The following are attachments to the testimony of Scott M. Payne, PhD, PG and Ian Magruder, M.S..

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B015A
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	15.0-15.5
Project No.:	2015-485-007	Sample No.:	ST-2
Lab ID:	2015-485-007-003	Soil Color:	Dark Brown

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		39.5	22.4	6.22	33.3	78.1	0.01307	0.0290	**69.8**
5		34.0	22.4	6.22	27.8	65.2	0.01307	0.0191	**58.2**
15		28.5	22.4	6.22	22.3	52.3	0.01307	0.0115	**46.7**
30		24.5	22.4	6.22	18.3	42.9	0.01307	0.0084	**38.3**
60		23.0	22.4	6.22	16.8	39.4	0.01307	0.0060	**35.2**
250		20.0	22.5	6.18	13.8	32.4	0.01305	0.0030	**29.0**
1440		17.0	22.3	6.25	10.7	25.2	0.01308	0.0013	**22.5**

Soil Specimen Data		Other Corrections		
Tare No.	644			
Weight of Tare & Dry Material (g)	146.77	a - Factor	0.99	
Weight of Tare (g)	99.57			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	89.34	
Weight of Dry Material (g)	42.2			
		Specific Gravity	2.7	Assumed

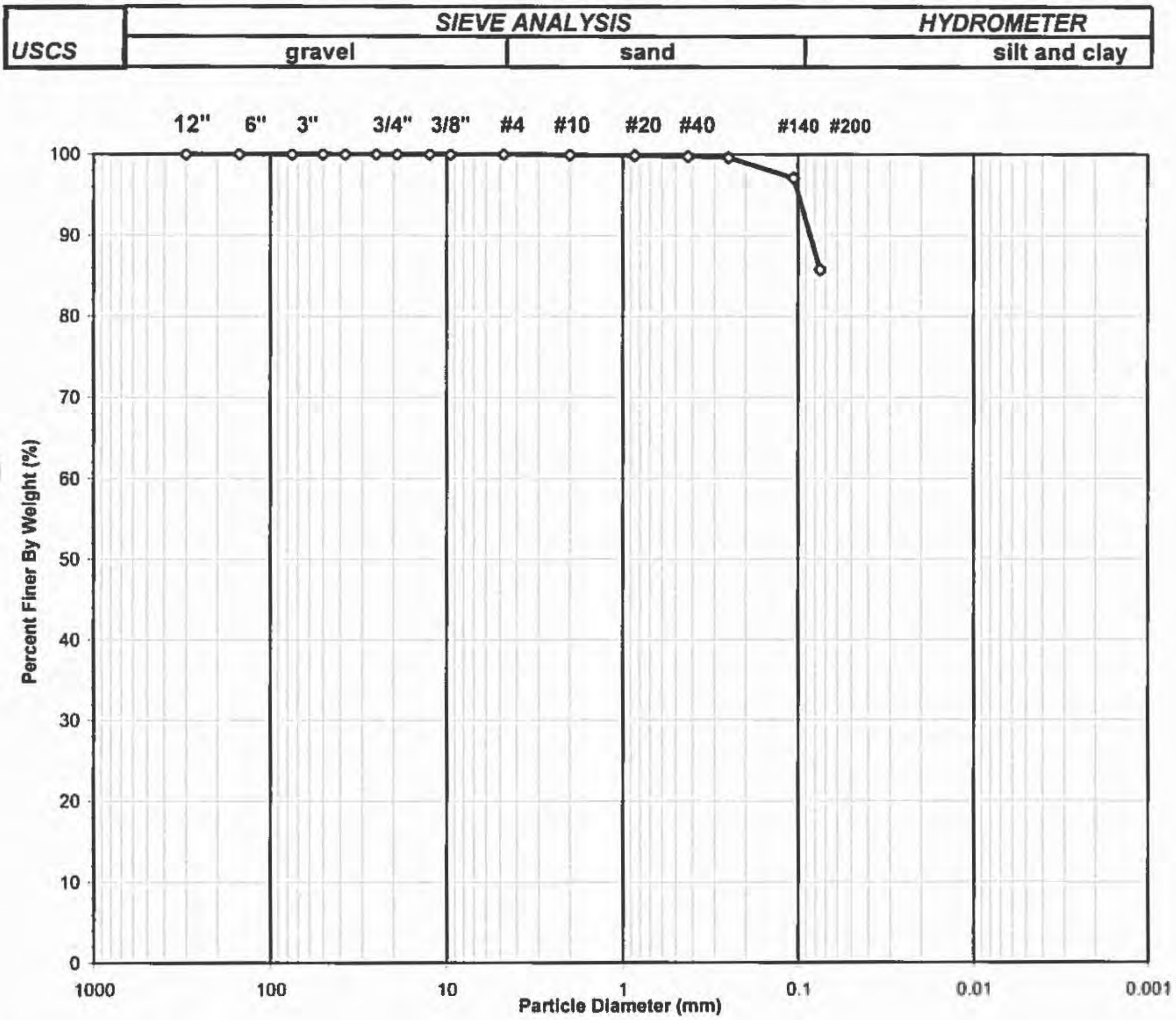
Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 10/31/15 Checked By KC Date 11/2/15

geotechnics
geotechnical & geosynthetic testing

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B016
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	3.5-5.0
Project No.:	2015-485-001	Sample No.:	SS-2
Lab ID:	2015-485-001-006	Soil Color:	Brown



USCS Symbol:
CL, TESTED

USCS Classification:
LEAN CLAY

Tested By JP Date 9/12/15 Checked By KC Date 9/16/15

geotechnics
geotechnical & geosynthetic testing

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B016
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	3.5-5.0
Project No.:	2015-485-001	Sample No.:	SS-2
Lab ID:	2015-485-001-006	Soil Color:	Brown

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	1418	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	552.80	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	491.20	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	145.19	Weight of Tare (g):	NA
Weight of Water (g):	61.60	Weight of Water (g):	NA
Weight of Dry Sample (g):	346.01	Weight of Dry Sample (g):	NA
Moisture Content (%):	**17.8**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	346.01
Dry Weight of - 3/4" Sample (g):	49.3	Weight of - #200 Material (g):	296.71
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	49.30
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

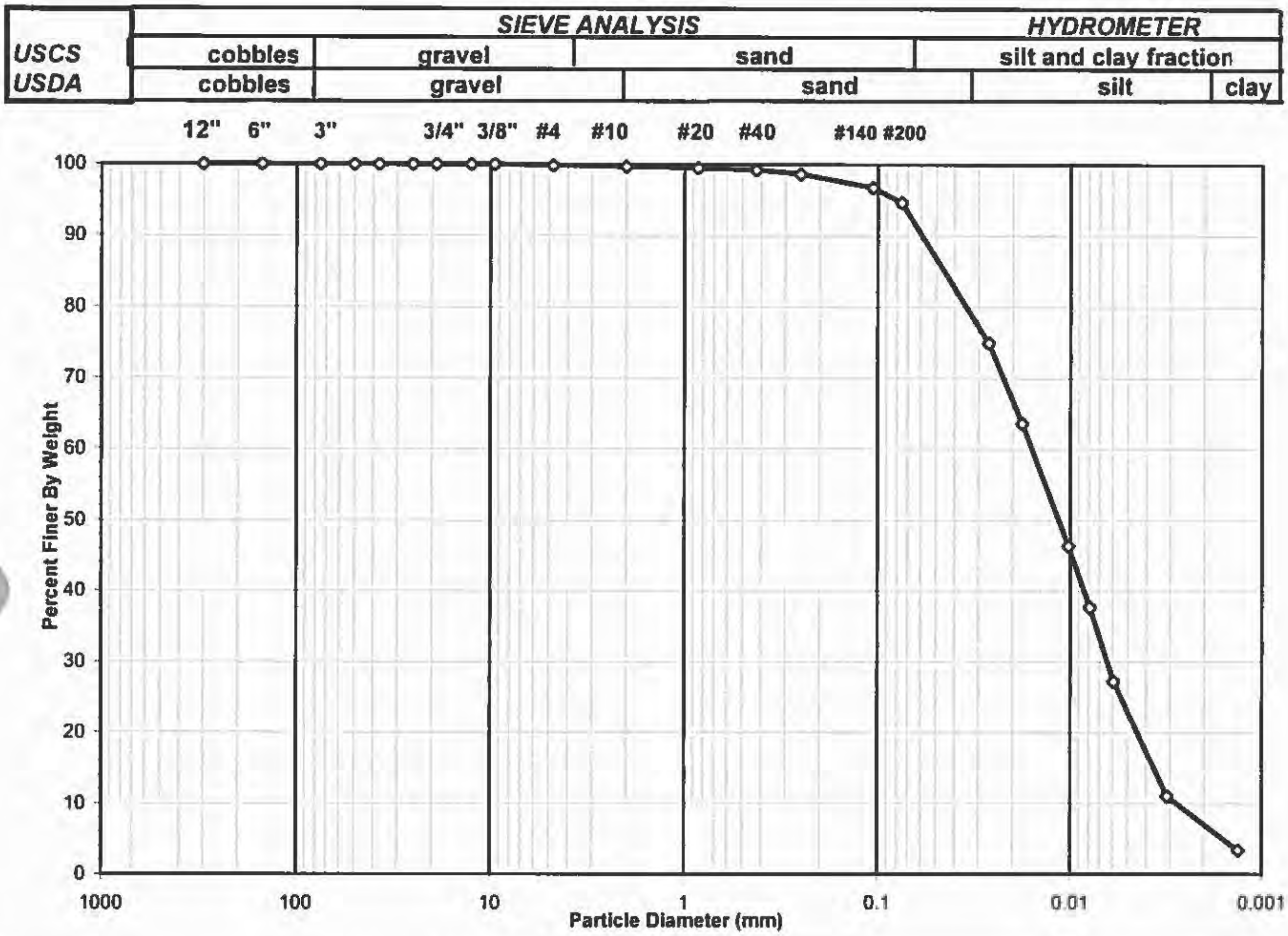
Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.20	0.06	0.06	99.94	**99.94**
#20	0.850	0.29	0.08	0.14	99.86	**99.86**
#40	0.425	0.42	0.12	0.26	99.74	**99.74**
#60	0.250	0.45	0.13	0.39	99.61	**99.61**
#140	0.106	8.66	2.50	2.90	97.10	**97.10**
#200	0.075	39.28	11.35	14.25	85.75	**85.75**
Pan	-	296.71	85.75	100.00	-	-

Tested By JP Date 9/12/15 Checked By KC Date 9/16/15

SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B016
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	31.0-32.5
Project No.:	2015-485-001	Sample No.:	SS-11
Lab ID:	2015-485-001-007	Soil Color:	Gray



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.14
#4 To #200	*Sand*	5.17
Finer Than #200	*Silt & Clay*	94.69

USCS Symbol:

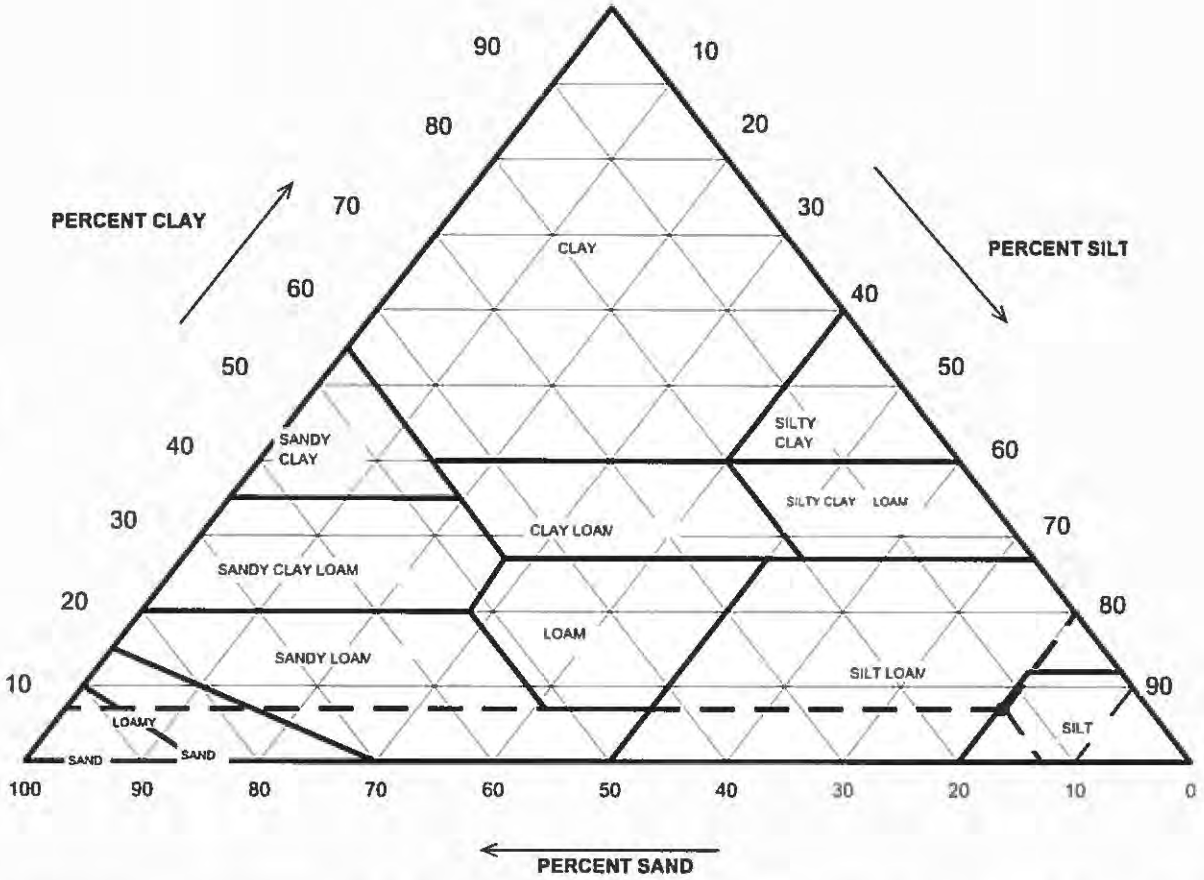
ML, TESTED

USCS Classification:

SILT
(NON-PLASTIC FINES)

USDA CLASSIFICATION CHART

Client:	AECOM	Boring No.:	WOR-B016
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	31.0-32.5
Project No.:	2015-485-001	Sample No.:	SS-11
Lab ID:	2015-485-001-007	Soil Color:	Gray



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
		Gravel	0.34	**0.00**
2	99.66	*Sand*	12.66	**12.70**
0.05	87.00	*Silt*	79.98	**80.25**
0.002	7.03	*Clay*	7.03	**7.05**

USDA Classification: ***SILT***

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B016
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	31.0-32.5
Project No.:	2015-485-001	Sample No.:	SS-11
Lab ID:	2015-485-001-007	Soil Color:	Gray

Moisture Content of Passing 3/4" Materia		Water Content of Retained 3/4" Material	
Tare No.	975	Tare No.	NA
Weight of Tare & Wet Sample (g)	423.04	Weight of Tare & Wet Sample (g)	NA
Weight of Tare & Dry Sample (g)	365.78	Weight of Tare & Dry Sample (g)	NA
Weight of Tare (g)	96.13	Weight of Tare (g)	NA
Weight of Water (g)	57.26	Weight of Water (g)	NA
Weight of Dry Sample (g)	269.65	Weight of Dry Sample (g)	NA
Moisture Content (%	**21.2**	**Moisture Content (%**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Sample (g)	269.65
Dry Weight of -3/4" Sample (g)	14.32	Weight of - #200 Material (g)	255.33
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 Material (g)	14.32
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00		100.00	**100.00**
#4	4.75	0.38	0.14	0.14		99.86	**99.86**
#10	2.00	0.53	0.20	0.34		99.66	**99.66**
#20	0.85	0.47	0.17	0.51		99.49	**99.49**
#40	0.425	0.70	0.26	0.77		99.23	**99.23**
#60	0.250	1.73	0.64	1.41		98.59	**98.59**
#140	0.106	5.06	1.88	3.29		96.71	**96.71**
#200	0.075	5.45	2.02	5.31		94.69	**94.69**
Pan	-	255.33	94.69	100.00		-	-

Tested By RAL Date 9/15/15 Checked By KC Date 9/17/15

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HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client: AECOM
Client Reference: Dynegy - Wood River Pwr. Sta. 60440115
Project No.: 2015-485-001
Lab ID: 2015-485-001-007

Boring No.: WOR-B016
Depth (ft): 31.0-32.5
Sample No.: SS-11
Soil Color: Gray

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		49.5	22.4	6.22	43.3	79.1	0.01307	0.0264	**74.9**
5		43.0	22.4	6.22	36.8	67.2	0.01307	0.0178	**63.7**
18		33.0	22.4	6.22	26.8	49.0	0.01307	0.0102	**46.4**
32		28.0	22.4	6.22	21.8	39.8	0.01307	0.0079	**37.7**
62		22.0	22.3	6.25	15.7	28.8	0.01308	0.0059	**27.3**
250		12.5	22.6	6.15	6.4	11.6	0.01303	0.0031	**11.0**
1440		8.0	22.8	6.07	1.9	3.5	0.01300	0.0013	**3.3**

Soil Specimen Data		**Other Corrections**		
Tare No.	970			
Weight of Tare & Dry Material (g)	159.79	a - Factor	0.99	
Weight of Tare (g)	100.63			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	94.69	
Weight of Dry Material (g)	54.2			
		Specific Gravity	2.7	Assumed

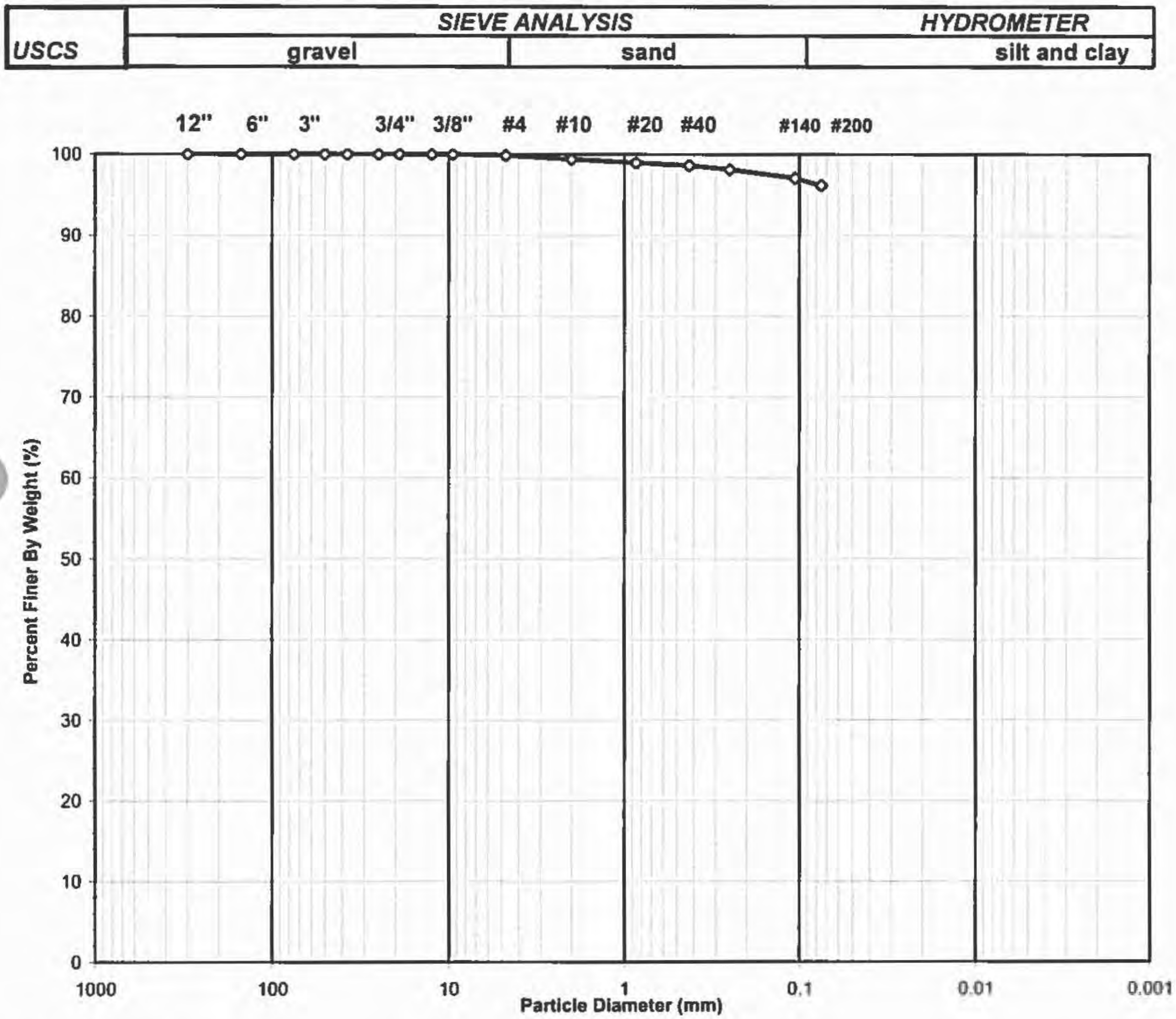
Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 9/15/15 Checked By KC Date 9/17/15

SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-18
Client Reference:	Dynegy-Wood River Pwr. Sta. 60440115	Depth (ft):	1.0-2.5
Project No.:	2015-485-003	Sample No.:	SS-1
Lab ID:	2015-485-003-008	Soil Color:	Brown



USCS Symbol:
cl, ASSUMED

USCS Classification:
LEAN CLAY

Tested By	PC	Date	10/2/15	Checked By	KC	Date	10/2/15

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-18
Client Reference:	Dynegy-Wood River Pwr. Sta. 60440115	Depth (ft):	1.0-2.5
Project No.:	2015-485-003	Sample No.:	SS-1
Lab ID:	2015-485-003-008	Soil Color:	Brown

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	1442	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	424.50	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	384.15	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	145.81	Weight of Tare (g):	NA
Weight of Water (g):	40.35	Weight of Water (g):	NA
Weight of Dry Sample (g):	238.34	Weight of Dry Sample (g):	NA
Moisture Content (%):	**16.9**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	238.34
Dry Weight of - 3/4" Sample (g):	9.1	Weight of - #200 Material (g):	229.27
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	9.07
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.40	0.17	0.17	99.83	**99.83**
#10	2.00	1.09	0.46	0.63	99.37	**99.37**
#20	0.850	1.00	0.42	1.04	98.96	**98.96**
#40	0.425	0.87	0.37	1.41	98.59	**98.59**
#60	0.250	1.13	0.47	1.88	98.12	**98.12**
#140	0.106	2.38	1.00	2.88	97.12	**97.12**
#200	0.075	2.20	0.92	3.81	96.19	**96.19**
Pan	-	229.27	96.19	100.00	-	-

Tested By PC Date 10/2/15 Checked By KC Date 10/2/15

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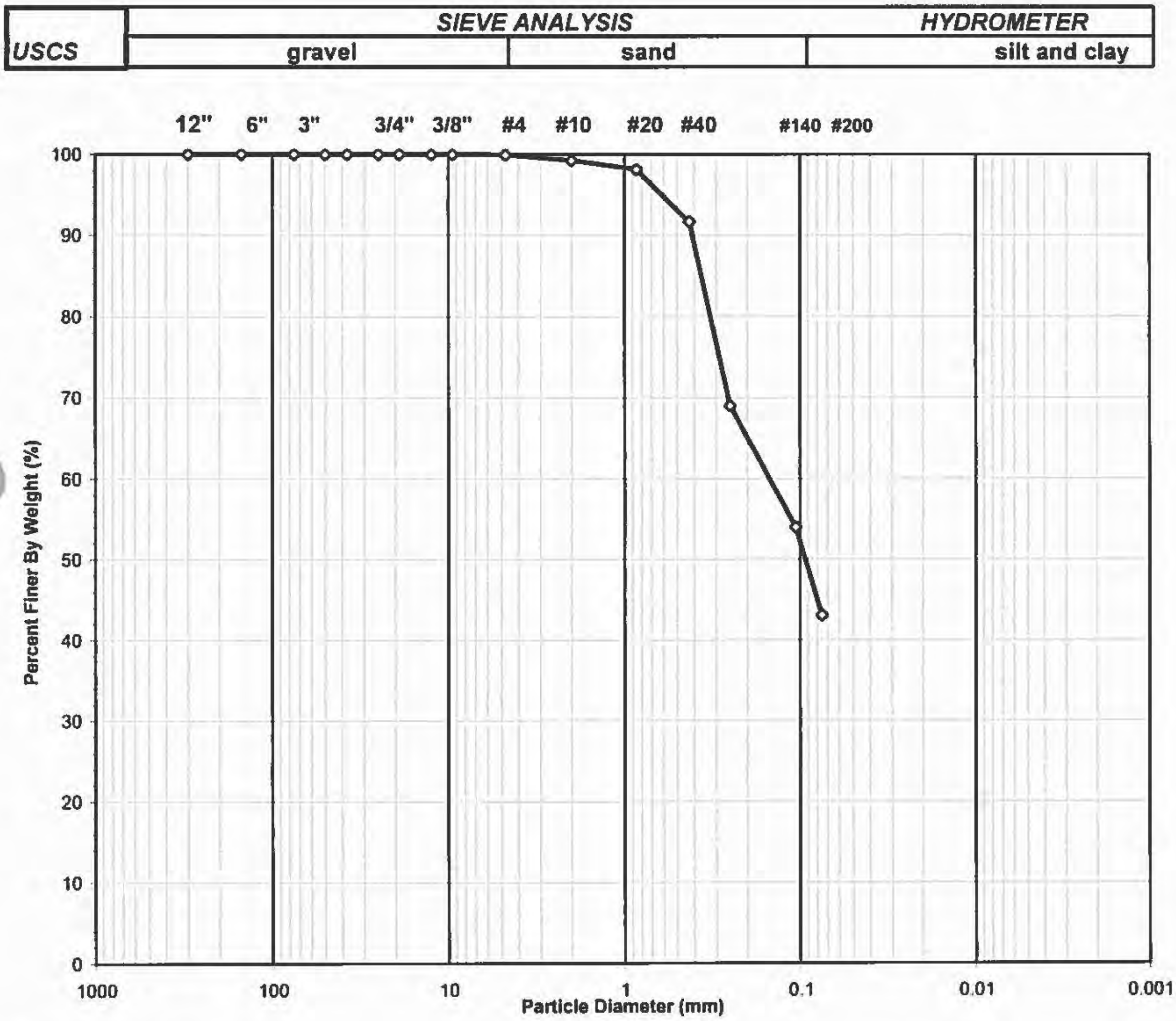
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client: AECOM
Client Reference: Dynegy-Wood River Pwr. Sta. 60440115
Project No.: 2015-485-003
Lab ID: 2015-485-003-009

Boring No.: B-18
Depth (ft): 11.0-12.5
Sample No.: SS-5
Soil Color: Brownish Gray



USCS Symbol:
sm, ASSUMED

USCS Classification:
SILTY SAND

Tested By PC Date 10/2/15 Checked By KC Date 10/2/15

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-18
Client Reference:	Dynegy-Wood River Pwr. Sta. 60440115	Depth (ft):	11.0-12.5
Project No.:	2015-485-003	Sample No.:	SS-5
Lab ID:	2015-485-003-009	Soil Color:	Brownish Gray

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	56	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	532.00	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	498.40	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	204.70	Weight of Tare (g):	NA
Weight of Water (g):	33.60	Weight of Water (g):	NA
Weight of Dry Sample (g):	293.70	Weight of Dry Sample (g):	NA
Moisture Content (%):	**11.4**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	293.70
Dry Weight of - 3/4" Sample (g):	167.2	Weight of - #200 Material (g):	126.48
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	167.22
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.21	0.07	0.07	99.93	**99.93**
#10	2.00	2.12	0.72	0.79	99.21	**99.21**
#20	0.850	3.25	1.11	1.90	98.10	**98.10**
#40	0.425	18.92	6.44	8.34	91.66	**91.66**
#60	0.250	66.71	22.71	31.06	68.94	**68.94**
#140	0.106	44.03	14.99	46.05	53.95	**53.95**
#200	0.075	31.98	10.89	56.94	43.06	**43.06**
Pan	-	126.48	43.06	100.00	-	-

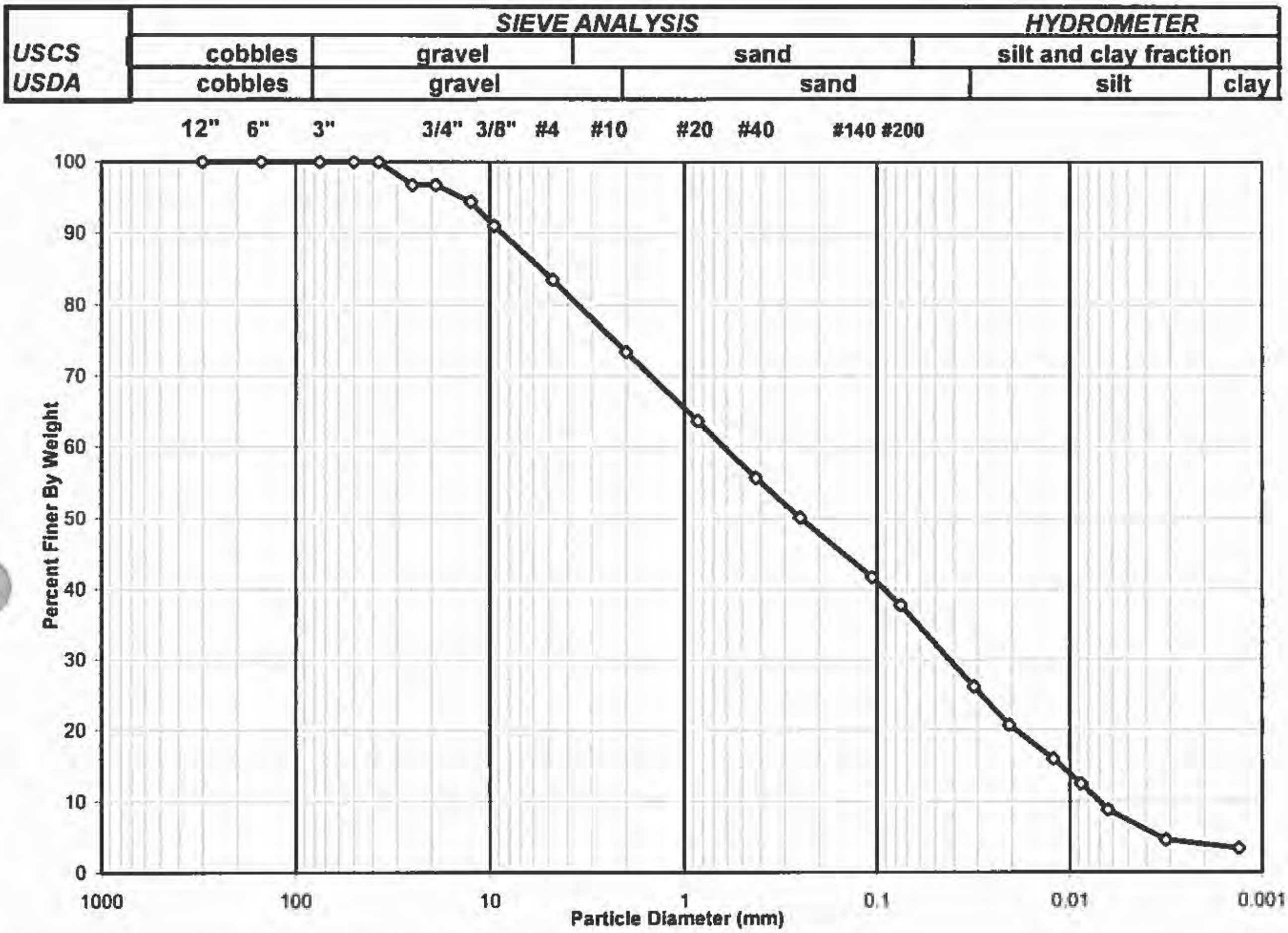
Tested By PC Date 10/2/15 Checked By KC Date 10/2/15

geotechnics
geotechnical & geosynthetic testing

SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-18
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	21.0-22.5
Project No.:	2015-485-003	Sample No.:	SS-9
Lab ID:	2015-485-003-010	Soil Color:	Dark Gray / Black



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	16.47
#4 To #200	*Sand*	45.86
Finer Than #200	*Silt & Clay*	37.67

USCS Symbol:

sm, ASSUMED

USCS Classification:

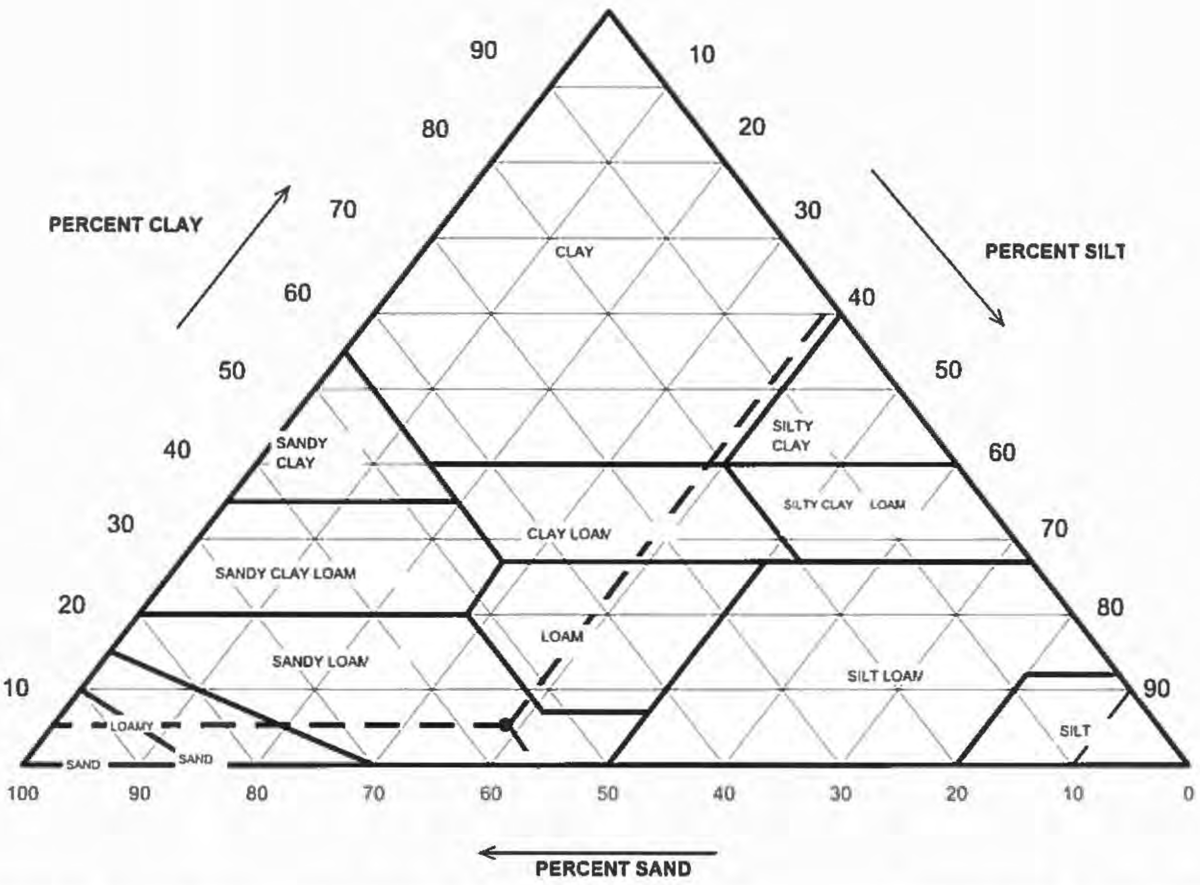
SILTY SAND WITH GRAVEL

VISUAL DESCRIPTION: Dark Gray / Black Ash

page 1 of 4 DCN: CT-S3A DATE: 3/18/13 REVISION: 11

USDA CLASSIFICATION CHART

Client:	AECOM	Boring No.:	B-18
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	21.0-22.5
Project No.:	2015-485-003	Sample No.:	SS-9
Lab ID:	2015-485-003-010	Soil Color:	Dark Gray / Black



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
		Gravel	26.62	**0.00**
2	73.38	*Sand*	41.10	**56.01**
0.05	32.28	*Silt*	28.37	**38.66**
0.002	3.92	*Clay*	3.92	**5.34**

USDA Classification: ***SANDY LOAM***

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-18
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	21.0-22.5
Project No.:	2015-485-003	Sample No.:	SS-9
Lab ID:	2015-485-003-010	Soil Color:	Dark Gray / Black

Moisture Content of Passing 3/4" Materia		Water Content of Retained 3/4" Material	
Tare No.	67	Tare No.	NA
Weight of Tare & Wet Sample (g)	631.30	Weight of Tare & Wet Sample (g)	NA
Weight of Tare & Dry Sample (g)	554.90	Weight of Tare & Dry Sample (g)	NA
Weight of Tare (g)	199.80	Weight of Tare (g)	NA
Weight of Water (g)	76.40	Weight of Water (g)	NA
Weight of Dry Sample (g)	355.10	Weight of Dry Sample (g)	NA
Moisture Content (%	**21.5**	**Moisture Content (%**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Sample (g)	355.10
Dry Weight of -3/4" Sample (g)	209.60	Weight of - #200 Material (g)	133.75
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 Material (g)	221.35
Dry Weight of +3/4" Sample (g)	11.75		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	11.75	3.31	3.31		96.69	**96.69**
3/4"	19.0	0.00	0.00	3.31		96.69	**96.69**
1/2"	12.5	8.04	2.26	5.57		94.43	**94.43**
3/8"	9.50	12.11	3.41	8.98		91.02	**91.02**
#4	4.75	26.59	7.49	16.47		83.53	**83.53**
#10	2.00	36.04	10.15	26.62		73.38	**73.38**
#20	0.85	34.59	9.74	36.36		63.64	**63.64**
#40	0.425	28.46	8.01	44.38		55.62	**55.62**
#60	0.250	19.91	5.61	49.98		50.02	**50.02**
#140	0.106	29.74	8.38	58.36		41.64	**41.64**
#200	0.075	14.12	3.98	62.33		37.67	**37.67**
Pan	-	133.75	37.67	100.00		-	-

Tested By RAL Date 10/7/15 Checked By KC Date 10/12/15

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-18
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	21.0-22.5
Project No.:	2015-485-003	Sample No.:	SS-9
Lab ID:	2015-485-003-010	Soil Color:	Dark Gray / Black

Elapsed Time		R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)			(°C)			(%)		(mm)	(%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		28.0	22.9	6.04	22.0	69.3	0.01299	0.0314	**26.1**
5		23.5	22.9	6.04	17.5	55.1	0.01299	0.0205	**20.8**
15		19.5	22.9	6.04	13.5	42.5	0.01299	0.0121	**16.0**
30		16.5	22.9	6.04	10.5	33.0	0.01299	0.0087	**12.4**
60		13.5	22.6	6.15	7.4	23.2	0.01303	0.0063	**8.7**
250		10.0	22.5	6.18	3.8	12.1	0.01305	0.0032	**4.5**
1440		9.0	22.5	6.18	2.8	8.9	0.01305	0.0013	**3.4**

Soil Specimen Data		Other Corrections		
Tare No.	967			
Weight of Tare & Dry Material (g)	136.73	a - Factor	0.99	
Weight of Tare (g)	100.37			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	37.67	
Weight of Dry Material (g)	31.4			
		Specific Gravity	2.7	Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 10/7/15 Checked By KC Date 10/12/15

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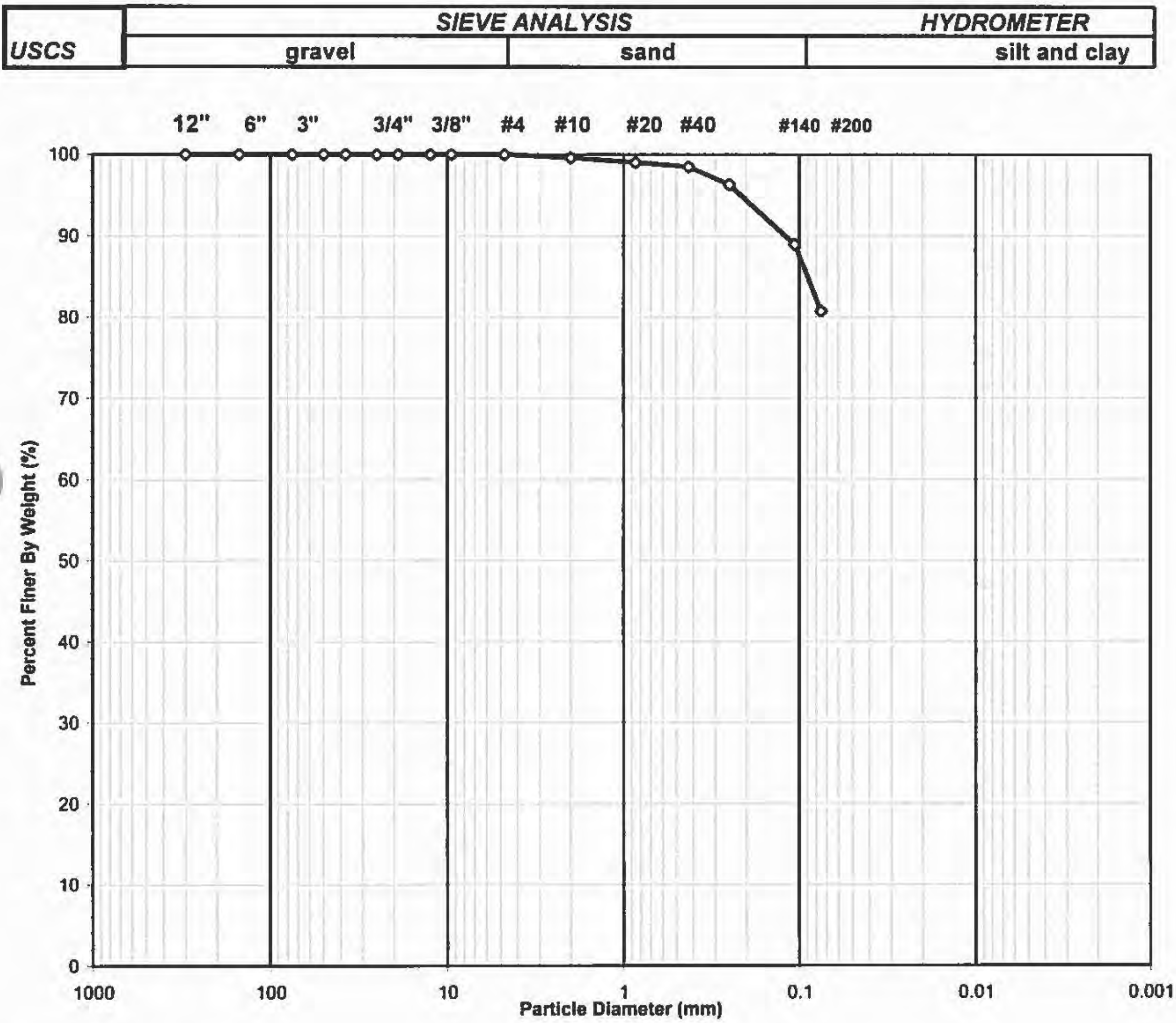
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-18
Client Reference:	Dynegy-Wood River Pwr. Sta. 60440115	Depth (ft):	31.0-32.5
Project No.:	2015-485-003	Sample No.:	SS-13
Lab ID:	2015-485-003-011	Soil Color:	Brown



USCS Symbol:

cl, ASSUMED

USCS Classification:

LEAN CLAY WITH SAND

Tested By PC Date 10/2/15 Checked By KC Date 10/2/15

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-18
Client Reference:	Dynegy-Wood River Pwr. Sta. 60440115	Depth (ft):	31.0-32.5
Project No.:	2015-485-003	Sample No.:	SS-13
Lab ID:	2015-485-003-011	Soil Color:	Brown

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	26	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	682.30	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	581.40	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	200.68	Weight of Tare (g):	NA
Weight of Water (g):	100.90	Weight of Water (g):	NA
Weight of Dry Sample (g):	380.72	Weight of Dry Sample (g):	NA
Moisture Content (%):	**26.5**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	380.72
Dry Weight of - 3/4" Sample (g):	73.3	Weight of - #200 Material (g):	307.45
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	73.27
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	1.66	0.44	0.44	99.56	**99.56**
#20	0.850	2.15	0.56	1.00	99.00	**99.00**
#40	0.425	2.10	0.55	1.55	98.45	**98.45**
#60	0.250	8.26	2.17	3.72	96.28	**96.28**
#140	0.106	27.98	7.35	11.07	88.93	**88.93**
#200	0.075	31.12	8.17	19.25	80.75	**80.75**
Pan	-	307.45	80.75	100.00	-	-

Tested By PC Date 10/2/15 Checked By KC Date 10/2/15

SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-18
Client Reference:	Dynegy-Wood River Pwr. Sta. 60440115	Depth (ft):	38.5-40.0
Project No.:	2015-485-003	Sample No.:	SS-16
Lab ID:	2015-485-003-012	Soil Color:	Brownish Gray

USCS Symbol:
sm, ASSUMED

USCS Classification:
SILTY SAND

Tested By	PC	Date	10/2/15	Checked By	KC	Date	10/2/15

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-18
Client Reference:	Dynegy-Wood River Pwr. Sta. 60440115	Depth (ft):	38.5-40.0
Project No.:	2015-485-003	Sample No.:	SS-16
Lab ID:	2015-485-003-012	Soil Color:	Brownish Gray

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	20	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	634.70	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	532.28	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	204.50	Weight of Tare (g):	NA
Weight of Water (g):	102.42	Weight of Water (g):	NA
Weight of Dry Sample (g):	327.78	Weight of Dry Sample (g):	NA
Moisture Content (%):	**31.2**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	327.78
Dry Weight of - 3/4" Sample (g):	271.1	Weight of - #200 Material (g):	56.72
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	271.06
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	1.02	0.31	0.31	99.69	**99.69**
#20	0.850	1.44	0.44	0.75	99.25	**99.25**
#40	0.425	3.09	0.94	1.69	98.31	**98.31**
#60	0.250	105.15	32.08	33.77	66.23	**66.23**
#140	0.106	152.64	46.57	80.34	19.66	**19.66**
#200	0.075	7.72	2.36	82.70	17.30	**17.30**
Pan	-	56.72	17.30	100.00	-	-

Tested By	PC	Date	10/2/15	Checked By	KC	Date	10/2/15

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-18
Client Reference:	Dynegy-Wood River Pwr. Sta. 60440115	Depth (ft):	56.0-57.5
Project No.:	2015-485-003	Sample No.:	SS-23
Lab ID:	2015-485-003-013	Soil Color:	Brown

USCS Symbol:
sp-sm, ASSUMED

USCS Classification:
POORLY GRADED SAND WITH SILT

D60 =	**0.25**	**CC =**	**0.84**
D30 =	**0.15**	**CU =**	**2.35**
D10 =	**0.11**		

Tested By PC Date 10/2/15 Checked By KC Date 10/2/15

page 1 of 2 **DCN: CT-S3C DATE 3/20/13 REVISION: 3**

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-18
Client Reference:	Dynegy-Wood River Pwr. Sta. 60440115	Depth (ft):	56.0-57.5
Project No.:	2015-485-003	Sample No.:	SS-23
Lab ID:	2015-485-003-013	Soil Color:	Brown

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	10	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	515.70	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	449.00	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	202.37	Weight of Tare (g):	NA
Weight of Water (g):	66.70	Weight of Water (g):	NA
Weight of Dry Sample (g):	246.63	Weight of Dry Sample (g):	NA
Moisture Content (%):	**27.0**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	246.63
Dry Weight of - 3/4" Sample (g):	231.6	Weight of - #200 Material (g):	15.05
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	231.58
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.40	0.16	0.16	99.84	**99.84**
#10	2.00	0.37	0.15	0.31	99.69	**99.69**
#20	0.850	1.49	0.60	0.92	99.08	**99.08**
#40	0.425	9.52	3.86	4.78	95.22	**95.22**
#60	0.250	88.41	35.85	40.62	59.38	**59.38**
#140	0.106	123.76	50.18	90.80	9.20	**9.20**
#200	0.075	7.63	3.09	93.90	6.10	**6.10**
Pan	-	15.05	6.10	100.00	-	-

Tested By PC Date 10/2/15 Checked By KC Date 10/2/15

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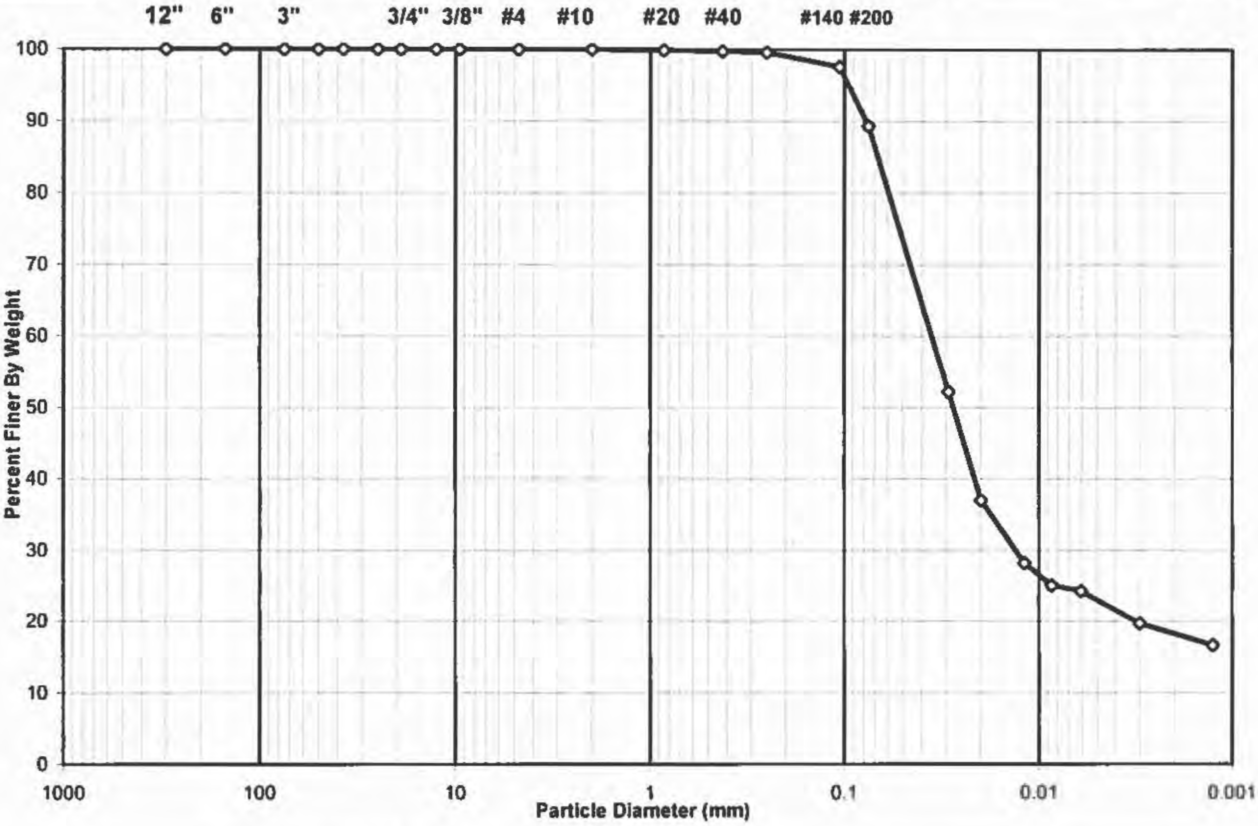
SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	3.0-5.5
Project No.:	2015-485-003	Sample No.:	SS-2
Lab ID:	2015-485-003-014	Soil Color:	Brown

	SIEVE ANALYSIS			*HYDROMETER*	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	10.64
Finer Than #200	*Silt & Clay*	89.36

USCS Symbol:

cl, ASSUMED

USCS Classification:

LEAN CLAY

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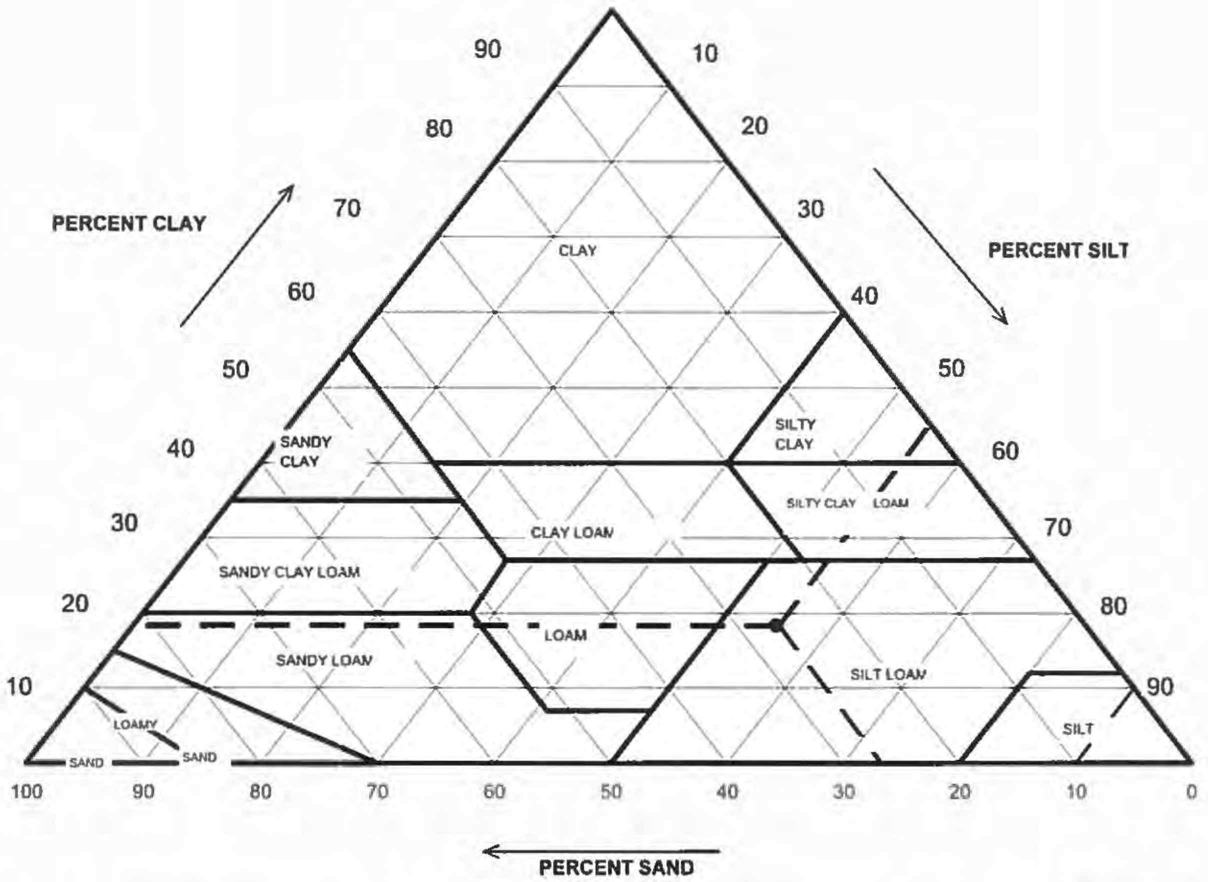
USDA CLASSIFICATION CHART

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	3.0-5.5
Project No.:	2015-485-003	Sample No.:	SS-2
Lab ID:	2015-485-003-014	Soil Color:	Brown



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
		Gravel	0.02	**0.00**
2	99.98	*Sand*	26.59	**26.60**
0.05	73.39	*Silt*	55.08	**55.09**
0.002	18.31	*Clay*	18.31	**18.31**

USDA Classification: ***SILT LOAM***

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	3.0-5.5
Project No.:	2015-485-003	Sample No.:	SS-2
Lab ID:	2015-485-003-014	Soil Color:	Brown

Moisture Content of Passing 3/4" Materia		Water Content of Retained 3/4" Material	
Tare No.	15	Tare No.	NA
Weight of Tare & Wet Sample (g)	552.50	Weight of Tare & Wet Sample (g)	NA
Weight of Tare & Dry Sample (g)	495.90	Weight of Tare & Dry Sample (g)	NA
Weight of Tare (g)	201.42	Weight of Tare (g)	NA
Weight of Water (g)	56.60	Weight of Water (g)	NA
Weight of Dry Sample (g)	294.48	Weight of Dry Sample (g)	NA
Moisture Content (%	**19.2**	**Moisture Content (%**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Sample (g)	294.48
Dry Weight of -3/4" Sample (g)	31.34	Weight of - #200 Material (g)	263.14
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 Material (g)	31.34
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00		100.00	**100.00**
#4	4.75	0.00	0.00	0.00		100.00	**100.00**
#10	2.00	0.05	0.02	0.02		99.98	**99.98**
#20	0.85	0.22	0.07	0.09		99.91	**99.91**
#40	0.425	0.43	0.15	0.24		99.76	**99.76**
#60	0.250	0.50	0.17	0.41		99.59	**99.59**
#140	0.106	5.85	1.99	2.39		97.61	**97.61**
#200	0.075	24.29	8.25	10.64		89.36	**89.36**
Pan	-	263.14	89.36	100.00		-	-

Tested By PC Date 10/2/15 Checked By KC Date 10/12/15

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	3.0-5.5
Project No.:	2015-485-003	Sample No.:	SS-2
Lab ID:	2015-485-003-014	Soil Color:	Brown

Elapsed Time		R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)			(°C)			(%)		(mm)	(%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		39.0	22.1	6.33	32.7	58.4	0.01311	0.0292	**52.2**
5		29.5	22.1	6.33	23.2	41.4	0.01311	0.0198	**37.0**
15		24.0	22.1	6.33	17.7	31.6	0.01311	0.0119	**28.2**
30		22.0	22.1	6.33	15.7	28.0	0.01311	0.0085	**25.0**
60		21.5	22.1	6.33	15.2	27.1	0.01311	0.0060	**24.2**
250		18.5	22.6	6.15	12.4	22.1	0.01303	0.0030	**19.7**
1440		16.5	22.9	6.04	10.5	18.7	0.01299	0.0013	**16.7**

Soil Specimen Data		Other Corrections		
Tare No.	695			
Weight of Tare & Dry Material (g)	152.89	a - Factor	0.99	
Weight of Tare (g)	92.49			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	89.36	
Weight of Dry Material (g)	55.4			
		Specific Gravity	2.7	Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 10/6/15 Checked By KC Date 10/12/15

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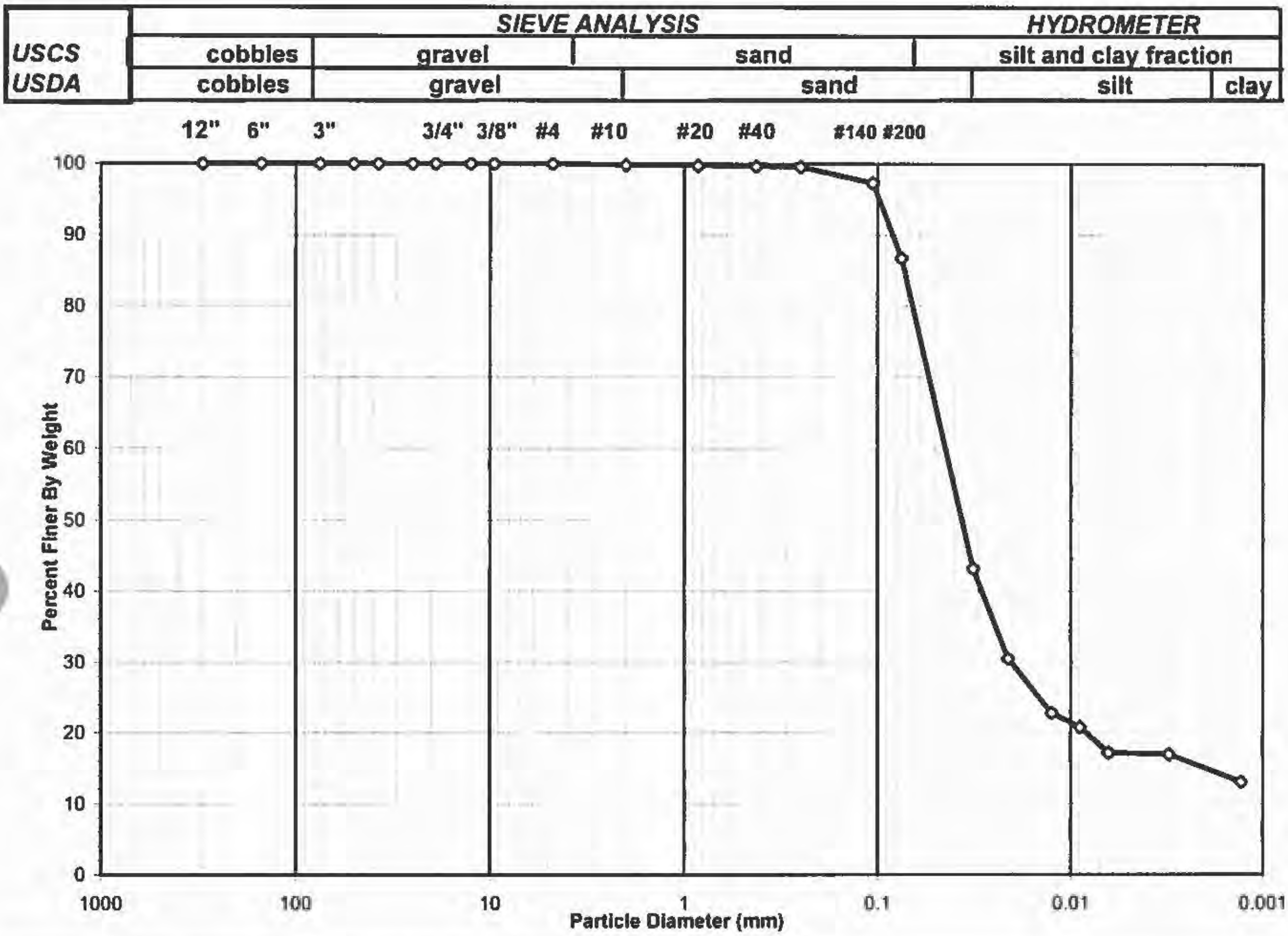
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	8.5-10.0
Project No.:	2015-485-003	Sample No.:	SS-4
Lab ID:	2015-485-003-015	Soil Color:	Brown



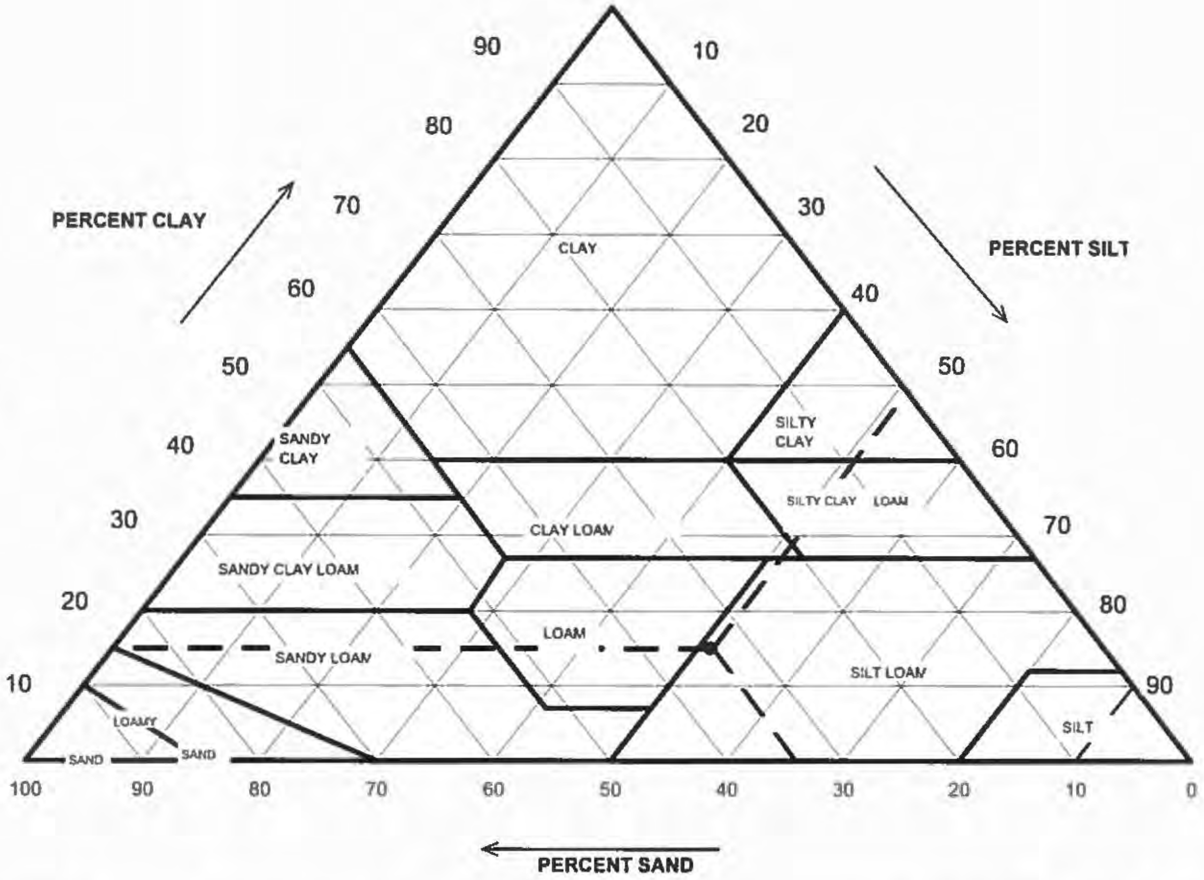
Sieve Sizes (mm)	USCS Summary	Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	13.28
Finer Than #200	*Silt & Clay*	86.72

USCS Symbol:
ml, ASSUMED

USCS Classification:
SILT

USDA CLASSIFICATION CHART

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	8.5-10.0
Project No.:	2015-485-003	Sample No.:	SS-4
Lab ID:	2015-485-003-015	Soil Color:	Brown



Particle Size	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
(mm)	(%)		(%)	(%)
		Gravel	0.16	**0.00**
2	99.84	*Sand*	33.85	**33.91**
0.05	65.99	*Silt*	51.00	**51.08**
0.002	14.99	*Clay*	14.99	**15.01**

USDA Classification: ***SILT LOAM***

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	8.5-10.0
Project No.:	2015-485-003	Sample No.:	SS-4
Lab ID:	2015-485-003-015	Soil Color:	Brown

Moisture Content of Passing 3/4" Materia		Water Content of Retained 3/4" Material	
Tare No.	64	Tare No.	NA
Weight of Tare & Wet Sample (g)	474.40	Weight of Tare & Wet Sample (g)	NA
Weight of Tare & Dry Sample (g)	424.30	Weight of Tare & Dry Sample (g)	NA
Weight of Tare (g)	200.72	Weight of Tare (g)	NA
Weight of Water (g)	50.10	Weight of Water (g)	NA
Weight of Dry Sample (g)	223.58	Weight of Dry Sample (g)	NA
Moisture Content (%	**22.4**	**Moisture Content (%**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Sample (g)	223.58
Dry Weight of -3/4" Sample (g)	29.69	Weight of - #200 Material (g)	193.89
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 Material (g)	29.69
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00		100.00	**100.00**
#4	4.75	0.00	0.00	0.00		100.00	**100.00**
#10	2.00	0.36	0.16	0.16		99.84	**99.84**
#20	0.85	0.14	0.06	0.22		99.78	**99.78**
#40	0.425	0.22	0.10	0.32		99.68	**99.68**
#60	0.250	0.25	0.11	0.43		99.57	**99.57**
#140	0.106	5.00	2.24	2.67		97.33	**97.33**
#200	0.075	23.72	10.61	13.28		86.72	**86.72**
Pan	-	193.89	86.72	100.00		-	-

Tested By	PC	Date	10/2/15	Checked By	KC	Date	10/14/15

geotechnics
geotechnical & geosynthetic testing

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	8.5-10.0
Project No.:	2015-485-003	Sample No.:	SS-4
Lab ID:	2015-485-003-015	Soil Color:	Brown

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		29.0	20.7	6.83	22.2	49.8	0.01333	0.0320	**43.2**
5		22.5	20.7	6.83	15.7	35.2	0.01333	0.0212	**30.5**
15		18.5	20.7	6.83	11.7	26.2	0.01333	0.0125	**22.7**
30		17.5	20.7	6.83	10.7	24.0	0.01333	0.0089	**20.8**
60		15.5	21.1	6.68	8.8	19.8	0.01327	0.0064	**17.2**
250		15.0	22.1	6.33	8.7	19.5	0.01311	0.0031	**16.9**
1440		13.0	22.2	6.29	6.7	15.1	0.01310	0.0013	**13.1**

Soil Specimen Data		Other Corrections		
Tare No.	694			
Weight of Tare & Dry Material (g)	143.19	a - Factor	0.99	
Weight of Tare (g)	94.13			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	86.72	
Weight of Dry Material (g)	44.1			
		Specific Gravity	2.7	Assumed

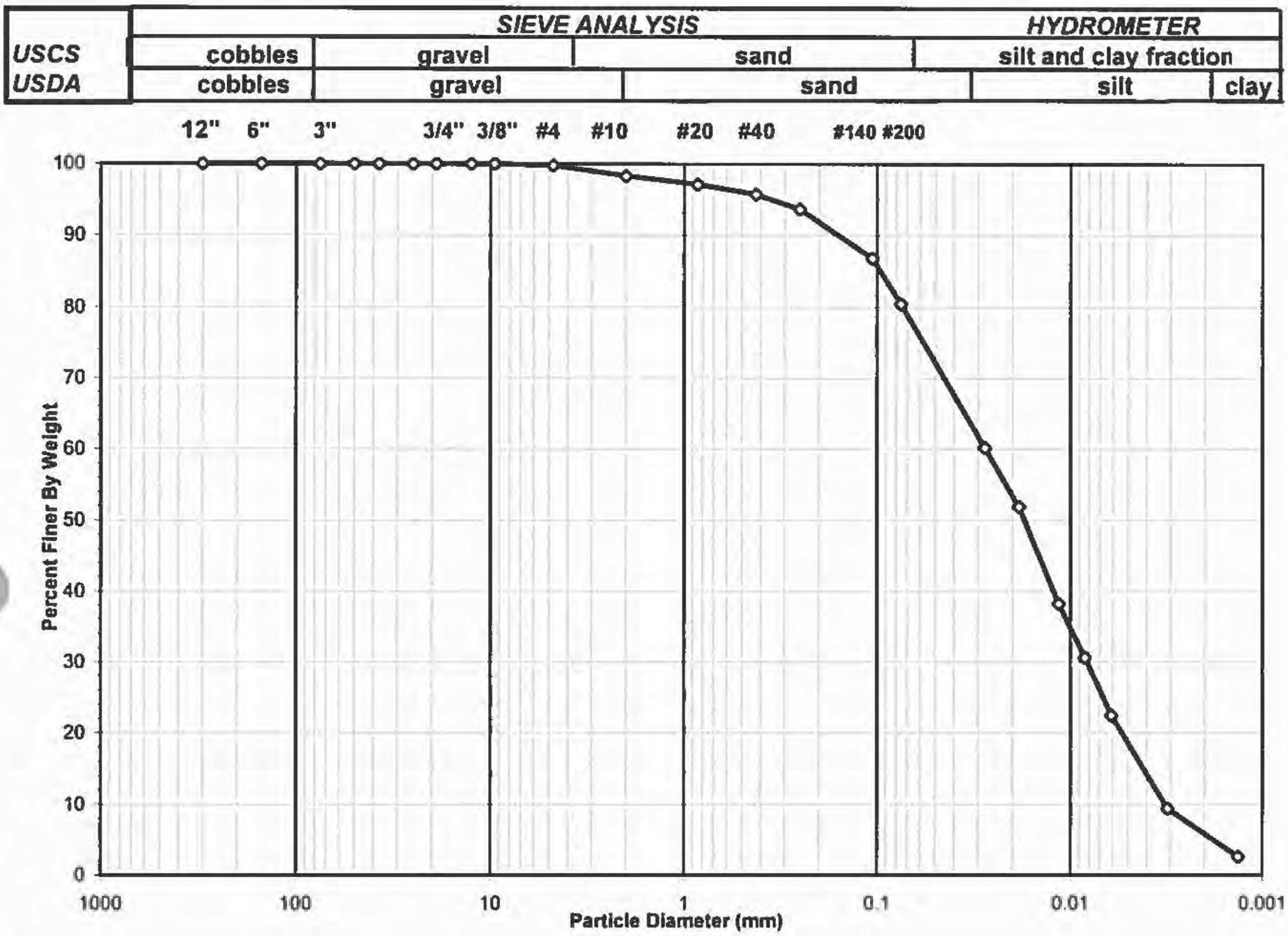
Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 10/12/15 Checked By KC Date 10/14/15

SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	18.5-20.0
Project No.:	2015-485-003	Sample No.:	SS-6
Lab ID:	2015-485-003-016	Soil Color:	Gray



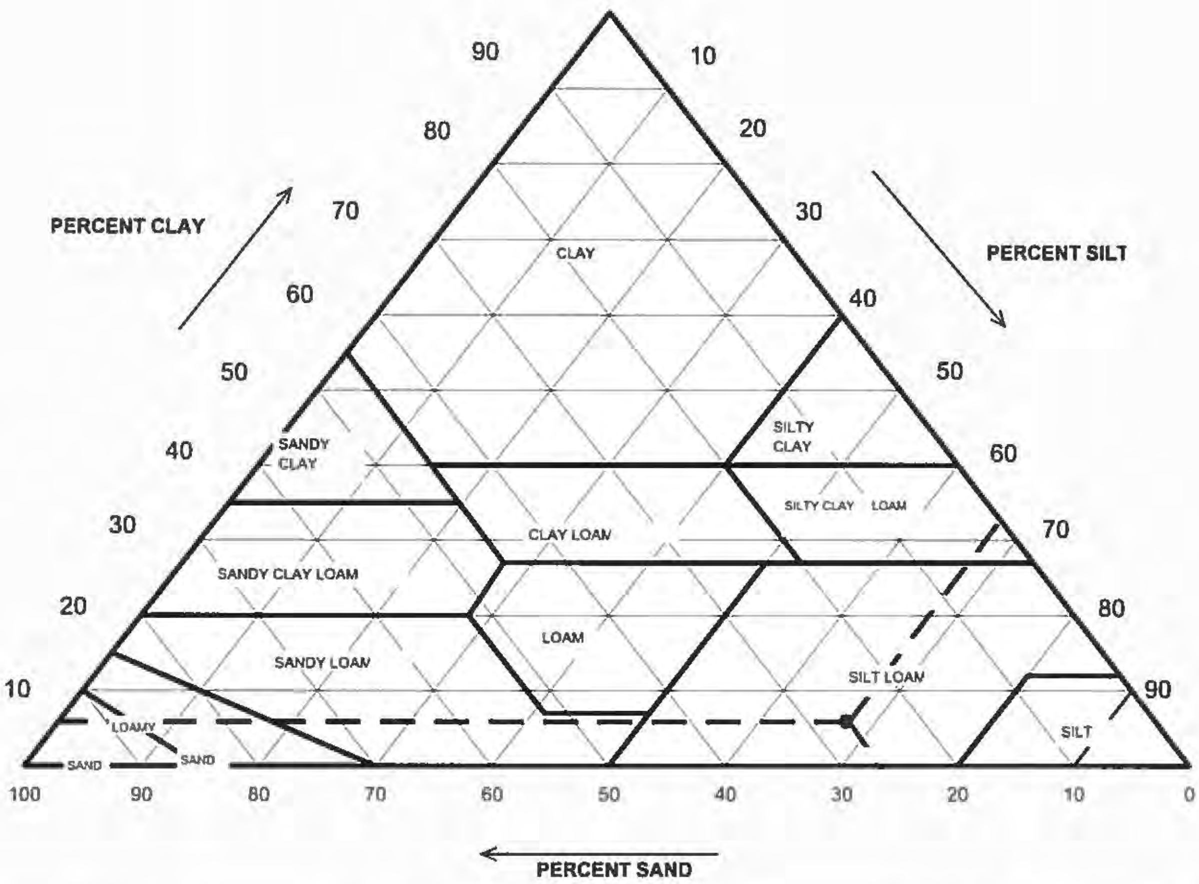
USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.26
#4 To #200	*Sand*	19.31
Finer Than #200	*Silt & Clay*	80.43

USCS Symbol:
ml, ASSUMED

USCS Classification:
SILT WITH SAND

USDA CLASSIFICATION CHART

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	18.5-20.0
Project No.:	2015-485-003	Sample No.:	SS-6
Lab ID:	2015-485-003-016	Soil Color:	Gray



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
		Gravel	1.70	**0.00**
2	98.30	*Sand*	26.14	**26.59**
0.05	72.16	*Silt*	66.36	**67.51**
0.002	5.80	*Clay*	5.80	**5.90**

USDA Classification: ***SILT LOAM***

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	18.5-20.0
Project No.:	2015-485-003	Sample No.:	SS-6
Lab ID:	2015-485-003-016	Soil Color:	Gray

Moisture Content of Passing 3/4" Materia		Water Content of Retained 3/4" Material	
Tare No.	31	Tare No.	NA
Weight of Tare & Wet Sample (g)	575.10	Weight of Tare & Wet Sample (g)	NA
Weight of Tare & Dry Sample (g)	464.50	Weight of Tare & Dry Sample (g)	NA
Weight of Tare (g)	203.34	Weight of Tare (g)	NA
Weight of Water (g)	110.60	Weight of Water (g)	NA
Weight of Dry Sample (g)	261.16	Weight of Dry Sample (g)	NA
Moisture Content (%	**42.3**	**Moisture Content (%**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Sample (g)	261.16
Dry Weight of -3/4" Sample (g)	51.10	Weight of - #200 Material (g)	210.06
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 Material (g)	51.10
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00		100.00	**100.00**
#4	4.75	0.67	0.26	0.26		99.74	**99.74**
#10	2.00	3.77	1.44	1.70		98.30	**98.30**
#20	0.85	3.18	1.22	2.92		97.08	**97.08**
#40	0.425	3.60	1.38	4.30		95.70	**95.70**
#60	0.250	5.43	2.08	6.38		93.62	**93.62**
#140	0.106	18.04	6.91	13.28		86.72	**86.72**
#200	0.075	16.41	6.28	19.57		80.43	**80.43**
Pan	-	210.06	80.43	100.00		-	-

Tested By PC Date 10/2/15 Checked By KC Date 10/14/15

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	18.5-20.0
Project No.:	2015-485-003	Sample No.:	SS-6
Lab ID:	2015-485-003-016	Soil Color:	Gray

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		46.5	20.7	6.83	39.7	74.8	0.01333	0.0278	**60.2**
5		41.0	20.7	6.83	34.2	64.4	0.01333	0.0184	**51.8**
15		32.0	20.7	6.83	25.2	47.5	0.01333	0.0114	**38.2**
30		27.0	20.7	6.83	20.2	38.0	0.01333	0.0084	**30.6**
60		21.5	21.1	6.68	14.8	27.9	0.01327	0.0061	**22.5**
250		12.5	22.1	6.33	6.2	11.6	0.01311	0.0031	**9.4**
1440		8.0	22.2	6.29	1.7	3.2	0.01310	0.0013	**2.6**

Soil Specimen Data		**Other Corrections**		
Tare No.	706			
Weight of Tare & Dry Material (g)	156.57	a - Factor	0.99	
Weight of Tare (g)	99.06			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	80.43	
Weight of Dry Material (g)	52.5			
		Specific Gravity	2.7	Assumed

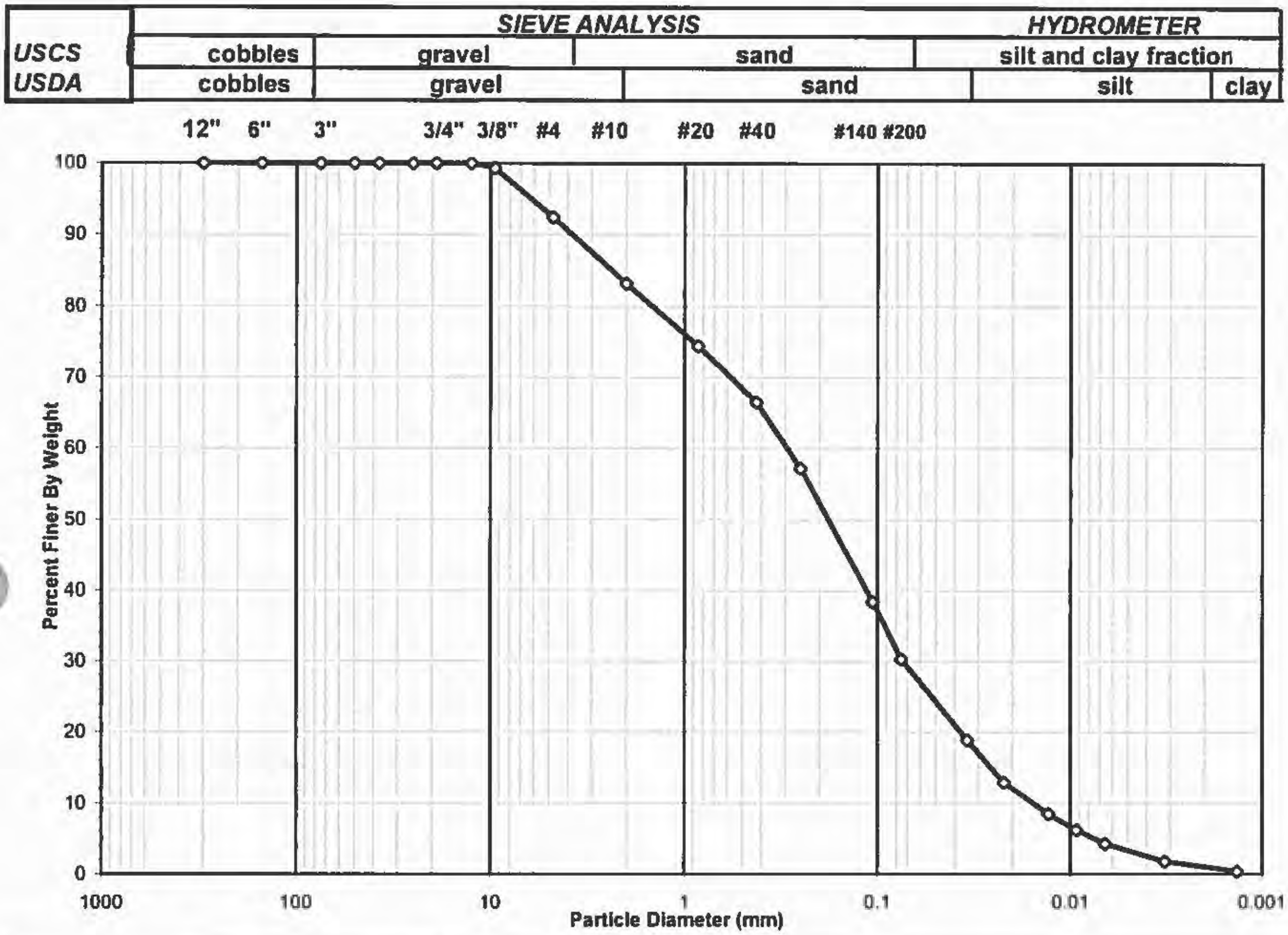
Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 10/12/15 Checked By KC Date 10/14/15

SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	23.5-25.0
Project No.:	2015-485-003	Sample No.:	SS-8
Lab ID:	2015-485-003-017	Soil Color:	Gray



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	7.52
#4 To #200	*Sand*	62.20
Finer Than #200	*Silt & Clay*	30.27

USCS Symbol:

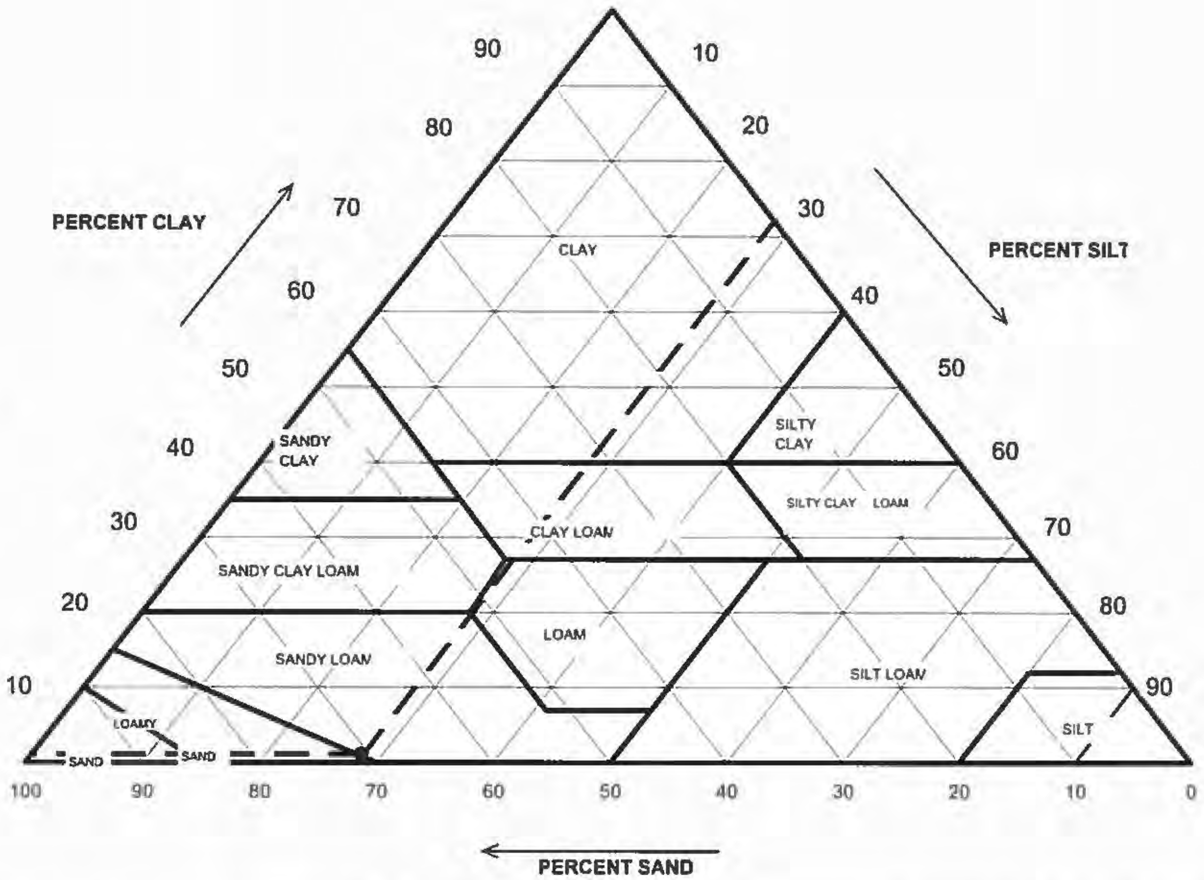
sm, ASSUMED

USCS Classification:

SILTY SAND

USDA CLASSIFICATION CHART

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	23.5-25.0
Project No.:	2015-485-003	Sample No.:	SS-8
Lab ID:	2015-485-003-017	Soil Color:	Gray



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat (%)
		Gravel	16.83	**0.00**
2	83.17	*Sand*	58.81	**70.71**
0.05	24.36	*Silt*	23.40	**28.14**
0.002	0.96	*Clay*	0.96	**1.16**

USDA Classification: *SANDY LOAM*

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	23.5-25.0
Project No.:	2015-485-003	Sample No.:	SS-8
Lab ID:	2015-485-003-017	Soil Color:	Gray

Moisture Content of Passing 3/4" Materia		Water Content of Retained 3/4" Material	
Tare No.	1422	Tare No.	NA
Weight of Tare & Wet Sample (g)	411.90	Weight of Tare & Wet Sample (g)	NA
Weight of Tare & Dry Sample (g)	334.10	Weight of Tare & Dry Sample (g)	NA
Weight of Tare (g)	144.98	Weight of Tare (g)	NA
Weight of Water (g)	77.80	Weight of Water (g)	NA
Weight of Dry Sample (g)	189.12	Weight of Dry Sample (g)	NA
Moisture Content (%	**41.1**	**Moisture Content (%**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Sample (g)	189.12
Dry Weight of -3/4" Sample (g)	131.87	Weight of - #200 Material (g)	57.25
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 Material (g)	131.87
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	1.29	0.68	0.68		99.32	**99.32**
#4	4.75	12.94	6.84	7.52		92.48	**92.48**
#10	2.00	17.60	9.31	16.83		83.17	**83.17**
#20	0.85	16.69	8.83	25.66		74.34	**74.34**
#40	0.425	14.82	7.84	33.49		66.51	**66.51**
#60	0.250	17.66	9.34	42.83		57.17	**57.17**
#140	0.106	35.67	18.86	61.69		38.31	**38.31**
#200	0.075	15.20	8.04	69.73		30.27	**30.27**
Pan	-	57.25	30.27	100.00		-	-

Tested By	PC	Date	10/2/15	Checked By	KC	Date	10/14/15

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	23.5-25.0
Project No.:	2015-485-003	Sample No.:	SS-8
Lab ID:	2015-485-003-017	Soil Color:	Gray

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		19.5	20.7	6.83	12.7	62.1	0.01333	0.0341	**18.8**
5		15.5	20.7	6.83	8.7	42.5	0.01333	0.0221	**12.9**
15		12.5	20.7	6.83	5.7	27.8	0.01333	0.0130	**8.4**
30		11.0	20.7	6.83	4.2	20.4	0.01333	0.0093	**6.2**
60		9.5	21.1	6.68	2.8	13.8	0.01327	0.0066	**4.2**
250		7.5	22.1	6.33	1.2	5.8	0.01311	0.0032	**1.7**
1440		6.5	22.2	6.29	0.2	1.0	0.01310	0.0013	**0.3**

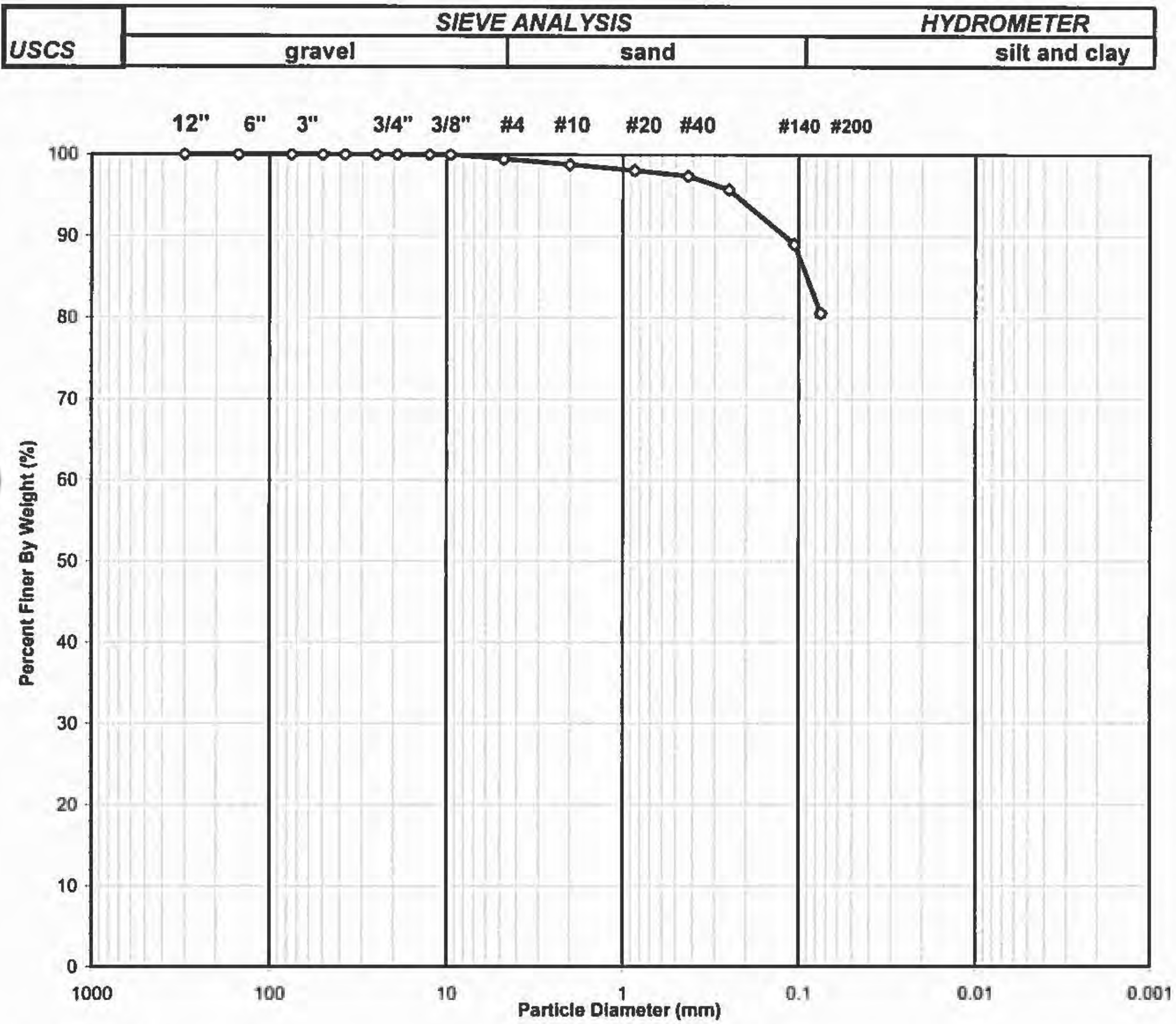
Soil Specimen Data		Other Corrections		
Tare No.	927			
Weight of Tare & Dry Material (g)	123.05	a - Factor	0.99	
Weight of Tare (g)	97.84			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	30.27	
Weight of Dry Material (g)	20.2			
		Specific Gravity	2.7	Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 10/12/15 Checked By KC Date 10/14/15

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy-Wood River Pwr. Sta. 60440115	Depth (ft):	31.0-32.5
Project No.:	2015-485-003	Sample No.:	SS-11
Lab ID:	2015-485-003-018	Soil Color:	Gray



USCS Symbol:
ml, ASSUMED

USCS Classification:
SILT WITH SAND

Tested By PC Date 10/2/15 Checked By KC Date 10/2/15

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy-Wood River Pwr. Sta. 60440115	Depth (ft):	31.0-32.5
Project No.:	2015-485-003	Sample No.:	SS-11
Lab ID:	2015-485-003-018	Soil Color:	Gray

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	1426	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	429.80	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	329.66	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	145.17	Weight of Tare (g):	NA
Weight of Water (g):	100.14	Weight of Water (g):	NA
Weight of Dry Sample (g):	184.49	Weight of Dry Sample (g):	NA
Moisture Content (%):	**54.3**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	184.49
Dry Weight of - 3/4" Sample (g):	35.9	Weight of - #200 Material (g):	148.63
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	35.86
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	1.00	0.54	0.54	99.46	**99.46**
#10	2.00	1.31	0.71	1.25	98.75	**98.75**
#20	0.850	1.31	0.71	1.96	98.04	**98.04**
#40	0.425	1.24	0.67	2.63	97.37	**97.37**
#60	0.250	3.09	1.67	4.31	95.69	**95.69**
#140	0.106	12.35	6.69	11.00	89.00	**89.00**
#200	0.075	15.56	8.43	19.44	80.56	**80.56**
Pan	-	148.63	80.56	100.00	-	-

Tested By PC Date 10/2/15 Checked By KC Date 10/2/15

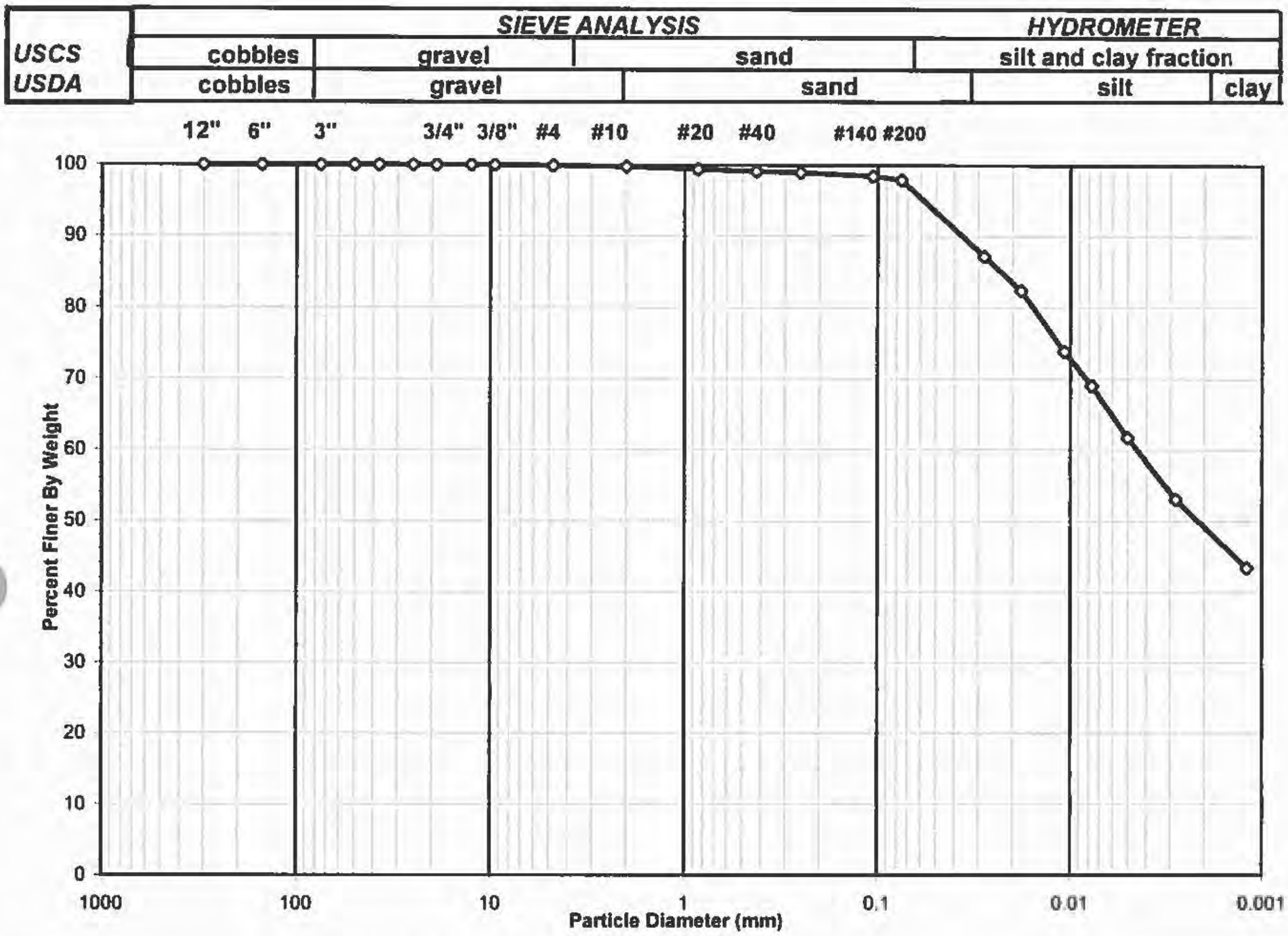
SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

geotechnics
geotechnical & geosynthetic testing

Client: AECOM
Client Reference: Dynegy - Wood River Pwr. Sta. 60440115
Project No.: 2015-485-002
Lab ID: 2015-485-002-005

Boring No.: B-20
Depth (ft): 43.8-44.3
Sample No.: ST-2
Soil Color: Gray



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.05
#4 To #200	*Sand*	2.01
Finer Than #200	*Silt & Clay*	97.95

USCS Symbol:

CH, TESTED

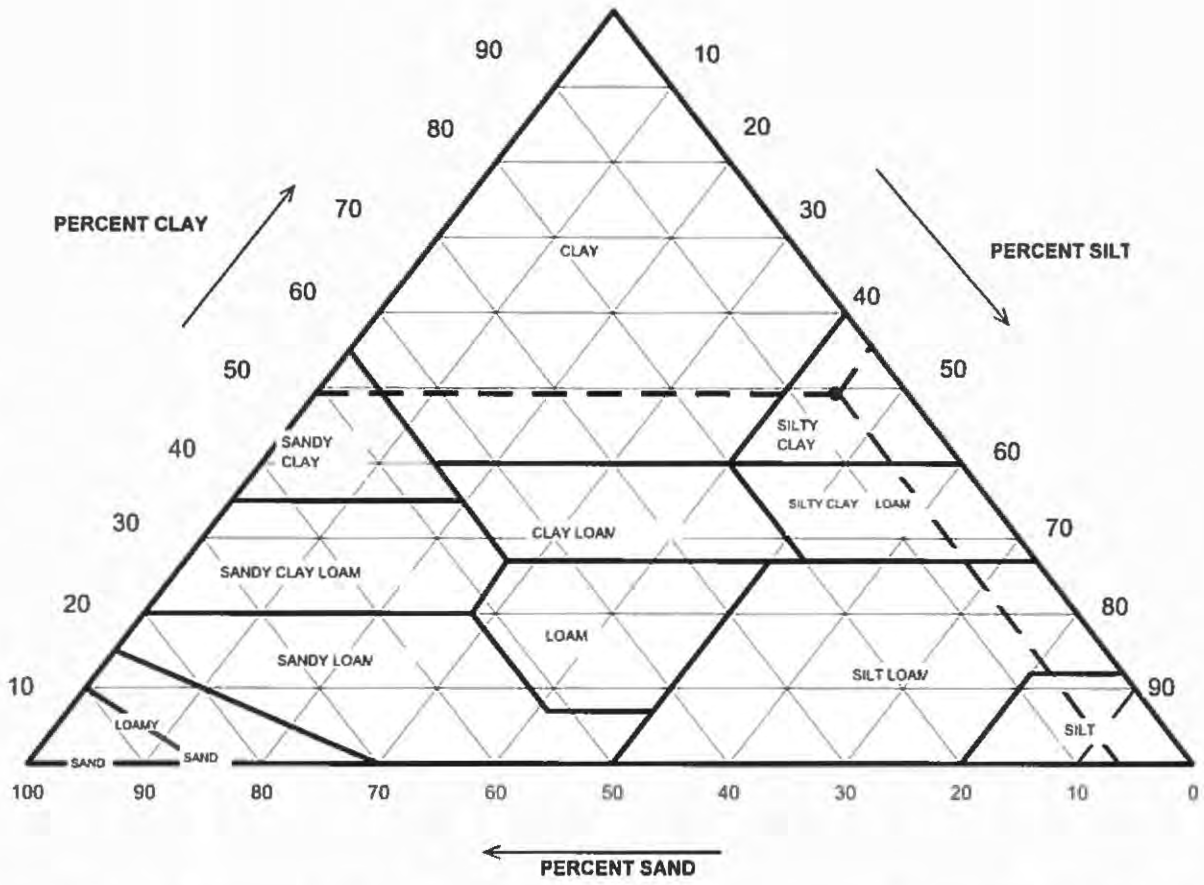
USCS Classification:

FAT CLAY

geotechnics
geotechnical & geosynthetic testing

USDA CLASSIFICATION CHART

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	43.8-44.3
Project No.:	2015-485-002	Sample No.:	ST-2
Lab ID:	2015-485-002-005	Soil Color:	Gray



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat (%)
		Gravel	0.28	**0.00**
2	99.72	*Sand*	6.21	**6.23**
0.05	93.50	*Silt*	44.41	**44.54**
0.002	49.09	*Clay*	49.09	**49.23**

USDA Classification: ***SILTY CLAY***

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	43.8-44.3
Project No.:	2015-485-002	Sample No.:	ST-2
Lab ID:	2015-485-002-005	Soil Color:	Gray

Moisture Content of Passing 3/4" Materia		Water Content of Retained 3/4" Material	
Tare No.	1440	Tare No.	NA
Weight of Tare & Wet Sample (g)	858.26	Weight of Tare & Wet Sample (g)	NA
Weight of Tare & Dry Sample (g)	649.90	Weight of Tare & Dry Sample (g)	NA
Weight of Tare (g)	145.70	Weight of Tare (g)	NA
Weight of Water (g)	208.36	Weight of Water (g)	NA
Weight of Dry Sample (g)	504.20	Weight of Dry Sample (g)	NA
Moisture Content (%	**41.3**	**Moisture Content (%**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Sample (g)	504.20
Dry Weight of -3/4" Sample (g)	10.36	Weight of - #200 Material (g)	493.84
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 Material (g)	10.36
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00		100.00	**100.00**
#4	4.75	0.24	0.05	0.05		99.95	**99.95**
#10	2.00	1.18	0.23	0.28		99.72	**99.72**
#20	0.85	1.48	0.29	0.58		99.42	**99.42**
#40	0.425	1.29	0.26	0.83		99.17	**99.17**
#60	0.250	1.17	0.23	1.06		98.94	**98.94**
#140	0.106	2.39	0.47	1.54		98.46	**98.46**
#200	0.075	2.61	0.52	2.05		97.95	**97.95**
Pan	-	493.84	97.95	100.00		-	-

Tested By AMC Date 9/30/15 Checked By KC Date 10/14/15

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	43.8-44.3
Project No.:	2015-485-002	Sample No.:	ST-2
Lab ID:	2015-485-002-005	Soil Color:	Gray

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		42.0	23.4	5.86	36.1	89.0	0.01291	0.0280	**87.2**
5		40.0	23.4	5.86	34.1	84.1	0.01291	0.0180	**82.3**
15		36.5	23.4	5.86	30.6	75.4	0.01291	0.0107	**73.9**
30		34.5	23.4	5.86	28.6	70.5	0.01291	0.0077	**69.1**
74		31.5	23.3	5.89	25.6	63.0	0.01293	0.0050	**61.7**
250		28.0	22.9	6.04	22.0	54.1	0.01299	0.0028	**53.0**
1440		24.0	22.9	6.04	18.0	44.2	0.01299	0.0012	**43.3**

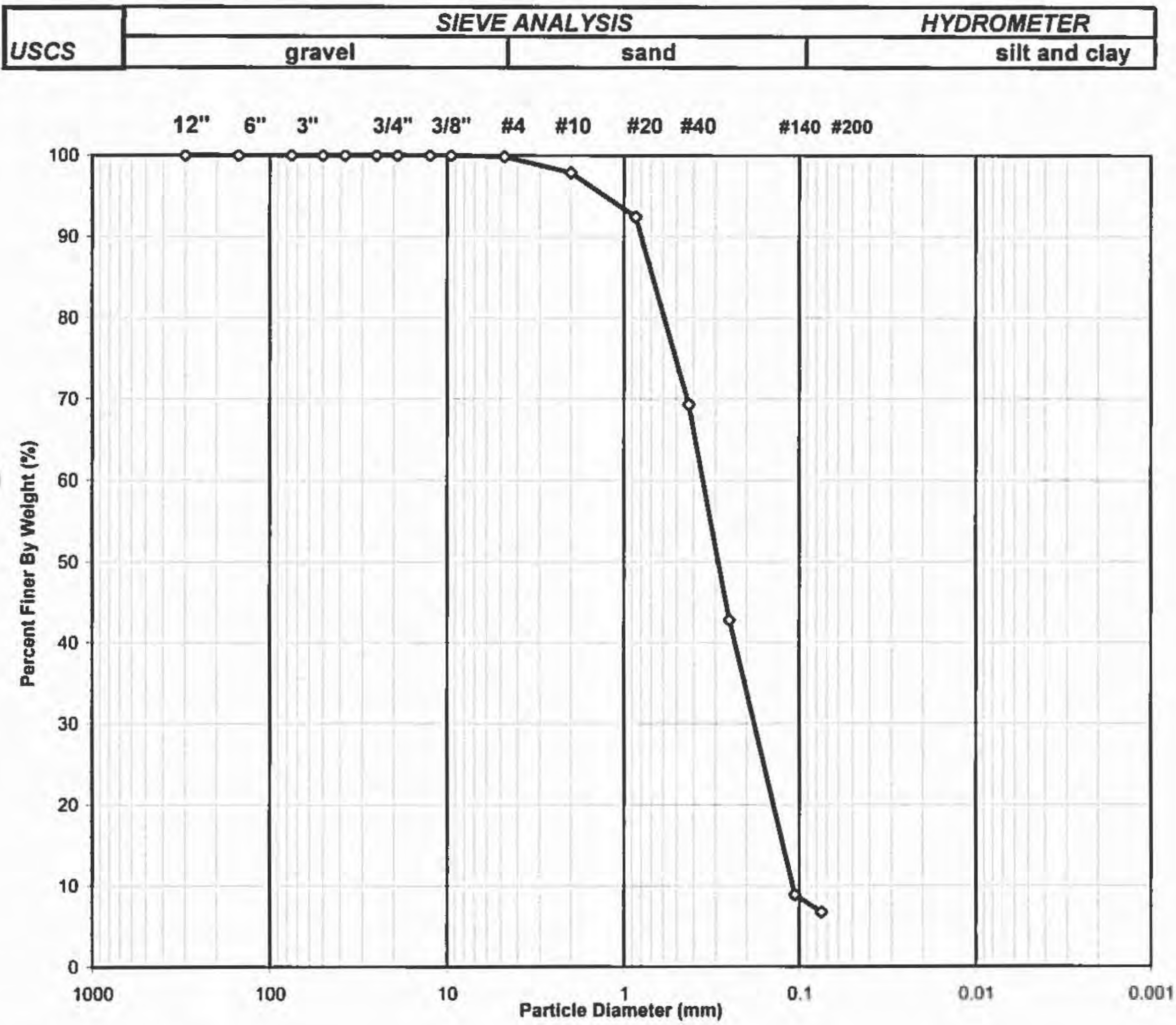
Soil Specimen Data		Other Corrections		
Tare No.	972			
Weight of Tare & Dry Material (g)	145.82	a - Factor	0.99	
Weight of Tare (g)	100.61			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	97.95	
Weight of Dry Material (g)	40.2			
		Specific Gravity	2.7	Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 9/30/15 Checked By KC Date 10/14/15

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy-Wood River Pwr. Sta. 60440115	Depth (ft):	48.5-50.0
Project No.:	2015-485-003	Sample No.:	SS-14
Lab ID:	2015-485-003-019	Soil Color:	Brown



USCS Symbol:
sp-sm, ASSUMED

USCS Classification:
POORLY GRADED SAND WITH SILT

D60 = **0.35** **CC =** **0.85**

D30 = **0.18** **CU =** **3.23**

D10 = **0.11**

Tested By PC Date 10/2/15 Checked By KC Date 10/2/15

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	B-20
Client Reference:	Dynegy-Wood River Pwr. Sta. 60440115	Depth (ft):	48.5-50.0
Project No.:	2015-485-003	Sample No.:	SS-14
Lab ID:	2015-485-003-019	Soil Color:	Brown

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	1450	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	472.00	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	416.60	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	145.02	Weight of Tare (g):	NA
Weight of Water (g):	55.40	Weight of Water (g):	NA
Weight of Dry Sample (g):	271.58	Weight of Dry Sample (g):	NA
Moisture Content (%):	**20.4**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	271.58
Dry Weight of - 3/4" Sample (g):	253.4	Weight of - #200 Material (g):	18.17
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	253.41
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.41	0.15	0.15	99.85	**99.85**
#10	2.00	5.50	2.03	2.18	97.82	**97.82**
#20	0.850	14.66	5.40	7.57	92.43	**92.43**
#40	0.425	62.81	23.13	30.70	69.30	**69.30**
#60	0.250	71.99	26.51	57.21	42.79	**42.79**
#140	0.106	92.19	33.95	91.16	8.84	**8.84**
#200	0.075	5.85	2.15	93.31	6.69	**6.69**
Pan	-	18.17	6.69	100.00	-	-

Tested By PC Date 10/2/15 Checked By KC Date 10/2/15

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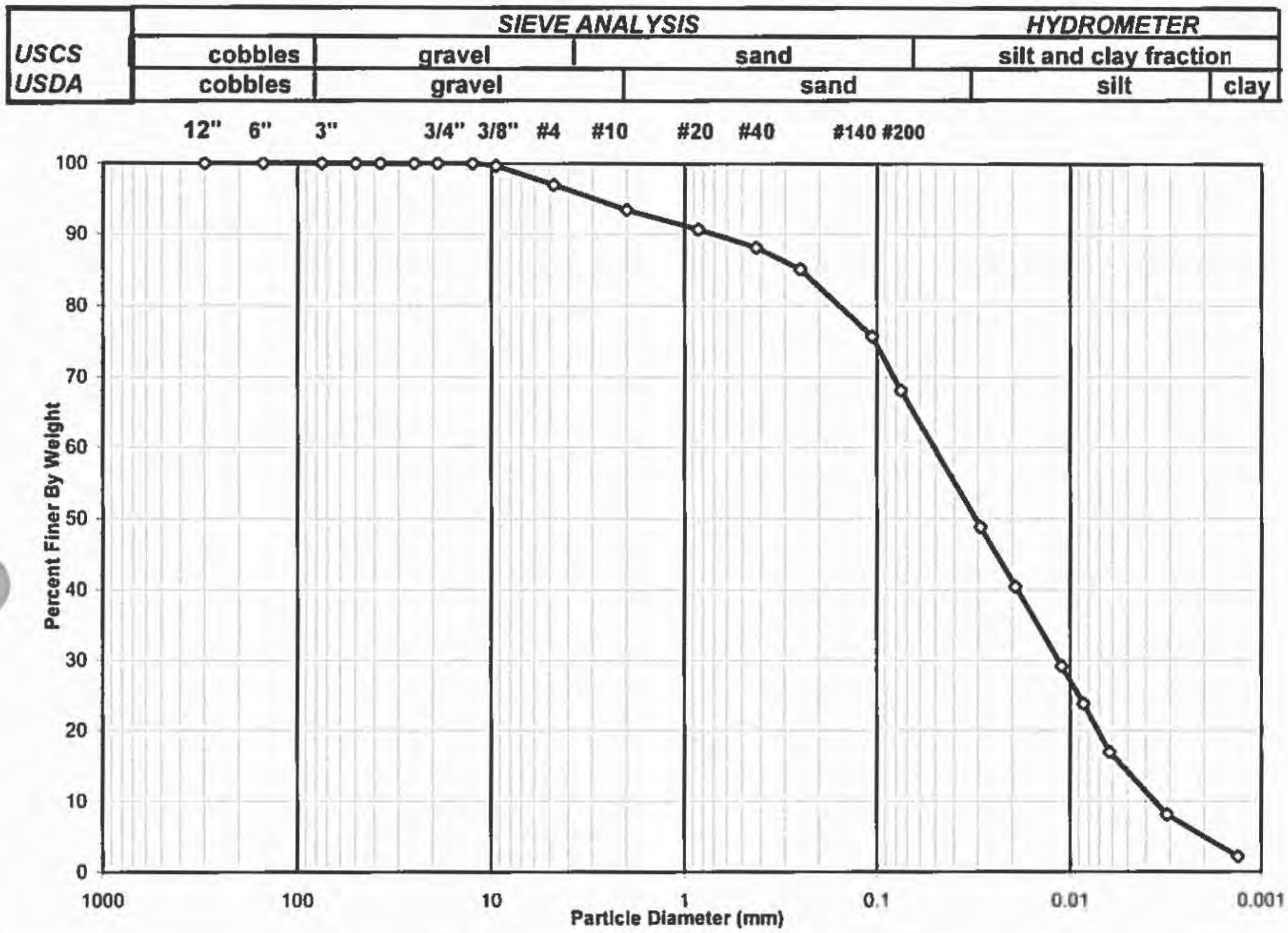
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

Client: AECOM
Client Reference: Dynegy - Wood River Pwr. Sta. 60440115
Project No.: 2015-485-001
Lab ID: 2015-485-001-009

Boring No.: WOR-B021
Depth (ft): 3.5-5.0
Sample No.: SS-1
Soil Color: Gray



USCS Summary

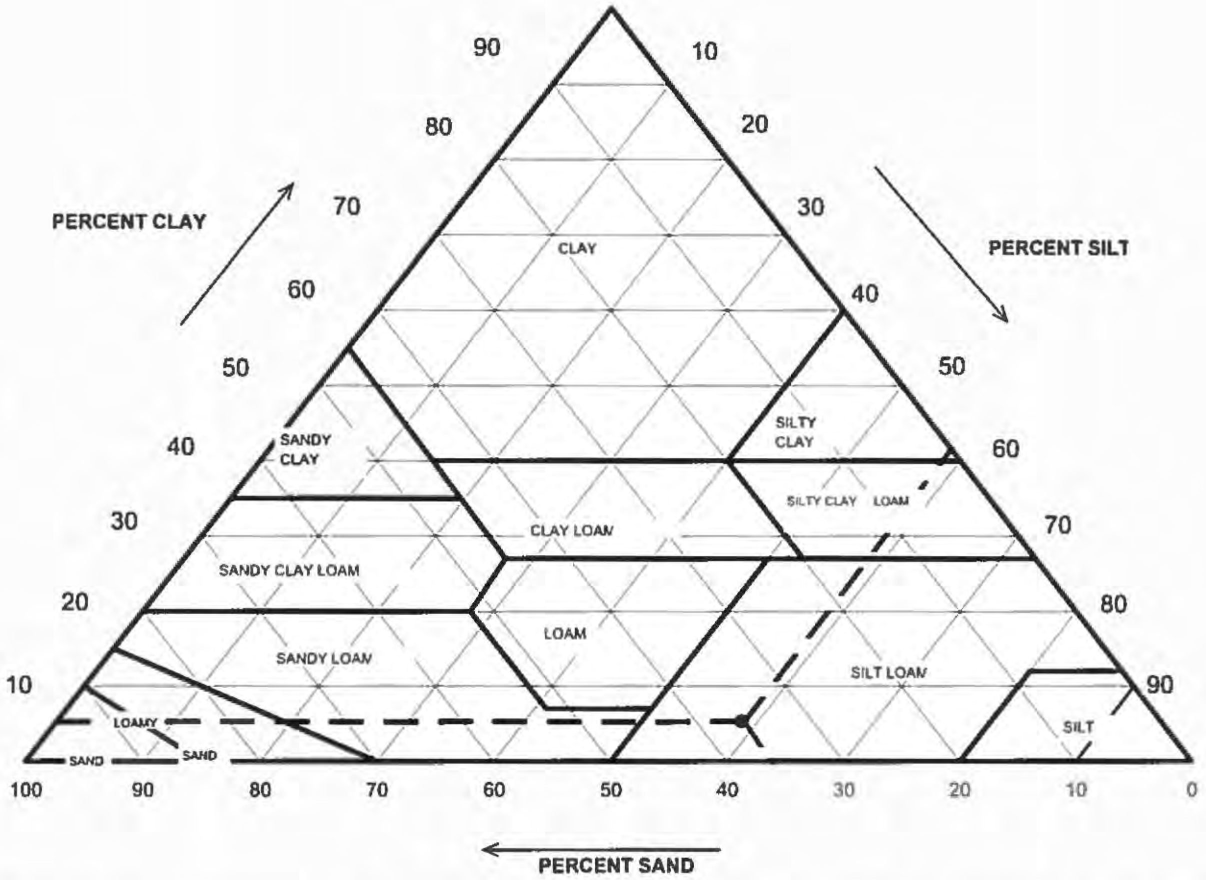
Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	2.99
#4 To #200	*Sand*	28.90
Finer Than #200	*Silt & Clay*	68.11

