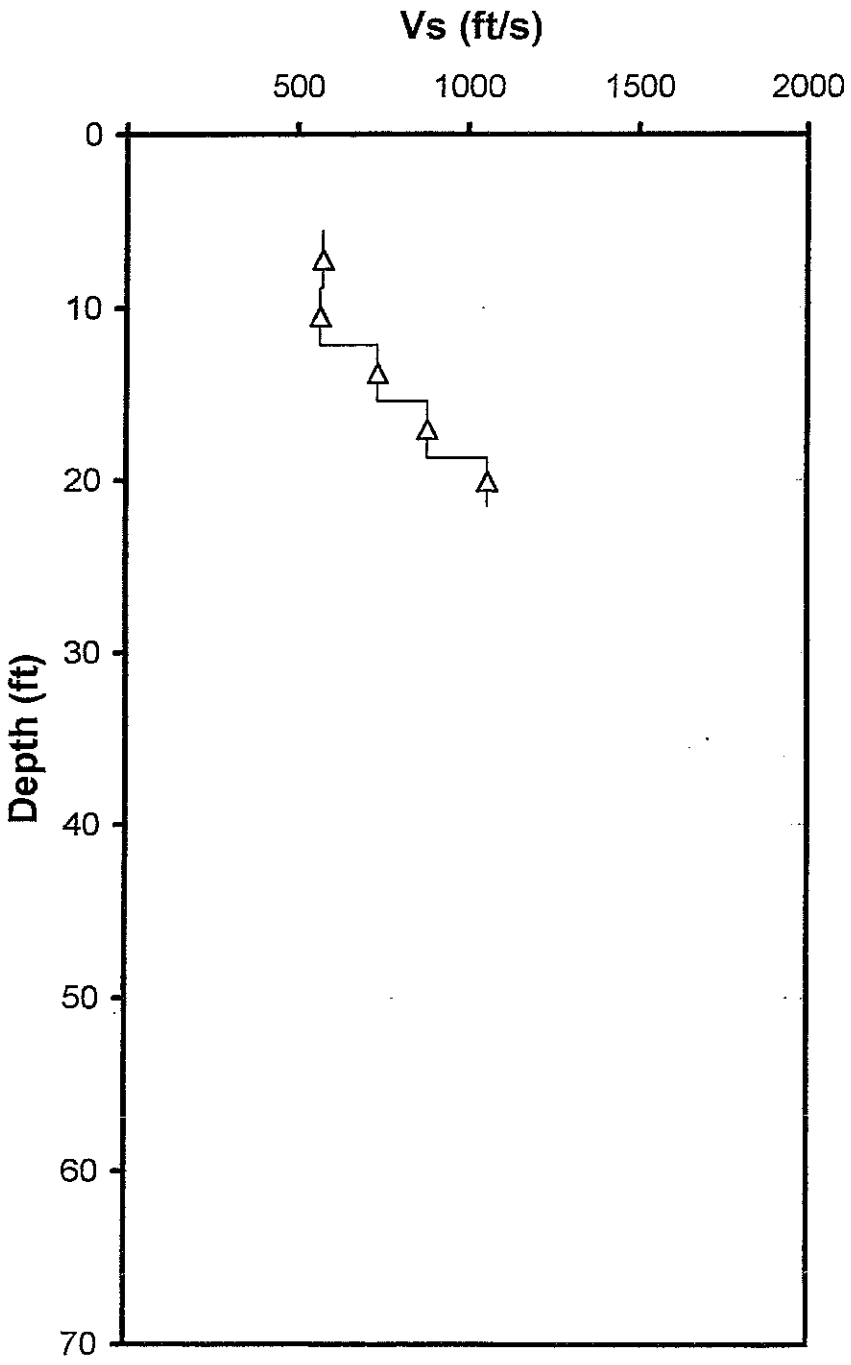
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.23	5.57	5.77				
9.51	8.85	8.98	3.21	5.56	7.21	577
12.80	12.14	12.24	3.26	5.72	10.50	569
16.08	15.42	15.50	3.26	4.42	13.78	738
19.36	18.70	18.76	3.27	3.70	17.06	883
22.15	21.49	21.55	2.78	2.63	20.10	1058

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-3
Date: October 31, 2007



CONETEC

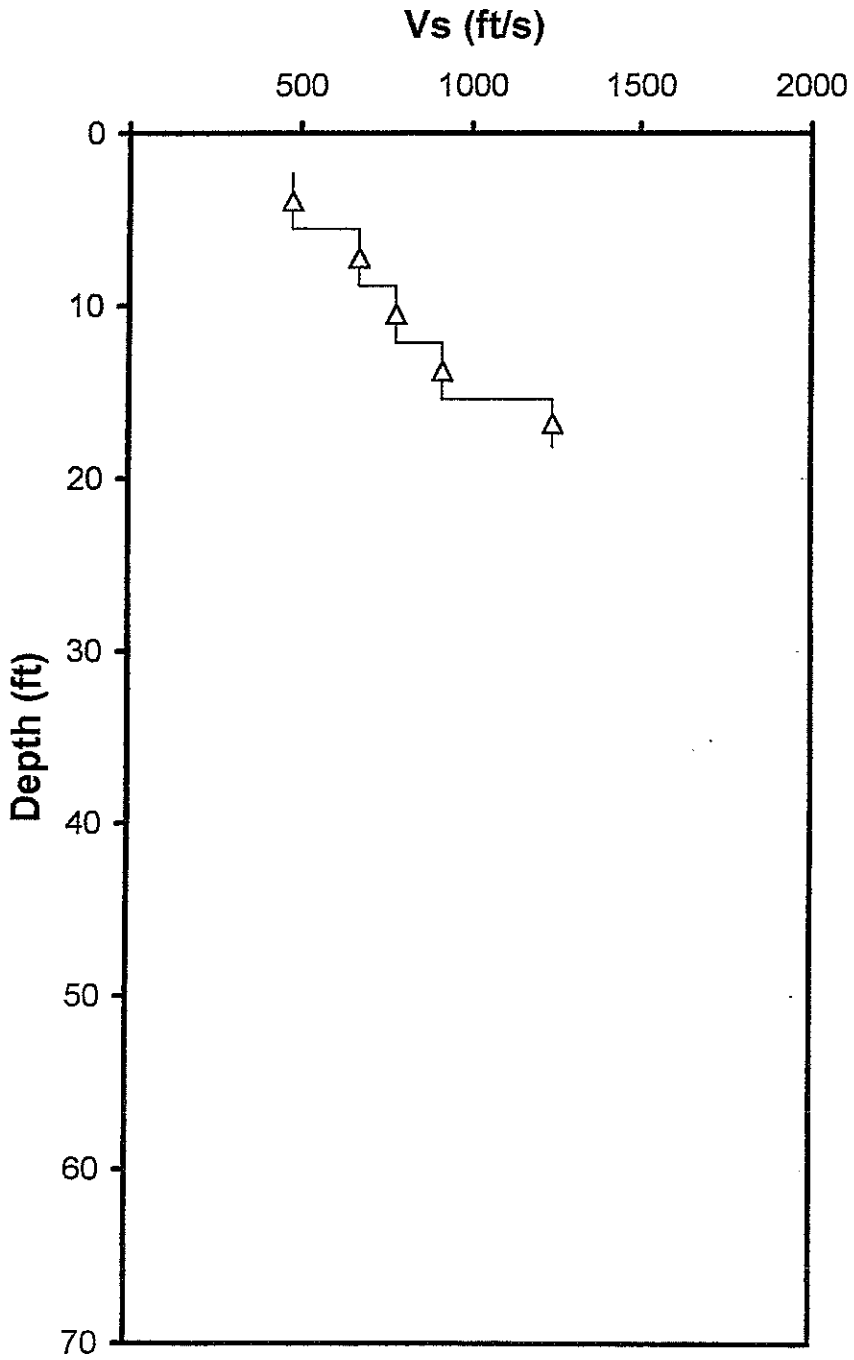
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-4
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
2.95	2.29	2.74				
6.23	5.57	5.77	3.03	6.37	3.93	476
9.51	8.85	8.98	3.21	4.77	7.21	673
12.80	12.14	12.24	3.26	4.17	10.50	781
16.08	15.42	15.50	3.26	3.57	13.78	913
18.86	18.20	18.27	2.77	2.23	16.81	1242

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-4
Date: October 31, 2007



CONETEC

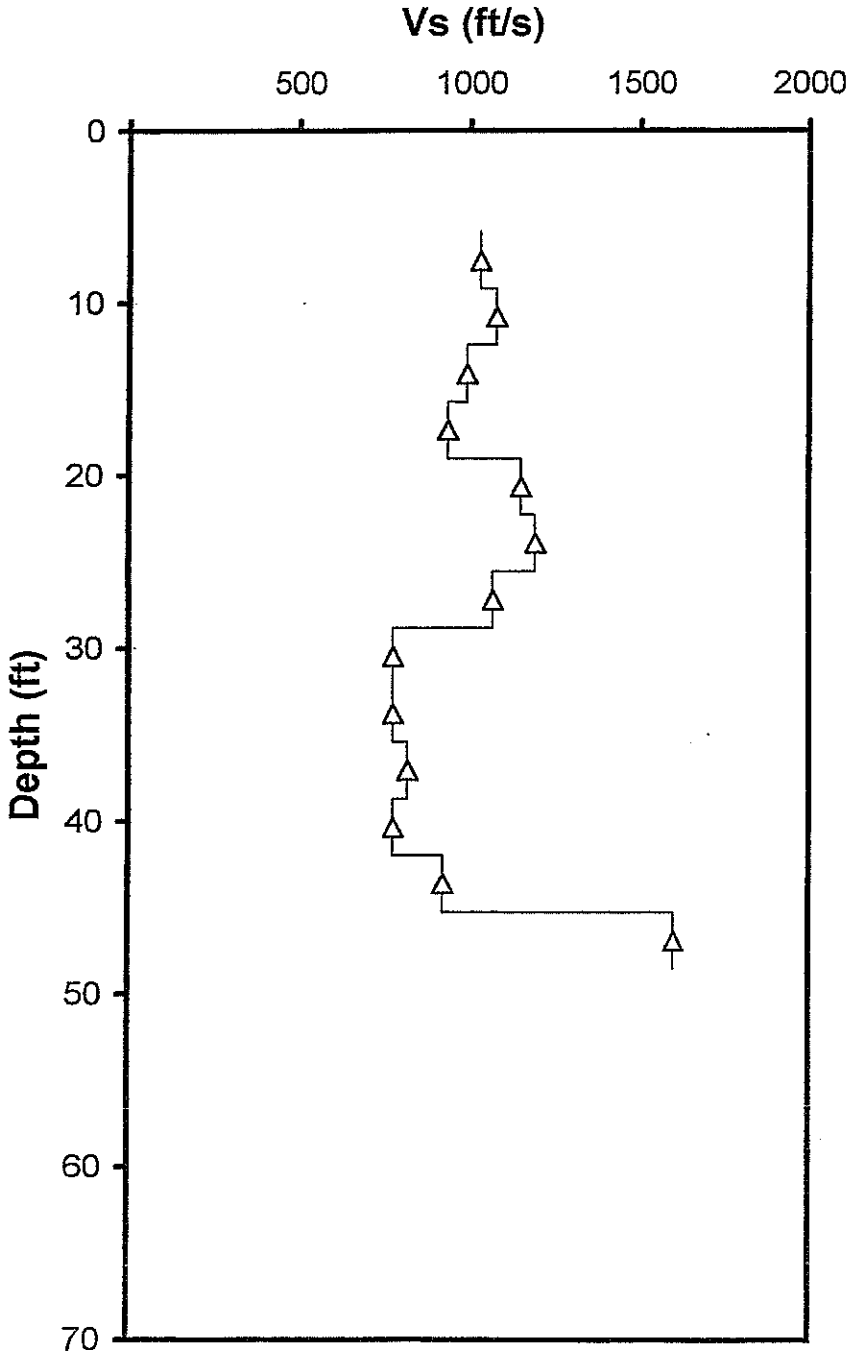
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-5
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	3.12	7.54	1030
13.12	12.46	12.55	3.25	3.02	10.82	1076
16.40	15.74	15.82	3.26	3.29	14.10	991
19.69	19.03	19.09	3.28	3.50	17.39	936
22.97	22.31	22.36	3.27	2.85	20.67	1148
26.25	25.59	25.64	3.27	2.75	23.95	1190
29.53	28.87	28.91	3.28	3.07	27.23	1067
32.81	32.15	32.19	3.28	4.20	30.51	780
36.09	35.43	35.47	3.28	4.20	33.79	780
39.37	38.71	38.74	3.28	3.99	37.07	821
42.65	41.99	42.02	3.28	4.20	40.35	780
45.93	45.27	45.30	3.28	3.55	43.63	923
49.21	48.55	48.58	3.28	2.05	46.91	1599

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-5
Date: October 30, 2007



CONETEC

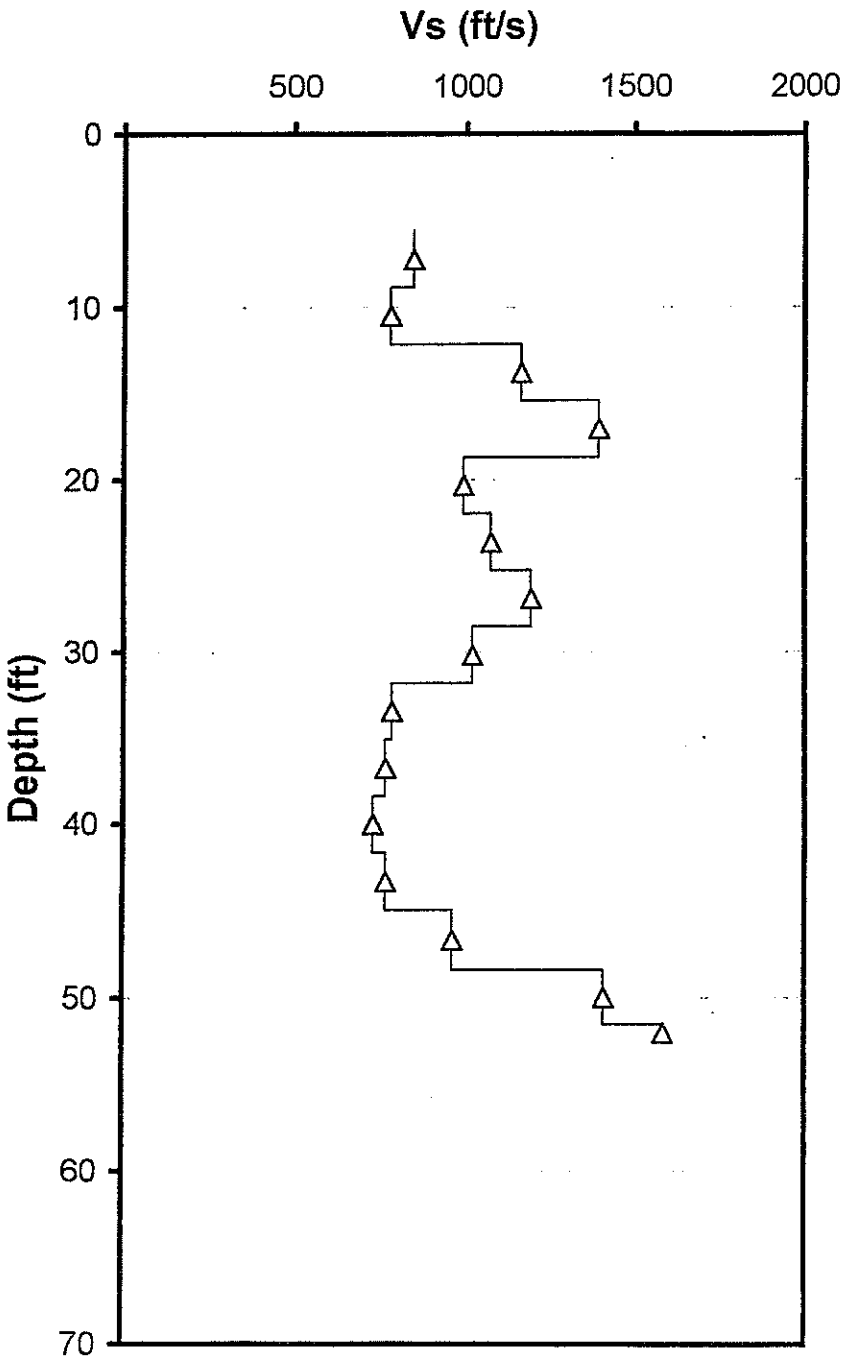
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-5A
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.23	5.57	5.77				
9.51	8.85	8.98	3.21	3.80	7.21	844
12.80	12.14	12.24	3.26	4.18	10.50	779
16.08	15.42	15.50	3.26	2.80	13.78	1164
19.36	18.70	18.76	3.27	2.34	17.06	1396
22.64	21.98	22.03	3.27	3.29	20.34	994
25.92	25.26	25.31	3.27	3.04	23.62	1077
29.20	28.54	28.58	3.27	2.74	26.90	1195
32.48	31.82	31.86	3.28	3.21	30.18	1021
35.76	35.10	35.14	3.28	4.18	33.46	784
39.04	38.38	38.41	3.28	4.29	36.74	764
42.32	41.66	41.69	3.28	4.50	40.02	728
45.60	44.94	44.97	3.28	4.27	43.30	768
49.05	48.39	48.42	3.45	3.59	46.67	961
52.17	51.51	51.54	3.12	2.21	49.95	1411
53.15	52.49	52.52	0.98	0.62	52.00	1580

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-5A
Date: October 30, 2007



CONETEC

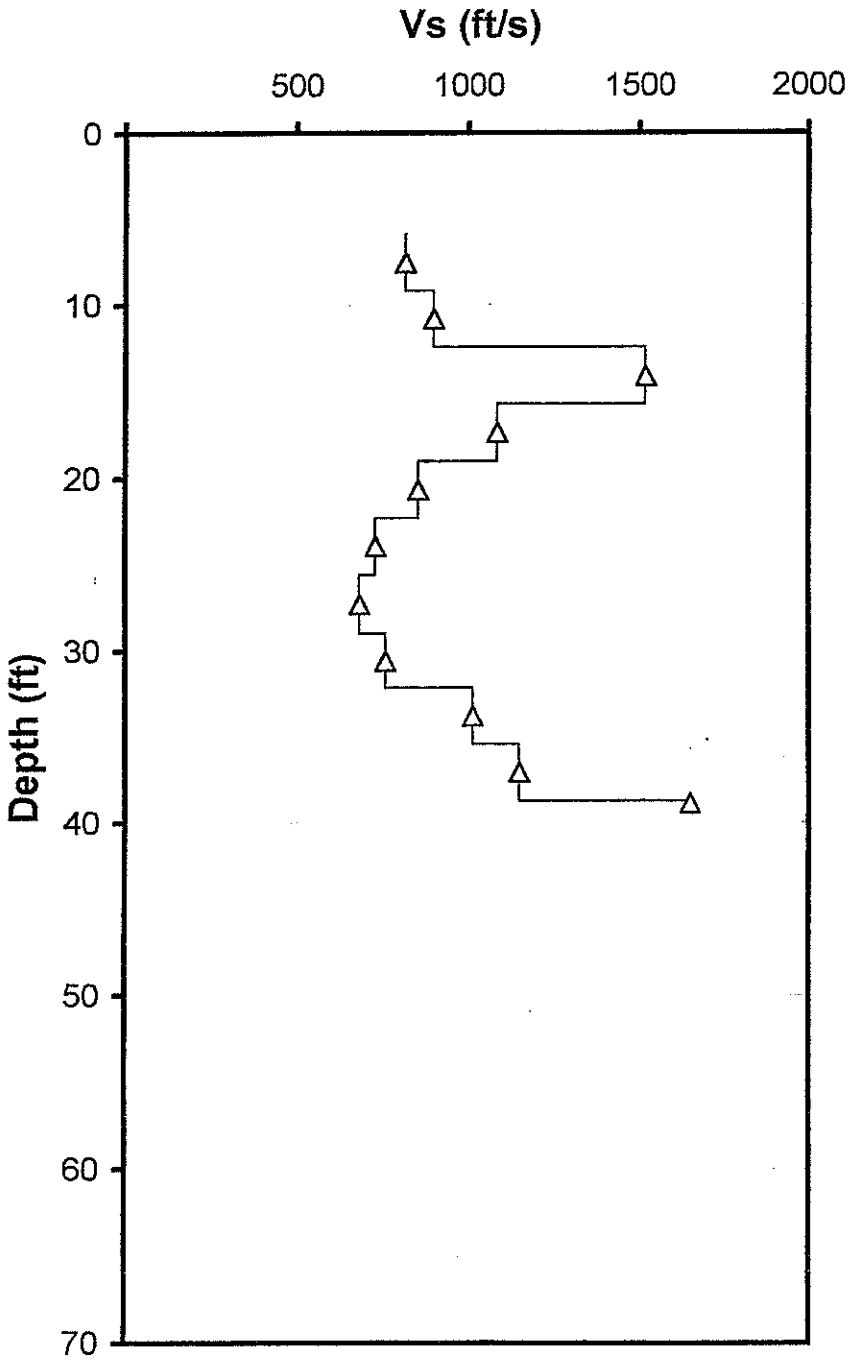
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-5B
Site	Williamson County, Illinois
Date	10/30/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
6.56	5.90	6.09				
9.84	9.18	9.31	3.21	3.93	7.54	818
13.12	12.46	12.55	3.25	3.61	10.82	900
16.40	15.74	15.82	3.26	2.15	14.10	1517
19.69	19.03	19.09	3.28	3.02	17.39	1085
22.97	22.31	22.36	3.27	3.82	20.67	856
26.25	25.59	25.64	3.27	4.47	23.95	732
29.69	29.03	29.07	3.43	5.01	27.31	686
32.81	32.15	32.19	3.12	4.09	30.59	762
36.09	35.43	35.47	3.28	3.23	33.79	1014
39.37	38.71	38.74	3.28	2.85	37.07	1150
39.70	39.04	39.07	0.33	0.20	38.88	1649

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-5B
Date: October 30, 2007



CONETEC

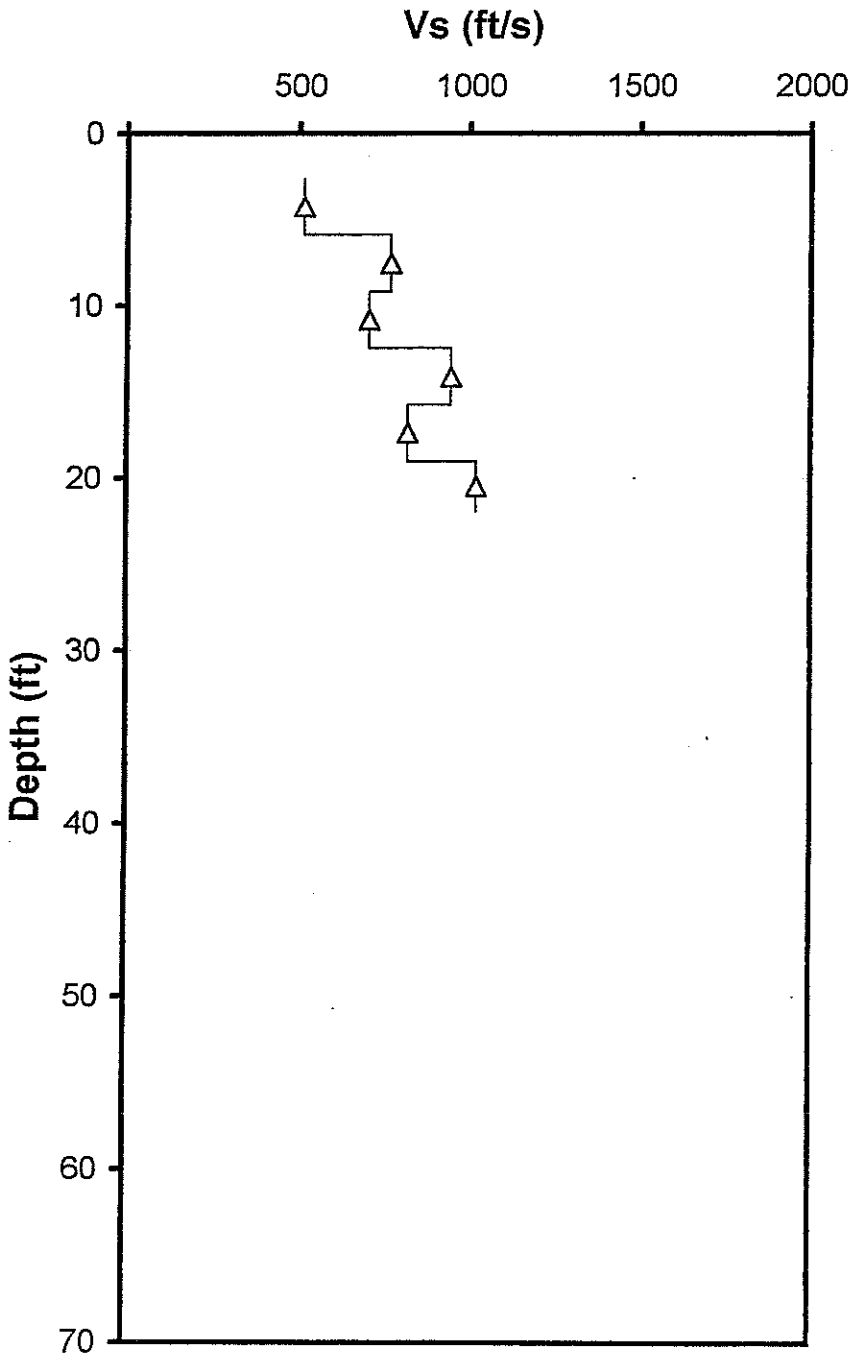
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-6
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	5.97	4.26	514
9.84	9.18	9.31	3.21	4.18	7.54	769
13.12	12.46	12.55	3.25	4.60	10.82	706
16.40	15.74	15.82	3.26	3.45	14.10	945
19.69	19.03	19.09	3.28	4.00	17.39	819
22.64	21.98	22.03	2.94	2.88	20.51	1022

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-6
Date: October 31, 2007



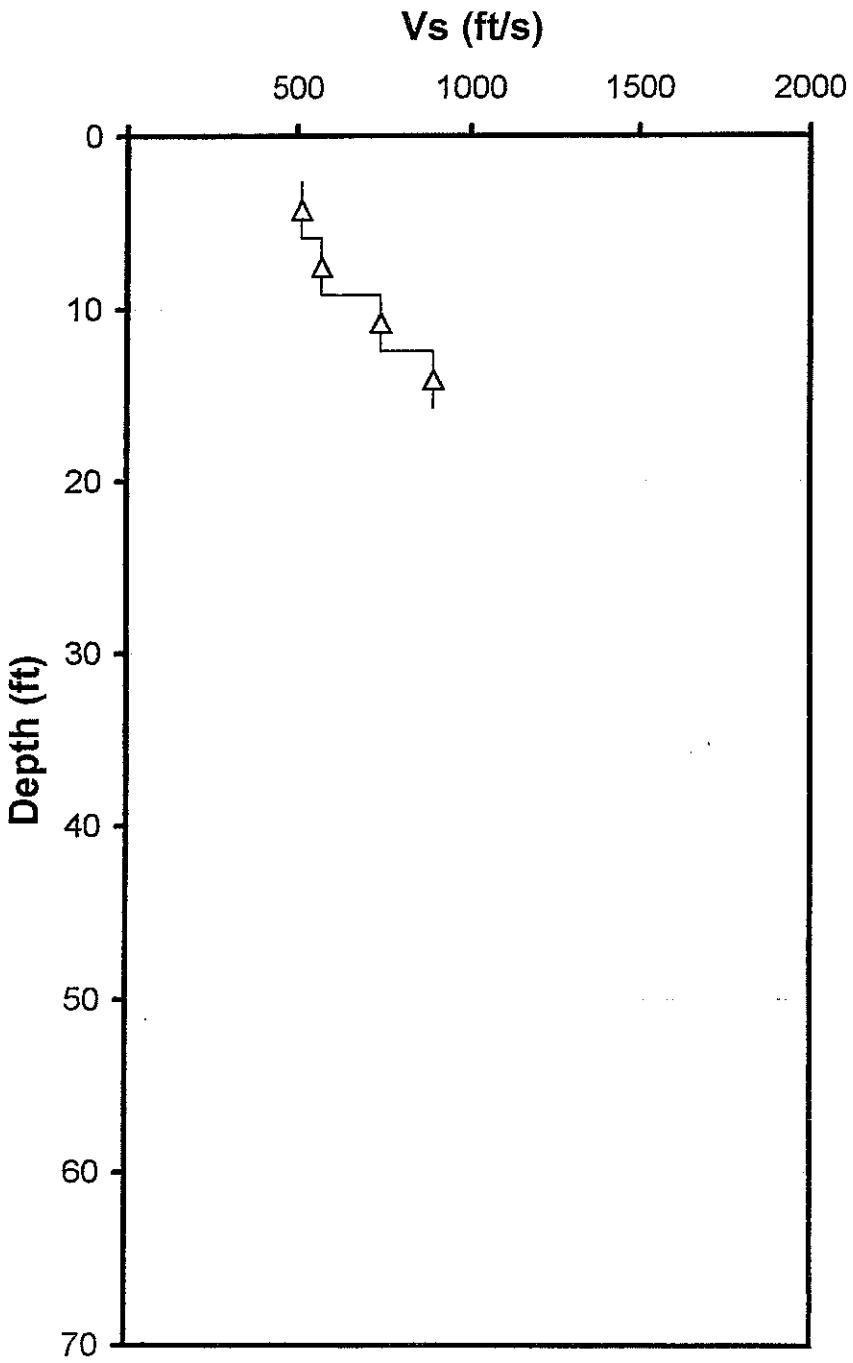
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-7
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	5.97	4.26	514
9.84	9.18	9.31	3.21	5.59	7.54	575
13.12	12.46	12.55	3.25	4.36	10.82	745
16.40	15.74	15.82	3.26	3.65	14.10	894

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-7
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-8
Site	Williamson County, Illinois
Date	10/31/2007

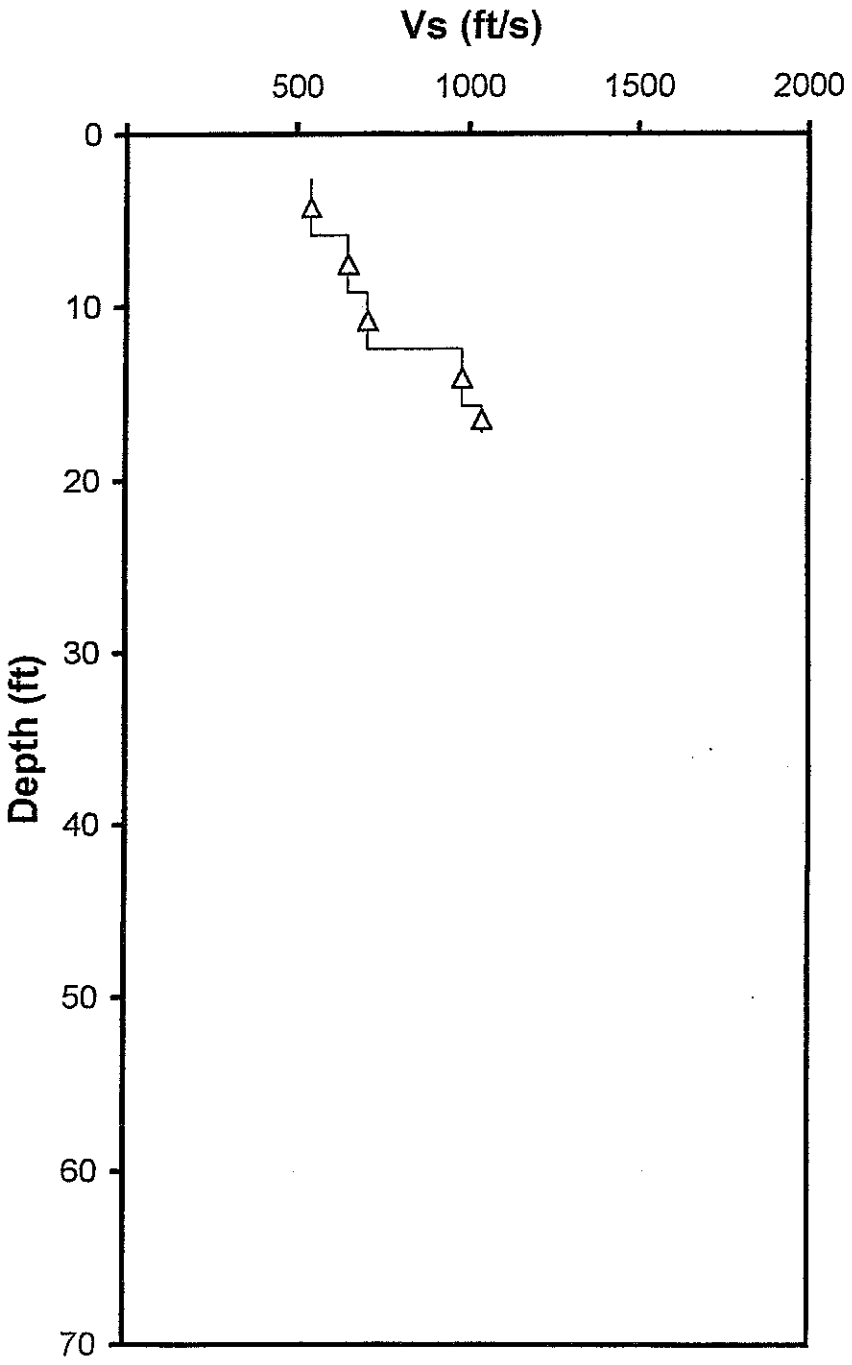
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	5.67	4.26	541
9.84	9.18	9.31	3.21	4.93	7.54	652
13.12	12.46	12.55	3.25	4.59	10.82	708
16.40	15.74	15.82	3.26	3.33	14.10	979
17.88	17.22	17.29	1.47	1.42	16.48	1038

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-8
Date: October 31, 2007



CONETEC

Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-9
Site	Williamson County, Illinois
Date	10/31/2007

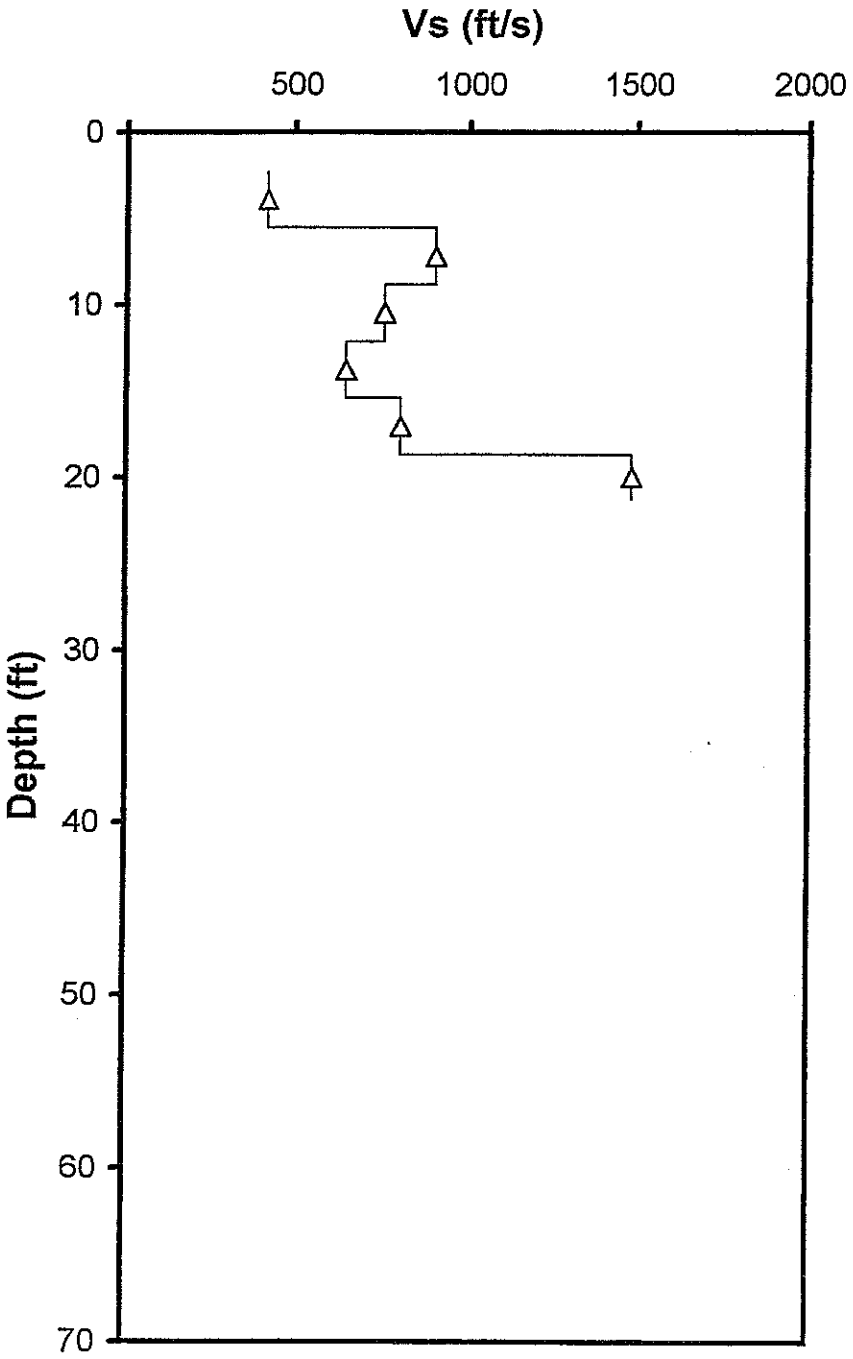
Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
2.95	2.29	2.74				
6.23	5.57	5.77	3.03	7.30	3.93	415
9.51	8.85	8.98	3.21	3.55	7.21	904
12.80	12.14	12.24	3.26	4.30	10.50	757
16.08	15.42	15.50	3.26	5.04	13.78	647
19.36	18.70	18.76	3.27	4.06	17.06	805
21.98	21.32	21.38	2.61	1.76	20.01	1484

CONETEC

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-9
Date: October 31, 2007



CONETEC

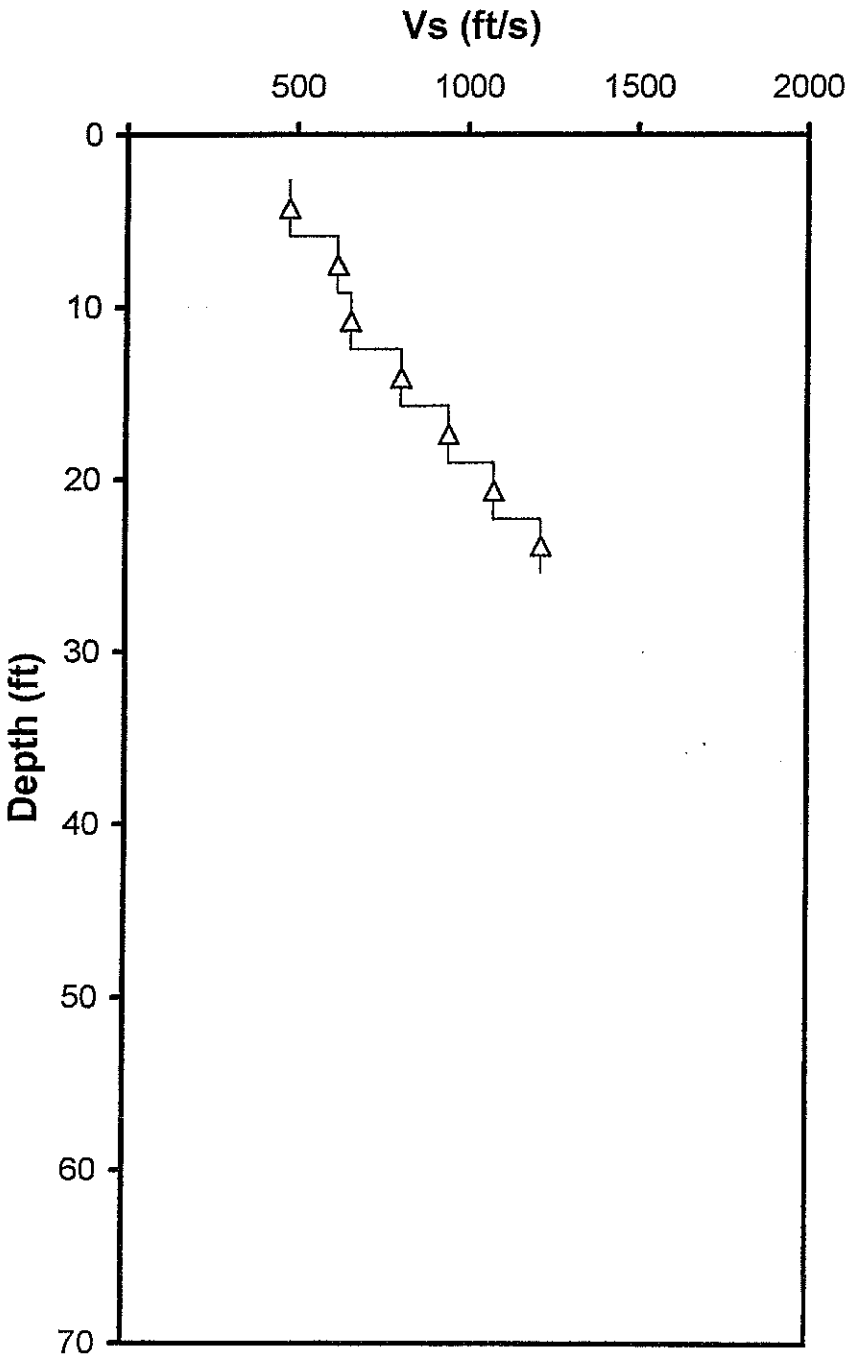
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-10
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	6.42	4.26	478
9.84	9.18	9.31	3.21	5.21	7.54	617
13.12	12.46	12.55	3.25	4.95	10.82	656
16.40	15.74	15.82	3.26	4.06	14.10	803
19.69	19.03	19.09	3.28	3.47	17.39	945
22.97	22.31	22.36	3.27	3.03	20.67	1080
26.08	25.42	25.47	3.10	2.55	23.87	1217

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-10
Date: October 31, 2007



CONETEC

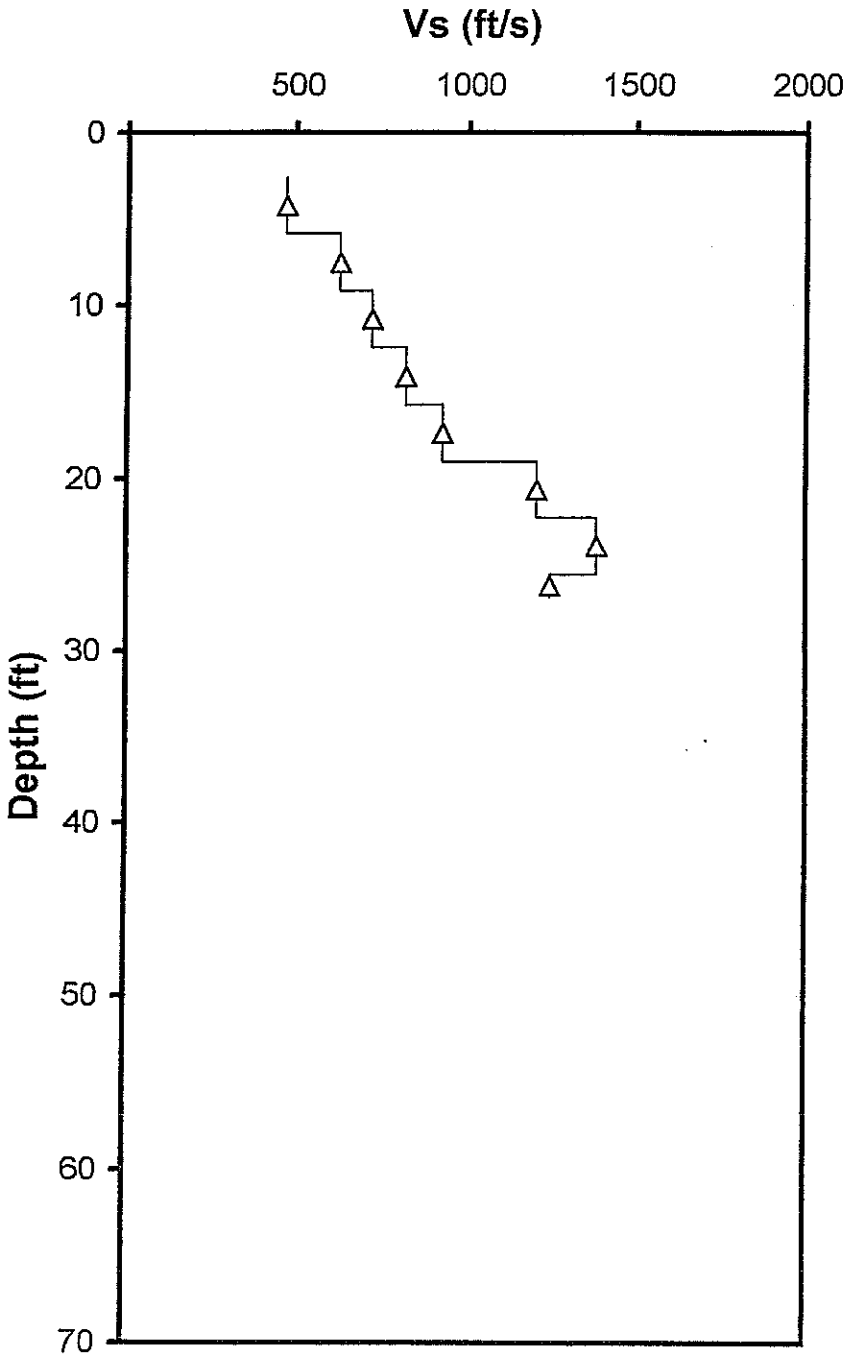
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-11
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
3.28	2.62	3.02				
6.56	5.90	6.09	3.07	6.51	4.26	471
9.84	9.18	9.31	3.21	5.12	7.54	628
13.12	12.46	12.55	3.25	4.52	10.82	719
16.40	15.74	15.82	3.26	3.99	14.10	817
19.69	19.03	19.09	3.28	3.54	17.39	926
22.97	22.31	22.36	3.27	2.71	20.67	1207
26.25	25.59	25.64	3.27	2.36	23.95	1387
27.56	26.90	26.95	1.31	1.05	26.25	1246

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-11
Date: October 31, 2007



CONETEC

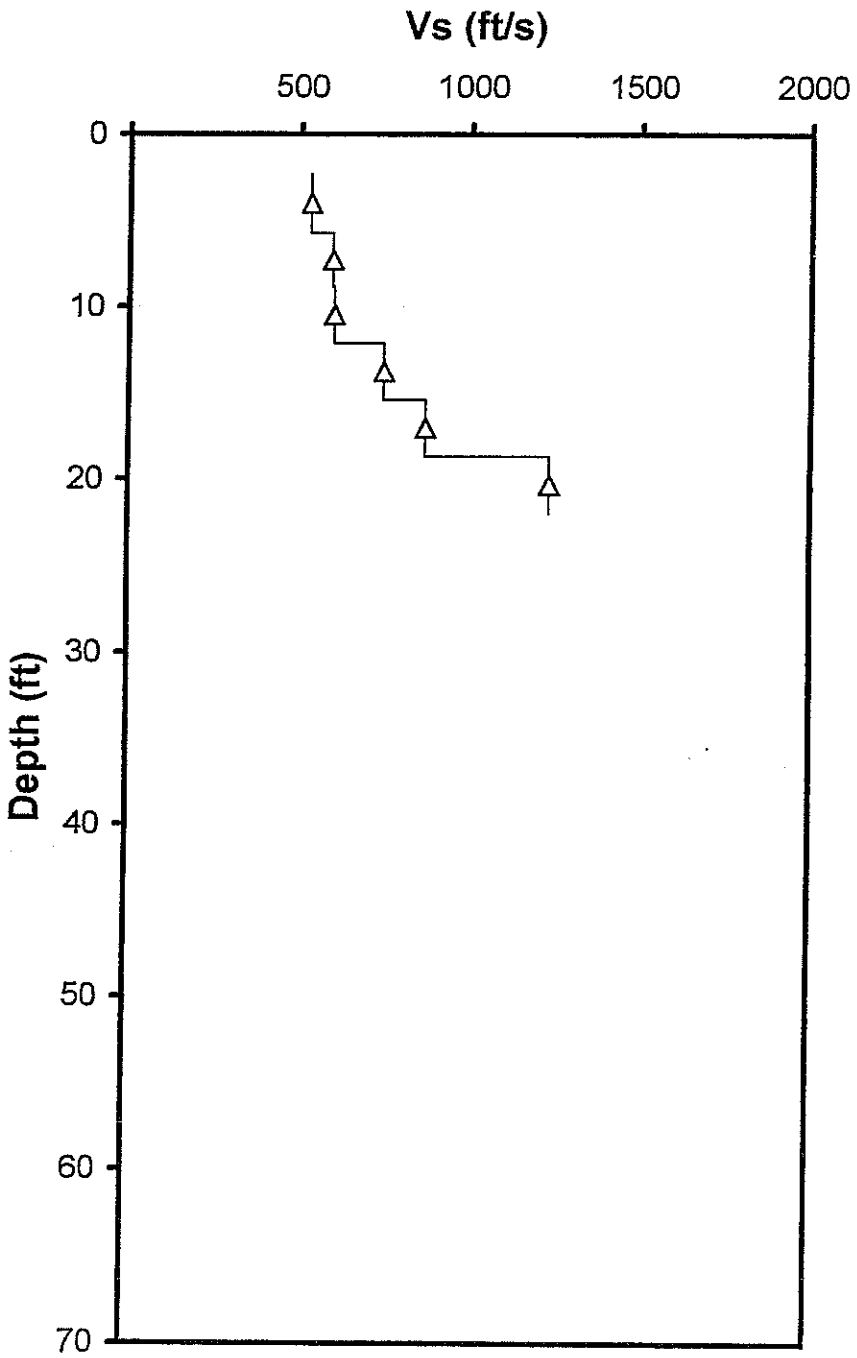
Job No	07-804
Client	Civil & Environmental Consultants
Project Title	Pond Creek Mine
Hole	CPT-12
Site	Williamson County, Illinois
Date	10/31/2007

Seismic Source:	Beam	
Source Offset:	1.50	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
2.95	2.29	2.74				
6.40	5.74	5.94	3.20	6.03	4.02	530
9.51	8.85	8.98	3.04	5.11	7.30	596
12.80	12.14	12.24	3.26	5.42	10.50	601
16.08	15.42	15.50	3.26	4.36	13.78	748
19.36	18.70	18.76	3.27	3.75	17.06	871
22.64	21.98	22.03	3.27	2.66	20.34	1230

Job No: 07-804
Client: C.E.C.
Project: Pond Creek Mine
Sounding: CPT-12
Date: October 31, 2007



No Dissipation Tests were performed

ConeTec Digital File Formats

CPT Data Files (COR Extension)

ConeTec CPT data files are named such that the first 3 characters contain the job number, the next two characters are CP followed by two characters indicating the sounding number. The last DOS character position is reserved for the letters a, b, c, d etc to uniquely identify multiple soundings at the same location. The CPT sounding file has the extensions COR, and pore pressure dissipation files have the extension PPD. As an example, for job number 99-127 the first sounding will have file names 127CP01.COR and 127CP01.PPD.

The CPT (COR) file consists of the following components:

1. Two lines of header information
2. Data records
3. End of data marker
4. Units information

Header Lines

Line 1: Columns 1-6 are blank (future use)
Columns 7-21 contain the sounding Date and Time
Columns 22-36 contain the sounding Operator

Line 2: Columns 1-16 contain the Job Location
Columns 17-31 contain the Cone ID
Columns 32-47 contain the sounding number

Data Records

The data records contain 4 or more columns of data in floating point format. A comma (and spaces) separates each data item:

Column 1:	Sounding Depth (meters)
Column 2:	Tip (q_c) data uncorrected for pore pressure effects. Recorded in units selected by the operator.
Column 3:	Sleeve (f_s) data. Recorded in units selected by the operator
Column 4:	Dynamic pore pressure readings. Recorded in units selected by the operator
Column 5:	UVIF Data. See UVIF section.

End of Data Marker

After the last line of data a line containing ASCII 26 (CTL-Z) and a newline (carriage return/ line feed) character. This is used to mark the end of data.

Units Information

The last section of the file contains information about the units that were selected for the sounding. A separator bar makes up the first line. The second line contains the type of units used for depth, q_c, f_s and u. The third line contains the conversion values required for ConeTec's software to convert the recorded data to an internal set of base units (bar for q_c, bar for $_{fs}$ and meters for u).

CPT Dissipation Files (PPD Extension)

CPT Dissipation files have the same naming convention as the CPT sounding files and have the extension PPD. PPD files consist of the following components:

1. Two lines of header information
2. Data records

Header Lines (same as COR file):

Line 1: Columns 1-6 are blank (future use)
Columns 7-21 contain the sounding Date and Time
Columns 22-36 contain the sounding Operator

Line 2: Columns 1-16 contain the Job Location
Columns 17-31 contain the Cone ID
Columns 32-47 contain the sounding number

Data Records

The data records immediately follow the header lines. Each data record can occupy several lines in the file and is a complete record of a dissipation test at a particular depth. Each data record starts with a line containing two values separated by spaces; the first value being an index number (not currently used by the Software) and the second being the dissipation test depth in meters. Following this line are the dissipation pore pressure values stored at 5 second intervals with a maximum of 12 entries per line. The last line of the dissipation record may not contain a full 12 entries. The data record is terminated with an ASCII 30 character (appears as a triangle in some editors).

This sequence is repeated for every dissipation test in the sounding. No marker is used to indicate end of file. Units information is not stored in this file. Users would have to check the CPT file for the units that were used.

CPT Basic Interpretations (TBL Extension)

ConeTec's basic CPT interpretation output files are generally delivered in text files with a TBL extension. The root file name is the same as the COR files. A number of calculated geotechnical parameters are presented in these files. The files are stored as ASCII text files that can be viewed using any text editor such as Notepad or Wordpad. The files do not contain any page formatting. These files are not distributed if the enhanced interpretation files are provided.

CPT Enhanced Interpretations (NLI, NLP, XLS Extension)

ConeTec's enhanced CPT interpretation output files are delivered in several formats, each file type containing the exact same information but formatted slightly differently. The files typically have any of the following file extensions:

1. NLI — an importable TAB delimited ASCII text file containing approximately 36 data columns of geotechnical interpretations. The file is designed for easy import to Excel. A companion document describes the techniques used for the interpretations (usually reproduced at the beginning of the Interpretation Appendix). Text editors can be used to view the file contents, however, they may remove the tabs or replace the tabs with spaces upon saving the file destroying the feature that makes them easy to import into Excel.

2. NLP — a printable ASCII text file containing the same 36 columns of geotechnical interpretations as the NLI file. This file type has been formatted as a multi-page document with up to 132 characters per line and up to 68 lines per page. Each page has been separated into multiple sections to accommodate all the data fields. Each physical page has a header section and a page/section number. The file is designed for direct printing to laser printers set into compressed font mode. This output is typically provided in the Interpretation Appendix.

3. XLS — an Excel format file that has been generated directly from the corresponding NLI file.

In each case root file name is the same as the COR files.

APPENDIX A-3

NORMALIZED PS-CPT DATA AND PARAMETER CORRELATIONS

3114-10
Part 20

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 1 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

CALCULATION BRIEF
FOR
NORMALIZED PS-CPT DATA AND PARAMETER CORRELATIONS

POND CREEK COAL REFUSE DISPOSAL SITE

OBJECTIVE:

Use data recorded during the piezo-seismic cone penetration testing (PS-CPT) at the Williamson Energy, Pond Creek Coal Refuse Disposal facility located in Williamson County, Illinois to correlate various index and strength properties. Also, nearly continuous profiles with depth of various applicable engineering properties of the refuse and subgrade soil materials in the fifteen (15) soundings tested at the Pond Creek facility are tabulated and attached.

REFERENCES:

1. Bowles, Joseph E. (1984) "Physical and Geotechnical Properties of Soils," Mc-Graw Hill. New York: 367-369 and 393-396.

2. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Summary of Piezo-Cone Penetration Testing," Pond Creek Coal Refuse Disposal Site, BEG, dated 12/21/07.

3. ConeTec, Inc. (2007), Field Report Entitled "Presentation of CPTU Test Results for: Pond Creek Mine – Williamson County, Illinois, December 10, 2007.

4. Robertson, P.K (1998), "Applications Guide – CPT" **Fax**

5. Robertson, P.K., et.al. (1992) "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE 109 (11): 1449-1459.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 2 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

6. Robertson, P.K and Campanella, R.G, (1989), "Guidelines for Geotechnical Design Using CPT and CPTU", UBC Soil Mechanics Series No. 120, Civil Eng. Dept., Vancouver, B.C., Canada

7. Robertson, P.K and Campanella, R.G, (1983), "SPT-CPT Correlations," Journal of Geotechnical Engineering, ASCE Vol. 109 No. 11, pp. 1449-1459.

8. Civil and Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak Undrained Shear Strength for Refuse and Subgrade Materials," Pond Creek Coal Refusal Site, BEG 12/28/07.

METHODOLOGY:

Using laboratory-derived unit weights for the coarse coal refuse and residual soil layers, provided by Alliance Consulting, Inc. (Alliance), the following parameters are correlated based on established CPT correlations (References 2, 3, 4, 5, 6 and 7) and the data collected during the Pond Creek Piezo-Seismic Cone Penetration Testing subsurface investigation (Ref. 2):

- Total stress (σ_v)
- Effective stress (σ_{vo}')
- Pore pressure (U_{eq})
- SPT N_{60} correction factor (C_n)
- SPT blow counts at 60% energy (N_{60})
- N_{60} corrected for overburden ($(N_1)_{60}$)
- Corrected tip resistance (q_c)
- Fines content (F_c)
- Effective friction angle (ϕ)
- Soil Behavior Index (I_c)

Undrained shear strength (S_u) was also correlated, and is discussed separately in the calculation brief entitled Estimation and Summary of Engineering Properties Including Peak Undrained Shear Strength for Refuse and Subgrade Materials," (Reference 8).

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 3 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

ANALYSIS:

ConeTec, Inc. (ConeTec) performed the PS-CPT and correlated the above noted parameters based on various unit weights that were correlated directly from the Soil Behavior Type (SBT) (Robertson and Campanella, 1989). The unit weights used by ConeTec were based on data interpolation and thus require modification to reflect the laboratory derived unit weights of the coarse refuse and residual soil, which were provided by Alliance. Therefore, laboratory-derived unit weight for each of the layers was used to correlate the applicable parameters, particularly total and effective stresses, which are used throughout the calculations.

PSCPT correlations were based on much of the work described by Robertson and Campanella (1998, 1992, 1989, 1988, 1983). During field testing, ConeTec measured four parameters insitu, which were not correlated. They include the recorded tip resistance (AvgQt), the recorded side friction (AvgFs), the recorded friction ratio (AvgRf) and the pore pressure generated by the CPT probe (AvgUd), all of which were used in subsequent correlations. The soil behavior type (SBT) was also determined by the ConeTec, and was based on observations and readings of the four parameters just listed.

The following paragraphs briefly describe the parameters as well as providing a definition of the parameter and any additional calculations needed: Total stress and effective stress are both used in many of the correlations, and are related to each other by the presence of water in the form of pore water pressure. Total stress was defined as:

$$\sigma_v = (\gamma * H) / 2000 \text{ (lb/ton)}$$

where: σ_v = total stress (tsf)
γ = unit weight (pcf)
H = depth of the sample (ft)

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 4 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

Pore pressure is defined as:

$$U_{eq} = (\gamma_w * H) / 2000 \text{ (lb/ton)}$$

where: U_{eq} = pore pressure (tsf)
γ_w = unit weight of water (pcf)
= 62.5 pcf
H = depth of the sample (ft)

The difference between the two determines the effective stress:

$$\sigma_{vo}' = \sigma_v - U_{eq}$$

where: U_{eq} = pore pressure (tsf)
σ_v = total stress (tsf)

The PS-CPT sampler correlated the number of blows per foot, without the overburden correction, to the tip resistance measured as the probe was advanced. This gave measurements of N_{60} every 0.2 meters. Corrected for overburden, the measured tip resistance was then calculated:

$$q_c = \text{AvgQt} - (1 - 0.85) * U$$

where: AvgQt = measured tip resistance (tsf)
0.85 = area ratio of the PS-CPT probe
U = measured pore pressure (tsf)

This corrected tip resistance (q_c) was used along with the soil behavior type index (Ic) and atmospheric pressure to give the recorded N_{60} value by the equation:

$$N_{60} = (q_c / Pa) / 8.5 * (1 - (Ic / 4.6))$$

where: q_c = corrected tip resistance (tsf)
Pa = atmospheric pressure (tsf)
= 1.058 tsf
Ic = soil behavior type index (dim)

Civil & Environmental Consultants, Inc.

PROJECT: Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 5 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

and: $Ic = ((3.47 - \text{Log}_{10}(Q))^2 + (\text{Log}_{10}(F) + 1.22)^2)^{0.5}$

where: Q = normalized cone penetration resistance (dim)
F = normalized friction ratio (pct)

and: $Q = (q_c - \sigma_v) / \sigma_{vo}'$

where: q_c = corrected tip resistance (tsf)
σ_v = total stress = (γ * H) / 2000(lb/ton) (tsf)
σ_{vo}' = vertical effective overburden (tsf)

and: $F = 100\% * \text{AvgFs} / (q_c - \sigma_{vo}')$

where: AvgFs = recorded side friction (tsf)
q_c = corrected tip resistance (tsf)
σ_{vo}' = vertical effective overburden (tsf)

Once N_{60} and σ_{vo}' had been calculated, a correction factor (Cn) was applied to N_{60} to give $(N_1)_{60}$:

$(N_1)_{60} = N_{60} * Cn$

where N_{60} = Number of blows/foot to advance 1.5 feet
Cn = $(\sigma_{vo}')^{-0.5}$ (dim)

Using tip resistance, corrected for overburden, and effective overburden the effective friction of the material in the Pond Creek facility could be calculated (Robertson, 1989). This was done using the following calculation:

$$\phi' = \tan^{-1}[(1/2.68) * (\text{Log}_{10}(q_c / \sigma_{vo}') + 0.29)]$$

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 6 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

where: q_c = corrected tip resistance (tsf)
σ_{vo}' = effective vertical stress (tsf)

Similarly, the fines content was correlated from PS-CPT data but was not used in any further analysis. The fines content was correlated using the soil behavior type index, I_c, as defined above. To determine the fines content of the material, the following relationship was used:

$$F_c = (1.75 * I_c^{3.25} - 3.7)$$

where: F_c = fines content (%)
I_c = soil behavior type index (dim)

RESULTS:

The results of the correlations between PS-CPT data recorded during field testing yield a profile of geotechnical parameters at the 15 sounding locations tested at the Pond Creek facility. Effective and total stresses provide an indication of the stresses being experienced insitu, and generally will increase as material is placed on top of the existing materials to the lines and grades of the proposed final geometry.

In-situ effective friction values were correlated using in-situ corrected tip resistance and effective overburden pressures for the 15 soundings tested at the Pond Creek facility.

CONCLUSIONS:

Summarizing, data recorded during PS-CPT field testing was used to correlate index and strength parameters for comparison to limited laboratory testing at discrete sample locations and to develop nearly continuous profile(s) of engineering properties with depth to model the variability of the insitu conditions at the Pond Creek facility.

Based on modified results, the correlated parameters from PS-CPT are generally consistent with each other and similar parameters determined from similar materials at other refuse facilities, and from laboratory testing of discrete samples. Therefore, in general, a reasonably high confidence level exists applying/using the results of the PS-CPT correlations to the 15 profiles shown in the attached tables.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 7 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-1

ConeTec Inc. Interpretation
Interpretation O... Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4622
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-1
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 13:23
CPT File: 804CP01.COR
Northing (m): 0.000000
Easting (m): 0.000000
Elevation (m): 482.2

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	41.95	2.43	76.91	26.81	2.38

User Inputs:
Assumed: Water Table Depth (ft): 15.3
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 482.2
Copied from ConeTec CPT Data File

Depth (ft)	Sample Et. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.026	16.61	0.44	2.66	0.11	1619.49	2.651	1.66	1619.49	2.65	5	125.00	0.010	0.010	0.000	2.000	2.89	5.79	0.514	16.61	5.45572	52.56
0.492	481.698	45.67	1.03	2.25	4.37	1484.2	2.257	1.60	1483.55	2.26	6	125.00	0.031	0.031	0.000	2.000	7.79	15.57	1.413	45.65	4.391	52.25
0.82	481.370	44.31	1.6	3.61	-3.26	863.585	3.615	1.86	863.98	3.61	5	125.00	0.051	0.051	0.000	2.000	8.26	16.52	1.370	44.33	9.36475	50.29
1.148	481.042	49.34	1.93	3.91	-6.42	686.666	3.917	1.92	687.22	3.91	5	125.00	0.072	0.072	0.000	2.000	9.42	18.84	1.525	49.38	10.8792	49.41
1.476	480.714	50.64	2.12	4.19	-7.64	547.943	4.194	1.98	548.49	4.19	5	125.00	0.092	0.092	0.000	2.000	9.90	19.80	1.565	50.69	12.4636	48.51
1.804	480.386	45.45	2.14	4.71	-0.65	402.104	4.720	2.08	402.10	4.72	4	125.00	0.113	0.113	0.000	2.000	9.23	18.46	1.404	45.45	15.2837	47.21
2.133	480.057	40.4	1.81	4.48	3.83	302.047	4.495	2.12	301.82	4.50	4	125.00	0.133	0.133	0.000	2.000	8.32	16.64	1.247	40.37	16.3803	45.96
2.461	479.729	34.96	1.32	3.78	8.22	226.29	3.792	2.12	225.96	3.80	5	125.00	0.154	0.154	0.000	2.000	7.19	14.38	1.078	34.91	16.3424	44.63
2.789	479.401	31.18	1.1	3.52	11.83	177.874	3.548	2.15	177.47	3.56	5	125.00	0.174	0.174	0.000	2.000	6.50	12.99	0.960	31.11	17.3915	43.48
3.117	479.073	29.29	1.15	3.92	14.97	149.35	3.953	2.23	148.89	3.96	5	125.00	0.195	0.195	0.000	2.000	6.31	12.62	0.901	29.2	20.1364	42.62
3.445	478.745	29.06	1.09	3.74	29.44	133.967	3.779	2.25	133.13	3.80	5	125.00	0.215	0.215	0.000	2.000	6.28	12.55	0.893	28.88	20.6255	42.05
3.773	478.417	32.91	1.15	3.49	32.64	138.56	3.520	2.21	137.67	3.54	5	125.00	0.236	0.236	0.000	2.000	7.01	14.02	1.012	32.7	19.4713	42.22
4.101	478.089	34.84	1.39	4	29.66	134.928	4.019	2.27	134.19	4.04	5	125.00	0.256	0.256	0.000	1.975	7.59	15.00	1.071	34.65	21.3078	42.09
4.429	477.761	35.38	1.49	4.22	29.72	126.812	4.245	2.30	126.16	4.27	4	125.00	0.277	0.277	0.000	1.901	7.83	14.88	1.087	35.2	22.5787	41.78
4.757	477.433	34.51	1.53	4.44	31.68	115.073	4.472	2.35	114.40	4.50	4	125.00	0.297	0.297	0.000	1.834	7.78	14.27	1.059	34.31	24.2407	41.27
5.085	477.105	32.05	1.52	4.75	32.73	99.8456	4.790	2.41	99.18	4.82	4	125.00	0.318	0.318	0.000	1.774	7.42	13.17	0.982	31.84	26.6972	40.52
5.413	476.777	33.07	1.53	4.62	33.55	96.7499	4.674	2.41	96.13	4.70	4	125.00	0.338	0.338	0.000	1.719	7.66	13.17	1.013	32.86	26.6937	40.36
5.741	476.449	28.11	1.63	5.81	25.36	77.3418	5.874	2.54	76.90	5.91	3	125.00	0.359	0.359	0.000	1.669	6.95	11.61	0.859	27.95	32.7178	39.15
6.069	476.121	23.82	1.72	7.24	8.62	61.7978	7.338	2.68	61.67	7.35	3	125.00	0.379	0.379	0.000	1.624	6.33	10.27	0.726	23.77	39.3343	37.91
6.398	475.792	23.35	1.75	7.49	4.73	57.3932	7.625	2.71	57.32	7.64	3	125.00	0.400	0.400	0.000	1.581	6.31	9.98	0.711	23.32	41.0639	37.49
6.726	475.464	25.01	1.76	7.04	4.71	58.4945	7.157	2.68	58.42	7.17	3	125.00	0.420	0.420	0.000	1.542	6.67	10.29	0.761	24.98	39.6542	37.60
7.054	475.136	26.32	1.96	7.47	4.23	58.6995	7.574	2.70	58.63	7.58	3	125.00	0.441	0.441	0.000	1.506	7.09	10.67	0.801	26.29	40.6073	37.62
7.382	474.808	26.5	1.77	6.7	3.32	56.437	6.798	2.68	56.39	6.80	3	125.00	0.461	0.461	0.000	1.472	7.04	10.37	0.806	26.48	39.2566	37.40
7.71	474.480	22.44	1.48	6.61	3	45.5681	6.740	2.74	45.53	6.75	3	125.00	0.482	0.482	0.000	1.441	6.15	8.86	0.680	22.42	42.3496	36.15
8.038	474.152	24.71	1.6	6.49	3.7	48.1864	6.609	2.71	48.15	6.61	3	125.00	0.502	0.502	0.000	1.411	6.69	9.44	0.749	24.69	41.1319	36.48
8.366	473.824	35.83	2.03	5.68	4.8	67.525	5.750	2.57	67.47	5.75	3	125.00	0.523	0.523	0.000	1.383	9.02	12.48	1.093	35.8	33.9863	38.42
8.694	473.496	39.18	2.59	6.61	3.46	71.1049	6.703	2.61	71.07	6.71	3	125.00	0.543	0.543	0.000	1.357	10.06	13.64	1.196	39.16	35.8018	38.71
9.022	473.168	64.62	3.1	4.8	6.26	113.6	4.840	2.37	113.53	4.84	11	125.00	0.564	0.564	0.000	1.332	14.63	19.75	1.983	64.58	25.3247	41.23
9.35	472.840	86.35	5.07	5.87	3.14	146.765	5.911	2.38	146.73	5.91	11	125.00	0.584	0.584	0.000	1.308	19.89	26.02	2.655	86.33	25.6191	42.54
9.678	472.512	73.23	5.54	7.56	-2.24	120.066	7.628	2.52	120.08	7.63	11	125.00	0.605	0.605	0.000	1.286	18.01	23.16	2.246	73.24	31.6127	41.52
10.006	472.184	46.41	4.03	8.68	-9.82	73.2115	8.802	2.69	73.31	8.79	0	125.00	0.625	0.625	0.000	1.265	12.47	15.77	1.417	46.47	40.1446	38.88
10.335	471.855	39.89	2.66	6.66	-11.18	60.7552	6.778	2.65	60.86	6.77	3	125.00	0.646	0.646	0.000	1.244	10.50	13.07	1.215	39.96	38.0706	37.83
10.663	471.527	54.17	2.97	5.48	-11.18	80.2829	5.551	2.51	80.39	5.54	3	125.00	0.666	0.666	0.000	1.226	13.28	16.26	1.656	54.24	31.1774	39.39
10.991	471.199	62.34	4.01	6.44	-10.85	89.7506	6.504	2.54	89.85	6.50	11	125.00	0.687	0.687	0.000	1.207	15.46	18.65	1.909	62.41	32.3205	39.99
11.319	470.871	75.65	4.58	6.06	-9.15	105.935	6.111	2.47	106.01	6.11	11	125.00	0.707	0.707	0.000	1.189	18.19	21.63	2.320	75.7	29.4445	40.87
11.647	470.543	96	6.72	7	-6.93	130.879	7.053	2.47	130.93	7.05	11	125.00	0.728	0.728	0.000	1.172	23.07	27.04	2.950	96.04	29.4226	41.97
11.975	470.215	83.38	6.59	7.9	-7.87	110.405	7.975	2.56	110.47	7.97	11	125.00	0.748	0.748	0.000	1.156	20.88	24.13	2.558	83.43	33.2785	41.09
12.303	469.887	57.02	4.42	7.74	-9.36	73.1543	7.858	2.66	73.23	7.85	3	125.00	0.769	0.769	0.000	1.140	15.01	17.11	1.742	57.08	38.1113	38.88
12.631	469.559	67.48	3.97	5.89	-6.63	84.4766	5.953	2.52	84.53	5.95	11	125.00	0.789	0.789	0.000	1.125	16.61	18.70	2.065	67.52	31.6601	39.66
12.959	469.231	79.63	5.29	6.64	-4.3	97.3162	6.711	2.53	97.35	6.71	11	125.00	0.810	0.810	0.000	1.111	19.65	21.83	2.440	79.66	31.8895	40.42
13.287	468.903	74.37	5.39	7.24	-3.35	88.5552	7.329	2.58	88.58	7.33	11	125.00	0.830	0.830	0.000	1.097	18.86	20.68	2.277	74.39	34.4742	39.92
13.615	468.575	71.75	5.08	7.08	-2.33	83.3186	7.165	2.59	83.34	7.16	11	125.00	0.851	0.851	0.000	1.084	18.25	19.79	2.195	71.77	34.8502	39.59
13.943	468.247	102.33	5.18	5.06	-0.78	116.427	5.106	2.38	116.44	5.11	11	125.00	0.871	0.871	0.000	1.071	23.62	25.31	3.141	102.34	25.6028	41.36
14.271	467.919	114.91	6.8	5.91	2.36	127.832	5.964	2.42	127.81	5.97	11	125.00	0.892	0.892	0.000	1.059	25.91	28.49	3.530	114.89	27.1057	41.84
14.6	467.590	134.53	9.49	7.06	8.6	148.43	7.102	2.45	148.36	7.11	11	125.00	0.913	0.913	0.000	1.047	31.95	33.45	4.137	134.47	28.4187	42.53
14.928	467.262	140.8	8.87	6.3	10.72	149.911	6.342	2.40	149.84	6.34	11	125.00	0.933	0.933	0.000	1.035	32.73	33.86	4.330	140.73	28.4588	42.65
15.256	466.934	130.39	7.43	5.7	2.1	135.749	5.740	2.39	135.74	5.74	11	125.00	0.954	0.954	0.000	1.024	30.14	30.87	4.007	130.38	25.9423	42.15

R16573

Depth (ft)	Sam (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	ress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.606	108.8	7.14	6.56	-4.18	111.721	6.622	2.49	111.74	6.62	11	135.00	0.974	0.965	0.009	1.018	26.34	26.81	3.338	108.82	30.1191	41.15
15.912	466.278	78.99	5.55	7.03	-5.77	79.8262	7.116	2.60	79.86	7.11	11	135.00	0.996	0.977	0.019	1.012	20.18	20.42	2.415	79.02	35.2737	39.35
16.24	465.950	119.1	5.81	4.88	-0.48	119.401	4.920	2.37	119.40	4.92	11	135.00	1.018	0.989	0.029	1.006	27.25	27.41	3.656	119.1	25.0315	41.50
16.568	465.622	148.8	8.34	5.6	-1.5	147.633	5.644	2.36	147.64	5.64	11	135.00	1.040	1.001	0.040	1.000	34.00	33.98	4.575	148.81	24.89	42.58
16.896	465.294	185.21	10.35	5.59	7.64	181.826	5.620	2.31	181.78	5.62	11	135.00	1.063	1.013	0.050	0.994	41.38	41.12	5.701	185.16	22.9713	43.60
17.224	464.966	333.69	12.91	3.87	16.63	324.597	3.881	2.05	324.50	3.88	12	135.00	1.085	1.025	0.060	0.988	66.82	66.01	10.297	333.59	14.2684	46.28
17.552	464.638	421.41	14.07	3.34	22.43	405.472	3.348	1.95	405.34	3.35	12	135.00	1.107	1.037	0.070	0.982	81.17	79.72	13.012	421.27	11.5386	47.25
17.88	464.310	395.49	15.59	3.94	0.37	376.125	3.953	2.03	376.12	3.95	12	135.00	1.129	1.048	0.080	0.977	78.54	76.70	12.209	395.49	13.6425	46.93

R16574

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 10 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-2

ConeTec Inc erpretation
Interpretation · Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4589
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-2
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 13:46
CPT File: 804CP02.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 494.21

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.31	1.83	59.64	24.15	2.30
125	Residual Soil	27.01	1.39	47.18	69.75	2.99

User Inputs:
Water Table Depth (ft): 38.8
Ground Surface Elev. 494.2
Assumed: Nk: 32.3
State Parameter: 1.2
CPT area ratio: 0.85
Unit Weight of Soil (pcf): Varies See Below See Below Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	494.046	4.44	0.09	1.92	0.14	415.51	2.032	1.75	415.51	2.03	4	130.00	0.011	0.011	0.000	2.000	0.80	1.59	0.137	4.44	7.06955	47.35
0.492	493.718	15.27	0.31	2	0	476.486	2.034	1.72	476.49	2.03	5	130.00	0.032	0.032	0.000	2.000	2.71	5.42	0.472	15.27	6.6253	47.93
0.82	493.390	32.2	0.81	2.51	0.41	603.128	2.520	1.76	603.13	2.52	6	130.00	0.053	0.053	0.000	2.000	5.80	11.60	0.995	32.2	7.92769	48.89
1.148	493.062	74.45	2.09	2.81	0.28	996.722	2.810	1.73	996.88	2.81	6	130.00	0.075	0.075	0.000	2.000	13.28	26.57	2.303	74.48	6.76819	50.83
1.476	492.734	107.36	2.19	2.03	0.26	1116.03	2.032	1.69	1116.03	2.03	7	130.00	0.096	0.096	0.000	2.000	18.21	36.42	3.321	107.36	4.12002	51.25
1.804	492.406	114.67	2.19	1.91	0.11	976.912	1.912	1.58	976.91	1.91	7	130.00	0.117	0.117	0.000	2.000	19.39	38.78	3.547	114.67	3.98073	50.76
2.133	492.077	93.71	1.85	1.98	0.3	674.899	1.977	1.65	674.90	1.98	7	130.00	0.139	0.139	0.000	2.000	16.22	32.44	2.897	93.71	5.18764	49.34
2.461	491.749	78.06	1.5	1.92	0.23	486.982	1.926	1.70	486.98	1.93	7	130.00	0.160	0.160	0.000	2.000	13.74	27.49	2.412	78.06	6.04007	48.02
2.789	491.421	58.8	1.47	2.51	0.67	323.351	2.508	1.88	323.36	2.51	6	130.00	0.181	0.181	0.000	2.000	11.06	22.13	1.816	58.8	9.97805	46.26
3.117	491.093	40.69	0.92	2.26	0.68	99.341	2.278	1.96	99.39	2.28	6	130.00	0.203	0.203	0.000	2.000	7.66	15.75	1.250	40.69	11.9986	44.04
3.445	490.765	28.44	0.67	2.16	0.21	117.075	2.174	2.10	117.08	2.17	6	130.00	0.224	0.224	0.000	2.000	5.40	10.79	0.812	28.44	15.6628	41.39
3.773	490.437	29.6	0.5	1.68	0.58	119.696	1.703	2.01	119.74	1.70	6	130.00	0.245	0.245	0.000	2.000	5.86	11.69	0.909	29.61	13.2597	41.61
4.101	490.109	25.33	0.62	2.43	0.39	94.0237	2.474	2.20	94.02	2.47	6	130.00	0.267	0.267	0.000	1.937	5.40	10.46	0.776	25.33	19.0184	40.24
4.429	489.781	26.49	0.71	2.6	0.44	97.3831	2.618	2.19	97.96	2.62	6	130.00	0.288	0.288	0.000	1.884	5.06	11.29	0.873	26.49	18.6026	40.46
4.757	489.453	31.04	0.87	2.79	0.58	99.3865	2.831	2.23	99.42	2.83	6	130.00	0.309	0.309	0.000	1.798	5.69	12.04	0.951	31.05	19.9408	40.64
5.085	489.125	58.32	1.11	1.88	0.63	175.447	1.897	1.94	175.45	1.90	7	130.00	0.331	0.331	0.000	1.739	11.19	19.47	1.795	58.32	11.2709	43.43
5.413	488.797	164.77	1.14	1.76	0.39	163.067	1.770	1.90	163.12	1.77	7	130.00	0.352	0.352	0.000	1.696	12.27	20.69	1.994	64.78	10.4054	43.83
5.741	488.469	46.99	1.55	3.1	0.19	132.962	3.124	2.19	132.96	3.12	6	130.00	0.373	0.373	0.000	1.637	10.56	17.29	1.536	46.99	18.3323	42.05
6.069	488.141	98.88	2.6	2.63	1.89	249.856	2.538	1.95	249.88	2.64	7	130.00	0.394	0.394	0.000	1.593	19.06	30.94	3.049	98.89	11.5492	46.10
6.398	487.812	86.03	2.55	2.97	3.23	205.868	2.978	2.05	205.92	2.98	6	130.00	0.416	0.416	0.000	1.551	17.26	28.77	2.651	86.05	14.3668	44.20
6.726	487.484	74.12	2.09	2.82	2.7	165.537	2.836	2.08	168.56	2.84	6	130.00	0.437	0.437	0.000	1.512	15.07	22.79	2.281	74.13	16.436	43.23
7.054	487.156	57.9	1.75	3.03	0.39	125.279	3.047	2.19	125.30	3.05	6	130.00	0.459	0.459	0.000	1.477	12.27	18.19	1.778	57.91	18.5782	41.74
7.382	486.828	73.94	1.79	2.42	0.82	155.096	2.437	2.06	163.10	2.44	6	130.00	0.480	0.480	0.000	1.444	14.87	21.47	2.274	73.94	14.5542	42.75
7.71	486.500	100.23	1.95	1.95	0.48	199	1.955	1.91	199.00	1.96	7	130.00	0.501	0.501	0.000	1.413	19.07	26.33	3.058	100.23	10.6818	44.03
8.038	486.172	98.56	2.95	3.06	0.34	183.814	3.072	2.09	183.81	3.07	6	130.00	0.522	0.522	0.000	1.383	19.67	27.21	2.973	98.56	15.6135	43.65
8.366	485.844	130.73	3.63	2.78	5.11	239.405	2.785	1.89	239.46	2.79	7	130.00	0.544	0.544	0.000	1.356	25.62	34.75	4.031	130.76	12.698	44.90
8.694	485.516	98.21	2.49	2.54	0.94	172.789	2.550	2.04	172.81	2.55	7	130.00	0.565	0.565	0.000	1.330	18.89	25.10	3.023	98.22	14.0762	43.35
9.022	485.188	72.31	1.82	2.52	0.92	122.305	2.538	2.13	122.32	2.54	6	130.00	0.586	0.586	0.000	1.306	14.99	19.67	2.221	72.32	16.8248	41.62
9.35	484.860	80.45	1.62	2.02	0.83	13.874	2.029	2.04	131.30	2.03	7	130.00	0.608	0.608	0.000	1.283	16.07	20.81	2.472	80.46	14.0383	41.99
9.678	484.532	69.94	1.16	1.66	0.99	110.18	1.674	2.03	110.20	1.67	7	130.00	0.629	0.629	0.000	1.261	13.92	17.65	2.146	69.95	13.7865	41.08
10.006	484.204	61.74	0.9	1.45	0.39	93.3277	1.473	2.04	93.93	1.47	7	130.00	0.650	0.650	0.000	1.240	12.34	15.30	1.891	61.74	14.1065	40.23
10.335	483.875	66.65	1.35	2.02	0.53	98.2148	2.046	2.13	98.23	2.05	7	130.00	0.672	0.672	0.000	1.220	13.79	16.82	2.043	66.66	16.6601	40.47
10.663	483.547	83.84	2.23	2.65	0.46	119.965	2.682	2.16	119.96	2.68	6	130.00	0.693	0.693	0.000	1.201	17.55	21.08	2.574	83.84	17.5802	41.62
10.991	483.219	117.25	2.55	2.17	0.63	163.12	2.188	2.00	163.12	2.19	7	130.00	0.714	0.714	0.000	1.183	23.09	27.32	3.608	117.25	13.0514	43.07
11.319	482.891	126.97	2.65	2.08	0.44	17.576	2.099	1.98	171.58	2.10	7	130.00	0.736	0.736	0.000	1.166	24.74	28.84	3.908	126.97	12.3081	43.32
11.647	482.563	100.73	2.81	2.79	1.16	132.056	2.811	2.15	132.07	2.81	6	130.00	0.757	0.757	0.000	1.149	20.99	24.12	3.096	100.74	17.2321	42.01
11.975	482.235	110.03	2.03	1.85	0.79	149.359	1.858	1.99	149.37	1.86	7	130.00	0.778	0.778	0.000	1.133	21.57	24.45	3.382	110.04	12.7249	42.32
12.303	481.907	89.84	1.64	1.83	0.58	11.343	1.842	2.06	111.36	1.84	7	130.00	0.800	0.800	0.000	1.118	18.07	20.20	2.757	89.85	14.5435	41.13
12.631	481.579	64.26	1.13	1.75	1.04	77.269	1.781	2.16	77.28	1.78	7	130.00	0.821	0.821	0.000	1.104	13.47	14.88	1.964	64.27	17.6781	39.17
12.959	481.251	53.66	0.81	1.5	0.76	62.7039	1.534	2.18	62.70	1.53	7	130.00	0.842	0.842	0.000	1.090	11.36	12.38	1.635	53.66	18.4929	38.00
13.287	480.923	47.49	0.8	1.68	0.14	53.9872	1.718	2.27	54.00	1.72	7	130.00	0.864	0.864	0.000	1.076	10.41	11.20	1.444	47.5	21.2802	37.15
13.615	480.595	49.6	0.9	1.82	0.26	55.0468	1.847	2.26	55.05	1.85	7	130.00	0.885	0.885	0.000	1.063	10.83	11.62	1.508	49.6	21.6025	37.26
13.943	480.267	33.73	0.59	1.74	0.11	36.2176	1.797	2.41	36.22	1.80	6	130.00	0.906	0.906	0.000	1.050	7.89	8.29	1.018	33.73	26.9611	34.77
14.271	479.939	30.54	0.58	1.92	0.3	31.2231	1.891	2.47	31.92	1.89	6	130.00	0.926	0.926	0.000	1.039	7.33	7.61	0.917	30.54	29.3952	34.00
14.6	479.610	31.88	0.49	1.49	0.09	32.5933	1.552	2.41	32.59	1.55	6	130.00	0.949	0.949	0.000	1.027	7.45	7.65	0.958	31.88	26.9209	34.13
14.928	479.282	41.36	0.41	0.98	0.28	41.5251	1.015	2.22	41.63	1.02	7	130.00	0.970	0.970	0.000	1.016	8.89	9.02	1.250	41.36	19.6777	35.61
15.256	478.954	37.15	0.45	1.21	0.14	36.4632	1.245	2.32	36.46	1.24	7	130.00	0.992	0.992	0.000	1.004	8.82	8.38	1.119	37.15	23.1707	34.81

R16576

Depth (ft)	Sar (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (csf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	478.626	35.51	0.42	1.19	-0.23	34.0557	1.217	2.34	34.07	1.22	7	130.00	1.015	1.013	0.000	0.994	8.02	7.97	1.068	35.52	23.8923	34.40
15.912	478.298	35.52	0.45	1.26	0.07	33.3427	1.305	2.35	33.34	1.30	7	130.00	1.034	1.034	0.000	0.983	8.11	7.98	1.068	35.52	24.8516	34.27
16.24	477.970	39.22	0.5	1.28	-0.18	36.1542	1.310	2.33	36.16	1.31	7	130.00	1.056	1.056	0.000	0.973	8.85	8.61	1.182	39.23	23.7631	34.76
16.568	477.642	38.39	0.42	1.08	0	34.648	1.126	2.31	34.65	1.13	7	130.00	1.077	1.077	0.000	0.964	8.56	8.27	1.155	38.39	22.946	34.50
16.896	477.314	40.69	0.25	0.6	0.04	36.0502	0.631	2.17	36.05	0.63	7	130.00	1.098	1.098	0.000	0.954	8.56	8.16	1.226	40.69	17.9445	34.74
17.224	476.986	26.93	0.46	1.71	0.18	23.0541	1.782	2.57	23.05	1.78	6	130.00	1.120	1.120	0.000	0.945	6.76	6.41	0.799	26.93	33.9054	31.95
17.552	476.658	23.41	0.62	2.63	0.25	19.5192	2.764	2.74	19.52	2.78	5	130.00	1.141	1.141	0.000	0.936	6.44	6.03	0.689	23.41	42.7557	30.87
17.88	476.330	65.32	1.62	2.49	0.04	55.2038	2.525	2.37	55.20	2.53	8	130.00	1.162	1.162	0.000	0.928	14.98	13.89	1.988	65.32	25.2187	37.27
18.208	476.002	75.66	2.12	2.8	0.99	62.9279	2.84854	2.36561	62.9279	2.84654	8	130.00	1.18352	1.18352	0	0.9192	17.31894	15.91506	2.30577	75.66	25.0311	38.024
18.537	475.673	74.29	1.97	2.66	0.05	60.6563	2.69549	2.36029	60.6563	2.69549	8	130.00	1.20491	1.204905	0	0.911	16.96011	15.45084	2.2627	74.29	24.8219	37.815
18.865	476.345	66.95	1.6	2.4	0.05	53.5985	2.43443	2.36877	53.5985	2.43443	8	130.00	1.22623	1.226225	0	0.9031	15.34246	13.85511	2.03479	66.95	25.168	37.104
19.193	475.017	63.56	1.37	2.18	0.04	49.9481	2.1986	2.36187	49.9481	2.1986	7	130.00	1.24765	1.247645	0	0.8953	14.52072	13.0005	1.92918	63.56	24.8899	36.693
19.521	474.689	54.9	1.01	1.84	0.12	42.267	1.88323	2.37383	42.267	1.88323	7	130.00	1.26887	1.268865	0	0.8878	12.60965	11.19426	1.66041	54.9	25.8569	35.705
19.849	474.361	41.75	0.84	2.02	0.51	31.3597	2.07613	2.50167	31.3697	2.07613	6	130.00	1.29019	1.290165	0	0.8804	10.17354	8.956661	1.26263	41.75	30.7677	33.607
20.177	474.033	46.14	0.67	1.25	0.28	33.4185	1.30052	2.35955	33.4108	1.30082	7	130.00	1.31161	1.311605	0	0.8732	10.29958	8.993624	1.35692	46.13	24.7928	34.278
20.505	473.705	50.75	0.86	1.29	0.28	37.077	1.33557	2.329	37.077	1.33557	7	130.00	1.33283	1.332825	0	0.8662	11.42634	9.897387	1.52994	50.75	23.6109	34.915
20.833	473.377	43.95	0.93	2.11	0.21	31.4559	2.18331	2.51412	31.4559	2.18331	6	130.00	1.35416	1.354145	0	0.8593	10.77855	9.25819	1.31878	43.95	31.3181	33.906
21.161	473.049	37.82	0.79	2	0.18	26.4962	2.08536	2.66096	26.4962	2.08536	6	130.00	1.37547	1.375465	0	0.8527	9.483875	8.086508	1.12831	37.82	33.4834	32.832
21.489	472.721	31.66	0.63	1.99	0.12	21.6663	2.08174	2.6309	21.6663	2.08174	6	130.00	1.39679	1.396785	0	0.8461	8.221135	6.956119	0.93694	31.66	36.886	31.548
21.817	472.393	29.26	0.61	1.76	0.11	19.6332	1.83177	2.63408	19.6332	1.83177	6	130.00	1.41811	1.418105	0	0.8397	7.810153	6.590564	0.86198	29.26	37.0448	30.91
22.145	472.065	27.79	0.57	2.04	0.16	18.3063	2.16314	2.70017	18.3063	2.16314	6	130.00	1.43943	1.439425	0	0.8335	7.479319	6.234011	0.81581	27.79	40.4629	30.453
22.473	471.737	29.87	0.47	1.58	0.21	19.4485	1.65439	2.61284	19.4485	1.65439	6	130.00	1.46075	1.460745	0	0.8274	7.685847	6.35823	0.87954	29.87	35.9677	30.646
22.802	471.408	28.42	0.68	2.03	0.16	18.1751	2.1531	2.70156	18.1751	2.1531	6	130.00	1.48213	1.482135	0	0.8214	7.864487	6.267427	0.83399	28.42	40.6369	30.406
23.13	471.080	31.05	0.62	1.99	0.28	19.6525	2.09838	2.66738	19.6525	2.09838	6	130.00	1.50345	1.503445	0	0.8156	8.214939	6.699789	0.91475	31.05	38.7438	30.916
23.458	470.752	46.22	1.11	2.4	0.37	29.3128	2.48349	2.67298	29.3128	2.48349	6	130.00	1.52477	1.52477	0	0.8098	11.65897	9.441869	1.38375	46.22	34.0532	33.467
23.786	470.424	39.92	0.83	2.08	0.37	24.82	2.16293	2.59316	24.82	2.16293	6	130.00	1.54609	1.54609	0	0.8042	10.1712	8.180027	1.18805	39.92	35.0255	32.418
24.114	470.096	27.63	0.53	1.93	0.37	16.564	2.0414	2.72167	16.564	2.0414	6	130.00	1.56741	1.56741	0	0.7987	7.493763	5.985613	0.8038	27.63	41.6107	29.796
24.442	469.768	29.77	0.61	1.72	0.37	17.7382	1.80971	2.66769	17.7382	1.80971	6	130.00	1.58873	1.58873	0	0.7934	7.877548	6.249799	0.87249	29.77	39.7598	30.247
24.77	469.440	42.96	0.65	1.63	0.32	25.3097	1.59509	2.50911	25.3097	1.59509	7	130.00	1.61005	1.61005	0	0.7881	10.35859	8.163824	1.25161	42.36	31.0917	32.642
25.098	469.112	53.82	1.3	2.41	0.39	31.9907	2.49096	2.54436	31.9907	2.49096	6	130.00	1.63137	1.631375	0	0.7829	13.38709	10.48117	1.61575	53.82	32.7057	34.01
25.426	468.784	61.08	0.9	1.77	0.53	29.9072	1.82066	2.4837	29.9011	1.82122	7	130.00	1.65269	1.65269	0	0.7779	12.33893	9.59802	1.63028	61.07	29.9598	33.691
25.754	468.456	40.34	0.96	2.39	0.39	23.0978	2.4828	2.65426	23.0978	2.4828	6	130.00	1.67401	1.67401	0	0.7729	10.60082	8.19333	1.19709	40.34	38.0669	31.959
26.082	468.128	38.33	0.52	1.36	0.09	21.6092	1.41942	2.6382	21.6092	1.41942	7	130.00	1.69533	1.69533	0	0.768	9.50564	7.300626	1.1342	38.33	32.4199	31.591
26.41	467.800	33.19	0.47	1.42	0.42	18.3342	1.49339	2.61024	18.3342	1.49339	7	130.00	1.71665	1.71665	0	0.7632	8.52896	6.509514	0.97441	33.19	35.8695	30.463
26.739	467.471	35.49	0.61	1.72	0.44	19.4196	1.8073	2.63471	19.4196	1.8073	6	130.00	1.73804	1.738035	0	0.7585	9.233542	7.003986	1.04496	35.49	37.0774	30.839
27.067	467.143	42.19	0.58	1.38	0.21	22.9804	1.49456	2.51828	22.9804	1.49456	7	130.00	1.75936	1.759365	0	0.7539	10.36277	7.812664	1.25172	42.19	31.5067	31.926
27.395	466.816	45.83	0.59	1.3	0.28	24.4566	1.35479	2.4822	24.451	1.3551	7	130.00	1.78068	1.780675	0	0.7494	10.94193	8.199766	1.34828	45.82	29.8938	32.323
27.723	466.487	34.11	0.71	2.09	0.25	17.929	2.1976	2.71151	17.929	2.1976	6	130.00	1.802	1.801995	0	0.7449	9.236424	6.879867	1.00025	34.11	41.0689	30.317
28.051	466.159	38.11	0.64	1.67	0.16	19.9015	1.76373	2.61995	19.9015	1.76373	7	130.00	1.82332	1.823315	0	0.7406	9.84131	7.28823	1.12343	38.11	36.3399	30.998
28.379	465.831	54.68	0.64	1.17	0.14	28.6427	1.21131	2.39804	28.6427	1.21131	7	130.00	1.84464	1.844635	0	0.7363	12.89719	9.548728	1.63577	54.68	26.331	33.328
28.707	465.503	38.3	0.68	1.78	0.12	19.5257	1.86639	2.64061	19.5257	1.86639	6	130.00	1.86598	1.865955	0	0.7321	9.994656	7.316734	1.12789	38.3	37.3751	30.674
29.035	465.175	39.55	0.71	1.8	0.09	19.9561	1.88515	2.63527	19.9561	1.88515	6	130.00	1.88728	1.887275	0	0.7279	10.29278	7.492285	1.16603	39.55	37.1054	31.016
29.363	464.847	136.83	0.63	1.71	0.04	18.2969	1.80405	2.65573	18.2969	1.80405	6	130.00	1.9086	1.908595	0	0.7238	9.885775	7.01096	1.09116	38.83	38.1443	30.45
29.691	464.519	45.2	0.73	1.62	0.32	22.4207	1.68708	2.66643	22.4155	1.68747	7	130.00	1.92892	1.929915	0	0.7198	11.36246	8.178056	1.33963	45.19	33.742	31.707
30.019	464.191	50.69	0.58	1.15	0.3	24.9784	1.19002	2.44408	24.9784	1.19002	7	130.00	1.95124	1.951235	0	0.7159	12.02196	8.606381	1.50894	50.69	28.246	32.458
30.347	463.863	39.45	0.49	1.23	0.32	18.9994	1.30745	2.56884	18.9994	1.30745	7	130.00	1.97256	1.972555	0	0.712	9.920241	7.0633	1.16029	39.45	33.752	30.696
30.675	463.535	51.05	0.69	1.36	0.21	24.6034	1.40655	2.48892	24.5984	1.40684	7	130.00	1.99388	1.993875	0	0.7082	12.06218	8.754796	1.51877	51.04	30.1901	32.361
31.004	463.206	35.96	0.8	2.22	0.25	16.8439	2.35677	2.75119	16.8439	2.35677	6	130.00	2.01526	2.015265	0	0.7044	9.945252	7.005692	1.05092	35.96	43.233	29.907
31.332	462.878	34.69	0.81	2.33	0.23	16.0335	2.4806	2.78153	16.0335	2.4806	6	130.00	2.03658	2.03658	0	0.7007	9.764086	6.834958	1.01094	34.69	44.9361	29.581
31.66	462.550	32.8	0.69	2.11	0.04	14.9386	2.24448	2.78183	14.9386	2.24448	6	130.00	2.0579	2.0579	0	0.6971	9.224214	6.430093	0.95177	32.8	44.9535	29.113
31.988	462.222	41.84	0.77	1.83	0.11	19.1229	1.93658	2.65715	19.1229	1.93658	6	130.00	2.07922	2.07922	0	0.6935	11.01136	7.638449	1.23098	41.84	38.2171	30.738
32.316	461.894	37.05	1.05	2.83	0.04	16.6383	3.00434	2.81778	16.6383	3.00434	6	125.00	2.10054	2.10054	0	0.69	10.62955	7.334144	1.08203	37.05	47.0264	29.826
32.644	461.566	67.03	0.55	0.82	-6.6	30.6024	0.84734	2.29207	30.6213	0.84682	8	125.00	2.12104	2.12104	0	0.6866	14.85918	10.20282	2.00957	67.07	22.2286	33.739
32.972	461.238	54.68	1.11	2.03	0.21	24.533	2.11274	2.59114	24.533	2.11274	7	125.00	2.14154	2.14154	0	0.6833	13.91768	9.510511	1.62658	54.68	34.9261	32.344
33.3	460.910	49.23	1.53	3.11	-2.91	21.7702	3.25062	2.74669	21.7794	3.24924	6	125.00	2.16204	2.16204	0	0.6801	13.56773	9.240913	1.45721	49.25	42.984	31.581
33.628	460.582	42.89	1.67	3.9	-0.53	18.6514	4.10244	2.86303	18.6514	4.10244	5	125.00	2.18254	2.18254	0	0.6769	12.62559	8.54615	1.26029	42.89	49.722	30.575
33.956	460.254	42.8	1.32	3.09	0.12	18.4277	3.25147	2.80358	18.4277	3.25147	6	125.00	2.20304	2.20304	0	0.6737	12.18217	8.207546	1.25687	42.8	46.2004	30.497
34.284	459.926	30.89	1.35	4.37	0.37	12.8923	4.70934	3.02533	12.8878	4.71098	4	125.00	2.22354	2.22354	0	0.6706	10.02714	6.72442	0.88751	30.88	60.2073	28.127
34.612	459.598	24.22	1.28	5.28	0.61	9.79303	5.82455	3.1763	9.78858	5.8272	3	125.00	2.24404	2.24404	0	0.6676	8.694916	5.804303	0.68037	24.21	71.1657	26.273
34.941	459.269	21.73	0.96	4.43	1.31	8.5955	4.93163	3.17671	8.59109	4.93436	4	125.00	2.2648	2.264603	0	0.6645	7.802906	5.185139	0.60264	21.72	71.1974	25.388
35.269	458.941	23.04	0.79	3.42	1.73	9.0827	3.80633	3.09074	9.07832	3.80817	5	125.00	2.2851	2.285103	0	0.6615	7.80225	5.161394	0.64257	23.03	64.8082	25.762
35.597	458.613	22.63	0.74	3.26	2.47	8.81522	3.64094	3.09045	8.80655	3.64463	5	125.00	2.3056	2.305603	0	0.6586	7.658449	5.043693	0.62924	22.61	64.7868	25.556
35.925	458.285	23.37	0.6	2.57	3.4	9.04685	2.65118	3.02107	9.03825	2.8539	5	125.00	2.3261	2.326103	0	0.6557	7.56159	4.95791	0.65151	23.35	59.9152	25.732
36.253	457.957	29.16	0.73	2.49	9.07	11.4265	2.72252	2.9266	11.4009	2.72863	6	125.00	2.3466	2.346603	0	0.6528	8.891671	5.804484	0.83014	29.1	53.6748	27.303
36.581	457.629	30.74	0.64	2.07	12.21	11.9863	2.25567	2.86414	11.9525	2.26205	6	125.00	2.3671	2.367103	0	0.65	9.031228	5.870002	0.87842	30.66	49.7897	27.622
36.909	457.301	30.69	0.47	1.52	13.92	11.8539	1.66064	2.79759	11.8162	1.66593	6	125.00	2.3876	2.387603	0	0.6472	8.680726	5.617913	0.87624	30.6	45.8547	27.544
37.237	456.973	31.76	0.55	1.72	16.67	12.1888	1.87381	2.81505	12.1431	1.88086	6	125.00	2.4081	2.408103	0	0.6444	9.066453	5.842516	0.90873	31.65	46.8672	27.728
37.565	456.645	33.62	0.61	1.8	17.92	12.8434	1.95567	2.80566	12.7981	1.96259	6	125.00	2.4286	2.428603	0	0.6417	9.549031	6.127468	0.96568	33.51	46.3211	28.081

12 of 70
R16577

Depth (ft)	S... (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.W... (pcf)	...Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	456.317	32.15	0.63	1.96	18.64	12.1273	2.12115	2.84602	12.0783	2.12975	6	125.00	2.4491	2.449103	0	0.639	9.337317	5.966486	0.91953	32.03	48.6978	27.692
38.221	455.989	25.87	0.58	2.25	19.84	9.47537	2.47859	2.97339	9.42678	2.49137	6	125.00	2.4696	2.469603	0	0.6363	8.094387	5.15075	0.72447	25.75	56.71	26.018
38.549	455.661	21.3	0.67	3.13	19.56	7.55386	3.56195	3.14336	7.50567	3.58482	5	125.00	2.4901	2.490103	0	0.6337	7.434711	4.711459	0.58235	21.18	68.672	24.471
38.877	455.333	19.83	0.72	3.64	19.54	6.90511	4.15719	3.21395	6.85727	4.18619	4	135.00	2.5105	2.5082	0.0024	0.6314	7.271031	4.591081	0.5362	19.71	74.0883	23.859
39.206	455.004	19.78	0.91	4.59	17.32	6.84374	5.27622	3.27716	6.80009	5.31009	3	135.00	2.53281	2.520143	0.0127	0.6299	7.602996	4.789302	0.53397	19.67	79.1712	23.806
39.534	454.676	20.68	0.93	4.48	18.01	7.15825	5.13102	3.25407	7.11481	5.16235	3	135.00	2.55495	2.532049	0.0229	0.6284	7.814492	4.91094	0.56115	20.57	77.2888	24.117
39.862	454.348	20.78	0.84	4.03	18.73	7.15536	4.61465	3.22705	7.11212	4.6427	4	135.00	2.57709	2.543956	0.0331	0.627	7.69793	4.826354	0.56356	20.67	75.1234	24.118
40.19	454.020	19.42	0.88	4.52	19.38	6.58125	5.23163	3.28913	6.5343	5.26922	3	135.00	2.59923	2.555862	0.0434	0.6255	7.526098	4.708868	0.52077	19.3	80.159	23.549
40.518	453.692	16.99	0.73	4.28	19.84	5.59577	5.08051	3.33962	5.54903	5.1233	3	135.00	2.62137	2.567768	0.0536	0.6241	6.843878	4.270948	0.44485	16.87	84.4156	22.454
40.846	453.364	16.52	0.38	2.28	21.46	5.37916	2.73844	3.20777	5.32489	2.76635	5	135.00	2.64351	2.579675	0.0638	0.6226	6.015767	3.745489	0.42961	16.38	73.6031	22.183
41.174	453.036	17.43	0.34	1.93	23.46	5.69704	2.30284	3.14792	5.63916	2.32648	6	135.00	2.66565	2.591581	0.0741	0.6212	6.084749	3.779725	0.4571	17.28	69.0136	22.571
41.502	452.708	22.29	0.68	3.06	24.25	7.52921	3.469	3.13915	7.46776	3.49754	5	135.00	2.68779	2.603488	0.0843	0.6198	7.745791	4.800517	0.60688	22.13	68.3574	24.466
41.83	452.380	19.58	0.73	3.74	20.72	6.4503	4.32719	3.24865	6.40059	4.36079	4	135.00	2.70993	2.615394	0.0945	0.6183	7.359357	4.550628	0.52229	19.45	76.8511	23.43
42.158	452.052	20.78	0.6	2.87	23.56	6.86938	3.32448	3.1617	6.8161	3.35047	5	135.00	2.73207	2.6273	0.1048	0.6169	7.337513	4.526828	0.55876	20.64	70.053	23.857
42.486	451.724	27.89	0.85	3.06	26.14	9.52399	3.38163	3.04802	9.45958	3.40466	5	135.00	2.75421	2.639207	0.115	0.6155	9.132647	5.6216	0.7782	27.72	61.7782	26.072
42.814	451.396	28.69	1.21	4.23	37.12	9.77463	4.66935	3.12299	9.68787	4.71117	4	135.00	2.77635	2.651113	0.1252	0.6142	9.852356	6.050983	0.80228	28.46	67.1585	26.236
43.143	451.067	21.75	0.81	3.73	40.41	7.11643	4.27408	3.214	7.02255	4.33122	4	135.00	2.79850	2.663056	0.1355	0.6128	7.931649	4.860415	0.58673	21.5	74.0922	24.069
43.471	450.739	22.78	0.69	3.01	41.96	7.46153	3.45703	3.14483	7.36059	3.50444	5	135.00	2.8207	2.674962	0.1457	0.6114	7.909522	4.836057	0.61794	22.51	68.7816	24.389
43.799	450.411	20.59	0.61	2.97	43.95	6.60515	3.43717	3.18878	6.50094	3.49227	5	135.00	2.84284	2.686869	0.156	0.6101	7.35876	4.489329	0.54945	20.31	72.126	23.557
44.127	450.083	23.42	1.1	4.71	47.39	7.61643	5.35149	3.24833	7.50897	5.42807	3	135.00	2.86498	2.698775	0.1662	0.6087	8.749722	5.32612	0.63638	23.13	76.8256	24.529
44.455	449.755	253.58	4.98	1.96	20.09	92.4833	1.96649	2.13724	92.4354	1.98753	8	135.00	2.88712	2.710682	0.1764	0.6074	52.62093	31.96092	7.76139	253.45	16.9566	40.151
44.783	449.427	555.99	13.9	2.5	-21.27	203.145	2.5132	1.99381	203.193	2.5126	12	135.00	2.90926	2.722588	0.1867	0.6061	109.1065	66.12409	17.1232	556.12	12.7619	44.134

13 / 48

R16578

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 14 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-2A

ConeTec Inc. Interpretation
Interpretation Release 1.22 Rev. Format: NLI Imperial

Run No: 07-1210-1008-4556
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-2A
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 14:50
CPT File: 804CP02A.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 492.4

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.34	1.38	45.43	22.11	2.23
125	Residual Soil	30.69	2.60	86.31	48.14	2.80

User Inputs:

Water Table Depth (ft): 37
Assumed: Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 492.4
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	492.236	8.72	0.08	0.86	0.23	817.011	0.919	1.31	817.01	0.92	5	130.00	0.011	0.011	0.000	2.000	1.35	2.71	0.270	8.72	0.48799	50.08
0.492	491.908	16.38	0.2	1.22	-0.05	511.195	1.223	1.51	511.20	1.22	6	130.00	0.032	0.032	0.000	2.000	2.71	5.43	0.508	16.38	3.02371	48.22
0.82	491.580	25.84	0.5	1.94	-0.39	483.803	1.939	1.70	483.80	1.94	6	130.00	0.053	0.053	0.000	2.000	4.56	9.11	0.798	25.84	5.11479	47.99
1.148	491.252	28.08	0.61	1.82	-0.21	378.307	1.821	1.73	375.31	1.82	6	130.00	0.075	0.075	0.000	2.000	5.00	10.01	0.867	28.08	6.6951	46.92
1.476	490.924	44.3	0.61	1.37	-0.26	460.747	1.380	1.58	460.75	1.38	7	130.00	0.096	0.096	0.000	2.000	7.50	15.01	1.369	44.3	4.05566	47.78
1.804	490.596	29.51	0.72	2.43	-0.14	250.663	2.450	1.93	250.66	2.45	6	130.00	0.117	0.117	0.000	2.000	5.66	11.31	0.910	29.51	11.2006	45.12
2.133	490.267	24.15	0.47	1.95	0.02	173.186	1.957	1.98	173.19	1.96	6	130.00	0.139	0.139	0.000	2.000	4.66	9.32	0.743	24.16	11.6289	43.36
2.461	489.939	20.69	0.35	1.67	-0.39	128.341	1.705	1.99	128.40	1.70	6	130.00	0.160	0.160	0.000	2.000	4.06	8.11	0.638	20.7	12.0808	41.87
2.789	489.611	29.8	0.44	1.46	-0.02	163.382	1.488	1.88	163.38	1.49	6	130.00	0.181	0.181	0.000	2.000	5.59	11.18	0.917	29.8	9.80656	43.08
3.117	489.283	30.73	0.22	0.72	0.05	150.674	0.721	1.68	150.67	0.72	7	130.00	0.203	0.203	0.000	2.000	5.99	10.77	0.945	30.73	5.79201	42.66
3.445	488.955	21.3	0.33	1.55	-0.07	94.1211	1.566	2.05	94.12	1.57	6	130.00	0.224	0.224	0.000	2.000	4.29	8.57	0.653	21.3	14.6052	40.24
3.773	488.627	26.89	0.22	0.82	-0.09	108.645	0.826	1.83	108.69	0.83	7	130.00	0.245	0.245	0.000	2.000	4.96	9.93	0.825	26.9	8.76744	41.01
4.101	488.299	18.61	0.35	1.84	0.07	69.5644	1.887	2.21	69.56	1.89	6	130.00	0.267	0.267	0.000	1.937	4.03	7.80	0.674	18.61	19.3515	38.59
4.429	487.971	43.41	0.31	0.72	0.16	149.789	0.719	1.68	149.79	0.72	7	130.00	0.288	0.288	0.000	1.864	7.61	14.19	1.335	43.41	5.8165	42.66
4.757	487.643	28.43	0.59	2.06	0.16	90.9455	2.098	2.16	90.95	2.10	6	130.00	0.309	0.309	0.000	1.798	5.06	10.73	0.8715	28.43	17.848	40.00
5.085	487.315	16	0.39	2.44	0.49	47.4078	2.489	2.41	47.41	2.49	5	130.00	0.331	0.331	0.000	1.739	3.74	6.51	0.486	16	27.0116	36.39
5.413	486.987	29.13	0.49	1.69	-0.72	61.7921	1.703	2.13	61.79	1.70	6	130.00	0.352	0.352	0.000	1.686	6.03	10.16	0.891	29.13	16.6865	39.46
5.741	486.659	49.67	0.79	1.59	-0.67	132.105	1.603	1.96	132.10	1.60	7	130.00	0.373	0.373	0.000	1.637	9.63	16.76	1.526	49.67	11.947	42.01
6.069	486.331	53.37	0.83	1.55	0.05	134.29	1.557	1.95	134.29	1.57	7	130.00	0.394	0.394	0.000	1.592	10.30	16.40	1.640	53.37	11.6576	42.10
6.398	486.002	49.98	0.63	1.26	-1.39	119.182	1.271	1.92	119.21	1.27	7	130.00	0.416	0.416	0.000	1.551	9.56	14.90	1.534	49.99	10.9396	41.49
6.726	485.674	38.17	0.52	1.35	-0.58	88.3076	1.378	2.05	88.31	1.38	7	130.00	0.437	0.437	0.000	1.512	7.65	11.67	1.168	38.17	14.3272	39.78
7.054	485.346	40.75	0.54	1.32	-0.74	87.8748	1.340	2.04	87.87	1.34	7	130.00	0.459	0.459	0.000	1.477	8.13	12.00	1.247	40.75	13.9337	39.87
7.382	485.018	37.01	0.6	1.62	-0.79	76.1316	1.642	2.14	76.15	1.64	7	130.00	0.480	0.480	0.000	1.444	7.70	11.11	1.131	37.02	17.0691	39.09
7.71	484.690	59.19	0.77	1.3	-0.23	117.108	1.312	1.94	117.11	1.31	7	130.00	0.501	0.501	0.000	1.413	11.37	16.06	1.817	59.19	11.3174	41.39
8.038	484.362	67.04	1.06	1.85	-0.25	108.174	1.876	2.07	108.17	1.88	7	130.00	0.522	0.522	0.000	1.383	11.53	16.96	1.760	67.04	14.9626	40.96
8.366	484.034	57.87	0.86	1.48	-0.53	105.42	1.500	2.01	105.44	1.50	7	130.00	0.544	0.544	0.000	1.356	11.43	15.60	1.775	57.88	13.2395	40.85
8.694	483.706	75.82	0.88	1.16	-0.74	133.169	1.169	1.86	133.19	1.17	8	130.00	0.565	0.565	0.000	1.330	14.16	18.84	2.330	75.83	9.50987	42.05
9.022	483.378	63.21	1.11	1.75	-0.44	106.788	1.772	2.06	106.79	1.77	7	130.00	0.586	0.586	0.000	1.306	12.71	16.60	1.939	63.21	14.6645	40.81
9.35	483.050	60.49	0.91	1.51	-0.93	98.5311	1.520	2.04	98.55	1.52	7	130.00	0.608	0.608	0.000	1.283	12.06	15.47	1.854	60.5	13.9359	40.49
9.678	482.722	64.51	0.83	1.28	-1.11	101.548	1.299	1.98	101.56	1.30	7	130.00	0.629	0.629	0.000	1.261	12.59	15.87	1.978	64.52	12.4093	40.86
10.006	482.394	80.55	1.03	1.28	-0.85	122.849	1.289	1.92	122.86	1.29	8	130.00	0.650	0.650	0.000	1.240	15.35	19.04	2.474	80.56	10.8105	41.64
10.335	482.065	67.71	1.38	2.04	-0.64	99.7927	2.059	2.12	99.79	2.06	7	130.00	0.672	0.672	0.000	1.220	13.99	17.07	2.075	67.71	16.6727	40.56
10.663	481.737	66.47	1.17	1.76	-0.6	94.9032	1.779	2.10	94.90	1.78	7	130.00	0.693	0.693	0.000	1.201	13.67	16.90	2.038	66.47	15.6621	40.29
10.991	481.409	56.44	0.72	1.28	-0.88	78.0017	1.292	2.06	78.00	1.29	7	130.00	0.714	0.714	0.000	1.183	11.36	13.47	1.725	56.44	14.7573	39.22
11.319	481.081	53.65	0.58	1.08	-0.95	71.9203	1.096	2.05	71.93	1.10	7	130.00	0.736	0.736	0.000	1.166	10.75	12.53	1.638	53.66	14.2461	38.78
11.647	480.753	39.63	0.46	1.16	-1.11	51.3476	1.163	2.18	51.36	1.18	7	130.00	0.757	0.757	0.000	1.149	8.39	9.84	1.203	39.64	18.4421	36.86
11.975	480.425	34.17	0.51	1.48	-1.16	42.8991	1.527	2.31	42.91	1.53	7	130.00	0.778	0.778	0.000	1.133	7.84	8.66	1.034	34.18	22.9801	35.80
12.303	480.097	26.58	0.35	1.33	-1.02	31.9876	1.368	2.39	31.99	1.37	6	130.00	0.800	0.800	0.000	1.118	6.10	6.82	0.792	26.38	25.9069	34.01
12.631	479.769	31.58	0.43	1.35	-1.16	37.4646	1.396	2.34	37.48	1.40	7	130.00	0.821	0.821	0.000	1.104	7.14	7.88	0.952	31.59	23.9035	34.98
12.959	479.441	33.88	0.34	0.99	-1.04	39.2215	1.029	2.24	39.23	1.03	7	130.00	0.842	0.842	0.000	1.090	7.36	8.02	1.023	33.89	20.5322	35.26
13.287	479.113	40.82	0.47	1.14	-0.55	46.2642	1.178	2.22	46.26	1.18	7	130.00	0.864	0.864	0.000	1.076	8.76	9.43	1.237	40.82	19.8264	36.24
13.615	478.785	40.88	0.48	1.18	-0.62	45.1934	1.200	2.23	45.19	1.20	7	130.00	0.885	0.885	0.000	1.063	8.83	9.38	1.238	40.88	20.0856	36.10
13.943	478.457	67.39	0.84	1.25	-0.51	73.3577	1.263	2.08	73.36	1.26	7	130.00	0.906	0.906	0.000	1.050	13.67	14.36	2.058	67.39	15.1748	38.88
14.271	478.129	83.33	1.06	1.27	-0.49	88.8326	1.286	2.02	88.83	1.29	8	130.00	0.928	0.928	0.000	1.038	16.92	17.76	2.561	83.33	13.6068	39.93
14.6	477.800	84.96	0.88	1.03	-0.44	88.5268	1.047	1.96	88.53	1.05	8	130.00	0.949	0.949	0.000	1.027	16.48	16.92	2.601	84.96	11.9944	39.91
14.928	477.472	62.57	1.08	1.72	-0.55	63.4839	1.753	2.22	63.48	1.75	7	130.00	0.970	0.970	0.000	1.016	13.44	13.64	1.907	62.57	19.6287	38.07
15.256	477.144	54.17	0.79	1.46	-0.62	53.6267	1.486	2.23	53.64	1.49	7	130.00	0.992	0.992	0.000	1.004	11.68	11.73	1.646	54.18	19.9668	37.11

R16580

Depth (ft)	Sam (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...tress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	476.816	44.07	0.61	1.38	-0.69	42.5062	1.417	2.30	42.52	1.42	7	130.00	1.013	1.013	0.000	0.994	9.78	9.72	1.333	44.08	22.369	35.74
15.912	476.488	48.55	0.7	1.45	-0.59	45.9409	1.473	2.28	45.94	1.47	7	130.00	1.034	1.034	0.000	0.983	10.70	10.62	1.471	48.55	21.7636	36.20
16.24	476.160	44.39	0.49	1.11	-0.51	41.0519	1.131	2.25	41.06	1.13	7	130.00	1.056	1.056	0.000	0.973	9.67	9.41	1.342	44.4	20.757	35.63
16.568	475.832	49.03	0.37	0.75	-0.55	44.528	0.772	2.13	44.53	0.77	8	130.00	1.077	1.077	0.000	0.964	10.16	9.79	1.485	49.03	18.7768	36.02
16.896	475.504	41.84	0.47	1.13	-0.34	37.0973	1.154	2.29	37.10	1.15	7	130.00	1.099	1.098	0.000	0.954	9.27	8.85	1.261	41.84	22.2493	34.92
17.224	475.176	36.67	0.81	2.21	-0.18	31.7539	2.278	2.52	31.75	2.28	6	130.00	1.120	1.120	0.000	0.945	9.03	8.53	1.101	36.67	31.6967	33.98
17.552	474.848	53.97	0.73	1.35	-0.44	46.3056	1.382	2.26	46.31	1.38	7	130.00	1.141	1.141	0.000	0.936	11.79	11.04	1.636	53.98	21.0557	36.25
17.88	474.520	91.09	1.68	1.85	-0.88	77.3772	1.868	2.17	77.38	1.87	7	130.00	1.162	1.162	0.000	0.928	19.20	17.81	2.764	91.09	18.1251	39.18
18.208	474.192	100.89	2.85	2.82	-1.27	84.2467	2.85839	2.27913	84.2642	2.8581	6	130.00	1.18352	1.18352	0	0.9192	22.22949	20.43346	3.06669	100.9	21.7659	39.649
18.537	473.863	79.53	2.26	2.84	-0.71	66.0052	2.88541	2.35986	66.0052	2.88541	6	130.00	1.20491	1.204905	0	0.911	18.16282	16.53742	2.42493	79.53	24.8046	38.206
18.865	473.535	60.94	1.2	1.97	-0.49	48.6972	2.00959	2.3448	48.6972	2.00959	7	130.00	1.22623	1.226225	0	0.9031	13.81554	12.47621	1.84872	60.94	24.2101	36.645
19.193	473.207	41.14	0.68	1.66	-0.56	31.9768	1.70458	2.44317	31.9768	1.70458	7	130.00	1.24755	1.247545	0	0.8959	9.752974	8.781904	1.23506	41.14	28.207	34.008
19.521	472.879	43.98	0.41	0.92	-0.85	33.6609	0.96994	2.28476	33.6609	0.95994	7	130.00	1.26887	1.268865	0	0.8878	9.712904	8.622663	1.32233	43.98	21.9609	34.324
19.849	472.551	44.49	0.5	1.13	-0.23	33.4834	1.15741	2.33046	33.4834	1.15741	7	130.00	1.29019	1.290165	0	0.8804	10.02335	8.824497	1.33748	44.49	23.6666	34.992
20.177	472.223	60.56	0.75	1.23	-0.23	45.176	1.26585	2.24572	45.176	1.26585	7	130.00	1.31151	1.311605	0	0.8732	13.15276	11.48502	1.83432	60.56	20.583	36.102
20.505	471.895	62.15	0.84	1.35	-0.37	45.6303	1.38119	2.26465	45.6378	1.38096	7	130.00	1.33283	1.332825	0	0.8662	13.60969	11.78858	1.88288	62.16	21.234	36.162
20.833	471.567	58.16	0.81	1.4	-0.14	41.9496	1.42591	2.30229	41.9496	1.42591	7	130.00	1.35415	1.354145	0	0.8593	12.84251	11.12207	1.7587	58.16	22.8062	35.66
21.161	471.239	61.14	0.98	1.6	-0.23	43.4504	1.63977	2.32698	43.4504	1.63977	7	130.00	1.37547	1.375465	0	0.8527	13.75845	11.7727	1.8503	61.14	23.5343	35.87
21.489	470.911	58.39	1.21	2.08	-0.09	40.8031	2.12306	2.4187	40.8031	2.12306	7	130.00	1.39679	1.396785	0	0.8461	13.66718	11.58104	1.7645	58.39	27.1802	35.494
21.817	470.583	68.58	1.4	2.05	-0.21	47.3603	2.08452	2.36412	47.3603	2.08452	7	130.00	1.41811	1.418105	0	0.8397	15.68834	13.16995	2.07932	68.58	24.9725	36.381
22.145	470.255	62.38	1.27	2.03	-0.14	42.3367	2.064	2.40123	42.3367	2.064	7	130.00	1.43943	1.439425	0	0.8335	14.50622	12.09093	1.88671	62.38	26.4611	36.715
22.473	469.927	56.41	1.04	1.85	-0.23	37.6173	1.89266	2.4147	37.6173	1.89266	7	130.00	1.46075	1.460745	0	0.8274	13.19879	10.92061	1.70122	56.41	27.0145	35.003
22.802	469.598	43.25	0.55	1.27	-0.21	28.181	1.3168	2.42392	28.181	1.3168	7	130.00	1.48213	1.482135	0	0.8214	10.16202	8.347122	1.29312	43.25	27.3931	33.22
23.13	469.270	47.18	0.49	1.04	-0.09	30.3812	1.07276	2.34808	30.3812	1.07276	7	130.00	1.50345	1.50345	0	0.8158	10.7128	8.736769	1.41413	47.18	24.3461	33.69
23.458	468.942	41.56	0.66	1.58	-0.04	26.2566	1.64855	2.50417	26.2566	1.64855	7	130.00	1.52477	1.52477	0	0.8098	10.13933	8.21121	1.23948	41.56	30.8699	32.775
23.786	468.614	33	0.65	1.96	0.16	20.3442	2.06652	2.65128	20.3442	2.06652	6	130.00	1.54609	1.54609	0	0.8042	8.66873	6.963648	0.97881	33	37.6169	31.141
24.114	468.286	31.46	0.73	2.33	0.09	19.0713	2.44208	2.71649	19.0713	2.44208	6	130.00	1.56741	1.567405	0	0.7987	8.540436	6.821639	0.92547	31.46	41.3365	30.721
24.442	467.958	28.46	0.84	2.94	-0.07	16.9137	3.12602	2.82253	16.9137	3.12602	6	130.00	1.58873	1.58873	0	0.7934	8.186954	6.498271	0.83193	28.46	47.3052	29.934
24.77	467.630	36.73	0.76	2.06	0.19	21.813	2.16401	2.63841	21.813	2.16401	6	130.00	1.61005	1.610055	0	0.7881	9.574187	7.545399	1.0873	36.73	37.2639	31.591
25.098	467.302	53.09	0.84	1.58	-0.04	31.5432	1.63238	2.49684	31.5432	1.63238	7	130.00	1.63137	1.631375	0	0.7829	12.54912	9.826098	1.58315	53.09	27.9392	33.923
25.426	466.974	37.37	0.93	2.48	0.02	21.6116	2.60378	2.68975	21.6116	2.60378	6	130.00	1.65269	1.65269	0	0.7779	10.00281	7.880841	1.1058	37.37	39.9116	31.631
25.754	466.646	29.67	0.83	2.8	0.05	16.7239	2.96471	2.81252	16.7239	2.96471	5	130.00	1.67401	1.67401	0	0.7729	8.467242	6.559754	0.86675	29.67	46.7198	29.86
26.082	466.318	29.89	0.72	2.4	0.04	16.6308	2.55367	2.77598	16.6308	2.55367	6	130.00	1.69533	1.69533	0	0.768	8.378865	6.435141	0.8729	29.89	44.6215	29.823
26.41	465.990	40.76	0.67	1.65	0.51	22.7439	1.71604	2.56534	22.7439	1.71604	7	130.00	1.71665	1.71665	0	0.7632	10.24312	7.817922	1.20877	40.76	33.6905	31.86
26.739	465.661	31.14	0.85	2.72	0.6	16.9168	2.89096	2.80197	16.9168	2.89096	6	130.00	1.73804	1.738035	0	0.7585	8.655459	6.67171	0.91028	31.14	46.1075	29.935
27.067	465.333	27.6	0.95	3.45	0.11	14.6876	3.67638	2.91406	14.6876	3.67638	5	130.00	1.75936	1.759355	0	0.7539	8.370606	6.310738	0.80002	27.6	52.8706	29
27.395	465.005	20.8	0.75	3.59	0.09	10.681	3.94336	3.04266	10.681	3.94336	5	130.00	1.78068	1.780675	0	0.7494	6.829167	5.117707	0.58883	20.8	61.4043	26.663
27.723	464.677	32.97	0.92	2.78	0.41	17.2984	2.95174	2.79991	17.2908	2.95269	6	130.00	1.802	1.801995	0	0.7449	9.382277	6.974365	0.99495	32.96	45.9884	30.079
28.051	464.349	34.02	0.76	2.2	0.56	17.6583	2.32943	2.73173	17.6528	2.33016	6	130.00	1.82332	1.823315	0	0.7406	9.30799	6.893266	0.9868	34.01	42.1628	30.215
28.379	464.021	30.26	0.66	1.86	0.39	15.3989	1.97146	2.73942	15.3989	1.97146	6	130.00	1.84464	1.844635	0	0.7363	8.313189	6.120845	0.87842	30.26	42.5839	29.314
28.707	463.693	26.45	0.54	2.03	0.44	13.175	2.19855	2.82207	13.1697	2.19744	6	130.00	1.86596	1.865955	0	0.732	7.603892	5.56654	0.76112	26.44	47.2761	28.272
29.035	463.365	35.65	0.64	1.79	0.42	17.8897	1.89558	2.67583	17.8897	1.89558	6	125.00	1.88728	1.887275	0	0.7279	9.473402	6.695859	1.04529	35.65	39.1825	30.303
29.363	463.037	31.91	0.9	2.81	0.93	15.7263	2.99978	2.83696	15.7263	2.99978	6	125.00	1.90778	1.907775	0	0.724	9.254513	6.700235	0.92886	31.91	48.1574	29.453
29.691	462.709	76.81	1.79	2.27	-13.37	39.8707	2.32825	2.45145	39.9174	2.32553	7	125.00	1.92828	1.928275	0	0.7201	18.77676	13.52185	2.38024	78.9	28.5599	35.362
30.019	462.381	75.42	2.46	3.26	-19.88	37.7012	3.34825	2.57393	37.7628	3.34279	6	125.00	1.94878	1.948775	0	0.7163	19.06391	13.65624	2.27465	75.54	34.0988	35.027
30.347	462.053	73.52	2.38	3.23	-21.24	36.3335	3.32631	2.58372	36.3998	3.32028	6	125.00	1.96928	1.969275	0	0.7126	18.67716	13.30937	2.21519	73.65	34.5679	34.803
30.675	461.725	61.35	2.05	3.35	-21.62	29.8326	3.45349	2.65802	29.903	3.44537	6	125.00	1.98978	1.989775	0	0.7089	16.19004	11.47746	1.83778	61.49	38.2614	33.591
31.004	461.396	28.32	1.36	4.8	-15.93	13.0872	5.1692	3.04324	13.1369	5.14963	3	125.00	2.01034	2.010338	0	0.7053	9.334539	6.583523	0.81454	28.42	61.4453	28.256
31.332	461.068	40.8	1.24	3.05	-12.77	19.0902	3.19842	2.78585	19.1296	3.19183	6	125.00	2.03084	2.030838	0	0.7017	11.52195	8.085156	1.20028	40.88	45.182	30.741
31.66	460.740	44.64	1.36	3.05	-16.6	20.7614	3.19334	2.75656	20.815	3.18511	6	125.00	2.05134	2.051338	0	0.6982	12.41234	8.66633	1.31853	44.75	43.5317	31.289
31.988	460.412	35.89	0.92	2.56	-16.6	16.3228	2.72043	2.79674	16.3759	2.71161	6	125.00	2.07184	2.071638	0	0.6947	10.20784	7.091796	1.047	36	45.8061	29.721
32.316	460.084	41.49	0.76	1.84	-15.52	18.8295	1.92905	2.6602	18.8773	1.92416	6	125.00	2.09234	2.092338	0	0.6913	10.96277	7.578869	1.21974	41.59	38.3734	30.654
32.644	459.756	44.62	0.87	1.94	-15.36	20.1185	2.04671	2.6514	20.1658	2.04191	6	125.00	2.11284	2.112838	0	0.688	11.73457	8.072984	1.31601	44.72	37.9227	31.084
32.972	459.428	46.81	0.97	2.07	-12.68	20.9421	2.17116	2.65248	20.9796	2.16728	6	125.00	2.13334	2.133338	0	0.6847	12.31082	8.428633	1.38318	46.89	37.978	31.34
33.3	459.100	34.78	0.63	1.82	-11.57	15.1479	1.93097	2.73912	15.1804	1.92683	6	125.00	2.15384	2.153838	0	0.6814	9.575763	6.524796	1.0101	34.85	42.5673	29.219
33.628	458.772	27.97	0.53	1.88	-11.11	11.8637	2.05461	2.84249	11.8959	2.04905	6	125.00	2.17434	2.174338	0	0.6782	8.157752	5.532317	0.79863	28.04	48.487	27.59
33.956	458.444	25.2	0.51	2.03	-10.93	10.4815	2.21689	2.90541	10.5134	2.21017	6	125.00	2.19484	2.194838	0	0.675	7.62481	5.146688	0.71223	25.27	52.3352	26.756
34.284	458.116	23.12	0.44	1.91	-10.81	9.43633	2.10479	2.93186	9.46793	2.09777	6	125.00	2.21534	2.215338	0	0.6719	7.108146	4.775693	0.6472	23.19	54.0101	26.047
34.612	457.788	24.88	0.56	2.24	-10.49	10.1278	2.47304	2.94368	10.1591	2.46542	6	125.00	2.23584	2.235838	0	0.6686	7.702224	5.151053	0.70106	24.95	54.7701	26.525
34.941	457.459	27.6	0.74	2.67	-10.42	11.2319	2.91987	2.94724	11.2585	2.91297	6	125.00	2.2564	2.2564	0	0.6657	8.557203	5.696706	0.78463	27.66	55.0001	27.219
35.269	457.131	22.71	0.58	2.56	-10.21	8.97409	2.83853	3.02029	9.00483	2.82884	5	125.00	2.2769	2.2769	0	0.6627	7.373349	4.886443	0.6326	22.78	59.8616	25.707
35.597	456.803	20.39	0.5	2.46	-9.49	7.87525	2.76356	3.06177	7.89701	2.75594	5	125.00	2.2974	2.2974	0	0.6598	6.794369	4.482609	0.56014	20.44	62.7431	24.816
35.925	456.475	20.1	0.58	2.89	-8.69	7.67164	3.26171	3.1108	7.69321	3.25256	5	125.00	2.3179	2.3179	0	0.6568	6.918507	4.54428	0.55053	20.15	66.264	24.639
36.253	456.147	21.46	0.65	3.04	-5.91	8.17722	3.3993	3.09836	8.19432	3.3922	5	125.00	2.3384	2.3384	0	0.6539	7.320835	4.787417	0.592	21.5	65.3582	25.067
36.581	455.819	18.81	0.64	3.38	-5.48	6.97406	3.89032	3.18867	6.98677	3.88324	5	125.00	2.3589	2.3589	0	0.6511	6.8256	4.444123	0.50932	18.84	72.1173	23.985
36.909	455.491	18.56	0.68	3.67	-4.62	6.80029	4.20256	3.21677	6.81289	4.19479	4	125.00	2.3794	2.3794	0	0.6483	6.871849	4.45492	0.50095	18.59	74.3104	23.814
37.237	455.163	16.65	0.84	5.06	-4.85	5.95614	5.8947	3.34912	5.96868	5.88231	3	135.00	2.3999	2.392506	0.0074	0.6465	6.818186	4.408008	0.44118	16.68	85.2328	22.923
37.565	454.835	18.46	0.76	4.13	-5.01	6.67022	4.73676	3.25373	6.6827	4.72991	4	135.00	2.42204	2.404412	0.0176	0.6449	7.022524	4.528859	0.49653	18.49	77.2612	23.691

R16581

Depth (ft)	Sa... (ft)	AvgQI (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.W... (pcf)	...Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.093	454.507	17.57	0.66	3.77	-4.48	6.25986	4.3634	3.25552	6.27228	4.35476	4	135.00	2.44418	2.416318	0.0279	0.6433	6.693405	4.30596	0.46829	17.6	77.4062	23.267
38.221	454.179	23.26	0.72	3.08	-3.6	8.56333	3.46259	3.08679	8.57568	3.4576	5	135.00	2.46632	2.428225	0.0381	0.6417	7.869741	5.050286	0.64377	23.29	64.5241	25.388
38.549	453.851	35.17	1.71	4.86	-4.65	13.3934	5.23231	3.04061	13.4056	5.22751	3	135.00	2.48846	2.440131	0.0483	0.6402	11.54187	7.388724	1.01181	35.2	61.2619	28.401
38.877	453.523	74.79	4.27	5.7	-12.75	29.4773	5.90763	2.82205	29.5099	5.9011	11	135.00	2.5106	2.452038	0.0586	0.6386	21.5316	13.75032	2.23775	74.87	47.2766	33.514
39.206	453.194	104.68	6.22	5.94	-19.79	41.4562	6.08925	2.72869	41.5049	6.08211	11	135.00	2.53281	2.46398	0.0688	0.6371	28.63555	18.24261	3.16245	104.8	41.9974	35.6
39.534	452.866	152.53	8.46	5.55	-19.17	60.5743	5.64094	2.59462	60.6227	5.63643	11	135.00	2.55495	2.475887	0.0791	0.6355	38.92148	24.73568	4.64319	152.65	35.0952	37.815
39.862	452.538	232.67	10.79	4.64	-19.12	92.4888	4.68941	2.41592	92.533	4.68717	11	135.00	2.57709	2.487793	0.0893	0.634	54.49618	34.55087	7.12362	232.78	27.0649	40.155
40.19	452.210	391.32	13.96	3.57	-18.27	155.507	3.59127	2.18739	155.551	3.59025	12	135.00	2.59923	2.4997	0.0995	0.6325	82.95769	52.47014	12.0347	391.43	18.574	42.835
40.518	451.882	504.54	14.95	2.96	-19.14	199.84	2.97857	2.05825	199.888	2.97786	12	135.00	2.62137	2.511606	0.1098	0.631	101.5206	64.05876	15.5393	504.66	14.5769	44.055
40.846	451.554	352.83	14.47	4.1	7.69	138.769	4.13208	2.26597	138.754	4.13256	12	135.00	2.64351	2.523512	0.12	0.6295	77.28576	48.65156	10.8417	352.79	21.2814	42.264
41.174	451.226	428.29	14.1	3.29	55.96	167.871	3.31278	2.14021	167.733	3.31551	12	135.00	2.66565	2.536419	0.1302	0.628	88.95563	55.86613	13.1772	427.94	17.0501	43.207

R16582

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 18 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY TJS DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-3

ConeTec Inc. Interpretation
Interpretation Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4528
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-3
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 07:09
CPT File: 804CP03.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 466.98

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	36.95	1.32	43.13	32.39	2.49

User Inputs:
Assumed: Water Table Depth (ft): 11.1
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 467.0
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	466.816	22.8	0.36	1.56	-0.74	2223.39	1.580	1.42	2224.37	1.58	6	125.00	0.010	0.010	0.000	2.000	3.67	7.34	0.706	22.81	1.81602	53.62
0.492	466.488	42.45	0.67	1.58	-5.17	1379.49	1.579	1.46	1380.46	1.58	7	125.00	0.031	0.031	0.000	2.000	6.91	13.82	1.313	42.48	2.23467	52.00
0.82	466.160	28.94	0.66	2.29	-5.45	563.683	2.285	1.73	564.27	2.28	6	125.00	0.051	0.051	0.000	2.000	5.17	10.34	0.894	28.97	6.77422	48.62
1.148	465.832	23.43	0.46	1.97	-7.27	325.551	1.969	1.79	326.25	1.97	6	125.00	0.072	0.072	0.000	2.000	4.27	8.55	0.723	23.48	7.91559	46.30
1.476	465.504	32.54	0.58	1.77	-11.34	351.737	1.787	1.74	352.50	1.78	6	125.00	0.092	0.092	0.000	2.000	5.82	11.65	1.005	32.61	6.82459	46.64
1.804	465.176	38.02	0.94	2.47	-4.06	336.206	2.480	1.87	336.38	2.48	6	125.00	0.113	0.113	0.000	2.000	7.12	14.25	1.174	38.04	9.67104	46.44
2.133	464.847	36.81	1.27	3.46	-2.93	275.118	3.463	2.04	275.27	3.46	5	125.00	0.133	0.133	0.000	2.000	7.35	14.70	1.136	36.83	14.0176	45.54
2.461	464.519	32.44	1.88	5.81	-1.76	209.906	5.823	2.29	209.97	5.82	3	125.00	0.154	0.154	0.000	2.000	7.19	14.38	1.000	32.45	22.2623	44.29
2.789	464.191	33.21	1.93	5.82	-0.93	189.52	5.842	2.32	189.58	5.84	3	125.00	0.174	0.174	0.000	2.000	7.44	14.88	1.023	33.22	23.1469	43.80
3.117	463.863	41.98	2.26	5.38	1.78	214.489	5.409	2.26	214.44	5.41	3	125.00	0.195	0.195	0.000	2.000	9.17	18.36	1.294	41.97	21.0994	44.39
3.445	463.535	51.02	2.5	4.89	1.36	235.958	4.921	2.20	235.91	4.92	4	125.00	0.215	0.215	0.000	2.000	10.89	21.78	1.573	51.01	19.1479	44.83
3.773	463.207	61.43	2.63	4.28	0.26	259.504	4.298	2.13	259.46	4.30	5	125.00	0.236	0.236	0.000	2.000	12.73	25.46	1.895	61.42	16.8244	45.27
4.101	462.879	66.35	2.47	3.72	5.77	257.864	3.737	2.08	257.71	3.74	5	125.00	0.256	0.256	0.000	1.975	13.47	26.60	2.046	66.31	15.2758	45.24
4.429	462.551	70.01	2.46	3.51	-1.2	251.915	3.528	2.07	251.91	3.53	6	125.00	0.277	0.277	0.000	1.901	14.12	26.84	2.159	70.01	14.7869	45.14
4.757	462.223	47.34	1.98	4.19	4.97	158.226	4.209	2.24	158.09	4.21	5	125.00	0.297	0.297	0.000	1.834	10.25	18.80	1.456	47.3	20.3659	42.91
5.085	461.895	35.26	1.25	3.54	14.76	109.946	3.577	2.28	109.66	3.59	5	125.00	0.318	0.318	0.000	1.774	7.75	13.74	1.092	35.17	21.7542	41.05
5.413	461.567	29.45	1.07	3.63	14.25	86.0497	3.675	2.36	85.78	3.69	5	125.00	0.338	0.338	0.000	1.719	6.69	11.50	0.901	29.36	24.6747	39.74
5.741	461.239	22.73	0.72	3.15	18.2	62.3478	3.218	2.41	62.01	3.24	5	125.00	0.359	0.359	0.000	1.669	5.28	8.81	0.693	22.61	26.8102	37.94
6.069	460.911	20.62	0.5	2.43	23.72	53.3615	2.470	2.38	52.97	2.49	5	125.00	0.379	0.379	0.000	1.624	4.71	7.85	0.627	20.47	25.5653	37.04
6.398	460.582	23.44	0.52	2.22	51.64	57.6183	2.257	2.33	56.82	2.29	6	125.00	0.400	0.400	0.000	1.581	5.21	8.24	0.713	23.12	23.7246	37.44
6.726	460.254	16.44	0.47	2.84	44.02	38.1079	2.934	2.54	37.44	2.99	5	125.00	0.420	0.420	0.000	1.542	4.02	6.20	0.496	16.16	32.6769	34.97
7.054	459.926	14.75	0.41	2.79	45.61	32.4562	2.865	2.59	31.82	2.92	5	125.00	0.441	0.441	0.000	1.506	3.68	5.65	0.443	14.47	34.9073	33.98
7.382	459.598	17.38	0.43	2.45	47.02	36.67	2.542	2.52	36.04	2.59	5	125.00	0.461	0.461	0.000	1.472	4.19	6.17	0.524	17.09	31.3627	34.74
7.71	459.270	18.54	0.47	2.51	37.83	37.4747	2.603	2.51	36.98	2.64	5	125.00	0.482	0.482	0.000	1.441	4.48	6.46	0.559	18.3	31.2347	34.90
8.038	458.942	19.4	0.5	2.58	37.94	37.6166	2.646	2.52	37.16	2.66	5	125.00	0.502	0.502	0.000	1.411	4.70	6.63	0.585	19.17	31.3584	34.93
8.366	458.614	17.21	0.55	3.2	34.73	31.9142	3.296	2.63	31.49	3.34	5	125.00	0.523	0.523	0.000	1.383	4.41	6.11	0.517	16.99	36.9521	33.91
8.694	458.286	17.95	0.56	3.1	31.31	32.0343	3.217	2.62	31.68	3.25	5	125.00	0.543	0.543	0.000	1.357	4.59	6.23	0.539	17.76	36.4732	33.95
9.022	457.958	19.33	0.57	2.93	27.69	33.2806	3.037	2.59	32.98	3.07	5	125.00	0.564	0.564	0.000	1.332	4.88	6.50	0.581	19.16	34.995	34.20
9.35	457.630	18.87	0.64	3.4	23.97	31.2909	3.500	2.65	31.03	3.53	5	125.00	0.584	0.584	0.000	1.308	4.92	6.43	0.566	18.72	37.9977	33.82
9.678	457.302	20.7	0.61	2.95	26.23	33.2219	3.036	2.59	32.94	3.06	6	125.00	0.605	0.605	0.000	1.286	5.23	6.72	0.622	20.53	34.9967	34.19
10.006	456.974	20.8	0.74	3.57	10.97	32.26	3.668	2.65	32.15	3.66	5	125.00	0.625	0.625	0.000	1.265	5.45	6.89	0.625	20.73	36.0423	34.04
10.335	456.645	22.06	0.78	3.52	8.13	33.1519	3.642	2.64	33.07	3.65	5	125.00	0.646	0.646	0.000	1.244	5.75	7.15	0.663	22.01	37.4577	34.22
10.663	456.317	22.26	0.84	3.76	9.06	32.4015	3.890	2.67	32.31	3.90	4	125.00	0.666	0.666	0.000	1.225	5.88	7.20	0.669	22.2	38.8361	34.07
10.991	455.989	22.23	0.86	3.88	10.07	31.361	3.992	2.69	31.27	4.00	4	135.00	0.687	0.687	0.000	1.207	5.93	7.15	0.667	22.17	39.7776	33.87
11.319	455.661	19.23	0.81	4.2	10.53	26.3739	4.373	2.77	26.27	4.39	4	135.00	0.709	0.702	0.007	1.193	5.35	6.39	0.573	19.16	44.2873	32.76
11.647	455.333	18	0.62	3.43	12.28	24.1809	3.590	2.74	24.07	3.61	5	135.00	0.731	0.714	0.017	1.183	4.93	5.84	0.535	17.92	42.7427	32.23
11.975	455.005	21.25	0.62	2.92	16.42	28.2301	3.025	2.64	28.09	3.04	5	135.00	0.753	0.726	0.027	1.174	5.53	6.49	0.635	21.15	37.4988	33.21
12.303	454.677	21.1	0.8	3.8	12.7	27.5413	3.936	2.73	27.43	3.95	4	135.00	0.775	0.738	0.038	1.164	5.73	6.67	0.629	21.02	41.8264	33.06
12.631	454.349	17.94	0.7	3.88	13.37	22.8604	4.083	2.80	22.74	4.11	4	135.00	0.798	0.750	0.048	1.155	5.06	5.86	0.531	17.85	45.8564	31.88
12.959	454.021	16.67	0.53	3.19	25.01	20.8069	3.344	2.78	20.60	3.38	5	135.00	0.820	0.762	0.058	1.146	4.63	5.30	0.491	16.51	44.6307	31.24
13.287	453.693	17.08	0.47	2.76	28.87	20.988	2.894	2.73	20.76	2.93	5	135.00	0.842	0.774	0.068	1.137	4.63	5.27	0.503	16.9	42.3273	31.30
13.615	453.365	15.98	0.45	2.79	32.33	19.2415	2.977	2.77	18.99	3.02	5	135.00	0.864	0.786	0.078	1.128	4.42	4.98	0.468	15.78	44.472	30.73
13.943	453.037	17	0.42	2.45	36.95	20.2055	2.606	2.72	19.92	2.64	5	135.00	0.886	0.797	0.089	1.120	4.57	5.11	0.499	16.77	41.6351	31.04
14.271	452.709	20.35	0.53	2.61	41.32	24.0198	2.726	2.67	23.70	2.76	5	135.00	0.908	0.809	0.099	1.112	5.33	5.93	0.602	20.09	39.0883	32.16
14.6	452.380	24.99	0.7	2.79	53.19	29.2928	2.909	2.63	28.89	2.95	5	135.00	0.931	0.821	0.109	1.103	6.39	7.05	0.745	24.66	36.6088	33.40
14.928	452.052	25.84	0.92	3.55	51.01	29.8677	3.697	2.69	29.48	3.74	5	135.00	0.953	0.833	0.119	1.095	6.82	7.47	0.771	25.52	39.7482	33.53
15.256	451.724	25.35	0.86	3.38	59.49	28.841	3.528	2.69	28.40	3.58	5	135.00	0.975	0.845	0.130	1.088	6.67	7.26	0.755	24.98	39.714	33.30

Depth (ft)	Sam. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	..ress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	451.396	25.2	0.94	3.72	60.14	28.2395	3.884	2.72	27.80	3.95	5	135.00	0.997	0.857	0.140	1.080	6.75	7.29	0.749	24.82	41.5723	33.17
15.912	451.068	23.53	0.87	3.69	59.12	25.9052	3.865	2.75	25.48	3.93	5	135.00	1.019	0.869	0.150	1.073	6.39	6.86	0.697	23.16	43.0523	32.63
16.24	450.740	24.42	0.79	3.22	95.41	26.5403	3.379	2.71	25.87	3.47	5	135.00	1.041	0.881	0.160	1.065	6.44	6.86	0.724	23.83	40.8417	32.73
16.568	450.412	23.13	0.79	3.4	93.16	24.7167	3.580	2.75	24.07	3.68	5	135.00	1.063	0.893	0.171	1.058	6.22	6.59	0.683	22.55	43.0416	32.27
16.896	450.084	25.8	0.86	3.32	86.21	27.3182	3.480	2.70	26.73	3.56	5	135.00	1.086	0.905	0.181	1.051	6.81	7.16	0.765	25.27	40.6511	32.94
17.224	449.756	27.36	1.09	3.99	68.75	28.6411	4.152	2.74	28.17	4.22	4	135.00	1.108	0.917	0.191	1.045	7.39	7.72	0.813	26.93	42.4068	33.26
17.552	449.428	23.92	1.23	5.16	49.52	24.5451	5.397	2.86	24.21	5.47	3	135.00	1.130	0.929	0.201	1.038	6.94	7.20	0.706	23.61	49.6011	32.32
17.88	449.100	22.38	1.09	4.86	39.24	22.5732	5.135	2.87	22.31	5.20	3	135.00	1.152	0.940	0.212	1.031	6.55	6.75	0.657	22.13	50.2616	31.80
18.208	448.772	17.75	0.82	4.63	24.36	17.4059	4.947	2.94	17.25	4.99	3	135.00	1.174	0.952	0.222	1.025	5.43	5.57	0.513	17.6	54.7916	30.15
18.537	448.443	16.18	0.53	3.25	29.47	15.5391	3.537	2.89	15.36	3.58	5	135.00	1.196	0.964	0.232	1.018	4.79	4.88	0.464	16	51.4876	29.40
18.865	448.115	16.38	0.38	2.32	30.44	15.5318	2.506	2.80	15.34	2.54	5	135.00	1.218	0.976	0.242	1.012	4.61	4.66	0.469	16.19	46.1677	29.39
19.193	447.787	17.22	0.42	2.44	41.84	16.1723	2.628	2.80	15.91	2.67	5	135.00	1.241	0.988	0.253	1.006	4.83	4.86	0.495	16.96	46.1732	29.64
19.521	447.459	27.26	0.55	2.02	43.37	25.9979	2.116	2.58	25.73	2.14	6	135.00	1.263	1.000	0.263	1.000	6.82	6.82	0.805	26.99	34.2771	32.71
19.849	447.131	15.42	0.71	4.62	19.56	13.9691	5.023	3.02	13.85	5.07	3	135.00	1.285	1.012	0.273	0.994	4.95	4.93	0.438	15.3	59.9097	28.74
20.177	446.803	42.76	1.36	3.19	-1.64	40.4898	3.281	2.55	40.50	3.28	5	135.00	1.307	1.024	0.283	0.988	10.65	10.52	1.283	42.77	32.7842	35.49
20.505	446.475	21.33	1.36	6.39	-21.13	19.3115	6.800	2.99	19.44	6.76	3	135.00	1.329	1.036	0.293	0.983	6.83	6.71	0.619	21.46	58.031	30.94
20.833	446.147	94.63	4.34	4.59	-16.03	89.0402	4.653	2.42	89.14	4.65	11	135.00	1.351	1.048	0.304	0.977	22.25	21.74	2.888	94.73	27.3675	39.97
21.161	445.819	325.72	14.52	4.46	-12.24	306.129	4.477	2.11	306.20	4.48	11	135.00	1.373	1.060	0.314	0.972	67.01	65.10	10.042	325.8	16.2306	46.03
21.489	445.491	395.71	17.73	4.48	-7.11	368.031	4.496	2.08	368.07	4.50	12	135.00	1.396	1.071	0.324	0.966	80.29	77.56	12.208	395.75	15.201	46.84
21.817	445.163	424.33	18.21	4.29	-16.47	390.385	4.306	2.05	390.48	4.30	12	135.00	1.418	1.083	0.334	0.961	85.16	81.82	13.093	424.43	14.3837	47.09

R16585

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 21 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-4

ConeTec Inc. erpretation
Interpretation C Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4501
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-4
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 12:51
CPT File: 804CP04.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 482.55

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	40.98	1.95	63.49	28.02	2.41

User Inputs:
Assumed: Water Table Depth (ft): 21.7
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 482.6
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.386	18.72	0.55	2.92	-0.12	1825.34	2.940	1.70	1825.34	2.94	5	125.00	0.010	0.010	0.000	2.000	3.30	6.60	0.579	18.72	6.13882	52.96
0.492	482.058	32.37	1.04	3.2	7.35	1051.68	3.216	1.79	1050.38	3.22	5	125.00	0.031	0.031	0.000	2.000	5.87	11.75	1.001	32.33	7.80728	51.02
0.82	481.730	59.25	1.53	2.59	5.03	1155.1	2.585	1.68	1154.51	2.59	6	125.00	0.051	0.051	0.000	2.000	10.38	20.76	1.833	59.22	5.79663	51.36
1.148	481.402	69.32	1.89	2.73	-7.9	965.132	2.729	1.73	965.83	2.73	6	125.00	0.072	0.072	0.000	2.000	12.34	24.68	2.144	69.37	6.60102	50.71
1.476	481.074	55.93	1.68	3.01	-4.6	605.287	3.009	1.83	605.61	3.01	6	125.00	0.092	0.092	0.000	2.000	10.34	20.68	1.729	55.96	8.8217	48.91
1.804	480.746	47.44	1.34	2.82	-9.26	419.754	2.831	1.87	420.29	2.83	6	125.00	0.113	0.113	0.000	2.000	8.91	17.82	1.465	47.5	9.76493	47.40
2.133	480.417	31.92	1.13	3.53	-8.69	238.437	3.555	2.08	238.81	3.55	5	125.00	0.133	0.133	0.000	2.000	6.49	12.97	0.984	31.97	15.2078	44.89
2.461	480.089	34.91	0.98	2.81	-9.96	225.965	2.820	2.01	226.35	2.81	6	125.00	0.154	0.154	0.000	2.000	6.90	13.80	1.076	34.97	13.1573	44.64
2.789	479.761	22.26	0.83	3.71	-10	126.702	3.758	2.25	127.05	3.75	4	125.00	0.174	0.174	0.000	2.000	4.87	9.73	0.684	22.32	20.8802	41.81
3.117	479.433	18.96	0.9	4.76	-6.79	96.3244	4.796	2.41	96.58	4.78	3	125.00	0.195	0.195	0.000	2.000	4.44	8.88	0.581	19.01	26.8756	40.38
3.445	479.105	26.28	1.23	4.69	-6.97	121.055	4.719	2.35	121.24	4.71	3	125.00	0.215	0.215	0.000	2.000	5.97	11.94	0.807	26.32	24.2842	41.57
3.773	478.777	29.78	1.59	5.34	-8.66	125.287	5.382	2.38	125.50	5.37	3	125.00	0.236	0.236	0.000	2.000	6.88	13.77	0.916	29.83	25.7669	41.75
4.101	478.449	30.45	1.78	5.86	-8.64	117.8	5.895	2.43	118.00	5.89	3	125.00	0.256	0.256	0.000	1.975	7.19	14.21	0.935	30.5	27.7303	41.43
4.429	478.121	31.27	1.79	5.72	-10.05	111.965	5.775	2.44	112.22	5.76	3	125.00	0.277	0.277	0.000	1.901	7.41	14.08	0.960	31.34	27.9465	41.17
4.757	477.793	29.3	1.55	5.3	-9.47	97.5495	5.344	2.45	97.75	5.33	3	125.00	0.297	0.297	0.000	1.834	6.97	12.78	0.898	29.36	28.3092	40.45
5.085	477.465	29.53	1.58	5.36	-6.95	91.9164	5.409	2.47	92.07	5.40	3	125.00	0.318	0.318	0.000	1.774	7.09	12.57	0.904	29.58	29.17	40.13
5.413	477.137	29.07	1.51	5.21	-5.13	84.9265	5.256	2.48	85.02	5.25	3	125.00	0.338	0.338	0.000	1.719	7.01	12.05	0.890	29.1	29.6819	39.69
5.741	476.809	26.51	1.35	5.1	-4.32	72.8826	5.162	2.51	72.97	5.16	3	125.00	0.359	0.359	0.000	1.669	6.50	10.86	0.810	26.54	31.275	38.86
6.069	476.481	27.29	1.35	4.94	-2.56	70.946	5.017	2.51	71.00	5.01	3	125.00	0.379	0.379	0.000	1.624	6.69	10.86	0.833	27.31	31.1947	38.70
6.398	476.152	32.7	1.45	4.43	4.16	80.7756	4.489	2.44	80.70	4.49	4	125.00	0.400	0.400	0.000	1.581	7.73	12.23	1.000	32.67	28.0404	39.41
6.726	475.824	32.33	1.57	4.85	6.33	75.9075	4.920	2.49	75.81	4.93	3	125.00	0.420	0.420	0.000	1.542	7.81	12.05	0.988	32.29	30.1186	39.07
7.054	475.496	27.79	1.42	5.1	5.89	62.0337	5.192	2.56	61.97	5.20	3	125.00	0.441	0.441	0.000	1.506	6.96	10.49	0.847	27.76	33.5207	37.94
7.382	475.168	27.8	1.26	4.54	6.3	59.2547	4.609	2.54	59.17	4.62	4	125.00	0.461	0.461	0.000	1.472	6.88	10.13	0.846	27.76	32.3359	37.57
7.71	474.840	26.97	1.13	4.2	7.16	54.9689	4.266	2.53	54.89	4.27	4	125.00	0.482	0.482	0.000	1.441	6.66	9.60	0.820	26.93	32.2137	37.24
8.038	474.512	23.35	0.77	3.28	9.98	45.4792	3.370	2.52	45.36	3.38	5	125.00	0.502	0.502	0.000	1.411	5.72	8.07	0.707	23.29	31.5492	36.13
8.366	474.184	23.34	0.89	3.8	13.65	43.6378	3.901	2.58	43.47	3.92	4	125.00	0.523	0.523	0.000	1.383	5.86	8.13	0.706	23.25	34.2563	35.87
8.694	473.856	23.05	1.41	6.13	7.81	41.4201	6.265	2.74	41.33	6.28	3	125.00	0.543	0.543	0.000	1.357	6.32	8.58	0.697	23	42.6219	35.57
9.022	473.528	21.04	1.1	5.22	9.84	36.3132	5.372	2.73	36.21	5.39	3	125.00	0.564	0.564	0.000	1.332	5.74	7.65	0.634	20.98	42.147	34.77
9.35	473.200	24.56	1.13	4.61	14	41.0278	4.713	2.65	40.87	4.73	3	125.00	0.584	0.584	0.000	1.308	6.43	8.41	0.742	24.47	38.0684	35.50
9.678	472.872	29.72	1.6	5.4	18.45	48.1341	5.495	2.66	47.95	5.52	3	125.00	0.605	0.605	0.000	1.286	7.78	10.01	0.901	29.61	38.1091	36.45
10.006	472.544	27.78	1.68	6.06	20.23	43.4213	6.187	2.72	43.23	6.21	3	125.00	0.625	0.625	0.000	1.265	7.54	9.53	0.841	27.66	41.7217	35.84
10.335	472.215	35.02	2.44	6.96	1.71	53.2158	7.098	2.71	53.20	7.10	3	125.00	0.646	0.646	0.000	1.244	9.46	11.77	1.064	35.01	40.8687	37.06
10.663	471.887	39.84	2.72	6.82	-8.71	58.7805	6.943	2.67	58.66	6.93	3	125.00	0.666	0.666	0.000	1.225	10.58	12.96	1.213	39.89	38.9729	37.64
10.991	471.559	51.44	3.01	5.85	-13.44	73.8831	5.931	2.56	74.00	5.92	3	125.00	0.687	0.687	0.000	1.207	12.89	15.55	1.571	51.52	33.2411	38.93
11.319	471.231	49.73	3.35	6.74	-15.68	69.296	6.834	2.62	69.44	6.82	3	125.00	0.707	0.707	0.000	1.189	12.87	15.31	1.518	49.83	36.392	38.58
11.647	470.903	59.48	3.27	5.5	-19.93	80.7103	5.566	2.51	80.88	5.55	11	125.00	0.728	0.728	0.000	1.172	14.58	17.09	1.819	59.6	31.1331	39.42
11.975	470.575	59.84	3.39	5.67	-19.21	78.9532	5.737	2.53	79.11	5.73	11	125.00	0.748	0.748	0.000	1.156	14.76	17.09	1.829	59.96	31.8713	39.30
12.303	470.247	46.27	3.26	7.05	-21.45	59.1739	7.165	2.68	59.36	7.14	3	125.00	0.769	0.769	0.000	1.140	12.36	14.09	1.409	46.41	39.3681	37.69
12.631	469.919	60.74	3.55	5.84	-21.71	75.9409	5.922	2.55	76.12	5.91	11	125.00	0.789	0.789	0.000	1.125	15.17	17.07	1.856	60.88	32.8461	39.09
12.959	469.591	85.44	5.35	6.27	-21.04	104.49	6.322	2.49	104.65	6.31	11	125.00	0.810	0.810	0.000	1.111	20.71	23.01	2.620	85.57	30.0976	40.81
13.287	469.263	93.83	6.4	6.82	-21.32	111.989	6.882	2.50	112.16	6.87	11	125.00	0.830	0.830	0.000	1.097	22.88	25.10	2.879	93.97	30.668	41.17
13.615	468.935	109.07	7.14	6.54	-21.2	127.176	6.598	2.45	127.33	6.59	11	125.00	0.851	0.851	0.000	1.084	26.01	28.20	3.350	109.2	28.6543	41.83
13.943	468.607	131.31	8.27	6.3	-20.49	149.682	6.340	2.40	149.83	6.33	11	125.00	0.871	0.871	0.000	1.071	30.56	32.73	4.038	131.44	26.4331	42.65
14.271	468.279	130.51	8.58	6.57	-20.11	145.322	6.619	2.42	145.47	6.61	11	125.00	0.892	0.892	0.000	1.059	30.69	32.49	4.013	130.64	27.3685	42.50
14.6	467.950	121.15	8.14	6.72	-19.98	131.767	6.770	2.45	131.91	6.76	11	125.00	0.913	0.913	0.000	1.047	28.90	30.26	3.723	121.28	28.6919	42.01
14.928	467.622	117.27	7.69	6.56	-18.71	124.691	6.610	2.46	124.81	6.60	11	125.00	0.933	0.933	0.000	1.035	28.04	29.03	3.602	117.38	28.8952	41.72
15.256	467.294	114.14	8.49	7.43	-17.94	118.706	7.501	2.52	118.82	7.49	11	125.00	0.954	0.954	0.000	1.024	28.04	28.72	3.504	114.25	31.4374	41.47

R16587

Depth (ft)	Sa... (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	vStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.966	104.36	7.93	7.6	-18.2	106.146	7.670	2.55	106.27	7.66	11	125.00	0.974	0.974	0.000	1.013	26.08	26.43	3.201	104.48	33.0563	40.89
15.912	466.638	108.46	7.37	6.8	-18.02	108.06	6.858	2.51	108.17	6.85	11	125.00	0.995	0.995	0.000	1.003	26.53	26.60	3.327	108.67	31.0225	40.98
16.24	466.310	113.79	7.8	6.86	-17.9	111.108	6.916	2.50	111.22	6.91	11	125.00	1.015	1.015	0.000	0.993	27.78	27.58	3.491	113.9	30.8499	41.13
16.568	465.982	153.77	8.7	5.66	-14.55	147.498	5.696	2.37	147.59	5.69	11	125.00	1.036	1.036	0.000	0.983	35.20	34.59	4.729	153.86	25.0169	42.67
16.896	465.654	147.94	9.72	6.57	-6	139.095	6.617	2.43	139.13	6.62	11	125.00	1.056	1.056	0.000	0.973	34.93	33.99	4.547	147.98	27.8141	42.28
17.224	465.326	138.28	8.74	6.32	-8.2	127.453	6.370	2.44	127.51	6.37	11	125.00	1.077	1.077	0.000	0.964	32.76	31.58	4.248	138.34	28.1122	41.83
17.552	464.998	221.55	7.13	3.22	-7.74	200.96	3.234	2.09	201.01	3.23	12	125.00	1.097	1.097	0.000	0.955	46.08	43.04	6.825	221.6	15.4029	44.08
17.88	464.670	100.12	6.85	6.84	-12.15	88.5928	6.919	2.56	88.66	6.91	11	125.00	1.118	1.118	0.000	0.946	25.13	23.77	3.065	100.2	33.4931	39.92
18.208	464.342	76.59	4.86	6.34	-10.09	66.3023	6.441	2.61	66.36	6.44	11	125.00	1.138	1.138	0.000	0.937	19.73	18.50	2.336	76.66	36.0279	38.32
18.537	464.013	175.62	5.94	3.38	2.08	150.584	3.405	2.18	150.68	3.40	6	125.00	1.159	1.159	0.000	0.929	37.06	34.43	5.401	175.61	18.2355	42.67

R16588

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 24 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5

ConeTec Inc. Interpretation
Interpretation - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4462
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 12:34
CPT File: 804CP05.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 482.55

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	37.49	1.51	49.57	22.51	2.24
125	Soil Embankment	27.37	1.95	65.50	63.68	3.04

User Inputs:
Assumed: Water Table Depth (ft): 34.4
Nk: 32.3
Slate Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 482.6
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.386	8.56	0.05	0.59	-0.16	802.002	0.585	1.14	802.00	0.58	1	130.00	0.011	0.011	0.000	2.000	1.26	2.53	0.265	8.56	1.0384	50.01
0.492	482.058	13.08	0.18	1.38	-0.41	407.38	1.382	1.61	407.69	1.38	6	130.00	0.032	0.032	0.000	2.000	2.23	4.47	0.403	13.07	4.60958	47.27
0.82	481.730	39.92	0.69	1.73	-0.58	747.956	1.731	1.58	748.16	1.73	7	130.00	0.053	0.053	0.000	2.000	8.75	13.50	1.234	39.93	3.96322	49.74
1.148	481.402	81.09	1.4	1.72	-0.71	1085.71	1.728	1.52	1085.84	1.73	7	130.00	0.075	0.075	0.000	2.000	18.47	26.93	2.508	81.1	3.13579	51.14
1.476	481.074	98.26	2.17	2.21	-0.39	1023.39	2.210	1.63	1023.39	2.21	7	130.00	0.096	0.096	0.000	2.000	16.92	33.85	3.040	98.28	4.67428	50.92
1.804	480.746	102.52	1.75	1.71	-0.72	873.296	1.709	1.55	873.38	1.71	7	130.00	0.117	0.117	0.000	2.000	17.17	34.33	3.170	102.53	3.60958	50.03
2.133	480.417	76.33	1.69	2.22	-0.49	649.543	2.218	1.73	649.61	2.22	7	130.00	0.139	0.139	0.000	2.000	13.69	27.38	2.359	76.34	6.64681	48.52
2.461	480.089	77.26	1.31	1.7	-0.51	481.981	1.699	1.65	481.98	1.70	7	130.00	0.160	0.160	0.000	2.000	13.39	26.78	2.387	77.28	5.20939	47.98
2.789	479.761	73.62	1.23	1.67	-0.64	405.101	1.675	1.68	405.10	1.67	7	130.00	0.181	0.181	0.000	2.000	12.90	25.80	2.274	73.62	5.78223	47.24
3.117	479.433	51.07	0.77	1.5	-1.11	251.067	1.514	1.76	251.07	1.51	7	130.00	0.203	0.203	0.000	2.000	9.20	18.40	1.575	51.07	7.83445	45.12
3.445	479.105	43.47	0.65	1.49	-0.99	193.127	1.503	1.83	193.17	1.50	7	130.00	0.224	0.224	0.000	2.000	8.03	16.06	1.339	43.48	8.80018	43.89
3.773	478.777	37.71	0.53	1.4	-1.27	152.765	1.415	1.88	152.91	1.41	7	130.00	0.246	0.246	0.000	2.000	7.09	14.18	1.160	37.72	8.80985	42.76
4.101	478.449	27.27	0.39	1.43	-1.04	101.302	1.444	2.01	101.34	1.44	6	130.00	0.267	0.267	0.000	1.937	5.39	10.44	0.836	27.28	13.2875	40.64
4.429	478.121	26.38	0.42	1.6	-1.23	90.6338	1.610	2.08	90.83	1.61	6	130.00	0.288	0.288	0.000	1.864	5.35	9.97	0.808	26.38	15.1944	40.04
4.757	477.793	18.36	0.58	3.17	-1.09	58.3781	3.213	2.43	58.38	3.21	5	130.00	0.309	0.309	0.000	1.798	4.32	7.77	0.559	18.36	27.4805	37.60
5.086	477.465	64.13	1.14	1.77	-1.43	193.025	1.787	1.89	193.05	1.79	7	130.00	0.331	0.331	0.000	1.736	12.10	21.04	1.976	64.14	10.1352	43.89
5.413	477.137	80.68	2.1	2.6	-1.02	228.306	2.614	1.98	228.33	2.61	6	130.00	0.352	0.352	0.000	1.686	15.74	26.64	2.487	80.69	12.3848	44.88
5.741	476.809	82.5	2.19	2.65	-0.19	220.082	2.667	2.00	220.08	2.67	6	130.00	0.373	0.373	0.000	1.637	16.19	26.61	2.543	82.5	12.8165	44.51
6.069	476.481	82.21	1.32	1.6	-0.88	207.398	1.613	1.84	207.40	1.61	7	130.00	0.394	0.394	0.000	1.592	15.20	24.21	2.533	82.21	8.89168	44.23
6.398	476.152	69.65	0.67	0.96	-0.92	166.48	0.968	1.74	166.50	0.97	8	130.00	0.416	0.416	0.000	1.551	12.44	19.28	2.143	69.66	6.60328	43.17
6.726	475.824	67.23	1.03	1.54	-0.51	152.778	1.542	1.91	152.78	1.54	7	130.00	0.437	0.437	0.000	1.512	12.78	19.31	2.068	67.23	10.5604	42.74
7.054	475.496	62.5	1.02	1.64	-0.74	135.314	1.644	1.96	135.33	1.64	7	130.00	0.459	0.459	0.000	1.477	12.12	17.90	1.921	62.51	11.9604	42.14
7.382	475.168	58.83	0.75	1.27	-0.83	121.606	1.285	1.92	121.61	1.29	7	130.00	0.480	0.480	0.000	1.444	11.22	16.20	1.807	58.83	10.869	41.59
7.71	474.840	46.66	0.49	1.05	-1.29	92.1059	1.062	1.96	92.11	1.06	7	130.00	0.501	0.501	0.000	1.418	9.02	12.74	1.429	46.66	11.7458	40.19
8.038	474.512	37.02	0.37	0.99	-0.74	69.8557	1.014	2.04	69.86	1.01	7	130.00	0.522	0.522	0.000	1.393	7.36	10.21	1.139	37.02	13.9456	39.61
8.366	474.184	26.16	0.38	1.46	-1.04	47.0884	1.464	2.27	47.11	1.48	6	130.00	0.544	0.544	0.000	1.356	5.76	7.79	0.793	26.16	21.5182	36.35
8.694	473.856	15.2	0.12	0.79	0.81	25.8974	0.820	2.95	25.90	0.82	6	130.00	0.565	0.565	0.000	1.330	3.45	4.59	0.453	15.2	24.3631	32.69
9.022	473.528	13.51	0.23	1.67	-1.09	22.0377	1.760	2.59	22.04	1.78	5	130.00	0.586	0.586	0.000	1.306	3.43	4.46	0.400	13.51	34.6567	31.66
9.35	473.200	16.76	0.4	2.39	-2.31	26.5771	2.476	2.61	26.59	2.47	5	130.00	0.608	0.608	0.000	1.283	4.30	5.61	0.500	16.77	35.6004	32.86
9.678	472.872	59.24	0.76	1.29	-1.66	93.1708	1.297	2.01	93.19	1.30	7	130.00	0.629	0.629	0.000	1.261	11.68	14.73	1.815	59.25	13.14	40.19
10.006	472.544	72.22	0.96	1.33	-0.79	110.041	1.341	1.96	110.04	1.34	7	130.00	0.650	0.650	0.000	1.240	14.01	17.37	2.216	72.22	11.9881	41.07
10.335	472.215	64.71	1.11	1.72	-0.61	95.3269	1.733	2.09	95.33	1.73	7	130.00	0.672	0.672	0.000	1.220	13.16	16.06	1.983	64.71	15.3858	40.31
10.663	471.887	67.23	1.33	1.98	-0.56	95.9997	1.999	2.13	96.00	2.00	7	130.00	0.693	0.693	0.000	1.201	13.90	16.70	2.060	67.23	16.6516	40.35
10.991	471.559	52.16	1.16	2.22	-1.01	72.0108	2.255	2.25	72.01	2.25	6	130.00	0.714	0.714	0.000	1.183	11.36	13.44	1.593	52.16	20.8128	38.78
11.319	471.231	50.94	1.24	2.17	-1.8	76.392	2.206	2.23	76.41	2.21	6	130.00	0.736	0.706	0.000	1.166	12.28	14.31	1740	56.95	19.9382	39.11
11.647	470.903	52.44	1.04	1.99	-1.08	68.2684	2.012	2.24	68.28	2.01	7	130.00	0.757	0.757	0.000	1.149	11.34	13.03	1.600	52.45	20.2019	38.48
11.975	470.575	33.75	0.91	2.69	-0.92	42.3596	2.760	2.48	42.37	2.76	6	130.00	0.778	0.778	0.000	1.133	8.16	9.23	1.021	33.76	28.8333	35.72
12.303	470.247	35.95	0.93	2.58	-2.38	43.9546	2.646	2.46	43.98	2.64	6	130.00	0.800	0.800	0.000	1.118	8.58	9.59	1.088	35.97	28.7745	35.94
12.631	469.919	39.85	0.73	1.84	-1.87	47.5375	1.870	2.33	47.55	1.87	6	130.00	0.821	0.821	0.000	1.104	8.99	9.92	1.208	39.86	23.739	36.40
12.959	469.591	38.57	0.32	0.82	-1.48	44.7894	0.849	2.15	44.80	0.85	7	130.00	0.842	0.842	0.000	1.090	8.05	8.78	1.168	38.58	17.3896	36.05
13.287	469.263	53.21	0.49	0.91	-0.83	60.6102	0.936	2.07	60.61	0.94	7	130.00	0.864	0.864	0.000	1.076	10.74	11.55	1.621	53.21	14.7902	37.81
13.615	468.935	34.3	0.61	1.77	-0.69	37.7582	1.826	2.40	37.77	1.82	6	130.00	0.885	0.885	0.000	1.063	7.90	8.49	1.035	34.31	26.6559	35.03
13.943	468.607	28.16	0.33	1.17	-0.69	30.0716	1.211	2.38	30.08	1.21	7	130.00	0.906	0.906	0.000	1.050	6.49	6.82	0.844	28.17	25.6033	33.63
14.271	468.279	26.64	0.48	1.79	-0.69	27.7188	1.867	2.52	27.72	1.87	6	130.00	0.928	0.928	0.000	1.038	6.54	6.79	0.796	26.64	31.4282	33.12
14.6	467.950	28.1	0.34	1.19	-0.97	28.6101	1.252	2.41	28.62	1.25	7	130.00	0.949	0.949	0.000	1.027	6.55	6.73	0.841	28.11	28.6607	33.32
14.928	467.622	26.73	0.36	1.33	-0.67	26.5478	1.398	2.46	26.55	1.40	6	130.00	0.970	0.970	0.000	1.015	6.39	6.48	0.798	26.73	28.615	32.84
15.256	467.294	39.64	0.32	0.81	-0.79	38.8733	0.830	2.20	38.88	0.83	7	130.00	0.992	0.992	0.000	1.004	8.42	8.46	1.193	39.65	18.9383	35.20

R16590

Depth (ft)	Sa... (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	466.966	58.96	0.32	0.81	-0.76	37.4615	0.843	2.22	37.46	0.84	7	130.00	1.013	1.013	0.000	0.994	6.36	6.30	1.175	38.90	19.527	34.98
15.912	466.638	27.47	0.36	1.28	-0.74	25.6595	1.324	2.46	25.56	1.32	6	130.00	1.034	1.034	0.000	0.983	6.57	6.46	0.818	27.47	28.9508	32.60
16.24	466.310	23.18	0.23	0.99	-0.74	20.9591	1.040	2.48	20.97	1.04	6	130.00	1.056	1.056	0.000	0.973	5.59	5.44	0.685	23.19	29.75	31.34
16.568	465.982	22.71	0.18	0.77	-0.46	20.0879	0.832	2.45	20.09	0.83	7	130.00	1.077	1.077	0.000	0.964	5.40	5.20	0.670	22.71	28.4423	31.06
16.896	465.654	24.05	0.41	1.71	-0.53	20.8987	1.786	2.61	20.90	1.79	6	130.00	1.098	1.098	0.000	0.954	6.17	5.88	0.711	24.05	35.6208	31.31
17.224	465.326	23.09	0.43	1.87	-0.51	19.6242	1.957	2.65	19.63	1.96	6	130.00	1.120	1.120	0.000	0.945	6.06	5.73	0.680	23.1	37.8641	30.91
17.552	464.998	22.68	0.23	1.02	-0.74	18.8794	1.068	2.62	18.88	1.07	6	130.00	1.141	1.141	0.000	0.936	6.59	6.23	0.667	22.68	31.7842	30.65
17.88	464.670	21.11	0.44	2.07	-0.46	17.1638	2.206	2.73	17.16	2.21	6	130.00	1.162	1.162	0.000	0.928	5.77	5.35	0.618	21.11	41.9584	30.03
18.208	464.342	25.83	0.62	2.41	-1.27	20.8247	2.51557	2.69328	20.8332	2.51455	5	130.00	1.18352	1.18352	0	0.9192	6.929377	6.369515	0.76305	25.84	40.0979	31.295
18.537	464.013	26.98	0.58	2.14	-1.5	21.3918	2.25023	2.65503	21.4001	2.24936	5	130.00	1.20491	1.204905	0	0.911	7.09544	6.464023	0.79799	26.99	38.1086	31.468
18.865	463.685	32.84	0.54	1.65	-0.37	25.7814	1.70812	2.61953	25.7814	1.70812	6	130.00	1.22623	1.226225	0	0.9031	8.07106	7.288623	0.97675	32.84	31.6636	32.659
19.193	463.357	28.01	0.56	2	-0.64	21.4521	2.09248	2.63571	21.4521	2.09248	6	130.00	1.24755	1.247545	0	0.8953	7.291148	6.627814	0.82858	28.01	37.1278	31.484
19.521	463.029	42.38	0.77	1.81	-1.09	32.3999	1.87297	2.463	32.4078	1.87252	7	130.00	1.26887	1.268885	0	0.8878	10.14259	9.004115	1.27879	42.39	29.0567	34.09
19.849	462.701	48.13	0.77	1.59	-0.46	36.3047	1.6439	2.58956	36.3047	1.6439	7	130.00	1.29019	1.290185	0	0.8804	11.18334	9.801857	1.45015	48.13	25.9872	34.787
20.177	462.373	40.56	1.01	2.6	-0.3	29.9263	2.57335	2.67572	29.9263	2.57335	6	130.00	1.31151	1.311505	0	0.8732	10.24612	8.946086	1.21512	40.56	34.1844	33.596
20.505	462.045	53.08	1.3	2.45	-0.41	38.8252	2.51221	2.4824	38.8252	2.51221	6	130.00	1.33283	1.332825	0	0.8662	12.8167	11.10171	1.60206	53.06	29.9025	35.196
20.833	461.717	72.85	1.66	2.28	-0.37	52.7978	2.32181	2.35982	52.8052	2.32149	7	130.00	1.35415	1.354145	0	0.8593	16.62662	14.26971	2.21349	72.86	24.7953	37.018
21.161	461.389	86.65	1.75	2.02	-0.53	61.9969	2.0522	2.27196	62.0041	2.05195	7	130.00	1.37547	1.375485	0	0.8527	19.03346	16.22904	2.64008	86.66	21.4966	37.941
21.489	461.061	99.74	1.63	1.63	-0.42	70.4068	1.55578	2.15069	70.414	1.55562	8	130.00	1.39679	1.396786	0	0.8461	20.8237	17.61949	3.04468	99.75	17.3621	38.657
21.817	460.733	86.18	1.62	1.88	-0.48	59.7712	1.91124	2.28316	59.7712	1.91124	7	130.00	1.41811	1.418105	0	0.8397	18.85677	15.83462	2.62421	86.18	21.1809	37.732
22.145	460.405	86.56	1.53	1.77	-0.55	59.1351	1.79745	2.24998	59.1351	1.79745	7	130.00	1.43943	1.439425	0	0.8335	18.82842	15.69181	2.63531	86.56	20.681	37.67
22.473	460.077	83.42	1.73	2.08	-0.6	56.1078	2.1108	2.3123	56.1147	2.11055	7	130.00	1.46075	1.460745	0	0.8274	18.64714	15.42855	2.53744	83.43	22.9795	37.389
22.802	459.748	74.32	1.6	2.15	-0.97	49.144	2.19666	2.36683	49.1508	2.19636	7	130.00	1.48213	1.48213	0	0.8214	17.01587	13.97937	2.25504	74.33	25.0792	36.599
23.13	459.420	71.29	1.63	2.28	-0.64	46.4176	2.33569	2.40313	46.4176	2.33569	7	130.00	1.50345	1.503455	0	0.8158	16.59263	13.63219	2.16057	71.29	26.5386	36.262
23.458	459.092	64.8	1.34	2.07	-0.61	41.4982	2.11773	2.41227	41.5048	2.1174	7	130.00	1.52477	1.52477	0	0.8098	15.14737	12.26691	1.95899	64.81	25.9142	35.596
23.786	458.764	57.87	0.87	1.5	-0.49	36.4946	1.5419	2.37112	36.4946	1.5419	7	130.00	1.54609	1.54609	0	0.8042	13.2986	10.69519	1.74687	57.87	25.2493	34.819
24.114	458.436	57.68	0.89	1.55	-0.58	35.7996	1.5861	2.38513	35.7996	1.5861	7	130.00	1.56741	1.56741	0	0.7987	13.31678	10.63693	1.73723	57.68	25.809	34.702
24.442	458.108	51.01	0.65	1.27	-0.53	31.1074	1.31522	2.38768	31.1074	1.31522	7	130.00	1.58873	1.58873	0	0.7934	11.79061	9.354301	1.53007	51.01	25.9197	33.637
24.77	457.780	45.04	0.65	1.45	-0.56	26.9743	1.49666	2.47065	26.9743	1.49666	7	130.00	1.61005	1.61005	0	0.7881	10.81633	8.523642	1.34458	45.04	29.3882	32.945
25.098	457.452	51.99	0.83	1.79	-0.67	30.8689	1.84675	2.47611	30.876	1.84639	7	130.00	1.63137	1.63187	0	0.7829	12.61872	9.8013	1.55909	52	29.6284	33.79
25.426	457.124	48.03	1.05	2.18	-0.67	28.0617	2.26404	2.56273	28.0678	2.26355	6	130.00	1.65269	1.65269	0	0.7779	12.05714	9.378831	1.43583	48.04	33.567	33.196
25.754	456.796	45.32	0.59	1.29	-0.49	26.0727	1.35179	2.46827	26.0727	1.35179	7	130.00	1.67401	1.67401	0	0.7729	10.81969	8.362491	1.35127	45.32	28.8526	32.73
26.082	456.468	55.38	0.34	0.62	-0.74	31.6662	0.63333	2.21862	31.6662	0.63333	8	130.00	1.69533	1.69533	0	0.768	11.89086	9.132429	1.66206	55.38	19.6248	33.947
26.41	456.140	73.15	0.73	0.99	-0.26	41.6121	1.02193	2.22191	41.6121	1.02193	8	130.00	1.71665	1.71685	0	0.7632	15.72803	12.00421	2.21156	73.16	19.7367	35.612
26.739	455.811	74.59	0.95	1.27	-0.07	41.9163	1.30401	2.27962	41.9163	1.30401	8	130.00	1.73804	1.738035	0	0.7585	16.43855	12.48758	2.25548	74.59	21.7737	35.856
27.067	455.483	59.6	1.26	2.11	-0.34	32.8761	2.1784	2.49849	32.8761	2.1784	7	130.00	1.75936	1.759355	0	0.7539	14.50122	10.93271	1.79073	59.6	30.6157	34.179
27.395	455.155	62.45	1.36	2.18	-0.02	34.071	2.24168	2.4942	34.071	2.24168	7	130.00	1.78068	1.780675	0	0.7494	15.16969	11.66351	1.87831	62.45	30.4245	34.399
27.723	454.827	50.82	1.25	2.47	-0.46	27.2021	2.55008	2.60548	27.2021	2.55008	6	130.00	1.802	1.801996	0	0.7449	13.02823	9.705289	1.51759	50.82	35.6264	32.998
28.051	454.499	35	1.06	3.08	-1.09	18.1958	3.2553	2.80804	18.2013	3.25432	5	130.00	1.82332	1.823315	0	0.7406	9.989687	7.398114	1.02714	35.01	48.4587	30.416
28.379	454.171	33.92	1.21	3.66	-0.14	17.3885	3.77237	2.86349	17.3885	3.77237	5	130.00	1.84464	1.844635	0	0.7363	9.98773	7.353796	0.99305	33.92	49.75	30.116
28.707	453.843	24.82	1.39	5.59	-20.74	12.3015	6.05558	3.10673	12.3712	6.02148	3	130.00	1.86596	1.865955	0	0.7321	8.543187	6.254185	0.71065	24.95	65.9662	27.853
29.035	453.515	30.38	1.32	4.36	-20.28	15.0973	4.63276	2.96484	15.1609	4.61333	4	125.00	1.88728	1.887275	0	0.7279	9.53739	6.942437	0.88213	30.5	56.1472	29.211
29.363	453.187	26.39	1.19	4.5	-19.63	12.8329	4.86067	3.03231	12.8958	4.83696	4	125.00	1.90776	1.907775	0	0.724	8.646449	6.259998	0.75796	26.51	60.6874	28.132
29.691	452.859	32.99	1.13	3.43	-15.73	16.1086	3.63792	2.87768	16.1604	3.62624	5	125.00	1.92828	1.928275	0	0.7201	9.823652	7.074381	0.96166	33.09	50.616	29.634
30.019	452.531	38.04	1.29	3.39	-14.99	18.52	3.57428	2.82578	18.5713	3.5644	5	125.00	1.94878	1.948775	0	0.7163	10.99164	7.873748	1.11738	38.14	47.4962	30.547
30.347	452.203	35.49	1.02	2.88	-14.16	17.0219	3.04269	2.8116	17.0676	3.03475	6	125.00	1.96928	1.969275	0	0.7126	10.17256	7.248986	1.03779	35.58	46.666	29.994
30.675	451.875	36.01	0.81	2.24	-13.42	17.0975	2.38094	2.74704	17.1377	2.37535	6	125.00	1.98978	1.989775	0	0.7089	9.958689	7.060069	1.05326	36.09	43.0037	30.021
31.004	451.546	30.49	0.67	2.19	-12.68	14.1666	2.35256	2.81069	14.2064	2.34597	6	125.00	2.01034	2.010338	0	0.7053	8.735746	6.161203	0.88172	30.57	46.6132	28.778
31.332	451.218	20.88	0.57	2.71	-12.47	9.28147	3.02401	3.02299	9.32087	3.01123	5	125.00	2.03084	2.030838	0	0.7017	6.795869	4.768781	0.58357	20.96	60.0464	25.941
31.66	450.890	16.5	0.4	2.43	-12.06	7.04353	2.76842	3.10136	7.08253	2.75318	5	125.00	2.05134	2.051338	0	0.6982	5.656888	3.949654	0.44733	16.58	65.5763	24.077
31.988	450.562	15.2	0.37	2.41	-11.71	6.33648	2.61837	3.1445	6.37027	2.60342	5	125.00	2.07184	2.071838	0	0.6947	5.364346	3.726824	0.40644	15.27	68.7573	23.359
32.316	450.234	13.42	0.31	2.32	-10.61	5.41388	2.73666	3.19603	5.44256	2.72224	5	125.00	2.09234	2.092338	0	0.6913	4.909323	3.393952	0.3507	13.48	72.6878	22.298
32.644	449.906	13.41	0.39	2.88	-10.09	5.34691	3.45219	3.25342	5.38005	3.43094	5	125.00	2.11284	2.112838	0	0.688	5.118563	3.521397	0.34976	13.48	77.2366	22.221
32.972	449.578	13.24	0.28	2.12	-7.72	5.20624	2.52101	3.19282	5.22968	2.50971	5	125.00	2.13334	2.133338	0	0.6847	4.829065	3.306232	0.34386	13.29	72.4383	22.031
33.3	449.250	15.29	0.27	1.74	-7.34	6.09896	2.05539	3.08974	6.11753	2.04916	6	125.00	2.15384	2.153838	0	0.6814	5.190141	3.536492	0.40669	15.33	64.7959	23.086
33.628	448.922	12.74	0.24	1.85	-6.3	4.85926	2.27151	3.19655	4.87765	2.26294	5	125.00	2.17434	2.174338	0	0.6782	4.656115	3.157623	0.32711	12.78	72.7283	21.565
33.956	448.594	15.46	0.33	2.14	-5.57	6.0438	2.48772	3.13551	6.05747	2.48211	5	125.00	2.19484	2.194838	0	0.675	5.408217	3.650504	0.41069	15.49	68.086	23.019
34.284	448.266	19.07	0.47	2.44	-5.31	7.60817	2.78855	3.07707	7.62171	2.78359	5	125.00	2.21534	2.215338	0	0.6719	6.41274	4.308476	0.52182	19.1	63.8284	24.575
34.612	447.938	20.99	0.5	2.36	-4.73	8.41287	2.66607	3.02992	8.42633	2.66182	5	135.00	2.23584	2.229223	0.0066	0.6698	6.845399	4.584817	0.58062	21.02	60.5225	25.259
34.941	447.609	25.65	0.82	3.18	-4.43	10.4374	3.50548	3.01977	10.4508	3.50099	5	135.00	2.25805	2.241166	0.0169	0.668	8.309312	5.550448	0.72421	25.68	59.8266	26.721
35.269	447.281	24.21	1.06	4.37	-9.81	9.73329	4.8336	3.12648	9.75992	4.82041	4	135.00	2.28019	2.253072	0.0271	0.6662	8.421758	5.610676	0.67894	24.27	67.4162	26.261
35.597	446.953	22.27	0.91	4.1	-14.16	8.81583	4.55737	3.14431	8.85557	4.53692	4	135.00	2.30233	2.264979	0.0373	0.6645	7.654004	5.218661	0.61819	22.36	68.7426	25.606
35.925	446.625	19.46	0.98	5.05	-13.21	7.52587	5.71911	3.25807	7.5654	5.68923	3	135.00	2.32447	2.276885	0.0476	0.6627	7.449111	4.936668	0.53051	19.55	77.6125	24.544
36.253	446.297	24.68	1.3	5.26	-11.24	9.75772	5.82088	3.17489	9.79268	5.8001	3	135.00	2.34661	2.288791	0.0578	0.661	6.883668	5.872043	0.69144	24.76	71.058	26.293
36.581	445.969	26.57	1.26	4.75	-10.88	10.5191	5.20634	3.11986	10.5452	5.19347	3	135.00	2.36875	2.300698	0.068	0.6593	9.199371	6.064966	0.74926	26.63	66.9282	26.796
36.909	445.641	22.11	0.92	4.17	-10.16	8.5268	4.66552	3.16289	8.55275	4.65137	4	135.00	2.39089	2.312604	0.0783	0.6576	7.867958	5.186973	0.6105	22.17	70.1433	25.384
37.237	445.313	21.91	0.71	3.22	-9.52	8.38756	3.64159	3.10571	8.41337	3.63042	5	135.00	2.41303	2.324511	0.0885	0.6559	7.517677	4.930806	0.60362	21.97	65.8921	25.277
37.565	444.985	23	0.88	3.81	-9.38	8.80187	4.27915	3.12957	8.82755	4.2667	4	135.00	2.43517	2.336417	0.0987	0.6542	8.018715	5.246016	0.63668	23.06	67.6451	25.605

Depth (ft)	Sa... (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	VStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	444.657	19.45	0.95	4.9	-10	7.2361	5.59064	3.26674	7.26165	5.57097	3	135.00	2.45731	2.348323	0.109	0.6526	7.482229	4.88261	0.52609	19.51	78.3181	24.29
38.221	444.329	18.24	0.79	4.34	-9.37	6.57755	5.01251	3.26644	6.70297	4.9935	3	135.00	2.47945	2.36023	0.1192	0.6509	7.016591	4.567189	0.48794	18.3	78.2934	23.755
38.549	444.001	21.57	0.78	3.6	-8.87	8.0385	4.09053	3.14988	8.06379	4.0777	5	135.00	2.50159	2.372136	0.1294	0.6493	7.626794	4.951904	0.59035	21.63	69.1608	25.004
38.877	443.673	18.25	0.67	3.65	-8.11	6.59647	4.26039	3.2302	6.61745	4.24688	4	135.00	2.52373	2.384043	0.1397	0.6477	6.83099	4.424117	0.48688	18.3	75.3741	23.677
39.206	443.344	20.75	0.81	3.91	-7.44	7.59774	4.44956	3.19132	7.61861	4.43737	4	135.00	2.54593	2.395985	0.1499	0.646	7.549899	4.87752	0.56359	20.8	72.3227	24.628
39.534	443.016	21.68	1.16	5.34	-5.68	7.9372	6.06951	3.25744	7.95382	6.05683	3	135.00	2.56807	2.407892	0.1602	0.6444	8.272102	5.330862	0.5917	21.72	77.562	24.921
39.862	442.688	22.71	1.16	5.1	-5.2	8.31466	5.76547	3.22788	8.33119	5.75403	3	135.00	2.59021	2.419798	0.1704	0.6429	8.477683	5.449889	0.6229	22.75	75.1893	25.237
40.19	442.360	28.63	1.19	4.17	-3.31	10.6993	4.57382	3.08047	10.7076	4.57031	4	135.00	2.61235	2.431705	0.1806	0.6413	9.640815	6.18229	0.8055	28.65	64.071	26.927
40.518	442.032	28.19	1.27	4.52	-2.28	10.4581	4.96957	3.11062	10.4622	4.96763	4	135.00	2.63449	2.443611	0.1909	0.6397	9.6813	6.193237	0.79119	28.2	66.2507	26.774
40.846	441.704	26.69	1.27	4.77	-1.8	9.7875	5.28432	3.14971	9.79157	5.28212	3	135.00	2.65663	2.455517	0.2011	0.6382	9.413383	6.007229	0.74407	26.7	69.148	26.331
41.174	441.376	24.58	1.31	5.34	-1.94	8.87615	5.9814	3.21633	8.8802	5.97867	3	135.00	2.67877	2.467424	0.2113	0.6366	9.086888	5.784866	0.67806	24.59	74.2759	25.678
41.502	441.048	24.83	1.39	5.59	-2.79	8.92543	6.28133	3.22741	8.9335	6.27565	3	135.00	2.70091	2.47933	0.2216	0.6351	9.257119	5.879071	0.68511	24.85	75.1525	25.721
41.83	440.720	23.62	1.17	4.95	-2.61	8.38818	5.5989	3.21797	8.3922	5.59623	3	135.00	2.72305	2.491237	0.2318	0.6336	8.742523	5.538974	0.64696	23.63	74.4055	25.304
42.158	440.392	24.48	0.98	4.01	-1.99	8.68301	4.5089	3.14929	8.667	4.50682	4	135.00	2.74519	2.503143	0.242	0.6321	8.631702	5.455739	0.6729	24.49	69.1162	25.538
42.486	440.064	22.76	1.14	5	-2.06	7.94921	5.70209	3.24129	7.95319	5.69924	3	135.00	2.76733	2.515049	0.2523	0.6306	8.568914	5.403219	0.61897	22.77	76.2598	24.949
42.814	439.736	20.25	0.99	4.9	-0.12	6.90971	5.66993	3.28858	6.90971	5.66993	3	135.00	2.78947	2.526956	0.2625	0.6291	7.69536	4.96676	0.54057	20.25	80.1137	24.011
43.143	439.407	14.05	0.79	5.63	-0.05	4.42646	7.02952	3.49955	4.42646	7.02952	3	135.00	2.81168	2.538898	0.2728	0.6276	6.528217	4.097056	0.34794	14.05	98.8834	21.08
43.471	439.079	11.7	0.65	5.57	1.64	3.47584	7.33123	3.59605	3.47192	7.33951	3	135.00	2.83382	2.550605	0.283	0.6261	5.953759	3.7278	0.27449	11.69	100	19.54
43.799	438.751	14.29	0.66	4.63	1.87	4.4617	5.77224	3.4474	4.45779	5.77729	3	135.00	2.85596	2.562711	0.2932	0.6247	6.334906	3.957221	0.354	14.28	93.9984	21.135
44.127	438.423	16.74	0.83	4.94	0.9	5.38406	5.98764	3.38977	5.38406	5.98764	3	135.00	2.8781	2.574618	0.3035	0.6232	7.072565	4.407787	0.42916	16.74	88.7893	22.371
44.455	438.095	16.83	0.84	5	0.58	5.38551	6.03025	3.39149	5.38551	6.03025	3	135.00	2.90024	2.586524	0.3137	0.6218	7.120717	4.427571	0.43126	16.83	88.9421	22.377
44.783	437.767	14.82	0.61	4.12	1.29	4.57877	5.12708	3.40827	4.57877	5.12708	3	135.00	2.92238	2.59843	0.3239	0.6204	6.358557	3.9446	0.38835	14.82	90.4396	21.323
45.111	437.439	17.14	0.44	2.57	3.14	5.43818	3.09958	3.22672	5.43052	3.10395	5	135.00	2.94452	2.610337	0.3342	0.6189	6.374336	3.94536	0.43949	17.12	75.0978	22.44
45.439	437.111	33.51	1.27	3.8	6.51	11.6478	4.15803	3.02727	11.6325	4.16349	5	135.00	2.96666	2.622243	0.3444	0.6175	10.88157	6.719778	0.94561	33.47	60.3406	27.515
45.767	436.783	58.12	2.69	4.62	3.76	20.9294	4.87927	2.87443	20.9218	4.88104	4	135.00	2.9888	2.63415	0.3547	0.6161	17.21601	10.60748	1.70685	58.1	50.4166	31.363
46.095	436.455	62.76	3.68	5.86	-7.46	22.588	6.15703	2.91763	22.6069	6.15189	11	135.00	3.01094	2.646056	0.3649	0.6148	19.09563	11.73909	1.85044	62.83	53.1048	31.86
46.423	436.127	83.6	4.9	5.86	-7.76	30.3115	6.0819	2.82272	30.3303	6.07613	11	135.00	3.03308	2.657962	0.3751	0.6134	24.06568	14.76127	2.49433	83.65	47.316	33.709
46.751	435.799	294.51	7.43	2.52	-2.96	109.164	2.54928	2.16692	109.168	2.54919	7	135.00	3.05522	2.669869	0.3854	0.612	61.8938	37.87932	9.02337	294.52	17.9036	41.036
47.079	435.471	443.15	13.54	3.06	-9.68	164.098	3.07676	2.11943	164.12	3.07635	12	135.00	3.07736	2.681775	0.3956	0.6106	91.3583	55.78749	13.6245	443.21	16.4026	43.103
47.408	435.142	441.36	16.48	3.73	-14.99	162.697	3.76032	2.19234	162.734	3.75946	12	135.00	3.09957	2.693718	0.4058	0.6093	93.75299	57.12275	13.5684	441.46	18.7382	43.062
47.736	434.814	430.27	19.31	4.49	-16.14	157.874	4.52068	2.2656	157.911	4.51962	12	135.00	3.12171	2.705624	0.4161	0.6079	94.26613	57.30888	13.2244	430.37	21.268	42.913
48.064	434.486	369.54	18.25	4.94	-18.24	134.827	4.98095	2.33911	134.867	4.97945	11	135.00	3.14385	2.717531	0.4263	0.6066	83.59886	50.71228	11.3435	369.65	23.9983	42.124
48.392	434.158	373.72	19.14	5.12	-23.12	135.762	5.16524	2.35029	135.817	5.16315	11	135.00	3.16599	2.729437	0.4366	0.6053	84.97333	51.4335	11.4723	373.87	24.4307	42.16
48.72	433.830	313.66	15.82	5.04	-20.02	113.255	5.09547	2.39117	113.303	5.09334	11	135.00	3.18813	2.741344	0.4468	0.604	72.63847	43.87175	9.61213	313.79	26.0526	41.23

R16592

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 28 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5A

ConeTec Inc. Interpretation

Interpretation - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4429
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5A
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 10:44
CPT File: 804CP05A.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 483

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	35.78	1.11	36.82	24.15	2.29
125	Soil Embankment	28.29	1.43	48.95	56.29	2.94

User Inputs:

Assumed: Water Table Depth (ft): 35.9
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below

CPT area ratio: 0.85 See Below

Ground Surface Elev. 483.0

Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	482.836	25.42	0.16	0.61	-0.04	2363.62	0.630	1.02	2383.62	0.63	7	130.00	0.011	0.011	0.000	2.000	6.63	7.27	0.787	25.42	1.8137	33.84
0.492	482.508	30.63	0.26	0.83	0.09	956.786	0.850	1.25	956.79	0.85	7	130.00	0.032	0.032	0.000	2.000	4.87	9.35	0.947	30.63	0.0948	50.67
0.82	482.180	34.85	0.47	1.34	0.02	652.846	1.351	1.50	652.85	1.35	7	130.00	0.053	0.053	0.000	2.000	5.75	11.50	1.077	34.85	2.85185	49.21
1.148	481.852	45.55	0.61	1.33	0.65	609.426	1.341	1.51	609.43	1.34	7	130.00	0.075	0.075	0.000	2.000	7.54	15.06	1.408	45.55	3.00348	48.93
1.476	481.524	30.66	0.46	1.49	0.16	316.575	1.505	1.70	318.57	1.51	6	130.00	0.096	0.096	0.000	2.000	5.40	10.81	0.948	30.66	6.10537	46.20
1.804	481.196	25.49	0.36	1.4	0.21	216.38	1.419	1.78	216.86	1.42	6	130.00	0.117	0.117	0.000	2.000	4.62	9.24	0.788	25.49	7.770884	44.43
2.133	480.867	24.98	0.31	1.22	0.07	179.172	1.248	1.79	179.17	1.25	6	130.00	0.139	0.139	0.000	2.000	4.65	9.10	0.789	24.98	7.96054	43.53
2.461	480.539	22	0.24	1.07	0.37	136.53	1.099	1.84	136.53	1.10	6	130.00	0.160	0.160	0.000	2.000	4.07	8.14	0.678	22	8.91183	42.19
2.789	480.211	19.96	0.2	1	0.25	109.103	1.011	1.88	109.10	1.01	6	130.00	0.181	0.181	0.000	2.000	3.78	7.52	0.612	19.96	10.022	41.03
3.117	479.883	16.87	0.21	1.22	0.14	82.2655	1.280	2.04	82.27	1.26	6	130.00	0.203	0.203	0.000	2.000	3.37	6.74	0.516	16.87	14.0492	39.62
3.445	479.555	27.63	0.29	1.05	-0.81	122.39	1.058	1.86	122.39	1.06	7	130.00	0.224	0.224	0.000	2.000	5.16	10.31	0.848	27.63	9.45061	41.02
3.773	479.227	28.29	0.55	1.95	-0.9	114.354	1.961	2.07	114.39	1.96	6	130.00	0.245	0.245	0.000	2.000	5.72	11.43	0.868	28.3	14.8825	41.27
4.101	478.899	31.49	0.42	1.32	-0.58	117.139	1.345	1.94	117.17	1.34	7	130.00	0.267	0.267	0.000	1.937	6.07	11.75	0.967	31.5	11.5005	41.40
4.429	478.571	21.63	0.34	1.58	-0.25	73.7866	1.601	2.14	73.79	1.60	6	130.00	0.288	0.288	0.000	1.864	4.48	8.35	0.668	21.63	17.1574	38.92
4.757	478.243	20.69	0.25	1.19	-1.01	65.9135	1.227	2.11	65.95	1.23	6	130.00	0.309	0.309	0.000	1.798	4.24	7.83	0.631	20.7	16.0068	38.29
5.085	477.915	16.26	0.33	2.14	-1.38	45.169	2.210	2.40	45.20	2.21	5	130.00	0.331	0.331	0.000	1.739	3.54	6.16	0.462	16.27	26.2447	36.10
5.413	477.587	14.21	0.29	2.05	-1.25	39.3871	2.093	2.43	39.39	2.09	5	130.00	0.352	0.352	0.000	1.686	3.04	5.64	0.429	14.21	27.5061	35.28
5.741	477.259	24.82	0.37	1.47	-0.26	65.5121	1.613	2.17	65.51	1.61	6	130.00	0.373	0.373	0.000	1.637	5.22	8.64	0.767	24.82	17.8966	38.25
6.069	476.931	37.64	0.39	1.02	-1.27	95.176	1.039	1.94	95.20	1.04	7	130.00	0.394	0.394	0.000	1.592	7.29	11.80	1.162	37.95	11.3095	40.30
6.398	476.602	38.71	0.49	1.26	-0.12	92.082	1.280	2.01	92.08	1.28	7	130.00	0.416	0.416	0.000	1.551	7.63	11.84	1.186	38.7	13.1428	40.13
6.726	476.274	62.69	0.91	1.45	0.74	142.393	1.462	1.91	142.42	1.46	7	130.00	0.437	0.437	0.000	1.512	11.92	18.03	1.927	62.7	10.6517	42.99
7.054	475.946	61.99	1.01	1.63	0.67	134.133	1.642	1.97	134.16	1.64	7	130.00	0.459	0.459	0.000	1.477	12.03	17.75	1.904	61.97	12.0278	42.09
7.382	475.618	77.1	0.92	1.19	-1.34	156.662	1.201	1.81	156.70	1.20	6	130.00	0.480	0.480	0.000	1.444	14.16	20.43	2.072	77.11	8.43681	42.66
7.71	475.290	60.49	0.84	1.38	-0.67	119.702	1.400	1.95	119.72	1.40	7	130.00	0.501	0.501	0.000	1.413	11.67	16.49	1.657	60.5	11.6404	41.51
8.038	474.962	43.56	0.42	0.95	-0.41	82.9732	0.976	1.97	82.99	0.98	7	130.00	0.522	0.522	0.000	1.383	8.47	11.72	1.332	43.57	12.1295	39.52
8.366	474.634	31.78	0.35	1.09	-0.72	57.4417	1.120	2.13	57.44	1.12	7	130.00	0.544	0.544	0.000	1.356	6.58	8.92	0.967	31.78	16.7393	37.50
8.694	474.306	23.44	0.25	1.07	-0.83	40.4787	1.093	2.25	40.50	1.09	6	130.00	0.566	0.566	0.000	1.330	5.10	6.78	0.708	23.45	20.6373	35.45
9.022	473.978	14.75	0.2	1.33	-1.36	24.1522	1.412	2.50	24.17	1.41	6	130.00	0.586	0.586	0.000	1.306	3.59	4.68	0.439	14.76	30.5056	32.25
9.35	473.650	18.83	0.1	0.53	-1.34	30.4477	0.546	2.21	30.16	0.55	7	130.00	0.608	0.608	0.000	1.283	4.05	5.19	0.567	18.84	19.2809	33.65
9.678	473.322	14.31	0.1	0.7	-0.39	21.7479	0.731	2.39	21.75	0.73	6	130.00	0.629	0.629	0.000	1.261	3.31	4.18	0.424	14.31	26.0949	31.67
10.006	472.994	13.41	0.1	0.75	-0.53	19.5184	0.784	2.45	19.53	0.78	6	130.00	0.650	0.650	0.000	1.240	3.18	3.96	0.395	13.42	28.3013	30.91
10.335	472.665	9.07	0.17	1.82	-0.74	12.5015	2.024	2.62	12.50	2.02	5	130.00	0.672	0.672	0.000	1.220	2.61	3.18	0.260	9.07	47.2437	27.92
10.663	472.337	9.3	0.05	0.54	-0.39	12.4181	0.581	2.67	12.42	0.58	1	130.00	0.693	0.693	0.000	1.201	2.34	2.82	0.286	9.3	83.9922	27.88
10.991	472.009	8.69	0.07	0.81	-0.46	11.1636	0.878	2.69	11.16	0.88	5	130.00	0.714	0.714	0.000	1.183	2.32	2.76	0.247	8.69	59.7705	27.16
11.319	471.681	8.9	0.07	0.84	-0.74	8.37636	1.136	2.85	8.38	1.14	1	130.00	0.736	0.736	0.000	1.166	2.01	2.36	0.191	8.9	48.8316	25.22
11.647	471.353	8.91	0.09	1.01	-0.44	10.7693	1.104	2.75	10.77	1.10	5	130.00	0.757	0.757	0.000	1.149	2.46	2.82	0.252	8.91	42.9199	26.92
11.975	471.025	18.87	0.21	1.09	-0.26	23.2428	1.161	2.46	23.26	1.16	6	130.00	0.778	0.778	0.000	1.133	4.52	5.12	0.560	18.88	29.1282	32.00
12.303	470.697	19.57	0.24	1.23	-0.51	23.4718	1.279	2.48	23.48	1.28	6	130.00	0.800	0.800	0.000	1.118	4.73	5.29	0.581	19.58	29.9383	32.07
12.631	470.369	17.34	0.28	1.62	0.61	20.1202	1.695	2.61	20.13	1.69	6	130.00	0.821	0.821	0.000	1.104	4.45	4.91	0.511	17.35	35.662	31.07
12.959	470.041	19.8	0.26	1.28	-0.3	22.6246	1.364	2.51	22.62	1.36	6	130.00	0.842	0.842	0.000	1.090	4.87	5.31	0.590	19.9	31.2276	31.83
13.287	469.713	30.28	0.23	0.76	-0.3	34.0603	0.762	2.23	34.06	0.78	7	130.00	0.864	0.864	0.000	1.076	6.55	7.04	0.911	30.28	20.1787	34.40
13.615	469.385	38.96	0.31	0.78	-0.41	43.0238	0.814	2.16	43.02	0.81	7	130.00	0.885	0.885	0.000	1.063	8.16	8.67	1.179	38.96	17.5679	35.91
13.943	469.057	33.22	0.36	1.07	-0.44	35.9647	1.114	2.30	35.05	1.11	7	130.00	0.906	0.906	0.000	1.050	7.38	7.75	1.000	33.22	22.4677	34.68
14.271	468.729	32.32	0.37	1.13	-0.62	33.842	1.179	2.33	33.84	1.18	7	130.00	0.928	0.928	0.000	1.038	7.26	7.66	0.972	32.32	23.6858	34.36
14.6	468.400	25.81	0.32	1.24	-0.3	26.197	1.267	2.44	26.20	1.29	6	130.00	0.949	0.949	0.000	1.027	6.12	6.29	0.770	25.81	29.2811	32.76
14.928	468.072	26.62	0.29	1.08	-0.97	26.6404	1.122	2.41	26.65	1.12	7	130.00	0.970	0.970	0.000	1.015	6.26	6.35	0.800	26.63	26.6786	32.87
15.256	467.744	27.37	0.29	1.06	-0.53	26.6007	1.099	2.40	26.61	1.10	7	130.00	0.992	0.992	0.000	1.004	6.37	6.40	0.817	27.38	26.5116	32.86

R16594

Depth (ft)	Sa (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	vStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	467.416	27.05	0.21	0.76	-0.81	25.7039	0.807	2.35	25.71	0.81	7	130.00	1.013	1.013	0.000	0.994	6.14	6.10	0.806	27.06	24.3313	32.64
15.912	467.088	23.69	0.19	0.78	-0.68	21.9048	0.839	2.42	21.91	0.84	7	130.00	1.034	1.034	0.000	0.983	5.85	5.46	0.701	23.7	27.103	31.62
16.24	466.760	39.67	0.35	0.87	-0.32	36.4858	0.909	2.24	36.50	0.91	7	130.00	1.056	1.056	0.000	0.973	8.58	8.35	1.102	39.68	20.444	34.62
16.568	466.432	74.07	1.13	1.62	0	67.7795	1.548	2.16	67.78	1.55	7	130.00	1.077	1.077	0.000	0.964	15.53	14.97	2.260	74.07	17.7993	36.44
16.896	466.104	66.69	1.62	2.43	-0.62	59.7244	2.470	2.34	59.72	2.47	6	130.00	1.098	1.098	0.000	0.954	15.08	14.39	2.031	66.69	23.9849	37.73
17.224	465.776	65.22	1.33	2.04	-0.58	57.256	2.075	2.30	57.26	2.07	7	130.00	1.120	1.120	0.000	0.945	14.50	13.71	1.985	65.22	22.5529	37.49
17.552	465.448	57.68	1.09	1.89	-0.39	49.5575	1.926	2.33	49.58	1.93	7	130.00	1.141	1.141	0.000	0.936	12.98	12.15	1.750	57.68	23.5396	36.85
17.88	465.120	32	1.01	3.16	-0.39	26.634	3.275	2.68	26.63	3.28	5	130.00	1.162	1.162	0.000	0.928	8.53	7.92	0.955	32	39.5519	32.84
18.208	464.792	51.85	0.91	1.76	-3.51	42.81	1.79806	2.55035	42.8269	1.79535	7	130.00	1.1835	1.18352	0	0.9192	11.82091	10.86693	1.568862	51.87	24.6874	35.784
18.537	464.463	43.9	1.02	2.33	-7.82	36.4344	2.38903	2.49787	36.4769	2.38624	6	130.00	1.20491	1.204905	0	0.911	10.69025	9.738938	1.328163	43.91	30.6877	34.646
18.865	464.135	23.27	0.79	3.4	-2.63	17.9769	3.58378	2.83772	17.9933	3.58053	5	130.00	1.22823	1.228225	0	0.9031	6.757445	6.102354	0.68247	23.29	48.2023	30.34
19.193	463.807	39.72	0.64	1.62	-1.94	30.8385	1.66353	2.44929	30.8548	1.66266	7	130.00	1.24765	1.247645	0	0.8953	9.447688	8.488758	1.1911	39.74	28.4675	33.786
19.521	463.479	50.04	1.09	2.17	-2.24	38.4368	2.23493	2.45278	38.4447	2.23447	6	130.00	1.26887	1.268865	0	0.8878	11.91839	10.58059	1.50994	50.05	28.617	35.135
19.849	463.151	60.08	1.06	1.76	-0.18	45.567	1.80303	2.33657	45.567	1.80303	7	130.00	1.29019	1.290185	0	0.8804	13.57227	11.94866	1.82012	60.08	23.9008	36.163
20.177	462.823	52.92	0.66	1.24	0.07	39.3506	1.27886	2.29701	39.3506	1.27886	7	130.00	1.31151	1.311505	0	0.8732	11.74944	10.25965	1.59779	52.92	22.4107	36.276
20.505	462.495	36.79	0.47	1.27	-0.14	26.603	1.32554	2.44629	26.603	1.32554	7	130.00	1.33283	1.332825	0	0.8662	8.734366	7.665626	1.09776	36.79	26.3397	32.858
20.833	462.167	44.24	0.4	0.91	-0.16	31.6701	0.93271	2.30083	31.6701	0.93271	7	130.00	1.35415	1.354145	0	0.8593	9.838615	8.454762	1.32774	44.24	22.5592	33.948
21.161	461.839	38.42	0.62	1.36	-0.21	26.9324	1.40372	2.45559	26.9324	1.40372	7	130.00	1.37547	1.376465	0	0.8527	9.160918	7.811137	1.14889	38.42	28.7374	32.935
21.489	461.511	36.09	0.66	1.83	-0.49	24.8379	1.90239	2.55989	24.8379	1.90239	6	130.00	1.39679	1.396785	0	0.8461	9.045298	7.653463	1.07409	36.09	33.4329	32.423
21.817	461.183	32.39	0.61	1.56	-0.46	21.8403	1.64865	2.5898	21.8403	1.64865	6	130.00	1.41811	1.418105	0	0.8397	8.157585	6.850266	0.95868	32.39	33.9021	31.599
22.145	460.855	35.62	0.56	1.58	-0.65	23.6765	1.64316	2.54029	23.6765	1.64316	7	130.00	1.43943	1.439425	0	0.8335	8.817706	7.349555	1.05513	35.62	32.5168	32.117
22.473	460.527	48.61	0.94	1.93	-0.44	32.2091	1.99791	2.46214	32.2159	1.99748	7	130.00	1.46075	1.460745	0	0.8274	11.71423	9.692283	1.45663	48.62	29.8912	34.054
22.802	460.198	40.72	0.8	1.97	-0.09	26.474	2.03885	2.55538	26.474	2.03885	6	130.00	1.48213	1.48213	0	0.8214	10.1832	8.364521	1.21479	40.72	33.2206	32.827
23.13	459.870	34.78	0.69	1.97	-0.11	22.1335	2.07353	2.62238	22.1335	2.07353	6	130.00	1.50345	1.503455	0	0.8156	8.69242	7.333861	1.03023	34.78	36.4607	31.685
23.458	459.542	27.98	0.71	2.53	0.02	17.3503	2.68378	2.77387	17.3503	2.68378	6	130.00	1.52477	1.52477	0	0.8098	7.83439	6.344682	0.81905	27.98	44.5023	30.102
23.786	459.214	34.66	0.84	1.83	-0.21	21.5601	1.91997	2.61226	21.5601	1.91997	6	130.00	1.54609	1.546089	0	0.8042	8.972823	7.216851	1.03201	34.66	35.9587	31.616
24.114	458.886	34.14	0.66	1.62	-0.04	20.7812	2.02624	2.63861	20.7812	2.02624	6	130.00	1.56741	1.56741	0	0.7987	8.900875	7.109538	1.00644	34.14	37.284	31.278
24.442	458.558	46.63	0.8	1.71	-0.12	28.3505	1.77615	2.49588	28.3505	1.77615	7	130.00	1.58873	1.58873	0	0.7934	11.33143	8.989997	1.39447	46.63	30.4993	33.258
24.77	458.230	37.3	0.79	2.12	-0.44	22.167	2.21351	2.63841	22.1732	2.21289	6	130.00	1.61005	1.61005	0	0.7881	9.725356	7.684543	1.10495	37.31	37.2838	31.697
25.098	457.902	36.41	0.89	2.46	-0.32	21.3187	2.55904	2.6899	21.3187	2.55904	6	130.00	1.63137	1.63137	0	0.7829	9.748595	7.630917	1.07674	36.41	39.8193	31.443
25.426	457.574	48.8	0.86	1.76	-0.18	28.5276	1.82407	2.50053	28.5276	1.82407	7	130.00	1.65269	1.65269	0	0.7779	11.88499	9.244918	1.45987	48.8	30.7065	33.297
25.754	457.246	74.39	0.71	0.96	-0.07	43.4382	0.9764	2.19543	43.4382	0.9764	8	130.00	1.67401	1.67401	0	0.7729	15.81851	12.22606	2.25127	74.39	18.841	35.869
26.082	456.918	60.47	1.1	1.82	-0.18	34.6686	1.87165	2.43963	34.6686	1.87165	7	130.00	1.69533	1.69533	0	0.768	14.31205	10.99195	1.819665	60.47	28.0573	34.605
26.41	456.590	80.94	0.74	0.91	-0.04	46.16	0.93407	2.16287	46.16	0.93407	8	130.00	1.71665	1.171665	0	0.7632	16.98142	12.96064	2.45274	80.94	17.7728	36.228
26.739	456.261	80.42	0.62	0.77	-0.07	45.2706	0.78798	2.18015	45.2764	0.78768	8	130.00	1.73804	1.738035	0	0.7585	16.85087	12.63012	2.43597	80.43	16.7349	36.116
27.067	455.933	65.83	0.67	1.2	-0.09	30.7332	1.23912	2.37764	30.7332	1.23912	7	130.00	1.75938	1.759355	0	0.7539	12.84542	9.68513	1.67401	65.83	25.5169	33.762
27.395	455.605	46.5	0.62	1.77	-0.14	25.1137	1.83366	2.64867	25.1137	1.83366	7	130.00	1.78068	1.780675	0	0.7494	11.5793	8.677407	1.3845	46.5	32.8128	32.493
27.723	455.277	57.97	0.96	1.65	0.23	31.1699	1.70916	2.45279	31.1699	1.70916	7	130.00	1.802	1.801995	0	0.7449	13.80444	10.28352	1.73895	57.97	26.6174	33.849
28.051	454.949	68	0.97	1.43	-0.32	36.2947	1.46577	2.36006	36.2947	1.46577	7	130.00	1.82332	1.823315	0	0.7406	15.62249	11.49557	2.04861	68	24.8126	34.786
28.379	454.621	53.43	1.26	2.36	-0.41	27.9651	2.44255	2.58442	27.9661	2.44255	6	130.00	1.84464	1.844635	0	0.7363	13.65423	9.979762	1.69707	53.43	34.6019	33.172
28.707	454.293	48.16	0.78	1.62	-0.58	24.8098	1.68488	2.52977	24.8098	1.68488	7	130.00	1.86599	1.865955	0	0.7321	11.89481	8.707769	1.43325	48.16	32.0316	32.415
29.035	453.965	64.33	0.45	0.69	-0.6	33.0862	0.72066	2.22831	33.0862	0.72066	8	125.00	1.88728	1.887275	0	0.7279	13.86901	10.0955	1.93321	64.33	19.9571	34.218
29.363	453.637	56.15	0.73	1.3	-0.09	28.4322	1.34581	2.42586	28.4322	1.34581	7	125.00	1.90778	1.907775	0	0.724	13.20537	9.560644	1.67933	56.15	27.4781	33.276
29.691	453.309	58.81	0.91	1.54	0.09	29.4988	1.59981	2.45535	29.4988	1.59981	7	125.00	1.92828	1.928275	0	0.7201	14.02117	10.09717	1.76104	58.81	28.7271	33.506
30.019	452.981	67.14	1.23	1.84	-0.11	33.4524	1.88676	2.45406	33.4524	1.88676	7	125.00	1.94878	1.948775	0	0.7163	15.99764	11.45968	2.0183	67.14	28.6717	34.286
30.347	452.653	112.05	2.2	1.96	-0.41	55.8991	1.99853	2.2978	55.8991	1.99863	7	125.00	1.96928	1.969275	0	0.7126	24.88619	17.73394	3.40807	112.05	22.4399	37.347
30.675	452.325	73.06	2.44	3.34	-8.34	35.7177	3.43322	2.59915	35.7428	3.43081	6	125.00	1.98978	1.989775	0	0.7089	16.6832	13.24492	2.20032	73.11	35.3168	34.692
31.004	451.996	39.96	1.78	4.47	-10.67	18.8773	4.69042	2.89568	18.9071	4.68302	4	125.00	2.01034	2.010338	0	0.7053	12.00548	8.468011	1.17491	40.02	51.728	30.664
31.332	451.668	36.72	1.19	3.25	-12.47	17.0812	3.43047	2.84264	17.1157	3.42356	5	125.00	2.03084	2.030838	0	0.7017	10.70429	7.511391	1.07397	36.79	48.4956	30.012
31.66	451.340	32.6	0.98	3	-11.92	14.8921	3.208	2.87199	14.9262	3.20066	5	125.00	2.05134	2.051338	0	0.6982	9.666982	6.749511	0.94578	32.67	50.2673	29.107
31.988	451.012	30.21	0.84	2.79	-11.04	13.5813	2.98527	2.8855	13.615	2.97786	6	125.00	2.07184	2.071838	0	0.6947	9.030418	6.27379	0.87115	30.28	51.0971	28.495
32.316	450.684	30.02	0.75	2.5	-10.81	13.3476	2.68551	2.86492	13.381	2.6788	6	125.00	2.09234	2.092338	0	0.6913	8.867287	6.130203	0.86463	30.09	49.8367	28.379
32.644	450.356	32.56	0.7	2.16	-8.52	14.4106	2.29906	2.79963	14.4342	2.2953	6	125.00	2.11284	2.112838	0	0.688	9.261455	6.371566	0.94264	32.61	45.9727	28.884
32.972	450.028	32.57	0.61	1.86	-7.05	14.2672	2.00416	2.77023	14.2859	2.00153	6	125.00	2.13334	2.133338	0	0.6847	9.112641	6.238993	0.94231	32.61	44.2973	28.816
33.3	449.700	31.3	0.63	2.02	-5.48	13.5322	2.16152	2.80746	13.5508	2.15856	6	125.00	2.15384	2.153838	0	0.6814	8.939627	6.091342	0.90236	31.34	46.4254	28.463
33.628	449.372	31.82	0.66	2.08	-3.97	13.6343	2.2263	2.81229	13.6435	2.22479	6	125.00	2.17434	2.174338	0	0.6782	9.106774	6.176912	0.91782	31.84	46.706	28.509
33.956	449.044	28.86	0.57	1.98	-2.68	12.149	2.13762	2.84432	12.1581	2.13602	6	125.00	2.19484	2.194838	0	0.675	8.41085	5.677259	0.82555	28.88	48.5967	27.736
34.284	448.716	23.21	0.5	2.14	-1.27	9.47696	2.38156	2.96057	9.48147	2.38042	6	125.00	2.21534	2.215338	0	0.6719	7.241997	4.865622	0.64999	23.22	55.8673	26.057
34.612	448.388	20.41	0.42	2.06	0.02	8.12857	2.31097	3.0103	8.12857	2.31097	6	125.00	2.23584	2.235838	0	0.6688	6.564749	4.390339	0.56267	20.41	59.1814	25.012
34.941	448.059	23.17	0.41	1.77	0.71	9.26857	1.96045	2.92469	9.26414	1.96138	6	125.00	2.2564	2.2564	0	0.6657	7.068599	4.705711	0.64748	23.16	53.5531	25.9
35.269	447.731	24.74	0.45	1.82	2.5	9.86565	2.00329	2.90667	9.85687	2.00507	6	125.00	2.2769	2.2769	0	0.6627	7.464431	4.946804	0.69545	24.72	52.4146	26.32
35.597	447.403	23.56	0.62	2.64	4.16	9.25507	2.91592	3.01628	9.24637	2.91866	5	125.00	2.2974	2.2974	0	0.6598	7.609665	5.020503	0.65828	23.54	59.7243	25.887
35.925	447.075	26.46	0.63	2.39	12.8	10.419	2.60955	2.95013	10.3845	2.61823	6	135.00	2.3179	2.31712	0.0008	0.6569	8.175519	5.370826	0.74743	26.38	55.1876	26.673
36.253	446.747	24.52	0.58	2.37	14.27	9.52328	2.61497	2.98363	9.48463	2.62563	6	135.00	2.34004	2.329026	0.011	0.6553	7.72807	5.063885	0.68659	24.43	57.3883	26.063
36.581	446.419	23.35	0.59	2.53	14.8	8.96558	2.81115	3.02295	8.92713	2.82326	5	135.00	2.36218	2.340933	0.0212	0.6536	7.541419	4.928997	0.64978	23.26	60.0438	25.655
36.909	446.091	20.73	0.59	2.83	15.59	7.79725	3.21602	3.10619	7.759	3.23187	5	135.00	2.38432	2.352839	0.0315	0.6519	7.064855	4.605822	0.56798	20.64	65.9272	24.708
37.237	445.763	23.32	0.68	2.92	16.49	8.84389	3.25148	3.06352	8.8016	3.2671	5	135.00	2.40646	2.364746	0.0417	0.6503	7.727244	5.024958	0.64748	23.22	62.8665	25.566
37.565	445.435	24.74	0.81	3.26	8.36	9.38774	3.63043	3.06819	9.36671	3.63859	5	135.00	2.4286	2.376652	0.0519	0.6487	8.24148	5.34592	0.69076	24.69	63.1968	25.99

Depth (ft)	San (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	ress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	445.107	23.87	0.87	3.63	-3.35	8.96744	4.06176	3.11089	8.97582	4.05798	5	135.00	2.45074	2.388558	0.0622	0.647	8.203105	5.307748	0.66313	23.89	66.2702	25.705
38.221	444.779	22.91	0.77	3.37	-3.42	8.51382	3.76765	3.10987	8.52632	3.76213	5	135.00	2.47268	2.400465	0.0724	0.6454	7.871536	5.080563	0.63273	22.94	66.196	25.361
38.549	444.451	25.19	0.68	2.69	-2.47	9.40775	2.99626	3.01817	9.41189	2.99494	5	135.00	2.49502	2.412371	0.0826	0.6438	8.145735	5.24455	0.70263	25.2	59.717	26.032
38.877	444.123	22.12	0.7	3.15	-2.17	8.08605	3.57091	3.11545	8.09018	3.56909	5	135.00	2.51716	2.424278	0.0929	0.6423	7.62211	4.895353	0.6069	22.13	66.604	25.012
39.206	443.794	19.76	0.61	3.07	3.07	7.06859	3.54226	3.1627	7.06036	3.54636	5	135.00	2.53937	2.43622	0.1031	0.6407	7.022462	4.499157	0.53315	19.74	70.1291	24.097
39.534	443.466	24.4	0.75	3.06	4.32	8.92049	3.4343	3.07189	8.90824	3.43903	5	135.00	2.56151	2.448127	0.1134	0.6391	8.154368	5.211628	0.67611	24.37	63.4594	25.669
39.862	443.138	25.59	0.74	2.9	5.43	9.35205	3.2165	3.03903	9.33579	3.22211	5	135.00	2.58365	2.460033	0.1236	0.6376	8.369236	5.335994	0.71227	25.55	61.1526	25.988
40.19	442.810	25.05	0.72	2.86	6.14	9.0796	3.20795	3.04897	9.06341	3.21368	5	135.00	2.60579	2.47194	0.1338	0.636	8.244866	5.244024	0.69487	25.01	61.8447	25.792
40.518	442.482	23.27	0.76	3.25	7.14	8.31053	3.6818	3.11505	8.2904	3.69074	5	135.00	2.62793	2.483846	0.1441	0.6345	7.995391	5.073146	0.63907	23.22	66.5748	25.193
40.846	442.154	25.96	0.88	3.4	8.43	9.33984	3.77521	3.08008	9.3166	3.78496	5	135.00	2.65007	2.495752	0.1543	0.633	8.713036	5.515295	0.72167	25.9	64.0434	25.982
41.174	441.826	25.09	1.01	4.03	8.59	8.93973	4.50535	3.14056	8.91979	4.51542	4	135.00	2.67221	2.507659	0.1645	0.6315	8.772768	5.539906	0.69405	25.04	68.4623	25.693
41.502	441.498	23.31	0.9	3.85	10.14	8.18223	4.36561	3.16384	8.15841	4.37836	4	135.00	2.69435	2.519565	0.1748	0.63	8.27767	5.214892	0.63826	23.25	70.2152	25.096
41.83	441.170	22.11	0.83	3.76	10.72	7.66096	4.27978	3.16239	7.63331	4.29529	4	135.00	2.71649	2.531472	0.185	0.6285	7.949599	4.996417	0.60042	22.04	71.6336	24.65
42.158	440.842	22.65	0.97	4.29	10.46	7.62871	4.87159	3.20785	7.60119	4.88877	4	135.00	2.73863	2.543378	0.1952	0.627	8.293291	5.200217	0.61645	22.58	73.6096	24.8
42.486	440.514	21.66	0.88	4.07	10.99	7.39614	4.65627	3.21626	7.36874	4.67358	4	135.00	2.76077	2.555284	0.2055	0.6256	7.977884	4.990776	0.58512	21.59	74.2704	24.42
42.814	440.186	22.04	0.74	3.34	10.67	7.50123	3.84274	3.16291	7.47396	3.85676	5	135.00	2.78291	2.567191	0.2157	0.6241	7.8169	4.878716	0.59619	21.97	70.1447	24.518
43.143	439.857	19.95	0.77	3.87	8.24	6.64754	4.49114	3.24432	6.62815	4.50427	4	135.00	2.80512	2.579133	0.226	0.6227	7.505574	4.673551	0.5308	19.9	76.5026	23.717
43.471	439.529	17	0.74	4.34	6.35	5.46991	5.22129	3.35118	5.45447	5.23607	3	135.00	2.82726	2.59104	0.2362	0.6212	6.944066	4.313967	0.43878	16.96	85.4106	22.424
43.799	439.201	19.37	0.84	4.35	6.47	6.34689	5.08456	3.29171	6.33152	5.0969	3	135.00	2.8494	2.602946	0.2464	0.6198	7.554698	4.692573	0.51147	19.33	80.3734	23.418
44.127	438.873	21.4	1.06	4.94	0.86	7.08585	5.72093	3.28218	7.08585	5.72093	3	135.00	2.87164	2.614853	0.2567	0.6184	8.303236	5.134803	0.57364	21.4	79.585	24.174
44.455	438.545	19.64	0.74	3.76	-0.78	6.37528	4.41888	3.25299	6.37909	4.41624	4	135.00	2.89368	2.626769	0.2669	0.617	7.458995	4.60225	0.51846	19.65	77.2014	23.476
44.783	438.217	15.29	0.69	5.63	-1.04	4.68956	7.19239	3.48477	4.69335	7.18659	3	135.00	2.91582	2.638665	0.2771	0.6156	7.014831	4.318422	0.3831	15.3	97.4824	21.456
45.111	437.889	18.24	0.81	4.42	1.23	5.77311	5.29341	3.33425	5.76934	5.29687	3	135.00	2.93796	2.650572	0.2874	0.6142	7.364226	4.52332	0.47375	18.23	83.9559	22.816
45.439	437.561	23.11	0.9	3.9	2.4	7.5681	4.46652	3.19593	7.56059	4.47096	4	135.00	2.9601	2.662478	0.2976	0.6129	8.408624	5.153258	0.62384	23.09	72.6801	24.62
45.767	437.233	23.58	1.04	4.42	10.81	7.70187	5.04909	3.22274	7.6757	5.06631	4	135.00	2.98224	2.674365	0.3079	0.6115	8.728223	5.337205	0.6377	23.51	74.782	24.724
46.095	436.905	23.42	0.95	4.05	11.02	7.59993	4.6533	3.20639	7.57387	4.66931	4	135.00	3.00438	2.686291	0.3181	0.6101	8.56709	5.227052	0.63206	23.35	73.495	24.638
46.423	436.577	19.68	0.81	4.12	11.46	6.17208	4.86385	3.29142	6.14613	4.88438	4	135.00	3.02652	2.698197	0.3283	0.6088	7.662429	4.664783	0.51559	19.61	80.3493	23.25
46.751	436.249	18.67	0.6	3.22	13.05	5.76411	3.8409	3.25826	5.73459	3.86067	5	135.00	3.04866	2.710104	0.3386	0.6074	7.084343	4.303349	0.48363	18.59	77.6282	22.795
47.079	435.921	19.1	0.56	2.91	15.36	5.88874	3.49362	3.22851	5.852	3.51556	5	135.00	3.0708	2.72201	0.3488	0.6061	7.083552	4.293448	0.49626	19	75.2399	22.932
47.408	435.592	21.41	0.69	3.23	16.68	6.69982	3.76699	3.19955	6.66324	3.78767	5	135.00	3.093	2.733953	0.359	0.6048	7.780455	4.70554	0.56709	21.31	72.9615	23.796
47.736	435.264	49.22	1.77	3.6	20.42	16.7907	3.83907	2.88182	16.7433	3.84993	5	135.00	3.11514	2.746869	0.3693	0.6035	14.60876	8.816054	1.42739	49.09	50.8702	29.92
48.064	434.936	108.31	4.31	3.98	24.9	38.1369	4.09802	2.63254	38.0789	4.10426	5	135.00	3.13728	2.757766	0.3795	0.6022	26.10668	16.92509	3.25612	108.15	36.9683	35.099
48.392	434.608	174.86	6.35	3.63	23.46	61.9931	3.6983	2.45237	61.9389	3.70153	12	135.00	3.15942	2.769672	0.3898	0.6009	41.59558	24.99384	5.31581	174.71	28.5992	37.947
48.72	434.280	126.51	6.37	5.04	9.38	44.3376	5.16507	2.65754	44.316	5.16758	11	135.00	3.18156	2.781579	0.4	0.5996	33.2856	19.95771	3.81822	126.45	38.2371	36.007
49.048	433.952	166.9	6.34	3.8	22.06	58.5993	3.87303	2.48371	58.5492	3.87634	12	135.00	3.2037	2.793485	0.4102	0.5983	40.29083	24.10644	5.068	166.76	29.9602	37.628
49.376	433.624	185.28	8	4.32	29.84	64.8944	4.3943	2.49436	64.8267	4.39889	11	135.00	3.22584	2.805391	0.4205	0.597	44.94566	26.83435	5.63635	185.09	30.4315	38.206
49.704	433.296	146.4	7.86	5.37	33.05	50.8118	5.49067	2.63756	50.7373	5.49873	11	135.00	3.24798	2.817298	0.4307	0.5958	38.08986	22.69306	4.43195	146.19	37.2207	36.803
50.032	432.968	154.76	6.18	3.99	62.54	53.5451	4.07948	2.52808	53.4072	4.09001	12	135.00	3.27012	2.829204	0.4409	0.5945	38.09591	22.64885	4.69009	154.37	31.9538	37.1
50.36	432.640	137.82	5.3	3.84	25.31	47.3504	3.93971	2.55353	47.2941	3.9444	12	135.00	3.29226	2.841111	0.4512	0.5933	34.39466	20.40549	4.16495	137.66	33.1337	36.392
50.688	432.312	83.38	3.81	4.57	22.91	28.0635	4.7586	2.77386	28.0144	4.76693	11	135.00	3.3144	2.853017	0.4614	0.592	23.30703	13.79859	2.47881	83.24	44.5017	33.219
51.016	431.984	58.49	2.41	4.12	21.11	19.2513	4.36963	2.87161	19.2059	4.37995	5	135.00	3.33654	2.864923	0.4716	0.5908	17.26483	10.20013	1.70764	58.36	50.2442	30.822
51.345	431.655	40.89	1.24	3.03	26.95	13.0459	3.30391	2.92987	12.9868	3.31895	6	135.00	3.35975	2.876866	0.4819	0.5898	12.46659	7.350011	1.16196	40.72	53.8834	28.264
51.673	431.327	51.35	1.29	2.52	29.37	16.6054	2.68923	2.79202	16.5431	2.69936	6	135.00	3.38089	2.888772	0.4921	0.5884	14.47144	8.514418	1.48511	51.17	45.5351	29.856
52.001	430.999	79.13	2.66	3.36	27.12	26.1066	3.51262	2.70938	26.048	3.52052	6	135.00	3.40303	2.900679	0.5024	0.5872	21.35463	12.5384	2.34449	78.96	40.9545	32.766
52.329	430.671	74.91	5.41	7.23	-2.71	24.5434	7.56804	2.95489	24.5503	7.56592	11	135.00	3.42517	2.912585	0.5126	0.586	23.28897	13.64618	2.21315	74.93	55.4968	32.394
52.657	430.343	267.69	12.98	4.85	-1.85	90.3561	4.91215	2.43828	90.3585	4.91197	11	135.00	3.44731	2.924492	0.5228	0.5848	63.31944	37.02643	8.18089	267.7	27.9998	40.035

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 24 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-5B

ConeTec Inc .erpretation
Interpretation - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4397
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-5B
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/30/10
CPT Time: 15:44
CPT File: 804CP05B.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 479.9

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
130	Coarse Refuse	38.10	1.25	40.93	19.30	2.15
125	Soil Embankment	31.26	1.88	62.63	50.48	2.84

User Inputs:

Assumed: Water Table Depth (ft): 28 Ground Surface Elev. 479.9
Nk: 32.3
State Parameter: 1.2 CPT area ratio: 0.85
Unit Weight of Soil (pcf): Varies See Below See Below Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	479.736	18.44	0.14	0.76	0.34	1728.83	0.760	1.13	1727.89	0.76	6	130.00	0.011	0.011	0.000	2.000	2.71	5.42	0.571	18.43	1.1328	32.78
0.492	479.408	23.22	0.26	1.12	0.21	726.079	1.121	1.41	725.06	1.12	6	130.00	0.032	0.032	0.000	2.000	3.72	7.44	0.718	23.22	1.62884	49.62
0.82	479.080	13.32	0.2	1.51	0.02	248.906	1.508	1.76	248.91	1.51	6	130.00	0.053	0.053	0.000	2.000	2.40	4.80	0.411	13.32	1.35209	45.08
1.148	478.752	12.84	0.15	1.17	0.16	171.072	1.175	1.79	171.07	1.18	6	130.00	0.075	0.075	0.000	2.000	2.33	4.67	0.395	12.84	1.64987	43.90
1.476	478.424	38.97	0.24	0.62	0.39	405.191	0.617	1.33	405.09	0.62	7	130.00	0.096	0.096	0.000	2.000	6.09	12.18	1204	38.96	0.7066	47.24
1.804	478.096	74.14	0.58	0.78	0.09	831.27	0.784	1.30	831.18	0.78	8	130.00	0.117	0.117	0.000	2.000	11.49	22.97	2.892	74.18	0.40522	48.07
2.133	477.767	60.91	0.73	1.2	0.14	438.323	1.201	1.54	438.32	1.20	7	130.00	0.139	0.139	0.000	2.000	10.18	20.36	1.581	60.91	3.43634	47.58
2.461	477.439	49.52	0.69	1.42	0.23	302.316	1.427	1.69	302.32	1.43	7	130.00	0.160	0.160	0.000	2.000	8.54	17.07	1.497	49.52	5.99658	45.97
2.789	477.111	43.89	0.75	1.7	0.09	241.105	1.716	1.82	241.10	1.72	7	130.00	0.181	0.181	0.000	2.000	8.06	16.12	1.353	43.89	8.4724	44.94
3.117	476.783	44.62	0.57	1.28	0.05	219.231	1.283	1.74	219.23	1.28	7	130.00	0.203	0.203	0.000	2.000	7.99	15.97	1.375	44.62	6.85479	44.49
3.445	476.455	38.58	0.44	1.13	0.02	171.29	1.147	1.78	171.29	1.15	7	130.00	0.224	0.224	0.000	2.000	6.99	13.98	1.167	38.58	7.68486	43.31
3.773	476.127	23.25	0.37	1.57	-0.61	93.8032	1.608	2.07	93.80	1.61	6	130.00	0.245	0.245	0.000	2.000	4.70	9.39	0.712	23.25	14.8691	40.23
4.101	475.799	18.59	0.19	1.02	-0.32	68.7391	1.037	2.05	68.74	1.04	6	130.00	0.267	0.267	0.000	1.937	3.72	7.31	0.567	18.59	14.2745	38.52
4.429	475.471	17.34	0.16	0.92	-0.21	59.2324	0.938	2.07	59.23	0.94	6	130.00	0.288	0.288	0.000	1.884	3.51	6.64	0.528	17.34	16.0432	37.66
4.757	475.143	25.61	0.26	1.09	-0.09	82.4721	1.098	2.00	82.47	1.10	7	130.00	0.309	0.309	0.000	1.798	6.08	9.13	0.780	25.61	12.0696	39.53
5.085	474.815	24.43	0.46	1.87	0.41	72.9127	1.909	2.20	72.91	1.91	6	130.00	0.331	0.331	0.000	1.789	5.20	9.05	0.746	24.43	18.9585	38.65
5.413	474.487	18.46	0.38	2.06	-0.64	51.4663	2.099	2.34	51.47	2.10	6	130.00	0.352	0.352	0.000	1.686	4.17	7.04	0.561	18.46	23.6842	36.87
5.741	474.159	16.54	0.27	1.61	-0.67	43.3236	1.670	2.33	43.35	1.67	6	130.00	0.373	0.373	0.000	1.637	3.73	6.11	0.501	16.55	23.7454	35.86
6.069	473.831	15.2	0.19	1.22	-0.62	37.5312	1.283	2.31	37.53	1.28	6	130.00	0.394	0.394	0.000	1.592	3.40	5.41	0.458	15.2	23.0694	34.99
6.398	473.502	15.29	0.17	1.08	-0.48	35.7663	1.143	2.30	35.79	1.14	6	130.00	0.416	0.416	0.000	1.551	3.41	6.28	0.460	15.3	22.6384	34.70
6.726	473.174	18.36	0.25	1.34	-0.09	40.9955	1.395	2.30	41.00	1.39	6	130.00	0.437	0.437	0.000	1.512	4.09	6.19	0.595	18.36	22.6937	35.52
7.054	472.846	20.73	0.37	1.77	0.23	44.2117	1.825	2.35	44.21	1.83	6	130.00	0.459	0.459	0.000	1.477	4.71	8.96	0.628	20.73	24.4234	35.97
7.382	472.518	11.94	0.22	1.8	-0.14	23.8838	1.920	2.68	23.88	1.92	5	130.00	0.480	0.480	0.000	1.444	3.02	4.35	0.355	11.94	34.1973	32.17
7.71	472.190	11.14	0.1	0.85	-0.35	21.2289	0.940	2.45	21.25	0.94	6	130.00	0.501	0.501	0.000	1.413	2.65	3.75	0.329	11.15	28.5942	31.42
8.038	471.862	15.59	0.13	0.8	-0.44	28.839	0.863	2.32	28.84	0.86	6	130.00	0.522	0.522	0.000	1.383	3.49	4.83	0.466	15.59	23.2198	33.96
8.366	471.534	15.96	0.17	1.04	-0.67	28.3496	1.103	2.38	28.37	1.10	6	130.00	0.544	0.544	0.000	1.356	3.68	4.99	0.477	15.97	25.5838	33.28
8.694	471.206	18.31	0.18	1.02	-0.46	32.5529	1.412	2.52	32.57	1.41	6	130.00	0.565	0.565	0.000	1.330	3.28	4.38	0.395	18.32	31.6281	31.81
9.022	470.878	16.16	0.14	0.84	-0.64	28.6566	0.899	2.36	28.68	0.90	6	130.00	0.588	0.588	0.000	1.306	3.69	4.81	0.462	16.16	24.7561	32.85
9.35	470.550	17.06	0.14	0.78	-0.6	28.6352	0.807	2.31	28.54	0.81	6	130.00	0.608	0.608	0.000	1.283	4.01	5.14	0.537	17.06	22.6351	33.30
9.678	470.222	14.69	0.11	0.72	-0.51	22.3519	0.782	2.39	22.37	0.78	6	130.00	0.629	0.629	0.000	1.261	3.41	4.30	0.435	14.7	28.1982	31.78
10.006	469.894	15.13	0.13	0.83	-0.32	22.263	0.898	2.42	22.28	0.90	6	130.00	0.650	0.650	0.000	1.240	3.56	4.41	0.448	15.14	27.4287	31.73
10.335	469.565	19.67	0.48	2.45	-0.05	28.2806	2.527	2.59	28.28	2.53	5	130.00	0.672	0.672	0.000	1.220	5.00	6.10	0.688	19.67	34.8607	33.24
10.663	469.237	22.61	0.74	3.23	-0.67	31.9104	3.346	2.63	31.91	3.35	5	130.00	0.693	0.693	0.000	1.201	5.92	7.11	0.885	22.61	36.7632	33.99
10.991	468.909	13.41	0.42	3.14	-0.42	17.7706	3.308	2.92	17.77	3.31	4	130.00	0.714	0.714	0.000	1.183	3.86	4.66	0.393	13.41	47.1932	30.26
11.319	468.581	19.13	0.26	1.36	-0.67	25.0012	1.413	2.48	25.00	1.41	6	130.00	0.736	0.736	0.000	1.166	4.62	6.39	0.669	19.13	29.9799	32.46
11.647	468.253	17.76	0.22	1.21	-0.62	22.4461	1.295	2.50	22.46	1.29	6	130.00	0.757	0.757	0.000	1.149	4.33	4.98	0.526	17.76	30.7942	31.78
11.975	467.925	18.33	0.28	1.53	-0.32	22.5491	1.595	2.55	22.55	1.60	6	130.00	0.778	0.778	0.000	1.133	4.57	5.18	0.543	18.33	32.9971	31.60
12.303	467.597	33.79	0.45	1.32	-0.58	41.2536	1.364	2.30	41.25	1.36	7	130.00	0.800	0.800	0.000	1.118	7.50	8.39	1.021	33.79	22.3995	36.56
12.631	467.269	97.99	1.27	1.31	0.35	117.621	1.315	1.94	117.62	1.32	8	130.00	0.821	0.821	0.000	1.104	19.70	20.64	2.990	97.99	1.13008	41.42
12.959	466.941	115.69	1.69	1.46	0.89	136.344	1.472	1.93	136.34	1.47	8	130.00	0.842	0.842	0.000	1.090	22.12	24.10	3.556	115.69	1.10264	42.17
13.287	466.613	120.13	2.46	1.95	0.69	145.042	1.964	2.00	145.04	1.96	7	130.00	0.864	0.864	0.000	1.076	24.61	26.70	3.878	120.13	12.9601	42.49
13.615	466.285	126.8	2.52	1.98	-0.67	142.281	2.001	2.01	142.28	2.00	7	130.00	0.885	0.885	0.000	1.063	25.06	26.63	3.898	126.8	13.2784	42.39
13.943	465.957	96.74	2.09	2.16	0.09	105.742	2.181	2.13	105.74	2.18	7	130.00	0.906	0.906	0.000	1.050	19.99	21.00	2.967	96.74	16.6031	40.66
14.271	465.629	74.23	1.62	2.18	-1.2	79.0224	2.210	2.22	79.03	2.21	7	130.00	0.928	0.928	0.000	1.038	15.94	16.65	2.269	74.24	19.5985	39.30
14.6	465.300	62.31	1	1.61	-0.99	64.6586	1.630	2.19	64.67	1.63	7	130.00	0.949	0.949	0.000	1.027	13.23	13.58	1.900	62.32	18.7205	38.18
14.928	464.972	62.86	1	1.59	-0.92	63.8034	1.615	2.19	63.81	1.61	7	130.00	0.970	0.970	0.000	1.015	13.38	13.57	1.917	62.89	18.7825	38.10
15.256	464.644	49.08	0.73	1.48	-1.5	48.4938	1.518	2.27	48.50	1.52	7	130.00	0.992	0.992	0.000	1.004	10.77	10.81	1.489	49.08	21.0776	36.52

R16598

Depth (ft)	San (ft)	AvgQl (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	.Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	464.316	46.97	0.47	1	1.56	45.3691	1.023	2.19	45.38	1.02	7	130.00	1.013	1.013	0.000	0.984	9.97	9.81	1.423	48.98	18.6666	36.13
15.912	463.988	56.81	0.64	1.12	-1.5	53.2271	1.147	2.16	53.94	1.15	7	130.00	1.034	1.034	0.000	0.983	11.90	11.70	1.727	58.82	17.6279	37.14
16.24	463.660	78.21	1	1.28	-1.71	73.5606	1.296	2.09	73.10	1.30	8	130.00	1.056	1.056	0.000	0.973	15.91	15.49	2.385	78.22	15.4178	38.87
16.568	463.332	70.07	1.01	1.44	-0.58	64.0662	1.4643	2.18	64.07	1.46	7	130.00	1.077	1.077	0.000	0.964	14.71	14.18	2.138	70.08	17.8431	38.19
16.896	463.004	58.9	0.8	1.36	-0.58	52.8319	1.384	2.22	52.63	1.38	7	130.00	1.098	1.098	0.000	0.954	12.83	12.05	1.790	58.9	19.5385	37.00
17.224	462.676	49.64	0.81	1.64	-0.21	43.3386	1.669	2.33	43.34	1.67	7	130.00	1.120	1.120	0.000	0.945	11.19	10.58	1.502	49.64	23.7508	35.65
17.552	462.348	41.77	0.69	1.64	-0.86	35.5121	1.698	2.40	36.62	1.70	7	130.00	1.141	1.141	0.000	0.936	9.73	9.11	1.258	41.76	26.5998	34.67
17.88	462.020	56.82	0.68	1.19	-0.42	47.69	1.222	2.22	47.69	1.22	7	130.00	1.162	1.162	0.000	0.926	12.19	11.31	1.723	56.82	19.5408	38.45
18.208	461.692	67.55	1.17	1.74	0.42	56.0755	1.76294	2.26108	56.0755	1.76294	7	130.00	1.18362	1.18362	0	0.9182	14.76722	13.67406	2.06489	67.55	21.1064	37.985
18.537	461.363	65.8	1.63	2.48	-0.64	53.6101	2.52341	2.3793	53.6101	2.52341	6	130.00	1.20491	1.204905	0	0.911	16.16043	14.80221	1.999985	65.8	25.5761	37.106
18.865	461.035	61.05	1.3	2.11	-0.67	49.2763	2.15147	2.36009	49.2763	2.15147	7	130.00	1.22623	1.226225	0	0.9031	14.07313	12.70883	1.87071	61.05	24.6197	36.814
19.193	460.707	47.05	0.79	1.67	-0.53	36.7141	1.7248	2.39828	36.7141	1.7248	7	125.00	1.24755	1.247545	0	0.8953	10.92664	9.782697	1.41803	47.05	26.3409	34.856
19.521	460.379	44.52	0.68	1.53	-0.9	34.1092	1.57218	2.39964	34.1171	1.57182	7	125.00	1.26805	1.268045	0	0.888	10.3478	9.189267	1.33907	44.53	26.3963	34.407
19.849	460.051	40.76	0.63	1.55	-0.25	30.6326	1.59609	2.44144	30.6326	1.59609	7	125.00	1.28855	1.288545	0	0.8809	9.665144	8.505678	1.22203	40.76	28.1337	33.741
20.177	459.723	38.62	0.63	1.64	-0.16	28.5024	1.68851	2.48112	28.5024	1.68851	7	125.00	1.30905	1.309045	0	0.874	9.319563	8.145509	1.16514	38.62	29.8463	33.291
20.505	459.395	44.39	0.75	1.69	-0.51	32.3874	1.74174	2.44416	32.3949	1.74133	7	125.00	1.32955	1.329545	0	0.8673	10.53065	9.132793	1.33314	44.4	28.2491	34.088
20.833	459.067	57.91	1.33	2.3	-0.41	41.8949	2.35149	2.43862	41.8949	2.35149	6	125.00	1.35005	1.350045	0	0.8606	13.69973	11.79066	1.76108	57.91	28.0145	35.652
21.161	458.739	25.08	1.34	5.36	-0.07	17.2993	5.65175	2.97846	17.2993	5.65175	3	125.00	1.37055	1.370545	0	0.8542	7.90839	6.75525	0.73404	25.08	57.0449	30.082
21.489	458.411	21.57	0.8	3.69	2.73	14.5063	3.96453	2.93879	14.4991	3.96649	4	125.00	1.39105	1.391045	0	0.8479	6.636117	5.626566	0.62474	21.56	54.455	28.914
21.817	458.083	29.59	0.95	3.2	6.9	19.9628	3.37137	2.78704	19.9345	3.37616	5	125.00	1.41155	1.411545	0	0.8417	8.334097	7.014733	0.8724	29.55	45.2501	31.009
22.145	457.755	33.08	1.22	3.68	8.57	22.0998	3.85491	2.79022	22.0649	3.86101	5	125.00	1.43205	1.432045	0	0.8356	9.331922	7.798171	0.97981	33.03	45.4317	31.665
22.473	457.427	36.31	1.19	3.29	9.54	23.9975	3.4139	2.72893	23.9562	3.41979	5	125.00	1.45255	1.452545	0	0.8297	9.906168	8.219431	1.07918	36.25	42.0101	32.192
22.802	457.098	35.83	1.22	3.4	9.26	23.3227	3.55096	2.74942	23.282	3.55717	5	125.00	1.47311	1.473108	0	0.8239	9.883284	8.142993	1.06368	35.77	43.1354	32.01
23.13	456.770	36.3	1.11	3.07	13.63	23.3036	3.18907	2.7202	23.25	3.19642	5	125.00	1.49361	1.493608	0	0.8182	9.862044	8.061356	1.0776	36.22	41.5368	32.001
23.458	456.442	34.31	1.06	3.08	15.82	21.6602	3.23211	2.74896	21.5942	3.242	5	125.00	1.51411	1.514108	0	0.8127	9.449872	7.679759	1.01535	34.21	43.1096	31.526
23.786	456.114	34.28	1.04	3.03	17.95	21.338	3.17602	2.74944	21.2663	3.18672	5	125.00	1.53461	1.534608	0	0.8072	9.441263	7.621342	1.01379	34.17	43.136	31.428
24.114	455.786	34.12	1.05	3.07	21.34	20.9406	3.22433	2.7603	20.857	3.23725	5	125.00	1.55511	1.555108	0	0.8019	9.44696	7.57551	1.0082	33.99	43.7399	31.302
24.442	455.458	33.09	1.19	3.59	20.71	20.0014	3.77605	2.8192	19.9189	3.79169	5	125.00	1.57661	1.576608	0	0.7987	9.463703	7.539406	0.97568	32.96	47.1098	31.004
24.77	455.130	35.21	1.24	3.53	21.94	21.0599	3.68895	2.79552	20.9722	3.70438	5	125.00	1.59611	1.596108	0	0.7915	9.937404	7.865781	1.04068	35.07	45.7358	31.338
25.098	454.802	35.32	1.2	3.39	24.9	20.8482	3.56047	2.78926	20.7554	3.57639	5	125.00	1.61661	1.616608	0	0.7865	9.93126	7.810917	1.04345	35.17	45.3767	31.27
25.426	454.474	33.07	1.09	3.29	27.37	19.2003	3.46771	2.81033	19.0964	3.48656	5	125.00	1.63711	1.637108	0	0.7816	9.399677	7.346396	0.97315	32.9	46.5923	30.729
25.754	454.146	30.14	0.89	2.96	28.13	17.1828	3.12474	2.82084	17.0742	3.14461	5	125.00	1.65761	1.657608	0	0.7767	8.610264	6.687682	0.88181	29.96	47.206	29.996
26.082	453.818	28.04	0.96	3.41	30.18	15.7093	3.64162	2.8929	15.5961	3.66806	5	125.00	1.67811	1.678108	0	0.772	8.341715	6.439401	0.81616	27.86	51.555	29.398
26.41	453.490	27.22	1.12	4.12	32.24	15.0249	4.38648	2.95894	14.9071	4.42314	4	125.00	1.69861	1.698608	0	0.7673	8.418813	6.459681	0.79014	27.02	55.761	29.099
26.739	453.161	25.07	1.08	4.3	31.06	13.5826	4.6251	3.00754	13.4721	4.66305	4	125.00	1.71917	1.71917	0	0.7627	7.988621	6.092736	0.72294	24.88	58.9941	28.424
27.067	452.833	22.52	0.88	3.89	31.69	11.945	4.23477	3.02853	11.83	4.27593	4	125.00	1.73967	1.73967	0	0.7582	7.262346	5.506094	0.64335	22.32	60.4271	27.552
27.395	452.505	23.13	1	4.33	31.09	12.1408	4.67949	3.04924	12.0328	4.72147	4	125.00	1.76017	1.76017	0	0.7537	7.563768	5.70113	0.6616	22.94	61.8634	27.667
27.723	452.177	24.42	1.29	5.28	27.74	12.7139	5.69805	3.08711	12.6129	5.74372	3	125.00	1.78067	1.78067	0	0.7494	8.192462	6.139354	0.70091	24.24	64.5468	27.983
28.051	451.849	25.99	1.44	5.53	25.13	13.4414	5.95316	3.07983	13.358	5.99031	3	135.00	1.80117	1.799579	0.0016	0.7454	8.691388	6.478936	0.74888	25.84	64.0251	28.368
28.379	451.521	24.42	1.32	5.42	22.7	12.4741	5.84156	3.09958	12.3913	5.8806	3	135.00	1.82331	1.811485	0.0118	0.743	8.270747	6.145077	0.69959	24.27	65.4465	27.867
28.707	451.193	24.47	1.16	4.75	25.24	12.4079	5.12717	3.06558	12.3202	5.16369	3	135.00	1.84545	1.823392	0.0221	0.7406	8.100847	5.99916	0.70045	24.31	63.0122	27.832
29.035	450.865	24.85	1.17	4.72	24.97	12.5224	5.09085	3.06047	12.4353	5.12654	3	135.00	1.86759	1.835298	0.0323	0.7382	8.200162	6.052979	0.71163	24.69	62.6514	27.897
29.363	450.537	25.04	1.24	4.96	25.89	12.5326	5.35631	3.07414	12.446	5.39359	3	135.00	1.88973	1.847204	0.0425	0.7358	8.337266	6.134317	0.71673	24.88	63.6191	27.906
29.691	450.209	24.64	1.36	5.51	22.33	12.2253	5.98377	3.1127	12.15	6.02086	3	135.00	1.91187	1.859111	0.0528	0.7334	8.422789	6.177365	0.70366	24.5	66.4024	27.747
30.019	449.881	19.78	1.13	5.7	16.6	9.53812	6.33195	3.21114	9.48467	6.36764	3	135.00	1.93401	1.871017	0.063	0.7311	7.245293	5.296842	0.55251	19.68	73.8677	26.083
30.347	449.553	16.42	0.86	5.37	15.59	7.68159	6.08413	3.27481	7.62848	6.12649	3	135.00	1.95615	1.882924	0.0732	0.7288	6.296958	4.588962	0.4478	16.32	78.9785	24.616
30.675	449.225	20.02	0.87	4.36	20.02	9.52155	4.82216	3.13916	9.45822	4.85445	4	135.00	1.97829	1.89483	0.0835	0.7265	6.965318	5.060062	0.55867	19.9	68.3583	26.072
31.004	448.896	23.04	1.19	5.16	16.63	11.0341	5.65603	3.1306	10.9816	5.66304	3	135.00	2.0005	1.906773	0.0937	0.7242	7.982538	5.780848	0.65138	22.94	67.7209	27.081
31.332	448.568	21.44	1.16	5.4	11.94	10.1202	5.97403	3.17402	10.0837	5.99565	3	135.00	2.02264	1.918679	0.104	0.7219	7.662654	5.531947	0.60116	21.37	70.991	26.51
31.66	448.240	16.83	1.16	6.88	4.5	7.65841	7.64567	3.34165	7.64287	7.65162	3	135.00	2.04478	1.930586	0.1142	0.7197	6.826488	4.913068	0.45775	16.8	84.59	24.646
31.988	447.912	14.1	1.08	7.64	2.65	6.19466	8.97526	3.44974	6.18437	8.9902	3	135.00	2.06692	1.942492	0.1244	0.7175	6.258887	4.490736	0.37254	14.08	94.2141	23.229
32.316	447.584	36.85	1.84	4.99	8.52	17.786	5.2933	2.95167	17.7553	5.30245	3	135.00	2.08906	1.954398	0.1347	0.7153	11.41236	8.163359	1.07619	36.79	55.2875	30.278
32.644	447.256	53.58	2.7	5.03	7.3	26.1754	5.2459	2.82443	26.15	5.251	4	135.00	2.1112	1.966305	0.1449	0.7131	15.41519	10.99318	1.59346	53.53	47.4168	32.767
32.972	446.928	41.03	2.46	5.99	2.4	19.6625	6.32445	2.97035	19.6524	6.3277	3	135.00	2.13334	1.978211	0.1551	0.711	12.86718	9.148439	1.20423	41.01	56.5089	30.942
33.3	446.600	30.73	1.67	5.43	5.52	14.3582	5.84437	3.04968	14.3431	5.85051	3	135.00	2.15548	1.990118	0.1654	0.7089	10.12626	7.177398	0.88466	30.7	61.8941	28.881
33.628	446.272	25.44	1.21	4.77	7.23	11.6194	5.20153	3.0884	11.5995	5.21049	3	135.00	2.17762	2.002024	0.1756	0.7067	8.591848	6.072283	0.7202	25.4	64.6397	27.47
33.956	445.944	24.48	1.07	4.38	8.06	11.0631	4.80246	3.08394	11.0382	4.81326	4	135.00	2.19976	2.01393	0.1858	0.7047	8.238887	5.80559	0.68979	24.43	64.3124	27.142
34.284	445.616	24.3	1.08	4.43	9.26	10.8983	4.89172	3.0942	10.8686	4.90505	4	135.00	2.2219	2.025837	0.1961	0.7026	8.231024	5.782979	0.68353	24.24	65.0574	27.041
34.612	445.288	25.03	1.22	4.87	9.17	11.182	5.35417	3.10955	11.1574	5.36595	3	135.00	2.24404	2.037743	0.2063	0.7005	8.569686	6.003302	0.70545	24.98	66.1725	27.219
34.941	444.959	21.34	0.88	4.11	11.34	9.3057	4.61367	3.13367	9.27155	4.63066	4	135.00	2.26625	2.049686	0.2166	0.6985	7.41695	5.180619	0.59052	21.27	67.9493	25.982
35.269	444.631	22.16	0.83	3.76	13.05	9.63896	4.17681	3.0961	9.59531	4.19582	4	135.00	2.28839	2.061592	0.2268	0.6965	7.503638	5.226013	0.61522	22.07	65.1947	26.215
35.597	444.303	27.65	1.08	3.92	12.93	12.2206	4.26212	3.01844	12.1821	4.27562	4	135.00	2.31053	2.073499	0.237	0.6945	8.913341	6.189971	0.7845	27.57	59.7354	27.812
35.925	443.975	41.71	1.36	3.26	15.45	18.8823	3.45376	2.81298	18.8392	3.46168	5	135.00	2.33267	2.085405	0.2473	0.6925	11.90861	8.246427	1.21911	41.62	46.7462	30.682
36.253	443.647	119.94	5.26	4.39	10.53	56.0647	4.47335	2.54245	56.0314	4.47602	11	135.00	2.35481	2.097311	0.2575	0.6905	29.76849	20.56918	3.64041	119.87	32.6167	37.373
36.581	443.319	232.64	9.81	4.21	-2.08	109.265	4.25665	2.33841	109.269	4.25646	12	135.00	2.37695	2.109218	0.2677	0.6886	52.64439	36.24861	7.13508	232.85	23.9715	41.04
36.909	442.991	245.39	11.65	4.75	-7.92	114.558	4.79442	2.36708	114.581	4.79343	11	135.00	2.39909	2.121124	0.278	0.6866	56.20318	38.59027	7.52294	245.44	25.0892	41.287
37.237	442.663	185.81	11.73	6.31	-9.21	85.9757	6.39625	2.54195	86.0038	6.39416	11	135.00	2.42123	2.133031	0.2882	0.6847	46.17875	31.61867	5.67767	185.87	32.5936	39.766
37.565	442.335	190.26	10.73	5.64	-3.86	87.5721	5.71241	2.49823	87.5814	5.7118	11	135.00	2.44337	2.144937	0.2984	0.6828	46.29593	31.61081	5.81538	190.3	30.6039	39.866

R16599

Depth (ft)	San. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	.Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
37.893	442.007	280.56	11.76	4.19	-0.79	128.936	4.22878	2.29281	128.941	4.22863	12	135.00	2.46551	2.156843	0.3087	0.6809	62.17955	42.33877	8.60974	280.57	22.2559	41.895
38.221	441.679	230.05	12.58	5.47	-8.43	104.928	5.52816	2.43946	104.951	5.52694	11	135.00	2.48765	2.16875	0.3189	0.679	54.45582	36.97767	7.04527	230.1	28.0501	40.829
38.549	441.351	214.58	12.79	5.96	-3.42	97.2506	6.03102	2.48953	97.2644	6.03017	11	135.00	2.50979	2.180656	0.3291	0.6772	51.99489	35.21008	6.56564	214.61	30.2173	40.427
38.877	441.023	252.97	15.89	6.28	5.22	114.222	6.34488	2.46678	114.208	6.34564	11	135.00	2.53193	2.192563	0.3394	0.6753	60.62771	40.94446	7.7535	252.94	29.2202	41.271
39.206	440.694	369.1	14.5	3.93	49.56	166.271	3.95585	2.20569	166.131	3.9592	12	135.00	2.55413	2.204505	0.3496	0.6735	78.75676	53.04353	11.3482	368.79	19.1864	43.163

R16600

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 28 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-6

ConeTec Inc .terpretation
Interpretation - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4364
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-6
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 12:00
CPT File: 804CP06.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 457.8

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	37.16	1.38	45.31	35.45	2.55

User Inputs:
Assumed: Water Table Depth (ft): 9.2
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 457.8
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tst)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	457.636	8.56	0.1	1.11	-0.53	834.122	1.170	1.40	834.12	1.17	5	125.00	0.010	0.010	0.000	2.000	1.37	2.74	0.265	8.56	1.52433	50.16
0.492	457.308	9.31	0.29	3.12	-2.93	301.764	3.125	1.98	302.41	3.12	4	125.00	0.031	0.031	0.000	2.000	1.82	3.64	0.287	9.33	12.388	45.97
0.82	456.980	10.89	0.47	4.33	-10.58	211.488	4.336	2.18	212.85	4.31	3	125.00	0.051	0.051	0.000	2.000	2.31	4.63	0.336	10.96	18.2558	44.35
1.148	456.652	15.32	0.83	5.4	-7.37	212.519	5.443	2.26	213.08	5.43	3	125.00	0.072	0.072	0.000	2.000	3.36	6.72	0.472	15.36	21.1963	44.36
1.476	456.324	38.89	1.49	3.84	3.12	420.572	3.840	1.99	420.36	3.84	5	125.00	0.092	0.092	0.000	2.000	7.62	15.25	1.201	38.87	12.7664	47.40
1.804	455.996	64.95	2.12	3.26	8.39	575.053	3.270	1.87	574.61	3.27	6	125.00	0.113	0.113	0.000	2.000	12.18	24.35	2.007	64.9	9.79283	48.70
2.133	455.667	91.43	3.22	3.53	-3.19	684.832	3.527	1.88	684.98	3.53	6	125.00	0.133	0.133	0.000	2.000	17.18	34.35	2.827	91.46	9.86183	49.40
2.461	455.339	106.27	4.78	4.5	0.53	689.906	4.504	1.98	689.84	4.50	11	125.00	0.154	0.154	0.000	2.000	20.72	41.43	3.285	106.26	12.339	49.42
2.789	455.011	97.06	5.09	5.25	3.16	555.816	5.254	2.07	555.70	5.25	11	125.00	0.174	0.174	0.000	2.000	19.62	39.25	3.000	97.04	14.9656	48.56
3.117	454.683	83.61	4.4	5.26	13.6	428.182	5.275	2.12	427.72	5.28	11	125.00	0.195	0.195	0.000	2.000	17.19	34.38	2.583	83.52	16.2983	47.48
3.445	454.355	75.27	3.59	4.77	18.34	348.585	4.783	2.11	348.07	4.79	11	125.00	0.215	0.215	0.000	2.000	15.46	30.93	2.324	75.16	16.2656	46.59
3.773	454.027	65.07	3.24	4.98	11.57	274.94	4.997	2.18	274.64	5.00	11	125.00	0.236	0.236	0.000	2.000	13.73	27.45	2.007	65	18.2882	45.53
4.101	453.699	64.94	3.2	4.93	6.12	252.363	4.947	2.19	252.21	4.95	11	125.00	0.256	0.256	0.000	1.975	13.78	27.23	2.003	64.9	18.7426	45.14
4.429	453.371	63.37	3.12	4.93	5.33	227.928	4.946	2.21	227.82	4.95	11	125.00	0.277	0.277	0.000	1.901	13.57	25.80	1.953	63.34	19.4706	44.67
4.757	453.043	55.6	2.82	5.07	3.75	186.009	5.099	2.27	185.91	5.10	4	125.00	0.297	0.297	0.000	1.834	12.20	22.38	1.712	55.57	21.4653	43.71
5.085	452.715	46.31	2.63	5.68	-1.89	144.715	5.718	2.37	144.75	5.72	3	125.00	0.318	0.318	0.000	1.774	10.63	18.85	1.424	46.32	25.262	42.47
5.413	452.387	49.15	2.45	4.98	-2.28	144.28	5.019	2.33	144.31	5.02	4	125.00	0.338	0.338	0.000	1.719	11.05	19.00	1.511	49.16	23.4659	42.46
5.741	452.059	41.44	2.45	5.91	-3.05	114.492	5.964	2.44	114.55	5.96	3	125.00	0.359	0.359	0.000	1.669	9.63	16.41	1.272	41.46	28.2345	41.28
6.069	451.731	40.26	2.34	5.81	-3.23	105.139	5.868	2.46	105.19	5.86	3	125.00	0.379	0.379	0.000	1.624	9.62	15.62	1.235	40.28	28.9115	40.83
6.398	451.402	35.34	1.94	5.49	-2.68	87.3776	5.552	2.49	87.43	5.55	3	125.00	0.400	0.400	0.000	1.581	8.56	13.64	1.082	35.36	30.1642	39.85
6.726	451.074	29.43	1.47	4.99	-1.85	69.0089	5.067	2.52	69.06	5.06	3	125.00	0.420	0.420	0.000	1.542	7.25	11.18	0.898	29.45	31.6997	38.55
7.054	450.746	22.96	1.12	4.89	-1.15	51.0783	4.974	2.60	51.10	4.97	3	125.00	0.441	0.441	0.000	1.508	5.88	8.66	0.697	22.97	35.5076	36.83
7.382	450.418	22.39	1.27	5.66	-4.08	47.5289	5.792	2.67	47.59	5.78	3	125.00	0.461	0.461	0.000	1.472	5.96	8.76	0.679	22.42	39.0065	36.41
7.71	450.090	24.72	1.47	5.94	-5.27	50.2996	6.065	2.67	50.38	6.05	3	125.00	0.482	0.482	0.000	1.441	6.56	9.46	0.750	24.76	38.9216	36.74
8.038	449.762	25.96	1.6	6.18	-6.42	50.6745	6.285	2.68	50.76	6.28	3	125.00	0.502	0.502	0.000	1.411	6.93	9.77	0.788	26	39.4189	36.79
8.366	449.434	23.65	1.49	6.3	-8.13	44.2307	6.443	2.73	44.33	6.43	3	125.00	0.523	0.523	0.000	1.383	6.47	8.95	0.716	23.7	41.9185	35.99
8.694	449.106	24.35	1.37	5.64	-8.36	43.8125	5.755	2.69	43.90	5.74	3	125.00	0.543	0.543	0.000	1.357	6.55	8.88	0.737	24.4	40.1258	35.93
9.022	448.778	28.28	1.49	5.28	-7.83	49.153	5.376	2.64	49.24	5.37	3	125.00	0.564	0.564	0.000	1.332	7.38	9.83	0.858	28.33	37.2649	36.61
9.35	448.450	28.51	1.65	5.78	-7.81	48.173	5.909	2.67	48.24	5.90	3	135.00	0.584	0.580	0.005	1.313	7.58	9.96	0.865	28.65	39.1366	36.49
9.678	448.122	28.8	1.69	5.86	-6.77	47.6662	5.994	2.68	47.72	5.99	3	135.00	0.607	0.592	0.016	1.300	7.69	10.00	0.873	28.84	39.5436	36.43
10.006	447.794	30.6	1.75	5.68	-4.18	49.9933	5.800	2.66	50.03	5.80	3	135.00	0.629	0.604	0.025	1.287	8.12	10.45	0.934	30.82	38.2961	36.71
10.335	447.465	27.19	1.42	5.23	-3.86	43.1215	5.351	2.68	43.17	5.34	3	135.00	0.651	0.615	0.035	1.275	7.23	9.22	0.822	27.22	39.1905	35.84
10.663	447.137	24.41	1.15	4.72	-3.58	37.8365	4.845	2.68	37.87	4.84	3	135.00	0.673	0.627	0.046	1.263	6.52	8.23	0.735	24.43	39.6428	35.06
10.991	446.809	22.72	0.94	4.13	-3.23	34.4535	4.268	2.68	34.48	4.26	4	135.00	0.695	0.639	0.056	1.251	6.04	7.55	0.682	22.74	39.1418	34.49
11.319	446.481	22.41	0.82	3.65	-2.63	33.3135	3.760	2.65	33.33	3.76	5	135.00	0.717	0.651	0.066	1.239	5.88	7.28	0.672	22.42	37.8448	34.28
11.647	446.153	22.09	0.86	3.9	-2.01	32.1993	4.028	2.68	32.21	4.03	4	135.00	0.739	0.663	0.076	1.228	5.86	7.23	0.661	22.1	39.3712	34.08
11.975	445.825	19.57	0.82	4.2	-1.41	27.8651	4.360	2.75	27.88	4.36	4	135.00	0.762	0.675	0.087	1.217	5.41	6.68	0.582	19.58	43.1036	33.18
12.303	445.497	18.59	0.79	4.26	-0.78	25.9231	4.437	2.78	25.92	4.44	4	135.00	0.784	0.687	0.097	1.207	5.22	6.29	0.551	18.59	44.7056	32.73
12.631	445.169	16.32	0.81	4.95	-0.6	22.2013	5.221	2.87	22.20	5.22	3	135.00	0.806	0.699	0.107	1.196	4.64	5.79	0.480	16.32	50.4414	31.75
12.959	444.841	19.07	0.83	4.36	0.74	25.6676	4.550	2.79	25.67	4.55	3	135.00	0.828	0.711	0.117	1.186	5.38	6.38	0.565	19.07	45.3058	32.67
13.287	444.513	21.2	1	4.73	8.36	28.1617	4.914	2.78	28.09	4.93	3	135.00	0.850	0.723	0.128	1.176	5.95	7.00	0.630	21.15	45.0064	33.24
13.615	444.185	20.7	0.95	4.58	10.95	26.9943	4.791	2.79	26.91	4.81	3	135.00	0.872	0.735	0.138	1.167	5.83	6.80	0.614	20.64	45.3618	32.97
13.943	443.857	23.12	1.2	5.2	13.55	29.7762	5.399	2.79	29.66	5.42	3	135.00	0.894	0.746	0.148	1.157	6.52	7.55	0.688	23.03	45.6855	33.58
14.271	443.529	29.53	1.34	4.53	13.72	37.7323	4.683	2.68	37.63	4.70	4	135.00	0.917	0.758	0.158	1.148	7.83	8.99	0.886	29.45	39.2582	35.04
14.6	443.200	26.74	0.91	3.39	16.67	33.4964	3.527	2.63	33.37	3.54	5	135.00	0.939	0.770	0.168	1.139	6.92	7.88	0.799	26.64	36.8635	34.31
14.928	442.872	20.25	0.7	3.44	21.11	24.6608	3.629	2.74	24.49	3.65	5	135.00	0.961	0.782	0.179	1.131	5.53	6.25	0.597	20.12	42.6233	32.39
15.256	442.544	17.79	0.62	3.49	24.51	21.1653	3.689	2.80	20.96	3.72	4	135.00	0.983	0.794	0.189	1.122	5.00	5.61	0.520	17.63	45.8297	31.41

R16602

Depth (ft)	Sa... (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pct)	...Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	442.216	15.28	0.55	3.61	26.19	17.7109	3.853	2.87	17.50	3.90	4	135.00	1.005	0.806	0.199	1.114	4.47	4.98	0.442	15.11	50.169	30.25
15.912	441.888	12.73	0.44	3.46	28.6	14.3083	3.760	2.94	14.09	3.82	4	135.00	1.027	0.818	0.209	1.106	3.86	4.27	0.362	12.55	54.4336	28.84
16.24	441.560	10.89	0.43	3.91	30.79	11.8589	4.370	3.05	11.63	4.46	3	135.00	1.049	0.830	0.220	1.098	3.52	3.86	0.305	10.7	61.5912	27.59
16.568	441.232	10.9	0.3	2.76	46.79	11.6767	3.052	2.96	11.33	3.15	4	135.00	1.072	0.842	0.230	1.090	3.32	3.61	0.304	10.61	56.0979	27.42
16.896	440.904	10.8	0.23	2.13	52.75	11.3708	2.370	2.91	11.00	2.45	5	135.00	1.094	0.854	0.240	1.082	3.18	3.44	0.301	10.48	52.8448	27.23
17.224	440.576	11.97	0.28	2.35	59.86	12.5406	2.580	2.90	12.10	2.67	5	135.00	1.116	0.865	0.250	1.075	3.49	3.75	0.336	11.59	52.0107	27.86
17.552	440.248	10.88	0.31	2.86	64.86	11.1029	3.182	3.00	10.66	3.32	4	135.00	1.138	0.877	0.261	1.068	3.35	3.57	0.302	10.48	58.4614	27.03
17.88	439.920	8.13	0.21	2.59	64.13	7.83716	3.013	3.12	7.39	3.20	4	135.00	1.160	0.889	0.271	1.060	2.67	2.83	0.216	7.73	67.0317	24.64
18.208	439.592	9.83	0.21	2.14	70.88	9.59534	2.428	2.99	9.11	2.56	5	135.00	1.182	0.901	0.281	1.053	2.99	3.15	0.266	9.39	57.9642	26.01
18.537	439.263	14.59	0.35	2.37	85.33	14.6581	2.615	2.85	14.07	2.72	5	135.00	1.204	0.913	0.291	1.046	4.11	4.30	0.414	14.05	49.0242	28.86
18.865	438.935	17.47	0.43	2.47	91.82	17.5587	2.647	2.79	16.94	2.74	5	135.00	1.227	0.925	0.302	1.040	4.77	4.96	0.503	16.9	45.2968	30.07
19.193	438.607	23.8	0.66	2.76	108.66	24.0676	2.927	2.70	23.34	3.02	5	135.00	1.249	0.937	0.312	1.033	6.23	6.44	0.698	23.12	40.6187	32.12
19.521	438.279	26.5	1.31	4.94	95.15	26.5877	5.192	2.83	25.97	5.32	3	135.00	1.271	0.949	0.322	1.027	7.49	7.69	0.781	25.91	47.7672	32.79
19.849	437.951	23.66	0.83	3.52	20.44	23.2793	3.711	2.76	23.15	3.73	5	135.00	1.293	0.961	0.332	1.020	6.56	6.69	0.692	23.54	43.9821	32.07
20.177	437.623	18.99	0.49	2.56	28.01	18.1706	2.772	2.77	18.00	2.80	5	135.00	1.315	0.973	0.342	1.014	5.26	5.34	0.547	18.82	44.4019	30.47
20.505	437.295	18.95	0.78	4.1	37.55	17.9877	4.429	2.91	17.65	4.49	4	135.00	1.337	0.985	0.353	1.008	5.65	5.70	0.545	18.72	52.3926	30.35
20.833	436.967	49.87	2.16	4.32	27.3	48.6795	4.453	2.58	48.51	4.47	5	135.00	1.359	0.997	0.363	1.002	12.61	12.63	1.502	49.7	34.6157	36.57
21.161	436.639	83.66	5.29	6.33	-14.43	81.5902	6.429	2.55	81.68	6.42	11	135.00	1.382	1.008	0.373	0.996	20.96	20.87	2.547	83.75	33.2996	39.50
21.489	436.311	243.98	10.44	4.28	-17.83	237.74	4.304	2.15	237.85	4.30	11	135.00	1.404	1.020	0.383	0.990	50.99	50.48	7.510	244.09	17.4322	44.88
21.817	435.983	336.34	16.44	4.89	-19.33	324.451	4.909	2.14	324.57	4.91	11	135.00	1.426	1.032	0.394	0.984	69.87	68.77	10.369	336.46	16.9751	46.29
22.145	435.655	423.23	17.94	4.24	-18.68	403.946	4.253	2.04	404.05	4.25	12	135.00	1.448	1.044	0.404	0.979	84.57	82.76	13.058	423.34	14.0663	47.24

50 / 48
R16603

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 31 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY TJS DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-7

ConeTec Inc. erpretation
Interpretation Of Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4331
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-7
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 07:56
CPT File: 804CP07.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 457.8

Material Types and Unit Weight (pcf)	Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125 Residual Soil	39.96	1.80	58.51	25.19	2.31

User Inputs:
Assumed: Water Table Depth (ft): 9.2
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 457.8
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	457.636	9.8	0.17	1.69	-0.53	955.098	1.737	1.54	955.10	1.74	5	125.00	0.010	0.010	0.000	2.000	1.64	3.27	0.303	9.8	3.41567	50.67
0.492	457.308	30.91	0.44	1.41	-5.98	1004.2	1.425	1.45	1005.50	1.42	6	125.00	0.031	0.031	0.000	2.000	5.02	10.05	0.956	30.95	2.16306	50.86
0.82	456.980	42	0.69	1.65	-14.97	818.512	1.645	1.54	820.46	1.64	7	125.00	0.051	0.051	0.000	2.000	7.03	14.07	1.299	42.1	3.40523	50.09
1.148	456.652	38.42	0.68	1.76	-15.08	534.47	1.773	1.64	536.86	1.77	6	125.00	0.072	0.072	0.000	2.000	6.66	13.33	1.187	38.52	5.10589	48.41
1.476	456.324	35.13	0.57	1.61	-15.89	379.813	1.627	1.68	380.90	1.62	6	125.00	0.092	0.092	0.000	2.000	6.18	12.36	1.085	35.23	5.82026	46.98
1.804	455.996	33.61	0.6	1.77	-9.56	297.093	1.791	1.78	297.63	1.79	6	125.00	0.113	0.113	0.000	2.000	6.10	12.20	1.037	33.67	7.65399	45.90
2.133	455.667	35.29	0.79	2.24	-0.3	263.716	2.247	1.89	263.79	2.25	6	125.00	0.133	0.133	0.000	2.000	6.66	13.32	1.088	35.3	10.1362	45.35
2.461	455.339	39.86	1	2.5	-0.42	258.147	2.518	1.94	258.15	2.52	6	125.00	0.154	0.154	0.000	2.000	7.65	15.30	1.229	39.86	11.2767	45.25
2.789	455.011	41.14	1.05	2.55	-0.46	235.013	2.563	1.96	235.01	2.56	6	125.00	0.174	0.174	0.000	2.000	7.98	15.97	1.268	41.14	12.0156	44.82
3.117	454.683	36.47	0.82	2.25	-0.6	186.206	2.260	1.98	186.26	2.26	6	125.00	0.195	0.195	0.000	2.000	7.12	14.23	1.123	36.48	12.3943	43.72
3.445	454.355	34.59	0.81	2.35	-0.76	159.65	2.356	2.03	159.65	2.36	6	125.00	0.215	0.215	0.000	2.000	6.89	13.79	1.064	34.59	13.9069	42.96
3.773	454.027	45.16	1.24	2.75	-0.76	190.508	2.760	2.04	190.51	2.76	6	125.00	0.236	0.236	0.000	2.000	9.03	18.06	1.391	45.16	14.1489	43.82
4.101	453.699	52.95	1.71	3.23	-0.23	205.584	3.245	2.08	205.58	3.25	6	125.00	0.256	0.256	0.000	1.976	10.75	21.24	1.631	52.95	15.2795	44.19
4.429	453.371	39.45	1.59	4.04	4.97	141.515	4.059	2.26	141.41	4.06	5	125.00	0.277	0.277	0.000	1.901	8.60	16.34	1.213	39.42	20.8937	42.36
4.757	453.043	25.66	0.97	3.77	17.39	85.3065	3.825	2.37	84.94	3.84	5	125.00	0.297	0.297	0.000	1.834	5.87	10.76	0.785	25.55	25.3185	39.69
5.085	452.715	16.21	0.6	3.68	17.83	50.0049	3.775	2.53	49.63	3.80	4	125.00	0.318	0.318	0.000	1.774	3.97	7.04	0.492	16.09	31.9342	36.66
5.413	452.387	12.96	0.42	3.21	19.31	37.3078	3.328	2.58	36.95	3.36	4	125.00	0.338	0.338	0.000	1.719	3.25	5.59	0.391	12.84	34.5011	34.90
5.741	452.059	11.85	0.37	3.13	19.93	32.0256	3.220	2.62	31.66	3.26	4	125.00	0.359	0.359	0.000	1.669	3.03	5.06	0.356	11.72	36.5018	33.95
6.069	451.731	10.67	0.33	3.1	21.39	27.1298	3.207	2.68	26.79	3.25	4	125.00	0.379	0.379	0.000	1.624	2.80	4.55	0.319	10.54	39.2642	32.90
6.398	451.402	9.96	0.31	3.07	23.76	23.9078	3.243	2.72	23.53	3.29	4	125.00	0.400	0.400	0.000	1.581	2.67	4.23	0.296	9.81	41.7687	32.08
6.726	451.074	9.7	0.29	2.95	38.8	22.0746	3.125	2.75	21.50	3.21	4	125.00	0.420	0.420	0.000	1.542	2.61	4.03	0.287	9.46	43.0291	31.50
7.054	450.746	14.29	0.34	2.35	47.48	31.4128	2.455	2.56	30.73	2.51	5	125.00	0.441	0.441	0.000	1.506	3.51	5.28	0.429	13.99	33.4317	33.76
7.382	450.418	16.68	0.5	3	58.9	35.1528	3.083	2.59	34.37	3.15	5	125.00	0.461	0.461	0.000	1.472	4.15	6.10	0.502	16.32	34.7346	34.45
7.71	450.090	21.63	0.76	3.61	62.19	43.8872	3.688	2.57	43.08	3.76	5	125.00	0.482	0.482	0.000	1.441	5.34	7.70	0.655	21.24	33.789	35.82
8.038	449.762	21.3	0.89	4.19	65.68	41.3986	4.279	2.63	40.58	4.37	4	125.00	0.502	0.502	0.000	1.411	5.43	7.66	0.644	20.89	36.9226	35.46
8.366	449.434	20.62	0.75	3.62	74.41	38.4358	3.732	2.62	37.54	3.82	4	125.00	0.523	0.523	0.000	1.383	5.19	7.18	0.622	20.15	36.1207	34.99
8.694	449.106	21.71	0.73	3.35	81.34	38.954	3.449	2.59	38.03	3.53	5	125.00	0.543	0.543	0.000	1.357	5.39	7.31	0.655	21.21	34.7719	35.07
9.022	448.778	22.26	0.62	2.79	96.35	38.4768	2.858	2.54	37.41	2.94	5	125.00	0.564	0.564	0.000	1.332	5.37	7.16	0.672	21.66	32.4751	34.97
9.35	448.450	20.7	0.61	2.93	91.74	34.7004	3.032	2.59	33.70	3.12	5	135.00	0.584	0.580	0.005	1.313	5.12	6.73	0.623	20.12	34.9106	34.33
9.678	448.122	20.96	0.7	3.35	82.7	34.4041	3.439	2.63	33.53	3.53	5	135.00	0.607	0.592	0.015	1.300	5.30	6.89	0.630	20.44	36.7405	34.30
10.006	447.794	23.37	0.86	3.67	95.38	37.6819	3.782	2.63	36.70	3.88	5	135.00	0.629	0.604	0.025	1.287	5.90	7.60	0.704	22.78	36.7081	34.86
10.335	447.465	23.21	0.93	4.02	86.47	36.6547	4.122	2.66	35.79	4.22	4	135.00	0.651	0.615	0.035	1.275	5.98	7.62	0.698	22.68	38.3828	34.71
10.663	447.137	22.31	0.82	3.68	48.55	34.4891	3.790	2.65	34.01	3.84	4	135.00	0.673	0.627	0.046	1.263	5.77	7.28	0.670	22.01	37.7717	34.40
10.991	446.809	21.94	0.83	3.79	50.34	33.2333	3.907	2.67	32.73	3.97	4	135.00	0.695	0.639	0.056	1.251	5.73	7.16	0.658	21.62	38.8777	34.17
11.319	446.481	23.94	0.89	3.73	69.05	35.6631	3.832	2.64	35.00	3.90	5	135.00	0.717	0.651	0.066	1.239	6.15	7.62	0.719	23.51	37.5487	34.58
11.647	446.153	31.54	1.47	4.66	33.07	46.451	4.773	2.62	46.13	4.81	4	135.00	0.739	0.663	0.076	1.228	8.10	9.95	0.954	31.33	36.4723	36.24
11.975	445.825	52.03	1.94	3.73	5.47	75.9552	3.784	2.40	75.91	3.79	5	135.00	0.762	0.675	0.087	1.217	12.09	14.71	1.587	52	26.4167	39.08
12.303	445.497	68.4	2.67	3.91	-22.86	98.4385	3.949	2.34	98.66	3.94	5	135.00	0.784	0.687	0.097	1.207	15.51	18.71	2.093	68.55	24.0213	40.50
12.631	445.169	53.25	3.19	6	-25.04	75.0494	6.083	2.56	75.26	6.07	3	135.00	0.806	0.699	0.107	1.196	13.38	16.01	1.624	53.4	33.4083	39.04
12.959	444.841	50.44	2.84	5.63	-25.2	69.8071	5.724	2.56	70.03	5.71	3	135.00	0.828	0.711	0.117	1.186	12.67	15.03	1.536	50.6	33.3638	38.64
13.287	444.513	31.23	2.43	7.77	-27.34	42.042	7.999	2.81	42.28	7.95	3	135.00	0.850	0.723	0.128	1.176	8.97	10.55	0.941	31.4	46.5809	35.73
13.615	444.185	36.66	2.18	5.95	-26.55	48.723	6.091	2.68	48.94	6.06	3	135.00	0.872	0.735	0.138	1.167	9.80	11.44	1.108	36.82	39.3835	36.60
13.943	443.857	56.53	3.08	5.44	-25.93	74.5365	5.536	2.53	74.75	5.52	3	135.00	0.894	0.746	0.148	1.157	14.00	16.20	1.722	56.69	32.013	39.00
14.271	443.529	129.14	5.32	4.12	-25.68	169.087	4.149	2.22	169.30	4.14	11	135.00	0.917	0.758	0.158	1.148	27.75	31.86	3.970	129.3	19.5836	43.26
14.6	443.200	241.69	8.13	3.37	-25.73	312.554	3.377	2.00	312.76	3.37	12	135.00	0.939	0.770	0.168	1.139	47.59	54.23	7.454	241.85	12.9931	46.12
14.928	442.872	231.67	8.83	3.81	-25.66	294.958	3.827	2.06	295.16	3.82	12	135.00	0.961	0.782	0.179	1.131	46.69	52.80	7.143	231.83	14.6671	45.86
15.256	442.544	258.78	8.95	3.46	-26.07	324.647	3.472	2.00	324.85	3.47	12	135.00	0.983	0.794	0.189	1.122	51.01	57.24	7.981	258.94	13.0637	46.29

R166605

Depth (ft)	El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.V. (pcf)	VStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	442.216	285.8	8.43	2.95	-26.9	353.348	2.960	1.93	353.55	2.96	12	135.00	1.005	0.806	0.199	1.114	54.68	60.90	8.817	285.96	11.0253	46.66
15.912	441.888	277.04	7.22	2.61	-28.01	337.467	2.616	1.89	337.67	2.61	7	135.00	1.027	0.818	0.209	1.106	52.28	57.81	8.545	277.21	10.1227	46.46
16.24	441.560	219.73	6.99	3.18	-28.89	263.533	3.196	2.02	263.75	3.19	12	135.00	1.049	0.830	0.220	1.098	43.55	47.81	6.770	219.91	13.4471	45.35

R16606

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 34 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY TJS DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-8

ConeTec Inc. erpretation
Interpretation Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4303
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-8
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 09:53
CPT File: 804CP08.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 445

Material Types and Unit Weight (pcf)		Phi Avg.	Su Avg.	Qc Avg.	Fc Avg.	Ic Avg.
		deg	tsf	tsf	%	%
125	Residual Soil	39.90	1.70	55.34	26.74	2.35

User Inputs:

Assumed:
Water Table Depth (ft): 6.6
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 445.0
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	444.836	17.37	0.13	0.75	0.35	1693.63	0.749	1.12	1693.63	0.75	6	125.00	0.010	0.010	0.000	2.000	2.55	5.11	0.637	17.37	-1.1659	52.71
0.492	444.508	21.17	0.35	1.66	-1.57	687.455	1.656	1.57	687.78	1.65	6	125.00	0.031	0.031	0.000	2.000	3.58	7.15	0.654	21.18	3.90719	49.41
0.82	444.180	31.35	0.66	2.09	-3.09	610.707	2.109	1.69	611.10	2.11	6	125.00	0.051	0.051	0.000	2.000	5.51	11.02	0.969	31.37	5.90214	48.94
1.148	443.852	43.85	0.95	2.17	-1.25	610.15	2.170	1.70	610.29	2.17	6	125.00	0.072	0.072	0.000	2.000	7.73	15.47	1.355	43.86	6.12164	48.94
1.476	443.524	44.4	1.46	3.29	-0.37	480.301	3.295	1.91	480.30	3.30	5	125.00	0.092	0.092	0.000	2.000	8.43	16.87	1.372	44.4	10.5955	47.96
1.804	443.196	47.24	1.66	3.51	0.21	417.98	3.522	1.96	417.98	3.52	5	125.00	0.113	0.113	0.000	2.000	9.15	18.30	1.459	47.24	11.8951	47.38
2.133	442.867	63.62	1.74	2.74	-0.23	476.225	2.741	1.84	476.22	2.74	6	125.00	0.133	0.133	0.000	2.000	11.78	23.55	1.966	63.62	8.93891	47.93
2.461	442.539	81.01	2.67	3.29	1.8	525.68	3.302	1.89	525.62	3.30	6	125.00	0.154	0.154	0.000	2.000	15.30	30.60	2.503	81	10.2349	48.33
2.789	442.211	87.64	3.13	3.57	-0.02	501.775	3.579	1.93	501.78	3.58	6	125.00	0.174	0.174	0.000	2.000	16.80	33.61	2.708	87.64	11.2144	48.14
3.117	441.883	72.36	2.94	4.06	0.81	370.434	4.074	2.04	370.38	4.07	5	125.00	0.195	0.195	0.000	2.000	14.45	28.90	2.234	72.35	14.0558	46.86
3.445	441.555	54.96	2.44	4.43	7.57	254.257	4.457	2.15	254.02	4.46	5	125.00	0.215	0.215	0.000	2.000	11.47	22.93	1.695	54.91	17.4107	45.18
3.773	441.227	45.6	1.94	4.26	13.4	192.374	4.277	2.20	192.03	4.28	5	125.00	0.236	0.236	0.000	2.000	9.70	19.39	1.404	45.52	18.9745	43.86
4.101	440.899	47.91	1.89	3.94	10.16	185.92	3.966	2.18	185.69	3.97	5	125.00	0.256	0.256	0.000	1.975	10.11	19.97	1.475	47.85	18.3226	43.70
4.429	440.571	55.66	1.91	3.43	18.45	200.075	3.449	2.11	199.64	3.46	5	125.00	0.277	0.277	0.000	1.901	11.41	21.70	1.715	55.64	16.1775	44.05
4.757	440.243	51.39	1.71	3.33	24.18	171.848	3.347	2.14	171.31	3.36	6	125.00	0.297	0.297	0.000	1.834	10.65	19.52	1.582	51.23	17.0225	43.31
5.085	439.915	45.68	1.53	3.36	21.34	142.733	3.373	2.19	142.32	3.38	5	125.00	0.318	0.318	0.000	1.774	9.66	17.14	1.404	45.55	18.6417	42.39
5.413	439.587	37.97	1.4	3.7	20.18	111.234	3.720	2.29	110.88	3.73	5	125.00	0.338	0.338	0.000	1.719	8.38	14.40	1.165	37.85	22.1372	41.11
5.741	439.259	32.73	1.25	3.83	18.96	90.2176	3.861	2.36	89.88	3.86	5	125.00	0.359	0.359	0.000	1.669	7.44	12.43	1.002	32.61	24.6088	40.00
6.069	438.931	32.51	1.3	3.99	14.67	84.7077	4.046	2.39	84.47	4.06	5	125.00	0.379	0.379	0.000	1.624	7.51	12.19	0.995	32.42	26.1077	39.66
6.398	438.602	30.81	1.37	4.44	8.27	76.0491	4.505	2.46	75.92	4.51	4	125.00	0.400	0.400	0.000	1.581	7.34	11.61	0.941	30.76	28.8283	39.08
6.726	438.274	30.16	1.35	4.47	11.29	71.4133	4.539	2.48	71.25	4.55	4	135.00	0.420	0.416	0.004	1.550	7.26	11.24	0.921	30.09	29.7266	38.72
7.054	437.946	30.78	1.3	4.22	12.22	70.824	4.285	2.46	70.64	4.30	4	135.00	0.443	0.428	0.014	1.528	7.34	11.22	0.939	30.7	29.0142	38.68
7.382	437.618	28.58	1.25	4.38	14.3	63.8613	4.446	2.50	63.66	4.46	4	135.00	0.465	0.440	0.024	1.507	6.95	10.48	0.870	28.49	30.8671	38.09
7.71	437.290	25.37	1.1	4.35	16	55.0315	4.421	2.55	54.81	4.44	4	135.00	0.487	0.452	0.035	1.487	6.29	9.36	0.770	25.27	32.7937	37.24
8.038	436.962	23.17	1.04	4.48	16.81	48.8312	4.589	2.59	48.59	4.61	4	135.00	0.509	0.464	0.045	1.468	5.88	8.63	0.702	23.06	35.0715	36.54
8.366	436.634	21.72	0.99	4.55	15.7	44.5168	4.672	2.63	44.31	4.69	3	135.00	0.531	0.476	0.055	1.449	5.60	8.12	0.656	21.62	36.7119	36.00
8.694	436.306	22.5	0.76	3.39	17	44.9838	3.463	2.53	44.76	3.48	5	135.00	0.553	0.488	0.065	1.432	5.54	7.93	0.679	22.39	32.1478	36.06
9.022	435.978	20.87	0.66	3.17	17.39	40.6065	3.252	2.55	40.41	3.27	5	135.00	0.575	0.500	0.076	1.415	5.17	7.31	0.628	20.77	32.7685	35.46
9.35	435.650	20.28	0.77	3.78	19.44	38.4653	3.912	2.62	38.23	3.94	4	135.00	0.597	0.512	0.086	1.398	5.20	7.27	0.609	20.16	36.2763	35.13
9.678	435.322	22.23	1.07	4.83	14.64	41.2726	4.951	2.67	41.08	4.97	3	135.00	0.620	0.524	0.096	1.382	5.86	8.10	0.669	22.13	38.7923	35.56
10.006	434.994	27.84	1.15	4.14	14.22	50.7896	4.228	2.56	50.62	4.24	4	135.00	0.642	0.536	0.106	1.367	6.94	9.48	0.842	27.75	33.2318	36.79
10.335	434.665	30.49	1.3	4.26	-2.51	54.4817	4.359	2.54	54.50	4.36	4	135.00	0.664	0.547	0.117	1.352	7.58	10.24	0.923	30.5	32.5983	37.22
10.663	434.337	20.58	1.04	5.04	-8.43	35.5656	5.228	2.73	35.67	5.21	3	135.00	0.686	0.559	0.127	1.337	5.63	7.53	0.616	20.64	41.8344	34.72
10.991	434.009	21.64	0.79	3.66	-8.2	36.6411	3.774	2.62	36.73	3.77	4	135.00	0.708	0.571	0.137	1.323	5.60	7.40	0.648	21.69	36.2422	34.90
11.319	433.681	18.91	0.92	4.85	-4.78	31.1738	5.061	2.76	31.23	5.05	3	135.00	0.730	0.583	0.147	1.309	5.26	6.88	0.563	18.94	43.5695	33.91
11.647	433.353	17	0.91	5.34	-3.97	27.3032	5.601	2.83	27.35	5.59	3	135.00	0.753	0.595	0.157	1.296	4.92	6.37	0.503	17.03	47.693	33.09
11.975	433.025	20.2	1.09	5.41	-3.4	32.0031	5.611	2.78	32.04	5.61	3	135.00	0.775	0.607	0.168	1.284	5.68	7.30	0.601	20.22	44.908	34.07
12.303	432.697	23.77	1.16	4.87	-3.74	37.12	5.049	2.70	37.15	5.04	3	135.00	0.797	0.619	0.178	1.271	6.41	8.15	0.711	23.79	40.6258	34.97
12.631	432.369	23.53	1.14	4.86	-2.66	36.0038	5.020	2.71	36.02	5.02	3	135.00	0.819	0.631	0.188	1.259	6.37	8.02	0.703	23.54	41.0417	34.79
12.959	432.041	25.86	1.03	3.99	-1.59	38.9277	4.117	2.63	38.94	4.12	4	135.00	0.841	0.643	0.198	1.247	6.70	8.36	0.775	25.87	36.659	35.26
13.287	431.713	28.74	1.22	4.25	4.68	42.5854	4.376	2.62	42.54	4.38	4	135.00	0.863	0.655	0.209	1.236	7.41	9.16	0.863	28.71	36.2582	35.79
13.615	431.385	23.7	0.95	4.02	4.89	34.2297	4.164	2.67	34.18	4.17	4	135.00	0.885	0.667	0.219	1.225	6.27	7.69	0.706	23.67	38.9352	34.48
13.943	431.057	21.82	0.56	2.55	10.93	30.8252	2.678	2.58	30.72	2.69	5	135.00	0.908	0.678	0.229	1.214	5.50	6.68	0.647	21.75	34.3343	33.83
14.271	430.729	17.59	0.45	2.54	19.05	24.134	2.701	2.67	23.96	2.72	5	135.00	0.930	0.690	0.239	1.204	4.62	5.56	0.516	17.47	38.6783	32.28
14.6	430.400	15.35	0.32	2.09	24.25	20.5023	2.223	2.67	20.29	2.25	5	135.00	0.952	0.702	0.250	1.193	4.03	4.81	0.446	15.2	39.0527	31.24
14.928	430.072	13.48	0.21	1.52	31.31	17.5111	1.679	2.66	17.25	1.71	6	135.00	0.974	0.714	0.260	1.183	3.51	4.15	0.387	13.29	38.5544	30.20
15.256	429.744	13.47	0.25	1.82	40.37	17.1797	2.004	2.72	16.84	2.05	5	135.00	0.996	0.726	0.270	1.174	3.59	4.21	0.386	13.22	41.3202	30.05

R16608

Depth (ft)	S... (psf)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.W. (pcf)	Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	429.416	18.28	0.5	2.74	47	23.3902	2.897	2.70	22.98	2.95	5	135.00	1.018	0.738	0.280	1.164	4.84	5.64	0.534	17.98	40.5576	32.03
15.912	429.088	44.7	2.02	4.53	28.04	58.2209	4.627	2.54	57.98	4.65	4	135.00	1.040	0.750	0.291	1.155	11.07	12.79	1.352	44.52	32.7068	37.60
16.24	428.760	126.44	5.34	4.22	-16.4	164.58	4.259	2.23	164.72	4.26	11	135.00	1.063	0.762	0.301	1.146	27.34	31.33	3.882	126.55	20.1417	43.13
16.568	428.432	213.9	10.81	5.05	-15.7	275.059	5.080	2.18	275.19	5.08	11	136.00	1.085	0.774	0.311	1.137	45.29	51.49	6.589	214	18.4606	45.55
16.896	428.104	378.56	14.03	3.71	-15.73	480.355	3.717	1.96	480.46	3.72	12	137.00	1.107	0.786	0.321	1.128	73.23	82.61	11.686	378.66	11.787	47.97
17.224	427.776	341.19	15.02	4.4	-15.91	426.134	4.417	2.05	426.26	4.42	12	136.00	1.129	0.798	0.331	1.119	68.32	76.47	10.528	341.29	14.2134	47.46
17.552	427.448	312.91	15.43	4.93	-12.1	384.691	4.949	2.11	384.79	4.95	11	139.00	1.152	0.810	0.342	1.111	64.25	71.37	9.652	312.99	16.0829	47.03

R16609

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 37 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-9

ConeTec Inc. Interpretation
Interpretation C Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4276
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-9
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 09:17
CPT File: 804CP09.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 445.7

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	39.25	1.38	45.19	28.02	2.40

User Inputs:
Assumed: Water Table Depth (ft): 7.8
Nk: 32.3
Slate Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 445.7
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (csf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	445.536	15.38	0.2	1.27	-2.59	1499.49	1.301	1.37	1501.44	1.30	6	125.00	0.010	0.010	0.000	2.000	2.43	4.87	0.476	15.4	1.11893	52.29
0.492	445.208	19.82	0.38	1.92	-12.01	643.553	1.920	1.64	646.15	1.91	6	125.00	0.031	0.031	0.000	2.000	3.44	6.88	0.613	19.9	5.03728	49.17
0.82	444.880	30.1	0.63	2.1	-9.01	586.317	2.097	1.69	587.29	2.09	6	125.00	0.051	0.051	0.000	2.000	5.30	10.61	0.930	30.15	5.98332	48.78
1.148	444.552	43.87	0.91	2.07	-3.21	610.429	2.078	1.68	610.71	2.08	6	125.00	0.072	0.072	0.000	2.000	7.69	15.39	1.356	43.89	5.7973	48.94
1.476	444.224	47.66	1.19	2.49	0.07	515.64	2.502	1.79	515.64	2.50	6	125.00	0.092	0.092	0.000	2.000	8.66	17.33	1.473	47.66	7.8425	48.25
1.804	443.896	45.87	1.66	3.62	0.07	405.829	3.628	1.98	405.83	3.63	5	125.00	0.113	0.113	0.000	2.000	8.94	17.89	1.417	45.87	12.3418	47.25
2.133	443.567	41.72	1.68	3.98	0.25	311.949	3.992	2.07	311.95	3.99	5	125.00	0.133	0.133	0.000	2.000	8.42	16.84	1.288	41.72	14.8063	46.11
2.461	443.239	37.44	1.52	4.06	0.39	242.413	4.077	2.13	242.41	4.08	5	125.00	0.154	0.154	0.000	2.000	7.74	15.49	1.154	37.44	16.6663	44.96
2.789	442.911	44.47	1.87	4.2	0.86	254.117	4.222	2.13	254.06	4.22	5	125.00	0.174	0.174	0.000	2.000	9.21	18.41	1.371	44.46	16.7567	45.18
3.117	442.583	59.57	2.65	4.44	0.23	304.781	4.463	2.11	304.78	4.46	5	125.00	0.195	0.195	0.000	2.000	12.25	24.50	1.838	59.57	16.2268	46.00
3.445	442.255	70.47	2.79	3.95	1.85	325.292	3.971	2.06	326.25	3.97	5	125.00	0.215	0.215	0.000	2.000	14.16	28.31	2.175	70.46	14.487	46.30
3.773	441.927	74.67	2.46	3.29	-0.62	315.65	3.305	1.99	315.69	3.30	6	125.00	0.236	0.236	0.000	2.000	14.64	29.28	2.304	74.68	12.725	46.16
4.101	441.599	84.53	2.85	3.37	1.85	323.793	3.382	1.99	326.75	3.38	6	125.00	0.256	0.256	0.000	1.975	16.57	32.73	2.609	84.52	12.7342	46.34
4.429	441.271	104.33	3.88	3.72	1.8	375.898	3.729	2.00	375.86	3.73	6	125.00	0.277	0.277	0.000	1.901	20.54	39.03	3.221	104.32	13.0225	46.92
4.757	440.943	96.44	3.96	4.11	2.45	323.373	4.119	2.07	323.34	4.12	5	125.00	0.297	0.297	0.000	1.834	19.50	35.76	2.977	96.43	14.9462	46.26
5.085	440.615	102.25	4.19	4.1	0.62	320.731	4.111	2.07	320.70	4.11	5	125.00	0.318	0.318	0.000	1.774	20.68	36.68	3.156	102.24	14.9718	46.23
5.413	440.287	98.2	4.51	4.59	1.13	289.264	4.609	2.14	289.23	4.61	11	125.00	0.338	0.338	0.000	1.719	20.38	35.04	3.030	98.19	16.9403	45.77
5.741	439.959	94.73	4.11	4.34	4.32	263.01	4.355	2.14	262.93	4.36	11	125.00	0.359	0.359	0.000	1.669	19.65	32.80	2.922	94.7	16.894	45.33
6.069	439.631	84.93	3.46	4.08	5.01	222.905	4.092	2.15	222.63	4.09	5	125.00	0.379	0.379	0.000	1.624	17.71	28.75	2.618	84.9	17.3092	44.57
6.398	439.302	87.66	3.56	4.07	-2.24	218.219	4.080	2.15	218.24	4.08	5	125.00	0.400	0.400	0.000	1.581	18.31	28.96	2.702	87.67	17.4182	44.47
6.726	438.974	69.12	3.37	4.87	4.69	163.425	4.905	2.29	163.35	4.91	11	125.00	0.420	0.420	0.000	1.542	15.27	23.56	2.127	69.09	22.0488	43.08
7.054	438.646	63.77	3.03	4.76	3.08	143.644	4.785	2.31	143.60	4.79	4	125.00	0.441	0.441	0.000	1.506	14.23	21.43	1.961	63.75	22.8724	42.43
7.382	438.318	53.39	2.77	5.19	7.53	114.719	5.233	2.40	114.61	5.24	3	125.00	0.461	0.461	0.000	1.472	12.39	18.24	1.639	53.34	26.3327	41.28
7.71	437.990	48.17	2.41	4.99	4.9	98 9637	5.054	2.42	98.90	5.06	4	125.00	0.482	0.482	0.000	1.441	11.31	16.30	1.476	48.14	27.4055	40.51
8.038	437.662	38.46	1.98	5.15	10.26	76 6899	5.216	2.50	76.55	5.23	3	135.00	0.502	0.495	0.007	1.421	9.37	13.31	1.175	38.39	30.6807	39.12
8.366	437.334	30.22	1.55	5.12	11.57	58 5876	5.220	2.58	58.45	5.23	3	135.00	0.525	0.507	0.018	1.405	7.63	10.72	0.919	30.15	34.4169	37.61
8.694	437.006	28.4	1.39	4.89	12.03	53 6919	4.990	2.59	53.66	5.00	3	135.00	0.547	0.519	0.028	1.386	7.21	10.01	0.862	28.33	34.9372	37.11
9.022	436.678	29.4	1.32	4.5	11.46	54.33	4.578	2.56	54.20	4.59	4	135.00	0.569	0.531	0.038	1.373	7.35	10.09	0.893	29.33	33.449	37.18
9.35	436.350	28.31	1.17	4.14	11.87	51.088	4.221	2.55	50.94	4.23	4	135.00	0.591	0.543	0.048	1.358	7.05	9.57	0.856	28.23	33.1117	36.82
9.678	436.022	26.35	1.19	4.53	15.1	46 4162	4.624	2.61	46.24	4.64	4	135.00	0.613	0.554	0.059	1.343	6.75	9.06	0.797	26.25	35.9001	36.25
10.006	435.694	25.07	1.15	4.6	14.55	43 1414	4.706	2.64	42.98	4.72	3	135.00	0.635	0.566	0.069	1.329	6.51	8.65	0.756	24.98	37.2699	35.82
10.335	435.365	25.89	1.24	4.78	13.4	49.63	4.914	2.65	43.49	4.93	3	135.00	0.657	0.578	0.079	1.315	6.76	8.89	0.781	25.81	37.7669	35.89
10.663	435.037	22.8	1.2	5.28	9.91	37 4772	5.425	2.72	37.38	5.44	3	135.00	0.680	0.590	0.089	1.302	6.20	8.07	0.685	22.74	41.7846	34.99
10.991	434.709	27.92	1.18	4.22	10.86	45 2024	4.335	2.60	45.09	4.35	4	135.00	0.702	0.602	0.100	1.289	7.11	9.17	0.843	27.85	35.267	36.11
11.319	434.381	29.42	1.45	4.92	10.88	46 7326	5.053	2.64	46.62	5.07	3	135.00	0.724	0.614	0.110	1.276	7.64	9.75	0.888	29.35	37.1499	36.31
11.647	434.053	26.23	1.41	5.39	11.38	40 7121	5.533	2.71	40.60	5.55	3	135.00	0.746	0.626	0.120	1.264	7.06	8.93	0.789	26.16	40.7787	35.49
11.975	433.725	23.16	0.99	4.29	10.95	35.1046	4.421	2.68	34.99	4.44	4	135.00	0.768	0.638	0.130	1.252	6.16	7.71	0.693	23.09	39.5208	34.60
12.303	433.397	20.42	0.52	2.55	11.83	30 2103	2.649	2.58	30.10	2.66	5	135.00	0.790	0.650	0.140	1.241	5.16	6.40	0.608	20.35	34.5204	33.68
12.631	433.069	18.58	0.49	2.64	14.43	26 8524	2.758	2.63	26.72	2.77	5	135.00	0.812	0.662	0.151	1.229	4.81	5.91	0.550	18.49	37.0571	32.94
12.959	432.741	22.2	0.51	2.28	45.47	31 7192	2.387	2.54	31.29	2.42	6	135.00	0.835	0.674	0.161	1.218	5.45	6.64	0.661	21.91	32.6826	33.92
13.287	432.413	18.14	0.35	1.91	50.26	25 2132	2.025	2.58	24.75	2.06	6	135.00	0.857	0.685	0.171	1.208	4.52	5.45	0.535	17.82	34.4848	32.46
13.615	432.085	15.81	0.26	1.65	56.56	21 4099	1.741	2.60	20.91	1.78	6	135.00	0.879	0.697	0.181	1.197	3.96	4.74	0.462	15.46	35.5971	31.40
13.943	431.757	12.95	0.21	1.59	52.01	16.9872	1.743	2.69	16.52	1.79	5	135.00	0.901	0.709	0.192	1.187	3.36	4.01	0.373	12.62	39.9818	29.89
14.271	431.429	11.94	0.19	1.55	59.86	15.2756	1.725	2.73	14.75	1.79	5	135.00	0.923	0.721	0.202	1.178	3.16	3.73	0.341	11.56	42.1627	29.15
14.6	431.100	12.26	0.19	1.51	66.28	15.433	1.679	2.72	14.87	1.74	5	135.00	0.945	0.733	0.212	1.168	3.23	3.77	0.350	11.85	41.679	29.21
14.928	430.772	11.19	0.19	1.7	73.44	13.7205	1.859	2.80	13.10	1.95	5	135.00	0.967	0.745	0.222	1.159	3.04	3.52	0.316	10.73	45.7108	28.39
15.256	430.444	15.59	0.3	1.9	87.39	19.2881	2.055	2.69	18.56	2.14	5	135.00	0.990	0.757	0.233	1.149	4.03	4.63	0.452	15.04	40.03	30.65

R16611

Depth (ft)	S... (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.W... (pcf)	...Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	430.116	23.74	0.44	1.84	87.72	29.5606	1.936	2.52	28.85	1.98	6	135.00	1.012	0.769	0.243	1.140	5.70	6.50	0.704	23.19	31.5153	33.43
15.912	429.788	29.33	0.85	2.89	108.61	36.2411	3.004	2.57	35.37	3.08	5	135.00	1.034	0.781	0.253	1.132	7.22	8.17	0.876	28.65	33.9566	34.68
16.24	429.460	38.72	1.48	3.83	103.37	47.5146	3.929	2.56	46.71	4.00	5	135.00	1.056	0.793	0.263	1.123	9.55	10.73	1.166	38.08	33.507	36.34
16.568	429.132	56.19	2.18	3.88	102.93	68.4969	3.956	2.45	67.69	4.00	5	136.00	1.078	0.805	0.274	1.115	13.22	14.73	1.706	55.54	28.5536	38.46
16.896	428.804	60.78	3.03	4.98	65.61	73.0777	5.077	2.51	72.58	5.11	11	137.00	1.100	0.817	0.284	1.107	14.78	16.36	1.848	60.37	31.2128	38.85
17.224	428.476	50.94	2.78	5.46	60.44	60.1007	5.580	2.60	59.64	5.62	3	138.00	1.123	0.829	0.294	1.098	12.92	14.19	1.542	50.56	35.2823	37.75
17.552	428.148	43.07	2.33	5.4	23.93	49.8334	5.558	2.65	49.66	5.58	3	139.00	1.146	0.841	0.304	1.090	11.25	12.26	1.298	42.92	37.7709	36.70
17.88	427.820	39.51	1.86	4.71	-0.56	44.9042	4.851	2.63	44.90	4.85	4	140.00	1.168	0.854	0.314	1.082	10.27	11.12	1.187	39.51	37.026	36.11
18.208	427.492	41.11	1.74	4.23	0.62	46.0646	4.359	2.59	46.06	4.36	4	141.00	1.191	0.867	0.325	1.074	10.47	11.25	1.236	41.11	34.9935	36.27
18.537	427.163	41.12	1.68	4.1	2.12	45.3724	4.210	2.59	45.35	4.21	5	142.00	1.215	0.880	0.335	1.066	10.44	11.13	1.236	41.1	34.7084	36.17
18.865	426.835	45.7	1.83	4	4.37	49.814	4.116	2.55	49.79	4.12	5	143.00	1.238	0.893	0.345	1.058	11.40	12.07	1.377	45.68	33.0275	36.72
19.193	426.507	43.86	2.11	4.81	4.87	47.0298	4.953	2.63	47.00	4.96	4	144.00	1.261	0.906	0.355	1.051	11.36	11.93	1.319	43.83	36.6851	36.38
19.521	426.179	36.52	1.92	5.26	11.85	38.3338	5.449	2.72	38.25	5.46	3	145.00	1.285	0.919	0.366	1.043	9.91	10.33	1.091	36.44	41.4759	35.17
19.849	425.851	49.37	2.52	5.1	12.88	51.5286	5.243	2.62	51.43	5.25	3	146.00	1.309	0.933	0.376	1.035	12.72	13.17	1.488	49.28	36.286	36.91
20.177	425.523	60.49	3.37	5.58	-1.34	62.5064	5.697	2.59	62.52	5.70	11	147.00	1.333	0.946	0.386	1.028	15.39	15.82	1.831	60.5	34.8428	38.02
20.505	425.195	75.15	3.54	4.72	-5.82	76.8443	4.797	2.47	76.89	4.79	11	148.00	1.357	0.960	0.396	1.020	18.09	18.46	2.285	75.19	29.5495	39.17
20.833	424.867	74.98	3.23	4.31	-7.5	75.5377	4.389	2.45	75.59	4.39	5	149.00	1.381	0.974	0.407	1.013	17.84	18.07	2.279	75.03	28.4777	39.08
21.161	424.539	51.59	2	3.88	-4.69	50.7665	3.985	2.53	50.80	3.98	5	150.00	1.405	0.989	0.417	1.006	12.78	12.85	1.554	51.62	32.2646	36.84
21.489	424.211	88.98	4.5	5.06	-4.99	87.2965	5.140	2.46	87.34	5.14	11	151.00	1.430	1.003	0.427	0.999	21.30	21.27	2.711	89.02	29.0451	39.87

R16612

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 40 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-10

ConeTec Inc. erpretation
Interpretation C Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4243
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-10
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 08:35
CPT File: 804CP10.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 442.1

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	39.49	1.77	57.88	26.87	2.36

User Inputs:
Assumed: Water Table Depth (ft): 3.4
Nk: 32.3
Slate Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 442.1
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	441.936	22.84	0.17	0.75	0.53	2227.29	0.745	1.10	2227.29	0.74	7	125.00	0.010	0.010	0.000	2.000	3.34	6.67	0.707	22.84	-1.3233	53.62
0.492	441.608	28.68	0.4	1.4	-1.45	921.683	1.396	1.45	931.68	1.40	6	125.00	0.031	0.031	0.000	2.000	4.66	9.32	0.887	28.68	2.20569	50.57
0.82	441.280	30.14	0.52	1.73	-6.33	587.098	1.728	1.62	587.88	1.73	6	125.00	0.051	0.051	0.000	2.000	5.17	10.35	0.932	30.18	4.63942	48.79
1.148	440.952	41.06	0.62	1.5	-7.39	571.265	1.513	1.57	571.96	1.51	7	125.00	0.072	0.072	0.000	2.000	6.94	13.88	1.269	41.11	3.88432	48.68
1.476	440.624	62.23	0.9	1.44	-3.79	673.58	1.448	1.52	673.91	1.46	7	125.00	0.092	0.092	0.000	2.000	10.34	20.69	1.924	62.26	3.15876	49.33
1.804	440.296	70.49	1.29	1.83	-0.76	624.188	1.833	1.63	624.28	1.83	7	125.00	0.113	0.113	0.000	2.000	12.13	24.27	2.179	70.5	4.85185	49.03
2.133	439.967	63.39	1.44	2.28	-1.34	474.499	2.276	1.77	474.57	2.26	6	125.00	0.133	0.133	0.000	2.000	11.44	22.87	1.958	63.4	7.40369	47.91
2.461	439.639	64.76	1.42	2.19	-1.66	420.032	2.198	1.78	420.10	2.20	7	125.00	0.154	0.154	0.000	2.000	11.73	23.46	2.000	64.77	7.63043	47.40
2.789	439.311	67.64	1.58	2.34	-1.64	387.039	2.342	1.82	387.10	2.34	6	125.00	0.174	0.174	0.000	2.000	12.43	24.87	2.089	67.65	8.50804	47.05
3.117	438.983	62.08	1.55	2.49	-2.26	317.665	2.505	1.89	317.77	2.50	6	125.00	0.195	0.195	0.000	2.000	11.70	23.40	1.916	62.1	10.0559	46.19
3.445	438.655	61.6	1.76	2.86	-2.61	286.967	2.867	1.96	287.01	2.87	6	125.00	0.215	0.214	0.001	2.000	11.93	23.86	1.900	61.61	11.8668	45.73
3.773	438.327	49.6	1.64	3.29	-3.46	221.096	3.309	2.07	221.23	3.31	6	125.00	0.236	0.224	0.012	2.000	10.08	20.15	1.534	49.83	14.9652	44.54
4.101	437.999	35.16	1.26	3.59	-0.53	148.88	3.610	2.20	148.92	3.61	5	125.00	0.256	0.234	0.022	2.000	7.49	14.99	1.081	35.17	19.0045	42.62
4.429	437.671	23.8	0.94	3.96	5.47	96.1277	3.996	2.35	95.96	4.00	4	125.00	0.277	0.245	0.032	2.000	5.41	10.81	0.728	23.76	24.5219	40.35
4.757	437.343	20.99	0.83	3.94	15.36	88.156	4.011	2.40	80.76	4.03	4	125.00	0.297	0.255	0.042	1.980	4.86	9.63	0.641	20.89	26.5321	39.43
5.085	437.015	23.58	0.9	3.8	17.32	87.7022	3.869	2.37	87.29	3.89	4	125.00	0.318	0.265	0.053	1.942	5.38	10.45	0.720	23.47	25.1707	39.85
5.413	436.687	26.07	1.08	4.15	16.35	93.3976	4.197	2.38	93.03	4.21	4	125.00	0.338	0.276	0.063	1.905	5.98	11.39	0.797	25.97	25.5391	40.19
5.741	436.359	28	1.25	4.46	13.72	96.7242	4.522	2.39	96.44	4.54	4	125.00	0.359	0.286	0.073	1.871	6.47	12.10	0.856	27.92	26.1485	40.39
6.069	436.031	27.78	1.26	4.55	13.97	92.5575	4.598	2.41	92.25	4.61	4	125.00	0.379	0.296	0.083	1.838	6.47	11.89	0.848	27.69	26.8768	40.15
6.398	435.702	23.67	0.97	4.09	20.99	75.9624	4.168	2.43	75.54	4.19	4	125.00	0.400	0.306	0.094	1.807	5.56	10.04	0.720	23.54	27.8545	39.07
6.726	435.374	22.65	0.83	3.65	20.09	70.2128	3.734	2.42	69.80	3.76	5	125.00	0.420	0.317	0.104	1.777	5.29	9.40	0.688	22.52	27.3099	38.63
7.054	435.046	23.86	0.78	3.26	20.76	71.6466	3.331	2.38	71.25	3.35	5	125.00	0.441	0.327	0.114	1.749	5.46	9.56	0.725	23.73	25.568	38.75
7.382	434.718	19.8	0.64	3.24	24.65	57.3614	3.309	2.45	56.89	3.34	5	125.00	0.461	0.337	0.124	1.722	4.66	8.03	0.599	19.64	28.3064	37.49
7.71	434.390	17.31	0.59	3.42	30.58	48.4398	3.506	2.52	47.89	3.55	4	125.00	0.482	0.347	0.134	1.697	4.20	7.13	0.521	17.12	31.4473	36.49
8.038	434.062	18.65	0.73	3.9	29.81	50.7385	4.023	2.54	50.21	4.07	4	135.00	0.502	0.358	0.145	1.672	4.59	7.68	0.562	18.46	32.7232	36.77
8.366	433.734	15.11	0.63	4.15	30.69	39.4655	4.319	2.65	38.95	4.38	3	135.00	0.525	0.370	0.155	1.645	3.90	6.42	0.452	14.92	37.5988	35.28
8.694	433.406	14.94	0.58	3.89	35.5	37.7301	4.030	2.64	37.15	4.09	4	135.00	0.547	0.381	0.165	1.619	3.84	6.22	0.446	14.72	37.3103	35.00
9.022	433.078	15.71	0.65	4.15	39.67	38.4892	4.293	2.65	37.85	4.36	3	135.00	0.569	0.393	0.175	1.594	4.06	6.47	0.469	15.46	38.0083	35.11
9.35	432.750	20.24	0.82	4.06	39.19	48.4809	4.173	2.57	47.86	4.23	4	135.00	0.591	0.405	0.186	1.571	5.04	7.91	0.608	19.99	33.9763	36.50
9.678	432.422	21.26	1.1	5.19	18.66	48.4891	5.328	2.64	49.23	5.36	3	135.00	0.613	0.417	0.196	1.548	5.51	8.53	0.639	21.15	37.2394	36.66
10.006	432.094	21.52	1.14	5.29	14.2	46.6703	5.459	2.65	48.46	5.48	3	135.00	0.635	0.429	0.206	1.527	5.62	8.58	0.647	21.43	37.8499	36.57
10.335	431.765	22.36	1.16	5.2	0.19	49.2066	5.345	2.64	49.21	5.34	3	135.00	0.657	0.441	0.216	1.506	5.83	8.77	0.672	22.36	37.2112	36.66
10.663	431.437	18.99	1.06	5.57	-6.84	40.4242	5.789	2.72	40.53	5.77	3	135.00	0.680	0.453	0.227	1.486	5.18	7.69	0.567	19.04	41.4795	35.53
10.991	431.109	14.81	0.82	5.55	-7.21	30.3493	5.812	2.81	30.44	5.80	3	135.00	0.702	0.465	0.237	1.467	4.23	6.21	0.437	14.85	46.4001	33.80
11.319	430.781	15.17	0.79	5.19	-6.65	30.3001	5.469	2.79	30.38	5.45	3	135.00	0.724	0.477	0.247	1.448	4.29	6.22	0.447	15.21	45.3583	33.80
11.647	430.453	13.83	0.74	5.37	-5.98	26.7744	5.656	2.84	26.84	5.64	3	135.00	0.746	0.489	0.257	1.431	4.02	5.75	0.405	13.86	48.2129	33.04
11.975	430.125	11.53	0.56	4.82	-4.81	21.4987	5.204	2.88	21.56	5.19	3	135.00	0.768	0.501	0.268	1.413	3.44	4.86	0.333	11.56	50.9108	31.67
12.303	429.797	12.82	0.45	3.52	-3.23	23.4732	3.741	2.76	23.51	3.73	4	135.00	0.790	0.512	0.278	1.397	3.57	4.98	0.372	12.84	43.714	32.22
12.631	429.469	13.05	0.43	3.3	-2.06	23.3366	3.514	2.74	23.37	3.51	4	135.00	0.812	0.524	0.288	1.381	3.60	4.97	0.379	13.07	42.8475	32.18
12.959	429.141	13.03	0.41	3.16	-0.78	22.7399	3.362	2.74	22.74	3.36	4	135.00	0.835	0.536	0.298	1.366	3.58	4.90	0.378	13.03	42.7021	32.01
13.287	428.813	14.48	0.43	2.98	12.21	24.8506	3.156	2.70	24.70	3.17	5	135.00	0.857	0.548	0.308	1.351	3.87	5.23	0.422	14.4	40.3482	32.53
13.615	428.485	14.54	0.43	2.97	15.45	24.39	3.148	2.70	24.21	3.17	5	135.00	0.879	0.560	0.319	1.338	3.90	5.20	0.423	14.44	40.6879	32.41
13.943	428.157	13.29	0.47	3.55	20.09	21.6584	3.794	2.80	21.43	3.83	4	135.00	0.901	0.572	0.329	1.322	3.73	4.94	0.384	13.16	45.8728	31.65
14.271	427.829	16.42	0.51	3.08	25.66	26.5391	3.291	2.69	26.27	3.33	5	135.00	0.923	0.584	0.339	1.309	4.35	5.70	0.480	16.26	39.9534	32.91
14.6	427.500	19.35	0.75	3.86	19.79	30.8871	4.075	2.70	30.69	4.10	4	135.00	0.945	0.596	0.349	1.295	5.18	6.71	0.570	19.23	40.477	33.87
14.928	427.172	23.7	1.01	4.25	-5.33	37.4028	4.443	2.66	37.45	4.44	4	135.00	0.967	0.608	0.360	1.283	6.26	8.03	0.704	23.73	38.4335	35.07
15.256	426.844	26.27	0.82	3.11	-8.01	40.7957	3.244	2.54	40.88	3.24	5	135.00	0.990	0.620	0.370	1.270	6.53	8.30	0.783	26.32	32.4669	35.59

R16614

Depth (ft)	San (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	...ress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	426.516	28.43	0.71	2.5	1.06	43.4116	2.590	2.45	43.40	2.59	6	135.00	1.012	0.632	0.380	1.258	6.77	8.52	0.849	28.42	28.7045	35.94
15.912	426.188	34.11	0.83	2.42	14.23	51.4007	2.509	2.39	51.26	2.52	6	135.00	1.034	0.643	0.390	1.247	7.88	9.82	1.024	34.02	26.1157	36.91
16.24	425.860	36.87	1.15	3.11	26.79	54.6443	3.211	2.45	54.38	3.23	5	135.00	1.056	0.655	0.401	1.235	8.72	10.78	1.109	36.7	28.4501	37.25
16.568	425.532	38.02	1.21	3.18	114.11	55.3595	3.275	2.46	54.30	3.34	5	136.00	1.078	0.667	0.411	1.224	8.91	10.91	1.144	37.31	28.9263	37.24
16.896	425.204	42.17	1.45	3.45	138.77	60.4516	3.531	2.46	59.17	3.61	5	137.00	1.100	0.679	0.421	1.213	9.86	11.96	1.272	41.3	28.8349	37.73
17.224	424.876	49.75	1.96	3.95	80.34	70.3096	4.031	2.45	69.59	4.07	5	138.00	1.123	0.692	0.431	1.202	11.71	14.08	1.505	49.25	28.4507	38.64
17.552	424.548	47.56	1.6	3.37	107.39	65.9285	3.447	2.42	64.98	3.50	5	139.00	1.146	0.704	0.442	1.192	11.00	13.11	1.437	46.89	27.2425	38.26
17.88	424.220	51.6	1.85	3.59	140.27	70.3788	3.668	2.42	69.15	3.73	5	140.00	1.168	0.717	0.452	1.181	11.91	14.07	1.561	50.72	27.3444	38.61
18.208	423.892	65.03	2.32	3.57	168.7	87.5341	3.634	2.36	86.09	3.69	5	141.00	1.191	0.729	0.462	1.171	14.58	17.07	1.976	63.98	24.6627	39.80
18.537	423.563	70.02	2.53	3.61	155.08	92.701	3.677	2.34	91.39	3.73	5	142.00	1.215	0.742	0.472	1.161	15.64	18.15	2.130	69.05	24.1296	40.12
18.865	423.235	65.59	2.53	3.86	43.83	85.2026	3.931	2.38	84.85	3.95	5	143.00	1.238	0.755	0.483	1.151	15.06	17.33	1.992	65.32	25.6929	39.72
19.193	422.907	55.6	2.73	4.9	4.71	70.7073	5.024	2.51	70.67	5.03	4	144.00	1.261	0.769	0.493	1.141	13.62	15.54	1.682	55.57	31.2954	38.73
19.521	422.579	110.1	2.81	2.55	-0.67	139.17	2.582	2.10	139.17	2.58	7	145.00	1.285	0.782	0.503	1.131	22.55	25.50	3.369	110.1	15.903	42.30
19.849	422.251	160.51	4.84	3.02	-18.41	200.145	3.040	2.06	200.30	3.04	7	146.00	1.309	0.795	0.513	1.121	32.40	36.33	4.929	160.63	14.7692	44.08
20.177	421.923	111.07	5.1	4.59	-23.58	135.622	4.647	2.31	135.79	4.64	11	147.00	1.333	0.809	0.523	1.112	24.86	27.63	3.397	111.21	22.9849	42.18
20.505	421.595	58.61	3.39	5.76	-23.83	69.8082	5.900	2.57	69.99	5.89	11	148.00	1.357	0.823	0.534	1.102	14.84	16.36	1.779	58.96	33.8626	38.67
20.833	421.267	53.52	2.16	4.03	-22.7	62.2887	4.143	2.48	62.46	4.13	5	149.00	1.381	0.837	0.544	1.093	12.97	14.18	1.614	53.66	30.0156	38.04
21.161	420.939	55.22	2.52	4.56	-21.43	63.2178	4.683	2.52	63.37	4.67	4	150.00	1.405	0.851	0.554	1.084	13.61	14.75	1.666	55.35	31.6051	38.12
21.489	420.611	99.33	2.92	2.94	-20.71	113.098	2.983	2.21	113.25	2.98	6	151.00	1.430	0.866	0.564	1.075	21.26	22.85	3.031	99.46	19.2589	41.25
21.817	420.283	112.37	3.22	2.86	-15.47	126.016	2.903	2.17	126.13	2.90	6	152.00	1.455	0.880	0.575	1.066	23.66	25.22	3.434	112.47	17.9771	41.80
22.145	419.955	57.05	2.85	4.99	-4.13	62.1002	5.129	2.56	62.13	5.13	4	153.00	1.480	0.895	0.585	1.057	14.28	15.10	1.720	57.08	33.269	38.01
22.473	419.627	49.22	2.02	4.1	-0.05	52.4512	4.233	2.54	52.45	4.23	5	154.00	1.505	0.910	0.595	1.048	12.24	12.84	1.477	49.22	32.7044	37.05
22.802	419.298	45.2	1.76	3.89	26.33	47.2222	4.030	2.56	47.04	4.05	5	155.00	1.530	0.925	0.605	1.040	11.30	11.75	1.352	45.03	33.5817	36.42
23.13	418.970	86.55	1.89	2.18	44.16	90.4233	2.224	2.18	90.13	2.23	7	156.00	1.556	0.940	0.616	1.031	18.23	18.81	2.631	86.27	18.3567	40.05
23.458	418.642	135.75	2.31	1.7	0.11	140.445	1.722	1.97	140.43	1.72	8	157.00	1.581	0.955	0.626	1.023	26.36	26.97	4.154	135.74	12.0719	42.35
23.786	418.314	80.31	2.82	3.51	-7.76	81.0662	3.583	2.36	81.12	3.58	6	158.00	1.607	0.971	0.636	1.015	18.37	18.64	2.437	80.36	24.9247	39.48
24.114	417.986	60.5	2.64	4.36	-3.63	59.6725	4.485	2.52	59.70	4.48	5	159.00	1.633	0.987	0.646	1.007	14.91	15.01	1.823	60.53	31.782	37.79
24.442	417.658	127.06	4.56	3.59	-4.92	125.108	3.636	2.25	125.14	3.64	6	160.00	1.659	1.002	0.657	0.999	27.63	27.60	3.882	127.09	20.6506	41.76
24.77	417.330	149.98	9.93	6.62	-11.87	145.622	6.696	2.43	145.70	6.69	11	161.00	1.685	1.018	0.667	0.991	35.31	34.99	4.591	150.06	27.5358	42.53
25.098	417.002	328.34	15.26	4.65	23.26	315.728	4.672	2.12	315.56	4.67	11	162.00	1.712	1.035	0.677	0.983	67.79	66.65	10.112	328.19	16.5598	46.17
25.426	416.674	419.75	19.4	4.62	18.11	397.781	4.641	2.08	397.68	4.64	11	163.00	1.738	1.051	0.687	0.976	85.07	82.99	12.942	419.64	15.1488	47.17
25.754	416.346	389.73	18.71	4.8	438.91	363.482	4.823	2.11	360.92	4.86	11	164.00	1.765	1.067	0.697	0.968	79.58	77.03	12.011	386.99	16.2214	46.75

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 43 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [signature] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-11

ConeTec Inc. erpretation
Interpretation Ou Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4215
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-11
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 10:31
CPT File: 804CP11.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 440.6

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	39.88	2.76	89.72	26.76	2.35

User Inputs:
Assumed: Water Table Depth (ft): 11.4
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 440.6
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rtn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	440.436	28.5	0.22	0.76	0.16	2779.49	0.772	1.11	2778.51	0.77	7	125.00	0.010	0.010	0.000	2.000	4.17	8.34	0.882	28.49	-1.2563	54.33
0.492	440.108	28.29	0.44	1.56	-0.67	919	1.557	1.50	919.33	1.56	6	125.00	0.031	0.031	0.000	2.000	4.67	9.34	0.875	28.3	2.83966	50.52
0.82	439.780	20.17	0.54	2.66	-2.66	392.561	2.684	1.87	392.76	2.68	5	125.00	0.051	0.051	0.000	2.000	3.78	7.55	0.623	20.18	9.60794	47.11
1.148	439.452	19.6	0.52	2.63	-12.35	272.171	2.663	1.94	273.29	2.65	5	125.00	0.072	0.072	0.000	2.000	3.79	7.57	0.605	19.68	11.4161	45.51
1.476	439.124	28.99	0.42	1.43	-1.13	313.255	1.453	1.69	313.36	1.45	6	125.00	0.092	0.092	0.000	2.000	5.10	10.19	0.895	29	5.94772	46.13
1.804	438.796	36.06	0.45	1.25	-0.07	318.823	1.252	1.63	318.82	1.25	7	125.00	0.113	0.113	0.000	2.000	6.22	12.43	1.113	36.06	4.93192	46.20
2.133	438.467	35.17	0.54	1.52	-0.16	262.816	1.541	1.76	262.82	1.54	7	125.00	0.133	0.133	0.000	2.000	6.32	12.65	1.085	35.17	7.21826	45.33
2.461	438.139	37.91	0.55	1.44	-0.05	245.469	1.457	1.76	245.47	1.46	7	125.00	0.154	0.154	0.000	2.000	6.81	13.63	1.169	37.91	7.18838	45.02
2.789	437.811	36.47	0.68	1.87	-0.34	208.222	1.874	1.89	208.22	1.87	6	125.00	0.174	0.174	0.000	2.000	6.87	13.74	1.124	36.47	10.0384	44.25
3.117	437.483	27.44	0.59	2.16	-0.37	139.853	2.166	2.04	139.85	2.17	6	125.00	0.195	0.195	0.000	2.000	5.49	10.97	0.844	27.44	14.139	42.30
3.445	437.155	20.54	0.66	3.22	-0.44	94.3962	3.247	2.29	94.40	3.25	5	125.00	0.215	0.215	0.000	2.000	4.54	9.08	0.629	20.54	22.0663	40.26
3.773	436.827	22.61	0.8	3.52	-1.01	94.8813	3.576	2.32	94.88	3.56	5	125.00	0.236	0.236	0.000	2.000	5.07	10.13	0.693	22.61	23.1951	40.29
4.101	436.499	26.22	0.98	3.73	-1.36	101.297	3.775	2.32	101.30	3.77	5	125.00	0.256	0.256	0.000	1.975	5.68	11.60	0.804	26.22	23.1946	40.63
4.429	436.171	31.36	1.08	3.45	-1.09	112.29	3.475	2.26	112.33	3.47	5	125.00	0.277	0.277	0.000	1.901	6.66	13.04	0.962	31.37	21.1287	41.18
4.757	435.843	38.92	1.07	2.74	1.76	129.906	2.770	2.15	129.84	2.77	6	125.00	0.297	0.297	0.000	1.834	8.11	14.86	1.196	38.9	17.2319	41.92
5.085	435.515	38.04	1.11	2.93	4.37	118.693	2.943	2.19	118.60	2.94	6	125.00	0.318	0.318	0.000	1.774	8.07	14.31	1.168	38.01	18.7018	41.46
5.413	435.187	30.78	1.06	3.45	13.37	89.981	3.482	2.33	89.71	3.49	5	125.00	0.338	0.338	0.000	1.719	6.90	11.86	0.942	30.69	23.4971	39.99
5.741	434.859	25.89	0.85	3.29	18.6	71.1547	3.329	2.38	70.86	3.34	5	125.00	0.359	0.359	0.000	1.669	5.94	9.91	0.790	25.78	25.6136	38.69
6.069	434.531	23.4	0.79	3.36	23.9	60.6906	3.432	2.44	60.30	3.45	5	125.00	0.379	0.379	0.000	1.624	5.50	8.93	0.713	23.25	28.015	37.78
6.398	434.202	25.75	1.15	4.46	22.01	63.3951	4.536	2.51	63.07	4.56	4	125.00	0.400	0.400	0.000	1.581	6.28	9.93	0.785	25.62	31.3104	36.04
6.726	433.874	29.09	1.27	4.36	14.11	68.2001	4.430	2.48	68.01	4.44	4	125.00	0.420	0.420	0.000	1.542	7.01	10.81	0.888	29.01	29.9625	36.46
7.054	433.546	24	1	4.16	11.96	53.4372	4.245	2.54	53.28	4.26	4	125.00	0.441	0.441	0.000	1.506	5.94	8.95	0.729	23.93	32.5699	37.07
7.382	433.218	21.53	0.94	4.35	14.92	45.6649	4.462	2.61	45.45	4.48	4	125.00	0.461	0.461	0.000	1.472	5.49	8.09	0.652	21.43	35.6188	36.14
7.71	432.890	22.03	1.05	4.75	14.57	44.7173	4.873	2.64	44.53	4.89	3	125.00	0.482	0.482	0.000	1.441	5.72	8.24	0.667	21.94	37.2891	36.02
8.038	432.562	22.77	0.99	4.34	10.23	44.3247	4.446	2.61	44.21	4.46	4	125.00	0.502	0.502	0.000	1.411	5.84	8.24	0.689	22.71	35.9462	35.97
8.366	432.234	32.54	1.27	3.9	8.77	61.2328	3.967	2.48	61.12	3.97	5	125.00	0.523	0.523	0.000	1.383	7.83	10.83	0.991	32.48	29.7484	37.66
8.694	431.906	28.72	1.47	5.13	1.57	51.8548	5.217	2.61	51.84	5.22	3	125.00	0.543	0.543	0.000	1.357	7.39	10.03	0.872	28.71	36.0689	36.91
9.022	431.578	25.38	1.28	5.04	3.58	44.01	5.158	2.66	43.97	5.16	3	125.00	0.564	0.564	0.000	1.332	6.68	8.90	0.768	25.36	38.3383	35.94
9.35	431.250	21.81	1.12	5.12	4.5	36.3219	5.277	2.72	36.27	5.28	3	125.00	0.584	0.584	0.000	1.308	5.94	7.77	0.657	21.78	41.7898	34.76
9.678	430.922	19.77	1.16	5.88	0.32	31.6844	6.053	2.81	31.68	6.05	3	125.00	0.605	0.605	0.000	1.286	5.64	7.25	0.593	19.77	46.4618	33.95
10.006	430.594	16.91	1.13	6.7	7.09	26.0398	6.939	2.91	25.98	6.96	3	125.00	0.625	0.625	0.000	1.265	5.11	6.46	0.504	16.87	52.7324	32.71
10.335	430.265	12.18	0.84	6.91	7.27	17.8563	7.263	3.05	17.78	7.31	3	125.00	0.646	0.646	0.000	1.244	3.99	4.96	0.357	12.13	61.5745	30.26
10.663	429.937	13.61	0.58	4.27	11.11	19.422	4.481	2.88	19.32	4.51	3	125.00	0.666	0.666	0.000	1.225	4.02	4.92	0.401	13.54	50.6152	30.80
10.991	429.609	16.16	0.58	3.6	16.15	22.5247	3.748	2.78	22.38	3.77	4	125.00	0.687	0.687	0.000	1.207	4.51	5.44	0.479	16.06	44.7951	31.76
11.319	429.281	20.35	0.95	4.66	10.23	27.7658	4.836	2.78	27.67	4.85	3	125.00	0.707	0.707	0.000	1.189	5.71	6.79	0.608	20.28	45.0299	33.10
11.647	428.953	15.41	0.83	5.37	7.37	20.3852	5.653	2.93	20.33	5.67	3	135.00	0.728	0.720	0.008	1.178	4.70	5.54	0.465	15.37	53.7104	31.14
11.975	428.625	15.03	0.51	3.4	12.31	19.5044	3.571	2.81	19.40	3.59	4	135.00	0.750	0.732	0.018	1.169	4.28	5.00	0.442	14.95	46.7592	30.84
12.303	428.297	13.48	0.39	2.86	16.05	17.0793	3.069	2.82	16.94	3.09	5	135.00	0.772	0.744	0.028	1.159	3.84	4.45	0.393	13.38	47.1053	29.96
12.631	427.969	14.27	0.45	3.13	24.68	17.8261	3.339	2.83	17.61	3.38	5	135.00	0.794	0.756	0.038	1.150	4.07	4.69	0.417	14.11	47.7069	30.22
12.959	427.641	16.62	0.59	3.53	32.75	20.5813	3.733	2.81	20.31	3.78	4	135.00	0.816	0.768	0.049	1.141	4.69	5.36	0.489	16.41	46.6978	31.15
13.287	427.313	15.45	0.53	3.41	85.75	18.7382	3.627	2.85	18.06	3.76	4	135.00	0.839	0.780	0.059	1.132	4.36	4.94	0.452	14.92	48.9421	30.39
13.615	426.985	14.31	0.4	2.77	92.79	16.9884	2.974	2.83	16.26	3.11	5	135.00	0.861	0.792	0.069	1.124	3.98	4.47	0.416	13.73	48.0254	29.71
13.943	426.657	16.27	0.56	3.45	78.04	19.1483	3.639	2.84	18.54	3.76	4	135.00	0.883	0.804	0.079	1.116	4.59	5.12	0.476	15.78	48.3929	30.57
14.271	426.329	75.29	0.83	1.1	37.25	91.2159	1.116	1.97	90.93	1.12	8	135.00	0.905	0.815	0.090	1.107	14.61	16.18	2.303	75.06	12.2389	40.07
14.6	426.000	92.32	1.92	2.08	-13.9	110.454	2.101	2.10	110.55	2.10	7	135.00	0.927	0.827	0.100	1.099	18.90	20.78	2.829	92.4	15.8278	41.10
14.928	425.672	64.03	2.18	3.4	-6.84	75.1556	3.456	2.37	75.22	3.45	6	135.00	0.949	0.839	0.110	1.092	14.71	16.06	1.953	64.08	25.3244	39.03
15.256	425.344	42.81	1.68	3.92	119.63	49.1501	4.015	2.56	48.27	4.09	5	135.00	0.972	0.851	0.120	1.084	10.53	11.42	1.295	42.06	33.3652	36.51

R16617

Depth (ft)	Sam (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	Stress (tsf)	EStress (tsf)	Leq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	425.016	31.18	1.38	4.44	88.96	34.9725	4.572	2.70	34.34	4.66	4	135.00	0.994	0.863	0.131	1.076	8.26	8.89	0.935	30.63	40.6127	34.47
15.912	424.688	74.08	1.85	2.5	119.6	83.4971	2.532	2.25	82.64	2.56	6	135.00	1.016	0.875	0.141	1.069	15.95	17.05	2.262	73.33	20.7052	39.55
16.24	424.360	168.1	3.39	2.02	-0.74	188.354	2.029	1.94	188.35	2.03	7	135.00	1.038	0.887	0.151	1.062	32.30	34.30	5.172	169.1	11.3615	43.77
16.568	424.032	179.25	4.43	2.47	-10.55	198.239	2.486	2.00	198.32	2.49	7	136.00	1.060	0.899	0.161	1.055	35.21	37.14	5.517	179.32	12.8436	44.02
16.896	423.704	134.23	3.06	2.28	-18.82	146.166	2.298	2.05	146.30	2.30	7	137.00	1.082	0.911	0.171	1.048	26.94	28.22	4.122	134.35	14.3363	42.53
17.224	423.376	78.48	1.39	1.78	-20.86	83.8148	1.796	2.14	83.96	1.79	7	138.00	1.105	0.923	0.182	1.041	16.31	16.98	2.398	78.61	16.912	39.64
17.552	423.048	61.76	2.91	4.71	-21.8	64.8083	4.799	2.52	64.96	4.79	4	139.00	1.128	0.936	0.192	1.034	15.23	15.74	1.877	61.9	31.6498	38.22
17.88	422.720	131.97	4.46	3.38	-22.01	137.977	3.409	2.20	138.12	3.41	6	140.00	1.150	0.948	0.202	1.027	28.14	28.90	4.050	132.11	18.9817	42.25
18.208	422.392	229.79	6.98	3.04	1.89	237.93	3.053	2.03	237.92	3.05	12	141.00	1.173	0.961	0.212	1.020	45.63	46.55	7.078	229.78	13.6451	44.88
18.537	422.063	178.23	4.87	2.73	5.5	181.799	2.751	2.05	181.77	2.75	7	142.00	1.196	0.974	0.223	1.013	35.79	36.27	5.481	178.2	14.4578	43.60
18.865	421.735	158.32	3.05	1.93	-5.91	159.195	1.941	1.97	159.24	1.94	8	143.00	1.220	0.987	0.233	1.007	30.79	31.00	4.864	158.36	12.157	42.96
19.193	421.407	129.65	3.89	3	-15.68	128.399	3.029	2.18	128.49	3.03	6	144.00	1.243	1.000	0.243	1.000	27.40	27.40	3.975	129.74	18.2843	41.88
19.521	421.079	173.42	5.09	2.94	-12.86	169.87	2.957	2.10	169.95	2.96	7	145.00	1.267	1.013	0.253	0.993	35.43	35.20	5.330	173.5	15.7016	43.28
19.849	420.751	263.85	6.2	2.35	-1.66	255.66	2.361	1.91	255.67	2.36	7	146.00	1.291	1.027	0.264	0.987	50.25	49.58	8.129	263.86	10.7536	45.21
20.177	420.423	128.37	5.69	4.43	4.11	122.087	4.478	2.33	122.06	4.48	11	147.00	1.315	1.041	0.274	0.980	28.87	28.30	3.934	128.34	23.5384	41.62
20.505	420.095	79.4	4.72	5.95	5.06	74.0219	6.047	2.56	73.99	6.05	11	148.00	1.339	1.055	0.284	0.974	19.92	19.40	2.417	79.37	33.5824	38.95
20.833	419.767	78.64	4.44	5.65	4.76	72.3155	5.746	2.55	72.29	5.75	11	149.00	1.363	1.069	0.294	0.967	19.63	18.99	2.392	78.61	33.0698	38.82
21.161	419.439	89.37	5.02	5.61	5.8	81.2538	5.706	2.52	81.23	5.71	11	150.00	1.387	1.083	0.305	0.961	21.94	21.09	2.724	89.34	31.4994	39.47
21.489	419.111	108.25	5.71	5.27	5.22	97.3752	5.345	2.45	97.36	5.35	11	151.00	1.412	1.097	0.315	0.955	25.71	24.54	3.308	108.22	28.3906	40.44
21.817	418.783	132	7.15	5.41	2.48	117.444	5.476	2.41	117.43	5.48	11	152.00	1.437	1.112	0.325	0.948	30.78	29.19	4.042	131.98	26.7224	41.42
22.145	418.455	152.55	8.54	5.6	-0.62	134.133	5.652	2.39	134.13	5.65	11	153.00	1.462	1.126	0.335	0.942	35.23	33.19	4.678	152.55	25.8345	42.10
22.473	418.127	166.92	10.03	6.01	-0.81	144.956	6.063	2.39	144.96	6.06	11	154.00	1.487	1.141	0.345	0.936	36.66	36.19	5.122	166.92	26.1022	42.49
22.802	417.798	175.61	10.85	6.18	-0.16	150.561	6.232	2.39	150.56	6.23	11	155.00	1.512	1.156	0.356	0.930	40.69	37.84	5.390	175.61	26.1461	42.68
23.13	417.470	186.83	11.72	6.27	0.3	158.165	6.325	2.39	158.16	6.33	11	156.00	1.537	1.172	0.366	0.924	43.17	39.89	5.737	186.82	25.9033	42.93
23.458	417.142	212.47	12.86	6.05	-0.81	177.701	6.097	2.35	177.70	6.10	11	157.00	1.563	1.187	0.376	0.918	48.23	44.27	6.530	212.47	24.3144	43.50
23.786	416.814	206.47	13.26	6.42	-3.42	170.396	6.472	2.38	170.42	6.47	11	158.00	1.589	1.202	0.386	0.912	47.54	43.35	6.343	206.5	25.5551	43.29
24.114	416.486	224.17	13.55	6.04	-3.65	182.713	6.088	2.34	182.73	6.09	11	159.00	1.615	1.218	0.397	0.906	50.73	45.97	6.890	224.19	24.049	43.63
24.442	416.158	237.64	15.41	6.48	-5.54	191.262	6.530	2.36	191.29	6.53	11	160.00	1.641	1.234	0.407	0.900	54.17	48.76	7.306	237.67	24.6695	43.85
24.77	415.830	244.94	15.19	6.2	-7.81	194.633	6.244	2.34	194.66	6.24	11	161.00	1.667	1.250	0.417	0.894	55.32	49.46	7.532	244.98	23.8705	43.94
25.098	415.502	239.96	14.94	6.23	-11.57	188.192	6.270	2.34	188.25	6.27	11	162.00	1.693	1.266	0.427	0.889	54.42	48.36	7.377	240.03	24.2139	43.78
25.426	415.174	217.85	14.42	6.62	-17.67	168.534	6.672	2.39	168.62	6.67	11	163.00	1.720	1.282	0.438	0.893	50.48	44.58	6.691	217.96	26.1001	43.24
25.754	414.846	219.37	13.74	6.26	-20.97	167.543	6.314	2.37	167.64	6.31	11	164.00	1.747	1.299	0.448	0.877	50.40	44.22	6.738	219.5	25.3316	43.21
26.082	414.518	214.66	13.21	6.15	-22.49	161.82	6.205	2.37	161.93	6.20	11	165.00	1.774	1.316	0.458	0.872	49.36	43.03	6.591	214.8	25.3926	43.04
26.41	414.190	225.44	13.56	6.01	-24.85	167.847	6.063	2.36	167.97	6.06	11	166.00	1.801	1.332	0.469	0.866	51.45	44.57	6.924	225.6	24.7228	43.22
26.739	413.861	268.44	15.56	5.8	-24.92	197.572	5.836	2.31	197.68	5.83	11	167.00	1.828	1.349	0.479	0.861	59.89	51.56	8.254	268.59	22.7802	44.01
27.067	413.533	344.83	16.55	4.8	-25.2	250.97	4.825	2.18	251.09	4.82	11	168.00	1.855	1.367	0.489	0.855	73.00	62.45	10.618	344.99	18.4477	45.13

R16618

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek Deformation Evaluation
Normalized PS-CPT Data and Parameter Correlations

PROJECT NO. 072046

PAGE 46 OF 48

MADE BY BEG DATE 12/28/07 CHECKED BY [illegible] DATE 1/23/08

NORMALIZED AND MODIFIED BY CEC
CONETEC, INC. – CPT DATA AND CORRELATED PARAMETERS
POND CREEK – WILLIAMSON COUNTY, ILLINOIS
CPT-12

ConeTec Inc. .erpretation
Interpretation - Release 1.22 Rev. Format: NLI Imperial
Run No: 07-1210-1008-4182
Job No: 07-804
Client: Civil & Environmental Consultants
Project: Pond Creek Mine - Williamson County, Illinois
Site: CPT-12
Location: Pond Creek Mine
Cone: 20 TON AD211
CPT Date: 07/31/10
CPT Time: 11:15
CPT File: 804CP12.COR
Northing (ft): 0.000000
Easting (ft): 0.000000
Elevation (ft): 442.1

Material Types and Unit Weight (pcf)		Phi Avg. deg	Su Avg. tsf	Qc Avg. tsf	Fc Avg. %	Ic Avg. %
125	Residual Soil	39.01	2.80	91.11	27.69	2.37

User Inputs:
Assumed:
Water Table Depth (ft): 11.7
Nk: 32.3
State Parameter: 1.2
Unit Weight of Soil (pcf): Varies See Below
CPT area ratio: 0.85 See Below
Ground Surface Elev. 442.1
Copied from ConeTec CPT Data File

Depth (ft)	Sample El. (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.Wt. (pcf)	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
0.164	441.936	11.62	0.14	1.16	-0.32	1132.66	1.206	1.37	1132.66	1.21	6	125.00	0.010	0.010	0.000	2.000	1.84	3.67	0.359	11.62	1.12402	51.29
0.492	441.608	7.94	0.16	2.02	-1.8	257.211	2.023	1.86	257.54	2.02	5	125.00	0.031	0.031	0.000	2.000	1.48	2.96	0.245	7.95	9.3841	45.24
0.82	441.280	9.78	0.15	1.54	-4.83	169.829	1.542	1.84	190.41	1.54	5	125.00	0.051	0.051	0.000	2.000	1.82	3.64	0.301	9.81	9.05791	43.82
1.148	440.952	14.93	0.28	1.85	-7.94	207.084	1.884	1.89	207.78	1.88	5	125.00	0.072	0.072	0.000	2.000	2.82	5.65	0.460	14.98	10.0719	44.24
1.476	440.624	13.35	0.35	2.59	-11.59	143.715	2.640	2.10	144.47	2.63	5	125.00	0.092	0.092	0.000	2.000	2.74	5.49	0.410	13.42	15.7665	42.47
1.804	440.296	10.42	0.21	2.02	-9.49	9[illegible].4169	2.037	2.14	91.95	2.03	5	125.00	0.113	0.113	0.000	2.000	2.18	4.36	0.319	10.48	17.1922	40.12
2.133	439.967	11.15	0.3	2.65	-4.09	82.6381	2.723	2.27	82.86	2.72	5	125.00	0.133	0.133	0.000	2.000	2.45	4.90	0.341	11.18	21.347	39.56
2.461	439.639	11.4	0.39	3.39	-0.6	73.1162	3.468	2.38	73.12	3.47	4	125.00	0.154	0.154	0.000	2.000	2.63	5.26	0.348	11.4	25.7091	38.87
2.789	439.311	19.33	0.58	3.01	0.23	109.893	3.028	2.22	109.89	3.03	5	125.00	0.174	0.174	0.000	2.000	4.16	8.31	0.593	19.33	19.7298	41.06
3.117	438.983	28.95	0.84	2.89	2.91	147.604	2.921	2.13	147.55	2.92	5	125.00	0.195	0.195	0.000	2.000	5.99	11.98	0.890	28.94	16.7116	42.57
3.445	438.655	31.92	1.09	3.41	12.38	147.25	3.438	2.19	146.92	3.45	5	125.00	0.215	0.215	0.000	2.000	6.75	13.50	0.982	31.85	18.5805	42.55
3.773	438.327	29.03	1.2	4.13	24.36	122.106	4.168	2.31	121.47	4.19	4	125.00	0.236	0.236	0.000	2.000	6.43	12.87	0.891	28.88	22.7083	41.58
4.101	437.999	26.16	1.06	4.04	36.19	101.063	4.092	2.35	100.20	4.13	4	125.00	0.256	0.256	0.000	1.975	5.90	11.65	0.802	26.94	24.4642	40.58
4.429	437.671	24.24	0.91	3.76	45.54	86.5683	3.797	2.37	85.56	3.84	4	125.00	0.277	0.277	0.000	1.901	5.50	10.45	0.742	23.96	25.2412	39.73
4.757	437.343	19.02	0.82	4.29	43.88	62.9731	4.360	2.51	62.06	4.44	4	125.00	0.297	0.297	0.000	1.834	4.59	8.41	0.580	18.75	31.1432	37.95
5.085	437.015	21.3	0.75	3.53	49.65	66.0206	3.574	2.43	65.05	3.63	5	125.00	0.318	0.318	0.000	1.774	4.95	8.78	0.650	20.99	27.7143	38.21
5.413	436.687	23.02	0.78	3.4	49.79	67.0436	3.439	2.41	66.13	3.49	5	125.00	0.338	0.338	0.000	1.719	5.31	9.13	0.702	22.71	26.9846	38.30
5.741	436.359	19.94	0.81	4.05	42.61	54.5722	4.137	2.53	53.82	4.19	4	125.00	0.359	0.359	0.000	1.669	4.87	8.13	0.606	19.67	32.2135	37.13
6.069	436.031	19.3	0.6	3.12	42.66	49.8815	3.171	2.48	49.20	3.22	5	125.00	0.379	0.379	0.000	1.624	4.59	7.45	0.586	19.04	29.7477	36.60
6.398	435.702	19.44	0.61	3.15	38.64	47.6152	3.204	2.50	47.02	3.24	5	125.00	0.400	0.400	0.000	1.581	4.67	7.38	0.589	19.2	30.4945	36.34
6.726	435.374	19.51	0.69	3.55	28.89	45.4109	3.615	2.55	44.98	3.65	4	125.00	0.420	0.420	0.000	1.542	4.81	7.42	0.591	19.33	32.7392	36.08
7.054	435.046	19.87	0.87	4.39	16.93	44.0695	4.478	2.62	43.84	4.50	3	125.00	0.441	0.441	0.000	1.506	5.10	7.68	0.602	19.77	36.2175	35.92
7.382	434.718	19.53	0.85	4.34	16.6	41.33	4.458	2.64	41.09	4.48	3	125.00	0.461	0.461	0.000	1.472	5.06	7.44	0.590	19.42	37.1432	35.54
7.71	434.390	17.5	0.83	4.73	14.09	35.3165	4.877	2.71	35.13	4.90	3	125.00	0.482	0.482	0.000	1.441	4.71	6.79	0.527	17.41	41.075	34.59
8.038	434.062	15.42	0.64	4.16	15.08	29.6942	4.290	2.73	29.52	4.32	3	125.00	0.502	0.502	0.000	1.411	4.19	5.91	0.462	15.33	41.9523	33.51
8.366	433.734	15.44	0.6	3.86	17.32	28.529	4.022	2.72	28.32	4.05	4	125.00	0.523	0.523	0.000	1.383	4.18	5.77	0.462	15.33	41.6655	33.25
8.694	433.406	19.79	0.74	3.75	16.06	35.4205	3.845	2.64	35.22	3.87	4	125.00	0.543	0.543	0.000	1.357	5.13	6.96	0.596	19.68	37.304	34.60
9.022	433.078	19.84	0.86	4.34	16.61	34.1851	4.461	2.69	34.01	4.48	4	125.00	0.564	0.564	0.000	1.332	5.30	7.05	0.597	19.74	40.1678	34.39
9.35	432.750	17.62	0.88	4.98	13.99	29.1519	5.166	2.79	29.01	5.19	3	125.00	0.584	0.584	0.000	1.308	4.95	6.48	0.527	17.54	45.3203	33.40
9.678	432.422	16.33	0.72	4.42	21.5	25.9973	4.579	2.79	25.77	4.62	3	125.00	0.605	0.605	0.000	1.286	4.58	5.88	0.487	16.19	45.491	32.66
10.006	432.094	13.67	0.59	4.33	11.13	20.8589	4.523	2.86	20.75	4.55	3	125.00	0.625	0.625	0.000	1.265	3.99	5.04	0.404	13.6	49.3482	31.27
10.335	431.765	12.63	0.44	3.49	13.16	18.553	3.672	2.84	18.43	3.70	4	125.00	0.646	0.646	0.000	1.244	3.64	4.53	0.371	12.55	48.2363	30.50
10.663	431.437	12.67	0.5	3.92	14.21	18.0115	4.165	2.88	17.69	4.19	3	125.00	0.666	0.666	0.000	1.225	3.75	4.59	0.372	12.59	50.9429	30.30
10.991	431.109	12.7	0.63	4.97	13.9	17.4879	5.244	2.96	17.37	5.28	3	125.00	0.687	0.687	0.000	1.207	3.93	4.74	0.372	12.62	55.6721	30.11
11.319	430.781	10.22	0.46	4.51	14.5	13.4465	4.836	3.02	13.31	4.89	3	125.00	0.707	0.707	0.000	1.189	3.28	3.91	0.295	10.12	60.1558	28.34
11.647	430.453	8.57	0.2	2.34	16.35	10.773	2.550	2.94	10.64	2.58	4	125.00	0.728	0.728	0.000	1.172	2.61	3.05	0.243	8.47	54.4211	26.83
11.975	430.125	9.06	0.17	1.83	18.91	11.234	2.045	2.87	11.07	2.08	5	135.00	0.748	0.740	0.009	1.163	2.64	3.08	0.257	8.94	50.2538	27.11
12.303	429.797	10.52	0.15	1.38	22.7	12.9687	1.539	2.75	12.78	1.56	5	135.00	0.771	0.762	0.019	1.153	2.87	3.32	0.302	10.38	43.3766	28.09
12.631	429.469	13.05	0.29	2.23	28.38	16.0505	2.366	2.78	15.81	2.40	5	135.00	0.793	0.764	0.029	1.144	3.61	4.13	0.379	12.87	44.7486	29.51
12.959	429.141	13.23	0.43	3.26	16.7	16.0076	3.464	2.87	15.88	3.49	4	135.00	0.815	0.776	0.039	1.136	3.89	4.42	0.384	13.13	50.3648	29.54
13.287	428.813	13.91	0.36	2.56	7.57	16.601	2.754	2.80	16.54	2.76	5	135.00	0.837	0.787	0.050	1.127	3.93	4.43	0.405	13.86	45.8936	29.81
13.615	428.485	17.32	0.69	3.96	6.49	20.5918	4.192	2.84	20.54	4.20	4	135.00	0.859	0.799	0.060	1.118	5.01	5.61	0.510	17.28	48.2013	31.23
13.943	428.157	28.85	1.37	4.74	1.25	34.4741	4.898	2.72	34.46	4.90	3	135.00	0.881	0.811	0.070	1.110	7.83	8.70	0.666	28.84	41.3835	34.48
14.271	427.829	35.76	1.81	5.06	8.08	42.3427	5.193	2.67	42.28	5.20	3	135.00	0.903	0.823	0.080	1.102	9.48	10.45	1.079	35.71	39.0642	35.72
14.6	427.500	93.11	1.97	2.12	5.47	110.381	2.137	2.11	110.35	2.14	7	135.00	0.926	0.835	0.090	1.094	19.09	20.89	2.854	93.08	16.0213	41.09
14.928	427.172	198.6	4.08	2.06	-1.59	233.341	2.064	1.89	233.35	2.06	8	135.00	0.948	0.847	0.101	1.087	37.46	40.71	6.119	198.61	10.1383	44.79
15.256	426.844	186.18	5.12	2.75	-9.91	215.622	2.764	2.01	215.70	2.76	7	135.00	0.970	0.859	0.111	1.079	36.81	39.72	5.734	186.25	13.2956	44.42

R16620

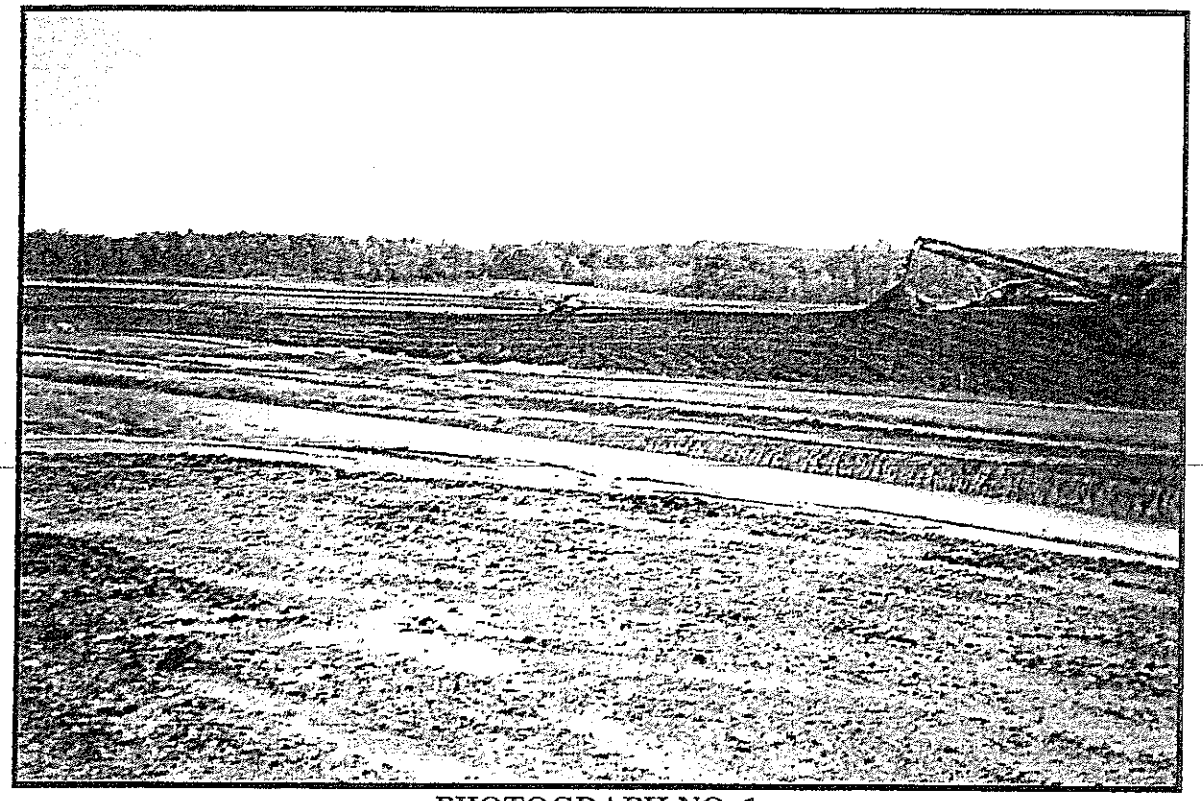
Depth (ft)	S... (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	Qtn (tsf)	Rfn (%)	Ic	Q	F	SBT	U.W. (pcf)	Stress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	qc (tsf)	Fc (%)	Phi (Deg.)
15.584	426.516	190.04	5.38	2.83	-11.83	217.081	2.846	2.02	217.16	2.84	7	135.00	0.992	0.671	0.121	1.072	37.70	40.40	5.853	190.11	13.5387	44.45
15.912	426.188	263.65	6.16	2.34	-13.14	297.513	2.345	1.88	297.60	2.34	7	135.00	1.014	0.863	0.131	1.064	49.51	52.70	8.131	263.73	9.83312	45.90
16.24	425.860	284.27	6.89	2.42	-9.63	316.576	2.433	1.88	316.64	2.43	7	135.00	1.036	0.895	0.142	1.057	53.37	56.42	8.769	284.33	9.8196	46.17
16.568	425.532	255.09	5.78	2.27	-12.84	280.208	2.275	1.88	280.30	2.27	7	136.00	1.058	0.907	0.152	1.050	47.96	50.37	7.865	255.17	9.90035	45.63
16.896	425.204	262.69	5.83	2.22	-14.73	284.775	2.229	1.87	284.87	2.23	8	137.00	1.081	0.919	0.162	1.043	49.18	51.31	8.099	262.78	9.63384	45.70
17.224	424.876	262.49	6.06	2.31	-15.84	280.793	2.318	1.89	280.90	2.32	7	138.00	1.103	0.931	0.172	1.036	49.47	51.27	8.092	262.59	10.0493	45.64
17.552	424.548	275.92	6.07	2.2	-16.9	291.316	2.209	1.86	291.43	2.21	8	139.00	1.126	0.943	0.183	1.030	51.50	53.02	8.508	276.03	9.43529	45.80
17.88	424.220	282.44	5.86	2.07	-17.67	294.284	2.083	1.84	294.40	2.08	8	140.00	1.149	0.956	0.193	1.023	52.26	53.45	8.709	282.65	8.89784	45.85
18.208	423.892	257.04	5.91	2.3	-18.27	264.17	2.310	1.90	264.28	2.31	7	141.00	1.172	0.969	0.203	1.016	48.68	49.46	7.922	257.15	10.3624	45.36
18.537	423.563	242.82	4.68	1.93	-18.43	246.178	1.937	1.85	246.30	1.94	6	142.00	1.195	0.982	0.213	1.009	45.22	45.65	7.481	242.94	9.29281	45.04
18.865	423.235	257.45	4.85	1.88	-18.64	257.634	1.893	1.83	257.75	1.89	8	143.00	1.218	0.995	0.224	1.003	47.61	47.74	7.933	257.57	8.85195	45.25
19.193	422.907	260.77	6.02	2.31	-18.77	257.525	2.320	1.91	257.64	2.32	7	144.00	1.242	1.008	0.234	0.998	49.52	49.33	8.035	260.89	10.5471	45.25
19.521	422.579	170.7	6.5	3.81	-14.05	165.924	3.836	2.19	166.01	3.83	12	145.00	1.265	1.021	0.244	0.990	36.30	35.92	5.246	170.79	16.807	43.16
19.849	422.251	99.46	6.5	6.53	-18.39	94.8975	6.620	2.53	95.00	6.61	11	146.00	1.289	1.035	0.254	0.983	24.57	24.16	3.040	99.59	31.9422	40.31
20.177	421.923	121.55	7.95	6.54	-17.74	114.684	6.612	2.48	114.80	6.61	11	147.00	1.313	1.048	0.264	0.977	29.34	28.66	3.723	121.67	29.7886	41.30
20.505	421.595	160.73	12.29	7.65	-14.95	150.046	7.711	2.47	150.13	7.71	11	148.00	1.337	1.062	0.275	0.970	38.65	37.50	4.935	160.82	29.4577	42.67
20.833	421.267	215.14	14.59	6.78	-12.33	198.618	6.825	2.36	198.69	6.82	11	149.00	1.361	1.076	0.285	0.964	49.23	47.45	6.619	215.22	24.995	44.03
21.161	420.939	213.16	15.63	7.33	2.1	194.194	7.380	2.40	194.18	7.38	11	150.00	1.386	1.091	0.295	0.958	49.52	47.42	6.556	213.14	26.385	43.92
21.489	420.611	245.28	17.26	7.04	16.49	220.717	7.078	2.36	220.62	7.08	11	151.00	1.410	1.105	0.305	0.951	55.88	53.16	7.550	245.17	24.68	44.53
21.817	420.283	304.39	19.87	6.53	34.99	270.633	6.559	2.29	270.44	6.56	11	152.00	1.435	1.119	0.316	0.945	67.22	63.53	9.379	304.17	22.0175	45.47
22.145	419.955	331.65	17.77	5.36	221.32	291.141	5.382	2.20	289.92	5.40	11	153.00	1.460	1.134	0.326	0.939	70.29	66.00	10.223	330.27	18.9079	45.78

R16621

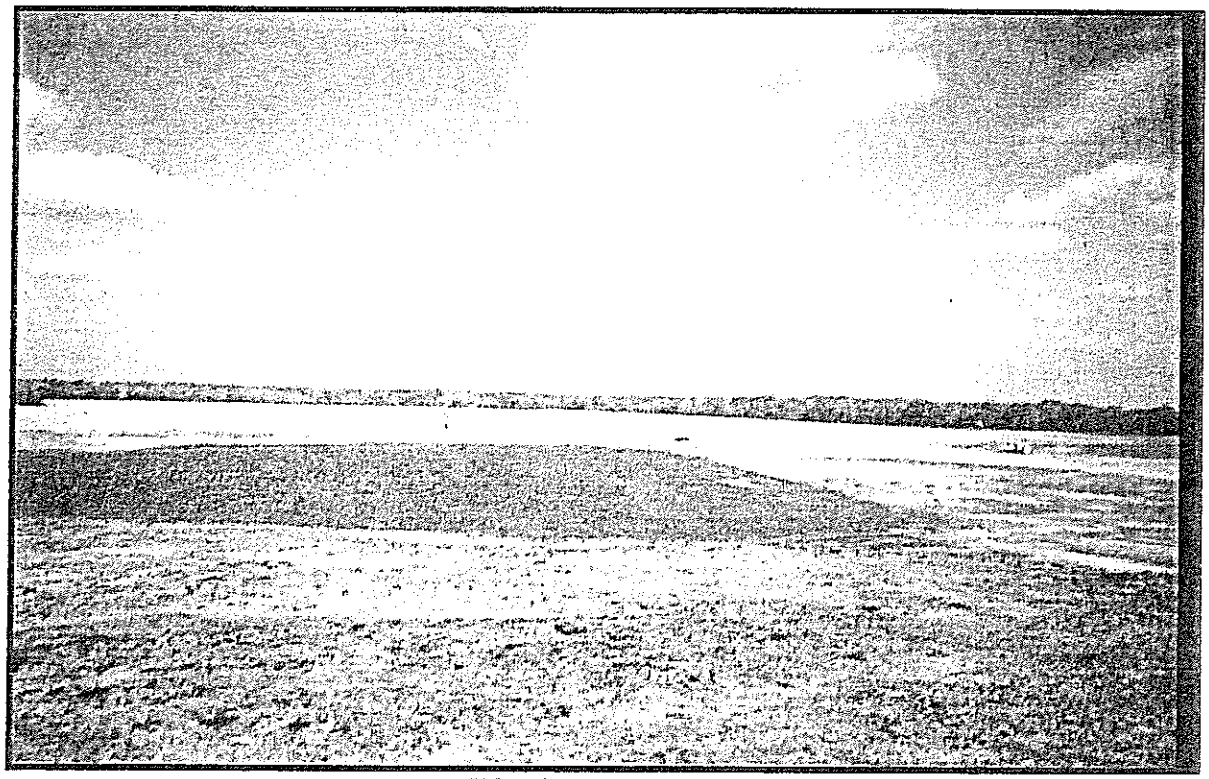
APPENDIX A-4

PHOTOGRAPHS OF OCTOBER 2007 FIELD TESTING

PHOTOGRAPHS

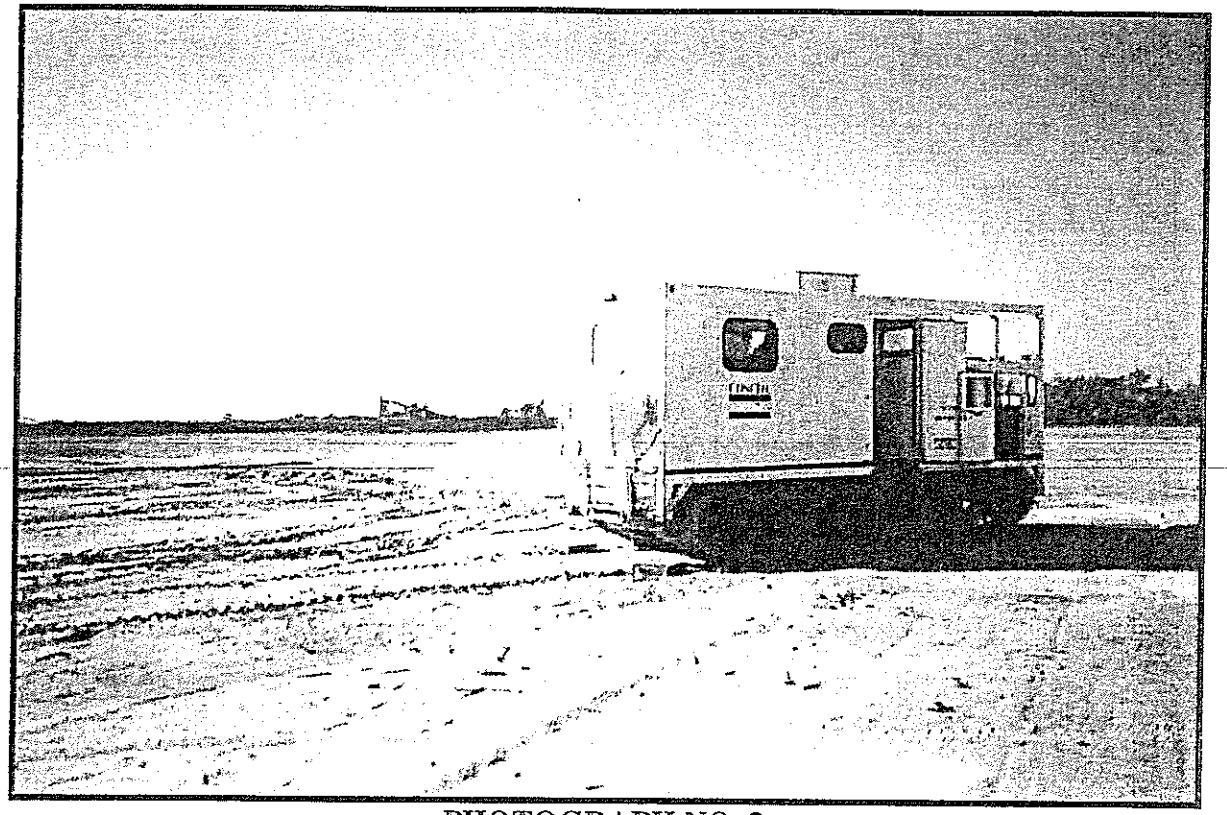


PHOTOGRAPH NO. 1
View of the Pond Creek facility and South Cell refuse looking southeast. (October 2007)

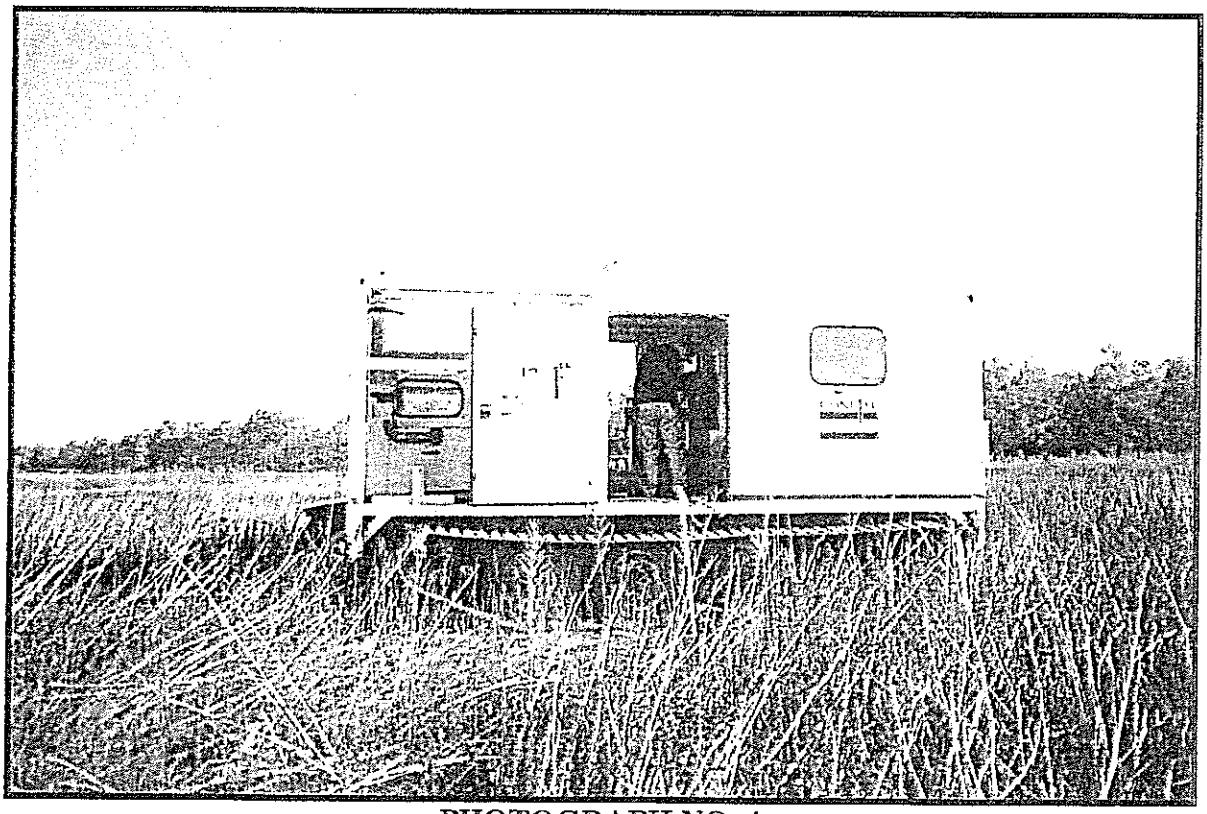


PHOTOGRAPH NO. 2
View of Pond Creek facility from existing coarse refuse crest at El. 482± looking north toward proposed Central and North Cells. ConeTec rig at CPT-6 middle right. (October 2007)

PHOTOGRAPHS

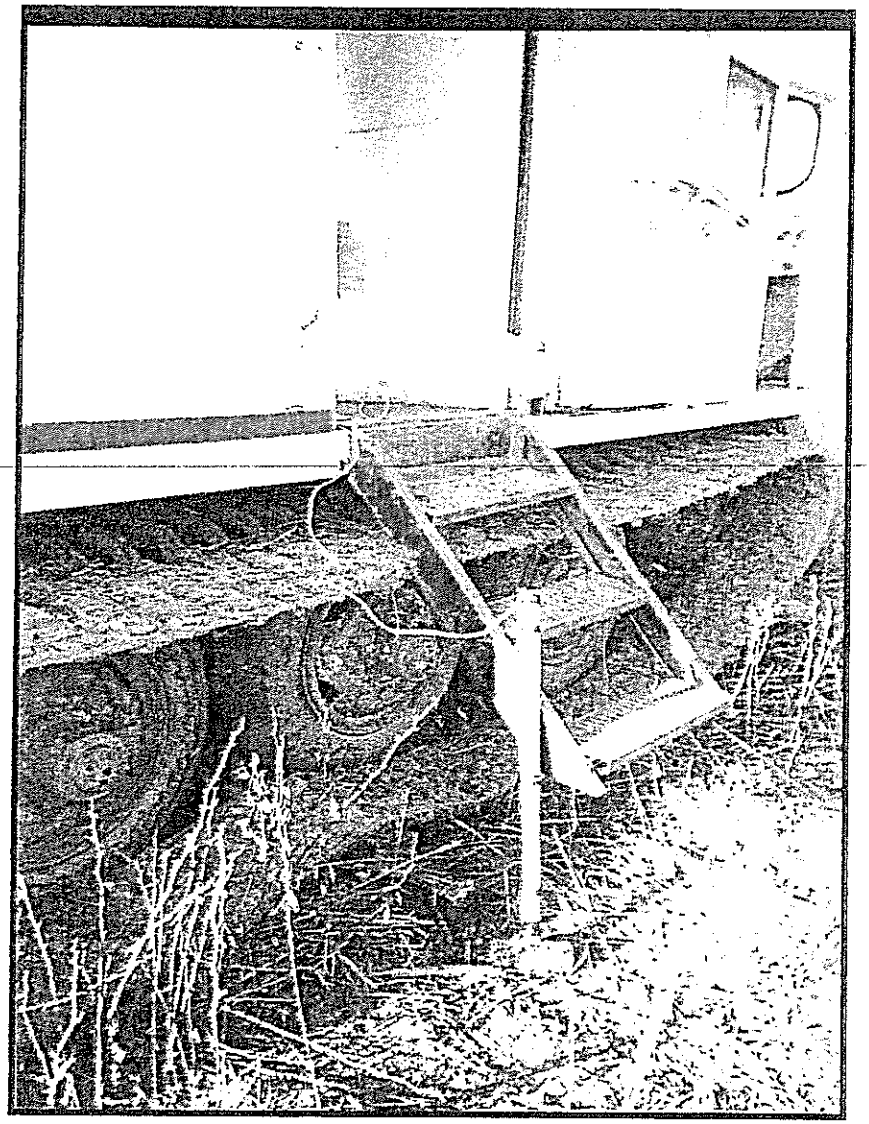


PHOTOGRAPH NO. 3
ConeTec CPT track rig at CPT-9 and proposed Central/North Cells
looking south. (October 2007)



PHOTOGRAPH NO. 4
ConeTec CPT track rig at CPT-7 and proposed Central Cell
looking northeast. (October 2007)

PHOTOGRAPHS



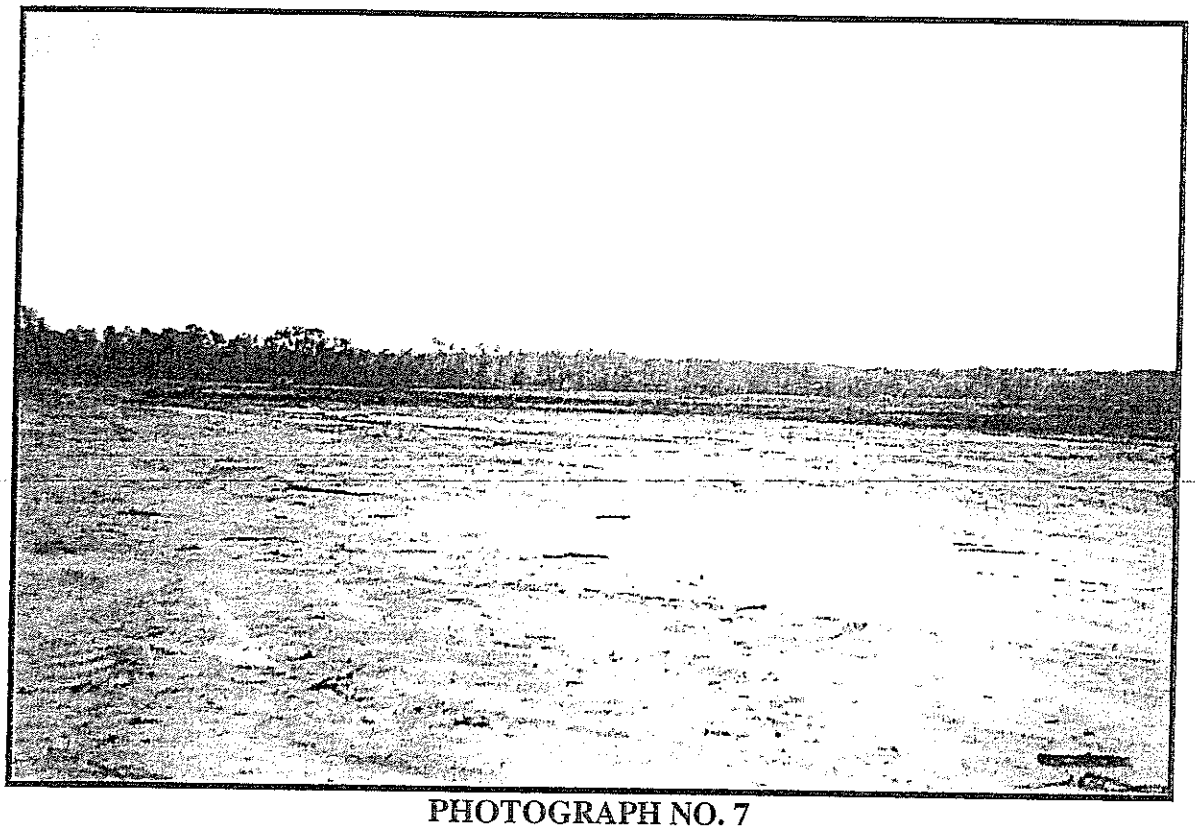
PHOTOGRAPH NO. 5
View of ConeTec seismic source beam beneath track and hammer with grounding cable. (October 2007)

PHOTOGRAPHS

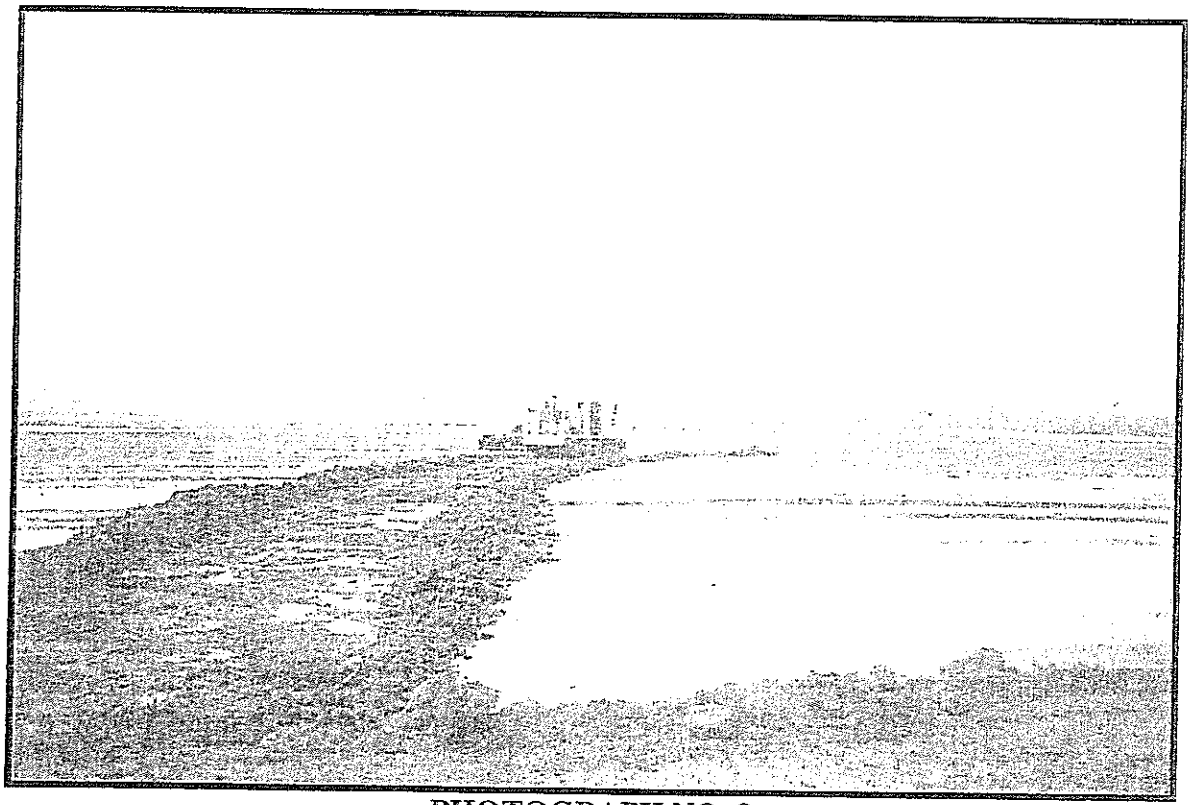


PHOTOGRAPH NO. 6
View of ConeTec CPT ram, rods and instrumentation cable from inside track rig.
(October 2007)

PHOTOGRAPHS



PHOTOGRAPH NO. 7
View of ConeTec track rig (in far left background) at CPT-8 looking northwest toward proposed North Cell. (October 2007)



PHOTOGRAPH NO. 8
View of ConeTec track rig at CPT-11 and proposed North Cell looking south. (October 2007)

8114-10
Part 21

APPENDIX C

SUPPLEMENTAL SUMMARY OF ENGINEERING PROPERTIES PREPARED BY GAI AND SUMMARY OF ENGINEERING PROPERTIES PREPARED BY CEC

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Summary of Engineering Properties and Coarse Refuse Tensile Strength

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY AMH DATE 5-12-09 SHEET NO. 1 OF 5

gai consultants

Engineers • Geologists • Planners
Environmental Specialists

CALCULATION BRIEF
FOR

SUPPLEMENTAL SUMMARY OF ENGINEERING PROPERTIES AND COARSE REFUSE TENSILE STRENGTH FOR SUBSIDENCE LIQUEFACTION AND EMBANKMENT CRACKING EVALUATIONS

POND CREEK COAL REFUSE DISPOSAL SITE – PHASE 3

OBJECTIVE: Summarize engineering properties for coarse and fine coal refuse and residual soil materials at the Pond Creek Coal Refuse Disposal site including unit weight (γ), specific gravity (G_s), effective strength, i.e., angle of internal friction (ϕ') and cohesion (c'), total strength, peak undrained shear strength (S_{up}), and steady-state undrained shear strength (S_{us}) (for fine coal refuse). Also, derive a tensile strength to effective stress relationship for coarse coal refuse from laboratory testing to subsequently evaluate potential post-subsidence embankment cracking. The various strengths will be used in the Pond Creek Phase 3 subsidence/stability analyses model(s).

REFERENCES:

1. Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Estimation and Summary of Engineering Properties Including Peak and Steady-State Undrained Shear Strength for Refuse and Subgrade Materials," Pond Creek Coal Refuse Disposal Site – South Pond Stage 2," BEG, 07/12/08.

2. Civil & Environmental Consultants, Inc. Calculation Brief Entitled "Characterization of Sand-Like and Clay-Like Subsurface Materials," Pond Creek Coal Refuse Disposal Site – South Cell, BEG, dated 7/11/08.

3. GAI Consultants, Inc. Calculation Brief Entitled "Supplemental Characterization of Subsurface Materials – Coarse Refuse and Residual Soil," Pond Creek Coal Refuse Disposal Site, BEG, dated 3/31/09.

4. GAI Consultants, Inc. Calculation Brief Entitled "Summary of Laboratory Testing," Pond Creek Coal Refuse Disposal Site, BEG, dated 3/30/09.

5. Civil & Environmental Consultants, Inc. Report Entitled "Abandonment Evaluation, Pond Creek No. 1 Coal Refuse Disposal Facility, Phase 2 South Pond Slurry Impoundment, Johnston City, Williamson County, Illinois," dated July 23, 2008.

6. Civil & Environmental Consultants, Inc. Report Entitled "Permanent Deformation Evaluation, Pond Creek No. 1 Coal Refuse Disposal Facility, South Cell Slurry Impoundment, Johnston City, Williamson County, Illinois," dated January 23, 2008.

7. Mine Safety and Health Administration, "Draft - Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 – Seismic Design: Stability and Deformation Analyses," dated, December 2007 (Updated August 2008).

8. Poulos, S.J., Castro, G., France, J.W. (1985), "Liquefaction Evaluation Procedure," Journal of Geotechnical Engineering, ASCE, 111(6), pp. 772-791.

9. Almes, R. A. and Butail, A. (1976) "Coal Refuse: Its Behavior Related to the Design and Operation of Coal Refuse Disposal Facilities," Proceedings of the Ohio River Valley Soils Seminar, Lexington, Kentucky, October, 1976.

10. Winterkorn, Hans F. and Fang, Hsai-Yang. (1975) "Foundation Engineering Handbook," Van Nostrand Reinhold Company. New York, page 116.

SOIL PROPERTIES:

From Reference (Ref.) Number (No.) 1, the following soil properties were estimated based on laboratory testing performed for previous permanent deformation (Ref. No. 5) and abandonment (Ref. No. 4) analyses, and/or provided by Alliance Consulting, Inc. (Alliance), which were used in the various slope stability analyses. These properties will subsequently be used in subsidence-related analyses, where appropriate, supplemented by additional engineering properties as necessary and described below.

Summary of Coarse and Fine Coal Refuse and Residual Soil Engineering Properties

Description	Unit Weight (γ) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion (c) (psf)	Comment
Coarse Refuse	130	33.7	0	Effective Strength (Drained)
		18.0	736	Total Strength (Undrained)
		0	$\sigma l/\sigma'v$–0.15 (See Below)	Tensile Strength
Fine Coal Refuse	80	36.9	0	Effective Strength (Drained)
		18.8	0	Total Strength (Undrained)
		0	Sus/$\sigma'v$=0.24 (See Ref. No. 1)	Steady-State (Undrained)
Residual Soil	125	26.8	0	Effective Strength (Drained)
		19.5	416	Total Strength (Undrained)
		0	3000	80% Peak Undrained

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Summary of Engineering Properties and Coarse Refuse Tensile Strength

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY AMH DATE 5-12-09 SHEET NO. 3 OF 5

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LABORATORY-DERIVED TENSILE STRENGTH OF COARSE COAL REFUSE, σ_t:

As presented in Ref. No. 4, two (2) consolidated–undrained (CU) triaxial series tests (3 points each) were performed by Holcolm Foundation Engineering Company, Inc. (Holcolm) on remolded coarse coal refuse to determine effective and total strength (undrained) parameters. CU tests were performed by Holcolm in November 2006 and April 2007 from site specific samples of coarse coal refuse. Remolded samples were prepared in the laboratory to approximately 95 percent of the standard Proctor maximum dry density at near optimum moisture conditions. Samples were consolidated to a range of vertical effective stresses of about 70, 90 and 110 pounds per square inch (psi) [or 10,080 to 15,840 pounds per square foot (psf)]. All specimens exhibited contractive behavior when sheared under undrained conditions. In general, all specimens reached, or nearly reached, a steady-state of deformation within the strain limits of the test equipment.

To evaluate the susceptibility of the Phase 3 compacted coarse refuse embankment to cracking during and following longwall mining beneath the Phase 3 impoundment, coarse refuse tensile strengths will be estimated from CU testing, and a relationship of tensile strength to effective stress developed to vary the strength in the stability model. A total of 6 CU points comprise the (2) series from which peak shear strength state failure conditions will be evaluated and a corresponding tensile strength calculated for each based on the tensile strength formula from Winterkorn and Fang (Ref. No. 10). Therefore, the following equation (Ref. No. 10) was used to calculate tensile strength (σ_t) from laboratory test specimens of coarse coal refuse:

Tensile Strength (σ_t):

$\sigma_t = P/\pi(KbH-a^2)$
Where,
P = Load at failure
K = Constant = 1.0 (per Ref. No. 10)
b = Radius of test specimen
H = Height of test specimen
a = Radius of disks/platens

The following tensile strength data is presented from CU testing on two (2) remolded coarse coal refuse samples (Ref. No. 4) and applying the equation above. CU laboratory test results are attached.

Sample No.	November 2006 Coarse Coal Refuse			April 2007 Coarse Coal Refuse		
CU Test No. (Confining Pressure)	1 (70 psi)	2 (90 psi)	3 (110 psi)	1 (70 psi)	2 (90 psi)	3 (105 psi)
Parameter						
P (lbs.) @ Failure	278.8	383.7	682.4	185.6	243.0	560.1
Failure Strain (%)	14.4	14.7	15.3	14.6	12.5	15.3
b (in.)	1.4	1.4	1.4	1.4	1.4	1.4
H (in.)	5.65	5.57	5.60	5.59	5.58	5.58
a (in.)	1.4	1.4	1.4	1.4	1.4	1.4
σ_t (psi)	14.9	20.9	36.9	10.1	13.2	30.5
σ_t (psf)	2146	3010	5314	1454	1901	4392

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Summary of Engineering Properties and Coarse Refuse Tensile Strength

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY AMH DATE 5-12-09 SHEET NO. 4 OF 5

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Each CU test tensile strength (σ_t) is subsequently normalized to its confining (isotropic) pressure, which is converted to equivalent vertical pressure. σ_t is plotted versus equivalent vertical effective stress ($\sigma'v$), and is presented in the attached Figure 1. The purpose of developing an effective stress relationship is to model the variation in tensile strength with depth, i.e., effective stress within the Phase 3 coarse refuse embankment, and estimate a factor of safety against embankment cracking due to the longwall mining beneath the impoundment.

The equivalent effective vertical stress ($\sigma'v$), is estimated at 1.5 times the isotropic effective consolidation stress (i.e., 1.5 * $\sigma3$). The all-around isotropic consolidation stress, $\sigma3$ is considered to be the mean effective stress (σ_m), which is converted to $\sigma'v$ utilizing Ko = 0.5, and the equation:

$\sigma3 = \sigma_m = (1+2Ko)/3 * \sigma'v$,

and thus equivalent vertical stress, $\sigma'v$ is:

$\sigma'v = 1.5 * \sigma3$.

EQUIVALENT VERTICAL STRESS:

Sample No.	November 2006 Coarse Coal Refuse			April 2007 Coarse Coal Refuse		
CU Test No. (Confining Pressure, $\sigma3$)	1 (70 psi)	2 (90 psi)	3 (110 psi)	1 (70 psi)	2 (90 psi)	3 (105 psi)
$\sigma'v$ (psf)	15120	19440	23760	15120	19440	22680
σ_t (psf)	2146	3010	5314	1454	1901	4392
$\sigma_t/\sigma'v$ (dim)	0.142	0.155	0.224	0.096	0.098	0.194

A 2/3 – 1/3 relationship of the data, as shown in the attached Figure 1, was employed to yield a conservative representation of the Pond Creek coarse refuse tensile strength-to-effective stress (σ_t to $\sigma'v$) relationship of $\sigma_t = 0.15\ \sigma'v$.

Since site specific testing was performed, and a relationship of $\sigma_t = 0.15\ \sigma'v$ is considered realistic with some conservatism, based on the various testing conditions and conversions to effective stress. The Phase 3 coarse coal refuse embankment will be modeled utilizing this relationship to evaluate the potential for cracking. The results of post-subsidence slope stability analyses will subsequently be evaluated in another calculation brief to assess the likelihood of cracking of the coarse refuse embankment and liquefaction (flow) potential during/following longwall mining beneath the embankment/impoundment.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – Summary of Engineering Properties and Coarse Refuse Tensile Strength

BY BEG DATE 2009-MAR-31 PROJ. NO. C090403.01.001

CHKD. BY AMH DATE 5-12-09 SHEET NO. 5 OF 5

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POND CREEK PHASE 3 CCR AVERAGE EFFECTIVE VERTICAL STRESS AND COARSE COAL REFUSE (CCR) AVERAGE TENSILE STRENGTH:

AVERAGE EFFECTIVE VERTICAL STRESSES (KSF):

INPUT:		DEPTH BELOW GROUND SURFACE							
STA	150	200	230	255	300	360	0	0	0
GWT	0	30	20	16	5	5	0	0	0
CCR	0	35	45	45	30	5	0	0	0
BCCR	0	35	45	45	45	45	0	0	0

OUTPUT:		AVERAGE EFFECTIVE VERTICAL STRESSES (ksf)							
STA	150	200	230	255	300	360	0	0	0
DEPTH									
10	NA	1.30	1.30	1.30	1.04	0.79	NA	NA	NA
20	NA	2.60	2.60	2.39	1.81	1.06	NA	NA	NA
30	NA	3.90	3.38	3.17	2.59	1.34	NA	NA	NA
40	NA	NA	4.15	3.94	2.62	1.62	NA	NA	NA
45	NA	NA	4.54	4.33	2.75	1.75	NA	NA	NA

Average Effective Vertical Stress:

WT. AVG. = 3.18 ksf

= **3184 psf**

Average CCR Tensile Strength:

WT. AVG. = $\sigma t = 0.15\ \sigma'v$ = 0.478 ksf

= **478 psf**

CONCLUSIONS:

Laboratory undrained shear strength data from CU triaxial tests of coarse coal refuse were determined. Procedures were performed to estimate tensile strength (σ_t) and a reasonable σ_t to $\sigma'v$ relationship of $\sigma_t = 0.15\ \sigma'v$ was estimated. As shown above, the average effective vertical stress within the Phase 3 embankment is 3184 psf and the corresponding coarse refuse tensile strength is 478 psf.

The susceptibility of the embankment to cracking and the impounded fine coal refuse to a liquefaction flow failure is a function of both the tensile strength of the coarse refuse, the total undrained strength of the fine refuse, and the in-situ driving shear stress on a critical failure plane through the Phase 3 embankment/impoundment. The likelihood of a flow failure and embankment cracking will be assessed in a subsequent calculation brief by evaluating the driving shear stress and factor of safety against liquefaction/cracking.

FIGURE 1

TENSILE STRENGTH (σ_t) TO EFFECTIVE STRESS (σ'_v) – COARSE COAL REFUSE
2/3 – 1/3 Relationship of Holcolm CU Data to Yield a σ_t to $\sigma'v$ Relationship

Pond Creek Phase 3 Coarse Refuse Embankment
Tensile Strength (σt) vs. Vertical Effective Stress (σ'v)

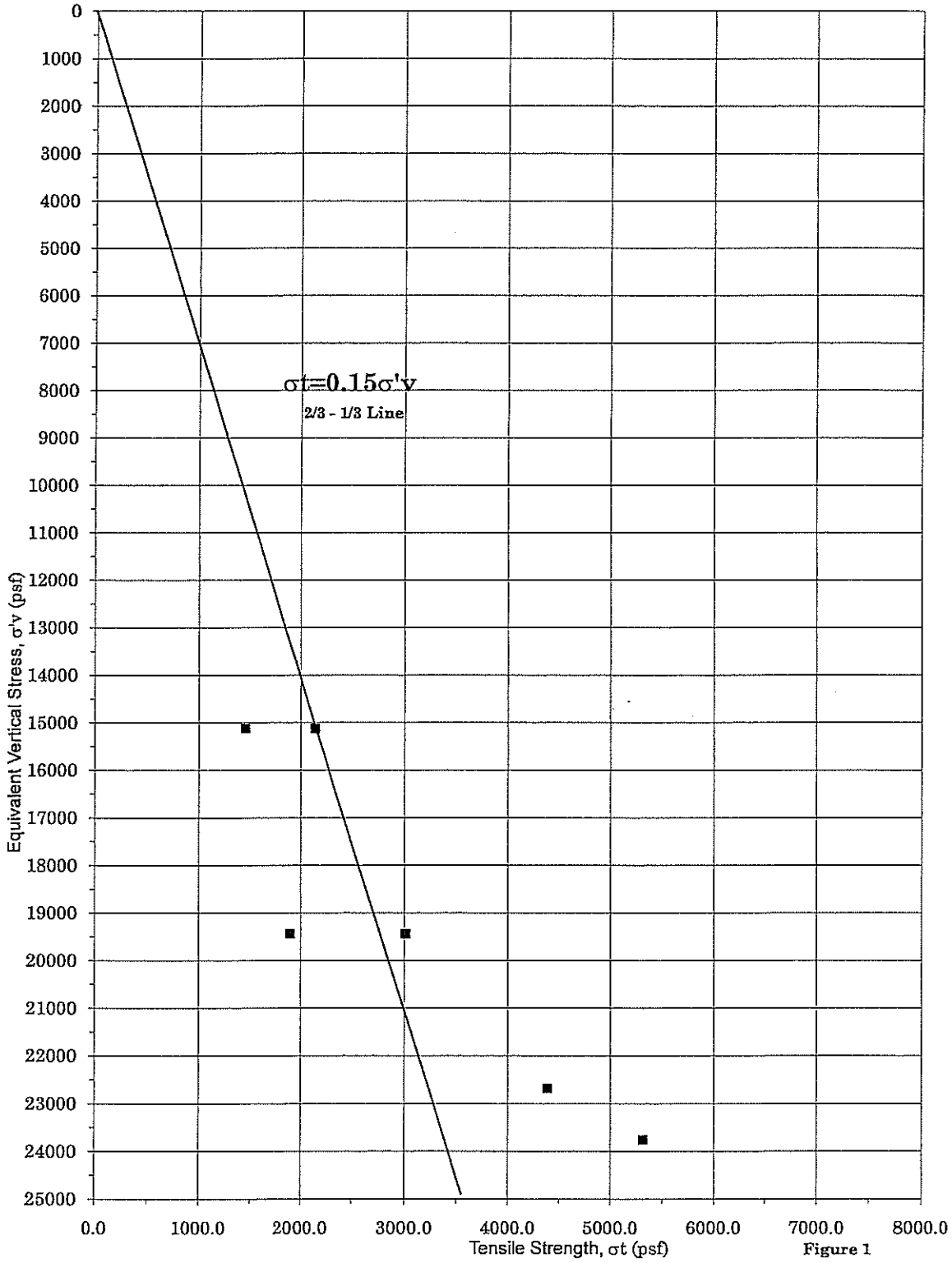

Figure 1

Coarse Refuse Tensile Strength vs. Equivalent Effectvie Stress

σt v σ'v	
σ'v	σt
15120	2146
19440	3010
23760	5314
15120	1454
19440	1901
22680	4392

7 of 57

R16637

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

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Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

February 10, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Soil Boring and Laboratory Tests
Boring #8874
Mach Mine #1
Johnston City, Illinois
HFE File H-05278
Mach Mining Purchase Order No. _____

Dear Sir:

In accordance with your instructions, on February 1, 2006, we drilled one soil boring and sampled the subsoils with Shelby tubes. The soil sample taken from 10 to 12 feet in depth was subjected to laboratory tests. Results of the tests are as follows:

Boring No.:	8874
Depth:	8.0-10.0'
Visual Classification:	Silty CLAY (CL)
Atterberg Limits:	LL = 41.8% PL = 17.7% PI = 24.1
Unit Weight:	105.3 PCF
Moisture Content:	21.5%
Effective Cohesion:	0 PSF
Effective Phi Angle:	26.8 Degrees

All Tubes From Boring 8874

The Boring Log and test results are enclosed. If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

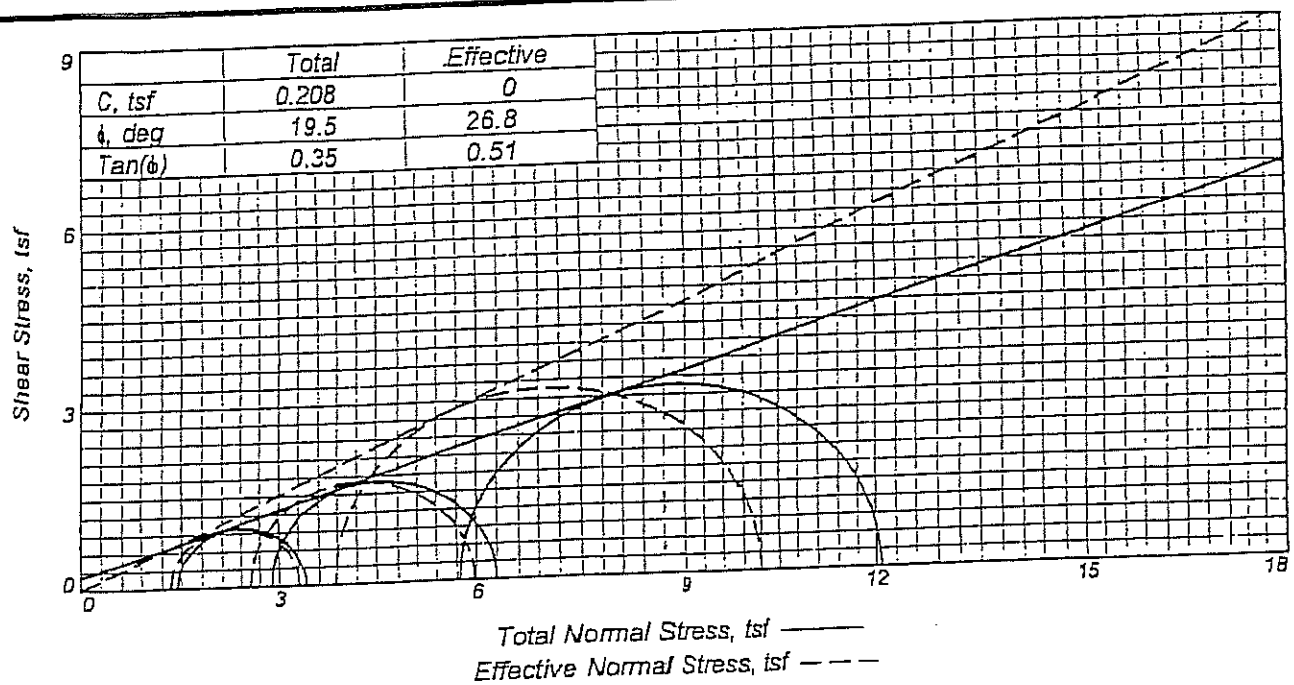
HOLCOMB FOUNDATION ENGINEERING CO.

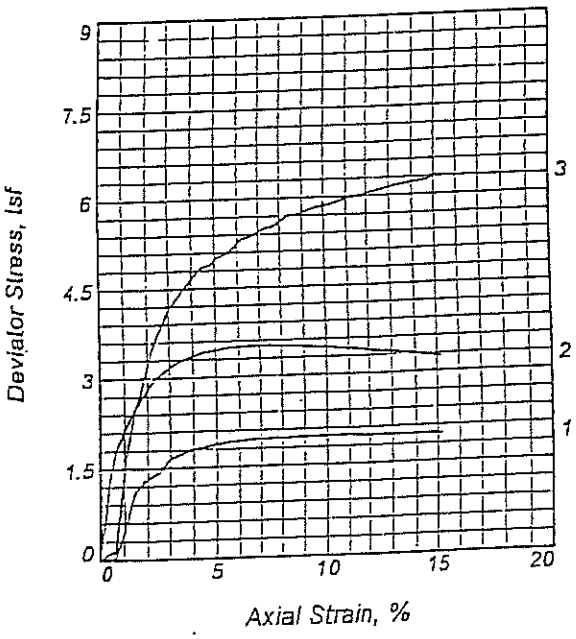
Timothy J. Holcomb, P.E.

REGISTERED PROFESSIONAL ENGINEER
TIMOTHY J.
HOLCOMB
062-042149
2-10-06
ILLINOIS

1 copy: Fred Vass - Alliance Consulting

3





Sample No.		1	2	3
Initial	Water Content,	21.5	20.8	17.6
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	99.7	98.9
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
At Test	Water Content,	21.5	20.9	17.8
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.6	3.6	2.2
Cell Pressure, tsf		5.0	6.5	7.9
Fail. Stress, tsf		2.0	3.4	6.3
Total Pore Pr., tsf		3.7	3.9	4.1
Ult. Stress, tsf		2.0	3.2	6.3
Total Pore Pr., tsf		3.6	3.8	4.1
$\bar{\sigma}_1$ Failure, tsf		3.3	6.0	10.2
σ_3 Failure, tsf		1.3	2.6	3.9

Type of Test:
CU with Pore Pressures
Sample Type: Shelby Tube - Undisturbed
Description: Gray Mottled Brown Silty CLAY

LL= 41.8 PL= 17.7 PI= 24.1
Assumed Specific Gravity= 2.65
Remarks:

Client: Alliance Consulting

Project: Triaxial Test
Mach Mine #1
Location: Boring #8874
Sample Number: 3 Depth: 10.0-12.0'
Proj. No.: H-05278 Date: 2-1-05

TRIAXIAL SHEAR TEST REPORT

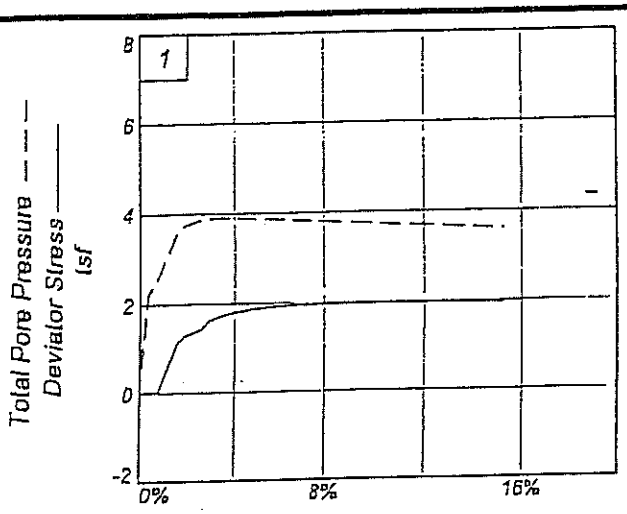
HOLCOMB FOUNDATION ENGINEERING CO.

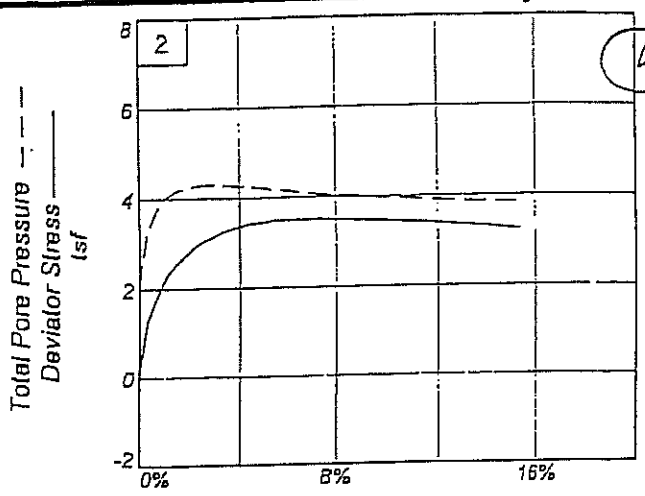
Plate _____

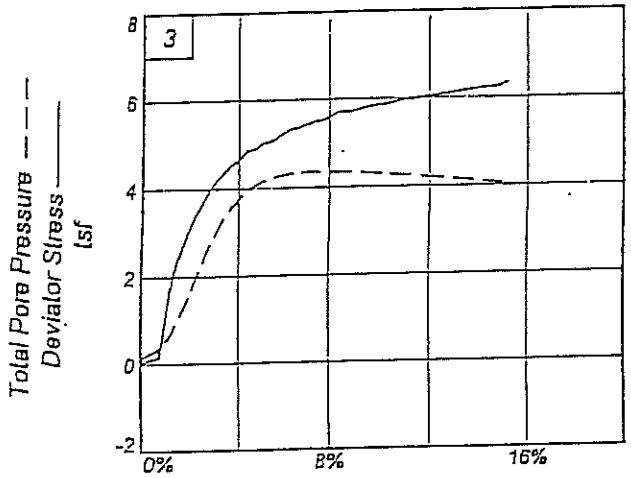
Tested By: LC Checked By: TH

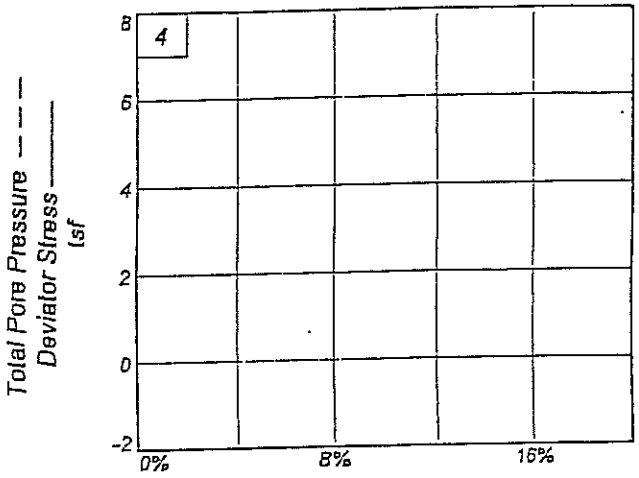
R16640

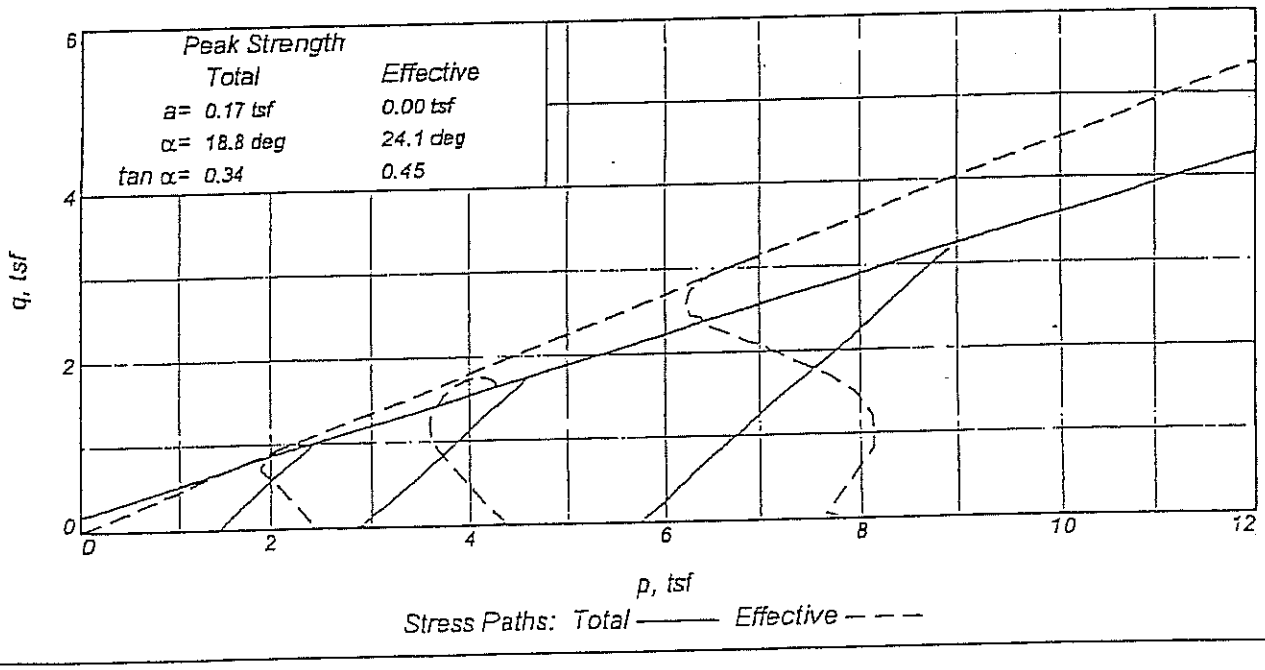
4











Client: Alliance Consulting
Project: Triaxial Test
Location: Boring #8874
Project No.: H-05278

Depth: 10.0-12.0'
Plate _____

Sample Number: 3

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC

Checked By: TH

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

2/9/2006 5
8:50 PM

Date:	2-1-05
Client:	Alliance Consulting
Project:	Triaxial Test Mach Mine #1 Johnston City, Illinois
Location:	Boring #8874
Depth:	10.0-12.0'
Sample Number:	3
Description:	Gray Mottled Brown Silty CLAY
Remarks:	
Type of Sample:	Shelby Tube - Undisturbed
Assumed Specific Gravity=2.65	LL=41.8 PL=17.7 PI=24.1
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	189.100			1279.000
Moisture content: Dry soil+tare, gms.	176.100			1072.200
Moisture content: Tare, gms.	115.700			103.200
Moisture, %	21.5	21.5	21.5	21.3
Moist specimen weight, gms.	1140.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.51	5.51	5.51	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.0	128.0	128.0	
Dry density, pcf	105.3	105.3	105.3	
Void ratio	0.5706	0.5706	0.5706	
Saturation, %	100.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.981 tsf at reading no. 24
Ult. Stress = 1.955 tsf at reading no. 30

R16642

(6)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	18.30	0.0	0.0	0.000	5.112	5.112	1.00	-1.00	5.112	0.000
1	0.0190	20.00	1.7	0.3	0.014	2.830	2.844	1.00	30.70	2.837	0.007
2	0.0400	21.60	3.3	0.7	0.026	2.426	2.452	1.01	36.30	2.439	0.013
3	0.0810	113.20	94.9	1.5	1.093	1.505	2.598	1.73	49.10	2.051	0.547
4	0.1010	129.80	111.5	1.8	1.280	1.318	2.597	1.97	51.70	1.958	0.640
5	0.1420	143.10	124.8	2.6	1.422	1.181	2.602	2.20	53.60	1.892	0.711
6	0.1620	161.50	143.2	2.9	1.625	1.159	2.784	2.40	53.90	1.972	0.813
7	0.1830	168.90	150.6	3.3	1.702	1.145	2.847	2.49	54.10	1.996	0.851
8	0.2030	174.80	156.5	3.7	1.763	1.138	2.900	2.55	54.20	2.019	0.881
9	0.2240	178.90	160.6	4.1	1.802	1.145	2.946	2.57	54.10	2.046	0.901
10	0.2440	182.30	164.0	4.4	1.833	1.145	2.978	2.60	54.10	2.061	0.916
11	0.2650	186.40	168.1	4.8	1.871	1.152	3.023	2.62	54.00	2.088	0.936
12	0.2850	188.10	169.8	5.2	1.883	1.166	3.049	2.61	53.80	2.108	0.941
13	0.3060	191.40	173.1	5.6	1.912	1.166	3.078	2.64	53.80	2.122	0.956
14	0.3260	193.10	174.8	5.9	1.923	1.181	3.104	2.63	53.60	2.142	0.962
15	0.3460	194.70	176.4	6.3	1.933	1.188	3.121	2.63	53.50	2.155	0.967
16	0.3670	196.40	178.1	6.7	1.944	1.202	3.146	2.62	53.30	2.174	0.972
17	0.3870	198.10	179.8	7.0	1.955	1.210	3.164	2.62	53.20	2.187	0.977
18	0.4080	198.10	179.8	7.4	1.947	1.224	3.171	2.59	53.00	2.197	0.973
19	0.4280	200.60	182.3	7.8	1.966	1.231	3.197	2.60	52.90	2.214	0.983
20	0.4490	200.60	182.3	8.1	1.958	1.238	3.196	2.58	52.80	2.217	0.979
21	0.4890	203.10	184.8	8.9	1.969	1.267	3.236	2.55	52.40	2.252	0.985
22	0.5300	204.70	186.4	9.6	1.970	1.289	3.259	2.53	52.10	2.274	0.985
23	0.5710	207.20	188.9	10.4	1.980	1.310	3.290	2.51	51.80	2.300	0.990
24	0.6120	208.90	190.6	11.1	1.981	1.332	3.313	2.49	51.50	2.323	0.991
25	0.6530	209.10	190.8	11.8	1.967	1.346	3.313	2.46	51.30	2.330	0.983
26	0.6940	211.40	193.1	12.6	1.974	1.361	3.334	2.45	51.10	2.348	0.987
27	0.7350	212.20	193.9	13.3	1.965	1.390	3.354	2.41	50.70	2.372	0.982
28	0.7790	213.90	195.6	14.1	1.964	1.404	3.368	2.40	50.50	2.386	0.982
29	0.8170	215.50	197.2	14.8	1.964	1.426	3.390	2.38	50.20	2.408	0.982
30	0.8380	215.50	197.2	15.2	1.955	1.433	3.388	2.36	50.10	2.410	0.978

7

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	154.800			1347.900
Moisture content: Dry soil+tare, gms.	145.800			1154.100
Moisture content: Tare, gms.	102.600			135.100
Moisture, %	20.8	20.9	20.9	19.0
Moist specimen weight, gms.	1142.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.49	5.49	5.49	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.7	128.7	128.7	
Dry density, pcf	106.5	106.5	106.5	
Void ratio	0.5536	0.5536	0.5536	
Saturation, %	99.7	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 3.418 tsf at reading no. 24
Ult. Stress = 3.250 tsf at reading no. 29

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	27.50	0.0	0.0	0.000	4.385	4.385	1.00	29.10	4.385	0.000
1	0.0190	134.00	106.5	0.3	1.241	3.254	4.495	1.38	44.80	3.875	0.620
2	0.0400	183.10	155.6	0.7	1.806	2.750	4.557	1.66	51.80	3.653	0.903
3	0.0600	218.90	191.4	1.1	2.214	2.484	4.698	1.89	55.50	3.591	1.107
4	0.0810	243.80	216.3	1.5	2.492	2.340	4.832	2.06	57.50	3.586	1.246
5	0.1010	264.60	237.1	1.8	2.721	2.254	4.975	2.21	58.70	3.614	1.361
6	0.1220	282.10	254.6	2.2	2.911	2.210	5.121	2.32	59.30	3.666	1.455
7	0.1420	295.40	267.9	2.6	3.052	2.182	5.233	2.40	59.70	3.707	1.526
8	0.1620	305.40	277.9	2.9	3.154	2.182	5.335	2.45	59.70	3.758	1.577
9	0.1830	314.60	287.1	3.3	3.245	2.189	5.434	2.48	59.60	3.811	1.623
10	0.2030	322.10	294.6	3.7	3.317	2.196	5.513	2.51	59.50	3.855	1.659
11	0.2240	327.10	299.6	4.1	3.360	2.218	5.578	2.52	59.20	3.898	1.680
12	0.2440	332.90	305.4	4.4	3.412	2.232	5.644	2.53	59.00	3.938	1.706
13	0.2650	336.20	308.7	4.8	3.435	2.254	5.689	2.52	58.70	3.971	1.718
14	0.2850	339.50	312.0	5.2	3.459	2.275	5.734	2.52	58.40	4.005	1.729
15	0.3060	343.70	316.2	5.6	3.491	2.297	5.788	2.52	58.10	4.042	1.746
16	0.3260	345.40	317.9	5.9	3.497	2.318	5.815	2.51	57.80	4.067	1.748
17	0.3670	348.70	321.2	6.7	3.505	2.369	5.874	2.48	57.10	4.121	1.752
18	0.4080	352.00	324.5	7.4	3.512	2.412	5.924	2.46	56.50	4.168	1.756
19	0.4490	353.70	326.2	8.2	3.502	2.441	5.943	2.43	56.10	4.192	1.751
20	0.4890	354.50	327.0	8.9	3.483	2.470	5.953	2.41	55.70	4.211	1.742
21	0.5300	355.40	327.9	9.7	3.464	2.498	5.963	2.39	55.30	4.230	1.732

(8)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.5510	357.00	329.5	10.0	3.466	2.513	5.979	2.38	55.10	4.246	1.733
23	0.5920	356.20	328.7	10.8	3.429	2.534	5.964	2.35	54.80	4.249	1.715
24	0.6330	357.90	330.4	11.5	3.418	2.556	5.974	2.34	54.50	4.265	1.709
25	0.6730	357.00	329.5	12.3	3.381	2.585	5.966	2.31	54.10	4.275	1.690
26	0.7140	357.90	330.4	13.0	3.361	2.599	5.960	2.29	53.90	4.280	1.681
27	0.7550	357.90	330.4	13.7	3.332	2.614	5.946	2.27	53.70	4.280	1.666
28	0.7960	356.20	328.7	14.5	3.286	2.628	5.914	2.25	53.50	4.271	1.643
29	0.8370	355.40	327.9	15.2	3.250	2.635	5.885	2.23	53.40	4.260	1.625

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	248.400			1374.500
Moisture content: Dry soil+tare, gms.	226.700			1195.400
Moisture content: Tare, gms.	103.200			127.700
Moisture, %	17.6	17.8	17.8	16.8
Moist specimen weight, gms.	1184.7			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.54	5.54	5.54	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	132.3	132.5	132.5	
Dry density, pcf	112.5	112.5	112.5	
Void ratio	0.4707	0.4707	0.4707	
Saturation, %	98.9	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 6.334 tsf at reading no. 33
Ult. Stress = 6.334 tsf at reading no. 33

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	31.60	0.0	0.0	0.000	7.812	7.812	1.00	1.50	7.812	0.000
1	0.0190	39.90	8.3	0.3	0.091	7.690	7.781	1.01	3.20	7.735	0.045
2	0.0400	44.10	12.5	0.7	0.133	7.574	7.707	1.02	4.80	7.641	0.066
3	0.0600	175.60	144.0	1.1	1.666	7.308	8.974	1.23	8.50	8.141	0.833
4	0.0810	240.50	208.9	1.5	2.407	6.926	9.333	1.35	13.80	8.130	1.203
5	0.1010	291.30	259.7	1.8	2.981	6.466	9.447	1.46	20.20	7.956	1.491
6	0.1220	329.60	298.0	2.2	3.408	5.983	9.391	1.57	26.90	7.687	1.704
7	0.1420	362.00	330.4	2.6	3.764	5.479	9.244	1.69	33.90	7.361	1.882
8	0.1620	392.00	360.4	2.9	4.091	5.040	9.131	1.81	40.00	7.085	2.045
9	0.1830	412.80	381.2	3.3	4.310	4.666	8.976	1.92	45.20	6.821	2.155

(9)

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
10	0.2030	432.80	401.2	3.7	4.519	4.363	8.883	2.04	49.40	6.623	2.260
11	0.2240	446.90	415.3	4.0	4.660	4.140	8.800	2.13	52.50	6.470	2.330
12	0.2440	465.20	433.6	4.4	4.847	3.982	8.828	2.22	54.70	6.405	2.423
13	0.2650	471.00	439.4	4.8	4.892	3.852	8.744	2.27	56.50	6.298	2.446
14	0.2850	483.50	451.9	5.1	5.012	3.766	8.778	2.33	57.70	6.272	2.506
15	0.3060	490.20	458.6	5.5	5.066	3.694	8.760	2.37	58.70	6.227	2.533
16	0.3260	503.50	471.9	5.9	5.193	3.643	8.837	2.43	59.40	6.240	2.597
17	0.3460	516.80	485.2	6.2	5.319	3.607	8.926	2.47	59.90	6.267	2.660
18	0.3670	521.80	490.2	6.6	5.352	3.586	8.938	2.49	60.20	6.262	2.676
19	0.3870	530.10	498.5	7.0	5.422	3.571	8.993	2.52	60.40	6.282	2.711
20	0.4080	538.40	506.8	7.4	5.490	3.564	9.054	2.54	60.50	6.309	2.745
21	0.4280	543.40	511.8	7.7	5.522	3.564	9.086	2.55	60.50	6.325	2.761
22	0.4490	554.30	522.7	8.1	5.617	3.571	9.188	2.57	60.40	6.380	2.808
23	0.4690	565.90	534.3	8.5	5.719	3.578	9.297	2.60	60.30	6.438	2.859
24	0.4890	567.60	536.0	8.8	5.714	3.578	9.293	2.60	60.30	6.436	2.857
25	0.5300	581.70	550.1	9.6	5.817	3.600	9.417	2.62	60.00	6.509	2.909
26	0.5710	591.70	560.1	10.3	5.874	3.636	9.510	2.62	59.50	6.573	2.937
27	0.6120	605.00	573.4	11.0	5.964	3.665	9.629	2.63	59.10	6.647	2.982
28	0.6530	615.00	583.4	11.8	6.018	3.701	9.719	2.63	58.60	6.710	3.009
29	0.6940	626.70	595.1	12.5	6.087	3.737	9.824	2.63	58.10	6.780	3.044
30	0.7350	638.30	606.7	13.3	6.153	3.773	9.926	2.63	57.60	6.849	3.077
31	0.7760	649.10	617.5	14.0	6.209	3.816	10.025	2.63	57.00	6.921	3.105
32	0.8170	657.50	625.9	14.7	6.240	3.852	10.092	2.62	56.50	6.972	3.120
33	0.8390	669.90	638.3	15.1	6.334	3.866	10.200	2.64	56.30	7.033	3.167

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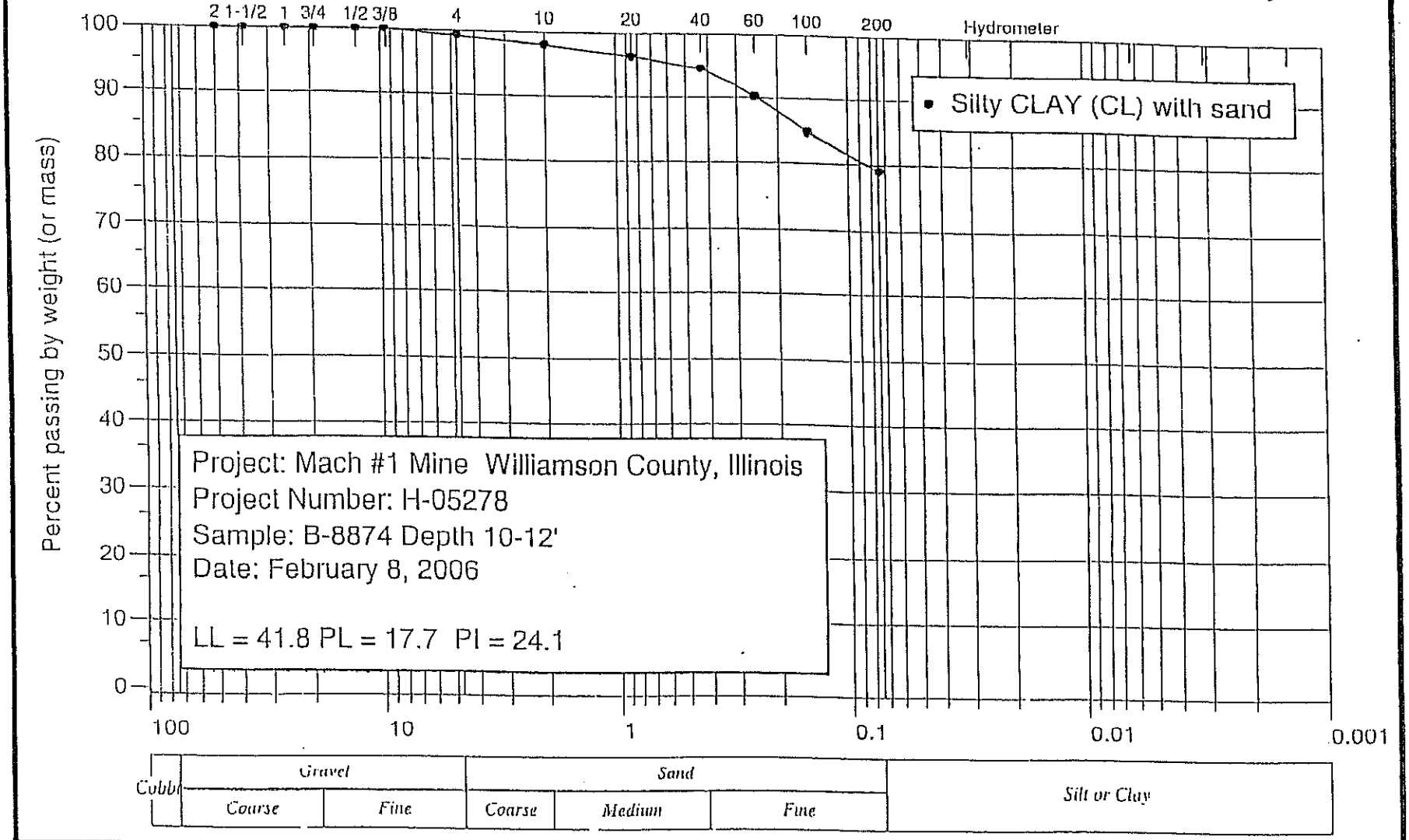
Grain Size Analysis



14 of 57

Holcomb Foundation Engineering Company

Laboratory Testing Results

2/8/2006

Project: Mach #1 Mine

Project No: H-05278

Sieve Analysis - ASTM C136-96a

Sample: Silty CLAY (CL)

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
1.5000	38.1000	1 -1/2"	0.0	0.0	100.0
1.0000	25.4000	1"	0.0	0.0	100.0
0.7500	19.1000	3/4"	0.0	0.0	100.0
0.5000	12.7000	1/2"	0.0	0.0	100.0
3.7500	9.5200	3/8"	0.0	0.0	100.0
0.1870	4.7600	No. 4	2.1	0.9	99.1
0.0790	2.0000	No. 10	4.6	2.0	98.0
0.0469	1.1800	No. 16	4.6	2.0	98.0
0.0331	0.8500	No. 20	8.6	3.8	96.2
0.0165	0.4200	No. 40	12.6	5.5	94.5
0.0117	0.2980	No. 50	12.6	5.5	94.5
0.0083	0.2500	No. 60	22.2	9.8	90.2
0.0059	0.1490	No. 100	34.6	15.2	84.8
0.0029	0.0740	No. 200	47.7	21.0	79.0

Total Weight in Grams 227.20

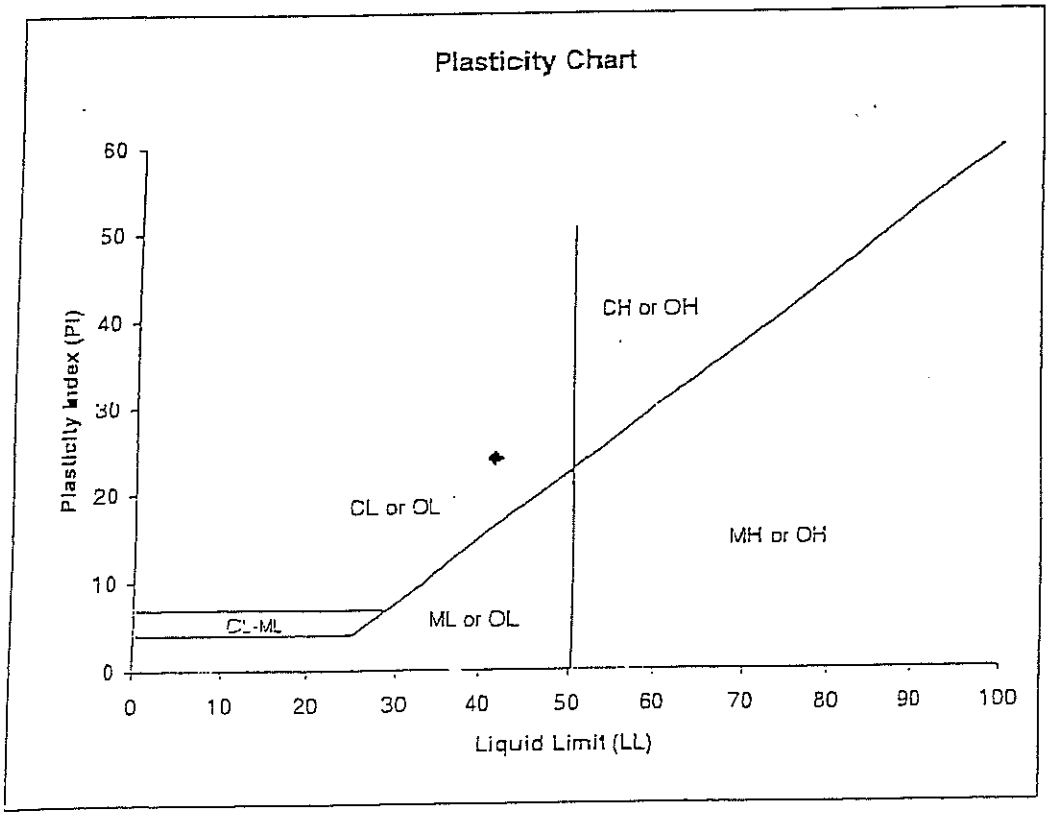
Holcomb Foundation Engineering Company

Laboratory Testing Results

Project: Mach #1 Mine
Project No: H-05278

Sample	1	2	3
Dish Number	LL_1	LL_2	LL_3
Mass of can, W_1 (g)	34.70		
Mass of can + moist soil, W_2 (g)	62.84		
Mass of can + dry soil, W_3 (g)	54.52		
Moisture content, w (%)	41.98		
Number of blows, N	24		
Liquid Limit, LL	41.8		

Dish Number	PL_1
Mass of can, W_1 (g)	39.76
Mass of can + moist soil, W_2 (g)	54.79
Mass of can + dry soil, W_3 (g)	52.53
Plastic Limit, PL	17.7
PI =	24.1



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13

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

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800-333-1740
FAX 618-457-8991

November 30, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Pond Creek Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on November 17, 2006, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification:	Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)
Proctor Test Results:	
Maximum Dry Unit Weight:	124.6 PCF
Optimum Moisture Content:	9.3 %
Specific Gravity:	2.37
Triaxial Test Results:	
Effective Cohesion:	0 PSF
Effective Phi Angle:	33.7 Degrees
Permeability:	2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

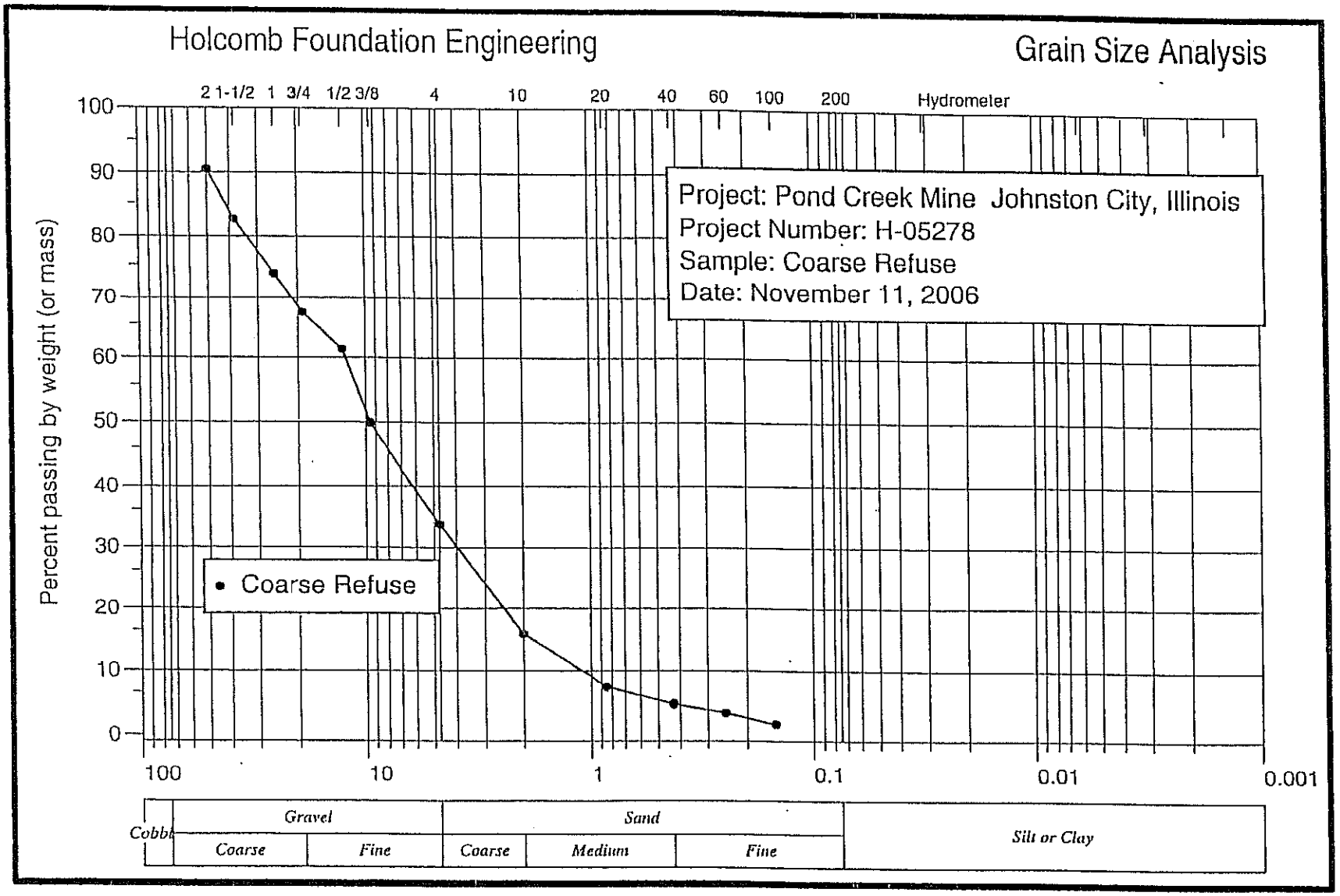
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting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Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
Project: Pond Creek Mine Johnston City, Illinois
Project Number: H-05278
Sample: Coarse Refuse
Date: November 11, 2006
• Coarse Refuse
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

21 / 57

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Holcomb Foundation Engineering Company

Laboratory Testing Results

11/30/2006

Project: Coarse Refuse Disposal Area
Pond Creek Mine Johnston City, Illinois

Project No: H-05317

Sieve Analysis - ASTM C136-96a

Sample: Coarse Refuse

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
3	76.2	3"	0.0	0.0	100.0
2.0000	50.8100	2"	619.6	9.5	90.5
1.5000	38.1000	1 -1/2"	1124.0	17.2	82.8
1.0000	25.4000	1"	1696.2	25.9	74.1
0.7500	19.1000	3/4"	2110.9	32.3	67.7
0.5000	12.7000	1/2"	2513.0	38.4	61.6
3.7500	9.5200	3/8"	3263.7	49.9	50.1
0.1870	4.7600	No. 4	4310.7	65.9	34.1
0.0790	2.0000	No. 10	5470.5	83.6	16.4
0.0469	1.1800	No. 16			
0.0331	0.8500	No. 20	6004.4	91.8	8.2
0.0165	0.4200	No. 40	6178.9	94.4	5.6
0.0117	0.2980	No. 50			
0.0083	0.2500	No. 60	6267.8	95.8	4.2
0.0059	0.1490	No. 100			
0.0029	0.0740	No. 200	6372.4	97.4	2.6

Total Weight in Grams 6542.80

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

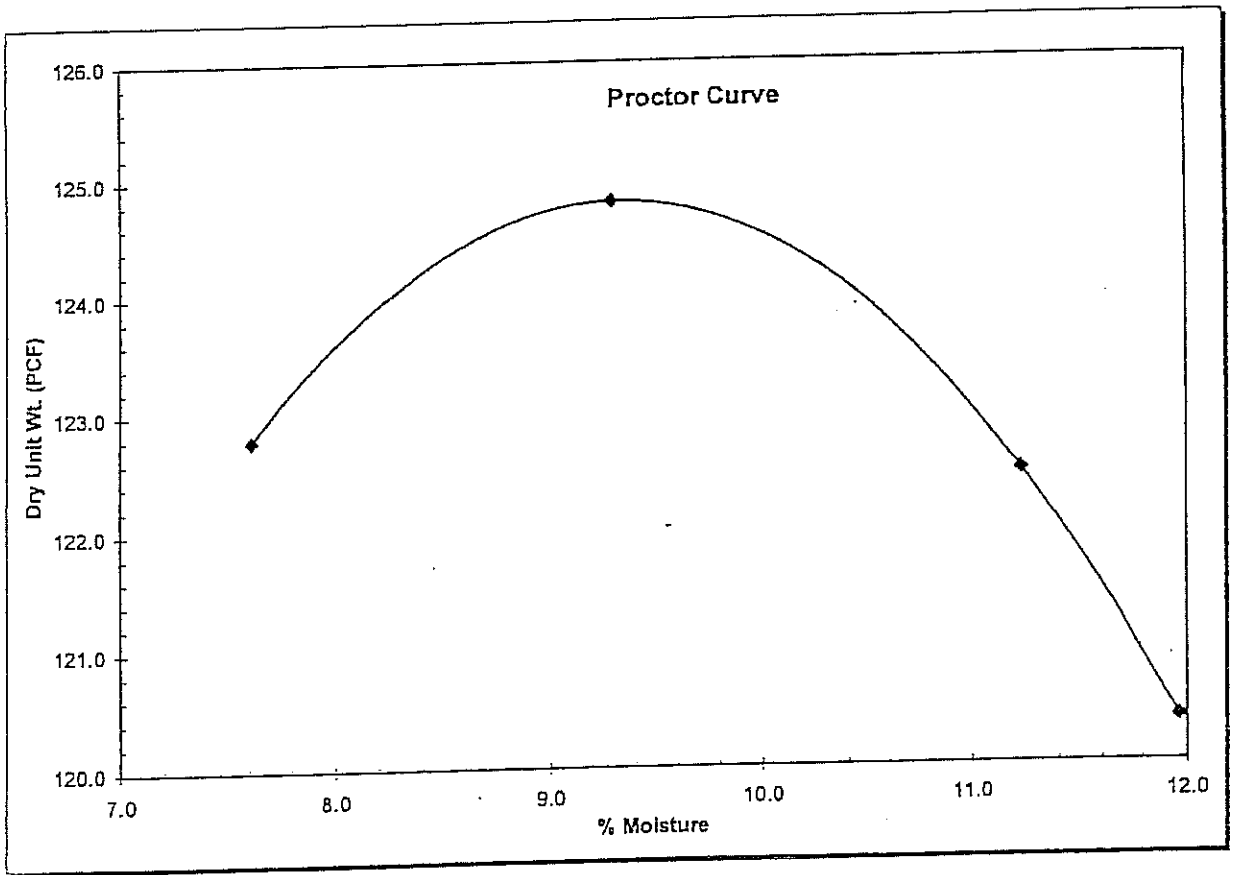
Date: 11/30/2006

Proctor Test Results

Soil Classification:	Gray Coarse Refuse
Maximum Dry Density (PCF)	124.8
Optimum Moisture Content (%)	9.3

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
7.6	122.8
11.2	122.5
12.0	120.4
9.3	124.8



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Permeability Tests Results

Laboratory Tests
Coarse Refuse
Pond Creek Mine - Johnston City, Illinois

Date: 11/30/2006

Client: Pond Creek Mine
Johnston City, Illinois

Project No.: H-05278

Sample	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse		7.7	11.8	119.3	2 x 10-4

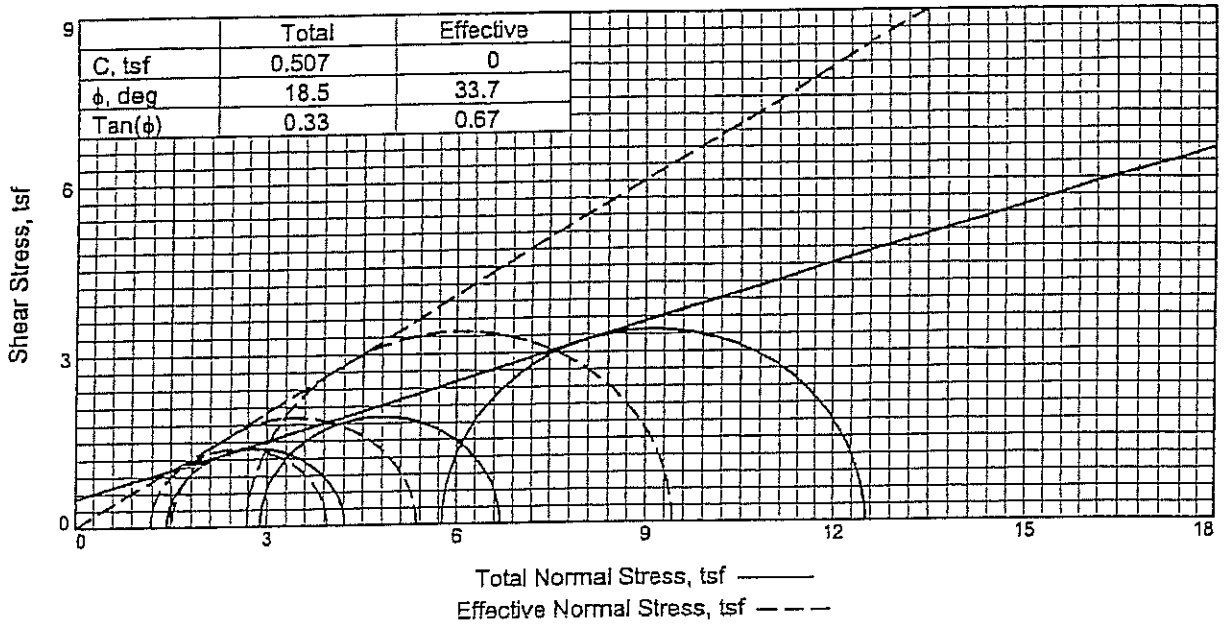
Permeability Tests performed in accordance with ASTM D-5084

PERMEABILITY TEST RESULTS

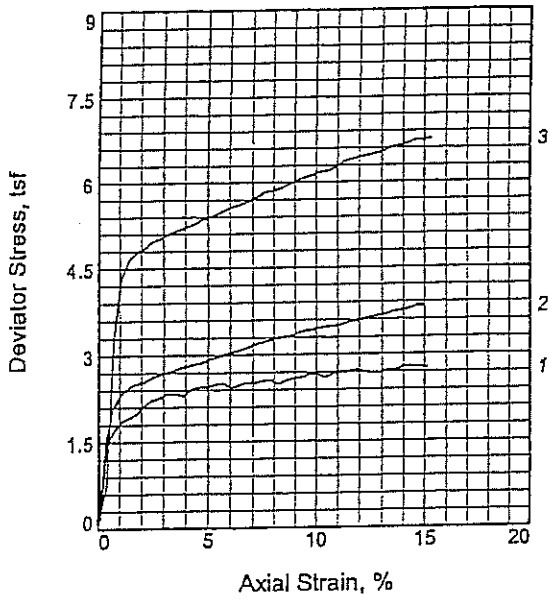
Project	Pond Creek Mine		Boring/Sample Depth		Coarse Refuse
Project #	H-05278		Classification		
Date	11/30/2006		Diameter	2.8	Inch
			Length	5.6	Inch

In Place Mc		After Test Mc		Unit Weight (PCF)	
Wet Wt.	195.3	Wet Wt.	1300.4	Sample Wt.	1161.8
Pan	94.2	Pan	103.1		
Dry Wt.	188.1	Dry Wt.	1173.6	Wet UW=	128.5
Mc (%)	7.7	Mc (%)	11.8	Dry UW=	119.3

Time(hrs)	Time(min)	Quantity (cc)	Head (psi)	Permeability (cm/sec)
7	26	24.7		
7	34	8.2	1	1.75E-04
7	33	24.5		
7	45	2.7	1	1.54E-04
7	47	0.8	1	1.44E-04
9	16	24.4		
9	23	9.6	1	1.79E-04
9	30	0.9	1	1.43E-04
			Average Permeability	1.63E-04



	Total	Effective
C, tsf	0.507	0
ϕ, deg	18.5	33.7
Tan(ϕ)	0.33	0.67



Sample No.		1	2	3
Initial	Water Content,	10.1	10.8	10.3
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	97.0	99.8	99.3
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
At Test	Water Content,	10.4	10.8	10.4
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
Strain rate, in./min.		0.01	0.01	0.01
Back Pressure, tsf		3.60	3.60	2.16
Cell Pressure, tsf		5.04	6.48	7.92
Fail. Stress, tsf		2.78	3.83	6.76
Total Pore Pr., tsf		3.86	4.96	5.23
Ult. Stress, tsf		2.77	3.83	6.76
Total Pore Pr., tsf		3.85	4.95	5.23
$\bar{\sigma}_1$ Failure, tsf		3.96	5.35	9.44
$\bar{\sigma}_3$ Failure, tsf		1.18	1.52	2.69

Type of Test:
CU with Pore Pressures
Sample Type: Remolded
Description: Coarse Coal Refuse

Assumed Specific Gravity= 2.37
Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

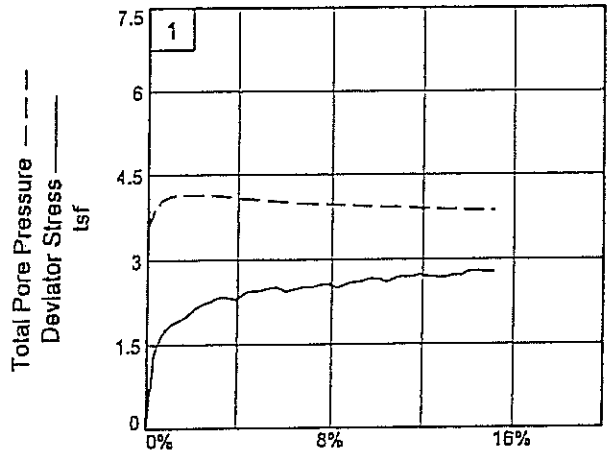
Location: Coarse Refuse Stockpile
Sample Number: Coarse Refuse
Proj. No.: H-05278 **Date:** 11/17/06

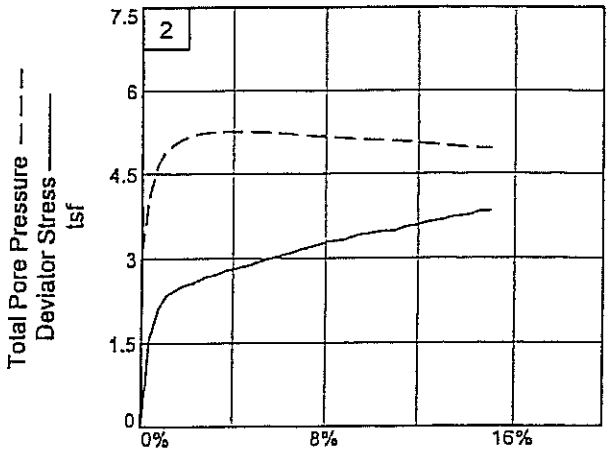
TRIAXIAL SHEAR TEST REPORT

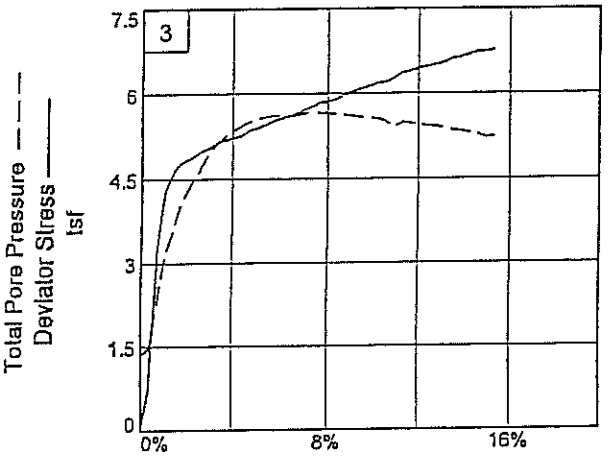
HOLCOMB FOUNDATION ENGINEERING CO.

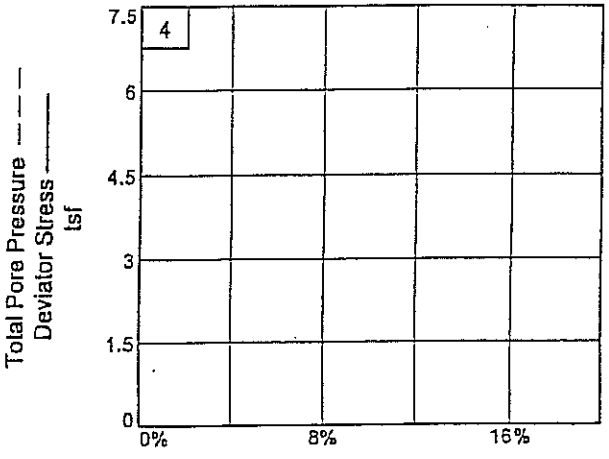
Plate _____

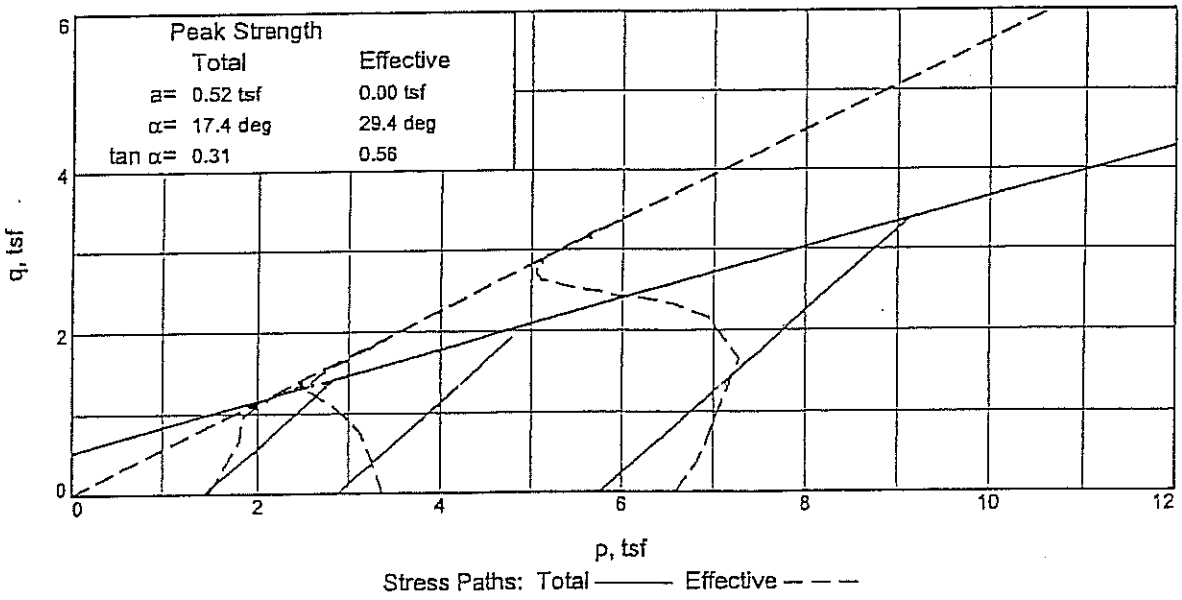
Tested By: LC Checked By: TH











Stress Paths: Total ——— Effective — — —

Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Coarse Refuse Stockpile
Project No.: H-05278
Sample Number: Coarse Refuse
Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC **Checked By:** TH

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

11/30/2006
10:19 AM

Date:	11/17/06
Client:	Pond Creek Mine
Project:	Coarse Refuse Laboratory Tests
Location:	Coarse Refuse Stockpile
Sample Number:	Coarse Refuse
Description:	Coarse Coal Refuse
Remarks:	
Type of Sample:	Remolded
Assumed Specific Gravity=2.37	LL= PL= PI=
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	226.800			1320.700
Moisture content: Dry soil+tare, gms.	218.600			1195.800
Moisture content: Tare, gms.	137.500			107.600
Moisture, %	10.1	10.4	10.4	11.5
Moist specimen weight, gms.	1193.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.65	5.65	5.65	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.6	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2470	0.2470	0.2470	
Saturation, %	97.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 2.778 tsf at reading no. 41
Ult. Stress = 2.767 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0010	46.60	0.0	0.0	0.000	1.498	1.498	1.00	49.20	1.498	0.000
1	0.0180	160.60	114.0	0.3	1.329	1.152	2.481	2.15	54.00	1.816	0.664
2	0.0390	189.70	143.1	0.7	1.662	1.001	2.663	2.66	56.10	1.832	0.831
3	0.0590	205.60	159.0	1.0	1.840	0.929	2.769	2.98	57.10	1.849	0.920
4	0.0800	212.20	165.6	1.4	1.909	0.907	2.816	3.10	57.40	1.862	0.955
5	0.1000	218.90	172.3	1.8	1.979	0.900	2.879	3.20	57.50	1.890	0.990
6	0.1200	232.20	185.6	2.1	2.125	0.900	3.025	3.36	57.50	1.962	1.062
7	0.1410	240.50	193.9	2.5	2.211	0.907	3.118	3.44	57.40	2.013	1.106
8	0.1610	245.50	198.9	2.8	2.260	0.914	3.174	3.47	57.30	2.044	1.130
9	0.1820	252.20	205.6	3.2	2.327	0.922	3.249	3.53	57.20	2.085	1.164
10	0.2020	253.80	207.2	3.6	2.337	0.936	3.273	3.50	57.00	2.104	1.168
11	0.2230	250.50	203.9	3.9	2.291	0.958	3.248	3.39	56.70	2.103	1.145
12	0.2430	261.30	214.7	4.3	2.403	0.972	3.375	3.47	56.50	2.173	1.201
13	0.2630	266.30	219.7	4.6	2.450	0.979	3.429	3.50	56.40	2.204	1.225
14	0.2840	266.30	219.7	5.0	2.440	0.994	3.434	3.46	56.20	2.214	1.220
15	0.3040	272.10	225.5	5.4	2.495	1.008	3.503	3.48	56.00	2.256	1.248
16	0.3250	274.60	228.0	5.7	2.513	1.022	3.536	3.46	55.80	2.279	1.257
17	0.3450	268.00	221.4	6.1	2.431	1.037	3.468	3.34	55.60	2.252	1.216
18	0.3660	273.00	226.4	6.5	2.476	1.051	3.527	3.36	55.40	2.289	1.238
19	0.3860	278.00	231.4	6.8	2.521	1.058	3.580	3.38	55.30	2.319	1.261
20	0.4070	278.00	231.4	7.2	2.511	1.066	3.577	3.36	55.20	2.321	1.256
21	0.4270	283.00	236.4	7.5	2.556	1.073	3.629	3.38	55.10	2.351	1.278
22	0.4470	284.60	238.0	7.9	2.563	1.080	3.643	3.37	55.00	2.362	1.282
23	0.4680	278.80	232.2	8.3	2.491	1.087	3.578	3.29	54.90	2.333	1.245
24	0.4880	286.30	239.7	8.6	2.561	1.087	3.648	3.36	54.90	2.368	1.281
25	0.5090	290.40	243.8	9.0	2.594	1.094	3.689	3.37	54.80	2.392	1.297
26	0.5290	292.10	245.5	9.3	2.602	1.102	3.704	3.36	54.70	2.403	1.301
27	0.5500	298.80	252.2	9.7	2.662	1.109	3.771	3.40	54.60	2.440	1.331
28	0.5700	299.60	253.0	10.1	2.660	1.116	3.776	3.38	54.50	2.446	1.330
29	0.5910	294.60	248.0	10.4	2.597	1.116	3.713	3.33	54.50	2.415	1.299
30	0.6110	302.10	255.5	10.8	2.665	1.123	3.788	3.37	54.40	2.456	1.333
31	0.6310	306.30	259.7	11.2	2.698	1.130	3.828	3.39	54.30	2.479	1.349
32	0.6520	306.30	259.7	11.5	2.687	1.130	3.817	3.38	54.30	2.474	1.343
33	0.6720	312.10	265.5	11.9	2.736	1.145	3.881	3.39	54.10	2.513	1.368
34	0.6930	309.60	263.0	12.2	2.699	1.145	3.843	3.36	54.10	2.494	1.349
35	0.7130	308.80	262.2	12.6	2.680	1.152	3.832	3.33	54.00	2.492	1.340
36	0.7340	309.60	263.0	13.0	2.676	1.159	3.835	3.31	53.90	2.497	1.338
37	0.7540	315.40	268.8	13.3	2.724	1.166	3.891	3.34	53.80	2.528	1.362
38	0.7750	316.20	269.6	13.7	2.721	1.166	3.887	3.33	53.80	2.527	1.360
39	0.7950	323.70	277.1	14.1	2.785	1.181	3.966	3.36	53.60	2.573	1.392
40	0.8150	325.40	278.8	14.4	2.790	1.181	3.971	3.36	53.60	2.576	1.395
41	0.8360	325.40	278.8	14.8	2.778	1.181	3.959	3.35	53.60	2.570	1.389
42	0.8560	325.40	278.8	15.1	2.767	1.188	3.955	3.33	53.50	2.571	1.383

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	211.600			1335.900
Moisture content: Dry soil+tare, gms.	203.200			1222.200
Moisture content: Tare, gms.	125.200			134.800
Moisture, %	10.8	10.8	10.8	10.5
Moist specimen weight, gms.	1175.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.57	5.57	5.57	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.5	130.5	130.5	
Dry density, pcf	117.8	117.8	117.8	
Void ratio	0.2558	0.2558	0.2558	
Saturation, %	99.8	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 3.829 tsf at reading no. 40
Ult. Stress = 3.828 tsf at reading no. 41

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	51.60	0.0	0.0	0.000	3.377	3.377	1.00	43.10	3.377	0.000
1	0.0190	185.60	134.0	0.3	1.562	2.340	3.902	1.67	57.50	3.121	0.781
2	0.0400	233.00	181.4	0.7	2.106	1.814	3.920	2.16	64.80	2.867	1.053
3	0.0600	253.00	201.4	1.1	2.330	1.562	3.892	2.49	68.30	2.727	1.165
4	0.0810	263.80	212.2	1.5	2.445	1.433	3.878	2.71	70.10	2.655	1.223
5	0.1010	270.50	218.9	1.8	2.513	1.346	3.860	2.87	71.30	2.603	1.257
6	0.1220	274.60	223.0	2.2	2.550	1.289	3.839	2.98	72.10	2.564	1.275
7	0.1420	281.30	229.7	2.5	2.617	1.260	3.877	3.08	72.50	2.569	1.309
8	0.1620	287.10	235.5	2.9	2.674	1.238	3.912	3.16	72.80	2.575	1.337
9	0.1830	291.30	239.7	3.3	2.711	1.231	3.942	3.20	72.90	2.587	1.355
10	0.2030	297.10	245.5	3.6	2.766	1.224	3.990	3.26	73.00	2.607	1.383
11	0.2240	301.30	249.7	4.0	2.802	1.224	4.026	3.29	73.00	2.625	1.401
12	0.2440	305.40	253.8	4.4	2.838	1.224	4.062	3.32	73.00	2.643	1.419
13	0.2650	309.60	258.0	4.8	2.873	1.224	4.097	3.35	73.00	2.661	1.437
14	0.2850	315.40	263.8	5.1	2.927	1.231	4.158	3.38	72.90	2.695	1.463
15	0.3060	320.40	268.8	5.5	2.970	1.238	4.209	3.40	72.80	2.724	1.485
16	0.3260	326.20	274.6	5.9	3.023	1.246	4.269	3.43	72.70	2.757	1.512
17	0.3460	330.40	278.8	6.2	3.058	1.253	4.310	3.44	72.60	2.782	1.529
18	0.3670	334.60	283.0	6.6	3.091	1.267	4.358	3.44	72.40	2.813	1.546
19	0.3870	341.20	289.6	6.9	3.151	1.282	4.433	3.46	72.20	2.857	1.576
20	0.4080	346.20	294.6	7.3	3.192	1.296	4.488	3.46	72.00	2.892	1.596
21	0.4280	351.20	299.6	7.7	3.234	1.310	4.544	3.47	71.80	2.927	1.617

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	357.00	305.4	8.1	3.283	1.318	4.601	3.49	71.70	2.959	1.642
23	0.4690	359.50	307.9	8.4	3.297	1.332	4.629	3.48	71.50	2.981	1.649
24	0.4890	362.80	311.2	8.8	3.319	1.339	4.659	3.48	71.40	2.999	1.660
25	0.5100	368.70	317.1	9.2	3.368	1.346	4.715	3.50	71.30	3.031	1.684
26	0.5300	374.50	322.9	9.5	3.416	1.361	4.777	3.51	71.10	3.069	1.708
27	0.5510	377.00	325.4	9.9	3.429	1.368	4.797	3.51	71.00	3.082	1.714
28	0.5710	381.20	329.6	10.2	3.459	1.368	4.827	3.53	71.00	3.098	1.730
29	0.5920	384.50	332.9	10.6	3.479	1.382	4.861	3.52	70.80	3.122	1.739
30	0.6120	386.20	334.6	11.0	3.483	1.390	4.872	3.51	70.70	3.131	1.741
31	0.6330	392.00	340.4	11.4	3.528	1.397	4.925	3.53	70.60	3.161	1.764
32	0.6530	397.00	345.4	11.7	3.565	1.411	4.977	3.53	70.40	3.194	1.783
33	0.6730	400.30	348.7	12.1	3.585	1.426	5.010	3.51	70.20	3.218	1.792
34	0.6940	406.10	354.5	12.5	3.629	1.440	5.069	3.52	70.00	3.254	1.814
35	0.7140	410.30	358.7	12.8	3.657	1.454	5.111	3.51	69.80	3.283	1.828
36	0.7350	413.60	362.0	13.2	3.674	1.469	5.143	3.50	69.60	3.306	1.837
37	0.7550	420.30	368.7	13.6	3.727	1.483	5.210	3.51	69.40	3.347	1.863
38	0.7760	423.60	372.0	13.9	3.744	1.498	5.242	3.50	69.20	3.370	1.872
39	0.7960	427.80	376.2	14.3	3.770	1.505	5.275	3.51	69.10	3.390	1.885
40	0.8170	435.30	383.7	14.7	3.829	1.519	5.348	3.52	68.90	3.434	1.914
41	0.8370	436.90	385.3	15.0	3.828	1.526	5.355	3.51	68.80	3.441	1.914

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	184.300			1333.800
Moisture content: Dry soil+tare, gms.	177.100			1230.400
Moisture content: Tare, gms.	107.500			135.300
Moisture, %	10.3	10.4	10.4	9.4
Moist specimen weight, gms.	1185.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.60	5.60	5.60	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.9	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2468	0.2468	0.2468	
Saturation, %	99.3	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 6.758 tsf at reading no. 42
Ult. Stress = 6.758 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	25.00	0.0	0.0	0.000	6.588	6.588	1.00	18.50	6.588	0.000
1	0.0190	88.20	63.2	0.3	0.736	6.458	7.195	1.11	20.30	6.827	0.368
2	0.0400	309.60	284.6	0.7	3.304	5.623	8.927	1.59	31.90	7.275	1.652
3	0.0600	397.00	372.0	1.1	4.303	4.795	9.098	1.90	43.40	6.947	2.152
4	0.0810	428.60	403.6	1.4	4.651	4.234	8.885	2.10	51.20	6.559	2.326
5	0.1010	441.90	416.9	1.8	4.787	3.830	8.617	2.25	56.80	6.224	2.393
6	0.1220	449.40	424.4	2.2	4.854	3.521	8.375	2.38	61.10	5.948	2.427
7	0.1420	460.20	435.2	2.5	4.960	3.283	8.243	2.51	64.40	5.763	2.480
8	0.1620	467.70	442.7	2.9	5.027	3.017	8.044	2.67	68.10	5.530	2.513
9	0.1830	476.00	451.0	3.3	5.101	2.837	7.938	2.80	70.60	5.387	2.551
10	0.2030	483.50	458.5	3.6	5.167	2.693	7.860	2.92	72.60	5.276	2.583
11	0.2240	489.30	464.3	4.0	5.212	2.585	7.797	3.02	74.10	5.191	2.606
12	0.2440	495.20	470.2	4.4	5.258	2.491	7.750	3.11	75.40	5.120	2.629
13	0.2650	505.20	480.2	4.7	5.349	2.419	7.768	3.21	76.40	5.094	2.675
14	0.2850	511.00	486.0	5.1	5.394	2.369	7.762	3.28	77.10	5.066	2.697
15	0.3060	518.50	493.5	5.5	5.455	2.333	7.788	3.34	77.60	5.060	2.728
16	0.3260	526.80	501.8	5.8	5.526	2.304	7.830	3.40	78.00	5.067	2.763
17	0.3460	533.50	508.5	6.2	5.579	2.297	7.875	3.43	78.10	5.086	2.789
18	0.3670	539.30	514.3	6.6	5.620	2.326	7.945	3.42	77.70	5.135	2.810
19	0.3870	548.40	523.4	6.9	5.697	2.275	7.972	3.50	78.40	5.124	2.849
20	0.4080	555.90	530.9	7.3	5.756	2.261	8.016	3.55	78.60	5.139	2.878
21	0.4280	565.90	540.9	7.6	5.841	2.261	8.102	3.58	78.60	5.181	2.921

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	569.20	544.2	8.0	5.853	2.268	8.121	3.58	78.50	5.195	2.927
23	0.4690	575.10	550.1	8.4	5.894	2.282	8.176	3.58	78.30	5.229	2.947
24	0.4890	584.20	559.2	8.7	5.968	2.297	8.265	3.60	78.10	5.281	2.984
25	0.5100	592.50	567.5	9.1	6.031	2.311	8.343	3.61	77.90	5.327	3.016
26	0.5300	599.20	574.2	9.5	6.079	2.333	8.411	3.61	77.60	5.372	3.039
27	0.5510	605.90	580.9	9.8	6.124	2.354	8.479	3.60	77.30	5.416	3.062
28	0.5710	613.30	588.3	10.2	6.178	2.362	8.539	3.62	77.20	5.450	3.089
29	0.5920	617.50	592.5	10.6	6.196	2.405	8.601	3.58	76.60	5.503	3.098
30	0.6120	626.70	601.7	10.9	6.267	2.527	8.794	3.48	74.90	5.661	3.133
31	0.6330	638.30	613.3	11.3	6.361	2.426	8.787	3.62	76.30	5.607	3.180
32	0.6530	644.10	619.1	11.7	6.395	2.448	8.843	3.61	76.00	5.646	3.198
33	0.6730	650.80	625.8	12.0	6.438	2.477	8.915	3.60	75.60	5.696	3.219
34	0.6940	656.60	631.6	12.4	6.470	2.498	8.968	3.59	75.30	5.733	3.235
35	0.7140	662.50	637.5	12.8	6.504	2.506	9.009	3.60	75.20	5.758	3.252
36	0.7350	669.10	644.1	13.1	6.543	2.542	9.085	3.57	74.70	5.813	3.271
37	0.7550	678.30	653.3	13.5	6.609	2.563	9.172	3.58	74.40	5.868	3.305
38	0.7760	684.10	659.1	13.9	6.639	2.585	9.224	3.57	74.10	5.904	3.319
39	0.7960	690.70	665.7	14.2	6.678	2.614	9.291	3.55	73.70	5.952	3.339
40	0.8170	699.10	674.1	14.6	6.732	2.635	9.367	3.55	73.40	6.001	3.366
41	0.8370	701.60	676.6	14.9	6.729	2.700	9.429	3.49	72.50	6.065	3.365
42	0.8570	707.40	682.4	15.3	6.758	2.686	9.444	3.52	72.70	6.065	3.379

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

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Box 393 Wood Road
Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

April 9, 2007

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Mach Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on March 29, 2007, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification:	Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)
Proctor Test Results:	
Maximum Dry Unit Weight:	120.3 PCF
Optimum Moisture Content:	10.7 %
Specific Gravity:	2.50
Triaxial Test Results:	
Effective Cohesion:	152 PSF
Effective Phi Angle:	29.3 Degrees
Permeability (2 tests):	3 x 10-4 cm./sec.
	2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

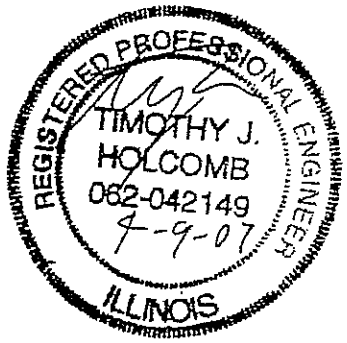
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting



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Permeability Tests Results

Mach Mine
Johnston City, Illinois

Date: 4/9/2007 Client: Williamson Energy

Project No.: H-05278

Boring No.	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse Sample #1		10.9	14.6	115.7	3 x 10-4
Coarse Refuse Sample #2		10.1	14.3	114.7	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

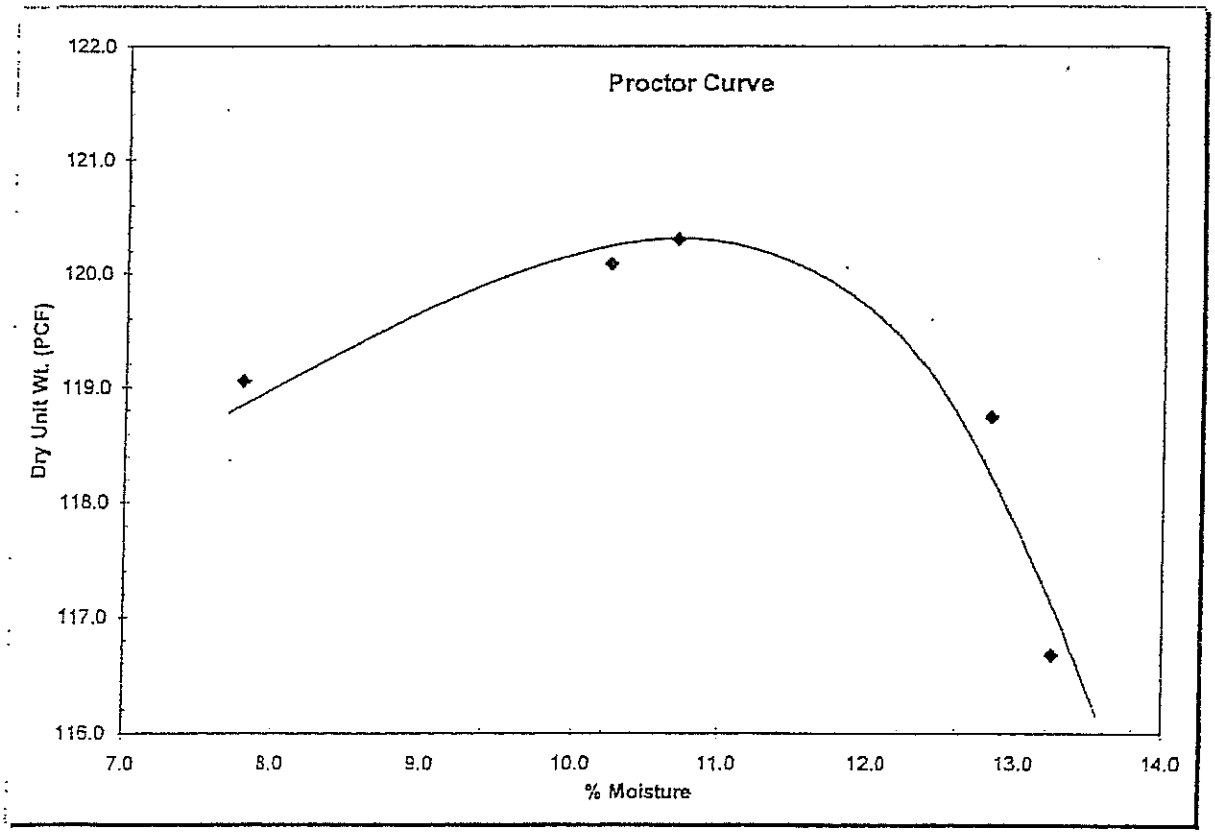
Date: 4/9/2007

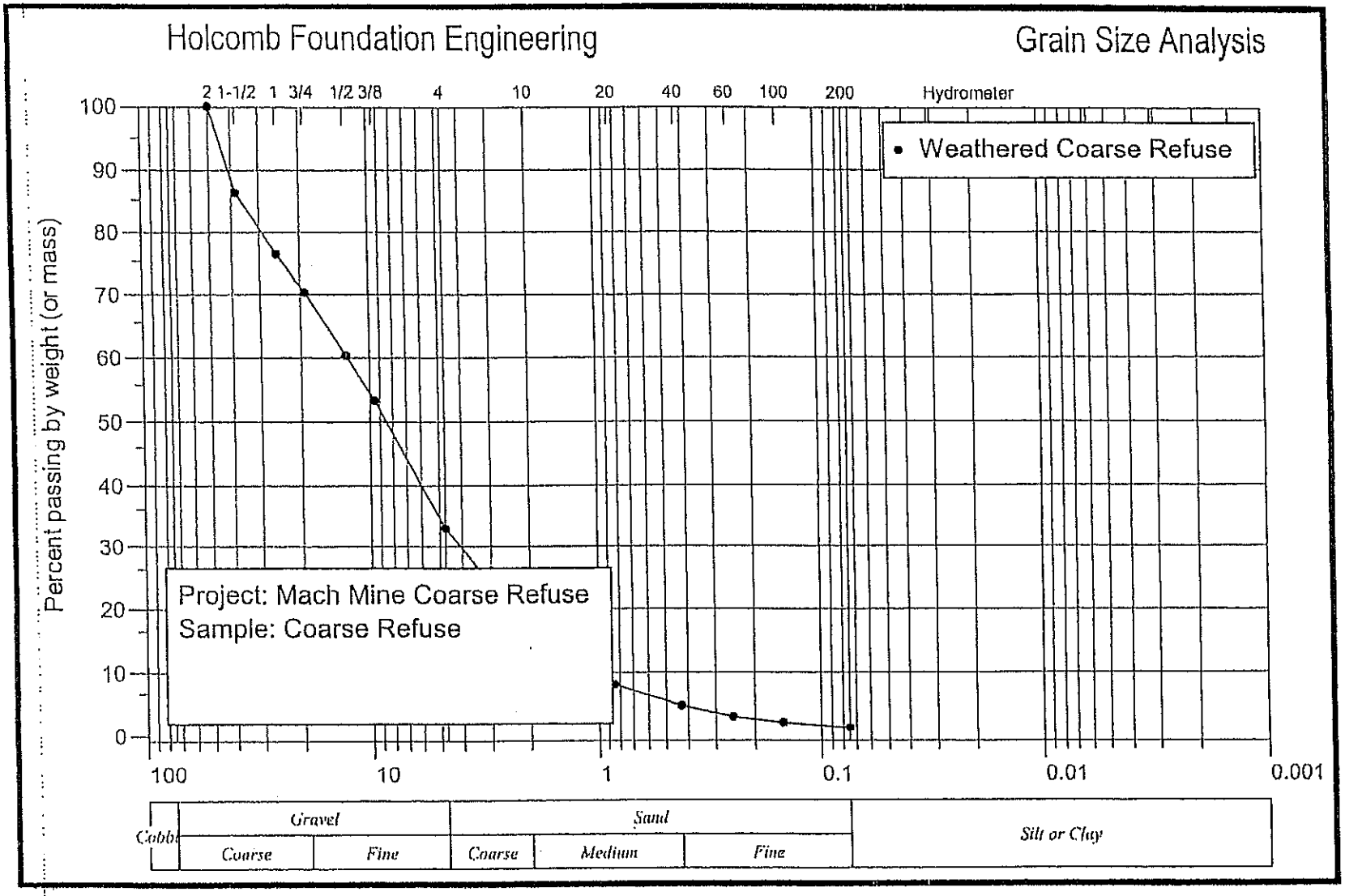
Proctor Test Results

Soil Classification:	**Weathered Coarse Refuse**
Maximum Dry Density (PCF)	**120.3**
Optimum Moisture Content (%)	**10.7**

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
12.8	118.7
13.2	116.7
10.2	120.1
7.8	119.1
10.7	120.3




Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
100 90 80 70 60 50 40 30 20 10 0
Percent passing by weight (or mass)
• Weathered Coarse Refuse
Project: Mach Mine Coarse Refuse
Sample: Coarse Refuse
100 10 1 0.1 0.01 0.001
Cobble
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

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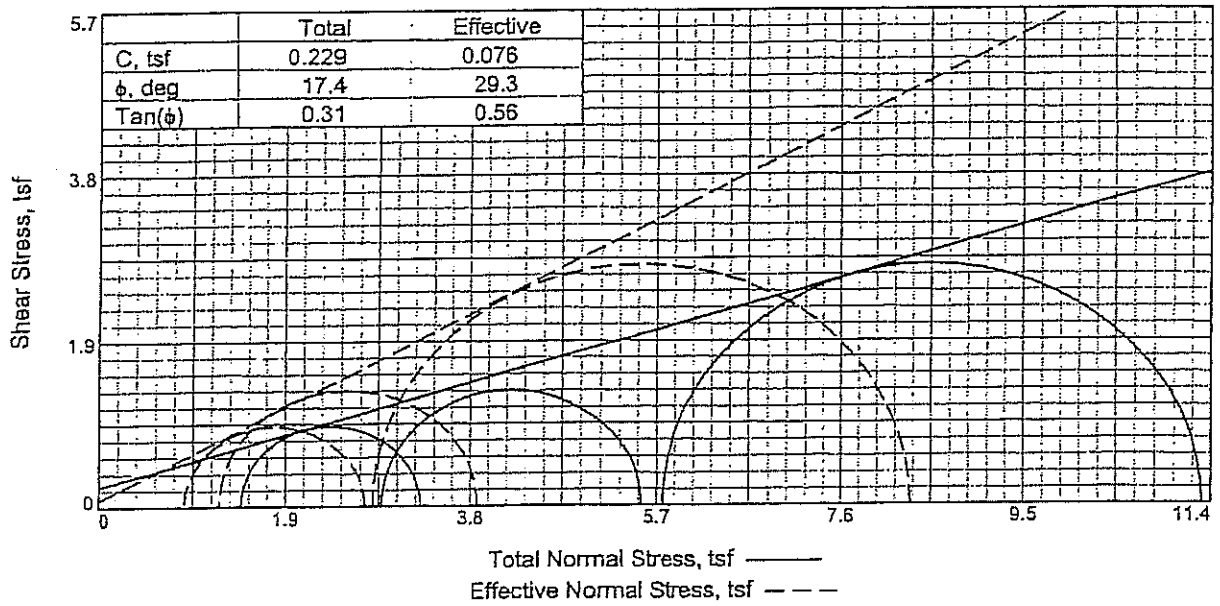
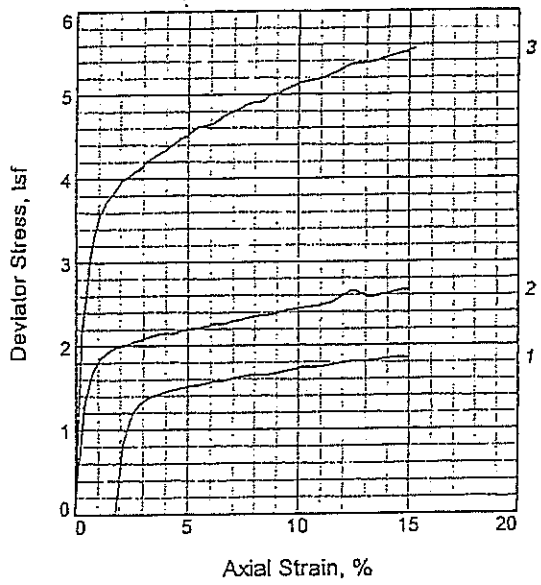
Grain Size Analysis

Project:	Mach Mine	Client:	Mach Mine
Project No.:	H-05278	Date:	4/9/2007
Sample No.	Coarse Refuse	Total Weight:	2290.30

Sieve	Wt. Retained	% Ret.	% Passing
2"	0.0	0.0	100.0
1.5"	314.4	13.7	86.3
1"	536.7	23.4	76.6
3/4"	674.8	29.5	70.5
1/2"	901.6	39.4	60.6
3/8"	1061.2	46.3	53.7
#4	1522.1	66.5	33.5
#10	1911.6	83.5	16.5
#20	2091.9	91.3	8.7
#40	2166.2	94.6	5.4
#60	2202.2	96.2	3.8
#100	2223.7	97.1	2.9
#200	2245.2	98.0	2.0





Sample No.		1	2	3
Initial	Water Content,	14.4	12.7	13.1
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	95.1	89.0	90.4
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
At Test	Water Content,	15.2	14.2	14.5
	Dry Density, pcf	113.2	115.1	114.6
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.3793	0.3560	0.3615
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.58	5.58
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.60	3.60	1.80
Cell Pressure, tsf		5.04	6.48	7.56
Fail. Stress, tsf		1.85	2.67	5.55
Total Pore Pr., tsf		4.18	5.27	4.77
Ult. Stress, tsf		1.85	2.66	5.55
Total Pore Pr., tsf		4.18	5.22	4.77
$\bar{\sigma}_1$ Failure, tsf		2.71	3.88	8.34
$\bar{\sigma}_3$ Failure, tsf		0.86	1.21	2.79

Type of Test:
CU with Pore Pressures
Sample Type: Coarse Refuse
Description:

Assumed Specific Gravity= 2.50
Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

Location: Weathered Coarse Refuse

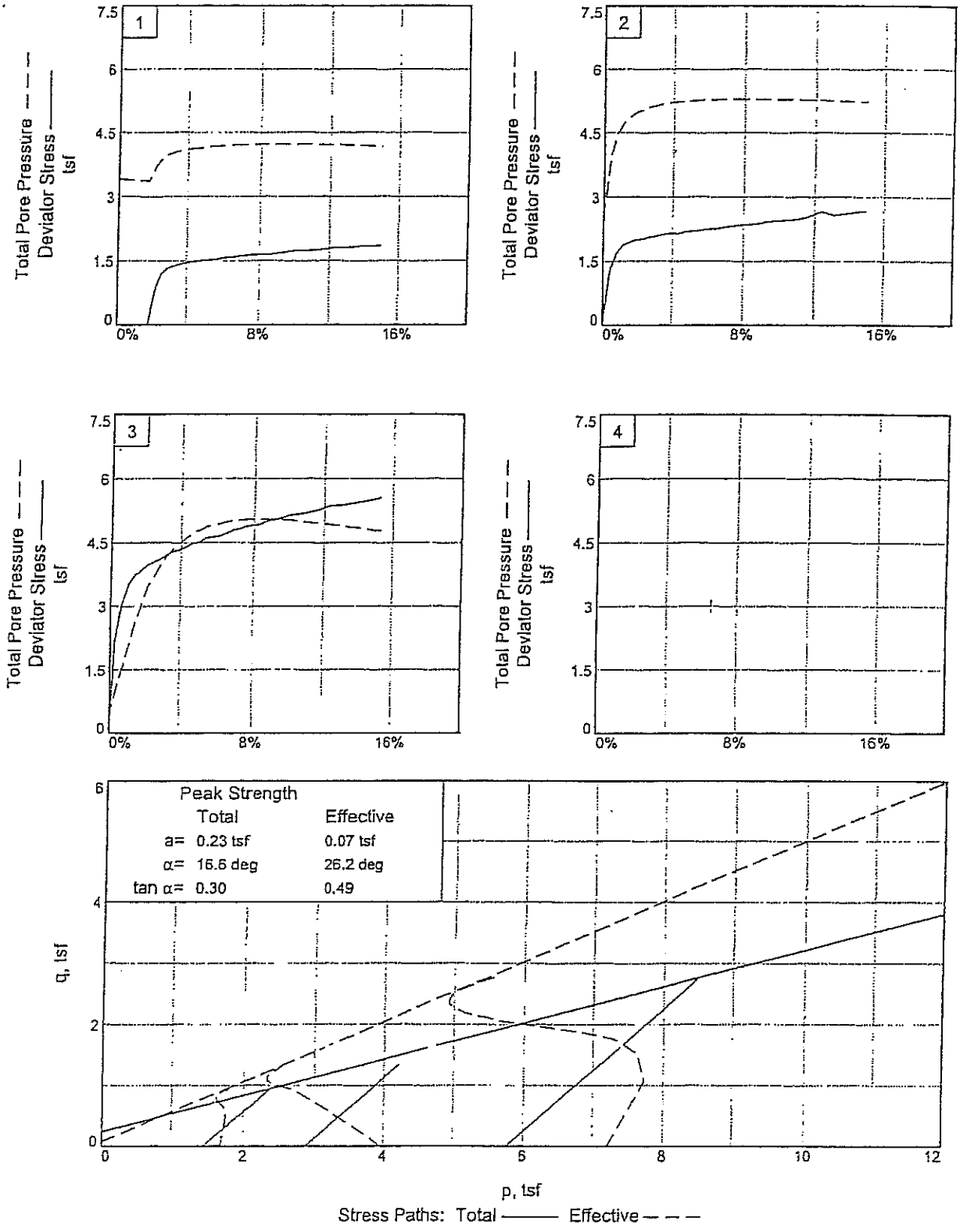
Proj. No.: H-05278 **Date:** 4/2/07

TRIAXIAL SHEAR TEST REPORT

HOLCOMB FOUNDATION ENGINEERING CO.

Plate _____

Tested By: LC Checked By: TH



Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Weathered Coarse Refuse
Project No.: H-05278
Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC Checked By: TH

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

4/9/2007
11:10 AM

Date: 4/2/07
Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Weathered Coarse Refuse
Description:
Remarks:
Type of Sample: Coarse Refuse
Assumed Specific Gravity=2.50 LL= PL= PI=
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	179.300			1255.500
Moisture content: Dry soil+tare, gms.	165.700			1117.500
Moisture content: Tare, gms.	71.400			79.600
Moisture, %	14.4	15.2	15.2	13.3
Moist specimen weight, gms.	1170.0			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.59	5.59	5.59	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.5	130.3	130.3	
Dry density, pcf	113.2	113.2	113.2	
Void ratio	0.3793	0.3793	0.3793	
Saturation, %	95.1	100.0	100.0	

Test Reading for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.845 tsf at reading no. 31
Ult. Stress = 1.845 tsf at reading no. 31

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	19.10	0.0	0.0	0.000	1.627	1.627	1.00	47.40	1.627	0.000
1	0.0190	20.00	0.9	0.3	0.001	1.642	1.642	1.00	47.20	1.642	0.000
2	0.0400	20.00	0.9	0.7	0.000	1.656	1.656	1.00	47.00	1.656	0.000
3	0.0600	20.00	0.9	1.1	0.000	1.663	1.663	1.00	46.90	1.663	0.000
4	0.0810	20.00	0.9	1.4	0.000	1.678	1.678	1.00	46.70	1.678	0.000
5	0.1010	25.00	5.9	1.8	0.017	1.678	1.694	1.01	46.70	1.686	0.008
6	0.1220	99.00	79.9	2.2	0.857	1.318	2.175	1.65	51.70	1.746	0.429
7	0.1420	124.00	104.9	2.5	1.195	1.152	2.347	2.04	54.00	1.750	0.598
8	0.1620	134.80	115.7	2.9	1.314	1.058	2.372	2.24	55.30	1.715	0.657
9	0.1830	140.60	121.5	3.3	1.374	1.001	2.375	2.37	56.10	1.688	0.687
10	0.2030	144.80	125.7	3.6	1.416	0.965	2.381	2.47	56.60	1.673	0.708
11	0.2240	148.10	129.0	4.0	1.448	0.936	2.384	2.55	57.00	1.660	0.724
12	0.2440	150.60	131.5	4.4	1.471	0.914	2.385	2.61	57.30	1.650	0.735
13	0.2650	153.10	134.0	4.7	1.493	0.900	2.393	2.66	57.50	1.646	0.746
14	0.2850	155.60	136.5	5.1	1.515	0.878	2.393	2.72	57.80	1.636	0.757
15	0.3060	157.30	138.2	5.5	1.528	0.864	2.392	2.77	58.00	1.628	0.764
16	0.3260	159.80	140.7	5.8	1.549	0.857	2.406	2.81	58.10	1.631	0.775
17	0.3460	162.30	143.2	6.2	1.571	0.850	2.420	2.85	58.20	1.635	0.785
18	0.3670	163.10	144.0	6.6	1.573	0.835	2.408	2.88	58.40	1.622	0.787
19	0.3870	166.40	147.3	6.9	1.603	0.828	2.431	2.94	58.50	1.630	0.802
20	0.4080	168.90	149.8	7.3	1.624	0.821	2.445	2.98	58.60	1.633	0.812
21	0.4490	172.30	153.2	8.0	1.648	0.814	2.461	3.02	58.70	1.637	0.824
22	0.4890	173.90	154.8	8.7	1.652	0.806	2.458	3.05	58.80	1.632	0.826
23	0.5300	178.90	159.8	9.5	1.691	0.806	2.498	3.10	58.80	1.652	0.846
24	0.5710	184.80	165.7	10.2	1.740	0.814	2.553	3.14	58.70	1.683	0.870
25	0.6120	186.40	167.3	10.9	1.742	0.806	2.549	3.16	58.80	1.677	0.871
26	0.6530	190.60	171.5	11.7	1.771	0.821	2.592	3.16	58.60	1.706	0.886
27	0.6940	195.60	176.5	12.4	1.808	0.821	2.628	3.20	58.60	1.725	0.904
28	0.7350	197.20	178.1	13.1	1.809	0.835	2.644	3.17	58.40	1.740	0.904
29	0.7760	201.40	182.3	13.9	1.836	0.842	2.678	3.18	58.30	1.760	0.918
30	0.8170	204.70	185.6	14.6	1.853	0.857	2.710	3.16	58.10	1.783	0.927
31	0.8370	204.70	185.6	15.0	1.845	0.864	2.709	3.14	58.00	1.787	0.923

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	169.900			1238.700
Moisture content: Dry soil+tare, gms.	158.800			1117.200
Moisture content: Tare, gms.	71.200			73.100
Moisture, %	12.7	14.2	14.2	11.6
Moist specimen weight, gms.	1169.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.7	131.5	131.5	
Dry density, pcf	115.1	115.1	115.1	
Void ratio	0.3560	0.3560	0.3560	
Saturation, %	89.0	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 2.666 tsf at reading no. 27
Ult. Stress = 2.663 tsf at reading no. 31

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	62.40	0.0	0.0	0.000	3.967	3.967	1.00	34.90	3.967	0.000
1	0.0220	173.10	110.7	0.4	1.289	2.484	3.773	1.52	55.50	3.129	0.645
2	0.0420	206.40	144.0	0.8	1.671	2.016	3.687	1.83	62.00	2.852	0.836
3	0.0620	223.00	160.6	1.1	1.857	1.764	3.621	2.05	65.50	2.693	0.929
4	0.0830	230.50	168.1	1.5	1.936	1.613	3.549	2.20	67.60	2.581	0.968
5	0.1030	235.50	173.1	1.8	1.987	1.512	3.499	2.31	69.00	2.505	0.993
6	0.1240	238.00	175.6	2.2	2.008	1.447	3.455	2.39	69.90	2.451	1.004
7	0.1440	242.20	179.8	2.6	2.048	1.390	3.438	2.47	70.70	2.414	1.024
8	0.1650	245.50	183.1	3.0	2.078	1.346	3.424	2.54	71.30	2.385	1.039
9	0.1850	248.80	186.4	3.3	2.107	1.310	3.418	2.61	71.80	2.364	1.054
10	0.2060	252.20	189.8	3.7	2.137	1.289	3.426	2.66	72.10	2.358	1.069
11	0.2260	254.70	192.3	4.0	2.158	1.267	3.425	2.70	72.40	2.346	1.079
12	0.2460	253.80	191.4	4.4	2.139	1.253	3.392	2.71	72.60	2.322	1.070
13	0.2670	258.80	196.4	4.8	2.187	1.238	3.425	2.77	72.80	2.332	1.093
14	0.2870	260.50	198.1	5.1	2.197	1.231	3.428	2.78	72.90	2.330	1.099
15	0.3080	263.00	200.6	5.5	2.216	1.217	3.433	2.82	73.10	2.325	1.108
16	0.3280	265.50	203.1	5.9	2.235	1.210	3.445	2.85	73.20	2.327	1.118
17	0.3490	268.80	206.4	6.3	2.263	1.210	3.472	2.87	73.20	2.341	1.131
18	0.3690	268.80	206.4	6.6	2.254	1.202	3.456	2.87	73.30	2.329	1.127
19	0.3900	273.00	210.6	7.0	2.290	1.195	3.486	2.92	73.40	2.340	1.145
20	0.4100	275.50	213.1	7.3	2.309	1.195	3.504	2.93	73.40	2.350	1.154
21	0.4510	281.30	218.9	8.1	2.353	1.188	3.541	2.98	73.50	2.364	1.176

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4920	284.60	222.2	8.8	2.369	1.195	3.564	2.98	73.40	2.380	1.185
23	0.5330	292.10	229.7	9.6	2.429	1.195	3.625	3.03	73.40	2.410	1.215
24	0.5740	296.30	233.9	10.3	2.454	1.202	3.656	3.04	73.30	2.429	1.227
25	0.6140	300.40	238.0	11.0	2.477	1.202	3.679	3.06	73.30	2.441	1.238
26	0.6440	305.40	243.0	11.5	2.514	1.217	3.730	3.07	73.10	2.474	1.257
27	0.6960	322.90	260.5	12.5	2.666	1.210	3.876	3.20	73.20	2.543	1.333
28	0.7370	316.20	253.8	13.2	2.576	1.238	3.814	3.08	72.80	2.526	1.288
29	0.7780	322.10	259.7	13.9	2.613	1.238	3.852	3.11	72.80	2.545	1.307
30	0.8190	328.70	266.3	14.7	2.657	1.253	3.910	3.12	72.60	2.581	1.328
31	0.8390	330.40	268.0	15.0	2.663	1.260	3.923	3.11	72.50	2.591	1.331

Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	171.400			1284.500
Moisture content: Dry soil+tare, gms.	160.000			1180.500
Moisture content: Tare, gms.	72.800			134.900
Moisture, %	13.1	14.5	14.5	9.9
Moist specimen weight, gms.	1168.8			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.58	5.58	5.58	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	129.6	131.2	131.2	
Dry density, pcf	114.6	114.6	114.6	
Void ratio	0.3615	0.3615	0.3615	
Saturation, %	90.4	100.0	100.0	

Test Readings for Specimen No. 3

Membrane modulus = 0.124105 kN/cm^2

Membrane thickness = 0.02 cm

Filter paper coefficient = 0.001926 kN/cm

Filter paper coverage = 50%

Consolidation cell pressure = 105.00 psi (7.560 tsf)

Consolidation back pressure = 25.00 psi (1.800 tsf)

Consolidation effective confining stress = 5.760 tsf

Strain rate, in./min. = 0.00

Fail. Stress = 5.549 tsf at reading no. 35

Ult. Stress = 5.549 tsf at reading no. 35

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0020	102.40	0.0	0.0	0.000	7.207	7.207	1.00	4.90	7.207	0.000
1	0.0170	286.30	183.9	0.3	2.145	6.674	8.819	1.32	12.30	7.747	1.072
2	0.0370	364.50	262.1	0.6	3.046	6.113	9.158	1.50	20.10	7.636	1.523
3	0.0580	407.00	304.6	1.0	3.526	5.537	9.063	1.64	28.10	7.300	1.763
4	0.0780	426.10	323.7	1.4	3.733	4.997	8.730	1.75	35.60	6.864	1.867
5	0.0990	437.70	335.3	1.7	3.853	4.536	8.389	1.85	42.00	6.462	1.926
6	0.1190	449.40	347.0	2.1	3.972	4.133	8.105	1.96	47.60	6.119	1.986
7	0.1400	457.70	355.3	2.5	4.052	3.838	7.889	2.06	51.70	5.863	2.026

Test Readings for Specimen No. 1

No.	Def. Dial In.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
8	0.1600	464.40	362.0	2.8	4.113	3.593	7.706	2.14	55.10	5.649	2.056
9	0.1810	474.40	372.0	3.2	4.210	3.384	7.594	2.24	58.00	5.489	2.105
10	0.2010	481.90	379.5	3.6	4.279	3.211	7.490	2.33	60.40	5.351	2.140
11	0.2210	487.70	385.3	3.9	4.328	3.074	7.403	2.41	62.30	5.239	2.164
12	0.2420	495.20	392.8	4.3	4.395	2.959	7.355	2.49	63.90	5.157	2.198
13	0.2620	503.50	401.1	4.7	4.471	2.851	7.323	2.57	65.40	5.087	2.236
14	0.2830	509.30	406.9	5.0	4.518	2.772	7.290	2.63	66.50	5.031	2.259
15	0.3030	519.30	416.9	5.4	4.612	2.693	7.305	2.71	67.60	4.999	2.306
16	0.3240	522.60	420.2	5.8	4.630	2.650	7.279	2.75	68.20	4.965	2.315
17	0.3440	526.00	423.6	6.1	4.650	2.621	7.270	2.77	68.60	4.946	2.325
18	0.3650	534.30	431.9	6.5	4.722	2.578	7.299	2.83	69.20	4.938	2.361
19	0.3850	541.80	439.4	6.9	4.785	2.549	7.334	2.88	69.60	4.941	2.393
20	0.4050	546.80	444.4	7.2	4.821	2.534	7.355	2.90	69.80	4.945	2.411
21	0.4260	553.40	451.0	7.6	4.873	2.520	7.393	2.93	70.00	4.956	2.436
22	0.4460	558.40	456.0	8.0	4.908	2.506	7.413	2.96	70.20	4.959	2.454
23	0.4670	560.90	458.5	8.3	4.914	2.506	7.420	2.96	70.20	4.963	2.457
24	0.4870	569.20	466.8	8.7	4.984	2.506	7.489	2.99	70.20	4.997	2.492
25	0.5080	574.20	471.8	9.1	5.016	2.513	7.529	3.00	70.10	5.021	2.508
26	0.5280	580.10	477.7	9.4	5.059	2.520	7.579	3.01	70.00	5.050	2.530
27	0.5690	592.50	490.1	10.2	5.148	2.534	7.683	3.03	69.80	5.109	2.574
28	0.6100	600.00	497.6	10.9	5.184	2.570	7.755	3.02	69.30	5.163	2.592
29	0.6510	610.90	508.5	11.6	5.254	2.599	7.853	3.02	68.90	5.226	2.627
30	0.6920	625.80	523.4	12.4	5.363	2.628	7.991	3.04	68.50	5.310	2.682
31	0.7330	631.70	529.3	13.1	5.378	2.671	8.049	3.01	67.90	5.360	2.689
32	0.7730	641.60	539.2	13.8	5.434	2.707	8.141	3.01	67.40	5.424	2.717
33	0.8140	651.60	549.2	14.6	5.487	2.750	8.238	3.00	66.80	5.494	2.744
34	0.8350	656.60	554.2	14.9	5.513	2.772	8.285	2.99	66.50	5.528	2.756
35	0.8540	662.50	560.1	15.3	5.549	2.786	8.335	2.99	66.30	5.561	2.775

ATTACHMENT

HOLCOLM FOUNDATION ENGINEERING COMPANY, INC.
COARSE COAL REFUSE LABORATORY TESTING RESULTS
NOVEMBER 2006 AND APRIL 2007

ATTACHMENT

Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Estimation and Summary of Engineering Properties Including Peak and Steady-State Undrained Shear Strength for Refuse and Subgrade Materials," Pond Creek Coal Refuse Disposal Site – South Pond Stage 2," BEG, 07/12/08.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation Estimation and Summary of Engineering Properties for Fine Coal Refuse

PROJECT NO. 080851

PAGE 1 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

CALCULATION BRIEF FOR

ESTIMATION AND SUMMARY OF ENGINEERING PROPERTIES INCLUDING PEAK AND STEADY-STATE UNDRAINED SHEAR STRENGTH FOR REFUSE AND SUBGRADE MATERIALS

POND CREEK COAL REFUSE DISPOSAL SITE – SOUTH POND STAGE 2

OBJECTIVE: To estimate and summarize engineering properties for fine coal refuse materials samples obtained at the Pond Creek Coal Refuse Disposal site including unit weight (γ), specific gravity (G_s), effective strength, i.e., angle of internal friction (ϕ') and cohesion (c'), total strength, peak undrained shear strength (S_{up}), and steady-state undrained shear strength (S_{us}). The various strengths will be used in the South Pond abandonment analyses model(s).

REFERENCES:

1. Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Summary of Piezo-Seismic Cone Penetration Testing," Pond Creek Coal Refuse Disposal Site," BEG, 12/21/07.

2. Civil & Environmental Consultants (CEC), Inc. Calculation Brief Entitled "Summary of Laboratory Testing – Fine Coal Refuse," Pond Creek Coal Refuse Disposal Site – South Pond," BEG, 7/10/08.

3. Alliance Consulting, Inc., "Appendix C Laboratory Testing, Proposed Coal Refuse Disposal Facility No. 2, Pond Creek Mine No. 1, Williamson County, Illinois."

4. Poulos, S.J., Castro, G., France, J.W. (1985), "Liquefaction Evaluation Procedure," Journal of Geotechnical Engineering, ASCE, 111(6), pp. 772-791.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation — PROJECT NO. 080851

Estimation and Summary of Engineering Properties for Fine Coal Refuse — PAGE 2 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MTS DATE 7/23/08

5. Genes, B.E., Keller, T.O., and Laird, J.P. (2000) "Steady State Liquefaction Susceptibility of High Hazard Upstream-Constructed Coal Refuse Disposal Facilities," Proceedings of Tailings Dams 2000, ASDSO/USCOLD, Las Vegas, NV, March 28-30, pp. 47-58.

6. Almes, R. A. and Butail, A. (1976) "Coal Refuse: Its Behavior Related to the Design and Operation of Coal Refuse Disposal Facilities," Proceedings of the Ohio River Valley Soils Seminar, Lexington, Kentucky, October, 1976.

7. Bowles, Joseph E. (1984) "Physical and Geotechnical Properties of Soils," Mc-Graw Hill. New York: 367-369 and 393-396.

SOIL PROPERTIES:

The following soil properties were estimated based on laboratory testing [Reference Numbers (Ref. Nos.) 2 and 3] performed for abandonment analyses and/or provided by Alliance Consulting, Inc. for previous deformation analyses, which are used in the various slope stability analyses and attached for information:

Refuse/Soil Properties

Description	Unit Weight (γ) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion [1] (c) (psf)	Comment
Coarse Refuse	130	36	0	Frictional
Fine Coal Refuse	85	36.9	0	Effective Strength (Drained)
		18.8	0	Total Strength (Undrained)
		0	Varies (See Below)	Steady-State (Undrained)
Residual Soil	125	19.5	400	Total Strength (Undrained)
		0	3000	80% Peak Undrained

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Estimation and Summary of Engineering Properties
for Fine Coal Refuse

PROJECT NO. 080851

PAGE 3 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

LABORATORY-DERIVED S_{up} and S_{us}:

Two (2) consolidated – undrained (CU) triaxial series tests (3 points each) were performed on reconstituted bulk fine coal refuse slurry to determine effective and total strength parameters as well as peak (S_{up}) and steady-state (S_{us}) undrained shear strengths. Samples were prepared in the laboratory to simulate in-situ placement and consolidation. Samples were consolidated to a range of vertical effective stresses of about 5, 10 and 20 pounds per square inch (psi) [or 720 to 2880 pounds per square foot (psf)]. All specimens exhibited contractive behavior when sheared under undrained conditions. In general, all specimens reached, or nearly reached, a steady-state of deformation within the strain limits of the test equipment.

A total of 6 CU points comprise the (2) series from which peak and steady-state shear strength state. S_{us} represents the liquefied shear strength [i.e., the minimum (residual) strength available following a rapid loading event, such as an earthquake].

The following equations (Ref. No. 4) were used to calculate peak (S_{up}) and steady-state (S_{us}) shear strengths from laboratory test specimens:

Peak:

$$S_{up} = q_{up} \cos \phi_p$$

Or

$$S_{up} = \sigma'_{3p} [\cos \phi_p \sin \phi_p] / (1 - \sin \phi_p)$$

Steady-State:

$$S_{us} = q_{us} \cos \phi_{us}$$

Or

$$S_{us} = \sigma'_{3s} [\cos \phi_{us} \sin \phi_{us}] / (1 - \sin \phi_{us})$$

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PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Estimation and Summary of Engineering Properties
for Fine Coal Refuse

PROJECT NO. 080851

PAGE 4 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

Where,

q_{up} = shear stress on 45-degree plane at peak strain

ϕ_p = friction angle at peak = arcsin (q/p) at peak strain

σ'_{3p} = lateral effective stress at peak strain

q_{us} = shear stress on 45-degree plane at steady-state (max) strain

ϕ_{us} = friction angle at steady-state = arcsin (q/p) at max strain

σ'_{3us} = lateral effective stress at steady-state (max) strain

The following peak and steady-state data is presented from CU testing on bulk fine coal refuse samples Bucket 1 and Bucket 2 and applying the equations above. CU laboratory test results are attached.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond
Phase 2 Abandonment Evaluation
Estimation and Summary of Engineering Properties
for Fine Coal Refuse

PROJECT NO. 080851

PAGE 5 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

Sample No.	Bucket 1 – Fine Coal Refuse			Bucket 2 – Fine Coal Refuse		
CU Test No. (Confining Pressure)	1 (5.2 psi)	2 (10.2 psi)	3 (20.4 psi)	1 (5.2 psi)	2 (10.4 psi)	3 (20.4 psi)
Parameter						
q_{up} (psi) @	4.61	7.54	10.82	3.37	5.73	11.67
Peak Strain (%)	18.4	13.4	13.5	10.3	14.2	8.4
ϕ_p (deg)	40.4	39.6	37.8	38.3	39.2	37.5
σ'_{3p} (psi)	2.5	4.3	6.8	2.1	3.3	7.5
S_{up} (psi)	3.51	5.81	8.55	2.64	4.44	9.26
q_{us} (psi) @	4.59	7.33	10.02	3.28	5.4	10.61
Max. Strain (%)	21.5	21.67	21.74	17.29	21.32	21.42
ϕ_{us} (deg)	40.4	39.0	36.7	36.3	38.6	35.7
σ'_{3us} (psi)	2.4	4.3	6.7	2.1	3.3	7.6
S_{us} (psi)	3.37	5.67	7.98	2.46	4.28	8.65

A plot of the S_{us} of the reconstituted coal refuse slurry samples versus vertical effective stress ($\sigma'v$) is presented in the attached Figure 1. The equivalent effective vertical stress was assumed to be 1.5 times the isotropic effective consolidation stress (i.e., $1.5*\sigma'3$). A 2/3 – 1/3 relationship of the data was employed to yield an S_{us} to $\sigma'v$ relationship of $S_{us} = 0.28\ \sigma'v$. Ref. No. 5 and recent undisturbed/remolded fine coal refuse testing on other projects yielded a range of $S_{us} = 0.06$ to $0.28\ \sigma'v$, with an average of about $S_{us} = 0.22\ \sigma'v$. Since site specific testing was performed, a reasonable S_{us} to $\sigma'v$ relationship of $S_{us} = 0.24\ \sigma'v$ is considered realistic with some conservatism. The impounded/abandoned fine coal refuse in the South Pond will be modeled utilizing this relationship.

Civil & Environmental Consultants, Inc.

PROJECT Williamson Energy Pond Creek – South Pond Phase 2 Abandonment Evaluation Estimation and Summary of Engineering Properties for Fine Coal Refuse

PROJECT NO. 080851

PAGE 6 OF 6

MADE BY BEG DATE 7/12/08 CHECKED BY MJS DATE 7/23/08

Subsequent slope stability analyses determine the magnitude of driving shear stress on a failure plane through the fine coal refuse impoundment to assess the required S_{us} to maintain equilibrium and assess the likelihood of a (liquefaction) flow failure. Post-earthquake slope stability of the embankment/impoundment is evaluated as well to assess the failure potential of the South Pond embankment using the abandonment geometry.

CONCLUSIONS

Laboratory undrained shear strength data from consolidated undrained triaxial tests of fine coal refuse were determined. Procedures were performed to estimate S_{up}, S_{us}, and a reasonable S_{us} to $\sigma'v$ relationship of $S_{us} = 0.24\ \sigma'v$ for the material. The results of the laboratory testing indicated Sup and Sus reach their peak and steady-state strength at high strains, and there is very little drop off with increasing strain. Further, Sup and Sus values generally indicated resistance to flow. Thus, the results suggest undrained strengths of the fine coal refuse will be maintained at or near peak levels during an undrained event such as an earthquake, and the susceptibility of the impounded fine coal refuse to a liquefaction flow failure is a function of both the undrained strength (worst case steady-state strength) and the in-situ driving shear stress on a critical failure plane through the fine refuse material.

Based on this information, the properties evaluated/developed in Ref. No. 2 for fine coal refuse, as well as coarse refuse and residual soil, indicated the South Pond fine coal refuse has sufficient steady-state shear strength to limit the flowability of the material. The likelihood of a flow failure associated with the abandonment scenario will be assessed in a subsequent calculation brief by evaluating the driving shear stress and factor of safety against liquefaction in the fine coal refuse.

POND CREEK PHASE 2 SOUTH POND
STEADY-STATE UNDRAINED SHEAR STRENGTH-TO-EFFECTIVE STRESS RELATIONSHIP

Pond Creek Phase 2 South Pond
Steady-State Undrained Strength vs. Vertical Effective Stress

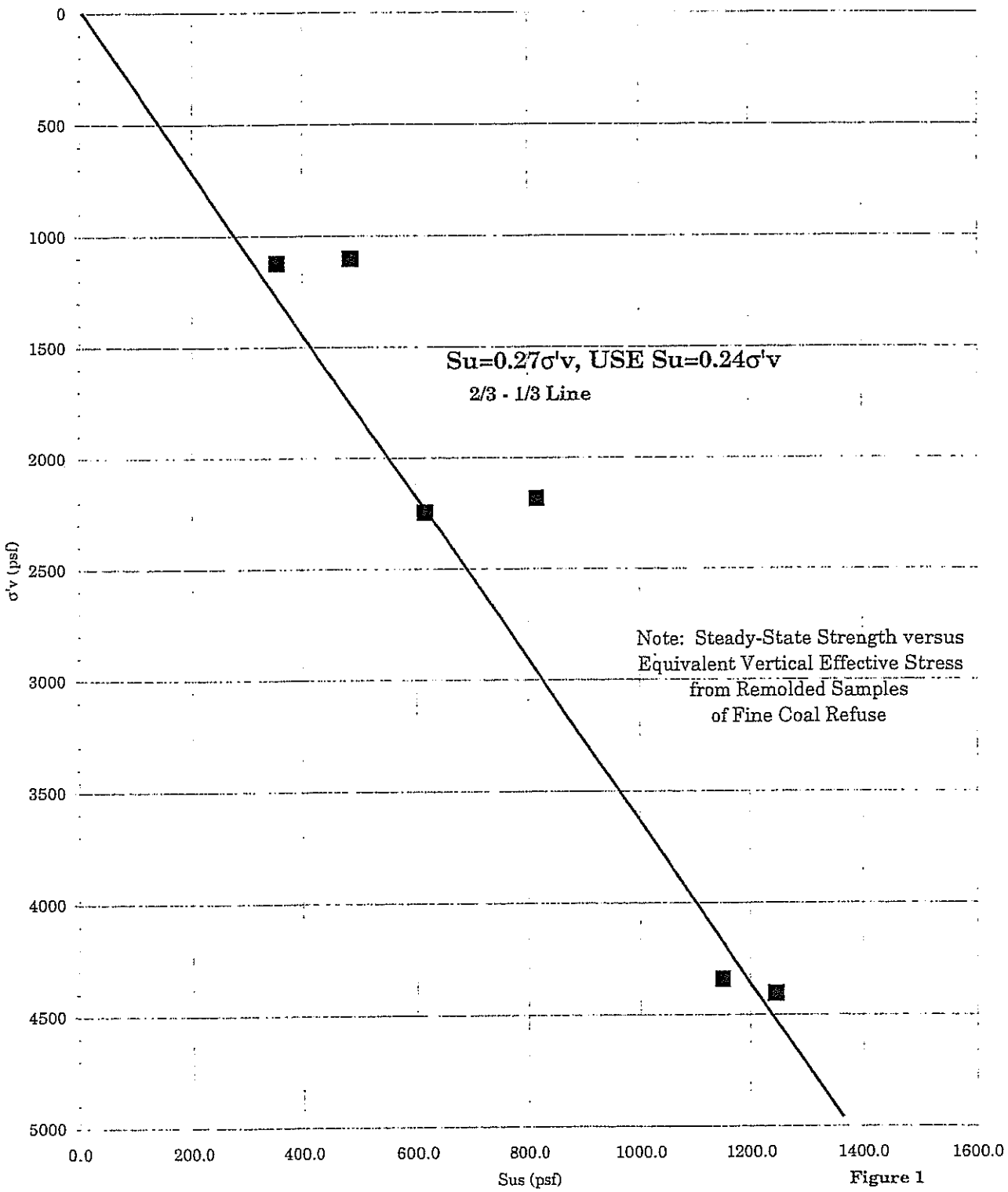

Figure 1

POND CREEK – SOUTH POND
CONSOLIDATED – UNDRAINED TRIAXIAL LABORATORY TESTING RESULTS FOR FINE COAL REFUSE

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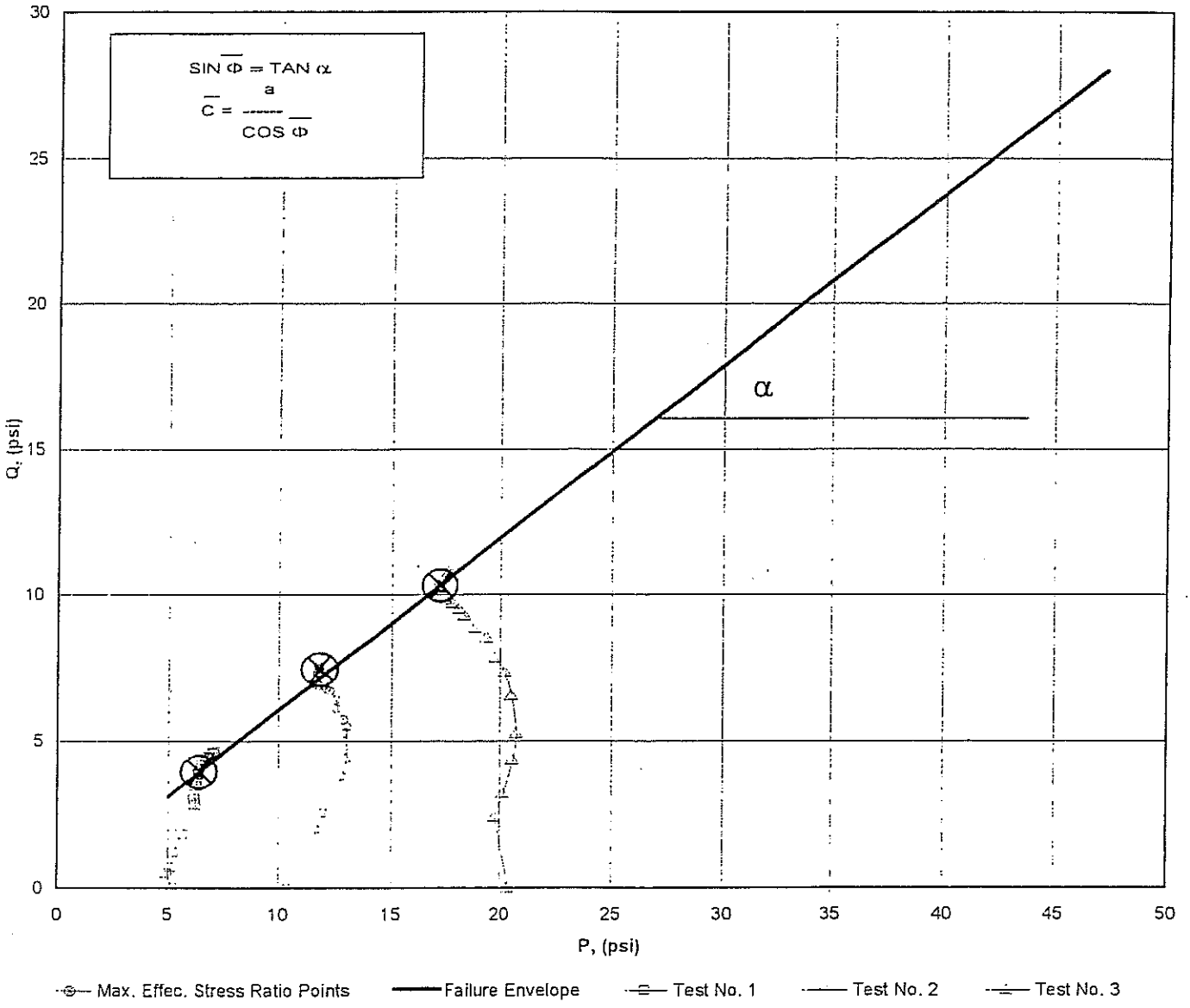
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	30.5	$\bar{\Phi}$	=	36.14

Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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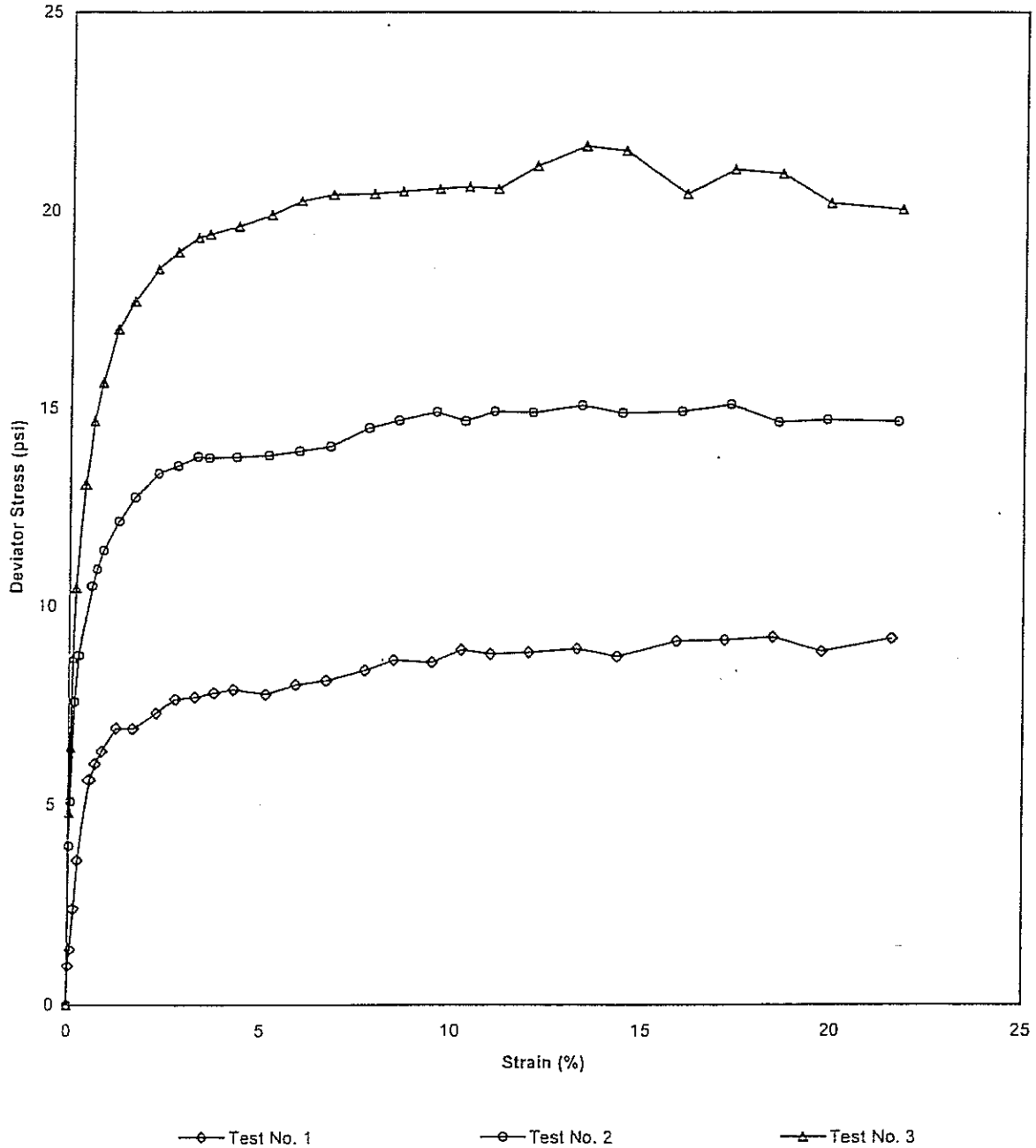
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		
Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/21/08 Approved By DB Date 6/19/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	1

PRESSURES (psi)

Cell Pressure(psi)	36.6
Back Pressure(psi)	31.4
Eff. Cons. Pressure(psi)	5.2
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	6.41
Q	=	3.95

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.140	Diameter 1	1.375
Length 2	3.148	Diameter 2	1.389
Length 3	3.151	Diameter 3	1.399
Avg Leng.=	3.146	Avg. Diam.=	1.388

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.7
Final Change (ml)	2.3

Initial Dial Reading (D.R.), mils	235
D.R. After Saturation, mils	250
D.R. After Consolidation, mils	294

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.4
8.2	0.001	32.1
8.8	0.002	32.1
10.3	0.005	32.5
12.1	0.008	32.8
15.1	0.016	33.2
15.8	0.020	33.4
16.2	0.026	33.6
17.1	0.038	33.7
17.2	0.051	33.8
17.8	0.069	33.9
18.4	0.085	34.0
18.5	0.101	34.0
18.8	0.116	34.1
19.0	0.132	34.1
18.9	0.158	34.1
19.4	0.182	34.2
19.6	0.205	34.2
20.2	0.236	34.2
20.7	0.260	34.2
20.8	0.292	34.1
21.4	0.316	34.3
21.4	0.340	34.1
21.6	0.371	34.1
22.0	0.411	34.1
21.8	0.443	34.1
22.8	0.490	34.1
23.1	0.530	34.2
23.5	0.569	34.1
23.1	0.610	34.1
24.0	0.664	34.2

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.2	*Stage No.*	1
		Test No	1

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.51
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.55
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.474

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	0.98	0.73	5.45	4.5	1.219	0.76	4.96	0.49
0.07	1.39	0.75	5.84	4.5	1.311	0.55	5.14	0.69
0.15	2.40	1.15	6.46	4.1	1.593	0.49	5.25	1.20
0.25	3.62	1.36	7.46	3.8	1.941	0.38	5.65	1.81
0.52	5.63	1.79	9.04	3.4	2.649	0.32	6.23	2.81
0.66	6.03	2.01	9.22	3.2	2.893	0.34	6.20	3.02
0.84	6.35	2.21	9.34	3.0	3.125	0.36	6.16	3.18
1.22	6.92	2.33	9.79	2.9	3.417	0.34	6.33	3.46
1.64	6.91	2.40	9.71	2.8	3.469	0.35	6.26	3.46
2.25	7.31	2.55	9.96	2.7	3.753	0.36	6.31	3.65
2.75	7.66	2.61	10.25	2.6	3.961	0.35	6.42	3.83
3.27	7.71	2.64	10.26	2.6	4.017	0.35	6.41	3.85
3.77	7.81	2.68	10.34	2.5	4.098	0.35	6.43	3.91
4.28	7.90	2.74	10.37	2.5	4.208	0.35	6.41	3.95
5.11	7.78	2.71	10.27	2.5	4.124	0.36	6.38	3.89
5.89	8.02	2.84	10.38	2.4	4.400	0.36	6.37	4.01
6.65	8.13	2.78	10.56	2.4	4.359	0.35	6.49	4.07
7.66	8.39	2.83	10.76	2.4	4.538	0.34	6.56	4.19
8.42	8.64	2.76	11.09	2.4	4.536	0.33	6.77	4.32
9.45	8.59	2.72	11.07	2.5	4.464	0.32	6.77	4.29
10.23	8.90	2.86	11.25	2.3	4.797	0.33	6.79	4.45
11.00	8.80	2.67	11.33	2.5	4.474	0.31	6.93	4.40
12.03	8.83	2.74	11.29	2.5	4.594	0.32	6.87	4.42
13.30	8.93	2.72	11.41	2.5	4.601	0.31	6.94	4.46
14.34	8.73	2.69	11.25	2.5	4.477	0.31	6.88	4.37
15.88	9.12	2.66	11.66	2.5	4.587	0.30	7.10	4.56
17.15	9.15	2.77	11.59	2.4	4.762	0.31	7.01	4.58
18.44	9.22	2.70	11.72	2.5	4.691	0.30	7.11	4.61
19.74	8.86	2.70	11.36	2.5	4.536	0.31	6.93	4.43
21.51	9.19	2.82	11.56	2.4	4.864	0.31	6.97	4.59

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	2

PRESSURES (psi)

Cell Pressure(psi)	46.5
Back Pressure(psi)	36.1
Eff. Cons. Pressure(ps	10.4
Pore Pressure Response (%)	100

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	11.84
Q	=	7.45

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.120	Diameter 1	1.396
Length 2	3.137	Diameter 2	1.398
Length 3	3.135	Diameter 3	1.344
Avg Leng.=	3.131	Avg. Diam.=	1.379

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	18.4
Final Change (ml)	5.6

Initial Dial Reading (D.R.), mils	77
D.R. After Saturation, mils	112
D.R. After Consolidation, mils	166

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.9	0.000	36.1
13.4	0.001	36.8
14.9	0.002	37.0
18.3	0.005	37.4
20.0	0.008	37.8
22.4	0.017	38.7
23.0	0.020	38.9
23.7	0.026	39.3
24.8	0.038	39.9
25.7	0.051	40.3
26.7	0.069	40.9
27.1	0.085	41.1
27.5	0.100	41.3
27.5	0.110	41.5
27.7	0.131	41.6
27.9	0.157	41.8
28.2	0.181	41.9
28.6	0.204	41.9
29.5	0.235	42.0
30.0	0.259	42.1
30.5	0.290	42.1
30.4	0.313	42.0
31.0	0.337	42.1
31.2	0.368	42.0
31.8	0.408	42.2
31.8	0.439	42.1
32.3	0.486	42.1
33.0	0.526	42.2
32.6	0.565	42.1
33.1	0.604	42.2
33.6	0.659	42.2

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.4	*Stage No.*	1
		Test No	2

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.49
Initial Sample Volume (in^3)	4.68

VOLUME CHANGE

Volume After Consolidation (in^3)	4.18
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.03	3.98	0.65	13.73	9.7	1.408	0.16	11.74	1.99
0.06	5.09	0.89	14.59	9.5	1.535	0.18	12.05	2.54
0.15	7.59	1.34	16.65	9.1	1.838	0.18	12.85	3.79
0.25	8.76	1.72	17.44	8.7	2.010	0.20	13.06	4.38
0.54	10.51	2.62	18.29	7.8	2.351	0.25	13.04	5.26
0.67	10.94	2.79	18.56	7.6	2.438	0.25	13.08	5.47
0.86	11.42	3.19	18.64	7.2	2.584	0.28	12.92	5.71
1.25	12.16	3.85	18.71	6.6	2.856	0.32	12.63	6.08
1.67	12.77	4.19	18.98	6.2	3.055	0.33	12.60	6.38
2.28	13.37	4.77	19.00	5.6	3.373	0.36	12.32	6.68
2.79	13.56	5.04	18.92	5.4	3.530	0.37	12.14	6.78
3.30	13.79	5.25	18.94	5.2	3.675	0.38	12.05	6.89
3.60	13.76	5.40	18.76	5.0	3.751	0.39	11.88	6.88
4.32	13.77	5.50	18.67	4.9	3.812	0.40	11.79	6.89
5.16	13.82	5.69	18.52	4.7	3.934	0.41	11.62	6.91
5.95	13.93	5.80	18.52	4.6	4.029	0.42	11.56	6.96
6.72	14.04	5.83	18.61	4.6	4.072	0.42	11.59	7.02
7.73	14.51	5.87	19.04	4.5	4.205	0.40	11.78	7.26
8.52	14.69	6.01	19.08	4.4	4.349	0.41	11.73	7.35
9.54	14.91	6.01	19.30	4.4	4.397	0.40	11.84	7.45
10.30	14.68	5.94	19.15	4.5	4.289	0.40	11.80	7.34
11.07	14.93	6.00	19.33	4.4	4.390	0.40	11.87	7.46
12.10	14.89	5.95	19.34	4.5	4.346	0.40	11.90	7.45
13.40	15.08	6.10	19.38	4.3	4.506	0.40	11.84	7.54
14.44	14.89	6.03	19.25	4.4	4.410	0.41	11.81	7.44
15.98	14.92	5.99	19.34	4.4	4.381	0.40	11.88	7.46
17.28	15.10	6.12	19.38	4.3	4.528	0.41	11.83	7.55
18.58	14.65	5.96	19.09	4.4	4.303	0.41	11.76	7.33
19.86	14.71	6.07	19.04	4.3	4.398	0.41	11.68	7.35
21.67	14.66	6.08	18.99	4.3	4.393	0.41	11.65	7.33

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	3

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	20.4
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	17.19
Q	=	10.31

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.130	Diameter 1	1.404
Length 2	3.121	Diameter 2	1.373
Length 3	3.136	Diameter 3	1.371
Avg Leng.=	3.129	Avg. Diam.=	1.383

VOLUME CHANGE

Initial Burette Reading (ml)	48.0
Final Burette Reading (ml)	40.5
Final Change (ml)	7.5

Initial Dial Reading (D.R.), mils	60
D.R. After Saturation, mils	68
D.R. After Consolidation, mils	154

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
6.8	0.000	31.0
13.5	0.001	34.0
15.7	0.002	34.5
18.9	0.003	35.2
21.3	0.005	35.9
25.0	0.011	37.4
27.3	0.017	38.5
28.7	0.024	39.4
30.6	0.036	40.5
31.7	0.049	41.4
33.1	0.067	42.3
33.8	0.083	42.8
34.5	0.099	43.2
34.7	0.108	43.4
35.2	0.131	43.7
35.9	0.157	44.0
36.6	0.180	44.2
37.1	0.204	44.3
37.5	0.236	44.4
37.8	0.260	44.4
38.3	0.290	44.5
38.7	0.314	44.5
38.8	0.337	44.5
40.1	0.369	44.6
41.4	0.408	44.6
41.7	0.440	44.6
40.5	0.488	44.6
42.1	0.527	44.6
42.5	0.566	44.6
41.7	0.605	44.6
42.3	0.660	44.7

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.4	*Stage No.*	1
		Test No	3

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.13
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.20
Length After Consolidation (in)	3.04
Area After Consolidation (in^2)	1.385

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	4.82	3.04	22.17	17.4	1.278	0.64	19.76	2.41
0.05	6.44	3.45	23.39	16.9	1.380	0.54	20.17	3.22
0.10	8.70	4.15	24.95	16.2	1.536	0.48	20.60	4.35
0.17	10.46	4.86	26.01	15.5	1.673	0.47	20.77	5.23
0.37	13.09	6.38	27.10	14.0	1.934	0.49	20.56	6.54
0.58	14.68	7.49	27.59	12.9	2.137	0.52	20.25	7.34
0.80	15.66	8.40	27.66	12.0	2.305	0.54	19.83	7.83
1.18	17.01	9.52	27.89	10.9	2.563	0.57	19.38	8.50
1.61	17.71	10.40	27.71	10.0	2.772	0.59	18.85	8.86
2.22	18.54	11.31	27.63	9.1	3.039	0.62	18.36	9.27
2.74	18.96	11.76	27.60	8.6	3.196	0.63	18.12	9.48
3.26	19.34	12.21	27.53	8.2	3.361	0.64	17.86	9.67
3.57	19.40	12.35	27.45	8.0	3.411	0.64	17.75	9.70
4.31	19.60	12.73	27.27	7.7	3.556	0.66	17.47	9.80
5.17	19.89	12.96	27.33	7.4	3.676	0.66	17.38	9.95
5.94	20.25	13.15	27.50	7.2	3.795	0.66	17.37	10.13
6.73	20.42	13.27	27.54	7.1	3.864	0.66	17.34	10.21
7.78	20.44	13.38	27.46	7.0	3.912	0.66	17.24	10.22
8.55	20.50	13.40	27.50	7.0	3.928	0.66	17.25	10.25
9.57	20.57	13.48	27.49	6.9	3.973	0.66	17.20	10.28
10.34	20.62	13.52	27.50	6.9	3.995	0.66	17.19	10.31
11.11	20.56	13.51	27.45	6.9	3.982	0.66	17.17	10.28
12.15	21.14	13.55	27.99	6.8	4.088	0.65	17.42	10.57
13.45	21.64	13.57	28.47	6.8	4.170	0.63	17.65	10.82
14.49	21.53	13.56	28.36	6.8	4.149	0.64	17.60	10.76
16.07	20.44	13.58	27.26	6.8	3.997	0.67	17.04	10.22
17.35	21.06	13.58	27.88	6.8	4.086	0.65	17.35	10.53
18.64	20.95	13.63	27.72	6.8	4.094	0.66	17.25	10.48
19.92	20.20	13.64	26.96	6.8	3.988	0.68	16.86	10.10
21.74	20.03	13.67	26.77	6.7	3.975	0.69	16.75	10.02

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-19-08

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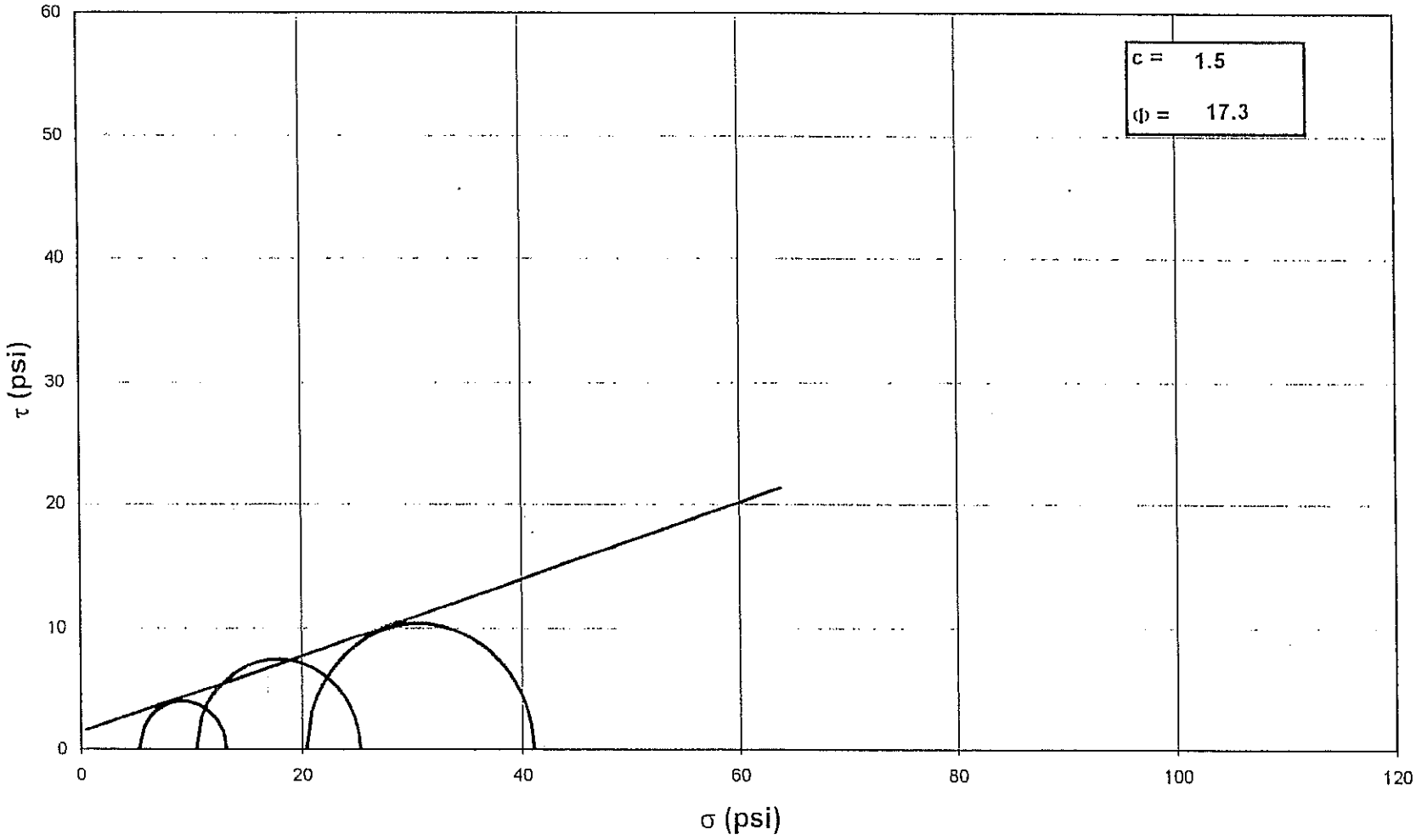
Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 1
Lab ID	2008-210-01-01	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/09/08

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	82.6	82.7	79.5
Total Unit Weight (pcf)	76.6	84.2	80.5
Dry Unit Weight (pcf)	42.0	46.1	44.8
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	2.333	2.035	2.119

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

DCN: CT-S28 DATE 6-25-98 REVISION: 1

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-01	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 1	Bucket 1	Bucket 1
Test No.	T1	T2	T3
Deformation Rate (in/min)	0.0007	0.0007	0.0011
Back Pressure (psi)	31.4	36.1	31
Consolidation Time (days)	1	1	1
Initial State (w%)	41.7	43.3	42.4
Total Unit Weight (pcf)	102.0	102.5	101.8
Dry Unit Weight (pcf)	71.9	71.5	71.5
Final State (w%)	36.8	34.5	32.7
Initial State Void Ratio,e	0.944	0.955	0.956

Tested By JCM Date 05/21/08 Input Checked By KB Date 6-3-08

DCN: GT-S28 DATE 6-25-98 REVISION: 1

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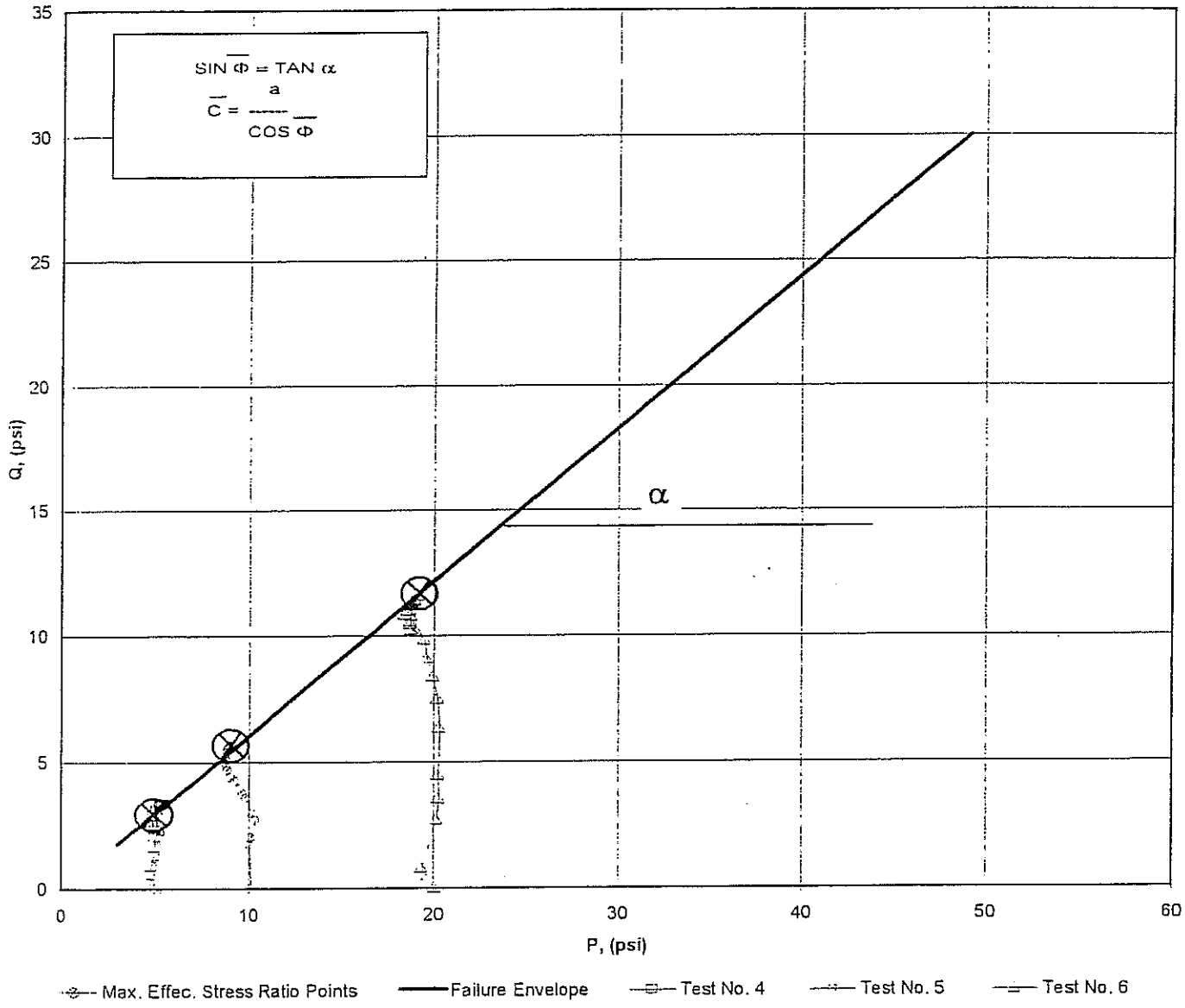
CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Consolidated Undrained Triaxial Test with Pore Pressure



a	=	0.00	$\bar{C}$	=	0.00
α	=	31.5	$\bar{\Phi}$	=	37.71

Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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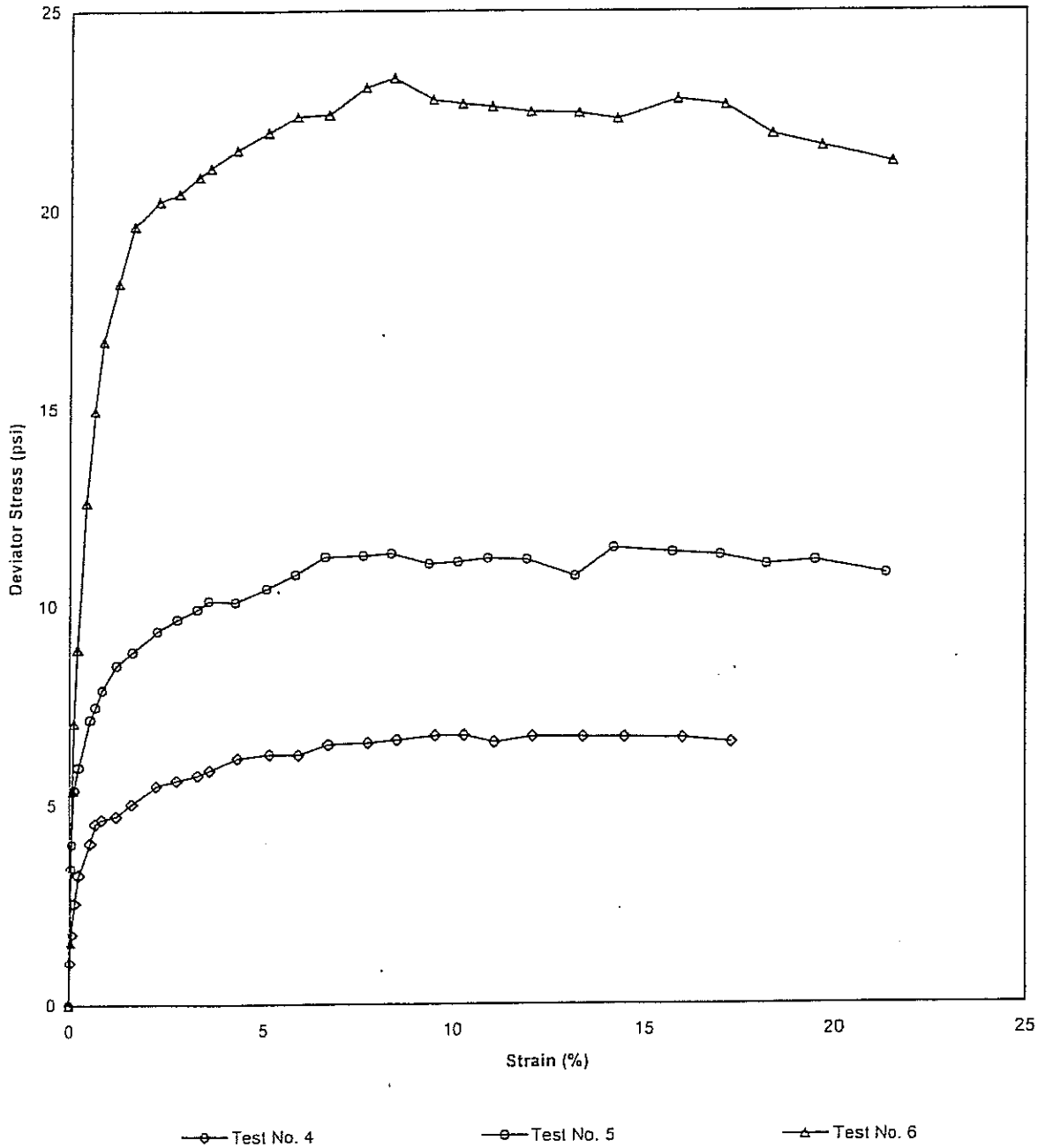
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		
Visual Description:	BLACK COAL REFUSE SLURRY (REMOLDED)		



Tested By JCM Date 05/27/08 Approved By DB Date 6/18/08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	4

PRESSURES (psi)

Cell Pressure(psi)	36.3
Back Pressure(psi)	31.2
Eff. Cons. Pressure(psi)	5.1
Pore Pressure Response (%)	98

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	4.92
Q	=	2.94

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.150	Diameter 1	1.453
Length 2	3.142	Diameter 2	1.463
Length 3	3.147	Diameter 3	1.461
Avg Leng.=	3.146	Avg. Diam.=	1.459

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	21.9
Final Change (ml)	2.1

Initial Dial Reading (D.R.), mils	54
D.R. After Saturation, mils	110
D.R. After Consolidation, mils	130

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
7.6	0.000	31.2
9.3	0.001	32.1
10.4	0.002	32.3
11.6	0.005	32.6
12.8	0.008	32.9
14.0	0.016	33.3
14.8	0.020	33.3
15.0	0.025	33.6
15.2	0.037	33.8
15.7	0.050	33.9
16.5	0.068	34.2
16.7	0.084	34.2
17.0	0.100	34.2
17.2	0.110	34.3
17.8	0.133	34.2
18.1	0.159	34.3
18.1	0.182	34.3
18.6	0.205	34.2
18.8	0.237	34.2
19.0	0.261	34.3
19.3	0.293	34.3
19.5	0.316	34.2
19.3	0.340	34.3
19.7	0.372	34.2
19.8	0.412	34.3
19.9	0.445	34.3
20.1	0.491	34.2
20.1	0.531	34.2

Tested By JCM Date 05/27/08 Input Checked By HRS Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics
INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	5.1	*Stage No.*	1
		Test No	4

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.15
Initial Sample Diameter (in.)	1.46
Initial Sample Area (in^2)	1.67
Initial Sample Volume (in^3)	5.26

VOLUME CHANGE

Volume After Consolidation (in^3)	4.85
Length After Consolidation (in)	3.07
Area After Consolidation (in^2)	1.580

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma_1}$	$\overline{\sigma_3}$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.02	1.06	0.90	5.26	4.2	1.253	0.86	4.73	0.53
0.07	1.77	1.15	5.72	4.0	1.449	0.66	4.84	0.89
0.15	2.55	1.44	6.21	3.7	1.698	0.58	4.94	1.28
0.25	3.26	1.71	6.65	3.4	1.959	0.53	5.02	1.63
0.53	4.05	2.11	7.04	3.0	2.358	0.53	5.01	2.03
0.65	4.54	2.14	7.50	3.0	2.531	0.48	5.23	2.27
0.82	4.65	2.39	7.36	2.7	2.712	0.52	5.04	2.32
1.21	4.72	2.58	7.25	2.5	2.873	0.56	4.89	2.36
1.62	5.03	2.72	7.42	2.4	3.112	0.55	4.90	2.52
2.22	5.48	2.95	7.63	2.1	3.550	0.55	4.89	2.74
2.74	5.62	3.02	7.70	2.1	3.705	0.55	4.89	2.81
3.27	5.75	3.04	7.81	2.1	3.790	0.54	4.93	2.87
3.59	5.88	3.12	7.86	2.0	3.968	0.54	4.92	2.94
4.33	6.18	3.02	8.27	2.1	3.967	0.50	5.17	3.09
5.17	6.27	3.08	8.30	2.0	4.101	0.50	5.16	3.14
5.93	6.25	3.13	8.22	2.0	4.176	0.51	5.10	3.13
6.69	6.51	3.03	8.58	2.1	4.152	0.48	5.32	3.26
7.73	6.56	3.04	8.62	2.1	4.176	0.47	5.34	3.28
8.50	6.63	3.14	8.59	2.0	4.380	0.48	5.27	3.31
9.53	6.72	3.14	8.68	2.0	4.436	0.48	5.32	3.36
10.30	6.74	3.03	8.81	2.1	4.256	0.46	5.44	3.37
11.09	6.56	3.07	8.59	2.0	4.235	0.48	5.31	3.28
12.10	6.71	3.03	8.78	2.1	4.233	0.46	5.43	3.35
13.42	6.69	3.06	8.74	2.0	4.281	0.47	5.39	3.35
14.49	6.68	3.10	8.68	2.0	4.342	0.47	5.34	3.34
16.00	6.66	3.02	8.74	2.1	4.204	0.46	5.41	3.33
17.29	6.55	3.03	8.62	2.1	4.171	0.47	5.34	3.28

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	5

PRESSURES (psi)

Cell Pressure(psi)	41.1
Back Pressure(psi)	31.0
Eff. Cons. Pressure(ps	10.1
Pore Pressure Response (%)	99

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	9.00
Q	=	5.66

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.138	Diameter 1	1.407
Length 2	3.138	Diameter 2	1.383
Length 3	3.137	Diameter 3	1.378
Avg Leng.=	3.138	Avg. Diam.=	1.389

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	20.2
Final Change (ml)	3.8

Initial Dial Reading (D.R.), mils	88
D.R. After Saturation, mils	94
D.R. After Consolidation, mils	124

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
8.5	0.000	31.0
13.5	0.001	32.8
14.3	0.002	33.0
16.3	0.004	33.4
17.2	0.007	33.9
18.9	0.016	34.9
19.4	0.020	35.2
20.0	0.025	35.6
21.0	0.038	36.1
21.5	0.051	36.6
22.4	0.070	37.0
22.9	0.085	37.2
23.4	0.101	37.4
23.7	0.110	37.4
23.8	0.132	37.5
24.5	0.158	37.6
25.1	0.181	37.7
26.0	0.205	37.7
26.2	0.236	37.7
26.4	0.259	37.8
26.2	0.290	37.7
26.4	0.314	37.8
26.7	0.338	37.8
26.9	0.370	37.8
26.5	0.410	37.8
27.9	0.441	37.8
28.0	0.488	37.8
28.2	0.527	37.8
28.1	0.566	37.8
28.5	0.605	37.8
28.4	0.661	37.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	10.1	*Stage No.*	1
		Test No	5

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.39
Initial Sample Area (in^2)	1.52
Initial Sample Volume (in^3)	4.76

VOLUME CHANGE

Volume After Consolidation (in^3)	4.50
Length After Consolidation (in)	3.10
Area After Consolidation (in^2)	1.450

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma}_1$	$\overline{\sigma}_3$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	3.42	1.75	11.77	8.3	1.410	0.52	10.06	1.71
0.06	4.03	2.01	12.12	8.1	1.497	0.50	10.11	2.01
0.13	5.39	2.43	13.05	7.7	1.703	0.46	10.36	2.69
0.23	5.96	2.92	13.13	7.2	1.830	0.50	10.16	2.98
0.51	7.15	3.87	13.37	6.2	2.148	0.55	9.80	3.57
0.64	7.46	4.19	13.37	5.9	2.262	0.57	9.64	3.73
0.82	7.88	4.57	13.41	5.5	2.427	0.59	9.47	3.94
1.21	8.51	5.13	13.48	5.0	2.714	0.61	9.22	4.26
1.63	8.84	5.57	13.38	4.5	2.950	0.64	8.96	4.42
2.24	9.37	5.97	13.50	4.1	3.271	0.64	8.81	4.69
2.75	9.67	6.18	13.59	3.9	3.468	0.65	8.75	4.84
3.25	9.92	6.35	13.66	3.7	3.648	0.65	8.70	4.96
3.56	10.14	6.40	13.83	3.7	3.741	0.64	8.76	5.07
4.26	10.10	6.55	13.65	3.6	3.843	0.66	8.60	5.05
5.08	10.44	6.59	13.95	3.5	3.978	0.64	8.73	5.22
5.85	10.80	6.68	14.21	3.4	4.161	0.63	8.81	5.40
6.60	11.25	6.70	14.65	3.4	4.304	0.60	9.03	5.62
7.60	11.27	6.75	14.63	3.4	4.363	0.60	8.99	5.64
8.34	11.32	6.76	14.66	3.3	4.395	0.60	9.00	5.66
9.36	11.06	6.74	14.42	3.4	4.292	0.62	8.89	5.53
10.13	11.11	6.76	14.46	3.3	4.323	0.61	8.90	5.56
10.91	11.20	6.81	14.49	3.3	4.401	0.61	8.89	5.60
11.94	11.17	6.80	14.47	3.3	4.383	0.62	8.88	5.58
13.21	10.75	6.76	14.09	3.3	4.214	0.64	8.72	5.37
14.21	11.47	6.77	14.80	3.3	4.445	0.60	9.06	5.73
15.72	11.35	6.78	14.67	3.3	4.418	0.60	9.00	5.68
16.98	11.28	6.79	14.59	3.3	4.411	0.61	8.95	5.64
18.25	11.04	6.80	14.33	3.3	4.350	0.62	8.81	5.52
19.51	11.13	6.82	14.40	3.3	4.397	0.62	8.84	5.56
21.32	10.80	6.85	14.05	3.3	4.318	0.64	8.65	5.40

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Stage No.	1
Test No	6

PRESSURES (psi)

Cell Pressure(psi)	51.4
Back Pressure(psi)	31.3
Eff. Cons. Pressure(ps	20.1
Pore Pressure Response (%)	97

MAXIMUM OBLIQUITY POINTS

$\overline{P}$	=	19.19
Q	=	11.67

INITIAL SAMPLE DIMENSIONS (in)

Length 1	3.142	Diameter 1	1.379
Length 2	3.130	Diameter 2	1.377
Length 3	3.141	Diameter 3	1.386
Avg Leng.=	3.138	Avg. Diam.=	1.381

VOLUME CHANGE

Initial Burette Reading (ml)	24.0
Final Burette Reading (ml)	17.7
Final Change (ml)	6.3

Initial Dial Reading (D.R.), mils	40
D.R. After Saturation, mils	56
D.R. After Consolidation, mils	91

LOAD (LBS)	DEFORMATION (INCHES)	PORE PRESSURE (PSI)
4.3	0.000	31.3
6.5	0.001	32.8
11.7	0.002	33.9
14.0	0.004	34.7
16.6	0.006	35.6
21.7	0.012	37.4
25.0	0.019	38.7
27.5	0.026	39.8
29.6	0.038	40.9
31.7	0.051	41.7
32.8	0.070	42.4
33.2	0.085	42.8
33.9	0.101	43.1
34.3	0.110	43.2
35.2	0.132	43.4
36.1	0.157	43.7
37.0	0.181	43.7
37.3	0.205	43.8
38.7	0.236	43.8
39.3	0.259	43.9
38.9	0.291	43.8
39.0	0.316	43.9
39.2	0.340	43.9
39.4	0.371	43.8
39.9	0.410	43.8
40.1	0.441	43.9
41.5	0.489	43.8
41.9	0.528	43.7
41.2	0.568	43.8
41.3	0.608	43.8
41.4	0.663	43.8

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

DCN: CT-S28 DATE 6-25-98 REVISION 1

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CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC	Boring No.	SOUTH POND
Client Reference	POND CREEK 080851	Depth(ft.)	NA
Project No.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02		

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

Effective Confining Pressure (psi)	20.1	*Stage No.*	1
		Test No	6

INITIAL DIMENSIONS

Initial Sample Length (in.)	3.14
Initial Sample Diameter (in.)	1.38
Initial Sample Area (in^2)	1.50
Initial Sample Volume (in^3)	4.70

VOLUME CHANGE

Volume After Consolidation (in^3)	4.24
Length After Consolidation (in)	3.09
Area After Consolidation (in^2)	1.374

Strain (%)	Deviation Stress	ΔU	$\overline{\sigma}_1$	$\overline{\sigma}_3$	Effective Principle Stress Ratio	$\overline{A}$	$\overline{P}$	Q
0.04	1.58	1.52	20.16	18.6	1.085	0.99	19.37	0.79
0.07	5.38	2.62	22.86	17.5	1.308	0.50	20.17	2.69
0.12	7.06	3.36	23.80	16.7	1.422	0.49	20.27	3.53
0.19	8.92	4.30	24.73	15.8	1.565	0.50	20.26	4.46
0.40	12.65	6.12	26.62	14.0	1.905	0.50	20.30	6.32
0.61	14.97	7.35	27.72	12.7	2.174	0.51	20.23	7.48
0.85	16.72	8.47	28.36	11.6	2.438	0.52	19.99	8.36
1.24	18.18	9.56	28.72	10.5	2.724	0.54	19.63	9.09
1.64	19.63	10.41	29.32	9.7	3.025	0.55	19.51	9.81
2.26	20.24	11.15	29.19	9.0	3.262	0.57	19.07	10.12
2.77	20.44	11.54	29.00	8.6	3.388	0.58	18.78	10.22
3.26	20.87	11.82	29.15	8.3	3.521	0.58	18.71	10.43
3.58	21.09	11.94	29.25	8.2	3.584	0.58	18.70	10.54
4.27	21.54	12.14	29.50	8.0	3.705	0.58	18.73	10.77
5.09	21.97	12.38	29.69	7.7	3.846	0.58	18.71	10.99
5.86	22.37	12.43	30.04	7.7	3.918	0.57	18.85	11.19
6.64	22.41	12.54	29.98	7.6	3.962	0.58	18.77	11.21
7.63	23.10	12.49	30.71	7.6	4.034	0.56	19.16	11.55
8.39	23.33	12.58	30.85	7.5	4.102	0.56	19.19	11.67
9.43	22.79	12.55	30.34	7.6	4.018	0.57	18.95	11.39
10.22	22.67	12.59	30.18	7.5	4.021	0.57	18.84	11.34
11.00	22.61	12.56	30.14	7.5	4.001	0.57	18.84	11.30
12.01	22.49	12.53	30.05	7.6	3.973	0.57	18.81	11.24
13.28	22.46	12.52	30.04	7.6	3.961	0.57	18.81	11.23
14.28	22.30	12.63	29.77	7.5	3.986	0.58	18.62	11.15
15.84	22.80	12.50	30.40	7.6	4.001	0.57	19.00	11.40
17.12	22.66	12.41	30.35	7.7	3.948	0.56	19.02	11.33
18.40	21.92	12.46	29.57	7.6	3.868	0.59	18.61	10.96
19.69	21.62	12.51	29.21	7.6	3.846	0.60	18.40	10.81
21.49	21.21	12.54	28.77	7.6	3.805	0.61	18.17	10.61

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-19-08

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MOHR TOTAL STRENGTH ENVELOPE

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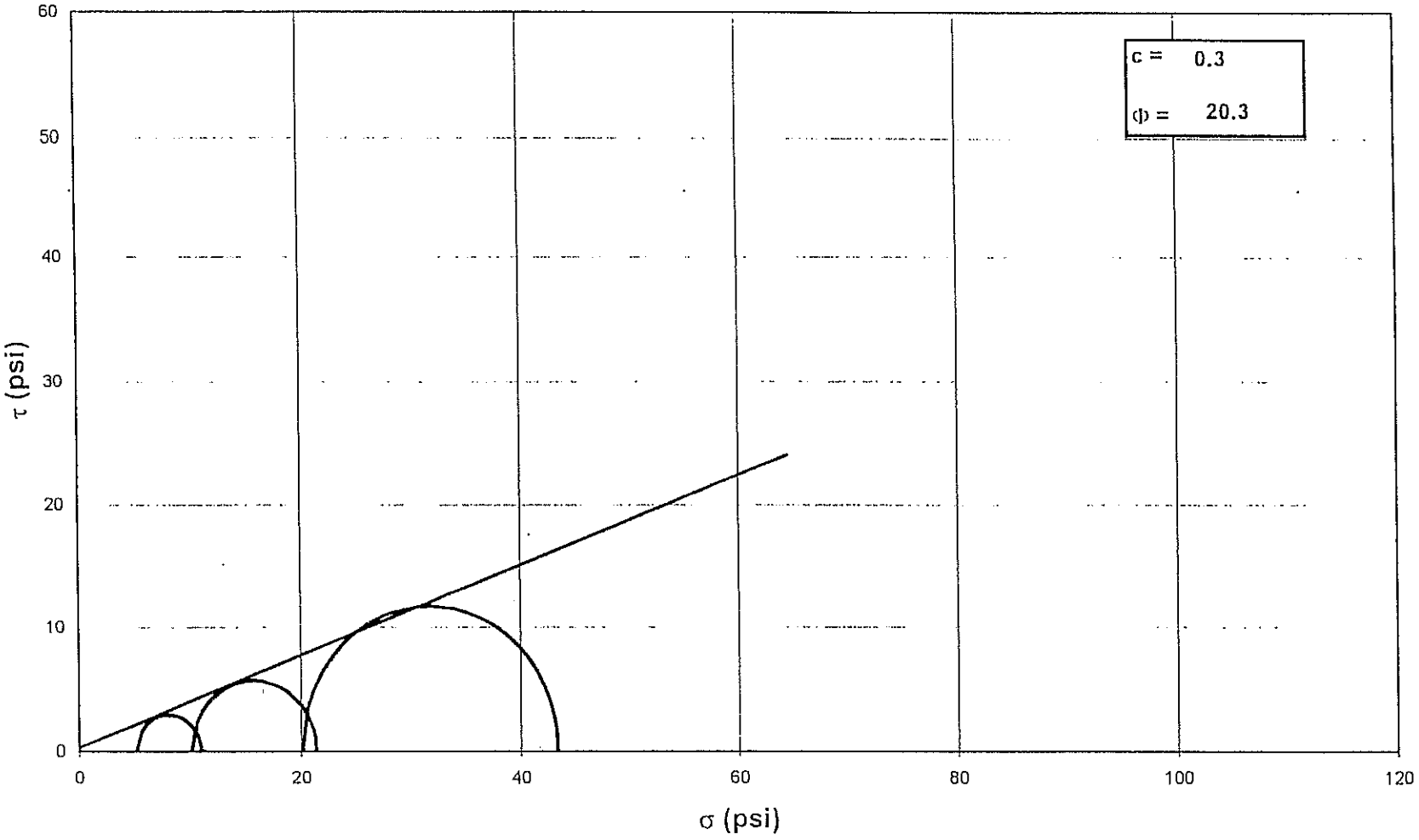
Client	CEC	Boring No.	SOUTH POND
Client Ref. No.	POND CREEK 080851	Depth(ft.)	NA
Project no.	2008-210-01	Sample No.	BUCKET 2
Lab ID	2008-210-01-02	Visual Description	BLACK COAL REFUSE SLURRY (REMOLDED)



NOTE: GRAPH NOT TO SCALE

Tested By: JCM *Date:* 05/21/08 *Approved By:* DB *Date:* 6/19/08

#N/A

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REMOLDED UNIT WEIGHT BEFORE INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	82.9	85.7	83.0
Total Unit Weight (pcf)	82.6	82.2	84.5
Dry Unit Weight (pcf)	45.2	44.3	46.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	2.095	2.159	2.029

Tested By JCM Date 05/27/08 Input Checked By KB Date 6-5-08

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UNIT WEIGHT AFTER INITIAL CONSOLIDATION
CONSOLIDATED UNDRAINED TRIAXIAL TEST
WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

Client	CEC		
Client Reference	POND CREEK 080851		
Project No.	2008-210-01		
Lab ID	2008-210-01-02	Specific Gravity (measured)	2.24

Visual Description: BLACK COAL REFUSE SLURRY (REMOLDED)

SAMPLE CONDITION SUMMARY

Boring No.	South Pond	South Pond	South Pond
Depth (ft)	NA	NA	NA
Sample No.	Bucket 2	Bucket 2	Bucket 2
Test No.	T4	T5	T6
Deformation Rate (in/min)	0.0003	0.0002	0.0003
Back Pressure (psi)	31.2	31	31.3
Consolidation Time (days)	1	1	1
Initial State (w%)	41.5	41.5	40.9
Total Unit Weight (pcf)	92.9	102.5	103.2
Dry Unit Weight (pcf)	65.7	72.4	73.2
Final State (w%)	37.6	35.9	32.5
Initial State Void Ratio,e	1.129	0.931	0.910

Tested By JCM Date 05/27/08 Input Checked By Date

DCN: CT-S28 DATE 6-25-98 REVISION: 1

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REFERENCE 5 AND OTHER PERTINENT FINE COAL REFUSE DATA EFFECTIVE STRESS – TO – STEADY STATE STRENGTH RELATIONSHIPS

R16711

Tailing Dams 2000

PROCEEDINGS

Association of State Dam Safety Officials • U.S. Committee on Large Dams

March 28-30, 2000 • Las Vegas, Nevada

STEADY STATE LIQUEFACTION SUSCEPTIBILITY OF HIGH HAZARD UPSTREAM-CONSTRUCTED COAL REFUSE DISPOSAL FACILITIES

Blaise E. Genes[1], Thomas O. Keller, P.E.[2] and Joseph P. Laird, P.E.[3]

1.0 Introduction

Coal refuse disposal facilities are manifestations of deep mining and surface mining activities and the resulting need for the disposal of waste materials. Due to the massive volumes of materials produced annually by mining operations, these "tailings dams" are among the largest earth structures in the world and consequently, receive intense regulatory and public scrutiny. Coal refuse disposal facilities, their design, construction and operation are regulated by the U.S. Department of Labor, Mine Safety and Health Administration (MSHA). The concern for refuse disposal safety and environmental control by MSHA, the coal industry, engineering consultants and the public has led to the development of design procedures that address these concerns, particularly siting, material handling and placement techniques.