USCS Symbol:
ml, ASSUMED

USCS Classification:
SANDY SILT

USDA CLASSIFICATION CHART

Client:	AECOM	Boring No.:	WOR-B021
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	3.5-5.0
Project No.:	2015-485-001	Sample No.:	SS-1
Lab ID:	2015-485-001-009	Soil Color:	Gray



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
		Gravel	6.51	**0.00**
2	93.49	*Sand*	33.70	**36.05**
0.05	59.79	*Silt*	54.81	**58.62**
0.002	4.98	*Clay*	4.98	**5.33**

USDA Classification: ***SILT LOAM***

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B021
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	3.5-5.0
Project No.:	2015-485-001	Sample No.:	SS-1
Lab ID:	2015-485-001-009	Soil Color:	Gray

Moisture Content of Passing 3/4" Materia		Water Content of Retained 3/4" Material	
Tare No.	706	Tare No.	NA
Weight of Tare & Wet Sample (g)	626.80	Weight of Tare & Wet Sample (g)	NA
Weight of Tare & Dry Sample (g)	442.70	Weight of Tare & Dry Sample (g)	NA
Weight of Tare (g)	98.94	Weight of Tare (g)	NA
Weight of Water (g)	184.10	Weight of Water (g)	NA
Weight of Dry Sample (g)	343.76	Weight of Dry Sample (g)	NA
Moisture Content (%	**53.6**	**Moisture Content (%**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Sample (g)	343.76
Dry Weight of -3/4" Sample (g)	109.63	Weight of - #200 Material (g)	234.13
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 Material (g)	109.63
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	1.28	0.37	0.37		99.63	**99.63**
#4	4.75	9.01	2.62	2.99		97.01	**97.01**
#10	2.00	12.10	3.52	6.51		93.49	**93.49**
#20	0.85	9.51	2.77	9.28		90.72	**90.72**
#40	0.425	8.84	2.57	11.85		88.15	**88.15**
#60	0.250	10.44	3.04	14.89		85.11	**85.11**
#140	0.106	32.54	9.47	24.35		75.65	**75.65**
#200	0.075	25.91	7.54	31.89		68.11	**68.11**
Pan	-	234.13	68.11	100.00		-	-

Tested By JP Date 9/12/15 Checked By KC Date 9/17/15

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B021
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	3.5-5.0
Project No.:	2015-485-001	Sample No.:	SS-1
Lab ID:	2015-485-001-009	Soil Color:	Gray

Elapsed Time		R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)			(°C)			(%)		(mm)	(%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		38.5	22.4	6.22	32.3	71.6	0.01307	0.0292	**48.7**
5		33.0	22.4	6.22	26.8	59.4	0.01307	0.0193	**40.4**
17		25.5	22.4	6.22	19.3	42.7	0.01307	0.0110	**29.1**
30		22.0	22.4	6.22	15.8	35.0	0.01307	0.0085	**23.8**
60		17.5	22.3	6.25	11.2	24.9	0.01308	0.0062	**17.0**
250		11.5	22.6	6.15	5.4	11.9	0.01303	0.0031	**8.1**
1440		7.5	22.8	6.07	1.4	3.2	0.01300	0.0013	**2.2**

Soil Specimen Data		Other Corrections		
Tare No.	644			
Weight of Tare & Dry Material (g)	149.39	a - Factor	0.99	
Weight of Tare (g)	99.73			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	68.11	
Weight of Dry Material (g)	44.7			
		Specific Gravity	2.7	Assumed

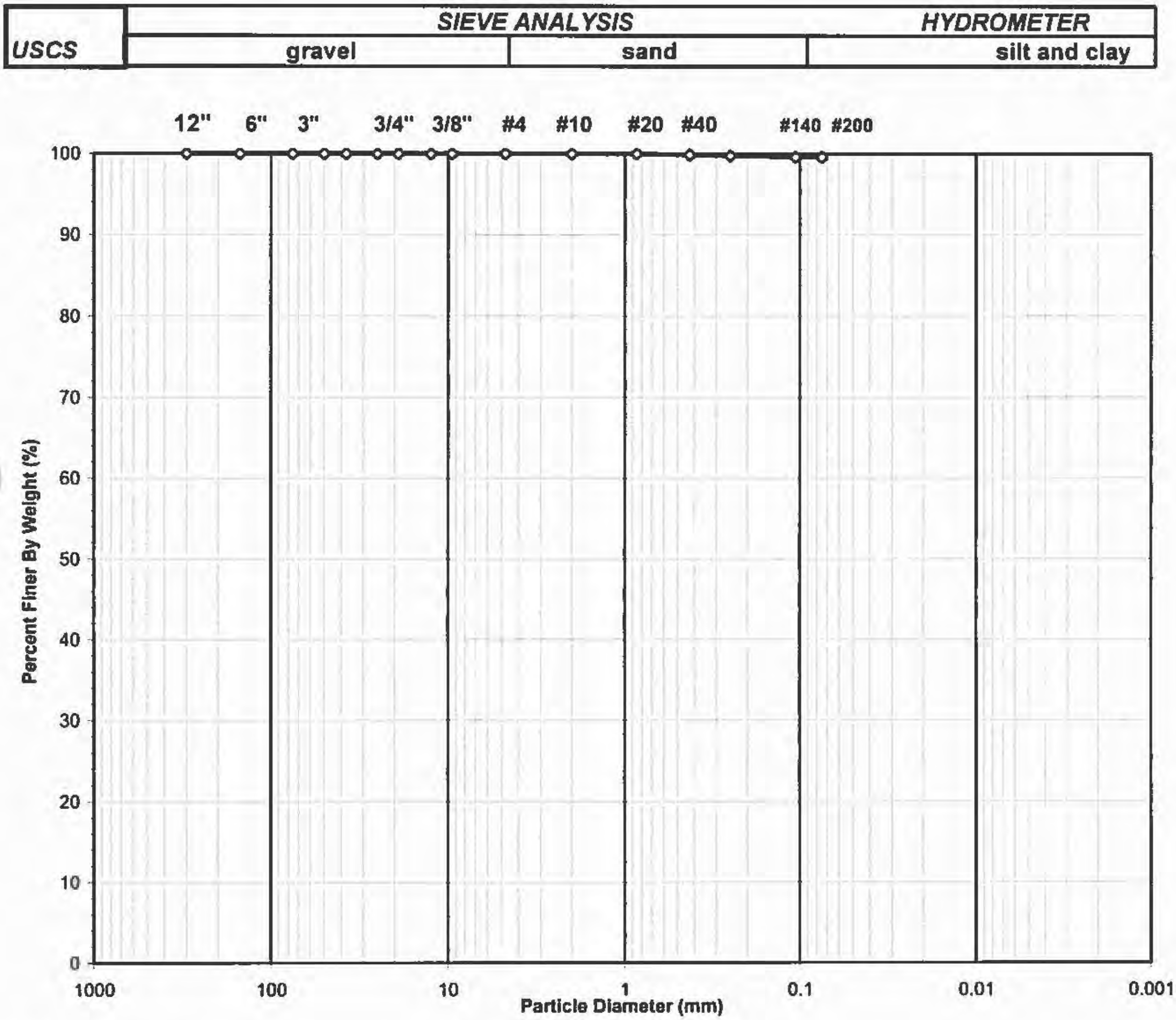
Note: *Hydrometer test is perfomed on - # 200 sieve material.*

Tested By TO Date 9/15/15 Checked By KC Date 9/17/15

SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B021
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	16.0-17.5
Project No.:	2015-485-001	Sample No.:	SS-4
Lab ID:	2015-485-001-010	Soil Color:	Gray



USCS Symbol:
CL, TESTED

USCS Classification:
LEAN CLAY

Tested By	JP	Date	9/12/15	Checked By	KC	Date	9/16/15

page 1 of 2 DCN: CT-S3C DATE 3/20/13 REVISION: 3

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B021
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	16.0-17.5
Project No.:	2015-485-001	Sample No.:	SS-4
Lab ID:	2015-485-001-010	Soil Color:	Gray

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	961	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	483.60	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	396.40	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	101.06	Weight of Tare (g):	NA
Weight of Water (g):	87.20	Weight of Water (g):	NA
Weight of Dry Sample (g):	295.34	Weight of Dry Sample (g):	NA
Moisture Content (%):	**29.5**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	295.34
Dry Weight of - 3/4" Sample (g):	1.3	Weight of - #200 Material (g):	294.02
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	1.32
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

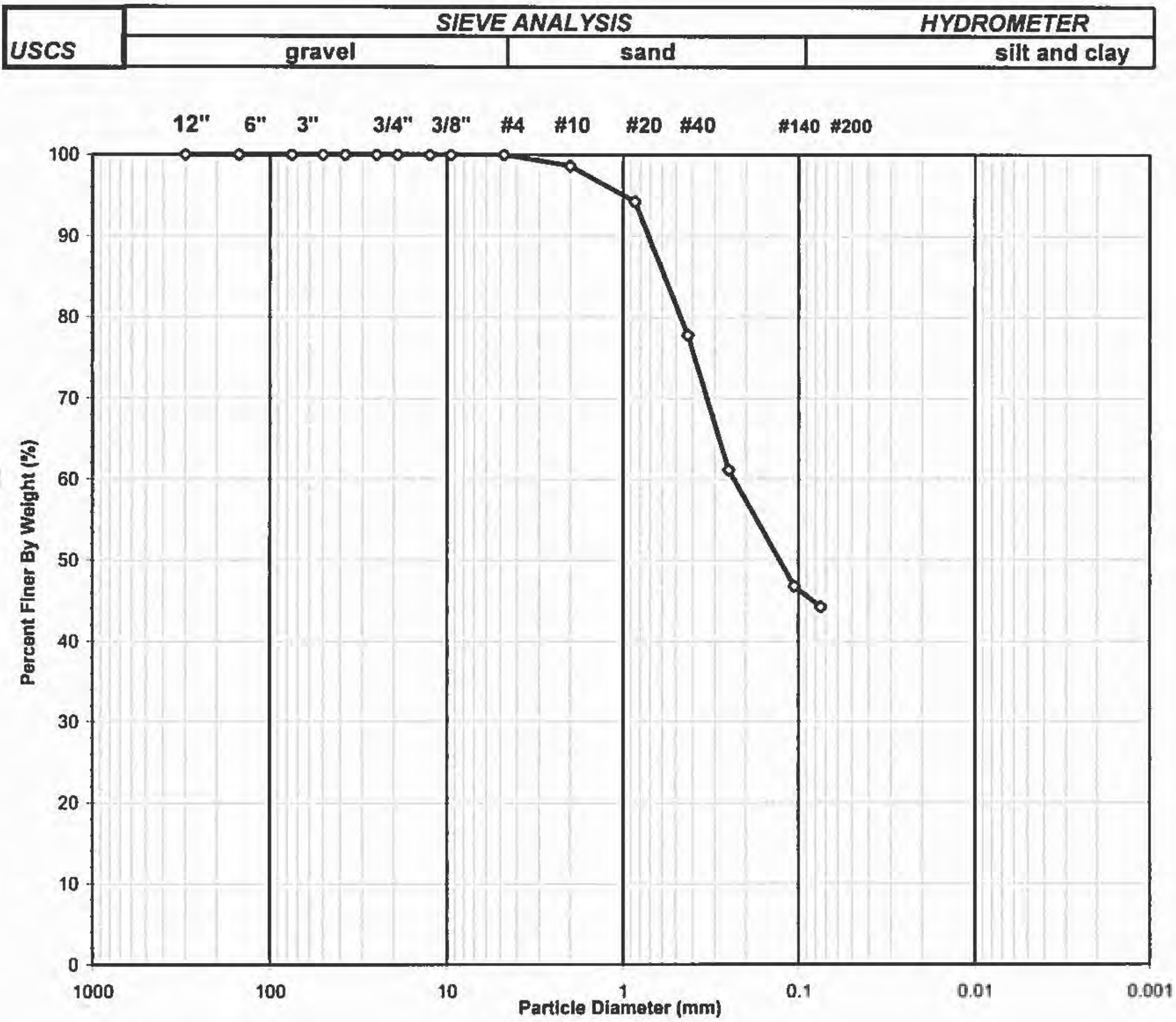
Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.00	0.00	0.00	100.00	**100.00**
#20	0.850	0.06	0.02	0.02	99.98	**99.98**
#40	0.425	0.35	0.12	0.14	99.86	**99.86**
#60	0.250	0.37	0.13	0.26	99.74	**99.74**
#140	0.106	0.42	0.14	0.41	99.59	**99.59**
#200	0.075	0.12	0.04	0.45	99.55	**99.55**
Pan	-	294.02	99.55	100.00	-	-

Tested By JP Date 9/12/15 Checked By KC Date 9/16/15

SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B021
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	23.5-25.0
Project No.:	2015-485-001	Sample No.:	SS-6
Lab ID:	2015-485-001-011	Soil Color:	Brown / Gray



USCS Symbol:
sm, ASSUMED

USCS Classification:
SILTY SAND

Tested By JP Date 9/12/15 Checked By KC Date 9/15/15

geotechnics
geotechnical & geosynthetic testing

WASH SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B021
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	23.5-25.0
Project No.:	2015-485-001	Sample No.:	SS-6
Lab ID:	2015-485-001-011	Soil Color:	Brown / Gray

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	1466	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	561.70	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	447.90	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	110.51	Weight of Tare (g):	NA
Weight of Water (g):	113.80	Weight of Water (g):	NA
Weight of Dry Sample (g):	337.39	Weight of Dry Sample (g):	NA
Moisture Content (%):	**33.7**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	337.39
Dry Weight of - 3/4" Sample (g):	188.0	Weight of - #200 Material (g):	149.36
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	188.03
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	4.74	1.40	1.40	98.60	**98.60**
#20	0.850	14.59	4.32	5.73	94.27	**94.27**
#40	0.425	55.73	16.52	22.25	77.75	**77.75**
#60	0.250	56.23	16.67	38.91	61.09	**61.09**
#140	0.106	48.15	14.27	53.18	46.82	**46.82**
#200	0.075	8.59	2.55	55.73	44.27	**44.27**
Pan	-	149.36	44.27	100.00	-	-

Tested By JP Date 9/12/15 Checked By KC Date 9/15/15

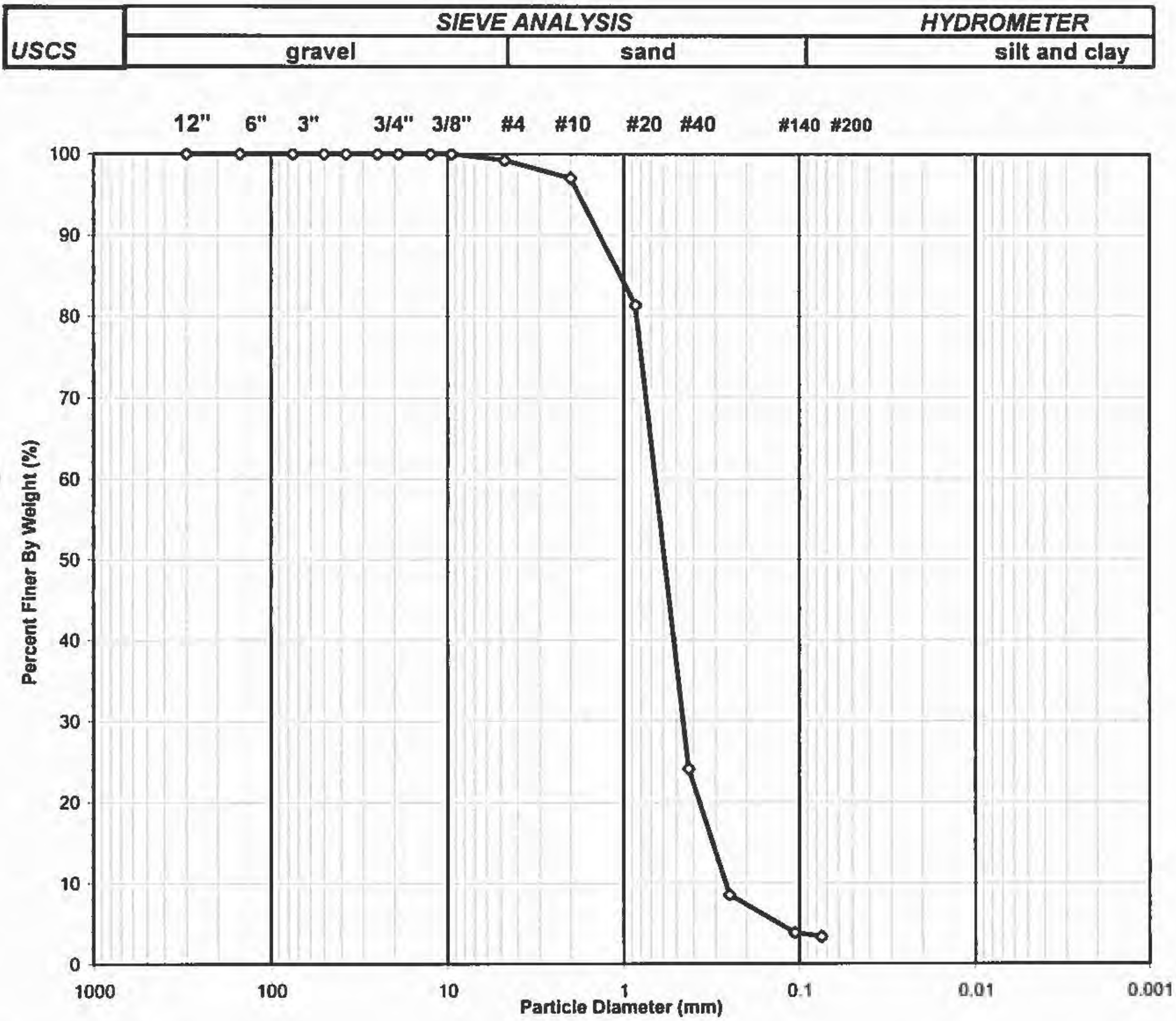
geotechnics
geotechnical & geosynthetic testing

SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client: AECOM
Client Reference: Dynegy - Wood River Pwr. Sta. 60440115
Project No.: 2015-485-001
Lab ID: 2015-485-001-012

Boring No.: WOR-B021
Depth (ft): 36.0-37.5
Sample No.: SS-11
Soil Color: Brown / Gray



USCS Symbol:
SP

USCS Classification:
POORLY GRADED SAND

D60 = 0.66
D30 = 0.46
D10 = 0.26

CC = 1.21
CU = 2.50

Tested By JP Date 9/12/15 Checked By KC Date 9/15/15

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B021
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	36.0-37.5
Project No.:	2015-485-001	Sample No.:	SS-11
Lab ID:	2015-485-001-012	Soil Color:	Brown / Gray

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	697	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	479.50	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	418.90	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	97.75	Weight of Tare (g):	NA
Weight of Water (g):	60.60	Weight of Water (g):	NA
Weight of Dry Sample (g):	321.15	Weight of Dry Sample (g):	NA
Moisture Content (%):	**18.9**	**Moisture Content (%):**	**NA**

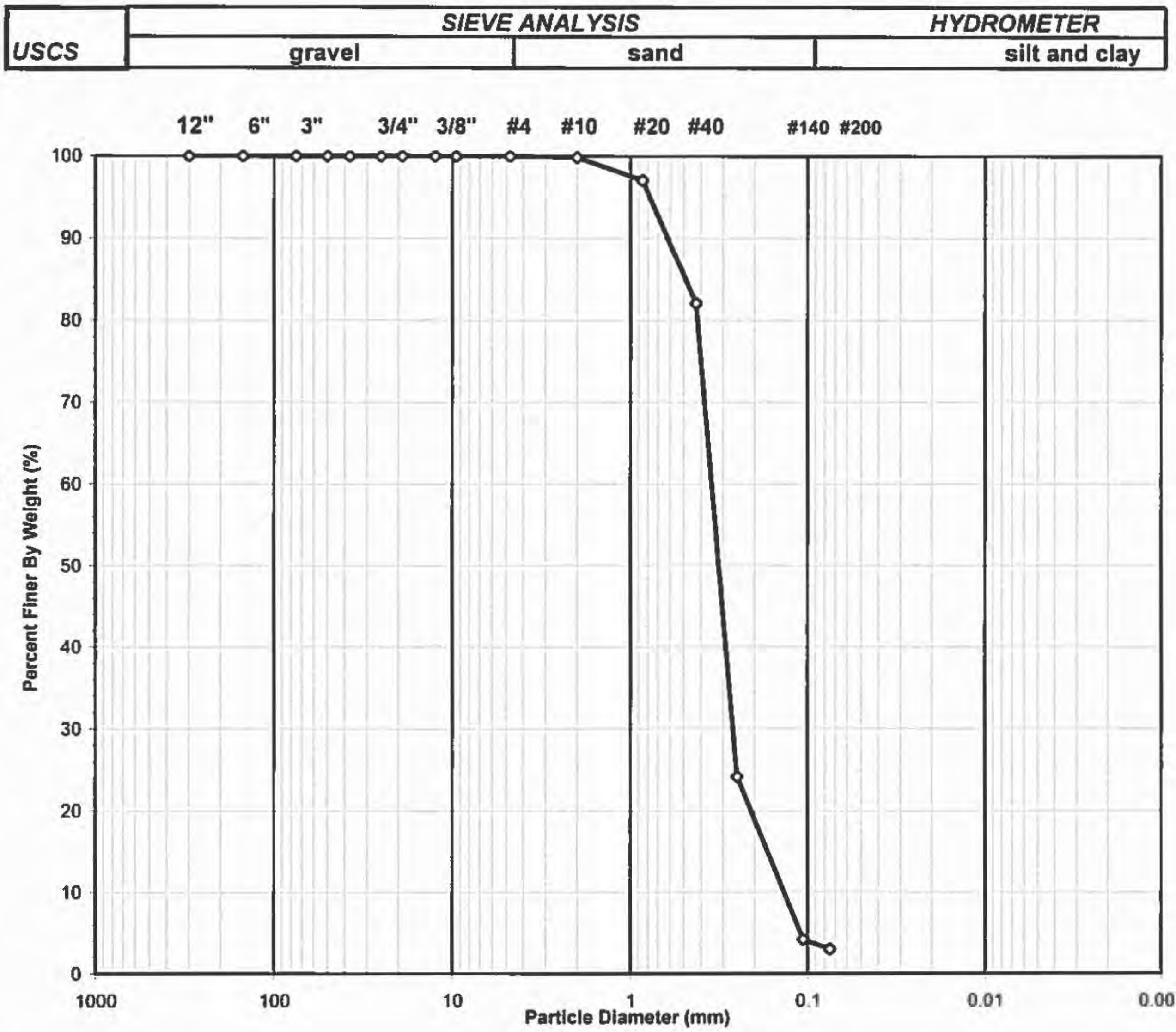
Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	321.15
Dry Weight of - 3/4" Sample (g):	310.4	Weight of - #200 Material (g):	10.75
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	310.40
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	2.49	0.78	0.78	99.22	**99.22**
#10	2.00	7.21	2.25	3.02	96.98	**96.98**
#20	0.850	50.32	15.67	18.69	81.31	**81.31**
#40	0.425	183.68	57.19	75.88	24.12	**24.12**
#60	0.250	49.99	15.57	91.45	8.55	**8.55**
#140	0.106	15.19	4.73	96.18	3.82	**3.82**
#200	0.075	1.52	0.47	96.65	3.35	**3.35**
Pan	-	10.75	3.35	100.00	-	-

Tested By	JP	Date	9/12/15	Checked By	KC	Date	9/15/15

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B021
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	43.5-45.0
Project No.:	2015-485-001	Sample No.:	SS-14
Lab ID:	2015-485-001-013	Soil Color:	Gray



USCS Symbol:
SP

USCS Classification:
POORLY GRADED SAND

D60 =	**0.35**	**CC =**	**1.47**
D30 =	**0.26**	**CU =**	**2.55**
D10 =	**0.14**		

Tested By JP Date 9/12/15 Checked By KC Date 9/15/15

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B021
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	43.5-45.0
Project No.:	2015-485-001	Sample No.:	SS-14
Lab ID:	2015-485-001-013	Soil Color:	Gray

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	968	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	640.20	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	549.50	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	99.97	Weight of Tare (g):	NA
Weight of Water (g):	90.70	Weight of Water (g):	NA
Weight of Dry Sample (g):	449.53	Weight of Dry Sample (g):	NA
Moisture Content (%):	**20.2**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	449.53
Dry Weight of - 3/4" Sample (g):	436.1	Weight of - #200 Material (g):	13.42
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	436.11
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.75	0.17	0.17	99.83	**99.83**
#20	0.850	12.78	2.84	3.01	96.99	**96.99**
#40	0.425	67.12	14.93	17.94	82.06	**82.06**
#60	0.250	260.21	57.88	75.83	24.17	**24.17**
#140	0.106	89.80	19.98	95.80	4.20	**4.20**
#200	0.075	5.45	1.21	97.01	2.99	**2.99**
Pan	-	13.42	2.99	100.00	-	**-**

Tested By JP Date 9/12/15 Checked By KC Date 9/15/15

geotechnics
geotechnical & geosynthetic testing

SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B022
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	13.9-14.4
Project No.:	2015-485-001	Sample No.:	ST-1
Lab ID:	2015-485-001-014	Soil Color:	Gray

USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.05
#4 To #200	*Sand*	5.94
Finer Than #200	*Silt & Clay*	94.01

USCS Symbol:

ML, TESTED

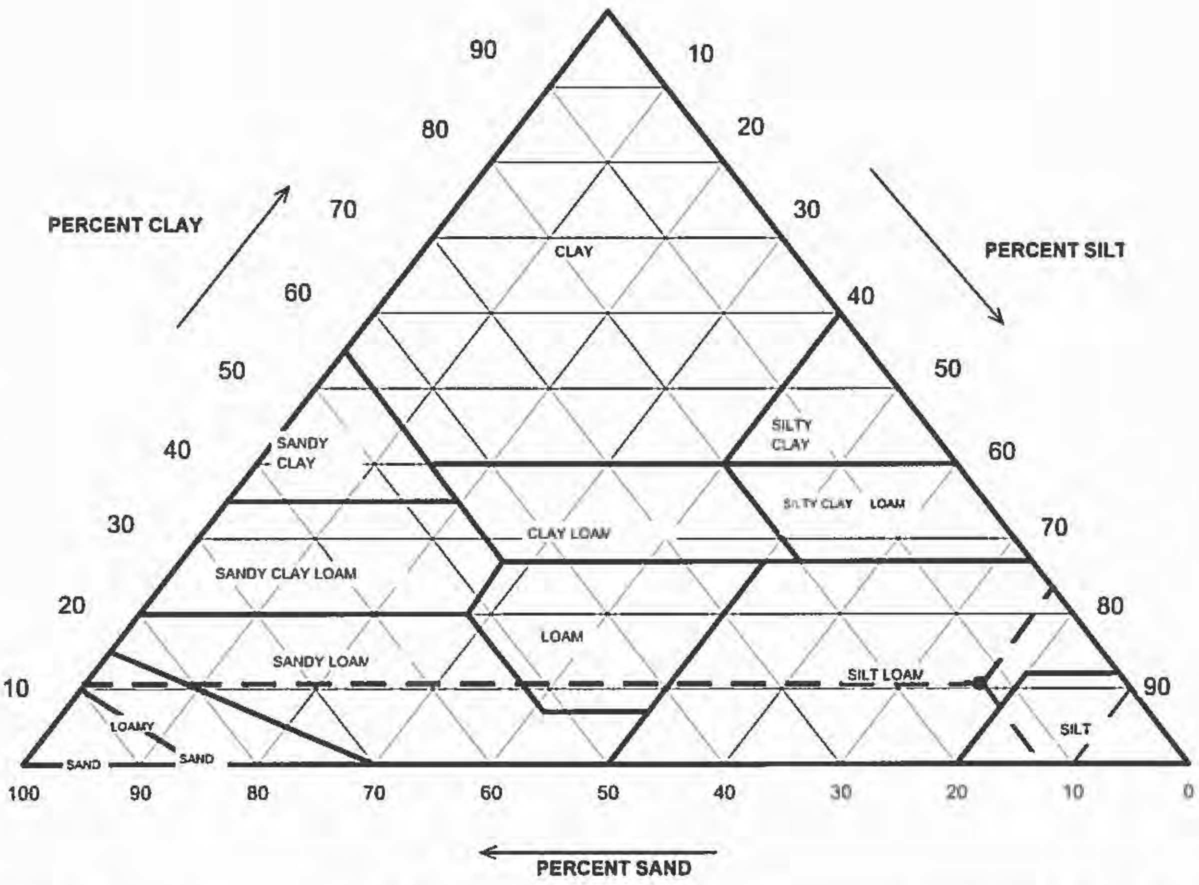
USCS Classification:

SILT
(NON-PLASTIC FINES)

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

USDA CLASSIFICATION CHART

Client:	AECOM	Boring No.:	WOR-B022
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	13.9-14.4
Project No.:	2015-485-001	Sample No.:	ST-1
Lab ID:	2015-485-001-014	Soil Color:	Gray



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
		Gravel	0.18	**0.00**
2	99.82	*Sand*	12.60	**12.62**
0.05	87.23	*Silt*	76.60	**76.74**
0.002	10.63	*Clay*	10.63	**10.65**

USDA Classification: ***SILT LOAM***

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B022
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	13.9-14.4
Project No.:	2015-485-001	Sample No.:	ST-1
Lab ID:	2015-485-001-014	Soil Color:	Gray

Moisture Content of Passing 3/4" Materia		Water Content of Retained 3/4" Material	
Tare No.	2471	Tare No.	NA
Weight of Tare & Wet Sample (g)	758.04	Weight of Tare & Wet Sample (g)	NA
Weight of Tare & Dry Sample (g)	407.30	Weight of Tare & Dry Sample (g)	NA
Weight of Tare (g)	98.28	Weight of Tare (g)	NA
Weight of Water (g)	350.74	Weight of Water (g)	NA
Weight of Dry Sample (g)	309.02	Weight of Dry Sample (g)	NA
Moisture Content (%	**113.5**	**Moisture Content (%**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Sample (g)	309.02
Dry Weight of -3/4" Sample (g)	18.51	Weight of - #200 Material (g)	290.51
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 Material (g)	18.51
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00		100.00	**100.00**
#4	4.75	0.15	0.05	0.05		99.95	**99.95**
#10	2.00	0.40	0.13	0.18		99.82	**99.82**
#20	0.85	0.79	0.26	0.43		99.57	**99.57**
#40	0.425	1.66	0.54	0.97		99.03	**99.03**
#60	0.250	1.48	0.48	1.45		98.55	**98.55**
#140	0.106	5.85	1.89	3.34		96.66	**96.66**
#200	0.075	8.18	2.65	5.99		94.01	**94.01**
Pan	-	290.51	94.01	100.00		-	-

Tested By RAL Date 9/15/15 Checked By KC Date 9/17/15

geotechnics
geotechnical & geosynthetic testing

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B022
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	13.9-14.4
Project No.:	2015-485-001	Sample No.:	ST-1
Lab ID:	2015-485-001-014	Soil Color:	Gray

Elapsed Time		**R Measured**	**Temp.**	**Composite Correction**	**R Corrected**	**N**	**K Factor**	**Diameter**	**N'**
(min)			**(°C)**			**(%)**		**(mm)**	**(%)**
0		NA	NA	NA	NA	NA	NA	NA	NA
2		43.5	22.4	6.22	37.3	82.4	0.01307	0.0280	**77.5**
5		39.0	22.4	6.22	32.8	72.5	0.01307	0.0184	**68.1**
15		30.0	22.4	6.22	23.8	52.6	0.01307	0.0114	**49.4**
32		23.5	22.4	6.22	17.3	38.2	0.01307	0.0081	**35.9**
60		19.0	22.3	6.25	12.7	28.2	0.01308	0.0061	**26.5**
250		12.5	22.6	6.15	6.4	14.1	0.01303	0.0031	**13.2**
1440		10.0	22.8	6.07	3.9	8.7	0.01300	0.0013	**8.2**

Soil Specimen Data		**Other Corrections**		
Tare No.	947			
Weight of Tare & Dry Material (g)	149.88	a - Factor	0.99	
Weight of Tare (g)	100.11			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	94.01	
Weight of Dry Material (g)	44.8			
		Specific Gravity	2.7	Assumed

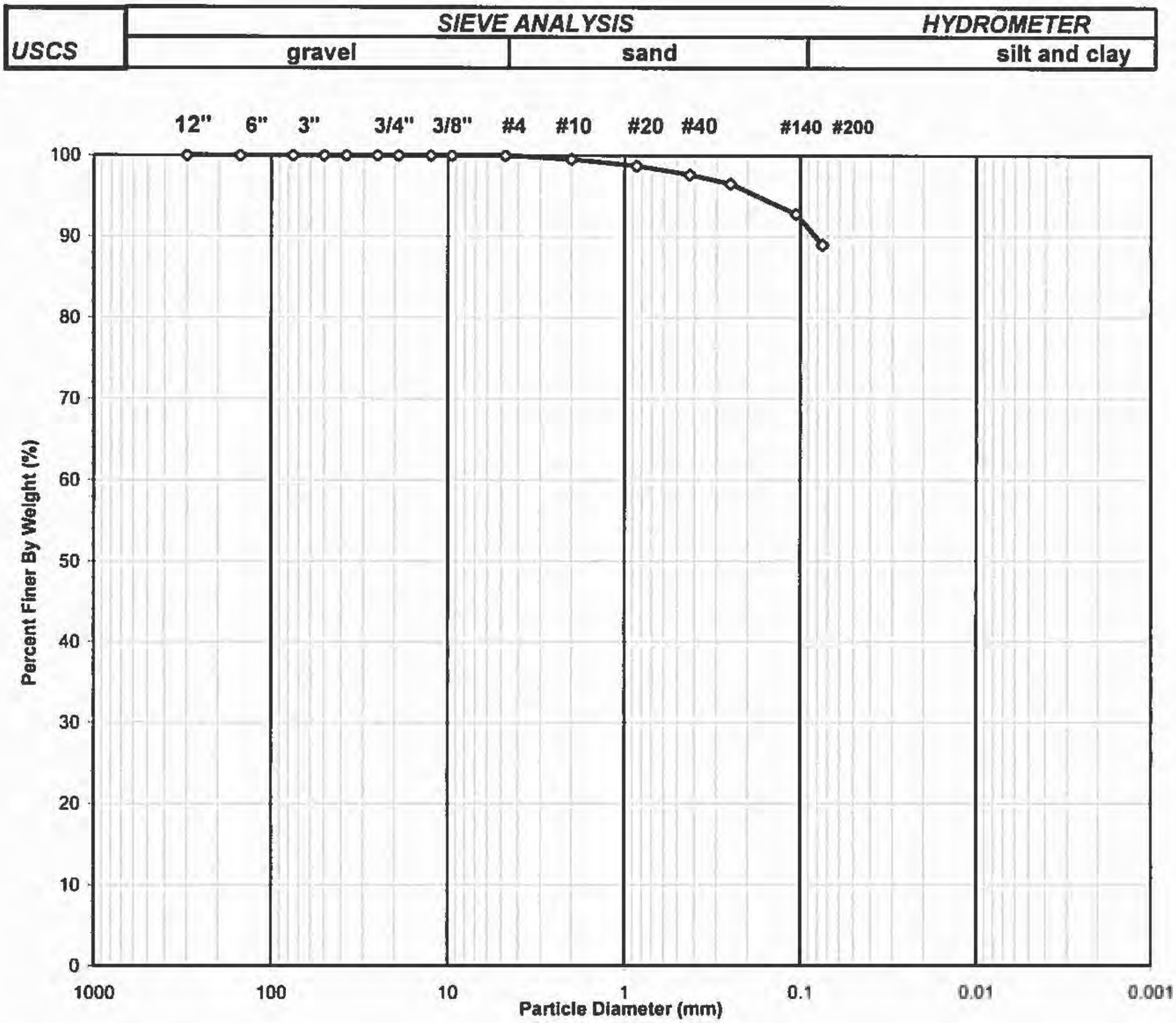
Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 9/15/15 Checked By KC Date 9/17/15

SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B022
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	17.0-17.55 Upper
Project No.:	2015-485-001	Sample No.:	ST-2
Lab ID:	2015-485-001-015	Soil Color:	Grayish Brown



USCS Symbol:

ML, TESTED

USCS Classification:

SILT

(NON-PLASTIC FINES), UNABLE TO RUN HYDROMETER

Tested By AMC Date 9/17/15 Checked By KC Date 9/18/15

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B022
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	17.0-17.55 Upper
Project No.:	2015-485-001	Sample No.:	ST-2
Lab ID:	2015-485-001-015	Soil Color:	Grayish Brown

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	21	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	429.10	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	373.34	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	201.74	Weight of Tare (g):	NA
Weight of Water (g):	55.76	Weight of Water (g):	NA
Weight of Dry Sample (g):	171.60	Weight of Dry Sample (g):	NA
Moisture Content (%):	**32.5**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	171.60
Dry Weight of - 3/4" Sample (g):	18.9	Weight of - #200 Material (g):	152.70
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	18.90
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.84	0.49	0.49	99.51	**99.51**
#20	0.850	1.44	0.84	1.33	98.67	**98.67**
#40	0.425	1.86	1.08	2.41	97.59	**97.59**
#60	0.250	1.98	1.15	3.57	96.43	**96.43**
#140	0.106	6.31	3.68	7.24	92.76	**92.76**
#200	0.075	6.47	3.77	11.01	88.99	**88.99**
Pan	-	152.70	88.99	100.00	-	-

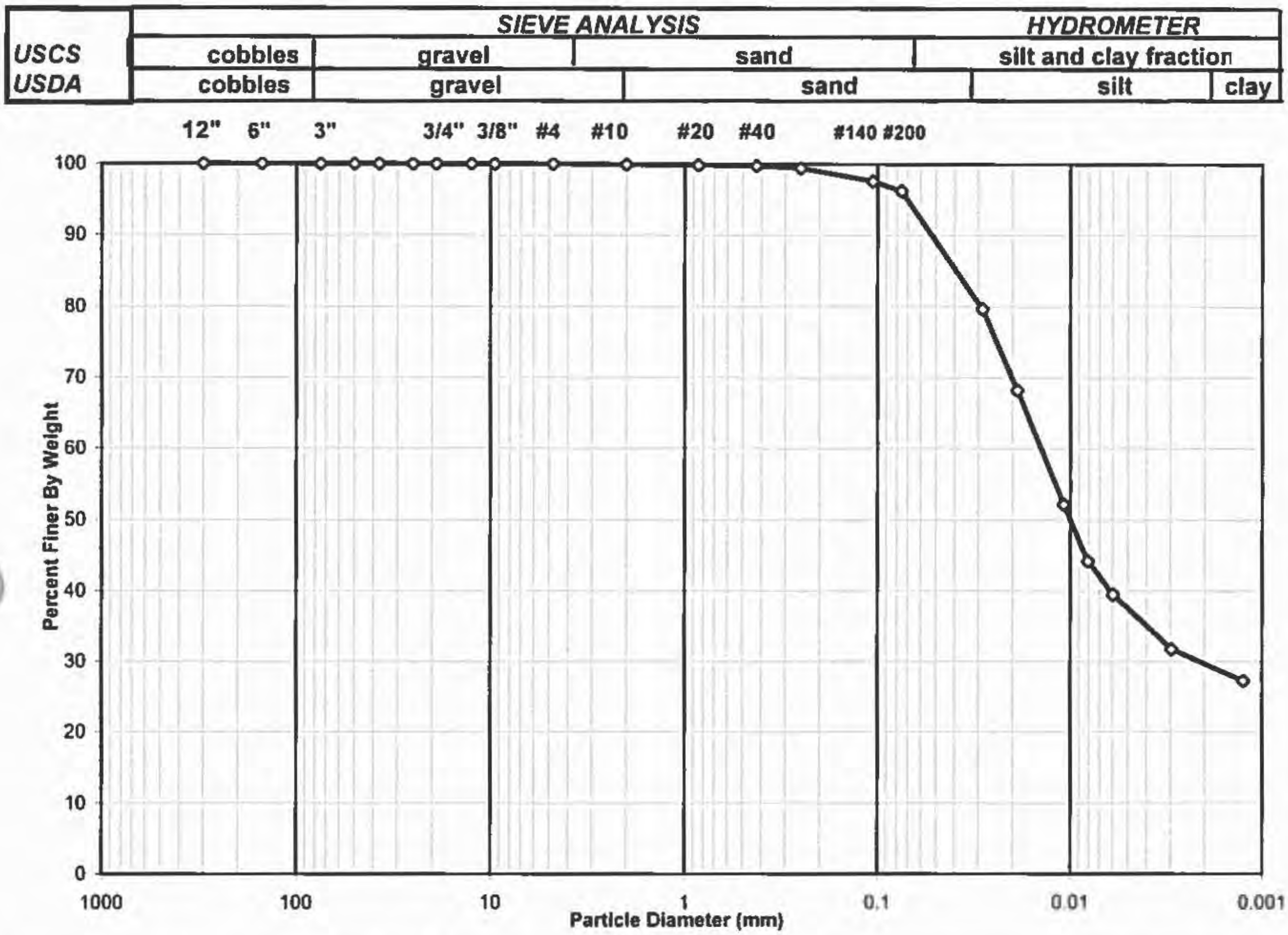
Tested By AMC Date 9/17/15 Checked By KC Date 9/18/15

SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

geotechnics
geotechnical & geosynthetic testing

Client: AECOM
Client Reference: Dynegy - Wood River Pwr. Sta. 60440115
Project No.: 2015-485-001
Lab ID: 2015-485-001-016

Boring No.: WOR-B022
Depth (ft): 18.4-18.8 Lower
Sample No.: ST-2
Soil Color: Gray



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	3.80
Finer Than #200	*Silt & Clay*	96.20

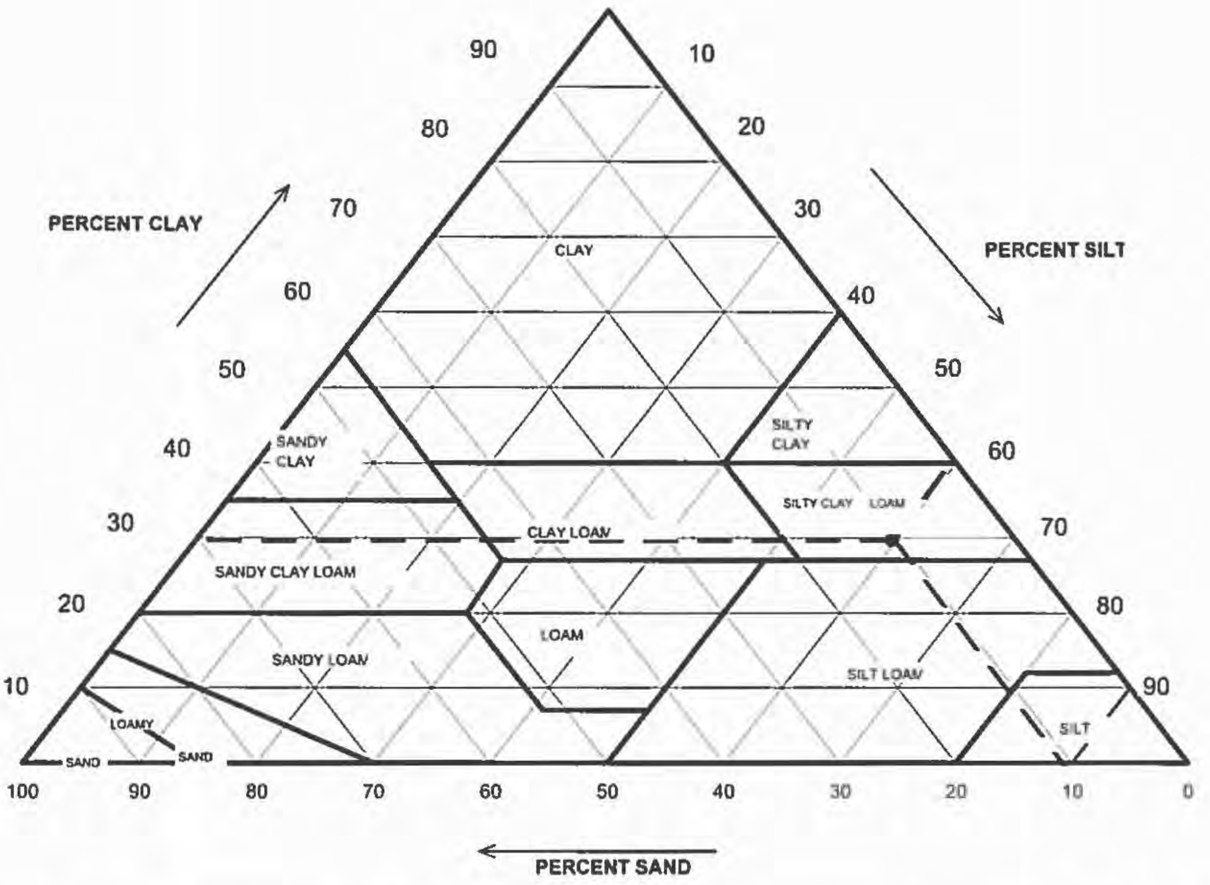
USCS Symbol:
CL, TESTED

USCS Classification:
LEAN CLAY

USDA CLASSIFICATION CHART

Client: AECOM
Client Reference: Dynegy - Wood River Pwr. Sta. 60440115
Project No.: 2015-485-001
Lab ID: 2015-485-001-016

Boring No.: WOR-B022
Depth (ft): 18.4-18.8 Lower
Sample No.: ST-2
Soil Color: Gray



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
		Gravel	0.10	**0.00**
2	99.90	*Sand*	10.68	**10.69**
0.05	89.22	*Silt*	59.54	**59.60**
0.002	29.69	*Clay*	29.69	**29.72**

USDA Classification: ***SILTY CLAY LOAM***

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B022
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	18.4-18.8 Lower
Project No.:	2015-485-001	Sample No.:	ST-2
Lab ID:	2015-485-001-016	Soil Color:	Gray

Moisture Content of Passing 3/4" Materia		Water Content of Retained 3/4" Material	
Tare No.	932	Tare No.	NA
Weight of Tare & Wet Sample (g)	595.27	Weight of Tare & Wet Sample (g)	NA
Weight of Tare & Dry Sample (g)	496.30	Weight of Tare & Dry Sample (g)	NA
Weight of Tare (g)	97.81	Weight of Tare (g)	NA
Weight of Water (g)	98.97	Weight of Water (g)	NA
Weight of Dry Sample (g)	398.49	Weight of Dry Sample (g)	NA
Moisture Content (%	**24.8**	**Moisture Content (%**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Sample (g)	398.49
Dry Weight of -3/4" Sample (g)	15.16	Weight of - #200 Material (g)	383.33
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 Material (g)	15.16
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00		100.00	**100.00**
#4	4.75	0.00	0.00	0.00		100.00	**100.00**
#10	2.00	0.40	0.10	0.10		99.90	**99.90**
#20	0.85	0.30	0.08	0.18		99.82	**99.82**
#40	0.425	0.24	0.06	0.24		99.76	**99.76**
#60	0.250	1.41	0.35	0.59		99.41	**99.41**
#140	0.106	7.31	1.83	2.42		97.58	**97.58**
#200	0.075	5.50	1.38	3.80		96.20	**96.20**
Pan	-	383.33	96.20	100.00		-	-

Tested By	RAL	Date	9/15/15	Checked By	KC	Date	9/17/15

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B022
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	18.4-18.8 Lower
Project No.:	2015-485-001	Sample No.:	ST-2
Lab ID:	2015-485-001-016	Soil Color:	Gray

Elapsed Time		R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)			(°C)			(%)		(mm)	(%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		41.0	22.4	6.22	34.8	82.8	0.01307	0.0286	**79.6**
5		36.0	22.4	6.22	29.8	70.9	0.01307	0.0188	**68.2**
17		29.0	22.4	6.22	22.8	54.2	0.01307	0.0108	**52.1**
32		25.5	22.4	6.22	19.3	45.9	0.01307	0.0080	**44.1**
60		23.5	22.3	6.25	17.2	41.0	0.01308	0.0060	**39.5**
250		20.0	22.6	6.15	13.9	33.0	0.01303	0.0030	**31.7**
1440		18.0	22.8	6.07	11.9	28.4	0.01300	0.0013	**27.3**

Soil Specimen Data		**Other Corrections**		
Tare No.	695			
Weight of Tare & Dry Material (g)	139.19	a - Factor	0.99	
Weight of Tare (g)	92.58			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	96.20	
Weight of Dry Material (g)	41.6			
		Specific Gravity	2.7	Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 9/15/15 Checked By KC Date 9/17/15

SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client: AECOM
Client Reference: Dynegy - Wood River Pwr. Sta. 60440115
Project No.: 2015-485-001
Lab ID: 2015-485-001-018

Boring No.: WOR-B022
Depth (ft): 36.0-37.5
Sample No.: SS-11
Soil Color: Brown / Gray

USCS Symbol:
sm, ASSUMED

USCS Classification:
SILTY SAND

Tested By JP Date 9/12/15 Checked By KC Date 9/15/15

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B022
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	36.0-37.5
Project No.:	2015-485-001	Sample No.:	SS-11
Lab ID:	2015-485-001-018	Soil Color:	Brown / Gray

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	1436	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	777.90	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	638.10	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	144.18	Weight of Tare (g):	NA
Weight of Water (g):	139.80	Weight of Water (g):	NA
Weight of Dry Sample (g):	493.92	Weight of Dry Sample (g):	NA
Moisture Content (%):	**28.3**	**Moisture Content (%):**	**NA**

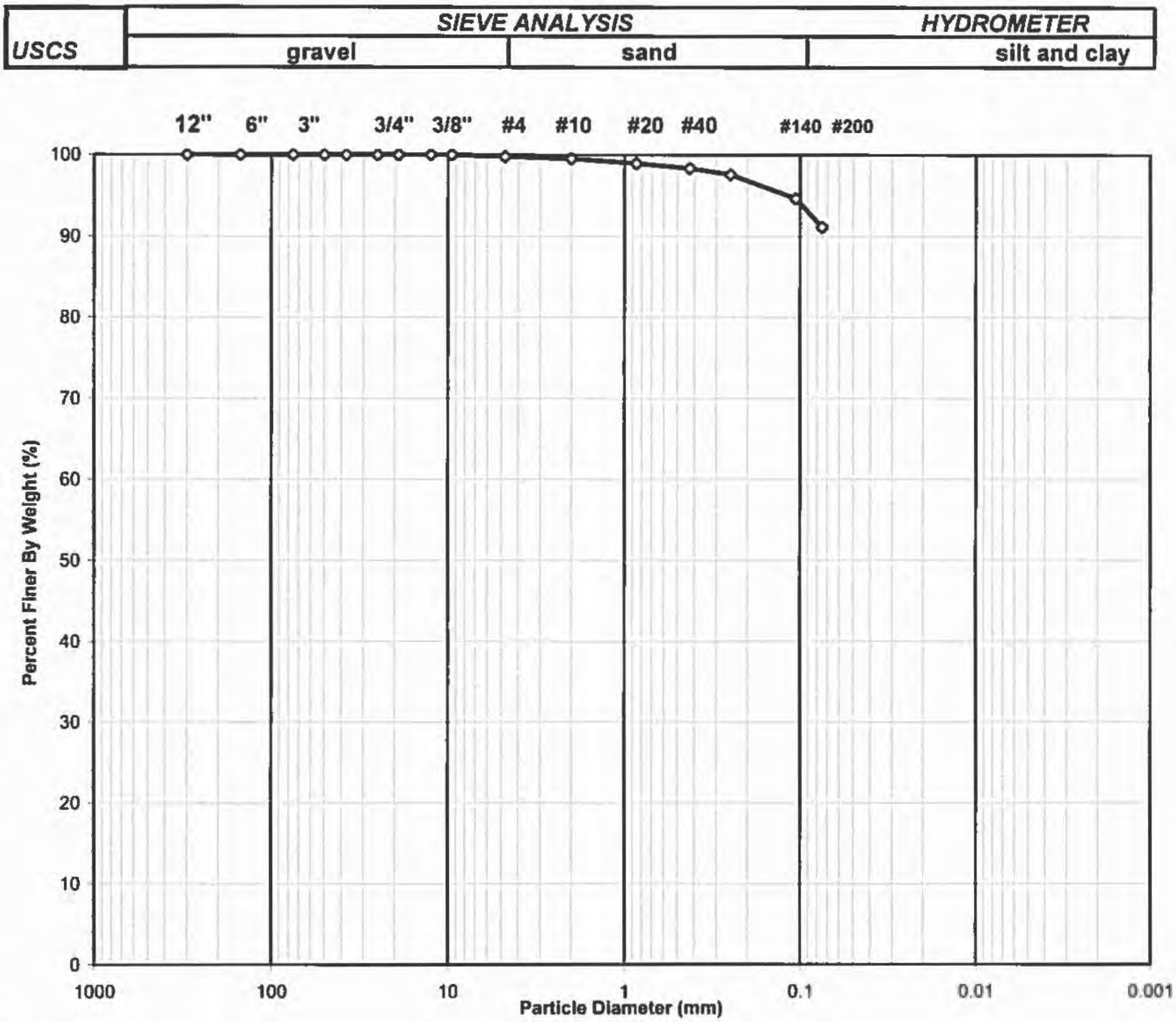
Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	493.92
Dry Weight of - 3/4" Sample (g):	398.5	Weight of - #200 Material (g):	95.38
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	398.54
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.81	0.16	0.16	99.84	**99.84**
#20	0.850	6.30	1.28	1.44	98.56	**98.56**
#40	0.425	36.57	7.40	8.84	91.16	**91.16**
#60	0.250	83.17	16.84	25.68	74.32	**74.32**
#140	0.106	260.54	52.75	78.43	21.57	**21.57**
#200	0.075	11.15	2.26	80.69	19.31	**19.31**
Pan	-	95.38	19.31	100.00	-	-

Tested By JP Date 9/12/15 Checked By KC Date 9/15/15

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B024
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	6.0-7.5
Project No.:	2015-485-001	Sample No.:	SS-2
Lab ID:	2015-485-001-019	Soil Color:	Gray



USCS Symbol:
ml, ASSUMED

USCS Classification:
SILT

Tested By	JP	Date	9/12/15	Checked By	KC	Date	9/15/15

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B024
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	6.0-7.5
Project No.:	2015-485-001	Sample No.:	SS-2
Lab ID:	2015-485-001-019	Soil Color:	Gray

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	926	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	521.30	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	378.73	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	95.48	Weight of Tare (g):	NA
Weight of Water (g):	142.57	Weight of Water (g):	NA
Weight of Dry Sample (g):	283.25	Weight of Dry Sample (g):	NA
Moisture Content (%):	**50.3**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	283.25
Dry Weight of - 3/4" Sample (g):	25.2	Weight of - #200 Material (g):	258.06
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	25.19
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.65	0.23	0.23	99.77	**99.77**
#10	2.00	0.80	0.28	0.51	99.49	**99.49**
#20	0.850	1.41	0.50	1.01	98.99	**98.99**
#40	0.425	1.82	0.64	1.65	98.35	**98.35**
#60	0.250	2.23	0.79	2.44	97.56	**97.56**
#140	0.106	8.18	2.89	5.33	94.67	**94.67**
#200	0.075	10.10	3.57	8.89	91.11	**91.11**
Pan	-	258.06	91.11	100.00	-	-

Tested By JP Date 9/12/15 Checked By KC Date 9/15/15

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B024
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	23.5-25.0
Project No.:	2015-485-001	Sample No.:	SS-7
Lab ID:	2015-485-001-021	Soil Color:	Gray

USCS Symbol:
sm, ASSUMED

USCS Classification:
SILTY SAND

Tested By	JP	Date	9/12/15	Checked By	KC	Date	9/15/15

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B024
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	23.5-25.0
Project No.:	2015-485-001	Sample No.:	SS-7
Lab ID:	2015-485-001-021	Soil Color:	Gray

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	703	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	559.20	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	446.70	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	97.71	Weight of Tare (g):	NA
Weight of Water (g):	112.50	Weight of Water (g):	NA
Weight of Dry Sample (g):	348.99	Weight of Dry Sample (g):	NA
Moisture Content (%):	**32.2**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	348.99
Dry Weight of - 3/4" Sample (g):	223.3	Weight of - #200 Material (g):	125.74
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	223.25
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

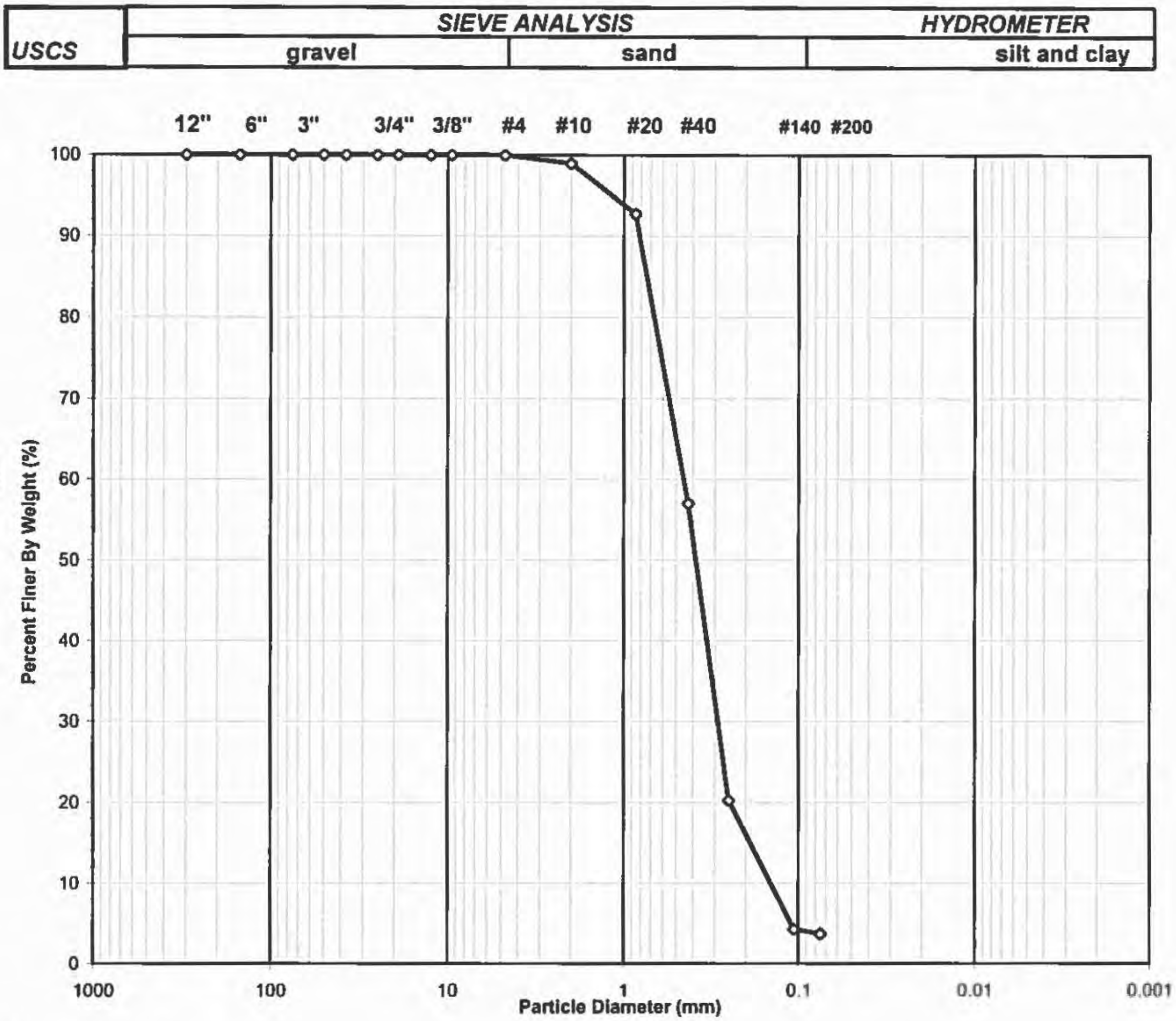
Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	1.12	0.32	0.32	99.68	**99.68**
3/8"	9.50	0.00	0.00	0.32	99.68	**99.68**
#4	4.75	0.00	0.00	0.32	99.68	**99.68**
#10	2.00	0.94	0.27	0.59	99.41	**99.41**
#20	0.850	1.20	0.34	0.93	99.07	**99.07**
#40	0.425	1.96	0.56	1.50	98.50	**98.50**
#60	0.250	3.14	0.90	2.40	97.60	**97.60**
#140	0.106	179.59	51.46	53.86	46.14	**46.14**
#200	0.075	35.30	10.11	63.97	36.03	**36.03**
Pan	-	125.74	36.03	100.00	-	-

Tested By	JP	Date	9/12/15	Checked By	KC	Date	9/15/15

SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B024
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	33.5-35.0
Project No.:	2015-485-001	Sample No.:	SS-11
Lab ID:	2015-485-001-022	Soil Color:	Brown / Gray



USCS Symbol:

SP

USCS Classification:

POORLY GRADED SAND

D60 =	**0.45**	**CC =**	**1.27**
D30 =	**0.29**	**CU =**	**3.12**
D10 =	**0.14**		

Tested By JP Date 9/12/15 Checked By KC Date 9/15/15

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B024
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	33.5-35.0
Project No.:	2015-485-001	Sample No.:	SS-11
Lab ID:	2015-485-001-022	Soil Color:	Brown / Gray

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	52	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	597.80	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	526.00	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	200.08	Weight of Tare (g):	NA
Weight of Water (g):	71.80	Weight of Water (g):	NA
Weight of Dry Sample (g):	325.92	Weight of Dry Sample (g):	NA
Moisture Content (%):	**22.0**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	325.92
Dry Weight of - 3/4" Sample (g):	314.0	Weight of - #200 Material (g):	11.91
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	314.01
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	3.47	1.06	1.06	98.94	**98.94**
#20	0.850	20.28	6.22	7.29	92.71	**92.71**
#40	0.425	116.27	35.67	42.96	57.04	**57.04**
#60	0.250	119.81	36.76	79.72	20.28	**20.28**
#140	0.106	52.24	16.03	95.75	4.25	**4.25**
#200	0.075	1.94	0.60	96.35	3.65	**3.65**
Pan	-	11.91	3.65	100.00	-	-

Tested By	JP	Date	9/12/15	Checked By	KC	Date	9/15/15

page 2 of 2 DCN: CT-S3C DATE 3/20/13 REVISION: 3

The following are attachments to the testimony of Scott M. Payne, PhD, PG and Ian Magruder, M.S..

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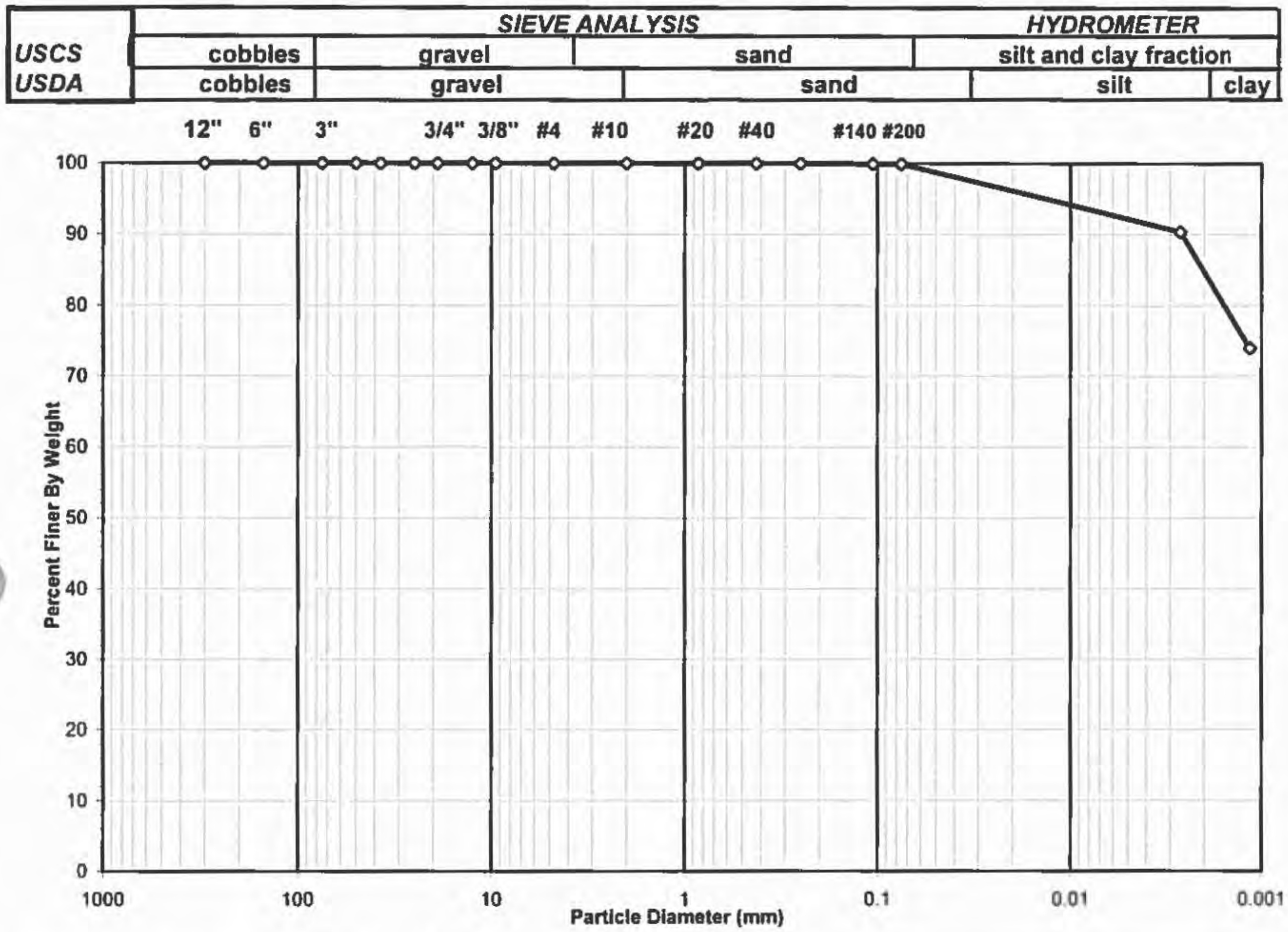
SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B025
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	32.3-32.7
Project No.:	2015-485-001	Sample No.:	ST-3
Lab ID:	2015-485-001-023	Soil Color:	Gray



USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	0.06
Finer Than #200	*Silt & Clay*	99.94

USCS Symbol:

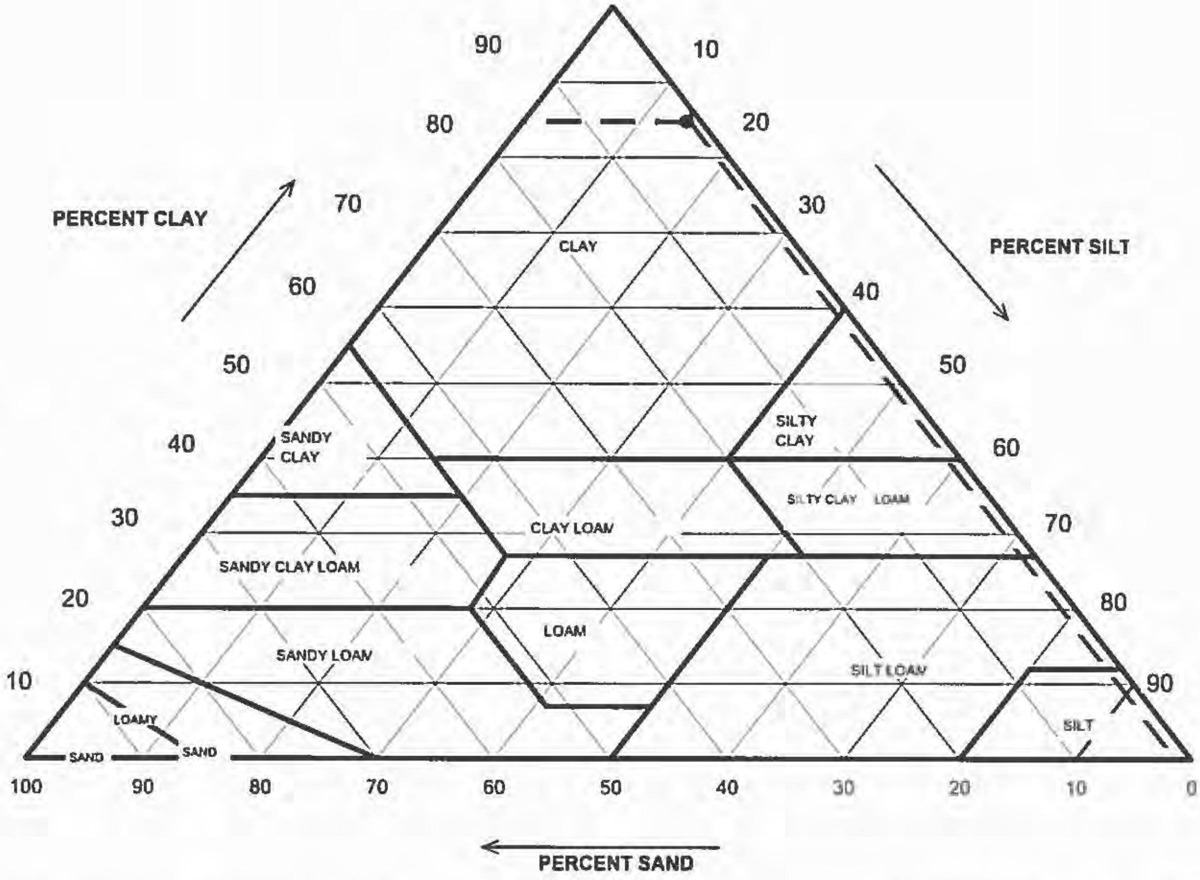
CH, TESTED

USCS Classification:

FAT CLAY

USDA CLASSIFICATION CHART

Client:	AECOM	Boring No.:	WOR-B025
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	32.3-32.7
Project No.:	2015-485-001	Sample No.:	ST-3
Lab ID:	2015-485-001-023	Soil Color:	Gray



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
		Gravel	0.00	**0.00**
2	100.00	*Sand*	1.23	**1.23**
0.05	98.77	*Silt*	14.00	**14.00**
0.002	84.77	*Clay*	84.77	**84.77**

USDA Classification: *CLAY*

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B025
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	32.3-32.7
Project No.:	2015-485-001	Sample No.:	ST-3
Lab ID:	2015-485-001-023	Soil Color:	Gray

Moisture Content of Passing 3/4" Materia		Water Content of Retained 3/4" Material	
Tare No.	1920	Tare No.	NA
Weight of Tare & Wet Sample (g)	630.49	Weight of Tare & Wet Sample (g)	NA
Weight of Tare & Dry Sample (g)	423.70	Weight of Tare & Dry Sample (g)	NA
Weight of Tare (g)	97.21	Weight of Tare (g)	NA
Weight of Water (g)	206.79	Weight of Water (g)	NA
Weight of Dry Sample (g)	326.49	Weight of Dry Sample (g)	NA
Moisture Content (%	**63.3**	**Moisture Content (%**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Sample (g)	326.49
Dry Weight of -3/4" Sample (g)	0.21	Weight of - #200 Material (g)	326.28
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 Material (g)	0.21
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00		100.00	**100.00**
#4	4.75	0.00	0.00	0.00		100.00	**100.00**
#10	2.00	0.00	0.00	0.00		100.00	**100.00**
#20	0.85	0.00	0.00	0.00		100.00	**100.00**
#40	0.425	0.00	0.00	0.00		100.00	**100.00**
#60	0.250	0.04	0.01	0.01		99.99	**99.99**
#140	0.106	0.13	0.04	0.05		99.95	**99.95**
#200	0.075	0.04	0.01	0.06		99.94	**99.94**
Pan	-	326.28	99.94	100.00		-	-

Tested By JP Date 9/12/15 Checked By KC Date 9/17/15

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B025
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	32.3-32.7
Project No.:	2015-485-001	Sample No.:	ST-3
Lab ID:	2015-485-001-023	Soil Color:	Gray

Elapsed Time		**R Measured**	**Temp.**	**Composite Correction**	**R Corrected**	**N**	**K Factor**	**Diameter**	**N'**
(min)			**(°C)**			**(%)**		**(mm)**	**(%)**
0		NA	NA	NA	NA	NA	NA	NA	NA
250		36.0	22.6	6.15	29.9	90.4	0.01303	0.0027	**90.4**
1440		30.5	22.8	6.07	24.4	74.0	0.01300	0.0012	**73.9**

Soil Specimen Data		**Other Corrections**		
Tare No.	633			
Weight of Tare & Dry Material (g)	133.79	a - Factor	0.99	
Weight of Tare (g)	96.10			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	99.94	
Weight of Dry Material (g)	32.7			
		Specific Gravity	2.7	Assumed

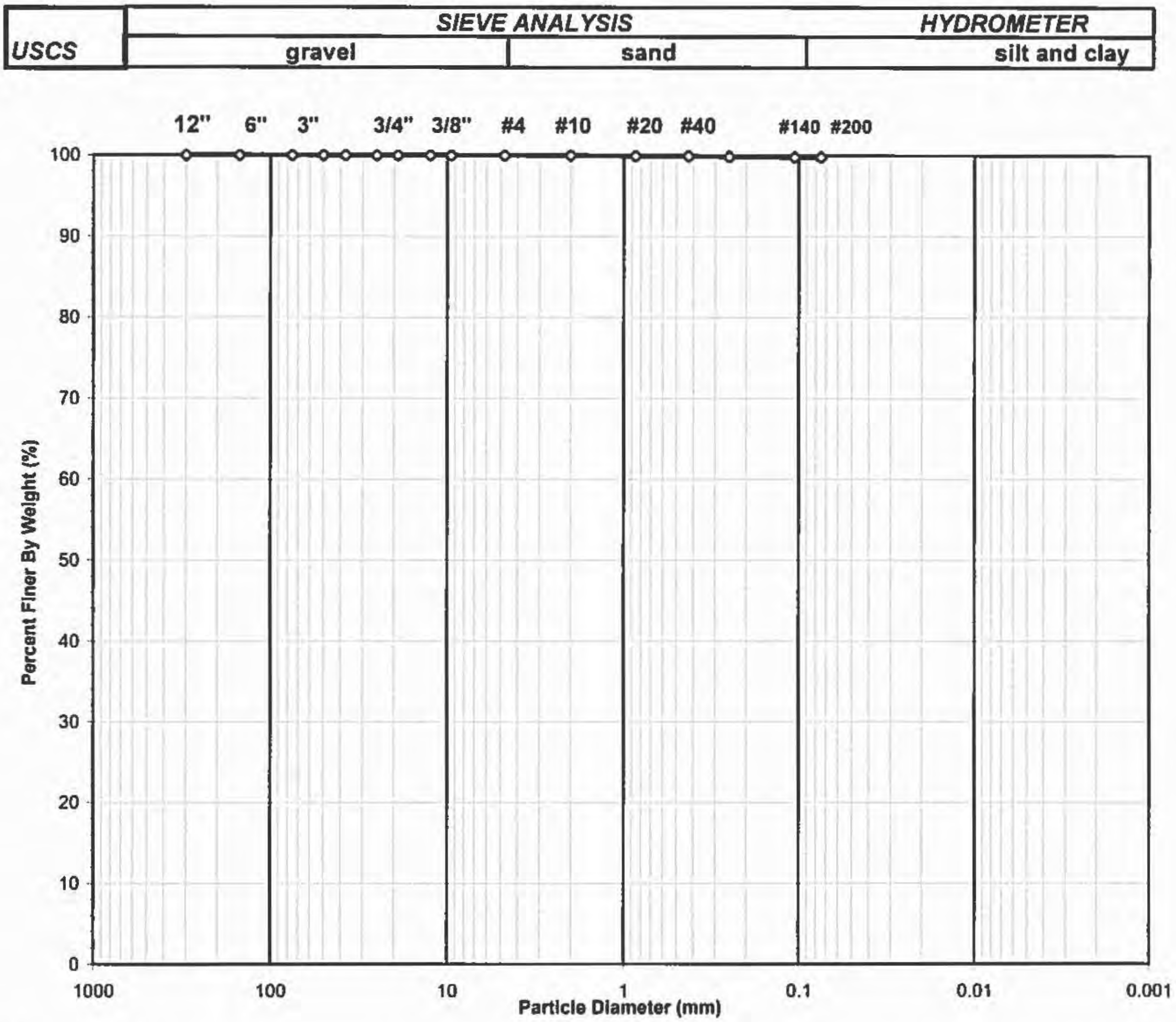
Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 9/15/15 Checked By KC Date 9/17/15

SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B025
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	36.0-37.5
Project No.:	2015-485-001	Sample No.:	SS-11
Lab ID:	2015-485-001-024	Soil Color:	Gray



USCS Symbol:

ml, ASSUMED

USCS Classification:

SILT

Tested By	JP	Date	9/12/15	Checked By	KC	Date	9/15/15

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B025
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	36.0-37.5
Project No.:	2015-485-001	Sample No.:	SS-11
Lab ID:	2015-485-001-024	Soil Color:	Gray

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	18	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	526.30	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	409.30	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	202.70	Weight of Tare (g):	NA
Weight of Water (g):	117.00	Weight of Water (g):	NA
Weight of Dry Sample (g):	206.60	Weight of Dry Sample (g):	NA
Moisture Content (%):	**56.6**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	206.60
Dry Weight of - 3/4" Sample (g):	0.5	Weight of - #200 Material (g):	206.13
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	0.47
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

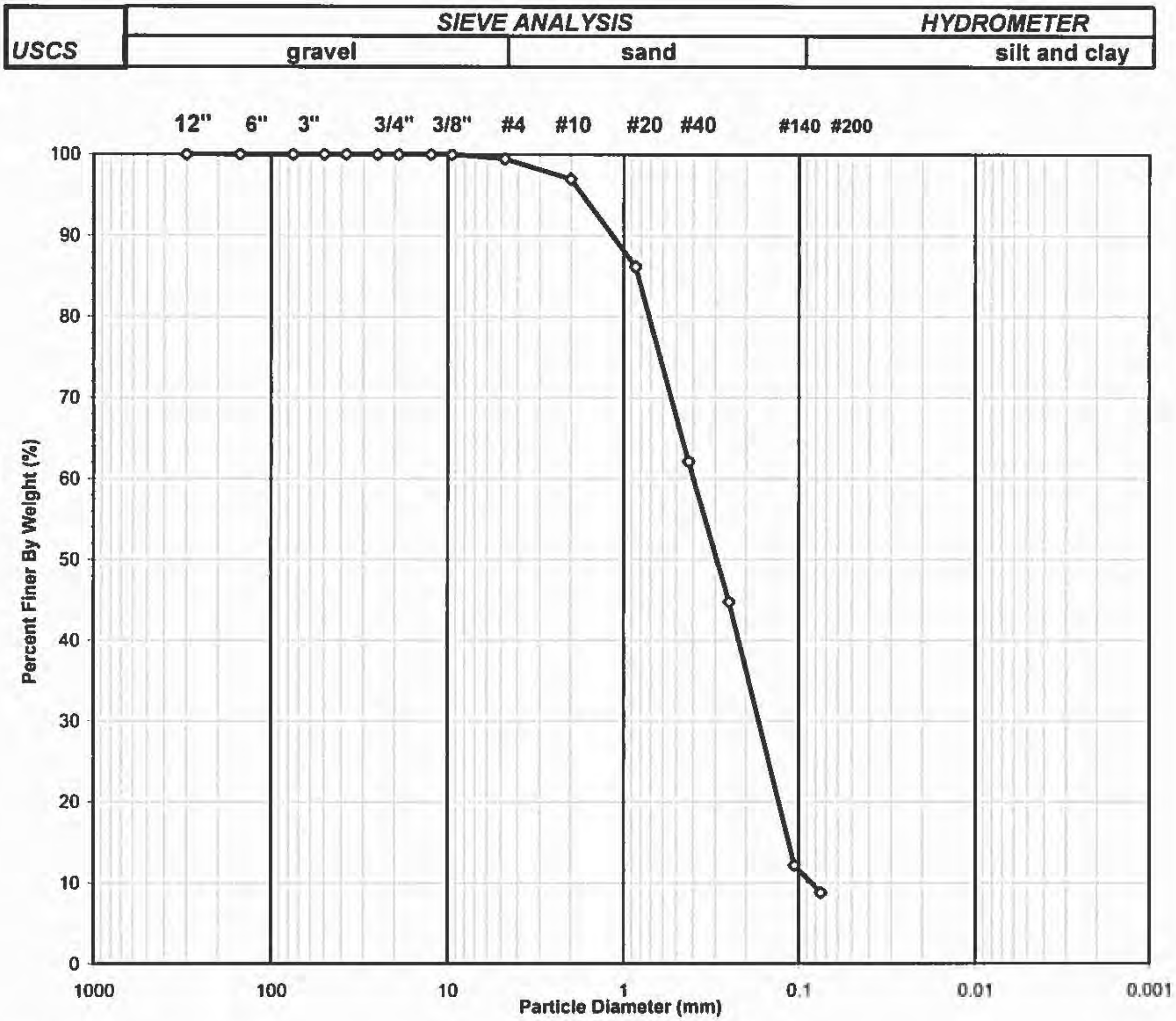
Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.04	0.02	0.02	99.98	**99.98**
#20	0.850	0.04	0.02	0.04	99.96	**99.96**
#40	0.425	0.09	0.04	0.08	99.92	**99.92**
#60	0.250	0.08	0.04	0.12	99.88	**99.88**
#140	0.106	0.13	0.06	0.18	99.82	**99.82**
#200	0.075	0.09	0.04	0.23	99.77	**99.77**
Pan	-	206.13	99.77	100.00	-	-

Tested By JP Date 9/12/15 Checked By KC Date 9/15/15

SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B025
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	43.5-45.0
Project No.:	2015-485-001	Sample No.:	SS-14
Lab ID:	2015-485-001-025	Soil Color:	Brown / Gray



USCS Symbol:

sp-sm, ASSUMED

D60 =	**0.40**	**CC =**	**0.85**
D30 =	**0.17**	**CU =**	**4.68**
D10 =	**0.09**		

USCS Classification:

POORLY GRADED SAND WITH SILT

Tested By JP Date 9/12/15 Checked By KC Date 9/15/15

page 1 of 2 **DCN: CT-S3C DATE 3/20/13 REVISION: 3**

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B025
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	43.5-45.0
Project No.:	2015-485-001	Sample No.:	SS-14
Lab ID:	2015-485-001-025	Soil Color:	Brown / Gray

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	41	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	649.70	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	577.30	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	205.85	Weight of Tare (g):	NA
Weight of Water (g):	72.40	Weight of Water (g):	NA
Weight of Dry Sample (g):	371.45	Weight of Dry Sample (g):	NA
Moisture Content (%):	**19.5**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	371.45
Dry Weight of - 3/4" Sample (g):	338.9	Weight of - #200 Material (g):	32.54
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	338.91
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	2.06	0.55	0.55	99.45	**99.45**
#10	2.00	9.31	2.51	3.06	96.94	**96.94**
#20	0.850	39.98	10.76	13.82	86.18	**86.18**
#40	0.425	89.47	24.09	37.91	62.09	**62.09**
#60	0.250	64.55	17.38	55.29	44.71	**44.71**
#140	0.106	121.00	32.58	87.86	12.14	**12.14**
#200	0.075	12.54	3.38	91.24	8.76	**8.76**
Pan	-	32.54	8.76	100.00	-	-

Tested By	JP	Date	9/12/15	Checked By	KC	Date	9/15/15

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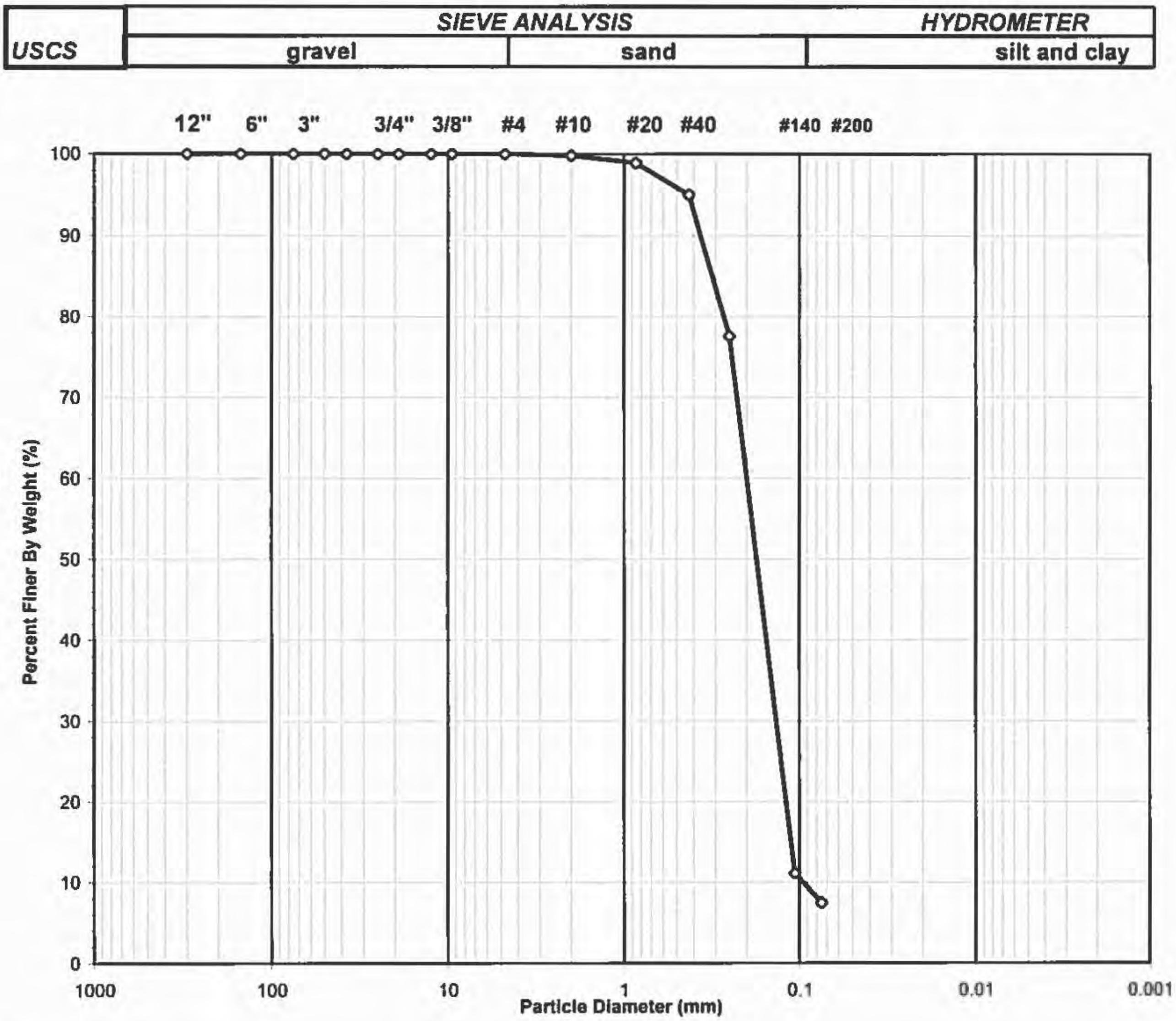
SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B025
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	48.5-50.0
Project No.:	2015-485-001	Sample No.:	SS-16
Lab ID:	2015-485-001-026	Soil Color:	Gray / Brown



USCS Symbol:
sp-sm, ASSUMED

USCS Classification:
POORLY GRADED SAND WITH SILT

D60 =	**0.20**	**CC =**	**0.96**
D30 =	**0.14**	**CU =**	**2.09**
D10 =	**0.10**		

Tested By JP Date 9/12/15 Checked By KC Date 9/15/15

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	AECOM	Boring No.:	WOR-B025
Client Reference:	Dynegy - Wood River Pwr. Sta. 60440115	Depth (ft):	48.5-50.0
Project No.:	2015-485-001	Sample No.:	SS-16
Lab ID:	2015-485-001-026	Soil Color:	Gray / Brown

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	61	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	589.90	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	510.70	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	205.33	Weight of Tare (g):	NA
Weight of Water (g):	79.20	Weight of Water (g):	NA
Weight of Dry Sample (g):	305.37	Weight of Dry Sample (g):	NA
Moisture Content (%):	**25.9**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	305.37
Dry Weight of - 3/4" Sample (g):	282.6	Weight of - #200 Material (g):	22.76
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	282.61
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.56	0.18	0.18	99.82	**99.82**
#20	0.850	2.90	0.95	1.13	98.87	**98.87**
#40	0.425	11.81	3.87	5.00	95.00	**95.00**
#60	0.250	53.30	17.45	22.45	77.55	**77.55**
#140	0.106	202.91	66.45	88.90	11.10	**11.10**
#200	0.075	11.13	3.64	92.55	7.45	**7.45**
Pan	-	22.76	7.45	100.00	-	-

Tested By JP Date 9/12/15 Checked By KC Date 9/15/15

APPENDIX B2

LABORATORY HYDRAULIC CONDUCTIVITY TEST RESULTS

PERMEABILITY TEST

ASTM D 5084-10

geotechnics
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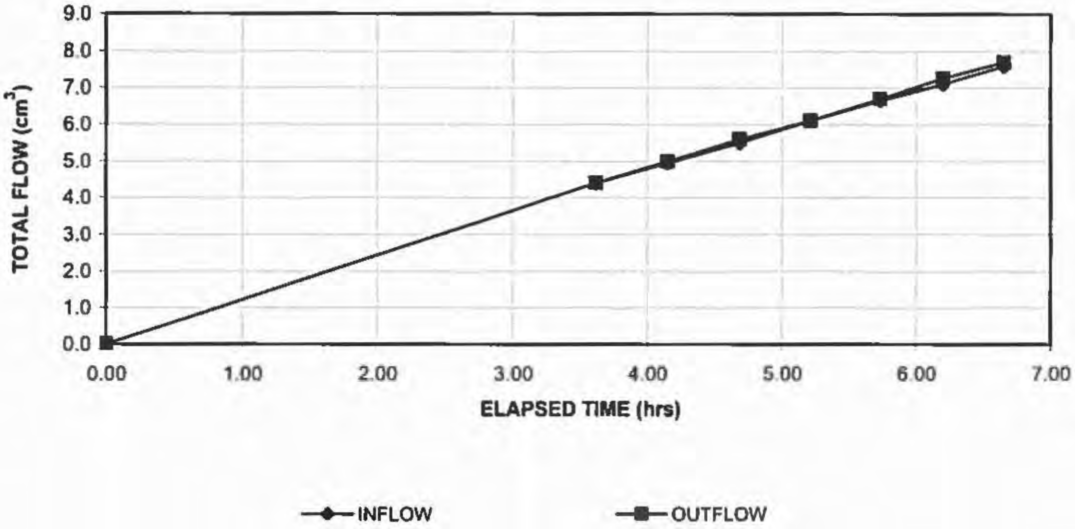
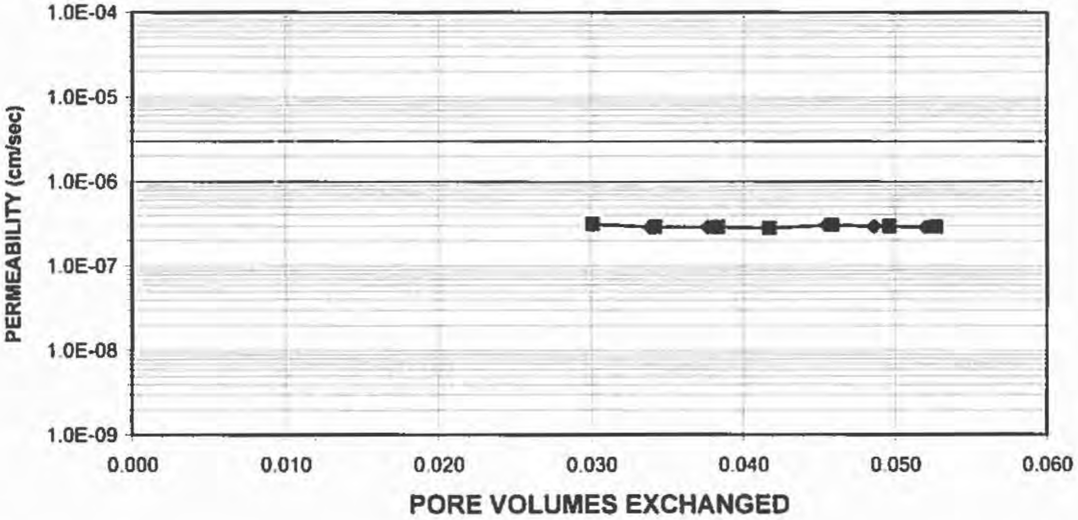
Client:	AECOM	Boring No.:	B-1
Client Project:	DYNEGY-Wood River Pwr. Sta. 60440115	Depth (ft):	41.7 - 41.9
Project No.:	2015-485-004	Sample No.:	ST-1
Lab ID No.:	2015-485-004-003		

AVERAGE PERMEABILITY = 2.9E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 2.9E-09 m/sec @ 20°C

TOTAL FLOW vs. ELAPSED TIME



PORE VOLUMES EXCHANGED vs. PERMEABILITY



Tested By: JAB Date: 9/28/15 Checked By: KC Date: 9/30/15

PERMEABILITY TEST

ASTM D 5084-10

geotechnics
geotechnical & geosynthetic testing

Client: AECOM
Client Project: DYNEGY-Wood River Pwr. Sta. 60440115
Project No.: 2015-485-004
Lab ID No.: 2015-485-004-003

Boring No.: B-1
Depth (ft): 41.7 - 41.9
Sample No.: ST-1

Specific Gravity: 2.70 Assumed
Sample Condition: Undisturbed

Visual Description: Gray Clay

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	577	875
Weight of Tare & Wet Sample (g)	279.21	741.71
Weight of Tare & Dry Sample (g)	234.28	604.90
Weight of Tare (g)	84.37	110.40
Weight of Water (g)	44.93	136.81
Weight of Dry Sample (g)	149.91	494.50
Moisture Content (%)	**30.0**	**27.7**

SPECIMEN:	BEFORE TEST	AFTER TEST
Weight of Tube & Wet Sample (g)	853.83	NA
Weight of Tube (g)	218.56	NA
Weight of Wet Sample (g)	635.27	624.00
Length 1 (in)	3.093	3.101
Length 2 (in)	3.073	3.097
Length 3 (in)	3.094	3.093
Top Diameter (in)	2.895	2.861
Middle Diameter (in)	2.879	2.858
Bottom Diameter (in)	2.884	2.875
Average Length (in)	3.09	3.10
Average Area (in^2)	6.54	6.45
Sample Volume (cm^3)	330.88	327.10
Unit Wet Weight (g/cm^3)	1.92	1.91
Unit Wet Weight (pcf)	119.8	119.1
Unit Dry Weight (pcf)	92.2	93.3
Unit Dry Weight (g/cm^3)	1.48	1.49
Void Ratio, e	0.83	0.81
Porosity, n	0.45	0.45
Pore Volume (cm^3)	149.9	146.1
Total Weight of Sample After Test (g)		631.6

Tested By: JAB Date: 9/28/15 Checked By: KC Date: 9/30/15

PERMEABILITY TEST

ASTM D 5084-10

Client:	AECOM	Boring No.:	B-1
Client Project:	DYNEGY-Wood River Pwr. Sta. 60440115	Depth (ft):	41.7 - 41.9
Project No.:	2015-485-004	Sample No.:	ST-1
Lab ID No.:	2015-485-004-003		

Pressure Heads (Constant)	
Top Cap (psi)	67.5
Bottom Cap (psi)	70.0
Cell (psi)	75.0
Total Pressure Head (cm)	175.8
Hydraulic Gradient	22.34

Final Sample Dimensions	
Sample Length (cm), L	7.87
Sample Diameter (cm)	7.28
Sample Area (cm^2), A	41.58
Inflow Burette Area (cm^2), a-in	0.866
Outflow Burette Area (cm^2), a-out	0.855
B Parameter (%)	97

AVERAGE PERMEABILITY = 2.9E-07 cm/sec @ 20°C

AVERAGE PERMEABILITY = 2.9E-09 m/sec @ 20°C

DATE (mm/dd/yy)	TIME (hr)	(min)	ELAPSED TIME t (hr)	TOTAL INFLOW (cm^3)	TOTAL OUTFLOW (cm^3)	TOTAL HEAD h (cm)	FLOW (0 flow) (1 stop)	TEMP. (°C)	INCREMENTAL PERMEABILITY @ 20°C (cm/sec)
9/29/15	8	36	0.000	0.0	0.0	200.8	0	21.5	NA
9/29/15	12	13	3.617	4.4	4.4	190.6	0	21.5	3.1E-07
9/29/15	12	45	4.150	5.0	5.0	189.3	0	21.5	2.9E-07
9/29/15	13	17	4.683	5.5	5.6	188.0	0	21.5	2.9E-07
9/29/15	13	49	5.217	6.1	6.1	186.7	0	21.5	2.8E-07
9/29/15	14	20	5.733	6.7	6.7	185.4	0	21.5	3.0E-07
9/29/15	14	48	6.200	7.1	7.3	184.2	0	21.5	2.9E-07
9/29/15	15	15	6.650	7.6	7.7	183.1	1	21.5	2.9E-07

Tested By: JAB Date: 9/28/15 Checked By: KC Date: 9/30/15

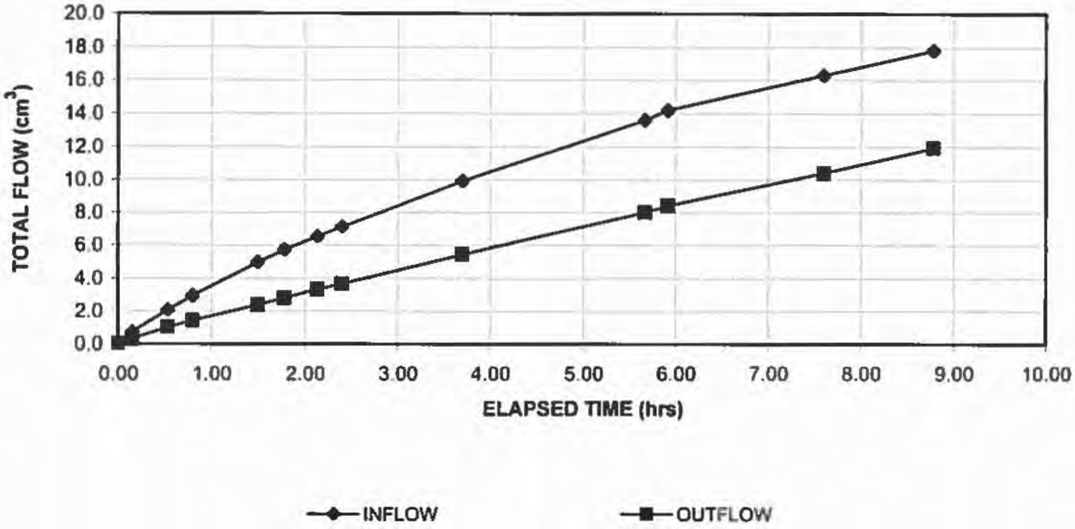
PERMEABILITY TEST

ASTM D 5084-10

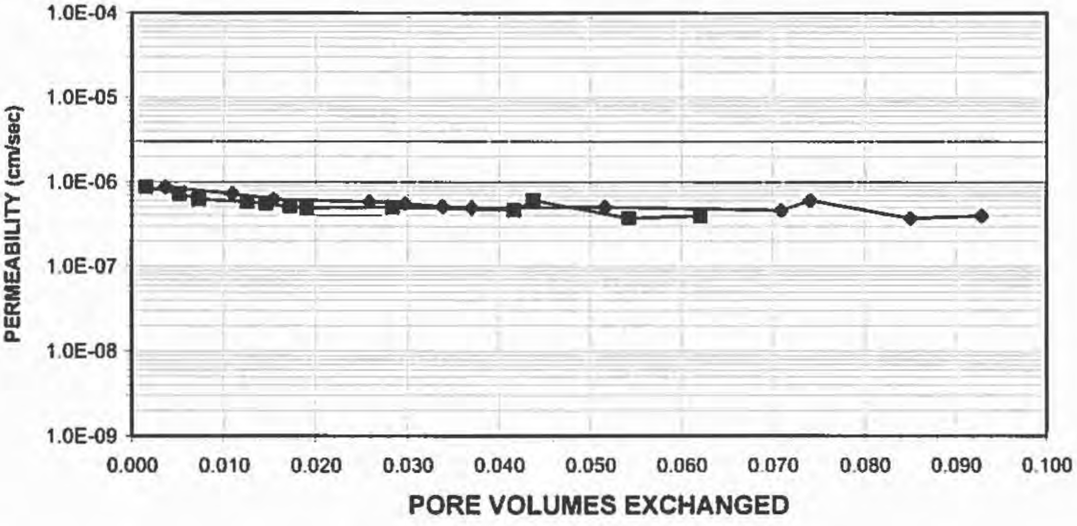
Client: AECOM
Client Project: DYNEGY-Wood River Pwr. Sta. 60440115
Project No.: 2015-485-004
Lab ID No.: 2015-485-004-016
Boring No.: B-4
Depth (ft): 31.7-31.9
Sample No.: ST-2

AVERAGE PERMEABILITY = 4.6E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 4.6E-09 m/sec @ 20°C

TOTAL FLOW vs. ELAPSED TIME



PORE VOLUMES EXCHANGED vs. PERMEABILITY



Tested By: JAB Date: 9/28/15 Checked By: KC Date: 10/2/15

PERMEABILITY TEST

ASTM D 5084-10

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Client: AECOM
Client Project: DYNEGY-Wood River Pwr. Sta. 60440115
Project No.: 2015-485-004
Lab ID No.: 2015-485-004-016

Boring No.: B-4
Depth (ft): 31.7-31.9
Sample No.: ST-2

Specific Gravity: 2.70 Assumed
Sample Condition: Undisturbed

Visual Description: Gray Silt

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	887	605
Weight of Tare & Wet Sample (g)	230.65	646.17
Weight of Tare & Dry Sample (g)	189.73	456.90
Weight of Tare (g)	109.63	86.42
Weight of Water (g)	40.92	189.27
Weight of Dry Sample (g)	80.10	370.48
Moisture Content (%)	**51.1**	**51.1**

SPECIMEN:	BEFORE TEST	AFTER TEST
Weight of Tube & Wet Sample (g)	785.70	NA
Weight of Tube (g)	218.18	NA
Weight of Wet Sample (g)	567.52	567.53
Length 1 (in)	3.119	3.166
Length 2 (in)	3.114	3.159
Length 3 (in)	3.105	3.134
Top Diameter (in)	2.882	2.855
Middle Diameter (in)	2.888	2.860
Bottom Diameter (in)	2.878	2.851
Average Length (in)	3.11	3.15
Average Area (in^2)	6.53	6.40
Sample Volume (cm^3)	332.90	330.85
Unit Wet Weight (g/cm^3)	1.70	1.72
Unit Wet Weight (pcf)	106.4	107.1
Unit Dry Weight (pcf)	70.4	70.9
Unit Dry Weight (g/cm^3)	1.13	1.14
Void Ratio, e	1.39	1.38
Porosity, n	0.58	0.58
Pore Volume (cm^3)	193.8	191.7
Total Weight of Sample After Test (g)		631.6

Tested By: JAB Date: 9/28/15 Checked By: KC Date: 10/2/15

PERMEABILITY TEST

ASTM D 5084-10

geotechnics
geotechnical & geosynthetic testing

Client:	AECOM	Boring No.:	B-4
Client Project:	DYNEGY-Wood River Pwr. Sta. 60440115	Depth (ft):	31.7-31.9
Project No.:	2015-485-004	Sample No.:	ST-2
Lab ID No.:	2015-485-004-016		

Pressure Heads (Constant)	
Top Cap (psi)	67.5
Bottom Cap (psi)	70.0
Cell (psi)	75.0
Total Pressure Head (cm)	175.8
Hydraulic Gradient	21.95

Final Sample Dimensions	
Sample Length (cm), L	8.01
Sample Diameter (cm)	7.25
Sample Area (cm^2), A	41.31
Inflow Burette Area (cm^2), a-in	0.861
Outflow Burette Area (cm^2), a-out	0.851
B Parameter (%)	98

AVERAGE PERMEABILITY = 4.6E-07 cm/sec @ 20°C

AVERAGE PERMEABILITY = 4.6E-09 m/sec @ 20°C

DATE (mm/dd/yy)	TIME (hr)	(min)	ELAPSED TIME t (hr)	TOTAL INFLOW (cm^3)	TOTAL OUTFLOW (cm^3)	TOTAL HEAD h (cm)	FLOW (0 flow) (1 stop)	TEMP. (°C)	INCREMENTAL PERMEABILITY @ 20°C (cm/sec)
9/30/15	8	48	0.000	0.0	0.0	199.6	0	21.3	NA
9/30/15	8	57	0.150	0.7	0.3	198.4	0	21.3	8.7E-07
9/30/15	9	20	0.533	2.1	1.0	196.0	0	21.3	7.2E-07
9/30/15	9	36	0.800	3.0	1.4	194.5	0	21.3	6.2E-07
9/30/15	10	18	1.500	5.0	2.4	191.0	0	21.3	5.8E-07
9/30/15	10	35	1.783	5.7	2.8	189.7	0	21.3	5.5E-07
9/30/15	10	56	2.133	6.5	3.3	188.2	0	21.3	5.1E-07
9/30/15	11	12	2.400	7.1	3.7	187.1	0	21.3	4.9E-07
9/30/15	12	30	3.700	9.9	5.5	181.7	0	21.3	5.0E-07
9/30/15	14	28	5.667	13.6	8.0	174.5	0	21.3	4.6E-07
9/30/15	14	43	5.917	14.2	8.4	173.3	0	21.3	6.0E-07
9/30/15	16	24	7.600	16.3	10.4	168.5	0	21.4	3.7E-07
9/30/15	17	35	8.783	17.8	11.9	165.0	1	21.5	3.9E-07

Tested By: JAB Date: 9/28/15 Checked By: KC Date: 10/2/15

PERMEABILITY TEST

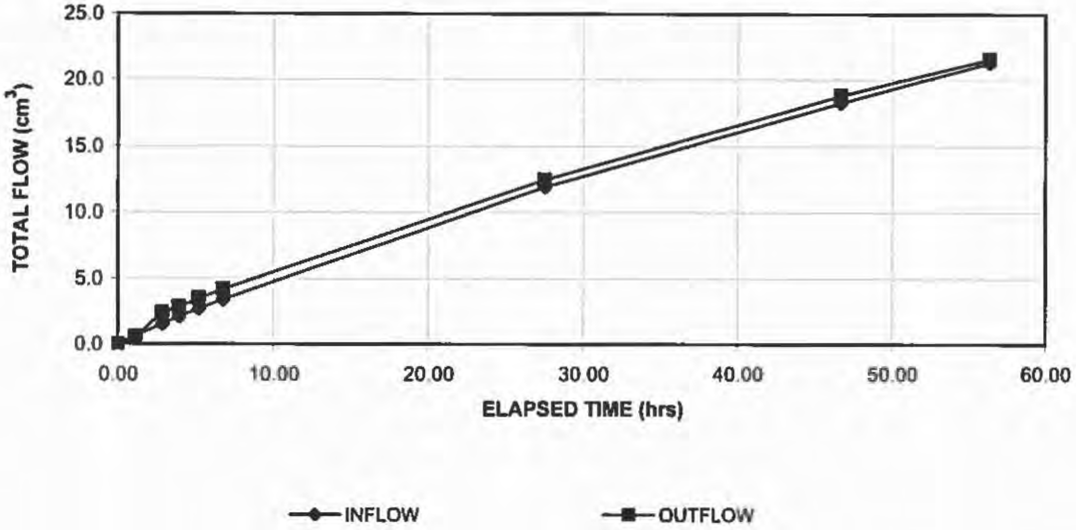
ASTM D 5084-10

Client:	AECOM	Boring No.:	WOR-B014
Client Project:	DYNEGY-Wood River Pwr. Sta. 60440115	Depth (ft):	28.95-29.2
Project No.:	2015-485-001	Sample No.:	ST-2
Lab ID No.:	2015-485-001-002		

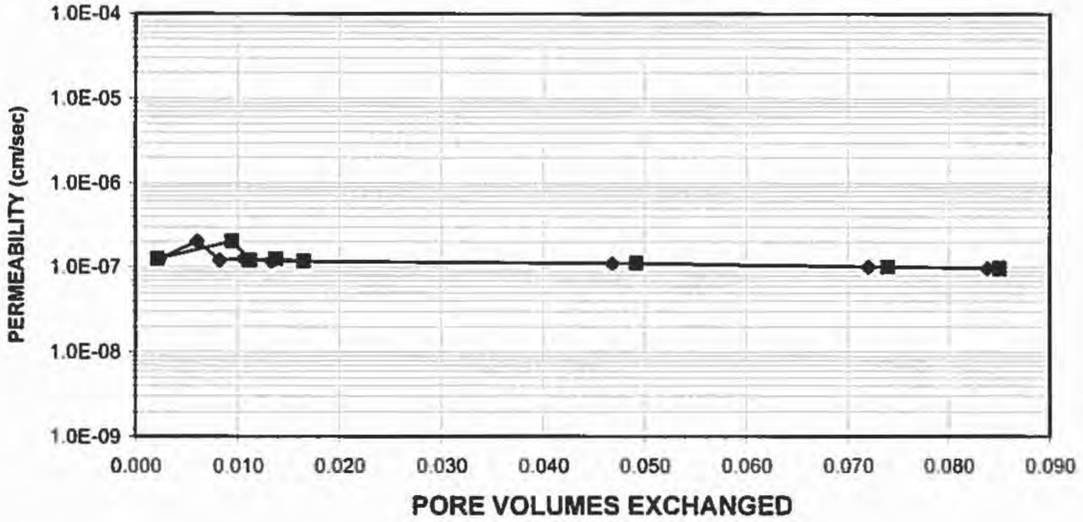
AVERAGE PERMEABILITY = 1.1E-07 cm/sec @ 20°C

AVERAGE PERMEABILITY = 1.1E-09 m/sec @ 20°C

TOTAL FLOW vs. ELAPSED TIME



PORE VOLUMES EXCHANGED vs. PERMEABILITY



Tested By: JAB Date: 9/10/15 Checked By: KC Date: 9/15/15

PERMEABILITY TEST

ASTM D 5084-10

Client:	AECOM	Boring No.:	WOR-B014
Client Project:	DYNEGY-Wood River Pwr. Sta. 60440115	Depth (ft):	28.95-29.2
Project No.:	2015-485-001	Sample No.:	ST-2
Lab ID No.:	2015-485-001-002		

Specific Gravity:	2.70	Assumed
Sample Condition:		Undisturbed

Visual Description: Gray Clay

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	3083	623
Weight of Tare & Wet Sample (g)	71.00	583.43
Weight of Tare & Dry Sample (g)	43.98	379.16
Weight of Tare (g)	6.52	83.41
Weight of Water (g)	27.02	204.27
Weight of Dry Sample (g)	37.46	295.75
Moisture Content (%)	**72.1**	**69.1**

SPECIMEN:	BEFORE TEST	AFTER TEST
Weight of Tube & Wet Sample (g)	548.51	NA
Weight of Tube (g)	212.80	NA
Weight of Wet Sample (g)	335.71	329.74
Length 1 (in)	3.048	3.108
Length 2 (in)	3.040	3.089
Length 3 (in)	3.031	3.115
Top Diameter (in)	2.871	2.856
Middle Diameter (in)	2.884	2.857
Bottom Diameter (in)	2.872	2.861
Average Length (in)	3.04	3.10
Average Area (in^2)	6.49	6.42
Sample Volume (cm^3)	323.51	326.32
Unit Wet Weight (g/cm^3)	1.04	1.01
Unit Wet Weight (pcf)	64.8	63.1
Unit Dry Weight (pcf)	37.6	37.3
Unit Dry Weight (g/cm^3)	0.60	0.60
Void Ratio, e	3.48	3.52
Porosity, n	0.78	0.78
Pore Volume (cm^3)	251.3	254.1
Total Weight of Sample After Test (g)		511.0

Tested By: JAB Date: 9/10/15 Checked By: KC Date: 9/15/15

PERMEABILITY TEST

ASTM D 5084-10

geotechnics geotechnical & geosynthetic testing

Client:	AECOM	Boring No.:	WOR-B014
Client Project:	DYNEGY-Wood River Pwr. Sta. 60440115	Depth (ft):	28.95-29.2
Project No.:	2015-485-001	Sample No.:	ST-2
Lab ID No.:	2015-485-001-002		

Pressure Heads (Constant)	
Top Cap (psi)	67.5
Bottom Cap (psi)	70.0
Cell (psi)	75.0
Total Pressure Head (cm)	175.8
Hydraulic Gradient	22.29

Final Sample Dimensions	
Sample Length (cm), L	7.88
Sample Diameter (cm)	7.26
Sample Area (cm^2), A	41.39
Inflow Burette Area (cm^2), a-in	0.897
Outflow Burette Area (cm^2), a-out	0.899
B Parameter (%)	98

AVERAGE PERMEABILITY = 1.1E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 1.1E-09 m/sec @ 20°C

DATE (mm/dd/yy)	TIME (hr)	(min)	ELAPSED TIME t (hr)	TOTAL INFLOW (cm^3)	TOTAL OUTFLOW (cm^3)	TOTAL HEAD h (cm)	FLOW (0 flow) (1 stop)	TEMP. (°C)	INCREMENTAL PERMEABILITY @ 20°C (cm/sec)
9/11/15	9	37	0.000	0.0	0.0	202.5	0	22.0	NA
9/11/15	10	46	1.150	0.6	0.6	201.2	0	22.0	1.2E-07
9/11/15	12	30	2.883	1.6	2.4	198.1	0	21.8	2.0E-07
9/11/15	13	33	3.933	2.1	2.9	197.0	0	21.8	1.2E-07
9/11/15	14	51	5.233	2.7	3.5	195.6	0	21.5	1.2E-07
9/11/15	16	24	6.783	3.4	4.2	194.0	0	21.5	1.2E-07
9/12/15	13	10	27.550	11.9	12.5	175.4	0	21.5	1.1E-07
9/13/15	8	20	46.717	18.3	18.8	161.3	0	21.4	1.0E-07
9/13/15	18	0	56.383	21.3	21.6	154.8	1	21.4	9.7E-08

Tested By: JAB Date: 9/10/15 Checked By: KC Date: 9/15/15

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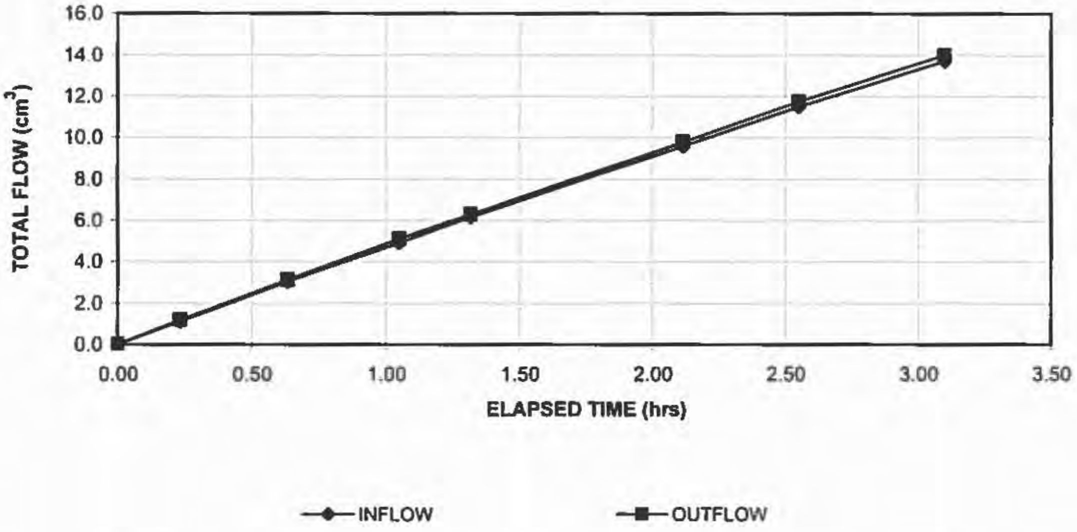
PERMEABILITY TEST

ASTM D 5084-10

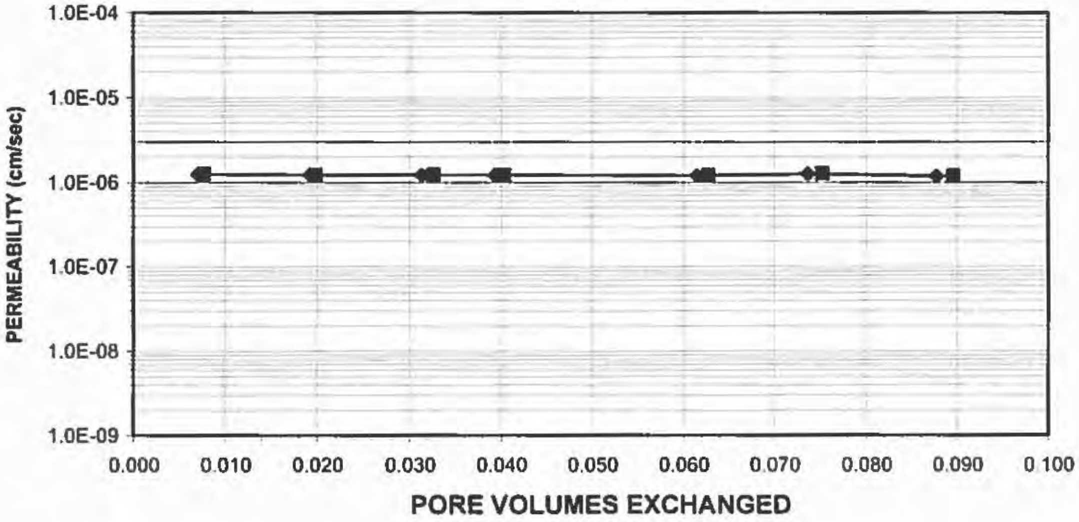
Client:	AECOM	Boring No.:	WOR-B022
Client Project:	DYNEGY-Wood River Pwr. Sta. 60440115	Depth (ft):	17.8 - 18.2
Project No.:	2015-485-010	Sample No.:	ST-2
Lab ID No.:	2015-485-010-001		

AVERAGE PERMEABILITY = 1.2E-06 cm/sec @ 20°C
AVERAGE PERMEABILITY = 1.2E-08 m/sec @ 20°C

TOTAL FLOW vs. ELAPSED TIME



PORE VOLUMES EXCHANGED vs. PERMEABILITY



Tested By: TRE Date: 11/11/15 Checked By: KC Date: 11/13/15

geotechnics
geotechnical & geosynthetic testing

PERMEABILITY TEST
ASTM D 5084-10

Client: AECOM
Client Project: DYNEGY-Wood River Pwr. Sta. 60440115
Project No.: 2015-485-010
Lab ID No.: 2015-485-010-001

Boring No.: WOR-B022
Depth (ft): 17.8 - 18.2
Sample No.: ST-2

Specific Gravity: 2.70 Assumed
Sample Condition: Undisturbed

Visual Description: Gray Clay

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	1706	881
Weight of Tare & Wet Sample (g)	186.57	669.31
Weight of Tare & Dry Sample (g)	160.96	529.30
Weight of Tare (g)	82.74	110.35
Weight of Water (g)	25.61	140.01
Weight of Dry Sample (g)	78.22	418.95
Moisture Content (%)	**32.7**	**33.4**

SPECIMEN:	BEFORE TEST	AFTER TEST
Weight of Tube & Wet Sample (g)	568.56	NA
Weight of Tube (g)	0.00	NA
Weight of Wet Sample (g)	568.56	571.47
Length 1 (in)	3.085	2.961
Length 2 (in)	3.096	3.026
Length 3 (in)	3.088	3.006
Top Diameter (in)	2.873	2.835
Middle Diameter (in)	2.856	2.860
Bottom Diameter (in)	2.848	2.875
Average Length (in)	3.09	3.00
Average Area (in^2)	6.42	6.41
Sample Volume (cm^3)	325.04	314.84
Unit Wet Weight (g/cm^3)	1.75	1.82
Unit Wet Weight (pcf)	109.2	113.3
Unit Dry Weight (pcf)	82.3	84.9
Unit Dry Weight (g/cm^3)	1.32	1.36
Void Ratio, e	1.05	0.98
Porosity, n	0.51	0.50
Pore Volume (cm^3)	166.4	156.2
Total Weight of Sample After Test (g)		559.3

Tested By: TRE Date: 11/11/15 Checked By: KC Date: 11/13/15

PERMEABILITY TEST

ASTM D 5084-10

Client:	AECOM	Boring No.:	WOR-B022
Client Project:	DYNEGY-Wood River Pwr. Sta. 60440115	Depth (ft):	17.8 - 18.2
Project No.:	2015-485-010	Sample No.:	ST-2
Lab ID No.:	2015-485-010-001		

Pressure Heads (Constant)	
Top Cap (psi)	67.5
Bottom Cap (psi)	70.0
Cell (psi)	75.0
Total Pressure Head (cm)	175.8
Hydraulic Gradient	23.08

Final Sample Dimensions	
Sample Length (cm), L	7.61
Sample Diameter (cm)	7.26
Sample Area (cm^2), A	41.35
Inflow Burette Area (cm^2), a-in	0.866
Outflow Burette Area (cm^2), a-out	0.855
B Parameter (%)	100

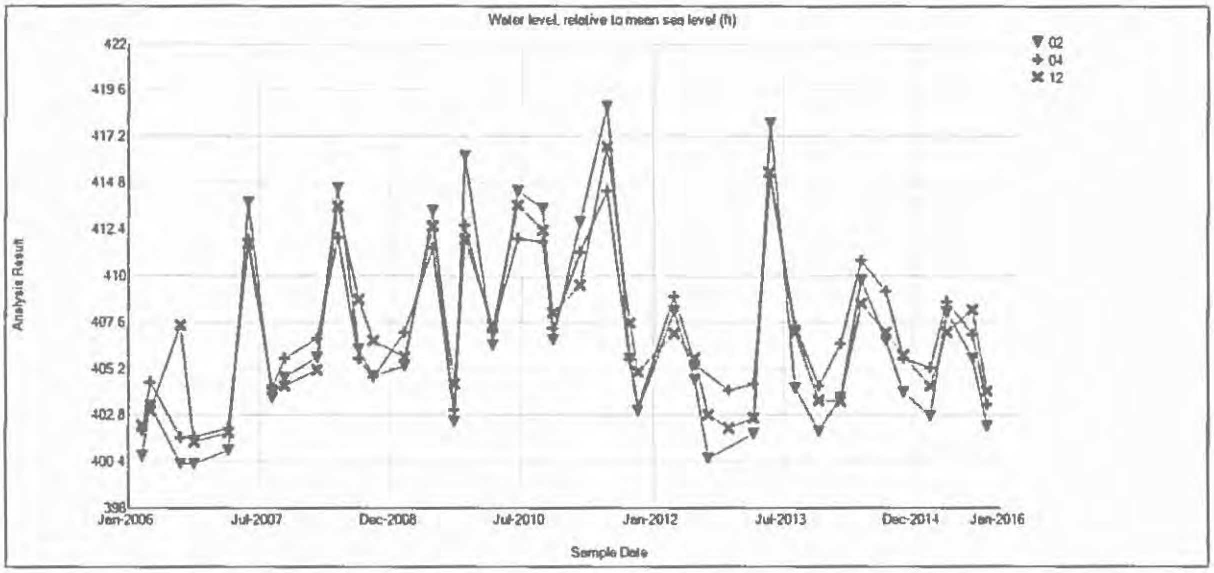
AVERAGE PERMEABILITY = 1.2E-06 cm/sec @ 20°C
AVERAGE PERMEABILITY = 1.2E-08 m/sec @ 20°C

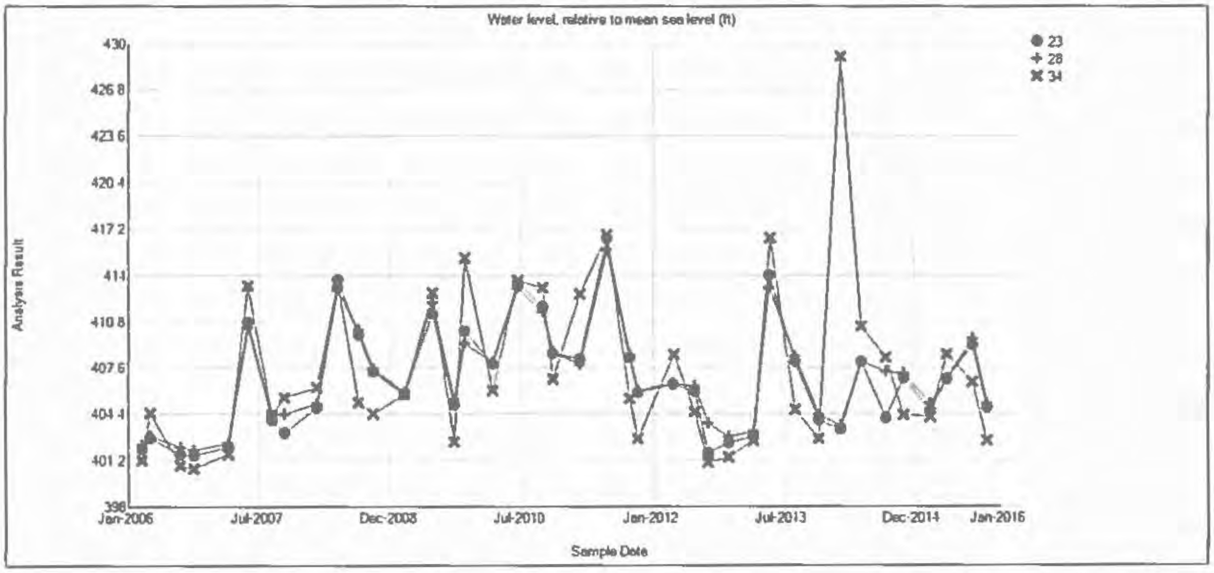
DATE (mm/dd/yy)	TIME (hr)	(min)	ELAPSED TIME t (hr)	TOTAL INFLOW (cm^3)	TOTAL OUTFLOW (cm^3)	TOTAL HEAD h (cm)	FLOW (0 flow) (1 stop)	TEMP. (°C)	INCREMENTAL PERMEABILITY @ 20°C (cm/sec)
11/12/15	8	44	0.000	0.0	0.0	200.8	0	20.7	NA
11/12/15	8	58	0.233	1.1	1.2	198.1	0	20.7	1.2E-06
11/12/15	9	22	0.633	3.0	3.1	193.7	0	20.7	1.2E-06
11/12/15	9	47	1.050	4.9	5.1	189.2	0	20.7	1.2E-06
11/12/15	10	3	1.317	6.2	6.3	186.4	0	20.7	1.2E-06
11/12/15	10	51	2.117	9.6	9.8	178.4	0	20.7	1.2E-06
11/12/15	11	17	2.550	11.5	11.8	173.9	0	20.7	1.3E-06
11/12/15	11	50	3.100	13.7	14.0	168.8	1	20.7	1.2E-06

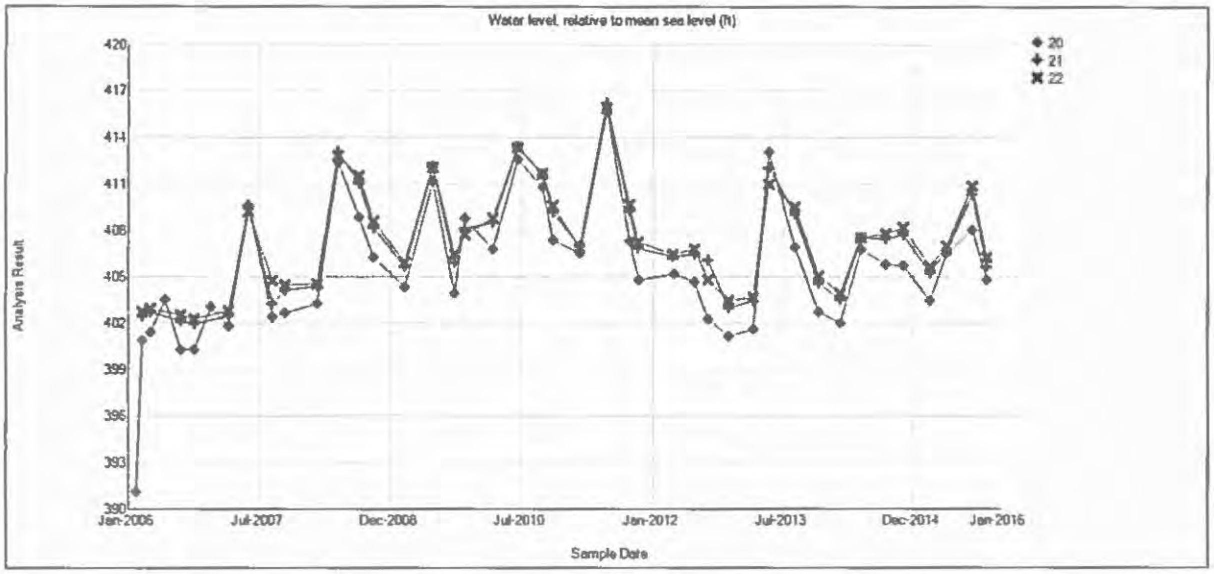
Tested By: TRE Date: 11/11/15 Checked By: KC Date: 11/13/15

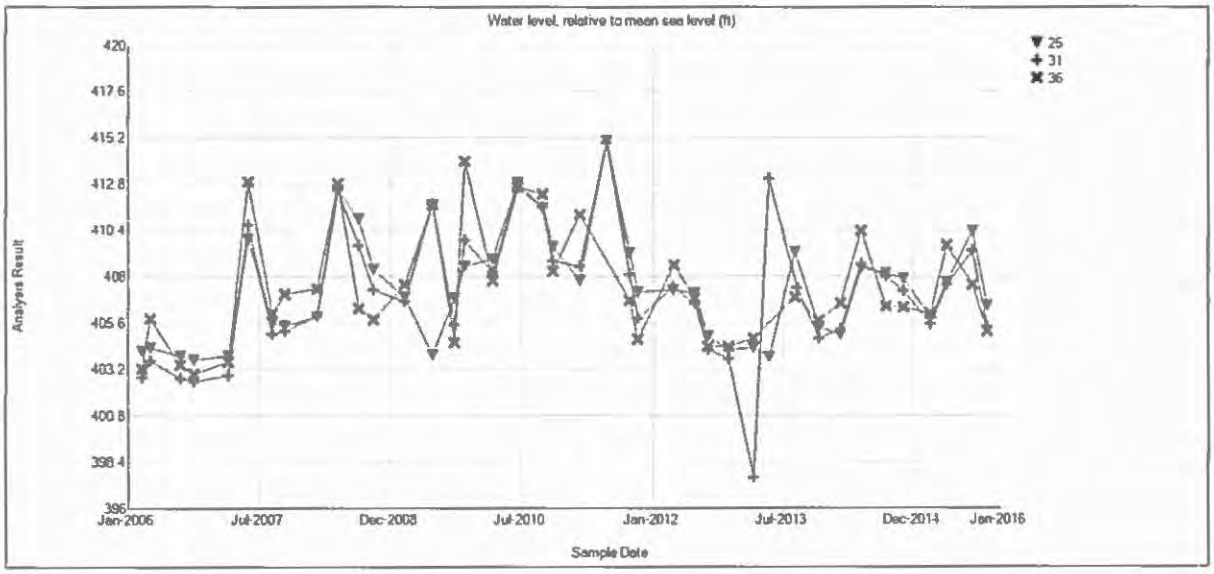
APPENDIX C

MONITORING WELL HYDROGRAPHS (2006-2015)


Water level, relative to mean sea level (ft)
▼ 02
+ 04
✖ 12
Analysis Result
422
419.6
417.2
414.8
412.4
410
407.6
405.2
402.8
400.4
398
Jan-2006
Jul-2007
Dec-2008
Jul-2010
Jan-2012
Jul-2013
Dec-2014
Jan-2016
Sample Date


Water level, relative to mean sea level (ft)
● 23
+ 28
✖ 34
Analysis Result
430
426.8
423.6
420.4
417.2
414
410.8
407.6
404.4
401.2
398
Jan-2006
Jul-2007
Dec-2008
Jul-2010
Jan-2012
Jul-2013
Dec-2014
Jan-2016
Sample Date


Water level, relative to mean sea level (ft)
◆ 20
✚ 21
✖ 22
Analysis Result
420
417
414
411
408
405
402
399
396
393
390
Jan-2006
Jul-2007
Dec-2008
Jul-2010
Jan-2012
Jul-2013
Dec-2014
Jan-2016
Sample Date


Water level, relative to mean sea level (ft)
▼ 25
✚ 31
✖ 36
Analysis Result
420
417.6
415.2
412.8
410.4
408
405.6
403.2
400.8
398.4
396
Jan-2006
Jul-2007
Dec-2008
Jul-2010
Jan-2012
Jul-2013
Dec-2014
Jan-2016
Sample Date

APPENDIX D

WATER WELL LOCATIONS AND RECORDS WITHIN 2,500-FOOT RADIUS OF PROPERTY BOUNDARY, WOOD RIVER POWER STATION

LEGEND

- WATER WELL LOCATION
- ASH POND
- APPROXIMATE PROPERTY BOUNDARY
- 2500 FT. RADIUS FROM PROPERTY BOUNDARY
- GROUNDWATER MANAGEMENT ZONE
- CWS PHASE 1 WELLHEAD PROTECTION AREA
- CWS PHASE 2 WELLHEAD PROTECTION AREA
- ADOPTED MAXIMUM SETBACK ZONE

SOURCE:
2007 DIGITAL ORTHOPHOTOS FROM THE NATIONAL MAP SEAMLESS SERVER (http://seamless.usgs.gov), AND REFERENCE UTM ZONE 15 NAD83 (meter) COORDINATE SYSTEM.

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY SOURCE WATER ASSESSMENT PROGRAM (SWAP) ArcIMS MAPPING TOOL (http://maps.epa.state.il.us/website/swap/intro.html)

ILLINOIS STATE GEOLOGICAL SURVEY, DIGITAL WATER WELL RECORDS INTERACTIVE MAP (http://www.isgs.illinois.edu/maps-data-pub/wwdb/wwdb.shtml)

N

0 600 1200
SCALE IN FEET

AERIAL PHOTOGRAPH WITH WATER WELLS

WATER WELL SURVEY
WOOD RIVER POWER STATION
WOOD RIVER, ILLINOIS

DRAWN BY: RLH DATE: 06/01/09
CHECKED BY: RJC DATE: 06/01/09
APPROVED BY: RJC DATE: 06/01/09
DRAWING NO: 1957-2-B02C
REFERENCE: 03556537.tif, 23301363.tif, 55874701.tif, 77718002.tif

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
1957/2.0

FIGURE NO.
2

KELRON environmental

Appendix D

Water Well Records Within 2,500-Foot Radius of Property Boundary Wood River Power Station; East Alton, Illinois

Map Well #	Source of Well Information				Location Name at Time of Well Completion	Well Depth	County	Location				Year Drilled	Aquifer Type	Formation	Well Use
	ISGS	ISWS**	IEPA	Other				Township	Range	Section	Subsection				
1	121190262400	12860	02624	--	Wood River Dr.& Levee Dist (Well #94)	75	Madison	5N	9W	19	NW/NW/SE	1971	unconsolidated	sand and gravel (shale at 75 feet)	IC
2	121192549600	017966	25496	--	Alberici-Eby	112	Madison	5N	9W	19	SW/NW/SE	1990	unconsolidated	sand and gravel	IC
3	121192565100	017965	25651	--	Alberici-Eby	90	Madison	5N	9W	19	SW/NW/SE	1990	unconsolidated	sand and gravel	IC
4	121190262500	**	02625	--	Wood River Dr.& Levee Dist (Well #95)	96	Madison	5N	9W	19	SW/NW/SE	1971	unconsolidated	sand and gravel	IC
5	121190262600	**	02626	--	Wood River Dr.& Levee Dist (Well #96)	102	Madison	5N	9W	19	SW/NW/SE	1971	unconsolidated	sand and gravel	IC
6	121190262700	**	02627	--	Wood River Dr.& Levee Dist (Well #97)	92	Madison	5N	9W	19	SW/NW/SE	1971	unconsolidated	sand and gravel	IC
7	121190262800	**	02628	--	Wood River Dr.&Levee Dist (Well #97X)	93	Madison	5N	9W	19	SW/NW/SE	1971	unconsolidated	sand and gravel	IC
8	121190262900	**	02629	--	Wood River Dr.&Levee Dist. (Well #98)	98	Madison	5N	9W	19	SE/NW/SE	1972	unconsolidated	sand and gravel	IC
9	121190263000	**	02630	--	Wood River Dr.&Levee Dist. (Well #99)	90	Madison	5N	9W	19	SE/NW/SE	1971	unconsolidated	sand and gravel	IC
10	121190263100	**	02631	--	Wood River Dr.&Levee Dist (Well #100)	92	Madison	5N	9W	19	SE/NW/SE	1971	unconsolidated	sand and gravel	IC
11	121190233300	NF 5874	02333	Olin	Mathieson, Olin (Well #2)	95	Madison	5N	9W	20	SW/SW/SE	1969	unconsolidated	sand and gravel	IC
12	121190233400	NF 5873	02334	Olin	Mathieson, Olin (Well #3)	93	Madison	5N	9W	20	SW/SW/SE	1969	unconsolidated	sand and gravel	IC
13	121190233500	NF 5875	02335	Olin	Mathieson, Olin (Well #4)	89	Madison	5N	9W	20	SE/SW/SE	1969	unconsolidated	sand and gravel	IC
14	121190233600	NF 5876	02336	Olin	Mathieson, Olin (Well #5)	87	Madison	5N	9W	20	SE/SW/SE	1969	unconsolidated	sand and gravel	IC
15	121192789700	**	27897	--	Olin Corporation	--	Madison	5N	9W	29	NE/NW/NE	--	--	--	IC
16	121192789800	**	27898	--	Olin Corporation	--	Madison	5N	9W	29	NE/NW/NE	--	--	--	IC
17	121192789600	**	27896	--	Olin Corporation	--	Madison	5N	9W	29	NW/NW/NE	--	--	--	IC
18	121190083100	**	00831	Olin	Mathieson, Olin Chemical Corp. (Ranney Well)	87	Madison	5N	9W	29	NE/SE/NW	1958	unconsolidated	sand and gravel	IC
19	121190233200	NF 5872	02332	Olin	Mathieson, Olin (Well #1)	117	Madison	5N	9W	20	SE/SW/NE	1969	unconsolidated	sand and gravel	IC
20	121190214100	**	60058	SWA	East Alton, City of (Well #2)	92	Madison	5N	9W	29	NW/NW/NE	1967	unconsolidated	sand and gravel	CWS
21	121190145800	**	60059	SWA	East Alton, City of (Well #3)	103	Madison	5N	9W	29	NW/NW/NE	--	--	--	CWS
22	121192446200	118416	60060	SWA	East Alton, City of (Well #4)	108	Madison	5N	9W	20	NW/NW/NE	1985	unconsolidated	sand and gravel	CWS
23	121192614300	E891782	00715	SWA	East Alton, City of #5	91	Madison	5N	9W	20	NW/NW/NE	1989	unconsolidated	sand and gravel	CWS
24	121192736600	E900108	00697	SWA	East Alton, City of (Well #7)	91	Madison	5N	9W	20	NW/NW/NE	--	unconsolidated	sand and gravel	CWS
25	121192748500	**	27485	--	International Mill Service	97	Madison	5N	9W	17	SW/SW/SW	1999	unconsolidated	sand and gravel shale at 90 feet	IC
26	121190161200	**	01612	--	Alton Boxboard & Paper Co. (Well #1)	94	Madison	5N	9W	18	NE/SW/SE	1928	unconsolidated	sand and gravel	IC
27	121190161300	**	01613	--	Alton Boxboard & Paper Co. (Well #2)	94	Madison	5N	9W	18	NW/SW/SE	1930	unconsolidated	sand and gravel	IC
28	121190161400	**	01614	--	Alton Boxboard & Paper Co. (Well #3)	90	Madison	5N	9W	18	NW/SW/SE	1931	unconsolidated	sand and gravel	IC
29	121190159900	**	01599	--	Alton Boxboard Co. (Well #3)	96	Madison	5N	9W	18	SW/SW/SE	1937	unconsolidated	sand and gravel	IC
30	121190161500	**	01615	--	Alton Boxboard & Paper Co. (Well #4)	90	Madison	5N	9W	18	NE/SW/SE	1931	unconsolidated	sand and gravel	IC
31	121190161600	**	01616	--	Alton Boxboard & Paper Co. (Well #5)	90	Madison	5N	9W	18	NW/SW/SE	1931	unconsolidated	sand and gravel	IC
32	121190160000	**	01600	--	Alton Boxboard Co. (Well #6)	109	Madison	5N	9W	18	NW/SW/SE	1937	unconsolidated	sand and gravel	IC
33	121190160100	**	01601	--	Alton Boxboard Co. (Well #7)	86	Madison	5N	9W	18	NE/SW/SE	1938	unconsolidated	sand and gravel	IC
34	121190160200	**	01602	--	Alton Boxboard Co. (Well #8)	96	Madison	5N	9W	18	SE/SW/SE	1938	unconsolidated	sand and gravel	IC
35	121190160300	**	01603	--	Alton Boxboard Co. (Well #9)	72	Madison	5N	9W	18	SE/NW/SE	1940	unconsolidated	sand and gravel	IC
36	121190160400	**	01604	--	Alton Boxboard Co. (Well #10)	99	Madison	5N	9W	18	SW/NW/SE	1940	unconsolidated	sand and gravel	IC
37	121190160500	**	01605	--	Alton Boxboard Co. (Well #16)	107	Madison	5N	9W	18	SE/NE/SW	1946	unconsolidated	sand and gravel	IC
38	121190161800	**	01618	--	Laclede Steel Co. (Well #2)	93	Madison	5N	9W	18	SW/NW/SE	--	unconsolidated	sand and gravel bedrock at 93 feet	IC
39	121190162000	**	01620	--	Leclede Steel Co (Well #4)	94	Madison	5N	9W	18	SW/NE/SW	1927	unconsolidated	sand and gravel	IC
40	121190162100	**	01621	--	Laclede Steel Co. (Well #5)	93	Madison	5N	9W	18	SE/NE/SW	1929	unconsolidated	sand and gravel	IC
41	121190162200	**	01622	--	Amer. Smelting & Ref.	85	Madison	5N	9W	19	NW/NW/NE	1913	--	--	IC
42	121190162300	**	01623	--	Amer. Smelting & Ref.	85	Madison	5N	9W	19	NW/NW/NE	1915	unconsolidated	sand and gravel	IC

Table 1. Water Well Records Within 2,500-Foot Radius of Property Boundary
Wood River Power Station; East Alton, Illinois

Map	Source of Well Information				Location Name	Well		Location				Year	Aquifer		Well
Well #	ISGS	ISWS**	IEPA	Other	at Time of Well Completion	Depth	County	Township	Range	Section	Subsection	Drilled	Type	Formation	Use
A	121192549700	018101	25497	- -	Kienstra Cement Inc. (Well #2)	79	Madison	Well is incorrectly located in ISGS/IEPA databases in NE/NE/SE, S19, T5N, R9W. Well is >1 mile from WRPS property boundary.				1990	unconsolidated	sand and gravel	IC
A	121192777500	**	27775	- -	Jefferson Smurfit Corp. (Well #25)	76	Madison	Well is incorrectly located in ISGS/IEPA databases in SW/SW/SW, S18, T5N, R9W. Well is >1 mile from WRPS property boundary.				1997	unconsolidated	sand and gravel	IC
A	121190064000	**	00640	- -	Owens-Illinois Glass Co. (Well #5)	82	Madison	Well is incorrectly located in ISGS/IEPA databases in NW/NW/NW, S19, T5N, R9W. Well is >1 mile from WRPS property boundary.				1956	unconsolidated	sand and gravel	IC

Sources of Information

IEPA	Illinois Environmental Protection Agency
ISGS	Illinois State Geological Survey
ISWS	Illinois State Water Survey
SWA	IEPA Source Water Assessment
Olin	2005 Correspondence from Olin Corporation

Well Use

FD	Farm and/or Domestic Water Well
IC	Industrial/Commercial Water Well
CWS	Community Water Supply
NCWS	Non-Community Water Supply

Notes

- -	Not applicable or no information available
**	ISWS data pending
A	Well is mislocated in ISGS and/or IEPA databases

APPENDIX E

GROUNDWATER QUALITY DATA

Wood River
Groundwater Monitoring Data for the West Ash Pond System: 2010 - 2015

Date Range: 01/01/2010 to 12/31/2015

Well Id	Date Sampled	Lab Id	Boron, dissolved, mg/L	Manganese, dissolved, mg/L	pH (field), SU	Water level, relative to, ft
02	03/02/2010					406.4
	06/14/2010		2.400	1.000	6.770	414.4
	09/27/2010					413.5
	11/09/2010		2.200	0.7700	6.730	406.7
	03/03/2011					412.8
	06/23/2011		2.200	0.8400	6.740	418.8
	09/27/2011					405.7
	11/01/2011		2.700	0.9600	6.870	403.0
	03/28/2012					408.2
	06/26/2012		2.300	0.7700	6.600	404.6
	08/21/2012					400.5
	02/27/2013					401.8
	05/06/2013		2.890	1.300	6.960	417.9
	08/20/2013					404.2
	11/25/2013		2.560	1.210	7.040	401.9
	02/26/2014					403.7
	05/22/2014		3.230	1.070	7.190	409.8
	09/03/2014					406.6
	11/18/2014		2.890	1.180	7.000	404.0
	03/11/2015					402.7
	05/21/2015		2.500	1.360	6.830	408.1
	09/04/2015					405.7
	11/03/2015		3.450	1.980	6.950	402.2
04	03/02/2010					407.1
	06/14/2010		0.3300	8.700	6.600	411.9
	09/27/2010					411.7
	11/09/2010		0.3600	5.400	6.670	407.3
	03/03/2011					411.2
	06/23/2011		0.3800	5.200	6.540	414.4
	09/27/2011					405.7
	11/01/2011		0.4900	6.300	6.570	403.2
	03/28/2012					408.9
	06/26/2012		0.4300	5.800	6.480	405.4
	11/14/2012		0.3600	5.980	6.760	404.1
	02/27/2013					404.4
	05/06/2013		0.3300	6.770	6.640	415.1
	08/20/2013					407.4

Wood River
Groundwater Monitoring Data for the West Ash Pond System: 2010 - 2015

Date Range: 01/01/2010 to 12/31/2015

		Boron, dissolved, mg/L	Manganese, dissolved, mg/L	pH (field), SU	Water level, relative to, ft
04	11/25/2013	0.3200	6.460	6.970	404.3
	02/26/2014				406.5
	05/22/2014	0.3510	4.910	6.970	410.8
	09/03/2014				409.2
	11/18/2014	0.3480	6.120	6.890	405.7
	03/11/2015				405.2
	05/21/2015	0.4440	5.230	6.880	408.7
	09/04/2015				406.9
	11/03/2015	0.3970	6.400	7.010	403.3
12	03/02/2010				407.4
	06/14/2010	2.000	0.4200	6.760	413.6
	09/27/2010				412.3
	11/09/2010	1.300	0.3100	6.950	408.1
	03/03/2011				409.5
	06/23/2011	1.900	0.3900	6.740	416.7
	09/27/2011				407.5
	11/01/2011	1.700	0.3800	6.670	405.0
	03/28/2012				407.0
	06/26/2012	2.000	0.4300	6.700	405.7
	08/21/2012				402.8
	11/14/2012	2.070	0.5400	7.000	402.1
	02/27/2013				402.6
	05/02/2013	2.320	0.5000	6.950	415.3
	08/20/2013				407.1
	11/25/2013	2.120	0.4500	6.540	403.5
	02/26/2014				403.5
	05/22/2014	2.270	0.4690	6.960	408.6
	09/03/2014				407.1
	11/18/2014	1.970	0.6160	7.210	405.9
	03/11/2015				404.3
	05/21/2015	2.210	0.5640	6.930	407.0
	09/04/2015				408.2
	11/05/2015	2.050	0.6350	6.990	404.0
20	03/02/2010	0.2800	<0.005000	6.330	406.8
	06/14/2010	0.2900	<0.005000	6.450	412.6
	09/27/2010	0.3700	<0.005000	6.120	410.8
	11/09/2010	0.3000	<0.005000	6.170	407.4

Wood River
Groundwater Monitoring Data for the West Ash Pond System: 2010 - 2015

Date Range: 01/01/2010 to 12/31/2015

		Boron, dissolved, mg/L	Manganese, dissolved, mg/L	pH (field), SU	Water level, relative to, ft
20	03/02/2011	0.3200	0.01100	6.120	406.6
	06/23/2011	0.3700	<0.005000	6.410	415.8
	09/27/2011	0.4700	<0.005000	6.770	407.4
	11/02/2011	0.3700	<0.005000	6.270	404.8
	03/28/2012	0.3900	0.009000	6.780	405.2
	06/26/2012	0.3200	<0.005000	6.490	404.7
	08/21/2012	0.3400	<0.005000	6.450	402.3
	11/14/2012	0.3500	0.04000	6.590	401.1
	02/27/2013	0.3300	0.1200	6.250	401.6
	05/02/2013	0.3300	<0.005000	7.140	413.1
	08/20/2013	0.2500	<0.005000	6.660	407.0
	11/25/2013	0.2600	0.05000	6.620	402.8
	02/26/2014	0.2400	0.01000	6.680	402.0
	05/22/2014	0.2100	<0.005000	7.130	406.8
	09/03/2014	0.2940	<0.005000	6.250	405.8
	11/18/2014	0.2000	<0.003000	6.350	405.7
	03/11/2015	0.2180	0.04210	6.250	403.4
	05/21/2015	0.2230	0.006900	6.250	406.5
	09/04/2015	0.2180	<0.005000	6.420	408.1
	11/05/2015	0.1920	0.006800	6.130	404.8
21	03/02/2010				408.5
	06/14/2010	0.2700	<0.005000	6.720	413.4
	09/27/2010				411.6
	11/09/2010	0.2500	<0.005000	6.900	409.2
	03/03/2011				407.0
	06/23/2011	0.2500	<0.005000	6.900	416.2
	09/27/2011				409.3
	11/01/2011	0.4100	<0.005000	6.440	406.9
	03/27/2012				406.3
	06/26/2012	0.3800	<0.005000	6.690	406.4
	08/21/2012				406.0
	11/14/2012	0.3100	0.008400	6.480	403.0
	02/27/2013				403.4
	05/02/2013	0.4100	0.3500	7.320	412.1
	08/20/2013				409.1
	11/25/2013	0.3300	0.007100	7.000	404.6
	02/26/2014				403.5

Wood River
Groundwater Monitoring Data for the West Ash Pond System: 2010 - 2015

Date Range: 01/01/2010 to 12/31/2015

		Boron, dissolved, mg/L	Manganese, dissolved, mg/L	pH (field), SU	Water level, relative to, ft
21	05/22/2014	0.3430	0.01370	6.940	407.5
	09/03/2014				407.5
	11/18/2014	0.2250	<0.003000	7.040	407.7
	03/11/2015				405.3
	05/21/2015	0.3640	0.05250	6.900	406.7
	09/04/2015				410.3
	11/04/2015	0.3680	<0.005000	6.820	405.7
22	03/02/2010				408.8
	06/14/2010	0.2900	<0.005000	6.530	413.4
	09/27/2010				411.7
	11/09/2010	0.2700	<0.005000	6.820	409.6
	03/03/2011				406.8
	06/23/2011	0.3000	<0.005000	6.850	415.9
	09/27/2011				409.7
	11/01/2011	0.3200	<0.005000	6.940	407.3
	03/27/2012				406.5
	06/26/2012	0.2900	<0.005000	6.770	406.8
	08/21/2012				404.8
	11/14/2012	0.2700	<0.005000	7.080	403.5
	02/27/2013				403.7
	05/02/2013	0.3200	0.1500	6.970	411.0
	08/20/2013				409.6
	11/25/2013	0.2600	<0.005000	7.050	405.1
	02/26/2014				403.9
	05/22/2014	0.3310	0.01630	7.020	407.5
	09/03/2014				407.8
	11/18/2014	0.2860	<0.003000	7.030	408.2
	03/11/2015				405.7
	05/21/2015	0.3270	<0.005000	6.890	407.0
	09/04/2015				410.9
	11/05/2015	0.2630	<0.005000	6.970	406.2
23	03/02/2010				407.9
	06/14/2010	0.3500	0.01200	6.210	413.5
	09/27/2010				411.9
	11/09/2010	0.3000	0.03700	6.070	408.5
	03/03/2011				408.2
	06/23/2011	0.3900	0.005600	6.300	416.6

Wood River
Groundwater Monitoring Data for the West Ash Pond System: 2010 - 2015

Date Range: 01/01/2010 to 12/31/2015

		Boron, dissolved, mg/L	Manganese, dissolved, mg/L	pH (field), SU	Water level, relative to, ft
23	09/27/2011				408.3
	11/01/2011	0.4000	0.07700	6.000	405.9
	03/27/2012				406.5
	06/26/2012	0.3600	0.03800	6.360	405.9
	08/21/2012				401.6
	11/14/2012	0.4000	0.4500	6.410	402.4
	02/27/2013				402.8
	05/02/2013	0.4500	0.4700	6.840	414.0
	08/20/2013				408.0
	11/25/2013	0.3500	0.3300	6.330	403.9
	02/26/2014				403.3
	05/22/2014	0.5530	1.010	6.940	408.0
	09/03/2014				404.1
	11/18/2014	0.4360	0.5100	6.320	406.8
	03/11/2015				404.6
	05/21/2015	0.3590	0.01300	6.260	406.8
	09/04/2015				409.2
	11/05/2015	0.3430	0.1190	6.030	404.8
25	03/02/2010				408.9
	06/14/2010	0.7600	0.04300	6.880	412.9
	09/27/2010				411.6
	11/09/2010	0.6100	0.1300	6.640	409.6
	03/03/2011				407.8
	06/23/2011	0.8300	0.7600	6.690	415.0
	09/27/2011				409.2
	11/01/2011	0.6800	0.05900	6.540	407.2
	03/27/2012				407.3
	06/26/2012	0.5600	0.007700	6.740	407.1
	08/21/2012				404.9
	11/14/2012	0.3900	0.1100	6.770	404.2
	02/27/2013				404.3
	05/02/2013	0.5800	0.8100	7.010	403.8
	08/20/2013				409.3
	11/25/2013	0.6200	0.001000	7.460	405.4
	02/26/2014				405.0
	05/22/2014	0.5010	0.07760	7.100	408.4
	09/03/2014				408.2

Wood River
Groundwater Monitoring Data for the West Ash Pond System: 2010 - 2015

Date Range: 01/01/2010 to 12/31/2015

		Boron, dissolved, mg/L	Manganese, dissolved, mg/L	pH (field), SU	Water level, relative to, ft
25	11/18/2014	0.6480	0.09080	6.870	407.9
	03/11/2015				405.9
	05/21/2015	0.5030	0.07110	6.920	407.7
	09/04/2015				410.4
	11/04/2015	0.5220	0.02020	6.730	406.5
28	03/02/2010				408.0
	06/14/2010	1.900	0.4500	6.390	413.1
	09/27/2010				411.5
	11/09/2010	1.200	0.4800	6.640	408.7
	03/03/2011				407.8
	06/23/2011	2.300	1.100	6.530	415.8
	09/27/2011				408.5
	11/01/2011	0.7900	0.2600	6.720	406.0
	03/27/2012				406.5
	06/26/2012	0.9500	0.8100	6.820	406.3
	08/21/2012				403.7
	11/14/2012	1.040	2.200	6.960	402.8
	02/27/2013				403.2
	05/02/2013	2.090	1.740	6.960	413.1
	08/20/2013				408.4
	11/25/2013	0.7600	0.5300	6.940	404.3
	02/26/2014				403.6
	05/22/2014	1.200	1.400	6.990	408.0
	09/03/2014				407.3
	11/18/2014	0.9130	3.540	6.930	407.1
	03/11/2015				405.1
	05/21/2015	1.020	1.540	6.860	406.8
	09/04/2015				409.6
	11/05/2015	0.9080	1.820	6.800	405.1
31	03/02/2010				408.2
	06/14/2010	1.100	0.4100	6.210	412.6
	09/27/2010				411.6
	11/09/2010	1.100	0.09600	6.510	408.8
	03/03/2011				408.5
	06/23/2011	1.200	0.1500	6.360	415.0
	09/27/2011				408.1
	11/01/2011	1.200	0.03100	6.390	405.8

Wood River
Groundwater Monitoring Data for the West Ash Pond System: 2010 - 2015

Date Range: 01/01/2010 to 12/31/2015

		Boron, dissolved, mg/L	Manganese, dissolved, mg/L	pH (field), SU	Water level, relative to, ft
31	03/27/2012				407.4
	06/26/2012	1.000	0.03400	6.100	406.6
	08/21/2012				404.2
	11/14/2012	0.9800	0.06000	7.020	403.7
	02/27/2013				397.6
	05/02/2013	1.190	0.001000	7.270	413.1
	08/29/2013	0.9900	0.05000	6.860	407.4
	11/25/2013	0.9000	0.07000	7.390	404.8
	02/26/2014				405.3
	05/22/2014	0.9270	0.04300	6.600	408.6
	09/03/2014				408.0
	11/18/2014	0.9360	0.05150	7.030	407.3
	03/11/2015				405.5
	05/21/2015	0.9020	0.04150	7.020	407.6
	09/04/2015				409.3
	11/04/2015	0.7970	0.04550	6.980	405.4
34	03/02/2010				406.0
	06/14/2010	1.300	6.100	6.740	413.7
	09/27/2010				413.2
	11/09/2010	0.9500	3.200	6.700	406.8
	03/03/2011				412.7
	06/23/2011	0.8000	6.200	6.630	416.8
	09/27/2011				405.4
	11/01/2011	0.9500	4.000	6.600	402.7
	03/28/2012				408.5
	06/26/2012	1.300	4.500	6.480	404.5
	08/21/2012				401.0
	11/14/2012	1.430	6.100	6.890	401.3
	02/27/2013				402.5
	05/06/2013	0.9000	6.050	6.820	416.5
	08/20/2013				404.6
	11/25/2013	7.390	4.450	7.030	402.6
	02/26/2014				429.1
	05/22/2014	2.090	7.750	6.890	410.4
	09/03/2014				408.3
	11/18/2014	5.890	5.250	6.860	404.3
	03/11/2015				404.2

Wood River
Groundwater Monitoring Data for the West Ash Pond System: 2010 - 2015

Date Range: 01/01/2010 to 12/31/2015

		Boron, dissolved, mg/L	Manganese, dissolved, mg/L	pH (field), SU	Water level, relative to, ft
34	05/21/2015	5.950	6.700	6.820	408.5
	09/04/2015				406.6
	11/03/2015	7.490	4.960	7.050	402.5
36	03/02/2010				407.8
	06/14/2010	0.07900	2.600	6.960	412.6
	09/27/2010				412.3
	11/09/2010	0.08900	2.200	6.810	408.3
	03/03/2011				411.2
	09/27/2011				406.7
	11/01/2011	0.09200	3.200	6.870	404.7
	03/28/2012				408.6
	06/26/2012	0.08500	2.600	7.090	406.9
	08/21/2012				404.4
	11/14/2012	0.1600	3.340	6.650	404.3
	02/27/2013				404.8
	08/20/2013				406.9
	11/25/2013	0.1300	2.520	7.320	405.7
	02/26/2014				406.6
	05/22/2014	0.1240	2.520	6.880	410.3
	09/03/2014				406.5
	11/18/2014	0.1220	2.630	7.010	406.4
	03/11/2015				406.1
	05/21/2015	0.1400	3.190	6.930	409.6
	09/04/2015				407.6
	11/03/2015	0.1190	2.520	7.140	405.2

Wood River
Groundwater Monitoring Data for the West Ash Pond System: 2010 - 2015

Date Range: 01/01/2010 to 12/31/2015

Well Id	Date Sampled	Lab Id	Residue, total filtrable, mg/L	Sulfate, total, mg/L
02	06/14/2010		930.0	180.0
	11/09/2010		940.0	140.0
	06/23/2011		880.0	160.0
	11/01/2011		930.0	210.0
	06/26/2012		1000.	220.0
	05/06/2013		1020	288.0
	11/25/2013		936.0	298.0
	05/22/2014		964.0	222.0
	11/18/2014		872.0	185.0
	05/21/2015		862.0	213.0
	11/03/2015		948.0	228.0
04	06/14/2010		1000.	10.00
	11/09/2010		970.0	11.00
	06/23/2011		940.0	<5.000
	11/01/2011		930.0	47.00
	06/26/2012		1000	<5.000
	11/14/2012		908.0	<10.00
	05/06/2013		894.0	10.00
	11/25/2013		928.0	<10.00
	05/22/2014		740.0	<10.00
	11/18/2014		820.0	<20.00
	05/21/2015		758.0	<10.00
	11/03/2015		884.0	<10.00
12	06/14/2010		520.0	37.00
	11/09/2010		460.0	18.00
	06/23/2011		530.0	50.00
	11/01/2011		460.0	16.00
	06/26/2012		570.0	30.00
	11/14/2012		490.0	71.00
	05/02/2013		500.0	74.00
	11/25/2013		436.0	33.00
	05/22/2014		498.0	68.00
	11/18/2014		454.0	33.00
	05/21/2015		496.0	39.00
	11/05/2015		502.0	48.00
20	03/02/2010		380.0	64.00
	06/14/2010		310.0	62.00

Wood River
Groundwater Monitoring Data for the West Ash Pond System: 2010 - 2015

Date Range: 01/01/2010 to 12/31/2015

		Residue, total filtrable, mg/L	Sulfate, total, mg/L
20	09/27/2010	490.0	150.0
	11/09/2010	360.0	110.0
	03/02/2011	450.0	100.0
	06/23/2011	380.0	100.0
	09/27/2011	450.0	140.0
	11/02/2011	400.0	97.00
	03/28/2012	530.0	140.0
	06/26/2012	700.0	150.0
	08/21/2012	730.0	180.0
	11/14/2012	652.0	152.0
	02/27/2013	600.0	162.0
	05/02/2013	590.0	157.0
	08/20/2013	548.0	87.00
	11/25/2013	546.0	93.00
	02/26/2014	528.0	91.00
	05/22/2014	468.0	74.00
	09/03/2014	518.0	111.0
	11/18/2014	440.0	56.00
	03/11/2015	420.0	83.00
	05/21/2015	424.0	61.00
	09/04/2015	422.0	72.00
	11/05/2015	430.0	70.00
21	06/14/2010	540.0	130.0
	11/09/2010	490.0	110.0
	06/23/2011	550.0	140.0
	11/01/2011	600.0	170.0
	06/26/2012	600.0	110.0
	11/14/2012	508.0	129.0
	05/02/2013	630.0	236.0
	11/25/2013	490.0	118.0
	05/22/2014	574.0	109.0
	11/18/2014	438.0	74.00
	05/21/2015	526.0	96.00
	11/04/2015	554.0	116.0
22	06/14/2010	570.0	78.00
	11/09/2010	500.0	91.00
	06/23/2011	520.0	75.00

Wood River
Groundwater Monitoring Data for the West Ash Pond System: 2010 - 2015

Date Range: 01/01/2010 to 12/31/2015

		Residue, total filtrable, mg/L	Sulfate, total, mg/L
22	11/01/2011	490.0	67.00
	06/26/2012	560.0	62.00
	11/14/2012	408.0	76.00
	05/02/2013	480.0	79.00
	11/25/2013	454.0	59.00
	05/22/2014	628.0	99.00
	11/18/2014	530.0	77.00
	05/21/2015	536.0	62.00
	11/05/2015	444.0	46.00
23	06/14/2010	640.0	180.0
	11/09/2010	610.0	130.0
	06/23/2011	670.0	150.0
	11/01/2011	670.0	140.0
	06/26/2012	720.0	150.0
	11/14/2012	626.0	158.0
	05/02/2013	552.0	183.0
	11/25/2013	604.0	132.0
	05/22/2014	760.0	219.0
	11/18/2014	644.0	180.0
	05/21/2015	668.0	182.0
	11/05/2015	670.0	123.0
25	06/14/2010	1500.	260.0
	11/09/2010	1600.	290.0
	06/23/2011	1200.	180.0
	11/01/2011	1700.	300.0
	06/26/2012	1600.	270.0
	11/14/2012	1140.	192.0
	05/02/2013	690.0	104.0
	11/25/2013	1710.	307.0
	05/22/2014	742.0	89.00
	11/18/2014	1410.	283.0
	05/21/2015	974.0	124.0
	11/04/2015	1320.	219.0
28	06/14/2010	800.0	180.0
	11/09/2010	730.0	130.0
	06/23/2011	800.0	180.0
	11/01/2011	490.0	68.00

Wood River

Groundwater Monitoring Data for the West Ash Pond System: 2010 - 2015

Date Range: 01/01/2010 to 12/31/2015

		Residue, total filtrable, mg/L	Sulfate, total, mg/L
28	06/26/2012	800.0	180.0
	11/14/2012	626.0	118.0
	05/02/2013	858.0	285.0
	11/25/2013	678.0	178.0
	05/22/2014	790.0	235.0
	11/18/2014	784.0	252.0
	05/21/2015	644.0	173.0
	11/05/2015	596.0	154.0
31	06/14/2010	2800.	270.0
	11/09/2010	4800.	250.0
	06/23/2011	6000.	230.0
	11/01/2011	5100.	230.0
	06/26/2012	3700.	240.0
	11/14/2012	2490.	206.0
	05/02/2013	1720.	164.0
	08/29/2013	2040.	169.0
	11/25/2013	1860.	149.0
	05/22/2014	1620.	129.0
	11/18/2014	2020.	161.0
	05/21/2015	2240.	118.0
	11/04/2015	2170.	149.0
34	06/14/2010	860.0	<5.000
	11/09/2010	670.0	7.400
	06/23/2011	860.0	<5.000
	11/01/2011	680.0	10.00
	06/26/2012	740.0	6.800
	11/14/2012	896.0	15.00
	05/06/2013	900.0	30.00
	11/25/2013	720.0	10.00
	05/22/2014	1050.	47.00
	11/18/2014	770.0	<10.00
	05/21/2015	902.0	<10.00
	11/03/2015	758.0	<10.00
36	06/14/2010	620.0	11.00
	11/09/2010	600.0	11.00
	11/01/2011	620.0	33.00
	06/26/2012	530.0	11.00

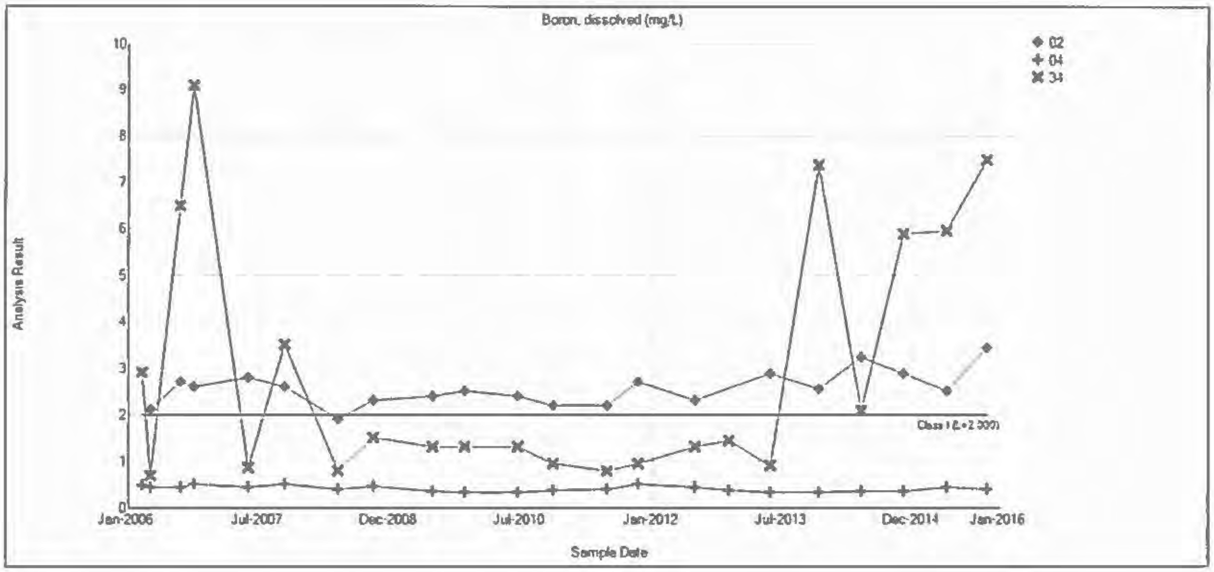
Wood River
Groundwater Monitoring Data for the West Ash Pond System: 2010 - 2015

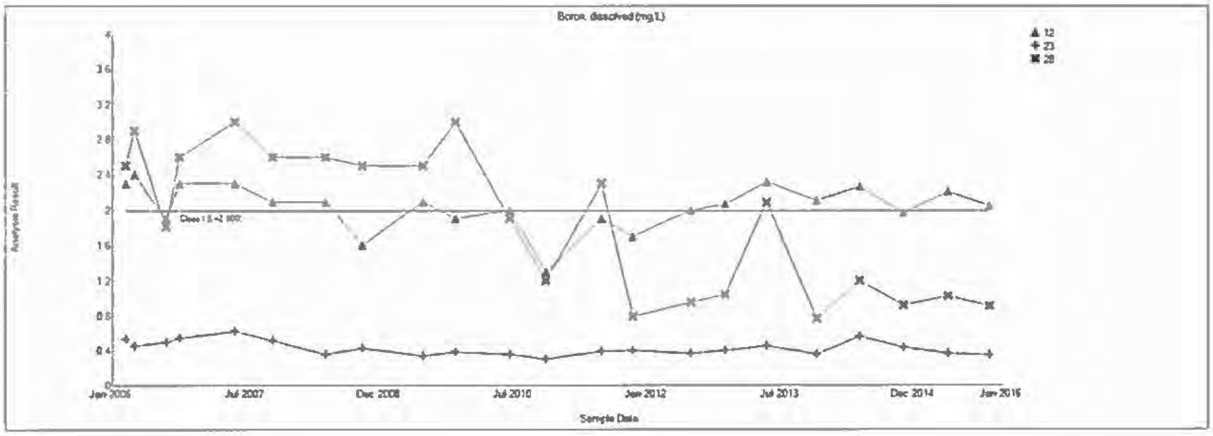
Date Range: 01/01/2010 to 12/31/2015

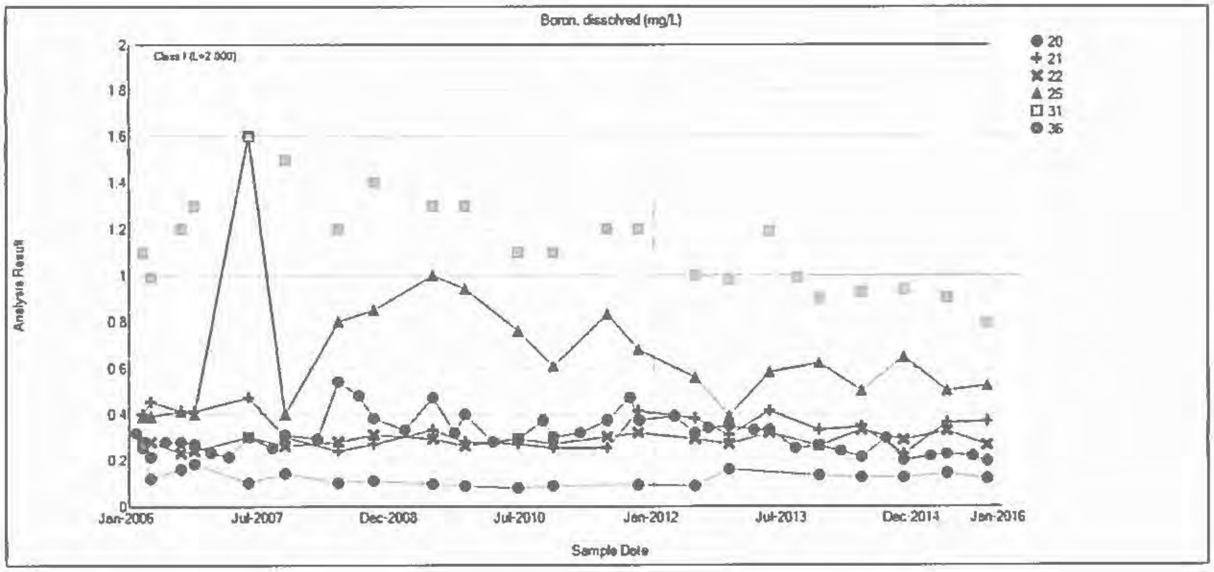
		Residue, total filtrable, mg/L	Sulfate, total, mg/L
36	11/14/2012	768.0	<10.00
	11/25/2013	474.0	<10.00
	05/22/2014	468.0	<10.00
	11/18/2014	474.0	<10.00
	05/21/2015	556.0	<10.00
	11/03/2015	430.0	<10.00

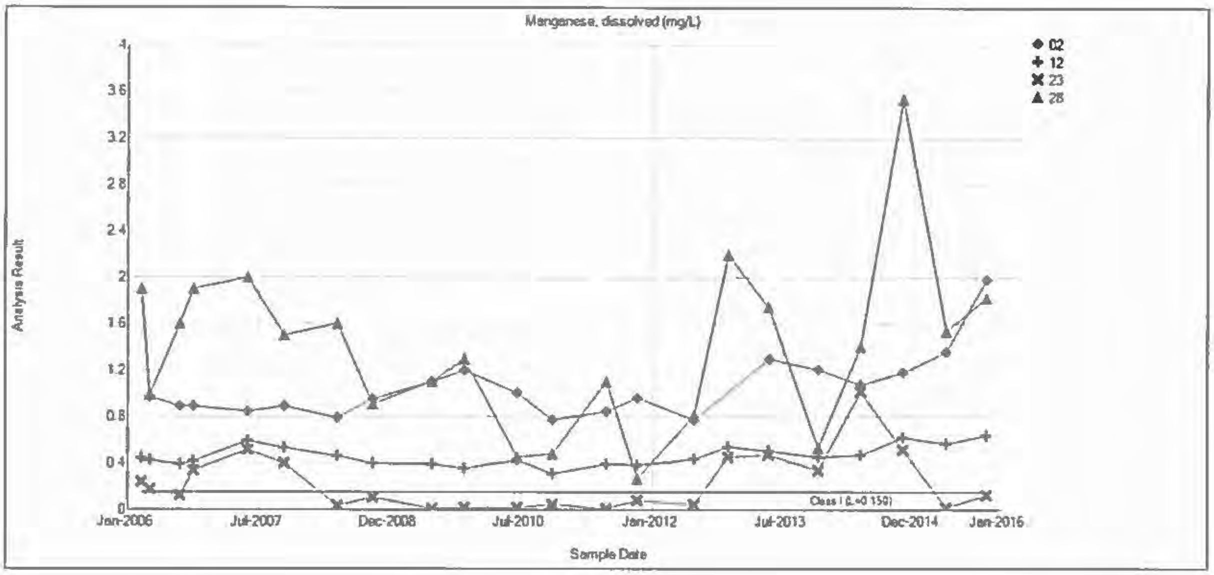
APPENDIX F

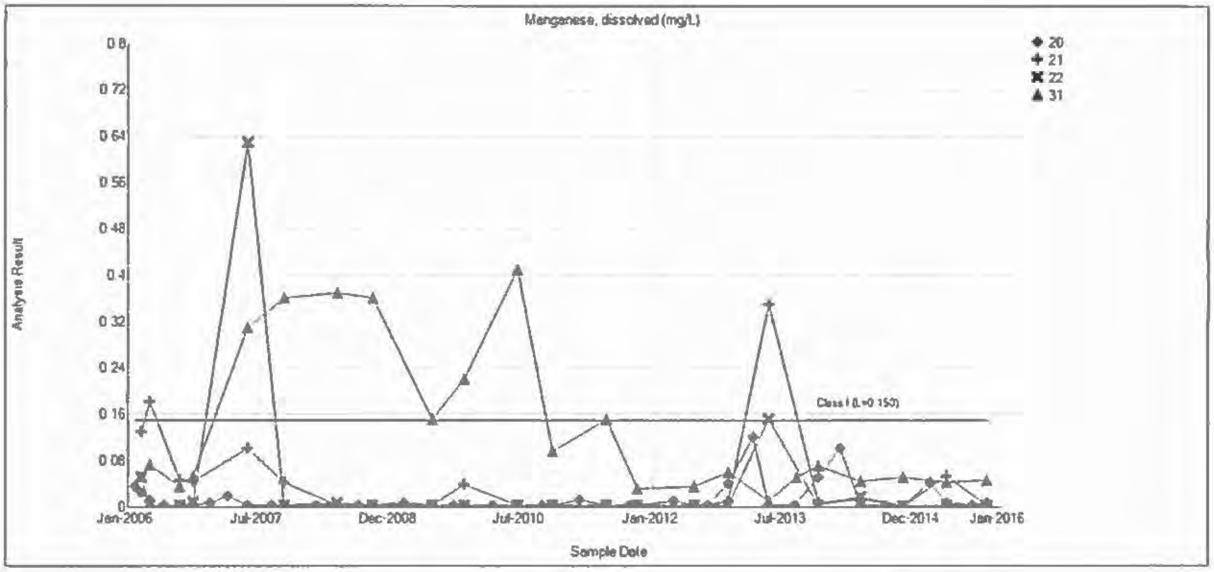
WATER QUALITY TREND GRAPHS

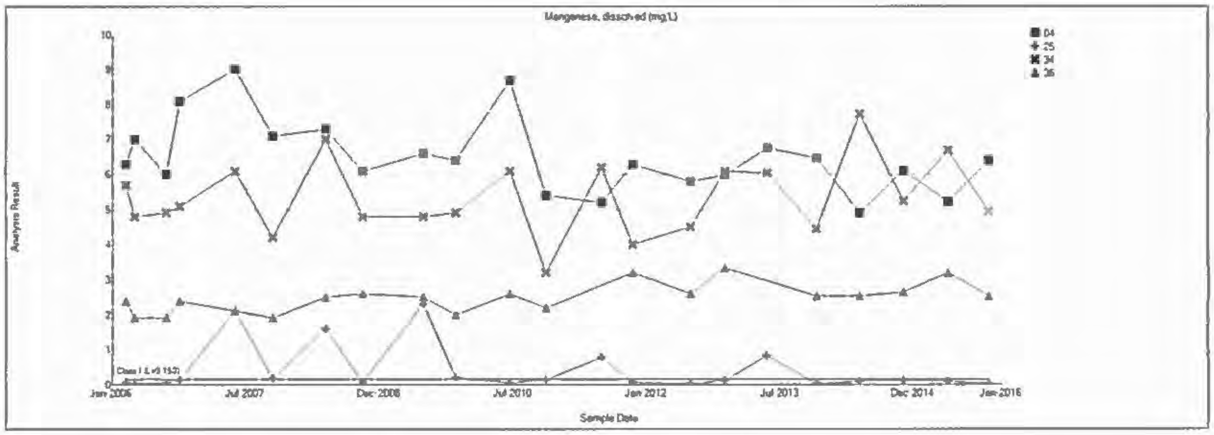

Boron, dissolved (mg/L)
02
04
34
Analysis Result
10
9
8
7
6
5
4
3
2
1
0
Class I (L=2.000)
Jan-2006
Jul-2007
Dec-2008
Jul-2010
Jan-2012
Jul-2013
Dec-2014
Jan-2016
Sample Date

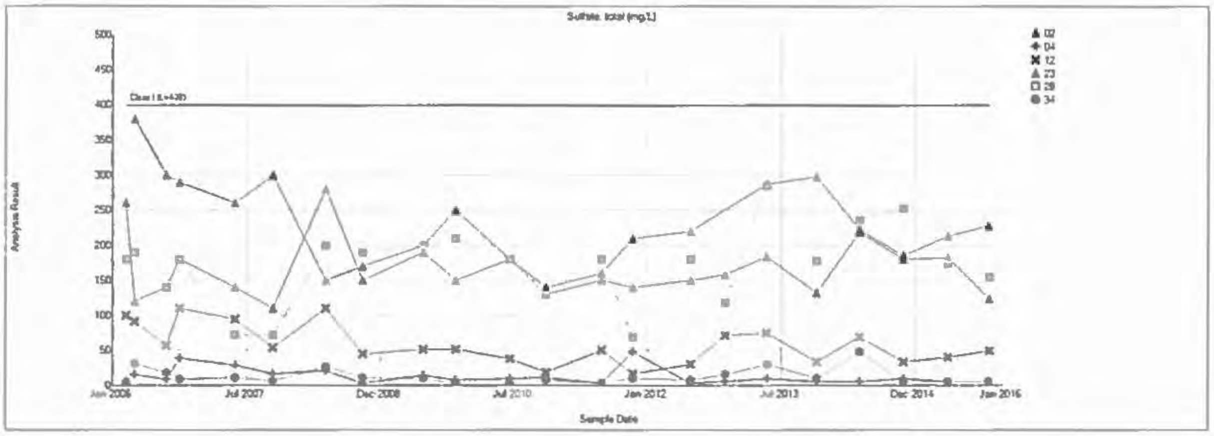

Boron, dissolved (mg/L)
12
23
28
Analysis Result
4
3.6
3.2
2.8
2.4
2
1.6
1.2
0.8
0.4
0
Class I (L=2.000)
Jan 2006
Jul 2007
Dec 2008
Jul 2010
Jan 2012
Jul 2013
Dec 2014
Jan 2016
Sample Date

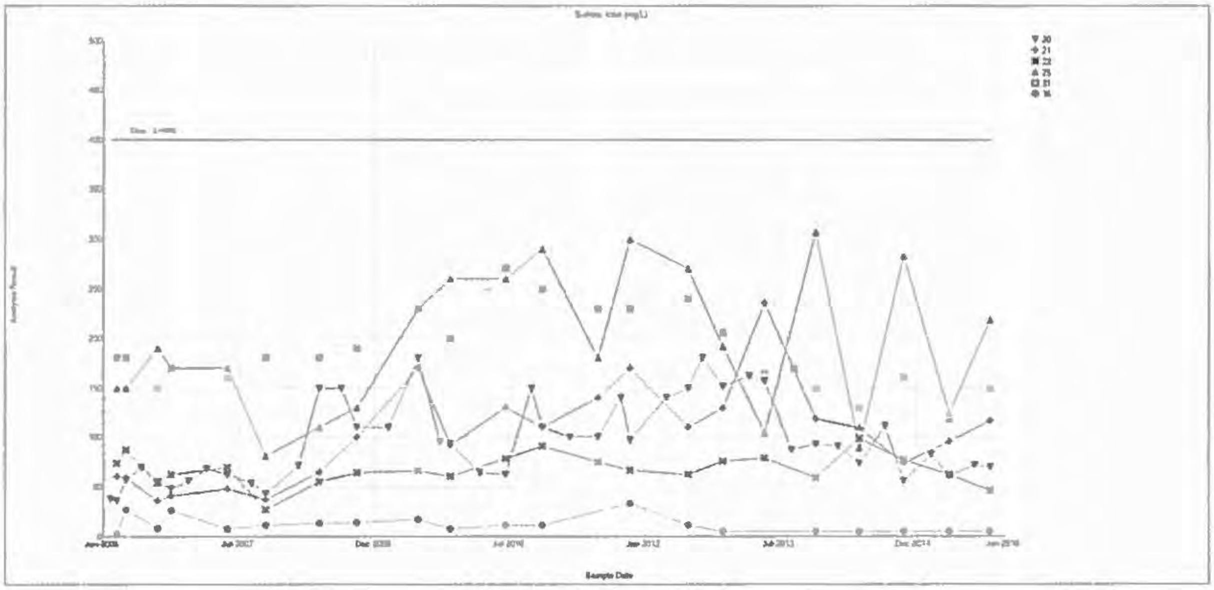

Boron, dissolved (mg/L)
20
21
22
25
31
36
Analysis Result
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Class I (L=2.000)
Jan-2006
Jul-2007
Dec-2008
Jul-2010
Jan-2012
Jul-2013
Dec-2014
Jan-2016
Sample Date


Manganese, dissolved (mg/L)
◆ 02
✚ 12
✖ 23
▲ 28
4
3.6
3.2
2.8
2.4
2
1.6
1.2
0.8
0.4
0
Analysis Result
Class I (L=0.150)
Jan-2006
Jul-2007
Dec-2008
Jul-2010
Jan-2012
Jul-2013
Dec-2014
Jan-2016
Sample Date


Manganese, dissolved (mg/L)
◆ 20
✚ 21
✖ 22
▲ 31
0.8
0.72
0.64
0.56
0.48
0.4
0.32
0.24
0.16
0.08
0
Analysis Result
Class I (L=0.150)
Jan-2006
Jul-2007
Dec-2008
Jul-2010
Jan-2012
Jul-2013
Dec-2014
Jan-2016
Sample Date


Manganese, dissolved (mg/L)
■ 04
✚ 25
✖ 34
▲ 36
10
9
8
7
6
5
4
3
2
1
0
Analysis Result
Class I (L=0.150)
Jan 2006
Jul 2007
Dec 2008
Jul 2010
Jan 2012
Jul 2013
Dec 2014
Jan 2016
Sample Date


Sulfate, total (mg/L)
Class I (L=400)
Analysis Result
500
450
400
350
300
250
200
150
100
50
0
Jan 2006
Jul 2007
Dec 2008
Jul 2010
Jan 2012
Jul 2013
Dec 2014
Jan 2016
Sample Date
▲ 02
✦ 04
✖ 12
△ 23
□ 28
● 34


Sulfate, total (mg/L)
Class I (L=400)
Analysis Result
500
450
400
350
300
250
200
150
100
50
0
Jan 2006
Jul 2007
Dec 2008
Jul 2010
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Jul 2013
Dec 2014
Jan 2016
Sample Date
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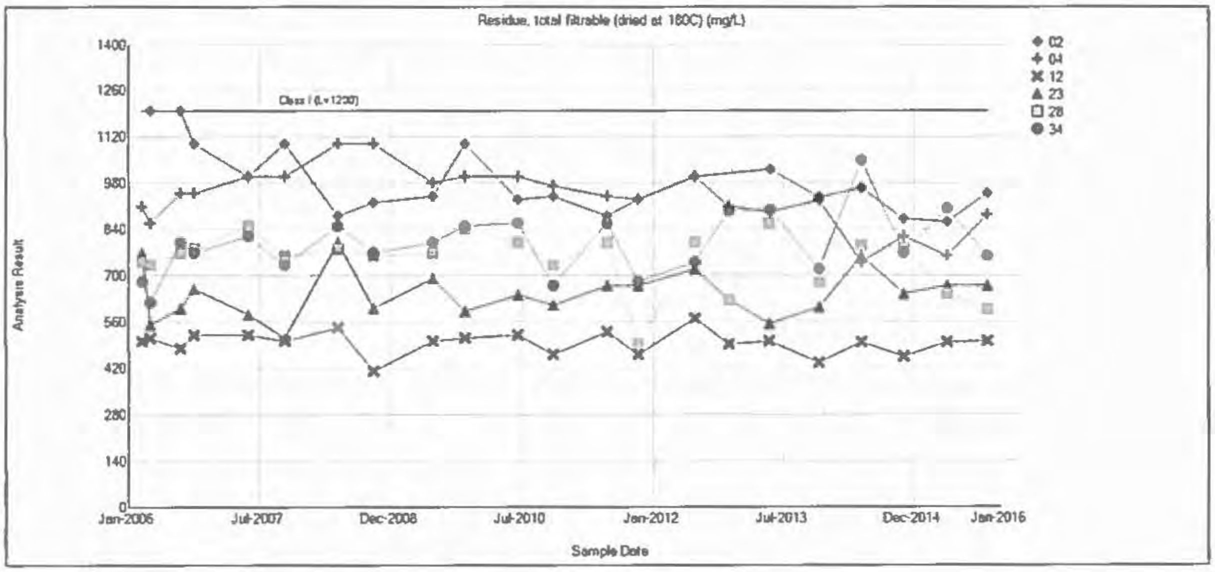
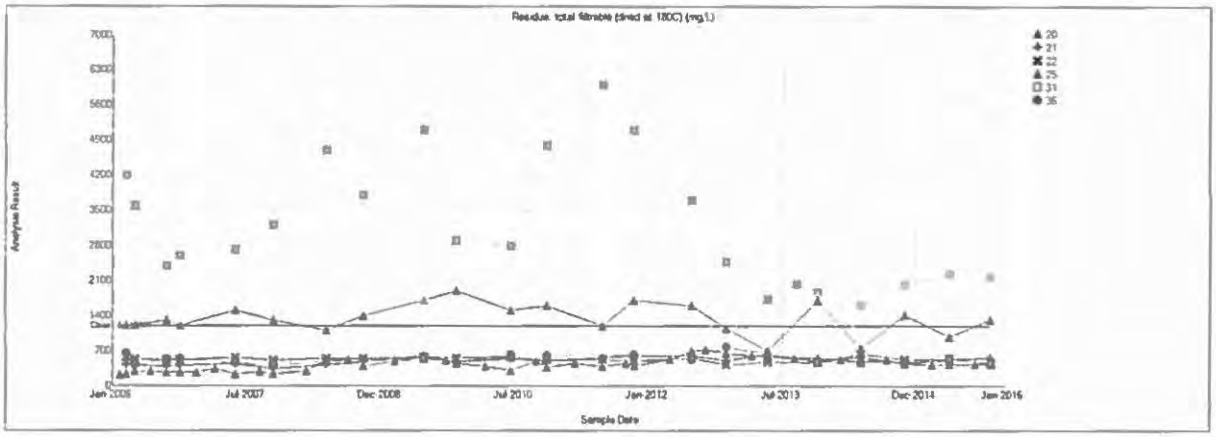
✦ 21
✖ 22
▲ 25
□ 31
● 36


Residue, total filtrable (dried at 180C) (mg/L)
Class I (L=1200)
Analysis Result
1400
1260
1120
980
840
700
560
420
280
140
0
Jan-2006
Jul-2007
Dec-2008
Jul-2010
Jan-2012
Jul-2013
Dec-2014
Jan-2016
Sample Date
◆ 02
✚ 04
✖ 12
▲ 23
□ 28
● 34


Residue, total filtrable (dried at 180C) (mg/L)
▲ 20
✚ 21
✖ 22
▲ 25
☐ 31
● 36
7000
6300
5600
4900
4200
3500
2800
2100
1400
Class
700
0
Analysis Result
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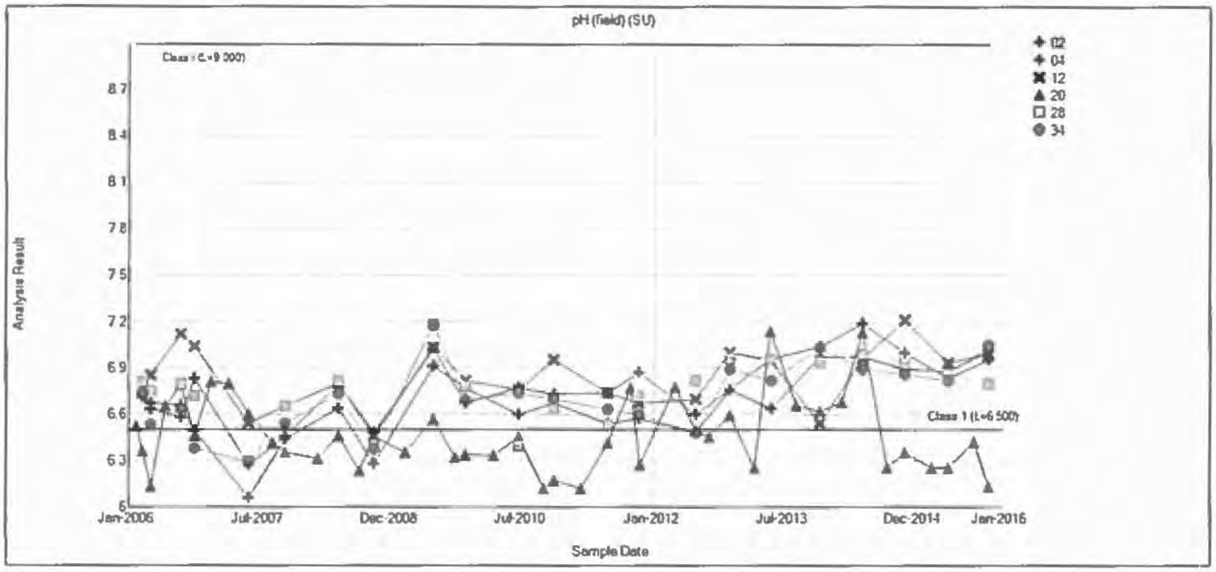
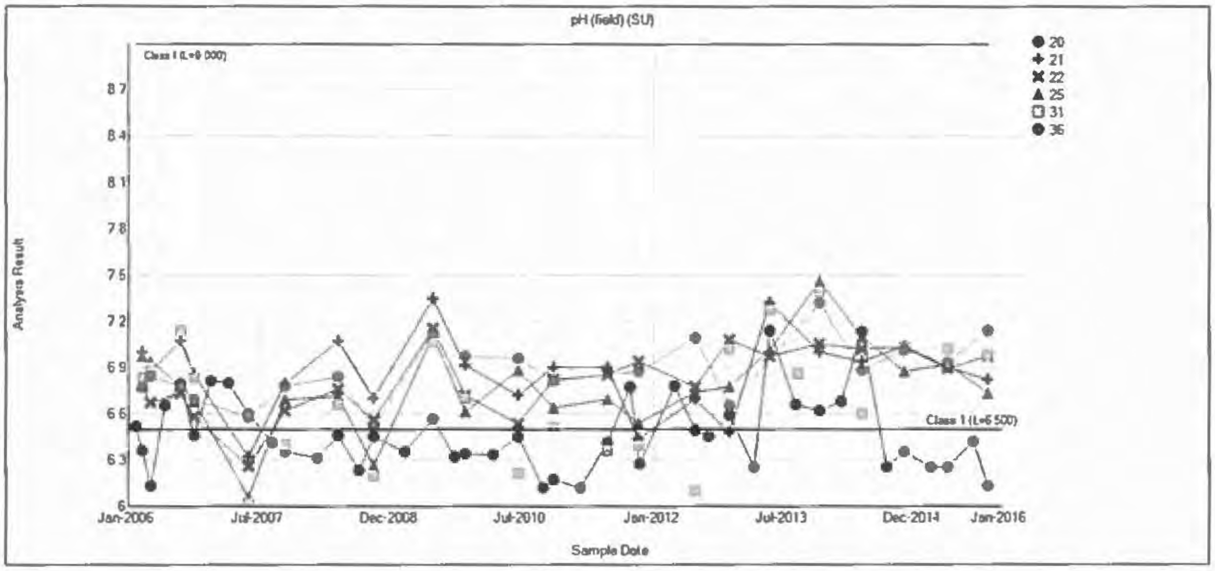
Jul 2007
Dec 2008
Jul 2010
Jan 2012
Jul 2013
Dec 2014
Jan 2016
Sample Date


pH (field) (SU)
✚ 02
✚ 04
✖ 12
▲ 20
☐ 28
● 34
Class I (L=9 000)
Class 1 (L=6 500)
8.7
8.4
8.1
7.8
7.5
7.2
6.9
6.6
6.3
6
Analysis Result
Jan-2006
Jul-2007
Dec-2008
Jul-2010
Jan-2012
Jul-2013
Dec-2014
Jan-2016
Sample Date


pH (field) (SU)
● 20
✚ 21
✖ 22
▲ 25
☐ 31
● 36
Class I (L=9 000)
Class 1 (L=6 500)
8.7
8.4
8.1
7.8
7.5
7.2
6.9
6.6
6.3
6
Analysis Result
Jan-2006
Jul-2007
Dec-2008
Jul-2010
Jan-2012
Jul-2013
Dec-2014
Jan-2016
Sample Date

The following are attachments to the testimony of Scott M. Payne, PhD, PG and Ian Magruder, M.S..

ATTACHMENT 21

Appendix C.
Hydrostatic Modeling Report

SMARTER SOLUTIONS

EXCEPTIONAL SERVICE

VALUE

HYDROSTATIC MODELING REPORT

West Ash Pond Complex
Wood River Power Station
Alton, Illinois

FINAL

October 19, 2016

NATURAL
RESOURCE
TECHNOLOGY

ENVIRONMENTAL CONSULTANTS

NATURAL
RESOURCE
TECHNOLOGY
ENVIRONMENTAL CONSULTANTS

234 W. FLORIDA STREET, FIFTH FLOOR
MILWAUKEE, WISCONSIN 53204
(P) 414.837.3607
(F) 414.837.3608

HYDROSTATIC MODELING REPORT

WEST ASH POND COMPLEX
WOOD RIVER POWER STATION
ALTON, ILLINOIS

Project No. 2376

Prepared For:

Dynegy Operating Company
1500 Eastport Plaza Drive
Collinsville, IL 62234

Prepared By:

Natural Resource Technology, Inc.
234 W. Florida Street, Fifth Floor
Milwaukee, Wisconsin 53204

FINAL
October 19, 2016

Stuart J. Cravens, PG
Principal Hydrogeologist

Meng Wang, PhD, PE
Environmental Engineer

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

1 BACKGROUND

1.1 Introduction

This Hydrostatic Modeling Report has been prepared by Natural Resource Technology (NRT) on behalf of Dynegy Midwest Generation, LLC (DMG) to estimate percolation from the Wood River West Ash Complex (Site) and to evaluate hydrostatic equilibrium of groundwater beneath the proposed pond cap systems at the Wood River Power Station, Alton, Madison County, Illinois. The cap systems, as described in the draft Closure and Post-Closure Care Plan for Dynegy Wood River Ash Complex (AECOM, 2016), are proposed to be implemented on West Ash Pond 1 (WAP 1), West Ash Pond 2W (WAP 2W), and West Ash Pond 2E (WAP 2E). The Hydrologic Evaluation of Landfill Performance (HELP) model was used to predict percolation and to evaluate hydrostatic conditions of each ash pond in response to the proposed cap system.

1.2 Ash Pond Scenarios

For each ash pond, two HELP model scenarios were established to represent the pond condition in different stages: the baseline conditions for the pre-construction stage, prior to the implementation of the proposed cap system, and the closure conditions for the post-construction stage, when the cap system is in-place.

1.2.1 Baseline Conditions

WAP 1, WAP 2W and WAP 2E were categorized into two groups to represent baseline conditions:

- Unlined Ash Ponds (WAP 1 and WAP 2W) – represents the condition when coal ash, primarily composed of fly ash in WAP 1 and WAP 2W, is deposited directly on the silty clay foundation soil. It is assumed for ground surface condition that there is no stormwater runoff and vegetation consists of a poor stand of grass.
- Lined Ash Pond (WAP 2E) – represents the condition when a composite clay/synthetic liner system was constructed at the bottom of the ash pond. The basal liner is comprised of (from bottom up) a 12-inch compacted clay layer and a 45-mil polypropylene liner. WAP 2E was primarily used for bottom ash storage. It is assumed for ground surface condition that there is no stormwater runoff and the ground is bare (i.e., no vegetation).

1.2.2 Closure Scenarios

Closure scenarios were modeled to represent the draft Closure and Post-Closure Care Plan cap configurations (AECOM, 2016). The preferred cap system is comprised of a geomembrane cover with a drainage layer, consisting of (from bottom up) a 40-mil LLDPE geomembrane, a geocomposite (to drain infiltrated surface water), and a 2-foot thick protective layer. The protective layer consists of an 18-inch rooting zone soil layer and a 6-inch topsoil layer.

HELP model input assumes the proposed cover systems are properly constructed and maintained to allow 100% stormwater runoff, i.e., the covers have positive drainage to prevent standing water and vegetation consists of a fair stand of grass.

1.3 Objective

The purpose of this report is to estimate percolation from the ponds and to evaluate the design of the cap systems on the hydrostatic conditions within the system. The time for the Wood River West Ash Complex ponds to reach hydrostatic equilibrium is also assessed. This modeling report addresses the following:

- Estimate the percolation rates from WAP 1, WAP 2W and WAP 2E. The percolation rates serve as input data for recharge rates in the groundwater flow model (MODFLOW model) to simulate Site hydraulics and leachate transport when no caps are implemented.
- Predict the percolation rates through the basal component of the pond when the designed caps are implemented for WAP 1, WAP 2W and WAP 2E. The percolation rates serve as input data for recharge rates in the MODFLOW model to predict Site hydraulics and leachate transport when caps are in-place.
- Assess whether the capped West Ash Complex ponds could reach hydrostatic equilibrium conditions for the proposed design of the cap system, when applied with Site-specific parameters, which means minimal water head fluctuation beneath the cap system on the foundation soil following the completion of cap construction (i.e., flow rate in equals flow rate out). If modeling indicates hydrostatic equilibrium is achievable, then the time it will take the West Ash Complex ponds to reach hydrostatic equilibrium status is estimated.

2 HELP MODEL SET-UP

2.1 Model Description

The Hydrologic Evaluation of Landfill Performance (HELP) model was developed by the U.S. Environmental Protection Agency (Schroeder et al., 1994). HELP is a one-dimensional hydrologic model of water movement across, into, through and out of a landfill or soil column based on precipitation, evapotranspiration, runoff, and the geometry and hydrogeologic properties of a layered soil and waste profile.

For this investigation, HELP Version 3.07 (Schroeder et al., 1994) was selected to estimate the hydraulic conditions beneath caps implemented on the Wood River West Ash Complex as prescribed by AECOM (2016). The hydrologic data entered into HELP are listed in Tables 1 through 4 and described in the following paragraphs.

2.2 Input Data

Tables 1 and 2 present input data used to configure the baseline HELP models for unlined ash ponds (WAP 1 and WAP 2W) and the lined ash pond (WAP 2E), respectively. Tables 3 and 4 present input data used to configure the cap HELP models for the capped unlined ash ponds (WAP 1 and WAP 2W) and capped lined ash pond (WAP 2E), respectively. Climatic input variables were synthetically generated by the HELP model using default values for St. Louis, MO, and a latitude of 38.87° N for the Wood River Power Station. Rainfall frequency and temperature patterns for more than 100 cities are programmed into HELP. St. Louis, MO was the closest city to the Site. The model used St. Louis, MO default precipitation and temperature coefficients to generate daily precipitation and temperature data. A 30-year simulation period was selected for baseline models of WAP 1 and WAP 2W, which provided a sufficient duration to review the impact of precipitation variance on outputs for models. The baseline model for WAP 2E used a 16-year simulation period to simulate only the time period following placement of the polypropylene liner. The closure was modeled for a 100-year simulation period after completion of cap construction. The 100-year simulation duration was required to indicate the trend for the designed cap to reach equilibrium.

Physical input data were based on the actual and proposed configurations of the ponds, measured soil properties, and in the absence of site specific measurements, assumed soil properties (NRT, 2016; AECOM, 2016). The coal ash was subdivided into several 18-inch thick (WAP 1 and WAP 2W) or 12-inch thick (WAP 2E) sublayers in the models. Coal ash thickness was obtained from the record of soil borings conducted in the pond (NRT, 2016).

The initial moisture content of the uncapped coal ash in the baseline scenarios was set equal to porosity for saturated coal ash or field capacity for unsaturated coal ash to simulate specific saturated conditions in each pond. The thickness of saturated coal ash was determined from soil boring records (NRT, 2016). The initial surface water of the WAP 2E baseline model was set as 60 inches to represent the standing water in the pond. Any excess water above 60 inches is removed as it flows through a weir into the adjacent Pond 3.

For closure scenarios of WAP 1 and WAP 2W, the initial moisture contents of existing layers were set to the steady-state conditions as in the baseline models. The initial moisture content of existing layers for the closure scenario of WAP 2E were set equal to the moisture content calculated by HELP at Year 16 from the baseline model under the assumption that the cap would be implemented in Year 2016. The initial moisture content for the cap/liner materials was set equal to field capacity. The cap was assumed to allow 100% surface water runoff provided the cap drainage is properly maintained.

Individual material layers were assumed to be homogenous; that is, the material layers have uniform texture and hydraulic properties. Hydraulic properties of materials, including hydraulic conductivity, porosity, field capacity, and wilting point, were either the default HELP database values or as provided by the geosynthetic manufacturer, such as the hydraulic conductivity (1×10^{-11} cm/s) of the basal polypropylene liner at WAP 2E. The hydraulic conductivity of fly ash in WAP 1 and WAP 2W was set equal to the calibrated value in the previous 2000 HELP Model (NRT, 2000). The hydraulic conductivity of bottom ash in WAP 2E was set as the default HELP database value.

Field measurement of horizontal hydraulic conductivity of the foundation layer silty clay has a geometric mean value of 2.4×10^{-5} cm/s (Hampton and O'Hearn, 1984). Laboratory measurement of vertical hydraulic conductivity of the silty clay has a geometric mean value of 1.1×10^{-7} cm/s (Hampton and O'Hearn, 1984; Kelron Environmental, 2004; NRT, 2016). A value of 3.0×10^{-7} cm/s (near the geometric mean vertical conductivity) was selected for modeling. The baseline scenarios for the West Ash Pond Complex resulted in saturated ash thicknesses that correlate well with observed conditions indicating the model was calibrated for prediction runs.

2.3 Types of Analysis

Two types of HELP simulations were performed: prediction analysis and sensitivity analysis.

The prediction analysis was conducted to estimate percolation rates for each capped pond, which were later input to the groundwater flow model. The prediction analysis was also performed to estimate the hydraulic head on the foundation soil, which was used to evaluate the hydrostatic status over time for the Wood River West Ash Complex and to estimate the time for the hydraulic head to reach equilibrium.

Sensitivity analysis was used to determine the significance of input parameters for the Wood River West Ash Complex to reach hydrostatic equilibrium. Sensitivity analysis was performed for parameters potentially influencing the capped West Ash Complex hydrostatic conditions, including:

- Initial thickness of saturated fly ash zone (applied only for capped unlined ash pond)
- Hydraulic conductivity of foundation soil
- Geomembrane placement
- Geomembrane installation defects

3 HELP MODEL RESULTS

3.1 Percolation Calculation

HELP input and output files are included as Appendix A on the attached CD. Calculated percolation rates through the foundation soil fluctuated with changes in precipitation and evaporation conditions. Average foundation soil percolation rates calculated from the HELP simulations are summarized in Table 5, and were used in the groundwater flow models. The baseline condition percolation rates though the foundation soil estimated for WAP 1, WAP 2W and WAP 2E are 8.67 inch/yr, 8.52 inch/yr and 0.71 inch/yr, respectively.

3.2 Prediction Analysis

The HELP model was run for 100 years after cap construction completion, applying the input parameters listed in Section 2.2.

Figures 1a, 1b and 1c exhibit the predicted hydraulic heads in the system and the predicted percolation rates through the basal component of the pond. Due to the different magnitudes of percolation rate decreases for capped unlined ash ponds (Figures 1a and 1b), the post closure period was divided into three stages: the initial one with dramatically decreasing percolation rate, the intermediate one with slowly decreasing percolation rate, and the last one with approaching-zero percolation rate. Mean values of the percolation rates for each period were calculated and shown in Table 5, which were 5.28 inch/yr (Year 1-10), 0.28 inch/yr (Year 11-31) and 0.002 inch/yr (Year 32-100) for capped WAP 1; and 5.24 inch/yr (Year 1-9), 0.28 inch/yr (Year 10-28) and 0.001 inch/yr (Year 29-100) for capped WAP 2W, respectively. The closure condition percolation rate though the foundation soil for WAP 2E was estimated as a mean value of 0.33 inch/yr throughout the 100-year period due to its relatively constant decreasing trend (Figure 1c).

As shown on Figures 1a and 1b, the hydraulic head on the foundation soil and percolation rate through the system behave in a similar manner for the two unlined ash ponds, WAP 1 and WAP 2W. The hydraulic heads on the foundation soil continuously decrease until approximately Year 10-11 from cap construction completion when equilibrium is reached and the head on the foundation soil is minimized.

Figure 1c shows the predicted hydraulic head on the basal liner and the predicted percolation rate through the basal liner and foundation soil for capped WAP 2E. The predicted hydraulic head starts to decrease from the beginning of the cap completion until the end of the 100-Year simulation duration. Correspondingly, the percolation rate follows a decreasing trend along with the hydraulic head. The capped pond does not reach equilibrium within the 100-year model simulation, which is largely because the hydraulic conductivity of the basal liner limits pond dewatering. Although this prediction model does not indicate the year when the cap scenario reaches equilibrium, the continuously decreasing trends in hydraulic head and percolation rate indicate the system is gradually approaching equilibrium.

3.3 Sensitivity Analysis

Sensitivity analyses were performed on select layer parameters as summarized in Table 6 and as described in the following paragraphs. The closure scenario of WAP 1 was chosen to represent capped unlined ash pond for sensitivity analyses. The changes in hydraulic heads under sensitivity analyses are shown on Figures 2 through 5.

Initial Thickness of Saturated Ash Zone

The hydraulic heads on the WAP 1 foundation soil were predicted under different initial thicknesses of saturated fly ash (from 90 inches to 210 inches) for the chosen cap scenario, as shown on Figure 2. The plot shows the hydraulic heads were sensitive to the initial thickness of saturated fly ash in the early years. At approximately Year 10, the different hydraulic heads converged to a minimum level approaching zero. The result implies hydrostatic equilibrium can be attained under all tested initial thickness of saturated ash zone in approximately 10 years.

Hydraulic Conductivity of Foundation Soil

The hydraulic heads within the ponds were predicted under a range of foundation soil hydraulic conductivities (1.0×10^{-8} to 1.0×10^{-5} cm/s), and plotted on Figures 3a (capped unlined ash pond) and 3b (capped lined ash pond), respectively.

For capped unlined ash pond WAP 1 (Figure 3a), the hydraulic head does not build up when the hydraulic conductivity of foundation soil is 3.0×10^{-7} cm/s or above. Additionally, in the extreme condition of 1.0×10^{-8} cm/s, the hydraulic head does not accumulate but decreases with time. Although this prediction model does not indicate the year when the 1.0×10^{-8} cm/s scenario reaches equilibrium, the continuously decreasing trends in hydraulic head indicate the system is gradually approaching equilibrium. It is not believed that the foundation soil behaves as a unit with a hydraulic conductivity as low as 1.0×10^{-8} cm/s because the ponds have been uncapped without any runoff for over 10 years, and water levels have not approached the top of the berms. Therefore, the result shows that hydrostatic equilibrium can be attained under a wide range of foundation soil hydraulic conductivity.

For WAP 2E (Figure 3b), the hydraulic heads in all scenarios remain consistent throughout the simulation period. The hydrostatic equilibrium of capped WAP 2E is not sensitive to the chosen range of hydraulic conductivity of the foundation soil.

Geomembrane Placement Quality

The hydraulic heads on the capped unlined ash pond foundation soil (Figure 4a) and the capped lined ash pond basal liner (Figure 4b) were predicted under a range of the cap geomembrane placement quality (from poor to excellent). The consistent hydraulic heads predicted for all scenarios reveal the hydrostatic conditions for both capped ponds are minimally sensitive to the placement quality of the geomembrane.

Geomembrane Installation Defects

The hydraulic heads on the capped unlined ash pond foundation soil (Figure 5a) and the capped lined ash pond basal liner (Figure 5b) were predicted under a range of installation defects for the cap geomembrane (from poor to excellent). According to Figure 5a, the hydrostatic equilibrium of capped unlined ash pond is not sensitive to the chosen range of installation defects. Figure 5b reveals that, for capped lined ash pond, with high geomembrane installation defects, the hydraulic head decreases more slowly than the scenario with low geomembrane installation defects. However, all scenarios show a decreasing trend in hydraulic head, suggesting hydrostatic equilibrium could be reached under the simulated range of geomembrane installation defects.

4 SUMMARY

The HELP model was used to estimate percolation rate within the Wood River West Ash Complex, and to evaluate the hydrostatic conditions with implementation of proposed cap systems. Input parameters were chosen based on Site specific configurations and a range of parameters were tested for sensitivity to the hydraulic head accumulated beneath the cap system in the 100 years following closure completion. The results of the modeling indicate:

- Hydrostatic equilibrium can be obtained for the proposed Wood River West Ash Complex under the current hydrogeological conditions for WAP 1, WAP 2W, and WAP 2E with the proposed cap system for each pond.
- Hydraulic head in the proposed cap system for WAP 1 and WAP 2W is expected to decrease to near-zero level for equilibrium at Year 10-11 after completion of cap construction (Figures 1a and 1b).
- Hydraulic head in WAP 2E with the proposed cap system is expected to keep decreasing beyond the 100-year simulation duration after the cap completion (Figure 1c). Although the system does not reach hydraulic equilibrium during the simulation timeframe, the continuously decreasing hydraulic head indicates a trend toward hydrostatic equilibrium.
- The hydrostatic condition of capped unlined ash ponds (WAP 1 and WAP 2) is sensitive to the foundation soil hydraulic conductivity as shown on Figure 3a. The higher foundation soil hydraulic conductivities of 1.0×10^{-6} and 1.0×10^{-5} cm/s indicate the hydraulic head is minimized within 3 years. Hydrostatic equilibrium is reached in approximately 10 to 11 years with a foundation soil hydraulic conductivity of 3.0×10^{-7} cm/s. Where the foundation soil hydraulic conductivity is unrealistically low, as with the 1.0×10^{-8} cm/s case, the calculated hydraulic head still demonstrates a decreasing trend, although equilibrium is not realized in the modeled 100 years following cap completion.
- The proposed cap with a permeability of 1.0×10^{-11} cm/s is lower than both the lab measured vertical permeability and the field measured horizontal hydraulic conductivity and meets the criteria of 40 CFR Part 257.102 (U.S. EPA, 2015).

The proposed capping system - a geomembrane cover with a drainage layer, consisting of (from bottom up) a 40-mil LLDPE geomembrane, a geocomposite (to drain infiltrated surface water), and a 2-foot thick protective layer - is feasible for all three ponds. The hydraulic heads within the ash ponds will continue to decrease following cap construction and hydrostatic equilibrium will be attained.

5 REFERENCES

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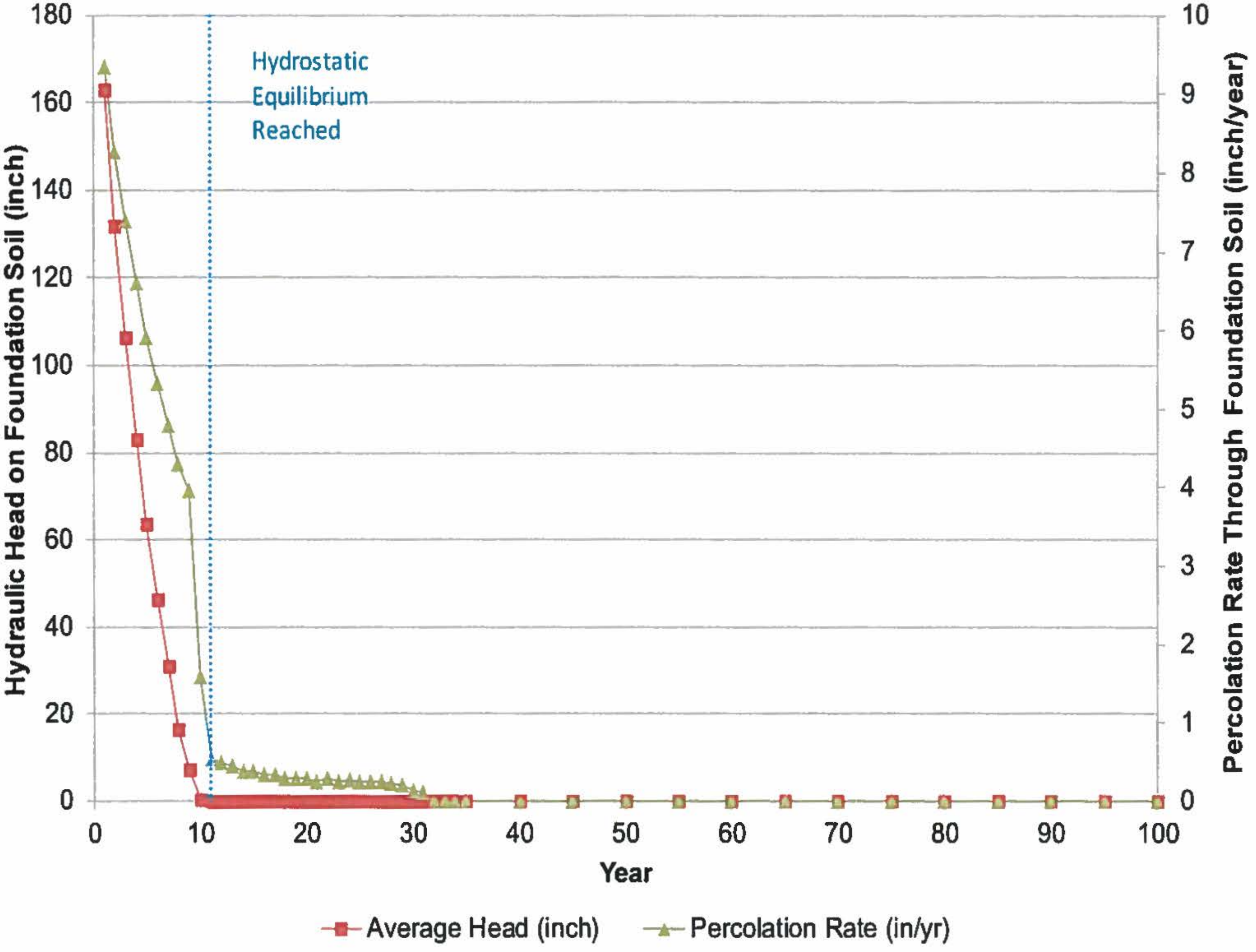
U.S. EPA, 2015. 40 CFR Parts 257 and 261 – *Hazardous and Solid Waste Management System; Disposal of Coal Ash Residuals from Electric Utilities.* Federal Register vol. 80, no. 74, April 17, 2015. 21467-21501.

FIGURES



PREPARED BY/DATE
M_W 08/18/2016
REVIEWED BY/DATE
BGH 08/22/2016

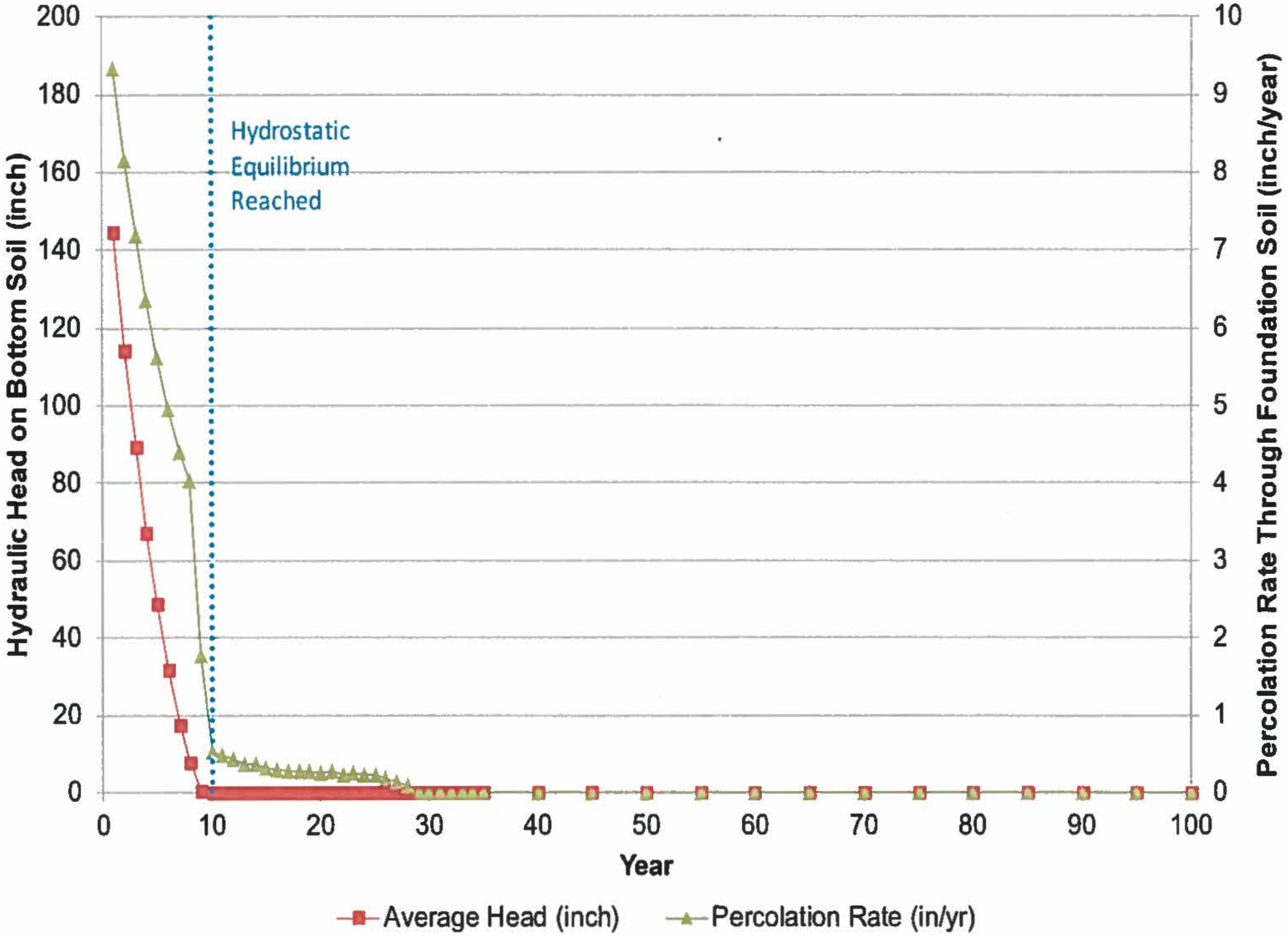
Hydraulic Head and Percolation Rate for Capped WAP 1

HYDROSTATIC MODELING REPORT
WOOD RIVER ASH IMPOUNDMENT SYSTEM
DYNEGY MIDWEST GENERATION, LLC

PROJECT NO: 2376

FIGURE NO: 1a

NATURAL RESOURCE TECHNOLOGY



PREPARED BY/DATE
M_W 08/18/2016
REVIEWED BY/DATE
BGH 08/22/2016

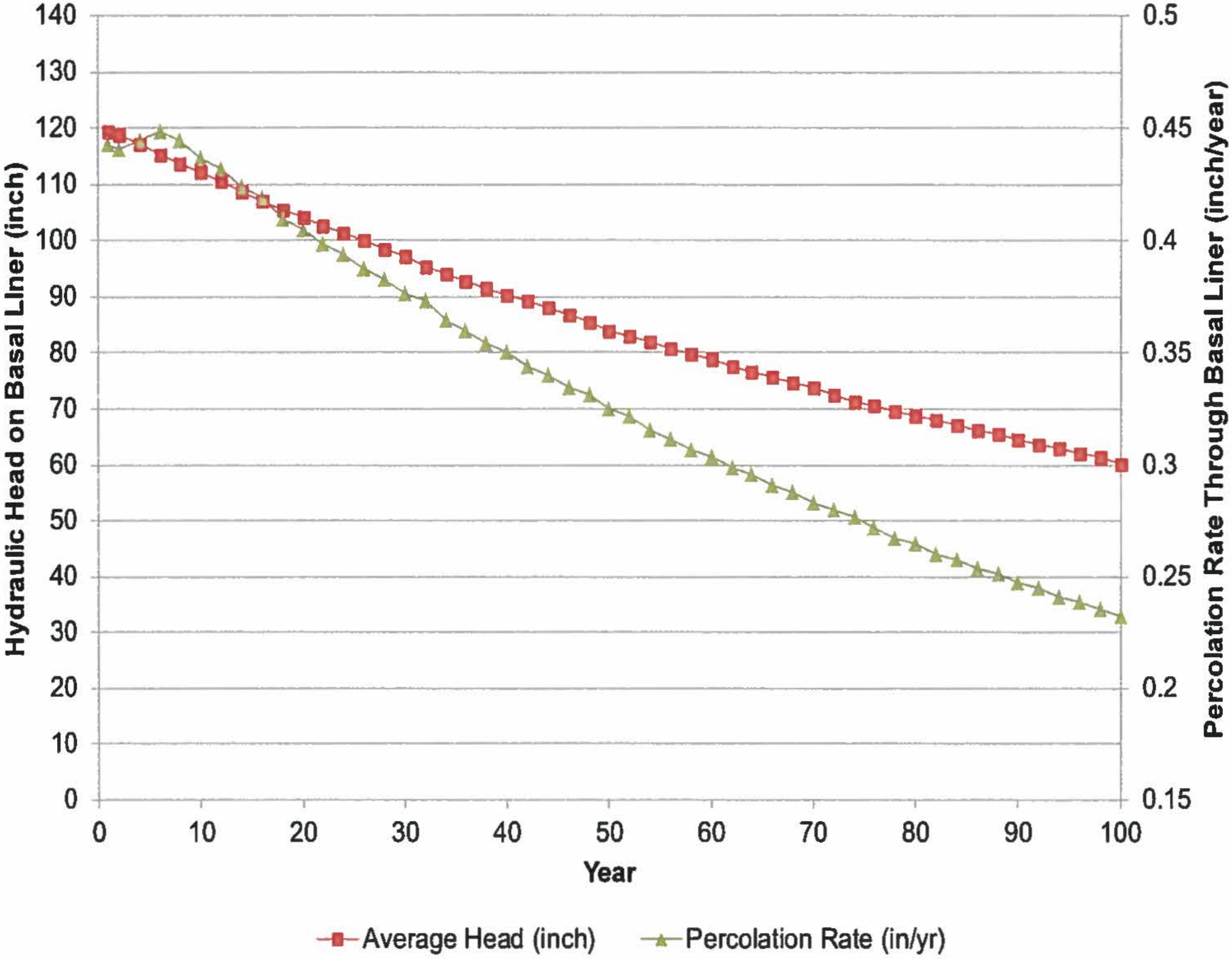
Hydraulic Head and Percolation Rate for Capped WAP 2W

HYDROSTATIC MODELING REPORT
WOOD RIVER ASH IMPOUNDMENT SYSTEM
DYNEGY MIDWEST GENERATION, LLC

PROJECT NO: 2376

FIGURE NO: 1b

NATURAL RESOURCE TECHNOLOGY



PREPARED BY/DATE
M_W 08/18/2016
REVIEWED BY/DATE
BGH 08/22/2016

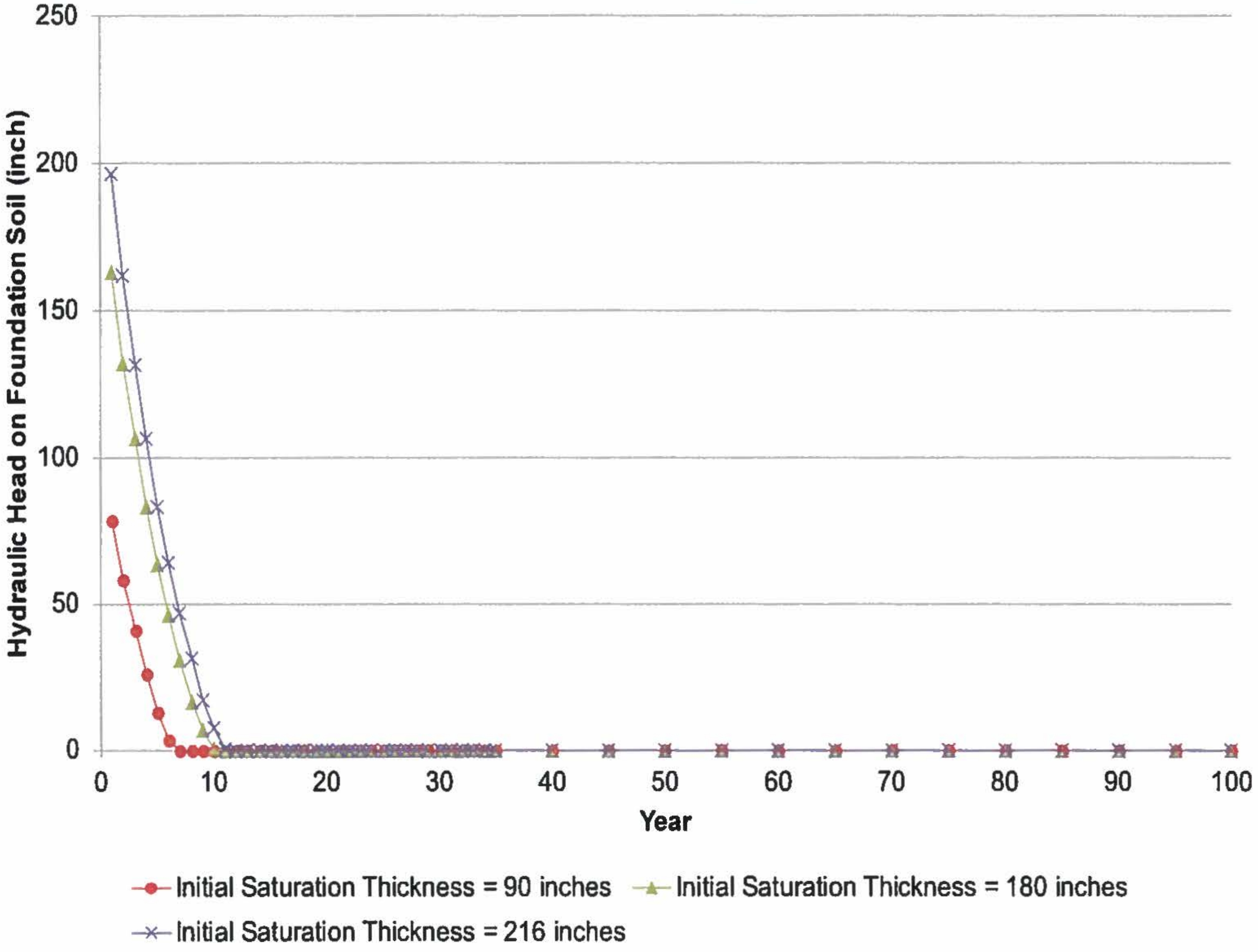
Hydraulic Head and Percolation Rate for Capped WAP 2E

HYDROSTATIC MODELING REPORT
WOOD RIVER ASH IMPOUNDMENT SYSTEM
DYNEGY MIDWEST GENERATION, LLC

PROJECT NO: 2376

FIGURE NO: 1c

NATURAL RESOURCE TECHNOLOGY



Sensitivity Explanation

Negligible - Hydraulic head changes within 1 inch and hydrostatic equilibrium can be attained.

Low - Hydraulic head changes within 10 inch and hydrostatic equilibrium can be attained.

Moderate - Hydraulic head changes higher than 10 inch and hydrostatic equilibrium can be attained.

High - Hydrostatic equilibrium cannot be attained.

PREPARED BY/DATE
M_W 08/18/2016
REVIEWED BY/DATE
BGH 08/22/2016

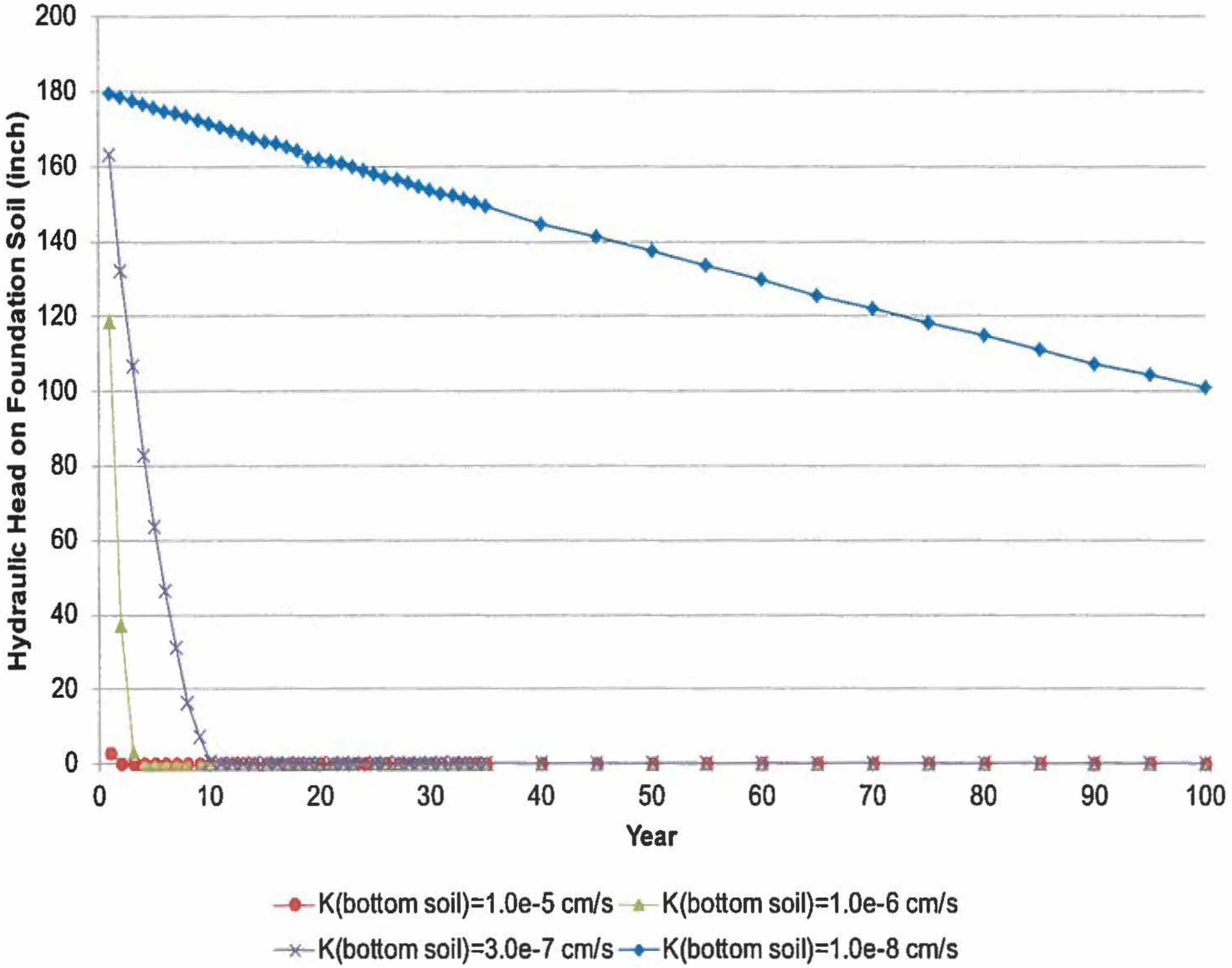
Sensitivity Analysis - Initial Saturation Thickness for Capped WAP 1

HYDROSTATIC MODELING REPORT
WOOD RIVER ASH IMPOUNDMENT SYSTEM
DYNEGY MIDWEST GENERATION, LLC

PROJECT NO: 2376

FIGURE NO: 2

NATURAL RESOURCE TECHNOLOGY



Sensitivity Explanation

Negligible - Hydraulic head changes within 1 inch and hydrostatic equilibrium can be attained.

Low - Hydraulic head changes within 10 inch and hydrostatic equilibrium can be attained.

Moderate - Hydraulic head changes higher than 10 inch and hydrostatic equilibrium can be attained.

High - Hydrostatic equilibrium cannot be attained.