For the most part, tailings dams evaluations are similar to those of water retention dams and address geotechnical issues such as foundation materials, hydrology, hydraulics, seepage control, slope stability (static and seismic), construction practices and long-term monitoring. In the past, pseudo-static analyses were performed to address seismic stability using regional, historic seismic acceleration values and a slightly lowered factor of safety limit to assess adequacy. Empirical evaluations are sometimes performed to address seismic stability with adequacy based on comparison of limited field and laboratory test data with historical performance data of liquefaction and non-liquefaction sites from around the world. During the initial to intermediate stages of a refuse facility design, simplified analytical methods may be appropriate, such as those based on pseudo-static and cone penetration testing (CPT) or standard penetration testing (SPT). However, given the uniqueness and complexity of moderate to high hazard tailings dams, which are significantly influenced by factors such as the number and geometry of upstream stages, deposition history and cross-valley topography, simplified analyses are often inadequate to effectively address safety and cost issues. They often do not account for critical site-specific conditions and may either over-predict strengths leading to a potentially unconservative analysis or under-predict strengths leading to costly remediation efforts.

The focus of this paper is on the application of established steady-state liquefaction evaluation procedures to high hazard tailings dams, assessing liquefaction susceptibility using site-specific data to estimate the factor of safety against a liquefaction flow slide failure. A significant emphasis is placed on obtaining in-situ samples and developing

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properties of the hydraulically placed, fine coal refuse consolidated beneath multiple, upstream-constructed stages of coarse coal refuse. Detailed evaluations have been performed at five Appalachian coal refuse disposal facilities in southern West Virginia as part of the permitting process for the various facilities.

2.0 Analytical Approach

Coal refuse disposal facilities are generally constructed by three methods, either separately or in combination, and include upstream, downstream, and centerline construction. Downstream and centerline constructed facilities typically pose only minor liquefaction concerns since critical failure surfaces pass mainly through the compacted coarse refuse embankments. A typical high hazard, upstream constructed coal refuse facility, such as the one shown in Figure 1, is constructed over long periods of time (up to 25 to 30 years) to heights of 400-plus feet and includes multiple upstream stages "pushed out" into the previous stage's tailings pond. Fine coal refuse consolidated under upstream stages typically is loose to very loose, silty sand to sandy silt- and clay-sized particles, saturated and usually highly contractive. Thus, the potential exists for excess pore pressure generation and significant loss of strength during and following a rapid (undrained) loading event, such as an earthquake.

All five facilities evaluated and discussed in the context of this paper were all moderate to high hazard structures with downstream toe to crest heights varying from 300 to 440 feet. Detailed studies of liquefaction susceptibility were performed using the methodology presented by Poulos, Castro, and France (1985) to estimate in-situ void ratio and undrained steady-state strength of the critical layer, fine coal refuse. Presented below are the generalized results of field and laboratory testing at the various sites. Field testing included performing fixed-piston undisturbed sampling to measure in-situ void ratio and piezo-seismic cone penetration testing (PS-CPT) to evaluate stratigraphy and estimate shear wave velocity with depth. Laboratory strength testing of undisturbed, remolded and slurry fine coal refuse samples was performed to estimate in-situ, undrained steady-state shear strength (S_{us}) and develop a site-specific S_{us}-to-effective stress relationship.

Liquefaction susceptibility was assessed based on the results of limit-equilibrium slope stability analyses. Post-earthquake deformations were estimated using one-dimensional wave propagation and sliding block analysis techniques and the results compared to the available freeboard to assess the likelihood of overtopping. Based on the regional database of information related to S_{us}, various trends regarding the general behavior of fine coal refuse during undrained loading and the practical implications affecting liquefaction susceptibility of upstream-constructed coal refuse impoundments are discussed. Detailed discussions regarding post-earthquake deformation analyses and the seismic response of coal refuse facilities to acceleration time-histories from stochastic simulations of eastern North America earthquakes are reserved for another paper.

3.0 Field Investigations

Fixed Piston Sampling

The main purpose of the subsurface exploration program at the various sites was to obtain high quality "undisturbed" fine coal refuse samples of a character suitable for

laboratory steady-state strength testing. Multiple undisturbed samples were obtained at each site at various depths using a hydraulically actuated Gregory Undisturbed Sampler (GUS) fixed piston sampler. The GUS fixed piston sampler was used to advance a thin-wall galvanized steel sampling tube by delivering drilling fluid pressure to the top of the sampler, which subsequently advanced the tube around a fixed piston. Penetration of the tube into the soil was accurately measured to within ½ to 1 millimeter when "full penetration" of the sampler was achieved. Full penetration of the sampling tube was confirmed by observation of the fluid level in the borehole casing which would dramatically rise when fluid pressure applied to the top of the sampler vented through ports in the sampler. The technique used for undisturbed fixed piston sampling allowed samples to be obtained to depths as great as 344 feet below the ground surface.

Detailed measurements of the tube inside, outside and cutting edge diameters and length were made and volume changes that occurred during sampling calculated in the field from tube penetration and sample recovery measurements. Samples were selected for subsequent laboratory testing based on the quality of the "undisturbed" sample using a criteria for the change in soil volume ($\Delta V/V$). For the fine coal refuse, minimizing the tube clearance ratio [(ID-CE)/CE] minimized sample volume changes, which typically ranged from zero to 2.5 percent. All undisturbed samples were stored in specially designed padded wooden boxes and changes in volume routinely monitored during storage and prior to and following shipment. Prior to laboratory testing, the tube samples were x-rayed and reviewed to select portions of the sample that had a minimum amount of stratification.

Piezo-Seismic/Cone Penetrometer Testing

PS-CPT soundings were performed prior to or concurrently with undisturbed sampling to help delineate the depth to the top and bottom of fine coal refuse. As shown in Figure 2, fine coal refuse layers are characterized by significantly lower tip stresses and elevated pore pressure generation, while the coarse and coarse-fine mix typically yield much higher tip stresses and lower pore pressure generation. Using seismic downhole techniques, estimates of shear wave velocity were obtained at each site to correlate small strain shear modulus (G) with depth. These tests were generally conducted at 5-foot intervals throughout the soil profile to depths of 365 feet at one site. Shear wave velocities for coarse, coarse-fines mix and fine coal refuse ranged from about 1,000 to 2,300 feet per second (fps), 800 to 2,000 fps and 800 to 1,200 fps, respectively. These velocities were based on data from 14 PS-CPT soundings. Velocities varied dramatically with depth, consistent with variations in placement techniques and the micro-layering associated with the deposition history of the facility.

Stratification

Much of the coarse refuse embankment drilled and sampled was dense to very dense as expected due to the structural placement of the material. Loose deposits of fine coal refuse were typically encountered below a dense mixed zone of coarse and fine coal refuse. The fines were characterized by corrected cone tip resistance values between 300 to 1,000 pounds per square inch (psi). The CPT soundings (and visually verified in SPT samples) have shown that there are significantly thick zones of mixed coarse and fine coal refuse. Mixing apparently occurred during the various push-out phases of upstream embankment construction into the tailings pond and possibly from the "pumping" of fines

up into the coarse refuse during subsequent stage construction. Due to the infusion of coarse refuse into the fines, the mix zones typically exhibited significantly higher average cone tip resistance, as well as lower pore pressure generation during cone advancement.

In-Situ Void Ratio

A total of 34 undisturbed fine coal refuse samples were obtained from the various sites. In-situ void ratio was calculated for each based on the field measurements described previously combined with laboratory measurements of the volume of solids in the tube. Table 1 presents a summary of sample depth and calculated in-situ void ratio at each site. Samples were obtained from beneath about 65 to 344 feet of overlying refuse and in-situ void ratios varied from about 0.39 to 0.79, with most (82 percent) of the values between 0.43 and 0.59. While in-situ void ratio is influenced by mean effective stress and time rate of consolidation, the range of values is relatively narrow. Direct correlation between estimated mean effective stress and in-situ void ratio can not be inferred due to the unique and complex nature of each site's geometric constraints and deposition history.

4.0 Laboratory Testing

Steady-state liquefaction-related laboratory test programs of the coal refuse materials sampled from the five sites included performing index tests such as grain size distributions, Atterberg limits, and specific gravity, as well as triaxial shear strength tests on undisturbed, remolded and slurry samples of fine coal refuse. Table 1 presents a summary of laboratory test results from Sites 1 through 5.

Index Tests

Fine coal refuse particles vary in size from about 2 mm (No. 10 sieve) to 0.0005 mm (finer than clay fraction). It is analogous to silty sand to silty clay-sized material. Fines content (passing a No. 200 sieve) for fine coal refuse from the five sites varied from 35 to 76 percent. Fine refuse generally has a low plasticity, ranging from nonplastic to Plasticity Indices of 12 percent or less. Values are affected by the parent rock formation from which the coal was extracted and from clay layers near the coal seam that get mixed within the coal. The specific gravity of fine coal refuse is low and generally varied from about 1.4 to 2.4 for the sites tested. As a result, densities are also relatively low, with in-place total unit weight ranging from about 75 to 90 pounds per cubic foot (pcf).

Steady-State Strength Of Undisturbed Samples

Isotropically consolidated, undrained triaxial compression ($\overline{CU}$) tests were performed on undisturbed, remolded and slurry samples of fine coal refuse. The main purpose of the triaxial tests was to measure the undrained steady-state shear strength of the samples in the laboratory to allow in-situ steady-state shear strengths to be estimated based on void ratio corrections (from laboratory to field). A total of 34 $\overline{CU}$ tests were performed on undisturbed samples of fine coal refuse from the five sites. Specimens were typically consolidated to an isotropic, effective consolidation stress ($\overline{\sigma}_{3c}$) ranging from 8 to 16 kilograms per square centimeter (kg/cm^2) [16.3 to 32.7 kips per square foot (ksf)]. These relatively high confining pressures were used to ensure contractive behavior,

particularly since most samples were obtained from 200 to 344 feet below the ground surface. The samples exhibited contractive behavior and reached or approximately reached a steady-state of deformation within the strain limits of the test. Laboratory values of S_{us} were corrected to represent steady-state strengths at in-situ void ratios.

Steady-State Line and In-Situ Steady-State Strength

Triaxial tests were performed on compacted specimens to determine the steady-state line (SSL) of the fine coal refuse representative for each site. Samples of each batch mix were formed using two methods: 1) by placing layers of fine coal refuse in a split mold and compacting each layer to a target void ratio; and 2) by placing the material in a mold as a slurry subject to one-dimensional consolidation to simulate in-situ placement conditions. The various SSL's for each batch mix are shown in Figure 3 where the slope ($\Delta e/\Delta \log S_{us}$) varies from 0.11 to 0.13 for moist tamped batch samples with additional slurry prepared samples of the batch mix shown for comparison. As discussed by Poulos et. al (1985), the slope of the steady state line is dependent on the shape of the grains and the vertical position is affected by slight differences in grain-size distribution. In general, the variation of the fine refuse coal particle shape from site to site would not be expected to vary significantly since the coal was mined from the same region using generally similar cleaning techniques. However, the fines content of the coal refuse sampled from the region varies widely. Thus, the SSL's in Figure 3 are consistent with the above observations.

In-situ S_{us} for each site was estimated by "correcting" the steady-state strengths at laboratory void ratios to their respective in-situ void ratio along the slope of the SSL as defined by Poulos et. al (1985). In-situ S_{us} values ranged from 0.06 to 4.62 kg/cm^2 (0.122 ksf to 9.42 ksf) with 74 percent of the data falling between 0.25 and 2.1 kg/cm^2 (0.51 ksf to 4.28 ksf). Figure 4 presents correlated S_{us} versus in-situ void ratio for 34 tested samples at the 5 sites. Note that S_{us} values can vary by more than a factor of 10 for a given void ratio.

S_{us} Versus Effective Stress Relationship

The estimation of S_{us} values for fine coal refuse layers that are at in-situ conditions different from the samples obtained and tested were estimated using a correlation between S_{us} and effective vertical stress (σ'_v) determined for each site. This includes proposed upstream stages where sampling is not yet feasible or existing portions of the embankment not sampled due to budgetary constraints. By generally assuming that S_{us} values vary linearly with σ'_v, and estimating the in-situ effective stress conditions for proposed layers of fine coal refuse, the in-situ S_{us} values for the proposed additional zones of fine coal refuse can be approximated. Site-specific S_{us} /σ'_v relationships are presented in Figure 5 and varied from 0.06 to 0.27. The various relationships were approximated by conservatively drawing a line from zero through the location at which two-thirds of the data points at a particular site lie above the line.

The lowest strength relationship was achieved at a narrow valley fill with over 200 feet of coarse and mixed refuse placed above the fine coal refuse. It is deduced that significant arching may be occurring within the coarse refuse preventing the full height of

overburden from consolidating the critical fine coal refuse layer. Therefore, factors such as cross-valley topography and deposition history are significantly relevant to the S_{us}/σ'_v relationship. Similarly, the database of S_{us}/σ'_v relationships obtained from bulk fine coal refuse samples prepared as slurried samples may be used to investigate what kind of relationship with depth (or effective stress) may be expected in the slurry pond prior to any encroachment of coarse embankments. The effective consolidation stresses at which the laboratory tests were performed were converted into equivalent vertical effective stresses in the field, assuming that the lateral stresses are equal to one-half of the vertical stresses. As shown in Figure 6, an S_{us}/σ'_v ratio of 0.18 extends from the zero intercept to the point where two-thirds of the data falls above the straight line.

5.0 Liquefaction Susceptibility Evaluations

Liquefaction susceptibility depends on the S_{us} of all the soils along the potential failure surface compared to the driving stress along that failure surface. Zones of loose (contractive) cohesionless soils are critical to analyzing liquefaction potential because they can have an undrained strength that is significantly lower than their drained strength. Therefore, the embankment geometry was evaluated to assess the liquefaction potential of each stage of construction estimating the average driving shear stresses along the critical failure surface at each of the high hazard sites. Generally, as the construction of future upstream staging progresses, there is a corresponding increase in driving stress. For layers in which fixed-piston samples were obtained and tested, or layers where similar effective stresses are present, a weighted average of steady-state strength, such as the Two-Thirds Strength Method, was utilized. This method, utilized by Castro et. al. (1989) and recommended by the U.S. Army Corps of Engineers (1970) in their manual for analyzing the stability of earth dams, involves using a design shear strength value that is lower than two-thirds of the total test values selected. S_{us} values for fine coal refuse layers at in-situ σ'_v values that significantly differ from the σ'_v values at sample locations were estimated using the site specific S_{us}/σ'_v relationship as previously discussed. Limit equilibrium slope stability analyses were performed at each site with S_{us} values applied to fine coal refuse layers and frictional (drained) strengths applied to coarse and mixed refuse layers. Factors of safety against liquefaction (F_L) along the critical failure surfaces for the various sites ranged from 1.02 to 1.32.

6.0 Notable Trends From Completed Studies

Liquefaction evaluations have been performed at five different sites using steady-state techniques as well as other complementary analyses. Since most of the sites are in the same geographical region, it is useful to compare the results of the fine coal refuse tested to identify trends in its engineering properties. A discussion of notable trends for the presented data is discussed below.

1. Consistent with the sensitivity of S_{us} to void ratio, S_{us} values can vary over 10 times at the same void ratio illustrating the need for site specific testing. In-situ void ratios varied between 0.39 and 0.79, however, most ranged from 0.43 to 0.59.

2. In-situ S_{us} values for unsampled fine coal refuse layers can be estimated based on S_{us} versus σ'_v correlations developed for a particular site. S_{us}/σ'_v relationships used for the coal refuse impoundment sites have ranged from 0.06 to 0.27 also illustrating the need for site specific testing, particularly at facilities with proposed multiple upstream stages.
3. S_{us} and S_{us}/σ'_v are significantly influenced by factors such as cross-valley topography, deposition history, upstream embankment geometry and construction sequencing.

7.0 Conclusions

Steady-state methodology can be effectively applied for the detailed evaluation of the liquefaction susceptibility of high hazard coal refuse disposal facilities. The evaluation needs to be based on site specific geometry and subsurface conditions, and properties developed accounting for the uniqueness and complexity of each site. While it is often useful to express the steady-state strength with respect to an estimated vertical stress, proper caution should be exercised during its development. The database of slurried samples has shown that the behavior of newly deposited fine coal refuse can be reasonably predicted. The S_{us}/σ'_v ratio of fine coal refuse consolidated beneath multiple upstream embankment stages can vary significantly with age, loading history, arching, and geometric constraints. For initial or preliminary liquefaction assessments, it is recommended that a range of S_{us}/σ'_v ratios be used to investigate the sensitivity of the critical layer to liquefaction susceptibility. For detailed evaluations where significant driving stresses are present for multiple upstream stages, site-specific shear strength testing of high quality undisturbed samples is recommended to develop the site's S_{us}/σ'_v relationship and each individual stage evaluated to estimate the factor of safety against liquefaction susceptibility. In general, factors of safety against liquefaction susceptibility were above 1.0 for the existing and proposed staging at the various high hazard sites. Factors of safety below 1.0 indicated the need for remedial design of existing embankments or redesign of the staging for proposed expansions to lower driving stresses.

References

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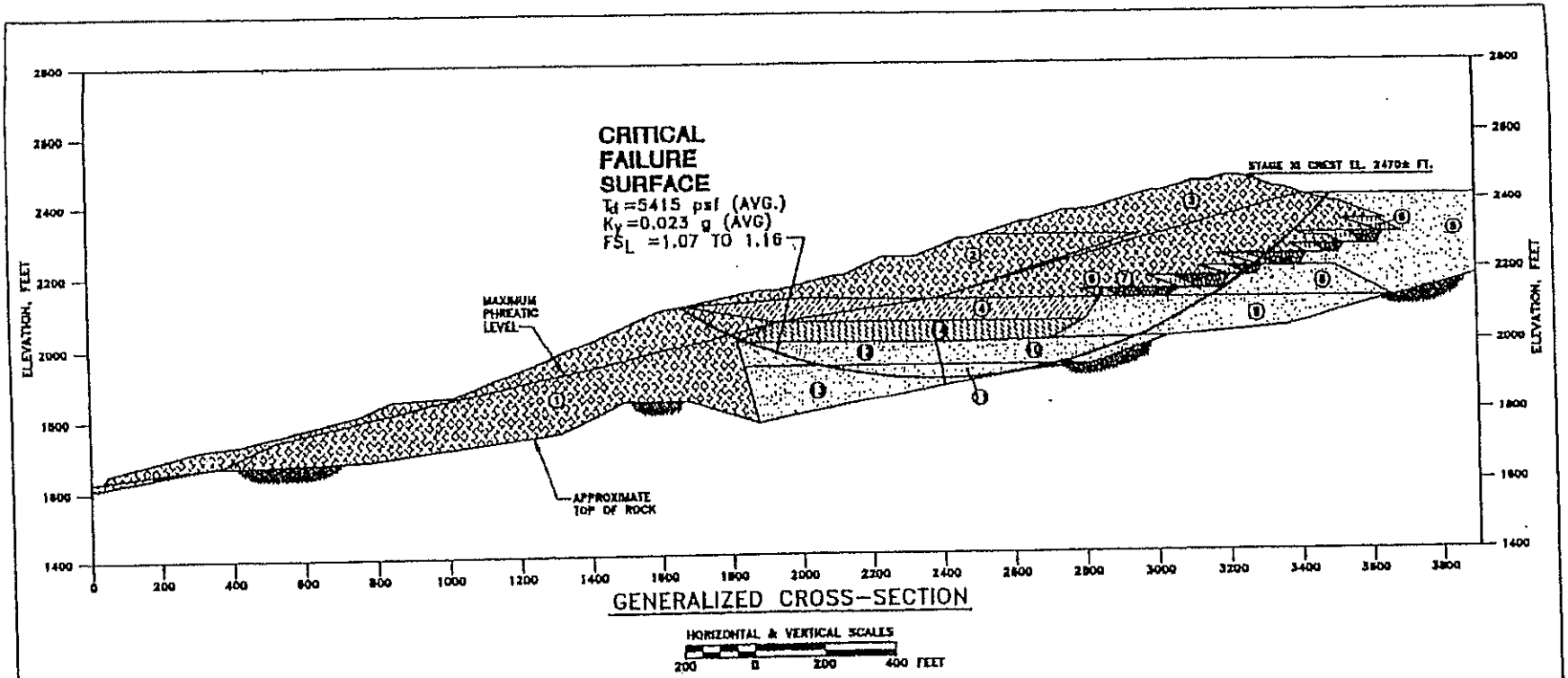
Table 1: Summary of Strength and Inde... ...ls Performed on Fine Coal Refuse Samples

					Field Data			Laboratory Data												
												(CU) Triaxial Results at Peak			Consolidated-Undrained (CU) Triaxial Results at Steady-State (SS)					
Site No	Sample Type	Percent Passing No. 200 Sieve	PI %	Specific Gravity	Depth to Top of Sample, Feet	Estimated In-Situ Vert. Effective Stress, kg/cm²	Void Ratio In-Situ (Sampled)	Void Ratio In Tube/Mold	Void Ratio During Shear	Lab Effective Consol Stress, kg/cm²	Estimated Equiv. Vert. Effect. Stress In Field [1], kg/cm²	Shear Stress at Peak, q, kg/cm²	Axial Strain, %	Peak Friction Angle	Shear Stress at SS, q, kg/cm²	Minor Principal Stress, kg/cm²	Axial Strain, %	Undrained SS Strength Sus, kg/cm²	SS Friction Friction Angle	Sus at In-Situ Void Ratio, kg/cm²
1	FP	29.4	NA	2.28	90.7	3.45	0.494	0.497	0.402	6.00	12.00	2.70	12.6	34.6	2.68	2.15	17.8	2.23	33.7	0.44
	FP	40.4	NA	2.02	70.3	3.19	0.511	0.615	0.397	6.00	12.00	2.61	12.2	34.7	2.71	2.22	22.6	2.26	33.4	0.19
	FP	44.7	NA	2.37	80.6	3.30	0.488	0.489	0.390	6.00	12.00	2.79	13.2	35.3	2.59	2.17	25.9	2.17	32.9	0.42
	FP	43.6	NA	1.94	76.8	3.25	0.496	0.502	0.384	6.00	12.00	3.38	16.0	33.7	3.29	2.93	22.6	2.78	32.0	0.63
2	FP	47.2	NP	1.78	100.3	4.61	0.565	0.567	0.443	8.00	12.00	3.60	17.9	35.3	3.38	2.76	24.5	2.81	33.4	0.36
	FP	38.8	7	2.01	105.8	4.68	0.469	0.462	0.414	8.00	12.00	3.20	15.1	34.2	3.00	2.65	24.4	2.64	32.1	1.39
	FP	63.9	11	1.63	65.0	4.10	0.553	0.543	0.454	8.00	12.00	2.95	14.2	32.7	2.88	2.58	22.9	2.45	31.9	0.53
	FP	87.0	4	1.84	75.6	4.27	0.541	0.529	0.421	8.00	12.00	3.41	16.7	34.1	3.29	2.78	23.3	2.77	32.6	0.38
1 & 2	BM	34.7	NP	1.98	NA	NA	NA	0.732	0.390	4.00	6.00	0.98	1.6	24.7	0.96	0.81	20.6	0.80	32.8	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.746	0.331	10.00	15.00	2.39	1.8	26.2	2.42	2.03	25.2	2.03	32.9	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.975	0.465	1.00	1.50	0.23	1.2	23.6	0.18	0.14	26.3	0.15	34.1	NA
	BM	34.7	NP	1.98	NA	NA	NA	0.973	0.433	2.00	3.00	0.46	1.3	23.2	0.41	0.36	23.0	0.34	32.9	NA
3	FP	97.7	NA	1.88	310.5	11.02	0.514	0.582	0.510	16.10	24.15	5.07	6.3	30.1	5.67	5.64	8.3	4.91	30.1	4.65
	FP	78.5	NA	1.89	209.6	10.07	0.444	0.488	0.424	16.20	24.30	5.40	7.3	28.1	5.21	5.13	16.6	4.62	27.4	3.15
	FP	78.7	NA	1.85	329.4	11.17	0.443	0.482	0.439	16.10	24.15	5.87	9.4	29.8	5.69	5.12	18.1	4.89	29.8	4.62
	FP	91.7	11	1.88	343.3	11.62	0.541	0.605	0.545	12.00	18.00	4.87	10.2	30.9	4.81	4.66	18.0	4.14	30.6	4.47
	FP	66.6	NA	1.61	260.6	10.65	0.662	0.568	0.495	12.00	18.00	6.67	18.7	33.7	6.57	5.27	16.7	5.47	33.7	0.85
	FP	21.3	NA	1.49	275.8	10.37	0.789	0.790	0.681	8.00	12.00	3.77	19.8	35.0	3.77	2.81	19.8	3.09	35.0	0.06
3	BM	70.1	8	1.80	NA	NA	NA	0.513	0.363	16.20	24.30	5.44	19.3	29.7	5.44	5.56	19.7	4.72	29.7	NA
	BM	70.1	8	1.80	NA	NA	NA	0.483	0.390	8.00	12.00	3.08	20.3	31.2	3.06	2.84	20.3	2.81	31.2	NA
	BM	70.1	8	1.80	NA	NA	NA	0.633	0.479	2.00	3.00	0.65	19.8	33.4	0.65	0.53	16.8	0.54	33.4	NA
	BM	70.1	8	1.80	NA	NA	NA	0.516	0.456	3.00	4.50	1.00	16.5	33.0	1.00	0.83	16.5	0.84	33.0	NA
	BM/S	70.1	8	1.80	NA	NA	NA	1.270	0.407	7.00	10.50	2.31	12.6	32.2	2.31	2.02	12.8	1.95	32.2	NA
	BM/S	37.0	4	2.29	NA	NA	NA	1.070	0.362	7.00	10.50	2.52	17.9	33.4	2.52	2.05	17.9	2.10	33.4	NA
	BM/S	23.6	NA	1.48	NA	NA	NA	0.840	0.504	7.00	10.50	3.71	19.7	35.2	3.71	2.72	19.7	3.03	35.2	NA
4	FP	24.9	NA	1.45	210.0	7.47	0.657	0.695	0.517	12.00	18.00	4.74	19.9	36.1	4.74	3.30	19.9	3.83	36.1	1.78
	FP	15.7	NA	1.48	222.2	7.68	0.640	0.671	0.468	12.00	18.00	4.85	18.7	36.2	4.85	3.45	18.7	3.91	36.2	0.95
	FP	72.0	NA	1.76	135.5	5.49	0.488	0.520	0.468	8.00	12.00	3.41	13.9	33.3	3.37	2.89	18.2	2.84	32.6	1.60
	FP	39.1	NA	1.58	150.2	5.75	0.389	0.400	0.360	8.00	12.00	3.92	14.1	35.2	3.90	3.09	17.6	3.24	33.9	1.60
	FP	71.3	NA	1.70	170.2	6.08	0.467	0.498	0.440	8.00	12.00	3.85	17.3	33.6	3.84	3.30	18.9	3.24	32.5	2.16
	FP	81.0	NA	1.65	218.3	7.74	0.491	0.519	0.453	12.00	18.00	4.94	14.2	33.6	4.89	4.17	17.7	4.11	32.7	1.98
	FP	72.7	NA	1.71	223.3	7.83	0.485	0.482	0.415	12.00	18.00	4.75	13.1	32.4	4.60	4.23	19.3	3.93	31.4	1.50
	FP	75.8	NA	1.73	213.2	7.85	0.484	0.507	0.428	12.00	18.00	6.06	12.8	35.2	4.88	3.77	19.7	3.90	33.6	1.33
4	BM	75.1	12	1.72	NA	NA	NA	0.676	0.410	8.00	12.00	2.99	20.8	32.4	2.92	2.56	18.0	2.47	32.3	NA
	BM	75.1	12	1.72	NA	NA	NA	0.795	0.460	4.00	6.00	1.41	17.3	33.2	1.42	1.18	18.0	1.19	33.0	NA
	BM	75.1	12	1.72	NA	NA	NA	0.804	0.387	11.00	17.85	4.31	19.3	31.8	4.26	3.86	18.0	3.63	31.6	NA
	BM	75.1	12	1.72	NA	NA	NA	0.805	0.481	2.00	3.00	0.66	21.4	32.9	0.62	0.53	18.0	0.52	32.8	NA
	BM	75.1	12	1.72	NA	NA	NA	NA	0.455	5.00	7.50	1.68	19.0	34.3	1.65	3.48	18.0	1.65	33.3	NA
	BM/S	75.1	12	1.72	NA	NA	NA	NA	0.380	5.00	7.50	2.48	23.4	37.2	2.48	1.81	23.4	2.02	35.3	NA
	BM/S	52.2	4	1.56	NA	NA	NA	NA	NA	5.00	7.50	2.48	23.4	37.2	2.48	1.81	23.4	2.02	35.3	NA
5	FP	81.0	NA	1.77	219.9	9.54	0.582	0.580	0.460	12.00	18.00	4.43	10.9	32.9	4.14	3.76	22.2	3.53	31.6	0.63
	FP	48.8	NA	1.64	234.3	9.72	0.546	0.661	0.446	12.00	18.00	5.34	18.7	35.8	5.33	3.66	17.3	4.34	35.4	0.53
	FP	90.5	NA	1.96	250.0	9.93	0.560	0.588	0.505	12.00	18.00	4.33	6.7	28.9	4.22	4.62	13.9	3.71	28.5	1.16
	FP	87.6	NA	1.79	188.3	8.53	0.522	0.615	0.440	12.00	18.00	4.68	8.5	32.6	4.23	3.98	20.7	3.62	31.0	0.64
	FP	88.9	NA	1.96	194.0	8.81	0.658	0.605	0.547	12.00	18.00	4.00	3.5	28.7	3.97	4.70	4.0	3.53	27.1	0.33
	FP	35.5	NA	1.65	233.3	11.02	0.609	0.525	0.421	12.00	18.00	4.83	20.3	35.6	4.63	3.35	20.3	3.77	35.5	0.69
	FP	22.5	NA	1.41	241.0	11.12	0.547	0.551	0.483	12.00	18.00	4.56	20.5	33.7	4.56	3.67	20.8	3.79	33.7	0.98
	FP	34.4	NA	1.54	180.4	8.67	0.628	0.608	0.444	12.00	18.00	4.37	19.6	35.5	4.30	3.21	21.6	3.57	35.1	0.08
	FP	79.5	NA	1.87	165.0	8.05	0.612	0.600	0.448	12.00	18.00	4.37	9.0	32.0	4.01	3.88	21.3	3.46	30.5	0.11
	FP	74.0	NA	1.88	183.3	8.46	0.618	0.588	0.450	12.00	18.00	5.12	8.8	33.7	4.78	4.20	19.4	4.05	32.1	0.12
	FP	80.7	NA	1.68	200.4	10.13	0.562	0.576	0.406	12.00	18.00	4.04	11.0	33.8	3.85	3.21	21.7	3.23	33.0	0.43
	FP	25.5	NA	1.67	210.3	10.63	0.588	0.599	0.460	12.00	18.00	4.88	17.9	36.3	4.75	3.65	24.4	3.90	34.0	0.26
5	BM	62.0	9	1.70	NA	NA	NA	0.545	0.401	8.00	12.00	2.56	19.2	32.9	2.56	2.17	19.2	2.15	32.7	NA
	BM	62.0	9	1.70	NA	NA	NA	0.544	0.473	2.00	3.00	0.58	20.2	34.6	0.58	0.48	20.3	0.48	33.9	NA
	BM	62.0	9	1.70	NA	NA	NA	0.548	0.512	1.00	1.50	0.28	1.7	35.2	0.27	0.21	19.8	0.22	33.7	NA
	BM/S	62.0	9	1.70	NA	NA	NA	0.753	0.358	6.50	9.75	2.32	19.6	32.0	2.32	2.10	19.6	1.98	31.6	NA
	BM/S	85.1	NP	1.88	NA	NA	NA	NA	0.633	6.50	9.75	3.08	18.3	34.0	3.08	2.32	18.3	2.53	34.8	NA

NOTES: FP - Fixed Piston, Undisturbed Sample
BM - Reconstituted Batch Mix Sample Prepared by Moist Tamping
[1] K_o = 0.5 (Ratio of Horizontal to Vertical Effective Stress)
BM/S - Reconstituted Batch Mix Sample Prepared as Slurry
NA - Not Applicable
NP - Non-Plastic
PI - Plasticity Index
$q = (\sigma_1 - \sigma_3)/2$

R16719



GENERALIZED CROSS-SECTION

HORIZONTAL & VERTICAL SCALES

200 0 200 400 FEET

LEGEND:

T_d (AVG.)	AVERAGE IN-SITU STATIC DRIVING SHEAR STRESS
K_y (AVG.)	AVERAGE YIELD ACCELERATION
FS_L (AVG.)/(MAX.)	AVERAGE AND MAXIMUM FACTORS OF SAFETY AGAINST LIQUEFACTION
①	MATERIAL LAYER NO.

- FINE COAL REFUSE
- FINE COAL REFUSE (BEACHED ZONES)
- MIXED COARSE AND FINE COAL REFUSE
- COARSE COAL REFUSE
- COMBINED COAL REFUSE
- MIXED COMBINED AND FINE COAL REFUSE

ALMES & ASSOCIATES, INC.
CONSULTING ENGINEERS
BECKLEY, WV
PITTSBURGH, PA

FIGURE 1
GENERALIZED CROSS-SECTION AND LIQUEFACTION SUSCEPTIBILITY EVALUATION SUMMARY

R16720

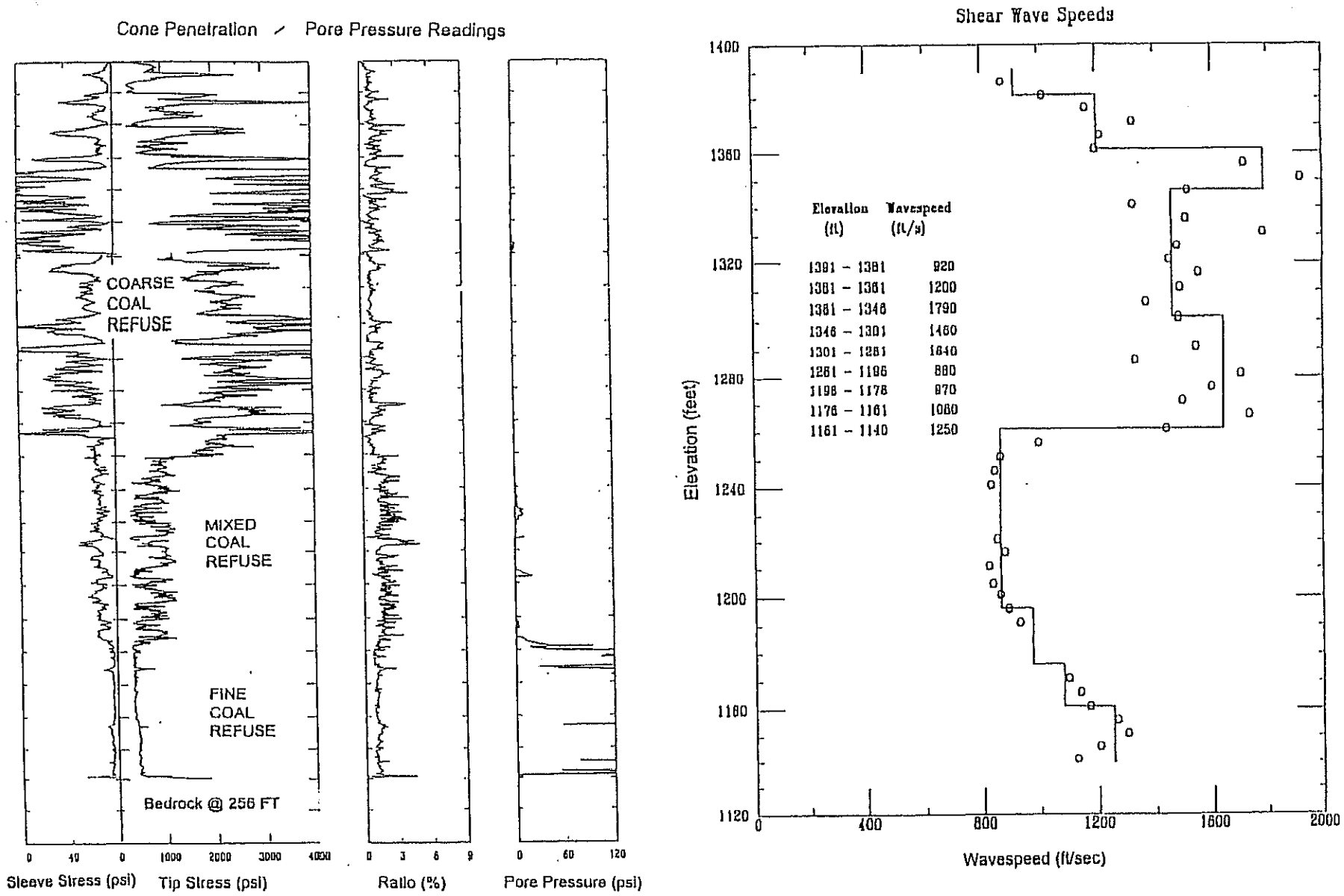


Figure 2 – CPT Log and Shear Wave Velocity Profile

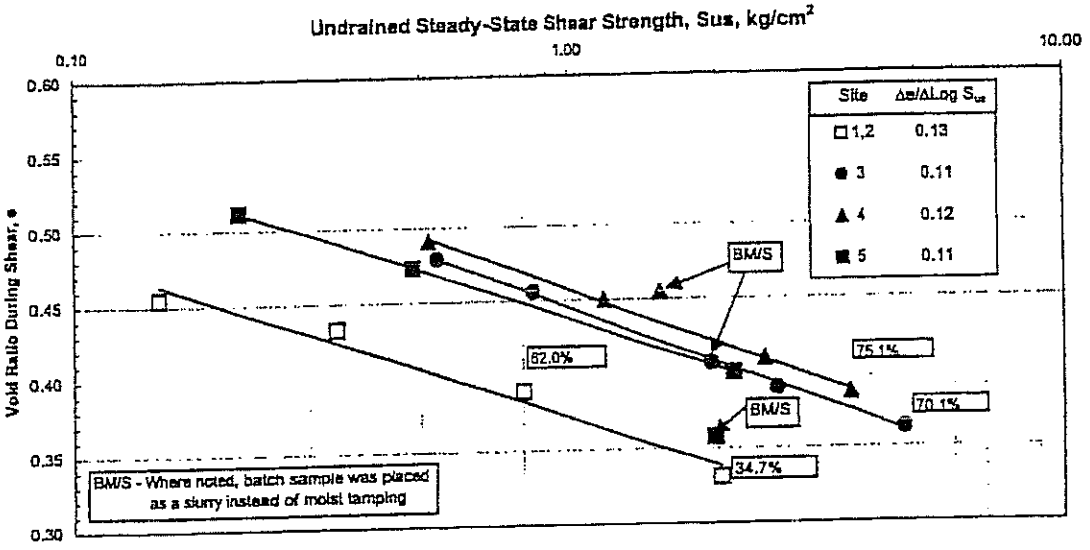


FIGURE 3 - Steady State Lines of Fine Coal Refuse Batch Samples

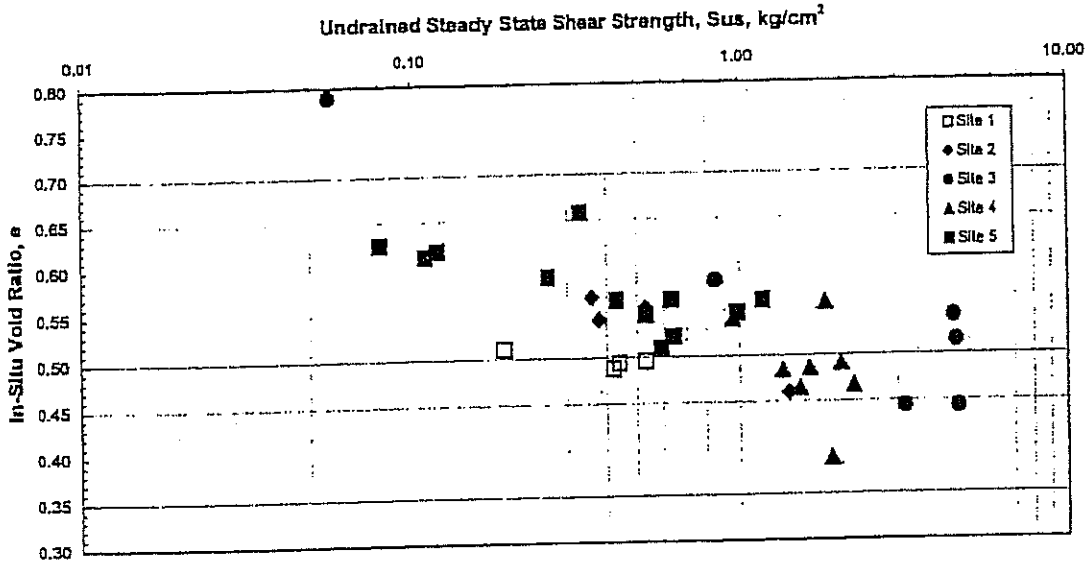


FIGURE 4 - S_{us} of Fixed Piston Samples at In-Situ Void Ratio, After Correction of Lab Void Ratio

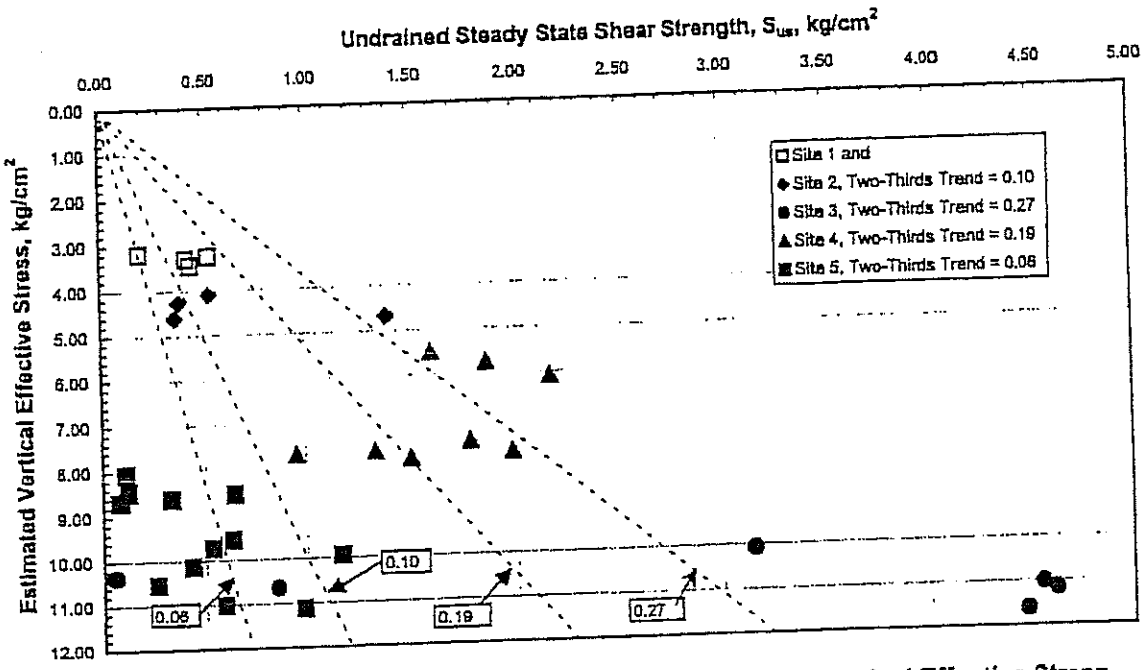


FIGURE 5 - S_{us} of Fixed Piston Samples Versus Estimated Vertical Effective Stress

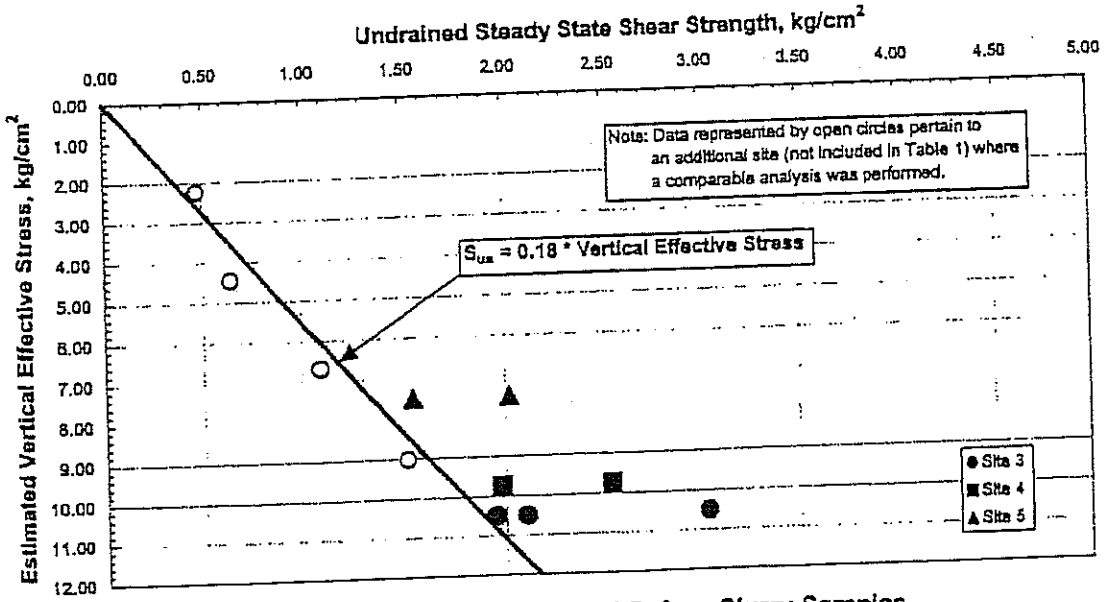
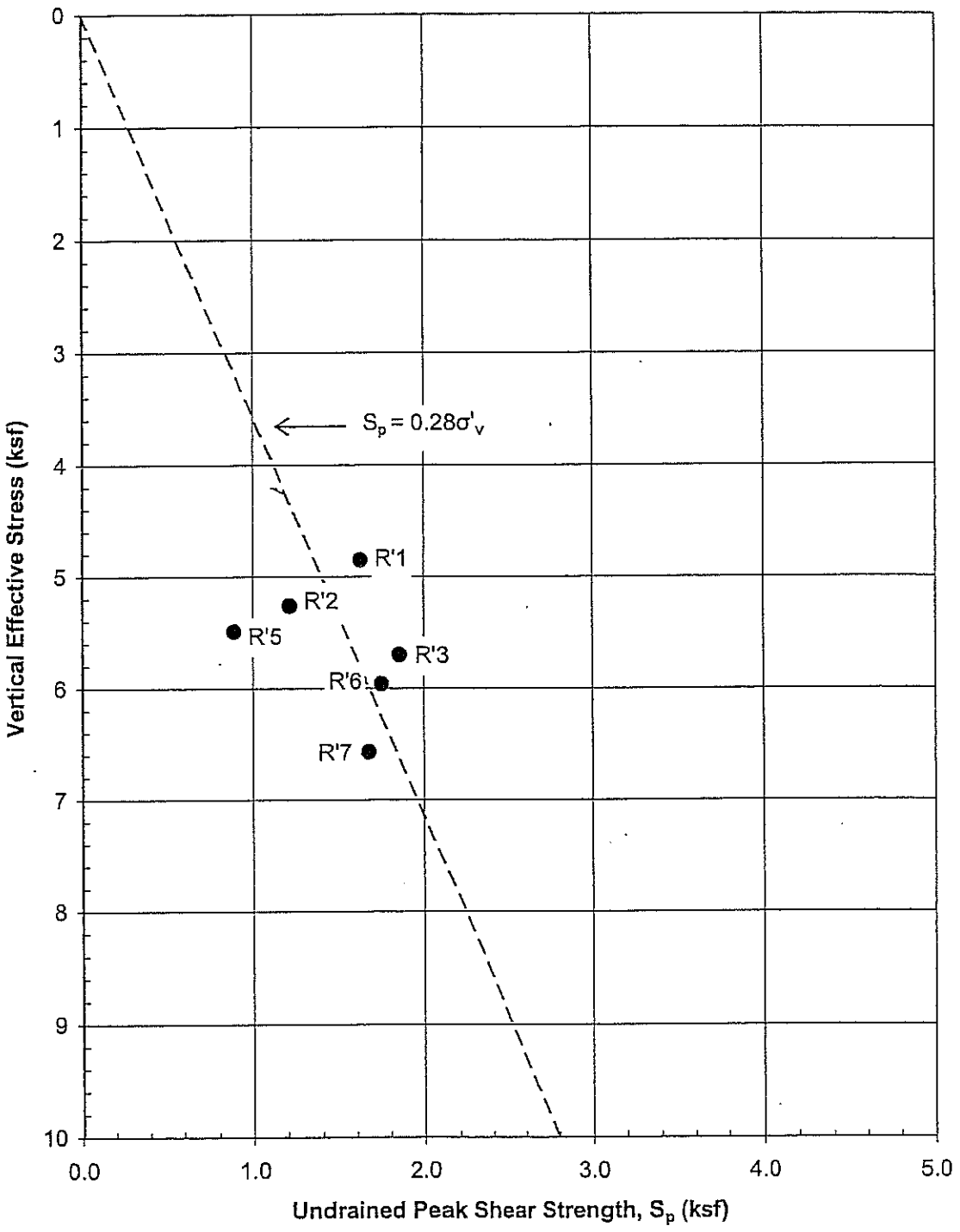
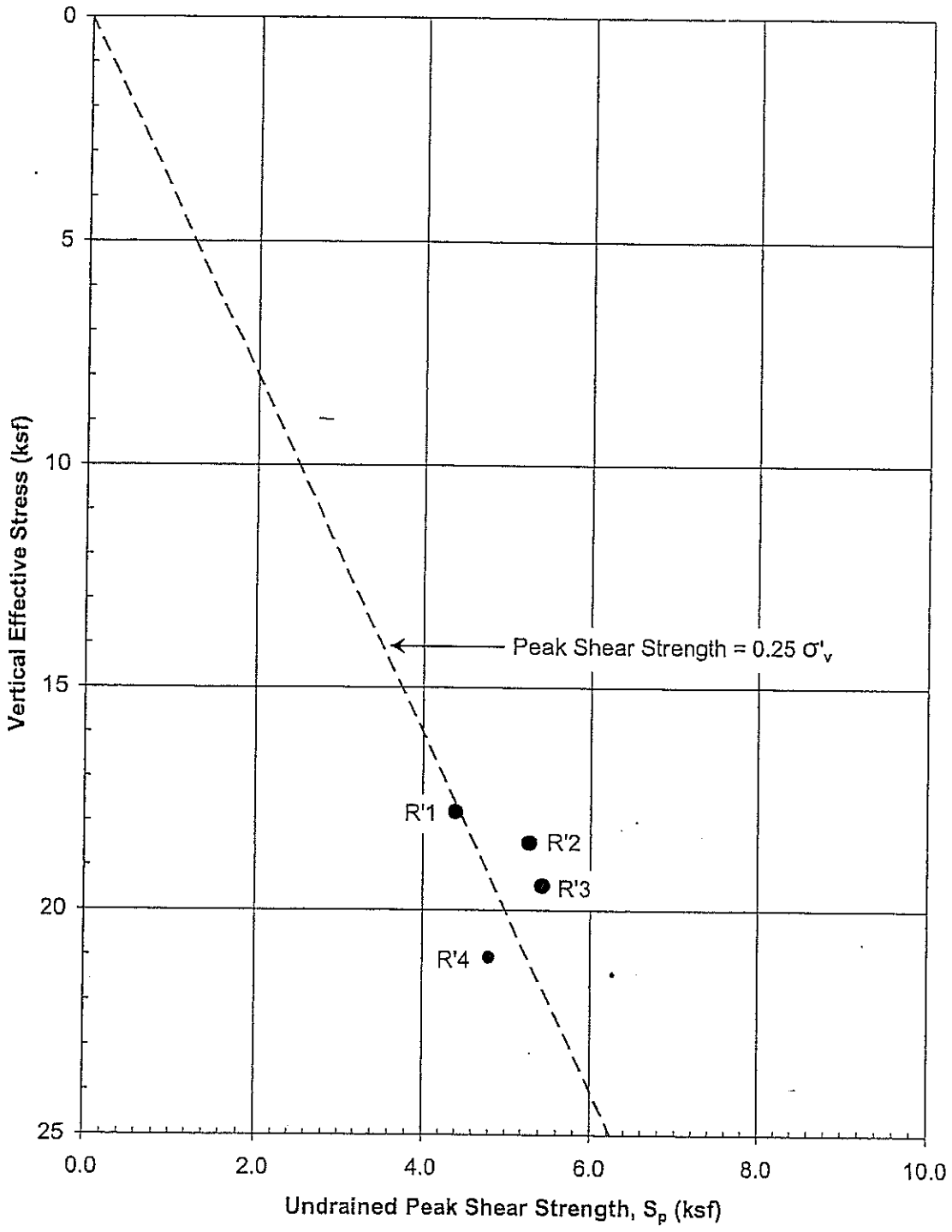


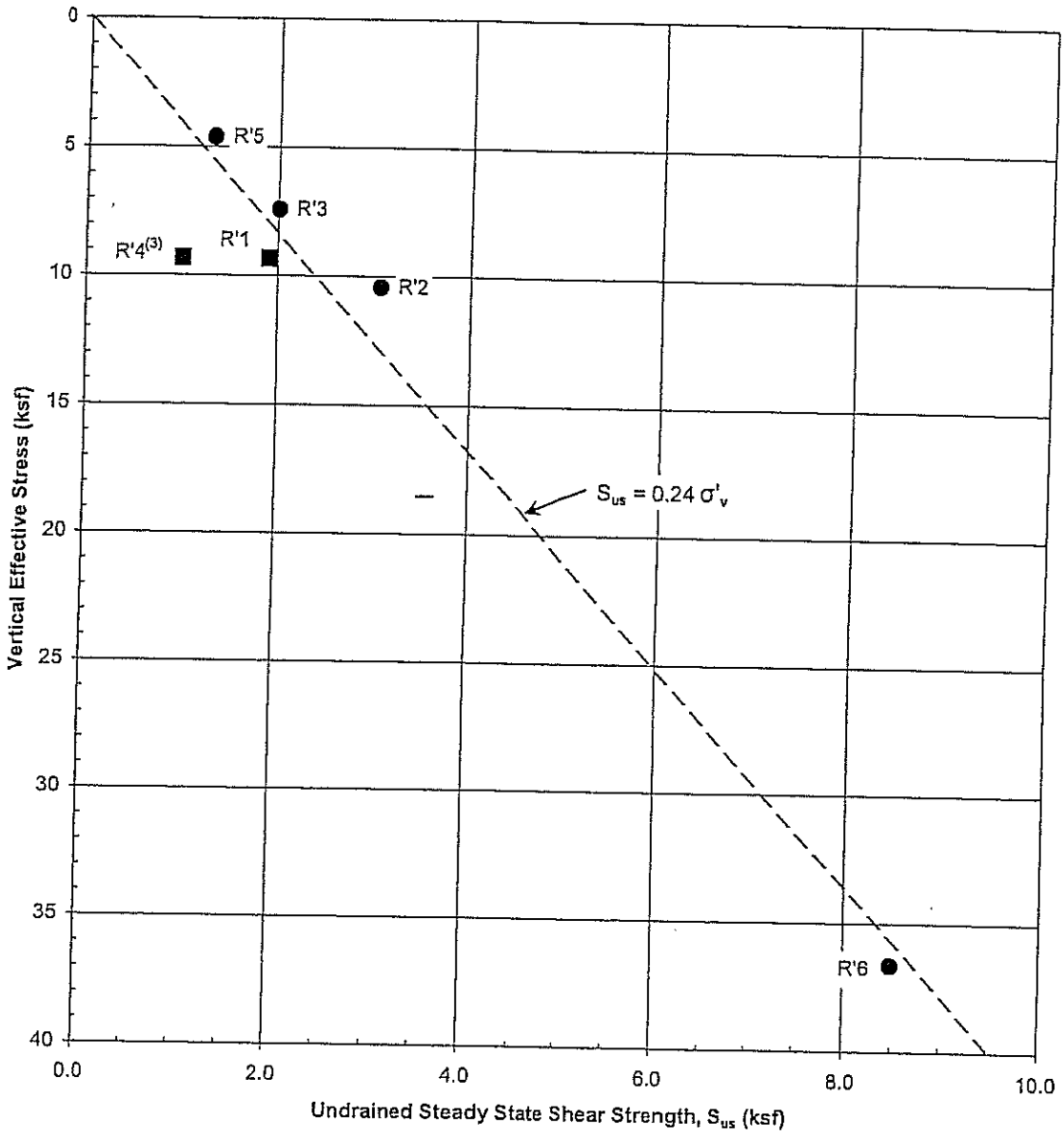
FIGURE 6 - S_{us} of Fine Coal Refuse Slurry Samples Versus Estimated In-Situ Vertical Effective Stress



Harvey Run No. 1 Slurry Impoundment Monongalia County, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_p VERSUS VERTICAL EFFECTIVE STRESS
Consolidation Coal Company Pittsburgh, Pennsylvania	Project 070810	June 2007 Figure 6



Wallace Cabin Branch Slurry Impoundment Wyoming County, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_p VERSUS VERTICAL EFFECTIVE STRESS
Kepler Processing Company Pineville, West Virginia	Project 063560	April 2007 Figure 4



LEGEND
- ● Reconstituted Coal Refuse Slurry Sample
- ■ Undisturbed Tube Sample

NOTES
1. Vertical effective stress for reconstituted coal refuse samples assumed to be 1.5 times the isotropic effective consolidation stress.
2. Vertical effective stress of undisturbed tube samples estimated by CEC, Inc.
3. R'4 composed of two different soil types. S_{us} shown is uncertain.

Hughes Hollow Slurry Impoundment Wana, West Virginia	GEI Consultants	ESTIMATED IN-SITU S_{us} VERSUS VERTICAL EFFECTIVE STRESS
Consolidation Coal Company Pittsburgh, Pennsylvania	Project 063570	February 2007 Figure 3

8114.10
Part 22

APPENDIX D

SLOPE STABILITY ANALYSES RESULTS
IN-SITU DRIVING SHEAR STRESS

gai consultants
transforming ideas into reality

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – In-Situ Driving Shear Stress Stability Analyses

BY AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY [illegible] DATE 5/6/09 SHEET NO. 1 OF 3

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CALCULATION BRIEF
FOR
DETERMINATION OF DOWNSTREAM AND UPSTREAM IN-SITU DRIVING SHEAR STRESS BY ELASTIC (PCSTABL) SOLUTION

POND CREEK COAL REFUSE DISPOSAL SITE – PHASE 3 IMPOUNDMENT

OBJECTIVE: To determine the initial state of static stress (a.k.a., "driving shear stress") for the Phase 3 fine coal refuse (FCR) impoundment in both downstream and upstream directions. The critical failure, in-situ driving shear stress will be used to evaluate the potential for a liquefaction (flow slide) failure of the Phase 3 FCR as part of the overall evaluation of the impact of longwall mining beneath the Phase 3 impoundment.

METHODOLOGY: Use limit equilibrium analyses to estimate the driving shear stress acting on the most critical circular failure surface passing through the Phase 3 impoundment and embankment geometry shown in Figure 1. Failure planes in both the upstream and downstream directions will be evaluated.

REFERENCES:

1. Gregory, P.E., Garry H., "PCSTABL5M with STEDwin Slope Stability Analysis System, Version 2.0," dated September 2001.

2. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak and Steady-State Undrained Shear Strengths For Refuse and Subgrade Materials, Pond Creek Coal Refuse Disposal Site – South Pond", BEG, 7/12/08.

3. GAI Consultants, Inc. Calculation, "Supplemental Summary of Engineering Properties and Coarse Refuse Tensile Strength for Subsidence Liquefaction and Embankment Cracking Evaluations, Pond Creek Coal Refuse Disposal Site – Phase 3," BEG, 3/31/09.

4. GAI Consultants, Inc. Calculation Brief Entitled "Summary of Laboratory Testing," Pond Creek Coal Refuse Disposal Site, BEG, dated 3/30/09.

5. Poulos, S.J., Castro, G., and France, J.W. (1985a) "Liquefaction Evaluation Procedure," Journal of the Geotechnical Engineering Division, ASCE, Vol. 111, No. GT6, pp. 772-792.

ANALYSIS:

Liquefaction (flow slide) susceptibility was determined by evaluating whether or not the Phase 3 FCR would resist triggering a loss of strength, and subsequently estimating the factor of safety against post-subsidence instability. The analysis requires the in-situ static driving shear stress be determined in the

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – In-Situ Driving Shear Stress Stability Analyses

BY AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY TBP DATE 5/6/09 SHEET NO. 2 OF 3

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critical layer FCR and based on the results of the characterization and triggering evaluations, a "zero-strength" analysis of the FCR is performed.

Poulos, et al (1985) states a soil mass susceptible to liquefaction will only experience a flow slide failure when a sufficiently large triggering event causes the strength of the soil to decrease to the undrained steady-state strength. Conversely, a soil mass which is not susceptible to liquefaction physically cannot fail by liquefaction since the minimum undrained strength exceeds the in-situ driving shear stress along the critical failure surface.

The driving shear stress in a critical soil layer is equal to the minimum shear resistance the layer must have to just maintain stability of the slope. This assumes fully mobilized shear strengths in the other soil layers comprising the slope. The fully mobilized strengths are those that would act while deformation of the slope is occurring and, thus, would be available to resist a massive flow slide. These shear strengths can be quantified by performing a stability analysis for the slope in question.

When evaluating slope stability by means of circular failure surface analysis (using the limit equilibrium approach), the driving shear stress (τ_d) acting along the failure surface analyzed can be determined by assuming that the shearing resistance (i.e., shear strength) of the material through which the failure surface passes is provided solely by cohesion [i.e., angle of internal friction ($\phi = 0$]. The driving stress is determined by varying the cohesion value used in the analysis until a factor of safety (F.S.) of 1.0 is obtained. For this condition (F.S. = 1.0), the driving stress acting along the failure surface analyzed is equal to the cohesion value used for the material.

The following soil properties were estimated based on previous field and laboratory testing as well as current FCR testing for use in the various slope stability analyses as noted in Reference Nos. 3 and 4:

Material Type	Total Unit Weight (γ_t) (pcf)	Saturated Unit Weight (γ_s) (pcf)	Effective Friction (ϕ') (deg)	Effective Cohesion (c') (psf)
Coarse Refuse	130	140	33.7	0
Fine Refuse	80	90	0	0
Residual Soil	125	135	19	400
Soil Cap	130	135	30	0

Results of Driving Shear Stress Slope Stability Analyses:

Phase 3 Impoundment (Crest El. 500 ft)	Top of Fines Elevation (ft)	Top of Cap Elevation[1] (ft)	Driving Shear Stress in Fine Coal Refuse (τ_d)[2] (psf)	Additional Factor of Safety Including Zero-Strength FCR (dim)
Downstream	495	500	0	2.2
Upstream	495	500	0	1.3

(1) Cap includes 5-foot coarse refuse layer above top of fines elevation as shown in Figure 1.
(2) Zero-strength driving shear stress analyses yielded additional factors of safety in downstream and upstream directions of 2.2 and 1.3, respectively.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Subsidence Evaluation – In-Situ Driving Shear Stress Stability Analyses

BY AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY BDJ DATE 5/6/09 SHEET NO. 3 OF 3

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CONCLUSION:

Based on the information presented in this calculation brief, GAI determined that the Pond Creek – Phase 3 impoundment geometry has ZERO (0) psf in-situ driving shear stress through the fine coal refuse in both the upstream and downstream directions.

Zero-strength driving shear stress analyses yielded additional factors of safety in downstream and upstream directions of 2.2 and 1.3, respectively.

The results indicate that a rapid loading event such as subsidence-related disturbance will not trigger a strength loss in FCR, and is therefore NOT susceptible to a flow slide failure.

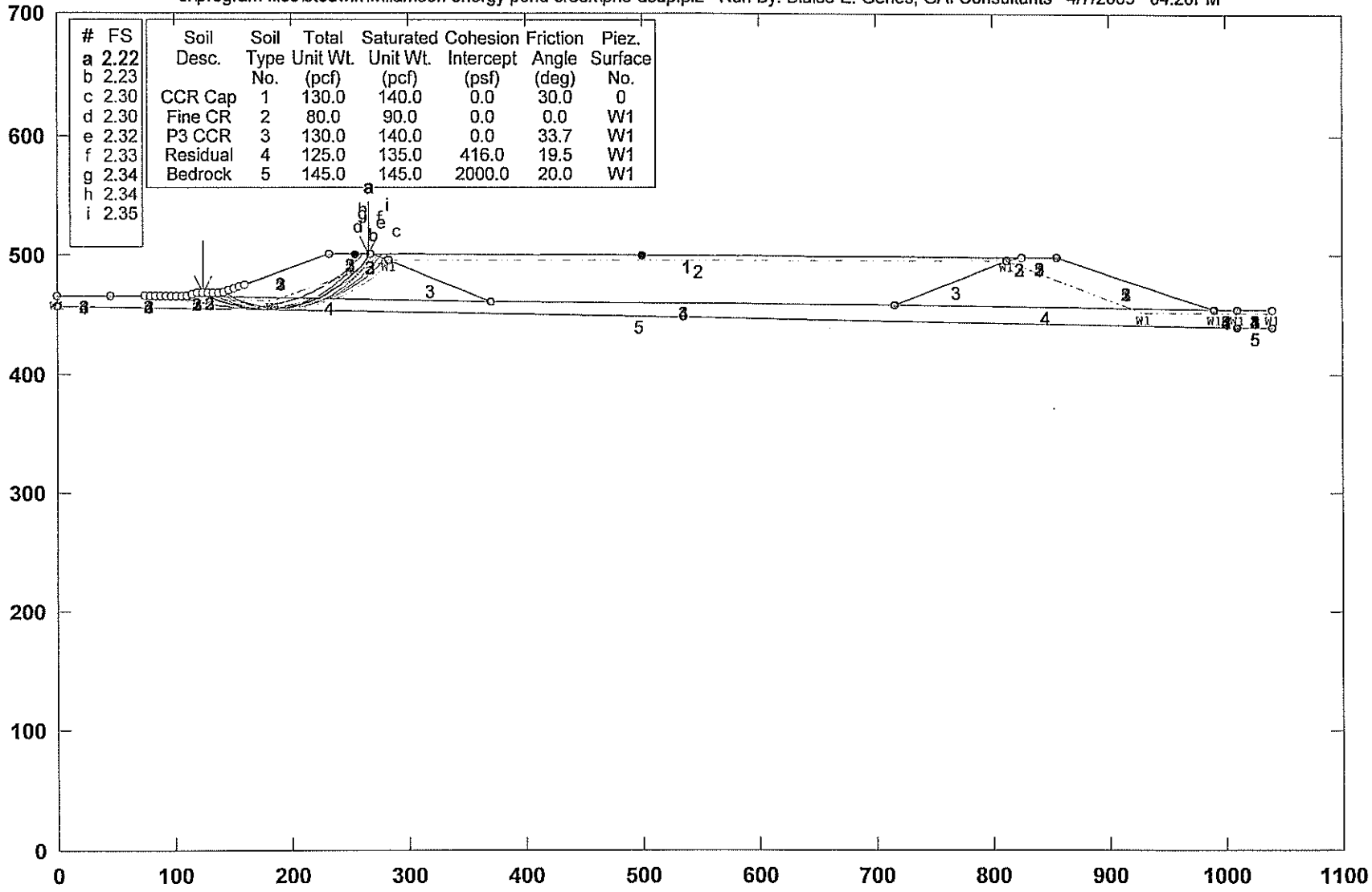
Hard copies of the Phase 3 driving shear stress downstream and upstream slope stability analyses are attached.

ATTACHMENT 1

IN-SITU DRIVING SHEAR STRESS PCSTABL SLOPE STABILITY ANALYSES PHASE 3 – DOWNSTREAM

Pond Creek, Phase 3 Downstream Driving Stress, Zero-Strength - Deep

c:\program files\stedwin\wiliamson energy pond creek\ph3-dsdp.pl2 Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:20PM



#	FS
a	2.22
b	2.23
c	2.30
d	2.30
e	2.32
f	2.33
g	2.34
h	2.34
i	2.35

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR Cap	1	130.0	140.0	0.0	30.0	0
Fine CR	2	80.0	90.0	0.0	0.0	W1
P3 CCR	3	130.0	140.0	0.0	33.7	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1

PCSTABL5M/si FSmin=2.22

Safety Factors Are Calculated By The Modified Bishop Method

STED



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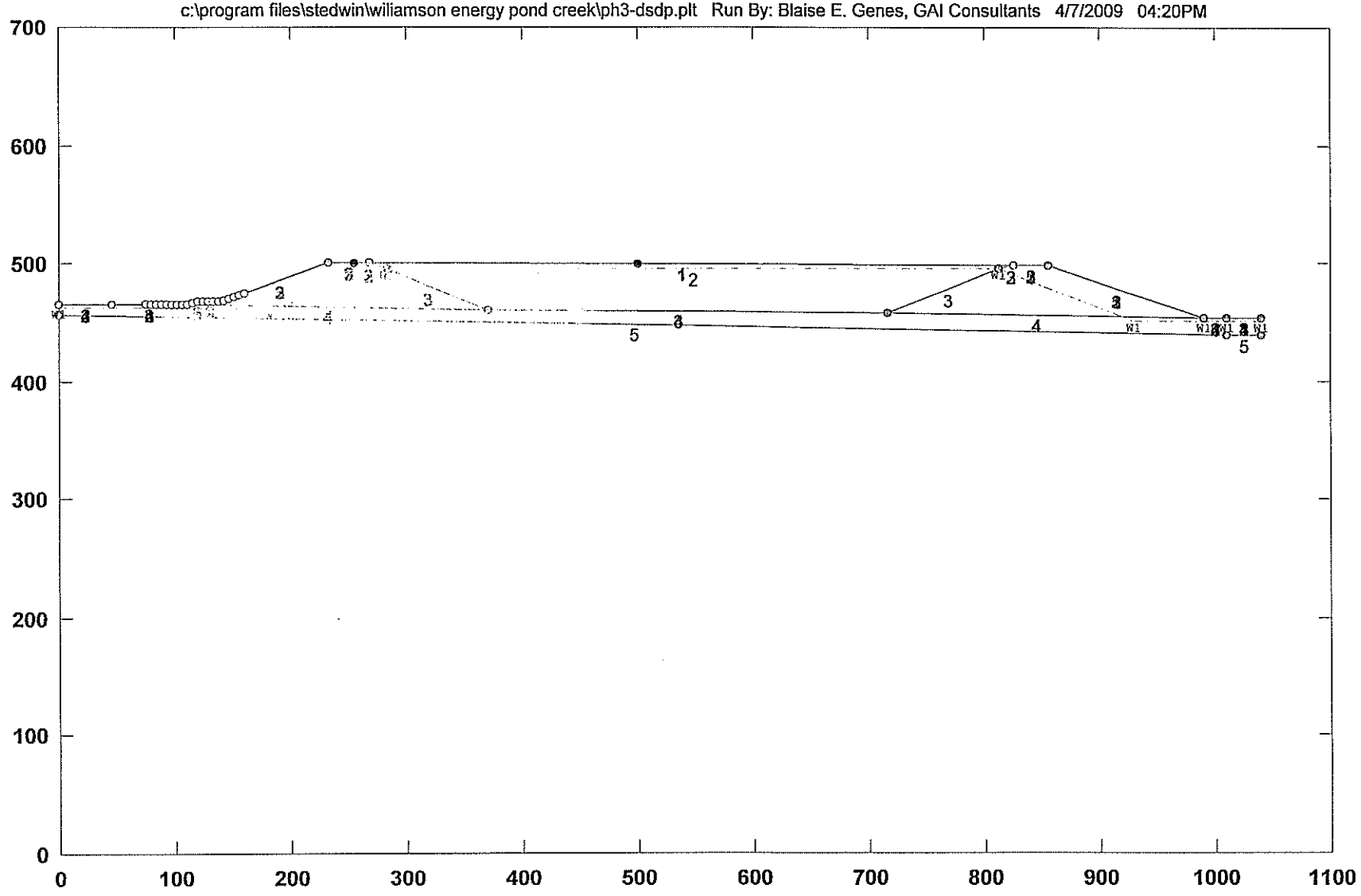
Pond Creek, Phase 3 Downstream Driving Stress, Zero-Strength - Deep

c:\program files\stedwin\wiliamson energy pond creek\ph3-dsdp.plt Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:20PM



STED



R16733

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4/7/2009
Time of Run: 04:20PM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph3-dsdp.in
Output Filename: C:ph3-dsdp.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3-dsdp.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 3 Downstream Driving S
tress, Zero-Strength - Deep

BOUNDARY COORDINATES
10 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1
5	140.00	468.00	233.00	500.00	1
6	233.00	500.00	268.00	500.00	1
7	268.00	500.00	825.00	498.00	1
8	825.00	498.00	855.00	498.00	1
9	855.00	498.00	990.00	454.00	1
10	990.00	454.00	1010.00	454.00	1
11	1010.00	454.00	1040.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1040.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1040.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4
46	1010.00	454.00	1040.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1040.00	439.00	5

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	30.0	.00	.0	0
2	80.0	90.0	.0	.0	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 75.00 ft.
and X = 160.00 ft.
Each Surface Terminates Between X = 255.00 ft.
and X = 500.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
5.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.21	468.00
2	128.62	465.65
3	133.14	463.49
4	137.74	461.55
5	142.43	459.82
6	147.20	458.31
7	152.03	457.02
8	156.91	455.95
9	161.84	455.10
10	166.80	454.48
11	171.79	454.08
12	176.78	453.92
13	181.78	453.98
14	186.78	454.28
15	191.75	454.80
16	196.69	455.54
17	201.60	456.51
18	206.45	457.71
19	211.25	459.13
20	215.97	460.76
21	220.62	462.61
22	225.18	464.67
23	229.63	466.93
24	233.98	469.40
25	238.21	472.06
26	242.32	474.91

27	246.29	477.95
28	250.12	481.17
29	253.80	484.56
30	257.31	488.11
31	260.67	491.82
32	263.85	495.68
33	266.85	499.68
34	267.06	500.00

Circle Center At X = 177.9 ; Y = 563.2 and Radius, 109.3

*** 2.222 ***

Individual data on the 41 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	4.4	675.1	.0	.0	.0	.0	.0	.0	.0
2	2.2	820.9	.0	.0	.0	.0	.0	.0	.0
3	2.3	1185.7	.0	.0	.0	.0	.0	.0	.0
4	4.6	3234.4	.0	.0	.0	.0	.0	.0	.0
5	.1	96.6	.0	.0	.0	.0	.0	.0	.0
6	2.1	1887.8	.0	54.5	.0	.0	.0	.0	.0
7	2.4	2557.5	.0	194.5	.0	.0	.0	.0	.0
8	4.8	6548.6	.0	738.6	.0	.0	.0	.0	.0
9	4.8	8588.0	.0	1160.2	.0	.0	.0	.0	.0
10	4.9	10524.5	.0	1512.7	.0	.0	.0	.0	.0
11	4.9	12338.2	.0	1795.4	.0	.0	.0	.0	.0
12	5.0	14010.7	.0	2007.7	.0	.0	.0	.0	.0
13	5.0	15525.9	.0	2149.1	.0	.0	.0	.0	.0
14	5.0	16869.3	.0	2219.3	.0	.0	.0	.0	.0
15	5.0	18028.8	.0	2218.2	.0	.0	.0	.0	.0
16	3.2	12131.8	.0	1394.8	.0	.0	.0	.0	.0
17	1.8	6861.7	.0	744.1	.0	.0	.0	.0	.0
18	5.0	19813.8	.0	2345.1	.0	.0	.0	.0	.0
19	.2	962.5	.0	120.9	.0	.0	.0	.0	.0
20	4.7	19494.1	.0	2545.0	.0	.0	.0	.0	.0
21	4.9	20888.9	.0	2916.6	.0	.0	.0	.0	.0
22	4.9	21110.0	.0	3096.4	.0	.0	.0	.0	.0
23	4.8	21121.5	.0	3205.1	.0	.0	.0	.0	.0
24	4.7	20927.4	.0	3242.5	.0	.0	.0	.0	.0
25	4.6	20534.4	.0	3208.4	.0	.0	.0	.0	.0
26	.6	2468.9	.0	389.4	.0	.0	.0	.0	.0
27	4.0	17463.6	.0	2713.6	.0	.0	.0	.0	.0
28	4.5	19120.9	.0	2926.4	.0	.0	.0	.0	.0
29	3.4	14095.7	.0	2098.7	.0	.0	.0	.0	.0
30	1.0	4024.1	.0	580.3	.0	.0	.0	.0	.0
31	4.2	16423.9	.0	2361.3	.0	.0	.0	.0	.0
32	4.1	14411.2	.0	1974.1	.0	.0	.0	.0	.0
33	4.0	12359.5	.0	1518.1	.0	.0	.0	.0	.0
34	3.8	10293.7	.0	994.3	.0	.0	.0	.0	.0
35	3.7	8239.4	.0	403.7	.0	.0	.0	.0	.0
36	.5	928.6	.0	6.1	.0	.0	.0	.0	.0
37	3.0	5322.9	.0	.0	.0	.0	.0	.0	.0
38	3.4	4373.3	.0	.0	.0	.0	.0	.0	.0
39	3.2	2583.4	.0	.0	.0	.0	.0	.0	.0
40	3.0	905.0	.0	.0	.0	.0	.0	.0	.0
41	.2	4.6	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.16	468.00
2	137.49	465.50
3	141.94	463.23
4	146.50	461.17
5	151.16	459.35
6	155.90	457.76
7	160.71	456.40
8	165.58	455.29

9	170.51	454.42
10	175.47	453.79
11	180.45	453.42
12	185.45	453.29
13	190.45	453.41
14	195.44	453.78
15	200.40	454.39
16	205.32	455.25
17	210.20	456.35
18	215.02	457.70
19	219.76	459.28
20	224.42	461.10
21	228.98	463.14
22	233.44	465.41
23	237.77	467.90
24	241.98	470.60
25	246.05	473.50
26	249.97	476.61
27	253.73	479.90
28	257.32	483.38
29	260.74	487.03
30	263.97	490.85
31	267.01	494.82
32	269.84	498.94
33	270.49	499.99

Circle Center At X = 185.6 ; Y = 553.9 and Radius, 100.6

*** 2.233 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	128.68	468.00
2	133.17	465.80
3	137.74	463.76
4	142.38	461.90
5	147.09	460.22
6	151.86	458.72
7	156.68	457.40
8	161.55	456.26
9	166.46	455.31
10	171.40	454.55
11	176.37	453.97
12	181.35	453.58
13	186.35	453.39
14	191.35	453.38
15	196.35	453.56
16	201.33	453.93
17	206.30	454.48
18	211.25	455.23
19	216.16	456.16
20	221.03	457.28
21	225.86	458.58
22	230.63	460.07
23	235.35	461.73
24	240.00	463.57
25	244.57	465.59
26	249.07	467.78
27	253.48	470.13
28	257.79	472.66
29	262.01	475.34
30	266.13	478.18
31	270.13	481.18
32	274.02	484.32
33	277.78	487.61
34	281.42	491.04
35	284.92	494.61
36	288.29	498.31
37	289.65	499.92

Circle Center At X = 189.1 ; Y = 585.3 and Radius, 131.9
*** 2.300 ***
Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	142.11	468.72
2	146.39	466.15
3	150.83	463.85
4	155.40	461.83
5	160.09	460.09
6	164.88	458.65
7	169.75	457.52
8	174.68	456.68
9	179.65	456.16
10	184.65	455.94
11	189.65	456.04
12	194.63	456.45
13	199.58	457.16
14	204.47	458.19
15	209.30	459.51
16	214.03	461.13
17	218.64	463.05
18	223.14	465.24
19	227.48	467.71
20	231.67	470.45
21	235.67	473.44
22	239.49	476.68
23	243.09	480.14
24	246.47	483.83
25	249.62	487.71
26	252.51	491.79
27	255.15	496.04
28	257.29	500.00

Circle Center At X = 185.6 ; Y = 536.3 and Radius, 80.3
*** 2.302 ***
Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	137.63	468.00
2	142.10	465.75
3	146.66	463.71
4	151.32	461.89
5	156.05	460.27
6	160.85	458.88
7	165.71	457.71
8	170.62	456.76
9	175.57	456.04
10	180.55	455.55
11	185.54	455.28
12	190.54	455.24
13	195.54	455.44
14	200.52	455.86
15	205.48	456.51
16	210.40	457.39
17	215.27	458.49
18	220.10	459.81
19	224.85	461.35
20	229.53	463.11
21	234.13	465.09
22	238.63	467.27
23	243.02	469.65
24	247.30	472.24
25	251.46	475.02
26	255.48	477.98
27	259.37	481.13
28	263.11	484.45
29	266.69	487.94

30	270.10	491.59
31	273.35	495.39
32	276.42	499.34
33	276.86	499.97

Circle Center At X = 188.8 ; Y = 564.2 and Radius, 109.0

*** 2.319 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	110.79	465.24
2	115.46	463.46
3	120.19	461.84
4	124.97	460.38
5	129.80	459.07
6	134.67	457.92
7	139.57	456.93
8	144.50	456.11
9	149.46	455.45
10	154.43	454.95
11	159.42	454.61
12	164.42	454.44
13	169.42	454.44
14	174.41	454.59
15	179.40	454.92
16	184.38	455.40
17	189.34	456.05
18	194.27	456.87
19	199.18	457.84
20	204.05	458.97
21	208.88	460.27
22	213.66	461.72
23	218.39	463.33
24	223.07	465.09
25	227.69	467.01
26	232.24	469.08
27	236.72	471.29
28	241.13	473.66
29	245.46	476.16
30	249.70	478.81
31	253.85	481.60
32	257.91	484.52
33	261.87	487.57
34	265.73	490.75
35	269.48	494.05
36	273.12	497.48
37	275.60	499.97

Circle Center At X = 167.1 ; Y = 606.4 and Radius, 152.0

*** 2.331 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	106.32	465.06
2	111.00	463.30
3	115.74	461.70
4	120.53	460.28
5	125.37	459.03
6	130.25	457.95
7	135.17	457.04
8	140.11	456.30
9	145.08	455.75
10	150.07	455.36
11	155.06	455.16
12	160.06	455.13
13	165.06	455.28
14	170.05	455.60
15	175.03	456.10
16	179.98	456.78

17	184.91	457.63
18	189.80	458.66
19	194.65	459.86
20	199.46	461.23
21	204.22	462.76
22	208.92	464.47
23	213.56	466.34
24	218.12	468.38
25	222.62	470.57
26	227.03	472.92
27	231.36	475.43
28	235.59	478.09
29	239.73	480.89
30	243.77	483.84
31	247.70	486.93
32	251.51	490.16
33	255.21	493.53
34	258.79	497.02
35	261.64	500.00

Circle Center At X = 158.4 ; Y = 596.4 and Radius, 141.3

*** 2.340 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.37	465.19
2	102.02	463.35
3	106.73	461.67
4	111.49	460.14
5	116.30	458.78
6	121.15	457.59
7	126.04	456.55
8	130.97	455.68
9	135.92	454.98
10	140.89	454.45
11	145.88	454.09
12	150.87	453.89
13	155.87	453.87
14	160.87	454.01
15	165.86	454.32
16	170.84	454.80
17	175.80	455.45
18	180.73	456.27
19	185.63	457.25
20	190.50	458.40
21	195.32	459.71
22	200.10	461.18
23	204.83	462.82
24	209.49	464.61
25	214.10	466.56
26	218.63	468.67
27	223.09	470.92
28	227.48	473.33
29	231.78	475.88
30	235.99	478.58
31	240.10	481.42
32	244.12	484.40
33	248.04	487.51
34	251.84	490.75
35	255.54	494.11
36	259.12	497.61
37	261.41	500.00

Circle Center At X = 154.1 ; Y = 601.7 and Radius, 147.8

*** 2.343 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	137.63	468.00

2	142.13	465.81
3	146.71	463.82
4	151.38	462.02
5	156.12	460.43
6	160.92	459.04
7	165.78	457.86
8	170.68	456.88
9	175.63	456.12
10	180.60	455.58
11	185.58	455.25
12	190.58	455.13
13	195.58	455.22
14	200.57	455.54
15	205.54	456.06
16	210.49	456.80
17	215.40	457.75
18	220.26	458.91
19	225.07	460.28
20	229.82	461.86
21	234.49	463.63
22	239.08	465.61
23	243.59	467.78
24	247.99	470.14
25	252.30	472.69
26	256.48	475.43
27	260.55	478.33
28	264.49	481.42
29	268.29	484.66
30	271.95	488.07
31	275.45	491.64
32	278.81	495.35
33	282.00	499.20
34	282.57	499.95

Circle Center At X = 190.8 ; Y = 571.4 and Radius, 116.3

*** 2.346 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.16	468.00
2	137.67	465.85
3	142.27	463.87
4	146.93	462.07
5	151.65	460.43
6	156.43	458.97
7	161.27	457.69
8	166.14	456.59
9	171.06	455.67
10	176.00	454.93
11	180.97	454.37
12	185.96	454.00
13	190.96	453.81
14	195.96	453.80
15	200.95	453.99
16	205.94	454.35
17	210.91	454.90
18	215.85	455.63
19	220.77	456.55
20	225.65	457.64
21	230.48	458.92
22	235.27	460.37
23	240.00	462.00
24	244.66	463.80
25	249.25	465.77
26	253.77	467.91
27	258.21	470.22
28	262.56	472.68
29	266.81	475.31

30	270.97	478.09
31	275.01	481.03
32	278.95	484.11
33	282.77	487.33
34	286.47	490.70
35	290.05	494.20
36	293.49	497.82
37	295.32	499.90

Circle Center At X = 193.6 ; Y = 589.2 and Radius, 135.4

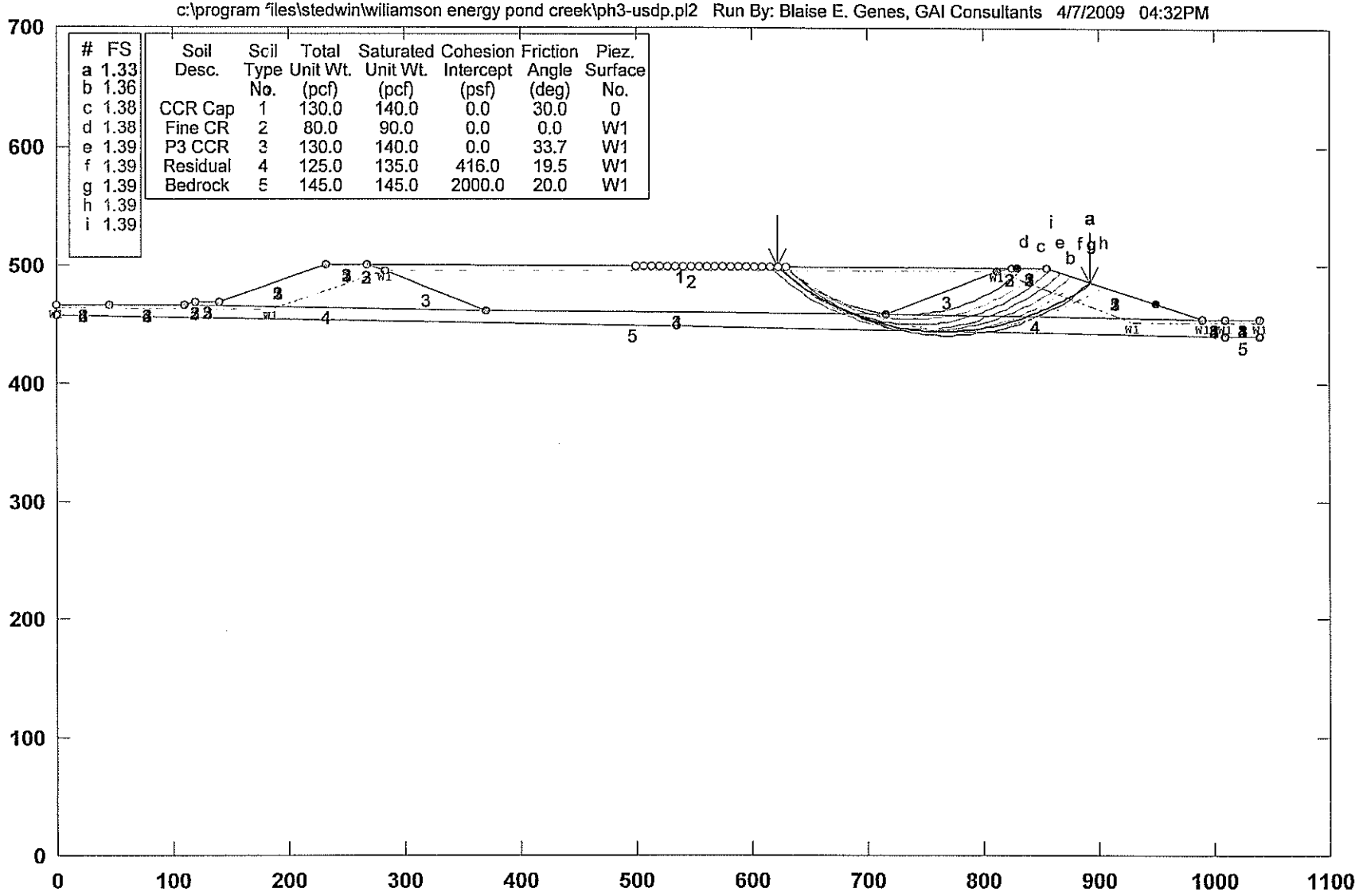
*** 2.350 ***

ATTACHMENT 2

IN-SITU DRIVING SHEAR STRESS PCSTABL SLOPE STABILITY ANALYSES PHASE 3 – UPSTREAM

Pond Creek, Phase 3 Upstream Driving Stress, Zero-Strength - Deep

c:\program files\stedwin\wiliamson energy pond creek\ph3-usdp.pl2 Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:32PM



PCSTABL5M/si FSmin=1.33

Safety Factors Are Calculated By The Modified Bishop Method

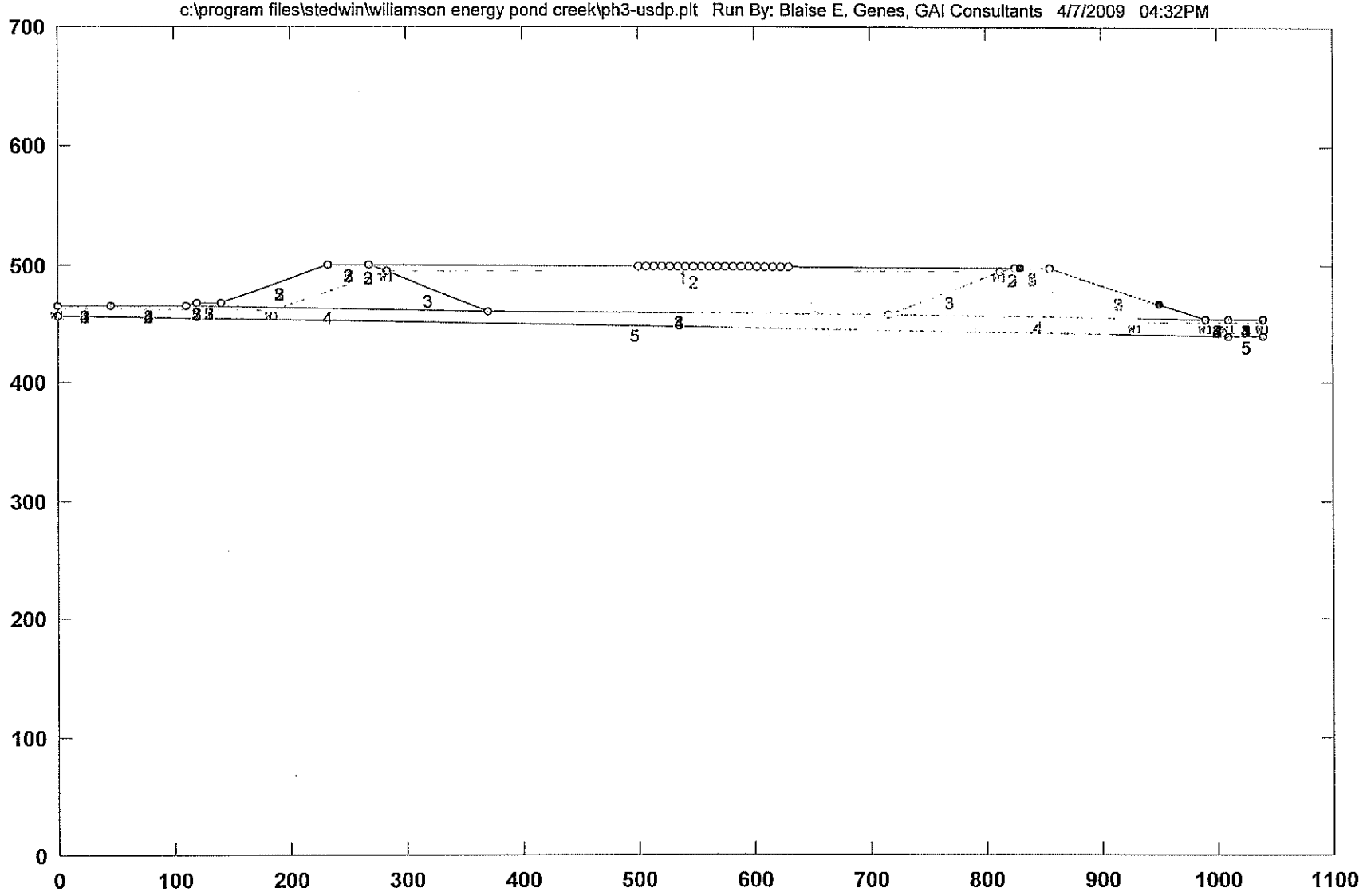
STED



R16744

Pond Creek, Phase 3 Upstream Driving Stress, Zero-Strength - Deep

c:\program files\stedwin\wiliamson energy pond creek\ph3-usdp.plt Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:32PM



STED



R16745

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4/7/2009
Time of Run: 04:32PM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph3-usdp.in
Output Filename: C:ph3-usdp.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3-usdp.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 3 Upstream Driving Str
ess, Zero-Strength - Deep

BOUNDARY COORDINATES
10 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1
5	140.00	468.00	233.00	500.00	1
6	233.00	500.00	268.00	500.00	1
7	268.00	500.00	825.00	498.00	1
8	825.00	498.00	855.00	498.00	1
9	855.00	498.00	990.00	454.00	1
10	990.00	454.00	1010.00	454.00	1
11	1010.00	454.00	1040.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1040.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1040.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4
46	1010.00	454.00	1040.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1040.00	439.00	5

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	30.0	.00	.0	0
2	80.0	90.0	.0	.0	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 500.00 ft.
and X = 630.00 ft.
Each Surface Terminates Between X = 830.00 ft.
and X = 950.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
5.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 60 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	623.16	498.72
2	626.89	495.40
3	630.71	492.17
4	634.60	489.02
5	638.56	485.97
6	642.59	483.01
7	646.69	480.15
8	650.85	477.39
9	655.08	474.72
10	659.37	472.15
11	663.72	469.69
12	668.13	467.33
13	672.59	465.07
14	677.10	462.92
15	681.67	460.87
16	686.28	458.93
17	690.93	457.10
18	695.62	455.38
19	700.36	453.77
20	705.13	452.27
21	709.93	450.89
22	714.77	449.62
23	719.63	448.46
24	724.52	447.41
25	729.43	446.48
26	734.37	445.67

27	739.32	444.97
28	744.28	444.39
29	749.26	443.93
30	754.25	443.58
31	759.25	443.35
32	764.24	443.24
33	769.24	443.25
34	774.24	443.37
35	779.24	443.61
36	784.22	443.96
37	789.20	444.44
38	794.17	445.03
39	799.12	445.74
40	804.05	446.56
41	808.96	447.50
42	813.85	448.55
43	818.71	449.72
44	823.54	451.00
45	828.34	452.40
46	833.11	453.90
47	837.84	455.52
48	842.53	457.25
49	847.18	459.09
50	851.79	461.04
51	856.34	463.10
52	860.85	465.26
53	865.31	467.53
54	869.71	469.90
55	874.06	472.37
56	878.34	474.95
57	882.57	477.62
58	886.73	480.39
59	890.82	483.26
60	893.70	485.39

Circle Center At X = 766.5 ; Y = 656.1 and Radius, 212.9

*** 1.329 ***

Individual data on the 67 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.7	803.7	.0	.0	.0	.0	.0	.0	.0
2	.5	216.2	.0	.0	.0	.0	.0	.0	.0
3	3.3	2033.4	.0	386.9	.0	.0	.0	.0	.0
4	3.9	3406.5	.0	1374.0	.0	.0	.0	.0	.0
5	4.0	4567.2	.0	2340.5	.0	.0	.0	.0	.0
6	4.0	5731.2	.0	3278.0	.0	.0	.0	.0	.0
7	4.1	6894.3	.0	4185.9	.0	.0	.0	.0	.0
8	4.2	8052.3	.0	5063.8	.0	.0	.0	.0	.0
9	4.2	9201.1	.0	5911.2	.0	.0	.0	.0	.0
10	4.3	10336.7	.0	6727.5	.0	.0	.0	.0	.0
11	4.4	11455.3	.0	7512.5	.0	.0	.0	.0	.0
12	4.4	12552.9	.0	8265.6	.0	.0	.0	.0	.0
13	4.5	13625.8	.0	8986.4	.0	.0	.0	.0	.0
14	4.5	14670.1	.0	9674.5	.0	.0	.0	.0	.0
15	4.6	15682.9	.0	10329.6	.0	.0	.0	.0	.0
16	4.6	16660.4	.0	10951.3	.0	.0	.0	.0	.0
17	4.3	16427.9	.0	10768.8	.0	.0	.0	.0	.0
18	.3	1172.3	.0	770.4	.0	.0	.0	.0	.0
19	4.7	18698.9	.0	12093.0	.0	.0	.0	.0	.0
20	4.7	19899.3	.0	12612.4	.0	.0	.0	.0	.0
21	4.8	21033.9	.0	13097.1	.0	.0	.0	.0	.0
22	4.8	22098.3	.0	13546.8	.0	.0	.0	.0	.0
23	4.8	23089.5	.0	13961.5	.0	.0	.0	.0	.0
24	1.2	6013.4	.0	3600.3	.0	.0	.0	.0	.0
25	3.6	18123.4	.0	10740.3	.0	.0	.0	.0	.0
26	4.9	25438.8	.0	14684.3	.0	.0	.0	.0	.0

27	4.9	26680.0	.0	14991.9	.0	.0	.0	.0	.0
28	4.9	27841.8	.0	15263.6	.0	.0	.0	.0	.0
29	5.0	28921.0	.0	15499.3	.0	.0	.0	.0	.0
30	5.0	29914.3	.0	15698.7	.0	.0	.0	.0	.0
31	5.0	30818.9	.0	15861.7	.0	.0	.0	.0	.0
32	5.0	31632.6	.0	15988.2	.0	.0	.0	.0	.0
33	5.0	32353.0	.0	16078.1	.0	.0	.0	.0	.0
34	5.0	32978.2	.0	16131.3	.0	.0	.0	.0	.0
35	5.0	33507.3	.0	16148.1	.0	.0	.0	.0	.0
36	5.0	33938.3	.0	16128.1	.0	.0	.0	.0	.0
37	5.0	34271.2	.0	16071.8	.0	.0	.0	.0	.0
38	5.0	34504.6	.0	15978.7	.0	.0	.0	.0	.0
39	5.0	34638.4	.0	15849.0	.0	.0	.0	.0	.0
40	5.0	34672.9	.0	15682.9	.0	.0	.0	.0	.0
41	4.9	34608.7	.0	15480.6	.0	.0	.0	.0	.0
42	4.9	34445.7	.0	15241.7	.0	.0	.0	.0	.0
43	4.9	34185.5	.0	14966.9	.0	.0	.0	.0	.0
44	3.0	21070.2	.0	9155.2	.0	.0	.0	.0	.0
45	1.8	12719.3	36192.7	5127.1	.0	.0	.0	.0	.0
46	4.9	32858.1	95248.0	12968.9	.0	.0	.0	.0	.0
47	4.8	31721.1	94688.9	12080.4	.0	.0	.0	.0	.0
48	1.5	9374.9	28570.0	3488.4	.0	.0	.0	.0	.0
49	3.3	21147.2	65506.5	7673.6	.0	.0	.0	.0	.0
50	4.8	29294.2	93409.2	10214.3	.0	.0	.0	.0	.0
51	4.7	27997.5	92690.5	9237.6	.0	.0	.0	.0	.0
52	.4	2169.3	7339.2	694.7	.0	.0	.0	.0	.0
53	4.3	24446.2	84581.1	7537.7	.0	.0	.0	.0	.0
54	4.6	25145.2	91098.8	7199.5	.0	.0	.0	.0	.0
55	4.6	23614.8	90228.1	6139.3	.0	.0	.0	.0	.0
56	3.2	15672.0	62954.5	3676.0	.0	.0	.0	.0	.0
57	1.3	6318.3	27735.3	1376.4	.0	.0	.0	.0	.0
58	4.5	19705.2	93256.8	3939.4	.0	.0	.0	.0	.0
59	4.5	17185.9	92608.4	2801.0	.0	.0	.0	.0	.0
60	4.4	14658.6	91894.1	1637.7	.0	.0	.0	.0	.0
61	3.8	10747.4	79736.2	459.5	.0	.0	.0	.0	.0
62	.5	1384.0	11376.9	.0	.0	.0	.0	.0	.0
63	4.3	9712.6	90266.0	.0	.0	.0	.0	.0	.0
64	4.2	7369.8	89352.1	.0	.0	.0	.0	.0	.0
65	4.2	5045.7	88370.9	.0	.0	.0	.0	.0	.0
66	4.1	2747.6	87325.6	.0	.0	.0	.0	.0	.0
67	2.9	572.8	61636.2	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 57 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	623.16	498.72
2	626.75	495.25
3	630.43	491.86
4	634.21	488.58
5	638.07	485.41
6	642.01	482.33
7	646.04	479.37
8	650.14	476.51
9	654.32	473.77
10	658.57	471.14
11	662.89	468.62
12	667.28	466.22
13	671.73	463.94
14	676.24	461.78
15	680.81	459.75
16	685.43	457.83
17	690.10	456.05
18	694.81	454.38
19	699.57	452.85
20	704.37	451.45
21	709.20	450.17
22	714.07	449.02
23	718.97	448.01

24	723.89	447.13
25	728.83	446.38
26	733.79	445.77
27	738.77	445.28
28	743.76	444.94
29	748.75	444.72
30	753.75	444.65
31	758.75	444.70
32	763.75	444.89
33	768.74	445.22
34	773.72	445.68
35	778.68	446.27
36	783.63	447.00
37	788.55	447.86
38	793.45	448.85
39	798.33	449.98
40	803.17	451.23
41	807.97	452.61
42	812.74	454.13
43	817.46	455.77
44	822.14	457.54
45	826.77	459.43
46	831.34	461.45
47	835.86	463.59
48	840.32	465.85
49	844.72	468.22
50	849.05	470.72
51	853.31	473.33
52	857.50	476.06
53	861.62	478.90
54	865.66	481.85
55	869.62	484.90
56	873.49	488.06
57	876.78	490.90

Circle Center At X = 754.2 ; Y = 630.4 and Radius, 185.7

*** 1.356 ***

Failure Surface Specified By 50 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	630.00	498.70
2	633.61	495.24
3	637.32	491.89
4	641.14	488.67
5	645.07	485.57
6	649.08	482.59
7	653.20	479.75
8	657.40	477.03
9	661.68	474.46
10	666.05	472.02
11	670.49	469.72
12	675.00	467.57
13	679.58	465.56
14	684.22	463.70
15	688.92	461.98
16	693.67	460.42
17	698.46	459.01
18	703.30	457.75
19	708.18	456.65
20	713.09	455.71
21	718.03	454.92
22	722.99	454.29
23	727.97	453.82
24	732.96	453.51
25	737.95	453.36
26	742.95	453.37
27	747.95	453.54
28	752.94	453.87

29	757.92	454.35
30	762.87	455.00
31	767.81	455.80
32	772.72	456.76
33	777.59	457.88
34	782.43	459.15
35	787.22	460.58
36	791.96	462.15
37	796.65	463.88
38	801.29	465.76
39	805.86	467.79
40	810.36	469.96
41	814.80	472.27
42	819.15	474.72
43	823.43	477.31
44	827.62	480.04
45	831.72	482.90
46	835.73	485.89
47	839.65	489.00
48	843.46	492.24
49	847.16	495.60
50	849.65	498.00

Circle Center At X = 740.2 ; Y = 609.9 and Radius, 156.5

*** 1.378 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	630.00	498.70
2	633.68	495.32
3	637.48	492.06
4	641.38	488.93
5	645.38	485.94
6	649.48	483.08
7	653.67	480.35
8	657.96	477.77
9	662.32	475.33
10	666.77	473.04
11	671.28	470.90
12	675.87	468.91
13	680.52	467.07
14	685.23	465.39
15	689.99	463.87
16	694.80	462.51
17	699.66	461.30
18	704.55	460.26
19	709.47	459.39
20	714.42	458.68
21	719.39	458.13
22	724.37	457.75
23	729.37	457.53
24	734.37	457.49
25	739.37	457.60
26	744.36	457.89
27	749.34	458.34
28	754.30	458.96
29	759.24	459.74
30	764.15	460.68
31	769.02	461.79
32	773.86	463.06
33	778.65	464.49
34	783.39	466.08
35	788.08	467.83
36	792.70	469.73
37	797.26	471.79
38	801.75	473.99
39	806.16	476.35
40	810.49	478.85

41	814.73	481.49
42	818.89	484.27
43	822.95	487.19
44	826.91	490.24
45	830.76	493.43
46	834.51	496.74
47	835.85	498.00

Circle Center At X = 733.3 ; Y = 607.6 and Radius, 150.1

*** 1.380 ***

Failure Surface Specified By 57 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	616.32	498.75
2	619.89	495.25
3	623.56	491.86
4	627.32	488.56
5	631.17	485.37
6	635.11	482.29
7	639.13	479.32
8	643.23	476.46
9	647.41	473.72
10	651.67	471.09
11	655.99	468.58
12	660.39	466.20
13	664.84	463.93
14	669.36	461.79
15	673.94	459.78
16	678.57	457.89
17	683.25	456.13
18	687.98	454.50
19	692.75	453.00
20	697.56	451.64
21	702.40	450.41
22	707.28	449.31
23	712.19	448.35
24	717.12	447.53
25	722.07	446.84
26	727.04	446.29
27	732.03	445.88
28	737.02	445.60
29	742.02	445.47
30	747.02	445.47
31	752.01	445.61
32	757.01	445.89
33	761.99	446.31
34	766.96	446.86
35	771.91	447.55
36	776.84	448.38
37	781.75	449.35
38	786.62	450.45
39	791.47	451.68
40	796.28	453.05
41	801.05	454.55
42	805.77	456.18
43	810.45	457.95
44	815.08	459.84
45	819.66	461.86
46	824.17	464.00
47	828.63	466.27
48	833.02	468.66
49	837.34	471.17
50	841.59	473.80
51	845.77	476.55
52	849.87	479.41
53	853.89	482.39
54	857.83	485.47
55	861.68	488.66

56	865.43	491.96
57	867.54	493.91

Circle Center At X = 744.4 ; Y = 626.1 and Radius, 180.6

*** 1.389 ***

Failure Surface Specified By 59 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	623.16	498.72
2	626.72	495.22
3	630.38	491.81
4	634.12	488.49
5	637.95	485.28
6	641.86	482.16
7	645.85	479.15
8	649.92	476.24
9	654.06	473.44
10	658.28	470.75
11	662.56	468.17
12	666.91	465.70
13	671.32	463.35
14	675.79	461.11
15	680.32	458.99
16	684.90	456.99
17	689.53	455.11
18	694.21	453.35
19	698.94	451.71
20	703.70	450.20
21	708.51	448.81
22	713.34	447.54
23	718.21	446.41
24	723.11	445.40
25	728.03	444.51
26	732.97	443.76
27	737.94	443.14
28	742.91	442.64
29	747.90	442.27
30	752.89	442.04
31	757.89	441.94
32	762.89	441.96
33	767.89	442.12
34	772.88	442.40
35	777.86	442.82
36	782.83	443.36
37	787.79	444.04
38	792.72	444.84
39	797.63	445.78
40	802.52	446.84
41	807.38	448.02
42	812.20	449.34
43	816.99	450.77
44	821.74	452.34
45	826.45	454.02
46	831.11	455.83
47	835.72	457.76
48	840.28	459.81
49	844.79	461.97
50	849.24	464.26
51	853.62	466.66
52	857.95	469.17
53	862.20	471.79
54	866.39	474.53
55	870.50	477.37
56	874.54	480.32
57	878.50	483.37
58	882.38	486.52
59	884.54	488.37

Circle Center At X = 759.4 ; Y = 633.8 and Radius, 191.8

*** 1.390 ***
Failure Surface Specified By 60 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	630.00	498.70
2	633.54	495.16
3	637.16	491.72
4	640.87	488.37
5	644.67	485.12
6	648.55	481.96
7	652.51	478.91
8	656.54	475.96
9	660.65	473.11
10	664.84	470.37
11	669.09	467.74
12	673.41	465.22
13	677.79	462.81
14	682.23	460.51
15	686.73	458.33
16	691.28	456.26
17	695.88	454.31
18	700.54	452.48
19	705.23	450.77
20	709.97	449.18
21	714.75	447.71
22	719.57	446.37
23	724.42	445.15
24	729.30	444.06
25	734.20	443.09
26	739.13	442.24
27	744.08	441.53
28	749.05	440.94
29	754.02	440.48
30	759.01	440.14
31	764.01	439.94
32	769.01	439.86
33	774.01	439.91
34	779.00	440.09
35	784.00	440.40
36	788.98	440.83
37	793.94	441.40
38	798.90	442.09
39	803.83	442.91
40	808.74	443.85
41	813.62	444.92
42	818.48	446.11
43	823.30	447.43
44	828.09	448.87
45	832.84	450.44
46	837.55	452.12
47	842.21	453.93
48	846.82	455.85
49	851.39	457.90
50	855.90	460.06
51	860.35	462.33
52	864.74	464.72
53	869.07	467.22
54	873.34	469.83
55	877.53	472.55
56	881.66	475.37
57	885.71	478.30
58	889.68	481.34
59	893.58	484.47
60	894.39	485.16

Circle Center At X = 769.5 ; Y = 634.7 and Radius, 194.8

*** 1.390 ***
Failure Surface Specified By 60 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	630.00	498.70
2	633.88	495.54
3	637.82	492.47
4	641.83	489.48
5	645.90	486.58
6	650.04	483.77
7	654.23	481.05
8	658.48	478.41
9	662.79	475.87
10	667.15	473.43
11	671.56	471.08
12	676.02	468.82
13	680.53	466.66
14	685.09	464.60
15	689.69	462.64
16	694.33	460.77
17	699.01	459.01
18	703.72	457.35
19	708.47	455.79
20	713.26	454.33
21	718.07	452.98
22	722.91	451.73
23	727.78	450.58
24	732.67	449.54
25	737.58	448.60
26	742.51	447.78
27	747.46	447.05
28	752.42	446.44
29	757.39	445.93
30	762.38	445.53
31	767.37	445.23
32	772.36	445.05
33	777.36	444.97
34	782.36	445.00
35	787.36	445.13
36	792.36	445.38
37	797.34	445.73
38	802.32	446.19
39	807.29	446.75
40	812.25	447.43
41	817.18	448.21
42	822.10	449.09
43	827.01	450.08
44	831.88	451.18
45	836.74	452.38
46	841.56	453.69
47	846.36	455.10
48	851.13	456.61
49	855.86	458.23
50	860.55	459.94
51	865.21	461.76
52	869.83	463.68
53	874.41	465.69
54	878.94	467.81
55	883.42	470.02
56	887.86	472.33
57	892.24	474.73
58	896.57	477.23
59	900.85	479.81
60	904.22	481.96

Circle Center At X = 778.5 ; Y = 677.1 and Radius, 232.1

*** 1.391 ***

Failure Surface Specified By 54 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	623.16	498.72
2	626.75	495.24
3	630.44	491.87
4	634.23	488.61
5	638.11	485.46
6	642.09	482.43
7	646.15	479.52
8	650.30	476.73
9	654.53	474.06
10	658.84	471.52
11	663.22	469.11
12	667.67	466.83
13	672.19	464.69
14	676.76	462.67
15	681.40	460.80
16	686.09	459.06
17	690.83	457.47
18	695.61	456.01
19	700.44	454.70
20	705.30	453.53
21	710.19	452.51
22	715.11	451.63
23	720.06	450.90
24	725.03	450.32
25	730.01	449.88
26	735.00	449.59
27	740.00	449.45
28	745.00	449.46
29	749.99	449.62
30	754.98	449.93
31	759.96	450.38
32	764.93	450.98
33	769.87	451.73
34	774.79	452.62
35	779.68	453.66
36	784.54	454.85
37	789.36	456.17
38	794.14	457.64
39	798.87	459.26
40	803.55	461.01
41	808.18	462.90
42	812.75	464.93
43	817.26	467.09
44	821.71	469.38
45	826.08	471.81
46	830.38	474.36
47	834.60	477.04
48	838.74	479.84
49	842.79	482.77
50	846.76	485.82
51	850.63	488.98
52	854.41	492.25
53	858.09	495.64
54	859.13	496.65

Circle Center At X = 742.2 ; Y = 617.8 and Radius, 168.4

*** 1.392 ***

Failure Surface Specified By 46 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	630.00	498.70
2	633.73	495.37
3	637.57	492.17
4	641.51	489.09
5	645.56	486.15
6	649.70	483.35
7	653.93	480.69
8	658.25	478.17

9	662.65	475.80
10	667.13	473.57
11	671.68	471.50
12	676.29	469.58
13	680.97	467.82
14	685.71	466.21
15	690.49	464.76
16	695.33	463.48
17	700.20	462.36
18	705.11	461.40
19	710.04	460.60
20	715.00	459.98
21	719.98	459.51
22	724.97	459.22
23	729.97	459.09
24	734.97	459.13
25	739.97	459.34
26	744.95	459.72
27	749.92	460.26
28	754.87	460.97
29	759.80	461.84
30	764.69	462.88
31	769.54	464.08
32	774.35	465.45
33	779.11	466.97
34	783.82	468.65
35	788.47	470.49
36	793.06	472.49
37	797.57	474.63
38	802.01	476.93
39	806.38	479.37
40	810.65	481.96
41	814.84	484.69
42	818.94	487.56
43	822.93	490.57
44	826.83	493.70
45	830.61	496.97
46	831.73	498.00

Circle Center At X = 731.2 ; Y = 608.3 and Radius, 149.2

*** 1.394 ***

8114-10
Part 23

APPENDIX E

SLOPE STABILITY ANALYSES RESULTS AND FACTORS OF SAFETY SUBSIDENCE-INDUCED EMBANKMENT CRACKING AND EMBANKMENT FAILURE

gai consultants
transforming ideas into reality

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Post-Subsidence Evaluation – Embankment Cracking and Total Embankment Failure Slope Stability Analyses

BY AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY [signature] DATE 5/7/09 SHEET NO. 1 OF 5

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CALCULATION BRIEF
FOR
POST-SUBSIDENCE EMBANKMENT CRACKING AND TOTAL EMBANKMENT FAILURE SLOPE STABILITY ANALYSES AND FACTORS OF SAFETY

POND CREEK COAL REFUSE DISPOSAL SITE – PHASE 3 IMPOUNDMENT

OBJECTIVE: To evaluate the susceptibility of the Phase 3 coarse coal refuse (CCR) embankment to cracking from subsidence-induced disturbance, and failure of the embankment due to elevated hydrostatic (pore) pressures from water in embankment cracks.

METHODOLOGY: Use PCSTABL limit equilibrium analyses, coarse coal refuse (CCR) tensile strength and zero-strength for fine coal refuse (FCR) estimated in Reference No. 3 to determine the factor of safety against embankment cracking. Also, utilize a total undrained and zero-strength approach to determine the factor of safety against a total strength embankment failure due to elevated hydrostatic (pore) pressures from the rapid loading, subsidence-induced longwall mining beneath the Pond Creek Phase 3 impoundment.

REFERENCES:

1. GAI Consultants, Inc. Calculation, "Determination of Downstream and Upstream In-Situ Driving Shear Stress By Elastic (PCSTABL) Solution, Pond Creek Coal Refuse Disposal Site – Phase 3 Impoundment," BEG; 4/08/09.

2. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak and Steady-State Undrained Shear Strengths For Refuse and Subgrade Materials, Pond Creek Coal Refuse Disposal Site – South Pond", BEG, 7/12/08.

3. GAI Consultants, Inc. Calculation, "Supplemental Summary of Engineering Properties and Coarse Refuse Tensile Strength for Subsidence Liquefaction and Embankment Cracking Evaluations, Pond Creek Coal Refuse Disposal Site – Phase 3," BEG, 3/31/09.

4. U.S. Department of Labor, Mine Safety and Health Administration, "Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 Seismic Design: Stability and Deformation Analyses," Final Draft Dated December 2007, Updated August 1, 2008.

5. Winterkorn and Fang, (1975), "Foundation Engineering Handbook," Van Nostrand Reinhold Publishers.

6. Gregory, P.E., Garry H., "PCSTABL5M with STEDwin Slope Stability Analysis System, Version 2.0," dated September 2001.

7. Poulos, S.J., Castro, G., and France, J.W. (1985a) "Liquefaction Evaluation Procedure," Journal of the Geotechnical Engineering Division, ASCE, Vol. 111, No. GT6, pp. 772-792.

ANALYSIS:

As previously discussed in Reference No. 1, GAI evaluated the possibility of a flow slide failure of the Phase 3 FCR impoundment following the longwall mining beneath the Phase 3 impoundment and the resulting subsidence-induced disturbance. Based on the results of analyses, triggering an FCR strength loss and/or flow slide failure is not a feasible failure mode since there is zero (0) driving shear stress along the critical failure surface through the Phase 3 impoundment FCR.

Additionally, and as requested by the Mine Safety and Health Administration (MSHA), the susceptibility of the Phase 3 CCR embankment to cracking from subsidence-induced disturbance, and failure of the embankment due to elevated hydrostatic (pore) pressures from water in embankment cracks is evaluated herein.

GAI's analysis of embankment cracking included evaluating the tensile strength (σ_t) of site-specific CCR material was based on Winterkorn and Fang, (1975), from six (6) consolidated-undrained (CU) triaxial test points of compacted CCR at various confining pressures. Reference No. 3 presents the detailed calculations of σ_t.

The following equation was used to calculate tensile strength (σ_t) from laboratory test specimens of coarse coal refuse:

Tensile Strength (σ_t):

$\sigma_t = P/\pi(KbH-a^2)$
Where,
P = Load at failure
K = Constant = 1.0 (per Ref. No. 10)
b = Radius of test specimen
H = Height of test specimen
a = Radius of disks/platens

CCR tensile strength was subsequently normalized to equivalent vertical effective stress (σ'_v), also presented in Reference No. 3, and a conservative 2/3-1/3 relationship of σ_t-to-σ'_v (σ_t/σ'_v) estimated at 0.15, and the corresponding average CCR σ_t for the Phase 3 embankment was estimated at 475 psf.

This σ_t is considered to be a reasonable, low tensile strength value for the Phase 3 structurally-placed CCR embankment.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Post-Subsidence Evaluation – Embankment Cracking and Total Embankment Failure Slope Stability Analyses

BY AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

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As presented herein, Phase 3 post-subsidence slope stability analyses were performed to evaluate the potential for embankment cracking, and included using the conservatively-derived CCR σ_t value as cohesion (ϕ=0, c=475 psf) for the embankment, a conservative zero (0) strength value for the FCR, and the total undrained shear strength parameters for residual soil. The minimum factor of safety against embankment cracking was estimated at 1.1.

Additional Phase 3 post-subsidence, undrained slope stability analyses were performed to evaluate the possibility of a total failure of the Phase 3 embankment due to the subsidence event. The analyses include using undrained total strength parameters for the CCR embankment and residual soil, which assumes an increase in pore pressure of the saturated portions of the embankment and underlying soil due to the rapid subsidence loading and corresponding decrease in strength from drained to undrained, and a conservative zero (0) strength cohesion value for the FCR. The minimum factor of safety against post-subsidence embankment failure was estimated at 2.4.

The following soil properties were estimated based on previous field and laboratory testing as well as current FCR testing for use in the various slope stability analyses as noted in Reference Nos. 2 and 3:

Description	Unit Weights (γ_t,γ_s) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion (c) (psf)	Strength
Coarse Coal Refuse (CCR)	130, 140	18.0 0	736 σ_t/σ'_v=0.15	Total Strength Tensile Strength
Fine Coal Refuse (FCR)	80, 90	0	S_u/σ'_v=0	Zero-Strength
Residual Soil	125, 135	19.5	416	Total Strength

Results of Embankment Cracking and Embankment Failure Slope Stability Analyses:

Phase 3 Impoundment (Crest/Cap El. 500 ft) (Top of Fines El. 496 ft)	Post-Subsidence Factor of Safety Including Zero-Strength FCR (dim)
Embankment Cracking – CCR Tensile Strength FCR Zero-Strength Residual Total Strength	1.1
Embankment Failure – CCR Total Strength FCR Zero-Strength Residual Total Strength	2.4

(1) Cap includes 5-foot coarse refuse layer above top of fines elevation.

Hard copies of the input and output files for the embankment cracking and embankment failure slope stability analyses are presented in Attachments 1 and 2, respectively.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Post-Subsidence Evaluation – Embankment Cracking and Total Embankment Failure Slope Stability Analyses

BY AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY BEG DATE 5/7/09 SHEET NO. 4 OF 5

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GAI notes the following conservatisms inherent in the engineering properties used in these post-subsidence stability analyses, particularly the embankment cracking analyses, which will increase the estimated factor of safety:

- CCR strength estimates discount negative pore pressures that will undoubtedly develop during the initial stages of the subsidence rapid loading event due to the compacted, dense initial state of stress of the CCR;
- CU testing results of all six (6) CCR points suggest that the peak strain for the CCR material ranges from about 12.5 to 15.3 percent, which attributed to the claystone and shale rock materials in the CCR; and
- Peak strain for the CCR material is significantly higher than the range of anticipated subsidence threshold strains of about 1 to 3 percent.

CONCLUSIONS

GAI has completed stability analyses to evaluate the potential for embankment cracking and embankment failure due to subsidence-related disturbance. Based on conservatively-derived strength parameters, adequate factor of safety exists relative to a total failure of the Phase 3 embankment. Marginal factor of safety exists relative to Phase 3 embankment cracking; however, conservatisms in the analyses exist as noted above. The following conclusions are noted:

- FCR was characterized as clay-like, which typically is more resistant to strength loss (or flow) than sand-like materials;
- In-situ driving shear stresses through the FCR are 0 psf;
- Phase 3 minimum factors of safety against flow slide susceptibility, with zero-strength FCR in the downstream and upstream directions were estimated at 2.2 and 1.3, respectively, as presented in Ref. No. 3;
- The Phase 3 factor of safety against embankment failure of 2.4, and
- The Phase 3 factor of safety against embankment cracking of 1.1.

Recommendations for instrumentation of the embankment prior to, during and following longwall mining beneath the Phase 3 impoundment are presented below.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 3 Post-Subsidence Evaluation – Embankment Cracking and Total Embankment Failure Slope Stability Analyses

BY AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

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RECOMMENDATIONS

Based on the results of the Phase 3 subsidence-related stability analyses, adequate factors of safety exist relative to catastrophic failure scenarios including a potential flow slide and embankment failure. Marginal stability exists relative to potential cracking of the Phase 3 embankment due to the proposed longwall mining beneath the impoundment; however, some conservatism exists in the analyses as previously noted, including derivation of tensile strength properties, negative pore pressure and increased strength during loading, and high strain capability of the CCR embankment materials relative to estimated induced subsidence strain. Consequently, GAI does not anticipate significant embankment cracking, if any. However, there are various unknowns relative to the actual performance of the impoundment that require attention.

Therefore, GAI recommends that instrumentation installations and monitoring of the Phase 3 embankment be performed prior to, during and following longwall mining beneath the Phase 3 impoundment including installing pore pressure transducers and inclinometers. Also, GAI recommends that detailed inspections of the embankment, cap, toe areas and outlet structures be performed two (2) times/days prior to, daily during, and daily following longwall mining beneath the Phase 3 impoundment for a period of two (2) weeks following completion of mining, and any deviations noted.

Further, GAI recommends that a CCR buttress or sealing layer remedial alternative, such as that proposed for the southern slope of the Phase 7 impoundment (Phase 7B) be designed, and construction implementation provisions made based on the results of the Phase 3 detailed inspections and instrumentation monitoring. If extensive cracking, seepage and/or other noticeable surface features are noted, and the magnitude of pore pressure and deformation are deemed potentially detrimental to the short- or long-term performance of the Phase 3 impoundment, then the implementation of the buttress/seal remedial alternative should be employed.

If the post-subsidence instrumentation monitoring and inspection results indicate that the Phase 3 embankment/impoundment distress is not a concern, i.e., no adverse cracking, seepage, excess pore pressure or deformation, then monitoring of the Phase 3 should continue twice a week for a period of two (2) months. If after an additional two (2) months of satisfactory monitoring results, and the embankment/impoundment continues to exhibit adequate performance characteristics, i.e., the magnitudes of pore pressure and deformation decrease, level off, or approach normal operating levels, and no increased seepage conditions or cracking exist, then monitoring of the Phase 3 embankment could be discontinued.

ATTACHMENT 1

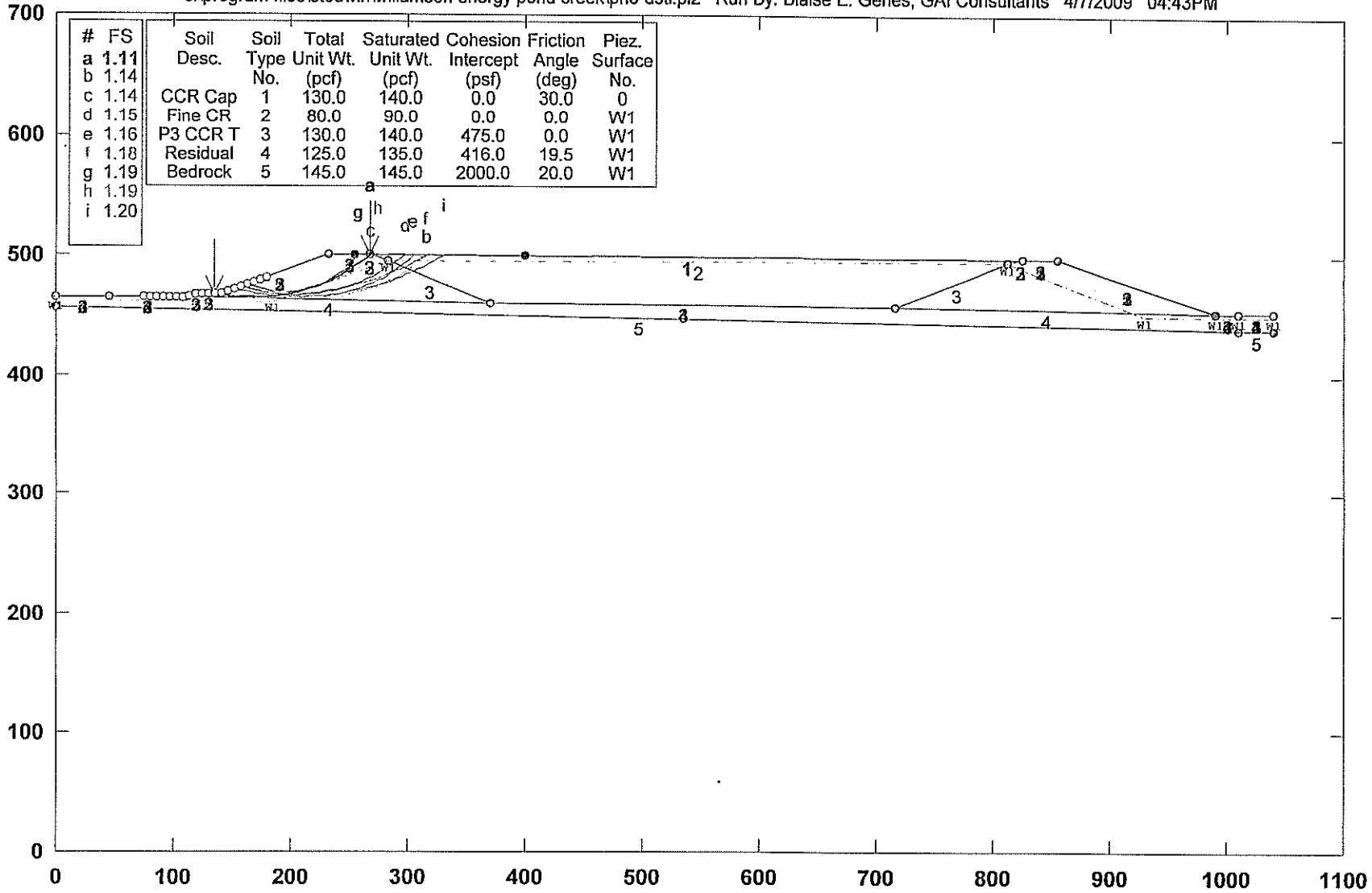
PHASE 3 POST-SUBSIDENCE
EMBANKMENT CRACKING PCSTABL SLOPE STABILITY ANALYSES

Pond Creek, Phase 3 Embankment Tensile Strength CCR, Zero-Strength FCR

c:\program files\stedwin\wiliamson energy pond creek\ph3-dstl.pl2 Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:43PM

#	FS
a	1.11
b	1.14
c	1.14
d	1.15
e	1.16
f	1.18
g	1.19
h	1.19
i	1.20

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR Cap	1	130.0	140.0	0.0	30.0	0
Fine CR	2	80.0	90.0	0.0	0.0	W1
P3 CCR T	3	130.0	140.0	475.0	0.0	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1



PCSTABL5M/si FSmin=1.11

Safety Factors Are Calculated By The Modified Bishop Method

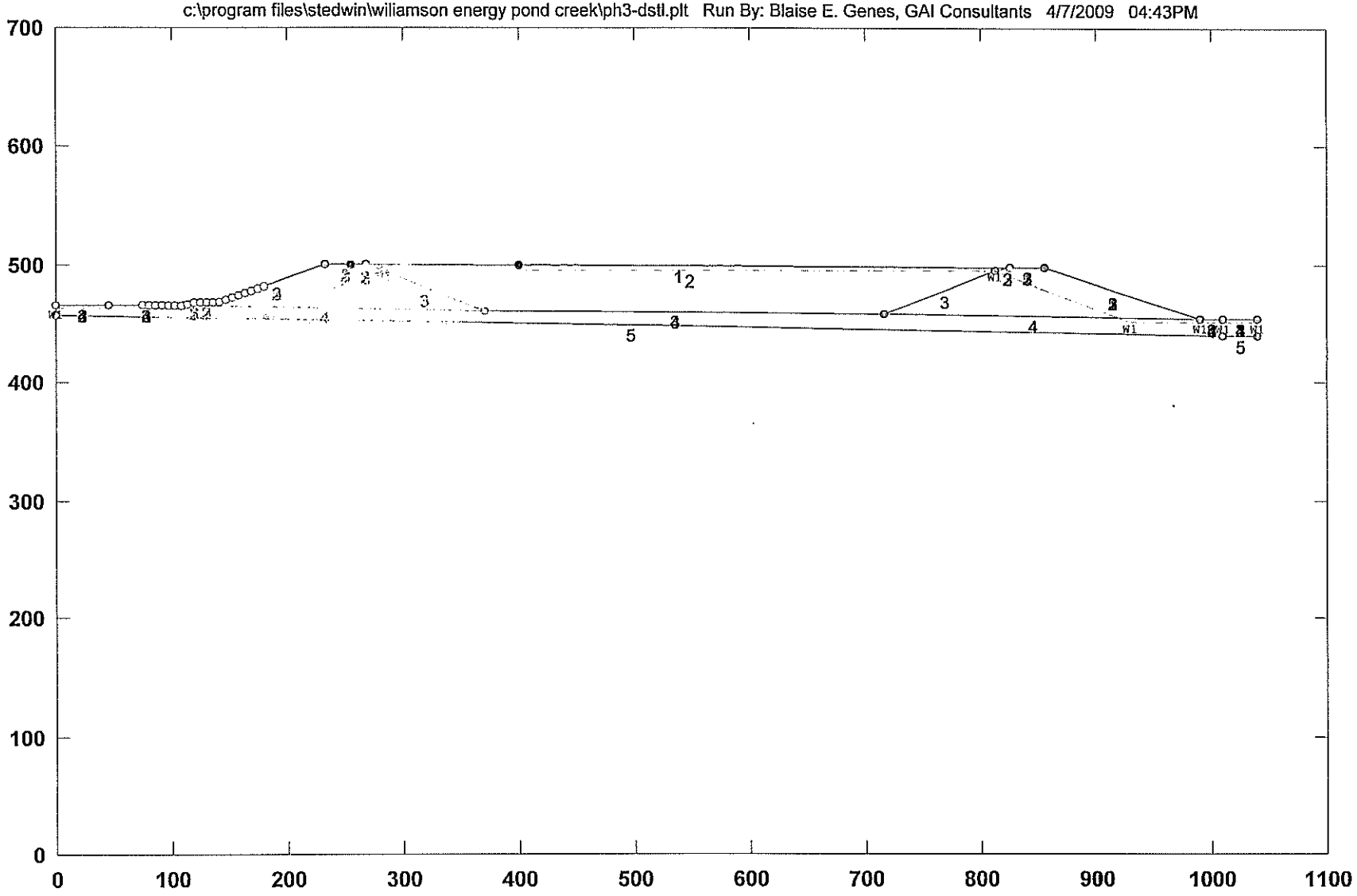
STED



R16765

Pond Creek, Phase 3 Embankment Tensile Strength CCR, Zero-Strength FCR

c:\program files\stedwin\wiliamson energy pond creek\ph3-dstl.plt Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:43PM



STED



R16766

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4/7/2009
Time of Run: 04:43PM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph3-dstl.in
Output Filename: C:ph3-dstl.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3-dstl.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 3 Embankment Tensile S
trength CCR, Zero-Strength FCR

BOUNDARY COORDINATES
10 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1
5	140.00	468.00	233.00	500.00	1
6	233.00	500.00	268.00	500.00	1
7	268.00	500.00	825.00	498.00	1
8	825.00	498.00	855.00	498.00	1
9	855.00	498.00	990.00	454.00	1
10	990.00	454.00	1010.00	454.00	1
11	1010.00	454.00	1040.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1040.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1040.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4
46	1010.00	454.00	1040.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1040.00	439.00	5

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	30.0	.00	.0	0
2	80.0	90.0	.0	.0	.00	.0	1
3	130.0	140.0	475.0	.0	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 75.00 ft.
and X = 180.00 ft.
Each Surface Terminates Between X = 255.00 ft.
and X = 400.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
5.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.79	468.00
2	140.70	467.07
3	145.64	466.29
4	150.60	465.67
5	155.58	465.21
6	160.57	464.90
7	165.57	464.75
8	170.57	464.76
9	175.57	464.92
10	180.56	465.24
11	185.53	465.72
12	190.49	466.35
13	195.43	467.14
14	200.34	468.08
15	205.22	469.18
16	210.06	470.43
17	214.86	471.83
18	219.61	473.38
19	224.32	475.08
20	228.96	476.93
21	233.55	478.92
22	238.07	481.05
23	242.52	483.33
24	246.90	485.74
25	251.20	488.29
26	255.42	490.98

27	259.56	493.79
28	263.60	496.73
29	267.54	499.80
30	267.78	500.00

Circle Center At X = 167.9 ; Y = 623.9 and Radius, 159.2

*** 1.108 ***

Individual data on the 31 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	4.2	218.1	.0	.0	.0	.0	.0	.0	.0
2	.7	89.9	.0	.0	.0	.0	.0	.0	.0
3	4.9	1547.2	.0	.0	.0	.0	.0	.0	.0
4	5.0	3102.8	.0	.0	.0	.0	.0	.0	.0
5	5.0	4570.9	.0	.0	.0	.0	.0	.0	.0
6	5.0	5944.9	.0	.0	.0	.0	.0	.0	.0
7	5.0	7218.7	.0	.0	.0	.0	.0	.0	.0
8	5.0	8386.8	.0	.0	.0	.0	.0	.0	.0
9	5.0	9444.4	.0	.0	.0	.0	.0	.0	.0
10	5.0	10387.7	.0	.0	.0	.0	.0	.0	.0
11	5.0	11213.2	.0	.0	.0	.0	.0	.0	.0
12	5.0	11918.4	.0	.0	.0	.0	.0	.0	.0
13	4.9	12501.6	.0	.0	.0	.0	.0	.0	.0
14	4.9	12961.6	.0	.0	.0	.0	.0	.0	.0
15	4.9	13298.3	.0	.0	.0	.0	.0	.0	.0
16	4.8	13512.1	.0	.0	.0	.0	.0	.0	.0
17	4.8	13604.1	.0	.0	.0	.0	.0	.0	.0
18	4.8	13576.4	.0	.0	.0	.0	.0	.0	.0
19	4.7	13431.7	.0	.0	.0	.0	.0	.0	.0
20	4.6	13173.5	.0	.0	.0	.0	.0	.0	.0
21	4.0	11281.8	.0	.0	.0	.0	.0	.0	.0
22	.6	1517.2	.0	.0	.0	.0	.0	.0	.0
23	4.5	11765.0	.0	.0	.0	.0	.0	.0	.0
24	4.5	10308.8	.0	.0	.0	.0	.0	.0	.0
25	4.4	8803.8	.0	.0	.0	.0	.0	.0	.0
26	4.3	7259.4	.0	.0	.0	.0	.0	.0	.0
27	4.2	5685.5	.0	.0	.0	.0	.0	.0	.0
28	4.1	4092.1	.0	.0	.0	.0	.0	.0	.0
29	4.0	2489.7	.0	.0	.0	.0	.0	.0	.0
30	3.9	888.9	.0	.0	.0	.0	.0	.0	.0
31	.2	3.1	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.32	468.45
2	146.28	467.84
3	151.25	467.30
4	156.23	466.86
5	161.22	466.50
6	166.21	466.22
7	171.21	466.03
8	176.20	465.92
9	181.20	465.90
10	186.20	465.97
11	191.20	466.12
12	196.20	466.36
13	201.19	466.68
14	206.17	467.09
15	211.14	467.58
16	216.11	468.16
17	221.07	468.82
18	226.01	469.57
19	230.94	470.40
20	235.86	471.32
21	240.75	472.32
22	245.64	473.41

23	250.50	474.57
24	255.34	475.82
25	260.16	477.16
26	264.95	478.57
27	269.72	480.07
28	274.47	481.65
29	279.18	483.31
30	283.87	485.05
31	288.53	486.87
32	293.15	488.77
33	297.75	490.75
34	302.30	492.80
35	306.82	494.94
36	311.31	497.15
37	315.75	499.44
38	316.48	499.83

Circle Center At X = 179.8 ; Y = 758.0 and Radius, 292.1

*** 1.137 ***

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.79	468.00
2	140.72	467.18
3	145.68	466.50
4	150.65	465.97
5	155.63	465.59
6	160.63	465.36
7	165.63	465.28
8	170.63	465.35
9	175.62	465.56
10	180.61	465.93
11	185.58	466.44
12	190.54	467.10
13	195.47	467.91
14	200.38	468.87
15	205.26	469.97
16	210.10	471.22
17	214.90	472.61
18	219.66	474.14
19	224.37	475.81
20	229.03	477.63
21	233.64	479.58
22	238.18	481.67
23	242.66	483.89
24	247.07	486.25
25	251.41	488.73
26	255.67	491.35
27	259.85	494.09
28	263.95	496.95
29	267.96	499.93
30	268.05	500.00

Circle Center At X = 165.9 ; Y = 633.0 and Radius, 167.7

*** 1.143 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	157.90	474.16
2	162.69	472.74
3	167.53	471.49
4	172.41	470.39
5	177.32	469.45
6	182.26	468.68
7	187.22	468.07
8	192.20	467.62
9	197.19	467.34
10	202.19	467.22
11	207.19	467.27

12	212.19	467.48
13	217.17	467.86
14	222.15	468.40
15	227.10	469.11
16	232.02	469.97
17	236.91	471.00
18	241.77	472.19
19	246.58	473.54
20	251.35	475.05
21	256.07	476.71
22	260.72	478.53
23	265.32	480.50
24	269.85	482.62
25	274.30	484.89
26	278.68	487.30
27	282.98	489.86
28	287.19	492.55
29	291.31	495.39
30	295.33	498.36
31	297.28	499.89

Circle Center At X = 203.2 ; Y = 619.0 and Radius, 151.7

*** 1.150 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	163.42	476.06
2	168.05	474.17
3	172.75	472.47
4	177.51	470.94
5	182.33	469.59
6	187.19	468.42
7	192.09	467.44
8	197.03	466.65
9	201.99	466.04
10	206.97	465.62
11	211.97	465.39
12	216.97	465.35
13	221.97	465.49
14	226.95	465.83
15	231.93	466.35
16	236.88	467.06
17	241.80	467.96
18	246.68	469.04
19	251.51	470.31
20	256.30	471.76
21	261.03	473.39
22	265.69	475.19
23	270.28	477.17
24	274.79	479.32
25	279.22	481.65
26	283.56	484.13
27	287.80	486.78
28	291.94	489.59
29	295.96	492.55
30	299.88	495.66
31	303.67	498.92
32	304.69	499.87

Circle Center At X = 215.6 ; Y = 597.6 and Radius, 132.2

*** 1.157 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	163.42	476.06
2	168.04	474.13
3	172.72	472.37
4	177.45	470.78
5	182.25	469.35

6	187.08	468.09
7	191.96	467.00
8	196.88	466.08
9	201.82	465.34
10	206.79	464.77
11	211.78	464.37
12	216.77	464.15
13	221.77	464.11
14	226.77	464.24
15	231.76	464.54
16	236.74	465.02
17	241.69	465.68
18	246.62	466.51
19	251.52	467.51
20	256.38	468.68
21	261.20	470.03
22	265.96	471.54
23	270.68	473.22
24	275.32	475.06
25	279.90	477.06
26	284.41	479.23
27	288.84	481.55
28	293.19	484.02
29	297.44	486.65
30	301.60	489.42
31	305.66	492.34
32	309.62	495.39
33	313.46	498.59
34	314.86	499.83

Circle Center At X = 220.5 ; Y = 606.4 and Radius, 142.3

*** 1.180 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	163.42	476.06
2	168.07	474.22
3	172.83	472.68
4	177.67	471.44
5	182.58	470.50
6	187.54	469.88
7	192.53	469.57
8	197.53	469.57
9	202.52	469.88
10	207.48	470.51
11	212.40	471.45
12	217.24	472.69
13	221.99	474.24
14	226.64	476.08
15	231.17	478.20
16	235.55	480.61
17	239.77	483.29
18	243.82	486.23
19	247.67	489.41
20	251.32	492.84
21	254.74	496.48
22	257.66	500.00

Circle Center At X = 195.0 ; Y = 549.2 and Radius, 79.6

*** 1.188 ***

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	146.84	470.35
2	151.78	469.58
3	156.74	468.96
4	161.72	468.48
5	166.71	468.15
6	171.71	467.97

7	176.71	467.93
8	181.71	468.04
9	186.70	468.30
10	191.68	468.71
11	196.65	469.26
12	201.60	469.96
13	206.53	470.80
14	211.43	471.79
15	216.30	472.92
16	221.14	474.20
17	225.93	475.62
18	230.68	477.18
19	235.38	478.88
20	240.03	480.72
21	244.63	482.69
22	249.16	484.80
23	253.63	487.04
24	258.03	489.41
25	262.36	491.91
26	266.62	494.54
27	270.79	497.29
28	274.62	499.98

Circle Center At X = 175.4 ; Y = 637.4 and Radius, 169.5

*** 1.190 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	152.37	472.26
2	157.25	471.17
3	162.15	470.18
4	167.07	469.30
5	172.01	468.52
6	176.97	467.84
7	181.93	467.27
8	186.91	466.79
9	191.90	466.43
10	196.89	466.16
11	201.89	466.00
12	206.89	465.94
13	211.89	465.99
14	216.88	466.14
15	221.88	466.39
16	226.86	466.75
17	231.84	467.21
18	236.81	467.78
19	241.77	468.45
20	246.71	469.22
21	251.63	470.09
22	256.53	471.06
23	261.42	472.14
24	266.28	473.32
25	271.11	474.60
26	275.92	475.97
27	280.69	477.45
28	285.44	479.03
29	290.15	480.70
30	294.82	482.48
31	299.46	484.35
32	304.06	486.31
33	308.61	488.37
34	313.13	490.53
35	317.59	492.77
36	322.01	495.11
37	326.38	497.55
38	330.20	499.78

Circle Center At X = 207.1 ; Y = 706.7 and Radius, 240.7

*** 1.197 ***

Failure Surface Specified By 48 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.26	468.00
2	135.22	467.32
3	140.18	466.70
4	145.15	466.13
5	150.12	465.63
6	155.10	465.19
7	160.09	464.80
8	165.08	464.48
9	170.07	464.22
10	175.07	464.02
11	180.06	463.88
12	185.06	463.79
13	190.06	463.77
14	195.06	463.81
15	200.06	463.91
16	205.06	464.07
17	210.05	464.29
18	215.05	464.57
19	220.03	464.91
20	225.02	465.31
21	230.00	465.77
22	234.97	466.29
23	239.94	466.87
24	244.90	467.51
25	249.85	468.21
26	254.79	468.97
27	259.72	469.79
28	264.64	470.67
29	269.55	471.61
30	274.45	472.61
31	279.34	473.66
32	284.21	474.78
33	289.07	475.95
34	293.92	477.18
35	298.75	478.47
36	303.57	479.82
37	308.36	481.23
38	313.14	482.69
39	317.91	484.22
40	322.65	485.80
41	327.38	487.43
42	332.08	489.13
43	336.76	490.88
44	341.43	492.68
45	346.07	494.54
46	350.68	496.46
47	355.28	498.44
48	358.07	499.68

Circle Center At X = 189.3 ; Y = 878.3 and Radius, 414.5

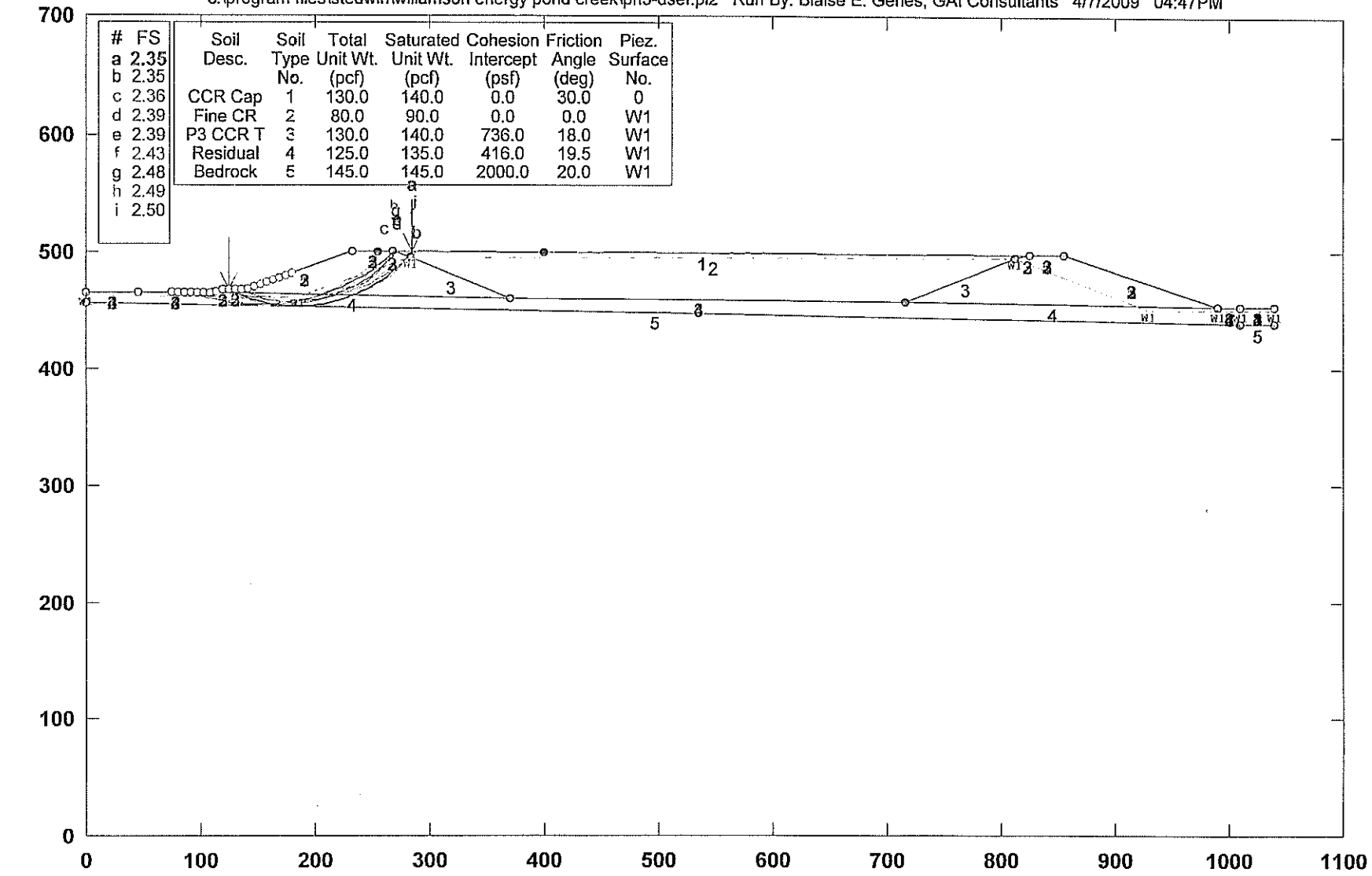
*** 1.200 ***

ATTACHMENT 2

PHASE 3 POST-SUBSIDENCE
EMBANKMENT FAILURE PCSTABL SLOPE STABILITY ANALSES

Pond Creek, Phase 3 Embankment Total S trength CCR, Zero-Strength FCR

c:\program files\stedwin\wiliamson energy pond creek\ph3-dsef.pl2 Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:47PM



#	FS
a	2.35
b	2.35
c	2.36
d	2.39
e	2.39
f	2.43
g	2.48
h	2.49
i	2.50

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR Cap	1	130.0	140.0	0.0	30.0	0
Fine CR	2	80.0	90.0	0.0	0.0	W1
P3 CCR T	3	130.0	140.0	736.0	18.0	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1

PCSTABL5M/si FSmin=2.35

Safety Factors Are Calculated By The Modified Bishop Method

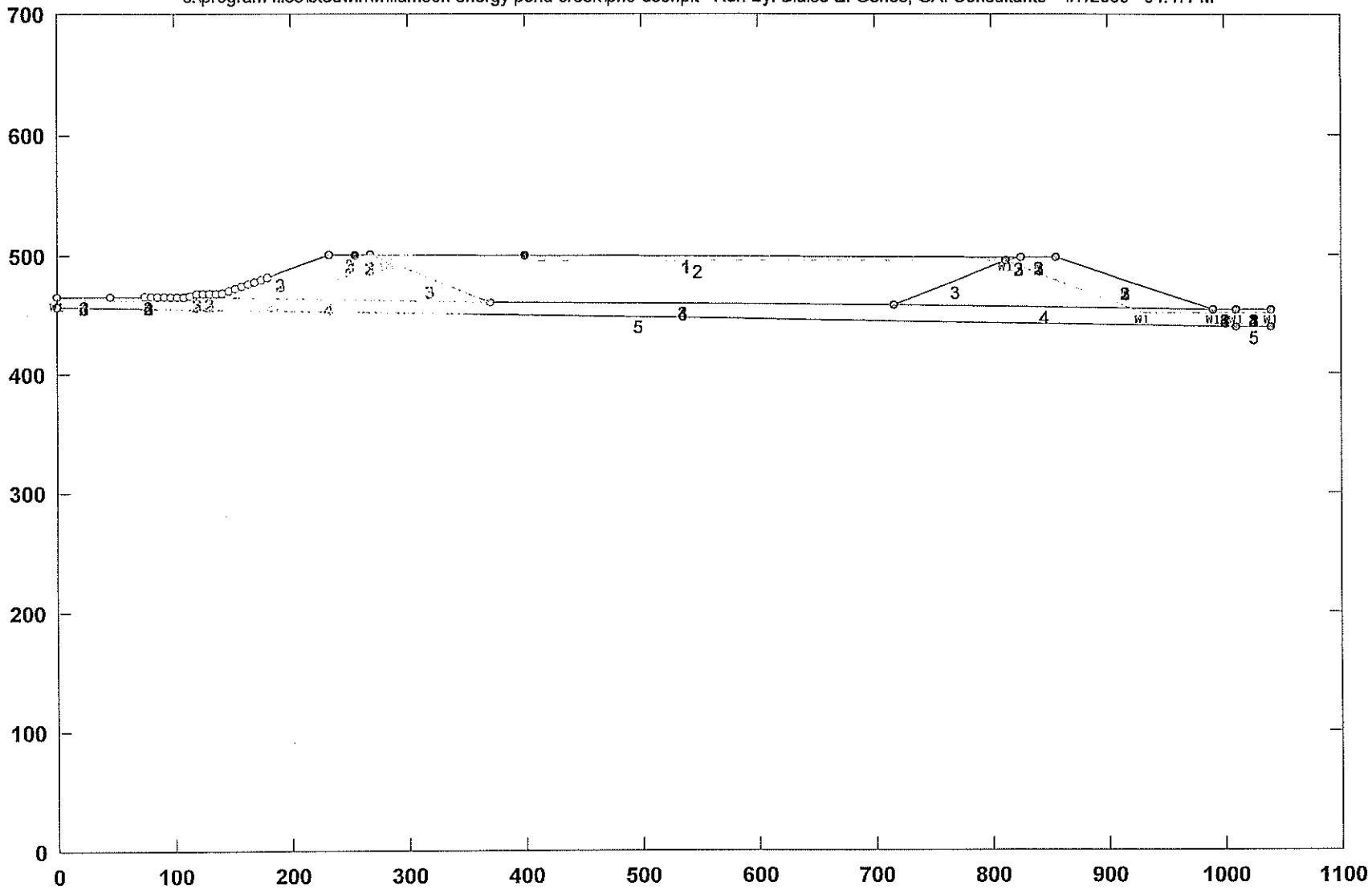
STED



R16776

Pond Creek, Phase 3 Embankment Total S trength CCR, Zero-Strength FCR

c:\program files\stedwin\wiliamson energy pond creek\ph3-dsef.plt Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:47PM



STED



R16777

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4/7/2009
Time of Run: 04:47PM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph3-dsef.in
Output Filename: C:ph3-dsef.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3-dsef.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 3 Embankment Total S
trength CCR, Zero-Strength FCR

BOUNDARY COORDINATES
10 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1
5	140.00	468.00	233.00	500.00	1
6	233.00	500.00	268.00	500.00	1
7	268.00	500.00	825.00	498.00	1
8	825.00	498.00	855.00	498.00	1
9	855.00	498.00	990.00	454.00	1
10	990.00	454.00	1010.00	454.00	1
11	1010.00	454.00	1040.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1040.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1040.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4
46	1010.00	454.00	1040.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1040.00	439.00	5

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	30.0	.00	.0	0
2	80.0	90.0	.0	.0	.00	.0	1
3	130.0	140.0	736.0	18.0	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 75.00 ft.
and X = 180.00 ft.
Each Surface Terminates Between X = 255.00 ft.
and X = 400.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
5.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.74	468.00
2	129.24	465.82
3	133.82	463.82
4	138.47	461.99
5	143.19	460.33
6	147.97	458.86
7	152.80	457.56
8	157.67	456.45
9	162.59	455.53
10	167.53	454.79
11	172.50	454.23
12	177.49	453.87
13	182.48	453.69
14	187.48	453.70
15	192.48	453.90
16	197.46	454.29
17	202.43	454.86
18	207.37	455.62
19	212.28	456.57
20	217.15	457.70
21	221.98	459.02
22	226.75	460.52
23	231.46	462.19
24	236.10	464.04
25	240.68	466.07
26	245.17	468.26

27	249.57	470.62
28	253.89	473.15
29	258.10	475.84
30	262.21	478.69
31	266.21	481.69
32	270.10	484.83
33	273.86	488.12
34	277.50	491.56
35	281.01	495.12
36	284.37	498.82
37	285.32	499.94

Circle Center At X = 184.7 ; Y = 586.3 and Radius, 132.6

*** 2.348 ***

Individual data on the 46 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	4.5	636.8	.0	.0	.0	.0	.0	.0	.0
2	2.9	1038.5	.0	.0	.0	.0	.0	.0	.0
3	1.7	851.1	.0	.0	.0	.0	.0	.0	.0
4	4.7	3045.6	.0	.0	.0	.0	.0	.0	.0
5	1.4	1142.7	.0	.0	.0	.0	.0	.0	.0
6	.1	83.9	.0	.1	.0	.0	.0	.0	.0
7	3.2	3137.9	.0	121.5	.0	.0	.0	.0	.0
8	4.8	6386.3	.0	570.9	.0	.0	.0	.0	.0
9	4.8	8396.3	.0	986.7	.0	.0	.0	.0	.0
10	4.9	10324.4	.0	1345.5	.0	.0	.0	.0	.0
11	4.9	12156.8	.0	1646.7	.0	.0	.0	.0	.0
12	4.9	13880.9	.0	1890.2	.0	.0	.0	.0	.0
13	5.0	15485.0	.0	2075.3	.0	.0	.0	.0	.0
14	5.0	16958.6	.0	2202.0	.0	.0	.0	.0	.0
15	5.0	18292.2	.0	2269.9	.0	.0	.0	.0	.0
16	2.5	9663.9	.0	1149.5	.0	.0	.0	.0	.0
17	2.5	9814.5	.0	1134.1	.0	.0	.0	.0	.0
18	4.5	18488.9	.0	2354.8	.0	.0	.0	.0	.0
19	.5	2084.2	.0	281.1	.0	.0	.0	.0	.0
20	5.0	21527.7	.0	3060.5	.0	.0	.0	.0	.0
21	5.0	22316.9	.0	3428.1	.0	.0	.0	.0	.0
22	4.9	22937.2	.0	3738.1	.0	.0	.0	.0	.0
23	4.9	23386.6	.0	3990.3	.0	.0	.0	.0	.0
24	4.9	23664.5	.0	4184.1	.0	.0	.0	.0	.0
25	4.8	23771.6	.0	4319.4	.0	.0	.0	.0	.0
26	4.8	23710.1	.0	4395.9	.0	.0	.0	.0	.0
27	4.7	23483.4	.0	4413.5	.0	.0	.0	.0	.0
28	1.1	5660.5	.0	1076.0	.0	.0	.0	.0	.0
29	.4	2016.5	.0	382.7	.0	.0	.0	.0	.0
30	3.1	15191.0	.0	2913.5	.0	.0	.0	.0	.0
31	4.6	21395.5	.0	4272.1	.0	.0	.0	.0	.0
32	4.5	19767.9	.0	4113.2	.0	.0	.0	.0	.0
33	4.4	18053.2	.0	3895.9	.0	.0	.0	.0	.0
34	4.3	16265.6	.0	3620.4	.0	.0	.0	.0	.0
35	4.2	14420.3	.0	3287.2	.0	.0	.0	.0	.0
36	4.1	12532.9	.0	2896.6	.0	.0	.0	.0	.0
37	4.0	10619.7	.0	2449.4	.0	.0	.0	.0	.0
38	1.8	4201.7	.0	960.1	.0	.0	.0	.0	.0
39	2.1	4494.6	.0	985.9	.0	.0	.0	.0	.0
40	3.8	6775.9	.0	1387.2	.0	.0	.0	.0	.0
41	3.6	4880.7	.0	773.8	.0	.0	.0	.0	.0
42	2.3	2173.4	.0	148.2	.0	.0	.0	.0	.0
43	1.2	860.0	.0	.0	.0	.0	.0	.0	.0
44	.4	228.1	.0	.0	.0	.0	.0	.0	.0
45	3.0	1075.7	.0	.0	.0	.0	.0	.0	.0
46	.9	69.2	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	119.21	467.76
2	123.76	465.68
3	128.37	463.76
4	133.05	462.00
5	137.79	460.39
6	142.58	458.95
7	147.41	457.68
8	152.29	456.57
9	157.20	455.63
10	162.14	454.85
11	167.10	454.25
12	172.08	453.82
13	177.07	453.56
14	182.07	453.47
15	187.07	453.55
16	192.07	453.80
17	197.05	454.22
18	202.01	454.81
19	206.95	455.58
20	211.87	456.51
21	216.75	457.61
22	221.58	458.87
23	226.37	460.30
24	231.11	461.89
25	235.80	463.65
26	240.41	465.56
27	244.97	467.63
28	249.44	469.86
29	253.84	472.24
30	258.16	474.76
31	262.38	477.44
32	266.51	480.25
33	270.55	483.21
34	274.48	486.30
35	278.30	489.52
36	282.00	492.88
37	285.60	496.36
38	289.04	499.92

Circle Center At X = 182.2 ; Y = 599.5 and Radius, 146.0

*** 2.354 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.63	465.11
2	107.28	463.27
3	111.99	461.60
4	116.76	460.09
5	121.58	458.76
6	126.44	457.59
7	131.34	456.61
8	136.28	455.79
9	141.24	455.16
10	146.21	454.70
11	151.21	454.42
12	156.21	454.31
13	161.20	454.39
14	166.20	454.64
15	171.18	455.08
16	176.14	455.69
17	181.08	456.47
18	185.99	457.43
19	190.86	458.57
20	195.68	459.88
21	200.46	461.36
22	205.18	463.01
23	209.84	464.83
24	214.43	466.81

25	218.94	468.95
26	223.38	471.26
27	227.73	473.72
28	231.99	476.34
29	236.16	479.10
30	240.22	482.01
31	244.18	485.07
32	248.03	488.26
33	251.76	491.59
34	255.37	495.05
35	258.85	498.64
36	260.08	500.00

Circle Center At X = 156.6 ; Y = 594.4 and Radius, 140.1

*** 2.360 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	119.21	467.76
2	123.79	465.75
3	128.44	463.92
4	133.16	462.27
5	137.94	460.80
6	142.77	459.52
7	147.65	458.42
8	152.57	457.51
9	157.52	456.80
10	162.49	456.27
11	167.48	455.94
12	172.48	455.80
13	177.48	455.85
14	182.47	456.09
15	187.45	456.53
16	192.41	457.15
17	197.34	457.97
18	202.24	458.98
19	207.10	460.18
20	211.90	461.56
21	216.65	463.12
22	221.33	464.87
23	225.95	466.80
24	230.48	468.90
25	234.94	471.18
26	239.30	473.62
27	243.56	476.24
28	247.72	479.01
29	251.77	481.94
30	255.70	485.03
31	259.51	488.27
32	263.20	491.65
33	266.75	495.17
34	270.16	498.82
35	271.17	499.99

Circle Center At X = 173.6 ; Y = 585.5 and Radius, 129.7

*** 2.385 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.79	468.00
2	140.31	465.87
3	144.93	463.95
4	149.63	462.24
5	154.40	460.75
6	159.24	459.48
7	164.13	458.44
8	169.06	457.62
9	174.02	457.02
10	179.01	456.66

11	184.01	456.53
12	189.01	456.62
13	194.00	456.95
14	198.97	457.50
15	203.91	458.28
16	208.80	459.29
17	213.65	460.52
18	218.43	461.97
19	223.15	463.64
20	227.78	465.53
21	232.32	467.62
22	236.76	469.92
23	241.08	472.43
24	245.29	475.13
25	249.37	478.02
26	253.32	481.09
27	257.12	484.34
28	260.76	487.76
29	264.24	491.35
30	267.56	495.09
31	270.70	498.98
32	271.44	499.99

Circle Center At X = 184.4 ; Y = 565.3 and Radius, 108.8

*** 2.393 ***

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	91.58	465.28
2	96.32	463.69
3	101.10	462.22
4	105.91	460.87
5	110.76	459.65
6	115.64	458.54
7	120.54	457.56
8	125.46	456.70
9	130.41	455.96
10	135.37	455.35
11	140.35	454.86
12	145.34	454.50
13	150.33	454.27
14	155.33	454.16
15	160.33	454.17
16	165.33	454.31
17	170.32	454.58
18	175.30	454.97
19	180.28	455.49
20	185.24	456.13
21	190.18	456.89
22	195.10	457.78
23	199.99	458.80
24	204.06	459.93
25	209.70	461.19
26	214.51	462.57
27	219.28	464.07
28	224.01	465.69
29	228.70	467.43
30	233.34	469.28
31	237.94	471.25
32	242.48	473.34
33	246.97	475.53
34	251.40	477.84
35	255.78	480.27
36	260.09	482.80
37	264.34	485.44
38	268.52	488.18
39	272.63	491.03
40	276.66	493.98

41	280.63	497.03
42	284.22	499.94

Circle Center At X = 157.2 ; Y = 653.1 and Radius, 199.0

*** 2.434 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	91.58	465.28
2	96.31	463.66
3	101.08	462.17
4	105.89	460.82
5	110.74	459.60
6	115.62	458.51
7	120.53	457.57
8	125.47	456.76
9	130.42	456.10
10	135.40	455.57
11	140.38	455.18
12	145.38	454.93
13	150.37	454.83
14	155.37	454.86
15	160.37	455.04
16	165.36	455.35
17	170.34	455.81
18	175.31	456.40
19	180.25	457.13
20	185.17	458.01
21	190.07	459.02
22	194.94	460.17
23	199.77	461.45
24	204.56	462.87
25	209.32	464.43
26	214.02	466.11
27	218.68	467.93
28	223.28	469.88
29	227.83	471.96
30	232.32	474.17
31	236.74	476.50
32	241.10	478.95
33	245.38	481.53
34	249.60	484.22
35	253.73	487.03
36	257.78	489.96
37	261.75	493.00
38	265.64	496.15
39	269.43	499.41
40	270.07	499.99

Circle Center At X = 151.7 ; Y = 632.6 and Radius, 177.8

*** 2.478 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.79	468.00
2	140.45	466.20
3	145.19	464.60
4	149.99	463.21
5	154.85	462.02
6	159.75	461.04
7	164.69	460.27
8	169.66	459.71
9	174.65	459.37
10	179.65	459.24
11	184.65	459.32
12	189.64	459.62
13	194.61	460.13
14	199.56	460.85
15	204.47	461.79

16	209.34	462.93
17	214.15	464.28
18	218.91	465.84
19	223.59	467.59
20	228.19	469.55
21	232.70	471.70
22	237.12	474.04
23	241.43	476.57
24	245.63	479.28
25	249.72	482.17
26	253.67	485.23
27	257.49	488.46
28	261.17	491.85
29	264.70	495.39
30	268.07	499.08
31	268.84	500.00

Circle Center At X = 180.2 ; Y = 576.1 and Radius, 116.8

*** 2.486 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.74	468.00
2	129.44	466.30
3	134.19	464.75
4	138.99	463.35
5	143.84	462.11
6	148.72	461.02
7	153.63	460.09
8	158.57	459.31
9	163.53	458.69
10	168.51	458.23
11	173.50	457.93
12	178.50	457.79
13	183.50	457.81
14	188.49	457.99
15	193.48	458.32
16	198.46	458.82
17	203.42	459.47
18	208.35	460.28
19	213.26	461.25
20	218.13	462.37
21	222.96	463.65
22	227.75	465.08
23	232.49	466.66
24	237.18	468.40
25	241.82	470.28
26	246.39	472.31
27	250.89	474.48
28	255.32	476.80
29	259.68	479.25
30	263.95	481.85
31	268.14	484.58
32	272.24	487.44
33	276.25	490.43
34	280.16	493.54
35	283.97	496.78
36	287.44	499.93

Circle Center At X = 180.4 ; Y = 614.7 and Radius, 156.9

*** 2.502 ***

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.11	465.20
2	101.92	463.85
3	106.76	462.60
4	111.63	461.46
5	116.52	460.43

6	121.44	459.51
7	126.37	458.69
8	131.32	457.99
9	136.28	457.39
10	141.26	456.91
11	146.25	456.53
12	151.24	456.27
13	156.24	456.12
14	161.24	456.07
15	166.24	456.14
16	171.23	456.32
17	176.23	456.61
18	181.21	457.01
19	186.18	457.51
20	191.15	458.13
21	196.09	458.86
22	201.02	459.70
23	205.93	460.65
24	210.82	461.70
25	215.68	462.86
26	220.52	464.13
27	225.32	465.51
28	230.10	466.99
29	234.84	468.58
30	239.55	470.27
31	244.21	472.07
32	248.84	473.97
33	253.42	475.97
34	257.96	478.07
35	262.45	480.27
36	266.89	482.57
37	271.27	484.97
38	275.61	487.46
39	279.88	490.05
40	284.10	492.73
41	288.26	495.51
42	292.36	498.38
43	294.44	499.91

Circle Center At X = 160.7 ; Y = 682.1 and Radius, 226.1

*** 2.511 ***

APPENDIX F

SLOPE STABILITY ANALYSES RESULTS AND FACTORS OF SAFETY END-OF-CONSTRUCTION AND STEADY-STATE STATIC AND POST-EARTHQUAKE SEISMIC CONDITIONS

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transforming ideas into reality

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 7 End-of-Construction and Steady-State Static, and Post-Earthquake Seismic Slope Stability Analyses

AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY TBG DATE 5/8/09 SHEET NO. 1 OF 4

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CALCULATION BRIEF
FOR
SHORT-TERM END-OF-CONSTRUCTION AND LONG-TERM STEADY-STATE STATIC, AND POST-EARTHQUAKE SEISMIC SLOPE STABILITY ANALYSES AND FACTORS OF SAFETY

POND CREEK COAL REFUSE DISPOSAL SITE – PHASE 7 SOUTH SLOPE

OBJECTIVE: To determine the static and seismic factors of safety for the Pond Creek, Phase 7 South slope (Phase 7C) embankment and impoundment.

METHODOLOGY: Use PCSTABL limit equilibrium analyses and a "zero-strength" fine coal refuse (FCR) approach to determine the short-term end-of-construction and long-term steady-state static factors of safety, as well as the post-earthquake seismic factor of safety for the Phase 7 South slope (Phase 7C) embankment/impoundment geometry presented in Figure 2.

REFERENCES:

1. Civil & Environmental Consultants, Inc. Calculation, "Calculation Brief for Estimation and Summary of Engineering Properties Including Peak and Steady-State Undrained Shear Strengths For Refuse and Subgrade Materials, Pond Creek Coal Refuse Disposal Site – South Pond", BEG, 7/12/08.

2. GAI Consultants, Inc. Calculation, "Supplemental Summary of Engineering Properties and Coarse Refuse Tensile Strength for Subsidence Liquefaction and Embankment Cracking Evaluations, Pond Creek Coal Refuse Disposal Site – Phase 3," BEG, 3/31/09.

3. GAI Consultants, Inc. Calculation, "Determination of Downstream and Upstream In-Situ Driving Shear Stress By Elastic (PCSTABL) Solution, Pond Creek Coal Refuse Disposal Site – Phase 3 Impoundment," BEG, 4/08/09.

4. U.S. Department of Labor, Mine Safety and Health Administration, "Engineering and Design Manual, Coal Refuse Disposal Facilities, Chapter 7 Seismic Design: Stability and Deformation Analyses," Final Draft Dated December 2007, Updated August 1, 2008.

5. Winterkorn and Fang, (1975), "Foundation Engineering Handbook," Van Nostrand Reinhold Publishers.

6. Gregory, P.E., Garry H., "PCSTABL5M with STEDwin Slope Stability Analysis System, Version 2.0," dated September 2001.

7. Poulos, S.J., Castro, G., and France, J.W. (1985a) "Liquefaction Evaluation Procedure," Journal of the Geotechnical Engineering Division, ASCE, Vol. 111, No. GT6, pp. 772-792.

SUBJECT WILLIAMSON ENERGY – POND CREEK

Phase 7 End-of-Construction and Steady-State Static, and Post-Earthquake Seismic Slope Stability Analyses

AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

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ANALYSIS:

END-OF-CONSTRUCTION AND STEADY-STATE STATIC SLOPE STABILITY ANALYSES

Static slope stability analyses were performed for the Phase 7 South slope geometry (Phase 7C), which includes the underlying Phase 3 impoundment FCR. The short-term, end-of-construction (EOC)analysis condition includes using effective strength parameters for the CCR, total undrained shear strengths for the residual soil, and zero (0) strength for the FCR. For the long-term, steady-state (SS) conditions stability analyses of the Phase 7C slope geometry, effective strength for CCR and total undrained strength for FCR and residual soil are utilized. The following soil properties were estimated based on previous field and laboratory testing as noted in Reference Nos. 1 and 2 and used in the various slope stability analyses:

Description	Unit Weights (γ_t,γ_s) (pcf)	Friction Angle (ϕ) (degrees)	Cohesion (c) (psf)	Strength
Coarse Coal Refuse (CCR)	130, 140	33.7	0	Effective Strength
Fine Coal Refuse (FCR)	80, 90	0 18.8	0, 260 0	Zero Strength, Sus=0.05 Total Strength
Residual Soil	125, 135	19.5	416	Total Strength

The results of the Phase 7C slope stability analyses indicate the Phase 7C embankment and underlying Phase 3 impoundment geometry is stable under both short-term, EOC and long-term, SS conditions. Utilizing conservative strength parameters for the various materials including "zero-strength" for FCR, the EOC and SS static factors of safety are 1.6 and 1.8, respectively.

Results of Static Slope Stability Analyses:

Phase 7C Impoundment (Crest El. 538 ft) (Top of Fines El. 496 ft)	Factor of Safety (dim)
End-Of-Construction – CCR Effective Strength FCR Zero-Strength Residual Total Strength	1.6
Steady-State – CCR Effective Strength FCR Total-Strength Residual Total Strength	1.8

Hard copies of the input and output files for the Phase 7C end-of-construction and long-term steady-state slope stability analyses are presented in Attachment 1.

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POST-EARTHQUAKE SEISMIC SLOPE STABILITY ANALYSES

Liquefaction susceptibility of the proposed Phase 7C slope geometry and the FCR hydraulically placed beneath the Phase 7 CCR embankment depends on the strength of all the soils along the critical failure surface. Zones of loose (contractive) soils are critical to analyzing liquefaction potential since only loose soils can have an undrained strength that is significantly lower than their drained strength. For the purpose of this evaluation, a conservative, simplified approach was employed, and assumes the FCR will lose strength during an earthquake, which changes the condition from drained to undrained.

Therefore, liquefaction susceptibility was determined by evaluating the Phase 7C embankment and underlying Phase 3 FCR utilizing a "zero-strength" approach for the FCR to evaluate the post-earthquake factors of safety. A "zero-strength" type analysis of the FCR, if stable, is considered the most conservative analysis because a true zero-strength condition physically cannot occur. Some minimum strength, i.e., steady-state undrained exists even if the material is susceptible to a strength loss triggering event such as an earthquake.

The post-earthquake analyses included using effective strength parameters for the CCR, total undrained shear strengths for the residual soil, and zero (0) strength for the FCR for a deep failure surface and 260 psf for a shallow failure surface equating to Sus/σ'v=0.05, which is far less than the site specific laboratory testing Sus/σ'v=0.24. Engineering soil parameters used in the post-earthquake stability analyses are presented above.

The results of the Phase 7C post-earthquake stability analyses indicate the Phase 7C embankment and underlying Phase 3 impoundment geometry is stable. Utilizing conservative strength parameters for the various materials including "zero-strength" for FCR, the post-earthquake factor of safety is 1.6 for a deep failure, and 1.2 for a shallow failure with Sus=260 psf.

Results of Post-Earthquake Seismic Slope Stability Analyses:

Phase 7C Impoundment (Crest El. 538 ft) (Top of Fines El. 496 ft)	**Factor of Safety (dim)**
Post-Earthquake – CCR Effective Strength FCR Zero-Strength Deep, Sus=260 psf Residual Total Strength	1.6 Deep 1.2 Shallow

Hard copies of the input and output files for the Phase 7C post-earthquake slope stability analyses are also presented in Attachment 2.

Poulos, et al (1985) states a soil mass that is not susceptible to liquefaction physically cannot fail by liquefaction since the minimum undrained strength exceeds the in-situ driving shear stress along the critical failure surface. Permanent deformation analyses were not considered pertinent to the Phase 7C geometry since there is no impounded FCR or freeboard. Therefore, permanent deformation analyses were not performed.

SUBJECT WILLIAMSON ENERGY – POND CREEK

R16791

Phase 7 End-of-Construction and Steady-State Static, and Post-Earthquake Seismic Slope Stability Analyses

AMH/BEG DATE 2009-APR-08 PROJ. NO. C090403.01.001

CHKD. BY BEG DATE 5/8/09 SHEET NO. 4 OF 4

REVISED BY: BEG 7/11/09

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CONCLUSIONS

GAI has completed static stability analyses to evaluate the end-of-construction and steady-state conditions of the proposed Phase 7 South (Phase7C) slope. GAI has also completed seismic stability analyses to evaluate the post-earthquake condition of the Phase 7C slope. Based on conservatively-derived strength parameters, including a zero-strength approach for the FCR, adequate static and seismic factors of safety exist for the Phase 7C slope. The conclusions are based on the following:

- Phase 7 minimum factor of safety for the short-term end-of-construction static condition, with zero-strength FCR in was estimated at 1.6 for a deep failure, and 1.2 for a shallow failure with Sus=260 psf;
- Phase 7 minimum factor of safety for the long-term, steady-state static condition was estimated at 1.8; and
- The Phase 7 factor of safety against a post-earthquake, seismic condition, with zero-strength FCR was estimated at 1.6

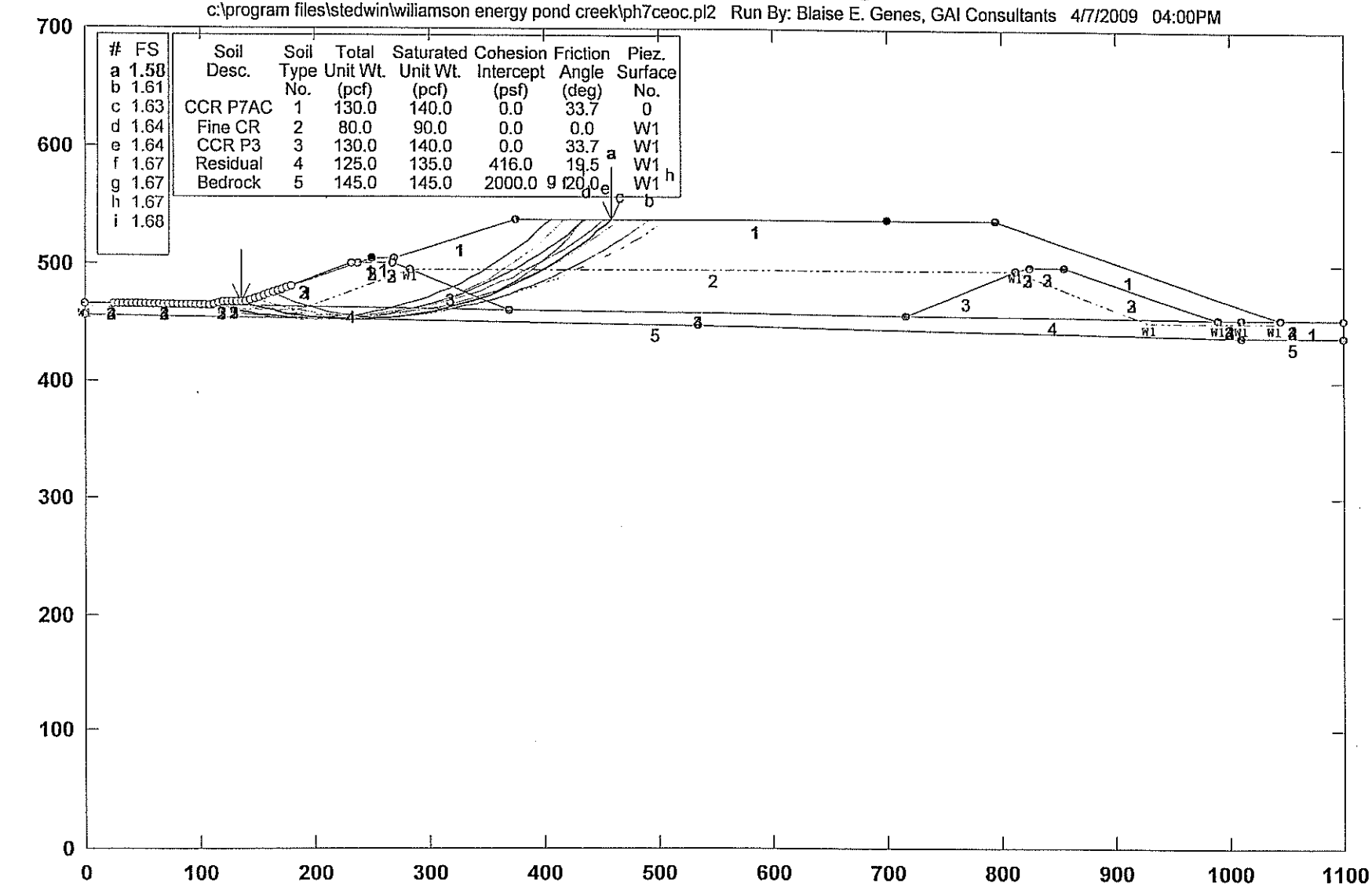
Hard copies of the input and output files for the Phase 7C end-of-construction and long-term steady-state slope stability analyses are presented in Attachment 1. Hard copies of the input and output files for the Phase 7C post-earthquake slope stability analyses are also presented in Attachment 2

ATTACHMENT 1

PHASE 7 SOUTH (PHASE 7C) SLOPE
SHORT-TERM END-OF-CONSTRUCTION AND LONG-TERM STEADY-STATE CONDITIONS
PCSTABL SLOPE STABILITY ANALYSES

Pond Creek, Phase 7C South - Zero Strength FCR Static EOC

c:\program files\stedwin\wiliamson energy pond creek\ph7ceoc.pl2 Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:00PM



PCSTABL5M/si FSmin=1.58

Safety Factors Are Calculated By The Modified Bishop Method

STED



R16793

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4/7/2009
Time of Run: 04:00PM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph7ceoc.in
Output Filename: C:ph7ceoc.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph7ceoc.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 7C South - Zero Streng th FCR Static EOC
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

11 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1
5	140.00	468.00	238.00	500.00	1
6	238.00	500.00	250.00	505.00	1
7	250.00	505.00	270.00	505.00	1
8	270.00	505.00	375.00	538.00	1
9	375.00	538.00	795.00	538.00	1
10	795.00	538.00	1045.00	454.00	1
11	1045.00	454.00	1100.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1100.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1100.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4

46	1010.00	454.00	1100.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1100.00	439.00	5

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	0
2	80.0	90.0	.0	.0	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
1600 Trial Surfaces Have Been Generated.
40 Surfaces Initiate From Each Of 40 Points Equally Spaced Along The Ground Surface Between X = 25.00 ft.
and X = 180.00 ft.
Each Surface Terminates Between X = 250.00 ft.
and X = 700.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.28	468.00
2	145.87	465.16
3	155.54	462.61
4	165.28	460.35
5	175.09	458.38
6	184.94	456.71
7	194.85	455.32
8	204.79	454.24
9	214.76	453.44
10	224.75	452.95
11	234.74	452.75
12	244.74	452.86
13	254.74	453.25
14	264.71	453.95
15	274.66	454.94
16	284.58	456.23
17	294.45	457.82
18	304.27	459.69
19	314.04	461.86
20	323.73	464.32
21	333.35	467.06
22	342.88	470.09
23	352.31	473.40

24	361.64	477.00
25	370.87	480.86
26	379.97	485.01
27	388.94	489.42
28	397.78	494.09
29	406.48	499.03
30	415.03	504.22
31	423.41	509.67
32	431.63	515.36
33	439.68	521.29
34	447.55	527.46
35	455.23	533.87
36	459.90	538.00

Circle Center At X = 236.3 ; Y = 788.5 and Radius, 335.8

*** 1.578 ***

Individual data on the 50 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.7	265.7	.0	.0	.0	.0	.0	.0	.0
2	5.9	2234.1	.0	.0	.0	.0	.0	.0	.0
3	3.5	2624.7	.0	.0	.0	.0	.0	.0	.0
4	6.2	6914.7	.0	.0	.0	.0	.0	.0	.0
5	5.9	9142.2	.0	.0	.0	.0	.0	.0	.0
6	3.9	7443.0	.0	107.1	.0	.0	.0	.0	.0
7	9.8	23519.9	.0	1118.2	.0	.0	.0	.0	.0
8	9.9	30190.0	.0	2189.7	.0	.0	.0	.0	.0
9	.1	187.0	.0	14.9	.0	.0	.0	.0	.0
10	7.0	25226.2	.0	2499.2	.0	.0	.0	.0	.0
11	2.9	11253.1	.0	1433.7	.0	.0	.0	.0	.0
12	9.9	42973.5	.0	6709.0	.0	.0	.0	.0	.0
13	10.0	48901.1	.0	9302.9	.0	.0	.0	.0	.0
14	10.0	54425.2	.0	11726.5	.0	.0	.0	.0	.0
15	8.3	48792.6	.0	11383.6	.0	.0	.0	.0	.0
16	1.7	10731.4	.0	2593.9	.0	.0	.0	.0	.0
17	3.3	20409.9	.0	5009.2	.0	.0	.0	.0	.0
18	6.7	44035.0	.0	11044.7	.0	.0	.0	.0	.0
19	5.3	36042.6	.0	9219.4	.0	.0	.0	.0	.0
20	4.7	33096.4	.0	8734.6	.0	.0	.0	.0	.0
21	10.0	69375.5	.0	19676.0	.0	.0	.0	.0	.0
22	3.3	22719.0	.0	6852.3	.0	.0	.0	.0	.0
23	2.0	13762.9	.0	4244.6	.0	.0	.0	.0	.0
24	4.7	32367.8	.0	10121.5	.0	.0	.0	.0	.0
25	8.3	59423.8	.0	18900.9	.0	.0	.0	.0	.0
26	1.6	11461.8	.0	3860.6	.0	.0	.0	.0	.0
27	9.9	71688.1	.0	23697.4	.0	.0	.0	.0	.0
28	9.8	71036.3	.0	22618.0	.0	.0	.0	.0	.0
29	6.5	46775.6	.0	14406.0	.0	.0	.0	.0	.0
30	3.2	23145.9	.0	6950.2	.0	.0	.0	.0	.0
31	9.7	68270.8	.0	19913.0	.0	.0	.0	.0	.0
32	9.6	66148.8	.0	18289.7	.0	.0	.0	.0	.0
33	9.5	63597.2	.0	16487.8	.0	.0	.0	.0	.0
34	1.1	7121.3	.0	1778.6	.0	.0	.0	.0	.0
35	8.3	54824.8	.0	12730.3	.0	.0	.0	.0	.0
36	9.3	61927.6	.0	12354.8	.0	.0	.0	.0	.0
37	9.2	61590.4	.0	10027.3	.0	.0	.0	.0	.0
38	4.1	27672.2	.0	3739.8	.0	.0	.0	.0	.0
39	5.0	32744.4	.0	3788.6	.0	.0	.0	.0	.0
40	9.0	56462.6	.0	4860.6	.0	.0	.0	.0	.0
41	8.8	51997.6	.0	2026.0	.0	.0	.0	.0	.0
42	1.6	9018.9	.0	52.2	.0	.0	.0	.0	.0
43	7.1	37804.0	.0	.0	.0	.0	.0	.0	.0
44	8.5	40413.1	.0	.0	.0	.0	.0	.0	.0
45	8.4	33864.3	.0	.0	.0	.0	.0	.0	.0
46	8.2	27242.9	.0	.0	.0	.0	.0	.0	.0
47	8.0	20586.5	.0	.0	.0	.0	.0	.0	.0

48	7.9	13933.9	.0	.0	.0	.0	.0	.0	.0
49	7.7	7324.2	.0	.0	.0	.0	.0	.0	.0
50	4.7	1254.2	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.36	468.00
2	134.04	465.51
3	143.78	463.24
4	153.57	461.21
5	163.41	459.40
6	173.28	457.82
7	183.19	456.47
8	193.13	455.36
9	203.09	454.47
10	213.07	453.82
11	223.06	453.41
12	233.06	453.22
13	243.06	453.27
14	253.06	453.56
15	263.04	454.07
16	273.01	454.82
17	282.97	455.81
18	292.89	457.02
19	302.79	458.47
20	312.65	460.14
21	322.46	462.05
22	332.23	464.18
23	341.95	466.55
24	351.61	469.13
25	361.20	471.95
26	370.73	474.98
27	380.19	478.24
28	389.56	481.72
29	398.85	485.42
30	408.06	489.33
31	417.17	493.46
32	426.18	497.79
33	435.08	502.34
34	443.88	507.09
35	452.57	512.05
36	461.13	517.21
37	469.58	522.57
38	477.89	528.12
39	486.08	533.87
40	491.68	538.00

Circle Center At X = 235.9 ; Y = 881.4 and Radius, 428.1

*** 1.613 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.31	468.00
2	142.00	465.55
3	151.76	463.35
4	161.57	461.42
5	171.43	459.74
6	181.33	458.32
7	191.26	457.17
8	201.22	456.27
9	211.20	455.64
10	221.19	455.27
11	231.19	455.17
12	241.19	455.33
13	251.18	455.76
14	261.16	456.44
15	271.11	457.39
16	281.04	458.60

17	290.93	460.08
18	300.78	461.81
19	310.58	463.80
20	320.32	466.06
21	330.00	468.56
22	339.61	471.32
23	349.15	474.34
24	358.60	477.60
25	367.96	481.11
26	377.23	484.87
27	386.40	488.87
28	395.45	493.11
29	404.39	497.59
30	413.21	502.30
31	421.91	507.24
32	430.47	512.42
33	438.89	517.81
34	447.16	523.43
35	455.29	529.26
36	463.25	535.30
37	466.62	538.00

Circle Center At X = 230.1 ; Y = 834.4 and Radius, 379.2

*** 1.625 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.46	465.02
2	118.16	462.58
3	127.92	460.40
4	137.73	458.48
5	147.60	456.84
6	157.50	455.47
7	167.44	454.36
8	177.41	453.53
9	187.39	452.98
10	197.39	452.69
11	207.39	452.68
12	217.38	452.95
13	227.37	453.48
14	237.34	454.29
15	247.28	455.37
16	257.19	456.72
17	267.05	458.35
18	276.87	460.24
19	286.64	462.40
20	296.34	464.82
21	305.97	467.52
22	315.52	470.47
23	324.99	473.68
24	334.37	477.15
25	343.65	480.88
26	352.83	484.86
27	361.89	489.08
28	370.83	493.56
29	379.65	498.27
30	388.34	503.23
31	396.88	508.42
32	405.28	513.84
33	413.53	519.49
34	421.63	525.37
35	429.56	531.46
36	437.32	537.77
37	437.58	538.00

Circle Center At X = 202.8 ; Y = 818.4 and Radius, 365.7

*** 1.635 ***

Failure Surface Specified By 38 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	108.46	465.02
2	118.20	462.73
3	127.98	460.68
4	137.82	458.88
5	147.70	457.31
6	157.61	455.99
7	167.55	454.92
8	177.52	454.09
9	187.50	453.50
10	197.49	453.17
11	207.49	453.08
12	217.49	453.23
13	227.48	453.64
14	237.46	454.28
15	247.42	455.18
16	257.36	456.32
17	267.26	457.70
18	277.13	459.33
19	286.95	461.20
20	296.72	463.32
21	306.44	465.67
22	316.10	468.26
23	325.69	471.10
24	335.21	474.16
25	344.65	477.46
26	354.01	480.99
27	363.27	484.75
28	372.44	488.74
29	381.51	492.96
30	390.47	497.39
31	399.32	502.05
32	408.06	506.92
33	416.67	512.01
34	425.15	517.30
35	433.50	522.81
36	441.71	528.52
37	449.77	534.43
38	454.40	538.00

Circle Center At X = 206.2 ; Y = 858.3 and Radius, 405.3

*** 1.640 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.21	470.68
2	157.72	467.59
3	167.34	464.88
4	177.07	462.55
5	186.87	460.60
6	196.75	459.04
7	206.68	457.87
8	216.65	457.09
9	226.65	456.71
10	236.65	456.72
11	246.64	457.12
12	256.61	457.92
13	266.53	459.11
14	276.41	460.69
15	286.21	462.66
16	295.93	465.01
17	305.55	467.74
18	315.06	470.85
19	324.43	474.33
20	333.66	478.18
21	342.73	482.39
22	351.63	486.95
23	360.34	491.86

24	368.85	497.11
25	377.15	502.69
26	385.23	508.59
27	393.06	514.81
28	400.64	521.33
29	407.96	528.14
30	415.01	535.24
31	417.54	538.00

Circle Center At X = 231.4 ; Y = 710.5 and Radius, 253.9

*** 1.668 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	112.44	465.73
2	122.09	463.11
3	131.82	460.82
4	141.62	458.84
5	151.49	457.19
6	161.40	455.86
7	171.35	454.86
8	181.32	454.19
9	191.32	453.85
10	201.32	453.83
11	211.31	454.15
12	221.29	454.79
13	231.24	455.77
14	241.16	457.07
15	251.03	458.69
16	260.83	460.65
17	270.57	462.92
18	280.23	465.51
19	289.80	468.42
20	299.27	471.64
21	308.62	475.17
22	317.85	479.01
23	326.96	483.15
24	335.92	487.59
25	344.73	492.32
26	353.38	497.34
27	361.86	502.64
28	370.16	508.22
29	378.27	514.07
30	386.19	520.18
31	393.89	526.55
32	401.39	533.17
33	406.51	538.00

Circle Center At X = 196.7 ; Y = 757.4 and Radius, 303.6

*** 1.673 ***

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	128.33	468.00
2	138.10	465.87
3	147.92	463.94
4	157.76	462.20
5	167.65	460.67
6	177.56	459.34
7	187.49	458.22
8	197.45	457.29
9	207.43	456.57
10	217.41	456.06
11	227.41	455.75
12	237.41	455.64
13	247.41	455.73
14	257.40	456.03
15	267.39	456.54
16	277.36	457.24

17	287.32	458.15
18	297.26	459.27
19	307.17	460.58
20	317.06	462.10
21	326.91	463.82
22	336.72	465.74
23	346.50	467.86
24	356.22	470.18
25	365.90	472.70
26	375.53	475.41
27	385.09	478.32
28	394.60	481.42
29	404.04	484.72
30	413.41	488.21
31	422.71	491.89
32	431.93	495.76
33	441.07	499.82
34	450.13	504.06
35	459.09	508.48
36	467.97	513.09
37	476.75	517.88
38	485.43	522.85
39	494.00	527.99
40	502.47	533.30
41	509.63	538.00

Circle Center At X = 237.7 ; Y = 945.7 and Radius, 490.1

*** 1.674 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.10	475.87
2	173.23	471.77
3	182.52	468.09
4	191.97	464.82
5	201.56	461.98
6	211.26	459.56
7	221.07	457.59
8	230.95	456.05
9	240.89	454.96
10	250.87	454.31
11	260.87	454.11
12	270.86	454.35
13	280.84	455.04
14	290.77	456.17
15	300.65	457.75
16	310.44	459.76
17	320.14	462.21
18	329.71	465.10
19	339.15	468.40
20	348.43	472.12
21	357.54	476.26
22	366.45	480.80
23	375.15	485.73
24	383.62	491.04
25	391.85	496.72
26	399.81	502.77
27	407.50	509.17
28	414.89	515.90
29	421.98	522.96
30	428.74	530.33
31	435.17	537.99
32	435.18	538.00

Circle Center At X = 260.4 ; Y = 678.1 and Radius, 224.0

*** 1.684 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

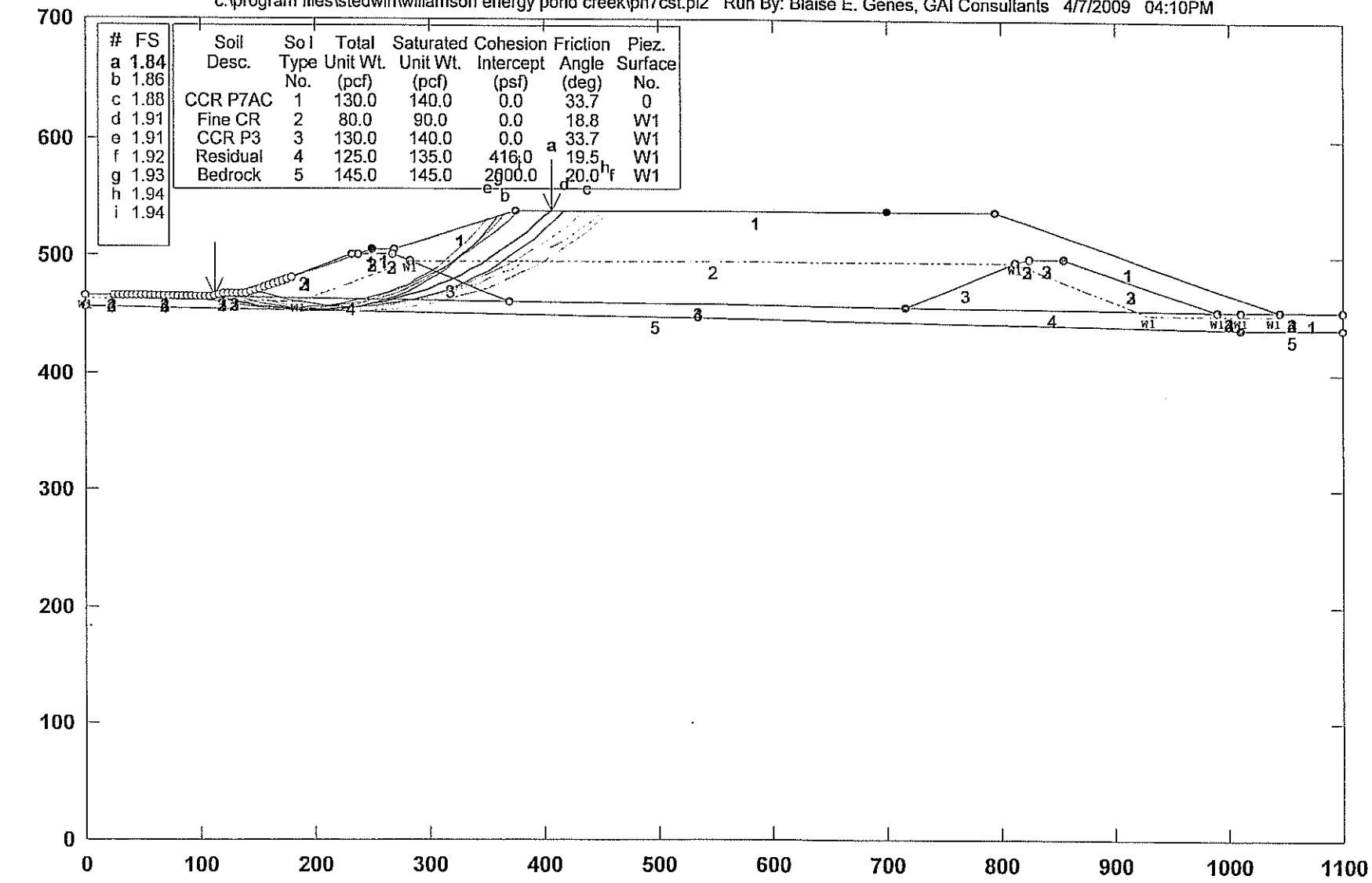
1	128.33	468.00
2	138.12	465.95
3	147.94	464.05
4	157.79	462.32
5	167.66	460.74
6	177.56	459.32
7	187.48	458.07
8	197.42	456.97
9	207.38	456.04
10	217.35	455.27
11	227.33	454.66
12	237.32	454.21
13	247.32	453.92
14	257.32	453.80
15	267.32	453.84
16	277.31	454.03
17	287.31	454.40
18	297.29	454.92
19	307.27	455.60
20	317.23	456.45
21	327.18	457.46
22	337.11	458.62
23	347.03	459.95
24	356.91	461.44
25	366.78	463.09
26	376.61	464.90
27	386.42	466.87
28	396.19	468.99
29	405.92	471.28
30	415.62	473.72
31	425.28	476.32
32	434.89	479.07
33	444.46	481.98
34	453.98	485.05
35	463.45	488.27
36	472.86	491.64
37	482.22	495.16
38	491.52	498.83
39	500.76	502.66
40	509.94	506.63
41	519.05	510.75
42	528.09	515.02
43	537.06	519.44
44	545.96	524.00
45	554.79	528.70
46	563.54	533.54
47	571.28	538.00

Circle Center At X = 260.0 ; Y = 1071.2 and Radius, 617.4

*** 1.689 ***

Pond Creek, Phase 7C South - Zero Strength FCR Static Long-Term SS

c:\program files\stedwin\wiliamson energy pond creek\ph7cst.pl2 Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:10PM



#	FS
a	1.84
b	1.86
c	1.88
d	1.91
e	1.91
f	1.92
g	1.93
h	1.94
i	1.94

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR P7AC	1	130.0	140.0	0.0	33.7	0
Fine CR	2	80.0	90.0	0.0	18.8	W1
CCR P3	3	130.0	140.0	0.0	33.7	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1

PCSTABL5M/si FSmin=1.84

Safety Factors Are Calculated By The Modified Bishop Method

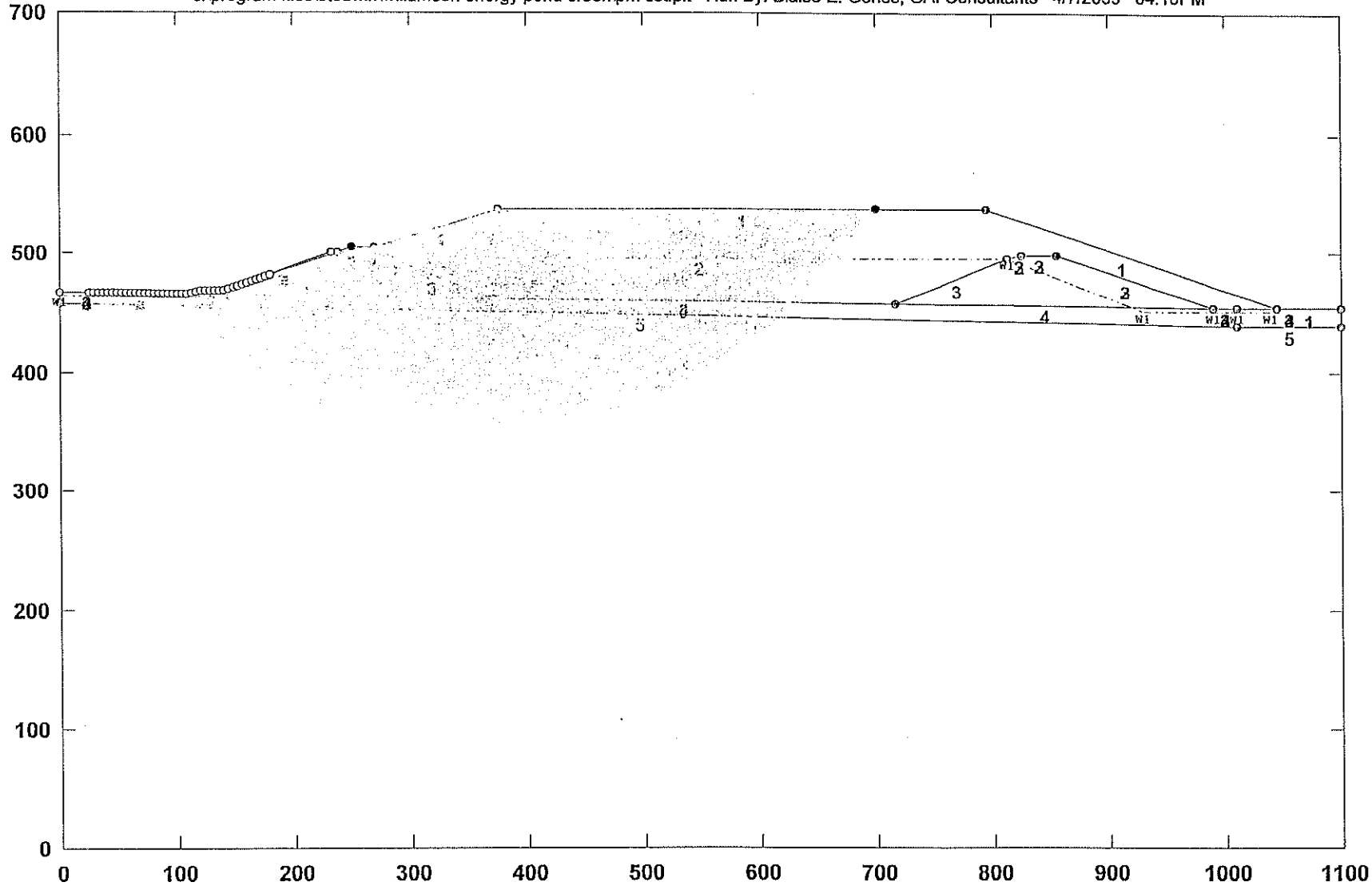
STED



R16803

Pond Creek, Phase 7C South - Zero Strength FCR Static Long-Term SS

c:\program files\stedwin\wiliamson energy pond creek\ph7cst.plt Run By: Blaise E. Genes, GAI Consultants 4/7/2009 04:10PM



STED



R16804

**** PCSTABL5M ****
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4/7/2009
Time of Run: 04:10PM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph7cst.in
Output Filename: C:ph7cst.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph7cst.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 7C South - Zero Streng th FCR Static Long-Term SS
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

11 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1
5	140.00	468.00	238.00	500.00	1
6	238.00	500.00	250.00	505.00	1
7	250.00	505.00	270.00	505.00	1
8	270.00	505.00	375.00	538.00	1
9	375.00	538.00	795.00	538.00	1
10	795.00	538.00	1045.00	454.00	1
11	1045.00	454.00	1100.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1100.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1100.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4

46	1010.00	454.00	1100.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1100.00	439.00	5

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	0
2	80.0	90.0	.0	18.8	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
1600 Trial Surfaces Have Been Generated.
40 Surfaces Initiate From Each Of 40 Points Equally Spaced
Along The Ground Surface Between X = 25.00 ft.
and X = 180.00 ft.
Each Surface Terminates Between X = 250.00 ft.
and X = 700.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	112.44	465.73
2	122.09	463.11
3	131.82	460.82
4	141.62	458.84
5	151.49	457.19
6	161.40	455.86
7	171.35	454.86
8	181.32	454.19
9	191.32	453.85
10	201.32	453.83
11	211.31	454.15
12	221.29	454.79
13	231.24	455.77
14	241.16	457.07
15	251.03	458.69
16	260.83	460.65
17	270.57	462.92
18	280.23	465.51
19	289.80	468.42
20	299.27	471.64
21	308.62	475.17
22	317.85	479.01
23	326.96	483.15

24	335.92	487.59
25	344.73	492.32
26	353.38	497.34
27	361.86	502.64
28	370.16	508.22
29	378.27	514.07
30	386.19	520.18
31	393.89	526.55
32	401.39	533.17
33	406.51	538.00

Circle Center At X = 196.7 ; Y = 757.4 and Radius, 303.6

*** 1.840 ***

Individual data on the 48 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.1	353.7	.0	.0	.0	.0	.0	.0	.0
2	4.5	1757.7	.0	.0	.0	.0	.0	.0	.0
3	2.1	1234.9	.0	.0	.0	.0	.0	.0	.0
4	6.4	4586.9	.0	.0	.0	.0	.0	.0	.0
5	3.4	2930.5	.0	82.1	.0	.0	.0	.0	.0
6	8.2	8458.9	.0	802.0	.0	.0	.0	.0	.0
7	1.6	1950.4	.0	255.7	.0	.0	.0	.0	.0
8	9.9	15575.1	.0	2123.6	.0	.0	.0	.0	.0
9	9.9	21804.6	.0	2986.4	.0	.0	.0	.0	.0
10	9.9	27644.7	.0	3645.3	.0	.0	.0	.0	.0
11	10.0	33065.4	.0	4099.4	.0	.0	.0	.0	.0
12	3.7	13444.6	.0	1582.3	.0	.0	.0	.0	.0
13	6.3	24639.2	.0	3039.6	.0	.0	.0	.0	.0
14	.7	2716.5	.0	372.5	.0	.0	.0	.0	.0
15	9.3	40173.7	.0	6174.6	.0	.0	.0	.0	.0
16	10.0	47244.4	.0	8505.8	.0	.0	.0	.0	.0
17	10.0	51091.9	.0	10267.9	.0	.0	.0	.0	.0
18	10.0	54417.7	.0	11831.6	.0	.0	.0	.0	.0
19	1.8	9925.0	.0	2243.7	.0	.0	.0	.0	.0
20	5.0	28751.4	.0	6609.0	.0	.0	.0	.0	.0
21	3.2	18592.7	.0	4342.5	.0	.0	.0	.0	.0
22	8.8	53952.7	.0	12813.6	.0	.0	.0	.0	.0
23	1.0	6417.4	.0	1543.5	.0	.0	.0	.0	.0
24	9.8	60080.5	.0	15316.2	.0	.0	.0	.0	.0
25	5.8	34135.3	.0	9420.1	.0	.0	.0	.0	.0
26	1.4	8216.4	.0	2341.6	.0	.0	.0	.0	.0
27	2.0	11558.9	.0	3346.1	.0	.0	.0	.0	.0
28	.6	3296.8	.0	963.7	.0	.0	.0	.0	.0
29	9.7	55913.6	.0	16621.9	.0	.0	.0	.0	.0
30	2.8	16126.0	.0	4885.4	.0	.0	.0	.0	.0
31	6.8	39212.7	.0	12244.6	.0	.0	.0	.0	.0
32	9.5	52691.9	.0	15581.1	.0	.0	.0	.0	.0
33	9.4	49475.2	.0	13473.6	.0	.0	.0	.0	.0
34	9.2	45848.8	.0	11173.8	.0	.0	.0	.0	.0
35	2.3	10875.7	.0	2431.0	.0	.0	.0	.0	.0
36	6.8	31961.2	.0	6253.2	.0	.0	.0	.0	.0
37	9.0	41908.2	.0	6007.6	.0	.0	.0	.0	.0
38	8.8	40765.1	.0	3146.9	.0	.0	.0	.0	.0
39	4.6	21080.3	.0	445.7	.0	.0	.0	.0	.0
40	4.0	18043.1	.0	.0	.0	.0	.0	.0	.0
41	8.5	35876.4	.0	.0	.0	.0	.0	.0	.0
42	8.3	32094.7	.0	.0	.0	.0	.0	.0	.0
43	4.8	17169.6	.0	.0	.0	.0	.0	.0	.0
44	3.3	10674.9	.0	.0	.0	.0	.0	.0	.0
45	7.9	21483.1	.0	.0	.0	.0	.0	.0	.0
46	7.7	14670.9	.0	.0	.0	.0	.0	.0	.0
47	7.5	7935.8	.0	.0	.0	.0	.0	.0	.0
48	5.1	1610.1	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 29 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	112.44	465.73
2	121.96	462.67
3	131.60	460.03
4	141.35	457.80
5	151.19	455.99
6	161.09	454.61
7	171.04	453.66
8	181.03	453.13
9	191.03	453.03
10	201.02	453.37
11	210.99	454.13
12	220.92	455.33
13	230.79	456.94
14	240.58	458.98
15	250.27	461.44
16	259.85	464.32
17	269.30	467.60
18	278.59	471.29
19	287.72	475.37
20	296.66	479.85
21	305.41	484.70
22	313.93	489.93
23	322.23	495.51
24	330.27	501.45
25	338.06	507.73
26	345.56	514.34
27	352.78	521.26
28	359.69	528.49
29	365.37	534.97

Circle Center At X = 188.3 ; Y = 685.5 and Radius, 232.4

*** 1.855 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.46	465.02
2	118.16	462.58
3	127.92	460.40
4	137.73	458.48
5	147.60	456.84
6	157.50	455.47
7	167.44	454.36
8	177.41	453.53
9	187.39	452.98
10	197.39	452.69
11	207.39	452.68
12	217.38	452.95
13	227.37	453.48
14	237.34	454.29
15	247.28	455.37
16	257.19	456.72
17	267.05	458.35
18	276.87	460.24
19	286.64	462.40
20	296.34	464.82
21	305.97	467.52
22	315.52	470.47
23	324.99	473.68
24	334.37	477.15
25	343.65	480.88
26	352.83	484.86
27	361.89	489.08
28	370.83	493.56
29	379.65	498.27
30	388.34	503.23
31	396.88	508.42
32	405.28	513.84

33	413.53	519.49
34	421.63	525.37
35	429.56	531.46
36	437.32	537.77
37	437.58	538.00

Circle Center At X = 202.8 ; Y = 818.4 and Radius, 365.7

*** 1.882 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.21	470.68
2	157.72	467.59
3	167.34	464.88
4	177.07	462.55
5	186.87	460.60
6	196.75	459.04
7	206.68	457.87
8	216.65	457.09
9	226.65	456.71
10	236.65	456.72
11	246.64	457.12
12	256.61	457.92
13	266.53	459.11
14	276.41	460.69
15	286.21	462.66
16	295.93	465.01
17	305.55	467.74
18	315.06	470.85
19	324.43	474.33
20	333.66	478.18
21	342.73	482.39
22	351.63	486.95
23	360.34	491.86
24	368.85	497.11
25	377.15	502.69
26	385.23	508.59
27	393.06	514.81
28	400.64	521.33
29	407.96	528.14
30	415.01	535.24
31	417.54	538.00

Circle Center At X = 231.4 ; Y = 710.5 and Radius, 253.9

*** 1.908 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.36	468.00
2	133.81	464.74
3	143.42	461.95
4	153.15	459.64
5	162.98	457.83
6	172.89	456.51
7	182.86	455.69
8	192.85	455.37
9	202.85	455.56
10	212.83	456.24
11	222.76	457.42
12	232.62	459.09
13	242.38	461.26
14	252.02	463.92
15	261.52	467.05
16	270.85	470.66
17	279.98	474.72
18	288.90	479.24
19	297.58	484.21
20	306.01	489.60
21	314.15	495.40

22	321.99	501.61
23	329.51	508.20
24	336.69	515.16
25	343.52	522.47
26	349.97	530.11
27	349.99	530.14

Circle Center At X = 194.2 ; Y = 655.0 and Radius, 199.6

*** 1.909 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.28	468.00
2	145.87	465.16
3	155.54	462.61
4	165.28	460.35
5	175.09	458.38
6	184.94	456.71
7	194.85	455.32
8	204.79	454.24
9	214.76	453.44
10	224.75	452.95
11	234.74	452.75
12	244.74	452.86
13	254.74	453.25
14	264.71	453.95
15	274.66	454.94
16	284.58	456.23
17	294.45	457.82
18	304.27	459.69
19	314.04	461.86
20	323.73	464.32
21	333.35	467.06
22	342.88	470.09
23	352.31	473.40
24	361.64	477.00
25	370.87	480.86
26	379.97	485.01
27	388.94	489.42
28	397.78	494.09
29	406.48	499.03
30	415.03	504.22
31	423.41	509.67
32	431.63	515.36
33	439.68	521.29
34	447.55	527.46
35	455.23	533.87
36	459.90	538.00

Circle Center At X = 236.3 ; Y = 788.5 and Radius, 335.8

*** 1.924 ***

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.36	468.00
2	133.67	464.36
3	143.16	461.19
4	152.79	458.51
5	162.55	456.31
6	172.40	454.61
7	182.33	453.42
8	192.31	452.72
9	202.30	452.53
10	212.30	452.85
11	222.27	453.67
12	232.18	454.99
13	242.01	456.81
14	251.74	459.13
15	261.34	461.93

16	270.78	465.22
17	280.05	468.97
18	289.11	473.20
19	297.95	477.87
20	306.55	482.99
21	314.87	488.53
22	322.90	494.49
23	330.62	500.84
24	338.01	507.58
25	345.05	514.68
26	351.73	522.13
27	358.01	529.90
28	360.62	533.48

Circle Center At X = 201.1 ; Y = 650.2 and Radius, 197.7

*** 1.926 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.46	465.02
2	118.20	462.73
3	127.98	460.68
4	137.82	458.88
5	147.70	457.31
6	157.61	455.99
7	167.55	454.92
8	177.52	454.09
9	187.50	453.50
10	197.49	453.17
11	207.49	453.08
12	217.49	453.23
13	227.48	453.64
14	237.46	454.28
15	247.42	455.18
16	257.36	456.32
17	267.26	457.70
18	277.13	459.33
19	286.95	461.20
20	296.72	463.32
21	306.44	465.67
22	316.10	468.26
23	325.69	471.10
24	335.21	474.16
25	344.65	477.46
26	354.01	480.99
27	363.27	484.75
28	372.44	488.74
29	381.51	492.96
30	390.47	497.39
31	399.32	502.05
32	408.06	506.92
33	416.67	512.01
34	425.15	517.30
35	433.50	522.81
36	441.71	528.52
37	449.77	534.43
38	454.40	538.00

Circle Center At X = 206.2 ; Y = 858.3 and Radius, 405.3

*** 1.936 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	96.54	465.21
2	106.24	462.77
3	116.01	460.66
4	125.85	458.88
5	135.75	457.43
6	145.68	456.32

7	155.66	455.55
8	165.65	455.12
9	175.65	455.02
10	185.64	455.26
11	195.63	455.85
12	205.58	456.77
13	215.50	458.02
14	225.38	459.61
15	235.19	461.54
16	244.93	463.79
17	254.59	466.38
18	264.16	469.29
19	273.62	472.52
20	282.97	476.07
21	292.19	479.93
22	301.28	484.11
23	310.22	488.59
24	319.00	493.37
25	327.62	498.44
26	336.06	503.81
27	344.31	509.46
28	352.37	515.38
29	360.22	521.57
30	367.86	528.02
31	375.28	534.73
32	378.65	538.00

Circle Center At X = 173.5 ; Y = 750.2 and Radius, 295.2

*** 1.943 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.36	468.00
2	133.58	464.13
3	143.03	460.85
4	152.66	458.17
5	162.45	456.11
6	172.34	454.66
7	182.31	453.84
8	192.31	453.65
9	202.30	454.08
10	212.24	455.15
11	222.10	456.83
12	231.83	459.14
13	241.39	462.05
14	250.76	465.56
15	259.88	469.65
16	268.73	474.31
17	277.27	479.51
18	285.46	485.25
19	293.28	491.48
20	300.69	498.20
21	307.66	505.37
22	314.17	512.96
23	320.02	520.72

Circle Center At X = 190.4 ; Y = 612.5 and Radius, 158.8

*** 1.950 ***

ATTACHMENT 2

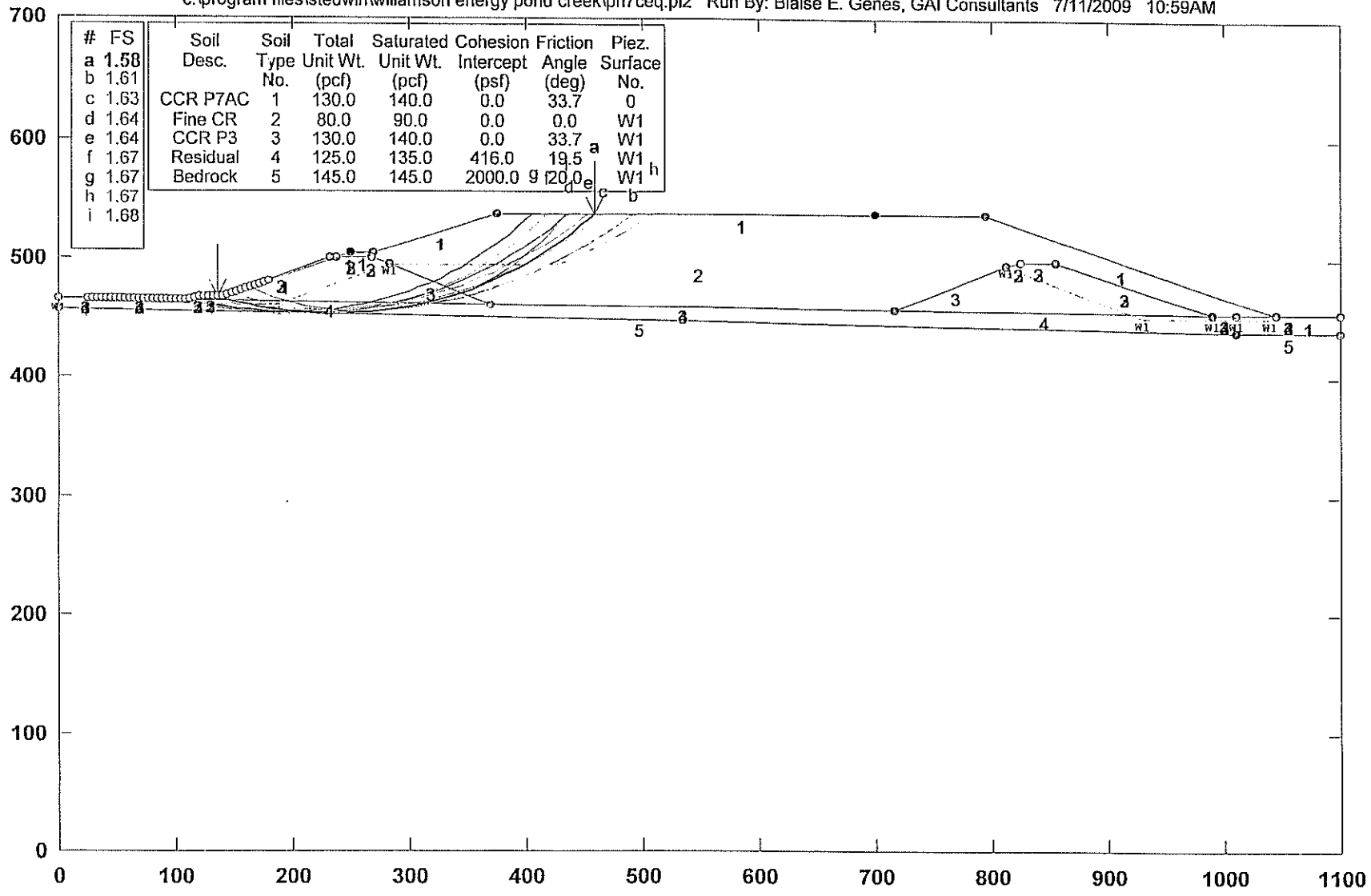
PHASE 7 SOUTH (PHASE 7C) SLOPE
POST-EARTHQUAKE SEISMIC CONDITIONS
PCSTABL SLOPE STABILITY ANALYSES

Pond Creek, Phase 7C South - Zero Strength FCR Post-EQ Deep

c:\program files\stedwin\wiliamson energy pond creek\ph7ceq.pl2 Run By: Blaise E. Genes, GAI Consultants 7/11/2009 10:59AM

#	FS
a	1.58
b	1.61
c	1.63
d	1.64
e	1.64
f	1.67
g	1.67
h	1.67
i	1.68

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR P7AC	1	130.0	140.0	0.0	33.7	0
Fine CR	2	80.0	90.0	0.0	0.0	W1
CCR P3	3	130.0	140.0	0.0	33.7	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1



PCSTABL5M/si FSmin=1.58

Safety Factors Are Calculated By The Modified Bishop Method

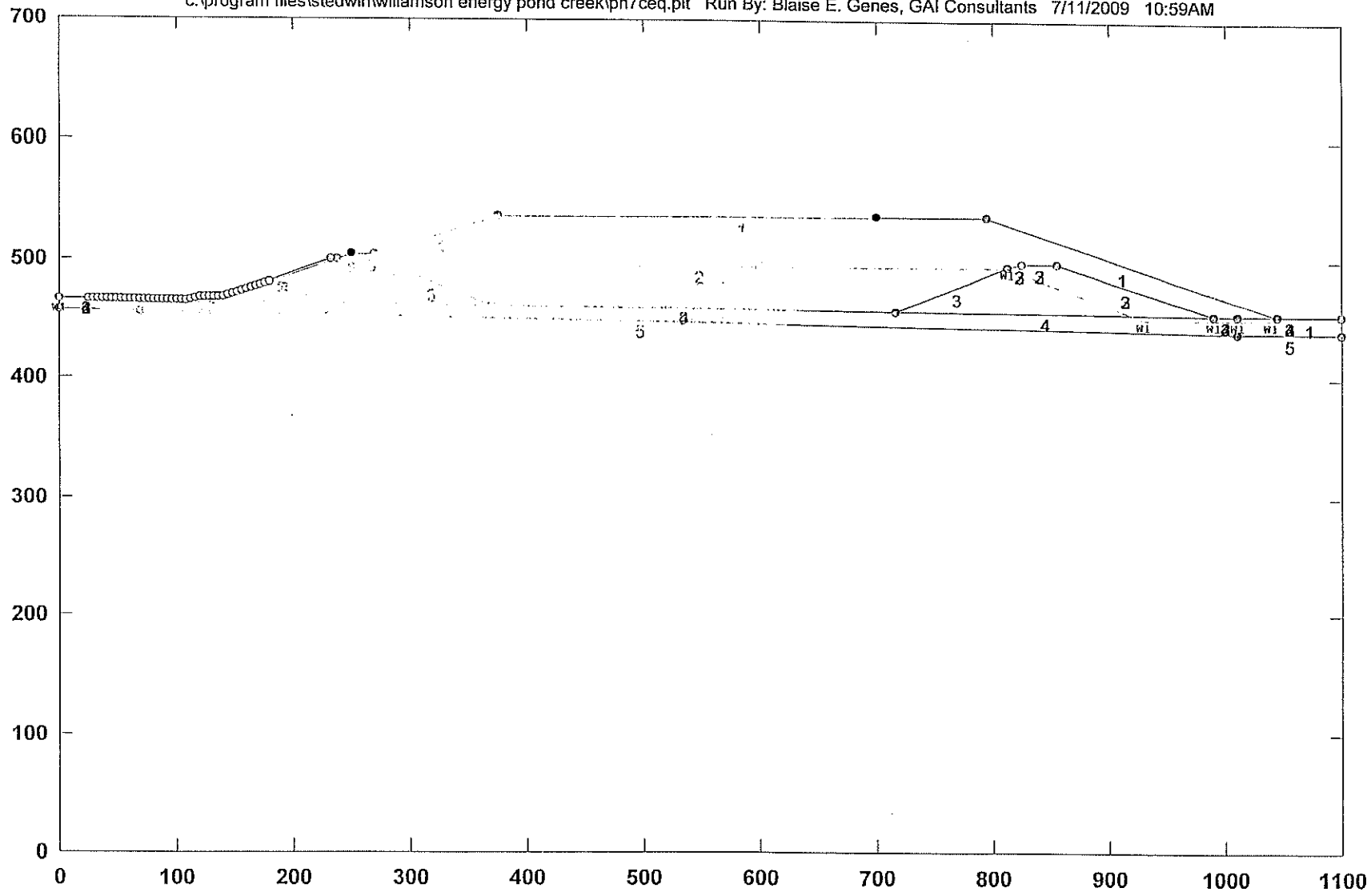
STED



R16814

Pond Creek, Phase 7C South - Zero Strength FCR Post-EQ Deep

c:\program files\stedwin\wiliamson energy pond creek\ph7ceq.plt Run By: Blaise E. Genes, GAI Consultants 7/11/2009 10:59AM



STED



R16815

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 7/11/2009
Time of Run: 10:59AM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph7ceq.in
Output Filename: C:ph7ceq.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph7ceq.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 7C South - Zero Streng
th FCR Post-EQ Deep
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

11 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1

5	140.00	468.00	238.00	500.00	1
6	238.00	500.00	250.00	505.00	1
7	250.00	505.00	270.00	505.00	1
8	270.00	505.00	375.00	538.00	1
9	375.00	538.00	795.00	538.00	1
10	795.00	538.00	1045.00	454.00	1
11	1045.00	454.00	1100.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1100.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1100.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4
46	1010.00	454.00	1100.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1100.00	439.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	0
2	80.0	90.0	.0	.0	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
1600 Trial Surfaces Have Been Generated.
40 Surfaces Initiate From Each Of 40 Points Equally Spaced
Along The Ground Surface Between X = 25.00 ft.
and X = 180.00 ft.
Each Surface Terminates Between X = 250.00 ft.
and X = 700.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.28	468.00
2	145.87	465.16
3	155.54	462.61
4	165.28	460.35
5	175.09	458.38
6	184.94	456.71
7	194.85	455.32
8	204.79	454.24
9	214.76	453.44
10	224.75	452.95
11	234.74	452.75
12	244.74	452.86
13	254.74	453.25
14	264.71	453.95
15	274.66	454.94
16	284.58	456.23
17	294.45	457.82
18	304.27	459.69
19	314.04	461.86
20	323.73	464.32
21	333.35	467.06
22	342.88	470.09
23	352.31	473.40
24	361.64	477.00
25	370.87	480.86
26	379.97	485.01
27	388.94	489.42
28	397.78	494.09
29	406.48	499.03
30	415.03	504.22
31	423.41	509.67
32	431.63	515.36
33	439.68	521.29
34	447.55	527.46
35	455.23	533.87
36	459.90	538.00

Circle Center At X = 236.3 ; Y = 788.5 and Radius, 335.8
*** 1.578 ***
Individual data on the 50 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.7	265.7	.0	.0	.0	.0	.0	.0	.0
2	5.9	2234.1	.0	.0	.0	.0	.0	.0	.0
3	3.5	2624.7	.0	.0	.0	.0	.0	.0	.0
4	6.2	6914.7	.0	.0	.0	.0	.0	.0	.0
5	5.9	9142.2	.0	.0	.0	.0	.0	.0	.0
6	3.9	7443.0	.0	107.1	.0	.0	.0	.0	.0

7	9.8	23519.9	.0	1118.2	.0	.0	.0	.0	.0
8	9.9	30190.0	.0	2189.7	.0	.0	.0	.0	.0
9	.1	187.0	.0	14.9	.0	.0	.0	.0	.0
10	7.0	25226.2	.0	2499.2	.0	.0	.0	.0	.0
11	2.9	11253.1	.0	1433.7	.0	.0	.0	.0	.0
12	9.9	42973.5	.0	6709.0	.0	.0	.0	.0	.0
13	10.0	48901.1	.0	9302.9	.0	.0	.0	.0	.0
14	10.0	54425.2	.0	11726.5	.0	.0	.0	.0	.0
15	8.3	48792.6	.0	11383.6	.0	.0	.0	.0	.0
16	1.7	10731.4	.0	2593.9	.0	.0	.0	.0	.0
17	3.3	20409.9	.0	5009.2	.0	.0	.0	.0	.0
18	6.7	44035.0	.0	11044.7	.0	.0	.0	.0	.0
19	5.3	36042.6	.0	9219.4	.0	.0	.0	.0	.0
20	4.7	33096.4	.0	8734.6	.0	.0	.0	.0	.0
21	10.0	69375.5	.0	19676.0	.0	.0	.0	.0	.0
22	3.3	22719.0	.0	6852.3	.0	.0	.0	.0	.0
23	2.0	13762.9	.0	4244.6	.0	.0	.0	.0	.0
24	4.7	32367.8	.0	10121.5	.0	.0	.0	.0	.0
25	8.3	59423.8	.0	18900.9	.0	.0	.0	.0	.0
26	1.6	11461.8	.0	3860.6	.0	.0	.0	.0	.0
27	9.9	71688.1	.0	23697.4	.0	.0	.0	.0	.0
28	9.8	71036.3	.0	22618.0	.0	.0	.0	.0	.0
29	6.5	46775.6	.0	14406.0	.0	.0	.0	.0	.0
30	3.2	23145.9	.0	6950.2	.0	.0	.0	.0	.0
31	9.7	68270.8	.0	19913.0	.0	.0	.0	.0	.0
32	9.6	66148.8	.0	18289.7	.0	.0	.0	.0	.0
33	9.5	63597.2	.0	16487.8	.0	.0	.0	.0	.0
34	1.1	7121.3	.0	1778.6	.0	.0	.0	.0	.0
35	8.3	54824.8	.0	12730.3	.0	.0	.0	.0	.0
36	9.3	61927.6	.0	12354.8	.0	.0	.0	.0	.0
37	9.2	61590.4	.0	10027.3	.0	.0	.0	.0	.0
38	4.1	27672.2	.0	3739.8	.0	.0	.0	.0	.0
39	5.0	32744.4	.0	3788.6	.0	.0	.0	.0	.0
40	9.0	56462.6	.0	4860.6	.0	.0	.0	.0	.0
41	8.8	51997.6	.0	2026.0	.0	.0	.0	.0	.0
42	1.6	9018.9	.0	52.2	.0	.0	.0	.0	.0
43	7.1	37804.0	.0	.0	.0	.0	.0	.0	.0
44	8.5	40413.1	.0	.0	.0	.0	.0	.0	.0
45	8.4	33864.3	.0	.0	.0	.0	.0	.0	.0
46	8.2	27242.9	.0	.0	.0	.0	.0	.0	.0
47	8.0	20586.5	.0	.0	.0	.0	.0	.0	.0
48	7.9	13933.9	.0	.0	.0	.0	.0	.0	.0
49	7.7	7324.2	.0	.0	.0	.0	.0	.0	.0
50	4.7	1254.2	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	124.36	468.00
2	134.04	465.51
3	143.78	463.24
4	153.57	461.21
5	163.41	459.40
6	173.28	457.82
7	183.19	456.47
8	193.13	455.36
9	203.09	454.47
10	213.07	453.82
11	223.06	453.41
12	233.06	453.22
13	243.06	453.27
14	253.06	453.56
15	263.04	454.07
16	273.01	454.82
17	282.97	455.81
18	292.89	457.02
19	302.79	458.47
20	312.65	460.14

21	322.46	462.05
22	332.23	464.18
23	341.95	466.55
24	351.61	469.13
25	361.20	471.95
26	370.73	474.98
27	380.19	478.24
28	389.56	481.72
29	398.85	485.42
30	408.06	489.33
31	417.17	493.46
32	426.18	497.79
33	435.08	502.34
34	443.88	507.09
35	452.57	512.05
36	461.13	517.21
37	469.58	522.57
38	477.89	528.12
39	486.08	533.87
40	491.68	538.00

Circle Center At X = 235.9 ; Y = 881.4 and Radius, 428.1

*** 1.613 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.31	468.00
2	142.00	465.55
3	151.76	463.35
4	161.57	461.42
5	171.43	459.74
6	181.33	458.32
7	191.26	457.17
8	201.22	456.27
9	211.20	455.64
10	221.19	455.27
11	231.19	455.17
12	241.19	455.33
13	251.18	455.76
14	261.16	456.44
15	271.11	457.39
16	281.04	458.60
17	290.93	460.08
18	300.78	461.81
19	310.58	463.80
20	320.32	466.06
21	330.00	468.56
22	339.61	471.32
23	349.15	474.34
24	358.60	477.60
25	367.96	481.11
26	377.23	484.87
27	386.40	488.87
28	395.45	493.11
29	404.39	497.59
30	413.21	502.30
31	421.91	507.24
32	430.47	512.42
33	438.89	517.81
34	447.16	523.43
35	455.29	529.26
36	463.25	535.30
37	466.62	538.00

Circle Center At X = 230.1 ; Y = 834.4 and Radius, 379.2

*** 1.625 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	108.46	465.02
2	118.16	462.58
3	127.92	460.40
4	137.73	458.48
5	147.60	456.84
6	157.50	455.47
7	167.44	454.36
8	177.41	453.53
9	187.39	452.98
10	197.39	452.69
11	207.39	452.68
12	217.38	452.95
13	227.37	453.48
14	237.34	454.29
15	247.28	455.37
16	257.19	456.72
17	267.05	458.35
18	276.87	460.24
19	286.64	462.40
20	296.34	464.82
21	305.97	467.52
22	315.52	470.47
23	324.99	473.68
24	334.37	477.15
25	343.65	480.88
26	352.83	484.86
27	361.89	489.08
28	370.83	493.56
29	379.65	498.27
30	388.34	503.23
31	396.88	508.42
32	405.28	513.84
33	413.53	519.49
34	421.63	525.37
35	429.56	531.46
36	437.32	537.77
37	437.58	538.00

Circle Center At X = 202.8 ; Y = 818.4 and Radius, 365.7

*** 1.635 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.46	465.02
2	118.20	462.73
3	127.98	460.68
4	137.82	458.88
5	147.70	457.31
6	157.61	455.99
7	167.55	454.92
8	177.52	454.09
9	187.50	453.50
10	197.49	453.17
11	207.49	453.08
12	217.49	453.23
13	227.48	453.64
14	237.46	454.28
15	247.42	455.18
16	257.36	456.32
17	267.26	457.70
18	277.13	459.33
19	286.95	461.20
20	296.72	463.32
21	306.44	465.67
22	316.10	468.26
23	325.69	471.10
24	335.21	474.16
25	344.65	477.46

26	354.01	480.99
27	363.27	484.75
28	372.44	488.74
29	381.51	492.96
30	390.47	497.39
31	399.32	502.05
32	408.06	506.92
33	416.67	512.01
34	425.15	517.30
35	433.50	522.81
36	441.71	528.52
37	449.77	534.43
38	454.40	538.00

Circle Center At X = 206.2 ; Y = 858.3 and Radius, 405.3

*** 1.640 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.21	470.68
2	157.72	467.59
3	167.34	464.88
4	177.07	462.55
5	186.87	460.60
6	196.75	459.04
7	206.68	457.87
8	216.65	457.09
9	226.65	456.71
10	236.65	456.72
11	246.64	457.12
12	256.61	457.92
13	266.53	459.11
14	276.41	460.69
15	286.21	462.66
16	295.93	465.01
17	305.55	467.74
18	315.06	470.85
19	324.43	474.33
20	333.66	478.18
21	342.73	482.39
22	351.63	486.95
23	360.34	491.86
24	368.85	497.11
25	377.15	502.69
26	385.23	508.59
27	393.06	514.81
28	400.64	521.33
29	407.96	528.14
30	415.01	535.24
31	417.54	538.00

Circle Center At X = 231.4 ; Y = 710.5 and Radius, 253.9

*** 1.668 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	112.44	465.73
2	122.09	463.11
3	131.82	460.82
4	141.62	458.84
5	151.49	457.19
6	161.40	455.86
7	171.35	454.86
8	181.32	454.19
9	191.32	453.85
10	201.32	453.83
11	211.31	454.15
12	221.29	454.79
13	231.24	455.77

14	241.16	457.07
15	251.03	458.69
16	260.83	460.65
17	270.57	462.92
18	280.23	465.51
19	289.80	468.42
20	299.27	471.64
21	308.62	475.17
22	317.85	479.01
23	326.96	483.15
24	335.92	487.59
25	344.73	492.32
26	353.38	497.34
27	361.86	502.64
28	370.16	508.22
29	378.27	514.07
30	386.19	520.18
31	393.89	526.55
32	401.39	533.17
33	406.51	538.00

Circle Center At X = 196.7 ; Y = 757.4 and Radius, 303.6

*** 1.673 ***

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	128.33	468.00
2	138.10	465.87
3	147.92	463.94
4	157.76	462.20
5	167.65	460.67
6	177.56	459.34
7	187.49	458.22
8	197.45	457.29
9	207.43	456.57
10	217.41	456.06
11	227.41	455.75
12	237.41	455.64
13	247.41	455.73
14	257.40	456.03
15	267.39	456.54
16	277.36	457.24
17	287.32	458.15
18	297.26	459.27
19	307.17	460.58
20	317.06	462.10
21	326.91	463.82
22	336.72	465.74
23	346.50	467.86
24	356.22	470.18
25	365.90	472.70
26	375.53	475.41
27	385.09	478.32
28	394.60	481.42
29	404.04	484.72
30	413.41	488.21
31	422.71	491.89
32	431.93	495.76
33	441.07	499.82
34	450.13	504.06
35	459.09	508.48
36	467.97	513.09
37	476.75	517.88
38	485.43	522.85
39	494.00	527.99
40	502.47	533.30
41	509.63	538.00

Circle Center At X = 237.7 ; Y = 945.7 and Radius, 490.1

*** 1.674 ***
Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.10	475.87
2	173.23	471.77
3	182.52	468.09
4	191.97	464.82
5	201.56	461.98
6	211.26	459.56
7	221.07	457.59
8	230.95	456.05
9	240.89	454.96
10	250.87	454.31
11	260.87	454.11
12	270.86	454.35
13	280.84	455.04
14	290.77	456.17
15	300.65	457.75
16	310.44	459.76
17	320.14	462.21
18	329.71	465.10
19	339.15	468.40
20	348.43	472.12
21	357.54	476.26
22	366.45	480.80
23	375.15	485.73
24	383.62	491.04
25	391.85	496.72
26	399.81	502.77
27	407.50	509.17
28	414.89	515.90
29	421.98	522.96
30	428.74	530.33
31	435.17	537.99
32	435.18	538.00

Circle Center At X = 260.4 ; Y = 678.1 and Radius, 224.0

*** 1.684 ***
Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	128.33	468.00
2	138.12	465.95
3	147.94	464.05
4	157.79	462.32
5	167.66	460.74
6	177.56	459.32
7	187.48	458.07
8	197.42	456.97
9	207.38	456.04
10	217.35	455.27
11	227.33	454.66
12	237.32	454.21
13	247.32	453.92
14	257.32	453.80
15	267.32	453.84
16	277.31	454.03
17	287.31	454.40
18	297.29	454.92
19	307.27	455.60
20	317.23	456.45
21	327.18	457.46
22	337.11	458.62
23	347.03	459.95
24	356.91	461.44
25	366.78	463.09
26	376.61	464.90

27	386.42	466.87
28	396.19	468.99
29	405.92	471.28
30	415.62	473.72
31	425.28	476.32
32	434.89	479.07
33	444.46	481.98
34	453.98	485.05
35	463.45	488.27
36	472.86	491.64
37	482.22	495.16
38	491.52	498.83
39	500.76	502.66
40	509.94	506.63
41	519.05	510.75
42	528.09	515.02
43	537.06	519.44
44	545.96	524.00
45	554.79	528.70
46	563.54	533.54
47	571.28	538.00

Circle Center At X = 260.0 ; Y = 1071.2 and Radius, 617.4

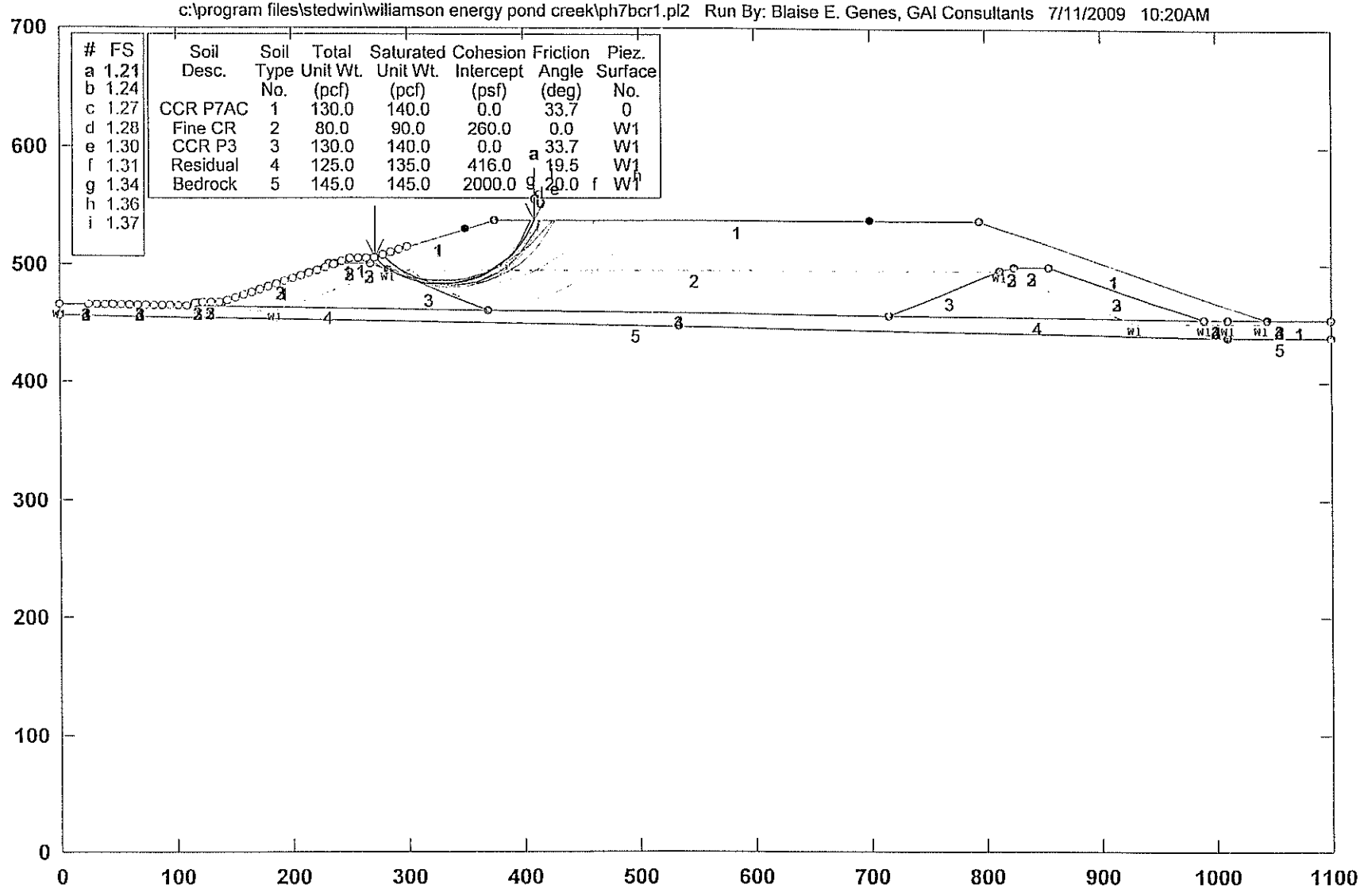
*** 1.689 ***

Pond Creek, Phase 7C South - Sus/sig=.05FCR Post-EQ Shallow

c:\program files\stedwin\wiliamson energy pond creek\ph7bcr1.pl2 Run By: Blaise E. Genes, GAI Consultants 7/11/2009 10:20AM

#	FS
a	1.21
b	1.24
c	1.27
d	1.28
e	1.30
f	1.31
g	1.34
h	1.36
i	1.37

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR P7AC	1	130.0	140.0	0.0	33.7	0
Fine CR	2	80.0	90.0	260.0	0.0	W1
CCR P3	3	130.0	140.0	0.0	33.7	W1
Residual	4	125.0	135.0	416.0	19.5	W1
Bedrock	5	145.0	145.0	2000.0	20.0	W1



PCSTABL5M/si FSmin=1.21

Safety Factors Are Calculated By The Modified Bishop Method

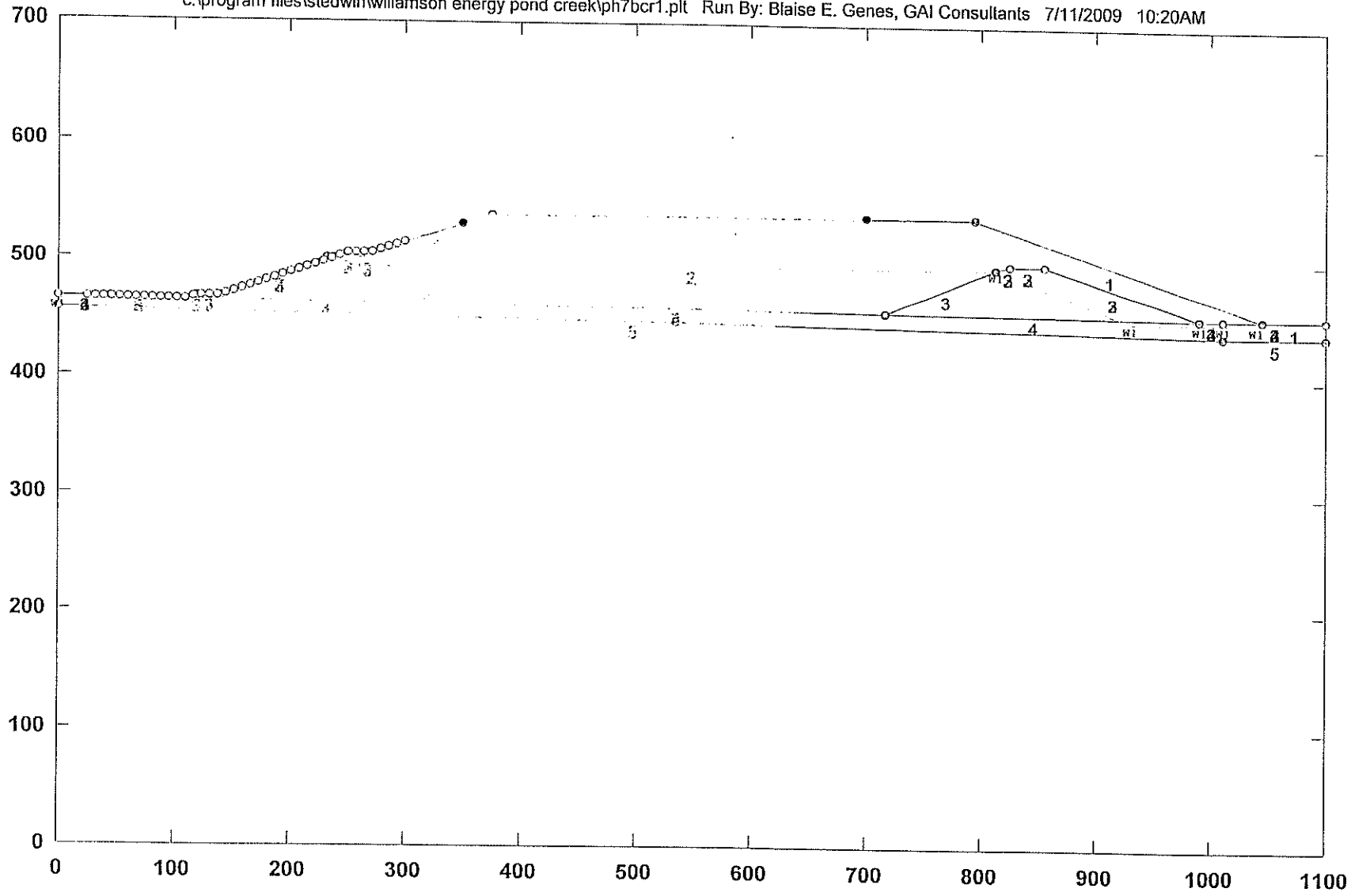
STED



R16826

Pond Creek, Phase 7C South - Sus/sig=.05FCR Post-EQ Shallow

c:\program files\stedwin\wiliamson energy pond creek\ph7bcr1.plt Run By: Blaise E. Genes, GAI Consultants 7/11/2009 10:20AM



STED



R16827

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 7/11/2009
Time of Run: 10:20AM
Run By: Blaise E. Genes, GAI Consultants
Input Data Filename: C:ph7bcr1.in
Output Filename: C:ph7bcr1.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph7bcr1.PLT
PROBLEM DESCRIPTION Pond Creek, Phase 7C South - Sus/sig=.05
FCR Post-EQ Shallow

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

11 Top Boundaries
48 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	466.00	45.00	466.00	1
2	45.00	466.00	110.00	465.00	1
3	110.00	465.00	120.00	468.00	1
4	120.00	468.00	140.00	468.00	1
5	140.00	468.00	238.00	500.00	1
6	238.00	500.00	250.00	505.00	1
7	250.00	505.00	270.00	505.00	1
8	270.00	505.00	375.00	538.00	1
9	375.00	538.00	795.00	538.00	1
10	795.00	538.00	1045.00	454.00	1
11	1045.00	454.00	1100.00	454.00	1
12	.00	466.00	45.00	466.00	2
13	45.00	466.00	110.00	465.00	2
14	110.00	465.00	120.00	468.00	2
15	120.00	468.00	140.00	468.00	2
16	140.00	468.00	233.00	500.00	2
17	233.00	500.00	268.00	500.00	2
18	268.00	500.00	283.00	495.00	2
19	283.00	495.00	812.00	495.00	2
20	812.00	495.00	825.00	498.00	2
21	825.00	498.00	855.00	498.00	2
22	855.00	498.00	990.00	454.00	2
23	990.00	454.00	1010.00	454.00	2
24	1010.00	454.00	1100.00	454.00	2
25	.00	466.00	45.00	466.00	3
26	45.00	466.00	110.00	465.00	3
27	110.00	465.00	120.00	468.00	3
28	120.00	468.00	140.00	468.00	3
29	140.00	468.00	233.00	500.00	3
30	233.00	500.00	268.00	500.00	3
31	268.00	500.00	283.00	495.00	3
32	283.00	495.00	370.00	460.00	3
33	370.00	460.00	716.00	457.00	3
34	716.00	457.00	812.00	495.00	3
35	812.00	495.00	825.00	498.00	3
36	825.00	498.00	855.00	498.00	3
37	855.00	498.00	990.00	454.00	3
38	990.00	454.00	1010.00	454.00	3
39	1010.00	454.00	1100.00	454.00	3
40	.00	466.00	45.00	466.00	4
41	45.00	466.00	110.00	465.00	4
42	110.00	465.00	370.00	460.00	4
43	370.00	460.00	716.00	457.00	4
44	716.00	457.00	990.00	454.00	4
45	990.00	454.00	1010.00	454.00	4

46	1010.00	454.00	1100.00	454.00	4
47	.00	456.00	1010.00	439.00	5
48	1010.00	439.00	1100.00	439.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	0
2	80.0	90.0	260.0	.0	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	416.0	19.5	.00	.0	1
5	145.0	145.0	2000.0	20.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	463.00
2	185.00	461.00
3	283.00	495.00
4	812.00	495.00
5	930.00	451.00
6	990.00	451.00
7	1010.00	451.00
8	1040.00	451.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

1600 Trial Surfaces Have Been Generated.

40 Surfaces Initiate From Each Of 40 Points Equally Spaced Along The Ground Surface Between X = 25.00 ft.
and X = 300.00 ft.

Each Surface Terminates Between X = 350.00 ft.
and X = 700.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	271.80	505.56
2	279.64	499.36
3	288.14	494.10
4	297.19	489.84
5	306.67	486.65
6	316.45	484.57
7	326.41	483.63
8	336.40	483.84
9	346.31	485.18
10	356.00	487.66
11	365.34	491.23
12	374.21	495.85
13	382.49	501.46
14	390.07	507.98
15	396.86	515.33
16	402.75	523.40
17	407.69	532.10
18	410.19	538.00

Circle Center At X = 329.6 ; Y = 570.4 and Radius, 86.9

*** 1.206 ***

Individual data on the 20 slices

	Water Force	Water Force	Tie Force	Tie Force	Earthquake Force	Surcharge

Slice No.	Width (ft)	Weight (lbs)	Top (lbs)	Bot (lbs)	Norm (lbs)	Tan (lbs)	Hor (lbs)	Ver (lbs)	Load (lbs)
1	7.8	4419.2	.0	.0	.0	.0	.0	.0	.0
2	7.0	10945.3	.0	.0	.0	.0	.0	.0	.0
3	1.5	2996.5	.0	48.4	.0	.0	.0	.0	.0
4	9.1	22614.7	.0	1891.4	.0	.0	.0	.0	.0
5	9.5	30446.4	.0	4213.2	.0	.0	.0	.0	.0
6	9.8	37586.9	.0	5856.6	.0	.0	.0	.0	.0
7	10.0	43623.8	.0	6799.9	.0	.0	.0	.0	.0
8	10.0	48218.5	.0	7030.7	.0	.0	.0	.0	.0
9	9.9	51123.8	.0	6545.8	.0	.0	.0	.0	.0
10	9.7	52197.6	.0	5351.8	.0	.0	.0	.0	.0
11	9.3	51410.1	.0	3464.4	.0	.0	.0	.0	.0
12	7.2	39848.3	.0	957.6	.0	.0	.0	.0	.0
13	1.6	8968.7	.0	.0	.0	.0	.0	.0	.0
14	.8	4292.9	.0	.0	.0	.0	.0	.0	.0
15	7.5	38044.0	.0	.0	.0	.0	.0	.0	.0
16	7.6	32804.2	.0	.0	.0	.0	.0	.0	.0
17	6.8	23237.6	.0	.0	.0	.0	.0	.0	.0
18	5.9	14286.4	.0	.0	.0	.0	.0	.0	.0
19	4.9	6570.2	.0	.0	.0	.0	.0	.0	.0
20	2.5	958.1	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	278.85	507.78
2	285.92	500.71
3	293.82	494.58
4	302.42	489.48
5	311.59	485.49
6	321.18	482.67
7	331.06	481.07
8	341.05	480.72
9	351.01	481.61
10	360.78	483.74
11	370.21	487.07
12	379.15	491.55
13	387.47	497.10
14	395.02	503.65
15	401.70	511.09
16	407.40	519.31
17	412.04	528.17
18	415.53	537.54
19	415.64	538.00

Circle Center At X = 338.9 ; Y = 560.8 and Radius, 80.1

*** 1.236 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	278.85	507.78
2	285.95	500.74
3	293.91	494.69
4	302.59	489.72
5	311.83	485.92
6	321.50	483.35
7	331.42	482.06
8	341.42	482.07
9	351.33	483.38
10	360.99	485.97
11	370.23	489.78
12	378.90	494.77
13	386.84	500.84
14	393.93	507.90
15	400.05	515.81
16	405.08	524.45
17	408.95	533.68
18	410.13	538.00

Circle Center At X = 336.3 ; Y = 558.5 and Radius, 76.6
*** 1.267 ***
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	278.85	507.78
2	286.11	500.91
3	294.17	494.99
4	302.90	490.12
5	312.17	486.35
6	321.83	483.77
7	331.74	482.40
8	341.73	482.26
9	351.67	483.36
10	361.40	485.68
11	370.77	489.18
12	379.63	493.82
13	387.85	499.51
14	395.30	506.18
15	401.87	513.72
16	407.46	522.01
17	411.98	530.93
18	414.53	538.00

Circle Center At X = 337.8 ; Y = 562.8 and Radius, 80.6
*** 1.284 ***
Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	278.85	507.78
2	286.39	501.22
3	294.61	495.52
4	303.40	490.74
5	312.65	486.96
6	322.26	484.20
7	332.12	482.50
8	342.10	481.89
9	352.09	482.37
10	361.97	483.93
11	371.61	486.56
12	380.92	490.23
13	389.77	494.88
14	398.06	500.47
15	405.69	506.93
16	412.58	514.19
17	418.63	522.15
18	423.78	530.72
19	427.14	538.00

Circle Center At X = 342.7 ; Y = 573.6 and Radius, 91.7
*** 1.296 ***
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	271.80	505.56
2	280.26	500.24
3	289.08	495.54
4	298.22	491.47
5	307.63	488.08
6	317.25	485.36
7	327.05	483.35
8	336.96	482.03
9	346.94	481.44
10	356.94	481.55
11	366.91	482.39
12	376.79	483.93
13	386.53	486.18
14	396.09	489.12
15	405.41	492.73

16	414.45	497.01
17	423.16	501.92
18	431.50	507.44
19	439.42	513.54
20	446.89	520.20
21	453.85	527.37
22	460.29	535.03
23	462.45	538.00

Circle Center At X = 350.3 ; Y = 621.0 and Radius, 139.6

*** 1.309 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	278.85	507.78
2	286.08	500.88
3	294.17	495.00
4	302.97	490.25
5	312.32	486.71
6	322.06	484.44
7	332.02	483.48
8	342.01	483.85
9	351.87	485.55
10	361.41	488.54
11	370.47	492.77
12	378.89	498.17
13	386.52	504.63
14	393.22	512.05
15	398.88	520.30
16	403.39	529.22
17	406.45	538.00

Circle Center At X = 334.2 ; Y = 558.6 and Radius, 75.2

*** 1.337 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	285.90	510.00
2	292.99	502.95
3	300.59	496.45
4	308.67	490.55
5	317.16	485.27
6	326.03	480.66
7	335.23	476.72
8	344.69	473.49
9	354.37	470.99
10	364.21	469.22
11	374.16	468.21
12	384.16	467.94
13	394.15	468.44
14	404.07	469.68
15	413.87	471.68
16	423.49	474.40
17	432.88	477.85
18	441.98	482.00
19	450.74	486.82
20	459.11	492.29
21	467.04	498.37
22	474.49	505.04
23	481.42	512.25
24	487.78	519.97
25	493.54	528.14
26	498.67	536.73
27	499.31	538.00

Circle Center At X = 382.6 ; Y = 600.2 and Radius, 132.3

*** 1.364 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	264.74	505.00
2	273.38	499.95
3	282.41	495.66
4	291.77	492.15
5	301.40	489.45
6	311.23	487.58
7	321.17	486.56
8	331.17	486.39
9	341.15	487.07
10	351.03	488.59
11	360.75	490.96
12	370.23	494.14
13	379.40	498.12
14	388.20	502.87
15	396.57	508.34
16	404.44	514.52
17	411.75	521.34
18	418.46	528.75
19	424.51	536.72
20	425.32	538.00

Circle Center At X = 328.2 ; Y = 603.5 and Radius, 117.2

*** 1.374 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	271.80	505.56
2	280.41	500.48
3	289.24	495.79
4	298.27	491.50
5	307.48	487.61
6	316.86	484.13
7	326.38	481.08
8	336.03	478.45
9	345.78	476.25
10	355.63	474.48
11	365.54	473.16
12	375.50	472.28
13	385.49	471.84
14	395.49	471.85
15	405.48	472.30
16	415.44	473.19
17	425.35	474.52
18	435.19	476.30
19	444.95	478.51
20	454.59	481.15
21	464.11	484.22
22	473.48	487.70
23	482.69	491.60
24	491.71	495.91
25	500.54	500.61
26	509.15	505.70
27	517.52	511.17
28	525.64	517.00
29	533.50	523.19
30	541.07	529.72
31	548.34	536.58
32	549.72	538.00

Circle Center At X = 390.3 ; Y = 696.7 and Radius, 224.9

*** 1.385 ***

Alliance Consulting, Inc.
Engineers • Constructors • Scientists

8114-710
Part 24

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
MODIFICATION TO PERMIT NO. IL0078565
ADDITIONAL MSHA INFORMATION
COMMENTS 2, 4, 5, 6, 9, 10 AND 11
VOLUME 5 OF 6

COAL REFUSE DISPOSAL FACILITY NO. 2
PHASE 3 THROUGH 7
IMPOUNDMENT I.D. NO. 1211-IL08-0341-02
MSHA I.D. NO. 11-03141
WILLIAMSON COUNTY, ILLINOIS

Prepared for

MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B10-148-1413
MARCH 2010

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
MODIFICATION TO PERMIT NO. IL0078565
ADDITIONAL MSHA INFORMATION
COMMENTS 2, 4, 5, 6, 9, 10 AND 11
VOLUME 5 OF 6

COAL REFUSE DISPOSAL FACILITY NO. 2
PHASE 3 THROUGH 7
IMPOUNDMENT I.D. NO. 1211-IL08-0341-02
MSHA I.D. NO. 11-03141
WILLIAMSON COUNTY, ILLINOIS

Prepared for

MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B10-148-1413
MARCH 2010

U.S. Department of Labor

Mine Safety and Health Administration
Pittsburgh Safety & Health Technology Center
P.O. Box 18233
Pittsburgh, PA 15236

November 12, 2009

MEMORANDUM FOR JOSEPH O'DONNELL
Acting District Manager, District 8
Coal Mine Safety and Health

THROUGH: JOHN W. FREDLAND
Acting Chief, Pittsburgh Safety and Health Technology Center

FROM: STANLEY J. MICHALEK
Chief, Mine Waste and Geotechnical Engineering Division

SUBJECT: Recommendation for Approval of Design Plans for Phases 3 through 6, and Request for Additional Information for Phase 7, Refuse Disposal Facility No. 2, Impoundment I.D. No. 1211-IL08-03141-02, Mach Mining, LLC, Mach Mine No. 1, Mine I.D. No. 11-03141, Williamson County, Illinois

As requested by your office, a technical review of the subject proposed impoundment plans has been completed. Our review included an initial submittal and two revisions submitted in response to our requests for additional information. Report No. MW09-077, which is attached, indicates that the subject plans appear to be technically acceptable only through Phase 6 and approval through Phase 6 is recommended. Additional information will be required before we can recommend approval of Phase 7.

The proposed mining under Phase 3 will be the most significant event at this facility. Phase 3 must be closed and covered with a stable cap of coarse refuse, be incapable of impounding water or slurry, and all the proposed instrumentation must be in place and operational before the proposed longwall mining is advanced within 100 feet of any part of the Phase 3 embankment.

The Impoundment and IRPI data sheets have been completed for Phases 3 through 6 and are included with the report. Please contact this office if there are any questions regarding this review.

Attachment

cc: L. Zeiler – Acting Director, TS
M. Smith – Acting Chief, Safety Div., CMS&H

UNITED STATES DEPARTMENT OF LABOR

MINE SAFETY AND HEALTH ADMINISTRATION

PITTSBURGH SAFETY AND HEALTH TECHNOLOGY CENTER
MINE WASTE AND GEOTECHNICAL ENGINEERING DIVISION
COCHRANS MILL ROAD
P.O. BOX 18233
PITTSBURGH, PENNSYLVANIA 15236

REPORT NO. MW09-077

REVIEW OF DESIGN PLANS FOR PHASES 3 THROUGH 7 REFUSE DISPOSAL AREA NO. 2 MSHA I.D. NO. 1211-IL08-03141-02 MACH MINING LLC MINE I.D. NO. 11-03141 WILLIAMSON COUNTY, ILLINOIS

NOVEMBER 12, 2009

BY

PAUL J. DONAHUE, P.E.
CIVIL ENGINEER

REPORT NUMBER MW09-077

OWNERSHIP AND LOCATION

The Refuse Disposal Area No. 2 is owned and operated by Mach Mining, LLC and receives coarse and fine coal refuse from the preparation plant for the Mach No. 1 Mine. The site can be found on the USGS 7.5 Minute Pittsburg (IL) quadrangle map at geographic coordinates N 37°50'30" latitude and W 88°49'17" longitude. This facility is located on a tract comprising the east half of Section 12, Township 8S, and Range 3E, Third Principal Meridian.

MATERIAL REVIEWED

Original Design Submittal

The original submitted design documents were prepared for Mach Mining, LLC by Alliance Consulting, Incorporated (Alliance) and included the following.

1. A report entitled "Engineering Design Plan – Proposed Coal Refuse Disposal, Facility No. 2, Williamson County, Illinois, dated January 2007." The report included a narrative description of the proposed design, and the testing and analyses performed. Appendices to the report included construction specifications, calculations, geotechnical test boring and laboratory test data.

2. Thirteen drawings depicting plans, profiles and details of the proposed facility dated January 16, 2007.

During our review of this plan, Mr. Duffy Stradner, former District 8 Impoundment Specialist, notified this reviewer in a phone conversation on October 23, 2007, that the impoundment layout and geometry would be substantially revised and a new plan submitted. Due to proposed mining under the impoundments and other issues that would similarly affect the new design, we completed the review and requested additional information in a memorandum to Robert Phillips, District Manager, Coal Mine Safety and Health (CMS&H) District 8, dated December 13, 2007. The memorandum identified 14 design issues to be addressed in the revised design submittal.

First Revised Design Submittal

The revised design package for the coal refuse impoundments was hand delivered to our office on August 19, 2008, in conjunction with a meeting with Mach Mining and Alliance Consulting personnel to discuss the new design.

The design documents received at this meeting included the following items.

1. A report entitled "Response to February 11, 2008, Comments, I.D. No. IL08-03141-02, Mach Mining, LLC – Mach No. 1 Mine ID No. 11-03141, Williamson County, Illinois – Coal Refuse Disposal Facility No. 2 Phases 3 through 7," dated August 2008. Appendices to

the report contained construction specifications, various design calculations, geotechnical test boring logs, laboratory test data and a CISPM Mine Subsidence Analysis Report prepared by Dr. Syd Peng of West Virginia University.

2. Nineteen drawings, with revision dates from February 14, 2008, to July 7, 2008, depicting plans, profiles and details of the proposed facility.

In addition, the following additional materials were submitted concurrent with the review of this submittal.

1. A set of three drawings depicting longwall panel surface subsidence measurements at Baselines "A" through "D" located over the eastern end of longwall Panel No. 1 of the subject mine. These drawings are dated August 29, 2008, and were received by the Mine Waste and Geotechnical Engineering Division (MWGED) on September 3, 2008,

2. Two Drawings entitled "Map 6 UG - Operations Plan Map" and "Map 10 – Geologic columns," prepared by Alliance and dated December 3, 2004, and November 29, 2004, respectively, and received by MWGED on September 3, 2008.

In addition to the submitted document, we also gathered additional information, concurrent with the review, through phone and e-mail communication with Mr. Claudio Yon of Alliance and Dan Barkley of the Illinois DNR.

We completed our review of the new design and found eleven items requiring additional substantiating data or calculations and/or design changes. These were outlined in our memorandum to Robert Phillips, District Manager, CMS&H District 8, dated November 10, 2008.

Second Revised Design Submittal

The second revised design submittal was received by MWGED on July 20, 2009, and included the following.

1. A report volume entitled "Additional information- Volume 1 of 3, Comments 2, 4, 5, 6, 9, 10 and 11, Coal Refuse Disposal Facility No. 2 Phases 3 through 7," Impoundment ID No. IL08-03141-02 (MSHA ID No. 11-03141), Williamson County, Illinois," dated July 2009. This volume included new, revised and copies of previously submitted materials from the earlier August 2008 submittal and was prepared by Alliance.

2. A second report volume entitled "Additional information- Volume 2 of 3, Comments 1, 3, 7 and 8, Coal Refuse Disposal Facility No. 2 Phases 3 through 7," Impoundment ID No. IL08-03141-02 (MSHA ID No. 11-03141), Williamson County, Illinois," dated July 2009. This volume contained new calculations and analysis performed by GAI consultants for Alliance.
3. A third volume containing 22 drawings, with revision dates from July 8, 2009, to July 13, 2009, depicting plans, profiles, and details of the proposed facility.

4. An addendum to the submittal, received on August 21, 2009. This addendum included corrected transmittal letters and tables of contents, a revised drawing B05-330-M32 – Phase 5 Plan View, revised August 18, 2009, and revised Phase 5 dam underdrain calculations.

Additionally, prior to the receipt of this submittal, we received electronically transmitted drawings depicting a longitudinal dynamic subsidence survey over the advancing face of Longwall Panel No. 1 at a location immediately to the east of the future Phase 5. These drawings were received in our office on February 10, 2009. This survey was performed in response to comment No. 4 in the November 10, 2008, memorandum.

The results of our review of this revised design are discussed in this report.

BACKGROUND

The revised Refuse Disposal Facility No. 2 will provide for the disposal of about 3 ½ years of coarse coal refuse (CCR) and 6 years of fine coal refuse (FCR) that will be produced from the Pond Creek No. 1 Mine following closure of previously approved Facility No. 1 which included Phases 1 and 2. This facility is to be constructed in five phases – Phase 3 through Phase 7.

As planned, the facility will consist of three, approximately rectangular, diked impoundments aligned in a north-south direction and sharing common embankments between them. The southernmost impoundment will be constructed during Phase 3, with fine refuse placement starting upon completion of the embankment to the design crest height. The central impoundment will be constructed in three Phases (Phases 4, 6 and 7) with fine refuse placement starting during Phase 7, when the embankment will be about 50 percent of the total completed height. The northernmost impoundment will be constructed during Phase 5 and will be partly incised by excavating the footprint of the impoundment. Fine refuse placement in this impoundment will begin once Phase 3 is filled to capacity, and the Phase 5 embankment is about 80 percent complete.

The impoundments will cover about 200 acres, and all the impounding embankments will be raised longitudinally in segments using belt-delivered coarse coal refuse. The upstream and downstream slopes will be 3 horizontal to 1 vertical (3H:1V) except for Phase 3 which will have 2.6H:1V upstream slopes. Maximum embankment heights will range from 49 feet for Phase 3 to 100 feet for Phase 7. All embankments, with the exception of a portion of the Phase 7 central impoundment, will be founded on 15 to 22 feet of medium to stiff clay deposits overlying shale bedrock. The south-facing slope of the Phase 7 embankment will be founded on the impounded fine refuse of the adjoining Phase 3.

The designer considered the impoundments to be of high hazard potential classification for the purposes of hydrologic/hydraulic design. Following one year from the start of construction, all phases will be able to accommodate a rainfall volume of two PMF's with pumping capacity capable of drawing down one 72-hour PMF in 30 days. When the final crest elevation is reached, an 18-inch-diameter HDPE SDR 26 decant spillway will be installed and be capable of

drawing down 90 percent of one PMF in less than 10 days. The only exception is the Phase 3 impoundment. Because of an expected life of less than 1 year, this phase was designed to handle at least one half of a 72-hour PMF, but less than a full 72-hour PMF.

The most significant consideration for these impoundments will be the concurrent mining of three longwall panels in the 6.5-foot-thick Herrin No. 6 coal seam beneath the impoundment footprints. There are 430 to 450 feet of overburden, with at least 420 feet of this being rock, between the embankment foundations or impoundment bottoms and the Herrin No. 6 seam. Boring data indicates that about 75 to 90 percent of the overburden rock is shale. A sandstone unit, 200 to 240 feet above the No. 6 seam and ranging from 21 to 54 feet thick, is the only persistent competent unit encountered in the borings.

The development entries for the longwall mining have a calculated minimum pillar safety factor of 2.3 as calculated by the program ALPS. A minimum rock overburden thickness of about 65 times the mine height is present above the seam. Therefore, this facility complies with the guidance contained in Bureau of Mines publication IC 8741 for limiting breakthrough risk. However, subsidence from the longwall mining will considerably impact surface structures over the mine.

The subsidence effects on the proposed coal refuse impoundments will be largely mitigated by the proposed phasing of the impoundments. Except for Phases 3 and 4, all refuse placement will take place after mining has been completed beneath the impoundment and subsidence is substantially complete. For Phase 3, FCR placement will be completed to an elevation of 5 feet below the crest, about 9 months prior to longwall mining beneath the impoundment. A 5-foot-thick cover of coarse refuse, level with the crest, will be placed over the fine refuse in order to eliminate any impounded water before the mining advances beneath the impoundment. Phase 4 will consist of a 45-foot-high non-impounding embankment placed prior to mining. After the mining, the 300-foot-wide Phase 6 embankment will buttress the downstream slope of the Phase 4 embankment. The width of this embankment is expected to mitigate any possible effects of subsidence-related damage to the Phase 4 embankment.

The planned mining beneath the Phase 3 impoundment, a short time after filling and capping of this impoundment, is the most significant issue in evaluating the subsidence impacts. There is currently little engineering experience in accommodating longwall mining under a coal refuse impoundment and a conservative consideration of all possible potential failure modes and mitigatory measures was the primary item of concern in the review of this plan.

REVIEW DISCUSSION

The submittal received on July 20, 2009, provided responses to the eleven items of additional information that were requested in the November 10, 2008, memorandum. Additionally the submitted addendum included a revised plan for the Phase 5, which will be enlarged by locating its north dike approximately 250 feet further north.

Phase 7 Stability

The submittal did not satisfactorily address comment Nos. 7 and 8 in the November 10, 2008, memorandum. These comments noted that a stability analysis of the Phase 7 south dike, which will be founded on the settled Phase 3 FCR, had not been performed and requested this analysis be performed along with a seismic liquefaction and deformation analysis. The submitted analysis in response to these comments included only an analysis of the less-critical completed Phase 7C configuration, and not the critical Phase 7A, which will entail advancing the 38-foot-high south dike embankment over the thin cover overlying the consolidating fine refuse. An independent check calculation using the "SlopeW" stability analysis program and normalized undrained strength parameters for the FCR developed in the submittal indicated a short-term post construction safety factor for the south dike of Phase 7A of considerably less than one. Therefore, Phase 7A, as currently planned, will require design revisions before MWGED can recommend approval.

Subsidence Impacts - Phase 3 Impoundment

The largest part of the most recent submittal consisted of various analyses and new test data submitted as justification for the proposed longwall mining beneath the capped Phase 3 impoundment, as requested in items 1 through 3 of the November 10, 2008, memorandum. MWGED performed this review in conjunction with a literature review of soil behavior when subjected to tensile strains and a published case-study of longwall mining under an impoundment in West Virginia.[1]

The Phase 3 impoundment is located so the dike bounding the FCR pool to the north is centered over the Panel's 2 and 3 gateroad development entries, the east and west dikes extend southward to approximately the center of the longwall panel, and the south dike runs along the center portion of the panel. The panel width (1,400 feet) with respect to depth is such that subsidence is supercritical, so the south dike will be subjected only to transient tensile, then compressive, strains in a longitudinal direction as the mine face advances east to west. The east and west dikes will be subjected to permanent tensile strains near the northwest and northeast corners of the impoundment and the north dike will be subjected to significant strains only near the inside toe.

Assuming the impoundment is capped and no longer impounding water at the time the longwall panel is advanced, the specific potential failure mechanisms that were examined for the Phase 3 impoundment included:

(1) Choi, D. S., et al, 1997, "A Case Study of Undermining Impoundment Embankment by the Longwall Mining Method," Proc. 36th US Rock Mechanics Symposium

1. Stability failure of the CCR embankment due to deformations and weakening from subsidence-induced shear strains and cracking.

2. The potential for the development of large, persistent transverse cracks in the CCR embankment or foundation materials capable of releasing flowable FCR. The calculated horizontal strains induced by the subsidence, using revised CISPM model calculations calibrated to actual subsidence measurements at this mine, is about 30 microstrain (3 percent).

3. Weakening and/or liquefaction of the FCR due to subsidence strain-induced pore pressures in conjunction with transverse cracking, possibly resulting in flow into, and/or erosion of, cracks in the CCR.

CCR Embankment Stability Under Subsidence Condition

In order to evaluate the possibility of the first of these mechanisms, a separate analysis performed by GAI Consultants for Alliance applied data from existing triaxial test data of the coarse refuse (CU with pore pressures) to the formula developed for the double-punch shear test developed by Fang and Chen[2] to determine a tensile strength for the CCR. The consolidation stresses for each test point were then corrected for equivalent effective vertical stress (σ'_v) and used to develop a "normalized tensile strength" ratio (σ_t / σ'_v) of 0.15 for the CCR. Using this ratio, an average tensile strength of C=475 psf and φ=0 degrees was used in a slope stability analysis to obtain a worst-case stability safety factor for the subsidence disturbed embankment of 1.10. We do not believe the derivation of this strength is technically correct. However, the strength parameter derived appears to be very conservative for coarse coal refuse in even the loosest condition. An independent analysis showed a factor of safety of 1.3 was achieved with φ=19 degrees, which is lower than CCR in its loosest condition based on the typical angle of repose of this material. Therefore, slope failure of the CCR embankment from subsidence-induced shear is very unlikely.

CCR and Foundation Cracking Susceptibility Under Subsidence

The second failure mechanism that was evaluated was the potential for large persistent cracks through the CCR embankment which, in conjunction with the third mechanism, could result in a breach and release of flowable FCR. The submitted data showed the CCR produced at the plant is a well graded gravel material (USCS classification GW) with very little fines (2.0 to 2.5 percent passing the No. 200 sieve). The gradation of oven-dried, compacted Proctor test specimens prepared by Alliance was somewhat higher, with an average of 30 percent passing the No. 200 sieve and was classified under the USCS system as "SC," a clayey sand. However, the lab sample preparation and oven drying likely produced a material with more fines than in the constructed embankment.

(2) Fang, H.Y. and Chen, Wai-Fai, "Determination of Tensile Strength of Soil by Unconfined Penetration Test," ASTM STP-740, R.N Young Ed., 1981

The gradation of the CCR and the foundation soil was compared to published correlations of deformation cracking and piping potential. The CCR as delivered to the impoundment prior to compaction is a cohesionless material and is not subject to cracking. The laboratory compacted and oven-dried CCR material was evaluated as having a medium deformation and cracking potential. However, this material is not likely to be representative of the material in the embankment which will have less fines; therefore, the overall deformation cracking susceptibility of the CCR was evaluated to be low.

The foundation soils are moderately plastic clays (USCS classification CL with a plasticity index of 24). These materials were evaluated as having low cracking potential because such materials in a saturated condition are subject to deformation rather than cracking under the expected strains. Mr. Harold Owens reported, in a phone conversation on June 4, 2009, that aside from a 1-inch-wide crack in desiccated materials, no obvious cracking was observed in the clayey native soils over the previously advanced Longwall Panel No. 1 in the future Phase 5 area. Considerable cracking was observed in a more brittle asphalt and chip pavement that crossed the edge of the panel. Due to the possibility of localized higher than predicted tensile deformations at any surface point over longwall panel edges, the development of significant cracks in the foundation and embankments is low but cannot be excluded.

A similar evaluation was performed for the piping resistance of the foundation and CCR materials. Piping resistance was evaluated as "high" for the foundation clay and plant-run CCR materials, and medium for the laboratory compacted materials. While not addressed in the submittal, we believe that if the impoundment is capped and not impounding water, there will be insufficient seepage water to erosively propagate any piping even if persistent cracks develop in the embankment. Therefore, for a capped impoundment, cracking and subsequent internal erosion via seepage piping is an unlikely possible failure mode.

Subsidence Induced FCR Flow Through Cracks

The third potential subsidence induced failure mechanism examined was the possibility of flowage of fluid FCR through large transverse cracks in the embankment or foundation. As described above, such cracks are unlikely, but cannot be precluded. However, if the FCR is not in a sufficiently flowable state, the cracking will be inconsequential, and this mode of failure can be precluded.

The most recent submittal provided the results of laboratory testing and an analysis of the potential for triggering strength loss (liquefaction) for the FCR under cyclic stresses from either earthquakes or the advancing subsidence across the impoundment. The FCR produced at the Mach Mine preparation plant was bulk-sampled and characterized as a fine grained plastic material with 93 percent passing the No. 200 sieve and more than 99 percent passing the No. 40 sieve. The liquid limit was 36 and the plasticity index was 17 and the material was classified under the USCS classification system as "CL."

The submittal included calculations from two triaxial tests performed on remolded FCR specimens prepared from bucket samples of the slurry produced by the preparation plant. These calculations showed a post-seismic strength ratio (S_{us}/ σ'_v) of 0.24, which is only slightly less than the peak (S_u/ σ'_v) value of 0.27. If fully consolidated, these materials are not flowable under any anticipated seismic or mine subsidence conditions. However, the fine grained FCR at this facility is likely to dissipate excess pore pressure and consolidate under self-weight very slowly, so the undrained strength of the FCR at the time of mining is likely to be the most critical condition, with a very weak upper FCR layer being potentially flowable through cracks extending through the embankment. The submittal did not include specific calculations addressing this scenario; however, a CCR cap with a minimum thickness of 5 feet is specified to be placed over the impoundment prior to mining. It is expected, based on MWGED's previous observations and independent calculations, that when CCR is pushed-out over the FCR, the upper materials with undrained strength (S_u) less than at least 150 pounds per square foot will be displaced during the pushout process and therefore are unlikely to be present beneath the pushout. The FCR and/or mixed FCR and CCR material that has reached an S_u of at least 150 psf is not flowable through a cracked embankment except in conjunction with erosive water flow, which will be precluded by the CCR cover. Therefore, provided that the Phase 3 impoundment is capped as shown in the submitted design, a failure by FCR flowage through cracks in the CCR embankment is also unlikely.

CONCLUSIONS AND RECOMMENDATIONS

MWGED noted some deficiencies in the submitted responses to our request for information; however, check calculations show the results of the analyses are conservative and the construction of this facility through Phase 6 is technically satisfactory. However, the submittal did not substantiate the stability of the Phase 7A south embankment which will be constructed over Phase 3A fine refuse, and an independent analysis performed in this office found that the design as currently planned will not be stable under static or seismic conditions. Therefore, approval is recommended through Phase 6 only. Additional information and design revisions as needed to substantiate the static and seismic stability of Phase7A will be needed before approval of this stage can be recommended.

Our recommendation for approval assumes the facility is constructed strictly in accordance with the submitted plan. In particular, the Phase 3 impoundment must be capped with a stable CCR cover and incapable of impounding water before longwall mining approaches the impoundment. Also, per the submitted Specification 6.03 for enhanced monitoring, the operability of all the specified instrumentation and preparations for the contingency buttress shall be verified by the operator's engineer before the longwall mining face is within 100 feet of any part of the Phase 3 capped impoundment.

The CCR embankments at this facility will be constructed in 500- to 600-foot-long longitudinal segments in order to take advantage of belt delivery of the CCR to the placement location. In order to assure the segments are adequately compacted and keyed into the adjoining segments, a specific placement plan was developed and is included in Appendix E of Volume 1 of the

submitted plan. This placement plan, particularly the use of the specified equipment, maximum push distances, and excavation of keys into the adjoining segment should be strictly followed.

The design report narratives and test data should also be considered part of the approved plan. If dam or foundation materials or conditions are discovered that are different than those described in the submitted reports, the plan should be modified as needed to address the changed conditions and submitted to MSHA for approval. In particular, the safety of this facility is contingent on the adherence to the specific mining schedule shown in Drawing B05-330-M36 -Mining/Impoundment Construction Timing Map, revised July 10, 2009.

Approved Plan Documents

Care should be taken to assure the most recent revisions to the drawings and specifications are incorporated into the revised plan documents. The approved plan consists of all the documents listed in the section of this report titled "Second Revised Design Submittal" with the exception of drawing B05-330-M33 – Phase 7 – Plan View and any other Phase 7 details shown on other drawings.

Report Prepared by:

Paul J. Donahue, P.E.
Civil Engineer

Report Approved by:

Darren J Blank, P.E.
Supervisory Civil Engineer

IMPOUNDMENT DATA SHEET

Completed by: PJD Date 27 October 2009
All Information Pertains to Construction North Impoundment (Stage 5)
Impoundment Name Mach Mine Coal Refuse Impoundment
Site ID No. 1211-IL08-03141-02

Hazard Potential Classification ☒ High ☐ Significant ☐ Low

CONFIGURATION

Maximum Crest Elevation 500.00 feet
Minimum Crest Width 30 feet
Minimum Required Freeboard from Max. Normal Pool to Crest is 8.0 feet

Decant Pipe
Material Type SDR 26 HDPE
Inside Diameter 16.6 inches
Inlet Elevation 480.0 feet

Open Channel (Emergency) Spillway
Invert Elevation N/A feet
Bottom Width feet
Lining Type

Embankment Slopes
Upstream 3.0H:1V
Downstream 3.0H:1V

Embankment Benches
Width 20.0 feet
Vertical Interval 45.0 feet (One bench near toe)

Groin Ditches
Lining Type N/A

COMPACTION

Compaction Test Frequency 1 Test per 2000 CY or min. 1 per lift
Moisture Content Range minus 2.00 % to plus 3.00 %
Compaction Density Standard 95.00 % Lift Thickness(es) 12.00 inches

INSTRUMENTATION

Standpipe Piezometers Piezometer No.	Maximum Allowable Water Elevation (feet)
P-9	437
P-10	455
P-11	473

See Sheets E12, Section C-C for tip elevations. Piezometers relocated to North Dike, but all values are still applicable.

CRITICAL CONSTRUCTION ITEMS

CCR embankment fill will be placed in segments by belt delivery and dozer. The fill placement procedure described in Appendix E of the approved plan including drawing A-4 should be strictly followed.

IMPOUNDMENT DATA SHEET

Completed by: PJD Date 27 October 2009
All Information Pertains to Construction North Impoundment (Stage 5)
Impoundment Name **Mach Mine Coal Refuse Impoundment**
Site ID No. **1211-IL08-03141-02**

Hazard Potential Classification ☒ High ☐ Significant ☐ Low

CONFIGURATION

Maximum Crest Elevation **500.00** feet
Minimum Crest Width **30** feet
Minimum Required Freeboard from Max. Normal Pool to Crest is **8.0** feet

Decant Pipe
Material Type **SDR 26 HDPE**
Inside Diameter **16.6** inches
Inlet Elevation **480.0** feet

Open Channel (Emergency) Spillway
Invert Elevation **N/A** feet
Bottom Width feet
Lining Type

Embankment Slopes
Upstream **3.0H:1V**
Downstream **3.0H:1V**

Embankment Benches
Width **20.0** feet
Vertical Interval **45.0** feet (One bench near toe)

Groin Ditches
Lining Type N/A

COMPACTION

Compaction Test Frequency 1 Test per 2000 CY or min. 1 per lift
Moisture Content Range minus 2.00 % to plus 3.00 %
Compaction Density Standard 95.00 % Lift Thickness(es) 12.00 inches

INSTRUMENTATION

Standpipe Piezometers Piezometer No.	Maximum Allowable Water Elevation (feet)
P-9	437
P-10	455
P-11	473

See Sheets E12, Section C-C for tip elevations. Piezometers relocated to North Dike, but all values are still applicable.

CRITICAL CONSTRUCTION ITEMS

CCR embankment fill will be placed in segments by belt delivery and dozer. The fill placement procedure described in Appendix E of the approved plan including drawing A-4 should be strictly followed.

IMPOUNDMENT DATA SHEET

Completed by: PJD Date 27 October 2009
All Information Pertains to Construction Central Impoundment (Stage 4/6)
Impoundment Name Mach Mine Coal Refuse Impoundment
Site ID No. 1211-IL08-03141-02

Hazard Potential Classification ☒ High ☐ Significant ☐ Low

CONFIGURATION

Maximum Crest Elevation 492.00 feet
Minimum Crest Width 100 feet
Minimum Required Freeboard from Pump Activation Elevation to Crest is 8.0 feet

Decant Pipe — Material Type None – pump with min capacity of 1902 gpm will be used
Start Pumping at 481.0 feet

Open Channel (Emergency) Spillway — Invert Elevation N/A feet
Bottom Width feet
Lining Type

Embankment Slopes — Upstream 3.0H:1V
Downstream 3.0H:1V

Embankment Benches — Width None feet
Vertical Interval feet (One bench near toe)

Groin Ditches — Lining Type N/A

COMPACTION

Compaction Test Frequency 1 Test per 2000 CY or min. 1 per lift
Moisture Content Range minus 2.00 % to plus 3.00 %
Compaction Density Standard 95.00 % Lift Thickness(es) 12.00 inches

INSTRUMENTATION

Standpipe Piezometers Piezometer No.	Maximum Allowable Water Elevation (feet)
P-12	445
P-13	450
P-15	451
P-16	465

See Sheets E12, Section D-D and E39 Section G-G for tip elevations. No FCR placement will be placed and impoundment will normally be dry.

CRITICAL CONSTRUCTION ITEMS

Stages 4/6 will be normally maintained in a dry condition. FCR placement will not start until Stage 7 raise is 50% complete. A pump will be provided for evacuation in event of a severe storm. See Appendix G.

Stage 4 will be constructed then undermined by the advance of Longwall panel No. 2. A thorough post-subsidence inspection is required before constructing the Stage 6 on the outer slope of Stage 4.