PREPARED BY/DATE
M_W 08/18/2016
REVIEWED BY/DATE
BGH 08/22/2016

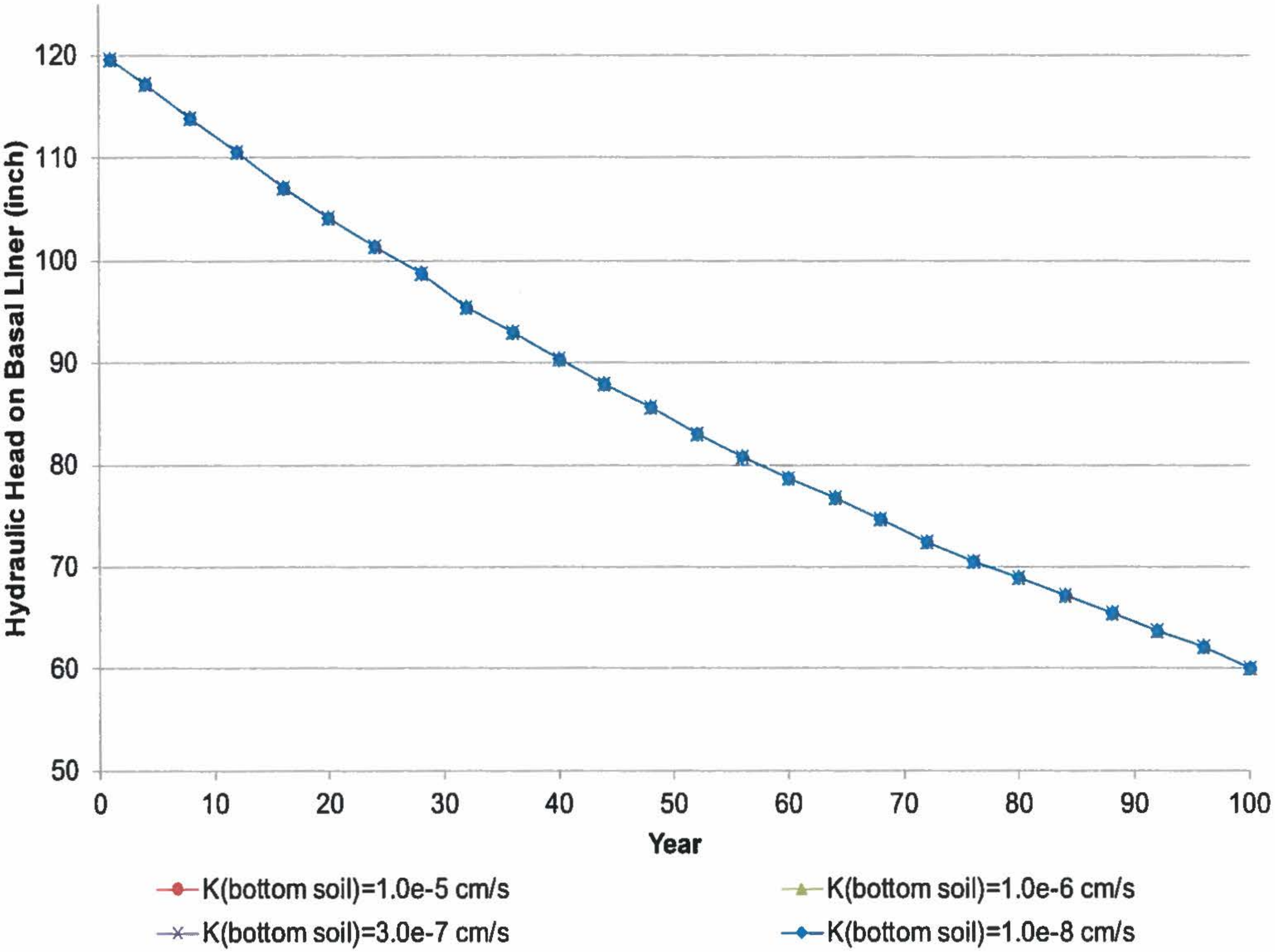
Sensitivity Analysis - Foundation Soil Hydraulic Conductivity for Capped WAP 1

HYDROSTATIC MODELING REPORT
WOOD RIVER ASH IMPOUNDMENT SYSTEM
DYNEGY MIDWEST GENERATION, LLC

PROJECT NO: 2376

FIGURE NO: 3a

NATURAL RESOURCE TECHNOLOGY



Sensitivity Explanation

Negligible - Hydraulic head changes within 1 inch and hydrostatic equilibrium can be attained.

Low - Hydraulic head changes within 10 inch and hydrostatic equilibrium can be attained.

Moderate - Hydraulic head changes higher than 10 inch and hydrostatic equilibrium can be attained.

High - Hydrostatic equilibrium cannot be attained.

PREPARED BY/DATE
M_W 08/18/2016
REVIEWED BY/DATE
BGH 08/22/2016

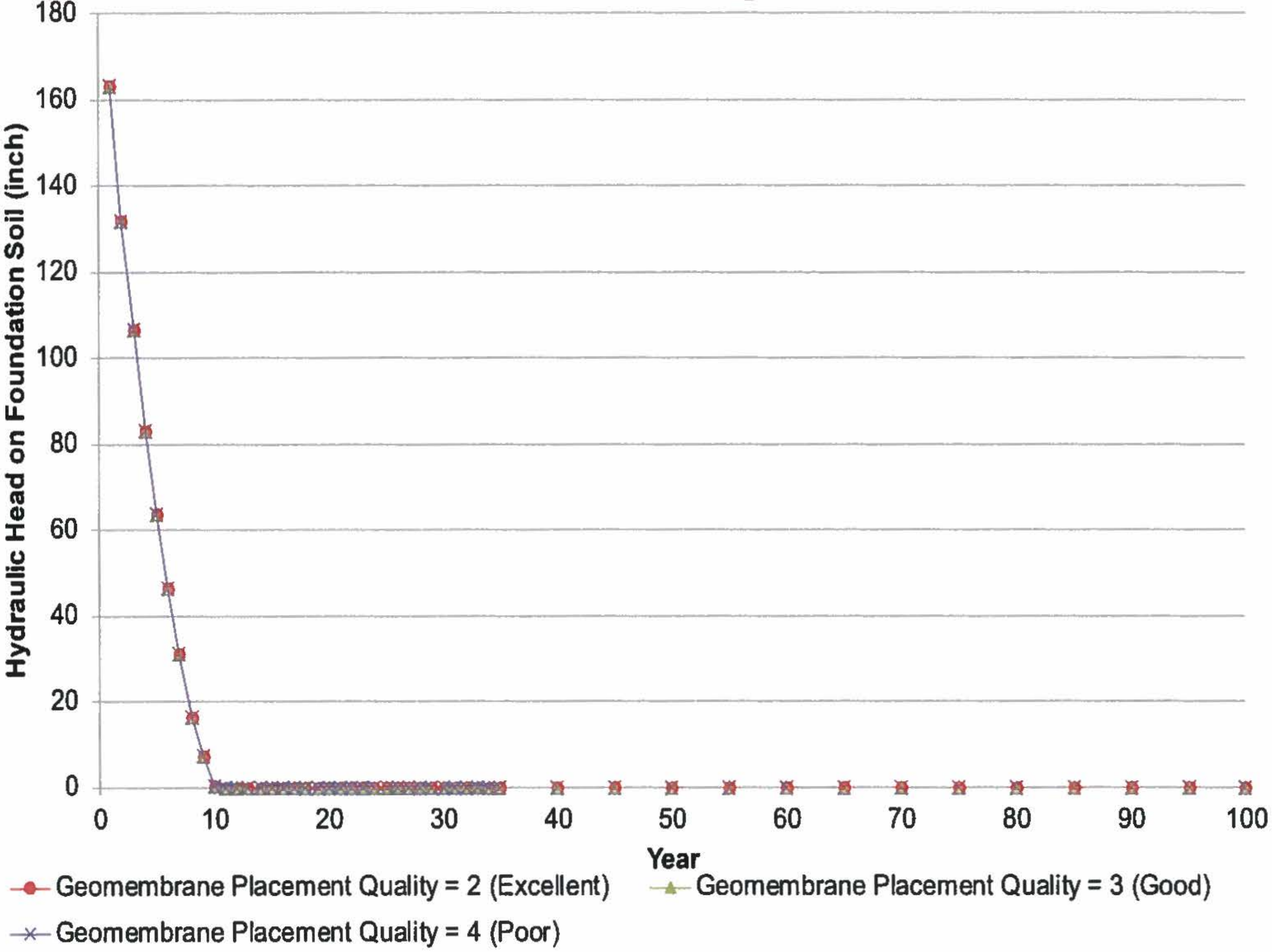
Sensitivity Analysis - Foundation Soil Hydraulic Conductivity for Capped WAP 2E

HYDROSTATIC MODELING REPORT
WOOD RIVER ASH IMPOUNDMENT SYSTEM
DYNEGY MIDWEST GENERATION, LLC

PROJECT NO: 2376

FIGURE NO: 3b

NATURAL
RESOURCE
TECHNOLOGY



Sensitivity Explanation
Negligible - Hydraulic head changes within 1 inch and hydrostatic equilibrium can be attained.
Low - Hydraulic head changes within 10 inch and hydrostatic equilibrium can be attained.
Moderate - Hydraulic head changes higher than 10 inch and hydrostatic equilibrium can be attained.
High - Hydrostatic equilibrium cannot be attained.

PREPARED BY/DATE
M_W 08/18/2016
REVIEWED BY/DATE
BGH 08/22/2016

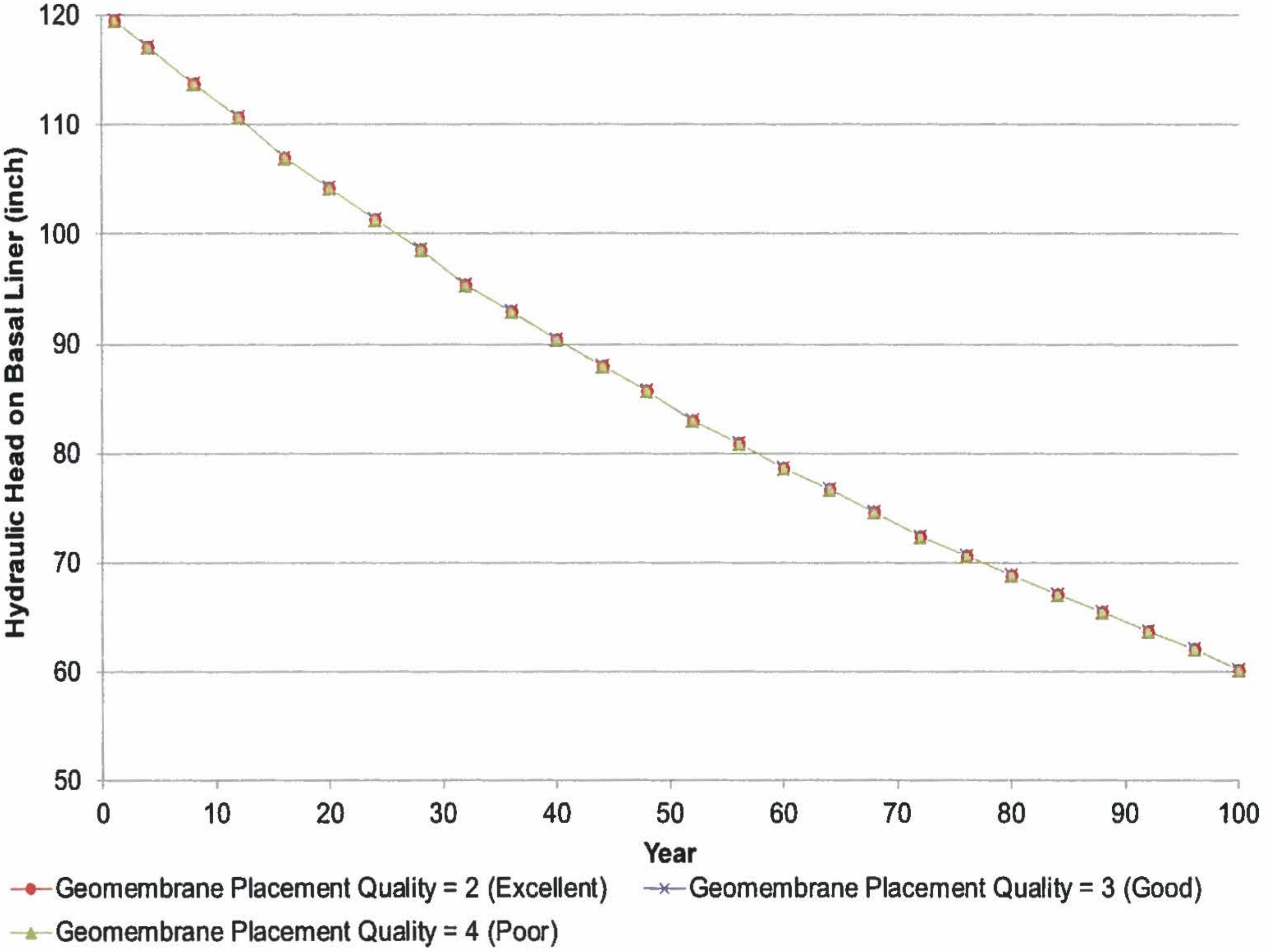
Sensitivity Analysis - Geomembrane Placement Quality for Capped WAP 1

HYDROSTATIC MODELING REPORT
WOOD RIVER ASH IMPOUNDMENT SYSTEM
DYNEGY MIDWEST GENERATION, LLC

PROJECT NO: 2376

FIGURE NO: 4a

NATURAL RESOURCE TECHNOLOGY



Sensitivity Explanation
Negligible - Hydraulic head changes within 1 inch and hydrostatic equilibrium can be attained.
Low - Hydraulic head changes within 10 inch and hydrostatic equilibrium can be attained.
Moderate - Hydraulic head changes higher than 10 inch and hydrostatic equilibrium can be attained.
High - Hydrostatic equilibrium cannot be attained.

PREPARED BY/DATE
M_W 08/18/2016
REVIEWED BY/DATE
BGH 08/22/2016

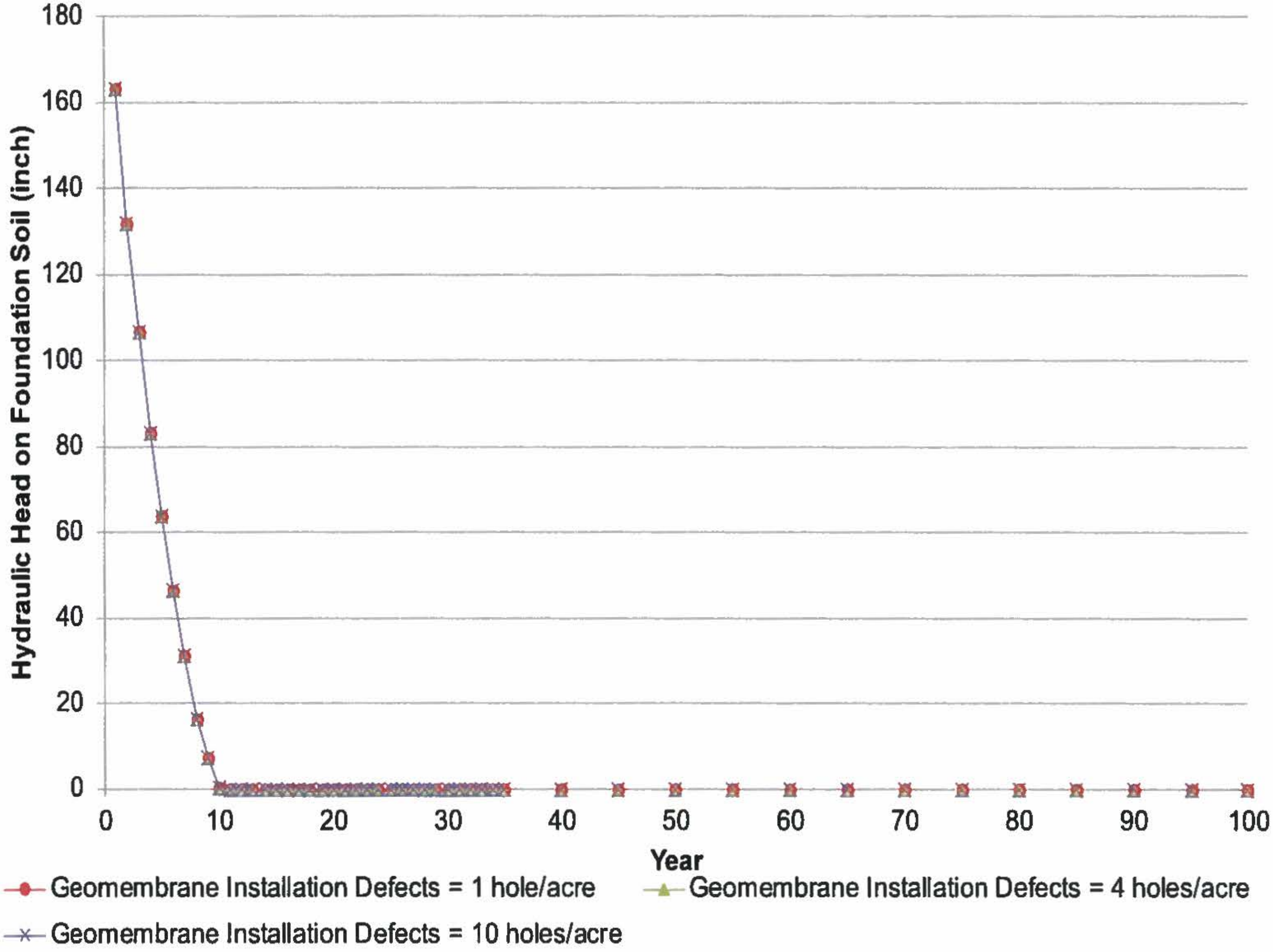
Sensitivity Analysis - Geomembrane Placement Quality for Capped WAP 2E

HYDROSTATIC MODELING REPORT
WOOD RIVER ASH IMPOUNDMENT SYSTEM
DYNEGY MIDWEST GENERATION, LLC

PROJECT NO: 2376

FIGURE NO: 4b

NATURAL
RESOURCE
TECHNOLOGY



Sensitivity Explanation

Negligible - Hydraulic head changes within 1 inch and hydrostatic equilibrium can be attained.

Low - Hydraulic head changes within 10 inch and hydrostatic equilibrium can be attained.

Moderate - Hydraulic head changes higher than 10 inch and hydrostatic equilibrium can be attained.

High - Hydrostatic equilibrium cannot be attained.

PREPARED BY/DATE
M_W 08/18/2016
REVIEWED BY/DATE
BGH 08/22/2016

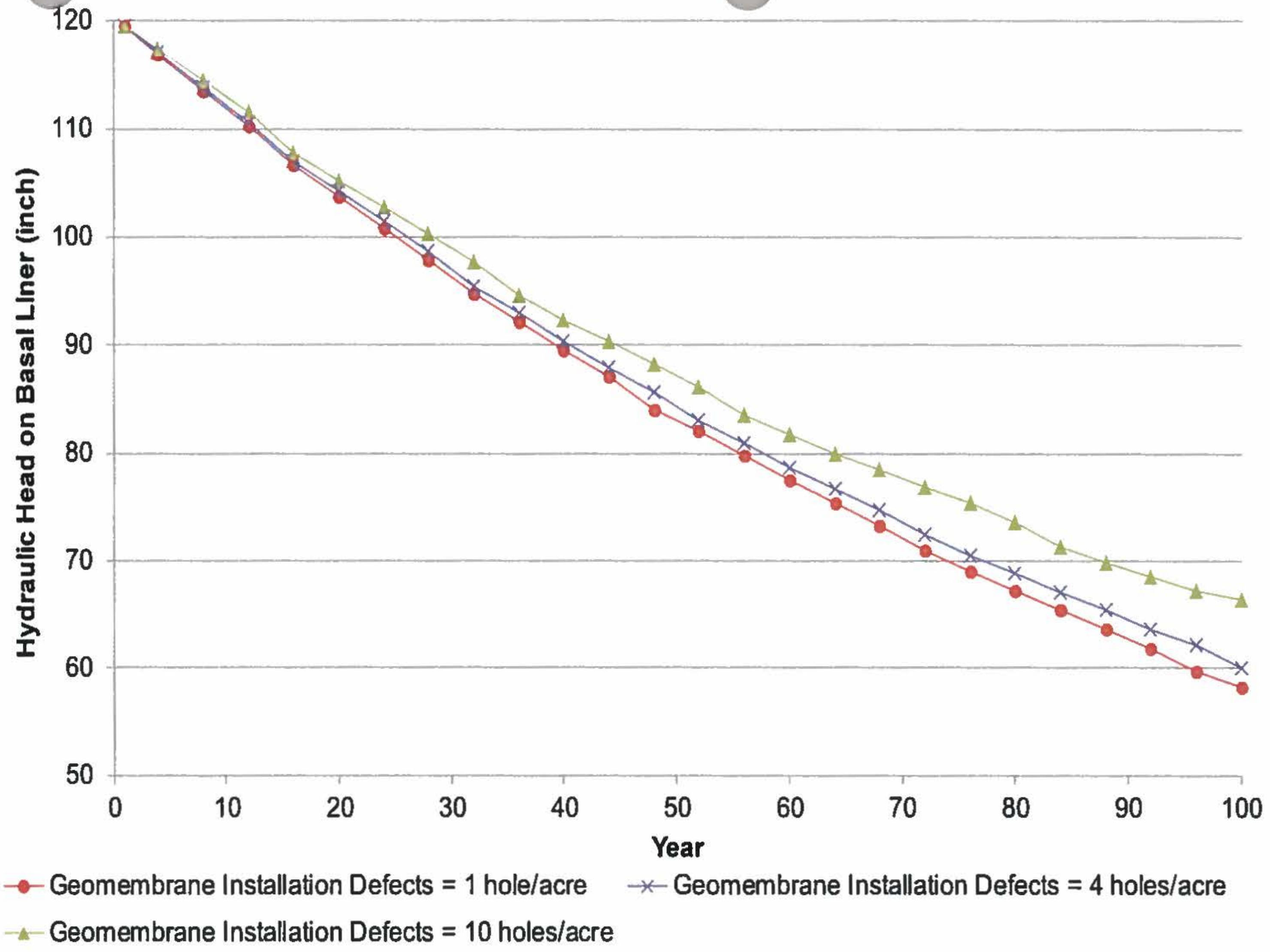
Sensitivity Analysis - Geomembrane Installation Defects for Capped WAP 1

HYDROSTATIC MODELING REPORT
WOOD RIVER ASH IMPOUNDMENT SYSTEM
DYNEGY MIDWEST GENERATION, LLC

PROJECT NO: 2376

FIGURE NO: 5a

NATURAL
RESOURCE
TECHNOLOGY



Sensitivity Explanation
Negligible - Hydraulic head changes within 1 inch and hydrostatic equilibrium can be attained.
Low - Hydraulic head changes within 10 inch and hydrostatic equilibrium can be attained.
Moderate - Hydraulic head changes higher than 10 inch and hydrostatic equilibrium can be attained.
High - Hydrostatic equilibrium cannot be attained.

PREPARED BY/DATE
M_W 08/18/2016
REVIEWED BY/DATE
BGH 08/22/2016

Sensitivity Analysis - Geomembrane Installation Defects for Capped WAP 2E

HYDROSTATIC MODELING REPORT
WOOD RIVER ASH IMPOUNDMENT SYSTEM
DYNEGY MIDWEST GENERATION, LLC

PROJECT NO: 2376

FIGURE NO: 5b

NATURAL RESOURCE TECHNOLOGY

TABLES

Table 1. HELP Input Parameters - West Ash Ponds 1 and 2W Baseline Conditions
Wood River Ash Impoundment System
Hydrostatic Modeling Report
Dynegy Midwest Generation, LLC

NRT PROJECT NO.: 2376
BY: M_W CHKD BY: BGH
DATE: 8/23/16

Parameter				Notes
Climate Data				
City	St. Louis, MO			Nearby city to the Site within HELP database
Latitude	38.87° N			Plant latitude
Evaporation Zone Depth (in)	20			8 - bare ground, 20 - fair grass
Leaf Index	1			1 - poor stand of grass (Schroeder, 1994)
Growing Season Period, Average Wind Speed, and Quarterly Relative Humidity.	HELP model defaults			See HELP output in Appendix A
Number of Years for Synthetic Data Generation	30			30-year period is applied to look for equilibrium.
Temperature, Evapotranspiration, and Precipitation	synthetically generated using St. Louis, MO defaults.			-
Soil Layer Data				
Soil-general				
% Where Runoff Possible	0			-
Area (acres)	1			Unit area
Specify Initial moisture content	Y			-
Initial Surface Water/Snow (in)	0			-
Soil Layers	**West Ash Pond 1**	**West Ash Pond 2W**		
1	Unsaturated Fly Ash	Unsaturated Fly Ash		-
2		Saturated Fly Ash		
3	Saturated Fly Ash			
4				
5				
6				
7				
8				
9				
10				
11		Silty Clay		
12		--		
13	Silty Clay			
Layer Parameter				
Layer # (West Ash Pond 1)	**1-2**	**3-12**	**13**	
Layer # (West Ash Pond 2W)	**1**	**2-10**	**11**	
Type	1	1	3	1 = vertical percolation layer, 3=barrier soil liner
Thickness Per Layer (in)	18	18	108 (Pond 1)/ 96 (Pond 2W)	Based on field measurement
Material Texture Number	30	30	14	14 = silty clay; 30 = fly ash
Porosity (vol/vol)	0.541	0.541	0.479	Default value for selected soil texture
Field Capacity (vol/vol)	0.187	0.187	0.371	Default value for selected soil texture
Wilting Point (vol/vol)	0.047	0.047	0.251	Default value for selected soil texture
Initial Moisture Content (vol/vol)	F	P	P	P = porosity, F = field capacity
Hydraulic Conductivity (cm/s)	1.00E-05	1.00E-05	3.00E-07	Fly ash value calibrated (2000 HELP Model); silty clay unit K value chosen based on the range of field/laboratory measurements
Soils-runoff				
SCS Runoff Curve Number	--			No runoff is assumed in this scenario
Slope				
Length (ft)				
Texture				
Vegetation				

Table 2. HELP Input Parameters - West Ash Pond 2E Baseline Condition
Wood River Ash Impoundment System
Hydrostatic Modeling Report
Dynegy Midwest Generation, LLC

NRT PROJECT NO.: 2376
BY: M_W CHKD BY: BGH
DATE: 8/23/16

Parameter					Notes
Climate Data					
City	St. Louis, MO				Nearby city to the Site within HELP database
Latitude	38.87° N				Plant latitude
Evaporation Zone Depth (in)	8				8 - bare ground, 20 - fair grass
Leaf Index	0				0 - bareground (Schroeder, 1994)
Growing Season Period, Average Wind Speed, and Quarterly Relative Humidity.	HELP model defaults				See HELP output in Appendix A
Number of Years for Synthetic Data Generation	16				Year 2000 - Year 2016
Temperature, Evapotranspiration, and	synthetically generated using St. Louis, MO defaults.				-
Soil Layer Data					
Soil-general					
% Where Runoff Possible	0				-
Area (acres)	1				Unit area
Specify Initial moisture content	Y				-
Initial Surface Water/Snow (in)	60				-
Soil Layers					
1-10	Saturated Bottom Ash				-
11	45-mil polypropylene liner				
12	clay liner				
13	Silty Clay				
Layer Parameter					
Layer #	**1-10**	**11**	**12**	**13**	
Type	1	4	3	1	1 = vertical percolation layer, 3 = barrier soil liner, 4 = flexible membrane liner
Thickness Per Layer (in)	12	0.045	12	90	Based on field measurement
Material Texture Number	31	--	16	14	14 = silty clay; 16 = barrier soil, 31= bottom ash
Porosity (vol/vol)	0.578	--	0.427	0.479	Default value for selected soil texture
Field Capacity (vol/vol)	0.076	--	0.418	0.371	Default value for selected soil texture
Wilting Point (vol/vol)	0.025	--	0.367	0.251	Default value for selected soil texture
Initial Moisture Content (vol/vol)	P	P	P	P	P = porosity, F = field capacity
Hydraulic Conductivity (cm/s)	4.1E-03*	1.00E-11	1.0E-7*	3.0E-7	* - default value; silty clay unit K value chosen based on the range of field/laboratory measurements; Polypropylene K value supplied by vendor
Pinhole Density (holes/acre)	--	1	--	--	1 = Excellent
Installation Defects (holes/acre)	--	4	--	--	4 = Good
Placement Quality	--	3	--	--	3 = Good
Soils-runoff					
SCS Runoff Curve Number	--				No runoff is assumed in this scenario
Slope					
Length (ft)					
Texture					
Vegetation					

Table 3. HELP Input Parameters - West Ash Ponds 1 and 2W Closure Conditions
Wood River Ash Impoundment System
Hydrostatic Modeling Report
Dynegy Midwest Generation, LLC

NRT PROJECT NO.: 2376
BY: M_W CHKD BY: BGH
DATE: 8/23/16

Parameter			Notes
Climate Data			
City	St. Louis, MO		Nearby city to the Site within HELP
Latitude	38.87° N		Plant latitude
Evaporation Zone Depth (in)	20		8 - bare ground, 20 - fair grass
Leaf Index	2		1 - poor stand of grass, 2 - fair stand of grass (Schroeder, 1994)
Growing Season Period, Average Wind Speed, and Quarterly Relative Humidity.	HELP model defaults		See HELP output in Appendix A
Number of Years for Synthetic Data Generation	100		-
Temperature, Evapotranspiration, and	synthetically generated using St. Louis, MO defaults.		-
Soil Layer Data			
Soil-general			
% Where Runoff Possible	100		The landfill cap does not have areas of ponding water
Area (acres)	1		Unit area
Specify Initial moisture content	Y		-
Initial Surface Water/Snow (in)	0		-
Soil Layers	**West Ash Pond 1 CAP**	**West Ash Pond 2W CAP**	-
1	Vegetative Cover	Vegetative Cover	
2	Soil Rooting Zone	Soil Rooting Zone	
3	Geocomposite Drainage Layer	Geocomposite Drainage Layer	
4	40-mil LLDPE geomembrane	40-mil LLDPE geomembrane	
5	Unsaturated Fly Ash	Unsaturated Fly Ash	
6		Saturated Fly Ash	
7	Saturated Fly Ash		
8			
9			
10			
11			
12			
13			
14			
15		Silty Clay	
16		--	
17	Silty Clay		

Table 3. HELP Input Parameters - West Ash Ponds 1 and 2W Closure Conditions
Wood River Ash Impoundment System
Hydrostatic Modeling Report
Dynegy Midwest Generation, LLC

NRT PROJECT NO.: 2376
BY: M_W CHKD BY: BGH
DATE: 8/23/16

Parameter								Notes
Layer Parameter								
Layer # (West Ash Pond 1)	**1**	**2**	**3**	**4**	**5-6**	**7-16**	**17**	
Layer # (West Ash Pond 2W)	**1**	**2**	**3**	**4**	**5**	**6-14**	**15**	
Type	1	1	2	4	1	1	3	1 = vertical percolation layer; 3=barrier soil liner
Thickness Per Layer (in)	6	18	0.33	0.04	18	18	108 (Pond 1)/ 96 (Pond 2W)	-
Material Texture Number	9	9	20	36	30	30	14	9 = silt loam, 14 = silty clay, 16 = barrier soil, 20 = drainage net, 30 = fly ash, 36 = LDPE
Porosity (vol/vol)	0.501	0.501	0.85	--	0.541	0.541	0.479	Default value for selected soil texture
Field Capacity (vol/vol)	0.284	0.284	0.01	--	0.187	0.187	0.371	Default value for selected soil texture
Wilting Point (vol/vol)	0.135	0.135	0.005	--	0.047	0.047	0.251	Default value for selected soil texture
Initial Moisture Content (vol/vol)	F	F	F	--	F	P	P	P = porosity, F = field capacity
Hydraulic Conductivity (cm/s)	1.90E-04*	1.90E-04*	10*	4.0E-13*	1.00E-05	1.00E-05	3 00E-07	*Default values. fly ash value calibrated (2000 HELP Model); silty clay unit K value chosen based on the range of field/laboratory measurements
Pinhole Density	--	--	--	1	--	--	--	
Installation Defects	--	--	--	4	--	--	--	
Placement Quality	--	--	--	3	--	--	--	
Soils-runoff								
SCS Runoff Curve Number	80.3							HELP Calculated
Slope	1% (Pond 1)/1.3% (Pond 2W)							AECOM 30% Design
Length (ft)	800 (Pond 1)/890 (Pond 2W)							Estimated values
Texture	9							Based on uppermost soil type (silt loam)
Vegetation	3							3 - fair stand of grass

Table 4. HELP Input Parameters - West Ash Pond 2E Closure Condition

Wood River Ash Impoundment System
Hydrostatic Modeling Report
Dynegy Midwest Generation, LLC

NRT PROJECT NO.: 2376
BY: M_W CHKD BY: BGH
DATE: 8/23/16

Parameter		Notes
Climate Data		
City	St. Louis, MO	Nearby city to the Site within HELP
Latitude	38.87° N	Plant latitude
Evaporation Zone Depth (in)	20	8 - bare ground, 20 - fair grass
Leaf Index	2	1 - poor stand of grass, 2 - fair stand of grass (Schroeder, 1994)
Growing Season Period, Average Wind Speed, and Quarterly Relative Humidity.	HELP model defaults	See HELP output in Appendix A
Number of Years for Synthetic Data Generation	100	-
Temperature, Evapotranspiration, and	synthetically generated using St. Louis, MO defaults.	-
Soil Layer Data		
Soil-general		
% Where Runoff Possible	100	The landfill cap does not have areas of ponding water
Area (acres)	1	Unit area
Specify Initial moisture content	Y	-
Initial Surface Water/Snow (in)	0	-
Soil Layers		
1	Vegetative Cover	-
2	Soil Rooting Zone	
3	Geocomposite Drainage Layer	
4	40-mil LLDPE geomembrane	
5	Saturated Bottom Ash	
6		
7		
8		
9		
10		
11		
12		
13		
14		
15	45-mil polypropylene liner	
16	clay liner	
17	Silty Clay	

Table 4. HELP Input Parameters - West Ash Pond 2E Closure Condition
Wood River Ash Impoundment System
Hydrostatic Modeling Report
Dynegy Midwest Generation, LLC

NRT PROJECT NO.: 2376
BY: M_W CHKD BY: BGH
DATE: 8/23/16

Parameter									Notes
Layer Parameter									
Layer #	**1**	**2**	**3**	**4**	**5-14**	**15**	**16**	**17**	
Type	1	1	2	4	1	4	3	1	1 = vertical percolation layer, 2 = lateral drainage layer, 3 = barrier soil liner, 4 = flexible membrane liner
Thickness Per Layer (in)	6	18	0.33	0.04	12	0.045	12	90	-
Material Texture Number	9	9	20	36	31	--	16	14	9 = silt loam, 14 = silty clay, 16 = barrier soil, 20 = drainage net, 31= bottom ash, 36 = LDPE
Porosity (vol/vol)	0.501	0.501	0.85	--	0.578	--	0.427	0.479	Default value for selected soil texture
Field Capacity (vol/vol)	0.284	0.284	0.01	--	0.076	--	0.418	0.371	Default value for selected soil texture
Wilting Point (vol/vol)	0.135	0.135	0.005	--	0.025	--	0.367	0.251	Default value for selected soil texture
Initial Moisture Content (vol/vol)	F	F	F	F	B	B	P	B	P = porosity, F = field capacity, B = estimated value from baseline
Hydraulic Conductivity (cm/s)	1.90E-04*	1.90E-04*	10*	4.0E-13*	4.1E-03*	1.00E-11	1.0E-7*	3.00E-07	* - default value; silty clay unit K value chosen based on the range of field/laboratory measurements; Polypropylene K value supplied by vendor
Pinhole Density	--	--	--	1	--	1	--	--	1 = Excellent
Installation Defects	--	--	--	4	--	4	--	--	4 = Good
Placement Quality	--	--	--	3	--	3	--	--	3 = Good
Soils-runoff									
SCS Runoff Curve Number	80.9								HELP Calculated
Slope	1.5%								AECOM 30% Design
Length (ft)	560								Estimated values
Texture	9								Based on uppermost soil type (silt
Vegetation	3								3 - fair stand of grass

Table 5. Foundation Soil Percolation Rate Summary
Wood River Ash Impoundment System
Hydrostatic Modeling Report
Dynegy Midwest Generation, LLC

NRT PROJECT NO.: 2376
BY: M_W CHKD BY: BGH
DATE: 8/23/16

	Percolation Rate through Foundation Soil (inches/year)	Simulation Year
West Ash Pond 1 Baseline	8.67	1-30
West Ash Pond 2W Baseline	8.52	1-30
West Ash Pond 2E Baseline	0.71	1-16
West Ash Pond 1 with CAP	5.28	1-10
	0.28	11-31
	0.002	32-100
West Ash Pond 2W with CAP	5.24	1-9
	0.28	10-28
	0.001	29-100
West Ash Pond 2E with CAP	0.33	1-100

Table 6. HELP Sensitivity Analysis

Wood River Ash Impoundment System
Hydrostatic Modeling Report
Dynegy Midwest Generation, LLC

NRT PROJECT NO.: 2376
BY: M_W CHKD BY: BGH
DATE: 8/23/16

Parameter			Sensitivity to Hydrostatic Equilibrium[1]	
	Model Value	Tested Range	Synthetic Cap for Unlined Pond[2]	Synthetic Cap for Lined Pond
Soil Layers				
Initial Saturation Thickness (in)	180	90, 180, 216	Moderate	NA
Soil Parameters--foundation soil				
Hyraulic conductivity (cm/s)	3.00E-07	1.0E-05, 1.0E-06, 3.0E-7, 1.0E-08	Moderate	Negligible
Soil Parameters - membrane layer				
Placement Quality	3	2, 3, 4	Negligible	Negligible
Installation Defects	4	1, 4, 10	Negligible	Low

Notes:

1. Sensitivity Explanation
   Negligible - Hydraulic head changes within 1 inch and hydrostatic equilibrium can be attained.
   Low - Hydraulic head changes within 10 inch and hydrostatic equilibrium can be attained.
   Moderate - Hydraulic head changes higher than 10 inch and hydrostatic equilibrium can be attained.
   High - Hydrostatic equilibrium cannot be attained.
2. West Ash Pond 1 Soil Cap was used to perform the sensitivity analyses.

APPENDIX A

HELP MODEL FILES

(PROVIDED SEPARATELY)

The following are attachments to the testimony of Scott M. Payne, PhD, PG and Ian Magruder, M.S..

ATTACHMENT 22

Appendix D.
Groundwater Model Report

SMARTER SOLUTIONS

EXCEPTIONAL SERVICE

VALUE

GROUNDWATER MODEL REPORT

West Ash Pond Complex
Wood River Power Station
Alton, Illinois

FINAL

October 19, 2016

NATURAL
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ENVIRONMENTAL CONSULTANTS

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GROUNDWATER MODEL REPORT

WEST ASH POND COMPLEX
WOOD RIVER POWER STATION
ALTON, ILLINOIS

Project No. 2376

Prepared For:

Dynegy Operating Company
1500 Eastport Plaza Drive
Collinsville, IL 62234

Prepared By:

Natural Resource Technology, Inc.
234 W. Florida Street, Fifth Floor
Milwaukee, Wisconsin 53204

FINAL
October 19, 2016

Stuart J. Cravens
Stuart J. Cravens, PG
Principal Hydrogeologist

Jacob J. Walczak, PG
Hydrogeologist

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FIGURES

TABLES

APPENDICES

ACRONYMS AND ABBREVIATIONS

CCR	coal combustion residual
WAP	West Ash Pond
WRPS	Wood River Power Station
cm/sec	centimeters per second
DMG	Dynegy Midwest Generation, Inc.
g/cm^3	grams per cubic centimeter
in/yr	inches per year
ft	Feet
bgs	below ground surface
mg/L	milligram per liter
HELP	Hydrologic Evaluation of Landfill Performance
IAC	Illinois Administrative Code
mg/L	milligrams per liter
NRT	Natural Resource Technology
TDS	total dissolved solids
OEAP	Old East Ash Pond
NEAP	New East Ash Pond
USACE	United States Army Corps of Engineers
LLDPE	Linear low density polyethylene
K_d	distribution coefficient
NAVD88	North American Vertical Datum of 1988

1 BACKGROUND

1.1 Introduction

This Groundwater Model Report has been prepared by Natural Resource Technology (NRT) on behalf of Dynegy Midwest Generation, LLC (DMG). A groundwater flow and transport model was developed for the Wood River West Ash Complex (Site) at the Wood River Power Station (WRPS), Alton, Madison County, Illinois with the objective of evaluating the effect constructing a cover system as part of a closure plan will have on surrounding groundwater quality. The cover system, as described in the draft Closure and Post-Closure Care Plan for Dynegy Wood River Ash Complex (AECOM, 2016), are proposed to be implemented on West Ash Pond (WAP 1), West Ash Pond 2W (WAP 2W), and West Ash Pond 2E (WAP 2E). This Groundwater Model Report was used to predict changes in groundwater quality in response to the proposed capping system.

In conjunction with this report, a Hydrogeologic Characterization Report (NRT, 2016d) was completed, which summarizes data collected to comply with Federal Coal Combustion Residual (CCR) Rule (40 CFR Part 257) as well as comprehensive data collection and evaluations from prior hydrogeologic investigation reports completed at the Site (1984 - present). A Groundwater Monitoring Plan (NRT, 2016c) and a Groundwater Management Zone Application (NRT, 2016b) are also being prepared to support the closure of the West Ash Pond Complex. In addition, Hydrologic Evaluation of Landfill Performance (HELP) modeling has also been conducted to enable estimation of the time required for hydrostatic equilibrium of groundwater to be achieved beneath the West Ash Pond Complex. The HELP modeling also provided percolation rates for existing conditions and predicted cap scenario that were used as inputs in the groundwater flow and transport model. A description of the HELP model inputs and modeling results are found in the Hydrostatic Modeling Report (NRT, 2016e).

1.2 Site Location and History

The WRPS includes a power plant and the West and East Ash Pond Complexes situated on the east bank of the Mississippi River, about six river miles upstream from the confluence of the Mississippi and Missouri Rivers. For the purposes of this groundwater model report, the Site is comprised of WAP 1, WAP 2E and WAP 2W at the WRPS. The Wood River, a perennial stream that discharges into the Mississippi River, lies on eastern edge of the site. The Site is located within Section 19 Township 5 North and Range 9 West. The cities of Alton, East Alton, and Wood River are within 2 miles of the West and East Ash Pond Complexes. The WRPS is located in an area of heavy industrial activity. Metal refining, vinegar production, cardboard manufacturing, and sewage treatment occur within ½ mile of the plant. The site location and an overview of the ash ponds system is shown on Figures 1-1 and 1-2. The WRPS property is bordered on the south by the State Route 143 and the Mississippi River, the east by the Wood River, the north by vacant/abandoned industrial property and railroad tracks, and the west by vacant land/water retention ponds of the Mississippi River levee system operated by the Army Corps of Engineers.

WRPS began operation in 1949 and ash from the first coal fired unit was disposed of in the Old East Ash Pond (OEAP). The OEAP was located on the eastern edge of the site along the Wood River and was utilized for approximately 30 years until the West Ash Pond Complex was constructed in 1978. Several modifications to the Site and its operation have been made following construction. The Hydrogeologic Characterization Report (NRT, 2016d) describes the operational history in detail, significant changes that are important to the development of the groundwater models are included below:

- During a plant shutdown in 1997, DMG began reconstruction of the ponds. All ash was removed from the West Ash Pond impoundment areas now known as Pond 3 and a new double-lined pond with leachate collection was constructed.
- In 1998 DMG began mining ash from West Ash Pond impoundments now known as WAP 2W and WAP 2E. After removing all ash from WAP 2E a composite clay/synthetic liner was constructed.
- Beginning in 1999 all fly ash was managed through a dry handling system. The dry ash was sold as cement additive and bottom ash was sluiced to the lined ponds (WAP 2E and Pond 3) where the ash settled and the sluice water discharged via the NPDES permitted outfall.
- Ash was handled through the west pond complex until 2006-2007, at which time it was redirected to the New East Ash Pond (also called the Primary East Ash Pond) following its construction.
- Ash from WAP 1 and WAP 2W has been mined periodically since closure in 2006.

1.3 Site Hydrogeology

According to the site investigations performed from 1984 to 2015, four principal hydrogeologic units were identified beneath the Site and the surrounding area. The details are described in the Hydrogeologic Characterization Report (NRT, 2016d). These units are, from top down:

- **Fill & Coal Combustion Residual (CCR) Unit**

  The Fill and CCR Unit consists of fly ash and bottom ash. The thickest accumulations of coal ash at the Site occur in WAP 1 with a maximum depth of approximately 26 feet. Ash thickness in WAP 2W ranged from 11 to 18.5 feet. No borings were advanced in WAP 2E because it is a lined unit; however, it is estimated that the maximum bottom ash thickness is less than 25 feet.

- **Silty Clay Units**

  The silty clay units are composed of layers and lenses of clay, silty clay and silt with varying amounts of sand, but is predominantly clay and silty clay. Across most of the site the silty clay unit is split into an upper and lower unit. The units are separated by the inter-sand unit, described below. The upper silty clay unit and portions of the inter-sand were removed during impoundment construction in the vicinity of the Site, such that the CCR is in contact with the inter-sand unit or the lower silty clay. In areas where both the upper silty clay unit and the inter-sand were removed, the lower silty clay unit separates the CCR of the Site impoundments from the primary sand unit and acts as a barrier to downward migrating leachate from WAP 1 and WAP 2W. In addition to the silty clay unit, WAP 2E and Pond 3 have designed liners consisting of polyethylene membrane and compacted clay which further limit the vertical migration of leachate.

  The total thickness of the silty clay unit beneath the Site ranges from less than 5 feet in the southeast corner of WAP 1 and the northwest section of WAP 2W (where the inter-sand layer was removed during filling), to greater than 20 feet beneath WAP 2E. The thickness of the silty clay unit decreases north and south of the ash pond complex as the base of the unit approaches the ground surface.

  Field testing of former Monitoring Wells 10 and 11, which were screened entirely within the silty clay unit, indicated a geometric mean horizontal hydraulic conductivity of 2.4×10^{-5} cm/s (NRT, 2000). Laboratory tests of vertical hydraulic conductivity on clay samples ranged from 1.7×10^{-8} cm/s (Kelron, 2004) to 1.2×10^{-6} cm/s (AECOM, 2015). These low values are indicative of a confining layer.

- **Inter-sand Unit**

  The inter-sand unit occurs between the upper and lower silty clay units beneath portions of the site and can intersect the primary sand unit, described below, as identified in a portion of the East Ash Pond Complex. The inter-sand unit is composed of heterogeneous fine to medium-grained sand and silty sand that ranges from well to poorly sorted and is generally 5 feet thick or less. The top of the inter-sand unit is deepest where the silty clay units are the thickest and shallows to the south and to the north where the silty clay units thin. There are no monitoring wells present onsite that are screened exclusively in the inter-sand unit, and no field hydraulic conductivities have been measured.

- **Primary Sand Unit**

  The primary sand unit is comprised of permeable valley fill that contains the uppermost aquifer known in the area as the American Bottoms. The estimated thickness of the permeable valley fill at WRPS is approximately 120 feet to 140 feet and the sand and gravel constitutes 80 to 100 feet of this thickness. The top of the primary sand unit reflects a former river channel which trends east-west across the site. The top of the sand unit is near the surface (<5 feet below ground surface [bgs]) in the northern portion of the WRPS property and is up to 60 feet deep in the center of the historical channel. The primary sand unit overlies silt, sandy silt and silty clay diamicton and limestone bedrock which are the lower limits of the uppermost aquifer in the vicinity of the Site. Field testing of monitoring wells screened entirely within the primary sand unit indicate high horizontal hydraulic conductivities of 10^{-1} to 10^{-3} cm/sec (NRT, 2000 & Kelron, 2004), the geometric mean of all wells tested is 5.7×10^{-2} cm/sec (Kelron, 2004).

Groundwater flow directions are variable and significantly influenced by the Mississippi River stage. During base stage or low river levels, groundwater flow occurs in both a southerly direction toward the

Mississippi River and southeasterly toward the Wood River (Figure 1-3). During spring flooding and high Mississippi River stages, groundwater flow is easterly away from the Mississippi River. After flood levels subside, the flow direction reverts to normal conditions and groundwater again discharges to the rivers. The flooding and high river stages only occur periodically and the dominant flow direction during any given year is toward the rivers. Vertical groundwater gradients indicate general downward flow of water from the silty clay into the primary sand. Near the groundwater discharge areas along the rivers gradients are flat to upward.

In the vicinity of the Site, surface water and groundwater flow is further altered by levee drainage improvements at the Mel Price Lock and Dam segment of the Wood River Upper Levee System implemented by the U.S. Army Corps of Engineers (USACE), Mississippi Valley Division, St. Louis District, the Wood River Drainage and Levee District, and the Southwestern Illinois Flood Prevention District Council. The seepage control systems alter landside ponding adjacent to the Mel Price Lock and Dam on the north bank of the Mississippi River. The controlled ponding is adjacent to and west-northwest of the Site and likely influences groundwater flow in the immediate area.

1.4 Groundwater Quality

Groundwater sampling at the West Ash Pond Complex was initiated in 1984; however, consistent data collection began in 1996. Currently, groundwater monitoring is completed in accordance with the Closure Work Plan (CWP) (NRT, 2000) approved by the Illinois EPA on December 13, 2000. As called for by the 2000 CWP, DMG is required to sample groundwater quarterly, submit the results quarterly to the Illinois EPA, and provide an annual data assessment (NRT, 2016a). Modifications to the 2000 CWP proposed in the "2005 Closure Work Plan Annual Report" and cover letter were approved by the Illinois EPA in a letter to DMG dated June 15, 2006. Modifications approved by the Illinois EPA include reduction of monitoring frequency from quarterly to semiannually and semiannual submittals of data discs to Illinois EPA.

Parameters that have been detected in groundwater at concentrations exceeding the Class I groundwater quality standards include the following: boron, manganese, pH, and total dissolved solids (total filterable residue). A detailed summary of the analytical results and statistical analysis of the results are found in the Hydrogeologic Characterization Report (NRT, 2016d) and the 2015 Closure Work Plan Annual Report (NRT, 2016a). Boron is the primary indicator of coal ash leachate among the parameters detected in exceedance of the Class I groundwater quality standards at the Site.

Boron exceeded the 2 mg/L standard at three of the 12 monitoring wells from 2013 through 2015. Well 02 had boron concentrations of 2.50 and 3.45 mg/L, and Well 34 had boron concentrations of 5.95 and 7.49 mg/L. Wells 02 and 34 are located to the south and downgradient of the Site and screened in the primary sand. Well 12 had boron concentrations of 2.21 and 2.05 mg/L. Well 12 is located east of the

West Ash Pond Complex adjacent to Pond 3 and screened in the top 6 feet of the primary sand just below the Silty Clay Unit.

Annual median boron concentrations have decreased since the unlined ponds were removed from service (prior to 1998) in eight of the eleven downgradient monitoring wells currently monitored, while concentrations have increased only in wells 02, 12, and 34. The recent increases in boron at these wells may be attributed to several natural and anthropogenic factors, including, but not limited to the following; unusually stable southerly groundwater flow directions in recent years, disrupted groundwater flow direction due to recently installed levee drainage improvements, ash mining/removal for beneficial reuse at WAP 1 potentially increasing infiltration and mobilization of boron. Additional information regarding groundwater quality can be found in the 2015 Closure Work Plan Annual Report dated January 20, 2016 (NRT, 2016a).

2 GROUNDWATER MODEL

2.1 Overview

This section presents the conceptual model and the overall modeling methodology. Specifically, the model was established to address the following points:

- The model's capability to simulate current Site hydrology and the extent of CCR leachate impacts on groundwater
- The effect of pond closure on nearby groundwater quality

2.2 Conceptual Model

The Site overlays unlithified deposits (e.g., silty clay and the sand and gravel units) and bedrock. The hydrostratigraphy consists of a confining silty clay unit over a thick, highly permeable sand and gravel aquifer. Groundwater flow is transient and flow reversals are regularly observed as a function of Mississippi River stage. Groundwater discharges to the Mississippi River or Wood River, which border the WRPS property to the south and east, respectively, during periods of base river stage. Groundwater flow is away from the rivers during periods of flood stage. Flood river stage is estimated to occur annually; however, base river stage and the associated groundwater flow direction toward the rivers is predominant. In addition, there are large cones of depression east and northwest of the WRPS, although regional water table information indicates that the Site is not within either cone of depression. Groundwater originates from five sources within the model domain:

1. Natural recharge outside of the East and West Ash Pond Complexes
2. Recharge (percolation) within the Ash Pond Complexes that varies over time with changes in use
3. Natural flow within the American Bottoms aquifer from upgradient (north) areas during base river stage
4. Flow from the landside ponding adjacent to the Mel Price Lock and Dam
5. Flow from the Mississippi River during periods of flood river stage.

Boron was modeled to simulate migration of CCR leachate because: (1) boron is the only monitored primary indicator parameter for CCR impacts on groundwater with concentrations exceeding Class I standards in some on-site and downgradient wells; (2) boron is relatively conservative in the subsurface; and (3) boron is more representative of CCR leachate than sulfate, which may originate from anthropogenic and natural sources other than CCR leachate.

The conceptual model for transport assumes boron leaching to recharge water during percolation through CCRs above the water table. The model also includes flow and transport percolation rates for the East Ash Pond Complex taken from the Transport Model Investigation for the New East Ash Pond (NRT, 2006).

2.3 Model Approach

Three model codes were used to simulate groundwater flow and boron transport:

- Groundwater flow was modeled in three dimensions using MODFLOW
- Boron transport was modeled in three dimensions using MT3DMS (MODFLOW calculated the flow field that MT3DMS used in the transport calculations)
- Leachate percolation after pond closure was modeled using the HELP model, details of HELP modeling are found in the Hydrostatic Model Report (NRT, 2016e) and the leachate percolation rates were applied in MODFLOW to simulate recharge beneath pond caps.

The approach used to calibrate the groundwater flow model and transport model was:

- A steady-state flow model was calibrated to approximate observed head distributions, based on the range of heads measured in November 2014 (Figure 1-3) (a period that overlapped with available river stage data).
- The transport model calibration simulated boron transport over a period of 67 years (1949-2015). The model was calibrated to concentrations measured in 2015 and concentration time series trends from 1995-2015 (NRT, 2016a).

The transport model calibration required iterative changes to and recalibration of the steady-state flow model. The results provided a representative simulation of groundwater flow and transport conditions in the proximity of the Site.

The calibrated model was then used to predict changes in groundwater quality over a period of 500 years (2016-2515). A cover system that meets the requirements of 35 IAC 840.126 consisting of a vegetated soil layer, geocomposite drainage layer and 40-mil LLDPE geomembrane was chosen as the closure solution. A baseline (no action) and a capping scenario were modeled and described below:

- Baseline (no action): assumes no action is undertaken.
- Cap Scenario: Capping of the WAP 1, WAP 2W and WAP 2E with a cover system consisting of a vegetative soil layer, geocomposite drainage layer and 40-mil LLDPE geomembrane.

3 MODEL SET-UP AND CALIBRATION

3.1 Model Descriptions

MODFLOW uses a finite difference approximation to solve a three-dimensional head distribution in a transient, multi-layer, heterogeneous, anisotropic, variable-gradient, variable-thickness, confined or unconfined flow system—given user-supplied inputs of hydraulic conductivity, aquifer/layer thickness, recharge, wells, and boundary conditions. The program also calculates water balance at wells, rivers, and drains.

MODFLOW was developed by the United States Geological Survey (McDonald and Harbaugh, 1988) and has been updated several times since. Major assumptions of the code are: (1) groundwater flow is governed by Darcy's law; (2) the formation behaves as a continuous porous medium; (3) flow is not affected by chemical, temperature, or density gradients; and (4) hydraulic properties are constant within a grid cell. Other assumptions concerning the finite difference equation can be found in McDonald and Harbaugh (1988).

MT3DMS (Zheng and Wang, 1998) is an update of MT3D. It calculates concentration distribution for a single dissolved solute as a function of time and space. Concentration is distributed over a three-dimensional, non-uniform, transient flow field. Solute mass may be input at discrete points (wells, drains, river nodes, constant head cells), or a really distributed evenly or unevenly over the land surface (recharge).

MT3DMS accounts for advection, dispersion, diffusion, first-order decay, and sorption. Sorption can be calculated using linear, Freundlich, or Langmuir isotherms. First-order decay terms may be differentiated for the adsorbed and dissolved phases.

The program uses the standard finite difference method, the particle-tracking-based Eulerian-Lagrangian methods and the higher-order finite-volume TVD method for the solution schemes. The finite difference solution has numerical dispersion for low-dispersivity transport scenarios but conserves good mass-balance. The particle-tracking method avoids numerical dispersion but was not accurate in conserving mass. The TVD solution is not subject to significant numerical distribution and adequately conserves mass, but is numerically intensive, particularly for long-term models such as developed for the APS. The finite difference solution was used for this simulation.

Major assumptions of MT3DMS are: (1) changes in the concentration field do not affect the flow field; (2) changes in the concentration of one solute do not affect the concentration of another solute;

(3) chemical and hydraulic properties are constant within a grid cell; and (4) sorption is instantaneous and fully reversible, while decay is not reversible.

3.2 Flow and Transport Model Setup

3.2.1 Grid and Boundary Conditions

An eight layer, 100 by 54 node grid was established with consistent 100 foot grid spacing (Figure 3-1). Flow and transport boundaries remain constant for all scenarios as shown in Figure 3-1. The upgradient edge of the model was a general head (Dirichlet) boundary, set at a close distance, which caused it to act as a constant head boundary. The general head boundary was used in this case, rather than a constant head boundary, because it was simpler to implement for transient constant head conditions. The lower and lateral boundaries were no-flow (Neumann) boundaries. The downgradient boundaries were either MODFLOW river (Mixed) boundaries (layer 2) or no flow (layers 1, 3-8). The upper boundary was a time-dependent specified flux (Neumann) boundary, with specified flux rates equal to the recharge rate or the rate of percolation from the ash pond complexes. A specified mass flux (Cauchy condition) boundary was used to simulate downward percolation of solute mass from the impoundment. This boundary condition assigns a specified concentration to recharge water entering the node, and the resulting concentration in the node is a function of the relative rate and concentration of recharge water (water percolating from the impoundments) compared to the rate and concentration of other water entering the node.

3.2.2 Flow Model Input Values and Sensitivity

Flow model input values and sensitivity analyses results are presented in Table 3-1 and described below.

<u>*Layer Top/Bottom.*</u> The top of layer 1 approximated the water table. This elevation was set at 430 feet, a value higher than the estimated maximum elevation of the top of the silty clay units across most of the WRPS property and the maximum water table elevation. This top elevation setting assures unconfined conditions in layer 1. The top of layers 2-8 was the base of the overlying layer.

The base of the upper confining layer (layer 1) was determined by contouring the top of the primary sand unit (i.e. base of the silty clay), as determined from site borings on the Hydrogeologic Characterization Report (NRT, 2016d), and importing the contour data into MODFLOW (Figure 3-2). The resulting base elevations for layer 1 were between 376 and 420 feet. Layers 2-8 represented the sand and gravel unit, and base elevations were 376-380, 368-370, 360, 354, 348, 342 and 336 feet, respectively (Figure 3-2). The base of layer 8 represents the contact between the primary sand unit and either: bedrock, the silt and sandy silt unit, or the silty clay diamicton (i.e., the basal confining unit of the American Bottoms aquifer).

Hydraulic Conductivity. Hydraulic conductivity values (Figure 3-3) were derived from field and laboratory measured values (NRT, 2016d). Vertical anisotropy ratios were set at 5.0 for the sand units and 100 for the silty clay unit. The Kx/Kz ratios represent expected stratification within the formations.

The model was sensitive to most hydraulic conductivity values. Calibrated heads were highly sensitive to horizontal and vertical hydraulic conductivity of zone 1 (layer 1, silty clay units). Calibrated heads had a low sensitivity to horizontal conductivity of zone 3 (layers 1-3, shallow primary sand unit) and moderately sensitive to vertical conductivity of zone 3. The sensitivity of the horizontal conductivity of zone 8 (layers 4-8, deep primary sand unit) was moderate to moderately high; however, the vertical conductivity of this zone was negligible.

Storage. No field data were available defining these terms, so representative values for similar materials were obtained from Smith and Wheatcraft (1993). Sensitivity analysis was not performed on this parameter. Values used in the model are listed below.

Silty Clay Units

- Specific Storage Ss: 3X10-4 ft-1
- Specific Yield Sy: 0.1

Sand Units

- Specific Storage Ss: 3X10-6 ft-1
- Specific Yield Sy: 0.2

Recharge. Recharge rates for the impoundments were determined from a combination of values attained from 2016 HELP modeling and values used in previous model calibrations (NRT, 2006 and NRT, 2000).

Recharge zones are illustrated in Figure 3-4. The extent of each recharge zone was constant. The infiltration rates for each zone varied with time with respect to changes in use and construction of the Site, the Old East Ash Pond (OEAP), and the New East Ash Pond (NEAP) (Table 3-2). For stress periods 1-58 (1949-1978) only the Old East Ash Ponds were active. For stress periods 59-98 (1978-1998) the Site became active while the OEAP infiltration rates were reduced. Also during this time period a recharge zone (i.e. zone 12) was included along the northern edge of WAP 2E and Pond 3 to simulate a possible inter-sand window and/or an area where the silty clay unit is thin allowing leachate to enter the model and match concentrations observed upgradient of the Site. For stress periods 99-114 (1999-2006) the infiltration rates of the Site were reduced due to removal of ponds from service and the installation of pond liners (installed liners cut off infiltration through zone 12), while the OEAP rates were unchanged. During stress periods 114-134 (2006-2015) the infiltration rates of the Site were unchanged, while a portion of the OEAP was covered with a zone of reduced infiltration in the footprint of the NEAP, which was constructed with a lower liner. Further, during stress periods 123-134 the infiltration at zone 8 (the zone representing infiltration in the inter-sand window) was reduced to simulate dewatering approximately 4 years after installation of the NEAP.

River Parameters. The Mississippi River and Wood River were represented by head-dependent flux nodes (Figure 3-1) that required inputs for river stage, width, bed thickness, and bed hydraulic conductivity. The latter three parameters are used to calculate a conductance term for the boundary node. This conductance term was determined by starting with calibrated values from the NRT (2000) model and adjusting during the 2016 model calibration.

Mississippi River stage fluctuates significantly over the course of a year and has a strong effect on groundwater flow (NRT, 2000). Therefore, stage could not be approximated as steady state; rather it was approximated as a transient event. Because river stage is too variable and unpredictable to model on a day by day or month by month basis, a simplification was performed where two stage conditions (base stage and flood stage) were modeled. Base stage was set at about 403 feet, the average mean monthly river stage observed at Mel Price Lock and Dam tailwater gauging station from 1990 to 2014 for months where groundwater flow is typically southeast, toward the river (Table 3-3). Flood stage was set at the average mean monthly river stage elevation for months where groundwater flow reversals, away from the river, were regularly observed, about 411 feet based on the same gauging station data.

In the NRT 2000 model, in order to estimate the period over which to model each stage, it was necessary to select an elevation at which all higher elevations were grouped with flood stage, and all lower values were grouped with base stage. An elevation of 407.5 feet was selected as the dividing point in the NRT 2000 model. River stage was below 407.5 feet 62 percent of the time, or 226 out of every 365 days, and the remaining period was modeled as flood stage (NRT, 2000). The time period estimated in the NRT 2000 model was maintained in the 2016 model.

Mississippi River stage downriver of the Mel Price Lock and Dam decreased at a gradient of about 1.3 feet/mile. Stage on the upriver side of the Mel Price Lock and Dam was set at a constant 418.5 feet, the approximate mean pool elevation (NRT, 2000). During low Mississippi River stage, Wood River was set at approximately 407 feet (same stage as the general head boundary) at the upstream (north) end and graded down to 401 feet to match the elevation of the Mississippi River at the confluence. During Mississippi River flood stage, Wood River was assigned a constant elevation equal to Mississippi River stage at the confluence with Wood River (approximately 409 feet). The riverbed thickness and river width values from the NRT (2000) report were used in this model. The riverbed conductivities from the NRT (2000) report were maintained initially for this model, final values were determined during calibration.

Calibrated heads were highly sensitive to river stage at reach 1 (Mississippi River stage downstream of the Mel Price Lock and Dam), while the model displayed negligible sensitivity to stage at reaches

0 (Mel Price Lock and Dam pool water) and 3 (Wood River). The model was insensitive to the conductance values for reach 0, 1 and 3.

General Head Boundary Parameters. General head boundary elevation and conductance were established during calibration. General head elevations were highest at about 409 feet on the west end of the model and graded approximately 1.5 ft/mile towards Wood River at approximately 407 feet. Calibrated heads were highly sensitive to general head boundary elevation, and displayed negligible sensitivity to the conductance values.

Constant Head Boundary Parameters. Constant head boundary elevations were determined by starting with approximated target ponding elevation at Alton Pump Station as part of the seepage control systems, then adjusted during calibration. The estimated elevation at the east side of the boundary at Alton Pump station was 408 feet, while the elevation at the west end of the model was maintained at approximately 409 feet. An approximate gradient of 1.2 ft/mile from the west end of the model toward Alton Pump Station was applied to the model. Calibrated heads were moderately sensitive to constant head boundary elevation.

3.2.3 Transport Model Input Values and Sensitivity

Transport model input values are listed in Table 3-2 and Table 3-4, and described below. The results of sensitivity analyses are presented in Table 3-4.

Initial Concentration. Initial concentration for the calibration model was set at zero, implicitly implying a background concentration of zero, which is reasonable for boron. Initial concentration for the prediction model was the final calibration model concentration.

Source Concentration. Boron concentrations were set during model calibration with the constraint that they must be equal to or less than the maximum observed leachate concentration of 80 mg/L. Source concentrations were varied with respect to changes in use and construction of the Site. For stress periods 1-58 (1949-1978) only the Old East Ash Ponds were active and source concentrations at the Site were set to 0 mg/L. For stress periods 59-98 (1978-1998) the Site became active and concentrations were set to a value of 80 mg/L or less to match observed concentrations in surrounding monitoring wells. For stress periods 99-134 (1999-2015) the source concentrations were reduced due to removal from service, construction of basal liners at WAP 2E and Pond 3, changes in ash handling operations, and periodic mining of ash from the impoundments to match observed concentrations.

Effective Porosity. Effective porosity values were based on ranges provided by Mercer and Waddel (1993). For sensitivity analysis the effective porosity input was varied by ±0.05. Predicted concentrations were highly sensitive to the increased and decreased porosity applied to the sand and gravel zone, and the model runs failed to converge with these changes. A test model was run with the MT3MS convergence criteria relaxed to allow the model to converge while maintaining mass balance. Results of the test model run indicated the predicted concentrations were still highly sensitive to changes in the effective porosity.

Dispersivity. Dispersivity was set as 10 ft for the sand and gravel unit and 1 ft for the silty clay units during calibration of the NRT 2000 model and retained for the 2016 model. Transverse and vertical dispersion were estimated according to ratios developed by Gelhar et al. (1985). The final calibrated value for dispersivity was towards the lower end of acceptable values; therefore, for sensitivity analysis the longitudinal, transverse and vertical dispersivities were increased by factors of 3 (rather than decreased) and 10. Predicted concentrations were highly sensitive to both increased values of longitudinal and vertical dispersivity. Predicted boron concentrations were less sensitive to transverse dispersivity. When transverse dispersivity was increased by a factor of 3, predicted boron concentrations had a low sensitivity, but when increased by a factor of 10, sensitivity was high.

Retardation. Retardation was calculated by the model based on the distribution coefficient (K_d) (Figure 3-5). The parameter simulated a reversible adsorption and desorption process, which would slow down the contaminant migration without reducing the total mass. The calibrated values for K_d were set to 0.7 g/cm^3 for silty clay units and 0 g/cm^3 for the sand and gravel units

The silty clay unit K_d value was varied by ±0.4 g/cm^3, predicted boron concentrations were highly sensitive to both the increased and decreased K_d values Sand and gravel K_d was only increased by 0.4 g/cm^3 for sensitivity as the calibrated value was 0 g/cm^3. The predicted boron concentrations were highly sensitive to the increased Kd value for the sand and gravel unit.

Diffusion. Diffusion was assumed to be zero for the entire model domain.

3.3 Flow and Transport Model Assumptions and Limitations

Simplifying assumptions are necessary when numerically representing the natural environment in a groundwater flow model. Assumptions specific to this model are listed below. The reader is referred to McDonald and Harbaugh (1988), Zheng and Wang (1998), and Schroeder et al., (1994) for assumptions inherent with the codes used to develop the model.

- Natural recharge is constant over the long term.
- Hydraulic conductivity is consistent within hydrostratigraphic units.
- River stage has regular and constant variability.
- Liners are constructed instantaneously.

- Source concentrations change instantaneously due to changes in operations
- Leachate instantaneously migrates to groundwater (e.g., rapid migration through the unsaturated zone).
- Boron undergoes a reversible adsorption and desorption process and does not decay. Dispersion and retardation are the primary attenuation mechanisms.
- Cap construction has an instantaneous effect on recharge and percolation through the underlying ash fill deposit, relative to the 500 year period of the prediction model.

The model is limited by the data used for calibration, which adequately describe groundwater flow and quality near the Site as of 2015. Model predictions of flow and concentration are less reliable with increasing distance from the Site. Furthermore, the reliability of model predictions decreases with increasing time since changes may occur that were not accounted for in the model. Groundwater flow and concentration data used for calibration were collected during November 2014 (overlaps with available river stage data) and November 2015, respectively.

3.4 Calibration Flow and Transport Model Results

Results of the MODFLOW/MT3DMS modeling are presented below. A disk containing the model files is attached to this report (Appendix A).

In Figure 3-6, the simulated hydraulic heads are compared with the observed range of the heads measured in 24 monitoring points at or surrounding the Site. Leachate well L1R (screened within the West Ash Pond complex above the watertable) was not included in flow calibration. The simulated values successfully fall within the observed range from 403 to 409 ft NAVD88 (excluding perched porewater level at leachate well L1R). The model captured the approximate 4 ft of head decrease from north of the impoundments (Wells 22, 30, 25 and 21) to the southeast (Wells 40S, 41 and 02) approaching the confluence of the Mississippi River and Wood River. The relative standard deviation, given as a percentage of standard deviation to data mean, was 2.3%, within the customary goal of less than 10% for this value. The observed heads are plotted versus the simulated heads in Figure 3-7. The near-linear relationship between observed and simulated values and the evenly distributed residuals indicate that the model adequately represents the calibration dataset. Further, all calibrated heads were within 1 foot of the observed values and were well distributed as illustrated in the plotted observed heads verse residuals in Figure 3-7, therefore, discrepancies between observed and predicted heads were not considered significant.

Simulated boron concentrations are compared to observed data in Figure 3-8. A subset of 7 of the available 25 wells were selected for calibration based on wells used in the previous modeling report (NRT, 2000), proximity to the Site and upgradient/downgradient position relative to the Site. The calibrated monitoring points were categorized into two groups: (1) wells with current observed boron concentrations over the Class I standard (2 mg/L) (i.e. 02, 12 and 34); and (2) wells with current observed boron concentrations equal to or below the standard (i.e. 04, 20, 23 and 28). The simulated boron concentrations reasonably matched the concentration trends over time observed between 1996 and 2015, and the most recent observed concentrations met the calibration criterion that simulated results for category (1) were all higher than 2 mg/L while the simulated results for category (2) were all equal to or below 2 mg/L. The model also successfully simulated the limited migration of boron from the ash sources to the surrounding groundwater (low boron concentrations in the category [2] wells). The agreement between modeled and predicted concentrations demonstrated that the transport model adequately simulates contaminant transport in groundwater in the proximity of the Site.

4 SIMULATION OF CAPPING SCENARIO

4.1 Overview

The baseline and capping scenario described in Section 2 were modeled for a time frame of 500 years. Capping of the ponds was simulated by applying the HELP-calculated percolation rates based on cap design documented in the draft Closure and Post-Closure Care Plan for Dynegy Wood River Ash Complex (AECOM, 2016) and found in the Hydrostatic Model Report (NRT, 2016) The changes in hydraulic head and boron concentrations were compared to a baseline condition when no cap was simulated. The following simplifying assumptions were made during the simulation:

- In the baseline scenario, HELP-calculated no cap percolation rates were assumed to remain constant where there was little change in predicted percolation rate.
- In the capping scenario, HELP-calculated with cap percolation rates were averaged over three periods to simulate the following: an initial high percolation rate occurring during initial dewatering of the pond leachate water (approximately 1-10 years following closure); a reduced percolation rate as the system moves toward equilibrium (approximately 10-30 years following closure); and a low percolation rate that remains relatively constant under hydrostatic equilibrium (approximately 30-500 years) (Table 4-1).
- Boron concentrations in leachate at WAP 1, WAP 2W and WAP 2E were assumed to remain constant as a function of time following the end of the calibration simulation. Boron concentration in Pond 3 was assumed to be 0 mg/L in the capping scenario following cap construction to simulate discontinuation of leachate and surface water inputs from WAP 2E.
- Caps were assumed to be constructed instantaneously at the start of the prediction simulation.
- Final grade of the capping system was at or above current top of berms. Proper storm water control system was assumed to remove excess water from the surface of the capped areas.

4.2 Simulation of the Capping Scenario

The calibrated model was used to evaluate the effect of the capping scenario by changing recharge rates to simulate capping of selected ponds in the Site. The extent of the recharge zones stayed constant as in Figure 3-4. The capping scenario represents a condition when all Site ash ponds are capped (i.e. WAP 1, WAP 2E and WAP 2W). The changes in recharge rate in the capping scenario in the predicted models are listed in Table 4-1. Discontinuation of leachate inputs from the Site at Pond 3 was simulated by reducing the boron concentration in Zone 5 to 0 mg/L.

4.2.1 Predicted Hydraulic Heads and Boron Concentrations

Predicted hydraulic heads do not vary significantly from the calibrated transport and flow models. As the upgradient General Head Boundary is the primary source of water during base river stage and the Mississippi River is the primary source of water during flood river stage; therefore, there is no significant change in hydraulic heads as a result of reduced recharge inputs at the Site during the capping scenario. Figure 3-8 compares predicted boron concentrations between baseline and capping scenarios at downgradient wells 02, 12, and 34. These wells were selected for presentation because they have observed boron concentrations higher than the Class I groundwater quality standard of 2 mg/L.

Concentrations are predicted to increase under the baseline scenario due to the continued infiltration of ash leachate. Concentrations continue to increase until a period approximately greater than 300 years when the concentration at the well asymptotically reaches equilibrium with concentrations released from the source. An example of this trend at downgradient well 02 is shown in Figure 4-1.

The prediction model indicates rapid response to the capping scenario and resulting reduced infiltration rates. The greatest extent of the boron plume exceeding the Class I standard of 2 mg/L occurs at the end of the first base river stage stress period (approximately 365 days), as shown on Figure 4-2. Following the first year of the prediction model, capping scenario concentrations begin to decrease (Figure 3-8). Approximately 28 years following cap construction boron concentrations at downgradient well 34 are predicted to be below the Class I standard. Similarly, approximately 33 years following cap construction boron concentrations at downgradient well 02 are predicted to be below the Class I standard.

Well 12 is predicted to take approximately 53 years following cap construction to meet the Class I standard for boron. The well construction log indicates the well was constructed through some of the thickest deposits of silty clay at the Site. The well is screened just below the silty clay unit in the top 6-feet of the sand and gravel unit and a portion of the filter pack is placed within the overlying silty clay unit, which likely contributes to slow infiltration of boron into the well screen. For these reasons, the well takes longer to achieve concentrations below the standard.

5 SUMMARY

A groundwater flow and transport model was calibrated to match hydraulic head and boron concentrations observed near the Site at the WRPS in November 2014 and November 2015, respectively. The calibrated model was then used to evaluate a baseline (no action) scenario and a capping scenario over a future time frame of 500 years. The capping scenario assumed cap construction with a geosynthetic barrier layer that complies with 40 CFR Part 257, Subpart D (CCR Rule). The results of the modeling indicated:

- The baseline (no action) scenario prediction model indicated boron concentrations at downgradient monitoring wells that currently exceed the Class I standard would slowly increase for a period of about 300 years before reaching an equilibrium concentration above the standard. There was no indication within the 500 year model run that boron concentrations would significantly decrease.
- The capping scenario prediction model indicated boron concentrations in all calibrated monitoring wells are predicted to start decreasing one year following cap construction. Predicted concentration distributions demonstrated reduced contaminant plumes relative to the calibrated transport model. The capping scenario model predicted all calibrated monitoring well concentrations to be below the Class I standard of 2 mg/L for boron within 53.5 years following cap construction. Similarly, the capping scenario model predicted two of the three calibrated monitoring well concentrations downgradient of the Site (wells 02 and 34) would decrease below the Class I standard for boron within 33 years following cap construction.

These model results suggest that the geosynthetic cover system will control recharge and subsequent leachate generation within the limits of the Site and sufficiently reduce concentrations of boron below Class I standards. Concentration reductions should begin approximately one year after completion of the cover system. Alternatively, the model results demonstrate that the base line scenario of no action will not significantly decrease concentrations of boron at downgradient wells, and boron concentrations will not be reduced below the standard within the modeled timeframe of 500 years.

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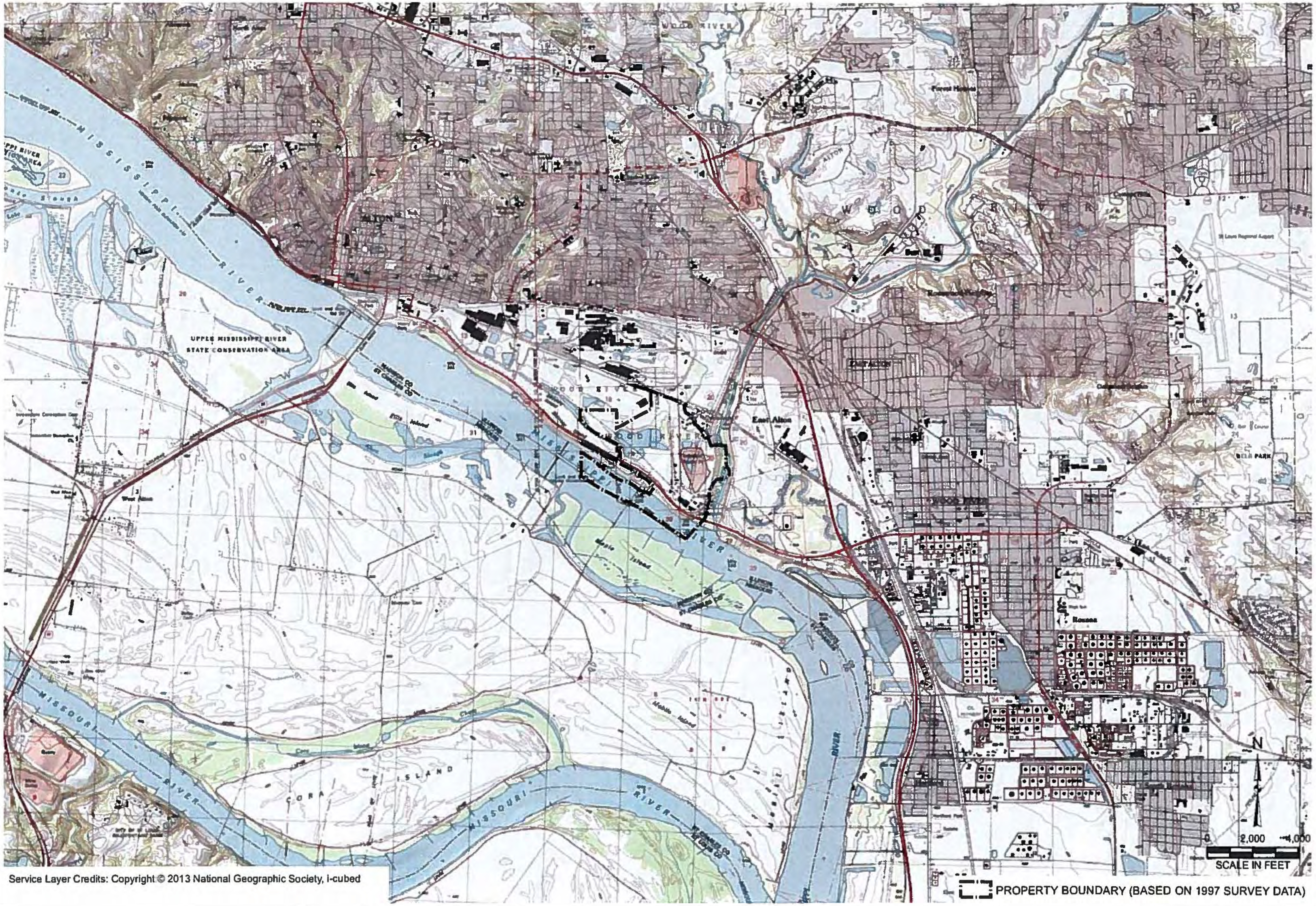
FIGURES



Service Layer Credits: Copyright © 2013 National Geographic Society, i-cubed

PROPERTY BOUNDARY (BASED ON 1997 SURVEY DATA)

DRAWN BY/DATE:
SDS 7/15/16
REVIEWED BY/DATE:
NRK 7/15/16
APPROVED BY/DATE:
SJC 7/28/16

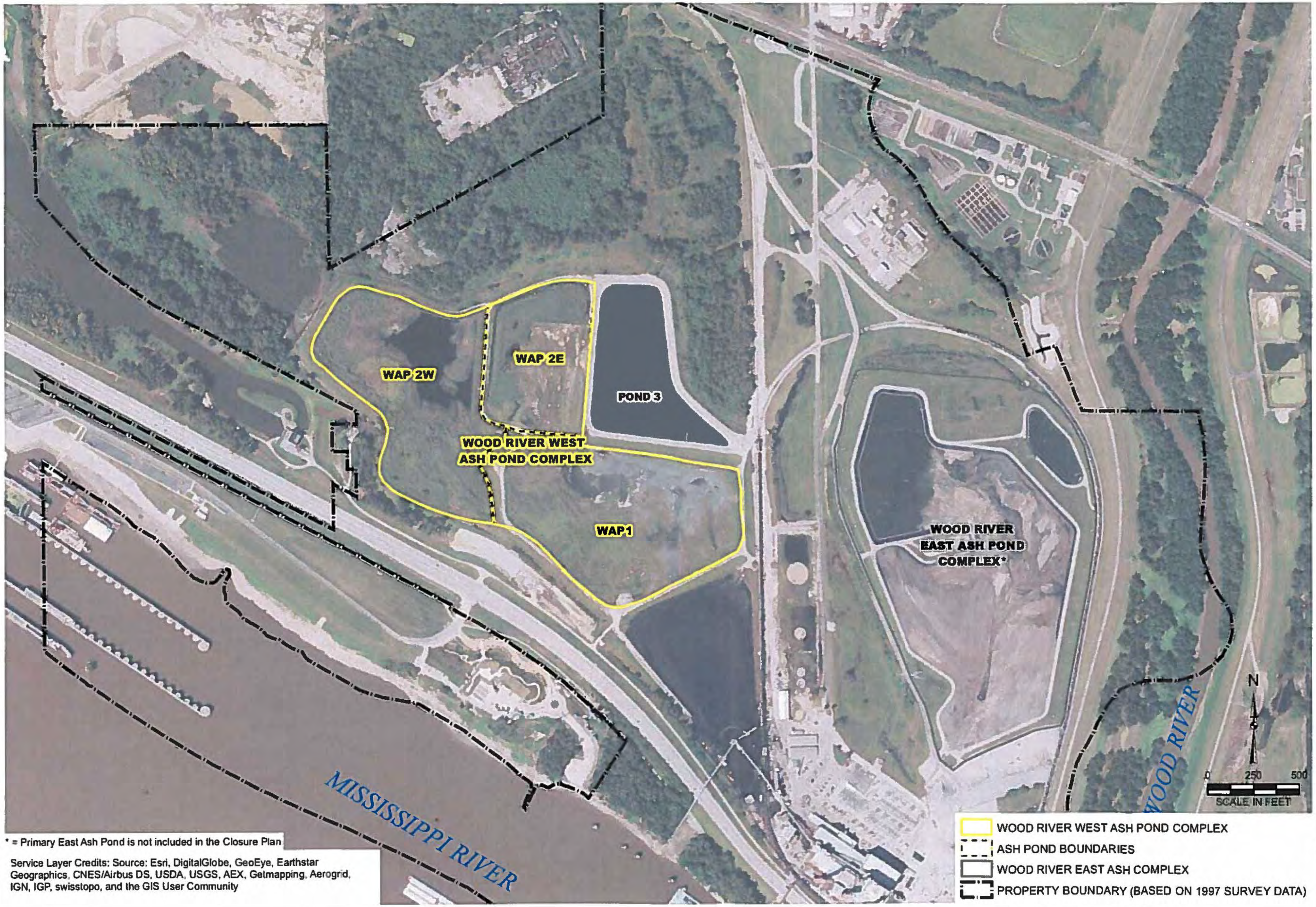
SITE LOCATION MAP

GROUNDWATER MODEL REPORT
WEST ASH POND COMPLEX
WOOD RIVER POWER STATION
ALTON, ILLINOIS

PROJECT NO: 2376

FIGURE NO: 1-1

NATURAL RESOURCE TECHNOLOGY



* = Primary East Ash Pond is not included in the Closure Plan

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

DRAWN BY/DATE:
SDS 7/15/16
REVIEWED BY/DATE:
NRK 7/15/16
APPROVED BY/DATE:
SJC 7/28/16

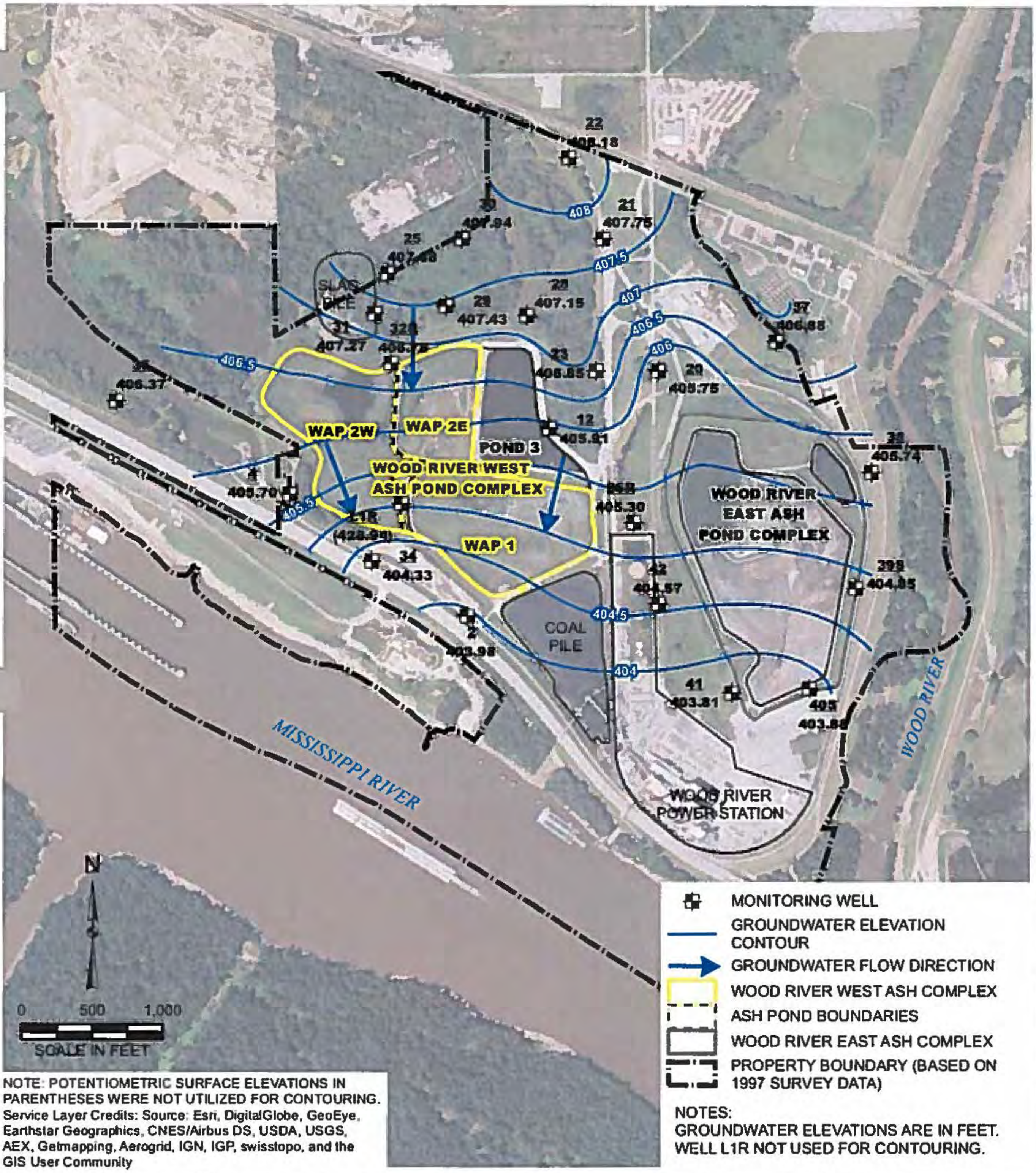
OVERVIEW OF ASH POND SYSTEM

GROUNDWATER MODEL REPORT
WEST ASH POND COMPLEX
WOOD RIVER POWER STATION
ALTON, ILLINOIS

PROJECT NO: 2376

FIGURE NO: 1-2

NATURAL RESOURCE TECHNOLOGY



NOTE: POTENTIOMETRIC SURFACE ELEVATIONS IN PARENTHESES WERE NOT UTILIZED FOR CONTOURING.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

NOTES:
GROUNDWATER ELEVATIONS ARE IN FEET.
WELL L1R NOT USED FOR CONTOURING.

DRAWN BY/DATE:
MDM 1/5/15
REVIEWED BY/DATE:
SJC 1/6/15
APPROVED BY/DATE:
SJC 1/6/15

POTENTIOMETRIC SURFACE
NOVEMBER 18, 2014

GROUNDWATER MODEL REPORT
DYNEGY MIDWEST GENERATION, LLC
WOOD RIVER POWER STATION

PROJECT NO: 2376

FIGURE NO: 1-3

NATURAL RESOURCE TECHNOLOGY

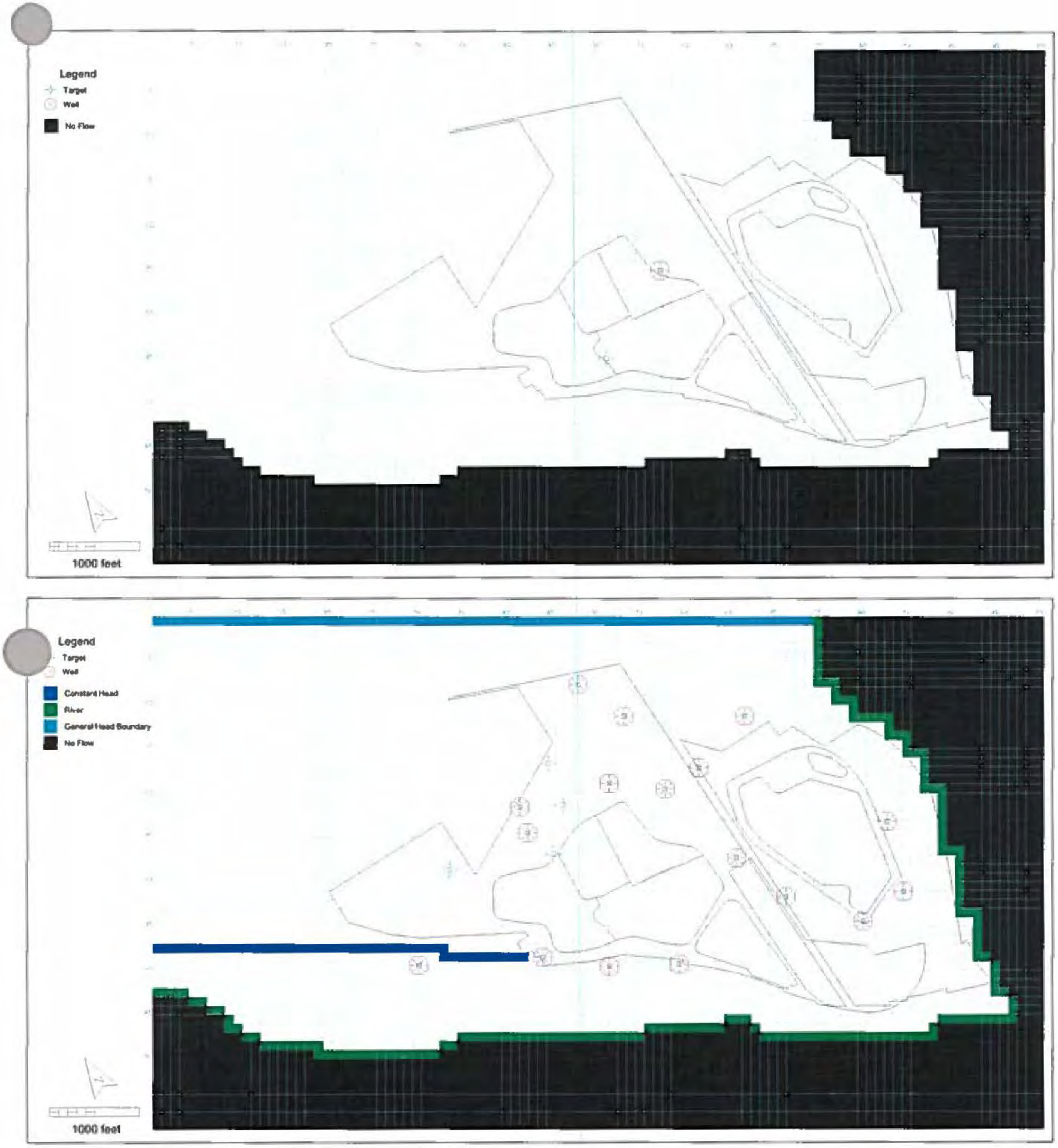


Figure 3-1. MODFLOW and MT3DMS Grid and Boundary Conditions for Layer 1 (top) and Layer 2 (bottom).

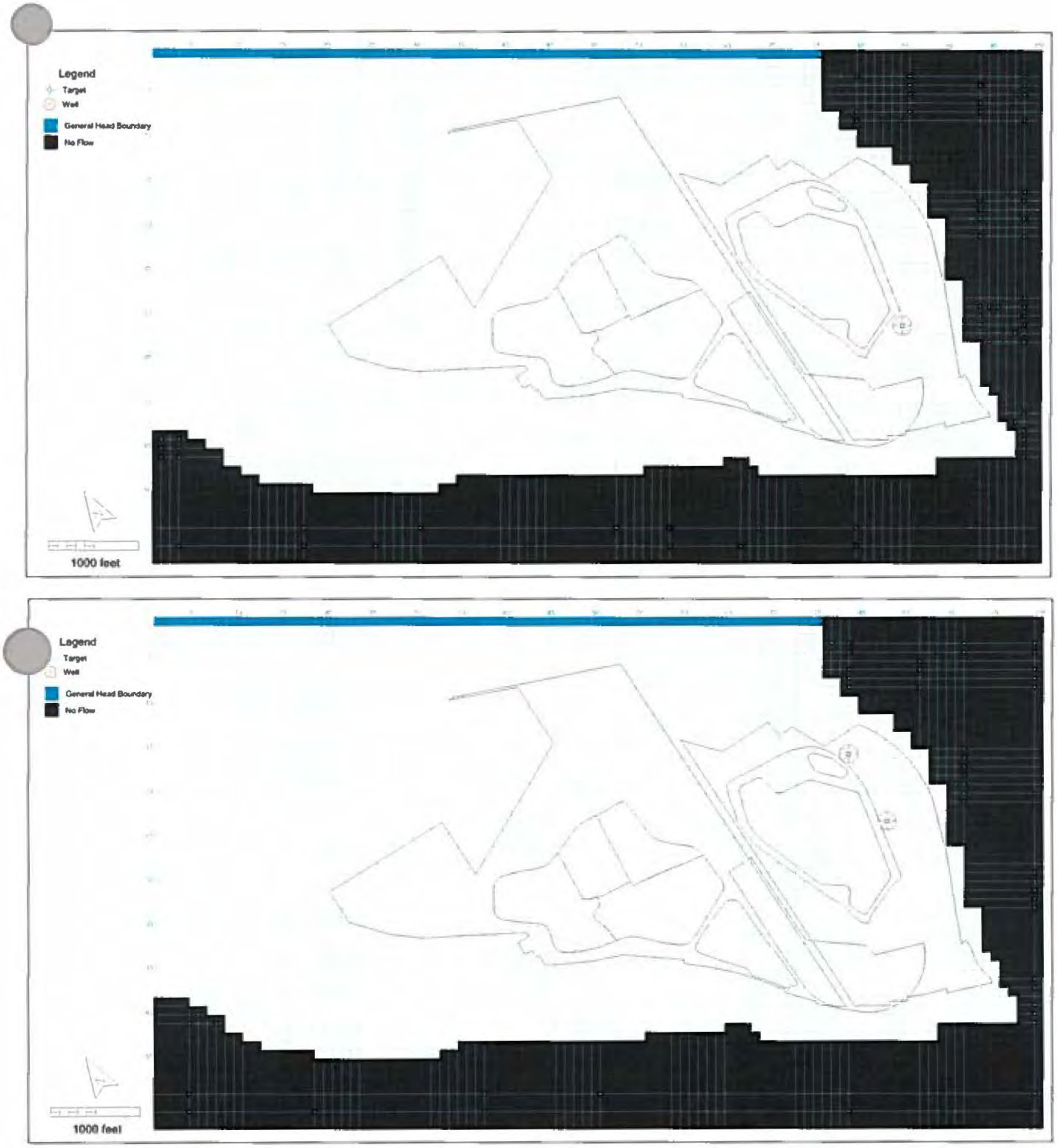


Figure 3-1 (cont'd). MODFLOW and MT3DMS Grid and Boundary Conditions for Layer 3 (top) and Layer 4 (bottom).

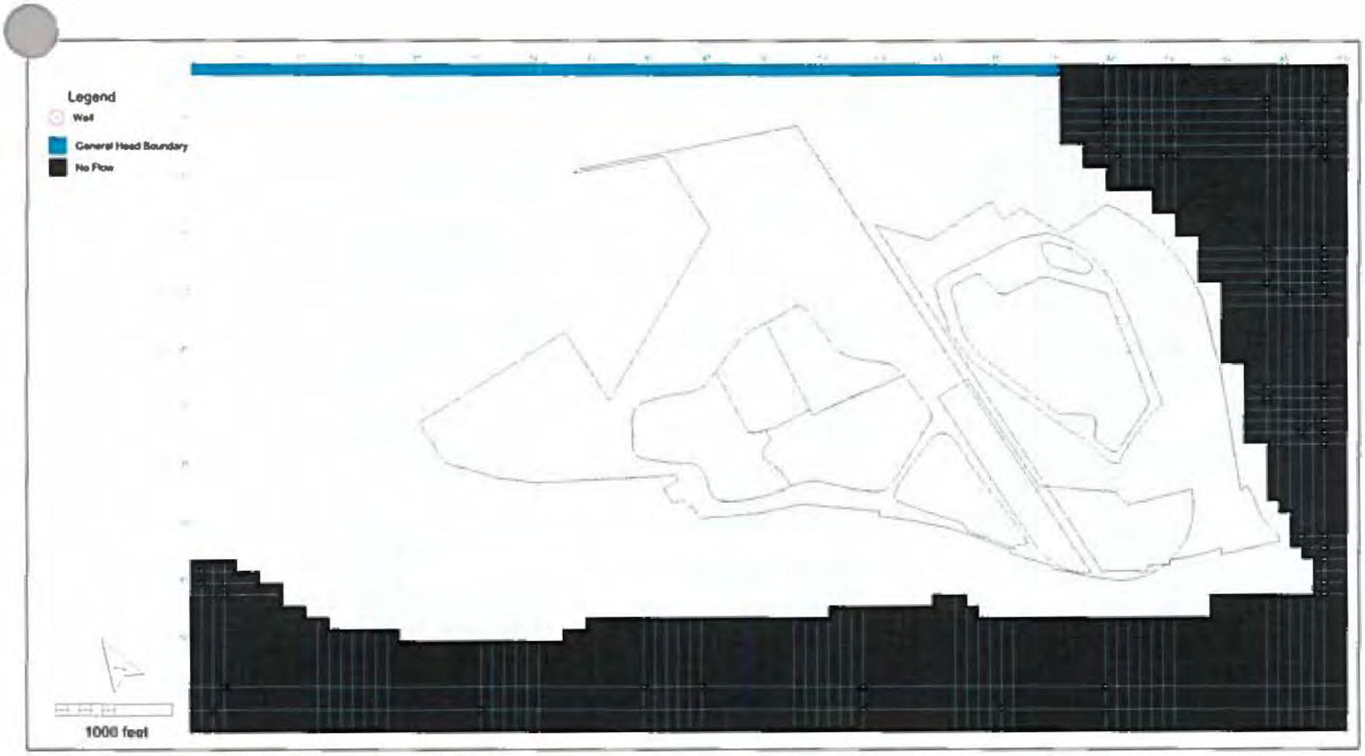


Figure 3-1 (cont'd). MODFLOW and MT3DMS Grid and Boundary Conditions for Layer 5 through yer 8.

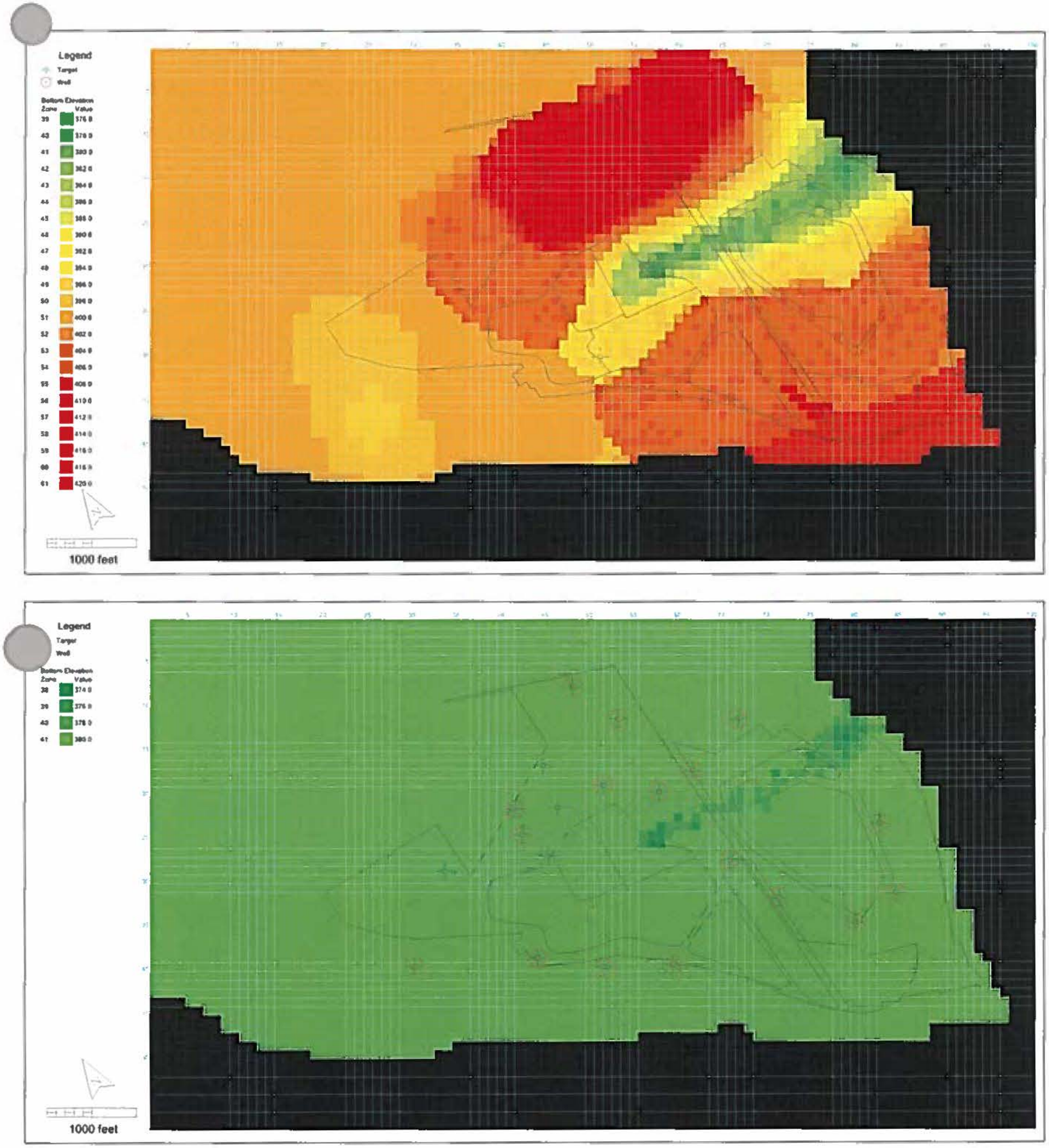


Figure 3-2. Bottom Elevation (feet) Array for Layer 1 (top) and Layer 2 (bottom).

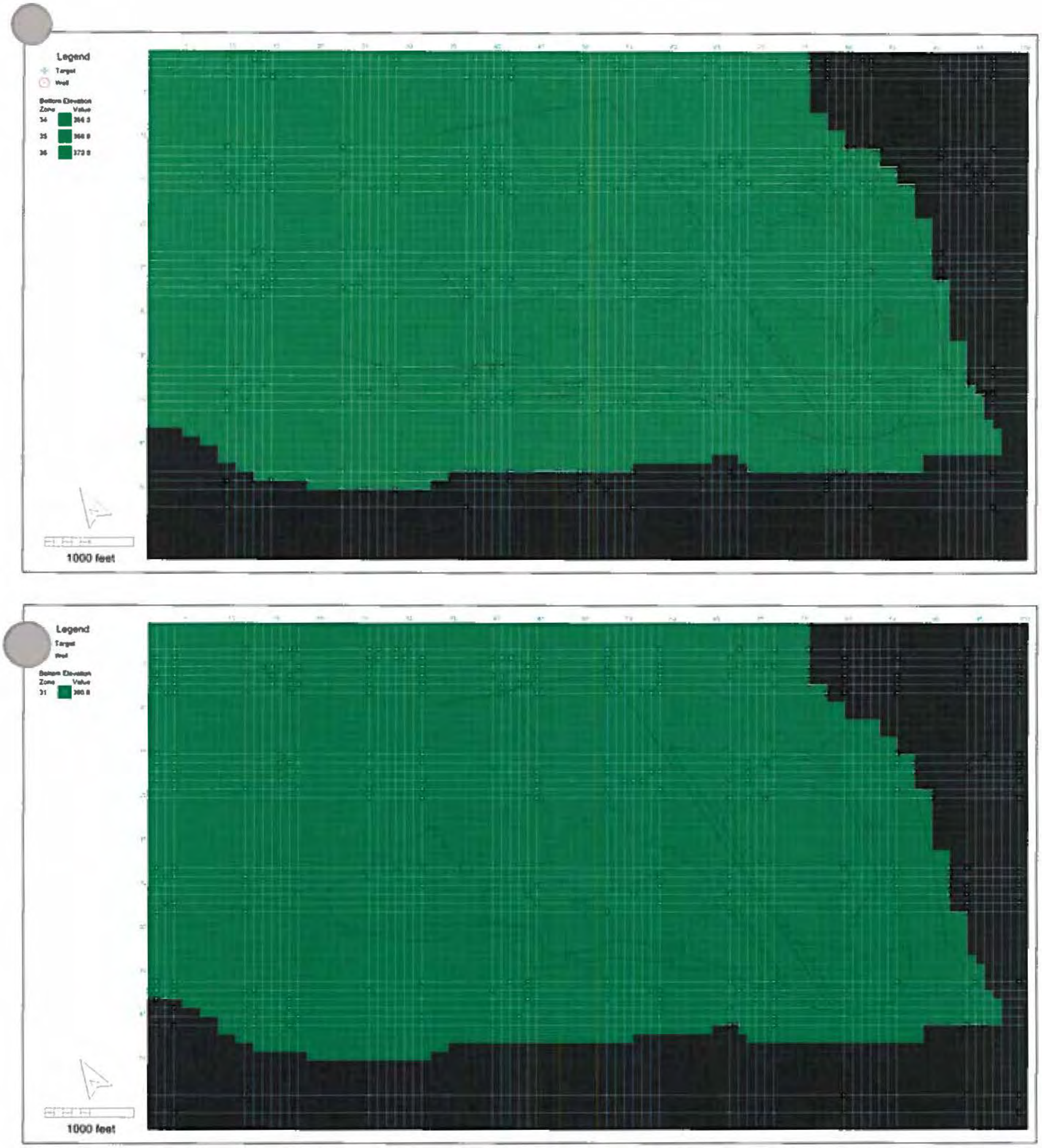


Figure 3-2 (cont'd). Bottom Elevation (feet) Array for Layer 3 (top) and Layer 4 (bottom).

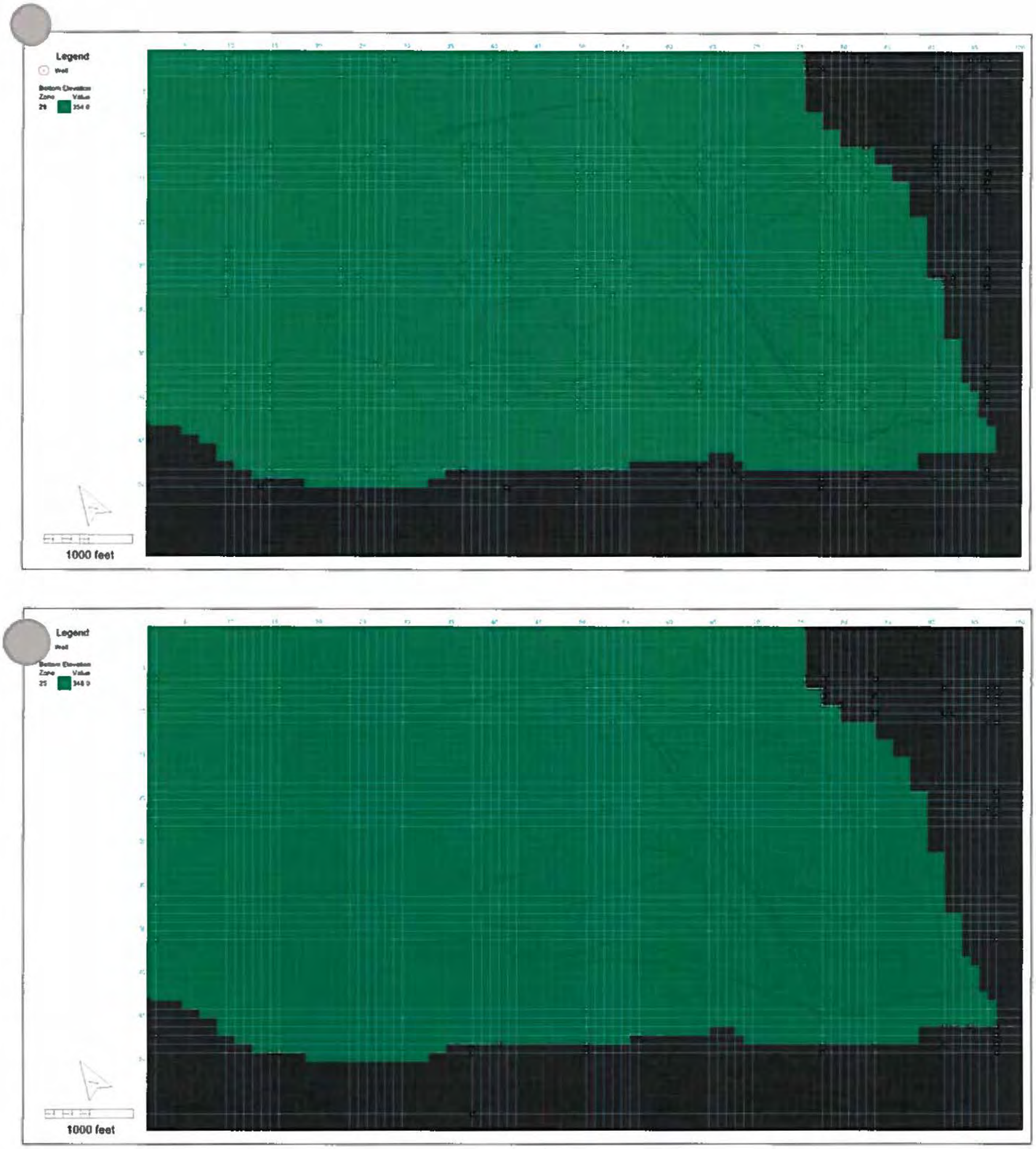
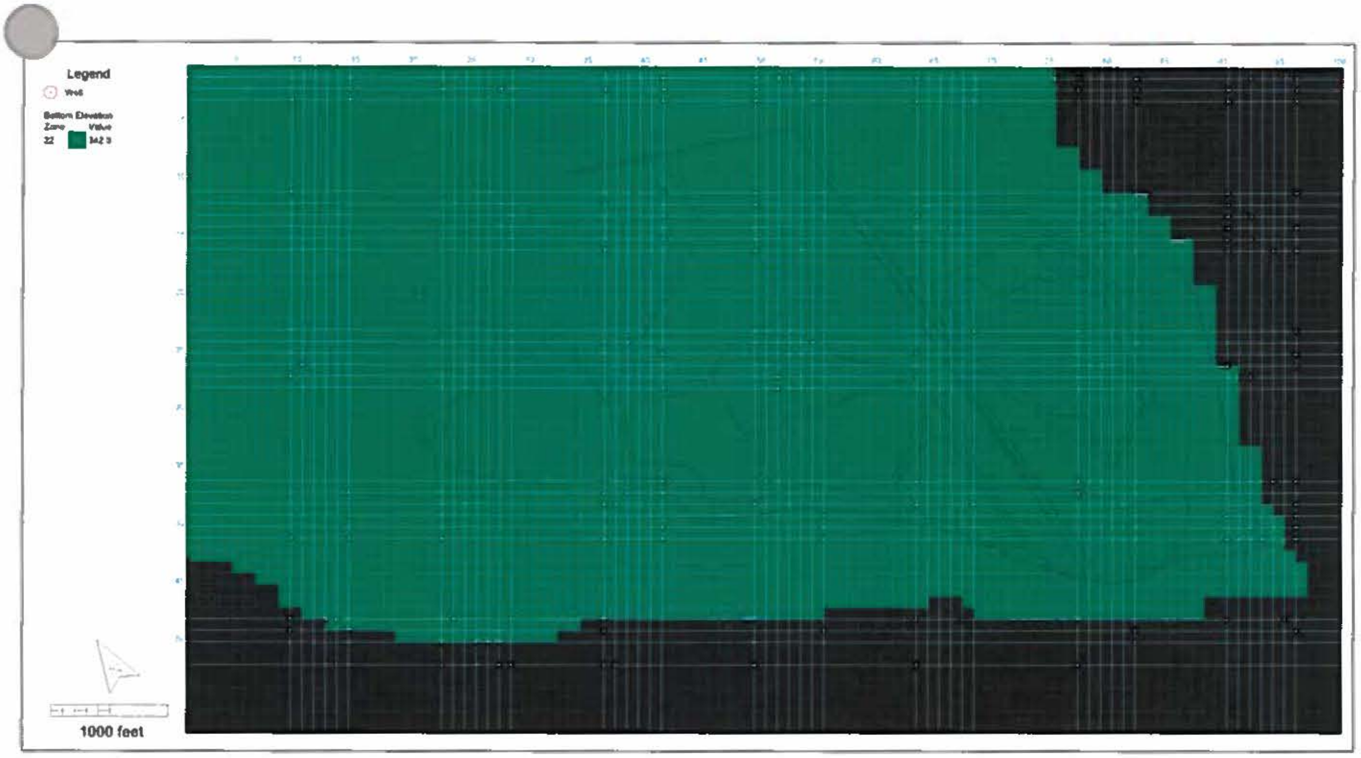


Figure 3-2 (cont'd). Bottom Elevation (feet) Array for Layer 5 (top) and Layer 6 (bottom).



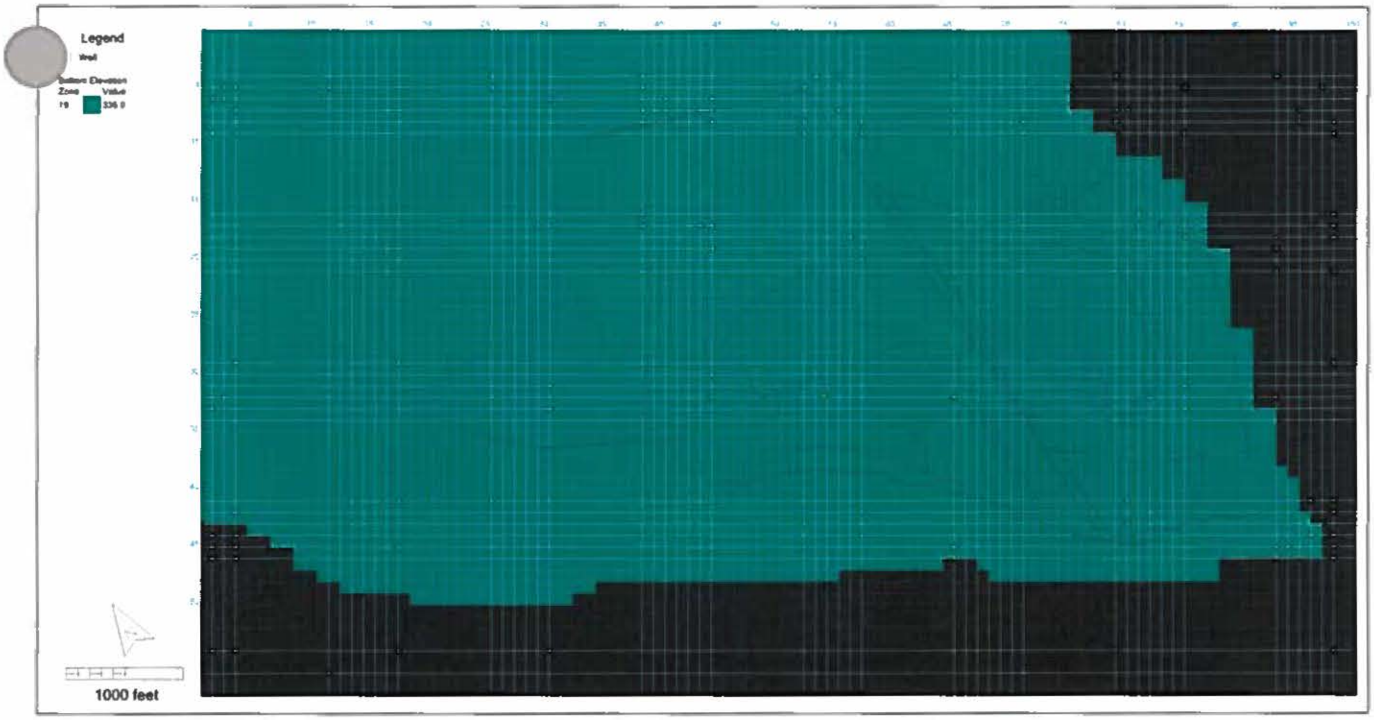


Figure 3-2 (cont'd). Bottom Elevation (feet) Array for Layer 7 (top) and Layer 8 (bottom).

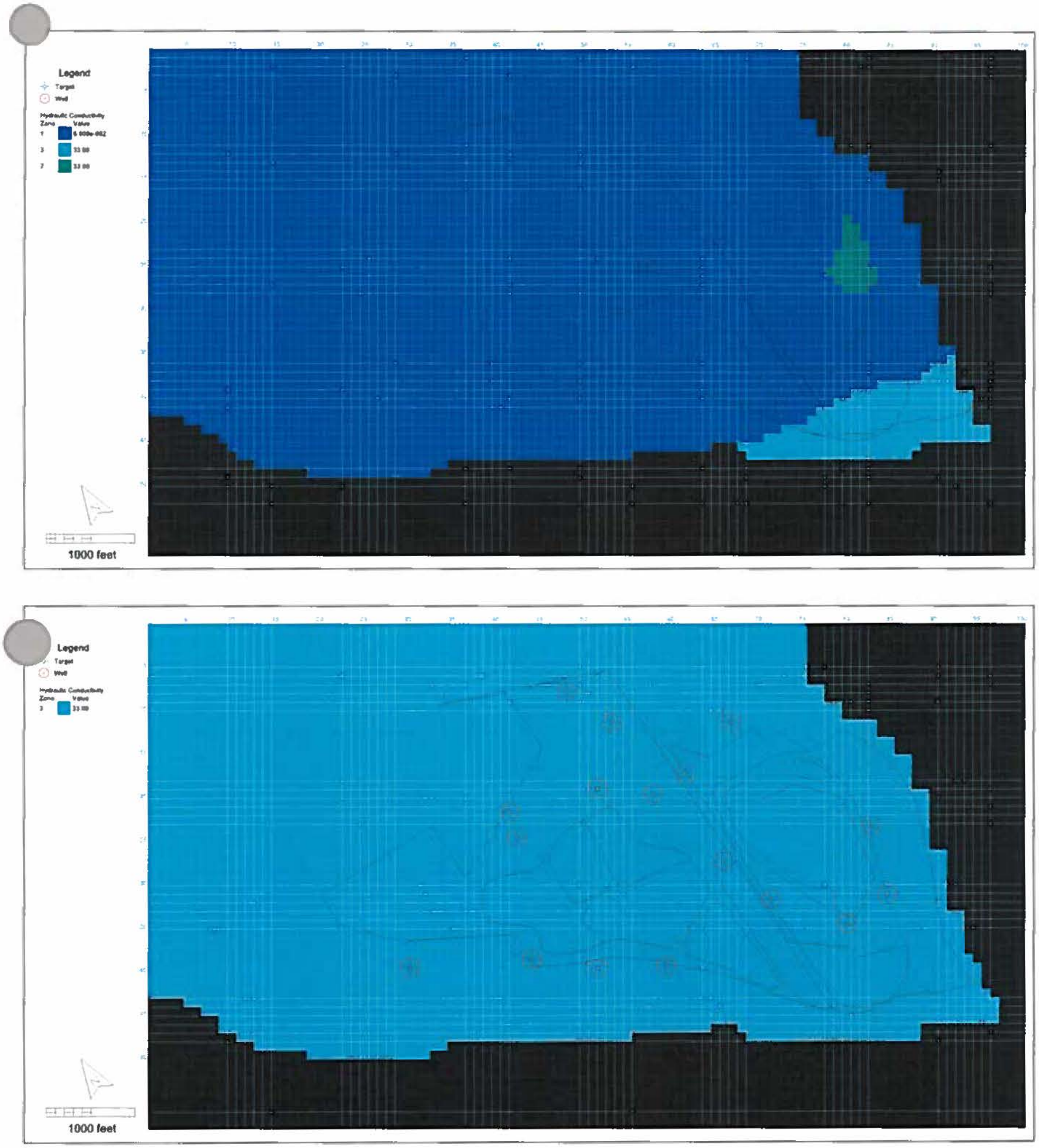


Figure 3-3. Hydraulic Conductivity (ft/day) for Layer 1 (top) and Layer 2 through Layer 3 (bottom).

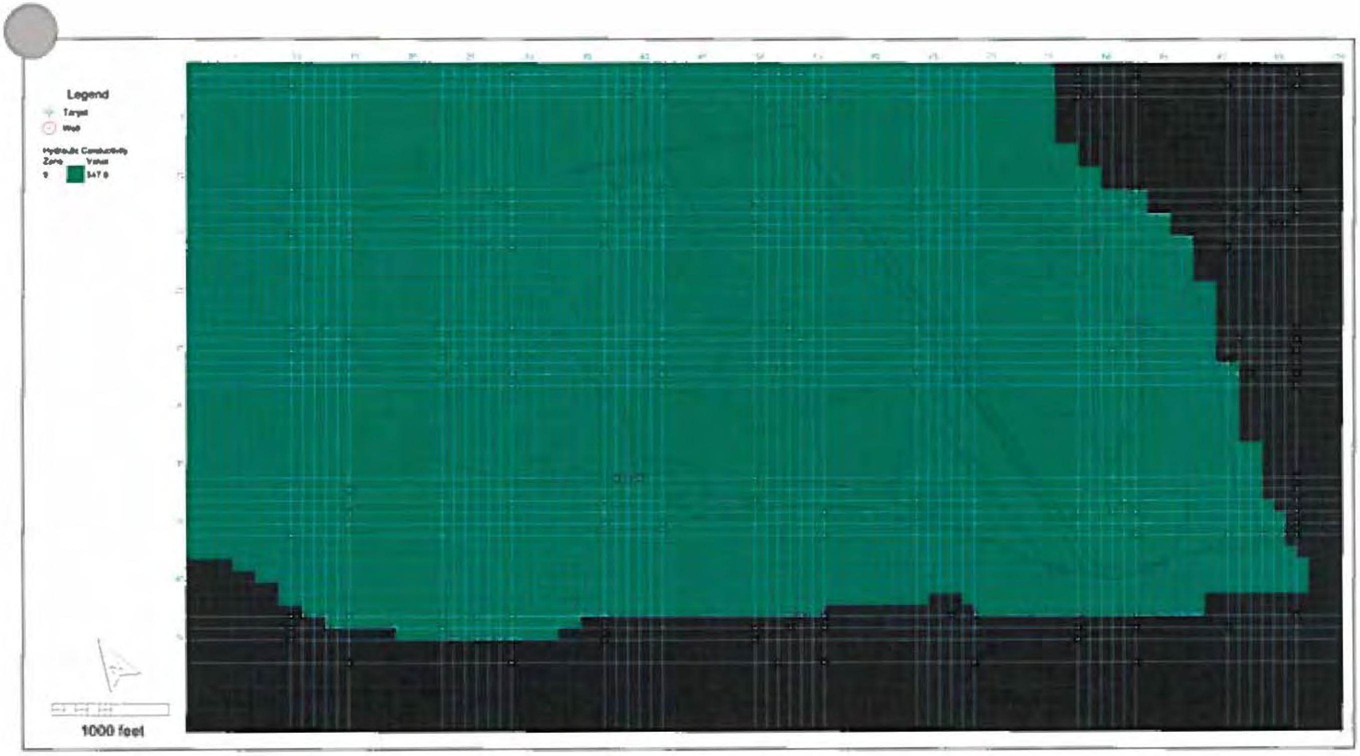


Figure 3-3 (cont'd). Hydraulic Conductivity (ft/day) for Layer 4 through Layer 8.

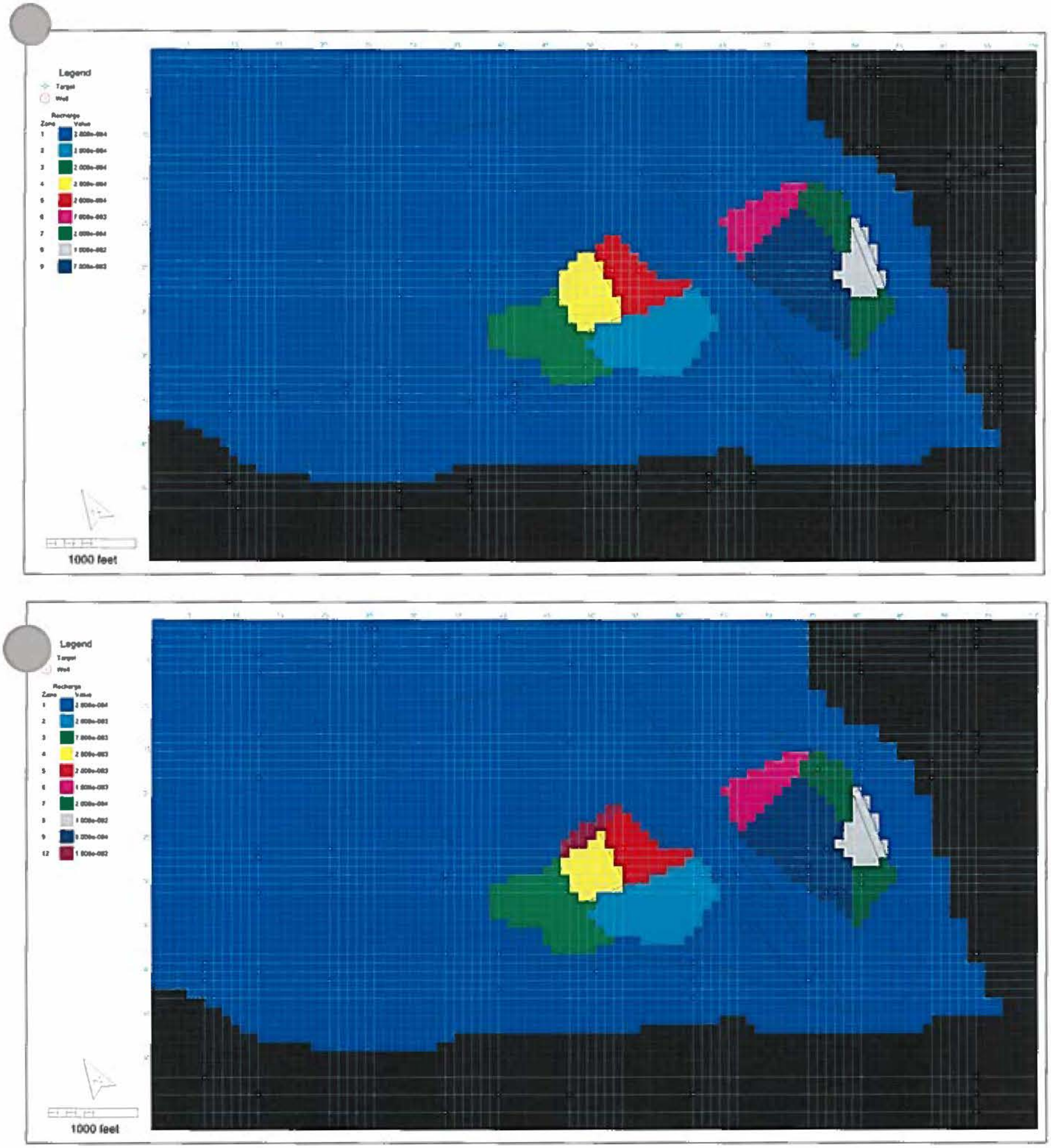


Figure 3-4. Recharge (ft/day) for Layer 1 Calibration Model Stress Periods 1 - 58 (top) and 59 - 98 (bottom).

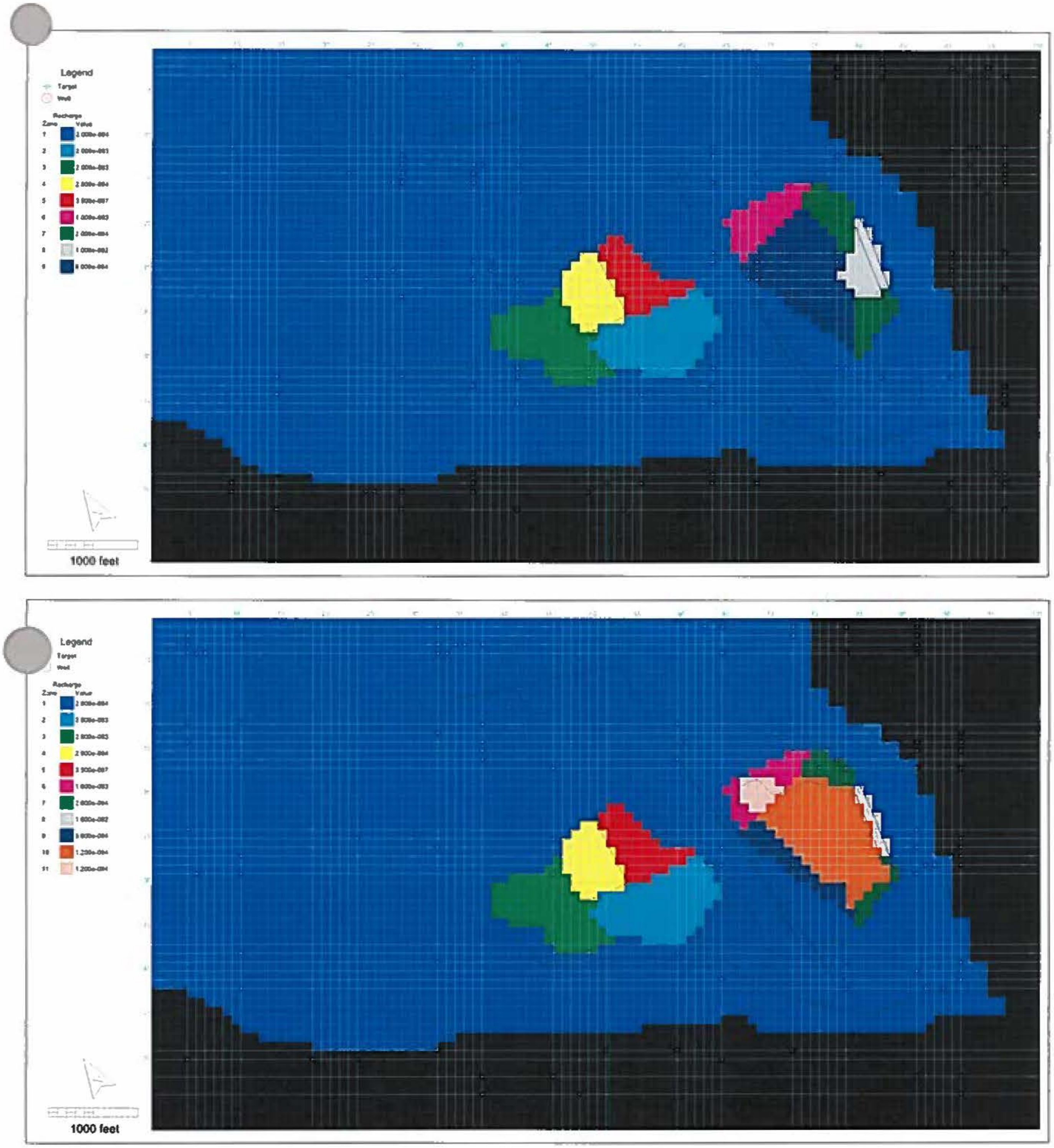


Figure 3-4 (cont'd). Recharge (ft/day) for Layer 1 Calibration Model Stress Periods 99 - 114 (top) and 115 - 122 (bottom).

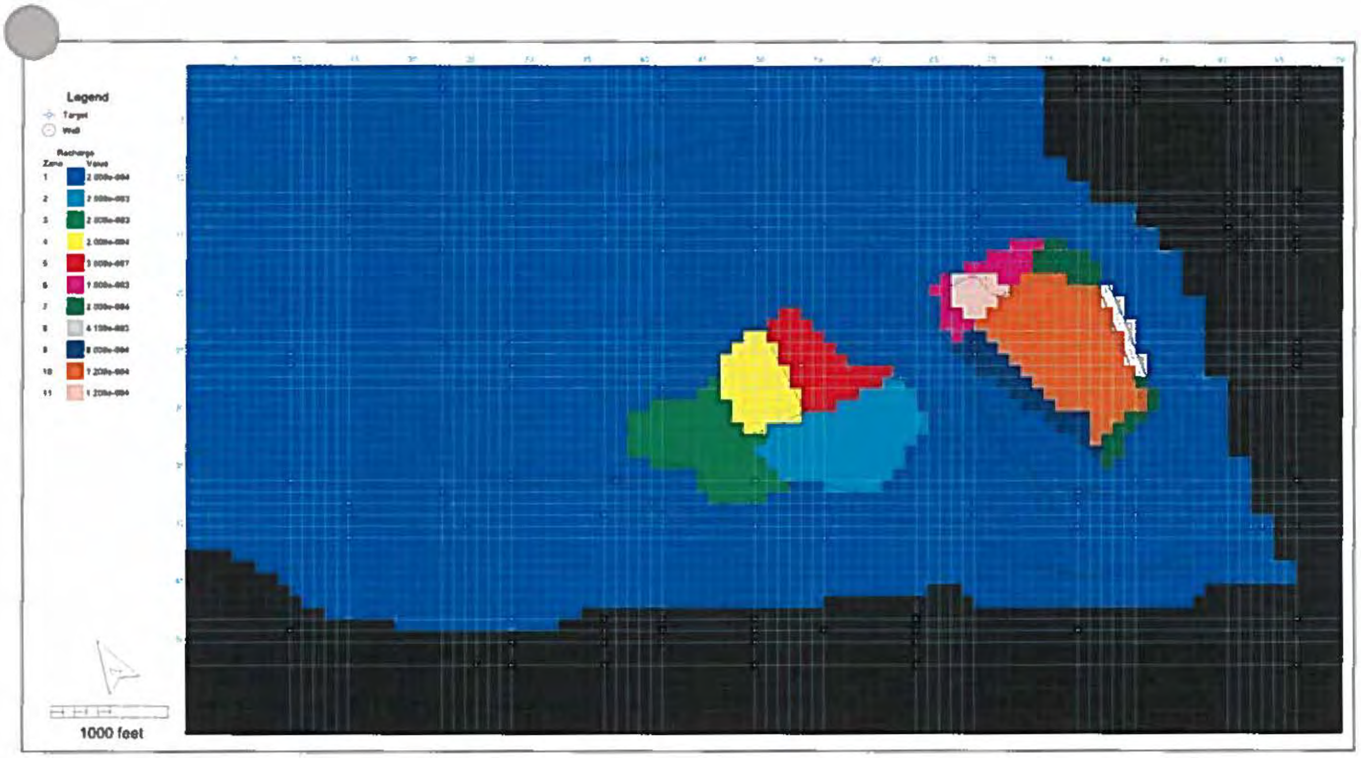


Figure 3-4 (cont'd). Recharge (ft/day) for Layer 1 Calibration Model Stress Periods 123 - 134.

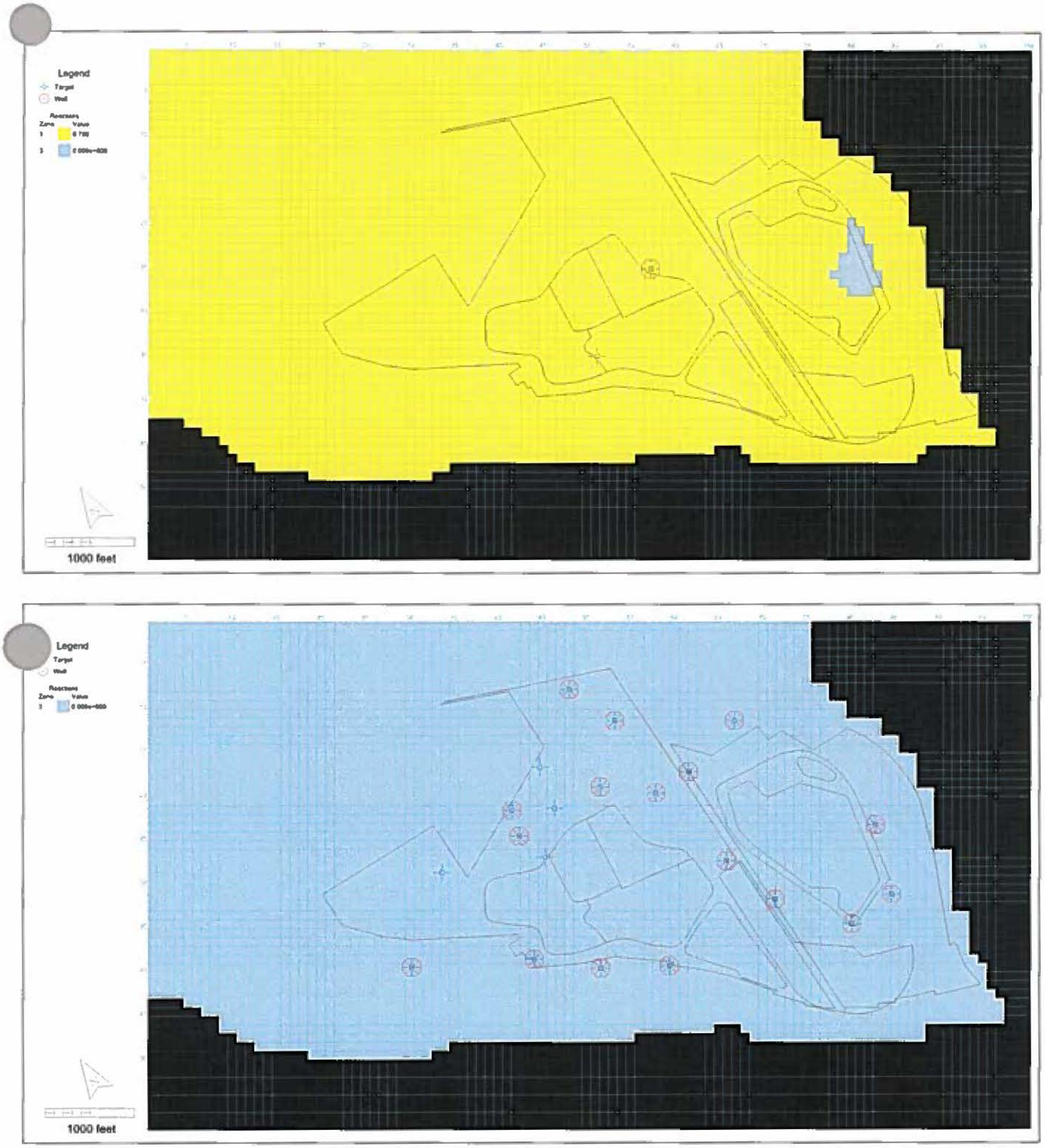


Figure 3-5. Reaction K_d (cm^3/g) for Layer 1 (top) and Layer 2 through Layer 8 (bottom).

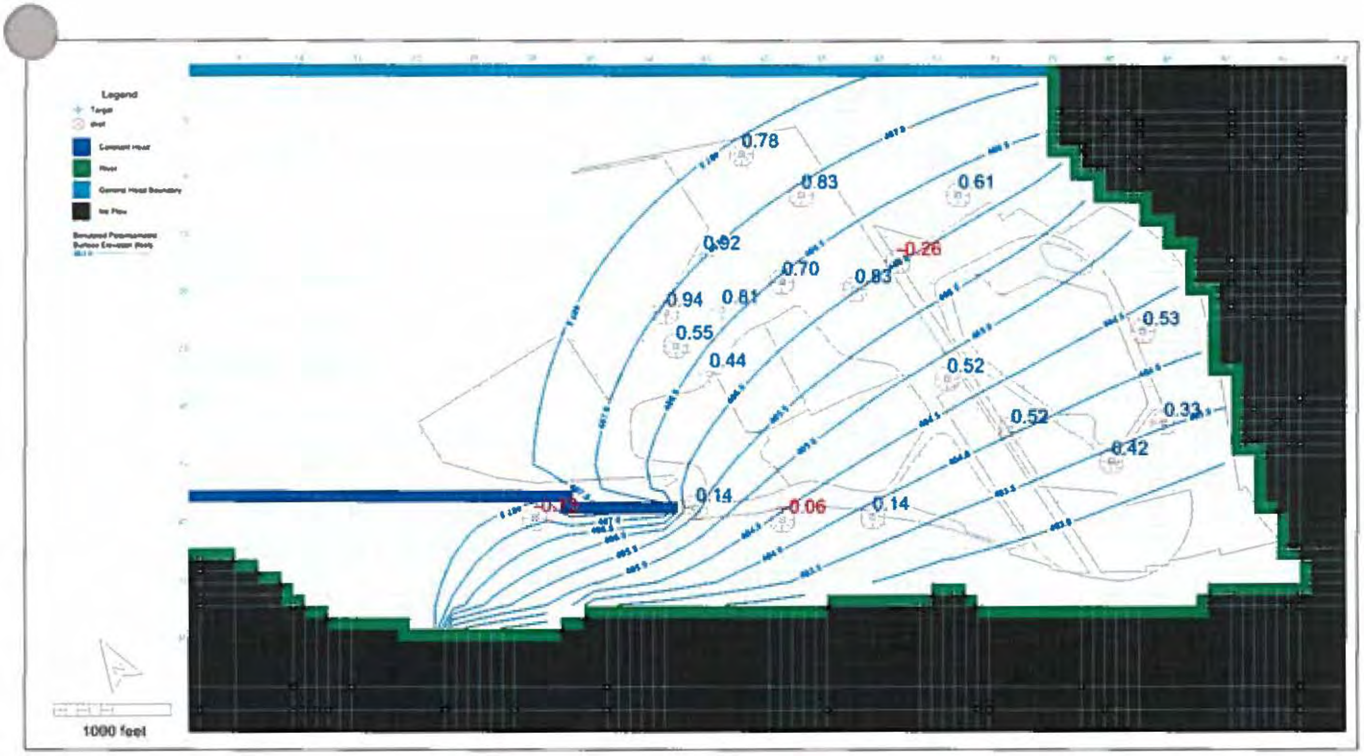


Figure 3-6. Comparison between Simulated Heads and Field Measurements for Layer 2.

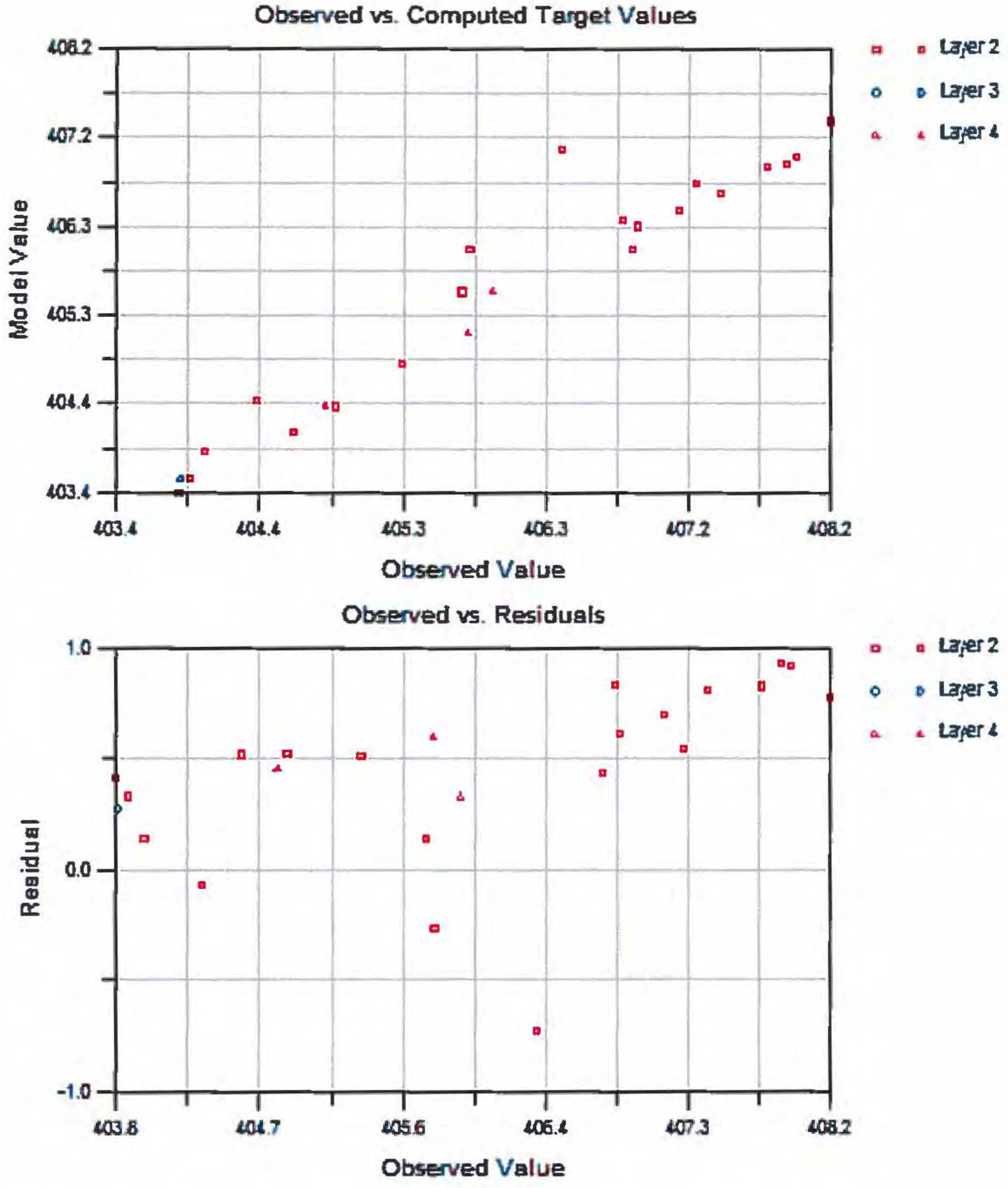


Figure 3-7. Steady-State MODFLOW Model Calibration Results.

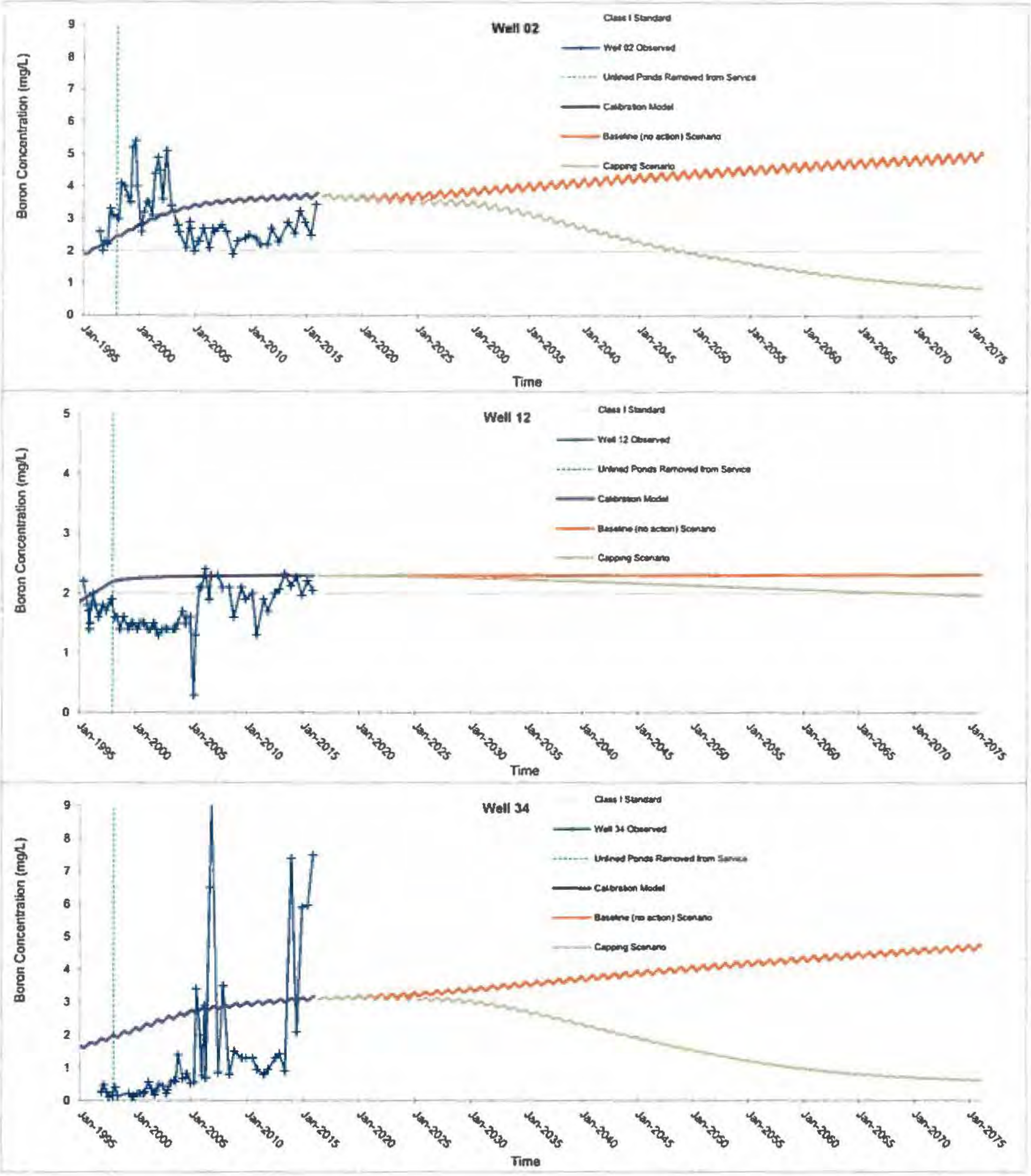


Figure 3-8. Predicted and observed boron concentrations (mg/L) (1995-2075)

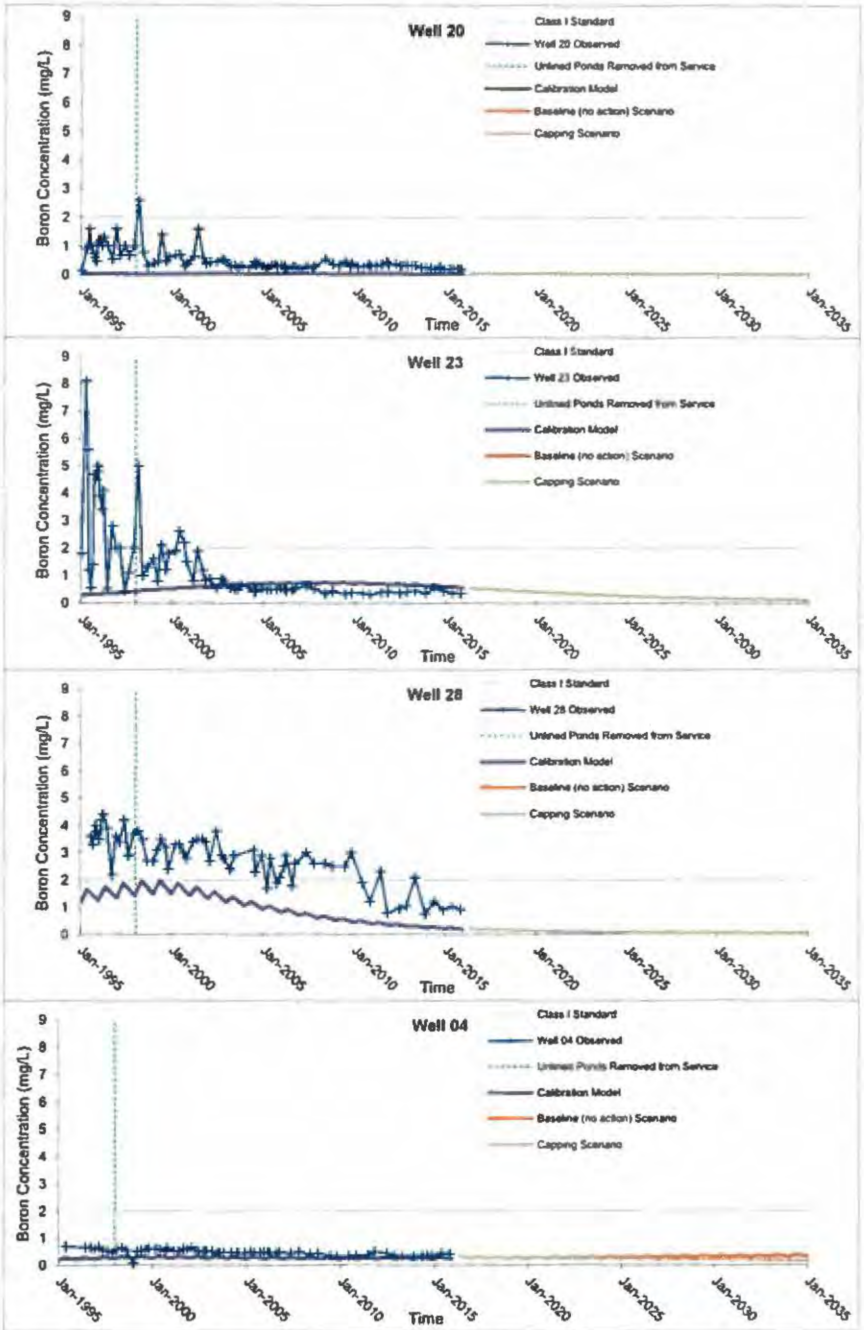


Figure 3-8 (cont'd). Predicted and observed boron concentrations (mg/L) (1995-2035)

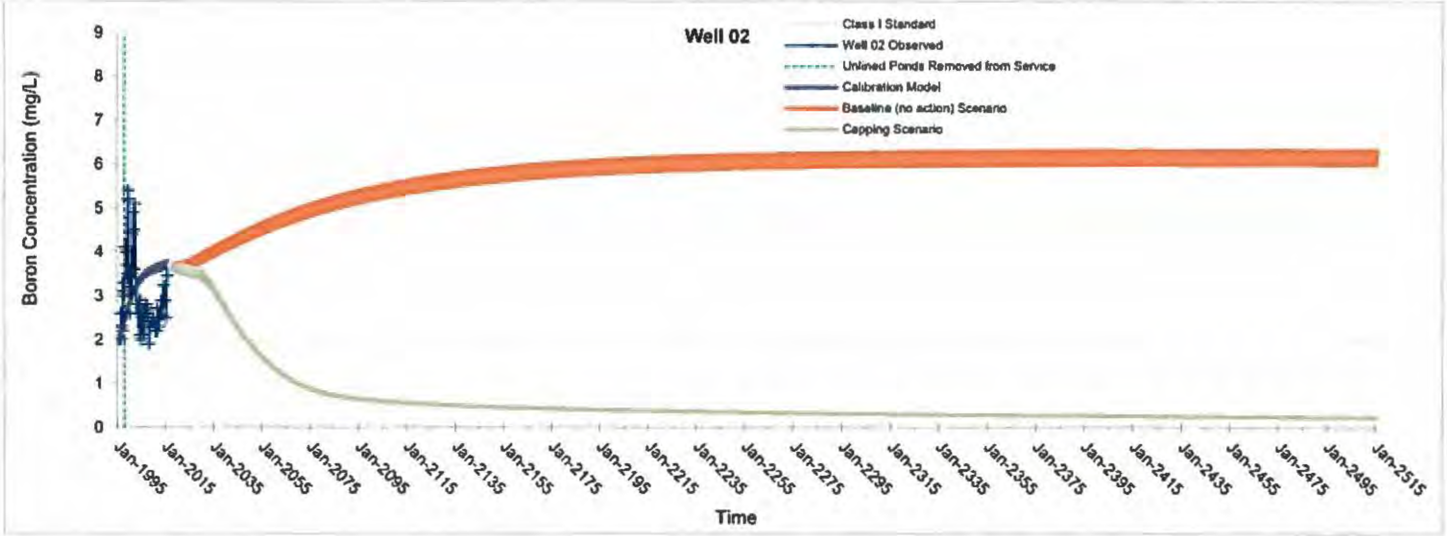


Figure 4-1. Predicted and observed boron concentrations (mg/L) (1995-2515)

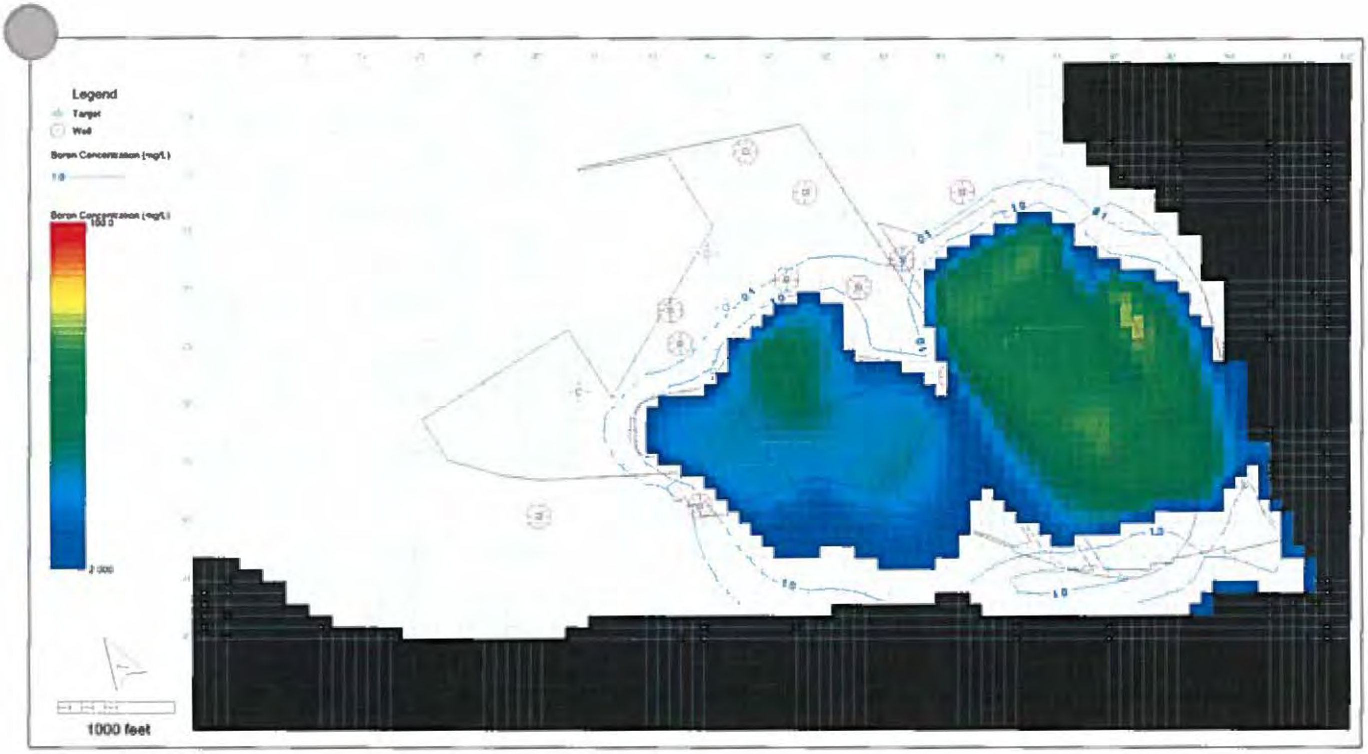


Figure 4-2. Predicted Maximum Extent of Boron Plume (2 mg/L) with Capping Scenario for Layer Layer 2 (Prediction Model, Capping Scenario, Stress Period 2, 365 days).

TABLES

Table 3-1. Flow Model Input Values (calibration and sensitivity)

Groundwater Model Report
Wood River West Ash Complex, Wood River Power Station
Dynegy Midwest Generation, LLC

NRT PROJECT NO : 2376/2
BY: JJW CHKD BY: BGH
DATE: 8/26/16

Horizontal Hydraulic Conductivity	**Property Zone ID**	**ft/d**	**cm/s**	**Sensitivity[1]**
Silty Clay Units	1	6.80E-02	2.4E-05	High
Inter-Sand Window	7	33	1.2E-02	Negligible
Shallow Primary Sand Unit	3	33	1.2E-02	Low
Deep Primary Sand Unit	8	547	1.9E-01	Moderate - Moderately High
Vertical Hydraulic Conductivity		**ft/d**	**Kh/Kv**	**Sensitivity[1]**
Silty Clay Units	1	6.80E-04	100	High
Inter-Sand Window	7	6.6	5.0	Negligible
Shallow Primary Sand Unit	3	6.6	5.0	Moderate
Deep Primary Sand Unit	8	109	5.0	Negligible
Recharge[2]		**ft/d**	**in/yr**	**Sensitivity[1]**
Silty Clay Units	1	2.0E-04	0.9	Negligible
WAP 1	2	2.0E-03	8.8	High
WAP 2E	3	2.0E-03	8.8	High
WAP 2W	4	2.0E-04	0.9	Low
Pond 3	5	3.9E-07	0.0	Negligible
OEAP	6	1.0E-03	4.4	Negligible
OEAP	7	2.0E-04	0.9	Negligible
OEAP	8	4.1E-03	18.0	Negligible
OEAP	9	8.0E-04	3.5	Negligible
NEAP	10	1.2E-04	0.5	Negligible
NEAP	11	1.2E-04	0.5	Negligible

Notes:

1. Sensitivity Explanation, based on maximum change in Sum of Squared Residuals (SSR)
   - Negligible - SSR changed by less than 1%
   - Low - SSR change between 1% and 10%
   - Moderate - SSR change between 10% and 50%
   - Moderately High - SSR change between 50% and 100%
   - High - SSR change greater than 100%
2. See figures for delineation of model zones, for flow model calibration inputs see stress periods 123-134
3. WAP-West Ash Pond, OEAP-Old East Ash Pond, NEAP - New East Ash Pond

NATURAL RESOURCE TECHNOLOGY

Table 3-1 (cont'd). Flow Model Input Values (calibration and sensitivity)

Groundwater Model Report
Wood River West Ash Complex, Wood River Power Station
Dynegy Midwest Generation, LLC

NRT PROJECT NO.: 2376/2
BY: JJW CHKD BY: BGH
DATE: 8/26/16

River Parameters		
Mississippi River - Mel Price Dam Pool		**Sensitivity[1]**
Upstream Stage (ft) to Downstream Stage (ft)	418.5 - 418.5	Negligible
Bed Thickness (ft)	20	not tested
Hydraulic Conductivity (cm/s)	1.00E-05	not tested
Conductance (ft^2/d, normalized per ft^2 area)	~697	Negligible
River Width (ft)	5000	not tested
Length of River (ft)	~98	not tested
Mississippi River (base stage)		**Sensitivity[1]**
Upstream Stage (ft) to Downstream Stage (ft)	402.9 - 401.2	High
Bed Thickness (ft)	1	not tested
Hydraulic Conductivity (cm/s)	2.30E-03	not tested
Conductance (ft^2/d, normalized per ft^2 area)	3.30E+06	Negligible
River Width (ft)	5000	not tested
Length of River (ft)	100	not tested
Wood River		**Sensitivity[1]**
Upstream Stage (ft) to Downstream Stage (ft)	407.1 - 401.1	Negligible
Bed Thickness (ft)	1	not tested
Hydraulic Conductivity (cm/s)	3.50E-07	not tested
Conductance (ft^2/d, normalized per ft^2 area)	2	Negligible
River Width (ft)	20	not tested
Length of River (ft)	100	not tested
General Head Boundary Parameters (upgradient groundwater input)		**Sensitivity[1]**
Upstream Stage (ft) to Downstream Stage (ft)	409.2 - 407.1	High
Saturated Thickness (ft)	20	not tested
Hydraulic Conductivity (cm/s)	3.50E-02	not tested
Conductance (ft^2/d, normalized per ft^2 area)	2.00E+05	Negligible
Width (ft)	100	not tested
Distance to Head (ft)	1	not tested
Constant Head Boundary Parameters (controlled levee landside ponding)		**Sensitivity[1]**
Upstream Stage (ft) to Downstream Stage (ft)	409.0 - 408.0	Moderate

Notes:

1. Sensitivity Explanation, based on maximum change in Sum of Squared Residuals (SSR)
   - Negligible - SSR changed by less than 1%
   - Low - SSR change between 1% and 10%
   - Moderate - SSR change between 10% and 50%
   - Moderately High - SSR change between 50% and 100%
   - High - SSR change greater than 100%
2. See figures for delineation of model boundary conditions

Table 3-2. Transport Model Recharge and Concentration Input Values (calibration)

Groundwater Model Report
Wood River West Ash Complex, Wood River Power Station
Dynegy Midwest Generation, LLC

NRT PROJECT NO.: 2376/2
BY: JJW CHKD BY: BGH
DATE: 8/18/16

Silty Clay Units	Stress Periods	Dates	Concentration (mg/L)	Recharge (ft/day)	Recharge (in/yr)
Zone 1	1-134	1949-2015	0	2.0E-04	0.88
Old East Ash Pond	**Stress Periods**	**Dates**	**Concentration (mg/L)**	**Recharge (ft/day)**	**Recharge (in/yr)**
Zone 6	1-58	1949-1978	80	7.0E-03	30.66
Zone 7			50	2.0E-04	0.88
Zone 8			50	1.0E-02	43.80
Zone 9			50	7.0E-03	30.66
Old East Ash Pond	**Stress Periods**	**Dates**	**Concentration (mg/L)**	**Recharge (ft/day)**	**Recharge (in/yr)**
Zone 6	59-122	1979-2010	80	1.0E-03	4.38
Zone 7			50	2.0E-04	0.88
Zone 8			50	1.0E-02	43.80
Zone 9			50	8.0E-04	3.50
Old East Ash Pond	**Stress Periods**	**Dates**	**Concentration (mg/L)**	**Recharge (ft/day)**	**Recharge (in/yr)**
Zone 6	123-134	2011-2015	80	1.0E-03	4.38
Zone 7			50	2.0E-04	0.88
Zone 8			50	4.1E-03	17.96
Zone 9			50	8.0E-04	3.50
New East Ash Pond	**Stress Periods**	**Dates**	**Concentration (mg/L)**	**Recharge (ft/day)**	**Recharge (in/yr)**
Zone 10	115-134	2007-2015	50	1.2E-04	0.53
Zone 11			80	1.2E-04	0.53
West Ash Ponds	**Stress Periods**	**Dates**	**Concentration (mg/L)**	**Recharge (ft/day)**	**Recharge (in/yr)**
Zone 2 (WAP 1)	1-58	1949-1978	0	2.0E-04	0.88
Zone 3 (WAP 2W)			0	2.0E-04	0.88
Zone 4 (WAP 2E)			0	2.0E-04	0.88
Zone 5 (Pond 3)			0	2.0E-04	0.88
West Ash Ponds	**Stress Periods**	**Dates**	**Concentration (mg/L)**	**Recharge (ft/day)**	**Recharge (in/yr)**
Zone 2 (WAP 1)	59-98	1979-1998	15	2.0E-03	8.76
Zone 3 (WAP 2W)			10	7.0E-03	30.66
Zone 4 (WAP 2E)			20	2.0E-03	8.76
Zone 5 (Pond 3)			25	2.0E-03	8.76
Zone 12 (WAP 2E, Pond 3)			80	1.0E-02	43.80
West Ash Ponds	**Stress Periods**	**Dates**	**Concentration (mg/L)**	**Recharge (ft/day)**	**Recharge (in/yr)**
Zone 2 (WAP 1)	99-134	1999-2015	10	2.0E-03	8.76
Zone 3 (WAP 2W)			10	2.0E-03	8.76
Zone 4 (WAP 2E)			10	2.0E-04	0.88
Zone 5 (Pond 3)			10	3.9E-07	1.71E-03

Notes:

1. Sensitivity Explanation
   - Negligible - little effect on concentrations
   - Low - concentrations at two or more wells changed by 2 to 10 percent
   - Moderate - concentrations at two or more wells changed by 10 to 20 percent
   - High - concentration at two or more wells changed by more than 20 percent

Table 3-3. Mean Monthly Mississippi River Stage from 1990 through 2002

Groundwater Model Report
Wood River West Ash Complex, Wood River Power Station
Dynegy Midwest Generation, LLC

NRT PROJECT NO.: 2376/2
BY: JJW CHKD BY: PMH
DATE: 6/14/16

Mean Monthly Mississippi River Stage Data for March, April, May, June, and July 1990-2002 (Flood Stage).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
March Mean Stage	408.8	406.2	407.37	412.92	409.23	404.85	403.6	414.55	413.15	406.68	402.72	411.3	403.29
April Mean Stage	404.55	412.64	408.96	421.94	412.21	411.39	406.86	416.57	420.07	413.1	401.78	413.28	406.91
May Mean Stage	414.06	414.83	405.9	421.78	412.61	423.49	418.41	413.15	412.16	419.32	403.05	418.01	419.57
June Mean Stage	416.4	412.64	400.65	417.36	406.64	421.02	419.03	408.41	413.26	415.9	409.86	417.93	411.83
July Mean Stage	411.09	404.86	406.06	431.47	405.71	410.23	409.77	406.5	413.46	410.25	408.49	406.78	403.56
Average Flood Stage	410.98	410.23	405.79	421.09	409.28	414.20	411.53	411.84	414.42	413.05	405.18	413.46	409.03

Mean Monthly Mississippi River Stage Data for August, September, October, November, December, January, and February 1990-2002 (Base stage).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
August Mean Stage	407.02	400.86	404.47	428.16	401.73	406.81	404.79	404.47	405.06	405.37	401.13	401.31	402.11
September Mean Stage	402.77	399.81	403.87	421.96	401.08	402.56	401.39	403.17	402.04	401.19	399.65	400.71	400.68
October Mean Stage	400.61	399.82	401.27	413.90	401.96	403.14	402.20	402.91	408.24	400.69	399.22	401.50	401.74
November Mean Stage	400.24	403.23	408.20	407.78	403.82	405.05	405.95	403.26	409.78	400.13	400.51	400.73	399.83
December Mean Stage	401.79	405.62	410.87	404.92	403.17	401.02	404.08	403.81	404.76	400.08	398.45	401.70	398.30
January Mean Stage	nd	402.15	401.69	408.74	401.49	402.65	400.28	402.37	404.64	403.48	399.41	399.10	399.33
February Mean Stage	400.48	403.10	402.67	405.31	403.88	402.68	402.04	407.77	406.51	409.68	399.96	407.13	402.61
Average Base Stage	402.15	402.08	404.72	412.97	402.45	403.42	402.96	403.97	405.86	402.95	399.76	401.74	400.66

Notes:

1. All river stage data are in feet above mean sea level
2. All river stage elevations were recorded by the United States Army Corps of Engineers from the Mel Price Lock and Dam tailwater gauging station
3. All river stage data were copied from the United States Army Corps of Engineers historical data published on the web at http://mvs-wc.mvs.usace.army.mil/archive/mi/mi6t/

Table 3-3 (cont'd). Mean Monthly Mississippi River Stage from 2003 through 2014

Groundwater Model Report

Wood River West Ash Complex, Wood River Power Station

Dynegy Midwest Generation, LLC

Mean Monthly Mississippi River Stage Data for March, April, May, June, and July 2003-2014 (Flood Stage).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
March Mean Stage	399.69	406.9	402.25	401.36	408.94	412.14	411.21	414	412.16	405	406.67	403.31
April Mean Stage	401.65	405.67	406.74	407.23	413.04	416.93	412.96	416.03	415.73	405.55	415.12	407.33
May Mean Stage	410.38	406.8	404.79	406.55	412.83	417.7	418.27	416.51	418.33	407.52	418.48	409.79
June Mean Stage	404.68	415.15	406.51	401.84	407.44	422.92	412.86	418.38	420.73	404.07	420.74	411.64
July Mean Stage	404.85	406.93	401.67	398.89	403.8	417.74	405.79	420.65	416.49	401.08	409.53	414.61
Average Flood Stage	404.25	408.29	404.39	403.17	409.21	417.49	412.22	417.11	416.69	404.64	414.11	409.34

Mean Monthly Mississippi River Stage Data for August, September, October, November, December, January, and February 2003-2014 (Base stage).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
August Mean Stage	398.58	402.38	399.05	398.49	403.99	405.23	403.18	415.88	411.09	398.15	401.18	402.45
September Mean Stage	398.56	401.78	399.28	399.30	404.17	409.56	401.63	409.77	404.66	397.79	398.22	408.46
October Mean Stage	397.59	400.40	401.32	398.61	405.16	403.37	406.68	409.20	401.59	398.02	398.57	407.89
November Mean Stage	400.10	403.91	398.50	398.07	401.84	401.61	414.24	405.08	401.74	398.42	399.51	401.82
December Mean Stage	400.93	404.28	398.59	401.37	400.77	401.48	406.16	401.48	402.97	397.78	397.98	nd
January Mean Stage	397.37	399.98	408.11	399.75	402.50	403.33	403.72	406.74	401.98	400.36	397.71	398.28
February Mean Stage	397.66	399.39	407.45	399.48	400.86	405.57	403.74	405.14	405.62	401.71	400.46	399.88
Average Base Stage	398.68	401.73	401.76	399.30	402.76	404.31	405.62	407.61	404.24	398.89	399.09	403.13

Average Mean Monthly River Stage (Base stage, 1990-2014)	**402.91**	**Average Mean Monthly River Stage (Flood stage, 1990-2014)**	**410.84**

Notes:

1. All river stage data are in feet above mean sea level
2. All river stage elevations were recorded by the United States Army Corps of Engineers from the Mel Price Lock and Dam tailwater gauging station
3. All river stage data were copied from the United States Army Corps of Engineers historical data published on the web at http://mvs-wc.mvs.usace.army.mil/archive/ml/mi6l/

Table 3-4. Transport Model Input Values (calibration and sensitivity)

Groundwater Model Report
Wood River West Ash Complex, Wood River Power Station
Dynegy Midwest Generation, LLC

NRT PROJECT NO.: 2376/2
BY: JJW CHKD BY: BGH
DATE: 8/18/16

Specific Storage (ft^{-1})	**Property Zone ID**	**Base Case**	**Alternatives**	**Sensitivity**[1]
Silty Clay Units	1	3.00E-04	not tested	-
Inter-Sand Window, Shallow & Deep Primary Sand Units	5	3.00E-06	not tested	-
Specific Yield	**Property Zone ID**	**Base Case**	**Alternatives**	**Sensitivity**[1]
Silty Clay Units	1	0.10	not tested	-
Inter-Sand Window, Shallow & Deep Primary Sand Units	5	0.20	not tested	-
Effective Porosity	**Property Zone ID**	**Base Case**	**Alternatives**	**Sensitivity**[1]
Silty Clay Units	1	0.10	0.05, 0.15	Model failed to converge
Inter-Sand Window, Shallow & Deep Primary Sand Units	5	0.20	0.15, 0.25	Model failed to converge
Dispersivity (ft)	**Property Zone ID**	**Base Case**	**Alternatives**	**Sensitivity**[1]
Silty Clay Units / Inter-Sand Window, Shallow & Deep Primary Sand Units Longitudinal	4 / 2	1 / 10	3 * Base Case, 10 * Base Case	High, High
Silty Clay Units / Inter-Sand Window, Shallow & Deep Primary Sand Units Transverse	4 / 2	0.1 / 1		Low, High
Silty Clay Units / Inter-Sand Window, Shallow & Deep Primary Sand Units Vertical	4 / 2	0.01 / 0.1		High, High
Retardation	**Property Zone ID**	**Base Case**	**Alternatives**	**Sensitivity**[1]
Bulk Density (g/cm^3)	1, 3	1.57	not tested	-
Silty Clay Units	1	0.7	0.4, 1.1	High
Inter-Sand Window, Shallow & Deep Primary Sand Units	3	0	0.4	High

Notes:

1. Sensitivity Explanation

Negligible - little effect on concentrations

Low - concentrations at two or more wells changed by 2 to 10 percent

Moderate - concentrations at two or more wells changed by 10 to 20 percent

High - concentration at two or more wells changed by more than 20 percent

Table 4-1. West Ash Ponds Transport Model Recharge Input Values (baseline and capping scenario prediction)

Groundwater Model Report
Wood River West Ash Complex, Wood River Power Station
Dynegy Midwest Generation, LLC

NRT PROJECT NO.: 2376/2
BY: JJW CHKD BY: BGH
DATE: 8/18/16

	Stress Periods	Simulation Year	Dates	Concentration (mg/L)	Recharge (ft/day)	Recharge (in/yr)
Zone 2 (WAP 1) Baseline	1-1000	1-500	2016-2515	10	**2.0E-03**	8.76
Zone 3 (WAP 2W) Baseline	1-1000	1-500	2016-2515	10	**2.0E-03**	8.76
Zone 4 (WAP 2E) Baseline	1-1000	1-500	2016-2515	10	**2.0E-04**	0.88
Zone 5 (Pond 3) Baseline	1-1000	1-500	2016-2515	10	**3.9E-07**	1.71E-03
	Stress Periods	**Simulation Year**	**Dates**	**Concentration (mg/L)**	**Recharge (ft/day)**	**Recharge (in/yr)**
Zone 2 (WAP 1) with CAP	1-20	1-10	2016-2025	10	**1.2E-03**	5.28
	21-62	11-31	2026-2046	10	**6.5E-05**	0.28
	63-1000	32-500	2047-2515	10	**4.9E-07**	0.002
Zone 3 (WAP 2W) with Cap	1-18	1-9	2016-2024	10	**1.2E-03**	5.24
	19-56	10-28	2025-2043	10	**6.3E-05**	0.28
	57-1000	29-500	2044-2515	10	**3.3E-07**	0.001
Zone 4 (WAP 2E) with Cap	1-1000	1-500	2016-2515	10	**7.6E-05**	0.33
Zone 5 (Pond 3) with Cap	1-1000	1-500	2016-2515	0	**3.9E-07**	1.71E-03

APPENDIX A

MODFLOW/MT3DMS MODEL FILES

(PROVIDED SEPARATELY)

The following are attachments to the testimony of Scott M. Payne, PhD, PG and Ian Magruder, M.S..

ATTACHMENT 23

APPENDIX A

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT

OBG

Hydrogeologic Site Characterization Report

Hennepin East Ash Pond No. 2

Hennepin, Illinois

Dynegy Midwest Generation, LLC

FINAL
December 20, 2017

Natural Resource Technology
AN OBG COMPANY

DECEMBER 20, 2017 | FINAL | PROJECT #2414

Hydrogeologic Site Characterization Report

Hennepin East Ash Pond No. 2
Hennepin, Illinois

Prepared for:

Dynegy Midwest Generation, LLC
1500 Eastport Plaza Drive
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STUART J. CRAVENS, PG
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ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
bgs	below ground surface
CCR	coal combustion residual
CFR	Code of Federal Regulations
cm/s	centimeters per second
CWS	Community Water Supply
DMG	Dynegy Midwest Generation, Inc.
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
ft	feet
ft/ft	feet per feet
ft MSL	feet above Mean Sea Level
gal/day	gallons per day
IAC	Illinois Administrative Code
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
ISGS	Illinois State Geological Survey
ISWS	Illinois State Water Survey
MDL	method detection limit
mg/L	milligram per liter
NRT	Natural Resource Technology, an OBG Company
PCP	Pentachlorophenol
PWS	Public Water Supply
SVOC	Semivolatile Organic Compound
S.U.	Standard Units
TDS	total dissolved solids
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WHPA	Wellhead Protection Area
WMA	Wildlife Management Area

1 INTRODUCTION

1.1 OVERVIEW

This Hydrogeologic Site Characterization Report was prepared by Natural Resource Technology, Inc., an OBG Company (NRT) in support of a Closure Plan for impoundments located at the Hennepin Power Station, Hennepin, Illinois (Figure1) which is owned by Dynegy Midwest Generation, LLC (DMG). This report and the Closure Plan apply to Coal Combustion Residuals (CCR) surface impoundments associated with Ash Pond No. 2 within the East Ash Pond System and not to any of the other impoundments present at the Hennepin Power Station. However, information gathered to evaluate other CCR units on site regarding geology, hydrogeology, and groundwater quality is included, where appropriate. The Closure Plan for Hennepin Ash Pond No. 2 includes the area previously intended to be future CCR disposal cells west of the Landfill. A notice of intent to close Ash Pond No. 2 was provided in November 2015.

Numerous hydrogeologic investigations have been performed concerning the CCR Units located at the Site. The information presented in this site characterization report includes recent data collected to comply with the Federal CCR Rule (40 CFR Part 257) as well as comprehensive data collection and evaluations from prior hydrogeologic investigation reports, including, but not limited to, the following:

- ***Hydrogeologic Study, Existing Ash Ponds, Hennepin Power Plant, Illinois Power Company, Hennepin, Illinois. John Mathes & Associates, Inc.; April 19, 1983***. Six monitoring wells were installed, currently designated as wells 02 through 06. Well 01 was abandoned during construction of the East Ash Pond, Monitoring wells 03 through 06 are downgradient of Ash Pond No. 2 and well 02 is an upgradient well located south of the impoundment. Grain size analyses were performed on soil samples.
- ***Investigation of Site Closure Options at Illinois Power Company's Hennepin East Ash Impoundment. Report No. STMI/135/96-02. Science & Technology Management, Inc., June 1996***. A supplemental hydrogeologic characterization was conducted to further characterize the Hennepin East Ash Pond System, develop a groundwater flow and transport model and evaluate four alternative closure options using the model. Eight new monitoring wells (wells 10 through 17) were installed around the east ash impoundment system to augment the existing network. Six new wells were located along the intermediate berm that separates Ash Pond No. 2 from the East Ash Pond, and two wells were located up gradient of the East Ash Pond. Field permeability tests were conducted on eight wells.
- ***Field Implementation Plan, New East Ash Landfill, Hennepin Power Station, Hennepin, Illinois. Natural Resource Technology and Kelron Environmental; February 2, 2009***. Described the data collection and analysis to be performed to satisfy the requirements of the hydrogeologic investigation as well as complete the groundwater impact assessment and groundwater monitoring plan.
- ***Water Well Survey, Dynegy Midwest Generation, Hennepin Power Station, Hennepin, Illinois. Natural Resource Technology and Kelron Environmental; June 3, 2009***. A water well survey was performed in accordance with the "Right to Know" Potable Water Well Survey procedures of 35 Illinois Administrative Code 1600.210(b)(1) and 1600.210(b)(2). The purpose of this survey was to identify water wells located within 2,500 feet of DMG's Hennepin Power Station property boundary.
- ***Prediction of Groundwater Transport: Pond 2 East, Hennepin Power Station, Hennepin, Illinois. Natural Resource Technology and Kelron Environmental; July 8, 2009***. Groundwater transport modeling was completed to evaluate liner alternatives proposed for the Leachate Pond by simulating the effects of a release on groundwater quality.
- ***Assessment of Potential for Groundwater Impact on Identified Water Wells, Dynegy Midwest Generation, Hennepin Power Station, Hennepin, Illinois. Natural Resource Technology and Kelron Environmental; August 26, 2009***. An assessment of the potential for impact of the ash impoundment on water quality of potable water wells identified in the water well survey.

- ***New Coal Combustion Waste (CCW) Landfill, Initial Facility Report, Hydrogeologic Studies and Evaluations, Section 25 Hydrogeological Investigation, Hennepin Power Station, Hennepin, Illinois. Natural Resource Technology and Kelron Environmental; December 19, 2010***. Provided the foundation on which the monitoring system, groundwater impact assessment, and groundwater quality standards are to be developed for inclusion with the Initial Facility Report for the New CCW Landfill. Forty-one borings (B-1 through B-41) were advanced near and within the footprint of the Site during February and March 2009 for Site engineering studies. Four new monitoring wells (18S, 18D, 19S and 19D) were installed along the north perimeter, downgradient of the Site. One new well (08D) was located to the south adjacent to existing well 08.
- ***New Coal Combustion Waste Landfill, Initial Facility Report, Hydrogeologic Studies and Evaluations, Section 27 Groundwater Impact Assessment, Hennepin Power Station, Hennepin, Illinois. Natural Resource Technology and Kelron Environmental; December 19, 2010.*** Three-dimensional numerical flow and transport modeling was used to estimate the effect of leachate seepage from the landfill on groundwater concentrations at the downgradient edge of the zone of attenuation.
- ***New Coal Combustion Waste Landfill, Initial Facility Report, Hydrogeologic Studies and Evaluations, Section 28 Groundwater Monitoring Program, Hennepin Power Station, Hennepin, Illinois. Natural Resource Technology and Kelron Environmental; December 19, 2010***. Describes the groundwater monitoring program to identify discharges from all waste disposal units (Phases) within Ash Pond No. 2 and the leachate collection system associated with the new CCW Landfill.
- ***30% Design Data Report for Dynegy Hennepin Power Station; West Polishing Pond, West Ash Pond, East Ash Pond and Ash Pond No. 2 CCR Units. AECOM, January 12, 2016***. The data package included summary tables, geotechnical laboratory data and exploratory logs for 32 auger borings, 38 CPT soundings and 7 standpipe piezometers.
- ***2016 East Ash Pond and Coal Combustion Waste Landfill Annual Report, Hennepin Power Station, Dynegy Operating Company, Hennepin, Illinois. Natural Resource Technology, Inc., March 13, 2017***. Annual report assessing groundwater quality data, statistical trend analysis and a waste management summary for the CCW Landfill.

Pursuant to the December 2010 Initial Facility Report (IFR) prepared for the Landfill at the Hennepin Power Station, DMG is required to perform groundwater monitoring and prepare annual reports in accordance with 35 IAC Part 815. These annual reports have been submitted to the Illinois EPA from March 2012 through March 2017 and have documented the groundwater levels, flow, and water quality at the CCW Landfill and East Ash Pond System during this six-year period.

In conjunction with this report, a Groundwater Monitoring Plan and a Groundwater Management Zone Application are being prepared to support the closure of Ash Pond No. 2. In addition, the groundwater flow and transport model was updated to evaluate the effect of the ash pond closure on groundwater quality and to predict the fate and transport of CCR leachate components. Modeling has also been conducted to enable estimation of the time required for hydrostatic equilibrium of groundwater to be achieved beneath Ash Pond No. 2.

1.2 SITE LOCATION AND BACKGROUND

Ash Pond No. 2 is located in the northeast quarter of Section 26, Township 33 North, Range 2 West, Putnam County, Illinois and approximately 3 miles north-northeast of the Village of Hennepin (Figure 1). The impoundments are situated less than 200 feet south of the Illinois River and approximately one mile east of the Big Bend, where the river shifts course from predominantly west to predominantly south. Existing ash impoundments border Ash Pond No. 2 to the east and south. Surrounding areas include industrial properties to the east and south of the impoundments, agricultural land to the southwest, and the Hennepin Power Station to the west (Figure 2). The industrial properties include:

- Tricon Materials is located immediately east of the site at 13559 Esk Street. Tricon Materials is an aggregate business providing various fill and washed sand, gravel, crushed rock, rock and boulder products.
- Washington Mills (formerly known as Exolon) is located south of the impoundment at 13230 Esk Street. They produce abrasive grains and specialty electro-fused minerals.
- Between the Hennepin Power Station property and Washington Mills, north of Esk Street, is a 9-acre parcel that was once owned by Advanced Asphalt. The unoccupied property includes several abandoned buildings.

1.3 SITE HISTORY

The Hennepin Power Station had two coal-fired units constructed in 1953 and 1959 with a capacity of 210 MW. The coal source changed several times since the station was constructed. The Hennepin East Ash Pond System is shown on Figure 2 and consists of the following CCR units:

Ash Pond No. 2 (East Ash Pond No. 2): Used to store and dispose fly ash, bottom ash, and other non-CCR waste streams, including coal pile runoff. The pond, currently encompassing approximately 18 acres, is unlined with a variable but lowermost bottom elevation of 451 feet. The approximate dates of construction of each successive stage of Ash Pond No. 2 are summarized below.

Date	Event
1958	Construction of Ash Pond No. 2
1978	Embankment raise of Ash Pond No. 2
1985	Embankment raise of Ash Pond No. 2 to elevation 484 feet
1989	Embankment raise of Ash Pond No. 2 to elevation 494 feet
1996	Pond was removed from service and completely dewatered
2009 to 2010	Eastern portion of Ash Pond No. 2 was removed to facilitate construction of the Leachate Pond.
2010 / 2011	Landfill Phase I cell was constructed in 2010 over placed CCR in Ash Pond No. 2 adjacent to the Leachate Pond. In February 2011, 7,500 cubic yards of bottom ash was placed into the Phase I cell as a post-construction freeze-protection measure to protect the leachate collection system and geomembrane liner. No other material (fly ash or bottom ash) has been placed in the landfill since then.
2014	North Embankment tree removal, grading, and vegetation re-establishment adjacent to Ash Pond No. 2.

A Modified Closure Work Plan was submitted in 2010 which indicated Ash Pond No. 2 would be closed by capping as future landfill phases were constructed. This Work Plan was approved by the the IEPA in a letter dated March 3, 2010. The former proposed Landfill Phases II, III and IV will no longer be constructed above Ash Pond No. 2, which is the subject of this Closure Work Plan.

East Ash Pond (Primary Pond): Used to store and dispose bottom ash, fly ash, and other non-CCR waste and to clarify process water prior to discharge in accordance with the station’s NPDES permit. The 510-acre-foot pond was constructed in two phases. The first phase occurred in 1995 when the pond bottom and sidewalls were constructed to a total depth of 32 feet with a variable but lowermost bottom elevation of 458 feet. The bottom and sidewall liners were constructed with 48 inches of compacted clay with a hydraulic conductivity of 1 x 10^{-7} centimeters per second (cm/sec). The sidewall liners constructed during the first phase extended 20 feet above the bottom liner and water level within the pond was limited to 15 feet above the bottom liner. The second phase of construction occurred in 2003 when the sidewall liners were raised an additional 12 feet and the total water depth was raised to approximately 30 feet. The raised sidewalls were lined with 12 inches of compacted clay having a hydraulic conductivity of 1 x 10^{-6} cm/s, a 45-mil polypropylene geomembrane, and a polypropylene geotextile fabric. This pond remains in service for the treatment of bottom ash transport waters, miscellaneous low volume wastewater streams, and unsold fly ash.

Polishing Pond (Secondary Pond): Constructed in 1995 with a 48-inch thick compacted clay liner having a vertical hydraulic conductivity of 1 x 10^{-7} cm/sec.

Leachate Pond (Pond 2 East): A 25.5-acre-foot pond constructed with a composite liner consisting of 60-mil HDPE overlying two feet of compacted clay with a vertical hydraulic conductivity of 1 x 10^{-7} cm/sec. Construction was completed December 2010.

Ash Pond No. 4 (Pond 4): A former unlined impoundment, now dry, classified as a non-CCR pond (capped or otherwise maintained).

2 REGIONAL AND LOCAL GEOLOGY

2.1 TOPOGRAPHY

There are three geomorphic features dominant in the immediate vicinity of the Hennepin Power Station: an upper river terrace at an elevation of about 500 to 550 feet, a lower river terrace at an elevation of about 450 to 460 feet, and the current river valley filled with alluvium to an elevation of about 445 feet. The plant and Ash Pond No. 2 were constructed on the original narrow lower terrace between the Illinois River and the uplands. The original lower terrace is approximately 10 to 20 feet above normal river level (441 feet at the Hennepin Power Station). The East Ash Pond, Polishing Pond and Ash Pond No. 4 were constructed on the upper terrace at an elevation of approximately 500 to 505 feet, or 60 to 65 feet above normal river level.

The lower road on the north side of the Site lies at an elevation of 480 to 485 feet. The upper road along the top of the north berm for Ash Pond No. 2 is at an elevation of approximately 494 to 500 feet. The berm slopes steeply toward the river and its base is close to the river bank.

2.2 REGIONAL GEOMORPHOLOGY

The Hennepin Power Station is located in the Bloomington Ridged Plain Section of the Central Lowland Province. The Bloomington Ridged Plain includes most of the Wisconsinan Stage moraines and is characterized by low, broad morainic ridges with intervening stretches of relatively flat or gently rolling ground moraine. Drainage is generally in the initial stages of development, and most streams follow, and are eroding, in constructional depressions, many of which cross morainic ridges. The valleys of principal streams are large and have floodplains bordered by valley-train terraces. The Illinois River has a broad, flat-bottomed valley with steep walls and is bordered by numerous steep-walled valleys with steep gradients.

2.3 SOILS

Surficial soils at the East Ash Pond System and vicinity are shown on Figure 3, based on the soil survey performed in Putnam County in 1986 (Soil Conservation Service, May 1992). Former soils underlying the Site are identified as Moundprairie Silty Clay Loam, Wet (#1480). The Moundprairie series soils consist of poorly drained, moderately permeable soils on floodplains. These soils formed in alluvium. This soil association is well suited for and used as habitat for wetland wildlife. These soils are unsuitable for dwellings and only moderately suitable for cultivated crops, due to shallow water table and flooding.

Areas surrounding the East Ash Pond System that are not designated Urban Land (#533) or Gravel Pits (#865) are predominantly classified as Wea Silt Loam (#398A, 398B). The Wea series consists of well drained soils on stream terraces. These soils formed in glacial outwash. Permeability is moderate in the upper part of the profile and very rapid in the lower part. Most areas of this association are well suited for and used in cultivating crops. Some areas are used as a source of sand and gravel, such as the property to the east.

2.4 BEDROCK

2.4.1 Lithology

The uppermost bedrock at the Hennepin Power Station, including the East Ash Pond System, is the Pennsylvanian Carbondale Formation (Kolata, 2005), which consists of shale with thin limestone, sandstone, and coal beds (Figure 4). The bedrock surface elevation is between 400 and 450 feet (Willman et al., 1967). Three deeper borings around the perimeter of the East Ash Pond System confirm the presence of shale bedrock between elevations 400 and 410. Water well logs at the power plant indicate shale bedrock at an elevation of roughly 350.

The thickness of the Pennsylvanian rocks ranges from 150 feet in the western part of Putnam County to more than 525 feet along the eastern margin of the county (Woller, 1976). In the vicinity of the Hennepin Power Station, the Pennsylvanian rocks have an estimated thickness of approximately 300 to 400 feet. Beneath the Pennsylvanian rocks are Mississippian and Devonian-age interbedded layers of limestone and shale over

Silurian-age dolomite. The dolomite generally ranges in thickness from 410 to 505 feet in the immediate region (Willman, 1942; Frankie, 2002). Crevassing in the unit varies widely and well yields are inconsistent.

Deeper bedrock units beneath the Silurian-age dolomite consist of the following in descending order (Woller, 1976; Frankie, 2002):

- Maquoketa Shale Group of Ordovician age, composed primarily of blue to green shales with some limestone and dolomite layers, occurs at depths of less than 1,000 feet in the northwest part of Putnam County to 1,200 feet in southern Putnam County, with a thickness generally ranging from 155 to 240 feet. This shale is an aquitard between the Silurian dolomite and deeper dolomite and sandstone aquifers.
- Ordovician age dolomite and sandstone aquifers, including the following:
  - Galena-Platteville Dolomite Group at depths of about 1,150 feet in northwest Putnam County to about 1,400 feet in the southeast, ranging in thickness from 320 to 380 feet
  - Glenwood-St. Peter Sandstone at depths of about 1,450 feet in west Putnam County near the site to 1,750 feet in the southeast part of the county, ranging in thickness from about 120 to 170 feet
  - Dolomite with some shale and sandstone beds below depths of 1,750 to 1,800 feet near the site, principally consisting of the Shakopee (130 to 150 feet thick), New Richmond (approximately 165 feet thick), and the Oneota (approximately 215 feet thick) formations
  - Cambrian age dolomite and sandstone aquifers, including the Ironton-Galesville and Elmhurst-Mt. Simon formations
  - Precambrian age igneous and metamorphic

Based on the directory of coal mines for Putnam County (ISGS, 2006), the nearest coal mines in the vicinity of the Hennepin Power Station are located approximately 3 miles to the northeast and 4 miles to the southeast. These mines, identified as #8 and #298, are both abandoned underground shaft mines that used the longwall method of mining, essentially removing all of the coal. The #8 mine, called the Lacey Mine, was active from 1883 to 1890. The coal seam at this location ranged from 28 to 42 inches in thickness. The #298 mine, called the St. Paul Mine, and later the Prairie State Mine, operated from 1905 to 1925 and from 1930 to 1939. The coal seam at this location ranged from 42 to 66 inches in thickness.

The coal mined is called the Colchester Seam, also known as the No. 2 and LaSalle Seam. The Colchester Seam is located within the lower portion of the Carbondale Formation, which is the shallowest coal mined in the region. In the vicinity of the site, the Colchester Coal occurs at a depth of approximately 200 to 300 feet.

2.4.2 Structure

The major geologic structural features around Illinois are shown on Figure 5. The Hennepin Power Station is located within a relatively stable region of the continent within the north-central portion of the Illinois Basin. Rock units to the northeast of the Site form the La Salle Anticlinorium where folds are expressed in synclines, anticlines, arches, and monoclines present in the area (Nelson 1995; Anderson 1988). The Paleozoic bedrock strata, consisting of Pennsylvanian and older rocks, have a southwestern regional dip of approximately 15 to 30 feet per mile due to the effects of the anticlinorium. Variations to the bedrock dip occur in areas where there are local structures. The anticlinorium has subparallel anticlines, domes, monoclines, and synclines, which can change local dip and strike of bedrock units (Nelson, 1995).

2.4.3 Seismic Setting

The Sandwich Fault Zone is located approximately 35 miles northeast of the Site (Figure 5). Vertical displacement on the Sandwich Fault Zone ranges from 150 to 800 feet. The fault zone is downthrown to the northeast. Due to the depth of burial by Quaternary sediments and the lack of well or seismic data, detailed information about the fault zone is unavailable. Although depicted as a single fault on this map, evidence from surrounding counties indicates that the Sandwich Fault Zone is a complex configuration of many faults of varying direction and amount of displacement (Kolata, 1976).

The Plum River Fault Zone is a 112-mile long, east-west trending zone of high-angle faulting in east-central Iowa and northwest Illinois, roughly 60 miles northwest of the Site. The north side of the fault zone is downthrown, with documented net vertical displacements of Silurian strata up to 270 feet. The physical relationships of Pennsylvanian deposits to the Plum River Fault Zone are not known with sufficient precision to preclude up to 33 feet of post-Pennsylvanian displacement. Historic data are inadequate to evaluate the potential for seismic hazard associated with the Plum River Fault Zone (Bunker, B.J., G.A. Ludvigson, B.J. Witzke, 1985). United States Geological Survey (USGS) seismic hazard maps show no enhanced ground acceleration in the Plum River Fault Zone vicinity.

2.5 UNLITHIFIED DEPOSITS GEOLOGY

2.5.1 General Unlithified Geology

The unlithified geologic deposits covering bedrock in the region surrounding the East Ash Pond System are derived from recent river deposition (alluvium), glacial outwash, and glacial till deposits. Total unlithified (drift) thickness ranges from 50 to 200 feet, generally becoming thicker with distance from the Illinois River southward from the impoundment. The geologic history of the Illinois River Valley was described in detail by Willman (1973), Hansel (1996), and Frankie (2002).

The Illinoian and Wisconsinan glaciers repeatedly moved over the area. The Illinois River established its present position during the Woodfordian substage of Wisconsinan glaciation, which covered the area as far south as Peoria. Wisconsinan drift lies directly on bedrock as a result of repeated Woodfordian glacial episodes eroding earlier deposits of loess and glacial drift.

During the glacial retreats from the Hennepin area, numerous moraines were deposited across the Illinois Valley. Large areas between these moraines and/or the glaciers subsequently flooded from meltwaters. One such lake was glacial Lake Illinois, which formed behind the Bloomington Moraine, crossing the Illinois River valley near Peoria. Rapid melting and drainage from this area (Kankakee Flood) deepened and widened the valley, cutting an extensive terrace at an elevation of 500 to 550 feet about 14,500 years ago. These deposits (Henry Formation) are mostly fine gravel and pebbly sand and may be as much as 150 to 200 feet thick in the large terrace on which the city of Hennepin is located (areas shown as ‘gh’ on Figure 6), along with the eastern (i.e., East Ash Pond System) and southeastern portion of the Hennepin Power Station property.

Another major flooded area formed behind the Tinley Moraine creating Lake Chicago. During downcutting of the Lake Chicago outlet about 3,000 years ago, the Chicago Outlet River deposited coarse gravel in bars on the eroded surfaces. The lower river terrace that underlies the Ash Pond No. 2 includes deposits of the Chicago Outlet River. These deposits commonly occur about 20 to 40 feet above the Illinois River and may be up to about 50 feet in thickness. They are generally coarser and more uniformly sorted than the higher terrace deposits that occur immediately south of the Site.

The Illinois River is currently shallowly entrenched in glacial outwash and the Chicago Outlet River deposits. Lateral erosion by the river has developed a floodplain and deposited alluvium (Cahokia Alluvium) in abandoned channels. Alluvial deposits of the modern Illinois River consist largely of clayey silt and sandy silt with lenses of sand and gravel. The alluvium, where present, is 20 to 40 feet thick, overlying thick deposits of sand and gravel of the Henry Formation. These areas (shown as ‘al’ on Figure 6), occur between the northernmost portion of the East Ash Pond System and the river.

2.5.2 Site Lithology

Based on stack-unit maps of geologic materials in the Site vicinity (Berg and Kempton, 1988), local stratigraphy is characterized by the following downward sequence of unlithified deposits:

- Cahokia Alluvium: These are the alluvial sediments deposited in abandoned channels from relatively recent lateral erosion by the Illinois River. These deposits extend to depths of less than 20 feet and consist largely of sandy silts and clays interbedded with sands and gravels.

- Henry Formation: These are the glacial outwash deposits comprising the low-level terraces, up to about 40 feet above the Illinois River. The deposits extend to depths greater than 20 feet and are dominated by gravelly soils. Beneath the pond berms and the surficial veneer of clay, granular deposits were encountered for nearly the full depth of all borings on the Site. These granular deposits are primarily gravel containing sand and lesser amounts of boulders, cobbles and fines.

The Henry Formation deposits are underlain by shale bedrock.

Three continuously sampled boring were drilled to confirm the local stratigraphy and hydrogeologic setting information. These borings fully penetrated the Cahokia Alluvium and Henry Formation into the shale bedrock. Boring 08D extended 30 feet below the bottom of the Henry Formation, which comprises the uppermost aquifer. The bedrock surface is relatively flat and was encountered between elevations 400 and 410, about 85 to 90 feet below ground surface.

3 REGIONAL AND LOCAL HYDROGEOLOGY

3.1 BEDROCK – REGIONAL AND LOCAL

The Pennsylvanian rocks in the region are not considered a municipal or subdivision water supply source (Gibb, 1979). Water-bearing openings are extremely variable from place to place and are best developed near the surface in thin limestones and sandstones, when present within the predominantly shale formation. In the bedrock upland areas away from the Illinois River, farm and domestic water supplies are obtained locally from sandstone and creviced limestone in the upper 250 feet of these rocks (Woller, 1976). When present, the limestone and sandstone units yield less than 10 gallons per minute (gpm) (Visocky et. al, 1985). Water quality within the bedrock varies considerably and it becomes highly mineralized with increasing depth. As a result, the Pennsylvanian bedrock is not a reliable source of groundwater.

The Pennsylvanian rocks generally have low porosity and hydraulic conductivity. The porosity of shale typically ranges from 1 to 20 percent (Walton, 1988). Representative horizontal hydraulic conductivity for shale typically ranges from $5x10^{-6}$ to $5x10^{-10}$ centimeters per second (cm/s). Representative vertical hydraulic conductivity ranges for shale are $5x10^{-8}$ to $5x10^{-12}$ cm/s (Walton, 1988).

Recharge to the Pennsylvanian rocks is derived locally from vertical leakage through the glacial drift and other unlithified materials that are in turn recharged from precipitation.

Deeper bedrock units beneath the Pennsylvanian rocks and their water-bearing properties (Woller, 1976) are as follows:

- Silurian dolomite, which may provide water to wells in moderate quantities from cracks and crevices, but is too mineralized for most uses.
- Maquoketa Group of Ordovician age composed of nonwater-bearing shales and acts as an aquitard between the Silurian dolomite and deeper water-bearing units.
- Cambrian-Ordovician Aquifer (a/k/a Midwest Bedrock Aquigroup), composed of the Ironton-Galesville aquifer at the base of this group up through the Glenwood-St. Peter Sandstones. These formations are the major bedrock aquifer and principal water producing zones in the region capable of yielding moderate quantities of groundwater (Visocky et. al, 1985).

In the region surrounding the site, these bedrock aquifers provide municipal water supply sources. The villages of Granville and Standard, about five miles southeast of the Site, both obtain their water supply from the Galena-Platteville Dolomite and Glenwood-St. Peter Sandstone, with wells ranging in depth from 1,740 to 1,793 feet. Pumping rates range from about 60 to 150 gpm.

As noted earlier, the Pennsylvanian-age Carbondale Formation defines the base of the unlithified deposits (and uppermost aquifer) underlying the East Ash Pond System and is regarded as the first confining unit beneath the uppermost aquifer. Water well logs at the power plant indicate shale bedrock at an elevation of roughly 350. In the vicinity of the Hennepin Power Station the Pennsylvanian rocks have an estimated thickness of approximately 300 to 400 feet. The Pennsylvanian rocks of this area contain little or no usable water and are seldom considered for even domestic water supply purposes due to generally low effective porosity and hydraulic conductivity (Gibb, 1979).

3.2 UNLITHIFIED DEPOSITS – REGIONAL

Regional groundwater flow in the unlithified deposits above the shale bedrock discharges into the Illinois River. Depth to the water table is typically greater than 20 feet below ground surface around the site. The water table elevation can vary significantly, depending on the river stage. During flood stages, exfiltration from the river may temporarily recharge groundwater close to the river and the water table beneath the East Ash Pond System and adjacent areas of the floodplain may rise to levels mimicking river elevations.

The Henry Formation deposits have high hydraulic conductivity compared to the underlying bedrock. Pump test and specific capacity data were obtained for five high capacity industrial and municipal wells screened in the unlithified deposits along the Illinois River within several miles of the Hennepin Power Station (ISWS, 1989). Hydraulic conductivity of the Henry Formation sand and gravel ranged from 5 x 10 2 cm/s to 3 x 10^{-1} cm/s, with a median of 1 x 10^{-1} cm/s. Pumping rates ranged from 125 to 1,570 gallons per minute and the tests were conducted over periods ranging from 30 minutes to 24 hours. Effective porosity typically ranges from 20 to 35 percent for poorly sorted sand and gravel alluvial deposits (Walton, 1988; Fetter, 1980).

Hydraulic conductivity of the alluvial deposits, generally consisting of lower permeability materials (i.e., silt, silty sand, and clay), will typically be several orders of magnitude lower than the more permeable outwash sand and gravel deposits of the Henry Formation. However, no published regional data is available specifically for the shallow alluvial deposits. Silt, clay, and mixtures of sand, silt, and clay typically have horizontal hydraulic conductivity ranging from 10^{-4} to 10^{-7} cm/s (USDI, 1981; Fetter, 1980).

3.3 UNLITHIFIED DEPOSITS – SITE SPECIFIC

3.3.1 Site Stratigraphy

The stratigraphy within and immediately surrounding the Site consists of fill, unlithified river alluvium, and Pleistocene-age glacial outwash deposits overlying Pennsylvanian-age shale bedrock. Surficial soils encountered at most boring locations at the site are coal ash fill and man-made berms constructed of a variety of locally available materials, primarily sand, gravel, and coal ash. Where undisturbed or partially excavated, the surficial soils at the Site (Figure 3) are poorly drained, moderately permeable Moundprairie Silty Clay Loam, Wet (#1480) formed in alluvium on floodplains.

Geologic cross-sections across of the study area (shown on Figures 7 and 8) include three southwest-northeast lines and two northwest-southeast lines. Ash Pond No. 2 is located over the original narrow lower terrace between the Illinois River and the uplands. The original lower terrace is approximately 10 to 20 feet above normal river level of 441 feet (see Figure 7 cross-section A-A', Figure 8 cross-section D-D'). The East Ash Pond, Polishing Pond and Ash Pond No. 4 were constructed on the upper terrace at an elevation of approximately 500 to 505 feet, or 60 to 65 feet above normal river level (see Figure 8 cross-sections D-D' and E-E').

There are two hydrogeologic units present at the site: alluvium and Henry Formation sands and gravels. The river is immediately adjacent to the lower terrace, east of the site, and there is minimal alluvium between the Site and the river. The highly permeable Henry Formation sands and gravels make up the upper and lower terraces, and fill the valley beneath the alluvium. The sand and gravels of the two terraces are indistinguishable, consisting of a heterogeneous mixture of silty-sandy gravel, with cobble zones and with boulders up to several feet in diameter. The Henry formation is more than 100 feet thick in the river valley and at least 130 feet thick on the upper terrace.

The Henry Formation and alluvium comprise the uppermost aquifer at the Site and extend from the water table to the bedrock. This uppermost aquifer extends about 7,000 feet upgradient from the site to the south where clay-rich glacial till is encountered. Glacial tills such as this typically yield little water.

The Pennsylvanian-age bedrock consists of interbedded layers of shale with thin limestone, sandstone, and coal beds. The shale bedrock unit has low hydraulic conductivity and defines the lower boundary of the uppermost aquifer.

3.3.2 Water Table Elevation and Groundwater Flow

Monitoring wells installed at the East Ash Pond System are shown on Figure 9. Well construction details are provided in Appendix A and summarized on Table 1.

3.3.2.1 Horizontal Groundwater Flow

Groundwater elevations have been measured quarterly since 2008. The Illinois River is the regional groundwater discharge area. Under normal conditions at the Site, groundwater flows from south to north discharging into the river as shown on Figure 10. Appendix B provides additional water table contour maps prepared for the Closure Work Plan Annual Reports during the years 2011 through 2016.

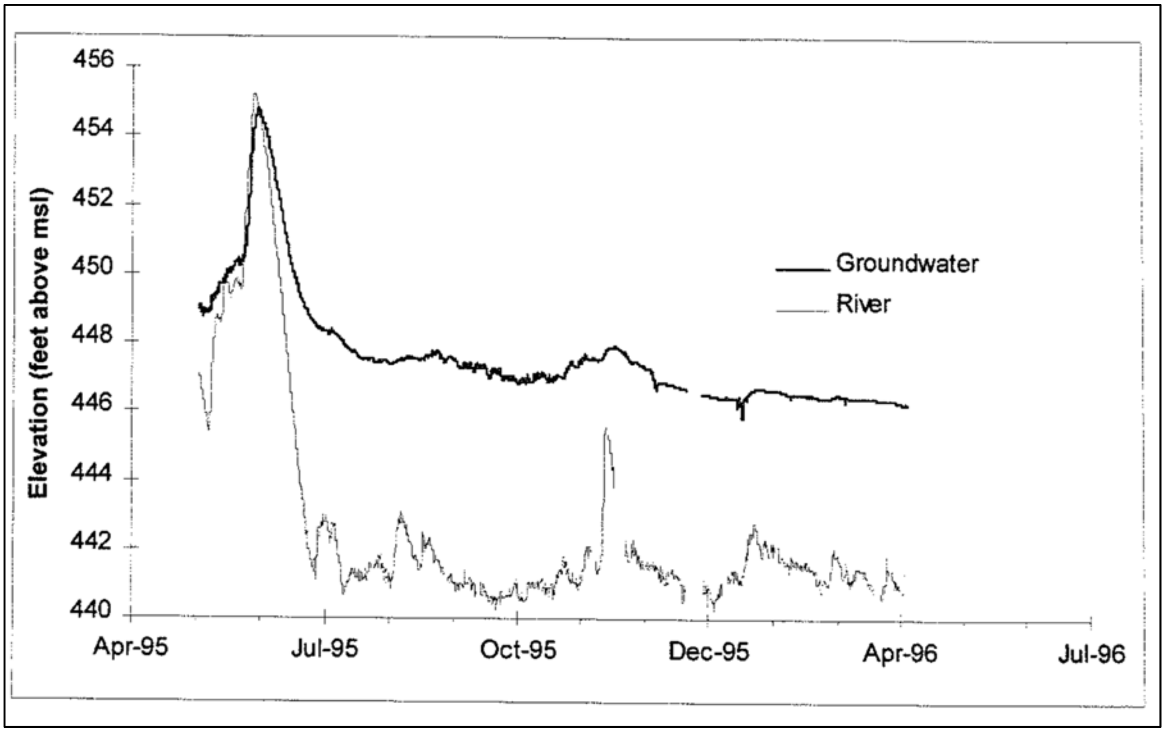
Horizontal hydraulic gradients are moderate (0.002 to 0.004) as groundwater approaches the site south of the East Ash Pond and Polishing Pond. The horizontal gradient becomes virtually flat beneath the East Ash Pond and Polishing Pond as well as the Site before steepening between the Site and the river. The flattening of the horizontal gradient is attributed to the highly permeable sand and gravel that runs continuously along the south perimeter of the East Ash Pond System, as illustrated in cross sections B-B', C-C' and D-D' (Figures 7 and 8).

Horizontal groundwater flow at the base of the uppermost aquifer also moves from south to north toward the Illinois River, based on hydraulic head measurements in monitoring wells 08D, 18D, and 19D. Horizontal gradients at depth are somewhat lower than at the water table, averaging 0.0003.

3.3.2.2 Impact of River Stage on Groundwater Flow

The river basin experiences annual spring flooding during the months of March, April, May, and sometimes June, while lesser flooding occasionally occurs during autumn. River stage during high precipitation and/or flood events seasonally rises above adjacent groundwater elevations and groundwater gradients will temporarily reverse in response to the river temporarily recharging the aquifer. Groundwater gradient reversals are observed on the quarterly groundwater elevation contour maps for December 29, 2008, March 16, 2010 and June 22-23, 2015. The contour map for June 2015 is attached as Figure 11. During these events, the groundwater flow direction reverses, moving south to southeasterly across the Site at moderate to steep horizontal gradients of about 0.01. Groundwater flow at depth also reverses but at a much lower horizontal gradient of 0.00006. The groundwater flow reversals are typically limited in duration and extent.

The figure below compares the groundwater hydrograph recorded at former well 14 with the river hydrograph recorded at the power plant (STMI, June, 1996). Well 14 was located adjacent to wells 12 and 13 between the CCR Landfill and East Ash Pond (Figure 9). This graph shows that groundwater elevations respond rapidly to major flood events where river elevations rise above adjacent groundwater levels. It also indicates that groundwater levels, at least as far as the south side of Ash Pond No. 2, can be expected to rise in response to river flooding to elevations consistent with those observed at the river.



Comparison of Illinois River and Monitoring Well 14 Hydrographs in 1995

3.3.2.3 Vertical Hydraulic Gradient

Vertical hydraulic gradients were calculated at nested well locations in September and December 2015 and are shown on Table 2. Vertical gradients in upgradient well nest 08/08D were consistently flat or moderately upward at about 0.01. Well nests adjacent to the river (18S/18D and 19S/19D) were inconsistent (0.01 downward to 0.007 upward) and showed no correlation with the Illinois River recharging the aquifer or receiving groundwater discharge. Based on these observations and the physical characteristics of the uppermost aquifer, vertical groundwater gradients do not appreciably affect the horizontal migration of dissolved constituents.

3.3.2.4 Impact of Existing Ponds

The existing ponds immediately south of the site do not appear to be altering groundwater flow direction. The East Ash Pond and Polishing Pond are lined as described in Section 1.3. The flat horizontal groundwater gradient beneath this area and the small and inconsistent upward/downward vertical gradients at well nest 12/13 suggests there is no mounding of the water table occurring due to leakage from the ponds.

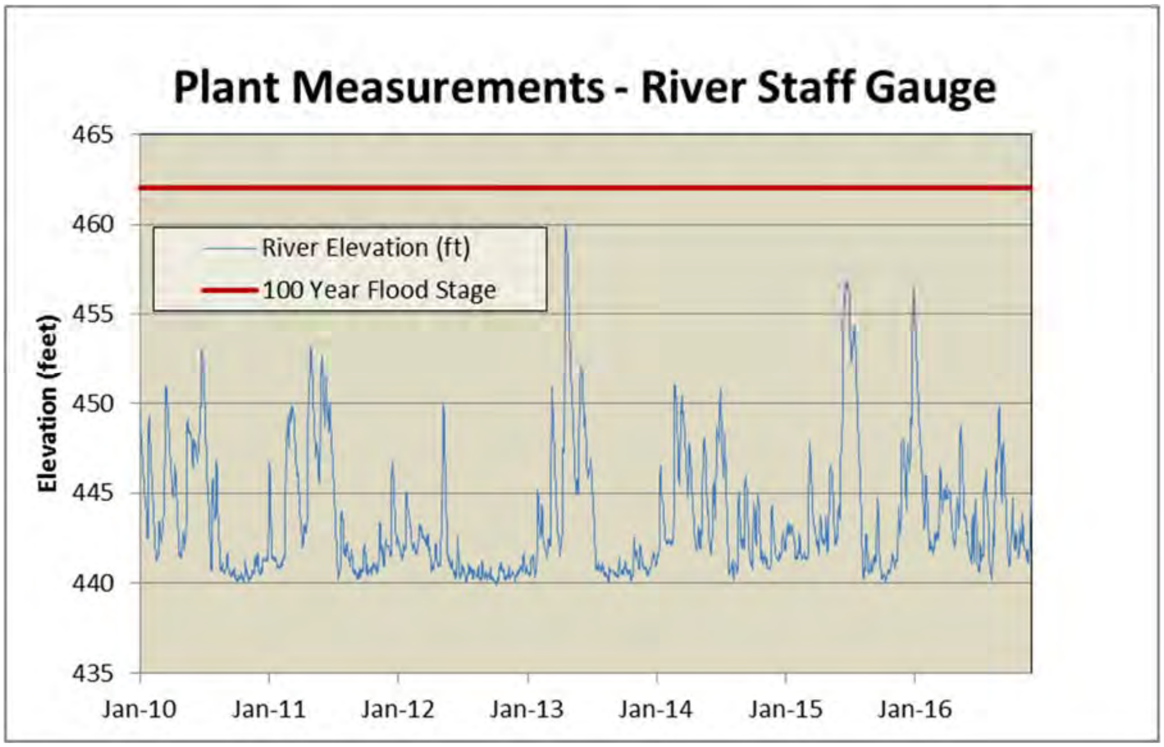
3.3.2.5 Groundwater Velocity

Groundwater flow velocity ranged from approximately 0.5 to 0.7 feet per day (ft/day) as groundwater flowed from south to north of the Hennepin East Ash Pond in September and December 2015 during periods of normal flow conditions (i.e. no flow reversals). As groundwater flowed from south to north of Hennepin Ash Pond No. 2, the flow velocity was slightly higher and ranged from approximately 0.9 to 1.5 ft/day in September and December 2015. Groundwater velocity was lowest, approximately 0.02 to 0.03 ft/day, as groundwater flowed from south to north of Hennepin Landfill in September and December 2015. September and December 2015 groundwater flow velocities are summarized in Table 3.

3.3.3 Ash Saturation

Soil boring logs performed within Ash Pond No. 2 indicate the base grade elevation of ash is as low as 451 feet (Appendix C). Groundwater elevations measured quarterly between the period of September 2007 and December 2015 showed typical groundwater elevations in wells surrounding Ash Pond No. 2 below 450 feet. However, as discussed in Section 3.3.2.2, groundwater elevations respond rapidly to river flood events that recharge the aquifer. Groundwater elevations measured at well 14 on the south berm of Ash Pond No. 2 appeared to closely mimic river elevations during major flooding events when river elevations rise above groundwater.

Daily river staff gauge elevations taken at the Hennepin Power Station crib house from January 2010 through December 2016 are shown on the time-series graph below. Based on the above, it appears a portion of the ash within Ash Pond No. 2 may occasionally become partially saturated for short periods during high precipitation and/or flood events when river elevations exceed an elevation of at least 451 feet.



3.3.4 Hydraulic Conductivity

3.3.4.1 Field Hydraulic Conductivity

The Henry Formation sands and gravels at the site are highly permeable with measured hydraulic conductivity ranging from 3 x 100 cm/s to 1 x 10^{-4} cm/s and a geometric mean of 5.6 x 10^{-2} cm/s (Table 4). At several monitoring well locations, water levels recovered as fast as the slug was removed and no drawdown recovery measurements could be made by the transducer. These values are consistent with pump test data from area high capacity wells screened in the unlithified deposits which ranged from 5 x 10^{-2} to 3 x 10^{-1} cm/s. The hydraulic conductivity test analysis and results are provided in Appendix D1.

Pump test data from the fire well installed at the power plant in 1968 was also available to estimate the permeability of the Henry Formation. This fire well is located at the southwest corner of the plant and was drilled to a depth of 112 feet, terminating on shale. The lower 30 feet of the well is screened within unlithified deposits. The well log is contained in 'Water Well Survey' (Kelron/NRT; June 3, 2009). The pump test hydraulic conductivity result reported by Mathes (1983) was 1.3 x 10^{-1} cm/s.

No vertical hydraulic conductivity pattern was discerned from the slug test data. Horizontal hydraulic conductivity appears consistently higher, on the order of 10^{-0} to 10^{-1} in an east-west trending line under the East Ash Pond and Polishing Pond. These high hydraulic conductivities coincide with a very flat hydraulic gradient.

A moderately steep horizontal gradient between wells 07 and 08 suggests that the hydraulic conductivity upgradient of the site in the upper terrace may be locally somewhat lower, based on the occurrence of finer-grained materials noted in the boring log for well 07.

3.3.4.2 Laboratory Hydraulic Conductivity

Test results for one sample collected by AECOM on the north berm of Ash Pond No. 2 for laboratory hydraulic conductivity (ASTM D 5084) were as follows:

Sample Location	Sample Depth (ft bgs)	Description	Hydraulic Conductivity (cm/sec)
HEN-B023	27.0'-29.0'	Very dark gray fly ash with sand and gravel	1.0 x 10^{-5}

Laboratory hydraulic conductivity test results are provided in Appendix D2. Other geotechnical test results on soil samples are provided in Appendix E.

3.3.5 Groundwater Classification

Per Illinois Administrative Code (IAC) Title 35, Section 620.210, groundwater within the Uppermost Aquifer at the East Ash Pond System meets the definition of a Class I, Potable Resource Groundwater based on the following criteria:

- Groundwater in the uppermost aquifer extends 10 feet or more below the land surface
- Hydraulic conductivity exceeds the 1 x 10^{-4} cm/s criterion (Table 4)

3.4 SURFACE WATER HYDROLOGY

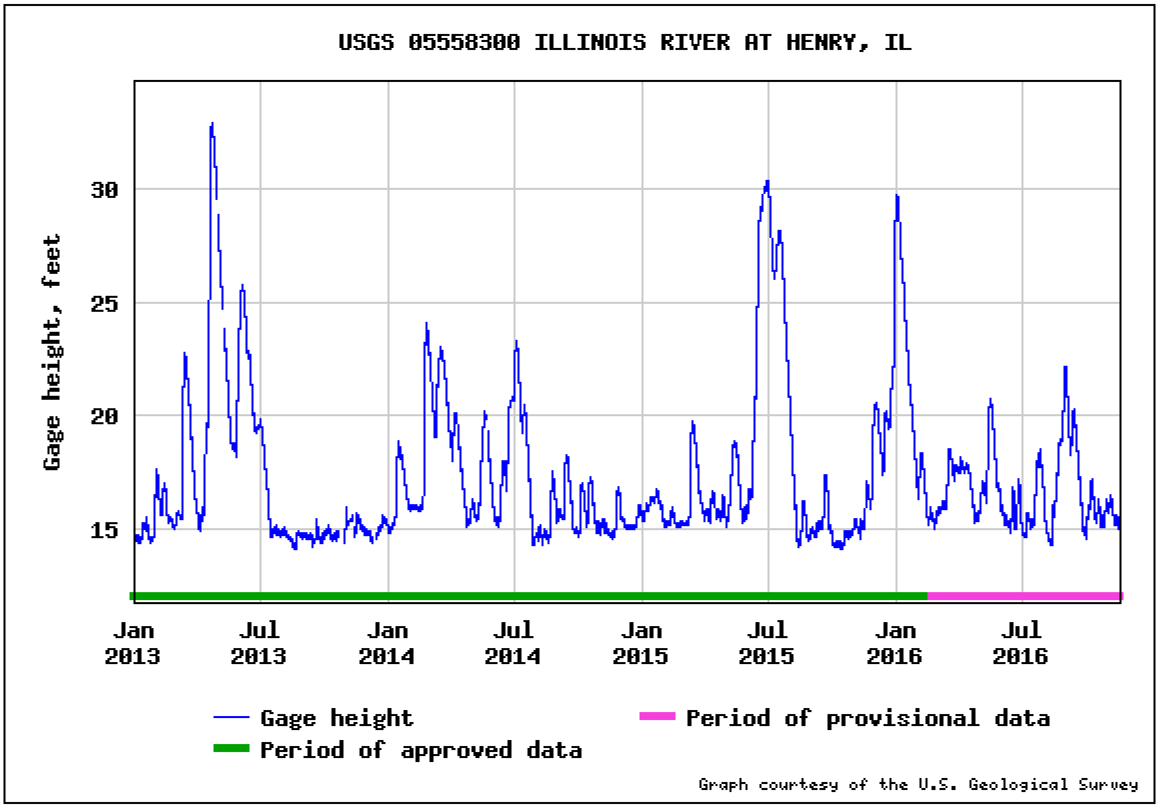
3.4.1 Climate

The climate in Hennepin is humid and annual precipitation generally exceeds evapotranspiration. Illinois State Water Survey records from 1962 through 2006 at the Hennepin Power Station indicate precipitation averages 34.45 inches per year. Monthly precipitation averages higher than 3 inches from April through September, and 1 to 3 inches in October through March. On average 16 inches of precipitation occur as snowfall.

State Water Survey temperature records show average daily temperatures for 1971 to 2000 ranging from above 70 degrees Fahrenheit in June, July, and August to below freezing in December, January, and February.

3.4.2 Surface Waters

The predominant surface water body in the region is the Illinois River and associated lowland backwater lakes. The Illinois River is located directly adjacent to and down-gradient from the East Ash Pond System. A United States Geological Survey (USGS) stream gage (#05558300) for the Illinois River at Henry, Illinois is located 15 river miles south (downstream) of the Hennepin Power Station. The gage datum elevation is 425.88 feet (NGVD 29). Daily gage heights for the periods of January 1, 2013 to November 18, 2016 are shown in the following graph (USGS, 2016). The gage height of 15 feet, representing approximate base flow, occurs at elevation of about 441.



Bordering the north perimeter of the East Ash Pond System, the river has a normal pool elevation of about 441 feet. River elevations measured at the USGS Henry, Illinois stream gage (#05558300) appear to be within about 1 foot of the elevations taken at the Hennepin Power Station crib house.

Other surface waters in the vicinity include various ponds on property to the east created by sand and gravel extraction as well as the East Ash Pond and Polishing Pond associated with the Hennepin Power Station.

A FEMA Flood Insurance Rate Map for Putnam County (Map No. 17155C0015E; Effective Date: February 4, 2011) is attached in Appendix F and can also be viewed online at: **http://www.illinoisfloodmaps.org/DFIRMpdf/putnam/putnam_fin_0025.jpg**

None of the impoundment berms within the East Ash Pond System occur below the base flood elevation value of 462 feet identified on the 2011 FEMA map. The berms of Ash Pond No. 2 were raised in 1989 to an elevation of 494 feet. The flood hazard areas shown on the map are defined as those areas subject to inundation by the 1% annual chance flood (i.e., 100-year flood), also known as the base flood, that has a 1% chance of being equaled or exceeded in any given year.

3.5 WATER WELL SURVEY

A comprehensive water well survey was conducted by NRT and Kelron (2009a) for a 2,500-foot radius around the entire Hennepin Power Station property boundary, inclusive of the East Ash Pond System (Appendix G). Based on State of Illinois records obtained from the Illinois EPA, Illinois State Geological Survey (ISGS), and Illinois State Water Survey (ISWS) there are nine wells located outside of the Hennepin Power Station property boundary within 2,500 feet of the East Ash Pond System. These included six industrial-commercial wells, two farm/domestic wells, and one Non-Community Water Supply (non-CWS) on property identified as Exolon (now known as Washington Mills). The Exolon non-CWS well has a 1,000 foot well head protection area (WHPA). The Exolon non-CWS WHPA is located south of and does not intersect the Hennepin Power Station property boundary. Each of the nine identified offsite water walls are upgradient of the Hennepin Power Station property or not in the prevailing direction of groundwater flow.

Within the plant property boundary, there are four wells owned by DMG, all of which are non-potable and non-contact industrial wells. One well is used exclusively for irrigation of the coal pile.

Kelron/Natural Resource Technology (2009b) performed an assessment of the potential for impact to water supply wells identified in the water well survey within 2,500 of the Hennepin Power Station property boundary. The assessment concluded there are no existing off-site water wells, potable or non-potable, that are likely to be impacted by groundwater from the HPS property.

4 GROUNDWATER QUALITY

4.1 SUMMARY OF GROUNDWATER MONITORING ACTIVITIES

Groundwater sampling at the East Ash Pond System was initiated in 1994 around Ash Pond No. 2. The monitoring network was expanded with the subsequent construction of the additional ponds. All existing well locations are shown on Figure 9. A summary of the monitoring activities performed at each well is shown below:

Well No.	Sampling Start Date	Sampling End Date	Current Sampling Frequency	CCR Unit Currently Monitored
2	Mar-95	NA	Quarterly	None
3R	Mar-15	NA	Quarterly	Ash Pond No 2
4R	Mar-15	NA	Quarterly	None
5R	Mar-15	NA	Quarterly	Landfill
5DR	Mar-15	NA	Quarterly	Landfill
6	Dec-94	NA	Quarterly	Ash Pond No 2
7	Dec-94	NA	Quarterly	Upgradient/Background Monitoring Well
8	Mar-95	NA	Quarterly	Upgradient/Background Monitoring Well
8D	Jun-09	NA	Quarterly	Upgradient/Background Monitoring Well
10	May-95	NA	Quarterly	None
11	May-95	Jun-06	Not Sampled	None
12	May-95	NA	Quarterly	East Ash Pond
13	May-95	NA	Quarterly	East Ash Pond
15	May-95	NA	Quarterly	None
16	May-95	NA	Quarterly	None
17	May-95	NA	Quarterly	None
18S	Jun-09	NA	Quarterly	Ash Pond No 2
18D	Jun-09	NA	Quarterly	Ash Pond No 2
19S	Jun-09	NA	Quarterly	None
19D	Jun-09	NA	Quarterly	None
40S	Mar-11	NA	Quarterly	Landfill
45S	Dec-15	NA	Quarterly	Ash Pond No 2
46	Dec-15	NA	Quarterly	East Ash Pond
47	Dec-15	NA	Quarterly	East Ash Pond
48	Dec-15	NA	Quarterly	Landfill

Wells 3, 4, 5 and 5D were abandoned and replaced in August 2014.

4.1.1 Illinois EPA Program Monitoring

Between 1994 and 2001, Ash Pond No 2 downgradient wells 03 and 06 were monitored for alkalinity, total dissolved solids (TDS), calcium, magnesium, sodium, potassium, chloride, sulfate, boron, iron, manganese, and field parameters (including pH). Based on the absence of exceedances of groundwater quality standards, subsequent sampling events through October 2008 monitored only boron and field parameters.

An expanded background groundwater quality monitoring program was initiated in 2008 in conjunction with the development of the CCR Landfill Phase I (Mathes, 1983), Phase II (STMI, 1996) and Phase III (NRT/Kelron, 2010). Monitoring wells were sampled over a period of six consecutive quarters between December 2008 through March 2010 for analytical parameters per 35 IAC Part 811. The monitoring well network consisted of 14 water table monitoring wells (02 through 08, 10, 12, 15, 16, 17, 18S and 19S), two intermediate depth piezometers (11 and 13), and three deep piezometers (08D, 18D and 19D) installed just above the bedrock.

Samples were analyzed for general chemistry parameters (total and/or dissolved), metals (total and dissolved), and organic parameters. Based on the results of the first two quarterly rounds of groundwater sampling and analysis, and after evaluating leach-testing data from the CCR to be placed in the landfill, the organic constituents are not expected in coal ash leachate and are monitored biennially at upgradient wells 08, 08D, 10, 12, 13 and wells 05, 05D, 40S, which are downgradient of the CCR Landfill Phase 1 cell.

The CCR Landfill became active in February 2011 with the placement of bottom ash into the Phase I cell in order to protect the geomembrane liner (see Section 1.3). Quarterly detection groundwater monitoring was initiated during the 1st Quarter of 2011 pursuant to DMG's Initial Facility Report (NRT/Kelron, 2010) prepared for the CCR Landfill, which calls for an annual report providing the following: an assessment of groundwater quality data for background wells 08, 08D, 10, 12, 13 and downgradient wells 05, 05D, and 40S; and, a waste management summary. In addition, the annual reports prepared from 2011 through 2016 have included groundwater monitoring results for entire East Ash Pond System, including Ash Pond No. 2. The East Ash Pond groundwater quality assessment utilizes the following 18 monitoring wells: upgradient wells 02, 07, 08, 08D, 16, 17; mid-gradient wells 10, 12, 13, and 15; and downgradient wells 03, 04R, 05R, 06, 18S, 18D, 19S, and 19D.

Of the 25 monitoring wells located at the East Ash Pond System in 2016, 20 are actively monitoring all of the CCR ponds, non-CCR ponds, and former ponds under Illinois EPA permit or IFR requirements (Landfill, Ash Pond No. 2 and East Ash Pond as well as the non-CCR units [Polishing Pond, Leachate Pond and former Ash Pond No. 4]). As a result of slope re-grading activities along the north side of Ash Pond No. 2, wells 03, 04, and 05 were sealed and properly abandoned on August 27, 2014 and replaced following completion of construction activities. During construction, which continued from September through December 2014, three additional monitoring wells (05D, 18S, and 18D) were inadvertently damaged. All sealed or damaged monitoring wells were replaced or repaired in January 2015 and were sampled in the 1st Quarter of 2015.

4.1.2 CCR Rule Program Monitoring

In August 2015, NRT began an assessment of the existing monitoring well network(s) at the East Ash Pond System with respect to the existing CCR units. Included in the assessment was a review of the current placement and number of monitoring wells with respect to individual and contiguous CCR units as well as potential locations for new monitoring wells, as appropriate.