IRPI DATA FROM IMPOUNDMENT PLANS

Date 10/19/2009 Completed by: PJD

(2) State IL (2) County Williamson

(3) Impoundment Name Mach Mine South Impoundment (Phase 3)

(4) Impoundment ID No. 1211-IL08-03141-02

(8) All Information Pertains to Construction Stage 3

(9) Nearest Downstream City/Town West Frankfort, IL (10) Distance to Nearest City/Town (mi.) 6.5

(11) Latitude N 37.8389 (Degrees + (Minutes/60) + (Seconds/3600)) (12) Longitude W 88.8222 (Degrees + (Minutes/60) + (Seconds/3600))

(15) Stream impoundment is located on or tributary to: Pond Creek

(16) Section/Range/Township East Half of S12, R3E, T8S, 3rd PM

(20) Company or consultant who prepared plan Alliance Consulting Inc.

(35) Foundation Type (rock; rock and soil; soil; unknown) Clay/Silt Soil – 12 to 20 ft thick over Shale

(37) Core Type (earth, plastic, etc.) None

(38) Core Position (Upstream, Homogeneous, Core) ☐ U ☒ H ☐ C

(40) Type of Construction (Upstream, Downstream, Centerline) ☐ U ☐ D ☒ C

(41) Dam Crest Length 5,450 ft. - Rectangular diked structure feet

(42) Structure Height (from downstream toe) 52 feet

(43) Open Channel Spillway Type ☐ Controlled ☒ Uncontrolled ☐ None

(44) Spillway Width at Maximum Discharge N/A feet

(45) Maximum Storage 812 (@ min freeboard) acre-feet

(46) Normal Storage 750 (@ riser elev 494.8) acre-feet

(47) Maximum Discharge 14.8 cfs

(49) Drainage Area 35.0 Acres square miles

(50) Surface Area 30.9 Acres acres

(51) Decant Pipe Type SDR 26 HDPE

(52) Decant Pipe Diameter (ID) 16.6 inch (Pipe and Riser) inches

(54) Mining Underneath or Adjacent: ☒ Yes ☐ No

(55) Hazard Potential Classification ☒ High ☐ Significant ☐ Low

IRPI DATA FROM IMPOUNDMENT PLANS

Date 10/19/2009 Completed by: PJD

(2) State IL (2) County Williamson

(3) Impoundment Name Mach Mine South Impoundment (Phase 3)

(4) Impoundment ID No. 1211-IL08-03141-02

(8) All Information Pertains to Construction Stage 3

(9) Nearest Downstream City/Town West Frankfort, IL (10) Distance to Nearest City/Town (mi.) 6.5

(11) Latitude N 37.8389 (Degrees + (Minutes/60) + (Seconds/3600)) (12) Longitude W 88.8222 (Degrees + (Minutes/60) + (Seconds/3600))

(15) Stream impoundment is located on or tributary to: Pond Creek

(16) Section/Range/Township East Half of S12, R3E, T8S, 3rd PM

(20) Company or consultant who prepared plan Alliance Consulting Inc.

(35) Foundation Type (rock; rock and soil; soil; unknown) Clay/Silt Soil – 12 to 20 ft thick over Shale

(37) Core Type (earth, plastic, etc.) None

(38) Core Position (Upstream, Homogeneous, Core) ☐ U ☒ H ☐ C

(40) Type of Construction (Upstream, Downstream, Centerline) ☐ U ☐ D ☒ C

(41) Dam Crest Length 5,450 ft. - Rectangular diked structure feet

(42) Structure Height (from downstream toe) 52 feet

(43) Open Channel Spillway Type ☐ Controlled ☒ Uncontrolled ☐ None

(44) Spillway Width at Maximum Discharge N/A feet

(45) Maximum Storage 812 (@ min freeboard) acre-feet

(46) Normal Storage 750 (@ riser elev 494.8) acre-feet

(47) Maximum Discharge 14.8 cfs

(49) Drainage Area 35.0 Acres square miles

(50) Surface Area 30.9 Acres acres

(51) Decant Pipe Type SDR 26 HDPE

(52) Decant Pipe Diameter (ID) 16.6 inch (Pipe and Riser) inches

(54) Mining Underneath or Adjacent: ☒ Yes ☐ No

(55) Hazard Potential Classification ☒ High ☐ Significant ☐ Low

IRPI DATA FROM IMPOUNDMENT PLANS

Date 10/26/2009 Completed by: PJD

(2) State IL (2) County Williamson

(3) Impoundment Name Mach Mine Center Impoundment First Crest Elev. (Phase 4/6)

(4) Impoundment ID No. 1211-IL08-03141-02

(8) All Information Pertains to Construction Stage 4/6

(9) Nearest Downstream City/Town West Frankfort, IL (10) Distance to Nearest City/Town (mi.) 6.5

(11) Latitude N 37.8427 (Degrees + (Minutes/60) + (Seconds/3600)) (12) Longitude W 88.8212 (Degrees + (Minutes/60) + (Seconds/3600))

(15) Stream impoundment is located on or tributary to: Pond Creek

(16) Section/Range/Township East Half of S12, R3E, T8S, 3rd PM

(20) Company or consultant who prepared plan Alliance Consulting Inc.

(35) Foundation Type (rock; rock and soil; soil; unknown) Clay/Silt Soil – 15 to 20 ft thick over Shale

(37) Core Type (earth, plastic, etc.) None

(38) Core Position (Upstream, Homogeneous, Core) U [X] C

(40) Type of Construction (Upstream, Downstream, Centerline) U [X] C Ph 6 placed as outer Buttress of Ph. 4

(41) Dam Crest Length 3750 ft. Rectangular diked structure feet

(42) Structure Height (from downstream toe) 47 feet

(43) Open Channel Spillway Type [ ] Controlled [ ] Uncontrolled [X] None

(44) Spillway Width at Maximum Discharge N/A feet

(45) Maximum Storage 1066 (@ 3 ft. freeboard) acre-feet

(46) Normal Storage 805 @ storm evacuation pump elev 481 acre-feet

(47) Maximum Discharge N/A cfs

(49) Drainage Area 46.6 Acres square miles

(50) Surface Area 31.3 acres

(51) Decant Pipe Type None

(52) Decant Pipe Diameter (ID) None inches

(54) Mining Underneath or Adjacent: [X] Yes [ ] No

(55) Hazard Potential Classification [X] High [ ] Significant [ ] Low

IRPI DATA FROM IMPOUNDMENT PLANS

Date 10/26/2009 Completed by: PJD

(2) State IL (2) County Williamson

(3) Impoundment Name Mach Mine Center Impoundment First Crest Elev. (Phase 4/6)

(4) Impoundment ID No. 1211-IL08-03141-02

(8) All Information Pertains to Construction Stage 4/6

(9) Nearest Downstream City/Town West Frankfort, IL (10) Distance to Nearest City/Town (mi.) 6.5

(11) Latitude N 37.8427 (Degrees + (Minutes/60) + (Seconds/3600)) (12) Longitude W 88.8212 (Degrees + (Minutes/60) + (Seconds/3600))

(15) Stream impoundment is located on or tributary to: Pond Creek

(16) Section/Range/Township East Half of S12, R3E, T8S, 3rd PM

(20) Company or consultant who prepared plan Alliance Consulting Inc.

(35) Foundation Type (rock; rock and soil; soil; unknown) Clay/Silt Soil – 15 to 20 ft thick over Shale

(37) Core Type (earth, plastic, etc.) None

(38) Core Position (Upstream, Homogeneous, Core) [ ] U [X] H [ ] C

(40) Type of Construction (Upstream, Downstream, Centerline) [ ] U [X] D [ ] C Ph 6 placed as outer Buttress of Ph. 4

(41) Dam Crest Length 3750 ft. Rectangular diked structure feet

(42) Structure Height (from downstream toe) 47 feet

(43) Open Channel Spillway Type [ ] Controlled [ ] Uncontrolled [X] None

(44) Spillway Width at Maximum Discharge N/A feet

(45) Maximum Storage 1066 (@ 3 ft. freeboard) acre-feet

(46) Normal Storage 805 @ storm evacuation pump elev 481 acre-feet

(47) Maximum Discharge N/A cfs

(49) Drainage Area 46.6 Acres square miles

(50) Surface Area 31.3 acres

(51) Decant Pipe Type None

(52) Decant Pipe Diameter (ID) None inches

(54) Mining Underneath or Adjacent: [X] Yes [ ] No

(55) Hazard Potential Classification [X] High [ ] Significant [ ] Low

IRPI DATA FROM IMPOUNDMENT PLANS

Date 10/19/2009 Completed by: PJD

(2) State IL (2) County Williamson

(3) Impoundment Name Mach Mine North Impoundment (Phase 5)

(4) Impoundment ID No. 1211-IL08-03141-02

(8) All Information Pertains to Construction Stage 5

(9) Nearest Downstream City/Town West Frankfort, IL (10) Distance to Nearest City/Town (mi.) 6.5

(11) Latitude N 37.8465 (Degrees + (Minutes/60) + (Seconds/3600)) (12) Longitude W 88.8202 (Degrees + (Minutes/60) + (Seconds/3600))

(15) Stream impoundment is located on or tributary to: Pond Creek

(16) Section/Range/Township East Half of S12, R3E, T8S, 3rd PM

(20) Company or consultant who prepared plan Alliance Consulting Inc.

(35) Foundation Type (rock; rock and soil; soil; unknown) Clay/Silt Soil – 20 to 25 ft thick over Shale

(37) Core Type (earth, plastic, etc.) None

(38) Core Position (Upstream, Homogeneous, Core) [ ] U [X] H [ ] C

(40) Type of Construction (Upstream, Downstream, Centerline) [ ] U [ ] D [X] C

(41) Dam Crest Length 5,260 ft. - Rectangular diked structure feet

(42) Structure Height (from downstream toe) 51 feet

(43) Open Channel Spillway Type [ ] Controlled [X] Uncontrolled [ ] None

(44) Spillway Width at Maximum Discharge N/A feet

(45) Maximum Storage 1382 (@ 3 ft. freeboard, excl. incised portion) acre-feet

(46) Normal Storage 750 (@ riser elev 488 excl incised portion) acre-feet

(47) Maximum Discharge 16.1 cfs

(49) Drainage Area 38 4 Acres square miles

(50) Surface Area 36.0 acres

(51) Decant Pipe Type SDR 26 HDPE

(52) Decant Pipe Diameter (ID) 16.6 inch (Pipe and Riser) inches

(54) Mining Underneath or Adjacent: [X] Yes [ ] No

(55) Hazard Potential Classification [X] High [ ] Significant [ ] Low

IRPI DATA FROM IMPOUNDMENT PLANS

Date 10/19/2009 Completed by: PJD

(2) State IL (2) County Williamson

(3) Impoundment Name Mach Mine North Impoundment (Phase 5)

(4) Impoundment ID No. 1211-IL08-03141-02

(8) All Information Pertains to Construction Stage 5

(9) Nearest Downstream City/Town West Frankfort, IL (10) Distance to Nearest City/Town (mi.) 6.5

(11) Latitude N 37.8465 (Degrees + (Minutes/60) + (Seconds/3600)) (12) Longitude W 88.8202 (Degrees + (Minutes/60) + (Seconds/3600))

(15) Stream impoundment is located on or tributary to: Pond Creek

(16) Section/Range/Township East Half of S12, R3E, T8S, 3rd PM

(20) Company or consultant who prepared plan Alliance Consulting Inc.

(35) Foundation Type (rock; rock and soil; soil; unknown) Clay/Silt Soil – 20 to 25 ft thick over Shale

(37) Core Type (earth, plastic, etc.) None

(38) Core Position (Upstream, Homogeneous, Core) [ ] U [X] H [ ] C

(40) Type of Construction (Upstream, Downstream, Centerline) [ ] U [ ] D [X] C

(41) Dam Crest Length 5,260 ft. - Rectangular diked structure feet

(42) Structure Height (from downstream toe) 51 feet

(43) Open Channel Spillway Type [ ] Controlled [X] Uncontrolled [ ] None

(44) Spillway Width at Maximum Discharge N/A feet

(45) Maximum Storage 1382 (@ 3 ft. freeboard, excl. incised portion) acre-feet

(46) Normal Storage 750 (@ riser elev 488 excl incised portion) acre-feet

(47) Maximum Discharge 16.1 cfs

(49) Drainage Area 38.4 Acres square miles

(50) Surface Area 36.0 acres

(51) Decant Pipe Type SDR 26 HDPE

(52) Decant Pipe Diameter (ID) 16.6 inch (Pipe and Riser) inches

(54) Mining Underneath or Adjacent: [X] Yes [ ] No

(55) Hazard Potential Classification [X] High [ ] Significant [ ] Low

IMPOUNDMENT DATA SHEET

Completed by: PJD Date 27 October 2009
All Information Pertains to Construction **South Impoundment (Stage 3)**
Impoundment Name **Mach Mine Coal Refuse Impoundment**
Site ID No. **1211-IL08-03141-02**

Hazard Potential Classification ☒ High ☐ Significant ☐ Low

CONFIGURATION

Maximum Crest Elevation **500.00** feet
Minimum Crest Width **30** feet
Minimum Required Freeboard from Max. Normal Pool to Crest is **5.20** feet

Decant Pipe
Material Type **SDR 26 HDPE**
Inside Diameter **16.6** inches
Inlet Elevation **494.8** feet

Open Channel (Emergency) Spillway
Invert Elevation **N/A** feet
Bottom Width feet
Lining Type

Embankment Slopes
Upstream **2.6H:1V**
Downstream **3.0H:1V**

Embankment Benches
Width **20.0** feet
Vertical Interval **40.0** feet

Groin Ditches
Lining Type N/A

COMPACTION

Compaction Test Frequency 1 Test per 2000 CY or min. 1 per lift
Moisture Content Range minus 2.00 % to plus 3.00 %
Compaction Density Standard 95.00 % Lift Thickness(es) 12.00 inches

INSTRUMENTATION

Standpipe Piezometers Piezometer No.	Maximum Allowable Water Elevation (feet)
P-6	463
P-7	475
P-8	487

Pneumatic Piezometers Piezometer No.	Maximum Allowable Pressure (PSI)*
PN-1	10.0
PN-2	10.0
PN-3	6.5
PN-4	6.5

See sheets E39 and E48 for Tip elevations.

Inclinometers:

Inclinometer No.	Action Criteria
I-1	1. Development of Breaks or other discontinuities in profile; or
I-2	2, Continued steady movement more than1 week after mine face passes borehole location
	3. Accelerating movement later than 3 days after mine face passes borehole location

Subsidence Profile Baselines "G" and "H" are to be used to verify previous subsidence predictions and interpret other instrument data. No action criteria are applicable.

* Pneumatic Piezo readings are to be used to measure pore pressure changes associated with consolidation of the FCR and from mine subsidence related shear strains.

CRITICAL CONSTRUCTION ITEMS

The most critical event affecting this phase will be the Longwall Panel No. 3 mining beneath this impoundment expected to occur mid-July through August, 2010. The following measures must be strictly implemented. **No mining within 100 feet of the projected footprint of the Phase 3 embankment should be permitted until the following measures are in place:**

1. The CCR cap over the settled FCR must be in place, sloped for drainage, and any capability to impound any water removed. **This is a critical measure.**

2. All instrumentation shown on drawing M30 and E47 (Piezometers and inclinometers) and M36 (Subsidence Baselines) are in place and operable. Also see Specification 2.05 through 2.07 and Appendix F – Subsidence Monitoring Plan

3. The procedures in Specification Section 6.03 – Enhanced Monitoring must be strictly followed.

IMPOUNDMENT DATA SHEET

Completed by: PJD Date 27 October 2009
All Information Pertains to Construction **South Impoundment (Stage 3)**
Impoundment Name **Mach Mine Coal Refuse Impoundment**
Site ID No. **1211-IL08-03141-02**

Hazard Potential Classification ☒ High ☐ Significant ☐ Low

CONFIGURATION

Maximum Crest Elevation **500.00** feet
Minimum Crest Width **30** feet
Minimum Required Freeboard from Max. Normal Pool to Crest is **5.20** feet

Decant Pipe
Material Type **SDR 26 HDPE**
Inside Diameter **16.6** inches
Inlet Elevation **494.8** feet

Open Channel (Emergency) Spillway
Invert Elevation **N/A** feet
Bottom Width feet
Lining Type

Embankment Slopes
Upstream **2.6H:1V**
Downstream **3.0H:1V**

Embankment Benches
Width **20.0** feet
Vertical Interval **40.0** feet

Groin Ditches
Lining Type N/A

COMPACTION

Compaction Test Frequency 1 Test per 2000 CY or min. 1 per lift
Moisture Content Range minus 2.00 % to plus 3.00 %
Compaction Density Standard 95.00 % Lift Thickness(es) 12.00 inches

INSTRUMENTATION

Standpipe Piezometers Piezometer No.	Maximum Allowable Water Elevation (feet)
P-6	463
P-7	475
P-8	487

Pneumatic Piezometers Piezometer No.	Maximum Allowable Pressure (PSI)*
PN-1	10.0
PN-2	10.0
PN-3	6.5
PN-4	6.5

See sheets E39 and E48 for Tip elevations.

Inclinometers:

Inclinometer No.	Action Criteria
I-1	1. Development of Breaks or other discontinuities in profile; or
I-2	2. Continued steady movement more than1 week after mine face passes borehole location
	3. Accelerating movement later than 3 days after mine face passes borehole location

Subsidence Profile Baselines "G" and "H" are to be used to verify previous subsidence predictions and interpret other instrument data. No action criteria are applicable.

* Pneumatic Piezo readings are to be used to measure pore pressure changes associated with consolidation of the FCR and from mine subsidence related shear strains.

CRITICAL CONSTRUCTION ITEMS

The most critical event affecting this phase will be the Longwall Panel No. 3 mining beneath this impoundment expected to occur mid-July through August, 2010. The following measures must be strictly implemented. **No mining within 100 feet of the projected footprint of the Phase 3 embankment should be permitted until the following measures are in place:**

1. The CCR cap over the settled FCR must be in place, sloped for drainage, and any capability to impound any water removed. **This is a critical measure.**

2. All instrumentation shown on drawing M30 and E47 (Piezometers and inclinometers) and M36 (Subsidence Baselines) are in place and operable. Also see Specification 2.05 through 2.07 and Appendix F – Subsidence Monitoring Plan

3. The procedures in Specification Section 6.03 – Enhanced Monitoring must be strictly followed.

IMPOUNDMENT DATA SHEET

Completed by: PJD Date 27 October 2009
All Information Pertains to Construction Central Impoundment (Stage 4/6)
Impoundment Name Mach Mine Coal Refuse Impoundment
Site ID No. 1211-IL08-03141-02

Hazard Potential Classification ☒ High ☐ Significant ☐ Low

CONFIGURATION

Maximum Crest Elevation 492.00 feet
Minimum Crest Width 100 feet
Minimum Required Freeboard from Pump Activation Elevation to Crest is 8.0 feet

Decant Pipe — Material Type None – pump with min capacity of 1902 gpm will be used
Start Pumping at 481.0 feet

Open Channel (Emergency) Spillway — Invert Elevation N/A feet
Bottom Width feet
Lining Type

Embankment Slopes — Upstream 3.0H:1V
Downstream 3.0H:1V

Embankment Benches — Width None feet
Vertical Interval feet (One bench near toe)

Groin Ditches — Lining Type N/A

COMPACTION

Compaction Test Frequency 1 Test per 2000 CY or min. 1 per lift
Moisture Content Range minus 2.00 % to plus 3.00 %
Compaction Density Standard 95.00 % Lift Thickness(es) 12.00 inches

INSTRUMENTATION

Standpipe Piezometers Piezometer No.	Maximum Allowable Water Elevation (feet)
P-12	445
P-13	450
P-15	451
P-16	465

See Sheets E12, Section D-D and E39 Section G-G for tip elevations. No FCR placement will be placed and impoundment will normally be dry.

CRITICAL CONSTRUCTION ITEMS

Stages 4/6 will be normally maintained in a dry condition. FCR placement will not start until Stage 7 raise is 50% complete. A pump will be provided for evacuation in event of a severe storm. See Appendix G.

Stage 4 will be constructed then undermined by the advance of Longwall panel No. 2. A thorough post-subsidence inspection is required before constructing the Stage 6 on the outer slope of Stage 4.

ADDITIONAL INFORMATION
VOLUME 1 OF 3
COMMENTS 2, 4, 5, 6, 9, 10 AND 11

COAL REFUSE DISPOSAL FACILITY NO. 2
PHASE 3 THROUGH 7
IMPOUNDMENT I.D. NO. 1211-IL08-0341-02
MSHA I.D. NO. 11-03141
WILLIAMSON COUNTY, ILLINOIS

Prepared for

MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS

ALLIANCE PROJECT NO. B05-330-1413
JULY 2009

U.S. Department of Labor

Mine Safety and Health Administration
2300 Willow Street
Suite 200
Vincennes, Indiana 47591-5416

August 21, 2009

Mr. Claudio E. Yon, P.E.
Principal Engineer
Alliance Consulting, Inc.
124 Philpott Lane
Raleigh County Airport Industrial Park
Beaver, WV 25813-9502

Dear Mr. Yon:

Subject: 77.216(a) - Impoundment Construction Plan
(Revised Information) (08/18/09)
Coal Refuse Disposal Facility No. 2
Impoundment I.D. No. 1211-IL08-03141-02
Mach #1 Mine (11-03141)
Mach Mining, LLC
Marion, Williamson County, Illinois

This will acknowledge receipt of the subject report, as required by the Federal Mine Safety and Health Act of 1977, Public Law 91-173, as amended by Public Law 95-164 or implementing regulations. Review by the District Manager is required, and action is being started to determine that this report provides the required information.

Sincerely,

Robert L. Phillips
District Manager
Coal Mine Safety and Health
District 8

U.S. Department of Labor

Mine Safety and Health Administration
2300 Willow Street
Suite 200
Vincennes, Indiana 47591-5416

July 27, 2009

Mr. Harold Owens
Project Manager, P.E.
Alliance Consulting, Inc.
124 Philpott Lane
Raleigh County Airport Industrial Park
Beaver, WV 25813-9502

Dear Mr. Owens:

Subject: 77.216(a) - Impoundment Construction Plan
(Additional Information) (07/15/09)
Coal Refuse Facility No. 2
Impoundment I.D. No. 1211-IL08-03141-02
Mach #1 Mine (11-03141)
Mach Mining, LLC
Marion, Williamson County, Illinois

This will acknowledge receipt of the subject report, as required by the Federal Mine Safety and Health Act of 1977, Public Law 91-173, as amended by Public Law 95-164 or implementing regulations. Review by the District Manager is required, and action is being started to determine that this report provides the required information.

Sincerely,

Robert L. Phillips
District Manager
Coal Mine Safety and Health
District 8

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

July 20, 2009

Project No. B05-330-1413

Mr. Robert L. Phillips
District Manager
Mine Safety and Health Administration
2300 Willow Street, Suite00
Vincennes, IN 47591-5416

Correction
Additional Information
Coal Refuse Disposal Facility No. 2
Phases 3 Through 7
Impoundment ID No. 1211-IL08-03141-02
Mach Mining LLC
Mach # 1 Mine
Mine ID No.11-03141

Dear Mr. Phillips:

On behalf of our client, Mach Mining LLC, please substitute the enclosed transmittal letters dated July 15, 2009 and July 16, 2009 and the revised Engineering Design Plan Report Table of Contents for the same dated letters and table of contents we sent to you on July 17, 2009. The enclosures correct the previously submitted information by showing the correct number of report volumes to be three rather than two.

Please accept our apologies in advance for any inconvenience caused by our oversight.

If you have any questions, or require additional information, please contact us.

Respectively submitted,

ALLIANCE CONSULTING, INC.

Harold L. Owens, P.E.
Senior Project Manager

Claudio E. Yon, P.E.
Principal Engineer
3 Enclosures

File: MSHA Response 01.doc, hlo, rev.7/20/09
xc: w/enclosure P. Donahue and J. Slapak

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

July 15, 2009

Project No. B05-330-1413

Mr. Robert L. Phillips
District Manager, District 8
MINE SAFETY AND HEALTH ADMINISTRATION
2300 Willow Street, Suite 200
Vincennes, IN 47591

Transmittal
Additional Information
Coal Refuse Disposal Facility No. 2
Phase 3 through 7
Impoundment ID No. 1211-IL08-03141-02
Mach Mining LLC
Mine ID No. 11-03141
Williamson County, Illinois

Dear Mr. Phillips:

On behalf of our client, Mach Mining, LLC, please find enclosed two copies of the information referencing above. This information is transmitted in response to a memo dated Nov. 10, 2008 from Paul J. Donahue P.E. MSHA, Pittsburgh Safety and Health Administration Technology Center, Mine Waste and Geotechnical Engineering Division.

The additional information is contained in three volumes. Volumes 1 of 3 was prepared by Alliance Consulting, Inc. and Dr. Syd Peng, and is a response to comments 2, 4, 5, 6, 9, 10 and 11. Volume 2 of 3 was prepared by GAI Consultants, Inc. and is a response to comments 1, 3, 7 and 8. One copy of the additional information was sent directly to Stanley J. Michalek at the MSHA Pittsburgh Technical Support, Mine Waste and Geotechnical Engineering Division.

If you have any questions, or require additional information, please contact us.

Sincerely,

ALLIANCE CONSULTING, INC.

Harold Owens
Project Manager, P.E.

Claudio E. Yon, P.E.
Senior Project Manager

HO/CEY:knm
Enclosures

File: 05330-61

xc: w/enclosure Paul J, Donahue and Jim Slapak

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

July 16, 2009

Project No. B05-330-1413

Mr. Robert L. Phillips
District Manager
Mine Safety and Health Administration
2300 Willow Street, Suite00
Vincennes, IN 47591-5416

Transmittal
Volume 1 of 3,
Additional Information Comments 2, 4, 5, 6, 9 10 and 11;
Volume 2 of 3,
Additional Information Comments 1, 3, 7 and 8
And
Volume 3 of 3,
Additional Information -Drawings
Coal Refuse Disposal Facility No. 2
Phases 3 Through 7
Impoundment ID No. 1211-IL08-03141-02
Mach Mining LLC
Mach # 1 Mine
Mine ID No.11-03141

Dear Mr. Phillips:

On behalf of our client, Mach Mining LLC, this letter and the subject report have been prepared in response to MSHA's Pittsburgh Safety and Health Technology Center's November 10, 2008 memorandum. The memorandum requested additional information concerning the plan for Phases 3 through 7 of Coal Refuse Disposal Facility No. 2. The impoundment plan has been modified to include the following information requested in the memorandum:

Comments – Design Analysis

1. Characterization of Fine Refuse

   Fine coal refuse samples were collected from the Phase 2 impoundment and tested. The testing results are described in the report "Response to MSHA Comments 1, 3, 7 and 8, Pond Creek Mine No. 1, Coal Refuse Facility No. 2, Phases 3 and 7, Impoundment

I.D. No. 1211-IL08-03141-02, Williamson Energy LLC, Mach Mining Company, Williamson County, Illinois," Project C090403.01, GAI Consultants, Inc., May 12, 2009. This report is Volume 2 of 3 of this report.

2. Impacts of Greater Than Predicted Subsidence Strains

The subsidence prediction model previously submitted was recalibrated and revised based on the subsidence measurements made to date. Revised predicted subsidence, horizontal strain, and displacement profiles have been include in the report "Prediction of Ground Movement due to Longwall Mining During Different Phases of Impoundment Construction, A Modified Report", Dr. Syd S. Peng and Thomas Du, May 2009. This report is included as Appendix H of Volume 1 of 3 of this report.

The impacts of the subsidence-induced deformations and strains are addressed in Volume 2 of 3 of this report. The predicted factor of safety against Phase 3 embankment cracking due to subsidence is 1.1 and significant embankment cracking is not anticipated due to the high peak strain characteristic of the coarse coal refuse. Additional monitoring and contingency measures to be implemented during longwall mining beneath Phase 3 are described in Item 3, below.

3. Fine Refuse Behavior when Subjected to Subsidence

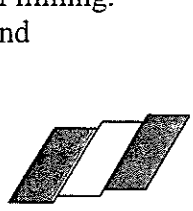
It is intended that the fine coal refuse in Phase 3 will be dewatered and covered with coarse coal refuse before the longwall face passes under the phase. Fine coal refuse laboratory testing, properties, and flow slide susceptibility are presented in Volume 2 of 3 of this report. Flow slide factors of safety of 2.2 and 1.3 in the downstream and upstream directions, respectively, were obtained. The additional instrumentation, additional embankment monitoring, and a contingency buttress/seal plan for the Phase 3 embankment as recommended in GAI's report will be implemented. These provisions are included in Appendix A, "Guideline Technical Specifications", in Volume 1 of 3 of this report.

4. Longwall Mining Subsidence Monitoring – Baseline "A"

As recommended, an additional subsidence baseline, "Subsidence Survey Panel No. 1" was established and data was obtained on the progression of the dynamic subsidence profile. This data was used to calibrate the revised dynamic subsidence prediction model referred to in Item 2, above. The data was previously submitted to MSHA and is shown on Drawing No. B05-330-M44.

5. Longwall Mining Subsidence Monitoring – Baselines "E" through "I"

Appendix F in Volume 1 of 3 of this report has been revised to reflect the recommended daily monitoring frequency for remaining baselines orientated in the direction of mining. Based on the results of the previously surveyed baselines, the baseline lengths and distances between the monitoring stations have been adjusted to target critical



information. Baseline measurement points will be 25 feet apart to meet the criteria of the overburden depth divided by 20.

6. Longwall Mining Subsidence Monitoring – Phase 3 Monitoring

   As recommended, a baseline "H" will be located on the southern crest of the Phase 3 impoundment. The locations of the subsidence monitoring baselines are shown on Drawing No. B05-330-M36 and the subsidence monitoring plan is in Appendix F in Volume 1 of 3 of this report.

7. Stability of Phase 7 South Slope

   Stability analysis were performed for the Phase 7 south slope (Phase 7C) using zero strength for the fine coal refuse for the end-of –construction condition and total undrained strength for the long-term condition. Safety factors of 1.6 and 1.8, respectively, were obtained. These stability analyses are contained in Volume 2 of 3 of this report.

8. Seismic Stability of Phase 7 South Slope

   A liquefaction susceptibility evaluation and a post-earthquake stability analysis were performed for the Phase 7 south slope (Phase 7C). The post-earthquake factor of safety was found to be 1.6. The analyses are contained in Volume 2 of 3 of this report.

Comments – Plans and Specifications

9. Specification Paragraph 2.08a – Decant Pipe Alignment

   The profile for the Phase 3 decant pipe has been put on Drawing No. B05-33-E13 and Specification 2.09.a has been revised to cite the correct drawing.

10. Drawing No. B05-330-E24

    The tractive forces and the uniform section mat ditch lining anchorage requirements have been reevaluated for Ditches "D", "F", "I", "L", "M", and the Decant Ditches. The anchorage capacity for a 5/8-inch diameter bolt with embedment length of 4-foot into the embankment has been determined and the required anchor bolt spacing for the various ditches has been shown on Drawing B05-330-E24 The revised and additional computations are in Appendix B of Volume 1 of 3 of this report. A tractive force analysis of the grouted riprap channel lining was also performed.

11. Coarse Coal Refuse Placement Guidelines

    Appendix E, "Coarse Coal Refuse Placement Guidelines," in Volume 1 of 3 of this report has been revised to include provisions concerning lift thickness, end slopes, trimming slopes, and keying new and old fills together. A typical drawing, B05-330-A4, showing refuse placement procedures, has been added to Appendix E.



The report narrative, technical specifications, computations, appendices, and drawings have all been revised as needed. The accompanying report, Volume 1 of 3 and Volume 3 of 3, supercedes the previously submitted design reports.

If you have any questions, or require additional information, please contact us.

Respectively submitted,

ALLIANCE CONSULTING, INC.

Harold L. Owens, P.E.
Senior Project Manager

Claudio E. Yon, P.E.
Principal Engineer

File: 05330-MSHA Response

SUPERCEDED

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

July 15, 2009

Project No. B05-330-1413

Mr. Robert L. Phillips
District Manager, District 8
MINE SAFETY AND HEALTH ADMINISTRATION
2300 Willow Street, Suite 200
Vincennes, IN 47591

Transmittal
Additional Information
Coal Refuse Disposal Facility No. 2
Phase 3 through 7
Impoundment ID No. 1211-IL08-03141-02
Mach Mining LLC
Mine ID No. 11-03141
Williamson County, Illinois

Dear Mr. Phillips:

On behalf of our client, Mach Mining, LLC, please find enclosed two copies of the information referencing above. This information is transmitted in response to a memo dated Nov. 10, 2008 from Paul J. Donahue P.E.

The additional information is contained in two volumes. Volume I of II and was prepared by Alliance Consulting, Inc. and Dr. Syd Peng, and is a response to comments 2, 4, 5, 6, 9, 10 and 11. Volume II of II was prepared by GAI Consultants, Inc. and is a response to comments 1, 3, 7 and 8. One copy of the additional information was sent directly to Stanley J. Michalek at the MSHA Pittsburgh Technical Support, Mine Waste and Geotechnical Engineering Division.

If you have any questions, or require additional information, please contact us.

SUPERCEDED

R16870

Sincerely,

ALLIANCE CONSULTING, INC.

for

Harold Owens
Project Manager, P.E.

Claudio E. Yon, P.E.
Senior Project Manager

HO/CEY:knm
Enclosures

File: 05330-61

xc: w/enclosure Paul J, Donahue and Jim Slapak

SUPERCEDED

R16871

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

July 16, 2009

Project No. B05-330-1413

Mr. Robert L. Phillips
District Manager
Mine Safety and Health Administration
2300 Willow Street, Suite00
Vincennes, IN 47591-5416

Transmittal
Additional Information Comments 2, 4, 5, 6, 9 10 and 11
Volume 1 of 2
and
Additional Information Comments 1, 3, 7 and 8
Volume 2 of 2
Coal Refuse Disposal Facility No. 2
Phases 3 Through 7
Impoundment ID No. 1211-IL08-03141-02
Mach Mining LLC
Mach # 1 Mine
Mine ID No.11-03141

Dear Mr. Phillips:

On behalf of our client, Mach Mining LLC, this letter and the subject report have been prepared in response to MSHA's Pittsburgh Safety and Health Technology Center's November 10, 2008 memorandum. The memorandum requested additional information concerning the plan for Phases 3 through 7 of Coal Refuse Disposal Facility No. 2. The impoundment plan has been modified to include the following information requested in the memorandum:

Comments – Design Analysis

1. Characterization of Fine Refuse

   Fine coal refuse samples were collected from the Phase 2 impoundment and tested. The testing results are described in the report "Response to MSHA Comments 1, 3, 7 and 8, Pond Creek Mine No. 1, Coal Refuse Facility No. 2, Phases 3 and 7, Impoundment I.D. No. 1211-IL08-03141-02, Williamson Energy LLC, Mach Mining Company,

Williamson County, Illinois," Project C090403.01, GAI Consultants, Inc., May 12, 2009. This report is Volume 2 of 2 of this report.

2. Impacts of Greater Than Predicted Subsidence Strains

The subsidence prediction model previously submitted was recalibrated and revised based on the subsidence measurements made to date. Revised predicted subsidence, horizontal strain, and displacement profiles have been include in the report "Prediction of Ground Movement due to Longwall Mining During Different Phases of Impoundment Construction, A Modified Report", Dr. Syd S. Peng and Thomas Du, May 2009. This report is included as Appendix H of Volume 1 of 2 of this report.

The impacts of the subsidence-induced deformations and strains are addressed in Volume 2 of 2 of this report. The predicted factor of safety against Phase 3 embankment cracking due to subsidence is 1.1 and significant embankment cracking is not anticipated due to the high peak strain characteristic of the coarse coal refuse. Additional monitoring and contingency measures to be implemented during longwall mining beneath Phase 3 are described in Item 3, below.

3. Fine Refuse Behavior when Subjected to Subsidence

It is intended that the fine coal refuse in Phase 3 will be dewatered and covered with coarse coal refuse before the longwall face passes under the phase. Fine coal refuse laboratory testing, properties, and flow slide susceptibility are presented in Volume 2 of 2 of this report. Flow slide factors of safety of 2.2 and 1.3 in the downstream and upstream directions, respectively, were obtained. The additional instrumentation, additional embankment monitoring, and a contingency buttress/seal plan for the Phase 3 embankment as recommended in GAI's report will be implemented. These provisions are included in Appendix A, "Guideline Technical Specifications", in Volume 1 of 2 of this report.

4. Longwall Mining Subsidence Monitoring – Baseline "A"

As recommended, an additional subsidence baseline, "Subsidence Survey Panel No. 1" was established and data was obtained on the progression of the dynamic subsidence profile. This data was used to calibrate the revised dynamic subsidence prediction model referred to in Item 2, above. The data was previously submitted to MSHA and is shown on Drawing No. B05-330-M44.

5. Longwall Mining Subsidence Monitoring – Baselines "E" through "I"

Appendix F in Volume 1 of 2 of this report has been revised to reflect the recommended daily monitoring frequency for remaining baselines orientated in the direction of mining.

Based on the results of the previously surveyed baselines, the baseline lengths and distances between the monitoring stations have been adjusted to target critical information. Baseline measurement points will be 25 feet apart to meet the criteria of the overburden depth divided by 20.

6. Longwall Mining Subsidence Monitoring – Phase 3 Monitoring

   As recommended, a baseline "H" will be located on the southern crest of the Phase 3 impoundment. The locations of the subsidence monitoring baselines are shown on Drawing No. B05-330-M36 and the subsidence monitoring plan is in Appendix F in Volume 1 of 2 of this report.

7. Stability of Phase 7 South Slope

   Stability analysis were performed for the Phase 7 south slope (Phase 7C) using zero strength for the fine coal refuse for the end-of-construction condition and total undrained strength for the long-term condition. Safety factors of 1.6 and 1.8, respectively, were obtained. These stability analyses are contained in Volume 2 of 2 of this report.

8. Seismic Stability of Phase 7 South Slope

   A liquefaction susceptibility evaluation and a post-earthquake stability analysis were performed for the Phase 7 south slope (Phase 7C). The post-earthquake factor of safety was found to be 1.6. The analyses are contained in Volume 2 of 2 of this report.

Comments – Plans and Specifications

9. Specification Paragraph 2.08a – Decant Pipe Alignment

   The profile for the Phase 3 decant pipe has been put on Drawing No. B05-33-E13 and Specification 2.09.a has been revised to cite the correct drawing.

10. Drawing No. B05-330-E24

    The tractive forces and the uniform section mat ditch lining anchorage requirements have been reevaluated for Ditches "D", "F", "I", "L", "M", and the Decant Ditches. The anchorage capacity for a 5/8-inch diameter bolt with embedment length of 4-foot into the embankment has been determined and the required anchor bolt spacing for the various ditches has been shown on Drawing B05-330-E24 The revised and additional computations are in Appendix B of Volume 1 of 2 of this report. A tractive force analysis of the grouted riprap channel lining was also performed.

11. Coarse Coal Refuse Placement Guidelines



SUPERCEDED

R16874

Appendix E, "Coarse Coal Refuse Placement Guidelines," in Volume 1 of 2 of this report has been revised to include provisions concerning lift thickness, end slopes, trimming slopes, and keying new and old fills together. A typical drawing, B05-330-A4, showing refuse placement procedures, has been added to Appendix E.

The report narrative, technical specifications, computations, appendices, and drawings have all been revised as needed. The accompanying report, Volume 1 of 1, supercedes the previously submitted design reports.

If you have any questions, or require additional information, please contact us.

Respectively submitted,

ALLIANCE CONSULTING, INC.

for

Harold L. Owens, P.E.
Senior Project Manager

Claudio E. Yon, P.E.
Principal Engineer

File: 05330-MSHA Response

U.S. Department of Labor

Mine Safety and Health Administration
Pittsburgh Safety & Health Technology Center
P.O. Box 18233
Pittsburgh, PA 15236

Mine Waste and Geotechnical Engineering Division

November 10, 2008

MEMORANDUM FOR ROBERT L. PHILLIPS
District Manager, District 8
Coal Mine Safety and Health

THROUGH: M. TERRY HOCH
Chief, Pittsburgh Safety and Health Technology Center

STANLEY J. MICHALEK
Chief, Mine Waste and Geotechnical Engineering Division

DARREN J. BLANK
Supervisory Civil Engineer, Mine Waste and Geotechnical Engineering Division

FROM: PAUL J. DONAHUE
Civil Engineer, Mine Waste and Geotechnical Engineering Division

SUBJECT: Request for Additional Information for Coal Refuse Disposal Facility No. 2, Phases 3 through 7, Impoundment I.D. No. 1211-IL08-03141-02, Williamson Energy LLC, Mach Mining Company, Pond Creek Mine No. 1, Mine I.D. No. 11-03141, Williamson County, Illinois

As requested by your office, we have reviewed the revised design documents submitted by Williamson Energy LLC/Mach Mining, and prepared by Alliance Consulting, Incorporated. The submitted materials included the following:

1. A report entitled "Response to Comments - February 11, 2008, I.D. No. 1211-IL08-03141-02 - Mach Mining, LLC - Mach No. 1 Mine I.D. No. 11-03141 - Williamson County, Illinois - Coal Refuse Disposal Facility No. 2 Phases 3 through 7." Appendices to the report contained proposed construction guidance specifications, various design calculations; geotechnical test boring and laboratory test data; and

thirteen drawings depicting plans, profiles, and details of the proposed facility. This report is dated August 2008 and was hand delivered to our office on August 19, 2008, in conjunction with a meeting with Mach Mining and Alliance Consulting personnel to discuss the plan.

2. A set of three drawings depicting longwall panel subsidence measurements at Baselines "A" through "D" at the subject mine. These drawings are dated August 29, 2008, and were received in our office on September 3, 2008.

Description of Proposed Facility

The revised Disposal Facility No. 2 will provide for the disposal of about 3 ½ years of coarse coal refuse (CCR) and 6 years of fine coal refuse (FCR) produced from the Pond Creek No. 1 Mine. This facility is to be constructed in five phases – Phase 3 through Phase 7. Phases 1 and 2 are part of Disposal Facility No. 1 which lies immediately to the south of Disposal Facility No. 2.

The currently planned facility will consist of three, four-sided diked impoundments aligned in a north-south direction and sharing common embankments between them. The southernmost impoundment will be constructed during Phase 3 with fine refuse placement starting upon completion of the embankment to the design crest height. The central impoundment will be constructed during Phases 4, 6 and 7 with fine refuse placement starting during Phase 7 when the embankment will be about 50 percent of the total completed height. The northernmost impoundment will be constructed during Phase 5 and will be partly incised by excavating the bottom of the impoundment. Fine refuse placement in this impoundment will begin when the embankment is about 80 percent complete.

The impoundments will cover about 200 acres, and all the impounding coarse refuse embankments will be raised by downstream or centerline construction methods. The upstream and downstream slopes will be of 3 horizontal to 1 vertical (3H:1V) except for Phase 3 which will have 2.6H:1V upstream slopes. Maximum slope heights will range from 49 feet for Phase 3 to 100 feet for Phase 7. All embankments with the exception of a portion of Phase 7 will be founded on 15 to 22 feet of medium to stiff clay deposits overlying shale bedrock. The south-facing slope of the Phase 7 embankment will be founded on the impounded fine refuse of the adjoining Phase 3.

The designer considered the impoundments to be of high-hazard potential classification for the purposes of hydrologic/hydraulic design. Following 1 year from the start of construction, all phases will be able to accommodate a rainfall volume of two PMF's with pumping capacity capable of drawing down one 72-hour PMF in 30 days. When the final crest elevation is reached, an 18-inch-diameter HDPE SDR 26 decant spillway will be installed and be capable of drawing down 90 percent of one PMF in less than 10

days. The only exception is the Phase 3 impoundment. Because of an impoundment life of less than 1 year, this impoundment was designed to handle at least one half of a 72 hour PMF but less than a full 72-hour PMF.

The most significant consideration for these impoundments will be the concurrent mining of three longwall panels in the 6.5-foot-thick Herrin No. 6 coal seam beneath the impoundment footprints. There is 430 to 450 feet of overburden with at least 420 feet of this being rock between the embankment foundations or impoundment bottoms and the Herrin No. 6 seam. Also, the development entries for the longwall mining have a calculated minimum pillar safety factor of 2.3 as calculated by the program ALPS. Therefore, breakthrough or sinkhole potential is low, but surface subsidence will considerably impact the facility.

The construction is to be phased so that, with the exception of Phases 3 and 4, all refuse placements will take place after mining has been completed beneath the impoundment and subsidence is substantially complete. For Phase 3, FCR placement will be completed to an elevation 5 feet below the crest, about 9 months prior to longwall mining beneath the impoundment. A 5-foot-thick cover of coarse refuse, level with the crest, will be placed over the fine refuse in order to eliminate any impounded water before the mining advances beneath the impoundment. Phase 4 will consist of a 45-foot-high non-impounding embankment placed prior to mining. After the mining and treatment of any subsidence related surface cracks, the 300-foot-wide Phase 6 embankment will buttress the downstream slope of the Phase 4 embankment. The width of this embankment is expected to mitigate the effects of any subsidence-related cracking of the Phase 4 embankment.

Based on our review of this submittal, the items of additional information for the original design, outlined in our memorandum dated December 13, 2007, have been satisfactorily addressed. However, the new impoundment design includes extensive changes from the old design, and mine subsidence data became available after the design was finalized. This subsidence data indicates the potential for more severe subsidence impacts which will require some additional analysis to justify the safety of the impoundment design.

The planned mining beneath the Phase 3 impoundment, a short time after filling and capping of this impoundment, is a critical issue. There is currently very little engineering experience in safely accommodating longwall mining under a coal refuse dam, and a conservative consideration of all possible potential failure modes and the implementation of mitigatory measures may be required.

The following items of additional information will be required to complete our review:

COMMENTS - DESIGN ANALYSIS

1. Characterization of Fine Refuse

   The submittal does not include any site-specific fine refuse strength test data. Laboratory and/or in-situ testing of fine refuse should be performed and submitted as appropriate to address the additional analyses requested in items 3, 7 and 8 below.

2. Impacts of Greater than Predicted Subsidence Strains

   The submitted subsidence data from Baselines "B" and "C" indicated up to 250 percent greater subsidence-related angular deformations, and consequently, much higher surface strains than the predictions furnished by Syd Peng, Anil Ray, and Thomas Doe that were relied on for the design. An independent subsidence analysis done in this office, using the computer program SDPS, with parameters calibrated from the actual measured subsidence profiles, indicates maximum horizontal tensile strains of about 3.3 percent compared with about 1.0 percent in Peng's analysis.

   The expected subsidence-related deformations and surface strains should be recalculated based on the actual survey measurements. The impacts of the higher deformations and strains on the embankments and related structures should be re-evaluated. If necessary, the proposed measures for subsidence monitoring and mitigation of the subsidence should be revised or new measures proposed.

3. Fine Refuse Behavior when Subjected to Subsidence

   The mining of the westernmost 2,300 feet of Longwall Panel No 3 is scheduled to occur beneath the Phase 3 impoundment about 9 months after completion of fine refuse placement, and an unspecified time after a 5-foot coarse refuse cover is placed. The submitted subsidence measurements indicate that somewhat higher-than-predicted tensile strains will occur in conjunction with a transient lowering of the eastern embankment crest to the approximate fine refuse elevation as the mine face advances beneath the embankment. The degree that the fine refuse will consolidate, gain strength, or resist possible strength loss under subsidence-related disturbance is not known. The possibilities of fine refuse flowage through large cracks in the embankment, or failures resulting from hydrostatic pressures from flowable slurry or water in subsidence-induced embankment cracks have not been analyzed or excluded.

Appropriate field and/or lab test analyses and calculations should be furnished that exclude the failure mode described above. Mitigatory measures to preclude a cracking and fine refuse flowage failure mode should also be provided if needed. Such measures may include provisions to dewater or accelerate the consolidation of the fine refuse prior to subsidence, or measures to prevent continuous cracks through the embankment.

Alternatively, any mining under Phase 3 may be limited to room-and-pillar mining using conservative pillar safety factors.

4. Longwall Mining Subsidence Monitoring - Baselines "A"

The submitted subsidence survey readings at Baseline "A" were not performed as specified in the submitted subsidence monitoring plan. No readings were taken until the mining face had advanced well beyond the end of the line. Since the purpose of this survey baseline was to obtain data on the progression of the dynamic subsidence profile in the direction of the longwall mining, no useful data was obtained at this line.

A new mid-panel survey baseline should be established as soon as possible and readings taken at sufficient frequency to obtain measurements of the subsidence profile in the direction of mining and its progression over time. The subsidence data should be submitted to this office for review.

5. Longwall Mining Subsidence Monitoring - Baselines "E" through "I"

The subsidence monitoring plan (Appendix F) does not specify a frequency of readings for these baselines shown on Drawing B05-330-M36. A frequency of readings should be specified for each line. Because of the dynamic nature of settlement in the direction of mining more frequent readings, daily at a minimum, will be required along Baseline "F."

6. Longwall Mining Subsidence Monitoring -Phase 3 Monitoring

The most critical phase of surface subsidence monitoring will be when mining of Panel No. 3 advances beneath the recently completed and capped Phase 3 impoundment. In addition to Baseline "I," an additional baseline should be considered for the southern crest of this impoundment, or other suitable location that is aligned in the direction of mining.

7. Stability of Phase 7 South Slope

The Phase 7 embankment will be founded on the impounded FCR from Phase 3 and therefore is the most critical stability analysis case. However, no stability analysis was furnished for this slope.

A stability analysis should be provided for a section through the Phase 7 and underlying Stage 3, using site-specific FCR strength parameters as requested in item No. 1 above. Because of the anticipated speed at which the Stage 7 embankment will be raised, analyses should be run for both the short-term end-of-construction and long-term steady-state conditions. Note that for loading of the consolidating, saturated FCR, appropriate undrained (phi=0) strength parameters should be used.

8. Seismic Stability of Phase 7 South Slope

The fine refuse on which Phase 7 will be founded may be subject to triggering strength loss (liquefaction) under earthquake shaking.

An evaluation of the susceptibility of the fine refuse to strength loss under appropriate earthquake shaking should be performed, and if required, the post seismic stability evaluated using estimated reduced post-seismic strengths. Alternatively, stability analyses can be performed using conservatively estimated post-earthquake strengths for the fine and coarse refuse. If a factor of safety of 1.20 or greater can be obtained with this conservative analysis, then additional liquefaction analyses will not be needed.

COMMENTS - PLANS AND SPECIFICATIONS

9. Specification Paragraph 2.08a - Decant Pipe Alignment

This paragraph references Drawing B05-330-E-14 and B05-330-E-32 for decant pipe profiles. However, drawing E-13, not E-14, contains the profiles for the Phase 5 and Phase 7 decants. Drawing E-32 does not exist in the submittal, and no profile or other elevation information was provided for the Phase 3 decant in any of the drawings.

A detail showing the intended Phase 3 decant profile with riser, inlet and outlet elevations should be added to the design drawings.

10. Drawing No. B05-330-E24 - Detail No. 5

This detail shows 5/8-inch-diameter roof bolts extending 4 feet into the embankment soil for anchorage of the Armorform uniform section grouted mats which will be used to line the decant outlet ditches running down the embankment

slopes. However, the design calculations show that a satisfactory factor of safety against sliding relies on the full allowable shear strength of the roof bolts. This is not possible if the bars are embedded into only 4 feet of soil.

Appropriate concrete deadman blocks or other provisions should be added to the design to provide satisfactory anchorage for the proposed roof bolts.

11. Coarse Coal Refuse Placement Guidelines

These guidelines specify the proposed CCR placement procedures using conveyors and dozers. The guidelines specify the use of two D-9 dozers and a D-10 dozer equipped with reclamation universal blades and maximum average push distances of 500 to 600 feet. Consequently, the operator's proposed construction method will be to construct the CCR dike embankments to their design crest elevation in 500 to 600 feet long segments by pushing refuse from a conveyor stacker at the end of the previously completed segment. Supporting calculations are included with the guidelines.

While the calculations appear to show this placement approach may be satisfactory with regard to the material handling capacity of the dozers, other potential problems must be addressed if such a placement method is used. The proposed dozer placement procedure must address a number of potential issues that include the following:

a. Inadequate compaction or excessive lift thickness at the conveyor end of a new embankment segment, or at the far end of the dozer pushes;

b. Preventing loose, over steepened and effectively end-dumped slopes at the end and sides of each dozed-out embankment segment;

c. Assuring that adequately compacted CCR extends to the limits of the design embankment template;

d. Assuring each embankment segment is suitably tied-in, by benching or other means, to assure loose or permeable zones are not present between segments.

Suitable drawings, cross sections and written specifications should be provided that address these issues and show the specific conveyor/dozer placement procedure that is proposed.

Satisfactory submission of the requested information will be required before we can recommend technical approval of this impoundment design from Phase 3 through Phase 7. However, item Nos. 7 and 8 are only applicable to Phase 7. Therefore, to

facilitate approval of the earlier phases, Mach Mining may first address all issues except for item Nos. 7 and 8 in an initial submittal with item Nos. 7 and 8 addressed in a later submittal.

If there are any questions concerning this review, please contact this office.

cc: S. Gigliotti - Chief, Safety Div., CMS&H
M. Skiles - Director, TS

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

November 9, 2009

Project No. B05-330-1413

Mr. Robert L. Phillips
District Manager
MINE SAFETY AND HEALTH ADMINISTRATION
Coal Mine Safety and Health, District 8
2300 Willow Street, Suite 200
Vincennes, IN 47591-5416

Transmittal
Response to Verbal Comments
Phase V Enlargement
Impoundment ID No. 1211-IL08-03141-02
Mach Mining LLC
Mach # 1 Mine, Mine ID No.11-03141

Dear Mr. Phillips:

On behalf of our client, Mach Mining LLC, please find enclosed two copies of response to verbal comments from Mr. Paul Donahue to Mr. Harold Owen concerning enlargement of Phase 5. The northern embankment of Phase 5 was moved approximately 300 feet north. This move was made as a result of the purchase of a piece of property. Enclosed is a set of revised drawings and calculations showing the enlarged Phase 5 cell.

One copy of the information has been sent directly to Mr. Donahue at Pittsburgh, Tech Support.

If you have any questions, or require additional information, please contact us.

Sincerely,

ALLIANCE CONSULTING, INC.

Brian W. Matherly
Assistant Project Engineer

Claudio E. Yon, P.E.
Principal Engineer

BWM/CEY:wmb
Enclosures

File: 05330-67

cc: Paul Donahue (w/enclosures)
J. Slapak (w/enclosures)

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

November 10, 2009

Project No. B05-330-1413

Mr. Paul J. Donahue
PITTSBURGH SAFETY AND HEALTH TECHNOLOGY CENTER
Cochrans Mill Road, Building 38
Pittsburgh, PA 15236

Transmittal
Response to Verbal Comments
Phase V Enlargement
Impoundment ID No. 1211-IL08-03141-02
Mach Mining LLC
Mach # 1 Mine, Mine ID No.11-03141

Dear Mr. Donahue:

On behalf of our client, Mach Mining LLC, please find enclosed one copy of response to verbal comments to Mr. Harold Owen concerning enlargement of Phase 5. The northern embankment of Phase 5 was moved approximately 300 feet north. This move was made as a result of the purchase of a piece of property. Enclosed is a set of revised drawings and calculations showing the enlarged Phase 5 cell.

Two copies of the information has been sent directly to Mr. Robert L. Phillips at the Mine Safety and Health Administration in Vincennes, IN.

If you have any questions, or require additional information, please contact us.

Sincerely,

ALLIANCE CONSULTING, INC.

Brian W. Matherly
Assistant Project Engineer

Claudio E. Yon, P.E.
Principal Engineer

BWM/CEY:knm
Enclosures

File: 05330-68

cc: Robert L. Phillips (w/enclosures)
J. Slapak (w/enclosures)

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Office: 618-983-3020 Fax: 618-983-3017

August 8, 2008

Mr. Robert L. Phillips
District Manager
MINE SAFETY AND HEALTH ADMINISTRATION
2300 Willow Street, Suite 200
Vincennes, IN 47591

Re: Pond Creek Mine No. 1, MSHA ID No. 1211IL0803141-01

Dear Mr. Phillips:

This letter authorizes Alliance Consulting, Inc. (Alliance) to perform work on MSHA Id No. 1211IL0803141-01 and make corrections as necessary. Please send copies of any comments to Alliance as well as Williams Energy, LLC.

Thank you for your cooperation.

Sincerely,

WILLIAMSON ENERGY, LLC

James Plumley

James Plumley – Authorized Person

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

August 6, 2008

Project No. B05-330-1413

Mr. Robert L. Phillips
District Manager
MINE SAFETY AND HEALTH ADMINISTRATION
2300 Willow Street, Suite 200
Vincennes, IN 47591

Transmittal
Williamson Energy
Pond Creek Mine No. 1
MSHA ID No. 1211IL0803141-01
Williamson County, Illinois

Dear Mr. Phillips:

On behalf of our client, Williamson Energy, LLC, please find enclosed two copies of the above-referenced application for your review. A preliminary review of this plan was conducted with Messers Mark Eslinger and Douglas Stradner of your office.

.ıe copy of this application will be provided to MSHA, Pittsburgh Safety And Technology Center, P. O. Box 18233, Pittsburgh, PA 15236 at a meeting to be held to review the final plan

If you have any questions, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Harold R. Owens, P. E.
Senior Project Engineer

Claudio E. Yon, P. E.
Senior Project Manager

HRO/CEY:wmb
Enclosures

James Plumley, Mach Mining

FILE: 05330-49

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

August 5, 2008

Project No. B07-038-1413

Mr. Robert L. Phillips, District Manager
MINE SAFETY AND HEALTH ADMINISTRATION
2300 Willow Street, Suite 200
Vincennes, IN 47591-5416

Transmittal
Additional Information
Coal Refuse Disposal Facility No. 2
Phases 3 Through 7
Impoundment I. D. No. 1211-IL08-03141-02
Williamson Energy, LLC
Pond Creek Mine No. 1
Mine I. D. No. 11-03141
Williamson County, Illinois

Dear Mr. Phillips:

On behalf of our client, Williamson Energy, LLC, this letter has been prepared in response to your request for additional information dated February 11, 2008.

As described in the memorandum attached to your letter on Page 3, the plan has been modified slightly since the original submittal. The sequence of construction will be from South to Center Cells to North Cell rather than South Cell to North Cell to Center Cells. The North and Center Cell configuration have changed but the overall concept remains the same. It should be noted that the two most southerly cells, Phase 2 and 3 will have been constructed, filled with fine coal refuse and abandoned prior to mining beneath the abandoned structures. The northern most cell will not be constructed until the longwall mining is completed and subsidence has occurred. Drawing No. B05-330-M36 entitled "Mining/Impoundment Construction" has been included which depicts the individual phases of construction sequentially and the timing of the mining. The following information has been included in response to your letter.

1. Longwall Mining Subsidence Analysis and Mitigation

a) Predicted subsidence, horizontal strain and displacement profiles have been included in a report entitled "Prediction of Ground Movement Parameters due to Longwall Mining During different Phases of Impoundments" by Dr. Syd Peng and are included in Appendix H of this response.

b) Measures for mitigation of the effects of mining subsidence on the dam embankment and foundation are included in Section 3.1.

Mining subsidence impact and mitigation measures for the various phases is described as follows:

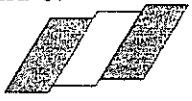
Phase 3 – This impounding embankment of Phase 3 will be completed and slurry pumping into the impoundment will be completed before mining beneath the phase occurs. The Phase 3 impoundment will be capped before undermining occurs. Based on subsidence predictions, the internal drainage system for the embankment has been redesigned to continue to function post-subsidence. Any disruption of surface drainage features due to subsidence will be repaired.

Phase 4 – Phase 4 is an intermediate phase in preparation for the construction of Phases 5, 6, and 7. No slurry will be pumped into Phase 4 and no internal drainage features are included in this phase. Undermining of Phase 4 will occur shortly after its construction. The embankment and pool area of this phase will be examined for subsidence cracks and repairs will be made as needed. It is anticipated that when slurry pumping begins in Phase 7 any undetected subsidence cracks in the Phase 4 embankment and foundation will be sealed by the slurry. This Phase will be buttressed to the south by Phase 3, which will be already completed and full of slurry; by Phase 6 to the east and west, which will be built post-subsidence; and by Phase 5 to the north, which will be also built post-subsidence.

Phase 5 – Phase 5 will be built post-undermining and the pool and embankment foundation area will be examined for subsidence cracks and repairs will be made as needed prior to construction. As previously stated, it is anticipated that theslurry will seal any undetected cracks. Phase 5 will be buttressed to the south by Phase 4. Phase 5 will contain an internal drain. This phase is predicted to be pumped full 22 months after construction starts (provides 17 months of slurry pumping).

Phase 6 – Phase 6 will be built post-mining and the embankment foundation area will be examined for subsidence cracks and repairs made as needed prior to construction. Phase 6 buttresses Phase 4 and an underdrain will be installed in this phase. No slurry will be pumped into Phase 6.

Phase 7 – Phase 7 will be built post-mining. Phase 7A will partially cap and consolidate the slurry in Phase 3. Phase 7B will provide a lining/buttress between the Phase 7 pool and the potentially cracked Phase 3 embankment (Phase 3 will be undermined after it has been pumped full of slurry). The remainder of Phase 7 will sit on top of the previously constructed Phases 4, 5, and 6. Phase 7C will finish covering and consolidating the slurry contained in the Phase 3 embankment. As previously stated, it is anticipated that the slurry will seal any undetected cracks not detected and repaired during Phases 4 and 6.



2. Treatment of Subsidence Cracking

The horizontal strain map, Drawing No. B05-330-M42, included in this report shows the areas that are most susceptible to cracking and which will be given special attention for the detection and repair of subsidence cracks. Areas considered susceptible to subsidence cracking are those predicted to have surface horizontal tensile strain of 0.1 percent or greater.

Examination of the subsidence prediction study data shows that horizontal strain and vertical subsidence values do not change significantly when mining occurs in a longwall panel adjacent to a previously mined panel directly beneath a phase undergoing construction. Overlapping subsidence and strain profiles should have negligible impact on ongoing construction.

The coarse coal refuse fill to be used in all phases of construction is broadly graded and should be less susceptible to cracking than earthern materials traditionally usually used in dam construction. Comparison of the gradation curves of the foundation soil and coarse coal refuse indicates that they do not fall into the most critical range for cracking (see Fig. 2.3:6 adopted from "Design of Earth and Earth Rock Dams", Sherard, etal, 1963, and the gradation curves for the foundation soil and coarse coal refuse contained in .... of this report). Based on Table 2.2.1 contained in Sherard, on a scale of 1 (highest) to 8 (lowest), the foundation soil has a piping resistance of (2, high) and the coarse coal refuse has a piping resistance of (3, intermediate).

2.a Crack Repair - Slurry discharge lines will be moved around the interior perimeter of each impoundment phase to maintain a delta against the slope and aid in sealing any embankment and foundation cracks not discovered by visual observation and sealed.

Subsidence crack repair of the foundation and the Phase 4 embankment will consist of excavation of the areas containing cracks to a depth of at least four feet, proof rolling the areas, and backfilling and sealing the areas with a compacted coarse coal refuse seal placed to the compaction standard in the Guideline Technical Specifications. In the unlikely event that extensive, deep cracking is discovered, a slurry trench or cutoff trench will be extended to bedrock through the affected areas. The trench will be located beneath the underdrain alignment for Stages 5 and 6. If it is discovered that a slurry or cutoff trench is needed, a specific design will be submitted for approval prior to its construction.

The Phase 4 embankment is the only embankment subject to subsidence cracking prior to slurry pumping. Before the construction of Phase 6, the Phase 4 embankment will be examined for cracking and any areas containing cracks will be excavated to a depth of at least 4 feet and sealed with compacted coarse coal refuse. Any additional cracks

discovered after slurry pumping begins during Phase 7 will be sealed by directing the slurry into the pool adjacent to the cracks.

2.b Defensive Measures - Phase 6, a wide zone of embankment, will be constructed post-mining by the downstream construction method on the east and west sides of Phase 4. It would serve as a "crack stopper" for any undetected cracks which may develop in the east and west sides of the Phase 4 embankment. The Phase 4 embankment will be buttressed on the north side by the Phase 5 embankment and impoundment. Phase 7 will be constructed partially on top of Phase 4, the resulting additional consolidation should aid in closing any cracks in the Phase 4 embankment. Likewise, the construction of Phases 6 and 7 should cause consolidation which should aid in closing any cracks in the underlying foundation soil.

The Stage 5 and 6 embankment underdrains have been redesigned to lower them as closely as possible to the predicted subsided original ground surface and still maintain gravity outlets. Neglecting the flow capacity of the gravel, the perforated collection pipes are designed to have a flow capacity safety factor of five or greater. The use of a safety factor of five for the collection pipe is felt to be justified as the entry of seepage water into the gravel drain envelope has a safety factor in excess of ten and the collection pipe is an engineered material which will be installed in a controlled fashion.

3. Subsidence Monitoring Plan

A subsidence monitoring plan which includes subsidence monument locations, reading schedules has been included in Appendix F, the rate and magnitude of vertical and horizontal movement will be recorded. The location of subsidence monuments are shown on Drawing No. B05-330-M36.

4. Coordination of Mining and Surface Disposal Operations

The construction timing and staging are contained in the calculation brief and are based on production ratios and rates provided by Mach Mining, LLC (Mach Mining). Mach Mining is the operator of the deep mine, preparation plant and coal refuse disposal facility. Therefore, coordination of the mining operation and surface operation should not be an issue. The timing of the panel advancement and developmental mining was modeled by Mach Mining. The modeling was performed using SurvCADD software. The mining completed during each stage is color coded on the map of each stage. Charts with the dates of mining, beginning and ending, fine and coarse coal refuse placement has been included for each phase on the "Mining/Impoundment Timing Map", Drawing No. B05-330-M36.

5. Drawing

The decant outlet ditch has been shown on Drawing Nos. B05-330-M30 and B05-330-M33.



6. The horizontal scale for the impoundment curve has been corrected on Drawing No. B05-330-E13.

7. Additional piezometer locations have been indicated on Drawing Nos. B05-330-M30, B05-330-M32, B05-330-M33 and B05-330-M34.

8. Design Comments – Specifications

The reference to maintaining a four-foot thick (minimum) soil layer between the coal refuse and bedrock has been deleted from Page A-3. This was an issue related to groundwater protection and was applicable to construction of the Phase 1 (incised area only) for the Illinois Department of Natural Resources. This language was contained in the approved MSHA plan (IL08-03131-01) for Phase 1 and was the method by which it was constructed.

A soil layer inside the incised portion would not affect the stability of the embankment.

9. Additional information has been provided on Page A-3 for the replacement of soft or wet soils with compacted coarse coal refuse. We propose that the soft soils be removed and replaced with coarse coal refuse.

10.

a) If subsidence cracks are discovered in the pool or embankment foundation area of Phases 5 or 6, areas containing cracks will be excavated to a depth of at least four feet, proof rolled, and sealed with a compacted coarse coal refuse placed to the compaction standard in the Guideline Technical Specifications.
b) The topsoil has already been removed from the entire site. No drain tiles or drain pipes were encountered. Additionally, the sediment cell has already been excavated around the entire perimeter of the facility to depths greater than the topsoil removal. The minimum excavation depth was approximately 4 feet up to approximately 15 feet. No drain tiles or pipes were encountered. We assume these excavations would have encountered any such structure and therefore no addition to the specifications should be required.

11. A placement plan for utilizing belts and dozers has been included in Appendix E. This plan is similar to the currently approved plan for Phase 2 (ID No. IL08-03141-01) for this type of placement at this facility except that an additional D-9 dozer has been purchased and two stackers (dump points) are proposed in-lieu of one. Compaction has been achieved by dozer traffic.

12. The pump activation levels have been added to Drawing No. B05-330-M5 for Phase 4, Drawing No. B05-330-M7 for Phase 6 and Drawing No. B05-330-M8 for Phase 7.

A statement has been added to the specifications in Section 3.1 of the engineering report stating that no significant depth of impounded water will be allowed prior to any of the required

remediation of subsidence disturbance or prior to the raising of the post subsidence stages to a suitable elevation.

13. Grout mix and placement procedures have been provided in Section 4.04, Page A-12. Uniform section mat has also been provided as an option for grouted rip-rap on Drawing No. B05-330-E24.

14. Additional Required Specifications

a) Specific pump specifications have been provided in Appendix G. The maximum required pumping rate for Phases 4 and 6 are 1,902 gpm with 32.5 feet of static head. For Phase 7, a pump will be required until the decant line is installed. The pump will be a Goodwin CD 3000 M Dri-Prime Pump manufactured by Goodwin Pumps of America, Inc. with a Caterpillar -9 diesel engine or equivalent. This pump will deliver 4,870 gpm at a total suction head of 120 feet.
b) Measures to address mine subsidence have been added in Section 3.1.

If you have any questions, or require additional information, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Harold L. Owens, P. E.
Senior Project Engineer

Claudio E. Yon, P. E.
Principal Engineer

HLO/CEY:wmb
Enclosures

FILE: 07038-17

U.S. Department of Labor

Mine Safety and Health Administration
2300 Willow Street
Suite 200
Vincennes, Indiana 47591-5416

February 11, 2008

Mr. Justin L. Harry, Staff Engineer
Alliance Consulting, Inc.
124 Philpott Lane
Raleigh County Airport Industrial Park
Beaver, WV 25813-9502

Dear Mr. Harry:

Re: Request of Additional Information dated December 13, 2007, for Coal Refuse Disposal Facility No. 2, Impoundment I.D. Number IL08 03141-02, Mach Mining, LLC, Mach #1 Mine, Mine I.D. No. 11-03141, Johnston City, Williamson County, Illinois

The Mine Safety Health Administration completed a review of the engineering plan for the design, construction, and maintenance of Mach #1 Mine, Mach Mining, LLC. Before the plan can be approved, some additional information is needed.

Please find attached a memorandum from the Mine Waste and Geotechnical Engineering Division of the Pittsburgh Safety and Health Technology Division. The information requested in the memorandum must be satisfactorily answered before approval can be granted.

If you have any questions concerning this matter, please contact Mark Eslinger, Supervisory Mining Engineer (Ventilation) at 812-882-7617.

Sincerely,

Robert L. Phillips

Robert L. Phillips
District Manager
Coal Mine Safety and Health
District 8

Attachment

cc: Mr. Pete Hendrick, President
Mach Mining, LLC
P.O. Box 300
Johnston City, IL 62951

U.S. Department of Labor

Mine Safety and Health Administration
Pittsburgh Safety & Health Technology Center
P.O. Box 18233
Pittsburgh, PA 15236

Mine Waste and Geotechnical Engineering Division

RECEIVED
JAN 14 2008
CMS & H/Dist 8
Vincennes, IN

December 13, 2007

MEMORANDUM FOR ROBERT PHILLIPS
District Manager, District 8
Coal Mine Safety and Health

THROUGH: M. TERRY HOCH
Chief, Pittsburgh Safety and Health Technology Center

STANLEY J. MICHALEK
Chief, Mine Waste and Geotechnical Engineering Division

FOR
DONALD T. KIRKWOOD
Supervisory Civil Engineer, Mine Waste and Geotechnical Engineering Division

FROM: PAUL J. DONAHUE
Civil Engineer, Mine Waste and Geotechnical Engineering Division

SUBJECT: Request for Additional Information, Coal Refuse Disposal Facility No. 2, Phases 3 through 7, Impoundment I.D. No. 1211-IL08-03141-02, Williamson Energy LLC, Pond Creek Mine No. 1, Mine I.D. No. 11-03141, Williamson County, Illinois

As requested by your office, we have reviewed the design documents submitted by Williamson Energy LLC, and prepared by Alliance Consulting, Incorporated The submitted material was received in our office on February 8, 2007.

The submitted design document consists of a report entitled: "Engineering Design Plan, Proposed Coal Refuse Disposal, Facility No. 2, Williamson County, Illinois, dated January 2007." The report includes a narrative description of the proposed design, and

the testing and analyses performed. Appendices to the report contain various design calculations; geotechnical test boring and laboratory test data; and thirteen drawings depicting plans, profiles, and details of the proposed facility.

Disposal Facility No. 2, as currently planned, will provide for the disposal of about 11 years of coarse coal refuse and 17 years of fine coal refuse produced from the Pond Creek No. 1 Mine, which has been previously referred to in District 8 correspondence as the "Mach No. 1 Mine." This facility is to be constructed in five phases - Phases 3 through 7. Phases 1 and 2 are part of currently active Disposal Facility No. 1, which lies immediately to the south of the proposed Disposal Facility No 2.

Description of Proposed Facility

The currently planned facility will consist of two four-sided diked impoundments that, upon completion, will share a common embankment separating them on their southern and northern margins, respectively. The smaller, partly incised north impoundment will be constructed as part of the placement Phases 3 and 5, and the larger south impoundment that will be constructed as part of Phases 4, 6 and 7. The north impoundment will be 1250 by 1850 feet, and the south impoundment 2400 feet by 2400 feet, in footprint dimensions. Both impoundments will be raised by downstream construction methods with upstream and downstream slopes of 3 horizontal to 1 vertical. The north impoundment will be a maximum of 52 feet in height above the downstream toe, and the south impoundment will be a maximum of 98 feet above the downstream toe.

The designer considered the impoundments to be of high hazard potential classification for the purposes of hydrologic/hydraulic design. Following 1 year from the start of construction, Phases 3, 4, and 6 will accommodate a rainfall volume of two PMF's with pumping capacity capable of drawing down one PMF in 30 days. Phases 5 and 7 will utilize an 18-inch SDR 26 decant spillway capable of drawing down 90% of one PMF in less than 10 days.

The most significant consideration for these impoundments will be the longwall mining of the 6.5-foot-thick Herrin No. 6 Coal Seam beneath the impoundment footprints concurrent with the disposal facility development. There is 420 to 450 feet of overburden, with at least 420 feet of this being rock, between the embankment foundations or impoundment bottoms and the Herrin No. 6 seam. Also, the headgate and tailgate pillars have a calculated minimum pillar safety factor of 2.3 as calculated by the program ALPS. Therefore, breakthrough or sinkhole potential is low, but surface subsidence is a significant consideration in the design of this facility.

The north impoundment will span the surface projection of the northernmost of the three 1200-foot-wide longwall panels that will impact the impoundments. The south

impoundment will span the southern two panels. The longwall mining for each panel will proceed east to west and panels will be mined north to south. The designer intends to accommodate the surface subsidence from the expected longwall mining by staging construction so that the downstream coarse refuse stage of each impoundment is placed after longwall mining is completed, subsidence is substantially ended, and surficial cracks on critical parts of the pre-mining stage are treated. No fine refuse slurry will be placed in either impoundment until this post-subsidence downstream stage has been raised to at least the expected slurry level. Fine refuse will be placed in the currently active Disposal Facility No. 1 impoundment prior to the start of the first post-subsidence stage. Longwall mining will be performed under Facility No. 1 after its closure. Thus, the safe operation of the proposed impoundments will rely on critical coordination of the surface disposal activities with the underground mining activities.

Design Comments - Longwall Mining Impacts

Based on our review of the submittal, we have concluded that additional engineering analyses will be required to assure the safe operation of the proposed mine waste facility. The potential impacts of mine subsidence on this facility are significant. However, the submittal does not contain sufficient information to demonstrate that the designer has thoroughly considered the adverse effects of longwall subsidence on the embankments or their foundations in the design of this facility.

In a phone conversation with Mr. Douglas (Duffy) Stradner, District 1 Impoundment Specialist, on October 23, 2007, we were notified that major revisions to the impoundment layout and geometry may be forthcoming. However, we expect that the comments and requested information in this memorandum will be applicable to any revised designs.

The following items of additional information will be required to complete our review:

1. Longwall Mining Subsidence Analysis and Mitigation

   The designer used the Bureau of Mines IC 8741 guidance to demonstrate that an adequate overburden thickness exists to preclude breakthrough. However, IC 8741 also specifies a dam protection zone where no mining is allowed within specified "safety zone " limits beneath the footprint of a dam. MSHA generally has allowed only essential ventilation or haulage way development mining within the IC 8741 limits at coal waste dams unless it can be demonstrated that the mining will not impact the integrity of the dam or that specific proposed measures will protect the integrity of the dam. Therefore, a detailed analysis of the mining related subsidence and possible impacts on the planned impoundments should be provided. This analysis should include the following:

a. Develop predicted subsidence, horizontal strain, and displacement profiles, at all significant stages of the mining and impoundment construction;

b. Furnish any designs and supporting calculations for any measures needed to mitigate the effects of the mining subsidence on the dam embankment and foundation. Additional, post-subsidence remedial features, such as a cutoff trench, compacted clay liner, or other defensive anti-seepage measures to address foundation or embankment disturbance should be considered.

2. Treatment of Subsidence Cracking

The submitted report narrative proposes to "over excavate and fill cracks to a minimum depth of 5 to 10 feet" at the south side of the Phase 5 embankment after expected longwall mining subsidence and cracking has occurred. However, no construction details of the proposed repair were provided. Also, the effectiveness of this repair is questionable because it will only address the near surface part of a crack and cracks that are visible at the surface.

a. The designer should provide additional details of the proposed crack repair procedure with specific dimensions for the excavation and backfilling for the various sizes of cracks expected, and provide a justification that the repairs will be effective.

b. Alternatively, the designer should consider suitable defensive design measures such as a graded rock filter zone between the pre- and post-mining stages, which may preclude the need for crack repair.

3. Subsidence Monitoring

The proposed design relies on mine surface subsidence being substantially complete before placing the downstream stages of the impoundments. However, no subsidence monitoring has been proposed. A subsidence monitoring plan should be proposed. This plan should include monument locations, reading schedules, and action thresholds for the rates and magnitudes of vertical and horizontal movement.

4. Coordination of Mining and Surface Disposal Operations

The proposed facility design relies on close coordination between the longwall mining operations and the staging of the surface refuse disposal operations. The mine operator should provide a plan for coordinating the underground mining and the surface disposal activities and any supporting documentation. This should

include timelines for the longwall mining development and impoundment construction that supports the assumptions used in the impoundment staging design.

Mining and impoundment timeline and expected production data should be provided in bar chart or other form for easy reference by mine and MSHA inspection personnel.

Design Comments - Drawings

5. Drawings B05-33-M6 and M8 – Decant Outlet Ditch

A decant ditch is specified on the ditch schedule on Drawing No. 05-330-E14, but is not shown on the plan drawings. The locations and intended plan extents of this ditch should be shown on the plan drawings.

6. Drawing B05-330-E13 – Stage/Storage Curves

The horizontal axis (storage volume) scale for the Phase 3/5 impoundment curve is incorrect (too high by a factor of 10). This error should be corrected.

7. Drawings B05-33-M6 and M8 – Piezometer Locations

The above drawings show pairs of proposed piezometers to be installed only in the lower half of the downstream slopes. In order to verify assumptions used in the slope stability analysis and confirm adequate performance of the underdrain, at least one additional piezometer will be needed further up the slope. Therefore, additional piezometers should be specified for the downstream edge of the Phase 5 and Phase 8 crests, or other suitable higher location, or justification provided for the currently proposed piezometer layout.

Design Comments - Specifications

8. Paragraph 1.02 – Stripping and Topsoil Removal

This paragraph specifies that a 4-foot-thick (minimum) soil layer shall be maintained between the coal refuse and bedrock.

a. It should be clarified if this minimum soil layer thickness is intended for beneath the impounded fine refuse as well as the coarse refuse embankment.

b. A list of specific acceptable soil types for the protective layer, using the Unified Soil classification System (USCS) should be included in this specification.

c. A means to confirm this soil thickness should be provided.

d. The excavation of the incised bottom of the north pond will likely encounter bedrock in some portions of the pond bottom. If the minimum soil layer requirement is applicable to the pond bottom, a specific treatment, such as over excavation and replacement with compacted clay soil, should be included in this specification.

9. Paragraph 1.03. - Surface Sealing/Proof rolling

Specific acceptable USCS soil types should be specified for replacement of soft or wet soils.

10. Section 1.0 - Site Preparation - General

a. As required to address Comment No. 1, additional preparation measures in both the embankment foundation and impoundment bottom areas will likely be needed to address mine subsidence impacts. The specific measures developed to address this issue should be included in this section of the specifications.

b. Underdrains or "drain tiles" are often used in level, low-lying former cropland such as this site. The site preparation specifications should include measures to explore for, and if necessary, remove a suitable portion of any drain pipes that could provide a seepage path under the coarse refuse embankment.

11. Paragraph 2.02.e. - Coarse Coal Refuse Placement and Compaction - Construction Procedures

This paragraph specifies that fill shall be placed in "nearly horizontal layers." However, similar wording has been used on sites where MSHA has observed excessively sloping coarse refuse fill with thick or poorly defined lifts. This typically occurs when dozers are used to push the coarse refuse excessive distances from the tail end of a conveyor used to convey the coarse refuse to the dam crest.

The specification should be revised with additional details to clearly define the maximum tolerable slope of the fill surface, and describe specific, acceptable lift spreading methods.

12. Paragraph 3.02 - Clarified Water Removal

a. This paragraph states that the water level in the impoundments should be maintained as "low as practicable." However, the submittal contains

calculations for specific maximum design storm storage water levels and pump activation levels prior to installation of the decant spillways. These elevations need to be provided in table or other form in the specifications for easy reference.

b. Additionally, the longwall mining will significantly disturb Phases 3, 4 and 6 embankments. Therefore, the specification should contain measures to prevent any impounding of water prior to any required remediation of subsidence disturbance or prior to the raising of the post-subsidence stages to a suitable elevation.

13. Paragraph 4.04 – Rock Riprap

a. "Grouted rock riprap" is specified for the decant ditches and other steep surface drainage ditches that will run down the embankment slopes. However, specifications for the grout mix and grout placement procedures were not provided. These details should be added to this specification.

b. Subparagraph "d" of this specification also provides the option of using grouted 8-inch filter point mat or 4-inch uniform section mat in place of riprap. Clarification is needed whether this lining is intended as a replacement for both grouted and ungrouted riprap lining. Additionally, calculations supporting the suitability of this alternate channel lining for the steep channels on the embankment slopes should be provided.

14. Additional Required Specifications

Additional significant construction requirements were not included in the submitted specifications. Additional sections to the specification should be provided for the following:

a. Pumping Requirements

Pumping will be required to meet storm water handling requirements during certain stages of construction. Required pumping capacity calculations were furnished, but no pump specifications were provided. Specifications should be furnished with specific requirements for pump capacity, power source or supply, and any testing required to assure reliable operation.

b. Specifications for Measures to Address Mine Subsidence

Additional detailed specification sections should be provided, as needed, for any new features of work developed from the additional subsidence analysis requested in items 1 through 4 of this memorandum.

If there are any questions concerning this review, please contact this office.

cc: S. Gigliotti - Acting Chief, Safety Div., CMS&H
M. Skiles - Director, TS
J. Fredland - DSO, TS

REPORT
ENGINEERING DESIGN PLAN
MACH #1 MINE
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
WILLIAMSON COUNTY, ILLINOIS
MACH MINING LLC
JOHNSON CITY, ILLINOIS

TABLE OF CONTENTS

VOLUME 1 of 3 **PAGE**

1.0 INTRODUCTION 1

2.0 EXISTING SITE CONDITIONS 2

2.1 Site Characteristics 2
2.2 Geology

3.0 MINING OPERATIONS AND COAL REFUSE PRODUCTION 2

3.1 Mining Operations 2
3.2 Coal Refuse Production 4

4.0 SUBSURFACE EXPLORATION 4

4.1 Subsurface Exploration 4

5.0 FIELD AND LABORATORY TESTING 4

5.1 Soil 4
5.2 Coarse Coal Refuse 5
5.3 Fine Coal Refuse 6
5.4 Piezo-Seismic Cone Penetration Testing 6

6.0 COAL REFUSE DISPOSAL PLAN 6

6.1 Phase 3 7
6.2 Phase 4 8
6.3 Phase 5 9
6.4 Phase 6 10
6.5 Phase 7 11
6.6 Abandonment Plan 13

7.0 ENGINEERING ANALYSES 13

7.1 Hydrologic and Hydraulic Analyses 13
7.2 Slope Stability Analyses 13

TABLE OF CONTENTS (continued)

PAGE

8.0 SUMMARY 15

CERTIFICATION OF PLAN 15

APPENDIX A – GUIDELINE TECHNICAL SPECIFICATIONS

APPENDIX B – CALCULATION BRIEF

APPENDIX C – LABORATORY TESTING

APPENDIX D – BORING LOGS

APPENDIX E – COARSE COAL REFUSE PLACEMENT PLAN

APPENDIX F – SUBSIDENCE MONITORING PLAN

APPENDIX G – PUMP SPECIFICATIONS

APPENDIX H – "PREDICTION OF GROUND MOVEMENT PARAMETERS DUE TO LONGWALL MINING DURING DIFFERENT PHASES OF IMPOUNDMENT", A MODIFIED REPORT SUBMITTED TO ALLIANCE CONSULTING, INC, SYD S. PENG AND THOMAS DU, DEPARTMENT OF MINING ENGINEERING, WEST VIRGINIA UNIVERSITY, MAY, 2009.

VOLUME 2 OF 3

"RESPONSE TO MSHA COMMENT NOS. 1, 3, 7 AND 8 POND CREEK MINE NO. 1, COAL REFUSE DISPOSAL FACILITY NO. 2, PHASES 3 AND 7,"GAI CONSULTANTS, INC., MAY, 2009.

VOLUME 3 OF 3

FIGURES

FIGURE NO.	DRAWING NO.	TITLE
1	B05-330-T2	Title Sheet
2	B05-330-M19	Existing Conditions
3	B05-330-M30	Plan – Phase 3
4	B05-330-M31	Plan – Phase 4
5	B05-330-M32	Plan – Phase 5
6	B05-330-M34	Plan – Phase 6
7	B05-330-M33	Plan – Phase 7
8	B05-330-E13	Sections C-C, D-D, and F-F

TABLE OF CONTENTS (continued)

9	B05-330-E22	Section E-E
10	B05-330-E14	Details
11	B05-330-E24	Decant Installation and Uniform Section Mat Details
12	B05-330-E49	Ditch "F" Profile and Details
13	B05-330-E47	Instrumentation and Contingency Buttress Details
14	B05-330-E12	Slope Stability Analysis – Sections C-C and D-D
15	B05-330-E39	Slope Stability Analysis – Sections F-F and G-G
16	B05-330-E48	Slope Stability Analysis – Section F-F (Phase 7C)
17	B05-330-M36	Mining/Impoundment Construction Timing Map
18	B05-330-E46	Subsidence Effects Predictions Map
19	B05-330-M50	Mine Vertical Subsidence Predictions
20	B05-330-M51	Mine Subsidence Horizontal Strain Predictions
21	B05-330-M44	Subsidence Survey Panel No. 1 Section
22	B05-330-M20	Abandonment Plan

SUPERCEDES

REPORT
ENGINEERING DESIGN PLAN
MACH #1 MINE
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
WILLIAMSON COUNTY, ILLINOIS
MACH MINING LLC
JOHNSON CITY, ILLINOIS

TABLE OF CONTENTS

VOLUME 1 of 2		PAGE
1.0 INTRODUCTION		1
2.0 EXISTING SITE CONDITIONS		2
2.1 Site Characteristics		2
2.2 Geology		
3.0 MINING OPERATIONS AND COAL REFUSE PRODUCTION		2
3.1 Mining Operations		2
3.2 Coal Refuse Production		4
4.0 SUBSURFACE EXPLORATION		4
4.1	Subsurface Exploration	4
5.0 FIELD AND LABORATORY TESTING		4
5.1	Soil	4
5.2	Coarse Coal Refuse	5
5.3	Fine Coal Refuse	6
5.4	Piezo-Seismic Cone Penetration Testing	6
6.0 COAL REFUSE DISPOSAL PLAN		6
6.1	Phase 3	7
6.2	Phase 4	8
6.3	Phase 5	9
6.4	Phase 6	10
6.5	Phase 7	11
6.6	Abandonment Plan	13
7.0 ENGINEERING ANALYSES		13
7.1	Hydrologic and Hydraulic Analyses	13
7.2	Slope Stability Analyses	13

TABLE OF CONTENTS (continued)

PAGE

8.0 SUMMARY 15

CERTIFICATION OF PLAN 15

APPENDIX A – GUIDELINE TECHNICAL SPECIFICATIONS

APPENDIX B – CALCULATION BRIEF

APPENDIX C – LABORATORY TESTING

APPENDIX D – BORING LOGS

APPENDIX E – COARSE COAL REFUSE PLACEMENT PLAN

APPENDIX F – SUBSIDENCE MONITORING PLAN

APPENDIX G – PUMP SPECIFICATIONS

APPENDIX H – "PREDICTION OF GROUND MOVEMENT PARAMETERS DUE TO LONGWALL MINING DURING DIFFERENT PHASES OF IMPOUNDMENT", A MODIFIED REPORT SUBMITTED TO ALLIANCE CONSULTING, INC, SYD S. PENG AND THOMAS DU, DEPARTMENT OF MINING ENGINEERING, WEST VIRGINIA UNIVERSITY, MAY, 2009.

VOLUME 2 OF 2 – "RESPONSE TO MSHA COMMENT NOS. 1, 3, 7 AND 8 POND CREEK MINE NO. 1, COAL REFUSE DISPOSAL FACILITY NO. 2, PHASES 3 AND 7," GAI CONSULTANTS, INC., MAY, 2009. (UNDER SEPARATE COVER)

LIST OF FIGURES

FIGURE NO.	DRAWING NO.	TITLE
1	B05-330-T2	Title Sheet
2	B05-330-M19	Existing Conditions
3	B05-330-M30	Plan – Phase 3
4	B05-330-M31	Plan – Phase 4
5	B05-330-M32	Plan – Phase 5
6	B05-330-M34	Plan – Phase 6
7	B05-330-M33	Plan – Phase 7
8	B05-330-E13	Sections C-C, D-D, and F-F

TABLE OF CONTENTS (continued)

9	B05-330-E22	Section E-E
10	B05-330-E14	Details
11	B05-330-E24	Decant Installation and Uniform Section Mat Details
12	B05-330-E49	Ditch "F" Profile and Details
13	B05-330-E47	Instrumentation and Contingency Buttress Details
14	B05-330-E12	Slope Stability Analysis – Sections C-C and D-D
15	B05-330-E39	Slope Stability Analysis – Sections F-F and G-G
16	B05-330-E48	Slope Stability Analysis – Section F-F (Phase 7C)
17	B05-330-M36	Mining/Impoundment Construction Timing Map
18	B05-330-E46	Subsidence Effects Predictions Map
19	B05-330-M50	Mine Vertical Subsidence Predictions
20	B05-330-M51	Mine Subsidence Horizontal Strain Predictions
21	B05-330-M44	Subsidence Survey Panel No. 1 Section
22	B05-330-M20	Abandonment Plan

REPORT
ENGINEERING DESIGN PLAN
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
MACH #1 MINE
MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS
JOHNSON CITY, ILLINOIS

1.0 INTRODUCTION

Plans have been developed for the construction of a coarse and fine coal refuse disposal facility to be located near Johnston City in Williamson County, Illinois. The proposed coal refuse disposal facility will provide disposal capacity for both coarse and fine coal refuse produced by the Mach #1 mine coal preparation plant located approximately 0.25 mile west of the proposed facility. The location of the site is just southwest of the intersection of Dwina Road and Dean Road and is shown on Figure No. 1.

The plan, as presented herein, provides for the disposal of approximately 4 years of coarse coal refuse and 7 years of fine coal refuse based on production rates provided by Mach Mining operations for Mach Mining LLC (Mach Mining). The facility shall be constructed in five phases of coarse coal refuse embankment construction (Phases 3 through 7). During the initial construction of the Disposal Facility No. 2, fine coal refuse shall be disposed in the Disposal Facility No. 1 impoundment[1] MSHA ID No. 1211-IL08-03141-02 (Phases 1 and 2).

The proposed facility has been designed as a high hazard impoundment using the Probable Maximum Flood (PMF) storm event. Based on the design production rates, at the 1-year anniversary of initial impounding capability and thereafter, the facility will be capable of storing the runoff associated with the design storm event. The stored runoff volume, as well as operational water, shall be evacuated using a pump for Phases 4 and 6 and decant pipes for Phases 3, 5 and 7.

Combination sedimentation and perimeter ditches, access road gutters and bench gutters have been specified to convey storm runoff away from the embankment in a controlled manner. The ditches have been designed for routing the runoff associated with the 100-year, 6-hour recurrence interval storm event.

This report presents the design drawings, guideline technical specifications (Appendix A), and calculations (Appendix B) necessary for the design and construction of the embankment. The laboratory data and boring logs are contained in Appendices C and D, respectively.

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[1] Alliance Consulting, Inc. report entitled "Report, Engineering Design Plan, Proposed Coal Refuse Disposal Facility, Pond Creek Mine No. 1, Williamson County, Illinois" prepared for Williamson Energy, LLC, Beckley, West Virginia, dated April 2006.

2.0 EXISTING SITE CONDITIONS

2.1 Site Characteristics

The general area of the proposed impoundment has previously been used for agricultural purposes and has relatively flat to mild slopes to the ridgeline at approximate Elevation 572. The surrounding landscape is characterized by extensive agricultural and rural residential land use. Regionally, the proposed permit area is located on the southern shelf of the Illinois Basin in the Mt. Vernon Hill Country physiographic division. Surrounding landforms are the results of both Wisconsinian glaciations and normal degradation processes such as weathering, mass wasting, and stream erosion. Surrounding topography is characterized by generally flat ridge tops, moderately steep hill slopes and broad flat valley floors associated with major streams. The local drainage pattern is dendritic reflecting the regional generally horizontal bedrock stratigraphy. The total relief of the Facility No. 2 footprint is approximately 32 feet ranging from approximately 436' to 468' above mean seal level (based on aerial photography).

Glacial deposits of the Carmi Member of the Equality Formation, consisting of quiet water lake silt and clay, constituted the original surface materials within the proposed permit area.

2.2 Geology

The proposed permit area is underlain by lower Pennsylvanian age rocks consisting of shale, sandstone, and siltstone with minor underclay, coal and limestone. These sequences reflect fluctuating shorelines, deltas, and shallow seas indicating deltaic, fluvial, and coal swamp depositional environments. These bedrock units can be highly variable in thickness and continuity. Mississippian rocks unconformably underlie the Pennsylvanian, however, they do not outcrop in the subject area and were not penetrated during exploration drilling.

The major stratigraphic marker is the Herrin No. 6 coal which is generally uniform and continuous in the subject area and occurs at approximate Elevation 10 beneath the proposed refuse disposal facility. Shale and sandstone units in the subject area exhibit a high degree of lateral facies changes and interbedding. The Herrin No. 6 seam is described as a normal bright-banded coal with a lower portion that contains a prominent claystone parting. The base of the Herrin No. 6 exhibits an undulating surface with a general structural trend toward the north-northeast dipping approximately 60 feet per mile. No major faults or other structural anomalies are known to be present within the proposed permit.

3.0 MINING OPERATIONS AND COAL REFUSE PRODUCTION

3.1 Mining Operations

The Herrin No. 6 coal seam (average Elevation 10 feet above mean sea level) is proposed to be mined by both longwall and conventional mining techniques beneath the footprint area of the proposed facility. The disposal plan has been staged to minimize the impacts of the mining on the integrity of the embankments. Due to the timing of the proposed mining, it will be necessary to initiate Phases 3 and 4 embankment construction above unmined areas.

Based on a report prepared by Syd S. Peng, etal[2], it is anticipated that substantially all of the significant surface subsidence resulting from the longwall mining activities should occur within approximately 14 to 21 days following longwall mining. Phase 3 shall be filled to capacity with fine coal refuse and the impounding capability eliminated before being mined under. Prior to the deposition of the fines, but following the subsidence period, a downstream stage (Phase 6) will be constructed around the Phase 4 impoundment area. This phase essentially "rings" the initial embankment and should serve to mitigate any cracks that may have developed in the initial embankment as a result of the subsidence. Internal drains have been specified for the Phase 3, 5, and 6 embankments to collect and convey potential seepage. Based on the predicted subsidence, the drains have been designed so that positive drainage will occur post subsidence. Also, as discussed in Section 6 of this report, observed cracks in the pool area of Phase 4, on the upstream and downstream slopes of Phase 4, the pool area and foundation area of Phase 5, and the foundation area of Phase 6 shall be over excavated to a depth of at least 4 feet and backfilled with compacted coarse coal refuse.

Subsidence monitoring baselines will be used to calibrate the subsidence prediction model and compare predicted to actual subsidence due to mining. The location of the baselines are shown on Figure No. 17 and the monitoring plan is discussed in Appendix F.

Concerning breakthrough potential, the Bureau of Mines Information Circular 8741 recommends an overburden thickness equal to 60 times the extraction height for total extraction mining. The lowest level of the proposed pool area is Elevation 426, and the bottom of coal seam is at average Elevation 10 feet with an extraction height of 6.5 feet. Therefore, the existing overburden thickness is greater than the recommended thickness and there is no significant potential for a catastrophic breakthrough of fine coal refuse slurry into the mine to occur.

Chapter 8, Section 25 of the MSHA Coal Mine Inspection and Plan Review Handbook, October, 2007, recommends a pillar factor of safety should be greater than 2.0 for the long-term support of critical areas. The maximum crest elevation of the proposed embankment is 538 which create an overburden height of 528 feet. Based on these dimensions, the ALPS factor of safety is 2.30, which is greater than the recommended minimum of 2.0.

Based on these conditions and recommended guidelines, it is expected that no adverse effects shall impact the stability or breakthrough potential of the impoundments.

No significant depth of impoundment water will be allowed prior to any of the required remediation of subsidence disturbance prior to the raising of the post-subsidence stages to a suitable elevation.

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[2]Report entitled "Prediction of Ground Movement Parameters due to Longwall Mining During different Phases of Impoundments", prepared by Syd S. Peng and Thomas Du, Department of Mining Engineering, West Virginia University, May 2009.

3.2 Coal Refuse Production

Based on information provided by Mach Mining, the following annual production quantities, beginning with the first year of plant operation, were used in the design (see Calculations in Appendix B).

• Coarse Coal Refuse	Prior to longwall startup	34,330 cubic yards/year
	After longwall startup	2.53 million cubic yards/year
• Fine Coal Refuse	Prior to longwall startup	17,945 cubic yards/year
	After longwall startup	1.32 million cubic yards/year

4.0 SUBSURFACE EXPLORATION

4.1 Subsurface Exploration

During the month of February 2006, a subsurface exploration program consisting of drilling one soil boring (No. 8874) was conducted within the footprint of the proposed embankment. The intent of the program was to obtain soil samples to define the conditions and engineering characteristics relative to the construction and operation of the fine coal refuse slurry disposal impoundment. In addition to this soil boring, the results of a previous subsurface exploration program performed by Holcomb Foundation Engineering Co. (Holcomb) are presented in Appendix C and indicate the following:

- Sample number, type, standard penetration test blow counts, and depth;
- An overall description of the consistency, color and character of the soil; and,
- Indication of the observed groundwater level in the boreholes at the time of drilling.

The locations of the borings are depicted on Figure No. 2.

Generally, the soils encountered beneath the dam footprint consist of brown and gray silty clay with sand and pebbles. The thickness of the soil varied from 12.5' to 22.5' while the surface elevation for the borings varied from Elevation 438.5± to Elevation 473.0±. Each of the borings was terminated at the top of the bedrock.

Groundwater was encountered in two (2) of the seven (7) borings (i.e. Nos. 8293 and 8295). Following drilling, the depth from the ground surface to groundwater level varied from 10 to 13.5 feet or from Elevation 432.4± to Elevation 438.5± in the borings.

5.0 FIELD AND LABORATORY TESTING

5.1 Soil

Samples of the soils obtained during the subsurface exploration program from Boring No. 8874 were used for laboratory testing. The scope of the testing is discussed below and the results are presented in Appendix D.

Visual classification tests were performed by Holcomb on the split spoon samples obtained during drilling. Samples from the borings represent the foundation conditions for the proposed embankment. Additional testing performed on the borings included the following:

- Grain Size Analysis – Grain size analysis were performed on a sample from Boring No. 8874;
- Atterberg Limits Test – Atterberg Limits tests were performed on a sample from Boring No. 8874;
- Unit Weight Determination – Performed on a Shelby tube sample from Boring No. 8874; and,
- Shear Strength Test – A consolidated, undrained triaxial shear strength test with pore pressure measurements was performed on a Shelby tube sample from Boring No. 8874.

5.2 Coarse Coal Refuse

The proposed embankment shall be constructed with coarse coal refuse. The coarse coal refuse used to construct the embankment has been sampled from the Mach #1 Mine coal processing plant and has undergone laboratory testing. The scope of the testing is discussed below and results are presented in Appendix C.

- Grain Size Analysis – A grain size analysis was performed on the coarse coal refuse sample.
- Shear Strength Test – A consolidated, undrained triaxial shear strength test with pore pressure measurements was performed on re-molded samples of the coarse coal refuse. Material from the sample was re-molded to a density equivalent to approximately 95 percent of Standard Proctor maximum dry density.
- Permeability – A constant head permeability test was performed on a re-molded sample to determine the permeability characteristics of the coarse coal refuse for the embankment construction. The sample was compacted to approximately 95 percent of the Standard Proctor maximum dry density.
- Compaction Test – A Standard Proctor compaction test was performed on the coarse coal refuse sample.

5.3 Fine Coal Refuse

Two fine coal refuse bulk samples were obtained from the South Pond (Phase 2) for laboratory testing. The scope of the testing is discussed below and the results are presented in Appendix I [3] (under separate cover).

- Moisture Content – Moisture contents were performed on the two fine coal refuse samples.
- Grain-size Analysis – Grain size distribution analysis was performed on the two fine coal refuse samples (sieve and hydrometer).
- Atterburg Limits – Atterberg Limit tests were performed on the two fine coal refuse samples.

- Specific Gravity – Specific gravity tests were performed on the two fine coal refuse samples.
- Shear Strength – Six consolidated – undrained triaxial tests were run on remolded fine coal refuse samples. These six tests included moisture content and total and dry density determinations.

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5.3 Piezo-Seismic Cone Penetration Testing

- Fifteen piezo-seismic cone penetration soundings were performed at the Pond Creek site to measure tip stress, sleeve stress, pore water pressure, and shear wave velocities. The testing g was used to correlate index and strength parameters for the coarse coal refuse and foundation soil and for use in a deformation analysis.

- The testing data and results are presented in Appendix I (under separate cover).

6.0 COAL REFUSE DISPOSAL PLAN

The proposed plan provides disposal capacity for approximately 4 years of coarse and 7 years of fine coal refuse production. The plan has been developed in accordance with prudent engineering principles and practices and current Mine Safety and Health Administration (MSHA) design criteria for coal refuse disposal facilities. It is intended that the construction of the facility be monitored by experienced persons knowledgeable of the design, specifications and regulatory requirements.

A brief description of the disposal plan is as follows:

1. Sedimentation control for the construction of the embankment shall be provided by sedimentation ditches. Bench gutters and conveyance ditches shall be constructed to route the runoff from the embankment area to the sedimentation ditches.

2. Following topsoil removal, the Phase 3 embankment footprint shall be proofrolled and the Phase 3 embankment shall be constructed. Subsequently, the Phase 4 embankment footprint shall be proofrolled and Phase 4 embankment constructed followed by Phases 5, 6 and 7. Phase 6 shall be constructed using downstream construction techniques and Phase 7 shall raise the Phase 6 crest.

3. Fine coal refuse slurry may be pumped into the Phase 3 impoundment upon commencement of the construction of the Phase 4 embankment. The discharge line(s) shall be moved to result in a relatively uniform surface of fines throughout the impoundment and to minimize the depth of any water impounded directly against the

(3) GAI Consulting, Inc. report entitled " Response to MSHA Comment Nos. 1, 3, 7 and 8, Pond Creek Mine No. 1, Coal Refuse Disposal Facility No. 2, Phases 3 and 7, Impoundment ID No. 1211-IL08-03141-02, Williamson Energy LLC, Mach Mining Company, Williamson County, Illinois," prepared for Alliance Consulting, Inc., Project C090403.01, May 2009.

embankment slope. Generally, a delta of fine coal refuse shall be maintained along the embankment slope.

4. Operational pump(s) and discharge line(s) shall be maintained to remove clarified water and normal rainfall from the impoundment. The facility has been designed to store the runoff associated with a PMF design storm event. Decant pipes have been specified to evacuate the design storm runoff.

5. An internal drainage system located within the Phases 3, 5 and 6 embankments shall be installed to aid in controlling the phreatic level within the embankments.

6. Bench and road gutters shall be installed to control surface runoff and minimize erosion. All final surfaces shall be revegetated upon completion.

6.1 Phase 3

Prior to Phase 2 embankment construction, it will be necessary to initiate general site preparation activities to include topsoil removal and proof rolling. Soft areas encountered during the proof rolling shall be compacted or the material shall be removed and replaced with the same material as used in the Phase 3 embankment. Following proof rolling, the Phase 3 embankment shall be constructed using coarse coal refuse from the Mach #1 Mine coal preparation plant. The approximate location of the Phase 3 embankment is shown in plan and cross section on Figure Nos. 3 and 8, respectively, requires approximately 0.5 years of coarse coal refuse production to construct. Pertinent construction items include:

1. Coarse Coal Refuse Disposal – Phase 3 involves constructing an embankment 50 feet high to Elevation 500 using coarse coal refuse. As shown on Figure No. 8, the upstream slope of the embankment shall be constructed on a grade of 2.6H:1V and the downstream slope shall be on a grade of 3H:1V.

2. Fine Coal Refuse Disposal – Fine coal refuse slurry may be pumped into the impoundment upon the end of Phase 3 construction. Periodic relocation of the slurry discharge line shall be performed to promote a more uniform distribution of the fine coal refuse and to minimize the depth of clarified water impounded directly against the embankment slope.

3. Decant Pipe – Construction of the decant pipe shall be performed concurrent with the construction of the Phase 3 embankment. The installation includes excavating a trench into the embankment and placing an HDPE pipe and appurtenant structures (drop inlet, ditch, filter and drainage diaphragm and outlet drain). The drop inlet shall be extended vertically to Elevation 494.8 by adding the appropriate length of 18-inch diameter SDR 26 HPDE pipe to the HDPE elbow attached to the transport section of the decant pipe. The decant pipe shall be installed in accordance with the details presented on Figure No. 11.

4. Internal Drain - An internal drainage system consisting of a perforated pipe and gravel, both wrapped with filter fabric, shall be installed during the construction of Phase 3 to

aid in controlling the phreatic level within the embankment. The location and invert elevations for the internal drain are presented on Figure No. 3. Details pertaining to the drain construction are provided in the guideline technical specifications and on Figure No. 10.

5. Surface Drainage – Sedimentation/perimeter ditches shall be constructed as shown on Figure No. 3, to collect surface water and clarify the runoff before it is discharged into an existing channel. Ditch details are included on Figure Nos. 10, 11 and 12.

6. Instrumentation – Piezometer Nos. P-6, P-7, and P-8 shall be installed during Phase 3 construction at the locations shown on Figure No. 3. The proposed piezometer tip elevations are presented on Figure No. 15 and the piezometer installation detail is presented on Figure No. 13. Pressure transducers PN-1 and PN-2 (pneumatic piezometers or vibrating wire piezometers) and inclinometers I-1 and I-2 shall be installed in the Phase 3 embankment prior to undermining the phase. Their locations are shown on Figure No. 3. The proposed pressure transducer elevations are shown on Figure No. 16 and the installations details for the transducers and inclinometers are shown on Figure No. 13.

7. This impounding embankment of Phase 3 will be completed and slurry pumping into the impoundment will be completed before mining beneath the phase occurs. The Phase 3 impoundment will be capped before undermining occurs. Based on subsidence predictions, the internal drainage system for the embankment has been redesigned to continue to function post-subsidence. Any disruption of surface drainage features due to subsidence will be repaired. In the unlikely event embankment cracking and potential loss of slurry occurs during undermining of Phase 3, a contingency buttress and blanket drain have been designed as shown on Figure No. 13.

6.2 Phase 4

Phase 4, which is shown in plan and cross section on Figure Nos. 4 and 8, respectively, requires approximately 0.5 years of coarse coal refuse production to construct. Pertinent construction items include:

1. Embankment Construction – The Phase 4 embankment shall be situated approximately as shown on Figure No. 4 with an upstream toe at Elevation 446± and a final crest at Elevation 492. The embankment will require the placement of approximately 1.33 million cubic yards of coarse coal refuse. The material used for the embankment construction shall be compacted to 95 percent of Standard Proctor maximum dry density. The moisture content of the material shall be within -2 to +3 percent of the optimum moisture content. As indicted on Figure No. 8 the upstream and downstream slopes of the Phase 4 embankment shall be constructed on a grade of 3 (horizontal) to 1 (vertical).

2. Fine Coal Refuse Disposal – During construction of the Phase 4 embankment, the fine coal refuse slurry shall continue to be pumped into the Phase 2 and 3 impoundments.

3. Pump Installation – An operational pump, of sufficient capacity to remove clarified water and normal precipitation, and associated discharge lines shall be installed during construction of Phase 4. The pump shall discharge into Sediment Pond No. 6 and/or the Freshwater Pond.

Phase 4 is an intermediate phase in preparation for the construction of Phases 5, 6, and 7. No slurry will be pumped into Phase 4 and no internal drainage features are included in this phase. Undermining of Phase 4 will occur shortly after its construction. The embankment and pool area of this phase will be examined for subsidence cracks and repairs will be made as needed. It is anticipated that when slurry pumping begins in Phase 7 any undetected subsidence cracks in the Phase 4 embankment and foundation will be sealed by the slurry. This Phase will be buttressed to the south by Phase 3, which will be already completed and full of slurry; by Phase 6 to the east and west, which will be built post-subsidence; and by Phase 5 to the north, which will be also built post-subsidence.

7.3 Phase 5

Phase 5 will be built post-undermining. Prior to Phase 5 embankment construction, the Phase 5 cell shall be excavated and general site preparation activities including topsoil removal, subsidence crack sealing, and proof rolling. Soft areas encountered during the proof rolling shall be compacted or the material shall be removed and replaced with the same material as used in the Phase 5 embankment. Following subsidence crack sealing and proof rolling, the Phase 5 embankment shall be constructed using coarse coal refuse from the Mach #1 Mine preparation plant. The approximate location of the Phase 5 embankment is shown in plan and cross section on Figure Nos. 5 and 8, respectively, requires approximately 0.6 years of coarse coal refuse production to construct. Pertinent construction items include:

1. Coarse Coal Refuse Disposal – Phase 5 involves constructing an embankment 50 feet high to Elevation 488 using coarse coal refuse. The upstream slope of the embankment shall be constructed on a grade of 3H:1V and the downstream slope shall be on a grade of 3H:1V.

2. Fine Coal Refuse Disposal – Fine coal refuse slurry may be pumped into the impoundment throughout Phase 5 construction. The average settled fine coal refuse level is expected to rise to Elevation 432± by the completion of the phase. Periodic relocation of the slurry discharge line shall be performed to promote a more uniform distribution of the fine coal refuse and to minimize the depth of clarified water impounded directly against the embankment slope.

3. Internal drain – An internal drainage system consisting of either a geocomposite and perforated pipe or non-calcareous gravel wrapped with a geotextile and perforated pipe, shall be installed during the construction of Phase 5 to aid in controlling the phreatic level within the embankment. The location and invert elevations for the internal drain are presented on Figure No. 5. Details pertaining to the drain construction are provided in the guideline technical specifications and on Figure No. 10.

4. Surface Drainage – Bench gutters shall be constructed as shown on Figure No. 5, to collect and convey surface water runoff to the sediment ditches. Ditch details are presented on Figure No. 10, 11 and 12.

5. Instrumentation – Piezometer Nos. P-9, P-10 and P-11 shall be installed during Phase 5 construction at the locations shown on Figure No. 5. The proposed piezometer tip elevations are presented on Figure No. 14 and the piezometer installation detail is presented on Figure No. 13.

6. Decant Pipe – Construction of the decant pipe shall be performed concurrent with the construction of the Phase 5 embankment. The installation includes excavating a trench into the embankment and placing approximately 94 feet of HDPE pipe and appurtenant structures (drop inlet, ditch, filter and drainage diaphragm and outlet drain). The drop inlet shall be extended vertically to Elevation 480 by adding the appropriate length of 18-inch diameter SDR 26 HPDE pipe to the HDPE elbow attached to the transport section of the decant pipe. The decant pipe shall be installed in accordance with the details presented on Figure No. 11.

7. Subsidence Crack Repair – The Phase 5 pool area will be examined for cracking and any areas containing cracks will be excavated to a depth of at least four feet, proof rolled, and backfilled and sealed with compacted coarse coal refuse placed to the compaction standard in the Guideline Technical Specifications. In the event that extensive, deep cracking is discovered, a slurry trench or cutoff trench will be extended to bedrock through the affected areas. The trench will be located beneath the underdrain alignment for Stage 5. If it is discovered that a slurry or cutoff trench is needed, a specific design will be submitted for approval prior to its construction. Any additional cracks discovered after slurry pumping begins during Phase 5 will be sealed by directing the slurry into the pool over to the cracks.

Phase 5 will be buttressed to the south by Phase 4.

6.4 Phase 6

Phase 6 will be built post-mining and no slurry will be pumped into this phase. Phase 6, which is shown in plan and cross section on Figure Nos. 6 and 8, respectively, requires approximately 0.7 years of coarse coal refuse production to construct. Pertinent construction items include:

1. Coarse Coal Refuse Disposal – Phase 6 involves widening the Phase 4 embankment crest and downstream construction techniques. The upstream and downstream slopes of the embankment shall be constructed on a grade of 3H:1V.

2. Fine Coal Refuse Disposal – Fine coal refuse slurry shall continue to be pumped into the Phase 3/5 impoundment throughout Phase 6 construction. The average settled fine coal refuse level is expected to rise to Elevation 462± in Phase 5 by the completion of Phase 6. Periodic relocation of the slurry discharge line shall be performed to promote a more uniform distribution of the fine coal refuse and to

minimize the depth of clarified water impounded directly against the Phase 5 embankment slope.

3. Pump Installation – An operational pump, of sufficient capacity to remove clarified water and normal precipitation, and associated discharge lines shall be installed during construction of Phase 6. The pump shall discharge into Sediment Pond No. 6 and/or the Fresh Water Pond.

4. Internal drain – An internal drainage system consisting of either a geocomposite and perforated pipe or non-calcareous gravel wrapped with a geotextile and perforated pipe, shall be installed during the construction of Phase 6 to aid in controlling the phreatic level within the embankment. The location and invert elevations for the internal drain are presented on Figure No. 6. Details pertaining to the drain construction are provided in the guideline technical specifications and on Figure No. 10.

5. Surface Drainage – Sedimentation/perimeter ditches shall be constructed as shown on Figure No. 6, to collect surface water and clarify the runoff before it is discharged into an existing channel. Ditch details are included on Figure Nos. 10, 11 and 12.

6. Instrumentation – Piezometer Nos. P-12, P-13, P-15 and P-16 shall be installed during Phase 6 construction at the locations shown on Figure No. 6. The proposed piezometer tip elevations are presented on Figure Nos. 14 and 15 and the piezometer installation detail is presented on Figure No. 13.

7. Subsidence Crack Repair – Prior to construction of the Phase 6 embankment, the Phase 4 pool area, Phase 4 embankment, and Phase 6 foundation area will be examined for cracking and any areas containing cracks will be excavated to a depth of at least four feet, proof rolled, and backfilled and sealed with a compacted coarse coal refuse placed to the compaction standard in the Guideline Technical Specifications. In the event that extensive, deep cracking is discovered, a slurry trench or cutoff trench will be extended to bedrock through the affected areas. The trench will be located beneath the underdrain alignment for Stage 6. If it is discovered that a slurry or cutoff trench is needed, a specific design will be submitted for approval prior to its construction. Any additional cracks discovered after slurry pumping begins during Phase 6 will be sealed by directing the slurry into the pool over to the cracks. The Phase 4 embankment is the only embankment subject to subsidence cracking prior to slurry pumping. Any additional cracks discovered after slurry pumping begins during Phase 6 will be sealed by directing the slurry into the pool over to the cracks.

6.5 Phase 7

Phase 7, which is shown in plan and cross section on Figures No. 7 and on Figure 8, respectively, requires approximately 1.0 years of coarse coal refuse production to construct. Pertinent construction items include:

1. Coarse Coal Refuse Disposal – Phase 7 involves raising the Phase 6 embankment crest 46 feet to Elevation 538 using coarse coal refuse. Phase 7 will be constructed in three phases, A, B and C, to facilitate impacts by undermining. The upstream and downstream embankment slopes shall be constructed to 3H:1V. The final embankment slopes shall be soil covered and vegetated in accordance with the Illinois reclamation permit.

2. Fine Coal Refuse Disposal – Fine coal refuse slurry shall be pumped into the Phase 5 impoundment to maximum Elevation 480, at which time slurry shall begin to be pumped into the Phase 7 impoundment. The average settled fine coal refuse level is expected to rise to Elevation 464± by the completion of the Phase 7 embankment. Periodic relocation of the slurry discharge line shall be performed to promote a more uniform distribution of the fine coal refuse and to minimize the depth of clarified water impounded directly against the embankment slope.

3. Surface Drainage – Bench and access road gutters shall be constructed as shown on Figure No. 7, to control and convey surface water runoff. Ditch details are presented on Figure Nos. 10, 11 and 12.

4. Instrumentation – Piezometer Nos. P-14 and P-17 shall be installed, during Phase 7 construction at the locations shown on Figure No. 7. Piezometer extension and installation details are presented on Figure No. 13. The piezometer tip elevations are specified on Figure Nos. 14 and 15. Pressure transducers PN-3 and PN-4 will be installed after Phase 3 is capped but before Phase 7C is started at the locations shown on Figure No. 3. The proposed pressure transducer elevations are shown on Figure 16 and the installation details are shown on Figure No. 13.

5. Decant Pipe – Construction of the decant pipe shall be performed concurrent with the construction of the Phase 7 embankment. The installation includes excavating a trench into the embankment and placing approximately 190 feet of HDPE pipe and appurtenant structures (drop inlet, ditch, filter and drainage diaphragm and outlet drain). The drop inlet shall be extended vertically to Elevation 530 by adding the appropriate length of 18-inch diameter SDR 26 HPDE pipe to the HDPE elbow attached to the transport section of the decant pipe. The decant pipe shall be installed in accordance with the details presented on Figure No. 11.

Phase 7 will be built post-mining. Phase 7A will partially cap and consolidate the slurry in Phase 3. Phase 7B will provide a lining/buttress between the Phase 7 pool and the potentially cracked Phase 3 embankment (Phase 3 will be undermined after it has been pumped full of slurry). The remainder of Phase 7 will sit on top of the previously constructed Phases 4, 5, and 6. Phase 7C will finish covering and consolidating the slurry contained in the Phase 3 embankment. As previously stated, it is anticipated that the slurry will seal any undetected cracks not detected and repaired during Phases 4 and 6.

6.6 Abandonment Plan

An abandonment grading plan has been provided on Figure No. 22. Briefly, the impounding capability shall be eliminated by filling the impoundment with coarse coal refuse. The final embankment configuration shall be constructed to drain as per the lines and grades shown on Figure No. 22 and the entire site shall be soil covered and seeded in accordance with the Illinois reclamation permit. The plan shall be reevaluated prior to abandonment based on actual coal refuse production rates, existing site conditions and embankment configuration, and revised if necessary.

7.0 ENGINEERING ANALYSES

In support of the plan, engineering analyses included slope stability analyses and the hydrologic and hydraulic studies for the impoundment and surface drainage facilities. The calculations describing the design assumptions, methodology and results are included in Appendix B.

7.1 Hydrologic and Hydraulic Analyses

The proposed facility has been evaluated using storm criteria for high hazard dams. Upon the one-year anniversary and thereafter, the impoundment shall be capable of storing the runoff associated with a PMF design storm event plus three feet of freeboard.

Evacuation of the stored water shall be accomplished by pumping for Phases 4 and 6. The required pumping capacity (1901.8 gallons per minute for Phases 4 and 6) is based on storing the runoff associated with two design storm events and evacuating the runoff associated with one design storm event within a reasonable time period (approximately 30 days). Should the available storage capacity be reduced to one design storm event, the emergency pumps shall be mobilized to the site to evacuate the stored runoff and provisions shall be made so the pumps and associated discharge line are readily available, when needed.

Evacuation of the stored runoff shall be accomplished by means of a decant pipe for the Phases 3, 5 and 7 impoundments. The required pipe size, 18-inch SDR 26, is based on evacuating 90% of the runoff associated with one design storm event within 10 days. The surface drainage facilities, including road and bench gutters, and Ditches C through M have been sized to convey runoff associated with the 100-year, 6-hour recurrence interval storm event. The computed peak discharges were estimated using the computer program SedCad developed by the University of Kentucky. All permanent facilities have been designed with appropriate protection to minimize the potential for channel erosion. Details for the surface drainage facilities are presented on Figure Nos. 10, 11 and 12.

7.2 Slope Stability Analyses

Slope stability analyses have been performed for the upstream and downstream slopes of the Phases 3, 5 and 7 embankments using PCSTABL5, a computerized version of the modified Bishop Method of Slices, developed by Purdue University and the Indiana State Highway Commission. The critical potential failure surfaces, minimum factors of safety,



and material properties used in the slope stability analyses are presented on Figure Nos. 14, 15 and 16 and in the calculation brief.

Slope stability was analyzed for both static and seismic (pseudo static) loading conditions for the downstream and upstream embankment slopes. For the static analysis, effective properties for the coal refuse and existing soil were used. For the pseudo-static analysis, total stress properties were used for the existing soils. The use of effective stress properties for the coal refuse and total stress properties for the existing cohesive soils is appropriate, giving the effects of the sudden loading in an earthquake event and the relatively slow drainage characteristics of the soils. Also, for the pseudo-static analysis, a horizontal acceleration of 0.15g[4] was used. The phreatic level used in the stability analyses was conservatively based on top flow line calculations performed on a transformed section. The transformed section was based on the horizontal permeability of the embankment material being nine times greater than the vertical permeability. The engineering properties of the embankment material were based on laboratory test results and our experience with similar materials.

The most critical potential long-term failure surfaces, as shown on Figure Nos. 14, 15 and 16, are summarized below:

Stage	Case	Minimum Static F.S.	Minimum Seismic F.S.
Phase 3	Downstream	1.51	1.23
	Upstream	1.89	1.20
Phase 5	Downstream	1.50	1.26
	Upstream	1.76	1.32
Phase 7	Downstream	1.52	1.20
	Upstream	1.82	1.26
Phase 7C South Slope	Downstream	1.50	*

As indicated in the above table, the computed factors of safety meet the minimum requirements (1.5 and 1.2 for the static and seismic cases, respectively).

* A liquefaction susceptibility analysis for Phase 7C was performed using zero-strength to very low strength for the fine coal refuse to evaluate the post-earthquake factors of safety. Factors of safety range from 1.2 to 1.6 for shallow and deep failure circles, respectively. The possibility of liquefaction of the fine coal refuse in Phase 3 during mining subsidence related disturbance was evaluated using a driving shear stress slope stability analysis with zero strength for the fine coal refuse. Factors of safety for the Phase 3 embankment, in the upstream and downstream directions, were 2.2 and 1.3 respectively. The factor of safety against embankment cracking during mine subsidence was evaluated and estimated to be 1.1. These analyses are contained in Appendix I (under separate cover).

[4] National Earthquake Hazards Reduction Program, Part I, Provisions for the Development of Seismic Regulations for New Buildings, Map 1, 1991 Edition.

8.0 SUMMARY

The design plans for the proposed Mach #1 Mine Coal Refuse Disposal Facility No. 2 (Phases 3 through 7) are based on the subsurface exploration program, field and laboratory testing, and the engineering analyses described herein. The plan should provide disposal for approximately 3.3 years of coarse coal refuse and 5.8 years of fine coal refuse.

We trust that the plans, design calculations and guideline technical specifications described herein are acceptable to Mach Mining and the appropriate regulatory authorities. In preparing this document, our professional services have been performed with care and skill ordinarily exercised by reputable members of the profession practicing under similar conditions at the same time and the same or similar locality. No warranty, expressed or implied, is made by rendition of these consulting services or by furnishing oral or written reports of the findings made.

If there are any questions, or if further clarification is required, please contact us.

Respectfully submitted,

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Part 25

APPENDIX A

GUIDELINE TECHNICAL SPECIFICATIONS
ENGINEERING DESIGN PLAN
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
MACH #1 MINE
MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS
JOHNSON CITY, ILLINOIS

TABLE OF CONTENTS

	PAGE
INTRODUCTION	A-1
LIST OF DRAWINGS	A-2
1.0 SITE PREPARATION	A-3
1.01 General	A-3
1.02 Stripping and Topsoil Removal	A-3
1.03 Surface Sealing/Proofrolling	A-3
2.0 EMBANKMENT CONSTRUCTION	A-4
2.01 General	A-4
2.02 Coarse Coal Refuse Placement and Compaction	A-4
2.03 Survey Con trol	A-6
2.04 Subsurface Drains	A-6
2.05 Standpipe Piezometers	A-7
2.06 Pore Pressure Transducers	A-7
2.07 Inclinometers	A-9
2.08 Refu se Haul and Access Road Construction	A-9
2.09 Decant Installation	A-9
2.10 Pipe Installation	A-10
2.11 Drop Inlet	A-11
2.12 Trash Rack	A-11
2.13 Filter and Drainage Diaphragm	A-12
3.0 FINE COAL REFUSE DISPOSAL	A-12
3.01 General	A-12
3.02 Clarified Water Removal	A-13
4.0 SURFACE WATER DRAINAGE FACILITIES	A-13
4.01 General	A-13
4.02 Ditches C through M	A-13
4.03 Access Road Gutters	A-13
4.04 Rock Riprap	A-14
4.05 Uniform Section Mat	A-15
5.0 REVEGETATION OF COMPLETED AREAS	A-16

TABLE OF CONTENTS
(Continued)

6.0	MONITORING AND MAINTENANCE	A-16
	6.01 Piezo meters and Impoundment Level	A-16
	6.02 General Observations	A-17
	6.03 Phase 3 Enhanced Monitoring	A-17
	6.04 Subsidence Baselines	A-18
	6.05 Maint enance	A-18
	6.06 Data Review	A-19

APPENDIX A

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INTRODUCTION

These specifications are intended to serve as guidelines for the construction of the Pond Creek No. 1 Mine Coal Refuse Disposal Facility No. 2 to serve Mach Mining LLC's (Mach Mining) coal preparation plant in Williamson County, Illinois. The information contained herein, including the accompanying drawings which illustrate the disposal plan, is sufficiently detailed to provide Mach Mining with the technical guidance required to perform coal refuse disposal operations in a manner consistent with the design assumptions and sound engineering practice. These specifications are intended to be supplemented with periodic site visits by persons knowledgeable of the design in order to conduct inspections of the construction procedures, conduct field tests and, if necessary, obtain samples and perform laboratory testing.

The specifications have been prepared to aid Mach Mining in the design, planning, and construction of the specific project. Its scope is limited to the project and location described herein and represents our understanding of the significant aspects relevant to the planned operations. If there are any differences in location and/or design features, the modification should be reviewed to determine if revision of conclusions or recommendations is required.

This refuse disposal plan provides for the construction of a two embankments sharing a common side, utilizing coarse coal refuse to form an impoundment for the disposal of fine coal refuse slurry. The disposal plan for the facility will provide approximately 4 years of coarse and 7 years of fine coal refuse disposal capacity based on refuse production rates supplied by Mach Mining.

Briefly, the work items required in the coal refuse disposal plan include:

1. Site Preparation - In areas of embankment construction, the site preparation items include topsoil stripping and stockpiling and proofrolling/sealing. During the disposal operations, benching of each lift of material into existing slopes shall be required as well as scarifying previously compacted surfaces.

2. Embankment Construction - Coarse coal refuse embankments shall be constructed to provide disposal capacity for approximately 7 years of fine coal refuse.

3. Subsurface Drainage – An internal drainage system shall be installed in the Phases 5 and 6 embankment to aid in controlling the phreatic level.

4. Fine Coal Refuse Disposal – Upon commencement of Phase 4 construction, fine coal refuse slurry may be pumped into the Phase 3 impoundment. A water pumping system shall be used to remove excess clarified slurry water and precipitation from the impoundment.

5. Surface Drainage Facilities - To control and direct surface water runoff from the embankment and road ditches, Ditches C through M shall be constructed concurrent with construction operations.

6. Abandonment – An abandonment grading plan has been provided. The plan shall be re-evaluated prior to abandonment based on actual coal refuse production rates, existing site conditions and embankment configuration, and revised if necessary.

7. Revegetation - To control erosion and provide an acceptable post mining land use, all completed embankment surfaces shall be revegetated in accordance with Mach Mining Mine Permit.

8. Monitoring and Maintenance - A program of regular monitoring and maintenance of the disposal operations is described herein.

LIST OF DRAWINGS

The following drawings form a part of these specifications:

FIGURE NO.	DRAWING NO.	TITLE
1	B05-330-T2	Title Sheet
2	B05-330-M19	Plan – Existing Conditions
3	B05-330-M30	Plan – Phase 3
4	B05-330-M31	Plan – Phase 4
5	B05-330-M32	Plan – Phase 5
6	B05-330-M34	Plan – Phase 6
7	B05-330-M33	Plan – Phase 7

FIGURE NO.	DRAWING NO.	TITLE
8	B05-330-E13	Sections C-C, D-D and F-F
9	B05-330-E22	Section E-E
10	B05-330-E14	Details
11	B05-330-E24	Decant Installation and Uniform Section Mat Details
12	B05-330-E49	Ditch "F" Profile and Details
13	B05-330-E47	Instrumentation and Contingency Buttress Details
14	B05-330-E12	Slope Stability Analysis – Sections C-C and D-D
15	B05-330-E39	Slope Stability Analysis – Sections F-F and G-G
16	B05-330-E48	Slope Stability Analysis – Section F-F (Phase 7C)
17	B05-330-M36	Mining/Impoundment Construction Timing Map
18	B05-330-E46	Subsidence Effects Predictions Map
19	B05-330-M50	Mine Vertical Subsidence Predictions
20	B05-330-M51	Mine Subsidence Horizontal Strain Predictions
21	B05-330-M44	Subsidence Survey Panel No. 1 Section
22	B05-330-M20	Abandonment Plan

1.0 SITE PREPARATION

1.01 General

Beneath all areas of the coarse coal refuse embankment, site preparation shall be required.

1.02 Stripping and Topsoil Removal

Stripping and stockpiling of topsoil and root matter are required to provide an adequate foundation for facility construction. All topsoil shall be removed prior to embankment construction. The stripped topsoil shall be stockpiled.

1.03 Surface Sealing/Proofrolling

The footprint of the embankment shall be proofrolled following stripping and topsoil removal to seal and compact the foundation soils. A minimum of three passes shall be made over each area using a large sheepsfoot roller or rubber-tired equipment (i.e. loaded truck) to produce a minimum dry density equivalent to 95 percent of the maximum dry density attainable by the Standard Proctor method of compaction (ASTM D 698). Any soft or wet soils shall be removed to a minimum depth of 2 feet below the previously excavated surface and replaced with coarse coal refuse. The

over-excavated area shall be backfilled in 12-inch lifts, and compacted to 95 percent of the Standard Proctor maximum dry density (ASTM D 698).

Random in-place density testing shall be performed throughout the impoundment area to verify that the existing stripped surface is compacted to 95 percent of the Standard Proctor maximum dry density prior to fine coarse coal refuse slurry disposal.

If subsidence cracks are discovered in the pool or embankment foundation area of Phases 5 or 6, areas containing cracks will be excavated to a depth of at least four feet, proof rolled, and sealed with compacted coarse coal refuse placed to the compaction standards in Section 2.02 of these specifications.

2.0 EMBANKMENT CONSTRUCTION

2.01 General

To provide storage capacity for approximately 4 years of coarse and 7 years of fine coal refuse, 3 embankments shall be constructed of coarse coal refuse sharing a common side. Drawing Nos. B05-330-M30, -M31, -M32, -M33, -M34 and -E13 present the plans and section of the proposed embankment phases.

Sediment control shall be provided by the combination sediment/perimeter ditches. Conveyance ditches shall be constructed to convey surface runoff to the sediment/perimeter ditches.

2.02 Coarse Coal Refuse Placement and Compaction

a. Lines and Grades – Coarse coal refuse shall be placed to the lines and grades shown on the drawings for the various stages. Control for placement can be established from the coordinate system provided on the drawings.

b. Material: Run-of-plant coarse coal refuse from the coal preparation plant shall be used for the embankment construction. Placement and compaction of the refuse shall be in accordance with Sections 2.02.c and d.

c. Placement: Coarse coal refuse shall be spread in lifts not more than 1 foot thick when compacted. Material that is too wet to be properly compacted shall be spread

and graded to facilitate drainage. Upon drying to within the acceptable moisture content range, compaction shall proceed.

d. Compaction: The coarse coal refuse in the impounding embankment shall be spread in layers having a compacted thickness of 1 foot or less. The material shall be compacted by routing heavy equipment (dozers, trucks, etc.) over it or utilizing specialized compaction equipment to attain the specified degree of compaction. No special compaction procedures are anticipated to be required to provide resulting densities which are consistent with those used in the design. A field density testing program shall be conducted during the placement operations to determine the actual dry density being achieved.

Field density testing of the foundation soil and coarse coal refuse placed in the embankment areas shall be performed to confirm that the compactive effort employed is yielding an in-place dry density of at least 95 percent of the maximum density obtainable by the Standard Proctor Compaction Method (ASTM D 698). Density testing shall be performed at equivalent frequencies of one test per 2,000 cubic yards of material placed and compacted and at least one test for each lift. Locations, elevations and dates of the tests shall be recorded and maintained for documentation purposes. The moisture at time of compaction shall be within the range of optimum moisture by -2 percent to +3 percent. If in-place dry densities are observed to be less than that required, additional compaction shall be performed on the effective test area and the area retested. Such work shall continue until satisfactory results are obtained.

At least one Standard Proctor test of the material shall be verified for every 20 field density tests performed. Additionally, should mining or preparation plant operations change such that a change in refuse material properties is anticipated, the Proctor shall be verified.

e. Construction Procedures: The work surface shall be advanced upward in nearly horizontal layers. To minimize penetration of precipitation, the work surface shall be sloped to drain and backbladed as the material is spread. No fill shall be placed that is or on frozen material. If the surface where fill is to be placed is frozen, the frozen material shall be removed over an area where one day's refuse will be placed prior to placement of a new lift. The frozen material shall be stored until it is thawed and then replaced. Surface material in the impounding embankment too

wet to support construction equipment shall be removed to expose drier material prior to placement of the next refuse layer. After drying, these wet materials can be reused in the embankment. As the level of the embankment is raised, it shall be graded smoothly to the contours shown on the plans. Coarse coal refuse placement guidelines are contained in Appendix E.

2.03 Survey Control

Survey control shall include establishment of permanent monuments outside of, but adjacent to the refuse disposal facility and underground mining limits. This control shall be used for the management of day-to-day operations.

2.04 Subsurface Drains

a. General – To minimize the possible rise in the phreatic level as the impoundment level rises, internal underdrains shall be installed within the embankment. The drains shall consist of either a geocomposite drainage material or non-calcareous gravel both with an HDPE perforated pipe wrapped entirely with geotextile. The approximate alignment and elevations of the drains are indicated on Drawing Nos. B05-330-M30, -M32, -M34 and –E22. The underdrain details are presented on Drawing No. B05-330-E14.

b. Filter Fabric – The filter fabric shall be "Propex 4550" manufactured by Propex Fabrics, Inc., or an approved equivalent geotextile that is ultraviolet stabilized to resist deterioration. The filter fabric shall be protected from ultraviolet exposure during storage.

c. Pipe – The pipe used in the internal drain shall be a perforated high-density polyethylene pipe as specified on the individual phase drawings. The perforations shall be in accordance with the detail on Drawing No. B05-330-E14. The outlet pipes shall not be perforated.

d. Rock Gravel – Competent, durable, clean gravel in the size range of 3/8" to 1½" shall be used in the drains. The gravel shall consist of non-acid, non-toxic, non-calcareous rock that will not slake in water or degrade to soil material during the life of the facility, and which is free of coal, clay or other non-durable material.

e. Geocomposite – If a geocomposite drainage material is selected for the drain in lieu of the river gravel, the geocomposite shall be PermaNet HL, manufactured by GSE Lining Technologies, or equivalent. The geocomposite shall be entirely wrapped with filter fabric and shall be wrapped around the HDPE perforated collection/conveyance pipe. The geocomposite underdain detail is presented on Drawing No. B05-330-E14.

3. Installation – Details pertaining to the internal drains are presented on Drawing No. B05-330-E14. As shown on the drawing, the pipe shall be perforated with ½ - inch diameter holes and wrapped entirely with filter fabric with a minimum 2-foot overlap for Phase 3. For Phases 5 and 6, 3/8 – inch perforations may be used in lieu if wrapping the pipe with filter fabric. The drain shall be constructed to the dimensions shown on the drawing.

   The installation of the underdrains shall be monitored by the engineer responsible for certifying the construction of the embankment or by a qualified person designated by the engineer.

2.05 Standpipe Piezometers

Standpipe Piezometers shall be installed at the locations shown on the drawings and in accordance with the detail on Drawing No. B05-330-E47. Clean concrete sand may be substituted for the pea gravel if the latter is difficult to obtain. The perforated section of the piezometer pipe shall be wrapped with filter fabric. Bentonite seals shall be placed immediately above the perforated section and just below the ground surface to isolate the piezometer tip from potential perched water tables and minimize any influence associated with surface water.

2.06 Pore Pressure Transducers (Piezometers)

a. Installed in Embankment – Pore pressure transducers shall be installed at the locations shown on the Drawing No. B05-330-M30 and in accordance with the details on Drawing No. B05-330-M47 Either pneumatic or vibrating wire piezometers may be used. Bentonite seals shall be placed immediately above the filter zone and just below the ground surface to isolate the piezometer from potential perched water tables and to minimize any influence associated with

surface water. Alternately, the borehole may be completely backfilled above the sand filter with bentonite or bentonite-cement grout.

b. Installed in Slurry - Pneumatic piezometers enclosed in a push-in well point or vibrating wire push-in piezometers shall be installed at the locations shown on the Drawing No. B05-330-M30 and in accordance with the detail on Drawing No. B05-330-M47 Bentonite seals shall be placed in the borehole through the coarse coal refuse immediately above the slurry zone and just below the ground surface to isolate the piezometer from potential perched water tables and to minimize any influence associated with surface water. The remainder of the borehole shall backfilled above the slurry zone with bentonite or bentonite-cement grout.

c. Pneumatic piezometers shall meet the following requirements:

Sensor Type	Twin-tube pneumatic transducer
Range	180 psi, pressure rated for 400 psi
Resolution	0.01 psi
Accuracy	± 0.015% FS (digital gauge)
Repeatability	± 0.05 psi
Filter	Sintered stainless steel, 50 micron pores
Materials	ABS and PVC plastic body, synthetic rubber diaphragm
Diameter	~ 1 inch

d. Vibrating wire piezometers shall meet the following requirements:

Sensor Type	Pluck-wire vibrating wire sensor with built-in thermistor or RTD
Range	100 psi
Resolution	0.025%
Accuracy	0.1% FS
Maximum Pressure	150% of range
Filter	Sintered stainless steel, 50 micron pores
Temperature Coefficient	<0.04%FS per °C
Materials	Stainless steel
Dimensions	~ 0.75" x 7.75"

2.07 Inclinometers

Inclinometers shall be installed at the locations shown on Drawing No. B05-330-M30. The inclinometer casing shall be 85 mm (3.34 – inch) diameter QC or Standard Casing as manufactured by Durham Geo Slope Indicator, or equivalent. The inclinometer casing shall grouted into a borehole extending to bedrock as shown in the detail on Drawing No. B05-330-M47.

Casing grooves are to be aligned with the direction of expected ground movement (north-south and east-west). Casing shall be supported evenly during transportation and storage and kept out of direct until installation to prevent deformation.

The top of the inclinometer casings shall be accurately located in plan view and elevation by surveying after installation. The locations shall be resurveyed prior to each reading during periods of ground movement (i.e. before the longwall approaches within 100-foot of the east side of the Phase 3 embankment, during mining under the embankment, and for two weeks after longwall wall mining under the east side of the Embankment)

2.08 Refuse Haul and Access Road Construction

An access road shall be extended to refuse facility operations as shown on the drawings. Throughout construction, access roads on the refuse pile shall be constructed to provide routes for access to the impoundment. Variations of road width or grade shall be determined by Mach Mining based upon site-specific considerations. The locations of the roads may vary from the roads shown on the drawings provided the specified crest widths and embankment slope grades are maintained.

2.09 Decant Installation

a. General

To aid in maintaining a normal pool elevation in the impoundment and to provide a mechanism to evacuate stored storm runoff, a 18-inch outside diameter, SDR 26 high density polyethylene (HDPE) decant pipe shall be installed at the elevations shown on Drawing No. B05-330-E13 where it shall discharge into a surface drainage ditch.

b. Decant Pipe

The pipe used for decant construction shall be 18-inch outside diameter, SDR 26 HDPE pipe (average inside diameter of 1.38 feet). The pipe joints shall be welded (fused) all around and pressure tested. Pressures used for the testing shall be for the maximum anticipated static water head of approximately 13 feet or approximately 6 pounds per square inch (psi) measured at the outlet end of the pipe. The pipe shall be tested prior to backfilling to facilitate repair or rewelding. End caps used for the pressure testing shall be welded sufficiently to withstand the test pressures. A pressure relief valve and pressure gauge shall be mounted on the downstream end of the pipe. The pipe shall maintain the constant test pressure for a minimum time period of 2 hours. No leakage is recommended, so extreme care shall be taken to account for any water added to or discharged from the pipe to maintain the specified test pressures. Records of the testing shall be maintained. Safety precautions for conducting the pressure testing shall be in accordance with current MSHA and Occupational Safety and Health Administration (OSHA) guidelines.

2.10 Pipe Installation

a. General - The decant pipe shall be installed on an adequate foundation in a manner to minimize differential settlement and excessive seepage along the outside of the pipe. All pipe installation shall be supervised by qualified personnel familiar with the intent of the design and knowledge of proper installation procedures.

b. Alignment - The pipe shall be placed in a trench excavated into the embankment at locations shown on Drawings No. B05-330-M30, -M32 and -M33 as determined by the engineer. Compacted fill used to level the pipe subgrade and form the bedding shall be a minimum of 6 inches thick, but shall not exceed approximately 2 feet beneath the pipe invert. Compaction shall be achieved in accordance with the detail presented on Drawing No. B05-330-E24 and Section 2.08e of these specifications. The decant drop inlet shall extended vertically from the upstream end of the pipe to the elevations shown on Drawing No. B05-330-E13.

c. Foundation Preparation - A 4-foot wide (minimum) trench shall be excavated at a location, determined by the Engineer, as per the detail presented on Drawing No. B05-330-E24. The trench shall be excavated 2 feet (minimum) below the final pipe invert. The backfill envelope shall be placed, as per the details shown on Drawing No. B05-330-E24 and in accordance with these specifications.

d. Pipe Connections - To provide a water-tight seal, the joints shall be welded (fused) sufficiently to withstand the design internal water pressure (6 psi, minimum) without leakage.

e. Backfilling - The backfill envelope, as shown on Drawing No. B05-330-E24, shall be raised uniformly on both sides of the pipe in 6-inch thick layers (8-inch thick loose lifts) and compacted to a density greater than or equal to 100 percent Standard Proctor maximum dry density (ASTM D 698) within -2 to +3 percent of the optimum water content. The bedding material shall be shaped to embed the 18-inch HDPE a minimum of 4 inches. One field density test (minimum) shall be performed for every 200 cubic yards of backfill placed and compacted with at least one test per lift.

f. Materials for Backfill - Materials used for backfilling shall consist of coarse coal refuse, free of any particles larger than 3 inches in any dimension.

2.11 Drop Inlet

a. General - To facilitate the installation of the trash rack and to prevent fines from entering the decant pipe, a drop inlet fabricated out of a 18-inch diameter SDR 26 HDPE 90 degree elbow shall be used. The elbow shall be fuse welded to the decant transport section and to the drop inlet riser.

b. Riser- The riser used to extend the drop inlet shall be 18-inch outside diameter, SDR 26 HDPE pipe, flange fitted at one end to facilitate connection to the trash rack. The riser connections shall be in accordance with the manufacturer's recommendations.

2.12 Trash Rack

a. General - To prevent large particles from entering and possibly clogging the decant pipe, a trash rack design has been provided. The trash rack shall be bolted to the riser pipe and can be removed for extension of the decant pipe. The trash rack may be fabricated with readily available parts.

b. Material - Materials required for the trash rack include 1 inch by 1 inch by 1/8-inch angle irons, No. 4 rebar, and 1/8-inch thick steel plate. Details are shown on Drawing No. B05-330-E24. The trash rack shall be flange fitted and bolted to the riser flange.

c. Paint - The trash rack shall be protected with rust-resistant paint after fabrication. The trash rack shall be inspected periodically and any damage repaired accordingly.

2.13 Filter and Drainage Diaphragm

a. General - A filter diaphragm shall be installed, as shown in plan and in detail on Drawing No. B05-330-E24, to minimize internal erosion (piping) along the outside of the decant pipe.

b. Material - The diaphragm shall be constructed of hard, durable, non-calcareous aggregate within the following gradation range and wrapped entirely in "Propex 4550" filter fabric or an equivalent approved by the Engineer.

Sieve Size	Percent Finer
3-inch	100
1-1/2-inch	84 to 100
3/4-inch	36 to 100
3/8-inch	6 to 100
No. 4	0 to 52
No. 10	0 to 10
No. 20	0 to 9
No. 40	0 to 8
No. 60	0 to 7
No. 140	0 to 6
No. 200	0 to 5

c. Filter and Drainage Diaphragm Outlet Drain - To convey seepage collected by the filter and drainage diaphragm to a surface drainage ditch, an outlet drain shall be constructed in accordance with the detail presented on Drawing No. B05-330-E24.

3.0 FINE COAL REFUSE DISPOSAL

3.01 General

Following disposal of the fine coal refuse in the Phase 2 impoundment to maximum Elevation 496, fine coal refuse shall be disposed in the Phase 3 impoundment. The slurry line(s) shall be periodically moved along the slope of the impoundment to maintain a relatively uniform fines level within the impoundment. Discharge shall initiate on the impoundment bottom and continue on fine coal refuse beaches as the slurry settles. In no case shall direct discharge onto embankment slopes be allowed.

3.02 Clarified Water Removal

Clarified water from the slurry impoundment shall be removed by a pumping system and directed into the proposed perimeter ditch system or to the coal preparation plant. The water level in the impoundment shall be maintained as low as practicable.

4.0 SURFACE WATER DRAINAGE FACILITIES

4.01 General

A system of sediment/perimeter ditches, access road gutters, bench gutters, and conveyance ditches shall be constructed to control surface runoff and minimize erosion. All runoff collected from the embankment area will be directed toward proposed sediment/perimeter ditches located at the toe of the Phases 5 and 7 embankment slopes. The conveyance ditches convey the flow from the embankment benches to the sediment/perimeter ditches.

4.02 Ditches C through M

To convey runoff from the embankment and slopes to the sediment/perimeter ditches, Ditches C through M, shall be constructed. The ditch locations are shown on the plan view Drawing Nos. B05-330-M20, -M30, -M32, -M33, and –M34 and the construction details are presented on Drawing Nos. B05-330-E14, -E24, and -E49. The final ditches shall be lined with the erosion protection specified on Drawing No. B05-330-E14. Temporary ditches shall be maintained around the base of the slopes. Any erosion damage sustained shall be immediately repaired.

4.03 Access Road Gutters

Surface runoff intercepted by access roads shall be kept off the road surface and in gutters on the uphill side. The roadway shall slope toward the gutter with the gutter approximately the same gradient as the access road. Permanent gutters shall be provided at abandonment with erosion protection (riprap) as shown in detail on Drawing No. B05-330-E14.

4.04 Rock Riprap

Where rock riprap protection is required in ditches and gutters because of high flow velocity, the riprap must have the following characteristics:

a. Material - Riprap shall be hard, durable cobbles and boulders of sandstone or limestone in the sizes specified on the details.

b. Size Gradation - Riprap size shall be predominantly in the range specified on the drawings. Smaller stones and cobbles shall be used to fill the voids between larger pieces.

c. Subgrade Preparation - The riprap subgrade shall be well compacted before riprap is placed. A layer of "Propex 4550" filter fabric, or approved equivalent, shall be placed on the subgrade prior to the riprap placement.

d. Riprap Placement - Riprap shall be spread to the thickness required in a single lift.

e. Grouted Riprap – The grout shall be a sand-concrete mixture, proportioned to result in a minimum 28-day compressive strength of 2000 pounds per square inch (psi). The stones shall be thoroughly moistened and any excess fines shall be sluiced to the underside of the stone blanket before grouting. The grout may be delivered to the site by any means that will assure uniformity and prevent segregation of the particles. The grout shall be vibrated by mechanical means to achieve grout penetration. If pressure grouting is used, care shall be taken to avoid unseating the stones. Penetration of the grout into the rock riprap shall be at least 12 inches. For a smooth surface, grout shall fill the void spaces to within ½-inch of the surface. Weep holes shall be provided through the blanket. A weep hole detail is presented on Drawing No. B05-330-E24.

Curing and Protection - The completed finished surface shall be prevented from drying for a minimum curing period of 7 days following placement. Exposed surfaces shall be maintained in a moist condition continuously for the 7-day curing period or until curing compound has been applied as specified in this

section. Moisture shall be maintained by sprinkling, fog spraying or by covering with continuously moistened canvas, cloth mats, straw, sand, or other approved material. Water or moist covering shall be used to protect the grout during the curing process without causing damage to the grout surface by erosion or other mechanisms that may cause physical damage.

The grouted rock may be coated with an approved curing compound as an alternative method to maintaining a continuous moisture condition during the curing period. The compound shall be sprayed on the moist grout surface as soon as free water has disappeared and all surface finishing has been completed. The compound shall be applied at a minimum uniform rate of 1 gallon per 175 square feet of surface and shall form a continuous adherent membrane over the entire surface. Curing compound shall not be applied to surfaces requiring bond to subsequently placed grout and/or concrete. If the membrane is damaged during the curing period, the damaged area shall be re-sprayed at the rate of application specified for the original treatment.

Grout mix shall be placed when the temperature is above 35 degrees Fahrenheit and rising and shall be protected from freezing. Grout mix shall not be placed on a frozen surface. After grouting is completed, no weight shall be placed on the grouted riprap until the grout has cured properly.

4.05 Uniform Section Mat

a. Material - In lieu of riprap, 4-inch thick Armorform®, or equivalent, uniform section mat may be used. The mat shall be keyed 18 inches (minimum) along both edges of the ditch and at the upstream end of each section. The mat shall be underlain with Propex 4550 filter fabric and installed in accordance with the manufacturer's recommendations. Weep holes shall be provided at 15-foot elevation intervals and anchor bolts shall be installed on the spacing shown on Drawing No. B05-330- E24.
b. Grout - The grout shall be a pumpable fine aggregate concrete (structural grout) proportioned to result in a minimum 28-day compressive strength of 3000

pounds per square inch (psi). A pozzolan grade fly ash may be substituted for up to 35 percent of the cement. Fine aggregate concrete consistency should be in the 9 – 11 second range when passed through the ¾ - inch orifice of the standard flow cone described in ASTM C-939-93. Tests utilizing a concrete slump cone are not appropriate. The grouted mat shall be protected from freezing and damage as described in Section 4.04.f above.

5.0 REVEGETATION OF COMPLETED AREAS

Revegetation of coarse coal refuse slopes can be accomplished by placing a cover of natural soil or other materials capable of supporting vegetation and subsequent planting to establish a continuous stand of vegetation. Soil cover and vegetation shall be in accordance with the Illinois reclamation permit.

6.0 MONITORING AND MAINTENANCE

6.01 Piezometers and Impoundment Level

Except as required by Section 6.03 below, water level readings from the piezometers and the impoundment level shall be recorded at 7-day intervals and compared to the levels used in the design. The standpipe piezometers shall be flushed on an annual basis to ensure they are functioning properly. Should the piezometers become damaged during operations, they shall be repaired or replaced. Maximum piezometer water levels used in the design of the embankments are shown in tables on Drawing Nos. B05-330-E12, -E39, and –E48. The piezometer levels in the tables are based on estimated maximum allowable phreatic surface to maintain a slope stability factor of safety of 1.5 for the static condition and 1.2 for seismic loading. Exceedance of the tabulated values does not necessarily mean that the slope stability has been reduced to unacceptable levels. It does mean that maximum anticipated phreatic level has been exceeded and that action in the form of reevaluation of the slope stability, reduction of the amount of water in the impoundment, reduction in the rate of embankment construction, installation of additional piezometers, or other remedial measures may be needed.

6.02 General Observations

Observations of the embankment and its appurtenant structures shall be made at 7-day intervals and immediately following any unusual events such as floods, heavy rainfalls, abnormal structural behavior, etc. Any unusual features shall be reported immediately to the engineer responsible for certifying the construction.

a. Embankment Slopes - Any irregularities such as scarps, wet areas, or vegetation disturbance shall be recorded.

b. Working Disposal Surface - Irregularities shall be recorded.

c. Access Road Gutters and Discharge Channels - General condition of channels, soil erosion adjacent to or beneath riprap and seeded slopes, blockage by debris, etc. shall be noted.

d. Pumps, Spillway Pipes and Underdrain Outlets – General condition of the discharge facilities and that they are not blocked and are functioning properly. Underdrain discharges shall be measured or estimated.

e. Vicinity of the Embankment - General conditions throughout the area of the embankment shall be observed to note any changes which could be associated with the behavior of the embankment and its foundation. During and post-longwall mining Particular attention should be paid to the predicted areas of high surface strain for the Phase 3 and Phase 4 embankments when the longwall mining passes beneath them. Horizontal strain and vertical subsidence predictions are shown on Drawing Nos. B05-330-M50 and –M51. Embankment deformation, cracking, and pore pressure buildup are of particular concern.

6.03 Phase 3 Enhanced Monitoring

a. Pore Pressure Transducers (pneumatic or vibrating wire) and Inclinometers will be installed in the Phase 3 embankment after the phase is capped with coarse coal refuse but prior to Phase 7C construction or longwall undermining under Phase 3.

b. Monitoring Frequency – Phase 3 instruments and general observations will be made twice daily beginning when the longwall face is within 100 feet of the eastern perimeter of the Phase 3 embankment and ending two weeks after the longwall face passes under its western end.

If post-subsidence instrumentation monitoring and inspection results indicate that Phase 3 embankment/impoundment distress is not a concern, i.e., no adverse cracking, seepage, excess pore pressure or deformation, then general observations and instrumentation readings for Phase 3 shall be conducted twice weekly for two additional months. If, after the two months of additional monitoring, no adverse pore pressures or embankment performance factors exist, monitoring may then revert to a 7-day basis until the site is reclassified as a non-impounding embankment or is abandoned.

If embankment distress such as excessive seepage, elevated pore pressures, excessive deformation or cracking is evident, remedial measures will be initiated and the inspection and instrumentation reading frequency will be decreased to eight hours until stable conditions are achieved. The construction of the Contingency Buttress shown on Drawing No. B05-330-E47 will be implemented.

c. Abandonment of Instrumentation – The pneumatic piezometers and the inclinometers may be left in place but considered abandoned and auxiliary to the approved plan starting two months after Phase 7C is completed - provided that no adverse conditions exists at the Phase 3 and Phase 7C embankments.

6.04 Subsidence Baselines - Subsidence baselines "A" through "H" shall be monitored as described in Appendix F.

6.05 Maintenance

The following maintenance shall be performed regularly:

a. Routine Maintenance - Maintenance, including replacement or patching of grouted riprap, regrading temporary bench and haul road gutters, backfilling of erosion rills and gullies, removal of debris from the ditches at the site, etc. shall be performed.

b. Maintenance After Unusual Meteorological Events (Heavy Precipitation Events and Floods). - The most important maintenance tasks at these times are the timely backfilling of all erosion scarps and slumps and the repair and improvement of drainage systems and riprap.

c. Maintenance After Abnormal Changes in the Behavior of the Structure - If abnormal behavior of any portion of the embankment is observed, qualified persons knowledgeable of the facility design characteristics shall be advised immediately and any recommended maintenance measures undertaken.

6.04 Data Review

All facility performance data and data obtained during periodic inspections and maintenance shall be reviewed by qualified persons knowledgeable of the facility construction and disposal requirements, including the design recommendations presented in these documents.

8114-10
Part 26

APPENDIX B

Calculation Brief

APPENDIX B

CALCULATION BRIEF
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
MACH #1 MINE
MACH MINING LLC
WILLIAMSON COUNTY, ILLINOIS

TABLE OF CONTENTS

TOPIC	PAGE
Production Rates	1
Staging Calculations	1-6
Storm Excavation Pump Activation Level and Pump Capacity Calculations	7-14
Volumes	15-29
Decant Pipe	30-35
Trash Rack	36
Freeboard Calculations	37-41
Filter Drainage Diaphragm Design	42-44
Filter Drainage Diaphragm Outlet Drain Design	45-46
Armorform Ditch Lining Tractive Force Calculations	47-58a
Armorform Ditch Lining Anchorage Calculations	58b-58i
Underdrain Design and Subsidence Effects Calculations	59-91
Structural Design and Underdrain Pipes	92-97
Horizontal Strain Due to Subsidence Calculations	98
Piping and Cracking Potential of Foundation Soil and Coarse Coal Refuse Due to Subsidence Calculations	99-119
Slope Stability Analysis	120-231z
Pillar Stability	232-234
Subsidence Baseline Survey Station Spacing	234a
Surface Drainage Ditch Calculations	235-368
Surface Drainage Design	369-383

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BY: [illegible] DATE: 1/31/08 CHKD BY: [illegible] DATE: 4/8/08

PROJECT NAME: Williamson Energy

PROJECT NO. B05-330-1413 SHEET ____ OF ____

DESCRIPTION Staging Calcs.

R16946

Production Rates:

Prior to 3-18-08 (long wall start up)

(From Mash Mining)

599598 Tons / 9 months Total refuse

= 66622 Tons / month

$CCR = \frac{66622}{5} \times 4 = 53297 \times 2000 \div 115 \div 27 = 34330\ yd^3/mon$

$FCR = \frac{66622}{5} \times 1 = 13324 \times 2000 \div 55 \div 27 = 17945\ yd^3/mon$

After 3-1-08

$CCR = 2.53 \times 10^6\ yd^3$

$FCR = 1.32 \times 10^6\ yd^3$

Phase 2

Time to complete embankment

Vol of Emb = $584047\ yd^3$

$584047 - 234277\ yd^3$ (2007 prod.) $= 349770\ yd^3$

$(349770 - 68660) \div 2.53 \times 10^6 =$ 0.11 yrs or 4-27-08

Fines life of Phase 2 imp.

Imp Vol = $1035338\ yd^3$ (max Fines from approved Plan.)

$1035338 - 122463$ (2007 prod) $= (912875 - 35890) \div 1.32 \times 10^6$

= 0.66 yrs or 11-15-08

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BY: [illegible] DATE: 1/31/08 CHKD BY: BWM RLF DATE: 4/8/08 (2) 11/4/09

PROJECT NAME: Williamson Energy

PROJECT NO. BOS-330-1413 SHEET ____ OF ____

DESCRIPTION Staging Calcs.

11/3/09 REVISED

Phase 3

Embankment built to mirror Ph 2 to the north. Ph 3 will be abandoned before Ph 6 or Ph 7 begin so it is being designed with a ½ PMF design storm.

Time to build Embankment:

Emb Vol = 1.18×10^6 yd^3

$1.18 \times 10^6 \div 2.53 \times 10^6 =$ 0.47 yrs or ~~10-16-08~~ ACTUAL COMPLETED DATE 9-17-08

Fines life of Ph 3 imp.

max Fines level

Design Storm Vol: $(20.5 (\frac{1}{2}) 31.9 \times 43560) \div 27 = 87919$ yd^3

$500 - 3 = 497 = 13.21 \times 10^5$ yd^3 $- 87919 = 1.23 \times 10^6$ yd^3

490	10.2
494.88	12.3 — Max Fines level = 494.88
500	14.5

life = $12.3 \times 10^5 \div 1.32 \times 10^6 =$ 0.93 yrs or 10-21-09

Phase 4

Time to build Emb

Vol of Emb = 1.33×10^6 yd^3

$1.33 \times 10^6 \div 2.53 \times 10^6 =$ 0.53 yrs or 3-28-09

No fines are to be pumped into Ph 4

The water level will be maintained to a minimum by pumps.

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SUMMERSVILLE, WV (304) 883-2360
CANONSBURG, PA (724) 745-3630

BY: BWM DATE: 11-3-09 CHKD BY: RLF DATE: 11/4/09 (3)
PROJECT NAME: WILLIAMSON ENERGY
PROJECT NO. 805-330-1413 SHEET ____ OF ____
DESCRIPTION STAGING CALCS (REVISED PHASE 5)

11/3/09 REVISED

PHASE 5

TIME TO BUILD EMBANKMENT

EMBANKMENT VOLUME = $1.166 \times 10^6 \text{ yd}^3$

$1.166 \times 10^6 \text{ yd}^3 \div 2.53 \times 10^6 = 0.46$ YRS OR 11-26-09

FINES LIFE OF PHASE 5

MAX. FINES LEVEL:

DRAINAGE AREA = 48.4 AC DESIGN STORM = 1 PMF (41 INCHES)

$$41 \text{ IN} \times 48.4 \text{ AC} \times \frac{1 \text{ FT}}{12 \text{ IN}} \times \frac{43,560 \text{ FT}^2}{\text{AC}} \times \frac{1 \text{ C.Y.}}{27 \text{ FT}^3} = 266,792 \text{ yd}^3$$

CREST EL 488 - 3' (FB) = 485

VOL @ 485 = 1 PMF VOL $\Rightarrow 2.70 \times 10^6 - 266,792 = 2.43 \times 10^6 \text{ yd}^3$

EL	VOL $\times 10^6$
480	2.40
X	2.43
485	2.70

$X = 480.50$ = MAX. FINES LEVEL

FINES LIFE = $2.43 \times 10^6 \div 1.32 \times 10^6 = 1.84$ YRS OR 8-23-11

PHASE 6

TIME TO BUILD EMBANKMENT

EMBANKMENT VOLUME = $1.72 \times 10^6 \text{ yd}^3$

$1.72 \times 10^6 \div 2.53 \times 10^6 = 0.7$ YRS OR 8-08-10

NO FINES WILL BE PUMPED INTO THE PHASE 6 IMPOUNDMENT.

Phase 7

Time to build

Vol of Emb = 2.52×10^6 yd^3

$2.52 \times 10^6 \div 2.53 \times 10^6$ = 1.0 yrs or 8-8-11

Ph 7 max Fines

Drainage Area to Phase 7 imp = 67 AC

Design Storm = 1 pmf

$(41(4/12) + 67 \times 43560) \div 27 = 369319$ yd^3

538 - 3 = 535 = 4.84×10^6 yd^3

530	4.43
535	4.84
538	5.09

$4.84 \times 10^6 - 369319 = 4.47 \times 10^6$ = 530.48

Life = $4.47 \times 10^6 \div 1.32 \times 10^6$ = 3.4 yrs or 1-17-15

Fines Elevations at specific Times during Construction:

Fines elev at end of Phase 2 construction

Ph 2 emb = 0.11 yrs

$(0.11 \times 1.32 \times 10^6) + 122463 + 35890 = 303553$ yd^3

257313	472
303553	473.7 = El of Fines in Ph 2 imp @ completion of Ph 2 emb.
311912	474

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BY: JLH DATE: 1/31/08 CHKD BY: JSWM DATE: 4/8/08

PROJECT NAME: Williamson Energy

PROJECT NO. R05-330-1413 SHEET ____ OF ____

DESCRIPTION Staging Calcs

R16950

Fines elev at end of Ph3 construction (Ph 2 imp)

Elev @ beginning of Ph3 = 473.7

Time to build Ph3 = 0.47 yrs

$1.32 \times 10^6 \times 0.47 = 620400$

473.7 = 303553 + 620400 = 923953

886585 492

923953 493.02 = El of Fines in Ph 2 imp at end of

959994 494 Ph3 construction.

Phase 4

Fines pumped into Ph 2 and 3 imp.

Ph 2 max Fines = 496 = 1035338 yd^3

At Ph3 end 1035338 - 923953 = 111385 yd^3 remain in 2

Time to build Ph 4 = 0.53 yrs

$.53 \times 1.32 \times 10^6 = 699600\ yd^3$

$699600 - 111385 = 588215\ yd^3$

3.14 470

5.88 478.3 = el of Fines in Ph 3 imp at end of

6.45 480 Ph 4 construction

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BY: JLH DATE: 1-31-08 CHKD BY: BWM RHE DATE: 4/8/08 11/4/09 (6) R10951

PROJECT NAME: Williamson Energy

PROJECT NO. 305-330-1413 SHEET ____ OF ____

DESCRIPTION Staging Calcs

11/3/2009 REVISED

Phase 5

Fines Pumped into Phase 3 imp and Ph 5 cell.

@ beginning of Phase Fines = 478.3 in Ph 3 imp = 5.88×10^5

Time to build Ph 5:

$0.66 \text{ yrs} \times 1.32 \times 10^6 = 871{,}200 \text{ yd}^3$

Ph 3 max Fines = 494.88 = 12.3×10^5

$12.3 \times 10^5 - 5.88 \times 10^5 - 871{,}200 = 229{,}200 \text{ yd}^3$ pumped into Ph 5 cell

1.31×10^5	430	
2.29×10^5	X = 432.8	= El of Fines in Ph 5 cell @ end of Ph 5 construction.
3.05×10^5	435	

Phase 6

Fines pumped into Ph 5 throughout construction.

At Beg. Fines = 432.8 = 2.29×10^5 in Ph 5 imp

Time to build Ph 6 = $0.7 \text{ yrs} \times 1.32 \times 10^6 = 924000 \text{ yd}^3$

$2.29 \times 10^5 + 924000 = 1.15 \times 10^6 \text{ yd}^3$

1.11	455	
1.15	455.8	= El of Fines in Ph 5 cell @ end of Ph 6
1.35	460	Construction

Phase 7

Fines Pumped into the Ph 5 and 7 imp.

Beg. @ 455.8 in Ph 5 imp = $1.15 \times 10^6 \text{ yd}^3$

Time to build Ph 7 emb = $1.0 \text{ yrs} \times 1.32 \times 10^6 = 1.32 \times 10^6$

$1.15 \times 10^6 + 1.32 \times 10^6 = 2.47 \times 10^6$, Max Fines of Ph 5 = 480.65 or 2.43×10^6

$2.47 \times 10^6 - 2.43 \times 10^6 = 40{,}000 \text{ yd}^3$ into Ph 7 imp

1.32	450	
4.00	451.7	El of Fines in Ph 7 imp @ end of Ph 7 const.
4.42	452	

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BY: MOB DATE: 3-20-08 CHKD BY: [illegible] DATE: 4/8/08 R16952

PROJECT NAME: Williamson Energy

PROJECT NO. BOS-330-1413 SHEET ____ OF ____

DESCRIPTION Storm Evacuation Pump activation Level

Phase 4 & 6

→ Crest Elev. = 492

* Most critical time is when phase 6 reaches the phase 4 crest.

→ Drainage Area = 73.8 AC

: Maximum slurry level prior to this point is:

→ 2 PMF vols = $\left[\frac{(41\ (\text{pmf rainfall})(1/12)(73.8)(43560))}{27}\right] \times 2 = 813604$ CY

492 - 3' (freeboard) = 489 vol @ 489 = 1.70×10^6

$1.70 \times 10^6 - 813604 = 8.86 \times 10^5$

EL	VOL
470	7.46×10^5
X	8.86×10^5
480	1.22×10^6

$\Rightarrow X = 472.95$ = Max Fins level until phase 6 reaches 492

Pump Activation Level

→ 489 - 1 Storm Volume

$1.70 \times 10^6 - 406802 = 1.29 \times 10^6$

EL	VOL
480	1.22×10^6
X	1.29×10^6
490	1.75×10^6

$\Rightarrow X = 481.32$ = Pump activation level for phase 4 crest

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BY: MOB DATE: 3-20-08 CHKD BY: TMM DATE: 4-08-08

PROJECT NAME: Williamson Energy

PROJECT NO. 805-330-1013 SHEET ____ OF ____

DESCRIPTION Storm Evacuation Pump Capacity

6953

Purpose: To determine the evacuation pump capacity for the phase 4 Impoundment.

Phase 4 & 6

∴ Worst case is when phase 6 reaches the phase 4 crest. (Elev. 492)

→ PMF Storm:

$41\left(\frac{1}{12}\right)(73.8) \times 43560 = 1.09837 \times 10^7 \text{ ft}^3$

$1.09837 \times 10^7 \times 7.48 \text{ gal/ft}^3 = 8.21577 \times 10^7 \text{ gal.}$

$30 \text{ days} \times 24 \text{ hrs} \times 60 \text{ min} = 43200 \text{ mins}$

$\frac{8.21577 \times 10^7 \text{ gal}}{43200 \text{ mins}} = 1901.8 \text{ gpm}$

* A pumping system with the capacity to transfer a minimum of 1901.8 gallons per minute shall be used.

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BY: MDB DATE: 4/1/03 CHKD BY: [illegible] DATE: 4-8-03 R16954

PROJECT NAME: Williamson Energy

PROJECT NO. B05-330-1413 SHEET 1 OF 2

DESCRIPTION Storm Evacuation Pump activation level

Phase 7:

→ Crest Elev. = 510

→ Drainage Area = 81.4 Ac.

∴ Maximum slurry level prior to this point is:

→ 2 PMF Vols. = $\left[\frac{(41\ (\text{Conf rainfall})\ (1/12)(81.4)(43560)}{27}\right] \times 2 = 897390$ cy

510 - 3' (Recovered) = 507 Vol @ 507 = 2.78×10^6 cy

$2.78 \times 10^6 - 897390 = 1.88 \times 10^6$

EL	VOL
490	1.75×10
X	1.88×10^6
500	2.33×10^6

⇒ X = 492.24 = Max Flow level until phase 7 reaches 510

∴ Pump Activation level:

→ 507 - 1 Storm Volume

$2.78 \times 10^6 - 449195 = 2.33 \times 10^6$

EL	VOL
500	2.33×10^6
X	2.33×10^6
510	2.97×10^6

⇒ X = 500

Pump Activation level for phase 7 evacuation must be below elevation 510.

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BY: MDB DATE: 4/1/08 CHKD BY: [illegible] DATE: 4-08-08 R16955

PROJECT NAME: Williamson Energy

PROJECT NO. 805-330-1413 SHEET ____ OF ____

DESCRIPTION Storm Evacuation Pump Capacity

Purpose: To determine the evacuation pump capacity for Phase 7 construction at elevation 510.

Phase 7

∴ Worst case is when construction reaches elevation 510

→ PMF Storm:

$$41\left(\tfrac{1}{12}\right)(81.4) \times 43560 = 1.21148 \times 10^7 \text{ ft}^3$$

$$1.21148 \times 10^7 \times 7.48 \text{ gal/ft}^3 = 9.06184 \times 10^7 \text{ gal.}$$

$$30 \text{ days} \times 24 \text{ hrs} \times 60 \text{ min} = 43200 \text{ mins}$$

$$\frac{9.06184 \times 10^7 \text{ gal}}{43200 \text{ mins}} = 2097.65 \text{ gpm}$$

* A pumping system with the capacity to transfer a minimum of 2097.65 gallons per minute shall be used.

Phase 7:

→ Crest Elev. = 500

→ Drainage Area = 86.7 Ac.

∴ Maximum Slurry level prior to this point is:

→ 2 PMF Vols. = $\left[\frac{(4)(\text{PMF Rainfall})(\frac{1}{12})(86.7)(43560)}{27}\right] \times 2 = 955819$ cy

500 − 3' (freeboard) = 497 vol @ 497 = 2.156×10^6 cy

$2.156 \times 10^6 - 955819 = 1.2 \times 10^6$

EL	VOL
470	7.46×10^5
X	1.2×10^6
480	1.22×10^6

$\Rightarrow X = 479.58$ = Max Fines level until Phase 7 reaches 500

∴ Pump Activation level:

→ 497 − 1 storm Volume

$2.156 \times 10^6 - 477919 = 1.678 \times 10^6$

EL	VOL
480	1.22×10^6
X	1.678×10^6
490	1.75×10^6

$\Rightarrow X = 488.64$ = Pump Activation level for phase 7 construction must occur before elevation 500.

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BY: MDB DATE: 4/9/08 CHKD BY: BTM DATE: 4/9/08

PROJECT NAME: Williamson Energy

PROJECT NO. 805-330-1413 SHEET ____ OF ____

DESCRIPTION Storm Evacuation Pump Capacity.

R16957

Purpose: To determine the elevation pump capacity for Phase 7 construction at elevation 500.

Phase 7

∴ Worst case is when construction reaches elevation 500

→ PMF Storm:

$41\ (1/12)\ (86.7) \times 43560 = 1.29036 \times 10^7\ ft^3$

$1.29036 \times 10^7 \times 7.48\ gal/ft^3 = 9.65186 \times 10^7\ gal.$

30 days × 24 hrs × 60 min = 43200 mins

$$\frac{9.65186 \times 10^7\ gal}{43200\ min} = 2234.23\ gpm$$

* A pumping system with the capacity to transfer a minimum of 2234.23 gallons per minute shall be used.

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BY: MDB DATE: 3/24/08 CHKD BY: [illegible] DATE: 4/8/08 R16958
PROJECT NAME: Williamson Energy
PROJECT NO. B05-330-1413 SHEET ____ OF ____
DESCRIPTION Storm Evacuation Pump Activation Level

Phase 7:

→ Crest EL. = 528

* Most critical time is when elevation of phase 7 construction is at maximum before installation of Decant Pipe.

→ Drainage Area = 71.3 Ac

Maximum slurry level prior to this point is:

→ 2 PMF vols. = $\left[\frac{(41\ (\text{pmf rainfall})\ (1/12)(71.3)(43560)}{27}\right] \times 2 = 786043$ cy

528 − 3' (freeboard) = 525 vol @ 525 = 4.05×10^6

$4.05 \times 10^6 - 786043 = 3.26 \times 10^6$

EL	VOL
510	2.97×10^6
x	3.26×10^6
520	3.67×10^6

⇒ 514.14 = Max fines level until Phase 7 reaches 528

Pump Activation Level

→ 525 − 1 Storm Volume

$4.05 \times 10^6 - 393022 = 3.65 \times 10^6$

EL	VOL
510	2.97×10^6
x	3.65×10^6
520	3.67×10^6

⇒ x = 519.71 = Pump Activation level for phase 7 construction [illegible] more before decant pipe installation

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engineers · Constructors · Scientists

BY: MDB DATE: 4/1/08 CHKD BY: [illegible] DATE: 4-08-08 R16959

PROJECT NAME: Williamson Energy

PROJECT NO. BOS-330-1013 SHEET ____ OF ____

DESCRIPTION Storm Evacuation Pump Capacities

Purpose: To determine the evacuation pump capacity for the Phase 7 Impoundment.

Phase 7:

∴ Worst case is when elevation of phase 7 construction is at maximum before installation of decant pipe. (Elev 528)

→ PMF Storm:

$$41\left(\tfrac{1}{12}\right)(71.3) \times 435600 = 1.06116 \times 10^7 \text{ ft}^3$$

$$1.06116 \times 10^7 \times 7.48 \text{ gal/ft}^3 = 7.93746 \times 10^7 \text{ gal.}$$

$$30 \text{ days} \times 24 \text{ hrs} \times 60 \text{ min} = 43200 \text{ mins.}$$

$$\frac{7.93746 \times 10^7 \text{ gal}}{43200 \text{ min}} = 1837.4 \text{ gpm}$$

∴ A pumping system with the capacity to transfer a minimum of 1837.4 gallons per minute shall be used.

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY PHASE 3 IMP VOL

SCALE: 1

CALCS. BY: JLH 10-22-07

CHECKED BY: MDB

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
452	1727.00	1.73E+03				0.00E+00	0.00E+00
			7.15E+03	2	1.43E+04		
454	12582.00	1.26E+04				1.43E+04	5.30E+02
			2.95E+04	2	5.90E+04		
456	46388.00	4.64E+04				7.33E+04	2.71E+03
			1.15E+05	2	2.29E+05		
458	182827.00	1.83E+05				3.02E+05	1.12E+04
			3.48E+05	2	6.97E+05		
460	514147.00	5.14E+05				9.99E+05	3.70E+04
			6.12E+05	2	1.22E+06		
462	710347.00	7.10E+05				2.22E+06	8.24E+04
			7.35E+05	2	1.47E+06		
464	758662.00	7.59E+05				3.69E+06	1.37E+05
			7.71E+05	2	1.54E+06		
466	783329.00	7.83E+05				5.23E+06	1.94E+05
			7.96E+05	2	1.59E+06		
468	807685.00	8.08E+05				6.83E+06	2.53E+05
			8.20E+05	2	1.64E+06		
470	832117.00	8.32E+05				8.47E+06	3.14E+05
			8.95E+05	10	8.95E+06		
480	957207.00	9.57E+05				1.74E+07	6.45E+05
			1.02E+06	10	1.02E+07		
490	1087747.00	1.09E+06				2.76E+07	1.02E+06
			1.16E+06	10	1.16E+07		
500	1223733.00	1.22E+06				3.92E+07	1.45E+06

R16960

Alliance Consulting, Inc.
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VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY PHASE 4 EMB VOL

SCALE: 1

CALCS. BY: JLH 10-22-07

CHECKED BY: MDB

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
444	26965.00	2.70E+04				0.00E+00	0.00E+00
			1.25E+05	2	2.50E+05		
446	222931.00	2.23E+05				2.50E+05	9.26E+03
			4.36E+05	2	8.73E+05		
448	649798.00	6.50E+05				1.12E+06	4.16E+04
			7.37E+05	2	1.47E+06		
450	823513.00	8.24E+05				2.60E+06	9.61E+04
			8.93E+05	2	1.79E+06		
452	962794.00	9.63E+05				4.38E+06	1.62E+05
			1.03E+06	2	2.05E+06		
454	1087982.00	1.09E+06				6.43E+06	2.38E+05
			1.09E+06	2	2.17E+06		
456	1085414.00	1.09E+06				8.61E+06	3.19E+05
			1.07E+06	2	2.14E+06		
458	1055127.00	1.06E+06				1.07E+07	3.98E+05
			1.04E+06	2	2.08E+06		
460	1024374.00	1.02E+06				1.28E+07	4.75E+05
			1.01E+06	2	2.02E+06		
462	995317.00	9.95E+05				1.48E+07	5.50E+05
			9.81E+05	2	1.96E+06		
464	966870.00	9.67E+05				1.68E+07	6.23E+05
			9.51E+05	2	1.90E+06		
466	934862.00	9.35E+05				1.87E+07	6.93E+05
			9.14E+05	2	1.83E+06		
468	893583.00	8.94E+05				2.05E+07	7.61E+05
			8.73E+05	2	1.75E+06		
470	852054.00	8.52E+05				2.23E+07	8.25E+05
			7.46E+05	10	7.46E+06		
480	640656.00	6.41E+05				2.97E+07	1.10E+06
			5.32E+05	10	5.32E+06		
490	423007.00	4.23E+05				3.51E+07	1.30E+06
			4.01E+05	2	8.02E+05		
492	378726.00	3.79E+05				3.59E+07	1.33E+06

(17)

R16961

Alliance Consulting, Inc.
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VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY (PHASE 5)
EMB. VOLS

SCALE: 1

CALCS. BY: BWM 11-04-09

CHECKED BY: CAD

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
436	8,117	8.12E+03				0.00E+00	0.00E+00
			3.70E+04	2	7.40E+04		
438	65,894	6.59E+04				7.40E+04	2.74E+03
			1.52E+05	2	3.03E+05		
440	237,202	2.37E+05				3.77E+05	1.40E+04
			4.05E+05	2	8.09E+05		
442	572,057	5.72E+05				1.19E+06	4.39E+04
			8.45E+05	2	1.69E+06		
444	1,118,526	1.12E+06				2.88E+06	1.07E+05
			1.23E+06	1	1.23E+06		
445	1,351,072	1.35E+06				4.11E+06	1.52E+05
			1.30E+06	0	0.00E+00		
445	1,250,920	1.25E+06				4.11E+06	1.52E+05
			1.28E+06	1	1.28E+06		
446	1,310,776	1.31E+06				5.39E+06	2.00E+05
			1.34E+06	4	5.36E+06		
450	1,368,975	1.37E+06				1.08E+07	3.98E+05
			1.31E+06	5	6.55E+06		
455	1,249,069	1.25E+06				1.73E+07	6.41E+05
			1.19E+06	5	5.94E+06		
460	1,127,319	1.13E+06				2.32E+07	8.61E+05
			1.07E+06	5	5.33E+06		
465	1,003,768	1.00E+06				2.86E+07	1.06E+06
			9.41E+05	5	4.71E+06		
470	878,628	8.79E+05				3.33E+07	1.23E+06
			8.15E+05	5	4.08E+06		
475	751,474	7.51E+05				3.73E+07	1.38E+06

REVISED 11/4/09

18 R18962

480	622,199	6.22E+05	6.87E+05	5	3.43E+06	4.08E+07	1.51E+06
485	491,443	4.91E+05	5.57E+05	5	2.78E+06	4.36E+07	1.61E+06
488	412,125	4.12E+05	4.52E+05	3	1.36E+06	4.49E+07	1.66E+06

REVISED 11/4/09

19

RN6963

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VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY (PHASE 5)
IMP. VOLS

SCALE: 1

CALCS. BY: BWM 11-04-09

CHECKED BY: CAD

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
426	863,976	8.64E+05				0.00E+00	0.00E+00
			8.87E+05	4	3.55E+06		
430	909,372	9.09E+05				3.55E+06	1.31E+05
			9.39E+05	5	4.69E+06		
435	967,748	9.68E+05				8.24E+06	3.05E+05
			9.98E+05	5	4.99E+06		
440	1,027,935	1.03E+06				1.32E+07	4.90E+05
			1.06E+06	5	5.29E+06		
445	1,089,935	1.09E+06				1.85E+07	6.86E+05
			1.12E+06	5	5.61E+06		
450	1,153,746	1.15E+06				2.41E+07	8.94E+05
			1.19E+06	5	5.93E+06		
455	1,219,370	1.22E+06				3.01E+07	1.11E+06
			1.25E+06	5	6.27E+06		
460	1,286,743	1.29E+06				3.63E+07	1.35E+06
			1.32E+06	5	6.61E+06		
465	1,355,821	1.36E+06				4.29E+07	1.59E+06
			1.39E+06	5	6.96E+06		
470	1,426,605	1.43E+06				4.99E+07	1.85E+06
			1.46E+06	5	7.31E+06		
475	1,499,093	1.50E+06				5.72E+07	2.12E+06
			1.54E+06	5	7.68E+06		
480	1,573,288	1.57E+06				6.49E+07	2.40E+06
			1.61E+06	5	8.06E+06		

Revised 11/4/09

20 RT6964

485	1,649,305	1.65E+06	1.67E+06	3	5.02E+06	7.29E+07	2.70E+06	
488	1,695,545	1.70E+06				7.80E+07	2.89E+06	

REVISED 11/4/09

27

RT6965

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VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY PHASE 6 EMB VOL

SCALE: 1

CALCS. BY: JLH 10-22-07

CHECKED BY: MOB

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
440	20548.00	2.05E+04				0.00E+00	0.00E+00
			3.93E+05	10	3.93E+06		
450	765316.00	7.65E+05				3.93E+06	1.46E+05
			8.77E+05	10	8.77E+06		
460	988066.00	9.88E+05				1.27E+07	4.70E+05
			9.98E+05	10	9.98E+06		
470	1008580.00	1.01E+06				2.27E+07	8.40E+05
			1.02E+06	10	1.02E+07		
480	1027914.00	1.03E+06				3.29E+07	1.22E+06
			1.04E+06	8	8.28E+06		
488	1043059.00	1.04E+06				4.11E+07	1.52E+06
			1.20E+06	0	0.00E+00		
488	1350082.00	1.35E+06				4.11E+07	1.52E+06
			1.34E+06	2	2.68E+06		
490	1330975.00	1.33E+06				4.38E+07	1.62E+06
			1.32E+06	2	2.64E+06		
492	1311871.00	1.31E+06				4.65E+07	1.72E+06

R16966

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VOLUME COMPUTATIONS

PROJECT NO.: B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY PHASE 7 EMB VOL

SCALE: 1

CALCS. BY: JLH 10-22-07

CHECKED BY: MDB

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
492	1689957.00	1.69E+06				0.00E+00	0.00E+00
			1.91E+06	8	1.53E+07		
500	2130161.00	2.13E+06				1.53E+07	5.66E+05
			1.93E+06	10	1.93E+07		
510	1739771.00	1.74E+06				3.46E+07	1.28E+06
			1.54E+06	10	1.54E+07		
520	1349290.00	1.35E+06				5.01E+07	1.85E+06
			1.15E+06	10	1.15E+07		
530	958717.00	9.59E+05				6.16E+07	2.28E+06
			8.02E+05	8	6.42E+06		
538	646196.00	6.46E+05				6.80E+07	2.52E+06

R16967

Alliance Consulting, Inc.
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VOLUME COMPUTATIONS

PROJECT NO : B05-330-1413

PROJECT NAME: WILLIAMSON ENERGY PHASE 7 IMP VOL

SCALE: 1

CALCS. BY: JLH 10-22-07

CHECKED BY: MDB

ELEV. (FT)	PLANIM. READING	AREA (SQ.FT.)	AVG AREA (SQ.FT.)	CHANGE IN EL.	VOL. (CU.FT.)	CUM. VOL. (CU.FT.)	CUM VOL.(CU.YD.)
448	59575.00	5.96E+04				0.00E+00	0.00E+00
			1.78E+05	2	3.56E+05		
450	295995.00	2.96E+05				3.56E+05	1.32E+04
			4.18E+05	2	8.36E+05		
452	540498.00	5.40E+05				1.19E+06	4.42E+04
			6.73E+05	2	1.35E+06		
454	805935.00	8.06E+05				2.54E+06	9.40E+04
			9.18E+05	2	1.84E+06		
456	1030203.00	1.03E+06				4.37E+06	1.62E+05
			1.05E+06	2	2.09E+06		
458	1062845.00	1.06E+06				6.47E+06	2.40E+05
			1.08E+06	2	2.15E+06		
460	1087807.00	1.09E+06				8.62E+06	3.19E+05
			1.15E+06	10	1.15E+07		
470	1216944.00	1.22E+06				2.01E+07	7.46E+05
			1.29E+06	10	1.29E+07		
480	1353294.00	1.35E+06				3.30E+07	1.22E+06
			1.43E+06	10	1.43E+07		
490	1496858.00	1.50E+06				4.72E+07	1.75E+06
			1.57E+06	10	1.57E+07		
500	1647636.00	1.65E+06				6.30E+07	2.33E+06
			1.73E+06	10	1.73E+07		
510	1805627.00	1.81E+06				8.02E+07	2.97E+06
			1.89E+06	10	1.89E+07		
520	1970832.00	1.97E+06				9.91E+07	3.67E+06
			2.06E+06	10	2.06E+07		
530	2143251.00	2.14E+06				1.20E+08	4.43E+06
			2.21E+06	8	1.77E+07		
538	2286379.00	2.29E+06				1.37E+08	5.09E+06

TAGE 7B EMBANKMENT VOLUME

R16969

olume Report 2/21/2008 12:18

o ring Grid: //Aci-acad/caddrawings/05330/7B-7C MERGED.grd
and Grid: //Aci-acad/caddrawings/05330/7B-7C PROPOSED EMB.grd
rid corner locations: 357504.45,426355.33 to 360456.45,427963.33
rid resolution X: 492, Y: 268 Grid cell size X: 6.00, Y: 6.00
rea in Cut : 382.3 S.F., 0.01 Acres
rea in Fill: 428,616.4 S.F., 9.84 Acres
otal inclusion area: 428,998.6 S.F., 9.85 Acres
ut to Fill ratio: 0.00
verage Cut Depth: 0.11 Average Fill Depth: 14.51
ax Cut Depth: 0.52 Max Fill Depth: 22.85
ut (C.Y.) / Area (acres): 0.16
ill (C.Y.) / Area (acres): 23389.91
ut volume: 41.8 C.F., 1.55 C.Y.
ill volume: 6,219,569.8 C.F., 230,354.44 C.Y.

one 453.19 to 460.00
u olume : 38.8 C.F., 1.44 C.Y.
i volume: 348,025.6 C.F., 12,889.84 C.Y.
unning total:
ut volume : 38.8 C.F., 1.44 C.Y.
ill volume: 348,025.6 C.F., 12,889.84 C.Y.

one 460.00 to 470.00
ut volume : 1.3 C.F., 0.05 C.Y.
ill volume: 740,644.0 C.F., 27,431.26 C.Y.
unning total:
ut volume : 40.1 C.F., 1.49 C.Y.
ill volume: 1,088,669.6 C.F., 40,321.10 C.Y.

one 470.00 to 480.00
ut volume : 1.6 C.F., 0.06 C.Y.
ill volume: 755,968.6 C.F., 27,998.84 C.Y.
unning total:
ut volume : 41.8 C.F., 1.55 C.Y.
ill volume: 1,844,638.2 C.F., 68,319.93 C.Y.

one 480.00 to 490.00
volume : 1.2 C.F., 0.04 C.Y.
volume: 739,011.0 C.F., 27,370.78 C.Y.
nning total:
lume : 43.0 C.F., 1.59 C.Y.
ll volume: 2,583,649.3 C.F., 95,690.71 C.Y.

one 490.00 to 500.00
ut volume : 1.2 C.F., 0.05 C.Y.
ll volume: 718,441.7 C.F., 26,608.95 C.Y.
unning total:
ut volume : 44.2 C.F., 1.64 C.Y.
ll volume: 3,302,091.0 C.F., 122,299.67 C.Y.

ne 500.00 to 510.00
t volume : 0.7 C.F., 0.02 C.Y.
ll volume: 723,597.6 C.F., 26,799.91 C.Y.
nning total:
t volume : 44.9 C.F., 1.66 C.Y.
ll volume: 4,025,688.6 C.F., 149,099.58 C.Y.

ne 510.00 to 520.00
t volume : 0.9 C.F., 0.03 C.Y.
ll volume: 755,277.5 C.F., 27,973.24 C.Y.
nning total:
volume : 45.8 C.F., 1.70 C.Y.
volume: 4,780,966.1 C.F., 177,072.82 C.Y.

.0.00 to 530.00

ill volume: 786,986.3 C.F., 29,147.64 C.Y.
unning total:
ut volume : 47.1 C.F., 1.74 C.Y.
ill volume: 5,567,952.4 C.F., 206,220.46 C.Y.

530.00 to 540.00
olume : 1.4 C.F., 0.05 C.Y.
ill volume: 651,624.1 C.F., 24,134.23 C.Y.
unning total:
ut volume : 48.5 C.F., 1.80 C.Y.
ill volume: 6,219,576.5 C.F., 230,354.69 C.Y.

TAGE 7C EMBANKMENT VOLUME

R16972

me Report 2/21/2008 11:38

ring Grid: //Aci-acad/caddrawings/05330/7B-7C MERGED.grd
and Grid: //Aci-acad/caddrawings/05330/7B-7C PROPOSED EMB.grd
rid corner locations: 357504.45,426355.33 to 360456.45,427963.33
rid resolution X: 492, Y: 268 Grid cell size X: 6.00, Y: 6.00
rea in Cut : 27.4 S.F., 0.00 Acres
rea in Fill: 942,917.1 S.F., 21.65 Acres
otal inclusion area: 942,944.5 S.F., 21.65 Acres
ut to Fill ratio: 0.00
verage Cut Depth: 0.07 Average Fill Depth: 25.05
ax Cut Depth: 0.44 Max Fill Depth: 38.00
ut (C.Y.) / Area (acres): 0.00
ill (C.Y.) / Area (acres): 40417.06
ut volume: 1.9 C.F., 0.07 C.Y.
ill volume: 23,622,547.1 C.F., 874,909.15 C.Y.

R16973

olumes by elevation zone 2/21/2008 11:39

o 500.00 to 510.00
ut volume : 1.3 C.F., 0.05 C.Y.
ill volume: 6,851,079.0 C.F., 253,743.67 C.Y.
unning total:
ut volume : 1.3 C.F., 0.05 C.Y.
ill volume: 6,851,079.0 C.F., 253,743.67 C.Y.

one 510.00 to 520.00
ut volume : 0.0 C.F., 0.00 C.Y.
ill volume: 6,292,799.0 C.F., 233,066.63 C.Y.
unning total:
ut volume : 1.3 C.F., 0.05 C.Y.
ill volume: 13,143,878.0 C.F., 486,810.30 C.Y.

one 520.00 to 530.00
ut volume : 0.0 C.F., 0.00 C.Y.
ill volume: 5,899,045.6 C.F., 218,483.17 C.Y.
unning total:
ut volume : 1.3 C.F., 0.05 C.Y.
ill volume: 19,042,923.7 C.F., 705,293.47 C.Y.

530.00 to 538.00
volume : 0.0 C.F., 0.00 C.Y.
olume: 4,578,137.9 C.F., 169,560.66 C.Y.
g total:
ut volume : 1.3 C.F., 0.05 C.Y.
ll volume: 23,621,061.6 C.F., 874,854.13 C.Y.

Alliance Consulting, Inc.
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R16974

PIPE FLOW CALCULATIONS

PROJECT NAME: WILLIAMSON ENERGY

PROJECT NO.: B05-330-1413

DESCRIPTION: PHASE 3

CALC. BY: MDB 4/2/08

CHECKED BY: [illegible] 4-08-08

WEIR FLOW Q=C(3.14)DH^1.5
C=3.22+0.44(H/P)

REF. MSHA MANUAL, PAGE 6.136

INLET DIAMETER(D)=	1.38	FEET
WEIR HEIGHT(P)=	1	FEET
INLET EL.=	494.8	

ORIFICE FLOW Q=CA(2GH)^0.5

REF. HANDBOOK OF CONCRETE CULVERT PIPE HYDRAULICS, PORTLAND CEMENT ASSOCIATION, PAGE 70

DISCHARGE COEFFICIENT(C)=	0.6	
ORIFICE DIAMETER	1.38	FEET
AREA(A)=	1.50	SQ. FT.
ORIFICE CONTROL ELEV.	493	

PRESSURE FLOW Q=AV
V=(2GH/F(L/D)+K+1)^0.5
F=185(N^2/D^.33)

REF. MSHA MANUAL, PAGE 6.154

MANNING'S N=	0.012	
PIPE LENGTH(L)=	98	FEET
ENERGY LOSSES(K)=	2.5	
OUTLET EL.=	482	
PIPE DIA. =	1.38	FEET

ELEVATION	HEAD, FT.	Q.CFS		
		WEIR	ORIFICE	PRESSURE
494.8	0	0.00	10.18	18.83
495	0.2	1.28	10.68	18.98
495.6	0.8	11.08	12.05	19.41
496	1.2	21.36	12.88	19.70
497	2.2	59.25	14.76	20.39

PROJECT NAME: WILLIAMSON ENERGY

CALC. BY: MDB

PROJECT NUMBER: B05-330-1413

CHECKED BY: [illegible]

DESCRIPTION: PHASE 3

TOTAL STORED VOLUME: 2.37 (FT^3 X 10^6)

ELEV.	CUM. VOLUME (FT.^3 X 10^6)	DISCHARGE (CFS)	TIME (HRS)	CUM. TIME (HRS)	CUM. TIME (DAYS)
494.8	33.16	0		165.58	6.90
			104.17		
495	33.4	1.28		61.41	2.56
			31.01		
495.6	34.09	11.08		30.39	1.27
			10.90		
496	34.56	12.88		19.50	0.81
			19.50		
497	35.53	14.76		0.00	0.00

VOLUME BELOW DECANT = 33.16 (FT^3 X 10^6)

10% VOLUME = 0.237 (FT^3 X 10^6)

10% LEVEL

ELEV.	VOLUME (FT.^3 X 10^6)
494.8	33.16
495.00	33.397
495.6	34.09

90% EVACUATION

ELEV	TIME,DAYS
494.8	6.9
495.00	5.47
495.6	1.27

PIPE FLOW CALCULATIONS

PROJECT NAME: WILLIAMSON

PROJECT NO.: B05-330-1413

DESCRIPTION: PHASE 5

CALC. BY: JLH 12/20/06

CHECKED BY: RF 12/20/06

WEIR FLOW Q=C(3.14)DH^1.5
C=3.22+0.44(H/P)

REF. MSHA MANUAL, PAGE 6.136

INLET DIAMETER(D)= 1.38 FEET
WEIR HEIGHT(P)= 1 FEET
INLET EL.= 480

ORIFICE FLOW Q=CA(2GH)^0.5

REF. HANDBOOK OF CONCRETE CULVERT PIPE HYDRAULICS, PORTLAND CEMENT ASSOCIATION, PAGE 70

DISCHARGE COEFFICIENT(C)= 0.6
ORIFICE DIAMETER 1.38 FEET
AREA(A)= 1.50 SQ. FT.
ORIFICE CONTROL ELEV. 478.00

PRESSURE FLOW Q=AV
V=(2GH/F(L/D)+K+1)^0.5
F=185(N^2/D^.33)

REF. MSHA MANUAL, PAGE 6.154

MANNING'S N= 0.012
PIPE LENGTH(L)= 100 FEET
ENERGY LOSSES(K)= 2.5
OUTLET EL.= 472.7
PIPE DIA. = 1.38 FEET

ELEVATION	HEAD, FT.	Q.CFS		
		WEIR	ORIFICE	PRESSURE
480	0	0.00	10.18	14.18
480.85	0.85	12.21	12.16	14.98
482	2	50.28	14.40	16.00
483	3	102.27	16.10	16.84
484.1	4.1	180.82	17.79	17.71
485	5	262.71	19.05	18.40
486	6	373.38	20.37	19.13
488	8	661.19	22.77	20.52

STORM EVACUATION

PROJECT NAME: Williamson Energy

PROJECT NUMBER: B05-330-1413

DESCRIPTION: Phase 5

CALC. BY: BWM 11/04/09

CHECKED BY: RLF 11/4/09

TOTAL STORED VOLUME: 7.21 (FT^3 X 10^6)

ELEV.	CUM. VOLUME (FT.^3 X 10^6)	DISCHARGE (CFS)	TIME (HRS)	CUM. TIME (HRS)	CUM. TIME (DAYS)
480	64.9	0		169.67	7.07
			63.96		
480.85	66.3	12.16		105.71	4.40
			37.65		
482	68.1	14.4		68.06	2.84
			29.14		
483	69.7	16.1		38.91	1.62
			29.58		
484.1	71.5	17.71		9.33	0.39
			9.33		
484.5	72.1	18.0		0.00	0.00

VOLUME BELOW DECANT = 64.9 (FT^3 X 10^6)

10% VOLUME = 0.721 (FT^3 X 10^6)

10% LEVEL

ELEV.	VOLUME (FT.^3 X 10^6)
480	64.9
480.44	65.621
480.85	66.3

90% EVACUATION

ELEV	TIME,DAYS
480	7.07
480.44	5.69
480.85	4.4

STORM EVACUATION

PROJECT NAME: WILLIAMSON ENERGY

PROJECT NUMBER: B05-330-1413

DESCRIPTION: PHASE 7

CALC. BY: MDB

CHECKED BY: [signature]

TOTAL STORED VOLUME: 9.97 (FT^3 X 10^6)

ELEV.	CUM. VOLUME (FT.^3 X 10^6)	DISCHARGE (CFS)	TIME (HRS)	CUM. TIME (HRS)	CUM. TIME (DAYS)
530	120	0		213.52	8.90
			82.69		
530.85	121.81	12.16		130.83	5.45
			51.54		
532	124.25	14.14		79.29	3.30
			40.73		
533	126.38	14.91		38.55	1.61
			38.55		
534	128.5	15.64		0.00	0.00
534.72	130.02	16.13			

VOLUME BELOW DECANT = 120 (FT^3 X 10^6)

10% VOLUME = 0.997 (FT^3 X 10^6)

10% LEVEL

ELEV.	VOLUME (FT.^3 X 10^6)
530	120
530.20	121.002
530.85	124.25

90% EVACUATION

ELEV	TIME,DAYS
530	8.9
530.20	8.09
530.85	5.45

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RALEIGH, NC (919) 861-2267

BY: ZLH DATE: 12/20/06 CHKD BY: RLF DATE: 12/20/06

PROJECT NAME: Williamson Energy

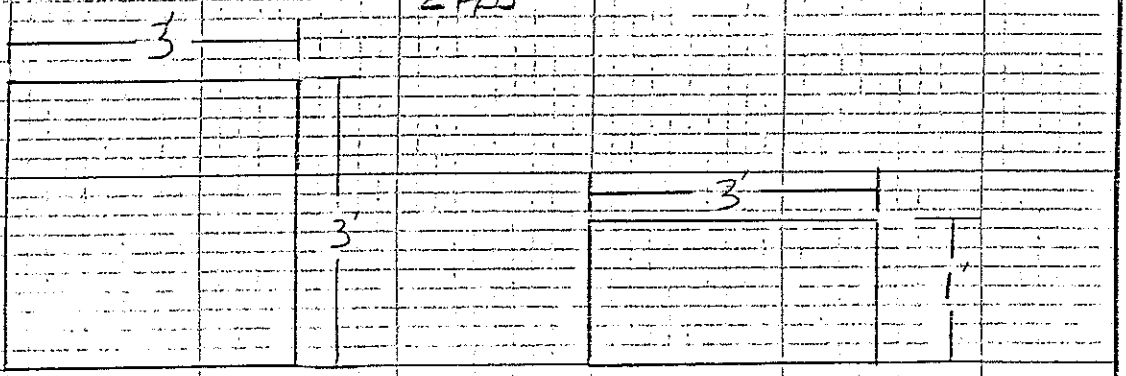
PROJECT NO. 305-330-1413 SHEET ____ OF ____

DESCRIPTION Phase 5 and 7 Trash Rack Design

The maximum anticipated peak flow for the 18" ϕ decant is 15.91 cfs (el 534 Phase 7)

The area of the trash rack is governed by limiting the velocity through the racks to 2 ft/sec (Bef Design of Small Dams, p 452)

Req Area of Trash Racks = $\frac{15.91 \text{ cfs}}{2 \text{ fps}} = 7.96 \text{ ft}^2$



Area of Trash Rack = $(3 \times 3) + ((3 \times 1) \times 4) = 21 \text{ ft}^2$

Since the bars in the trash rack are 1/2" dia and are spaced on 4" centers every square foot is reduced by 25%

Actual Area = $21 - (21 \times .25) = 15.75 \text{ ft}^2$

Actual Velocity = $\frac{15.91 \text{ cfs}}{15.75 \text{ ft}^2} = 1.01 \text{ fps} < 2$ ok

(39)

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BY: MDB DATE: 3/19/08 CHKD BY: [illegible] DATE: 4-07-08 R16980

PROJECT NAME: WILLIAMSON ENERGY

PROJECT NO. B05-330-1413 SHEET ____ OF ____

DESCRIPTION FREEBOARD CALCULATION

PURPOSE: TO DETERMINE THE MINIMUM FREEBOARD REQUIRED FOR THE PROPOSED EMBANKMENT.

ASSUMPTIONS:

FETCH (F_e) = 2200 ft. (0.42 MILES)

WIND SPEED (U_d) = 50 MPH

EMBANKMENT SLOPE = 3:1

REFERENCE: SOIL CONSERVATION SERVICE, TECHNICAL RELEASE NO. 69, FEBRUARY 1983

FROM FIGURE NO. 2:

FOR F_e = 0.42 AND U_d = 50 $\Rightarrow H_s$ = 1.5

FROM FIGURE NO. 11:

FOR F_e = 0.42 AND U_d = 50 $\Rightarrow L$ = 24

$$\frac{H_s}{L} = \frac{1.5}{24} = 0.0625$$

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BY: MDB DATE: 3/19/08 CHKD BY: [illegible] DATE: 4.07-08 R16981

PROJECT NAME: WILLIAMSON ENERGY

PROJECT NO. 805-330-1413 SHEET ____ OF ____

DESCRIPTION FREEBOARD CALCULATION

From Figure No. 12:

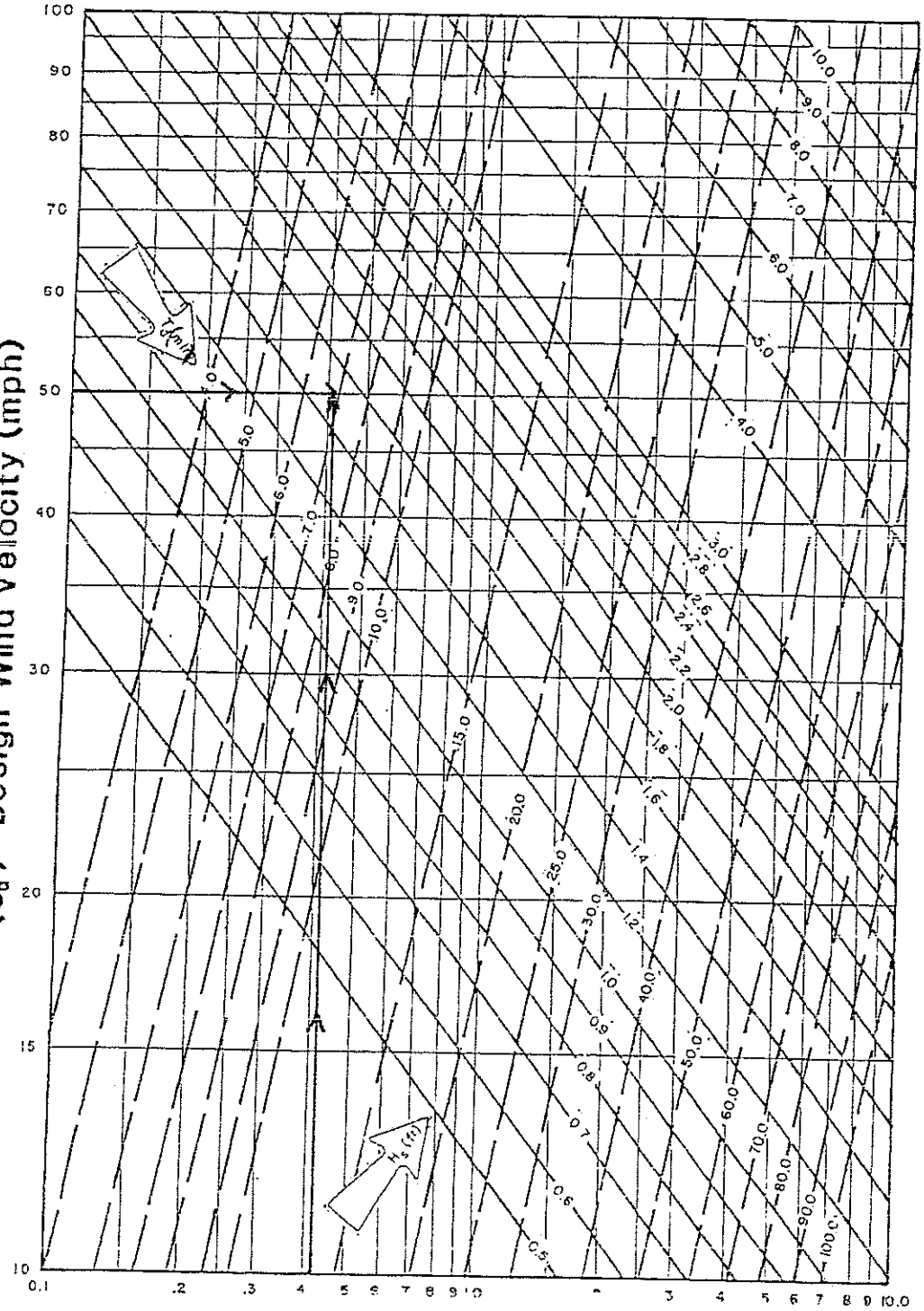
For $H_s/L = 0.0625$ and 3:1 slope $\Rightarrow R/H_s = 1.32$

For smooth embankment slope, multiply $R/H_s \times 1.2$

$\rightarrow 1.32 \times 1.2 = 1.58$

* Runup (R) = $1.58 \times H_s = 1.58 \times 1.5 = 2.37$
* Wind Setup (S) = $0.1 \times H_s = 0.1 \times 1.5 = 0.15$
* Minimum Freeboard = $R + S = 2.37 + 0.15 = 2.52'$

Use: Minimum Freeboard = 3 Feet



REF. (2)

Equation; (A17) & (A18) From Appendix A

$$g\frac{H_s}{U^2} = 0.0025\left(\frac{gF_e}{U^2}\right)^{0.47}$$

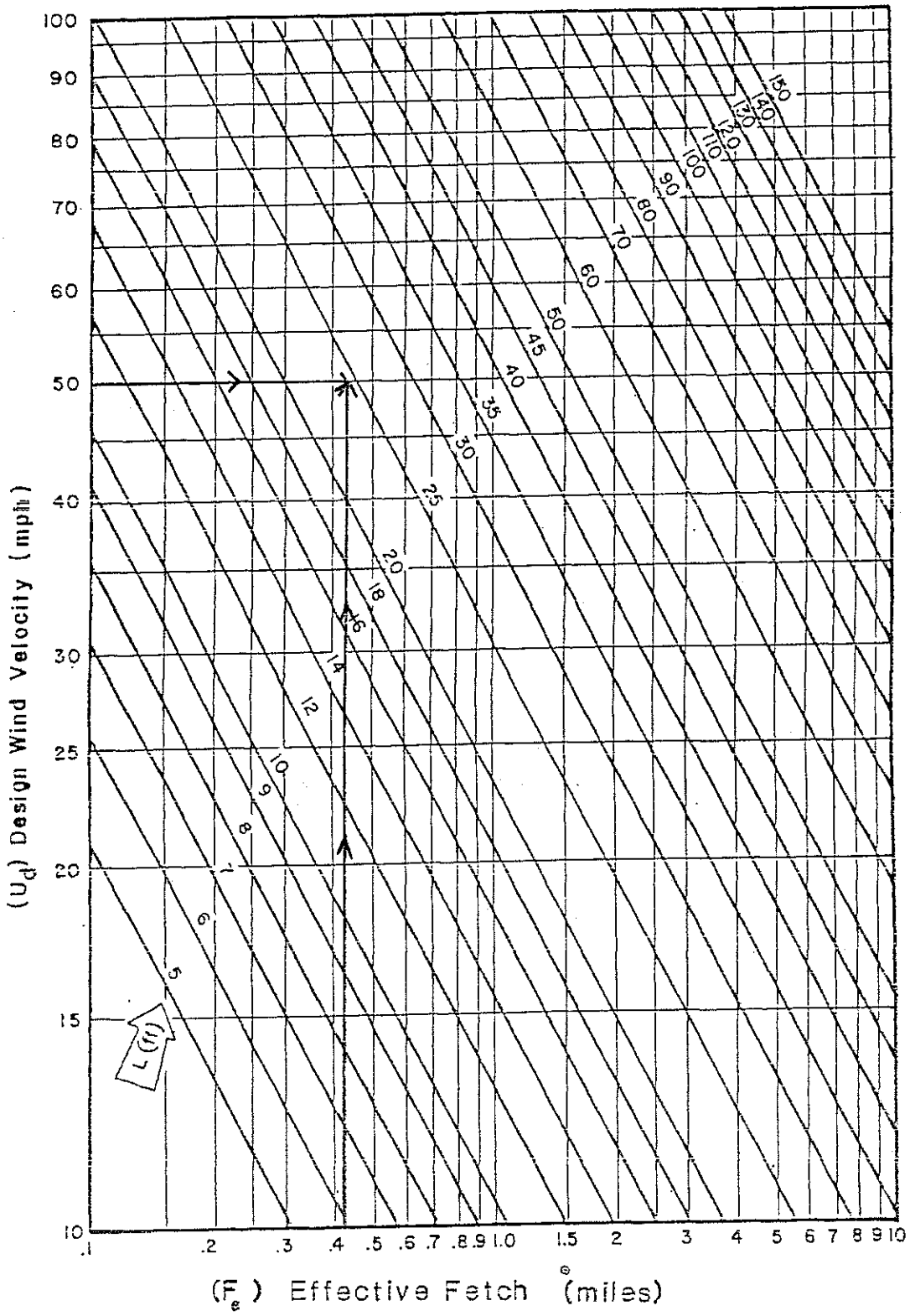
$$g\frac{T}{U} = 0.46\left(\frac{gF_e}{U^2}\right)^{0.28}$$

FIGURE 2

GENERALIZED CORRELATIONS OF SIGNIFICANT WAVE HEIGHTS WITH RELATED FACTORS

WNTC ENG. STAFF
PORTLAND, OREGON

R16983



Equation (A21) From Appendix A

$$\frac{g\sqrt{L}}{U} = 1.041 \left(\frac{g\,F_e}{U^2}\right)^{0.28}$$

REF (2) (8)

FIGURE 11
WAVE LENGTH
RELATIONSHIP

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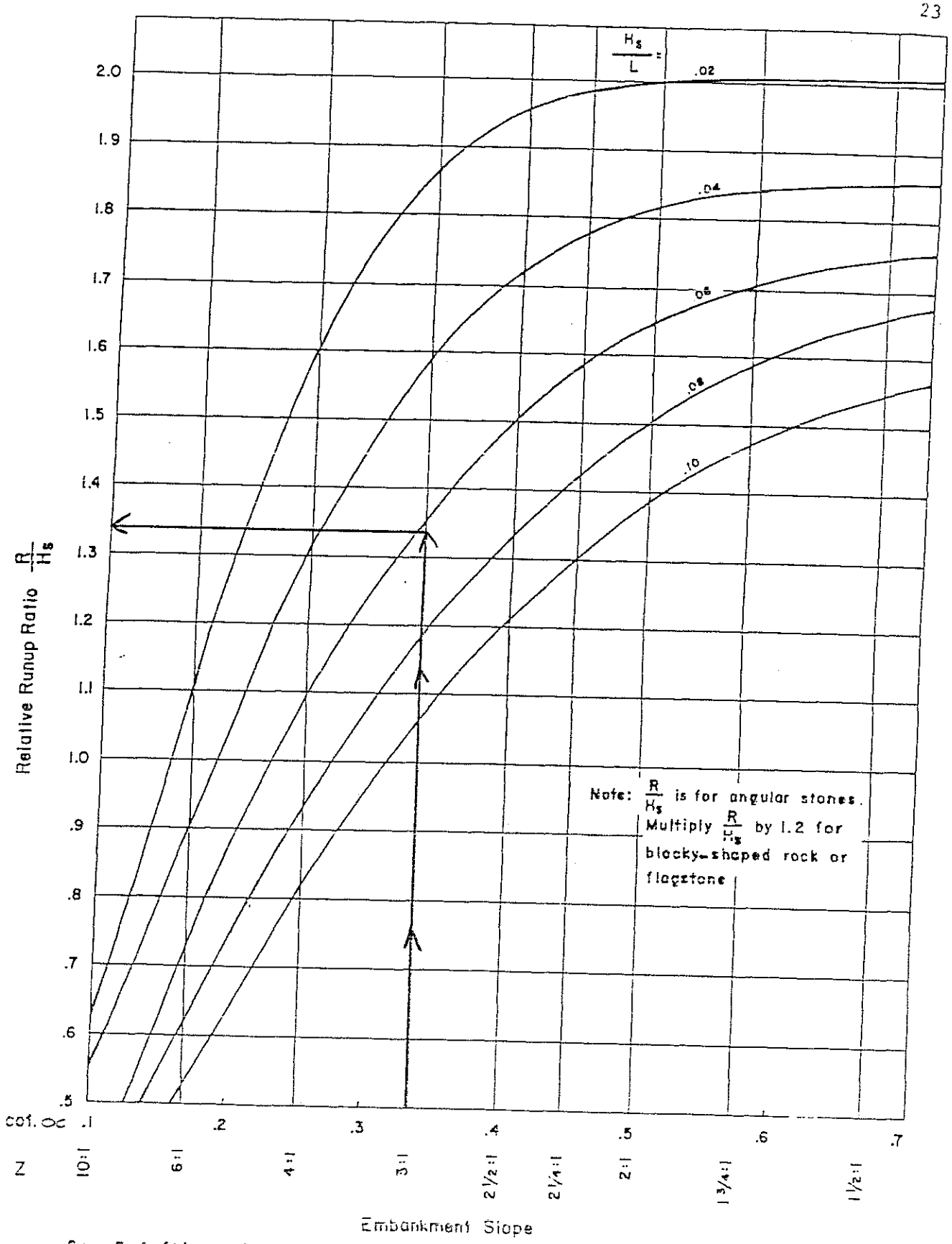

Note: See Ref. (2) and (20) and footnote 1 on page 9.

The surface smoothness represented by these curves is simulated by a single layer of rocks of uniform size.

FIGURE 12
WAVE RUNUP RATIO
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BY: JLH DATE: 12/01/06 CHKD BY: [illegible] DATE: 12-04-06

PROJECT NAME: WILLIAMSON ENERGY R16985

PROJECT NO. B05-330-1413 SHEET ____ OF ____

DESCRIPTION FILTER DRAINAGE DIAPHRAGM DESIGN

The purpose of the following calculations is to design a filter drainage diaphragm for the proposed decant pipe.

Reference: Soil Conservation Service, National Engineering Handbook, Chapter 26, Gradation Design of sand and gravel filters.

The attached sheet presents a grain size distribution curve for the Coarse Coal Refuse that will be placed at the subject facility which shall be used to backfill around the proposed pipe. Since the refuse has particles larger than the No. 4 sieve the grain size distribution curve will be adjusted by dividing 100 by the percent passing the No. 4 sieve.

Correction Factor = 100/34.1 = 2.93

Following are the adjusted percentages:

#4	100
#10	48.1
#20	24.0
#40	16.4
#60	12.3
#200	7.6

For 7.6% passing the No. 200 sieve, use category 4 for the soil (ref, table 26-1, p.26-3)

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BY: SEH DATE: 12/7/05 CHKD BY: DWH DATE: 12-4-06 (43)

PROJECT NAME: Williamson Energy R16986

PROJECT NO. BOS-330-143 SHEET ____ OF ____

DESCRIPTION Filter Drainage Diaphragm Design

For category 4 base material

D_{15} max $\leq 4 \times d_{85}$ after regrading

$= 4 \times 3.6 = 14.4$ mm

D_{15} min $\geq 14.4 / 5 = 2.88$ mm

Set $\frac{D_{60}}{D_{10}} \leq 6$ and $\frac{\text{max}}{\text{min}} \leq 5$

Set $D_{100} \leq 3''$

$D_5 \geq .075$ mm

Set D_{10} (max) $= \frac{D_{15}\text{ max}}{1.2} = \frac{14.4}{1.2} = 12$ mm

Set D_{10} (min) $= \frac{D_{15}\text{ min}}{1.2} = \frac{2.88}{1.2} = 2.4$ mm

or D_{10} min ≥ 2.4 mm D_{90} max $= 40$ mm

The filter drainage diaphragm shall have the following Gradation:

Sieve Size	% Passing
3	100
1½	84-100
¾	36-100
⅜	6-100
4	0-52
10	0-10
20	0-9
40	0-8
60	0-7
140	0-6
200	0-5

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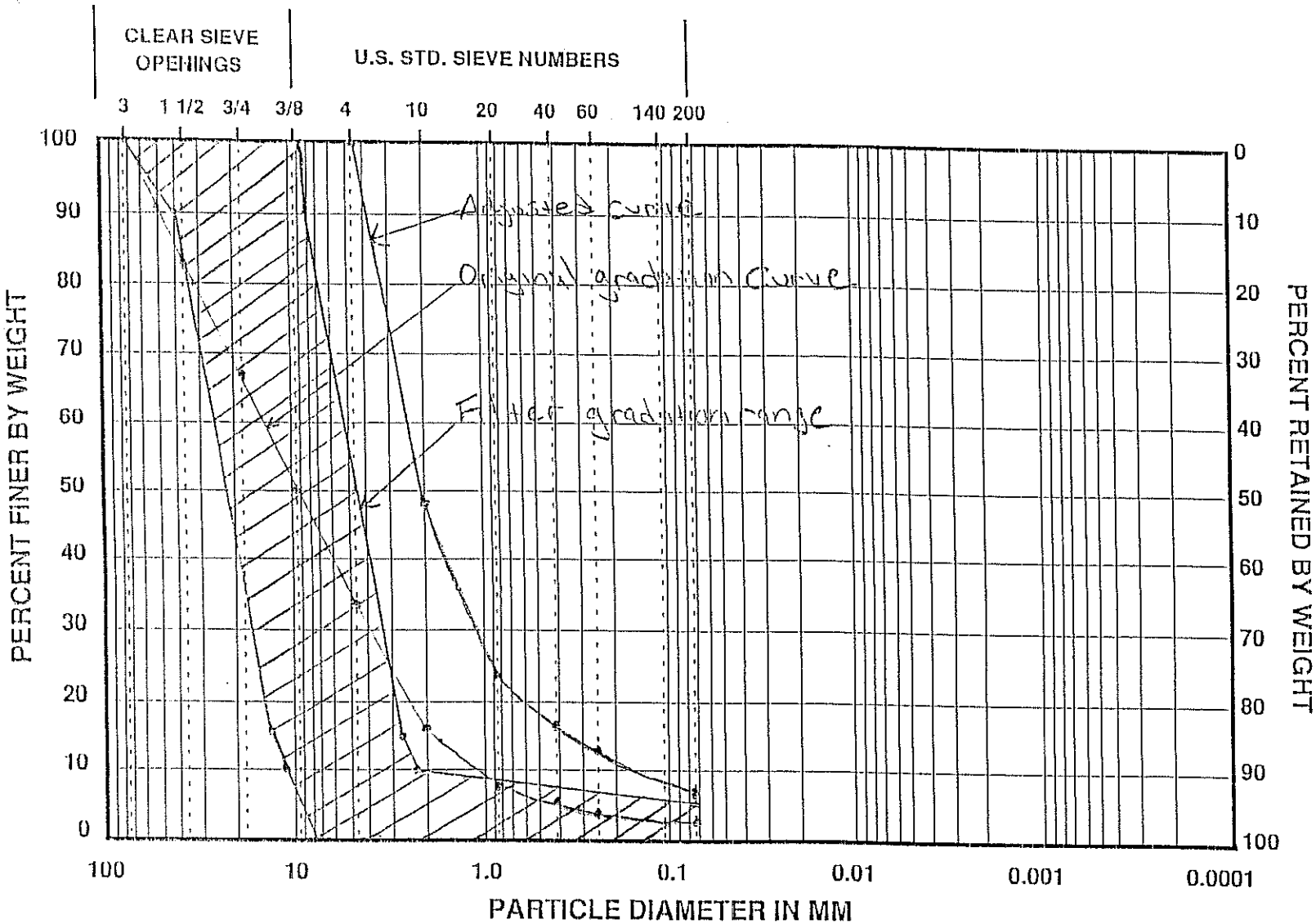
GRAIN SIZE ANALYSIS

PROJECT NAME: Williamson Energy
PROJECT NO.: BOE-830-1413 R16987
BORING NUMBER: 44
PLOTTED BY:
CHECKED BY:



COBBLES	GRAVEL		SAND			SILT AND CLAY	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT FRACTION	CLAY FRACTION

BORING	SAMPLE, DEPTH	SOIL DESCRIPTION	USCS	L.L.	P.L.	WC, %

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BY: [illegible] DATE: 12/20/06 CHKD BY: RLF DATE: 12/22/06 (45) R16988

PROJECT NAME: Williamson Energy

PROJECT NO. B05-330-1413 SHEET ____ OF ____

DESCRIPTION Filter drainage diaphragm Outlet drain Phase 5

The purpose of the following Calculation is to design an Outlet drain for the proposed filter drainage diaphragm.

Reference: Soil Conservation Service, Technical Note Supplement Series No 709, Filter drainage diaphragm Outlet.

Area of diaphragm = $40.5 ft^2$

Maximum Head (H) = 8ft

Seepage length (L) = 62ft

Hydraulic Gradient = $H/L = 8/62 = 0.13$

Permeability of embankment material = 0.57 ft/day

$K = 100$ times $= 100 \times .57 = 57$ ft/day

$Q = KiA = 57 \times .13 \times 40.5 = 300 ft^3/day$

For $D_{50} = 1/2$" stone $\Rightarrow$ $Wm^{.5} = 57600$ ft/day

$$Q_{drain} = A_{drain} \times Wm^{.5} \times (.06)^{.54} \times \frac{C}{1+e}$$

$$300 = A \times 57600 \times (0.06)^{.54} \times \frac{.25}{1+.25}$$

$A = 300 / 2521.5$

$= .12 ft^2$

A 4ft^2 drain is proposed therefore Ok

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BY: [illegible] DATE: 12/20/06 CHKD BY: TKF DATE: 12/20/06

PROJECT NAME: Williamson Energy

R16989

PROJECT NO. 805-330-1413 SHEET ____ OF ____

DESCRIPTION Filter drainage diaphragm Outlet drain Phase 7

The purpose of the following Calculation is to design an Outlet drain for the proposed filter drainage diaphragm.

Reference: Soil Conservation Service, Technical Note Supplement Series No 709, Filter Drainage Diaphragm Outlet

Area of diaphragm = $40.5\ ft^2$

Maximum Head (H) = 9 ft

Seepage length (L) = 97 ft

Hydraulic Gradient = $H/L = 9/97 = 0.09$

Permeability of embankment material = 0.57 ft/day

$K = 100$ Kemb = $100 \times .57 = 57$ ft/day

$Q = KiA = 57 \times .09 \times 40.5 = 207.8\ ft^3/day$

For D_{50} = ½" stone $\Rightarrow$ $V_m{}^{.5} = 57{,}600$ ft/day

$Q_{drain} = A_{drain} \times V_m{}^{.5} \times .54 \times \frac{e}{1+e}$

$207.8 = A_{drain} \times 57600 \times (0.06)^{.54} \times \frac{.25}{1+.25}$

$A_{drain} = 207.8 / 2521.5$

$= 0.08\ ft^2$

A 4 ft^2 drain is proposed therefore OK

47

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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF _____
DESCRIPTION: Ditch "D" Tractive Force Computations, 4" USM

File: Ditch D 4-in USM.xls

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	99.10
BOTTOM WIDTH (ft), b=	12.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	25.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.31
AREA OF FLOW (sq ft), A=	3.91
WETTED PERIMETER (ft), P=	13.39
HYDRAULIC RADIUS (ft), R=	0.29
VELOCITY OF FLOW (fps), V=	25.19
LINING PERIMETER (ft)=	19.76
TOP WIDTH (ft)=	18.94
FREEBOARD (ft)=	1.43
TOTAL DITCH DEPTH (ft), d=	1.74

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 6.08

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 4.80

TOTAL STRESS

t (psf) = 6.08
T (lb/ft) = 81.37

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 9.12
(lb/ft) = 122.06

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\tan(d)-So\right)$$ (psf)= 3.26

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 2.06

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 2.79 Tr,t (lb/ft) = 55.12

(48)

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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF ___
DESCRIPTION: Ditch "D" Tractive Force Computations, 4" USM

File: Ditch D 4-in USM.xls

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 6.33 (lb/ft) = 66.94

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

REBAR SIZE (#)= 5

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= 28.85

USE REBAR SPACING OF 20.00 20 ft MAXIMUM

RESISTANCE PROVIDED (psf)= 13.18

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), $W = \frac{Cw*H*Gw}{12*Z^{.33}}$

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Cw= 3.7

W (lbs)= 4.74

MAT WEIGHT (lbs), $Wm = \frac{t(Gc-Gw)}{12}$

= 25.87

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: USE 4 INCH USM WITH ROOF BOLT (#5) ANCHORS ON 20 FOOT SPACING.

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

(49)

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BY: HLO DATE: 5/14/09 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF _____
DESCRIPTION: Ditch "F" Tractive Force Computations, 4" USM

File: Ditch F 4-in USM.xls

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	119.30
BOTTOM WIDTH (ft), b=	12.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	25.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.35
AREA OF FLOW (sq ft), A=	4.45
WETTED PERIMETER (ft), P=	13.57
HYDRAULIC RADIUS (ft), R=	0.33
VELOCITY OF FLOW (fps), V=	27.18
LINING PERIMETER (ft)=	20.18
TOP WIDTH (ft)=	19.32
FREEBOARD (ft)=	1.48
TOTAL DITCH DEPTH (ft), d=	1.83

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 6.81

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 5.38

TOTAL STRESS

t (psf) = 6.81
T (lb/ft) = 92.45

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 10.22
(lb/ft) = 138.67

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\tan(d)-So\right)$$ (psf)= 3.26

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 2.06

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 2.77 Tr,t (lb/ft) = 55.98

(50)

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

BY: HLO DATE: 5/14/09 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF _____
DESCRIPTION: Ditch "F" Tractive Force Computations, 4" USM

File: Ditch F 4-in USM.xls

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 7.45 (lb/ft) = 82.69

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

REBAR SIZE (#)= 4

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= 21.37

USE REBAR SPACING OF 20.00 20 ft MAXIMUM

RESISTANCE PROVIDED (psf)= 8.50

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), W= $\frac{Cw*H*Gw}{12*Z^{.33}}$

Cw= 3.7

W (lbs)= 5.36

MAT WEIGHT (lbs), Wm= $\frac{t(Gc-Gw)}{12}$

= 25.87

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: USE 4 INCH USM WITH ROOF BOLT (#4) ANCHORS ON 20 FOOT SPACING.

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

51

Alliance Consulting, Inc.
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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF ___
DESCRIPTION: Ditch "I" Tractive Force Computations, 4" USM

File: Ditch I 4-in USM.xls

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	82.90
BOTTOM WIDTH (ft), b=	12.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	25.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.28
AREA OF FLOW (sq ft), A=	3.52
WETTED PERIMETER (ft), P=	13.25
HYDRAULIC RADIUS (ft), R=	0.27
VELOCITY OF FLOW (fps), V=	23.62
LINING PERIMETER (ft)=	19.45
TOP WIDTH (ft)=	18.67
FREEBOARD (ft)=	1.39
TOTAL DITCH DEPTH (ft), d=	1.67

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 5.52

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 4.36

TOTAL STRESS

t (psf) = 5.52
T (lb/ft) = 73.15

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 8.28
(lb/ft) = 109.72

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\tan(d)-So\right)$$ (psf)= 3.26

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 2.06

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 2.80 Tr,t (lb/ft) = 54.47

52

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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF _____
DESCRIPTION: Ditch "I" Tractive Force Computations, 4" USM

File: Ditch I 4-in USM.xls

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 5.48 (lb/ft) = 55.25

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

REBAR SIZE (#)= 5

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= 31.01

USE REBAR SPACING OF 20.00 20 ft MAXIMUM

RESISTANCE PROVIDED (psf)= 13.18

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), W= $\frac{Cw*H*Gw}{12*Z^{.33}}$

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Cw= 3.7

W (lbs)= 4.29

MAT WEIGHT (lbs), Wm= $\frac{t(Gc-Gw)}{12}$

= 25.87

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: USE 4 INCH USM WITH ROOF BOLT (#5) ANCHORS ON 20 FOOT SPACING.

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

53

Alliance Consulting, Inc.
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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF ___
DESCRIPTION: Ditch "L" Tractive Force Computations, 4" USM

File: Ditch L 4-in USM.xls

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	118.00
BOTTOM WIDTH (ft), b=	12.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	25.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.35
AREA OF FLOW (sq ft), A=	4.45
WETTED PERIMETER (ft), P=	13.57
HYDRAULIC RADIUS (ft), R=	0.33
VELOCITY OF FLOW (fps), V=	27.18
LINING PERIMETER (ft)=	20.18
TOP WIDTH (ft)=	19.32
FREEBOARD (ft)=	1.48
TOTAL DITCH DEPTH (ft), d=	1.83

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 6.82

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 5.38

TOTAL STRESS

t (psf) = 6.82
T (lb/ft) = 92.46

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 10.22
(lb/ft) = 138.68

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}(\tan(d)-So)$$ (psf)= 3.26

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 2.06

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 2.77 Tr,t (lb/ft) = 55.97

(54)

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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF _____
DESCRIPTION: Ditch "L" Tractive Force Computations, 4" USM

File: Ditch L 4-in USM.xls

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 7.45 (lb/ft) = 82.71

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

REBAR SIZE (#)= 5

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= 26.60

USE REBAR SPACING OF 20.00 20 ft MAXIMUM

RESISTANCE PROVIDED (psf)= 13.18

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), $W = \frac{Cw*H*Gw}{12*Z^{.33}}$

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Cw= 3.7

W (lbs)= 5.36

MAT WEIGHT (lbs), $Wm = \frac{t(Gc-Gw)}{12}$

= 25.87

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: USE 4 INCH USM WITH ROOF BOLT (#5) ANCHORS ON 20 FOOT SPACING.

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

55

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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF _____
DESCRIPTION: Ditch "M" Tractive Force Computations, 4" USM

File: Ditch M 4-in USM.xls

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	75.40
BOTTOM WIDTH (ft), b=	12.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	25.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.27
AREA OF FLOW (sq ft), A=	3.39
WETTED PERIMETER (ft), P=	13.21
HYDRAULIC RADIUS (ft), R=	0.26
VELOCITY OF FLOW (fps), V=	23.08
LINING PERIMETER (ft)=	19.35
TOP WIDTH (ft)=	18.57
FREEBOARD (ft)=	1.37
TOTAL DITCH DEPTH (ft), d=	1.64

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 5.33

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 4.21

TOTAL STRESS

t (psf) = 5.33
T (lb/ft) = 70.42

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 8.00
(lb/ft) = 105.64

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\tan(d)-So\right)$$ (psf)= 3.26

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 2.06

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 2.80 Tr,t (lb/ft) = 54.26

56

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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ___ OF ___
DESCRIPTION: Ditch "M" Tractive Force Computations, 4" USM

File: Ditch M 4-in USM.xls

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 5.19 (lb/ft) = 51.38

ANCHOR RESISTANCE (PSF)= As*(Phi)(fs)/L^2

As=CROSS-SECTIONAL AREA OF REBAR TO BE USED (sq in)
Phi=SHEAR FACTOR=0.85
fs=ALLOWABLE STRESS FOR STEEL=20,000 psi
L=ANCHOR SPACING

REBAR SIZE (#)= 5

SOLVE FOR REQUIRED ANCHOR SPACING

L (ft)= 31.85

USE REBAR SPACING OF 20.00 20 ft MAXIMUM

RESISTANCE PROVIDED (psf)= 13.18

REBAR#	As (sq in)
3	0.11
4	0.20
5	0.31
6	0.44
7	0.60
8	0.79

NOTE: ABOVE IS BASED ON YIELD SHEAR STRESS ON BOLT, MUST ALSO CHECK GROUND ANCHORAGE CAPACITY OF BOLT!

CHECK UPLIFT

REQUIRED WEIGHT (lbs), W= $\frac{Cw*H*Gw}{12*Z^{.33}}$

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Cw= 3.7

W (lbs)= 4.13

MAT WEIGHT (lbs), Wm= $\frac{t(Gc-Gw)}{12}$

= 25.87

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

DESIGN: USE 4 INCH USM WITH ROOF BOLT (#5) ANCHORS ON 20 FOOT SPACING.

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

57

Alliance Consulting, Inc.
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BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ____ OF _____
DESCRIPTION: Decant Ditch Tractive Force Computations, 4" USM

File: Decant Ditch 4-in USM.xls

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	19.10
BOTTOM WIDTH (ft), b=	0.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	USM
UNIT WEIGHT OF CONCRETE (pcf), Gc=	140.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	25.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.015
DEPTH OF FLOW (ft), y=	0.63
AREA OF FLOW (sq ft), A=	0.79
WETTED PERIMETER (ft), P=	2.82
HYDRAULIC RADIUS (ft), R=	0.28
VELOCITY OF FLOW (fps), V=	24.58
LINING PERIMETER (ft)=	9.65
TOP WIDTH (ft)=	8.63
FREEBOARD (ft)=	1.53
TOTAL DITCH DEPTH (ft), d=	2.16

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 5.86

THE DITCH IS V-SHAPED THEREFORE BOTTOM TRACTIVE STRESS IS ZERO. BOTTOM TRACTIVE STRESS IS ONLY CALCULATED TO ALLOW CALCULATION OF SIDE SLOPE TRACTIVE STRESS.

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 4.63

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

TOTAL STRESS

t (psf) = 4.63
T (lb/ft) = 13.04

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 6.94
(lb/ft) = 19.57

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 4

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\tan(d)-So\right)$$ (psf)= 0.00 DITCH IS V-SHAPED THEREFORE BOTTOM STRESS IS ZERO

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 2.06

NOTE: TOTAL RESISTING STRESS INCLUDES FREEBOARD PORTION OF MAT, CONSERVATIVELY USING MAT'S SUBMERGED UNIT WEIGHT FOR FREEBOARD ZONE.

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 2.06 Tr,t (lb/ft) = 19.82

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

BY: HLO 6/9/2009 CHKD BY: _____ DATE: _____

PROJECT NAME: Williamson Energy LLC

PROJECT NO.: B05-330-1413 SHEET ___ OF _____

DESCRIPTION: Decant Ditch Tractive Force Computations, 4" USM

File: Decant Ditch 4-in USM.xls

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 4.89 (lb/ft) = -0.26

NOTE: NO ANCHORS REQUIRED FOR THIS DITCH, REQUIRED RESISTING STRESS < AVE. RESISTING STRESS FROM MAT IN LB/FT !

CHECK UPLIFT

REQUIRED WEIGHT (lbs), W= $\frac{Cw*H*Gw}{12*Z^{.33}}$

Cw= 3.7

W (lbs)= 9.64

MAT WEIGHT (lbs), Wm= $\frac{t(Gc-Gw)}{12}$

= 25.87

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

58

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BY: HLO DATE: 7/2/09 CHKD BY: _____ DATE: _____
PROJECT NAME: **Williamson Energy LLC**
PROJECT NO.: B05-330-1413 SHEET ___ OF _____
DESCRIPTION: **Ditch "F" Tractive Force Computations, 15" Grouted RRP**

File: Ditch F 15-in GRRP

DITCH PROPERTIES

	ENTERED VALUES
DESIGN DISCHARGE (cfs), Q=	119.30
BOTTOM WIDTH (ft), b=	12.00
CHANNEL SLOPE (%), So=	33.33
SIDE SLOPES, Z=	2.00
TYPE OF MAT TO BE DESIGNED=	Grouted Riprap
UNIT WEIGHT OF CONCRETE (pcf), Gc=	150.00
UNIT WEIGHT OF WATER (pcf), Gw=	62.40
SUBGRADE FRICTION ANGLE (deg), δ=	25.00

	CALCULATED VALUES
MANNING'S COEFFICIENT, n=	0.035
DEPTH OF FLOW (ft), y=	0.58
AREA OF FLOW (sq ft), A=	7.63
WETTED PERIMETER (ft), P=	14.59
HYDRAULIC RADIUS (ft), R=	0.52
VELOCITY OF FLOW (fps), V=	15.91
LINING PERIMETER (ft)=	20.55
TOP WIDTH (ft)=	19.65
FREEBOARD (ft)=	1.33
TOTAL DITCH DEPTH (ft), d=	1.91

SIDE SLOPE	COEFFICIENT
<1.5	0.76
2	0.79
3	0.85
4	0.94

MAT TYPE	n
ABM	0.045
FPM	0.025
USM	0.015

TRACTIVE STRESSES DUE TO FLOW OF WATER

BOTTOM STRESS

tb=Gw*R*So (psf)= 10.88

SIDE SLOPE STRESS

SIDE SLOPE COEFFICIENT= 0.79

ts=0.79*tb (psf)= 8.59

TOTAL STRESS

t (psf) = 10.88
T (lb/ft) = 158.75

CONDITION	COARSE GRAINED	FINE GRAINED NO COHESION	FINE GRAINED LOW COHESION	COHESIVE
ARMORFORM ON SOIL	25	25	30	45
ARMORFORM ON FABRIC	30	25	25	32.5

REQUIRED RESISTING STRESS

DESIRED FACTOR OF SAFETY= 1.5

REQUIRED RESISTING STRESS (psf)= 16.32
(lb/ft) = 238.12

RESISTING STRESS

BOTTOM STRESS

MAT THICKNESS (in), t= 15

$$tr,b = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\tan(d)-So\right)$$ (psf)= 13.82

SIDE SLOPE STRESS

$$tr,s = \frac{t(Gc-Gw)}{\sqrt{1+So^2}}\left(\frac{Z\tan(d)}{\sqrt{1+Z^2}}-So\right)$$ (psf)= 8.70

AVERAGE TOTAL RESISTING STRESS FROM MAT

Tr,t (psf)= 11.69 Tr,t (lb/ft) = 240.21

$FS = \frac{240.2\ LB}{158.8\ LB}$

$= 1.51 > 1.50$, OK

NOTE: 15" LAYER SPECIFIED WITH 12" GROUT PENETRATION

Alliance Consulting, Inc.
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BY: HLO DATE: 7/2/09 CHKD BY: _____ DATE: _____
PROJECT NAME: Williamson Energy LLC
PROJECT NO.: B05-330-1413 SHEET ____ OF _____
DESCRIPTION: Ditch "F" Tractive Force Computations, 15" Grouted RRP

ANCHOR RESISTING STRESS

REMAINING RESISTANCE REQUIRED (psf)= 4.63 (lb/ft) = -2.09

CHECK UPLIFT

REQUIRED WEIGHT (lbs), W= $\frac{Cw*H*Gw}{12*Z^{.33}}$

CW= 1.3 FOR USM OR FPM, SHORT TERM
3.7 FOR USM OR FPM, LONG TERM
2.0 FOR ABM

Cw= 3.7

W (lbs)= 8.88

MAT WEIGHT (lbs), Wm= $\frac{t(Gc-Gw)}{12}$

= 109.50

Wm IS GREATER THAN W. NO ADDITIONAL UPLIFT RESISTANCE IS NEEDED.

Design procedure based on Nicolon Corporation, Design Theory Manual for Armorform Erosion Protection Mats, dated September 25, 1989.

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BY: HJO DATE: 03/02/09 CHKD BY: MT DATE: 3.10 (586)

PROJECT NAME: WILLIAMSON ENERGY, LLC

PROJECT NO. 805-330-1413 SHEET 1 OF

DESCRIPTION DETERMINE METHOD TO ESTIMATE THE ANCHORAGE CAPACITY OF A BOLT

REFERENCES

(1) "FOUNDATION DESIGN", WAYNE C. TENG, PRENTICE HALL, INC., 1962

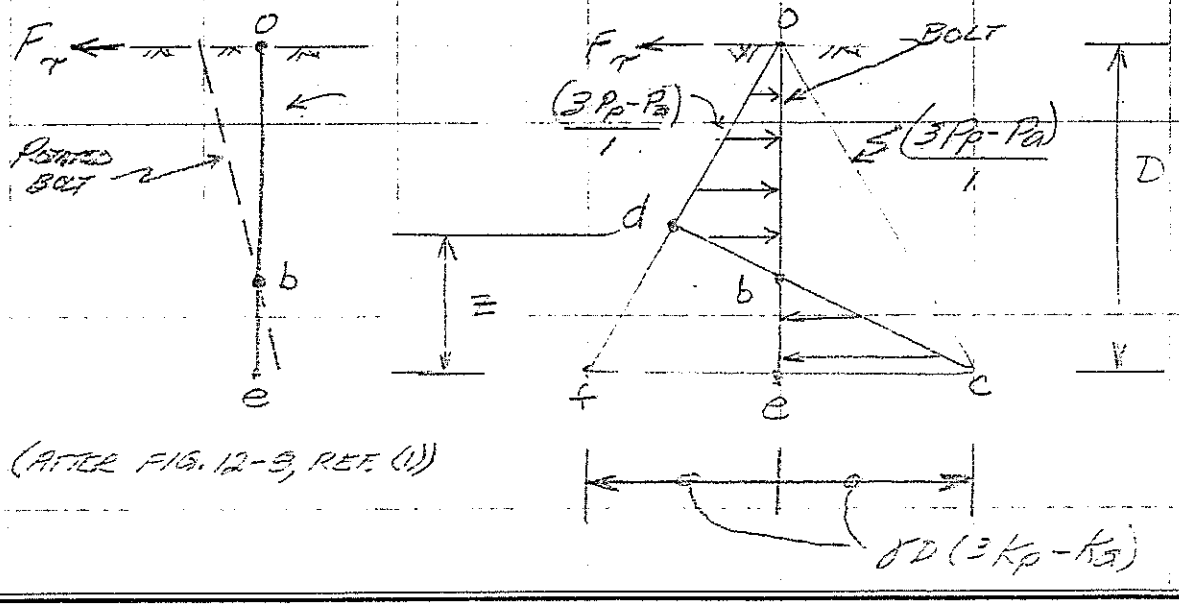
(2) REPORT NO. FHWA-RD-75-128, "LATERAL SUPPORT AND UNDERPINNING, VOL. 1, DESIGN AND CONSTRUCTION", APRIL 1976

(3) "GEOTECHNICAL ENGINEERING CIRCULAR NO. 4, GROUND ANCHORS AND ANCHORED SYSTEMS", REPORT NO. FHWA-IF-99-015, JUNE 1999.

FIND: THE ANCHORAGE CAPACITY OF ROOF BOLTS OR SIMILAR RODS TO ANCHOR RIGID CHANNEL LINERS AGAINST TRACTIVE FORCE AND UPLIFT CAUSED BY FLOWING WATER.

ASSUMPTIONS

1. THE ROOF BOLTS WILL BEHAVE IN UNDER LOAD IN A MANNER SIMILAR TO SOLDIER PILES
2. THE ROOF BOLTS ARE RELATIVELY RIGID AND WILL ROTATE TOWARD LATERAL LOADS AROUND SOME POINT ABOVE THE BOTTOM OF THE BOLT (FREE EARTH SUPPORT CONDITION).
3. IN COHESIONLESS SOILS AND FOR DRAINED CONDITIONS IN COHESIVE SOILS, PASSIVE RESISTANCE AT DEPTH IS DEVELOPED OVER 3 TIMES THE ROOF BOLT (SOLDIER PILE) WIDTH.
4. RANKINE EARTH PRESSURE COEFFICIENTS APPLY.



(AFTER FIG. 12-9, REF. (1))

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BY: HDD DATE: 3/24/09 CHKD BY: MKT DATE: 7/1/09 (58c)

PROJECT NAME: WILLIAMSON ENERGY LLC

PROJECT NO. 805-330-1413 SHEET 2 OF

DESCRIPTION DETERMINE METHOD TO ESTIMATE THE ANCHORAGE CAPACITY OF A BOLT

D = DEPTH BOLT IS DRIVEN INTO GROUND

P_p = PASSIVE EARTH PRESSURE = $3 k_p \gamma D$

P_a = ACTIVE EARTH PRESSURE = $k_a D \gamma$

$k_p = \tan^2(45° + \phi/2)$

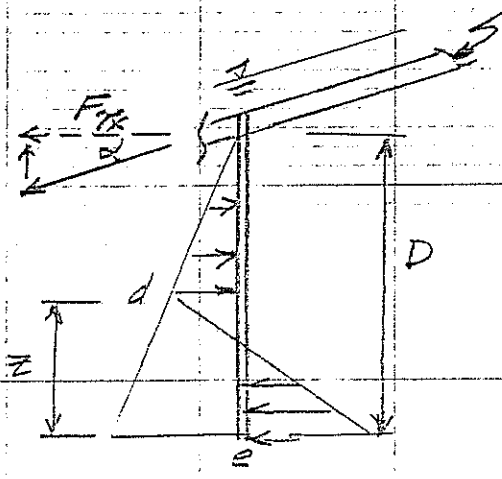
$k_a = \tan^2(45° - \phi/2)$

ϕ = DAMPED SOIL ϕ (EFFECTIVE STRESS)

γ = SOIL DENSITY

F_x = LOAD ON BOLT DUE TO TRACTIVE FORCE OF WATER

TO SOLVE FOR F_T, CHECK STATIC EQUILIBRIUM OF THE FORCES IN THE PRECEDING DIAGRAM ($\Sigma F_x = 0$) AND THEN ΣM ABOUT ANY POINT ON THE BOLT = 0. WHEN DISTANCE Z IS CORRECT, FORCES WILL BALANCE. THIS IS A TRIAL AND ERROR SOLUTION.



$F_{T_z} = F_T \cos \alpha$

γ = CHANNEL SLOPE

SURCHARGE LOAD OF CHANNEL LINING MAT AND DEPTH OF WATER IGNORED AS IT IS ON ALL SIDES OF THE BOLT

$\Sigma F_x = 0$

$\Sigma M_e = 0$

NOTE: THIS IS FOR COHESIONLESS, GRANULAR SOILS ONLY

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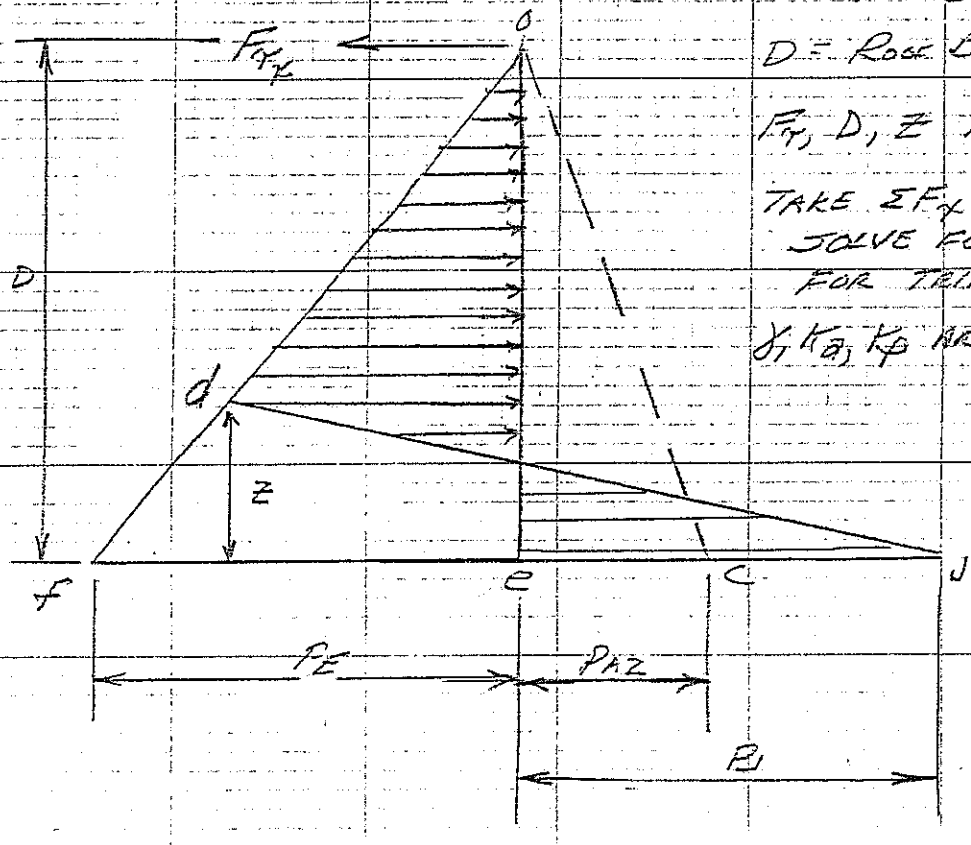
BY: HLD DATE: 3/19/09 CHKD BY: [illegible] DATE: 7/[illegible] (58d)

PROJECT NAME: WILLIAMSON ENERGY LLC

PROJECT NO. B05-330-1413 SHEET 3 OF

DESCRIPTION DETERMINE METHOD TO ESTIMATE THE ANCHORAGE CAPACITY OF A BOLT



F_{T_x} = TRACTIVE FORCE PER BOLT

D = ROCK BOLT DEPTH

F_T, D, Z ARE UNKNOWNS

TAKE $\Sigma F_x = 0$, $\Sigma M_F = 0$, SOLVE FOR F_T AND Z FOR TRIAL D

γ, K_a, K_p ARE KNOWN

$P_{A2} = \gamma D K_a$

$P_E = \gamma D (3K_p - K_a)$

$P_J = \gamma D (3K_p - K_a)$

$P_E = P_J$ FOR THIS CASE

SUM FORCES BY PRESSURE AREAS

$\Sigma F_x = 0$ ←

- $F_{T_x} + P_{A2}(D/2) + (P_E + P_J)\, Z/2 - (P_E + P_{A2})\, D/2 = 0$
- $F_{T_x} + \gamma D K_a (D/2) + 2(\gamma D)(3K_p - K_a)\, Z/2 - [\gamma D(3K_p - K_a) + \gamma D K_a]\, D/2 = 0$
- $F_{T_x} + \frac{\gamma D^2 K_a}{2} + Z\gamma D(3K_p - K_a) - \left[\frac{\gamma D^2}{2}(3K_p - K_a) - \frac{\gamma D^2}{2}(K_a)\right] = 0$
- $F_{T_x} + \frac{\gamma D^2}{2}[K_a - (3K_p - K_a + K_a)] + Z\gamma D(3K_p - K_a) = 0$
- $F_{T_x} + \frac{\gamma D^2}{2}(K_a - 3K_p) + Z\gamma D(3K_p - K_a) = 0$

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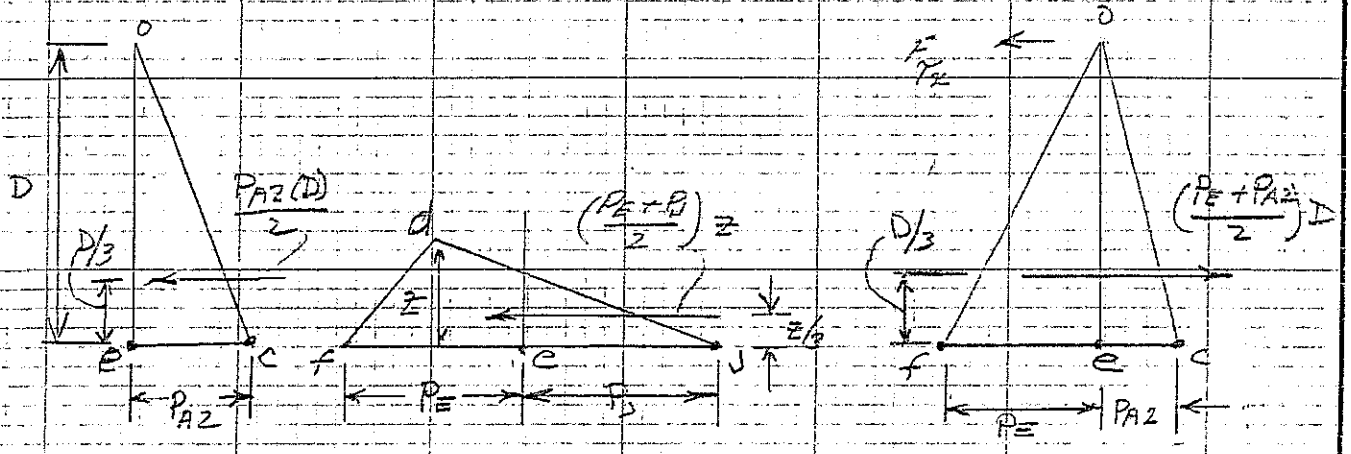
BY: HRD DATE: 3/20/09 CHKD BY: [illegible] DATE: 7/6/09 (58e)

PROJECT NAME: WILLIAMSON ENERGY LLC

PROJECT NO. B05-330-1413 SHEET 4 OF

DESCRIPTION DETERMINE METHOD TO ESTIMATE THE ANCHORAGE CAPACITY OF A BOLT

FORCE PRESSURE AREAS



$\Sigma M_e = 0$ ↺+

- $D(F_{T_x}) + \frac{P_{A2}(D)}{2}\left(\frac{D}{3}\right) + \left(\frac{P_E+P_J}{2}\right)z\left(\frac{z}{3}\right) - \left(\frac{P_E+P_{A2}}{2}\right)D\left(\frac{D}{3}\right) = 0$
- $D(F_{T_x}) + P_{A2}\left(\frac{D^2}{6}\right) + (P_E+P_J)\frac{z^2}{6} - (P_E+P_{A2})\frac{D^2}{6} = 0$
- $D(F_{T_x}) - \frac{D^2}{6}(P_E) + \frac{z^2}{6}(P_E+P_J) = 0$
- $D(F_{T_x}) - \frac{D^2}{6}\left[\gamma D(3K_p - K_a)\right] + \frac{z^2}{6}\left[\gamma D(3K_p - K_a)\,2\right]$
- $D(F_{T_x}) - \frac{\gamma D^3}{6}(3K_p - K_a) + \frac{\gamma D z^2}{3}(3K_p - K_a) = 0$

$F_{T_x} - \frac{\gamma D^2}{6}(3K_p - K_a) + \frac{\gamma z^2}{3}(3K_p - K_a) = 0$

NOW HAVE 2 EQUATIONS AND 3 UNKNOWNS – F_{T_x}, D, AND z FOR TRIAL VALUE OF D, TRIAL AND ERROR SOLVE FOR z AND F_{T_x} UNTIL $\Sigma F_x = 0$ AND $\Sigma M_F = 0$

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BY: HLO DATE: 3/31/2009 CHKD BY: MKT DATE: 7/14/09 (584)

PROJECT NAME: Williamson Energy LLC

PROJECT NO.: B05-330-1413 SHEET 5 OF

DESCRIPTION: Drainage Channel USM Lining Anchorage Bolt Design

---

Lined Channel Anchor Bolt Capacity - 4' long, 5/8" diameter
Case: Cohesionless Soil

Factor	Value
γ = soil weight, PCF	120
Φ = effective angle of soil friction, degrees	34
D = Bolt anchorage depth, FT	4
z = trial distance to balance forces	
F_{TX} = Horizontal component of channel tractive force, LB	
α = channel slope, degrees	18.44
$Ka = \tan^2(45° - Φ/2)$	0.28271
$Kp = \tan^2(45° + Φ/2)$	3.53713
d = bolt diameter, feet	0.05208

Channel Slope (H:V)	α (degrees)
2 : 1	26.565
2.5 : 1	21.801
3 : 1	18.435
3.5 : 1	15.945
4 : 1	14.036

Bolt Φ (inches)	Bolt Φ (FT)
1/2	0.04167
5/8	0.05208
3/4	0.06250
1	0.08333

Σ Forces x = 0

$F_{TX} + (γD^2/2)(Ka-3Kp) + zγD(3Kp-Ka) = 0$
For given D, Compute F_{TX} for trial z distance
$F_T = F_{TX}/(\cos α)$

D (FT)	Bolt Φ (FT)	Trial z (FT)	F_{TX} (LB)	F_T (LB)	(γD2/2)(Ka-3Kp)	zγD(3Kp-Ka)
4	0.05208	1.2	207	218	-516	310
4	0.05208	1.3	181	191	-516	336
4	0.05208	1.4	155	163	-516	361
4	0.05208	**1.526**	**122**	**129**	-516	394

Σ Moments = 0 (about bottom of bolt)

$F_{TX} + (γz^2/3)(3Kp-Ka) = (γD^2/6)(3Kp-Ka)$
For given D, use trial z and trial F_{TX} to make ΣM = 0

D (FT)	Bolt Φ (FT)	Trial z (FT)	Trial F_{TX} (LB)	F_T (LB)	(γz2/3)(3Kp-Ka)	(γD2/6)(3kp-Ka)	Σ M = ?
4	0.05208	1.4	130	137.0	42.2	172.1	0.0
4	0.05208	1.014	150	158.1	22.1	172.1	0.0
4	0.05208	**1.526**	**122**	**128.6**	50.1	172.1	0.0

ΣFx balanced with ΣM=0 at z = 1.53', F_T = 129 LBS ←

Note: F_T and F_{TX} multiplied by bolt Φ to get pounds on bolt
If it is impossible to make Σ M = 0, D is is too short

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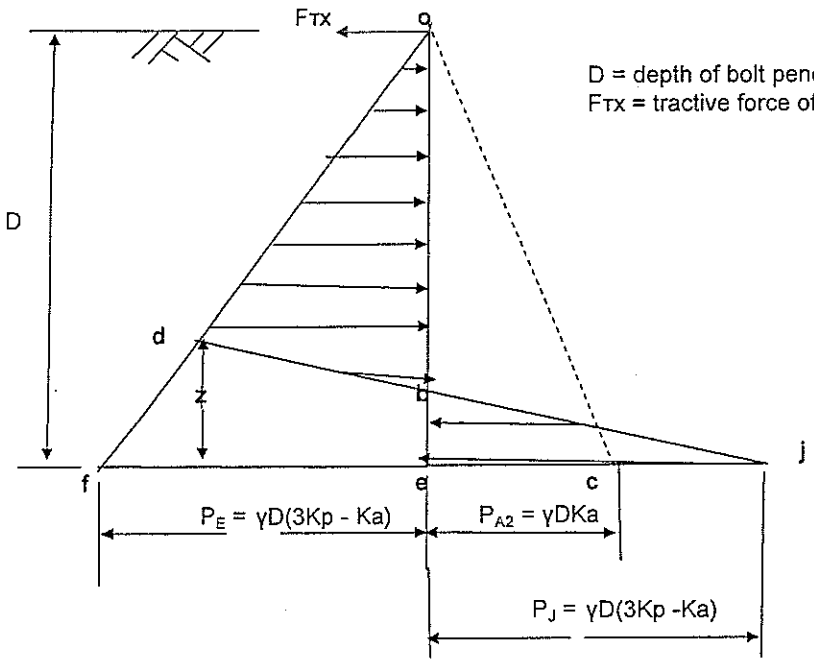
BY: HLO DATE: 3/31/2009 CHKD BY: [illegible] DATE: 7/16/09 (589)

PROJECT NAME: Williamson Energy LLC

PROJECT NO.: B05-330-1413 SHEET 6 OF

DESCRIPTION: Drainage Channel USM Lining Anchorage Bolt Design

Case: Cohesionless Soils



D = depth of bolt penetration
FTX = tractive force of water in x directon

Σ Fx = 0 by force areas

FTX + (oec) + (fdj) - (cfo) = 0, reduces to :

$F_{TX} + (\gamma D^2/2)(Ka - 3Kp) + z\gamma D(3Kp - Ka) = 0$

ΣMe = 0 by force areas

(D)FTX + (oec)D/3 + (fdj)z/3 - (cfo)D/3 = 0, reduces to:

$F_{TX} - (\gamma D^2/6)(3Kp - Ka) + (\gamma z^2/3)(3kp-Ka) = 0$

Reference: "Foundation Design", Wayne C. Teng, Prentice Hall, Inc., 1962, Figure 12-8.

File: Channel Anchor Bolts Force Diagram.xls, hlo, rev. 05/19/09

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BY: H2O DATE: 5/18/09 CHKD BY: TWT DATE: 7/16/09 (Sch)

PROJECT NAME: WILLIAMSON ENERGY LLC

PROJECT NO. 305-330-1413 SHEET 7 OF

DESCRIPTION DRAINAGE CHANNEL USM LINING
ANCHORAGE BOLT DESIGN

CHECK ANCHORAGE STRESSES ON BOLTS AND CONCRETE

BOLTS

LOAD/BOLT = 82.7 LB/FT (6 FT ROWS C-C)/(4 BOLTS - ROW)
= 124 LB/BOLT

ALLOW $f_y = 0.85 f_s = 0.85(20{,}000 \text{ PSI}) = 17000 \text{ PSI}$

A_S FOR 5/8" BOLT = 0.31 IN^2

ACTUAL $f_y = 124 \text{ LB}/0.31/\text{IN}^2 = 400 \text{ PSI}$, $< 17000 \text{ PSI}$, OK

CONCRETE (USM)

$f_c' = 4000$ PSI FOR ARMORFORM MAT

$f_c = \phi(0.85 f_c' A_1)$ (ACI-318-95, SECT. 10.17)

A_1 = BEARING AREA BOLT TO USM
= 5/8" X 4" = 2.5 IN^2

$\phi = 0.70$ (ACI-318-95, SECT. 9.3.2.4)

$f_c = 0.70(0.85)4000(2.5) = 5950 \text{ LB}$

f_c (ACTUAL) = 124 LB << 5,950 LB, ∴ OK

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BY: WJO DATE: 6/9/09 CHKD BY: MKT DATE: 7/10/09 (50 2)

PROJECT NAME: WILLIAMSTON ENERGY LLC

PROJECT NO. 805-330-1413 SHEET 9 OF

DESCRIPTION DRAINAGE CHANNEL USM LINING ANCHORAGE DESIGN

DETERMINE ANCHOR BOLT SPACING

ANCHORAGE CAPACITY FOR A 4'-LONG 3/8" BOLT = 129 LBS

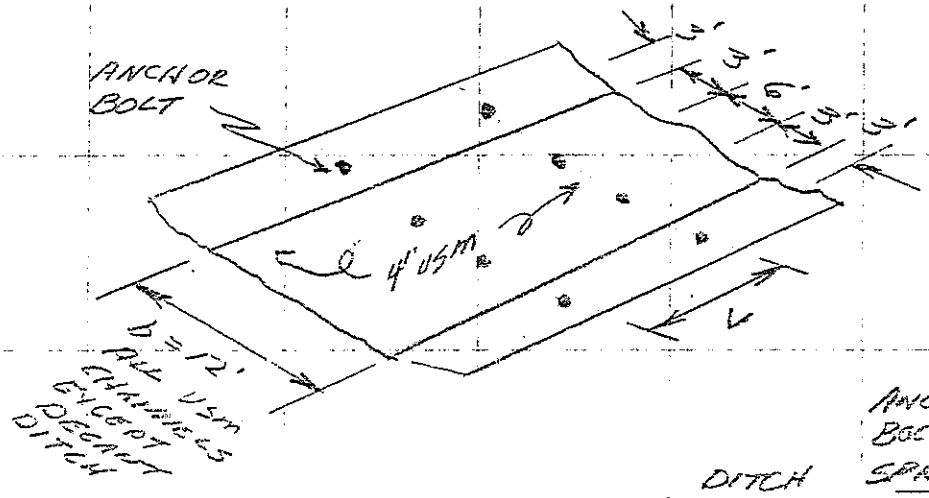
TRY 4 BOLTS/ROW

ANCHORAGE CAPACITY = 4 (129 LB/BOLT) = 516 LB/ROW

BOLT ROW SPACING = (516 LB/ROW) ÷ (REMAINING RESISTANCE REQUIRED - LB/FT)

DITCH	REMAINING RESISTANCE REQ'D (LB/FT)	MAX. ROW SPACING (FT)	ROW SPACING TO USE (FT)
D	66.9	7.71	7.5'
F	82.7	6.24	6'
I	55.2	9.35	9'
L	82.7	6.24	6'
M	51.4	10.04	10'
DECANT	0	NONE	NONE REQ'D

TYPICAL DITCH USM ANCHORING ISOMETRIC VIEW



DITCH	ANCHOR BOLT ROW SPACING (FT)
D	7.5'
F	6'
I	9'
L	6'
M	10'

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BY: HLO	DATE: 6/18/2008	CHKD BY: CLY	DATE: 8/8/08
PROJECT NAME: Williamson Energy LLC			
PROJECT NO. B05-033-1413	SHEET 1	OF 12	
DESCRIPTION Phase 5 & 6 Underdrain Design Revisions			
Outlet Pipes	File: PondCkUDOutlets.xls		

Phases 5 & 6: Revised Design - Underdrain Collector Pipe Outlets Capacity
12" SDR 13.5 HDPE Pipe, ID = 10.749", n = 0.015 (aged)
16" SDR 13.5 HDPE Pipe, ID = 13.488", n = 0.015 (aged)
10" SDR 26 HDPE Pipe, ID = 9.874", n = 0.015 (aged)

Phase	Sta.	Σ ΔL to Sta. (ft)	Σ Q to Sta. (gpm)	Inlet Elev. (msl)	Outlet Elev (msl)	Outlet Pipe Length	Pipe Slope (ft/ft)	Pipe) Q (full) (gpm)	Outlet Pipe Flow S.F.	Outlet Pipe Type
5	3+40	1080	317	438.5	437.0	150	0.01000	1893	6.0	16" SDR 13.5 HDPE
	10+00	820	142	435.0	433.5	110	0.01364	962	6.8	10" SDR 26 HDPE
	16+00	440	76	441.5	440.5	110	0.00909	786	10.3	10" SDR 26 HDPE
	29+50	1300	225	435.0	433.0	110	0.01818	1111	4.9	10" SDR 26 HDPE
	34+00	600	104	436.0	435.0	110	0.00909	786	7.6	16 " SDR 13.5 HDPE
	39+00	710	427	438.5	437.0	110	0.01364	2210	5.2	16 " SDR13.5 HDPE
6 (EAST)	0+00		197		442.5					Connect to Phase 5
	7+60	710	332	445.0	442.0	330	0.00909	1805	5.4	16" SDR 13.5 HDPE
	12+30	400	187	449.0	448.0	310	0.00323	1076	5.7	16" SDR 13.5 HDPE
6 (WEST)	0+00		206		444.0					Connect to Phase 5
	7+60	460	215	445.5	442.0	330	0.01061	1064	4.9	12" SDR 13.5 HDPE
	13+40	700	328	446.0	443.0	360	0.00833	1727	5.3	16" SDR 13.5 HDPE
					Σ =	2030				

Note: A 16" SDR 26 HDPE Pipe can be used instead of a 16" SDR 13.5 HDPE Pipe for Phase 5 (except at Sta. 3+40).

Outlet Pipe Footage: 10" SDR 26 = 330' | 12" SDR 13.5 = 330' | 16" SDR 13.5 = 1370'

Phase 5 Underdrain: Revised Design: Post Subsidence Underdrain Collector Pipe Capacity
12" SDR 13.5 HDPE Collector Pipe, ID = 10.749", n = 0.015 (aged), 0+00 TO 3+40
10" SDR 26 HDPE Collection Pipe, ID = 9.874" n =0.015 (aged), 3+40 to 40+90

Sta.	Δ L (ft)	Pipe Invert Elev	Pipe Slope (ft/ft)	Pipe Q (full) (gpm)	Σ ΔL Sta. to Sta (ft)	Σ Inflow Q (gpm)	Post Sub. Flow S.F.	
						(206 gpm)		from Phase 6
0		444.00						ties to phase 6
	110		0.01618	1314	110	225	5.8	
110		442.22						
	230		0.01618	1314	***340***	265	5.0	
340		438.50						outlet
	300		0.00500	582	***300***	52	11.2	
640		440.00						
	360		0.01389	939	***360***	62	15.1	
1000		435.00						outlet
	160		0.00938	798	***460***	80	10.0	
1160		436.50						
	300		0.02167	1213	300	52	23.4	
1460		443.00						
	140		0.01071	853	***140***	24	35.2	
1600		441.50						outlet
	300		0.00667	693	***300***	52	13.4	
1900		443.50						
	600		0.00500	582	600	104	5.6	
2500		440.50						
	450		0.01222	911	***1050***	182	5.0	
2950		435.00						outlet
	250		0.01200	903	***250***	43	20.9	
3200		438.00						
	200		0.01000	824	***200***	35	23.8	
3400		436.00						outlet
	400		0.01125	874	***400***	69	12.6	
3800		440.50						
	100		0.02000	1165	***100***	17	68.5	
3900		438.50						outlet
	190		0.02105	1195	***190***	230	5.2	
4090		442.50						ties to phase 6
Σ =	4090			Σ (bold) =	4090	(197 gpm)		from Phase 6

Bold - grade change *Bold & Italic* - sum of foot of pipe draining to outlet

Σ Inflow Q = 0.173 gpm/ft of pipe for Phase 5 embankment

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BY:	HLO	DATE:	4/29/2008	CHKD BY:	CEY	DATE:	8/8/08
PROJECT NAME:	Williamson Energy LLC						
PROJECT NO.	B05-33--1413			SHEET	3	OF	12
DESCRIPTION	Phase 5 Underdrain Design Revisions for Predicted Subsidence (File: PondCkUD5.xls)						

Phase 5 Underdrain: Existing Design: Underdrain Collector Pipe Capacity
12" SDR 13.5 HDPE Collector Pipe, ID = 10.749", n = 0.015 (aged)

Sta.	Δ L (ft)	Pipe Invert Elev	Pipe Slope (ft/ft)	Pipe Q (full) (gpm)	Σ ΔL Sta. to Sta (ft)	Σ Inflow Q (gpm)	Post Sub. Flow S.F. (1)	
0		444.00						ties to phase 6
	110		0.00588	792	110	21	37.3	
110		443.35						
	230		0.00588	792	***340***	66	12.1	
340		442.00						outlet
	190		0.00526	749	***190***	37	20.4	
530		443.00						
	360		0.00833	943	**360**	69	13.6	
890		440.00						outlet
	270		0.00504	734	***1190***	230	3.2	
1160		441.36						
	220		0.00504	734	920	178	4.1	
		442.47						
	80		0.00504	734	700	135	5.4	
1460		442.87						
	480		0.00504	734	620	120	6.1	
1940		445.29						
	140		0.00504	734	140	27	27.2	
2080		446.00						
	870		0.00632	821	870	168	4.9	
2950		440.50						
	80		0.00632	821	***950***	183	4.5	
3030		440.00						outlet
	655		0.00611	808	***655***	126	6.4	
3685		444.00						
	230		0.00494	726	230	44	16.4	
3915		442.86						
	175		0.00494	726	***405***	78	9.3	
4090		442.00						ties to phase 6
Σ =	4090		Σ (bold) =	4090				

old - grade change
Σ Inflow Q = 0.193 gpm/ft of pipe
Italic & Bold - sum of foot of pipe draining to outlet

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BY:	HLO	DATE:	5/14/2008	CHKD BY:	CEY	DATE:	5/16/2008
PROJECT NAME:	Williamson Energy LLC						
PROJECT NO.	B05-33--1413			SHEET	4	OF	12
DESCRIPTION	Phase 6 Underdrain Design Revisions - West Side						
	for Predicted Subsidence (File: PondCkUD6W(rev2).xls)						

Phase 6 Underdrain: Revised Design - Post Subsidence Underdrain Collector Pipe Capacity
West Side 12" SDR 13.5 HDPE Collector Pipe, ID = 10.749", n = 0.015 (aged)

Sta.	Δ L (ft)	Pipe Invert Elev	Pipe Slope	Pipe Q (full) (gpm)	Σ ΔL Sta. to Sta. (ft)	Σ Inflow Q (gpm) (1)	Post Sub. Flow S.F. (1)	
0		444.00						
	290		0.01023	1045	***440***	206	5.1	connect to phase 5
290		446.97						
	150		0.01023	1045	*150*	70	14.9	
440		448.50						
	60		0.00938	1001	60	28	35.6	
500		447.94						
	160		0.00938	1001	220	103	9.7	
660		446.44						
	100		0.00938	1001	***320***	150	6.7	
760		445.50						Outlet
	110		0.03929	2048	***140***	66	31.3	
0		449.82						
	30		0.03929	2048	30	14	145.9	
		451.00						
	335		0.01136	1101	335	157	7.0	Outlet
1235		447.19						
	105		0.01136	1101	***440***	206	5.3	
1340		446.00						Outlet
	30		0.00577	785	***260***	122	6.5	
1370		446.17						
	60		0.00577	785	230	108	7.3	
1430		446.52						
	100		0.00577	785	170	80	9.9	
1530		447.10						
	20		0.00577	785	70	33	24.0	
1550		447.21						
	50		0.00577	785	50	23	33.5	
1600		447.50						
Σ =	1600		Σ (bold) =	1600				

old - grade change Σ Inflow Q = 0.468 gpm/ft of pipe
allic & Bold - sum of foot of pipe draining to outlet

Alliance Consulting, Inc. ...neers · Constructors · Scientists	BY:	HLO	DATE:	5/3/2008	CHKD BY:	CEY	DATE: 8/8/08
	PROJECT NAME:	Williamson Energy LLC					
	PROJECT NO.	B05-33--1413			SHEET	5	OF 12
	DESCRIPTION	Phase 6 Underdrain Design Revisions - West Side for Predicted Subsidence (File: PondCkUD6W.xls)					

R17016

Phase 6 Underdrain: Existing Design - Underdrain Collector Pipe Capacity
West Side 12" SDR 13.5 HDPE Collector Pipe, ID = 10.749", n = 0.015 (aged)

Sta.	Δ L (ft)	Pipe Invert Elev	Pipe Slope (ft/ft)	Pipe Q (full) (gpm)	Σ ΔL Sta. to Sta (ft)	Σ Inflow Q (gpm) (1)	Post Sub. Flow S.F. (1)	
0		444.00		0				ties to phase 5
	290		0.01222	1142	***900***	421	2.7	
290		447.54						
	210		0.01222	1142	610	285	4.0	
500		450.11						
	156		0.01222	1142	400	187	6.1	
656		452.02						
	104		0.01222	1142	244	114	10.0	
760		453.29						
	110		0.01222	1142	140	66	17.4	
870		454.63						
	30		0.01222	1142	30	14	81.3	
00		455.00						Outlet
	335		0.00571	781	335	157	5.0	
1255		453.09						
	105		0.00571	781	440	206	3.8	
1340		452.49						
	30		0.00571	781	470	220	3.6	
1370		452.31						
	60		0.00571	781	530	248	3.1	
1430		451.97						
	100		0.00571	781	630	295	2.6	
1530		451.40						
	20		0.00571	781	650	304	2.6	
1550		451.29						
	50		0.00571	781	***700***	328	2.4	
1600		451.00						ties to phase3
Σ =	1600			Σ (bold) =	1600			

1) - Not including flows into or from Phases 3 or 5 underdrains
Bold - grade change Σ Inflow = 0.468 gpm/ft of pipe
Italic & Bold - sum of foot of pipe draining to outlet

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BY:	HLO	DATE:	5/14/2008	CHKD BY:	CEY	DATE:	6/4 8/8/08
PROJECT NAME:	Williamson Energy LLC						
PROJECT NO.	B05-33--1413			SHEET	6	OF	12
DESCRIPTION	Phase 6 Underdrain Design Revisions -East Side						
	for Predicted Subsidence - File: PondCkUD6E(rev).xls						

Phase 6 Underdrain: Revised Design - Underdrain Collector Pipe Capacity
East Side 12" SDR HDPE Collector Pipe, ID = 10.749", n = 0.015 (aged)

Note: Phase 6 will be built post subsidence.

Sta.	Δ L (ft)	Pipe Invert Elev.	Pipe Slope (ft/ft)	Pipe Q (full) (gpm)	Σ ΔL Sta. to Sta (ft)	Σ Inflow Q (gpm)	Post Sub. Flow S.F.	
0		442.50					Connect to Phase 5	
	225		0.01071	1069	***420***	197	5.4	
225		444.91						
	165		0.01071	1069	*195*	91	11.7	
390		446.68						
	30		0.01071	1069	30	14	76.1	
420		447.00						
	60		0.00645	830	60	28	29.6	
480		446.61						
	250		0.00645	830	***310***	145	5.7	
730		445.00						OUTLET
	400		0.01125	1096	***400***	187	5.9	
1130		449.50						
	100		0.00500	731	***100***	47	15.6	
1230		449.00						OUTLET
	300		0.01167	1116	***300***	140	7.9	
1530		452.50						
Σ ΔL =	1530			Σ (bold) =	1530			

Bold - grade change
Σ Inflow = 0.468 gpm/ft of pipe
Italic & Bold - sum of pipe footage draining to outlet

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BY:	HLO	DATE:	5/6/2008	CHKD BY:	DATE: 8/8/08
PROJECT NAME:	Williamson Energy LLC				
PROJECT NO.	B05-33--1413	SHEET	7	OF	
DESCRIPTION	Phase 6 Underdrain Design Revisions - East Side for Predicted Subsidence (File: PondCkUD6E.xls)				

R17018

Phase 6 Underdrain: Existing Design - Underdrain Collector Pipe Capacity

East Side 12" SDR 13.5 HDPE Collector Pipe, N = 0.015 (aged)

Sta.	Δ L (ft)	Pipe Invert Elev	Pipe Slope (ft/ft)	Pipe Q (full) (gpm)	Σ ΔL Sta. to Sta (ft)	Σ Inflow Q (gpm)	Post Sub. Flow S.F.	
0		442.00						outlet & ties to Phase 5
	225		0.01111	1089	***1440***	674	1.6	
225		444.50						
	165		0.00864	960	1215	569	1.7	
390		445.93						
	170		0.00864	960	1050	491	2.0	
560		447.40						
	172		0.00864	960	880	412	2.3	
732		448.88						
	168		0.00864	960	708	331	2.9	
900		450.33						
	330		0.00864	960	540	253	3.8	
30		453.19						
	210		0.00864	960	210	98	9.8	
1440		455.00						
	90		0.01111	1089	***90***	42	25.9	
1530		454.00						outlet & ties to Phase 3
Σ =	1530			Σ (bold) =	1530			

old - grade change Σ Inflow Q = 0.468 gpm/ft of pipe

allic & Bold - sum of foot of pipe draining to outlet

R17019

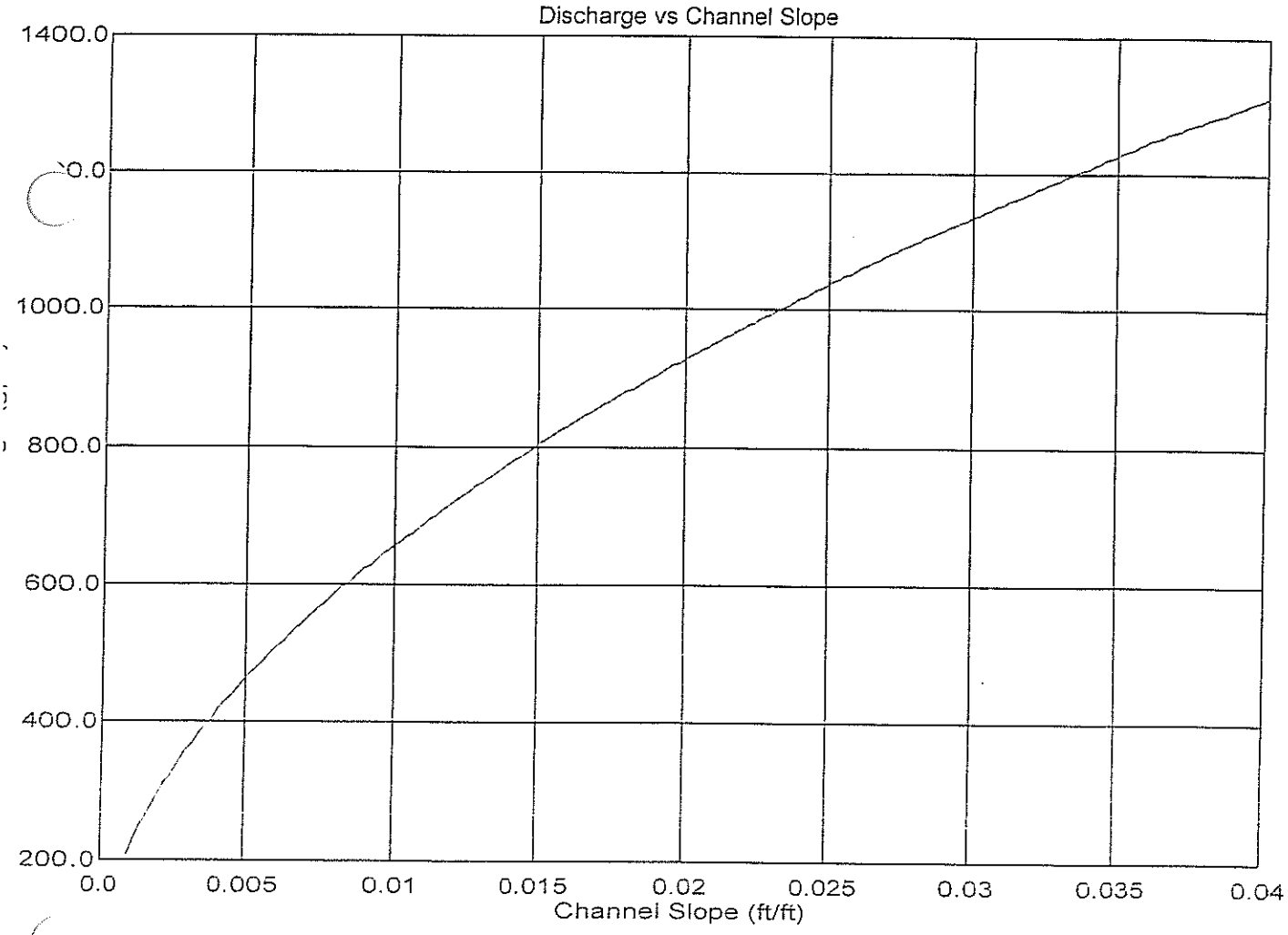
10" SDR 13.5 HDPE Pipe Rating Curve
Plotted Curves for Circular Channel

Project Description	
Project File	c:\haestad\fmw\pondck.fm2
Worksheet	10" SDR 13.5 HDPE Pipe Rating Curve
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

WILLIAMSON ENERGY LLC
203-330-1413
UNDERDRAIN REVISIONS
PHASES 3, 5, AND 6
WJG 4/29/09
SHEET 9 OF 12

Constant Data	
Mannings Coefficient	0.015
Depth	9.062 in
Diameter	9.062 in

Input Data			
	Minimum	Maximum	Increment
Channel Slope	0.001000	0.040000	0.000200 ft/ft



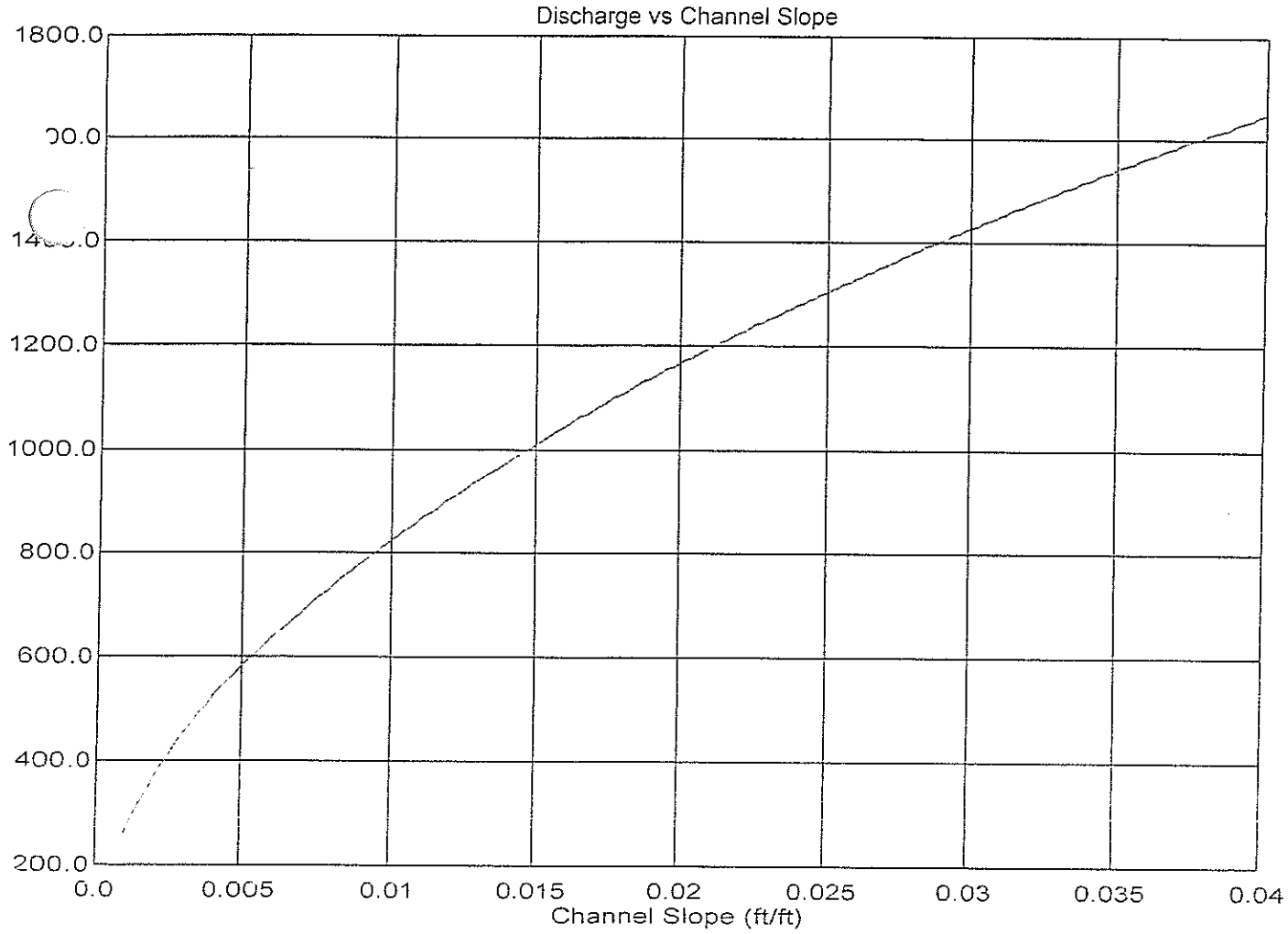
10" SDR 26 HDPE Pipe Rating Curve
Plotted Curves for Circular Channel

WILLIAMSON ENERGY LLC
805-330-1443
UNDERDRAIN REVISIONS
PHASES 3, 5 AND 6
HJD 4/29/08
SHEET 9 OF 12

Project Description	
Project File	c:\haestad\fmw\pondck.fm2
Worksheet	10" SDR 26 HDPE Pipe Rating curve
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data	
Mannings Coefficient	0.015
Depth	9.874 in
Diameter	9.874 in

Input Data			
	Minimum	Maximum	Increment
Channel Slope	0.001000	0.040000	0.000200 ft/ft



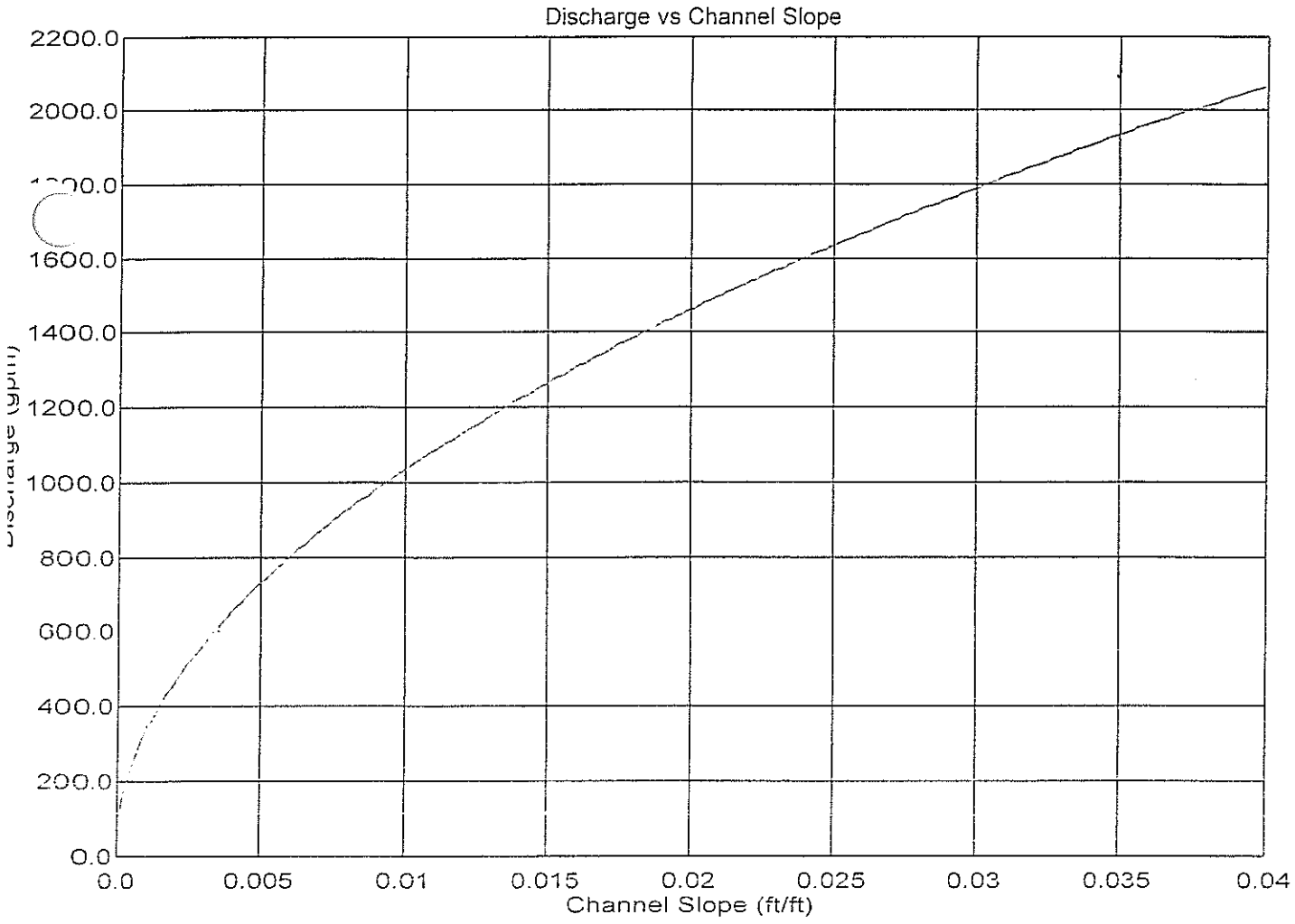
12" SDR 13.5 HDPE Pipe Rating Curve
Plotted Curves for Circular Channel

WILLIAMSON ENERGY LLC
605-330-1443
UNDERDRAIN REVISIONS
PAGES 3, 5, AND 6
W.O. #18813
SHEET 10 OF 12

Project Description	
Project File	c:\haestad\fmw\pondck.fm2
Worksheet	12" SDR 13.5 HDPE Pipe Rating Curve
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data	
Mannings Coefficient	0.015
Depth	10.749 in
Diameter	10.749 in

Input Data			
	Minimum	Maximum	Increment
Channel Slope	0.000100	0.040000	0.000200 ft/ft



16" SDR 13.5 HDPE Pipe Rating Curve
Plotted Curves for Circular Channel

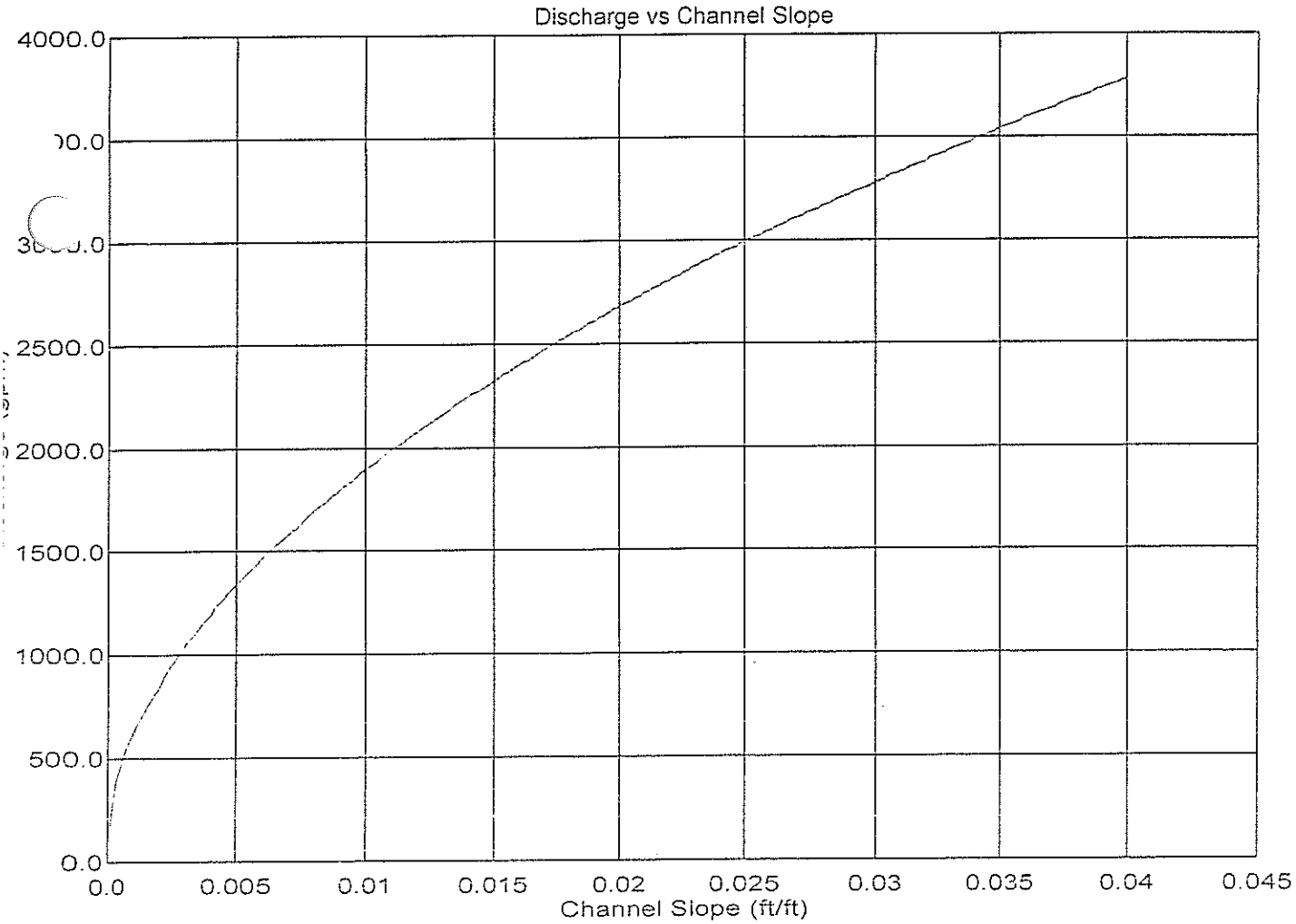
R17022

WILLIAMSON ENERGY LLC
805-330-1413
UNDERDRAIN REVISIONS
PAGES 3, 5, AND 6
NTS 4/09/08
SHEET 11 OF 12

Project Description	
Project File	c:\haestad\fmw\pondck.fm2
Worksheet	16" SDR 13.5 HDPE Pipe Rating curve
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data	
Mannings Coefficient	0.015
Depth	13.488 in
Diameter	13.488 in

Input Data			
	Minimum	Maximum	Increment
Channel Slope	0.000010	0.040000	0.000200 ft/ft



(70)
R17023

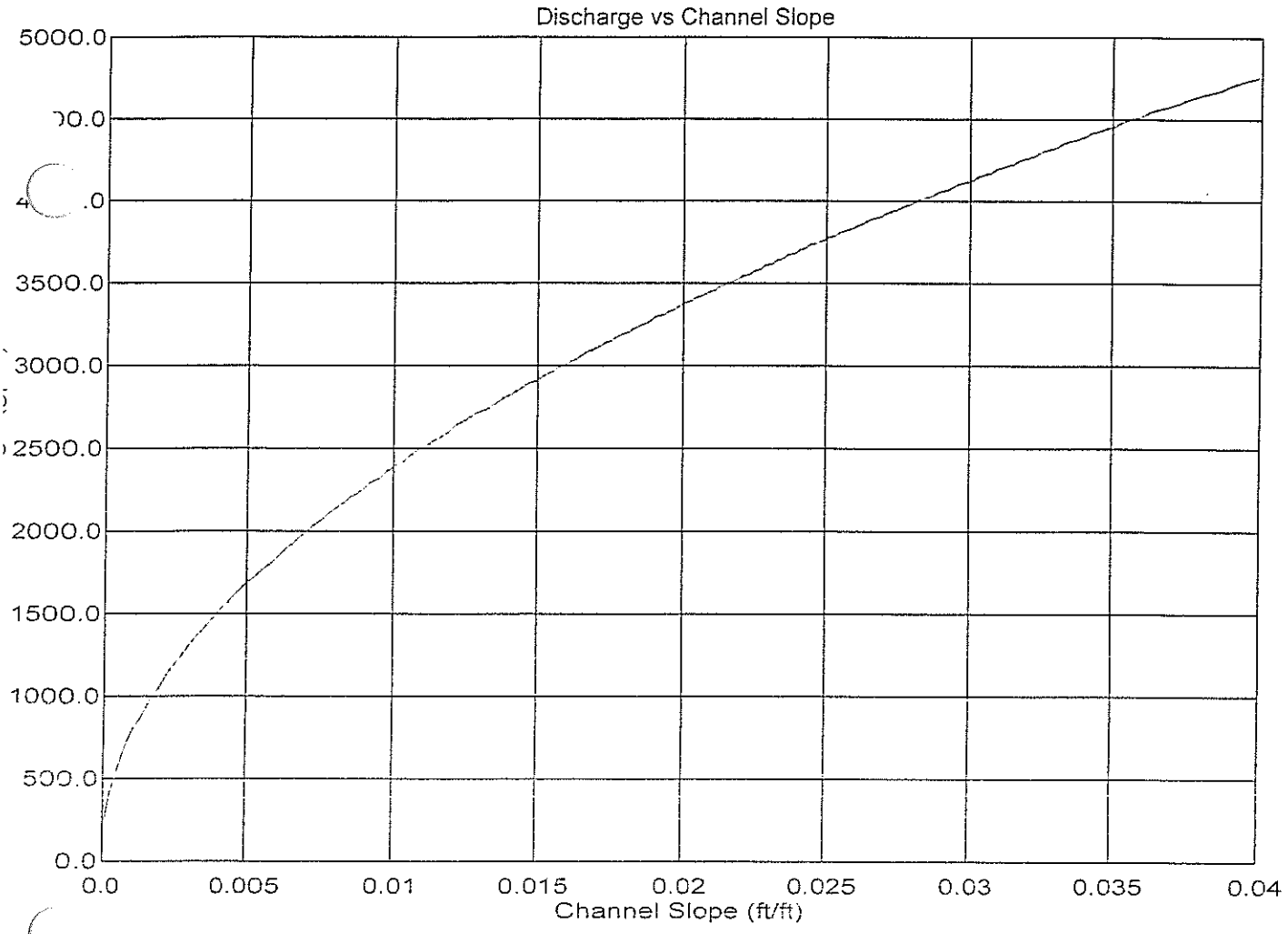
16" SDR 26 HDPE Pipe Rating Curve
Plotted Curves for Circular Channel

WILLIAMSON ENERGY LLC
905-330-1413
UNDERDRAIN REVISIONS
PHASES 3, 5, AND 6
NJD 4/29/08
SHEET 12 OF 12

Project Description	
Project File	c:\haestad\fmw\pondck.fm2
Worksheet	12" SDR HDPE Pipe Rating Curye
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data	
Mannings Coefficient	0.015
Depth	14.696 in
Diameter	14.696 in

Input Data			
	Minimum	Maximum	Increment
Channel Slope	0.000100	0.040000	0.000200 ft/ft



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(71)

Title: WILLIAMSON ENERGY, LLC R17024
UNDERDRAIN DESIGN
Project No.: 805-330-1413
By: HO Date: 4/10/08 Chkd: CEY Date: 8/8/08
SHEET 1 OF 10

REFERENCES: "PREDICTION OF GROUND MOVEMENT PARAMETERS DUE TO LONGWALL MINING DURING DIFFERENT PHASES OF IMPOUNDMENT," PENG, RAY, DU, WVU, MARCH 2008.

DRAWING - "PLAN - PHASE 2", ALLIANCE CONSULTING, INC., REV. 2, 08/10/06, DWG. NO. 805-330-M3, FIGURE NO. 4.

USING PENG'S REPORT, DETERMINE IF PREDICTED SUBSIDENCE ADVERSELY EFFECTS THE FUNCTION OF THE PHASE 2 EMBANKMENT UNDER DRAINS.

RESULTS - THE GROUND UNDER THE UNDERDRAINS WILL SUBSIDE 3.84' TO 1.72'. NO ADVERSE SLOPES WILL BE CREATED. THE OUTLET DRAIN ON THE SOUTH SIDE WILL BE SUBSIDED TO ≈0% SLOPE FOR IT'S 80' LENGTH. (THIS DRAIN IS ALREADY CONSTRUCTED) ←

PHASE 2 COMPLETION DATE: 11/13/08 (END OF PUMPING FCR)
LW MINING BENEATH:
PANEL 3: START - > 4/18/10 FINISH - 7/14/10
PANEL 4: START - > 1/18/11 FINISH - 7/11/11

∴ PHASE 2 WILL BE FINISHED & CAPPED BEFORE LW MINES UNDER

SEE ATTACHED DRAWING FOR SUBSIDENCE AMOUNTS ALONG UNDERDRAIN.

SUBSIDENCE EFFECTS ON PHASE 3 UNDERDRAIN

SEE ATTACHED DRAWING FOR SUBSIDENCE AMOUNTS ALONG DRAIN AND RECOMMENDED DRAIN INVERT ELEVATION CHANGES.

START ELEVATION ADJUSTMENTS FROM EXISTING DRAIN OUTLET INVERTS THE UNDERDRAIN IS A PERFORATED 12" DR-13.5 HDPE PIPE IN A 4' x 4' GRAVEL ENVELOPE. THE DRAIN SLOPE IS 0.43% TO 1.0%

PHASE 3 COMPLETION DATE: 9/8/09 (END OF PUMPING FCR)
LW MINING BENEATH:
PANEL 3: START - > 7/18/10 FINISH - 8/30/10
PANEL 2: START - > 10/17/09 FINISH - 10/28/09

∴ PHASE 3 WILL BE FINISHED (BY ABOUT A MONTH) BEFORE IT EXPERIENCES SUBSIDENCE.

SEE ATTACHED DRAWING FOR RECOMMENDED UNDERDRAIN INVERT ELEVATION ADJUSTMENTS. DRAIN OUTLETS ON NORTH SIDE MOVED TO EAST AND WEST SIDE TO AVOID THEIR TERMINATION INTO THE POOL OF PHASE 4 AND PHASE 6 EMBANKMENT.

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UNDERDRAIN DESIGN

Project No.: 805-330-1413

By: MD Date: 4/14/08 Chkd: DEW Date: 5/8/08

SHEET 2 OF 10

CROSS SECTION UNDERDRAIN

REFERENCE - "SOIL MECHANICS NOTE NO. 7, THE MECHANICS OF SEEPAGE ANALYSIS", SCS, USDA, OCTOBER 1979.

USE CASE II - HOMOGENEOUS SOIL, FIGURE 2, PAGE 11, TO GET DESIGN DISCHARGE FOR DRAIN.

SEE SHEET 3 OF FOR TRANSFORMED SECTION.

FROM TESTING CONCRETE BENCH $K_H = 2 \times 10^{-4}$ CM/SEC

ASSUME $K_H = 9$ K'

TRANSFORMATION FACTOR = $\sqrt{K_H/K_V} = \sqrt{9/1} = 3$ (HORIZONTAL)

Q = DISCHARGE PER UNIT WIDTH

$K' = \sqrt{K_H K_V} = \sqrt{9 \times 1} \times 10^{-4} = 6 \times 10^{-4}$ cm/sec $= 1.7$ FT/DAY

$$q = K' \frac{h^2}{2d} = \left(1.7 \frac{FT}{DAY}\right) \frac{(30 FT)^2}{2(135 FT)} = 5.7 \; FT^2/DAY\text{-}FT$$

$$= \frac{5.7 \; FT^2}{DAY\text{-}FT} \left(\frac{7.48 \; GAL}{FT^3}\right) \frac{DAY}{24 \times 60 \; MIN} = 0.193 \; GPM/FT$$

THE SOUTH AND PARTS OF THE EAST AND WEST SIDES OF PART 2 ARE AS SHOWN ON THE SHEET 2 OF CROSS SECTIONS. PHASE 1 WILL NOT BE AND COVER UP THE NORTH END.

USE A 10" SDR-26 HDPE PIPE FOR THE UNDERDRAIN FOR COLLECTOR PIPE ON THE SOUTH SIDE AND WHERE COVER ALLOWS (SEE PHASE 2 & 3 CROSS SECTIONS FOR PART 3)

USE A 10" SDR-13.5 HDPE PIPE FOR THE NORTH END AND EAST AND WEST SIDES WHERE COVER OVER THE PIPE EXCEED 37' (SEE PHASE 2 & 3 CROSS SECTIONS FOR DRAINS)

3 TRANSECTS TAKEN ALONG THE LENGTH OF THE 10" PIPE CLOSE TO THE OUTLET.

NOTE: TRENCH WIDTH THE UNDERDRAIN SHOULD BE AT LEAST $2 \times 6'$ MAY TO CHANGE DUE TO THE FIELD. PHASE 3 IS SHOWN TO SCALE.

ABOUT 10 MINUTES OF FLOW EXAMINED, AND DOES NOT HAVE ANY APPARENT SEEPAGE. IT IS DOWN HILL OF THE PROPOSED UNDERDRAIN. SEEPAGE SHOULD BE ENOUGH TO KEEP SAMPLES. THE SEEPAGE TAKEN THROUGH THE EMBANKMENT CONTAINMENT

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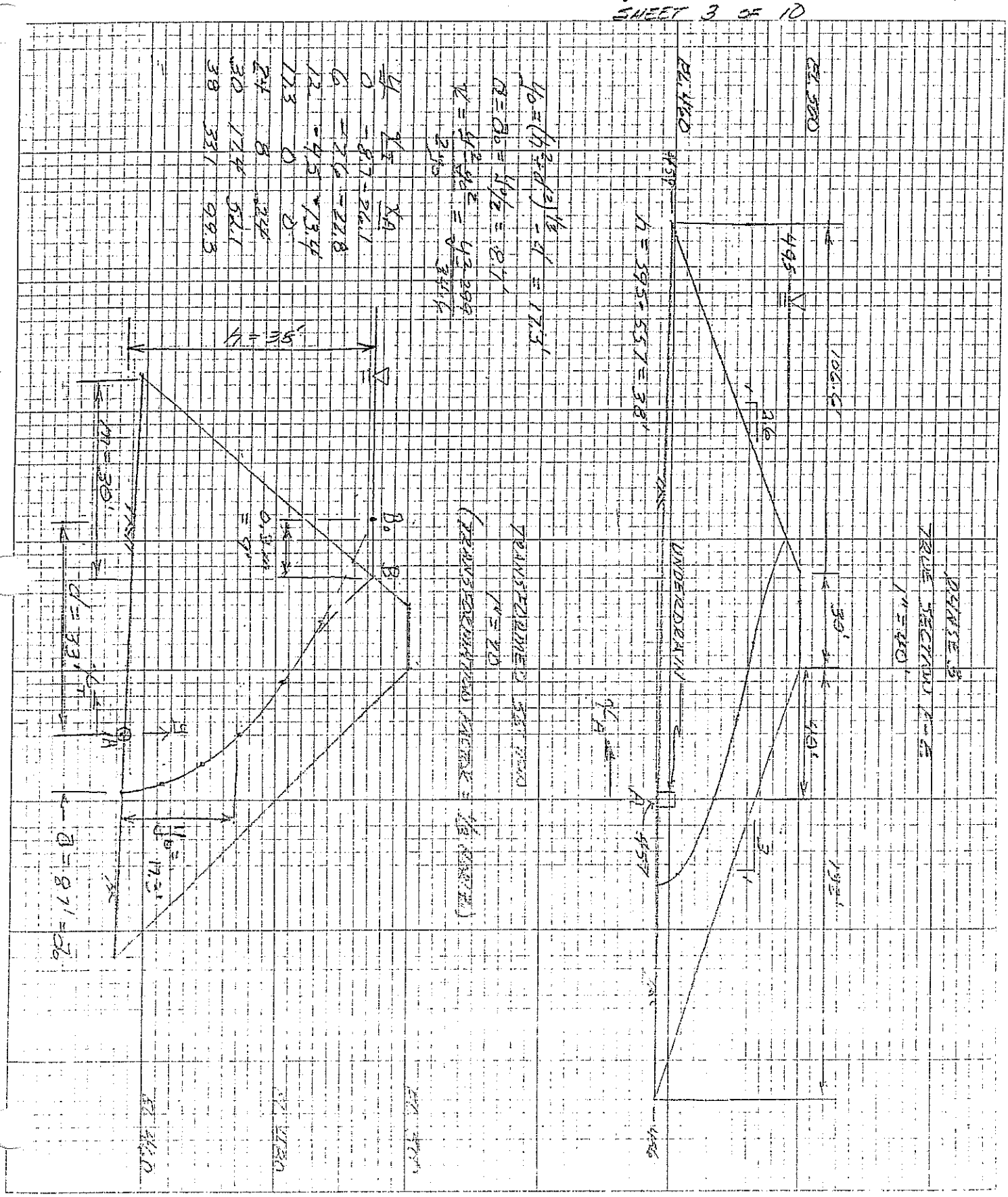
Title: WILLIAMSON ENERGY LLC
UNDERDRAIN DESIGN

R17026

Project No.: BOS-330-1413

By: MD Date: 4/14/08 Chkd: CH Date: 8/8/08

SHEET 3 OF 10



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Title: WILLIAMSON ENERGY LLC R17027
UNDERDRAIN DESIGN

Project No.: 805-330-1413

By: MD Date: 4/14/08 Chkd: CEY Date: 8/8/08

SHEET 4 OF 10

UNDERDRAIN COLLECTOR PIPE CAPACITY - PHASE 3

PIPE: 10" SDR-26 HDPE PIPE (IPS SIZE)
n = 0.015, ID = 9.874", OD = 10.75", t = 0.413"
A = 0.532 FT²

DETERMINE PIPE CAPACITY FOR VARIOUS SLOPES

SLOPE (FT/FT)	FLOW DEPTH (IN)	Q(FULL) (GPM)	Q(MAX) (GPM)	MAX. RUN LENGTH (FT)	
0.005	9.874	583	427	3021'	MAX. RUN LENGTH
0.006		638	456	3306'	TO COLLECT
0.007		689	742	3570'	0.193 GPM/FT
0.0075		714	768	3699'	FLOWING FULL
0.008		737	793	3819'	(NO S.F.)
0.009		782	841	4052'	
0.010		824	886	4269'	
0.011		864	930	4477'	
0.0028		436	469	2259'	

PIPE: 10" SDR-13.5 HDPE PIPE (IPS SIZE)
n = 0.015, ID = 9.062", OD = 10.75", t = 0.786"
A = 0.448 SF

DETERMINE PIPE CAPACITY FOR VARIOUS SLOPES

SLOPE (FT/FT)	FLOW DEPTH (IN)	Q(FULL) (GPM)	Q(MAX) (GPM)	MAX RUN LENGTH (FT)
0.005	9.062	463	498	2580'
0.006		508	546	2832'
0.007		548	590	2839'
0.0075		568	610	2943'
0.008		587	631	3534'
0.009		622	669	3223'
0.010		655	705	3394'

NOTE: Q(FULL) ≥ 93% Q(MAX.)

PRELIMINARY DESIGN
FOR SHEET - NOT FOR USE
FOR CONSTRUCTION

Alliance Consulting, Inc.

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Phone: (304) 255-0491 Fax: (304) 255-4232

Title: Williamson Energy LLC R17028
Underdrain Design

Project No.: BOS-330 - 1413

By: MS Date: 4/7/08 Chkd: DJH Date: 8/8/08

SHEET 5 OF 10

CHECK MAIN U/D COLLECTOR PIPE CAPACITY - PIPE SIZE SDR 26

REQUIRED: Q = 15.40 GPM - 330 - 237, CAP BY MANNING EQ, n = 0.015 (HDPE, NOTE)

10" SDR-26 HDPE PIPE

MAN. EQ = 9.874", A = 0.532 FT²

10" SDR-135 HDPE PIPE

MAN. EQ = 9.02", A = 0.448 FT²

STA.	PIPE SIZE	ΔL (FT)	Σ L (FT)	MFLOW @ (GPM)	PIPE SLOPE	PIPE FULL CAPACITY (GPM)	MFLOW @ Σ L
0+00	SDR 26	430	430	83	0.00512	590	2.11
4+30	"	430	430	93	0.00512	590	7.41
8+60	"	700	700	135	0.00386	441	3.27
15+40	SDR 13.5	165	165	32	0.03907	627	19.5
17+25	"	375	540	104	0.00307	424	6.0
21+00	"	310	310	60	0.00434	420	7.46
24+10	"	1890	1890	365	0.00503	485	1.27
42+00	"	370	960	185	0.00630	597	3.23
51+70	SDR 26	100	590	114	0.00836	751	6.59
52+70	"	470	470	93	0.02347	1462	13.25
57+40	"	420	890	131	0.00662	670	5.71

5745 GPM — 1458

MFLOW @ = 0.183 GPM/FT OF PIPE DRAINING TO THAT SECTION

CHECK OUTLET PIPE CAPACITY

OUTLET NO.	PIPE SIZE	ΣL (FT)	Σ MFLOW @ (GPM)	PIPE SLOPE	PIPE FULL CAPACITY (GPM)	Σ MFLOW @ Σ L
1	SDR 13.5	850	1458	0.021	950	5.79
2	SDR 26	1150	2113	0.010	824	17.8
3	SDR 26	1110	2114	0.010	824	3.85
4	SDR 13.5	1850	3550	0.0069	524	0.97
		3945 GPM	1458 GPM			

ABOVE PIPE CAPACITY (MFLOW @) DOES NOT INCLUDE THE HEAD CAPACITY OF THE GRAVEL UNDERDRAIN.

NOTE: MANNING EQ FOR HDPE (SMOOTH) PIPE FROM CALX, PG 5-23

CONCLUSION: OUTLET PIPE NO. 4 AND 1470 IS ADEQUATE FOR THE CALCULATED FLOW OF 3945 GPM.

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Title: Williamson Energy LLC R17029
Underground Design

Project No.: BDS-330-1413

By: HB Date: 4/21/08 Chk'd: CEW Date: 8/8/08

SHEET 6 OF 10

CHECK PHASE 5 COLLECTOR PIPE CAPACITY: POST-SUBSIDENCE

STA	ΔL (FT)	INVERT ELEV PRE-SUB.	SUB. ΔH (FT)	POST-SUB. INVERT ELEV	POST-SUB SLOPE (FT/FT)	10" PIPE SDR	PIPE FULL FLOW (GPM)	INFLOW Q (GPM)	INFLOW Q S.F.
0+00		464	-3.83	460.17					
4+30	430	466.2	-3.44	462.76	0.00602	26	639	83	7.70
8+60	330	464	-3.37	461.63	0.00663	26	422	83	5.08
13+40	200	466	-0.37	465.59	0.00566	26	620	135	4.59
17+25	165	464.5	-0.24	464.26	0.00806	13.5	588	32	18.38
21+00	375	461.1	-3.55	457.55	0.00344	13.5	384	104	3.69
24+00	310	462.6	-3.83	458.95	0.00452	13.5	441	60	7.35
45+00	1800	453.1	-3.55	449.55	0.00497	13.5	462	365	1.27
46+70	320	456.17	-0.22	455.95	0.0173	13.5	860	185	4.65
47+70	100	457	-0.23	456.73	0.0080	26	737	114	6.46
52+60	490	458.3	-3.84	454.66	0.00427	26	538	95	5.66
57+40	680	464	-3.83	400.17	0.0081	26	742	131	5.66

CHECK OUTLET PIPES CAPACITY: POST-SUBSIDENCE

OUTLET NO	L (FT)	OUTLET ELEV PRE-SUB.	OUTLET SUB. ΔH (FT)	POST-SUB. OUTLET ELEV	INLET ELEV PRE-SUB.	INLET SUB. ΔH (FT)	POST-SUB. INLET ELEV.	POST-SUB. SLOPE (FT/FT)
1	100	459	-3.55	455.45	461.1	-3.55	457.55	0.0210
2	100	463	-3.62	459.38	464	-3.37	461.63	0.0225
3	100	463	-3.84	459.16	464	-3.83	460.17	0.0101
4	160	451	-3.55	448.45	453.1	-3.55	449.55	0.0069

OUTLET NO	10" PIPE SDR	PIPE FULL FLOW (GPM)	Σ INFLOW Q (GPM)	Σ INFLOW Q S.F.
1	13.5	950	164	5.79
2	26	1236	218	5.67
3	26	829	214	3.87
4	13.5	751	550	1.37

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Title: William Geary LLC R17030
Underdrain Design
Project No.: 205-330-1413
By: MD Date: 4/25/08 Chkd: CEH Date: 8/8/08
Sheet 7 of 10

PHASE 4 UNDERDRAIN

NO UNDERDRAINS WILL BE INSTALLED IN THIS PHASE

PHASE 5 UNDERDRAIN

PIPE: 12" SDR 13.5 (PE)
OD = 12.75" ID = 10.719"
n = 0.015

(SEE VENA'S DRAINAGE CALCULATIONS)

EXISTING DESIGN: (PHASE 5 WILL BE BUILT POST-SETTLEMENT)

STA.	ΔL (FT)	INVERT ELEV.	ΔH (FT)	SLOPE (FT/FT)	Q (FULL) (GPM)	INFLOW Q (GPM)	FLOW V. FT
0+00		4424					
3+40	340	4422	2	0.005882	792	46	12.0
5+30	190	4423	1	0.005263	749	37	20.2
5+40	340	4440	3	0.008823	943	69	13.7
20+80	1740	4446	6	0.003207	734	250	3.2
30+30	1950	4449	6	0.003034	921	193	4.5
34+85	655	4444	4	0.006107	898	127	6.4
40+90	605	4442	2	0.003306	724	77	9.4
	4090'						

INFLOW Q = 46 (0.1 GPM) = MAX HEAD OF 4' ± 443-440 = 40" ± 39"
CHECK VENA HAS THE PHASE 4 UNDERDRAIN CONNECTED TO THE PHASE 5 UNDERDRAIN.

REVISE PHASE 5 AND PHASE 6 UNDERDRAIN DESIGN FROM ORIGINAL PLAN DESIGN TO ACHIEVE A FLOW CAPACITY SIMILAR TO THE 24" PVC FOR THE RELOCATED COLLECTION PIPE (SINCE THE PIPE IS A CONTROLLED, MANUFACTURED MATERIAL, I'M CONSIDERING I USE A SAFETY FACTOR OF 1/2 FOR THE ROUGHNESS AROUND THE UNDERDRAIN AGGREGATE AND THE FLOW THROUGH THE PIPE PERFORATIONS.

PHASE 6

NOTE I WILL USE THE PHASE 6 UNDERDRAIN DESIGN TIME PHASE 6 UNDERDRAIN WILL HAVE ESTIMATED SETTLEMENT SEE NOTE 5 ON SHEET 7

NOTE 5

NO ADDITIONAL UNDERDRAINS ARE PLANNED FOR THIS PHASE

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Title: WILLIAMSON ENERGY LLC R17031
UNDERDRAIN DESIGN

Project No.: BOS-330-1413

By: HB Date: 4/28/08 Chkd: RFH Date: 8/8/08

SHEET 8 OF 10

PHASE 5 UNDERDRAIN - EXISTING DESIGN

SUBSIDENCE PLONG UNDERDRAIN (FROM PENG'S MARCH 2008 REPORT)

	UNDERDRAIN STATION	DISTANCE ON A-A	SUBSIDENCE (FT)	ORIGINAL GROUND ELEV.	REMARKS
x	0+00	1440	0.35	442	TIE TO PHASE 6 UNDERDRAIN
	1+10	1440	0.35	444	CORNER
	3+90	1210	3.36	441	OUTLET
	5+30	1020	3.87	442.5	GRADE CHANGE
	8+90	660	3.87	440	" " & OUTLET
	11+60	390	3.86	439.5	SUBSIDENCE PROFILE CHANGE
	13+80	170	1.90	442	" " "
	14+60	80	0.39	443.5	CORNER
	19+40	160	1.69	444	SUBSIDENCE PROFILE CHANGE
	20+80	185	2.22	444	GRADE CHANGE.
	29+50	320	3.78	439	CORNER
	30+30	400	3.81	440	GRADE CHANGE & OUTLET
	36+85	1055	3.87	442	GRADE CHANGE
	39+15	1295	2.10	441	SUBSIDENCE PROFILE CHANGE
x	40+90	1460	0.24	442	TIE TO PHASE 6 UNDERDRAIN (OUTLET)

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UNDERDRAIN DESIGN - PHASE 6
Project No.: 805-330-1413
By: MD Date: 5/6/08 Chkd: DEW Date: 8/8/08
SHEET 9 OF 10

PHASE 6 UNDERDRAIN DESIGN - EXISTING DESIGN - EAST SIDE

PIPE STA.	EXIST. GROUND ELEV.	PIPE INVERT ELEV.	SUB. (FT)	POST-SUB. GROUND ELEV	PENG'S SECT. A-A STATION
0+00	442.4	442	0.24	442.2	1445
2+25	443.6	443.5	0.24	443.3	1460
5+60	446.8	—	1.45	445.3	1795
9+00	450	—	3.85	446.2	2135
12+30	452	—	3.85	448.2	2465
14+40	—	455	3.85	—	2675
15+30	454.5	454	3.80	450.7	2765

CRITICAL SUBSIDENCE STATIONS (CHANGE IN CURVATURE)

PIPE STA	PENG'S SECT. A-A STA	SUB (FT.)	
0+00	1445	0.24	(AND 2+25)
3+91	1624	0.22	
5+71	1806	1.66	
7+32	1967	3.79	

(PIPE STA. + 1225) = PENG'S STA

PHASE 6 EXISTING DESIGN FLOW CAPACITY SAFETY FACTOR

PIPE STA	PIPE INVERT ELEV	ΔL (FT)	SLOPE (FT/FT)	PIPE FULL FLOW (GPM)	INFLOW Q (GPM)	INFLOW S.F.
0+00	442	225	0.01111	1099	674	1.6
2+25	443.5	125	0.00384	960	509	1.7
14+40	455	90	0.01111	1097	42	25.9
15+30	454					

NOTE - PHASE 3 UNDERDRAINS WILL NOT BE CONNECTED TO PHASE 6 UNDERDRAINS

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Title: WILLIAMSON ENERGY
UNDERDRAIN DESIGN - PHASE 6

R17033

Project No.: 205-330-1413

By: HS Date: 5/2/08 Chkd: CFY Date: 8/8/08

SHEET 10 OF 10

PHASE 6 UNDERDRAIN PROFILES - EXISTING DESIGN - WESTSIDE

PIPE STATION	EXIST GROUND ELEV.	PIPE INVERT ELEV.	SUB. (FT)	POST-SUB. GROUND ELEV.	RENO'S SECT A-A STATION	
0+00	442	442A	0.32	441.7	13+20	
2+50	444	—	0.32	443.7	14+50	
5+45	447	—	0.25	445.8	16+50	
7+65	443	—	3.37	439.6	17+10	
8+70	450	—	3.82	446.2	20+20	Edge Spoil
9+07	455	455	3.84	451.2	20+50	
10+32	452	—	3.85	448.2	23+35	Edge Spoil
13+40	448	—	3.85	444.2	24+90	
13+70	448	—	3.85	444.2	25+20	Creek
14+50	450	—	3.85	446.2	25+50	
15+50	448	—	3.85	444.2	26+50	
15+80	445	—	3.85	441.2	27+00	Creek
16+20	454	454	3.84	450.2	27+50	

VERTICAL SUBSOILING STATIONS (CHANGE IN CURVATURE)

PIPE STATION	EXIST GRD ELEV	SUB DEPTH
2+25	1444	0.26
4+75	1426	0.22
6+35	1506	1.66
7+17	1447	3.79

(PIPE STA. - 1+50' = SUBSOIL STA)

PHASE 6 UNDERDRAIN PIPE

12" SDR 35 PIPE, TO = ADS N-12, N-12 HDPE

PHASE 6 UNDERDRAIN - EXISTING DESIGN - PIPE SIZING SPREADSHEET FLOW DATA

STATION	LENGTH	SLOPE (%)	RATIONAL Q (CFS)	CHES Q (CFS)	PIPE CAP. FLOW (GPM)	VELOCITY (FPS)
0+00 E						
9+00 E	900	33	4.91	5.0222	1178	6.71
18+50 E	950	20	5.18	5.0057A	751	2.38
2+25 W	225	1.00	0.44	0.0111	1057	1.44
4+75 W	225	1.00	0.27	0.00834	790	1.09
6+35 W	160	1.00	0.18	0.0071	1057	2.29

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D1

R17034

Title: WILLIAMSON ENERGY LLC
PHASE 5 SEEPAGE THROUGH DAM

Project No.: 805-330-1493

By: MO Date: 5/14/09 Chkd: CEH Date: 8/8/08

SHEET 1 OF 2

PHASE 5 EMBANKMENT

REFERENCE: SM NOTE NO. 7, SCS, USDA, OCT. 1979. CASE II, FIG. 4, PG. 11. ANISOTROPIC SOIL, $K_H = K_V$ (ASSUMED)

CROSS-SECTION DATA - MOST CONSERVATIVE SECTION

UPSTREAM SLOPE = 3:1
DOWNSTREAM SLOPE = 3:1
DAM CREST TOP WIDTH = 20', ELEV. 488
UNDERDRAIN IS 50' D.S. OF D.S. EDGE OF DAM CREST
(SEE ATTACHED CROSS-SECTIONS)

GROUND ELEVATIONS (AT UNDERDRAIN STA 26+10)

X-SECT STA	PRE-SUBSIDENCE	SUBSIDENCE ΔH-FT	POST-SUBSIDENCE	PERP A'-A STA
0+00	444.2	3.87	440.3	535
0+75	444.0	3.87	440.1	460
2+00	442.5	3.81	438.7	330
2+50	442.0	3.64	438.4	285
3+50	440.0	2.12	437.9	180
4+00	446.0	1.09	438.9	130

DAM CROSS-SECTION (TRUE SECTION)

X-SECT STA.	ΔL (FT)	EL (FT)	ELEV.	REMARKS
0+00		0	440 ±	IN CUT (INCISED PART, POST SUBSIDENCE)
	30			
0+30		30	440 ±	U.S. TOE (POST SUBSIDENCE)
	120			
1+50		150	480.0	MAX. SLURRY LEVEL
	24			
1+74		174	488.0	U.S. EDGE DAM CREST
	20			
1+94		194	488.0	D.S. EDGE DAM CREST
	50			
2+44		244	438 ±	℄ UNDERDRAIN (POST SUBSIDENCE)
	81			
3+25		325	444 ±	U.S. EDGE BENCH
	20			
3+45		345	444 ±	D.S. " "
	18			
3+63		363	438 ±	D.S. TOE OF DAM (POST SUBSIDENCE).

FLOW THROUGH DAM

$K_V = 2\times10^{-4}$ cm/sec, $K_H = 9K_V = 18\times10^{-4}$ cm/sec

$K' = (K_V K_H)^{1/2} = 6\times10^{-4}$ cm/sec = 1.7 FPD

$Q = K'\left(\frac{h^2}{2L_{eq}}\right) = (1.7\ FT/DAY)\frac{(4.5\ FT)^2}{2(44\ FT)} = 39.3\ FT^2/DAY$

$= \frac{39.3\ FT^2}{DAY}\left(\frac{7.48\ GAL}{FT^3}\right)\left(\frac{DAY}{24\ HOURS}\right) = 0.173$ GPM/FT OF DAM

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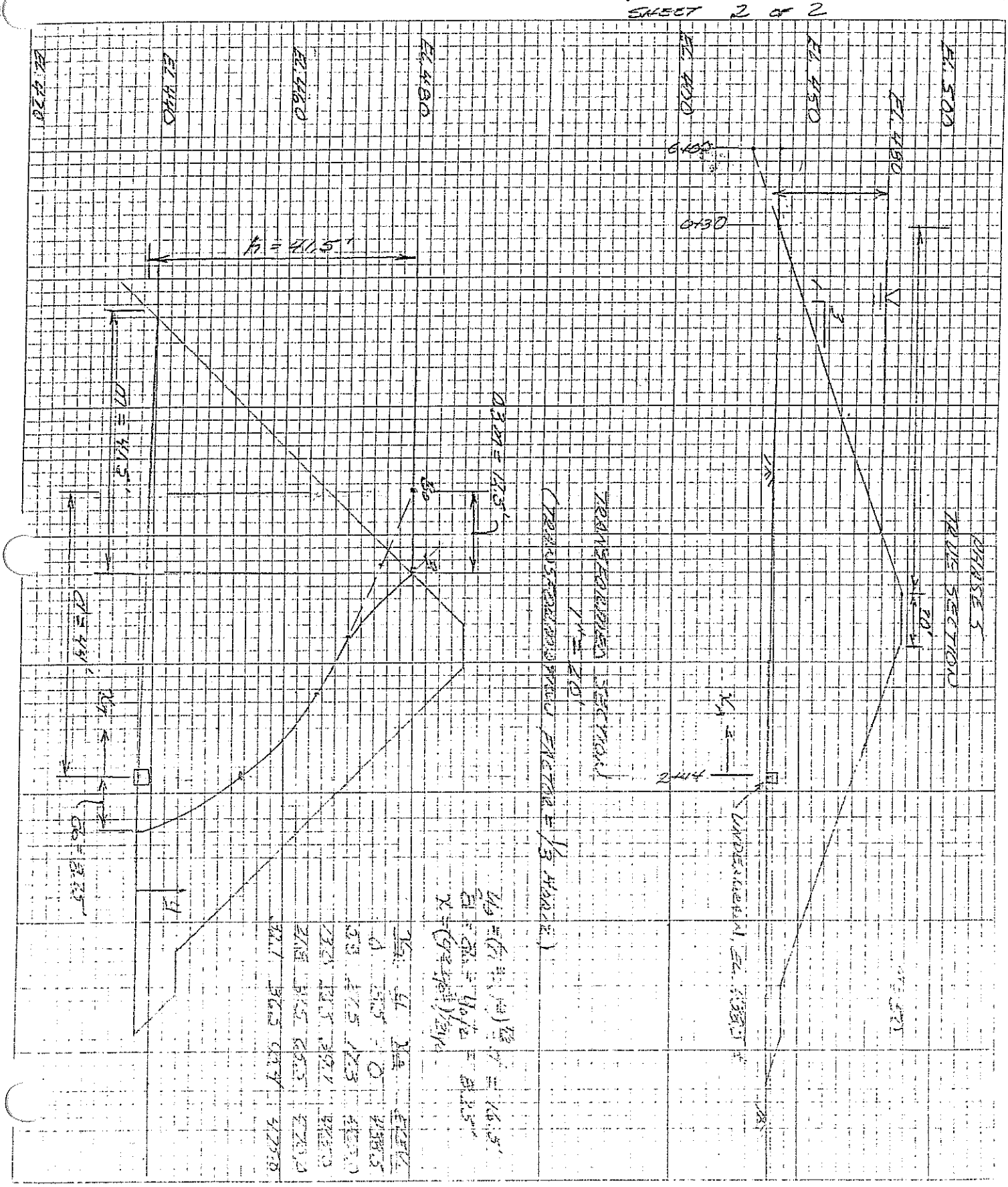
Title: Williamson Energy LLC — Phase 5 Seepage through Dam

R17035

Project No.: ECS-330-1413

By: MS Date: 5/14/08 Chkd: CEY Date: 8/8/08

Sheet 2 of 2



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Title: WILLIAMSON ENERGY, LLC R17036
UNDERDRAIN DESIGN - PHASE 7
Project No.: 205-330-413
By: MO Date: 5/1/08 Chkd: CEY Date: 8/8/08
SHEET 1 OF 2

PHASE 7 UNDERDRAIN (INSTALLED IN PHASE 6)

REFERENCE: "SOIL MECHANICS NOTE NO. 7, THE MECHANICS OF SEEPAGE ANALYSIS", SCS, USDA, OCTOBER 1979

USE CASE V - ARMSTRONG SOIL, FIGURE 6, PAGE 11 TO GET DESIGN DISCHARGE FOR UNDERDRAIN.

SEE NEXT SHEET FOR TRUE AND TRANSFORMED SECTION

TRANSFORMATION FACTORS

$K_V = 2 \times 10^{-4}$ cm/sec (FROM CCR PERMEABILITY TEST)

ASSUME $K_H = 9\ K_V$

TRANSFORMATION FACTOR $= (K_V/K_H)^{1/2} = 1/3$ (HORIZONTAL)

$K' = (K_V K_H)^{1/2} = 1/3 (2 \times 10^{-4})^{1/2} = 6.6 \times 10^{-4}$ cm/sec $= 1.9 \times 10^{-3}$ ft/day

EQUATIONS:

$y_0 = [(h^2 + d^2)^{1/2} - d] = [(54^2 + 66.5^2)^{1/2} - 66.5] = 40.6'$

$a = a_0 = y_0/2 = 40.6/2 = 20.3'$

$w = (y^2 - y_0^2)/2y_0 = (y^2 - 1649)/81.3$

WALL COORDINATES OF TRANSFORMED & TRUE SECTION (RADIATE LINE)

y	y_T	y_A		SLOPE (%)	STA (TRUE)
0	-20.3'	40.6'	a_0	4.4%	4+37
10	-19.1'	51.2		4.5%	4+33
20	-13.4'	46.2		4.6%	4+22
30	-8.2	27.7		4.8%	4+04
40.6	0	0	UNDERDRAIN	4.8%	3+76
50	10.4	31.3		4.7%	3+45
60	24.0	72.2		4.6%	3+16
70	40.1	112.3		4.5%	2+86
84	64.4	174.4	a_1	5.0%	2+53

HEADLESS TRENCH

POOL EDGE

FLOW THROUGH DRAIN

$Q = K' \frac{A^2}{P_{wet}} = (6.7 \times 10^{-3}) \frac{(54 \times 7)^2}{2(66.5 ft)} = 10.2\ ft^3/day\text{-}ft$

$= \frac{10.2\ ft^2}{day \cdot ft} \left(\frac{7.48\ gal}{ft^3}\right) \frac{DAM}{24(60)\ min} = 0.53\ GPM/ft$

USING PLANIMETER, MEASURED AREA OF SECTION AT ANGLE SECTION D-D, DWG. NO. 205-330-E12 (MEASURED AT TRANSFORMATION LINE AT BASE OF TRUE SECTION)

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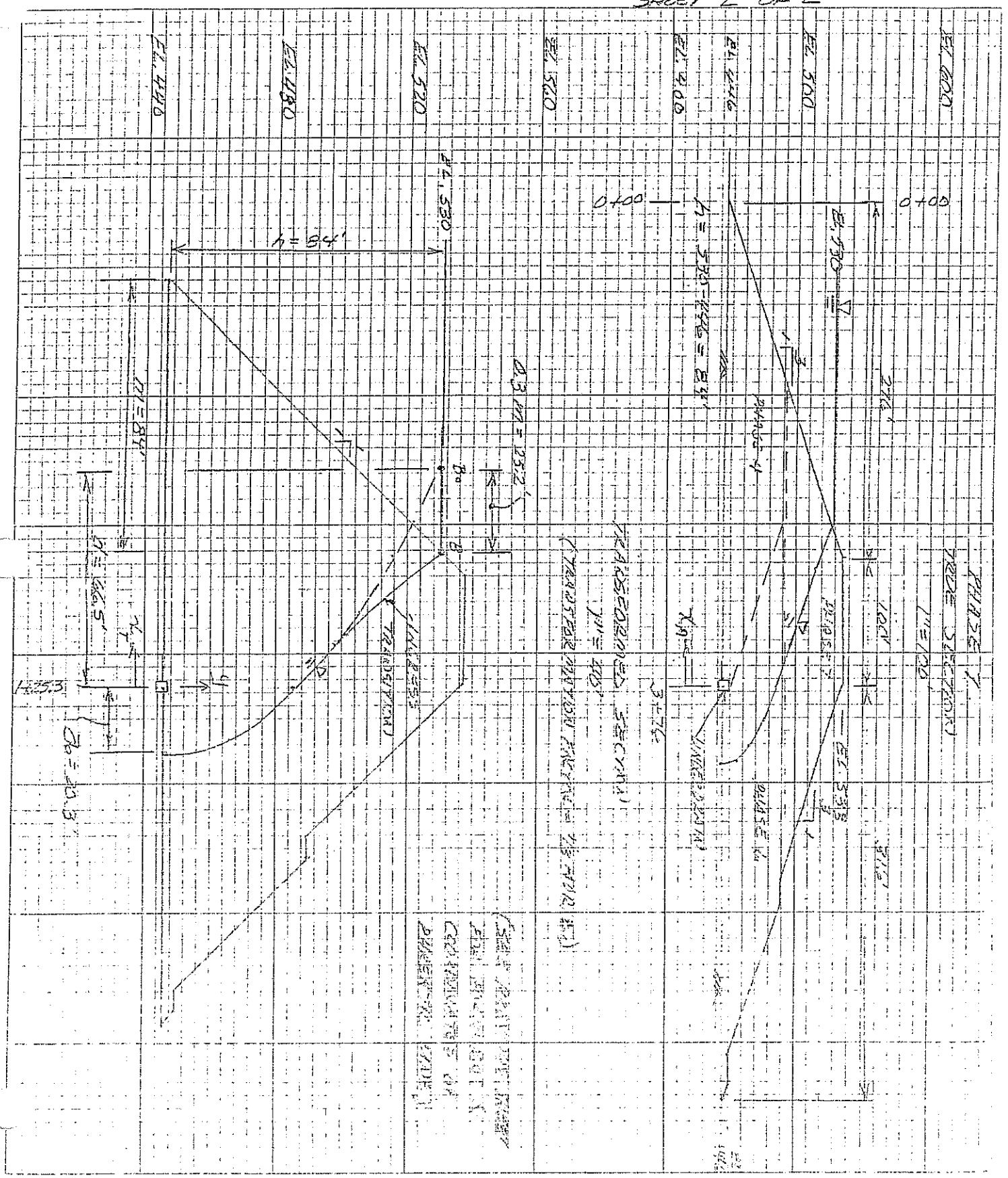
Title: Williamson Energy LLC
Under Drain Design - Sheet 7B

R17037

Project No.: 805-330-1413

By: MC Date: 5/1/08 Chkd: LEY Date: 8/8/08

SHEET 2 OF 2


EL. 4180
EL. 4080
EL. 3980
EL. 3920
EL. 3880
EL. 3840
EL. 3800
EL. 3760
EL. 3720
EL. 3680
EL. 3640
EL. 3600
EL. 3560
EL. 3520
EL. 3480
EL. 3440
EL. 3400
EL. 3360
EL. 3320
EL. 3280
EL. 3240
EL. 3200
EL. 3160
EL. 3120
EL. 3080
EL. 3040
EL. 3000
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EL. 2440
EL. 2400
EL. 2360
EL. 2320
EL. 2280
EL. 2240
EL. 2200
EL. 2160
EL. 2120
EL. 2080
EL. 2040
EL. 2000
EL. 1960
EL. 1920
EL. 1880
EL. 1840
EL. 1800
EL. 1760
EL. 1720
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EL. 1640
EL. 1600
EL. 1560
EL. 1520
EL. 1480
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EL. 1400
EL. 1360
EL. 1320
EL. 1280
EL. 1240
EL. 1200
EL. 1160
EL. 1120
EL. 1080
EL. 1040
EL. 1000
EL. 960
EL. 920
EL. 880
EL. 840
EL. 800
EL. 760
EL. 720
EL. 680
EL. 640
EL. 600
EL. 560
EL. 520
EL. 480
EL. 440
EL. 400
EL. 360
EL. 320
EL. 280
EL. 240
EL. 200
EL. 160
EL. 120
EL. 80
EL. 40
0+00
0+00
0+00
h = 99.4'
h = 125.2'
h = 84'
h = 125.3'
h = 84'
h = 84'
h = 84

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Title: WILLIAMSON ENERGY LLC R17038
UNDERDRAIN DESIGN

Project No.: 805-330-1413

By: HO Date: 5/16/08 Chkd: KEY Date: 8/8/08

SHEET 1 OF 6

PHASES 5 AND 6 REVISED DESIGN

UNDERDRAIN AGGREGATE SUPPLIED

REF: 05/16/08 PHONE CONVERSATION WITH BOB ORR, FREEDOM MATERIALS
(618) 937-6415
AGGREGATE IS WASHED RIVER GRAVEL (WALBASH RIVER)
3/8" TO 1 1/2"
2/3's IS 3/8" TO 1" (67% < 1")
1/3 IS 1" TO 1 1/2" 0% < 3/8"
0% > 1 1/2"

GEOTEXTILE SPECIFIED

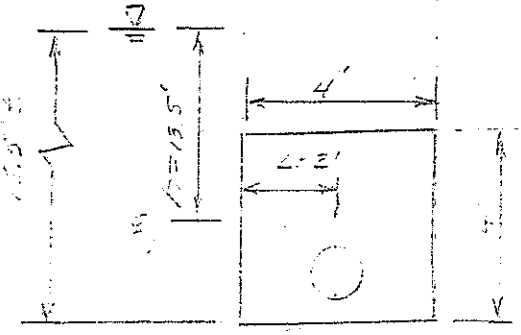
PROPEX 4550 (NOW KNOWN AS GEOTEX 501)
NONWOVEN, NEEDLE PUNCHED
AOS = # 70 SIEVE (
PERMITTIVITY = 1.40 SEC^{-1}
WATER FLOW RATE = 115 GPM/FT^2
THIS FABRIC IS CLASS 3 (LOW SURVIVABILITY)
GRAB TENSILE STR. = 140 LB @ 50% (< 180)
TRAP. TEAR = 60 LBS (< 68)
CBR PUNCTURE = 360 LBS (< 380)

UNDERDRAIN CAPACITY (AGGREGATE PORTION)

THE UNDERDRAIN IS GENERALLY ON A 0.005 TO 0.01 FT/FT SLOPE
AGGREGATE UNDER DRAIN AREA = 15.4 SF = A
THE AGGERGATE SHOULD HAVE A PERMABILITY ≥ GRADATION NO. 15
(SEE ATTACHED FIG. 1 AND FIG. C-15

HYDRAULIC GRADIENT, L	$q/A \times 10^3$ FPD	q (FT³/DAY)	q (GPM)
0.005	0.38	5852	30
0.100	0.64	10164	53

CHECK ABILITY OF AGGREGATE TO ADMIT FLOW TO PERFORATED PIPE



FOR PHASE 5:
DESIGN PHREATIC LEVEL
= 15.5' OVER UNDERDRAIN

TO ℄ UNDERDRAIN
[illegible] h = 13.5', L ≅ 13.5'/2' = 6.75 FT/FT
[illegible] > 4.0 (FIG. C-15)
A = (4'×4')(1 FT WIDTH) = [illegible]
[illegible] > [illegible] FT²/DAY [illegible] = [illegible] FT³/DAY [illegible]
> 337 GPM/FT

PHASE 5 q = 0.73 GPM/FT
S.F. ≥ 337/0.73 = 1948 > 10 [illegible] OK

[illegible] FOR [illegible] PHASE [illegible]

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Title: Wilderness Energy LLC R17039
Unnamed Tributary

Project No.: 805-330-PH3

By: MC Date: 7/16/08 Chkd: CEY Date: 8/8/08

SHEET 2 OF 6

PHASES 5 AND 6 REVISED DESIGN

CHECK DEPTH OF GRAVEL TO INCREASE SLOPE IF DIRECTLY TO TOP OF UNDERDRAIN

(ASSUMING ALL FLOW ENTERS FROM ONE SIDE)

$i = \frac{5}{17} = .294$

$Q_{10} = 7(10^{-3})$ CFS

$Q_{25} = (14 \text{ SHEET}) 7(10)^{-3} \text{ CFS/FT} = 14(10^{-3})$ CFS/FT

$Q = 83$ GPM/FT

THIS IS TWO TIMES OF THE 0.173 GPM/FT PROTECTED VELOCITY FOR PHASE 5 (SEE PAGE 7)

CHECK NEED OF GEOTEXTILE TO PROVIDE WATER WITH THE UNDERDRAIN

USE 1 PSI GEOTEX 801 (FROM PROPEX 4500)

CHECK NEED PERMITTIVITY OF GEOTEXTILE

STAGE 5 - FLOW PARALLEL VELOCITY

$Q = KiA = K(\Delta H/t)A$

t = FABRIC THICKNESS

ΔH = HEAD = 18.5

$K/t = \psi$ = PERMITTIVITY OF FABRIC

$(K/t) = \psi = (Q/iA)$

$Q = 33.3 \text{ FT}^3/\text{DAY} = 0.000385 \text{ FT}^3/\text{SEC}$ (SEE PG)

ASSUMING $K = 1.0 = 10^0$, $\psi = 0.00021$ FT/SEC-FT

$A = 16$ SQ FT

$\psi_{REQ'D} = \frac{0.000385 \text{ FT}^3}{18.5 \text{ FT}(16 \text{ FT}^2)(1 \text{ SEC})} = 1.3 \times 10^{-5} \text{ SEC}^{-1}$

$\psi_{ISO} = 1.4 \text{ SEC}^{-1} >> 1.3(10)^{-5} \text{ SEC}^{-1}$ OK

STAGE 7 - FLOW PARALLEL VELOCITY (USES STAGE 5 SUBSTRATE)

$\Delta H = 46.4'$

$Q = 0.173 \text{ GPM/FT} = 24 \text{ FT}^3/\text{DAY-FT} = 0.00154 \text{ FT}^3/\text{SEC-FT}$

$A = 16$ SF

$\psi_{REQ'D} = \frac{0.00154 \text{ FT}^3}{(46.4')(16 \text{ FT}^2)(1 \text{ SEC})} = 0.000021 = 2.1(10)^{-5} \text{ SEC}^{-1}$

$\psi_{ISO} = 1.4 \text{ SEC}^{-1} >> 2.1(10)^{-5} \text{ SEC}^{-1}$ OK

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UNDERDRAIN DESIGN

Project No.: 205-330-M13

By: JAO Date: 5/19/08 Chkd: CEY Date: 8/8/08

PHASES 5 AND 6 REVISED DESIGN) SHEET 3 OF 6

FINAL STATE - REMOVING 1200 CUBIC YARDS ONLY ONE SIDE OF DRAIN

(REFER TO SKETCH SHEET 2)

$A_H = 2'$ (ASSUMED) $\therefore A = 4\,ft^2/ft$ (ONE SIDE)

USE OF AVE SLOPE $I = 0.010\,ft/ft$ (CONSERVATIVE)

$\gamma_{WATER} = 62.4\,lb/ft^3$

$\gamma_{SOIL} = 120\,lb/ft^3$

$q_{REQD} = Q/AIBA = \frac{0.0004}{2(4)} = 4.3(10)^{-5}\,ft/sec$

$V_{SCR} = 1.4\,ft/sec > 4.3(10^{-5})\,ft/sec$ ∴ OK

CHECK GEOTEXTILE COVERING POTENTIAL

USE ALLIANCE'S MOST RECENT CREATED TEST ON PLACED CCR

SAMPLE DATE	$P_{\#200}$	D_{85}
4/15/08	32.8	0.5 mm
10/26/07	29.6	1.6 mm
6/22/07	23.4	7 mm
4/30/07	21.9	6 mm

(LESS THAN 50% < #200 SIEVE)

USE SMALLEST D_{85}

$AOS \leq D_{85}$ SOIL (CRITERIA)

$EOS \geq AOS = \#70$ SIEVE $= 0.210\,mm < 7\,mm$ ∴ OK

USING MEA'S CRITERIA: (DOT MOST RESTRICTIVE)

FOR A NON-WOVEN GEOTEXTILE:

$AOS \leq \#40$ SIEVE (< #70 ACCEPTABLE)

$\psi \geq 0.1\,sec^{-1}$ ($1.40\,sec^{-1}$ PROVIDED)

GEOTEX 351 MEETS BOTH OF THESE CRITERIA

CHECK THE PERMEATION OF UNDERDRAIN GEOTEXTILE

CONCENTRATED 1.2 RISE 12" DEEP AT 12" C-C

ASSUMING $1/2" > D_{85} > 1"$, $D_{15} > 0.4$

GEOTEX 351 HAS $O_{90} = 0.212\,mm$ (#70 SIEVE) WHICH IS TOO LARGE

TO PREVENT SOIL PARTICLES FROM MIGRATING INTO

GEOTEXTILE AND CLOGGING IT. THEREFORE

$O_{90} > 4D_{85}$ SOIL PARTICLE SIZE

DUE TO THE POTENTIAL FOR CLOGGING, THE GEOTEXTILE

SHOULD NOT BE USED AS A FILTER. FROM THE

LONG TERM PERMEABILITY TEST, THE GEOTEXTILE

IS MORE THAN 4 TIMES MORE PERMEABLE THAN

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Title: WILLIAMSON ENERGY LLC R17041
UNDERDRAIN DESIGN

Project No.: 805-330-1413

By: HL Date: 4/20/08 Chkd: CEY Date: 8/8/08

SHEET 4 OF 6

PHASES 5 AND 6 REVISED DESIGN

CHECK FOR PERFORATIONS IN UNDERDRAIN COLLECTION LINE (CONTINUED)

REF: SOIL MECHANICS NOTE NO. 3, SOIL MECHANICS CONSIDERATIONS FOR EMBANKMENT DRAINS, SCS, USDA, MAY 1971

AGGREGATE $C_u = D_{60}/D_{10} = 25mm/13mm = 1.8 < 3.0$, OK (REF, PG. F-4)

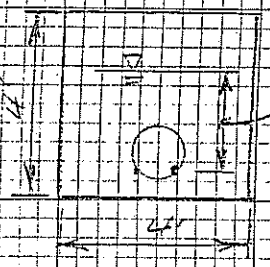
70% PERFORATION FLOW AREA REDUCTION (" " ")

DESIGN INFLOW RATE (SHEET 7) = 0.465 GPM/FT OF PIPE
= 0.00104 CFS/FT

ASSUME A.S.F. = 10, $Q = 0.0104$ CFS/FT

ASSUME $H = 2'$ (FOR FREE WATER SURFACE WITHIN DRAIN ENVELOPE)

$$Q = CA_e(2gh)^{1/2} = 0.6(0.3A)(2gh)^{1/2}$$
$$= 1.4445\,A\,h^{1/2}$$
$$= 2.043\,A, \quad A = \frac{0.0104\ CFS}{2.043\ FT} = 0.0051\ SF/FT$$



FOR 3/8" HOLES

$A = \pi D^2/4 - \pi(0.375)^2/4 = 0.1104\ IN^2 = 0.00077\ FT^2$

NO. HOLES = $0.0051/0.0007 = 6.6$ HOLES/FT

FOR 1/2" HOLES

$A = \pi(0.5)^2/4 = 0.1745\ IN^2 = 0.00121\ FT^2$

NO. HOLES = $0.0051/0.0012 = 3.7$ HOLES/FT

CHOOSE 3/8" HOLES, 4 PER FT = 2 ROWS, HOLES 4" C-C FOR PHASES 5 AND 6.

THIS PIPE IS TRIANGULAR PERF PIPE, USE SPEC = 4" PUT THE 2 ROWS OF HOLES DOWN.

NOTE: IF FOAM GRAVEL IS TO BE USED, INCREASE PERF AREA BY 70% REQUIRED FLOW FOR PIPING CLOSER OF FOAM GRAVEL USED BY SCHEER

Form SCS 130
5-65

PHASES 5 AND 6
805-330-1413

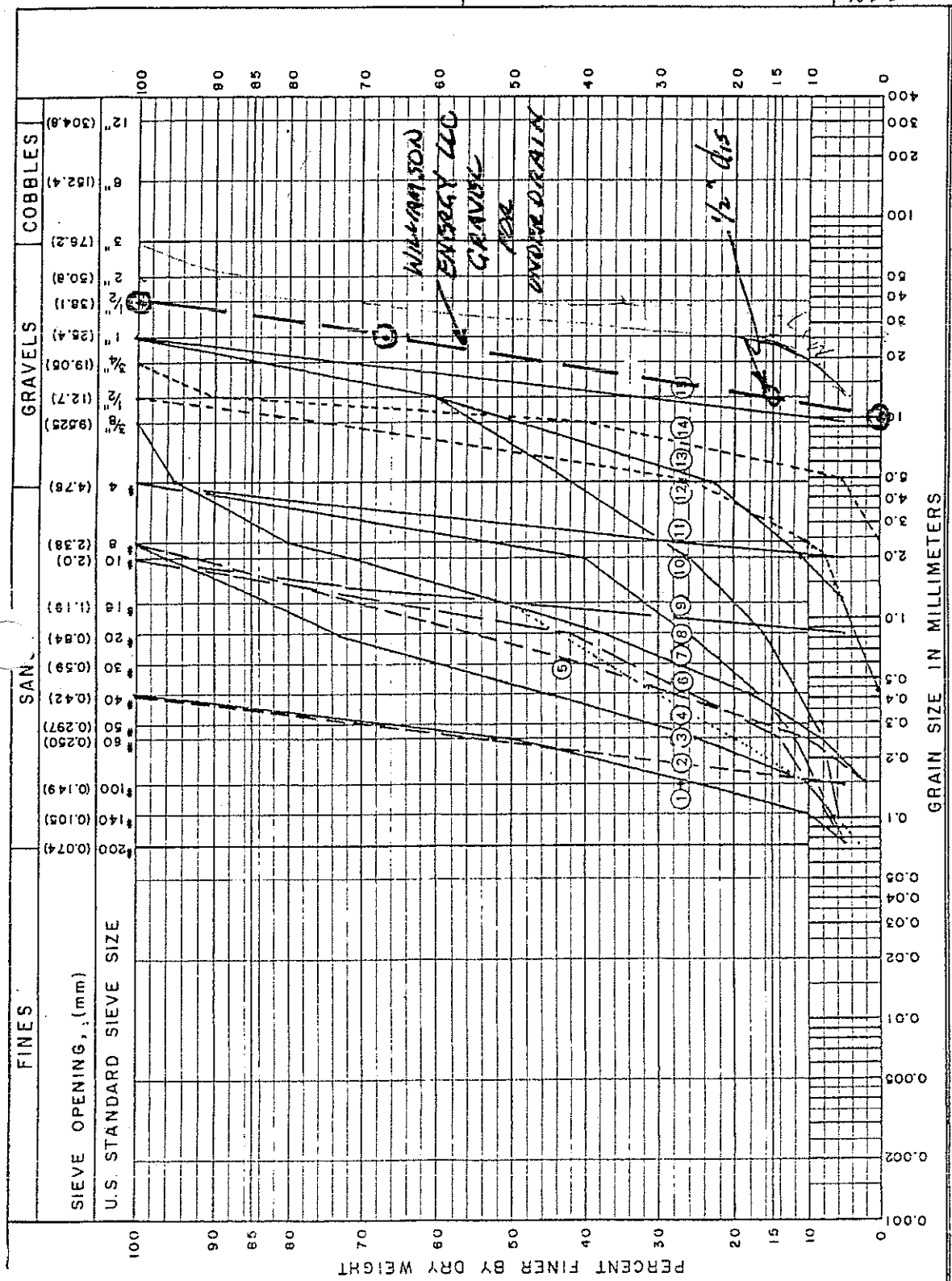
(89)

R17042

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	DRAIN MATERIALS

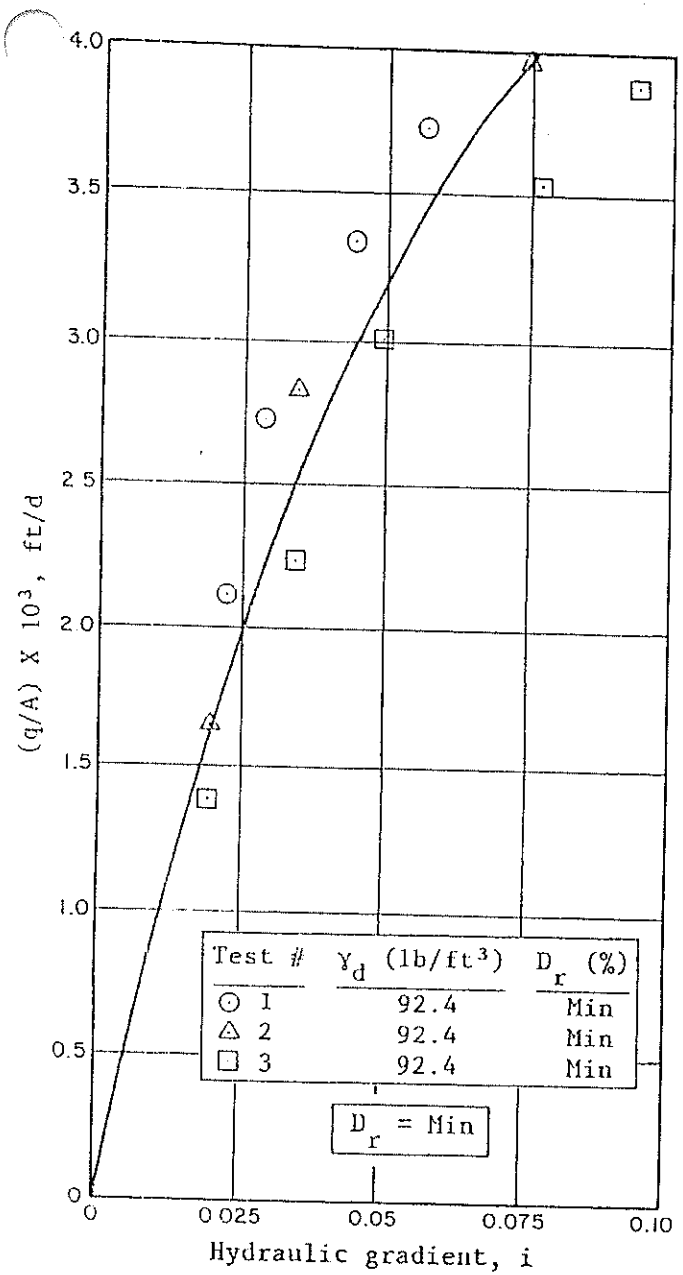
PROJECT and STATE: Project Study No. 101 — SHEET 5 OF 6

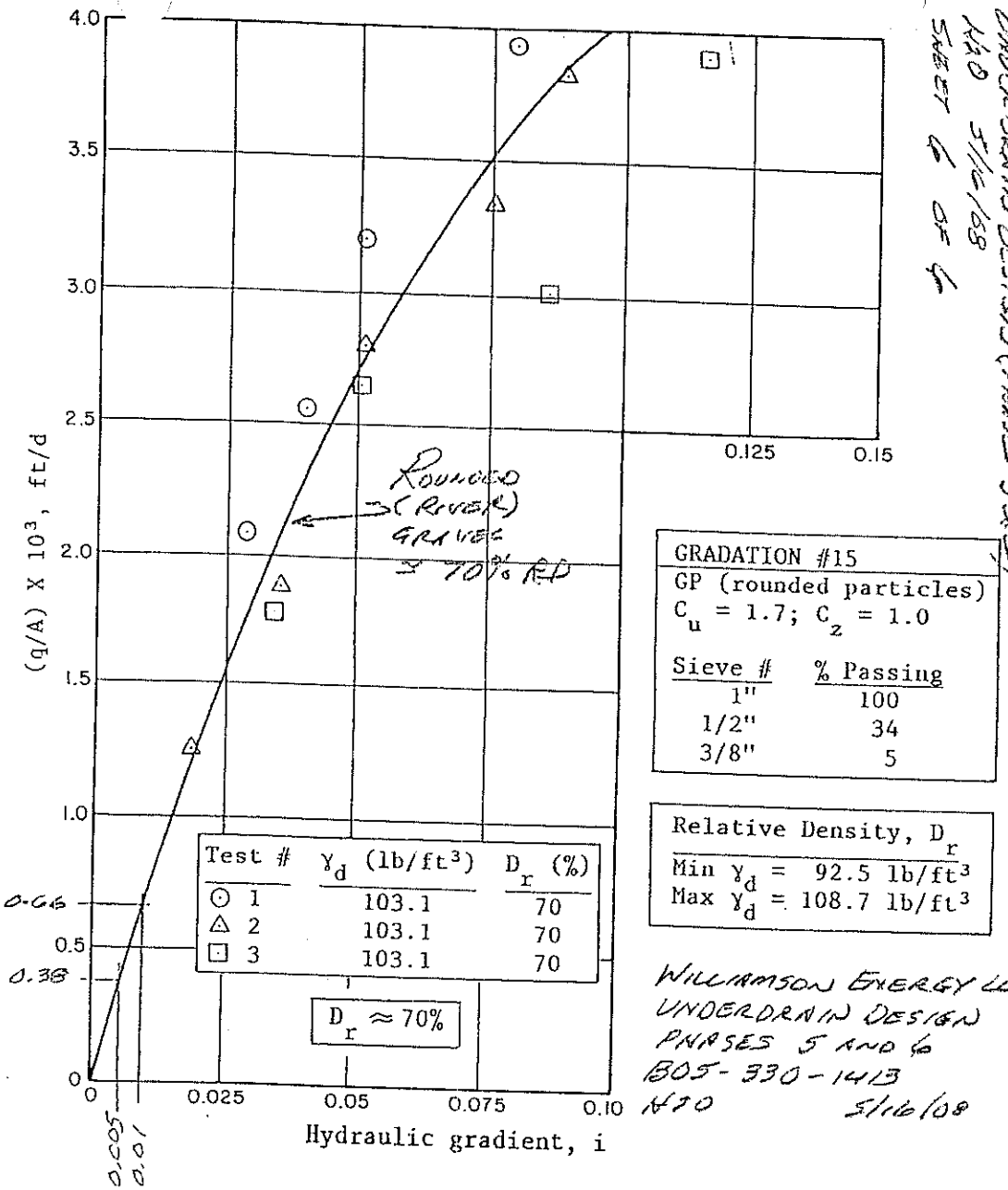
DESIGNED AT: | BY: SML | DATE: H2D 5/16/08



REMARKS 1. Gradations No. 3 and 7 represent the fine and coarse limits of fine aggregate sand (ASTM Designation C33).
2. Gradations No. 12 and 14 represent the fine and coarse limits of gravel size No. 78 (ASTM Designation D448).

Figure 1. Gradations of sands and gravels tested – SM NOTE No. 9, SCS, USDA, MARCH 1964





GRADATION #15	
GP (rounded particles)	
C_u = 1.7; C_z = 1.0	
Sieve #	% Passing
1"	100
1/2"	34
3/8"	5

Relative Density, D_r
Min γ_d = 92.5 lb/ft³
Max γ_d = 108.7 lb/ft³

Figure C-15. Relationship between q/A and i for Gradation No. 15 (GP, rounded)

SM Note No. 9, SCS, USDA, March 1984

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PHASES 5 AND 6
805-330-1413
NTO 5/16/08

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UNDERDRAIN DESIGN (PHASES 5 & 6)
NTO 5/16/08
SHEET 1 OF 1

C - 20

R17043

*U.S. GOVERNMENT PRINTING OFFICE : 1984 0-420-931/SCS-628

PRODUCT DATA SHEET

GEOTEX® 501

GEOTEX 501 is a polypropylene, staple fiber, needlepunched nonwoven geotextile produced by Propex, and will meet the following Minimum Average Roll Values (MARV) when tested in accordance with the methods listed below. The fibers are needled to form a stable network that retains dimensional stability relative to each other. The geotextile is resistant to ultraviolet degradation and to biological and chemical environments normally found in soils.

GEOTEX 501 conforms to the property values listed below.[1] Propex performs internal Manufacturing Quality Control (MQC) tests that have been accredited by the Geosynthetic Accreditation Institute - Laboratory Accreditation Program (GAI-LAP).

PROPERTY	TEST METHOD	MARV ENGLISH	MARV METRIC
Mechanical			
Tensile Strength (Grab)	ASTM D-4632	140 lbs	623 N
Elongation	ASTM D-4632	50%	50%
Puncture	ASTM D-4833	85 lbs	378 N
CBR Puncture	ASTM D-6241	360 lbs	1601 N
Mullen Burst	ASTM D-3786	280 psi	1930 kPa
Trapezoidal Tear	ASTM D-4533	60 lbs	267 N
Endurance			
UV Resistance	ASTM D-4355	70%	70%
Hydraulic			
Apparent Opening Size (AOS)[3]	ASTM D-4751	70 US Std. Sieve	0.212 mm
Permittivity	ASTM D-4491	1.40 sec^{-1}	1.40 sec^{-1}
Water Flow Rate	ASTM D-4491	115 gpm/ft^2	4686 $l/min/m^2$
Roll Sizes		15 ft x 360 ft	4.57 m x 109.8 m

NOTES:

1. The property values listed above are effective 08/2006 and are subject to change without notice.
2. Values shown are in weaker principal direction. Minimum average roll values (MARV) are calculated as the typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any samples taken from quality assurance testing will exceed the value reported.
3. Maximum average roll value.

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805-330-1413
UNDESIGNATED DESIGN
H70 5/16/2005
SHEET 6A OF 6

PROPEX GEOSYNTHETICS | THE ADVANTAGE CREATORS.

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(42)

Title: WILLIAMSON ENERGY LLC R17045
UNDERDRAIN DESIGN

Project No.: BLE-330-1413

By: MC Date: 5/22/08 Chkd: CEY Date: 8/8/08

SHEET 1 OF 2

CHECK EMBANKMENT LOADING ON PHASE 5 COLLECTOR PIPE

- SOIL ≤ 130 PCF
- PIPE BEDDING IS GRAVEL AT 95% PROCTOR EQUIV.
- PIPE IS IN VERY LOW-PRESSURE FLOW

EL. 495

EL. 471.5

H = 36' (MAX)

H1 = 25.5'

3 : 1

EL. 435 (LOWEST INVERT EL.)

50' →

REFERENCE: "THE PERFORMANCE OF ENGINEERING MANUAL", FIRST EDITION, 2001, CHEVRON PHILLIPS CHEMICAL CO. LP

DE 3408 PIPE PROPERTIES & DESIGN COEFFICIENTS

E' = SOIL MODULUS = 3000 PSI (TABLE 7-7)
K = BEDDING FACTOR = 0.1 (PAGE 105)
L = DEFLECTION LAG FACTOR = 6.5 (PAGE 111)
E = 29,900 PSI (20°F AT 50 YRS) (TABLE 1-5 (EXTRAP) PP 814-7)
SP = 1600 PSI @ 73°F (USE 650 PSI) (TABLE E-1)
M = 0.45 LONG TERM (PAGE 104)
CD = SLOW/INTERMITTENT FLOW = 0% (PAGE 112)
(OR 2-2% FOR 4 CONSERVATIVE VALUES)

PIPE IS 10" SDR 26, ID = 9.814", t = 0.413", OD = 10.75"

DEFLECTION FACTORS

$D_m = D_o - k_2 t = 10.75 - 1.06(0.413) = 10.312"$ (EQ. 7-27)
= MEAN DIAMETER

$B' = \frac{1}{1+4(e^{-0.065H})} - 0.06\frac{H}{r}$ (EQ. 7-25)
$= \frac{1}{1+4(e^{-0.065(36)})} - 0.06\frac{36}{5}$
= 0.722 = SOIL-STRUCTURE INTERACTION FACTOR

$R = 1 - 0.33\left(\frac{H}{R}\right) = 1 - 0.33\left(\frac{36}{5}\right) = 0.525$ (EQ. 7-24)
= BEDDING CONSTANT FACTOR

$S_{LX} = \frac{0.145}{M}\left[R^3 E\left(\frac{E'}{12(DR-1)^3}\right)\right]^{1/2}$ (EQ. 7-23)

$= \frac{0.145}{0.45}\left[(0.525)^3(0.722)(3000)\left(\frac{29,900}{12(26-1)^3}\right)\right]^{1/2}$

= 45.6 PSI = PREDICTED SOIL-INDUCED DEFLECTION
WHERE DR = DIMENSION RATIO = 26.0

P_T = LIVE LOAD (HIGHWAY) = 4500 PSF = 32.5 PSI (EQ. 7-1)
= FROM DEPARTMENT OF = PE

DF (LIVE LOAD FACTOR) = $\frac{P_{SIC}}{P_T}$ = $\frac{\text{PSI OF}}{32.5 \text{ PSI}}$ = F.S.

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Title: WILLIAMSON ENERGY LLC R17046
UNDERDRAIN DESIGN

Project No.: 505-330-1413

By: MC Date: 5/27/08 Chkd: CEY Date: 8/8/08

SHEET 2 OF 2

PHASE 5 COLLECTOR AND LATERALS (CONTINUED)

$S_1 = \frac{P_T D}{288 t} =$ PIPE WALL CIRCUMFERENTIAL STRESS (EQ. 7-33)

$= \frac{(160\ PSI)(10.2\ IN)}{288\,(0.448\ IN)} = 439\ PSI < 1600\ PSI$, OK

$\frac{\Delta X}{D_L} = \frac{P_T}{144}\left(\frac{K_L}{\frac{2E'}{3}\left(\frac{t}{D_A - t}\right)^3 + 0.061E'}\right) =$ RING DEFLECTION (EQ. 7-37)

$= \frac{(160)}{144}\left(\frac{0.1(1.5)}{\frac{2}{3}(28{,}900)\left(\frac{0.448}{12 - 0.448}\right)^3 + 0.061(1{,}555)}\right) = 0.0365$

WHERE: $K =$ BEDDING CONSTANT = 0.1 (TBL. 7-15)

$L =$ DEFLECTION LAG FACTOR = 1.5 (PG. 7-11)

$E' = 0.75(E) = 0.75(3200) = 2400$ PSI
(CONSERVATIVELY TAKEN 25% REDUCTION IN E')

% DEFLECTION $= \frac{\Delta X}{D_L}(100) = 0.0365(100) = 3.65\%$ (EQ. 7-36)

ALLOWABLE DEFLECTION FOR DR-26 = 7.5% > 3.65%, OK (STDS 7-3)

$\varepsilon = 12\left(\frac{\Delta X}{D_M}\right)\left(\frac{t}{D_M}\right) =$ MAX BENDING STRAIN (EQ. 7-34)

$t =$ MIN WALL THICKNESS = 0.448 IN (CTR 2.4)

$D_M = D_A - t = 12 - 0.448 = 11.552$" (EQ. 7-27)

$C = 0.5\left(1 - \frac{t}{D_M}\right) = 0.5\left(1 - \frac{0.448}{11.552}\right) = 0.219$ (EQ. 7-28)

$\Delta X = \left(\frac{\Delta X}{D_L}\right) D_L = 0.0365(12) = 0.438$"

$\Delta X / D_M = 0.438 / 11.552 = 0.038$

$\varepsilon = 12(0.219)(0.038) = 0.00509 = 0.51\%$

ALLOW. $\varepsilon = 4.2\%$ TO $5.0\% > 0.51\%$, OK (PG. 7-14)

∴ DR-26 HDPE PIPE IS OF MIN. SUFFICIENT WALL THICKNESS

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BY: JLH DATE: 5/9/05 CHKD BY: [illegible] DATE: 6-29-05

PROJECT NAME: Mach Mining

PROJECT NO. B05-330-1413 SHEET 1 OF 4

DESCRIPTION Structural Design of Drain Pipe
PHASE 7

04

R17047

The purpose of the following calculations is to determine if the proposed 12-inch, SDR 13.5 high density polyethylene pipe is structurally adequated for the pressures associated with the anticipated depth of cover

Design Assumptions

1) maximum Coal Refuse Cover height = 100'
2) Average Density of refuse 120 pcf
3) Soil modulus (E') of compacted soil = 2500 psi

References:

1) A guide for design and installation 2nd Ed American Water Works Association AWWA Manual M11 1989
2) Plexco Manual
3) Driscopipe manual

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BY: ZLL DATE: 5/9/06 CHKD BY: BMM DATE: 6-29-06

PROJECT NAME: Mach Mining

PROJECT NO. B05-330-145 SHEET 2 OF 4

DESCRIPTION Structural Design of Drain Pipe

95

F17048

Check F.S. Against Internal Pressure.

SDR 13.5 is Rated at 128 psi

Max head loss

El 535 (max water level) - 442.5 (outlet) = 92.5'

92.5 x 62.4 = 5772 lb/ft² = 40.08 psi

FS: 128/40.08 = 3.19 ok

Check F.S. Against External Pressure

Total External Pressure (P_t) = 100' x 120 lb/ft³ = 12000 lb/ft² = 83.3 psi

Wall crushing

$$S_A = \frac{(SDR-1)P_t}{2} = \frac{12.5 \times 83.3}{2}$$

= 520.6 psi

$$F.S. = \frac{CYS}{S_A}$$

CYS = Compressive Yield Strength of Pipe - 1500 psi (Driscopipe Manual)

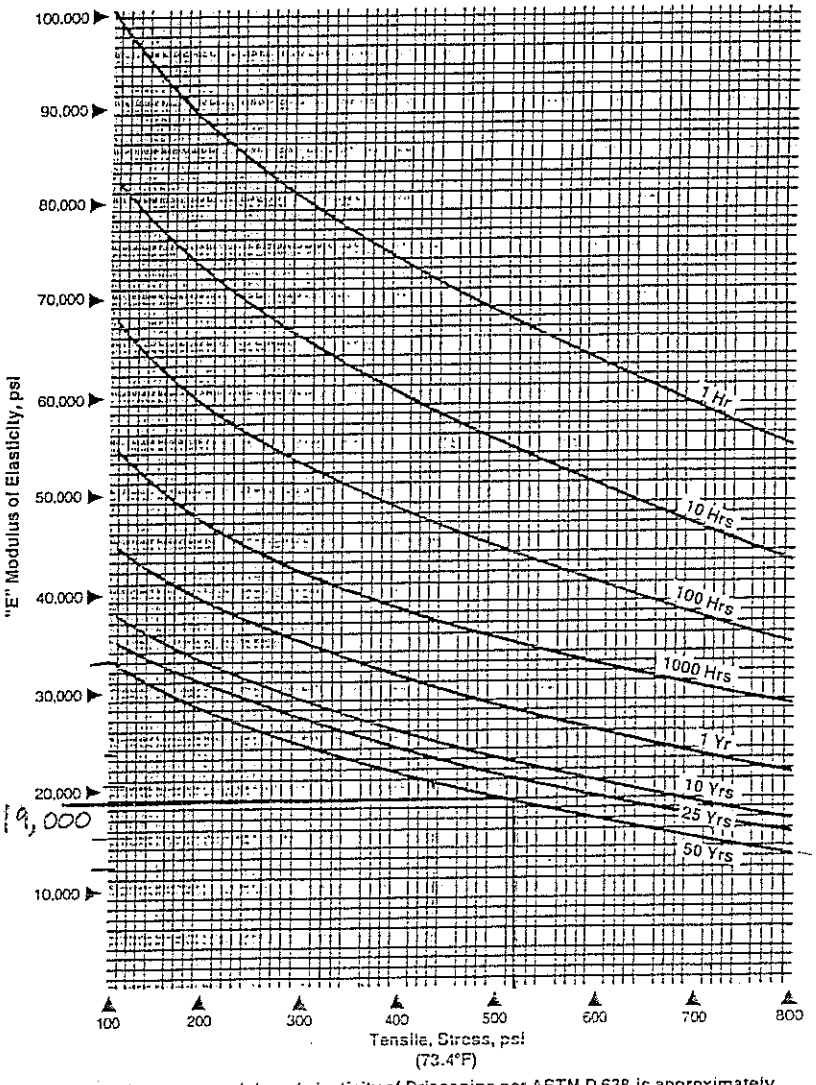
$$\frac{1500}{520.6}$$

= 2.88 ok

Wall Buckling
SA = 520.6

Reference Driscopipe Manual p3.7

Chart 25
Time Dependent Modulus of Elasticity for Polyethylene Pipe vs. Stress Intensity (73.4°F)



NOTE: The short term modulus of elasticity of Driscopipe per ASTM D 638 is approximately 100,000 psi. Due to the cold flow (creep) characteristic of the pipe material, this modulus is dependent upon the stress intensity and the time duration of the applied stress.

From chart modulus of Elasticity (E) = 19,000 psi (50 yr life)

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BY: JLH DATE: 5/9/06 CHKD BY: BWM DATE: 6-29-06

PROJECT NAME: Mach Mining

PROJECT NO. BOS-330-143 SHEET 4 OF 4

DESCRIPTION Structural Design of Drain Pipe

97 RM17050

Critical Collapse Differential Pressure (P_c)

$$= \frac{2.32(E)}{(SDR)^3}$$

$$= \frac{2.32(19000)}{(13.5)^3} = 17.9 \text{ psi}$$

Critical Buckling Pressure (P_{cb})

$= 0.8\sqrt{E' \times P_c}$ where E' = soil Modulus of Backfill

$= 0.8\sqrt{2500 \times 17.9}$

$= 169.2$ psi

$F.S. = P_{cb} \div P_t = 169.2 \div 83.3 = 2.0$ ok

Check F.S. Against Deflection

Allowable deflection for SDR 13.5 = 3.4%

With flexable pipe the actual deflection will equal the deflection of the backfill material

Total deflection = $P_t / E' = 83.3/2500 \times 100 = 3.33\%$ ok

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BY: HJO DATE: 7/3/03 CHKD BY: CEY DATE: 8/5/03 (98)

PROJECT NAME: WILLIAMSON ENERGY LLC

PROJECT NO. 805-330-H13 SHEET 1 OF 1

DESCRIPTION HORIZONTAL STRAIN DUE TO SUBSIDENCE
CRITICAL AREAS

R17051

REFERENCE: "PREDICTION OF GROUND MOVEMENT... IMPOUNDMENTS," SYD E. PENG, 2ED, MARCH 2005, APPENDIX I

DETERMINE: ZONES MOST SUSCEPTIBLE TO FOUNDATION SOIL OR EMBANKMENT CRACKING

CRITERIA:
FOR TENSILE STRAIN IN THE RANGE OF 0.1 TO 0.3% MAY INDUCE CRACKING, SHERARD (1972) - THIS IS FOR EARTH DAMS BUT SINCE THE FOUNDATION IS A CLAY SOIL USE THIS TO IDENTIFY AREAS FOR EXTRA OBSERVATION AND POSSIBLE REMEDIAL TREATMENT

INTERPRETATION OF THE STRAIN CONTS IN PENG'S REPORT:
PLUS STRAIN - TENSION (+)
MINUS " - COMPRESSION (-)

LOCATIONS ON PENG'S SECTION A-A WHERE HORIZ. STRAIN ≥ +1.0E-3 (0.1% = 0.001 = 1×10^{-3} = 1.0E-3). FT/FT

DISTANCE ALONG CROSS SECTION A-A (FT)	
START	FINISH
-19	161
1300	1465
1644	1804
2950	3110
3291	3452
4595	4774

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BY: HJP DATE: 7/3/08 CHKD BY: CEY DATE: 8/8/08 (09)

PROJECT NAME: WILLIAMSON ENERGY LLC

PROJECT NO. P06-330-1413 SHEET 1 OF 21

DESCRIPTION: CHECK PIPING AND CRACKING POTENTIAL OF FOUNDATION SOIL AND COARSE COAL REFUSE

SAMPLE	SOIL TYPE	PIPING RESISTANCE		CRACKING RESISTANCE	
		SM-10, SCS	SHEPARD	SM-10, SCS	SHEPARD
HOLCOMB (2/8/04)	CL-SOIL PI=24	HIGH	1-HIGH	LOW	—
HOLCOMB (11/1/04)	GW-GCR Cu=11.8	HIGH	3-INTERMEDIATE	NONE	—
ALLIANCE (4/8/08)	SC-CCR PI=24	MEDIUM	3-INTERMEDIATE	MEDIUM	—

* IT APPEARS THAT THE COARSE COAL REFUSE (CCR) HAS HIGH TO MEDIUM RESISTANCE TO PIPING AND MEDIUM RESISTANCE TO CRACKING. THE HOLCOMB SAMPLE IS REFUSE AS DELIVERED TO THE SITE. THE ALLIANCE SAMPLE IS REFUSE AFTER COMPACTION.

THE HOLCOMB FOUNDATION SOIL SAMPLE HAS HIGH PIPING RESISTANCE AND LOW CRACKING RESISTANCE (BUT NOT IN THE CRACKING PHASE), SEE SHEET 4.

* THE FOUNDATION SOIL FOR THE IMPOUNDING EMBANKMENT SHOULD BE EXAMINED PRIOR TO PIPING FOR CRACKS AND SEALED. IT SHOULD BE RECOGNIZED THAT THE SLURRY WILL TEND TO SEAL THE CRACKS AND THAT THE FOUNDATION SOIL HAS A HIGH RESISTANCE TO PIPING.

SEE SHEET 3 FOR REFERENCES AND SHEET 2 FOR THE TABLES.

SEE SHEETS 5 THROUGH 21 FOR THE SOIL TESTS DATA

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BY: HTD DATE: 7/8/08 CHKD BY: CEY DATE: 8/8/08 (108) R17053

PROJECT NAME: WILLIAMSON ENERGY LLC

PROJECT NO. BOS-330-14B SHEET 2 OF 21

DESCRIPTION CHECK PIPING AND CRACKING POTENTIAL OF FOUNDATION SOIL AND COARSE COAL REFUSE

Group Symbol	TYPICAL NAMES	RELATIVE PROPERTIES OF MATERIALS COMPACTED TO 95% OF (1) MAXIMUM STANDARD DENSITY OR (2) 70% RELATIVE DENSITY: Shear strength when saturated	Compressibility when saturated	Permeability*	Resistance to piping	Susceptibility to cracking by deformation
GW	Well graded gravels, gravel-sand mixtures, little or no fines.	High	Low	High	High	None
GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.	High	Low	High	High	None
GM	Silty gravels, gravel-sand-silt mixtures.	High	Low	Medium	Medium to low	Medium
GC	Clayey gravels, gravel-sand-clay mixtures.	High	Low	Low	High	Medium
SW	Well graded sands, gravelly sands, little or no fines.	High	Low	High	Medium	None
SP	Poorly graded sands, gravelly sands, little or no fines.	Medium	Low	High	Medium to low	None
SM	Silty sands, sand-silt mixtures	Medium	Medium	Medium	Med. PI>5 - Low PI<6	Medium to high
SC	Clayey sands, sand-clay mixtures.	Medium	Medium	Low	Medium	Medium
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.	Medium to Low	Medium	Medium	High PI>15 Med. PI<15	High PI<15 Low PI>15
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Medium	Medium	Low	High PI>15 Med. PI<15	High PI<15 Low PI>15
OL	Organic silts and organic silty clays of low plasticity.	Low	High	Medium	Medium to low	Medium
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.	Low	High	Low	Medium to low	Medium
CH	Inorganic clays of high plasticity, fat clays.	Low	High	Low	High	Low
OH	Organic clays of medium to high plasticity, organic silts.	Low	High	Low	Medium to high	Medium
Pt	Peat and other highly organic soils	NOT SUITABLE FOR CONSTRUCTION				

* High > 1.0 ft./day; Medium 0.001 - 1.0 ft./day; Low < 0.001 ft./day

FIGURE 8-2(d). RELATIVE PROPERTIES OF COMPACTED MATERIALS (UNIFIED SOIL CLASSIFICATION SYSTEM)

8-9 Tentative

Table 2.2:1 Rough Empirical Relationship Observed between Piping Resistance in Earth Dam Embankments and Soil Types and Construction Methods (In Order of Decreasing Piping Resistance)

Greatest piping resistance	1. Clay of high plasticity (P.I. greater than 15%). Well compacted.
	2. Clay of high plasticity (P.I. greater than 15). Poorly compacted.
Intermediate piping resistance	3. Well-graded coarse sand or sand-gravel mixtures with binder of clay of medium plasticity (P.I. greater than 6). Well compacted.
	4. Well-graded coarse sand or sand-gravel mixtures with binder of clay of medium plasticity (P.I. greater than 6). Poorly compacted.
	5. Well-graded cohesionless gravel-sand-silt mixtures (P.I. less than 6). Well compacted.
Least piping resistance	6. Well-graded cohesionless gravel-sand-silt mixtures (P.I. less than 6). Poorly compacted.
	7. Very uniform fine cohesionless sand. (P.I. less than 6). Well compacted.
	8. Very uniform fine cohesionless sand. (P.I. less than 6). Poorly compacted.

Alliance Consulting, Inc.

124 Philpott Lane, Beaver, West Virginia 25813
Phone: (304) 255-0491 Fax: (304) 255-4232

(101) R17054

Title: WILLIAMSON ENERGY LLC
MSHA COMMENTS

Project No.: B05-330-1413

By: WC Date: 8/5/08 Chkd: FEY Date: 8/8/08

SHEET 3 OF 21

REFERENCES:

1. "DESIGN OF EARTH AND EARTH-ROCK DAMS", SHERARD, WE, ENE, JOHN WILEY AND SONS, INC., 1963.
2. "BASIC JOB MECHANICS COURSE SM-10), VOL. 1 OF 3, SCS, USDA, REV. 1968, AG. B-2 (61)

CHARACTERISTICS OF FOUNDATION SOIL & COARSE COAL REFUSE

FOUNDATION SOIL

DEPTH: 18.5' - 25.5'
USCS: SILTY CLAY (CL)
w = 21.1%

C = 0
ϕ = 24.2°
77% < #200 SIEVE

LL = 41.5%
PI = 17.7%
RF = 54.1%

COARSE COAL REFUSE

BEFORE COMPACTION

USCS - (GW)
K = 2x10⁻⁴ cm/sec
@ DD = 119.3 PCF)

C = 0
ϕ = 29.7°
24% < #200
25.7% > 1"

PROCTOR TEST
γ_{max} = 124.6 PCF
w_{opt} = 9.3%

POST COMPACTION (AFTER QUICK DRAINAGE)

TEST DATE	% > #4	% < #200	USCS	
10/26/07	64.2	22.6	SM	MOVED TO SE CORNER OF PAD
8/22/07	25.6	14.7	SM	
4/30/07	27.7	15.1	SM	
4/5/06	35.7	32.8	SC	LL & PI TESTS WERE RUN

- THE CCR REMAINS DOWN FROM A SAT. TO A DRY DENSITY AS ACHIEVED & COMPACTED
- THE K CHECKED LAB AND ALSO PROCTOR TESTS WERE RUN TO THE TESTED VALUE OF 2x10⁻⁴ cm/sec. 2x10⁻⁴ cm/sec FALLS WITHIN THE EXPECTED RANGE OF A SILTY SAND

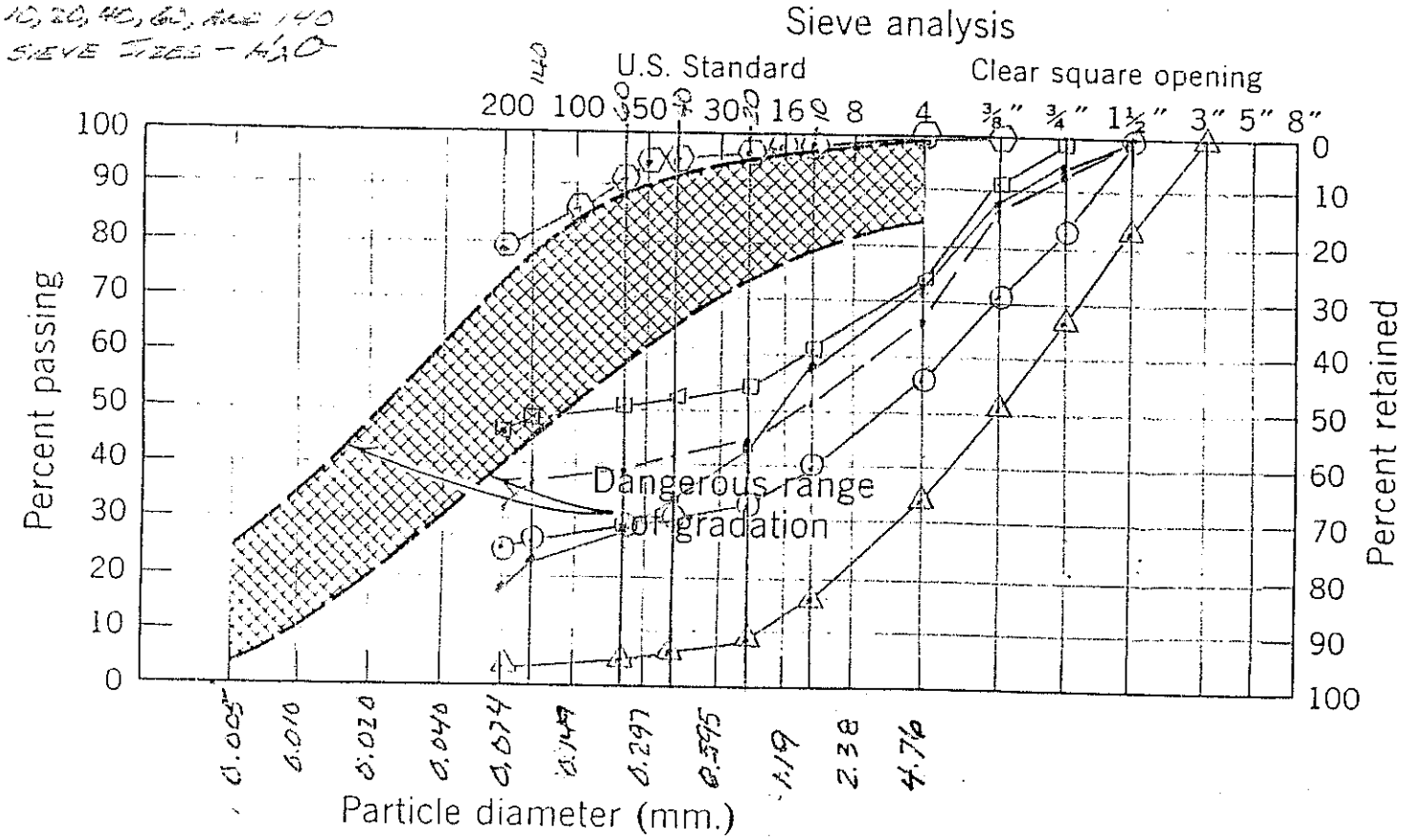
THE STRAIGHT FACE FOR CCR AND FOUNDATION SOIL SHOULD BE CONSIDERED FOR CRITICAL CONDITIONS.

THE CCR SHOULD BE ON THE SAFE SIDE OF THE CRITICAL CRACKING POTENTIAL SOILS (HAS SUFFICIENT COHESION TO RESIST CRACKING)

THE PERMEABILITY OF THE CCR IS NOT AS GOOD AS THE CRITICAL CRACKING CONDITIONS

THE "EARTH AND EARTH-ROCK DAMS" BOOK ON PAGE 30 FOR IMPERVIOUS CORE MATERIAL MAY BE SUSCEPTIBLE TO CRACKING AS THE CCR

FIG. 2.3.6 MODIFIED TO CORRECT PARTICLE DIAMETER AND TO ADD 10, 20, 40, 60, AND 140 SIEVE SIZES – H2O



COARSE COAL REFUSE SAMPLES

ALLIANCE SAMPLES
4-30-07
8-22-07
10-26-07
4-15-08

HOLCOMB SAMPLE
11-30-06

ALLIANCE SAMPLES ARE AFTER PLACEMENT IN FILL.

HOLCOMB SAMPLE IS AS DELIVERED TO SITE

FOUNDATION SOIL
HOLCOMB SAMPLE
2-6-06

Fig. 2.3:6 Range of gradation of soils suspected to be most critical embankment materials from standpoint of cracking (Ref. 95).

REFERENCE: "EARTH AND EARTH-ROCK DAMS", SHERARD, J. L., etal, JOHN WILEY AND SONS, INC., 1963

WILLIAMSON ENERGY LLC
BOS-330-1413
H2O 4/23/08
SHEET 4 OF 21

R17055

811-10
Part 27

WILLIAMSON ENERGY LLC
BOS-330-1413
FOUNDATION SOIL
SHEET 5 OF 21

Holcomb Foundation Engineering Company

Laboratory Testing Results

2/8/2006

Project: Mach #1 Mine
Project No: H-05278

Sieve Analysis - ASTM C136-96a

Sample: Silty CLAY (CL)

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
1.5000	38.1000	1 -1/2"	0.0	0.0	100.0
1.0000	25.4000	1"	0.0	0.0	100.0
0.7500	19.1000	3/4"	0.0	0.0	100.0
0.5000	12.7000	1/2"	0.0	0.0	100.0
3.7500	9.5200	3/8"	0.0	0.0	100.0
0.1870	4.7600	No. 4	2.1	0.9	99.1
0.0790	2.0000	No. 10	4.6	2.0	98.0
0.0469	1.1800	No. 16	4.6	2.0	98.0
0.0331	0.8500	No. 20	8.6	3.8	96.2
0.0165	0.4200	No. 40	12.6	5.5	94.5
0.0117	0.2980	No. 50	12.6	5.5	94.5
0.0083	0.2500	No. 60	22.2	9.8	90.2
0.0059	0.1490	No. 100	34.6	15.2	84.8
0.0029	0.0740	No. 200	47.7	21.0	79.0

Total Weight in Grams 227.20

Holcomb Foundation Engineering Company

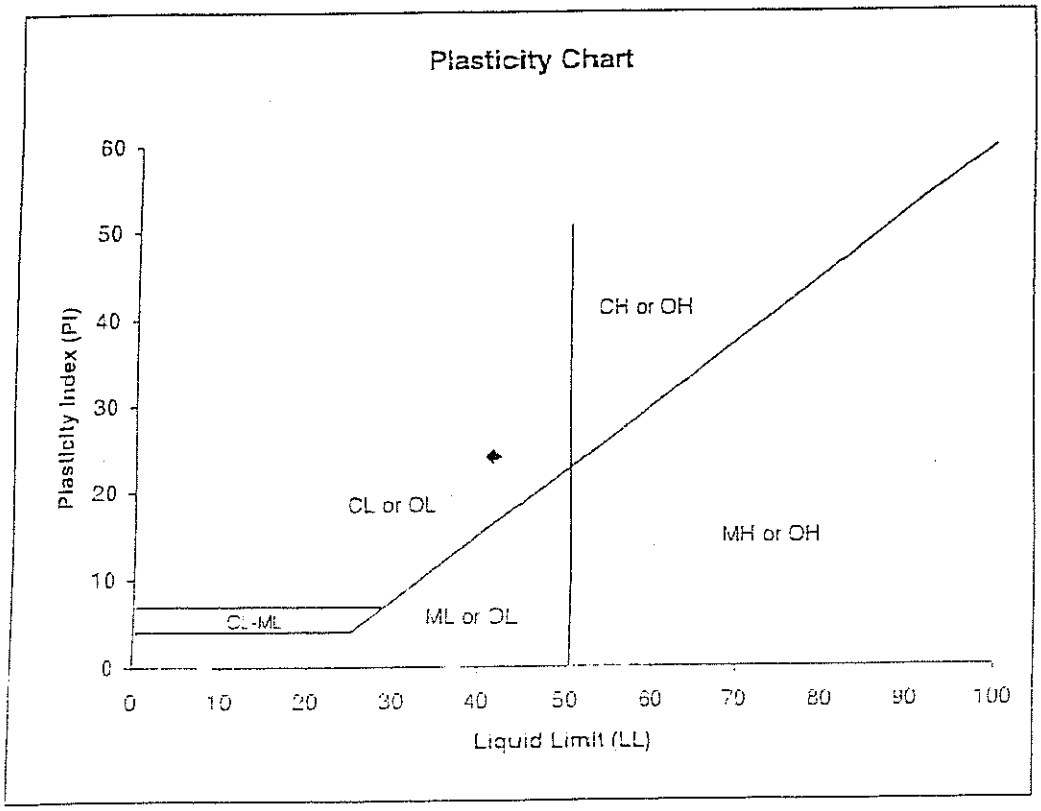
Laboratory Testing Results

Project: Mach #1 Mine
Project No: H-05278

Sample	1	2	3
Dish Number	LL_1	LL_2	LL_3
Mass of can, W_1 (g)	34.70		
Mass of can + moist soil, W_2 (g)	62.84		
Mass of can + dry soil, W_3 (g)	54.52		
Moisture content, w (%)	41.98		
Number of blows, N	24		
Liquid Limit, LL	41.8		

Dish Number	PL_1
Mass of can, W_1 (g)	39.76
Mass of can + moist soil, W_2 (g)	54.79
Mass of can + dry soil, W_3 (g)	52.53
Plastic Limit, PL	17.7

PI = 24.1



(103)

R17058

Sheet 7 of 21

Holcomb Foundation Engineering Company

Laboratory Testing Results

11/30/2006

Project: Coarse Refuse Disposal Area
Pond Creek Mine Johnston City, Illinois

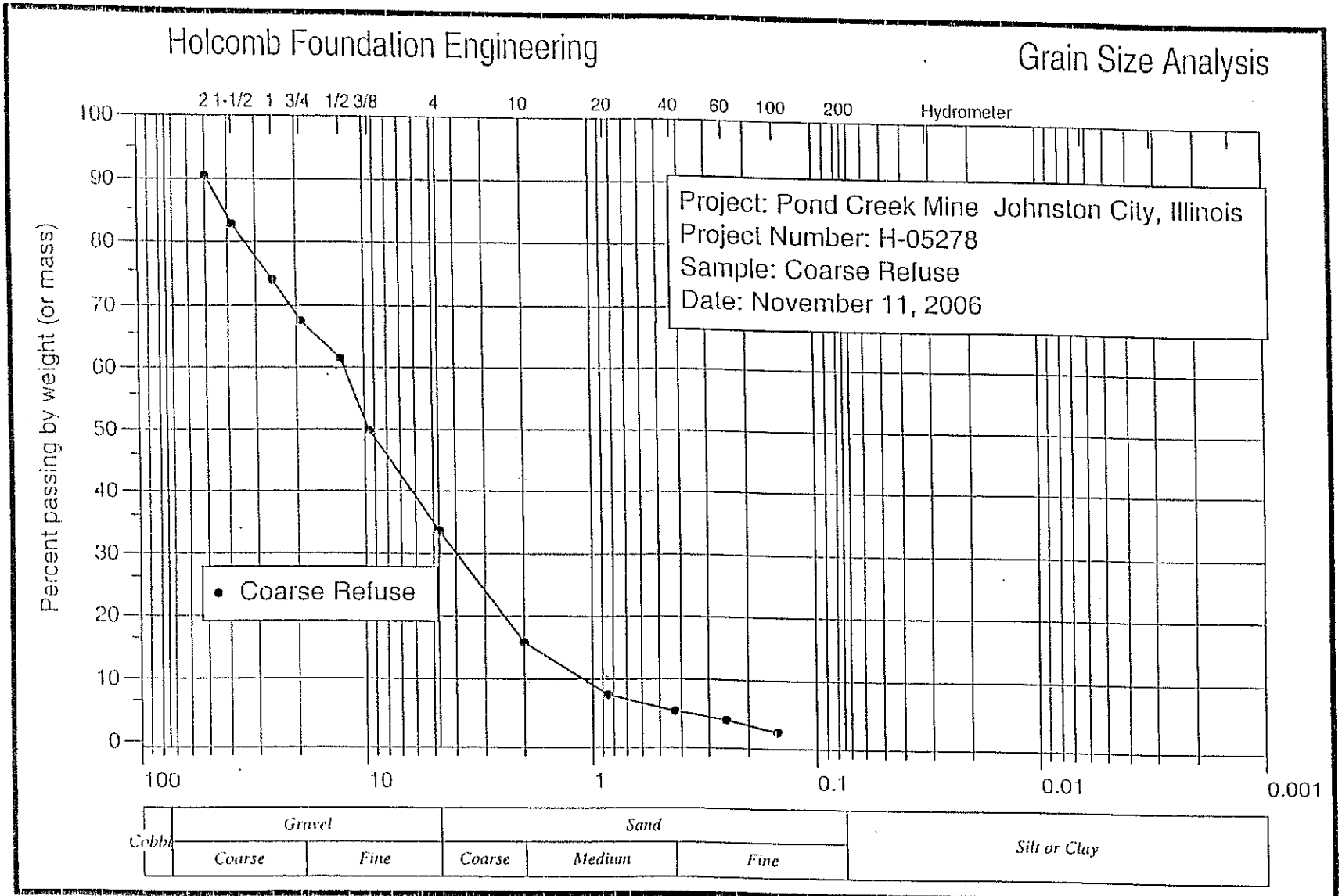
Project No: H-05317

Sieve Analysis - ASTM C136-96a

Sample: Coarse Refuse

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
3	76.2	3"	0.0	0.0	100.0
2.0000	50.8100	2"	619.6	9.5	90.5
1.5000	38.1000	1 -1/2"	1124.0	17.2	82.8
1.0000	25.4000	1"	1696.2	25.9	74.1
0.7500	19.1000	3/4"	2110.9	32.3	67.7
0.5000	12.7000	1/2"	2513.0	38.4	61.6
3.7500	9.5200	3/8"	3263.7	49.9	50.1
0.1870	4.7600	No. 4	4310.7	65.9	34.1
0.0790	2.0000	No. 10	5470.5	83.6	16.4
0.0469	1.1800	No. 16			
0.0331	0.8500	No. 20	6004.4	91.8	8.2
0.0165	0.4200	No. 40	6178.9	94.4	5.6
0.0117	0.2980	No. 50			
0.0083	0.2500	No. 60	6267.8	95.8	4.2
0.0059	0.1490	No. 100			
0.0029	0.0740	No. 200	6372.4	97.4	2.6

Total Weight in Grams 6542.80



USCS - GW

$C_u = 13/1.1 = 11.8$ (>4)

% < #200 = 2.6

% > #4 = 65.9

$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = \frac{4^2}{(1.1)13} = 1.1$ (BETWEEN 1 AND 3)

FROM: ACTS APRIL 2006 REPORT "ENGINEERING DESIGN PLAN, PROPOSED CONC REFUSE DISPOSAL FACILITY, POND CREEK MINE NO. 1", APPENDIX C, "LABORATORY TESTING

R17059

Client: MACH MINING
Project: POND CREEK MINE REFUSE DISPOSAL FACILITY
Project Number: B06-328-1444

Sample Data

Source:
Sample No.:
Elev. or Depth:
Location:
Description: 4-30-07 STANDARD PROCTOR
Date: 4-30-07 PL:
USCS Classification:
Testing Remarks:

Sample Length(in./cm.):
LL: PI:
AASHTO Classification:

Mechanical Analysis Data

	Initial	After wash
Dry sample and tare=	4012.00	3326.00
Tare =	215.40	215.40
Dry sample weight =	3796.60	3110.60

Minus #200 from wash= 18.1 %
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
3 inch	0.00	100.0
2 inch	0.00	100.0
1.5 inch	0.00	100.0
nch	104.50	97.2
inch	201.30	94.7
inch	446.90	88.2
# 4	1059.70	72.1
# 10	1598.10	57.9
# 20	2156.50	43.2
# 40	2522.10	33.6
# 60	2718.80	28.4
# 140	2944.50	22.4
# 200	3110.90	18.1

Gravel
Sand

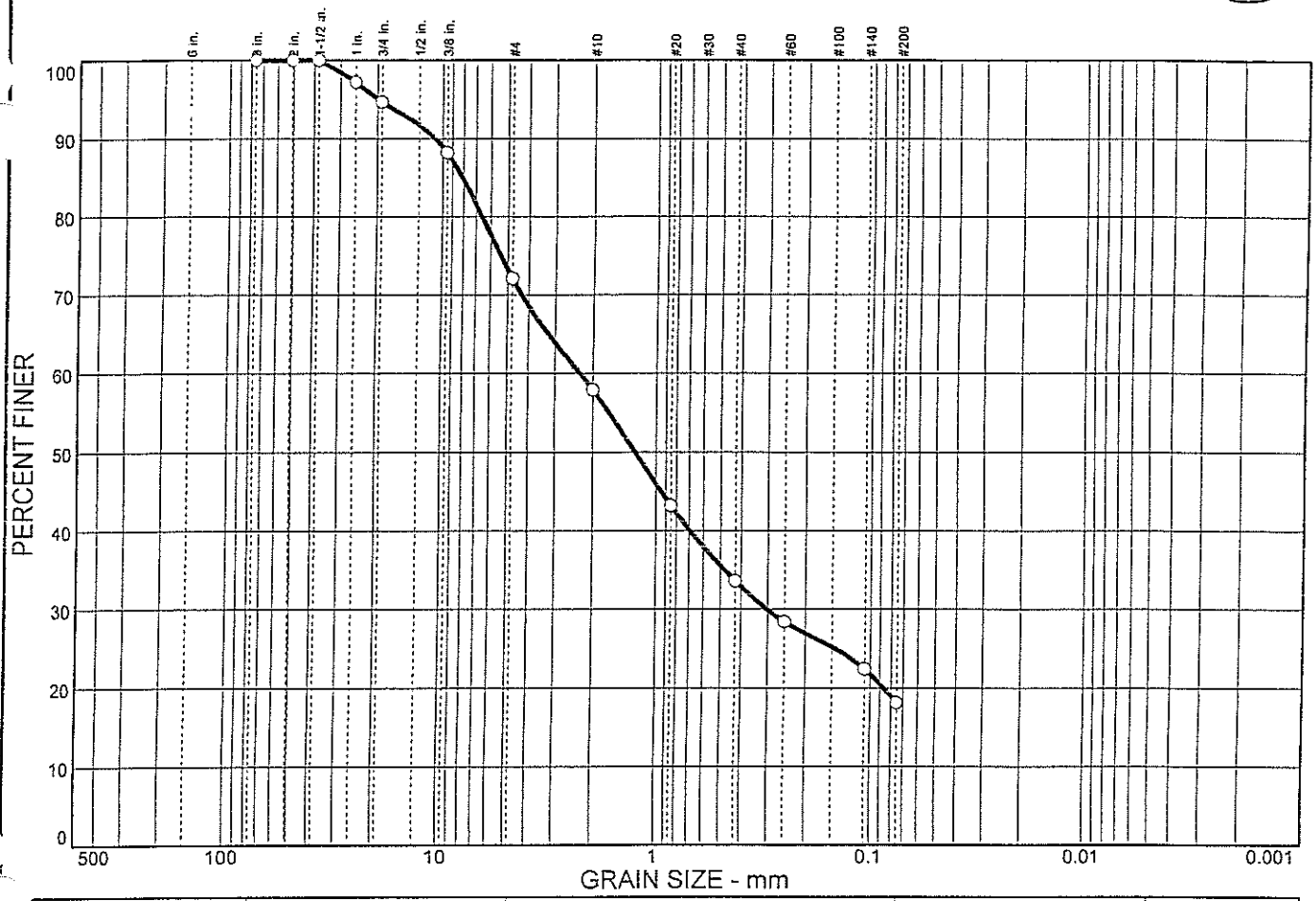
Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
COBBLES = 0.0 % GRAVEL = 27.9 % SAND = 54.0
FINES = 18.1

D_{85}= 8.09 D_{60}= 2.30 D_{50}= 1.26
D_{10}= 0.30

Particle Size Distribution Report

R17061



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	27.9	54.0	18.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
2 in.	100.0		
1.5 in.	100.0		
1 in.	97.2		
.75 in.	94.7		
.375 in.	88.2		
#4	72.1		
#10	57.9		
#20	43.2		
#40	33.6		
#60	28.4		
#140	22.4		
#200	18.1		

* (no specification provided)

Material Description

4-30-07 STANDARD PROCTOR

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 8.09 D_{60}= 2.30 D_{50}= 1.26
D_{30}= 0.302 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample No.: Source of Sample: Date: 4-30-07
Location: Elev./Depth:

ALLIANCE CONSULTING, INC.
Beaver, West Virginia

Client: MACH MINING
Project: POND CREEK MINE REFUSE DISPOSAL FACILITY

Project No: B06-328-1444 Figure

GRAIN SIZE DISTRIBUTION TEST DATA

SHEET 11 of 21 (109) R17062

lient: MACH MINING
roject: POND CREEK MINE REFUSE DISPOSAL FACILITY
r ect Number: B06-328-1444

Sample Data

ource:
ample No.:
lev. or Depth: Sample Length(in./cm.):
ocation:
escription: 8-22-07 STANDARD PROCTOR
ate: 8-22-07 PL: LL: PI:
SCS Classification: AASHTO Classification:
esting Remarks:

Mechanical Analysis Data

	Initial	After wash
ry sample and tare=	3992.00	2396.90
are =	436.00	436.00
ry sample weight =	3556.00	1960.90

inus #200 from wash= 44.9 %
are for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
3 inch	0.00	100.0
2 inch	0.00	100.0
5 inch	0.00	100.0
nch	0.00	100.0
inch	58.50	98.4
.3/8 inch	293.80	91.7
# 4	911.80	74.4
# 10	1402.30	60.6
# 20	1630.40	54.2
# 40	1722.60	51.6
# 60	1768.00	50.3
# 140	1837.70	48.3
# 200	1959.90	44.9

Fractional Components

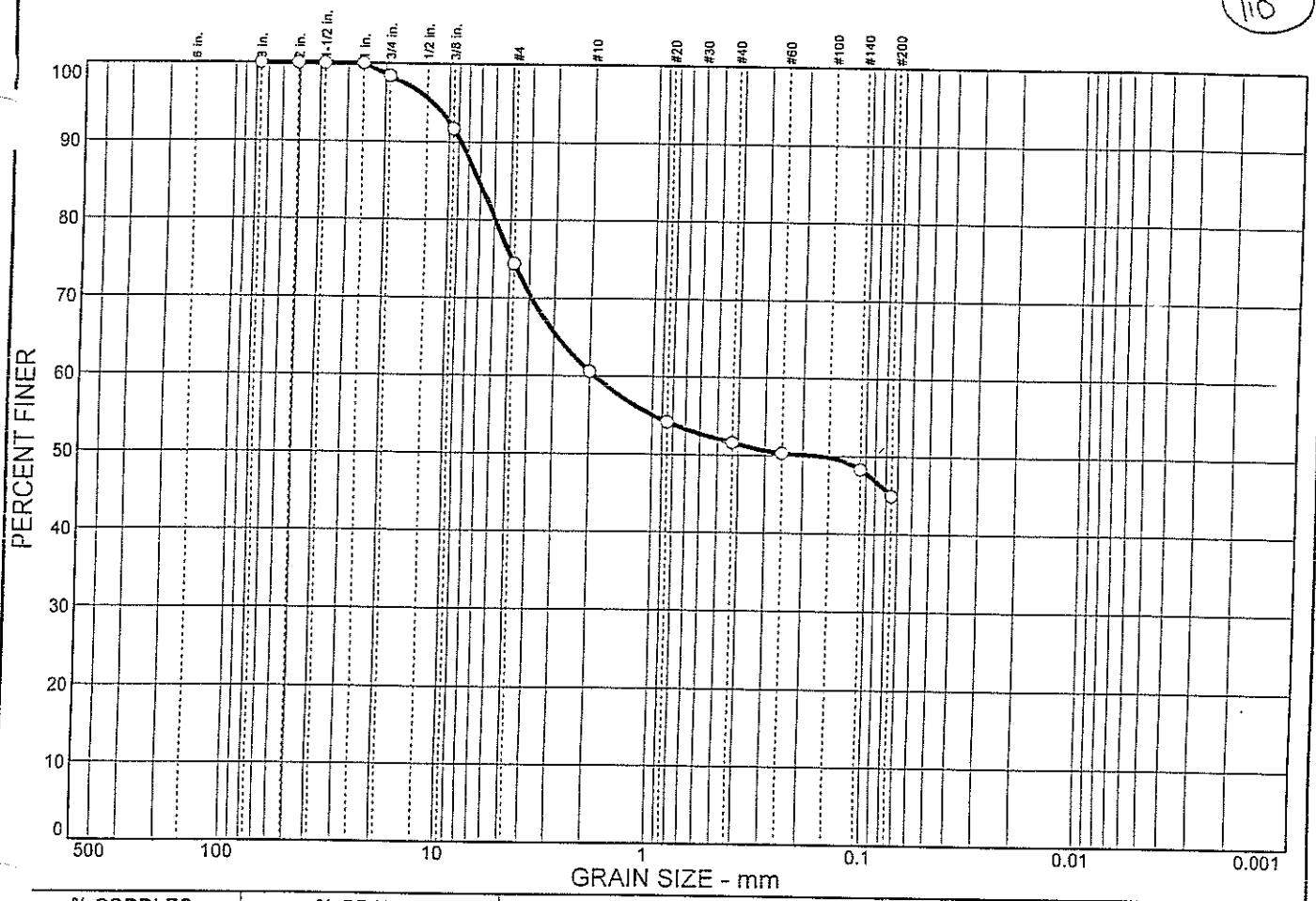
avel/Sand based on #4
nd/Fines based on #200
COBBLES = 0.0 % GRAVEL = 25.6 % SAND = 29.5
FINES = 44.9

5= 7.12 D_{60}= 1.89 D_{50}= 0.17

R17063

(110)

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	25.6	29.5	44.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
2 in.	100.0		
1.5 in.	100.0		
1 in.	100.0		
.75 in.	98.4		
.375 in.	91.7		
#4	74.4		
#10	60.6		
#20	54.2		
#40	51.6		
#60	50.3		
#140	48.3		
#200	44.9		

* (no specification provided)

Material Description

8-22-07 STANDARD PROCTOR

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 7.12 D_{60}= 1.89 D_{50}= 0.168
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample No.: Source of Sample: Date: 8-22-07
Location: Elev./Depth:

ALLIANCE CONSULTING, INC.
Beaver, West Virginia

Client: MACH MINING
Project: POND CREEK MINE REFUSE DISPOSAL FACILITY
Project No: B06-328-1444 Figure

GRAIN SIZE DISTRIBUTION TEST DATA

R17064

Client: MACH MINING
Project: POND CREEK MINE REFUSE DISPOSAL FACILITY
Project Number: B06-328-1444

Sample Data

Source:
Sample No.:
Elev. or Depth: Sample Length(in./cm.):
Location:
Description: 10-26-07 STANDARD PROCTOR
Date: 10-26-07 PL: LL: PI:
USCS Classification: AASHTO Classification:
Testing Remarks:

Mechanical Analysis Data

	Initial	After wash
Dry sample and tare=	3949.30	3089.10
Tare =	412.50	412.50
Dry sample weight =	3536.80	2676.60

Minus #200 from wash= 24.3 %
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
3 inch	0.00	100.0
2 inch	0.00	100.0
1.5 inch	0.00	100.0
1 inch	120.20	96.6
.75 inch	270.30	92.4
.375 inch	1023.50	71.1
# 4	1562.90	55.8
# 10	2144.50	39.4
# 20	2386.40	32.5
# 40	2482.30	29.8
# 60	2526.70	28.6
# 140	2587.30	26.8
# 200	2667.70	24.6

Fractional Components

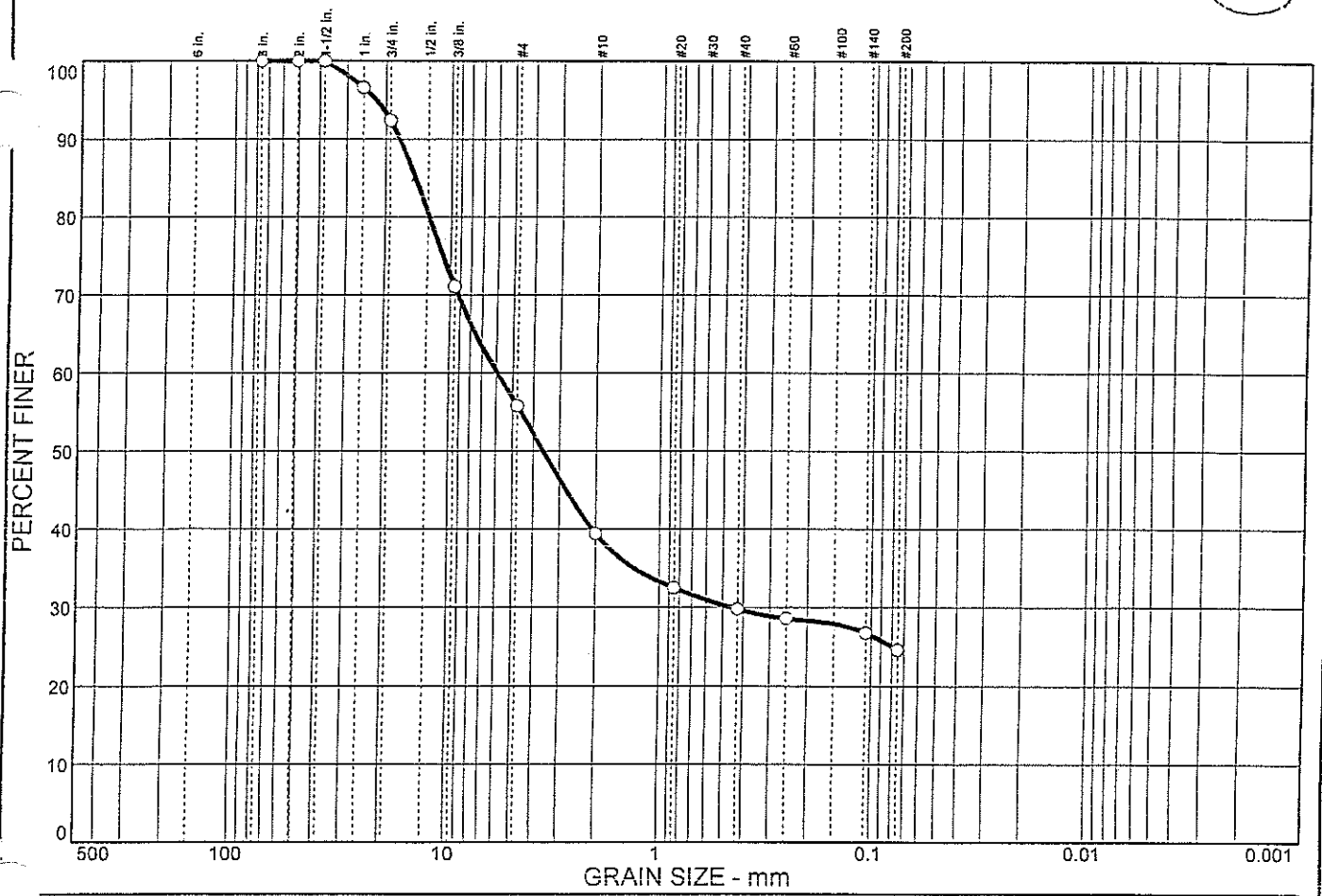
Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = 0.0 % GRAVEL = 44.2 % SAND = 31.2
% FINES = 24.6

D_{30}= 14.55 D_{60}= 5.90 D_{50}= 3.57
C_c= 0.45

Particle Size Distribution Report

112

R17065



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	44.2	31.2	24.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
2 in.	100.0		
1.5 in.	100.0		
1 in.	96.6		
.75 in.	92.4		
.375 in.	71.1		
#4	55.8		
#10	39.4		
#20	32.5		
#40	29.8		
#60	28.6		
#140	26.8		
#200	24.6		

* (no specification provided)

Material Description

10-26-07 STANDARD PROCTOR

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 14.5 D_{60}= 5.90 D_{50}= 3.57
D_{30}= 0.453 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample No.: Source of Sample: Date: 10-26-07
Location: Elev./Depth:

ALLIANCE CONSULTING, INC.
Beaver, West Virginia

Client: MACH MINING
Project: POND CREEK MINE REFUSE DISPOSAL FACILITY

Project No: B06-328-1444 Figure

(13)

R17066

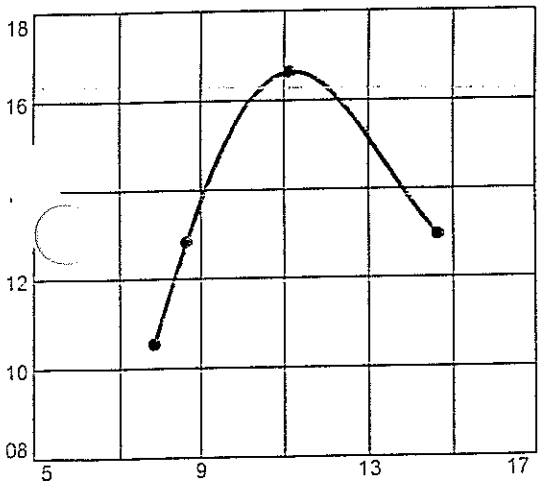
ient: MACH MINING
oject: POND CREEK MINE REFUSE DISPOSAL FACILITY
oject Number: B06-328-1444

Specimen Data

u :
mple No.:
ev. or Depth: Sample Length(in./cm.):
cation:
scription: 4-15-08 STANDARD PROCTOR
ter Content: Liquid Limit: 32 Plasticity Index: 10
CS: AASHTO:
sting Remarks: 116.6 PCF @ 11.2% (METHOD "C")
rcent retained on 3/4 in. sieve: 6.9
rcent passing No. 200 sieve: 32.8 Specific gravity: 2.23

Test Data And Results

pe of test: ASTM D 698-91 Procedure C Standard
ld Dia.: 6.00 in. Hammer Wt.: 5.5 lb. Drop: 12 in.
Layers: three Blows per Layer: 56



POINT NO.	1	2	3	4
WM + WS	9720.0	9606.0	9960.0	9955.0
WM	5550.0	5550.0	5550.0	5550.0
WW+T #1	256.56	235.69	223.31	267.45
WD+T #1	244.70	224.58	204.41	224.60
TARE #1	102.78	94.55	38.96	36.57
MOIST #1	8.4	8.5	11.4	22.8
WW+T #2	261.85	270.29	232.15	251.18
WD+T #2	248.96	259.08	212.88	238.33
TARE #2	104.64	102.78	35.38	39.84
MOIST #2	8.9	7.2	10.9	6.5
MOISTURE	8.6	7.9	11.1	14.6
DRY DEN	112.8	110.5	116.6	113.0

Max dry den= 118.0 pcf Opt moisture= 10.8 %
Uncorrected Results: Max dry den= 116.6 pcf Opt moisture= 11.2 %

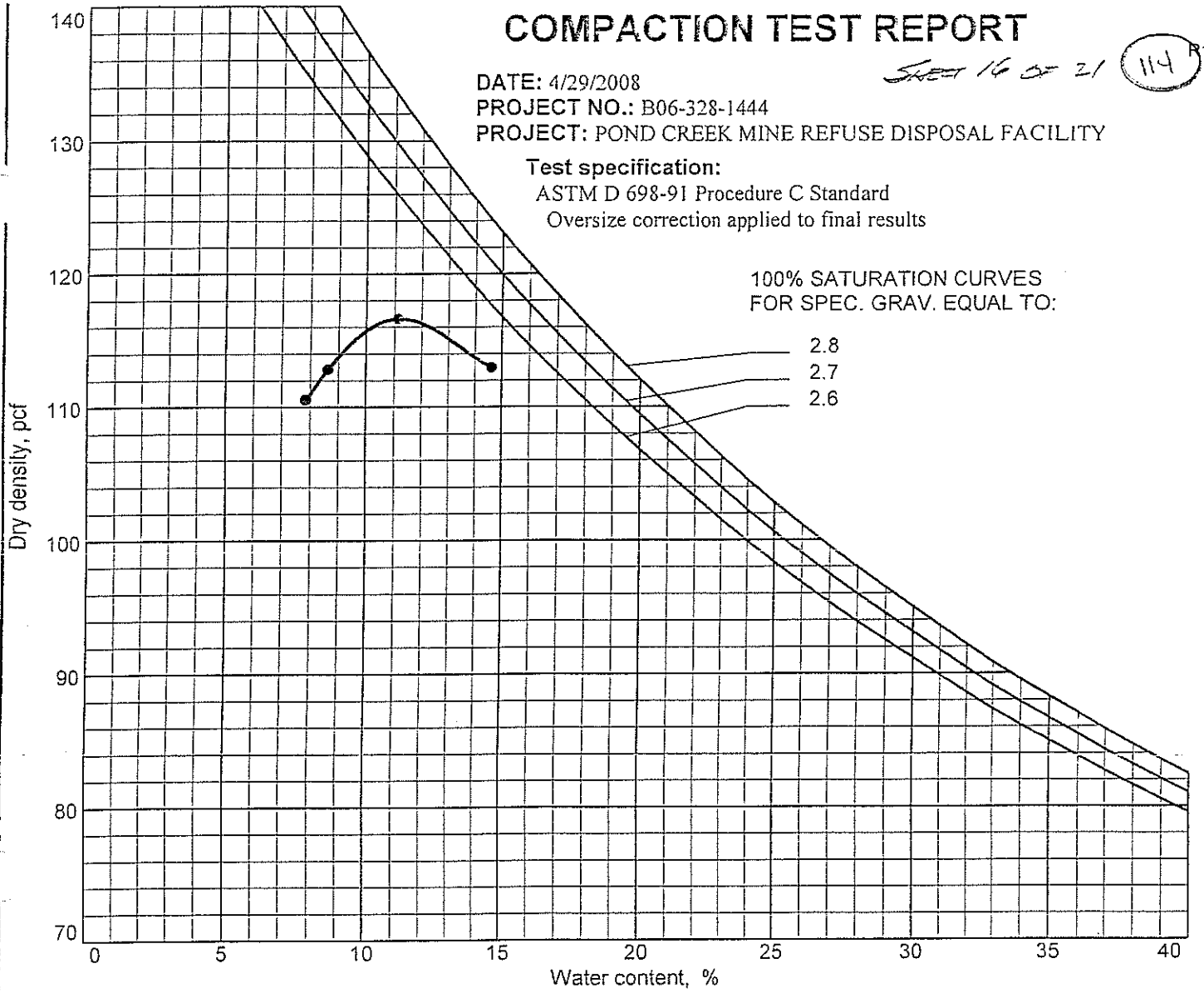
TM D 4718 Correction Data:
Bulk Specific Gravity of Oversize Material = 2.23
Moisture of Oversize Material = 5.5 %
rrections Applied to Calculated Maximum Density and Optimum Moisture Values

cf 4/29/08

COMPACTION TEST REPORT

DATE: 4/29/2008
PROJECT NO.: B06-328-1444
PROJECT: POND CREEK MINE REFUSE DISPOSAL FACILITY

Test specification:
ASTM D 698-91 Procedure C Standard
Oversize correction applied to final results



No.	LOCATION AND DESCRIPTION	REMARKS
●	Source: 4-15-08 STANDARD PROCTOR	116.6 PCF @ 11.2% (METHOD "C")

No.	USCS	LL	PI	NAT. MOIST.	OVERSIZE	%< No.200	MAX. DRY DEN.	OPT. MOIST.
●		32	10		%>3/4 in.=6.9	32.8 %	118.0 pcf	10.8 %

Figure

ALLIANCE CONSULTING, INC.

Client: MACH MINING
Project: POND CREEK MINE REFUSE DISPOSAL FACILITY
Project Number: B06-328-1444

Sample Data

Source:
Sample No.:
Elev. or Depth: Sample Length(in./cm.):
Location:
Description: 4-15-08 STANDARD PROCTOR
Date: 4-15-08 PL: 22 LL: 32 PI: 10
USCS Classification: AASHTO Classification:
Testing Remarks:

Mechanical Analysis Data

	Initial	After wash
Dry sample and tare=	3750.30	2627.80
Tare =	332.00	332.00
Dry sample weight =	3418.30	2295.80

Minus #200 from wash= 32.8 %
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
3 inch	0.00	100.0
2 inch	0.00	100.0
1.5 inch	0.00	100.0
1 inch	117.90	96.6
.75 inch	234.90	93.1
.5 inch	436.40	87.2
# 4	1157.70	66.1
# 10	1666.30	51.3
# 20	1907.60	44.2
# 40	2009.80	41.2
# 60	2078.70	39.2
# 140	2187.00	36.0
# 200	2297.90	32.8

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
COBBLES = 0.0 % GRAVEL = 33.9 % SAND = 33.3
FINES = 32.8

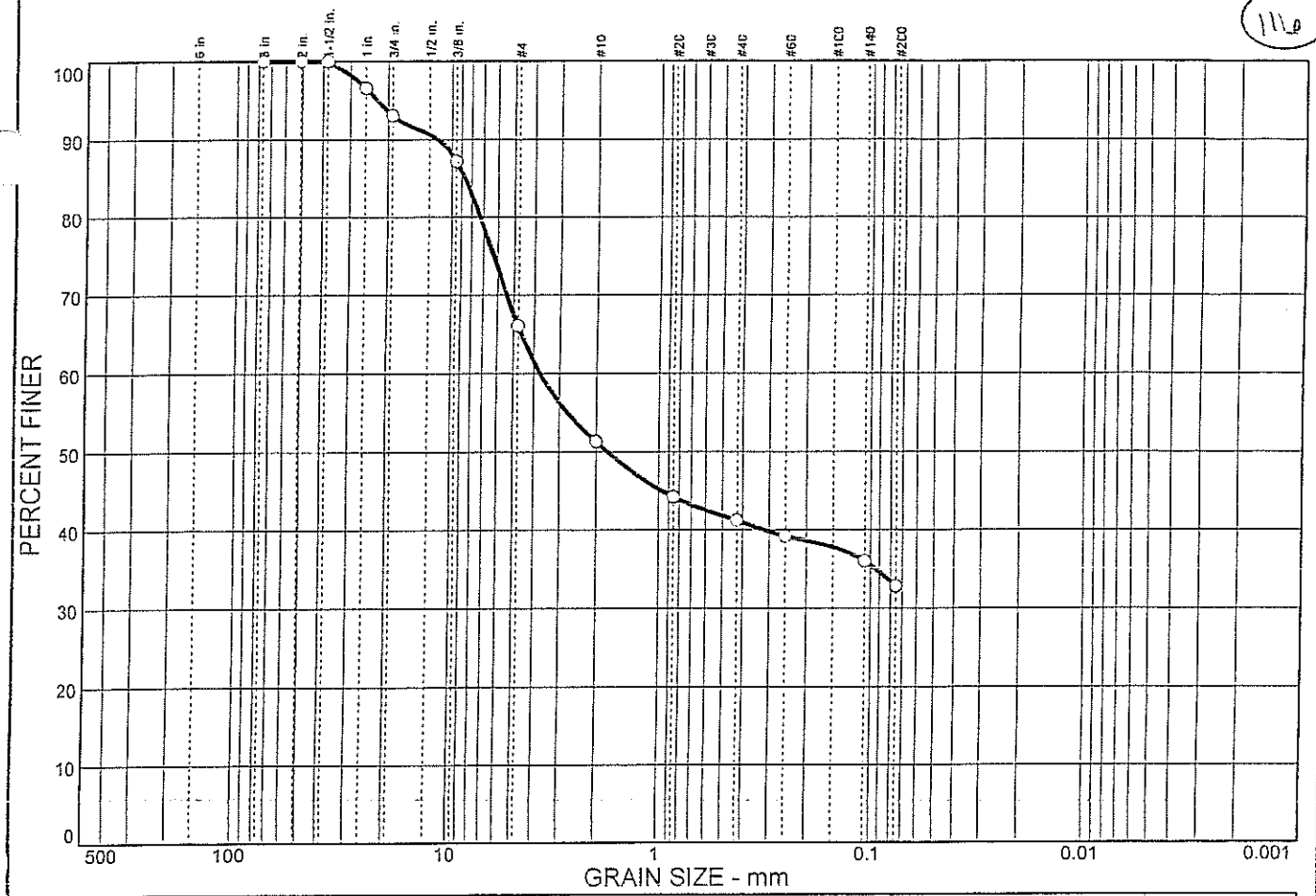
C_c= 8.64 D_{60}= 3.70 D_{50}= 1.76

RCP 4/28/08

Particle Size Distribution Report

SHEET 18 OF 21

R17069



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	33.9	33.3	32.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
2 in.	100.0		
1.5 in.	100.0		
1 in.	96.6		
.75 in.	93.1		
.375 in.	87.2		
#4	66.1		
#10	51.3		
#20	44.2		
#40	41.2		
#60	39.2		
#140	36.0		
#200	32.8		

* (no specification provided)

Material Description

4-15-08 STANDARD PROCTOR

Atterberg Limits

PL= 22 LL= 32 PI= 10

Coefficients

D_{85}= 8.64 D_{60}= 3.70 D_{50}= 1.76
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample No.: Source of Sample: Date: 4-15-08
Location: Elev./Depth:

ALLIANCE CONSULTING, INC.
Beaver, West Virginia

Client: MACH MINING
Project: POND CREEK MINE REFUSE DISPOSAL FACILITY

Project No: B06-328-1444 Figure

+3/4 INCH SPECIFIC GRAVITY

(117)

R17070

Weight of dry sample & pan	3405.0	gms
Weight of pan	424.3	gms
Weight of oven-dried sample (A)	2980.7	gms
Weight of saturated surface-dry sample & pan	3570.0	gms
Weight of pan	424.3	gms
Weight of saturated surface-dry sample (B)	3145.7	gms
Weight of saturated sample in water & basket	3600.0	gms
Weight of basket in water	1790.0	gms
Weight of saturated sample in water (C)	1810.0	gms

TEST RESULTS		Material Description
Specific gravity of sample A/(B-C)	2.23	COARSE COAL REFUSE
Percent absorption B-A/A X 100	5.5%	

Project No.: B06-328-1444 Client: WILLIAMSON ENERGY, LLC Tested By: CRKII

Project: POND CREEK MINE Sample Date: 4-15-08 Checked By: AP 4/28/08

Source: REFUSE FACILITY Sample No.: Elev./Depth:

Remarks:

+3/4 INCH SPECIFIC GRAVITY

ALLIANCE CONSULTING, INC.

R17071

(118)

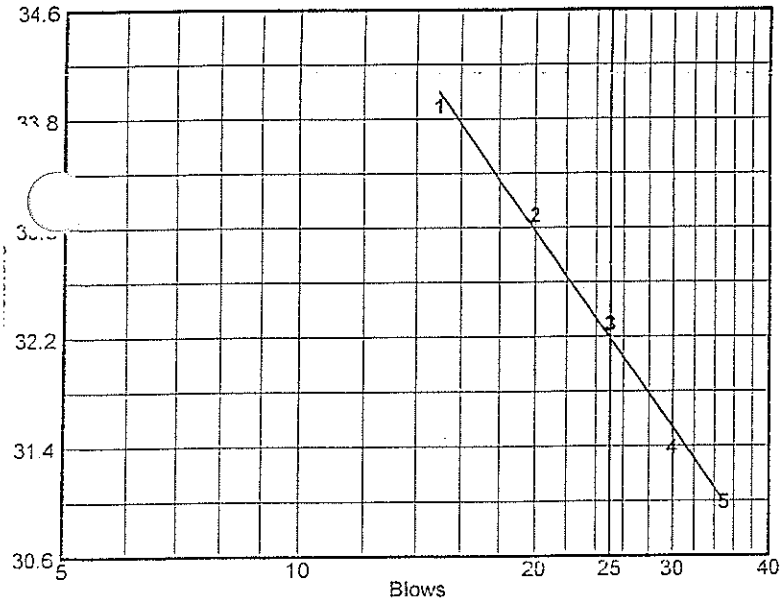
lient: MACH MINING
roject: POND CREEK MINE REFUSE DISPOSAL FACILITY
roject Number: B06-328-1444

Sample Data

ou e:
ample No.:
lev. or Depth: Sample Length(in./cm.):
ocation:
escription: Clayey gravel with sand4-15-08 STANDARD PROCTOR
ater Content: USCS: GC AASHTO:
esting Remarks:

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	36.46	39.14	35.32	35.46	38.23	
Dry+Tare	31.08	33.19	30.41	30.63	32.78	
Tare	15.20	15.23	15.21	15.26	15.21	
# Blows	15	20	25	30	35	
Moisture	33.9	33.1	32.3	31.4	31.0	



Liquid Limit= 32
Plastic Limit= 22
Plasticity Index= 10

Plastic Limit Data

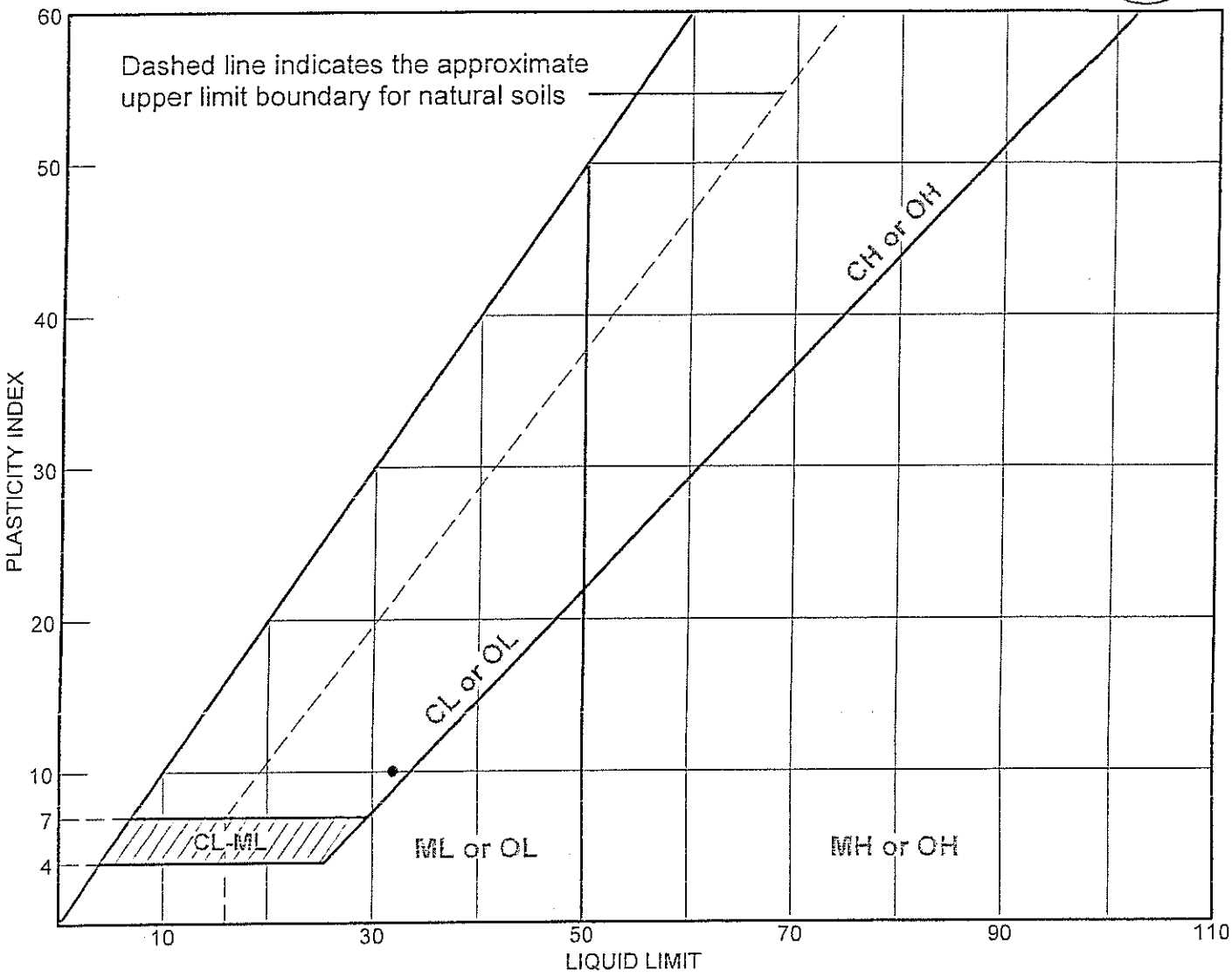
Run No.	1	2	3	4	
Wet+Tare	19.82	20.62	18.83		
Dry+Tare	18.99	19.62	18.17		
Tare	15.27	15.21	15.21		
Moisture	22.3	22.7	22.3		

ACP 4/22/08

LIQUID AND PLASTIC LIMITS TEST REPORT

119

R17072



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●					22	32	10	GC

LIQUID AND PLASTIC LIMITS TEST REPORT

ALLIANCE
CONSULTING, INC.
Beaver, West Virginia

Client: MACH MINING

Project: POND CREEK MINE REFUSE DISPOSAL FACILITY

Project No.: B06-328-1444

Figure

STABILTY ANALYSIS FILES – Phase 3 & Phase 7
Williamson Energy, LLC
Refuse Disposal Area No. 2
Project No.: B05-330-1413

File Name	Subject	F.S.
PH3DSST2	Downstream static, Phase 3, Section F-F	1.51
PH3DSSE1	Downstream seismic, Phase 3, two phreatic surfaces, to get Allowable phreatic level for Piezometers P-6, -7 and -8	1.23
PH3USSE2	Upstream seismic, Phase 3 two phreatic surfaces, pond about 1/2 full, (these are shallow circles that do not go through the crest)	1.16
PH3USSE3	Upstream seismic, Phase 3, two phreatic surfaces, pond full, done to check if slurry can be released during earthquake	1.20
PH3USSE4	Upstream seismic, Phase 3, two phreatic surfaces, pond about 1/4 full	1.20
PH3USST	Upstream static, Phase 3, pond about ½ full	1.89
PH7DSST	Downstream static, Phase 7, toe circle.	1.53
PH7DSST2	Downstream static, Phase 7, Section G-G, whole slope circle.	1.52
PH7DDSE	Downstream seismic, Phase 7, Section G-G, two phreatic surfaces, pond level the same as for Section D-D, to get allow Phreatic level for Piezometers P-15 -16, and -17.	1.20
PH7USSE	Upstream seismic, Phase 7, Section G-G, two phreatic surfaces, pond level the same as for Section D-D.	1.26
PH7USST	Upstream static, Phase 7, Section G-G, pond level same as for Section D-D.	1.82
PH7CEOC1	Downstream static, total stress foundation soil, total strength FCR, effective stress CCR, - for allowable phreatic level end of construction Phase 3/7C, Section F-F (P-6, -7, & -8), deep toe circles.	1.50
PH7CEOC2	Downstream static, total stress foundation soil, total strength FCR, effective stress CCR, - for allowable phreatic level end of construction Phase 3/7C, Section F-F (P-6, -7, & -8),. "hinge" circles Phase 3 to Phase 7 interface.	2.05
PH7CDSLT	Downstream static, effective stress foundation soil, FCR, & CCR - for allowable phreatic level long term Phase 3/&C, Section F-F (P-6, -7, & -8), deep toe circles.	1.50

(File: Stability Runs.doc, hlo, rev. 06/26/09)

Alliance Consulting, Inc.
Engineers
Constructors
Scientists

BECKLEY, WV
(304) 255-0491

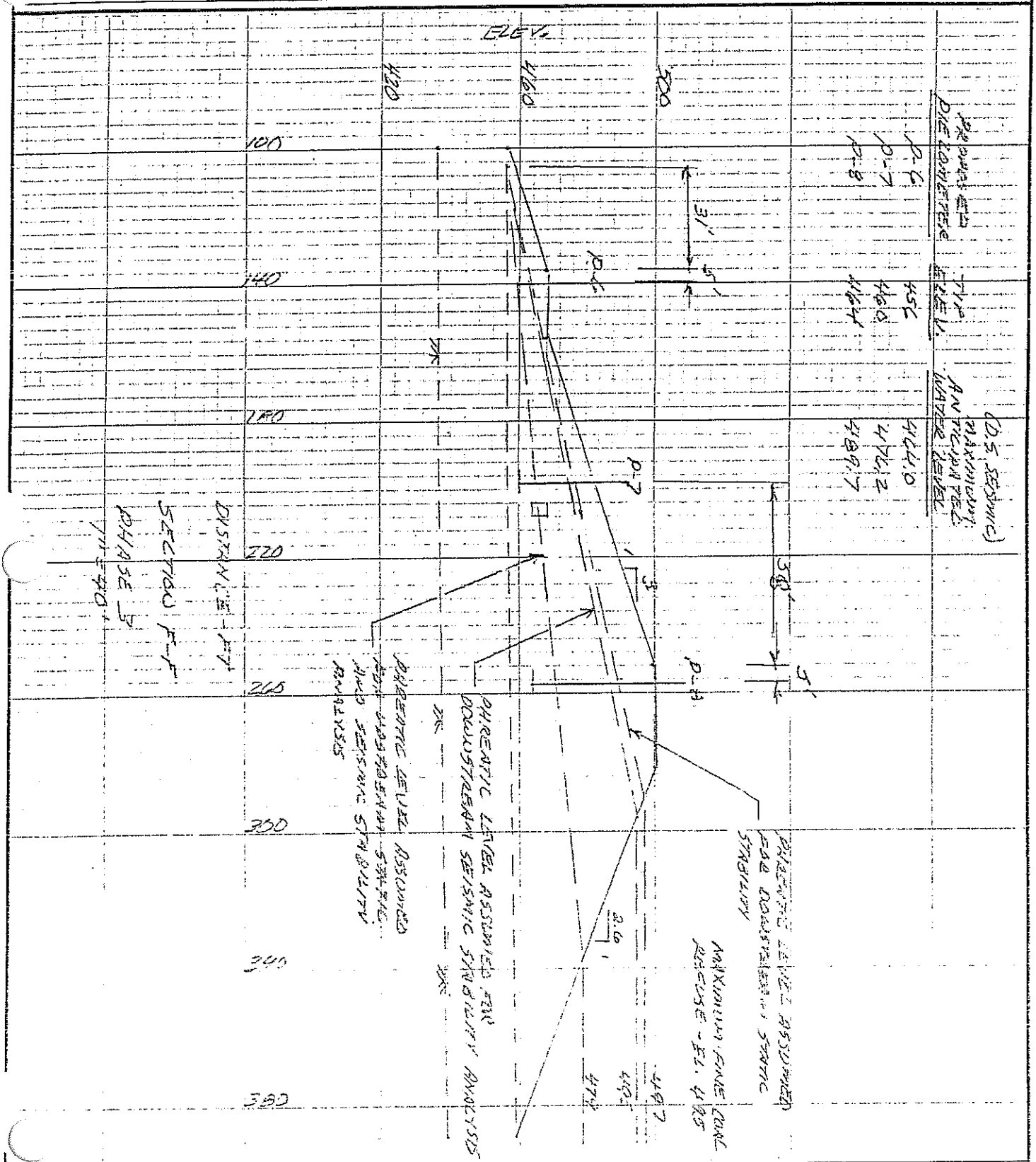
BY: MO DATE: 6/30/08 CHKD BY: CEY DATE: 8/8/08 (121)

PROJECT NAME: WILLIAMSON ENERGY LLC

PROJECT NO. 805-330-1413 SHEET 1 OF 1

DESCRIPTION PHASE 3 STABILITY CROSS-SECTION SHOWING PIEZOMETER LOCATIONS

R17074



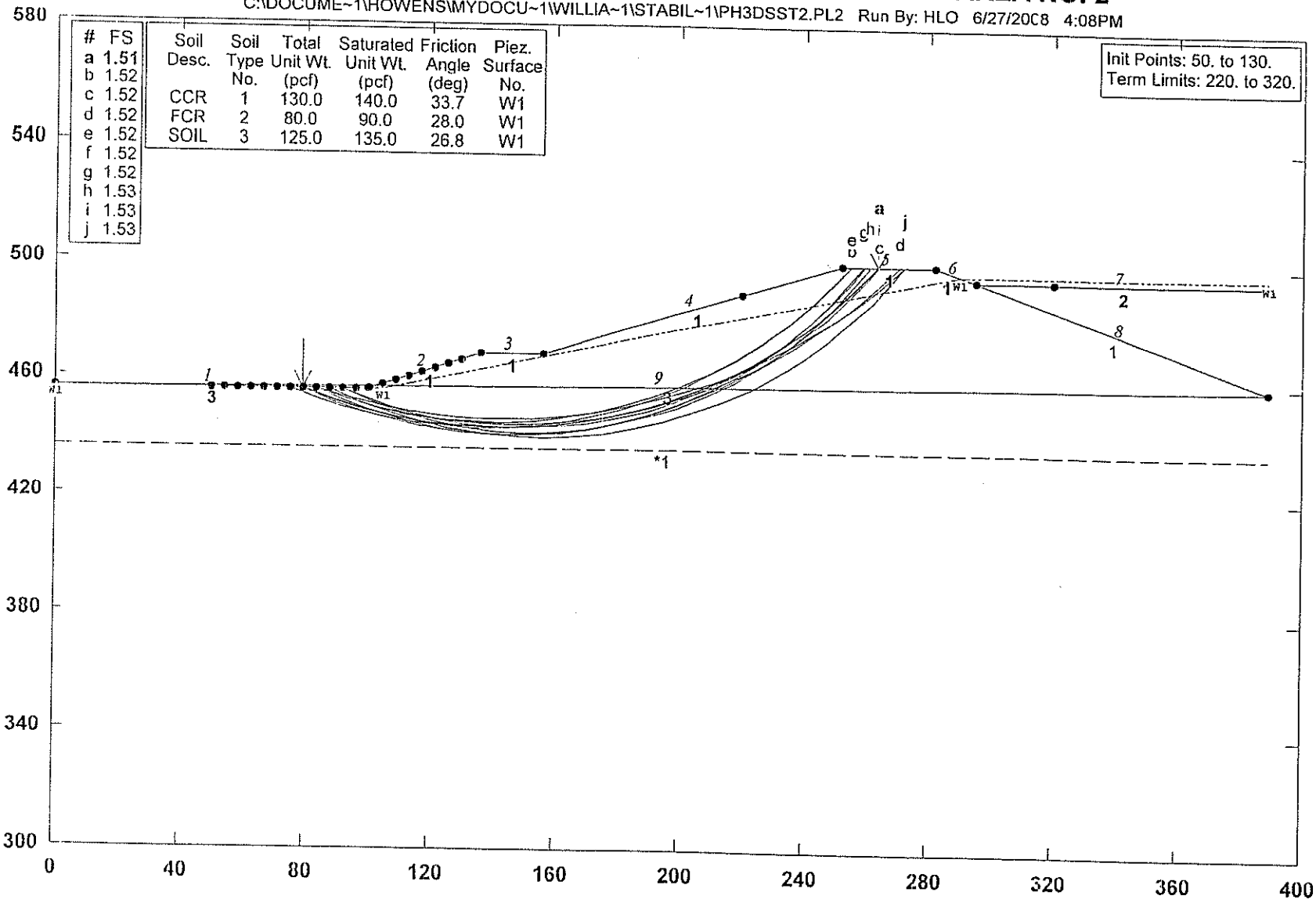
PHASE 3 DOWNSTREAM STATIC REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH3DSST2.PL2 Run By: HLO 6/27/2008 4:08PM

#	FS
a	1.51
b	1.52
c	1.52
d	1.52
e	1.52
f	1.52
g	1.52
h	1.53
i	1.53
j	1.53

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
SOIL	3	125.0	135.0	26.8	W1

Init Points: 50. to 130.
Term Limits: 220. to 320.



PCSTABL5M/si FSmin=1.51

Safety Factors Are Calculated By The Modified Bishop Method

STED



R17075

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 6/27/2008
Time of Run: 4:08PM
Run By: HLO
Input Data Filename: C:ph3dsst2.
Output Filename: C:ph3dsst2.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3dsst2.PLT
PROBLEM DESCRIPTION PHASE 3 DOWNSTREAM STATIC
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

7 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	156.00	100.00	156.00	3
2	100.00	156.00	136.00	168.00	1
3	136.00	168.00	156.00	168.00	1
4	156.00	168.00	252.00	200.00	1
5	252.00	200.00	282.00	200.00	1
6	282.00	200.00	295.00	195.00	1
7	295.00	195.00	389.00	195.00	2
8	295.00	195.00	389.00	159.00	1
9	.00	156.00	389.00	159.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	156.00
2	105.00	156.00
3	289.80	197.00
4	389.00	197.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	136.00	389.00	136.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 130.00 ft.
Each Surface Terminates Between X = 220.00 ft.
and X = 320.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical

First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	79.47	156.00
2	88.79	152.36
3	98.31	149.31
4	108.01	146.86
5	117.84	145.04
6	127.77	143.83
7	137.75	143.25
8	147.75	143.30
9	157.73	143.98
10	167.64	145.29
11	177.45	147.21
12	187.12	149.76
13	196.62	152.90
14	205.89	156.64
15	214.92	160.95
16	223.65	165.82
17	232.06	171.23
18	240.11	177.16
19	247.77	183.59
20	255.02	190.48
21	261.81	197.82
22	263.59	200.00

Circle Center At X = 141.9 ; Y = 301.9 and Radius, 158.7
*** 1.513 ***
Individual data on the 29 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.3	2229.3	.0	1136.4	.0	.0	.0	.0	.0
2	9.5	6574.4	.0	3224.1	.0	.0	.0	.0	.0
3	1.7	1561.3	.0	750.4	.0	.0	.0	.0	.0
4	5.0	5751.1	.0	2492.6	.0	.0	.0	.0	.0
5	3.0	4394.6	.0	1718.1	.0	.0	.0	.0	.0
6	.8	1243.4	.0	477.5	.0	.0	.0	.0	.0
7	9.1	17703.0	.0	6717.4	.0	.0	.0	.0	.0
8	9.9	25619.0	.0	9455.1	.0	.0	.0	.0	.0
9	8.2	25582.2	.0	9233.8	.0	.0	.0	.0	.0
10	1.7	5834.7	.0	2111.2	.0	.0	.0	.0	.0
11	10.0	33509.6	.0	12856.9	.0	.0	.0	.0	.0
12	8.3	27467.6	.0	11498.2	.0	.0	.0	.0	.0
13	1.7	5750.9	.0	2486.6	.0	.0	.0	.0	.0
14	9.9	34700.8	.0	14724.5	.0	.0	.0	.0	.0
15	9.8	36606.4	.0	15072.8	.0	.0	.0	.0	.0
16	9.7	37452.6	.0	15028.4	.0	.0	.0	.0	.0
17	9.5	37257.4	.0	14591.5	.0	.0	.0	.0	.0
18	9.3	36063.5	.0	13763.8	.0	.0	.0	.0	.0
19	2.0	7746.6	.0	2937.2	.0	.0	.0	.0	.0
20	7.0	26133.5	.0	9611.4	.0	.0	.0	.0	.0
21	8.7	30721.4	.0	10950.6	.0	.0	.0	.0	.0
22	8.4	26818.7	.0	8976.4	.0	.0	.0	.0	.0
23	8.1	22313.1	.0	6633.6	.0	.0	.0	.0	.0
24	7.7	17358.2	.0	3931.6	.0	.0	.0	.0	.0
25	4.2	7631.6	.0	905.6	.0	.0	.0	.0	.0
26	1.4	2105.8	.0	58.1	.0	.0	.0	.0	.0
27	1.6	2197.2	.0	.0	.0	.0	.0	.0	.0
28	6.8	5168.6	.0	.0	.0	.0	.0	.0	.0
29	1.8	252.5	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	83.68	156.00

2	93.07	152.54
3	102.66	149.72
4	112.42	147.55
5	122.31	146.04
6	132.27	145.21
7	142.27	145.04
8	152.26	145.55
9	162.19	146.74
10	172.02	148.58
11	181.70	151.09
12	191.19	154.24
13	200.44	158.03
14	209.42	162.43
15	218.09	167.42
16	226.39	172.99
17	234.31	179.10
18	241.79	185.74
19	248.81	192.86
20	254.95	200.00

Circle Center At X = 139.7 ; Y = 293.3 and Radius, 148.3

*** 1.516 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	79.47	156.00
2	88.61	151.93
3	98.00	148.49
4	107.60	145.68
5	117.36	143.52
6	127.25	142.02
7	137.21	141.18
8	147.21	141.02
9	157.20	141.52
10	167.13	142.69
11	176.96	144.53
12	186.64	147.02
13	196.14	150.15
14	205.41	153.91
15	214.40	158.28
16	223.08	163.25
17	231.41	168.78
18	239.35	174.86
19	246.86	181.46
20	253.92	188.55
21	260.48	196.09
22	263.45	200.00

Circle Center At X = 144.7 ; Y = 290.0 and Radius, 149.1

*** 1.517 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	83.68	156.00
2	93.10	152.63
3	102.70	149.83
4	112.45	147.60
5	122.31	145.95
6	132.25	144.89
7	142.24	144.42
8	152.24	144.54
9	162.22	145.26
10	172.13	146.57
11	181.95	148.46
12	191.64	150.93
13	201.17	153.98
14	210.49	157.58
15	219.59	161.72
16	228.43	166.41

17	236.97	171.60
18	245.20	177.30
19	253.06	183.47
20	260.55	190.09
21	267.64	197.15
22	270.17	200.00

Circle Center At X = 145.1 ; Y = 312.8 and Radius, 168.4

*** 1.520 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	75.26	156.00
2	84.54	152.28
3	94.05	149.17
4	103.74	146.70
5	113.57	144.87
6	123.50	143.70
7	133.49	143.18
8	143.49	143.31
9	153.46	144.11
10	163.35	145.56
11	173.13	147.66
12	182.75	150.40
13	192.16	153.77
14	201.34	157.74
15	210.23	162.32
16	218.80	167.47
17	227.02	173.17
18	234.84	179.40
19	242.23	186.13
20	249.17	193.34
21	254.78	200.00

Circle Center At X = 136.4 ; Y = 294.9 and Radius, 151.8

*** 1.523 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	92.11	156.00
2	101.31	152.10
3	110.79	148.89
4	120.47	146.39
5	130.31	144.62
6	140.26	143.58
7	150.25	143.28
8	160.24	143.72
9	170.17	144.90
10	179.99	146.81
11	189.63	149.45
12	199.06	152.79
13	208.21	156.82
14	217.04	161.51
15	225.50	166.85
16	233.54	172.80
17	241.11	179.33
18	248.18	186.40
19	254.71	193.97
20	259.17	200.00

Circle Center At X = 149.3 ; Y = 278.1 and Radius, 134.8

*** 1.524 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	83.68	156.00
2	92.73	151.74
3	102.07	148.15
4	111.64	145.26
5	121.40	143.08

6	131.29	141.62
7	141.27	140.90
8	151.27	140.90
9	161.24	141.64
10	171.13	143.11
11	180.89	145.30
12	190.46	148.20
13	199.79	151.79
14	208.83	156.06
15	217.54	160.98
16	225.86	166.53
17	233.75	172.67
18	241.17	179.38
19	248.08	186.61
20	254.43	194.33
21	258.45	200.00

Circle Center At X = 146.2 ; Y = 277.0 and Radius, 136.2

*** 1.524 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	92.11	156.00
2	101.18	151.80
3	110.55	148.30
4	120.16	145.53
5	129.95	143.50
6	139.87	142.22
7	149.85	141.70
8	159.85	141.95
9	169.80	142.95
10	179.64	144.71
11	189.33	147.22
12	198.79	150.46
13	207.98	154.40
14	216.84	159.04
15	225.32	164.34
16	233.37	170.27
17	240.94	176.80
18	248.00	183.88
19	254.50	191.48
20	260.40	199.56
21	260.67	200.00

Circle Center At X = 151.7 ; Y = 272.8 and Radius, 131.1

*** 1.532 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	83.68	156.00
2	93.23	153.03
3	102.93	150.59
4	112.75	148.69
5	122.66	147.32
6	132.62	146.51
7	142.62	146.23
8	152.61	146.51
9	162.58	147.33
10	172.49	148.70
11	182.30	150.61
12	192.00	153.06
13	201.55	156.03
14	210.92	159.52
15	220.08	163.52
16	229.02	168.01
17	237.69	172.99
18	246.08	178.43
19	254.15	184.33
20	261.90	190.66

21	269.28	197.41
22	271.82	200.00

Circle Center At X = 142.6 ; Y = 328.5 and Radius, 182.2

*** 1.534 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	87.90	156.00
2	96.96	151.77
3	106.29	148.17
4	115.84	145.22
5	125.58	142.94
6	135.45	141.32
7	145.40	140.39
8	155.40	140.14
9	165.39	140.58
10	175.33	141.70
11	185.16	143.50
12	194.85	145.97
13	204.35	149.09
14	213.61	152.86
15	222.60	157.26
16	231.25	162.27
17	239.55	167.85
18	247.44	173.99
19	254.89	180.66
20	261.87	187.82
21	268.34	195.45
22	271.70	200.00

Circle Center At X = 154.0 ; Y = 285.7 and Radius, 145.6

*** 1.535 ***

PHASE 3 DOWNSTREAM SEISMIC REFUSE DISPOSAL AREA NO. 2 .

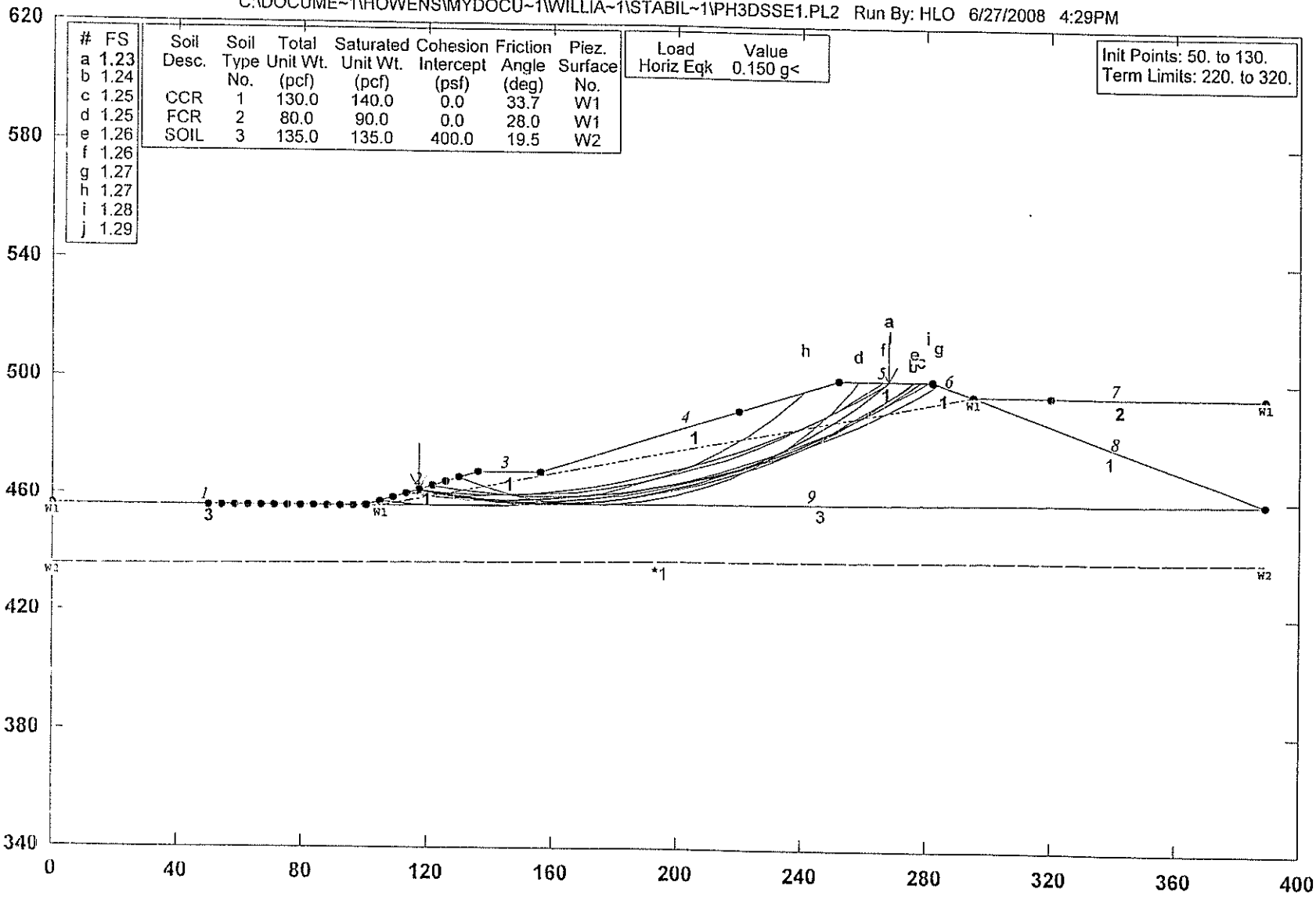
C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH3DSSE1.PL2 Run By: HLO 6/27/2008 4:29PM

#	FS
a	1.23
b	1.24
c	1.25
d	1.25
e	1.26
f	1.26
g	1.27
h	1.27
i	1.28
j	1.29

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	28.0	W1
SOIL	3	135.0	135.0	400.0	19.5	W2

Load	Value
Horiz Eqk	0.150 g<

Init Points: 50. to 130.
Term Limits: 220. to 320.



PCSTABL5M/si FSmin=1.23
Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 6/27/2008
Time of Run: 4:29PM
Run By: HLO
Input Data Filename: C:ph3dsse1.
Output Filename: C:ph3dsse1.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3dsse1.PLT
PROBLEM DESCRIPTION PHASE 3 DOWNSTREAM SEISMIC
REFUSE DISPOSAL AREA NO. 2
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 340.00 to Y-values listed.

7 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	116.00	100.00	116.00	3
2	100.00	116.00	136.00	128.00	1
3	136.00	128.00	156.00	128.00	1
4	156.00	128.00	252.00	160.00	1
5	252.00	160.00	282.00	160.00	1
6	282.00	160.00	295.00	155.00	1
7	295.00	155.00	389.00	155.00	2
8	295.00	155.00	389.00	119.00	1
9	100.00	116.00	389.00	119.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	135.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	116.00
2	105.00	116.00
3	295.00	155.00
4	389.00	155.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	96.00
2	389.00	99.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	96.00	389.00	99.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.

20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 130.00 ft.
Each Surface Terminates Between X = 220.00 ft.
and X = 320.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 96.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	117.37	121.79
2	127.15	119.72
3	137.04	118.24
4	147.00	117.36
5	157.00	117.08
6	166.99	117.41
7	176.95	118.33
8	186.84	119.85
9	196.61	121.96
10	206.24	124.66
11	215.69	127.93
12	224.93	131.76
13	233.92	136.14
14	242.62	141.06
15	251.02	146.49
16	259.08	152.41
17	266.76	158.81
18	268.03	160.00

Circle Center At X = 156.6 ; Y = 283.1 and Radius, 166.0
*** 1.231 ***
Individual data on the 22 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	7.8	2154.5	.0	.0	.0	.0	323.2	.0	.0
2	2.0	1243.4	.0	51.2	.0	.0	186.5	.0	.0
3	8.8	8794.8	.0	1310.2	.0	.0	1319.2	.0	.0
4	1.0	1354.5	.0	267.5	.0	.0	203.2	.0	.0
5	10.0	13770.1	.0	3543.8	.0	.0	2065.5	.0	.0
6	9.0	13318.4	.0	4570.8	.0	.0	1997.8	.0	.0
7	1.0	1531.8	.0	579.4	.0	.0	229.8	.0	.0
8	10.0	17594.6	.0	6391.3	.0	.0	2639.2	.0	.0
9	10.0	21165.7	.0	7262.4	.0	.0	3174.9	.0	.0
10	9.9	23767.3	.0	7760.4	.0	.0	3565.1	.0	.0
11	9.8	25379.1	.0	7883.5	.0	.0	3806.9	.0	.0
12	9.6	26003.4	.0	7631.2	.0	.0	3900.5	.0	.0
13	9.5	25665.2	.0	7004.5	.0	.0	3849.8	.0	.0
14	9.2	24411.8	.0	6005.7	.0	.0	3661.8	.0	.0
15	9.0	22311.6	.0	4638.3	.0	.0	3346.7	.0	.0
16	8.7	19453.1	.0	2907.3	.0	.0	2918.0	.0	.0
17	7.2	13925.0	.0	840.6	.0	.0	2088.8	.0	.0
18	1.2	2021.5	.0	.0	.0	.0	303.2	.0	.0
19	1.0	1650.2	.0	.0	.0	.0	247.5	.0	.0
20	7.1	9380.0	.0	.0	.0	.0	1407.0	.0	.0
21	7.7	4386.6	.0	.0	.0	.0	658.0	.0	.0
22	1.3	98.2	.0	.0	.0	.0	14.7	.0	.0

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	117.37	121.79
2	127.18	119.87

3	137.09	118.48
4	147.05	117.63
5	157.04	117.32
6	167.04	117.55
7	177.01	118.33
8	186.93	119.64
9	196.75	121.49
10	206.47	123.86
11	216.04	126.76
12	225.44	130.17
13	234.64	134.09
14	243.62	138.50
15	252.34	143.38
16	260.79	148.74
17	268.93	154.54
18	275.78	160.00

Circle Center At X = 157.8 ; Y = 301.9 and Radius, 184.5

*** 1.243 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.16	120.39
2	123.06	119.00
3	133.02	118.07
4	143.01	117.59
5	153.01	117.57
6	163.00	118.00
7	172.96	118.89
8	182.87	120.23
9	192.71	122.02
10	202.45	124.26
11	212.09	126.94
12	221.59	130.05
13	230.94	133.59
14	240.12	137.56
15	249.11	141.94
16	257.89	146.72
17	266.45	151.90
18	274.76	157.47
19	278.19	160.00

Circle Center At X = 148.5 ; Y = 337.1 and Radius, 219.5

*** 1.247 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.00	126.00
2	139.33	122.40
3	148.95	119.69
4	158.79	117.89
5	168.75	117.02
6	178.75	117.10
7	188.70	118.11
8	198.51	120.04
9	208.10	122.89
10	217.37	126.63
11	226.26	131.22
12	234.67	136.62
13	242.54	142.79
14	249.80	149.67
15	256.38	157.20
16	258.40	160.00

Circle Center At X = 173.0 ; Y = 223.2 and Radius, 106.3

*** 1.255 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	121.58	123.19

2	131.44	121.53
3	141.37	120.38
4	151.35	119.75
5	161.35	119.64
6	171.34	120.06
7	181.30	121.00
8	191.19	122.45
9	201.00	124.42
10	210.69	126.90
11	220.23	129.87
12	229.61	133.35
13	238.79	137.31
14	247.76	141.74
15	256.48	146.63
16	264.93	151.97
17	273.10	157.75
18	275.95	160.00

Circle Center At X = 158.4 ; Y = 310.9 and Radius, 191.3

*** 1.261 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	117.37	121.79
2	127.31	120.72
3	137.29	120.13
4	147.29	120.04
5	157.29	120.43
6	167.25	121.31
7	177.15	122.67
8	186.98	124.51
9	196.71	126.84
10	206.31	129.63
11	215.76	132.89
12	225.05	136.61
13	234.14	140.78
14	243.01	145.38
15	251.66	150.42
16	260.04	155.86
17	265.77	160.00

Circle Center At X = 144.3 ; Y = 324.8 and Radius, 204.8

*** 1.261 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.16	120.39
2	123.10	119.32
3	133.08	118.64
4	143.07	118.36
5	153.07	118.47
6	163.06	118.97
7	173.02	119.86
8	182.94	121.15
9	192.80	122.82
10	202.58	124.88
11	212.28	127.32
12	221.87	130.14
13	231.35	133.33
14	240.69	136.90
15	249.89	140.83
16	258.92	145.12
17	267.78	149.75
18	276.45	154.74
19	283.75	159.33

Circle Center At X = 145.3 ; Y = 372.9 and Radius, 254.5

*** 1.273 ***

Failure Surface Specified By 15 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	117.37	121.79
2	127.18	119.83
3	137.10	118.62
4	147.09	118.16
5	157.09	118.45
6	167.03	119.50
7	176.87	121.30
8	186.54	123.83
9	196.00	127.08
10	205.18	131.04
11	214.04	135.69
12	222.52	140.98
13	230.58	146.90
14	238.17	153.42
15	241.13	156.38

Circle Center At X = 148.2 ; Y = 250.6 and Radius, 132.4

*** 1.273 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	104.74	117.58
2	114.70	116.72
3	124.69	116.24
4	134.69	116.12
5	144.68	116.37
6	154.67	116.99
7	164.62	117.99
8	174.52	119.34
9	184.37	121.07
10	194.15	123.15
11	203.85	125.60
12	213.45	128.40
13	222.94	131.56
14	232.30	135.06
15	241.53	138.91
16	250.61	143.10
17	259.53	147.62
18	268.28	152.47
19	276.84	157.63
20	280.45	160.00

Circle Center At X = 132.9 ; Y = 386.2 and Radius, 270.0

*** 1.280 ***

Failure Surface Specified By 18 Coordinate Points

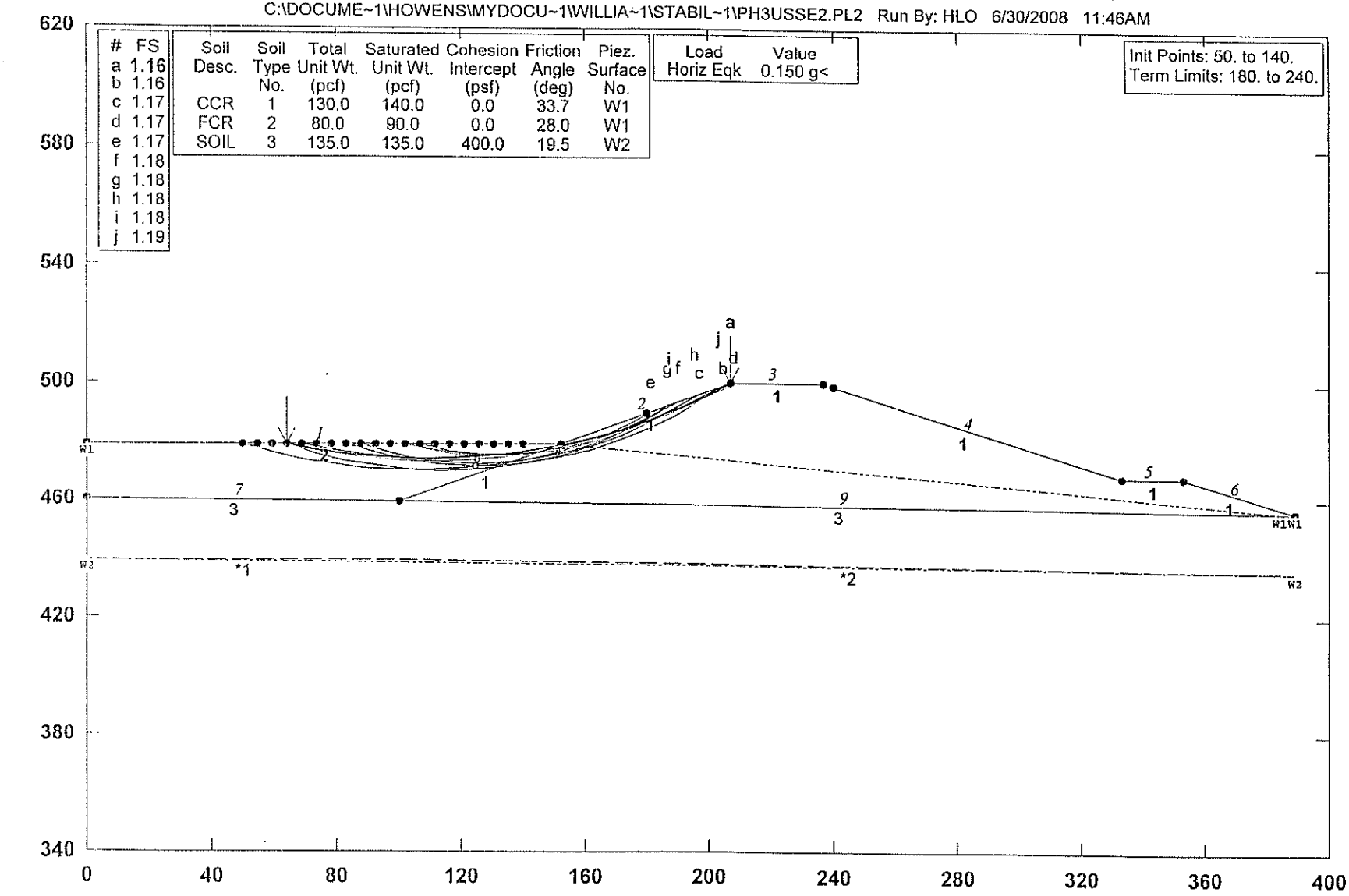
Point No.	X-Surf (ft)	Y-Surf (ft)
1	113.16	120.39
2	123.15	119.88
3	133.14	119.76
4	143.14	120.04
5	153.12	120.70
6	163.06	121.76
7	172.96	123.21
8	182.79	125.04
9	192.54	127.26
10	202.20	129.86
11	211.74	132.83
12	221.17	136.18
13	230.45	139.90
14	239.58	143.97
15	248.55	148.40
16	257.33	153.18
17	265.92	158.30
18	268.54	160.00

Circle Center At X = 131.2 ; Y = 374.3 and Radius, 254.6

*** 1.286 ***

PHASE 3 UPSTREAM SEISMIC REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH3USSE2.PL2 Run By: HLO 6/30/2008 11:46AM



PCSTABL5M/si FSmin=1.16

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 6/30/2008
Time of Run: 11:46AM
Run By: HLO
Input Data Filename: C:ph3usse2.
Output Filename: C:ph3usse2.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3usse2.PLT
PROBLEM DESCRIPTION PHASE 3 UPSTREAM SEISMIC
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 340.00 to Y-values listed.

6 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	139.00	152.00	139.00	2
2	152.00	139.00	207.00	160.00	1
3	207.00	160.00	237.00	160.00	1
4	237.00	160.00	333.00	128.00	1
5	333.00	128.00	353.00	128.00	1
6	353.00	128.00	389.00	116.00	1
7	.00	120.00	100.00	119.00	3
8	100.00	119.00	152.00	139.00	1
9	100.00	119.00	389.00	116.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	135.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	139.00
2	152.00	139.00
3	384.00	116.00
4	389.00	116.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	99.00
2	389.00	96.00

Searching Routine Will Be Limited To An Area Defined By 2 Boundaries
Of Which The First 2 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	99.00	100.00	99.00
2	100.00	99.00	389.00	96.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 140.00 ft.
Each Surface Terminates Between X = 180.00 ft.
and X = 240.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 99.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.21	139.00
2	74.01	137.01
3	83.90	135.52
4	93.85	134.52
5	103.84	134.02
6	113.84	134.03
7	123.82	134.53
8	133.77	135.53
9	143.66	137.03
10	153.46	139.02
11	163.15	141.50
12	172.70	144.46
13	182.09	147.89
14	191.30	151.79
15	200.30	156.15
16	207.34	160.00

Circle Center At X = 108.8 ; Y = 333.5 and Radius, 199.5
*** 1.161 ***
Individual data on the 19 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.8	876.2	.0	619.8	.0	.0	131.4	.0	.0
2	9.9	2432.6	.0	1705.8	.0	.0	364.9	.0	.0
3	10.0	3563.3	.0	2483.0	.0	.0	534.5	.0	.0
4	10.0	4248.9	.0	2949.5	.0	.0	637.3	.0	.0
5	10.0	4477.3	.0	3104.3	.0	.0	671.6	.0	.0
6	10.0	4244.9	.0	2946.9	.0	.0	636.7	.0	.0
7	9.9	3555.5	.0	2477.6	.0	.0	533.3	.0	.0
8	9.9	2421.0	.0	1697.7	.0	.0	363.2	.0	.0
9	6.8	784.4	.0	554.9	.0	.0	117.7	.0	.0
10	1.5	70.3	.0	42.2	.0	.0	10.5	.0	.0
11	.9	44.2	.0	8.1	.0	.0	6.6	.0	.0
12	.5	34.6	.0	.0	.0	.0	5.2	.0	.0
13	9.7	1447.0	.0	.0	.0	.0	217.1	.0	.0
14	9.6	2610.7	.0	.0	.0	.0	391.6	.0	.0
15	9.4	3078.7	.0	.0	.0	.0	461.8	.0	.0
16	9.2	2879.2	.0	.0	.0	.0	431.9	.0	.0
17	9.0	2052.0	.0	.0	.0	.0	307.8	.0	.0
18	6.7	644.3	.0	.0	.0	.0	96.7	.0	.0
19	.3	4.1	.0	.0	.0	.0	.6	.0	.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.21	139.00
2	73.97	136.81
3	83.83	135.14
4	93.76	134.00
5	103.74	133.40
6	113.74	133.33

7	123.73	133.80
8	133.68	134.80
9	143.57	136.34
10	153.35	138.40
11	163.01	140.98
12	172.52	144.07
13	181.85	147.67
14	190.97	151.76
15	199.87	156.34
16	204.48	159.04

Circle Center At X = 110.0 ; Y = 319.6 and Radius, 186.3

*** 1.161 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	139.00
2	59.58	136.14
3	69.31	133.84
4	79.16	132.09
5	89.09	130.90
6	99.07	130.27
7	109.07	130.22
8	119.06	130.73
9	129.00	131.81
10	138.86	133.45
11	148.62	135.64
12	158.23	138.39
13	167.68	141.68
14	176.92	145.50
15	185.93	149.84
16	194.68	154.68
17	197.15	156.24

Circle Center At X = 105.1 ; Y = 306.3 and Radius, 176.1

*** 1.166 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	68.95	139.00
2	78.76	137.10
3	88.67	135.69
4	98.63	134.80
5	108.62	134.41
6	118.62	134.53
7	128.60	135.16
8	138.53	136.30
9	148.40	137.94
10	158.17	140.08
11	167.81	142.72
12	177.31	145.84
13	186.64	149.44
14	195.77	153.52
15	204.69	158.05
16	208.08	160.00

Circle Center At X = 111.2 ; Y = 330.4 and Radius, 196.0

*** 1.168 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	106.84	139.00
2	116.61	136.85
3	126.55	135.77
4	136.55	135.76
5	146.49	136.83
6	156.26	138.96
7	165.75	142.13
8	174.84	146.30
9	181.46	150.25

Circle Center At X = 131.6 ; Y = 228.5 and Radius, 92.8
*** 1.174 ***
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.11	139.00
2	111.90	136.97
3	121.83	135.84
4	131.83	135.59
5	141.81	136.25
6	151.69	137.80
7	161.39	140.24
8	170.83	143.53
9	179.94	147.66
10	188.64	152.59
11	189.91	153.47

Circle Center At X = 129.5 ; Y = 246.8 and Radius, 111.2
*** 1.178 ***
Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.11	139.00
2	111.84	136.69
3	121.74	135.35
4	131.74	134.99
5	141.72	135.63
6	151.59	137.24
7	161.25	139.82
8	170.61	143.34
9	179.57	147.77
10	186.85	152.31

Circle Center At X = 130.3 ; Y = 235.9 and Radius, 100.9
*** 1.179 ***
Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.21	139.00
2	73.70	135.85
3	83.39	133.37
4	93.23	131.58
5	103.17	130.47
6	113.16	130.07
7	123.15	130.36
8	133.10	131.35
9	142.96	133.04
10	152.68	135.41
11	162.20	138.45
12	171.49	142.15
13	180.50	146.49
14	189.18	151.45
15	195.29	155.53

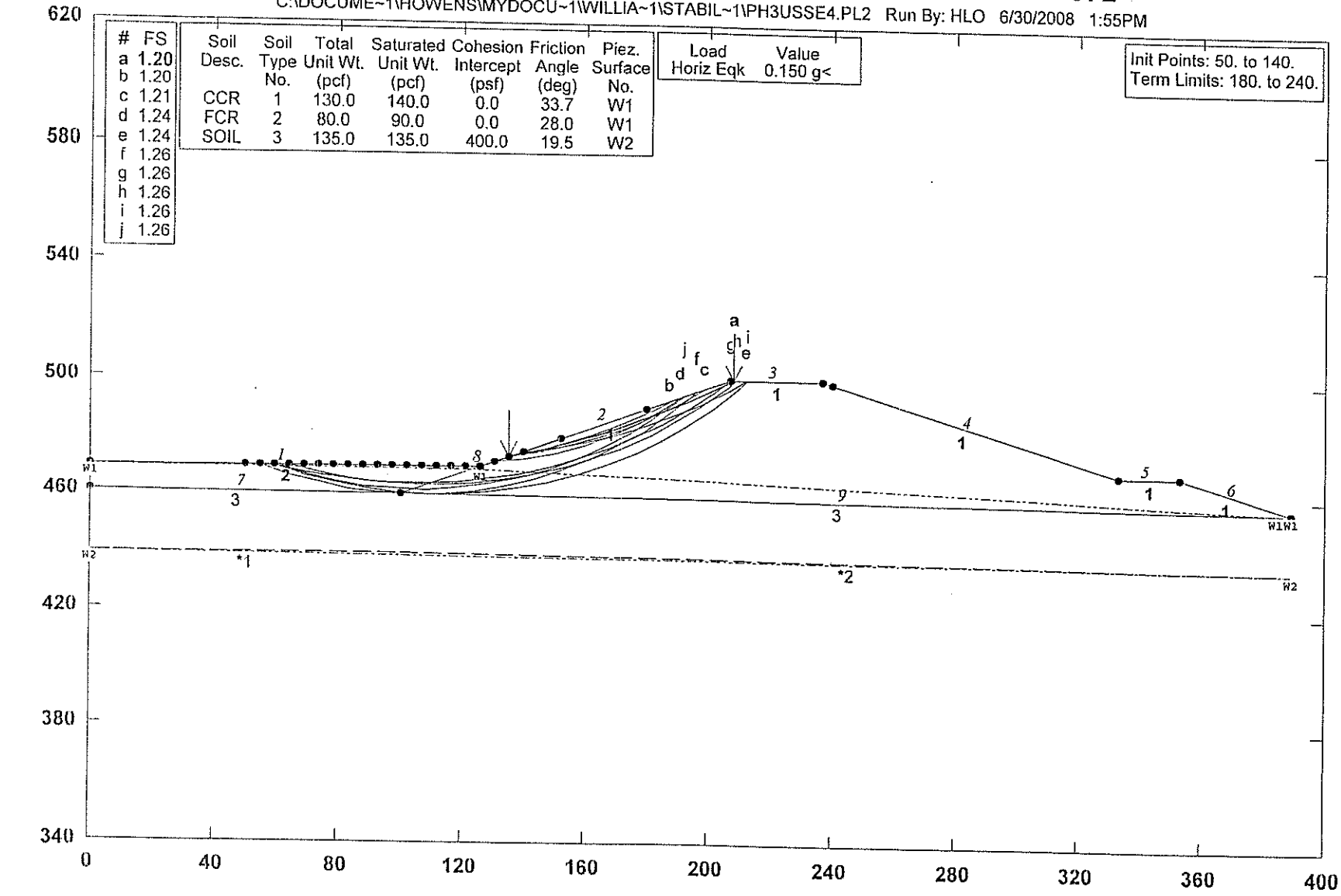
Circle Center At X = 114.0 ; Y = 273.0 and Radius, 143.0
*** 1.181 ***
Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	87.90	139.00
2	97.43	136.00
3	107.21	133.89
4	117.14	132.70
5	127.14	132.44
6	137.11	133.11
7	146.99	134.70
8	156.67	137.19
9	166.08	140.58
10	175.13	144.82
11	183.76	149.89

```
   12        187.41      152.52
Circle Center At X =  124.9 ; Y =  239.6  and Radius,  107.2
     ***     1.182   ***
Failure Surface Specified By 14 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         83.16      139.00
    2         92.71      136.03
    3        102.46      133.82
    4        112.36      132.40
    5        122.34      131.76
    6        132.34      131.91
    7        142.29      132.85
    8        152.14      134.57
    9        161.82      137.07
   10        171.28      140.33
   11        180.45      144.32
   12        189.27      149.03
   13        197.69      154.42
   14        203.08      158.50
Circle Center At X =  125.4 ; Y =  257.7  and Radius,  126.0
     ***     1.188   ***
```

PHASE 3 UPSTREAM SEISMIC REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH3USSE4.PL2 Run By: HLO 6/30/2008 1:55PM



PCSTABL5M/si FSmin=1.20

Safety Factors Are Calculated By The Modified Bishop Method

STED



R17094

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 6/30/2008
Time of Run: 1:55PM
Run By: HLO
Input Data Filename: C:PH3USSE4.
Output Filename: C:PH3USSE4.OUT
Unit: ENGLISH
Plotted Output Filename: C:PH3USSE4.PLT
PROBLEM DESCRIPTION PHASE 3 UPSTREAM SEISMIC
REFUSE DISPOSAL AREA NO. 2
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 340.00 to Y-values listed.

6 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	129.00	126.00	129.00	2
2	126.00	129.00	207.00	160.00	1
3	207.00	160.00	237.00	160.00	1
4	237.00	160.00	333.00	128.00	1
5	333.00	128.00	353.00	128.00	1
6	353.00	128.00	389.00	116.00	1
7	.00	120.00	100.00	119.00	3
8	100.00	119.00	152.00	139.00	1
9	100.00	119.00	389.00	116.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	135.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	129.00
2	126.00	128.00
3	384.00	116.00
4	389.00	116.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	99.00
2	389.00	96.00

Searching Routine Will Be Limited To An Area Defined By 2 Boundaries
Of Which The First 2 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	99.00	100.00	99.00
2	100.00	99.00	389.00	96.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 140.00 ft.
Each Surface Terminates Between X = 180.00 ft.
and X = 240.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 99.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.26	132.55
2	144.98	134.92
3	154.60	137.63
4	164.13	140.68
5	173.54	144.06
6	182.83	147.76
7	191.98	151.80
8	200.98	156.15
9	208.30	160.00

Circle Center At X = 72.5 ; Y = 410.6 and Radius, 285.1
*** 1.195 ***
Individual data on the 10 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.7	849.6	.0	.0	.0	.0	127.4	.0	.0
2	7.0	1551.9	.0	.0	.0	.0	232.8	.0	.0
3	2.6	739.9	.0	.0	.0	.0	111.0	.0	.0
4	9.5	3239.4	.0	.0	.0	.0	485.9	.0	.0
5	9.4	3702.5	.0	.0	.0	.0	555.4	.0	.0
6	9.3	3695.1	.0	.0	.0	.0	554.3	.0	.0
7	9.2	3235.3	.0	.0	.0	.0	485.3	.0	.0
8	9.0	2345.1	.0	.0	.0	.0	351.8	.0	.0
9	6.0	874.0	.0	.0	.0	.0	131.1	.0	.0
10	1.3	57.5	.0	.0	.0	.0	8.6	.0	.0

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.26	132.55
2	145.04	134.66
3	154.65	137.42
4	164.06	140.80
5	173.23	144.79
6	182.12	149.37
7	187.14	152.40

Circle Center At X = 108.0 ; Y = 282.1 and Radius, 152.0
*** 1.201 ***
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.26	132.55
2	145.13	134.19
3	154.86	136.50
4	164.40	139.49
5	173.72	143.12
6	182.76	147.38
7	191.49	152.26
8	198.20	156.63

Circle Center At X = 116.6 ; Y = 275.7 and Radius, 144.3
*** 1.214 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.53	130.73
2	140.48	131.73
3	150.29	133.67
4	159.87	136.54
5	169.13	140.32
6	177.99	144.96
7	186.36	150.42
8	190.40	153.65

Circle Center At X = 125.3 ; Y = 234.0 and Radius, 103.4

*** 1.242 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.00	134.36
2	149.91	135.73
3	159.71	137.70
4	169.38	140.26
5	178.87	143.41
6	188.15	147.13
7	197.18	151.42
8	205.94	156.24
9	211.87	160.00

Circle Center At X = 122.6 ; Y = 297.2 and Radius, 163.7

*** 1.243 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	54.74	129.00
2	64.12	125.53
3	73.73	122.79
4	83.53	120.78
5	93.45	119.53
6	103.44	119.03
7	113.44	119.29
8	123.38	120.31
9	133.22	122.09
10	142.90	124.60
11	152.36	127.85
12	161.55	131.80
13	170.41	136.44
14	178.89	141.74
15	186.94	147.67
16	194.52	154.19
17	196.19	155.86

Circle Center At X = 105.0 ; Y = 250.6 and Radius, 131.5

*** 1.257 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	59.47	129.00
2	69.17	126.56
3	79.00	124.73
4	88.93	123.50
5	98.91	122.88
6	108.91	122.88
7	118.89	123.50
8	128.81	124.72
9	138.64	126.56
10	148.34	128.99
11	157.87	132.02
12	167.20	135.63
13	176.29	139.80
14	185.10	144.53
15	193.61	149.79

16	201.77	155.56
17	207.30	160.00

Circle Center At X = 103.9 ; Y = 285.4 and Radius, 162.5

*** 1.261 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.21	129.00
2	73.87	126.40
3	83.67	124.44
4	93.59	123.13
5	103.57	122.46
6	113.57	122.45
7	123.54	123.08
8	133.46	124.37
9	143.27	126.30
10	152.94	128.87
11	162.42	132.06
12	171.67	135.86
13	180.65	140.26
14	189.32	145.23
15	197.65	150.76
16	205.61	156.82
17	209.27	160.00

Circle Center At X = 108.8 ; Y = 275.6 and Radius, 153.3

*** 1.261 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	59.47	129.00
2	68.90	125.67
3	78.54	122.99
4	88.34	121.00
5	98.25	119.69
6	108.23	119.07
7	118.23	119.14
8	128.20	119.91
9	138.09	121.37
10	147.86	123.52
11	157.46	126.33
12	166.83	129.81
13	175.95	133.93
14	184.75	138.67
15	193.20	144.01
16	201.27	149.93
17	208.90	156.39
18	212.61	160.00

Circle Center At X = 112.1 ; Y = 262.7 and Radius, 143.7

*** 1.262 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	59.47	129.00
2	68.97	125.85
3	78.67	123.44
4	88.53	121.79
5	98.49	120.90
6	108.49	120.78
7	118.47	121.44
8	128.37	122.86
9	138.13	125.04
10	147.69	127.96
11	157.00	131.62
12	166.00	135.98
13	174.64	141.02
14	182.86	146.71
15	190.61	153.02

(146)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   16        191.86       154.20
Circle Center At X =  105.0 ; Y =  250.2  and Radius,  129.4
      ***     1.263    ***
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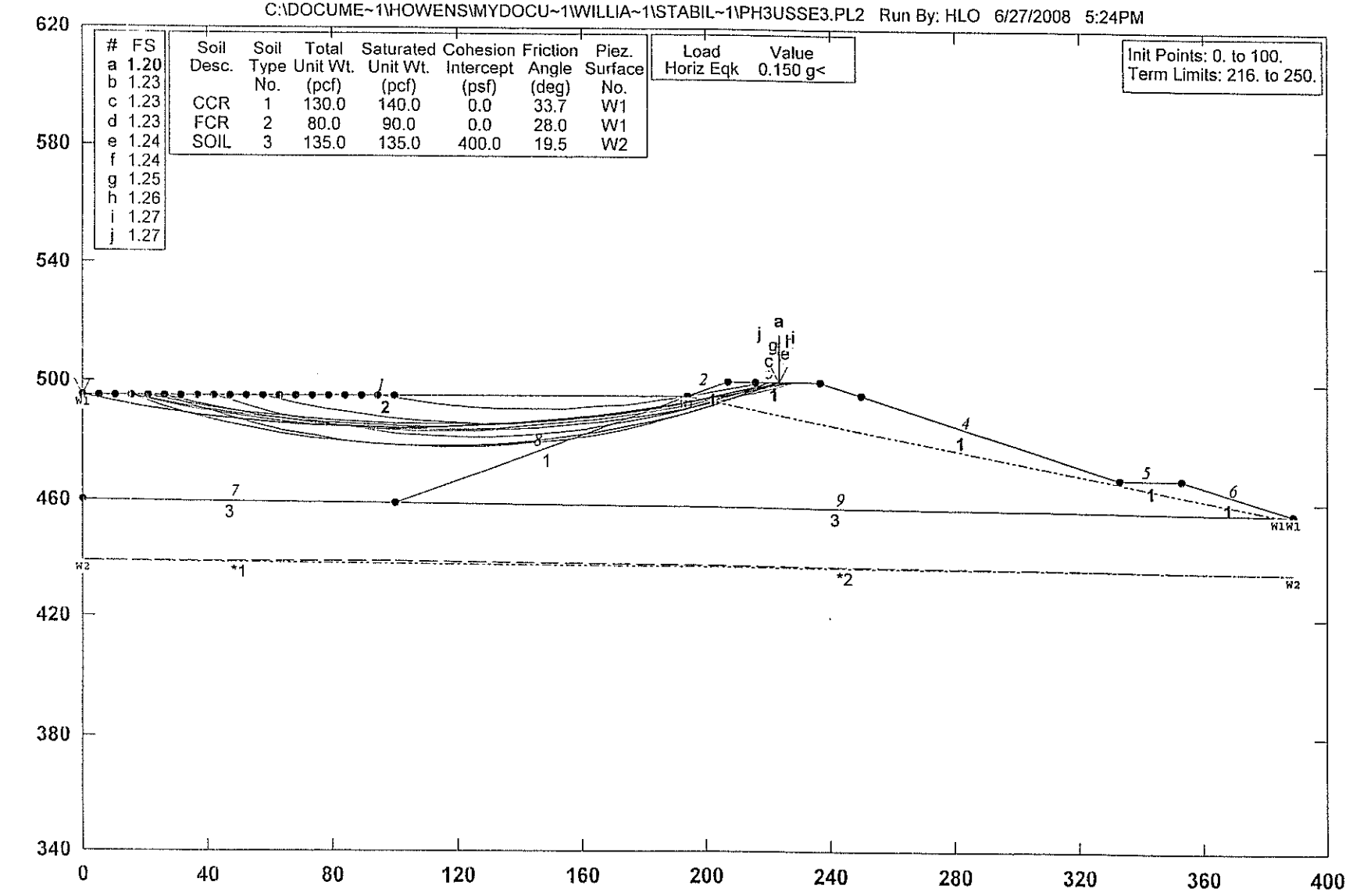
PHASE 3 UPSTREAM SEISMIC REFUSE DISPOSAL AREA NO. 2

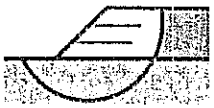
C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH3USSE3.PL2 Run By: HLO 6/27/2008 5:24PM



PCSTABL5M/si FSmin=1.20

Safety Factors Are Calculated By The Modified Bishop Method

STED



R17100

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 6/27/2008
Time of Run: 5:24PM
Run By: HLO
Input Data Filename: C:ph3usse3.
Output Filename: C:ph3usse3.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3usse3.PLT
PROBLEM DESCRIPTION PHASE 3 UPSTREAM SEISMIC
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 340.00 to Y-values listed.

6 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	155.00	194.00	155.00	2
2	194.00	155.00	207.00	160.00	1
3	207.00	160.00	237.00	160.00	1
4	237.00	160.00	333.00	128.00	1
5	333.00	128.00	353.00	128.00	1
6	353.00	128.00	389.00	116.00	1
7	.00	120.00	100.00	119.00	3
8	100.00	119.00	194.00	155.00	1
9	100.00	119.00	389.00	116.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	135.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	155.00
2	194.00	155.00
3	384.00	116.00
4	389.00	116.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	99.00
2	389.00	96.00

Searching Routine Will Be Limited To An Area Defined By 2 Boundaries
Of Which The First 2 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	99.00	100.00	99.00
2	100.00	99.00	389.00	96.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = .00 ft.
and X = 100.00 ft.
Each Surface Terminates Between X = 216.00 ft.
and X = 250.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 99.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	.00	155.00
2	9.81	153.06
3	19.66	151.31
4	29.54	149.77
5	39.45	148.42
6	49.38	147.28
7	59.33	146.33
8	69.31	145.59
9	79.29	145.05
10	89.29	144.71
11	99.29	144.57
12	109.29	144.64
13	119.28	144.91
14	129.27	145.38
15	139.25	146.05
16	149.21	146.93
17	159.15	148.00
18	169.07	149.28
19	178.96	150.75
20	188.82	152.43
21	198.64	154.30
22	208.43	156.38
23	218.16	158.65
24	223.48	160.00

Circle Center At X = 101.0 ; Y = 638.6 and Radius, 494.0
*** 1.202 ***
Individual data on the 27 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.8	858.0	.0	606.5	.0	.0	128.7	.0	.0
2	9.8	2495.7	.0	1757.3	.0	.0	374.4	.0	.0
3	9.9	3967.1	.0	2784.0	.0	.0	595.1	.0	.0
4	9.9	5267.9	.0	3685.9	.0	.0	790.2	.0	.0
5	9.9	6394.5	.0	4462.9	.0	.0	959.2	.0	.0
6	10.0	7343.7	.0	5114.5	.0	.0	1101.6	.0	.0
7	10.0	8112.8	.0	5640.5	.0	.0	1216.9	.0	.0
8	10.0	8699.7	.0	6040.6	.0	.0	1305.0	.0	.0
9	10.0	9102.6	.0	6314.8	.0	.0	1365.4	.0	.0
10	10.0	9320.5	.0	6462.8	.0	.0	1398.1	.0	.0
11	10.0	9352.7	.0	6484.7	.0	.0	1402.9	.0	.0
12	10.0	9199.2	.0	6380.4	.0	.0	1379.9	.0	.0
13	10.0	8860.4	.0	6150.0	.0	.0	1329.1	.0	.0
14	10.0	8337.2	.0	5793.5	.0	.0	1250.6	.0	.0
15	10.0	7631.1	.0	5311.2	.0	.0	1144.7	.0	.0
16	9.9	6744.1	.0	4703.1	.0	.0	1011.6	.0	.0
17	9.9	5678.7	.0	3969.7	.0	.0	851.8	.0	.0
18	9.9	4437.9	.0	3111.0	.0	.0	665.7	.0	.0
19	7.1	2328.4	.0	1637.5	.0	.0	349.3	.0	.0
20	2.8	737.4	.0	490.1	.0	.0	110.6	.0	.0

21	5.2	1249.6	.0	683.6	.0	.0	187.4	.0	.0
22	4.0	1054.2	.0	196.8	.0	.0	158.1	.0	.0
23	.6	203.4	.0	.0	.0	.0	30.5	.0	.0
24	8.4	3481.1	.0	.0	.0	.0	522.2	.0	.0
25	1.4	699.3	.0	.0	.0	.0	104.9	.0	.0
26	9.7	3150.4	.0	.0	.0	.0	472.6	.0	.0
27	5.3	467.5	.0	.0	.0	.0	70.1	.0	.0

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.90	155.00
2	67.62	152.69
3	77.43	150.71
4	87.29	149.07
5	97.21	147.77
6	107.16	146.80
7	117.14	146.18
8	127.14	145.90
9	137.14	145.96
10	147.13	146.36
11	157.10	147.10
12	167.04	148.19
13	176.94	149.61
14	186.78	151.37
15	196.56	153.46
16	206.26	155.89
17	215.88	158.65
18	220.05	160.00

Circle Center At X = 130.3 ; Y = 438.0 and Radius, 292.1

*** 1.226 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	42.11	155.00
2	51.64	152.00
3	61.29	149.37
4	71.03	147.11
5	80.86	145.23
6	90.74	143.74
7	100.68	142.62
8	110.66	141.90
9	120.65	141.56
10	130.65	141.60
11	140.64	142.04
12	150.61	142.86
13	160.53	144.06
14	170.41	145.65
15	180.21	147.62
16	189.93	149.97
17	199.55	152.69
18	209.06	155.78
19	218.45	159.24
20	220.28	160.00

Circle Center At X = 124.4 ; Y = 399.6 and Radius, 258.1

*** 1.228 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.79	155.00
2	25.55	152.81
3	35.35	150.85
4	45.21	149.14
5	55.10	147.66
6	65.02	146.42
7	74.97	145.43
8	84.94	144.67
9	94.93	144.16

10	104.92	143.90
11	114.92	143.87
12	124.92	144.09
13	134.91	144.55
14	144.89	145.25
15	154.84	146.19
16	164.77	147.38
17	174.67	148.80
18	184.53	150.47
19	194.35	152.37
20	204.11	154.51
21	213.83	156.89
22	223.48	159.50
23	225.15	160.00

Circle Center At X = 111.0 ; Y = 555.9 and Radius, 412.0

*** 1.231 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.79	155.00
2	25.59	153.01
3	35.43	151.24
4	45.31	149.69
5	55.22	148.36
6	65.16	147.25
7	75.12	146.36
8	85.10	145.69
9	95.09	145.25
10	105.09	145.02
11	115.09	145.01
12	125.08	145.23
13	135.07	145.67
14	145.05	146.33
15	155.01	147.21
16	164.95	148.31
17	174.87	149.64
18	184.75	151.18
19	194.59	152.94
20	204.39	154.92
21	214.15	157.11
22	223.85	159.52
23	225.61	160.00

Circle Center At X = 110.3 ; Y = 596.0 and Radius, 451.0

*** 1.237 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.79	155.00
2	25.28	151.85
3	34.87	149.03
4	44.56	146.53
5	54.32	144.36
6	64.15	142.53
7	74.04	141.04
8	83.97	139.88
9	93.94	139.06
10	103.93	138.58
11	113.92	138.44
12	123.92	138.64
13	133.91	139.18
14	143.87	140.07
15	153.79	141.29
16	163.67	142.84
17	173.49	144.74
18	183.24	146.96
19	192.91	149.52
20	202.48	152.41

21	211.95	155.61
22	221.31	159.14
23	223.36	160.00

Circle Center At X = 113.0 ; Y = 432.1 and Radius, 293.6

*** 1.238 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.32	155.00
2	35.72	151.60
3	45.25	148.58
4	54.89	145.92
5	64.63	143.65
6	74.45	141.76
7	84.34	140.25
8	94.27	139.13
9	104.25	138.39
10	114.24	138.05
11	124.24	138.09
12	134.23	138.53
13	144.20	139.35
14	154.12	140.57
15	164.00	142.16
16	173.80	144.15
17	183.51	146.51
18	193.13	149.25
19	202.63	152.36
20	212.01	155.84
21	221.24	159.69
22	221.91	160.00

Circle Center At X = 118.1 ; Y = 394.3 and Radius, 256.3

*** 1.245 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	21.05	155.00
2	30.87	153.10
3	40.73	151.41
4	50.62	149.93
5	60.54	148.68
6	70.48	147.64
7	80.45	146.81
8	90.43	146.21
9	100.42	145.82
10	110.42	145.65
11	120.42	145.70
12	130.42	145.97
13	140.41	146.45
14	150.38	147.16
15	160.34	148.08
16	170.27	149.21
17	180.18	150.57
18	190.06	152.14
19	199.90	153.92
20	209.70	155.92
21	219.45	158.14
22	226.90	160.00

Circle Center At X = 113.1 ; Y = 603.4 and Radius, 457.8

*** 1.259 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	26.32	155.00
2	36.03	152.64
3	45.81	150.55
4	55.65	148.73
5	65.52	147.17

6	75.44	145.87
7	85.39	144.85
8	95.36	144.09
9	105.35	143.60
10	115.34	143.39
11	125.34	143.44
12	135.34	143.77
13	145.32	144.36
14	155.28	145.22
15	165.22	146.35
16	175.12	147.75
17	184.98	149.42
18	194.79	151.35
19	204.55	153.55
20	214.24	156.01
21	223.86	158.73
22	227.93	160.00

Circle Center At X = 118.3 ; Y = 513.1 and Radius, 369.7

*** 1.272 ***

Failure Surface Specified By 14 Coordinate Points

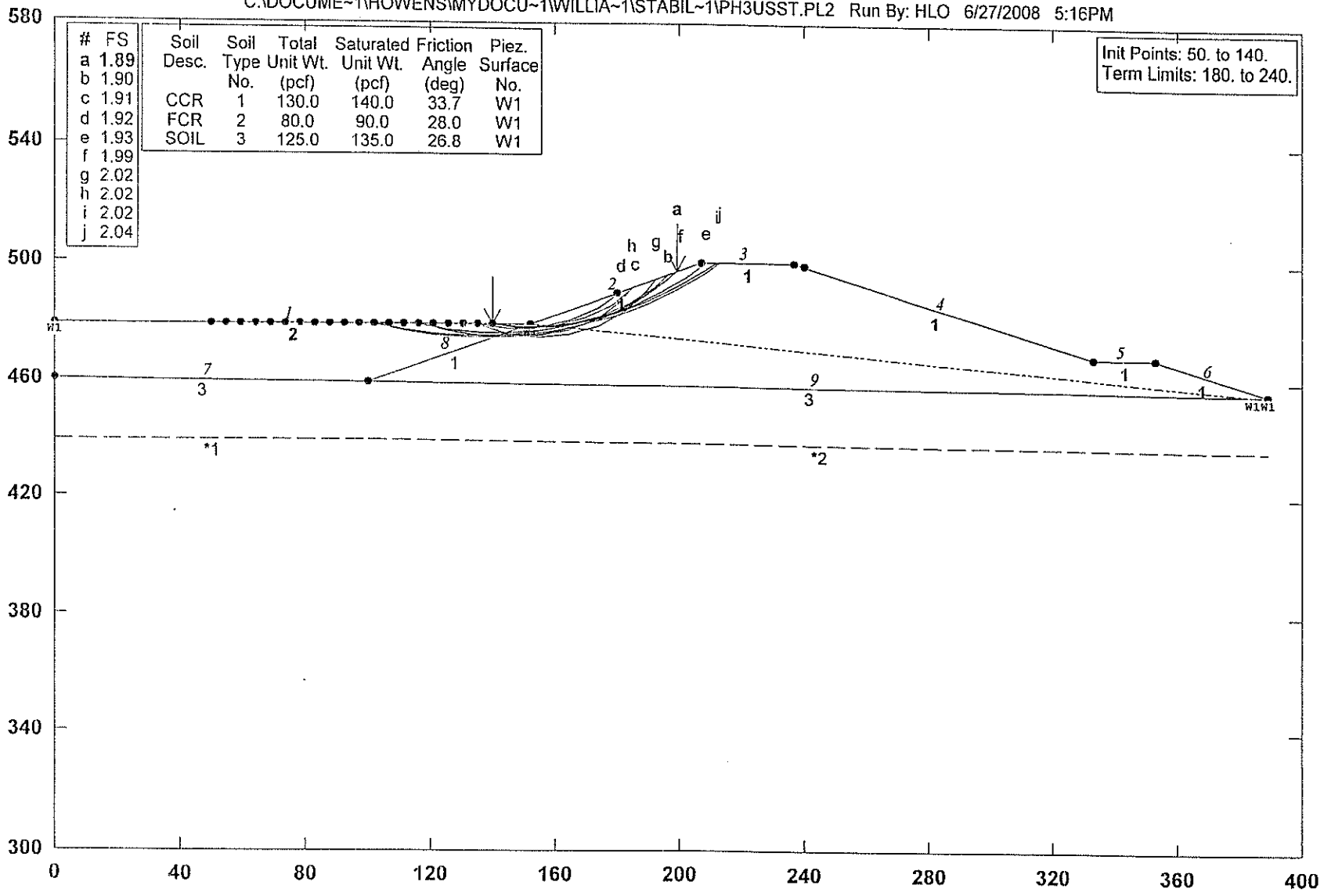
Point No.	X-Surf (ft)	Y-Surf (ft)
1	94.74	155.00
2	104.62	153.49
3	114.55	152.31
4	124.52	151.47
5	134.50	150.96
6	144.50	150.79
7	154.50	150.96
8	164.49	151.47
9	174.45	152.31
10	184.38	153.49
11	194.27	155.01
12	204.10	156.85
13	213.86	159.03
14	217.60	160.00

Circle Center At X = 144.4 ; Y = 446.0 and Radius, 295.2

*** 1.275 ***

PHASE 3 UPSTREAM STATIC REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH3USST.PL2 Run By: HLO 6/27/2008 5:16PM



PCSTABL5M/si FSmin=1.89

Safety Factors Are Calculated By The Modified Bishop Method

STED



154

R17107

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 6/27/2008
Time of Run: 5:16PM
Run By: HLO
Input Data Filename: C:ph3usst.
Output Filename: C:ph3usst.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph3usst.PLT
PROBLEM DESCRIPTION PHASE 3 UPSTREAM STATIC
REFUSE DISPOSAL AREA NO. 2
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

6 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	179.00	152.00	179.00	2
2	152.00	179.00	207.00	200.00	1
3	207.00	200.00	237.00	200.00	1
4	237.00	200.00	333.00	168.00	1
5	333.00	168.00	353.00	168.00	1
6	353.00	168.00	389.00	156.00	1
7	.00	160.00	100.00	159.00	3
8	100.00	159.00	152.00	179.00	1
9	100.00	159.00	389.00	156.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	179.00
2	152.00	179.00
3	384.00	156.00
4	389.00	156.00

Searching Routine Will Be Limited To An Area Defined By 2 Boundaries
Of Which The First 2 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	139.00	100.00	139.00
2	100.00	139.00	389.00	136.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 140.00 ft.
Each Surface Terminates Between X = 180.00 ft.
and X = 240.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =139.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial

Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.00	179.00
2	149.94	177.88
3	159.93	178.24
4	169.76	180.09
5	179.20	183.38
6	188.05	188.04
7	196.11	193.96
8	199.18	197.01

Circle Center At X = 152.5 ; Y = 244.1 and Radius, 66.3
*** 1.895 ***
Individual data on the 10 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.3	437.7	.0	305.4	.0	.0	.0	.0	.0
2	.7	70.5	.0	45.4	.0	.0	.0	.0	.0
3	2.1	272.9	.0	140.0	.0	.0	.0	.0	.0
4	7.7	2433.3	.0	251.8	.0	.0	.0	.0	.0
5	.2	99.5	.0	.0	.0	.0	.0	.0	.0
6	9.8	6054.0	.0	.0	.0	.0	.0	.0	.0
7	9.4	7180.4	.0	.0	.0	.0	.0	.0	.0
8	8.8	6175.1	.0	.0	.0	.0	.0	.0	.0
9	8.1	3463.3	.0	.0	.0	.0	.0	.0	.0
10	3.1	375.9	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.26	179.00
2	145.13	177.39
3	155.13	177.30
4	165.03	178.74
5	174.59	181.67
6	183.60	186.01
7	191.83	191.68
8	196.34	195.93

Circle Center At X = 150.7 ; Y = 242.0 and Radius, 64.8
*** 1.902 ***
Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	140.00	179.00
2	149.92	177.70
3	159.89	178.44
4	169.50	181.19
5	178.36	185.83
6	185.78	191.90

Circle Center At X = 151.3 ; Y = 226.6 and Radius, 49.0
*** 1.909 ***
Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.26	179.00
2	145.15	177.49
3	155.14	177.95
4	164.84	180.36
5	173.88	184.64
6	181.39	190.22

Circle Center At X = 147.8 ; Y = 227.8 and Radius, 50.4
*** 1.919 ***
Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.32	179.00
2	126.13	177.09
3	136.08	176.11
4	146.08	176.07
5	156.04	176.97
6	165.87	178.80
7	175.49	181.55
8	184.80	185.19
9	193.74	189.69
10	202.21	195.00
11	208.71	200.00

Circle Center At X = 141.5 ; Y = 282.3 and Radius, 106.3

*** 1.929 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	116.32	179.00
2	125.96	176.37
3	135.86	174.91
4	145.85	174.66
5	155.81	175.60
6	165.58	177.73
7	175.02	181.02
8	184.00	185.42
9	192.39	190.87
10	200.06	197.28
11	200.17	197.39

Circle Center At X = 143.0 ; Y = 257.8 and Radius, 83.2

*** 1.989 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.26	179.00
2	144.68	175.63
3	154.61	174.41
4	164.56	175.40
5	174.05	178.54
6	182.63	183.68
7	189.87	190.58
8	192.44	194.44

Circle Center At X = 155.1 ; Y = 219.2 and Radius, 44.8

*** 2.017 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.26	179.00
2	144.73	175.78
3	154.70	175.02
4	164.55	176.77
5	173.65	180.91
6	181.43	187.20
7	184.59	191.44

Circle Center At X = 152.7 ; Y = 214.8 and Radius, 39.8

*** 2.017 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.11	179.00
2	111.90	176.96
3	121.81	175.66
4	131.80	175.10
5	141.79	175.28
6	151.75	176.21
7	161.61	177.87
8	171.32	180.26

9	180.83	183.37
10	190.08	187.17
11	199.02	191.65
12	207.60	196.79
13	212.16	200.00

Circle Center At X = 134.3 ; Y = 309.5 and Radius, 134.4

*** 2.022 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.11	179.00
2	111.84	176.72
3	121.73	175.20
4	131.70	174.46
5	141.70	174.49
6	151.67	175.30
7	161.54	176.88
8	171.26	179.23
9	180.77	182.32
10	190.01	186.15
11	198.92	190.68
12	207.46	195.89
13	213.14	200.00

Circle Center At X = 136.3 ; Y = 302.9 and Radius, 128.5

*** 2.037 ***

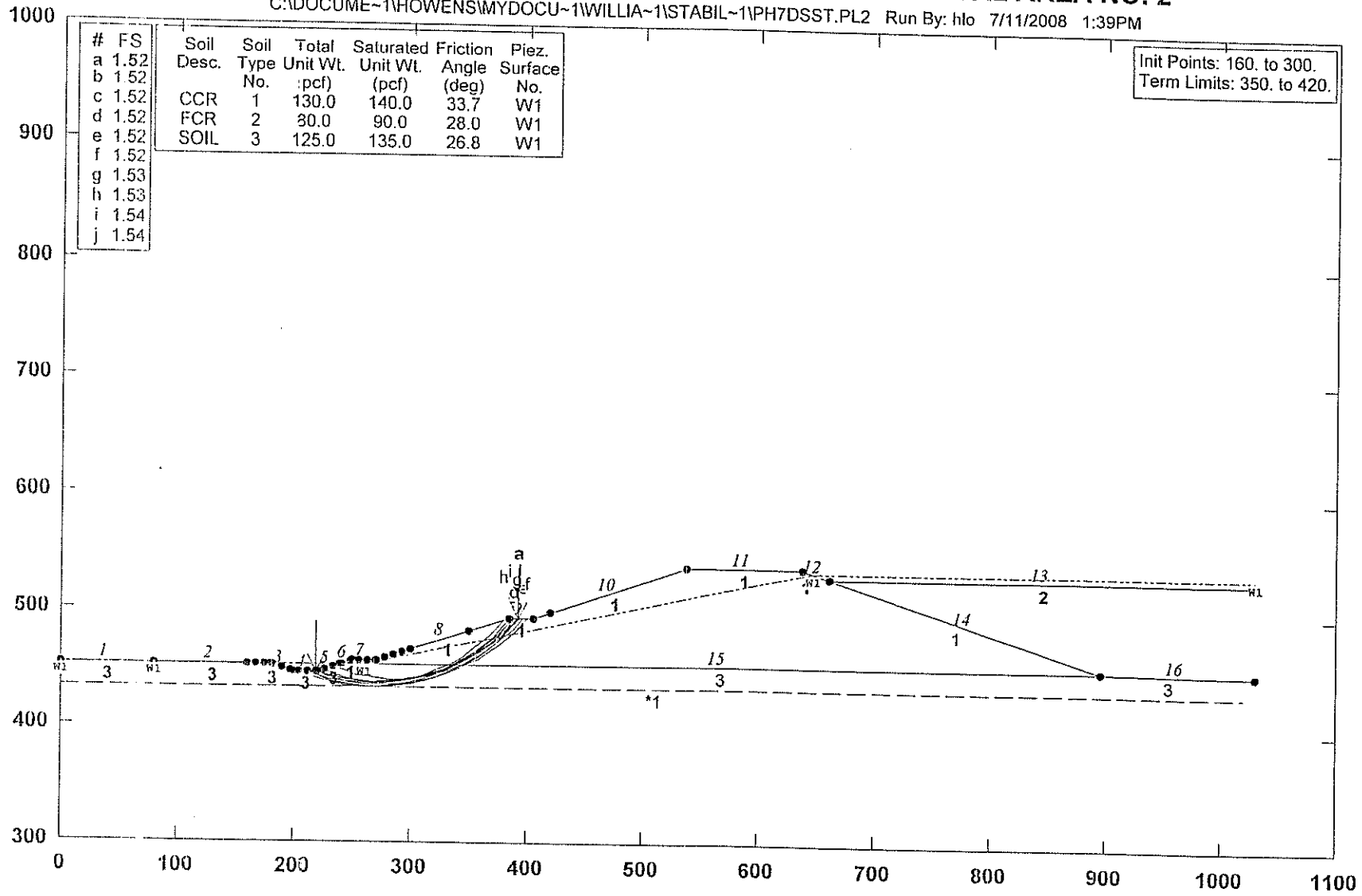
PHASE 7 D.S. STATIC, PIEZ. 15, 16, 17 REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH7DSST.PL2 Run By: hlo 7/11/2008 1:39PM

#	FS
a	1.52
b	1.52
c	1.52
d	1.52
e	1.52
f	1.52
g	1.53
h	1.53
i	1.54
j	1.54

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
SOIL	3	125.0	135.0	26.8	W1

Init Points: 160. to 300.
Term Limits: 350. to 420.



PCSTABL5M/si FSmin=1.52

Safety Factors Are Calculated By The Modified Bishop Method

STED



R17112

160

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 7/11/2008
Time of Run: 1:39PM
Run By: hlo
Input Data Filename: C:PH7DSST.
Output Filename: C:PH7DSST.OUT
Unit: ENGLISH
Plotted Output Filename: C:PH7DSST.PLT
PROBLEM DESCRIPTION PHASE 7 D.S. STATIC, PIEZ. 15, 16, 17
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

13 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	151.50	80.00	152.50	3
2	80.00	152.50	180.00	152.00	3
3	180.00	152.00	200.00	145.30	3
4	200.00	145.30	220.00	145.30	3
5	220.00	145.30	240.00	152.00	3
6	240.00	152.00	250.00	155.30	1
7	250.00	155.30	270.00	155.30	1
8	270.00	155.30	385.00	193.60	1
9	385.00	193.60	405.00	193.60	1
10	405.00	193.60	538.20	238.00	1
11	538.20	238.00	638.20	238.00	1
12	638.20	238.00	662.20	230.00	1
13	662.20	230.00	1030.00	230.00	2
14	662.20	230.00	896.20	152.00	1
15	240.00	152.00	896.20	152.00	3
16	896.20	152.00	1030.00	150.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	151.50
2	80.00	152.00
3	260.00	152.00
4	647.20	235.00
5	1030.00	235.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	132.00	1020.00	132.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 160.00 ft.

and X = 300.00 ft.
Each Surface Terminates Between X = 350.00 ft.
and X = 420.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	218.95	145.30
2	228.53	142.43
3	238.27	140.16
4	248.13	138.50
5	258.07	137.45
6	268.06	137.01
7	278.06	137.20
8	288.03	138.00
9	297.93	139.41
10	307.72	141.44
11	317.37	144.06
12	326.84	147.28
13	336.09	151.08
14	345.09	155.44
15	353.80	160.34
16	362.20	165.78
17	370.24	171.73
18	377.90	178.16
19	385.14	185.05
20	391.95	192.37
21	392.95	193.60

Circle Center At X = 270.1 ; Y = 298.8 and Radius, 161.8
*** 1.516 ***
Individual data on the 28 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.1	22.4	439.9	469.9	.0	.0	.0	.0	.0
2	8.5	3476.2	2958.5	4605.4	.0	.0	.0	.0	.0
3	9.7	11162.3	1417.6	6677.9	.0	.0	.0	.0	.0
4	1.7	2735.2	33.1	1314.0	.0	.0	.0	.0	.0
5	8.1	15477.7	.0	6591.0	.0	.0	.0	.0	.0
6	1.9	4165.0	.0	1597.5	.0	.0	.0	.0	.0
7	8.1	18855.5	.0	7154.3	.0	.0	.0	.0	.0
8	1.9	4624.3	.0	1756.9	.0	.0	.0	.0	.0
9	8.1	19621.8	.0	7720.3	.0	.0	.0	.0	.0
10	1.9	4775.3	.0	1998.6	.0	.0	.0	.0	.0
11	8.1	21264.9	.0	8799.7	.0	.0	.0	.0	.0
12	10.0	29735.5	.0	11803.9	.0	.0	.0	.0	.0
13	9.9	32516.2	.0	12427.1	.0	.0	.0	.0	.0
14	9.8	34273.6	.0	12665.6	.0	.0	.0	.0	.0
15	9.6	35004.6	.0	12518.4	.0	.0	.0	.0	.0
16	9.5	34729.7	.0	11986.2	.0	.0	.0	.0	.0
17	9.3	33493.2	.0	11070.9	.0	.0	.0	.0	.0
18	1.9	6776.2	.0	2194.1	.0	.0	.0	.0	.0
19	7.1	24524.7	.0	7582.0	.0	.0	.0	.0	.0
20	8.7	28167.4	.0	8106.7	.0	.0	.0	.0	.0
21	8.4	24323.9	.0	6069.0	.0	.0	.0	.0	.0
22	8.0	19906.7	.0	3670.9	.0	.0	.0	.0	.0
23	6.2	12600.4	.0	971.4	.0	.0	.0	.0	.0
24	1.4	2470.1	.0	.0	.0	.0	.0	.0	.0
25	7.1	10050.8	.0	.0	.0	.0	.0	.0	.0
26	.1	159.1	.0	.0	.0	.0	.0	.0	.0

27	6.8	4326.6	.0	.0	.0	.0	.0	.0	.0
28	1.0	80.2	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	218.95	145.30
2	228.34	141.86
3	237.94	139.08
4	247.72	136.99
5	257.62	135.58
6	267.60	134.88
7	277.60	134.87
8	287.57	135.57
9	297.48	136.96
10	307.26	139.05
11	316.87	141.81
12	326.26	145.24
13	335.39	149.33
14	344.21	154.04
15	352.67	159.36
16	360.75	165.26
17	368.39	171.71
18	375.56	178.68
19	382.22	186.14
20	388.00	193.60

Circle Center At X = 272.7 ; Y = 277.3 and Radius, 142.5

*** 1.518 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	211.58	145.30
2	221.07	142.16
3	230.75	139.62
4	240.56	137.70
5	250.48	136.41
6	260.45	135.75
7	270.45	135.72
8	280.44	136.32
9	290.36	137.56
10	300.18	139.42
11	309.87	141.90
12	319.38	144.99
13	328.68	148.67
14	337.73	152.94
15	346.48	157.77
16	354.91	163.14
17	362.99	169.04
18	370.68	175.44
19	377.94	182.31
20	384.76	189.62
21	388.02	193.60

Circle Center At X = 265.9 ; Y = 293.5 and Radius, 157.8

*** 1.518 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	211.58	145.30
2	220.83	141.49
3	230.32	138.34
4	240.00	135.84
5	249.83	134.02
6	259.77	132.89
7	269.76	132.44
8	279.75	132.69
9	289.71	133.63
10	299.58	135.25
11	309.31	137.55

12	318.86	140.52
13	328.18	144.14
14	337.23	148.40
15	345.96	153.27
16	354.34	158.73
17	362.31	164.76
18	369.86	171.33
19	376.92	178.40
20	383.49	185.95
21	389.27	193.60

Circle Center At X = 271.2 ; Y = 277.0 and Radius, 144.6

*** 1.522 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	204.21	145.30
2	213.59	141.83
3	223.15	138.91
4	232.88	136.57
5	242.72	134.81
6	252.65	133.63
7	262.63	133.05
8	272.63	133.06
9	282.62	133.66
10	292.54	134.85
11	302.39	136.62
12	312.10	138.98
13	321.67	141.91
14	331.04	145.40
15	340.19	149.44
16	349.08	154.01
17	357.69	159.10
18	365.98	164.69
19	373.92	170.77
20	381.49	177.30
21	388.66	184.27
22	395.40	191.66
23	396.98	193.60

Circle Center At X = 267.5 ; Y = 301.7 and Radius, 168.7

*** 1.523 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	204.21	145.30
2	213.59	141.82
3	223.15	138.89
4	232.86	136.52
5	242.70	134.72
6	252.62	133.49
7	262.60	132.84
8	272.60	132.77
9	282.59	133.27
10	292.53	134.36
11	302.39	136.02
12	312.14	138.24
13	321.74	141.03
14	331.17	144.37
15	340.39	148.25
16	349.36	152.66
17	358.07	157.58
18	366.48	162.99
19	374.55	168.89
20	382.28	175.24
21	389.62	182.03
22	396.55	189.23
23	400.30	193.60

Circle Center At X = 268.9 ; Y = 305.2 and Radius, 172.5

*** 1.525 ***
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	226.32	147.42
2	235.52	143.49
3	244.99	140.29
4	254.68	137.82
5	264.53	136.09
6	274.48	135.13
7	284.48	134.93
8	294.46	135.49
9	304.37	136.82
10	314.15	138.90
11	323.75	141.73
12	333.10	145.28
13	342.15	149.53
14	350.84	154.47
15	359.14	160.05
16	366.98	166.26
17	374.32	173.04
18	381.13	180.37
19	387.35	188.20
20	391.01	193.60

Circle Center At X = 282.1 ; Y = 265.3 and Radius, 130.4

*** 1.529 ***
Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	218.95	145.30
2	228.45	142.18
3	238.15	139.74
4	247.99	137.99
5	257.94	136.94
6	267.93	136.60
7	277.93	136.96
8	287.87	138.03
9	297.71	139.80
10	307.40	142.26
11	316.90	145.40
12	326.15	149.20
13	335.10	153.65
14	343.73	158.71
15	351.97	164.38
16	359.79	170.61
17	367.15	177.38
18	374.01	184.65
19	379.96	191.92

Circle Center At X = 267.8 ; Y = 278.0 and Radius, 141.4

*** 1.532 ***
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	204.21	145.30
2	213.51	141.61
3	223.02	138.55
4	232.73	136.12
5	242.57	134.34
6	252.50	133.23
7	262.49	132.77
8	272.49	132.98
9	282.45	133.85
10	292.34	135.38
11	302.09	137.56
12	311.69	140.39
13	321.07	143.85
14	330.20	147.92

15	339.05	152.59
16	347.56	157.83
17	355.71	163.64
18	363.45	169.96
19	370.75	176.79
20	377.59	184.09
21	383.93	191.83
22	385.19	193.60

Circle Center At X = 264.4 ; Y = 283.2 and Radius, 150.4

*** 1.536 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	233.68	149.88
2	243.02	146.29
3	252.59	143.41
4	262.36	141.26
5	272.26	139.84
6	282.24	139.17
7	292.24	139.25
8	302.20	140.08
9	312.08	141.65
10	321.81	143.96
11	331.34	146.99
12	340.61	150.72
13	349.58	155.14
14	358.20	160.22
15	366.40	165.93
16	374.16	172.25
17	381.42	179.12
18	388.15	186.52
19	393.68	193.60

Circle Center At X = 286.2 ; Y = 272.5 and Radius, 133.3

*** 1.536 ***

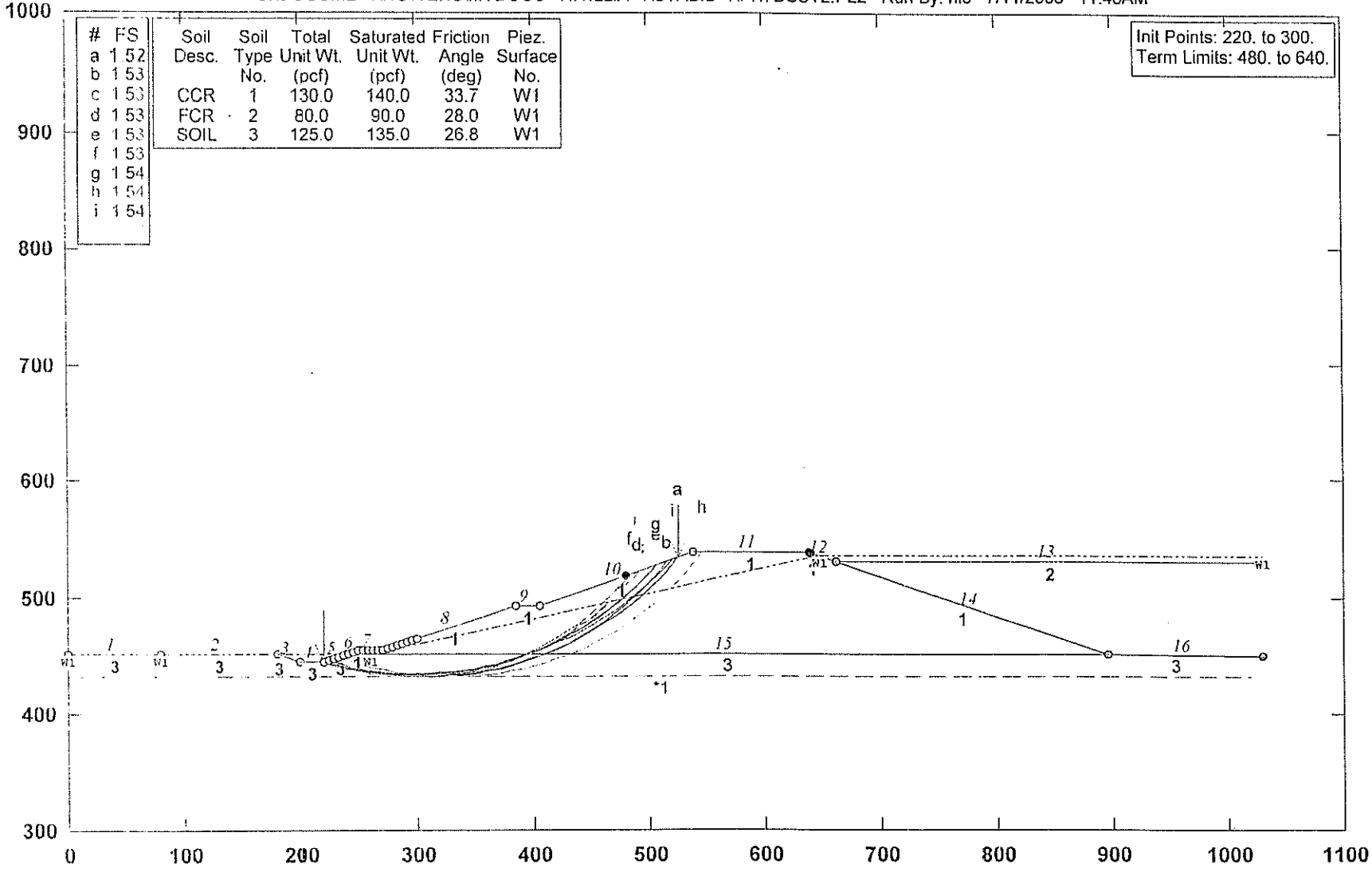
PHASE 7 D.S. STATIC, PIEZ. 15, 16, 17 REFUSE DISPOSAL AREA NO. 2

C:\DCCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH7DSST2.PL2 Run By: hlo 7/11/2008 11:48AM

#	FS
a	1.52
b	1.53
c	1.53
d	1.53
e	1.53
f	1.53
g	1.54
h	1.54
i	1.54

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
SOIL	3	125.0	135.0	26.8	W1

Init Points: 220. to 300.
Term Limits: 480. to 640.



PCSTABL5M/si FSmin=1.52

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 7/11/2008
Time of Run: 11:48AM
Run By: hlo
Input Data Filename: C:ph7dsst2.
Output Filename: C:ph7dsst2.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph7dsst2.PLT
PROBLEM DESCRIPTION PHASE 7 D.S. STATIC, PIEZ. 15, 16, 17
REFUSE DISPOSAL AREA NO. 2
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

13 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	151.50	80.00	152.50	3
2	80.00	152.50	180.00	152.00	3
3	180.00	152.00	200.00	145.30	3
4	200.00	145.30	220.00	145.30	3
5	220.00	145.30	240.00	152.00	3
6	240.00	152.00	250.00	155.30	1
7	250.00	155.30	270.00	155.30	1
8	270.00	155.30	385.00	193.60	1
9	385.00	193.60	405.00	193.60	1
10	405.00	193.60	538.20	238.00	1
11	538.20	238.00	638.20	238.00	1
12	638.20	238.00	662.20	230.00	1
13	662.20	230.00	1030.00	230.00	2
14	662.20	230.00	896.20	152.00	1
15	240.00	152.00	896.20	152.00	3
16	896.20	152.00	1030.00	150.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	151.50
2	80.00	152.00
3	260.00	152.00
4	647.20	235.00
5	1030.00	235.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	132.00	1020.00	132.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 220.00 ft.

and X = 300.00 ft.
Each Surface Terminates Between X = 480.00 ft.
and X = 640.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	220.00	145.30
2	229.61	142.53
3	239.31	140.10
4	249.09	138.00
5	258.93	136.23
6	268.83	134.81
7	278.77	133.73
8	288.74	132.99
9	298.73	132.59
10	308.73	132.54
11	318.73	132.83
12	328.71	133.47
13	338.66	134.45
14	348.57	135.77
15	358.43	137.43
16	368.23	139.43
17	377.96	141.77
18	387.59	144.43
19	397.13	147.43
20	406.56	150.76
21	415.88	154.41
22	425.06	158.37
23	434.09	162.65
24	442.98	167.24
25	451.70	172.13
26	460.25	177.32
27	468.62	182.79
28	476.79	188.56
29	484.76	194.60
30	492.51	200.91
31	500.05	207.48
32	507.35	214.31
33	514.42	221.39
34	521.24	228.71
35	525.69	233.83

Circle Center At X = 305.2 ; Y = 423.1 and Radius, 290.6
*** 1.524 ***
Individual data on the 42 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.6	3883.3	3218.9	5044.3	.0	.0	.0	.0	.0
2	9.7	11560.6	1184.7	6667.7	.0	.0	.0	.0	.0
3	.7	1107.0	5.3	528.5	.0	.0	.0	.0	.0
4	9.1	17749.9	.0	7554.5	.0	.0	.0	.0	.0
5	.9	2113.1	.0	816.5	.0	.0	.0	.0	.0
6	8.9	21872.0	.0	8471.8	.0	.0	.0	.0	.0
7	1.1	2750.2	.0	1069.7	.0	.0	.0	.0	.0
8	8.8	23564.8	.0	9525.2	.0	.0	.0	.0	.0
9	1.2	3253.6	.0	1387.5	.0	.0	.0	.0	.0
10	8.8	26720.5	.0	11238.5	.0	.0	.0	.0	.0
11	10.0	35769.9	.0	14484.3	.0	.0	.0	.0	.0
12	10.0	41131.6	.0	16136.4	.0	.0	.0	.0	.0

13	10.0	46002.2	.0	17580.7	.0	.0	.0	.0	.0
14	10.0	50357.2	.0	18815.1	.0	.0	.0	.0	.0
15	10.0	54176.6	.0	19838.4	.0	.0	.0	.0	.0
16	10.0	57444.6	.0	20649.3	.0	.0	.0	.0	.0
17	9.9	60148.6	.0	21246.8	.0	.0	.0	.0	.0
18	9.9	62280.9	.0	21630.2	.0	.0	.0	.0	.0
19	9.8	63838.0	.0	21799.2	.0	.0	.0	.0	.0
20	9.7	64819.9	.0	21753.4	.0	.0	.0	.0	.0
21	7.0	47606.0	.0	15746.2	.0	.0	.0	.0	.0
22	2.6	17479.3	.0	5746.7	.0	.0	.0	.0	.0
23	9.5	62038.7	.0	21018.1	.0	.0	.0	.0	.0
24	7.9	48243.7	.0	17013.1	.0	.0	.0	.0	.0
25	1.6	9309.2	.0	3316.4	.0	.0	.0	.0	.0
26	3.2	18830.0	.0	6728.9	.0	.0	.0	.0	.0
27	6.1	36219.2	.0	12699.0	.0	.0	.0	.0	.0
28	9.2	53255.8	.0	18314.4	.0	.0	.0	.0	.0
29	9.0	50965.3	.0	16990.3	.0	.0	.0	.0	.0
30	8.9	48216.5	.0	15457.2	.0	.0	.0	.0	.0
31	8.7	45042.4	.0	13716.8	.0	.0	.0	.0	.0
32	8.5	41479.5	.0	11771.4	.0	.0	.0	.0	.0
33	8.4	37567.0	.0	9623.0	.0	.0	.0	.0	.0
34	8.2	33347.4	.0	7274.4	.0	.0	.0	.0	.0
35	8.0	28866.0	.0	4728.2	.0	.0	.0	.0	.0
36	7.8	24170.5	.0	1987.6	.0	.0	.0	.0	.0
37	1.4	3961.8	.0	53.5	.0	.0	.0	.0	.0
38	6.1	15469.4	.0	.0	.0	.0	.0	.0	.0
39	7.3	14814.4	.0	.0	.0	.0	.0	.0	.0
40	7.1	10142.1	.0	.0	.0	.0	.0	.0	.0
41	6.8	5459.1	.0	.0	.0	.0	.0	.0	.0
42	4.5	1053.3	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	224.21	146.71
2	233.72	143.62
3	243.34	140.90
4	253.06	138.55
5	262.86	136.56
6	272.73	134.95
7	282.66	133.71
8	292.62	132.86
9	302.61	132.38
10	312.61	132.28
11	322.60	132.56
12	332.58	133.23
13	342.53	134.26
14	352.43	135.68
15	362.27	137.47
16	372.03	139.64
17	381.70	142.17
18	391.27	145.07
19	400.73	148.33
20	410.05	151.95
21	419.23	155.92
22	428.25	160.24
23	437.10	164.89
24	445.77	169.88
25	454.24	175.19
26	462.50	180.82
27	470.55	186.76
28	478.36	193.01
29	485.93	199.54
30	493.24	206.36
31	500.29	213.45
32	507.07	220.80
33	513.57	228.41
34	515.05	230.28

Circle Center At X = 310.2 ; Y = 395.4 and Radius, 263.1
*** 1.531 ***
Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	220.00	145.30
2	229.53	142.28
3	239.18	139.65
4	248.93	137.40
5	258.75	135.55
6	268.65	134.10
7	278.59	133.05
8	288.57	132.40
9	298.57	132.15
10	308.57	132.30
11	318.55	132.85
12	328.51	133.81
13	338.41	135.16
14	348.26	136.92
15	358.02	139.06
16	367.70	141.60
17	377.26	144.53
18	386.70	147.84
19	395.99	151.52
20	405.13	155.58
21	414.10	160.00
22	422.89	164.78
23	431.47	169.90
24	439.85	175.37
25	447.99	181.17
26	455.90	187.30
27	463.55	193.73
28	470.94	200.47
29	478.05	207.51
30	484.87	214.82
31	491.39	222.40

Circle Center At X = 299.8 ; Y = 380.6 and Radius, 248.5
*** 1.532 ***
Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	220.00	145.30
2	229.53	142.27
3	239.17	139.62
4	248.92	137.37
5	258.74	135.52
6	268.64	134.06
7	278.58	133.02
8	288.56	132.37
9	298.56	132.13
10	308.56	132.30
11	318.54	132.87
12	328.49	133.85
13	338.40	135.23
14	348.24	137.01
15	358.00	139.19
16	367.66	141.77
17	377.21	144.73
18	386.63	148.08
19	395.91	151.82
20	405.03	155.92
21	413.97	160.39
22	422.73	165.22
23	431.28	170.40
24	439.62	175.93
25	447.72	181.79
26	455.58	187.97

27	463.18	194.47
28	470.51	201.27
29	477.56	208.37
30	484.31	215.74
31	489.36	221.72

Circle Center At X = 299.4 ; Y = 378.3 and Radius, 246.2

*** 1.532 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	220.00	145.30
2	229.64	142.63
3	239.36	140.31
4	249.17	138.34
5	259.04	136.73
6	268.96	135.47
7	278.92	134.58
8	288.90	134.04
9	298.90	133.87
10	308.90	134.06
11	318.89	134.61
12	328.84	135.52
13	338.76	136.79
14	348.63	138.42
15	358.43	140.40
16	368.15	142.74
17	377.78	145.43
18	387.31	148.46
19	396.73	151.84
20	406.01	155.56
21	415.15	159.61
22	424.14	163.98
23	432.97	168.68
24	441.62	173.70
25	450.09	179.02
26	458.35	184.65
27	466.41	190.57
28	474.25	196.78
29	481.86	203.27
30	489.22	210.04
31	496.34	217.06
32	503.20	224.33
33	505.68	227.16

Circle Center At X = 298.7 ; Y = 410.3 and Radius, 276.4

*** 1.534 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	220.00	145.30
2	229.53	142.25
3	239.17	139.61
4	248.91	137.37
5	258.74	135.53
6	268.64	134.11
7	278.59	133.10
8	288.57	132.51
9	298.57	132.33
10	308.57	132.58
11	318.55	133.23
12	328.49	134.31
13	338.38	135.79
14	348.20	137.69
15	357.93	140.00
16	367.55	142.71
17	377.06	145.81
18	386.43	149.32
19	395.64	153.21

20	404.68	157.48
21	413.54	162.12
22	422.19	167.13
23	430.63	172.49
24	438.84	178.20
25	446.80	184.25
26	454.51	190.63
27	461.94	197.32
28	469.08	204.32
29	475.93	211.60
30	482.47	219.17
31	482.74	219.51

Circle Center At X = 297.8 ; Y = 372.1 and Radius, 239.8

*** 1.535 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	220.00	145.30
2	229.66	142.71
3	239.41	140.47
4	249.23	138.58
5	259.11	137.04
6	269.03	135.85
7	279.00	135.02
8	288.99	134.54
9	298.99	134.41
10	308.99	134.65
11	318.97	135.23
12	328.92	136.18
13	338.84	137.48
14	348.70	139.13
15	358.50	141.13
16	368.22	143.47
17	377.85	146.17
18	387.38	149.20
19	396.79	152.57
20	406.08	156.27
21	415.23	160.30
22	424.24	164.66
23	433.08	169.33
24	441.75	174.32
25	450.23	179.61
26	458.52	185.20
27	466.61	191.08
28	474.49	197.24
29	482.13	203.68
30	489.55	210.39
31	496.72	217.36
32	503.64	224.58
33	506.05	227.28

Circle Center At X = 297.4 ; Y = 415.2 and Radius, 280.8

*** 1.537 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	232.63	149.53
2	242.08	146.26
3	251.64	143.32
4	261.30	140.73
5	271.05	138.49
6	280.87	136.60
7	290.75	135.07
8	300.68	133.89
9	310.64	133.07
10	320.63	132.61
11	330.63	132.51
12	340.63	132.77

13	350.61	133.39
14	360.56	134.36
15	370.47	135.70
16	380.33	137.38
17	390.12	139.43
18	399.83	141.82
19	409.45	144.56
20	418.96	147.64
21	428.35	151.06
22	437.62	154.82
23	446.75	158.91
24	455.72	163.33
25	464.53	168.06
26	473.16	173.11
27	481.60	178.47
28	489.85	184.12
29	497.89	190.07
30	505.71	196.31
31	513.30	202.82
32	520.65	209.60
33	527.75	216.64
34	534.60	223.93
35	541.18	231.46
36	546.49	238.00

Circle Center At X = 328.5 ; Y = 410.6 and Radius, 278.1

*** 1.537 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	220.00	145.30
2	229.71	142.89
3	239.49	140.80
4	249.33	139.04
5	259.23	137.60
6	269.16	136.49
7	279.13	135.71
8	289.12	135.26
9	299.12	135.14
10	309.12	135.34
11	319.11	135.88
12	329.07	136.75
13	339.00	137.94
14	348.88	139.46
15	358.71	141.31
16	368.47	143.48
17	378.15	145.97
18	387.75	148.78
19	397.25	151.90
20	406.64	155.34
21	415.92	159.08
22	425.06	163.13
23	434.06	167.48
24	442.92	172.12
25	451.62	177.05
26	460.15	182.27
27	468.51	187.76
28	476.68	193.53
29	484.65	199.57
30	492.42	205.86
31	499.98	212.41
32	507.32	219.20
33	514.43	226.23
34	519.76	231.85

Circle Center At X = 297.8 ; Y = 438.1 and Radius, 303.0

*** 1.538 ***

Failure Surface Specified By 31 Coordinate Points

Point	X-Surf	Y-Surf

(174)

No.	(ft)	(ft)
1	224.21	146.71
2	233.70	143.55
3	243.31	140.78
4	253.03	138.43
5	262.84	136.49
6	272.72	134.97
7	282.66	133.86
8	292.64	133.18
9	302.63	132.92
10	312.63	133.08
11	322.61	133.66
12	332.56	134.67
13	342.46	136.09
14	352.29	137.93
15	362.03	140.19
16	371.67	142.85
17	381.19	145.92
18	390.57	149.39
19	399.79	153.25
20	408.84	157.50
21	417.71	162.13
22	426.37	167.13
23	434.81	172.49
24	443.02	178.20
25	450.98	184.25
26	458.68	190.63
27	466.10	197.34
28	473.23	204.35
29	480.06	211.65
30	486.57	219.24
31	488.23	221.34

Circle Center At X = 303.8 ; Y = 369.5 and Radius, 236.6

*** 1.541 ***

PHASE 7 D.S. SEISMIC, PIEZ. 15, 16, 17 REFUSE DISPOSAL AREA NO. 2

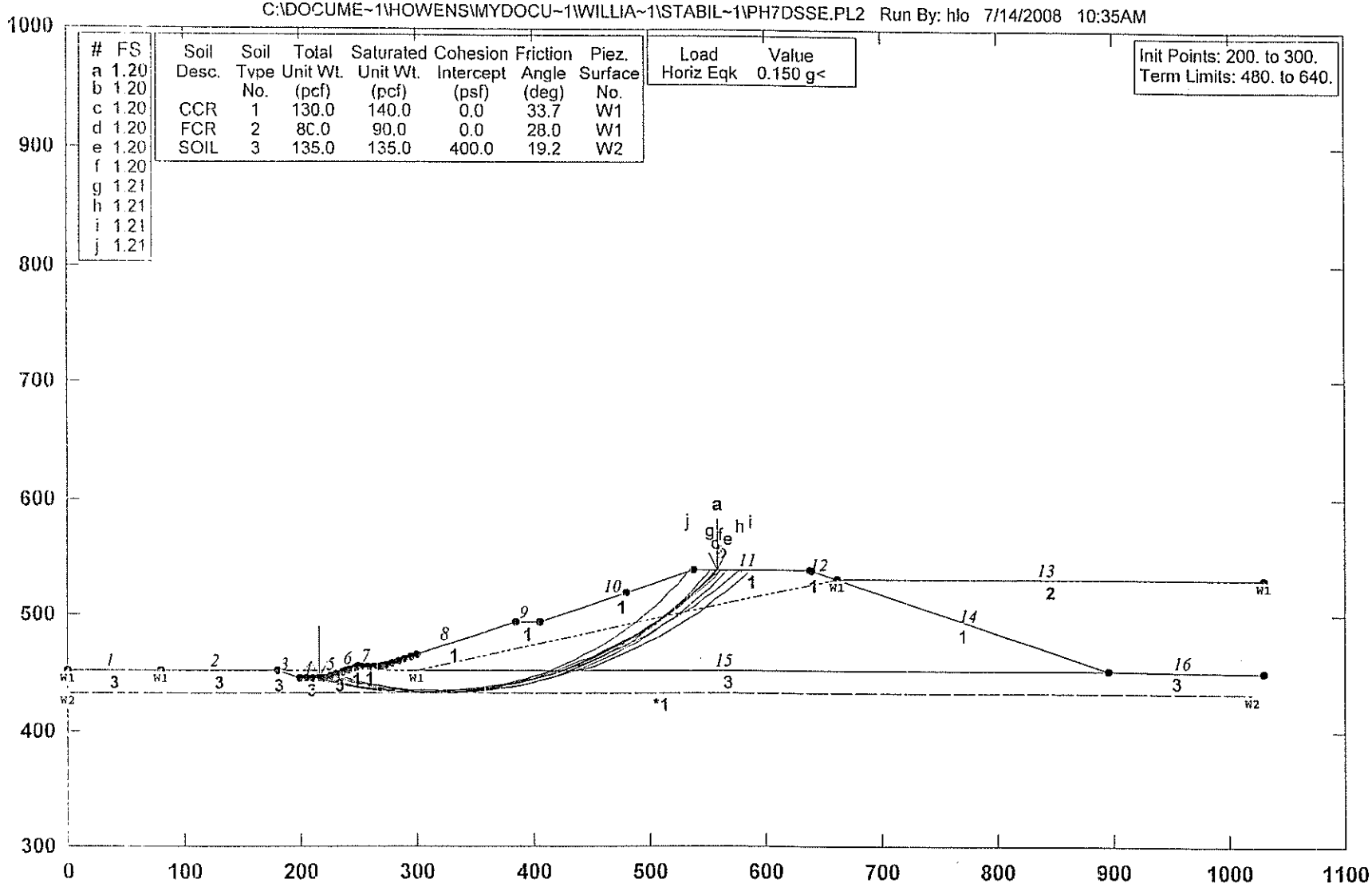
C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH7DSSE.PL2 Run By: hlo 7/14/2008 10:35AM

#	FS
a	1.20
b	1.20
c	1.20
d	1.20
e	1.20
f	1.20
g	1.21
h	1.21
i	1.21
j	1.21

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	28.0	W1
SOIL	3	135.0	135.0	400.0	19.2	W2

Load	Value
Horiz Eqk	0.150 g<

Init Points: 200. to 300.
Term Limits: 480. to 640.