Based on this review, NRT completed monitoring well installations at four additional locations as part of the CCR monitoring network. Well 45S was installed to supplement the monitoring network at Ash Pond No. 2. Well 45S is intended to replace existing well 06, which was drilled in 1982 and is located approximately 300 feet beyond the Ash Pond No. 2 berm (Figure 9). However, well 06 is continuing to be monitored under an existing Illinois EPA permit. Wells 46 and 47 were installed at the East Ash Pond. Well 48 was installed as part of the CCR monitoring network at the Landfill. The boring logs, well construction forms and other related monitoring well forms are provided in Appendix A3.

The 40 CFR Part 257 monitoring well network locations for the CCR units are shown on Figure 9. The well network consists of three upgradient/background wells (07, 08, 08D) and twelve monitoring wells installed in the uppermost aquifer adjacent to the Landfill (40S, 05R, 05DR and 48), Ash Pond No. 2 (03R, 18S, 18D and 45S), and the East Ash Pond (12, 13, 46 and 47). Sampling of these wells commenced December 2015.

All 25 existing wells at the East Ash Pond System are monitored for groundwater elevations, which are used to produce groundwater flow maps.

4.2 GROUNDWATER MONITORING RESULTS AND ANALYSIS

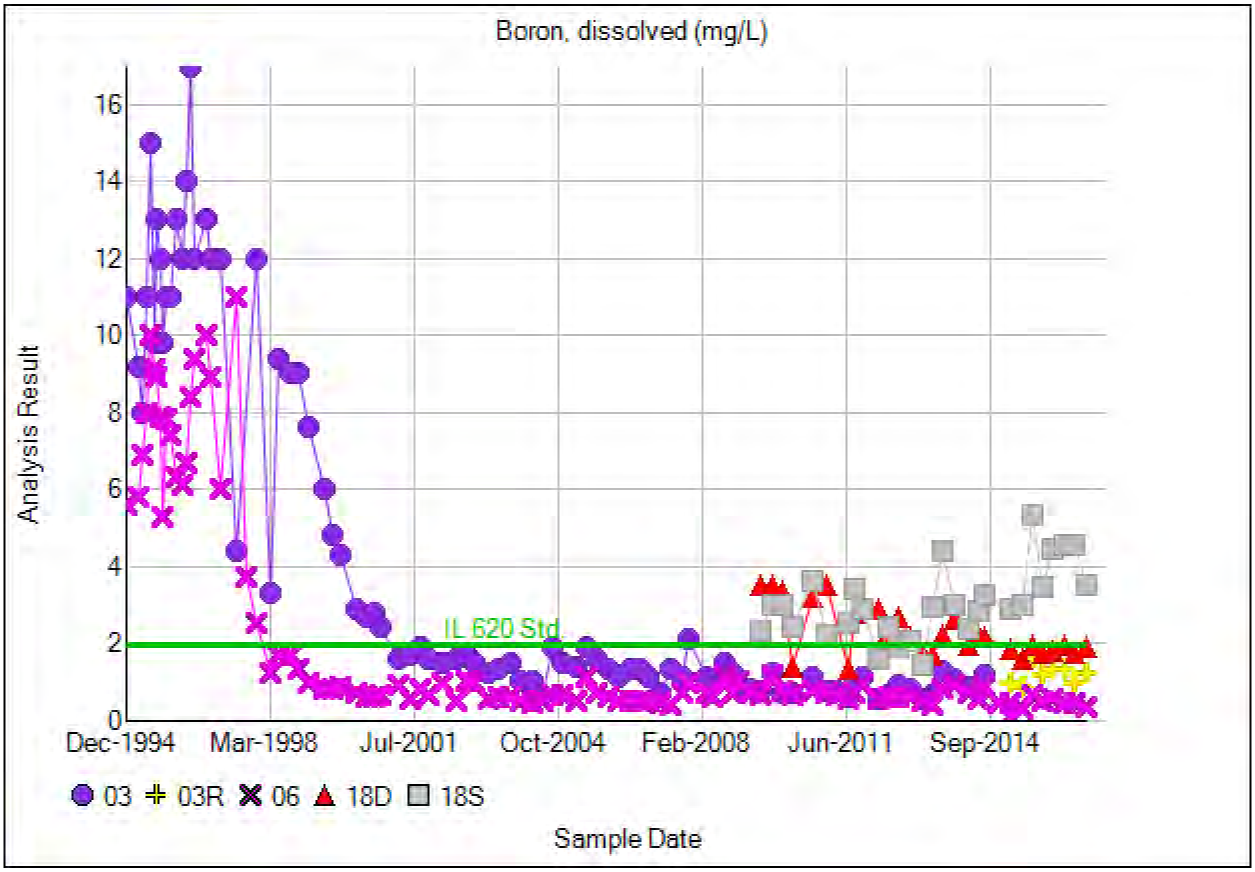
4.2.1 Illinois EPA Program Monitoring Results

The following discusses groundwater quality data collected specific to Ash Pond No. 2 under the Illinois EPA monitoring between 2008 through 2016. Summary tables of the inorganic groundwater quality data are provided in Appendix H1. The groundwater quality standards that apply to Class I Potable Resource

Groundwater are listed in 35 IAC 620.410 or background concentrations based on statistical analyses, as described in the Groundwater Monitoring Plan (NRT, 2017).

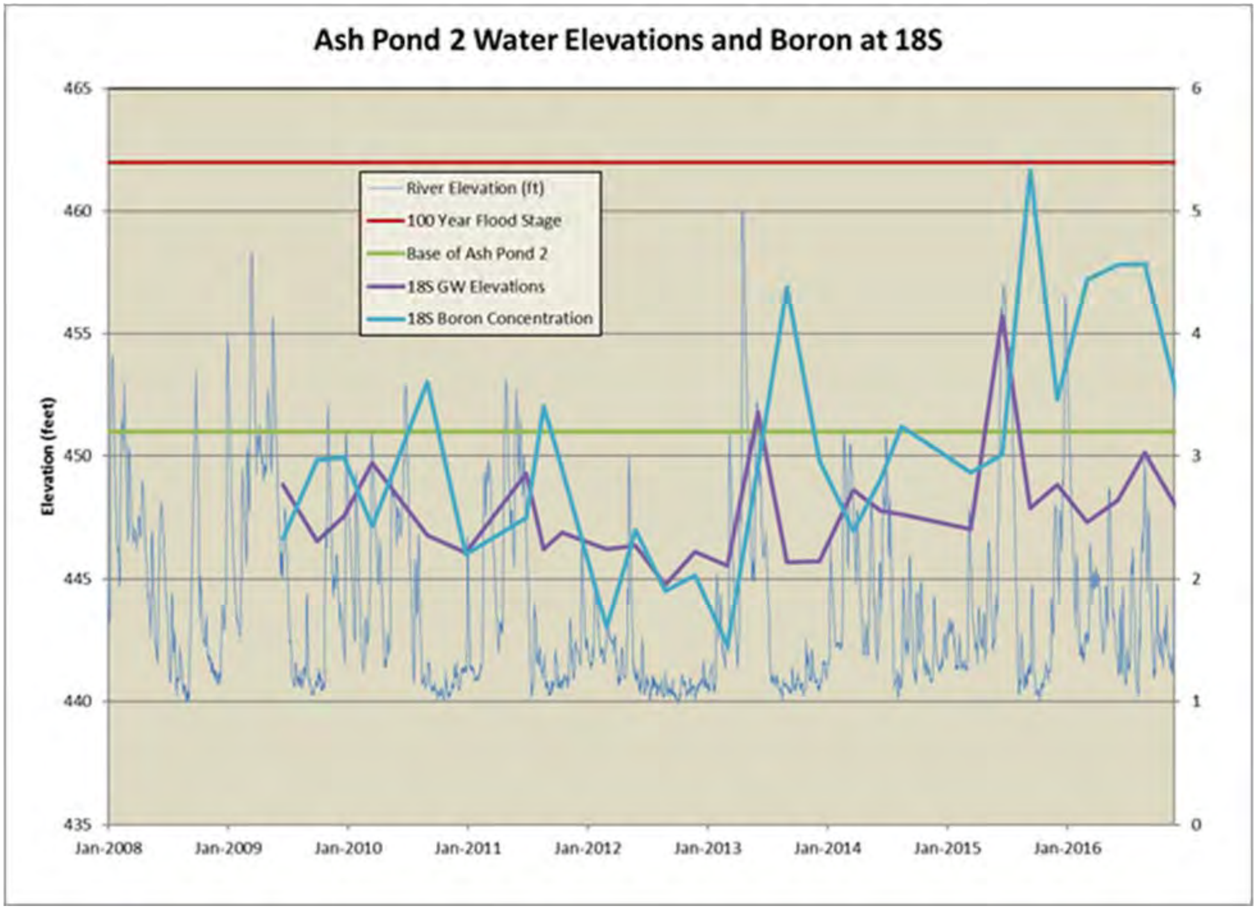
4.2.1.1 General Inorganic Constituents

Boron is a primary indicator parameter for CCR leachate impacts on groundwater quality. Boron concentrations in downgradient monitoring wells are shown in the graph below.



Boron concentrations have significantly decreased in wells 03 and 06 since Ash Pond No. 2 was removed from service and unwatered in 1996. Concentrations in 18D have also decreased and remain below the Illinois Class I groundwater standard (2.0 mg/L) since March 2015.

As discussed in Section 3.3.3, a portion of the ash within Ash Pond No. 2 may occasionally become partially saturated for short periods during high precipitation and/or flood events when river elevations exceed an elevation of at least 451 feet. These high precipitation/flood events and the partial saturation of the ash coincide with increases in boron concentrations at well 18S, as shown in the graph below.



Boron concentrations appear to typically fall in the range of 1.5 mg/L to 3 mg/L during normal river elevations. Boron concentrations rise above 3 mg/L following events when the river elevation rises above 451 feet (green line). Further, it also appears that the concentration rise is related to the magnitude and duration of the precipitation/flood event above the 451-foot river elevation. The elevation of boron concentrations is also likely attributed to the increased precipitation percolating through Ash Pond No. 2 that occurs with these events.

The increase in boron concentrations in downgradient groundwater at 18S can occur a month or two after the high river stage event due to several processes:

- During high precipitation/flood events, the river recharges the aquifer and the direction of groundwater flow will temporarily reverse. The increase in boron concentrations will not be observed in 18S until normal baseflow conditions toward the river resume.
- The ash has a lower hydraulic conductivity, so even though sampling may occur a month or two after the high river stage event, the leachate drains out of the saturated ash at a slower rate than the groundwater elevation subsides within the highly permeable sand and gravel aquifer.

The above trends observed at well 18S appear to be associated with this particular area downgradient from Ash Pond No. 2. The deeper monitoring well 18D at this location does not have similarly high boron concentrations and all other downgradient wells are currently below the Class I standard for boron.

Summary statistics for samples collected between March 2008 and December 2015 for other inorganic parameters are shown on the table below:

	Nitrate nitrogen, total	Cyanide, total	Chloride, dissolved	Sulfate, dissolved	Fluoride, dissolved	Iron, total	Iron, dissolved	Manganese, total	Manganese, dissolved	pH	Total Dissolved Solids
Class I Standard	10	2	200	400	4	5	5	0.15	0.15	6.5-9	1,200
Downgradient Wells (03, 06, 18S, 18D)											
No. of Exceedances	22	0	0	0	0	2	0	4	17	1	0
Minimum	0.27	0.005	11	40	0.077	0.034	0.02	0.005	0.005	6.4	252
Maximum	18	0.17	130	238	0.39	8.90	0.09	0.83	0.66	8.0	930
Samples Analyzed	118	122	110	110	117	20	118	20	118	128	118
Upgradient Wells (07, 08, 08D)											
No. of Exceedances	24	0	30	0	0	1	0	2	1	5	6
Minimum	2.60	0.005	18	49	0.07	0.02	0.02	0.005	0.003	6.3	504
Maximum	17	0.1	351	218	0.16	5.48	0.071	0.40	0.21	7.8	1,420
Samples Analyzed	93	96	85	85	93	28	91	16	91	102	93

There were no exceedances of groundwater quality standards for cyanide, sulfate or fluoride in upgradient or downgradient wells. Exceedances of groundwater standards for nitrate were distributed across the site and occurred sporadically in all monitoring wells, indicating that the concentrations reflect background variability from upgradient sources.

Chloride periodically exceeded groundwater quality standards only in upgradient wells 08 and 08D. Chloride was significantly lower in upgradient well 07, typically less than 40 mg/L, compared to wells 8 and 8D. Chloride is a major component of Total Dissolved Solids (TDS), which exhibited similar trends but fewer Class I exceedances. Elevated concentrations of chloride and TDS, above their respective Class I standards, are attributed to road salting off-site to the south of wells 08 and 08D.

Iron exceedances occurred in three unfiltered (total) samples. These detections were anomalously high values compared to all other analytical results and may have been related to sample turbidity. Exceedances of groundwater standards for manganese were associated with downgradient well 18D, suggesting differences in groundwater chemistry occur at depth rather than from Ash Pond No. 2 leachate. Detailed discussions of the manganese geochemistry in wells at the Hennepin Power Station are provided in the EPRI manganese research report submitted to the Illinois EPA on November 6, 2002 (EPRI, 2002).

There have been several seemingly random exceedances of the lower groundwater standard for pH (6.5 units) that appear in multiple wells. There have been no exceedances in the upper or lower pH standards at any monitoring wells since 2010.

4.2.1.2 Trace Metals

The following metals were not detected in upgradient or downgradient wells:

Antimony (total and dissolved)	Lead (dissolved)	Silver (total and dissolved)
Beryllium (total and dissolved)	Mercury (total and dissolved)	Thallium (total and dissolved)

The following metals were detected sporadically in less than 5 percent of the samples collected in the upgradient and downgradient wells:

Arsenic (total and dissolved)	Lead (total)
Chromium (total and dissolved)	Vanadium (total and dissolved)

There were no exceedances of the groundwater standards for arsenic, chromium and vanadium. Lead exceeded the Class I groundwater standard (0.0075 mg/L) on one sampling event at a concentration of 0.008 mg/L.

The following metals were frequently detected in the upgradient and downgradient wells but there were no exceedances of their respective groundwater quality standards:

Barium (total and dissolved)	Copper (total and dissolved)	Zinc (total and dissolved)
Cobalt (total and dissolved)	Selenium (total)	

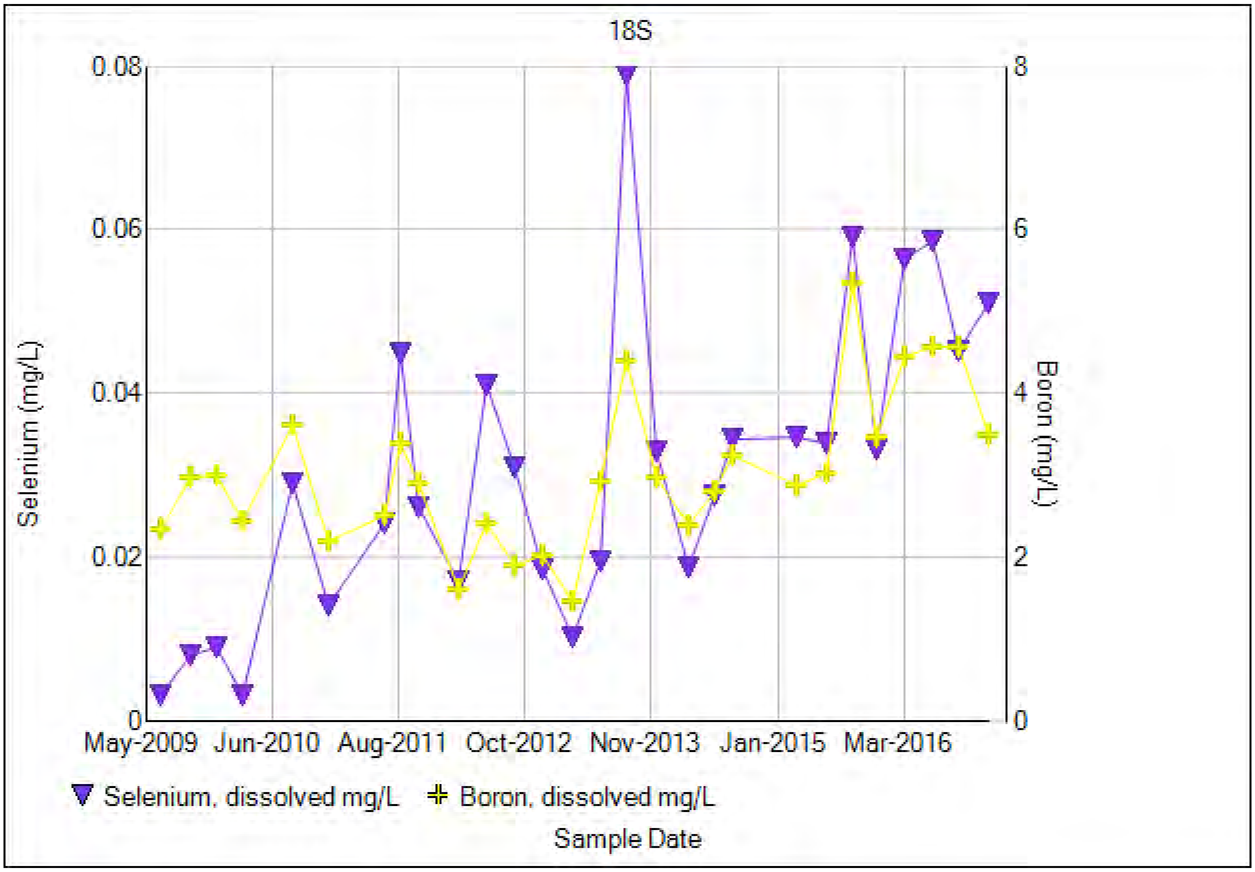
Other metals that were observed at concentrations exceeding Class I groundwater quality standards on one or more occasions included the following:

Cadmium (total and dissolved)	Nickel (total and dissolved)	Selenium (dissolved)

Total and dissolved cadmium has been frequently detected in the shallow downgradient wells 03, 06 and 18S above the groundwater standard (0.005 mg/L). No exceedances have been observed, however, since the March 2015 sampling event. Cadmium is consistently below detection limits in the upgradient wells. Leaching from Ash Pond No. 2 does not appear to be a significant source of cadmium to groundwater.

Total and dissolved nickel is consistently detected in all downgradient monitoring wells but only exceeded the Class I groundwater standard (0.10 mg/L) at well 06 in one sampling event. Dissolved nickel has been frequently detected in upgradient wells 08 and 08D since 2013, exceeding the standard at concentrations up to 0.23 mg/L. The observed distribution of nickel concentrations appears to reflect background variability in groundwater from an upgradient source.

Exceedances of the groundwater standards for dissolved selenium (0.05 mg/L) have been limited to well 18S in five sampling events since September 2013. As shown in the graph below, dissolved selenium appears to mimic the recent increases in boron concentrations and may be related to ash saturation during high precipitation/flood events.



4.2.1.3 Organic Parameters

Organic parameters were analyzed at wells 02 through 08 and 16, 17 in December 2008 and March 2009 during the IFR for the new CCR Landfill. The parameters included volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), organochlorine pesticides, chlorinated herbicides, general solvents (1-propanol, isopropyl alcohol, ethanol), endothall, EDB, DBCP and PCBs.

Two organic constituents were detected at concentrations above the method detection limit:

- Pentachlorophenol (PCP), a pesticide commonly used for wood treating, was observed in well 07 at 0.00025 mg/L in March 2009. The Class I groundwater standard is 0.001 mg/L.
- Picloram, a herbicide typically used for control of woody plants, was observed at well 08 at a concentration of 0.0011 mg/L in March 2009. The Class I groundwater standard is 0.5 mg/L.

Wells 07 and 08 are upgradient wells at the site and the closest wells to other industrial facilities in the area.

VOCs are analyzed biannually at upgradient wells 08, 08D, 10, 12, 13 and wells 05, 05D, 40S which are downgradient of the CCR Landfill. Phenols are monitored quarterly. These results were submitted with the May 2012 and June 2014 annual reports per the IFR and in accordance with Illinois EPA Part 815 rules. Constituents detected at concentrations above the method detection limit included the following:

- Acetone is occasionally detected in both background wells 08 and 10, and downgradient wells 05 and 40S, at concentrations less than 0.010 mg/L. Acetone is a common laboratory contaminant and has also been detected in a field blank. The Class I groundwater standard for acetone is 6.3 mg/L.

- Phenol has been occasionally detected in background wells 08, 8D, 12, and 13, and downgradient wells 05 and 05D, below the Class I groundwater standard (0.1 mg/L). Observed concentrations are typically less than 0.01 mg/L.

Organic constituents are not expected in coal ash leachate and all of the above detections are not related to CCRs.

4.2.2 CCR Rule Groundwater Monitoring Results

The following discusses groundwater quality data collected specific to Ash Pond No. 2 under the CCR Rule monitoring program based on four quarters of sampling from December 2015 through September 2016 for the USEPA 40 CFR 257 Appendix III and IV parameters. Summary tables of the groundwater quality results are provided in Appendix H2 for upgradient wells 07, 08, and 08D, and downgradient wells 03R, 18S, 18D, and 45S. All samples were analyzed as totals. The groundwater quality standards that apply for each monitored parameter are the greater of either the Class I Potable Resource Groundwater Standards as listed in 35 IAC 620.410 or background concentrations based on statistical analyses, as described in the Groundwater Monitoring Plan (NRT, 2017).

4.2.2.1 Appendix III Parameters

Sampling events for CCR monitoring coincided with monitoring performed under the Illinois EPA program. The findings reported above for the Illinois EPA monitoring are consistent with the CCR monitoring program results for boron, chloride, fluoride, sulfate, TDS and pH. The groundwater monitoring results at the additional CCR well 45S were consistent with other shallow Ash Pond No. 2 downgradient wells and there were no exceedances of Class I groundwater standards.

Calcium concentrations ranged from 82 to 299 mg/L and values were generally higher in upgradient wells. There is no Class I groundwater standard for calcium

4.2.2.2 Appendix IV Parameters

The analysis of Appendix IV parameters was also generally consistent with the Illinois EPA monitoring results with respect to constituents not detected (beryllium, mercury) as well as constituents detected below Class I groundwater quality standards. The Appendix IV parameters detected that did not exceed groundwater standards included the following:

Parameter	Groundwater Standard (mg/L)	Highest Concentration Detected (mg/L)
Antimony	0.006	0.0006
Arsenic	0.010	0.0007
Barium	2.0	0.16
Cadmium	0.005	0.0023
Chromium	0.10	0.0029
Cobalt	--	0.011
Fluoride	4.0	0.34
Lead	0.015	0.0007
Lithium	--	0.081
Molybdenum	--	0.35
Thallium	0.002	0.0004
Radium 226/228	5	2.45

Cadmium, which has historically exceeded the groundwater standard prior to March 2015 under Illinois EPA monitoring, was observed below the standard in all CCR monitoring events at all well locations from December 2015 through September 2016. Selenium was the only constituent exceeding its groundwater standard (0.05 mg/L). The exceedances occurred at well 18S during the March and June 2016 sampling events at concentrations of 0.0596 mg/L and 0.0506 mg/L, respectively.

5 POTENTIAL IMPACTS TO THE ILLINOIS RIVER

As discussed previously in this report, groundwater flows north during baseflow conditions and groundwater from below the Hennepin East Ash Pond No. 2 discharges to the Illinois River (Figure 2). During baseflow, the groundwater discharging to the Illinois River has the potential to impact the river, increasing concentrations of CCR indicators, boron and sulfate. Calculations for the potential impact from groundwater discharge to the Illinois River are provided in the tables below for boron and sulfate, respectively. The 7-day, 10-year low flow event (i.e. 7Q10) was used to estimate flow volume in the river and a mixing zone of 50 feet was used to determine dilution of the groundwater concentrations.

Conservative assumptions were used to calculate the resulting change in concentration to the Illinois River. Based on the calculations, groundwater discharge to the Illinois River could potentially increase concentrations of boron by 0.0066 mg/L and sulfate by 0.29 mg/L. Both concentrations are below their respective detection limits reported by the laboratory, indicating that changes in concentration would not likely be detected and impacts would be negligible.

Mixing Calculation Showing Effect of Boron Loading on Illinois River Quality at Low Flow

Baseflow		3515	cfs	Source: NPDES Permit IL0001554
	=	8.6E+09	L/day	
Boron loading rate				
Maximum Boron Concentration in Groundwater (CAvg)		9.25	mg/L	Maximum Concentration Well 18S - 4/2017
Hydraulic Conductivity (between Ash Complex and River)		0.0161	cm/s	Geometric mean of sand and gravel downgradient (Table 4)
Hydraulic Gradient		0.0040		Maximum included in report (Subsection 3.3.2.1)
Aquifer Thickness		50	ft	Estimated maximum depth of impacts in sand and gravel
Length of Ponds (max length, west to east)		2,100	ft	
Q = KIA				
K = Max Hydraulic Conductivity		5.3E-04	ft/s	
I = Hydraulic Gradient		0.00400		
A = Cross-Sectional Area		105,000	ft^2	
Q (per second)		0.22226	cfs	
Q (per day)		543,788.07	L/day	
Loading Rate (L)		5.0E+06	mg/day	= Cmax * Q
	L =	11.07	lb/day	
Boron concentration increase in Illinois River at low flow due to loading from East Ash Pond No. 2				
	d_B =	5.8E-04	mg/L	= $L/Q_{7,10}$
Boron concentration increase near-shore in Illinois River at low flow due to loading from the East Ash Pond No. 2				
Assumes loading distributed within 75 feet of shoreline		0.0066	mg/L	River is approximately 850 ft wide
Typical boron laboratory detection limit		0.01	mg/L	Source: Teklab Report 3/2016

Conclusion:

The calculated boron concentration increase in the Illinois River at ***low flow*** due to groundwater loading from the East Ash Pond No. 2 is less than the typical boron detection limit, indicating that increases due to impacted discharge would not be detectable. These calculations indicate that the effects of boron loading in groundwater discharge to the Illinois River are negligible.

Mixing Calculation Showing Effect of Sulfate Loading on Illinois River Quality at Low Flow

Baseflow		3515	cfs	Source: NPDES Permit IL0001554
	=	8.6E+09	L/day	
Sulfate loading rate				
Maximum Sulfate Concentration in Groundwater (CAvg)		400	mg/L	Maximum Concentration Well 18S - 4/2017
Hydraulic Conductivity (between Ash Complex and River)		0.0161	cm/s	Geometric mean of sand and gravel (Table 3)
Hydraulic Gradient		0.0040		Maximum included in report (Subsection 3.3.2.1)
Aquifer Thickness		50	ft	Estimated maximum depth of impacts in sand and gravel
Length of Ponds (max length, west to east)		2,100	ft	
Q = KIA				
K = Max Hydraulic Conductivity		5.3E-04	ft/s	
I = Hydraulic Gradient		0.00400		
A = Cross-Sectional Area		105,000	ft^2	
Q (per second)		0.22185	cfs	
Q (per day)		542,776.69	L/day	
Loading Rate (L)		2.2E+08	mg/day	= Cmax * Q
	L =	477.64	lb/day	
Sulfate concentration increase in Illinois River at low flow due to loading from West Ash Pond System				
	d_B =	2.5E-02	mg/L	= $L/Q_{7,10}$
Sulfate concentration increase near-shore in Illinois River at low flow due to loading from the West Ash Pond System				
Assumes loading distributed within 75 feet of shoreline		0.2861	mg/L	River is approximately 850 ft wide
Typical sulfate laboratory detection limit		5	mg/L	Source: Teklab Report 3/2016

Conclusion:

The calculated sulfate concentration increase in the Illinois River at ***low flow*** due to groundwater loading from the East Ash Pond No. 2 is an order of magnitude less than the typical sulfate detection limit, indicating that increases due to impacted discharge would not be detectable. These calculations indicate that the effects of sulfate loading in groundwater discharge to the Illinois River are negligible.

6 CONCLUSIONS

Data acquired from prior investigations and activities at the East Ash Pond System were incorporated into this Hydrogeologic Site Characterization Report to provide a complete physical and chemical evaluation of the impoundments and vicinity. The site characterization findings are summarized below:

- Ash Pond No. 2 originally encompassed approximately 34 acres and was operational from 1958 through 1996. The eastern portion of Ash Pond No. 2 was removed to facilitate construction of the Leachate Pond in 2009. The Phase I cell of the Landfill was constructed adjacent to the Leachate Pond as an overfill above Ash Pond No. 2 in 2010 to 2011, with 7,500 cubic yards of bottom ash placed into the Landfill to protect the liner. No ash has been disposed into the Landfill since the protective layer of bottom ash was placed in 2011.
- The current area of Ash Pond No. 2 remaining to be closed is approximately 18 acres.
- Three hydrogeologic units are present at the site.
    - Fill Unit, the uppermost unit, is comprised of CCRs – fly ash, bottom ash and minor slag. In some areas, such as constructed berms, the Fill Unit is CCR mixed with sand, silt, and clay.
    - The Uppermost Aquifer is comprised of mixed alluvial deposits (clay, silt, and sand) which overlie coarser grained outwash sand and gravel deposits. This unit is the primary groundwater transport pathway.
    - Bedrock Confining Unit is defined by Pennsylvanian age shale with minor layers of limestone, sandstone, and coal. This low permeability unit defines the lower boundary of the Uppermost Aquifer.
- The Illinois River is located directly adjacent to and downgradient from the East Ash Pond System. Flood events typically occur in March, April, May, and sometimes June, while lesser flooding occasionally occurs during autumn. Ash Pond No. 2 is not subject to 100-year flooding at the base flood elevation value of 462 feet.
- The Illinois River is the regional groundwater discharge area and localized groundwater flow under Ash Pond No. 2 occurs in a general northerly orientation. River stage during high precipitation and/or flood events seasonally rises above adjacent groundwater elevations and the river recharges the aquifer, temporarily reversing the direction of groundwater flow to the south.
- High precipitation and/or flood events that recharge the aquifer may result in temporary groundwater elevation increases above the base grade of Ash Pond No. 2. Saturation of a portion of the CCR within Ash Pond No. 2 may occur when river stage exceeds an elevation of at least 451 feet. These events appear to be short in duration but occur on an almost annual basis.
- The Henry Formation sands and gravels (Uppermost Aquifer) which underlie Ash Pond No. 2 are highly permeable with measured hydraulic conductivity ranging from 3 x 100 cm/s to 1 x 10^{-4} cm/s with a geometric mean of 5.6 x 10^{-2} cm/s. These values are consistent with pump test data from area high capacity wells screened in the unlithified deposits, which ranged from 5 x 10^{-2} to 3 x 10^{-1} cm/s. Hydraulic conductivity was not measured in the Bedrock Confining Unit.
- Groundwater within the Uppermost Aquifer, at Ash Pond No. 2 meets the definition of a Class I, Potable Resource Groundwater.
- Of the 25 monitoring wells located at the East Ash Pond System in 2016, 20 are actively monitoring all of the CCR units and ponds (CCR Landfill Phase 1, Ash Pond No. 2 and East Ash Pond as well as the non-CCR units (Polishing Pond, Leachate Pond, and Ash Pond No. 4) under Illinois EPA permits. Groundwater monitoring was initiated to assess compliance with the 35 IAC 620.410 Groundwater Quality Standards for Class I: Potable Resource Groundwater.
- The results of the Illinois EPA groundwater monitoring network at Ash Pond No. 2 upgradient (wells 07, 08, 08D) and downgradient (wells 03R, 06, 18S, 18D) wells indicate the following:

  - There were no exceedances of groundwater quality standards for cyanide, sulfate or fluoride in upgradient or downgradient wells.
  - Parameters observed in groundwater that are likely derived from CCRs and currently exceed Class I standards were boron and selenium. Exceedances of Class I standards for boron and selenium occur only in downgradient monitoring wells 18S and/or 18D, located immediately adjacent to the ash pond. The Class I standard exceedances at these wells appear to be related to partial saturation of the ash for short periods when high precipitation/flood events result in aquifer recharge and groundwater elevation increases above the base grade of Ash Pond No. 2 in the vicinity of these wells.
  - Boron has been monitored since 1994 and concentrations have significantly decreased in downgradient wells 03 and 06 since Ash Pond No. 2 was removed from service in 1996. Boron concentrations in wells 03, 06 and 45S remain below the Class I groundwater standard (2.0 mg/L).
  - Based on the frequency of detection, the parameter distribution and/or anomalous concentrations, iron, manganese, nitrate-N, TDS and pH exceedances of Class I standards are not related to Ash Pond No. 2 or CCR at the East Ash Pond System.
  - The following metals (total and dissolved) were either not detected or were detected sporadically in less than 5 percent of the samples collected in the upgradient or downgradient wells: antimony, beryllium, lead (dissolved), mercury, silver, and thallium. None of these parameters exceeded the Class I groundwater standards.
  - The following metals (total and dissolved) were frequently detected in the upgradient and downgradient wells but there were no exceedances of their respective Class I groundwater quality standards: barium, copper, cobalt, and zinc.
  - Other metals that were observed at concentrations exceeding groundwater quality standards included the following:
    - Total and dissolved cadmium has been frequently detected in the shallow downgradient wells 03, 06 and 18S above the groundwater standard (0.005 mg/L). No exceedances have been observed, however, since the March 2015 sampling event. Cadmium is consistently below detection limits in the upgradient wells.
    - Total lead exceeded the groundwater standard (0.0075 mg/L) on one sampling event at a concentration of 0.008 mg/L. Because dissolved lead has been consistently below detection limits, the exceedance is likely related to sample turbidity.
    - Total and dissolved nickel is consistently detected in all downgradient monitoring wells but only exceeded the groundwater standard (0.10 mg/L) at well 06 in one sampling event. Dissolved nickel has frequently been detected since 2013 in upgradient wells 08 and 08D, exceeding the Class I standard with concentrations up to 0.23 mg/L. The observed distribution of nickel concentrations appears to reflect background variability in groundwater from an upgradient source.
  - Organic constituents detected in conjunction with monitoring the CCR Landfill Phase I cell included PCP, Picloram, acetone and phenol. These constituents were detected below Class I standards and are not related to CCR.

- The results of the CCR Rule groundwater monitoring network initiated in December 2015 at Ash Pond No. 2 upgradient wells (07, 08, and 08D) and downgradient wells (03R, 18S, 18D,and 45S) indicate the following:
  - The findings reported above for the Illinois EPA inorganic monitoring parameters are consistent with the CCR monitoring program Appendix III and IV results with respect to Class I groundwater quality standards.
  - The groundwater monitoring results at the additional CCR well 45S were consistent with other shallow Ash Pond No. 2 downgradient wells. There were no exceedances of Class I groundwater standards at this location.

- An assessment of potable and non-potable water wells for a 2,500-foot radius around the Hennepin Power Station property boundary demonstrated that there is no potential for groundwater impact to existing off-site wells from the East Ash Pond System or Hennepin Power Station.
- An evaluation was completed to determine potential CCR groundwater impacts on the Illinois River. The evaluation determined that the primary CCR indicator parameters for Ash Pond No. 2, boron and sulfate, would have negligible impacts to the Illinois River.

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Tables

Table 1. Monitoring Well Locations and Construction Details
Hydrogeologic Site Characterization Report
East Ash Pond No. 2, Hennepin Power Station

Well	Prior Designation	State Plane North[1]	State Plane East[1]	Gradient Position[1]	Well Top Elevatin	Ground Elevation	Screen Top Elv.	Screen Bot Elv.	Stick Up	Screen Length[2]	Depth to Screen Bottom	Total Boring Depth
02	E-2	1689081	2532172	u	492.00	488.60	444	434	3.4	10	55	57
03R		1690299	2532307	d	481.92	479.38	437	427	2.5	10	52	53
05R		1690521	2533196	d	488.43	485.60	442	432	2.8	10	54	55
05DR		1690520	2533190	d	488.37	485.70	416	411	2.7	5	75	76
06	E-6	1690112	2531833	d	469.58	466.20	438	428	3.4	10	39	40
07	E-7	1687889	2533137	u	518.29	514.60	447	437	3.7	10	78	78
08	E-8	1688880	2533477	u	501.18	499.00	448	438	2.2	10	62	62
08D	- -	1688932	2533463	u	501.45	499.23	416	411	2.2	5	88	120
10	- -	1689661	2532595	u	494.56	495.30	447	437	-0.7	10	59	57
11	- -	1689663	2532598	u	494.61	495.30	429	427	-0.7	2	68	80
12	- -	1689975	2533513	u	494.42	495.20	446	436	-0.8	10	59	60
13	- -	1689977	2533516	u	494.39	495.20	428	426	-0.8	2	69	75
15	- -	1690248	2534147	u	493.79	494.20	444	434	-0.4	10	61	60
16	- -	1689254	2533894	u	501.68	500.20	444	434	1.5	10	66	68
17	- -	1689459	2534510	u	506.96	504.60	447	437	2.4	10	68	68
18S	- -	1690428	2532740	d	484.64	485.22	445	435	-0.6	10	50	52
18D	- -	1690429	2532742	d	484.43	485.22	414	409	-0.8	5	76	95
19S	- -	1690631	2533810	d	483.34	483.86	444	434	-0.5	10	50	52
19D	- -	1690632	2533812	d	483.28	483.86	417	412	-0.6	5	72	85
40S	- -	1690571	2533494	d	487.67	484.76	440	435	2.9	5	50	51
45S	- -	1689994	2531897	d	467.48	465.70	431	421	1.8	10	45	45
46	- -	1690085	2533743	d	498.75	496.44	446	436	2.3	10	60	60
47	- -	1689838	2533053	d	504.32	502.13	452	442	2.2	10	60	60
48	- -	1690546	2533338	d	487.46	485.19	441	431	2.3	10	54	54

Notes:

(O/C: RMW/BGH 9/2009 Revised: EDP,RJK 8/30/17)

1. Gradient position is relative to the Site; u = upgradient, d = downgradient
2. All wells are constructed from 2 inch PVC with 0.01 inch slotted screens.

Table 2. Vertical Gradients - September and December 2015
Hydrogeologic Site Characterization Report
East Ash Pond No. 2, Hennepin Power Station

Date	08 Groundwater Elevation (ft.)	08D Groundwater Elevation (ft.)	Head Change (dH)	Dist. Change (dL)	Vertical Hydraulic Gradient (dH/dL)*	
09/16/2015	448.60	448.24	0.36	28.80	0.01	down
12/08/2015	449.20	447.92	1.28	28.80	0.04	down

Middle of screen elevation (08)	442.5
Middle of screen elevation (08D)	413.7

Date	12 Groundwater Elevation (ft.)	13 Groundwater Elevation (ft.)	Head Change (dH)	Dist. Change (dL)	Vertical Hydraulic Gradient (dH/dL)*	
09/16/2015	448.29	448.30	-0.01	13.60	-0.001	flat
12/08/2015	448.97	449.00	-0.03	13.60	-0.002	up

Middle of screen elevation (12)	440.8
Middle of screen elevation (13)	427.2

Date	18S Groundwater Elevation (ft.)	18D Groundwater Elevation (ft.)	Head Change (dH)	Dist. Change (dL)	Vertical Hydraulic Gradient (dH/dL)*	
09/16/2015	447.90	447.65	0.25	28.50	0.009	down
12/08/2015	448.84	448.78	0.06	28.50	0.002	down

Middle of screen elevation (18S)	440.2
Middle of screen elevation (18D)	411.7

Date	05R Groundwater Elevation (ft.)	05DR Groundwater Elevation (ft.)	Head Change (dH)	Dist. Change (dL)	Vertical Hydraulic Gradient (dH/dL)*	
09/16/2015	448.13	448.03	0.10	23.40	0.004	down
12/08/2015	448.86	448.82	0.04	23.40	0.002	down

Middle of screen elevation (05R)	436.6
Middle of screen elevation (05DR)	413.2

Date	19S Groundwater Elevation (ft.)	19D Groundwater Elevation (ft.)	Head Change (dH)	Dist. Change (dL)	Vertical Hydraulic Gradient (dH/dL)*	
09/16/2015	448.19	448.07	0.12	23.40	0.005	down
12/08/2015	448.90	448.84	0.06	23.40	0.003	down

Middle of screen elevation (19S)	438.9
Middle of screen elevation (19D)	414.4

[OB-JJW 4/27/16, CB-]

Notes:

1. Distance between wells was calculated from midpoint of each well screen, unless the water level was below the midpoint of the screen, then the midpoint of the saturated screen was used.

*: Vertical gradients less than ±0.0015 are considered flat, and they typically have less than 0.02 foot difference between wells

Table 3. Groundwater Flow Velocities - September and December 2015
Hydrogeologic Site Characterization Report
East Ash Pond No. 2, Hennepin Power Station

September 16, 2015				
	Average Hydraulic Conductivity (cm/s)	**Horizontal Hydraulic Gradient**	**Effective Porosity**	**Velocity (ft/day)**
Well 10 to Well 03R	2E-01	0.0006	0.22	1.5
Well 12 to Well 05R	8E-03	0.0003	0.22	0.03
Well 17 to Well 12	2E-02	0.003	0.22	0.7
December 8, 2015				
	Average Hydraulic Conductivity (cm/s)	**Horizontal Hydraulic Gradient**	**Effective Porosity**	**Velocity (ft/day)**
Well 10 to Well 03R	2E-01	0.0004	0.22	0.9
Well 12 to Well 05R	8E-03	0.0002	0.22	0.02
Well 17 to Well 12	2E-02	0.002	0.22	0.5

Note:

1) cm/sec x 2,835 = feet/day
2) Source of hydraulic conductivity values was the Initial Facility Report for the New Coal Combustion Landfill (Kelron/NRT, December 10, 2010)

Table 4. Summary of Slug Test Results
Hydrogeologic Site Characterization Report
East Ash Pond No. 2, Hennepin Power Station

				Phase II K Tests[5]		Phase III Tests[4*]										All data
Well[1]	Gradient Position[2]	Screen Bot Elv.	Screen Length[3]	K (cm/s)	K Notes	K (cm/s)	K Notes	K (cm/s)	K Notes	K (cm/s)	K Notes	K (cm/s)	K Notes	K (cm/s)	K Notes	Geomean (cm/s)
02	u	433	10	- -	- -	3.1E+00	slug out	3.2E+00	slug in	- -	- -	- -	- -	- -	- -	3.2E+00
03	d	428	15	4.4E-02	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	4.4E-02
04	d	437	15	- -	- -	1.4E-02	slug out	4.6E-02	slug in	1.7E-02	slug out B-R[6]					2.2E-02
05	d	436	10	- -	- -	3.8E-03	slug out	4.4E-03	slug in	- -	- -	- -	- -	- -	- -	4.1E-03
06	d	428	10	3.7E-01	estimated[7]	4.2E-02	slug out	1.4E-02	slug in	- -	- -	- -	- -	- -	- -	5.9E-02
07	u	438	10	- -	- -	4.0E-02	slug out	3.5E-02	slug in	- -	- -	- -	- -	- -	- -	3.7E-02
08	u	438	10	- -	- -	1.0E-02	air 1	1.2E-02	air 2	7.4E-03	slug in QA	1.0E-02	slug out QA	9.2E-03	slug out B-R[6]	9.7E-03
08D	u	411	5	- -	- -	1.7E-01	slug out	1.4E-01	slug in	- -	- -	- -	- -	- -	- -	1.6E-01
10	u	437	10	3.7E-01	estimated[7]	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	3.7E-01
11	u	427	2	2.2E-01	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	2.2E-01
12	u	436	10	1.2E-02	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1.2E-02
13	u	426	2	2.9E-01	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	2.9E-01
14	u	435	10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
15	u	434	10	3.7E-01	estimated[7]	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	3.7E-01
16	u	434	10	3.7E-01	estimated[7]	6.9E-01	air 1	4.7E-01	air 2	1.5E+00	slug in QA	1.5E+00	slug out QA	- -	- -	7.6E-01
17	u	437	10	- -	- -	2.8E-02	air 1	2.2E-02	air 2	- -	- -	- -	- -	- -	- -	2.4E-02
18S	d	435	10	- -	- -	5.1E-02	slug out	1.1E-01	slug in	- -	- -	- -	- -	- -	- -	7.6E-02
18D	d	409	5	- -	- -	9.0E-04	air 1	1.4E-05	air 2	- -	- -	- -	- -	- -	- -	1.1E-04
19S	d	434	10	- -	- -	7.0E-02	slug out	5.2E-02	slug in	- -	- -	- -	- -	- -	- -	6.0E-02
19D	d	412	5	- -	- -	3.6E-02	air 1	2.8E-02	air 2	5.7E-02	slug in QA	- -	- -	- -	- -	3.8E-02

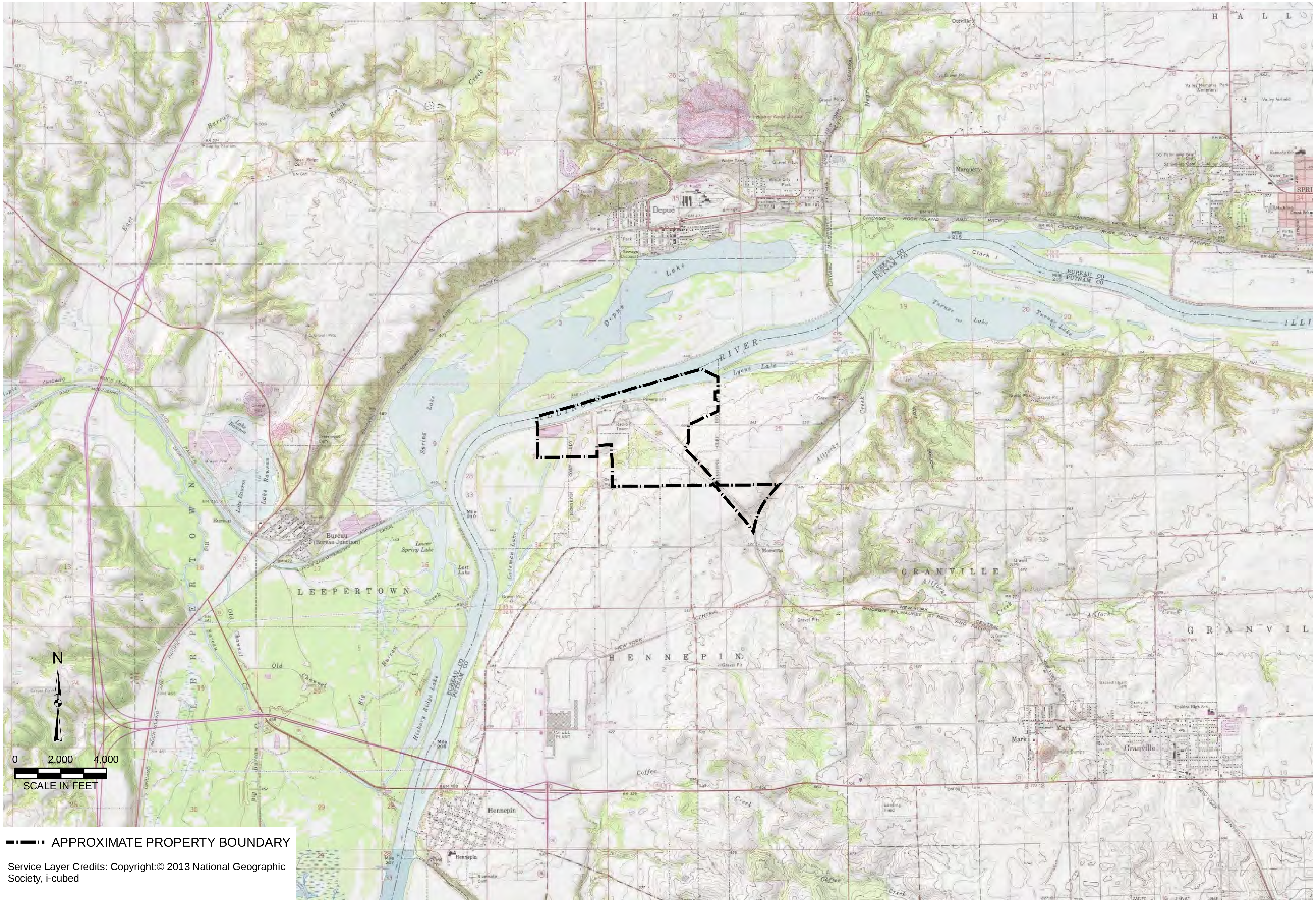
Notes:

(O/C: RMW/BGH 5/2009)

1. Monitoring well construction details are summarized in Table 1.
2. gradient position is relative to the Site; u = upgradient, d = downgradient
3. All wells are constructed from 2 inch PVC with 0.01 inch slotted screens.
4. Three of the air slug tested wells were chosen for QA/QC and also had a standard slug test performed for comparison.
5. Phase II aquifer tests were reported in the STMI report (1996).
6. Slug out data was interpreted using both Springer-Gelhar and Bouwer-Rice solution methods for comparison.
7. Well recovered before the transducer could make measurements, so the result was estimated.

* - In all piezometers, air slugs were the preferred method. In each case where air slugs were used, the test was performed twice.

Figures



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SITE LOCATION MAP

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
EAST ASH POND NO. 2
DYNEGY MIDWEST GENERATION, LLC
HENNEPIN POWER STATION, HENNEPIN, ILLINOIS

PROJECT NO: 2414

FIGURE NO: 1

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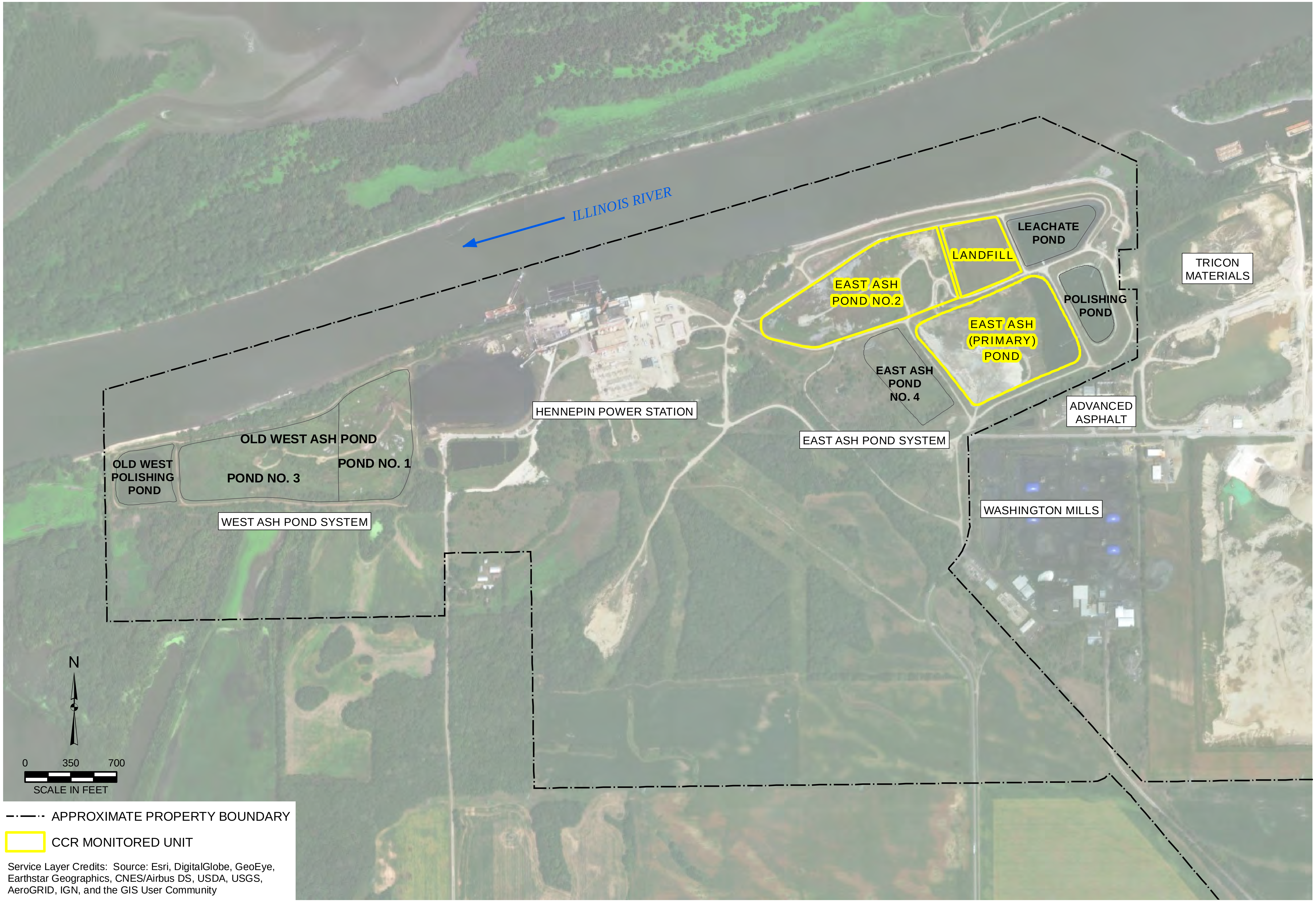

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ASH IMPOUNDMENT LOCATION MAP

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
EAST ASH POND NO. 2
DYNEGY MIDWEST GENERATION, LLC
HENNEPIN POWER STATION, HENNEPIN, ILLINOIS

PROJECT NO: 2414

FIGURE NO: 2

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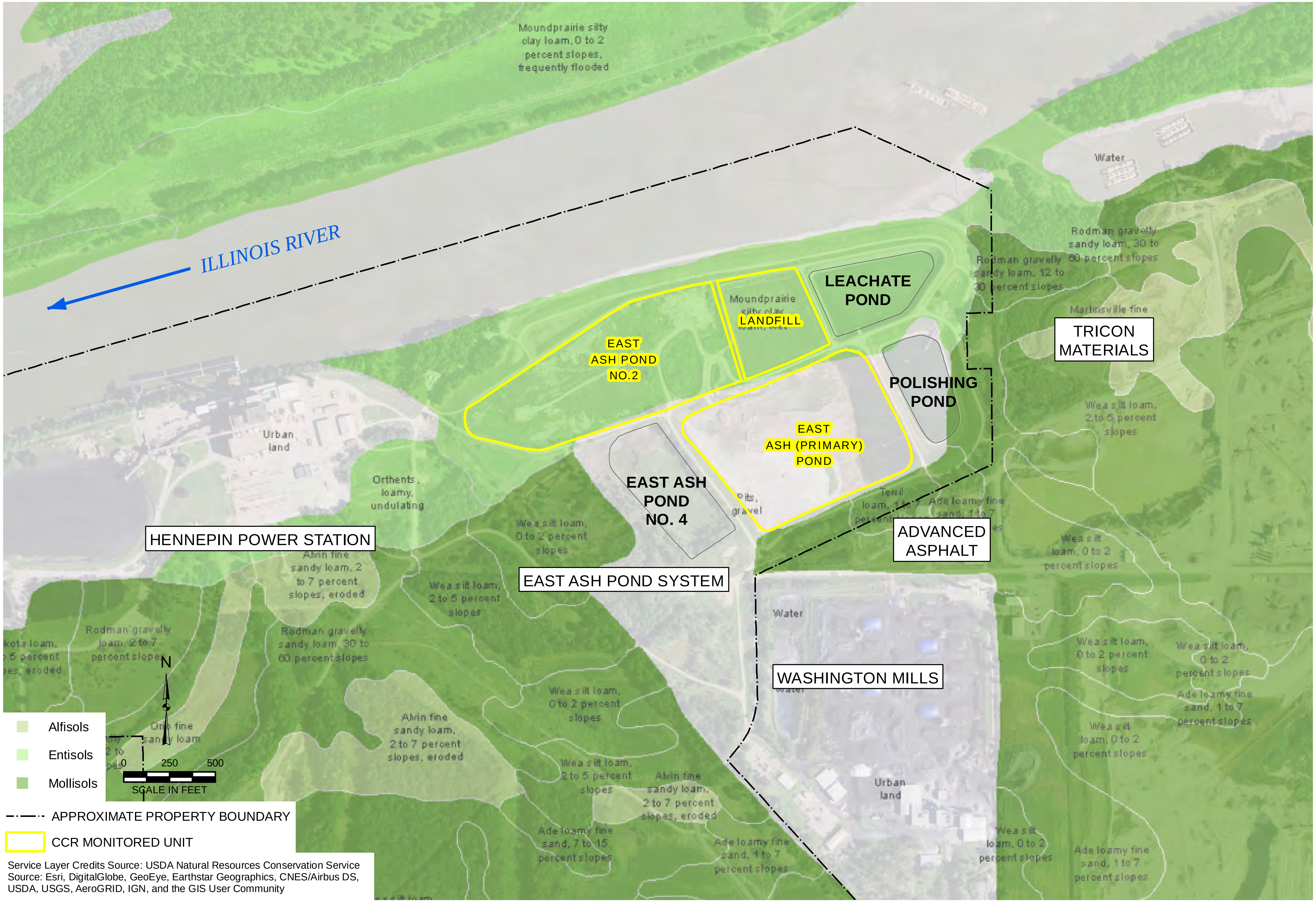

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SOIL SURVEY MAP

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
EAST ASH POND NO. 2
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HENNEPIN POWER STATION, HENNEPIN, ILLINOIS

PROJECT NO: 2414

FIGURE NO: 3

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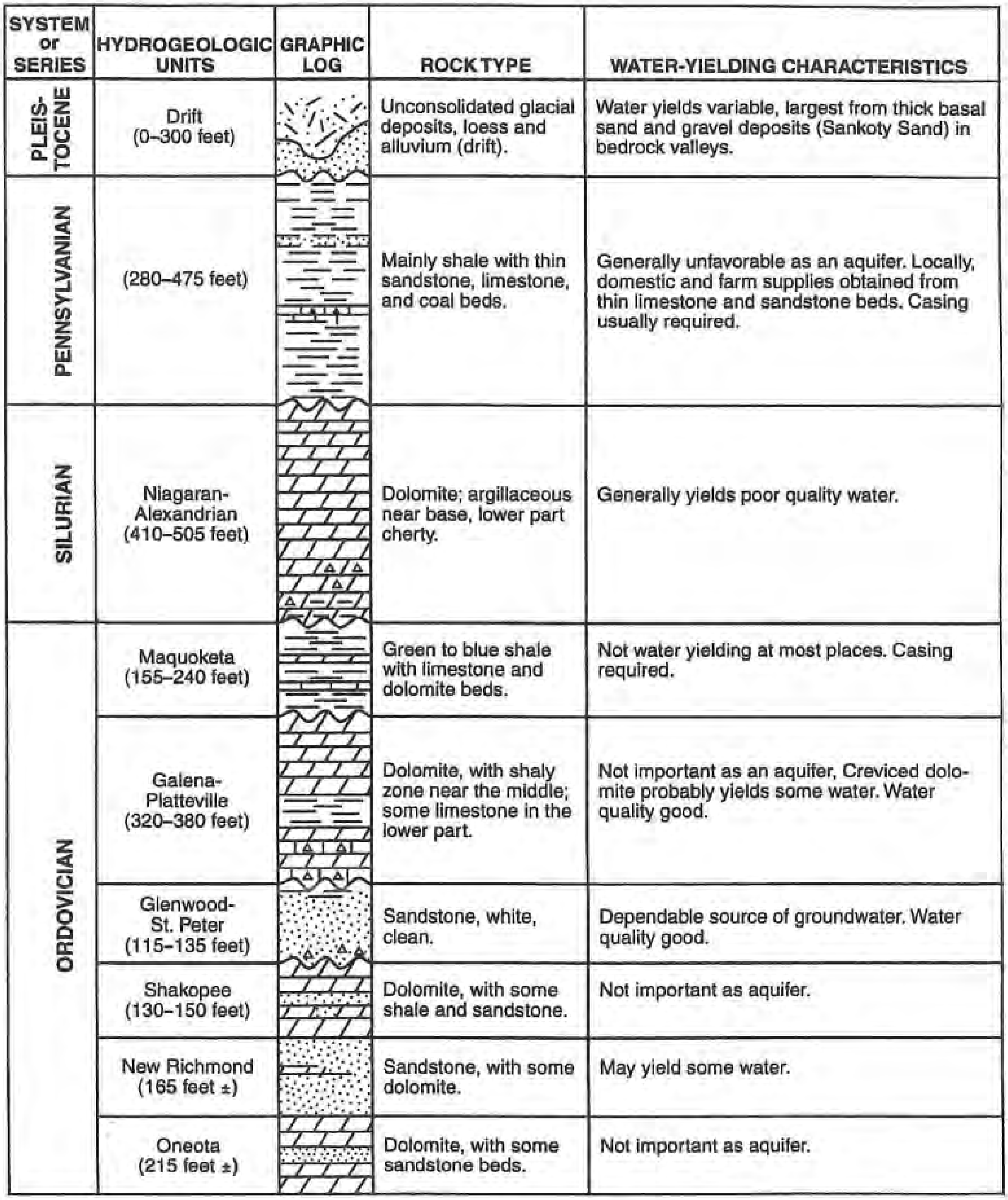

SYSTEM or SERIES	HYDROGEOLOGIC UNITS	GRAPHIC LOG	ROCK TYPE	WATER-YIELDING CHARACTERISTICS
PLEIS-TOCENE	Drift (0–300 feet)		Unconsolidated glacial deposits, loess and alluvium (drift).	Water yields variable, largest from thick basal sand and gravel deposits (Sankoty Sand) in bedrock valleys.
PENNSYLVANIAN	(280–475 feet)		Mainly shale with thin sandstone, limestone, and coal beds.	Generally unfavorable as an aquifer. Locally, domestic and farm supplies obtained from thin limestone and sandstone beds. Casing usually required.
SILURIAN	Niagaran-Alexandrian (410–505 feet)		Dolomite; argillaceous near base, lower part cherty.	Generally yields poor quality water.
ORDOVICIAN	Maquoketa (155–240 feet)		Green to blue shale with limestone and dolomite beds.	Not water yielding at most places. Casing required.
	Galena-Platteville (320–380 feet)		Dolomite, with shaly zone near the middle; some limestone in the lower part.	Not important as an aquifer, Creviced dolomite probably yields some water. Water quality good.
	Glenwood-St. Peter (115–135 feet)		Sandstone, white, clean.	Dependable source of groundwater. Water quality good.
	Shakopee (130–150 feet)		Dolomite, with some shale and sandstone.	Not important as aquifer.
	New Richmond (165 feet ±)		Sandstone, with some dolomite.	May yield some water.
	Oneota (215 feet ±)		Dolomite, with some sandstone beds.	Not important as aquifer.

SOURCE NOTE: MODIFIED FROM "MCCOMAS, M.R. (1968), GEOLOGY RELATED TO LAND USE IN THE HENNEPIN REGION FIGURE 2, ILLINOIS STATE GEOLOGICAL SURVEY, CIRCULAR 422, CHAMPAIGN, ILLINOIS.

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GENERALIZED STRATIGRAPHIC COLUMN FOR THE HENNEPIN AREA

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
EAST ASH POND NO. 2
DYNEGY MIDWEST GENERATION, LLC
HENNEPIN POWER STATION, HENNEPIN, ILLINOIS

PROJECT NO: 2414

FIGURE NO: 4

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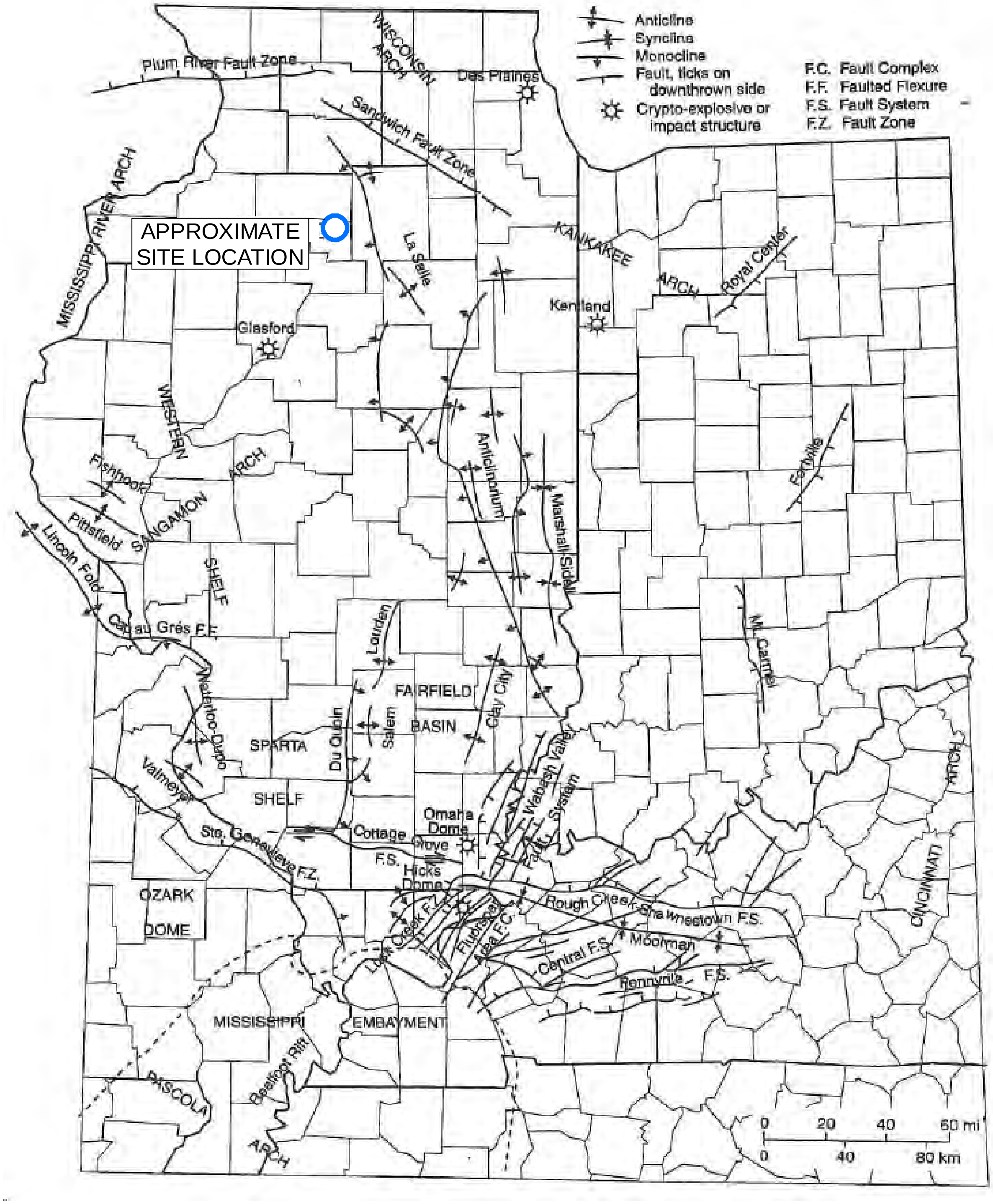

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STRUCTURAL FEATURES IN ILLINOIS, ILLINOIS STATE
GEOLOGICAL SURVEY, BULLETIN 100, CHAMPAIGN, ILLINOIS.

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MAJOR STRUCTURAL FEATURES OF ILLINOIS

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
EAST ASH POND NO. 2
DYNEGY MIDWEST GENERATION, LLC
HENNEPIN POWER STATION, HENNEPIN, ILLINOIS

PROJECT NO: 2414

FIGURE NO: 5

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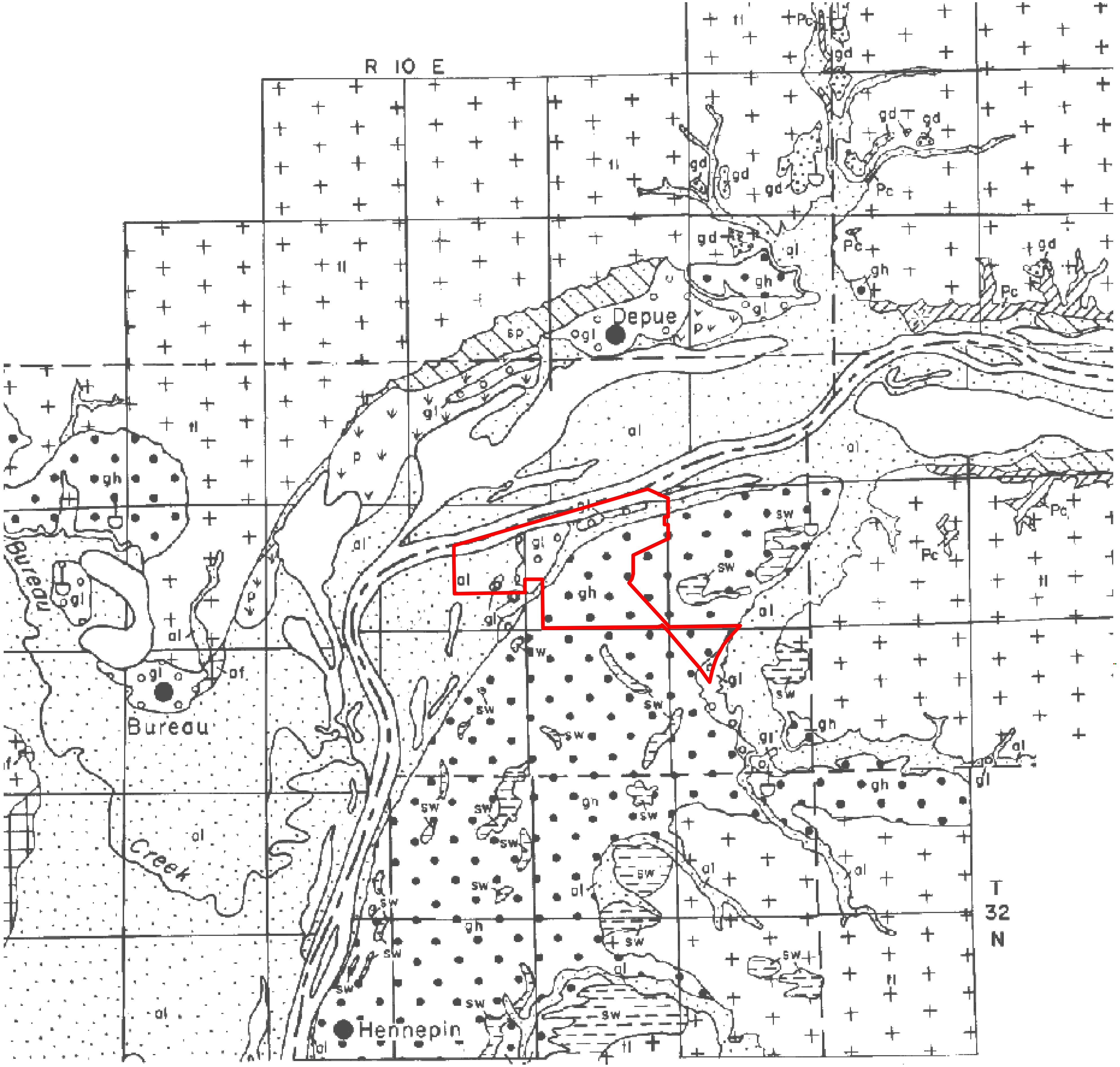
Y:\Mapping\Projects\24\2414\MXD\hgscr\Figure 5_Major Structural Features of Illinois.mxd Author: stolzsd; Date/Time: 1/3/2018, 1:07:42 PM



al	ALLUVIUM. DEPOSITS OF MODERN RIVERS AND STREAMS IN FLOODPLAINS. LARGELY CLAYEY SILT AND SANDY SILT WITH LENSES OF SAND AND GRAVEL. GENERALLY LESS THAN 20 FEET THICK. IN THE ILLINOIS VALLEY WEST OF STARVED ROCK, IT IS AS MUCH AS 40 FEET THICK AND IT OVERLIES THICK DEPOSITS OF SAND AND GRAVEL OF THE HENRY FORMATION. IN THE ILLINOIS VALLEY EAST OF STARVED ROCK, IT IS LARGELY SAND AND GRAVEL 15–30 FEET THICK UNDER THIN SILT AND IT OVERLIES BEDROCK FORMATIONS. (CAHOKIA ALLUVIUM)
+ tl +	TILL. MOSTLY UNSORTED CALCAREOUS PEBBLY SILTY CLAY DEPOSITED BY GLACIERS. CONTAINS SCATTERED COBBLES AND BOULDERS AND, IN PLACES, LENSES OF SAND AND GRAVEL. GENERALLY 25–50 FEET THICK BUT AS MUCH AS 300 FEET THICK IN DEEP VALLEYS IN THE BEDROCK SURFACE, WHERE IT INCLUDES THE GLASFORD AND BANNER FORMATIONS. THE TILL HAS A THIN COVER OF CLAYEY SILT (RICHLAND LOESS), THE THICKNESS OF WHICH IS SHOWN ON THE SMALL INSET MAP. (WEDRON FORMATION)
● gh ●	HIGH–LEVEL TERRACES UNDERLAIN BY GLACIAL OUTWASH. SURFACES ARE 75–100 FEET ABOVE THE ILLINOIS RIVER. MOSTLY FINE GRAVEL AND PEBBLY SAND, BUT THE UPPER PART IS LOCALLY COARSER AND BOULDERY, AS ALONG ALLFORKS CREEK, NORTHEAST OF HENNEPIN. GENERALLY 10–30 FEET THICK IN THE TRIBUTARY VALLEYS, BUT AS MUCH AS 150–200 FEET THICK IN THE LARGE TERRACE ON WHICH HENNEPIN IS LOCATED. (HENRY FORMATION)
○ gl ○	LOW–LEVEL TERRACES UNDERLAIN BY DEPOSITS OF THE CHICAGO OUTLET RIVER. SURFACES ARE COMMONLY 20–40 FEET ABOVE THE ILLINOIS RIVER. MOSTLY FINE TO COARSE GRAVEL, COARSER AND MORE UNIFORMLY SORTED THAN THE HIGH–TERRACE DEPOSITS. LARGELY 20–50 FEET THICK ALONG THE ILLINOIS VALLEY AND 10–20 FEET ALONG TRIBUTARIES. (HENRY FORMATION)
🟥	APPROXIMATE PROPERTY BOUNDARY

DRAWN BY/DATE:
SDS 8/29/17
REVIEWED BY/DATE:
RJK 8/30/17
APPROVED BY/DATE:
SJC 9/6/17

SURFICIAL GEOLOGIC DEPOSITS

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
EAST ASH POND NO. 2
DYNEGY MIDWEST GENERATION, LLC
HENNEPIN POWER STATION, HENNEPIN, ILLINOIS

PROJECT NO: 2414

FIGURE NO: 6

Natural Resource Technology
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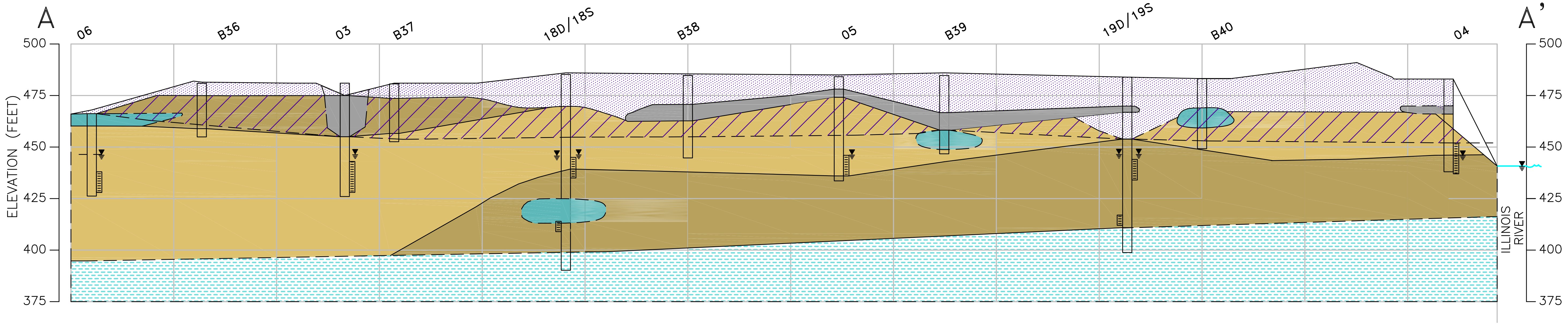
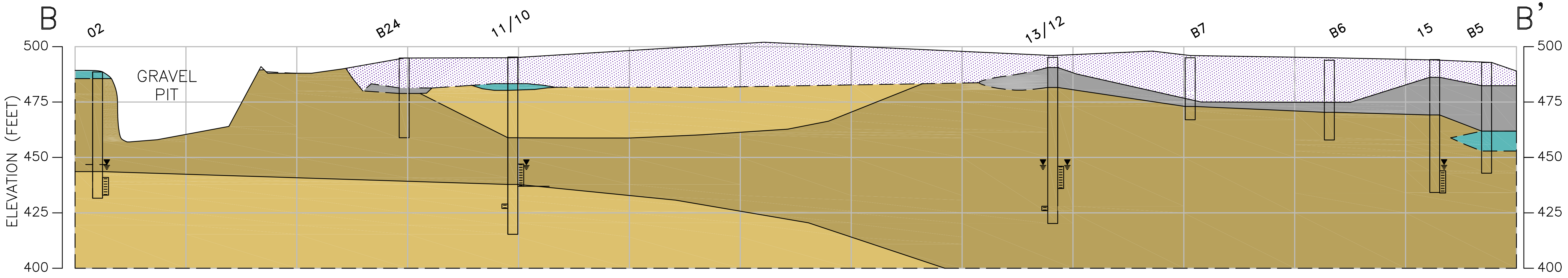
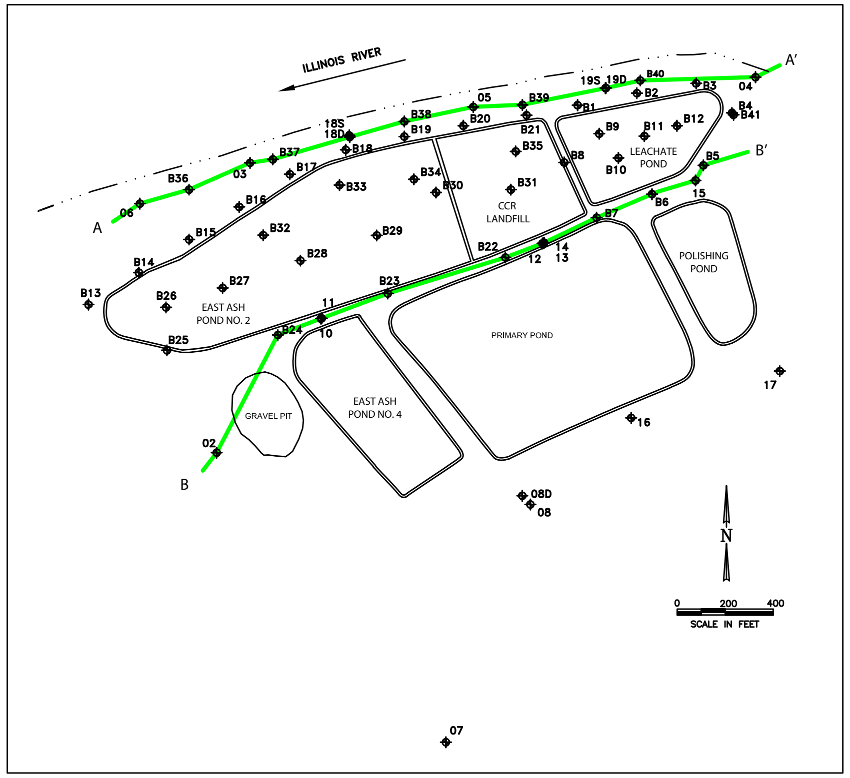
Y:\Mapping\Projects\24\2414\MXD\ngsc\Figure 6_Surficial Geology Deposits.mxd Author: stolzsd; Date/Time: 1/3/2018, 1:09:48 PM

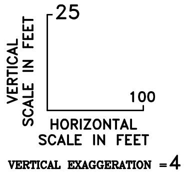




LEGEND

- ▼ SEPTEMBER 2009 WATER TABLE ELEVATION
- ▇ COAL ASH
- ▒ FILL
- ▨ PROBABLE FILL
- ▇ SAND AND GRAVEL
- ▇ SAND AND GRAVEL WITH FINES
- ▇ SILT/CLAY
- ▤ SHALE





Note: Cross-sections are based on data collected through 2009 and do not represent or include any subsequent changes due to grading, landfill construction, or other site activities. Cross-sections are modified from the following report: Natural Resource Technology and Kelron Environmental; December 19, 2010. New Coal Combustion Waste (CCW) Landfill, Initial Facility Report, Hydrogeologic Studies and Evaluations, Section 25 Hydrogeological Investigation, Hennepin Power Station, Hennepin, Illinois.

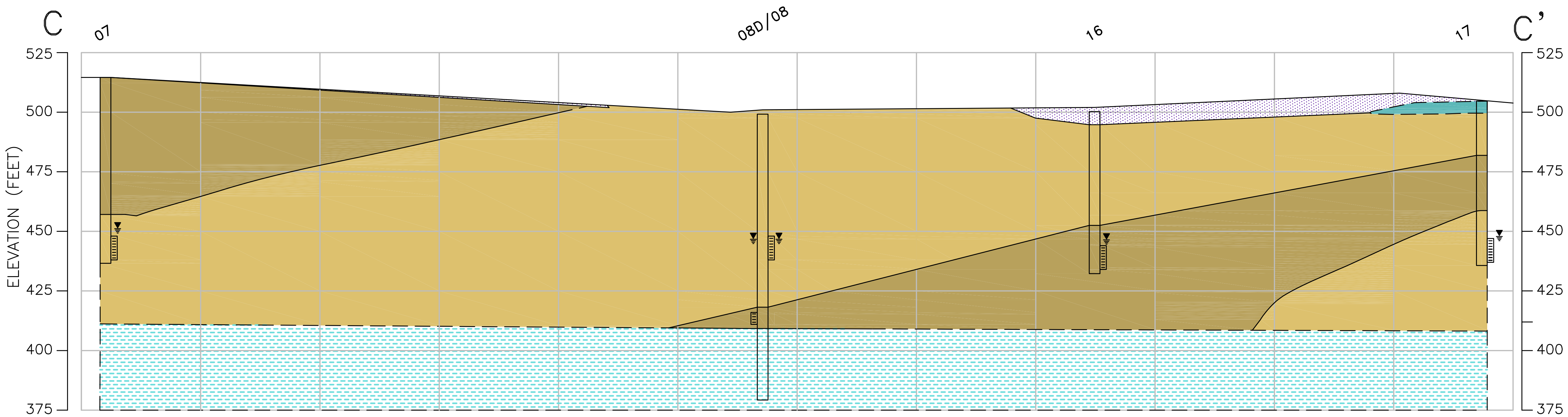
Natural Resource Technology
AN OBG COMPANY

FIGURE NO. 7

PROJECT NO.	1940/3.0
DRAWN BY:	KNW 09/27/10
CHECKED BY:	BGH 12/08/10
APPROVED BY:	BRH 12/08/10

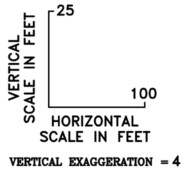
GEOLOGIC CROSS SECTIONS A-A' AND B-B'

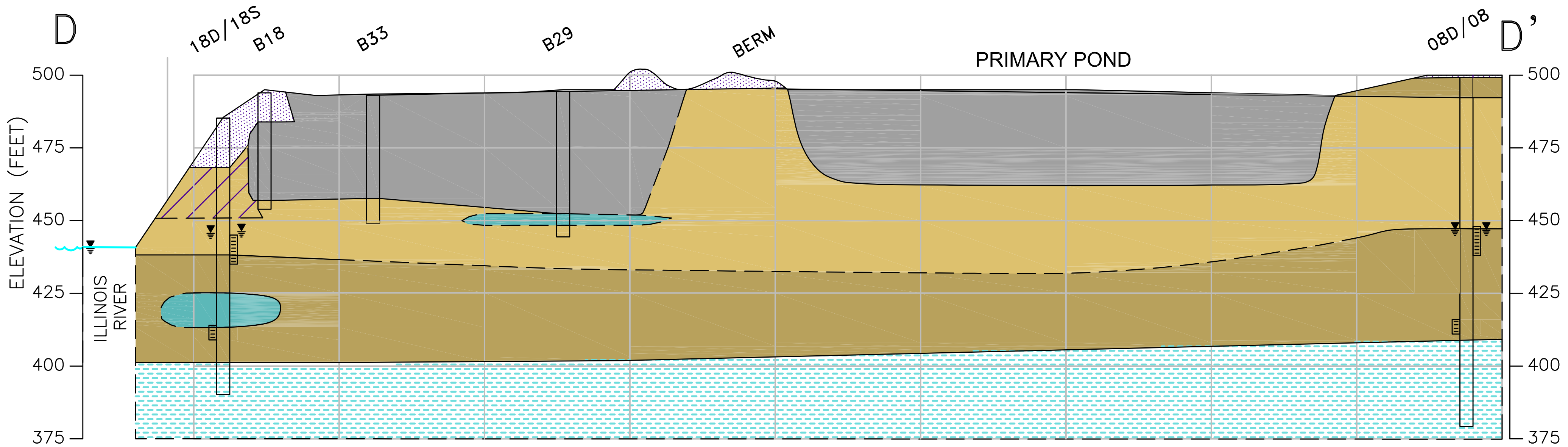
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
EAST ASH POND NO. 2
DYNEGY MIDWEST GENERATION, LLC
HENNEPIN POWER STATION, HENNEPIN, ILLINOIS

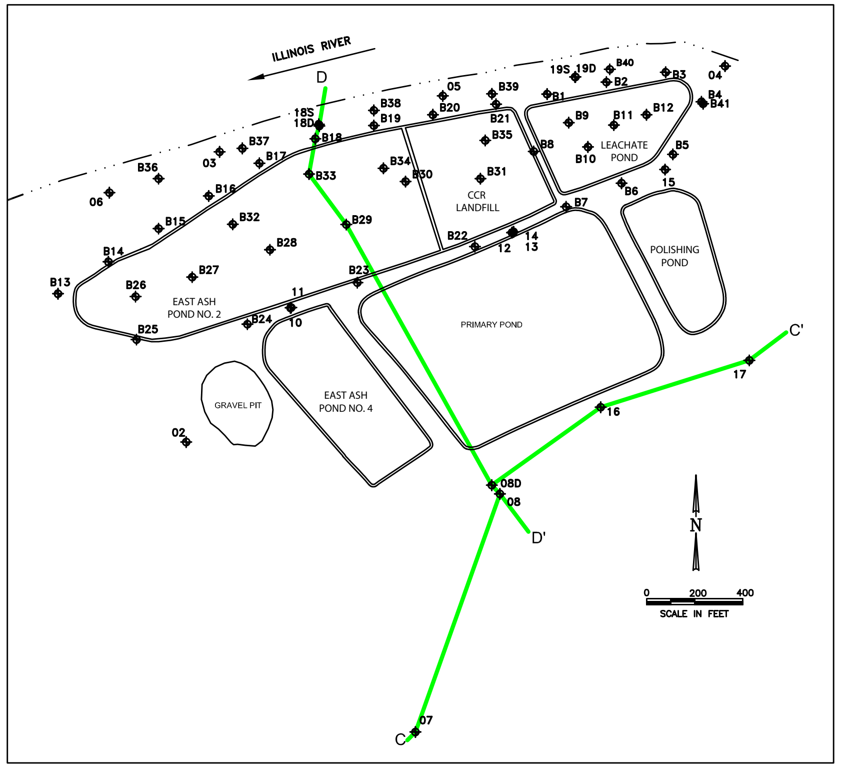


LEGEND

- ▾ GROUNDWATER ELEVATION SEPTEMBER 2009
- ▬ COAL ASH
- ▨ FILL
- ▨ PROBABLE FILL
- ▬ SAND AND GRAVEL
- ▬ SAND AND GRAVEL WITH FINES
- ▬ SILT/CLAY
- ▨ SHALE







Note: Cross-sections are based on data collected through 2009 and do not represent or include any subsequent changes due to grading, landfill construction, or other site activities. Cross-sections are modified from the following report: Natural Resource Technology and Kelron Environmental; December 19, 2010. New Coal Combustion Waste (CCW) Landfill, Initial Facility Report, Hydrogeologic Studies and Evaluations, Section 25 Hydrogeological Investigation, Hennepin Power Station, Hennepin, Illinois.

Natural Resource Technology
AN OBG COMPANY

FIGURE NO. 8

PROJECT NO. 1940/3.0
DRAWN BY: KNW 09/27/10
CHECKED BY: BGH 12/08/10
APPROVED BY: BRH 12/08/10

GEOLOGIC CROSS SECTIONS C-C' AND D-D'

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
EAST ASH POND NO. 2
DYNEGY MIDWEST GENERATION, LLC
HENNEPIN POWER STATION, HENNEPIN, ILLINOIS

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Y:\Mapping\Projects\24\2414\MXD\hgscr\Figure 9_Monitoring Well Location Map.mxd Author: stolzsd; Date/Time: 1/3/2018, 1:15:49 PM

DRAWN BY/DATE:
SDS 8/29/17
REVIEWED BY/DATE:
RJK 8/30/17
APPROVED BY/DATE:
SJC 9/6/17

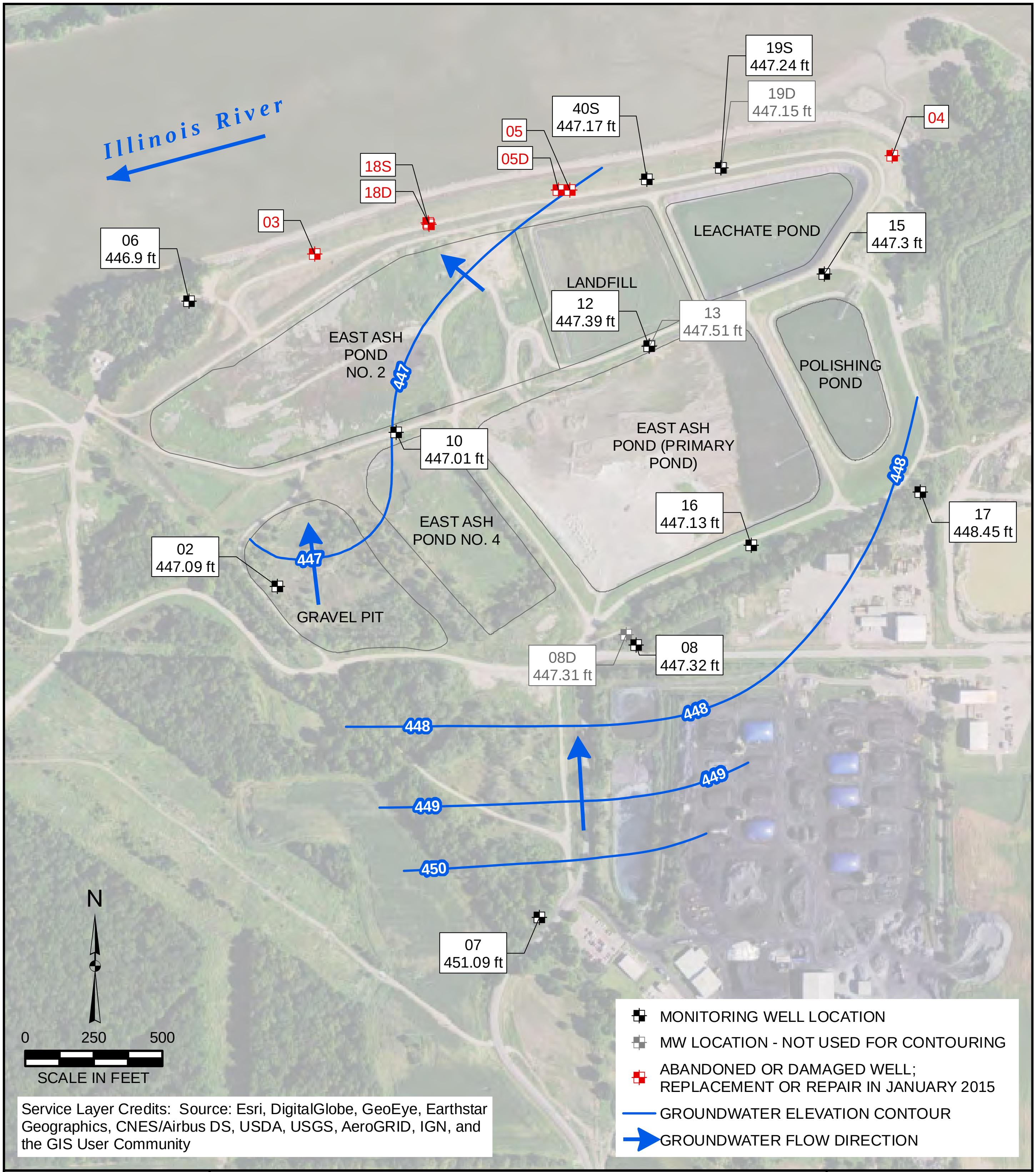
MONITORING WELL LOCATION MAP

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
EAST ASH POND NO. 2
DYNEGY MIDWEST GENERATION, LLC
HENNEPIN POWER STATION, HENNEPIN, ILLINOIS

PROJECT NO: 2414

FIGURE NO: 9

Natural Resource Technology
AN OBG COMPANY



Y:\Mapping\Projects\24\2414\MXD\hgscr\Figure 10_GWElevation_201412.mxd Author: stolzsd; Date/Time: 1/3/2018, 1:20:28 PM

DRAWN BY/DATE:
SDS 8/29/17
REVIEWED BY/DATE:
RJK 8/30/17
APPROVED BY/DATE:
SJC 9/6/17

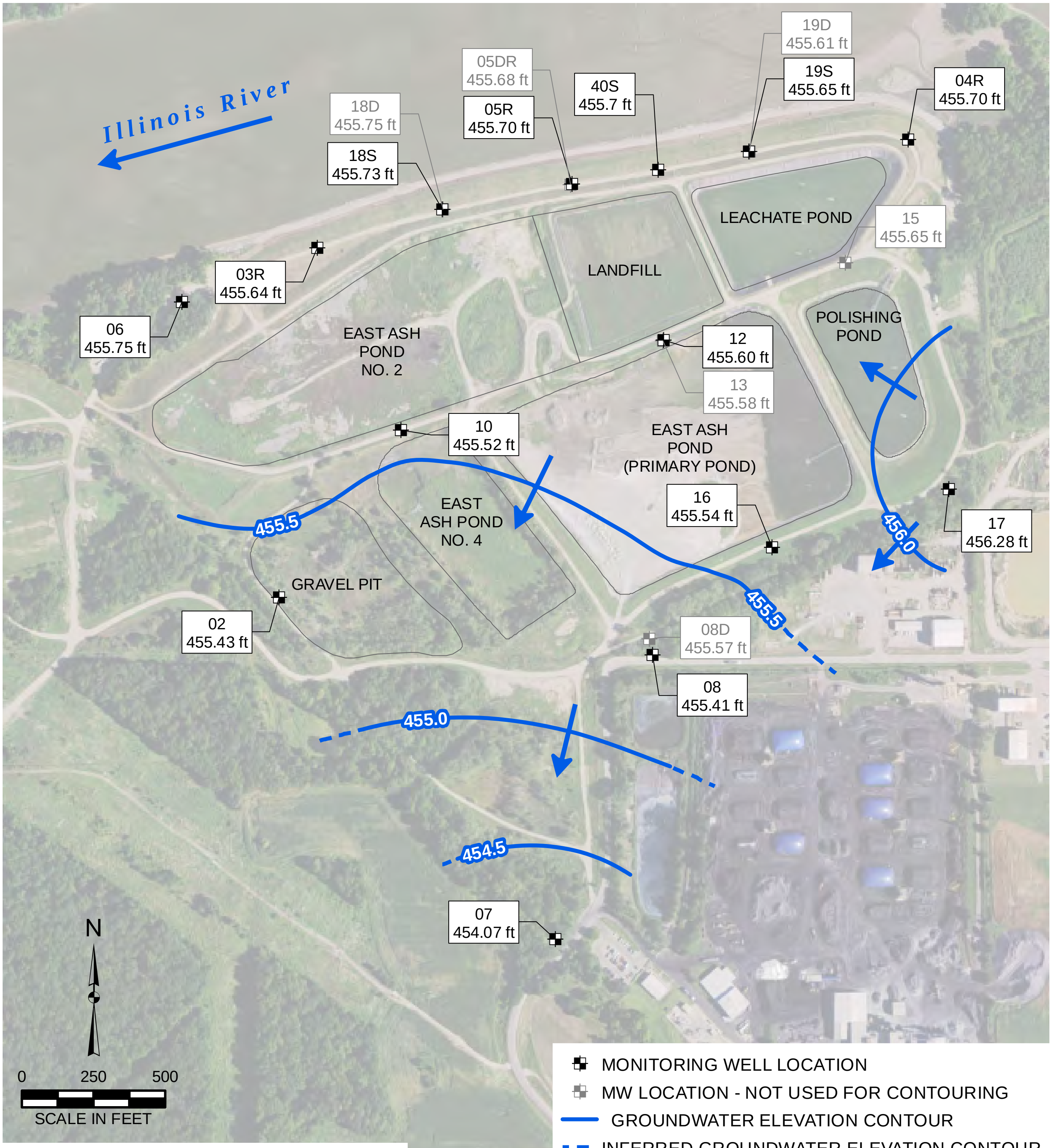
GROUNDWATER ELEVATION CONTOURS
DECEMBER 9, 2014

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
EAST ASH POND NO. 2
DYNEGY MIDWEST GENERATION, LLC
HENNEPIN POWER STATION, HENNEPIN, ILLINOIS

PROJECT NO: 2414

FIGURE NO: 10

Natural Resource Technology
AN OBG COMPANY



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Y:\Mapping\Projects\24\2414\MXD\hgscr\Figure 11_GWElevation_201506.mxd Author: stolzsd; Date/Time: 1/3/2018, 1:23:39 PM

DRAWN BY/DATE:
SDS 8/29/17
REVIEWED BY/DATE:
RJK 8/30/17
APPROVED BY/DATE:
SJC 9/6/17

GROUNDWATER ELEVATION CONTOURS
JUNE 22-23, 2015

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
EAST ASH POND NO. 2
DYNEGY MIDWEST GENERATION, LLC
HENNEPIN POWER STATION, HENNEPIN, ILLINOIS

PROJECT NO: 2414

FIGURE NO: 11

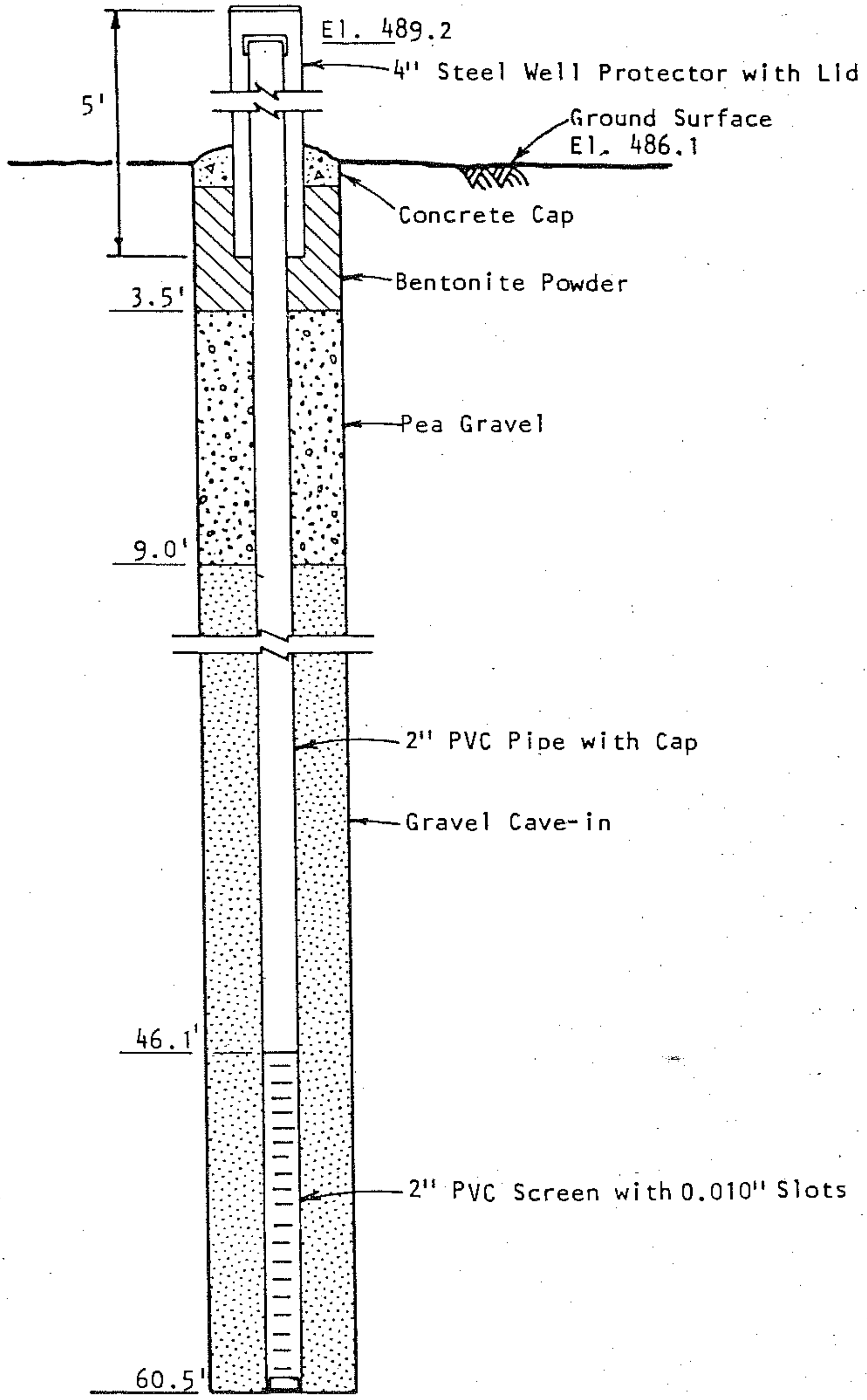
Natural Resource Technology
AN OBG COMPANY

Appendix A

Boring and Well Construction Logs

Appendix A1

MATHES Boring Logs and Well Details

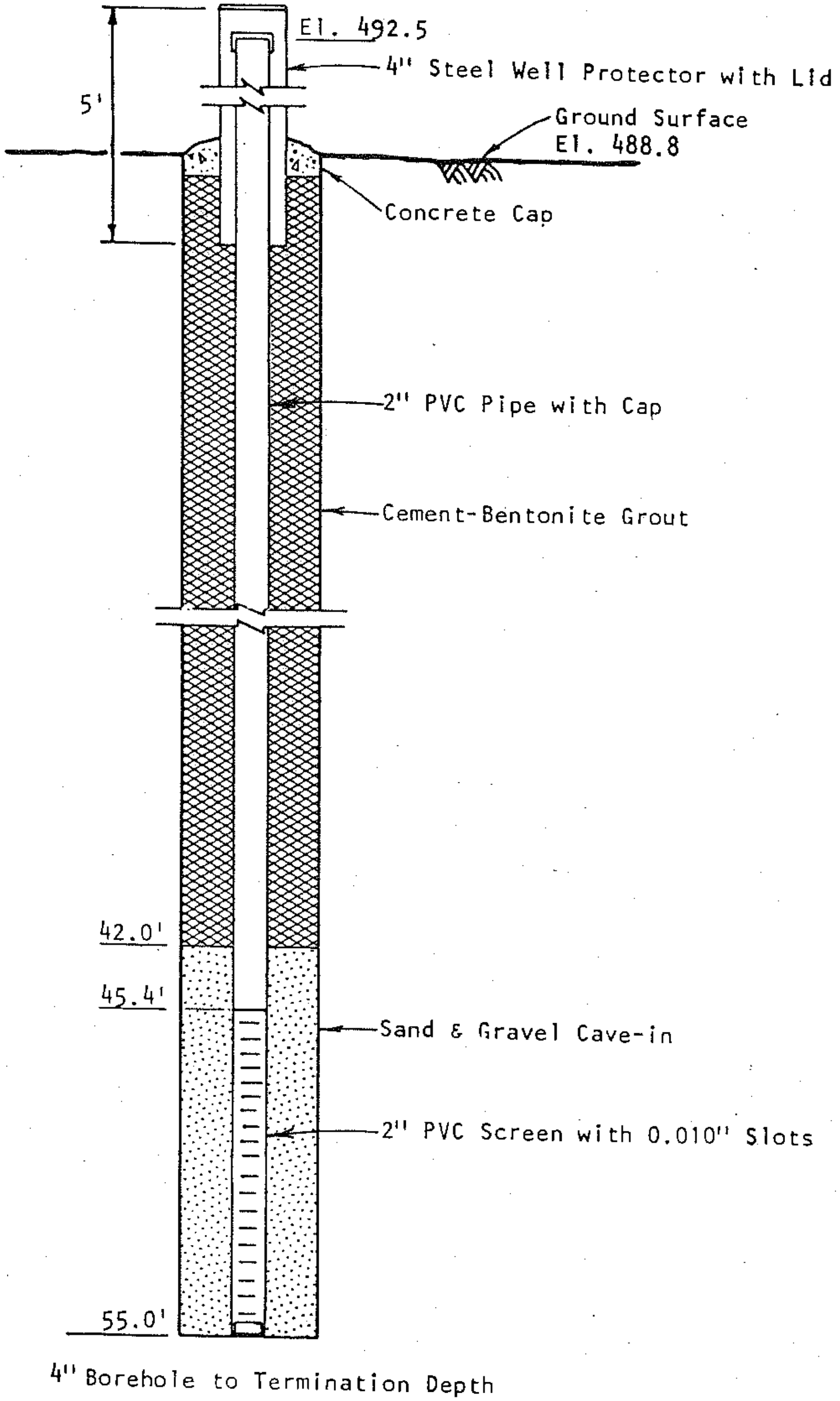


4" Borehole to Termination Depth

Not to Scale

PIEZOMETER E-1

John Mathes & Associates, Inc.

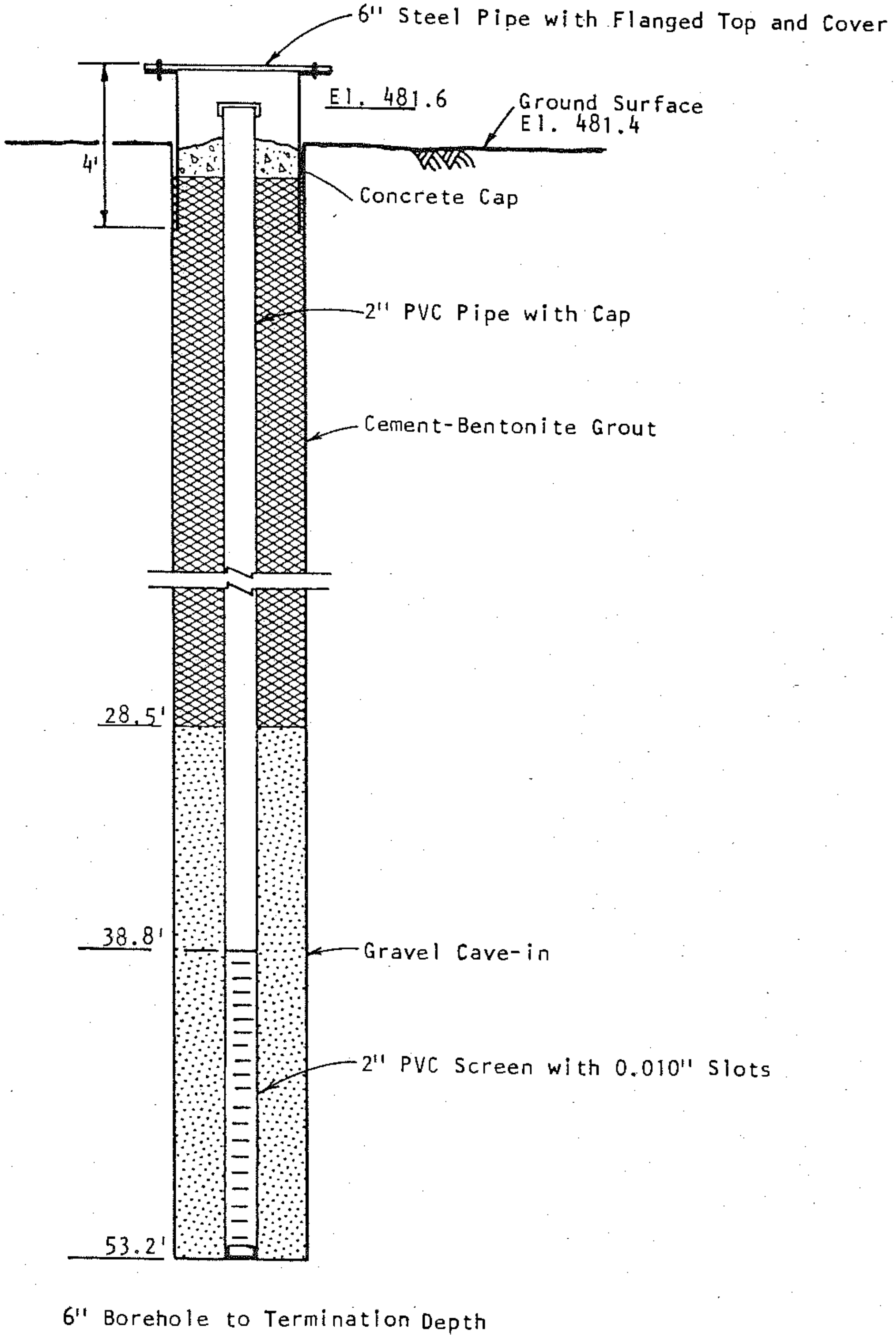


Not to Scale

PIEZOMETER E-2

John Mathes & Associates, Inc.

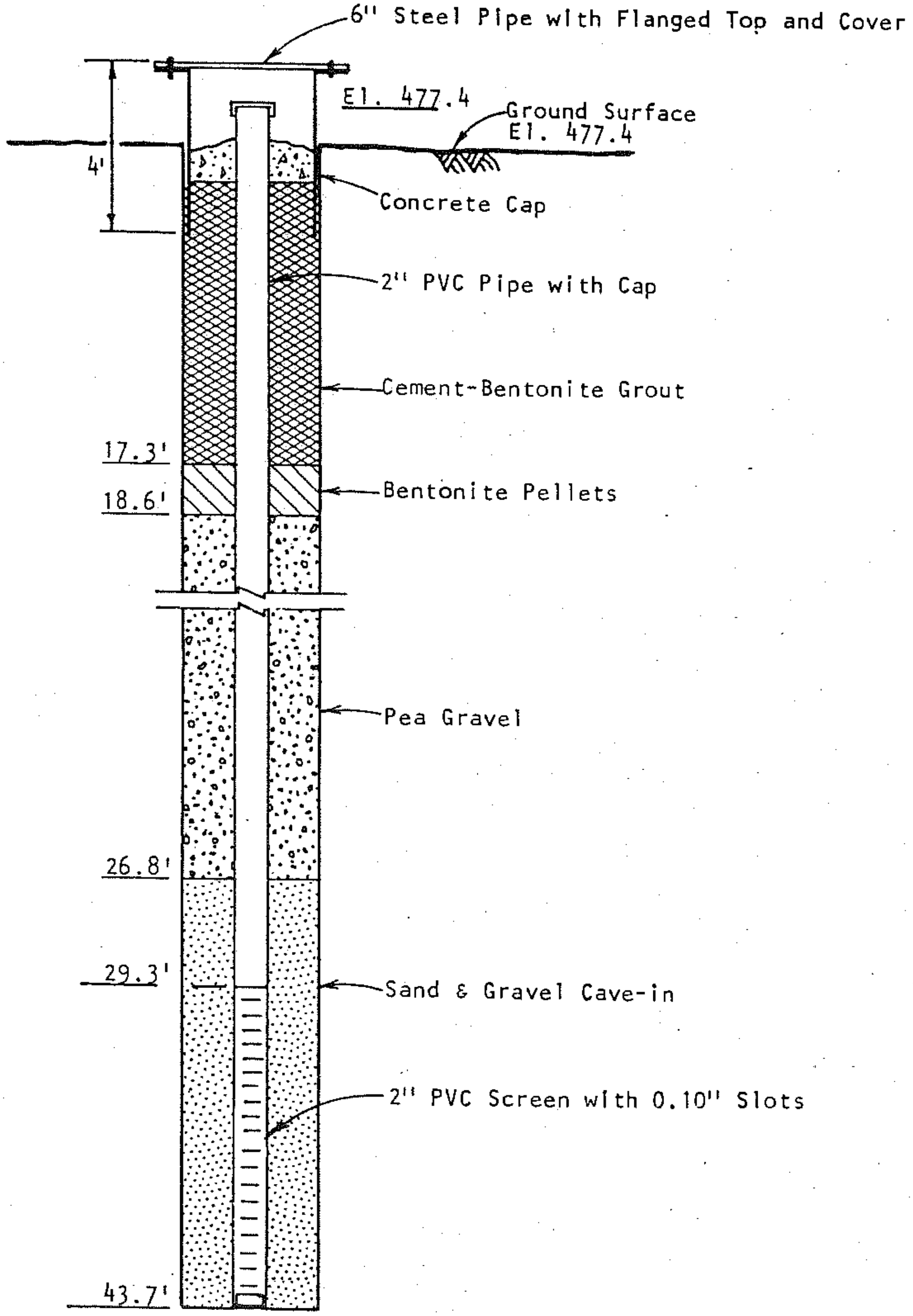
PLATE 10



Not to Scale

PIEZOMETER E-3

John Mathes & Associates, Inc.



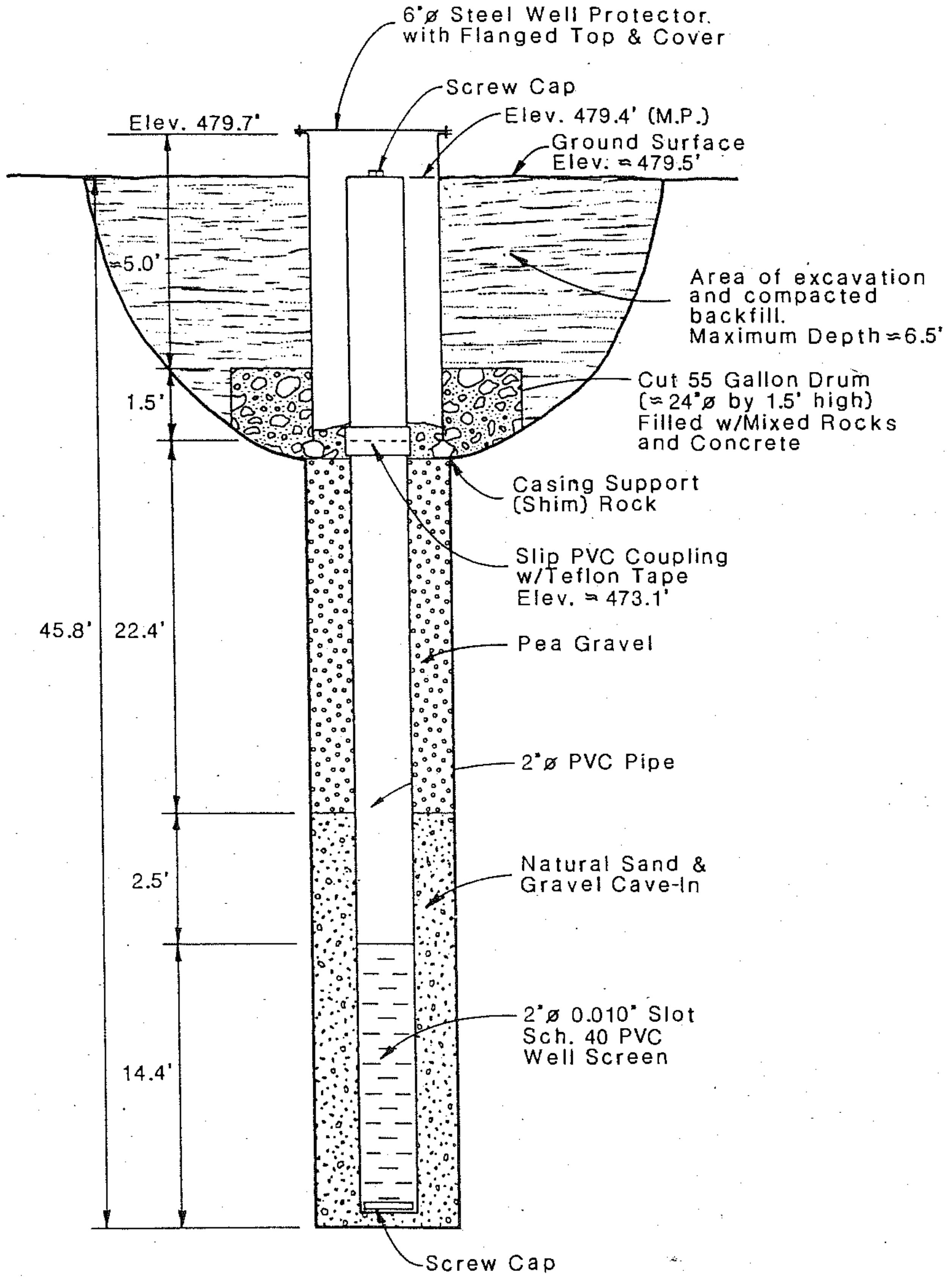
6" Borehole to Termination Depth

Not to Scale

PIEZOMETER E-4

John Mathes & Associates, Inc.