PCSTABL5M/si FSmin=1.20

Safety Factors Are Calculated By The Modified Bishop Method

STED



175

R17128

8114-10
Part 28

(176)

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 7/14/2008
Time of Run: 10:35AM
Run By: hlo
Input Data Filename: C:PH7DSSE.
Output Filename: C:PH7DSSE.OUT
Unit: ENGLISH
Plotted Output Filename: C:PH7DSSE.PLT
PROBLEM DESCRIPTION PHASE 7 D.S. SEISMIC, PIEZ. 15, 16, 17
REFUSE DISPOSAL AREA NO. 2
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

13 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	151.50	80.00	152.50	3
2	80.00	152.50	180.00	152.00	3
3	180.00	152.00	200.00	145.30	3
4	200.00	145.30	220.00	145.30	3
5	220.00	145.30	240.00	152.00	3
6	240.00	152.00	250.00	155.30	1
7	250.00	155.30	270.00	155.30	1
8	270.00	155.30	385.00	193.60	1
9	385.00	193.60	405.00	193.60	1
10	405.00	193.60	538.20	238.00	1
11	538.20	238.00	638.20	238.00	1
12	638.20	238.00	662.20	230.00	1
13	662.20	230.00	1030.00	230.00	2
14	662.20	230.00	896.20	152.00	1
15	240.00	152.00	896.20	152.00	3
16	896.20	152.00	1030.00	150.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	135.0	135.0	400.0	19.2	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	151.50
2	80.00	152.00
3	300.00	152.00
4	662.20	230.00
5	1030.00	230.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	132.00
2	1020.00	132.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	132.00	1020.00	132.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 200.00 ft.
and X = 300.00 ft.
Each Surface Terminates Between X = 480.00 ft.
and X = 640.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	215.79	145.30
2	225.45	142.73
3	235.19	140.45
4	244.99	138.44
5	254.84	136.72
6	264.73	135.28
7	274.67	134.13
8	284.63	133.26
9	294.61	132.68
10	304.61	132.39
11	314.61	132.39
12	324.60	132.68
13	334.59	133.25
14	344.55	134.12
15	354.48	135.26
16	364.38	136.70
17	374.23	138.42
18	384.03	140.42
19	393.76	142.71
20	403.43	145.27
21	413.02	148.11
22	422.52	151.23
23	431.93	154.62
24	441.23	158.28
25	450.43	162.20
26	459.51	166.39
27	468.47	170.84
28	477.29	175.55
29	485.98	180.50
30	494.51	185.71
31	502.90	191.16
32	511.12	196.85
33	519.18	202.77
34	527.06	208.93
35	534.76	215.31
36	542.28	221.91
37	549.60	228.72
38	556.72	235.74
39	558.89	238.00

Circle Center At X = 309.7 ; Y = 479.3 and Radius, 346.9
*** 1.197 ***
Individual data on the 48 slices

	Water Force	Water Force	Tie Force	Tie Force	Earthquake Force	Surcharge

Slice No.	Width (ft)	Weight (lbs)	Top (lbs)	Bot (lbs)	Norm (lbs)	Tan (lbs)	Hor (lbs)	Ver (lbs)	Load (lbs)
1	4.2	317.8	.0	.0	.0	.0	47.7	.0	.0
2	5.5	2029.8	.0	.0	.0	.0	304.5	.0	.0
3	9.7	9421.2	.0	.0	.0	.0	1413.2	.0	.0
4	4.8	7299.9	.0	.0	.0	.0	1095.0	.0	.0
5	5.0	9318.2	.0	.0	.0	.0	1397.7	.0	.0
6	5.0	11086.2	.0	.0	.0	.0	1662.9	.0	.0
7	4.8	11778.6	.0	.0	.0	.0	1766.8	.0	.0
8	9.9	25623.5	.0	.0	.0	.0	3843.5	.0	.0
9	5.3	14365.8	.0	.0	.0	.0	2154.9	.0	.0
10	4.7	13562.5	.0	.0	.0	.0	2034.4	.0	.0
11	10.0	33055.4	.0	.0	.0	.0	4958.3	.0	.0
12	10.0	38407.6	.0	.0	.0	.0	5761.1	.0	.0
13	5.4	22787.1	.0	.0	.0	.0	3418.1	.0	.0
14	4.6	20579.5	.0	.0	.0	.0	3086.9	.0	.0
15	10.0	48066.7	.0	.0	.0	.0	7210.0	.0	.0
16	10.0	52392.2	.0	.0	.0	.0	7858.8	.0	.0
17	10.0	56275.6	.0	.0	.0	.0	8441.3	.0	.0
18	10.0	59705.3	.0	.0	.0	.0	8955.8	.0	.0
19	9.9	62672.0	.0	.0	.0	.0	9400.8	.0	.0
20	9.9	65168.7	.0	.0	.0	.0	9775.3	.0	.0
21	9.9	67191.3	.0	.0	.0	.0	10078.7	.0	.0
22	9.8	68737.8	.0	.0	.0	.0	10310.7	.0	.0
23	1.0	6904.4	.0	.0	.0	.0	1035.7	.0	.0
24	8.8	61241.2	.0	.0	.0	.0	9186.2	.0	.0
25	9.7	64716.1	.0	.0	.0	.0	9707.4	.0	.0
26	1.6	10208.4	.0	.0	.0	.0	1531.3	.0	.0
27	8.0	52080.8	.0	.0	.0	.0	7812.1	.0	.0
28	9.5	61983.9	.0	.0	.0	.0	9297.6	.0	.0
29	2.1	13973.9	.0	.0	.0	.0	2096.1	.0	.0
30	7.3	47267.8	.0	12404.2	.0	.0	7090.2	.0	.0
31	9.3	59957.1	.0	15233.2	.0	.0	8993.6	.0	.0
32	9.2	58243.6	.0	14134.9	.0	.0	8736.5	.0	.0
33	9.1	56123.6	.0	12859.9	.0	.0	8418.5	.0	.0
34	9.0	53616.6	.0	11409.4	.0	.0	8042.5	.0	.0
35	8.8	50745.2	.0	9784.5	.0	.0	7611.8	.0	.0
36	8.7	47533.5	.0	7986.6	.0	.0	7130.0	.0	.0
37	8.5	44007.1	.0	6017.2	.0	.0	6601.1	.0	.0
38	8.4	40194.6	.0	3877.9	.0	.0	6029.2	.0	.0
39	8.2	36125.3	.0	1570.5	.0	.0	5418.8	.0	.0
40	1.2	4902.2	.0	27.5	.0	.0	735.3	.0	.0
41	6.9	27048.6	.0	.0	.0	.0	4057.3	.0	.0
42	7.9	27790.7	.0	.0	.0	.0	4168.6	.0	.0
43	7.7	23480.3	.0	.0	.0	.0	3522.0	.0	.0
44	3.4	9212.5	.0	.0	.0	.0	1381.9	.0	.0
45	4.1	9476.5	.0	.0	.0	.0	1421.5	.0	.0
46	7.3	12076.5	.0	.0	.0	.0	1811.5	.0	.0
47	7.1	5344.7	.0	.0	.0	.0	801.7	.0	.0
48	2.2	318.7	.0	.0	.0	.0	47.8	.0	.0

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	210.53	145.30
2	220.21	142.79
3	229.95	140.56
4	239.76	138.59
5	249.61	136.89
6	259.51	135.47
7	269.44	134.31
8	279.41	133.44
9	289.39	132.83
10	299.38	132.51
11	309.38	132.46
12	319.38	132.68
13	329.37	133.18
14	339.34	133.95

15	349.28	135.00
16	359.19	136.33
17	369.07	137.92
18	378.89	139.79
19	388.66	141.93
20	398.37	144.33
21	408.00	147.01
22	417.56	149.94
23	427.04	153.14
24	436.42	156.60
25	445.70	160.32
26	454.88	164.29
27	463.94	168.51
28	472.89	172.98
29	481.71	177.70
30	490.39	182.65
31	498.94	187.85
32	507.34	193.28
33	515.58	198.93
34	523.67	204.82
35	531.59	210.92
36	539.34	217.24
37	546.91	223.77
38	554.30	230.51
39	561.51	237.44
40	562.05	238.00

Circle Center At X = 306.3 ; Y = 495.2 and Radius, 362.7

*** 1.199 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	210.53	145.30
2	220.21	142.78
3	229.95	140.54
4	239.75	138.57
5	249.61	136.87
6	259.51	135.45
7	269.44	134.31
8	279.41	133.45
9	289.39	132.86
10	299.38	132.55
11	309.38	132.52
12	319.38	132.78
13	329.37	133.31
14	339.33	134.12
15	349.27	135.20
16	359.18	136.57
17	369.04	138.21
18	378.86	140.12
19	388.62	142.31
20	398.31	144.77
21	407.93	147.50
22	417.47	150.50
23	426.92	153.77
24	436.28	157.29
25	445.53	161.08
26	454.68	165.12
27	463.71	169.42
28	472.62	173.97
29	481.39	178.76
30	490.03	183.80
31	498.52	189.08
32	506.87	194.59
33	515.05	200.33
34	523.08	206.30
35	530.93	212.50
36	538.61	218.90

37	546.10	225.52
38	553.41	232.35
39	559.12	238.00

Circle Center At X = 305.4 ; Y = 490.5 and Radius, 358.0

*** 1.199 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	226.32	147.42
2	235.87	144.46
3	245.51	141.82
4	255.24	139.49
5	265.03	137.47
6	274.89	135.76
7	284.79	134.38
8	294.73	133.31
9	304.70	132.56
10	314.70	132.13
11	324.69	132.03
12	334.69	132.24
13	344.68	132.78
14	354.64	133.64
15	364.57	134.81
16	374.46	136.31
17	384.29	138.12
18	394.07	140.25
19	403.76	142.68
20	413.38	145.43
21	422.90	148.49
22	432.32	151.85
23	441.62	155.52
24	450.81	159.47
25	459.86	163.73
26	468.77	168.27
27	477.53	173.09
28	486.12	178.19
29	494.56	183.57
30	502.81	189.22
31	510.88	195.12
32	518.75	201.29
33	526.43	207.70
34	533.89	214.36
35	541.13	221.25
36	548.15	228.37
37	554.94	235.72
38	556.92	238.00

Circle Center At X = 323.0 ; Y = 443.2 and Radius, 311.2

*** 1.199 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	226.32	147.42
2	235.92	144.63
3	245.61	142.14
4	255.36	139.94
5	265.18	138.03
6	275.05	136.42
7	284.96	135.10
8	294.91	134.07
9	304.88	133.35
10	314.87	132.92
11	324.87	132.80
12	334.87	132.97
13	344.86	133.44
14	354.83	134.21
15	364.77	135.27
16	374.68	136.64

17	384.54	138.29
18	394.35	140.25
19	404.09	142.49
20	413.76	145.03
21	423.36	147.85
22	432.86	150.96
23	442.27	154.35
24	451.57	158.02
25	460.76	161.97
26	469.82	166.19
27	478.76	170.68
28	487.56	175.44
29	496.21	180.45
30	504.70	185.73
31	513.04	191.25
32	521.21	197.02
33	529.20	203.03
34	537.00	209.28
35	544.62	215.76
36	552.04	222.47
37	559.26	229.39
38	566.26	236.52
39	567.63	238.00

Circle Center At X = 324.1 ; Y = 467.3 and Radius, 334.5

*** 1.200 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	215.79	145.30
2	225.52	142.98
3	235.31	140.93
4	245.15	139.15
5	255.03	137.64
6	264.95	136.40
7	274.91	135.42
8	284.88	134.72
9	294.87	134.30
10	304.87	134.14
11	314.87	134.26
12	324.86	134.65
13	334.84	135.31
14	344.80	136.25
15	354.72	137.45
16	364.61	138.93
17	374.46	140.68
18	384.26	142.69
19	393.99	144.97
20	403.66	147.51
21	413.26	150.32
22	422.78	153.39
23	432.21	156.72
24	441.54	160.30
25	450.78	164.14
26	459.91	168.22
27	468.92	172.56
28	477.81	177.14
29	486.57	181.95
30	495.20	187.01
31	503.68	192.30
32	512.02	197.82
33	520.21	203.57
34	528.23	209.53
35	536.09	215.71
36	543.78	222.11
37	551.29	228.71
38	558.62	235.52
39	561.15	238.00

Circle Center At X = 305.6 ; Y = 500.7 and Radius, 366.6
*** 1.203 ***
Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	231.58	149.18
2	241.09	146.07
3	250.69	143.30
4	260.39	140.84
5	270.16	138.72
6	280.00	136.94
7	289.89	135.49
8	299.83	134.37
9	309.80	133.60
10	319.79	133.16
11	329.79	133.06
12	339.79	133.31
13	349.77	133.89
14	359.73	134.81
15	369.65	136.07
16	379.52	137.67
17	389.33	139.60
18	399.07	141.87
19	408.73	144.46
20	418.29	147.38
21	427.75	150.63
22	437.09	154.19
23	446.31	158.07
24	455.39	162.26
25	464.32	166.76
26	473.10	171.56
27	481.70	176.65
28	490.13	182.04
29	498.37	187.70
30	506.41	193.65
31	514.25	199.86
32	521.86	206.34
33	529.26	213.07
34	536.42	220.05
35	543.34	227.27
36	550.01	234.72
37	552.76	238.00

Circle Center At X = 327.6 ; Y = 427.1 and Radius, 294.1
*** 1.207 ***
Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	205.26	145.30
2	215.01	143.05
3	224.80	141.04
4	234.65	139.27
5	244.53	137.73
6	254.44	136.44
7	264.39	135.38
8	274.35	134.57
9	284.34	134.00
10	294.33	133.67
11	304.33	133.58
12	314.33	133.73
13	324.32	134.13
14	334.30	134.76
15	344.26	135.64
16	354.20	136.76
17	364.11	138.12
18	373.98	139.72
19	383.81	141.55
20	393.59	143.63

21	403.32	145.94
22	412.99	148.48
23	422.60	151.26
24	432.14	154.27
25	441.60	157.51
26	450.98	160.97
27	460.27	164.67
28	469.47	168.58
29	478.57	172.72
30	487.58	177.08
31	496.47	181.65
32	505.25	186.44
33	513.91	191.44
34	522.45	196.64
35	530.86	202.05
36	539.13	207.67
37	547.27	213.48
38	555.26	219.49
39	563.11	225.69
40	570.81	232.07
41	577.61	238.00

Circle Center At X = 303.0 ; Y = 546.9 and Radius, 413.3

*** 1.209 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	226.32	147.42
2	236.01	144.97
3	245.77	142.78
4	255.58	140.84
5	265.44	139.16
6	275.34	137.73
7	285.27	136.57
8	295.23	135.66
9	305.20	135.01
10	315.20	134.63
11	325.20	134.50
12	335.20	134.63
13	345.19	135.03
14	355.17	135.68
15	365.12	136.59
16	375.06	137.77
17	384.95	139.20
18	394.81	140.89
19	404.62	142.83
20	414.37	145.03
21	424.07	147.48
22	433.70	150.19
23	443.25	153.14
24	452.72	156.34
25	462.11	159.79
26	471.40	163.48
27	480.60	167.41
28	489.69	171.58
29	498.66	175.99
30	507.52	180.63
31	516.26	185.49
32	524.87	190.59
33	533.34	195.90
34	541.67	201.43
35	549.85	207.18
36	557.88	213.14
37	565.75	219.31
38	573.46	225.68
39	581.00	232.25
40	587.26	238.00

Circle Center At X = 325.1 ; Y = 518.4 and Radius, 383.9

*** 1.210 ***
Failure Surface Specified By 36 Coordinate Points

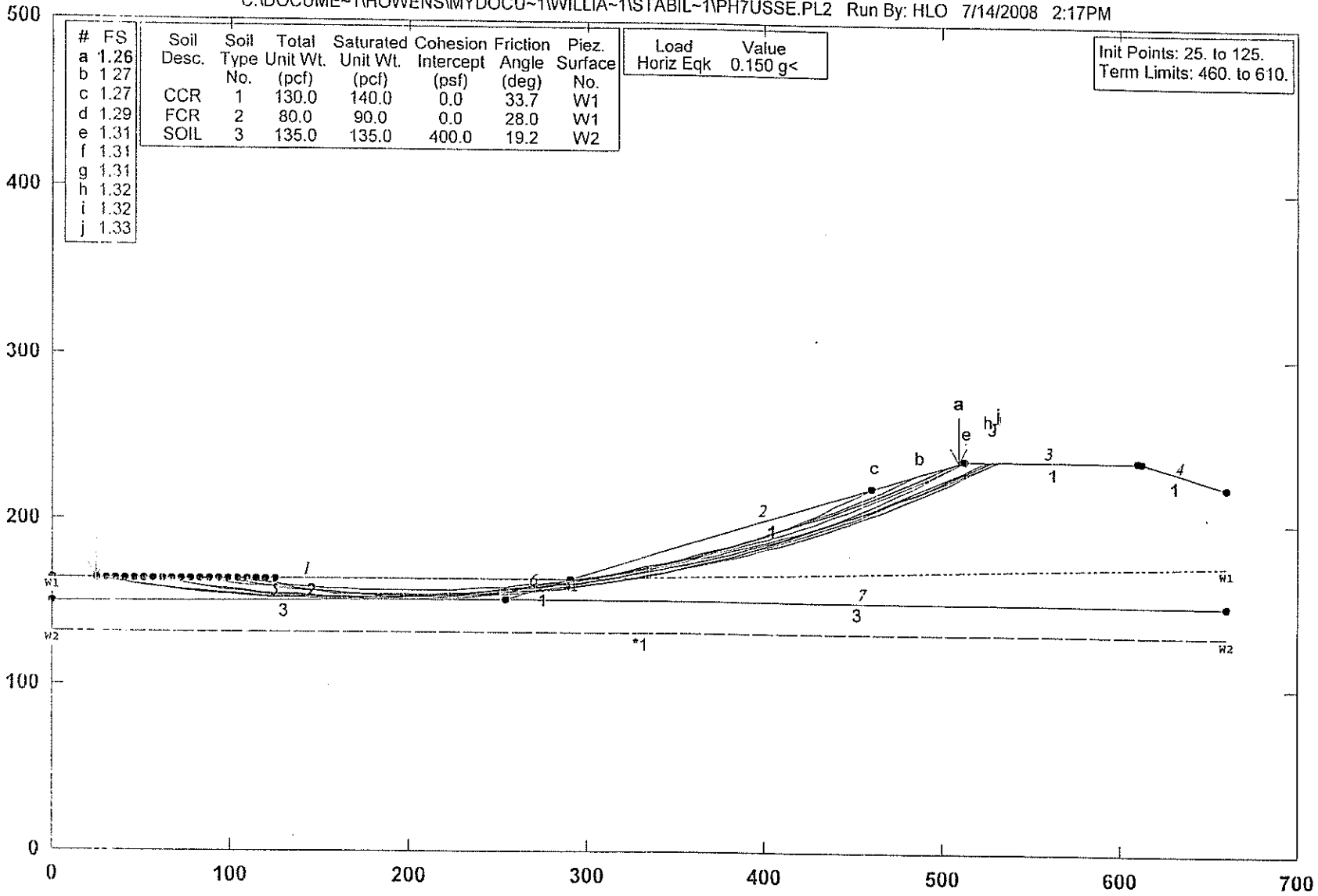
Point No.	X-Surf (ft)	Y-Surf (ft)
1	221.05	145.65
2	230.65	142.85
3	240.34	140.37
4	250.11	138.22
5	259.94	136.41
6	269.83	134.93
7	279.76	133.78
8	289.73	132.98
9	299.72	132.51
10	309.72	132.39
11	319.72	132.60
12	329.70	133.15
13	339.66	134.05
14	349.59	135.28
15	359.46	136.84
16	369.28	138.74
17	379.03	140.98
18	388.69	143.54
19	398.27	146.43
20	407.74	149.64
21	417.09	153.18
22	426.32	157.02
23	435.42	161.19
24	444.36	165.65
25	453.15	170.42
26	461.78	175.48
27	470.22	180.84
28	478.48	186.48
29	486.54	192.39
30	494.40	198.58
31	502.04	205.02
32	509.46	211.73
33	516.65	218.68
34	523.60	225.88
35	530.30	233.30
36	532.72	236.17

Circle Center At X = 308.4 ; Y = 426.6 and Radius, 294.2

*** 1.212 ***

PHASE 7 UPSTREAM SEISMIC, SECTION G-G REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH7USSE.PL2 Run By: HLO 7/14/2008 2:17PM



PCSTABL5M/si FSmin=1.26

Safety Factors Are Calculated By The Modified Bishop Method

STED

195

R17138

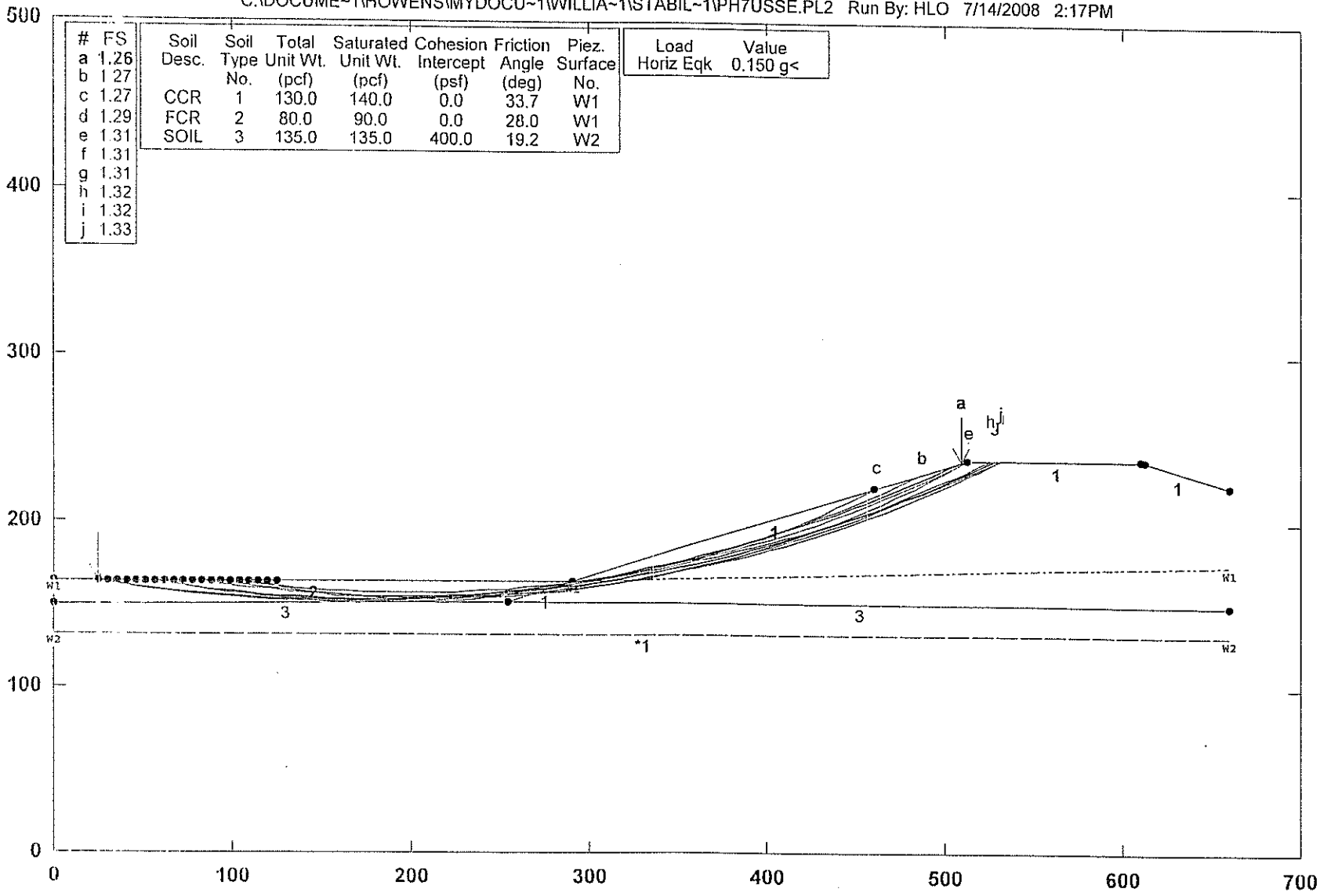
PHASE 7 UPSTREAM SEISMIC, SECTION G-G REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH7USSE.PL2 Run By: HLO 7/14/2008 2:17PM

#	FS
a	1.26
b	1.27
c	1.27
d	1.29
e	1.31
f	1.31
g	1.31
h	1.32
i	1.32
j	1.33

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	28.0	W1
SOIL	3	135.0	135.0	400.0	19.2	W2

Load	Value
Horiz Eqk	0.150 g<



PCSTABL5M/si FSmin=1.26

Safety Factors Are Calculated By The Modified Bishop Method

STED



R17139

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 7/14/2008
Time of Run: 2:17PM
Run By: HLO
Input Data Filename: C:PH7USSE.
Output Filename: C:PH7USSE.OUT
Unit: ENGLISH
Plotted Output Filename: C:PH7USSE.PLT
PROBLEM DESCRIPTION PHASE 7 UPSTREAM SEISMIC, SECTION G-G
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
4 Top Boundaries
7 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	164.00	290.00	164.00	2
2	290.00	164.00	512.00	238.00	1
3	512.00	238.00	612.00	238.00	1
4	612.00	238.00	660.00	222.00	1
5	.00	150.00	254.00	152.00	3
6	254.00	152.00	290.00	164.00	1
7	254.00	152.00	660.00	150.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	135.0	135.0	400.0	19.2	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 3 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	164.00
2	290.00	164.00
3	660.00	175.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	132.00
2	660.00	132.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	132.00	660.00	132.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 25.00 ft.
and X = 125.00 ft.
Each Surface Terminates Between X = 460.00 ft.
and X = 610.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 51 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.00	164.00
2	34.86	162.30
3	44.73	160.74
4	54.63	159.30
5	64.54	157.99
6	74.47	156.82
7	84.42	155.77
8	94.38	154.85
9	104.35	154.07
10	114.32	153.41
11	124.31	152.89
12	134.30	152.49
13	144.30	152.23
14	154.30	152.10
15	164.30	152.10
16	174.30	152.23
17	184.29	152.49
18	194.29	152.89
19	204.27	153.41
20	214.25	154.07
21	224.22	154.85
22	234.18	155.77
23	244.12	156.82
24	254.05	157.99
25	263.97	159.30
26	273.86	160.74
27	283.74	162.30
28	293.59	164.00
29	303.43	165.83
30	313.23	167.78
31	323.01	169.86
32	332.77	172.07
33	342.49	174.41
34	352.18	176.88
35	361.84	179.47
36	371.46	182.19
37	381.05	185.03
38	390.60	188.00
39	400.11	191.10
40	409.58	194.32
41	419.00	197.66
42	428.38	201.13
43	437.71	204.72
44	447.00	208.43
45	456.24	212.26
46	465.42	216.21
47	474.55	220.29
48	483.63	224.48
49	492.66	228.79
50	501.62	233.22
51	509.07	237.02

Circle Center At X = 159.3 ; Y = 914.8 and Radius, 762.7
*** 1.262 ***
Individual data on the 53 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)

1	9.9	752.2	.0	529.2	.0	.0	112.8	.0	.0
2	9.9	2204.0	.0	1547.2	.0	.0	330.6	.0	.0
3	9.9	3546.1	.0	2484.4	.0	.0	531.9	.0	.0
4	9.9	4776.9	.0	3340.7	.0	.0	716.5	.0	.0
5	9.9	5895.0	.0	4115.8	.0	.0	884.3	.0	.0
6	9.9	6899.0	.0	4809.7	.0	.0	1034.9	.0	.0
7	10.0	7787.7	.0	5422.3	.0	.0	1168.2	.0	.0
8	10.0	8560.1	.0	5953.4	.0	.0	1284.0	.0	.0
9	10.0	9215.1	.0	6402.9	.0	.0	1382.3	.0	.0
10	10.0	9752.2	.0	6770.8	.0	.0	1462.8	.0	.0
11	10.0	10170.5	.0	7057.0	.0	.0	1525.6	.0	.0
12	10.0	10469.7	.0	7261.5	.0	.0	1570.5	.0	.0
13	10.0	10649.3	.0	7384.2	.0	.0	1597.4	.0	.0
14	10.0	10709.2	.0	7425.0	.0	.0	1606.4	.0	.0
15	10.0	10649.2	.0	7384.1	.0	.0	1597.4	.0	.0
16	10.0	10469.5	.0	7261.4	.0	.0	1570.4	.0	.0
17	10.0	10170.3	.0	7056.8	.0	.0	1525.5	.0	.0
18	10.0	9751.9	.0	6770.6	.0	.0	1462.8	.0	.0
19	10.0	9214.7	.0	6402.6	.0	.0	1382.2	.0	.0
20	10.0	8559.6	.0	5953.1	.0	.0	1283.9	.0	.0
21	10.0	7787.2	.0	5421.9	.0	.0	1168.1	.0	.0
22	9.9	6898.4	.0	4809.3	.0	.0	1034.8	.0	.0
23	9.9	5894.3	.0	4115.3	.0	.0	884.1	.0	.0
24	9.9	4776.1	.0	3340.1	.0	.0	716.4	.0	.0
25	9.9	3545.2	.0	2483.8	.0	.0	531.8	.0	.0
26	9.9	2203.1	.0	1546.6	.0	.0	330.5	.0	.0
27	2.4	324.9	.0	228.6	.0	.0	48.7	.0	.0
28	3.8	385.7	.0	229.7	.0	.0	57.9	.0	.0
29	3.6	437.0	.0	82.3	.0	.0	65.6	.0	.0
30	.7	110.3	.0	2.3	.0	.0	16.5	.0	.0
31	9.2	2348.2	.0	.0	.0	.0	352.2	.0	.0
32	9.8	4216.0	.0	.0	.0	.0	632.4	.0	.0
33	9.8	5789.4	.0	.0	.0	.0	868.4	.0	.0
34	9.8	7179.0	.0	.0	.0	.0	1076.8	.0	.0
35	9.7	8385.1	.0	.0	.0	.0	1257.8	.0	.0
36	9.7	9408.6	.0	.0	.0	.0	1411.3	.0	.0
37	9.7	10250.4	.0	.0	.0	.0	1537.6	.0	.0
38	9.6	10911.7	.0	.0	.0	.0	1636.8	.0	.0
39	9.6	11393.9	.0	.0	.0	.0	1709.1	.0	.0
40	9.5	11698.6	.0	.0	.0	.0	1754.8	.0	.0
41	9.5	11827.7	.0	.0	.0	.0	1774.2	.0	.0
42	9.5	11783.1	.0	.0	.0	.0	1767.5	.0	.0
43	9.4	11567.2	.0	.0	.0	.0	1735.1	.0	.0
44	9.4	11182.2	.0	.0	.0	.0	1677.3	.0	.0
45	9.3	10631.0	.0	.0	.0	.0	1594.6	.0	.0
46	9.3	9916.3	.0	.0	.0	.0	1487.4	.0	.0
47	9.2	9041.1	.0	.0	.0	.0	1356.2	.0	.0
48	9.2	8008.7	.0	.0	.0	.0	1201.3	.0	.0
49	9.1	6822.6	.0	.0	.0	.0	1023.4	.0	.0
50	9.1	5486.3	.0	.0	.0	.0	822.9	.0	.0
51	9.0	4003.7	.0	.0	.0	.0	600.5	.0	.0
52	9.0	2378.6	.0	.0	.0	.0	356.8	.0	.0
53	7.5	639.7	.0	.0	.0	.0	96.0	.0	.0

Failure Surface Specified By 46 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	56.58	164.00
2	66.42	162.24
3	76.29	160.63
4	86.19	159.17
5	96.10	157.86
6	106.03	156.70
7	115.98	155.69
8	125.94	154.83
9	135.92	154.12
10	145.90	153.56
11	155.90	153.16

12	165.89	152.90
13	175.89	152.80
14	185.89	152.85
15	195.89	153.05
16	205.88	153.40
17	215.87	153.90
18	225.85	154.55
19	235.82	155.35
20	245.77	156.31
21	255.71	157.41
22	265.63	158.67
23	275.53	160.07
24	285.41	161.62
25	295.26	163.33
26	305.09	165.18
27	314.89	167.18
28	324.66	169.33
29	334.39	171.63
30	344.08	174.07
31	353.74	176.66
32	363.36	179.40
33	372.94	182.28
34	382.47	185.30
35	391.95	188.47
36	401.39	191.79
37	410.77	195.24
38	420.10	198.84
39	429.38	202.57
40	438.60	206.45
41	447.76	210.47
42	456.85	214.62
43	465.88	218.91
44	474.85	223.34
45	483.75	227.90
46	487.16	229.72

Circle Center At X = 177.7 ; Y = 813.5 and Radius, 660.7

*** 1.266 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	98.68	164.00
2	108.50	162.11
3	118.36	160.40
4	128.24	158.88
5	138.15	157.55
6	148.09	156.41
7	158.04	155.46
8	168.01	154.70
9	178.00	154.12
10	187.99	153.74
11	197.99	153.54
12	207.99	153.54
13	217.99	153.72
14	227.98	154.09
15	237.96	154.66
16	247.93	155.41
17	257.89	156.35
18	267.83	157.48
19	277.74	158.80
20	287.62	160.31
21	297.48	162.00
22	307.30	163.88
23	317.08	165.95
24	326.83	168.20
25	336.53	170.64
26	346.18	173.26
27	355.78	176.06

28	365.32	179.05
29	374.81	182.21
30	384.23	185.56
31	393.59	189.08
32	402.88	192.78
33	412.10	196.66
34	421.24	200.71
35	430.31	204.93
36	439.29	209.33
37	448.19	213.89
38	457.00	218.62
39	461.57	221.19

Circle Center At X = 203.3 ; Y = 680.4 and Radius, 526.9

*** 1.270 ***

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	103.95	164.00
2	113.78	162.19
3	123.65	160.54
4	133.54	159.07
5	143.45	157.77
6	153.39	156.65
7	163.34	155.69
8	173.31	154.91
9	183.29	154.31
10	193.28	153.87
11	203.28	153.61
12	213.28	153.53
13	223.28	153.61
14	233.28	153.88
15	243.27	154.31
16	253.25	154.92
17	263.22	155.70
18	273.17	156.66
19	283.11	157.79
20	293.02	159.09
21	302.91	160.56
22	312.78	162.21
23	322.61	164.03
24	332.41	166.01
25	342.18	168.17
26	351.90	170.50
27	361.59	172.99
28	371.23	175.66
29	380.82	178.49
30	390.36	181.48
31	399.84	184.65
32	409.27	187.97
33	418.64	191.46
34	427.95	195.12
35	437.20	198.93
36	446.37	202.90
37	455.48	207.04
38	464.51	211.33
39	473.47	215.77
40	482.35	220.38
41	491.14	225.13
42	499.86	230.04
43	508.48	235.10
44	513.24	238.00

Circle Center At X = 213.2 ; Y = 728.6 and Radius, 575.0

*** 1.294 ***

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	103.95	164.00

2	113.86	162.64
3	123.78	161.44
4	133.73	160.38
5	143.69	159.48
6	153.66	158.73
7	163.64	158.13
8	173.63	157.69
9	183.63	157.39
10	193.62	157.25
11	203.62	157.26
12	213.62	157.42
13	223.62	157.74
14	233.61	158.21
15	243.59	158.83
16	253.56	159.60
17	263.52	160.52
18	273.46	161.60
19	283.38	162.83
20	293.29	164.21
21	303.17	165.73
22	313.03	167.41
23	322.86	169.24
24	332.66	171.22
25	342.43	173.35
26	352.17	175.63
27	361.87	178.05
28	371.53	180.62
29	381.16	183.34
30	390.74	186.21
31	400.27	189.22
32	409.76	192.38
33	419.20	195.68
34	428.59	199.12
35	437.92	202.71
36	447.20	206.44
37	456.42	210.31
38	465.58	214.32
39	474.68	218.47
40	483.72	222.75
41	492.69	227.18
42	501.58	231.74
43	510.41	236.44
44	513.25	238.00

Circle Center At X = 197.9 ; Y = 813.2 and Radius, 656.0

*** 1.306 ***

Failure Surface Specified By 50 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	56.58	164.00
2	66.42	162.24
3	76.29	160.61
4	86.18	159.13
5	96.09	157.78
6	106.01	156.57
7	115.96	155.50
8	125.91	154.57
9	135.88	153.77
10	145.86	153.12
11	155.85	152.61
12	165.84	152.24
13	175.84	152.00
14	185.84	151.91
15	195.84	151.96
16	205.84	152.14
17	215.83	152.47
18	225.82	152.94
19	235.80	153.54

20	245.77	154.29
21	255.73	155.17
22	265.68	156.20
23	275.61	157.36
24	285.53	158.66
25	295.42	160.10
26	305.30	161.68
27	315.15	163.40
28	324.98	165.25
29	334.78	167.25
30	344.55	169.38
31	354.29	171.64
32	363.99	174.04
33	373.67	176.58
34	383.30	179.25
35	392.90	182.06
36	402.46	185.00
37	411.98	188.07
38	421.45	191.28
39	430.87	194.62
40	440.25	198.09
41	449.58	201.69
42	458.86	205.42
43	468.08	209.28
44	477.25	213.27
45	486.37	217.39
46	495.42	221.63
47	504.41	226.01
48	513.35	230.50
49	522.21	235.12
50	527.55	238.00

Circle Center At X = 187.5 ; Y = 866.6 and Radius, 714.6

*** 1.306 ***

Failure Surface Specified By 50 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	56.58	164.00
2	66.45	162.39
3	76.34	160.91
4	86.25	159.56
5	96.17	158.35
6	106.12	157.27
7	116.07	156.32
8	126.04	155.51
9	136.01	154.82
10	146.00	154.27
11	155.99	153.86
12	165.99	153.57
13	175.98	153.42
14	185.98	153.41
15	195.98	153.53
16	205.98	153.78
17	215.97	154.16
18	225.96	154.68
19	235.94	155.33
20	245.91	156.11
21	255.87	157.03
22	265.81	158.08
23	275.74	159.26
24	285.65	160.58
25	295.55	162.03
26	305.42	163.61
27	315.28	165.32
28	325.10	167.16
29	334.91	169.13
30	344.68	171.23
31	354.43	173.47

32	364.15	175.83
33	373.83	178.33
34	383.48	180.95
35	393.10	183.70
36	402.67	186.58
37	412.21	189.58
38	421.71	192.72
39	431.16	195.98
40	440.57	199.36
41	449.93	202.87
42	459.25	206.51
43	468.52	210.27
44	477.73	214.15
45	486.89	218.16
46	496.00	222.29
47	505.05	226.54
48	514.05	230.90
49	522.98	235.39
50	528.00	238.00

Circle Center At X = 182.2 ; Y = 902.5 and Radius, 749.1

*** 1.314 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	82.90	164.00
2	92.78	162.49
3	102.69	161.13
4	112.61	159.90
5	122.55	158.81
6	132.51	157.87
7	142.48	157.07
8	152.45	156.41
9	162.44	155.89
10	172.43	155.51
11	182.43	155.28
12	192.43	155.18
13	202.43	155.23
14	212.43	155.42
15	222.42	155.76
16	232.41	156.23
17	242.39	156.85
18	252.36	157.61
19	262.32	158.51
20	272.27	159.55
21	282.20	160.73
22	292.11	162.06
23	302.00	163.52
24	311.87	165.13
25	321.72	166.87
26	331.54	168.76
27	341.33	170.78
28	351.10	172.94
29	360.83	175.24
30	370.53	177.68
31	380.19	180.26
32	389.81	182.98
33	399.40	185.83
34	408.94	188.81
35	418.44	191.93
36	427.90	195.19
37	437.30	198.58
38	446.66	202.10
39	455.97	205.76
40	465.23	209.55
41	474.43	213.47
42	483.57	217.52
43	492.65	221.69

44	501.68	226.00
45	510.64	230.44
46	519.54	235.00
47	525.20	238.00

Circle Center At X = 194.0 ; Y = 859.1 and Radius, 703.9

*** 1.319 ***

Failure Surface Specified By 54 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.00	164.00
2	34.88	162.45
3	44.78	161.02
4	54.69	159.70
5	64.62	158.50
6	74.56	157.42
7	84.51	156.46
8	94.48	155.61
9	104.45	154.88
10	114.43	154.26
11	124.42	153.77
12	134.41	153.39
13	144.41	153.12
14	154.41	152.98
15	164.41	152.95
16	174.41	153.05
17	184.40	153.25
18	194.40	153.58
19	204.39	154.02
20	214.37	154.59
21	224.35	155.26
22	234.32	156.06
23	244.28	156.97
24	254.22	158.00
25	264.16	159.15
26	274.08	160.41
27	283.98	161.80
28	293.87	163.29
29	303.74	164.90
30	313.59	166.63
31	323.42	168.48
32	333.22	170.44
33	343.00	172.51
34	352.76	174.70
35	362.49	177.01
36	372.19	179.43
37	381.87	181.96
38	391.51	184.61
39	401.12	187.37
40	410.70	190.24
41	420.25	193.22
42	429.76	196.32
43	439.23	199.53
44	448.66	202.85
45	458.05	206.28
46	467.40	209.82
47	476.71	213.47
48	485.98	217.23
49	495.20	221.10
50	504.38	225.07
51	513.51	229.16
52	522.59	233.35
53	531.62	237.65
54	532.34	238.00

Circle Center At X = 161.6 ; Y = 1003.3 and Radius, 850.4

*** 1.319 ***

Failure Surface Specified By 47 Coordinate Points

Point	X-Surf	Y-Surf

(19)

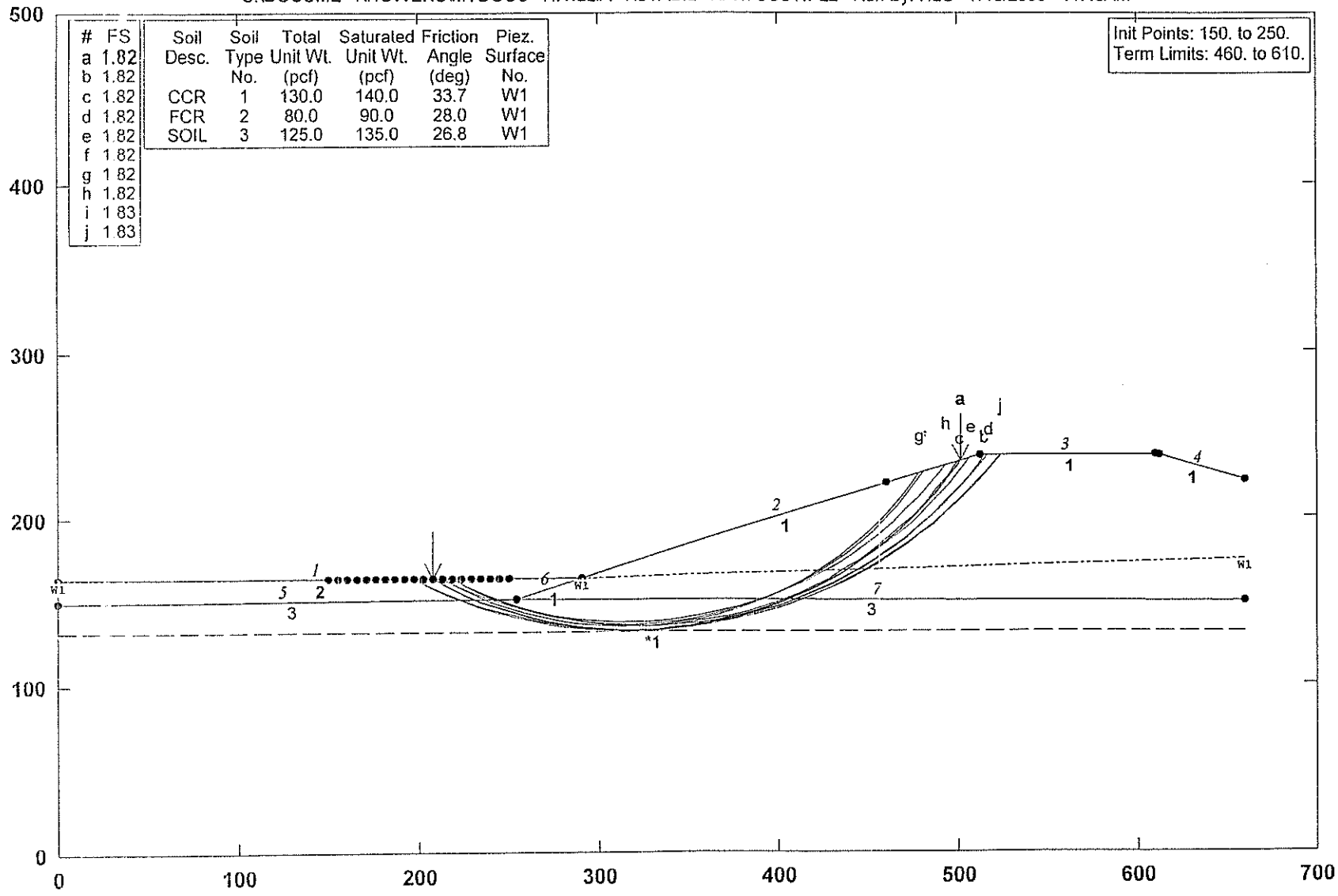
No.	(ft)	(ft)
1	93.42	164.00
2	103.29	162.40
3	113.19	160.95
4	123.10	159.64
5	133.03	158.48
6	142.98	157.47
7	152.95	156.61
8	162.92	155.89
9	172.90	155.32
10	182.89	154.90
11	192.89	154.63
12	202.89	154.51
13	212.89	154.53
14	222.89	154.70
15	232.88	155.02
16	242.87	155.49
17	252.85	156.11
18	262.82	156.87
19	272.78	157.79
20	282.73	158.85
21	292.65	160.05
22	302.56	161.41
23	312.45	162.91
24	322.31	164.55
25	332.15	166.35
26	341.96	168.28
27	351.74	170.37
28	361.49	172.60
29	371.20	174.97
30	380.88	177.48
31	390.52	180.14
32	400.12	182.95
33	409.68	185.89
34	419.19	188.97
35	428.66	192.20
36	438.07	195.57
37	447.44	199.07
38	456.75	202.71
39	466.01	206.49
40	475.21	210.41
41	484.35	214.46
42	493.43	218.65
43	502.45	222.98
44	511.40	227.43
45	520.29	232.02
46	529.10	236.74
47	531.38	238.00

Circle Center At X = 206.3 ; Y = 829.3 and Radius, 674.8

*** 1.331 ***

PHASE 7 UPSTREAM STATIC, SECTION G-G REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH7USST.PL2 Run By: HLO 7/15/2008 11:43AM



#	FS
a	1.82
b	1.82
c	1.82
d	1.82
e	1.82
f	1.82
g	1.82
h	1.82
i	1.83
j	1.83

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
SOIL	3	125.0	135.0	26.8	W1

PCSTABL5M/si FSmin=1.82

Safety Factors Are Calculated By The Modified Bishop Method

STED

197

R17150

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 7/14/2008
Time of Run: 2:30PM
Run By: HLO
Input Data Filename: C:PH7USST.
Output Filename: C:PH7USST.OUT
Unit: ENGLISH
Plotted Output Filename: C:PH7USST.PLT
PROBLEM DESCRIPTION PHASE 7 UPSTREAM SEISMIC, SECTION G-G
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
4 Top Boundaries
7 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	164.00	290.00	164.00	2
2	290.00	164.00	512.00	238.00	1
3	512.00	238.00	612.00	238.00	1
4	612.00	238.00	660.00	222.00	1
5	.00	150.00	254.00	152.00	3
6	254.00	152.00	290.00	164.00	1
7	254.00	152.00	660.00	150.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 3 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	164.00
2	290.00	164.00
3	660.00	175.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	132.00	660.00	132.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 150.00 ft.
and X = 250.00 ft.
Each Surface Terminates Between X = 460.00 ft.
and X = 610.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	207.90	164.00

2	216.56	159.01
3	225.45	154.42
4	234.54	150.26
5	243.81	146.52
6	253.25	143.22
7	262.84	140.36
8	272.54	137.95
9	282.35	136.00
10	292.24	134.51
11	302.18	133.48
12	312.17	132.91
13	322.17	132.81
14	332.16	133.18
15	342.13	134.01
16	352.04	135.31
17	361.89	137.06
18	371.64	139.27
19	381.28	141.94
20	390.78	145.05
21	400.13	148.60
22	409.30	152.58
23	418.28	156.99
24	427.04	161.81
25	435.57	167.03
26	443.84	172.65
27	451.85	178.64
28	459.56	185.00
29	466.98	191.71
30	474.07	198.77
31	480.82	206.14
32	487.22	213.82
33	493.26	221.79
34	498.92	230.04
35	501.74	234.58

Circle Center At X = 319.3 ; Y = 347.3 and Radius, 214.5

*** 1.817 ***

Individual data on the 39 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	8.7	1946.9	.0	1558.0	.0	.0	.0	.0	.0
2	8.9	5827.6	.0	4546.4	.0	.0	.0	.0	.0
3	5.7	5560.8	.0	4240.9	.0	.0	.0	.0	.0
4	3.4	4102.1	.0	3035.4	.0	.0	.0	.0	.0
5	9.3	14491.5	.0	9741.7	.0	.0	.0	.0	.0
6	9.4	19263.3	.0	11937.5	.0	.0	.0	.0	.0
7	.7	1704.0	.0	1016.5	.0	.0	.0	.0	.0
8	8.8	22505.5	.0	12842.1	.0	.0	.0	.0	.0
9	9.7	29526.3	.0	15501.1	.0	.0	.0	.0	.0
10	9.8	34318.9	.0	16861.3	.0	.0	.0	.0	.0
11	7.7	29490.5	.0	13796.3	.0	.0	.0	.0	.0
12	2.2	9101.5	.0	4142.9	.0	.0	.0	.0	.0
13	9.9	44027.6	.0	18849.1	.0	.0	.0	.0	.0
14	10.0	49611.8	.0	19531.8	.0	.0	.0	.0	.0
15	10.0	54500.0	.0	19924.7	.0	.0	.0	.0	.0
16	10.0	58647.5	.0	20027.0	.0	.0	.0	.0	.0
17	10.0	62019.3	.0	19838.5	.0	.0	.0	.0	.0
18	9.9	64590.3	.0	19359.6	.0	.0	.0	.0	.0
19	9.8	66345.8	.0	18591.3	.0	.0	.0	.0	.0
20	9.8	67281.3	.0	17535.4	.0	.0	.0	.0	.0
21	9.6	67402.7	.0	16193.9	.0	.0	.0	.0	.0
22	9.5	66726.4	.0	14570.1	.0	.0	.0	.0	.0
23	9.3	65278.9	.0	12667.2	.0	.0	.0	.0	.0
24	6.1	42099.7	.0	7233.3	.0	.0	.0	.0	.0
25	3.1	20986.2	.0	3256.2	.0	.0	.0	.0	.0
26	9.0	60064.0	.0	8041.7	.0	.0	.0	.0	.0

27	8.8	56357.3	.0	5329.2	.0	.0	.0	.0	.0
28	8.5	52073.5	.0	2357.7	.0	.0	.0	.0	.0
29	2.0	11733.2	.0	97.5	.0	.0	.0	.0	.0
30	6.3	35681.2	.0	.0	.0	.0	.0	.0	.0
31	8.0	42634.7	.0	.0	.0	.0	.0	.0	.0
32	7.7	37532.1	.0	.0	.0	.0	.0	.0	.0
33	7.4	32180.4	.0	.0	.0	.0	.0	.0	.0
34	7.1	26670.8	.0	.0	.0	.0	.0	.0	.0
35	6.8	21098.5	.0	.0	.0	.0	.0	.0	.0
36	6.4	15561.1	.0	.0	.0	.0	.0	.0	.0
37	6.0	10158.7	.0	.0	.0	.0	.0	.0	.0
38	5.7	4991.6	.0	.0	.0	.0	.0	.0	.0
39	2.8	660.3	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	218.42	164.00
2	227.24	159.28
3	236.26	154.97
4	245.46	151.06
5	254.84	147.57
6	264.35	144.51
7	274.00	141.87
8	283.76	139.68
9	293.60	137.92
10	303.52	136.61
11	313.48	135.75
12	323.47	135.33
13	333.47	135.37
14	343.46	135.85
15	353.41	136.79
16	363.32	138.17
17	373.15	139.99
18	382.89	142.25
19	392.52	144.95
20	402.02	148.08
21	411.36	151.64
22	420.54	155.61
23	429.53	159.99
24	438.32	164.77
25	446.88	169.94
26	455.19	175.49
27	463.26	181.41
28	471.04	187.68
29	478.54	194.30
30	485.73	201.25
31	492.60	208.51
32	499.14	216.08
33	505.33	223.93
34	511.16	232.06
35	515.04	238.00

Circle Center At X = 327.7 ; Y = 357.6 and Radius, 222.3

*** 1.819 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	218.42	164.00
2	227.16	159.13
3	236.11	154.69
4	245.28	150.68
5	254.62	147.12
6	264.13	144.02
7	273.77	141.37
8	283.53	139.20
9	293.39	137.50
10	303.31	136.27
11	313.28	135.53

12	323.28	135.26
13	333.28	135.48
14	343.25	136.18
15	353.18	137.36
16	363.04	139.02
17	372.81	141.15
18	382.47	143.75
19	391.99	146.82
20	401.35	150.33
21	410.53	154.30
22	419.51	158.70
23	428.27	163.53
24	436.78	168.78
25	445.03	174.43
26	453.00	180.47
27	460.66	186.89
28	468.01	193.68
29	475.02	200.81
30	481.69	208.26
31	487.98	216.03
32	493.89	224.10
33	499.41	232.44
34	500.42	234.14

Circle Center At X = 323.7 ; Y = 342.6 and Radius, 207.3

*** 1.819 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	197.37	164.00
2	206.17	159.25
3	215.16	154.87
4	224.32	150.86
5	233.64	147.23
6	243.10	143.99
7	252.68	141.14
8	262.38	138.69
9	272.17	136.65
10	282.03	135.01
11	291.96	133.77
12	301.92	132.95
13	311.91	132.54
14	321.91	132.54
15	331.90	132.95
16	341.87	133.77
17	351.79	135.01
18	361.66	136.65
19	371.45	138.70
20	381.14	141.15
21	390.73	144.00
22	400.19	147.24
23	409.51	150.87
24	418.67	154.88
25	427.65	159.26
26	436.45	164.01
27	445.05	169.12
28	453.43	174.58
29	461.57	180.38
30	469.47	186.52
31	477.11	192.97
32	484.48	199.73
33	491.56	206.79
34	498.35	214.14
35	504.82	221.76
36	510.98	229.64
37	516.81	237.76
38	516.96	238.00

Circle Center At X = 316.9 ; Y = 374.9 and Radius, 242.4

*** 1.819 ***
Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	197.37	164.00
2	206.12	159.15
3	215.06	154.69
4	224.19	150.61
5	233.49	146.93
6	242.94	143.66
7	252.52	140.80
8	262.22	138.35
9	272.01	136.32
10	281.88	134.72
11	291.81	133.55
12	301.79	132.80
13	311.78	132.49
14	321.78	132.61
15	331.77	133.15
16	341.72	134.13
17	351.62	135.54
18	361.45	137.38
19	371.19	139.63
20	380.83	142.31
21	390.34	145.39
22	399.71	148.89
23	408.92	152.79
24	417.95	157.08
25	426.79	161.75
26	435.42	166.80
27	443.82	172.22
28	451.98	178.00
29	459.89	184.13
30	467.52	190.59
31	474.87	197.37
32	481.92	204.46
33	488.65	211.86
34	495.06	219.53
35	501.14	227.48
36	506.86	235.68
37	507.35	236.45

Circle Center At X = 314.1 ; Y = 364.2 and Radius, 231.7

*** 1.822 ***
Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	213.16	164.00
2	221.80	158.97
3	230.70	154.40
4	239.81	150.28
5	249.12	146.64
6	258.61	143.49
7	268.25	140.82
8	278.01	138.65
9	287.87	136.99
10	297.81	135.83
11	307.78	135.18
12	317.78	135.05
13	327.78	135.43
14	337.74	136.33
15	347.64	137.73
16	357.45	139.64
17	367.16	142.05
18	376.73	144.95
19	386.13	148.35
20	395.36	152.22
21	404.36	156.55

22	413.14	161.35
23	421.66	166.59
24	429.90	172.26
25	437.83	178.34
26	445.44	184.83
27	452.71	191.69
28	459.62	198.92
29	466.15	206.50
30	472.28	214.40
31	478.00	222.60
32	481.20	227.73

Circle Center At X = 315.3 ; Y = 329.7 and Radius, 194.7

*** 1.823 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	218.42	164.00
2	227.07	158.98
3	235.97	154.42
4	245.10	150.34
5	254.44	146.76
6	263.95	143.67
7	273.61	141.09
8	283.40	139.04
9	293.28	137.50
10	303.23	136.49
11	313.21	136.01
12	323.21	136.06
13	333.20	136.64
14	343.14	137.75
15	353.00	139.39
16	362.76	141.55
17	372.40	144.23
18	381.88	147.41
19	391.18	151.09
20	400.27	155.26
21	409.12	159.91
22	417.72	165.02
23	426.03	170.58
24	434.03	176.57
25	441.71	182.98
26	449.03	189.79
27	455.98	196.98
28	462.54	204.53
29	468.69	212.42
30	474.41	220.62
31	478.22	226.74

Circle Center At X = 317.3 ; Y = 324.2 and Radius, 188.2

*** 1.823 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	213.16	164.00
2	222.03	159.39
3	231.11	155.20
4	240.38	151.44
5	249.81	148.12
6	259.39	145.24
7	269.09	142.81
8	278.89	140.84
9	288.78	139.33
10	298.72	138.28
11	308.70	137.70
12	318.70	137.59
13	328.70	137.94
14	338.66	138.76
15	348.58	140.05

16	358.43	141.80
17	368.18	144.00
18	377.82	146.66
19	387.32	149.77
20	396.67	153.32
21	405.85	157.31
22	414.82	161.71
23	423.58	166.53
24	432.11	171.76
25	440.38	177.38
26	448.38	183.38
27	456.09	189.75
28	463.50	196.47
29	470.58	203.53
30	477.32	210.91
31	483.71	218.60
32	489.74	226.58
33	493.28	231.76

Circle Center At X = 316.1 ; Y = 351.4 and Radius, 213.8

*** 1.824 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	197.37	164.00
2	206.21	159.33
3	215.23	155.01
4	224.41	151.05
5	233.74	147.46
6	243.21	144.24
7	252.80	141.40
8	262.50	138.95
9	272.28	136.88
10	282.14	135.21
11	292.06	133.92
12	302.02	133.04
13	312.01	132.55
14	322.00	132.45
15	332.00	132.76
16	341.98	133.46
17	351.92	134.55
18	361.80	136.05
19	371.62	137.93
20	381.36	140.20
21	391.00	142.86
22	400.53	145.90
23	409.93	149.31
24	419.19	153.10
25	428.28	157.25
26	437.21	161.75
27	445.95	166.61
28	454.49	171.82
29	462.81	177.36
30	470.91	183.22
31	478.77	189.40
32	486.38	195.89
33	493.73	202.68
34	500.79	209.76
35	507.58	217.11
36	514.06	224.72
37	520.24	232.58
38	524.15	238.00

Circle Center At X = 319.3 ; Y = 383.9 and Radius, 251.5

*** 1.825 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	197.37	164.00

2	206.22	159.35
3	215.26	155.06
4	224.45	151.13
5	233.79	147.57
6	243.27	144.38
7	252.87	141.57
8	262.57	139.14
9	272.36	137.10
10	282.22	135.45
11	292.14	134.19
12	302.10	133.32
13	312.09	132.85
14	322.09	132.78
15	332.09	133.11
16	342.06	133.83
17	352.00	134.95
18	361.89	136.46
19	371.70	138.36
20	381.44	140.64
21	391.07	143.32
22	400.60	146.37
23	409.99	149.80
24	419.24	153.60
25	428.33	157.76
26	437.25	162.28
27	445.99	167.15
28	454.52	172.36
29	462.84	177.91
30	470.94	183.78
31	478.79	189.97
32	486.39	196.47
33	493.73	203.26
34	500.80	210.34
35	507.57	217.69
36	514.06	225.30
37	520.23	233.17
38	523.72	238.00

Circle Center At X = 318.9 ; Y = 384.7 and Radius, 251.9

*** 1.825 ***

PHASE EMB 5 DS STATIC

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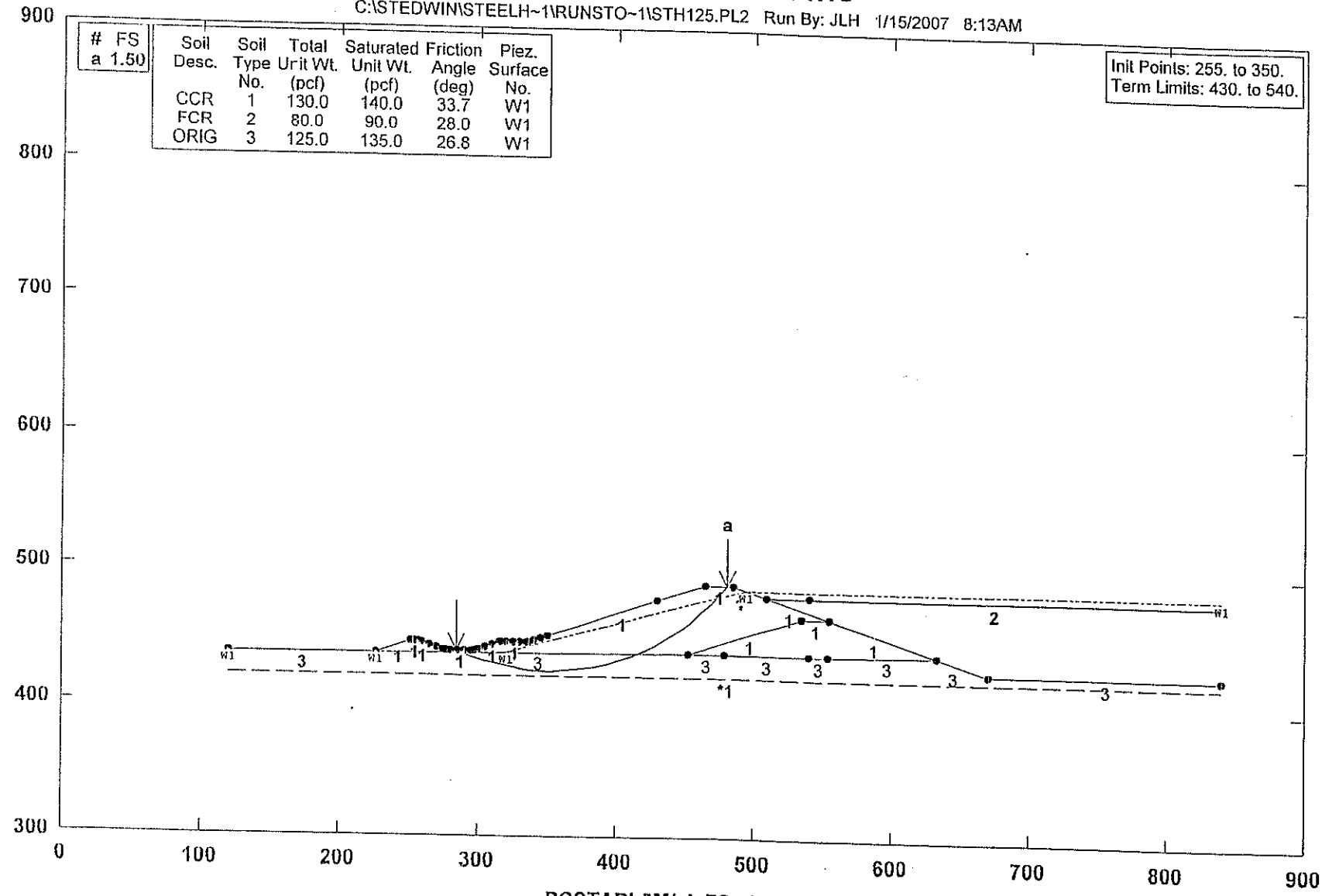


PCSTABL5M/si FSmin=1.50

Safety Factors Are Calculated By The Modified Bishop Method

STED



R17159

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 1/15/2007
Time of Run: 8:13AM
Run By: JLH
Input Data Filename: C:sth125.
Output Filename: C:sth125.OUT
Unit: ENGLISH
Plotted Output Filename: C:sth125.PLT
PROBLEM DESCRIPTION PHASE EMB 5 DS STATIC
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

11 Top Boundaries
22 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	120.00	136.00	226.50	136.40	3
2	226.50	136.40	252.20	145.00	1
3	252.20	145.00	257.20	145.00	1
4	257.20	145.00	276.70	138.50	1
5	276.70	138.50	296.70	138.50	1
6	296.70	138.50	316.20	145.00	1
7	316.20	145.00	336.20	145.00	1
8	336.20	145.00	465.20	188.00	1
9	465.20	188.00	485.20	188.00	1
10	485.20	188.00	509.20	180.00	1
11	509.20	180.00	840.00	180.00	2
12	226.50	136.40	452.70	137.80	3
13	509.20	180.00	554.20	165.00	1
14	452.70	137.80	534.20	165.00	1
15	452.70	137.80	478.80	138.00	3
16	534.20	165.00	554.20	165.00	1
17	478.80	138.00	539.40	138.00	3
18	539.40	138.00	553.30	138.00	3
19	554.20	165.00	632.90	138.70	1
20	553.30	138.00	632.90	138.70	3
21	632.90	138.70	671.20	126.00	3
22	671.20	126.00	840.00	126.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	120.00	136.00
2	226.50	136.40
3	320.00	137.20
4	494.20	185.00
5	840.00	185.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	120.00	121.00	840.00	120.00

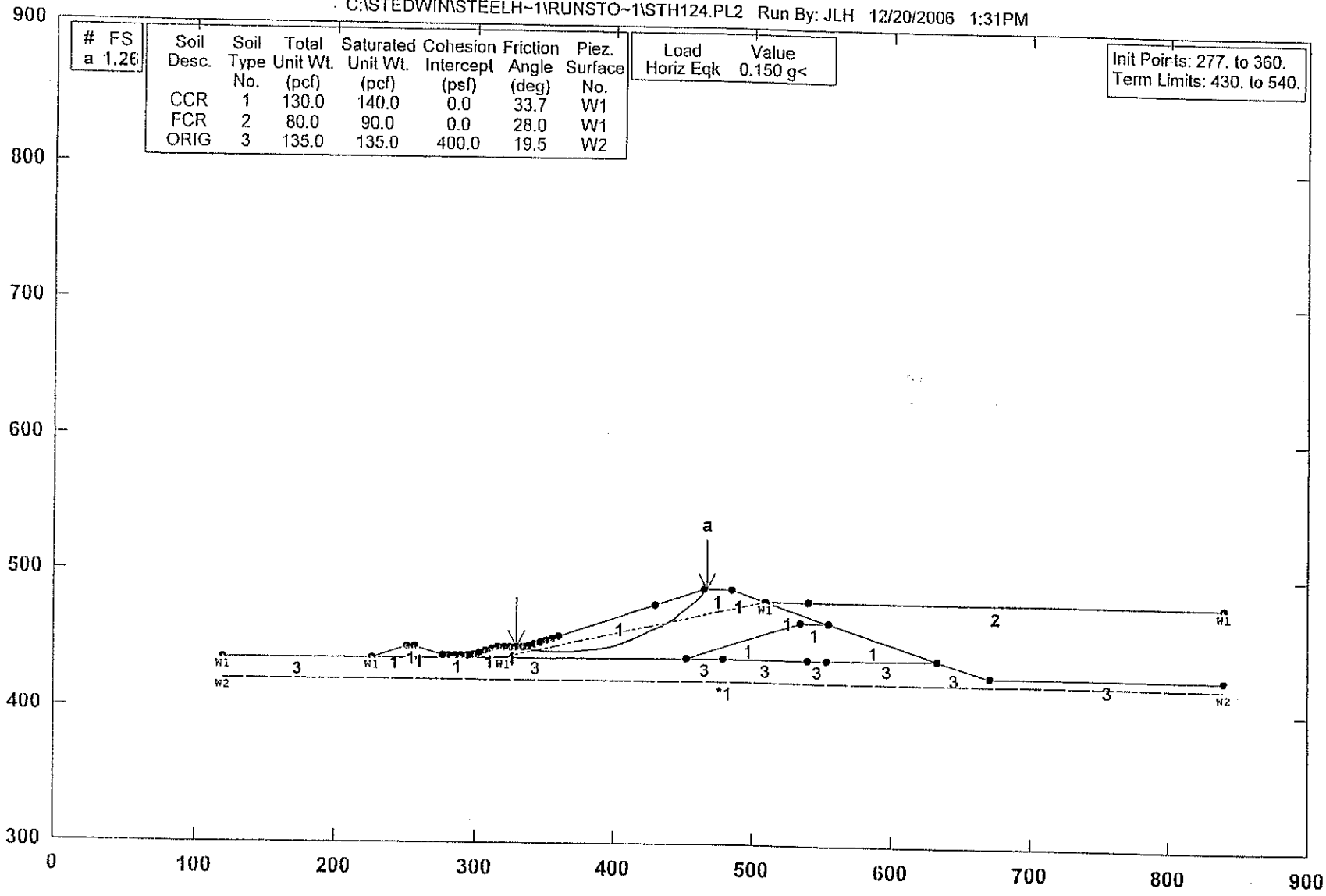
A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Horizontal Earthquake Loading Coefficient
Of .000 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 255.00 ft.
and X = 350.00 ft.
Each Surface Terminates Between X = 430.00 ft.
and X = 540.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =100.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	285.00	138.50
2	294.24	134.67
3	303.69	131.41
4	313.33	128.75
5	323.12	126.69
6	333.01	125.23
7	342.97	124.39
8	352.97	124.16
9	362.96	124.55
10	372.91	125.56
11	382.78	127.18
12	392.53	129.41
13	402.12	132.23
14	411.52	135.64
15	420.69	139.63
16	429.60	144.17
17	438.21	149.26
18	446.49	154.86
19	454.41	160.97
20	461.94	167.55
21	469.04	174.59
22	475.70	182.05
23	480.38	188.00

Circle Center At X = 351.6 ; Y = 286.1 and Radius, 161.9
*** 1.503 ***

PHASE 5 EMB DS SEISMIC

C:\STEDWIN\STEELH~1\RUNSTO~1\STH124.PL2 Run By: JLH 12/20/2006 1:31PM



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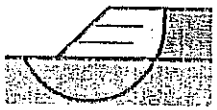
Safety Factors Are Calculated By The Modified Bishop Method

STED



209

R17162

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 12/20/2006
Time of Run: 1:31PM
Run By: JLH
Input Data Filename: C:sth124.
Output Filename: C:sth124.OUT
Unit: ENGLISH
Plotted Output Filename: C:sth124.PLT
PROBLEM DESCRIPTION PHASE 5 EMB DS SEISMIC
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

11 Top Boundaries
22 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	120.00	136.00	226.50	136.40	3
2	226.50	136.40	252.20	145.00	1
3	252.20	145.00	257.20	145.00	1
4	257.20	145.00	276.70	138.50	1
5	276.70	138.50	296.70	138.50	1
6	296.70	138.50	316.20	145.00	1
7	316.20	145.00	336.20	145.00	1
8	336.20	145.00	465.20	188.00	1
9	465.20	188.00	485.20	188.00	1
10	485.20	188.00	509.20	180.00	1
11	509.20	180.00	840.00	180.00	2
12	226.50	136.40	452.70	137.80	3
13	509.20	180.00	554.20	165.00	1
14	452.70	137.80	534.20	165.00	1
15	452.70	137.80	478.80	138.00	3
16	534.20	165.00	554.20	165.00	1
17	478.80	138.00	539.40	138.00	3
18	539.40	138.00	553.30	138.00	3
19	554.20	165.00	632.90	138.70	1
20	553.30	138.00	632.90	138.70	3
21	632.90	138.70	671.20	126.00	3
22	671.20	126.00	840.00	126.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	135.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	120.00	136.00
2	226.50	136.40
3	320.00	137.20
4	509.20	180.00
5	840.00	180.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	120.00	121.00
2	840.00	120.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	120.00	121.00	840.00	120.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 277.00 ft.
and X = 360.00 ft.
Each Surface Terminates Between X = 430.00 ft.
and X = 540.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =100.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.42	145.00
2	339.25	143.13
3	349.18	141.95
4	359.16	141.45
5	369.16	141.65
6	379.12	142.53
7	389.00	144.10
8	398.74	146.34
9	408.31	149.26
10	417.65	152.82
11	426.73	157.02
12	435.49	161.84
13	443.90	167.25
14	451.92	173.23
15	459.50	179.75
16	466.62	186.77
17	467.70	188.00

Circle Center At X = 361.4 ; Y = 286.3 and Radius, 144.9
*** 1.259 ***

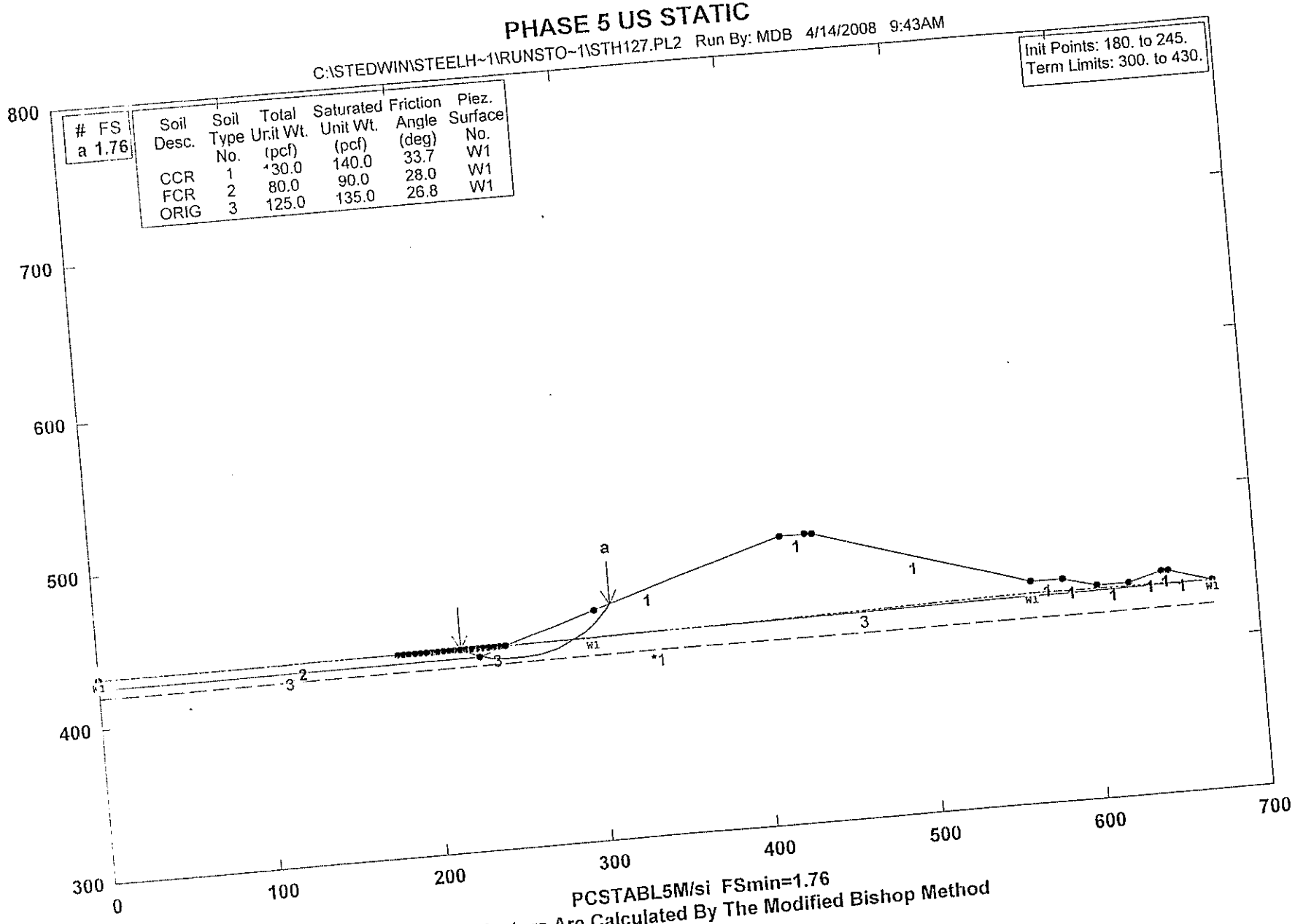
PHASE 5 US STATIC

C:\STEDWIN\STEELH~1\RUNSTO~1\STH127.PL2 Run By: MDB 4/14/2008 9:43AM

Init Points: 180. to 245.
Term Limits: 300. to 430.

#	FS
a	1.76

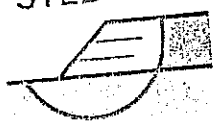
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	*130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
ORIG	3	125.0	135.0	26.8	W1



PCSTABL5M/si FSmin=1.76

Safety Factors Are Calculated By The Modified Bishop Method

STED



R17165

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4/15/2008
Time of Run: 2:55PM
Run By: MDB
Input Data Filename: C:sth127.
Output Filename: C:sth127.OUT
Unit: ENGLISH
Plotted Output Filename: C:sth127.PLT
PROBLEM DESCRIPTION PHASE 5 US STATIC
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

10 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	132.00	245.00	132.00	2
2	245.00	132.00	414.70	188.00	1
3	414.70	188.00	434.70	188.00	1
4	434.70	188.00	563.70	145.00	1
5	563.70	145.00	583.70	145.00	1
6	583.70	145.00	603.20	138.50	1
7	603.20	138.50	623.20	138.50	1
8	623.20	138.50	642.70	145.00	1
9	642.70	145.00	647.70	145.00	1
10	647.70	145.00	673.40	136.40	1
11	.00	126.00	228.70	126.00	3
12	228.70	126.00	245.00	132.00	3
13	245.00	132.00	673.40	136.40	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	132.00
2	297.70	132.00
3	563.70	137.00
4	673.40	136.40

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	120.00	673.40	121.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Horizontal Earthquake Loading Coefficient
Of .000 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 180.00 ft.
and X = 245.00 ft.

Each Surface Terminates Between X = 300.00 ft.
and X = 430.00 ft.

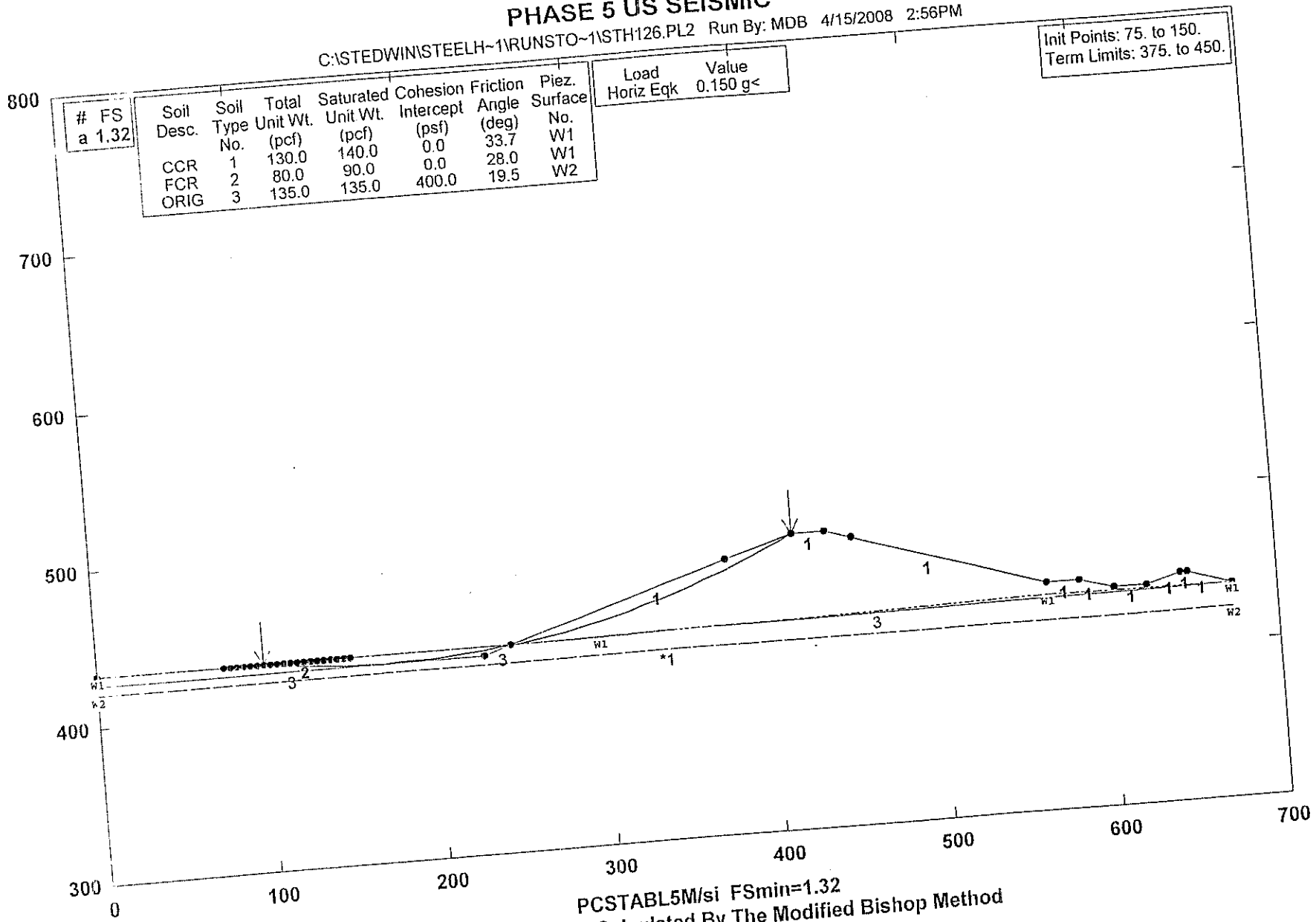
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =100.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	217.63	132.00
2	226.71	127.82
3	236.29	124.95
4	246.18	123.45
5	256.18	123.35
6	266.10	124.65
7	275.73	127.33
8	284.89	131.34
9	293.40	136.59
10	301.10	142.98
11	307.82	150.38
12	309.87	153.41

Circle Center At X = 251.8 ; Y = 194.1 and Radius, 70.9
*** 1.762 ***

PHASE 5 US SEISMIC

C:\STEDWIN\STEELH~1\RUNSTO~1\STH126.PL2 Run By: MDB 4/15/2008 2:56PM



PCSTABL5M/si FSmin=1.32

Safety Factors Are Calculated By The Modified Bishop Method

STED

R17168

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4/15/2008
Time of Run: 2:56PM
Run By: MDB
Input Data Filename: C:sth126.
Output Filename: C:sth126.OUT
Unit: ENGLISH
Plotted Output Filename: C:sth126.PLT
PROBLEM DESCRIPTION PHASE 5 US SEISMIC
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 300.00 to Y-values listed.

10 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	132.00	245.00	132.00	2
2	245.00	132.00	414.70	188.00	1
3	414.70	188.00	434.70	188.00	1
4	434.70	188.00	563.70	145.00	1
5	563.70	145.00	583.70	145.00	1
6	583.70	145.00	603.20	138.50	1
7	603.20	138.50	623.20	138.50	1
8	623.20	138.50	642.70	145.00	1
9	642.70	145.00	647.70	145.00	1
10	647.70	145.00	673.40	136.40	1
11	.00	126.00	228.70	126.00	3
12	228.70	126.00	245.00	132.00	3
13	245.00	132.00	673.40	136.40	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	135.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	132.00
2	297.70	132.00
3	563.70	137.00
4	673.40	136.40

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	120.00
2	673.40	121.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	120.00	673.40	121.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 75.00 ft.
and X = 150.00 ft.
Each Surface Terminates Between X = 375.00 ft.
and X = 450.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =100.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 34 Coordinate Points

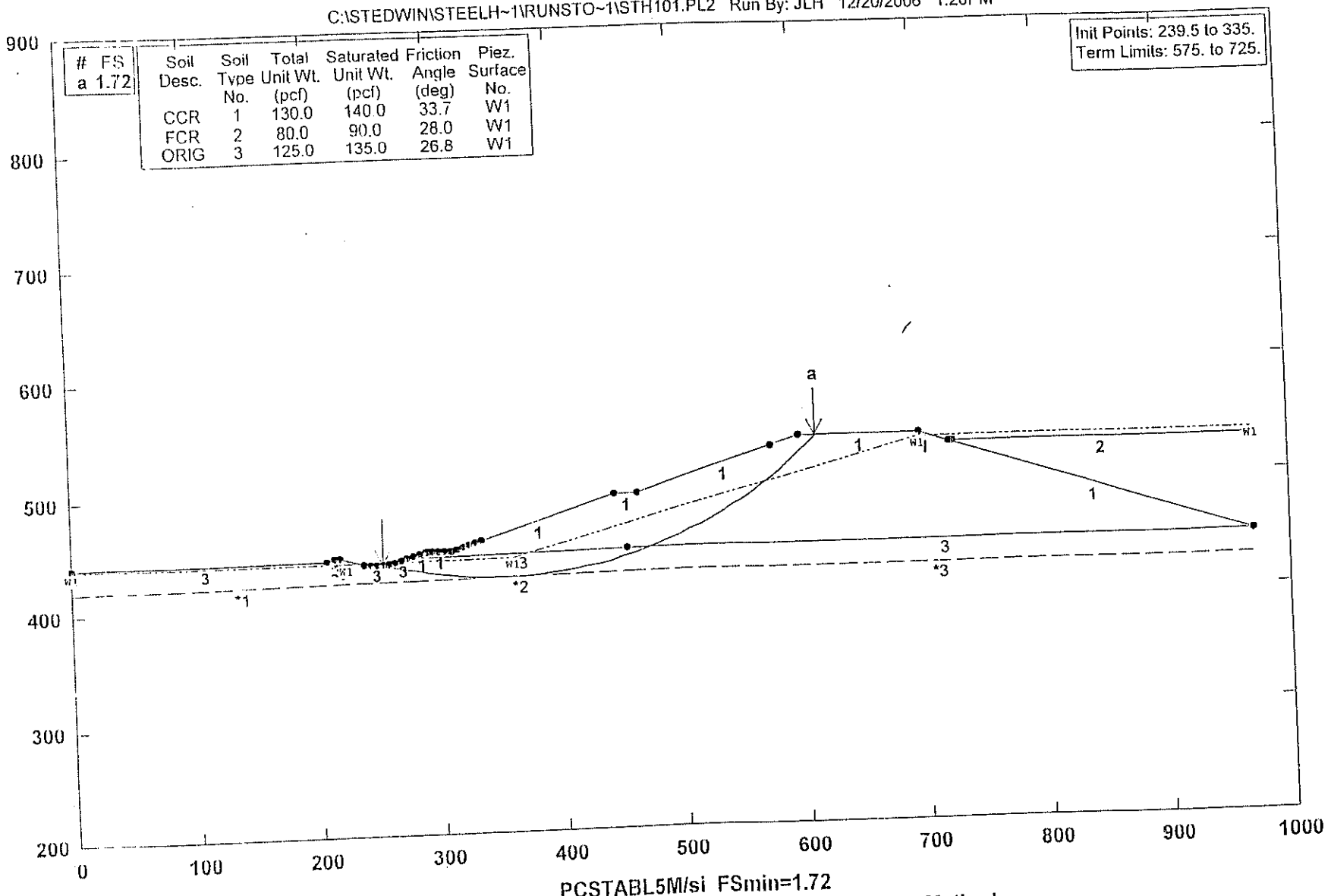
Point No.	X-Surf (ft)	Y-Surf (ft)
1	98.68	132.00
2	108.59	130.66
3	118.53	129.50
4	128.48	128.55
5	138.45	127.79
6	148.44	127.22
7	158.43	126.85
8	168.43	126.68
9	178.43	126.70
10	188.43	126.91
11	198.42	127.32
12	208.40	127.93
13	218.37	128.73
14	228.32	129.73
15	238.25	130.92
16	248.15	132.30
17	258.02	133.88
18	267.87	135.65
19	277.67	137.62
20	287.44	139.77
21	297.16	142.12
22	306.83	144.65
23	316.45	147.38
24	326.02	150.29
25	335.53	153.38
26	344.97	156.67
27	354.35	160.13
28	363.66	163.78
29	372.90	167.62
30	382.06	171.63
31	391.14	175.82
32	400.14	180.18
33	409.05	184.72
34	415.17	188.00

Circle Center At X = 172.4 ; Y = 637.8 and Radius, 511.1
*** 1.322 ***

SECT D-D

PHASE 7 EMB DS STATIC

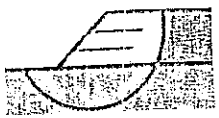
C:\STEDWIN\STEELH~1\RUNSTO~1\STH101.PL2 Run By: JLH 12/20/2006 1:20PM



PCSTABL5M/si FSmin=1.72

Safety Factors Are Calculated By The Modified Bishop Method

STED



Q14

R17171

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 12/20/2006
Time of Run: 1:20PM
Run By: JLH
Input Data Filename: C:sth101.
Output Filename: C:sth101.OUT
Unit: ENGLISH
Plotted Output Filename: C:sth101.PLT
PROBLEM DESCRIPTION PHASE 7 EMB DS STATIC
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 200.00 to Y-values listed.

14 Top Boundaries
17 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	241.00	208.60	242.90	3
2	208.60	242.90	214.90	245.00	3
3	214.90	245.00	219.90	245.00	3
4	219.90	245.00	239.40	238.50	3
5	239.40	238.50	259.40	238.50	3
6	259.40	238.50	274.40	243.40	3
7	274.40	243.40	291.00	249.00	1
8	291.00	249.00	311.00	249.00	1
9	311.00	249.00	445.10	293.70	1
10	445.10	293.70	465.10	293.50	1
11	465.10	293.50	597.90	338.00	1
12	597.90	338.00	697.90	338.00	1
13	697.90	338.00	721.90	330.00	1
14	721.90	330.00	970.70	330.00	2
15	274.40	243.40	455.30	246.00	3
16	721.90	330.00	970.70	247.00	1
17	455.30	246.00	970.70	247.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	60.0	90.0	.0	28.0	.00	.0	1
3	125.0	135.0	.0	26.8	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	240.00
2	225.00	240.00
3	360.00	242.00
4	696.70	335.00
5	970.71	335.00

Searching Routine Will Be Limited To An Area Defined By 3 Boundaries
Of Which The First 3 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	220.00	277.00	223.00
2	277.00	223.00	455.00	226.00
3	455.00	226.00	970.00	227.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient

Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Horizontal Earthquake Loading Coefficient
Of .000 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 239.50 ft.
and X = 335.00 ft.
Each Surface Terminates Between X = 575.00 ft.
and X = 725.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =200.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	254.58	238.50
2	264.21	235.82
3	273.92	233.43
4	283.70	231.30
5	293.52	229.46
6	303.40	227.90
7	313.32	226.63
8	323.27	225.63
9	333.25	224.92
10	343.24	224.50
11	353.24	224.36
12	363.23	224.51
13	373.23	224.94
14	383.20	225.66
15	393.15	226.66
16	403.07	227.94
17	412.94	229.51
18	422.77	231.36
19	432.54	233.49
20	442.25	235.89
21	451.88	238.58
22	461.43	241.53
23	470.90	244.76
24	480.27	248.26
25	489.53	252.02
26	498.69	256.05
27	507.72	260.33
28	516.63	264.87
29	525.41	269.67
30	534.04	274.71
31	542.53	280.00
32	550.86	285.52
33	559.04	291.29
34	567.04	297.28
35	574.87	303.50
36	582.52	309.94
37	589.98	316.60
38	597.25	323.47
39	604.32	330.54
40	611.19	337.81
41	611.36	338.00

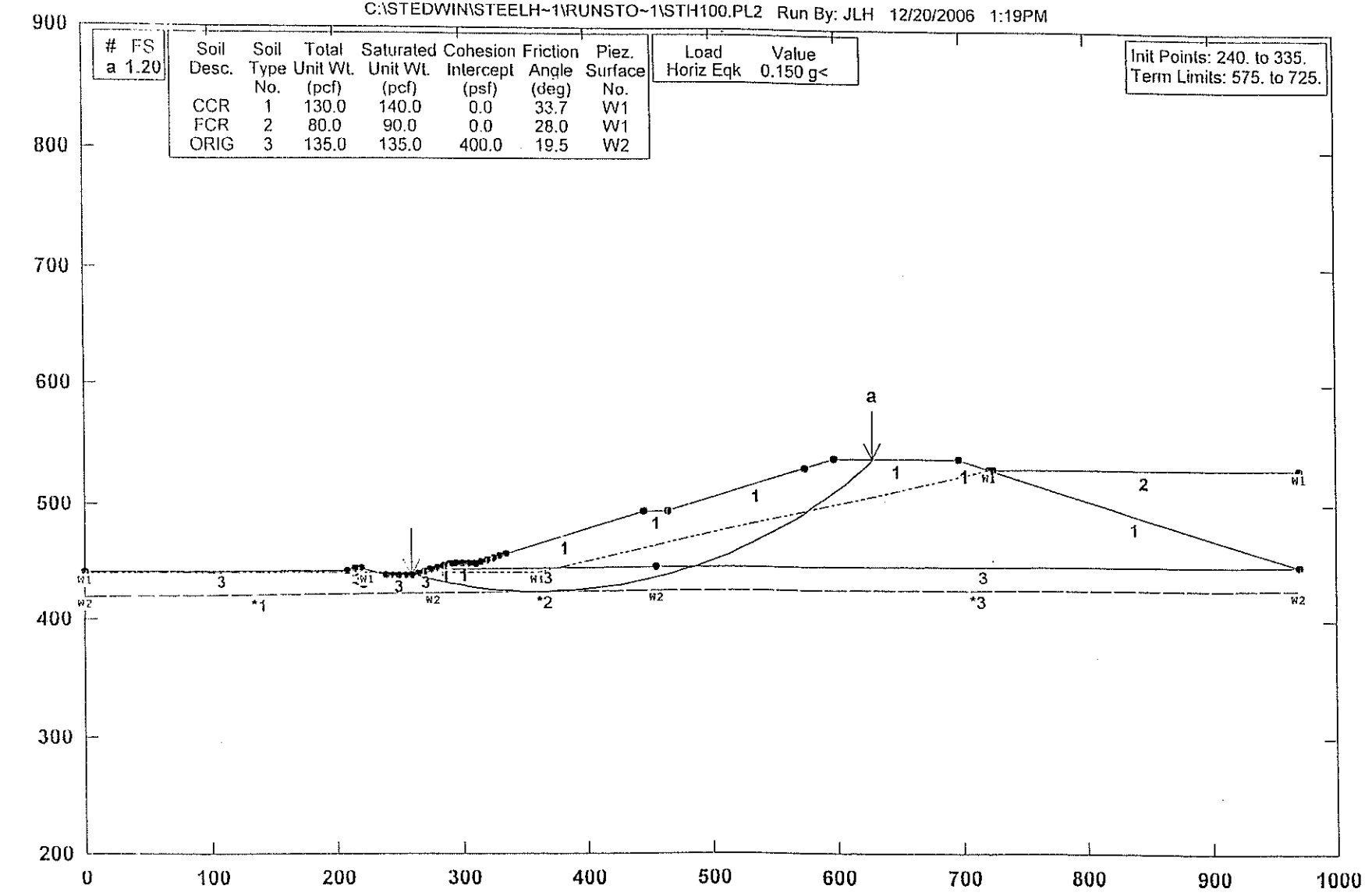
Circle Center At X = 353.1 ; Y = 574.7 and Radius, 350.3

*** 1.717 ***

Sect. D-D

PHASE 7 EMB DS SEISMIC

C:\STEDWIN\STEELH~1\RUNSTO~1\STH100.PL2 Run By: JLH 12/20/2006 1:19PM



PCSTABL5M/si FSmin=1.20

Safety Factors Are Calculated By The Modified Bishop Method

STED

222

R17175

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 12/20/2006
Time of Run: 1:19PM
Run By: JLH
Input Data Filename: C:sth100.
Output Filename: C:sth100.OUT
Unit: ENGLISH
Plotted Output Filename: C:sth100.PLT
PROBLEM DESCRIPTION PHASE 7 EMB DS SEISMIC
BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 200.00 to Y-values listed.

14 Top Boundaries
17 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	241.00	208.60	242.90	3
2	208.60	242.90	214.90	245.00	3
3	214.90	245.00	219.90	245.00	3
4	219.90	245.00	239.40	238.50	3
5	239.40	238.50	259.40	238.50	3
6	259.40	238.50	274.40	243.40	3
7	274.40	243.40	291.00	249.00	1
8	291.00	249.00	311.00	249.00	1
9	311.00	249.00	445.10	293.70	1
10	445.10	293.70	465.10	293.50	1
11	465.10	293.50	597.90	338.00	1
12	597.90	338.00	697.90	338.00	1
13	697.90	338.00	721.90	330.00	1
14	721.90	330.00	970.70	330.00	2
15	274.40	243.40	455.30	246.00	3
16	721.90	330.00	970.70	247.00	1
17	455.30	246.00	970.70	247.00	3

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	135.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	240.00
2	225.00	242.00
3	360.00	242.00
4	721.90	330.00
5	970.71	330.00

Piezometric Surface No. 2 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	220.00
2	277.00	223.00
3	455.00	226.00
4	970.00	227.00

Searching Routine Will Be Limited To An Area Defined By 3 Boundaries
Of Which The First 3 Boundaries Will Deflect Surfaces Upward

Boundary	X-Left	Y-Left	X-Right	Y-Right

No.	(ft)	(ft)	(ft)	(ft)
1	.00	220.00	277.00	223.00
2	277.00	223.00	455.00	226.00
3	455.00	226.00	970.00	227.00

A Horizontal Earthquake Loading Coefficient
Of .150 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned
Cavitation Pressure = .0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 240.00 ft.
and X = 335.00 ft.
Each Surface Terminates Between X = 575.00 ft.
and X = 725.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =200.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	260.00	238.70
2	269.67	236.13
3	279.40	233.82
4	289.18	231.78
5	299.02	229.99
6	308.91	228.48
7	318.83	227.22
8	328.78	226.23
9	338.75	225.51
10	348.74	225.06
11	358.74	224.87
12	368.74	224.96
13	378.74	225.30
14	388.72	225.92
15	398.68	226.81
16	408.61	227.96
17	418.51	229.37
18	428.37	231.05
19	438.18	232.99
20	447.93	235.20
21	457.62	237.66
22	467.24	240.39
23	476.79	243.37
24	486.25	246.60
25	495.63	250.09
26	504.90	253.83
27	514.07	257.81
28	523.14	262.04
29	532.08	266.51
30	540.90	271.21
31	549.60	276.16
32	558.16	281.33
33	566.57	286.73
34	574.84	292.35
35	582.96	298.19
36	590.92	304.25
37	598.71	310.52
38	606.33	316.99
39	613.77	323.67
40	621.04	330.54

```
   41          628.11        337.61
   42          628.49        338.00
Circle Center At X =   360.7 ; Y =   598.4   and Radius,   373.5
      ***      1.203    ***
```

SC ON D-D

PHASE 7 EMB US STATIC

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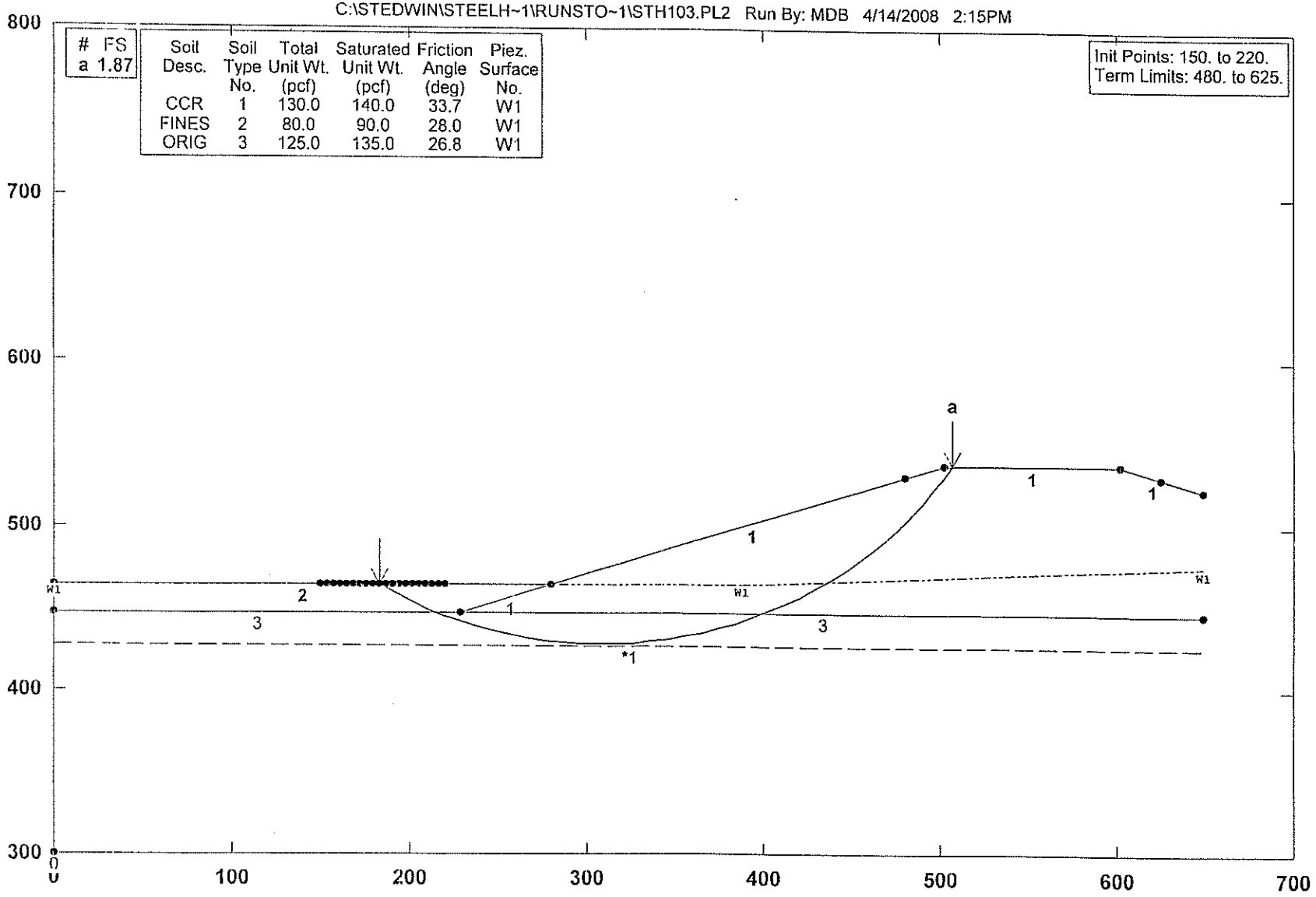

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	33.7	W1
FINES	2	80.0	90.0	28.0	W1
ORIG	3	125.0	135.0	26.8	W1

PCSTABL5M/si FSmin=1.87

Safety Factors Are Calculated By The Modified Bishop Method

STED

226

R17179

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                    ** PCSTABL5M **
                          by
                    Purdue University
               --Slope Stability Analysis--
            Simplified Janbu, Simplified Bishop
               or Spencer`s Method of Slices
 Run Date:                    4/15/2008
 Time of Run:                 2:50PM
 Run By:                      MDB
 Input Data Filename:         C:sth103.
 Output Filename:             C:sth103.OUT
 Unit:                        ENGLISH
 Plotted Output Filename:     C:sth103.PLT
 PROBLEM DESCRIPTION    PHASE 7 EMB US STATIC
 BOUNDARY COORDINATES
      Note: User origin value specified.
      Add 0.00 to X-values and 300.00 to Y-values listed.

     4 Top   Boundaries
     8 Total Boundaries
 Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
    No.        (ft)       (ft)       (ft)       (ft)    Below Bnd
     1          .00     164.00     280.00     164.00        2
     2       280.00     164.00     502.00     238.00        1
     3       502.00     238.00     602.00     238.00        1
     4       602.00     238.00     649.00     222.00        1
     5          .00     147.00     229.00     147.00        3
     6       229.00     147.00     280.00     164.00        1
     7       229.00     147.00     649.00     146.00        3
     8          .00        .00        .00        .00        0
ISOTROPIC SOIL PARAMETERS
  3 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.   (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)    No.
   1   130.0    140.0       .0      33.7     .00        .0      1
   2    80.0     90.0       .0      28.0     .00        .0      1
   3   125.0    135.0       .0      26.8     .00        .0      1
 1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
 Unit Weight of Water =  62.40
 Piezometric Surface No.  1 Specified by  3 Coordinate Points
   Point      X-Water     Y-Water
    No.         (ft)        (ft)
     1          .00      164.00
     2       388.00      164.00
     3       649.00      175.00
Searching Routine Will Be Limited To An Area Defined By  1 Boundaries
 Of Which The First  1 Boundaries Will Deflect Surfaces Upward
 Boundary     X-Left     Y-Left    X-Right    Y-Right
    No.        (ft)       (ft)       (ft)       (ft)
     1          .00     127.00     649.00     126.00
 A Horizontal Earthquake Loading Coefficient
 Of .150 Has Been Assigned
 A Vertical Earthquake Loading Coefficient
 Of .000 Has Been Assigned
 Cavitation Pressure =      .0 (psf)
 A Horizontal Earthquake Loading Coefficient
 Of .000 Has Been Assigned
 A Vertical Earthquake Loading Coefficient
 Of .000 Has Been Assigned
 Cavitation Pressure =      .0 (psf)
 A Critical Failure Surface Searching Method, Using A Random
 Technique For Generating Circular Surfaces, Has Been Specified.
 400 Trial Surfaces Have Been Generated.
  20 Surfaces Initiate From Each Of 20 Points Equally Spaced
 Along The Ground Surface Between  X = 150.00 ft.
                             and  X = 220.00 ft.
```

Each Surface Terminates Between X = 480.00 ft.
and X = 625.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =100.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 38 Coordinate Points

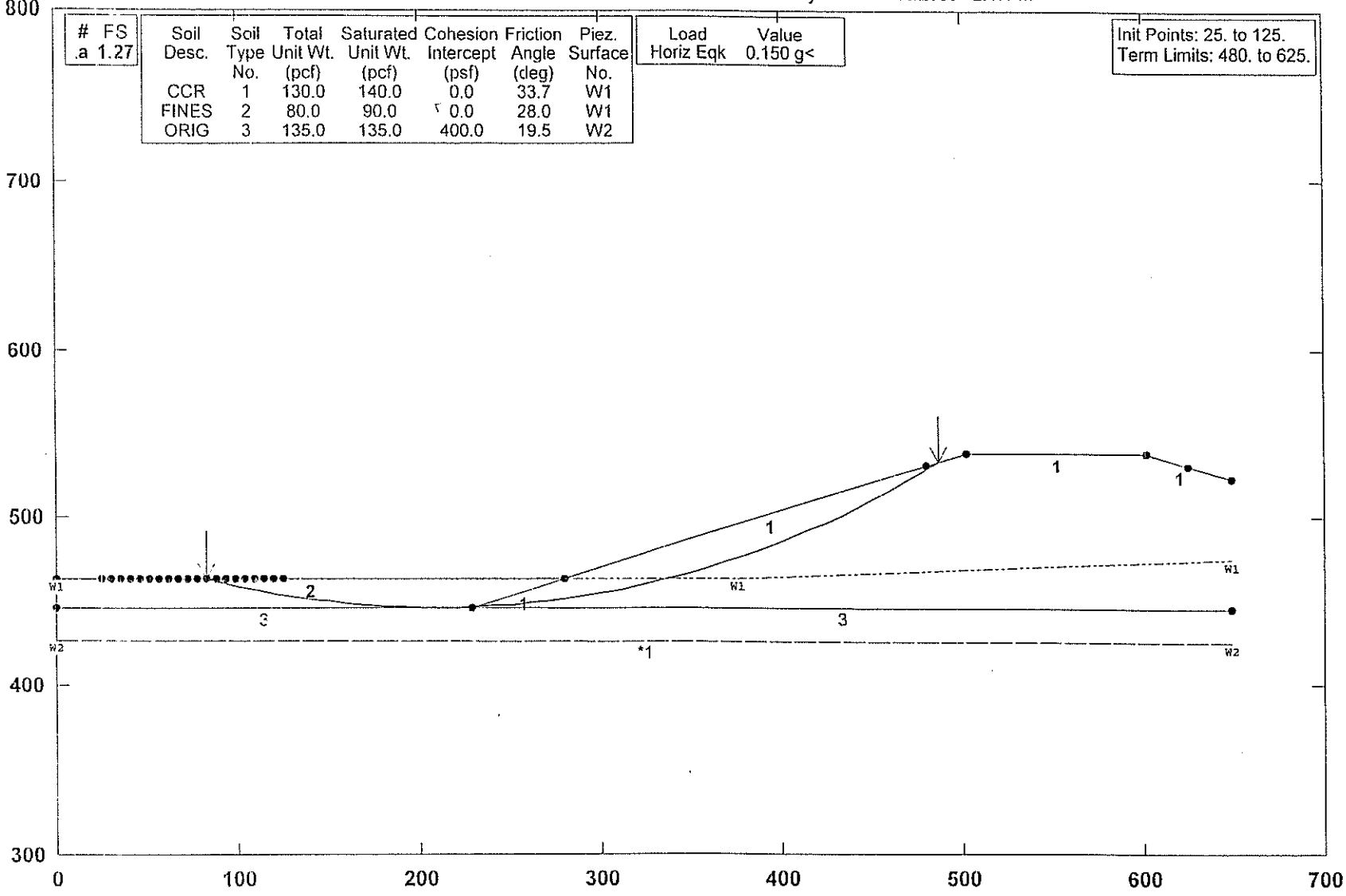
Point No.	X-Surf (ft)	Y-Surf (ft)
1	183.16	164.00
2	191.72	158.84
3	200.50	154.05
4	209.48	149.64
5	218.63	145.61
6	227.95	141.99
7	237.41	138.76
8	247.01	135.94
9	256.71	133.53
10	266.51	131.54
11	276.39	129.97
12	286.32	128.82
13	296.30	128.10
14	306.29	127.81
15	316.29	127.94
16	326.28	128.50
17	336.23	129.48
18	346.13	130.89
19	355.96	132.72
20	365.70	134.97
21	375.34	137.64
22	384.86	140.71
23	394.23	144.19
24	403.45	148.06
25	412.50	152.33
26	421.35	156.98
27	430.00	162.00
28	438.43	167.38
29	446.61	173.12
30	454.55	179.21
31	462.22	185.63
32	469.60	192.37
33	476.69	199.42
34	483.48	206.77
35	489.94	214.40
36	496.08	222.30
37	501.86	230.45
38	506.75	238.00

Circle Center At X = 308.2 ; Y = 361.8 and Radius, 234.0
*** 1.867 ***

SEC N

PHASE 7 EMB US SEISMIC

C:\STEDWIN\STEELH~1\RUNSTO~1\STH102.PL2 Run By: MDB 4/15/2008 2:47PM



#	FS
.a	1.27

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR	1	130.0	140.0	0.0	33.7	W1
FINES	2	80.0	90.0	0.0	28.0	W1
ORIG	3	135.0	135.0	400.0	19.5	W2

Load	Value
Horiz Eqk	0.150 g<

Init Points: 25. to 125.
Term Limits: 480. to 625.

PCSTABL5M/si FSmin=1.27

Safety Factors Are Calculated By The Modified Bishop Method

STED

229

R17182

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                    ** PCSTABL5M **
                          by
                    Purdue University
               --Slope Stability Analysis--
            Simplified Janbu, Simplified Bishop
              or Spencer`s Method of Slices
 Run Date:                  4/15/2008
 Time of Run:               2:47PM
 Run By:                    MDB
 Input Data Filename:       C:sth102.
 Output Filename:           C:sth102.OUT
 Unit:                      ENGLISH
 Plotted Output Filename:   C:sth102.PLT
 PROBLEM DESCRIPTION   PHASE 7 EMB US SEISMIC
 BOUNDARY COORDINATES
      Note: User origin value specified.
      Add 0.00 to X-values and 300.00 to Y-values listed.

     4 Top   Boundaries
     7 Total Boundaries
 Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
    No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
     1          .00     164.00      280.00     164.00        2
     2       280.00     164.00      502.00     238.00        1
     3       502.00     238.00      602.00     238.00        1
     4       602.00     238.00      649.00     222.00        1
     5          .00     147.00      229.00     147.00        3
     6       229.00     147.00      280.00     164.00        1
     7       229.00     147.00      649.00     146.00        3
ISOTROPIC SOIL PARAMETERS
  3 Type(s) of Soil
 Soil   Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.   (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)    No.
   1    130.0    140.0       .0      33.7     .00        .0      1
   2     80.0     90.0       .0      28.0     .00        .0      1
   3    135.0    135.0     400.0     19.5     .00        .0      2
 2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
 Unit Weight of Water =  62.40
 Piezometric Surface No.  1 Specified by  3 Coordinate Points
   Point      X-Water     Y-Water
    No.         (ft)        (ft)
     1          .00      164.00
     2       376.00      164.00
     3       649.00      175.00
 Piezometric Surface No.  2 Specified by  2 Coordinate Points
   Point      X-Water     Y-Water
    No.         (ft)        (ft)
     1          .00      127.00
     2       649.00      126.00
Searching Routine Will Be Limited To An Area Defined By  1 Boundaries
 Of Which The First  1 Boundaries Will Deflect Surfaces Upward
 Boundary     X-Left     Y-Left     X-Right    Y-Right
    No.        (ft)       (ft)       (ft)       (ft)
     1          .00     127.00      649.00     126.00
 A Horizontal Earthquake Loading Coefficient
 Of .150 Has Been Assigned
 A Vertical Earthquake Loading Coefficient
 Of .000 Has Been Assigned
 Cavitation Pressure =      .0 (psf)
 A Critical Failure Surface Searching Method, Using A Random
 Technique For Generating Circular Surfaces, Has Been Specified.
 400 Trial Surfaces Have Been Generated.
  20 Surfaces Initiate From Each Of 20 Points Equally Spaced
 Along The Ground Surface Between  X =  25.00 ft.
                                and  X = 125.00 ft.
 Each Surface Terminates Between   X = 480.00 ft.
```

and X = 625.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y =100.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 44 Coordinate Points

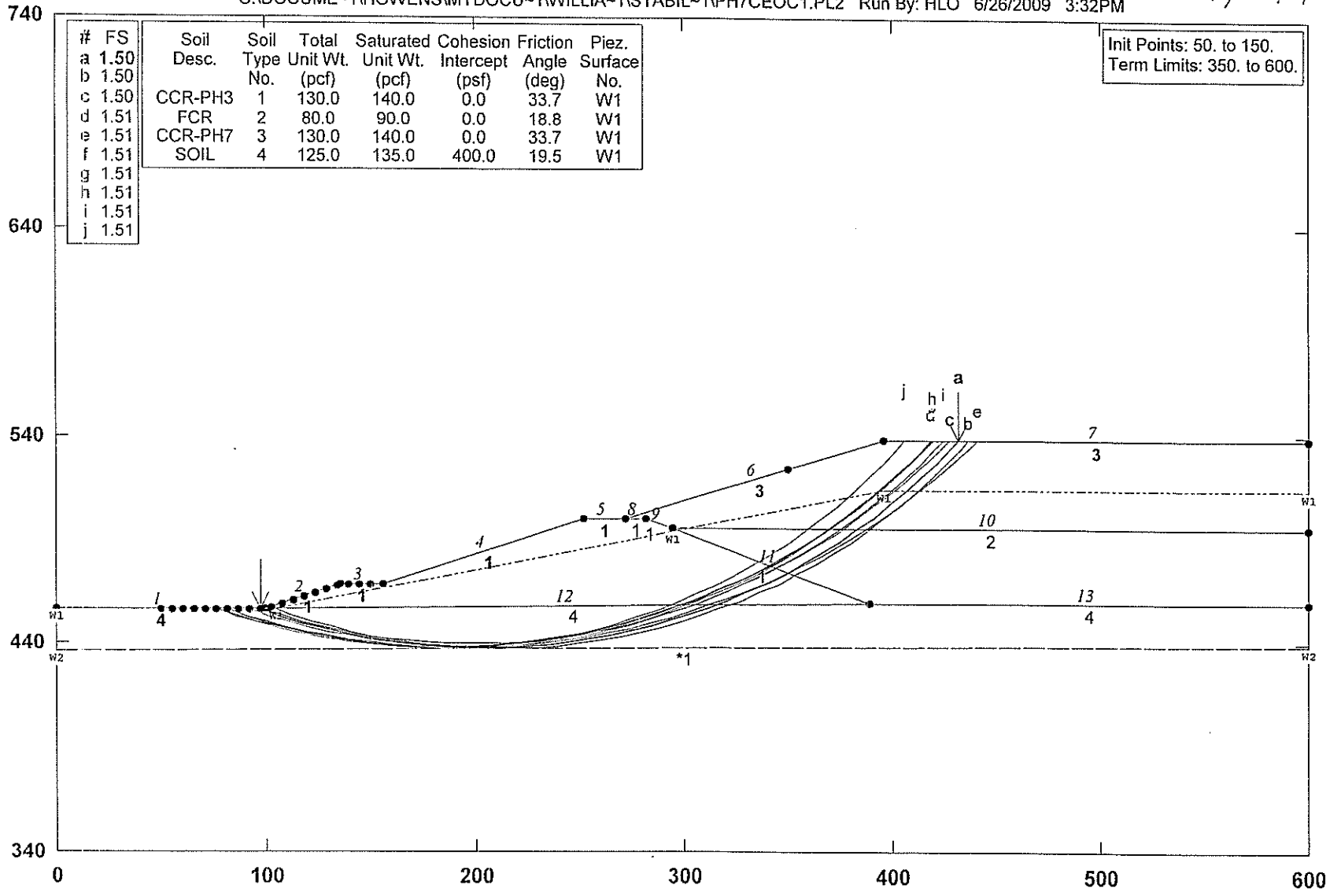
Point No.	X-Surf (ft)	Y-Surf (ft)
1	82.90	164.00
2	92.58	161.49
3	102.31	159.18
4	112.08	157.07
5	121.90	155.16
6	131.75	153.46
7	141.64	151.95
8	151.55	150.65
9	161.49	149.55
10	171.45	148.65
11	181.42	147.96
12	191.41	147.47
13	201.41	147.18
14	211.41	147.10
15	221.41	147.23
16	231.40	147.56
17	241.39	148.09
18	251.36	148.83
19	261.32	149.77
20	271.25	150.91
21	281.16	152.26
22	291.04	153.81
23	300.88	155.56
24	310.69	157.52
25	320.46	159.67
26	330.18	162.02
27	339.85	164.57
28	349.46	167.32
29	359.02	170.26
30	368.51	173.40
31	377.94	176.74
32	387.30	180.26
33	396.58	183.98
34	405.79	187.88
35	414.91	191.97
36	423.95	196.25
37	432.90	200.71
38	441.76	205.36
39	450.52	210.18
40	459.18	215.18
41	467.73	220.36
42	476.18	225.71
43	484.51	231.24
44	487.12	233.04

Circle Center At X = 210.3 ; Y = 635.8 and Radius, 488.7
*** 1.270 ***

PHASE 3/7C DOWNSTREAM EOC STATIC REFUSE DISPOSAL AREA NO. 2

MK 7/6/09

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH7CEOC1.PL2 Run By: HLO 6/26/2009 3:32PM



PCSTABL5M/si FSmin=1.50

Safety Factors Are Calculated By The Modified Bishop Method

STED



231

R17185

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 6/26/2009
Time of Run: 3:32PM
Run By: HLO
Input Data Filename: C:ph7ceoc1.
Output Filename: C:ph7ceoc1.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph7ceoc1.PLT
PROBLEM DESCRIPTION PHASE 3/7C DOWNSTREAM EOC STATIC
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 340.00 to Y-values listed.

7 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	116.00	100.00	116.00	4
2	100.00	116.00	136.00	128.00	1
3	136.00	128.00	156.00	128.00	1
4	156.00	128.00	252.00	160.00	1
5	252.00	160.00	272.00	160.00	1
6	272.00	160.00	396.00	198.00	3
7	396.00	198.00	600.00	198.00	3
8	272.00	160.00	282.00	160.00	1
9	282.00	160.00	295.00	155.00	1
10	295.00	155.00	600.00	155.00	2
11	295.00	155.00	389.00	119.00	1
12	100.00	116.00	389.00	119.00	4
13	389.00	119.00	600.00	119.00	4

ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	18.8	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	400.0	19.5	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	116.00
2	105.00	116.00
3	295.00	153.90
4	396.00	174.00
5	600.00	174.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	96.00
2	600.00	99.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	96.00	600.00	99.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 150.00 ft.
Each Surface Terminates Between X = 350.00 ft.
and X = 600.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 96.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.37	116.00
2	106.82	112.74
3	116.38	109.79
4	126.02	107.14
5	135.74	104.81
6	145.54	102.79
7	155.39	101.09
8	165.30	99.71
9	175.24	98.65
10	185.21	97.91
11	195.20	97.49
12	205.20	97.39
13	215.20	97.61
14	225.19	98.16
15	235.15	99.03
16	245.08	100.22
17	254.96	101.72
18	264.80	103.55
19	274.56	105.69
20	284.26	108.15
21	293.87	110.91
22	303.38	113.99
23	312.79	117.37
24	322.09	121.05
25	331.27	125.03
26	340.31	129.30
27	349.21	133.86
28	357.95	138.71
29	366.54	143.84
30	374.96	149.24
31	383.19	154.90
32	391.25	160.84
33	399.10	167.02
34	406.76	173.46
35	414.20	180.14
36	421.42	187.06
37	428.41	194.20
38	431.90	198.00

Circle Center At X = 203.2 ; Y = 407.5 and Radius, 310.2
*** 1.496 ***
Individual data on the 53 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.6	161.1	.0	78.8	.0	.0	.0	.0	.0
2	5.0	1735.3	.0	583.9	.0	.0	.0	.0	.0
3	.3	160.2	.0	48.1	.0	.0	.0	.0	.0
4	1.5	1033.1	.0	321.0	.0	.0	.0	.0	.0
5	9.6	11020.6	.0	3705.0	.0	.0	.0	.0	.0
6	9.6	18951.4	.0	6590.0	.0	.0	.0	.0	.0

7	9.7	26630.9	.0	9295.3	.0	.0	.0	.0	.0
8	.3	797.5	.0	277.1	.0	.0	.0	.0	.0
9	9.5	31249.5	.0	11540.8	.0	.0	.0	.0	.0
10	9.9	34898.6	.0	14155.3	.0	.0	.0	.0	.0
11	.6	2227.0	.0	939.4	.0	.0	.0	.0	.0
12	9.3	36965.2	.0	15365.5	.0	.0	.0	.0	.0
13	9.9	45442.6	.0	18264.8	.0	.0	.0	.0	.0
14	10.0	51280.5	.0	20032.6	.0	.0	.0	.0	.0
15	10.0	56670.4	.0	21606.7	.0	.0	.0	.0	.0
16	10.0	61587.9	.0	22985.3	.0	.0	.0	.0	.0
17	10.0	66011.6	.0	24167.2	.0	.0	.0	.0	.0
18	10.0	69923.4	.0	25150.9	.0	.0	.0	.0	.0
19	10.0	73308.3	.0	25935.5	.0	.0	.0	.0	.0
20	9.9	76154.9	.0	26520.3	.0	.0	.0	.0	.0
21	6.9	54682.8	.0	18809.3	.0	.0	.0	.0	.0
22	3.0	23581.9	.0	8095.2	.0	.0	.0	.0	.0
23	9.8	76846.9	.0	27087.8	.0	.0	.0	.0	.0
24	7.2	54775.0	.0	19977.7	.0	.0	.0	.0	.0
25	2.6	19272.8	.0	7092.2	.0	.0	.0	.0	.0
26	7.4	56240.9	.0	20627.6	.0	.0	.0	.0	.0
27	2.3	17153.0	.0	6223.6	.0	.0	.0	.0	.0
28	9.6	73245.7	.0	26431.4	.0	.0	.0	.0	.0
29	1.1	8652.0	.0	3111.6	.0	.0	.0	.0	.0
30	1.9	14391.6	.0	5167.6	.0	.0	.0	.0	.0
31	3.6	27484.9	.0	9864.4	.0	.0	.0	.0	.0
32	2.9	21378.7	.0	7668.6	.0	.0	.0	.0	.0
33	9.4	69050.4	.0	24989.7	.0	.0	.0	.0	.0
34	2.2	15636.1	.0	5713.0	.0	.0	.0	.0	.0
35	7.1	50069.7	.0	18255.0	.0	.0	.0	.0	.0
36	9.2	61843.5	.0	22748.5	.0	.0	.0	.0	.0
37	9.0	57596.0	.0	21332.5	.0	.0	.0	.0	.0
38	8.9	53000.5	.0	19721.2	.0	.0	.0	.0	.0
39	.4	2295.6	.0	862.6	.0	.0	.0	.0	.0
40	8.3	47428.2	.0	17054.0	.0	.0	.0	.0	.0
41	8.6	48071.6	.0	15920.4	.0	.0	.0	.0	.0
42	8.4	46134.2	.0	13734.7	.0	.0	.0	.0	.0
43	8.2	43929.1	.0	11361.7	.0	.0	.0	.0	.0
44	.1	680.7	.0	162.8	.0	.0	.0	.0	.0
45	7.9	39643.2	.0	8641.2	.0	.0	.0	.0	.0
46	4.8	21864.7	.0	4007.5	.0	.0	.0	.0	.0
47	3.1	13241.6	.0	2020.6	.0	.0	.0	.0	.0
48	7.7	27904.3	.0	2345.8	.0	.0	.0	.0	.0
49	.6	1902.3	.0	13.7	.0	.0	.0	.0	.0
50	6.8	18608.4	.0	.0	.0	.0	.0	.0	.0
51	7.2	13522.1	.0	.0	.0	.0	.0	.0	.0
52	7.0	6703.4	.0	.0	.0	.0	.0	.0	.0
53	3.5	860.6	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.63	116.88
2	112.04	113.48
3	121.55	110.40
4	131.16	107.63
5	140.86	105.18
6	150.63	103.05
7	160.46	101.25
8	170.35	99.76
9	180.28	98.60
10	190.25	97.77
11	200.24	97.27
12	210.24	97.10
13	220.23	97.25
14	230.22	97.73
15	240.19	98.55
16	250.12	99.68
17	260.02	101.15

18	269.86	102.94
19	279.63	105.05
20	289.33	107.48
21	298.94	110.23
22	308.46	113.29
23	317.88	116.67
24	327.17	120.35
25	336.35	124.33
26	345.38	128.62
27	354.27	133.20
28	363.00	138.07
29	371.57	143.22
30	379.97	148.66
31	388.18	154.36
32	396.20	160.34
33	404.02	166.57
34	411.63	173.06
35	419.03	179.79
36	426.19	186.76
37	433.13	193.97
38	436.76	198.00

Circle Center At X = 210.5 ; Y = 401.2 and Radius, 304.1
*** 1.498 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.32	116.00
2	85.80	112.84
3	95.38	109.96
4	105.04	107.36
5	114.77	105.06
6	124.56	103.05
7	134.41	101.32
8	144.31	99.90
9	154.25	98.76
10	164.21	97.93
11	174.20	97.39
12	184.19	97.14
13	194.19	97.20
14	204.19	97.55
15	214.17	98.20
16	224.12	99.14
17	234.04	100.38
18	243.93	101.92
19	253.76	103.75
20	263.53	105.87
21	273.23	108.28
22	282.86	110.98
23	292.41	113.96
24	301.86	117.23
25	311.21	120.77
26	320.45	124.60
27	329.57	128.69
28	338.57	133.06
29	347.43	137.69
30	356.16	142.58
31	364.73	147.73
32	373.14	153.13
33	381.39	158.78
34	389.47	164.68
35	397.37	170.81
36	405.09	177.17
37	412.61	183.76
38	419.93	190.57
39	427.05	197.60
40	427.43	198.00

Circle Center At X = 187.4 ; Y = 433.2 and Radius, 336.1

*** 1.504 ***
Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	92.11	116.00
2	101.58	112.80
3	111.15	109.91
4	120.82	107.34
5	130.56	105.09
6	140.37	103.16
7	150.24	101.56
8	160.16	100.29
9	170.12	99.34
10	180.10	98.72
11	190.09	98.43
12	200.09	98.47
13	210.09	98.84
14	220.06	99.54
15	230.01	100.57
16	239.92	101.92
17	249.78	103.60
18	259.57	105.61
19	269.30	107.94
20	278.94	110.59
21	288.49	113.55
22	297.94	116.83
23	307.27	120.42
24	316.48	124.31
25	325.56	128.50
26	334.50	133.00
27	343.28	137.78
28	351.89	142.85
29	360.34	148.21
30	368.61	153.84
31	376.68	159.73
32	384.56	165.90
33	392.23	172.31
34	399.68	178.98
35	406.91	185.89
36	413.90	193.04
37	418.45	198.00

Circle Center At X = 193.9 ; Y = 401.5 and Radius, 303.1

*** 1.507 ***
Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.32	116.00
2	85.84	112.96
3	95.45	110.18
4	105.13	107.67
5	114.87	105.42
6	124.68	103.45
7	134.53	101.75
8	144.43	100.32
9	154.36	99.17
10	164.32	98.30
11	174.31	97.69
12	184.30	97.37
13	194.30	97.32
14	204.30	97.55
15	214.28	98.06
16	224.25	98.84
17	234.20	99.90
18	244.11	101.24
19	253.98	102.84
20	263.80	104.72
21	273.57	106.87

22	283.27	109.30
23	292.90	111.98
24	302.45	114.94
25	311.92	118.16
26	321.30	121.63
27	330.57	125.37
28	339.74	129.36
29	348.80	133.61
30	357.73	138.10
31	366.54	142.84
32	375.21	147.82
33	383.74	153.04
34	392.12	158.49
35	400.35	164.18
36	408.41	170.08
37	416.32	176.21
38	424.04	182.56
39	431.59	189.12
40	438.96	195.88
41	441.14	198.00

Circle Center At X = 191.0 ; Y = 458.5 and Radius, 361.2

*** 1.508 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	116.00
2	91.07	112.85
3	100.65	109.99
4	110.32	107.44
5	120.06	105.19
6	129.87	103.24
7	139.74	101.60
8	149.65	100.27
9	159.60	99.25
10	169.57	98.54
11	179.56	98.14
12	189.56	98.06
13	199.56	98.28
14	209.55	98.82
15	219.51	99.67
16	229.44	100.83
17	239.33	102.30
18	249.18	104.08
19	258.96	106.17
20	268.67	108.55
21	278.30	111.25
22	287.84	114.24
23	297.28	117.52
24	306.62	121.10
25	315.84	124.97
26	324.94	129.13
27	333.90	133.56
28	342.72	138.28
29	351.39	143.26
30	359.89	148.52
31	368.23	154.04
32	376.40	159.81
33	384.38	165.84
34	392.16	172.12
35	399.75	178.63
36	407.13	185.38
37	414.30	192.35
38	419.75	198.00

Circle Center At X = 187.3 ; Y = 418.3 and Radius, 320.3

*** 1.510 ***

Failure Surface Specified By 38 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	81.58	116.00
2	91.07	112.85
3	100.65	109.99
4	110.32	107.44
5	120.06	105.19
6	129.87	103.24
7	139.74	101.61
8	149.65	100.28
9	159.60	99.27
10	169.57	98.56
11	179.57	98.17
12	189.57	98.09
13	199.56	98.33
14	209.55	98.88
15	219.51	99.73
16	229.44	100.91
17	239.33	102.39
18	249.17	104.18
19	258.95	106.27
20	268.66	108.68
21	278.28	111.38
22	287.82	114.39
23	297.26	117.69
24	306.59	121.28
25	315.81	125.17
26	324.89	129.34
27	333.85	133.80
28	342.66	138.53
29	351.31	143.53
30	359.81	148.81
31	368.14	154.35
32	376.29	160.14
33	384.25	166.19
34	392.02	172.48
35	399.59	179.02
36	406.95	185.79
37	414.10	192.78
38	419.11	198.00

Circle Center At X = 187.1 ; Y = 417.5 and Radius, 319.4

*** 1.511 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.32	116.00
2	85.80	112.82
3	95.37	109.94
4	105.03	107.35
5	114.77	105.06
6	124.57	103.07
7	134.42	101.39
8	144.33	100.00
9	154.27	98.92
10	164.24	98.15
11	174.23	97.69
12	184.23	97.53
13	194.23	97.68
14	204.22	98.13
15	214.19	98.90
16	224.13	99.97
17	234.03	101.34
18	243.89	103.02
19	253.69	105.00
20	263.43	107.28
21	273.09	109.86
22	282.67	112.74
23	292.16	115.90

24	301.54	119.36
25	310.81	123.11
26	319.96	127.13
27	328.99	131.44
28	337.88	136.02
29	346.62	140.88
30	355.21	146.00
31	363.64	151.38
32	371.90	157.02
33	379.98	162.91
34	387.87	169.04
35	395.58	175.42
36	403.08	182.03
37	410.38	188.87
38	417.47	195.92
39	419.43	198.00

Circle Center At X = 184.4 ; Y = 422.8 and Radius, 325.3

*** 1.511 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	97.37	116.00
2	106.88	112.92
3	116.49	110.16
4	126.19	107.70
5	135.96	105.56
6	145.79	103.73
7	155.67	102.22
8	165.60	101.03
9	175.56	100.16
10	185.55	99.61
11	195.55	99.39
12	205.54	99.48
13	215.54	99.90
14	225.51	100.64
15	235.45	101.70
16	245.36	103.08
17	255.21	104.77
18	265.01	106.79
19	274.73	109.12
20	284.38	111.76
21	293.93	114.71
22	303.39	117.96
23	312.73	121.52
24	321.96	125.38
25	331.05	129.53
26	340.01	133.98
27	348.82	138.71
28	357.48	143.72
29	365.96	149.01
30	374.28	154.57
31	382.41	160.39
32	390.34	166.47
33	398.08	172.81
34	405.61	179.39
35	412.93	186.21
36	420.02	193.26
37	424.49	198.00

Circle Center At X = 197.6 ; Y = 409.8 and Radius, 310.4

*** 1.512 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	116.00
2	91.00	112.66
3	100.54	109.64
4	110.17	106.95

5	119.88	104.58
6	129.68	102.55
7	139.53	100.85
8	149.44	99.49
9	159.38	98.46
10	169.36	97.77
11	179.35	97.43
12	189.35	97.42
13	199.35	97.75
14	209.33	98.42
15	219.28	99.43
16	229.18	100.78
17	239.04	102.46
18	248.84	104.48
19	258.56	106.83
20	268.19	109.51
21	277.73	112.52
22	287.16	115.84
23	296.47	119.49
24	305.65	123.45
25	314.70	127.72
26	323.59	132.29
27	332.32	137.17
28	340.88	142.34
29	349.26	147.79
30	357.45	153.53
31	365.44	159.54
32	373.22	165.83
33	380.78	172.37
34	388.12	179.16
35	395.22	186.20
36	402.08	193.48
37	406.06	198.00

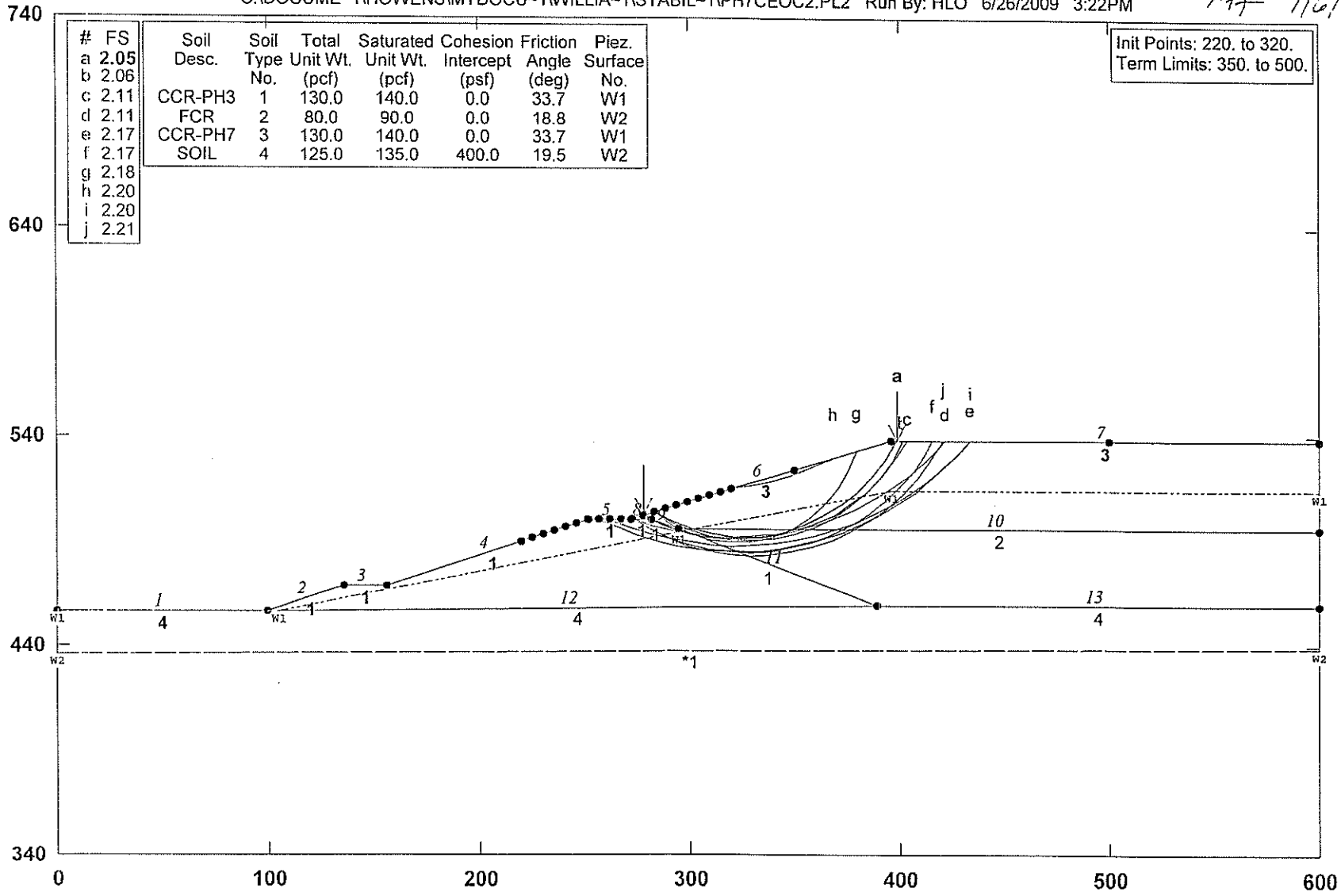
Circle Center At X = 184.6 ; Y = 391.6 and Radius, 294.2

*** 1.515 ***

PHASE 3/7C DOWNSTREAM EOC STATIC REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH7CEOC2.PL2 Run By: HLO 6/26/2009 3:22PM

7/6/09



#	FS
a	2.05
b	2.06
c	2.11
d	2.11
e	2.17
f	2.17
g	2.18
h	2.20
i	2.20
j	2.21

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CCR-PH3	1	130.0	140.0	0.0	33.7	W1
FCR	2	80.0	90.0	0.0	18.8	W2
CCR-PH7	3	130.0	140.0	0.0	33.7	W1
SOIL	4	125.0	135.0	400.0	19.5	W2

PCSTABL5M/si FSmin=2.05

Safety Factors Are Calculated By The Modified Bishop Method

STED

R17/95
23/7

** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 6/26/2009
Time of Run: 3:22PM
Run By: HLO
Input Data Filename: C:PH7CEOC2.
Output Filename: C:PH7CEOC2.OUT
Unit: ENGLISH
Plotted Output Filename: C:PH7CEOC2.PLT
PROBLEM DESCRIPTION PHASE 3/7C DOWNSTREAM EOC STATIC
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 340.00 to Y-values listed.

7 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	116.00	100.00	116.00	4
2	100.00	116.00	136.00	128.00	1
3	136.00	128.00	156.00	128.00	1
4	156.00	128.00	252.00	160.00	1
5	252.00	160.00	272.00	160.00	1
6	272.00	160.00	396.00	198.00	3
7	396.00	198.00	600.00	198.00	3
8	272.00	160.00	282.00	160.00	1
9	282.00	160.00	295.00	155.00	1
10	295.00	155.00	600.00	155.00	2
11	295.00	155.00	389.00	119.00	1
12	100.00	116.00	389.00	119.00	4
13	389.00	119.00	600.00	119.00	4

ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	18.8	.00	.0	2
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	400.0	19.5	.00	.0	2

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	116.00
2	105.00	116.00
3	295.00	153.90
4	396.00	174.00
5	600.00	174.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	96.00
2	600.00	99.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	96.00	600.00	99.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 220.00 ft.
and X = 320.00 ft.
Each Surface Terminates Between X = 350.00 ft.
and X = 500.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 96.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	277.90	161.81
2	286.87	157.39
3	296.28	154.02
4	306.02	151.75
5	315.96	150.60
6	325.96	150.59
7	335.89	151.72
8	345.63	153.98
9	355.06	157.33
10	364.04	161.73
11	372.46	167.13
12	380.21	173.44
13	387.19	180.61
14	393.30	188.51
15	398.48	197.07
16	398.91	198.00

Circle Center At X = 321.0 ; Y = 238.0 and Radius, 87.6
*** 2.046 ***
Individual data on the 25 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.7	699.1	.0	.0	.0	.0	.0	.0	.0
2	.4	175.8	.0	.0	.0	.0	.0	.0	.0
3	4.9	3304.3	.0	.0	.0	.0	.0	.0	.0
4	8.1	10432.1	.0	.0	.0	.0	.0	.0	.0
5	1.0	1744.5	.0	.0	.0	.0	.0	.0	.0
6	.2	407.1	.0	1.0	.0	.0	.0	.0	.0
7	.6	1054.9	.0	10.1	.0	.0	.0	.0	.0
8	2.6	4799.5	.0	159.9	.0	.0	.0	.0	.0
9	1.0	1915.2	.0	.0	.0	.0	.0	.0	.0
10	5.5	11589.7	.0	.0	.0	.0	.0	.0	.0
11	9.9	25120.6	.0	.0	.0	.0	.0	.0	.0
12	10.0	29914.7	.0	.0	.0	.0	.0	.0	.0
13	9.9	33417.4	.0	.0	.0	.0	.0	.0	.0
14	9.7	35457.0	.0	.0	.0	.0	.0	.0	.0
15	2.9	10832.2	.0	.0	.0	.0	.0	.0	.0
16	6.6	24667.8	.0	3845.2	.0	.0	.0	.0	.0
17	9.0	32502.7	.0	4416.9	.0	.0	.0	.0	.0
18	8.4	27771.6	.0	2478.4	.0	.0	.0	.0	.0
19	3.6	10545.0	.0	307.0	.0	.0	.0	.0	.0
20	4.2	11344.0	.0	.0	.0	.0	.0	.0	.0
21	7.0	15611.3	.0	.0	.0	.0	.0	.0	.0
22	6.1	9288.1	.0	.0	.0	.0	.0	.0	.0
23	2.7	2398.7	.0	.0	.0	.0	.0	.0	.0
24	2.5	962.2	.0	.0	.0	.0	.0	.0	.0
25	.4	25.8	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	283.16	163.42
2	291.77	158.33
3	300.95	154.36
4	310.55	151.56
5	320.42	149.99
6	330.42	149.66
7	340.37	150.58
8	350.14	152.73
9	359.56	156.09
10	368.48	160.60
11	376.78	166.19
12	384.31	172.76
13	390.96	180.23
14	396.63	188.47
15	401.23	197.35
16	401.46	198.00

Circle Center At X = 328.0 ; Y = 229.5 and Radius, 79.9

*** 2.064 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	283.16	163.42
2	292.02	158.79
3	301.37	155.23
4	311.06	152.79
5	320.98	151.49
6	330.98	151.37
7	340.92	152.42
8	350.68	154.62
9	360.11	157.95
10	369.08	162.36
11	377.48	167.78
12	385.19	174.16
13	392.10	181.39
14	398.11	189.38
15	403.14	198.00

Circle Center At X = 327.0 ; Y = 236.6 and Radius, 85.3

*** 2.109 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	272.63	160.19
2	282.10	156.98
3	291.79	154.49
4	301.63	152.73
5	311.58	151.70
6	321.57	151.43
7	331.56	151.90
8	341.49	153.12
9	351.29	155.08
10	360.93	157.76
11	370.33	161.16
12	379.46	165.25
13	388.25	170.01
14	396.66	175.42
15	404.65	181.44
16	412.16	188.04
17	419.16	195.18
18	421.53	198.00

Circle Center At X = 320.2 ; Y = 284.8 and Radius, 133.4

*** 2.114 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	262.11	160.00
2	271.38	156.25
3	280.88	153.14

4	290.57	150.68
5	300.41	148.88
6	310.35	147.75
7	320.34	147.29
8	330.33	147.51
9	340.29	148.41
10	350.17	149.98
11	359.92	152.21
12	369.49	155.10
13	378.85	158.62
14	387.95	162.77
15	396.74	167.53
16	405.20	172.87
17	413.27	178.77
18	420.93	185.21
19	428.13	192.14
20	433.44	198.00

Circle Center At X = 322.1 ; Y = 294.9 and Radius, 147.6

*** 2.171 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	272.63	160.19
2	281.29	155.19
3	290.41	151.08
4	299.88	147.89
5	309.63	145.67
6	319.56	144.42
7	329.55	144.18
8	339.53	144.92
9	349.37	146.66
10	359.00	149.37
11	368.31	153.03
12	377.20	157.60
13	385.60	163.03
14	393.42	169.27
15	400.57	176.25
16	406.99	183.92
17	412.62	192.18
18	415.78	198.00

Circle Center At X = 327.0 ; Y = 244.2 and Radius, 100.1

*** 2.172 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	283.16	163.42
2	291.26	157.56
3	300.24	153.15
4	309.82	150.30
5	319.75	149.10
6	329.74	149.59
7	339.50	151.74
8	348.77	155.50
9	357.27	160.77
10	364.77	167.38
11	371.05	175.16
12	375.94	183.88
13	379.13	192.83

Circle Center At X = 321.9 ; Y = 208.5 and Radius, 59.4

*** 2.185 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	320.00	174.71
2	329.85	176.44
3	339.58	178.76
4	349.15	181.65

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     5        358.53      185.12
     6        367.69      189.14
     7        368.58      189.60
Circle Center At X =  296.1 ; Y =  339.7  and Radius,  166.7
      ***     2.200   ***
Failure Surface Specified By 21 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
     1        256.84      160.00
     2        265.91      155.79
     3        275.25      152.21
     4        284.82      149.30
     5        294.57      147.07
     6        304.44      145.51
     7        314.41      144.65
     8        324.41      144.49
     9        334.39      145.03
    10        344.32      146.26
    11        354.13      148.18
    12        363.79      150.78
    13        373.24      154.04
    14        382.44      157.96
    15        391.34      162.51
    16        399.91      167.67
    17        408.09      173.42
    18        415.86      179.72
    19        423.16      186.55
    20        429.98      193.87
    21        433.32      198.00
Circle Center At X =  321.7 ; Y =  287.8  and Radius,  143.3
      ***     2.201   ***
Failure Surface Specified By 19 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
     1        272.63      160.19
     2        281.19      155.02
     3        290.21      150.71
     4        299.61      147.29
     5        309.30      144.81
     6        319.18      143.29
     7        329.17      142.74
     8        339.16      143.17
     9        349.06      144.56
    10        358.78      146.92
    11        368.22      150.22
    12        377.29      154.42
    13        385.91      159.49
    14        394.00      165.37
    15        401.47      172.02
    16        408.26      179.36
    17        414.30      187.33
    18        419.53      195.85
    19        420.58      198.00
Circle Center At X =  329.8 ; Y =  245.1  and Radius,  102.3
      ***     2.212   ***
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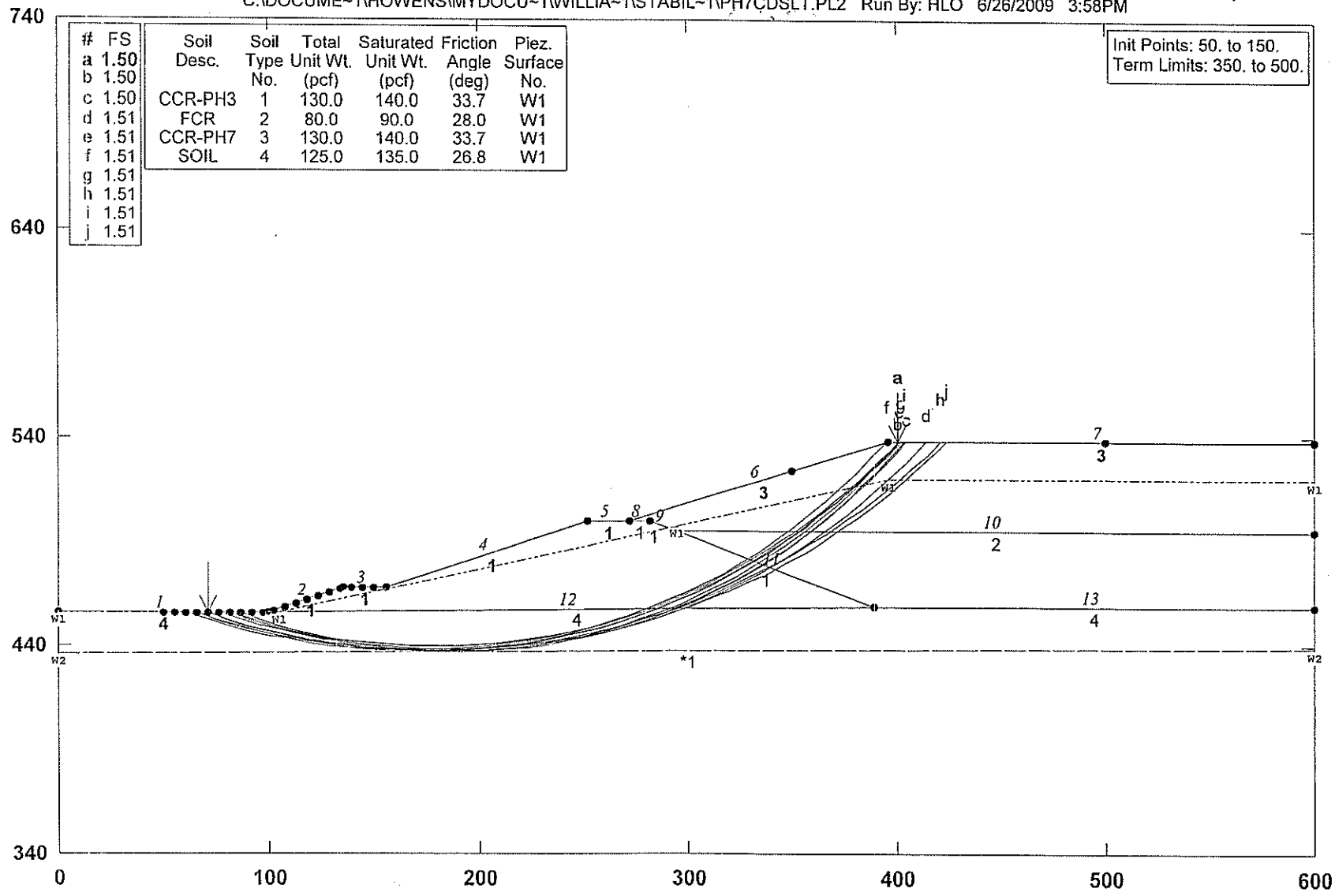
PHASE 3/7C DOWNSTREAM LONGTERM REFUSE DISPOSAL AREA NO. 2

C:\DOCUME~1\HOWENS\MYDOCU~1\WILLIA~1\STABIL~1\PH7CDSLT.PL2 Run By: HLO 6/26/2009 3:58PM

#	FS
a	1.50
b	1.50
c	1.50
d	1.51
e	1.51
f	1.51
g	1.51
h	1.51
i	1.51
j	1.51

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
CCR-PH3	1	130.0	140.0	33.7	W1
FCR	2	80.0	90.0	28.0	W1
CCR-PH7	3	130.0	140.0	33.7	W1
SOIL	4	125.0	135.0	26.8	W1

Init Points: 50. to 150.
Term Limits: 350. to 500.



PCSTABL5M/si FSmin=1.50

Safety Factors Are Calculated By The Modified Bishop Method

STED



** PCSTABL5M **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 6/26/2009
Time of Run: 3:58PM
Run By: HLO
Input Data Filename: C:ph7cdslt.
Output Filename: C:ph7cdslt.OUT
Unit: ENGLISH
Plotted Output Filename: C:ph7cdslt.PLT
PROBLEM DESCRIPTION PHASE 3/7C DOWNSTREAM LONGTERM
REFUSE DISPOSAL AREA NO. 2

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 340.00 to Y-values listed.

7 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	116.00	100.00	116.00	4
2	100.00	116.00	136.00	128.00	1
3	136.00	128.00	156.00	128.00	1
4	156.00	128.00	252.00	160.00	1
5	252.00	160.00	272.00	160.00	1
6	272.00	160.00	396.00	198.00	3
7	396.00	198.00	600.00	198.00	3
8	272.00	160.00	282.00	160.00	1
9	282.00	160.00	295.00	155.00	1
10	295.00	155.00	600.00	155.00	2
11	295.00	155.00	389.00	119.00	1
12	100.00	116.00	389.00	119.00	4
13	389.00	119.00	600.00	119.00	4

ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	140.0	.0	33.7	.00	.0	1
2	80.0	90.0	.0	28.0	.00	.0	1
3	130.0	140.0	.0	33.7	.00	.0	1
4	125.0	135.0	.0	26.8	.00	.0	1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	116.00
2	105.00	116.00
3	295.00	157.80
4	396.00	180.00
5	600.00	180.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	96.00
2	600.00	99.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	.00	96.00	600.00	99.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

400 Trial Surfaces Have Been Generated.
20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 150.00 ft.
Each Surface Terminates Between X = 350.00 ft.
and X = 500.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 96.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	71.05	116.00
2	80.50	112.71
3	90.04	109.73
4	99.68	107.07
5	109.40	104.72
6	119.20	102.70
7	129.05	101.01
8	138.96	99.64
9	148.90	98.59
10	158.88	97.88
11	168.87	97.50
12	178.87	97.44
13	188.87	97.72
14	198.85	98.33
15	208.80	99.26
16	218.72	100.53
17	228.60	102.12
18	238.41	104.03
19	248.16	106.27
20	257.82	108.83
21	267.40	111.71
22	276.88	114.90
23	286.24	118.40
24	295.49	122.21
25	304.60	126.33
26	313.58	130.74
27	322.40	135.44
28	331.07	140.44
29	339.56	145.72
30	347.87	151.27
31	356.00	157.10
32	363.93	163.19
33	371.66	169.54
34	379.17	176.14
35	386.46	182.99
36	393.52	190.07
37	400.34	197.38
38	400.87	198.00

Circle Center At X = 175.5 ; Y = 400.3 and Radius, 302.8
*** 1.503 ***
Individual data on the 52 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.4	2098.7	.0	1027.3	.0	.0	.0	.0	.0
2	9.5	6163.1	.0	2984.2	.0	.0	.0	.0	.0
3	9.6	9894.0	.0	4744.5	.0	.0	.0	.0	.0
4	.3	387.3	.0	184.1	.0	.0	.0	.0	.0
5	5.0	7030.4	.0	3085.4	.0	.0	.0	.0	.0
6	.2	396.9	.0	159.5	.0	.0	.0	.0	.0

7	4.2	7371.7	.0	2940.7	.0	.0	.0	.0	.0
8	9.8	22475.3	.0	8737.6	.0	.0	.0	.0	.0
9	9.9	29483.0	.0	11188.1	.0	.0	.0	.0	.0
10	6.9	24686.2	.0	9207.4	.0	.0	.0	.0	.0
11	3.0	11251.9	.0	4240.3	.0	.0	.0	.0	.0
12	9.9	38956.6	.0	15514.0	.0	.0	.0	.0	.0
13	7.1	28670.3	.0	12189.1	.0	.0	.0	.0	.0
14	2.9	11967.4	.0	5195.7	.0	.0	.0	.0	.0
15	10.0	44888.7	.0	19058.0	.0	.0	.0	.0	.0
16	10.0	49756.9	.0	20531.9	.0	.0	.0	.0	.0
17	10.0	54128.6	.0	21804.6	.0	.0	.0	.0	.0
18	10.0	57985.2	.0	22875.0	.0	.0	.0	.0	.0
19	10.0	61311.6	.0	23741.9	.0	.0	.0	.0	.0
20	9.9	64096.2	.0	24404.2	.0	.0	.0	.0	.0
21	9.9	66331.2	.0	24861.3	.0	.0	.0	.0	.0
22	9.8	68012.4	.0	25112.7	.0	.0	.0	.0	.0
23	9.7	69139.1	.0	25158.0	.0	.0	.0	.0	.0
24	3.8	27609.1	.0	9970.4	.0	.0	.0	.0	.0
25	5.8	41370.8	.0	15027.0	.0	.0	.0	.0	.0
26	9.6	65341.2	.0	24630.8	.0	.0	.0	.0	.0
27	4.6	30076.4	.0	11760.5	.0	.0	.0	.0	.0
28	4.9	31369.0	.0	12298.3	.0	.0	.0	.0	.0
29	5.1	32789.3	.0	12841.5	.0	.0	.0	.0	.0
30	3.0	18806.5	.0	7285.4	.0	.0	.0	.0	.0
31	1.3	8190.5	.0	3155.0	.0	.0	.0	.0	.0
32	4.1	26024.1	.0	10083.2	.0	.0	.0	.0	.0
33	4.6	28900.8	.0	11063.6	.0	.0	.0	.0	.0
34	.5	3034.7	.0	1154.2	.0	.0	.0	.0	.0
35	9.1	54727.2	.0	21117.4	.0	.0	.0	.0	.0
36	9.0	50388.9	.0	19730.8	.0	.0	.0	.0	.0
37	8.8	45714.5	.0	18144.0	.0	.0	.0	.0	.0
38	8.7	40741.7	.0	16358.9	.0	.0	.0	.0	.0
39	.7	3305.2	.0	1346.6	.0	.0	.0	.0	.0
40	7.7	33712.5	.0	13030.7	.0	.0	.0	.0	.0
41	8.3	35115.4	.0	12201.3	.0	.0	.0	.0	.0
42	5.2	21272.7	.0	6576.8	.0	.0	.0	.0	.0
43	2.9	11548.9	.0	3256.8	.0	.0	.0	.0	.0
44	7.9	28567.8	.0	7276.4	.0	.0	.0	.0	.0
45	7.7	23649.5	.0	4532.7	.0	.0	.0	.0	.0
46	7.5	18598.4	.0	1605.4	.0	.0	.0	.0	.0
47	.2	474.8	.0	1.5	.0	.0	.0	.0	.0
48	7.1	13163.6	.0	.0	.0	.0	.0	.0	.0
49	7.1	8834.1	.0	.0	.0	.0	.0	.0	.0
50	2.5	2007.7	.0	.0	.0	.0	.0	.0	.0
51	4.3	1657.5	.0	.0	.0	.0	.0	.0	.0
52	.5	21.5	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	65.79	116.00
2	75.27	112.83
3	84.85	109.96
4	94.52	107.39
5	104.26	105.14
6	114.07	103.19
7	123.93	101.56
8	133.85	100.24
9	143.80	99.23
10	153.77	98.54
11	163.77	98.17
12	173.77	98.11
13	183.76	98.38
14	193.75	98.96
15	203.71	99.85
16	213.63	101.06
17	223.51	102.59
18	233.34	104.43

19	243.11	106.58
20	252.80	109.03
21	262.41	111.80
22	271.93	114.87
23	281.35	118.23
24	290.65	121.90
25	299.83	125.86
26	308.89	130.11
27	317.80	134.64
28	326.57	139.45
29	335.17	144.54
30	343.62	149.90
31	351.88	155.53
32	359.97	161.41
33	367.86	167.55
34	375.56	173.93
35	383.05	180.56
36	390.33	187.42
37	397.38	194.51
38	400.64	198.00

Circle Center At X = 170.5 ; Y = 413.1 and Radius, 315.0

*** 1.505 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	116.00
2	90.98	112.60
3	100.50	109.53
4	110.12	106.78
5	119.82	104.37
6	129.60	102.30
7	139.45	100.57
8	149.36	99.17
9	159.30	98.12
10	169.28	97.42
11	179.27	97.06
12	189.27	97.04
13	199.26	97.37
14	209.24	98.04
15	219.19	99.06
16	229.10	100.42
17	238.95	102.12
18	248.74	104.16
19	258.45	106.54
20	268.08	109.25
21	277.60	112.29
22	287.02	115.66
23	296.31	119.36
24	305.47	123.37
25	314.49	127.69
26	323.35	132.32
27	332.05	137.26
28	340.57	142.49
29	348.91	148.02
30	357.04	153.83
31	364.98	159.91
32	372.70	166.27
33	380.19	172.89
34	387.46	179.76
35	394.48	186.89
36	401.25	194.24
37	404.47	198.00

Circle Center At X = 184.7 ; Y = 386.6 and Radius, 289.6

*** 1.505 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	81.58	116.00
2	91.02	112.72
3	100.57	109.74
4	110.21	107.08
5	119.93	104.73
6	129.72	102.71
7	139.58	101.00
8	149.48	99.62
9	159.43	98.56
10	169.40	97.83
11	179.39	97.42
12	189.39	97.34
13	199.39	97.59
14	209.37	98.16
15	219.33	99.06
16	229.26	100.28
17	239.14	101.82
18	248.96	103.69
19	258.72	105.88
20	268.40	108.39
21	277.99	111.21
22	287.49	114.34
23	296.88	117.78
24	306.15	121.52
25	315.30	125.57
26	324.30	129.91
27	333.16	134.55
28	341.87	139.47
29	350.41	144.67
30	358.78	150.15
31	366.96	155.90
32	374.95	161.91
33	382.74	168.19
34	390.32	174.71
35	397.68	181.47
36	404.82	188.48
37	411.72	195.71
38	413.77	198.00

Circle Center At X = 186.9 ; Y = 403.4 and Radius, 306.1

*** 1.506 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	116.00
2	90.98	112.58
3	100.49	109.49
4	110.10	106.74
5	119.81	104.33
6	129.59	102.26
7	139.44	100.53
8	149.34	99.15
9	159.29	98.12
10	169.27	97.44
11	179.26	97.11
12	189.26	97.14
13	199.25	97.51
14	209.23	98.24
15	219.17	99.31
16	229.07	100.73
17	238.91	102.50
18	248.68	104.62
19	258.38	107.08
20	267.98	109.87
21	277.48	113.00
22	286.86	116.47
23	296.11	120.26
24	305.23	124.37

25	314.19	128.80
26	322.99	133.55
27	331.62	138.60
28	340.07	143.95
29	348.33	149.59
30	356.38	155.52
31	364.22	161.73
32	371.83	168.21
33	379.22	174.96
34	386.36	181.95
35	393.25	189.20
36	399.88	196.68
37	400.97	198.00

Circle Center At X = 183.6 ; Y = 381.7 and Radius, 284.6

*** 1.507 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	65.79	116.00
2	75.22	112.68
3	84.76	109.68
4	94.39	106.99
5	104.11	104.63
6	113.90	102.59
7	123.75	100.88
8	133.66	99.49
9	143.60	98.44
10	153.57	97.71
11	163.57	97.32
12	173.57	97.26
13	183.56	97.53
14	193.54	98.13
15	203.50	99.06
16	213.42	100.32
17	223.29	101.92
18	233.11	103.83
19	242.85	106.08
20	252.52	108.64
21	262.09	111.53
22	271.57	114.73
23	280.93	118.25
24	290.17	122.07
25	299.28	126.20
26	308.24	130.63
27	317.06	135.35
28	325.71	140.36
29	334.19	145.66
30	342.49	151.24
31	350.60	157.09
32	358.51	163.20
33	366.22	169.58
34	373.71	176.20
35	380.97	183.08
36	388.01	190.18
37	394.80	197.52
38	394.93	197.67

Circle Center At X = 170.4 ; Y = 398.4 and Radius, 301.1

*** 1.507 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.58	116.00
2	91.09	112.91
3	100.70	110.15
4	110.40	107.70
5	120.17	105.57
6	130.01	103.78

7	139.90	102.30
8	149.83	101.16
9	159.80	100.35
10	169.79	99.87
11	179.78	99.72
12	189.78	99.90
13	199.77	100.41
14	209.73	101.25
15	219.67	102.43
16	229.55	103.93
17	239.38	105.76
18	249.15	107.92
19	258.84	110.40
20	268.44	113.19
21	277.94	116.31
22	287.33	119.74
23	296.61	123.48
24	305.75	127.52
25	314.76	131.86
26	323.62	136.51
27	332.32	141.44
28	340.85	146.66
29	349.20	152.16
30	357.36	157.93
31	365.33	163.97
32	373.10	170.27
33	380.65	176.83
34	387.98	183.63
35	395.08	190.67
36	401.94	197.95
37	401.99	198.00

Circle Center At X = 179.3 ; Y = 401.1 and Radius, 301.4

*** 1.509 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.53	116.00
2	70.04	112.91
3	79.63	110.08
4	89.30	107.53
5	99.04	105.26
6	108.83	103.26
7	118.69	101.54
8	128.58	100.10
9	138.51	98.95
10	148.48	98.07
11	158.46	97.48
12	168.45	97.17
13	178.45	97.15
14	188.45	97.41
15	198.44	97.95
16	208.40	98.78
17	218.34	99.89
18	228.24	101.28
19	238.10	102.95
20	247.91	104.90
21	257.66	107.13
22	267.34	109.63
23	276.95	112.41
24	286.47	115.46
25	295.90	118.78
26	305.24	122.36
27	314.47	126.21
28	323.59	130.32
29	332.58	134.68
30	341.45	139.30
31	350.19	144.17

32	358.78	149.29
33	367.22	154.65
34	375.51	160.24
35	383.64	166.07
36	391.60	172.12
37	399.38	178.40
38	406.98	184.90
39	414.39	191.61
40	421.06	198.00

Circle Center At X = 174.3 ; Y = 449.4 and Radius, 352.3

*** 1.509 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	86.84	116.00
2	96.23	112.54
3	105.73	109.42
4	115.33	106.64
5	125.03	104.21
6	134.81	102.12
7	144.66	100.39
8	154.56	99.01
9	164.51	97.99
10	174.49	97.32
11	184.49	97.01
12	194.49	97.06
13	204.48	97.46
14	214.45	98.23
15	224.38	99.34
16	234.28	100.82
17	244.11	102.65
18	253.87	104.82
19	263.54	107.35
20	273.12	110.22
21	282.59	113.43
22	291.94	116.98
23	301.16	120.86
24	310.23	125.07
25	319.14	129.60
26	327.89	134.45
27	336.46	139.60
28	344.84	145.06
29	353.02	150.82
30	360.98	156.86
31	368.73	163.19
32	376.24	169.79
33	383.51	176.65
34	390.53	183.77
35	397.30	191.14
36	403.16	198.00

Circle Center At X = 188.1 ; Y = 376.3 and Radius, 279.3

*** 1.510 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.32	116.00
2	85.83	112.93
3	95.44	110.14
4	105.12	107.63
5	114.87	105.42
6	124.68	103.49
7	134.55	101.86
8	144.46	100.53
9	154.40	99.48
10	164.38	98.74
11	174.37	98.28
12	184.36	98.13

13	194.36	98.27
14	204.35	98.72
15	214.33	99.45
16	224.27	100.48
17	234.18	101.81
18	244.05	103.43
19	253.87	105.35
20	263.62	107.55
21	273.30	110.05
22	282.91	112.83
23	292.43	115.89
24	301.85	119.24
25	311.17	122.86
26	320.38	126.76
27	329.47	130.93
28	338.43	135.37
29	347.26	140.07
30	355.94	145.04
31	364.47	150.26
32	372.84	155.73
33	381.04	161.44
34	389.08	167.40
35	396.93	173.59
36	404.59	180.02
37	412.06	186.67
38	419.33	193.53
39	423.78	198.00

Circle Center At X = 184.5 ; Y = 434.8 and Radius, 336.6

*** 1.511 ***

ALPS, 1/23/2007, 11:41:04

(939)

ALPS module build: 5.1.21
Project File: UnTitled
Units: (ft) (psi)

[PROJECT TITLE]
POND CREEK NO. 1 PILLAR STABILITY

[PROJECT DESCRIPTION]
AREA UNDER PHASE 7 IMPOUNDMENT

[GEOMETRY PARAMETERS]
Entry Height.....8 (ft)
Depth of Cover.....528 (ft)
Panel Width.....1250 (ft)
Entry Width.....18 (ft)
Number of Entries.....3
Center to Center Distance #1.....100 (ft)
Center to Center Distance #2.....100 (ft)
Crosscut Spacing.....100 (ft)

[DEFAULT PARAMETERS]
In Situ Coal Strength.....900 (psi)
Abutment Angle.....21 (deg)
Unit Weight of Overburden.....154 (pcf)

[ALPS STABILITY FACTORS - STANDARD GEOMETRY]

	Classic ALPS	ALPS (R)
Development Loading	4.64	4.64
Headgate Loading	3.70	3.70
Bleeder Loading	3.08	3.08
*** Tailgate Loading	2.49	2.49
Isolated Loading	2.30	2.30

[PILLAR LOAD BEARING CAPACITY]

PILLAR #1
for Pillar Width (ft).....82.0
and Pillar Length (ft).....82.0
Width/Height Ratio.....10.25
Unit Pillar Strength (psi).....3897
Pillar Load Bearing Capacity (lbs) / (ft) of gate entry.....3.77E+07

Unit Pillar Strength (R) (psi).....3897
Pillar Load Bearing Capacity (R) (lbs) / (ft) of gate entry....3.77E+07

PILLAR #2
for Pillar Width (ft).....82.0
and Pillar Length (ft).....82.0
Width/Height Ratio.....10.25
Unit Pillar Strength (psi).....3897
Pillar Load Bearing Capacity (lbs) / (ft) of gate entry.....3.77E+07

Unit Pillar Strength (R) (psi).....3897
Pillar Load Bearing Capacity (R) (lbs) / (ft) of gate entry....3.77E+07

TOTAL PILLAR SYSTEM LOAD BEARING CAPACITY [ALPS Classic]
Total Load (lbs) / (ft) of gate entry.....7.55E+07

TOTAL PILLAR SYSTEM LOAD BEARING CAPACITY [ALPS (R)]
Total Load (lbs) / (ft) of gate entry.....7.55E+07

[DESIGN LOADINGS ON PILLAR SYSTEM (lbs) / (ft) of gate entry]

(232)


```
    Development Loading.............................16,262,400
    Headgate Loading................................20,381,370
    Bleeder Loading.................................24,500,340
*** Tailgate Loading................................30,270,590
    Isolated Loading................................32,742,620
```

[INDIVIDUAL PILLAR LOADING (psi)]

LOADING CONDITION	PILLAR #1	PILLAR #2
Development	840	840
Headgate	1201	904
Bleeder	1562	968
Unit Pill.Str.	3897	3897
Unit Pill.Str.(R)	3897	3897

NOTE: INDIVIDUAL PILLAR LOADINGS DO NOT CONSIDER LOAD TRANSFER DUE TO PILLAR YIELDING!

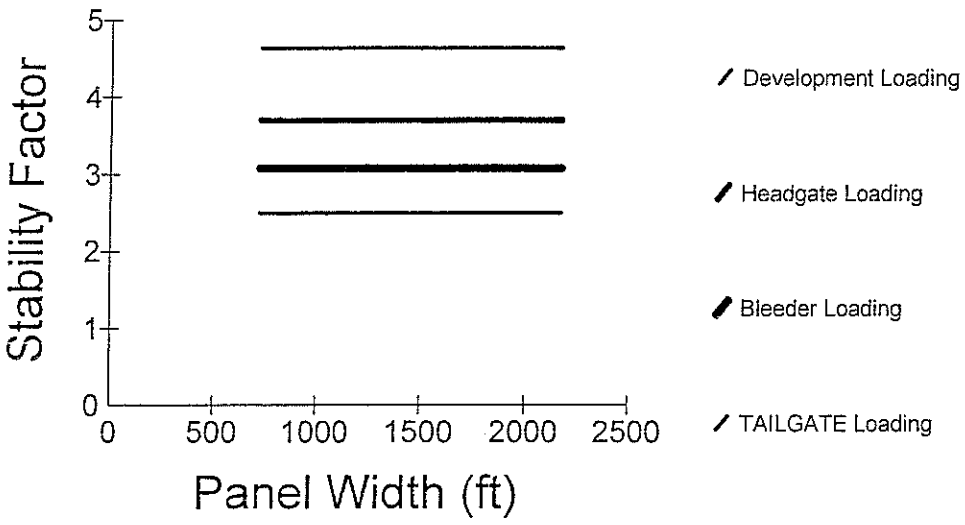
Unit weight of overburden =
100' X 130 lb (coal refuse) + 20' X 120 lb (existing soil) + 408' X 162 lb (Rock) ÷ 528
= 154 pcf

Entry Height = 15 8' in general with as much as 10' in isolated areas

(All mine related input supplied by Williamson Energy LLC)

234

Analysis of Longwall Pillar Stability



Alliance Consulting, Inc.
Engineers
Constructors
Scientists
BECKLEY, WV
(304) 255-0491

BY: HJO DATE: 4/5/09 CHKD BY: _____ DATE: _____ (234)

PROJECT NAME: WILLIAMSON ENERGY LLC

PROJECT NO. 805-330-1413 SHEET _____ OF _____

DESCRIPTION SUBSIDENCE BASELINE CRITERIA

REFERENCE: "COAL MINE GROUND CONTROL", S. PENG, JOHN WILEY AND SONS, 1978.

FIND: REQUIRED DISTANCE BETWEEN BASELINE SURVEY STATIONS

CRITERIA: DISTANCE $\leq h/20$ (PENG, PG 315)

h = DEPTH OF COAL SEAM BELOW SURFACE

$464' < h < 522'$

$464/20 <$ DISTANCE $< 522/20$

$23.2' <$ DISTANCE $< 26.1'$

USE SURVEY STATIONS 25' APART FOR SUBSIDENCE BASELINES "E", "F", "G", AND "H"

DITCH N 75.5 AC.

DIMENT DITCH 3
3.6 AC.

CULVERT 5
2.8 AC.

DITCH L
37.0 AC.

DITCH J
7.9 AC.

DITCH K
11.0 AC.

DITCH M
14.5 AC.

P-3

P-4

P-5

DITCH H
11.5 AC.

DRAWING NO. BCC-330-E

SCALE

§ 114-10
Part 29

236

MACH MINING

DITCH "C"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

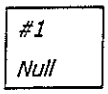
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH C



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	39.500	39.500	95.83	13.07

Structure Detail:

Structure #1 (Null)

DITCH C

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	39.500	0.667	0.000	0.000	80.000	M	95.83	13.072
	Σ	**39.500**						**95.83**	**13.072**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	9.00	900.00	3.000	0.083
		8. Large gullies, diversions, and low flowing streams	0.25	7.88	3,155.00	1.500	0.584
#1	**1**	**Time of Concentration:**					**0.667**

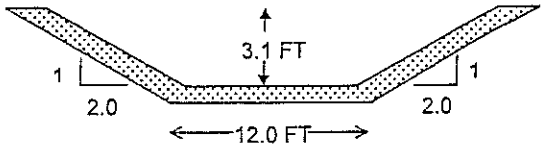
242

CALCULATED BY: JLH 5/24/2006
CHECKED BY: 6/20/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH C

PEAK FLOW =	95.8	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.0025	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	20.95	FT	DEPTH OF FLOW =	2.00	FT
AREA OF FLOW =	32.05	SQ.FT.	MEAN DEPTH =	1.60	FT
HYDRAULIC RADIUS, Rh =	1.53	FT	FROUDE NO. =	0.42	SUBCRITICAL
CALC. VELOCITY =	2.99	FPS			

FREEBOARD REQUIRED =	1.09	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	**3.1**	**FT**	**(CHANNEL LINING: SOIL AND GRASS)**

MACH MINING

DITCH "D"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

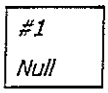
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH D



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	41.000	41.000	99.13	13.57

Structure Detail:

Structure #1 (Null)

DITCH D

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	41.000	0.671	0.000	0.000	80.000	M	99.13	13.568
	Σ	**41.000**						**99.13**	**13.568**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	9.00	900.00	3.000	0.083
		8. Large gullies, diversions, and low flowing streams	27.69	72.00	260.00	15.780	0.004
		8. Large gullies, diversions, and low flowing streams	0.25	7.88	3,155.00	1.500	0.584
#1	**1**	**Time of Concentration:**					**0.671**

SEDCAD 4.0

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CULVERT NO. 1

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 36 inches

Detailed Performance Curves

Design Discharge = 49.56 cfs X 2 pipes = 99.13 cfs

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (30 in)	**Discharge (cfs) (36 in)**	Discharge (cfs) (42 in)
0.50	1.86	**2.22**	2.59
1.00	5.24	**6.28**	7.33
1.50	9.62	**11.54**	13.47
2.00	14.81	**17.77**	20.73
2.50	20.69	**24.83**	28.97
3.00	26.85	**32.64**	38.08
3.50	31.83	**41.13**	47.99
4.00	36.21	**47.70**	58.63
4.50	40.12	**53.79**	67.36
5.00	43.68	**59.27**	75.38
5.50	46.97	**64.27**	82.63
6.00	50.04	**68.91**	89.30
6.50	52.94	**73.27**	95.50
7.00	55.69	**77.37**	101.32
7.50	58.30	**81.27**	106.82

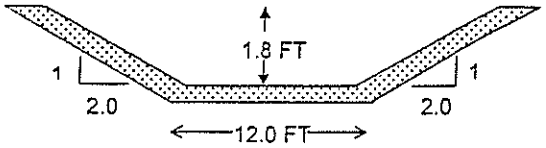
250

CALCULATED BY: JLH / 6/24/2006
CHECKED BY: [illegible] 6/20/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH D

PEAK FLOW =	99.1	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.33	FT/FT
MANNING'S N =	0.035	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	14.31	FT	DEPTH OF FLOW =	0.52	FT
AREA OF FLOW =	6.72	SQ.FT.	MEAN DEPTH =	0.48	FT
HYDRAULIC RADIUS, Rh =	0.47	FT	FROUDE NO. =	3.76	SUPERCRITICAL
CALC. VELOCITY =	14.74	FPS			

FREEBOARD REQUIRED =	1.30	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	1.8	FT	(CHANNEL LINING: GROUTED RIPRAP)

MACH MINING

DITCH "E"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

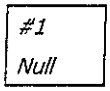
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH E



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	42.000	42.000	101.89	13.90

Structure Detail:

Structure #1 (Null)

DITCH E

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	42.000	0.667	0.000	0.000	80.000	M	101.89	13.899
	Σ	**42.000**						**101.89**	**13.899**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	9.00	900.00	3.000	0.083
		8. Large gullies, diversions, and low flowing streams	0.25	7.88	3,155.00	1.500	0.584
#1	**1**	**Time of Concentration:**					**0.667**

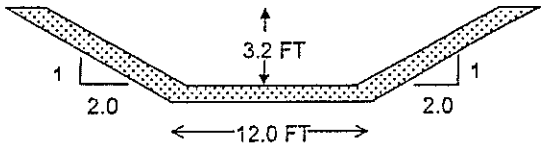
257

CALCULATED BY: JLH 5/24/2006
CHECKED BY: JLH 6/12/2006

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH E

PEAK FLOW =	101.9	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.0025	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	21.27	FT	DEPTH OF FLOW =	2.07	FT
AREA OF FLOW =	33.45	SQ.FT.	MEAN DEPTH =	1.65	FT
HYDRAULIC RADIUS, Rh =	1.57	FT	FROUDE NO. =	0.42	SUBCRITICAL
CALC. VELOCITY =	3.05	FPS			

FREEBOARD REQUIRED =	1.10	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	3.2	FT	(CHANNEL LINING: SOIL AND GRASS)

DCAD 4 for Windows
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MACH MINING

DITCH "F"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

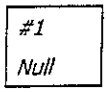
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH F



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	49.400	49.400	119.34	16.35

Structure Detail:

Structure #1 (Null)

DITCH F

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	49.400	0.672	0.000	0.000	80.000	M	119.34	16.348
	Σ	**49.400**						**119.34**	**16.348**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	9.00	900.00	3.000	0.083
		8. Large gullies, diversions, and low flowing streams	28.67	86.00	300.00	16.060	0.005
		8. Large gullies, diversions, and low flowing streams	0.25	7.88	3,155.00	1.500	0.584
#1	**1**	**Time of Concentration:**					**0.672**

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264

CULVERT NO. 2

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.05	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 36 inches

Detailed Performance Curves

Design Discharge = 59.67 cfs x 2 pipes = 119.34 cfs

Maximum Headwater = 5.05 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (30 in)	**Discharge (cfs) (36 in)**	Discharge (cfs) (42 in)
0.50	1.88	**2.26**	2.63
1.01	5.32	**6.38**	7.44
1.51	9.76	**11.72**	13.67
2.02	15.03	**18.03**	21.04
2.53	21.00	**25.20**	29.41
3.03	27.09	**33.13**	38.65
3.54	32.15	**41.55**	48.71
4.04	36.54	**48.21**	59.51
4.55	40.45	**54.31**	68.11
5.05	44.02	**59.78**	76.13
5.56	47.32	**64.80**	83.39
6.06	50.40	**69.45**	90.06
6.57	53.31	**73.81**	96.27
7.07	56.06	**77.92**	102.10
7.58	58.69	**81.83**	107.62

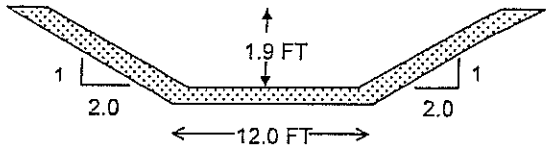
245

CALCULATED BY: JLH 5/24/2006
CHECKED BY: [illegible] 6/20/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH F

PEAK FLOW =	119.3	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.33	FT/FT
MANNING'S N =	0.035	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	14.57	FT	DEPTH OF FLOW =	0.58	FT
AREA OF FLOW =	7.57	SQ.FT.	MEAN DEPTH =	0.53	FT
HYDRAULIC RADIUS, Rh =	0.52	FT	FROUDE NO. =	3.82	SUPERCRITICAL
CALC. VELOCITY =	15.76	FPS			

FREEBOARD REQUIRED =	1.33	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	1.9	FT	(CHANNEL LINING: GROUTED RIPRAP)

265 a

Williamson Energy, LLC, Ditch F, USM
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\williams.fm2
Worksheet	Williamson Energy, LLC - Ditch "F"
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.015	
Channel Slope	0.100000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	12.00	ft
Discharge	119.30	cfs

Results		
Depth	0.50	ft
Flow Area	6.45	ft²
Wetted Perimeter	14.22	ft
Top Width	13.99	ft
Critical Depth	1.34	ft
Critical Slope	0.003296	ft/ft
Velocity	18.49	ft/s
Velocity Head	5.32	ft
Specific Energy	5.81	ft
Froude Number	4.80	
Flow is supercritical.		

No Hydraulic Jump

10% SECTION THROUGH BENCH GUTTER

$y = 0.5'$
$V = 18.49$ FPS

$FB = 1.0 + 0.025 V y^{1/3}$
$= 1.0 + 0.4 = 1.4'$

$d = y + FB = 0.5 + 1.4 = 1.9'$

USE FOR DITCHES/FLUMES D, F, I, L, & M

SEE DWG NO. BOS-330-E49

SD: PUT DITCH ON 10% GRADE THROUGH CURVES, KEEP DEPTH THE SAME.

4.75

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MACH MINING

DITCH "G"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

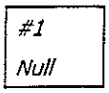
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH G



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	7.200	7.200	28.29	2.38

Structure Detail:

Structure #1 (Null)

DITCH G

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	7.200	0.170	0.000	0.000	80.000	M	28.29	2.383
	Σ	**7.200**						**28.29**	**2.383**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	5.00	500.00	3.000	0.046
		8. Large gullies, diversions, and low flowing streams	0.25	1.67	670.00	1.500	0.124
#1	**1**	**Time of Concentration:**					**0.170**

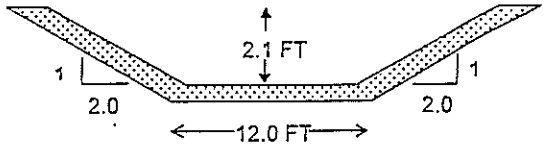
272

CALCULATED BY: JLH 5/24/2006
CHECKED BY: [illegible] 6/20/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH G

PEAK FLOW =	28.3	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.0025	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	16.47	FT	DEPTH OF FLOW =	1.00	FT
AREA OF FLOW =	14.00	SQ.FT.	MEAN DEPTH =	0.88	FT
HYDRAULIC RADIUS, Rh =	0.85	FT	FROUDE NO. =	0.38	SUBCRITICAL
CALC. VELOCITY =	2.02	FPS			

FREEBOARD REQUIRED =	1.05	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	2.1	FT	(CHANNEL LINING: SOIL AND GRASS)

MACH MINING

DITCH "H"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #-	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH H



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	11.500	11.500	37.18	3.81

Structure Detail:

Structure #1 (Null)

DITCH H

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	11.500	0.356	0.000	0.000	80.000	M	37.18	3.806
	Σ	**11.500**						**37.18**	**3.806**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	5.20	520.00	3.000	0.048
		8. Large gullies, diversions, and low flowing streams	0.25	4.17	1,668.00	1.500	0.308
#1	**1**	**Time of Concentration:**					**0.356**

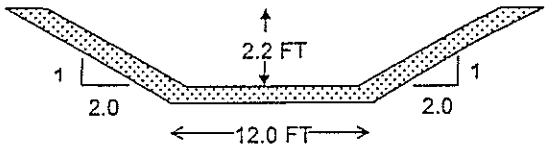
279

CALCULATED BY: JLH 5/24/2006
CHECKED BY: [illegible] 6/12/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH H

PEAK FLOW =	37.2	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.0025	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	17.23	FT	DEPTH OF FLOW =	1.17	FT
AREA OF FLOW =	16.78	SQ.FT.	MEAN DEPTH =	1.01	FT
HYDRAULIC RADIUS, Rh =	0.97	FT	FROUDE NO. =	0.39	SUBCRITICAL
CALC. VELOCITY =	2.21	FPS			

FREEBOARD REQUIRED =	1.06	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	**2.2**	FT	**(CHANNEL LINING: SOIL AND GRASS)**

MACH MINING

DITCH "I"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

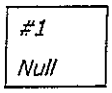
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH I



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	25.700	25.700	82.86	8.51

Structure Detail:

Structure #1 (Null)

DITCH I

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	25.700	0.359	0.000	0.000	80.000	M	82.86	8.505
	Σ	**25.700**						**82.86**	**8.505**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	5.20	520.00	3.000	0.048
		8. Large gullies, diversions, and low flowing streams	24.21	46.00	190.00	14.760	0.003
		8. Large gullies, diversions, and low flowing streams	0.25	4.17	1,668.00	1.500	0.308
#1	**1**	**Time of Concentration:**					**0.359**

CULVERT NO. 3

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.60	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 42 inches

Detailed Performance Curves

Design Discharge = 82.86 cfs

Maximum Headwater = 5.60 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (36 in)	**Discharge (cfs) (42 in)**	Discharge (cfs) (45 in)
0.56	2.63	**3.07**	3.29
1.12	7.45	**8.69**	9.31
1.68	13.68	**15.96**	17.10
2.24	21.06	**24.57**	26.33
2.80	29.44	**34.34**	36.79
3.36	38.69	**45.14**	48.36
3.92	46.65	**56.88**	60.94
4.48	53.56	**67.01**	73.53
5.04	59.68	**75.99**	84.06
5.60	65.22	**84.01**	93.58
6.16	70.34	**91.32**	102.22
6.72	75.09	**98.10**	110.18
7.28	79.57	**104.44**	117.60
7.84	83.82	**110.41**	124.58
8.40	87.85	**116.08**	131.19

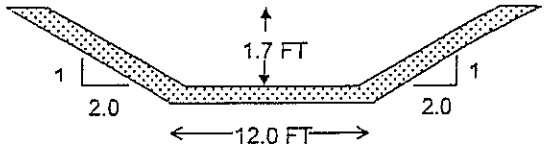
287

CALCULATED BY: JLH 6/29/2006
CHECKED BY: [illegible] 6/30/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH I

PEAK FLOW =	82.9	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.33	FT/FT
MANNING'S N =	0.035	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	14.07	FT	DEPTH OF FLOW =	0.46	FT
AREA OF FLOW =	6.00	SQ.FT.	MEAN DEPTH =	0.43	FT
HYDRAULIC RADIUS, Rh =	0.43	FT	FROUDE NO. =	3.70	SUPERCRITICAL
CALC. VELOCITY =	13.81	FPS			

FREEBOARD REQUIRED =	1.27	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	1.7	FT	(CHANNEL LINING: GROUTED RIPRAP)

MACH MINING

DITCH "J"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

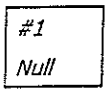
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH J



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	7.900	7.900	31.07	2.61

Structure Detail:

Structure #1 (Null)

DITCH J

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	7.900	0.169	0.000	0.000	80.000	M	31.07	2.614
	Σ	**7.900**						**31.07**	**2.614**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	5.00	500.00	3.000	0.046
		8. Large gullies, diversions, and low flowing streams	0.25	1.67	668.00	1.500	0.123
#1	**1**	**Time of Concentration:**					**0.169**

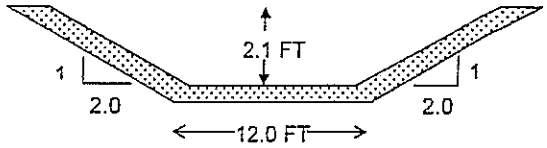
(294)

CALCULATED BY: JLH 5/24/2006
CHECKED BY: [illegible] 6/20/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH J

PEAK FLOW =	31.0	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.0025	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	16.72	FT	DEPTH OF FLOW =	1.05	FT
AREA OF FLOW =	14.88	SQ.FT.	MEAN DEPTH =	0.92	FT
HYDRAULIC RADIUS, Rh =	0.89	FT	FROUDE NO. =	0.38	SUBCRITICAL
CALC. VELOCITY =	2.08	FPS			

FREEBOARD REQUIRED =	1.05	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	**2.1**	**FT**	**(CHANNEL LINING: SOIL AND GRASS)**

MACH MINING

DITCH "K"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LN
BEAVER, WV 25813

Phone: 304
Email: 255-0491

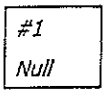
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH K



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	10.800	10.800	34.53	2.85

Structure Detail:

Structure #1 (Null)

DITCH K

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	10.800	0.368	0.000	0.000	80.000	M	34.53	2.852
	Σ	**10.800**						**34.53**	**2.852**

Subwatershed Time of Concentration Details:

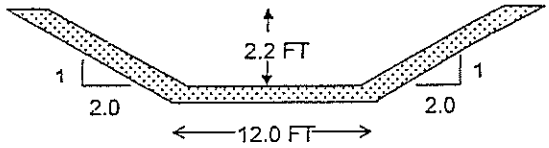
Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	5.20	520.00	3.000	0.048
		8. Large gullies, diversions, and low flowing streams	0.25	4.32	1,730.00	1.500	0.320
#1	**1**	**Time of Concentration:**					**0.368**

CALCULATED BY: JLH 1/8/2007
CHECKED BY: JLF 1/9/07

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH K

PEAK FLOW =	34.5	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.0025	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	17.02	FT	DEPTH OF FLOW =	1.12	FT
AREA OF FLOW =	15.98	SQ.FT.	MEAN DEPTH =	0.97	FT
HYDRAULIC RADIUS, Rh =	0.94	FT	FROUDE NO. =	0.39	SUBCRITICAL
CALC. VELOCITY =	2.16	FPS			

FREEBOARD REQUIRED =	1.06	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	2.2	FT	(CHANNEL LINING: SOIL AND GRASS)

MACH MINING

DITCH "L"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

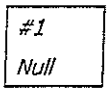
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH L



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	37.000	37.000	117.98	12.24

Structure Detail:

Structure #1 (Null)

DITCH L

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	37.000	0.371	0.000	0.000	80.000	M	117.98	12.245
	Σ	**37.000**						**117.98**	**12.245**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.00	5.20	520.00	3.000	0.048
		8. Large gullies, diversions, and low flowing streams	21.50	43.00	200.00	13.910	0.003
		8. Large gullies, diversions, and low flowing streams	0.25	4.31	1,728.00	1.500	0.320
#1	**1**	**Time of Concentration:**					**0.371**

CULVERT NO. 6

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 36 inches

Detailed Performance Curves

Design Discharge = 59.00 cfs x 2 pipes = 117.98 cfs

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

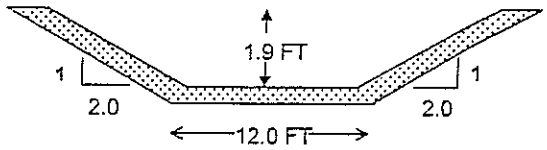
Headwater (ft)	Discharge (cfs) (30 in)	**Discharge (cfs) (36 in)**	Discharge (cfs) (42 in)
0.50	1.86	**2.22**	2.59
1.00	5.24	**6.28**	7.33
1.50	9.62	**11.54**	13.47
2.00	14.81	**17.77**	20.73
2.50	20.69	**24.83**	28.97
3.00	26.85	**32.64**	38.08
3.50	31.83	**41.13**	47.99
4.00	36.21	**47.70**	58.63
4.50	40.12	**53.79**	67.36
5.00	43.68	**59.27**	75.38
5.50	46.97	**64.27**	82.63
6.00	50.04	**68.91**	89.30
6.50	52.94	**73.27**	95.50
7.00	55.69	**77.37**	101.32
7.50	58.30	**81.27**	106.82

CALCULATED BY: JLH 6/28/2006
CHECKED BY: [illegible] 6/29/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH L

PEAK FLOW =	118.0	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.33	FT/FT
MANNING'S N =	0.035	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	14.56	FT	DEPTH OF FLOW =	0.57	FT
AREA OF FLOW =	7.51	SQ.FT.	MEAN DEPTH =	0.53	FT
HYDRAULIC RADIUS, Rh =	0.52	FT	FROUDE NO. =	3.81	SUPERCRITICAL
CALC. VELOCITY =	15.69	FPS			

FREEBOARD REQUIRED =	1.33	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	**1.9**	FT	**(CHANNEL LINING: GROUTED RIPRAP)**

MACH MINING

DITCH "M"

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LN
BEAVER, WV 25813

Phone: 304
Email: 255-0491

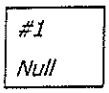
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH M



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	14.500	14.500	75.40	5.39

Structure Detail:

Structure #1 (Null)

DITCH M

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	14.500	0.277	0.000	0.000	87.000	F	75.40	5.390
	Σ	**14.500**						**75.40**	**5.390**

Subwatershed Time of Concentration Details:

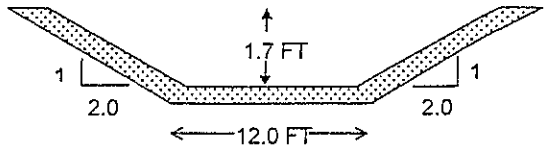
Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	10.00	40.00	400.00	9.480	0.011
		8. Large gullies, diversions, and low flowing streams	0.50	10.17	2,035.00	2.120	0.266
		8. Large gullies, diversions, and low flowing streams	33.33	20.00	60.00	17.320	0.000
#1	**1**	**Time of Concentration:**					**0.277**

CALCULATED BY: JLH 1/8/2007
CHECKED BY: KLF 1/8/07

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH M

PEAK FLOW =	75.4	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.33	FT/FT
MANNING'S N =	0.035	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	13.96	FT	DEPTH OF FLOW =	0.44	FT
AREA OF FLOW =	5.65	SQ.FT.	MEAN DEPTH =	0.41	FT
HYDRAULIC RADIUS, Rh =	0.40	FT	FROUDE NO. =	3.67	SUPERCRITICAL
CALC. VELOCITY =	13.34	FPS			

FREEBOARD REQUIRED =	1.25	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	1.7	FT	(CHANNEL LINING: GROUTED RIPRAP)

WILLIAMSON ENERGY, LLC

POND CREEK MINE NO. 1

WILLIAMSON COUNTY, ILLINOIS

DITCH "N"

AND

CULVERTS 12 AND 15

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LN
BEAVER, WV 25813

Phone: 304
Email: 255-0491

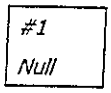
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	5.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	DITCH N



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	75.500	75.500	84.55	14.49

Structure Detail:

Structure #1 (Null)

DITCH N

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	75.500	0.854	0.000	0.000	78.000	M	84.55	14.486
	Σ	**75.500**						**84.55**	**14.486**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	0.27	5.00	1,867.06	1.550	0.334
		8. Large gullies, diversions, and low flowing streams	2.32	12.00	518.00	4.560	0.031
		8. Large gullies, diversions, and low flowing streams	0.25	5.70	2,286.00	1.490	0.426
		8. Large gullies, diversions, and low flowing streams	1.00	2.42	243.00	2.990	0.022
		8. Large gullies, diversions, and low flowing streams	1.50	8.17	545.00	3.670	0.041
#1	**1**	**Time of Concentration:**					**0.854**

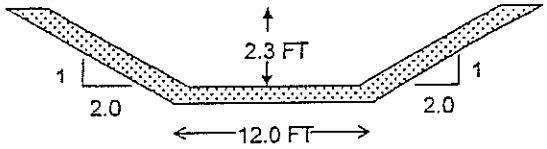
CALCULATED BY: JLH 1/4/2007
CHECKED BY: KLF 1/9/07

(293)

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DITCH N

PEAK FLOW =	84.6	CFS
BOTTOM WIDTH =	12	FT
SIDE SLOPE 1 =	2.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.015	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRAPEZOIDAL DITCH

WETTED PERIMETER =	17.02	FT	DEPTH OF FLOW =	1.12	FT
AREA OF FLOW =	15.98	SQ.FT.	MEAN DEPTH =	0.97	FT
HYDRAULIC RADIUS, Rh =	0.94	FT	FROUDE NO. =	0.95	SUBCRITICAL
CALC. VELOCITY =	5.29	FPS			

FREEBOARD REQUIRED =	1.14	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	2.3	FT	(CHANNEL LINING: SOIL LINED)

CULVERTS 12 AND 15

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
60.00	3.00	0.0240	4.70	0.00	0.90

Culvert Results:

Minimum pipe diameter: 1 - 48 inch pipe(s) required

Detailed Performance Curves

Design Discharge = 84.55 cfs

Maximum Headwater = 4.70 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (45 in)	**Discharge (cfs) (48 in)**	Discharge (cfs) (54 in)
0.47	2.53	**2.70**	3.04
0.94	7.16	**7.63**	8.59
1.41	13.15	**14.03**	15.78
1.88	20.24	**21.59**	24.29
2.35	28.29	**30.17**	33.95
2.82	37.19	**39.67**	44.62
3.29	46.86	**49.98**	56.23
3.76	57.25	**61.06**	68.70
4.23	68.31	**72.86**	81.97
4.70	77.71	**85.07**	96.01
5.17	86.36	**94.61**	110.76
5.64	94.22	**103.87**	122.59
6.11	101.47	**112.37**	134.05
6.58	108.24	**120.26**	144.62
7.05	114.61	**127.67**	154.46

MACH MINING

CULVERT NO. 4

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

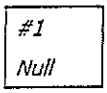
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT NO. 4



329

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	5.300	5.300	33.09	2.08

Structure Detail:

Structure #1 (Null)

CULVERT NO. 4

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	5.300	0.084	0.000	0.000	87.000	F	33.09	2.084
	Σ	**5.300**						**33.09**	**2.084**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	31.62	43.00	136.00	16.860	0.002
		8. Large gullies, diversions, and low flowing streams	1.00	8.89	890.00	3.000	0.082
#1	**1**	**Time of Concentration:**					**0.084**

CULVERT NO. 4

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 30 inches

Detailed Performance Curves

Design Discharge = 33.09 cfs

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (24 in)	**Discharge (cfs) (30 in)**	Discharge (cfs) (36 in)
0.50	1.49	**1.86**	2.22
1.00	4.19	**5.24**	6.28
1.50	7.69	**9.62**	11.54
2.00	11.85	**14.81**	17.77
2.50	16.11	**20.69**	24.83
3.00	19.52	**26.85**	32.64
3.50	22.43	**31.83**	41.13
4.00	25.01	**36.21**	47.70
4.50	27.23	**40.12**	53.79
5.00	29.01	**43.68**	59.27
5.50	30.67	**46.97**	64.27
6.00	32.26	**50.04**	68.91
6.50	33.78	**52.94**	73.27
7.00	35.24	**55.69**	77.37
7.50	36.63	**58.30**	81.27

MACH MINING

CULVERT NO. 5

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

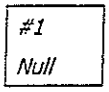
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT NO. 5



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	2.800	2.800	17.48	1.10

Structure Detail:

Structure #1 (Null)

CULVERT NO. 5

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	2.800	0.071	0.000	0.000	87.000	F	17.48	1.101
	Σ	**2.800**						**17.48**	**1.101**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	31.62	43.00	136.00	16.860	0.002
		8. Large gullies, diversions, and low flowing streams	1.00	7.50	750.00	3.000	0.069
#1	**1**	**Time of Concentration:**					**0.071**

CULVERT NO. 5

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 21 inches

Detailed Performance Curves

Design Discharge = 17.48 cfs

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (18 in)	**Discharge (cfs) (21 in)**	Discharge (cfs) (24 in)
0.50	1.12	**1.30**	1.49
1.00	3.14	**3.66**	4.19
1.50	5.77	**6.73**	7.69
2.00	8.43	**10.33**	11.85
2.50	10.45	**13.32**	16.11
3.00	11.83	**15.78**	19.52
3.50	12.91	**17.78**	22.43
4.00	13.91	**19.28**	25.01
4.50	14.83	**20.64**	27.23
5.00	15.71	**21.92**	29.01
5.50	16.54	**23.13**	30.67
6.00	17.33	**24.28**	32.26
6.50	18.08	**25.38**	33.78
7.00	18.80	**26.43**	35.24
7.50	19.50	**27.44**	36.63

MACH MINING

CULVERT NO. 7

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LN
BEAVER, WV 25813

Phone: 304
Email: 255-0491

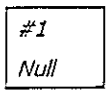
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT NO. 7



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	3.600	3.600	22.48	1.41

Structure Detail:

Structure #1 (Null)

CULVERT NO. 7

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	3.600	0.015	0.000	0.000	87.000	F	22.48	1.411
	Σ	**3.600**						**22.48**	**1.411**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	10.00	52.10	521.00	9.480	0.015
#1	**1**	**Time of Concentration:**					**0.015**

CULVERT NO. 7

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter: 1 - 24 inch pipe(s) required

Detailed Performance Curves

Design Discharge = 22.48 cfs

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (21 in)	**Discharge (cfs) (24 in)**	Discharge (cfs) (30 in)
0.50	1.30	**1.49**	1.86
1.00	3.66	**4.19**	5.24
1.50	6.73	**7.69**	9.62
2.00	10.33	**11.85**	14.81
2.50	13.32	**16.11**	20.69
3.00	15.78	**19.52**	26.85
3.50	17.78	**22.43**	31.83
4.00	19.28	**25.01**	36.21
4.50	20.64	**27.23**	40.12
5.00	21.92	**29.01**	43.68
5.50	23.13	**30.67**	46.97
6.00	24.28	**32.26**	50.04
6.50	25.38	**33.78**	52.94
7.00	26.43	**35.24**	55.69
7.50	27.44	**36.63**	58.30

346

MACH MINING

CULVERT NO. 8

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

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General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

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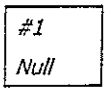
34R

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT NO. 8



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Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	1.200	1.200	7.49	0.47

Structure Detail:

Structure #1 (Null)

CULVERT NO. 8

351

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	1.200	0.053	0.000	0.000	87.000	F	7.49	0.472
	Σ	**1.200**						**7.49**	**0.472**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	0.50	2.05	410.00	2.120	0.053
#1	**1**	**Time of Concentration:**					**0.053**

SEDCAD 4.0

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352

CULVERT NO. 8

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 15 inches

Detailed Performance Curves

Design Discharge = 7.49 cfs

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (12 in)	**Discharge (cfs) (15 in)**	Discharge (cfs) (18 in)
0.50	0.74	**0.94**	1.12
1.00	2.10	**2.62**	3.14
1.50	3.37	**4.78**	5.77
2.00	3.99	**6.36**	8.43
2.50	4.45	**7.28**	10.45
3.00	4.87	**8.02**	11.83
3.50	5.25	**8.70**	12.91
4.00	5.61	**9.32**	13.91
4.50	5.95	**9.90**	14.83
5.00	6.27	**10.46**	15.71
5.50	6.57	**10.99**	16.54
6.00	6.86	**11.49**	17.33
6.50	7.14	**11.98**	18.08
7.00	7.40	**12.44**	18.80
7.50	7.67	**12.89**	19.50

SEDCAD 4 for Windows
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(353)

MACH MINING

CULVERT NO. 9

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

General Information

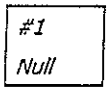
Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

355

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT NO. 9



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	16.200	16.200	84.24	6.37

Structure Detail:

Structure #1 (Null)

CULVERT NO. 9

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	16.200	0.277	0.000	0.000	87.000	F	84.24	6.370
	Σ	**16.200**						**84.24**	**6.370**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	10.00	40.00	400.00	9.480	0.011
		8. Large gullies, diversions, and low flowing streams	33.33	20.00	60.00	17.320	0.000
		8. Large gullies, diversions, and low flowing streams	0.50	10.17	2,035.00	2.120	0.266
#1	**1**	**Time of Concentration:**					**0.277**

CULVERT NO. 9

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 30 inches

Detailed Performance Curves

Design Discharge = 42.12 cfs x 2 pipes = 84.24 cfs

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (24 in)	**Discharge (cfs) (30 in)**	Discharge (cfs) (36 in)
0.50	1.49	**1.86**	2.22
1.00	4.19	**5.24**	6.28
1.50	7.69	**9.62**	11.54
2.00	11.85	**14.81**	17.77
2.50	16.11	**20.69**	24.83
3.00	19.52	**26.85**	32.64
3.50	22.43	**31.83**	41.13
4.00	25.01	**36.21**	47.70
4.50	27.23	**40.12**	53.79
5.00	29.01	**43.68**	59.27
5.50	30.67	**46.97**	64.27
6.00	32.26	**50.04**	68.91
6.50	33.78	**52.94**	73.27
7.00	35.24	**55.69**	77.37
7.50	36.63	**58.30**	81.27

MACH MINING

CULVERT NO. 10

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

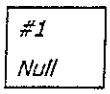
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	CULVERT NO. 10



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	1.500	1.500	9.37	0.59

Structure Detail:

Structure #1 (Null)

CULVERT NO. 10

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	1.500	0.087	0.000	0.000	87.000	F	9.37	0.590
	Σ	**1.500**						**9.37**	**0.590**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	0.50	3.35	670.00	2.120	0.087
#1	**1**	**Time of Concentration:**					**0.087**

CULVERT NO. 10

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter required: 15 inches

Detailed Performance Curves

Design Discharge = 9.37 cfs

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (12 in)	**Discharge (cfs) (15 in)**	Discharge (cfs) (18 in)
0.50	0.74	**0.94**	1.12
1.00	2.10	**2.62**	3.14
1.50	3.37	**4.78**	5.77
2.00	3.99	**6.36**	8.43
2.50	4.45	**7.28**	10.45
3.00	4.87	**8.02**	11.83
3.50	5.25	**8.70**	12.91
4.00	5.61	**9.32**	13.91
4.50	5.95	**9.90**	14.83
5.00	6.27	**10.46**	15.71
5.50	6.57	**10.99**	16.54
6.00	6.86	**11.49**	17.33
6.50	7.14	**11.98**	18.08
7.00	7.40	**12.44**	18.80
7.50	7.67	**12.89**	19.50

CULVERT 11

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
170.00	1.00	0.0240	5.20	0.00	0.90

Culvert Results:

Minimum pipe diameter: 1 - 48 inch pipe(s) required

Detailed Performance Curves

Design Discharge = 86.22 cfs *

Maximum Headwater = 5.20 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (45 in)	**Discharge (cfs) (48 in)**	Discharge (cfs) (54 in)
0.52	18.97	**21.43**	26.54
1.04	22.68	**25.78**	32.32
1.56	26.02	**29.69**	37.54
2.08	29.06	**33.27**	42.33
2.60	31.90	**36.60**	46.76
3.12	37.00	**39.70**	50.91
3.64	48.36	**50.77**	55.47
4.16	60.05	**63.64**	69.72
4.68	70.71	**76.44**	85.18
5.20	76.26	**86.49**	100.75
5.72	81.42	**92.69**	116.12
6.24	86.28	**98.50**	124.23
6.76	90.88	**103.99**	131.85
7.28	95.25	**109.20**	139.05
7.80	99.44	**114.18**	145.87

* Q Based on Spillway Flow for Sediment Ditch 3

CULVERTS 13 AND 14

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
30.00	3.00	0.0240	5.00	0.00	0.90

Culvert Results:

Minimum pipe diameter: 1 - 21 inch pipe(s) required

Detailed Performance Curves

Design Discharge = 19.10 cfs *

Maximum Headwater = 5.00 ft

(BOLD indicates design pipe size)

Headwater (ft)	Discharge (cfs) (18 in)	**Discharge (cfs) (21 in)**	Discharge (cfs) (24 in)
0.50	1.12	**1.30**	1.49
1.00	3.14	**3.66**	4.19
1.50	5.77	**6.73**	7.69
2.00	8.43	**10.33**	11.85
2.50	10.45	**13.32**	16.11
3.00	11.83	**15.78**	19.52
3.50	12.91	**17.78**	22.43
4.00	13.91	**19.28**	25.01
4.50	14.83	**20.64**	27.23
5.00	15.71	**21.92**	29.01
5.50	16.54	**23.13**	30.67
6.00	17.33	**24.28**	32.26
6.50	18.08	**25.38**	33.78
7.00	18.80	**26.43**	35.24
7.50	19.50	**27.44**	36.63

* Q Baseflow Flow From Decant Pipes.

MACH MINING

ROAD GUTTER

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

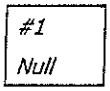
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	ROAD GUTTER



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	0.900	0.900	5.62	0.35

Structure Detail:

Structure #1 (Null)

ROAD GUTTER

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	0.900	0.011	0.000	0.000	87.000	F	5.62	0.354
	Σ	**0.900**						**5.62**	**0.354**

Subwatershed Time of Concentration Details:

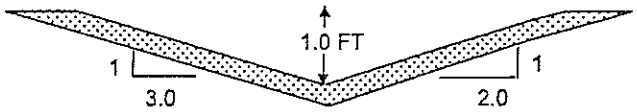
Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	10.00	40.00	400.00	9.480	0.011
#1	**1**	**Time of Concentration:**					**0.011**

CALCULATED BY: JLH 5/25/2006
CHECKED BY: [illegible] 6/21/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: ROAD GUTTER

PEAK FLOW =	5.6	CFS
BOTTOM WIDTH =	0	FT
SIDE SLOPE 1 =	3.00:1	
SIDE SLOPE 2 =	2.00:1	
CHANNEL SLOPE =	0.1	FT/FT
MANNING'S N =	0.035	FT^(1/6)



OUTPUT:

TRIANGULAR DITCH

WETTED PERIMETER =	3.34	FT	DEPTH OF FLOW =	0.62	FT
AREA OF FLOW =	0.96	SQ.FT.	MEAN DEPTH =	0.31	FT
HYDRAULIC RADIUS, Rh =	0.29	FT	FROUDE NO. =	1.85	SUPERCRITICAL
CALC. VELOCITY =	5.84	FPS			

	0.00	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	1.0	FT	(SLOPE OF ROAD WILL PROVIDE ADDITIONAL FREEBOARD)

MACH MINING

BENCH GUTTER

JLH

ALLIANCE CONSULTING INC
124 PHILPOTT LANE
BEAVER WV 25813

Phone: 304-255-0491

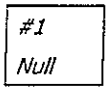
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	BENCH GUTTER



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	8.200	8.200	40.81	3.22

Structure Detail:

Structure #1 (Null)

BENCH GUTTER

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	8.200	0.338	0.000	0.000	87.000	F	40.81	3.224
	Σ	**8.200**						**40.81**	**3.224**

Subwatershed Time of Concentration Details:

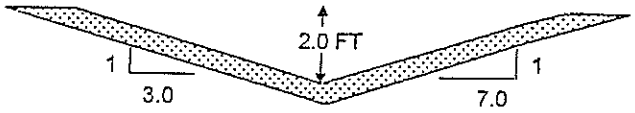
Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	0.50	12.92	2,586.00	2.120	0.338
#1	**1**	**Time of Concentration:**					**0.338**

CALCULATED BY: JLH 6/28/2006
CHECKED BY: [illegible] 6/29/06

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: BENCH GUTTER

PEAK FLOW =	40.8	CFS
BOTTOM WIDTH =	0	FT
SIDE SLOPE 1 =	3.00:1	
SIDE SLOPE 2 =	7.00:1	
CHANNEL SLOPE =	0.005	FT/FT
MANNING'S N =	0.033	FT^(1/6)



OUTPUT:

TRIANGULAR DITCH

WETTED PERIMETER =	17.41	FT	DEPTH OF FLOW =	1.70	FT
AREA OF FLOW =	14.48	SQ.FT.	MEAN DEPTH =	0.85	FT
HYDRAULIC RADIUS, Rh =	0.83	FT	FROUDE NO. =	0.54	SUBCRITICAL
CALC. VELOCITY =	2.82	FPS			

	0.00	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	2.0	FT	(SLOPE OF BENCH WILL PROVIDE ADDITIONAL FREEBOARD)

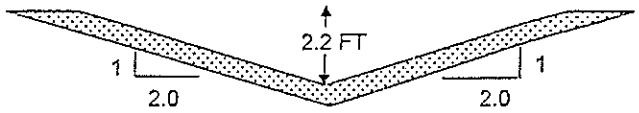
R17364

CALCULATED BY: JLH 12/28/2006
CHECKED BY:

DITCH SIZING UTILITY FOR TRIANGULAR AND TRAPEZOIDAL CONFIGURATIONS USING MANNING'S EQUATION:

INPUT: DECANT DITCH

PEAK FLOW =	19.1	CFS	FLOW BASED ON MAXIMUM FLOW OF DECANT PIPE
BOTTOM WIDTH =	0	FT	
SIDE SLOPE 1 =	2.00:1		
SIDE SLOPE 2 =	2.00:1		
CHANNEL SLOPE =	0.33	FT/FT	
MANNING'S N =	0.035	FT^(1/6)	



OUTPUT:

TRIANGULAR DITCH

WETTED PERIMETER =	3.84	FT	DEPTH OF FLOW =	0.86	FT
AREA OF FLOW =	1.48	SQ.FT.	MEAN DEPTH =	0.43	FT
HYDRAULIC RADIUS, Rh =	0.38	FT	FROUDE NO. =	3.47	SUPERCRITICAL
CALC. VELOCITY =	12.89	FPS			

FREEBOARD REQUIRED =	1.31	FT	(1+0.025vd^1/3)
TOTAL DEPTH =	2.2	FT	(CHANNEL LINING: GROUTED RIPRAP)

8114-10
Part 31

APPENDIX C

Laboratory Testing

APPENDIX C

LABORATORY TESTING
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
POND CREEK MINE NO. 1
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY, LLC
~~BECKLEY, WEST VIRGINIA~~

TABLE OF CONTENTS

	PAGE
SOIL TESTING	
Summary	1
Strength Test	3
Grain Size	10
Atterberg Limits Test Results	12
COARSE COAL REFUSE TESTING	
Summary	13
Grain Size	15
Proctor Test	17
Permeability Test	18
Strength Test	20

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

SHIPPING ADDRESS
Box 393 Wood Road
Carbondale, IL 62901

MAILING ADDRESS
P.O. Box 88
Carbondale, IL 62903

618-529-5262
800-333-1740
FAX 618-457-8991

3

February 10, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Soil Boring and Laboratory Tests
Boring #8874
Mach Mine #1
Johnston City, Illinois
HFE File H-05278
Mach Mining Purchase Order No. _____

Dear Sir:

In accordance with your instructions, on February 1, 2006, we drilled one soil boring and sampled the subsoils with Shelby tubes. The soil sample taken from 10 to 12 feet in depth was subjected to laboratory tests. Results of the tests are as follows:

Boring No.:	8874
Depth:	8.0-10.0'
Visual Classification:	Silty CLAY (CL)
Atterberg Limits:	LL = 41.8% PL = 17.7% PI = 24.1
Unit Weight:	105.3 PCF
Moisture Content:	21.5%
Effective Cohesion:	0 PSF
Effective Phi Angle:	26.8 Degrees

4

The Boring Log and test results are enclosed. If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

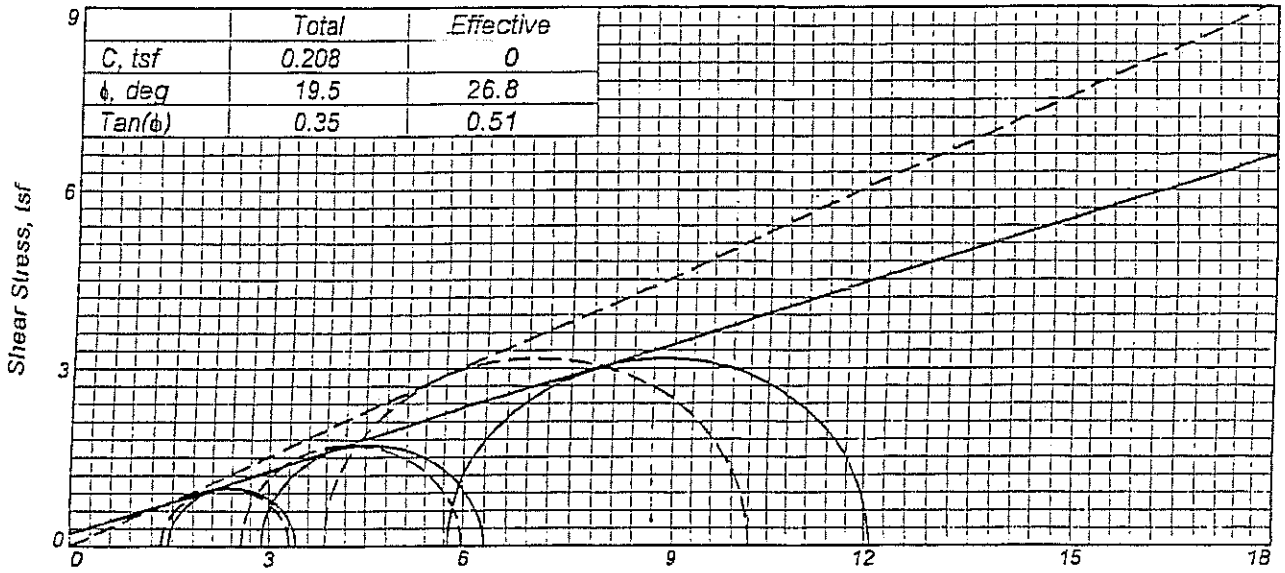
REGISTERED PROFESSIONAL ENGINEER
TIMOTHY J.
HOLCOMB
062-042149
2-10-06
ILLINOIS

1 copy: Fred Vass - Alliance Consulting

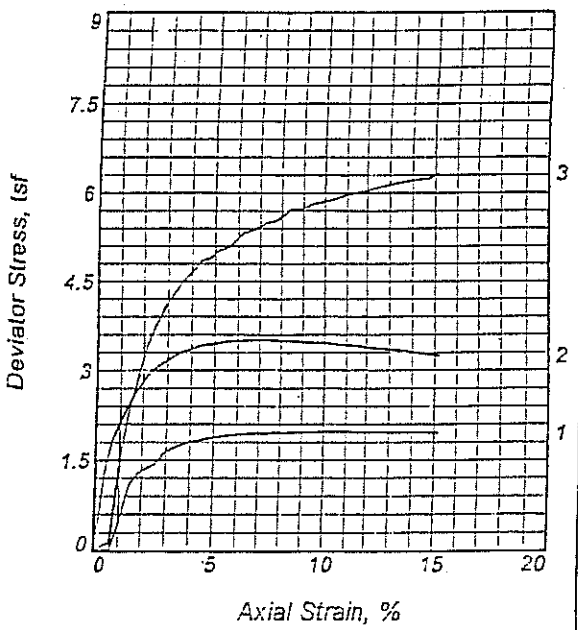
R17369

5

	Total	Effective
C, tsf	0.208	0
ϕ, deg	19.5	26.8
Tan(ϕ)	0.35	0.51



Total Normal Stress, tsf ———
Effective Normal Stress, tsf — — —



Sample No.		1	2	3
Initial	Water Content,	21.5	20.8	17.6
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	99.7	98.9
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
At Test	Water Content,	21.5	20.9	17.8
	Dry Density, pcf	105.3	106.5	112.5
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.5706	0.5536	0.4707
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.51	5.49	5.54
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, tsf		3.6	3.6	2.2
Cell Pressure, tsf		5.0	6.5	7.9
Fail. Stress, tsf		2.0	3.4	6.3
Total Pore Pr., tsf		3.7	3.9	4.1
Ult. Stress, tsf		2.0	3.2	6.3
Total Pore Pr., tsf		3.6	3.8	4.1
$\bar{\sigma}_1$ Failure, tsf		3.3	6.0	10.2
$\bar{\sigma}_3$ Failure, tsf		1.3	2.6	3.9

Type of Test:
CU with Pore Pressures
Sample Type: Shelby Tube - Undisturbed
Description: Gray Mottled Brown Silty CLAY

LL= 41.8 PL= 17.7 PI= 24.1
Assumed Specific Gravity= 2.65
Remarks:

Client: Alliance Consulting

Project: Triaxial Test
Mach Mine #1
Location: Boring #8874
Sample Number: 3 **Depth:** 10.0-12.0'
Proj. No.: H-05278 **Date:** 2-1-05

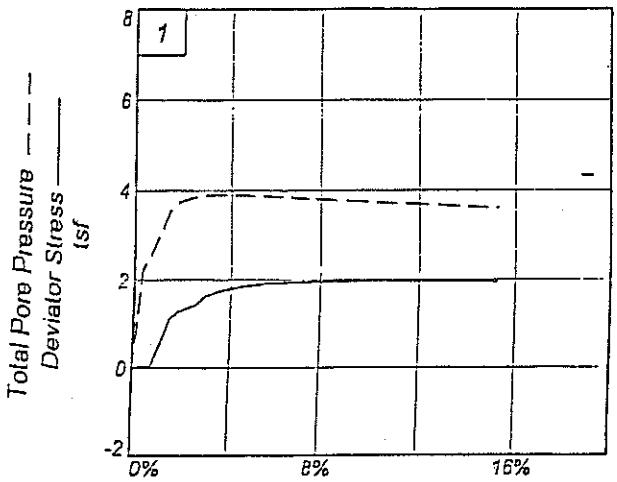
TRIAXIAL SHEAR TEST REPORT

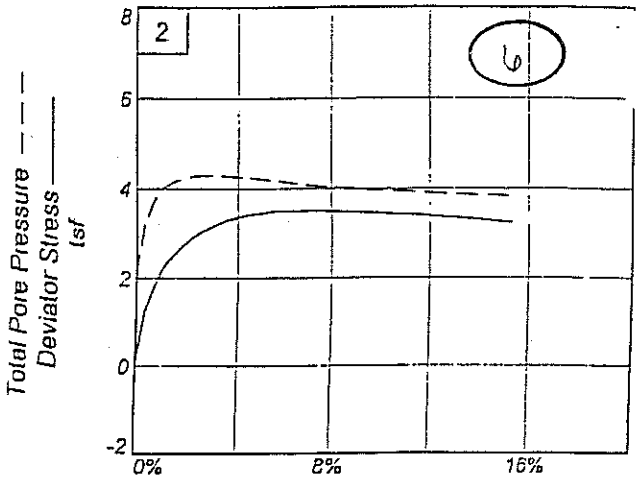
HOLCOMB FOUNDATION ENGINEERING CO.

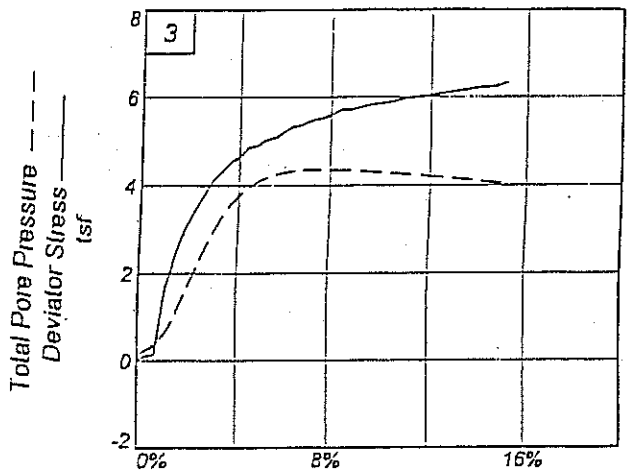
Plate _____

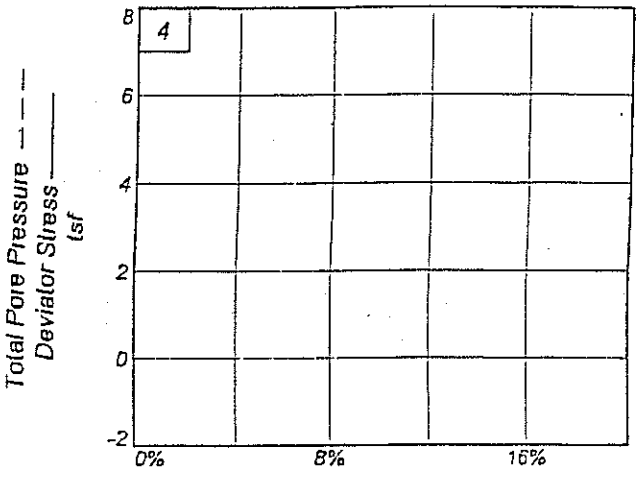
Tested By: LC Checked By: TH

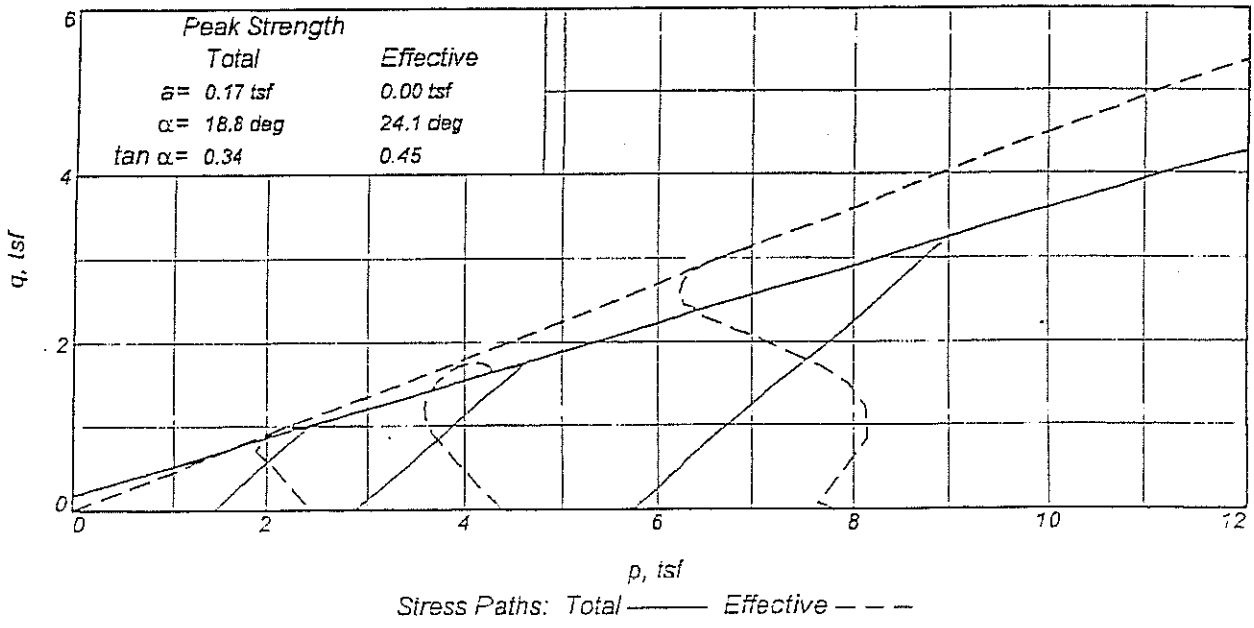
R17870











Client: Alliance Consulting
Project: Triaxial Test
Location: Boring #8874
Project No.: H-05278

Depth: 10.0-12.0'
Plate _____

Sample Number: 3

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC

Checked By: TH

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

(7)

Date: 2-1-05
Client: Alliance Consulting
Project: Triaxial Test
Mach Mine #1
Johnston City, Illinois
Location: Boring #8874
Depth: 10.0-12.0' Sample Number: 3
Description: Gray Mottled Brown Silty CLAY
Remarks:
Type of Sample: Shelby Tube - Undisturbed
Assumed Specific Gravity=2.65 LL=41.8 PL=17.7 PI=24.1
Test Method: COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	189.100			1279.000
Moisture content: Dry soil+tare, gms.	176.100			1072.200
Moisture content: Tare, gms.	115.700			103.200
Moisture, %	21.5	21.5	21.5	21.3
Moist specimen weight, gms.	1140.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.51	5.51	5.51	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.0	128.0	128.0	
Dry density, pcf	105.3	105.3	105.3	
Void ratio	0.5706	0.5706	0.5706	
Saturation, %	100.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 1.981 tsf at reading no. 24
Ult. Stress = 1.955 tsf at reading no. 30

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	18.30	0.0	0.0	0.000	5.112	5.112	1.00	-1.00	5.112	0.000
1	0.0190	20.00	1.7	0.3	0.014	2.830	2.844	1.00	30.70	2.837	0.007
2	0.0400	21.60	3.3	0.7	0.026	2.426	2.452	1.01	36.30	2.439	0.013
3	0.0810	113.20	94.9	1.5	1.093	1.505	2.598	1.73	49.10	2.051	0.547
4	0.1010	129.80	111.5	1.8	1.280	1.318	2.597	1.97	51.70	1.958	0.640
5	0.1420	143.10	124.8	2.6	1.422	1.181	2.602	2.20	53.60	1.892	0.711
6	0.1620	161.50	143.2	2.9	1.625	1.159	2.784	2.40	53.90	1.972	0.813
7	0.1830	168.90	150.6	3.3	1.702	1.145	2.847	2.49	54.10	1.996	0.851
8	0.2030	174.80	156.5	3.7	1.763	1.138	2.900	2.55	54.20	2.019	0.881
9	0.2240	178.90	160.6	4.1	1.802	1.145	2.946	2.57	54.10	2.046	0.901
10	0.2440	182.30	164.0	4.4	1.833	1.145	2.978	2.60	54.10	2.061	0.916
11	0.2650	186.40	168.1	4.8	1.871	1.152	3.023	2.62	54.00	2.088	0.936
12	0.2850	188.10	169.8	5.2	1.883	1.166	3.049	2.61	53.80	2.108	0.941
13	0.3060	191.40	173.1	5.6	1.912	1.166	3.078	2.64	53.80	2.122	0.956
14	0.3260	193.10	174.8	5.9	1.923	1.181	3.104	2.63	53.60	2.142	0.962
15	0.3460	194.70	176.4	6.3	1.933	1.188	3.121	2.63	53.50	2.155	0.967
16	0.3670	196.40	178.1	6.7	1.944	1.202	3.146	2.62	53.30	2.174	0.972
17	0.3870	198.10	179.8	7.0	1.955	1.210	3.164	2.62	53.20	2.187	0.977
18	0.4080	198.10	179.8	7.4	1.947	1.224	3.171	2.59	53.00	2.197	0.973
19	0.4280	200.60	182.3	7.8	1.966	1.231	3.197	2.60	52.90	2.214	0.983
20	0.4490	200.60	182.3	8.1	1.958	1.238	3.196	2.58	52.80	2.217	0.979
21	0.4890	203.10	184.8	8.9	1.969	1.267	3.236	2.55	52.40	2.252	0.985
22	0.5300	204.70	186.4	9.6	1.970	1.289	3.259	2.53	52.10	2.274	0.985
23	0.5710	207.20	188.9	10.4	1.980	1.310	3.290	2.51	51.80	2.300	0.990
24	0.6120	208.90	190.6	11.1	1.981	1.332	3.313	2.49	51.50	2.323	0.991
25	0.6530	209.10	190.8	11.8	1.967	1.346	3.313	2.46	51.30	2.330	0.983
26	0.6940	211.40	193.1	12.6	1.974	1.361	3.334	2.45	51.10	2.348	0.987
27	0.7350	212.20	193.9	13.3	1.965	1.390	3.354	2.41	50.70	2.372	0.982
28	0.7790	213.90	195.6	14.1	1.964	1.404	3.368	2.40	50.50	2.386	0.982
29	0.8170	215.50	197.2	14.8	1.964	1.426	3.390	2.38	50.20	2.408	0.982
30	0.8380	215.50	197.2	15.2	1.955	1.433	3.388	2.36	50.10	2.410	0.978

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	154.800			1347.900
Moisture content: Dry soil+tare, gms.	145.800			1154.100
Moisture content: Tare, gms.	102.600			135.100
Moisture, %	20.8	20.9	20.9	19.0
Moist specimen weight, gms.	1142.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.49	5.49	5.49	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	128.7	128.7	128.7	
Dry density, pcf	106.5	106.5	106.5	
Void ratio	0.5536	0.5536	0.5536	
Saturation, %	99.7	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 90.00 psi (6.480 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 2.880 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 3.418 tsf at reading no. 24
Ult. Stress = 3.250 tsf at reading no. 29

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	27.50	0.0	0.0	0.000	4.385	4.385	1.00	29.10	4.385	0.000
1	0.0190	134.00	106.5	0.3	1.241	3.254	4.495	1.38	44.80	3.875	0.620
2	0.0400	183.10	155.6	0.7	1.806	2.750	4.557	1.66	51.80	3.653	0.903
3	0.0600	218.90	191.4	1.1	2.214	2.484	4.698	1.89	55.50	3.591	1.107
4	0.0810	243.80	216.3	1.5	2.492	2.340	4.832	2.06	57.50	3.586	1.246
5	0.1010	264.60	237.1	1.8	2.721	2.254	4.975	2.21	58.70	3.614	1.361
6	0.1220	282.10	254.6	2.2	2.911	2.210	5.121	2.32	59.30	3.666	1.455
7	0.1420	295.40	267.9	2.6	3.052	2.182	5.233	2.40	59.70	3.707	1.526
8	0.1620	305.40	277.9	2.9	3.154	2.182	5.335	2.45	59.70	3.758	1.577
9	0.1830	314.60	287.1	3.3	3.245	2.189	5.434	2.48	59.60	3.811	1.623
10	0.2030	322.10	294.6	3.7	3.317	2.196	5.513	2.51	59.50	3.855	1.659
11	0.2240	327.10	299.6	4.1	3.360	2.218	5.578	2.52	59.20	3.898	1.680
12	0.2440	332.90	305.4	4.4	3.412	2.232	5.644	2.53	59.00	3.938	1.706
13	0.2650	336.20	308.7	4.8	3.435	2.254	5.689	2.52	58.70	3.971	1.718
14	0.2850	339.50	312.0	5.2	3.459	2.275	5.734	2.52	58.40	4.005	1.729
15	0.3060	343.70	316.2	5.6	3.491	2.297	5.788	2.52	58.10	4.042	1.746
16	0.3260	345.40	317.9	5.9	3 497	2.318	5.815	2.51	57.80	4.067	1.748
17	0.3670	348.70	321.2	6.7	3.505	2.369	5.874	2.48	57.10	4.121	1.752
18	0.4080	352.00	324.5	7.4	3.512	2.412	5.924	2.46	56.50	4.168	1.756
19	0.4490	353.70	326.2	8.2	3.502	2.441	5.943	2.43	56.10	4.192	1.751
20	0.4890	354.50	327.0	8.9	3.483	2.470	5.953	2.41	55.70	4.211	1.742
21	0.5300	355.40	327.9	9.7	3.464	2.498	5.963	2.39	55.30	4.230	1.732

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.5510	357.00	329.5	10.0	3.466	2.513	5.979	2.38	55.10	4.246	1.733
23	0.5920	356.20	328.7	10.8	3.429	2.534	5.964	2.35	54.80	4.249	1.715
24	0.6330	357.90	330.4	11.5	3.418	2.556	5.974	2.34	54.50	4.265	1.709
25	0.6730	357.00	329.5	12.3	3.381	2.585	5.966	2.31	54.10	4.275	1.690
26	0.7140	357.90	330.4	13.0	3.361	2.599	5.960	2.29	53.90	4.280	1.681
27	0.7550	357.90	330.4	13.7	3.332	2.614	5.946	2.27	53.70	4.280	1.666
28	0.7960	356.20	328.7	14.5	3.286	2.628	5.914	2.25	53.50	4.271	1.643
29	0.8370	355.40	327.9	15.2	3.250	2.635	5.885	2.23	53.40	4.260	1.625

10

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	248.400			1374.500
Moisture content: Dry soil+tare, gms.	226.700			1195.400
Moisture content: Tare, gms.	103.200			127.700
Moisture, %	17.6	17.8	17.8	16.8
Moist specimen weight, gms.	1184.7			
Diameter, in.	2.80	2.80	2.80	
Area, in.^{2}	6.16	6.16	6.16	
Height, in.	5.54	5.54	5.54	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	132.3	132.5	132.5	
Dry density, pcf	112.5	112.5	112.5	
Void ratio	0.4707	0.4707	0.4707	
Saturation, %	98.9	100.0	100.0	

Membrane modulus = 0.124105 kN/cm^2
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 30%
Consolidation cell pressure = 110.00 psi (7.920 tsf)
Consolidation back pressure = 30.00 psi (2.160 tsf)
Consolidation effective confining stress = 5.760 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 6.334 tsf at reading no. 33
Ult. Stress = 6.334 tsf at reading no. 33

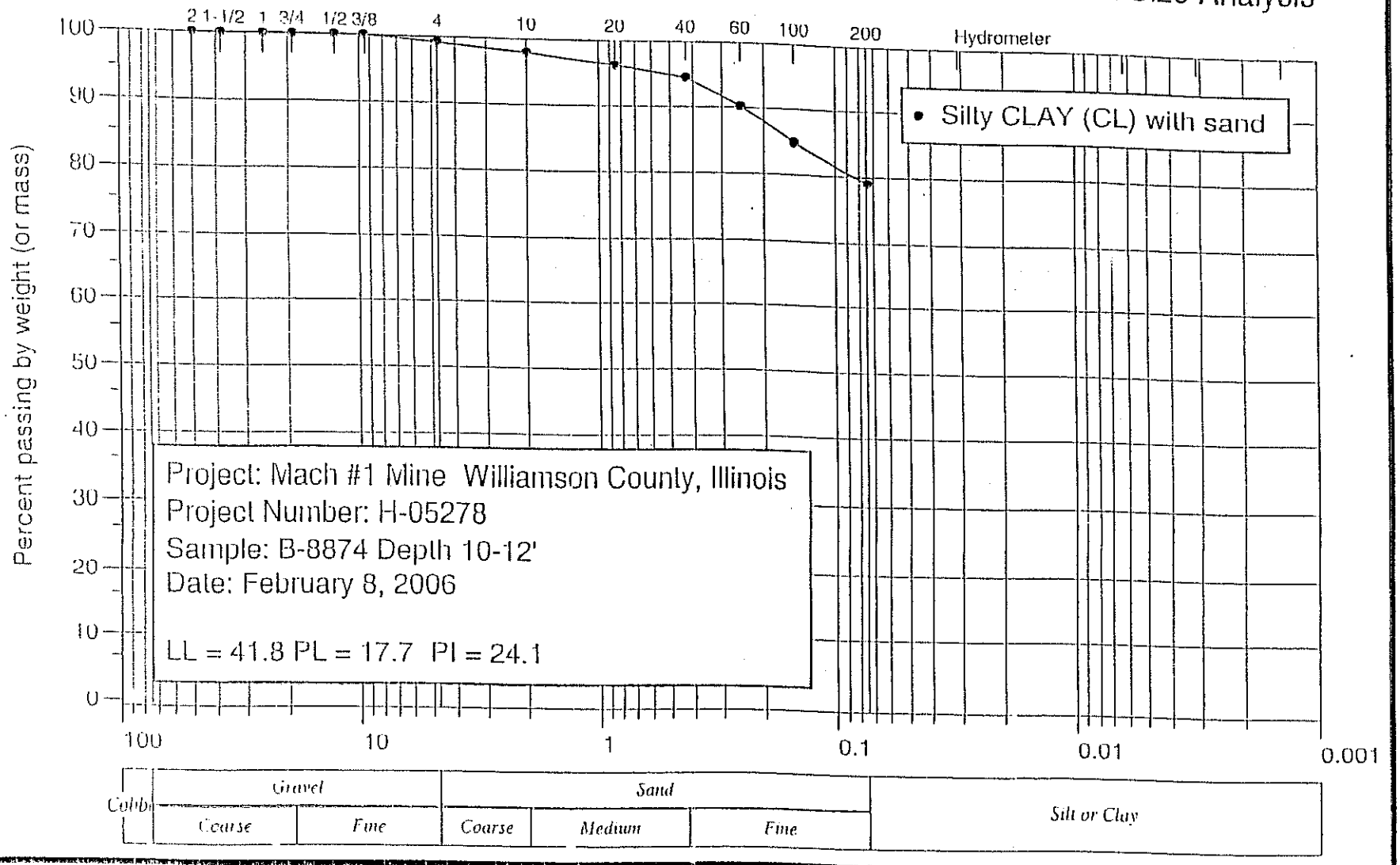
No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	31.60	0.0	0.0	0.000	7.812	7.812	1.00	1.50	7.812	0.000
1	0.0190	39.90	8.3	0.3	0.091	7.690	7.781	1.01	3.20	7.735	0.045
2	0.0400	44.10	12.5	0.7	0.133	7.574	7.707	1.02	4.80	7.641	0.066
3	0.0600	175.60	144.0	1.1	1.666	7.308	8.974	1.23	8.50	8.141	0.833
4	0.0810	240.50	208.9	1.5	2.407	6.926	9.333	1.35	13.80	8.130	1.203
5	0.1010	291.30	259.7	1.8	2.981	6.466	9.447	1.46	20.20	7.956	1.491
6	0.1220	329.60	298.0	2.2	3.408	5.983	9.391	1.57	26.90	7.687	1.704
7	0.1420	362.00	330.4	2.6	3.764	5.479	9.244	1.69	33.90	7.361	1.882
8	0.1620	392.00	360.4	2.9	4.091	5.040	9.131	1.81	40.00	7.085	2.045
9	0.1830	412.80	381.2	3.3	4.310	4.666	8.976	1.92	45.20	6.821	2.155

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
10	0.2030	432.80	401.2	3.7	4.519	4.363	8.883	2.04	49.40	6.623	2.260
11	0.2240	446.90	415.3	4.0	4.660	4.140	8.800	2.13	52.50	6.470	2.330
12	0.2440	465.20	433.6	4.4	4.847	3.982	8.828	2.22	54.70	6.405	2.423
13	0.2650	471.00	439.4	4.8	4.892	3.852	8.744	2.27	56.50	6.298	2.446
14	0.2850	483.50	451.9	5.1	5.012	3.766	8.778	2.33	57.70	6.272	2.506
15	0.3060	490.20	458.6	5.5	5.066	3.694	8.760	2.37	58.70	6.227	2.533
16	0.3260	503.50	471.9	5.9	5.193	3.643	8.837	2.43	59.40	6.240	2.597
17	0.3460	516.80	485.2	6.2	5.319	3.607	8.926	2.47	59.90	6.267	2.660
18	0.3670	521.80	490.2	6.6	5.352	3.586	8.938	2.49	60.20	6.262	2.676
19	0.3870	530.10	498.5	7.0	5.422	3.571	8.993	2.52	60.40	6.282	2.711
20	0.4080	538.40	506.8	7.4	5.490	3.564	9.054	2.54	60.50	6.309	2.745
21	0.4280	543.40	511.8	7.7	5.522	3.564	9.086	2.55	60.50	6.325	2.761
22	0.4490	554.30	522.7	8.1	5.617	3.571	9.188	2.57	60.40	6.380	2.808
23	0.4690	565.90	534.3	8.5	5.719	3.578	9.297	2.60	60.30	6.438	2.859
24	0.4890	567.60	536.0	8.8	5.714	3.578	9.293	2.60	60.30	6.436	2.857
25	0.5300	581.70	550.1	9.6	5.817	3.600	9.417	2.62	60.00	6.509	2.909
26	0.5710	591.70	560.1	10.3	5.874	3.636	9.510	2.62	59.50	6.573	2.937
27	0.6120	605.00	573.4	11.0	5.964	3.665	9.629	2.63	59.10	6.647	2.982
28	0.6530	615.00	583.4	11.8	6.018	3.701	9.719	2.63	58.60	6.710	3.009
29	0.6940	626.70	595.1	12.5	6.087	3.737	9.824	2.63	58.10	6.780	3.044
30	0.7350	638.30	606.7	13.3	6.153	3.773	9.926	2.63	57.60	6.849	3.077
31	0.7760	649.10	617.5	14.0	6.209	3.816	10.025	2.63	57.00	6.921	3.105
32	0.8170	657.50	625.9	14.7	6.240	3.852	10.092	2.62	56.50	6.972	3.120
33	0.8390	669.90	638.3	15.1	6.334	3.866	10.200	2.64	56.30	7.033	3.167

11

Holcomb Foundation Engineering

Grain Size Analysis



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13

Holcomb Foundation Engineering Company

Laboratory Testing Results

2/8/2006

Project: Mach #1 Mine

Project No: H-05278

Sieve Analysis - ASTM C136-96a

Sample: Silty CLAY (CL)

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
1.5000	38.1000	1 -1/2"	0.0	0.0	100.0
1.0000	25.4000	1"	0.0	0.0	100.0
0.7500	19.1000	3/4"	0.0	0.0	100.0
0.5000	12.7000	1/2"	0.0	0.0	100.0
3.7500	9.5200	3/8"	0.0	0.0	100.0
0.1870	4.7600	No. 4	2.1	0.9	99.1
0.0790	2.0000	No. 10	4.6	2.0	98.0
0.0469	1.1800	No. 16	4.6	2.0	98.0
0.0331	0.8500	No. 20	8.6	3.8	96.2
0.0165	0.4200	No. 40	12.6	5.5	94.5
0.0117	0.2980	No. 50	12.6	5.5	94.5
0.0083	0.2500	No. 60	22.2	9.8	90.2
0.0059	0.1490	No. 100	34.6	15.2	84.8
0.0029	0.0740	No. 200	47.7	21.0	79.0

Total Weight in Grams 227.20

Holcomb Foundation Engineering Company

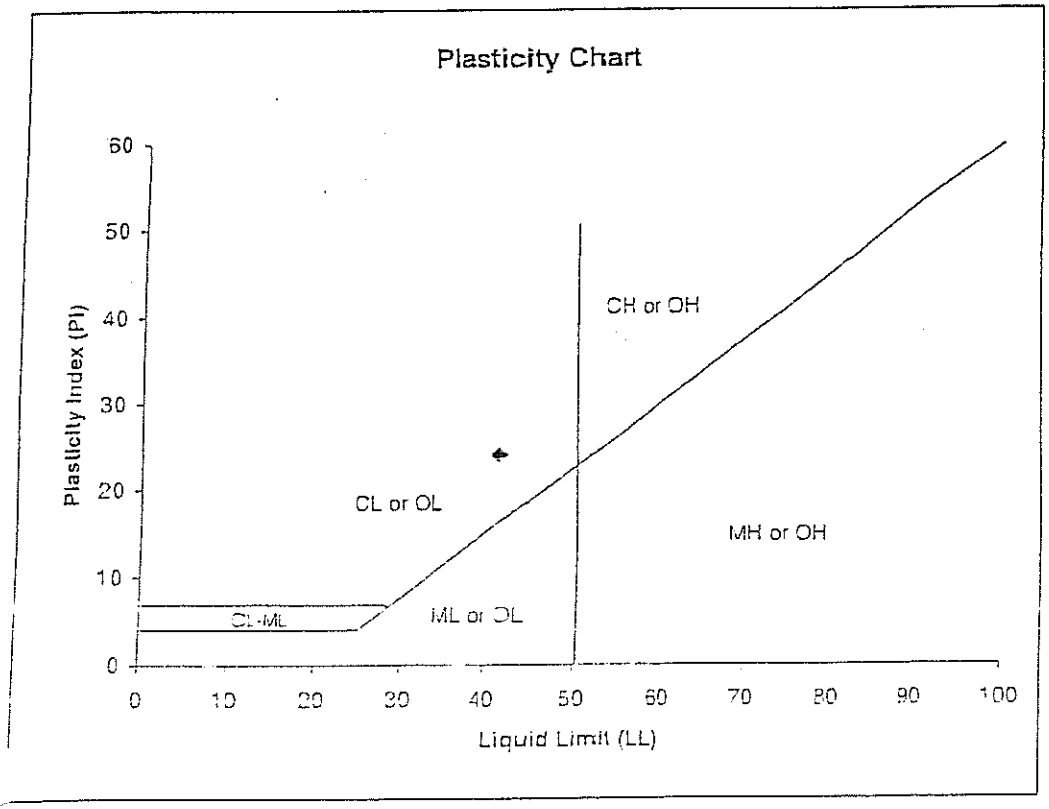
Laboratory Testing Results

Project: Mach #1 Mine
Project No: H-05278

Sample	1	2	3
Dish Number	LL_1	LL_2	LL_3
Mass of can, W_1 (g)	34.70		
Mass of can + moist soil, W_2 (g)	62.84		
Mass of can + dry soil, W_3 (g)	54.52		
Moisture content, w (%)	41.98		
Number of blows, N	24		
Liquid Limit, LL	41.8		

Dish Number	PL_1
Mass of can, W_1 (g)	39.76
Mass of can + moist soil, W_2 (g)	54.79
Mass of can + dry soil, W_3 (g)	52.53
Plastic Limit, PL	17.7

PI = 24.1



HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

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November 30, 2006

Williamson Energy LLC
PO Box 99
Johnston City, Illinois 62951

Attention: Mr. James Plumley

Re: Coarse Refuse Laboratory Tests
Pond Creek Mine
Johnston City, Illinois
HFE File H-05278

Dear Sir:

In accordance with your instructions, on November 17, 2006, we sampled coarse refuse at Mach Mine and performed laboratory tests on remolded samples. Results of the tests are as follows:

Visual Classification: Coarse Coal Refuse (Shale, Coal, Sandstone Mixture)

Proctor Test Results:
Maximum Dry Unit Weight: 124.6 PCF
Optimum Moisture Content: 9.3 %

Specific Gravity: 2.37

Triaxial Test Results:
Effective Cohesion: 0 PSF
Effective Phi Angle: 33.7 Degrees

Permeability: 2 x 10-4 cm./sec.

Results of the grain size analysis and the laboratory tests are attached.

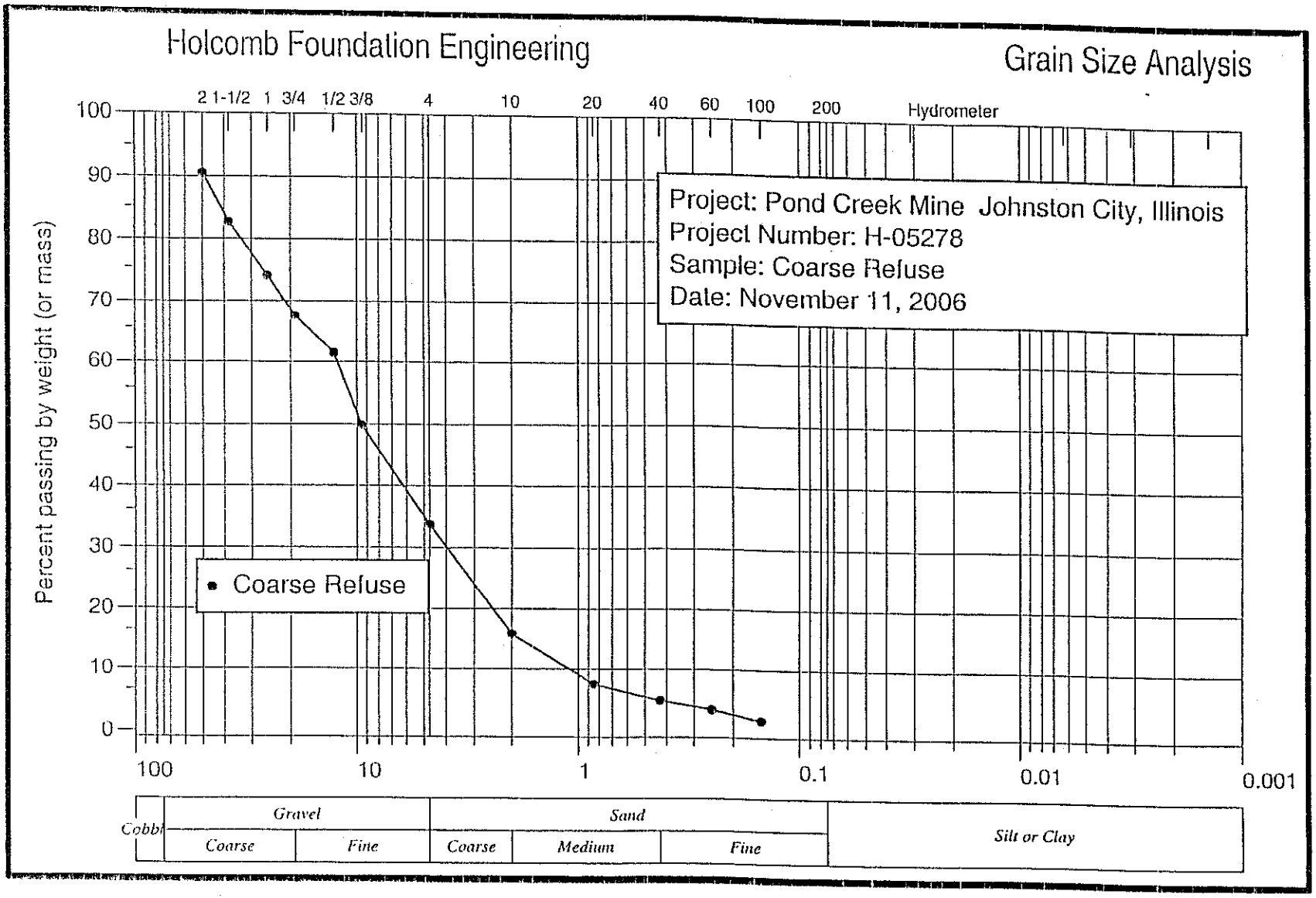
If you should have any questions, or if we can be of further assistance, please feel free to contact us at your convenience.

Sincerely,

HOLCOMB FOUNDATION ENGINEERING CO.

Timothy J. Holcomb, P.E.

1 copy: Justin Harry - Alliance Consulting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Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
Project: Pond Creek Mine Johnston City, Illinois
Project Number: H-05278
Sample: Coarse Refuse
Date: November 11, 2006
Coarse Refuse
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

R17381

Holcomb Foundation Engineering Company

Laboratory Testing Results 11/30/2006

Project: Coarse Refuse Disposal Area
Pond Creek Mine Johnston City, Illinois

Project No: H-05317

Sieve Analysis - ASTM C136-96a

Sample: Coarse Refuse

Sieve Openings		US Standard	Weight	Percent	Percent
Inches	Millimeters	Sieve Size	Retained	Retained	Finer
3	76.2	3"	0.0	0.0	100.0
2.0000	50.8100	2"	619.6	9.5	90.5
1.5000	38.1000	1 -1/2"	1124.0	17.2	82.8
1.0000	25.4000	1"	1696.2	25.9	74.1
0.7500	19.1000	3/4"	2110.9	32.3	67.7
0.5000	12.7000	1/2"	2513.0	38.4	61.6
3.7500	9.5200	3/8"	3263.7	49.9	50.1
0.1870	4.7600	No. 4	4310.7	65.9	34.1
0.0790	2.0000	No. 10	5470.5	83.6	16.4
0.0469	1.1800	No. 16			
0.0331	0.8500	No. 20	6004.4	91.8	8.2
0.0165	0.4200	No. 40	6178.9	94.4	5.6
0.0117	0.2980	No. 50			
0.0083	0.2500	No. 60	6267.8	95.8	4.2
0.0059	0.1490	No. 100			
0.0029	0.0740	No. 200	6372.4	97.4	2.6

Total Weight in Grams 6542.80

Holcomb Foundation Engineering

Moisture Density Relationship

Project: Pond Creek Mine
Johnston City, Illinois

Location: Coarse Refuse Disposal Area

Project No.: H-05278

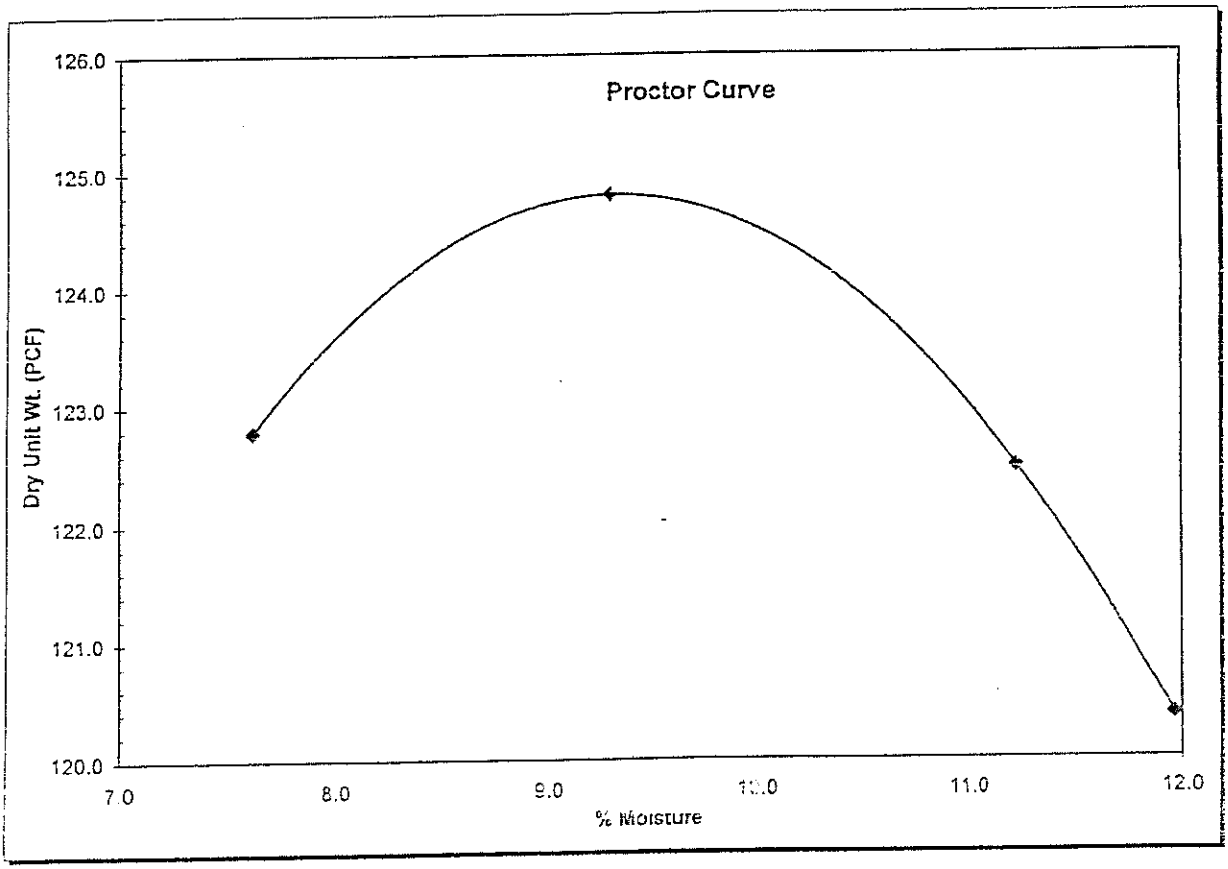
Date: 11/30/2006

Proctor Test Results

Soil Classification:	Gray Coarse Refuse
Maximum Dry Density (PCF)	124.8
Optimum Moisture Content (%)	9.3

Test Data ASTM D-698 (standard)

Moisture Content (%)	Dry Unit Wt. (PCF)
7.6	122.8
11.2	122.5
12.0	120.4
9.3	124.8



HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

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P.O. Box 88
Carbondale, IL 62903

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800-333-1740
FAX 618-457-8991

Permeability Tests Results

Laboratory Tests
Coarse Refuse
Pond Creek Mine - Johnston City, Illinois

Date: 11/30/2006

Client: Pond Creek Mine
Johnston City, Illinois

Project No.: H-05278

Sample	Depth (Ft.)	Moisture Content (%) Before Test	Moisture Content (%) After Test	Dry Unit Weight (PCF)	Permeability (Cm./Sec.)
Coarse Refuse		7.7	11.8	119.3	2 x 10-4

Permeability Tests performed in accordance with ASTM D-5084

21

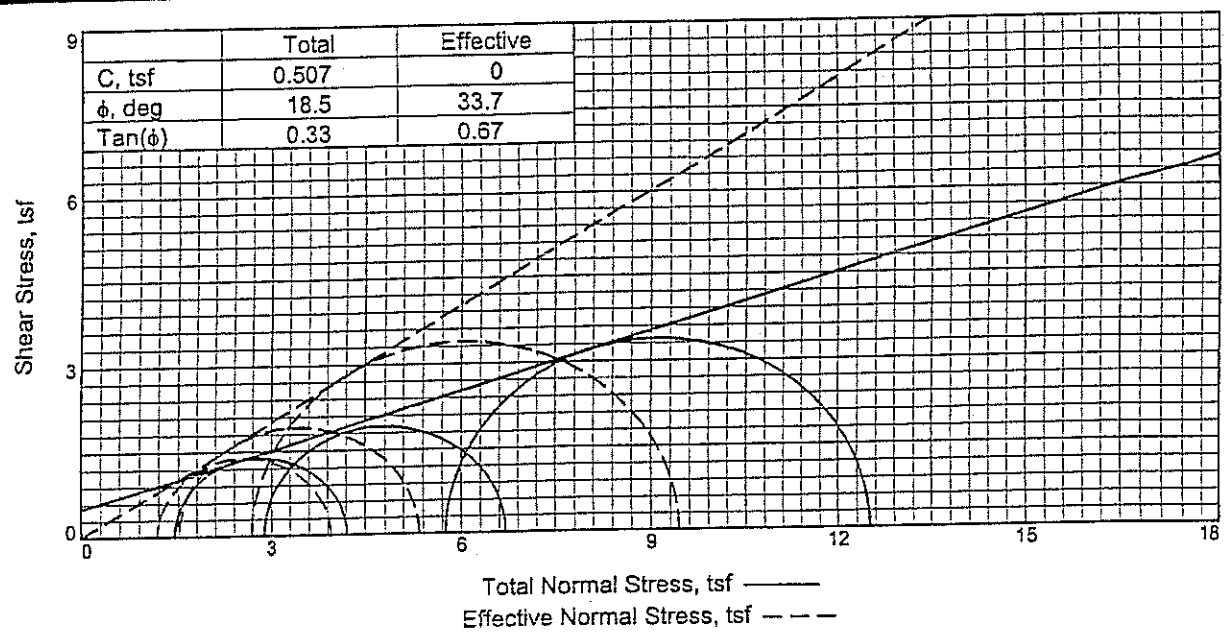
PERMEABILITY TEST RESULTS

Project	Pond Creek Mine	Boring/Sample Depth	Coarse Refuse
Project #	H-05278	Classification	
Date	11/30/2006	Diameter	2.8 Inch
		Length	5.6 Inch

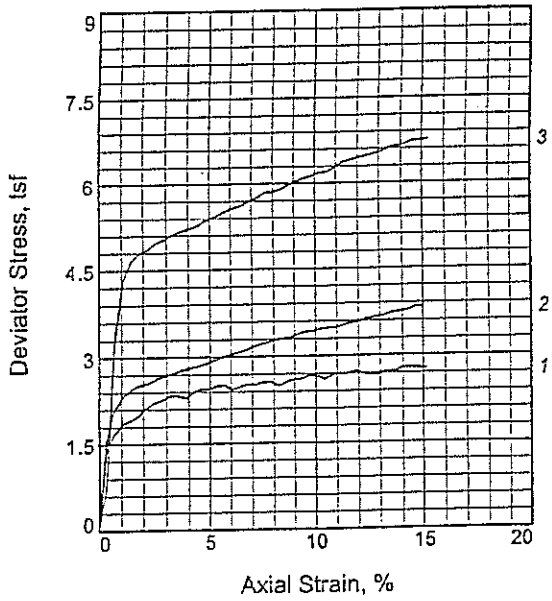
In Place Mc		After Test Mc		Unit Weight (PCF)	
Wet Wt.	195.3	Wet Wt.	1300.4	Sample Wt.	1161.8
Pan	94.2	Pan	103.1		
Dry Wt.	188.1	Dry Wt.	1173.6	Wet UW=	128.5
Mc (%)	7.7	Mc (%)	11.8	Dry UW=	119.3

Time(hrs)	Time(min)	Quantity (cc)	Head (psi)	Permeability (cm/sec)
7	26	24.7		
7	34	8.2	1	1.75E-04
7	33	24.5		
7	45	2.7	1	1.54E-04
7	47	0.8	1	1.44E-04
9	16	24.4		
9	23	9.6	1	1.79E-04
9	30	0.9	1	1.43E-04
			Average Permeability	1.63E-04

R17386



	Total	Effective
C, tsf	0.507	0
ϕ, deg	18.5	33.7
Tan(ϕ)	0.33	0.67



Sample No.		1	2	3
Initial	Water Content,	10.1	10.8	10.3
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	97.0	99.8	99.3
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
At Test	Water Content,	10.4	10.8	10.4
	Dry Density, pcf	118.7	117.8	118.7
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.2470	0.2558	0.2468
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.65	5.57	5.60
Strain rate, in./min.		0.01	0.01	0.01
Back Pressure, tsf		3.60	3.60	2.16
Cell Pressure, tsf		5.04	6.48	7.92
Fail. Stress, tsf		2.78	3.83	6.76
Total Pore Pr., tsf		3.86	4.96	5.23
Ult. Stress, tsf		2.77	3.83	6.76
Total Pore Pr., tsf		3.85	4.95	5.23
$\bar{\sigma}_1$ Failure, tsf		3.96	5.35	9.44
$\bar{\sigma}_3$ Failure, tsf		1.18	1.52	2.69

Type of Test:
CU with Pore Pressures
Sample Type: Remolded
Description: Coarse Coal Refuse

Assumed Specific Gravity= 2.37
Remarks:

Client: Pond Creek Mine

Project: Coarse Refuse Laboratory Tests

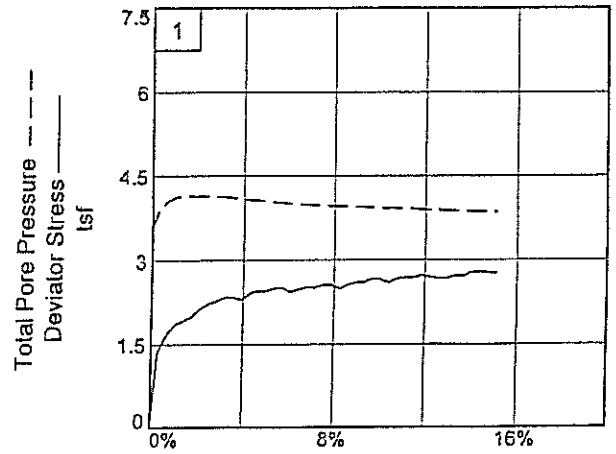
Location: Coarse Refuse Stockpile
Sample Number: Coarse Refuse
Proj. No.: H-05278 **Date:** 11/17/06

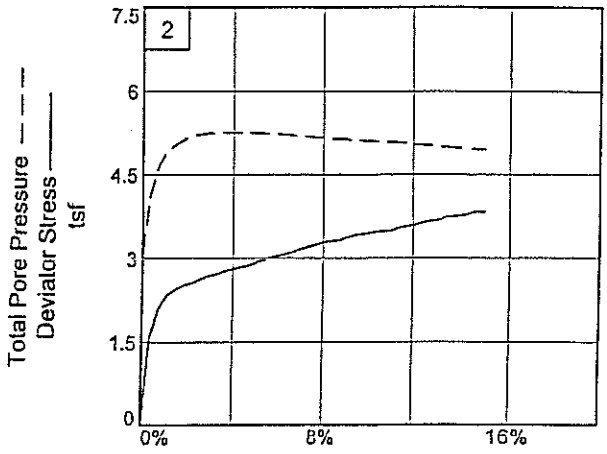
TRIAXIAL SHEAR TEST REPORT

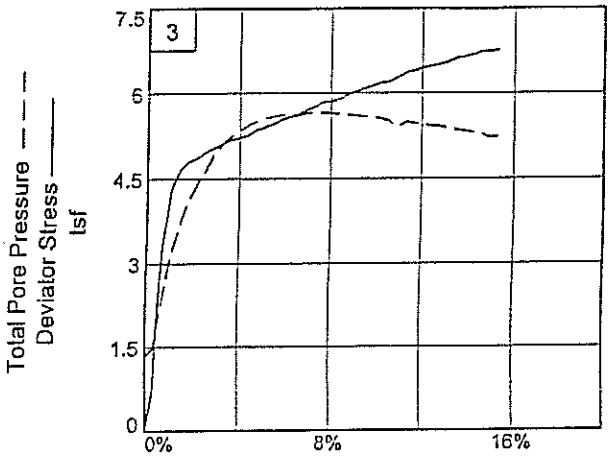
HOLCOMB FOUNDATION ENGINEERING CO.

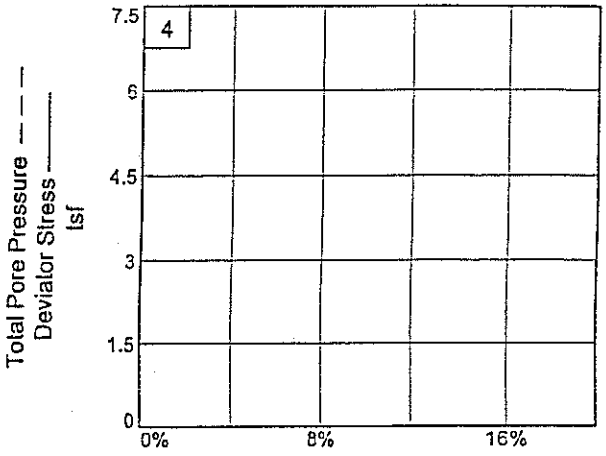
Plate _____

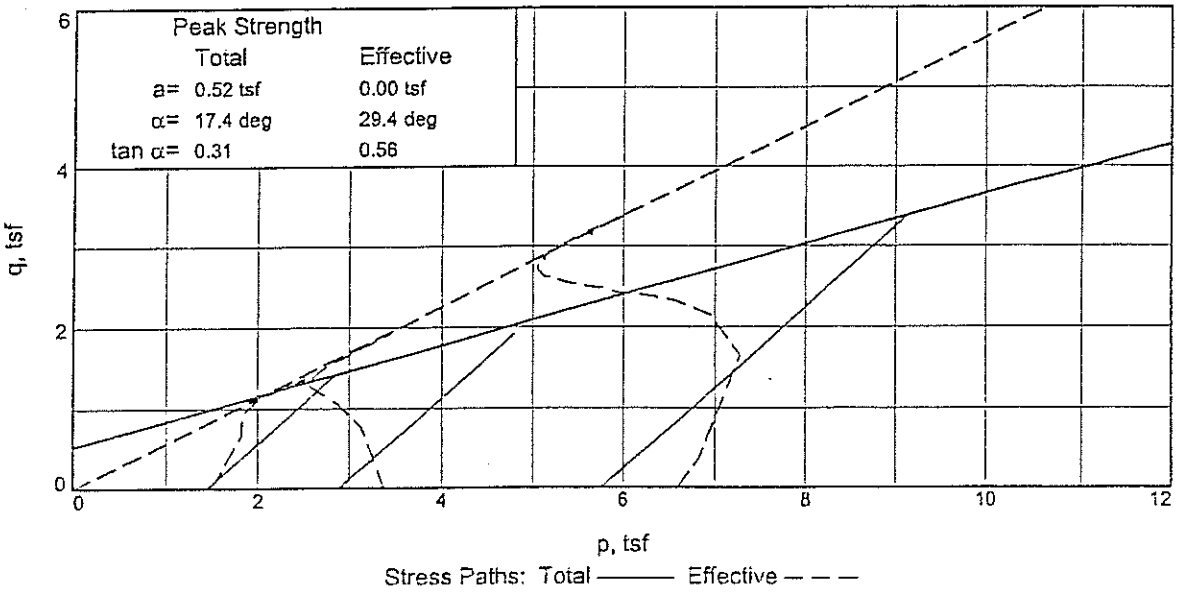
Tested By: LC Checked By: TH











Client: Pond Creek Mine
Project: Coarse Refuse Laboratory Tests
Location: Coarse Refuse Stockpile
Project No.: H-05278

Sample Number: Coarse Refuse
Plate _____

HOLCOMB FOUNDATION ENGINEERING CO.

Tested By: LC

Checked By: TH

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

11/30/2006
10:19 AM

Date:	11/17/06
Client:	Pond Creek Mine
Project:	Coarse Refuse Laboratory Tests
Location:	Coarse Refuse Stockpile
Sample Number:	Coarse Refuse
Description:	Coarse Coal Refuse
Remarks:	
Type of Sample:	Remolded
Assumed Specific Gravity=2.37	LL= PL= PI=
Test Method:	COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	226.800			1320.700
Moisture content: Dry soil+tare, gms.	218.600			1195.800
Moisture content: Tare, gms.	137.500			107.600
Moisture, %	10.1	10.4	10.4	11.5
Moist specimen weight, gms.	1193.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.65	5.65	5.65	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.6	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2470	0.2470	0.2470	
Saturation, %	97.0	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.440 tsf
Strain rate, in./min. = 0.01
Fail. Stress = 2.778 tsf at reading no. 41
Ult. Stress = 2.767 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0010	46.60	0.0	0.0	0.000	1.498	1.498	1.00	49.20	1.498	0.000
1	0.0180	160.60	114.0	0.3	1.329	1.152	2.481	2.15	54.00	1.816	0.664
2	0.0390	189.70	143.1	0.7	1.662	1.001	2.663	2.66	56.10	1.832	0.831
3	0.0590	205.60	159.0	1.0	1.840	0.929	2.769	2.98	57.10	1.849	0.920
4	0.0800	212.20	165.6	1.4	1.909	0.907	2.816	3.10	57.40	1.862	0.955
5	0.1000	218.90	172.3	1.8	1.979	0.900	2.879	3.20	57.50	1.890	0.990
6	0.1200	232.20	185.6	2.1	2.125	0.900	3.025	3.36	57.50	1.962	1.062
7	0.1410	240.50	193.9	2.5	2.211	0.907	3.118	3.44	57.40	2.013	1.106
8	0.1610	245.50	198.9	2.8	2.260	0.914	3.174	3.47	57.30	2.044	1.130
9	0.1820	252.20	205.6	3.2	2.327	0.922	3.249	3.53	57.20	2.085	1.164
10	0.2020	253.80	207.2	3.6	2.337	0.936	3.273	3.50	57.00	2.104	1.168
11	0.2230	250.50	203.9	3.9	2.291	0.958	3.248	3.39	56.70	2.103	1.145
12	0.2430	261.30	214.7	4.3	2.403	0.972	3.375	3.47	56.50	2.173	1.201
13	0.2630	266.30	219.7	4.6	2.450	0.979	3.429	3.50	56.40	2.204	1.225
14	0.2840	266.30	219.7	5.0	2.440	0.994	3.434	3.46	56.20	2.214	1.220
15	0.3040	272.10	225.5	5.4	2.495	1.008	3.503	3.48	56.00	2.256	1.248
16	0.3250	274.60	228.0	5.7	2.513	1.022	3.536	3.46	55.80	2.279	1.257
17	0.3450	268.00	221.4	6.1	2.431	1.037	3.468	3.34	55.60	2.252	1.216
18	0.3660	273.00	226.4	6.5	2.476	1.051	3.527	3.36	55.40	2.289	1.238
19	0.3860	278.00	231.4	6.8	2.521	1.058	3.580	3.38	55.30	2.319	1.261
20	0.4070	278.00	231.4	7.2	2.511	1.066	3.577	3.36	55.20	2.321	1.256
21	0.4270	283.00	236.4	7.5	2.556	1.073	3.629	3.38	55.10	2.351	1.278
22	0.4470	284.60	238.0	7.9	2.563	1.080	3.643	3.37	55.00	2.362	1.282
23	0.4680	278.80	232.2	8.3	2.491	1.087	3.578	3.29	54.90	2.333	1.245
24	0.4880	286.30	239.7	8.6	2.561	1.087	3.648	3.36	54.90	2.368	1.281
25	0.5090	290.40	243.8	9.0	2.594	1.094	3.689	3.37	54.80	2.392	1.297
26	0.5290	292.10	245.5	9.3	2.602	1.102	3.704	3.36	54.70	2.403	1.301
27	0.5500	298.80	252.2	9.7	2.662	1.109	3.771	3.40	54.60	2.440	1.331
28	0.5700	299.60	253.0	10.1	2.660	1.116	3.776	3.38	54.50	2.446	1.330
29	0.5910	294.60	248.0	10.4	2.597	1.116	3.713	3.33	54.50	2.415	1.299
30	0.6110	302.10	255.5	10.8	2.665	1.123	3.788	3.37	54.40	2.456	1.333
31	0.6310	306.30	259.7	11.2	2.698	1.130	3.828	3.39	54.30	2.479	1.349
32	0.6520	306.30	259.7	11.5	2.687	1.130	3.817	3.38	54.30	2.474	1.343
33	0.6720	312.10	265.5	11.9	2.736	1.145	3.881	3.39	54.10	2.513	1.368
34	0.6930	309.60	263.0	12.2	2.699	1.145	3.843	3.36	54.10	2.494	1.349
35	0.7130	308.80	262.2	12.6	2.680	1.152	3.832	3.33	54.00	2.492	1.340
36	0.7340	309.60	263.0	13.0	2.676	1.159	3.835	3.31	53.90	2.497	1.338
37	0.7540	315.40	268.8	13.3	2.724	1.166	3.891	3.34	53.80	2.528	1.362
38	0.7750	316.20	269.6	13.7	2.721	1.166	3.887	3.33	53.80	2.527	1.360
39	0.7950	323.70	277.1	14.1	2.785	1.181	3.966	3.36	53.60	2.573	1.392
40	0.8150	325.40	278.8	14.4	2.790	1.181	3.971	3.36	53.60	2.576	1.395
41	0.8360	325.40	278.8	14.8	2.778	1.181	3.959	3.35	53.60	2.570	1.389
42	0.8560	325.40	278.8	15.1	2.767	1.188	3.955	3.33	53.50	2.571	1.383

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	211.600			1335.900
Moisture content: Dry soil+tare, gms.	203.200			1222.200
Moisture content: Tare, gms.	125.200			134.800
Moisture, %	10.8	10.8	10.8	10.5
Moist specimen weight, gms.	1175.1			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.57	5.57	5.57	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.5	130.5	130.5	
Dry density, pcf	117.8	117.8	117.8	
Void ratio	0.2558	0.2558	0.2558	
Saturation, %	99.8	100.0	100.0	

Membrane modulus = 0.124105 kN/cm²

Membrane thickness = 0.02 cm

Filter paper coefficient = 0.001926 kN/cm

Filter paper coverage = 50%

Consolidation cell pressure = 90.00 psi (6.480 tsf)

Consolidation back pressure = 50.00 psi (3.600 tsf)

Consolidation effective confining stress = 2.880 tsf

Strain rate, in./min. = 0.01

Fail. Stress = 3.829 tsf at reading no. 40

Ult. Stress = 3.828 tsf at reading no. 41

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	51.60	0.0	0.0	0.000	3.377	3.377	1.00	43.10	3.377	0.000
1	0.0190	185.60	134.0	0.3	1.562	2.340	3.902	1.67	57.50	3.121	0.781
2	0.0400	233.00	181.4	0.7	2.106	1.814	3.920	2.16	64.80	2.867	1.053
3	0.0600	253.00	201.4	1.1	2.330	1.562	3.892	2.49	68.30	2.727	1.165
4	0.0810	263.80	212.2	1.5	2.445	1.433	3.878	2.71	70.10	2.655	1.223
5	0.1010	270.50	218.9	1.8	2.513	1.346	3.860	2.87	71.30	2.603	1.257
6	0.1220	274.60	223.0	2.2	2.550	1.289	3.839	2.98	72.10	2.564	1.275
7	0.1420	281.30	229.7	2.5	2.617	1.260	3.877	3.08	72.50	2.569	1.309
8	0.1620	287.10	235.5	2.9	2.674	1.238	3.912	3.16	72.80	2.575	1.337
9	0.1830	291.30	239.7	3.3	2.711	1.231	3.942	3.20	72.90	2.587	1.355
10	0.2030	297.10	245.5	3.6	2.766	1.224	3.990	3.26	73.00	2.607	1.383
11	0.2240	301.30	249.7	4.0	2.802	1.224	4.026	3.29	73.00	2.625	1.401
12	0.2440	305.40	253.8	4.4	2.838	1.224	4.062	3.32	73.00	2.643	1.419
13	0.2650	309.60	258.0	4.8	2.873	1.224	4.097	3.35	73.00	2.661	1.437
14	0.2850	315.40	263.8	5.1	2.927	1.231	4.158	3.38	72.90	2.695	1.463
15	0.3060	320.40	268.8	5.5	2.970	1.238	4.209	3.40	72.80	2.724	1.485
16	0.3260	326.20	274.6	5.9	3.023	1.246	4.269	3.43	72.70	2.757	1.512
17	0.3460	330.40	278.8	6.2	3.058	1.253	4.310	3.44	72.60	2.782	1.529
18	0.3670	334.60	283.0	6.6	3.091	1.267	4.358	3.44	72.40	2.813	1.546
19	0.3870	341.20	289.6	6.9	3.151	1.282	4.433	3.46	72.20	2.857	1.576
20	0.4080	346.20	294.6	7.3	3.192	1.296	4.488	3.46	72.00	2.892	1.596
21	0.4280	351.20	299.6	7.7	3.234	1.310	4.544	3.47	71.80	2.927	1.617

27

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	357.00	305.4	8.1	3.283	1.318	4.601	3.49	71.70	2.959	1.642
23	0.4690	359.50	307.9	8.4	3.297	1.332	4.629	3.48	71.50	2.981	1.649
24	0.4890	362.80	311.2	8.8	3.319	1.339	4.659	3.48	71.40	2.999	1.660
25	0.5100	368.70	317.1	9.2	3.368	1.346	4.715	3.50	71.30	3.031	1.684
26	0.5300	374.50	322.9	9.5	3.416	1.361	4.777	3.51	71.10	3.069	1.708
27	0.5510	377.00	325.4	9.9	3.429	1.368	4.797	3.51	71.00	3.082	1.714
28	0.5710	381.20	329.6	10.2	3.459	1.368	4.827	3.53	71.00	3.098	1.730
29	0.5920	384.50	332.9	10.6	3.479	1.382	4.861	3.52	70.80	3.122	1.739
30	0.6120	386.20	334.6	11.0	3.483	1.390	4.872	3.51	70.70	3.131	1.741
31	0.6330	392.00	340.4	11.4	3.528	1.397	4.925	3.53	70.60	3.161	1.764
32	0.6530	397.00	345.4	11.7	3.565	1.411	4.977	3.53	70.40	3.194	1.783
33	0.6730	400.30	348.7	12.1	3.585	1.426	5.010	3.51	70.20	3.218	1.792
34	0.6940	406.10	354.5	12.5	3.629	1.440	5.069	3.52	70.00	3.254	1.814
35	0.7140	410.30	358.7	12.8	3.657	1.454	5.111	3.51	69.80	3.283	1.828
36	0.7350	413.60	362.0	13.2	3.674	1.469	5.143	3.50	69.60	3.306	1.837
37	0.7550	420.30	368.7	13.6	3.727	1.483	5.210	3.51	69.40	3.347	1.863
38	0.7760	423.60	372.0	13.9	3.744	1.498	5.242	3.50	69.20	3.370	1.872
39	0.7960	427.80	376.2	14.3	3.770	1.505	5.275	3.51	69.10	3.390	1.885
40	0.8170	435.30	383.7	14.7	3.829	1.519	5.348	3.52	68.90	3.434	1.914
41	0.8370	436.90	385.3	15.0	3.828	1.526	5.355	3.51	68.80	3.441	1.914

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	184.300			1333.800
Moisture content: Dry soil+tare, gms.	177.100			1230.400
Moisture content: Tare, gms.	107.500			135.300
Moisture, %	10.3	10.4	10.4	9.4
Moist specimen weight, gms.	1185.2			
Diameter, in.	2.80	2.80	2.80	
Area, in.²	6.16	6.16	6.16	
Height, in.	5.60	5.60	5.60	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	130.9	131.0	131.0	
Dry density, pcf	118.7	118.7	118.7	
Void ratio	0.2468	0.2468	0.2468	
Saturation, %	99.3	100.0	100.0	

28

Membrane modulus = 0.124105 kN/cm²

Membrane thickness = 0.02 cm

Filter paper coefficient = 0.001926 kN/cm

Filter paper coverage = 50%

Consolidation cell pressure = 110.00 psi (7.920 tsf)

Consolidation back pressure = 30.00 psi (2.160 tsf)

Consolidation effective confining stress = 5.760 tsf

Strain rate, in./min. = 0.01

Fail. Stress = 6.758 tsf at reading no. 42

Ult. Stress = 6.758 tsf at reading no. 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	25.00	0.0	0.0	0.000	6.588	6.588	1.00	18.50	6.588	0.000
1	0.0190	88.20	63.2	0.3	0.736	6.458	7.195	1.11	20.30	6.827	0.368
2	0.0400	309.60	284.6	0.7	3.304	5.623	8.927	1.59	31.90	7.275	1.652
3	0.0600	397.00	372.0	1.1	4.303	4.795	9.098	1.90	43.40	6.947	2.152
4	0.0810	428.60	403.6	1.4	4.651	4.234	8.885	2.10	51.20	6.559	2.326
5	0.1010	441.90	416.9	1.8	4.787	3.830	8.617	2.25	56.80	6.224	2.393
6	0.1220	449.40	424.4	2.2	4.854	3.521	8.375	2.38	61.10	5.948	2.427
7	0.1420	460.20	435.2	2.5	4.960	3.283	8.243	2.51	64.40	5.763	2.480
8	0.1620	467.70	442.7	2.9	5.027	3.017	8.044	2.67	68.10	5.530	2.513
9	0.1830	476.00	451.0	3.3	5.101	2.837	7.938	2.80	70.60	5.387	2.551
10	0.2030	483.50	458.5	3.6	5.167	2.693	7.860	2.92	72.60	5.276	2.583
11	0.2240	489.30	464.3	4.0	5.212	2.585	7.797	3.02	74.10	5.191	2.606
12	0.2440	495.20	470.2	4.4	5.258	2.491	7.750	3.11	75.40	5.120	2.629
13	0.2650	505.20	480.2	4.7	5.349	2.419	7.768	3.21	76.40	5.094	2.675
14	0.2850	511.00	486.0	5.1	5.394	2.369	7.762	3.28	77.10	5.066	2.697
15	0.3060	518.50	493.5	5.5	5.455	2.333	7.788	3.34	77.60	5.060	2.728
16	0.3260	526.80	501.8	5.8	5.526	2.304	7.830	3.40	78.00	5.067	2.763
17	0.3460	533.50	508.5	6.2	5.579	2.297	7.875	3.43	78.10	5.086	2.789
18	0.3670	539.30	514.3	6.6	5.620	2.326	7.945	3.42	77.70	5.135	2.810
19	0.3870	548.40	523.4	6.9	5.697	2.275	7.972	3.50	78.40	5.124	2.849
20	0.4080	555.90	530.9	7.3	5.756	2.261	8.016	3.55	78.60	5.139	2.878
21	0.4280	565.90	540.9	7.6	5.841	2.261	8.102	3.58	78.60	5.181	2.921

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
22	0.4490	569.20	544.2	8.0	5.853	2.268	8.121	3.58	78.50	5.195	2.927
23	0.4690	575.10	550.1	8.4	5.894	2.282	8.176	3.58	78.30	5.229	2.947
24	0.4890	584.20	559.2	8.7	5.968	2.297	8.265	3.60	78.10	5.281	2.984
25	0.5100	592.50	567.5	9.1	6.031	2.311	8.343	3.61	77.90	5.327	3.016
26	0.5300	599.20	574.2	9.5	6.079	2.333	8.411	3.61	77.60	5.372	3.039
27	0.5510	605.90	580.9	9.8	6.124	2.354	8.479	3.60	77.30	5.416	3.062
28	0.5710	613.30	588.3	10.2	6.178	2.362	8.539	3.62	77.20	5.450	3.089
29	0.5920	617.50	592.5	10.6	6.196	2.405	8.601	3.58	76.60	5.503	3.098
30	0.6120	626.70	601.7	10.9	6.267	2.527	8.794	3.48	74.90	5.661	3.133
31	0.6330	638.30	613.3	11.3	6.361	2.426	8.787	3.62	76.30	5.607	3.180
32	0.6530	644.10	619.1	11.7	6.395	2.448	8.843	3.61	76.00	5.646	3.198
33	0.6730	650.80	625.8	12.0	6.438	2.477	8.915	3.60	75.60	5.696	3.219
34	0.6940	656.60	631.6	12.4	6.470	2.498	8.968	3.59	75.30	5.733	3.235
35	0.7140	662.50	637.5	12.8	6.504	2.506	9.009	3.60	75.20	5.758	3.252
36	0.7350	669.10	644.1	13.1	6.543	2.542	9.085	3.57	74.70	5.813	3.271
37	0.7550	678.30	653.3	13.5	6.609	2.563	9.172	3.58	74.40	5.868	3.305
38	0.7760	684.10	659.1	13.9	6.639	2.585	9.224	3.57	74.10	5.904	3.319
39	0.7960	690.70	665.7	14.2	6.678	2.614	9.291	3.55	73.70	5.952	3.339
40	0.8170	699.10	674.1	14.6	6.732	2.635	9.367	3.55	73.40	6.001	3.366
41	0.8370	701.60	676.6	14.9	6.729	2.700	9.429	3.49	72.50	6.065	3.365
42	0.8570	707.40	682.4	15.3	6.758	2.686	9.444	3.52	72.70	6.065	3.379

29

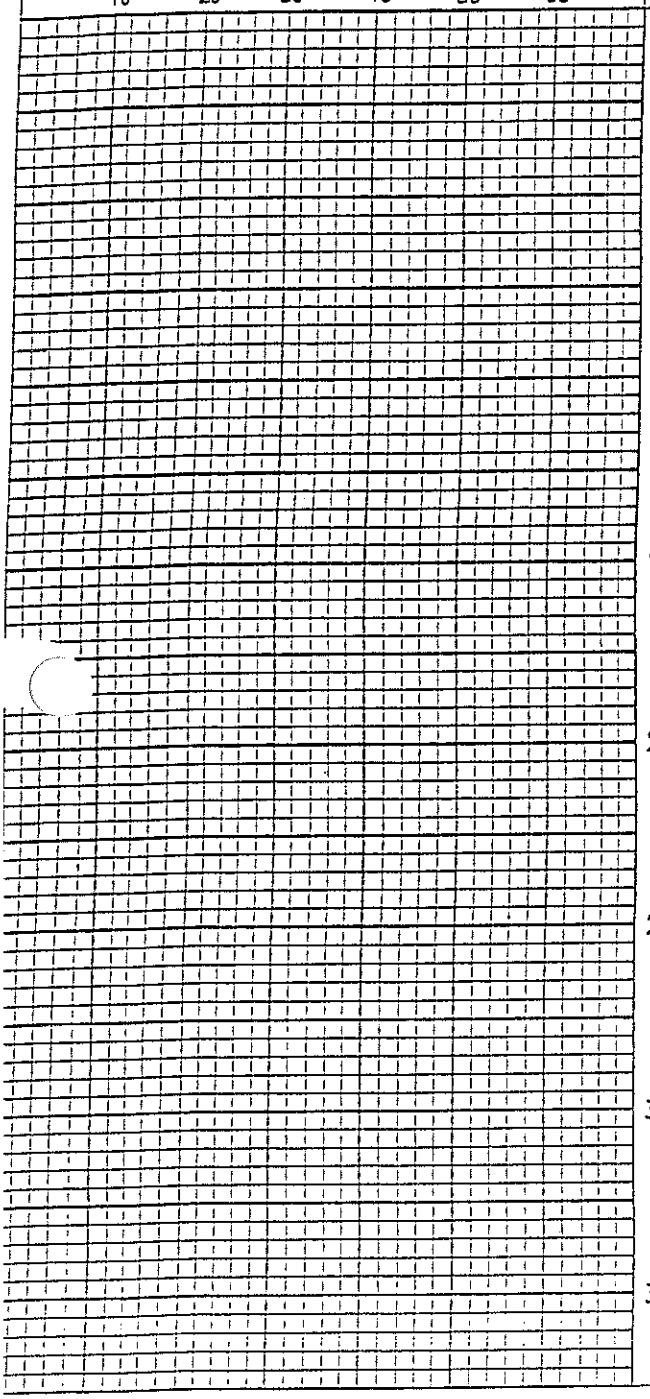
APPENDIX D

Boring Logs

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 8874

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6
Water Content (%)
Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Brown Silty CLAY (CL) with sand and pebbles
5	1	st		
	2	st		
10				Gray Mottled Brown Silty CLAY (CL)
	3	st		
15				
	4	st		
	5	st		
20				End of Boring @ -20.0'
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling and None Upon Completion.

Mach #1 Mine Soils investigation
Mach #1 Mine Williamson County Illinois

Date of Boring
February 1, 2006

Client:
Alliance Consulting, Inc.
Beaver, West Virginia

Project No.
H-05278

R17396

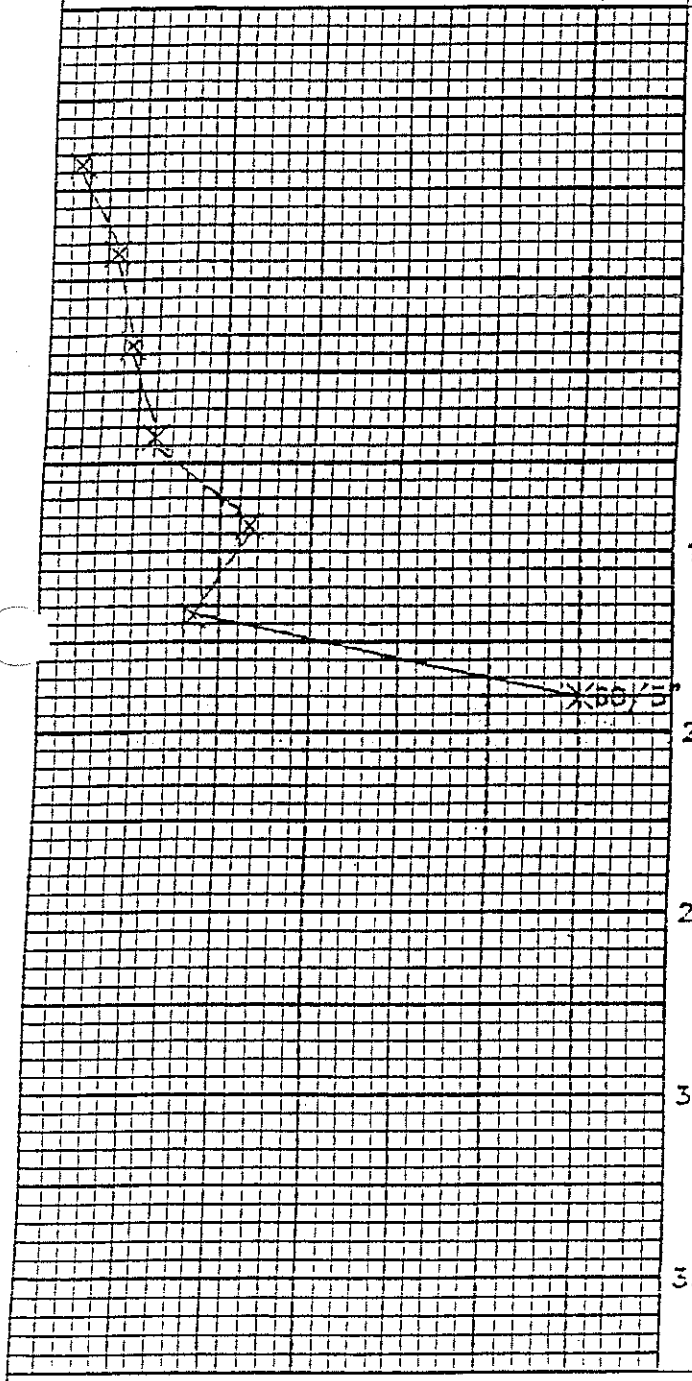
LOG of BORING B293

Holcomb Foundation Engineering Co.

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				7" Topsoil
				Gray Mottled Brown Silty CLAY (CL) with trace of sand
5	1	ss		
	2	ss		
	3	ss		
10				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
	4	ss		
15	5	ss		
	6	ss		
	7	ss		Gray SHALE
20				End of Boring @ −19.0'
25				
30				
35				

Ground Water Data
Ground Water Encountered @ −12.0' During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

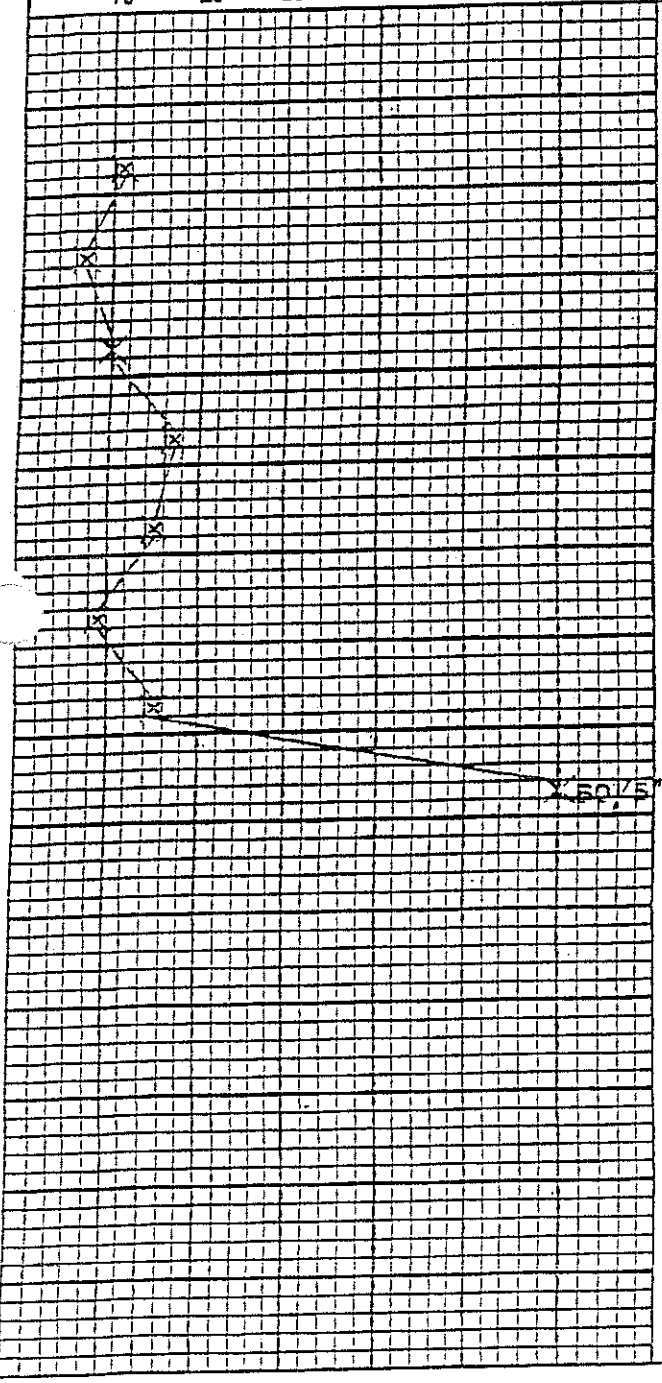
Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

LOG of BORING 8294

Holcomb Foundation Engineering Co.



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				7" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
10	3	ss		
	4	ss		
15	5	ss		
	6	ss		
20	7	ss		
	8	ss		Brown SHALE
				End of Boring @ -22.5'
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

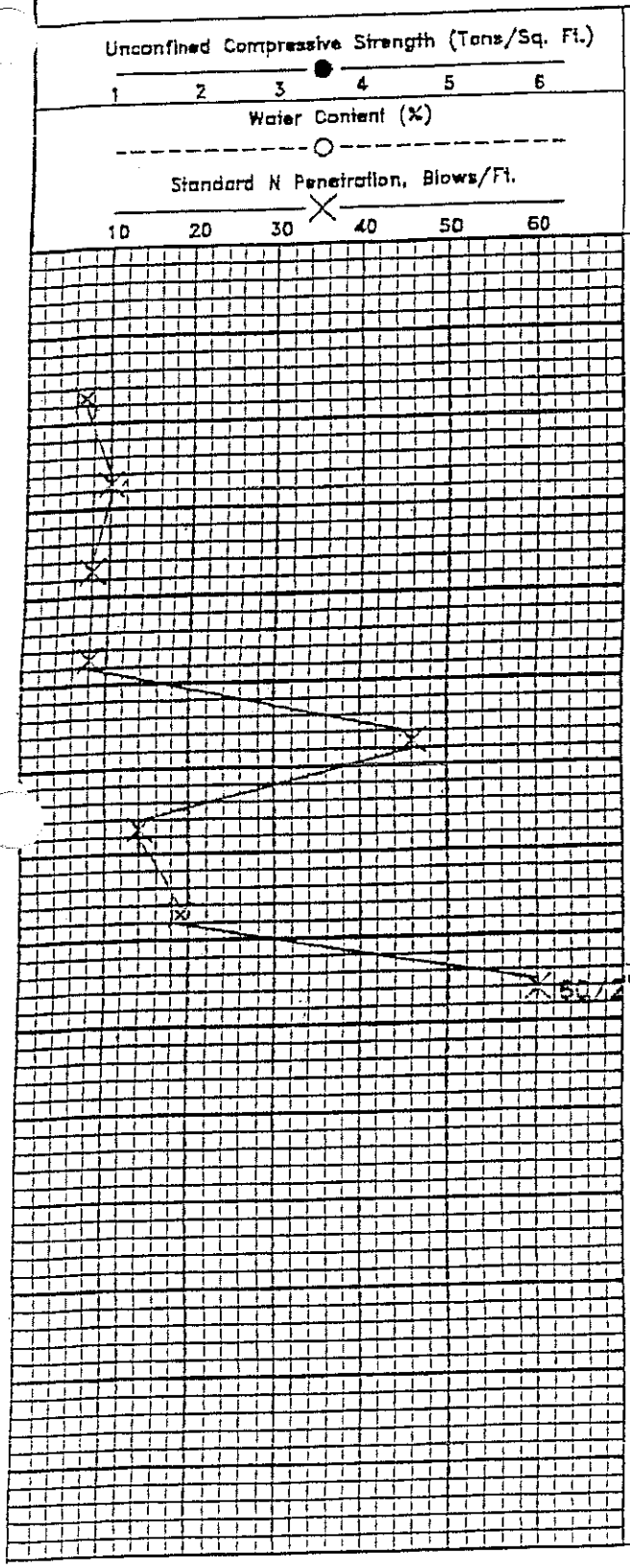
Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

LOG of BORING B295

Holcomb Foundation Engineering Co.



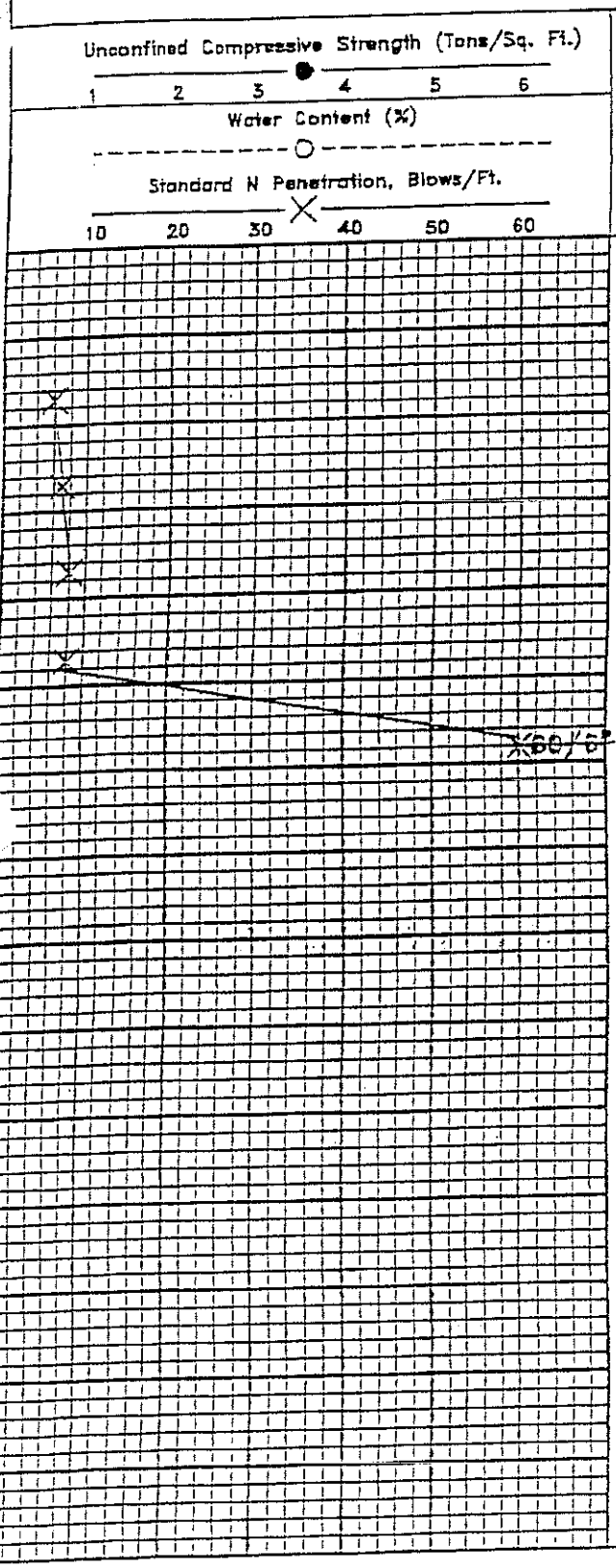
Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				9" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
10	3	ss		
	4	ss		
15	5	ss		Brown SILT (ML)
	6	ss		Brown Medium to Coarse SAND (SC-SP)
20	7	ss		
	8	ss		Gray Mottled Brown SHALE
				End of Boring @ -22.0'
25				
30				
35				

Ground Water Data
Ground Water Encountered @ -16.0' During Drilling/ @ -10.0' Upon Completion.

Project: Rock Probes for Mach Mine Johnston City, Illinois	Date of Boring December 5, 2005
Client: Williamson County Energy Marion, Illinois	Project No. H-05278

LOG of BORING B297

Holcomb Foundation Engineering Co.



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				9" Topsoil
				Gray Mottled Brown Silty CLAY (CL) with sand and pebbles
5	1	SS		
	2	SS		
10	3	SS		Brown Mottled Gray Silty CLAY (CL) with trace of sand
	4	SS		Gray Mottled Brown Silty CLAY (CL) with trace of sand
15	5	SS		Brown SHALE
				End of Boring @ -15.5'
20				
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

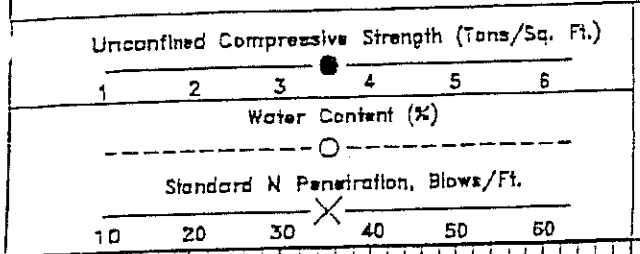
Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

R17400

LOG of BORING B298

Holcomb Foundation Engineering Co.



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				6" Topsoil
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	SS		
	2	SS		
	3	SS		Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
10	4	SS		Brown Mottled Gray SHALE
	5	SS		Gray SHALE
15				End of Boring @ −14.5'
20				
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

R17401

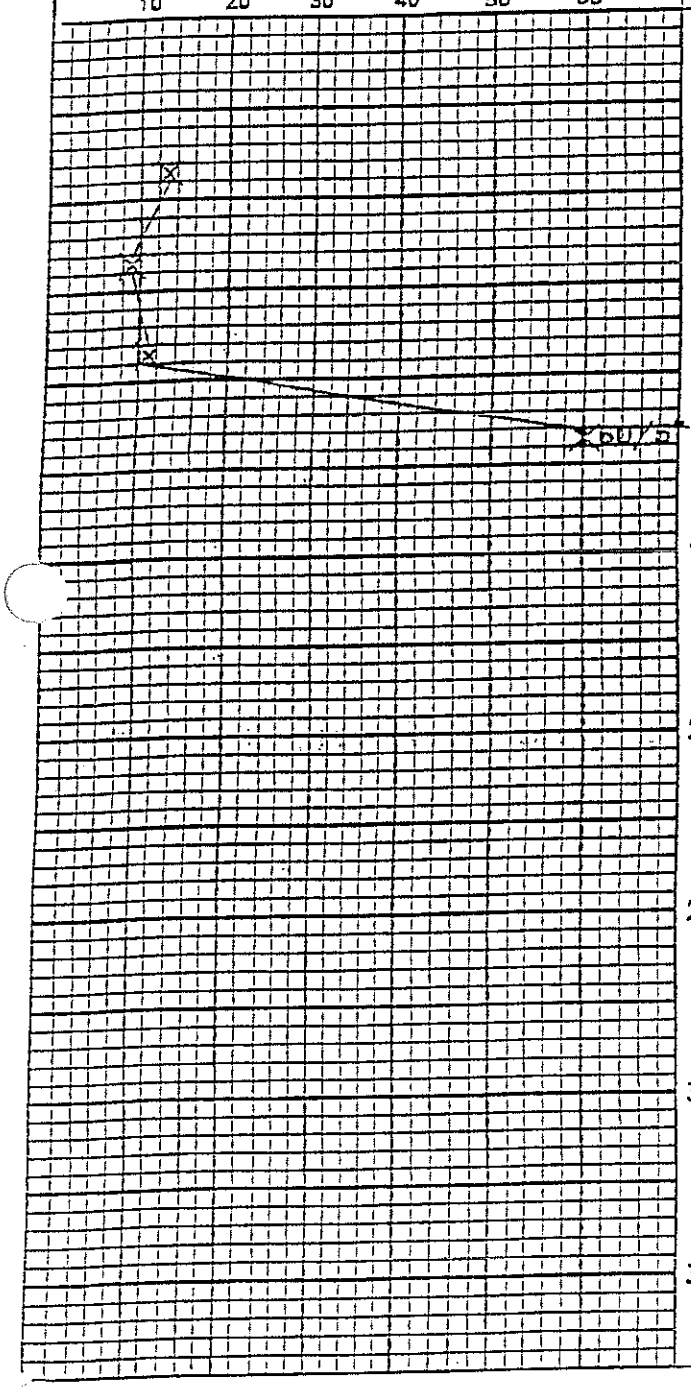
LOG of BORING B299

Holcomb Foundation Engineering Co.

Unconfined Compressive Strength (Tons/Sq. Ft.)
1 2 3 4 5 6

Water Content (%)

Standard N Penetration, Blows/Ft.
10 20 30 40 50 60



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
5	1	ss		
	2	ss		
10	3	ss		
	4	ss		Brown SHALE
				End of Boring @ -12.5'
15				
20				
25				
30				
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Rock Probes for Mach Mine
Johnston City, Illinois

Date of Boring
December 5, 2005

Client: Williamson County Energy
Marion, Illinois

Project No.
H-05278

APPENDIX E

COARSE COAL REFUSE PLACEMENT GUIDELINES

APPENDIX E

COARSE COAL REFUSE PLACEMENT GUIDELINES
COAL REFUSE DISPOSAL FACILITY NO. 2
MACH #1 MINE
MACH MINING LLC
WILLIAMSON, ILLINOIS

INTRODUCTION

This coal refuse placement plan is intended to serve as a guidance document for the placement of coarse coal refuse at the Pond Creek Mine No.1 coal refuse disposal area which serves Mach Mining LLC's (Mach Mining) Mach #1 Mine coal preparation plant located in Williamson County, Illinois. The information contained herein is sufficiently detailed to provide Mach Mining with the technical guidance required to perform coal refuse disposal operations in a manner consistent with generally accepted construction techniques and sound engineering practice. This plan has been developed based on our understanding of the proposed production rates, proposed placement techniques, and the heavy equipment available for use at the facility, as provided by Mach Mining. The general placement technique for the coarse coal refuse proposed by Mach Mining is to discharge the refuse from a conveyor belt into a stockpile adjacent to the active work surface of the disposal area. Tracked dozers will then be used to push the refuse contained in the stockpile across the work surface in lifts.

HEAVY EQUIPMENT AND ESTIMATED PRODUCTION CAPABILITY

As provided by Mach Mining, two Caterpillar D-9 tracked type dozers and one D-10 tracked type dozer will be available for use at the disposal facility. The D-9 dozers will be dedicated to placing refuse at disposal facility. The D-10 dozer will be utilized at the disposal facility on an as needed basis and be a backup dozer for the D-9 dozers in the event of unexpected downtime. The D-10 will also be used to perform other task at the mine facility. Both the D-9 and D-10 dozers are equipped with a reclamation universal blade which has added capacity over a standard universal blade.

Utilizing information and procedures contained in the Caterpillar Performance Handbook, Edition 33, the estimated production capability for each of the dozers was determined. The procedures require obtaining the maximum estimated production capability of the machine for an average distance of push from a chart and applying

appropriate correction factors to the maximum production in order to estimate on the job performance.

The estimated production capability of the D-9 dozer was determined to be 136 cubic yards/hour at an average push distance of 600 feet and 170 cubic yards/hour at an average push distance of 500 feet. The estimated production capability of the D-10 dozer was determined to bc 256 cubic yards/hour at an average push distance of 600 feet and 292 cubic yards/hour at an average push distance of 500 feet. One of the correction factors used to estimate the production capability provided that each dozer would place refuse for 45 minutes of each hour worked. This factor allows approximately 2 hours per each 10 hour work shift for work surface grading, backblading and compaction. The supporting calculations are attached.

The information taken from the handbook and used to determine these production rates is based on a wide variety of job conditions and should only be considered estimates. The only correct way to determine machine performance is by measuring on the job production.

PRODUCTION RATE AND OPERATING SCHEDULE

As provided by Mach Mining, coarse coal refuse production is estimated to be 2.53×10^6 cubic yards per year or 486 cubic yards per hour. Mach Mining is projecting to be operating on a double shift, 20 hour per day, 5 days per week work schedule.

REFUSE PLACEMENT

Coarse coal refuse will be transported to the work surface by a conveyor belt and discharged at two different locations from a stacker belt into stockpiles located adjacent to the active work surfaces. The refuse production will be divided by approximately 50 percent between the two different stockpile locations. The dozers will be used to push the refuse out of the stockpiles onto the two work surfaces in lifts. The dozers will also be used to provide compactive effort to the refuse.

Comparing the production rates and work schedule to the estimated production capability of the dozers indicates that both of the D-9 dozers and the D-10 dozer will be required to manage the refuse production. One D-9 dozer will be required to place refuse on a full time basis from each stockpile area. The D-10 will be required to provide additional

placement capacity for an estimated combined maximum time of 10 hours per day. The dozers will be able to place the refuse in lifts extending an average distance of 500 to 600 feet from the stockpile.

Refuse shall be placed in lifts not to exceed one-foot thickness as specified in the Technical Specifications. The work surface should be graded to drain surface water away from the refuse stockpile area. As a section of the lift is completed the area should be backbladed to eliminate windrows. With each backblade pass the dozer should be offset one half of the dozer width to provide compactive effort over the work surface. The field density testing program will indicate if additional passes are required.

Mach Mining proposes to construct the embankments in 500 to 600 feet long sections. Each section will be completed from the foundation to the proposed crest elevation in compacted lifts not exceeding one-foot. As each section is completed, the conveyor belt and stacker will be advanced on the completed section. The refuse belt discharge point shall be positioned so that the stockpile is over top of the previously placed and compacted refuse.

Refuse shall be pushed from the stockpile area on top of the completed section down onto the working surface on a slope of 2 horizontal to 1 vertical or flatter. All embankment side slopes, except the working end slope of the completed section, shall be kept trimmed to design grade in compacted material. When each new one-foot thick lift is started, it shall be keyed in to the end slope of the completed section trimmed to no steeper than 2 horizontal to 1 vertical in compacted material as shown on Drawing No. B05-33-A4. Compacted material means coarse coal refuse compacted to the density required in the Technical Specifications.

Each of the proposed stacker belts which will discharge the refuse is approximately 29 feet high. Assuming that the natural angle of repose of the refuse is 36°, each belt will stockpile approximately 1,800 cubic yards or a total of 3,600 cubic yards for both belts. This volume provides approximately 8 hours of refuse production storage. This storage volume should be adequate to provide time for the dozers to perform other tasks on the work surface.

These recommendations are based on information contained in the Caterpillar Performance Handbook. This information has been developed from studies performed at various job sites operating under various conditions and should only be considered

estimates of performance. These guidelines may have to be altered to best suit actual field conditions.

File: Appendix E Revised.doc, hlo, 6/11/09

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

BY: DE DATE: 1/10/03 CHKD BY: _____ DATE: _____ R17407

PROJECT NAME: MACH MINING

PROJECT NO. BOS-330-1413 SHEET _____ OF _____

DESCRIPTION REFUSE DOZER PRODUCTION ESTIMATE

PURPOSE: MACH MINING IS PROPOSING TO USE 2 D-9 TRACK TYPE CATERPILLAR DOZERS TO PUSH REFUSE FROM A STOCKPILE AND PLACE IT ON THE WORK SURFACE. ONE CATERPILLAR D-10 DOZER WILL BE AVALIABLE ON AN AS NEEDED BASIS TO ASSIST IN MANAGING THE REFUSE. THE MACHINES ARE EQUIPPED WITH RECLAMATION U-BLADES. USING THE CATERPILLAR PERFORMANCE HANDBOOK DETERMINE THE ESTIMATED AVERAGE DISTANCE THE DOZERS CAN PUSH REFUSE.

PRODUCTION CORRECTION FACTORS (1)

OPERATOR	
EXCELLENT TO AVG.	.88
MATERIAL	
LOOSE STOCKPILE	1.20
VISIBILITY	
.80 FOR DARK USE .90 FOR 50% DAY / 50% NIGHT	.90
EFFICIENCY	
45 MIN OF PLACEMENT / HOUR - ALLOWS FOR LUNCH BREAK, BACKBLADING AND COMPACTING	.75

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

BY: _____ DATE: _____ CHKD BY: _____ DATE: _____
PROJECT NAME: _____
PROJECT NO. _____ SHEET _____ OF _____
DESCRIPTION _____

RECLAMATION BLADE

D-9 STANDARD U-BLADE 1.28
CAPACITY = 21.4 CY
RECLAMATION BLADE
CAPACITY = 27.3 CY
27.3 / 21.4

D-10 STANDARD U-BLADE = 1.39
28.7 CY RECLAMATION
U BLADE = 40 CY
40.0 / 28.7

WEIGHT CORRECTION .74
LOOSE REFUSE = 3105 LBS/CY
PRODUCTION CHART IS
BASED ON 2300 LBS/CY
MATERIAL
2300 LBS/CY / 3105 LBS/CY

D-9 CORRECTION FACTOR = (.88)(1.20)(.90)(.75)(1.28)(.74)
D-9 CF = .68

D-10 CORRECTION FACTOR = (.88)(1.20)(.90)(.75)(1.39)(.74)
D-10 CF = .73

600' PUSH
D-9 FROM CHART (1) = 200 CY/HR
CORRECTED = 200 x .68 = 136 CY/HR
D-10 FROM CHART (1) = 350 CY/HR
CORRECTED = 350 x .73 = 256 CY/HR

500' PUSH
D-9 FROM CHART (1) = 250 CY/HR
CORRECTED = 250 x .68 = 170 CY/HR
D-10 FROM CHART (1) = 400 CY/HR
CORRECTED = 400 x .73 = 292 CY/HR

R17409

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

BY: _____ DATE: _____ CHKD BY: _____ DATE: _____

PROJECT NAME: _____

PROJECT NO. _____ SHEET _____ OF _____

DESCRIPTION _____

400' PUSH

D-9 FROM CHART(1) = 300 CY/HR

CORRECTED = 300 X .68 = 204 CY/HR

D-10 FROM CHART(1)

CORRECTED = 500 X .73 = 365 CY/HR

REFUSE PRODUCTION

MAXIMUM PRODUCTION = 2.53×10^6 CY/YEAR

PRODUCTION DAYS/YEAR = 260 DAYS

DAILY PRODUCTION = 20 HOURS

$$\frac{2.53 \times 10^6 \text{ CY}}{\text{YR}} \times \frac{\text{YR}}{260 \text{ DAYS}} \times \frac{\text{DAY}}{20 \text{ HOURS}} = 486 \text{ CY/HR}$$

TWO D-9 DOZERS WILL BE USED 20 HOURS/DAY TO PLACE REFUSE. THE PUSH DISTANCE WILL BE LIMITED TO 500'.

D-9 = 170 CY/HR X 2 = 340 CY/HR

REMAINING REFUSE TO BE PLACED BY D-10 = 486 - 340 = 146 CY/HR

$$\text{D-10} = \frac{146 \text{ CY/HR} \times 20 \text{ HRS}}{292 \text{ CY/HR}} = 10 \text{ HOURS}$$

THE D-10 WILL BE REQUIRED TO PUSH REFUSE 10 HOURS/DAY.

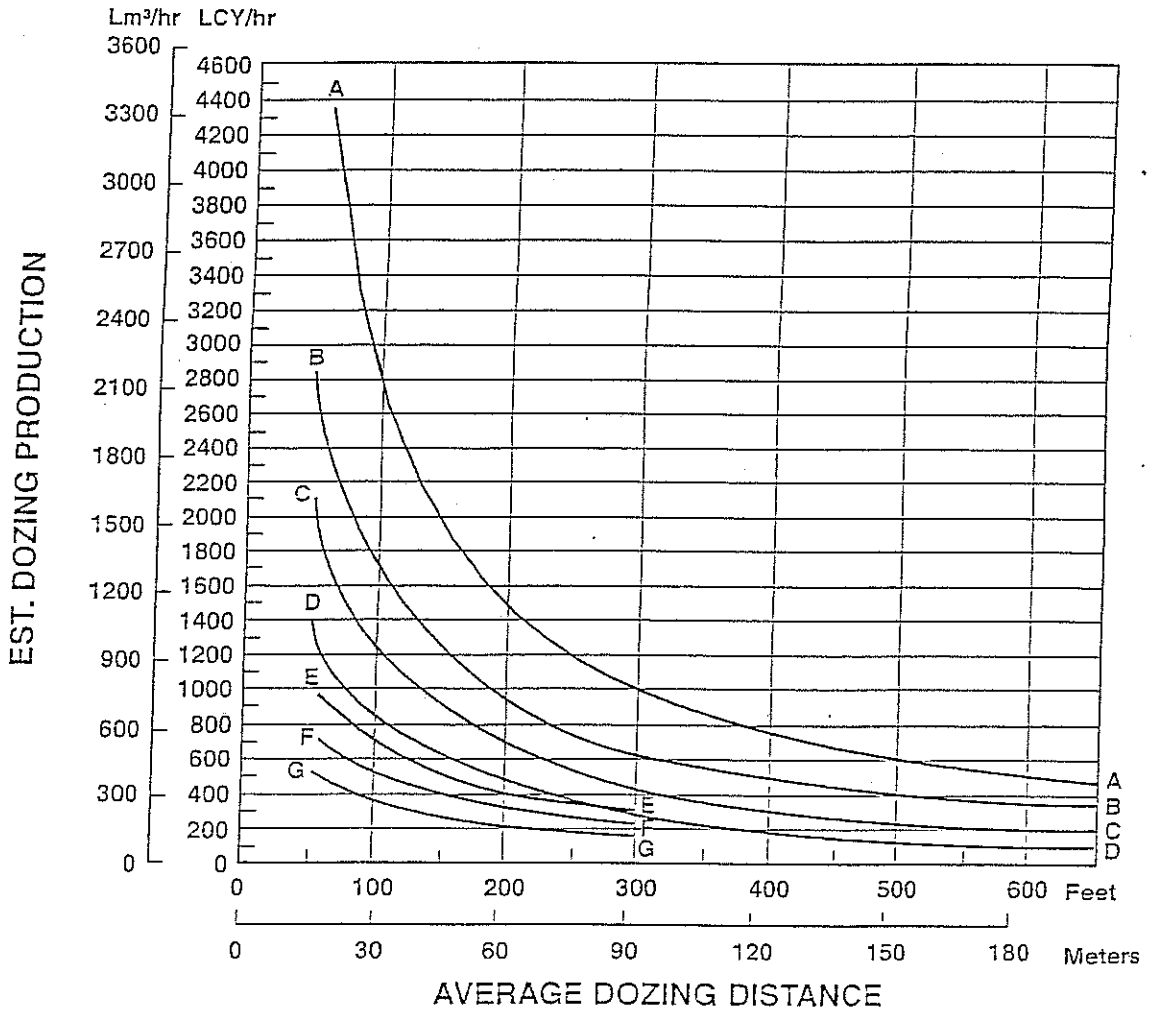
(1) CATERPILLAR PERFORMANCE HANDBOOK, EDITION 33
PAGES 1-38 THROUGH 1-44

Alliance Consulting, Inc.
124 Philpott Lane, Beaver, West Virginia 25813
Phone: (304) 255-0491 Fax: (304) 255-4232

Title: Mach Mining Refuse Placement Plan (2) R17410 (8)
Project No.: B05-330-1413
By: DI Date: 1/10/08 Chkd: ____ Date: ____

Bulldozers | Estimating Production Off-The-Job • SU-Blades

ESTIMATED DOZING PRODUCTION • Semi-Universal Blades • D6N through D11R



KEY
A — D11R-11SU
B — D10R-10SU
C — D9R-9SU
D — D8R/D8R Series II-8SU
E — D7R Series II-7SU
F — D6R Series II-6SU
G — D6N-6SU

NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

1-40

Ref: Caterpillar Performance Handbook, Edition 33

Alliance Consulting, Inc.
124 Philpott Lane, Beaver, West Virginia 25813
Phone: (304) 255-0491 Fax: (304) 255-4232

Title: MACH MINING REFUSE PLACEMENT PLAN (3) (9) R17411

Project No.: 805-330-1413

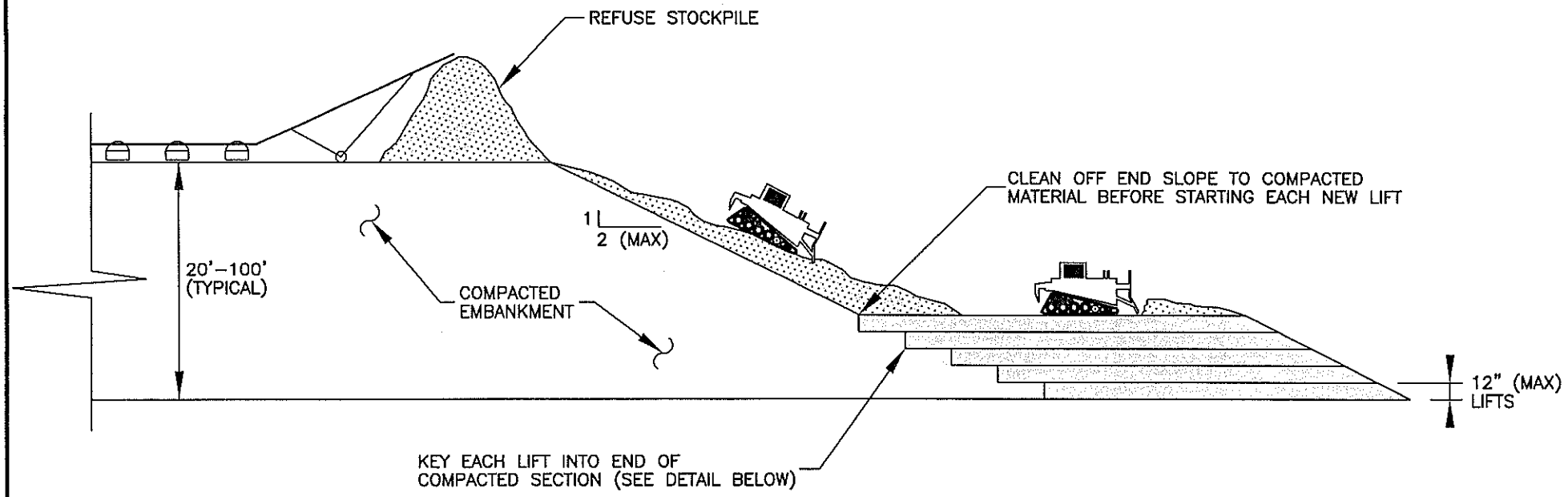
By: DL Date: 1/19/09 Chkd: ____ Date: ____

JOB CONDITION CORRECTION FACTORS

	TRACK-TYPE TRACTOR	WHEEL-TYPE TRACTOR
OPERATOR —		
Excellent	1.00	1.00
Average	0.75	0.60
Poor	0.60	0.50
MATERIAL —		
Loose stockpile	1.20	1.20
Hard to cut; frozen —		
with tilt cylinder	0.80	0.75
without tilt cylinder	0.70	—
Hard to drift; "dead" (dry, non-cohesive material) or very sticky material	0.80	0.80
Rock, ripped or blasted	0.60-0.80	—
SLOT DOZING	1.20	1.20
SIDE BY SIDE DOZING	1.15-1.25	1.15-1.25
VISIBILITY —		
Dust, rain, snow, fog or darkness	0.80	0.70
JOB EFFICIENCY —		
50 min/hr	0.83	0.83
40 min/hr	0.67	0.67
BULLDOZER*		
Adjust based on SAE capacity relative to the base blade used in the Estimated Dozing Production graphs.		
GRADES — See following graph.		

*NOTE: Angling blades and cushion blades are not considered production dozing tools. Depending on job conditions, the A-blade and C-blade will average 50-75% of straight blade production.

REF. CATERPILLAR PERFORMANCE HANDBOOK, EDITION 33



REFUSE PLACEMENT PROCEDURE

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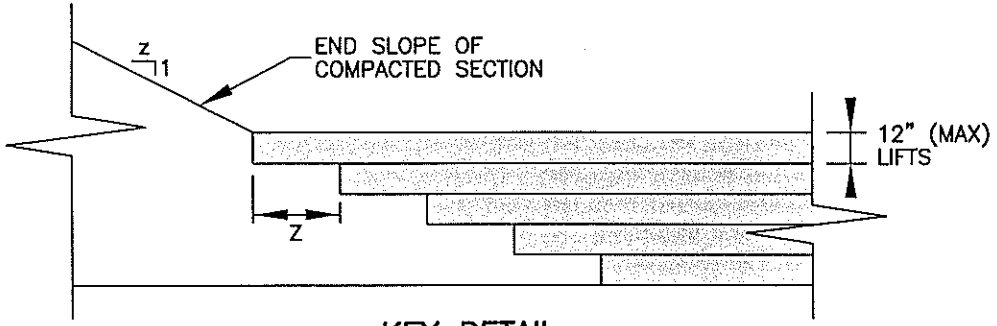

KEY DETAIL

NEW EMBANKMENT TO COMPLETED EMBANKMENT SECTION

N.T.S.

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Constructors
Scientists
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HOUSTON, PA (724) 503-7242

REFUSE PLACEMENT PROCEDURE DETAILS
MACH #1 MINE
PROPOSED COAL REFUSE DISPOSAL FACILITY
PREPARED FOR
WILLIAMSON ENERGY, LLC.
P.O. BOX 99, JOHNSTON CITY, ILLINOIS 62951

DRAWN BY	DSM	06/15/09
CHECKED BY		
APPROVED BY		
DRAWING NUMBER		FIGURE NUMBER
B05–330–A4		

R17412

8114-10
Part 32

APPENDIX F

SUBSIDENCE MONITORING PLAN

APPENDIX F

SUBSIDENCE MONITORING PLAN
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
MACH #1 MINE
WILLIAMSON ENERGY LLC
JOHNSON CITY, ILLIOIS

Installation and Location

Subsidence survey control monuments will be installed away from areas of potential ground movement. The monuments will be constructed to minimize the impact of frost heave. A detail of the monument is included on Drawing No. B05-330-A3.

The locations for all of the subsidence monitoring baselines are shown on Drawing No. B05-330-M36.

Subsidence monitoring baseline stations have been installed on 25-foot spacing for Baselines A through D on the eastern end of Panel No. 1.

Baseline A has been installed near the center of the panel. The direction of the baseline is east to west and starts at a point 300 feet west of the initial longwall face. The baseline is 325-foot long.

Baseline B has been installed 700 feet west of the initial longwall face and runs from Baseline A north for a distance of 1200 feet.

Baseline C has been installed 1250 feet west of the initial longwall face and is 550-foot long running south to north over the developmental entries between Panel No. 1 and Panel No. 2. The purpose for this baseline is to determine the effect of the chain pillars on surface subsidence after mining on both sides of the chain pillars.

Baseline D has been installed in the northeast corner of Panel 1 and extends at an Azimuth of 45 degrees for a distance of 500 feet. This baseline provides information on surface subsidence in the panel corners.

Baselines E and F will be installed in the Phase 4 pool area over Panel No. 2 on 25-foot station spacing. These baselines will provide information as to when foundation subsidence is complete and provide dynamic subsidence data. Baseline E will be 650 feet long, extending one-half the panel width in a south to north direction. Baseline F will run west to east for 300 feet over the center of the panel.

Baseline I has been replaced by Baselines G and H.

Baselines G and H – Baseline G and H will be installed on the Stage 3 embankment crest on 25-foot station spacing. Baseline G will be located on the entire length of eastern crest running a distance of 400 feet north to south. This baseline begins over the Panel No. 3 edge and should

provide data on the maximum embankment strain and slope. Baseline H will be located on the southern crest for a distance of 400 feet over the center of Panel No. 3 and should provide data on the maximum vertical surface movement for Phase 3 and the dynamic subsidence profile in the direction of mining.

Pneumatic piezometers and inclinometers will be installed in the Phase 3 embankment/impoundment prior to its being undermined as described in Technical Specification 6.03.

Panel No. 1 Subsidence Survey baseline was established over the center of Panel No. 1 in a west to east direction starting about 250 feet east of the impoundment Phase 5 footprint. This line contained 21 surface subsidence monuments spaced 30 feet apart. The main purpose of this baseline was to obtain dynamic subsidence survey measurements.

Monitoring

The monitoring will consist of collecting data including elevation, coordinates in east and north planes, date of monitoring, time of monitoring and the location of the longwall face by its underground survey station.

Baselines A, B, C, and D were surveyed on April 24, May 6, and May 19, 2008. The longwall started in Panel 1 on March 18, 2008. The longwall face passed under the southwest end of Baseline D on April 2, 2008, under Baseline B on April 10, 2008, and under the western end of Baseline A on April 14, 2008. The longwall face passed under Baseline C on April 24, 2008, the day the first post-mining subsidence monitoring survey was conducted.

Due to the time lag between the subsidence monitoring surveys and the position of the longwall face with respect to the baseline locations, the survey measurements for Baseline A, B, and D represent near total surface subsidence.

Panel No. 1 Subsidence Survey Baseline was surveyed from November 18, 2008 through January 9, 2009. The longwall face moved under the eastern end of this baseline on November 21, 2008 and left its western end on December 9, 2008. The subsidence monuments were surveyed on a daily basis from November 18, 2008 through January 9, 2009 on those days when the longwall was advancing. Drawing No. B05-330-M36 (and Drawing No. B05-330-B4 in this Appendix) show the location of the baseline survey points and the timing of the longwall face movement and Drawing No. B05-330-M44 shows the tabular and plotted data.

The subsidence measurement data from the five baselines described above was used to recalibrate the subsidence prediction model used in our August 2008 report. The modified subsidence prediction report is contained in Appendix H and the drawings which show subsidence predictions have been revised to reflect the changes.

Baseline E will be surveyed daily starting when or before the longwall face approaches it within 100 feet and ending two weeks after the face passes under it.

Baseline F will be surveyed daily starting when or before the longwall face is within 100 feet of its eastern end and ending two weeks after the face passes under its western end.

Baseline G will be surveyed daily starting when or before the longwall face approaches it within 100 feet and ending two weeks after the face passes under it.

Baseline H will be surveyed daily starting when or before the longwall face is within 100 feet of its eastern end and ending two weeks after the face passes under its western end.

Before, during, and after undermining of the Phase 3 embankment and impoundment , Phase 3 inspections and instrumentation readings will be done on the frequency described in Technical Specification 6.03.b

The top of the inclinometer casings shall be accurately located in plan view and elevation by surveying after installation. The locations shall be resurveyed prior to each reading during periods of ground movement (i.e. before the longwall approaches within 100-foot of the east side of the Phase 3 embankment, during mining under the embankment, and for two weeks after longwall wall mining under the east side of the Embankment)

File: Appendix F Revised.doc, hlo, rev. 7/16/09

R17417

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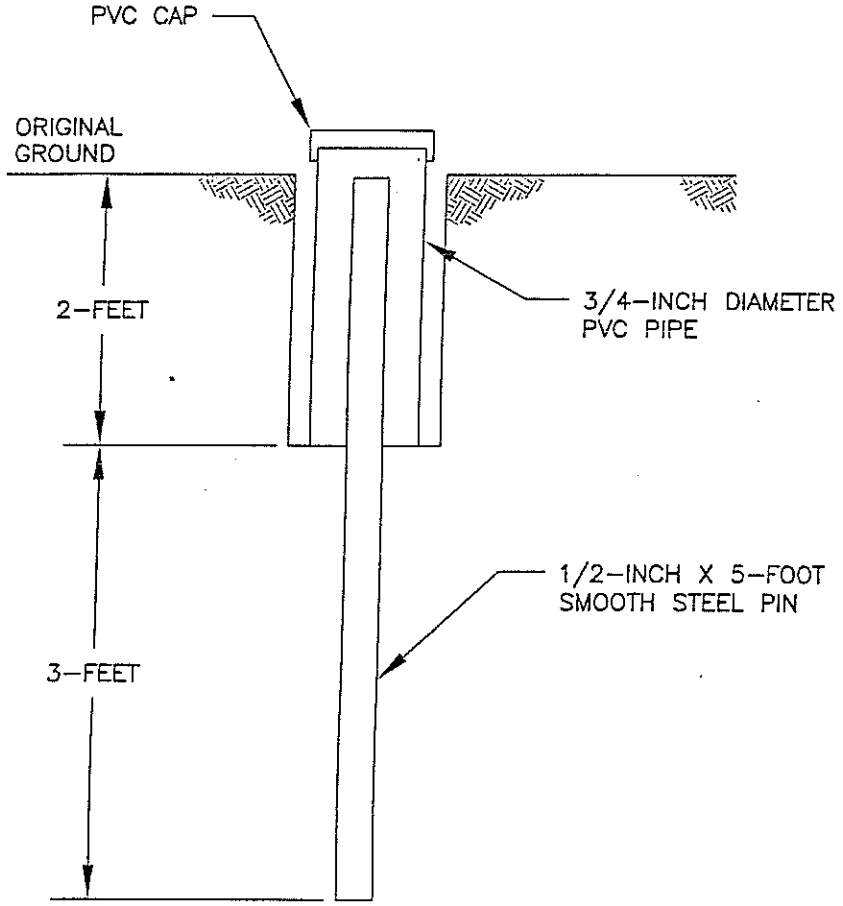

SECTION VIEW

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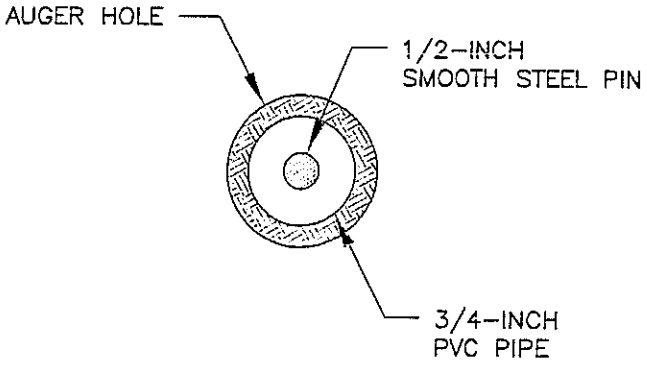

PLAN VIEW

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Scientists

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HOUSTON, PA (724) 503-7242

TYPICAL DETAILS
SUBSIDENCE MONITORING STATION
POND CREEK MINE NO. 1
PROPOSED COAL REFUSE DISPOSAL FACILITY
PREPARED FOR
WILLIAMSON ENERGY, LLC.
430 HARPER DRIVE, BECKLEY, WEST VIRGINIA 25801

DRAWN BY	JUS	03/14/08
CHECKED BY		
APPROVED BY		
DRAWING NUMBER		FIGURE NUMBER
B05–330–A3		



SCALE

100 0 100 200 FEET

REV.	DATE	DESCRIPTION	P.M.

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(724) 745-3630

MSHA ID NO. IL08-03141-02

NOIS DEPARTMENT OF NATURAL RESOURCES PERMIT NO. 375

UBSIDENCE SURVEY PANEL NO. 1 PLAN VIEW

MACH #1 MINE

PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2

WILLIAMSON COUNTY, ILLINOIS

Prepared For

WILLIAMSON ENERGY, LLC.

P.O. BOX 99, JOHNSTON CITY, ILLINOIS 62951

BY	JUS	07/09/09	PROJECT NO. B05-533-1413	
CKED BY				
ROVED BY			DRAWING NO. B05-330-B4	

APPENDIX G

PUMP SPECIFICATIONS

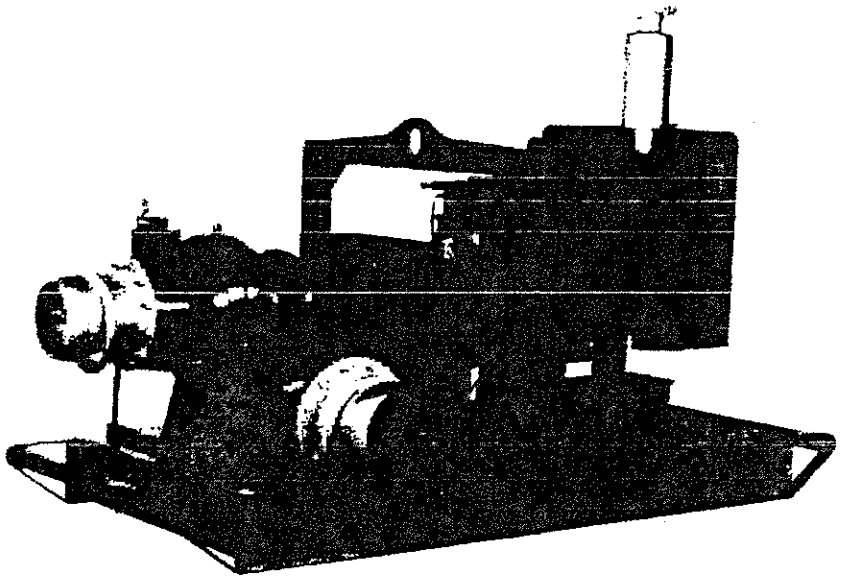
The following specifications are for a pump capable of evacuating 1902 gpm with 32.5 feet of static head during Phases 4 through 6 construction until the Phase 7 decant is installed. If this particular pump is not utilized, any equally sized pump will be maintained.

2

godwin pumps

ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data



Attn: Claudio Maris Niday

The Godwin CD300M Dri-Prime pump is a 12 inch (300mm) centrifugal trash pump perfect for your biggest jobs. Offering flows to 6,000 gallons per minute (380 liters per second), discharge heads to 200 feet (60 meters), and solids handling to 3-3/4" (95mm) in diameter, the CD300M moves large volumes of water and provides automatic self-priming to 28 feet. For intermittent flows, the double high pressure mechanical seal means the CD300M can run dry indefinitely without damage. And the underslung discharge flange makes pump connections easy and efficient. When your job calls for both high volume and high head, the Godwin CD300M is the pump that does it all.

Features

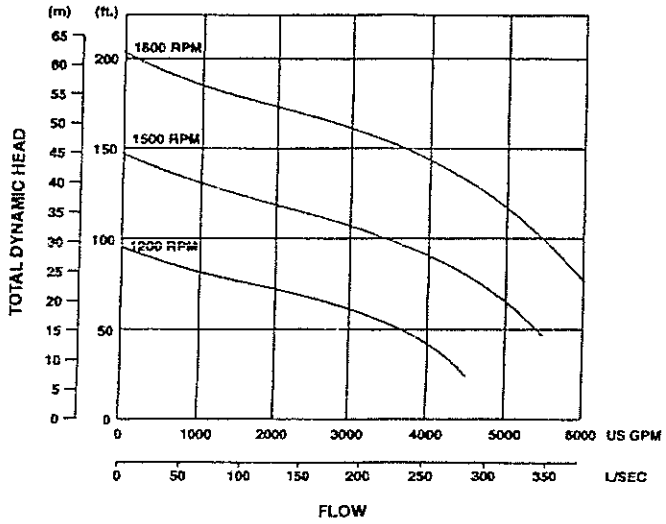
- Direct drive automatic priming 12" (300mm) high volume centrifugal pump with vacuum priming compressor mounted to a diesel engine. Also available in electric drive or as bare shaft pumpend.
- Extensive application flexibility – handles raw sewage, sludges and liquids with solids up to 3-3/4" (95mm) in diameter.
- Continuously operated "Godwin" air ejector priming device requiring no form of periodic adjustment or control.
- Compact design – Pump is direct coupled to engine flywheel for increased reliability.
- Underslung side discharge for easy pipe connection.
- Double, high pressure mechanical seal with high abrasion resistant silicon carbide interfaces. Oil bath immersion for dry running.
- Skid base incorporating integral overnight running fuel tank.
- Simple maintenance – normally limited to checking engine oil, compressor oil and seal lubrication.
- Standard Caterpillar C-9 engine. Also available with a variety of other engines including John Deere, Cummins and Deutz.
- Balanced unit with centralized lifting bracket for easy handling.

godwin pumps

ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data

Summary Performance Curve



Performance Table

Diesel Set: Caterpillar C-9, 275 hp (170 kw) @ 1800 rpm
Impeller Diameter: 14-1/4 in. (362 mm)

Total Suction Head – Feet	Total Delivery Head – Feet 40	80	120	160
	Output – GPM			
10	6000	5810	4870	3010
15	5480	5250	4700	3000
20	4850	4780	4500	2900
25	4300	4100	3800	2800

Performance data listed in table and curves are based on water tests at sea level and 68° F (20° C). Larger diameter pipes may be required for maximum flows.

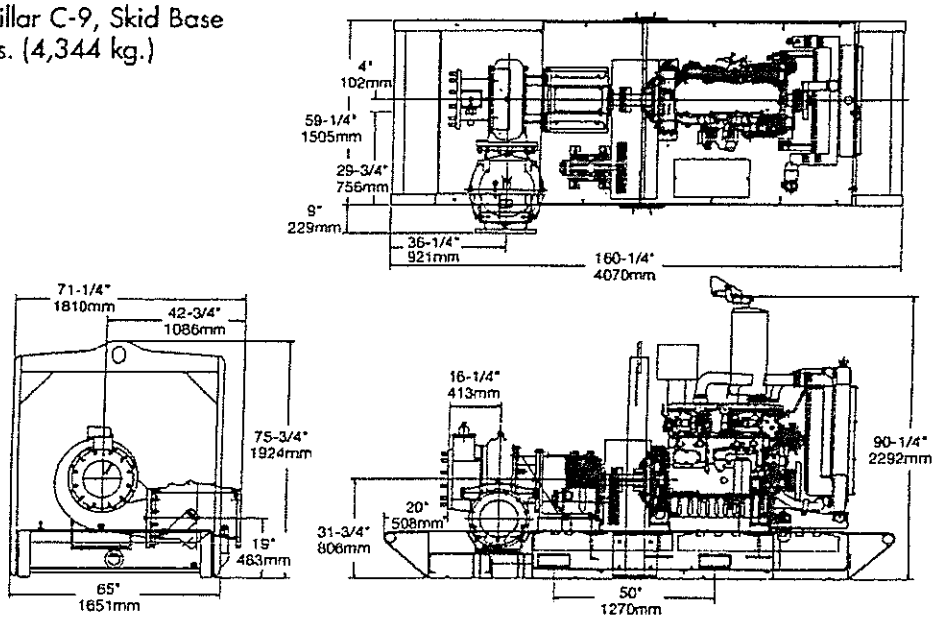
godwin pumps

ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data

Dimensions

CD300M, Caterpillar C-9, Skid Base
Weight: 9,600 lbs. (4,344 kg.)



Specifications

Maximum Operating Speed	1800 rpm
Maximum Operating Temperature	+212° F (100° C)
Maximum Working Pressure	87 psi (6.0 BAR)
Maximum Suction Pressure	88 psi (6.1 BAR)
Maximum Casing Pressure	130 psi (9.0 BAR)
Fuel tank Capacity	250 gallons (946 liters)
Fuel Consumption	11.1 gph (42.0 lph) @ 1800 rpm
Pipe Connections	12" (300mm) ASA 150#
Solids Handling	3-3/4" (95mm) diameter

Materials

Pump Casing, Suction Cover and Separation Tank	Close Grained Cast Iron
Impeller	Nitride Hardened Cast Chromium Steel
Front Wearplate	25% Chromium Iron
Rear Wearplate	Nitride Hardened Cast Iron
Pump shaft	1-1/2% Nickel/Chromium Steel
Non Return Valve Body Ejector Housing	Close Grained Cast Iron
Non Return Valve Flapper	High Nitrile Rubber
Mechanical Seal Faces	Solid Silicon Carbide

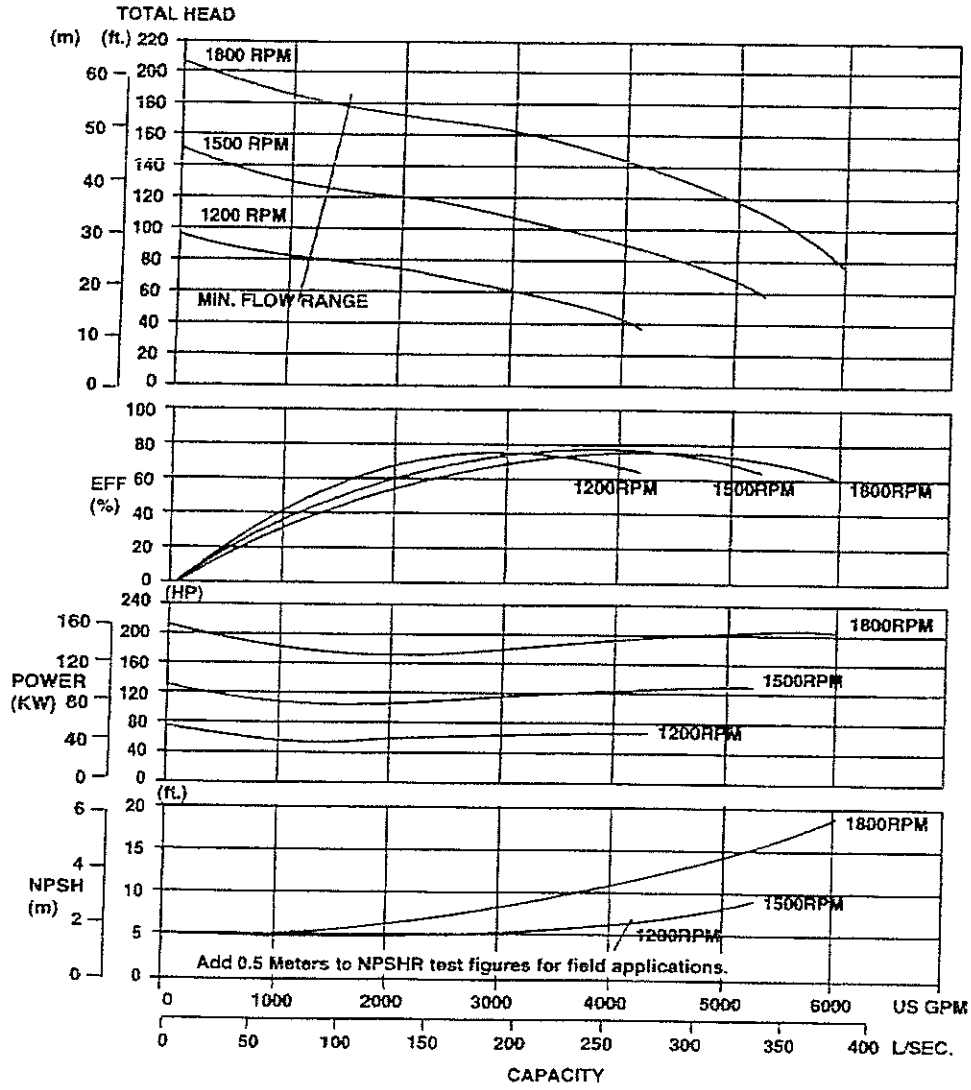
5

godwin pumps

ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data

Pump	CD300M
Curve	CD300M 2B-1
Branch Sizes	12" x 12" (300mm x 300mm)
Speed	Variable



Notes:

1. Max. impeller diameter 362mm (14.25").
2. Min. impeller diameter 330mm (13").
3. Max. solids handling 95.0mm (3.75").
4. Add 12% for V-belt drives.
5. Max. V-belt speed 1600 rpm.
6. Where a compressor is fitted, add 2.6Kw (3.5 HP) for small size and for large size 8.25 Kw (11.1 HP).
7. Published performance is achieved at total suction heads up to 2.05m (10ft.). When great, reduce performance.

R17424

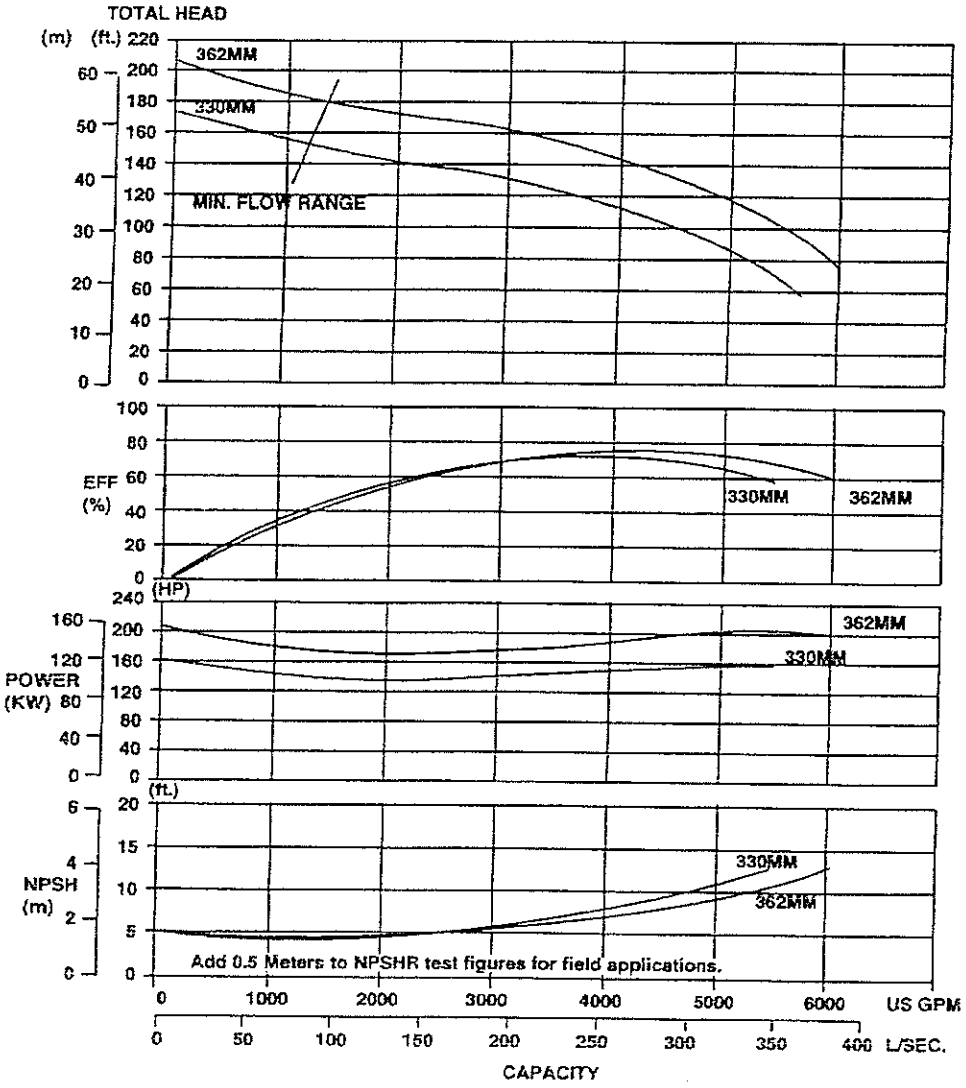


godwin pumps

ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data

Pump	CD300M Electric
Curve	CD300M-2B-2A
Branch Sizes	12" x 12" (300mm x 300mm)
Speed	1800 rpm



Notes:

1. Max. impeller diameter 362mm (14.25").
2. Min. impeller diameter 330mm (13").
3. Max. solids handling 95.0mm (3.75").
4. Add 12% for V-belt drives.
5. Max. V-belt speed 1600rpm.
6. Where a compressor is fitted, add 2.6Kw (3.5 HP) for small size and for large size 8.25 Kw (11.1 HP).
7. Published performance is achieved at total suction heads up to 2.05m (10ft.). When great, reduce performance.

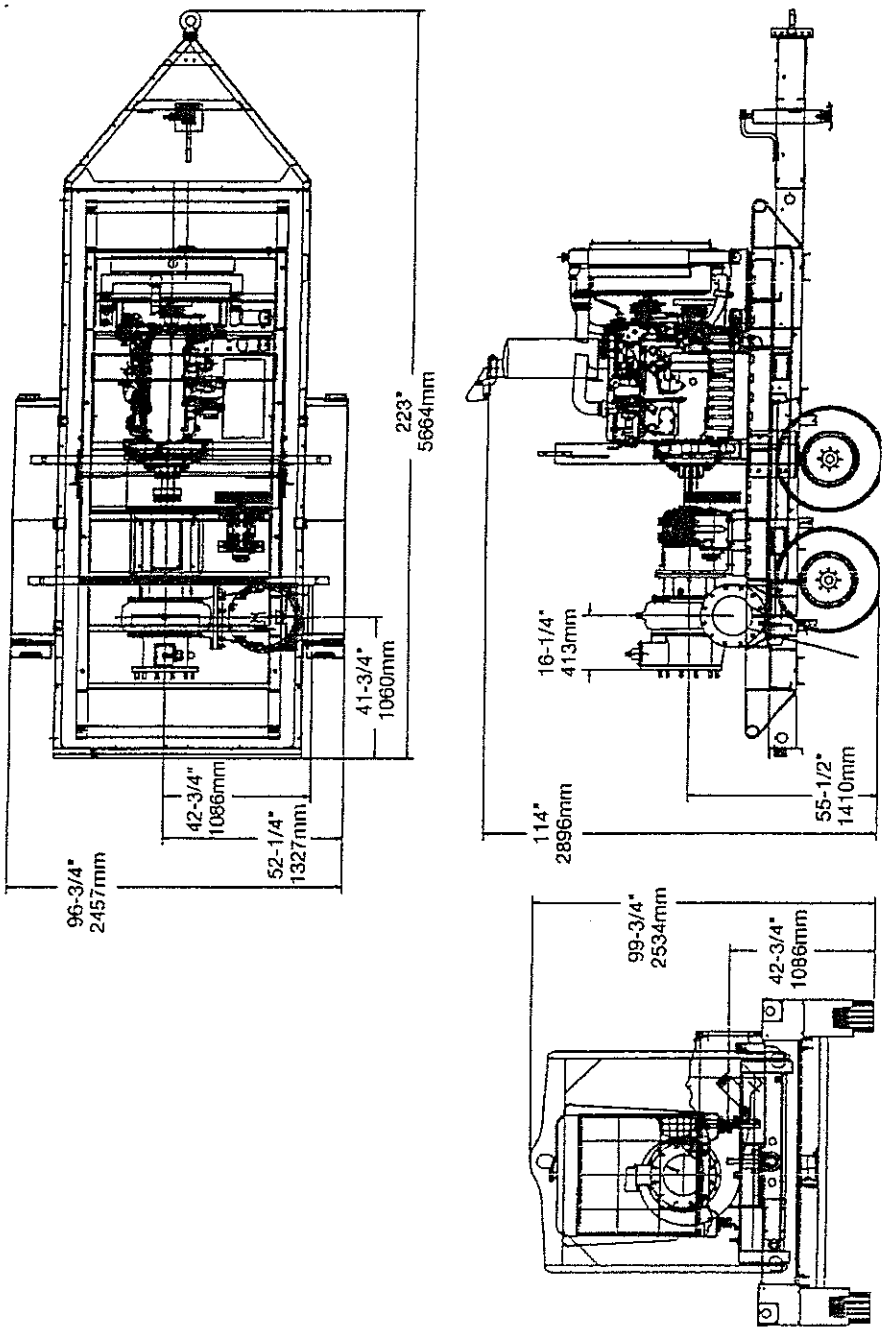
R17425

7

godwin pumps

ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data

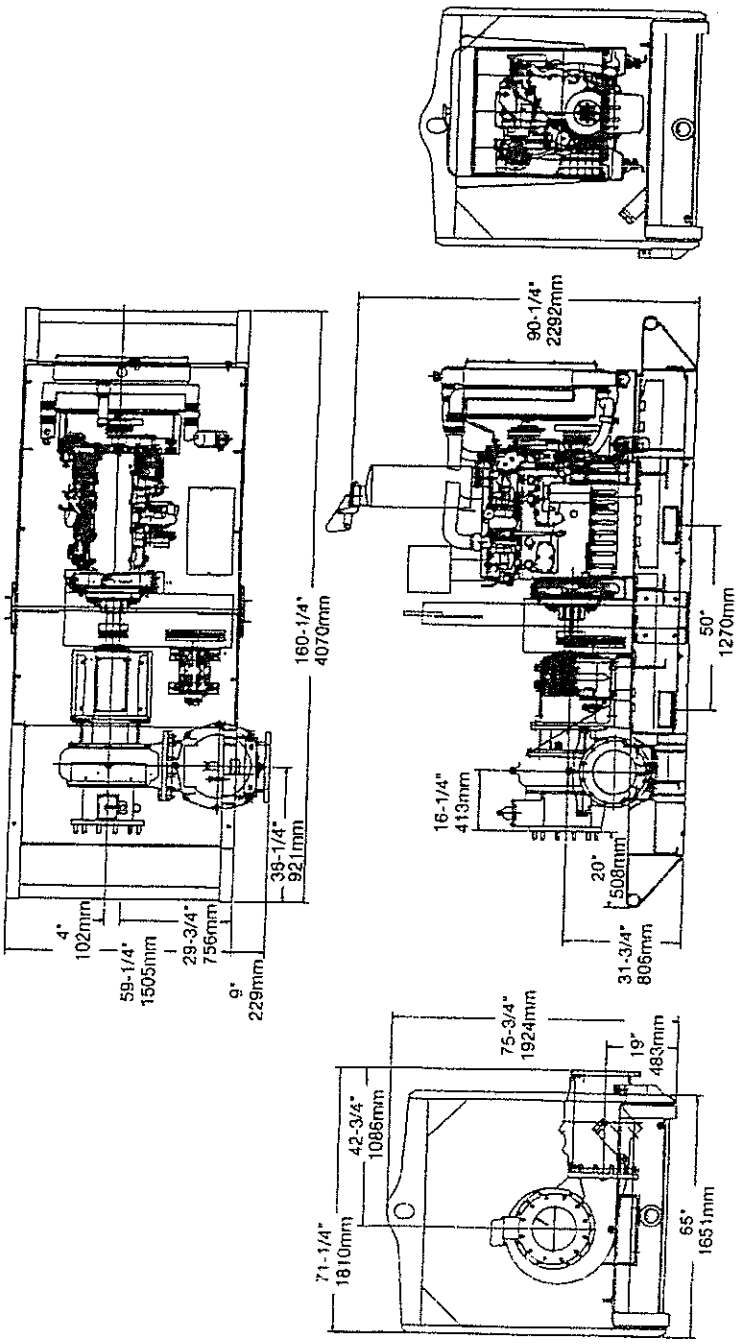


CD300M — Caterpillar C-9 — Trailer Configuration

godwin pumps

ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data



CD300M — Caterpillar C-9 — 250 Gallon Skid Base Configuration

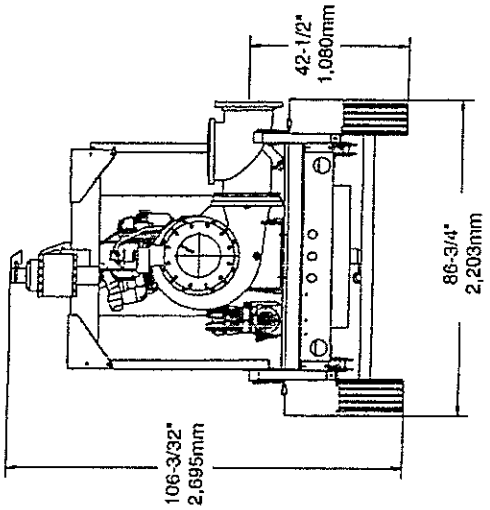
R17427

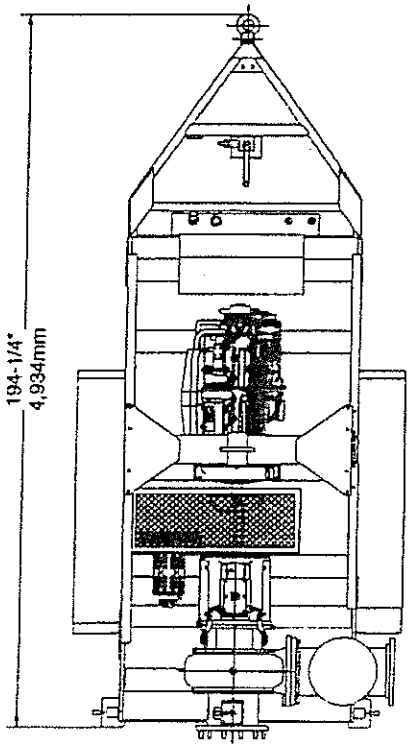
9

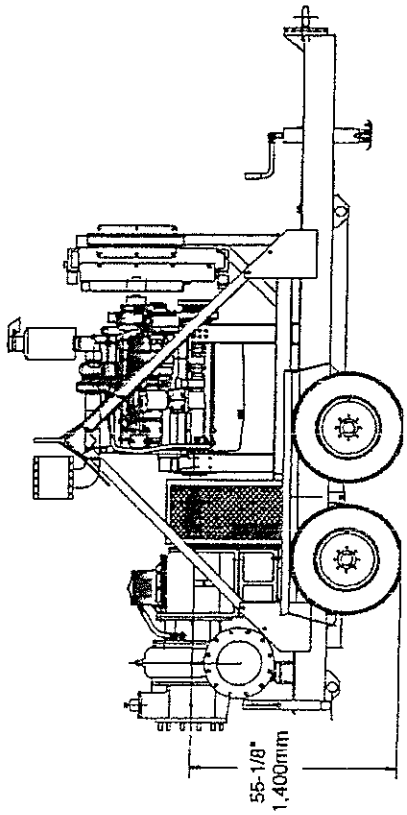
godwin pumps

ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data





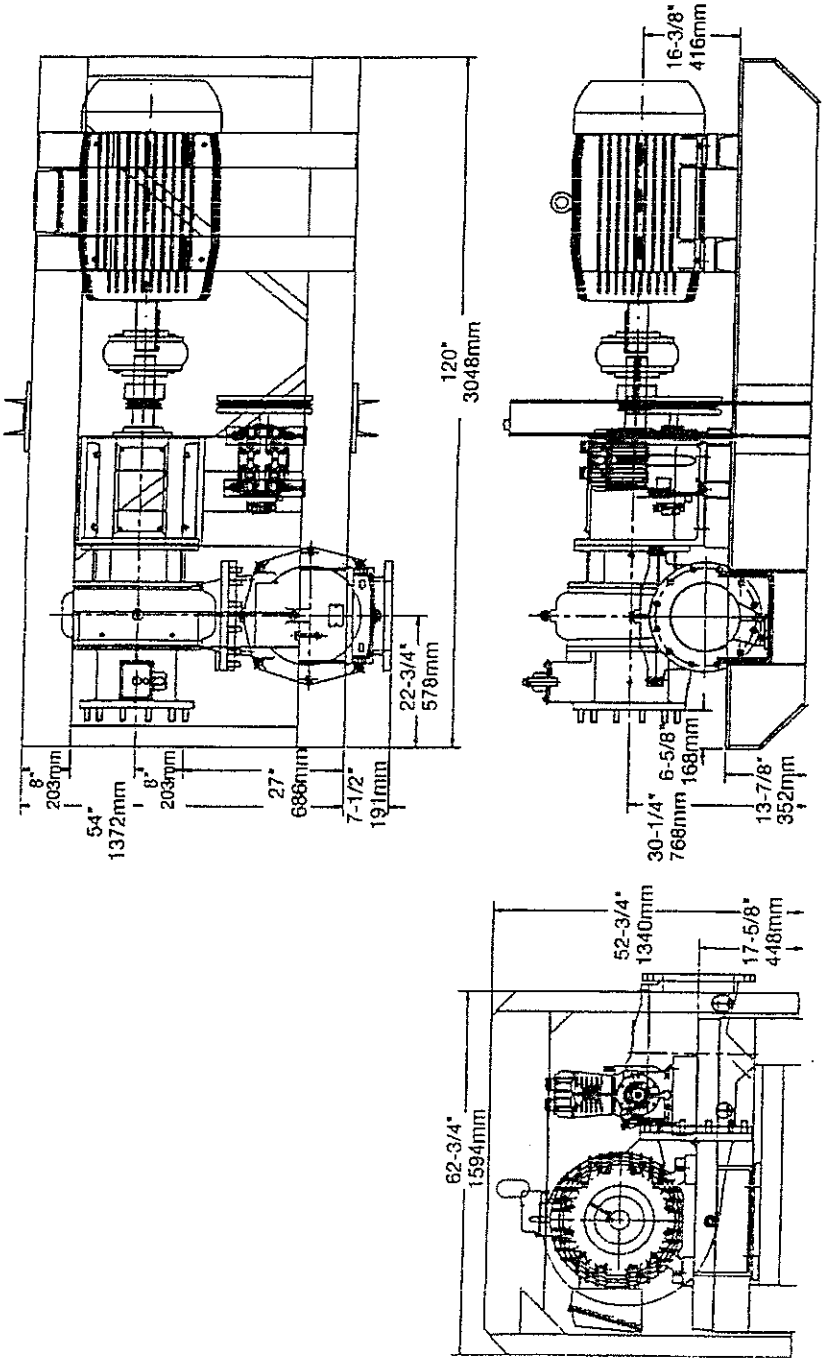


CD300M — John Deere 6081A — GP10000 Trailer Mounted Configuration

godwin pumps

ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data



CD300M — 200 HP Electric Motor — Portable Skid Base Configuration

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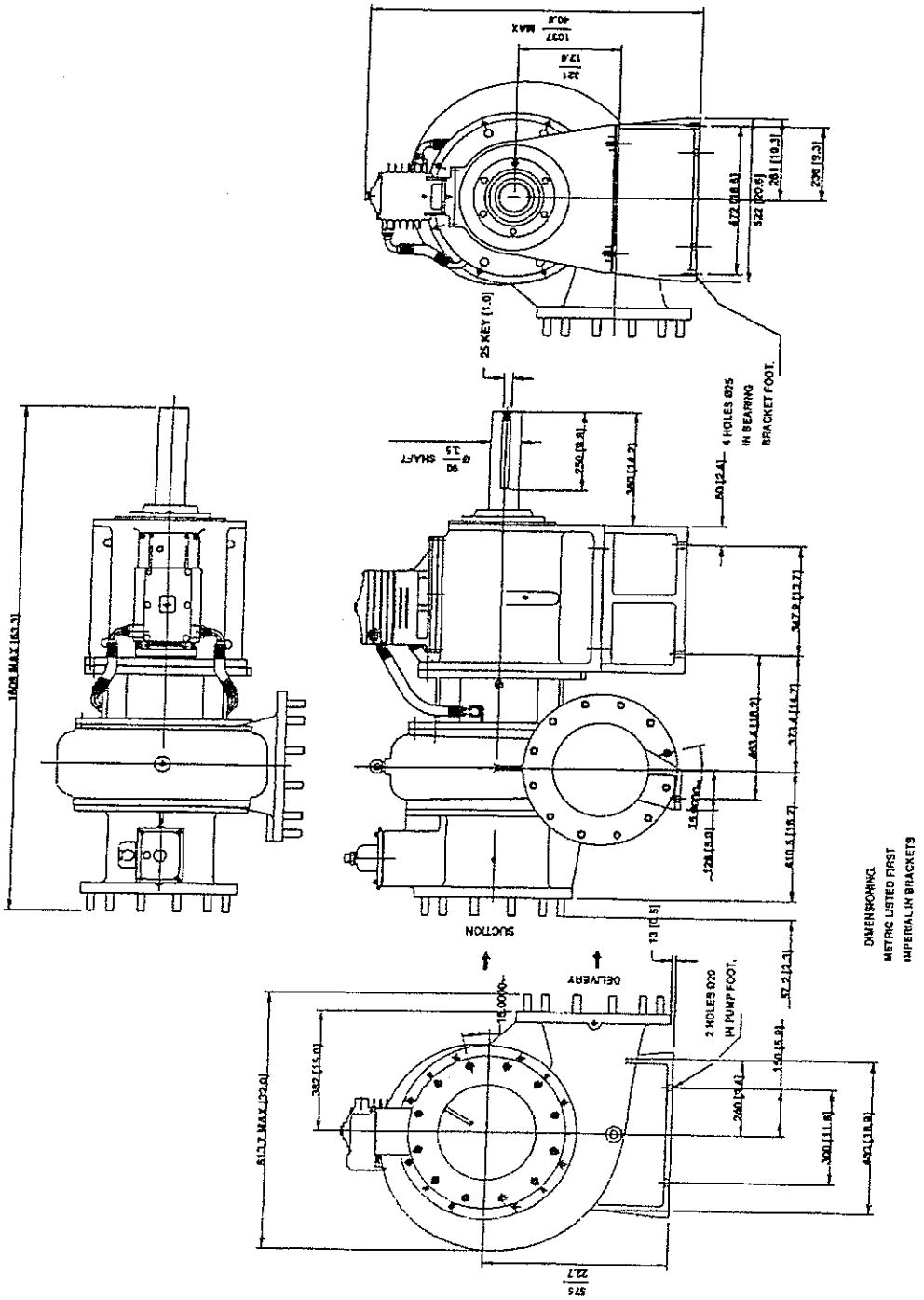
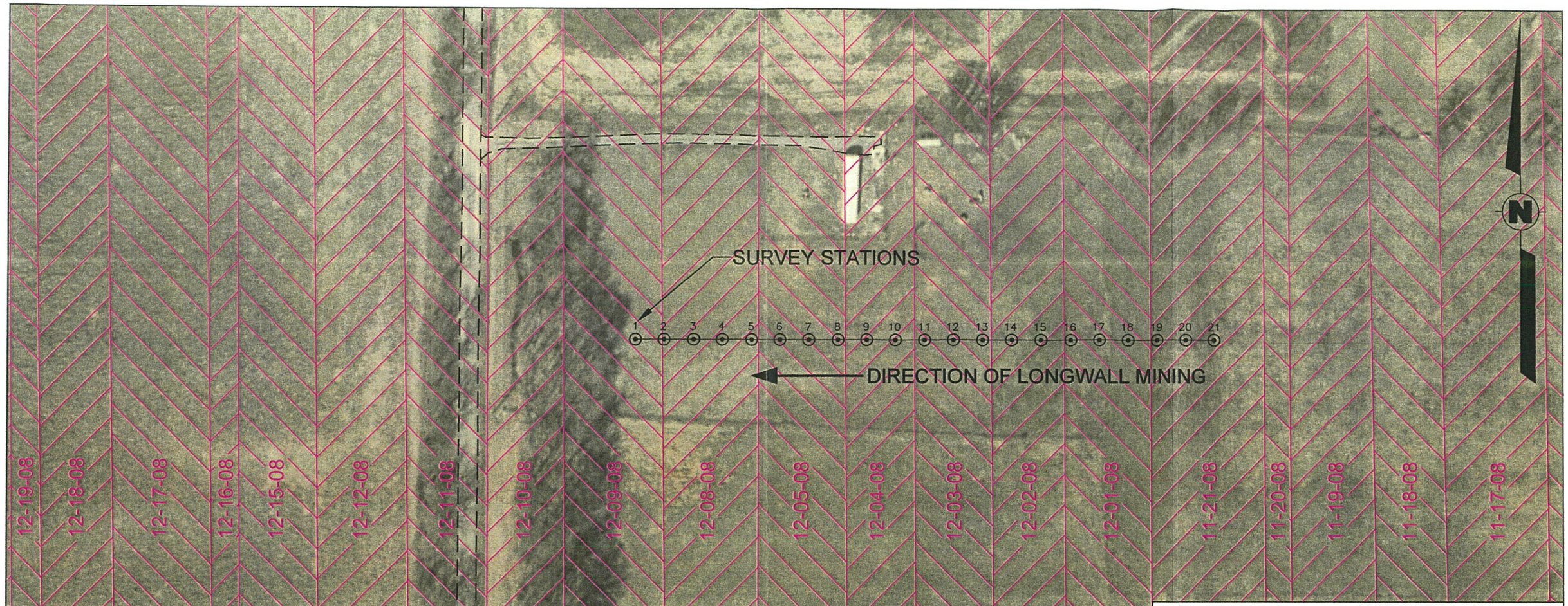
ENGINEERING CATALOG

CD300M Dri-Prime® Pump Engineering Data



CD300M-BS-002 — CD300M Bareshaft Outline Drawing

R17430



NOTE:
FOR SECTION SEE
DRAWING NO. B05-330-M44.

SCALE

100 0 100 200 FEET

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(724) 745-3630

MSHA ID NO. IL08-03141-02
ILLINOIS DEPARTMENT OF NATURAL RESOURCES PERMIT NO. 375

SUBSIDENCE SURVEY PANEL NO. 1 PLAN VIEW

MACH #1 MINE
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
WILLIAMSON COUNTY, ILLINOIS
Prepared For
WILLIAMSON ENERGY, LLC.
P.O. BOX 99, JOHNSTON CITY, ILLINOIS 62951

CAD BY	JUS	07/09/09	PROJECT NO. B05-533-1413	
CHECKED BY				
APPROVED BY			DRAWING NO. B05-330-B4	

R17431

8114-10 Part 33

Prediction of Ground Movement due to Longwall Mining During different Phases of Impoundments Construction

A Modified report

Submitted to

Alliance Consulting, Inc.

by

Syd S. Peng, Charles E. Lawall Chair of Mining Engineering

Thomas Du, Graduate Research Assistant

Department of Mining Engineering

West Virginia University

May 2009

1.0 INTRODUCTION – REGRESSION ANALYSIS OF THE MEASURED SUBSIDENCE DATA IN PANEL 1

Among the five survey lines in panel 1 (Fig. 1), line A with 13 monuments was located at the panel center along the mining direction; line D was diagonal and intersects the tailgate corner of the set-up room; lines B and C were transverse to panel 1 mining direction; and points 1-21 just east of the proposed impoundment location (Phase 5), was at the panel center along the mining direction. Therefore, only line B and C are amenable for regression calibration.

CISPM, a subsidence prediction software developed by the senior author, was used to calibrate the subsidence parameters using the subsidence data measured on lines B and C in Panel 1 (Fig. 1). The regression results of calibration are shown in Figs. 2 and 3 for lines B and C, respectively. From these two figures, the subsidence factors are:

For line B: Subsidence factor = 0.83

Major influence angle = 75.86°

Offset of inflection point (left) = 112 ft

Offset of inflection point (right) = 76.46 ft

For line C Subsidence factor = 0.81

Major influence angle = 78.53°

Offset of inflection point (left) = 157.16 ft

Offset of inflection point (right) = 119.78 ft

Combine the regression results for line B and C, the modified subsidence parameters are:

Subsidence factor = 0.83

Major influence angle = 80°

Offset of inflection point (left) = 140 ft

Offset of inflection point (right) = 110 ft

The above modified subsidence parameters were used to predict the final and dynamic subsidence indices along lines A, B, and C, and points 1-21, respectively. Figs. 4, 5 and 6 show the measured and predicted subsidence profiles and slope profiles using the regressed subsidence parameters for line A, line B, and the combined regression results, respectively. The subsidence profiles match perfectly except on both edges. For the slope profiles, using the line B combined parameters match better than using the regression parameters.

Figs. 7 and 8 show the measured and predicted subsidence profiles and slope profiles using the regressed subsidence parameters for lines C and the combined regression results, respectively. Similarly, the subsidence profiles match well except on both edges probably showing the effect of not a complete survey line where the monuments did not extend far enough toward the panel center. For the slope profiles, using the line C combined parameters match

better than using the regression parameters. Note the slope for C line is positive while for B is negative because they are in opposite direction.

For calibration of dynamic subsidence profile, only those subsidence data obtained for points 1-21 were used. Those obtained for line A could not be used for two reasons: (1) Line A is flat and only the final subsidence profile was available, and (2) Line A had only 13 monuments, too short for dynamic subsidence calibration.

Figures 9 and 10 show the dynamic subsidence and slope profiles for points 1-21, respectively. The solid lines with subsidence and slope data points are the measured dynamic profiles, while the dashed lines are the predicted dynamic profiles using the combined regressed subsidence parameters. Note the maximum possible subsidence is 5.1 ft and since the mining height in points 1-21 is 82 in. (6.83 ft.), the subsidence factor in this area is 0.75 (5.1/6.83) instead of 0.83 in lines A, B and C areas.

In summary, using the subsidence survey data for lines A, B, C, and points 1-21, the combined regressed subsidence parameters were obtained which proved to be valid for subsidence prediction for subsequent panels as demonstrated by Figs. 4 -10.

The calibrated input parameters were used to predict the subsidence profiles from Figs. 11 to 18 using the subsidence prediction program CISPM.

2.0 Predicted subsidence movements

Figure 1 shows the location of impoundments and longwall panels 1 to 4. The gateroads of the longwall panels are orientated towards east-west direction. Table 1 shows the mining conditions for the four longwall panels over which impoundment will be constructed. The panel widths are 1,250 for the first two longwall panels and 1,400 ft for the third and fourth longwall panel. The width of chain pillar /gateroad system is 220 ft for all the panels.

Cross section 'A-A' (Figure 1) parallel to the longwall panel width and in the center of the impoundment has been considered for prediction of the subsidence movements. Table 1 shows the longwall panel parameters.

Table 1 Longwall panels parameters

Panel No.	Panel Length, ft	Panel Width, ft	Overburden Depth, ft			Mining Height, ft		
			Max.	Min.	Average	Max.	Min.	Average
Panel 1	17,200	1,250	498	470	482	6.83	5.8	6.3
Panel 2	17,200	1,250	522	486	501	5.8	5.8	5.8
Panel 3	17,200	1,400	522	490	506	5.8	5.8	5.8
Panel 4	18,000	1,400	504	464	475	6.0	6.0	6.0

3.0 Prediction of Final Subsidence Parameters

In order to estimate the ground movement parameters associated with longwall mining over the surface where impoundments are located, a local coordinate system has been selected with origin (0, 0) at the right edge of 1st longwall panel gateroad system (Figure 1). The X-axis is parallel to the mining direction and the distance is measured from the setup room. The Y-axis is along the panel width direction or along section A-A.

The prediction of surface subsidence and subsidence parameters due to mining on the surface was performed with monument spacing at 20 ft interval across the panel width. The total width along the cross section A-A is 6,360 ft covering all four longwall panels and gateroad systems. The prediction points along the cross section A-A are shown in Figure 1.

The final surface movements and deformations along the cross-section A-A have been predicted using the subsidence prediction program CISPM version 2.01. Average mining parameters of longwall panels (Table 1) were used for this subsidence prediction.

3.1 Surface Subsidence during Phases 2 and 3

The predicted final subsidence profile across the impoundments after phase 2 and 3 and before phase 5 is shown in Fig. 11. Since there is no longwall workings below phase 2 and 3 before phase 2 and 3 gets eliminated, no ground movement effect will be observed during phase 2 and 3 periods.

3.2 Subsidence movements during Phase 4

Phase 4 will be built before completion of longwall retreat in panel 1. So during construction it will not be influenced by mining induced subsidence.

3.3 Surface movements during Phase 5

Before Phase 5 construction starts, the surface will experience mining induced ground movements. The subsidence, horizontal displacement, slopes and horizontal strain profiles are shown in Figures 11, 12, 13, and 14.

The maximum subsidence may be 5.67 ft at the center of the panel with a flat bottom. The predicted value of maximum horizontal displacement, slopes and horizontal strain are 1.87 ft, 6.6% and 3.50×10^{-2} ft/ft, respectively.

3.4 Subsidence Movements during Phase 6

During Phases 4 and 6 the longwall retreat will be below the impoundments in panel 2. Hence it may be affected by the mining induced subsidence and other ground movements. During Phases 4 and 6 the final surface movements are shown in Figs. 15, 16, 17 and 18.

4.0 Time Required to Attain Majority of Final Surface movements

From past field experience, the final subsidence at any point/cross section takes place after 2 to 3 weeks of passing of the longwall face. Furthermore, the final surface subsidence also depends upon the face retreat rate.

The dynamic subsidence prediction has been performed for three face retreat rate, i.e., 60, 80, and 100 ft/day [2] as shown in figure 19.

There is no subsidence when the longwall face is directly under the point of interest. Thereafter, the subsidence process accelerates and reaches about one half of its final subsidence at which subsidence process is most active. A deceleration process is followed. The ground surface re-establishes about 500 ft behind the face. Figure 19 also shows that a slower advance rate induces a steeper subsidence development curve. However, the differences between the subsidence development curves are not significant for the range of high face advance rates used in the dynamic subsidence predictions.

Based on the dynamic subsidence prediction for face retreat rate of 60 ft/day, it will take more than 10 working days for the dynamic subsidence to reach the values of final subsidence. Hence, on the safe side, 2 weeks is used as the time required to reach the final subsidence.

5.0 Reference

1. S.S. Peng and Y Luo, Instruction Manual for CISPM software for Subsidence prediction
2. S.S. peng, Khaled Morsey, Anil Ray and Thomas Du, "Assessment of subsidence influence on Buried Pipeline due to Longwall Mining: Williamson Energy, Johnson City, IL ,July 2007

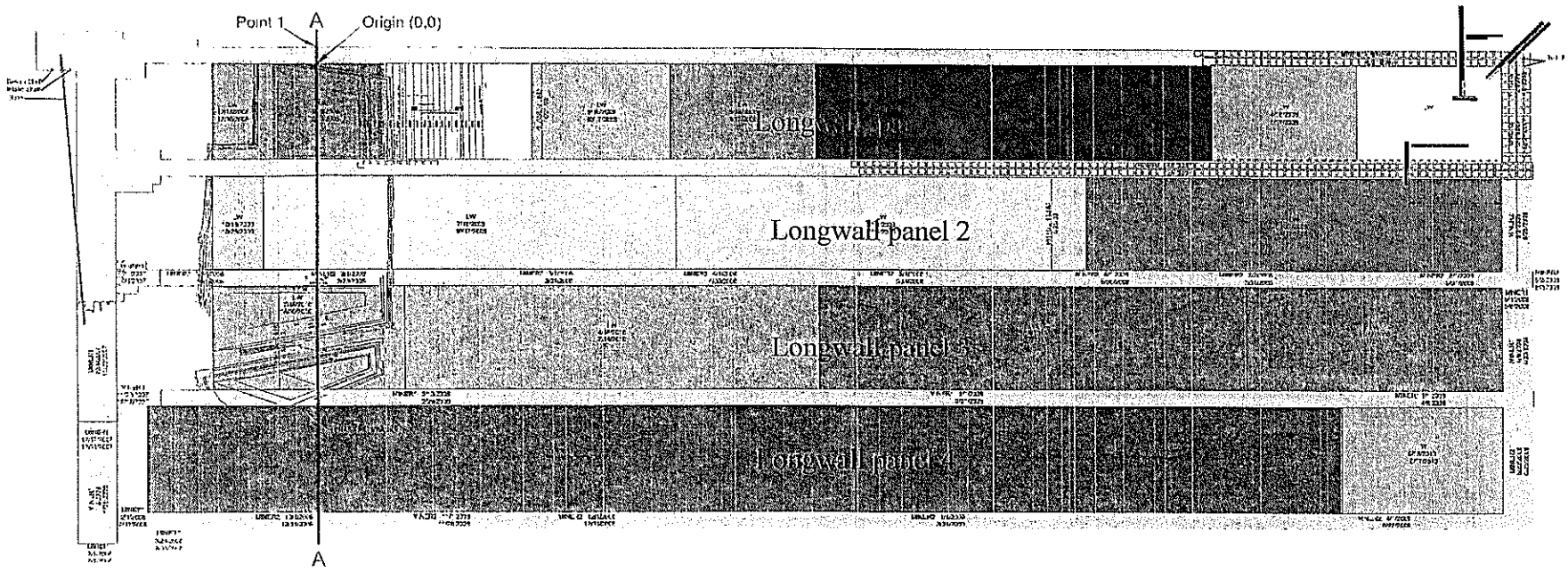


Figure 1 Mine map showing cross section A-A across the longwall panels and Lines A, B, C, D, E, and Points 1-21

R17436

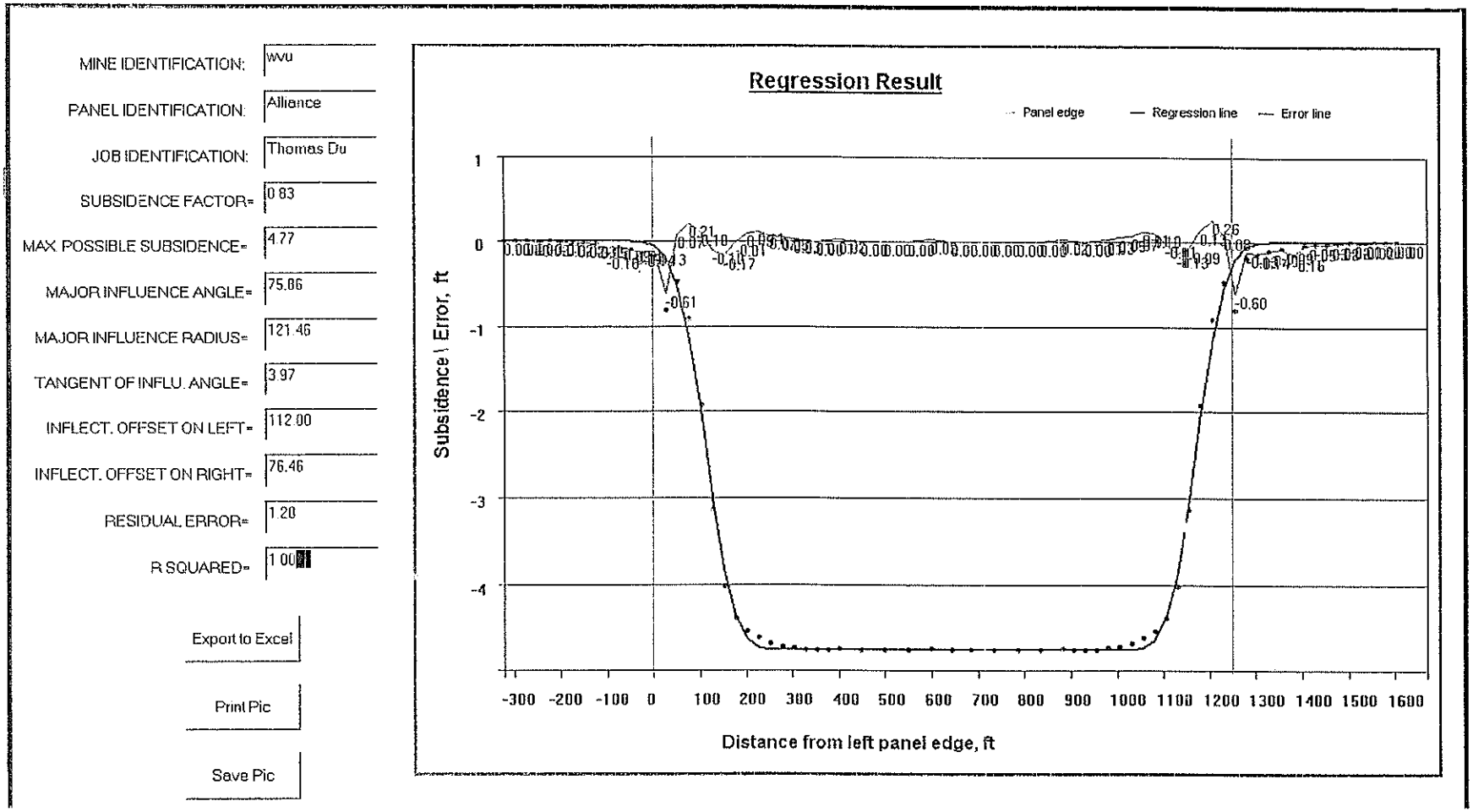


Fig. 2 Line B Regression Results

R17437

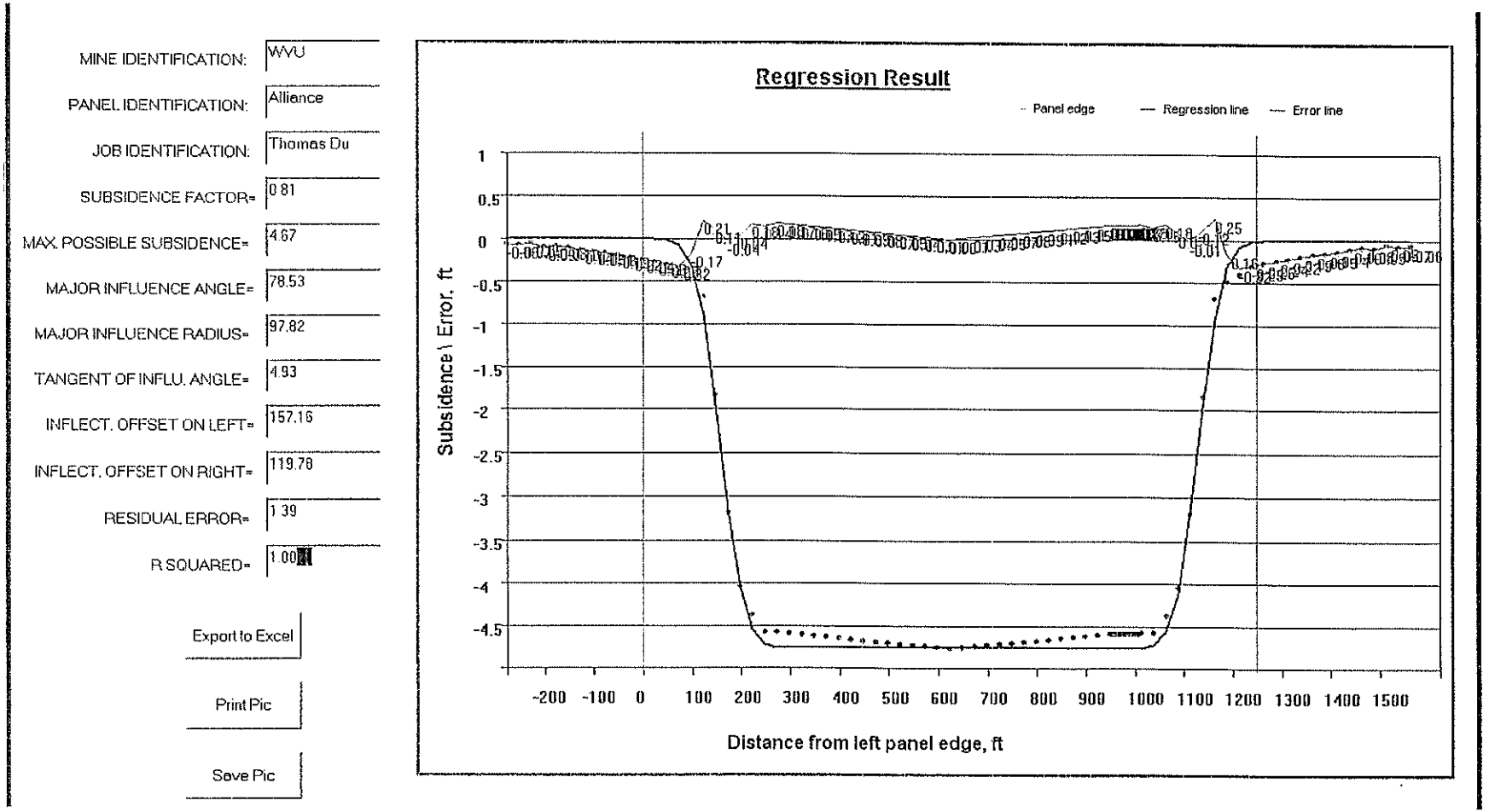


Fig. 3 Line C Regression Results

R17438

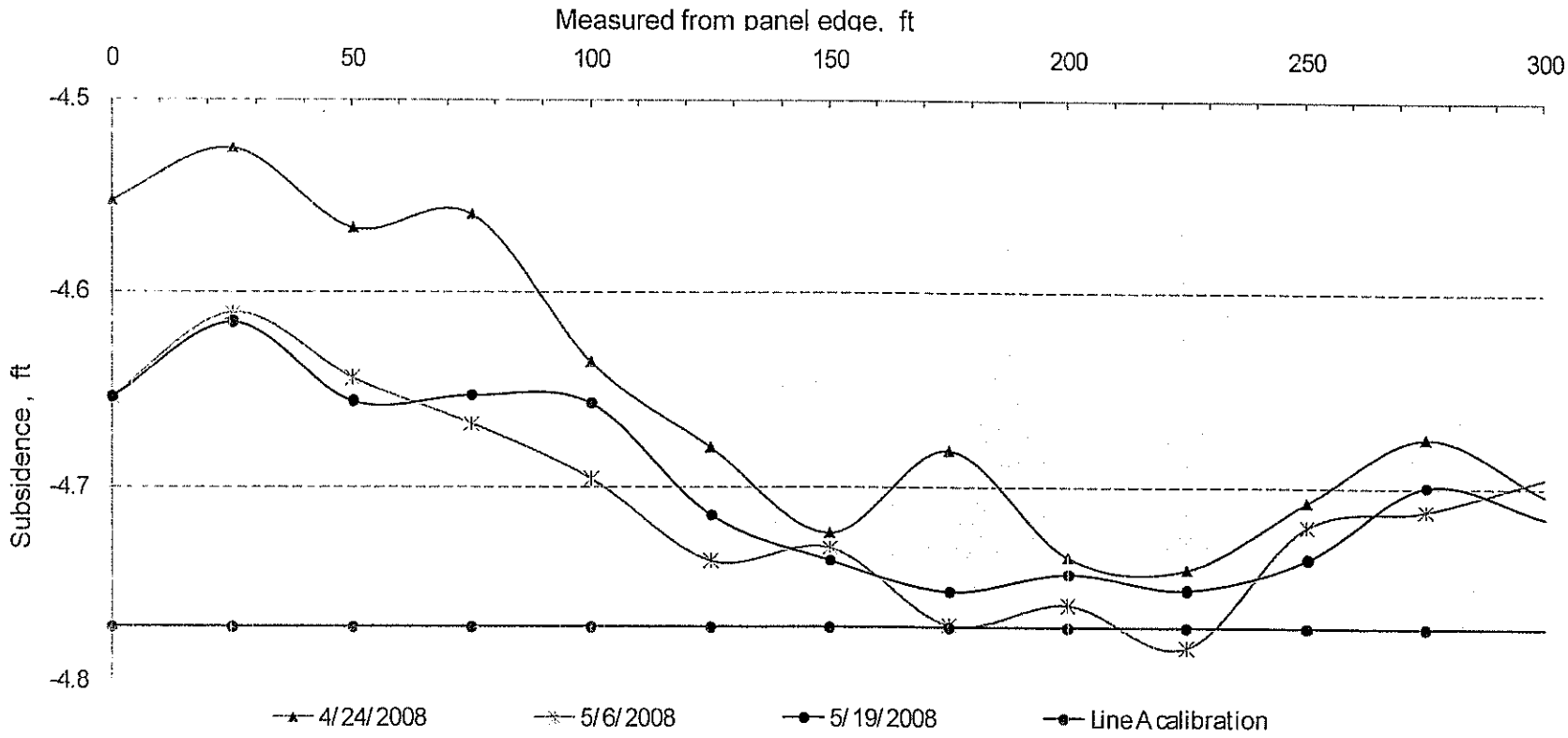


Fig. 4 Line A subsidence profile calibration

9 R17439

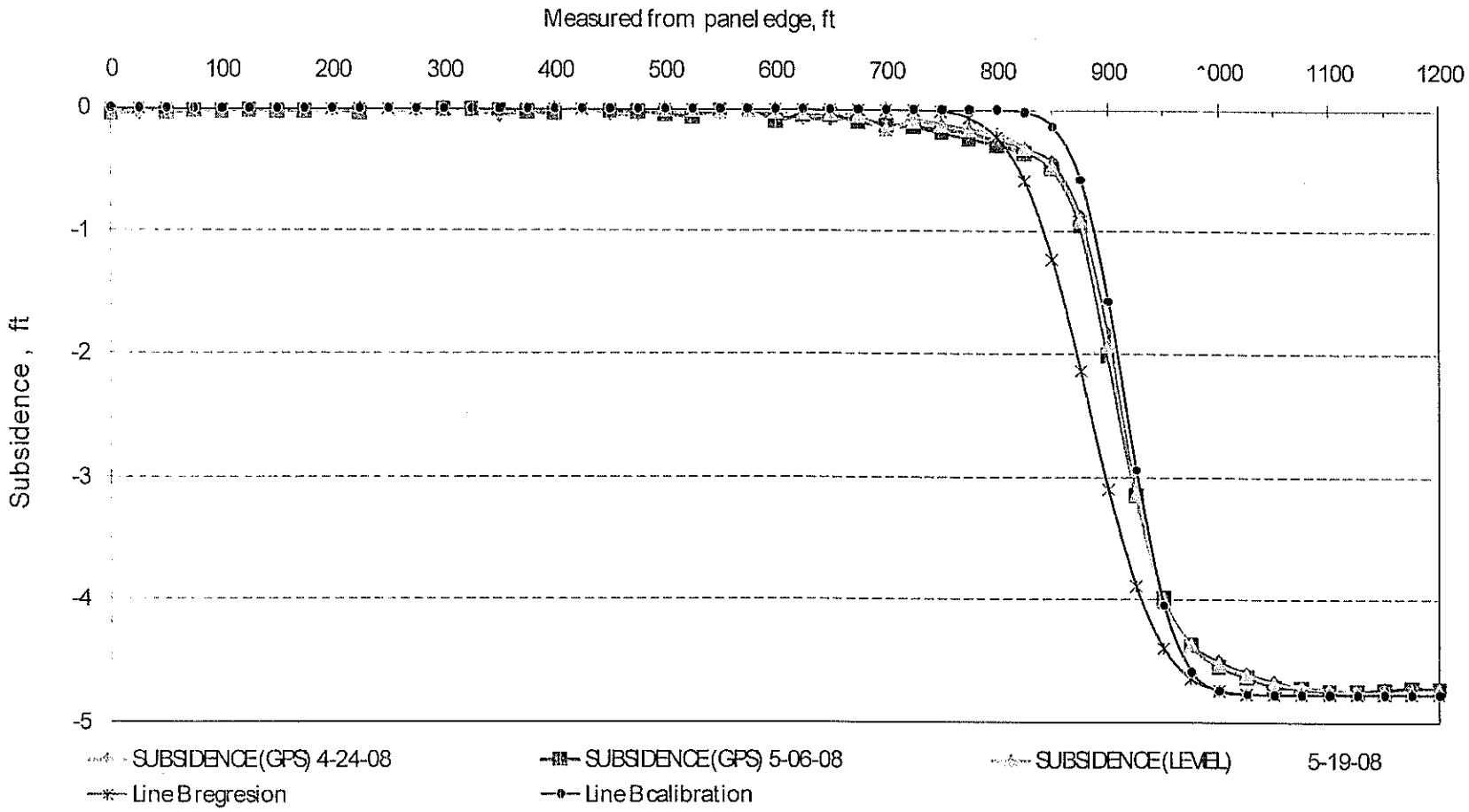


Fig. 5 Line B subsidence profile calibration

R17440

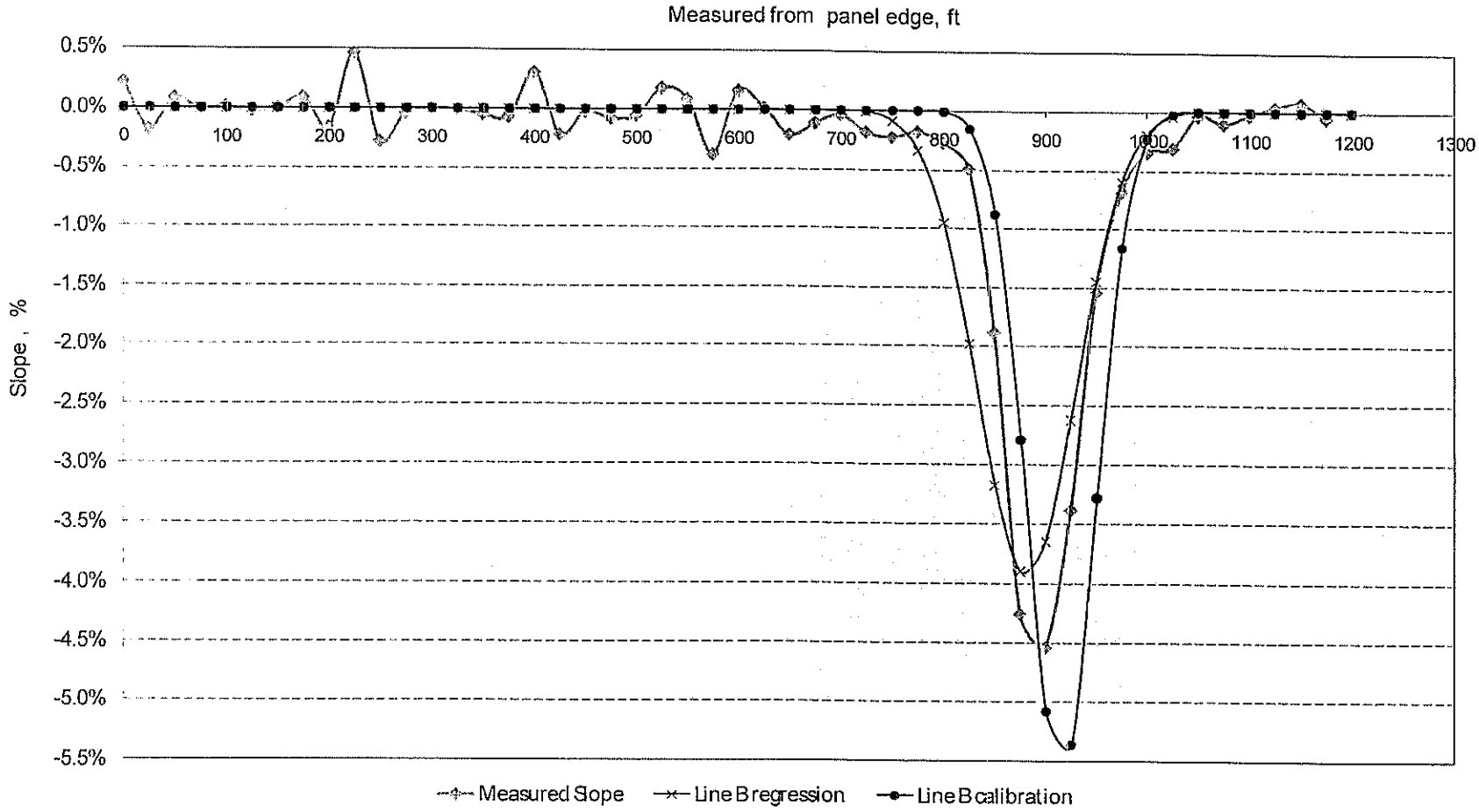


Fig. 6 Line B slope profile calibration

R17441

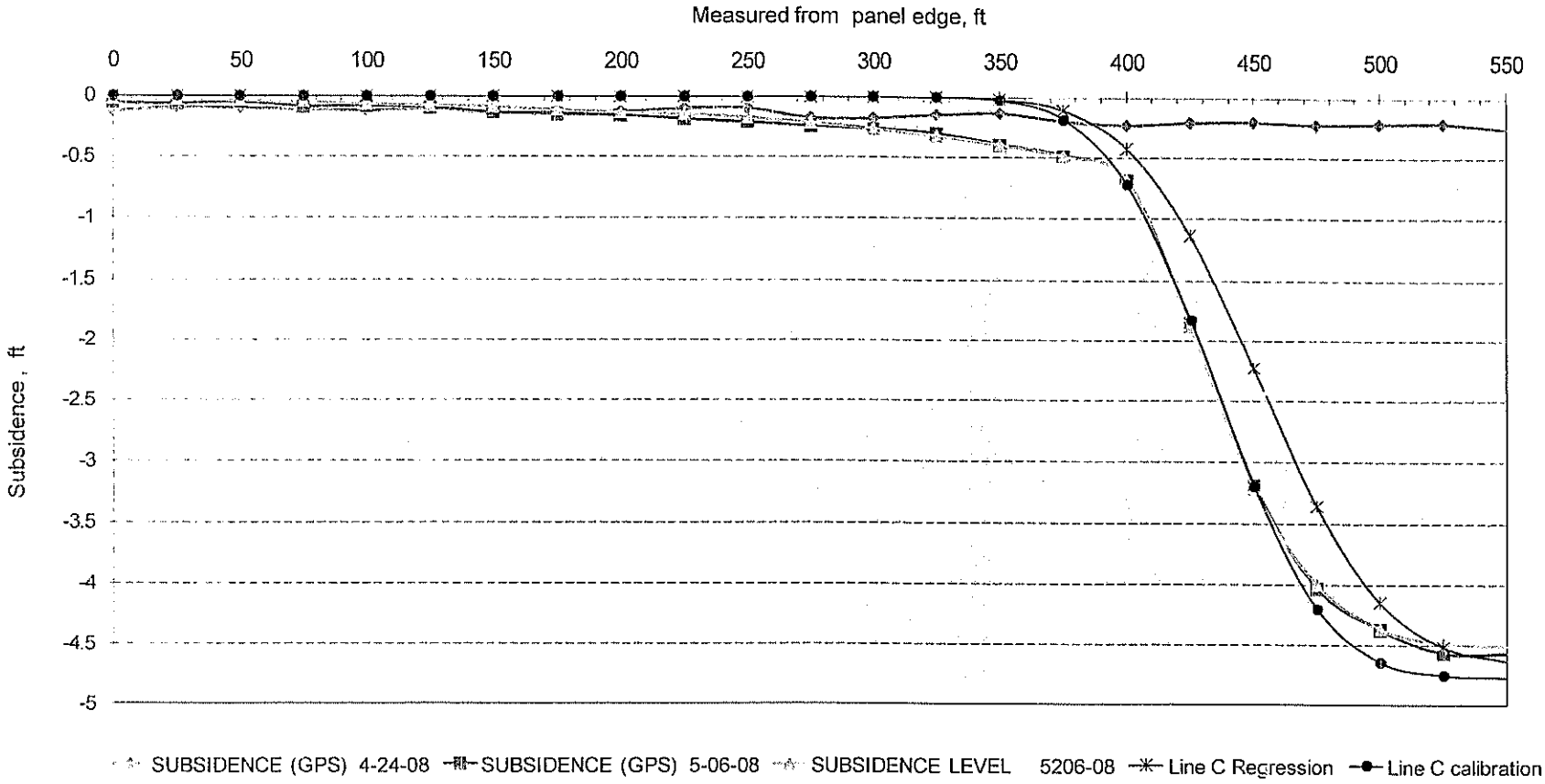


Fig. 7 Line C subsidence profile calibration

R17442

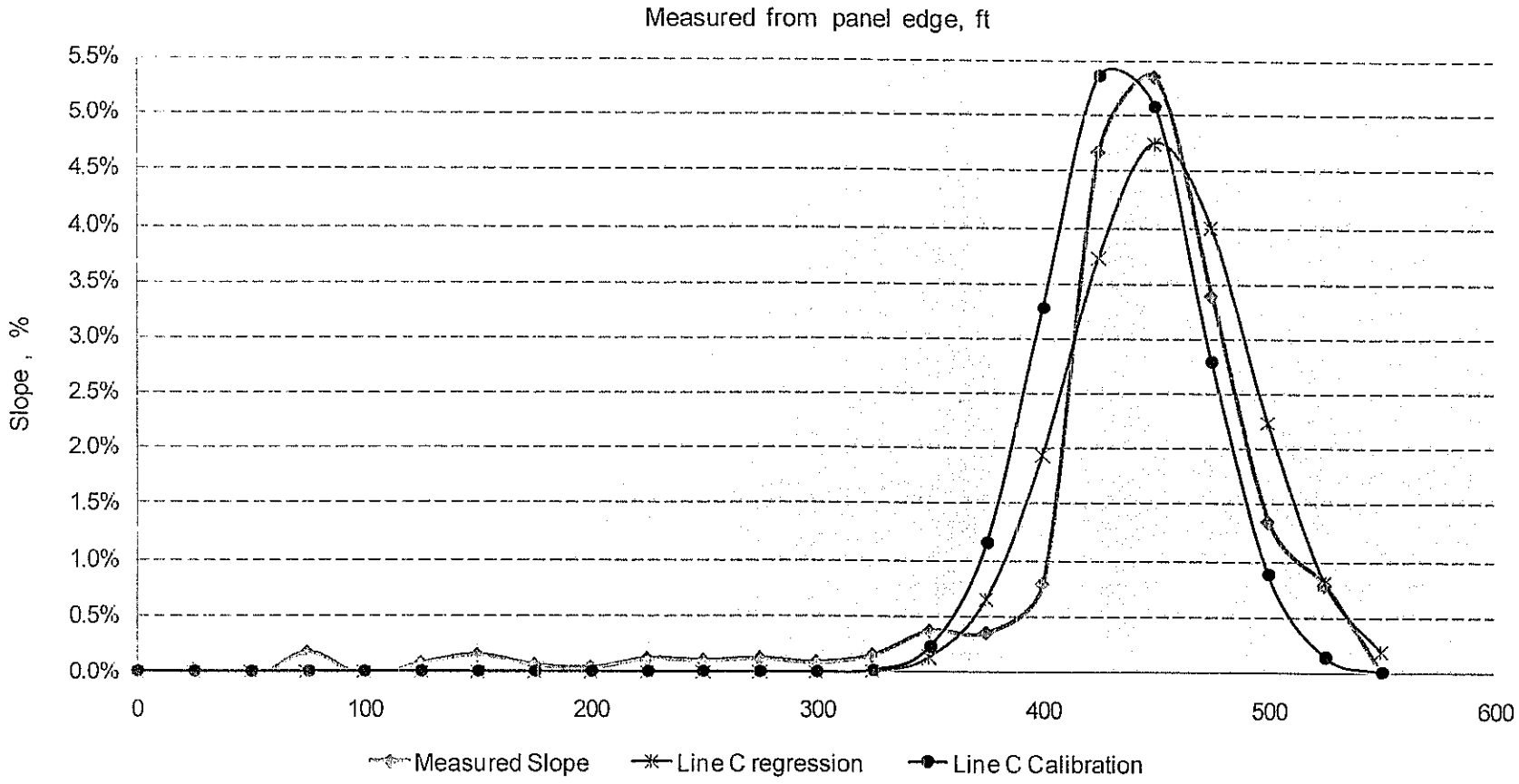


Fig. 8 Line C slope profile calibration

R17443

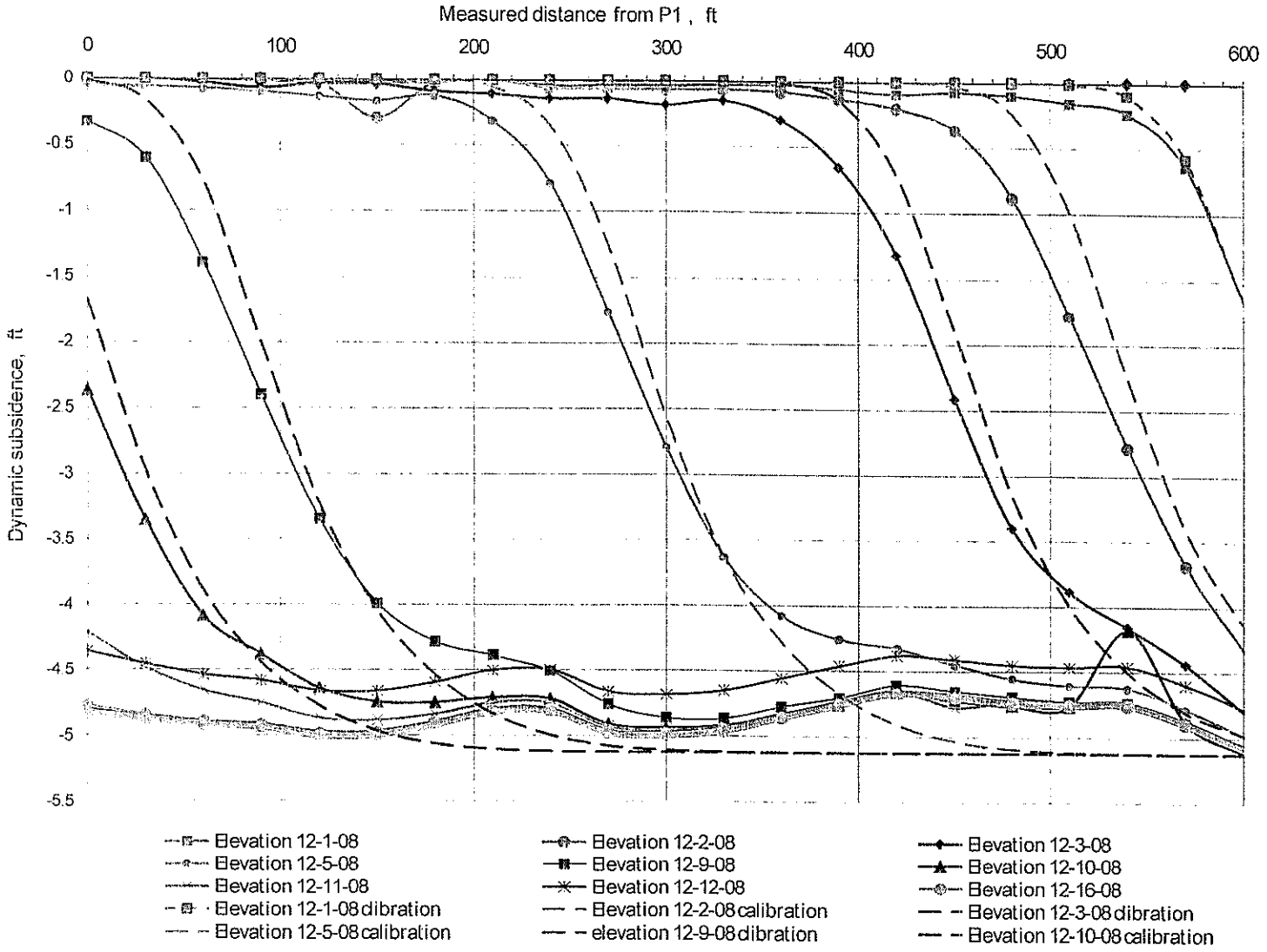


Fig. 9 Dynamic subsidence Calibration

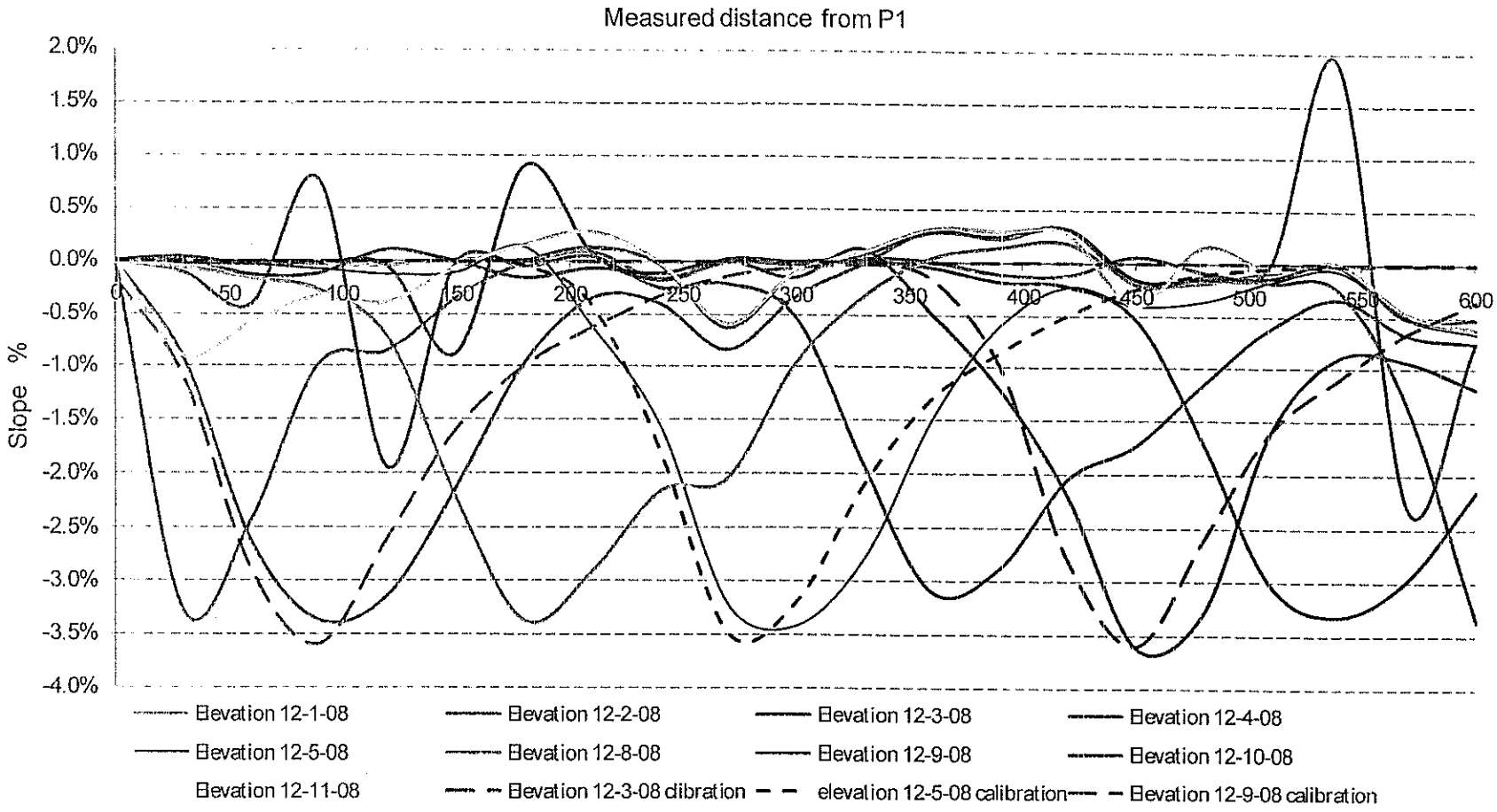


Fig. 10 Dynamic profile Calibration

R17445

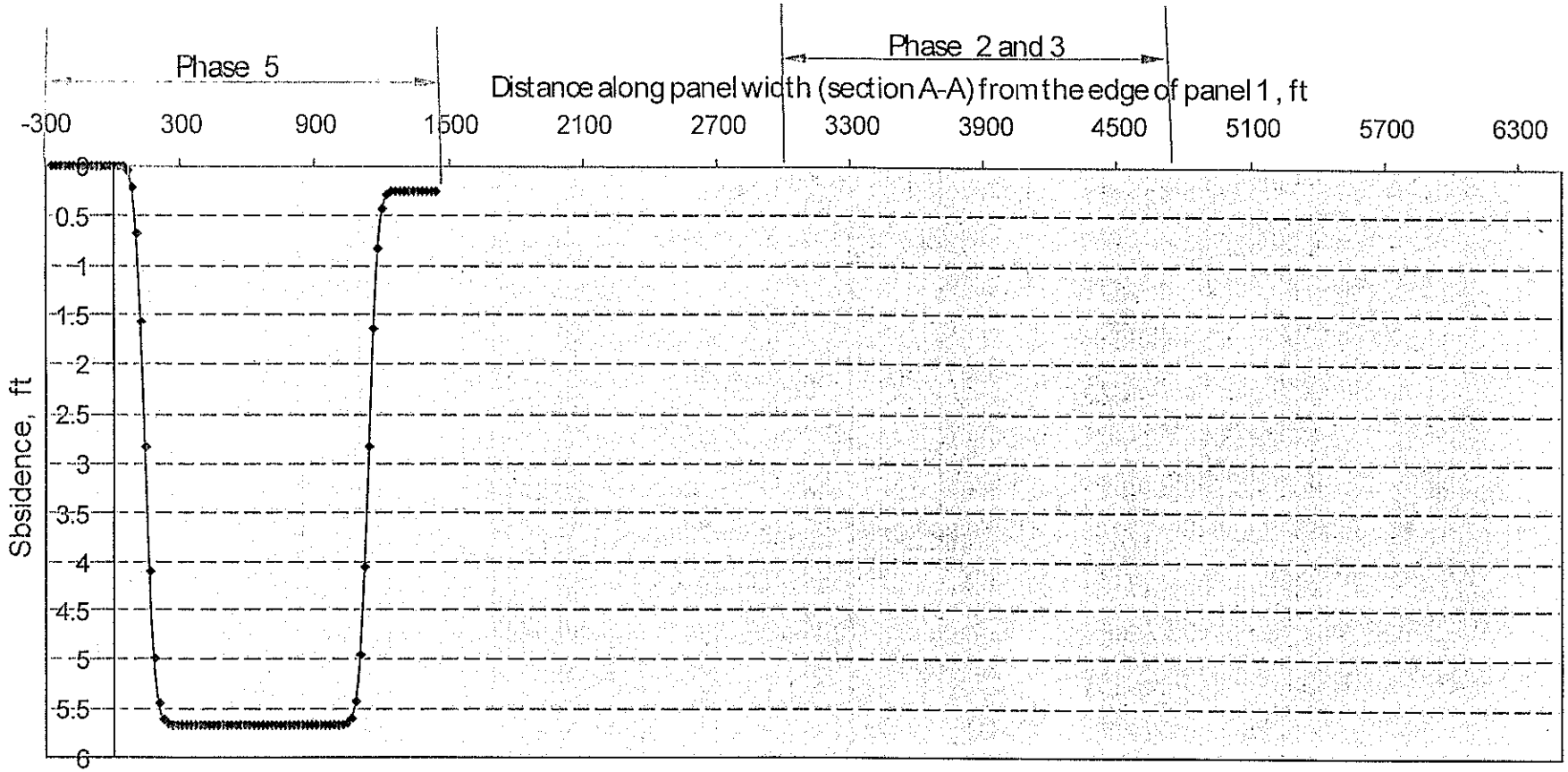


Fig. 11 Predicated Subsidence profile before phase 5 begins (No longwall mining below phase 2 workings)

R17446

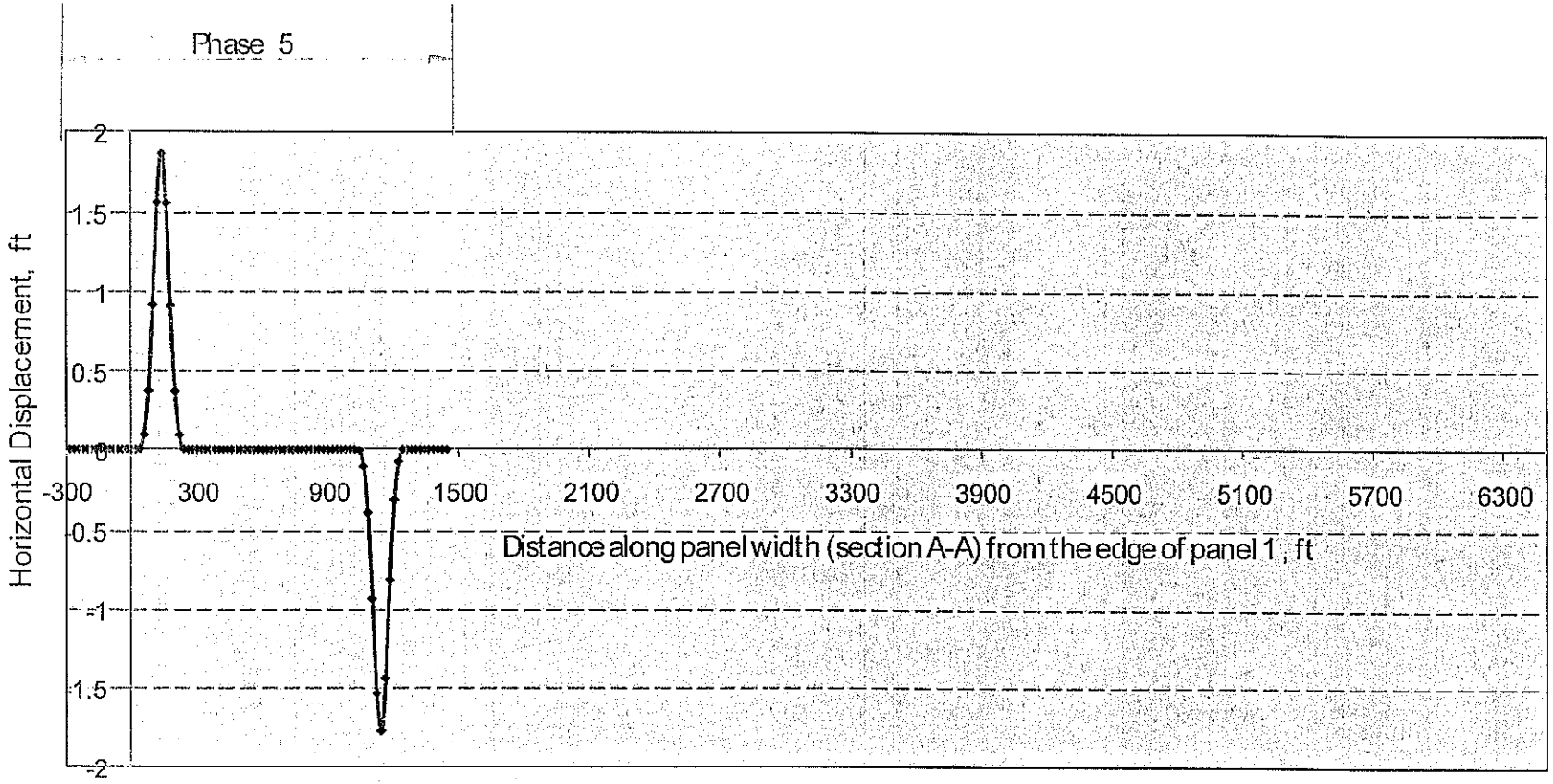


Fig. 12 Predicted horizontal displacement profile before phase 5 begins

R17447

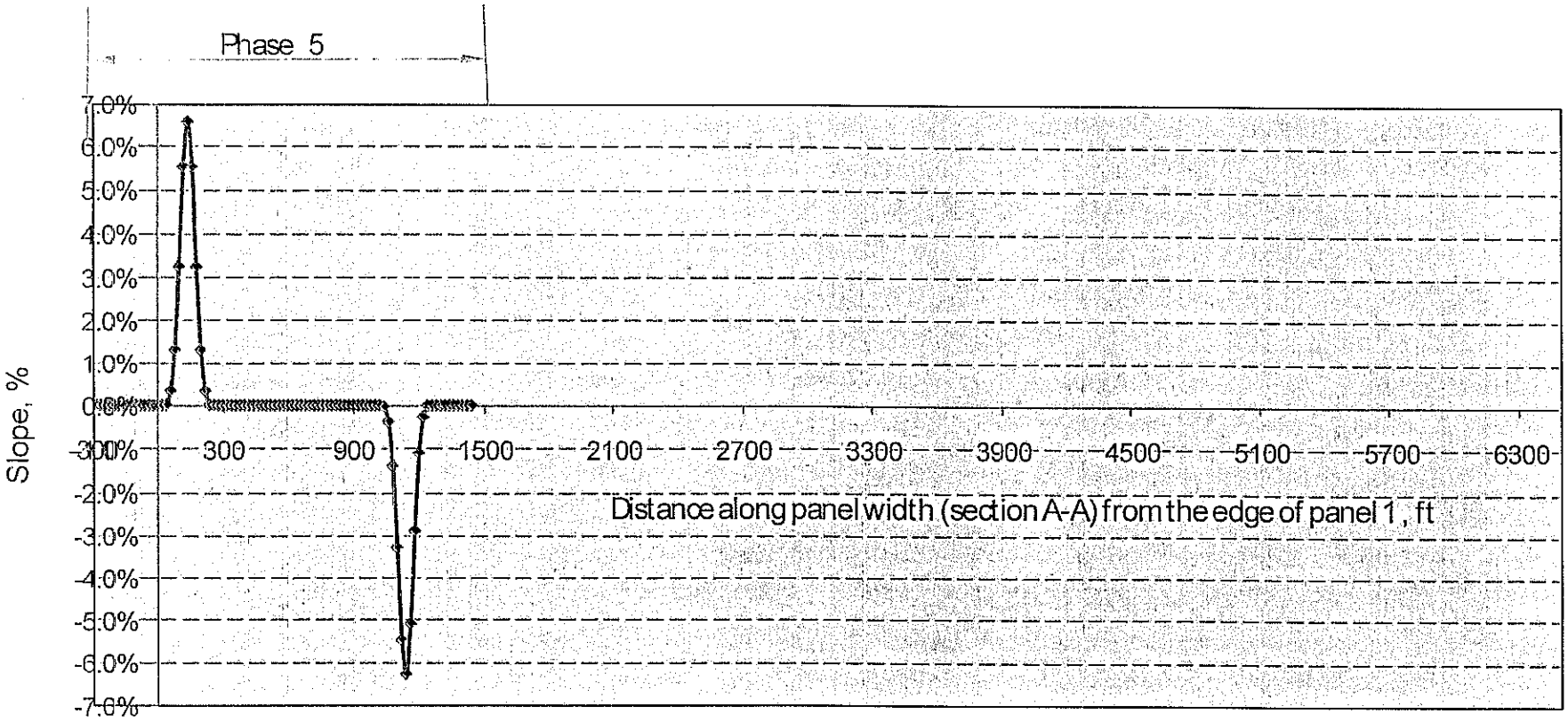


Fig. 13 Predicted slope profile before phase 5 begins

R17448

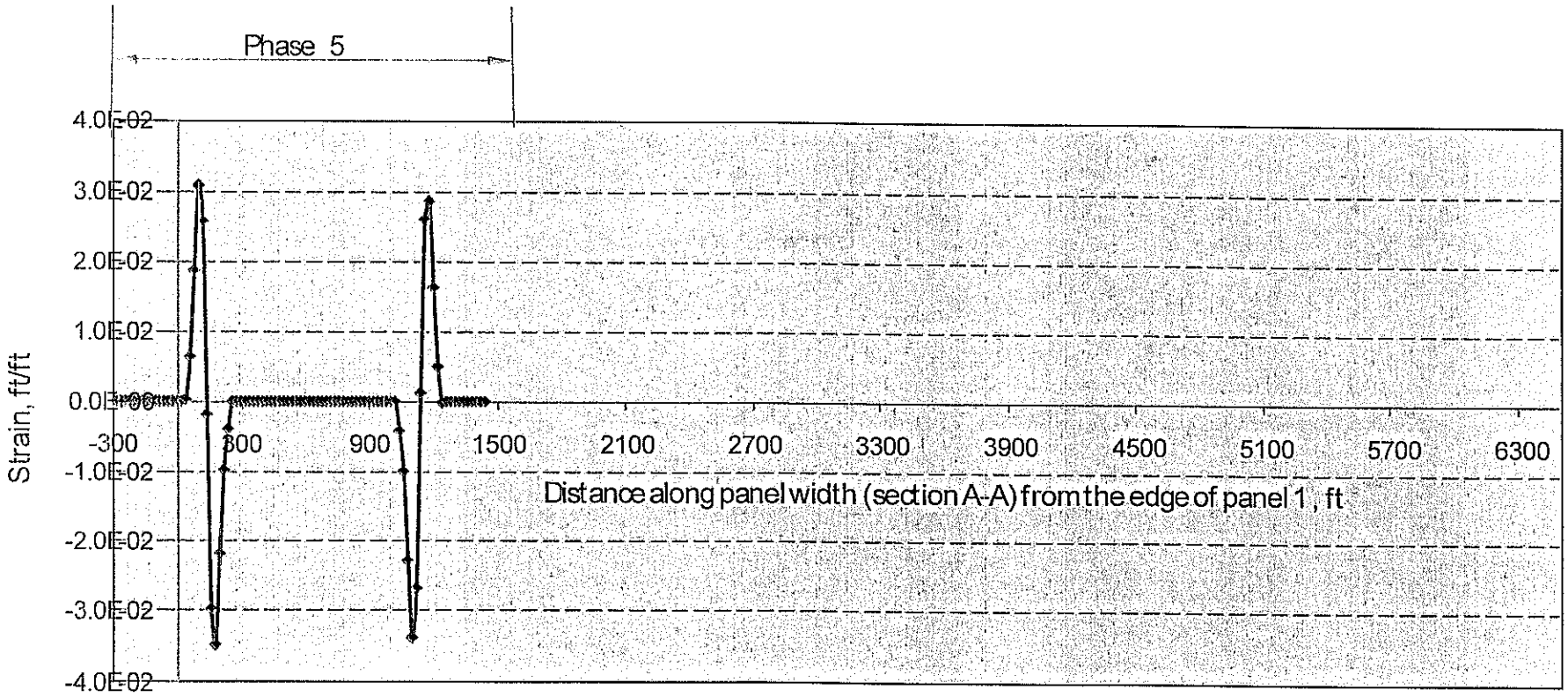


Fig. 14 Predicted horizontal strain profile before phase 5 begins

R17449

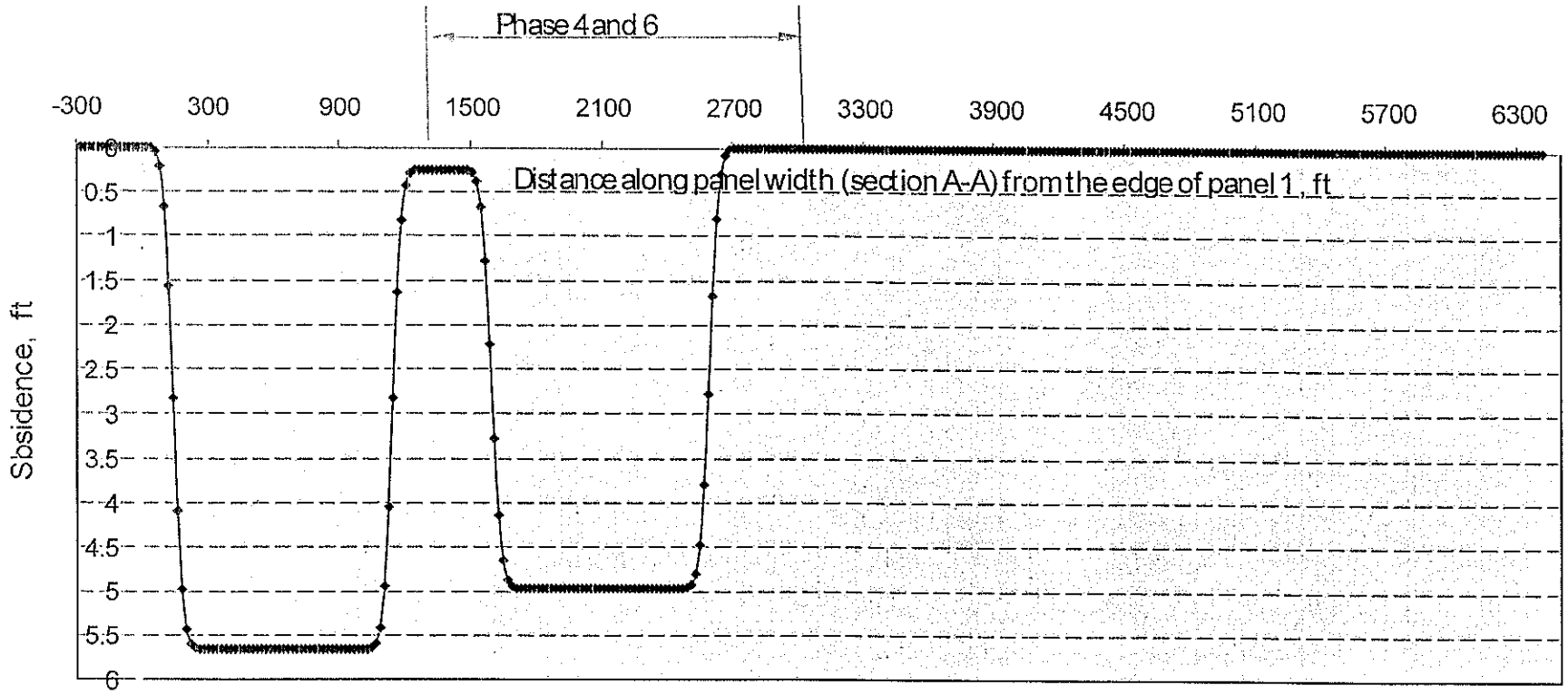


Fig. 15 Predicted subsidence profile during phases 4 and 6

R17450

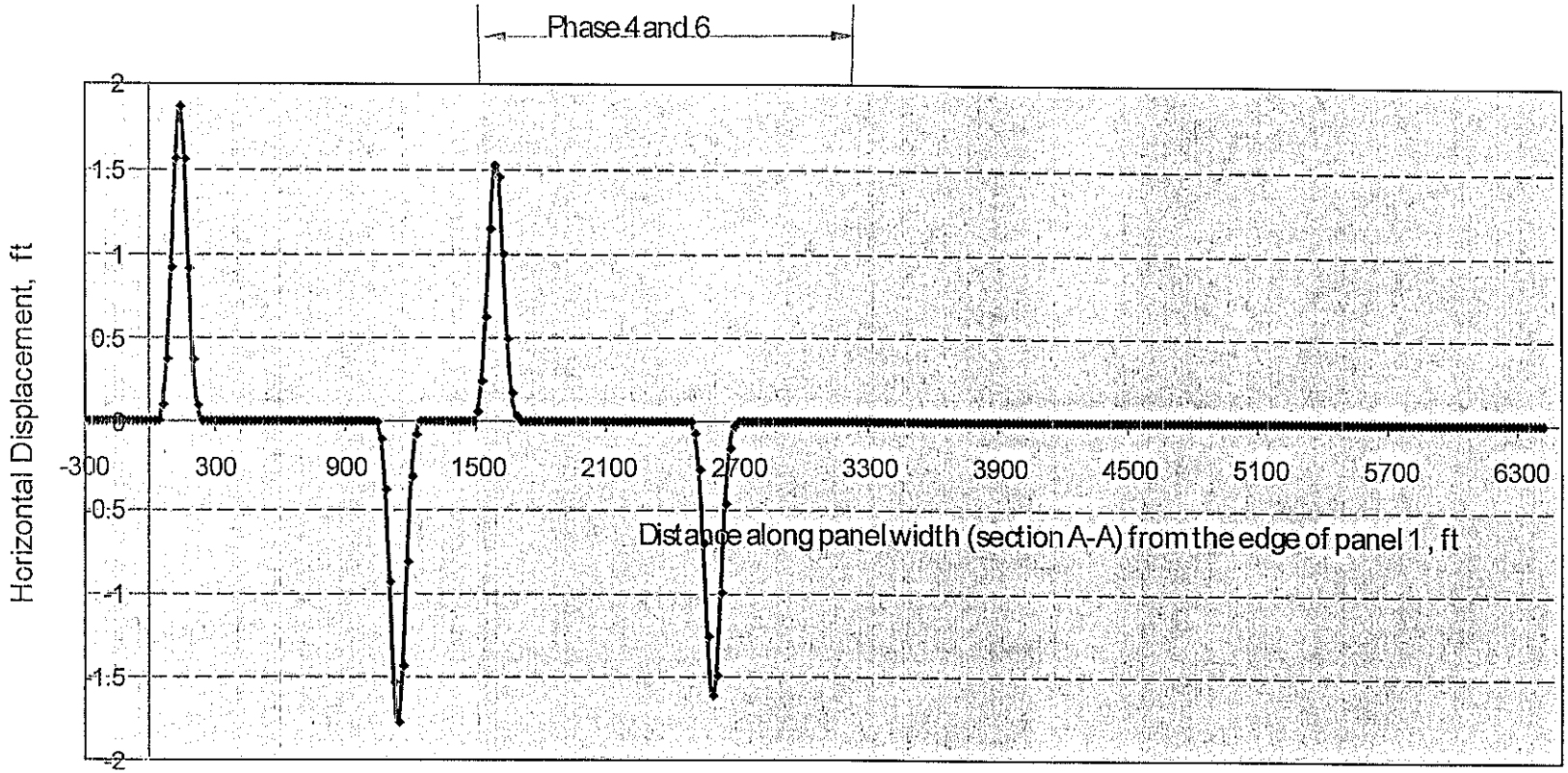


Fig. 16 Predicted horizontal displacement profile during phases 4 and 6

R17451

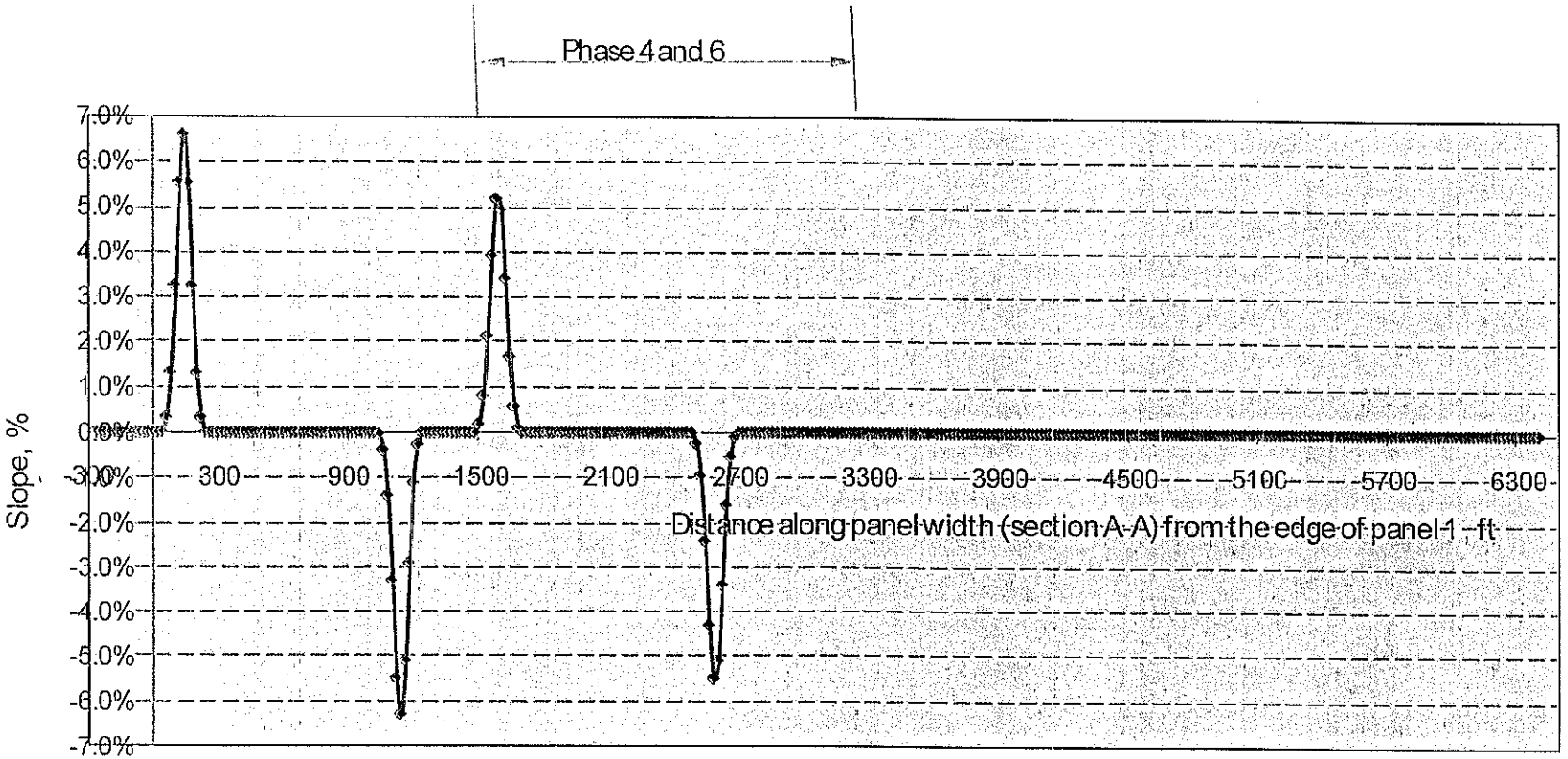


Fig. 17 Predicted slope profile during phases 4 and 6

ZZ
R17452

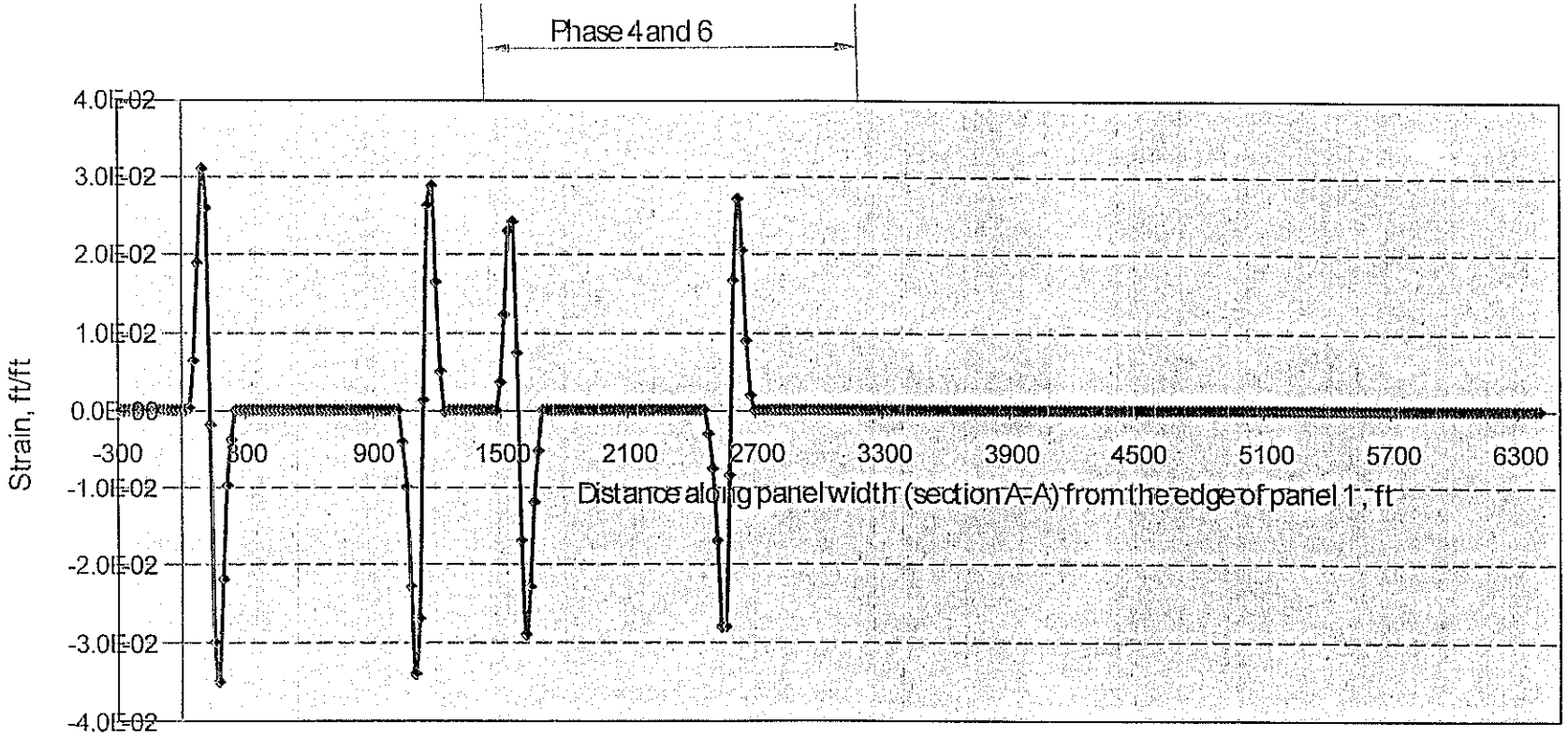


Fig. 18 Predicted strain profile during phases 4 and 6

R17453

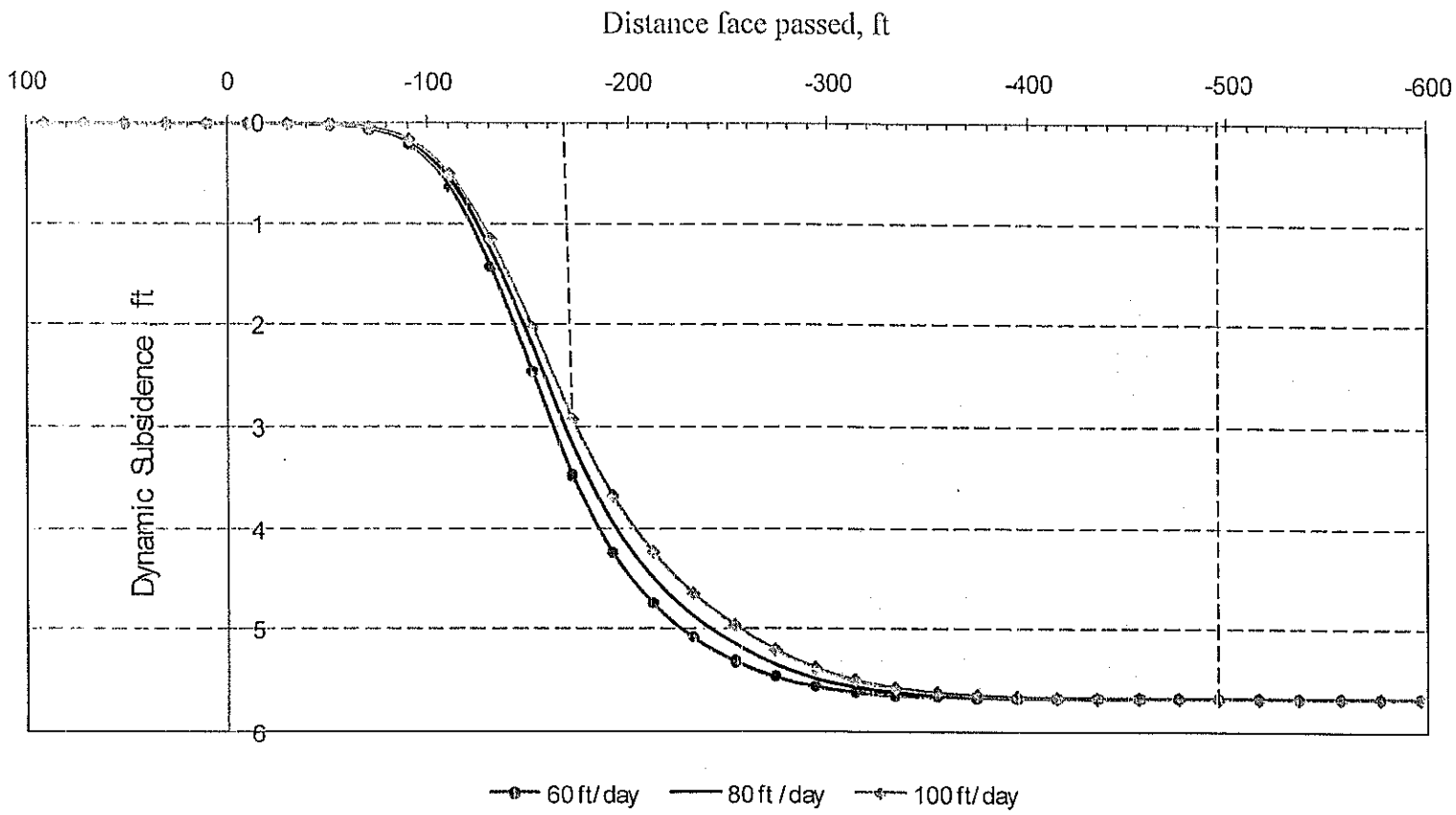


Fig. 19 Predicted dynamic subsidence development curves

R17454

Appendix 1

Final subsidence parameters along cross section A-A after mining all four longwall panels (note -the distance is measured from the right edge of panel1)

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
1	-220	0	0	0.00E+00	0.00E+00	0.00E+00
2	-200	0	0	0.00E+00	0.00E+00	0.00E+00
3	-180	0	0	0.00E+00	0.00E+00	0.00E+00
4	-160	0	0	0.00E+00	0.00E+00	0.00E+00
5	-140	0	0	0.00E+00	0.00E+00	0.00E+00
6	-120	0	0	0.00E+00	0.00E+00	0.00E+00
7	-100	0	0	0.00E+00	0.00E+00	0.00E+00
8	-80	0	0	0.00E+00	0.00E+00	0.00E+00
9	-59	0	0	0.00E+00	0.00E+00	0.00E+00
10	-39	0	0	0.00E+00	0.00E+00	0.00E+00
11	-19	0	0	0.00E+00	0.00E+00	0.00E+00
12	1	0	0	0.00E+00	0.00E+00	0.00E+00
13	21	0	0	0.00E+00	0.00E+00	0.00E+00
14	41	0.002	0.006	2.01E-04	4.42E-04	1.56E-05
15	61	0.048	0.104	3.66E-03	6.72E-03	2.37E-04
16	81	0.224	0.394	1.39E-02	1.95E-02	6.88E-04
17	101	0.702	0.954	3.37E-02	3.12E-02	1.10E-03
18	121	1.627	1.595	5.64E-02	2.48E-02	8.76E-04
19	141	2.903	1.866	6.59E-02	-3.70E-03	-1.30E-04
20	161	4.154	1.532	5.41E-02	-3.00E-02	-1.10E-03
21	181	5.028	0.88	3.11E-02	-3.40E-02	-1.20E-03
22	201	5.462	0.347	1.23E-02	-2.10E-02	-7.60E-04
23	221	5.615	0.085	3.02E-03	-9.30E-03	-3.30E-04
24	241	5.654	0.001	3.52E-05	-3.70E-03	-1.30E-04
25	262	5.669	0	0.00E+00	0.00E+00	0.00E+00
26	282	5.669	0	0.00E+00	0.00E+00	0.00E+00
27	302	5.669	0	0.00E+00	0.00E+00	0.00E+00
28	322	5.669	0	0.00E+00	0.00E+00	0.00E+00
29	342	5.669	0	0.00E+00	0.00E+00	0.00E+00
30	362	5.669	0	0.00E+00	0.00E+00	0.00E+00
31	382	5.669	0	0.00E+00	0.00E+00	0.00E+00
32	402	5.669	0	0.00E+00	0.00E+00	0.00E+00
33	422	5.669	0	0.00E+00	0.00E+00	0.00E+00
34	442	5.669	0	0.00E+00	0.00E+00	0.00E+00
35	462	5.669	0	0.00E+00	0.00E+00	0.00E+00
36	482	5.669	0	0.00E+00	0.00E+00	0.00E+00
37	502	5.669	0	0.00E+00	0.00E+00	0.00E+00
38	522	5.669	0	0.00E+00	0.00E+00	0.00E+00
39	542	5.669	0	0.00E+00	0.00E+00	0.00E+00
40	562	5.669	0	0.00E+00	0.00E+00	0.00E+00
41	583	5.669	0	0.00E+00	0.00E+00	0.00E+00
42	603	5.669	0	0.00E+00	0.00E+00	0.00E+00

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
43	623	5.669	0	0.00E+00	0.00E+00	0.00E+00
44	643	5.669	0	0.00E+00	0.00E+00	0.00E+00
45	663	5.669	0	0.00E+00	0.00E+00	0.00E+00
46	683	5.669	0	0.00E+00	0.00E+00	0.00E+00
47	703	5.669	0	0.00E+00	0.00E+00	0.00E+00
48	723	5.669	0	0.00E+00	0.00E+00	0.00E+00
49	743	5.669	0	0.00E+00	0.00E+00	0.00E+00
50	763	5.669	0	0.00E+00	0.00E+00	0.00E+00
51	783	5.669	0	0.00E+00	0.00E+00	0.00E+00
52	803	5.669	0	0.00E+00	0.00E+00	0.00E+00
53	823	5.669	0	0.00E+00	0.00E+00	0.00E+00
54	843	5.669	0	0.00E+00	0.00E+00	0.00E+00
55	863	5.669	0	0.00E+00	0.00E+00	0.00E+00
56	883	5.669	0	0.00E+00	0.00E+00	0.00E+00
57	904	5.669	0	0.00E+00	0.00E+00	0.00E+00
58	924	5.669	0	0.00E+00	0.00E+00	0.00E+00
59	944	5.669	0	0.00E+00	0.00E+00	0.00E+00
60	964	5.669	0	0.00E+00	0.00E+00	0.00E+00
61	984	5.669	0	0.00E+00	0.00E+00	0.00E+00
62	1004	5.669	0	0.00E+00	0.00E+00	0.00E+00
63	1024	5.669	0	0.00E+00	0.00E+00	0.00E+00
64	1044	5.649	-0.013	-4.60E-04	-4.60E-03	-1.60E-04
65	1064	5.593	-0.127	-4.50E-03	-1.20E-02	-4.10E-04
66	1084	5.392	-0.444	-1.60E-02	-2.40E-02	-8.70E-04
67	1104	4.873	-1.015	-3.60E-02	-3.40E-02	-1.20E-03
68	1124	3.918	-1.604	-5.70E-02	-2.40E-02	-8.60E-04
69	1144	2.67	-1.776	-6.30E-02	4.82E-03	1.71E-04
70	1164	1.51	-1.378	-4.90E-02	2.78E-02	9.82E-04
71	1184	0.742	-0.747	-2.60E-02	2.78E-02	9.82E-04
72	1204	0.381	-0.276	-9.80E-03	1.47E-02	5.21E-04
73	1225	0.261	-0.061	-2.10E-03	4.03E-03	1.43E-04
74	1245	0.234	0	0.00E+00	0.00E+00	0.00E+00
75	1265	0.234	0	0.00E+00	0.00E+00	0.00E+00
76	1285	0.234	0	0.00E+00	0.00E+00	0.00E+00
77	1305	0.234	0	0.00E+00	0.00E+00	0.00E+00
78	1325	0.234	0	0.00E+00	0.00E+00	0.00E+00
79	1345	0.234	0	0.00E+00	0.00E+00	0.00E+00
80	1365	0.234	0	0.00E+00	0.00E+00	0.00E+00
81	1385	0.234	0	0.00E+00	0.00E+00	0.00E+00
82	1405	0.234	0	0.00E+00	0.00E+00	0.00E+00
83	1425	0.234	0	0.00E+00	0.00E+00	0.00E+00
84	1445	0.234	0	0.00E+00	0.00E+00	0.00E+00
85	1465	0.234	0	0.00E+00	0.00E+00	0.00E+00
86	1485	0.234	0	0.00E+00	0.00E+00	0.00E+00
87	1505	0.235	0.002	7.64E-05	1.69E-04	5.75E-06
88	1525	0.266	0.07	2.38E-03	4.32E-03	1.47E-04

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
89	1546	0.383	0.271	9.20E-03	1.33E-02	4.53E-04
90	1566	0.705	0.675	2.29E-02	2.31E-02	7.84E-04
91	1586	1.351	1.186	4.03E-02	2.19E-02	7.45E-04
92	1606	2.297	1.497	5.09E-02	3.62E-03	1.23E-04
93	1626	3.309	1.363	4.63E-02	-1.90E-02	-6.50E-04
94	1646	4.099	0.893	3.03E-02	-2.80E-02	-9.40E-04
95	1666	4.549	0.417	1.42E-02	-2.10E-02	-7.20E-04
96	1686	4.736	0.133	4.53E-03	-1.10E-02	-3.60E-04
97	1706	4.793	0.021	7.09E-04	-4.40E-03	-1.50E-04
98	1726	4.814	0	0.00E+00	0.00E+00	0.00E+00
99	1746	4.814	0	0.00E+00	0.00E+00	0.00E+00
100	1766	4.814	0	0.00E+00	0.00E+00	0.00E+00
101	1786	4.814	0	0.00E+00	0.00E+00	0.00E+00
102	1806	4.814	0	0.00E+00	0.00E+00	0.00E+00
103	1826	4.814	0	0.00E+00	0.00E+00	0.00E+00
104	1846	4.814	0	0.00E+00	0.00E+00	0.00E+00
105	1867	4.814	0	0.00E+00	0.00E+00	0.00E+00
106	1887	4.814	0	0.00E+00	0.00E+00	0.00E+00
107	1907	4.814	0	0.00E+00	0.00E+00	0.00E+00
108	1927	4.814	0	0.00E+00	0.00E+00	0.00E+00
109	1947	4.814	0	0.00E+00	0.00E+00	0.00E+00
110	1967	4.814	0	0.00E+00	0.00E+00	0.00E+00
111	1987	4.814	0	0.00E+00	0.00E+00	0.00E+00
112	2007	4.814	0	0.00E+00	0.00E+00	0.00E+00
113	2027	4.814	0	0.00E+00	0.00E+00	0.00E+00
114	2047	4.814	0	0.00E+00	0.00E+00	0.00E+00
115	2067	4.814	0	0.00E+00	0.00E+00	0.00E+00
116	2087	4.814	0	0.00E+00	0.00E+00	0.00E+00
117	2107	4.814	0	0.00E+00	0.00E+00	0.00E+00
118	2127	4.814	0	0.00E+00	0.00E+00	0.00E+00
119	2147	4.814	0	0.00E+00	0.00E+00	0.00E+00
120	2168	4.814	0	0.00E+00	0.00E+00	0.00E+00
121	2188	4.814	0	0.00E+00	0.00E+00	0.00E+00
122	2208	4.814	0	0.00E+00	0.00E+00	0.00E+00
123	2228	4.814	0	0.00E+00	0.00E+00	0.00E+00
124	2248	4.814	0	0.00E+00	0.00E+00	0.00E+00
125	2268	4.814	0	0.00E+00	0.00E+00	0.00E+00
126	2288	4.814	0	0.00E+00	0.00E+00	0.00E+00
127	2308	4.814	0	0.00E+00	0.00E+00	0.00E+00
128	2328	4.814	0	0.00E+00	0.00E+00	0.00E+00
129	2348	4.814	0	0.00E+00	0.00E+00	0.00E+00
130	2368	4.814	0	0.00E+00	0.00E+00	0.00E+00
131	2388	4.814	0	0.00E+00	0.00E+00	0.00E+00
132	2408	4.814	0	0.00E+00	0.00E+00	0.00E+00
133	2428	4.814	0	0.00E+00	0.00E+00	0.00E+00
134	2448	4.814	0	0.00E+00	0.00E+00	0.00E+00

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
135	2468	4.814	0	0.00E+00	0.00E+00	0.00E+00
136	2489	4.814	0	0.00E+00	0.00E+00	0.00E+00
137	2509	4.798	-0.008	-2.60E-04	-3.50E-03	-1.20E-04
138	2529	4.759	-0.09	-3.10E-03	-8.50E-03	-2.90E-04
139	2549	4.619	-0.32	-1.10E-02	-1.80E-02	-6.20E-04
140	2569	4.252	-0.755	-2.60E-02	-2.70E-02	-9.20E-04
141	2589	3.549	-1.26	-4.30E-02	-2.30E-02	-7.90E-04
142	2609	2.569	-1.512	-5.10E-02	-2.90E-03	-9.90E-05
143	2629	1.571	-1.307	-4.40E-02	1.87E-02	6.34E-04
144	2649	0.831	-0.812	-2.80E-02	2.45E-02	8.32E-04
145	2669	0.43	-0.358	-1.20E-02	1.63E-02	5.54E-04
146	2689	0.272	-0.106	-3.60E-03	6.27E-03	2.13E-04
147	2709	0.226	-0.012	-4.20E-04	7.68E-04	2.61E-05
148	2729	0.222	0	0.00E+00	0.00E+00	0.00E+00
149	2749	0.222	0	0.00E+00	0.00E+00	0.00E+00
150	2769	0.222	0	0.00E+00	0.00E+00	0.00E+00
151	2789	0.222	0	0.00E+00	0.00E+00	0.00E+00
152	2810	0.222	0	0.00E+00	0.00E+00	0.00E+00
153	2830	0.222	0	0.00E+00	0.00E+00	0.00E+00
154	2850	0.222	0	0.00E+00	0.00E+00	0.00E+00
155	2870	0.222	0	0.00E+00	0.00E+00	0.00E+00
156	2890	0.222	0	0.00E+00	0.00E+00	0.00E+00
157	2910	0.222	0	0.00E+00	0.00E+00	0.00E+00
158	2930	0.222	0	0.00E+00	0.00E+00	0.00E+00
159	2950	0.222	0	0.00E+00	0.00E+00	0.00E+00
160	2970	0.222	0	0.00E+00	0.00E+00	0.00E+00
161	2990	0.242	0.046	1.56E-03	2.94E-03	9.88E-05
162	3010	0.329	0.207	6.95E-03	1.08E-02	3.62E-04
163	3030	0.587	0.559	1.88E-02	2.11E-02	7.09E-04
164	3050	1.143	1.063	3.58E-02	2.38E-02	8.00E-04
165	3070	2.021	1.457	4.90E-02	9.69E-03	3.26E-04
166	3090	3.039	1.449	4.87E-02	-1.40E-02	-4.60E-04
167	3110	3.907	1.044	3.51E-02	-2.70E-02	-9.10E-04
168	3131	4.45	0.542	1.82E-02	-2.40E-02	-8.00E-04
169	3151	4.699	0.198	6.65E-03	-1.30E-02	-4.50E-04
170	3171	4.782	0.043	1.45E-03	-5.80E-03	-2.00E-04
171	3191	4.814	0	0.00E+00	0.00E+00	0.00E+00
172	3211	4.814	0	0.00E+00	0.00E+00	0.00E+00
173	3231	4.814	0	0.00E+00	0.00E+00	0.00E+00
174	3251	4.814	0	0.00E+00	0.00E+00	0.00E+00
175	3271	4.814	0	0.00E+00	0.00E+00	0.00E+00
176	3291	4.814	0	0.00E+00	0.00E+00	0.00E+00
177	3311	4.814	0	0.00E+00	0.00E+00	0.00E+00
178	3331	4.814	0	0.00E+00	0.00E+00	0.00E+00
179	3351	4.814	0	0.00E+00	0.00E+00	0.00E+00
180	3371	4.814	0	0.00E+00	0.00E+00	0.00E+00

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
181	3391	4.814	0	0.00E+00	0.00E+00	0.00E+00
182	3411	4.814	0	0.00E+00	0.00E+00	0.00E+00
183	3431	4.814	0	0.00E+00	0.00E+00	0.00E+00
184	3452	4.814	0	0.00E+00	0.00E+00	0.00E+00
185	3472	4.814	0	0.00E+00	0.00E+00	0.00E+00
186	3492	4.814	0	0.00E+00	0.00E+00	0.00E+00
187	3512	4.814	0	0.00E+00	0.00E+00	0.00E+00
188	3532	4.814	0	0.00E+00	0.00E+00	0.00E+00
189	3552	4.814	0	0.00E+00	0.00E+00	0.00E+00
190	3572	4.814	0	0.00E+00	0.00E+00	0.00E+00
191	3592	4.814	0	0.00E+00	0.00E+00	0.00E+00
192	3612	4.814	0	0.00E+00	0.00E+00	0.00E+00
193	3632	4.814	0	0.00E+00	0.00E+00	0.00E+00
194	3652	4.814	0	0.00E+00	0.00E+00	0.00E+00
195	3672	4.814	0	0.00E+00	0.00E+00	0.00E+00
196	3692	4.814	0	0.00E+00	0.00E+00	0.00E+00
197	3712	4.814	0	0.00E+00	0.00E+00	0.00E+00
198	3732	4.814	0	0.00E+00	0.00E+00	0.00E+00
199	3752	4.814	0	0.00E+00	0.00E+00	0.00E+00
200	3773	4.814	0	0.00E+00	0.00E+00	0.00E+00
201	3793	4.814	0	0.00E+00	0.00E+00	0.00E+00
202	3813	4.814	0	0.00E+00	0.00E+00	0.00E+00
203	3833	4.814	0	0.00E+00	0.00E+00	0.00E+00
204	3853	4.814	0	0.00E+00	0.00E+00	0.00E+00
205	3873	4.814	0	0.00E+00	0.00E+00	0.00E+00
206	3893	4.814	0	0.00E+00	0.00E+00	0.00E+00
207	3913	4.814	0	0.00E+00	0.00E+00	0.00E+00
208	3933	4.814	0	0.00E+00	0.00E+00	0.00E+00
209	3953	4.814	0	0.00E+00	0.00E+00	0.00E+00
210	3973	4.814	0	0.00E+00	0.00E+00	0.00E+00
211	3993	4.814	0	0.00E+00	0.00E+00	0.00E+00
212	4013	4.814	0	0.00E+00	0.00E+00	0.00E+00
213	4033	4.814	0	0.00E+00	0.00E+00	0.00E+00
214	4053	4.814	0	0.00E+00	0.00E+00	0.00E+00
215	4074	4.814	0	0.00E+00	0.00E+00	0.00E+00
216	4094	4.814	0	0.00E+00	0.00E+00	0.00E+00
217	4114	4.814	0	0.00E+00	0.00E+00	0.00E+00
218	4134	4.792	-0.023	-7.80E-04	-4.60E-03	-1.50E-04
219	4154	4.733	-0.139	-4.70E-03	-1.10E-02	-3.70E-04
220	4174	4.543	-0.425	-1.40E-02	-2.10E-02	-7.10E-04
221	4194	4.093	-0.899	-3.00E-02	-2.80E-02	-9.30E-04
222	4214	3.308	-1.366	-4.60E-02	-1.90E-02	-6.40E-04
223	4234	2.304	-1.504	-5.10E-02	3.26E-03	1.09E-04
224	4254	1.36	-1.202	-4.00E-02	2.15E-02	7.24E-04
225	4274	0.707	-0.695	-2.30E-02	2.32E-02	7.78E-04
226	4294	0.376	-0.286	-9.60E-03	1.37E-02	4.62E-04

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
227	4314	0.253	-0.077	-2.60E-03	4.67E-03	1.57E-04
228	4334	0.22	-0.004	-1.50E-04	3.31E-04	1.11E-05
229	4354	0.218	0	0.00E+00	0.00E+00	0.00E+00
230	4374	0.218	0	0.00E+00	0.00E+00	0.00E+00
231	4395	0.218	0	0.00E+00	0.00E+00	0.00E+00
232	4415	0.218	0	0.00E+00	0.00E+00	0.00E+00
233	4435	0.218	0	0.00E+00	0.00E+00	0.00E+00
234	4455	0.218	0	0.00E+00	0.00E+00	0.00E+00
235	4475	0.218	0	0.00E+00	0.00E+00	0.00E+00
236	4495	0.218	0	0.00E+00	0.00E+00	0.00E+00
237	4515	0.218	0	0.00E+00	0.00E+00	0.00E+00
238	4535	0.218	0	0.00E+00	0.00E+00	0.00E+00
239	4555	0.218	0	0.00E+00	0.00E+00	0.00E+00
240	4575	0.218	0	0.00E+00	0.00E+00	0.00E+00
241	4595	0.218	0	0.00E+00	0.00E+00	0.00E+00
242	4615	0.238	0.046	1.63E-03	3.09E-03	1.11E-04
243	4635	0.336	0.224	8.05E-03	1.24E-02	4.44E-04
244	4655	0.641	0.63	2.26E-02	2.43E-02	8.72E-04
245	4675	1.309	1.191	4.28E-02	2.50E-02	8.98E-04
246	4695	2.334	1.554	5.58E-02	4.72E-03	1.70E-04
247	4716	3.445	1.406	5.05E-02	-2.20E-02	-7.70E-04
248	4736	4.292	0.881	3.16E-02	-3.00E-02	-1.10E-03
249	4756	4.746	0.377	1.36E-02	-2.10E-02	-7.70E-04
250	4776	4.918	0.104	3.72E-03	-9.90E-03	-3.60E-04
251	4796	4.963	0.009	3.07E-04	-3.90E-03	-1.40E-04
252	4816	4.98	0	0.00E+00	0.00E+00	0.00E+00
253	4836	4.98	0	0.00E+00	0.00E+00	0.00E+00
254	4856	4.98	0	0.00E+00	0.00E+00	0.00E+00
255	4876	4.98	0	0.00E+00	0.00E+00	0.00E+00
256	4896	4.98	0	0.00E+00	0.00E+00	0.00E+00
257	4916	4.98	0	0.00E+00	0.00E+00	0.00E+00
258	4936	4.98	0	0.00E+00	0.00E+00	0.00E+00
259	4956	4.98	0	0.00E+00	0.00E+00	0.00E+00
260	4976	4.98	0	0.00E+00	0.00E+00	0.00E+00
261	4996	4.98	0	0.00E+00	0.00E+00	0.00E+00
262	5016	4.98	0	0.00E+00	0.00E+00	0.00E+00
263	5037	4.98	0	0.00E+00	0.00E+00	0.00E+00
264	5057	4.98	0	0.00E+00	0.00E+00	0.00E+00
265	5077	4.98	0	0.00E+00	0.00E+00	0.00E+00
266	5097	4.98	0	0.00E+00	0.00E+00	0.00E+00
267	5117	4.98	0	0.00E+00	0.00E+00	0.00E+00
268	5137	4.98	0	0.00E+00	0.00E+00	0.00E+00
269	5157	4.98	0	0.00E+00	0.00E+00	0.00E+00
270	5177	4.98	0	0.00E+00	0.00E+00	0.00E+00
271	5197	4.98	0	0.00E+00	0.00E+00	0.00E+00
272	5217	4.98	0	0.00E+00	0.00E+00	0.00E+00

Points	Distance along cross section, A-A, ft	Subsidence, ft	Horizontal displacement, ft	Slope, %	Strain, ft/ft	Curvature, 1/ft
273	5237	4.98	0	0.00E+00	0.00E+00	0.00E+00
274	5257	4.98	0	0.00E+00	0.00E+00	0.00E+00
275	5277	4.98	0	0.00E+00	0.00E+00	0.00E+00
276	5297	4.98	0	0.00E+00	0.00E+00	0.00E+00
277	5317	4.98	0	0.00E+00	0.00E+00	0.00E+00
278	5337	4.98	0	0.00E+00	0.00E+00	0.00E+00
279	5358	4.98	0	0.00E+00	0.00E+00	0.00E+00
280	5378	4.98	0	0.00E+00	0.00E+00	0.00E+00
281	5398	4.98	0	0.00E+00	0.00E+00	0.00E+00
282	5418	4.98	0	0.00E+00	0.00E+00	0.00E+00
283	5438	4.98	0	0.00E+00	0.00E+00	0.00E+00
284	5458	4.98	0	0.00E+00	0.00E+00	0.00E+00
285	5478	4.98	0	0.00E+00	0.00E+00	0.00E+00
286	5498	4.98	0	0.00E+00	0.00E+00	0.00E+00
287	5518	4.98	0	0.00E+00	0.00E+00	0.00E+00
288	5538	4.98	0	0.00E+00	0.00E+00	0.00E+00
289	5558	4.98	0	0.00E+00	0.00E+00	0.00E+00
290	5578	4.98	0	0.00E+00	0.00E+00	0.00E+00
291	5598	4.98	0	0.00E+00	0.00E+00	0.00E+00
292	5618	4.98	0	0.00E+00	0.00E+00	0.00E+00
293	5638	4.98	0	0.00E+00	0.00E+00	0.00E+00
294	5658	4.98	0	0.00E+00	0.00E+00	0.00E+00
295	5679	4.98	0	0.00E+00	0.00E+00	0.00E+00
296	5699	4.98	0	0.00E+00	0.00E+00	0.00E+00
297	5719	4.98	0	0.00E+00	0.00E+00	0.00E+00
298	5739	4.98	0	0.00E+00	0.00E+00	0.00E+00
299	5759	4.958	-0.022	-7.90E-04	-4.90E-03	-1.80E-04
300	5779	4.891	-0.154	-5.50E-03	-1.30E-02	-4.50E-04
301	5799	4.659	-0.498	-1.80E-02	-2.50E-02	-9.00E-04
302	5819	4.094	-1.06	-3.80E-02	-3.20E-02	-1.10E-03
303	5839	3.123	-1.554	-5.60E-02	-1.70E-02	-6.10E-04
304	5859	1.948	-1.58	-5.70E-02	1.14E-02	4.10E-04
305	5879	0.946	-1.115	-4.00E-02	2.80E-02	1.00E-03
306	5899	0.343	-0.542	-1.90E-02	2.31E-02	8.27E-04
307	5919	0.088	-0.175	-6.30E-03	1.04E-02	3.71E-04
308	5939	0.012	-0.028	-1.00E-03	2.09E-03	7.50E-05
309	5959	0	0	0.00E+00	0.00E+00	0.00E+00
310	5979	0	0	0.00E+00	0.00E+00	0.00E+00
311	6000	0	0	0.00E+00	0.00E+00	0.00E+00
312	6020	0	0	0.00E+00	0.00E+00	0.00E+00
313	6040	0	0	0.00E+00	0.00E+00	0.00E+00
314	6060	0	0	0.00E+00	0.00E+00	0.00E+00
315	6080	0	0	0.00E+00	0.00E+00	0.00E+00
316	6100	0	0	0.00E+00	0.00E+00	0.00E+00
317	6120	0	0	0.00E+00	0.00E+00	0.00E+00
318	6140	0	0	0.00E+00	0.00E+00	0.00E+00

DOCUMENT

75

STATE OF ILLINOIS

ENVIRONMENTAL PROTECTION AGENCY

Subject: Williamson Energy, LLC – Pond Creek Mine

Data: Log No. 8091-10

Reviewed by: D. Maschhoff **Date:** 2/20/15

Log No. 8091-10 ⇒ IBR No. 25 to OMM Permit No. 375

Log No. 8091-10

- IBR consisting of 8.10 acres located in Sections 9 and 10, Township 8 South, Range 4 East, Williamson County.
- Activities will include two (2) concrete transport boreholes, the installation of a turbine pump site, installation and maintenance of a buried waterline and power line, and an access road.
- The boreholes will be drilled to pump concrete into the mine roof for stabilization of the bleeder entries to insure ventilation of the mine.
- A turbine pump site is being proposed to help de-water the mine. A water line and power line will be installed along the access road and will connect to previously installed water and power lines.
- Cuttings from the hole will be deposited in a cutting pit and the pit will be reclaimed after the installation of the pump.
- The water discharge line will be buried in a trench and will connect with the discharge line located on the previous IBR area.
- Upon completing the pump installation, the entire area will be seeded and mulched using the approved revegetation plan.
- Surface drainage in the turbine pump site will be directed to the cuttings pond for retention and de-watering. Berms, silt fence and/or straw/hay bales will be used where needed to prevent sedimentation from entering the receiving stream.

* Action: Reference IEPA Log No. 8091-10 in renewed and modified NPDES permit for additional 8.10 acres for an access road, water and power lines, emergency boreholes and a turbine pump site.

8091 · / 10
Due date: 4/23/10

Illinois Department of Natural Resources

One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

Pat Quinn, Governor
Marc Miller, Director

March 5, 2010

Michael Beyer
Williamson Energy
PO Box 99
Johnston City, IL 62951

RECEIVED
MAR 11 2010
IL Environmental Protection Agency
MARION REGIONAL OFFICE

Re: Permit No. 375
Incidental Boundary Revision No. 25

Dear Mr. Beyer:

The appropriate Department technical staff have reviewed the proposed incidental boundary revision dated January 4, 2010 and the supplemental information dated February 25, 2010, submitted by Williamson Energy for Pond Creek Mine, Permit No. 375. The request would add 8.10 acres to conduct surface coal mining activities. The additional acres would be used for an access road, water and power lines, emergency concrete boreholes and a turbine pump site.

The Department finds Williamson Energy has demonstrated in its request, and field inspections by the Department's field representative have confirmed that these areas (8.10acres) meet the requirements for an incidental boundary change as outlined in 62 Ill. Adm. Code 1774.13(d). The Department finds section 1774.13(d)(6) publication requirements have been met. This request is approved with the following condition:

> The applicant shall submit a cultural and historic survey to the Department and have the appropriate finding of no sites eligible for National Register listing

The fee for the area will be $202.00. The fee is comprised of $202.00 for non-surface mining area ($5/acres x 8.10 acres x 5 years the bond is in force).

The bond for the area will be $61,090.00. Copies of bond form SCML-2 have been enclosed for your use. For additional bonding and other forms, please contact this office or download a copy from the web at: www.dnr.state.il.us/mines/lrd/forms.htm. Please note many forms have been modified. **Only** the most current versions will be accepted.

Upon receipt by the Department of the fee and bond, plus forwarding three complete copies of your request letter and map(s) to Ronald Morse, Illinois Environmental Protection Agency, 2309 West Main Street, Marion, Illinois 62959, and meeting the required condition listed above, mining activities on these 8.10 acres may commence, following Department approval.

8091 · / 10
R17465
Rec'd date 4-23-10

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

March 10, 2010

Project No. B09-514-1413

Mr. Ronald Morse
ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY
2309 West Main Street
Marion, IL 62959

Transmittal Letter
8.10 Acres Incidental Boundary Revision
Williamson Energy LLC - Permit No. 375
Pond Creek Mine No. 1
Williamson County, Illinois

Dear Mr. Morse:

The Illinois Department of Natural Resources; Land Reclamation Division approved IBR No. 25 for Permit 375 on March 5, 2010. Per Mr. Scott Fowler's approval letter, Alliance Consulting, Inc. is submitting three copies of the IBR on behalf of our client, Williamson Energy LLC.

This IBR is for the purpose of drilling a new turbine pump hole and to drill to holes for transporting concrete into the mine.

If you have any questions, or require additional information, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Stephen M. Sutphin
Project Manager

SMS:sms
Enclosures

FILE: 09514-05

RECEIVED
MAR 12 2010
IL Environmental Protection Agency
MARION REGIONAL OFFICE

124 Philpott Lane • Raleigh County Airport Industrial Park • Beaver, WV 25813-9502 • TELE: (304) 255-0491 • FAX (304) 255-4232

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

January 4, 2010

Project No. B09-514-1413

Mr. Scott Fowler
ILLINOIS DEPARTMENT
OF NATURAL RESOURCES
Office of Mines and Minerals
Land Reclamation Division
One Natural Resources Way
Springfield, IL 62702-1271

Request for Incidental
Boundary Revision for 8.10 Acres
Williamson Energy LLC - Permit No. 375
Pond Creek Mine No. 1
Williamson County, Illinois

Dear Mr. Fowler:

On behalf of our client, Williamson Energy LLC, Alliance Consulting, Inc. is submitting an original and one copy of an 8.10 acres IBR application. This IBR is to drill a new turbine pump hole and to drill to concrete bore holes. The concrete bore holes are needed to repair roof falls located in the ventilation bleeder entries. Please refer to the enclosed incidental boundary revision form, narrative, revised reclamation estimate spreadsheet and associated maps.

Please be advised that one copy of this IBR application has been sent to Mr. Brad Murphy in the Benton office.

If you have any questions, or require additional information, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Stephen M. Sutphin
Project Manager

SMS:sms
Enclosures

FILE: 09514-01

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

January 4, 2010

Project No. B09-514-1413

Mr. Brad Murphy
ILLINOIS DEPARTMENT
OF NATURAL RESOURCES
Land Reclamation Division
503 E. Main, FL 001
Benton, IL 62812

Request for Incidental
Boundary Revision for 8.10 Acres
Williamson Energy LLC - Permit No. 375
Pond Creek Mine No. 1
Williamson County, Illinois

Dear Mr. Murphy:

On behalf of our client, Williamson Energy LLC, Alliance Consulting, Inc. is submitting a copy of an 8.10 acres IBR application. This IBR is to drill a new turbine pump hole and to drill to concrete bore holes. The concrete bore holes are needed to repair roof falls located in the ventilation bleeder entries. Please refer to the enclosed incidental boundary revision form, narrative, revised reclamation estimate spreadsheet and associated maps.

Please be advised that an original and one copy of this IBR application have been sent to Mr. Scott Fowler in the Springfield office.

If you have any questions, or require additional information, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Stephen M. Sutphin
Project Manager

SMS:sms
Enclosures

FILE: 09514-02

INCIDENTAL BOUNDARY REVISION FOR PERMIT NO. 375

(8.10 ACRES FOR EMERGENCY CONCRETE BOREHOLES & TURBINE PUMP SITE)

WILLIAMSON COUNTY, IL
POND CREEK MINE NO. 1

Prepared for

WILLIAMSON ENERGY LLC
JOHNSTON CITY, IL

ALLIANCE PROJECT NO. B09-514-1413
JANUARY 2010

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Office: 618-983-3020 Fax: 618-983-3017

Mr. Scott K. Fowler, Supervisor
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
One Natural Resources Way
Springfield, IL 62702-1271

Re: Williamson Energy, LLC - Permit No. 375; 8.10 acres IBR

Dear Mr. Fowler:

This letter authorizes Mr. Jim Slapak and Alliance Consulting, Inc. (Alliance) and its representatives, permission to perform work on, receive comments and submit corrections on the above referenced application. Please send copies of any comments to Alliance Consulting, Inc. at 124 Philpott Lane, Beaver, WV 25813, as well as Williamson Energy, LLC at the above address.

Thank you for your cooperation.

Sincerely,

WILLIAMSON ENERGY, LLC

Michael J. Beyer
Authorized Agent

PART I

State of Illinois
Department of Natural Resources
Office of Mines and Minerals
Land Reclamation Division
One Natural Resources Way
Springfield, IL 62702-1271

APPLICATION FOR SURFACE COAL MINING AND RECLAMATION OPERATIONS
INCIDENTAL BOUNDARY REVISION IBR-1

PART I

DATE: _____

NOTICE : This state agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Ill. Rev. Stat. 1987 Ch. 96 1/2, par. 7901.01 et seq. Disclosure of this information is voluntary, however failure to comply may result in this form not being processed. This form has been approved by the Forms Management Center.

1) A) General Information

(I)(~~We~~)(The) Williamson Energy LLC
(Name of Company, Corporation. Partnership or Individual)

P. O. Box 99. Johnston City, IL 62951 (618) 983-3020
(Address) (Telephone Number)

hereby submit application for an Incidental Boundary Revision to Permit 375

Name of Mine Pond Creek No. 1.

MSHA No. 11-03141

I, Michael J. Beyer under penalty of
(vice president or his duly authorized representative under the existing permit)

perjury declare that all information provided in this application is true and correct to the best of my knowledge.

_____ Authorized Agent
Title

Surface Area:

ADDITIONAL ACRES REQUESTED 8.10 EXISTING PERMIT ACREAGE 604.82

B) Indicate the type of disturbance and associated acreage.

Type of Disturbance	Existing Permit	IBR	Total
Area Stripping	20.13	0	20.13
Mine Waste Areas	277.39	0	277.39
Processing Areas & Support Facilities	111.97	8.10	120.07
Access, Haul Roads & Transport Facilities	23.57	0	23.57
Soil Storage Areas	75.70	0	75.70
Diversions	32.85	0	32.85
Coal Recovery (Gob & Slurry)	0	0	0
Other	30.46	0	30.46
Not to be Disturbed	37.19	0	37.19

619.36

2) A) Provide name and address of every legal or equitable owner of record of the IBR area. 4.44

RESPONSE: Refer to Attachment Part I.2.A.

B) Provide name and address of the owner of record for all surface and subsurface areas contiguous to any part of the proposed IBR area.

RESPONSE: Refer to Attachment Part I.2.B.

C) Show location of owners of record of those lands, both surface and subsurface, included in or contiguous to the IBR area on premining land use map or another map, if necessary.

RESPONSE: Refer to Map 6 S.F. – Sheet 2 of 2.

3) Provide name and address of any holder of record of leasehold interest for the IBR area.

RESPONSE: Refer to Attachment Part I.3.

4) Affidavits, Certifications

A) Complete affidavit regarding applicant's legal right to enter and begin surface coal mining and reclamation operations in the IBR area and whether that right is the subject of pending litigation. Identify the documents upon which affidavit is based by type and date of execution and identify specific lands to which each document pertains and explain the legal rights claimed by the applicant (1778.15(a)). If the private mineral estate to be mined has been severed from the private surface estate, provide copies of the documents required under Section 1778.15(B)(1)-(3). On the permit map or other designated map show the boundaries of land within the permit area upon which the applicant has the legal right to enter and begin surface mining activities.

RESPONSE: Refer to Attachment Part I.4.A.

B) Complete certification for engineering aspects of the application. In addition to the general certification, three specific certifications are included which are applicable only if the box in front of each is marked. The first two cover special permit requirements and should be marked only when they occur for the proposed permit. The third certification covers the Illinois Environmental Protection Agency permit requirements. In most cases, an Illinois registered engineer will be required to certify IEPA permit requirements. Except as otherwise provided all maps, plans and cross-sections included in the permit application shall be prepared by, or under the direction of, and sealed by a qualified registered professional engineer licensed under the Illinois Professional Engineering Act, a qualified registered structural engineer licensed under the Illinois Structural Engineering Act or if authorized by state law, a qualified registered professional land survey or licensed under the Illinois Land Surveyors Act with assistance from experts in related fields.

RESPONSE: Refer to Attachment Part I.4.B.

5) Areas Designated Unsuitable for Mining

A) Does proposed IBR area include --

(1) Lands within boundaries of the National Park System, National Wildlife Refuge System, National Recreation Areas, etc. [Section 1761.11(a)]?

Yes _____ No X

(2) National forest land?

Yes _____ No X

(3) Any land which will adversely affect any publicly-owned park or places included in or eligible for listing in the National Register of Historic places, etc. [per 62 Ill. Adm. Code 1761.11(a)(3) or Section 10, (B)(C) of the SCM-1?

Yes _____ No X

If yes, complete Part II, Section 10, (B) & (C) of the SCM-1 or the UCM-1 Application.

(4) Any public roads which are to be removed, relocated or temporarily closed?

Yes _____ No X

Indicate on the pre-mining land use map or other designated map the location of the public roads and attach a copy of the written agreement from the appropriate authority authorizing the relocation, removal or temporary closure. Describe the measures to be used to insure that the interest of the public and land owners affected will be protected.

B) Will proposed IBR area be located --

(1) Within 100 feet of the right-of-way line of any public road?

Yes _____ No X

If yes, explain proposed procedure for complying with regulation section 1761.11(d), including request for variance, if relevant. Provide location of public roads on pre-mining land use map or other designated map. Describe the measures to be used to insure that the interest of the public and land owners affected will be protected.

(2) Within 300 feet measured horizontally from any occupied dwelling?

Yes _____ No ___X___

If so, is waiver provided meeting requirements of Section 1761.15?

(3) Within 300 feet measured horizontally of any public building, school, church, community or institutional building or public park?

Yes _____ No ___X___

(4) Within 100 feet measured horizontally of a cemetery?

Yes _____ No ___X___

C) Are valid existing rights (per 1761.11) claimed for any part of the IBR area?

Yes _____ No ___X___

If yes, provide documentation to substantiate claim.

D) Provide a draft copy of the proposed newspaper notice and name of local newspaper of general circulation in which advertisement of the application will be published, per 62 Ill. Adm. Code 1774.13(d)(6). Certification of publication is to be furnished to the Department and must be received prior to Department approval of the IBR.

RESPONSE: Refer to Attachment Part I.5.D.

PART I ATTACHMENTS

ATTACHMENT PART I.2.A

Map Key ID	Owners	Address	City	State	Zip
A080409-107	WILLIAMSON DEVELOPMENT CO, LLC	P.O. Box 1829	Marion	IL	62959
A080409-215	WILLIAMSON DEVELOPMENT CO, LLC	P.O. Box 1829	Marion	IL	62960
A080410-104	RANDY L. & REBECCA A. WRIGHT	917 13th	St. Clound	FL	34772
A080410-301	RANDY L. & REBECCA A. WRIGHT	917 13th	St. Clound	FL	34772
A080410-308	RANDY L. & REBECCA A. WRIGHT	917 13th	St. Clound	FL	34772

Attachment I.2.A.

ATTACHMENT PART I.2.B

Key_ID	Owners	Address	City	State	Zip	Coal Owner	Type Control
A080409-107	WILLIAMSON DEVELOPMENT CO, LLC	P.O. Box 1829	Marion	IL	62959	COLT LLC, P. O. BOX 1829, MARION, IL 62959	WARRENTY DEED
A080409-215	WILLIAMSON DEVELOPMENT CO, LLC	P.O. Box 1829	Marion	IL	62960	COLT LLC, P. O. BOX 1829, MARION, IL 62960	WARRENTY DEED
A080410-104	RANDY L. & REBECCA A. WRIGHT	917 13th	St. Clound	FL	34772	COLT LLC, P. O. BOX 1829, MARION, IL 62961	WARRENTY DEED
A080410-301	RANDY L. & REBECCA A. WRIGHT	917 13th	St. Clound	FL	34772	COLT LLC, P. O. BOX 1829, MARION, IL 62962	WARRENTY DEED
A080410-308	RANDY L. & REBECCA A. WRIGHT	917 13th	St. Clound	FL	34772	COLT LLC, P. O. BOX 1829, MARION, IL 62963	WARRENTY DEED

Attachment 1.2.B.

ATTACHMENT PART I.3

Attachment I.3

Williamson Energy LLC entered into a lease agreement with the land owners, Randy L. and Rebecca A. Wright. The lease agreement was signed on December 11, 2009 and will be in effect for a term of 10 years.

ATTACHMENT PART I.4.A

Attachment I.4.A

(I) (~~We~~) Michael J. Beyer
(Individual or Individuals)

under penalty of perjury declare on behalf of the applicant, Williamson Energy LLC, that said applicant has valid documents which bestow upon the applicant a legal right to enter and commence surface coal mining and reclamation operations upon lands contained in the proposed IBR area, and such legal right is not in any way the subject of pending court litigation.

Dated this 10th day of December, 2009.

Signature /Title

State of Florida

County of Palm Beach

Signed by and subscribed to before me on 12-10-09 (date) by Michael J. Beyer (name of person).

ERIN R MENDEZ
MY COMMISSION # DD875102
EXPIRES March 29, 2013
(407) 398-0153 FloridaNotaryService.com

(Signature of Notary Public)

ATTACHMENT PART I.4.B

Attachment I.4.B.

ENGINEERING CERTIFICATION

I hereby certify the engineering design used in preparation of this application, attachments, and supplements was done by me or under my direct supervision.

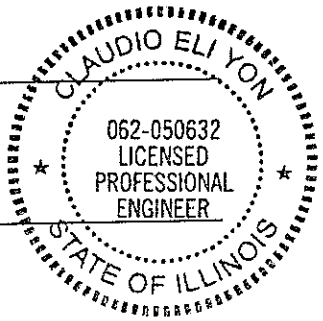
I further certify to the best of my knowledge all such design is in accordance with all applicable local, state and federal laws, rules and regulations. I have placed an "X" in the box below if that item is relevant.

☐ Whereas the Reclamation Plan calls for an alternative land use, I also certify the plans to conform to applicable accepted standards for adequate land stability, drainage, vegetative cover, and aesthetic design appropriate for the post-mining use of the site.

☐ Whereas the operation proposes disposal of spoil or waste materials in areas other than mining workings or excavations, I also certify such fills are designed in accordance with recognized professional standards and all applicable laws.

☒ Certification of Illinois Environmental Protection Agency-35 Ill. Adm. Code 405.104(a) Permit. In my professional judgement, the plans and specifications submitted as part of this application describe an operation which will meet all applicable effluent and water quality standards. I certify that I am familiar with all of the plans, specifications, reports, and maps submitted as part of this application and that said plans, etc. are accurate insofar as they represent existing conditions.

Claudio E. Yon
Name



062-050632
Illinois Registration Number (Seal)

Alliance Consulting, Inc.
Firm

(304) 255-0491
Phone Number

124 Philpott Lane, Beaver, West Virginia 25801
Address

Signature

2/25/10
Date

ATTACHMENT PART I.5.D

Attachment I.5.D.

PUBLIC NOTICE

Pursuant to the Surface Coal Mining Land Conservation and Reclamation Act (PA-81-1015, as amended) and the Rules and Regulations of the Act, Williamson Energy LLC, P. O. Box 99, Johnston City, IL 62951 hereby gives notice that on _____ 2010, an incidental boundary revision (IBR) has been submitted to the Illinois Department of Natural Resources, Office of Mines and Minerals, Land Reclamation Division, One Natural Resources Way, Springfield, IL 62702-1271. The IBR application is for 8.10 acres located in Williamson County, Township 8 South, Range 4 East, the northeast quadrant of Section 9 and the northwest and southwest quadrants of Section 10, , south of Locust Road.

Activities will include two concrete transport bore holes, the installation of a turbine pump site, installation and maintenance of a buried waterline and power line, and an access road.

Copies of the application are on file with the Illinois Department of Natural Resources, Office of Mines and Mineral, 503 East Main St., Benton, Illinois 62812, and the Springfield, Illinois Office.

Written comments concerning the operations should be addressed to the Office of Mines and Minerals, Land Reclamation Division at the Springfield office, no later than 7 days from the date of this notice.

PART II

PART II

PREMINING INFORMATION

Premining information is to be displayed on premining land use map unless otherwise indicated.

1) Describe how the IBR area perimeter will be marked and discuss the method or system employed to locate permit area perimeter and set markers along it. Designate a reference point outside the IBR area if different then the original permit. Provide a description of the reference point and a sketch relating the reference point to the IBR area perimeter.

RESPONSE: The perimeter of the IBR area will be delineated by using PVC and/or metal post and be located within eye sight of one another, if the property owner will allow it. A reference point will be adjacent permitted site.

2) Explain and locate areas where the IBR is contiguous to an existing permit.

RESPONSE: The IBR area is adjacent to the previously permitted IBR No. 16 pump site. Two separate roof falls have occurred in the bleeder entries necessary for the ventilation of the active mine works. In order to stabilize the mine roof and protect the health and safety of the miners, concrete must be pumped into the fallen area. This IBR area is to construct an access road to the surface areas above the roof fall areas, bore drill two seven (7) inch diameter bore holes over the roof fall area. The seven (7) inch bore holes will be cased to five (5) inch diameter holes and will have a depth of approximately 500 to 530 feet. When the bore holes is no longer needed, they will be grouted the entire length. In addition to the concrete bore holes, a turbine pump site will be drilled to help control water, which inhibits ventilation of the mine.

3) Give the acreages of each land use within the proposed IBR and existing permit area, employing land use categories of Section 1701.5 listed below, and delineate on premining land use map existing land uses in the proposed permit area and adjacent to it. Include on the premining land use map the location of all buildings and identify the current use of these buildings.

Pre-Mine Land Use	Existing Permit	IBR	Total
Cropland	503.22	0	503.22
Pasture land	0	0	0
Grazing land	0	0	0
Forestry	101.86	0	101.86
Residential	2.55	0	2.55
Industrial/Commercial			
Recreation	0	0	0
Fish and Wildlife Habitat	0.20	8.10	8.30
Developed Water Resources	1.44	0	1.44
Undeveloped land	0	0	0

4) Soils Information Map

A) Does the submitted soils map represent a map developed by the National Resources Conservation Service (NRCS)?

Yes __X__ No_____.

If no, explain.

B) Delineate on the soils map(s) the area which will incur actual mining (removal of overburden and/or deposition of overburden for the extraction of coal).

RESPONSE: No removal of overburden or deposition of overburden for the extraction of coal will occur on the IBR area. Topsoil material will be temporarily stored on site.

C) Are any of the identified map units correlated as prime farmland by NRCS criteria?

Yes __X__ No_____.

If yes, explain and provide documentation to meet the requirements of Section 1785.17, if a determination for grandfathering and/or negative determination is sought. If prime farmlands exist, which will not meet the exemption criteria described above, the approved prime farmlands restoration plan must be followed.

RESPONSE: Map 5 - Soils Resources Map indicates a small portion of the IBR area (1.90 acres) as being prime farmland. Another 1.16 acres is identified as prime farmland if the area is drained and protected from flooding. However, the IBR area has been utilized for hunting and not for farmland.

D) Submit, by completing soils information chart, acreage totals of each map unit (soil type and slope classification) and land use capability classes in the IBR area and the percent slope range of each lettered slope classification used on the soil map.

RESPONSE: Refer to Map 5 – Soils Resources Map. Additional information can be found in the NRCS Custom Soil Resource Report.

E) Provide, by completing soil information chart, acreage for each of the map units of high capability land (including grandfathered and negatively determined prime farmland) and non-cropland capability land with respect to areas which will be mined and areas which will incur other forms of disturbance (i.e., roads, ditches, etc.). Identify and provide map unit acreage values, if any, for areas which will not be disturbed.

RESPONSE: Refer to Map 5 – Soils Resources Map. Although the Soil Resource Report indicates that some soil types are or could prime farmland, the area has been designated as hunting club property for a number of years and has not been cultivated for farming.

F) Are selected overburden materials proposed to be used in lieu of or as a supplement to the A-horizon?

Yes _____ No__X____.

If yes, provide the appropriate information required under 1780.18(b)(4)/1784.13(b)(4).

PART II ATTACHMENTS

ATTACHMENT PART II.4.

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Williamson County, Illinois

Emergency Concrete Bore Holes and Turbine Pump Site



December 15, 2009

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means

for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Preface.....2
How Soil Surveys Are Made.....5
Soil Map.....7
Soil Map.....8
Legend.....9
Map Unit Legend.....10
Map Unit Descriptions.....10
Williamson County, Illinois.....12
10C—Plumfield silty clay loam, 5 to 10 percent slopes.....12
10D—Plumfield silty clay loam, 10 to 18 percent slopes.....12
14B—Ava silt loam, 2 to 5 percent slopes.....13
14B2—Ava silt loam, 2 to 5 percent slopes, eroded.....14
14C2—Ava silt loam, 5 to 10 percent slopes, eroded.....15
14C3—Ava silty clay loam, 5 to 10 percent slopes, severely eroded.....16
301B—Grantsburg silt loam, 2 to 5 percent slopes.....16
340D3—Zanesville silty clay loam, 10 to 18 percent slopes, severely eroded.....17
908D3—Hickory-Kell clay loams, 10 to 18 percent slopes, severely eroded.....18
3072A—Sharon silt loam, 0 to 2 percent slopes, frequently flooded.....19
3382A—Belknap silt loam, 0 to 2 percent slopes, frequently flooded.....20
W—Water.....21
Soil Information for All Uses.....22
Suitabilities and Limitations for Use.....22
Land Classifications.....22
Farmland Classification.....22
Soil Properties and Qualities.....26
Soil Qualities and Features.....26
Unified Soil Classification (Surface).....26
Soil Reports.....30
Vegetative Productivity.....30
Forestland Productivity.....30
Irrigated and Nonirrigated Yields by Map Unit Component.....32
References.....37

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Map Unit Legend

Williamson County, Illinois (IL199)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
10C	Plumfield silty clay loam, 5 to 10 percent slopes	40.6	25.1%
10D	Plumfield silty clay loam, 10 to 18 percent slopes	7.6	4.7%
14B	Ava silt loam, 2 to 5 percent slopes	4.1	2.6%
14B2	Ava silt loam, 2 to 5 percent slopes, eroded	14.4	8.9%
14C2	Ava silt loam, 5 to 10 percent slopes, eroded	7.0	4.3%
14C3	Ava silty clay loam, 5 to 10 percent slopes, severely eroded	2.9	1.8%
301B	Grantsburg silt loam, 2 to 5 percent slopes	9.0	5.5%
340D3	Zanesville silty clay loam, 10 to 18 percent slopes, severely eroded	10.4	6.4%
908D3	Hickory-Kell clay loams, 10 to 18 percent slopes, severely eroded	17.2	10.6%
3072A	Sharon silt loam, 0 to 2 percent slopes, frequently flooded	17.5	10.8%
3382A	Belknap silt loam, 0 to 2 percent slopes, frequently flooded	30.5	18.8%
W	Water	0.8	0.5%
Totals for Area of Interest		**162.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties

and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Williamson County, Illinois

10C—Plumfield silty clay loam, 5 to 10 percent slopes

Map Unit Setting

Elevation: 360 to 840 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition

Plumfield and similar soils: 85 percent

Description of Plumfield

Setting

Landform: Till plains
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Convex
Across-slope shape: Linear

Properties and qualities

Slope: 5 to 10 percent
Depth to restrictive feature: 5 to 20 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.8 inches)

Interpretive groups

Land capability (nonirrigated): 4e

Typical profile

0 to 5 inches: Silty clay loam
5 to 12 inches: Silt loam
12 to 36 inches: Silt loam
36 to 60 inches: Silt loam

10D—Plumfield silty clay loam, 10 to 18 percent slopes

Map Unit Setting

Elevation: 360 to 840 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition
Plumfield and similar soils: 100 percent

Description of Plumfield

Setting
Landform: Till plains
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear

Properties and qualities
Slope: 10 to 18 percent
Depth to restrictive feature: 5 to 20 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.8 inches)

Interpretive groups
Land capability (nonirrigated): 6e

Typical profile
0 to 5 inches: Silty clay loam
5 to 12 inches: Silt loam
12 to 36 inches: Silt loam
36 to 60 inches: Silt loam

14B—Ava silt loam, 2 to 5 percent slopes

Map Unit Setting
Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition
Ava and similar soils: 90 percent

Description of Ava

Setting
Landform: Till plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Peoria loess/roxana loess/drift

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: 25 to 40 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Moderate (about 7.4 inches)

Interpretive groups

Land capability (nonirrigated): 2e

Typical profile

0 to 8 inches: Silt loam
8 to 18 inches: Silt loam
18 to 36 inches: Silty clay loam
36 to 53 inches: Silt loam
53 to 80 inches: Silt loam

14B2—Ava silt loam, 2 to 5 percent slopes, eroded

Map Unit Setting

Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition

Ava and similar soils: 85 percent

Description of Ava

Setting

Landform: Till plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: 25 to 40 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None

Available water capacity: Moderate (about 6.4 inches)

Interpretive groups

Land capability (nonirrigated): 2e

Typical profile

0 to 9 inches: Silt loam
9 to 28 inches: Silty clay loam
28 to 64 inches: Silty clay loam
64 to 78 inches: Silt loam

14C2—Ava silt loam, 5 to 10 percent slopes, eroded

Map Unit Setting

Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition

Ava and similar soils: 90 percent

Description of Ava

Setting

Landform: Till plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear

Properties and qualities

Slope: 5 to 10 percent
Depth to restrictive feature: 25 to 40 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.5 inches)

Interpretive groups

Land capability (nonirrigated): 3e

Typical profile

0 to 9 inches: Silt loam
9 to 28 inches: Silty clay loam
28 to 64 inches: Silty clay loam
64 to 78 inches: Silt loam

14C3—Ava silty clay loam, 5 to 10 percent slopes, severely eroded

Map Unit Setting

Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition

Ava and similar soils: 90 percent

Description of Ava

Setting

Landform: Till plains
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear

Properties and qualities

Slope: 5 to 10 percent
Depth to restrictive feature: 25 to 40 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.5 inches)

Interpretive groups

Land capability (nonirrigated): 3e

Typical profile

0 to 9 inches: Silty clay loam
9 to 28 inches: Silty clay loam
28 to 64 inches: Silty clay loam
64 to 78 inches: Silt loam

301B—Grantsburg silt loam, 2 to 5 percent slopes

Map Unit Setting

Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition
Grantsburg and similar soils: 90 percent

Description of Grantsburg

Setting
Landform: Loess hills
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Peoria loess /roxana loess/residuum

Properties and qualities
Slope: 2 to 5 percent
Depth to restrictive feature: 24 to 40 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 6.5 inches)

Interpretive groups
Land capability (nonirrigated): 2e

Typical profile
0 to 11 inches: Silt loam
11 to 24 inches: Silt loam
24 to 38 inches: Silty clay loam
38 to 61 inches: Silt loam
61 to 80 inches: Silt loam

340D3—Zanesville silty clay loam, 10 to 18 percent slopes, severely eroded

Map Unit Setting
Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition
Zanesville and similar soils: 85 percent

Description of Zanesville

Setting
Landform: Hillslopes
Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope, head slope
Down-slope shape: Linear
Across-slope shape: Linear

Properties and qualities

Slope: 10 to 18 percent
Depth to restrictive feature: 19 to 32 inches to fragipan; 40 to 80 inches to lithic bedrock
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.20 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.8 inches)

Interpretive groups

Land capability (nonirrigated): 6e

Typical profile

0 to 2 inches: Silty clay loam
2 to 19 inches: Silty clay loam
19 to 39 inches: Silt loam
39 to 49 inches: Channery silt loam
49 to 59 inches: Bedrock

908D3—Hickory-Kell clay loams, 10 to 18 percent slopes, severely eroded

Map Unit Setting

Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Map Unit Composition

Hickory and similar soils: 50 percent
Kell and similar soils: 50 percent

Description of Kell

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear

Properties and qualities

Slope: 10 to 18 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock; 20 to 40 inches to lithic bedrock
Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Low to high (0.01 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.2 inches)

Interpretive groups

Land capability (nonirrigated): 4e

Typical profile

0 to 7 inches: Clay loam
7 to 13 inches: Silt loam
13 to 35 inches: Very channery silt loam
35 to 60 inches: Bedrock

Description of Hickory

Setting

Landform: Till plains
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear

Properties and qualities

Slope: 10 to 18 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Available water capacity: High (about 9.9 inches)

Interpretive groups

Land capability (nonirrigated): 4e

Typical profile

0 to 8 inches: Clay loam
8 to 46 inches: Clay loam
46 to 58 inches: Clay loam
58 to 80 inches: Loam

3072A—Sharon silt loam, 0 to 2 percent slopes, frequently flooded

Map Unit Setting

Elevation: 360 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F

Frost-free period: 175 to 195 days

Map Unit Composition

Sharon, frequently flooded, and similar soils: 85 percent

Description of Sharon, Frequently Flooded

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 36 to 72 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: High (about 11.0 inches)

Interpretive groups

Land capability (nonirrigated): 2w

Typical profile

0 to 13 inches: Silt loam
13 to 40 inches: Silt loam
40 to 80 inches: Silt loam

3382A—Belknap silt loam, 0 to 2 percent slopes, frequently flooded

Map Unit Setting

Elevation: 330 to 660 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 200 days

Map Unit Composition

Belknap, frequently flooded, and similar soils: 85 percent
Minor components: 4 percent

Description of Belknap, Frequently Flooded

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty alluvium

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 6 to 24 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: Very high (about 13.7 inches)

Interpretive groups

Land capability (nonirrigated): 3w

Typical profile

0 to 7 inches: Silt loam
7 to 59 inches: Silt loam
59 to 80 inches: Silt loam

Minor Components

Bonnie, frequently flooded

Percent of map unit: 2 percent
Landform: Flood plains
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear

Piopolis, frequently flooded

Percent of map unit: 2 percent
Landform: Flood plains
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear

W—Water

Map Unit Composition

Water: 100 percent

Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

Land Classifications

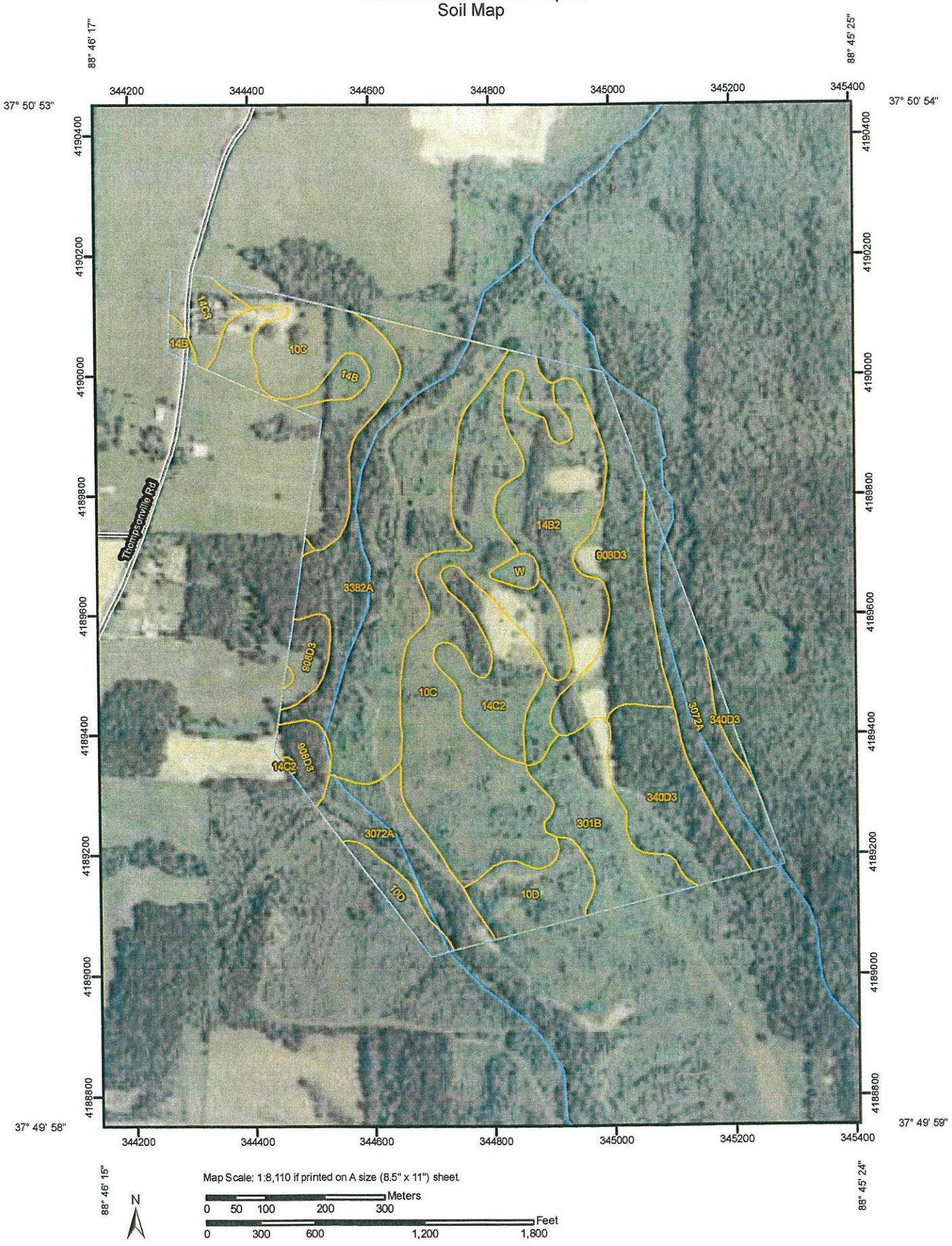
Land Classifications are specified land use and management groupings that are assigned to soil areas because combinations of soil have similar behavior for specified practices. Most are based on soil properties and other factors that directly influence the specific use of the soil. Example classifications include ecological site classification, farmland classification, irrigated and nonirrigated land capability classification, and hydric rating.

Farmland Classification

Farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. It identifies the location and extent of the soils that are best suited to food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the "Federal Register," Vol. 43, No. 21, January 31, 1978.

R17513

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:8,110 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 16N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Williamson County, Illinois
Survey Area Data: Version 5, Sep 14, 2009

Date(s) aerial images were photographed: 6/13/2007

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Farmland Classification

Farmland Classification— Summary by Map Unit — Williamson County, Illinois				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
10C	Plumfield silty clay loam, 5 to 10 percent slopes	Not prime farmland	40.6	25.1%
10D	Plumfield silty clay loam, 10 to 18 percent slopes	Not prime farmland	7.6	4.7%
14B	Ava silt loam, 2 to 5 percent slopes	All areas are prime farmland	4.1	2.6%
14B2	Ava silt loam, 2 to 5 percent slopes, eroded	All areas are prime farmland	14.4	8.9%
14C2	Ava silt loam, 5 to 10 percent slopes, eroded	Farmland of statewide importance	7.0	4.3%
14C3	Ava silty clay loam, 5 to 10 percent slopes, severely eroded	Farmland of statewide importance	2.9	1.8%
301B	Grantsburg silt loam, 2 to 5 percent slopes	All areas are prime farmland	9.0	5.5%
340D3	Zanesville silty clay loam, 10 to 18 percent slopes, severely eroded	Not prime farmland	10.4	6.4%
908D3	Hickory-Kell clay loams, 10 to 18 percent slopes, severely eroded	Not prime farmland	17.2	10.6%
3072A	Sharon silt loam, 0 to 2 percent slopes, frequently flooded	Prime farmland if protected from flooding or not frequently flooded during the growing season	17.5	10.8%
3382A	Belknap silt loam, 0 to 2 percent slopes, frequently flooded	Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season	30.5	18.8%
W	Water	Not prime farmland	0.8	0.5%
Totals for Area of Interest			**162.0**	**100.0%**

Rating Options—Farmland Classification

Aggregation Method: No Aggregation Necessary

Tie-break Rule: Lower

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Unified Soil Classification (Surface)

The Unified soil classification system classifies mineral and organic mineral soils for engineering purposes on the basis of particle-size characteristics, liquid limit, and plasticity index. It identifies three major soil divisions: (i) coarse-grained soils having less than 50 percent, by weight, particles smaller than 0.074 mm in diameter; (ii) fine-grained soils having 50 percent or more, by weight, particles smaller than 0.074 mm in diameter; and (iii) highly organic soils that demonstrate certain organic characteristics. These divisions are further subdivided into a total of 15 basic soil groups. The major soil divisions and basic soil groups are determined on the basis of estimated or measured values for grain-size distribution and Atterberg limits. ASTM D 2487 shows the criteria chart used for classifying soil in the Unified system and the 15 basic soil groups of the system and the plasticity chart for the Unified system.

The various groupings of this classification correlate in a general way with the engineering behavior of soils. This correlation provides a useful first step in any field or laboratory investigation for engineering purposes. It can serve to make some general interpretations relating to probable performance of the soil for engineering uses.

For each soil horizon in the database one or more Unified soil classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

Custom Soil Resource Report
Map—Farmland Classification



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if subsoiled, completely removing the root inhibiting soil layer
- Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance
- Farmland of local importance
- Farmland of unique importance
- Not rated or not available

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:8,110 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 16N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Williamson County, Illinois
Survey Area Data: Version 5, Sep 14, 2009

Date(s) aerial images were photographed: 6/13/2007

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Farmland Classification

Farmland Classification— Summary by Map Unit — Williamson County, Illinois				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
10C	Plumfield silty clay loam, 5 to 10 percent slopes	Not prime farmland	40.6	25.1%
10D	Plumfield silty clay loam, 10 to 18 percent slopes	Not prime farmland	7.6	4.7%
14B	Ava silt loam, 2 to 5 percent slopes	All areas are prime farmland	4.1	2.6%
14B2	Ava silt loam, 2 to 5 percent slopes, eroded	All areas are prime farmland	14.4	8.9%
14C2	Ava silt loam, 5 to 10 percent slopes, eroded	Farmland of statewide importance	7.0	4.3%
14C3	Ava silty clay loam, 5 to 10 percent slopes, severely eroded	Farmland of statewide importance	2.9	1.8%
301B	Grantsburg silt loam, 2 to 5 percent slopes	All areas are prime farmland	9.0	5.5%
340D3	Zanesville silty clay loam, 10 to 18 percent slopes, severely eroded	Not prime farmland	10.4	6.4%
908D3	Hickory-Kell clay loams, 10 to 18 percent slopes, severely eroded	Not prime farmland	17.2	10.6%
3072A	Sharon silt loam, 0 to 2 percent slopes, frequently flooded	Prime farmland if protected from flooding or not frequently flooded during the growing season	17.5	10.8%
3382A	Belknap silt loam, 0 to 2 percent slopes, frequently flooded	Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season	30.5	18.8%
W	Water	Not prime farmland	0.8	0.5%
Totals for Area of Interest			**162.0**	**100.0%**

Rating Options—Farmland Classification

Aggregation Method: No Aggregation Necessary

Tie-break Rule: Lower

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

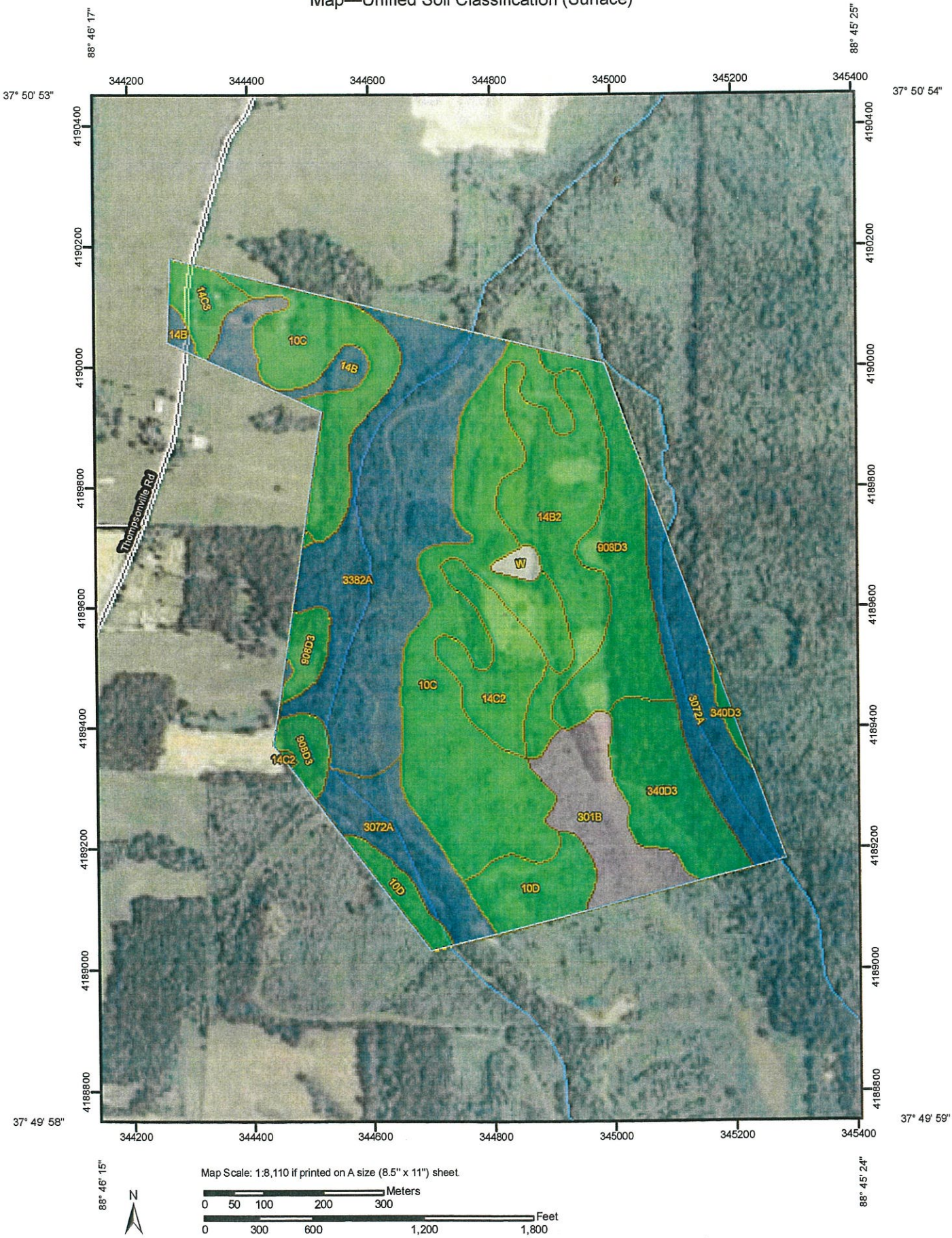
Unified Soil Classification (Surface)

The Unified soil classification system classifies mineral and organic mineral soils for engineering purposes on the basis of particle-size characteristics, liquid limit, and plasticity index. It identifies three major soil divisions: (i) coarse-grained soils having less than 50 percent, by weight, particles smaller than 0.074 mm in diameter; (ii) fine-grained soils having 50 percent or more, by weight, particles smaller than 0.074 mm in diameter; and (iii) highly organic soils that demonstrate certain organic characteristics. These divisions are further subdivided into a total of 15 basic soil groups. The major soil divisions and basic soil groups are determined on the basis of estimated or measured values for grain-size distribution and Atterberg limits. ASTM D 2487 shows the criteria chart used for classifying soil in the Unified system and the 15 basic soil groups of the system and the plasticity chart for the Unified system.

The various groupings of this classification correlate in a general way with the engineering behavior of soils. This correlation provides a useful first step in any field or laboratory investigation for engineering purposes. It can serve to make some general interpretations relating to probable performance of the soil for engineering uses.

For each soil horizon in the database one or more Unified soil classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

Custom Soil Resource Report
Map—Unified Soil Classification (Surface)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- CH
- CL
- CL-A (proposed)
- CL-K (proposed)
- CL-ML
- CL-O (proposed)
- CL-T (proposed)
- GC
- GC-GM
- GM
- GP
- GP-GC
- GP-GM
- GW
- GW-GC
- GW-GM
- MH
- MH-A (proposed)
- MH-K (proposed)
- MH-O (proposed)
- MH-T (proposed)
- ML
- ML-A (proposed)
- ML-K (proposed)
- ML-O (proposed)
- ML-T (proposed)
- OH
- OH-T (proposed)
- OL
- PT
- SC
- SC-SM
- SM
- SP
- SP-SC
- SP-SM
- SW
- SW-SC
- SW-SM
- Not rated or not available

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
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MAP INFORMATION

Map Scale: 1:8,110 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 16N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Williamson County, Illinois
Survey Area Data: Version 5, Sep 14, 2009

Date(s) aerial images were photographed: 6/13/2007

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Unified Soil Classification (Surface)

Unified Soil Classification (Surface)— Summary by Map Unit — Williamson County, Illinois				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
10C	Plumfield silty clay loam, 5 to 10 percent slopes	CL	40.6	25.1%
10D	Plumfield silty clay loam, 10 to 18 percent slopes	CL	7.6	4.7%
14B	Ava silt loam, 2 to 5 percent slopes	CL-ML	4.1	2.6%
14B2	Ava silt loam, 2 to 5 percent slopes, eroded	CL	14.4	8.9%
14C2	Ava silt loam, 5 to 10 percent slopes, eroded	CL	7.0	4.3%
14C3	Ava silty clay loam, 5 to 10 percent slopes, severely eroded	CL	2.9	1.8%
301B	Grantsburg silt loam, 2 to 5 percent slopes	ML	9.0	5.5%
340D3	Zanesville silty clay loam, 10 to 18 percent slopes, severely eroded	CL	10.4	6.4%
908D3	Hickory-Kell clay loams, 10 to 18 percent slopes, severely eroded	CL	17.2	10.6%
3072A	Sharon silt loam, 0 to 2 percent slopes, frequently flooded	CL-ML	17.5	10.8%
3382A	Belknap silt loam, 0 to 2 percent slopes, frequently flooded	CL-ML	30.5	18.8%
W	Water		0.8	0.5%
Totals for Area of Interest			**162.0**	**100.0%**

Rating Options—Unified Soil Classification (Surface)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Layer Options: Surface Layer

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Vegetative Productivity

This folder contains a collection of tabular reports that present vegetative productivity data. The reports (tables) include all selected map units and components for each map unit. Vegetative productivity includes estimates of potential vegetative production for a variety of land uses, including cropland, forestland, hayland, pastureland, horticulture and rangeland. In the underlying database, some states maintain crop yield data by individual map unit component. Other states maintain the data at the map unit level. Attributes are included for both, although only one or the other is likely to contain data for any given geographic area. For other land uses, productivity data is shown only at the map unit component level. Examples include potential crop yields under irrigated and nonirrigated conditions, forest productivity, forest site index, and total rangeland production under of normal, favorable and unfavorable conditions.

Forestland Productivity

This table can help forestland owners or managers plan the use of soils for wood crops. It shows the potential productivity of the soils for wood crops.

Potential productivity of merchantable or *common trees* on a soil is expressed as a site index and as a volume number. The *site index* is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that forestland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability. More detailed information regarding site index is available in the "National Forestry Manual," which is available in local offices of the Natural Resources Conservation Service or on the Internet.

The *volume of wood fiber*, a number, is the yield likely to be produced by the most important tree species. This number, expressed as cubic feet per acre per year and calculated at the age of culmination of the mean annual increment (CMAI), indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

Trees to manage are those that are preferred for planting, seeding, or natural regeneration and those that remain in the stand after thinning or partial harvest.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service, National forestry manual.

Report—Forestland Productivity

Forestland Productivity– Williamson County, Illinois				
Map unit symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site Index	Volume of wood fiber	
			Cu ft/ac	
10C—Plumfield silty clay loam, 5 to 10 percent slopes				
Plumfield	Northern red oak	64	0	Black oak, Chinkapin oak, Hickory, Northern red oak, Southern red oak, White oak
	White oak	58	0	
10D—Plumfield silty clay loam, 10 to 18 percent slopes				
Plumfield	Northern red oak	60	0	Black oak, Chinkapin oak, Hickory, Northern red oak, Southern red oak, White oak
	White oak	54	0	
14B—Ava silt loam, 2 to 5 percent slopes				
Ava	Northern red oak	71	0	Black oak, Chinkapin oak, Hickory, Northern red oak, White oak
	White oak	70	0	
	Yellow poplar	90	0	
14B2—Ava silt loam, 2 to 5 percent slopes, eroded				
Ava	Northern red oak	68	0	Black oak, Chinkapin oak, Hickory, Northern red oak, White oak
	White oak	66	0	
	Yellow poplar	85	0	
14C2—Ava silt loam, 5 to 10 percent slopes, eroded				
Ava	Northern red oak	63	—	Black oak, Chinkapin oak, Hickory, Northern red oak, White oak
	White oak	62	—	
	Yellow poplar	81	—	
14C3—Ava silty clay loam, 5 to 10 percent slopes, severely eroded				
Ava	Northern red oak	61	—	Black oak, Chinkapin oak, Hickory, Northern red oak, White oak
	White oak	60	—	
	Yellow poplar	77	—	
301B—Grantsburg silt loam, 2 to 5 percent slopes				
Grantsburg	Northern red oak	71	—	Black oak, Chinkapin oak, Hickory, Northern red oak, Southern red oak, White oak
	White oak	70	—	

Forestland Productivity– Williamson County, Illinois				
Map unit symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site Index	Volume of wood fiber	
			Cu ft/ac	
340D3—Zanesville silty clay loam, 10 to 18 percent slopes, severely eroded				
Zanesville	Northern red oak	43	—	Black oak, Chinkapin oak, Hickory, Northern red oak, Southern red oak, White oak
	White oak	45	—	
908D3—Hickory-Kell clay loams, 10 to 18 percent slopes, severely eroded				
Hickory	Eastern cottonwood	86	—	Black oak, Chinkapin oak, Hickory, Northern red oak, Southern red oak, White ash, White oak
	Northern red oak	61	—	
	White ash	65	—	
	White oak	65	—	
Kell	**Northern red oak**	**57**	—	**Black oak, Chinkapin oak, Hickory, Northern red oak, Southern red oak, White ash, White oak**
	White ash	**50**	—	
	White oak	**54**	—	
3072A—Sharon silt loam, 0 to 2 percent slopes, frequently flooded				
Sharon, frequently flooded	Eastern cottonwood	103	—	Black walnut, Cherrybark oak, Common persimmon, Pecan, Shellbark hickory, Swamp white oak
	Pin oak	93	—	
3382A—Belknap silt loam, 0 to 2 percent slopes, frequently flooded				
Belknap, frequently flooded	Eastern cottonwood	102	—	Bur oak, Cherrybark oak, Common persimmon, Eastern cottonwood, Pin oak, Red maple, Shellbark hickory, Swamp chestnut oak, Swamp white oak, Sweetgum
	Pin oak	92	—	
W—Water				
Water	—	—	—	—

Irrigated and Nonirrigated Yields by Map Unit Component

The average yields per acre that can be expected of the principal crops under a high level of management are shown in this table. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations also are considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

If yields of irrigated crops are given, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good-quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

Pasture yields are expressed in terms of animal unit months. An animal unit month (AUM) is the amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in the table are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

The land capability classification of map units in the survey area is shown in this table. This classification shows, in a general way, the suitability of soils for most kinds of field crops (United States Department of Agriculture, Soil Conservation Service, 1961). Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forestland, or for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit.

Capability classes, the broadest groups, are designated by the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

- Class 1 soils have slight limitations that restrict their use.
- Class 2 soils have moderate limitations that restrict the choice of plants or that require moderate conservation practices.
- Class 3 soils have severe limitations that restrict the choice of plants or that require special conservation practices, or both.
- Class 4 soils have very severe limitations that restrict the choice of plants or that require very careful management, or both.

- Class 5 soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.
- Class 6 soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.
- Class 7 soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to grazing, forestland, or wildlife habitat.
- Class 8 soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, 2e. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class 5 are subject to little or no erosion.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, 2e-4 and 3e-6. These units are not given in all soil surveys.

Reference:
United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210.

Irrigated and Nonirrigated Yields by Map Unit Component– Williamson County, Illinois								
Map symbol and soil name	Land capability		Corn		Grain sorghum		Soybeans	
	Irrigated	Nonirrigated	Irrigated	Nonirrigated	Irrigated	Nonirrigated	Irrigated	Nonirrigated
			Bu		*Bu*		*Bu*	
10C—Plumfield silty clay loam, 5 to 10 percent slopes								
Plumfield	—	4e	—	92	—	78	—	31
10D—Plumfield silty clay loam, 10 to 18 percent slopes								
Plumfield	—	6e	—	—	—	—	—	—
14B—Ava silt loam, 2 to 5 percent slopes								
Ava	—	2e	—	120	—	95	—	39
14B2—Ava silt loam, 2 to 5 percent slopes, eroded								
Ava	—	2e	—	113	—	89	—	36
14C2—Ava silt loam, 5 to 10 percent slopes, eroded								
Ava	—	3e	—	109	—	86	—	35
14C3—Ava silty clay loam, 5 to 10 percent slopes, severely eroded								
Ava	—	3e	—	90	—	71	—	29
301B—Grantsburg silt loam, 2 to 5 percent slopes								
Grantsburg	—	2e	—	119	—	93	—	41
340D3—Zanesville silty clay loam, 10 to 18 percent slopes, severely eroded								
Zanesville	—	6e	—	—	—	—	—	—

R17529

Irrigated and Nonirrigated Yields by Map Unit Component– Williamson County, Illinois								
Map symbol and soil name	Land capability		Corn		Grain sorghum		Soybeans	
	Irrigated	Nonirrigated	Irrigated	Nonirrigated	Irrigated	Nonirrigated	Irrigated	Nonirrigated
			Bu		*Bu*		*Bu*	
908D3—Hickory-Kell clay loams, 10 to 18 percent slopes, severely eroded								
Hickory	—	4e	—	86	—	—	—	29
Kell	—	**4e**	—	**73**	—	**57**	—	**24**
3072A—Sharon silt loam, 0 to 2 percent slopes, frequently flooded								
Sharon, frequently flooded	—	2w	—	133	—	—	—	43
3382A—Belknap silt loam, 0 to 2 percent slopes, frequently flooded								
Belknap, frequently flooded	—	3w	—	127	—	—	—	42
W—Water								
Water	—	—	—	—	—	—	—	—

R17530

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SOILS RESOURCES MAP

GENERAL INFORMATION

- MINING PERMIT #375 SURFACE FACILITIES
- PROPOSED IBR AREA (8.10 AC.)
- DRAINAGE DITCHES (CONSTRUCTED)
- ROAD
- SOIL SERIES BOUNDARY (14B)

SOIL INFORMATION

Acres	Soil ID	Soil Series	Slope (%)	Capability
0.20	10C	Plumfield	5 - 10	LC
1.11	10D	Plumfield	10 - 18	LC
0.26	14B2	Ava	2 - 5	PF
1.71	301B	Grantsburg	2 - 5	PF
1.20	340D3	Zanesville	10 - 18	LC
2.91	908D3	Hickroy-Kell	10 - 18	LC
0.45	3072A	Sharon	0 - 2	PF
0.26	3382A	Belknap	0 - 2	PF

PF = Prime Farmland
HC = High Capability
LC = Limited Capability

* REFER TO THE NRCS SOIL RESOURCE REPORT FOR ADDITIONAL INFORMATION ON SOIL CAPABILITIES.

400' 0 400' 800'

SCALE: 1"=400'

N

Mine Name: POND CREEK MINE #1	Permit No: 375
Quadrangle: PITTSBURG, ILLINOIS	Description: WILLIAMSON COUNTY, ILLINOIS T8S R3E - SECTIONS 1, 2, 11, 12, 13, 14, 23, & 24 T8S R4E - SECTIONS 4, 5, 6, 7, 8, 9, 16, 17, 18, 19, 20, & 21
Date: 12/09/09	

REV.	DATE	DESCRIPTION	P.M.
1	02/23/10	REVISED IBR BOUNDARY	SMS

BECKLEY, WV
(304) 255-0491

Alliance Consulting, Inc.
Engineers Constructors Scientists

MAP 5

SOILS RESOURCES MAP

POND CREEK 1 MINE

Prepared For

WILLIAMSON ENERGY LLC.
JOHNSTON CITY, IL

CAD BY	SMS	12/09/09	PROJECT NO. B09-514-1413	
CHECKED BY	SMS	12/30/09		
APPROVED BY	SMS	12/30/09	DRAWING NO. B09-514-B1	

PART III

PART III

OPERATIONS PLAN

1) Explain the proposed operation and why the IBR is needed. Locate on a mining operations map.

RESPONSE: The purpose of this IBR is to permit access to two emergency concrete bore holes located in the bleeder entries. The location of the bore holes are dictated by the location of the roof falls and the it is necessary to stabilize the mine roof of the bleeder entries to insure ventilation of the mine. The bore holes will be drilled to a diameter of 7⅞ and cased to an opening of 6 inches. Concrete will be pumped into the bore hole to fill the mine roof void and to grout the bore hole.

A turbine pump site is being proposed to help de-water the mine. A water line and a power line will be installed along the access road and will connect to previously installed water and power lines. Topsoil will be removed prior to disturbing the site and trees will be windrowed in accordance to the land owners request. A drill hole will be drilled to a diameter of 18⅞ inches. A 15 ½ steel casing will be installed and grouted into the hole. Cuttings from the hole will be deposited in a cutting pit. The pit will be reclaimed after the installation of the pump.

Access to the site will be by using the previously permitted access road. Topsoil will be stripped and stockpiled and/or windrowed. Trees will be windrowed along the road in accordance to the land owners' request. Existing roads/trails will be utilized where possible. An 8-foot diameter pipe will be place in the first stream crossing and gravel will be used to bridge over the pipe. A second crossing, located between the two concrete bore holes, will be installed. A 30-inch CMP will used as a temporary crossing and removed upon completion of the concrete operation. A letter requesting a Nationwide Permit 14 will be sent to the U. S Army Corps of Engineers.

The water discharge line will be buried in a trench and will connect with the discharge line located on the previous IBR area. Power will be provided by overhead lines and will terminate at a pole located near the pump site. A small 12 X 12 foot concrete pad will be installed for electrical transformer. Connections to the pump will be by buried cable.

Upon the completing the pump installation, the entire disturbed area will be seeded and mulched using the approved revegetation plan.

Refer to Map 6 S.F. – Sheet 2 of 2 and Map 6 S.F. for the location of the IBR area outlined in red.

2) Surface Drainage Control

A) 1) Locate on the mining operations map or on a separate drainage map all proposed drainage control systems. Show drainage patterns of all affected mining areas.

RESPONSE: Refer to Map 6 S.F. – Sheet 2 of 2.

2) Will all surface drainage from the affected mining area be collected and treated prior to leaving the IBR area?

Yes _____ No ___X___

If yes, delineate how and where surface drainage will be collected and treated, and list permit numbers and type of permit that the drainage control systems are operated under. If above answer is no, explain how regulatory compliance will be achieved without treatment, i.e., address the requirements of 1816.46(e)/1817.46(e).

RESPONSE: The applicant is requesting to utilize alternate sediment control measures as described in 1817.46(e). Disturbance will be kept to a minimum to compile with the land owners' request. Topsoil and vegetation will be windrowed along the access road and to the specifications of the land owner. An existing road/trail will be utilized where possible. Access to the emergency concrete bore holes will be reclaimed and vegetated as soon as the concrete pumping is completed.

Surface drainage in the turbine pump site will be directed to the cuttings pond for retention and de-watering. Berms, silt fence and/or straw/hay bales will be used where needed to prevent sedimentation from entering the receiving stream. All disturbances will be vegetated with the approved seed mixture as soon as possible.

B) Will all surface drainage from unaffected areas be intercepted and diverted around the affected mining area?

Yes _____ No ___X___

If no, please discuss.

RESPONSE: There will be no unaffected areas within the IBR area.

C) Overland Flow Diversions and Sediment Ponds:

Are either overland flow diversions or sediment ponds to be constructed?

Yes _____ No ___X___

If yes, complete applicable parts of the SCM-1 or UCM-1 Part IV (surface drainage control).

D) Does a perennial or intermittent stream occur within the proposed IBR area?

Yes _____ No ___X___

If yes, is an exception to the 100 foot buffer zone being requested or is a stream diversion being proposed. For an exception to the 100 foot buffer zone, indicate how compliance with 1816.57/1817.57 will be assured. For a stream diversion, complete applicable parts of the SCM-1 or UCM-1.

3) Roads and other activities:

A) Are roads to be constructed in the IBR area?

Yes ___X___ No _____

If yes, complete the applicable part of the SCM-1or UCM-1 (transportation facilities).

B) If the operations involve other activities not specifically addressed above complete applicable parts of the SCM-1 or UCM-1.

RESPONSE: Refer to Attachment III.3.A.

4) Are any existing structures proposed for utilization in the IBR?

Yes _____ No __X_____

If yes, complete Part IV.4 of the SCM-1 or UCM-1.

ATTACHMENT PART III.3.A

PART III ATTACHMENTS

Attachment III.3.A.

Transportation Facilities

1) Provide a detailed description on mining operations map or other map and show location of the following:

   a) Proposed road(s), conveyor system(s), or rail system.

   b) Related sediment control facilities.

   c) Earth borrow locations and/or locations for deposition of excess excavation.

RESPONSE: From a previously permitted pump site, a new access road will be constructed to tie into an existing road/trail. The existing road/trial will be upgraded to allow vehicular traffic. In order to have access to the emergency concrete pump bore holes and the proposed turbine pump site, construction of a new portion of access road will be built.

2) Provide specifications and plan-profiles of existing gradeline, proposed road centerline, ditch flow lines, road cut, fill embankment, culvert, bridge and drainage structures. Provide typical cross sections where appropriate.

RESPONSE: Refer to the Access Road Plan View, Profile and Section drawing.

3) For all transportation facilities to be constructed, provide construction details for all sediment control facilities to be constructed to prevent additional contributions of suspended solids to streamflow or to runoff outside the permit area.

RESPONSE: The access road will be constructed and graveled. Topsoil material and vegetation will be stockpile (windrowed) on-site. Gravel and temporary/permanent vegetation will be utilized to prevent additional contributions of suspended solids or runoff. As needed, silt fence, straw and/or hay bales will be installed.

4) Discuss the revegetation of ditch and borrow areas involved in construction.

RESPONSE: No ditches or borrow areas are proposed by this IBR application.

5) Discuss the estimated life of each facility and how materials will be removed when the facility becomes inactive.

RESPONSE: The current lease agreement is for a term of 10 years and this should be adequate time for the mining operation. The access road to the emergency concrete bore holes will be graded and seeded as soon as the concrete pumping is completed and weather will allow such work. The main access to the proposed turbine pump site will be graded and seeeded within the 10 years time frame. However, as stated in the lease agreement, prior to reclaiming the sites, Williamson Energy "will offer the Lessor the option to leave in place roads, electrical facilities and water transportation lines." If the land owner requests the roads and other facilities to remain, the disturbed area will be vegetated and lease agreement will be terminated.

PART IV

PART IV

RECLAMATION PLAN

1) Provide a reclamation plan map outlining proposed reclamation of the lands within the proposed IBR area and state how the IBR area will be reclaimed in conformity with the original plan.

RESPONSE: Refer to Map 7 S.F.; Reclamation Plan Map. The reclamation of the IBR areas will comply with the approved reclamation.

2) Post Mining Land Use

A) Provide a detailed description of proposed post-mining land uses and capabilities employing land use and capability categories listed below. Provide acreage figures for each post-mining land use proposed for the existing permit, the IBR area and total permit after inclusion of the IBR acreage and designate the postmining land uses on the Post Mining Land Use Map. Acreage figures for postmining land use must differentiate between mined and surface disturbance areas based on the mining line used in the premining section of the application.

RESPONSE: Refer to Map 7 S.F.; Reclamation Plan Map

	Capability								
	Existing Permit (ac)			IBR (ac)			Total (ac)		
Land Use	Prime	HCap	NonCr	Prime	HCap	NonCr	Prime	HCap	NonCr
Cropland			0.00			0.00			0.00
Pasture Land			0.00			0.00			0.00
Grazing Land			0.00			0.00			0.00
Forestry			13.36			0.00			13.36
Residential			0.00			0.00			0.00
Industrial / Commercial			0.00			0.00			0.00
Recreation			0.00			0.00			0.00
Fish & Wildlife Habitat (Herbaceous)			18.40			8.10			26.50
Fish & Wildlife Habitat (Woody)			558.25			0.00			558.25
Fish & Wildlife Habitat (Wetland)			0.00			0.00			0.00
Developed Water Resources			19.26			0.00			19.26
Undeveloped Land			0.00			0.00			0.00

Prime: Prime farmland
HCap: High Capability - meeting productivity requirements of 62 Ill. Adm. Code 1825.
NonCrop: Non-Cropland - All soils which do not qualify as prime farmland or high capability.

R17E R18E

WL

Map 7 S.F. - RECLAMATION PLAN MAP

GENERAL INFORMATION

- MINING PERMIT #375 SURFACE FACILITIES
- PROPOSED IBR AREA (8.10 AC.)
- ROAD

SOIL INFORMATION

- LOW CAPABILITY SOILS
- ALTERNATIVE SOILS
- 8.10 AC. WOODY WILDLIFE AREA
- HERBACEOUS WILDLIFE AREA
- PONDS, STREAMS & WETLANDS

LAND USE INFORMATION

C CROPLAND
F FORESTRY
WL WILDLIFE
W WATER

400' 0' 400' 800'

SCALE: 1"=400'

N

Mine Name: POND CREEK MINE #1	Permit No: 375
Quadrangle: PITTSBURG, ILLINOIS	Description: WILLIAMSON COUNTY, ILLINOIS T8S R3E - SECTIONS 1, 2, 11, 12, 13, 14, 23, & 24 T8S R4E - SECTIONS 4, 5, 6, 7, 8, 9, 16, 17, 18, 19, 20, & 21
Date: 12/09/09	

REV.	DATE	DESCRIPTION	P.M.
1	02/23/10	REVISED IBR BOUNDARY	SMS

BECKLEY, WV
(304) 255-0491

Alliance Consulting, Inc.
Engineers Constructors Scientists

MAP 7 S.F.

RECLAMATION PLAN MAP

POND CREEK 1 MINE

Prepared For

WILLIAMSON ENERGY LLC.
JOHNSTON CITY, IL

CAD BY	SMS	12/09/09	PROJECT NO. B09-514-1413
CHECKED BY	SMS	12/31/09	
APPROVED BY	SMS	12/31/09	**DRAWING NO. B09-514-B2**

DOCUMENT

76

9555 · 109
Due date 2-1-10
R17545

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

December 29, 2009

Project No. B09-444-1413

Mr. Larry Crislip
Illinois Environmental Protection Agency
Mine Pollution Control Program
2309 West Main Street
Suite 116
Marion, IL 62959

Transmittal
NPDES Renewal for IL0077666
Williamson Energy LLC - Pond Creek No. 1 Mine
Williamson County, Illinois

Dear Mr. Crislip:

On behalf of our client, Williamson Energy LLC, we are submitting an original and two copies of the renewal for the above referenced permit.

If there are any questions or you require additional information, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Stephen M. Sutphin
Project Manager

SMS:sms
Enclosures

FILE: 09444-02

RECEIVED
DEC 31 2009
IL Environmental Protection Agency
MARION REGIONAL OFFICE

124 Philpott Lane • Raleigh County Airport Industrial Park • Beaver, WV 25813-9502 • TELE: (304) 255-0491 • FAX: (304) 255-4232

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

December 29, 2009

Project No. B09-444-1413

Mr. Larry Crislip
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
2309 West Main Street
Suite 116
Marion, IL 62959

Williamson Energy LLC - NPDES No. 0077666
Renewal No. 1
Pond Creek Mine No. 1
Williamson County, Illinois

Dear Mr. Crislip:

Attached, please the Permit Renewal information for Williamson Energy LLC; Pond Creek No. 1 Mine located in Williamson County, Illinois. This renewal package includes:

- EPA Form 1
- EPA Form 2C
- Water analysis from each sediment pond. Ponds were not discharging, therefore grab samples were taken.
- Receiving stream sample - Un-named tributary of Pond Creek
- Schedule A identifying each outfall.
- Information regarding volume and discharge rate of mine pumpage.
- 1" = 400' Location Maps showing the current permit boundary with acreages, NPDES outfall locations and stream monitoring point.

Should you have any questions, or require additional information, please contact us.

Respectfully submitted for Williamson Energy LLC,

Stephen M. Sutphin
ALLIANCE CONSULTING, INC.
Project Manager

SMS:sms
Enclosures

FILE: 09444-01

NPDES RENEWAL #1
FOR
PERMIT NO. IL0077666
(IDNR PERMIT 375)

WILLIAMSON COUNTY, IL
POND CREEK MINE NO. 1

Prepared for

WILLIAMSON ENERGY LLC
JOHNSTON CITY, IL

ALLIANCE PROJECT NO. B09-444-1413
DECEMBER 2009

EPA FORM 1

FORM 1 GENERAL

U.S. ENVIRONMENTAL PROTECTION AGENCY

GENERAL INFORMATION

Consolidated Permits Program

(Read the "General Instructions" before starting.)

I. EPA I.D. NUMBER

S			T/A	R 7549
F				D
1	2	13	14	15

LABEL ITEMS

EPA I.D. NUMBER

II. FACILITY NAME

III. FACILITY MAILING ADDRESS

IV. FACILITY LOCATION

PLEASE PLACE LABEL IN THIS SPACE

GENERAL INSTRUCTIONS

If a preprinted label has been provided, affix it in the designated space. Review the information carefully; if any of it is incorrect, cross through it and enter the correct data in the appropriate fill-in area below. Also, if any of the preprinted data is absent (the area to the left of the label space lists the information that should appear), please provide it in the proper fill-in area(s) below. If the label is complete and correct, you need not complete Items I, III, V, and VI(except VI-B which must be completed regardless). Complete all items if no label has been proved. Refer to the instructions for detailed item descriptions and for the legal authorization under which this data is collected.

II. POLLUTANT CHARACTERISTICS

INSTRUCTIONS: Complete A through J to determine whether you need to submit any permit application forms to the EPA. If you answer "yes" to any questions, you must submit this form and the supplemental from listed in the parenthesis following the question. Mark "X" in the box in the third column if the supplemental form is attached. If you answer "no" to each question, you need not submit any of these forms. You may answer "no" if your activity is excluded from permit requirements; see Section C of the instructions. See also, Section D of the instructions for definitions of **bold-faced terms**.

SPECIFIC QUESTIONS	MARK "X" YES	NO	FORM ATTACHED	SPECIFIC QUESTIONS	MARK "X" YES	NO	FORM ATTACHED
A. Is this facility a **publicly owned treatment works** which results in a **discharge to waters of the U.S.?** (FORM 2A)	☐ 16	☒ 17	☐ 18	B. Does or will this facility *(either existing or proposed)* include a **concentrated animal feeding operation** or **aquatic animal production facility** which results in a **discharge to waters of the U.S.?** (FORM 2B)	☐ 19	☒ 20	☐ 21
C. Is this facility which currently results in **discharges to waters of the U.S.** other than those described in A or B above? (FORM 2C)	☒ 22	☐ 23	☐ 24	D. Is this proposal facility *(other than those described in A or B above)* which will result in a **discharge to waters of the U.S.?** (FORM 2D)	☐ 25	☒ 26	☐ 27
E. Does or will this facility treat, store, or dispose of **hazardous wastes?** (FORM 3)	☐ 28	☒ 29	☐ 30	F. Do you or will you inject at this facility industrial or municipal effluent below the lowermost stratum containing, within one quarter mile of the well bore, underground sources of drinking water? (FORM 4)	☐ 31	☒ 32	☐ 33
G. Do you or will you inject at this facility any produced water other fluids which are brought to the surface in connection with conventional oil or natural gas production, inject fluids used for enhanced recovery of oil or natural gas, or inject fluids for storage of liquid hydrocarbons? (FORM 4)	☐ 34	☒ 35	☐ 36	H. Do you or will you inject at this facility fluids for special processes such as mining of sulfer by the Frasch process, solution mining of minerals, in situ combustion of fossil fuel, or recovery of geothermal energy? (FORM 4)	☐ 37	☒ 38	☐ 39
Is this facility a proposed **stationary source** which is one of the 28 industrial categories listed in the instructions and which will potentially emit 100 tons per year of any air pollutant regulated under the Clean Air Act and may affect or be located in an **attainment area?** (FORM 5)	☐ 40	☒ 41	☐ 42	J. Is this facility a proposed **stationary source** which is NOT one of the 28 industrial categories listed in the instructions and which will potentially emit 250 tons per year of any air pollutant regulated under the Clean Air Act and may affect or be located in an **attainment are?** (FORM 5)	☐ 43	☒ 44	☐ 45

III. NAME OF FACILITY

C 1 | SKIP | POND CREEK 1 MINE

15 | 16-29 | 30 ... 69

IV. FACILITY CONTACT

A. NAME & TITLE *(last, first, & title)*	B. PHONE *(area code & no.)*		
C 2 SLAPAK, JAMES - CHIEF SURVEYOR	618	683	3020
15 16 ... 45	46 48	49 51	52 55

V. FACILITY MAILING ADDRESS

A. STREET OR P.O. BOX

C 3 P. O. BOX 300

15 16 ... 45

B. CITY OR TOWN	C. STATE	D. ZIP CODE
C 4 JOHNSTON CITY	IL	62651
15 16 ... 40	41 42	47 51

VI. FACILITY LOCATION

A. STREET, ROUTE NO. OR OTHER SPECIFIC IDENTIFIER

C 5 16468 LIBERTY SCHOOL ROAD

15 16 ... 45

B. COUNTY NAME

WILLIAMSON

70

C. CITY OR TOWN	D. STATE	E. ZIP CODE	F. COUNTY CODE
C 6 MARION	IL	62959	
15 16 ... 40	41 42	47 51	52 54

CONTINUED ON REVERSE

CONTINUED FROM THE FRONT

VII. SIC CODES *(4-digit, in order of priority)*

A. FIRST	B. SECOND
1222 (specify) COAL MINING - UNDERGROUND	(specify) N/A
C. THIRD	**D. FOURTH**
(specify) N/A	(specify) N/A

VIII. OPERATOR INFORMATION

A. NAME	B. Is the name listed in Item VIII-A also the owner?
WILLIAMSON ENERGY LLC	☒ YES ☐ NO

C. STATUS OF OPERATOR *(Enter the appropriate letter into the answer box; if "Other," specify.)*

F = FEDERAL; M = PUBLIC (other than federal or state); S = STATE; O = OTHER (specify); P = PRIVATE

P (specify) -

D. PHONE *(area code & no.)*: 618 983 3020

E. STREET OR PO BOX: P. O. BOX 99

F. CITY OR TOWN	G. STATE	H. ZIP CODE
JOHNSTON CITY	IL	62951

IX. INDIAN LAND

Is the facility located on Indian lands? ☐ YES ☒ NO

X. EXISTING ENVIRONMENTAL PERMITS

A. NPDES *(Discharges to Surface Water)*: IL0077666	D. PSD *(Air Emissions from Proposed Sources)*: 05040012	
B. UIC (Underground Injection of Fluids): N/A	E. OTHER *(specify)*: 375	*(Specify)* IDNR
C. RCRA (Hazardous Wastes): N/A	E. OTHER *(specify)*: N/A	*(Specify)*

XI. MAP

Attach to this application a topographic map of the area extending to at least one mile beyond property boundaries. The map must show the outline of the facility, the location of each of its existing and proposed intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids underground. Include all springs, rivers and other surface water bodies in the map area. See instructions for precise requirements.

XII. NATURE OF BUSINESS *(provide a brief description)*

UNDERGROUND BITUMINOUS COAL MINE WITH COAL PREPARATION PLANT, REFUSE DISPOSAL FACILITIES AND COAL HANDLING FACILITIES.

XIII. CERTIFICATION *(see instructions)*

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that, based on my inquiry of those persons immediately responsible for obtaining the information contained in the application, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

A. NAME & OFFICIAL TITLE *(type or print)*	B. SIGNATURE	C. DATE SIGNED
MICHAEL J. BEYER	MJBeyer	12/2/09

COMMENTS FOR OFFICIAL USE ONLY

EPA FORM 2C

R17552

Please type or print in the unshaded areas only

EPA ID Number *(Copy from Item 1 of Form 1)*

Form Approved
OMB No. 2040-0086
Approval expires 7-31-88

Form **2C** NPDES

U.S. ENVIRONMENTAL PROTECTION AGENCY
APPLICATION FOR PERMIT TO DISCHARGE WASTEWATER
EXISTING MANUFACTURING, COMMERCIAL, MINING AND SILVICUTLRAL OPERATIONS
Consolidated Permits Program

Outfall Location

For this outfall, list the latitude and longitude, and name of the receiving water(s)

Outfall Number *(list)*	Latitude			Longitude			Receiving Water *(name)*
	Deg	Min	Sec	Deg	Min	Sec	
001	*37*	*50*	*59.2*	*88*	*49*	*37.5*	*UN-NAMED TRIBUTARY TO POND CREEK*
002	*37*	*50*	*26*	*88*	*49*	*51.5*	*UN-NAMED TRIBUTARY TO POND CREEK*
003	*37*	*50*	*26*	*88*	*49*	*58*	*UN-NAMED TRIBUTARY TO POND CREEK*
004	*37*	*50*	*25*	*88*	*49*	*56.6*	*UN-NAMED TRIBUTARY TO POND CREEK*
005	*37*	*50*	*9.1*	*88*	*50*	*0*	*UN-NAMED TRIBUTARY TO POND CREEK*
006	*37*	*50*	*28.4*	*88*	*50*	*40.6*	*UN-NAMED TRIBUTARY TO POND CREEK*
007	*37*	*50*	*29.5*	*88*	*49*	*34*	*UN-NAMED TRIBUTARY TO POND CREEK*
008	*37*	*50*	*31.4*	*88*	*49*	*33.9*	*UN-NAMED TRIBUTARY TO POND CREEK*

II. Flows, Sources of Pollution, and Treatment Technologies

A. For each outfall, provide a description of (1) all operations contributing wastewater to the effluent, including process wastewater, sanitary wastewater, cooling water, and stormwater runoff; (2) the average flow contributed by each operation; and (3) the treatment received by the wastewater. Continue on additional sheets if necessary.

For each outfall, provide a description of (1) all operations contributing wastewater to the effluent, including process wastewater, sanitary wastewater, cooling water, and stormwater runoff; (2) the average flow contributed by each operation; and (3) the treatment received by the wastewater. Continue on additional sheets if necessary.

1. Outfall Number	2. Operations Contributing Flow		3. Treatment		
	a. OPERATION *(list)*	b. AVERAGE FLOW	a. DESCRIPTION	b. LIST CODES FROM TABLE 2C-1	
001	*Stormwater Runoff*	*2 gpm*	*Sedimentation*	*1-U*	
002	*Stormwater Runoff*	*1 gpm*	*Sedimentation*	*1-U*	
003	*Stormwater Runoff*	*1 gpm*	*Sedimentation*	*1-U*	
004	*Stormwater Runoff*	*2 gpm*	*Sedimentation*	*1-U*	
005	*Stormwater Runoff*	*5 gpm*	*Sedimentation*	*1-U*	
006	*Stormwater Runoff,*	*2 gpm*	*Sedimentation*	*1-U*	
	Process Wastewater,	*3 gpm*	*Sedimentation*	*1-U*	
	Deep Mine Drainage	*10 gpm*	*Sedimentation*	*1-U*	
007	*Stormwater Runoff*	*1 gpm*	*Sedimentation*	*1-U*	
008	*Stormwater Runoff*	*1 gpm*	*Sedimentation*	*1-U*	
	Process Wastewater	*2 gpm*	*Sedimentation*	*1-U*	

CONTINUED FROM THE FRONT

C. Except for storm runoff, leaks, or spills, are any of the discharges described in Items II-A or B intermittent or seasonal?

☐ YES *(complete the following table)* ☒ NO *(go to Section III)*

1. OUTFALL NUMBER (list)	2. OPERATION(s) CONTRIBUTING FLOW (list)	3. FREQUENCY		4. FLOW				
		a. DAYS PER WEEK (specify average)	b. MONTHS PER YEAR (specify average)	a. FLOW RATE (in mgd)		b. TOTAL VOLUME (specify with units		c. DURATION (in days)
				1. LONG TERM AVERAGE	2. MAXIMUM DAILY	1. LONG TERM AVERAGE	2. MAXIMUM DAILY	

III. PRODUCTION

A. Does an effluent guideline limitation promulgated by EPA under Section 304 of the Clean Water Act apply to your facility?

☐ YES *(complete Item III-B)* ☒ NO *(go to Section IV)*

B. Are the limitations in the applicable effluent guideline expressed in terms of production *(or other measure of operation)*?

☐ YES *(complete Item III-C)* ☒ NO *(go to Section IV)*

C. If you answered "yes" to Item III-B, list the quantity which represents an actual measurement of your level of production, expressed in the terms and units used in the applicable effluent guideline, and indicate the affected outfalls.

1. AVERAGE DAILY PRODUCTION			2. AFFECTED OUTFALLS
a. QUANTITY PER DAY	b. UNITS OF MEASURE	c. OPERATION, PRODUCT, MATERIAL, ETC. (specify)	(list outfall numbers)

IV. IMPROVEMENTS

A. Are you now required by any Federal, State, or local authority to meet any implementation schedule for the construction, upgrading, or operation of wastewater treatment equipment or practices or any other environmental programs which may affect the discharges described in this application? This includes, but is not limited to, permit conditions, administrative or enforcement orders, enforcement compliance schedule letters, stipulations, court orders, and grant or loan conditions.

☐ YES *(complete the following table)* ☒ NO *(go to Item IV-B)*

1. IDENTIFICATION OF CONDITION, AGREEMENT, ETC.	2. AFFECTED OUTFALLS		3. BRIEF DESCRIPTION OF PROJECT	4. FINAL COMPLIANCE DATE	
	a. No	b. SOURCE OF DISCHARGE		a. REQUIRED	b. PROJECTED

B. OPTIONAL. You may attach additional sheets describing any additional water pollution control programs *(or other environmental projects which may affect your discharges)* you now have underway or which you plan. Indicate whether each program is now underway or planned, and indicate your actual or planned schedules for construction.

☐ MARK "X" IF DESCRIPTION OF ADDITIONAL CONTROL PROGRAM IS ATTACHED

CONTINUED FROM PAGE 2

V. INTAKE AND EFFLUENT CHARACTERISTICS

A, B, & C: See instructions before proceeding - Complete one set of tables or each outfall - Annotate the outfall number in the space provided. NOTE: Tables V-A, V-B, and V-C are included on separate sheets number V-1 through V-9.

D: Use the space below t list any of the pollutants listed in Tables 2c-3 of the instructions, which you know or have reason to believe is discharged or may be discharged from any outfall. For every pollutant you list, briefly describe the reasons you believe it to be present and report any analytical data in your possession.

1. POLLUTANT	2. SOURCE	1. POLLUTANT	2. SOURCE
N/A			

VI. POTENTIAL DISCHARGES NOT COVERED BY ANALYSIS

Is any pollutant listed in Item V-C a substance or a component of a substance which you currently use or manufacture as an intermediate or final product or byproduct?

☐ YES *(list all such pollutants below)* ☒ NO *(go to Item VI-B)*

CONTINUED FROM THE FRONT

VII. BIOLOGICAL TOXICITY TESTING DATA

Do you have any knowledge or reason to believe that any biological test for acute or chronic toxicity has been made on any of your discharges or on a receiving water in relation to your discharge within the last 3 years?

☐ **YES** *(identify the test(s) and describe their purpose below)* ☒ **NO** *(go to Section VIII)*

VIII. CONTRACT ANALYSIS INFORMATION

Were any of the analyses reported in Item V performed by a contract laboratory or consulting firm?

☒ **YES** *(list the name, address, and telephone number of, and pollutants analyzed by, each such laboratory or firm below)* ☐ **NO** *(go to Section IX)*

A. NAME	B. ADDRESS	C. TELEPHONE *(area code & no.)*	D. POLLUTANTS ANALYZED *(list)*
SUMMIT ENVIRONMENTAL	*7630 HIGHWAY 60, WEST PADUCAH, KY 42086*	*(270) 744-6172*	*1M - 15M*
		( )	
		( )	
		( )	
		( )	
		( )	
		( )	
		( )	
		( )	
		( )	
		( )	
		( )	
		( )	
		( )	

IX. CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. NAME & OFFICIAL TITLE *(type or print)*	B. PHONE NO. *(area code & no.)*
MICHAEL J. BEYER, AUTHORIZED AGENT	*(618) 983-3020*
C. SIGNATURE	D. DATE SIGNED
	12/2/09

gw4

PLEASE PRINT OR TYPE IN THE UNSHADED AREAS ONLY. You may report some or all of this information on separate sheets *(use the same format)* instead of completing these pages. SEE INSTRUCTIONS.

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*

V. INTAKE AND EFFLUENT CHARACTERISTICS *(continued from page 3 of Form 2-C)*

001

PART A - You must provide the results of at least one analysis for every pollutant in this table. Complete one table for each outfall. See instructions for additional details.

1. POLLUTANT	2. EFFLUENT a. MAXIMUM DAILY VALUE (1) CONCENTRATION	2. EFFLUENT a. MAXIMUM DAILY VALUE (2) MASS	2. EFFLUENT b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	2. EFFLUENT b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	2. EFFLUENT c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	2. EFFLUENT c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	2. EFFLUENT d. NO. OF ANALYSIS	3. UNITS *(specify if blank)* a. CONCENTRATION	3. UNITS *(specify if blank)* b. MASS	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (2) MASS	4. INTAKE *(optional)* b. NO. OF ANALYSES
a. Biochemical Oxygen Demand *(BOD)*												
b. Chemical Oxygen Demand *(COD)*												
c. Total Organic Carbon *(TOC)*												
d. Total Suspended Solids *(TSS)*	*8*	*mg/L*					*1*					
e. Ammonia *(as N)*												
f. Flow	Value *0*		Value		Value		*1*			Value		
g. Temperature *(winter)*	Value		Value		Value			°C		Value		
h. Temperature *(summer)*	Value		Value		Value			°C		Value		
i. pH	Minimum *-*	Maximum *9.2*	Minimum	Maximum			*1*	STANDARD UNTIS				

PART B - Mark "X" in column 2-a for each pollutant you know or have reason to believe is present. Mark "X" in column 2-b for each pollutant you believe to be absent. If you mark column 2a for any pollutant which is limited either directly, or indirectly but expressly, in an effluent limitation guideline, you must provide the results of at least one analysis for that pollutant. For other pollutants for which you mark column 2a, you must provide quantitative data or an explanation of their presence in your discharge. Complete one table for each outfall. See the instructions for additional details and requirements.

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X' a. BELIEVED PRESENT	2. MARK 'X' b. BELIEVED ABSENT	2. EFFLUENT a. MAXIMUM DAILY VALUE (1) CONCENTRATION	2. EFFLUENT a. MAXIMUM DAILY VALUE (2) MASS	2. EFFLUENT b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	2. EFFLUENT b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	2. EFFLUENT c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	2. EFFLUENT c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	2. EFFLUENT d. NO. OF ANALYSIS	3. UNITS *(specify if blank)* a. CONCENTRATION	3. UNITS *(specify if blank)* b. MASS	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (2) MASS	4. INTAKE *(optional)* b. NO. OF ANALYSES
a. Bromide (24959-67-9)	☐	☒												
b. Chlorine, Total Residual	☐	☒												
c. Color	☐	☒												
d. Fecal Coliform	☐	☒												
e. Fluoride (16984-48-8)	☐	☒												
f. Nitrate-Nitrite *(as N)*	☐	☒												

R17556

ITEM V-C CONTINUED FROM FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'		2. EFFLUENT						3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. BELIEVED PRESENT	b. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
			(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
g. Nitrogen, Total Organic *(as N)*	☐	☒												
h. Oil and Grease	☐	☒												
i. Phosphorus *(as P)*, Total (7723-14-0)	☐	☐												
j. Radioactivity														
(1) Alpha, Total	☐	☒												
(2) Bets, Total	☐	☒												
(3) Radium, Total	☐	☒												
(4) Radium 226, Total	☐	☒												
k. Sulfate *(as SO_4)* *(14808-79-8)*	☒	☐	*250*	*mg/L*					*1*					
l. Sulfide (as S)	☐	☒												
m. Sulfite *(as SO_3)(14265-45-3)*	☐	☒												
n. Surfactants	☐	☒												
o. Aluminum, Total (7429-90-5)	☐	☒												
p. Barium, Total (7440-39-3)	☐	☒												
q. Boron, Total (7440-42-8)	☐	☒												
r. Cobalt, Total (7440-48-4)	☐	☒												
s. Iron, Total (7439-89-4)	☒	☐	*<0.006*	*mg/L*					*1*					
t. Magnesium, Total (7439-95-4)	☐	☒												
u. Molybdenum, Total (7439-98-7)	☐	☒												
v. Manganese, Total (7439-96-5)	☐	☒												
w. Tin, Total (7440-31-5)	☐	☒												
x. Titanium, Total (7440-32-6)	☐	☒												

R17557

CONTINUED FROM PAGE 3 OF FORM 2-C

EPA I.D. NUMBER *(copy ...n Item 1 of Form 1)*	OUTFALL NUMBER
	001

PART C - If you are a primary industry and this outfall contains process wastewater, refer to Table 2c-2 in the instructions to determine which of the GC/MS fractions you must test for. Mark "X" in column 2-a for all such GC/MS fractions that apply to your industry and for ALL toxic metals, cyanides, and total phenols. If you are not required to mark column 2-a *(secondary industries, nonprocess wastewater outfalls, and non-required GC/MS fractions)*, mark "X" in column 2-b for each pollutant you know or have reason to believe is present. Mark "X" in column 2-c for each pollutant you believe is absent. If you mark column 2a for any pollutant, you must provide the results of at least one analysis for that pollutant. If you mark column 2b for any pollutant, you must provide the results of at least one analysis for that pollutant. If you know or have reason to believe it will be discharged in concentrations of 10 ppb or greater. If you mark column 2b for acrolein, acrylonitrile, 2,4 dinitrophenol, or 2-methyl-4, 6 dinitrophenol, you must provide the results of at least one analysis for each of these pollutants which you know or have reason to believe that you discharge in concentrations of 100 ppb or greater. Otherwise, for pollutants for which you mark column 2b, you must either submit at least one analysis or briefly describe the reasons the pollutant is expected to be discharged. Note that there are 7 pages to this part; please review each carefully. Complete one table *(all 7 pages)* for each outfall. See instructions for additional details and requirements.

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
METALS, CYANIDE, AND TOTAL PHENOLS															
1m. Antimony, Total (7440-36-0)	☐	☒	☐	<0.002	mg/L					1					
2M. Arsenic, Total (7440-38-2)	☐	☒	☐	<0.002	mg/L					1					
3M. Beryllium, Total (7440-41-7)	☐	☒	☐	<0.001	mg/L					1					
4M. Cadmium, Total (7440-43-9)	☐	☒	☐	0.003	mg/L					1					
5M Chromium, Total (7440-47-3)	☐	☒	☐	<0.006	mg/L					1					
6M Copper, Total (7440-50-8)	☐	☒	☐	0.013	mg/L					1					
7M lead, Total (7439-92-1)	☐	☒	☐	<0.0075	mg/L					1					
8M Mercury, Total (7439-97-6)	☐	☒	☐	<0.002	mg/L					1					
9M Nickel, Total (7440-02-0)	☐	☒	☐	<0.010	mg/L					1					
10M Selenium, Total (7782-49-2)	☐	☒	☐	<0.002	mg/L					1					
11M Silver, Total (7440-22-4)	☐	☒	☐	<0.002	mg/L					1					
12M Thallium, Total (7440-28-0)	☐	☒	☐	<0.020	mg/L					1					
13M Zinc, Total (7440-66-6)	☐	☒	☐	<0.001	mg/L					1					
14M Cyanide, Total (57-12-5)	☐	☒	☐	<0.007	mg/L					1					
15M Phenols, Total	☐	☒	☐	0.006	mg/L					1					
DIOXIN															
2,3,7,8-Tetrachlorodibenzo-P-Dioxin (1764-01-6)	☐	☐	☒	DESCRIBE RESULTS											

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS		a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS		a. CONCENTRATION	b. MASS	(1) CONCENTRATION	(2) MASS	
GC/MS - VOLATILE COMPOUNDS															
1V. *Acrolein (107-02-8)*	☐	☐	☒												
2V *Acrylonitrile (107-13-1)*	☐	☐	☒												
3V Benzene (71-43-2)	☐	☐	☒												
4V Bis *(Chloromethyl)* Ether (542-88-1)	☐	☐	☒												
5V Bromoform (75-25-2)	☐	☐	☒												
6V Carbon Tetrachloride (56-23-5)	☐	☐	☒												
7V Chlorobenzene (108-90-7)	☐	☐	☒												
8V Chlorodibromomethane (124-48-1)	☐	☐	☒												
9V Chloroethane (75-00-3)	☐	☐	☒												
10V 2-Chloroethylvinyl Ether (110-75-8)	☐	☐	☒												
11V Chloroform (67-66-3)	☐	☐	☒												
12V Dichlorobromoethane (75-71-8)	☐	☐	☒												
13V Dichlorodifluoromethane (75-71-8)	☐	☐	☒												
14V 1,1-Dichloroethane (75-34-3)	☐	☐	☒												
15V 1,2-Dichloroethane (107-06-2)	☐	☐	☒												
16V 1,1-Dichloroethylene (75335-4)	☐	☐	☒												
17V 1,2-Dichloropropane (78-87-5)	☐	☐	☒												
18V 1,3-Dichloropropylene (542-76-6)	☐	☐	☒												
19V Ethylbenzene (100-41-4)	☐	☐	☒												
20V Methyl Bromide (74-83-9)	☐	☐	☒												
21V Methyl Chloride (74-87-3)	☐	☐	☒												

CONTINUED FROM PAGE V-4

EPA I.D. NUMBER (copy from Item 1 of Form 1)

OUTFALL NUMBER 001

1. POLLUTANT AND CAS NO. (if available)	2. MARK 'X'			2. EFFLUENT						3. UNITS (specify if blank)		4. INTAKE (optional)		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE (if available)		c. LONG TERM AVRG. VALUE (if available)		d. NO. OF ANALYSIS		a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS		a. CONCENTRATION	b. MASS	(1) CONCENTRATION	(2) MASS	
GC/MS - VOLATILE COMPOUNDS (continued)															
22 V Methylene Chloride (75-09-2)	☐	☐	☒												
23V 1,1,2,2-Tetrachloroethane (79-34-5)	☐	☐	☒												
24V Tetrachloroethylene (127-18-4)	☐	☐	☒												
25V Toluene (108-88-3)	☐	☐	☒												
26V 1,2-Trans-Dichloroethylene (156-60-5)	☐	☐	☒												
27V 1,1,1-Trichloroethane (71-55-6)	☐	☐	☒												
28V 1,1,2-Trichloroethane (79-00-5)	☐	☐	☒												
29V Trichloroethylene (79-01-6)	☐	☐	☒												
30V Trichlorofluoromethane (75-69-4)	☐	☐	☒												
31V Vinyl Chloride (75-01-4)	☐	☐	☒												
GC/MS FRACTION - ACID COMPOUNDS															
1A 2-Chlorophenol (95-57-8)	☐	☐	☒												
2A 2,4-Dichlorophenol (120-83-2)	☐	☐	☒												
3A 2,4-Dimethylphenol (105-67-9)	☐	☐	☒												
4A 4,6-Dinitro-O-cresol (534-52-1)	☐	☐	☒												
5A 2,4-Dinitrophenol (51-28-5)	☐	☐	☒												
6A 2-Nitrophenol (88-75-5)	☐	☐	☒												
7A 4-Nitrophenol (100-02-7)	☐	☐	☒												
8A P-Chloro-M-Cresol (59-50-7)	☐	☐	☒												
9A Pentachlorophenol (87-86-5)	☐	☐	☒												
10A Phenol (10/-95-2)	☐	☐	☒												
11A 2,4,6-Trichlorophenol (88-06-2)	☐	☐	☒												

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						d. NO. OF ANALYSIS	3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*			a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION - BASE/NEUTRAL COMPOUNDS															
1B Acenphthene (83-32-9)	☐	☐	☒												
2B Acenaphtylene (208-96-8)	☐	☐	☒												
3B Anthracene (120-12-7)	☐	☐	☒												
4B Benzidine (92-87-5)	☐	☐	☒												
5B Benzo (a) Anthracene (56-55-3)	☐	☐	☒												
6B Benzo (a) Pyrene (50-32-8)	☐	☐	☒												
7B 3,4-Benzo-fluoranthene (205-99-2)	☐	☐	☒												
8B Benzo *(ghi)* Perylene (191-24-2)	☐	☐	☒												
9B Benzo *(k)* Fluoranthene (207-08-9)	☐	☐	☒												
10B Bis *(2-Chloroethoxy)* Methane (111-91-1)	☐	☐	☒												
11B Bis *(2-Chloro-ethyl)* Ether (111-44-4)	☐	☐	☒												
12B Bis *(2-Chloroisepropyl)* Ether (102-60-1	☐	☐	☒												
13B Bis*(2-Ethyl-hexyl)* Phthalate (117-81-7)	☐	☐	☒												
14 B 4-Bromo-phenyl Phenyl Ether (101-55-3)	☐	☐	☒												
15B Butyl Benzyl Phthalate (85-68-7)	☐	☐	☒												
16B 2-Chloro-naphthalene (91-68-7)	☐	☐	☒												
17B 4-Chloro-phenyl Phenyl Ether (7005-72-3)	☐	☐	☒												
18B Chrysene (218-01-9)	☐	☐	☒												
19B Dibenzo *(a,h)* Anthracene (53-70-3)	☐	☐	☒												
20B 1,2-Dichloro-benzene (95-50-1)	☐	☐	☒												
21B 1,3-Dichloro-benzene (541-73-1)	☐	☐	☒												

CONTINUE ON PAGE V-7

CONTINUED FROM PAGE V-6

EPA I.D. NUMBER (copy from Item 1 of Form 1) | OUTFALL NUMBER 001

1. POLLUTANT AND CAS NO. (if available)	2. MARK 'X'			2. EFFLUENT						3. UNITS (specify if blank)		4. INTAKE (optional)		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE (1) CONCENTRATION	a. MAXIMUM DAILY VALUE (2) MASS	b. MAXIMUM 30 DAY VALUE (if available) (1) CONCENTRATION	b. MAXIMUM 30 DAY VALUE (if available) (2) MASS	c. LONG TERM AVRG. VALUE (if available) (1) CONCENTRATION	c. LONG TERM AVRG. VALUE (if available) (2) MASS	d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	a. LONG TERM AVERAGE VALUE (2) MASS	b. NO. OF ANALYSES
GC/MS - BASE/NEUTRAL COMPOUNDS (continued)															
22B 1,4-Dichlorobenzene (106-46-7)	☐	☐	☒												
23B 3,3'-Dichlorobenzidine (91-94-1)	☐	☐	☒												
24B Diethyl Phthalate (84-66-2)	☐	☐	☒												
25B Dimethyl Phthalate (131-11-3)	☐	☐	☒												
26B Di-N-Butyl Phthalate (131-11-3)	☐	☐	☒												
27B 2,4-Dinitrotoluene (121-14-2)	☐	☐	☒												
28B 2,6-Dinitrotoluene (606-20-2)	☐	☐	☒												
29B Di-N-Octyl Phthalate (117-84-0)	☐	☐	☒												
30B 1,2-Diphenylhydrazine (as Azobenzene) (122-66-7)	☐	☐	☒												
31B Fluoranthene (206-44-0)	☐	☐	☒												
32B Fluorene (86-73-7)	☐	☐	☒												
33B Hexachlorobenzene (118-74-1)	☐	☐	☒												
34B Hexachlorobutadiene (87-68-3)	☐	☐	☒												
35B Hexachlorocyclopentadiene (77-47-4)	☐	☐	☒												
36B Hexachloroethane (67-72-1)	☐	☐	☒												
37B Indeno (1,2,3-cd) Pyrene (193-39-5)	☐	☐	☒												
38B Isophorone (78-59-1)	☐	☐	☒												
39B Napthalene (91-20-3)	☐	☐	☒												
40B Nitrobenzene (98-95-3)	☐	☐	☒												
41B N-Nitrosodimethylamine (62-75-9)	☐	☐	☒												
42B N-Nitrosdi-N-Propylamine (621-64-7)	☐	☐	☒												

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION - BASE/NEUTRAL COMPOUNDS *(continued)*															
43B N-Nitrosodiphenylamine (86-30-6)	☐	☐	☒												
44B Phenanthrene (85-01-/	☐	☐	☒												
45B Pyrene (129-00-0)	☐	☐	☒												
46B 1,2,4-Trichlorobenzene (120-82-1)	☐	☐	☒												
GC/MS FRACTION - PESTICIDES															
1P Aldrin (309-00-2)	☐	☐	☒												
2P β-Bhc (319-85-7)	☐	☐	☒												
4P γ-BHC (58-89-9)	☐	☐	☒												
5P δ-BHC (319-86-8)	☐	☐	☒												
6P Chlordane (57-74-9)	☐	☐	☒												
7P 4,4'-DDT (50-29-3)	☐	☐	☒												
8P 4,4'-DDE (72-55-9)	☐	☐	☒												
9P 4,4'-DDD (72-54-8)	☐	☐	☒												
10P Dieldrin (60-57-1)	☐	☐	☒												
11P α-Endosulfan (115-29-7)	☐	☐	☒												
12P β-Endosulfan (115-29-7	☐	☐	☒												
13P Endosulfan Sulfate (1031-07-8)	☐	☐	☒												
14P Endrin (72-20-8)	☐	☐	☒												
15P Endrin Aldehyde (7421-93-4)	☐	☐	☒												
16P Heptachlor (76-44-8)	☐	☐	☒												

CONTINUED FROM PAGE V-6

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*	OUTFALL NUMBER
	001

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - PESTICIDES *(continued)*															
17P Heptachlor Expxide (1024-57-3)	☐	☐	☒												
18P PCB-1242 (53469-21-9)	☐	☐	☒												
19P PCB-1254 (11097-69-1)	☐	☐	☒												
20P PCB-1221 (11104-28-2)	☐	☐	☒												
21P PCB-1232 (11141-16-5)	☐	☐	☒												
22P PCB-1248 (12672-29-6)	☐	☐	☒												
23P PCB-1260 (11096-82-5)	☐	☐	☒												
24P PCB-1016 (12674-11-2)	☐	☐	☒												
25P Toxaphene (8001-35-2)	☐	☐	☒												

PLEASE PRINT OR TYPE IN THE UNSHADED AREAS ONLY. You may report some or all of this information on separate sheets *(use the same format)* instead of completing these pages. SEE INSTRUCTIONS.

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*

V. INTAKE AND EFFLUENT CHARACTERISTICS *(continued from page 3 of Form 2-C)* 002

PART A - You must provide the results of at least one analysis for every pollutant in this table. Complete one table for each outfall. See instructions for additional details.

1. POLLUTANT	2. EFFLUENT a. MAXIMUM DAILY VALUE (1) CONCENTRATION	a. MAXIMUM DAILY VALUE (2) MASS	b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	d. NO. OF ANALYSIS	3. UNITS *(specify if blank)* a. CONCENTRATION	3. UNITS b. MASS	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	a. LONG TERM AVERAGE VALUE (2) MASS	b. NO. OF ANALYSES
a. Biochemical Oxygen Demand *(BOD)*												
b. Chemical Oxygen Demand *(COD)*												
c. Total Organic Carbon *(TOC)*												
d. Total Suspended Solids *(TSS)*	*3*	*mg/L*					*1*					
e. Ammonia *(as N)*												
f. Flow	Value *0*		Value		Value		*1*			Value		
g. Temperature *(winter)*	Value		Value		Value			°C		Value		
h. Temperature *(summer)*	Value		Value		Value			°C		Value		
i. pH	Minimum *-*	Maximum *8*	Minimum	Maximum			*1*	STANDARD UNTIS				

PART B - Mark "X" in column 2-a for each pollutant you know or have reason to believe is present. Mark "X" in column 2-b for each pollutant you believe to be absent. If you mark column 2a for any pollutant which is limited either directly, or indirectly but expressly, in an effluent limitation guideline, you must provide the results of at least one analysis for that pollutant. For other pollutants for which you mark column 2a, you must provide quantitative data or an explanation of their presence in your discharge. Complete one table for each outfall. See the instructions for additional details and requirements.

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X' a. BELIEVED PRESENT	2. MARK 'X' b. BELIEVED ABSENT	2. EFFLUENT a. MAXIMUM DAILY VALUE (1) CONCENTRATION	a. MAXIMUM DAILY VALUE (2) MASS	b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	d. NO. OF ANALYSIS	3. UNITS *(specify if blank)* a. CONCENTRATION	3. UNITS b. MASS	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	a. LONG TERM AVERAGE VALUE (2) MASS	b. NO. OF ANALYSES
a. Bromide (24959-67-9)	☐	☒												
b. Chlorine, Total Residual	☐	☒												
c. Color	☐	☒												
d. Fecal Coliform	☐	☒												
e. Fluoride (16984-48-8)	☐	☒												
f. Nitrate-Nitrite *(as N)*	☐	☒												

ITEM V-C CONTINUED FROM FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'		2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. BELIEVED PRESENT	b. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
			(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
g. Nitrogen, Total Organic *(as N)*	☐	☒												
h. Oil and Grease	☐	☒												
i. Phosphorus *(as P)*, Total (7723-14-0)	☐	☐												
j. Radioactivity														
(1) Alpha, Total	☐	☒												
(2) Bets, Total	☐	☒												
(3) Radium, Total	☐	☒												
(4) Radium 226, Total	☐	☒												
k. Sulfate *(as SO_4)* *(14808-79-8)*	☒	☐	*110*	*mg/L*					*1*					
l. Sulfide (as S)	☐	☒												
m. Sulfite *(as SO_3)(14265-45-3)*	☐	☒												
n. Surfactants	☐	☒												
o. Aluminum, Total (7429-90-5)	☐	☒												
p. Barium, Total (7440-39-3)	☐	☒												
q. Boron, Total (7440-42-8)	☐	☒												
r. Cobalt, Total (7440-48-4)	☐	☒												
s. Iron, Total (7439-89-4)	☒	☐	*<0.006*	*mg/L*					*1*					
t. Magnesium, Total (7439-95-4)	☐	☒												
u. Molybdenum, Total (7439-98-7)	☐	☒												
v. Manganese, Total (7439-96-5)	☐	☒												
w. Tin, Total (7440-31-5)	☐	☒												
x. Titanium, Total (7440-32-6)	☐	☒												

R17566

CONTINUED FROM PAGE 3 OF FORM 2-C

EPA I.D. NUMBER *(copy ... Item 1 of Form 1)*	OUTFALL NUMBER
	002

PART C - If you are a primary industry and this outfall contains process wastewater, refer to Table 2c-2 in the instructions to determine which of the GC/MS fractions you must test for. Mark "X" in column 2-a for all such GC/MS fractions that apply to your industry and for ALL toxic metals, cyanides, and total phenols. If you are not required to mark column 2-a *(secondary industries, nonprocess wastewater outfalls, and non-required GC/MS fractions)*, mark "X" in column 2-b for each pollutant you know or have reason to believe is present. Mark "X" in column 2-c for each pollutant you believe is absent. If you mark column 2a for any pollutant, you must provide the results of at least one analysis for that pollutant. If you mark column 2b for any pollutant, you must provide the results of at least one analysis for that pollutant. If you know or have reason to believe it will be discharged in concentrations of 10 ppb or greater. If you mark column 2b for acrolein, acrylonitrile, 2,4 dinitrophenol, or 2-methyl-4, 6 dinitrophenol, you must provide the results of at least one analysis for each of these pollutants which you know or have reason to believe that you discharge in concentrations of 100 ppb or greater. Otherwise, for pollutants for which you mark column 2b, you must either submit at least one analysis or briefly describe the reasons the pollutant is expected to be discharged. Note that there are 7 pages to this part; please review each carefully. Complete one table *(all 7 pages)* for each outfall. See instructions for additional details and requirements.

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
METALS, CYANIDE, AND TOTAL PHENOLS															
1m. Antimony, Total (7440-36-0)	☐	☒	☐	<0.002	mg/L					1					
2M. Arsenic, Total (7440-38-2)	☐	☒	☐	<0.002	mg/L					1					
3M. Beryllium, Total (7440-41-7)	☐	☒	☐	<0.001	mg/L					1					
4M. Cadmium, Total (7440-43-9)	☐	☒	☐	0.003	mg/L					1					
5M Chromium, Total (7440-47-3)	☐	☒	☐	<0.006	mg/L					1					
6M Copper, Total (7440-50-8)	☐	☒	☐	<0.003	mg/L					1					
7M lead, Total (7439-92-1)	☐	☒	☐	<0.0075	mg/L					1					
8M Mercury, Total (7439-97-6)	☐	☒	☐	<0.002	mg/L					1					
9M Nickel, Total (7440-02-0)	☐	☒	☐	<0.010	mg/L					1					
10M Selenium, Total (7782-49-2)	☐	☒	☐	<0.002	mg/L					1					
11M Silver, Total (7440-22-4)	☐	☒	☐	<0.002	mg/L					1					
12M Thallium, Total (7440-28-0)	☐	☒	☐	<0.020	mg/L					1					
13M Zinc, Total (7440-66-6)	☐	☒	☐	<0.001	mg/L					1					
14M Cyanide, Total (57-12-5)	☐	☒	☐	<0.008	mg/L					1					
15M Phenols, Total	☐	☒	☐	0.007	mg/L					1					
DIOXIN															
2,3,7,8-Tetrachlorodibenzo-P-Dioxin (1764--01-6)	☐	☐	☒	DESCRIBE RESULTS											

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						d. NO. OF ANALYSIS	3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*			a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - VOLATILE COMPOUNDS															
1V. Acrolein (107-02-8)	☐	☐	☒												
2V Acrylonitrile (107-13-1)	☐	☐	☒												
3V Benzene (71-43-2)	☐	☐	☒												
4V Bis (Chloromethyl) Ether (542-88-1)	☐	☐	☒												
5V Bromoform (75-25-2)	☐	☐	☒												
6V Carbon Tetrachloride (56-23-5)	☐	☐	☒												
7V Chlorobenzene (108-90-7)	☐	☐	☒												
8V Chlorodibromomethane (124-48-1)	☐	☐	☒												
9V Chloroethane (75-00-3)	☐	☐	☒												
10V 2-Chloroethylvinyl Ether (110-75-8)	☐	☐	☒												
11V Chloroform (67-66-3)	☐	☐	☒												
12V Dichlorobromoethane (75-71-8)	☐	☐	☒												
13V Dichlorodifluoromethane (75-71-8)	☐	☐	☒												
14V 1,1-Dichloroethane (75-34-3)	☐	☐	☒												
15V 1,2-Dichloroethane (107-06-2)	☐	☐	☒												
16V 1,1-Dichloroethylene (75335-4)	☐	☐	☒												
17V 1,2-Dichloropropane (78-87-5)	☐	☐	☒												
18V 1,3-Dichloropropylene (542-76-6)	☐	☐	☒												
19V Ethylbenzene (100-41-4)	☐	☐	☒												
20V Methyl Bromide (74-83-9)	☐	☐	☒												
21V Methyl Chloride (74-87-3)	☐	☐	☒												

EPA I.D. NUMBER (copy ... Item 1 of Form 1) | OUTFALL NUMBER 002

1. POLLUTANT AND CAS NO. (if available)	2. MARK 'X'			2. EFFLUENT						3. UNITS (specify if blank)		4. INTAKE (optional)		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE (if available)		c. LONG TERM AVRG. VALUE (if available)		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - VOLATILE COMPOUNDS (continued)															
22 V Methylene Chloride (75-09-2)	☐	☐	☒												
23V 1,1,2,2-Tetra-Chloroethane (79-34-5)	☐	☐	☒												
24V Tetrachloro-ethylene (127-18-4)	☐	☐	☒												
25V Toluene (108-88-3)	☐	☐	☒												
26V 1,2-Trans-Dichloroethylene (156-60-5)	☐	☐	☒												
27V 1,1,1-Tri-chloroethane (71-55-6)	☐	☐	☒												
28V 1,1,2-Tri-chloroethane (79-00-5)	☐	☐	☒												
29V Trichloro-ethylene (79-01-6)	☐	☐	☒												
30V Trichloro-fluoromethane (75-69-4)	☐	☐	☒												
31V Vinyl Chloride (75-01-4)	☐	☐	☒												
GC/MS FRACTION - ACID COMPOUNDS															
1A 2-Chlorophenol (95-57-8)	☐	☐	☒												
2A 2,4-Dichloro-phenol (120-83-2)	☐	☐	☒												
3A 2,4-Dimethyl-phenol (105-67-9)	☐	☐	☒												
4A 4,6-Dinitro-O-cresol (534-52-1)	☐	☐	☒												
5A 2,4-Dinitro-phenol (51-28-5)	☐	☐	☒												
6A 2-Nitro-phenol (88-75-5)	☐	☐	☒												
7A 4-Nitro-phenol (100-02-7)	☐	☐	☒												
8A P-Chloro-M-Cresol (59-50-7)	☐	☐	☒												
9A Penta-chlorophenol (87-86-5)	☐	☐	☒												
10A Phenol (10/-95-2)	☐	☐	☒												
11A 2,4,6-Tri-chlorophenol (88-06-2)	☐	☐	☒												

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						d. NO. OF ANALYSIS	3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*			a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION - BASE/NEUTRAL COMPOUNDS															
1B Acenphthene (83-32-9)	☐	☐	☒												
2B Acenaphtylene (208-96-8)	☐	☐	☒												
3B Anthracene (120-12-7)	☐	☐	☒												
4B Benzidine (92-87-5)	☐	☐	☒												
5B Benzo (a) Anthracene (56-55-3)	☐	☐	☒												
6B Benzo (a) Pyrene (50-32-8)	☐	☐	☒												
7B 3,4-Benzo-fluoranthene (205-99-2)	☐	☐	☒												
8B Benzo *(ghi)* Perylene (191-24-2)	☐	☐	☒												
9B Benzo *(k)* Fluoranthene (207-08-9)	☐	☐	☒												
10B Bis *(2-Chloroethoxy)* Methane (111-91-1)	☐	☐	☒												
11B Bis *(2-Chloro-ethyl)* Ether (111-44-4)	☐	☐	☒												
12B Bis *(2-Chloroisepropyl)* Ether (102-60-1	☐	☐	☒												
13B Bis*(2-Ethyl-hexyl)* Phthalate (117-81-7)	☐	☐	☒												
14 B 4-Bromo-phenyl Phenyl Ether (101-55-3)	☐	☐	☒												
15B Bulyl Benzyl Phthalate (85-68-7)	☐	☐	☒												
16B 2-Chloro-naphthalene (91-68-7)	☐	☐	☒												
17B 4-Chloro-phenyl Phenyl Ether (7005-72-3)	☐	☐	☒												
18B Chrysene (218-01-9)	☐	☐	☒												
19B Dibenzo *(a,h)* Anthracene (53-70-3)	☐	☐	☒												
20B 1,2-Dichloro-benzene (95-50-1)	☐	☐	☒												
21B 1,3-Dichloro-benzene (541-73-1)	☐	☐	☒												

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*

OUTFALL NUMBER *002*

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE (1) CONCENTRATION	a. MAXIMUM DAILY VALUE (2) MASS	b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	d. NO. OF ANALYSES	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	a. LONG TERM AVERAGE VALUE (2) MASS	b. NO. OF ANALYSES
GC/MS - BASE/NEUTRAL COMPOUNDS *(continued)*															
22B 1,4-Dichlorobenzene (106-46-7)	☐	☐	☒												
23B 3,3'-Dichlorobenzidine (91-94-1)	☐	☐	☒												
24B Diethyl Phthalate (84-66-2)	☐	☐	☒												
25B Dimethyl Phthalate (131-11-3)	☐	☐	☒												
26B Di-N-Butyl Phthalate (131-11-3)	☐	☐	☒												
27B 2,4-Dinitrotoluene (121-14-2)	☐	☐	☒												
28B 2,6-Dinitrotoluene (606-20-2)	☐	☐	☒												
29B Di-N-Octyl Phthalate (117-84-0)	☐	☐	☒												
30B 1,2-Diphenylhydrazine *(as Azo-benzene)* (122-66-7)	☐	☐	☒												
31B Fluoranthene (206-44-0)	☐	☐	☒												
32B Fluorene (86-73-7)	☐	☐	☒												
33B Hexachlorobenzene (118-74-1)	☐	☐	☒												
34B Hexachlorobutadiene (87-68-3)	☐	☐	☒												
35B Hexachlorocyclopentadiene (77-47-4)	☐	☐	☒												
36B Hexachloroethane (67-72-1)	☐	☐	☒												
37B Indeno *(1,2,3-cd)* Pyrene (193-39-5)	☐	☐	☒												
38B Isophorone (78-59-1)	☐	☐	☒												
39B Napthalene (91-20-3)	☐	☐	☒												
40B Nitrobenzene (98-95-3)	☐	☐	☒												
41B N-Nitrosodimethylamine (62-75-9)	☐	☐	☒												
42B N-Nitrosdi-N-Propylamine (621-64-7)	☐	☐	☒												

R17571

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1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION - BASE/NEUTRAL COMPOUNDS *(continued)*															
43B N-Nitrosodiphenylamine (86-30-6)	☐	☐	☒												
44B Phenanthrene (85-01-/	☐	☐	☒												
45B Pyrene (129-00-0)	☐	☐	☒												
46B 1,2,4-Trichlorobenzene (120-82-1)	☐	☐	☒												
GC/MS FRACTION - PESTICIDES															
1P Aldrin (309-00-2)	☐	☐	☒												
2P β-Bhc (319-85-7)	☐	☐	☒												
4P γ-BHC (58-89-9)	☐	☐	☒												
5P δ-BHC (319-86-8)	☐	☐	☒												
6P Chlordane (57-74-9)	☐	☐	☒												
7P 4,4'-DDT (50-29-3)	☐	☐	☒												
8P 4,4'-DDE (72-55-9)	☐	☐	☒												
9P 4,4'-DDD (72-54-8)	☐	☐	☒												
10P Dieldrin (60-57-1)	☐	☐	☒												
11P α-Endosulfan (115-29-7)	☐	☐	☒												
12P β-Endosulfan (115-29-7	☐	☐	☒												
13P Endosulfan Sulfate (1031-07-8)	☐	☐	☒												
14P Endrin (72-20-8)	☐	☐	☒												
15P Endrin Aldehyde (7421-93-4)	☐	☐	☒												
16P Heptachlor (76-44-8)	☐	☐	☒												

CONTINUED FROM PAGE V-6

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*

OUTFALL NUMBER
002

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - PESTICIDES *(continued)*															
17P Heptachlor Expxide (1024-57-3)	☐	☐	☒												
18P PCB-1242 (53469-21-9)	☐	☐	☒												
19P PCB-1254 (11097-69-1)	☐	☐	☒												
20P PCB-1221 (11104-28-2)	☐	☐	☒												
21P PCB-1232 (11141-16-5)	☐	☐	☒												
22P PCB-1248 (12672-29-6)	☐	☐	☒												
23P PCB-1260 (11096-82-5)	☐	☐	☒												
24P PCB-1016 (12674-11-2)	☐	☐	☒												
25P Toxaphene (8001-35-2)	☐	☐	☒												

PLEASE PRINT OR TYPE IN THE UNSHADED AREAS ONLY. You may report some or all of this information on separate sheets *(use the same format)* instead of completing these pages. SEE INSTRUCTIONS.

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*

V. INTAKE AND EFFLUENT CHARACTERISTICS ***(continued from page 3 of Form 2-C)*** 003

PART A - You must provide the results of at least one analysis for every pollutant in this table. Complete one table for each outfall. See instructions for additional details.

1. POLLUTANT	2. EFFLUENT a. MAXIMUM DAILY VALUE (1) CONCENTRATION	a. MAXIMUM DAILY VALUE (2) MASS	b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	d. NO. OF ANALYSIS	3. UNITS *(specify if blank)* a. CONCEN-TRATION	3. UNITS b. MASS	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	a. LONG TERM AVERAGE VALUE (2) MASS	b. NO. OF ANALYSES
a. Biochemical Oxygen Demand *(BOD)*												
b. Chemical Oxygen Demand *(COD)*												
c. Total Organic Carbon *(TOC)*												
d. Total Suspended Solids *(TSS)*	*3*	*mg/L*					*1*					
e. Ammonia *(as N)*												
f. Flow	Value *0*		Value		Value		*1*			Value		
g. Temperature *(winter)*	Value		Value		Value			°C		Value		
h. Temperature *(summer)*	Value		Value		Value			°C		Value		
i. pH	Minimum *-*	Maximum *7.2*	Minimum	Maximum			*1*	STANDARD UNTIS				

PART B - Mark "X" in column 2-a for each pollutant you know or have reason to believe is present. Mark "X" in column 2-b for each pollutant you believe to be absent. If you mark column 2a for any pollutant which is limited either directly, or indirectly but expressly, in an effluent limitation guideline, you must provide the results of at least one analysis for that pollutant. For other pollutants for which you mark column 2a, you must provide quantitative data or an explanation of their presence in your discharge. Complete one table for each outfall. See the instructions for additional details and requirements.

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X' a. BELIEVED PRESENT	2. MARK 'X' b. BELIEVED ABSENT	2. EFFLUENT a. MAXIMUM DAILY VALUE (1) CONCENTRATION	a. MAXIMUM DAILY VALUE (2) MASS	b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	d. NO. OF ANALYSIS	3. UNITS *(specify if blank)* a. CONCEN-TRATION	3. UNITS b. MASS	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	a. LONG TERM AVERAGE VALUE (2) MASS	b. NO. OF ANALYSES
a. Bromide (24959-67-9)	☐	☒												
b. Chlorine, Total Residual	☐	☒												
c. Color	☐	☒												
d. Fecal Coliform	☐	☒												
e. Fluoride (16984-48-8)	☐	☒												
f. Nitrate-Nitrite *(as N)*	☐	☒												

ITEM V-C CONTINUED FROM FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'		2. EFFLUENT						d. NO. OF ANALYSIS	3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. BELIEVED PRESENT	b. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*			a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
			(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
g. Nitrogen, Total Organic *(as N)*	☐	☒												
h. Oil and Grease	☐	☒												
i. Phosphorus *(as P)*, Total (7723-14-0)	☐	☐												
j. Radioactivity														
(1) Alpha, Total	☐	☒												
(2) Bets, Total	☐	☒												
(3) Radium, Total	☐	☒												
(4) Radium 226, Total	☐	☒												
k. Sulfate *(as SO_4)* *(14808-79-8)*	☒	☐	*30*	*mg/L*					*1*					
l. Sulfide (as S)	☐	☒												
m. Sulfite *(as SO_3)(14265-45-3)*	☐	☒												
n. Surfactants	☐	☒												
o. Aluminum, Total (7429-90-5)	☐	☒												
p. Barium, Total (7440-39-3)	☐	☒												
q. Boron, Total (7440-42-8)	☐	☒												
r. Cobalt, Total (7440-48-4)	☐	☒												
s. Iron, Total (7439-89-4)	☒	☐	*0.133*	*mg/L*					*1*					
t. Magnesium, Total (7439-95-4)	☐	☒												
u. Molybdenum, Total (7439-98-7)	☐	☒												
v. Manganese, Total (7439-96-5)	☐	☒												
w. Tin, Total (7440-31-5)	☐	☒												
x. Titanium, Total (7440-32-6)	☐	☒												

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CONTINUED FROM PAGE 3 OF FORM 2-C

EPA I.D. NUMBER *(copy ... Item 1 of Form 1)*	OUTFALL NUMBER
	003

PART C - If you are a primary industry and this outfall contains process wastewater, refer to Table 2c-2 in the instructions to determine which of the GC/MS fractions you must test for. Mark "X" in column 2-a for all such GC/MS fractions that apply to your industry and for ALL toxic metals, cyanides, and total phenols. If you are not required to mark column 2-a *(secondary industries, nonprocess wastewater outfalls, and non-required GC/MS fractions)*, mark "X" in column 2-b for each pollutant you know or have reason to believe is present. Mark "X" in column 2-c for each pollutant you believe is absent. If you mark column 2a for any pollutant, you must provide the results of at least one analysis for that pollutant. If you mark column 2b for any pollutant, you must provide the results of at least one analysis for that pollutant. If you know or have reason to believe it will be discharged in concentrations of 10 ppb or greater. If you mark column 2b for acrolein, acrylonitrile, 2,4 dinitrophenol, or 2-methyl-4, 6 dinitrophenol, you must provide the results of at least one analysis for each of these pollutants which you know or have reason to believe that you discharge in concentrations of 100 ppb or greater. Otherwise, for pollutants for which you mark column 2b, you must either submit at least one analysis or briefly describe the reasons the pollutant is expected to be discharged. Note that there are 7 pages to this part; please review each carefully. Complete one table *(all 7 pages)* for each outfall. See instructions for additional details and requirements.