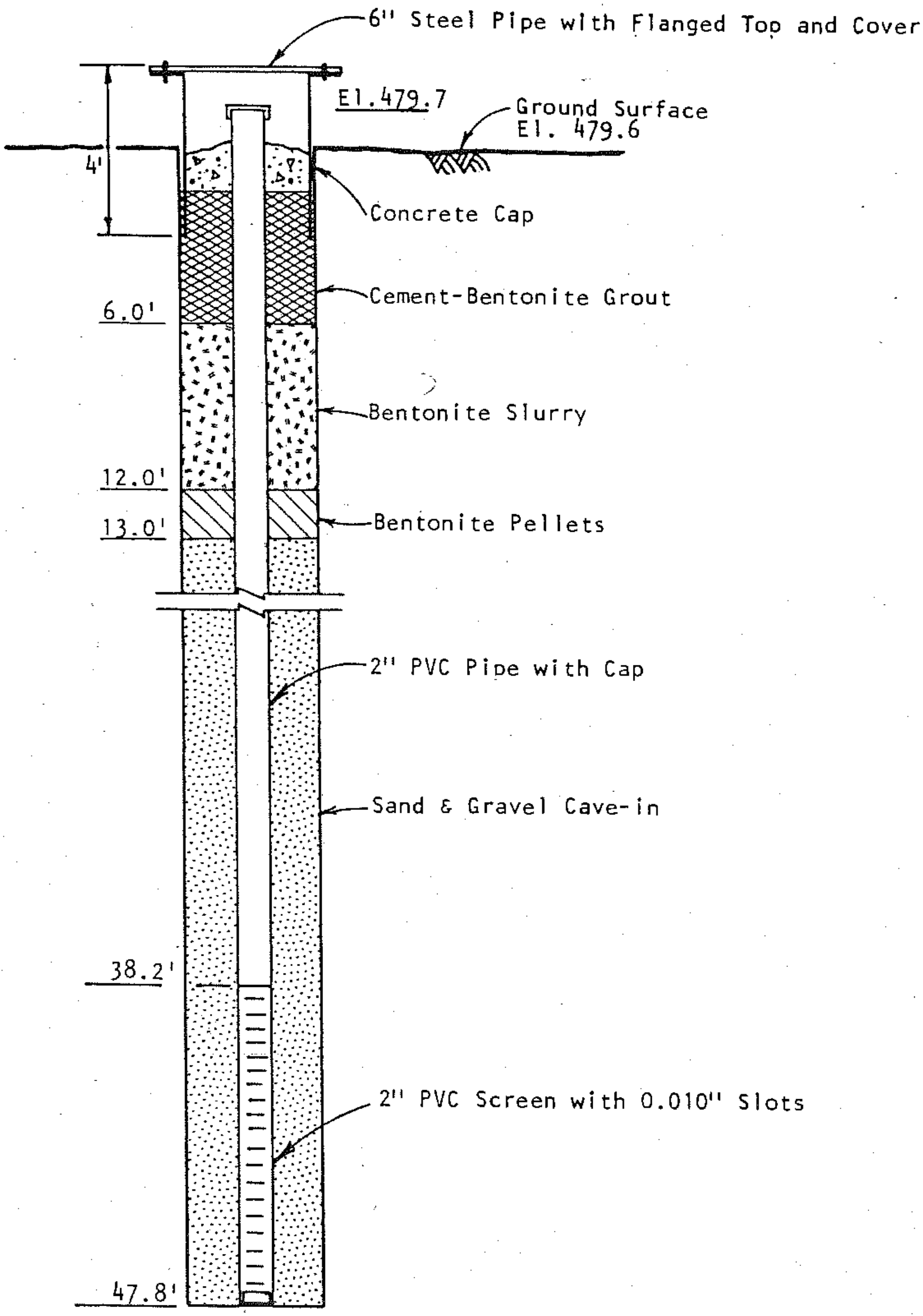
PLATE 12



Not To Scale

PIEZOMETER E-4 (Modified)

John Mathes & Associates, Inc.



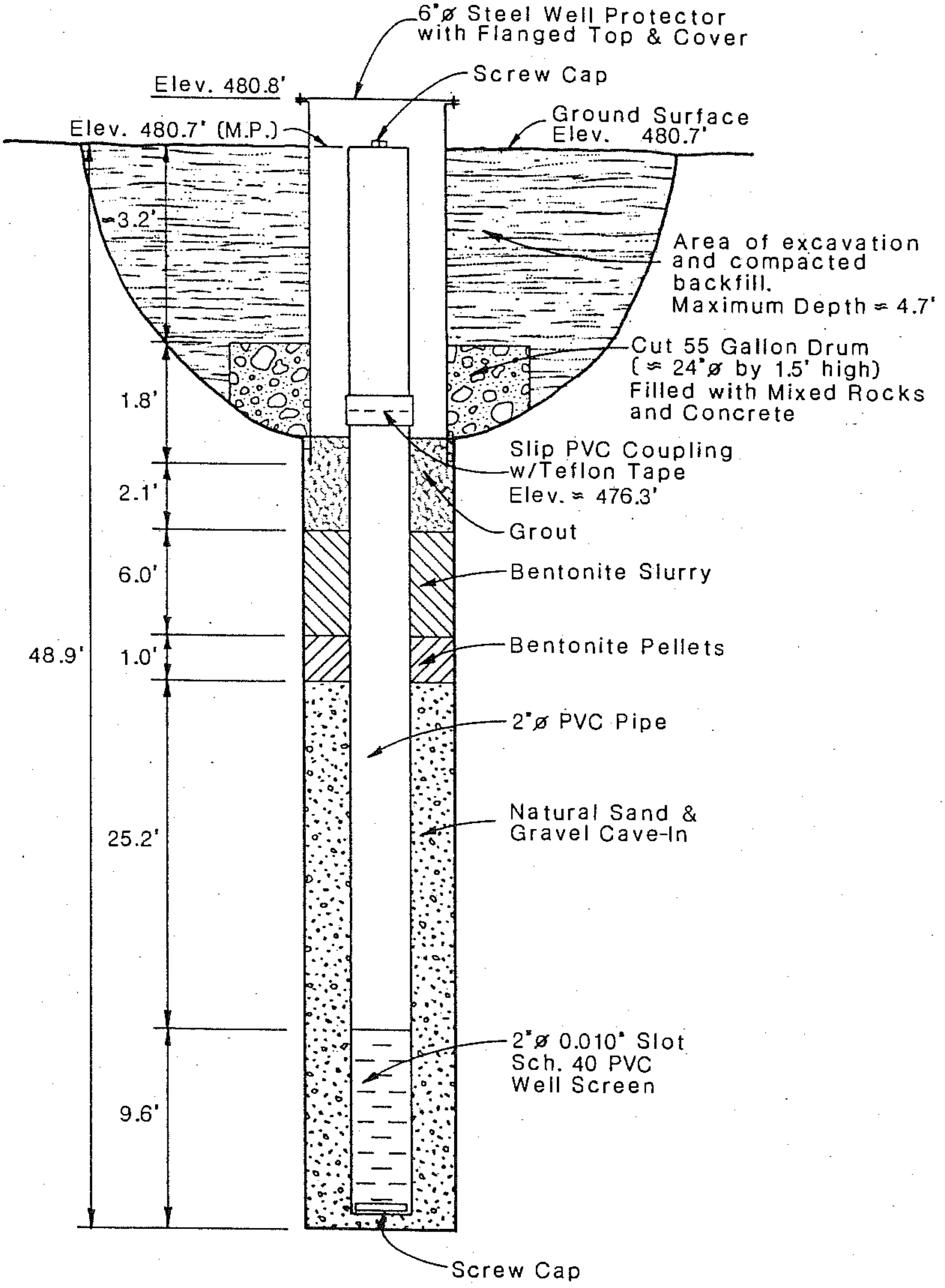
6" Borehole to Termination Depth
Borehole Enlarged to 12" in Upper Zones

Not to Scale

PIEZOMETER E-5

John Mathes & Associates, Inc.

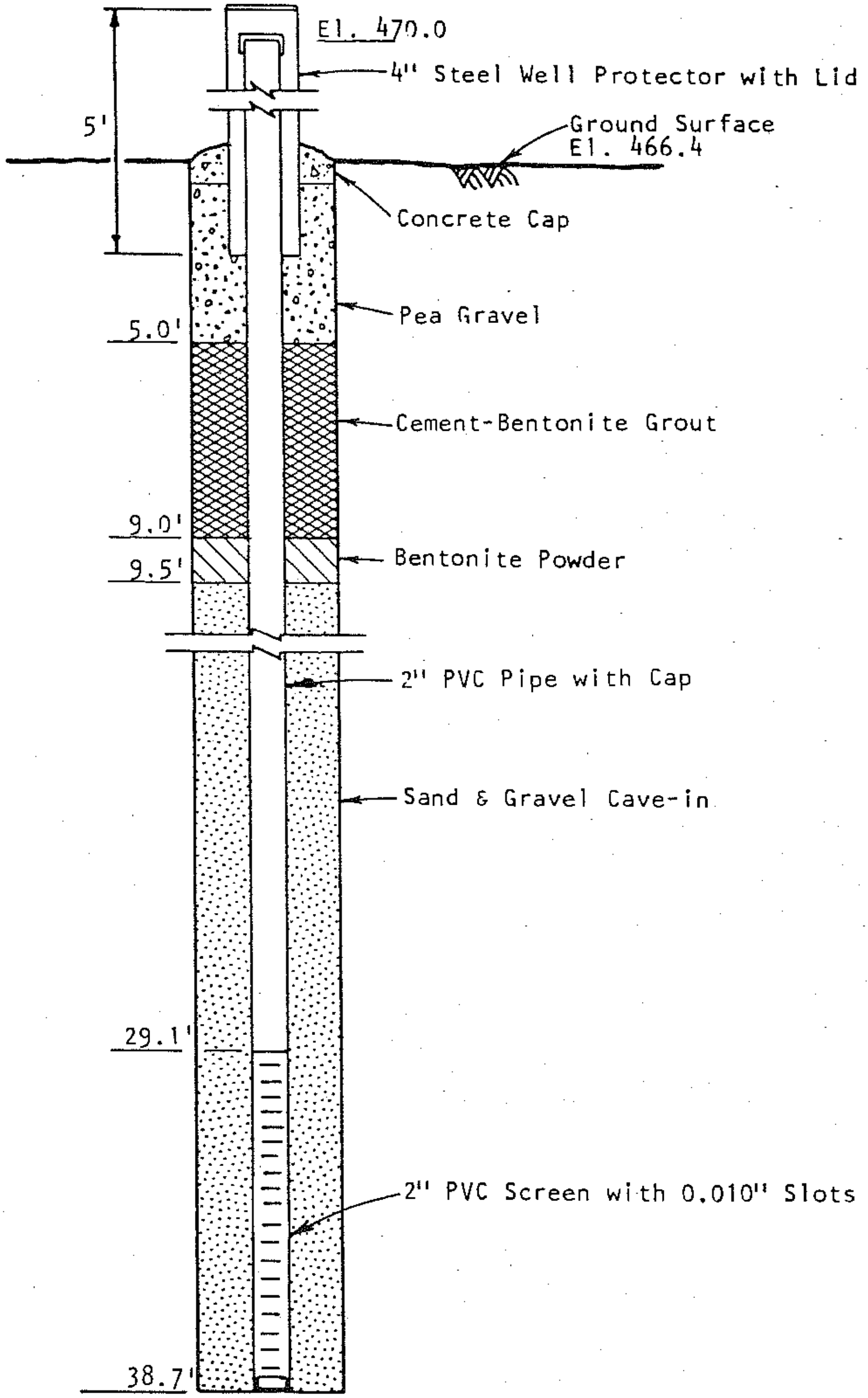
PLATE 13



Not To Scale

PIEZOMETER E-5
(Modified)

John Mathes & Associates, Inc.



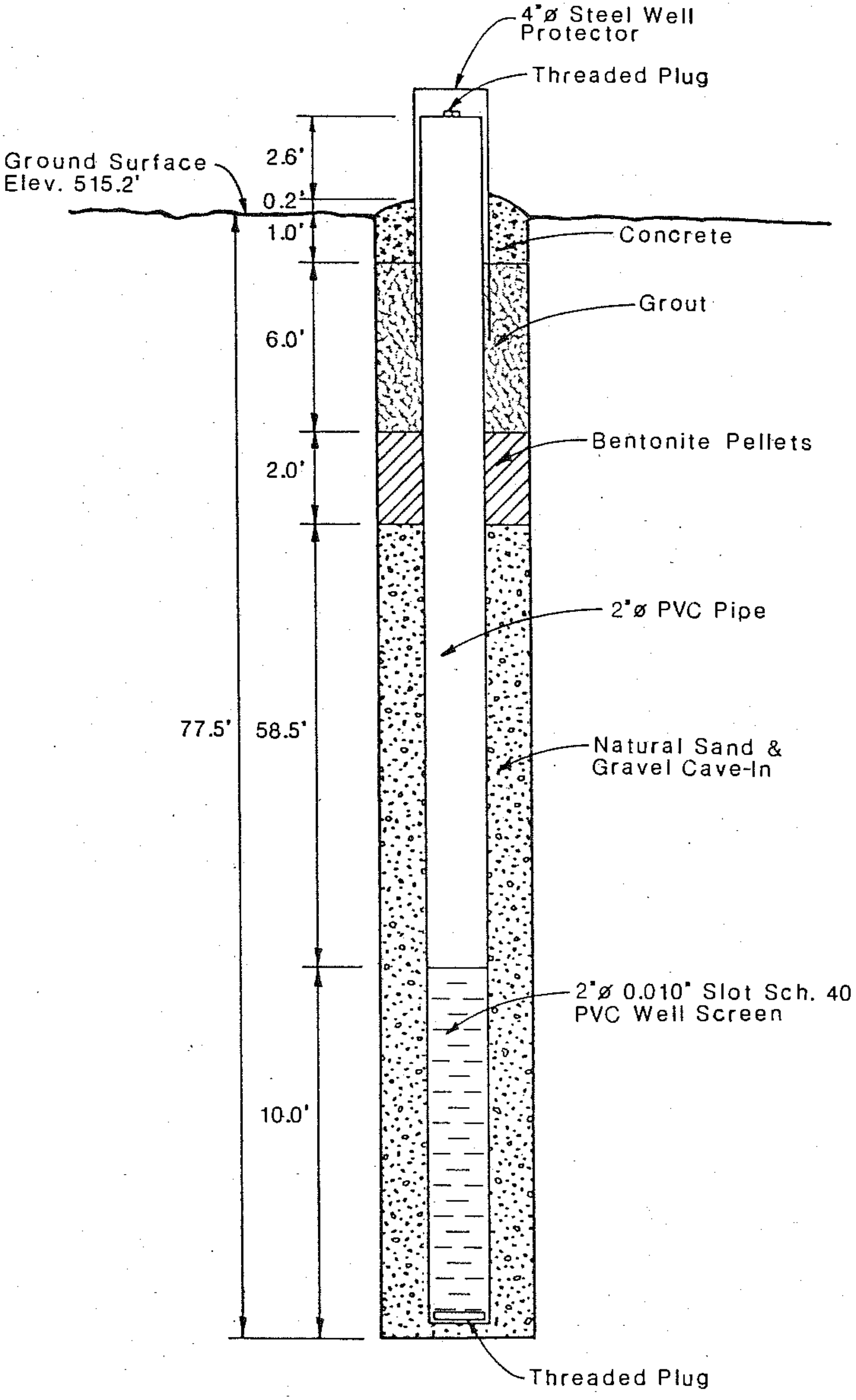
6" Borehole to Termination Depth

Not to Scale

John Mathes & Associates, Inc.

PIEZOMETER E-6

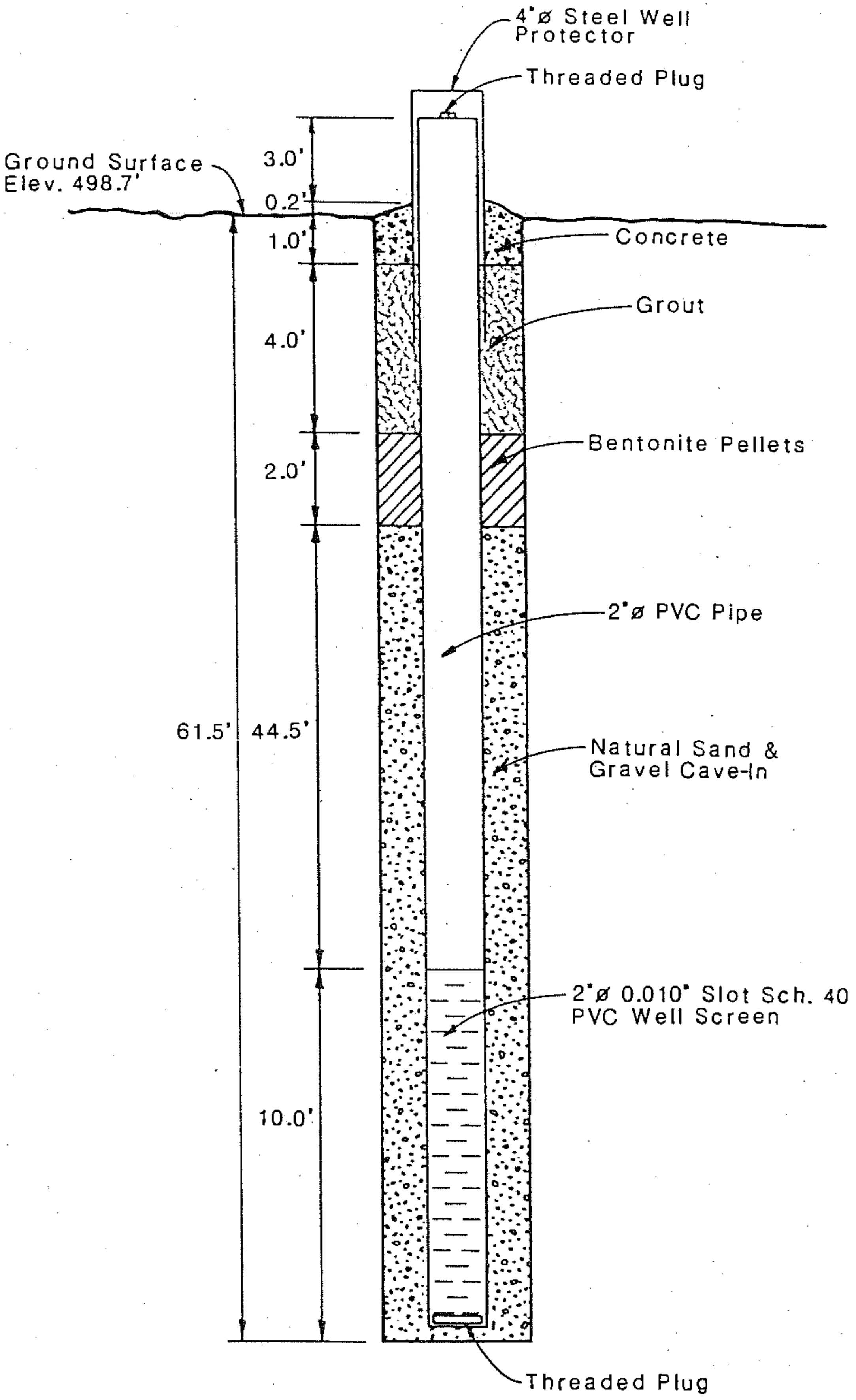
PLATE 14



Not To Scale

PIEZOMETER E-7

John Mathes & Associates, Inc.



Not To Scale

PIEZOMETER E-8B

John Mathes & Associates, Inc.

PROJECT Hydrogeologic
Hennepin Power Plant
JOB NO. 82-1293

BORING E-1
SHEET 1 **OF** 2

Soil Classification System Unified
Surface Elevation 486.1'

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS (Color Modifier MATERIAL. Classification)	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)	Shear Strength, tsf SV△ QP/2□ QU/2○ 0 ½ 1 1½ 2 2½; PL + NMC ● LL x 0 50 100; Rock Quality Designation 0 50 100
					Brown Silty CLAY w/Sand, CL			
					Brown Sandy CLAY w/Silt, Gravel, CL			
5	1	SS	30/20	1	Gray-Brown GRAVEL w/Sand Trace Clay, GP	10-24-34		
10	2	SS	18/12			38-31-14		
15	3	SS	18/5			11-44-36		
20	4	SS	13/13			16-16-17		
					-Sand Seam 22.5-23.5'			
25	5	SS	18/6			9-10-14		
30	6	SS	18/12			10-10-9		
35	7	SS	18/4			9-17-16		

DRILLING METHOD NW Casing Advancer
DATE DRILLED 11/23, 24/82
DRILLED BY Roberts
LOGGED BY Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS

Encountered at 39.3 Feet
15 Hours after completion 39.7 Feet
22 Days after completion 31.9 Feet
____ after completion ____ Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

mathes

John Mathes & Associates, Inc.

RECORD OF SUBSURFACE EXPLORATION

PROJECT Hydrogeologic Study
Hennepin Power Plant
JOB NO. 82-1293

BORING E-1
SHEET 2 OF 2

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS (Color Modifier MATERIAL. Classification) Soil Classification System Unified Surface Elevation 486.1'	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)	Shear Strength, tsf SV△ QP/2□ QU/2○ 0 ½ 1 1½ 2 2½; PL + NMC • LL x 0 50 100; ▨ Rock Quality Designation 0 50 100
	7	SS			Gray-Brown GRAVEL w/Sand Trace Clay, GP			
40	8	SS	18/9			8-11-8		
45	9	SS	18/8			8-9-8		
50	10	SS	18/3			6-17-20		
55	11	SS	18/3			15-19-21		
60	12	SS	15/7		TOB ≈426.0'	13-16-100/3"		
65								

Remarks:
1. Sample was driven 30" Blow counts are for the first 3-6" increments.

DRILLING METHOD NW Casing Advancer
DATE DRILLED 11/23, 24/82
DRILLED BY Roberts
LOGGED BY Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS

Encountered at 39.3 Feet
15 Hours after completion 39.7 Feet
22 Days after completion 31.9 Feet
___ after completion ___ Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

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John Mathes & Associates, Inc.

RECORD OF SUBSURFACE EXPLORATION

PROJECT Hydrogeologic Study
Hennepin Power Plant
JOB NO. 82-1293

BORING E-2
SHEET 1 OF 2

DESCRIPTION OF MATERIALS
(Color Modifier MATERIAL. Classification)
Soil Classification System Unified
Surface Elevation 488.8'

Shear Strength, tsf: SV△ QP/2□ QU/2○ — 0, ½, 1, 1½, 2, 2½
PL + NMC ● LL x — 0, 50, 100
Rock Quality Designation — 0, 50, 100

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)
					Brown Silty CLAY, CL		
					Brown GRAVEL w/ Sand, Clay, GC		
5	1	SS	18/4			5-2-22	
10	2	SS	18/12		Brown Medium-Coarse SAND w/ Gravel, Clay, SC	10-23-19	
15	3	SS	18/8			15-14-11	
20	4	SS	18/10			8-17-12	
25	5	SS	18/5		Gray-Brown GRAVEL w/Sand, GP	49-27-25	
30	6	SS	18/8		Gray-Brown Fine SAND Trace Silt, SP-SM	15-12-9	
35	7	SS	18/14			7-10-13	

DRILLING METHOD NW Casing Advancer
DATE DRILLED 11/24, 29/82
DRILLED BY Roberts
LOGGED BY Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS

Encountered at — Feet
15 Hours after completion 42.1 Feet
17 Days after completion 34.3 Feet
— after completion — Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

John Mathes & Associates, Inc.

RECORD OF SUBSURFACE EXPLORATION

PROJECT Hydrogeologic Study
Hennepin Power Plant
JOB NO. 82-1293

BORING E-2
SHEET 2 OF 2

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS (Color Modifier MATERIAL. Classification) Soil Classification System Unified Surface Elevation 488.8'	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)	Shear Strength, tsf SV△ QP/2□ QU/2○ 0 ½ 1 1½ 2 2½ PL + NMC ● LL x 0 50 100 ▮ Rock Quality Designation 0 50 100
	7	SS	18/14		Gray-Brown Fine SAND Trace Silt, SP-SM	7-10-13		
40	8	SS	18/18		-Clay Seam 40.2-41.1' Brown Silty Fine SAND, SM -Black Peat @ 45.3'	5-8-10		●
45	9	SS	18/10		Gray-Brown Sandy GRAVEL Trace Clay, GP	8-9-10		
50	10	SS	18/8			34-29-32		
55	11	SS	18/6		Brown Medium SAND Trace Coarse, SP TOB ~ 433.0'	5-18-16		
60								

DRILLING METHOD NW Casing Advancer
DATE DRILLED 11/24, 29/82
DRILLED BY Roberts
LOGGED BY Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS

Encountered at — Feet
15 Hours after completion 42.1 Feet
17 Days after completion 34.3 Feet
after completion Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

mathes

John Mathes & Associates, Inc.

RECORD OF SUBSURFACE EXPLORATION

PROJECT Hydrogeologic Study
Hennepin Power Plant
JOB NO. 82-1293

BORING E-3
SHEET 1 **OF** 2

DESCRIPTION OF MATERIALS
(Color Modifier MATERIAL. Classification)
Soil Classification System Unified
Surface Elevation 481.4'

Shear Strength, tsf: SV△ QP/2□ QU/2○ — 0, ½, 1, 1½, 2, 2½
PL + NMC • LL x — 0, 50, 100
▨ Rock Quality Designation — 0, 50, 100

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)
					Brown GRAVEL w/Sand Trace Clay, FILL, GP		
5	1	SS	18/12			7-27-32	
					Dark Gray FLYASH, FILL, ML.		
10	2	SS	18/15			3-5-5	
					Dark Gray Brown Fine SAND w/Flyash, FILL, SP		
15	3	SS	18/4			3-5-10	
					Dark Gray FLYASH w/Bottom Ash, FILL, ML		
20	4	SS	18/15			4-8-14	
25	5	SS	18/16			11-23-19	
					Gray-Brown Sandy GRAVEL, GP		
30	6	SS	18/13			16-30-40	
					Gray-Brown GRAVEL w/Sand Trace Clay, GP-GC		
35	7	SS	18/15			27-49-29	

DRILLING METHOD Hollow Auger
DATE DRILLED 12/1/82
DRILLED BY Roberts
LOGGED BY Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS

Encountered at 34.6 Feet
0 Hours after completion 38.0 Feet
15 Days after completion 27.8 Feet
____ after completion ____ Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

mathes

John Mathes & Associates, Inc.

PROJECT Hydrogeologic Study
Hennepin Power Plant
JOB NO. 82-1293

BORING E-3
SHEET 2 **OF** 2

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS (Color Modifier MATERIAL. Classification) Soil Classification System Unified Surface Elevation 481.4'	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)	Shear Strength, tsf SV△ QP/2□ QU/2○ 0 ½ 1 1½ 2 2½; PL + NMC • LL x 0 50 100; ▇ Rock Quality Designation 0 50 100
	7	SS			Gray-Brown GRAVEL w/Sand Trace Clay, GP-GC			
40	8	SS	18/11			12-11-11		
45	9	SS	18/8			6-8-8		
50	10	SS	18/5			6-7-9		
55	11	SS	18/8		TOB ~426.0'	11-10-11		
60								

DRILLING METHOD Hollow Auger
DATE DRILLED 12/1/82
DRILLED BY Roberts
LOGGED BY Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS
Encountered at 34.6 Feet
0 Hours after completion 38.0 Feet
15 Days after completion 27.8 Feet
___ after completion ___ Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

John Mathes & Associates, Inc.

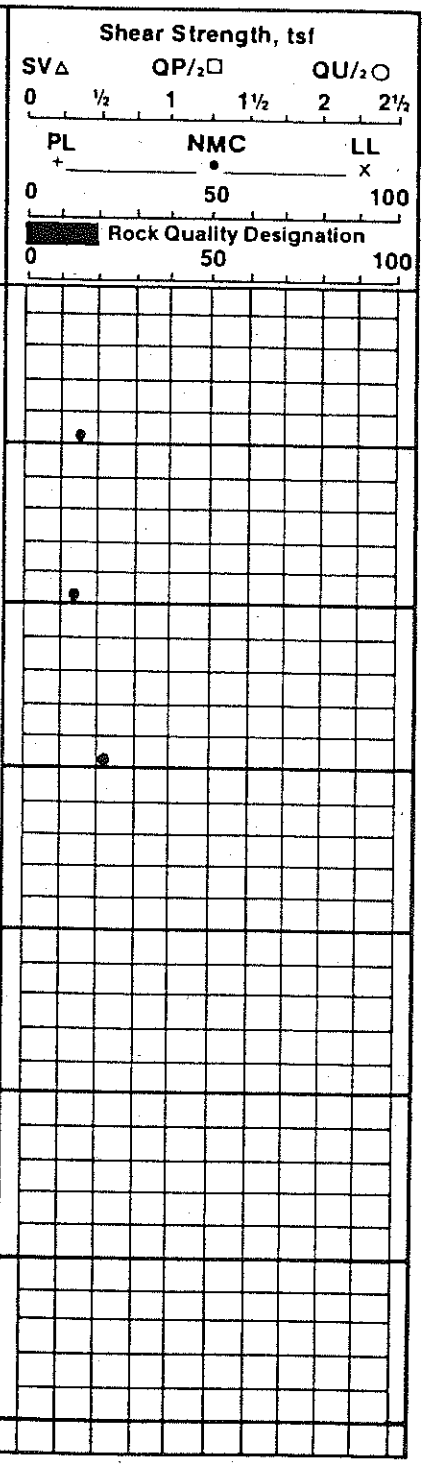
RECORD OF SUBSURFACE EXPLORATION

PROJECT Hydrogeologic Study
Hennepin Power Plant
JOB NO. 82-1293

BORING E-4
SHEET 1 **OF** 2

DESCRIPTION OF MATERIALS
(Color Modifier MATERIAL. Classification)
Soil Classification System Unified
Surface Elevation 477.4'

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)
	1	AS			Gray-Brown GRAVEL w/Sand Trace Clay, FILL, GP		
5	2	SS	18/18		Dark Gray Silty CLAY Trace Coal, Gravel, FILL, CL	8-12-15	
					Gray-Brown Clayey SILT w/Sand Trace Gravel, FILL, ML		
10	3	SS	18/15			4-6-12	
					Gray GRAVEL w/Silt, Clay Trace FlyAsh, Fill, GC		
15	4	SS	18/15		Gray FLYASH, FILL, ML	19-19-18	
					Brown Fine SAND w/Gravel, SP		
20	5	SS	18/6			3-22-31	
					Gray-Brown Sandy GRAVEL, GP		
25	6	SS	18/13			15-15-15	
					Gray-Brown GRAVEL w/Sand Trace Clay, GP		
30	7	SS	18/18			14-33-38	
					Gray-Brown Sandy GRAVEL, GP		
35	8	SS	18/16			8-28-41	



DRILLING METHOD Hollow Auger
DATE DRILLED 12/23/82
DRILLED BY Roberts
LOGGED BY Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS
Encountered at 28.9 Feet
0 Hours after completion 27.0 Feet
13 Days after completion 24.5 Feet
after completion Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

John Mathes & Associates, Inc.

RECORD OF SUBSURFACE EXPLORATION

PROJECT Hydrogeologic Study
Hennepin Power Plant
JOB NO. 82-1293

BORING E-4
SHEET 2 **OF** 2

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS (Color Modifier MATERIAL. Classification) Soil Classification System Unified Surface Elevation 477.4'	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)	Shear Strength, tsf SV△ QP/2□ QU/2○ 0 ½ 1 1½ 2 2½; PL + NMC ● LL x 0 50 100; Rock Quality Designation 0 50 100
	8	SS			Gray-Brown Sandy GRAVEL, GP			
					Gray-Brown GRAVEL w/Sand, Silt, GM			
40	9	SS	18/7			5-9-13		
					Gray CLAY, CH			
45	10	SS	15/9		TOB ~432.0'	32-50 50/3"		●
50								

DRILLING METHOD Hollow Auger
DATE DRILLED 12/23/82
DRILLED BY Roberts
LOGGED BY Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS

Encountered at 28.9 Feet
0 Hours after completion 27.0 Feet
13 Days after completion 24.5 Feet
____ after completion ____ Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

mathes

John Mathes & Associates, Inc.

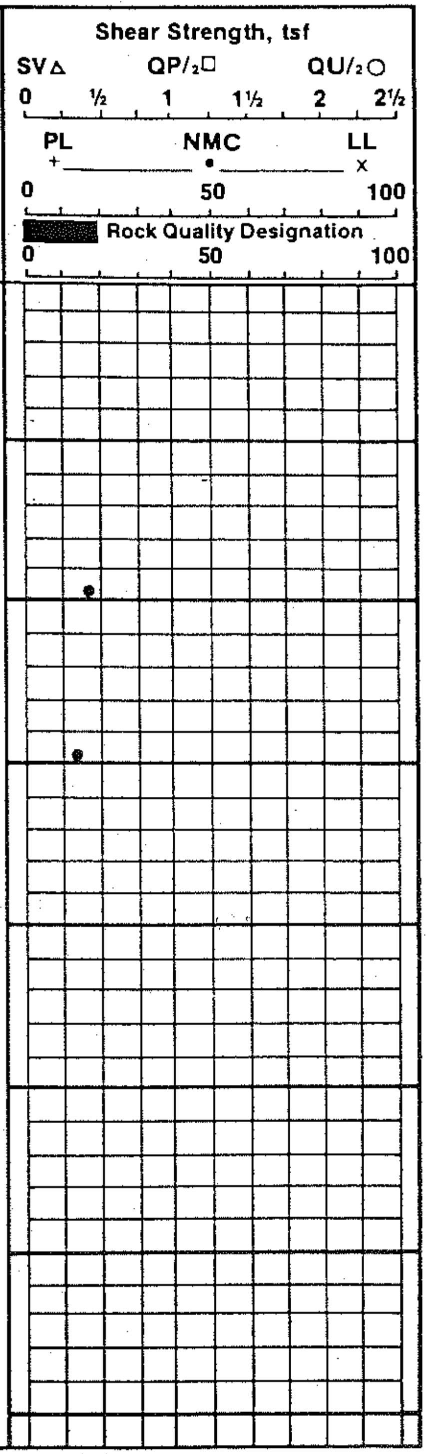
RECORD OF SUBSURFACE EXPLORATION

PROJECT Hydrogeologic Study
Hennepin Power Plant
JOB NO. 82-1293

BORING E-5
SHEET 1 OF 2

Soil Classification System Unified
Surface Elevation 479.6'

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS (Color Modifier MATERIAL. Classification)	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)
					Gray-Brown Gravel w/Sand Trace Clay, FILL, GP		
5	1	SS	18/8			5-14-19	
					Gray FLYASH w/Bottom Ash, Fill, ML		
10	2	SS	18/12			4-5-5	
				1	Brown Silty Fine SAND w/Gravel, SM		
15	3	SS	18/13		Gray-Brown Gravel w/Sand, GP	4-14-10	
	3A	AS			Brown Clayey SAND, SC		
					Brown Fine SAND, SP		
20	4	SS	18/3		Gray-Brown Sandy Gravel, GP	8-24-49	
25	5	SS	18/10			6-32-27	
30	6	SS	14/11			8-34-50/2"	
					Gray-Brown Fine-Medium SAND SP		
35	7	SS	18/16		Gray-Brown GRAVEL w/Sand, Silt, GP-GM	12-12-20	



DRILLING METHOD Hollow Auger
DATE DRILLED 12/6 /82
DRILLED BY Roberts
LOGGED BY Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS

Encountered at 27.3 Feet
0 Hours after completion 29.0 Feet
16 Hrs. after completion 23.3 Feet
10 Days after completion 25.7 Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

John Mathes & Associates, Inc.

RECORD OF SUBSURFACE EXPLORATION

PROJECT Hydrogeologic Study
Hennepin Power Plant
JOB NO. 82-1293

BORING E-5
SHEET 2 **OF** 2

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	**DESCRIPTION OF MATERIALS** (Color Modifier MATERIAL. Classification) Soil Classification System Unified Surface Elevation 479.6'	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)	Shear Strength, tsf SV△ QP/2□ QU/2○ 0 ½ 1 1½ 2 2½ PL + NMC ● LL x 0 50 100 Rock Quality Designation 0 50 100
	7	SS			Gray-Brown GRAVEL w/Sand, Silt GP-GM			
40	8	SS	18/15		Gray-Brown Silty GRAVEL w/SAND, GM Brown GRAVEL w/Sand Trace Silt GP-GM	15-45-16		
45	9	SS	18/11			3-9-12		
50	10	SS	18/6		TOB ~ 429.0'	2-10-11		
55								

Remarks:
1. Rough Drilling @ 11.5' Boulders could not penetrate offset 7.0' East & Augered to 14.0' without sampling.

DRILLING METHOD Hollow Auger
DATE DRILLED 12/6/82
DRILLED BY Roberts
LOGGED BY Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS

Encountered at 27.3 Feet
0 Hours after completion 29.0 Feet
16 Hrs. after completion 23.3 Feet
10 Days after completion 25.7 Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

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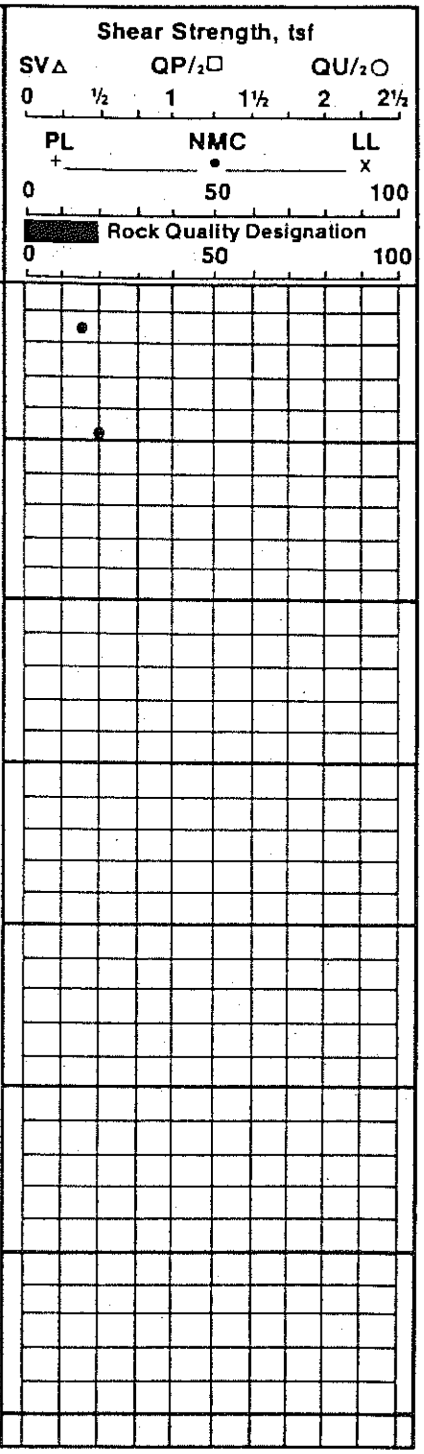
John Mathes & Associates, Inc.

RECORD OF SUBSURFACE EXPLORATION

PROJECT Hydrogeologic Study
Hennepin Power Plant
JOB NO. 82-1293

BORING E-6
SHEET 1 **OF** 2

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS (Color Modifier MATERIAL, Classification) Soil Classification System Unified Surface Elevation 466.4'	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)
	1	AS			Dark Brown Silty CLAY w/Sand, CL		
5	2	SS	18/8		Brown Sandy CLAY w/Gravel, CL	3-3-2	
					Gray-Brown Sandy GRAVEL, GP		
10	3	SS	18/9			12-12-13	
15	4	SS	18/10		Gray-Brown GRAVEL w/Sand Trace Clay, GP	9-30-35	
20	5	SS	4/4			50/4"	
25	6	SS	18/6			6-10-14	
30	7	SS	18/4			3-5-7	
35	8	SS	18/7			5-7-12	



DRILLING METHOD Hollow Auger
DATE DRILLED 12/8/82
DRILLED BY Roberts
LOGGED BY Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS
Encountered at 18.0 Feet
___ Hours after completion ___ Feet
8 Days after completion 12.4 Feet
___ after completion ___ Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

John Mathes & Associates, Inc.

RECORD OF SUBSURFACE EXPLORATION

PROJECT Hydrogeologic Study
Hennepin Power Plant
JOB NO. 82-1293

BORING E-6
SHEET 2 **OF** 2

DEPTH (ft)	SAMPLE NUMBER	 INTERVAL AND TYPE	 ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS (Color Modifier MATERIAL. Classification) Soil Classification System Unified Surface Elevation 466.4'	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)	Shear Strength, tsf SV△ QP/2□ QU/2○ 0 ½ 1 1½ 2 2½ PL + NMC • LL x 0 50 100 ▩ Rock Quality Designation 0 50 100
	8	SS			Gray-Brown GRAVEL w/Sand Trace Clay, GP			
40	9	SS	18/6		TOB ~ 426.0'	5-6-6		

DRILLING METHOD Hollow Auger
DATE DRILLED 12/8/82
DRILLED BY Roberts
LOGGED BY Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS

Encountered at 18.0 Feet
____ Hours after completion ____ Feet
8 Days after completion 12.4 Feet
____ after completion ____ Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

John Mathes & Associates, Inc.

RECORD OF SUBSURFACE EXPLORATION

PROJECT I.P. Hennepin, Hydrogeologic Investigation

JOB NO. 04-1934

BORING E-7

SHEET 1 OF 3

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS (Color Modifier MATERIAL, Classification) Soil Classification System Unified Surface Elevation 515.2'	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)	Shear Strength, tsf SV△ QP/2□ QU/2○ 0 ½ 1 1½ 2 2½ PL + NMC ● LL x 0 50 100 Rock Quality Designation 0 50 100
					Brown Fine SAND w/Silt, SM			
5	1	SS	18/18			4-6-6		
					Brown Fine SAND w/Coarse Trace Gravel, Silt, SP			
10	2	SS	18/14			7-7-8		
					Brown Gravelly Medium-Coarse SAND w/Fine, Silt, SM			
15	3	SS	18/16			18-35-33		
20	4	SS	18/12			18-34-31		
25	5	SS	18/6			36-48-51		
					Brown Gravelly Fine SAND w/Medium Trace Silt, SP-SM			
30	6	SS	18/-			17-31-44		
					Brown Gravelly Medium-Coarse SAND w/Silt, SM			
35	7	SS	18/-			19-29-37		

DRILLING METHOD Casing Advancer & NW

DATE DRILLED 11/13-15/84

DRILLED BY Maniaci

LOGGED BY Hebel/Maxeiner

PIEZOMETER Yes

GROUNDWATER LEVELS

Encountered at - Feet

Hours after completion Feet

after completion Feet

after completion Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

John Mathes & Associates, Inc.

RECORD OF SUBSURFACE EXPLORATION

PROJECT I.P. Hennepin, Hydrogeologic Investigation

JOB NO. 04-1934

BORING E-7

SHEET 2 OF 3

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS (Color Modifier MATERIAL. Classification) Soil Classification System Unified Surface Elevation 515.2'	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)	Shear Strength, tsf SV△ QP/₂□ QU/₂○ 0 ½ 1 1½ 2 2½ PL + NMC ● LL x 0 50 100 ▬ Rock Quality Designation 0 50 100
					Brown Gravelly Medium-Coarse SAND w/Silt, SM			
40	8	SS	18/12			10-23-27		
45	9	SS	18/14			12-20-25		
50	10	SS	18/11			14-31-36		
55	11	SS	18/14		- Boulders 55.0-57.0'	16-46-52		
					Gray Fine-Medium SAND Trace Coarse, SP			
60	12	SS	18/3			12-22-30		
65	13	SS	18/12			18-27-43		
70	14	SS	18/12			20-22-34		

DRILLING METHOD Casing Advancer & NW

DATE DRILLED 11/13-15/84

DRILLED BY Maniaci

LOGGED BY Hebel/Maxeiner

PIEZOMETER Yes

GROUNDWATER LEVELS

Encountered at ______ Feet

____ Hours after completion ____ Feet

____ after completion ____ Feet

____ after completion ____ Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

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RECORD OF SUBSURFACE EXPLORATION

PROJECT I. P. Hennepin, Hydrogeologic Investigation
BORING E-7
SHEET 3 OF 3
JOB NO. 04-1934

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS (Color Modifier MATERIAL. Classification) Soil Classification System Unified Surface Elevation 515.2'	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)	Shear Strength, tsf SV△ QP/2□ QU/2○ 0 ½ 1 1½ 2 2½ PL + NMC • LL x 0 50 100 ▬ Rock Quality Designation 0 50 100
					Gr Fi-Med SAND Tr Co, SP			
					Gray Medium SAND w/Fine Trace Gravel, SP			
	15	SS	18/10			15-15-22		
75								
					TOB			
80								
85								
90								
95								
100								
105								

DRILLING METHOD Casing Advancer & NW
DATE DRILLED 11/13-15/84
DRILLED BY Maniaci
LOGGED BY Hebel/Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS

Encountered at - Feet
___ Hours after completion ___ Feet
___ after completion ___ Feet
___ after completion ___ Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

John Mathes & Associates, Inc.

RECORD OF SUBSURFACE EXPLORATION

PROJECT I. P. Hennepin, Hydrogeologic Investigation
JOB NO. 04-1934
BORING E-8B
SHEET 1 OF 2

DEPTH (ft)	SAMPLE			SEE REMARK #	DESCRIPTION OF MATERIALS (Color Modifier MATERIAL. Classification) Soil Classification System Unified Surface Elevation 498.7'	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)	Shear Strength, tsf SV△ QP/2□ QU/2○ 0 ½ 1 1½ 2 2½ PL + NMC ● LL x 0 50 100 ▇ Rock Quality Designation 0 50 100
	NUMBER	INTERVAL AND TYPE	ADVANCED / RECOVERED (in)					
					Dark Brown Silty CLAY w/Sand Trace Gravel, CL			
5	1	SS	18/14			6-11-13		
					Brown Sandy GRAVEL Trace Clay, Silt, GC-GP			
	2	SS	18/12			11-9-7		
10								
	3	SS	18/12			5-7-8		
15								
	4	SS	18/12			5-5-10		
20								
					Gray Medium-Coarse SAND w/Fine, SP			
	5	SS	18/14			5-6-9		
25								
	6	SS	18/0			11-15-18		
30								
					Brown Fine SAND w/Silt Trace Clay, SM			
	7	SS	18/12			3-10-10		
35								

DRILLING METHOD Casing Advancer & NW
DATE DRILLED 11/16-17/84
DRILLED BY Maniaci
LOGGED BY Hebel/Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS

Encountered at - Feet
___ Hours after completion ___ Feet
___ after completion ___ Feet
___ after completion ___ Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

mathes

John Mathes & Associates, Inc.

RECORD OF SUBSURFACE EXPLORATION

PROJECT I. P. Hennepin, Hydrogeologic Investigation

JOB NO. 04-1934

BORING E-8B

SHEET 2 OF 2

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS (Color Modifier MATERIAL. Classification) Soil Classification System Unified Surface Elevation 498.7'	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)	Shear Strength, tsf SV△ QP/2□ QU/2○ 0 ½ 1 1½ 2 2½ PL + NMC • LL x 0 50 100 ▆ Rock Quality Designation 0 50 100
					Brown Fine SAND w/Silt Trace Clay, SM			
	8	SS	18/14			3-7-9		
40								
	9	SS	18/16		-w/Gravel @ 43.0'	4-7-10		
45								
	10	SS	13/14			12-10-12		
50								
	11	SS	18/10		-Trace Gravel @ 53.0'	5-8-11		
55								
	12	SS	18/10		Brown Sandy GRAVEL w/Silt, Clay, GC-GM	25-30-33		
60								
					TOB			
65								
70								

DRILLING METHOD Casing Advancer & NW

DATE DRILLED 11/16-17/84

DRILLED BY Maniaci

LOGGED BY Hebel/Maxeiner

PIEZOMETER Yes

GROUNDWATER LEVELS

Encountered at ____ Feet

____ Hours after completion ____ Feet

____ after completion ____ Feet

____ after completion ____ Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

John Mathes & Associates, Inc.

Appendix A2

STMI Boring Logs and Well Details

Monitoring Well No. 10

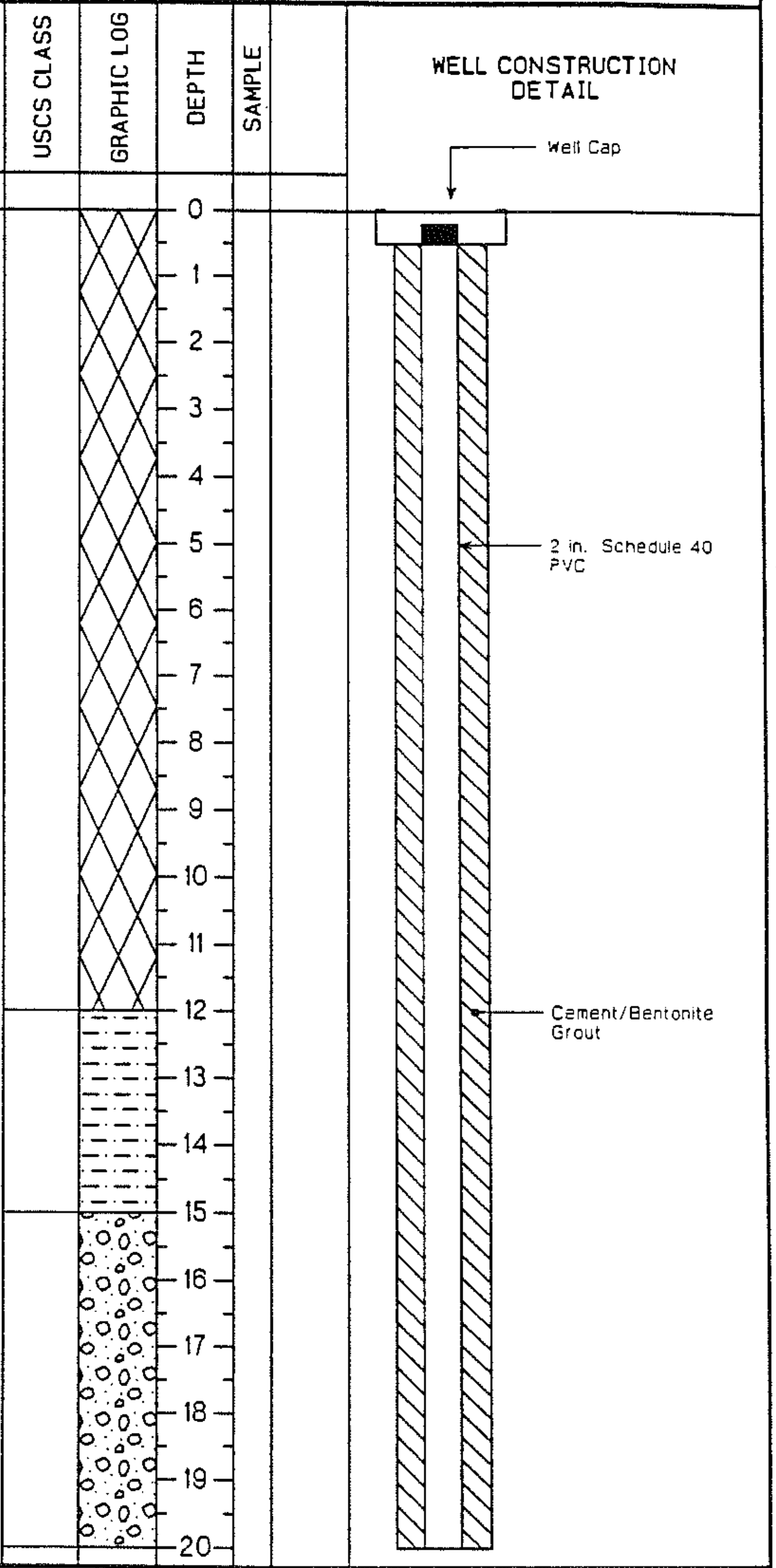
PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-28-95
HOLE DIA.: 6 in.
GW DEPTH: Not Measured ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core Barrel
HOLE ELEV.: 495.10 ft. MSL

DESCRIPTION

Blind Drilling (Refer to boring log for MW 11 for lithologic descriptions)



STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

Sample 10-1 was collected between 45-55 feet

Project No.
135-1.21

Page 1 of 3

Monitoring Well No. 10

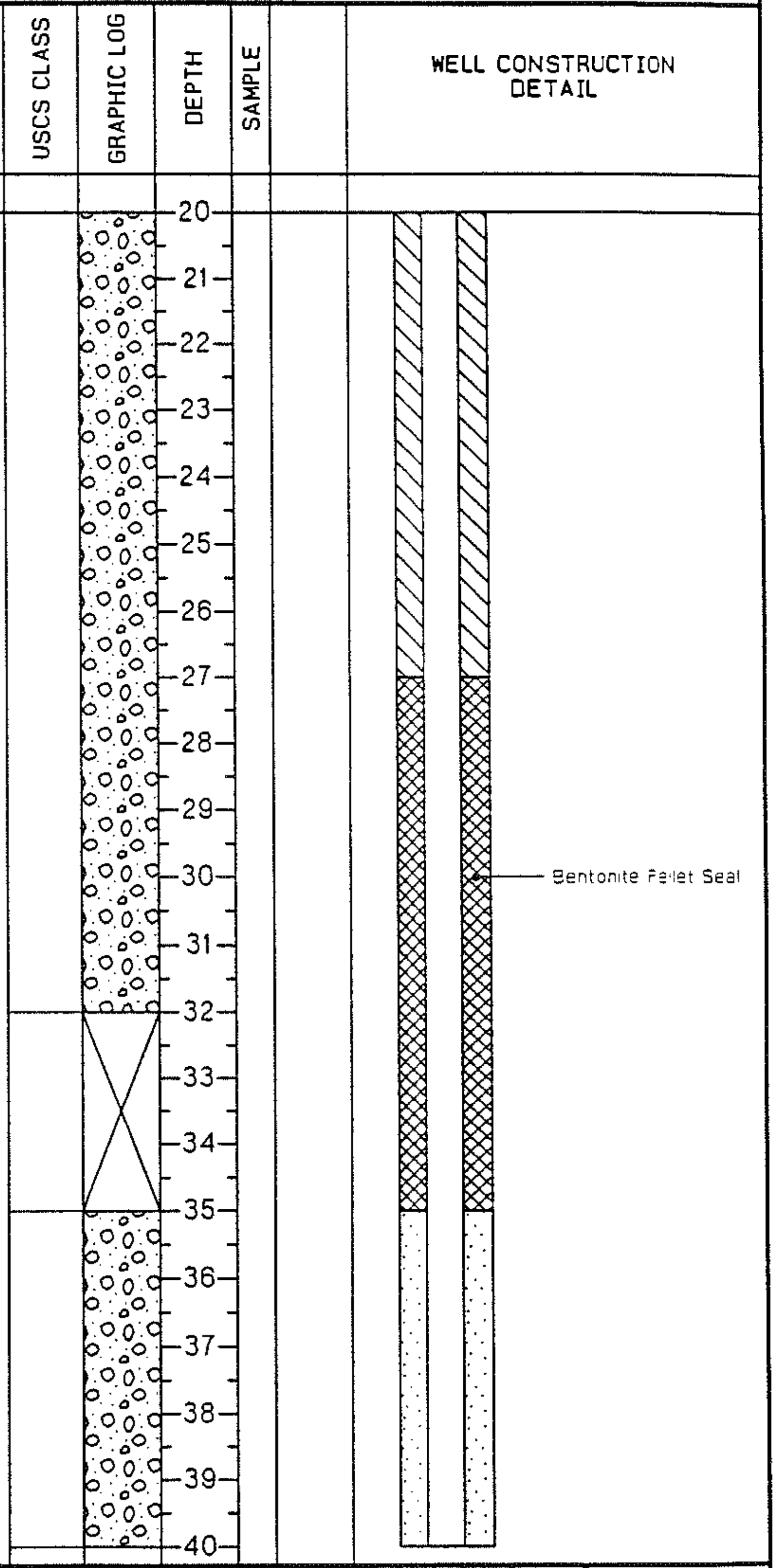
PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-28-95
HOLE DIA.: 6 in.
GW DEPTH: Not Measured ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core Barrel
HOLE ELEV.: 495.10 ft. MSL

DESCRIPTION

Blind Drilling (Refer to boring log for MW 11 for lithologic descriptions)



STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

Sample 10-1 was collected between 45-55 feet

Project No.
135-1.21

Monitoring Well No. 10

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

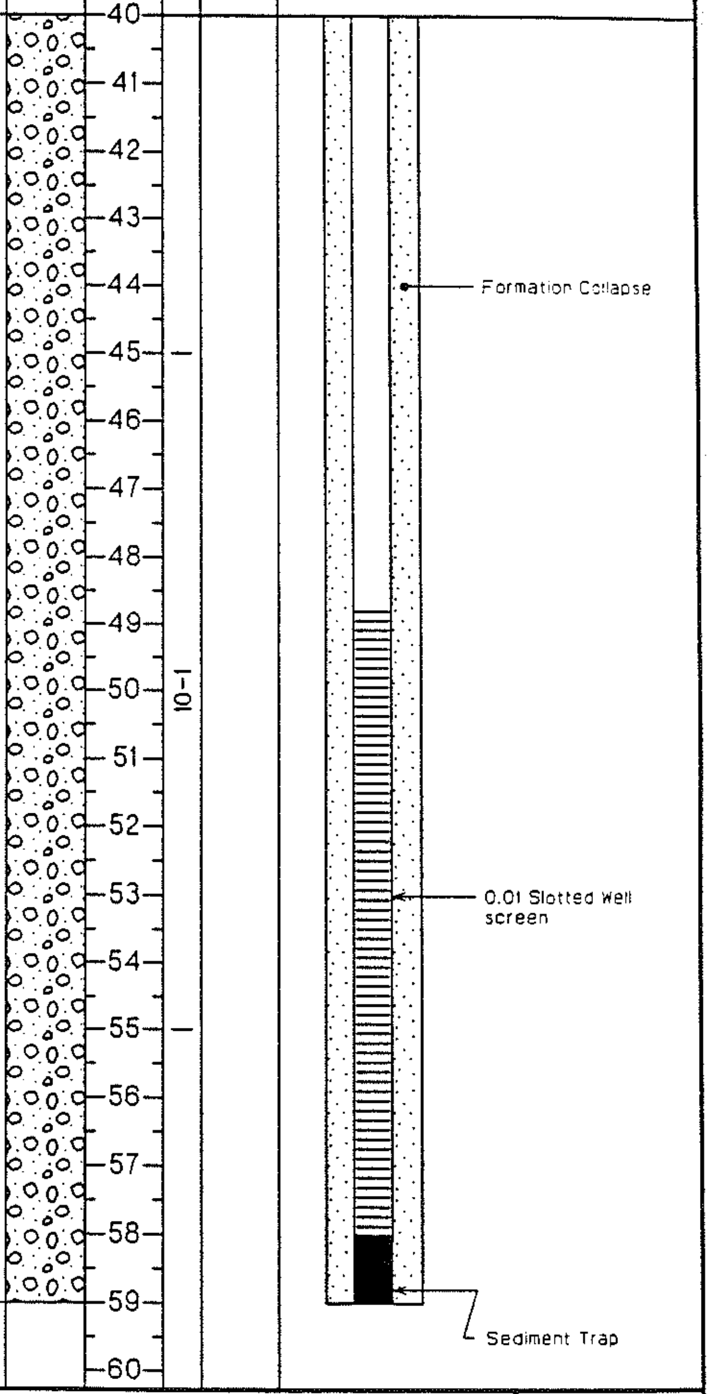
DATE: 03-28-95
HOLE DIA.: 6 in.
GW DEPTH: Not Measured ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core Barrel
HOLE ELEV.: 495.10 ft. MSL

DESCRIPTION | USCS CLASS | GRAPHIC LOG | DEPTH | SAMPLE | WELL CONSTRUCTION DETAIL

Clean, fine to coarse gravels w/ cobbles up to 4" in diameter, well rounded to subangular

Blind Drilling (Refer to boring log for MW 11 for lithologic descriptions)



STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:
Sample 10-1 was collected between 45-55 feet

Project No.
135-1.21

Monitoring Well No. 11

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-27-95
HOLE DIA.: 6 in.
GW DEPTH: 50 ft.

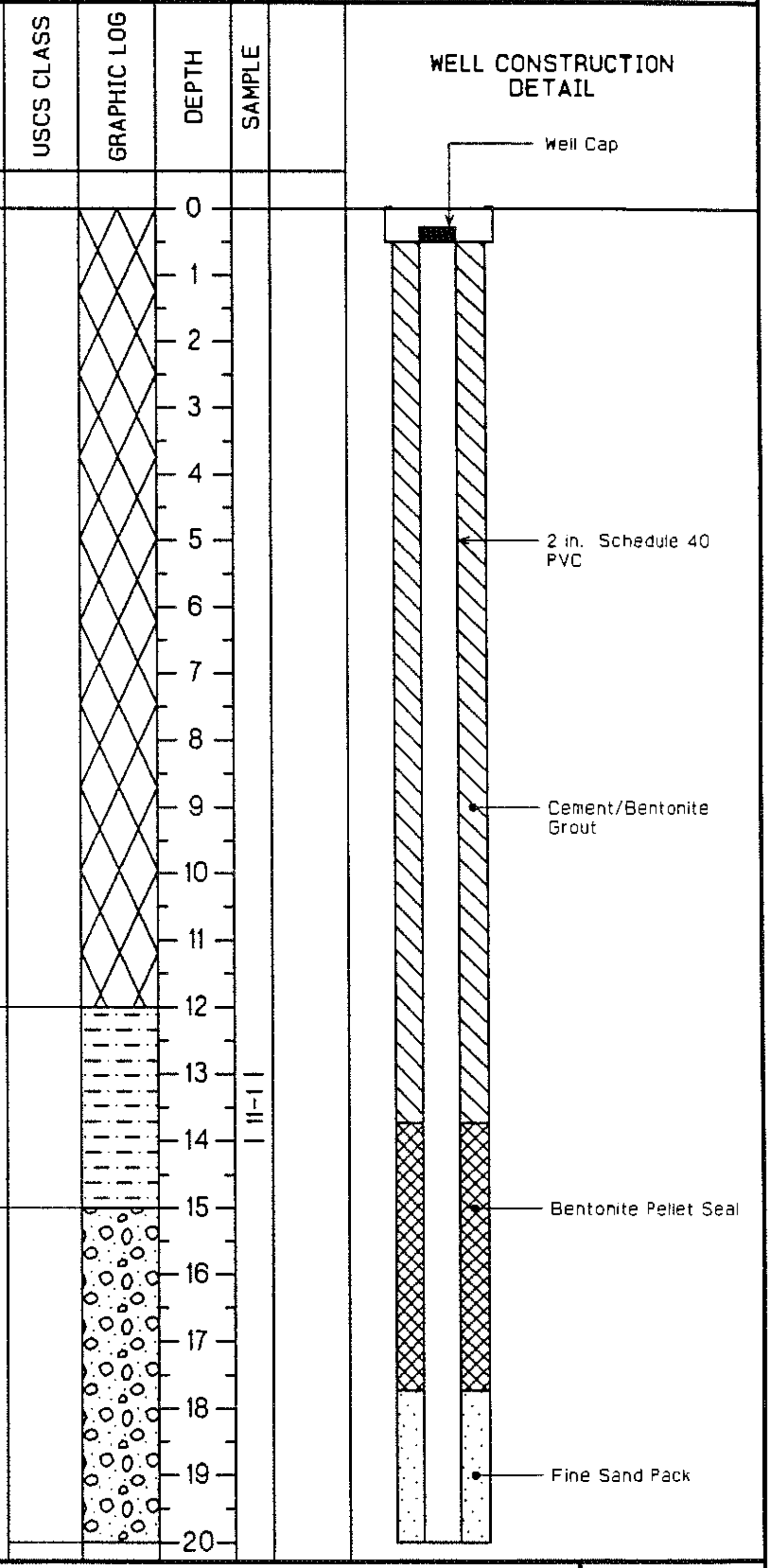
LOGGED BY: Hensel/Tu
SAMPLER: Core barrel
HOLE ELEV.: 494.84 ft. MSL

DESCRIPTION

Fill, consisting of poorly sorted sand, gravels (gravels up to 3") and crushed limestone

Olive, silty clay w/ gravels up to 2", and some fine sand

Dry, brown, med sand to coarse gravel, cobbles up to 4"



STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

Continuously sampled bore-hole. Sample numbers refer to saved samples

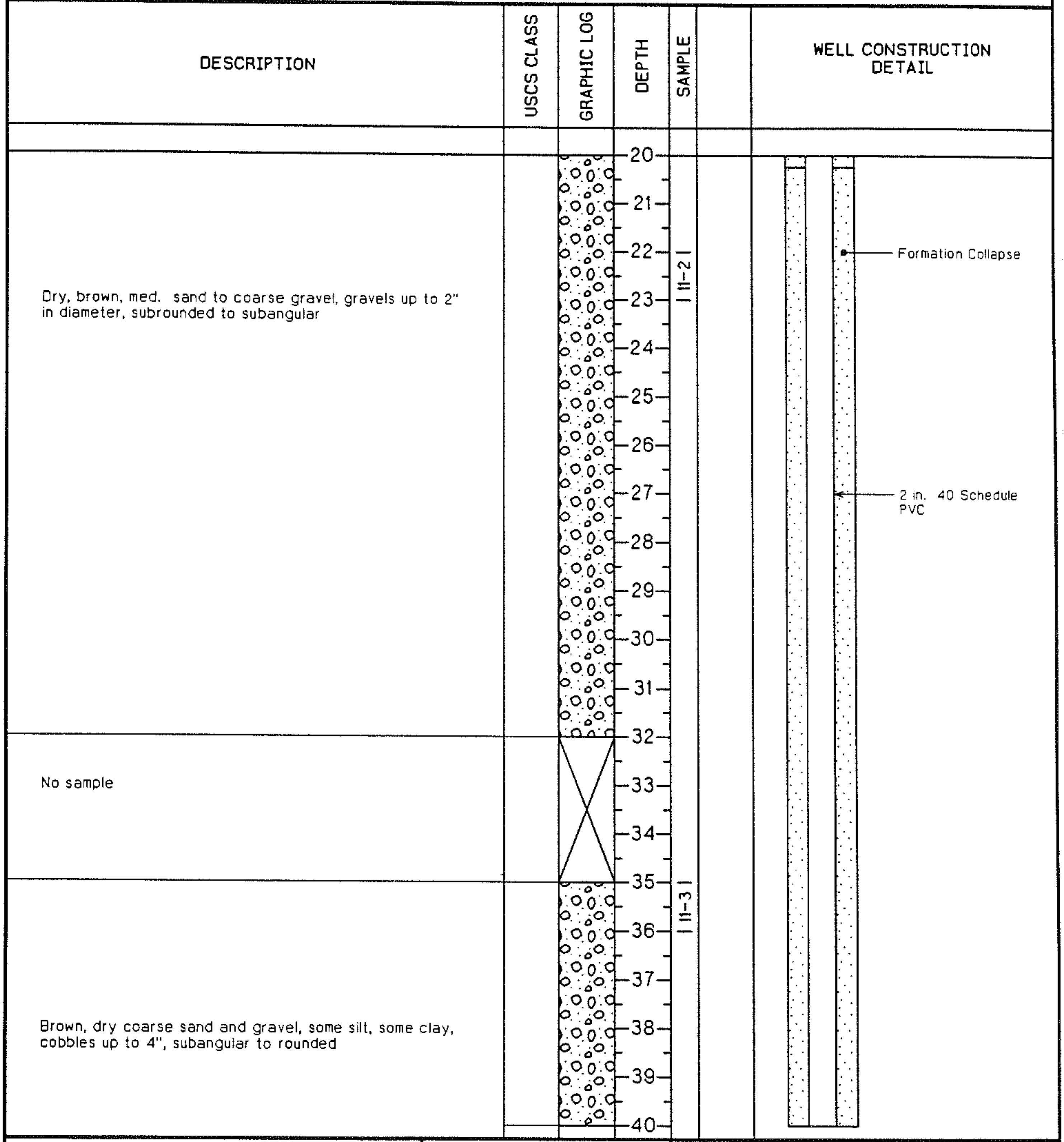
Project No.
135-1.21

Monitoring Well No. 11

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-27-95
HOLE DIA.: 6 in.
GW DEPTH: 50 ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core barrel
HOLE ELEV.: 494.84 ft. MSL



Dry, brown, med. sand to coarse gravel, gravels up to 2" in diameter, subrounded to subangular

No sample

Brown, dry coarse sand and gravel, some silt, some clay, cobbles up to 4", subangular to rounded

STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

Continuously sampled bore-hole. Sample numbers refer to saved samples

Project No.
135-1.21

Page 2 of 4

Monitoring Well No. 11

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-27-95
HOLE DIA.: 6 in.
GW DEPTH: 50 ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core barrel
HOLE ELEV.: 494.84 ft. MSL

DESCRIPTION

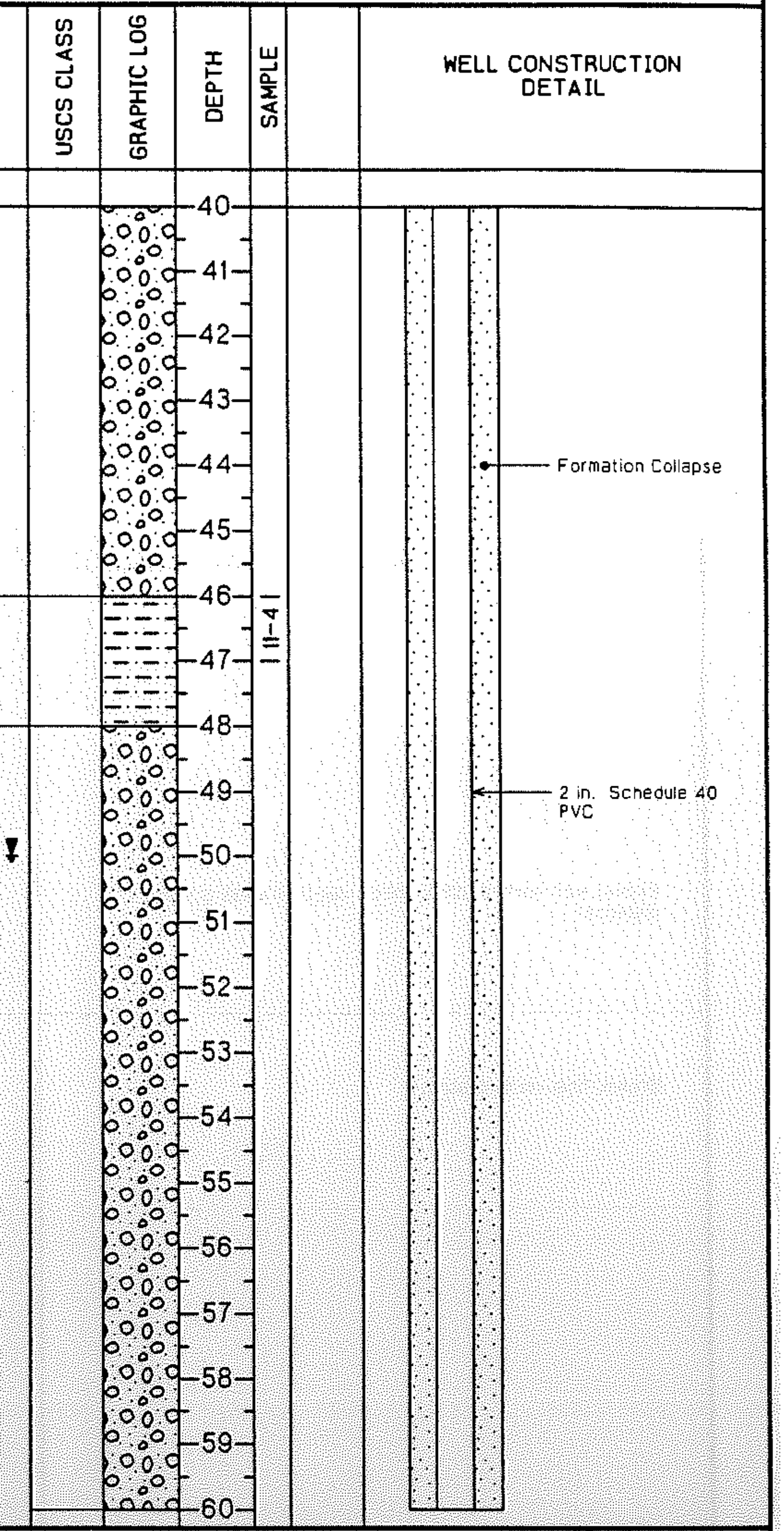
Grading from fine to coarse sand w/ some gravels and fines

2' Dark brown, sandy clay w/ gravels

Coarse sand and gravel, some silt, gravels to 2", subrounded to subangular, fines may have been washed out during drilling

Coarse sand and gravel, some silt; well rounded, gravels up to 2"

Clean fine to coarse gravel, gravels up to 3"



STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

Continuously sampled bore-hole. Sample numbers refer to saved samples

Project No.
135-1.21

Monitoring Well No. 11

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

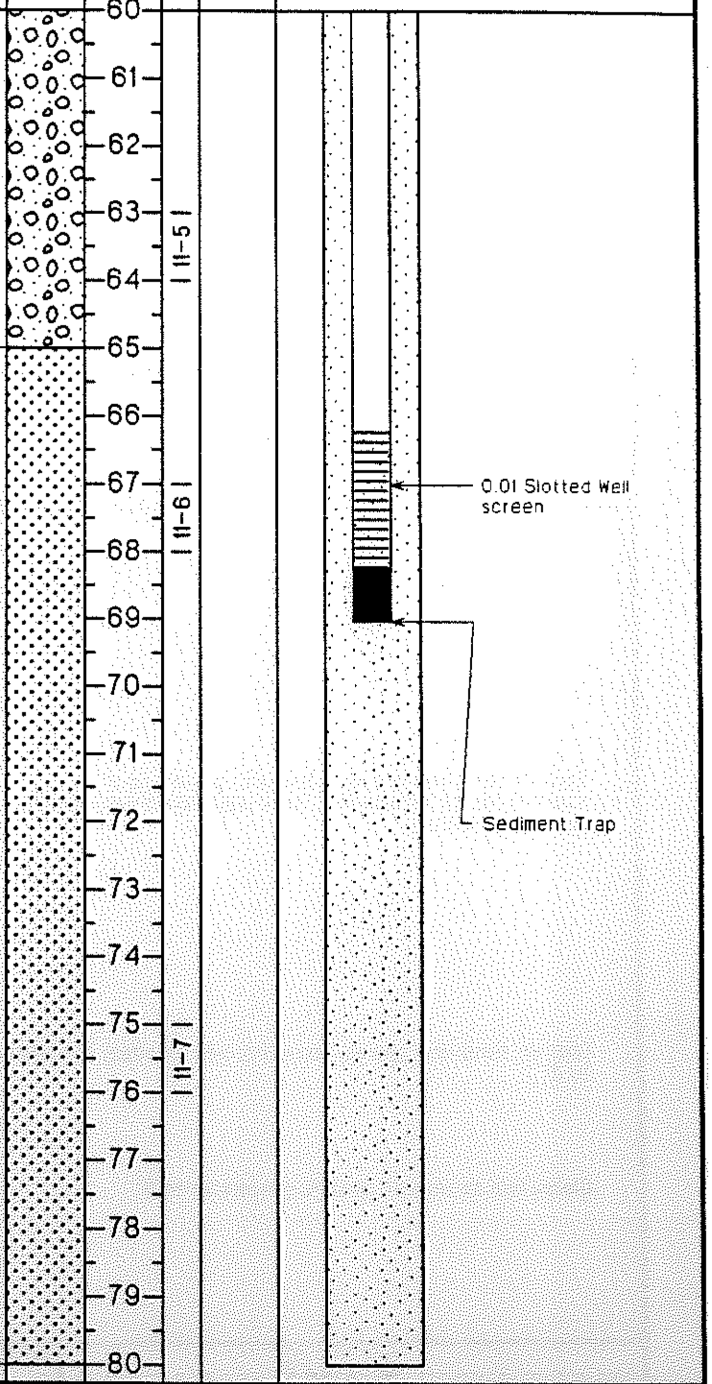
DATE: 03-27-95
HOLE DIA.: 6 in.
GW DEPTH: 50 ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core barrel
HOLE ELEV.: 494.84 ft. MSL

DESCRIPTION | USCS CLASS | GRAPHIC LOG | DEPTH | SAMPLE | WELL CONSTRUCTION DETAIL

Brown, well sorted, clean med. sand w/ small gravels 1" in diameter

Brown, fine uniform sand



STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

Continuously sampled bore-hole. Sample numbers refer to saved samples

Project No.
135-1.21

Monitoring Well No. 12

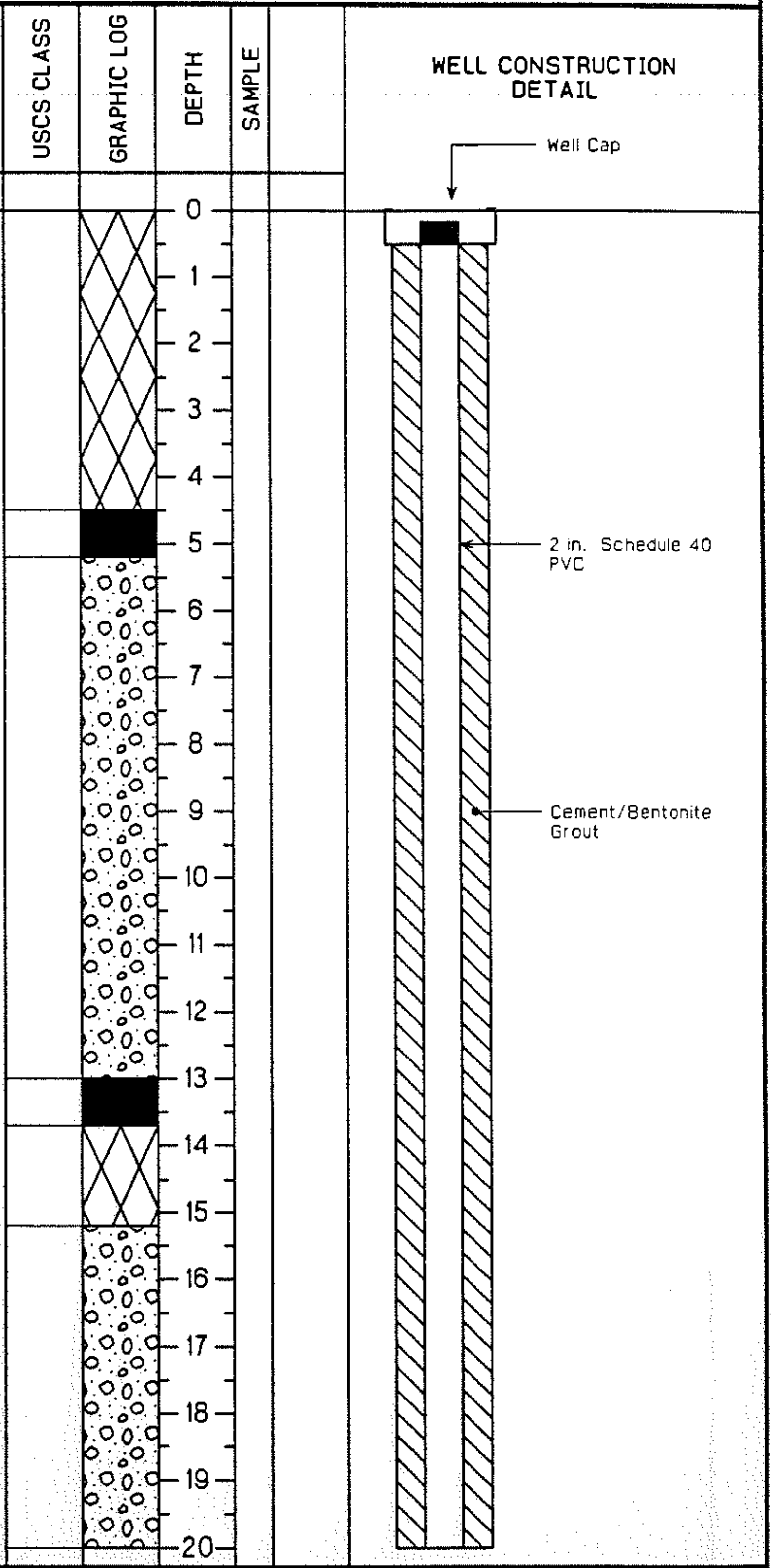
PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-28-95
HOLE DIA.: 6 in.
GW DEPTH: 48.5 ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core Barrel
HOLE ELEV.: 494.84 ft. MSL

DESCRIPTION

Blind Drilling (Refer to boring log for MW 13 for lithologic descriptions)



STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

No samples were collected from MW 12

Project No.
135-1.21

Monitoring Well No. 12

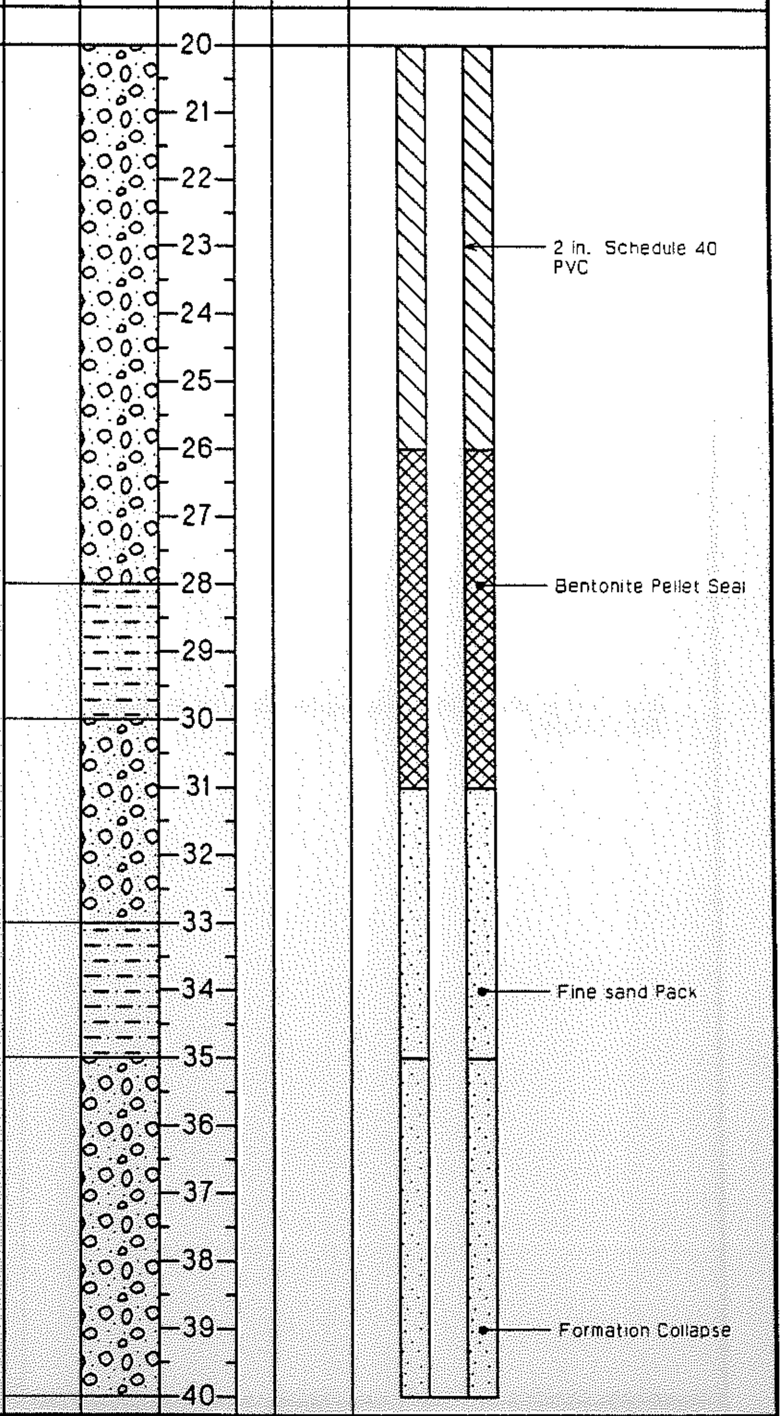
PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-28-95
HOLE DIA.: 6 in.
GW DEPTH: 48.5 ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core Barrel
HOLE ELEV.: 494.84 ft. MSL

DESCRIPTION | USCS CLASS | GRAPHIC LOG | DEPTH | SAMPLE | WELL CONSTRUCTION DETAIL

Blind Drilling (Refer to boring log for MW 13 for lithologic descriptions)



STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:
No samples were collected from MW 12

Project No.
135-1.21

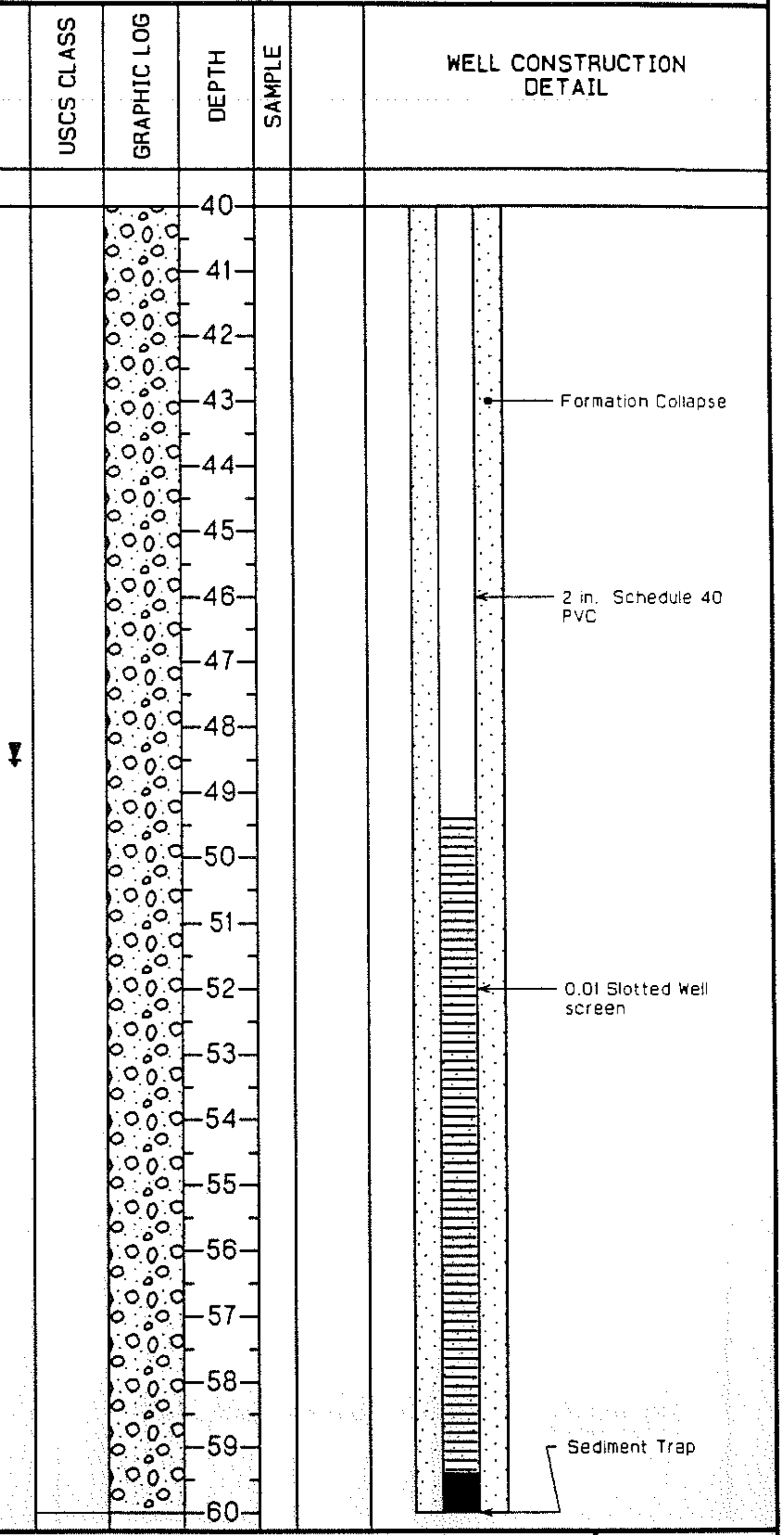
Page 2 of 3

Monitoring Well No. 12

PROJECT: Hennepin East Ash Impoundment
DATE: 03-28-95
LOGGED BY: Hensel/Tu
DRILL RIG: Rotosonic Drill
HOLE DIA.: 6 in.
SAMPLER: Core Barrel
DRILLER: Boart Longyear
GW DEPTH: 48.5 ft.
HOLE ELEV.: 494.84 ft. MSL

DESCRIPTION

Blind Drilling (Refer to boring log for MW 13 for lithologic descriptions)



STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:
No samples were collected from MW 12

Project No.
135-1.21

Page 3 of 3

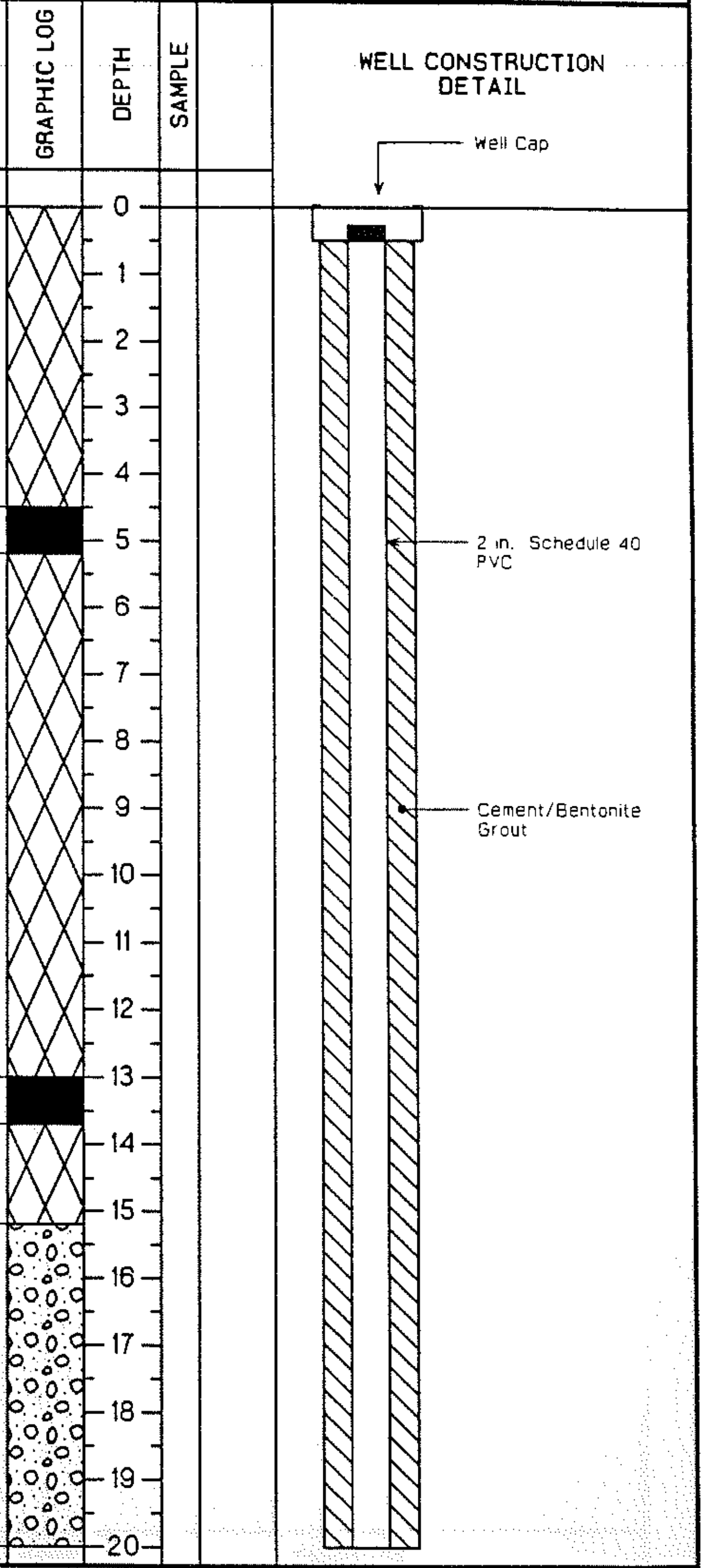
Monitoring Well No. 13

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-28-95
HOLE DIA.: 6 in.
GW DEPTH: 49.5 ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core Barrel
HOLE ELEV.: 494.82 ft. MSL

DESCRIPTION	USCS CLASS
Fill, consisting of olive, silty clay loam, with gravels up 3 in in diameter	
Fly ash	
Brown gravel w/ sand and silt, gravels up to 3", poorly sorted, subrounded to subangular	
Fly ash	
Fill, consisting of fine silty sand, wood chips, gravels up to 1".	
Tan sand and gravel, some silt, gravels up to 3", poorly sorted, rounded	



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2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

Continuously sampled bore-hole. Sample numbers refer to saved samples

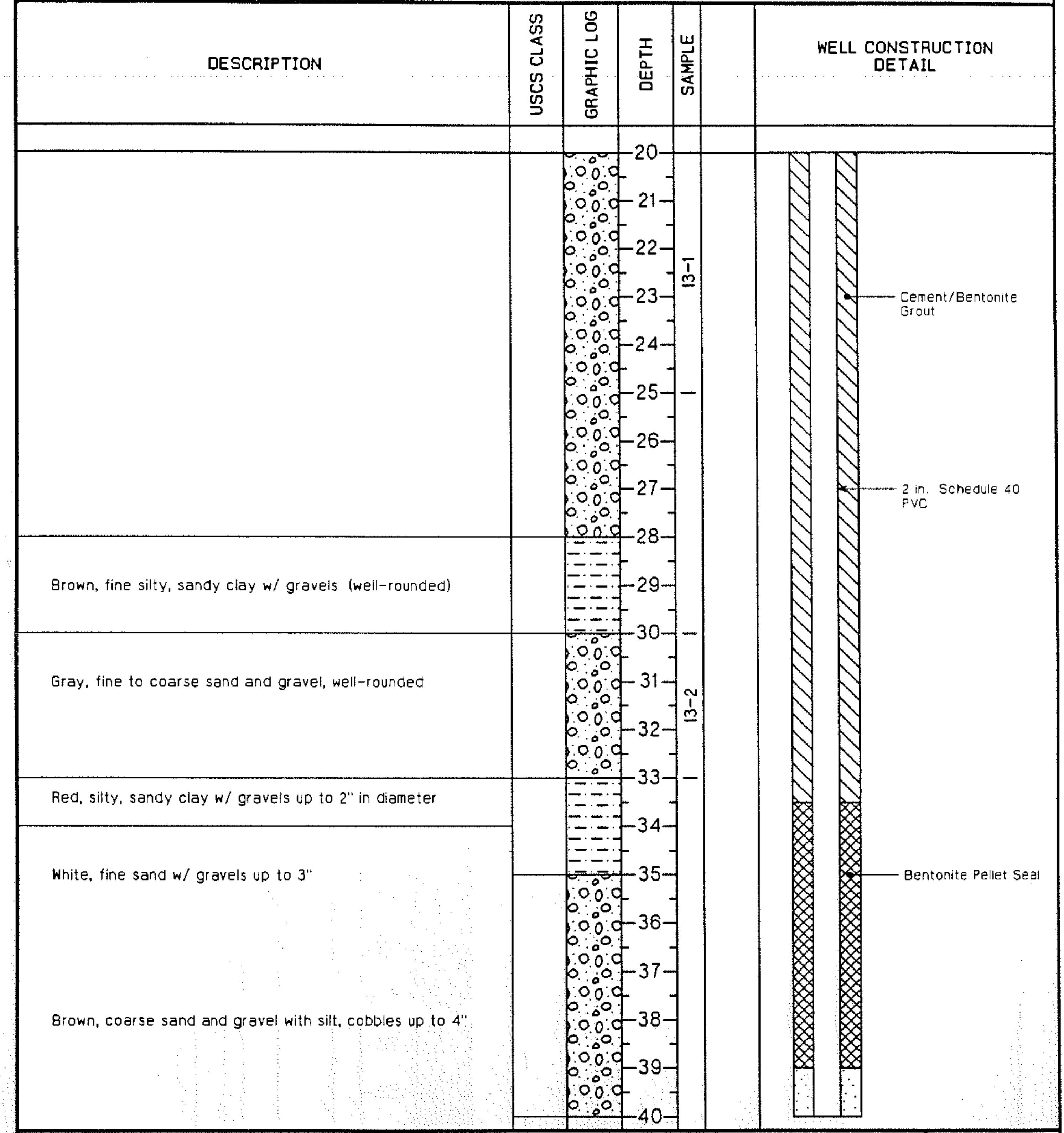
Project No.
135-1.21

Monitoring Well No. 13

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-28-95
HOLE DIA.: 6 in.
GW DEPTH: 49.5 ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core Barrel
HOLE ELEV.: 494.82 ft. MSL



Brown, fine silty, sandy clay w/ gravels (well-rounded)

Gray, fine to coarse sand and gravel, well-rounded

Red, silty, sandy clay w/ gravels up to 2" in diameter

White, fine sand w/ gravels up to 3"

Brown, coarse sand and gravel with silt, cobbles up to 4"

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2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:
Continuously sampled bore-hole. Sample numbers refer to saved samples

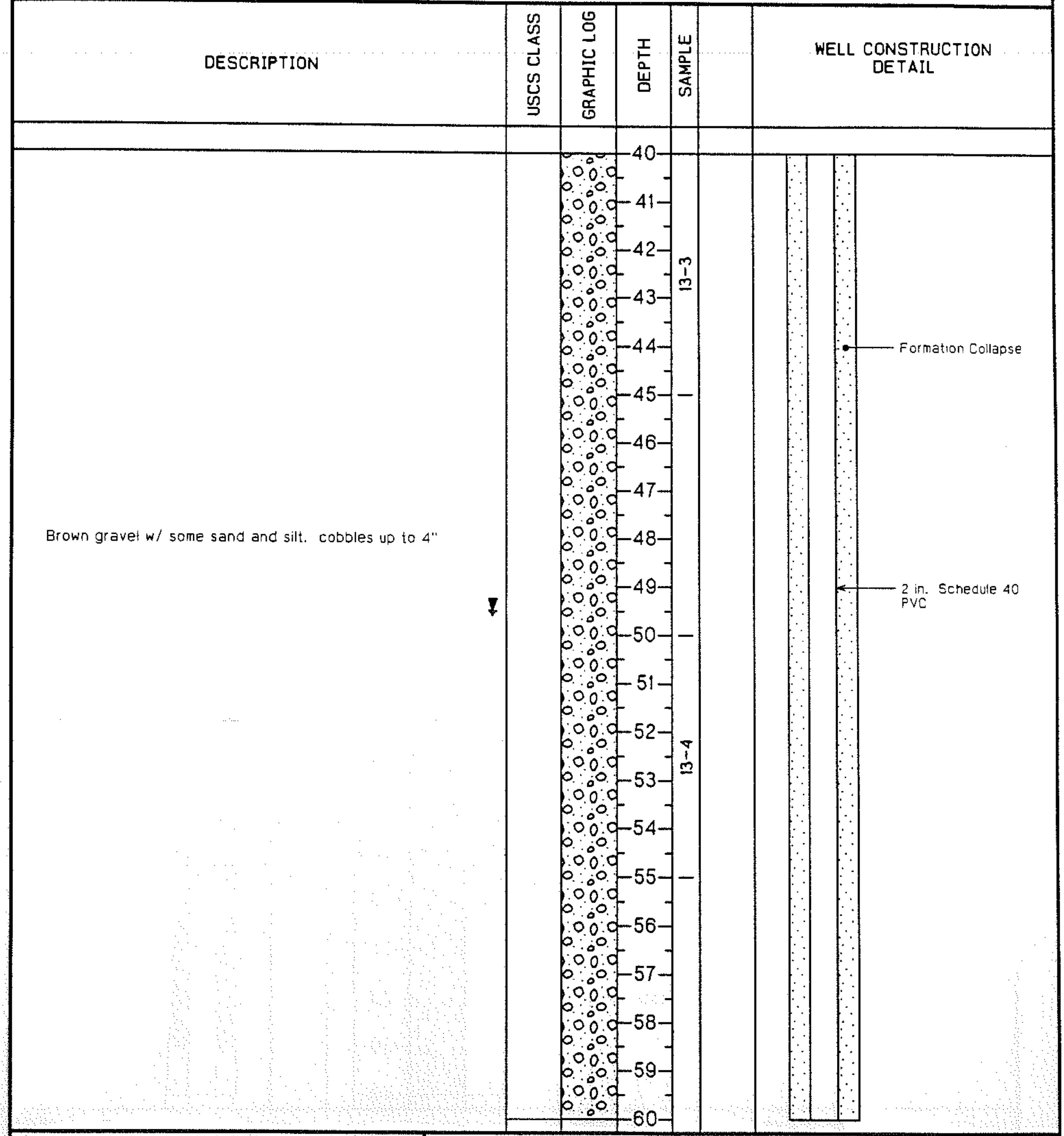
Project No.
135-1.21

Monitoring Well No. 13

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-28-95
HOLE DIA.: 6 in.
GW DEPTH: 49.5 ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core Barrel
HOLE ELEV.: 494.82 ft. MSL



Brown gravel w/ some sand and silt. cobbles up to 4"

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Brookfield, Wisconsin 53005-8208

Notes:

Continuously sampled bore-hole. Sample numbers refer to saved samples

Project No.
135-1.21

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Monitoring Well No. 13

PROJECT: Hennepin East Ash Impoundment	**DATE:** 03-28-95	**LOGGED BY:** Hensel/Tu
DRILL RIG: Rotosonic Drill	**HOLE DIA.:** 6 in.	**SAMPLER:** Core Barrel
DRILLER: Boart Longyear	**GW DEPTH:** 49.5 ft.	**HOLE ELEV.:** 494.82 ft. MSL

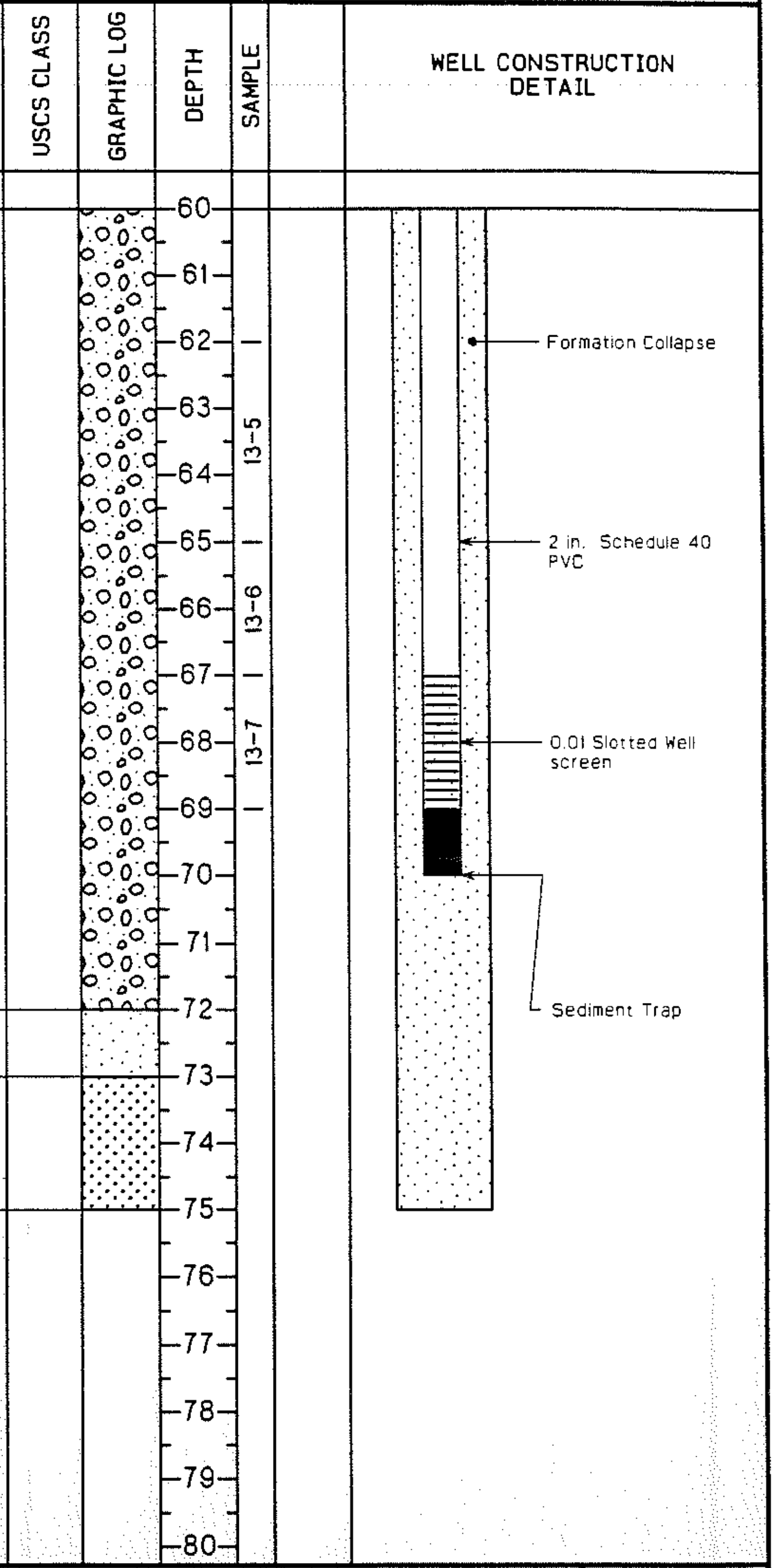
DESCRIPTION

Gravel becomes finer

Brown, fine gravel w/ little silt and sand, well rounded, well sorted

Fine, uniform silty sand w/ cobbles up to 3"

Brown, uniform fine to med. sand with some gravel



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2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

Continuously sampled bore-hole. Sample numbers refer to saved samples

Project No.
135-1.21

Monitoring Well No. 14

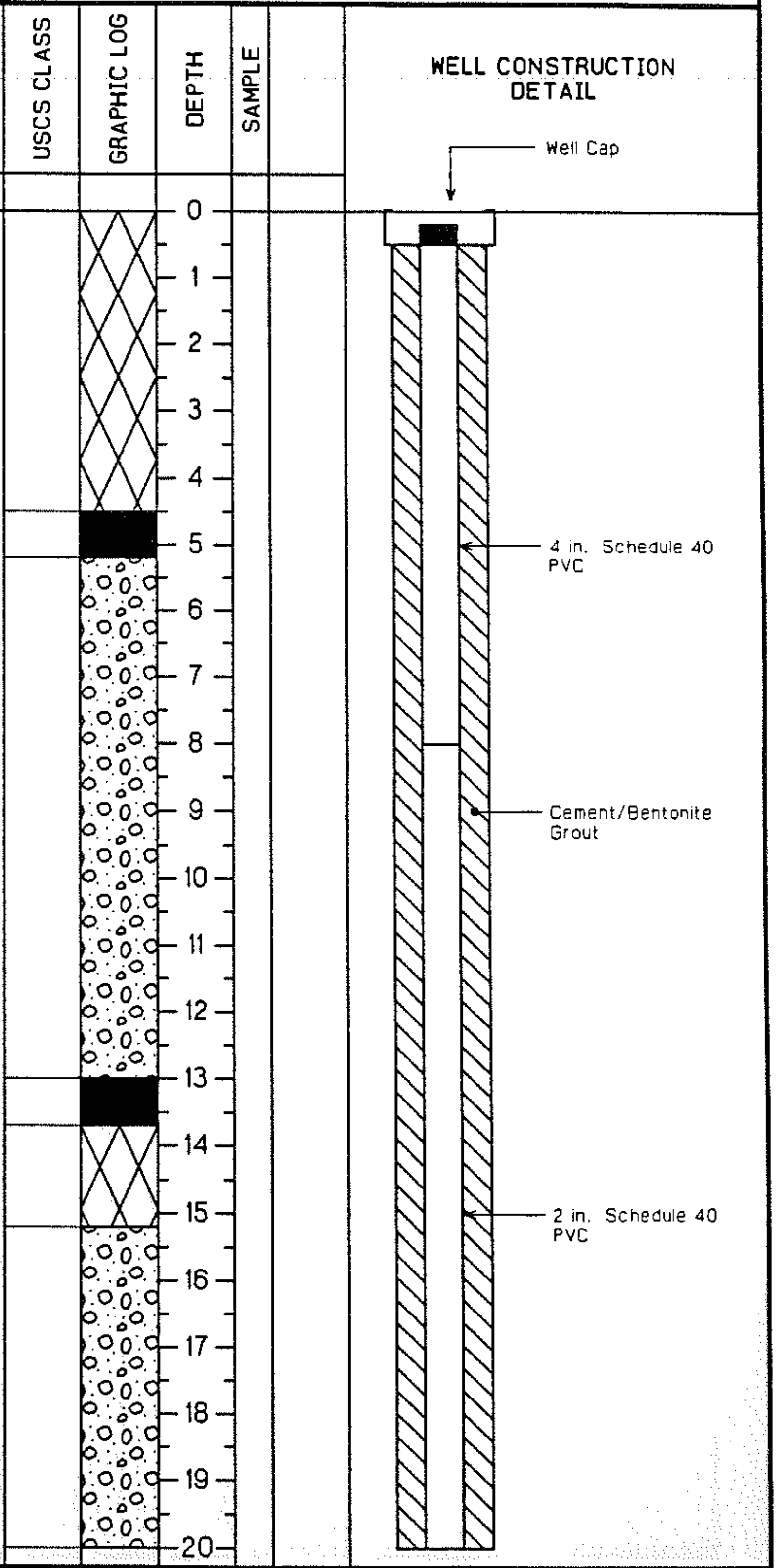
PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-29-95
HOLE DIA.: 6 in.
GW DEPTH: Not Measured ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core Barrel
HOLE ELEV.: 494.83 ft. MSL

DESCRIPTION

Blind Drilling (Refer to boring log for MW 13 for lithologic descriptions)



STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:
No samples were collected from MW 14

Project No.
135-1.21

Page 1 of 3

Monitoring Well No. 14

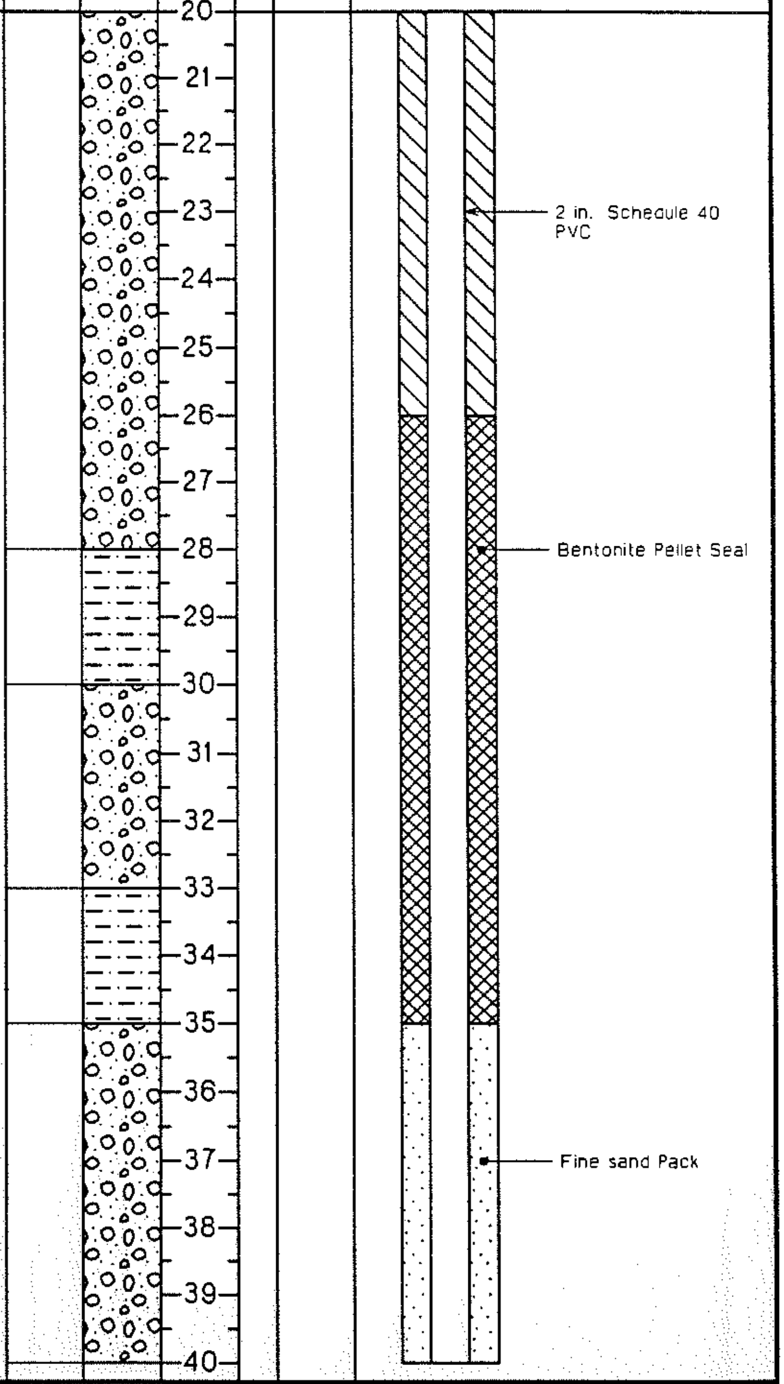
PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-29-95
HOLE DIA.: 6 in.
GW DEPTH: Not Measured ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core Barrel
HOLE ELEV.: 494.83 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE		WELL CONSTRUCTION DETAIL

Blind Drilling (Refer to boring log for MW 13 for lithologic descriptions)



STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:
No samples were collected from MW 14

Project No.
135-1.21

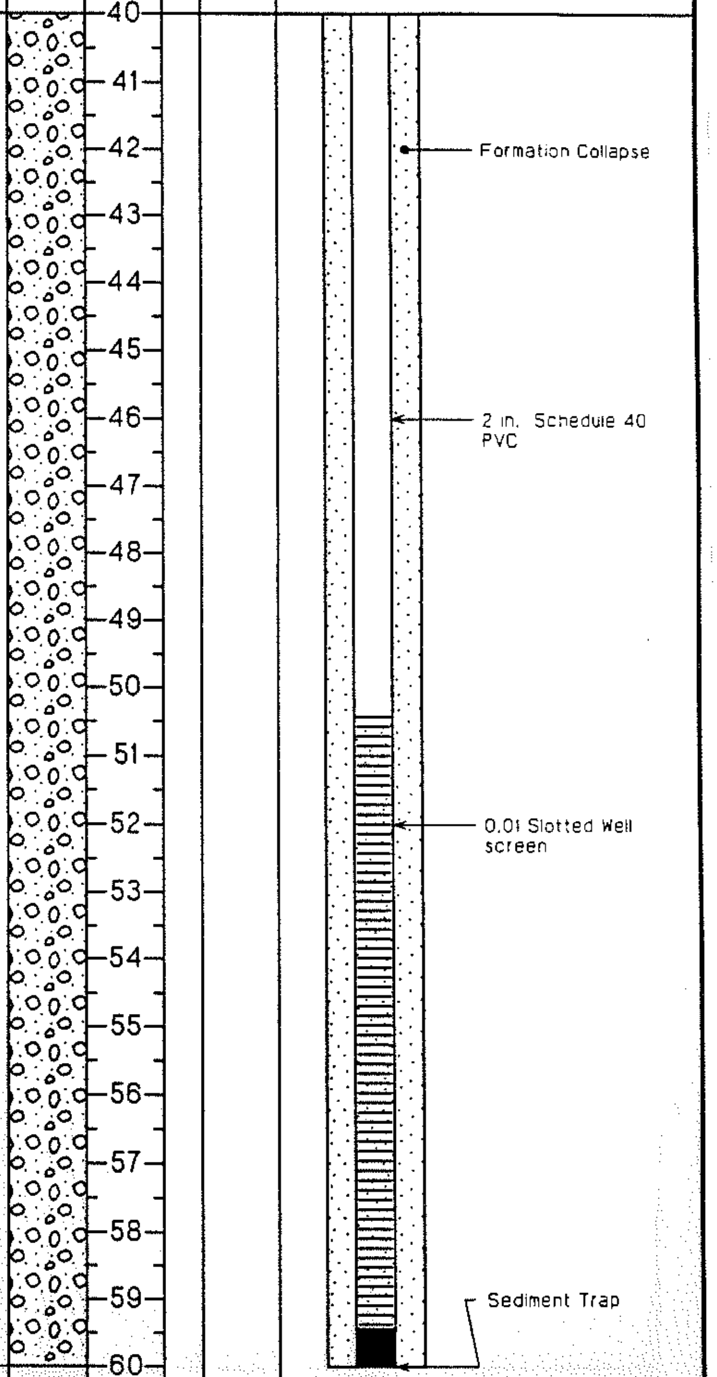
Monitoring Well No. 14

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-29-95
HOLE DIA.: 6 in.
GW DEPTH: Not Measured ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core Barrel
HOLE ELEV.: 494.83 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE		WELL CONSTRUCTION DETAIL
Blind Drilling (Refer to boring log for MW 13 for lithologic descriptions)			40–60			



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2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:
No samples were collected from MW 14

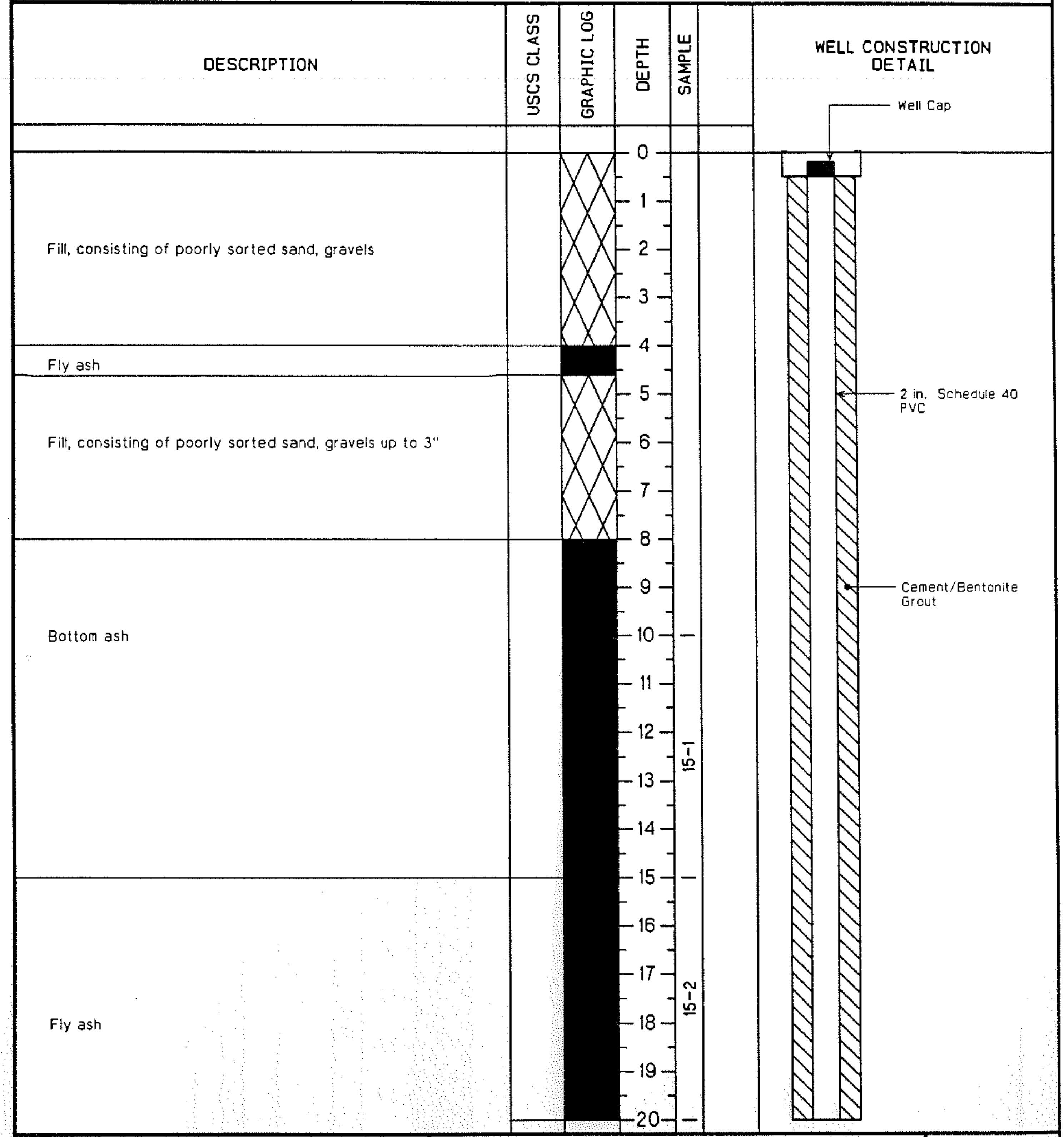
Project No.
135-1.21

Monitoring Well No. 15

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-29-95
HOLE DIA.: 6 in.
GW DEPTH: Not Measured ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core barrel
HOLE ELEV.: 494.41 ft. MSL



Fill, consisting of poorly sorted sand, gravels

Fly ash

Fill, consisting of poorly sorted sand, gravels up to 3"

Bottom ash

Fly ash

STMI

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Brookfield, Wisconsin 53005-8208

Notes:
Continuously sampled bore-hole. Sample numbers refer to saved samples

Project No.
135-1.21

Monitoring Well No. 15

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-29-95
HOLE DIA.: 6 in.
GW DEPTH: Not Measured ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core barrel
HOLE ELEV.: 494.41 ft. MSL

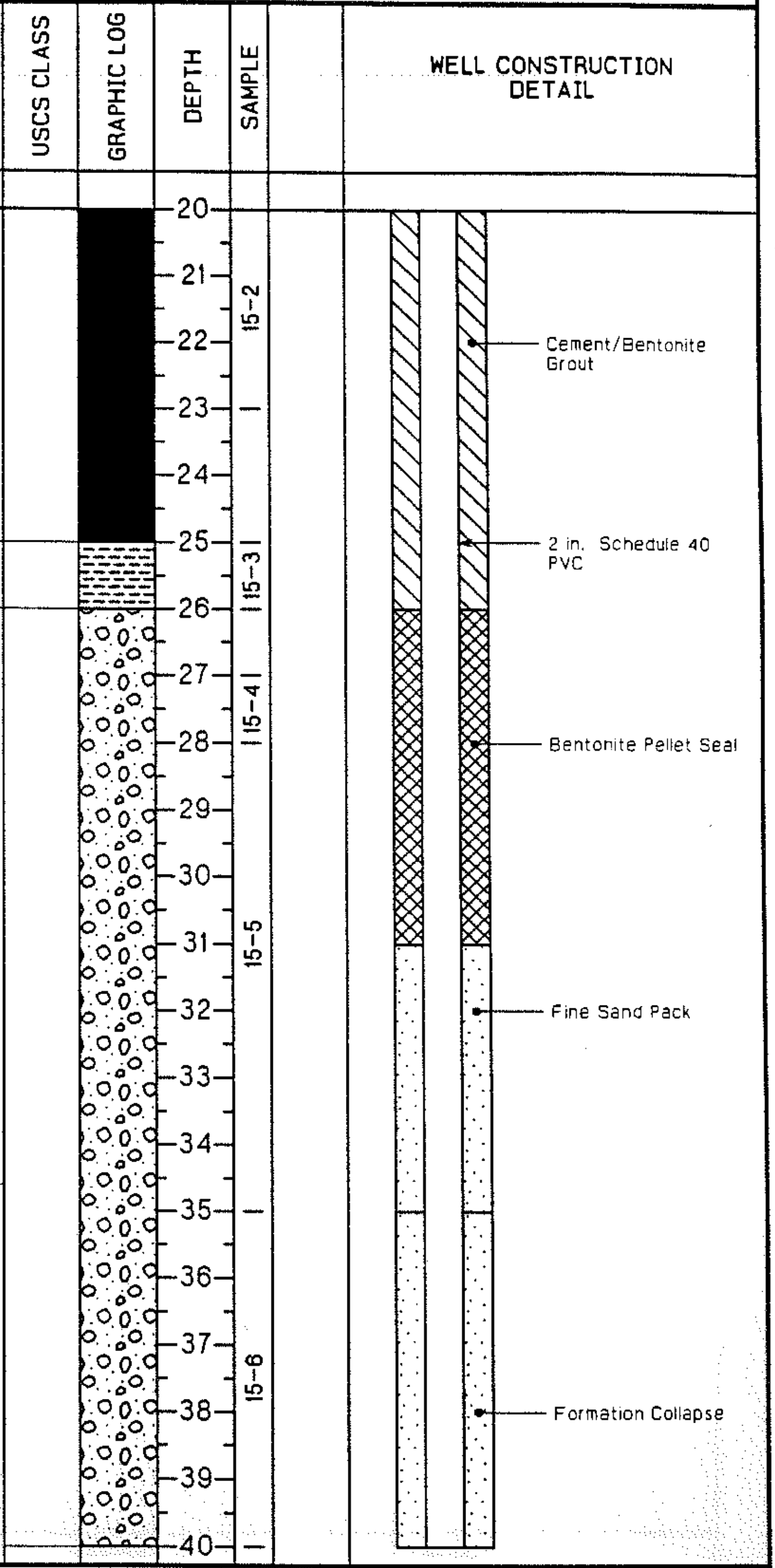
DESCRIPTION

Same as above

Brown uniform silt w/ organic matter

White gravel w/ sand and gravels up to 1.5"

Brown gravel w/ silty, fine-med. sand, rounded to subrounded



STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

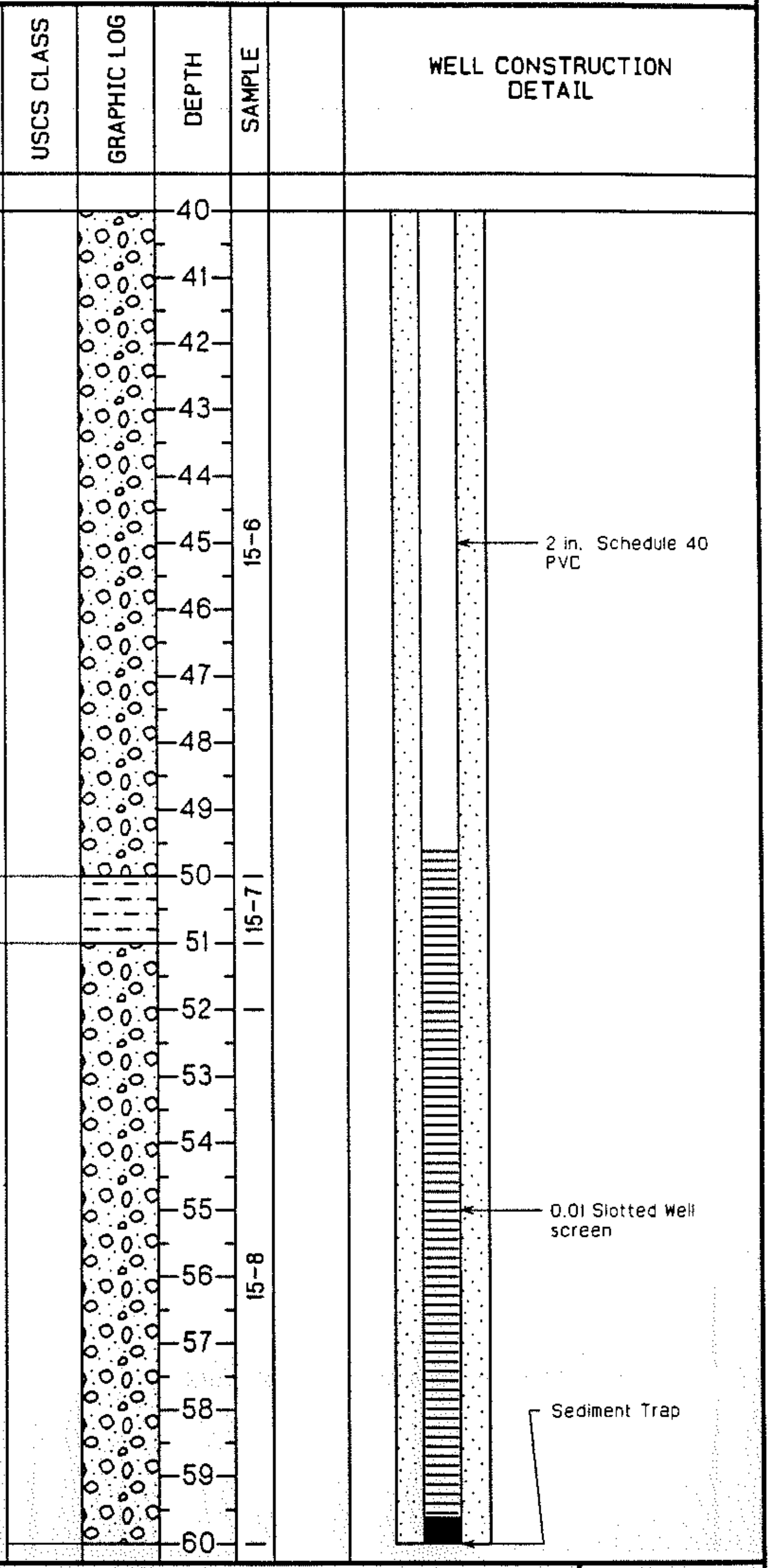
Continuously sampled bore-hole. Sample numbers refer to saved samples

Project No.
135-1.21

Monitoring Well No. 15

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear
DATE: 03-29-95
HOLE DIA.: 6 in.
GW DEPTH: Not Measured ft.
LOGGED BY: Hensel/Tu
SAMPLER: Core barrel
HOLE ELEV.: 494.41 ft. MSL

DESCRIPTION
Same as above
Olive fine sand and silt, platy structure, well sorted
Gravel w/ some sand, some silt, generally finer gravel than above



STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:
Continuously sampled bore-hole. Sample numbers refer to saved samples

Project No.
135-1.21

Page 3 of 3

Monitoring Well No. 16

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-30-95
HOLE DIA.: 6 in.
GW DEPTH: 53 ft.