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
METALS, CYANIDE, AND TOTAL PHENOLS															
1m. Antimony, Total (7440-36-0)	☐	☒	☐	*<0.002*	*mg/L*					*1*					
2M. Arsenic, Total (7440-38-2)	☐	☒	☐	*<0.002*	*mg/L*					*1*					
3M. Beryllium, Total (7440-41-7)	☐	☒	☐	*<0.001*	*mg/L*					*1*					
4M. Cadmium, Total (7440-43-9)	☐	☒	☐	*0.008*	*mg/L*					*1*					
5M Chromium, Total (7440-47-3)	☐	☒	☐	*<0.006*	*mg/L*					*1*					
6M Copper, Total (7440-50-8)	☐	☒	☐	*0.007*	*mg/L*					*1*					
7M lead, Total (7439-92-1)	☐	☒	☐	*<0.0075*	*mg/L*					*1*					
8M Mercury, Total (7439-97-6)	☐	☒	☐	*<0.002*	*mg/L*					*1*					
9M Nickel, Total (7440-02-0)	☐	☒	☐	*<0.010*	*mg/L*					*1*					
10M Selenium, Total (7782-49-2)	☐	☒	☐	*<0.002*	*mg/L*					*1*					
11M Silver, Total (7440-22-4)	☐	☒	☐	*<0.002*	*mg/L*					*1*					
12M Thallium, Total (7440-28-0)	☐	☒	☐	*<0.020*	*mg/L*					*1*					
13M Zinc, Total (7440-66-6)	☐	☒	☐	*<0.001*	*mg/L*					*1*					
14M Cyanide, Total (57-12-5)	☐	☒	☐	*<0.008*	*mg/L*					*1*					
15M Phenols, Total	☐	☒	☐	*0.006*	*mg/L*					*1*					
DIOXIN															
2,3,7,8-Tetrachlorodibenzo-P-Dioxin (1764--01-6)	☐	☐	☒	DESCRIBE RESULTS											

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						d. NO. OF ANALYSIS	3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*			a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - VOLATILE COMPOUNDS															
1V. *Acrolein (107-02-8)*	☐	☐	☒												
2V *Acrylonitrile (107-13-1)*	☐	☐	☒												
3V Benzene (71-43-2)	☐	☐	☒												
4V Bis *(Chloromethyl)* Ether (542-88-1)	☐	☐	☒												
5V Bromoform (75-25-2)	☐	☐	☒												
6V Carbon Tetrachloride (56-23-5)	☐	☐	☒												
7V Chlorobenzene (108-90-7)	☐	☐	☒												
8V Chlorodibromomethane (124-48-1)	☐	☐	☒												
9V Chloroethane (75-00-3)	☐	☐	☒												
10V 2-Chloroethylvinyl Ether (110-75-8)	☐	☐	☒												
11V Chloroform (67-66-3)	☐	☐	☒												
12V Dichlorobromoethane (75-71-8)	☐	☐	☒												
13V Dichlorodifluoromethane (75-71-8)	☐	☐	☒												
14V 1,1-Dichloroethane (75-34-3)	☐	☐	☒												
15V 1,2-Dichloroethane (107-06-2)	☐	☐	☒												
16V 1,1-Dichloroethylene (75335-4)	☐	☐	☒												
17V 1,2-Dichloropropane (78-87-5)	☐	☐	☒												
18V 1,3-Dichloropropylene (542-76-6)	☐	☐	☒												
19V Ethylbenzene (100-41-4)	☐	☐	☒												
20V Methyl Bromide (74-83-9)	☐	☐	☒												
21V Methyl Chloride (74-87-3)	☐	☐	☒												

1. POLLUTANT AND CAS NO. (if available)	2. MARK "X"			2. EFFLUENT							3. UNITS (specify if blank)		4. INTAKE (optional)		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE (if available)		c. LONG TERM AVRG. VALUE (if available)		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - VOLATILE COMPOUNDS (continued)															
22 V Methylene Chloride (75-09-2)	☐	☐	☒												
23V 1,1,2,2-Tetra-Chloroethane (79-34-5)	☐	☐	☒												
24V Tetrachloro-ethylene (127-18-4)	☐	☐	☒												
25V Toluene (108-88-3)	☐	☐	☒												
26V 1,2-Trans-Dichloroethylene (156-60-5)	☐	☐	☒												
27V 1,1,1-Tri-chloroethane (71-55-6)	☐	☐	☒												
28V 1,1,2-Tri-chloroethane (79-00-5)	☐	☐	☒												
29V Trichloro-ethylene (79-01-6)	☐	☐	☒												
30V Trichloro-fluoromethane (75-69-4)	☐	☐	☒												
31V Vinyl Chloride (75-01-4)	☐	☐	☒												
GC/MS FRACTION - ACID COMPOUNDS															
1A 2-Chlorophenol (95-57-8)	☐	☐	☒												
2A 2,4-Dichloro-phenol (120-83-2)	☐	☐	☒												
3A 2,4-Dimethyl-phenol (105-67-9)	☐	☐	☒												
4A 4,6-Dinitro-O-cresol (534-52-1)	☐	☐	☒												
5A 2,4-Dinitro-phenol (51-28-5)	☐	☐	☒												
6A 2-Nitro-phenol (88-75-5)	☐	☐	☒												
7A 4-Nitro-phenol (100-02-7)	☐	☐	☒												
8A P-Chloro-M-Cresol (59-50-7)	☐	☐	☒												
9A Penta-chlorophenol (87-86-5)	☐	☐	☒												
10A Phenol (10/-95-2)	☐	☐	☒												
11A 2,4,6-Tri-chlorophenol (88-06-2)	☐	☐	☒												

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION - BASE/NEUTRAL COMPOUNDS															
1B Acenphthene (83-32-9)	☐	☐	☒												
2B Acenaphtylene (208-96-8)	☐	☐	☒												
3B Anthracene (120-12-7)	☐	☐	☒												
4B Benzidine (92-87-5)	☐	☐	☒												
5B Benzo (a) Anthracene (56-55-3)	☐	☐	☒												
6B Benzo (a) Pyrene (50-32-8)	☐	☐	☒												
7B 3,4-Benzo-fluoranthene (205-99-2)	☐	☐	☒												
8B Benzo *(ghi)* Perylene (191-24-2)	☐	☐	☒												
9B Benzo *(k)* Fluoranthene (207-08-9)	☐	☐	☒												
10B Bis *(2-Chloroethoxy)* Methane (111-91-1)	☐	☐	☒												
11B Bis *(2-Chloro-ethyl)* Ether (111-44-4)	☐	☐	☒												
12B Bis *(2-Chloroisepropyl)* Ether (102-60-1	☐	☐	☒												
13B Bis*(2-Ethyl-hexyl)* Phthalate (117-81-7)	☐	☐	☒												
14 B 4-Bromo-phenyl Phenyl Ether (101-55-3)	☐	☐	☒												
15B Butyl Benzyl Phthalate (85-68-7)	☐	☐	☒												
16B 2-Chloro-naphthalene (91-68-7)	☐	☐	☒												
17B 4-Chloro-phenyl Phenyl Ether (7005-72-3)	☐	☐	☒												
18B Chrysene (218-01-9)	☐	☐	☒												
19B Dibenzo *(a,h)* Anthracene (53-70-3)	☐	☐	☒												
20B 1,2-Dichloro-benzene (95-50-1)	☐	☐	☒												
21B 1,3-Dichloro-benzene (541-73-1)	☐	☐	☒												

EPA I.D. NUMBER *(copy ...l Item 1 of Form 1)*

OUTFALL NUMBER *003*

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						d. NO. OF ANALYSIS	3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*			a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - BASE/NEUTRAL COMPOUNDS *(continued)*															
22B 1,4-Dichlorobenzene (106-46-7)	☐	☐	☒												
23B 3,3'-Dichlorobenzidine (91-94-1)	☐	☐	☒												
24B Diethyl Phthalate (84-66-2)	☐	☐	☒												
25B Dimethyl Phthalate (131-11-3)	☐	☐	☒												
26B Di-N-Butyl Phthalate (131-11-3)	☐	☐	☒												
27B 2,4-Dinitrotoluene (121-14-2)	☐	☐	☒												
28B 2,6-Dinitrotoluene (606-20-2)	☐	☐	☒												
29B Di-N-Octyl Phthalate (117-84-0)	☐	☐	☒												
30B 1,2-Diphenylhydrazine *(as Azo-benzene)* (122-66-7)	☐	☐	☒												
31B Fluoranthene (206-44-0)	☐	☐	☒												
32B Fluorene (86-73-7)	☐	☐	☒												
33B Hexachlorobenzene (118-74-1)	☐	☐	☒												
34B Hexachlorobutadiene (87-68-3)	☐	☐	☒												
35B Hexachlorocyclopentadiene (77-47-4)	☐	☐	☒												
36B Hexachloroethane (67-72-1)	☐	☐	☒												
37B Indeno *(1,2,3-cd)* Pyrene (193-39-5)	☐	☐	☒												
38B Isophorone (78-59-1)	☐	☐	☒												
39B Napthalene (91-20-3)	☐	☐	☒												
40B Nitrobenzene (98-95-3)	☐	☐	☒												
41B N-Nitrosodimethylamine (62-75-9)	☐	☐	☒												
42B N-Nitrosdi-N-Propylamine (621-64-7)	☐	☐	☒												

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION - BASE/NEUTRAL COMPOUNDS *(continued)*															
43B N-Nitrosodiphenylamine (86-30-6)	☐	☐	☒												
44B Phenanthrene (85-01-/	☐	☐	☒												
45B Pyrene (129-00-0)	☐	☐	☒												
46B 1,2,4-Trichlorobenzene (120-82-1)	☐	☐	☒												
GC/MS FRACTION - PESTICIDES															
1P Aldrin (309-00-2)	☐	☐	☒												
2P β-Bhc (319-85-7)	☐	☐	☒												
4P γ-BHC (58-89-9)	☐	☐	☒												
5P δ-BHC (319-86-8)	☐	☐	☒												
6P Chlordane (57-74-9)	☐	☐	☒												
7P 4,4'-DDT (50-29-3)	☐	☐	☒												
8P 4,4'-DDE (72-55-9)	☐	☐	☒												
9P 4,4'-DDD (72-54-8)	☐	☐	☒												
10P Dieldrin (60-57-1)	☐	☐	☒												
11P α-Endosulfan (115-29-7)	☐	☐	☒												
12P β-Endosulfan (115-29-7	☐	☐	☒												
13P Endosulfan Sulfate (1031-07-8)	☐	☐	☒												
14P Endrin (72-20-8)	☐	☐	☒												
15P Endrin Aldehyde (7421-93-4)	☐	☐	☒												
16P Heptachlor (76-44-8)	☐	☐	☒												

CONTINUED FROM PAGE V-6

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*	OUTFALL NUMBER
	003

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - PESTICIDES *(continued)*															
17P Heptachlor Expxide (1024-57-3)	☐	☐	☒												
18P PCB-1242 (53469-21-9)	☐	☐	☒												
19P PCB-1254 (11097-69-1)	☐	☐	☒												
20P PCB-1221 (11104-28-2)	☐	☐	☒												
21P PCB-1232 (11141-16-5)	☐	☐	☒												
22P PCB-1248 (12672-29-6)	☐	☐	☒												
23P PCB-1260 (11096-82-5)	☐	☐	☒												
24P PCB-1016 (12674-11-2)	☐	☐	☒												
25P Toxaphene (8001-35-2)	☐	☐	☒												

PLEASE PRINT OR TYPE IN THE UNSHADED AREAS ONLY. You may report some or all of this information on separate sheets *(use the same format)* instead of completing these pages. SEE INSTRUCTIONS.

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*

V. INTAKE AND EFFLUENT CHARACTERISTICS *(continued from page 3 of Form 2-C)* 004

PART A - You must provide the results of at least one analysis for every pollutant in this table. Complete one table for each outfall. See instructions for additional details.

1. POLLUTANT	2. EFFLUENT a. MAXIMUM DAILY VALUE (1) CONCENTRATION	a. MAXIMUM DAILY VALUE (2) MASS	b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	d. NO. OF ANALYSIS	3. UNITS *(specify if blank)* a. CONCENTRATION	3. UNITS b. MASS	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	a. LONG TERM AVERAGE VALUE (2) MASS	b. NO. OF ANALYSES
a. Biochemical Oxygen Demand *(BOD)*												
b. Chemical Oxygen Demand *(COD)*												
c. Total Organic Carbon *(TOC)*												
d. Total Suspended Solids *(TSS)*	*3*	*mg/L*					*1*					
e. Ammonia *(as N)*												
f. Flow	Value *0*		Value		Value		*1*			Value		
g. Temperature *(winter)*	Value		Value		Value			°C		Value		
h. Temperature *(summer)*	Value		Value		Value			°C		Value		
i. pH	Minimum *-*	Maximum *8.9*	Minimum	Maximum			*1*	STANDARD UNTIS				

PART B - Mark "X" in column 2-a for each pollutant you know or have reason to believe is present. Mark "X" in column 2-b for each pollutant you believe to be absent. If you mark column 2a for any pollutant which is limited either directly, or indirectly but expressly, in an effluent limitation guideline, you must provide the results of at least one analysis for that pollutant. For other pollutants for which you mark column 2a, you must provide quantitative data or an explanation of their presence in your discharge. Complete one table for each outfall. See the instructions for additional details and requirements.

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X' a. BELIEVED PRESENT	2. MARK 'X' b. BELIEVED ABSENT	2. EFFLUENT a. MAXIMUM DAILY VALUE (1) CONCENTRATION	a. MAXIMUM DAILY VALUE (2) MASS	b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	d. NO. OF ANALYSIS	3. UNITS *(specify if blank)* a. CONCENTRATION	3. UNITS b. MASS	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	a. LONG TERM AVERAGE VALUE (2) MASS	b. NO. OF ANALYSES
a. Bromide (24959-67-9)	☐	☒												
b. Chlorine, Total Residual	☐	☒												
c. Color	☐	☒												
d. Fecal Coliform	☐	☒												
e. Fluoride (16984-48-8)	☐	☒												
f. Nitrate-Nitrite *(as N)*	☐	☒												

ITEM V-C CONTINUED FROM FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'		2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. BELIEVED PRESENT	b. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
			(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
g. Nitrogen, Total Organic *(as N)*	☐	☒												
h. Oil and Grease	☐	☒												
i. Phosphorus *(as P)*, Total (7723-14-0)	☐	☐												
j. Radioactivity														
(1) Alpha, Total	☐	☒												
(2) Bets, Total	☐	☒												
(3) Radium, Total	☐	☒												
(4) Radium 226, Total	☐	☒												
k. Sulfate *(as SO_4)* (14808-79-8)	☒	☐	*3*	*mg/L*					*1*					
l. Sulfide (as S)	☐	☒												
m. Sulfite *(as SO_3)*(14265-45-3)	☐	☒												
n. Surfactants	☐	☒												
o. Aluminum, Total (7429-90-5)	☐	☒												
p. Barium, Total (7440-39-3)	☐	☒												
q. Boron, Total (7440-42-8)	☐	☒												
r. Cobalt, Total (7440-48-4)	☐	☒												
s. Iron, Total (7439-89-4)	☒	☐	*<0.006*	*mg/L*					*1*					
t. Magnesium, Total (7439-95-4)	☐	☒												
u. Molybdenum, Total (7439-98-7)	☐	☒												
v. Manganese, Total (7439-96-5)	☐	☒												
w. Tin, Total (7440-31-5)	☐	☒												
x. Titanium, Total (7440-32-6)	☐	☒												

CONTINUED FROM PAGE 3 OF FORM 2-C

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*	OUTFALL NUMBER
	004

PART C - If you are a primary industry and this outfall contains process wastewater, refer to Table 2c-2 in the instructions to determine which of the GC/MS fractions you must test for. Mark "X" in column 2-a for all such GC/MS fractions that apply to your industry and for ALL toxic metals, cyanides, and total phenols. If you are not required to mark column 2-a *(secondary industries, nonprocess wastewater outfalls, and non-required GC/MS fractions)*, mark "X" in column 2-b for each pollutant you know or have reason to believe is present. Mark "X" in column 2-c for each pollutant you believe is absent. If you mark column 2a for any pollutant, you must provide the results of at least one analysis for that pollutant. If you mark column 2b for any pollutant, you must provide the results of at least one analysis for that pollutant. If you know or have reason to believe it will be discharged in concentrations of 10 ppb or greater. If you mark column 2b for acrolein, acrylonitrile, 2,4 dinitrophenol, or 2-methyl-4, 6 dinitrophenol, you must provide the results of at least one analysis for each of these pollutants which you know or have reason to believe that you discharge in concentrations of 100 ppb or greater. Otherwise, for pollutants for which you mark column 2b, you must either submit at least one analysis or briefly describe the reasons the pollutant is expected to be discharged. Note that there are 7 pages to this part; please review each carefully. Complete one table *(all 7 pages)* for each outfall. See instructions for additional details and requirements.

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
METALS, CYANIDE, AND TOTAL PHENOLS															
1m. Antimony, Total (7440-36-0)	☐	☒	☐	*<0.002*	*mg/L*					*1*					
2M. Arsenic, Total (7440-38-2)	☐	☒	☐	*<0.002*	*mg/L*					*1*					
3M. Beryllium, Total (7440-41-7)	☐	☒	☐	*<0.001*	*mg/L*					*1*					
4M. Cadmium, Total (7440-43-9)	☐	☒	☐	*0.004*	*mg/L*					*1*					
5M Chromium, Total (7440-47-3)	☐	☒	☐	*<0.006*	*mg/L*					*1*					
6M Copper, Total (7440-50-8)	☐	☒	☐	*<0.003*	*mg/L*					*1*					
7M lead, Total (7439-92-1)	☐	☒	☐	*<0.0075*	*mg/L*					*1*					
8M Mercury, Total (7439-97-6)	☐	☒	☐	*<0.002*	*mg/L*					*1*					
9M Nickel, Total (7440-02-0)	☐	☒	☐	*<0.010*	*mg/L*					*1*					
10M Selenium, Total (7782-49-2)	☐	☒	☐	*<0.002*	*mg/L*					*1*					
11M Silver, Total (7440-22-4)	☐	☒	☐	*<0.002*	*mg/L*					*1*					
12M Thallium, Total (7440-28-0)	☐	☒	☐	*<0.020*	*mg/L*					*1*					
13M Zinc, Total (7440-66-6)	☐	☒	☐	*<0.001*	*mg/L*					*1*					
14M Cyanide, Total (57-12-5)	☐	☒	☐	*<0.007*	*mg/L*					*1*					
15M Phenols, Total	☐	☒	☐	*<0.005*	*mg/L*					*1*					
DIOXIN															
2,3,7,8-Tetrachlorodibenzo-P-Dioxin (1764--01-6)	☐	☐	☒	DESCRIBE RESULTS											

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - VOLATILE COMPOUNDS															
1V. Acrolein (107-02-8)	☐	☐	☒												
2V Acrylonitrile (107-13-1)	☐	☐	☒												
3V Benzene (71-43-2)	☐	☐	☒												
4V Bis (Chloromethyl) Ether (542-88-1)	☐	☐	☒												
5V Bromoform (75-25-2)	☐	☐	☒												
6V Carbon Tetrachloride (56-23-5)	☐	☐	☒												
7V Chlorobenzene (108-90-7)	☐	☐	☒												
8V Chlorodibromomethane (124-48-1)	☐	☐	☒												
9V Chloroethane (75-00-3)	☐	☐	☒												
10V 2-Chloroethylvinyl Ether (110-75-8)	☐	☐	☒												
11V Chloroform (67-66-3)	☐	☐	☒												
12V Dichlorobromoethane (75-71-8)	☐	☐	☒												
13V Dichlorodifluoromethane (75-71-8)	☐	☐	☒												
14V 1,1-Dichloroethane (75-34-3)	☐	☐	☒												
15V 1,2-Dichloroethane (107-06-2)	☐	☐	☒												
16V 1,1-Dichloroethylene (75335-4)	☐	☐	☒												
17V 1,2-Dichloropropane (78-87-5)	☐	☐	☒												
18V 1,3-Dichloropropylene (542-76-6)	☐	☐	☒												
19V Ethylbenzene (100-41-4)	☐	☐	☒												
20V Methyl Bromide (74-83-9)	☐	☐	☒												
21V Methyl Chloride (74-87-3)	☐	☐	☒												

EPA I.D. NUMBER *(copy from item 1 of Form 1)*

OUTFALL NUMBER *004*

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS		a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS		a. CONCENTRATION	b. MASS	(1) CONCENTRATION	(2) MASS	
GC/MS - VOLATILE COMPOUNDS *(continued)*															
22 V Methylene Chloride (75-09-2)	☐	☐	☒												
23V 1,1,2,2-Tetrachloroethane (79-34-5)	☐	☐	☒												
24V Tetrachloroethylene (127-18-4)	☐	☐	☒												
25V Toluene (108-88-3)	☐	☐	☒												
26V 1,2-Trans-Dichloroethylene (156-60-5)	☐	☐	☒												
27V 1,1,1-Trichloroethane (71-55-6)	☐	☐	☒												
28V 1,1,2-Trichloroethane (79-00-5)	☐	☐	☒												
29V Trichloroethylene (79-01-6)	☐	☐	☒												
30V Trichlorofluoromethane (75-69-4)	☐	☐	☒												
31V Vinyl Chloride (75-01-4)	☐	☐	☒												
GC/MS FRACTION - ACID COMPOUNDS															
1A 2-Chlorophenol (95-57-8)	☐	☐	☒												
2A 2,4-Dichlorophenol (120-83-2)	☐	☐	☒												
3A 2,4-Dimethylphenol (105-67-9)	☐	☐	☒												
4A 4,6-Dinitro-O-cresol (534-52-1)	☐	☐	☒												
5A 2,4-Dinitrophenol (51-28-5)	☐	☐	☒												
6A 2-Nitrophenol (88-75-5)	☐	☐	☒												
7A 4-Nitrophenol (100-02-7)	☐	☐	☒												
8A P-Chloro-M-Cresol (59-50-7)	☐	☐	☒												
9A Pentachlorophenol (87-86-5)	☐	☐	☒												
10A Phenol (10/-95-2)	☐	☐	☒												
11A 2,4,6-Trichlorophenol (88-06-2)	☐	☐	☒												

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						d. NO. OF ANALYSIS	3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*			a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION - BASE/NEUTRAL COMPOUNDS															
1B Acenphthene (83-32-9)	☐	☐	☒												
2B Acenaphtylene (208-96-8)	☐	☐	☒												
3B Anthracene (120-12-7)	☐	☐	☒												
4B Benzidine (92-87-5)	☐	☐	☒												
5B Benzo (a) Anthracene (56-55-3)	☐	☐	☒												
6B Benzo (a) Pyrene (50-32-8)	☐	☐	☒												
7B 3,4-Benzo-fluoranthene (205-99-2)	☐	☐	☒												
8B Benzo *(ghi)* Perylene (191-24-2)	☐	☐	☒												
9B Benzo *(k)* Fluoranthene (207-08-9)	☐	☐	☒												
10B Bis *(2-Chloroethoxy)* Methane (111-91-1)	☐	☐	☒												
11B Bis *(2-Chloro-ethyl)* Ether (111-44-4)	☐	☐	☒												
12B Bis *(2-Chloroisepropyl)* Ether (102-60-1	☐	☐	☒												
13B Bis*(2-Ethyl-hexyl)* Phthalate (117-81-7)	☐	☐	☒												
14 B 4-Bromo-phenyl Phenyl Ether (101-55-3)	☐	☐	☒												
15B Butyl Benzyl Phthalate (85-68-7)	☐	☐	☒												
16B 2-Chloro-naphthalene (91-68-7)	☐	☐	☒												
17B 4-Chloro-phenyl Phenyl Ether (7005-72-3)	☐	☐	☒												
18B Chrysene (218-01-9)	☐	☐	☒												
19B Dibenzo *(a,h)* Anthracene (53-70-3)	☐	☐	☒												
20B 1,2-Dichloro-benzene (95-50-1)	☐	☐	☒												
21B 1,3-Dichloro-benzene (541-73-1)	☐	☐	☒												

CONTINUED FROM PAGE V-6

EPA I.D. NUMBER *(copy , Item 1 of Form 1)*

OUTFALL NUMBER *004*

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						d. NO. OF ANALYSIS	3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		b. NO. OF ANALYSES
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*			a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - BASE/NEUTRAL COMPOUNDS *(continued)*															
22B 1,4-Dichlorobenzene (106-46-7)	☐	☐	☒												
23B 3,3'-Dichlorobenzidine (91-94-1)	☐	☐	☒												
24B Diethyl Phthalate (84-66-2)	☐	☐	☒												
25B Dimethyl Phthalate (131-11-3)	☐	☐	☒												
26B Di-N-Butyl Phthalate (131-11-3)	☐	☐	☒												
27B 2,4-Dinitrotoluene (121-14-2)	☐	☐	☒												
28B 2,6-Dinitrotoluene (606-20-2)	☐	☐	☒												
29B Di-N-Octyl Phthalate (117-84-0)	☐	☐	☒												
30B 1,2-Diphenylhydrazine *(as Azo-benzene)* (122-66-7)	☐	☐	☒												
31B Fluoranthene (206-44-0)	☐	☐	☒												
32B Fluorene (86-73-7)	☐	☐	☒												
33B Hexachlorobenzene (118-74-1)	☐	☐	☒												
34B Hexachlorobutadiene (87-68-3)	☐	☐	☒												
35B Hexachlorocyclopentadiene (77-47-4)	☐	☐	☒												
36B Hexachloroethane (67-72-1)	☐	☐	☒												
37B Indeno *(1,2,3-cd)* Pyrene (193-39-5)	☐	☐	☒												
38B Isophorone (78-59-1)	☐	☐	☒												
39B Napthalene (91-20-3)	☐	☐	☒												
40B Nitrobenzene (98-95-3)	☐	☐	☒												
41B N-Nitrosodimethylamine (62-75-9)	☐	☐	☒												
42B N-Nitrosdi-N-Propylamine (621-64-7)	☐	☐	☒												

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1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION - BASE/NEUTRAL COMPOUNDS *(continued)*															
43B N-Nitrosodiphenylamine (86-30-6)	☐	☐	☒												
44B Phenanthrene (85-01-/	☐	☐	☒												
45B Pyrene (129-00-0)	☐	☐	☒												
46B 1,2,4-Trichlorobenzene (120-82-1)	☐	☐	☒												
GC/MS FRACTION - PESTICIDES															
1P Aldrin (309-00-2)	☐	☐	☒												
2P β-Bhc (319-85-7)	☐	☐	☒												
4P γ-BHC (58-89-9)	☐	☐	☒												
5P δ-BHC (319-86-8)	☐	☐	☒												
6P Chlordane (57-74-9)	☐	☐	☒												
7P 4,4'-DDT (50-29-3)	☐	☐	☒												
8P 4,4'-DDE (72-55-9)	☐	☐	☒												
9P 4,4'-DDD (72-54-8)	☐	☐	☒												
10P Dieldrin (60-57-1)	☐	☐	☒												
11P α-Endosulfan (115-29-7)	☐	☐	☒												
12P β-Endosulfan (115-29-7	☐	☐	☒												
13P Endosulfan Sulfate (1031-07-8)	☐	☐	☒												
14P Endrin (72-20-8)	☐	☐	☒												
15P Endrin Aldehyde (7421-93-4)	☐	☐	☒												
16P Heptachlor (76-44-8)	☐	☐	☒												

CONTINUED FROM PAGE V-6

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*	OUTFALL NUMBER *004*

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - PESTICIDES *(continued)*															
17P Heptachlor Expxide (1024-57-3)	☐	☐	☒												
18P PCB-1242 (53469-21-9)	☐	☐	☒												
19P PCB-1254 (11097-69-1)	☐	☐	☒												
20P PCB-1221 (11104-28-2)	☐	☐	☒												
21P PCB-1232 (11141-16-5)	☐	☐	☒												
22P PCB-1248 (12672-29-6)	☐	☐	☒												
23P PCB-1260 (11096-82-5)	☐	☐	☒												
24P PCB-1016 (12674-11-2)	☐	☐	☒												
25P Toxaphene (8001-35-2)	☐	☐	☒												

R17591

PLEASE PRINT OR TYPE IN THE UNSHADED AREAS ONLY. You may report some or all of this information on separate sheets *(use the same format)* instead of completing these pages. SEE INSTRUCTIONS.

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*

V. INTAKE AND EFFLUENT CHARACTERISTICS *(continued from page 3 of Form 2-C)* 005

PART A - You must provide the results of at least one analysis for every pollutant in this table. Complete one table for each outfall. See instructions for additional details.

1. POLLUTANT	2. EFFLUENT a. MAXIMUM DAILY VALUE (1) CONCENTRATION	a. MAXIMUM DAILY VALUE (2) MASS	b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	d. NO. OF ANALYSIS	3. UNITS *(specify if blank)* a. CONCENTRATION	3. UNITS b. MASS	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	a. LONG TERM AVERAGE VALUE (2) MASS	b. NO. OF ANALYSES
a. Biochemical Oxygen Demand *(BOD)*												
b. Chemical Oxygen Demand *(COD)*												
c. Total Organic Carbon *(TOC)*												
d. Total Suspended Solids *(TSS)*	*35*	*mg/L*					*1*					
e. Ammonia *(as N)*												
f. Flow	Value *0*		Value		Value		*1*			Value		
g. Temperature *(winter)*	Value		Value		Value			°C		Value		
h. Temperature *(summer)*	Value		Value		Value			°C		Value		
i. pH	Minimum -	Maximum *7.5*	Minimum	Maximum			*1*	STANDARD UNTIS				

PART B - Mark "X" in column 2-a for each pollutant you know or have reason to believe is present. Mark "X" in column 2-b for each pollutant you believe to be absent. If you mark column 2a for any pollutant which is limited either directly, or indirectly but expressly, in an effluent limitation guideline, you must provide the results of at least one analysis for that pollutant. For other pollutants for which you mark column 2a, you must provide quantitative data or an explanation of their presence in your discharge. Complete one table for each outfall. See the instructions for additional details and requirements.

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X' a. BELIEVED PRESENT	2. MARK 'X' b. BELIEVED ABSENT	2. EFFLUENT a. MAXIMUM DAILY VALUE (1) CONCENTRATION	a. MAXIMUM DAILY VALUE (2) MASS	b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	d. NO. OF ANALYSIS	3. UNITS *(specify if blank)* a. CONCENTRATION	3. UNITS b. MASS	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	a. LONG TERM AVERAGE VALUE (2) MASS	b. NO. OF ANALYSES
a. Bromide (24959-67-9)	☐	☒												
b. Chlorine, Total Residual	☐	☒												
c. Color	☐	☒												
d. Fecal Coliform	☐	☒												
e. Fluoride (16984-48-8)	☐	☒												
f. Nitrate-Nitrite *(as N)*	☐	☒												

ITEM V-B CONTINUED FROM FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'		2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. BELIEVED PRESENT	b. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
			(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
g. Nitrogen, Total Organic *(as N)*	☐	☒												
h. Oil and Grease	☐	☒												
i. Phosphorus *(as P)*, Total (7723-14-0)	☐	☐												
j. Radioactivity														
(1) Alpha, Total	☐	☒												
(2) Bets, Total	☐	☒												
(3) Radium, Total	☐	☒												
(4) Radium 226, Total	☐	☒												
k. Sulfate *(as SO_4)* *(14808-79-8)*	☒	☐	*120*	*mg/L*					*1*					
l. Sulfide (as S)	☐	☒												
m. Sulfite *(as SO_3)(14265-45-3)*	☐	☒												
n. Surfactants	☐	☒												
o. Aluminum, Total (7429-90-5)	☐	☒												
p. Barium, Total (7440-39-3)	☐	☒												
q. Boron, Total (7440-42-8)	☐	☒												
r. Cobalt, Total (7440-48-4)	☐	☒												
s. Iron, Total (7439-89-4)	☒	☐	*0.593*	*mg/L*					*1*					
t. Magnesium, Total (7439-95-4)	☐	☒												
u. Molybdenum, Total (7439-98-7)	☐	☒												
v. Manganese, Total (7439-96-5)	☐	☒												
w. Tin, Total (7440-31-5)	☐	☒												
x. Titanium, Total (7440-32-6)	☐	☒												

R17593

CONTINUED FROM PAGE 3 OF FORM 2-C

EPA I.D. NUMBER (copy from Item 1 of Form 1)	OUTFALL NUMBER
	005

PART C - If you are a primary industry and this outfall contains process wastewater, refer to Table 2c-2 in the instructions to determine which of the GC/MS fractions you must test for. Mark "X" in column 2-a for all such GC/MS fractions that apply to your industry and for ALL toxic metals, cyanides, and total phenols. If you are not required to mark column 2-a *(secondary industries, nonprocess wastewater outfalls, and non-required GC/MS fractions)*, mark "X" in column 2-b for each pollutant you know or have reason to believe is present. Mark "X" in column 2-c for each pollutant you believe is absent. If you mark column 2a for any pollutant, you must provide the results of at least one analysis for that pollutant. If you mark column 2b for any pollutant, you must provide the results of at least one analysis for that pollutant. If you know or have reason to believe it will be discharged in concentrations of 10 ppb or greater. If you mark column 2b for acrolein, acrylonitrile, 2,4 dinitrophenol, or 2-methyl-4, 6 dinitrophenol, you must provide the results of at least one analysis for each of these pollutants which you know or have reason to believe that you discharge in concentrations of 100 ppb or greater. Otherwise, for pollutants for which you mark column 2b, you must either submit at least one analysis or briefly describe the reasons the pollutant is expected to be discharged. Note that there are 7 pages to this part; please review each carefully. Complete one table *(all 7 pages)* for each outfall. See instructions for additional details and requirements.

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
METALS, CYANIDE, AND TOTAL PHENOLS															
1m. Antimony, Total (7440-36-0)	☐	☒	☐	<0.002	mg/L					1					
2M. Arsenic, Total (7440-38-2)	☐	☒	☐	<0.002	mg/L					1					
3M. Beryllium, Total (7440-41-7)	☐	☒	☐	<0.001	mg/L					1					
4M. Cadmium, Total (7440-43-9)	☐	☒	☐	0.006	mg/L					1					
5M Chromium, Total (7440-47-3)	☐	☒	☐	<0.006	mg/L					1					
6M Copper, Total (7440-50-8)	☐	☒	☐	0.003	mg/L					1					
7M lead, Total (7439-92-1)	☐	☒	☐	<0.0075	mg/L					1					
8M Mercury, Total (7439-97-6)	☐	☒	☐	<0.002	mg/L					1					
9M Nickel, Total (7440-02-0)	☐	☒	☐	<0.010	mg/L					1					
10M Selenium, Total (7782-49-2)	☐	☒	☐	<0.002	mg/L					1					
11M Silver, Total (7440-22-4)	☐	☒	☐	<0.002	mg/L					1					
12M Thallium, Total (7440-28-0)	☐	☒	☐	<0.020	mg/L					1					
13M Zinc, Total (7440-66-6)	☐	☒	☐	<0.001	mg/L					1					
14M Cyanide, Total (57-12-5)	☐	☒	☐	<0.008	mg/L					1					
15M Phenols, Total	☐	☒	☐	<0.005	mg/L					1					
DIOXIN															
2,3,7,8-Tetrachlorodibenzo-P-Dioxin (1764--01-6)	☐	☐	☒	DESCRIBE RESULTS											

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - VOLATILE COMPOUNDS															
1V. *Acrolein (107-02-8)*	☐	☐	☒												
2V *Acrylonitrile (107-13-1)*	☐	☐	☒												
3V Benzene (71-43-2)	☐	☐	☒												
4V Bis *(Chloromethyl)* Ether (542-88-1)	☐	☐	☒												
5V Bromoform (75-25-2)	☐	☐	☒												
6V Carbon Tetrachloride (56-23-5)	☐	☐	☒												
7V Chlorobenzene (108-90-7)	☐	☐	☒												
8V Chlorodibromomethane (124-48-1)	☐	☐	☒												
9V Chloroethane (75-00-3)	☐	☐	☒												
10V 2-Chloroethylvinyl Ether (110-75-8)	☐	☐	☒												
11V Chloroform (67-66-3)	☐	☐	☒												
12V Dichlorobromoethane (75-71-8)	☐	☐	☒												
13V Dichlorodifluoromethane (75-71-8)	☐	☐	☒												
14V 1,1-Dichloroethane (75-34-3)	☐	☐	☒												
15V 1,2-Dichloroethane (107-06-2)	☐	☐	☒												
16V 1,1-Dichloroethylene (75335-4)	☐	☐	☒												
17V 1,2-Dichloropropane (78-87-5)	☐	☐	☒												
18V 1,3-Dichloropropylene (542-76-6)	☐	☐	☒												
19V Ethylbenzene (100-41-4)	☐	☐	☒												
20V Methyl Bromide (74-83-9)	☐	☐	☒												
21V Methyl Chloride (74-87-3)	☐	☐	☒												

CONTINUED FROM PAGE V-4

EPA I.D. NUMBER *(copy ... Item 1 of Form 1)*

OUTFALL NUMBER *005*

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS		a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS		a. CONCENTRATION	b. MASS	(1) CONCENTRATION	(2) MASS	
GC/MS - VOLATILE COMPOUNDS *(continued)*															
22 V Methylene Chloride (75-09-2)	☐	☐	☒												
23V 1,1,2,2-Tetra-Chloroethane (79-34-5)	☐	☐	☒												
24V Tetrachloro-ethylene (127-18-4)	☐	☐	☒												
25V Toluene (108-88-3)	☐	☐	☒												
26V 1,2-Trans-Dichloroethylene (156-60-5)	☐	☐	☒												
27V 1,1,1-Tri-chloroethane (71-55-6)	☐	☐	☒												
28V 1,1,2-Tri-chloroethane (79-00-5)	☐	☐	☒												
29V Trichloro-ethylene (79-01-6)	☐	☐	☒												
30V Trichloro-fluoromethane (75-69-4)	☐	☐	☒												
31V Vinyl Chloride (75-01-4)	☐	☐	☒												
GC/MS FRACTION - ACID COMPOUNDS															
1A 2-Chlorophenol (95-57-8)	☐	☐	☒												
2A 2,4-Dichloro-phenol (120-83-2)	☐	☐	☒												
3A 2,4-Dimethyl-phenol (105-67-9)	☐	☐	☒												
4A 4,6-Dinitro-O-cresol (534-52-1)	☐	☐	☒												
5A 2,4-Dinitro-phenol (51-28-5)	☐	☐	☒												
6A 2-Nitro-phenol (88-75-5)	☐	☐	☒												
7A 4-Nitro-phenol (100-02-7)	☐	☐	☒												
8A P-Chloro-M-Cresol (59-50-7)	☐	☐	☒												
9A Penta-chlorophenol (87-86-5)	☐	☐	☒												
10A Phenol (10/-95-2)	☐	☐	☒												
11A 2,4,6-Tri-chlorophenol (88-06-2)	☐	☐	☒												

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION - BASE/NEUTRAL COMPOUNDS															
1B Acenphthene (83-32-9)	☐	☐	☒												
2B Acenaphtylene (208-96-8)	☐	☐	☒												
3B Anthracene (120-12-7)	☐	☐	☒												
4B Benzidine (92-87-5)	☐	☐	☒												
5B Benzo (a) Anthracene (56-55-3)	☐	☐	☒												
6B Benzo (a) Pyrene (50-32-8)	☐	☐	☒												
7B 3,4-Benzo-fluoranthene (205-99-2)	☐	☐	☒												
8B Benzo *(ghi)* Perylene (191-24-2)	☐	☐	☒												
9B Benzo *(k)* Fluoranthene (207-08-9)	☐	☐	☒												
10B Bis *(2-Chloroethoxy)* Methane (111-91-1)	☐	☐	☒												
11B Bis *(2-Chloro-ethyl)* Ether (111-44-4)	☐	☐	☒												
12B Bis *(2-Chloroisepropyl)* Ether (102-60-1	☐	☐	☒												
13B Bis*(2-Ethyl-hexyl)* Phthalate (117-81-7)	☐	☐	☒												
14 B 4-Bromo-phenyl Phenyl Ether (101-55-3)	☐	☐	☒												
15B Butyl Benzyl Phthalate (85-68-7)	☐	☐	☒												
16B 2-Chloro-naphthalene (91-68-7)	☐	☐	☒												
17B 4-Chloro-phenyl Phenyl Ether (7005-72-3)	☐	☐	☒												
18B Chrysene (218-01-9)	☐	☐	☒												
19B Dibenzo *(a,h)* Anthracene (53-70-3)	☐	☐	☒												
20B 1,2-Dichloro-benzene (95-50-1)	☐	☐	☒												
21B 1,3-Dichloro-benzene (541-73-1)	☐	☐	☒												

CONTINUED FROM PAGE V-6

EPA I.D. NUMBER *(copy ... item 1 of Form 1)*

OUTFALL NUMBER *005*

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - BASE/NEUTRAL COMPOUNDS *(continued)*															
22B 1,4-Dichlorobenzene (106-46-7)	☐	☐	☒												
23B 3,3'-Dichlorobenzidine (91-94-1)	☐	☐	☒												
24B Diethyl Phthalate (84-66-2)	☐	☐	☒												
25B Dimethyl Phthalate (131-11-3)	☐	☐	☒												
26B Di-N-Butyl Phthalate (131-11-3)	☐	☐	☒												
27B 2,4-Dinitrotoluene (121-14-2)	☐	☐	☒												
28B 2,6-Dinitrotoluene (606-20-2)	☐	☐	☒												
29B Di-N-Octyl Phthalate (117-84-0)	☐	☐	☒												
30B 1,2-Diphenylhydrazine *(as Azo-benzene)* (122-66-7)	☐	☐	☒												
31B Fluoranthene (206-44-0)	☐	☐	☒												
32B Fluorene (86-73-7)	☐	☐	☒												
33B Hexachlorobenzene (118-74-1)	☐	☐	☒												
34B Hexachlorobutadiene (87-68-3)	☐	☐	☒												
35B Hexachlorocyclopentadiene (77-47-4)	☐	☐	☒												
36B Hexachloroethane (67-72-1)	☐	☐	☒												
37B Indeno *(1,2,3-cd)* Pyrene (193-39-5)	☐	☐	☒												
38B Isophorone (78-59-1)	☐	☐	☒												
39B Napthalene (91-20-3)	☐	☐	☒												
40B Nitrobenzene (98-95-3)	☐	☐	☒												
41B N-Nitrosodimethylamine (62-75-9)	☐	☐	☒												
42B N-Nitrosdi-N-Propylamine (621-64-7)	☐	☐	☒												

R17598

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION - BASE/NEUTRAL COMPOUNDS *(continued)*															
43B N-Nitrosodiphenylamine (86-30-6)	☐	☐	☒												
44B Phenanthrene (85-01-/	☐	☐	☒												
45B Pyrene (129-00-0)	☐	☐	☒												
46B 1,2,4-Trichlorobenzene (120-82-1)	☐	☐	☒												
GC/MS FRACTION - PESTICIDES															
1P Aldrin (309-00-2)	☐	☐	☒												
2P β-Bhc (319-85-7)	☐	☐	☒												
4P γ-BHC (58-89-9)	☐	☐	☒												
5P δ-BHC (319-86-8)	☐	☐	☒												
6P Chlordane (57-74-9)	☐	☐	☒												
7P 4,4'-DDT (50-29-3)	☐	☐	☒												
8P 4,4'-DDE (72-55-9)	☐	☐	☒												
9P 4,4'-DDD (72-54-8)	☐	☐	☒												
10P Dieldrin (60-57-1)	☐	☐	☒												
11P α-Endosulfan (115-29-7)	☐	☐	☒												
12P β-Endosulfan (115-29-7	☐	☐	☒												
13P Endosulfan Sulfate (1031-07-8)	☐	☐	☒												
14P Endrin (72-20-8)	☐	☐	☒												
15P Endrin Aldehyde (7421-93-4)	☐	☐	☒												
16P Heptachlor (76-44-8)	☐	☐	☒												

CONTINUED FROM PAGE V-6

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*	OUTFALL NUMBER
	005

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - PESTICIDES *(continued)*															
17P Heptachlor Expxide (1024-57-3)	☐	☐	☒												
18P PCB-1242 (53469-21-9)	☐	☐	☒												
19P PCB-1254 (11097-69-1)	☐	☐	☒												
20P PCB-1221 (11104-28-2)	☐	☐	☒												
21P PCB-1232 (11141-16-5)	☐	☐	☒												
22P PCB-1248 (12672-29-6)	☐	☐	☒												
23P PCB-1260 (11096-82-5)	☐	☐	☒												
24P PCB-1016 (12674-11-2)	☐	☐	☒												
25P Toxaphene (8001-35-2)	☐	☐	☒												

PLEASE PRINT OR TYPE IN THE UNSHADED AREAS ONLY. You may report some or all of this information on separate sheets *(use the same format)* instead of completing these pages. SEE INSTRUCTIONS.

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*

V. INTAKE AND EFFLUENT CHARACTERISTICS *(continued from page 3 of Form 2-C)* 006

PART A - You must provide the results of at least one analysis for every pollutant in this table. Complete one table for each outfall. See instructions for additional details.

1. POLLUTANT	2. EFFLUENT a. MAXIMUM DAILY VALUE (1) CONCENTRATION	2. EFFLUENT a. MAXIMUM DAILY VALUE (2) MASS	2. EFFLUENT b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	2. EFFLUENT b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	2. EFFLUENT c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	2. EFFLUENT c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	2. EFFLUENT d. NO. OF ANALYSIS	3. UNITS *(specify if blank)* a. CONCENTRATION	3. UNITS *(specify if blank)* b. MASS	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (2) MASS	4. INTAKE *(optional)* b. NO. OF ANALYSES
a. Biochemical Oxygen Demand *(BOD)*												
b. Chemical Oxygen Demand *(COD)*												
c. Total Organic Carbon *(TOC)*												
d. Total Suspended Solids *(TSS)*	*1*	*mg/L*					*1*					
e. Ammonia *(as N)*												
f. Flow	Value *0*		Value		Value		*1*			Value		
g. Temperature *(winter)*	Value		Value		Value			°C		Value		
h. Temperature *(summer)*	Value		Value		Value			°C		Value		
i. pH	Minimum -	Maximum *8.6*	Minimum	Maximum			*1*	STANDARD UNTIS				

PART B - Mark "X" in column 2-a for each pollutant you know or have reason to believe is present. Mark "X" in column 2-b for each pollutant you believe to be absent. If you mark column 2a for any pollutant which is limited either directly, or indirectly but expressly, in an effluent limitation guideline, you must provide the results of at least one analysis for that pollutant. For other pollutants for which you mark column 2a, you must provide quantitative data or an explanation of their presence in your discharge. Complete one table for each outfall. See the instructions for additional details and requirements.

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X' a. BELIEVED PRESENT	2. MARK 'X' b. BELIEVED ABSENT	2. EFFLUENT a. MAXIMUM DAILY VALUE (1) CONCENTRATION	2. EFFLUENT a. MAXIMUM DAILY VALUE (2) MASS	2. EFFLUENT b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	2. EFFLUENT b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	2. EFFLUENT c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	2. EFFLUENT c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	2. EFFLUENT d. NO. OF ANALYSIS	3. UNITS *(specify if blank)* a. CONCENTRATION	3. UNITS *(specify if blank)* b. MASS	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (2) MASS	4. INTAKE *(optional)* b. NO. OF ANALYSES
a. Bromide (24959-67-9)	☐	☒												
b. Chlorine, Total Residual	☐	☒												
c. Color	☐	☒												
d. Fecal Coliform	☐	☒												
e. Fluoride (16984-48-8)	☐	☒												
f. Nitrate-Nitrite *(as N)*	☐	☒												

ITEM V-C CONTINUED FROM FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'		2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. BELIEVED PRESENT	b. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
			(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
g. Nitrogen, Total Organic *(as N)*	☐	☒												
h. Oil and Grease	☐	☒												
i. Phosphorus *(as P)*, Total (7723-14-0)	☐	☐												
j. Radioactivity														
(1) Alpha, Total	☐	☒												
(2) Bets, Total	☐	☒												
(3) Radium, Total	☐	☒												
(4) Radium 226, Total	☐	☒												
k. Sulfate *(as SO_4)* *(14808-79-8)*	☒	☐	*330*	*mg/L*					*1*					
l. Sulfide (as S)	☐	☒												
m. Sulfite *(as SO_3)(14265-45-3)*	☐	☒												
n. Surfactants	☐	☒												
o. Aluminum, Total (7429-90-5)	☐	☒												
p. Barium, Total (7440-39-3)	☐	☒												
q. Boron, Total (7440-42-8)	☐	☒												
r. Cobalt, Total (7440-48-4)	☐	☒												
s. Iron, Total (7439-89-4)	☒	☐	*<0.006*	*mg/L*					*1*					
t. Magnesium, Total (7439-95-4)	☐	☒												
u. Molybdenum, Total (7439-98-7)	☐	☒												
v. Manganese, Total (7439-96-5)	☒	☐	*0.022*	*mg/L*					*1*					
w. Tin, Total (7440-31-5)	☐	☒												
x. Titanium, Total (7440-32-6)	☐	☒												

CONTINUED FROM PAGE 3 OF FORM 2-C

EPA I.D. NUMBER *(copy . ...tem 1 of Form 1)*	OUTFALL NUMBER
	006

PART C - If you are a primary industry and this outfall contains process wastewater, refer to Table 2c-2 in the instructions to determine which of the GC/MS fractions you must test for. Mark "X" in column 2-a for all such GC/MS fractions that apply to your industry and for ALL toxic metals, cyanides, and total phenols. If you are not required to mark column 2-a *(secondary industries, nonprocess wastewater outfalls, and non-required GC/MS fractions)*, mark "X" in column 2-b for each pollutant you know or have reason to believe is present. Mark "X" in column 2-c for each pollutant you believe is absent. If you mark column 2a for any pollutant, you must provide the results of at least one analysis for that pollutant. If you mark column 2b for any pollutant, you must provide the results of at least one analysis for that pollutant. If you know or have reason to believe it will be discharged in concentrations of 10 ppb or greater. If you mark column 2b for acrolein, acrylonitrile, 2,4 dinitrophenol, or 2-methyl-4, 6 dinitrophenol, you must provide the results of at least one analysis for each of these pollutants which you know or have reason to believe that you discharge in concentrations of 100 ppb or greater. Otherwise, for pollutants for which you mark column 2b, you must either submit at least one analysis or briefly describe the reasons the pollutant is expected to be discharged. Note that there are 7 pages to this part; please review each carefully. Complete one table *(all 7 pages)* for each outfall. See instructions for additional details and requirements.

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
METALS, CYANIDE, AND TOTAL PHENOLS															
1m. Antimony, Total (7440-36-0)	☐	☒	☐	*<0.002*	*mg/L*					*1*					
2M. Arsenic, Total (7440-38-2)	☐	☒	☐	*<0.002*	*mg/L*					*1*					
3M. Beryllium, Total (7440-41-7)	☐	☒	☐	*<0.001*	*mg/L*					*1*					
4M. Cadmium, Total (7440-43-9)	☐	☒	☐	*0.003*	*mg/L*					*1*					
5M Chromium, Total (7440-47-3)	☐	☒	☐	*<0.006*	*mg/L*					*1*					
6M Copper, Total (7440-50-8)	☐	☒	☐	*0.003*	*mg/L*					*1*					
7M lead, Total (7439-92-1)	☐	☒	☐	*<0.0075*	*mg/L*					*1*					
8M Mercury, Total (7439-97-6)	☐	☒	☐	*<0.002*	*mg/L*					*1*					
9M Nickel, Total (7440-02-0)	☐	☒	☐	*<0.010*	*mg/L*					*1*					
10M Selenium, Total (7782-49-2)	☐	☒	☐	*<0.002*	*mg/L*					*1*					
11M Silver, Total (7440-22-4)	☐	☒	☐	*<0.002*	*mg/L*					*1*					
12M Thallium, Total (7440-28-0)	☐	☒	☐	*<0.020*	*mg/L*					*1*					
13M Zinc, Total (7440-66-6)	☐	☒	☐	*<0.001*	*mg/L*					*1*					
14M Cyanide, Total (57-12-5)	☐	☒	☐	*<0.007*	*mg/L*					*1*					
15M Phenols, Total	☐	☒	☐	*<0.005*	*mg/L*					*1*					
DIOXIN															
2,3,7,8-Tetrachlorodibenzo-P-Dioxin (1764--01-6)	☐	☐	☒	DESCRIBE RESULTS											

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						d. NO. OF ANALYSES	3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*			a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - VOLATILE COMPOUNDS															
1V. Acrolein *(107-02-8)*	☐	☐	☒												
2V Acrylonitrile *(107-13-1)*	☐	☐	☒												
3V Benzene (71-43-2)	☐	☐	☒												
4V Bis *(Chloromethyl)* Ether (542-88-1)	☐	☐	☒												
5V Bromoform (75-25-2)	☐	☐	☒												
6V Carbon Tetrachloride (56-23-5)	☐	☐	☒												
7V Chlorobenzene (108-90-7)	☐	☐	☒												
8V Chlorodibromomethane (124-48-1)	☐	☐	☒												
9V Chloroethane (75-00-3)	☐	☐	☒												
10V 2-Chloroethylvinyl Ether (110-75-8)	☐	☐	☒												
11V Chloroform (67-66-3)	☐	☐	☒												
12V Dichlorobromoethane (75-71-8)	☐	☐	☒												
13V Dichlorodifluoromethane (75-71-8)	☐	☐	☒												
14V 1,1-Dichloroethane (75-34-3)	☐	☐	☒												
15V 1,2-Dichloroethane (107-06-2)	☐	☐	☒												
16V 1,1-Dichloroethylene (75335-4)	☐	☐	☒												
17V 1,2-Dichloropropane (78-87-5)	☐	☐	☒												
18V 1,3-Dichloropropylene (542-76-6)	☐	☐	☒												
19V Ethylbenzene (100-41-4)	☐	☐	☒												
20V Methyl Bromide (74-83-9)	☐	☐	☒												
21V Methyl Chloride (74-87-3)	☐	☐	☒												

CONTINUED FROM PAGE V-4

EPA I.D. NUMBER (copy from Item 1 of Form 1) | OUTFALL NUMBER 006

1. POLLUTANT AND CAS NO. (if available)	2. MARK 'X'			2. EFFLUENT						d. NO. OF ANALYSIS	3. UNITS (specify if blank)		4. INTAKE (optional)		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE (if available)		c. LONG TERM AVRG. VALUE (if available)			a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - VOLATILE COMPOUNDS (continued)															
22 V Methylene Chloride (75-09-2)	☐	☐	☒												
23V 1,1,2,2-Tetra-Chloroethane (79-34-5)	☐	☐	☒												
24V Tetrachloro-ethylene (127-18-4)	☐	☐	☒												
25V Toluene (108-88-3)	☐	☐	☒												
26V 1,2-Trans-Dichloroethylene (156-60-5)	☐	☐	☒												
27V 1,1,1-Tri-chloroethane (71-55-6)	☐	☐	☒												
28V 1,1,2-Tri-chloroethane (79-00-5)	☐	☐	☒												
29V Trichloro-ethylene (79-01-6)	☐	☐	☒												
30V Trichloro-fluoromethane (75-69-4)	☐	☐	☒												
31V Vinyl Chloride (75-01-4)	☐	☐	☒												
GC/MS FRACTION - ACID COMPOUNDS															
1A 2-Chlorophenol (95-57-8)	☐	☐	☒												
2A 2,4-Dichloro-phenol (120-83-2)	☐	☐	☒												
3A 2,4-Dimethyl-phenol (105-67-9)	☐	☐	☒												
4A 4,6-Dinitro-O-cresol (534-52-1)	☐	☐	☒												
5A 2,4-Dinitro-phenol (51-28-5)	☐	☐	☒												
6A 2-Nitro-phenol (88-75-5)	☐	☐	☒												
7A 4-Ntro-phenol (100-02-7)	☐	☐	☒												
8A P-Chloro-M-Cresol (59-50-7)	☐	☐	☒												
9A Penta-chlorophenol (87-86-5)	☐	☐	☒												
10A Phenol (10/-95-2)	☐	☐	☒												
11A 2,4,6-Tri-chlorophenol (88-06-2)	☐	☐	☒												

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						d. NO. OF ANALYSIS	3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*			a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION - BASE/NEUTRAL COMPOUNDS															
1B Acenphthene (83-32-9)	☐	☐	☒												
2B Acenaphtylene (208-96-8)	☐	☐	☒												
3B Anthracene (120-12-7)	☐	☐	☒												
4B Benzidine (92-87-5)	☐	☐	☒												
5B Benzo (a) Anthracene (56-55-3)	☐	☐	☒												
6B Benzo (a) Pyrene (50-32-8)	☐	☐	☒												
7B 3,4-Benzo-fluoranthene (205-99-2)	☐	☐	☒												
8B Benzo *(ghi)* Perylene (191-24-2)	☐	☐	☒												
9B Benzo *(k)* Fluoranthene (207-08-9)	☐	☐	☒												
10B Bis *(2-Chloroethoxy)* Methane (111-91-1)	☐	☐	☒												
11B Bis *(2-Chloro-ethyl)* Ether (111-44-4)	☐	☐	☒												
12B Bis *(2-Chloroisepropyl)* Ether (102-60-1	☐	☐	☒												
13B Bis*(2-Ethyl-hexyl)* Phthalate (117-81-7)	☐	☐	☒												
14 B 4-Bromo-phenyl Phenyl Ether (101-55-3)	☐	☐	☒												
15B Butyl Benzyl Phthalate (85-68-7)	☐	☐	☒												
16B 2-Chloro-naphthalene (91-68-7)	☐	☐	☒												
17B 4-Chloro-phenyl Phenyl Ether (7005-72-3)	☐	☐	☒												
18B Chrysene (218-01-9)	☐	☐	☒												
19B Dibenzo *(a,h)* Anthracene (53-70-3)	☐	☐	☒												
20B 1,2-Dichloro-benzene (95-50-1)	☐	☐	☒												
21B 1,3-Dichloro-benzene (541-73-1)	☐	☐	☒												

1. POLLUTANT AND CAS NO. (if available)	2. MARK 'X'			2. EFFLUENT						3. UNITS (specify if blank)		4. INTAKE (optional)		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE (if available)		c. LONG TERM AVRG. VALUE (if available)		d. NO. OF ANALYSIS		a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS		a. CONCENTRATION	b. MASS	(1) CONCENTRATION	(2) MASS	
GC/MS - BASE/NEUTRAL COMPOUNDS (continued)															
22B 1,4-Dichlorobenzene (106-46-7)	☐	☐	☒												
23B 3,3'-Dichlorobenzidine (91-94-1)	☐	☐	☒												
24B Diethyl Phthalate (84-66-2)	☐	☐	☒												
25B Dimethyl Phthalate (131-11-3)	☐	☐	☒												
26B Di-N-Butyl Phthalate (131-11-3)	☐	☐	☒												
27B 2,4-Dinitrotoluene (121-14-2)	☐	☐	☒												
28B 2,6-Dinitrotoluene (606-20-2)	☐	☐	☒												
29B Di-N-Octyl Phthalate (117-84-0)	☐	☐	☒												
30B 1,2-Diphenylhydrazine (as Azo-benzene) (122-66-7)	☐	☐	☒												
31B Fluoranthene (206-44-0)	☐	☐	☒												
32B Fluorene (86-73-7)	☐	☐	☒												
33B Hexachlorobenzene (118-74-1)	☐	☐	☒												
34B Hexachlorobutadiene (87-68-3)	☐	☐	☒												
35B Hexachlorocyclopentadiene (77-47-4)	☐	☐	☒												
36B Hexachloroethane (67-72-1)	☐	☐	☒												
37B Indeno (1,2,3-cd) Pyrene (193-39-5)	☐	☐	☒												
38B Isophorone (78-59-1)	☐	☐	☒												
39B Napthalene (91-20-3)	☐	☐	☒												
40B Nitrobenzene (98-95-3)	☐	☐	☒												
41B N-Nitrosodimethylamine (62-75-9)	☐	☐	☒												
42B N-Nitrosdi-N-Propylamine (621-64-7)	☐	☐	☒												

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION - BASE/NEUTRAL COMPOUNDS *(continued)*															
43B N-Nitrosodiphenylamine (86-30-6)	☐	☐	☒												
44B Phenanthrene (85-01-/	☐	☐	☒												
45B Pyrene (129-00-0)	☐	☐	☒												
46B 1,2,4-Trichlorobenzene (120-82-1)	☐	☐	☒												
GC/MS FRACTION - PESTICIDES															
1P Aldrin (309-00-2)	☐	☐	☒												
2P β-Bhc (319-85-7)	☐	☐	☒												
4P γ-BHC (58-89-9)	☐	☐	☒												
5P δ-BHC (319-86-8)	☐	☐	☒												
6P Chlordane (57-74-9)	☐	☐	☒												
7P 4,4'-DDT (50-29-3)	☐	☐	☒												
8P 4,4'-DDE (72-55-9)	☐	☐	☒												
9P 4,4'-DDD (72-54-8)	☐	☐	☒												
10P Dieldrin (60-57-1)	☐	☐	☒												
11P α-Endosulfan (115-29-7)	☐	☐	☒												
12P β-Endosulfan (115-29-7	☐	☐	☒												
13P Endosulfan Sulfate (1031-07-8)	☐	☐	☒												
14P Endrin (72-20-8)	☐	☐	☒												
15P Endrin Aldehyde (7421-93-4)	☐	☐	☒												
16P Heptachlor (76-44-8)	☐	☐	☒												

CONTINUED FROM PAGE V-6

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*	OUTFALL NUMBER
	006

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - PESTICIDES *(continued)*															
17P Heptachlor Expxide (1024-57-3)	☐	☐	☒												
18P PCB-1242 (53469-21-9)	☐	☐	☒												
19P PCB-1254 (11097-69-1)	☐	☐	☒												
20P PCB-1221 (11104-28-2)	☐	☐	☒												
21P PCB-1232 (11141-16-5)	☐	☐	☒												
22P PCB-1248 (12672-29-6)	☐	☐	☒												
23P PCB-1260 (11096-82-5)	☐	☐	☒												
24P PCB-1016 (12674-11-2)	☐	☐	☒												
25P Toxaphene (8001-35-2)	☐	☐	☒												

PLEASE PRINT OR TYPE IN THE UNSHADED AREAS ONLY. You may report some or all of this information on separate sheets *(use the same format)* instead of completing these pages. SEE INSTRUCTIONS.

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*

V. INTAKE AND EFFLUENT CHARACTERISTICS *(continued from page 3 of Form 2-C)*

007

PART A - You must provide the results of at least one analysis for every pollutant in this table. Complete one table for each outfall. See instructions for additional details.

1. POLLUTANT	2. EFFLUENT a. MAXIMUM DAILY VALUE (1) CONCENTRATION	a. MAXIMUM DAILY VALUE (2) MASS	b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	d. NO. OF ANALYSIS	3. UNITS *(specify if blank)* a. CONCEN-TRATION	3. UNITS b. MASS	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	a. LONG TERM AVERAGE VALUE (2) MASS	4. b. NO. OF ANALYSES
a. Biochemical Oxygen Demand *(BOD)*												
b. Chemical Oxygen Demand *(COD)*												
c. Total Organic Carbon *(TOC)*												
d. Total Suspended Solids *(TSS)*	*1*	*mg/L*					*1*					
e. Ammonia *(as N)*												
f. Flow	Value *0*		Value		Value		*1*			Value		
g. Temperature *(winter)*	Value		Value		Value			°C		Value		
h. Temperature *(summer)*	Value		Value		Value			°C		Value		
i. pH	Minimum *-*	Maximum *9.1*	Minimum	Maximum			*1*	STANDARD UNTIS				

PART B - Mark "X" in column 2-a for each pollutant you know or have reason to believe is present. Mark "X" in column 2-b for each pollutant you believe to be absent. If you mark column 2a for any pollutant which is limited either directly, or indirectly but expressly, in an effluent limitation guideline, you must provide the results of at least one analysis for that pollutant. For other pollutants for which you mark column 2a, you must provide quantitative data or an explanation of their presence in your discharge. Complete one table for each outfall. See the instructions for additional details and requirements.

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X' a. BELIEVED PRESENT	2. MARK 'X' b. BELIEVED ABSENT	2. EFFLUENT a. MAXIMUM DAILY VALUE (1) CONCENTRATION	a. MAXIMUM DAILY VALUE (2) MASS	b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	d. NO. OF ANALYSIS	3. UNITS *(specify if blank)* a. CONCEN-TRATION	3. UNITS b. MASS	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	a. LONG TERM AVERAGE VALUE (2) MASS	4. b. NO. OF ANALYSES
a. Bromide (24959-67-9)	☐	☒												
b. Chlorine, Total Residual	☐	☒												
c. Color	☐	☒												
d. Fecal Coliform	☐	☒												
e. Fluoride (16984-48-8)	☐	☒												
f. Nitrate-Nitrite *(as N)*	☐	☒												

R17610

ITEM V-B CONTINUED FROM FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'		2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. BELIEVED PRESENT	b. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
			(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
g. Nitrogen, Total Organic *(as N)*	☐	☒												
h. Oil and Grease	☐	☒												
i. Phosphorus *(as P)*, Total (7723-14-0)	☐	☐												
j. Radioactivity														
(1) Alpha, Total	☐	☒												
(2) Bets, Total	☐	☒												
(3) Radium, Total	☐	☒												
(4) Radium 226, Total	☐	☒												
k. Sulfate *(as SO_4) (14808-79-8)*	☒	☐	*1130*	*mg/L*					*1*					
l. Sulfide (as S)	☐	☒												
m. Sulfite *(as SO_3)(14265-45-3)*	☐	☒												
n. Surfactants	☐	☒												
o. Aluminum, Total (7429-90-5)	☐	☒												
p. Barium, Total (7440-39-3)	☐	☒												
q. Boron, Total (7440-42-8)	☐	☒												
r. Cobalt, Total (7440-48-4)	☐	☒												
s. Iron, Total (7439-89-4)	☒	☐	*<0.006*	*mg/L*					*1*					
t. Magnesium, Total (7439-95-4)	☐	☒												
u. Molybdenum, Total (7439-98-7)	☐	☒												
v. Manganese, Total (7439-96-5)	☒	☐	*0.741*	*mg/L*					*1*					
w. Tin, Total (7440-31-5)	☐	☒												
x. Titanium, Total (7440-32-6)	☐	☒												

CONTINUED FROM PAGE 3 OF FORM 2-C

EPA I.D. NUMBER *(copy ... item 1 of Form 1)*	OUTFALL NUMBER
	007

PART C - If you are a primary industry and this outfall contains process wastewater, refer to Table 2c-2 in the instructions to determine which of the GC/MS fractions you must test for. Mark "X" in column 2-a for all such GC/MS fractions that apply to your industry and for ALL toxic metals, cyanides, and total phenols. If you are not required to mark column 2-a *(secondary industries, nonprocess wastewater outfalls, and non-required GC/MS fractions)*, mark "X" in column 2-b for each pollutant you know or have reason to believe is present. Mark "X" in column 2-c for each pollutant you believe is absent. If you mark column 2a for any pollutant, you must provide the results of at least one analysis for that pollutant. If you mark column 2b for any pollutant, you must provide the results of at least one analysis for that pollutant. If you know or have reason to believe it will be discharged in concentrations of 10 ppb or greater. If you mark column 2b for acrolein, acrylonitrile, 2,4 dinitrophenol, or 2-methyl-4, 6 dinitrophenol, you must provide the results of at least one analysis for each of these pollutants which you know or have reason to believe that you discharge in concentrations of 100 ppb or greater. Otherwise, for pollutants for which you mark column 2b, you must either submit at least one analysis or briefly describe the reasons the pollutant is expected to be discharged. Note that there are 7 pages to this part; please review each carefully. Complete one table *(all 7 pages)* for each outfall. See instructions for additional details and requirements.

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						d. NO. OF ANALYSIS	3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*			a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
METALS, CYANIDE, AND TOTAL PHENOLS															
1m. Antimony, Total (7440-36-0)	☐	☒	☐	<0.002	mg/L					1					
2M. Arsenic, Total (7440-38-2)	☐	☒	☐	<0.002	mg/L					1					
3M. Beryllium, Total (7440-41-7)	☐	☒	☐	<0.001	mg/L					1					
4M. Cadmium, Total (7440-43-9)	☐	☒	☐	0.006	mg/L					1					
5M Chromium, Total (7440-47-3)	☐	☒	☐	<0.006	mg/L					1					
6M Copper, Total (7440-50-8)	☐	☒	☐	0.003	mg/L					1					
7M lead, Total (7439-92-1)	☐	☒	☐	<0.0075	mg/L					1					
8M Mercury, Total (7439-97-6)	☐	☒	☐	<0.002	mg/L					1					
9M Nickel, Total (7440-02-0)	☐	☒	☐	<0.010	mg/L					1					
10M Selenium, Total (7782-49-2)	☐	☒	☐	<0.002	mg/L					1					
11M Silver, Total (7440-22-4)	☐	☒	☐	<0.002	mg/L					1					
12M Thallium, Total (7440-28-0)	☐	☒	☐	<0.020	mg/L					1					
13M Zinc, Total (7440-66-6)	☐	☒	☐	<0.001	mg/L					1					
14M Cyanide, Total (57-12-5)	☐	☒	☐	<0.007	mg/L					1					
15M Phenols, Total	☐	☒	☐	0.005	mg/L					1					
DIOXIN															
2,3,7,8-Tetrachlorodibenzo-P-Dioxin (1764--01-6)	☐	☐	☒	DESCRIBE RESULTS											

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - VOLATILE COMPOUNDS															
1V. Acrolein (107-02-8)	☐	☐	☒												
2V Acrylonitrile (107-13-1)	☐	☐	☒												
3V Benzene (71-43-2)	☐	☐	☒												
4V Bis *(Chloromethyl)* Ether (542-88-1)	☐	☐	☒												
5V Bromoform (75-25-2)	☐	☐	☒												
6V Carbon Tetrachloride (56-23-5)	☐	☐	☒												
7V Chlorobenzene (108-90-7)	☐	☐	☒												
8V Chlorodibromomethane (124-48-1)	☐	☐	☒												
9V Chloroethane (75-00-3)	☐	☐	☒												
10V 2-Chloroethylvinyl Ether (110-75-8)	☐	☐	☒												
11V Chloroform (67-66-3)	☐	☐	☒												
12V Dichlorobromoethane (75-71-8)	☐	☐	☒												
13V Dichlorodifluoromethane (75-71-8)	☐	☐	☒												
14V 1,1-Dichloroethane (75-34-3)	☐	☐	☒												
15V 1,2-Dichloroethane (107-06-2)	☐	☐	☒												
16V 1,1-Dichloroethylene (75335-4)	☐	☐	☒												
17V 1,2-Dichloropropane (78-87-5)	☐	☐	☒												
18V 1,3-Dichloropropylene (542-76-6)	☐	☐	☒												
19V Ethylbenzene (100-41-4)	☐	☐	☒												
20V Methyl Bromide (74-83-9)	☐	☐	☒												
21V Methyl Chloride (74-87-3)	☐	☐	☒												

1. POLLUTANT AND CAS NO. (if available)	2. MARK 'X'			2. EFFLUENT							3. UNITS (specify if blank)		4. INTAKE (optional)		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE (if available)		c. LONG TERM AVRG. VALUE (if available)		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - VOLATILE COMPOUNDS (continued)															
22 V Methylene Chloride (75-09-2)	☐	☐	☒												
23V 1,1,2,2-Tetrachloroethane (79-34-5)	☐	☐	☒												
24V Tetrachloroethylene (127-18-4)	☐	☐	☒												
25V Toluene (108-88-3)	☐	☐	☒												
26V 1,2-Trans-Dichloroethylene (156-60-5)	☐	☐	☒												
27V 1,1,1-Trichloroethane (71-55-6)	☐	☐	☒												
28V 1,1,2-Trichloroethane (79-00-5)	☐	☐	☒												
29V Trichloroethylene (79-01-6)	☐	☐	☒												
30V Trichlorofluoromethane (75-69-4)	☐	☐	☒												
31V Vinyl Chloride (75-01-4)	☐	☐	☒												
GC/MS FRACTION - ACID COMPOUNDS															
1A 2-Chlorophenol (95-57-8)	☐	☐	☒												
2A 2,4-Dichlorophenol (120-83-2)	☐	☐	☒												
3A 2,4-Dimethylphenol (105-67-9)	☐	☐	☒												
4A 4,6-Dinitro-O-cresol (534-52-1)	☐	☐	☒												
5A 2,4-Dinitrophenol (51-28-5)	☐	☐	☒												
6A 2-Nitrophenol (88-75-5)	☐	☐	☒												
7A 4-Nitrophenol (100-02-7)	☐	☐	☒												
8A P-Chloro-M-Cresol (59-50-7)	☐	☐	☒												
9A Pentachlorophenol (87-86-5)	☐	☐	☒												
10A Phenol (10/-95-2)	☐	☐	☒												
11A 2,4,6-Trichlorophenol (88-06-2)	☐	☐	☒												

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION - BASE/NEUTRAL COMPOUNDS															
1B Acenphthene (83-32-9)	☐	☐	☒												
2B Acenaphtylene (208-96-8)	☐	☐	☒												
3B Anthracene (120-12-7)	☐	☐	☒												
4B Benzidine (92-87-5)	☐	☐	☒												
5B Benzo (a) Anthracene (56-55-3)	☐	☐	☒												
6B Benzo (a) Pyrene (50-32-8)	☐	☐	☒												
7B 3,4-Benzo-fluoranthene (205-99-2)	☐	☐	☒												
8B Benzo *(ghi)* Perylene (191-24-2)	☐	☐	☒												
9B Benzo *(k)* Fluoranthene (207-08-9)	☐	☐	☒												
10B Bis *(2-Chloroethoxy)* Methane (111-91-1)	☐	☐	☒												
11B Bis *(2-Chloro-ethyl)* Ether (111-44-4)	☐	☐	☒												
12B Bis *(2-Chloroisepropyl)* Ether (102-60-1	☐	☐	☒												
13B Bis*(2-Ethyl-hexyl)* Phthalate (117-81-7)	☐	☐	☒												
14 B 4-Bromo-phenyl Phenyl Ether (101-55-3)	☐	☐	☒												
15B Butyl Benzyl Phthalate (85-68-7)	☐	☐	☒												
16B 2-Chloro-naphthalene (91-68-7)	☐	☐	☒												
17B 4-Chloro-phenyl Phenyl Ether (7005-72-3)	☐	☐	☒												
18B Chrysene (218-01-9)	☐	☐	☒												
19B Dibenzo *(a,h)* Anthracene (53-70-3)	☐	☐	☒												
20B 1,2-Dichloro-benzene (95-50-1)	☐	☐	☒												
21B 1,3-Dichloro-benzene (541-73-1)	☐	☐	☒												

EPA I.D. NUMBER (copy from Item 1 of Form 1)

OUTFALL NUMBER 007

1. POLLUTANT AND CAS NO. (if available)	2. MARK 'X'			2. EFFLUENT							3. UNITS (specify if blank)		4. INTAKE (optional)		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE (if available)		c. LONG TERM AVRG. VALUE (if available)		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - BASE/NEUTRAL COMPOUNDS (continued)															
22B 1,4-Dichlorobenzene (106-46-7)	☐	☐	☒												
23B 3,3'-Dichlorobenzidine (91-94-1)	☐	☐	☒												
24B Diethyl Phthalate (84-66-2)	☐	☐	☒												
25B Dimethyl Phthalate (131-11-3)	☐	☐	☒												
26B Di-N-Butyl Phthalate (131-11-3)	☐	☐	☒												
27B 2,4-Dinitrotoluene (121-14-2)	☐	☐	☒												
28B 2,6-Dinitrotoluene (606-20-2)	☐	☐	☒												
29B Di-N-Octyl Phthalate (117-84-0)	☐	☐	☒												
30B 1,2-Diphenylhydrazine (as Azo-benzene) (122-66-7)	☐	☐	☒												
31B Fluoranthene (206-44-0)	☐	☐	☒												
32B Fluorene (86-73-7)	☐	☐	☒												
33B Hexachlorobenzene (118-74-1)	☐	☐	☒												
34B Hexachlorobutadiene (87-68-3)	☐	☐	☒												
35B Hexachlorocyclopentadiene (77-47-4)	☐	☐	☒												
36B Hexachloroethane (67-72-1)	☐	☐	☒												
37B Indeno (1,2,3-cd) Pyrene (193-39-5)	☐	☐	☒												
38B Isophorone (78-59-1)	☐	☐	☒												
39B Napthalene (91-20-3)	☐	☐	☒												
40B Nitrobenzene (98-95-3)	☐	☐	☒												
41B N-Nitrosodimethylamine (62-75-9)	☐	☐	☒												
42B N-Nitrosdi-N-Propylamine (621-64-7)	☐	☐	☒												

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION - BASE/NEUTRAL COMPOUNDS *(continued)*															
43B N-Nitrosodiphenylamine (86-30-6)	☐	☐	☒												
44B Phenanthrene (85-01-/	☐	☐	☒												
45B Pyrene (129-00-0)	☐	☐	☒												
46B 1,2,4-Trichlorobenzene (120-82-1)	☐	☐	☒												
GC/MS FRACTION - PESTICIDES															
1P Aldrin (309-00-2)	☐	☐	☒												
2P β-Bhc (319-85-7)	☐	☐	☒												
4P γ-BHC (58-89-9)	☐	☐	☒												
5P δ-BHC (319-86-8)	☐	☐	☒												
6P Chlordane (57-74-9)	☐	☐	☒												
7P 4,4'-DDT (50-29-3)	☐	☐	☒												
8P 4,4'-DDE (72-55-9)	☐	☐	☒												
9P 4,4'-DDD (72-54-8)	☐	☐	☒												
10P Dieldrin (60-57-1)	☐	☐	☒												
11P α-Endosulfan (115-29-7)	☐	☐	☒												
12P β-Endosulfan (115-29-7	☐	☐	☒												
13P Endosulfan Sulfate (1031-07-8)	☐	☐	☒												
14P Endrin (72-20-8)	☐	☐	☒												
15P Endrin Aldehyde (7421-93-4)	☐	☐	☒												
16P Heptachlor (76-44-8)	☐	☐	☒												

CONTINUED FROM PAGE V-6

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*	OUTFALL NUMBER
	007

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - PESTICIDES *(continued)*															
17P Heptachlor Expxide (1024-57-3)	☐	☐	☒												
18P PCB-1242 (53469-21-9)	☐	☐	☒												
19P PCB-1254 (11097-69-1)	☐	☐	☒												
20P PCB-1221 (11104-28-2)	☐	☐	☒												
21P PCB-1232 (11141-16-5)	☐	☐	☒												
22P PCB-1248 (12672-29-6)	☐	☐	☒												
23P PCB-1260 (11096-82-5)	☐	☐	☒												
24P PCB-1016 (12674-11-2)	☐	☐	☒												
25P Toxaphene (8001-35-2)	☐	☐	☒												

PLEASE PRINT OR TYPE IN THE UNSHADED AREAS ONLY. You may report some or all of this information on separate sheets *(use the same format)* instead of completing these pages. SEE INSTRUCTIONS.

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*

V. INTAKE AND EFFLUENT CHARACTERISTICS *(continued from page 3 of Form 2-C)*

008

PART A - You must provide the results of at least one analysis for every pollutant in this table. Complete one table for each outfall. See instructions for additional details.

1. POLLUTANT	2. EFFLUENT a. MAXIMUM DAILY VALUE (1) CONCENTRATION	a. MAXIMUM DAILY VALUE (2) MASS	b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	d. NO. OF ANALYSIS	3. UNITS *(specify if blank)* a. CONCENTRATION	3. UNITS b. MASS	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	a. LONG TERM AVERAGE VALUE (2) MASS	b. NO. OF ANALYSES
a. Biochemical Oxygen Demand *(BOD)*												
b. Chemical Oxygen Demand *(COD)*												
c. Total Organic Carbon *(TOC)*												
d. Total Suspended Solids *(TSS)*	*19*	*mg/L*					*1*					
e. Ammonia *(as N)*												
f. Flow	Value *0*		Value		Value		*1*			Value		
g. Temperature *(winter)*	Value		Value		Value			°C		Value		
h. Temperature *(summer)*	Value		Value		Value			°C		Value		
i. pH	Minimum *-*	Maximum *8.7*	Minimum	Maximum			*1*	STANDARD UNTIS				

PART B - Mark "X" in column 2-a for each pollutant you know or have reason to believe is present. Mark "X" in column 2-b for each pollutant you believe to be absent. If you mark column 2a for any pollutant which is limited either directly, or indirectly but expressly, in an effluent limitation guideline, you must provide the results of at least one analysis for that pollutant. For other pollutants for which you mark column 2a, you must provide quantitative data or an explanation of their presence in your discharge. Complete one table for each outfall. See the instructions for additional details and requirements.

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X' a. BELIEVED PRESENT	2. MARK 'X' b. BELIEVED ABSENT	2. EFFLUENT a. MAXIMUM DAILY VALUE (1) CONCENTRATION	a. MAXIMUM DAILY VALUE (2) MASS	b. MAXIMUM 30 DAY VALUE *(if available)* (1) CONCENTRATION	b. MAXIMUM 30 DAY VALUE *(if available)* (2) MASS	c. LONG TERM AVRG. VALUE *(if available)* (1) CONCENTRATION	c. LONG TERM AVRG. VALUE *(if available)* (2) MASS	d. NO. OF ANALYSIS	3. UNITS *(specify if blank)* a. CONCENTRATION	3. UNITS b. MASS	4. INTAKE *(optional)* a. LONG TERM AVERAGE VALUE (1) CONCENTRATION	a. LONG TERM AVERAGE VALUE (2) MASS	b. NO. OF ANALYSES
a. Bromide (24959-67-9)	☐	☒												
b. Chlorine, Total Residual	☐	☒												
c. Color	☐	☒												
d. Fecal Coliform	☐	☒												
e. Fluoride (16984-48-8)	☐	☒												
f. Nitrate-Nitrite *(as N)*	☐	☒												

ITEM V-C CONTINUED FROM FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'		2. EFFLUENT						3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. BELIEVED PRESENT	b. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
			(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
g. Nitrogen, Total Organic *(as N)*	☐	☒												
h. Oil and Grease	☐	☒												
i. Phosphorus *(as P)*, Total (7723-14-0)	☐	☐												
j. Radioactivity														
(1) Alpha, Total	☐	☒												
(2) Bets, Total	☐	☒												
(3) Radium, Total	☐	☒												
(4) Radium 226, Total	☐	☒												
k. Sulfate *(as SO_4)* *(14808-79-8)*	☒	☐	*1100*	*mg/L*					*1*					
l. Sulfide (as S)	☐	☒												
m. Sulfite *(as SO_3)(14265-45-3)*	☐	☒												
n. Surfactants	☐	☒												
o. Aluminum, Total (7429-90-5)	☐	☒												
p. Barium, Total (7440-39-3)	☐	☒												
q. Boron, Total (7440-42-8)	☐	☒												
r. Cobalt, Total (7440-48-4)	☐	☒												
s. Iron, Total (7439-89-4)	☒	☐	*<0.006*	*mg/L*					*1*					
t. Magnesium, Total (7439-95-4)	☐	☒												
u. Molybdenum, Total (7439-98-7)	☐	☒												
v. Manganese, Total (7439-96-5)	☒	☐	*0.011*	*mg/L*					*1*					
w. Tin, Total (7440-31-5)	☐	☒												
x. Titanium, Total (7440-32-6)	☐	☒												

CONTINUED FROM PAGE 3 OF FORM 2-C

EPA I.D. NUMBER (copy from Item 1 of Form 1)	OUTFALL NUMBER
	008

PART C - If you are a primary industry and this outfall contains process wastewater, refer to Table 2c-2 in the instructions to determine which of the GC/MS fractions you must test for. Mark "X" in column 2-a for all such GC/MS fractions that apply to your industry and for ALL toxic metals, cyanides, and total phenols. If you are not required to mark column 2-a *(secondary industries, nonprocess wastewater outfalls, and non-required GC/MS fractions)*, mark "X" in column 2-b for each pollutant you know or have reason to believe is present. Mark "X" in column 2-c for each pollutant you believe is absent. If you mark column 2a for any pollutant, you must provide the results of at least one analysis for that pollutant. If you mark column 2b for any pollutant, you must provide the results of at least one analysis for that pollutant. If you know or have reason to believe it will be discharged in concentrations of 10 ppb or greater. If you mark column 2b for acrolein, acrylonitrile, 2,4 dinitrophenol, or 2-methyl-4, 6 dinitrophenol, you must provide the results of at least one analysis for each of these pollutants which you know or have reason to believe that you discharge in concentrations of 100 ppb or greater. Otherwise, for pollutants for which you mark column 2b, you must either submit at least one analysis or briefly describe the reasons the pollutant is expected to be discharged. Note that there are 7 pages to this part; please review each carefully. Complete one table *(all 7 pages)* for each outfall. See instructions for additional details and requirements.

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
METALS, CYANIDE, AND TOTAL PHENOLS															
1m. Antimony, Total (7440-36-0)	☐	☒	☐	<0.002	mg/L					1					
2M. Arsenic, Total (7440-38-2)	☐	☒	☐	<0.002	mg/L					1					
3M. Beryllium, Total (7440-41-7)	☐	☒	☐	<0.001	mg/L					1					
4M. Cadmium, Total (7440-43-9)	☐	☒	☐	0.008	mg/L					1					
5M Chromium, Total (7440-47-3)	☐	☒	☐	<0.006	mg/L					1					
6M Copper, Total (7440-50-8)	☐	☒	☐	0.003	mg/L					1					
7M lead, Total (7439-92-1)	☐	☒	☐	<0.0075	mg/L					1					
8M Mercury, Total (7439-97-6)	☐	☒	☐	<0.002	mg/L					1					
9M Nickel, Total (7440-02-0)	☐	☒	☐	<0.010	mg/L					1					
10M Selenium, Total (7782-49-2)	☐	☒	☐	<0.002	mg/L					1					
11M Silver, Total (7440-22-4)	☐	☒	☐	<0.002	mg/L					1					
12M Thallium, Total (7440-28-0)	☐	☒	☐	<0.020	mg/L					1					
13M Zinc, Total (7440-66-6)	☐	☒	☐	<0.001	mg/L					1					
14M Cyanide, Total (57-12-5)	☐	☒	☐	<0.007	mg/L					1					
15M Phenols, Total	☐	☒	☐	0.005	mg/L					1					
DIOXIN															
2,3,7,8-Tetrachlorodibenzo-P-Dioxin (1764--01-6)	☐	☐	☒	DESCRIBE RESULTS											

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - VOLATILE COMPOUNDS															
1V. *Acrolein (107-02-8)*	☐	☐	☒												
2V *Acrylonitrile (107-13-1)*	☐	☐	☒												
3V Benzene (71-43-2)	☐	☐	☒												
4V Bis *(Chloromethyl)* Ether (542-88-1)	☐	☐	☒												
5V Bromoform (75-25-2)	☐	☐	☒												
6V Carbon Tetrachloride (56-23-5)	☐	☐	☒												
7V Chlorobenzene (108-90-7)	☐	☐	☒												
8V Chlorodibromomethane (124-48-1)	☐	☐	☒												
9V Chloroethane (75-00-3)	☐	☐	☒												
10V 2-Chloroethylvinyl Ether (110-75-8)	☐	☐	☒												
11V Chloroform (67-66-3)	☐	☐	☒												
12V Dichlorobromoethane (75-71-8)	☐	☐	☒												
13V Dichlorodifluoromethane (75-71-8)	☐	☐	☒												
14V 1,1-Dichloroethane (75-34-3)	☐	☐	☒												
15V 1,2-Dichloroethane (107-06-2)	☐	☐	☒												
16V 1,1-Dichloroethylene (75335-4)	☐	☐	☒												
17V 1,2-Dichloropropane (78-87-5)	☐	☐	☒												
18V 1,3-Dichloropropylene (542-76-6)	☐	☐	☒												
19V Ethylbenzene (100-41-4)	☐	☐	☒												
20V Methyl Bromide (74-83-9)	☐	☐	☒												
21V Methyl Chloride (74-87-3)	☐	☐	☒												

CONTINUED FROM PAGE V-4

EPA I.D. NUMBER *(copy ... Item 1 of Form 1)*

OUTFALL NUMBER *008*

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT							3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - VOLATILE COMPOUNDS *(continued)*															
22 V Methylene Chloride (75-09-2)	☐	☐	☒												
23V 1,1,2,2-Tetrachloroethane (79-34-5)	☐	☐	☒												
24V Tetrachloroethylene (127-18-4)	☐	☐	☒												
25V Toluene (108-88-3)	☐	☐	☒												
26V 1,2-Trans-Dichloroethylene (156-60-5)	☐	☐	☒												
27V 1,1,1-Trichloroethane (71-55-6)	☐	☐	☒												
28V 1,1,2-Trichloroethane (79-00-5)	☐	☐	☒												
29V Trichloroethylene (79-01-6)	☐	☐	☒												
30V Trichlorofluoromethane (75-69-4)	☐	☐	☒												
31V Vinyl Chloride (75-01-4)	☐	☐	☒												
GC/MS FRACTION - ACID COMPOUNDS															
1A 2-Chlorophenol (95-57-8)	☐	☐	☒												
2A 2,4-Dichlorophenol (120-83-2)	☐	☐	☒												
3A 2,4-Dimethylphenol (105-67-9)	☐	☐	☒												
4A 4,6-Dinitro-O-cresol (534-52-1)	☐	☐	☒												
5A 2,4-Dinitrophenol (51-28-5)	☐	☐	☒												
6A 2-Nitrophenol (88-75-5)	☐	☐	☒												
7A 4-Nitrophenol (100-02-7)	☐	☐	☒												
8A P-Chloro-M-Cresol (59-50-7)	☐	☐	☒												
9A Pentachlorophenol (87-86-5)	☐	☐	☒												
10A Phenol (10/-95-2)	☐	☐	☒												
11A 2,4,6-Trichlorophenol (88-06-2)	☐	☐	☒												

CONTINUE FROM THE FRONT

1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						d. NO. OF ANALYSIS	3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*			a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION - BASE/NEUTRAL COMPOUNDS															
1B Acenphthene (83-32-9)	☐	☐	☒												
2B Acenaphtylene (208-96-8)	☐	☐	☒												
3B Anthracene (120-12-7)	☐	☐	☒												
4B Benzidine (92-87-5)	☐	☐	☒												
5B Benzo (a) Anthracene (56-55-3)	☐	☐	☒												
6B Benzo (a) Pyrene (50-32-8)	☐	☐	☒												
7B 3,4-Benzo-fluoranthene (205-99-2)	☐	☐	☒												
8B Benzo *(ghi)* Perylene (191-24-2)	☐	☐	☒												
9B Benzo *(k)* Fluoranthene (207-08-9)	☐	☐	☒												
10B Bis *(2-Chloroethoxy)* Methane (111-91-1)	☐	☐	☒												
11B Bis *(2-Chloro-ethyl)* Ether (111-44-4)	☐	☐	☒												
12B Bis *(2-Chloroisepropyl)* Ether (102-60-1	☐	☐	☒												
13B Bis*(2-Ethyl-hexyl)* Phthalate (117-81-7)	☐	☐	☒												
14 B 4-Bromo-phenyl Phenyl Ether (101-55-3)	☐	☐	☒												
15B Butyl Benzyl Phthalate (85-68-7)	☐	☐	☒												
16B 2-Chloro-naphthalene (91-68-7)	☐	☐	☒												
17B 4-Chloro-phenyl Phenyl Ether (7005-72-3)	☐	☐	☒												
18B Chrysene (218-01-9)	☐	☐	☒												
19B Dibenzo *(a,h)* Anthracene (53-70-3)	☐	☐	☒												
20B 1,2-Dichloro-benzene (95-50-1)	☐	☐	☒												
21B 1,3-Dichloro-benzene (541-73-1)	☐	☐	☒												

CONTINUED FROM PAGE V-6

EPA I.D. NUMBER (copy Item 1 of Form 1) | OUTFALL NUMBER 008

1. POLLUTANT AND CAS NO. (if available)	2. MARK 'X'			2. EFFLUENT						3. UNITS (specify if blank)		4. INTAKE (optional)		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE (if available)		c. LONG TERM AVRG. VALUE (if available)		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - BASE/NEUTRAL COMPOUNDS (continued)															
22B 1,4-Dichlorobenzene (106-46-7)	☐	☐	☒												
23B 3,3'-Dichlorobenzidine (91-94-1)	☐	☐	☒												
24B Diethyl Phthalate (84-66-2)	☐	☐	☒												
25B Dimethyl Phthalate (131-11-3)	☐	☐	☒												
26B Di-N-Butyl Phthalate (131-11-3)	☐	☐	☒												
27B 2,4-Dinitrotoluene (121-14-2)	☐	☐	☒												
28B 2,6-Dinitrotoluene (606-20-2)	☐	☐	☒												
29B Di-N-Octyl Phthalate (117-84-0)	☐	☐	☒												
30B 1,2-Diphenylhydrazine (as Azo-benzene) (122-66-7)	☐	☐	☒												
31B Fluoranthene (206-44-0)	☐	☐	☒												
32B Fluorene (86-73-7)	☐	☐	☒												
33B Hexachlorobenzene (118-74-1)	☐	☐	☒												
34B Hexachlorobutadiene (87-68-3)	☐	☐	☒												
35B Hexachlorocyclopentadiene (77-47-4)	☐	☐	☒												
36B Hexachloroethane (67-72-1)	☐	☐	☒												
37B Indeno (1,2,3-cd) Pyrene (193-39-5)	☐	☐	☒												
38B Isophorone (78-59-1)	☐	☐	☒												
39B Napthalene (91-20-3)	☐	☐	☒												
40B Nitrobenzene (98-95-3)	☐	☐	☒												
41B N-Nitrosodimethylamine (62-75-9)	☐	☐	☒												
42B N-Nitrosdi-N-Propylamine (621-64-7)	☐	☐	☒												

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1. POLLUTANT AND CAS NO. *(if available)*	2. MARK 'X'			2. EFFLUENT						d. NO. OF ANALYSIS	3. UNITS *(specify if blank)*		4. INTAKE *(optional)*		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE *(if available)*		c. LONG TERM AVRG. VALUE *(if available)*			a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS FRACTION - BASE/NEUTRAL COMPOUNDS *(continued)*															
43B N-Nitrosodiphenylamine (86-30-6)	☐	☐	☒												
44B Phenanthrene (85-01-/	☐	☐	☒												
45B Pyrene (129-00-0)	☐	☐	☒												
46B 1,2,4-Trichlorobenzene (120-82-1)	☐	☐	☒												
GC/MS FRACTION - PESTICIDES															
1P Aldrin (309-00-2)	☐	☐	☒												
2P β-Bhc (319-85-7)	☐	☐	☒												
4P γ-BHC (58-89-9)	☐	☐	☒												
5P δ-BHC (319-86-8)	☐	☐	☒												
6P Chlordane (57-74-9)	☐	☐	☒												
7P 4,4'-DDT (50-29-3)	☐	☐	☒												
8P 4,4'-DDE (72-55-9)	☐	☐	☒												
9P 4,4'-DDD (72-54-8)	☐	☐	☒												
10P Dieldrin (60-57-1)	☐	☐	☒												
11P α-Endosulfan (115-29-7)	☐	☐	☒												
12P β-Endosulfan (115-29-7	☐	☐	☒												
13P Endosulfan Sulfate (1031-07-8)	☐	☐	☒												
14P Endrin (72-20-8)	☐	☐	☒												
15P Endrin Aldehyde (7421-93-4)	☐	☐	☒												
16P Heptachlor (76-44-8)	☐	☐	☒												

CONTINUED FROM PAGE V-6

EPA I.D. NUMBER (copy ... item 1 of Form 1)	OUTFALL NUMBER
	008

1. POLLUTANT AND CAS NO. (if available)	2. MARK 'X'			2. EFFLUENT							3. UNITS (specify if blank)		4. INTAKE (optional)		
	a. TESTING REQUIRED	b. BELIEVED PRESENT	c. BELIEVED ABSENT	a. MAXIMUM DAILY VALUE		b. MAXIMUM 30 DAY VALUE (if available)		c. LONG TERM AVRG. VALUE (if available)		d. NO. OF ANALYSIS	a. CONCENTRATION	b. MASS	a. LONG TERM AVERAGE VALUE		b. NO. OF ANALYSES
				(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS	(1) CONCENTRATION	(2) MASS				(1) CONCENTRATION	(2) MASS	
GC/MS - PESTICIDES (continued)															
17P Heptachlor Expxide (1024-57-3)	☐	☐	☒												
18P PCB-1242 (53469-21-9)	☐	☐	☒												
19P PCB-1254 (11097-69-1)	☐	☐	☒												
20P PCB-1221 (11104-28-2)	☐	☐	☒												
21P PCB-1232 (11141-16-5)	☐	☐	☒												
22P PCB-1248 (12672-29-6)	☐	☐	☒												
23P PCB-1260 (11096-82-5)	☐	☐	☒												
24P PCB-1016 (12674-11-2)	☐	☐	☒												
25P Toxaphene (8001-35-2)	☐	☐	☒												

GRAB SAMPLES
FROM SEDIMENT PONDS

SUMMIT ENVIRONMENTAL SERVICES, INC.

CHEMICAL ANALYSTS & CONSULTANTS

17650 Route 37
West Frankfort, Illinois 62896
Phone (618) 983-8280
Fax (618) 983-8208
Website: www.summitenviro.com

CLIENT:	Mach Mining	**REPORT DATE:**	12-04-09
PDL:	14084-1	**COMMENT:**	No Flow
SAMPLE ID:	Pond 1	**SAMPLED BY:**	Client
DATE SAMPLED:	11-17-09	**DATE RECEIVED:**	11-17-09

TEST DESCRIPTION	RESULT	UNITS	DETECTION LIMIT	METHOD	DATE/ ANALYST
Acidity	< 10	mg/L	10	305.1	11-17-09 LS
Alkalinity	135	mg/L	2	310.1	11-17-09 LS
Chlorides	273.6	mg/L	1	325.3	11-19-09 LS
Cyanide	< 0.007	mg/L	0.007	335.4	11-25-09 TL
pH	9.2	Unit		150.1	11-17-09 LS
Phenols, Total Recoverable	0.006	mg/L	0.005	420.1	11-23-09 TL
Sulfates	250	mg/L	1.0	375.4	11-20-09 LS
Total Suspended Solids	8	mg/L	1	160.2	11-18-09 LS
Metals:					
Antimony	< 0.002	mg/L	0.002	204.1	12-04-09 JB
Arsenic	< 0.002	mg/L	0.002	206.4	12-04-09 JB
Beryllium	< 0.001	mg/L	0.001	210.1	12-04-09 JB
Cadmium	0.003	mg/L	0.002	213.1	12-04-09 JB
Chromium	< 0.006	mg/L	0.006	218.1	12-04-09 JB
Copper	0.013	mg/L	0.003	220.1	12-04-09 JB
Iron	< 0.006	mg/L	0.006	236.1	12-04-09 JB
Lead	< 0.0075	mg/L	0.0075	239.1	12-04-09 JB
Mercury	< 0.002	mg/L	0.002	245.1	12-04-09 JB
Nickel	< 0.010	mg/L	0.010	249.1	12-04-09 JB
Selenium	< 0.002	mg/L	0.002	270.2	12-04-09 JB
Silver	< 0.002	mg/L	0.002	272.1	12-04-09 JB
Thallium	< 0.020	mg/L	0.020	279.1	12-04-09 JB
Zinc	< 0.001	mg/L	0.001	289.1	12-04-09 JB

Reviewed by: Joseph Bencini

SUMMIT ENVIRONMENTAL SERVICES, INC.

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Website: www.summitenviro.com

CLIENT:	Mach Mining	**REPORT DATE:**	12-04-09
PDL:	14084-2	**COMMENT:**	No Flow
SAMPLE ID:	Pond 2	**SAMPLED BY:**	Client
DATE SAMPLED:	11-17-09	**DATE RECEIVED:**	11-17-09

TEST DESCRIPTION	RESULT	UNITS	DETECTION LIMIT	METHOD	DATE/ ANALYST
Acidity	< 10	mg/L	10	305.1	11-17-09 LS
Alkalinity	116	mg/L	2	310.1	11-17-09 LS
Chlorides	74.0	mg/L	1	325.3	11-19-09 LS
Cyanide	< 0.008	mg/L	0.008	335.4	11-25-09 TL
pH	8.0	Unit		150.1	11-17-09 LS
Phenols, Total Recoverable	0.007	mg/L	0.005	420.1	11-23-09 TL
Sulfates	110	mg/L	1.0	375.4	11-20-09 LS
Total Suspended Solids	3	mg/L	1	160.2	11-18-09 LS
Metals:					
Antimony	< 0.002	mg/L	0.002	204.1	12-04-09 JB
Arsenic	< 0.002	mg/L	0.002	206.4	12-04-09 JB
Beryllium	< 0.001	mg/L	0.001	210.1	12-04-09 JB
Cadmium	0.003	mg/L	0.002	213.1	12-04-09 JB
Chromium	< 0.006	mg/L	0.006	218.1	12-04-09 JB
Copper	< 0.003	mg/L	0.003	220.1	12-04-09 JB
Iron	< 0.006	mg/L	0.006	236.1	12-04-09 JB
Lead	< 0.0075	mg/L	0.0075	239.1	12-04-09 JB
Mercury	< 0.002	mg/L	0.002	245.1	12-04-09 JB
Nickel	< 0.010	mg/L	0.010	249.1	12-04-09 JB
Selenium	< 0.002	mg/L	0.002	270.2	12-04-09 JB
Silver	< 0.002	mg/L	0.002	272.1	12-04-09 JB
Thallium	< 0.020	mg/L	0.020	279.1	12-04-09 JB
Zinc	< 0.001	mg/L	0.001	289.1	12-04-09 JB

Reviewed by: Joseph Bencini

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Website: www.summitenviro.com

CLIENT:	Mach Mining	**REPORT DATE:**	12-04-09
PDL:	14084-3	**COMMENT:**	No Flow
SAMPLE ID:	Pond 3	**SAMPLED BY:**	Client
DATE SAMPLED:	11-17-09	**DATE RECEIVED:**	11-17-09

TEST DESCRIPTION	RESULT	UNITS	DETECTION LIMIT	METHOD	DATE/ ANALYST
Acidity	< 10	mg/L	10	305.1	11-17-09 LS
Alkalinity	54	mg/L	2	310.1	11-17-09 LS
Chlorides	7.2	mg/L	1	325.3	11-19-09 LS
Cyanide	< 0.008	mg/L	0.008	335.4	11-25-09 TL
pH	7.2	Unit		150.1	11-17-09 LS
Phenols, Total Recoverable	0.006	mg/L	0.005	420.1	11-23-09 TL
Sulfates	30	mg/L	1.0	375.4	11-20-09 LS
Total Suspended Solids	3	mg/L	1	160.2	11-18-09 LS
Metals:					
Antimony	< 0.002	mg/L	0.002	204.1	12-04-09 JB
Arsenic	< 0.002	mg/L	0.002	206.4	12-04-09 JB
Beryllium	< 0.001	mg/L	0.001	210.1	12-04-09 JB
Cadmium	0.008	mg/L	0.002	213.1	12-04-09 JB
Chromium	< 0.006	mg/L	0.006	218.1	12-04-09 JB
Copper	0.007	mg/L	0.003	220.1	12-04-09 JB
Iron	0.133	mg/L	0.006	236.1	12-04-09 JB
Lead	< 0.0075	mg/L	0.0075	239.1	12-04-09 JB
Mercury	< 0.002	mg/L	0.002	245.1	12-04-09 JB
Nickel	< 0.010	mg/L	0.010	249.1	12-04-09 JB
Selenium	< 0.002	mg/L	0.002	270.2	12-04-09 JB
Silver	< 0.002	mg/L	0.002	272.1	12-04-09 JB
Thallium	< 0.020	mg/L	0.020	279.1	12-04-09 JB
Zinc	< 0.001	mg/L	0.001	289.1	12-04-09 JB

Reviewed by: Joseph Bencini

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CLIENT:	Mach Mining	**REPORT DATE:**	12-04-09
PDL:	14084-4	**COMMENT:**	No Flow
SAMPLE ID:	Pond 4	**SAMPLED BY:**	Client
DATE SAMPLED:	11-17-09	**DATE RECEIVED:**	11-17-09

TEST DESCRIPTION	RESULT	UNITS	DETECTION LIMIT	METHOD	DATE/ ANALYST
Acidity	< 10	mg/L	10	305.1	11-17-09 LS
Alkalinity	84	mg/L	2	310.1	11-17-09 LS
Chlorides	13.2	mg/L	1	325.3	11-19-09 LS
Cyanide	< 0.007	mg/L	0.007	335.4	11-25-09 TL
pH	8.9	Unit		150.1	11-17-09 LS
Phenols, Total Recoverable	< 0.005	mg/L	0.005	420.1	11-23-09 TL
Sulfates	110	mg/L	1.0	375.4	11-20-09 LS
Total Suspended Solids	3	mg/L	1	160.2	11-18-09 LS
Metals:					
Antimony	< 0.002	mg/L	0.002	204.1	12-04-09 JB
Arsenic	< 0.002	mg/L	0.002	206.4	12-04-09 JB
Beryllium	< 0.001	mg/L	0.001	210.1	12-04-09 JB
Cadmium	0.004	mg/L	0.002	213.1	12-04-09 JB
Chromium	< 0.006	mg/L	0.006	218.1	12-04-09 JB
Copper	< 0.003	mg/L	0.003	220.1	12-04-09 JB
Iron	< 0.006	mg/L	0.006	236.1	12-04-09 JB
Lead	< 0.0075	mg/L	0.0075	239.1	12-04-09 JB
Mercury	< 0.002	mg/L	0.002	245.1	12-04-09 JB
Nickel	< 0.010	mg/L	0.010	249.1	12-04-09 JB
Selenium	< 0.002	mg/L	0.002	270.2	12-04-09 JB
Silver	< 0.002	mg/L	0.002	272.1	12-04-09 JB
Thallium	< 0.020	mg/L	0.020	279.1	12-04-09 JB
Zinc	< 0.001	mg/L	0.001	289.1	12-04-09 JB

Reviewed by: Joseph Bencini Joseph Bencini

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Website: www.summitenviro.com

CLIENT:	Mach Mining	**REPORT DATE:**	12-04-09
PDL:	14084-5	**COMMENT:**	No Flow
SAMPLE ID:	Pond 5	**SAMPLED BY:**	Client
DATE SAMPLED:	11-17-09	**DATE RECEIVED:**	11-17-09

TEST DESCRIPTION	RESULT	UNITS	DETECTION LIMIT	METHOD	DATE/ ANALYST
Acidity	< 10	mg/L	10	305.1	11-17-09 LS
Alkalinity	51	mg/L	2	310.1	11-17-09 LS
Chlorides	12.0	mg/L	1	325.3	11-19-09 LS
Cyanide	< 0.008	mg/L	0.008	335.4	11-25-09 TL
pH	7.5	Unit		150.1	11-17-09 LS
Phenols, Total Recoverable	< 0.005	mg/L	0.005	420.1	11-23-09 TL
Sulfates	120	mg/L	1.0	375.4	11-20-09 LS
Total Suspended Solids	35	mg/L	1	160.2	11-18-09 LS
Metals:					
Antimony	< 0.002	mg/L	0.002	204.1	12-04-09 JB
Arsenic	< 0.002	mg/L	0.002	206.4	12-04-09 JB
Beryllium	< 0.001	mg/L	0.001	210.1	12-04-09 JB
Cadmium	0.006	mg/L	0.002	213.1	12-04-09 JB
Chromium	< 0.006	mg/L	0.006	218.1	12-04-09 JB
Copper	< 0.003	mg/L	0.003	220.1	12-04-09 JB
Iron	0.593	mg/L	0.006	236.1	12-04-09 JB
Lead	< 0.0075	mg/L	0.0075	239.1	12-04-09 JB
Mercury	< 0.002	mg/L	0.002	245.1	12-04-09 JB
Nickel	< 0.010	mg/L	0.010	249.1	12-04-09 JB
Selenium	< 0.002	mg/L	0.002	270.2	12-04-09 JB
Silver	< 0.002	mg/L	0.002	272.1	12-04-09 JB
Thallium	< 0.020	mg/L	0.020	279.1	12-04-09 JB
Zinc	< 0.001	mg/L	0.001	289.1	12-04-09 JB

Reviewed by: Joseph Bencini Joseph Bencini

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Website: www.summitenviro.com

CLIENT:	Mach Mining	**REPORT DATE:**	12-04-09
PDL:	14084-6	**COMMENT:**	No Flow
SAMPLE ID:	Pond 6	**SAMPLED BY:**	Client
DATE SAMPLED:	11-17-09	**DATE RECEIVED:**	11-17-09

TEST DESCRIPTION	RESULT	UNITS	DETECTION LIMIT	METHOD	DATE/ ANALYST
Acidity	< 10	mg/L	10	305.1	11-17-09 LS
Alkalinity	68	mg/L	2	310.1	11-17-09 LS
Chlorides	316	mg/L	1	325.3	11-19-09 LS
Cyanide	< 0.007	mg/L	0.007	335.4	11-25-09 TL
pH	8.6	Unit		150.1	11-17-09 LS
Phenols, Total Recoverable	< 0.005	mg/L	0.005	420.1	11-23-09 TL
Sulfates	330	mg/L	1.0	375.4	11-20-09 LS
Total Suspended Solids	1	mg/L	1	160.2	11-18-09 LS
Metals:					
Antimony	< 0.002	mg/L	0.002	204.1	12-04-09 JB
Arsenic	< 0.002	mg/L	0.002	206.4	12-04-09 JB
Beryllium	< 0.001	mg/L	0.001	210.1	12-04-09 JB
Cadmium	0.003	mg/L	0.002	213.1	12-04-09 JB
Chromium	< 0.006	mg/L	0.006	218.1	12-04-09 JB
Copper	< 0.003	mg/L	0.003	220.1	12-04-09 JB
Iron	< 0.006	mg/L	0.006	236.1	12-04-09 JB
Lead	< 0.0075	mg/L	0.0075	239.1	12-04-09 JB
Manganese	0.022	mg/L	0.002	243.1	12-04-09 JB
Mercury	< 0.002	mg/L	0.002	245.1	12-04-09 JB
Nickel	< 0.010	mg/L	0.010	249.1	12-04-09 JB
Selenium	< 0.002	mg/L	0.002	270.2	12-04-09 JB
Silver	< 0.002	mg/L	0.002	272.1	12-04-09 JB
Thallium	< 0.020	mg/L	0.020	279.1	12-04-09 JB
Zinc	< 0.001	mg/L	0.001	289.1	12-04-09 JB

Reviewed by: Joseph Bencini

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Website: www.summitenviro.com

CLIENT:	Mach Mining	**REPORT DATE:**	12-04-09
PDL:	14084-7	**COMMENT:**	No Flow
SAMPLE ID:	Pond 7	**SAMPLED BY:**	Client
DATE SAMPLED:	11-17-09	**DATE RECEIVED:**	11-17-09

TEST DESCRIPTION	RESULT	UNITS	DETECTION LIMIT	METHOD	DATE/ ANALYST
Acidity	< 10	mg/L	10	305.1	11-17-09 LS
Alkalinity	208	mg/L	2	310.1	11-17-09 LS
Chlorides	831	mg/L	1	325.3	11-19-09 LS
Cyanide	< 0.007	mg/L	0.007	335.4	11-25-09 TL
pH	9.1	Unit		150.1	11-17-09 LS
Phenols, Total Recoverable	< 0.005	mg/L	0.005	420.1	11-23-09 TL
Sulfates	1,130	mg/L	1.0	375.4	11-20-09 LS
Total Suspended Solids	1	mg/L	1	160.2	11-18-09 LS
Metals:					
Antimony	< 0.002	mg/L	0.002	204.1	12-04-09 JB
Arsenic	< 0.002	mg/L	0.002	206.4	12-04-09 JB
Beryllium	< 0.001	mg/L	0.001	210.1	12-04-09 JB
Cadmium	0.006	mg/L	0.002	213.1	12-04-09 JB
Chromium	< 0.006	mg/L	0.006	218.1	12-04-09 JB
Copper	< 0.003	mg/L	0.003	220.1	12-04-09 JB
Iron	< 0.006	mg/L	0.006	236.1	12-04-09 JB
Lead	< 0.0075	mg/L	0.0075	239.1	12-04-09 JB
Manganese	0.741	mg/L	0.002	243.1	12-04-09 JB
Mercury	< 0.002	mg/L	0.002	245.1	12-04-09 JB
Nickel	< 0.010	mg/L	0.010	249.1	12-04-09 JB
Selenium	< 0.002	mg/L	0.002	270.2	12-04-09 JB
Silver	< 0.002	mg/L	0.002	272.1	12-04-09 JB
Thallium	< 0.020	mg/L	0.020	279.1	12-04-09 JB
Zinc	< 0.001	mg/L	0.001	289.1	12-04-09 JB

Reviewed by: Joseph Bencini Joseph Bencini

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Website: www.summitenviro.com

CLIENT:	Mach Mining	**REPORT DATE:**	12-04-09
PDL:	14084-8	**COMMENT:**	No Flow
SAMPLE ID:	Pond 8	**SAMPLED BY:**	Client
DATE SAMPLED:	11-17-09	**DATE RECEIVED:**	11-17-09

TEST DESCRIPTION	RESULT	UNITS	DETECTION LIMIT	METHOD	DATE/ ANALYST
Acidity	< 10	mg/L	10	305.1	11-17-09 LS
Alkalinity	114	mg/L	2	310.1	11-17-09 LS
Chlorides	745	mg/L	1	325.3	11-19-09 LS
Cyanide	< 0.007	mg/L	0.007	335.4	11-25-09 TL
pH	8.7	Unit		150.1	11-17-09 LS
Phenols, Total Recoverable	0.005	mg/L	0.005	420.1	11-23-09 TL
Sulfates	1,100	mg/L	1.0	375.4	11-20-09 LS
Total Suspended Solids	19	mg/L	1	160.2	11-18-09 LS
Metals:					
Antimony	< 0.002	mg/L	0.002	204.1	12-04-09 JB
Arsenic	< 0.002	mg/L	0.002	206.4	12-04-09 JB
Beryllium	< 0.001	mg/L	0.001	210.1	12-04-09 JB
Cadmium	0.008	mg/L	0.002	213.1	12-04-09 JB
Chromium	< 0.006	mg/L	0.006	218.1	12-04-09 JB
Copper	< 0.003	mg/L	0.003	220.1	12-04-09 JB
Iron	< 0.006	mg/L	0.006	236.1	12-04-09 JB
Lead	< 0.0075	mg/L	0.0075	239.1	12-04-09 JB
Manganese	0.011	mg/L	0.002	243.1	12-04-09 JB
Mercury	< 0.002	mg/L	0.002	245.1	12-04-09 JB
Nickel	< 0.010	mg/L	0.010	249.1	12-04-09 JB
Selenium	< 0.002	mg/L	0.002	270.2	12-04-09 JB
Silver	< 0.002	mg/L	0.002	272.1	12-04-09 JB
Thallium	< 0.020	mg/L	0.020	279.1	12-04-09 JB
Zinc	< 0.001	mg/L	0.001	289.1	12-04-09 JB

Reviewed by: Joseph Bencini Joseph Bencini

UN-NAMED TRIBUTARY OF POND CREEK STREAM SAMPLES

R17638

SUMMIT ENVIRONMENTAL SERVICES, INC.

CHEMICAL ANALYSTS & CONSULTANTS

17650 Route 37
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Website: www.summitenviro.com

CLIENT:	Pond Creek	**REPORT DATE:**	12/10/09
PDL:	14094-12	**COMMENT:**	Flow = 1 cu.ft./sec
SAMPLE ID:	Unnamed Tributary (PC)	**SAMPLED BY:**	Client
DATE SAMPLED:	11/30/09 PC-1	**DATE RECEIVED:**	11/30/09

TEST DESCRIPTION	RESULT	UNITS	DETECTION LIMIT	METHOD	DATE/ ANALYST
Acidity	< 10	mg/L	10	305.1	12/01/09 BH
Alkalinity	246	mg/L	2	310.1	12/01/09 BH
Chlorides	1,170	mg/L	1	325.3	12/01/09 BH
Hardness, Total	400	mg/L	0.250	130.2	12/02/09 LS
pH	8.1	Unit		150.1	11/30/09 TG
Sulfates	860	mg/L	1.0	375.4	12/02/09 BH
Total Suspended Solids	2	mg/L	1	160.1	12/01/09 LS
Iron, Total	< 0.006	mg/L	0.006	236.1	12/04/09 JB
Iron, Dissolved	< 0.006	mg/L	0.006	236.1	12/04/09 JB
Manganese, Total	0.212	mg/L	0.002	243.1	12/04/09 JB
Manganese, Dissolved	0.199	mg/L	0.002	243.1	12/04/09 JB

Reviewed By: Jeffrey C. Hoyt

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Website: www.summitenviro.com

CLIENT:	Pond Creek	**REPORT DATE:**	12-21-09
PDL:	14110-1	**COMMENT:**	Flow = 2.0 cu.ft./sec
SAMPLE ID:	Unnamed Tributary PC-1	**SAMPLED BY:**	Client
DATE SAMPLED:	12-10-09	**DATE RECEIVED:**	12-10-09

TEST DESCRIPTION	RESULT	UNITS	DETECTION LIMIT	METHOD	DATE/ ANALYST
Acidity	12	mg/L	10	305.1	12/10/09 LS
Alkalinity	168	mg/L	2	310.1	12/10/09 LS
Chlorides	290	mg/L	1	325.3	12/14/09 LS
Hardness, Total	200	mg/L	0.250	130.2	12/14/09 LS
pH	6.7	Unit		150.1	12/10/09 LS
Sulfates	270	mg/L	1.0	375.4	12/16/09 LS
Total Suspended Solids	9	mg/L	1	160.1	12/14/09 LS
Iron, Dissolved	0.332	mg/L	0.006	236.1	12/21/09 JB
Iron, Total	0.716	mg/L	0.006	236.1	12/21/09 JB
Manganese, Dissolved	< 0.002	mg/L	0.002	243.1	12/21/09 JB
Manganese, Total	0.035	mg/L	0.002	243.1	12/21/09 JB

Reviewed by: Joseph Bencini Joseph Bencini

SUMMIT ENVIRONMENTAL SERVICES, INC.
CHEMICAL ANALYSTS & CONSULTANTS

17650 Route 37
West Frankfort, Illinois 62896
Phone (618) 983-8280
Fax (618) 983-8208
Website: www.summitenviro.com

CLIENT:	Pond Creek	**REPORT DATE:**	12-21-09
PDL:	14110-2	**COMMENT:**	Flow = 1.5 cu.ft./sec
SAMPLE ID:	Unnamed Tributary PC-1	**SAMPLED BY:**	Client
DATE SAMPLED:	12-11-09	**DATE RECEIVED:**	12-11-09

TEST DESCRIPTION	RESULT	UNITS	DETECTION LIMIT	METHOD	DATE/ ANALYST
Acidity	< 10	mg/L	10	305.1	12/10/09 LS
Alkalinity	103	mg/L	2	310.1	12/10/09 LS
Chlorides	280	mg/L	1	325.3	12/14/09 LS
Hardness, Total	300	mg/L	0.250	130.2	12/14/09 LS
pH	7.6	Unit		150.1	12/10/09 LS
Sulfates	350	mg/L	1.0	375.4	12/16/09 LS
Total Suspended Solids	10	mg/L	1	160.1	12/14/09 LS
Iron, Dissolved	0.163	mg/L	0.006	236.1	12/21/09 JB
Iron, Total	0.457	mg/L	0.006	236.1	12/21/09 JB
Manganese, Dissolved	0.004	mg/L	0.002	243.1	12/21/09 JB
Manganese, Total	0.088	mg/L	0.002	243.1	12/21/09 JB

Reviewed by: Joseph Bencini Joseph Bencini

SCHEDULE A INFORMATION

Pond Classification

Currently, Pond Nos. 006, 007, and 008 are classified as Acid Mine Drainage ponds. However, based upon the grab samples from these ponds, the pH ranges from 8.6 to 9.1. Therefore, the applicant is requesting the ponds to be re-classified as Alkaline Mine Drainage.

SCHEDULE A

DISCHARGE #	001	002	003	004	005
QUARTER SECTION	NW	SW	SW	SW	SW
SECTION	12	12	12	12	12
TOWNSHIP	8 South	8 South	8 South	8 South	8 South
RANGE	3 East	3 East	3 East	3 East	3 East
COUNTY	Williamson	Williamson	Williamson	Williamson	Williamson
AVERAGE FLOW (gpd) if discharge does not result from precipitation.	Precipitation	Precipitation	Precipitation	Precipitation	Precipitation
MAX FLOW (gpd) if discharge does not result from precipitation.	Precipitation	Precipitation	Precipitation	Precipitation	Precipitation
SOURCE OF DISCHARGE	Surface Runoff	Surface Runoff	Surface Runoff	Surface Runoff	Surface Runoff
SAMPLING METHOD	Grab	Grab	Grab	Grab	Grab
Acidity (mg/l)	20	20	20	20	20
Alkalinity (mg/l)	300	300	300	300	300
Lead (mg/l)	0.05	0.05	0.05	0.05	0.05
Iron (mg/l)	1.5	3	1.0	3	3
Magnanese (mg/l)	0.2	0.2	0.2	0.2	0.2
pH (range)	6.5 - 8.5	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5
Zinc (mg/l)	0.1	0.1	0.1	0.1	0.1
Fluoride (mg/l)	1.0	1.0	0.8	1.0	1.0
Total Suspended Solids (mg/l)	10 – 50	10 – 50	5 – 20	10 – 50	10 – 50
Sulfate (mg/l)	2000	2000	2000	2000	2000
Total Dissolved Solids (mg/l)	450	450	450	450	450
Chloride (mg/l)	500	500	500	500	500
Receiving Stream	Unnamed	Unnamed	Unnamed	Unnamed	Unnamed
Tributary to	Pond Creek	Pond Creek	Pond Creek	Pond Creek	Pond Creek
Tributary to	Big Muddy River	Big Muddy River	Big Muddy River	Big Muddy River	Big Muddy River
Tributary to	Mississippi River	Mississippi River	Mississippi River	Mississippi River	Mississippi River

SCHEDULE A

DISCHARGE #	006	007	008		
QUARTER SECTION	SW	NW	NW		
SECTION	12	12	12		
TOWNSHIP	8 South	8 South	8 South		
RANGE	3 East	3 East	3 East		
COUNTY	Williamson	Williamson	Williamson		
AVERAGE FLOW (gpd) if discharge does not result from precipitation.	Precipitation	Precipitation	Precipitation		
MAX FLOW (gpd) if discharge does not result from precipitation.	Precipitation	Precipitation	Precipitation		
SOURCE OF DISCHARGE	Surface Runoff	Surface Runoff	Surface Runoff		
SAMPLING METHOD	Grab	Grab	Grab		
Acidity (mg/l)	20	20	20		
Alkalinity (mg/l)	300	300	300		
Lead (mg/l)	0.05	0.05	0.05		
Iron (mg/l)	3	3	3		
Magnanese (mg/l)	0.2	0.2	0.2		
pH (range)	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5		
Zinc (mg/l)	0.1	0.1	0.1		
Fluoride (mg/l)	1.0	1.0	1.0		
Total Suspended Solids (mg/l)	10 – 50	10 – 50	10 – 50		
Sulfate (mg/l)	2000	2000	2000		
Total Dissolved Solids (mg/l)	450	450	450		
Chloride (mg/l)	500	500	500		
Receiving Stream	Unnamed	Unnamed	Unnamed		
Tributary to	Pond Creek	Pond Creek	Pond Creek		
Tributary to	Big Muddy River	Big Muddy River	Big Muddy River		
Tributary to	Mississippi River	Mississippi River	Mississippi River		

MINE PUMPAGE INFORMATION

MINE PUMPAGE

A series of pumps have been installed to pump mine water to Pond No. 6. HDPE pipes are used to connect the pumps to Pond No. 6.

Refer to the attached chart for the pump name/location and the maximum gallons per minute capacity of each pump.

Pond Creek No. 1 Mine
Mine Pumps & Maximum GPM

PUMP NAME	HP	GPM MAX	COMMENTS
ZEIGLER	350	1500	ZIEGLER PUMPS NO LONGER RUNNING.
POND 5	35	1000	POND 5 PUMP WATER USED FOR UNDERGROUND AT APPROX. 1000 - 1500 GPM. CAN ALSO BE USED AT PLANT
POND 6	140	1800	POND 6 HAS A PUMP BUT ONLY PUMPS BACK TO FRESH WATER LAKE FOR USE IN PLANT.
FRESH WATER LAKE	95	2000	FRESH WATER LAKE USED IN PLANT AT 1500-2000 GPM. 90% RUNTIME.
SLURRY CELL DECANT PUMP	25	600	SLURRY DECANT PUMP ONLY USED ABOUT 10 HOURS PER WEEK. EQUIVALENT TO 42000GPD.
POND #1	25	600	PONDS 1-4 USED FOR ADDITIONAL MAKE UP WATER ONLY.
PONDS #2,#3,#4	5	200	
BLEEDER SHAFT	125	500	
JOHNSTON CITY LAKE PUMPS (2)	100	1000	JOHNSTON CITY LAKE PUMP RUNS WHEN POND 5 POOL ELVATION DROPS. ONE PUMP ONLY.
RETURN SHAFT TURBINE	250	1000	RETURN SHAFT TURBINE PUMPING 200000GPD.
XC136 -TG- SWAG PUMP**	200	1000	XC136 PUMPING 575000GPD.
XC169-HG#1 PUMP	300	1000	NO LONGER IN SERVICE.
XC47-HG1- DWINA ROAD PUMP	100	300	XC47 DWINA RD NO LONGER PUMPING.
XC144-HG#2 THOMPSONVILLE RD	250	1000	XC144 HG2 PUMPING 150000 GPD.
SEDIMENT DITCHES 2 AND 1 (POND #11) (2) 4" AND 8" DISCHARGE LINES	25	600	POND 11 PUMPING WITH TWO ELECTRICS AND ONE 6" DIESEL PUMPING AROUND CLOCK. DIESEL - 1000GPM -25HP 8" DISCHARGE-500GPM - 25 HP 4" LINE - 250GPM OR 2.3MGD
POND #9 AT BLEEDER SHAFTS	50	500	POND # 9 PUMPS EVERY TWO MONTHS FOR ABOUT 24 HOURS - APPROXIMATELY 10000 GPD (AVERAGED OVER 365 DAYS)
6" DIESEL PUMP GODWIN CDM150		1700	

NOTE: THE GPM IS THE RATED FLOWS AS INITIALLY DESIGNED. THE FURTHER DISTANCE PUMPS MAY SLIGHTLY VARY.

**NOTE: THE 136 PUMP 2-STAGES LESS THAN THE 169 AND 144 PUMP. WE OPTED TO STANDARDIZE JUST AFTER THAT INSTALLATION.

MAP 6 S.F.
(SURFACE FACILITIES MAP)

DOCUMENT

77

(OPEN) KEN
M9555.109
Due date 3-11-10

R17650

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

IEPA-DIVISION OF RECORDS MANAGEMENT
RELEASABLE
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REVIEWER: SAB

December 29, 2009

Project No. B09-444-1413

Mr. Larry Crislip
Illinois Environmental Protection Agency
Mine Pollution Control Program
2309 West Main Street
Suite 116
Marion, IL 62959

Transmittal
NPDES Renewal for IL0077666
Williamson Energy LLC - Pond Creek No. 1 Mine
Williamson County, Illinois

Dear Mr. Crislip:

On behalf of our client, Williamson Energy LLC, we are submitting an original and two copies of the renewal for the above referenced permit.

If there are any questions or you require additional information, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Stephen M. Sutphin
Project Manager

SMS:sms
Enclosures

FILE: 09444-02

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IL Environmental Protection Agency
MARION REGIONAL OFFICE

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Environmental Protection Agency
WPC--Permit Log In

124 Philpott Lane • Raleigh County Airport Industrial Park • Beaver, WV 25813-9502 • TELE: (304) 255-0491 • FAX: (304) 255-4232

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

December 29, 2009

Project No. B09-444-1413

Mr. Larry Crislip
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
2309 West Main Street
Suite 116
Marion, IL 62959

Williamson Energy LLC - NPDES No. 0077666
Renewal No. 1
Pond Creek Mine No. 1
Williamson County, Illinois

Dear Mr. Crislip:

Attached, please the Permit Renewal information for Williamson Energy LLC; Pond Creek No. 1 Mine located in Williamson County, Illinois. This renewal package includes:

- EPA Form 1
- EPA Form 2C
- Water analysis from each sediment pond. Ponds were not discharging, therefore grab samples were taken.
- Receiving stream sample - Un-named tributary of Pond Creek
- Schedule A identifying each outfall.
- Information regarding volume and discharge rate of mine pumpage.
- 1" = 400' Location Maps showing the current permit boundary with acreages, NPDES outfall locations and stream monitoring point.

Should you have any questions, or require additional information, please contact us.

Respectfully submitted for Williamson Energy LLC,

Stephen M. Sutphin
ALLIANCE CONSULTING, INC.
Project Manager

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WPC--Permit Log In

SMS:sms
Enclosures

FILE: 09444-01

NPDES RENEWAL #1
FOR
PERMIT NO. IL0077666
(IDNR PERMIT 375)

WILLIAMSON COUNTY, IL
POND CREEK MINE NO. 1

Prepared for

WILLIAMSON ENERGY LLC
JOHNSTON CITY, IL

ALLIANCE PROJECT NO. B09-444-1413
DECEMBER 2009

EPA FORM 1

FORM 1 GENERAL

U.S. ENVIRONMENTAL PROTECTION AGENCY

GENERAL INFORMATION

Consolidated Permits Program

(Read the "General Instructions" before starting.)

R17654

I. EPA I.D. NUMBER

S		T/A	
F			D
1	2 — 13	14	15

LABEL ITEMS

- EPA I.D. NUMBER
- II. FACILITY NAME
- III. FACILITY MAILING ADDRESS
- IV. FACILITY LOCATION

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PLEASE PLACE LABEL IN THIS SPACE

GENERAL INSTRUCTIONS

If a preprinted label has been provided, affix it in the designated space. Review the information carefully; if any of it is incorrect, cross through it and enter the correct data in the appropriate fill-in area below. Also, if any of the preprinted data is absent (the area to the left of the label space lists the information that should appear), please provide it in the proper fill-in area(s) below. If the label is complete and correct, you need not complete Items I, III, V, and VI(except VI-B which must be completed regardless). Complete all items if no label has been proved. Refer to the instructions for detailed item descriptions and for the legal authorization under which this data is collected.

II. POLLUTANT CHARACTERISTICS

INSTRUCTIONS: Complete A through J to determine whether you need to submit any permit application forms to the EPA. If you answer "yes" to any questions, you must submit this form and the supplemental from listed in the parenthesis following the question. Mark "X" in the box in the third column if the supplemental form is attached. If you answer "no" to each question, you need not submit any of these forms. You may answer "no" if your activity is excluded from permit requirements; see Section C of the instructions. See also, Section D of the instructions for definitions of bold-faced terms.

SPECIFIC QUESTIONS	MARK "X" YES	NO	FORM ATTACHED	SPECIFIC QUESTIONS	MARK "X" YES	NO	FORM ATTACHED
A. Is this facility a **publicly owned treatment works** which results in a **discharge to waters of the U.S.?** (FORM 2A)	☐ 16	☒ 17	☐ 18	B. Does or will this facility *(either existing or proposed)* include a **concentrated animal feeding operation** or **aquatic animal production facility** which results in a **discharge to waters of the U.S.?** (FORM 2B)	☐ 19	☒ 20	☐ 21
C. Is this facility which currently results in **discharges to waters of the U.S.** other than those described in A or B above? (FORM 2C)	☒ 22	☐ 23	☐ 24	D. Is this proposal facility *(other than those described in A or B above)* which will result in a **discharge to waters of the U.S.?** (FORM 2D)	☐ 25	☒ 26	☐ 27
E. Does or will this facility treat, store, or dispose of **hazardous wastes?** (FORM 3)	☐ 28	☒ 29	☐ 30	F. Do you or will you inject at this facility industrial or municipal effluent below the lowermost stratum containing, within one quarter mile of the well bore, underground sources of drinking water? (FORM 4)	☐ 31	☒ 32	☐ 33
G. Do you or will you inject at this facility any produced water other fluids which are brought to the surface in connection with conventional oil or natural gas production, inject fluids used for enhanced recovery of oil or natural gas, or inject fluids for storage of liquid hydrocarbons? (FORM 4)	☐ 34	☒ 35	☐ 36	H. Do you or will you inject at this facility fluids for special processes such as mining of sulfer by the Frasch process, solution mining of minerals, in situ combustion of fossil fuel, or recovery of geothermal energy? (FORM 4)	☐ 37	☒ 38	☐ 39
I. Is this facility a proposed **stationary source** which is one of the 28 industrial categories listed in the instructions and which will potentially emit 100 tons per year of any air pollutant regulated under the Clean Air Act and may affect or be located in an **attainment area?** (FORM 5)	☐ 40	☒ 41	☐ 42	J. Is this facility a proposed **stationary source** which is NOT one of the 28 industrial categories listed in the instructions and which will potentially emit 250 tons per year of any air pollutant regulated under the Clean Air Act and may affect or be located in an **attainment are?** (FORM 5)	☐ 43	☒ 44	☐ 45

III. NAME OF FACILITY

C		
1	SKIP	POND CREEK 1 MINE
15	16-29	30 — 69

IV. FACILITY CONTACT

	A. NAME & TITLE *(last, first, & title)*	B. PHONE *(area code & no.)*		
C 2	SLAPAK, JAMES - CHIEF SURVEYOR	618	683	3020
15	16 — 45	46 — 48	49 — 51	52 — 55

V. FACILITY MAILING ADDRESS

	A. STREET OR P.O. BOX
C 3	P. O. BOX 300
15	16 — 45

	B. CITY OR TOWN	C. STATE	D. ZIP CODE
C 4	JOHNSTON CITY	IL	62651
15	16 — 40	41 — 42	47 — 51

VI. FACILITY LOCATION

	A. STREET, ROUTE NO. OR OTHER SPECIFIC IDENTIFIER
C 5	16468 LIBERTY SCHOOL ROAD
15	16 — 45

B. COUNTY NAME
WILLIAMSON
70

	C. CITY OR TOWN	D. STATE	E. ZIP CODE	F. COUNTY CODE
C 6	MARION	IL	62959	
15	16 — 40	41 — 42	47 — 51	52 — 54

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CONTINUED FROM THE FRONT

VII. SIC CODES (4-digit, in order of priority)

A. FIRST		B. SECOND	
1222	(specify) COAL MINING - UNDERGROUND		(specify) N/A
C. THIRD		**D. FOURTH**	
	(specify) N/A		(specify) N/A

VIII. OPERATOR INFORMATION

A. NAME	B. Is the name listed in Item VIII-A also the owner?
WILLIAMSON ENERGY LLC	☒ YES ☐ NO

C. STATUS OF OPERATOR (Enter the appropriate letter into the answer box; if "Other," specify.)
F = FEDERAL, S = STATE, P = PRIVATE, M = PUBLIC (other than federal or state), O = OTHER (specify)
P (specify) -

D. PHONE (area code & no.): A 618 983 3020

E. STREET OR PO BOX: P. O. BOX 99

F. CITY OR TOWN	G. STATE	H. ZIP CODE
JOHNSTON CITY	IL	62951

IX. INDIAN LAND

Is the facility located on Indian lands? ☐ YES ☒ NO

X. EXISTING ENVIRONMENTAL PERMITS

A. NPDES (Discharges to Surface Water): IL0077666	D. PSD (Air Emissions from Proposed Sources): 05040012	
B. UIC (Underground Injection of Fluids): N/A	E. OTHER (specify): 375	(Specify) IDNR
C. RCRA (Hazardous Wastes): N/A	E. OTHER (specify): N/A	(Specify)

XI. MAP

Attach to this application a topographic map of the area extending to at least one mile beyond property boundaries. The map must show the outline of the facility, the location of each of its existing and proposed intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids underground. Include all springs, rivers and other surface water bodies in the map area. See instructions for precise requirements.

XII. NATURE OF BUSINESS (provide a brief description)

UNDERGROUND BITUMINOUS COAL MINE WITH COAL PREPARATION PLANT, REFUSE DISPOSAL FACILITIES AND COAL HANDLING FACILITIES.

XIII. CERTIFICATION (see instructions)

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that, based on my inquiry of those persons immediately responsible for obtaining the information contained in the application, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

A. NAME & OFFICIAL TITLE (type or print)	B. SIGNATURE	C. DATE SIGNED
MICHAEL J. BEYER	M J Beyer	12/2/03

COMMENTS FOR OFFICIAL USE ONLY

Draft

EPA FORM 2C

R17657

Please type or print in the unshaded areas only

EPA ID Number *(Copy from Item 1 of Form 1)*

Form Approved
OMB No. 2040-0086
Approval expires 7-31-88

Form **2C** NPDES

U.S. ENVIRONMENTAL PROTECTION AGENCY

APPLICATION FOR PERMIT TO DISCHARGE WASTEWATER
EXISTING MANUFACTURING, COMMERCIAL, MINING AND SILVICUTLRAL OPERATIONS
Consolidated Permits Program

.. Outfall Location

For this outfall, list the latitude and longitude, and name of the receiving water(s)

Outfall Number *(list)*	Latitude			Longitude			Receiving Water *(name)*
	Deg	Min	Sec	Deg	Min	Sec	
001	37	50	59.2	88	49	37.5	UN-NAMED TRIBUTARY TO POND CREEK
002	37	50	26	88	49	51.5	UN-NAMED TRIBUTARY TO POND CREEK
003	37	50	26	88	49	58	UN-NAMED TRIBUTARY TO POND CREEK
004	37	50	25	88	49	56.6	UN-NAMED TRIBUTARY TO POND CREEK
005	37	50	9.1	88	50	0	UN-NAMED TRIBUTARY TO POND CREEK
006	37	50	28.4	88	50	40.6	UN-NAMED TRIBUTARY TO POND CREEK
007	37	50	29.5	88	49	34	UN-NAMED TRIBUTARY TO POND CREEK
008	37	50	31.4	88	49	33.9	UN-NAMED TRIBUTARY TO POND CREEK

II. Flows, Sources of Pollution, and Treatment Technologies

A. For each outfall, provide a description of (1) all operations contributing wastewater to the effluent, including process wastewater, sanitary wastewater, cooling water, and stormwater runoff; (2) the average flow contributed by each operation; and (3) the treatment received by the wastewater. Continue on additional sheets if necessary.

For each outfall, provide a description of (1) all operations contributing wastewater to the effluent, including process wastewater, sanitary wastewater, cooling water, and stormwater runoff; (2) the average flow contributed by each operation; and (3) the treatment received by the wastewater. Continue on additional sheets if necessary.

1. Outfall Number	2. Operations Contributing Flow		3. Treatment		
	a. OPERATION *(list)*	b. AVERAGE FLOW	a. DESCRIPTION	b. LIST CODES FROM TABLE 2C-1	
001	Stormwater Runoff	2 gpm	Sedimentation	1-U	
002	Stormwater Runoff	1 gpm	Sedimentation	1-U	
003	Stormwater Runoff	1 gpm	Sedimentation	1-U	
004	Stormwater Runoff	2 gpm	Sedimentation	1-U	
005	Stormwater Runoff	5 gpm	Sedimentation	1-U	
006	Stormwater Runoff,	2 gpm	Sedimentation	1-U	
	Process Wastewater,	3 gpm	Sedimentation	1-U	
	Deep Mine Drainage	10 gpm	Sedimentation	1-U	
007	Stormwater Runoff	1 gpm	Sedimentation	1-U	
008	Stormwater Runoff	1 gpm	Sedimentation	1-U	
	Process Wastewater	2 gpm	Sedimentation	1-U	

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C. Except for storm runoff, leaks, or spills, are any of the discharges described in Items II-A or B intermittent or seasonal?

☐ YES *(complete the following table)* ☒ NO *(go to Section III)*

1. OUTFALL NUMBER (list)	2. OPERATION(s) CONTRIBUTING FLOW (list)	3. FREQUENCY a. DAYS PER WEEK (specify average)	3. FREQUENCY b. MONTHS PER YEAR (specify average)	4. FLOW a. FLOW RATE (in mgd) 1. LONG TERM AVERAGE	4. FLOW a. FLOW RATE (in mgd) 2. MAXIMUM DAILY	4. FLOW b. TOTAL VOLUME (specify with units) 1. LONG TERM AVERAGE	4. FLOW b. TOTAL VOLUME (specify with units) 2. MAXIMUM DAILY	4. FLOW c. DURATION (in days)

III. PRODUCTION

A. Does an effluent guideline limitation promulgated by EPA under Section 304 of the Clean Water Act apply to your facility?

☐ YES *(complete Item III-B)* ☒ NO *(go to Section IV)*

B. Are the limitations in the applicable effluent guideline expressed in terms of production *(or other measure of operation)*?

☐ YES *(complete Item III-C)* ☒ NO *(go to Section IV)*

C. If you answered "yes" to Item III-B, list the quantity which represents an actual measurement of your level of production, expressed in the terms and units used in the applicable effluent guideline, and indicate the affected outfalls.

1. AVERAGE DAILY PRODUCTION a. QUANTITY PER DAY	b. UNITS OF MEASURE	c. OPERATION, PRODUCT, MATERIAL, ETC. (specify)	2. AFFECTED OUTFALLS (list outfall numbers)

IV. IMPROVEMENTS

A. Are you now required by any Federal, State, or local authority to meet any implementation schedule for the construction, upgrading, or operation of wastewater treatment equipment or practices or any other environmental programs which may affect the discharges described in this application? This includes, but is not limited to, permit conditions, administrative or enforcement orders, enforcement compliance schedule letters, stipulations, court orders, and grant or loan conditions.

☐ YES *(complete the following table)* ☒ NO *(go to Item IV-B)*

1. IDENTIFICATION OF CONDITION, AGREEMENT, ETC.	2. AFFECTED OUTFALLS a. No	2. AFFECTED OUTFALLS b. SOURCE OF DISCHARGE	3. BRIEF DESCRIPTION OF PROJECT	4. FINAL COMPLIANCE DATE a. REQUIRED	4. FINAL COMPLIANCE DATE b. PROJECTED

B. OPTIONAL: You may attach additional sheets describing any additional water pollution control programs *(or other environmental projects which may affect your discharges)* you now have underway or which you plan. Indicate whether each program is now underway or planned, and indicate your actual or planned schedules for construction.

☐ MARK "X" IF DESCRIPTION OF ADDITIONAL CONTROL PROGRAM IS ATTACHED

CONTINUED ON PAGE 3

EPA ID Number *(Copy from Item 1 of Form 1)*

CONTINUED FROM PAGE 2

V. INTAKE AND EFFLUENT CHARACTERISTICS

A, B, & C: See instructions before proceeding - Complete one set of tables or each outfall - Annotate the outfall number in the space provided. **NOTE:** Tables V-A, V-B, and V-C are included on separate sheets number V-1 through V-9.

D. Use the space below t list any of the pollutants listed in Tables 2c-3 of the instructions, which you know or have reason to believe is discharged or may be discharged from any outfall. For every pollutant you list, briefly describe the reasons you believe it to be present and report any analytical data in your possession.

1. POLLUTANT	2. SOURCE	1. POLLUTANT	2. SOURCE
N/A			

VI. POTENTIAL DISCHARGES NOT COVERED BY ANALYSIS

Is any pollutant listed in Item V-C a substance or a component of a substance which you currently use or manufacture as an intermediate or final product or byproduct?

☐ **YES** *(list all such pollutants below)* ☒ **NO** *(go to Item VI-B)*

CONTINUED FROM THE FRONT

VII. BIOLOGICAL TOXICITY TESTING DATA

Do you have any knowledge or reason to believe that any biological test for acute or chronic toxicity has been made on any of your discharges or on a receiving water in relation to your discharge within the last 3 years?

☐ YES *(identify the test(s) and describe their purpose below)* ☒ NO *(go to Section VIII)*

VIII. CONTRACT ANALYSIS INFORMATION

Were any of the analyses reported in Item V performed by a contract laboratory or consulting firm?

☒ YES *(list the name, address, and telephone number of, and pollutants analyzed by, each such laboratory or firm below)* ☐ NO *(go to Section IX)*

A. NAME	B. ADDRESS	C. TELEPHONE *(area code & no.)*	D. POLLUTANTS ANALYZED *(list)*
SUMMIT ENVIRONMENTAL	*7630 HIGHWAY 60, WEST PADUCAH, KY 42086*	*(270) 744-6172*	*1M - 15M*
		( )	
		( )	
		( )	
		( )	
		( )	
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IX. CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. NAME & OFFICIAL TITLE *(type or print)*	B. PHONE NO. *(area code & no.)*
MICHAEL J. BEYER, AUTHORIZED AGENT	*(618) 983-3020*
C. SIGNATURE	D. DATE SIGNED
	12/2/09

DOCUMENT

78

9198 • /09-A
Due date: 6-26-09
R17662

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

May 15, 2009

Project No. B09-018-1413

Mr. Larry Crislip
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
2309 West Main Street, Suite 116
Marion, IL 62959

Transmittal
IPR For Permit No. 375
Dated April 21, 2009
Williamson Energy, LLC
Pond Creek No. 1 Mine
Williamson County, Illinois

Dear Mr. Crislip:

On behalf of our client, Williamson Energy, LLC, Alliance Consulting, Inc. is submitting two copies of Supplemental Information for the insignificant permit revision submitted April 21, 2009. The Supplemental Information is a result of a conversation with Mr. Tim DeVardo in the Benton IDNR office.

A copy of this Supplemental Information has been sent to Mr. Tim DeVardo in the IDNR Benton office and two copies of the Supplemental Information have been sent to Mr. Scott Fowler in the IDNR Sprinffield office.

If you have any questions, or require additional information regarding this application, please contact us.

Sincerely,

ALLIANCE CONSULTING, INC.

Stephen M. Sutphin
Project Manager

SMS:knm
Enclosures

FILE: 09018-05

RECEIVED
MAY 18 2009
IL Environmental Protection Agency
MARION REGIONAL OFFICE

124 Philpott Lane • Raleigh County Airport Industrial Park • Beaver, WV 25813-9502 • TELE: (304) 255-0491 • FAX: (304) 255-4232

GENERAL INFORMATION
Permit No. **375**
Structure ID: **Sediment Ditch Structure No. 1**
Type: **Combination** (Dam, Incised, or Combination)

DESIGN DETAILS

A.	Design Storm: 100yr/6hr	**6.21**	in	
B.	Estimated Runoff Area:	**139.10**	acres	
C.	Estimated Distrubed Area:	**139.10**	acres	
D.	Runoff Coefficient:	**100.00**	percent	
E.	Quanitity of Runoff (10 hrs of a 10yr/24hr stor	**14.47**	ac/ft	
F.	Sediment Volume (Dist. Area X 0.1):	**13.91**	ac/ft	
G.	Pit Pumpage:	**2000.00**	gpm	
H.	Pit Pumpage Treatment:	**None**		
I.	Basin Volume (Required at Normal Pool*):	**32.80**	ac/ft	
	Basin Volume (Provided at Normal Pool):		ac/ft	
J.	Basin Freeboard (Designed Storm 100yr/6hr):	**2.00**	feet	(Reference SCS-IL, June, 1992)
K.	Surface Area at Design Storm (25yr/6hr):	-	acres	
L.	Diversion Ditching:	**None**		
M.	Inlet Elevation**:	**N/A**	feet	
	Outlet Elevation	**N/A**	feet	
	Outfall Elevation	**N/A**	feet	
N.	Emergency Spillway System**: (Design Storm 25yr/6hr)	**None**		

Notes:

* Basin Volume Required = (0.33 X Runoff Volume) + Sediment Volume + (pit Pumpage X 0.00442 X 0.5)

** Detailed drawings are submitted with the basin plan view and sections.

EXCAVATED SEDIMENT DITCH
STRUCTURE PROPORTIONING SHEET

PROJECT NAME:	POND CREEK MINE NO.1
PROJECT NUMBER:	B09-018-1413
DESCRIPTION:	*SEDIMENT DITCH NO. 1*

SEDIMENT STORAGE REQUIREMENTS:

DRAINAGE AREA NO. :	SD1				
TOTAL AREA =	139.10	ACRES	DISTURBED AREA =	139.10	ACRES
SED STORAGE FACTOR =	0.1	AC.FT./AC	REQUIRED SED VOL =	13.91	AC. FT.
10YR. 24HR. RUNOFF VOL	34.737	AC.FT	REQUIRED RUNOFF VOL=	14.47	AC. FT.
PUMPAGE	2000	GPM	PUMPAGE VOLUME =	4.42	AC. FT.
LINEAR FEET OF DITCHLINE AVAILABLE =			6438 FEET	32.80	TOTAL REQ.

PROPOSED DITCH DIMENSIONS:

SIDE SLOPE (L) =	2.00:1		SIDE SLOPE (R) =	2.00:1	
BOTTOM WIDTH =	20.0	FEET	BARRIER DAM HEIGHT (MIN) =	6.76	FEET
NUMBER OF CELLS =	13		BARRIER SPACING =	495.23	FEET
NUMBER OF BARRIERS =	12		TOP WIDTH (TOTAL) =	60.88	FEET
POOL AREA=	7.89	AC.			

SEDIMENT DITCH CAPACITY:

TOTAL VOLUME OF DITCH (NO BARRIERS) =	33.40	ACRE FEET
TOTAL VOLUME OF BARRIERS =	0.47	ACRE FEET
TOTAL AVAILABLE STORAGE VOLUME =	32.94	ACRE FEET
60% CLEANOUT DEPTH = 4.04	FEET	

BARRIER/SPILLWAY DIMENSIONS:

SPILLWAY LENGTH =	5.0	FEET	REQD SPILLWAY FLOW =	243.82	CFS

SPILLWAY CHECK BASED ON WEIR EQUATION

Q = CLH^1.5 OR
Q = CH^1.5(L+0.4(Z1+Z2)H)
REF. (MESA MANUAL, Pg. 6.136)

REF. (OPEN CHANNEL HYDRAULICS, CHOW, Pg. 53)

WHERE:

COEFFICIENT C =	2.8	
BOTTOM WIDTH L =	47.0	FEET
SIDE SLOPE Z1 =	2	
SIDE SLOPE Z2 =	2	

SPILLWAY FLOW DEPTH =	1.46	FEET
AREA OF FLOW =	72.95	SQ.FT.
VELOCITY =	3.34	FPS
FREEBOARD =	2.00	FEET
TOP WIDTH =	60.88	FEET

Q ACTUAL = 243.91 CFS

TOTAL SPILLWAY DEPTH (DEPTH ABOVE BARRIER DAM) =	3.46	FEET
TOTAL (MINIMUM) DITCH DEPTH =	10.22	FEET

NOTES:
1. BARRIERS SHALL BE SPACED TO MAINTAIN A BOTTOM GRADE ON THE SEDIMENT DITCH OF 0%, BUT IN NO CASE MORE THAN 500 FT APART.
2. ALL BARRIER DAM UPSTREAM AND DOWNSTREAM SIDE SLOPES WILL BE 3:1.

5/15/09

DOCUMENT

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9198-/09
Due date: 6 R176669

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

April 22, 2009

Project No. B09-018-1413

Mr. Larry Crislip
Illinois Environmental Protection Agency
Mine Pollution Control Program
2309 West Main Street
Suite 116
Marion, IL 62959

Transmittal
IPR for Permit 375 / IL0077666
Williamson Energy LLC - Pond Creek No. 1 Mine
Williamson County, Illinois

Dear Mr. Crislip:

The above referenced insignificant permit revision has been submitted to the IDNR Land Reclamation Division. The IPR addresses the expansion of the Coal Refuse Disposal Facility No. 2 toward the north. The expansion is a result of Williamson Energy LLC purchasing the dwellings on the north side of Dean Road, which eliminated the 300 foot buffer that had prevented the refuse facility from being designed closer to the permit boundary.

As a result of the expansion, Pond 011 – Sediment Ditch 1 has been lengthened. In addition, this IPR proposes a buried pipeline from Pond 001 to Pond 011 – Sediment Ditch 1. Sediment Ditch 1 has been re-designed to account for the additional length and a pump volume of 2000 gpm.

With the expansion of the Coal Refuse Disposal Facility No. 2 to the north, Ground Water Well GW-11 is proposed to be moved. This IPR shows the new location of GW-11 and the IPR is requesting that Ground Water Well GW-11 replace Ground Water Well GW-3 and GW-3 be deleted from the monitoring program.

If there are any questions or you require additional information, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Stephen M. Sutphin
Project Manager

SMS:knm
Enclosures

FILE: 09018-03

RECEIVED
APR 23 2009
IL Environmental Protection Agency
MARION REGIONAL OFFICE

124 Philpott Lane • Raleigh County Airport Industrial Park • Beaver, WV 25813-9502 • TELE: (304) 255-0491 • FAX: (304) 255-4232

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

April 22, 2009

Project No. B09-018-1413

Mr. Larry Crislip
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
2309 West Main Street, Suite 116
Marion, IL 62959

Transmittal
IPR For Permit No. 375
Williamson Energy, LLC
Pond Creek No. 1 Mine
Williamson County, Illinois

Dear Mr. Crislip:

On behalf of our client, Williamson Energy, LLC, Alliance Consulting, Inc. is submitting two copies of an insignificant permit revision.

Each change is outlined below and addressed within this letter:

- Propose a 248-foot expansion of the Coal Refuse Disposal Facility No. 2 (Phase 5) to the north.
- Modify Sediment Pond No. 11 (Sediment Ditch 1, and Sediment Ditch).
- Propose to pump water from Sediment Pond 001 into Sediment Pond 011 (Sediment Ditch 1).
- Relocate Ground Water Well GW-11 and sealing of Ground Water Well GW-3.

- **Expansion of the Coal Refuse Disposal Facility No. 2**

Phase 5 of the coal refuse disposal facility contained in Permit 375; Revision No. 2 was limited by a 300-foot buffer zone which has been maintained from residential structures located along Dean Road. Williamson Energy has purchased the residential property and thus eliminated the need of the 300-foot buffer. Therefore, Williamson Energy is proposing to expand the north portion for Coal Refuse Disposal Facility No. 2 (Phase 5) to the north approximately 248 feet and within 50-feet of the existing permit boundary. The expansion has been shown on drawings for Phases 5, 6, 7 and the abandonment plan. Refer to Phase 5-Plan View (Drawing No. B09-018-M2), Phase 6-Plan View (Drawing No. B09-018-M4),

Phase 7-Plan View (Drawing No. B09-018-M3), Abandonment Plan (Drawing No. B09-018-M1), and Section E-E (Drawing No. B09-018-E1).

- **Modify Sediment Pond 011 (Sediment Ditch 1 and Sediment Ditch 2)**

Due to the expansion of Phase 5 and the addition of a pump discharge, Sediment Pond 011, which consists of Sediment Ditches 1, 2, 3, and 4, will be modified.

The drainage area for Sediment Ditch 1 will be increase by 10.41 acres from 128.71 acres to 139.12 acres. In addition to the increased size of the drainage area, the ditch will receive a pump discharge from Sediment Pond 001. Details concerning the pump and proposed pipeline are included in this submittal and Map 6 S.F. A pump discharge rate of 2000 gallons per minute has been added to the calculation of Sediment Ditch 1. Refer to the design information and SedCad printouts for Sediment Ditch 1. Due to the pump discharge and the additional drainage area into Sediment Ditch 1, Sediment Ditch 2 has been modified to accommodate the increased flow. The spillway for Sediment Pond 011 (Sediment Ditches 1, 2, 3, & 4) has been reviewed and the modifications of the proposed will not affect the approved spillway dimensions.

Refer to the General Design Information Sheets and the SedCad printouts for information pertaining to Outlet 011.

- **Propose to pump water from Pond 001 into Pond 011 (Sediment Ditch 1).**

Due to quality issues associated with water that is collected in underground sumps, the permittee is requesting to pump water from Sediment Pond 001. Therefore, the permittee is requesting to place a 2000 gpm pump into Sediment Pond 001 and install a pipeline within the existing permit boundary and discharge into Sediment Pond 011 and specifically into Sediment Ditch 1 of Pond 011. The pump discharge has been incorporated into the design calculations for Sediment Ditch 1 and the required flow for Sediment Pond 011 has been revised based upon the routing of the storm flow through Sediment Ditches 1 and 2.

A buried power line will be installed from the Dean Road intake shaft to the pump in Pond 001. The discharge line from the pump will be buried within the permit boundary and the Dean Road right-of-way. Refer to the attached letter from the Williamson County Highway Department. A portion of the buried waterline will cross beneath the un-named tributary of Pond Creek. If, for any reason, the installation activities would encroach on the stream buffer zone area, temporary sediment control structures, such as hay bales and/or silt fence will be installed between the disturbance and the stream. Upon completion of the waterline installation, an approved temporary and permanent seed mixture will be sewn to insure the stabilization of the disturb area within the stream buffer zone.



To avoid disturbance within the stream channel, the permittee intends to bore beneath the stream channel. Since no disturbance is planned within the stream channel, no additional permits will be necessary. Refer to Map 6 S.F – Sheet 1 of 3 (Drawing No. B09-018-M5).

Any disturbance within an area designated for a small area drainage exemption will utilize hay bales and/or silt fence during construction and upon completion of the construction, an approved temporary and permanent seed mixture will be sewn to insure the stabilization of the disturbed area within the small area drainage exemption area. Refer to Map 6 S.F – Sheet 1 of 3 (Drawing No. B09-018-M5).

Sediment Ponds 007 and 008 are still active and functioning. As specified in the approval for IPR No. 8/IBR No. 9, Sediment Ditch 1 discharges into Sediment Ditch 2, which discharges into Sediment Pond 008 until IEPA approved the installation of Outlet 011. However, due to elevation differences, a open channel spillway, approximately three feet wide and three feet deep has been constructed from Sediment Pond 008 to Sediment Pond 011 (Sediment Ditch 2). An open channel spillway of the same dimensions has been constructed from Sediment Pond 007 to Sediment Pond 008. The existing pump, which was previously located in Sediment Pond 008, has been re-located and placed in Sediment Ditch 2. The pump is part of the approved closed-loop water system utilized by the mine and the preparation plant and keeps Sediment Ponds 007, 008 and 011 from discharging. The operator will maintain the pool elevations of Sediment Ponds 007 & 008 to prevent a discharge except during a 10 year/24 hour storm event of 5.21 inches as specified by NPDES Permit No. IL0077666.

- **Relocate Ground Water Well No. 11 and deletion of Ground Water Well No. 3**

As a result of expanding Phase 5 of the refuse facility, Ground Water Well GW-11 will need to be relocated. The well location will be 248-feet north of the approved location. All requirements pertaining to the installation of GW-11 and detailed in Permit 375; Revision No. 2 will be met. The well will be located at the toe of the Sediment Pond 011 (Sediment Ditch 1). Refer to Phase 5-Plan View (Drawing No. B09-018-M2), Phase 6-Plan View (Drawing No. B09-018-M4), Phase 7-Plan View (Drawing No. B09-018-M3), Abandonment Plan (Drawing No. B09-018-M1) and Map 6 SF (Drawing No. B09-018-M5).

The permittee is requesting to seal Ground Water Well GW-3. The location of this ground water well is approximately 296 feet northeast from the location of the proposed Ground Water Well GW-11 location. GW-3 will not be sealed until GW-11 is installed and functioning. At that time, the approved abandonment procedures will be followed to seal GW-3. Sealing documentation will be submitted to IDNR upon completion of the well.

An additional copy has been sent to Mr. Bill O'Leary in the IDNR-Benton office and two copies of this IPR have been sent to Mr. Scott Fowler, IDNR-Springfield office.



If you have any questions, or require additional information regarding this application, please contact us.

Sincerely,

ALLIANCE CONSULTING, INC.

Stephen M. Sutphin
Project Manager

SMS:knm
Enclosures

FILE: 09018-02

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Office: 618-983-3020 Fax: 618-983-3017

April 14, 2009

Mr. Scott K. Fowler, Supervisor
Land Reclamation Division
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
One Natural Resources Way
Springfield, ILL 62702-1271

IPR For Permit No. 375
Modification to the Coal Refuse Disposal Facility No. 2 Plans
Williamson Energy, LLC
Pond Creek No. 1 Mine
Williamson County, Illinois

Dear Mr. Fowler:

This letter authorizes Alliance Consulting, Inc. to prepare an application and make corrections, as necessary, for Permit No. 375 to modify the Coal Refuse Disposal Facility No. 2. Please send Williamson Energy LLC and Alliance Consulting, Inc. copies of all correspondence concerning this application.

If you have any questions or require additional information, please do not hesitate to contact me.

Sincerely,

WILLIAMSON ENERGY, LLC

Michael J. Beyer
Authorized Agent

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

April 21, 2009

Project No. B09-018-1413

Mr. Scott K. Fowler, Supervisor
Land Reclamation Division
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
One Natural Resources Way
Springfield, IL 62702-1271

Transmittal
IPR For Permit No. 375
Williamson Energy, LLC
Pond Creek No. 1 Mine
Williamson County, Illinois

Dear Mr. Fowler:

On behalf of our client, Williamson Energy, LLC, Alliance Consulting, Inc. is submitting two copies of an insignificant permit revision. This IPR submittal supersedes the IPR submitted on March 27, 2009 by Mr. Jim Slapak.

Each change is outlined below and addressed within this letter:

- Propose a 248-foot expansion of the Coal Refuse Disposal Facility No. 2 (Phase 5) to the north.
- Modify Sediment Pond No. 11 (Sediment Ditch 1, and Sediment Ditch).
- Propose to pump water from Sediment Pond 001 into Sediment Pond 011 (Sediment Ditch 1).
- Relocate Ground Water Well GW-11 and sealing of Ground Water Well GW-3.

- Expansion of the Coal Refuse Disposal Facility No. 2

Phase 5 of the coal refuse disposal facility contained in Permit 375; Revision No. 2 was limited by a 300-foot buffer zone which has been maintained from residential structures located along Dean Road. Williamson Energy has purchased the residential property and thus eliminated the need of the 300-foot buffer. Therefore, Williamson Energy is proposing to expand the north portion for Coal Refuse Disposal Facility No. 2 (Phase 5) to the north approximately 248 feet and within 50-feet of the existing permit boundary. The expansion has been shown on drawings for Phases 5, 6, 7 and the abandonment plan. Refer to Phase 5-Plan View (Drawing No. B09-018-M2), Phase 6-Plan View (Drawing No. B09-018-M4),

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An additional copy has been sent to Mr. Bill O'Leary in the Benton office and two copies of this IPR have been sent to Mr. Larry Crislip, IEPA.



If you have any questions, or require additional information regarding this application, please contact us.

Sincerely,

ALLIANCE CONSULTING, INC.

Stephen M. Sutphin
Project Manager

Claudio E. Yon
Senior Project Manager

SMS/CEY:knm
Enclosures

FILE: 09018-01

ENGINEERING CERTIFICATION

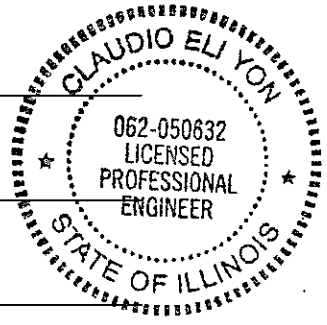
I hereby certify the engineering design used in preparation of this application, attachments, and supplements was done by me or under my direct supervision.

I further certify to the best of my knowledge all such design is in accordance with all applicable local, state and federal laws, rules and regulations. I have placed an "X" in the box below if that item is relevant.

☐ Whereas the Reclamation Plan calls for an alternative land use, I also certify the plans to conform to applicable accepted standards for adequate land stability, drainage, vegetative cover, and aesthetic design appropriate for the post-mining use of the site.

☒ Whereas the operation proposes disposal of spoil or waste materials in areas other than mining workings or excavations, I also certify such fills are designed in accordance with recognized professional standards and all applicable laws.

☐ Certification of the Illinois Environmental Protection Agency-35 Ill. Adm. Code 405.104(a) Permit. In my professional judgment, the plans and specifications submitted as part of this application describe an operation, which will meet all applicable effluent and water quality standards. I certify that I am familiar with all of the plans, specifications, reports, and maps submitted as part of this application and that said plans, etc. are accurate insofar as they represent existing conditions.



Claudio E. Yon
Name

062-050632
Illinois Registration Number (Seal)

Alliance Consulting, Inc.
Firm

(304) 255-0491
Phone Number

124 Philpott Lane,
Address

Beaver, WV 25813

Signature

4/21/09
Date

JAMES J. WEBB
COUNTY ENGINEER

SCOTT BARGER
DESIGN ENGINEER

YVONNE RICHERT
OFFICE MANAGER

WILLIAMSON COUNTY
HIGHWAY DEPARTMENT
MARION, ILLINOIS 62959

1817 NORTH COURT ST
TELEPHONE (618) 997-1301
EXT. 145

PERMIT REQUEST TO INSTALL WATERLINE

WHEREAS, Mach Mining, LLC, Williamson County, Illinois, has requested permission to construct a waterline along roads in Williamson County which is subject to the jurisdiction and authority of said County and its officers.

WHEREAS, the proposed construction consists of various waterline sizes which will be laid along and under Dean Road and Thorn Road (See Attachment Drawings).

THEREFORE, be it permitted and granted by the County Engineer of Williamson County, Illinois, that permission be granted to proceed with said construction, subject to the following conditions:

1. That the developer shall furnish all materials, do all work and pay all costs of such work.

2. That one-way traffic be maintained during the period of construction and adequate protection for the safety of the public be provided.

3. That the petitioner or his assigns shall assume all risks and liability for accidents and damages that may occur to persons or property on account of said work.

4. That this permit is effective insofar only as the County has jurisdiction and does not presume to release the petitioner from compliance with the provisions of any existing statute relative to the work involved.

5. That the said work shall be constructed to the satisfaction of the County Engineer.

6. That the work shall be performed so as not to permanently impair the existing road, and that any damage to the said road that might be done during the time of construction shall be repaired to the satisfaction of the County Engineer.

7. That the waterline shall be a minimum of three (3) feet below the present grade of the road where the waterline crosses the roadway or two feet below the existing ground line if located outside of the roadbed but within the R.O.W. The said waterline will be placed in the back slope of the ditch.

8. That the waterline shall be relocated at no expense to the County if such a move is needed or maintenance or construction work on the road

9. Open cutting of the road surface will not be allowed.

10. The county will not be held liable for any damage to the meter or waterline that is installed on county R.O.W. The meter shall be flagged properly to avoid damage while mowing on or maintaining R.O.W.

PERMIT REQUESTED BY James W. Clayton 2-10-09
Authorized Person For Mach Mining, LLC

IN WITNESS WHEREOF, I have hereunto set my hand and seal as the County Engineer of Williamson County, Illinois, this 9th day of February, 2009.

James J. Webb
County Engineer
Williamson County Highway Dept.

GENERAL INFORMATION
Permit No. **375**
Structure ID: **Sediment Ditch Structure No. 1**
Type: **Combination** (Dam, Incised, or Combination)

DESIGN DETAILS

A.	Design Storm: 100yr/6hr	**6.21**	in
B.	Estimated Runoff Area:	**139.10**	acres
C.	Estimated Distrubed Area:	**139.10**	acres
D.	Runoff Coefficient:	**100.00**	percent
E.	Quanitity of Runoff (8 hrs of a 10yr/24hr storn	**11.58**	ac/ft
F.	Sediment Volume (Dist. Area X 0.1):	**13.91**	ac/ft
G.	Pit Pumpage:	**2000.00**	gpm
H.	Pit Pumpage Treatment:	**None**	
I.	Basin Volume (Required at Normal Pool*):	**29.91**	ac/ft
	Basin Volume (Provided at Normal Pool):		ac/ft
J.	Basin Freeboard (Designed Storm 100yr/6hr):	**2.00**	feet (Reference SCS-IL, June, 1992)
K.	Surface Area at Design Storm (25yr/6hr):	-	acres
L.	Diversion Ditching:	**None**	
M.	Inlet Elevation**:	**N/A**	feet
	Outlet Elevation	**N/A**	feet
	Outfall Elevation	**N/A**	feet
N.	Emergency Spillway System**: (Design Storm 25yr/6hr)	**None**	

Notes:

* Basin Volume Required = (0.33 X Runoff Volume) + Sediment Volume + (pit Pumpage X 0.00442 X 0.5)

** Detailed drawings are submitted with the basin plan view and sections.

EXCAVATED SEDIMENT DITCH
STRUCTURE PROPORTIONING SHEET

PROJECT NAME: POND CREEK MINE NO.1
PROJECT NUMBER: B09-018-1413
DESCRIPTION: *SEDIMENT DITCH NO. 1*

SEDIMENT STORAGE REQUIREMENTS:

DRAINAGE AREA NO. :	SD1				
TOTAL AREA =	139.10	ACRES	DISTURBED AREA =	139.10	ACRES
SED STORAGE FACTOR =	0.1	AC.FT./AC	REQUIRED SED VOL =	13.91	AC. FT.
10YR. 24HR. RUNOFF VOL	34.737	AC.FT	REQUIRED RUNOFF VOL=	11.58	AC. FT.
PUMPAGE	2000	GPM	PUMPAGE VOLUME =	4.42	AC. FT.
LINEAR FEET OF DITCHLINE AVAILABLE =			6438 FEET	29.91	TOTAL REQ.

PROPOSED DITCH DIMENSIONS:

SIDE SLOPE (L) =	2.00:1		SIDE SLOPE (R) =	2.00:1	
BOTTOM WIDTH =	20.0	FEET	BARRIER DAM HEIGHT (MIN) =	6.33	FEET
NUMBER OF CELLS =	13		BARRIER SPACING =	495.23	FEET
NUMBER OF BARRIERS =	12		TOP WIDTH (TOTAL) =	59.29	FEET
POOL AREA=	7.65	AC.			

SEDIMENT DITCH CAPACITY:

TOTAL VOLUME OF DITCH (NO BARRIERS) =	30.47	ACRE FEET
TOTAL VOLUME OF BARRIERS =	0.43	ACRE FEET
TOTAL AVAILABLE STORAGE VOLUME =	30.04	ACRE FEET
60% CLEANOUT DEPTH = 3.78 FEET		

BARRIER/SPILLWAY DIMENSIONS:

SPILLWAY LENGTH = 5.0 FEET REQD SPILLWAY FLOW = 243.82 CFS

SPILLWAY CHECK BASED ON WEIR EQUATION

Q = CLH^1.5 OR
Q = CH^1.5(L+0.4(Z1+Z2)H)
REF. (MESA MANUAL, Pg. 6.136)

REF. (OPEN CHANNEL HYDRAULICS, CHOW, Pg. 53)

WHERE:

COEFFICIENT C =	2.8	
BOTTOM WIDTH L =	45.3	FEET
SIDE SLOPE Z1 =	2	
SIDE SLOPE Z2 =	2	

SPILLWAY FLOW DEPTH =	1.49	FEET
AREA OF FLOW =	72.15	SQ.FT.
VELOCITY =	3.38	FPS
FREEBOARD =	2.00	FEET
TOP WIDTH =	59.29	FEET

Q ACTUAL = 243.85 CFS

TOTAL SPILLWAY DEPTH (DEPTH ABOVE BARRIER DAM) = 3.49 FEET
TOTAL (MINIMUM) DITCH DEPTH = 9.82 FEET

NOTES:
1. BARRIERS SHALL BE SPACED TO MAINTAIN A BOTTOM GRADE ON THE SEDIMENT DITCH OF 0%, BUT IN NO CASE MORE THAN 500 FT APART.
2. ALL BARRIER DAM UPSTREAM AND DOWNSTREAM SIDE SLOPES WILL BE 3:1.

GENERAL INFORMATION
Permit No. 375
Structure ID: **Sediment Ditch Structure No. 2**
Type: **Combination** (Dam, Incised, or Combination)

DESIGN DETAILS

A.	Design Storm: 100yr/6hr	**6.21**	in	
B.	Estimated Runoff Area:	**43.50**	acres	
C.	Estimated Distrubed Area:	**43.50**	acres	
D.	Runoff Coefficient:	**100.00**	percent	
E.	Quanitity of Runoff (8 hrs of a 10yr/24hr storn	**3.98**	ac/ft	
F.	Sediment Volume (Dist. Area X 0.1):	**4.35**	ac/ft	
G.	Pit Pumpage:	**0.00**	gpm	
H.	Pit Pumpage Treatment:	**None**		
I.	Basin Volume (Required at Normal Pool*):	**8.33**	ac/ft	
	Basin Volume (Provided at Normal Pool):		ac/ft	
J.	Basin Freeboard (Designed Storm 100yr/6hr):	**2.00**	feet	(Reference SCS-IL, June, 1992)
K.	Surface Area at Design Storm (25yr/6hr):	-	acres	
L.	Diversion Ditching:	**None**		
M.	Inlet Elevation**:	**N/A**	feet	
	Outlet Elevation	**N/A**	feet	
	Outfall Elevation	**N/A**	feet	
N.	Emergency Spillway System**: (Design Storm 25yr/6hr)	**None**		

Notes:
* Basin Volume Required = (0.5 X Runoff Volume) + Sediment Volume + (pit Pumpage X 0.00442 X 0.5)
** Detailed drawings are submitted with the basin plan view and sections.

EXCAVATED SEDIMENT DITCH
STRUCTURE PROPORTIONING SHEET

PROJECT NAME: POND CREEK MINE NO.1
PROJECT NUMBER: B09-018-1413
DESCRIPTION: *SEDIMENT DITCH NO. 2*

SEDIMENT STORAGE REQUIREMENTS:

DRAINAGE AREA NO. :	SD2				
TOTAL AREA =	43.50	ACRES	DISTURBED AREA =	43.50	ACRES
SED STORAGE FACTOR =	0.1	AC.FT./AC	REQUIRED SED VOL =	4.35	AC. FT.
10YR. 24HR. RUNOFF VOL	11.939	AC.FT	REQUIRED RUNOFF VOL=	3.98	AC. FT.
LINEAR FEET OF DITCHLINE AVAILABLE =			1910 FEET	8.33	TOTAL REQ.

PROPOSED DITCH DIMENSIONS:

SIDE SLOPE (L) =	2.00:1		SIDE SLOPE (R) =	2.00:1	
BOTTOM WIDTH =	20.0	FEET	BARRIER DAM HEIGHT (MIN) =	6.07	FEET
NUMBER OF CELLS =	4		BARRIER SPACING =	477.50	FEET
NUMBER OF BARRIERS =	3		TOP WIDTH (TOTAL) =	58.88	FEET
POOL AREA=	2.34	AC.			

SEDIMENT DITCH CAPACITY:

TOTAL VOLUME OF DITCH (NO BARRIERS) =	8.47	ACRE FEET
TOTAL VOLUME OF BARRIERS =	0.10	ACRE FEET
TOTAL AVAILABLE STORAGE VOLUME =	8.37	ACRE FEET
60% CLEANOUT DEPTH = 3.62 FEET		

BARRIER/SPILLWAY DIMENSIONS:

SPILLWAY LENGTH = 5.0 FEET REQD SPILLWAY FLOW = 279.42 CFS

SPILLWAY CHECK BASED ON WEIR EQUATION

Q = CLH^1.5 OR
Q = CH^1.5(L+0.4(Z1+Z2)H)
REF. (MESA MANUAL, Pg. 6.136)

REF. (OPEN CHANNEL HYDRAULICS, CHOW, Pg. 53)

WHERE:

COEFFICIENT C =	2.8	
BOTTOM WIDTH L =	44.3	FEET
SIDE SLOPE Z1 =	2	
SIDE SLOPE Z2 =	2	

SPILLWAY FLOW DEPTH =	1.65	FEET
AREA OF FLOW =	78.70	SQ.FT.
VELOCITY =	3.55	FPS
FREEBOARD =	2.00	FEET
TOP WIDTH =	58.88	FEET

Q ACTUAL = 279.50 CFS

TOTAL SPILLWAY DEPTH (DEPTH ABOVE BARRIER DAM) = 3.65 FEET
TOTAL (MINIMUM) DITCH DEPTH = 9.72 FEET

NOTES:
1. BARRIERS SHALL BE SPACED TO MAINTAIN A BOTTOM GRADE ON THE SEDIMENT DITCH OF 0%, BUT IN NO CASE MORE THAN 500 FT APART.
2. ALL BARRIER DAM UPSTREAM AND DOWNSTREAM SIDE SLOPES WILL BE 3:1.

Coal Refuse Disposal Facility No.2

100yr. 6hr. Event

Combined Routing of Diversion Ditches and Sediment Ditches 1-4

BLA

Alliance Consulting, inc.
124 Philpott Lane
Beaver, WV 25813

Phone: (304)-255-0491

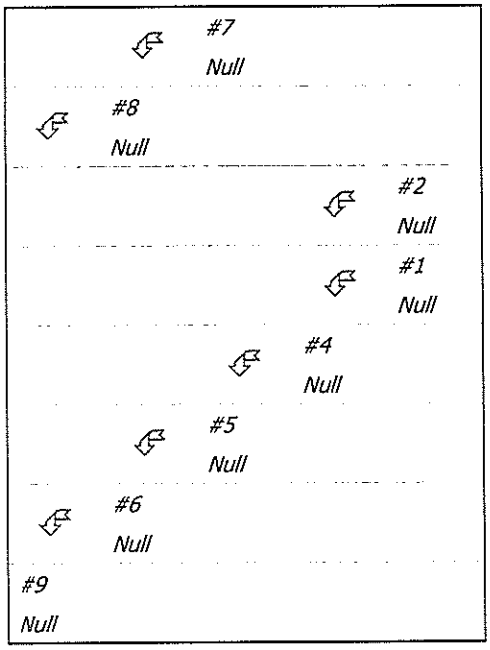
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#4	0.427	0.234	DITCH 8-A
Null	#2	==>	#4	0.101	0.234	DITCH 8-B
Null	#4	==>	#5	0.072	0.277	SED DITCH 3
Null	#5	==>	#6	0.153	0.234	DITCH N
Null	#6	==>	#9	0.000	0.000	SED DITCH 4
Null	#7	==>	#8	0.337	0.234	SED DITCH 1
Null	#8	==>	#9	0.000	0.000	SED DITCH 2
Null	#9	==>	End	0.000	0.000	Outlet



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.25	5.77	2,310.00	1.50	0.427
#1	**Muskingum K:**					**0.427**
#2	8. Large gullies, diversions, and low flowing streams	0.25	1.37	550.00	1.50	0.101
#2	**Muskingum K:**					**0.101**

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#4	8. Large gullies, diversions, and low flowing streams	0.50	2.75	550.00	2.12	0.072
#4	**Muskingum K:**					**0.072**
#5	8. Large gullies, diversions, and low flowing streams	0.25	2.07	830.00	1.50	0.153
#5	**Muskingum K:**					**0.153**
#7	8. Large gullies, diversions, and low flowing streams	0.25	4.54	1,820.00	1.50	0.337
#7	**Muskingum K:**					**0.337**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#7	139.100	139.100	243.82	43.53
#8	47.700	186.800	279.42	58.49
#2	19.400	19.400	77.79	6.10
#1	32.600	32.600	113.07	10.21
#4	20.000	72.000	179.64	22.59
#5	3.300	75.300	181.36	23.89
#6	4.600	79.900	184.79	25.35
#9	0.000	266.700	416.54	83.84

Structure Detail:

Structure #7 (Null)

SED DITCH 1

Structure #8 (Null)

SED DITCH 2

Structure #2 (Null)

DITCH 8-B

Structure #1 (Null)

DITCH 8-A

Structure #4 (Null)

SED DITCH 3

Structure #5 (Null)

DITCH N

Structure #6 (Null)

SED DITCH 4

Structure #9 (Null)

Outlet

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#7	1	139.100	1.462	0.000	0.000	87.000	M	243.82	43.528
	Σ	**139.100**						**243.82**	**43.528**
#8	1	47.700	0.499	0.000	0.000	87.000	M	159.52	14.960
	Σ	**186.800**						**279.42**	**58.488**
#2	1	19.400	0.286	0.000	0.000	87.000	M	77.79	6.098
	Σ	**19.400**						**77.79**	**6.098**
#1	1	32.600	0.460	0.000	0.000	87.000	M	113.07	10.214
	Σ	**32.600**						**113.07**	**10.214**
#4	1	20.000	0.427	0.000	0.000	87.000	M	71.59	6.281
	Σ	**72.000**						**179.64**	**22.594**
#5	1	3.300	0.072	0.000	0.000	87.000	M	20.60	1.294
	Σ	**75.300**						**181.36**	**23.887**
#6	1	4.600	0.184	0.000	0.000	87.000	M	20.44	1.460
	Σ	**79.900**						**184.79**	**25.348**
#9	Σ	**266.700**						**416.54**	**83.836**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#4	1	8. Large gullies, diversions, and low flowing streams	0.25	5.77	2,310.00	1.500	0.427
#4	**1**	**Time of Concentration:**					**0.427**
#5	1	8. Large gullies, diversions, and low flowing streams	0.50	2.75	550.00	2.120	0.072
#5	**1**	**Time of Concentration:**					**0.072**
#6	1	8. Large gullies, diversions, and low flowing streams	8.00	76.79	960.00	8.480	0.031
		8. Large gullies, diversions, and low flowing streams	0.25	2.07	830.00	1.500	0.153
#6	**1**	**Time of Concentration:**					**0.184**
#7	1	8. Large gullies, diversions, and low flowing streams	1.00	31.00	3,100.00	3.000	0.287
		8. Large gullies, diversions, and low flowing streams	0.25	15.87	6,348.00	1.500	1.175
#7	**1**	**Time of Concentration:**					**1.462**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#8	1	8. Large gullies, diversions, and low flowing streams	1.00	17.50	1,750.00	3.000	0.162
		8. Large gullies, diversions, and low flowing streams	0.25	4.54	1,820.00	1.500	0.337
#8	**1**	**Time of Concentration:**					**0.499**

Coal Refuse Disposal Facility No.2

10yr. 24hr. Event

Combined Routing of Diversion Ditches and Sediment Ditches 1-4

BLA

Alliance Consulting, inc.
124 Philpott Lane
Beaver, WV 25813

Phone: (304)-255-0491

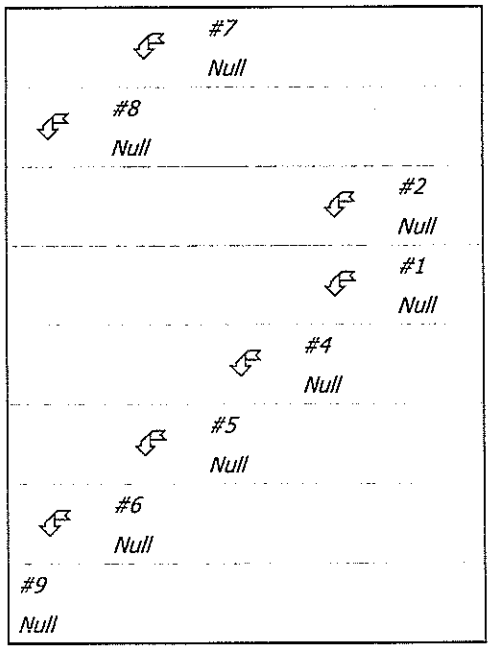
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	5.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#4	0.427	0.234	DITCH 8-A
Null	#2	==>	#4	0.101	0.234	DITCH 8-B
Null	#4	==>	#5	0.072	0.277	SED DITCH 3
Null	#5	==>	#6	0.153	0.234	DITCH N
Null	#6	==>	#9	0.000	0.000	SED DITCH 4
Null	#7	==>	#8	0.337	0.234	SED DITCH 1
Null	#8	==>	#9	0.000	0.000	SED DITCH 2
Null	#9	==>	End	0.000	0.000	Outlet



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.25	5.77	2,310.00	1.50	0.427
#1	**Muskingum K:**					**0.427**
#2	8. Large gullies, diversions, and low flowing streams	0.25	1.37	550.00	1.50	0.101
#2	**Muskingum K:**					**0.101**

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#4	8. Large gullies, diversions, and low flowing streams	0.50	2.75	550.00	2.12	0.072
#4	**Muskingum K:**					**0.072**
#5	8. Large gullies, diversions, and low flowing streams	0.25	2.07	830.00	1.50	0.153
#5	**Muskingum K:**					**0.153**
#7	8. Large gullies, diversions, and low flowing streams	0.25	4.54	1,820.00	1.50	0.337
#7	**Muskingum K:**					**0.337**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#7	139.100	139.100	144.63	34.74
#8	47.700	186.800	165.46	46.68
#2	19.400	19.400	44.85	4.87
#1	32.600	32.600	65.69	8.15
#4	20.000	72.000	105.63	18.03
#5	3.300	75.300	106.72	19.06
#6	4.600	79.900	108.67	20.23
#9	0.000	266.700	246.34	66.91

Structure Detail:

Structure #7 (Null)

SED DITCH 1

Structure #8 (Null)

SED DITCH 2

Structure #2 (Null)

DITCH 8-B

Structure #1 (Null)

DITCH 8-A

Structure #4 (Null)

SED DITCH 3

Structure #5 (Null)

DITCH N

Structure #6 (Null)

SED DITCH 4

Structure #9 (Null)

Outlet

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#7	1	139.100	1.462	0.000	0.000	87.000	M	144.63	34.737
	Σ	**139.100**						**144.63**	**34.737**
#8	1	47.700	0.499	0.000	0.000	87.000	M	92.80	11.939
	Σ	**186.800**						**165.46**	**46.676**
#2	1	19.400	0.286	0.000	0.000	87.000	M	44.85	4.867
	Σ	**19.400**						**44.85**	**4.867**
#1	1	32.600	0.460	0.000	0.000	87.000	M	65.69	8.151
	Σ	**32.600**						**65.69**	**8.151**
#4	1	20.000	0.427	0.000	0.000	87.000	M	41.54	5.013
	Σ	**72.000**						**105.63**	**18.030**
#5	1	3.300	0.072	0.000	0.000	87.000	M	11.75	1.035
	Σ	**75.300**						**106.72**	**19.065**
#6	1	4.600	0.184	0.000	0.000	87.000	M	11.72	1.165
	Σ	**79.900**						**108.67**	**20.230**
#9	Σ	**266.700**						**246.34**	**66.906**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#4	1	8. Large gullies, diversions, and low flowing streams	0.25	5.77	2,310.00	1.500	0.427
#4	**1**	**Time of Concentration:**					**0.427**
#5	1	8. Large gullies, diversions, and low flowing streams	0.50	2.75	550.00	2.120	0.072
#5	**1**	**Time of Concentration:**					**0.072**
#6	1	8. Large gullies, diversions, and low flowing streams	8.00	76.79	960.00	8.480	0.031
		8. Large gullies, diversions, and low flowing streams	0.25	2.07	830.00	1.500	0.153
#6	**1**	**Time of Concentration:**					**0.184**
#7	1	8. Large gullies, diversions, and low flowing streams	1.00	31.00	3,100.00	3.000	0.287
		8. Large gullies, diversions, and low flowing streams	0.25	15.87	6,348.00	1.500	1.175
#7	**1**	**Time of Concentration:**					**1.462**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#8	1	8. Large gullies, diversions, and low flowing streams	1.00	17.50	1,750.00	3.000	0.162
		8. Large gullies, diversions, and low flowing streams	0.25	4.54	1,820.00	1.500	0.337
#8	**1**	**Time of Concentration:**					**0.499**

Outlet 011 Channel Design

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
20.00	2.0:1	2.0:1	0.5	1.00		

PADER Method - Mild Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	416.54 cfs	
Depth:	2.92 ft	3.92 ft
Top Width:	31.66 ft	35.66 ft
Velocity:	5.53 fps	
X-Section Area:	75.32 sq ft	
Hydraulic Radius:	2.280 ft	
Froude Number:	0.63	
Manning's n:	0.0330	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

Coal Refuse Disposal Facility No.2

100yr. 6hr. Event

Combined Routing of Diversion Ditches and Sediment Ditches 1-4

BLA

Alliance Consulting, inc.
124 Philpott Lane
Beaver, WV 25813

Phone: (304)-255-0491

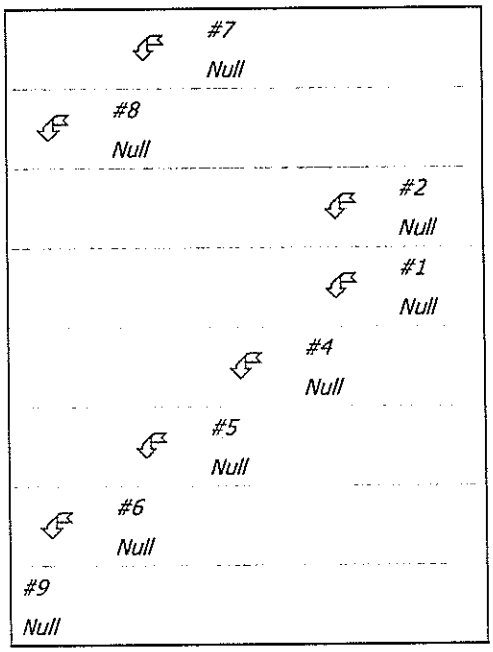
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	6.210 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#4	0.427	0.234	DITCH 8-A
Null	#2	==>	#4	0.101	0.234	DITCH 8-B
Null	#4	==>	#5	0.072	0.277	SED DITCH 3
Null	#5	==>	#6	0.153	0.234	DITCH N
Null	#6	==>	#9	0.000	0.000	SED DITCH 4
Null	#7	==>	#8	0.337	0.234	SED DITCH 1
Null	#8	==>	#9	0.000	0.000	SED DITCH 2
Null	#9	==>	End	0.000	0.000	Outlet



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.25	5.77	2,310.00	1.50	0.427
#1	**Muskingum K:**					**0.427**
#2	8. Large gullies, diversions, and low flowing streams	0.25	1.37	550.00	1.50	0.101
#2	**Muskingum K:**					**0.101**

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#4	8. Large gullies, diversions, and low flowing streams	0.50	2.75	550.00	2.12	0.072
#4	**Muskingum K:**					**0.072**
#5	8. Large gullies, diversions, and low flowing streams	0.25	2.07	830.00	1.50	0.153
#5	**Muskingum K:**					**0.153**
#7	8. Large gullies, diversions, and low flowing streams	0.25	4.54	1,820.00	1.50	0.337
#7	**Muskingum K:**					**0.337**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#7	139.100	139.100	243.82	43.53
#8	47.700	186.800	279.42	58.49
#2	19.400	19.400	77.79	6.10
#1	32.600	32.600	113.07	10.21
#4	20.000	72.000	179.64	22.59
#5	3.300	75.300	181.36	23.89
#6	4.600	79.900	184.79	25.35
#9	0.000	266.700	416.54	83.84

Structure Detail:

Structure #7 (Null)

SED DITCH 1

Structure #8 (Null)

SED DITCH 2

Structure #2 (Null)

DITCH 8-B

Structure #1 (Null)

DITCH 8-A

Structure #4 (Null)

SED DITCH 3

Structure #5 (Null)

DITCH N

Structure #6 (Null)

SED DITCH 4

Structure #9 (Null)

Outlet

Subwatershed Hydrology Detail:

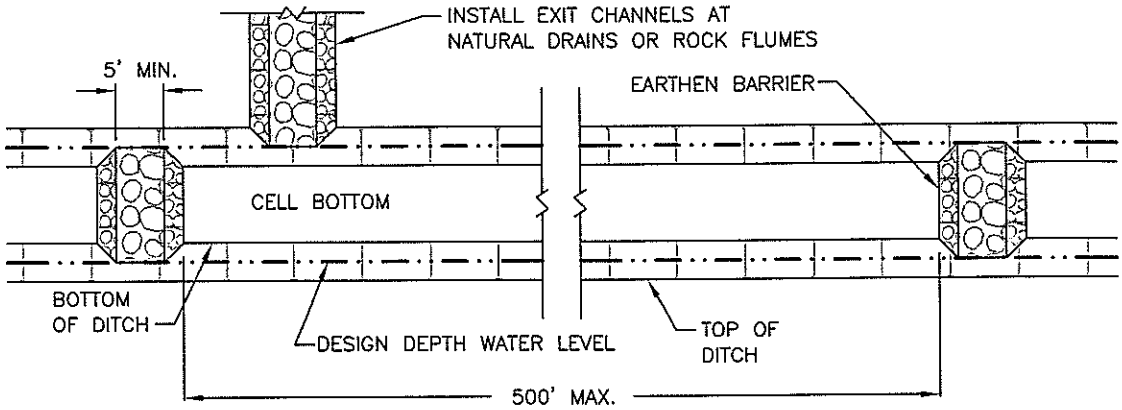
Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#7	1	139.100	1.462	0.000	0.000	87.000	M	243.82	43.528
	Σ	**139.100**						**243.82**	**43.528**
#8	1	47.700	0.499	0.000	0.000	87.000	M	159.52	14.960
	Σ	**186.800**						**279.42**	**58.488**
#2	1	19.400	0.286	0.000	0.000	87.000	M	77.79	6.098
	Σ	**19.400**						**77.79**	**6.098**
#1	1	32.600	0.460	0.000	0.000	87.000	M	113.07	10.214
	Σ	**32.600**						**113.07**	**10.214**
#4	1	20.000	0.427	0.000	0.000	87.000	M	71.59	6.281
	Σ	**72.000**						**179.64**	**22.594**
#5	1	3.300	0.072	0.000	0.000	87.000	M	20.60	1.294
	Σ	**75.300**						**181.36**	**23.887**
#6	1	4.600	0.184	0.000	0.000	87.000	M	20.44	1.460
	Σ	**79.900**						**184.79**	**25.348**
#9	Σ	**266.700**						**416.54**	**83.836**

Subwatershed Time of Concentration Details:

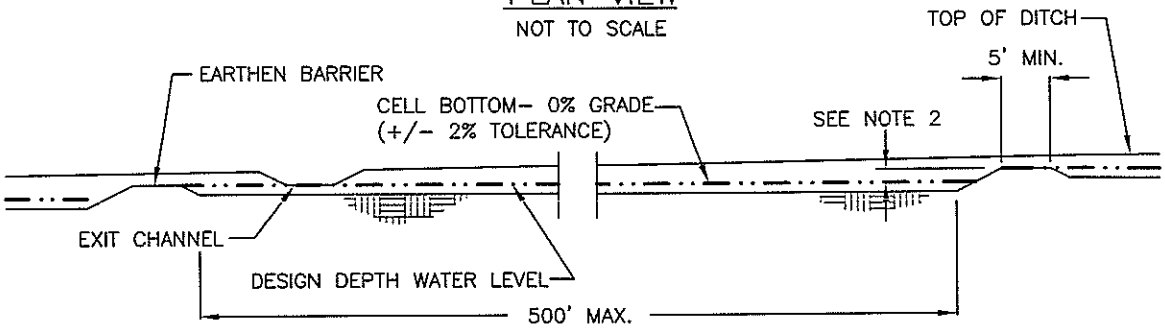
Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#4	1	8. Large gullies, diversions, and low flowing streams	0.25	5.77	2,310.00	1.500	0.427
#4	**1**	**Time of Concentration:**					**0.427**
#5	1	8. Large gullies, diversions, and low flowing streams	0.50	2.75	550.00	2.120	0.072
#5	**1**	**Time of Concentration:**					**0.072**
#6	1	8. Large gullies, diversions, and low flowing streams	8.00	76.79	960.00	8.480	0.031
		8. Large gullies, diversions, and low flowing streams	0.25	2.07	830.00	1.500	0.153
#6	**1**	**Time of Concentration:**					**0.184**
#7	1	8. Large gullies, diversions, and low flowing streams	1.00	31.00	3,100.00	3.000	0.287
		8. Large gullies, diversions, and low flowing streams	0.25	15.87	6,348.00	1.500	1.175
#7	**1**	**Time of Concentration:**					**1.462**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#8	1	8. Large gullies, diversions, and low flowing streams	1.00	17.50	1,750.00	3.000	0.162
		8. Large gullies, diversions, and low flowing streams	0.25	4.54	1,820.00	1.500	0.337
#8	**1**	**Time of Concentration:**					**0.499**

R17708



PLAN VIEW
NOT TO SCALE



PROFILE
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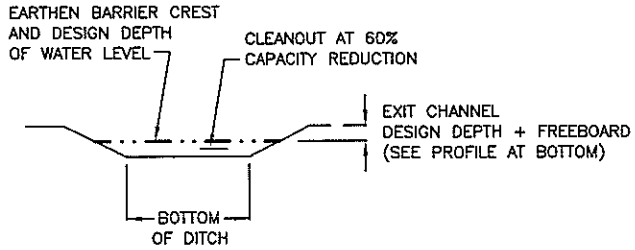
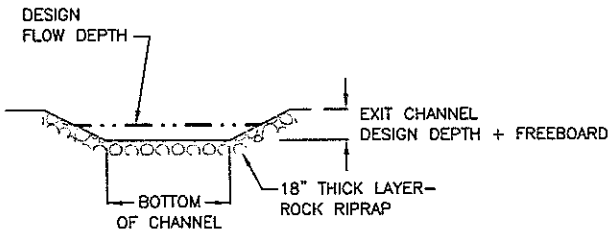


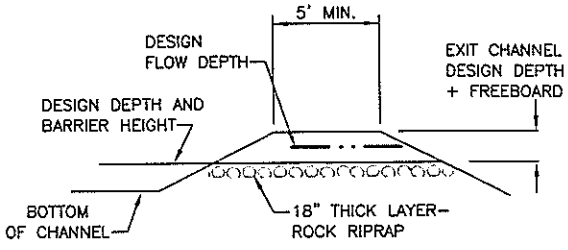
TYPICAL SECTION- SEDIMENT DITCH
NOT TO SCALE

NOTES:

1. SEE DESIGN SHEETS FOR SIDE SLOPES AND DIMENSIONS OF PROPOSED STRUCTURES.
2. TO PREVENT BACKWATER FLOODING ON THE COMBINATION SEDIMENT/PERIMETER DITCHES AROUND THE EMBANKMENTS, THIS DIMENSION MUST BE EQUAL TO OR GREATER THAN THE MINIMUM HEAD DIMENSIONS (BARRIER/SPILLWAY) ON THE SEDIMENT DITCH DESIGN SHEETS. A CHART WHICH SHOWS THIS MINIMUM DIMENSION FOR EACH DITCH IS CONTAINED IN THIS SECTION.



TYPICAL SECTION- EXIT CHANNEL
NOT TO SCALE



TYPICAL PROFILE- EXIT CHANNEL
NOT TO SCALE

Alliance Consulting, Inc.
Engineers
Constructors
Scientists
BECKLEY, WV
(304) 255-0491
RALEIGH, NC.
(919) 861-2267

TYPICAL DETAILS
POND 011\SEDIMENT DITCHES 1, 2, 3, & 4
POND CREEK MINE NO. 1
COAL REFUSE DISPOSAL FACILITY NO. 2
PREPARED FOR
WILLIAMSON ENERGY, LLC.
P.O. BOX 99, JOHNSTON CITY, IL

DRAWN BY	JWD	08/16/06
CHECKED BY		
APPROVED BY		
DRAWING NUMBER	FIGURE NUMBER	
B09-018-A1	--	

DOCUMENT

80

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

January 6, 2009

Project No. B08-516-1413

Mr. Ronald Morse
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
2309 West Main Street
Marion, IL 62949

Transmittal
Permit No. 375
Williamson Energy, LLC
Insignificant Revision No. 16

Dear Mr. Morse:

On behalf of our client, Williamson Energy, LLC, and as requested by Mr. Scott Fowler's letter dated December 10, 2008, please find enclosed two copies of the above-referenced permit application.

If you have any questions, or require additional information, please contact us.

Sincerely,

ALLIANCE CONSULTING, INC.

Stephen M. Sutphin
Project Manager

Claudio E. Yon, P. E.
Senior Project Manager

SMS/CEY:wmb
Enclosures

FILE: 08516-03

Illinois Department of
Natural Resources
One Natural Resources Way · Springfield, Illinois 62702-1271
http://dnr.state.il.us

Rod R. Blagojevich, Governor
Sam Flood, Acting Director

December 10, 2008

Michael J. Beyer
Williamson Energy, LLC
P.O. Box 99
Johnston City, IL 62951

Re: Permit No. 375
Insignificant Revision No. 16

Dear Mr. Beyer:

The appropriate Department technical staff have reviewed the proposed change dated November 5, 2008, submitted by Alliance Consulting for the Pond Creek Mine. The permittee has requested approval to dispose of coal refuse in areas beyond that currently approved. Since this operation is not currently approved, it will constitute a change to the approved plan. Insignificant permit revisions are allowed under 62 Ill. Adm. Code 1774.13(b)(2).

The Department has determined the proposed alteration is in compliance with 62 Ill. Adm. Code 1700 - 1850, and is insignificant and hereby exempts the permittee from submitting a permit revision application in accordance with Section 1774.13(b)(2). The Department grants permission to dispose of refuse as proposed.

No additional bond is required because of this change.

All conditions and provisions contained in the approved permit also apply to this revision. Approval from this agency does not relieve the permittee from obtaining approval from other agencies requiring such.

Please submit two additional copies of your request letter and maps to Ronald Morse, Illinois Environmental Protection Agency, 2309 West Main Street, Marion, Illinois 62959.

Should you have any questions, please contact William O'Leary at our Benton office.

Sincerely,

Scott K. Fowler, Supervisor
Land Reclamation Division

SKF:WO:gr
cc: W. O'Leary
OSMRE
R. Morse

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

November 5, 2008

Project No. B08-516-1413

Mr. Scott Fowler
ILLINOIS DEPARTMENT
OF NATURAL RESOURCES
Land Reclamation Division
503 E. Main, FL 001
Benton, IL 62812

IPR for Permit No. 375
Phases 3 and 4 Refuse Expansion
Williamson Energy, LLC
Pond Creek Mine No. 1
Williamson County, Illinois

Dear Mr. O'Leary:

On behalf of our client, Williamson Energy, LLC, Alliance Consulting, Inc. is submitting an original and one copy of an insignificant permit revision for placement of coal refuse in Phases 3 and 4 and removing soil from the Phase 5 footprint. A road will also be constructed to haul the soil from the Phase 5 area to the south topsoil stockpile. One copy of the application has been submitted to William O'Leary.

If you have any questions, or require additional information, please contact us.

Sincerely,

ALLIANCE CONSULTING, INC.

Claudio E. Yon, P. E.
Senior Project Manager

CEY:jea
Enclosures

FILE: 08516-02

REPORT
ENGINEERING DESIGN PLAN
POND CREEK MINE NO. 1
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
PHASES 3 AND 4
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY, LLC
JOHNSON CITY, ILLINOIS

TABLE OF CONTENTS

	PAGE
1.0 INTRODUCTION	1
2.0 EXISTING SITE CONDITIONS	1
2.1 Site Characteristics	1
2.2 Geology	2
3.0 COAL REFUSE PRODUCTION	2
3.1 Coal Refuse Production	2
4.0 SUBSURFACE EXPLORATION	2
4.1 Subsurface Exploration	2
5.0 FIELD AND LABORATORY TESTING	3
5.1 Soil	3
5.2 Coarse Coal Refuse	3
6.0 COAL REFUSE DISPOSAL PLAN	4
6.1 Phase 3	4
6.2 Phase 4	5
7.0 ENGINEERING ANALYSES	6
7.1 Slope Stability Analyses	6
8.0 SUMMARY	17

TABLE OF CONTENTS (continued)

CERTIFICATION OF PLAN

APPENDIX A – GUIDELINE TECHNICAL SPECIFICATIONS

FIGURES

LIST OF FIGURES

DRAWING NO.	TITLE
B08-516-M3	Map 6 S.F. – Operations Plan Map Surface Facilities
B08-516-M1	Phase 3/Phase 4
B08-516-E2	Slope Stability Analysis Sections D-D and F-F

REPORT
ENGINEERING DESIGN PLAN
POND CREEK MINE NO. 1
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
PHASE 3 AND 4
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY, LLC
JOHNSON CITY, ILLINOIS

1.0 INTRODUCTION

Plans have been developed for the construction of a coarse and fine coal refuse disposal facility to be located near Johnston City in Williamson County, Illinois. The proposed coal refuse disposal facility will provide disposal capacity for both coarse and fine coal refuse produced by the Pond Creek No. 1 Mine coal preparation plant located approximately 0.25 mile west of the proposed facility. The location of the site is just southwest of the intersection of Dwina Road and Dean Road.

The proposed facility has been designed as a high hazard impoundment using the Probable Maximum Flood (PMF) storm event. Based on the design production rates, at the 1-year anniversary of initial impounding capability and thereafter, the facility will be capable of storing the runoff associated with the design storm event. The stored runoff volume, as well as operational water, shall be evacuated using a decant pipe for Phase 3 and a pump for Phases 4.

Combination sedimentation and perimeter ditches, access road gutters and bench gutters have been specified to convey storm runoff away from the embankment in a controlled manner. The ditches have been designed for routing the runoff associated with the 100-year, 6-hour recurrence interval storm event.

2.0 EXISTING SITE CONDITIONS

2.1 Site Characteristics

The general area of the proposed impoundment has previously been used for agricultural purposes and has relatively flat to mild slopes to the ridgeline at approximate Elevation 572. The surrounding landscape is characterized by extensive agricultural and rural residential land use. Regionally, the proposed permit area is located on the southern shelf of the Illinois Basin in the Mt. Vernon Hill Country physiographic division. Surrounding landforms are the results of both Wisconsinian glaciations and normal degradation processes such as weathering, mass wasting, and stream erosion. Surrounding topography is characterized by generally flat ridge tops, moderately steep hill slopes and broad flat valley floors associated with major streams. The local drainage pattern is dendritic reflecting the regional generally horizontal bedrock stratigraphy. The total relief of the Facility No. 2 footprint is approximately 32 feet ranging from approximately 436' to 468' above mean seal level (based on aerial photography).

Glacial deposits of the Carmi Member of the Equality Formation, consisting of quiet water lake silt and clay, constituted the original surface materials within the proposed permit area.

2.2 Geology

The proposed permit area is underlain by lower Pennsylvanian age rocks consisting of shale, sandstone, and siltstone with minor underclay, coal and limestone. These sequences reflect fluctuating shorelines, deltas, and shallow seas indicating deltaic, fluvial, and coal swamp depositional environments. These bedrock units can be highly variable in thickness and continuity. Mississippian rocks unconformably underlie the Pennsylvanian, however, they do not outcrop in the subject area and were not penetrated during exploration drilling.

The major stratigraphic marker is the Herrin No. 6 coal which is generally uniform and continuous in the subject area and occurs at approximate Elevation 10 beneath the proposed refuse disposal facility. Shale and sandstone units in the subject area exhibit a high degree of lateral facies changes and interbedding. The Herrin No. 6 seam is described as a normal bright-banded coal with a lower portion that contains a prominent claystone parting. The base of the Herrin No. 6 exhibits an undulating surface with a general structural trend toward the north-northeast dipping approximately 60 feet per mile. No major faults or other structural anomalies are known to be present within the proposed permit.

3.0 COAL REFUSE PRODUCTION

3.1 Coal Refuse Production

Based on information provided by Williamson Energy, the following annual production quantities, beginning with the first year of plant operation, were used in the design.

• Coarse Coal Refuse	Prior to longwall startup	34,330 cubic yards/year
	After longwall startup	2.53 million cubic yards/year
• Fine Coal Refuse	Prior to longwall startup	17,945 cubic yards/year
	After longwall startup	1.32 million cubic yards/year

4.0 SUBSURFACE EXPLORATION

4.1 Subsurface Exploration

During the month of February 2006, a subsurface exploration program consisting of drilling one soil boring (No. 8874) was conducted within the footprint of the proposed embankment. The intent of the program was to obtain soil samples to define the conditions and engineering characteristics relative to the construction and operation of the fine coal refuse slurry disposal impoundment. In addition to this soil boring, the results of a previous subsurface exploration program performed by Holcomb Foundation Engineering Co. (Holcomb) indicate the following:

- Sample number, type, standard penetration test blow counts, and depth;
- An overall description of the consistency, color and character of the soil; and,
- Indication of the observed groundwater level in the boreholes at the time of drilling.



Generally, the soils encountered beneath the dam footprint consist of brown and gray silty clay with sand and pebbles. The thickness of the soil varied from 12.5' to 22.5' while the surface elevation for the borings varied from Elevation 438.5± to Elevation 473.0±. Each of the borings was terminated at the top of the bedrock.

Groundwater was encountered in two (2) of the seven (7) borings (i.e. Nos. 8293 and 8295). Following drilling, the depth from the ground surface to groundwater level varied from 10 to 13.5 feet or from Elevation 432.4± to Elevation 438.5± in the borings.

5.0 FIELD AND LABORATORY TESTING

5.1 Soil

Samples of the soils obtained during the subsurface exploration program from Boring No. 8874 were used for laboratory testing. The scope of the testing is discussed below.

Visual classification tests were performed by Holcomb on the split spoon samples obtained during drilling. Samples from the borings represent the foundation conditions for the proposed embankment. Additional testing performed on the borings included the following:

- Grain Size Analysis – Grain size analysis were performed on a sample from Boring No. 8874;
- Atterberg Limits Test – Atterberg Limits tests were performed on a sample from Boring No. 8874;
- Unit Weight Determination – Performed on a Shelby tube sample from Boring No. 8874; and,
- Shear Strength Test – A consolidated, undrained triaxial shear strength test with pore pressure measurements was performed on a Shelby tube sample from Boring No. 8874.

5.2 Coarse Coal Refuse

The proposed embankment shall be constructed with coarse coal refuse. The coarse coal refuse used to construct the embankment has been sampled from the Pond Creek Mine No. 1 coal processing plant and has undergone laboratory testing. The scope of the testing is discussed below.

- Grain Size Analysis – A grain size analysis was performed on the coarse coal refuse sample.
- Shear Strength Test – A consolidated, undrained triaxial shear strength test with pore pressure measurements was performed on re-molded samples of the coarse coal refuse. Material from the sample was re-molded to a density equivalent to approximately 95 percent of Standard Proctor maximum dry density.
- Permeability – A constant head permeability test was performed on a re-molded sample to determine the permeability characteristics of the coarse coal refuse for the embankment construction. The sample was compacted to approximately 95 percent of the Standard Proctor maximum dry density.



2. Fine Coal Refuse Disposal – During construction of the Phase 4 embankment, the fine coal refuse slurry shall continue to be pumped into the Phase 2 and 3 impoundment.

3. Pump Installation – An operational pump, of sufficient capacity to remove clarified water and normal precipitation, and associated discharge lines shall be installed during construction of Phase 4. The pump shall discharge into a surface drainage ditch.

7.0 ENGINEERING ANALYSES

7.1 Hydrologic and Hydraulic Analyses

The proposed facility has been evaluated using storm criteria for high hazard dams. Upon the one-year anniversary and thereafter, the impoundment shall be capable of storing the runoff associated with a PMF design storm event plus three feet of freeboard.

Evacuation of the stored water shall be accomplished by pumping for Phase 4. The required pumping capacity (1901.8 gallons per minute for Phase 4) is based on storing the runoff associated with two design storm events and evacuating the runoff associated with one design storm event within a reasonable time period (approximately 30 days). Should the available storage capacity be reduced to one design storm event, the emergency pumps shall be mobilized to the site to evacuate the stored runoff and provisions shall be made so the pumps and associated discharge line are readily available, when needed.

Evacuation of the stored runoff shall be accomplished by means of a decant pipe for the Phase 3. The required pipe size, 18-inch SDR 26, is based on evacuating 90% of the runoff associated with one design storm event within 10 days.

The surface drainage facilities, including road and bench gutters, and Ditches C through M have been sized to convey runoff associated with the 100-year, 6-hour recurrence interval storm event. The computed peak discharges were estimated using the computer program SedCad developed by the University of Kentucky. All permanent facilities have been designed with appropriate protection to minimize the potential for channel erosion.

7.2 Slope Stability Analyses

Slope stability analyses have been performed using PCSTABL5, a computerized version of the modified Bishop Method of Slices, developed by Purdue University and the Indiana State Highway Commission. The critical potential failure surfaces, minimum factors of safety, and material properties used in the slope stability analyses are presented on drawings contained herein.

Slope stability was analyzed for both static and seismic (pseudo static) loading conditions for the downstream and upstream embankment slopes. For the static analysis, effective properties for the coal refuse and existing soil were used. For the pseudo-static analysis, total stress properties were used for the existing soils. The use of effective stress properties for the coal refuse and total stress properties for the existing cohesive soils is appropriate, giving the effects of the sudden loading in an earthquake event and the relatively slow drainage characteristics of the soils. Also, for the pseudo-static analysis, a horizontal



acceleration of 0.15g[4] was used. The phreatic level used in the stability analyses was conservatively based on top flow line calculations performed on a transformed section. The transformed section was based on the horizontal permeability of the embankment material being nine times greater than the vertical permeability. The engineering properties of the embankment material were based on laboratory test results and our experience with similar materials.

Stage	Case	Minimum Static F.S.	Minimum Seismic F.S.
Phase 5	Downstream	1.50	1.26
	Upstream	1.85	1.21
Phase 7	Downstream	1.72	1.20
	Upstream	2.06	1.20

As indicated in the above table, the computed factors of safety meet the minimum requirements (1.5 and 1.2 for the static and seismic cases, respectively).

8.0 SUMMARY

The design plans for the proposed Pond Creek No. 1 Mine Coal Refuse Disposal Facility No. 2 (Phases 3 and 4) are based on the subsurface exploration program, field and laboratory testing, and the engineering analyses described herein.

We trust that the plans, design calculations and guideline technical specifications described herein are acceptable to Williamson Energy and the appropriate regulatory authorities. In preparing this document, our professional services have been performed with care and skill ordinarily exercised by reputable members of the profession practicing under similar conditions at the same time and the same or similar locality. No warranty, expressed or implied, is made by rendition of these consulting services or by furnishing oral or written reports of the findings made.

If there are any questions, or if further clarification is required, please contact us.

Respectfully submitted,

ALLIANCE CONSULTING, INC.

Claudio E. Yon, P. E.
Principal Engineer

CEY:jea

[4] National Earthquake Hazards Reduction Program, Part I, Provisions for the Development of Seismic Regulations for New Buildings, Map 1, 1991 Edition.

APPENDIX A

GUIDELINE TECHNICAL SPECIFICATIONS
ENGINEERING DESIGN PLAN
POND CREEK MINE NO. 1
PROPOSED COAL REFUSE DISPOSAL FACILITY NO. 2
PHASES 3 AND 4
WILLIAMSON COUNTY, ILLINOIS
WILLIAMSON ENERGY, LLC
JOHNSON CITY, ILLINOIS

INTRODUCTION

These specifications are intended to serve as guidelines for the construction of the Pond Creek No. 1 Mine Coal Refuse Disposal Facility No. 2 to serve Williamson Energy, LLC's (Williamson Energy) coal preparation plant in Williamson County, Illinois. The information contained herein, including the accompanying drawings which illustrate the disposal plan, is sufficiently detailed to provide Williamson Energy with the technical guidance required to perform coal refuse disposal operations in a manner consistent with the design assumptions and sound engineering practice. These specifications are intended to be supplemented with periodic site visits by persons knowledgeable of the design in order to conduct inspections of the construction procedures, conduct field tests and, if necessary, obtain samples and perform laboratory testing.

The specifications have been prepared to aid Williamson Energy in the design, planning, and construction of the specific project. Its scope is limited to the project and location described herein and represents our understanding of the significant aspects relevant to the planned operations. If there are any differences in location and/or design features, the modification should be reviewed to determine if revision of conclusions or recommendations is required.

This refuse disposal plan provides for the construction of a two embankments sharing a common side, utilizing coarse coal refuse to form an impoundment for the disposal of fine coal refuse slurry. The disposal plan for the facility will provide approximately 4 years of coarse and 7 years of fine coal refuse disposal capacity based on refuse production rates supplied by Williamson Energy.

Briefly, the work items required in the coal refuse disposal plan include:

1. Site Preparation - In areas of embankment construction, the site preparation items include topsoil stripping and stockpiling and proofrolling/sealing. During the disposal operations, benching of each lift of material into existing slopes shall be required as well as scarifying previously compacted surfaces.

2. Embankment Construction - Coarse coal refuse embankments shall be constructed to the appropriate lines and grades on the drawings.

3. Subsurface Drainage – An internal drainage system shall be installed in the Phases 5 and 6 embankment to aid in controlling the phreatic level.

4. Fine Coal Refuse Disposal – Upon commencement of Phase 4 construction, fine coal refuse slurry may be pumped into the Phase 3 impoundment. A water pumping system shall be used to remove excess clarified slurry water and precipitation from the impoundment.

5. Surface Drainage Facilities - To control and direct surface water runoff from the embankment and road ditches, Ditches C through M shall be constructed concurrent with construction operations.

6. Revegetation - To control erosion and provide an acceptable post mining land use, all completed embankment surfaces shall be revegetated in accordance with Williamson Energy's Mine Permit.

7. Monitoring and Maintenance - A program of regular monitoring and maintenance of the disposal operations is described herein.

The following drawings form a part of these specifications:

DRAWING NO.	TITLE
B08-516-M3	Map 6 S.F. – Operations Plan Map Surface Facilities
B08-516-M1	Phase 3/Phase 4
B08-516-E2	Slope Stability Analysis Sections D-D and F-F

1.0 SITE PREPARATION

1.01 General

Beneath all areas of the coarse coal refuse embankment, site preparation shall be required.

1.02 Stripping and Topsoil Removal

Stripping and stockpiling of topsoil and root matter are required to provide an adequate foundation for facility construction. All topsoil shall be removed prior to embankment construction. The stripped topsoil shall be stockpiled.

1.03 Surface Sealing/Proofrolling

The footprint of the embankment shall be proofrolled following stripping and topsoil removal to seal and compact the foundation soils. A minimum of three passes shall be made over each area using a large sheepsfoot roller or rubber-tired equipment (i.e. loaded truck) to produce a minimum dry density equivalent to 95 percent of the maximum dry density attainable by the Standard Proctor method of compaction (ASTM D 698). Any soft or wet soils shall be removed to a minimum depth of 2 feet below the previously excavated surface and replaced with coarse coal refuse. The over-excavated area shall be backfilled in 12-inch lifts, and compacted to 95 percent of the Standard Proctor maximum dry density (ASTM D 698).

Random in-place density testing shall be performed throughout the impoundment area to verify that the existing stripped surface is compacted to 95 percent of the Standard Proctor maximum dry density prior to fine coarse coal refuse slurry disposal.

2.0 EMBANKMENT CONSTRUCTION

2.01 General

To provide storage capacity for fine coal refuse, 2 embankments shall be constructed of coarse coal refuse sharing a common side. The plans and section of the proposed embankment phases are contained herein.



Sediment control shall be provided by the combination sediment/perimeter ditches. Conveyance ditches shall be constructed to convey surface runoff to the sediment/perimeter ditches.

2.02 Coarse Coal Refuse Placement and Compaction

a. Lines and Grades – Coarse coal refuse shall be placed to the lines and grades shown on the drawings for the various stages. Control for placement can be established from the coordinate system provided on the drawings.

b. Material: Run-of-plant coarse coal refuse from the coal preparation plant shall be used for the embankment construction. Placement and compaction of the refuse shall be in accordance with Sections 2.02.c and d.

c. Placement: Coarse coal refuse shall be spread in lifts not more than 1 foot thick when compacted. Material that is too wet to be properly compacted shall be spread and graded to facilitate drainage. Upon drying to within the acceptable moisture content range, compaction shall proceed.

d. Compaction: The coarse coal refuse in the impounding embankment shall be spread in layers having a compacted thickness of 1 foot or less. The material shall be compacted by routing heavy equipment (dozers, trucks, etc.) over it or utilizing specialized compaction equipment to attain the specified degree of compaction. No special compaction procedures are anticipated to be required to provide resulting densities which are consistent with those used in the design. A field density testing program shall be conducted during the placement operations to determine the actual dry density being achieved.

Field density testing of the foundation soil and coarse coal refuse placed in the embankment areas shall be performed to confirm that the compactive effort employed is yielding an in-place dry density of at least 95 percent of the maximum density obtainable by the Standard Proctor Compaction Method (ASTM D 698). Density testing shall be performed at equivalent frequencies of one test per 2,000 cubic yards of material placed and compacted and at least one test for each lift. Locations, elevations and dates of the tests shall be recorded and maintained for documentation purposes. The moisture at time of compaction shall be within the range of optimum moisture by -2 percent to +3 percent. If in-place dry densities



are observed to be less than that required, additional compaction shall be performed on the effective test area and the area retested. Such work shall continue until satisfactory results are obtained.

At least one Standard Proctor test of the material shall be verified for every 20 field density tests performed. Additionally, should mining or preparation plant operations change such that a change in refuse material properties is anticipated, the Proctor shall be verified.

e. Construction Procedures: The work surface shall be advanced upward in nearly horizontal layers. To minimize penetration of precipitation, the work surface shall be sloped to drain and backbladed as the material is spread. No fill shall be placed that is or on frozen material. If the surface where fill is to be placed is frozen, the frozen material shall be removed over an area where one day's refuse will be placed prior to placement of a new lift. The frozen material shall be stored until it is thawed and then replaced. Surface material in the impounding embankment too wet to support construction equipment shall be removed to expose drier material prior to placement of the next refuse layer. After drying, these wet materials can be reused in the embankment. As the level of the embankment is raised, it shall be graded smoothly to the contours shown on the plans. Coarse coal refuse placement guidelines are contained in Appendix E.

2.03 Survey Control

Survey control shall include establishment of permanent monuments outside of, but adjacent to the refuse disposal facility and underground mining limits. This control shall be used for the management of day-to-day operations.

2.04 Subsurface Drains

a. General – To minimize the possible rise in the phreatic level as the impoundment level rises, internal underdrains shall be installed within the embankment. The drains shall consist of either a geocomposite drainage material or non-calcareous gravel both with an HDPE perforated pipe wrapped entirely with geotextile. The approximate alignment and elevations of the drains are indicated on drawings contained herein.



b. Filter Fabric – The filter fabric shall be "Propex 4550" manufactured by Propex Fabrics, Inc., or an approved equivalent geotextile that is ultraviolet stabilized to resist deterioration. The filter fabric shall be protected from ultraviolet exposure during storage.

c. Pipe – The pipe used in the internal drain shall be a 12-inch diameter, SDR-13.5 or 26.5, perforated high-density polyethylene pipe as specified on the individual phase drawings. The outlet pipes shall not be perforated.

d. Rock Gravel – Competent, durable, clean gravel in the size range of ¼" to 1½" shall be used in the drains. The gravel shall consist of non-acid, non-toxic, non-calcareous rock that will not slake in water or degrade to soil material during the life of the facility, and which is free of coal, clay or other non-durable material.

e. Geocomposite – If a geocomposite drainage material is selected for the drain in lieu of the river gravel, the geocomposite shall be PermaNet HL, manufactured by GSE Lining Technologies, or equivalent. The geocomposite shall be entirely wrapped with filter fabric and shall be wrapped around the HDPE perforated collection/conveyance pipe.

3. Installation – The pipe shall be wrapped entirely with filter fabric with a minimum 2-foot overlap. The drain shall be constructed to the dimensions specified.

The installation of the underdrains shall be monitored by the engineer responsible for certifying the construction of the embankment or by a qualified person designated by the engineer.

2.05 Piezometers

Piezometers shall be installed at the locations shown on the drawings contained herein. Clean concrete sand may be substituted for the pea gravel if the latter is difficult to obtain. The perforated section of the piezometer pipe shall be wrapped with filter fabric. Bentonite seals shall be placed immediately above the perforated section and just below the ground surface to isolate the piezometer tip from potential perched water tables and minimize any influence associated with surface water.



2.06 Refuse Haul and Access Road Construction

An access road shall be extended to refuse facility operations as shown on the drawings. Throughout construction, access roads on the refuse pile shall be constructed to provide routes for access to the impoundment. Variations of road width or grade shall be determined by Williamson Energy based upon site-specific considerations. The locations of the roads may vary from the roads shown on the drawings provided the specified crest widths and embankment slope grades are maintained.

2.07 Decant Installation

a. General

To aid in maintaining a normal pool elevation in the impoundment and to provide a mechanism to evacuate stored storm runoff, a 18-inch outside diameter, SDR 26 high density polyethylene (HDPE) decant pipe shall be installed where applicable at the elevations shown on the drawings where it shall discharge into a surface drainage ditch.

b. Decant Pipe

The pipe used for decant construction shall be 18-inch outside diameter, SDR 26 HDPE pipe (average inside diameter of 1.38 feet). The pipe joints shall be welded (fused) all around and pressure tested. Pressures used for the testing shall be for the maximum anticipated static water head of approximately 13 feet or approximately 6 pounds per square inch (psi) measured at the outlet end of the pipe. The pipe shall be tested prior to backfilling to facilitate repair or rewelding. End caps used for the pressure testing shall be welded sufficiently to withstand the test pressures. A pressure relief valve and pressure gauge shall be mounted on the downstream end of the pipe. The pipe shall maintain the constant test pressure for a minimum time period of 2 hours. No leakage is recommended, so extreme care shall be taken to account for any water added to or discharged from the pipe to maintain the specified test pressures. Records of the testing shall be maintained. Safety precautions for conducting the pressure testing shall be in accordance with current MSHA and Occupational Safety and Health Administration (OSHA) guidelines.

2.08 Pipe Installation

a. General - The decant pipe shall be installed on an adequate foundation in a manner to minimize differential settlement and excessive seepage along the outside of the pipe. All pipe installation shall be supervised by qualified personnel familiar with the intent of the design and knowledge of proper installation procedures.

b. Alignment - The pipe shall be placed in a trench excavated into the embankment and at a location determined by the engineer. Compacted fill used to level the pipe subgrade and form the bedding shall be a minimum of 6 inches thick, but shall not exceed approximately 2 feet beneath the pipe invert. Compaction shall be achieved in accordance with Section 2.08e of these specifications.

c. Foundation Preparation - A 4-foot wide (minimum) trench shall be excavated at a location, determined by the Engineer, as per the detail presented on Drawing No. B05-330-E24. The trench shall be excavated 2 feet (minimum) below the final pipe invert. The backfill envelope shall be placed in accordance with these specifications.

d. Pipe Connections - To provide a water-tight seal, the joints shall be welded (fused) sufficiently to withstand the design internal water pressure (6 psi, minimum) without leakage.

e. Backfilling - The backfill envelope shall be raised uniformly on both sides of the pipe in 6-inch thick layers (8-inch thick loose lifts) and compacted to a density greater than or equal to 100 percent Standard Proctor maximum dry density (ASTM D 698) within -2 to +3 percent of the optimum water content. The bedding material shall be shaped to embed the 18-inch HDPE a minimum of 4 inches. One field density test (minimum) shall be performed for every 200 cubic yards of backfill placed and compacted with at least one test per lift.

f. Materials for Backfill - Materials used for backfilling shall consist of coarse coal refuse, free of any particles larger than 3 inches in any dimension.

2.09 Drop Inlet

a. General - To facilitate the installation of the trash rack and to prevent fines from entering the decant pipe, a drop inlet fabricated out of a 18-inch diameter SDR 26 HDPE 90 degree elbow shall be used. The elbow shall be fuse welded to the decant transport section and to the drop inlet riser.



b. Riser- The riser used to extend the drop inlet shall be 18-inch outside diameter, SDR 26 HDPE pipe, flange fitted at one end to facilitate connection to the trash rack. The riser connections shall be in accordance with the manufacturer's recommendations.

2.10 Trash Rack

a. General - To prevent large particles from entering and possibly clogging the decant pipe, a trash rack design has been provided. The trash rack shall be bolted to the riser pipe and can be removed for extension of the decant pipe. The trash rack may be fabricated with readily available parts.

b. Material - Materials required for the trash rack include 1 inch by 1 inch by 1/8-inch angle irons, No. 4 rebar, and 1/8-inch thick steel plate. The trash rack shall be flange fitted and bolted to the riser flange.

c. Paint - The trash rack shall be protected with rust-resistant paint after fabrication. The trash rack shall be inspected periodically and any damage repaired accordingly.

2.11 Filter and Drainage Diaphragm

a. General - A filter diaphragm shall be installed to minimize internal erosion (piping) along the decant.

b. Material - The diaphragm shall be constructed of hard, durable, non-calcareous aggregate within the following gradation range and wrapped entirely in "Propex 4550" filter fabric or an equivalent approved by the Engineer.

Sieve Size	Percent Finer
3-inch	100
1-1/2-inch	84 to 100
3/4-inch	36 to 100
3/8-inch	6 to 100
No. 4	0 to 52
No. 10	0 to 10
No. 20	0 to 9
No. 40	0 to 8
No. 60	0 to 7
No. 140	0 to 6
No. 200	0 to 5

c. Filter and Drainage Diaphragm Outlet Drain - To convey seepage collected by the filter and drainage diaphragm to a surface drainage ditch, an outlet drain shall be constructed.

3.0 FINE COAL REFUSE DISPOSAL

3.01 General

Following disposal of the fine coal refuse in the Phase 2 impoundment to maximum Elevation 496, fine coal refuse shall be disposed in the Phase 3 impoundment. The slurry line(s) shall be periodically moved along the slope of the impoundment to maintain a relatively uniform fines level within the impoundment. Discharge shall initiate on the impoundment bottom and continue on fine coal refuse beaches as the slurry settles. In no case shall direct discharge onto embankment slopes be allowed.

3.02 Clarified Water Removal

Clarified water from the slurry impoundment shall be removed by a pumping system and directed into the proposed perimeter ditch system or to the coal preparation plant. The water level in the impoundment shall be maintained as low as practicable.

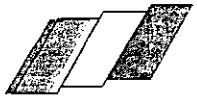
4.0 SURFACE WATER DRAINAGE FACILITIES

4.01 General

A system of sediment/perimeter ditches, access road gutters, bench gutters, and conveyance ditches shall be constructed to control surface runoff and minimize erosion. All runoff collected from the embankment area will be directed toward proposed sediment/perimeter. The conveyance ditches convey the flow from the embankment benches to the sediment/perimeter ditches.

4.02 Ditches C through M

To convey runoff from the embankment and slopes to the sediment/perimeter ditches, Ditches C through M, shall be constructed. Temporary ditches shall be maintained around the base of the slopes. Any erosion damage sustained shall be immediately repaired.



4.03 Access Road Gutters

Surface runoff intercepted by access roads shall be kept off the road surface and in gutters on the uphill side. The roadway shall slope toward the gutter with the gutter approximately the same gradient as the access road. Permanent gutters shall be provided at abandonment with erosion protection (riprap).

4.04 Rock Riprap

Where rock riprap protection is required in ditches and gutters because of high flow velocity, the riprap must have the following characteristics:

a. Material - Riprap shall be hard, durable cobbles and boulders of sandstone or limestone in the sizes specified on the details.

b. Size Gradation - Riprap size shall be predominantly in the range specified on the drawings. Smaller stones and cobbles shall be used to fill the voids between larger pieces.

c. Subgrade Preparation - The riprap subgrade shall be well compacted before riprap is placed. A layer of "Propex 4550" filter fabric, or approved equivalent, shall be placed on the subgrade prior to the riprap placement.

d. Riprap Placement - Riprap shall be spread to the thickness required in a single lift. In lieu of riprap, 8-inch filter point mat or 4-inch uniform section may be used. The mat shall be keyed 18 inches (minimum) along both edges of the ditch and at the upstream end of each section. The mat shall be underlain with Propex 4550 filter fabric and installed in accordance with the manufacturer's recommendations. If uniform section mat is used, weep holes shall be provided at 15-foot elevation intervals.

e. Grouted Riprap – The grout shall be a sand-concrete mixture, proportioned to result in a minimum 28-day compressive strength of 2000 pounds per square inch (psi). The stones shall be thoroughly moistened and any excess fines shall be sluiced to the underside of the stone blanket before grouting. The grout may



be delivered to the site by any means that will assure uniformity and prevent segregation of the particles. The grout shall be vibrated by mechanical means to achieve grout penetration. If pressure grouting is used, care shall be taken to avoid unseating the stones. Penetration of the grout shall be to the depth specified. For a smooth surface, grout shall fill the void spaces to within ½-inch of the surface. Weep holes shall be provided through the blanket.

Grout shall be placed only when the temperature is above 35 degrees Fahrenheit and rising. It shall be protected from freezing and cured the same as for concrete. After grouting is completed, no weight shall be placed on the grouted riprap until the grout has cured properly.

5.0 REVEGETATION OF COMPLETED AREAS

Revegetation of coarse coal refuse slopes can be accomplished by placing a cover of natural soil or other materials capable of supporting vegetation and subsequent planting to establish a continuous stand of vegetation. Soil cover and vegetation shall be in accordance with the Illinois reclamation permit.

6.0 MONITORING AND MAINTENANCE

6.01 Piezometers and Impoundment Level

Water level readings from the piezometers and the impoundment level shall be recorded at 7-day intervals and compared to the levels used in the design. The piezometers shall be flushed on an annual basis to ensure they are functioning properly. Should the piezometers become damaged during operations, they shall be repaired or replaced.

6.02 General Observations

Observations of the embankment and its appurtenant structures shall be made at 7-day intervals and immediately following any unusual events such as floods, heavy rainfalls, abnormal structural behavior, etc. Any unusual features shall be reported immediately to the engineer responsible for certifying the construction.



a. Embankment Slopes - Any irregularities such as scarps, wet areas, or vegetation disturbance shall be recorded.

b. Working Disposal Surface - Irregularities shall be recorded.

c. Access Road Gutters and Discharge Channels - General condition of channels, soil erosion adjacent to or beneath riprap and seeded slopes, blockage by debris, etc. shall be noted.

d. Vicinity of the Embankment - General conditions throughout the area of the embankment shall be observed to note any changes which could be associated with the behavior of the embankment and its foundation.

6.03 Maintenance

The following maintenance shall be performed regularly:

a. Routine Maintenance - Maintenance, including replacement or patching of grouted riprap, regrading temporary bench and haul road gutters, backfilling of erosion rills and gullies, removal of debris from the ditches at the site, etc. shall be performed.

b. Maintenance After Unusual Meteorological Events (Heavy Precipitation Events and Floods). - The most important maintenance tasks at these times are the timely backfilling of all erosion scarps and slumps and the repair and improvement of drainage systems and riprap.

c. Maintenance After Abnormal Changes in the Behavior of the Structure - If abnormal behavior of any portion of the embankment is observed, qualified persons knowledgeable of the facility design characteristics shall be advised immediately and any recommended maintenance measures undertaken.

6.04 Data Review

All facility performance data and data obtained during periodic inspections and maintenance shall be reviewed by qualified persons knowledgeable of the facility

construction and disposal requirements, including the design recommendations presented in these documents.



CERTIFICATION OF PLAN

I, Claudio E. Yon, P. E., certify[1] the plan entitled "Phases 3 and 4 Refuse Expansion, Pond Creek Mine No. 1, Williamson County, Illinois" was developed in accordance with prudent engineering principles and practices and Illinois Department of Environmental Protection design criteria.

SIGNED: _____
Claudio E. Yon, P. E.

DATE: 11/5/05
ALLIANCE CONSULTING, INC.

[1] The term "certify," as used herein, is defined as follows: "An Engineer's certification of conditions is a declaration of professional judgment. It does not constitute a warranty or guarantee, either expressed or implied, nor does it relieve any other party of their responsibility to abide by contract documents, applicable codes, standards, regulations and ordinances."

DOCUMENT

81

1465-107-E
Due date: 1-22-09 R17737

MEMORANDUM

Date: December 11, 2008

To: Larry Crislip

From: Bill Buscher BB

Subject: Review and Comment on Pond Creek Mine #1, Permit #375, Williamson County, Revision No. 2, Response to Comments, April 4, 2008

At the request of the Mine Pollution Control Program (MPCP) the Groundwater Section has reviewed the additional data provided in Revision No. 2, Response to Comments, dated April 4, 2008 for the Pond Creek Mine #1 site. The purpose of the review is to evaluate groundwater protection for the new underground mine and refuse disposal area.

1. The Agency requests that previous language included for Refuse Disposal Facility No. 1 regarding the proposed method of slurry pond construction, including exploratory drilling on a 200 by 200 foot grid and/or probing at a minimum 100 by 100 foot grid to determine elevation of bedrock, also be included for Refuse Disposal Facility No. 2, cell 4, the cell furthest to the north. This will be followed by placement of compacted soils if needed to ensure total clay layer thickness between refuse and bedrock is at least four feet.

DOCUMENT

82

1465 - 107 - D
Due date 11-7-08
R17739

Alliance Consulting, Inc.
Engineers · Constructors · Scientists

September 24, 2008

B07-038-1413

Mr. Scott Fowler
ILLINOIS DEPARTMENT OF NATURAL RESOURCES
OFFICE OF MINE AND MINERALS
Land Reclamation Division
One Natural Resources Way
Springfield, IL 62702-1271

Williamson Energy, LLC
Pond Creek No. 1 Mine
IDNR/OMM Application No. 375, Revision No. 2
IEPA Log No. 1465-07

Dear Mr. Fowler:

This letter is written in response to Mr. Larry Crislip's letter dated December 5, 2007. The following information is provided.

1. Part I, Page 1 of the application states that 16.52 acres will be added to the permit area; however, Part II(1) states that no additional area will be added to the permit. The cited acreage is apparently an Incidental Boundary Revision submitted separately. This apparent discrepancy should be corrected to provide consistency with the remainder of the application which states that no area is being added.

Part I, Page 1 of the application has been changed to state that no acreage will be added to the permit area.

2. It does not appear sediment control plans are adequate to prevent effluent violations or to comply with 62 Ill. Adm. Code 1817.46(b)(1).

a. Sediment ditches are proposed in lieu of sediment ponds. Impounding structure, whether a pond or ditch, receiving drainage from coal mine affected areas should provide a minimum average detention time of 8 hours for runoff from a 10-year, 24-hour precipitation event, plus a sediment storage volume of 0.1 ac-ft per disturbed

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acre for impoundments to be functional in excess of three (3) years. The sediment ditches as designed do not provide adequate volume to meet these criteria.

The Applicant should revise the sediment control plan to include sufficient detention and sediment storage volume in accordance with the above guidelines to insure compliance with 62 Ill. Adm. Code 1784.13(b)(9) as it pertains to effluent contaminant concentrations. It is also noted that the flow from the internal drains should be considered and addressed in the revised impoundment designs.

The sediment control structures or "sediment ditches" are in actuality elongated sediment ponds. These structures in series we believe will provide better sediment control than one large structure. Calculations have been included that show a minimum average detention time of 8 hours for runoff from a 10-year, 24-hour precipitation event, plus a sediment storage volume of 0.1 ac-ft per disturbed acre has been provided.

The flow from the internal drains is insignificant compared to the required volume for the sediment control structures. These drains are designed to control the phreatic level in the dam embankment to a level which increases slope stability. The drains may weep some flow into the sediment control structures but no substantial flow is anticipated. Page 45 of the original permit application estimates the flow from the drain to be 0.3 gpm/day/lf.

b. *Disposal of accumulated sediments from sediment ditches was not discussed in Part IV(7)(G) of the application. Since sediment collecting in the ditches will be affected by refuse, a discussion should be provided regarding proper disposal of this material.*

The Applicant should submit a plan for sediment ditch cleanout material disposal that will comply with 62 Ill. Adm. Code 1817-81(a)(1) and prevent contamination of surface water.

Accumulated sediments from sediment control structures will be disposed of in the coal refuse disposal impoundment. This has been added to Part IV(7)(G) on Page No. 23.

c. *Appropriate design information to comply with 62 Ill. Adm. Code 1817.49(c), for the discharges from Outfall 011 does not appear to have been provided. The Applicant should provide design information for a 25-year, 6 hour precipitation event for discharges from Outfall 011. The Applicant should also note additional design information required by Item No. 3(c) below.*

Design information for a 25-year, 6 hour precipitation event for discharges from Outfall 011 had been provided.

d. The location of the decant pipe depicted on Drawing No. B07-038-M6 appears to be at an elevation of 520 MSL with a flow path down the side slope of the embankment which does not appear to be a designed channel. The Applicant should provide design information to demonstrate that all flow paths and channels are adequate to safely convey the discharges from the decant pipe to an appropriately designed sediment ditch. In addition, areas that may be subject to erosion due to concentrated flows, such as the flow from the decant pipe, should be identified on an appropriate map or drawing, and a detailed discussion of erosion measures should be provided regarding such areas.

The refuse disposal facility has been completely redesigned and this comment is no longer applicable.

3. Complete plans and designs for proposed Outfall 011 from the sediment ditches do not appear to be provided in the application. The following information should be provided for proposed Outfall 011 to insure compliance with 62 Ill. Adm. Code 1817.42.

a. Sulfate concentrations of 200 mg/l as estimated in the Schedule 1 (submitted in correspondence dated September 12, 2007) are not likely to be representative of concentrations expected in runoff from coal refuse. The Applicant should review this estimate with consideration of the effects of drainage from coal refuse and underdrains.

The sulfate concentration has been revised and a revised Schedule A is included. The revised concentration has been revised based upon previous monitoring reports and a review of a permit application that proposed a pond as sediment control for a refuse disposal area.

b. As the unaffected receiving stream watershed upstream of Outfall 011 consists of only approximately 16 acres which appears insufficient to provide beneficial mixing, the permit effluent limit will be established equal to the sulfate water quality standard. Therefore, to determine the applicable sulfate water quality standard, three (3) samples of the effluent from a similar discharge will be required to be analyzed for hardness, sulfate and chloride. It appears that discharges from Pond 006 which receives flow from the south refuse area may likely be similar to the discharges expected from proposed Outfall 011 and would be acceptable for the required analyses.

Please refer to the attached three samples taken from Outlet 006.

c. In general, in accordance with 62 Ill. Adm. Code 1817.49, the sedimentation ditches are to be designed with a treatment volume adequate to provide an 8-hour detention



time for a 10-year, 24-hour precipitation event, with a discharge structure capable of safely discharging the flow from a 25-year, 6-hour precipitation event as discussed and required in Item No. 2(c) above. However, as impounding structures and drainage control structures in the watershed of the sediment ditches and Outfall 011 requires designs to safely convey the flow from a 100-year, 6-hour precipitation event, the Applicant should also provide design information for this precipitation event to demonstrate that the sediment ditches and discharge structure (Outfall 011) are adequate to safely convey this flow.

Calculations to demonstrate that the sedimentation ditches are designed with a treatment volume adequate to provide an 8-hour detention time for a 10-year, 24-hour precipitation event, with a discharge structure capable of safely discharging the flow from a 100-year, 6-hour precipitation event have been included.

d. *The Antidegradation Assessment for the modified NPDES Permit to incorporate proposed Outfall 011 for this facility will require "Assessments of Alternatives for Less Increase in Loading or Minimal Environmental Degradation". Therefore, a detailed alternatives analysis is required for the proposed increase in loading from proposed Outfall 011. This alternative analysis should include a detailed discussion of all alternatives considered to the proposed discharge, and the justification for the option selected. In order that all reviewers have this information available, the Applicant should submit the required Alternatives Analysis with the modification responses.*

A detailed alternatives analysis has been included for the proposed increase in loading from proposed Outfall 011.

4. *Additional groundwater monitoring and reporting for the proposed refuse area will be required as follows:*

a. *Monitoring Well No. GW-6 may be abandoned as requested; however, a new well should be constructed north of the current Well No. GW-6 location and south of Refuse Disposal Facility No. 1. The new well should be finished at a lower elevation within the water bearing zone in order to obtain up-gradient water quality data. The Applicant should commit to constructing this replacement for Well No. GW-6 in the described location.*

A new well (GW-8) has been constructed northwest of the current Well No. GW-6 location and south of Refuse Disposal Facility No. 1 as shown on Drawing No. B05-330-M8. This well replaces Well No. GW-6. The new well is finished at a lower elevation within the water bearing zone in order to obtain up-gradient water quality data.



b. The Applicant should commit to installing three (3) additional monitoring wells for the Refuse Disposal facility No. 2 expansion as follows:

i. A well should be located just north of the waterway on the west side of the disposal area.
ii. A well should be located west of the area where the northern and southern portions of the disposal area meet.
iii. A well should be located on the northern side of the area approximately 250 feet west of the northeast corner of the disposal area.

The wells described above should be located 30-35 feet from the edge of the impoundment and screened in the first water bearing zone beneath the elevation of the bottom of the refuse disposal area.

Three (3) additional monitoring wells for the Refuse Disposal Facility No. 2 expansion will be provided as follows:

i. A well will be located just north of the waterway on the west side of the disposal area.
ii. A well will be located west of the area where the northern and southern portions of the disposal area meet.
iii. A well will be located on the northern side of the area approximately 250 feet west of the northeast corner of the disposal area.

These wells will be located approximately 30-35 feet from the edge of the impoundment and screened in the first water bearing zone beneath the elevation of the bottom of the refuse disposal area. The locations of the wells, GW-9, GW-10 and GW-11 are shown on Drawing No. B07-038-M8.

5. The Applicant should modify the groundwater monitoring plan for Monitoring Well No. GW-5 as well as the monitoring wells required in accordance with Item No. 4 above to include monitoring during six (6) separate sample events within one year(approximately bi-monthly) prior to the placement of refuse for the inorganic parameters listed in Table A to establish background concentrations. Following completion of these background monitoring requirements, quarterly monitoring for the parameters listed in Table B should be proposed:

TABLE A

Antimony	Cyanide	Sulfate
Arsenic	Fluoride	Thallium
Barium	Iron	Total Dissolved Solids (TDS)
Beryllium	Lead	Vanadium
Boron	Manganese	Zinc
Cadmium	Mercury	pH
Chloride	Molybdenum	Alkalinity
Chromium	Nickel	Acidity
Cobalt	Selenium	Hardness
Copper	Silver	Static Water Level

TABLE B

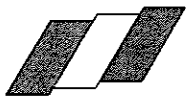
Chloride	Total Dissolved Solids (TDS)	Acidity
Iron	pH	Hardness
Manganese	Sulfate	Static Water Level
		Alkalinity

The groundwater monitoring plan for Monitoring Well No. GW-5 as well as the proposed monitoring wells will be sampled during six (6) separate sample events within one year(approximately bi-monthly) prior to the placement of refuse for the following inorganic parameters:

Antimony	Cyanide	Sulfate
Arsenic	Fluoride	Thallium
Barium	Iron	Total Dissolved Solids (TDS)
Beryllium	Lead	Vanadium
Boron	Manganese	Zinc
Cadmium	Mercury	pH
Chloride	Molybdenum	Alkalinity
Chromium	Nickel	Acidity
Cobalt	Selenium	Hardness
Copper	Silver	Static Water Level

Following completion of these background monitoring requirements, quarterly monitoring for the following parameters are proposed:

Chloride	Total Dissolved Solids (TDS)	Acidity
Iron	pH	Hardness
Manganese	Sulfate	Static Water Level
		Alkalinity



6. A statistical representation of existing water quality must be established using the method outlined in Attachment 1 for Monitoring Well No. GW-5 as well as the monitoring wells required in accordance with Item No. 4 above. This method should be used to determine the 95 percent confidence limit for each parameter. The Applicant should commit to submitting the results of the calculations within 90 days of completion of background monitoring.

A statistical representation of existing water quality will be established using the method outlined below for Monitoring Well No. GW-5 as well as the proposed monitoring. This method will be used to determine the 95 percent confidence limit for each parameter. The results of the calculations will be submitted to the Illinois Environmental Protection Agency within 90 days of completion of background monitoring.

MONITORING WELL METHODOLOGY

A. This method should be used to predict the confidence limit when single groundwater samples are taken from each monitoring (test) well.

1. Determine the arithmetic mean ($\overline{X}_b$) of each parameter for the background sampling period. If more than one background well is used, an equal number of samples must be taken from each well.

$$\overline{X}_b = \frac{X_1 + X_2 + \ldots X_n}{n}$$

Where:

$\overline{X}_b$ = Average background value for a given chemical parameter

X_n – Background values for each sample

n = Number of background samples taken

2. Calculate the background variance (S_b^2) and standard deviation (S_b) for each parameter using the values (X_n) from each background sample of the well(s) as follows:

$$S_b^2 = \frac{(X_1 - \overline{X}_b)^2 + (X_2 - \overline{X}_b)^2 + \ldots + (X_n - X_b)^2}{n-1}$$

$$S_b = \sqrt{S_b^2}$$

3. Calculate the upper confidence limit using the following formula:

$$CL = X_b \pm t\sqrt{X_b + t1 + 1/n(S_b)}$$

Where:

CL = upper confidence limit prediction
(upper and lower limits should be calculated for pH)
t = one-tailed t value at the required significance level and at n-1 degrees of freedom from Table 1
(a two-tailed t value should be used for pH)

4. If the value of any routine parameter for any monitoring well exceeds the upper confidence limit for that parameter, the permittee shall conclude that a statistically significant change has occurred at that well.

5. For background values that are less than the Method Detection Limit (MDL), a value of one-half (1/2) the MDL shall be substituted for each background value that is reported as less than the MDL. All other computations shall be calculated as given above.

B. If all background values are less than the MDL for a given parameter, the Practical Quantitation Limit (PQL), as given in 35 Ill. Adm. Code Part 724, Appendix I, shall be used to evaluate data from monitoring wells. If an analytical result from any monitoring well exceeds two (2) times the PQL for any single parameter, or if it exceeds the PQLs for two or more parameters, the permittee shall conclude that a statistically significant change has occurred.

Table 1
Standard T-Tables Level of Significance

Degrees of freedom	t-values (one-tail)		t-values (two-tail)*	
	99%	95%	99%	95%
4	3.747	2.132	4.604	2.776
5	3.365	2.015	4.032	2.571
6	3.143	1.943	3.707	2.447
7	2.998	1.895	3.499	2.365
8	2.896	1.860	3.355	2.306
9	2.821	1.833	3.250	2.262
10	2.764	1.812	3.169	2.228
11	2.718	1.796	3.106	2.201
12	2.681	1.782	3.055	2.179
13	2.650	1.771	3.012	2.160
14	2.624	1.761	2.977	2.145
15	2.602	1.753	2.947	2.131
16	2.583	1.746	2.921	2.120
17	2.567	1.740	2.898	2.110
18	2.552	1.734	2.878	2.101
19	2.539	1.729	2.861	2.093
20	2.528	1.725	2.845	2.086
21	2.518	1.721	2.831	2.080
22	2.508	1.717	2.819	2.074
23	2.500	1.714	2.807	2.069
24	2.492	1.711	2.797	2.064
25	2.485	1.708	2.787	2.060
30	2.457	1.697	2.750	2.042
40	2.423	1.684	2.704	2.021

Adopted from Table III of "Statistical Tables for Biological Agricultural and Medical Research" (1947. R.A. Fisher and F. Yates).

*For pH only when required.



7. The Applicant should provide technical justification for allowing the planned subsidence associated with long wall mining beneath the proposed refuse disposal areas at this facility. This discussion should address in detail the affects of subsidence on the permeability of the foundation soils.

The timing of the mining in relationship to construction and elimination of the impoundments is shown on Drawing No. B05-330-E38, contained in Volume 4 of 5. Calculations for the underdrain and subsidence effects calculations are contained on Page Nos. 59-91, horizontal strain due to subsidence calculations are contained on Page No. 98, piping and cracking potential of foundation soil and coarse coal refuse due to subsidence calculations are contained on Page Nos. 99-119, all contained in Appendix B of Volume 4 of 5. A report entitled "Prediction of Ground Movement Parameters Due to Longwall Mining During Different Phases of Impoundments" by Syd. S. Peng dated March 2008 is contained in Appendix H contained in Volume 4 of 5. Measures for mitigation of the effects of mining subsidence on the dam embankment and foundation are included in Section 3.1 on Page Nos. 2 and 3 of the Engineering Report. A "flowability analysis" of the fine coal refuse at abandonment is contained in Volume 5 of 5.

8. As longwall mining with planned subsidence beneath the existing refuse disposal area would threaten the integrity of the existing impoundment, such mining is prohibited by the Agency. The Applicant should modify the underground mine plan for the area beneath the existing refuse disposal are to eliminate the longwall mining in this area.

The plan has been modified slightly since the original submittal to minimize potential impacts of mining. The sequence of construction will be from South to Center Cells to North Cell rather than South Cell to North Cell to Center Cells. The North and Center Cell configuration have changed but the overall concept remains the same. It should be noted that the two most southerly cells, Phase 2 and 3 will have been constructed, filled with fine coal refuse and abandoned by filling the pool area with coarse coal refuse prior to mining beneath the abandoned structures. The northern most cell will not be constructed until the longwall mining is completed beneath the area where it is to be constructed and subsidence has occurred. Drawing No. B07-038-E38 entitled "Mining/Impoundment Construction" has been included which depicts the individual phases of construction sequentially and the timing of the mining.

The following is a description of the phases of construction in relation to the mining and mitigative measures.

Phase 3 – This impounding embankment of Phase 3 will be completed and slurry pumping into the impoundment will be completed before mining beneath the phase occurs. The Phase 3 impoundment will be capped before undermining occurs. Based on

subsidence predictions, the internal drainage system for the embankment has been redesigned to continue to function post-subsidence. Any disruption of surface drainage features due to subsidence will be repaired.

Phase 4 – Phase 4 is an intermediate phase in preparation for the construction of Phases 5, 6, and 7. No slurry will be pumped into Phase 4 and no internal drainage features are included in this phase. Undermining of Phase 4 will occur shortly after its construction. The embankment and pool area of this phase will be examined for subsidence cracks and repairs will be made as needed. It is anticipated that when slurry pumping begins in Phase 7 any undetected subsidence cracks in the Phase 4 embankment and foundation will be sealed by the slurry. This Phase will be buttressed to the south by Phase 3, which will be already completed and full of slurry; by Phase 6 to the east and west, which will be built post-subsidence; and by Phase 5 to the north, which will be also built post-subsidence.

Phase 5 – Phase 5 will be built post-undermining and the pool and embankment foundation area will be examined for subsidence cracks and repairs will be made as needed prior to construction. As previously stated, it is anticipated that the slurry will seal any undetected cracks. Phase 5 will be buttressed to the south by Phase 4. Phase 5 will contain an internal drain. This phase is predicted to be pumped full 22 months after construction starts (provides 17 months of slurry pumping).

Phase 6 – Phase 6 will be built post-mining and the embankment foundation area will be examined for subsidence cracks and repairs made as needed prior to construction. Phase 6 buttresses Phase 4 and an underdrain will be installed in this phase. No slurry will be pumped into Phase 6.

Phase 7 – Phase 7 will be built post-mining. Phase 7A will partially cap and consolidate the slurry in Phase 3. Phase 7B will provide a lining/buttress between the Phase 7 pool and the potentially cracked Phase 3 embankment (Phase 3 will be undermined after it has been pumped full of slurry). The remainder of Phase 7 will sit on top of the previously constructed Phases 4, 5, and 6. Phase 7C will finish covering and consolidating the slurry contained in the Phase 3 embankment. As previously stated, it is anticipated that the slurry will seal any undetected cracks not detected and repaired during Phases 4 and 6.

The horizontal strain map, Drawing No. B05-330-M42, included in this report shows the areas that are most susceptible to cracking and which will be given special attention for the detection and repair of subsidence cracks. Areas considered susceptible to subsidence cracking are those predicted to have surface horizontal tensile strain of 0.1 percent or greater.

Examination of the subsidence prediction study data shows that horizontal strain and vertical subsidence values do not change significantly when mining occurs in a longwall

panel adjacent to a previously mined panel directly beneath a phase undergoing construction. Overlapping subsidence and strain profiles should have negligible impact on ongoing construction.

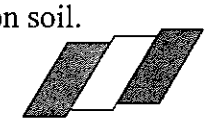
The coarse coal refuse fill to be used in all phases of construction is broadly graded and should be less susceptible to cracking than earthern materials traditionally usually used in dam construction. Comparison of the gradation curves of the foundation soil and coarse coal refuse indicates that they do not fall into the most critical range for cracking (see Fig. 2.3:6 adopted from "Design of Earth and Earth Rock Dams", Sherard, etal, 1963, and the gradation curves for the foundation soil and coarse coal refuse contained in .... of this report). Based on Table 2.2.1 contained in Sherard, on a scale of 1 (highest) to 8 (lowest), the foundation soil has a piping resistance of (2, high) and the coarse coal refuse has a piping resistance of (3, intermediate).

Slurry discharge lines will be moved around the interior perimeter of each impoundment phase to maintain a delta against the slope and aid in sealing any embankment and foundation cracks not discovered by visual observation and sealed.

Subsidence crack repair of the foundation and the Phase 4 embankment will consist of excavation of the areas containing cracks to a depth of at least four feet, proof rolling the areas, and backfilling and sealing the areas with a compacted coarse coal refuse seal placed to the compaction standard in the Guideline Technical Specifications. In the unlikely event that extensive, deep cracking is discovered, a slurry trench or cutoff trench will be extended to bedrock through the affected areas. The trench will be located beneath the underdrain alignment for Stages 5 and 6. If it is discovered that a slurry or cutoff trench is needed, a specific design will be submitted for approval prior to its construction.

The Phase 4 embankment is the only embankment subject to subsidence cracking prior to slurry pumping. Before the construction of Phase 6, the Phase 4 embankment will be examined for cracking and any areas containing cracks will be excavated to a depth of at least 4 feet and sealed with compacted coarse coal refuse. Any additional cracks discovered after slurry pumping begins during Phase 7 will be sealed by directing the slurry into the pool adjacent to the cracks.

Phase 6, a wide zone of embankment, will be constructed post-mining by the downstream construction method on the east and west sides of Phase 4. It would serve as a "crack stopper" for any undetected cracks which may develop in the east and west sides of the Phase 4 embankment. The Phase 4 embankment will be buttressed on the north side by the Phase 5 embankment and impoundment. Phase 7 will be constructed partially on top of Phase 4, the resulting additional consolidation should aid in closing any cracks in the Phase 4 embankment. Likewise, the construction of Phases 6 and 7 should cause consolidation which should aid in closing any cracks in the underlying foundation soil.



The Stage 5 and 6 embankment underdrains have been redesigned to lower them as closely as possible to the predicted subsided original ground surface and still maintain gravity outlets. Neglecting the flow capacity of the gravel, the perforated collection pipes are designed to have a flow capacity safety factor of five or greater. The use of a safety factor of five for the collection pipe is felt to be justified as the entry of seepage water into the gravel drain envelope has a safety factor in excess of ten and the collection pipe is an engineered material which will be installed in a controlled fashion.

A subsidence monitoring plan which includes subsidence monument locations, reading schedules has been included in Appendix F, the rate and magnitude of vertical and horizontal movement will be recorded. The location of subsidence monuments are shown on Drawing No. B05-330-M36.

9. Pursuant to 35 Ill. Adm. Code 620.450(b)(4)(C), groundwater underlying a coal refuse disposal area may be deemed Class IV; however, Class II standards will apply outside the Class IV zone. The Applicant should provide contingency plans for the following:

c. *In the event that groundwater quality in private wells in the area is adversely impacted by a release of contaminants from the refuse disposal area, the Applicant should include the replacement source for private well owners.*

In the event that groundwater quality in private wells in the area is adversely impacted by a release of contaminants from the refuse disposal area, a replacement well will be drilled or public water will be provided by the Applicant. The replacement water will be of at least equal quality and quantity.

d. *The Applicant should provide a plan to minimize the impact to on-site groundwater in the event there is a release of contaminants from the refuse disposal area, and propose a plan for preventing off-site migration of contaminants should such a release occur.*

Internal drains will be installed to minimize the phreatic surface inside the embankment. This water will be collected and discharged into the series of sediment structures around the impoundment. The groundwater monitoring wells will be used to monitor the migration of contaminants.



10. Pursuant to 62 Ill. Adm. Code 1817.49(a)(2), a registered professional engineer's seal is needed for the responses to the above items.

An Engineer's Certification is provided.

Should you need any additional information, please do not hesitate to contact us.

Sincerely,

ALLIANCE CONSULTING, INC.

Stephen M. Sutphin
Project Manager

Claudio E. Yon, P. E.
Principal Engineer

SMS/CEY:wmb
Enclosures

FILE: 07038-26

PART III ATTACHMENT III.2.C.2
POND NO. 6 DISCHARGE SAMPLING
(Revision No. 2 Submittal)

SUMMIT ENVIRONMENTAL SERVICES, INC.

CHEMICAL ANALYSTS & CONSULTANTS

P.O. Box 1002
200 East Union Street
Marion, Illinois 62959
Phone (618) 997-9200
Fax (618) 997-9204

Website: www.summitenviro.com

CLIENT:	Mach Mining	**REPORT DATE:**	01-08-08
PDL:	13172-1	**COMMENT:**	Surface Water
SAMPLE ID:	Stream Prior To Pond #6 Discharge	**SAMPLED BY:**	Client
DATE SAMPLED:	01-05-08	**DATE RECEIVED:**	01-07-08

TEST DESCRIPTION	RESULT	UNITS	DETECTION LIMIT	METHOD	DATE/ ANALYST
Sulfates	798	mg/L	1.0	375.4	01-07-08 BH
Chlorides	95	mg/L		325.3	01-07-08 BH
Hardness, Total	336	mg/L	0.1	130.2	01-07-08 BH

Reviewed By: Joseph Duncan

SUMMIT ENVIRONMENTAL SERVICES, INC.

CHEMICAL ANALYSTS & CONSULTANTS

P.O. Box 1002
200 East Union Street
Marion, Illinois 62959
Phone (618) 997-9200
Fax (618) 997-9204

Website: www.summitenviro.com

CLIENT: Mach Mining
PDL: 13172-2
SAMPLE ID: Stream Prior To Pond #6 Discharge
DATE SAMPLED: 01-06-08

REPORT DATE: 01-08-08
COMMENT: Surface Water
SAMPLED BY: Client
DATE RECEIVED: 01-07-08

TEST DESCRIPTION	RESULT	UNITS	DETECTION LIMIT	METHOD	DATE/ ANALYST
Sulfates	720	mg/L	1.0	375.4	01-07-08 BH
Chlorides	136	mg/L		325.3	01-07-08 BH
Hardness, Total	352	mg/L	0.1	130.2	01-07-08 BH

Reviewed By: Joseph Duncan

SUMMIT ENVIRONMENTAL SERVICES, INC.

P.O. Box 1002
200 East Union Street
Marion, Illinois 62959
Phone (618) 997-9200
Fax (618) 997-9204

CHEMICAL ANALYSTS & CONSULTANTS

Website: www.summitenviro.com

CLIENT:	Mach Mining	**REPORT DATE:**	01-08-08
PDL:	13172-3	**COMMENT:**	Surface Water
SAMPLE ID:	Stream Prior To Pond #6 Discharge	**SAMPLED BY:**	Client
DATE SAMPLED:	01-07-08	**DATE RECEIVED:**	01-07-08

TEST DESCRIPTION	RESULT	UNITS	DETECTION LIMIT	METHOD	DATE/ ANALYST
Sulfates	638	mg/L	1.0	375.4	01-07-08 BH
Chlorides	61	mg/L		325.3	01-07-08 BH
Hardness, Total	240	mg/L	0.1	130.2	01-07-08 BH

Reviewed By: Jeffrey Stevens

DOCUMENT

83

STATE OF ILLINOIS

ENVIRONMENTAL PROTECTION AGENCY

Subject: Williamson Energy, LLC – Pond Creek Mine

Data: Log No. 0369-08

Reviewed by: D. Maschhoff **Date:** 3/3/15

Log No. 0369-08 ⇒ IBR No. 14 to OMM Permit No. 375

Log No. 0369-08

- IBR consisting of 3.57 acres located in Section 9, Township 8 South, Range 4 East, Williamson County.
- Two (2) boreholes will be drilled and a vertical pump will be install to ensure no mine water has blocked the mine ventilation.
- The pump discharge pipeline will be buried and will connect to a pipeline located along the railroad spur right-of-way.
- The vertical pump will pump mine water to an existing buried waterline.
- A sediment pond exemption is requested for this permit area. Silt fence and/or straw bales will be placed for drainage control.

* Action: Reference IEPA Log No. 0369-08 in renewed and modified NPDES permit for additional 3.57 acres for the installation of a vertical pump, a concrete borehole and buried waterline.

MORSE R17758
0369-108
Due date: 10-31-08

Illinois Department of
Natural Resources
One Natural Resources Way • Springfield, Illinois 62702-1271
http://dnr.state.il.us

Rod R. Blagojevich, Governor
Sam Flood, Acting Director

December 30, 2008

Michael J. Beyer
Williamson Energy, LLC
P.O. Box 99
Johnston City, IL 62951

Re: Permit No. 375
Incidental Boundary Revision No. 14

Dear Mr. Beyer:

The appropriate Department technical staff have reviewed the proposed incidental boundary revision dated September 19, 2008 submitted by Williamson Energy for Pond Creek Mine, Permit No. 375. The request would add 3.57 acres to conduct surface coal mining activities. The additional acres would be used for a water recovery borehole and associated facilities.

The Department finds Williamson Energy has demonstrated in its request, and field inspections by the Department's field representative have confirmed that these areas (total of 3.57acres) meet the requirements for an incidental boundary change as outlined in 62 Ill. Adm. Code 1774.13(d). Section 1774.13(d)(6) publication requirements have been met.

The fee for the area will be $89.25. The fee is comprised of $0 for surface mining area ($125/acres x 0 acres) and $89.25 ($5/acres x 3.57 non-surface mined acres x 5 years).

The bond for the area will be $35,449.00 Copies of bond form SCML-2 have been enclosed for your use. For additional bonding and other forms, please contact this office or download a copy from the web at: www.dnr.state.il.us/mines/lrd/forms.htm. Please note many forms have been modified. **Only** the most current versions will be accepted.

Upon receipt by the Department of the fee and bond, plus forward two copies of your request letter and map(s) to Ronald Morse, Illinois Environmental Protection Agency, 2309 West Main Street, Marion, Illinois 62959, mining activities on these 3.57acres may commence, following Department approval.

RECEIVED
JAN - 2 2009
IL Environmental Protection Agency
MARION REGIONAL OFFICE

0369-108
Due date: 10-31-08
R17759

September 19, 2008

Project No. B0-395-1413

Mr. Larry Crislip
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
Mine Pollution Control Program
2309 West Main Street
Suite 116
Marion, IL 62959

Request for Incidental
Boundary Revision for 3.57 Acres
Williamson Energy LLC - Permit No. 375
Pond Creek Mine No. 1
Williamson County, Illinois

Dear Mr. Crislip:

Williamson Energy LLC, is submitting two copies of a 3.57 acre non-contiguous incidental boundary revision to add a water recovery borehole site and infrequently used access road. Please refer to the enclosed incidental boundary revision form, narrative, revised reclamation estimate spreadsheet and associated maps.

Please be advised that an original and two copies of this IBR application has been sent to IDNR.

If you have any questions, or require additional information, please contact us.

Respectfully submitted,

WILLIAMSON ENERGY, LLC.

James Plumley
Engineer

SMS:wmb
Enclosures

cc: Steve Supthin, Alliance Consulting, Inc. w/enclosures

FILE: 07363-02

RECEIVED
SEP 22 2008
IL Environmental Protection Agency
MARION REGIONAL OFFICE

State of Illinois
Department of Natural Resources
Office of Mines and Minerals
Land Reclamation Division
One Natural Resources Way
Springfield, IL 62702-1271

APPLICATION FOR SURFACE COAL MINING AND RECLAMATION OPERATIONS
INCIDENTAL BOUNDARY REVISION IBR-1

PART I

DATE: 9-18-08

NOTICE : This state agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Ill. Rev. Stat. 1987 Ch. 96 1/2, par. 7901.01 et seq. Disclosure of this information is voluntary, however failure to comply may result in this form not being processed. This form has been approved by the Forms Management Center.

1) A) General Information

(~~I~~)(~~We~~)(The) Williamson Energy LLC
(Name of Company, Corporation, Partnership or Individual)

P. O. Box 99, Johnston City, IL 62951 (618) 983-3020
(Address) (Telephone Number)

hereby submit application for an Incidental Boundary Revision to Permit 375

Name of Mine Pond Creek No. 1.

MSHA No. 81-0669143

I, Michael J. Beyer under penalty
(vice president or his duly authorized representative under the existing permit)

of perjury declare that all information provided in this application is true and correct to the best of my knowledge.

CEO

Surface Area:
ADDITIONAL ACRES REQUESTED 3.57 EXISTING PERMIT ACREAGE 592.56

B) Indicate the type of disturbance and associated acreage.

Type of Disturbance	Existing Permit	IBR	Total
Area Stripping	20.13	0	20.13
Mine Waste Areas	277.39	0	277.39
Processing Areas & Support Facilities	117.20	3.57	120.77
Access, Haul Roads & Transport Facilities	18.16	0	18.16
Soil Storage Areas	59.18	0	59.18
Diversions	32.85	0	32.85
Coal Recovery (Gob & Slurry)	0	0	0
Other	30.46	0	30.46
Not to be Disturbed	37.19	0	37.19

2) A) Provide name and address of every legal or equitable owner of record of the IBR area.

RESPONSE: Williamson Development Company LLC, P.O. Box 99, Johnston City, IL 62951.

B) Provide name and address of the owner of record for all surface and subsurface areas contiguous to any part of the proposed IBR area.

RESPONSE: Refer to Attachment Part I.2.B.

C) Show location of owners of record of those lands, both surface and subsurface, included in or contiguous to the IBR area on premining land use map or another map, if necessary.

RESPONSE: Refer to Map 6 S.F.

3) Provide name and address of any holder of record of leasehold interest for the IBR area.

RESPONSE: Refer to Attachment Part I.3.

4) Affidavits, Certifications

A) Complete affidavit regarding applicant's legal right to enter and begin surface coal mining and reclamation operations in the IBR area and whether that right is the subject of pending litigation. Identify the documents upon which affidavit is based by type and date of execution and identify specific lands to which each document pertains and explain the legal rights claimed by the applicant (1778.15(a)). If the private mineral estate to be mined has been severed from the private surface estate, provide copies of the documents required under Section 1778.15(B)(1)-(3). On the permit map or other designated map show the boundaries of land within the permit area upon which the applicant has the legal right to enter and begin surface mining activities.

RESPONSE: Refer to Attachment Part I.4.A.

B) Complete certification for engineering aspects of the application. In addition to the general certification, three specific certifications are included which are applicable only if the box in front of each is marked. The first two cover special permit requirements and should be marked only when they occur for the proposed permit. The third certification covers the Illinois Environmental Protection Agency permit requirements. In most cases, an Illinois registered engineer will be required to certify IEPA permit requirements. Except as otherwise provided all maps, plans and cross-sections included in the permit application shall be prepared by, or under the direction of, and sealed by a qualified registered professional engineer licensed under the Illinois Professional Engineering Act, a qualified registered structural engineer licensed under the Illinois Structural Engineering Act or if authorized by state law, a qualified registered professional land survey or licensed under the Illinois Land Surveyors Act with assistance from experts in related fields.

RESPONSE: Refer to Attachment Part I.4.B.

5) Areas Designated Unsuitable for Mining

A) Does proposed IBR area include --

(1) Lands within boundaries of the National Park System, National Wildlife Refuge System, National Recreation Areas, etc. [Section 1761.11(a)]?

Yes _____ No ___X_____

(2) National forest land?

Yes _____ No ___X_____

(3) Any land which will adversely affect any publicly-owned park or places included in or eligible for listing in the National Register of Historic places, etc. [per 62 Ill. Adm. Code 1761.11(a)(3) or Section 10, (B)(C) of the SCM-1?

Yes _____ No ___X_____

If yes, complete Part II, Section 10, (B) & (C) of the SCM-1 or the UCM-1 Application.

(4) Any public roads which are to be removed, relocated or temporarily closed?

Yes _____ No ___X_____

Indicate on the pre-mining land use map or other designated map the location of the public roads and attach a copy of the written agreement from the appropriate authority authorizing the relocation, removal or temporary closure. Describe the measures to be used to insure that the interest of the public and land owners affected will be protected.

B) Will proposed IBR area be located --

(1) Within 100 feet of the right-of-way line of any public road?

Yes __X_____ No _____

If yes, explain proposed procedure for complying with regulation section 1761.11(d), including request for variance, if relevant. Provide location of public roads on pre-mining land use map or other designated map. Describe the measures to be used to insure that the interest of the public and land owners affected will be protected.

RESPONSE: Waiver from County Highway Department Attached.

(2) Within 300 feet measured horizontally from any occupied dwelling?

Yes _____ No ___X___

If so, is waiver provided meeting requirements of Section 1761.15?

(3) Within 300 feet measured horizontally of any public building, school, church, community or institutional building or public park?

Yes _____ No ___X___

(4) Within 100 feet measured horizontally of a cemetery?

Yes _____ No ___X___

C) Are valid existing rights (per 1761.11) claimed for any part of the IBR area?

Yes _____ No ___X___

If yes, provide documentation to substantiate claim.

D) Provide a draft copy of the proposed newspaper notice and name of local newspaper of general circulation in which advertisement of the application will be published, per 62 Ill. Adm. Code 1774.13(d)(6). Certification of publication is to be furnished to the Department and must be received prior to Department approval of the IBR.

RESPONSE: Refer to Attachment Part I.5.D.

Attachment I.4.A

(I) (~~We~~) Michael J. Beyer
(Individual or Individuals)

under penalty of perjury declare on behalf of the applicant, Williamson Energy LLC, that said applicant has valid documents which bestow upon the applicant a legal right to enter and commence surface coal mining and reclamation operations upon lands contained in the proposed IBR area, and such legal right is not in any way the subject of pending court litigation.

Dated this 19th day of September, 2008.

Signature /Title

Attachment I.5.D.

PUBLIC NOTICE

Pursuant to the Surface Coal Mining Land Conservation and Reclamation Act (PA-81-1015, as amended) and the Rules and Regulations of the Act, Williamson Energy LLC, P.O. Box 99, Johnston City, IL 62951 hereby gives notice that on _____2008, a permit incidental boundary revision (IBR-1) has been submitted to the Illinois Department of Natural Resources, Office of Mines and Minerals, One Natural Resources Way, Springfield, IL 62702-1271. The IBR application is for 3.57 acres located in Williamson County., NE ¼ SE ¼ NW ¼ of Section 9, Township 8 South, Range 4 East, Williamson County, Illinois and along portions of the Thompsonville Road, as support area to Permit No. 375.

Activities will include drilling two bore holes for concrete grouting. Construction of and infrequently used access road is proposed within 100' of the outside right-of way- of Thompsonville Road.

Copies of the application for this permit request are available for inspection at the following locations:

Copies of the application are on file with the Illinois Department of Natural Resources, Office of Mines and Minerals. Written comments concerning the operations should be addressed to the Office of Mines and Minerals, Land Reclamation Division at the address above, no later than 7 days from the date of this notice.

Attachment I.4.B.

ENGINEERING CERTIFICATION

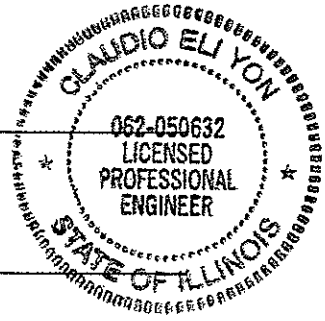
I hereby certify the engineering design used in preparation of this application, attachments, and supplements was done by me or under my direct supervision.

I further certify to the best of my knowledge all such design is in accordance with all applicable local, state and federal laws, rules and regulations. I have placed an "X" in the box below if that item is relevant.

☐ Whereas the Reclamation Plan calls for an alternative land use, I also certify the plans to conform to applicable accepted standards for adequate land stability, drainage, vegetative cover, and aesthetic design appropriate for the post-mining use of the site.

☐ Whereas the operation proposes disposal of spoil or waste materials in areas other than mining workings or excavations, I also certify such fills are designed in accordance with recognized professional standards and all applicable laws.

☒ Certification of Illinois Environmental Protection Agency-35 Ill. Adm. Code 405.104(a) Permit. In my professional judgement, the plans and specifications submitted as part of this application describe an operation which will meet all applicable effluent and water quality standards. I certify that I am familiar with all of the plans, specifications, reports, and maps submitted as part of this application and that said plans, etc. are accurate insofar as they represent existing conditions.



Claudio E. Yon — Name

062-050632 — Illinois Registration Number (Seal)

Alliance Consulting, Inc. — Firm

(304) 255-0491 — Phone Number

124 Philpott Lane, Beaver, West Virginia 25801 — Address

Claudio E. Yon — Signature

8/13/08 — Date

JAMES J. WEBB
COUNTY ENGINEER

SCOTT BARGER
DESIGN ENGINEER

YVONNE RICHERT
OFFICE MANAGER

WILLIAMSON COUNTY
HIGHWAY DEPARTMENT
MARION, ILLINOIS 62959

1817 NORTH COURT ST.
TELEPHONE (618) 997-13(
EXT. 145

August 13, 2008

Mr. James Plumley
Williamson Energy, LLC
P. O. Box 99
Johnston City, IL 62951

Dear Mr. Plumley:

The Williamson County Highway Department hereby grants Williamson Energy, LLC permission to be within 100 feet of Thompsonville Road (FAS 1887), in Williamson County, IL for the purpose of constructing an infrequently used access road.

Please call if you have any questions.

Sincerely,

James J. Webb
County Engineer
Williamson County Highway Department

PART II

PREMINING INFORMATION

Premining information is to be displayed on premining land use map unless otherwise indicated.

1) Describe how the IBR area perimeter will be marked and discuss the method or system employed to locate permit area perimeter and set markers along it. Designate a reference point outside the IBR area if different then the original permit. Provide a description of the reference point and a sketch relating the reference point to the IBR area perimeter.

RESPONSE: The perimeter of the permit area will be delineated by using PVC or metal post and the posts will be located within eye sight of one another. A reference point will be located at the approximately 1/2 mile south of the intersection of Locus Grove Road and Thompsonville Road.

2) Explain and locate areas where the IBR is contiguous to an existing permit.

RESPONSE: The IBR area will be located west side of the Thompsonville Road and approximately 1,500 feet south of the Locus Grove Bleeder Shafts on Permit 375.

3) Give the acreages of each land use within the proposed IBR and existing permit area, employing land use categories of Section 1701.5 listed below, and delineate on premining land use map existing land uses in the proposed permit area and adjacent to it. Include on the premining land use map the location of all buildings and identify the current use of these buildings.

Pre-Mine Land Use	Existing Permit	IBR	Total
Cropland	486.71	3.57	490.28
Pasture land	0	0	0
Grazing land	0	0	0
Forestry	101.86	0	101.86
Residential	2.55	0	2.55
Industrial/Commercial			
Recreation	0	0	0
Fish and Wildlife Habitat	0	0	0
Developed Water Resources	1.44	0	1.44
Undeveloped land	0	0	0

4) Soils Information Map

A) Does the submitted soils map represent a map developed by the National Resources Conservation Service (NRCS)?

Yes __X__ No_____.

If no, explain.

RESPONSE: Information previously submitted in UCM-1 application for Permit 375.

B) Delineate on the soils map(s) the area which will incur actual mining (removal of overburden and/or deposition of overburden for the extraction of coal).

RESPONSE: Information previously submitted in UCM-1 application for Permit 375.

C) Are any of the identified map units correlated as prime farmland by NRCS criteria?

Yes ___X___ No_____.

If yes, explain and provide documentation to meet the requirements of Section 1785.17, if a determination for grandfathering and/or negative determination is sought. If prime farmlands exist which will not meet the exemption criteria described above, the approved prime farmlands restoration plan must be followed.

RESPONSE: Information previously submitted in UCM-1 application for Permit 375.

D) Submit, by completing soils information chart, acreage totals of each map unit (soil type and slope classification) and land use capability classes in the IBR area and the percent slope range of each lettered slope classification used on the soil map.

RESPONSE: Information previously submitted in UCM-1 application for Permit 375.

E) Provide, by completing soil information chart, acreage for each of the map units of high capability land (including grandfathered and negatively determined prime farmland) and non-cropland capability land with respect to areas which will be mined and areas which will incur other forms of disturbance (i.e., roads, ditches, etc.). Identify and provide map unit acreage values, if any, for areas which will not be disturbed.

RESPONSE: Information previously submitted in UCM-1 application for Permit 375.

F) Are selected overburden materials proposed to be used in lieu of or as a supplement to the A-horizon?

Yes _____ No___X_____.

If yes, provide the appropriate information required under 1780.18(b)(4)/1784.13(b)(4).

PART III

OPERATIONS PLAN

1) Explain the proposed operation and why the IBR is needed. Locate on a mining operations map.

RESPONSE: The purpose of this IBR is to permit an infrequency used access road and area for a water recovery borehole(s). In mining the permitted coal seam, the operation has mined through a low area and to insure that no mine water has block the mine ventilation, the mine operator is requesting to drill a hole(s) from the surface into the mine and install a vertical turbine pump(s). The drill site is being permitted large enough to drill two 18-inch boreholes, if needed. The pump discharge pipeline will be buried within the confines of the access road boundary. This pipeline will connect to a pipeline located along the railroad spur right-of-way. Each borehole will be approximately 530 feet deep and will be fully cased and grouted between the casing and the sides of the borehole. Upon abandonment, the boreholes will be fully grouted.

2) Surface Drainage Control

A) 1) Locate on the mining operations map or on a separate drainage map all proposed drainage control systems. Show drainage patterns of all affected mining areas.

RESPONSE: Refer to the Surface Operations Map; Map 6 S.F.

2) Will all surface drainage from the affected mining area be collected and treated prior to leaving the IBR area?

Yes _____ No ___X___

If yes, delineate how and where surface drainage will be collected and treated, and list permit numbers and type of permit that the drainage control systems are operated under. If above answer is no, explain how regulatory compliance will be achieved without treatment, i.e., address the requirements of 1816.46(e)/1817.46(e).

B) Will all surface drainage from unaffected areas be intercepted and diverted around the affected mining area?

Yes _____ No ___X___

If no, please discuss.

RESPONSE:

C) Overland Flow Diversions and Sediment Ponds:

Are either overland flow diversions or sediment ponds to be constructed?

Yes _____ No ___X___

If yes, complete applicable parts of the SCM-1 or UCM-1 Part IV (surface drainage control).

D) Does a perennial or intermittent stream occur within the proposed IBR area?

Yes _____ No X

If yes, is an exception to the 100 foot buffer zone being requested or is a stream diversion being proposed. For an exception to the 100 foot buffer zone, indicate how compliance with 1816.57/1817.57 will be assured. For a stream diversion, complete applicable parts of the SCM-1 or UCM-1.

3) Roads and other activities:

A) Are roads to be constructed in the IBR area?

Yes _____ No X

If yes, complete the applicable part of the SCM-1or UCM-1 (transportation facilities).

B) If the operations involve other activities not specifically addressed above complete applicable parts of the SCM-1 or UCM-1.

RESPONSE: Refer to Attachment III.3.A.

4) Are any existing structures proposed for utilization in the IBR?

Yes _____ No X

If yes, complete Part IV.4 of the SCM-1 or UCM-1.

RESPONSE: Refer to Attachment III.3.A.

Map Key ID	Owners	Address	City	State	Zip
8407100-008	WILLIAMSON DEVELOPMENT CO, LLC	430 HARPER PARK DR SUITE A	BECKLEY	WV	25801

Attachment I.2.A.

Key_ID	Owners	Address	City	State	Zip	Coal Tax ID	Coal Owner	Type Control
A080409-109	MICHAEL & RUTH MILLER*	567 SOUTH THOMPSONVILLE RD	THOMPSONVILLE	IL	62890	8409700-003	INDEPENDENCE LAND COMPANY, LLC	LEASE
A080409-213	MICHAEL & RUTH MILLER*	567 SOUTH THOMPSONVILLE RD	THOMPSONVILLE	IL	62890	8409700-004	INDEPENDENCE LAND COMPANY, LLC	LEASE
A080409-102	THOMAS MICK*	21671 LOCUS GROVE RD.	THOMPSONVILLE	IL	62890	8409700-001	INDEPENDENCE LAND COMPANY, LLC	LEASE
t above land owner to allow approprate								

Attachment I.2.B.

MINERAL OWNER OF RECORD	DOCUMENT TYPE	GRANTOR OF RIGHT
Independence Land, Inc.	Deed	Williamson Development Company, LLC
Williamson Development Company, LLC	Lease	Independence Land, Inc.
Williamson Energy, LLC	Sub-lease	Williamson Development Company, LLC

PART IV

RECLAMATION PLAN

1) Provide a reclamation plan map outlining proposed reclamation of the lands within the proposed IBR area and state how the IBR area will be reclaimed in conformity with the original plan.

2) Post Mining Land Use

   A) Provide a detailed description of proposed post-mining land uses and capabilities employing land use and capability categories listed below. Provide acreage figures for each post-mining land use proposed for the existing permit, the IBR area and total permit after inclusion of the IBR acreage and designate the postmining land uses on the Post Mining Land Use Map. Acreage figures for postmining land use must differentiate between mined and surface disturbance areas based on the mining line used in the premining section of the application.

RESPONSE: Refer to Attachment IV.2.A.

Land Use	Capability								
	Existing Permit (ac)			IBR (ac)			Total (ac)		
	Prime	HCap	NonCr	Prime	HCap	NonCr	Prime	HCap	NonCr
Cropland			0.00			0.00			0.00
Pasture Land			0.00			0.00			0.00
Grazing Land			0.00			0.00			0.00
Forestry			13.36			0.00			13.36
Residential			0.00			0.00			0.00
Industrial/Commercial			0.00			0.00			0.00
Recreation			0.00			0.00			0.00
Fish & Wildlife Habitat (Herbaceous)			0.00			0.00			0.00
Fish & Wildlife Habitat (Woody)			559.94			3.57			563.51
Fish & Wildlife Habitat (Wetland)			0.00			0.00			0.00
Developed Water Resources			19.26			0.00			19.26
Undeveloped Land			0.00			0.00			0.00

Prime: Prime farmland
HCap: High Capability - meeting productivity requirements of 62 Ill. Adm. Code 1825.
NonCrop: Non-Cropland - All soils which do not qualify as prime farmland or high capability.

ATTACHMENT V.1.B
REFUSE AREA
RECLAMATION ESTIMATE
PERMIT No. 375
WATER RECOVERY BOREHOLES

	Number	Width	Length	Height	Description	Units		Price	COST	
Topsoil Borehole Site	1	2.87	Acres	1	Topsoil Redistributed	4,630	Yards	1.5	$6,945	
Topsoil on IUA Road	1	0.7	Acres	1	Topsoil Redistributed	1,129	Yards	2.5	$2,823	
Lime	1	3.57	Acres		Revegetation	3.2	Acres	500	$1,600	
Control Building	1	100	Sq Ft	0.5	Concrete pad	100.00	Sq Ft	1	$100	
Water Recovery Boreholes	2	2	2	530	Backfill Boreholes	1,060.0	Yards	1.5	$1,590	
						TOTAL				$13,059

R17776

DOCUMENT

84

STATE OF ILLINOIS
ENVIRONMENTAL PROTECTION AGENCY

Subject: Williamson Energy, LLC – Pond Creek Mine

Data: Log No. 0371-08

Reviewed by: D. Maschhoff **Date:** 7/13/17

Log No. 0371-08 ⇒ IPR No. 13 to OMM Permit No. 375

Log No. 0371-08

- Installation of a concrete sump at the existing road tunnel and pipeline to Sediment Pond No. 003.
- This operation keeps the road tunnel operational at all times (heavy rainfalls) for health and safety issues.

* Action: Reference IEPA Log No. 0371-08 in renewed and modified NPDES permit for installation of a concrete sump at the existing road tunnel and pipeline to Sediment Pond No. 003.

Q371-/08
Due date 5-28-08

Illinois Department of
Natural Resources
One Natural Resources Way • Springfield, Illinois 62702-1271
http://dnr.state.il.us

Rod R. Blagojevich, Governor
Sam Flood, Acting Director

April 14, 2008

Mr. James Plumley
Williamson Energy, LLC
P.O. Box 99
Johnston City, IL 62951

RECEIVED
APR 2 1 2008
IL Environmental Protection Agency
MARION REGIONAL OFFICE

Re: Permit No. 375
Insignificant Revision No. 13

Dear Mr. Plumley:

The appropriate Department technical staff have reviewed the proposed change dated March 26, 2008, submitted by Williamson Energy for the Pond Creek Mine. The permittee has requested approval to drill an emergency concrete supply borehole, and install a concrete sump for the road tunnel drainage ditches. Since this operation is not currently approved, it will constitute a change to the approved plan. Insignificant permit revisions are allowed under 62 Ill. Adm. Code 1774.13(b)(2).

The Department has determined the proposed alteration is in compliance with 62 Ill. Adm. Code 1700 - 1850, and is insignificant and hereby exempts the permittee from submitting a permit revision application in accordance with Section 1774.13(b)(2). The Department grants permission to install the emergency concrete supply borehole, and a concrete sump for the road tunnel drainage ditches.

No additional bond is required because of this change.

All conditions and provisions contained in the approved permit also apply to this revision. Approval from this agency does not relieve the permittee from obtaining approval from other agencies requiring such.

Please submit two additional copies of your request letter and maps to Ronald Morse, Illinois Environmental Protection Agency, 2309 West Main Street, Marion, Illinois 62959.

Printed on recycled and recyclable paper

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 – (217) 782-3397
JAMES R. THOMPSON CENTER, 100 WEST RANDOLPH, SUITE 11-300, CHICAGO, IL 60601 – (312) 814-6026

ROD R. BLAGOJEVICH, GOVERNOR DOUGLAS P. SCOTT, DIRECTOR

July 14, 2008 618/993-7200

Mr. James Plumley
Williamson Energy, LLC
P.O. Box 99
Johnston City, IL 62951

Re: Williamson Energy, LLC – Pond Creek Mine No. 1
Permit No. 375
Insignificant Revision No. 13

Dear Mr. Plumley:

The Agency is in receipt of the Office of Mines and Minerals approval letter dated April 14, 2008, for the above referenced project. In the OMM approval letter, it is so indicated that two (2) copies of the request letter and map(s) were to be forwarded to Ronald Morse, Illinois Environmental Protection Agency, 2309 West Main Street, Suite 116, Marion, IL, 62959. To date, the Agency has no record of receipt of the above referenced submittal.

The referenced OMM approval letter indicates that approval from the Office Mines and Minerals does not relieve Williamson Energy, LLC, from obtaining approval from other agencies requiring such.

Please be advised that approval from the Office of Mines and Minerals is in no way to be considered as approval from this Agency, and any action taken on the proposed activities without prior Agency approval, if required, may be a violation of Title 35, Subtitle D: Mine Related Water Pollution regulations and the IEPA Permit for your facility. The required copies shall be forwarded to the Agency no later than August 15, 2008.

Should you have any questions or comments regarding the above, or need any additional information concerning Agency requirements, please contact Environmental Protection Engineer, Iwona Ward at 618/993-7200 or the Marion address listed below.

Sincerely,

Larry D. Crislip, P.E.
Manager, Permit Section
Mine Pollution Control Program
Bureau of Water

LDC:IKW:jkb/4983c/07-14-08

cc: IDNR/Office of Mines and Minerals
Stephen M. Sutphin, Alliance Consulting, Inc.
bcc: BOW/MPCP/FOS/Springfield
BOW/MPCP/FOS/Marion

IPR No. 13

R17781

Williamson Energy, LLC
PO Box 99
Johnston City, IL 62951
Office: 618-983-3020 Fax: 618-983-3017

March 26, 2008

Project No. B08-180-1413

Mr. William O' Leary
ILLINOIS DEPARTMENT
OF NATURAL RESOURCES
Land Reclamation Division
503 E. Main, FL 001
Benton, IL 62812

IPR for Permit No. 375
Refuse/Underdrain Placement
Williamson Energy, LLC
Pond Creek Mine No. 1
Williamson County, Illinois

RECEIVED
SEP 22 2008
IL Environmental Protection Agency
MARION REGIONAL OFFICE

Dear Mr. O'Leary:

Williamson Energy, LLC, is submitting an original and two copies of an insignificant permit revision to show an emergency concrete borehole located within the railroad loop near Pond 003, a concrete sump for the road tunnel drainage and two road drainage ditches.

A roof fall in the mine slope entry has occurred and has mandated that Williamson Energy will drill a seven (7) inch diameter borehole over the roof fall area. The seven (7) inch borehole will be cased to a five (5) inch diameter hole and will have a depth of approximately 180 feet. The purpose of the borehole is to transport concrete to the slope entry. When the borehole is no longer needed, it will be grouted the entire length. Refer to Map 6 S.F. (Drawing B08-180-B1) for the location of the borehole.

Due to the recent rainfall, the operator is proposing to install a concrete sump at the existing road tunnel and install a pipe and pipeline. The pipeline would discharge into the existing Pond No. 003. The sump would be approximately 11 feet long X 6 feet wide X 4.5 feet deep. The operator must keep this tunnel accessible at all times because of health and safety issues. Two road drainage ditches are proposed along the access road at the tunnel. The ditch located outside the railroad loop will drain toward railroad which just better defines the natural drainage pattern in that area. The ditch located inside the railroad loop will drain away from the tunnel and into a 15 inch steel pipe located under the roadbed and

within the ditch line. The ditch and pipe will discharge into the existing Pond No. 003. Refer to Map 6 S.F. (Drawing B08-180-B1) for the location of the sump and the ditches. If you have any questions, or require additional information, please contact us.

Sincerely,

James Plumley

James Plumley
Authorized Representative

SMS:wmb
Enclosures

FILE: 08180 - 01

R17783

CONCRETE PUMP HOLES - 6" ~ 285' DEEP

EMERGENCY CONCRETE BOREHOLE

TWIN 10' CULVERTS

Underground Slope

TOP SOIL

SUB SOIL

TOP SOIL

ADMINISTRATIVE BUILDING

5

CONCRETE SUMP

ROAD DITCH

Sediment Pond 003

FLOATING PUMP

CONCRETE HOLE(S)

(1) 15" STEEL PIPE

NPDES 003

TUNNEL AND ROAD

Culvert #1 (1) 60" CMP

S5

S8

NPDES 002

FLOATING PUMP

Sediment Pond 002

S9

RAW COAL STORAGE WITH RECLAIM TUNNEL

NPDES 004

FLOATING PUMP

CONCRETE HOLE

SUPPLY YARD

Sediment Pond 004

Rock dust pad 3456 SQ. FT.

72" RAW COAL TRAN. CONV.

60" PLANT FEED CONV.

TANK FARM 1692 SQ. FT.

PREPARATION PLANT

Belt Drive Building 2,400 SQ. FT.

8" PIPE

4" PIPE

2" PIPE

36" C

10" PIP

OPERATIONS PLAN MAP (SURFACE FACILITIES)

GENERAL INFORMATION

- MINING PERMIT #375 SURFACE FACILITIES
- ROAD
- PROPERTY BOUNDARY
- FENCE LINE
- PERENNIAL STREAMS
- NON-PERENNIAL STREAMS
- 100 YEAR FLOOD PLAIN
- PHASE 3 REFUSE UNDERDRAIN
- LAKES
- 8418100-002 LAND PARCEL KEY ID
- WETLANDS
- P-1 PIEZOMETER LOCATION
- MSHA P-3 MSHA PIEZOMETER LOCATION

UTILITY INFORMATION

- PWR SE ELECTRIC COOPERATIVE
- WTR CORINTH WATER DISTRICT
- TELE GTE TELEPHONE
- GAS GAS PIPELINE
- POWER POLE

STRUCTURES

- 1 RESIDENCE (OCCUPIED)
- 1VAC RESIDENCE (UNOCCUPIED)
- 2 MOBILE HOME (OCCUPIED)
- 2VAC MOBILE HOME (UNOCCUPIED)
- 3 SHED
- 4 GARAGE
- 5 BARN
- 6 GRAIN BIN OR SILO
- BUFFER ZONE WITHIN 300' OF OCCUPIED DWELLING
- AREAS OF DISTURBANCE IN STREAM BUFFER ZONE
- AREAS FOR EXEMPTION PER 1817.46(e)

NOTE:
REFER TO PART I.1.G FOR ACREAGE COMPONENTS

N

0 100' 200' 300'

SCALE: 1" = 100'

Mine Name: POND CREEK MINE #1	Permit No: 375
Quadrangle: PITTSBURG, ILLINOIS	Description: WILLIAMSON COUNTY, ILLINOIS T8S R3E - SECTIONS 1, 2, 11, 12, 13, 14, 23, & 24 T8S R4E - SECTIONS 4, 5, 6, 7, 8, 9, 16, 17, 18, 19, 20, & 21
Date: 03/25/08	

REV.	DATE	DESCRIPTION	P.M.

BECKLEY, WV
(304) 255-0491

Alliance Consulting, Inc.
Engineers Constructors Scientists

MAP 6 S.F.
OPERATIONS PLAN MAP (SURFACE FACILITIES)

POND CREEK MINE NO. 1

Prepared For
WILLIAMSON ENERGY LLC.
P. O. BOX 99, JOHNSTON CITY, IL 62951

CAD BY	SMS	03/26/08	PROJECT NO. B08-180-1413
CHECKED BY	SMS	03/26/08	
APPROVED BY	CEY	03/26/08	DRAWING NO. B08-180-B1