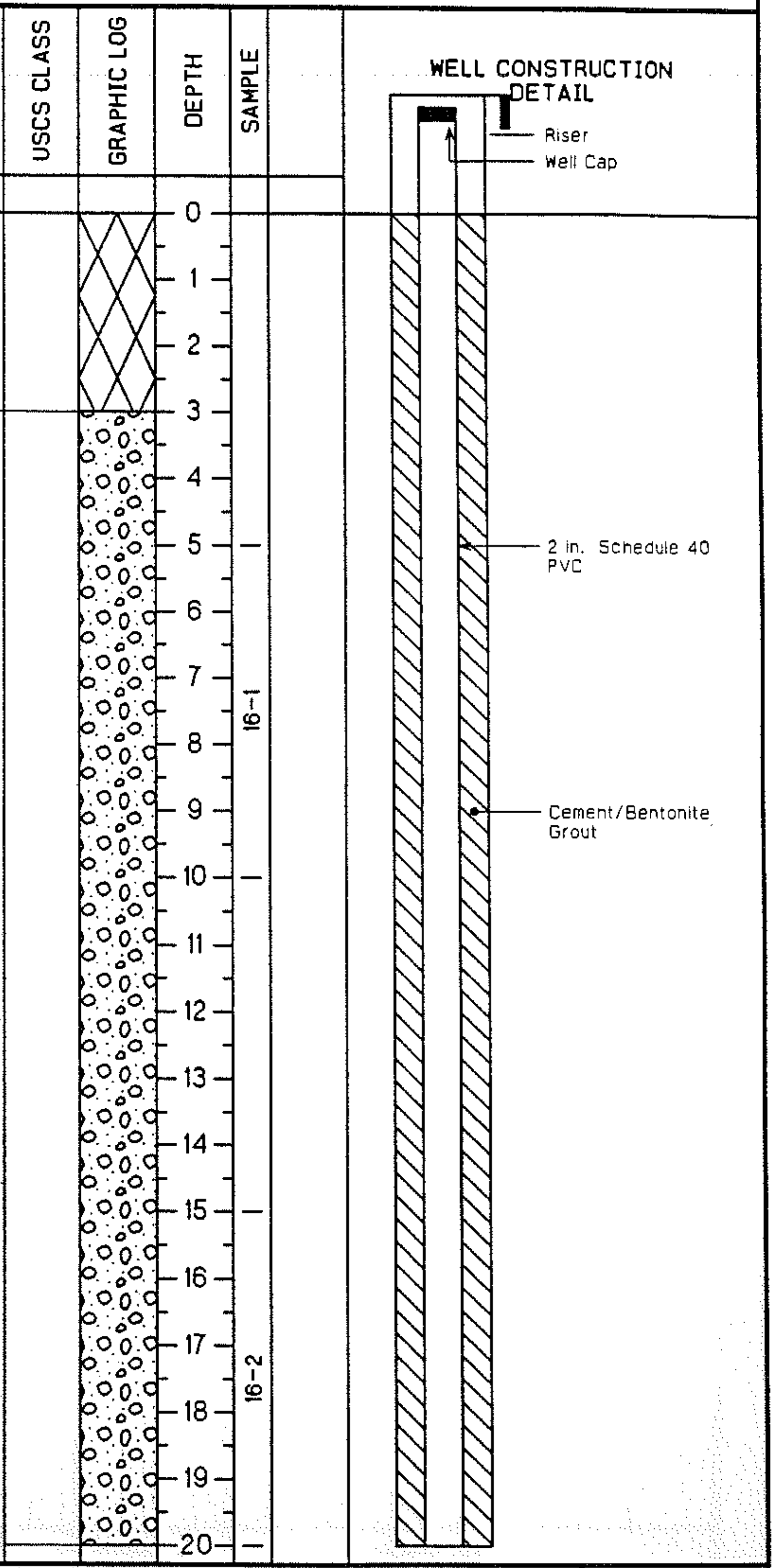
LOGGED BY: Hensel/Tu
SAMPLER: Core barrel
HOLE ELEV.: 502.09 ft. MSL

DESCRIPTION

Possible fill, consisting of brown, well-sorted, fine-med. sand

Brown, dry gravel w/ fine-coarse sands, gravels up to 2", well-rounded, poorly sorted

Same as above, cobbles up to 4", rust stain at 22 ft.



STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

Continuously sampled bore-hole. Sample numbers refer to saved samples

Project No.
135-1.21

Monitoring Well No. 16

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

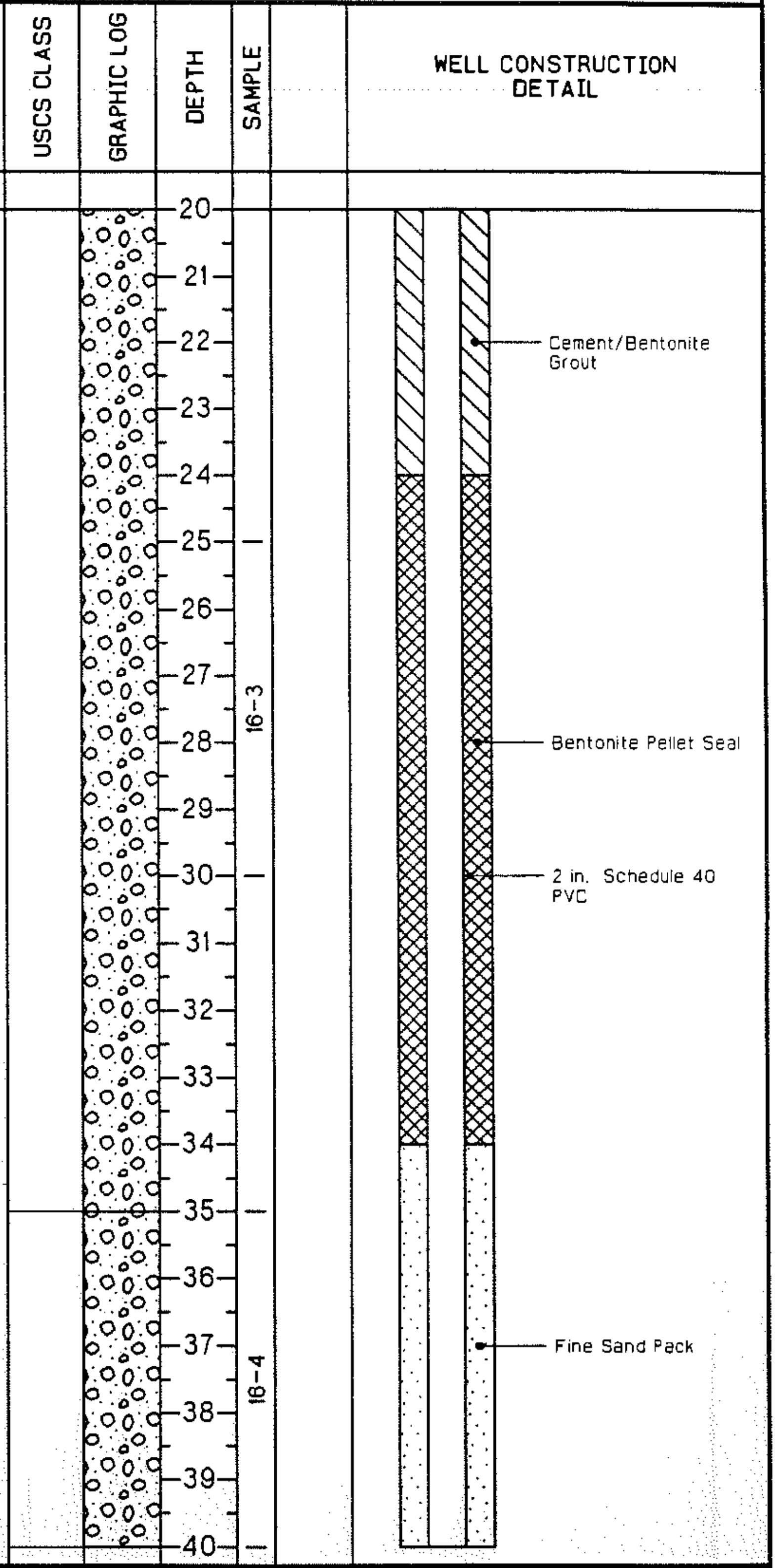
DATE: 03-30-95
HOLE DIA.: 6 in.
GW DEPTH: 53 ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core barrel
HOLE ELEV.: 502.09 ft. MSL

DESCRIPTION

Same as above

Gravel becomes finer at 35'



STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:
Continuously sampled bore-hole. Sample numbers refer to saved samples

Project No.
135-1.21

Monitoring Well No. 16

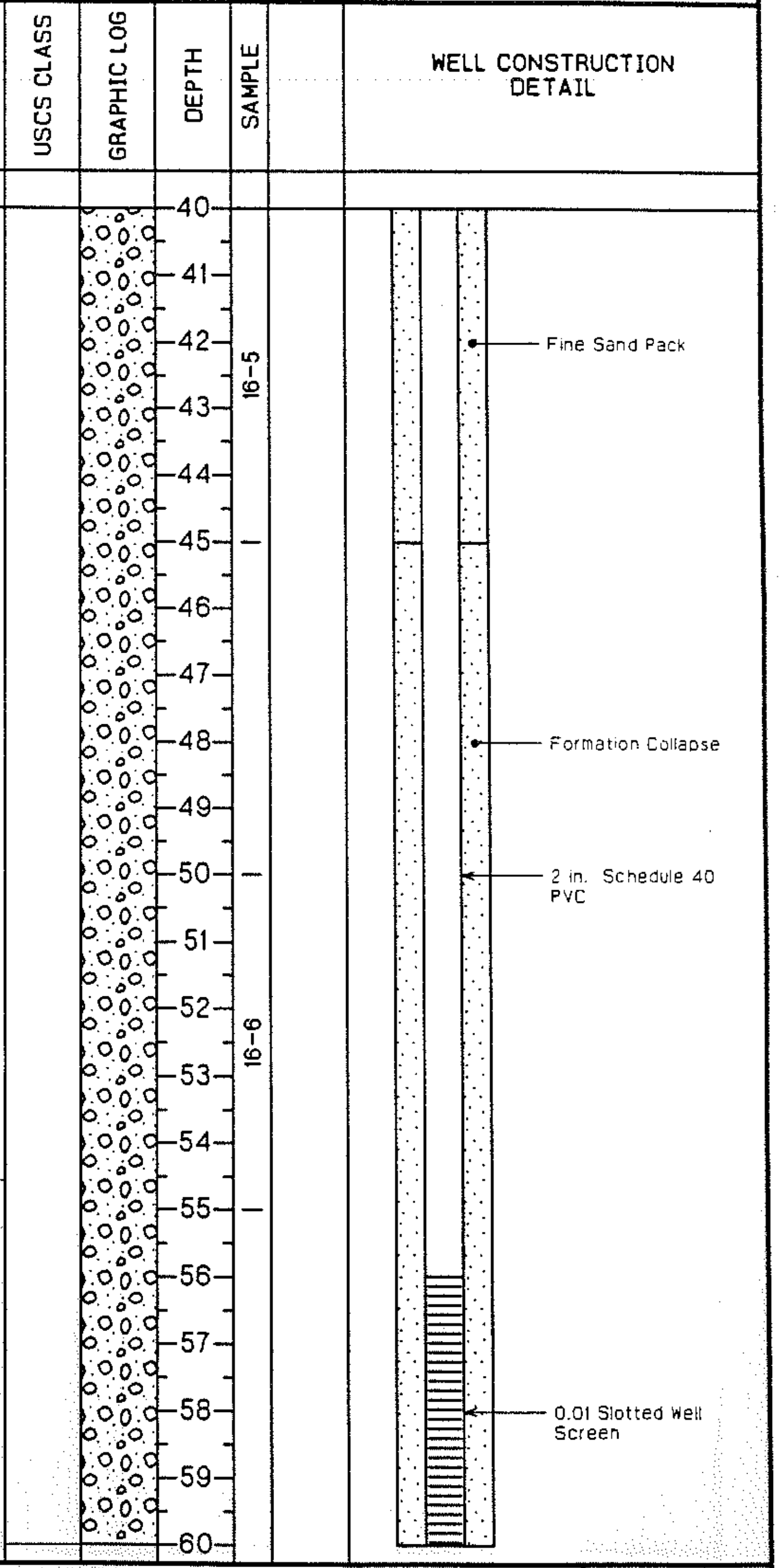
PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-30-95
HOLE DIA.: 6 in.
GW DEPTH: 53 ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core barrel
HOLE ELEV.: 502.09 ft. MSL

DESCRIPTION

Brown gravel w/ fine to med. sand and silt (more sand than above), poorly sorted



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2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

Continuously sampled bore-hole. Sample numbers refer to saved samples

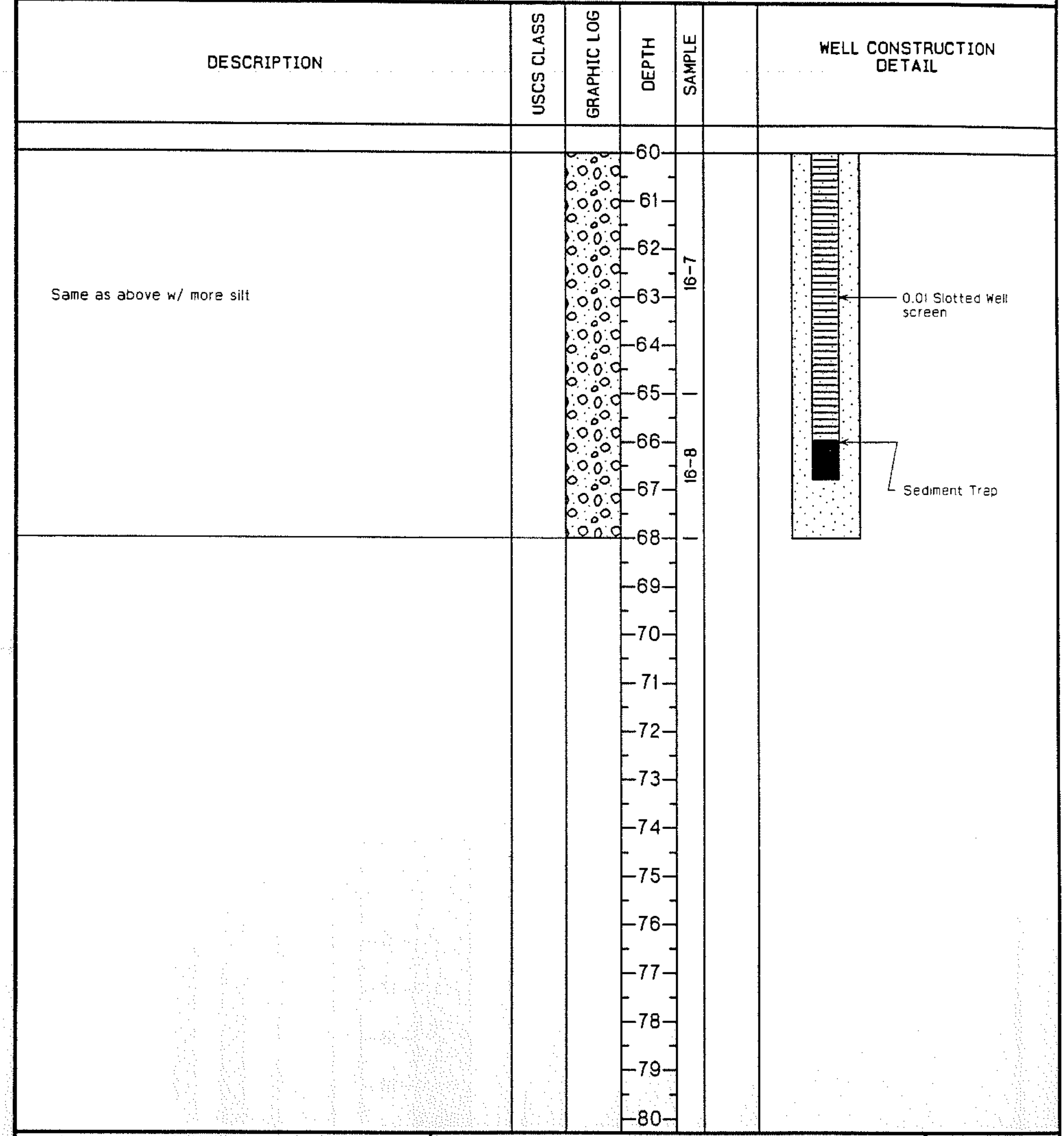
Project No.
135-1.21

Monitoring Well No. 16

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-30-95
HOLE DIA.: 6 in.
GW DEPTH: 53 ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core barrel
HOLE ELEV.: 502.09 ft. MSL



Same as above w/ more silt

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Brookfield, Wisconsin 53005-8208

Notes:

Continuously sampled bore-hole. Sample numbers refer to saved samples

Project No.
135-1.21

Monitoring Well No. 17

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-30-95
HOLE DIA.: 6 in.
GW DEPTH: 56 ft.

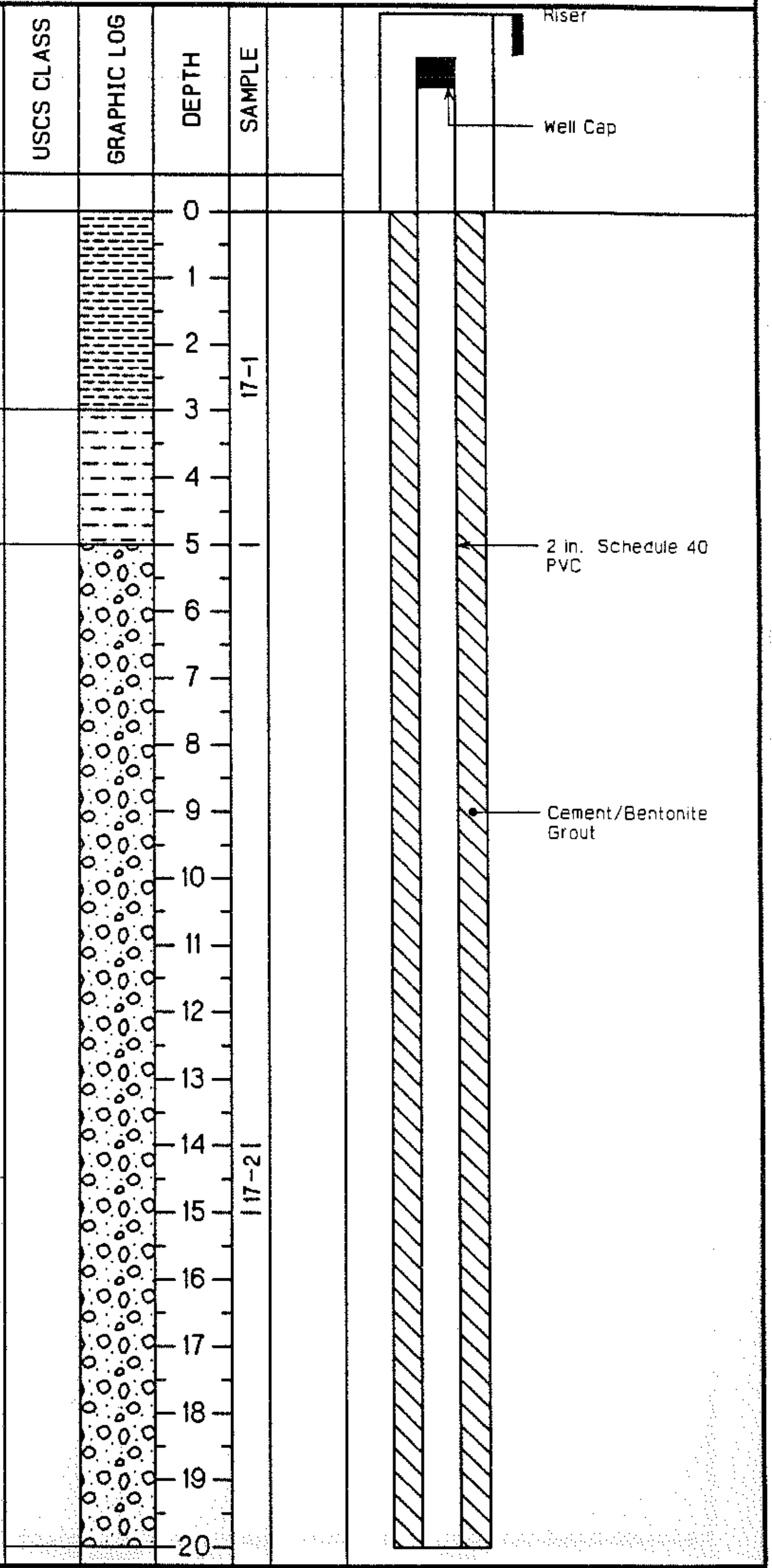
LOGGED BY: Hensel/Tu
SAMPLER: Core barrel
HOLE ELEV.: 507.34 ft. MSL

DESCRIPTION

Silt, dark brown, no structure or pebbles, organic material to 2 ft.

Light brown, gravel w/ sand and silt, gravels up to 3", subrounded to angular, poorly sorted

White gravel w/ sand, angular to subangular



STMI

2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

Continuously sampled bore-hole. Sample numbers refer to saved samples

Project No.
135-1.21

Monitoring Well No. 17

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-30-95
HOLE DIA.: 6 in.
GW DEPTH: 56 ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core barrel
HOLE ELEV.: 507.34 ft. MSL

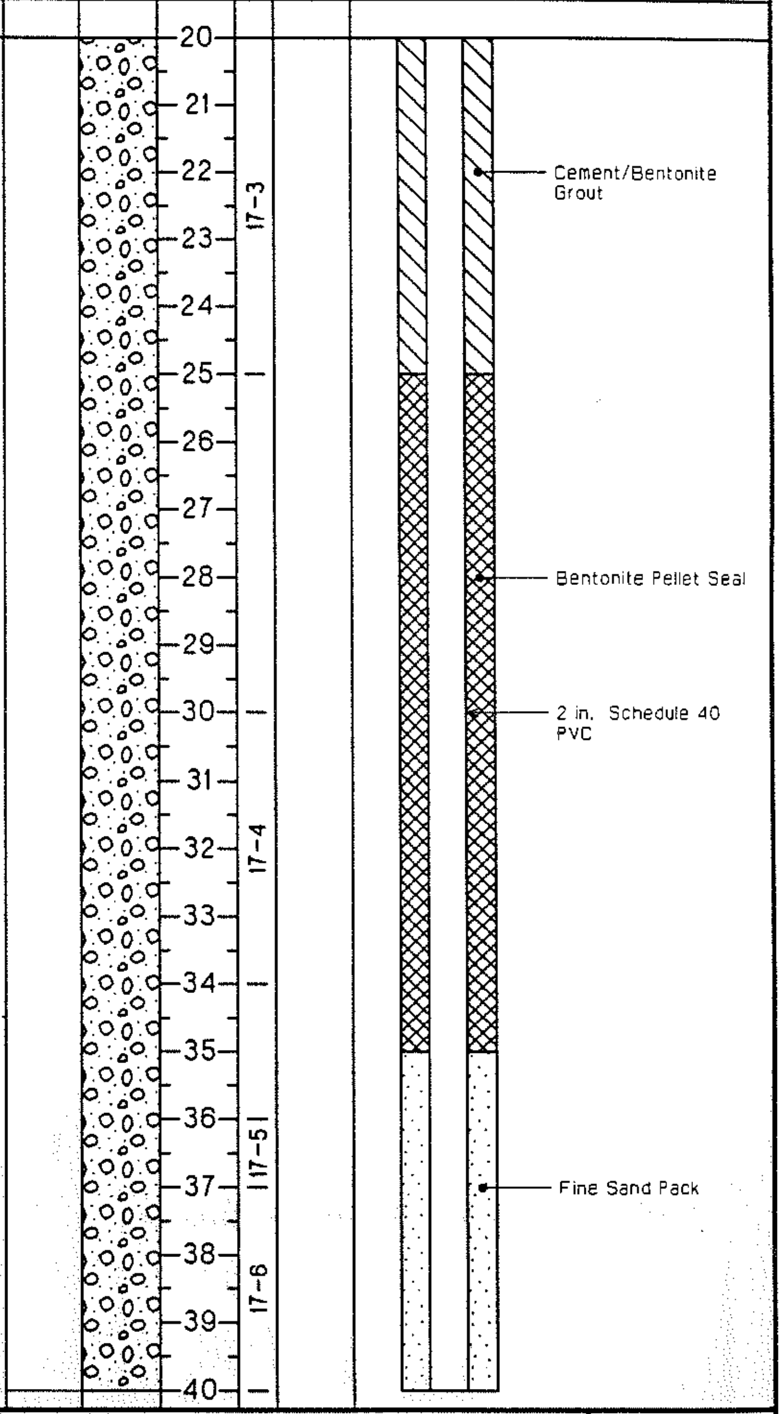
DESCRIPTION | USCS CLASS | GRAPHIC LOG | DEPTH | SAMPLE | WELL CONSTRUCTION DETAIL

Brown gravel w/ sand, some silt, poorly sorted, subangular to rounded

Same as above w/ more silt

2" lens of gray sand and gravel at 36 ft.

Brownish-red gravel w/ sand and silt, poorly sorted, gravels up 1.5", rounded



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Brookfield, Wisconsin 53005-8208

Notes:
Continuously sampled bore-hole. Sample numbers refer to saved samples

Project No.
135-1.21

Page 2 of 4

Monitoring Well No. 17

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-30-95
HOLE DIA.: 6 in.
GW DEPTH: 56 ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core barrel
HOLE ELEV.: 507.34 ft. MSL

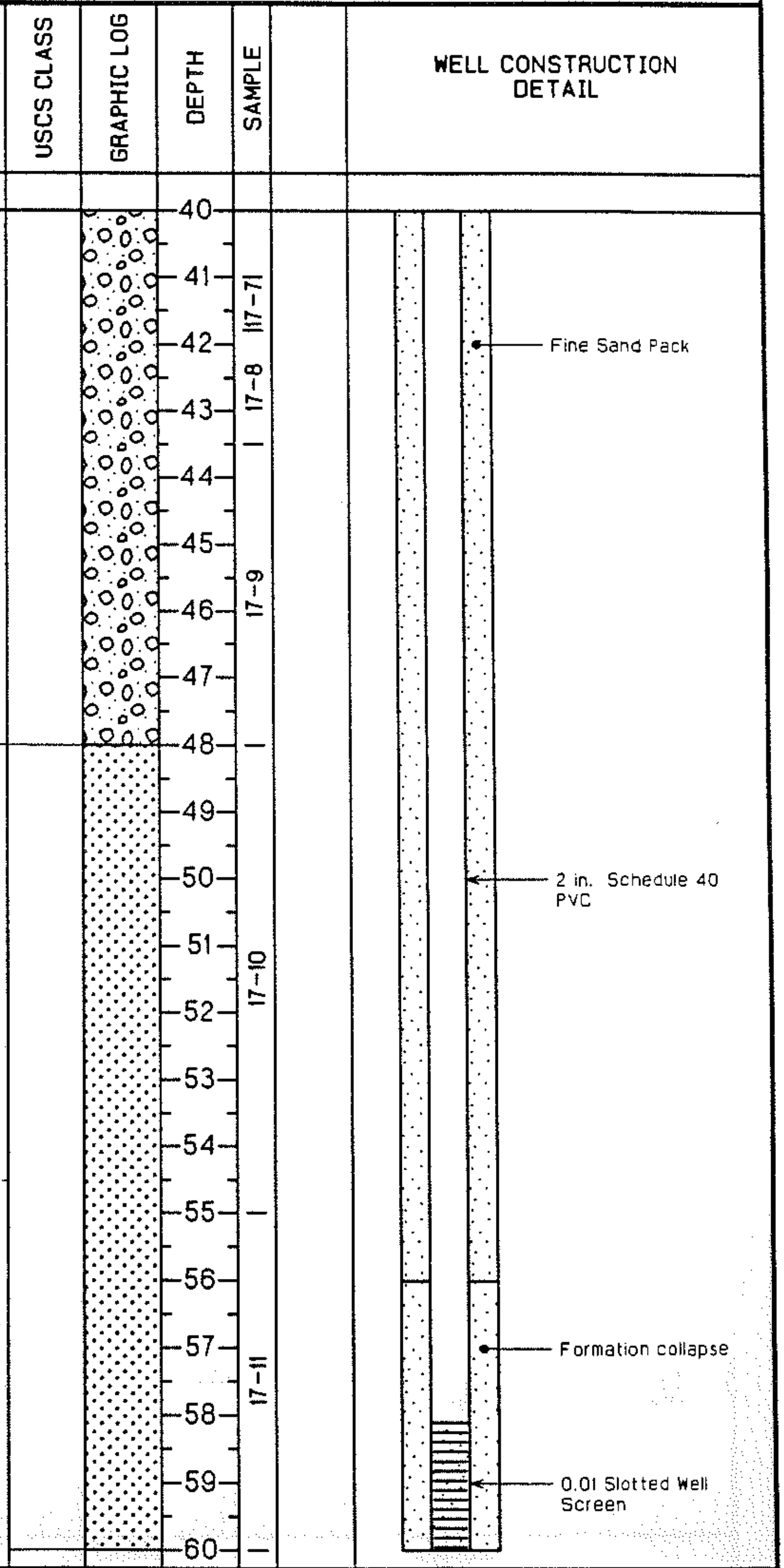
DESCRIPTION

Sequence of black and yellow sand and gravel

Brown gravel w/ sand and silt, poorly sorted, gravels up to 1.5"

Brown, med. sand, well-sorted, dry

Becomes wet at 56 ft. Same as above w/ few gravels



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Notes:

Continuously sampled bore-hole. Sample numbers refer to saved samples

Project No.
135-1.21

Monitoring Well No. 17

PROJECT: Hennepin East Ash Impoundment
DRILL RIG: Rotosonic Drill
DRILLER: Boart Longyear

DATE: 03-30-95
HOLE DIA.: 6 in.
GW DEPTH: 56 ft.

LOGGED BY: Hensel/Tu
SAMPLER: Core barrel
HOLE ELEV.: 507.34 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE		WELL CONSTRUCTION DETAIL
			60			
			61			
Same as above			62	17-12		
			63			
			64			
			65			
			66			
			67			
			68			
			69			
			70			
			71			
			72			
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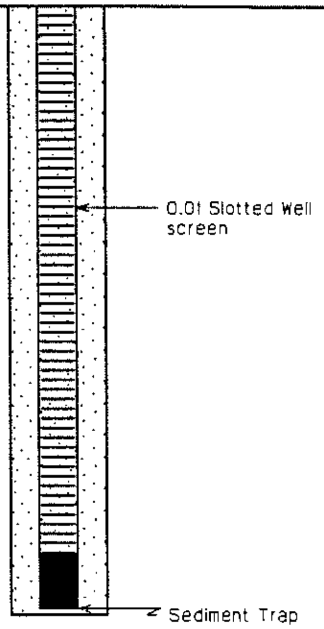
			75			
			76			
			77			
			78			
			79			
			80			



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Brookfield, Wisconsin 53005-8208

Notes:
Continuously sampled bore-hole. Sample numbers refer to saved samples

Project No.
135-1.21

Appendix A3

NRT Boring Logs and Well Details

SOIL BORING LOG INFORMATION

Page 1 of 4

Facility/Project Name: Hennepin Power Station - New East Ash Landfill
License/Permit/Monitoring Number:
Boring Number: 03R
Boring Drilled By: Name of crew chief (first, last) and Firm: Randy Redke, Cascade
Date Drilling Started: 1/15/2015
Date Drilling Completed: 1/15/2015
Drilling Method: Sonic
Common Well Name: 03R
Final Static Water Level: 447.8 Feet (NAVD88)
Surface Elevation: 479.4 Feet (NAVD88)
Borehole Diameter: 6.0 inches
Local Grid Origin ☐ (estimated: ☒) or Boring Location ☒
State Plane 1,690,297 N, 2,532,308 E S / C /Ⓝ
1/4 of 1/4 of Section , T N, R
Lat ° ' "
Long ° ' "
Local Grid Location: Feet ☐ N ☐ S Feet ☐ E ☐ W
Facility ID:
County: Putnam
State: IL
Civil Town/City/ or Village: Hennepin

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1	30 30		1 2	0 - 5.8' **FILL, SILTY CLAY** CL/ML, with gravel and some sand.		▨								
2	30 26		3 4		(FILL) CL/ML	▨								
3	120 93		5			▨								
			6 7 8 9 10 11 12	5.8 - 23.9' **FILL, ASH (Coal):** ASH (Coal), trace silt and gravel, dark gray, medium dense.	(FILL) ASH (Coal)	░								

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm Natural Resource Technology
234 W. Florida St., Fifth Floor, Milwaukee, WI 53204
Tel: (414) 837-3607
Fax: (414) 837-3608

Boring Number 03R

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				5.8 - 23.9' **FILL, ASH (Coal):** ASH (Coal), trace silt and gravel, dark gray, medium dense. *(continued)*										
			13											
			14											
4	120 96		15											
			16											
			17											
			18		(FILL) ASH (Coal)									
			19											
			20											
			21											
			22											
			23											
			24	23.9 - 52' **POORLY-GRADED SAND WITH GRAVEL:** (SP)g, fine grained sized gravel, trace silt, light brown, loose, dry.										
5	60 44		25											
			26											
			27											
			28		(SP)g									
			29											
6	60 54		30											
			31				▼							
			32	31.6' Wet.										

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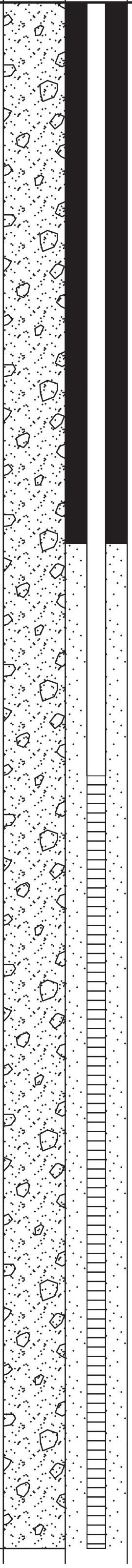
SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number 03R

Page 3 of 4

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			33	23.9 - 52' **POORLY-GRADED SAND WITH GRAVEL:** (SP)g, fine grained sized gravel, trace silt, light brown, loose, dry. *(continued)*										
			34											
7	120 69		35											
			36											
			37											
			38											
			39											
			40											
			41											
			42		(SP)g									
			43											
			44											
8	84 36		45											
			46											
			47											
			48											
			49											
			50											
			51											
			52											



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SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number 03R

Page 4 of 4

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				52 - 53' Blind drilled to 53' for well installation.			░							
			53	53' End of Boring.										

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SOIL BORING LOG INFORMATION

Page 1 of 4

Facility/Project Name Hennepin Power Station - New East Ash Landfill	License/Permit/Monitoring Number	Boring Number 05R

Boring Drilled By: Name of crew chief (first, last) and Firm Randy Redke Cascade	Date Drilling Started 1/15/2015	Date Drilling Completed 1/15/2015	Drilling Method Sonic
Common Well Name 05R	Final Static Water Level Feet (NAVD88)	Surface Elevation 485.6 Feet (NAVD88)	Borehole Diameter 6.0 inches

Local Grid Origin ☐ (estimated: ☒) or Boring Location ☒
State Plane 1,690,518 N, 2,533,196 E S / C / [✓ N]
1/4 of 1/4 of Section , T N, R
Lat ° ' "
Long ° ' "
Local Grid Location
Feet ☐ N ☐ S
Feet ☐ E ☐ W

Facility ID	County Putnam	State IL	Civil Town/City/ or Village Hennepin

Sample									Soil Properties						
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				0 - 55' See boring 05DR for details.										
			1											
			2											
			3											
			4											
			5											
			6											
			7											
			8											
			9											
			10											
			11											
			12											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm Natural Resource Technology
234 W. Florida St., Fifth Floor, Milwaukee, WI 53204
Tel: (414) 837-3607
Fax: (414) 837-3608

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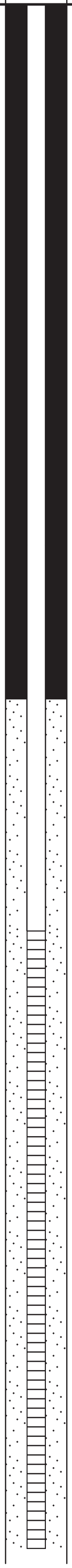
SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number 05R

Page 2 of 4

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				0 - 55' See boring 05DR for details. *(continued)*										
			13											
			14											
			15											
			16											
			17											
			18											
			19											
			20											
			21											
			22											
			23											
			24											
			25											
			26											
			27											
			28											
			29											
			30											
			31											
			32											

Boring Number 05R

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52	0 - 55' See boring 05DR for details. *(continued)*										

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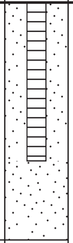
SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number 05R

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			53 54	0 - 55' See boring 05DR for details. *(continued)*										
				55.										

SOIL BORING LOG INFORMATION

Facility/Project Name: Hennepin Power Station - New East Ash Landfill
License/Permit/Monitoring Number:
Boring Number: 05DR

Boring Drilled By: Name of crew chief (first, last) and Firm: Randy Redke, Cascade
Date Drilling Started: 1/14/2015
Date Drilling Completed: 1/14/2015
Drilling Method: Sonic

Common Well Name: 05DR
Final Static Water Level: 454.5 Feet (NAVD88)
Surface Elevation: 485.7 Feet (NAVD88)
Borehole Diameter: 6.0 inches

Local Grid Origin ☐ (estimated: ☒) or Boring Location ☒
State Plane 1,690,517 N, 2,533,190 E S / C / [✓ N]
1/4 of 1/4 of Section , T N, R
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N ☐ E
Feet ☐ S Feet ☐ W

Facility ID:
County: Putnam
State: IL
Civil Town/City/ or Village: Hennepin

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	
1	60 40			0 - 10' **FILL, LEAN CLAY:** CL, with some sand, rounded to subrounded gravel, light brown to dark brown.										
			1											
			2											
			3											
			4											
2	60 24		5		(FILL) CL									
			6											
			7											
			8											
			9											
3	120 40		10	10 - 22' **FILL, ASH (Coal):** ASH (Coal), fine grained sand sized particles, dark gray, loose, wet.										
			11		(FILL) ASH (Coal)									
			12											

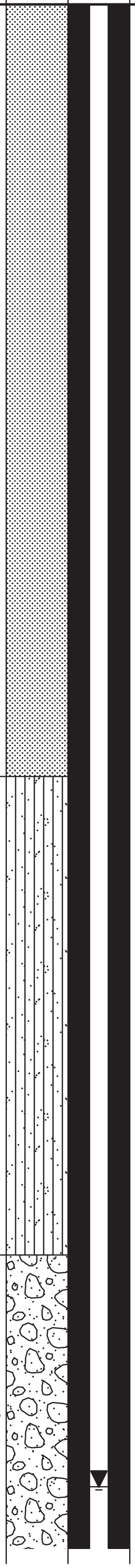
I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm Natural Resource Technology
234 W. Florida St., Fifth Floor, Milwaukee, WI 53204
Tel: (414) 837-3607
Fax: (414) 837-3608

SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number 05DR



Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties: Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			13 14 15 16 17 18 19	10 - 22' **FILL, ASH (Coal):** ASH (Coal), fine grained sand sized particles, dark gray, loose, wet. *(continued)*	(FILL) ASH (Coal)									
4	120 84		20 21											
			22 23 24 25 26 27	22 - 28.2' **SANDY SILT:** s(ML), with little fine grained gravel and coal, dark brown, dense, dry.	s(ML)									
			28 29	28.2 - 72.7' **WELL-GRADED GRAVEL WITH SAND:** (GW)s, coarse grained sand, little silt, light brown, loose, dry.	(GW)s									
5	72 60		30 31 32	31.2' Wet.										

SOIL BORING LOG INFORMATION SUPPLEMENT

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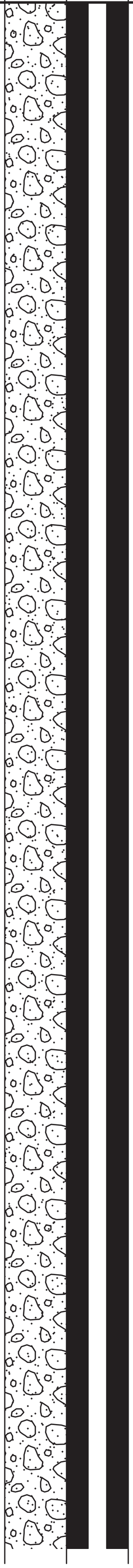
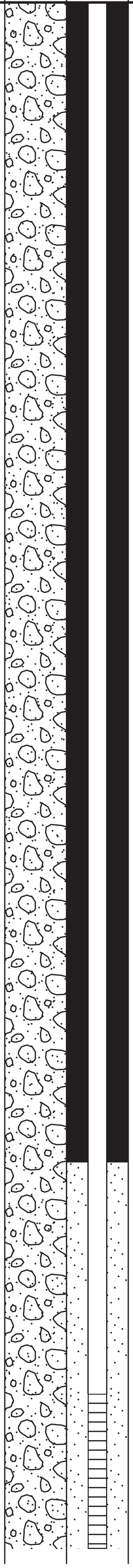
Boring Number 05DR

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				28.2 - 72.7' **WELL-GRADED GRAVEL WITH SAND:** (GW)s, coarse grained sand, little silt, light brown, loose, dry. *(continued)*										
			33											
			34											
			35											
6	108 96		36											
			37											
			38											
			39											
			40											
			41											
			42		(GW)s									
			43											
			44											
7	120 86		45											
			46											
			47											
			48											
			49											
			50											
			51											
			52											



Boring Number 05DR

Sample								Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				28.2 - 72.7' **WELL-GRADED GRAVEL WITH SAND:** (GW)s, coarse grained sand, little silt, light brown, loose, dry. *(continued)*									
			53										
			54										
8	60 40		55										
			56										
			57										
			58										
			59										
9	180 144		60										
			61										
			62		(GW)s								
			63										
			64										
			65										
			66										
			67										
			68										
			69										
			70										
			71										
			72										



NATURAL RESOURCE TECHNOLOGY

SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number 05DR

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Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
					(GW)s									
			73 74	72.7 - 75' **SILT:** ML, little clay and gravel, gray, dense, dry.	ML									
			75	75 - 76' Blind drilled to 76' for well installation.										
				76' End of Boring.										

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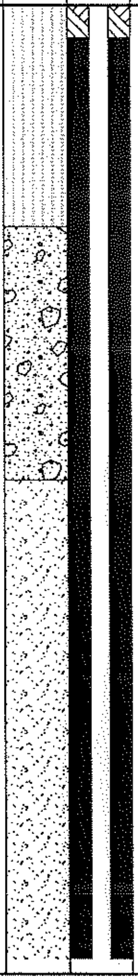
SOIL BORING LOG INFORMATION

Page 1 of 3

Facility/Project Name: Hennepin Power Station - New East Ash Landfill
License/Permit/Monitoring Number:
Boring Number: 08D
Boring Drilled By: Name of crew chief (first, last) and Firm: Mike Hansen, Boart Longyear Company
Date Drilling Started: 4/16/2009
Date Drilling Completed: 4/17/2009
Drilling Method: sonic
Common Well Name: 08D
Final Static Water Level: 448.4 Feet (Site)
Surface Elevation: 499.2 Feet (Site)
Borehole Diameter: 6.0 inches
Local Grid Origin ☐ (estimated: ☐) or Boring Location ☐
State Plane 1,688,932 N, 2,533,463 E S/C/N
1/4 of 1/4 of Section , T N, R
Lat ° ' "
Long ° ' "
Local Grid Location: ☐ N ☐ E Feet ☐ S Feet ☐ W
Facility ID:
County:
State: IL
Civil Town/City/ or Village: Hennepin

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
CS	60 60		2.5	0 - 7' **FILL, SILTY SAND:** SM, very dark brown (7.5YR 2.5/3), well graded, mostly sand [mostly fine, little coarse], few gravel [mostly fine], some silt, moist.	(FILL) SM									Relative Density by visual inspection, not SPT
CS	120 120		5.0											
			7.5 10.0 12.5	7 - 15' **FILL, WELL-GRADED SAND WITH GRAVEL:** (SW)g, brown (7.5YR 4/4), well graded, mostly sand [mostly medium, few coarse], some gravel [mostly fine], moist, trace brick pieces.	(FILL) (SW)g									
CS	120 120		15.0 17.5 20.0 22.5	15 - 40' **FILL, POORLY-GRADED SAND:** SP, yellowish brown (10YR 5/4), poorly graded, mostly sand [mostly medium, trace coarse], few subangular gravel [mostly coarse], moist, loose.	(FILL) SP									
CS	120 120		25.0 27.5 30.0											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Rachel Wilberding
Firm: Natural Resource Technology, Inc.
23713 W. Paul Road, St D. Pewaukee, WI 53072
Tel: 262.523.9000
Fax: 262.532.9001

Template: SOIL BORING - Project: 1940 GINT.GPJ

NATURAL RESOURCE TECHNOLOGY

SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number 08D

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	
			32.5	15 - 40' **FILL, POORLY-GRADED SAND:** SP, yellowish brown (10YR 5/4), poorly graded, mostly sand [mostly medium, trace coarse], few subangular gravel [mostly coarse], moist, loose. *(continued)*										
CS	120 120		35.0 37.5		(FILL) SP									
			40.0 42.5	40 - 52' **FILL, POORLY-GRADED SAND:** SP, yellowish brown (10YR 5/4), poorly graded, mostly sand [mostly medium], few silt, moist, trace bottom ash, loose.										
CS	120 120		45.0	46' wet.	(FILL) SP									
			47.5 50.0				▼							
			52.5	52 - 55' **CLAYEY SAND:** SC, yellowish brown (10YR 5/4), well graded, mostly sand [mostly medium, little coarse], few gravel [mostly coarse], some clay.	SC									
CS	120 0		55.0 57.5 60.0 62.5	55 - 65' No Recovery. Some black fine sand on outside of core barrel, possible peat.										
CS	120 120		65.0	65 - 66' **CLAYEY GRAVEL:** GC, dark yellowish brown (10YR 4/6), high plasticity, mostly gravel [mostly fine, few coarse], some clay.	GC									
			67.5	66 - 67' **WELL-GRADED SAND:** SW, dark brown (10YR 3/3), well graded, mostly sand [mostly medium].	SW									
			70.0 72.5	67 - 83' **WELL-GRADED GRAVEL WITH CLAY AND SAND:** (GW-GC)s, yellowish brown (10YR 5/6), well graded, some sand [mostly medium], mostly gravel [mostly fine, few coarse], little clay.	(GW-GC)s									
CS	120 120		75.0 77.5 80.0	75' 12-inch medium sand seam.										

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SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number 08D

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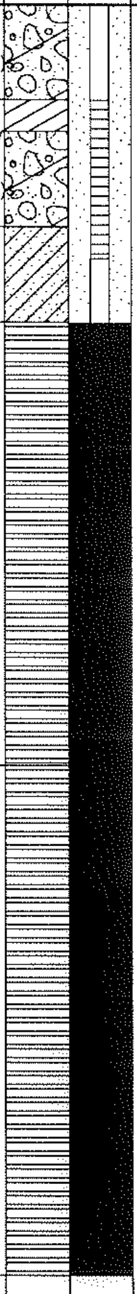

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			82.5		(GW-GC)								
				83 - 84' **LEAN CLAY**: CL, gray), hard, dry.	CL								
CS	120 120		85.0	84 - 87' **WELL-GRADED GRAVEL WITH CLAY AND SAND**: (GW-GC)s, brownish yellow (10YR 5/8), well graded, some sand [mostly medium], mostly gravel [mostly fine, few coarse], little clay.	(GW-GC)								
			87.5	87 - 90' **CLAYEY SAND**: SC, yellowish brown), well graded, mostly sand [mostly medium], some clay, medium dense.	SC								
			90.0	90 - 104' **WEATHERED BEDROCK** BDX (SH), gray (7/5B), Weathered Shale. Samples expanded in core sleeve with addition of water.									
			92.5										
CS	120 120		95.0										
			97.5		BDX (SH)								
			100.0										
			102.5										
				104 - 120' **SHALE**: BDX (SH), gray (7/5B), drilling more difficult.									
CORE	60 60		105.0										RQD = 66%
			107.5										
CORE	120 120		110.0										RQD = 63%
			112.5		BDX (SH)								
			115.0										
			117.5										
			120.0	120' EOB.									

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SOIL BORING LOG INFORMATION

Facility/Project Name Hennepin Power Station - New East Ash Landfill	License/Permit/Monitoring Number	Boring Number 18D

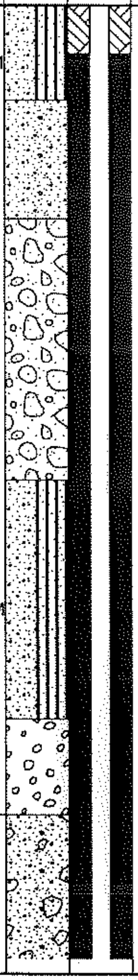
Boring Drilled By: Name of crew chief (first, last) and Firm Mike Hansen Boart Longyear Company	Date Drilling Started 4/14/2009	Date Drilling Completed 4/14/2009	Drilling Method sonic
Common Well Name 18D	Final Static Water Level 451.3 Feet (Site)	Surface Elevation 485.2 Feet (Site)	Borehole Diameter 6.0 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☐
State Plane 1,690,429 N, 2,532,742 E S/C/N
1/4 of 1/4 of Section , T N, R

Lat ____° ____' ______"
Long ____° ____' ______"

Local Grid Location
Feet ☐ N ☐ S
Feet ☐ E ☐ W

Facility ID	County	State IL	Civil Town/City/ or Village Hennepin



Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
CS	60 60		1.5	0 - 2' **FILL, WELL-GRADED SAND WITH SILT:** SW-SM, strong brown (7.5YR 4/6), well graded, mostly sand [mostly medium, few coarse], trace subrounded gravel [mostly medium], some silt, moist.	(FILL) SW-SM									Relative Density by visual inspection, not SPT
			3.0 4.5	2 - 4.5' **FILL, WELL-GRADED SAND:** SW, dark gray (2.5Y 4/1), well graded, mostly sand [trace fine, little medium, mostly coarse], some gravel [mostly medium], very dense.	(FILL) SW									
CS	120 120		6.0 7.5 9.0	4.5 - 10' **FILL, WELL-GRADED GRAVEL WITH SAND:** (GW)s, strong brown (7.5YR 4/6), well graded, some sand [some medium, few coarse], mostly gravel [mostly medium, little coarse], trace clay, dry, medium dense.	(FILL) (GW)s									
			10.5 12.0 13.5	10 - 15' **FILL, WELL-GRADED SAND WITH SILT:** SW-SM, very dark brown (2.5Y 2.5/1), 50% dark olive brown (2.5Y 3/3) mottling, well graded, mostly sand [mostly fine, little coarse], few gravel [mostly medium], some silt, trace bottom ash.	(FILL) SW-SM									
CS	120 120		15.0 16.5	15 - 17' **POORLY-GRADED GRAVEL:** GP, poorly graded, mostly gravel [mostly coarse], with limestone cobbles (2 - 4 inches diameter).	GP									
			18.0 19.5	17 - 22' **WELL-GRADED SAND WITH GRAVEL:** (SW)g, very dark grayish brown (2.5Y 3/2), well graded, mostly sand [mostly fine, few coarse], little gravel [mostly medium], moist, medium dense.	(SW)g									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm Natural Resource Technology, Inc. 23713 W. Paul Road, St D. Pewaukee, WI 53072 Tel: 262.523.9000 Fax: 262.532.9001

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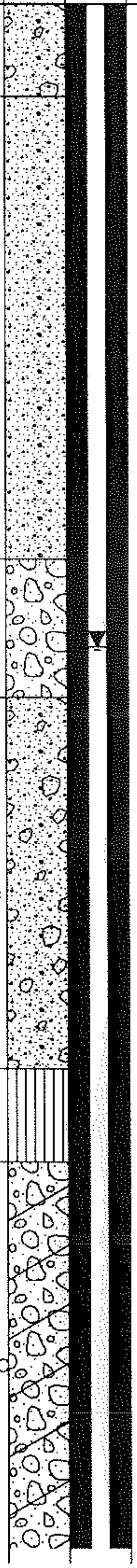
Boring Number 18D



Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram		Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			21.0		(SW)g									
			22.5	22 - 32' **WELL-GRADED SAND:** SW, strong brown (7.5YR 5/6), well graded, mostly sand [mostly fine, some medium, trace coarse].										
			24.0											
CS	120 120		25.5											grain size @ 25'
			27.0		SW									
			28.5											
			30.0											
			31.5											
			33.0	32 - 35' **WELL-GRADED GRAVEL WITH SAND:** (GW)s, strong brown (7.5YR 5/6), well graded, some sand [mostly coarse], mostly gravel [mostly fine, few coarse].	(GW)s									
			34.5											
CS	120 120		36.0	35 - 43' **WELL-GRADED SAND WITH GRAVEL:** (SW)g, strong brown (7.5YR 5/6), well graded, mostly sand [mostly fine], little gravel [little fine, few medium], medium dense, trace cobbles.										
			37.5											
			39.0		(SW)g									
			40.5											
			42.0											
			43.5	43 - 45' **SILT:** ML, very pale brown (10YR 8/2), dry, very loose.	ML									
CS	120 120		45.0	45 - 58' **WELL-GRADED GRAVEL WITH CLAY:** GW-GC, yellowish brown (10YR 5/4), very soft, well graded, mostly subrounded gravel [mostly fine, few coarse], little clay, wet, trace cobbles.										grain size @ 45'
			46.5											
			48.0											
			49.5		GW-GC									
			51.0											
			52.5											

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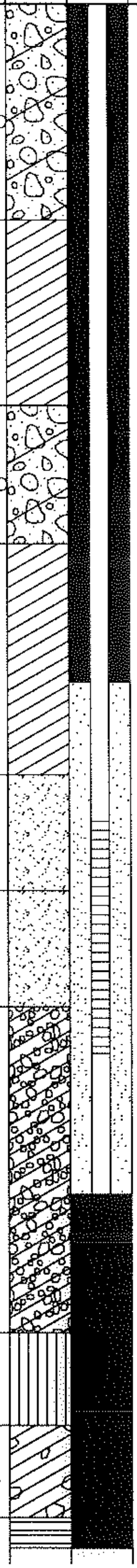
TECHNOLOGY

Boring Number 18D

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Soil Properties Compressive Strength	Soil Properties Moisture Content	Soil Properties Liquid Limit	Soil Properties Plasticity Index	Soil Properties P 200	RQD/ Comments
CS	120 120		54.0 55.5 57.0	45 - 58' **WELL-GRADED GRAVEL WITH CLAY:** GW-GC, yellowish brown (10YR 5/4), very soft, well graded, mostly subrounded gravel [mostly fine, few coarse], little clay, wet, trace cobbles. *(continued)*	GW-GC						grain size @ 55'
			58.5 60.0 61.5	58 - 62' **LEAN CLAY:** CL, yellowish brown (10YR 5/4), medium toughness, medium plasticity, firm, laminated, PP = 1.5.	CL						PP = Pocket Pen
			63.0 64.5	62 - 65' **WELL-GRADED GRAVEL WITH CLAY:** GW-GC, yellowish brown (10YR 5/4), very soft, well graded, mostly subrounded gravel [mostly fine, few coarse], little clay, wet, trace cobbles.	GW-GC						
CS	120 120		66.0 67.5 69.0	65 - 70' **LEAN CLAY:** CL, dark gray (2.5Y 4/1), medium toughness, medium to high plasticity, soft, PP = 0.5.	CL						
			70.5 72.0	70 - 72.5' **POORLY-GRADED SAND:** SP, dark gray (2.5Y 4/1), poorly graded, mostly sand [mostly fine], wet.	SP						
			73.5	72.5 - 75' **POORLY-GRADED SAND:** SP, yellowish brown (10YR 5/4), poorly graded, mostly sand [mostly medium].	SP						
CS	120 120		75.0 76.5 78.0 79.5 81.0	75 - 82' **CLAYEY GRAVEL:** GC, dark yellowish brown (10YR 3/4), well graded, little sand [mostly coarse], mostly subrounded gravel [mostly medium], some clay, dense. 80' gray (N 5/), Dolomite Boulder.	GC						grain size @ 77'
			82.5	82 - 84' **SILT:** ML, gray (N 5/), dry, medium dense.	ML						
CS	120 120		84.0 85.5	84 - 86' **LEAN CLAY WITH GRAVEL:** (CL)g, gray (N 5/), some gravel [mostly coarse], dense, Till.	(CL)g						



SOIL BORING LOG INFORMATION SUPPLEMENT

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Boring Number 18D

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			87.0 88.5 90.0 91.5 93.0 94.5	86 - 95' **WEATHERED BEDROCK** BDX (SH), gray (N 5/), very hard, dry, Weathered Shale. *(continued)*	BDX (SH)									
				95' EOB.										

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SOIL BORING LOG INFORMATION

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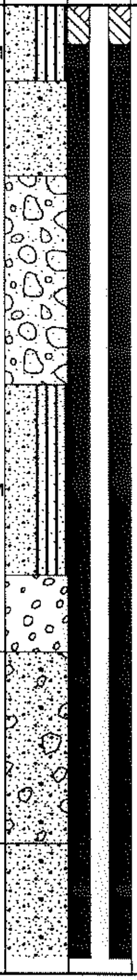
Facility/Project Name Hennepin Power Station - New East Ash Landfill	License/Permit/Monitoring Number	Boring Number 18S

Boring Drilled By: Name of crew chief (first, last) and Firm Mike Hansen Boart Longyear Company	Date Drilling Started 4/14/2009	Date Drilling Completed 4/15/2009	Drilling Method sonic

Common Well Name 18S	Final Static Water Level 450.7 Feet (Site)	Surface Elevation 485.2 Feet (Site)	Borehole Diameter 6.0 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☐
State Plane 1,690,428 N, 2,532,740 E S/C/N
1/4 of 1/4 of Section , T N, R
Lat ° ' "
Long ° ' "
Local Grid Location
Feet ☐ N ☐ S
Feet ☐ E ☐ W

Facility ID	County	State IL	Civil Town/City/ or Village Hennepin



Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties: Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				0 - 2' SW-SM, Blind Drilled to 52'. See log for 18D.	(FILL) SW-SM									
			2 4	2 - 4.5' SW.	(FILL) SW									
			6 8	4.5 - 10' (GW)s.	(FILL) (GW)s									
			10 12 14	10 - 15' SW-SM.	(FILL) SW-SM									
			16	15 - 17' GP.	GP									
			18 20	17 - 22' (SW)g.	(SW)g									
			22 24	22 - 32' SW.	SW									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Rachel Wilberta	Firm Natural Resource Technology, Inc. 23713 W. Paul Road, St D. Pewaukee, WI 53072	Tel: 262.523.9000 Fax: 262.532.9001

Template: SOIL BORING - Project: 1940 GINT.GPJ

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SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number 18S

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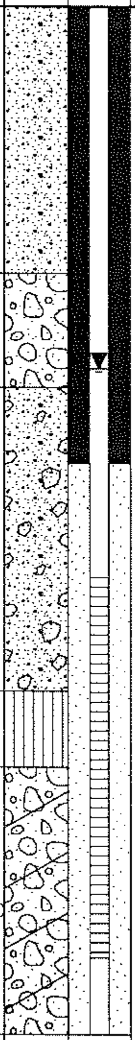


Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			26 28 30	22 - 32' SW. *(continued)*	SW									
			32 34	32 - 35' (GW)s.	(GW)s									
			36 38 40 42	35 - 43' (SW)g.	(SW)g									
			44	43 - 45' ML.	ML									
			46 48 50	45 - 52' GW-GC.	GW-GC									
			52	52' EOB.										

SOIL BORING LOG INFORMATION

Page 1 of 3

Facility/Project Name: Hennepin Power Station - New East Ash Landfill
License/Permit/Monitoring Number:
Boring Number: 19D

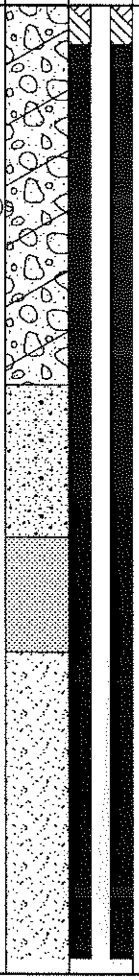
Boring Drilled By: Name of crew chief (first, last) and Firm
Mike Hansen
Boart Longyear Company

Date Drilling Started: 4/15/2009
Date Drilling Completed: 4/15/2009
Drilling Method: sonic

Common Well Name: 19D
Final Static Water Level: 450.8 Feet (Site)
Surface Elevation: 483.9 Feet (Site)
Borehole Diameter: 6.0 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☐
State Plane 1,690,632 N, 2,533,812 E S/C/N
1/4 of 1/4 of Section , T N, R
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N ☐ E
Feet ☐ S Feet ☐ W

Facility ID:
County:
State: IL
Civil Town/City/ or Village: Hennepin

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
CS	60 60		2	0 - 10' **FILL, WELL-GRADED GRAVEL WITH CLAY AND SAND:** (GP-GC)s, dark yellowish brown (10YR 4/4), well graded, some sand [few medium, mostly coarse], mostly gravel [mostly fine, trace coarse], little clay.										Relative Density by visual inspection, not SPT
			4	4' 5 - 10% bottom ash to 5'.										
CS	120 120		6 8		(FILL) (GP-GC)s									
			10 12	10 - 14' **FILL, WELL-GRADED SAND:** SW, dark yellowish brown (10YR 3/6), 35% black) mottling, well graded, mostly sand [mostly fine], some bottom ash.	(FILL) SW									
			14	14 - 17' **FILL, ASH (Coal):** ASH (Coal), fine grained, gray.	(FILL) ASH (Coal)									
CS	120 120		16											
			18 20 22 24	17 - 30' **FILL, POORLY-GRADED SAND:** SP, dark yellowish brown (10YR 3/6), poorly graded, mostly sand [mostly fine, few coarse], moist, trace bottom ash, cohesive.	(FILL) SP									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Rachel Wilberding

Firm: Natural Resource Technology, Inc.
23713 W. Paul Road, St D. Pewaukee, WI 53072
Tel: 262.523.9000
Fax: 262.532.9001

SOIL BORING LOG INFORMATION SUPPLEMENT

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Boring Number 19D

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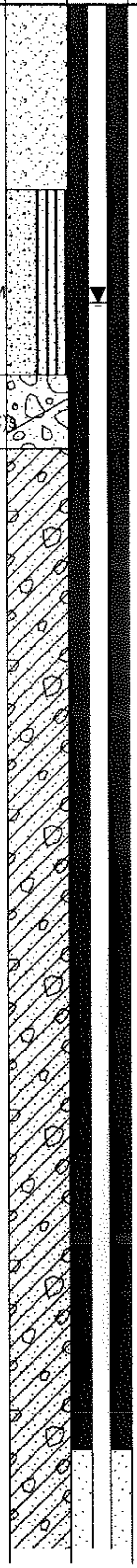
Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
CS	120 120		26 28 30 32 34	17 - 30' **FILL, POORLY-GRADED SAND:** SP, dark yellowish brown (10YR 3/6), poorly graded, mostly sand [mostly fine, few coarse], moist, trace bottom ash, cohesive. *(continued)* 30 - 35' **WELL-GRADED SAND WITH SILT:** SW-SM, yellowish brown (2.5Y 6/3), well graded, mostly sand [mostly coarse], little angular to subangular gravel [mostly fine, few coarse], some silt, dry, loose.	(FILL) SP SW-SM									
CS	120 120		36 38 40 42 44	35 - 37' **WELL-GRADED GRAVEL WITH CLAY AND SAND:** (GW-GC)s, yellowish brown (10YR 5/6), well graded, some sand [mostly coarse], mostly subrounded to rounded gravel [mostly fine, few coarse], little clay, wet, loose. 37 - 73' **CLAYEY SAND WITH GRAVEL:** (SC)g, yellowish brown (10YR 5/6), soft, well graded, mostly sand [few fine, mostly coarse], little gravel [mostly coarse], some clay, wet.	(GW-GC)s									
CS	120 60		46 48 50 52 54	45' - 55' Poor Recovery.	(SC)g									
CS	120 120		56 58 60 62 64											
CS	120 120		66											



SOIL BORING LOG INFORMATION SUPPLEMENT

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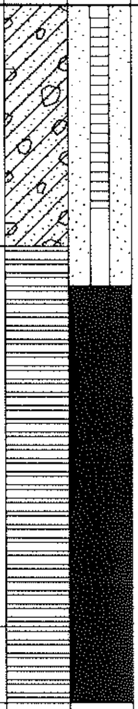
Boring Number 19D



Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			68 70 72	37 - 73' **CLAYEY SAND WITH GRAVEL:** (SC)g, yellowish brown (10YR 5/6), soft, well graded, mostly sand [few fine, mostly coarse], little gravel [mostly coarse], some clay, wet. *(continued)*	(SC)g									
CS	120 120		74 76 78 80 82	73 - 83' **WEATHERED BEDROCK** BDX (SH), dark gray (N 4/), dry, Weathered Shale.	BDX (SH)									
			84	83 - 85' **SHALE:** BDX (SH), dark gray (N 4/), dry, samples were pulverized, drilling more difficult.	BDX (SH)									
				85' EOB.										

SOIL BORING LOG INFORMATION

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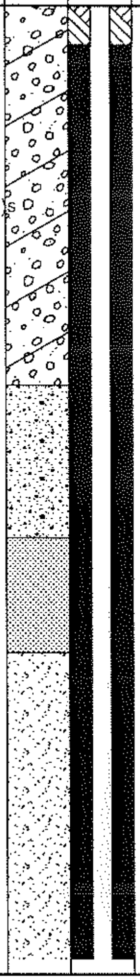
Facility/Project Name: Hennepin Power Station - New East Ash Landfill
License/Permit/Monitoring Number:
Boring Number: 19S

Boring Drilled By: Name of crew chief (first, last) and Firm: Mike Hansen, Boart Longyear Company
Date Drilling Started: 4/16/2009
Date Drilling Completed: 4/16/2009
Drilling Method: sonic

Common Well Name: 19S
Final Static Water Level: 450.6 Feet (Site)
Surface Elevation: 483.9 Feet (Site)
Borehole Diameter: 6.0 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☐
State Plane 1,690,631 N, 2,533,810 E S/C/N
1/4 of 1/4 of Section , T N, R
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N ☐ E
Feet ☐ S Feet ☐ W

Facility ID:
County:
State: IL
Civil Town/City/ or Village: Hennepin



Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram		Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			2 4 6 8	0 - 10' (GW-GC)s, Blind drilled to 52'. See log for 19D.	(FILL) (GW-GC)s									
			10 12	10 - 14' SW.	(FILL) SW									
			14 16	14 - 17' ASH (Coal).	(FILL) ASH (Coal)									
			18 20 22 24	17 - 30' SP.	(FILL) SP									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm: Natural Resource Technology, Inc.
23713 W. Paul Road, St D. Pewaukee, WI 53072
Tel: 262.523.9000
Fax: 262.532.9001

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Boring Number 19S

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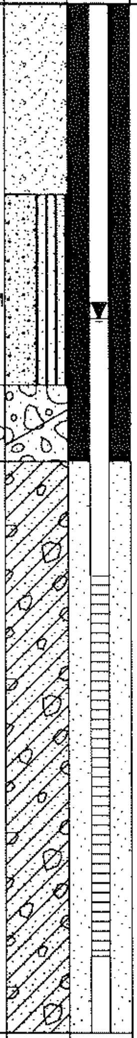

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			26 28	17 - 30' SP. *(continued)*	(FILL) SP									
			30 32 34	30 - 35' SW-SM.	SW-SM									
			36	35 - 37' GW-GC.	GW-GC									
			38 40 42 44 46 48 50	37 - 52' (SC)g.	(SC)g									
			52	52' EOB.										

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SOIL BORING LOG INFORMATION

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Facility/Project Name Hennepin Power Station - New East Ash Landfill	License/Permit/Monitoring Number	Boring Number 40S

Boring Drilled By: Name of crew chief (first, last) and Firm Jerry Hancock PSC Drilling	Date Drilling Started 10/25/2010	Date Drilling Completed 10/26/2010	Drilling Method hollow stem auger
Common Well Name 40S	Final Static Water Level 473.8 Feet (Site)	Surface Elevation 485.8 Feet (Site)	Borehole Diameter 8.3 inches

Local Grid Origin ☐ (estimated: ☒) or Boring Location ☒

State Plane 1,690,567 N, 2,533,492 E S/C/N

1/4 of 1/4 of Section , T N, R

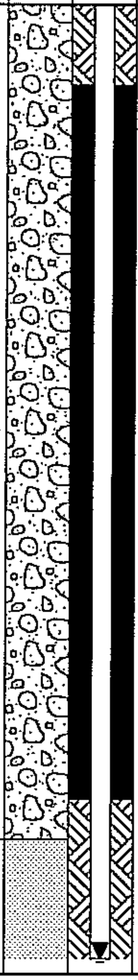
Lat ° ' "

Long ° ' "

Local Grid Location ☐ N ☐ E

Feet ☐ S Feet ☐ W

Facility ID	County	State	Civil Town/City/ or Village
		IL	Hennepin



Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID 10.6 eV Lamp	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
1 CS	60 42		0	**0 - 10.5' FILL, WELL-GRADED GRAVEL WITH SAND:** (GW)s, brown (7.5YR 5/4), well graded, dry, Gravel is composed of lithics (granite and dolomite). 16-30% lean clay.										
			1											
			2											
			3											
			4											
2 CS	60 42		5		(FILL) (GW)s									10-15 ft. dense. A lot of hammer blows
			6											
			7											
			8											
			9											
3 CS	60 60		10											15-20 ft. softer. Few hammer blows
			11	**10.5 - 28' FILL, ASH (Coal):** ASH (Coal), black (5YR 2.5/1), dry, Coarse like bottom ash to 15 ft.	(FILL) ASH (Coal)									
			12											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm Natural Resource Technology

Tel:

Fax:

SOIL BORING LOG INFORMATION SUPPLEMENT

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Boring Number 40S

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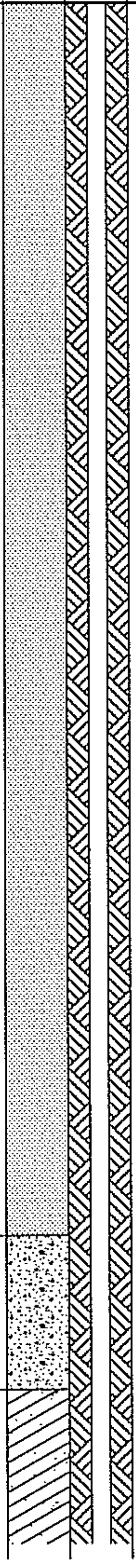
Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID 10.6 eV Lamp	Soil Properties Compressive Strength	Soil Properties Moisture Content	Soil Properties Liquid Limit	Soil Properties Plasticity Index	Soil Properties P 200	RQD/ Comments
				10.5 - 28' FILL, ASH (Coal): ASH (Coal), black (5YR 2.5/1), dry, Coarse like bottom ash to 15 ft. *(continued)*										
			13											
			14											
4 CS	60 60		15	15' very dark grayish brown (10YR 3/2), Fine like fly ash. Horizontally laminated in alternating layers of fine and coarse ash.										
			16											
			17	17' moist.										
			18											
			19											
5 CS	60 60		20		(FILL) ASH (Coal)									
			21	21' wet, Very soft to 24 ft.										
			22											
			23											
			24	24' moist.										
6 CS	60 52		25	25 - 28' wet, Soft. Very fine ash.										
			26											
			27											
			28	28 - 30' WELL-GRADED SAND: SW, dark yellowish brown (10YR 4/4), moist to wet, Native, buried terrace. Well graded fine to medium sand. 5-10% silt. Trace fine gravel (rounded) and root fibers.										
			29		SW									
7 CS	60 48		30	30 - 33.5' LEAN CLAY WITH SAND: (CL)s, dark grayish brown (2.5Y 4/2), slow dilatency, medium toughness, medium plasticity, moist to wet, 5-10% fine sand. Trace organics (black, woody).										
			31		(CL)s									
			32											



SOIL BORING LOG INFORMATION SUPPLEMENT

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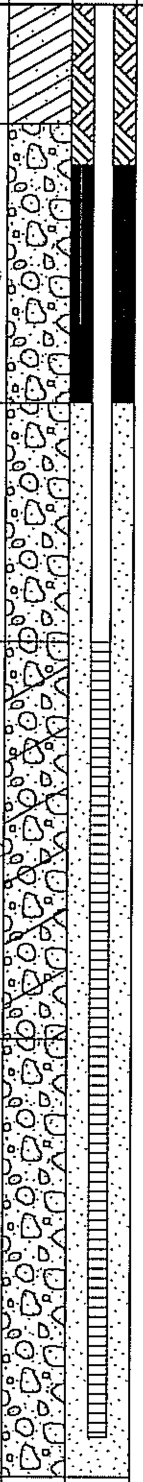
Boring Number 40S



Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID 10.6 eV Lamp	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			33	30 - 33.5' LEAN CLAY WITH SAND: (CL)s, dark grayish brown (2.5Y 4/2), slow dilatency, medium toughness, medium plasticity, moist to wet, 5-10% fine sand. Trace organics (black, woody). *(continued)*	(CL)s									
8 CS	60 27		34 35 36	33.5 - 37' WELL-GRADED GRAVEL WITH SAND: (GW)s, strong brown (7.5YR 5/6), well graded, wet, Fine to coarse gravel.	(GW)s									Poor recovery
			37 38 39	37 - 40' WELL-GRADED GRAVEL: GW, very pale brown (10YR 7/3), well graded, Fine to coarse angular gravel. 5-10% medium sand.	GW									
9 CS	60 27		40 41 42 43 44	40 - 45' WELL-GRADED GRAVEL WITH CLAY: GW-GC, light yellowish brown (10YR 6/4), wet, Fine sand to coarse gravel. 15-25% lean clay. 5-10% sand (well graded). 20% lean clay. Occasionally gravelly layers ~3 in. thick.	GW-GC									
10 CS	60 18		45 46 47 48 49 50	45 - 50.5' WELL-GRADED GRAVEL WITH SAND: (GW)s, light yellowish brown (10YR 6/4), wet, Fine to coarse gravel. 15-25% well graded sand (fine to coarse). <5% silt.	(GW)s									Poor recovery
				50.5' EOB.										

NATURAL RESOURCE TECHNOLOGY

SOIL BORING LOG INFORMATION

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Facility/Project Name: Hennepin Power Station
License/Permit/Monitoring Number:
Boring Number: 45S
Boring Drilled By: Name of crew chief (first, last) and Firm: Chad Dutton, Bulldog Drilling
Date Drilling Started: 6/23/2015
Date Drilling Completed: 6/24/2015
Drilling Method: hollow stem auger
Common Well Name: 45S
Final Static Water Level: Feet (NAVD88)
Surface Elevation: 465.70 Feet (NAVD88)
Borehole Diameter: 8.3 inches
Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 1,689,993.67 N, 2,531,896.69 E E/Ⓦ
1/4 of 1/4 of Section , T N, R
Lat 41° 18' 13.503"
Long -89° 18' 36.702"
Local Grid Location: Feet ☐N ☐S Feet ☐E ☐W
Facility ID:
County: Putnam
State: Illinois
Civil Town/City/ or Village: Hennepin

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties: Compressive Strength (tsf)	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
1 SS	24 20	2 5 4 3	0.5 1.0 1.5 2.0	0 - 2.5' **SILT:** ML, very dark grayish brown (10YR 3/2), mostly silt, some very fine sand, trace roots and gravel, cohesive, nonplastic, dry to moist.	ML									
2 SS	24 6	2 10 6 4	2.5 3.0 3.5 4.0 4.5	2.5 - 5' **SILT WITH SAND:** (ML)s, very dark grayish brown (10YR 3/2) to dark reddish gray (5YR 4/2), trace clay.	(ML)s									
3 ST	18 17.5		5.0 5.5 6.0	5 - 6.5' Shelby Tube.										ST3: 18" at 550 lbs of pressure.
			6.5 7.0	6.5 - 7.5' **SILT WITH SAND:** (ML)s, very dark grayish brown (10YR 3/2) to dark reddish gray (5YR 4/2), trace clay.	(ML)s									
4 SS	24 18	6 12 20 18	7.5 8.0 8.5 9.0 9.5	7.5 - 10.5' **WELL-GRADED SAND WITH GRAVEL:** (SW)g, brown (7.5YR 4/3), subangular gravel, trace clay, moist, top 2" of unit is fine poorly-graded sand. 8.2' thin layer of black material.	(SW)g									
5 SS	24 16	7 3 3	10.0 10.5											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm Natural Resource Technology
234 W. Florida St., Fifth Floor, Milwaukee, WI 53204
Tel: (414) 837-3607
Fax: (414) 837-3608

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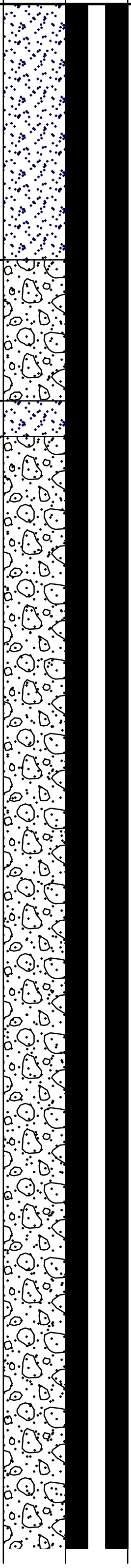
NATURAL RESOURCE TECHNOLOGY

SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number 45S



Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
		7	11.0 11.5 12.0	10.5 - 13.4' **POORLY-GRADED SAND:** SP, brown (7.5YR 5/4), fine sand, trace to little clay, trace silt, cohesive, decreasing cohesiveness and clay content with depth, moist to wet.	SP									
6 SS	24 24	8 19 22 9	12.5 13.0											
			13.5 14.0 14.5	13.4 - 15' **WELL-GRADED GRAVEL WITH SAND:** (GW)s, brown (7.5YR 5/3), subangular to rounded gravel, fine sand, trace clay and silt, wet.	(GW)s									
7 SS	24 19	8 23 40 25	15.0	15 - 15.4' **POORLY-GRADED SAND:** SP, brown (7.5YR 5/4), fine sand, trace clay and silt, wet.	SP									
			15.5 16.0 16.5 17.0	15.4 - 32.5' **WELL-GRADED GRAVEL WITH SAND:** (GW)s, yellowish brown (10YR 5/4), rounded to subangular gravel, fine sand, trace clay and silt, wet.	(GW)s									
8 SS	24 12	2 10 17 15	17.5 18.0 18.5 19.0 19.5											
9 SS	24 10	10 31 25 3	20.0 20.5 21.0 21.5 22.0											
10 SS	24 8	9 14 12 13	22.5 23.0 23.5 24.0 24.5	22.7' brown (7.4YR 4/2), thin layer of poorly-graded fine sand.										
11 SS	24 11	5 8 10 9	25.0 25.5 26.0 26.5 27.0											
12 SS	24 8	10 11 11	27.5 28.0	27.5' increase in clay content.										

SOIL BORING LOG INFORMATION SUPPLEMENT

NATURAL
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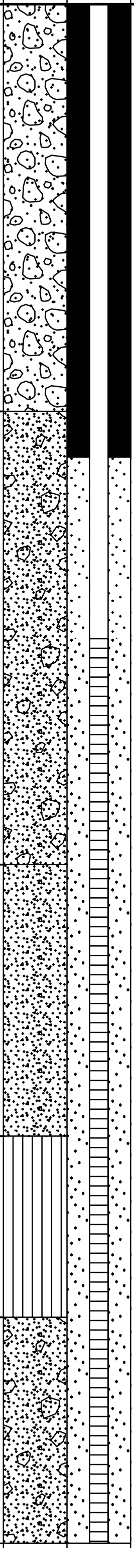
TECHNOLOGY

Boring Number 45S



Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
		10	28.5 29.0 29.5	15.4 - 32.5' **WELL-GRADED GRAVEL WITH SAND:** (GW)s, yellowish brown (10YR 5/4), rounded to subangular gravel, fine sand, trace clay and silt, wet. *(continued)*	(GW)s									
13 SS	24 19	7 8 6 6	30.0 30.5 31.0 31.5 32.0											
14 SS	24 8	5 6 11 12	32.5 33.0 33.5 34.0 34.5	32.5 - 37.5' **WELL-GRADED SAND WITH GRAVEL:** (SW)g, yellowish brown (10YR 5.4), medium to coarse sand, fine subangular to rounded gravel, fine gravel, trace silt and clay, wet.	(SW)g									
15 SS	24 9	4 5 9 11	35.0 35.5 36.0 36.5 37.0											
16 SS	24 14	7 10 9 9	37.5 38.0 38.5 39.0 39.5	37.5 - 40.5' **WELL-GRADED SAND:** SW, yellowish brown (10YR 5/4), fine to coarse sand, few to little subangular to subrounded gravel, trace clay, wet, layer of fine sand at top 1" of unit.	SW									
17 SS	24 19	9 6 7 8	40.0											
			40.5 41.0 41.5 42.0	40.5 - 42.5' **SILT:** ML, yellowish brown (10YR 5/4), little to some clay, trace medium sand, cohesive, nonplastic, moist.	ML									
18 SS	24 16	3 13 11 13	42.5 43.0 43.5 44.0 44.5	42.5 - 45' **WELL-GRADED SAND WITH GRAVEL:** to **POORLY-GRADED SAND WITH GRAVEL:** (SW)g, yellowish brown (10YR 5/4), mostly fine sand, subangular to rounded gravel, little to some medium to coarse sand, trace clay and silt, wet.	(SW)g									
			45.0	45' End of Boring.										

NATURAL RESOURCE TECHNOLOGY

SOIL BORING LOG INFORMATION

Page 1 of 4

Facility/Project Name Hennepin Power Station		License/Permit/Monitoring Number		Boring Number 46	
Boring Drilled By: Name of crew chief (first, last) and Firm Jason Drabek Cascade Drilling		Date Drilling Started 8/11/2015	Date Drilling Completed 8/11/2015		Drilling Method Sonic
Common Well Name 46		Final Static Water Level Feet (NAVD88)	Surface Elevation 496.44 Feet (NAVD88)		Borehole Diameter 6.0 inches
Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒ State Plane 1,690,085.24 N, 2,533,743.42 E E/[✓ W] 1/4 of 1/4 of Section , T N, R		Lat 41° 18' 14.23" Long -89° 18' 12.5"	Local Grid Location Feet ☐ N ☐ S Feet ☐ E ☐ W		
Facility ID	County Putnam	State Illinois	Civil Town/City/ or Village Hennepin		

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties: Compressive Strength (tsf)	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
1 CS	60 41.5		1	0 - 5' **FILL, TOPSOIL:** GM, dark yellowish brown (10YR 4/4), mostly fine to coarse gravel, silt (<50%), roots (<10%).										
			2	2' ash (30-50%).	(FILL) GM									
			3	3' - 3.5' fine to coarse gravel layer.										
			4											
2 CS	60 42		5	5 - 11' **FILL, SILT:** ML, yellowish brown (10YR 5/8) mottling, fine to coarse gravel (<40%), clay (<20%), ash (5-15%), ash content increases with depth, dry.										
			6											
			7											
			8		(FILL) ML									
			9											
3 CS	30 30		10	10' decrease in fine gravel content (<10%), decrease in ash content (<10%), increase in clay content with depth, low plasticity, moist.										
			11	11 - 12.5' **FILL, ASH (Coal):** very dark brown (10YR 2/2), clay (30-50%), fine gravel (5-15%), low plasticity, moist.										
			12		(FILL)									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Andrea Salus

Firm Natural Resource Technology
234 W. Florida St., Fifth Floor, Milwaukee, WI 53204
Tel: (414) 837-3607
Fax: (414) 837-3608

SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number 46

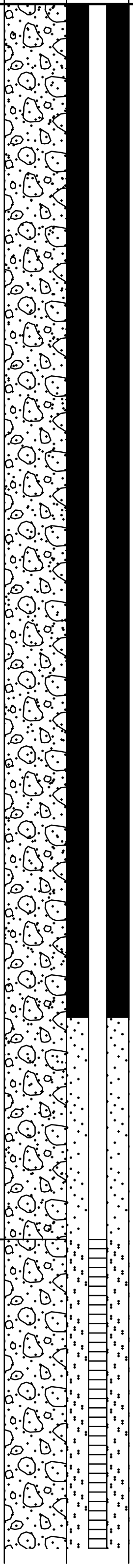
Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
4 CS	30 30		13 14	12.5 - 15' **FILL, LEAN CLAY:** CL, very dark grayish brown (10YR 3/2), silt-sized ash (30-50%), cobbles (15-30%), fine subrounded gravel (10-15%), very fine sand (10-15%), trace silt-sized ash, medium plasticity, cohesive, wet.	(FILL) CL									
			15	14.8' wood fragments (5-15%).										
5 CS	60 58		16 17	15 - 18' **FILL, SILTY CLAY** CL/ML, very dark gray (10YR 3/1), fine gravel (5-10%), very fine sand (10-15%), cohesive, medium plasticity, soft, wet. 16' - 16.5' dark brown (10YR 3/3). 16.5' - 17.0' mostly silt [very soft, wet].	(FILL) CL/ML									
			18 19	18 - 19.9' **FILL, CLAYEY SILT** ML/CL, pale brown (10YR 6/3), fine to coarse angular gravel (>15%), fine sand (10-20%), dry.	(FILL) ML/CL									
6 CS	60 60		20 21 22	20 - 23' **FILL, ASH (Coal):** very dark brown (10YR 2/2), clay to silt-sized ash, wood fragments (5-10%), seams of very dark gray (10YR 3/1) material.	(FILL)									
			23 24	23 - 30' **CLAYEY SILT** ML/CL, very dark grayish brown (10YR 3/2), fine to medium sand (30-50%), subangular to subrounded gravel (>15%), dry. 24' grayish brown (10YR 5/2).										
7 CS	60 60		25 26 27 28 29	25' cobbles (15-30%).	ML/CL									
8 CS	60 58		30 31 32 33	30 - 50' **WELL-GRADED GRAVEL WITH SAND:** (GW)s, grayish brown (10YR 5/2), dark yellowish brown (10YR 4/6), and yellowish brown (10YR 5/8), subangular to subrounded gravel, coarse sand, clay (5-15%), dry.	(GW)s									

SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number 46

Page 3 of 4

Sample								Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			34	30 - 50' **WELL-GRADED GRAVEL WITH SAND:** (GW)s, grayish brown (10YR 5/2), dark yellowish brown (10YR 4/6), and yellowish brown (10YR 5/8), subangular to subrounded gravel, coarse sand, clay (5-15%), dry. *(continued)*									
9 CS	60 23		35										
			36										
			37										
			38										
			39										
10 CS	60 54		40	40' clay (5-10%) , clay content increasing with depth, trace silt and very fine sand, moist.									
			41										
			42		(GW)s								
			43										
			44										
11 CS	60 54		45	45' increase in clay content (10-15%), trace fine sand.									
			46										
			47										
			48	47.5' - 49.0' pulverized cobble (white, rock flour and gravel-sized fragments).									
			49										
12 CS	120 72		50	50 - 60' **WELL-GRADED GRAVEL:** GW, subrounded to rounded gravel, clay (15-20%), trace fine sand and silt, wet.									
			51										
			52		GW								
			53										
			54										



SOIL BORING LOG INFORMATION SUPPLEMENT

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Boring Number 46

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			55 56 57 58 59	50 - 60' **WELL-GRADED GRAVEL:** GW, subrounded to rounded gravel, clay (15-20%), trace fine sand and silt, wet. *(continued)* 55' - 56' yellowish brown (10YR 5/5).	GW									
			60	60' End of Boring.										

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TECHNOLOGY

SOIL BORING LOG INFORMATION

Page 1 of 4

Facility/Project Name Hennepin Power Station	License/Permit/Monitoring Number	Boring Number 47

Boring Drilled By: Name of crew chief (first, last) and Firm Jason Drabek Cascade Drilling	Date Drilling Started 8/10/2015	Date Drilling Completed 8/10/2015	Drilling Method Sonic
Common Well Name 47	Final Static Water Level Feet (NAVD88)	Surface Elevation 502.13 Feet (NAVD88)	Borehole Diameter 6.0 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒

State Plane 1,689,837.69 N, 2,533,052.86 E E / [✓ W]

1/4 of 1/4 of Section , T N, R

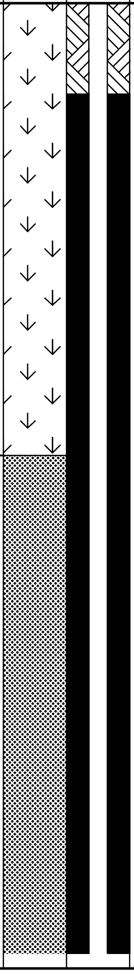
Lat 41° 18' 11.85"

Long -89° 18' 21.579"

Local Grid Location

Feet ☐ N ☐ S Feet ☐ E ☐ W

Facility ID	County	State	Civil Town/City/ or Village
	Putnam	Illinois	Hennepin



Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties: Compressive Strength (tsf)	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
1 CS	60 26		0.5	0 - 5' **FILL, TOPSOIL:** ML, brown (7.5YR 4/2), silt, trace roots, trace angular to subangular gravel dry.										
			1.0	0.7' grayish brown (10YR 5/2), subangular gravel (5-10%).										
			1.5	1' very dark gray (5YR 3/1), trace rounded to subrounded gravel, trace sand-sized ash, dry.										
			2.0											
			2.5		(FILL) ML									
			3.0											
			3.5											
			4.0											
			4.5											
2 CS	60 43		5.0	5 - 11.5' **FILL, ASH (Coal):** black (5YR 2.5/1), clay (5-15%), trace subrounded to subangular gravel, moist.										
			5.5											
			6.0											
			6.5											
			7.0	7' very dark brown (7.5YR 2.5/2), cohesive, dry to moist.										
			7.5											
			8.0		(FILL)									
			8.5	8.6' increased clay content.										
			9.0											
			9.5											
3 CS	60 32		10.0	10' increase in clay content (15-25%).										
			10.5											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm Natural Resource Technology
234 W. Florida St., Fifth Floor, Milwaukee, WI 53204

Tel: (414) 837-3607
Fax: (414) 837-3608

Template: ILLINOIS BORING LOG - Project: HENNEPIN 2015 GINT LOGS.GPJ

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			11.0	5 - 11.5' **FILL, ASH (Coal):** black (5YR 2.5/1), clay (5-15%), trace subrounded to subangular gravel, moist. *(continued)*	(FILL)									
			11.5	11.5 - 16.3' **FILL, CLAYEY SILT** ML/CL, dark reddish gray (5YR 4/2), gravel (>5%), dry.										
			12.0											
			12.5											
			13.0											
			13.5											
			14.0		(FILL) ML/CL									
			14.5											
4 CS	60 60		15.0											
			15.5											
			16.0											
			16.5	16.3 - 20' **FILL, ASH (Coal):** dark gray (10YR 4/1), mostly silt-sized ash, clay (0-10%), dry to moist.										
			17.0											
			17.5											
			18.0		(FILL)									
			18.5											
			19.0											
			19.5											
5 CS	60 60		20.0	20 - 21.8' **FILL, CLAYEY SILT** ML/CL, dark reddish gray (5YR 4/2), strong brown mottling, gravel (>5%), moist to wet.										
			20.5											
			21.0		(FILL) ML/CL									
			21.5											
			22.0	21.8 - 30' **FILL, SILT:** ML, dark gray (10YR 4/1) to very dark brown (7.5YR 2.5/2), clay, trace sand and gravel-sized bottom ash, moist to wet.										
			22.5											
			23.0	22.7' wood chips (<1" layer).										
			23.5											
			24.0											
			24.5											
6 CS	60 60		25.0	25' - 26.6' very dark brown (7.5YR 2.5/2), moist to wet.	(FILL) ML									
			25.5											
			26.0											
			26.5											
			27.0											
			27.5											
			28.0											

NATURAL RESOURCE TECHNOLOGY

SOIL BORING LOG INFORMATION SUPPLEMENT

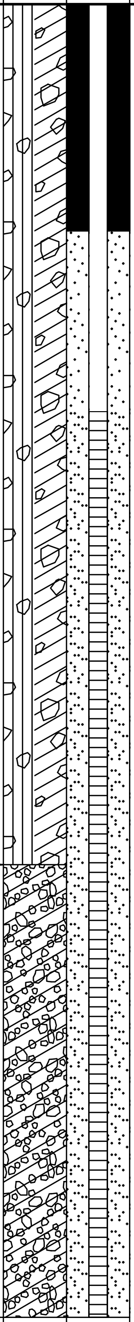
Boring Number 47

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties: Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			28.5 29.0 29.5	21.8 - 30' **FILL, SILT:** ML, dark gray (10YR 4/1) to very dark brown (7.5YR 2.5/2), clay, trace sand and gravel-sized bottom ash, moist to wet. *(continued)*	(FILL) ML									
7 CS	60 60		30.0 30.5 31.0 31.5 32.0 32.5 33.0	30 - 33.5' **POORLY-GRADED SAND:** SP, light brown (10YR 5/4), clay (5-15%), subrounded gravel (5-10%), dry. 31.2' - 33.5' white cobble pulverized by drilling method into angular to subangular gravel-sized pieces, dry.	SP									
			33.5 34.0 34.5	33.5 - 35' **SILT WITH GRAVEL:** (ML)g, light brown (10YR 7/3), subangular to subrounded gravel, noncohesive, dry.	(ML)g									
8 CS	60 18		35.0 35.5 36.0 36.5 37.0 37.5 38.0 38.5 39.0 39.5	35 - 40.9' **WELL-GRADED GRAVEL:** GW, very pale brown (10YR 7/3), gravel and cobbles (50%), sand (10-20%), trace clay. 36.5' cobble (>6" diameter) pulverized by drilling method into gravel-sized, sand-sized, and silt-sized pieces.	GW									
9 CS	60 60		40.0 40.5	40' piece of cobble.										
			41.0 41.5 42.0 42.5 43.0 43.5 44.0 44.5	40.9 - 45' **POORLY-GRADED SAND WITH CLAY AND GRAVEL:** (SC)g, sand (20-40%), subangular gravel (25-30%), clay (15-25%). 43.7' - 45' increased clay content.	(SC)g									
10 CS	60 42		45.0 45.5	45 - 55' **CLAYEY SILT** ML/CL, light brown (10YR 5/4), moist.	ML/CL									

SOIL BORING LOG INFORMATION SUPPLEMENT

NATURAL
RESOURCE
TECHNOLOGY

Boring Number 47



Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			46.0 46.5 47.0 47.5 48.0 48.5 49.0 49.5	45 - 55' **CLAYEY SILT** ML/CL, light brown (10YR 5/4), moist. *(continued)* 45.6' - 45.7 ' trace black silt-sized material. 45.8' - 46.7' wet.										
11 CS	60 34		50.0 50.5 51.0		ML/CL									
			51.5 52.0 52.5 53.0 53.5 54.0 54.5	51.4' wet.										
12 CS	60 33		55.0 55.5 56.0 56.5 57.0	55 - 60' **CLAYEY GRAVEL:** GC, subrounded gravel, clay (5-15%), trace silt and sand, decreasing silt and sand content with depth, wet.										
			57.5 58.0 58.5 59.0 59.5		GC									
			60.0	60' End of Boring.										

SOIL BORING LOG INFORMATION

Facility/Project Name Hennepin Power Station	License/Permit/Monitoring Number	Boring Number 48

Boring Drilled By: Name of crew chief (first, last) and Firm Jason Drabek Cascade Drilling	Date Drilling Started 8/11/2015	Date Drilling Completed 8/11/2015	Drilling Method Sonic
Common Well Name 48	Final Static Water Level Feet (NAVD88)	Surface Elevation 485.19 Feet (NAVD88)	Borehole Diameter 6.0 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒

State Plane 1,690,545.64 N, 2,533,337.84 E E/Ⓦ

1/4 of 1/4 of Section , T N, R

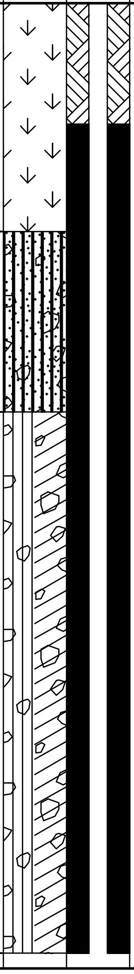
Lat 41° 18' 18.816"

Long -89° 18' 17.753"

Local Grid Location ☐ N ☐ S Feet ☐ E ☐ W Feet

Facility ID	County Putnam	State Illinois	Civil Town/City/ or Village Hennepin

Sample								Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 CS	60 60		0.5 1.0 1.5	0 - 1.9' **FILL, TOPSOIL:** ML, brown (7.5YR 4/2), gravel (5-10%), trace roots, clay, and sand, dry.	(FILL) ML								
			2.0 2.5 3.0	1.9 - 3.4' **FILL, SILTY SAND WITH GRAVEL:** (SM)g, very pale brown (10YR 7/3), very fine sand, dry.	(FILL) (SM)g								
			3.5 4.0	3.4 - 7.9' **FILL, CLAYEY SILT** ML/CL, very dark brown (7YR 2/2), gravel (>15%), cohesive, dry.									
			4.5	4.2' cobbles.									
2 CS	60 42		5.0 5.5 6.0	5' - 7.9' decreased cobble content.	(FILL) ML/CL								
			6.5 7.0 7.5	6.6' ash seam (2" layer, color changes from gray to reddish brown with depth).									



I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm Natural Resource Technology
234 W. Florida St., Fifth Floor, Milwaukee, WI 53204
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Natural Resource Technology

SOIL BORING LOG INFORMATION SUPPLEMENT

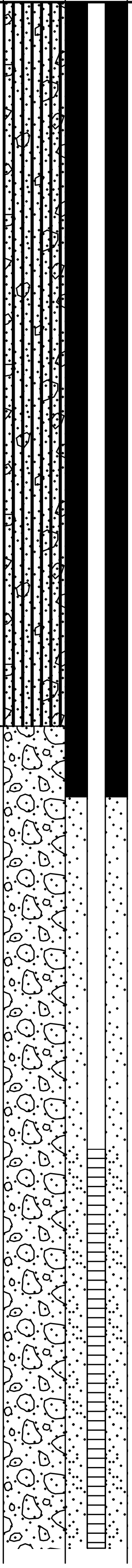
Boring Number 48

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			8.0	7.9 - 11.4' **FILL, SANDY SILT WITH GRAVEL:** s(ML)g, silt (>50%), cobbles (20-40%), sand (10-20%), trace clay, noncohesive, dry.										
			8.5											
			9.0											
			9.5		(FILL) s(ML)g									
3 CS	60 56		10.0											
			10.5											
			11.0											
			11.5	11.4 - 23.4' **FILL, ASH (Coal):** dark gray, (10YR 4/1), cohesive, dry.										
			12.0											
			12.5											
			13.0	13' - 13.4' very dark brown (7.5YR 2.5/2).										
			13.5											
			14.0											
			14.5											
4 CS	60 55		15.0	15' - 20' trace gravel-sized ash.										
			15.5											
			16.0		(FILL)									
			16.5											
			17.0	16.9' moist.										
			17.5											
			18.0											
			18.5											
			19.0											
			19.5											
5 CS	60 60		20.0	20' - 23.4' trace white particles, wet.										
			20.5											
			21.0											

SOIL BORING LOG INFORMATION SUPPLEMENT

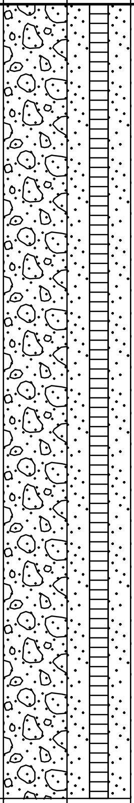
Boring Number 48

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	
			21.5	11.4 - 23.4' **FILL, ASH (Coal):** dark gray, (10YR 4/1), cohesive, dry. *(continued)*										
			22.0		(FILL)									
			22.5											
			23.0											
			23.5	23.2' white particles (0.2" layer). 23.4 - 24.5' **FILL, SILT:** ML, trace subangular to subrounded gravel, cohesive, dry.										
			24.0		(FILL) ML									
			24.5	24.5 - 25' **FILL, SANDY SILT WITH GRAVEL:** s(ML)g, silt (>50%), gravel (30-40%), very fine sand (5-10%), dry.	(FILL) s(ML)g									
6 CS	60 52		25.0	25 - 40.4' **FILL, SILTY SAND WITH GRAVEL:** (SM)g, very fine sand (30-40%), gravel (20-40%), silt (20-30%), dry.										
			25.5											
			26.0											
			26.5											
			27.0											
			27.5											
			28.0											
			28.5											
			29.0											
			29.5		(FILL) (SM)g									
7 CS	60 36		30.0	30' - 33' decrease in silt content (0-10%), trace clay, dry.										
			30.5											
			31.0											
			31.5											
			32.0	31.9' brown (10YR 4/3), trace ash.										
			32.5											
			33.0											
			33.5											
			34.0											



Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties: Compressive Strength (tsf)	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			34.5	25 - 40.4' **FILL, SILTY SAND WITH GRAVEL:** (SM)g, very fine sand (30-40%), gravel (20-40%), silt (20-30%), dry. *(continued)*										
8 CS	60 36		35.0	35' - 40' clay content increases with depth, iron oxidation.										
			35.5											
			36.0											
			36.5											
			37.0											
			37.5	37.3' wet.	(FILL) (SM)g									
			38.0											
			38.5											
			39.0											
			39.5											
9 CS	120 78		40.0											
			40.5	40.4 - 54' **WELL-GRADED GRAVEL:** GW, brown (10YR 4/3), gravel (>50%), clay (10-30%), increase in clay content (20-40%) with depth, sand (10-20%).										
			41.0											
			41.5											
			42.0											
			42.5											
			43.0											
			43.5											
			44.0		GW									
			44.5											
			45.0											
			45.5											
			46.0											
			46.5											
			47.0											

Boring Number 48

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	
10 CS	48 28		47.5 48.0 48.5 49.0 49.5 50.0 50.5 51.0 51.5 52.0 52.5 53.0 53.5	40.4 - 54' **WELL-GRADED GRAVEL:** GW, brown (10YR 4/3), gravel (>50%), clay (10-30%), increase in clay content (20-40%) with depth, sand (10-20%). *(continued)*	GW									
			54.0	54' End of Boring.										

NATURAL
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SOIL BORING LOG INFORMATION

Facility/Project Name Hennepin Power Station	License/Permit/Monitoring Number	Boring Number 49

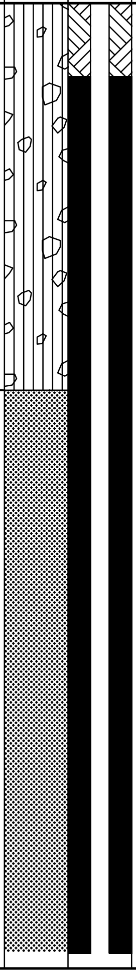
Boring Drilled By: Name of crew chief (first, last) and Firm Chad Dutton Bulldog Drilling	Date Drilling Started 7/2/2015	Date Drilling Completed 7/6/2015	Drilling Method hollow stem auger

Common Well Name 49	Final Static Water Level Feet (NAVD88)	Surface Elevation 465.76 Feet (NAVD88)	Borehole Diameter 8.3 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 1,689,022.19 N, 2,528,297.09 E E / [✓ W]
1/4 of 1/4 of Section , T N, R
Lat 41° 18' 4.255"
Long -89° 19' 23.987"
Local Grid Location ☐ N ☐ S Feet ☐ E ☐ W Feet

Facility ID	County Putnam	State Illinois	Civil Town/City/ or Village Hennepin

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 SS	24 13	3 4 7 10	1 2	0 - 5.3' **FILL, SILT WITH GRAVEL:** (ML)g, very dark grayish brown (10YR 3/2), trace sand and roots, rounded to subangular fine gravel, noncohesive, nonplastic, dry.										
2 SS	24 10.5	4 6 5 3	3 4	2.5' increase in gravel content and gravel size to fine to coarse, coarse sand (5-15%), dry.	(FILL) (ML)g									
3 SS	24 19	2 3 9 10	5 6 7	5' moist. 5.3 - 20.2' **FILL, ASH (Coal):** very dark gray (10YR 3/1), mostly silt sized particles, few interbedded sand sized layers, trace coarse ash, noncohesive, nonplastic, moist to wet.										
4 SS	24 22	5 27 30 50 for 5"	8 9	7.5' black (10YR 2/1). 8.2' mostly medium sand-sized particles with some coarse sand to fine gravel-sized ash.	(FILL)									
5 SS	24 24	5 11 20 50 for 5"	10 11 12	10' mostly silt sized particles, trace fine gravel to coarse sand sized ash, trace fine sand sized ash.										
6	24	4 22	13											



I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm Natural Resource Technology
234 W. Florida St., Fifth Floor, Milwaukee, WI 53204
Tel: (414) 837-3607
Fax: (414) 837-3608

SOIL BORING LOG INFORMATION SUPPLEMENT

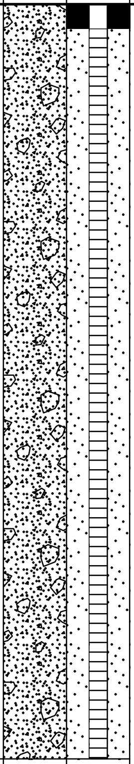
NATURAL RESOURCE TECHNOLOGY

Boring Number 49

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	
SS	24	26 24	14	5.3 - 20.2' **FILL, ASH (Coal):** very dark gray (10YR 3/1), mostly silt sized particles, few interbedded sand sized layers, trace coarse ash, noncohesive, nonplastic, moist to wet. *(continued)*										
7 SS	24 22	4 9 38 16	15 16	15' wet.										
			17	16.4' seam of sand-sized particles (2" thick).	(FILL)									
8 SS	10 7.5	22 50 for 4"	18 19	17.5' mostly sand sized particles, trace gravel, trace silt.										
9 SS	24 14	2 2 2 2	20 21 22	20.2 - 22.5' **LEAN CLAY:** CL, black (10YR 2/1), cohesive, medium plasticity, wet.	CL									
10 ST	24 0		23 24	22.5 - 24.5' Shelby Tube Sample. No Recovery.										ST10: 24" push at 150lbs of pressure. No Recovery.
11 SS	24 2	4 4 4 4	25 26 27	24.5 - 27.8' **LEAN CLAY:** CL, Low Recovery, trace gravel, cohesive, low plasticity, wet.	CL									
12 SS	24 21.5	1 1 4 7		27.5' very dark gray (10YR 3/1).										
			28 29	27.8 - 30' **SILTY SAND:** SM, mostly fine sand, coarse to fine gravel (5-15%), wet.	SM									
13 SS	24 14	6 15 18 14	30 31	30 - 45' **WELL-GRADED SAND WITH GRAVEL:** (SW)g, yellowish brown (10YR 5/4), fine to medium sand, fine to coarse rounded to subangular gravel, silt decreasing to trace silt with depth (5-15%), trace clay, wet.										
14 SS	24 15	16 16 14 12	32 33	33.2' piece of gravel (2" diameter).	(SW)g									
15 SS	24 5	8 3 2	34	34' fine to coarse sand.										

SOIL BORING LOG INFORMATION SUPPLEMENT

Boring Number 49

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
		5	35	30 - 45' **WELL-GRADED SAND WITH GRAVEL:** (SW)g, yellowish brown (10YR 5/4), fine to medium sand, fine to coarse rounded to subangular gravel, silt decreasing to trace silt with depth (5-15%), trace clay, wet. *(continued)*										
16 SS	24 9	3 3 4 11	36 37	36' increased gravel content with depth. 36.3' - 36.4' layer of increased clay content [15-30%].										
17 SS	24 18	11 10 8 22	38 39	38.3' trace very dark brown silt nodules (10YR 2/2).										
18 SS	24 14.5	9 16 15 16	40 41	40' trace very dark brown (10YR 2/2) and light brown (7.5YR 6/3) mottling.	(SW)g									
19 SS	24 17.5	12 21 21 17	42 43	42' no light brown (7.5YR 6/3) mottling.										
20 SS	12 9.5	10 14	44											
			45	45' End of Boring.										